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5th International Meeting on Meteorology and Climatology of the Mediterranean

Abstracts book

Organized by Associació Catalana de Meteorologia (ACAM) and Network of Meteorology of the Mediterranean with support from Tethys, Journal of Mediterranean Meteorology & Climatology and Istanbul Technical University (ITU)

Istanbul, March 2nd-4th 2015

General information

Location of the meeting

Istanbul Technical University
Ayazaga Campus
Süleyman Demirel Cultural Center
34469 Maslak - Istanbul (Turkey)
Tel. + 90 212 285 70 70
www.sdkm.itu.edu.tr

Organization

Network of Meteorology of the Mediterranean
Tethys, Jounal of the Mediterranan Meteoology and Climatology (http://www.tethys.cat/en)
Support from:
Spanish Ministry of Economy and Competitiveness

Support

ACAM, Associació Catalana de Meteorologia (www.acam.cat)
Istanbul Technical University (ITU, http://www.itu.edu.tr/en/)
PROMETEO program 2014 Phase II/2015, Generalitat Valenciana

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Dino Zardi (University of Trento, Trento, Italy)

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February 2nd-4th March 2015

Oral

Monday, 2nd

Session 0: Welcome

9:20-9:25: Welcome and opening the 5th MetMed Conference

Jose Luis Palau
Chair of Conference, on behalf of the Organising Committee

9:25-9:45: Climate Change in Mediterranean: Current, Future and Challenges

Prof. Selahattin Incecik
Department of Meteorological Engineering, ITU

9:45-9:50: Welcome Talk

Pof. Ahmet Duran Sahin
Head of the Department of Meteorological Engineering, ITU

9:50-10:10: Natural Resource Management, International Cooperation Mechanisms and Opportunities related to Forestry and Combat Desertification in Mediterranean Region, and UNCCD COP12

Mr. Ismail Belen
Vice General Manager, Republic of Turkey Ministry of Forestry and Water Affairs, General Directorate of Combating Desertification and Erosion

10:10-10:30: Welcome Talk

Prof. Mehmet Karaca
Rector of ITU

Session 5: Wind energy

Chairmen: *Dr. Zardi, Dr. Codina and Dr. Tan*

10:30-10:45: Weather Intelligence for Wind Energy - WILL4WIND

[1]**K. Horvath**, [1]**A. Bajić**, [1]**S. Ivatek-Šahdan**, [1]**A. Stanešić**, [1]**I. Odak**, [1]**M. Hrastinski**, [1]**M. Tudor**, [1]**E. Ivanković**, [2]**M. Vašak**, [2]**M. Đalto**, [2]**J. Matuško**, [2]**M. Baotić** and [2]**N. Perić**

[1] *Meteorological and Hydrological Service, Zagreb, Croatia*
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Current state-of-the-art global and mesoscale models are still limited in representing the challenging local wind conditions, such as in coastal and complex terrains. This is due to prevailing wind systems which are -due to their smaller scales- not adequately represented in typical operational weather prediction models. An enhanced dynamical-statistical short-range (up to 3 days) wind forecasting model is being developed to support efficient wind energy integration and wind power plant management.
We present first results of the new short-range wind forecasting system prototype designed for the wind regimes prevailing in coastal and complex terrain. The wind prediction system comprises of the three types of refinements 1) Regional refinement of global weather model predictions through a mesoscale NWP model; 2) Subregional refinement through a simplified mesoscale NWP model; 3) Site-specific refinement that is a self-learning, site-specific probabilistic statistical model based on analogues, which utilizes both wind predictions and wind tower or nacelle observations. Additionally, an ultrashort range forecasting module (0-3h lead time) is developed using neural networks with recent measurements and near-history numerical forecasts used as inputs. The moment-based and spectral verification suggests a

substantial improvement of the model accuracy may be reached through a chain of dynamical-statistical models across all forecast lead times.
Finally, we assess the challenges of enhancing collaboration of meteorology and wind energy communities as well as the topic of interactions of meteorology and wind energy sectors identified through the identification of joint research priorities of those two sectors.
Study is supported by the EU-IPA (Instrument for Pre-Accession) fund for Croatia, within the framework of the Action "Weather Intelligence for Wind Energy - WILL4WIND".

10:45-11:00: Wind Speed Ensemble Predictions With an Analog-Based Method in Complex Terrain

[1]**I. Odak**, [2]**L. Delle Monache**, [1]**K. Horvath**, [1]**M. Hrastinski** and [1]**A. Bajić**

[1] *Meteorological and Hydrological Service, Zagreb, Croatia*
[2] *Research Applications Laboratory, NCAR, Boulder, Co, USA*

The first step to build an analog ensemble (AnEn) method is the search for similar (i.e. analogs) past predictions across several variables (e.g., wind speed, wind direction, temperature) to the current prediction. The measurements corresponding to the analogs form the AnEn. AnEn can be used to generate deterministic (e.g., the AnEn mean or median) and probabilistic short- or medium-range forecasts. It provides accurate predictions while reliably quantifying their uncertainty. The AnEn was generated by Aire Limitée Adaptation dynamique Développement InterNational model (ALADIN) run over two nested domain with 8 and 2 km horizontal resolution. It was tested at several climatologically different locations across Croatia for point-based wind speed predictions at 10 m height. Results were verified and compared to ALADIN model to address the following question: what is the impact of the ALADIN model resolution on the performance of the AnEn?
The verification procedure includes several metrics computed considering wind speed as continuous, categorical and probabilistic predictand, to optimize the AnEn configuration, and to test both the deterministic and probabilistic prediction performances.
This study shows that deterministic AnEn predictions, compared to model used to generate it, improve linear correlation between predictions and measurements and reduce bias and root-mean-square error, especially in complex terrain. Besides, probabilistic AnEn predictions provide reliable information about their uncertainty.
Improvement in forecast accuracy brought by computationally cost effective AnEn generated by ALADIN model with 8 km horizontal resolution is comparable to the improvement of higher-resolution output of ALADIN model (2 km). Refinement of ALADIN model horizontal resolution used to generate AnEn additionally improves AnEn predictions for high wind speeds. Thus, optimal chain of different components in the weather prediction systems can successfully be broaden by using deterministic AnEn forecast in assessment of wind power, and probabilistic product in operative purposes at wind farms.

11:00-11:15: Resilience: A Semi-Operational Prototype to Forecast Wind Power from Weeks to Months Ahead

[1]**M. Davis**, [1,2]**F. Doblas-Reyes**, [1]**V. Torralba Fernandez**, [1]**N. Gonzalez-Reviriego** and [1]**A. Pintó Biescas**

[1] *Climate Forecasting Unit, Catalan Institute of Climate Science (IC3)*
[2] *Institució Catalana de Recerca i Estudis Avançats (ICREA)*

Predicting the future variability of energy resources beyond the first two-weeks can allow end users to take calculated, precautionary action with a potential cost savings. Weather and its behaviour over time, known as climate, has a considerable affect on energy demand and supply and influences many decisions. For example, energy producers adjust their strategies based on a foreseen energy capacity, or wind farm operators plan for optimal meteorological conditions to undertake maintenance works. The earlier these decisions can be planned, the sooner unforeseen operational risks could be identified. To estimate future climate variability over coming weeks or seasons, current energy practices use a deterministic approach based on retrospective climatology. Recent advances in global climate models, which simulate the physics of the whole climate system, demonstrate that probabilistic forecasting can improve upon this methodology at some spatial and temporal scales. Energy decision makers now have a new set of climate risk management tools that can strengthen their decision making, but are they ready to use them?
Probabilistic climate forecasts come with a new set of challenges for end users: information is often untailored, hard to understand and apply in a decision-making context. EUPORIAS is a collaborative project funded by the European Commission to address these challenges and support the development of climate services in Europe. One outcome of this project will be RESILIENCE, a semi-operational, energy prototype of climate services that will operate on a sub-seasonal to seasonal timescale and address the needs of the specific decisions mentioned above. State-of-the-art forecasts will be created in partnership with project SPECS, an ongoing, parallel European project that will deliver a new generation of climate forecast systems with improved forecast quality.

11:15-11:30: WRF's wind power ensembles for a wind farm located in a coastal area of Turkey

[1]**G. Kirkil**, [2]**Y. Ezber** and [3]**T. Kaytanci**

[1]*Department of Energy Systems Engineering, Kadir Has University, Istanbul, Turkey*
[2]*Eurasia Earth Sciences Institute, Istanbul Technical University, Istanbul, Turkey*
[3]*Department of Meteorological Engineering, Istanbul Technical University, Istanbul, Turkey*

Short-term wind forecasts are obtained for a wind farm located in a coastal area of Turkey. The simulated month is March when the plant is under strong southwesterly gusts. We performed multi-scale simulations using WRF's different Planetary Boundary Layer (PBL) parameterizations as well as Large Eddy Simulation (LES). WRF ensembles with different PBL parameterizations showed little spread for wind speed forecasts. LES models improved the forecasts. Statistical error analysis is performed and ramp events are analyzed. Model forecasts for ramps in general were poor. Complex topography of the study area also affects PBL and LES parameterizations' performance, especially the accuracy of wind forecasts were poor in late afternoons.

11:30-11:45: Microscale Variability of Wind Power Density Assessment in Complex Terrain and Wind Regime Trends in Future Climate Projections

[1,2]**D. Koračin**, [3]**R. Belu**, [1]**C. Smith**, [1]**J. Mejia**, [4]**K. Horvath** and [5]**R. Vellore**

[1]*Desert Research Institute, Reno, Nevada, USA*
[2]*University of Split, Croatia*
[3]*Drexel University, Philadelphia, Pennsylvania, USA*
[4]*Meteorological and Hydrological Service, Zagreb, Croatia*
[5]*Indian Institute of Tropical Meteorology, Pune, India*

Assessment and forecasting of wind resources is of great importance for the socio-economic community, especially considering the impacts of global and regional climate change. Consequently, there is strong need to replace fossil fuels based electricity generation with wind, solar, or biomass electricity generation. Due to the high spatial and temporal variability of winds and turbulence, it is essential to understand wind structure and its evolution. Additional problem is to understand wind characteristics in complex terrain where topographic forcing can significantly alter wind magnitude and persistence. To address these questions, a research project was conducted in the western U.S. The project consisted of a field campaign during a period of more than one year and forecasting studies. Two 60-m towers and a collocated acoustic sounder were deployed over the mountain ridges in the area of developed topography. Both towers were equipped with standard anemometers at three levels and sonic anemometers at two levels. A preliminary analysis quantified differences in wind speed among cup and sonic anemometers and the sodar as well as how these differences affect assessment of wind power density on seasonal and annual periods in complex terrain. The analysis also included estimates of the differences in wind characteristics between these two towers that were located 2700 m apart with a vertical distance of 140 m elevation between their bases. An additional objective of the study is to investigate how this seasonal and annual wind power density assessment will evolve under the expected climate change projections. Analysis of results from the regional climate model for the western U.S. with a horizontal resolution of 12 km with a nested domain covering Nevada of 4 km is currently ongoing. The results for future expected trends in winds, wind shear, and turbulence intensity will be presented at the conference.

11:45-12:00: Offshore Wind Energy Potential of Turkey

E. Tan

Istanbul Technical University, Department of Meteorological Engineering, Istanbul Turkey

Turkey has made a respectable amount of investment on wind energy sector during the last two decades. As of 2013, the installed capacity of the country has reached to 2,760 MW and it is scheduled to reach 20,000 MW by the end of 2023, which will be centenary of the Republic of Turkey. In this respect, a smart wind resource assessment plan is necessary to make a great deal of profit by optimizing land use and other related effects. Therefore, making an investment on offshore wind farms would be inevitable in the consideration that Turkey is a peninsula surrounded by Black Sea, Marmara Sea, Aegean Sea and Mediterranean Sea. On the other hand, installation regulations should be determined carefully for offshore wind farms. Thus, in this study, the offshore wind energy potential of Turkey is evaluated by taking into account all aspects of it. Wind fields are going to be modeled by using the WRF Model and the results are going to be validated by 10 offshore buoys of State Meteorological Service of Turkey and satellite data. Afterwards, high potential areas will be determined based on these model results as well as reanalysis data. Since shallow water may be preferable economically for the siting of offshore wind farms, their feasibility depending on their types will be discussed. As a preliminary resource assessment, the application of wind farms for three depth options (less than 20m, 50m, and 200m) will also be evaluated.

Session 5: Numerical modelling

Chairmen: *Dr. Horvath, Dr. Teller and Dr. Palau*

13:15-13:30: Solar parameterizations: impact on real WRF-ARW simulations

[1]**A. Montornès**, [1]**B. Codina** and [2]**J. Zack**

[1]*Department of Astronomy and Meteorology, University of Barcelona, Barcelona, Spain*
[2]*MESO, INC., Troy, USA*

A wide range of approaches for radiative transfer computations lead to several parameterizations. As a consequence, these approximations bring to distinct results in radiative fluxes and heating rate profiles, even under the same atmospheric conditions. Since the transfer of solar and terrestrial radiation represents the primordial physical process that shapes the atmospheric circulation, these deviations must have an impact in the numerical weather prediction (NWP) model performance. An analysis about the role of the shortwave schemes provided in the Weather Research and Forecasting (WRF-ARW) model is presented. The study compares the effect of four parameterizations (Dudhia, New Goddard, CAM and RRTMG) in two scenarios: i) cloudless and ii) cloudy sky situations for a domain defined over Catalonia (northeast of the Iberian Peninsula). The discussion analyzes both direct and indirect feedback between the dynamical aspects and the physical parameterizations driven by changes on the treatment of the radiative transfer equation. The impact of these variations in time are studied through three simulation windows: current day (0-23 h), day-ahead (24-47 h) and two days ahead (48-71 h).
These analyses are focused on several NWP model fields. From the most directly related to the shortwave schemes such as the global horizontal irradiance or the heating rate profile, to apparently secondary outcomes such as the wind speed or the cloud composition among others. The observed differences between simulations using different solar parameterizations increase with the simulation horizon, being more important in the cloudy scenario than in the cloudless sky.

13:30-13:45: Observational and Numerical Study of the Severe Convective Storm of 29Th October 2013 in the Balearic Islands

R. Romero, **C. Ramis** and **V. Homar**

Meteorology Group, Departament de Física, Universitat de les Illes Balears, Palma de Mallorca, Spain

Mesoscale convective systems organized as squall lines occasionally occur in the Balearic Islands (Spain) during the fall and these can inflict serious disruptions in populated areas owing to the high precipitation rates and violent wind gusts. One of such high impact weather situations occurred on 29th October 2013 when a NE-SW elongated squall line developed to the west of the islands ahead of an advancing cold front and then crossed the south of the archipelago. We first provide an observational characterization of the event based on surface reports, remote sensing products, radiosoundings and synoptic information. We also achieve, by means of numerical experiments, new insights into the kinematic and thermodynamic factors that governed the genesis and evolution of the linear convective system. Radar and satellite data confirm the fast-moving and linear character of the system, more evident over maritime areas than over land. However, transition into a bow echo structure seems unlikely except in the later stages when the system already passed the island of Mallorca. The synoptic setting at mid-upper tropospheric levels was dominated by a cold trough extended over Western Europe associated with a jet stream along its eastern flank. Convection evolved under the right-entrance region of the jet, and initiated under the crucial influence of a concomitant surface low developed over the Mediterranean Sea ahead of the cold front. The low not only cooperated with the upper-level dynamical forcing to erode a capping inversion initially present over the Balearics and to moisten the atmospheric column above, but also shaped and enhanced a convergence line along which the first convective cells grew and self-aggregated. This scenario is confirmed by the numerical simulations of the case, which also emphasize a relevant action of the regional topography in terms of favouring the previous maritime convergence through the mesoscale modulation of the low-level flow. Additional simulations show that (i) the destabilization of the low-level air mass necessary for triggering and feeding an organized convective system on 29th October 2013 was attributable to the intense evaporation from the Mediterranean that took place during the hours immediately before the event and (ii) regardless of the synoptic and mesoscale dynamical forcing, prescription of accurate sea surface temperatures appears to be critical in this kind of situations for a successful fine-grid numerical forecast of the convective mode, degree of severity, timing and track of the precipitation system.

13:45-14:00: Impact of Mesoscale Meteorological Processes on Anomalous Propagation Conditions Over the Northern Adriatic Area

[1]**M. Telišman-Prtenjak**, [2]**I. Horvat**, [3]**I. Tomažić**, [4]**M. Kvakić**, [5]**M. Viher** and [1]**B. Grisogono**

[1]*Department of Geophysics, Faculty of Science, University of Zagreb, Zagreb, Croatia*
[2]*Meteorological and Hydrological Service, Zagreb, Croatia*
[3]*University of Liège/AGO/GHER, Liège, Belgium*
[4]*2 Mua Park Road, Muthaiga Nairobi, Kenya*
[5]*Croatian Air Force HQ, Croatia*

The impacts of mesoscale processes on the occurrence of anomalous propagation conditions (named anaprop) for radio waves, including ducts, superrefractions and subrefractions, were studied. The chosen formations are the famous bora winds, and the sporadical sea/land breeze (SB/LB) during three selected cases over a large portion of the northern Adriatic. For this purpose, we used available radiosoundings and numerical WRF-ARW model simulations (of real cases and their sensitivity tests) at a horizontal resolution of 1.5 km. The model simulated the occurrences of anaprops satisfactorily, although their intensities and frequency were underestimated at times. Certain difficulties existed in reproducing the vertical profile of the modified refractive index, which is mainly dependent on the accuracy of the modeled relative humidity. The spatial distributions of

summer anaprop reveal that the surface layer above the sea (roughly between 30 and 100 m asl) is often covered by superrefractions and ducts. The SB is highly associated with the anaprop formations: (i) in the first 100 m asl, where superrefractions and ducts form because of the advection of colder and moister air, and (ii) inside the transition layer between the SB body and the anti-SB current in the form of subrefractions. When a deep convection occurs, all three types of anaprop are caused by the downdraft beneath the cumulonimbus cloud base in its mature phase that creates smaller but significant pools of cold and dry air. The bora wind usually creates an anaprop pattern associated with the hydraulic jump and influences anaprop distribution over the sea surface.

14:00-14:15: Impact of Kitcube Data on the Prediction of Maritime Convective Severe Weather. Test for HyMeX IOP13 Event

[1]**D. C. Carrió**, [1]**V. Homar** and [2]**U. Corsmeier**

[1]*Meteorology Group, Physics Department. Universitat de les Illes Balears*
[2]*Institute for Meteorology and Climate Research, Karlsruhe Institute of Technology (KIT), Karlsruhe, Germany*

The Special Observation Period 1 (SOP1) was a great milestone reached by the HyMeX scientific community. Observations sampling on 20 cases of severe weather were taken under an unprecedented international collaboration. The underlying objective of this campaign was to improve the knowledge of the mechanisms leading to heavy precipitation and flash flooding in the Mediterranean. One of the most active platforms during the campaign was the KITcube-observatory of Karlsruhe Institute of Technology, a mobile platform that includes ground-based remote sensors (radar and lidar) and instruments for in-situ measurements. During SOP1, the KITcube operated on the island of Corsica, providing direct observational data on severe weather occurring in the north-eastern region of the Western Mediterranean. IOP 13 occurred between 15-16 October 2012 and it was characterized by heavy rains over northern and central Italy. Storms formed over the French coastlands and over the sea, progressing eastwards across the Gulf of Genoa. The most affected areas were north-eastern Italy (160mm/24h), Liguria-Tuscany (120mm/24h) and central Italy (600mm/24h). The prediction of these maritime convection driven cases is highly demanding for both operational offices and high resolution numerical models. Ensemble data assimilation methods provide the tools to combine observational and modeling information to formalize the problem of optimal use and transference of information in the initialization and integration of a forecasting system.
We test the benefits offered by an Ensemble Kalman Filter (EnKF) system for the prediction of the IOP13 event. We assess the impacts of various in-situ special observations taken by the KITcube team during this event on the forecasts of socially sensible parameters such as probability of severe and accumulated precipitation. We discuss these impacts not only on the forecasts products but also in terms of the relevant physical mechanisms involved in the event

14:15-14:30: Development and Validation of a Regional Earth System Model (RegESM) for the Mediterranean Region

[1,2]**U. Turuncoglu**

[1]*Informatics Institute, Istanbul Technical University, Istanbul, Turkey*
[2]*Earth System Physics Section, International Center for Theoretical Physics, Trieste, Italy*

The large water bodies such as the Mediterranean and Black Seas are one of the main driving components of the basin's hydrological budget, and the connection among these seas and the ocean through the straits (i.e. Straits of Gibraltar, Dardanelles, and Bosporus) plays a very exclusive and interesting role in the water balance of the seas along with the contributions of land-based runoff, evaporation and precipitation. Especially, the interaction between Mediterranean and Black Seas through the Turkish Strait System (TSS; Dardanelles, and Bosporus) is very complex component of the water budget of the both seas as well as their hydrodynamic properties. As a result of the recent studies, the investigation of nonlinear interaction between atmosphere and large water bodies (i.e. Mediterranean and Black Sea) and the identifying of their connections with the regional climate of the Mediterranean Region (especially Anatolian Peninsula) become very crucial and open research areas. Especially in the winter and fall seasons the feedback mechanisms between large water bodies (i.e. Mediterranean Sea) and atmosphere might became very significant due to the increased evaporation over the seas and the fully coupled regional atmosphere-ocean models, which represent these interactions more realistically than the standalone regional climate models, might help to understand the mechanisms behind theses complex interactions.
In this study, the newly designed fully coupled regional earth system model (RegESM) is used to investigate the climate of the Mediterranean region. The model is capable to estimate the heat and water balance of the Mediterranean Sea. The regional earth system model is run for the period 1979-2012 and it is compared to corresponding standalone model simulation and the available observational datasets to evaluate the performance of the modeling system.

15:40-15:55: Does increasing the resolution of Mesoscale Numerical Weather Prediction models enhance reproduction of wind regimes in the complex terrain?

M. Hrastinski, **K. Horvath**, **I. Odak**, **S. Ivatek-Šahdan** and **A. Bajić**

Meteorological and Hydrological Service, Zagreb, Croatia

In the complex terrain of Eastern Adriatic where wind climate is governed by regional/local winds, it is beneficial to utilize a chain of numerical models to refine the associated wind predictions. The principal questions we address are i) whether an increase of model resolution improves the accuracy and ii) could simplified and computationally cheaper Mesoscale Numerical Weather Prediction (MNWP) models be used in the model chain for assessment and forecasting of wind properties?
To answer the above questions, wind forecasts from Aire Limitée Adaptation dynamique Développement International (ALADIN) MNWP model with 8 km horizontal grid spacing were used in period 2010-2012. Those forecasts were further refined to 2 km grid spacing using: i) full-physics based model, and ii) so-called dynamical adaptation method (DADA) over subdomain that covers broader area around Croatia. Statistical and spectral verification were performed for three different forecasting setups using measured wind speeds from several meteorological stations that represent different climate regions of Croatia.
Based on variety of statistical scores and spectral measures inferred in frequency domain, it is suggested that the results generally improved with increasing the model resolution. The largest portion of errors can be attributed to phase errors, while the most significant increase of accuracy was found for diurnal periods of motions. Furthermore, a correlation between phase error and spectral measures of model performance at different temporal scales was found. Simplified DADA forecasts have proven to be valuable in forecasting wind propertirs on majority of stations, except for those near the very coast and steep terrain where full-physics based model was more successful in representing regional/local wind systems. Finally, kinetic energy, vorticity and divergence spectra were analyzed to provide a scale-dependent measure of model performance as well as to study the gross effects of horizontal diffusion on the effective model resolution.

15:55-16:10: Regional results of the coupling of LMDZ physics in WRF

[1]L. Fita, **[2]P. Drobinski**, **[1]F. Hourdin** and **[1]L. Fairhead**

[1]*Laboratorie de Météorologie Dynamique (LMD), UPMC-Jussieu, CNRS, Paris, France*
[2] *Laboratorie de Météorologie Dynamique, Ecole Polytechnique, CNRS, Palisseau, France*

In parallel to the growing of the computational power, GCM resolutions are getting finner. This increase in resolution might poses a challenge for their current physical parameterizations. Laboratoire de Météorologie Dynamique model (LMDZ) is the atmospheric component of the Global Climate Model of the IPSL used in the recent CMIP5 data-set (as IPSL5A/B). In order to analyze the performance of the physical schemes of the LMDZ at higher resolutions, they have been introduced in the Weather Research and Forecasting Limited Area Model (WRF). This makes possible the test of LMDZ physics at high resolutions and compare the results to similar runs directly from the WRF model using the same dynamical core. We present and analyze the results from an ensemble of runs with the LMDZ, WRF and the coupling on 4 different extreme events occurred in the Mediterranean basin: Superstorm of 2001 in the Balearic Islands, medicane 1995, Cevennes floods of 1996, IOP15 from the HyMeX data-base with the respective available observations. Results should be useful to improve LMDZ schemes and prepare them to the incoming resolutions.

16:10-16:25: A Lagrangian Description of the Flow Feeding Precipitating Systems over a Mediterranean Mountainous Region (Eastern Pyrenees)

[1,2]L. Trapero, **[2]J. Bech**, **[3]F. Duffourg** and **[2]J. Lorente**

[1]*Snow and Mountain Research Center of Andorra, Andorran Research Institute, Andorra*
[2]*Department of Astronomy and Meteorology, University of Barcelona, Spain*
[3]*Centre National de Recherches Météorologiques, Groupe d'Étude de l'Atmosphère Météorologique, Météo-France, Centre National de la Recherce Scientifique, France*

Heavy precipitation events (HPE) over complex terrain are often favoured by enhancement mechanisms of precipitation. The windward slopes of the Eastern Pyrenees, as other mountainous Mediterranean regions, are regularly affected by HPE. This study benefits from high resolution numerical simulations (with horizontal grid lengths of 2.5 km) of different case studies using the MESO-NH research model. The analysis has a twofold objective: to describe the synoptic environment in which the HPE developed and to identify the mesoscale mechanisms that lead to steady rainfall over the Eastern Pyrenees as well as the features of the moisture inflow feeding the precipitation systems which were fairly well reproduced by the model.
From the analysis of the different conditionally unstable episodes the simulations indicate a marked dependence of the precipitation intensity over the Pyrenees on two factors: the intensity of the wind at low and mid levels and the moisture advection towards the Pyrenees in the lowest 3 km of the atmosphere (Q_3). According to the simulations, it has been detected three different rainfall intensity regimes ranging from weak to heavy orographic precipitation where Q_3 exceeded 550 kg/mÂůs and a low level jet of 30 m/s was also present. From the backward trajectories based on Eulerian on-line tracers, it has been found that the feeding flow is confined between 0.5 and 3 km of altitude, mainly in the top edge of the conditionally unstable boundary layer (>1000 m), whereas for the precipitating systems close to the coast the flow is confined in the first 1000 m within the PBL.

16:25-16:40: Interactions lake-atmosphere under Mediterranean conditions: ALEX 2014 observations and simulations

[1]R. Salgado, [1]M. Potes, [1]C. Policarpo, [2]P. Le Moigne, ALEX 2014 Scientific Team

[1] *Departamento de Física e Centro de Geofísica de Évora, Escola de Ciência e Tecnologia, Universidade de Évora*
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The ALqueva hydro-meteorological EXperiment, ALEX 2014, was an integrated field campaign (http://www.alex2014.cge.uevora.pt) with measurements of chemical, physical and biological parameters in water and air at the Alqueva reservoir, a 250 km2 man made lake, in the southeast of Portugal. The ALEX 2014 took place from June 1 to September 30, 2014 and includes an Intensive Observation Period (IOP) of three days (22 to 24 July). During the IOP, radiosondes were launched every tree hours, allowing a good characterization of the atmospheric boundary layer and its evolution. Simultaneously, energy, vapor and momentum fluxes between the water and the air were measured using the new IRGASON eddy covariance system, installed on a floating platform. This platform were instrumented in order to measure, among other parameters: solar and thermal downward and upward radiative fluxes, air temperature and humidity, wind speed and water temperature at 9 different depths. The ALEX 2014 includes also several surface meteorological stations in order to characterize the local horizontal structure of surface atmospheric fields and detect lake effects.
The lake-atmosphere interactions and its impact in the boundary layer structure and in the local circulations are studied using data collected during the ALEX 2014 POI together with results from numerical simulations performed with the non-hydrostatic Meso-NH french model.

Tuesday, 3rd

Session 2: Processes and applications

Chairmen: *Dr.Cuxart and Dr. Palau*

8:50-9:05: Field Study of the Atmospheric Boundary Layer in the Pannonian Plain

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The PABLS13 (Pannonian Atmospheric Boundary Layer Study 2013) was a measuring international campaign that took place in Szeged (Hungary) in late November 2013. The aim of this campaign was to study the characteristics of the daily cycle of the ABL in the center of the wide Pannonian plain and its interaction with the underlying surface. Data were collected from the surface layer and the soil with fixed instrumentation, and a number of devices were used for the exploration of the vertical structure of the ABL, including a Sodar, a tethered balloon, remotedly-controlled multicopter and plane, and radiosoundings. Here we will focus on the first Intensive Observation Period (IOP1) which was a late fall case with nocturnal cold advection under overcast skies followed by the establishment of a very strong morning inversion. The gathered data will be analyzed conjointly and use of outputs of numerical models will be also made. Also the hypothesis of the arrival of downslope flows from the distant Dynaric Alps to the South will be tested.

9:05-9:20: Mistral and Tramontane Patterns in Regional Climate Models

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Mistral and Tramontane are regional winds in southern France. The correct simulation of wind speed in this area is important for evaluation of fire risks, damage due to strong winds and the modeling of deep-water formation in the Mediterranean Sea. Both winds are funneled through valleys and show extensive airflow patterns in complex terrain, which makes them difficult to simulate correctly in climate models. We survey the regional climate models CCLM, ALADIN, WRF, PROMES, LMD and RegCM (all from the MedCORDEX/HyMeX data base) and use gridded and surface station data to evaluate the quality of model wind speed. We investigate the effect of orographic features (Alps, Massif Central and Pyrenees) and surface roughness parameterization (e.g. from vegetation and water waves). Emphasis is on spatial patterns in the areas of Mistral and Tramontane as well as the overlapping zone. Additionally, we survey the wind speed development and error propagation along the wind tracks.

9:20-9:35: The imbalance of the measured surface energy budget and an estimation of the latent heat flux

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Here we present two aspects of our studies on the surface energy budget. On one hand we evaluate the magnitude of the imbalance using data of a two-year series from a station belonging to the Catalan Meteorological Service at Raimat near Lleida. The imbalance of the energy is inspected according to the season, type of weather or moment of the day. The values range typically between 10 and 30% of the value of the net radiation, and they are of the same order of magnitude as the values of the atmospheric turbulent latent and sensible heat fluxes or the soil heat flux. On the other hand, we take advantage of the complete experimental display in this site to evaluate an estimation of the latent heat flux (or evapotranspiration) using the air humidity and the soil water contents, and we compare it to the values measured by the eddy-correlation device. Such an expression could be of use for many surface energy stations that could not afford the very costly device that is needed for the eddy-correlation determination of the latent heat flux.

9:35-9:50: The Quantification of The Relationship Between Hydraulic Geometry of Rivers in Western Anatolia and The Formative Discharges

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Channelization programs against to flooding have been conducted in many rivers more than 50 years all around the world. However, recently it was seen that channelization of the natural streams resulted in devastating consequences in terms of ecosystem and biodiversity. Thanks to the increasing ecological awareness, recent years however have witnessed re-naturalization of concrete-lined channels commonly. In this context, a simple but crucial question supposed to be answered arises. How could we decide about the hydraulic geometry of the main channel of a river for re-naturalization program? It is a crucial question in re-naturalization, since the main channel dimensions dictates the sediment transport process, fish and vegetation ecosystem, and potential flood risks in the surrounding environment.
A typical cross-section of a river arises as a result of some formative discharges. From this motivation, a study is undertaken to give a better understanding to the relationship between the characteristic of discharge values and main channel dimensions of rivers located in Western Anatolia. To serve this aim only unregulated (natural) stream dimensions were taken into consideration. To determine the discharge, which has the highest correlation with channel forms, a series of statistical analysis was undertaken. Based on the analysis the most formative discharges were quantified and empirical equations were generated based on the relationship between discharge values and main channel.

9:50-10:05: Spatio-Temporal Variability of Atmospheric Precipitable Water Vapor Accumulation over the Mediterranean Sea

J. L. Palau and **F. Rovira**

CEAM - Centro de Estudios Ambientales del Mediterráneo. Valencia (Spain)

In this study we present the spatiotemporal variability of total column of precipitable water over the Mediterranean Sea. These kind of studies are relevant for distinguish some of the feedbacks driving climate change in both the Western and the Eastern Mediterranean Basins (WMB and EMB respectively) as, e.g., precipitation regimes, secondary pollutant production, ventilation conditions, etc. The dataset used is provided by the MODIS instrument on board the Terra Satellite: IR Total column precipitable water with the time pass over the Mediterranean at 11:00 h. In this study we have used an eleven-year period (2000-2010).
To show water vapour spatial patterns, we have combined some different statistical techniques. The empirical orthogonal function (EOF) and the regression box are used to highlight the different spatial behaviour of the total column of precipitable water vapor, comparing the WMB and the EMB. In this study, on one hand, we show how the first component (EOF1) is related with annual variability and it extends over the whole Mediterranean sea; whereas, on the other hand, the second component (EOF2) is associated with a semi-annual cycle and shows a completely differentiated pattern between the WMB and the EMB. Both components explain the 74% of the total variability in the datasets. Additionally, this study shows the water vapor cycles (or periodicities), both in the WMB and the EMB, using a numeric methodology based in a parametric reconstruction of harmonics of non-steady and noisy time series (Palau and Rovira, 2012). This latter result remarks the spatial and seasonal differences, between both Mediterranean basins, that are in good agreement with previous studies focused on the tropospheric ozone accumulation cycles found on the Western Mediterranean Basin throughout the year during a 14-year period of observations (Palau and Rovira 2012) and on the climatology of aerosol optical depth over the Eastern Mediterranean Basin using a 10-year period of observations (Mishra et al. 2014).

11:15-11:30: The 'DAPHNE' Conceptual Model for the Design of a Precipitation Enhancement Project in Thessaly, Greece

Th. Karacostas, **I. Pytharoulis**, **I. Tegoulias**, **D. Bampzelis** and **S. Kartsios**

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The impact of climate change and the continued increase in water needs for urban and agricultural use have largely exhausted the water supplies in the most vital agricultural area of Greece, Thessaly. To alleviate that, the "DAPHNE" conceptual model is being developed, to support the potentiality and applicability of a well designed precipitation enhancement program. DAPHNE project integrates all contemporary components in order to have the most comprehensive state-of-the-science results. These components include, the use of the state-of-the-art Weather Research and Forecasting (WRF) numerical model at very high resolution (1km x 1km), considering the different types of hydrometeors through sophisticated microphysical parameterizations, the adaptation and redevelopment of a 3D cloud model for performing simulations of seeding material dispersion, the -specially equipped- seeding aircraft measurements and the weather radar images from a C-band weather radar. The objectives are integrated and accomplished by performing -during the experimental phase of the project- in-situ measurement campaigns and cloud seeding experiments on suitably chosen appropriate clouds, associated with environmental impact assessment studies. Gridded projections of regional climate models, during the period 2041-2050 are also used in the study. It is the first time that all the aforementioned state-of-the-art tools, radar data and aircraft observations are combined in order to create the fundamental principles for the development of the "DAPHNE" Conceptual Model that should define -if, when, where and how- a precipitation enhancement program would be applicable over the examined area.

11:30-11:45: Impact of the mixing state on aerosol optical properties and radiative effect during a severe wildfire episode over Eastern Spain in summer 2012

[1,2]**J. L. Gómez-Amo**, [2]**A. Di Sarra**, [1]**C. Marcos**, [1]**V. Estellés**, [1]**R. Pedrós**[1]**M. P. Utrillas** and [1]**J. A. Martínez-Lozano**

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A severe wildfire occurred in Eastern Spain in summer 2012. The fresh smoke plume was detected during an intense dust episode at the Burjassot (39.5°N, 0.4°W) measurement station. This caused a huge increase in the aerosol optical depth (AOD) and a marked change in the aerosol optical properties. The dust contribution led to an increase in AOD at 500nm up to 0.80, and a decrease in the Ångström exponent (AE) down to 0.05. AOD was drastically enhanced by the smoke plume reaching values higher than 2 during the wildfire peak, with an extremely high maximum of 8, on 29 June.

We applied an improved approach to derive the column-integrated size distribution, single scattering albedo (SSA) and asymmetry parameter (g) in the different aerosol conditions during the wildfire. This retrieval combined direct sun-photometer measurements; the King inversion; the Mie Theory; and the refractive index provided by AERONET. A methodology to determine the microphysical and optical properties of mineral dust and the smoke plume separately during the mixing cases was implemented. The sensitivity of these properties to the mixing ratio was also analysed. The mixed aerosol cases showed a bimodal size distribution, with the fine and coarse modes dominated by the smoke particles and the mineral dust, respectively. Mineral dust, the smoke plume, and the mixture show similar absorption at 440 nm (SSA $\sim$ 0.90). However an opposite spectral dependency was observed for dust and smoke, with averaged SSA of 0.96 and 0.87 at 1020 nm, respectively. SSA and g for the mixture showed a strong spectral dependency which increased with the smoke mixing ratio. The radiative impact due to the different aerosol types has been also evaluated using only measurements of surface irradiance. Special attention to the radiative effect due to the aerosol mixture (dust+smoke) has been taken into account.

11:45-12:00: Comprehensive Assessment of Atmospheric Benzo(A)Pyrene in the Mediterranean under Present and Climate Change Scenarios – A Field and Modelling Approach

[1]**P. Jiménez-Guerrero**, [1]**J. P. Montávez** and [1,2]**N. Ratola**

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Combining field and modelling strategies is necessary for the definition and validation of the spatial, temporal and chemical transport patterns of atmospheric pollutants, providing at the same time important feedbacks for such fields as meteorology, atmospheric chemistry and even climate change.
In our study, a comprehensive assessment of present and climate change scenarios was proposed for an airborne carcinogenic contaminant of natural and anthropogenic origin for which some legal limits already exist: benzo(a)pyrene (BaP). The modelling system WRF+CHIMERE was implemented with high spatial and temporal resolution to the Mediterranean area, using BaP atmospheric levels estimated from the levels found in pine needles collected in 27 sampling sites in Portugal, Spain and Greece (9 per country in urban and non-urban areas). Model pollutants climatologies were validated for the present scenarios with the concentrations in pine needles, comparing the tree countries and urban and non-urban sites in each country.

However, it is also crucial to update the currently available information of these kinds of persistent pollutants, to include regional climate impacts on air quality. Hence the need to understand local and regional phenomena of transport of atmospheric pollutants also in future scenarios and, ultimately, to provide valuable tools for the establishment of advisory or legal limits for their presence. To achieve this purpose, this work presents several scenarios of how climate change affects air quality, modifying dispersion (wind speed, mixing height, convection and fronts), wet and dry deposition, chemistry, emissions, chemical transport and background concentrations of BaP, including a perspective on their influence on the available health safety thresholds. WRF-simulations driven by the ECHAM5 SRES A2 and B1 forcing were used for a time period covering the year1991-2050.

12:00-12:15: FF: Water budget analysis on a set of severe cyclogenesis events in the Mediterranean basin

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Extreme cyclones in the Mediterranean basin have a severe impact on the population residing along the coasts that are mostly related to floods, strong winds and storm surges. Water induced processes such as diabatical cloud formation has been proved as one of the key aspects for the development of deep cyclones. Here we present a new water budget diagnostic, implemented in the WRF model. In comparison to the other existing computations of the water budget, this one differs in two key aspects: terms of the budget are kept at each grid point, and the terms are obtained as accumulated values from the internal time-step. That makes possible to analyze the water cycle with a remarkable detail, difficult to obtain with the other implementations. What we will here present is the application of this new methodology on a series of strong cyclones along the Mediterranean basin. The large number of analyzed cases and the capabilities of this new WRF implementation allows to perform a statistical analysis and to obtain robust conclusions about the insights of the water processes in cyclones life-cycle.

Session 3: Remote and in-situ measurements

Chairmen: *Dr. Roujean, Dr. Caselles and Dr. Bech*

13:15-13:30: Using a Model Hybrid Based on ANN-MLP and the SPI Index for drought Prediction case of Inaouen Basin (Northern Morocco)

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This paper describes an approach for predicting droughts in the basin Inaouen by using a hybrid model based on artificial neural networks such Multilayer Perceptron (ANN-MLP) and SPI index (Standardized Precipitation Index).
During the first step, the calculation of the SPI index has been taken. This is achieved by adjusting the frequency distribution monthly records precipitation, to a probability density function.
In a second step, three models of ANN-MLP were constructed using, for inputs a dataset containing the SPI calculated, the values of monthly precipitation and introducing also the NAO index to estimate the effect of the North Atlantic Oscillation on the drought in the region.
The performance of the neural prediction model integrating the three variables as inputs (ANN-MLP 3) are showing far greater than those established by other models considering only precipitation and / or SPI. This optimal model (ANN-MLP 3) was applied to the prediction of drought in the region using SPI 3, SPI 6, SPI 9, SPI 12 and SPI 24. These SPI values were predicted for one month ahead. The model shows very good precision and which become greater when we move from SPI 3 to SPI 24.

13:30-13:45: Surface Temperature and Emissivity Retrieval from Seviri Observations: Results and Comparisons with Remote and in-situ Measurements

S. Venafra, **M. G. Blasi**, **G. Liuzzi**, **G. Masiello**, **C. Serio** and **V. Telesca**

Scuola di Ingegneria, University of Basilicata. Potenza, Italy

Nowadays the retrieval of geophysical parameters from satellite observations largely relies on a priori information, which is derived from climatology and/or models for Numerical Weather Prediction. Thus, the retrieval problem can be efficiently analyzed within the broad context of data assimilation, which is indeed the paradigm of the many seemingly different methods, which have been developed over the past years, such as Optimal Estimation and Kalman Filter which end up with the same formal solution as far as the estimate of geophysical parameters is concerned. In a recent study, the high temporal resolution of data acquisition by geostationary satellites and their capability to resolve the diurnal cycle has been exploited for the retrieval of surface temperature and emissivity. We have examined the case of SEVIRI (Spinning Enhanced Visible and Infrared Imager) high rate level 1.5 image data. A suitable

Kalman Filter approach has been developed and demonstrated on the basis of suitable case studies encompassing a variety of surface features. The results have been quite recently documented in the peer review literature. We pursue a genuine dynamical strategy which exploits the sequential approach of the Kalman filter. This results in an algorithm which does not need to increase the dimensionality of the data space, e.g., because of time accumulation of observations, while preserving the highest time resolution prescribed by the repeat time of the geostationary instrumentation (15 min for SEVIRI). In this presentation we show some results on emissivity and surface temperature retrieval from SEVIRI observations, choosing as target area the Mediterranean area and using the Kalman filter methodology. We also compare the retrievals with ECMWF, MODIS, AVHRR products and in-situ co-located observations.

13:45-14:00: Daily rainfall detection and estimation over land using microwave surface emissivities

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Rainfall is a key parameter for meteorology, hydrology and climate, but its estimation using remote sensing observations still remains a major scientific challenge. A method is developed using surface emissivities computed at 89 GHz from AMSU-A, AMSU-B and SSMI/S instruments to detect rain events and to estimate a daily precipitation rate over land surfaces. This new retrieval algorithm, called EMIssivity Rainfall Retrieval (EMIRR), is evaluated over France and compared to several other precipitation products. The precipitation detection is performed using temporal changes of daily surface emissivities. A statistical fit, derived from a rainfall analysis product using raingauge and radar data, is devised to estimate a daily precipitation rate from surface emissivities. Rain retrievals are evaluated over a one year period in 2010 against other precipitation products including rain gauge measurements.
The EMIRR algorithm allows a reasonable detection of rainy events from daily surface emissivities. The number of rainy days and the daily rainfall rates compare well with estimates from other precipitation products. However, the algorithm tends to overestimate low precipitation amounts and to underestimate higher ones, with reduced performances in the presence of snow. Despite such limitations, this new method is very promising and provides a demonstration of the potential use of the 89 GHz surface emissivities to infer relevant information (occurrence and amounts) on daily precipitation over land surfaces.

14:00-14:15: Diffusion in Convective Flows Laboratory Experiments and Atmospheric Flows

[1]**J. M. Redondo**, [1]**T. Vila**, [1,2]**J. Tellez** and [2]**J. M. Sanchez**

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Experimental results in order to map the different transitions between two and three dimensional convection in an enclosure with complex driven heat flows. The size of the water tank is of 0.2 x 0.2x 0.1 m and the heat sources or sinks can be regulated both in power and sign (Redondo, 1992; Redondo et al., 1995). The thermal convective driven flows are generated by Seebeck and Peltier effects in two opossed walls, thus generating different types of convective cells that varies strongly with the Topology of the boundary conditions as a function of Rayleigh, Peclet and Nusselt numbers, (Kuramitsu et al., 2003; Nicolleau et al, 2011). Visualizations are performed by PIV, Particle tracking and shadowgraph. Diffusion is measured in the transition from a homogeneous linearly stratified fluid to a cellular or layered structure by means of convective stirring. Patterns arise by setting up a convective flow generated by a buoyant heat flux (Kimura and Iga, 1995). The experiments described here investigate high Prandtl number mixing using brine and fresh water in order to form density interfaces and low Prandtl number mixing with temperature gradients (Mahjoub et al., 2000).
We also present a detailed comparison of the evolution of Jets and Plumes in overall mixing. The relation between fractal analysis and spectral analysis can be very useful to determine the evolution of scales. Experimental and numerical results on the convective cells are compared with Remote Sensing observations of the atmosphere, SAR images of the ocean can detect well these types of structures over the ocean (Kimura and Iga, 1995; Platonov et al., 2008).
The evolution of the turbulent mixing layer and its complex configuration is studied taking into account the dependence on the initial modes at the early stages and its spectral, self-similar information [6]. Spectral and Fractal analysis on the images has been used in order to estimate dominant mixing structures as well as the dispersion relations of basic instabilities (Platonov et al., 2008).

14:15-14:30: Satellite Application Facilities on Land Surface Analysis (LSA SAF): an overview of existing MSG SEVIRI products

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Characterization of land surfaces is possible with the use of products estimated and disseminated by the Land Surface Analysis (LSA) SAF (http://landsaf.ipma.pt/), which is supported by EUMETSAT and the National Meteorological Sevices. Products are distributed via EUMETCast and FTP, with temporal samplings ranging from 15 minutes to daily and monthly basis, at the spatial resolution provided by SEVIRI (MSG). A global 10 daily composite product -NDVI- based on AVHRR-Metop is also available from 2007 onwards by ftp (http://www.metops10.vito.be). Among those LSA-SAF products, some of the most relevant for include: radiation parameters (surface albedo and temperature), evapotranspiration, vegetation (fraction of vegetation cover, leaf area index and fraction of absorbed photosynthetic active radiation) and products related to wild fires detection and monitoring (fire detection and radiative emission from fires). An update of recent developments regarding shortwave fluxes (albedo, incoming radiation) developed at METEO FRANCE will be swept. This includes notably the separation between direct and diffuse radiation components, also the data fusion between LEO (Low Elevation Orbit) sensors like EUMETSAT Polar System (EPS) and GEO like geostationnary system SEVIRI.
The LSA SAF is committed to continue this NRT service, providing products and service for the full MSG and EPS satellite series. In order to ensure temporal homogeneity of time-series, the LSA SAF will reprocess the most relevant MSG-derived products (albedo, temperature, vegetation and fire radiative power products) in 2015. To facilitate handling of operationally provided, MSG-based LSA SAF products, a post-processing toolbox has been developed. This toolbox enables (n-)daily compositing, spatial sub-setting and remapping of products and reached its first open release this year.

14:30-14:45: Comparing three popular methods for monitoring weather radar antenna pointing accuracy

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Weather surveillance, hydrological models and Numerical Weather Prediction systems rely strongly on weather radar observations and derived products. Therefore it is essential to assess the performance of the radar system on a continuous basis for a dynamic evaluation of the data quality.
Within this context, three methods for monitoring weather radar antenna pointing accuracy are reviewed and compared. Two of the methods use the known location of Sun as a reference. The first of these methods is based on an offline radar scan of the Sun-disk and is of widespread employment in routine technical maintenance tasks and implemented commercially by several weather radar manufacturers (Vaisala, 2013). The second method detects and characterizes solar interferences in online radar data for the retrieval of calibration parameters (Huuskonen and Holleman, 2007). A third complementary online method consists on cross-correlating measured ground clutter echoes with echoes simulated using a high-resolution digital elevation model (Rico-Ramirez et al., 2009).
Daily measurements using the offline Sun-scanning procedure collected in a dedicated campaign from February to March 2014, are base for an intercomparison of the three methods aforementioned. The analysis, when applied for three weather radars operated by the Meteorological Service of Catalonia, reveals specific advantages and limitations of the considered approaches. A long term comparison (from January 2013 to March 2014) serves to confirm and clarify the behaviours inferred from the short term analysis.
These results are potentially useful for both research and operational weather radar communities requiring high quality data observations.

15:45-16:00: AERUS-GEO: An advanced initiative for tracking operationally aerosol events over any surface targets (including the Mediterranean Basin) based on satellite MSG/SEVIRI observations

[1]**D. Carrer**, [1]**X. Ceamanos**, [1]**J.-L. Roujean**, [2]**B. Six**, [1]**P. Nabat**

[1]*Météo France, CNRM-GAME, UMR3589, Toulouse, France*
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The major difficulty in detecting the aerosol signal from visible and near-infrared remote sensing observations is to reach the proper separation of the components related to the atmosphere and the surface. This issue becomes especially challenging over bright targets such as deserts. A method is proposed to circumvent this issue by exploiting the directional and temporal dimensions of the satellite signal through the use of a semi-empirical kernel-driven model for the surface/atmosphere coupled system. As a result, simultaneous retrieval of surface albedo and aerosol properties is made possible. The proposed method proves to be capable of detecting and tracking the presence of anthropogenic aerosols, volcanic ash emissions and dust events over deserts.
The proposed method referred to as AERUS-GEO (Aerosol and surface albEdo Retrieval Using a directional Splitting method - application to GEO data) is applied to three spectral bands (0.6 mm, 0.8 mm, and 1.6 mm) of MSG (Meteosat Second Genera-

tion) observations, which scan Europe, Africa, and the Eastern part of South America every 15 minutes. The AERUS-GEO AOD estimates compare favorably with measurements of several AERONET stations, MODIS-derived (Moderate Resolution Imaging Spectroradiometer), and MISR-derived (Multi-angle Imaging Spectro-Radiometer) products within a 20% of accuracy. Results reveal the capability of AERUS-GEO to detect more aerosol events within a given time period compared to products derived from low Earth orbit satellites. Evaluations were also conduced during the CHARMEX/TRAQA campaigns over Mediterranean Basin in 2012 and 2013.
The higher availability of AOD products thanks to AERUS-GEO may benefit the accurate monitoring of the aerosol radiative forcing. The AERUS-GEO algorithm was recently implemented by the ICARE Data Center (http://www.icare.univ-lille1.fr), which operationally disseminates a daily AOD product at 670 nm over the MSG disk since 2014.

16:00-16:15: Lightning studies in the frame of TALOS Project: Climatology, forecasting and nowcasting

K. Lagouvardos, **V. Kotroni**, **E. Galanaki**, **Th. Giannaros**, **A. Karagiannidis**, **S. Kazadzis** and **E. Proestakis**

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Thunder And Lightning Observing System (TALOS) is a research program funded by the Greek Ministry of Education with the aim to promote excellence in the field of lightning meteorology. The main data set used is the nine-year period (2005-2013) lightning provided by the Very-Low-Frequency Lightning detection network ZEUS operated by the National Observatory of Athens.
The presentation first focuses on the spatial and temporal (seasonal and diurnal) variability of Cloud to Ground (CG) strokes over Greece and the surrounding maritime areas. The areas with the highest thunderstorm activity are identified and related with the underlying physiographic characteristics. Additional analysis focuses on the links of CG strokes with indices related with the atmospheric instability such as the Convective Available Potential Energy (CAPE). The developed nowcasting tools are based on the use of lightning data and by high-time resolution METEOSAT imagery. The lightning forecasting is based on the use of WRF numerical weather prediction model, in which a lightning forecasting algorithm is implemented and modifications have been proposed based on the performed analysis. Both nowcasting and forecasting are verified for a large number of cases characterized by severe lightning over Greece, observed during the warm as well as during the cold period of the year. Finally the relationship between lightning and aerosol concentrations is explored.

16:15-16:30: Comparing Different Manners to Characterize the Atmosphere for Meteorological Applications

V. García-Santos, **Ll. Pérez** and **V. Caselles**

Department of Earth Physics and Thermodynamics, Faculty of Physics, University of Valencia, Valencia, Spain

Land surface temperature (LST) retrievals from sensors aboard orbiting satellites, are supedited to the corresponding atmospheric correction, especially in the Thermal InfraRed (TIR) spectral domain (8-14 μm). To remove the atmospheric effects from at-sensor radiance measurements is needed to characterize the atmosphere by means of three specific variables; the upwelling path and the hemispherical downwelling radiances plus the atmospheric transmissivity. Those variables can be derived from the previous knowledge of vertical atmospheric profiles of air temperature and relative humidity for different geo-potential heights and pressures.
In this work, the above mentioned atmospheric variables were analyzed for a specific weather station site located in the north of Spain. These variables were calculated with atmospheric profiles retrieved from three different sources; The National Centers for Environmental Prediction (NCEP) web-tool atmospheric profiles calculator, the MODIS MOD07 product and the radiosoundings launched at the selected site by the University of Wyoming (WYO). Atmospheric profiles from 2010 to 2013 were obtained to carry out the present study. Results from comparison of these two different atmospheric profiles with WYO data show that the NCEP profiles characterize the atmosphere in a more fitted manner than the MOD07 do with an average RMSE of $\pm 0.2 W/m^2 sr \mu m$ for upwelling radiance; of $\pm 0.3 W/m^2 sr \mu m$ for the donwelling radiance and $\pm 0.03 W/m^2 sr \mu m$ for the atmospheric transmissivity.
Considering NCEP in turn of WYO atmospheric profiles when retrieving LST from satellite data can lead to errors lower than $\pm 1K$, when applying a single-channel method. While using MOD07 profiles introduces LST errors up to $\pm 6K$, depending on the MODIS spectral band.

Wednesday, 4th

Session 1: Climatology

Chairmen: *Dr.Guijarro, Dr. Fita and Dr. Calbó*

8:50-9:05: Long Term Changes in Three Dimensional Middle Atmospheric Residual Circulation

[1]**D. Demirhan Bari**, [2]**A. Gabriel** and [1]**C. Ozen**

[1]*Istanbul Technical University Department of Meteorological Engineering, Istanbul, Turkey*
[2]*Leibniz-Institute for Atmospheric Physics E.V. at the U.*

Niversity of Rostock, Kühlungsborn, Germany

The residual circulation, which is the approximation of mean meridional Brewer-Dobson circulation, formulated by using transformed Eulerian Mean (TEM) equations. In a three dimensional (3D) point of view the residual circulation formulations includes also effect of time-mean 3-D eddy fluxes. In this study the long-term changes in the 3D BDC is analyzed because atmospheric pattern in the 3D approach are more significant than those identified by the 2D approach. In order to examine the long term changes in 3D residual circulation ERA-INTERIM data from 1979 to 2013 is used and the evolution of zonal asymmetries determining the stationary waves in ozone and water vapor is identified.

9:05-9:20: Synoptic Anomalies Resulting in Pervasive Frosts in Iran

[1]P. Mahmoudi

[1]*Department of Physical Geography, Faculty of geography and environmental planning, University of Sistan and Baluchestan, Zahedan, Iran*

This study has focused on synoptic anomalies resulting in pervasive frosts in Iran with the aim of improving the predictive capabilities of this phenomenon in Iran. So, to achieve this goal, Iran's frosts were classified based on a spatial principle into three categories, including pervasive frosts, semi-pervasive frosts and partial frosts. It should be noted that this analysis only studies the years having maximum and minimum frequencies the days with pervasive frosts that were a standard deviation above and below the average for a 43-year period from 1962 to 2004.
At low levels of atmosphere for the maximum frequency of days with pervasive frosts, a bipolar pressure anomaly with a positive value in the north east and a weak negative value in the north west of Iran above the Turkey are seen. In other words, with a strengthened Siberian high-pressure system and extending its western tongue on the Mediterranean sea, the conditions for establishment of a high pressure system on this sea is provided that the result of such an establishment would be pushing back the low pressure system tongue of Sudan monsoon to the lower latitudes as well as provided synoptic conditions for moving the cold air from the higher latitudes to the western part of Iran.
It is also seen for the minimum frequency of days with pervasive frosts that the entire studied area is dominated by a negative anomaly, which its central focus of severity is located over the Turkey. Thus, the spatial patterns configuration of this group indicates the weakening of the Siberian high pressure and its subsequent lack of extension of this pressure western tongue to the Mediterranean sea that as a result, the conditions for establishment of a low pressure system with a cyclonic circulation over the Mediterranean sea will be provided; therefore, under these circumstances and with the expansion of Sudan monsoon low pressure tongue and humidity injection from anticyclone circulation of the Indian Ocean (Arabian Sea), Iran's climate experiences a more humid and warmer conditions, which reduces the frequency of days with inclusive frosts over Iran.

9:20-9:35: Medicanes in HadGEM3 N512 climate simulations

[1]M. Tous, **[2]G. Zappa**, **[1]R. Romero** and **[2]L. Shaffrey**

[1]*Universitat de les Illes Balears, Spain*
[2]*University of Reading, United Kingdom*

Medicanes are exceptional cyclones that form over the Mediterranean sea with similar development (based on the thermodynamical disequilibrium between the cold air and the warm sea) and properties (intense vorticities with a warm core) to tropical cyclones. Despite medicane size and wind speed are lower than in tropical cyclones, the severity of the winds can inflict substantial damage on islands and coastal areas.
Recently, interest and concern about how climate change will affect extreme events are increasing, including what could happen with medicanes. Most global climate models do not have high enough spatial resolution to represent these small cyclones, and additional techniques, like downscaling, are necessary to build an adequate medicane risk assessment.
In this study, we apply a cyclone track algorithm on global climate model data at high-resolution (about 25 km, in the horizontal at mid-latitudes), which seems enough to properly represent medicane-type cyclones. After an initial validation of the method for the full Mediterranean cyclone climatology, a medicane risk assessment is derived using present and future climatic conditions: The magnitude of the expected winds and the frequency and location of storms are some of the aspects that are evaluated. The results are also compared with those obtained using alternative techniques.

9:35-9:50: Homogenization and Trends of Spanish Mean Wind Speed Monthly Series

J. A. Guijarro

Spanish State Meteorological Agency (AEMET), Balearic Islands Office

Mean wind speed monthly Spanish series from 233 sites that had a minimum of 10 years of observations during 1951-2013 were compiled from daily observations at 07, 13 and 18 hours UTC. Wind speed series derived from daily wind runs were considered first, but due to their higher rate of missing data, the three observations per day wind speeds were preferred for this study. This is a limited sampling for the whole day, but at the monthly scale the correspondence is quite good, with an average speed bias of an 8% higher than the values derived from daily wind runs.

The selected wind speed series were homogenized by means or the R package Climatol twice: a) using a ratio normalization; b) applying a cubic root transformation and a full standardization. First diagnostic graphics of the process showed a poor and incoherent spatial correlation structure, hampering the quality of the homogenization. Anyway, 360 sudden shifts were detected and corrected in two thirds of the series that were found inhomogeneous. Therefore, wind speed series appear very affected by inhomogeneities, probably due to its sensitivity to obstacles and surface roughness changes in the surroundings of the observatories.
Wind speed trends were then computed from the homogenized series, yielding values between around -1.5 (from June to October) and -2 (from November to May) m/s/century. These negative trends are in accordance with the wind stilling observed in many areas, their cause being attributable to a lower baroclinity in middle latitudes and/ or to an increasing surface roughness in the surroundings of the observatories.
Due to the almost lack of conventional observations on ocean areas, NCEP reanalysis were used to compute wind speed trends over a wide domain including the Spanish territories. Differences between observed and reanalysis (on land and on sea) trends are discussed.

9:50-10:05: Extension of Mediterranean Summer towards Spring

[1]**A. Jansà**, [1]**V. Homar**, [1]**R. Romero**, [1,2]**S. Alonso**, [3]**J. A. Guijarro** and [1]**C. Ramis**

[1]*Universitat de les Illes Balears, Departament de Física, Palma, Mallorca, Spain*
[2]*Institut Mediterrani d'Estudis Avançats, Departament de Recerca del Canvi Global, Palma, Mallorca, Spain*
[3]*Agencia Estatal de Meteorologia (AEMET), Delegación en Illes Balears, Palma, Mallorca, Spain*

The authors have already reported an important and positive 2 m temperature tendency in May-June at Palma (Mallorca), as well as a simultaneous and highly correlated strong increase of local 500 hPa geopotential. The present work seeks to frame these observed tendencies in a wider seasonal and geographical context.
A first finding is the high correlation between 2 m temperature and 500 hPa geopotential only during the warmer months. This suggests different mechanisms for temperature change acting throughout the year. High near-surface temperatures in the warm season would be mostly associated with the dominance of a subtropical anticyclone, associated with the northern edge of the Western Mediterranean section of the Hadley circulation. Therefore, higher temperatures in this season would mean an extension of the climatic inter-tropical area towards the region.
Highest positive low-level temperature tendencies in May-June are not a local particularity but they are also observed in a relatively wide area over the Western Mediterranean. Different geographical patterns are observed in other periods of the year. In July-August, for instance, the most intense positive pole of low-level temperature tendency drifts to the East-Northeast, towards Russia. On the other hand, the 500 hPa geopotential tendencies show the following pattern: ridge of intense positive tendency over West Mediterranean in May-June, and this ridge displaced to the north-east of the Mediterranean in July-August.
With regard to the 500 hPa structures present in May-June, a PC analysis of the field followed by a multiple lineal regression of surface temperature against the leading PCs shows that half of the temperature tendency is explained by the time evolution of a geopotential ridge centered over the Western Mediterranean.
These results are compatible with a northern expansion of the Hadley circulation, whose downward branch in late spring would now be further focused in the West Mediterranean zone.

10:05-10:20: Impact of Atmospheric Circulation Patterns on the Airborne Pollen Dynamics in Catalonia (NE Iberian Peninsula)

[1]**M. Alarcón**, [2,3]**B. Jordina**, [1]**T. Majeed Husam**, [1]**C. Periago** and [1]**R. Izquierdo**

[1]*Departament de Física i Enginyeria Nuclear, Universitat Politècnica de Catalunya, Barcelona, Spain*
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[3]*Departament de Biologia Animal, Biologia Vegetal i Ecologia, Universitat Autònoma de Barcelona (UAB). Bellaterra, Spain*

Here we explore the effect of climatic variability on the airborne pollen series recorded in Catalonia (NE Iberian Peninsula) considered of high interest due to abundance, landscape importance and/or allergenic significance. In this sense, the relationship between the annual and winter (December to March) phases of the North Atlantic Oscillation (NAO), the Western Mediterranean Oscillation (WeMO) and the Arctic Oscillation (AO) and the Annual Pollen Index (API), the start, the end and the length of the pollination seasons of 22 taxa collected at 6 aerobiological stations in Catalonia during the 18 years-period 1994-2011 have been computed. In addition, daily back-trajectories cluster analysis has been carried out in order to determine the influence of climatic indices on the main atmospheric transport routes frequencies and the long range pollen transport. Our aim is to determine the respective vulnerability of taxa to climate variability, taking also into account the pollen provenance area.
Climatic indices showed significant negative correlations with the parameters API (except for "Corylus") and pollination start (except for "Ambrosia", "Castanea", "Fagus" and "Betula", the latter being Eurosiberian taxa often long range transported) of most taxa, while significant positive correlations with the end of the pollination period of most taxa. The most vulnerable taxa (more significant correlations) with regard to API were "Corylus", "Olea", "Platanus" and "Quercus" deciduous

type.

11:25-11:40: Performance Evaluation of CMIP5 Simulations for Turkey and Neighboring Region

[1]**Y. Yilmaz**, [2]**U. Turuncoglu** and [1]**O. L. Sen**

[1]*Istanbul Technical University, Eurasia Institute of Earth Sciences*
[2]*Istanbul Technical University, Informatics Institute*

GCMs are advanced tools essential for simulating the climate and changes in the climate system, however, their performances in simulating the regional climate characteristics could be quite different from each other. A performance evaluation of the GCMs could be especially useful to determine which ones to use in a dynamical downscaling study, if downscaling does not involve sufficient number of them warranting an uncertainty analysis. The aim of the study is, therefore, to determine the better performing ones amongst all CMIP5 simulations for Turkey and surrounding region in terms of temperature and precipitation. Model outputs are compared for main domain (Turkey and the neighboring region) and its subdomains. Taylor diagrams are used to analyze the outputs (temperature and precipitation) of CMIP5 simulations. High-resolution gridded CRU (Climate Research Unit) datasets are used for the observational data. Study period is 30 years between 1971 and 2000. Overall, for the main domain, superior results for temperature are found in the simulations of 'MIROC4h' of Center for Climate Systems Research (CCSR) and 'CMCC-CM' (The Centro Euro-Mediterraneo sui Cambiamenti Climatici Climate Model), and for precipitationÂăin the simulations of 'EC-Earth' earth-system model of The European Centre for Medium-Range Weather Forecasts (ECMWF) and 'CESM1-CAM5' of National Center for Atmospheric Research (NCAR). The analysis is currently in progress to come up with a ranking that combines both temperature and precipitation performances of the models.

11:40-11:55: Present and Future Variation of drought Patterns over Mediterranean under Several Climate Change Scenarios

J. P. Montávez, **P. Jiménez-Guerrero**, **A. Olmedo**, **S. Jerez** and **N. Ratola**

Department of physics, University of Murcia, Spain

Droughts have been and still are a natural phenomenon that affects considerable parts of the world, causing important problems in many sectors of the society, mainly in agriculture and water resources. In the case of Europe, they are particularly relevant mostly in the Mediterranean area, the water resources of this basin are limited and they suffer unpredictable variations due to the irregular climate in these areas, which are increasing ever more as a result of climate change (Palmer and Räisänen, 2002). This is the reason for a reliable characterization of drought patterns over this area, in order to serve as the preparation of plans and programs to prevent and mitigate the negative effects of possible future changes in climatic conditions.
In this work the characterization of drought patterns in the Mediterranean has been carried out for the period 1961-2000 employing the E-OBS data base from the European Climate Assessment & Dataset project (ECAD) (Haylock et al., 2008). Subsequently, we have obtained the principal spatial modes of drought. Diverse future scenarios of behaviour from PDSI were obtained using outputs from regional climate change projections (2001-2050), run with the MM5 model in the framework of the ESCENA project (Jiménez-Guerrero et al., 2013). The regional projections are based on various global models (ARPEGE, ECHAM5, HDQ03 and HDQ16) under the climate change scenarios SRES A1B and B1. Results show a clear intensification of the main drought patterns for the next future.

11:55-12:10: A climatological analysis of diurnal winds in the Adige Valley in the Alps

[1,2]**L. Giovannini**, [1,2]**L. Laiti**, [3]**S. Serafin** and [1,2]**D. Zardi**

[1]*Atmospheric Physics Group – Department of Civil, Environmental and Mechanical Engineering – University of Trento. Trento, Italy*
[2]*National Consortium of Universities for Atmospheric and Hydrospheric Physics (CINFAI). Roma, Italy*
[3]*Department of Meteorology and Geophysics, University of Vienna, Vienna, Austria*

The Adige Valley is one of the main corridors connecting the Po Plain to with the inner Alps.
It displays a gradually sloping floor along the 150 km path connecting the valley outlet into the plain, near the city of Verona (91 m AMSL) in the plain, to the upper valley at Merano (330 m AMSL).
Various Several weather stations are operated along the Adige vValley extent, providing regular measurements of the main atmospheric variables, such as air temperature, atmospheric pressure, wind strength speed and direction.
A careful climatological analysis was performed on time series of these data for the years 2004-2013, based on a selection ofing all the days in which favorable weather conditions allowed a full development of valley winds in the years 2004-20112013.
Mean Diurnal meandaily cycles of along-valley wind speed were evaluated at each station along in the valley. Although amplitude and phase of local wind strength turn out to be strongly affected by local topography and land cover, nevertheless the typical cycle of diurnaldaytime up-valley winds - peaking in the afternoon, - and nocturnal down-valley nocturnal winds -, weaker but persisting throughout the night - is clearly reproduced observed at all the stations. This diurnal daily

wind cycle occurs in connection with the correspondingis associated with a corresponding cycle of horizontal pressure distribution, as shown by the mean diurnal daily oscillation of surface-level pressure at various the stations along the valley, from the plain (Verona) to the upper valley (Merano). The amplitude of the diurnal surface pressure cycle displays an increaseing trendin up-valley direction, with the smallest value in Verona and the largest in Merano. As a consequence, the along-valley pressure distribution changes with along-valley distance from the plain almost linearly at any time. However, the higher larger amplitudes of the diurnaldaily surface pressure cycles occurring further up-valley cause a daily periodic reversal of the pressure gradient.

Session 6: Water cycle and climate change

Chairmen: *Dr. Scavone and Dr. Tan*

13:00-13:20: Probable Impacts of Climate Change on Water Potential of Turkey

I. Ozturk

Istanbul Technical University, Environmental Engineering Department

13:20-13:35: Changes in water cycle at resent past 60 year in Georgia

[1]**N. Kutaladze**, [1]**L. Megrelidze** and [2]**M. Shvangiradze**

[1] *The national environmental agency*
[2] *Georgia's Third National Communication to UNFCCC*

West and East Territories of Georgia are characterized with different climate features, which is mainly expressed in precipitation amount and it's annual distribution.
Some changes in mentioned patterns of precipitation caused by climate change is discussed in the paper.
Western Georgia's climate is sub-tropical with great amount of annual precipitation, having maximums in spring and summer, bringing floods and flash floods. Oppositely in East of country semiarid climate is dominant, with water scarcity in summer time. From analyzed annual sums statistically significant increasing trend have been revealed in western Georgia's mountainous parts, which is more danger, because of landslides and mudflows. As for seasonality most trends and all positive are presented in transitional seasons and more intensive in autumn. Reduction of summer sums is characterising most Eastern part, but this trend is less stable. Consecutive dry spells in East Georgia is increased on most analyzed stations, with accompanied increased number of meteorological droughts, which partly compensated with also increased consecutive wet period's length. Heavy precipitation events, such as daily and 5 daily maximums of precipitation, as well as number of days with 50 and 90 mm precipitation became more frequent. On some east stations 100 year maximum of daily rainfall in historical records, was occurred several times in last decade. Most frequent from them in Tbilisi, where urban scale precipitation redistribution caused different infrastructural difficulties.
Future prediction for county expect intensification of mentioned problems, mainly increase of total precipitation up to 50-ies of century and increase of heavy rain events up to end of 21 century. Additionally sharp decrease of summer rains is predicted with high confidence for the whole region, what will necessary impact on water discharge in trans-boundary rivers in Eastern Georgia, as well as may reduce hydropower potential of country in Western part for the mentioned period.

13:35-13:50: Long Term Analysis of Rainfall Characteristics Related to Erosion Risk in Turkey

D. D. Bari

Istanbul Technical University Department of Meteorological Engineering, Istanbul, Turkey

Daily total rainfall data from 87 stations from different regions of Turkey has been analyzed from 1979 to 2013. Precipitation concentration index (PCI) is used to identify the characteristics of the precipitation. Seasonal distribution of the rainfall data showed strictly assorted regions according to the PCI. The yearly variability and the type of the precipitation due to being seasonal or uniform indicate whether the flow is eligible to form a surface runoff and erosion. Soil's water storage capacity and the surface runoff highly effects the vegetation. The increase in the water erosion is liable to decrease the vegetation cover. Hence the observed regional rainfall characteristics is processed in order to assess the soil erosion risk by using Fournier Index (FI) and Modified Fournier Index (MFI). The Black Sea coastal region of Turkey indicates a high risk for erosion due to high surface runoff.

13:50-14:05: Analysis of Simulated Snow Variability During The 2013-2014 Drought over Turkey

B. Önol

Istanbul Technical University, Department of Meteorology, Istanbul Turkey

In this study, snow cover and snow water equivalent change have been investigated over highlands of Turkey by performing regional climate model simulation for the drought period (2013-2014). The severe drought in 2013-2014 is quite persistent over most of Turkey and precipitation decrease in all rivers basins are in range of %10 to %50. Since the snowmelt process over the highlands of Turkey supply most of the runoff for the Eu-

phrates and Tigris basins, variability in snow accumulation is significant factor in terms of the sustainability of fresh water resources which also affects social-economic life in neighboring countries. To analyze the snow variability, the ICTP-RegCM model has been applied for 10-km horizontal resolution and double-nested method has been used to downscale NCEP-NCAR Reanalysis over the Eastern Mediterranean region. The snow cover produced by model compared with NOAA-NNVL satellite data. The snowmelt process monitored by defining certain dates (March 1st, April 1st, May 1st) during the period of drought and it is clear that the spatial variability of the model and satellite data are consistent each other. Simulated snow water equivalent (SWE) has been also analyzed during the drought period and the anomaly of SWE with respect to the 1971-2000 period reaches 500 mm over the mountainous areas. SWE declined all over the Turkey except very narrow coastal band in the Black Sea region. These results are also consistent with precipitation observations. The model results also indicate that the negative trend in SWE has been found over the areas where the elevation is higher than 1500 m since the 1960s. We also detected similar declining trend in previous studies based on the future scenario simulations and it is also possible that the recent drought has been enhanced by the human-induced climate change.

14:05-14:20: A comparative analysis of climate change and impact on agriculture and food security and also practices for adaptation and mitigating climate change, The Cases and Asian Countries

Ali and **Khan**

African Asian Rural Development Organization, New Delhi, India

This research paper highlighting the comparative analysis of climate change and impact on agriculture and food security and also practices for adaptation and mitigating climate change of Asian region. The Asian Countries namely (India, Pakistan, Sri Lanka, Malaysia, ROC (Taiwan)).
Climate changes are an increase of total heavy rainfall, severe drought, rising mean sea level and possibly an extreme weather condition. Climate changes are seen as a major potential threat to national food security and sustainable agriculture in Asia. Agricultural sector is a very important to Asian economis and to this fact priority has been given to the concept of sustainable agriculture and food security. Climate change monitoring and forecasting capabilities have to be improved to give planners ample information to formulate affective policy and counter measures.
As we Know, Asia is the most populous continent in the world. In Asia, past and present climate trends and variability have been characterized by an increasing temperature. In the region there is evidence of prominent increases in the intensity and/or frequency of many extreme events such as heat waves, tropical cyclones, prolonged dry spells, intense rainfall, tornadoes, snow avalanches, thunderstorms, and severe dust storms in the region. Furthermore, the region is highly subject to natural hazards, such as the 2004 Indian Ocean Tsunami, the 2005 Pakistan Earthquake, and the 2006 landslides in the Philippines. Such impacts pose additional risks for already vulnerable communities striving to combat poverty and achieve sustainable development. The Asia/Pacific region accounted for 91% of the world's total death and 49% of the world's total damage due to natural disasters in the last century. Therefore, climate change poses a serious and additional threat to poor farmers and rural communities in the region who live in remote, marginal areas such as mountains, drylands and deserts; areas with limited natural resources, communication and transportation networks and weak institutions.

14:20-14:35: Meso-scale Processes in the Western Mediterranean and their implications on the Water Cycle in the Basin

[1]**J. L. Palau**, [2]**M. J. Sales** and [1]**M. M. Millan**

[1]*CEAM - Centro de Estudios Ambientales del Mediterráneo. Valencia (Spain)*
[2]*Modeliza. Parc Científic de la Universitat de València. Paterna, (Valencia) Spain*

This presentation summarizes the main relevant findings, most of them already published recently, in regard of the forcing feedbacks between some tropospheric dynamics on the Western Mediterranean area and the water vapour cycle in this basin.
In this presentation we summarize the main features regarding the specificity of the Mediterranean Basin, showing some key regional and local meteorological processes which drive, trigger or condition the Mediterranean climate and its eventual abrupt change (as, it is the case of the intensity and recurrence of droughts, floods, heat waves, desertification, etc. on the Western Mediterranean Basin). We also discuss feedbacks among tropospheric processes leading to a positive synergetic sum of effects and the consequences of not considering them when simulating numerically the meteorology and the climate evolution on this area.
From the analysis of dozens experimental campaigns and eleven-year period (2000-2010) of systematic satellite measurements (MODIS instrument onboard of TERRA and AQUA satellites) and also from the results of some modelling exercises on selected case studies, in this presentation we present the following main conclusions:

- From ends of May to beginnings of October there is a net accumulation of water vapour and pollutants on the WMB that favours the instabilization of the atmosphere.

- From the point of view of tropospheric dynamics there are two well-differentiated basins within the Mediterranean Basin.

• Atmospheric physical forcing acting bidirectionally among the different atmospheric scales (global and local); downwards and upwards). This important feature is not included in the current climate models.

• Among others, the inclusion or not of the abovementioned feedbacks among the different scales result in the simulation or not of typical summer storms (eventual floods) in the region.

• Local forcing is one of the trigger mechanisms of the formation and development of convective storms on the coastal areas of the WMB.

15:35-15:50: Development of new formula to estimate groundwater recharge and evapotranspiration in semi-arid area

[1]**A. R. Salah Eddine**, [1]**C. Brahim** and [2]**B. Abdelkader**

[1] *Geo-environment Laboratory FSTGAT, Algiers Algeria*
[2] *University of Khemis Miliana, Algeria*

The new concepts in hydrological science give an important interest to quantifying groundwater recharge for a best management of water resources. Different technique was used to estimate this complex variable, whichever the classic techniques give uncertainty values of this recharge. Many research papers were published in this field of sciences, but in all cases the real estimation of groundwater recharge is not achieved. In this work we present the principles steps of demonstration of our new formula to estimate groundwater recharge using only two or three parameters in a semi area we tack an example of Djelfa located in south west of Algeria. The area of study was characterized by a moderate rainfall, generally around 300 mm/year, and the annual temperature average vary around 15 °C. The primary results of this equation are give an annual recharge approximates to 16 mm/year.
Finally we can generate the application of this formula in all semi-arid area, to make easy the operation of water resources management.

15:50-16:05: Impacts of Climate Change on Water Resources in Turkey - A Focus on Assimilation Capacity for Freshwater Ecosystems

A. Erturk, **R. Albay Akcaalan**, **Z. Dorak**, **O. Gaygusuz**, **C. Gurevin**, **L. Koker** and **M. Albay**

Istanbul University, Faculty of Fisheries, Department of Freshwater Biology

Based on monitoring data and climate projections, scientists highly agree that water resources have the potential to be strongly affected by the climate change in the long-run. However, there is no consensus about the degree of the impact of human activities on climate change.
Turkey, that is located in the temperate zone is a relatively large country (780,000 km^2) with considerably high environmental gradients such as changes in elevation, a high biogeographical diversity and several climate zones that differ from each other (such as the very wet climate of the Eastern Black Sea Region with more than 2000 mm annual precipitation compared to dry climate of the Central Anatolia less than 300 mm annual precipitation, or the Mediterranean Coastal Zone that receives most of the rain in winter followed by a dry period extending from late spring to October with almost no rain fall). Data analyses conducted by several independent and institutional studies revealed that Turkey's territory is expected to be under a relatively strong climate change impact towards the end of 21^{st} century. As of the first decade in this century Turkey was classified as a water stressed country. Higher temperatures and less precipitation are expected to increase the pressure on Turkey's freshwater resources even more.
Water resources management deals not only with water quantity but also with water quality. Turkey as an industrializing agriculture country is facing several water quality problems including organic matter accumulation, sedimentation and eutrophication in inland waters. We will present a prediction of Turkey's nutrient budget for different climate change scenarios and a digest of the present situation of Turkey's freshwater ecosystems, with a focus on their vulnerability to climate change in terms of assimilation capacity of inland waterbodies.

16:05-16:20: Impact of Climate Variability on Contributions to Dam Watershed of Tafna (NW of Algeria)

A. Bouanani, **K. Baba-Hamed** and **R. Bouanani**

Laboratory num. 25, Department of Hydraulics, Faculty of de Technology, University of Tlemcen. Algeria

Currently, the watershed of Tafna includes five functional dams (Beni Bahdel, Meffrouche El Izdihar (Sidi Abdelli), Hammam and Boughrara Sikkak), these dams fed several towns and cities including Oran, Tlemcen, Ain Témouchent and Sidi Bel Abbes. Studies of these dams were generally made âĂŃâĂŃbefore the 80s, the drought is not yet installed, so that the volumes mobilized initially planned are currently far from being achieved. Also, we present in this paper, the evolution of liquid flows in the basin of Tafna since 1943 and the impact of drought on the volumes made âĂŃâĂŃto various dams in the basin.

16:20-16:35: Climate Change and its Impacts on Water Resources in Turkey

[1]**O. L. Sen**, [1]**O. M. Gokturk** and [2]**D. Bozkurt**

[1] *Istanbul Technical University, Eurasia Institute of Earth Sciences*
[2] *University of Chile, Center for Climate and Resilience Re-*

search

Turkey lies in a region that is highly vulnerable to climate change, and the indicators show that climate has been changing in Turkey. The station observations show that temperatures are increasing throughout the country. Summer temperatures increase more than those of the other seasons. There are significant shifts in the timing of the snowfed river discharges, which indicates that snow melts earlier in response to the elevated temperatures. No significant coherent change has yet been detected in precipitation observations. Future climate change projections agree on an increase in temperatures throughout the country and a reduction in precipitation in the southern half of the country. An analysis reveals that these changes will impact the country's water resources negatively by reducing the water potentials in the southern basins. The projections that were based on the high emissions scenarios (SRES A2) indicate water potential reductions up to 37% in the Mediterranean basins, up to 70% in Konya basin and up to 10% in the Euphrates and Tigris basins by the mid twenty first century. Little or no change is detected in the water potentials for the basins in the northern half of the country. The decline in the water resources in the southern basins has the potential to adversely affect the agriculture, energy and tourism that are important sectors in Turkey.

Poster

Session 5: Wind energy

Water cycle and climate change

P5.1: Application of a Wind-Wave-Current Coupled Model in the NW Zone of the Mediterranean Sea, next to the Catalan Coast

[1]**A. M. Palomares**, [2]**M. Espino**, [1]**J. Navarro**, [2]**M. Grifoll**, [1]**P. A. Jiménez** and [2]**E. Pallares**

[1] *Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas (CIEMAT), Madrid, Spain*
[2] *LIM, Technical University of Catalonia, Barcelona, Spain*

Offshore Wind Energy has become one of the main topics within the research in Wind Energy research.
Although there are quite a few models with a high level of reliability for wind simulation and prediction in onshore places, the wind prediction needs further investigations for adaptation to the Offshore emplacements, taking into account the interaction atmosphere-ocean.
The main problem in these ocean areas is the lack of wind data, which neither allows for characterizing the energy potential and wind behaviour in a particular place nor validating the forecasting models.
In this work, the results of the implementation of a coupled ocean-atmosphere-wave model (COAWST) in the NW zone of the Mediterranean Sea, next to the Catalan Coast are presented.
The COAWST model (Coupled-Ocean-Atmosphere-Wave Sediment Transport Model; Warner et al., 2010) system has been implemented in the region considering a set of downscaling nested meshes to obtain high-resolution outputs in the region.
This work shows the main results of the COAWST model adaptation and application to this particular area, including both monthly tests and other tests in atmospheric situations, especially chosen for their particular interest.

P5.2: Performance analysis of the WRF Model coupled to WindSim and WAsP Models for the Short Term Wind Energy Prediction System of Keltepe Wind Farm of Turkey

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In this study, we assessed the results of the short-term wind energy prediction system (SWEPS) that our research group has recently developed for Turkey. SWEPS uses the numerical weather prediction model (WRF), a CFD model WindSim, a physical model WAsP, and a model output statistics method to improve the results of the models. Here, we present the comparisons of WRF/WindSim with WRF/WAsP coupled model results with Artifical Neural Network improvement. The study area is the wind farm Keltepe located in the town of Balikesir where is the northwestern part of Turkey. We evaluated the coupled model performance by using the hourly data for the year of 2010. Wind power of the farm has been estimated up to 3-day coupling with WRF, WindSim, and WAsP Models. The resulting estimates of 2010 are compared with observational wind power data in terms of error analyses namely root mean square error (RMSE) and normalized root mean square errors (nRMSE). Performance comparisons of the coupled model WRF, WindSim and WAsP include the horizontal resolutions of the WRF model 9km, 3km, and 1km. Wind power model results for each turbine were evaluated for 24, 48, and 72 hours and seasonally. Consequently, both resolutions of the models show variability at different seasons for depending on the turbine locations including the complexity of the terrain of the interest. Moreover, our results also show that WRF/WindSim coupling system may be better than WRF/WAsP system for Keltepe.

P5.3: Economic assessment of CO_2 emission reduction in Latvia when part of CHP generated electricity is replaced by small scale wind turbines generated electricity

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The paper illustrates economic assessment of CO_2 emission reduction in Latvia when part of CHP generated electricity is replaced by small scale wind turbines generated electricity.
As the base scenario is assumed generation of electricity in CHP plant. As an alternative scenario is assumed generation of electricity by small scale wind turbines. The study represents the cost of CO_2 avoidance from a base scenario of the existing CHP plant.
In this assessment is taken into account investment and operating costs of wind turbine. A case study was carried for 3 type's horizontal axis wind turbines with rated power 1kW, 3kW and 5kW. The study is conducted for commercially available wind turbines. The calculation is based on onshore wind speed hourly minimum value of 4 m height in Latvia approximated according to each wind turbine tower height.

Session 4: Numerical modelling

P4.1: A Probabilistic Risk Assessment of Time to Rainfall of Turkey: a Censoring Approach

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Several statistical methods such as nonparametric approaches, quantile regression, neural networks, logistic regression are used for examining climate risk assessment. Furthermore, survival analysis is an alternative tool to make inferences for climate research and applications. The Kaplan-Meier method and Cox-type model are the most popular methods to characterize the time to event data in survival analysis. Cox-type model provides a good approximation to the survival function and also its dependence on covariates. In the last century, the climate change is one of the most important problem. Climate change alters the rainfall patterns in Turkey as well as worldwide. It causes insufficient rainfalls and irregular rainfall periods. We analyze the rainfall data from the meteorological stations of Turkey. The reduction in rainfalls decreases the water resources in Turkey and drought seems to be an inescapable end. Therefore, we use the survival approach as the risk assessment tool in time to wet season and rainfall probability estimations. The Cox-type model is applied to determine the influence of some climate predictors. We define the onset of wet season as the date at which 15% of the long-term mean of total rainfall is first reached and evaluated the related risk factors.

P4.2: Potential of Ensemble Data Assimilation Methods to Forecast Severe Convective Phenomena Over the Sea

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The prediction of mesoscale phenomena which initiates, organizes and evolves over the sea is a extremely demanding challenge of great importance for coastal regions. The afternoon of 4th October 2007, severe damaging winds and torrential rainfall affected the island of Mallorca. Reportedly, this storm produced F2-F3 tornadoes in the vicinity of Palma, with one person killed and estimated damages to property exceeding 10 million euro. Several studies have analysed the meteorological context in which this episode unfolded, describing the formation of a train of multiple thunderstorms along a warm front and the evolution of a squall line organized after the convective initiation offshore Murcia at about 10UTC. Couhet et al. (2011) attributed the correct simulation of the convective system and its organization as a squall line to the presence of a convergence line at low-levels over the Alboran sea during the first hours of the day.
In this study, we devise a mesoscale ensemble data assimilation experiment to analyse the predictability of the 4th October 2007 episode and the potential of the assimilation cycle to advect critical observational information towards decisive data-void areas over the sea. We compare the skill of 3 ensemble configurations in representing both the convection initiation, and the later evolution of the squall line. On one hand, we test an Ensemble Kalman Filter which assimilates conventional (surface, radiosonde and AMDAR) data; and on the other, two downscaling configurations from the operational ECMWF global ensemble.
Results show that the 6-h EnKF assimilation period produces initial fields that successfully represents the environment in which initiation occurred and thus the derived numerical predictions render improved evolutions of the squall line. Synthetic maps of severe convective risk reveal the improved predictability of the event using the EnKF as opposed to deterministic or downscaled configurations. Discussion on further improvements to the forecasting systems are also provided.

P4.3: SAR Observations of Convective Flows in the Coastal Region of the NW Mediterranean

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In many geophysical phenomena with great environmental interest appear simple processes that generate complexity and mixing (Redondo, 1995). This can be found both in the Atmosphere and in the Ocean as long as the

Reynolds number is high and the regime corresponds to a turbulent fluid flow, The different dominant sizes and the PDF's of the vortical structures detected correspond to the different Rossby deformation scales, in the NW mediterranean, Coriolis parameter does not change much, but thermal stratification produces the 20 to 100 ratio between atmospheric synoptic scales and ocean eddies. SAR images of the sea surface provide a tool to describe the spectral turbulent fluid flow and to investigate the multiple scale structure, this geometrical description of environmental turbulence can be modeled using a complex hierachy of eddies or scales. The energy enters in the system at a 3D large scales and goes down to produce heat at the Kolmogorov micro scale (K41), the large eddies break in smaller and even smaller eddies, this is a self-similar description. Due to 2D flows there is also an inverse energy cascade, when two-dimensional turbulence properties emerge at scales comparable with the Rossby deformation scale or radius and energy is regulated by enstrophy cascade.
Diffusion is measured in the framework of Lagrangian measures, noting the transition from a homogeneous rotating stratified fluid to a forced Coastal Canyon Induced Patterns (CCIP) that arise by resonant interactions between wind and buoyant heat flux (Redondo and Platonov, 2009). The experiments described here investigate high Prandtl number mixing using brine and fresh water in order to form density interfaces and low Prandtl number mixing with temperature gradients (Mahjoub et al., 2000). Experimental and numerical results are compared with Remote Sensing observations of the atmosphere, SAR images of the ocean can detect well these types of structures over the ocean.
The evolution of the turbulent mixing layer and its complex configuration is studied taking into account the dependence on the initial modes at the early stages and its spectral, self-similar information (Nicolleau et al., 2011). Spectral and Fractal analysis on the images has been used in order to estimate dominant mixing structures as well as the dispersion relations of basic instabilities (Platonov et al., 2008; Redondo and Patolov, 2001).

P4.4: Verification of the WRF Model Wind Speed Forecasts for the Western Coastline of Turkey

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Since wind energy sector has grown rapidly during the last decade in Turkey, reliability of the wind power prediction has become more important due to the competitions between wind energy companies. Our recent studies showed that it is crucial to use a numerical weather prediction model for accurate wind energy prediction before using any local model, since the wind speed and direction is not only dependent upon local effects but the mesoscale effects also play significant role in both the magnitude and the direction of wind, especially the interested domain is located on a highly complex terrain. On the other hand, numerical weather prediction models may have some difficulties resolving local effects on complex terrain especially near to the coastal regions. Western part of Turkey, having the highest wind energy potential, has a similar complexity that some wind farms are both close to the shore and they have a complex topography. Thus the aim of this study is to understand how the WRF model responds this complexity in the western part of Turkey. We present wind speed and direction model results of the WRF model for 4 different model domains on the western coastal line of Turkey and verify the results by using near to coast observational data obtained 10 Turkish State Meteorological Service Weather Stations. In the WRF model configurations, the highest domain resolution is set to 1km by using 3 nested domain structures starting from 9km resolution with the downscale ratio of 3. The comparisons of the domain resolutions are also presented. The best physical parameterization options are determined by using sensitivity analyses for atmospheric boundary layer and land surface schemes and their errors from the observations are determined. Preliminary results indicate the needs for more observations on the coastline and better parameterizations especially for the locations where the land and sea interactions are highly pronounced.

P4.5: Sub-Kilometer Dynamical Downscaling of Near-Surface Wind Profiles in Complex Terrain

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The vertical structure of near-surface winds is pivotal for many research and application areas including including air pollution, wind energy, transport and infrastructural design. Although observational and modeling studies have been mainly focusing on the winds at the standard surface level, i.e., 10 m, broader aspects of the near-surface wind profiles received less attention, especially over the complex terrain. Furthermore, a principal question arises as to whether a refinement of horizontal grid spacing in mesoscale models can yield accurate estimates of the near-surface wind profiles over the complex terrain to serve as a surrogate to supplement the scarcity of observations.
Therefore, Mesoscale Model 5 (MM5) and the Weather Research and Forecasting (WRF) model were configured with multiple domains centered in the complex terrain of central Nevada with horizonatal grid spacings ranging from 27 km to 333 m. Using observations from five meteorological 50-m towers, the model success in representing winds, wind shear and directional wind shear is assessed using moment-based as well as spectral verifi-

cation metrics. In particular, we address the potential strengths and weaknesses of these two mesoscale models from the wind energy variability viewpoint and also considering the appropriateness of the physical parameterizations suitable to a variety of airflow scales.

P4.6: Using object based methods to verify weather predictions

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The advent of high power computing facilities gave the opportunity to use state of the art numerical weather prediction models at high resolutions. Intense weather phenomena can now be studied at these high resolutions providing detailed information about their characteristics. Verifying the results of the aforementioned numerical models plays an important role in the effort of improving them. Using traditional point verification methods present various drawbacks (double penalty problem, etc). To overcome those limitations new spatial verification methods have been proposed. In the present study the ability of WRF-ARW model to reproduce thunderstorm days during the year 2010 is estimated using object based methods. Three 2-way telescoping nests cover Europe and northern Africa (domain 1), the central and a large part of eastern Mediterranean (domain 2) and central Greece-Thessaly region (domain 3) at grid-spacings of 15km, 5km and 1km, respectively. Using different boundary layer, microphysics and cumulus convection schemes an array of experiments is performed. A C-Band radar located at the centre of the domain 3 is used to evaluate the results of those simulations. Results present the ability of the model to spatially position the thunderstorms, lacking, on the other hand, the skill to precisely indicate their temporal evolution.

P4.7: Extreme Hot Days Trends and its Relation With Changes in the Atmospheric Circulation

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In this work a methodology for attributing extreme events trends to changes in the atmospheric dynamics using Circulation Types (CTs) is proposed. The method mainly evaluates links between trends in the frequency of the CTs and trends in extremes based on regional series. Here is presented an example of application to the occurrence of Extremely Hot Days (EHD) in Spain during the summertime from 1951 to 2008. Regional series comes from a regionalization of the maximum daily temperatures obtained from the Spain02 dataset (Spain02). Eight regions with different daily time variability are found, observing in all them important trends in the occurrence of EHDs along the last decades, especially at inner regions of the Iberian Peninsula (IP). The CT classification considered here differs from others previously used in other studies related to extreme events since regional series information is used, allowing to obtain more robust links between the regional series and the CTs because of the strongest control of atmospheric dynamics over the regional than local variability. Furthermore, the sensitivity of results to the atmospheric variables used for defining the CTs. Surface Level Pressure (SLP), Temperature at 850 hPa Level (T850) and Geopotential Height at 500 hPa (Z500) from the ERA40 dataset have been used for the six CT classifications obtained using the variables individually and in combination of pairs. The optimum choice of large scale variables depends on the region under consideration, being the combination SLP-T850 which gives the best characterization for most of them. Finally, an attribution exercise of the regional EHDs trends to the dynamics is proposed. Results show that less than 50% of the regional EHDs can be associated with changes in the CTs frequency, being even less than 20% in the regions with the largest EHD trends, mainly located at the center of the IP.

P4.8: Evaluation of the Performance of a Mesoscale Modeling System for Wind Resource Assessment

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High quality wind data are essential for assessing the wind resource of a particular area. Typically, these data can be retrieved from ground-based weather station networks. However, the spatial resolution of such networks is unacceptably coarse for wind energy applications due to the high installation and operation costs. Further, most of the existing networks do not provided information on the full range of the variables required for wind resource assessment. Therefore, alternative wind data sources should be employed. Numerical weather prediction (NWP) models are considered to be one valuable tool for this purpose.
In this study we evaluate the performance of the Weather Research and Forecasting (WRF) NWP model in terms of simulating wind. WRF is implemented for

a full year, providing hourly data on a 6x6 km^2 modeling domain focusing on Greece. Observational data, including surface and upper-air observations, are used for data assimilation during the entire modeling period, at 6h intervals. Wind measurements from 20 surface synoptic weather stations are used for verifying model results for 10m wind speed. The verification procedure includes the determination of common verification metrics, such as the model's bias and root mean squared error, as well as examination of the observed and modeled wind speed distributions. In addition, the parameters of the observed and simulated Weibull distributions are computed.
Overall, the results indicate a satisfactory performance of the modeling system. The wind regime of the study area was reproduced adequately well, although the model showed a slight tendency to overestimate the occurrences of high wind velocities.

P4.9: Investigating the Local Circulations by WRF Model: A Case Study of İzmir

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The surface wind field plays an important role at the regional scale such as the dispersion of pollutants and air quality problems over a region, or the wind resource evaluation. Specifically during the summer, strong surface heating combines with the terrain and land/water contrasts of the areas to create a complex array of diurnal circulations. Summer circulations over the Eastern Mediterranean is dominated by the Etesian which significantly affect the Ionian Sea and Aegean Coasts as well as İzmir and surrounding areas having with complex coastal environments located at west part of Turkey.
The aim of the study is to improve our knowledge of the circulations in the complex coastal environments of İzmir. For this purpose, our aim is to identify and examine the effect of sea/land breezes under different atmospheric circulation patterns for the two contrast seasons in one-year study period. Generally, observational and modeling studies have described some of these circulations, advances in high-resolution numerical modeling allow for a more comprehensive and three-dimensional examination. In order to simulate typical summer conditions (June-July-August) and winter conditions (January) in 2011 over the İzmir and surrounding areas, a high resolution WRF model was run. A high horizontal resolution of 1km is used to provide an accurate representation of the terrain features including coastal boundaries. To make sure the performance of the WRF mesoscale model with regard to the surface wind conditions realism of the simulation, it was compared to observations on a collection of days representing both typical summer and winter conditions. Generally, it was found that the simulated diurnal wind, relative humidity, and temperature were close to observations. The accuracy of the simulations to reproduce the wind field under representative synoptic situations of the Aegean Coast is also considered in order to diagnose errors as a function of the large-scale situation. The evaluation is accomplished using daily averages in order to inspect the ability of WRF to reproduce the surface flow as a result of the interaction between the synoptic scale and the regional topography. A special emphasis in this analysis is the influence of complex terrain on the accuracy of the WRF model in reproducing the measured surface wind conditions. The evaluation is accomplished using daily averages in order to inspect the ability of WRF to reproduce the surface flow as a result of the interaction between the synoptic scale and the regional topography.

P4.10: Calibration and validation of a model rainfall-runoff: Application to Watershed Haute Tafna Beni Bahdel (Tafna, NW Algeria)

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Hydrological modeling is a widespread activity among hydrologists. The hydrological models now an indispensable tool in understanding the dynamics of a watershed, in problem solving management of water resources(irrigation), in the predetermination off loading and the development of the environment(dam building) and the prediction of natural disasters(flood simulation in the short term and prediction of low flows). Thanks to major advances in the field of computing, many hydrological models have emerged over the last twenty years, especially those who watch the rainfall-runoff relationship, providing great flexibility in manipulating and gain time hardware. The use by spatially distributed models of many physical and hydrological parameters does not mean they provide better results. That is why in this article we have chosen a global model that can account for the behavior of the watershed without requiring a lot of data and parameters to be calibrated. CEMAGREF models GR1A,GR2M and GR4J were selected. The objective is to determine the characteristic parameters of these models for the watershed of Haute Tafna in Béni-Bahdel station.
This study of the rainfall-runoff relationship on an annual monthly and daily scale is based on flows and rainfall measured at the station of Beni-Bahdel. Model parameters of GR1A,GR2M and GR4Jwere determined with satisfactory quality criteria. The long-term behavior of the dam of Béni-Bahdel, taking into account the evolution of the water resource and management constraints can be studied at the appropriate time scale in hydrological model by forcing the outputs of climate models. The results obtained by the simulation of the transformation of rain-flow by use of rural GR1A,

GR2M and GR4J engineering models indicate that models "to tanks" are more satisfactory than a model of "black box" type. Indeed the GR model takes into account the chronological succession of phenomena and influence as well climate parameters (evapotranspiration) than physical and Hydrogeological of the basin (soil moisture and external exchanges)

P4.11: Evaluation of Wavelet and ANN Analyses for Wind Energy Potential

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This paper presents different case studies on application of wavelet techniques to analyse wind energy potential in Northern Cyprus. Wind energy, on the other words renewable and environmental friendly energy potentials based on air-sea-land interactions are main sources of energy in islands. There are different wind energy applications: They allow farmers to have the potential for transferring kinetic energy by the wind mill for pumping water, drying crops, heating systems of green houses, rural electrification's or cooking etc. Larger wind turbines (over than 1 MW) can pump enough water for small-scale irrigation. The main objectives of this study are; i) to define variations of wind speed and energy potential in Northern Republic of Cyprus (NRC), ii) to study trends, cyclic components, micro, meso and macro scale effects, iii) to predict wind energy potential by using artificial neural networks (ANN). Wavelet methodologies present better results on temporal and spatial data analyses. This study tries to evaluate data interpretation process with wavelet and ANN analyses based on wind speed data recorded in two study areas Selvitepe and Kalkanli in Northern Cyprus. Hourly, daily, monthly and seasonal averages of wind speed data are analysed by using automatic station's records at two regions. By using time series and wavelet techniques, small, meso and large scale factors and their roles on wind speed and energy potential have been analysed. MATLAB and SPSS programs had been used to study some statistical properties of the wind speeds at pilot areas. The hourly average wind speeds are represented by a Weibull function. Statistical properties of average wind energy parameters were compared. The graphs and numerical values are evaluated by using Wave-menu, under the packet program of the MATLAB Software. Additionally, some descriptive statistics of the ground data are analysed by using SPSS Program. Advantages of ANN approach are its faster learning time, simplicity and adaptability in parameters. Results of ANN analyses evaluate wind energy potential, its annual and inter-annual variability, self-similarity; and relation with periodic and non-periodic fluctuations of wind speed values in two study areas. Conclusion of this study covers temporal and spatial variations of wind speed wind energy potential in NRC. This paper underlines the role of factors in different scales and their importance on wind energy potential variations in space and time domain. The results of this study would be applicable in the field of other wind energy modelling and combined energy systems.

Session 2: Processes and applications

P2.1: Retrieval of aerosol optical properties from a multifilter rotating shadowband radiometer over Girona, NE Spain

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Aerosols still remain as one of the major uncertainties in estimating the radiative forcing of climate change, especially if compared with the greenhouse gases. The most important of aerosol radiative properties is the aerosol optical depth (AOD), which is a measure of the total aerosol burden in the atmosphere. The spectral dependence of AOD, typically described by the Ångström exponent (AE), is an indicator of the particle size.
We present an analysis of AOD and AE measurements made with a multifilter rotating shadowband radiometer (MFR7), that measures solar irradiance at five 10 nm bandwidth channels between 415 and 870 nm. We have analized 2 years of data of MFR7 comprised between June 2012 and June 2014.
A first step to obtain AOD for each channel is to perform Langley calibrations. However, the daily Langley regressions exhibit significant noise mostly due to atmospheric variability. So, a calibration based on several close Langley plots is generated for each day. After applying the calibration method, time-series of AOD for each spectral channel are calculated on minute basis. Finally, we eliminate the data that are contaminated by the presence of clouds in front of the Sun, average on daily basis and calculate AE. We find that the whole method has an error of 0.01-0.02 in AOD and of 0.5 in AE.
The daily values of AOD have relatively low values along the year in Girona, and follow an annual pattern with maximum values in summertime. A prominent secundary springtime peak is also observed. The daily averages of AE range in values typical of continental aerosols and present a maximum value during summertime, so the summer increase in AOD is linked with an increased concentration of fine particles. Comparing our data with those from a CIMEL sunphotometer of

the AERONET network located in Barcelona (100 km south from Girona), we find a good correlation for the AOD, though, as expected, not as good as were found by other authors with the CIMEL and MFR7 located at the same place. The correlation of AE is worse (but similar as found by other authors) probably due to the uncertainy of AE estimation.

P2.2: Heat waves prediction system in a Mediterranean area (Valencia Region)

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Since summer 2008, Fundación CEAM has been operationally running a heat wave prediction system in the Valencia region in coordination with regional health authorities. The system is based on the Regional Atmospheric Modelling System, run as a forecast model to predict temperatures in the Valencia region. Prior to the launch of the forecasting system, a climatological study of maximum temperature on the Valencia region was run to determine the existence of thermoclimatic areas inside the study region. This work led to the distinction of 30 areas with their own distinct characteristics and in their thermometric regime. Then, for each of such areas, proper temperature thresholds were evaluated for the onset of alert levels. In the actual operation of the system, heat alert levels are issued by comparing the model temperature forecast with the thresholds for each thermoclimatic area. Before issuing any alert, expert forecaster supervision is needed to approve or modify RAMS model forecasted alert levels. The system runs twice daily but only one alert level is broadcasted early in the morning to the health authorities. In this poster, a description of the system and its performance since 2008 is presented. General results show fairly good agreement between forecasted levels and actual heat levels calculated from observational data.

P2.3: Meteo-Climatic Analysis at Local Scale by Means of a Multivariate Statistical Procedure

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We propose the application of a statistical innovative procedure, based on multivariate techniques, able to identify the correlation structure between different variables measured in multiple meteo-climatological stations.
This procedure was applied to data collected from 1997 to 2013 in meteo-climatological stations located in Agri Valley (Basilicata Region, Southern Italy). In the recent years, this zone was suffer a great anthropogenic pressure due to oil extraction and pretreatment activities. The main land use is agriculture (arable lands, vineyards and vegetable cultivations) but also many forests surround the area. The geology is quite uniform; the area is characterized by sand and silt soils. In this study, the meteorological data were organized into a three-dimensional matrix at daily scale [H years x M stations x N measured variables], evaluating the distribution of missing data along the observation period that can strongly influence the effectiveness and the quality of the data analysis. From this data matrix, for each year, the best two-dimensional sub-matrix [measurement stations x measured variables] was identified for applying recursively the principal component analysis (PCA) and the cluster analysis (CA). The joined application of these two techniques was aimed to put in evidence the information content of the descriptors (meteorological variables) and objects (sites), as well as to compare the behavior of the different variables in the correlation structures. Furthermore, two synthetic multivariate indices, could be applied, for assigning standardized weights to descriptors and objects, in order to identify the role of each variable in the investigated period in an unique and quantitative way and to read the evolution of their multi-dimensional correlation as well as the occurrence of isolated events. This procedure may allow to identify the redundant descriptors, to highlight the behavior of each station in the correlation structure, to distinguish among groups of sites pointing out extreme sites.

P2.4: Effect of Environmental Conditions on the Deposits of Seagrass Litter in two Contrasting Beaches of Mallorca Island

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Although deposits of seagrass ("Posidonia oceanica") litter are commonly found along the Mediterranean shores, little is know about their dynamics, fate and the depositional and erosive processes driving them. To understand this transport of seagrass material (from sea to the shore and from the shore to the inland direction or back to the sea), two beaches in Mallorca island were studied (Son Real at the north and Es Trenc at the south). During 2013 - 2014, fortnight measurements of the dimensions of seagrass' beach-cast deposits were taken to estimate the temporal evolution of its total volume in both beaches. Wind speed and direction were obtained from the AEMET surface weather stations close to both beaches to examine the role of environmental forcing on the dynamics and fate of seagrass beach-cast.
The amount of seagrass litter arriving annually at Es Trenc was 6 times larger than that at Son Real. From the analysis of the wind speed and direction we esti-

mated that 50% the beach-cast that arrives at Es Trenc is exported inland, and it is 21 times larger than that exported inland at Son Real. The differences in the magnitude, dynamics and fate of seagrass litter deposits between both beaches are attributable to coastline geomorphology, type of vegetation on land and wind conditions. Our results demonstrate a close coupling between the dynamics of seagrass litter deposits and wind conditions allowing estimation of the magnitude of seagrass litter export towards adjacent terrestrial ecosystems and thus assessment of the role of seagrass ecosystems beyond the marine boundaries.

P2.5: Phases of the Sea-Breeze in the Island of Mallorca

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In order to better understand the diurnal cycle of the Sea-Breeze (SB) in the island of Mallorca, during September 2013 and June 2014 two experimental field campaigns have been conducted in the Campos basin (at the south side). A total of 6 IOPs (clear skies and weak pressure gradient conditions) are analysed using data from the AEMET network and the observations taken close to the coastline (about 900 m inland). They consist on a surface portable station (equipped with an IR camera and a sonic anemometer), a captive balloon (temperature and humidity) and a multicopter (temperature and humidity). Preliminary analysis of the observations show a good agreement between the different sources of data.
During the "previous" phase (0430-0730 UTC) land-breeze conditions were present and after sunrise the sensible heat flux turned to positive meanwhile the turbulence started. In the "preparatory" phase (0730-0900 UTC) the wind close to the coast started to veer progressively towards the SB direction. As soon as the SB was "initiated" (0900-1200 UTC), the SB front progressed to the inland direction reaching a "mature" phase between 1200-1500 UTC. Afterwards, the SB "decaying" starts and at about 1900 UTC the wind speed was close to zero and the wind veered towards the land to sea direction. During the campaign all phases were measured, except the sounding systems for the mature phase due to the strong wind.
Some selected IOPs are further analysed through the use of high-resolution mesoscale simulation. It is found that the model is able to reproduce the observed establishment of the SB although the observed temperature gradients are larger than those observed.

P2.6: A stochastic generation of daily precipitation in Turkey

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A Weather Generator (WG) produces daily synthetic time series of weather data of unlimited length. Among different WGs, there are those built in a two-step processes, a first-order Markov-chain for occurrence and an exponential distribution for non-zero amounts. Climgen is a widely used as WG that belongs to this kind. But, the main assumption of Climgen is no reliable for the study area or rather the existence of a linear-relationship between the transitional probabilities and the fraction of wet days per month (with the linear coefficient constant and equal to 0.75).
In this work, the capability of a new Daily Precipitation Stochastic Generator (DPSG) based on a multivariate quasi-stationary and weakly depending stochastic process, has been presented. So, the DPSG, that fits climate features including variability in frequency of wet days in a month, has been developed for precipitation generation.
The methodology was applied for daily precipitation series (1960-2006) collected at over 200 Turkish rainfall stations by "Turkish State Meteorological Service". The reconstruction of missing data was carried out by an Hidden Markov Model, statistical downscaling technique which relates the occurrence of weather states to local climate according to their synoptic similarity. Then, statistical tests ("K-S test and Student's t-test") were conducted to evaluate the capability in reproducing monthly patterns which are maybe required for operational purposes in engineering. The results obtained suggest the first-order Markov chain is capable to capture dry and wet spells, and that the single-parameter Weibull distribution function is suitable to generate the monthly amounts of precipitation.

P2.7: Mesoscale cold pool flow organization in the Pannonian basin

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The Pannonian basin is a topographic structure in Central Europe surrounded by mountain ranges that allow the formation of large and distinct atmospheric bound-

ary layer structures, different from the surrounding areas. The wide scale of the structure, of a characteristic diameter of 600 km, surrounded by mountain ranges with tops above 800 m in respect to the sea level, allows the formation of a basin scale cold pool in wintertime under high pressure systems. This phenomenon can last for weeks and has implications for pollutant dispersion. It is related to strong Bora events, when the anticyclonic northeasterly winds push the cold air across the Dynaric Alps that falls violently over the Adriatic sea. In November 2011 a high-pressure system was over the area for more than two weeks, leading to the building up of a cold pool of the size of the Pannonia basin, with formation of fog at the end of the episode. There were severe pollution events that activated alert protocols. The establishment and evolution of the November 2011 cold pool is studied making use of the analyses of the ECMWF, focusing on the role of the slope flows from the surrounding mountain ranges in the formation, the diurnal cycle and the dissipation of this long-lasting late fall cold pool. The analyses are compared to available data near the surface and differences are discussed.

P2.8: Inferring cloud optical depth of broken clouds

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Broken clouds present a three-dimensional structure that is why complex models are required to study each possible scenario. However, this work presents a process of getting an effective cloud optical depth (COD) in broken clouds using traditional one-dimensional radiative transfer model, both in the ultraviolet erythemal radiation (UVER) and the solar broadband ranges. This method can be used only in particular conditions, when the sun is blocked with clouds and cloud cover between 0.2 and 1. All measurements of irradiance were taken every 5 minutes at the Burjassot campus of the University of Valencia (39°30' N, 0°25' W, 30 m) using a UVB-1 radiometer by Yankee Environmental Systems for UVER and a CM-6 pyranometer by Kipp & Zonen for solar broadband radiation. In order to register the cloud cover for low cloudiness, an automatized sky camera SONA SIELTEC SL was used; it takes images of the whole hemisphere every 5 minutes. Therefore, this method is based in a combination of measurements of surface irradiance in the UVER and the solar broadband, cloud cover and radiative transfer simulations by means of the multiple scattering model (SBDART) for the years 2011 and 2012. Considering both spectral ranges, the results show that the more frequency values are between 5 and 20. COD values larger than 30 ranges represent only 5% of cases. The frequency peak is observed in the interval of 5-10 with an average of 12. As a validation of these results a relationship between the estimated COD and the cloud modification factor (CMF) is established. These relationships are similar to those obtained previously by the authors for overcast skies.

P2.9: An Experimental Evolution of the Fine Structure of the Temperature Profile 2m above the Surface

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A surface based meteorological station is installed in the campus university of the Balearic Islands (Majorca) since 2012. The equipment provides measurements for monitoring the surface exchange processes, including thermal soil properties and the heat flux of the thin layer close to the surface, water condensation at 2 cm above ground level (agl), the surface temperature, and the net radiation and buoyancy flux at 1 and 2 m agl, respectively.
During three periods from different seasons in 2012 (February, July and October), a column of eight thermocouples was installed to measure the air temperature evolution at a high frequency between 1.5 and 192.0 cm agl. The fine vertical structure allows to analyse in detail the thermal stability very close to the surface and its relation with the rest of surface processes observed like the dew formation, soil and atmospheric heat fluxes or turbulent mixing.
The present study will expose the preliminary analysis of the results as well as the instrumental characteristics of the meteorological laboratory installed in Majorca.

P2.10: Solar resource assessment in complex orography: a comparison of available datasets for the Trentino region

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The accurate assessment of the solar radiation available at the Earth's surface is essential for a wide range of energy-related applications, like the design of solar power plants, water heating systems and energy-efficient buildings, as well as in the fields of climatology, hydrology, ecology and agriculture. The characterization of

solar radiation is particularly challenging in complex-orography areas, where topographic shadowing and altitude effects, together with local weather phenomena, greatly increase the spatial and temporal variability of such variable. At present, approaches ranging from surface measurements interpolation to orographic downscaling of satellite data, to numerical model simulations are adopted to map solar radiation.
In this contribution a high-resolution (200 m) solar atlas for the Trentino region (Italy) is presented, which was recently developed on the basis of hourly observations of global radiation collected from the local radiometric stations during the period 2004-2012. Monthly and annual climatological irradiation maps were obtained by the combined use of a GIS-based clear-sky model (r.sun module of GRASS GIS) and geostatistical interpolation techniques (kriging). Moreover, satellite radiation data derived by the MeteoSwiss HelioMont algorithm (2 km resolution) were used for missing-data reconstruction and for the final mapping, thus integrating ground-based and remote-sensing information. The results are compared with existing solar resource datasets, such as the PVGIS dataset, produced by the Joint Research Center Institute for Energy and Transport, and the HelioMont dataset, in order to evaluate the accuracy of the different datasets available for the region of interest.

P2.11: Experimental Characterization of the Spatial Distribution of NO_2 Urban Pollution

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Despite the major improvement of air quality produced in most of the European cities in the last decades, where levels of traditional pollutants have definitively declined (black smoke, SO_2, etc.), the continuous increase of traffic density has remained unsolved some pollution problems linked to vehicles exhausts (both primary contaminants, NO_2, VOCs, particles, ... and secondary, specially derived from photooxidant transformation).
From the atmospheric dynamics perspective, the urban environment is usually a very complex scenario, with big influence from the small scales of movement, increased by the traffic emissions mobile nature, variable in time and space. The NO_2 immission field in a city is highly anisotropic, usually showing strong spatial gradients, with high temporal variability.
In this environment many questions arise: the need for adequate measurement of immission levels for normative achievement; the need to investigate the system behaviour in order to improve its management, with occasional adoption of correcting rules; the need to analyze relationships between air pollution and health at a small scale area; etc.
The use of passive dosimetry for the characterisation of urban pollution has been widely used in several cities during the past decades, appearing as an attractive technique due to its characteristics: low cost, easy installation in the field, possibility of large area coverage, etc. Results from an extensive NO_2 measurement with passive dosimeters in Valencia city (Spain) are presented. From several campaigns with high density measurement distribution points along the city, both spatial distribution and meteorological dependence has been showed. In spite of strong time variability driven by atmospheric forcing, the overall urban structure and traffic distribution seems to determine a persistent relative behaviour within the campaigns, as if the city impressed its fingerprint in the immission field. Such evidence has important implication in the design of strategic abatement plans, as well as other air quality management issues.

Session 3: Remote and in-situ measurements

P3.1: Comparison Between Micrometeorological Techniques and Lysimetry Measurements in a Mediterranean Vineyard

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Land surface evapotranspiration (ET) is recognized as a key input in numerical climate and weather prediction, as well as drought detection and crop irrigation management. Vineyards occupy more than 25% of the total agricultural area in Mediterranean regions, and there is a growing interest for a better understanding of the energy balance over this challenging row-crop. In previous works we stated the significance of a good thermal characterization of the soil-canopy structure, and analyzed the partition evaporation/transpiration using a two-source energy balance model. Encouraged by the necessity to validate this model performance a new experiment was carried out in the summer of 2014 in a row-crop vineyard in Barrax, Central Spain. A set of thermal-infrared radiometers (IRTs) were mounted in the middle of a row, standing on a 9-m2 monolithic weighting lysimeter. An eddy covariance (EC) system was deployed together with a net radiometer and a battery of soil heat flux plates. Data of the different terms of the energy balance equation were stored every 15 min, and then averaged at an hourly and daily scales. In this work we focus on the comparison between flux measurements from the two methods, EC and lysimetry, since understanding the uncertainty associated with ground truth data is critical for accurately assessing remote sensing based products and models. The imbalance in the surface energy budget was first analyzed. Discrep-

ancies between after forcing closure EC and lysimetry measurements were observed and possible causes were identified and discussed. This study underscores a need for caution when using some micrometeorological measurements as ground-truth data to assess energy balance modeling.

P3.2: Characterization of the precipitation variation and its impact on landscapes changing in Algeria

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The steppe environment in Algeria changes in depending on the climate and society. Aim for sustainable development is wanting to reconcile economic activity, social development and environmental management. The climate is very important because of its leading role in this type of environment and precipitation have a higher share for the definition of the overall dry climate. It is contrasted with a dry and hot summer season alternating with a rainy winter fresh cold otherwise. However, the climatic trend is not always easily seen and is still controversial.
Thus, this research aims to answer the following questions:

- rainfall it's been trending downward or upward?
- The phenomenon of drought is still threatening?

The area of study is situated in the western highlands, the Algerian-Moroccan border. Our research focused on the characterization of the precipitation variation over a period of 24 years, from 1983 to 2006. We are based on data available from the meteorologic station of Mecheria and remains the most representative station in the region. The series of observations are provided by services of National Office of Meteorologie (NOM). The proposed approach focuses on the search for variation of the dry season during the reporting period and the study of inter and intra-annual irregularity to determine their impact on landscapes changing.
Depending on rainfall and Evapotranspiration (E.T.P.), we see that from 1999 the E.T.P. is much greater than for rainfall. Thus, we consider that this period is a sequence of water stress (drought). This means, the region recorded a net drying, especially during the last decade. Although it was marked by a significant increase in rainfall, E.T.P. increased twice the amount of precipitation received. Causing advantage of dry years sequences.

P3.3: Development of a surface albedo product from PROBA-V at the nominal resolution of 333M: method and preliminary validation around the Mediterranean basin

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The main objectives of EC-funded FP7 IMAGINES (Implementation of Multi-scale Agricultural Indicators Exploiting Sentinels) project are to (i) improve the retrieval of basic biophysical variables, mainly LAI, FAPAR and the surface albedo, identified as Terrestrial Essential Climate Variables, by merging the information coming from different Sentinel sensors and other GMES contributing missions; (ii) propose an original agriculture service relying upon a new method to assess the biomass, based on the assimilation of satellite products in a Land Data Assimilation System (LDAS) in order to monitor the crop/fodder biomass production together with the carbon and water fluxes. For time being, observations from PROBA-V sensor (SPOT/VGT follow on) launched in May 2013, are exploited to ensure continuity in the production in the frame of GLOB-LAND services related to Copernicus.
A surface albedo is being prepared from PROBA-V at the resolution of 333M. The detailed method will be exposed, which encompasses a somewhat optimal temporal resolution of 5 days to detect suitable changes. In the frame of PROBA-V programme, albedo products it is proposed broadband spectra in visible, near infrared and solar as well spectral albedos in the original spectral channels (blue, red, near-infrared, and middle infrared). Preliminary validation will be shown for all PROBA-V albedo products through a comparison with ground data and intercomparison with other moderate resolution satellites like MODIS and SEVIRI. Emphasis will be put on the features that can be now detected from PROBA-V along coastal areas and within ecosystem components owing to the enchanced resolution.

P3.4: The Theia Land Data Centre

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Nine French public institutions involved in Earth Observation, environmental studies and scientific research (CEA, CNES, Cirad, CNRS, IGN, INRA, IRD, Irstea and Météo-France), have launched in 2012 the Theia Land Data Centre, pooling their expertise and resources to make satellite data available to the environmental research community and to public policy actors. The Theia primary mission is (i) to build a national space data infrastructure able to produce value-added space data over land and provide services fitted to users' needs, (ii) to support the sharing of experience and scientific knowledge on methodologies relevant to process and use space data for land thematic issues.

To this end, Theia is working to produce data, products, methods and services linked to space observations of continental areas, from local (ecosystem and territory) to global scale, and make them available to the user community. It is backed up by a distributed spatial data infrastructure (SDI), and by scientific expertise hubs in various regions. The SDI links Montpellier (GEOSUD at Maison de la Télédétection) and Toulouse (CNES supported by the CESBIO laboratory, and IGN).
The SDI provides already through its portal (http://www.theia-land.fr) a number of satellite products : yearly coverages at high resolution over the French territory with Spot and Rapid Eye, results from the Take 5 - Spot 4 experiment over 45 sites wordwide from February to June 2013 to simulate Sentinel-2 imagery, time series of orthorectified, atmospherically corrected Landsat data over France. Much more is to come : a first batch of 100,000 images over areas worldwide from the Spot World Heritage programme, provided free of charge for non commercial users, time series of river and lakes height worldwide, atmospherically corrected and monthly composites of Sentinel-2 data over an area equivalent to that of Europe, a new climate record of vegetal variables at global scale with AVHRR, and others.
The organisation of science expertise hubs at national level has been initiated. A number of science teams have been created with the goal to prepare processing lines of value added satellite products, in particular from the Sentinel satellites, such as land cover, watered areas, snow areas, imperviousness areas, albedo, vegetal variables at decametric scale, water quality and height, and others.

P3.5: Calibration of Landsat-8 Tirs Bands For Meteorological And Climatological Studies Of The Mediterranean Area

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The Landsat-8 (L8) was launched on February 2013, and operational acquisitions started middle April 2013. The L8 Thermal Infrared Sensor (TIRS) has two thermal bands, 10 (11.60-11.19 μm) and 11 (11.50-12.51), aimed to provide more accurate Land Surface Temperature (LST) than the Landsat-7ETM+, at 100-m spatial resolution. The first studies by the L8 calibration team showed TIRS temperature offsets, and in January 2014 they proposed subtracting 2.1 $\pm 0.8K$ and $4.4 \pm 1.8K$ from temperatures measured by bands 10 and 11. The aim of this study is to contribute to the TIRS calibration efforts with the objective to solve the current problems in order to can use L8 in Mediterranean meteorological and climatological studies.
Ground transects measurements of LST performed in a $100km^2$, flat and thermally homogeneous area of rice-crop fields (39.295°N, -0.308°E in WGS-84, at sea level) close to Valencia-Spain, were used for the vicarious calibration of the L8 thermal bands. Three different surface conditions were covered during the measurement period: flooded soil (water surface), bare soil and rice with full vegetation cover, with LSTs ranging from less than 10°C to 30°C. Four TIR radiometers were used to perform the transects: two CIMEL CE 312-1 with four bands (8-13, 11.5-12.5, 10.5-11.5 and 8.2-9.2 μm) and two CIMEL 312-2 with six (8-13, 8.1-8.5, 8.5-8.9, 8.9-9.3, 10.3-11.0 and 11.0-11.7 μm). Calibration against a reference blackbody ensured absolute accuracy of all the radiometer bands within 0.1-0.2 K. The CE 312 radiometers were carried back and forth along transects of 100 m in length, and temperatures measured within 3 min centred at the satellite overpass time were averaged. Field emissivity measurements were also performed.
Significant differences between "in situ" and L8 temperatures were observed, and the recalibration proposed by the L8 team was shown not to be satisfactory.

P3.6: Satellite Land Surface Temperature and Ground Data for the Calibration of a Distributed Energy Water Balance Model

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Distributed hydrological models of energy and mass balance usually need in input many soil and vegetation parameters, which are usually difficult to define. This paper will try to approach this problem performing a parameters calibration based on satellite land surface temperature data (LST) as a complementary method to the traditional calibration with ground data.
The distributed hydrological model, FEST-EWB, will be used that solves the system of energy and mass balance equations as a function of the representative equilibrium temperature (RET) that governs the fluxes of energy and mass over the basin domain. RET is then comparable to LST as retrieved from operational remote sensing data at different spatial and temporal resolutions. The LST is a critical model state variable and remote sensing LST that can be effectively used, in combination with energy and mass balance modeling, to monitor latent and sensible heat fluxes.
A pixel to pixel calibration procedure of soil hydraulic and vegetation parameters in each pixel of the domain is then implemented based on the comparison between the model internal state variable RET and the remotely observed LST to better understand the internal hydro-

logic processes. The traditional calibration methodology based only on ground discharges or soil moisture measurements will also be applied and results will be compared with the new implemented methodology.
A number of case studies have been carried out ranging from agricultural district areas to river basins using data from operational satellite sensors and specific airborne flight and eddy covariance tower. The case studies include a maize field in Landriano (Italy), the agricultural district of Barrax (Spain) and the Upper Po river basin (Italy) and Yangtze river baisn (China).

P3.7: Angular Thermal-Infrared Measurements by an Autonomous Data Acquisition System to Validate Satellite-Retrieved LST Products

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Routinely thermal infrared, TIR, radiometric measurements at standard weather stations may take advantage of the use of specific instrumentation to sample air and land skin temperatures at different azimuth and zenith angles rather than using several radiometers fixed at specific viewing angles. This type of angular measurements can provide valuable information for the understanding of land-atmosphere interactions such as the estimation of different heat fluxes and other magnitudes by a simple numerical sum or integration of samples. By selecting the appropriate viewing angles and targets, they also can be used as "ground truth" measurements for the validation of satellite sensed estimates of skin temperature. The referred data acquisition system is based on an autonomous device that can rotate automatically to attain certain zenith and azimuthal viewing angles and to perform measurements using a single thermal radiometer. The convenience of this configuration is the achievement of complete scans of both land and sky hemispheres by means of sweeping measurements at predefined zenith and azimuthal angles and the use of only one sensor with one single calibration to undertake measurements. By using a unique sensor, the achieved angular system improves sampling homogeneity and saves in instrumentation.
A prototype of this data acquisition system was deployed in the summer period at an extensive, homogenous and flat cultivated-rice area with full vegetation cover (FCV$\sim$1) which has been widely used in experimental calibration and validation campaigns of TIR sensors in other previous campaigns. With the estimation of the hemispheric downwelling sky radiance, the measured TIR data were processed to obtain ground-truth Land Surface Temperature (LST) in cloud-free conditions and compared with operational LST products such as the MSG-SEVIRI LSA SAF LST product and the EOS-MODIS MOD11A1/MYD11A1 LST product. Both products were shown to work within the expected uncertainties, but a general overestimation was observed for the MSG-SEVIRI product during midday and a slight underestimation, especially for off-nadir observation angles, was observed for the EOS-MODIS LST product.

P3.8: Cloud and Aerosol Effects upon Surface Solar UV Irradiance in Barcelona

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The variability and trends in surface solar ultraviolet (UV) irradiance has become of great interest given the potentially harmful effects on humans, such as erythema and DNA damage. During the last decades the station networks making regular measurements of UV and erythemal irradiance have spread out and the radiative transfer models have also improved. However, the effects of clouds and aerosols on both the measured and modeled irradiances is complex, owing to the large number of properties characterizing their vertical and horizontal distributions and their composition, among others. In spite of this, it is well established that cloudiness in mid-latitudes is typically the main factor of the day-to-day variability in the UV irradiance.
We analyze 15-year data set of erythemal irradiance from a YES UVB-1 broadband radiometer, belonging to the Spanish State Meteorological Agency (AEMET) deployed at the University of Barcelona. We also have used cloud type and coverage observations from Observatori Fabra of the Royal Academy of Arts and Sciences of Barcelona. Specific events have been studied with the help of additional spectroradiometer data and total-sky camera images.
We have considered attenuation due to clouds and aerosol obtained from observed and expected values at the top of the atmosphere and a radiative transfer model. According to previous studies in Barcelona, broken clouds can produce large attenuation but also small enhancements depending on the cloud type and its relative position to the sun. This phenomenon is even more relevant on days with high erythemal irradiances when the UV index can oscillate from 4 (Moderate) to 10 (Very High) in only a few minutes. Similarly, although to a lesser extent, some atmospheric situations leading to large aerosol concentrations attenuate the UV irradiance in relation to the previous days measurements and to the modeled expected value according to climatological aerosol properties.

Session 1: Climatology energy

P1.1: Interaction with climate and ecosys-

tem of Saharan dust dynamics

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North African deserts are the world's largest sources of atmospheric mineral dust produced by aeolian. During my thesis studies, the impact of various growth media on development of some bread wheat (*Triticum aestivum* L.) and durum wheat (*Triticum durum* L.) cultivars have been investigated. The first time it has been shown that comparable growth can be sustained by using Saharan desert soil samples the tested and the results were analyzed statistically. The effect on the vegetative growth of plants of Saharan dust have been investigated and physical, chemical and mineralogical composition for its role in crop production have been analyzed (Yücekutlu, 2012, 2013) and thus natural mineral dust interacts with climate and ecosystems. How Saharan dust sources on plants growth will respond to global climate change, and how photosynthesis will impact the transport of bioavailable fraction of iron chemistry to the plant. This paper reviews investigate on the role of Saharan dust inputs in aerosols as a contribution of natural fertilizer, mineralogical composition, microorganisms, enzymes to the vegetation.

P1.2: Implications of Climate Change to Croatian Tourism

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Weather and climate constitute one of the most important natural resource for recreation tourism because during their activities, tourists are affected by atmospheric conditions. Due to its geographical diversity Croatia has the potential for wide range of tourist activities and leisure. Different kinds of tourist activities need different weather requirements. For quantitative estimation of climate potential of different kinds of tourism, climate index for tourism (CIT) is used. CIT integrates thermal, aesthetic and physical facets of atmospheric environment and therefore is suitable for estimation of climate satisfaction that ranges from very poor to very good. The thermal component is estimated using the physiologically equivalent temperature (PET).
Changes in climate potential of tourism in Croatia are estimated by changes of climate index for tourism in the two future 30-year periods 2011-2040 and 2041-2070. For future climate, two randomly chosen simulations from the global atmosphere-ocean circulation model ECHAM5-MPIOM under the IPCC emission scenario A2 were downscaled using regional climate model RegCM3. The integration domain covered almost the whole of Europe with the 35-km horizontal resolution.

P1.3: Compression of multiple drought indices for meteorological drought monitoring in the Eastern Mediterranean

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Drought monitoring is an essential component of drought risk management. It is normally performed using several drought indices that are effectively continuous functions of rainfall and other hydrometeorological variables. We have calculated and compared many drought indices (DIs) to monitor meteorological drought conditions in the Eastern Mediterranean. Actually, this region has recently suffered one of the most extreme drought episodes (1998-2008) in the last decades. This calls for further study of drought variability in the Eastern Mediterranean. The DIs considered are as follows: Rainfall Decile based Drought Index (RDDI), statistical Z-Score, Modified China-Z Index (MCZI), Standardized Precipitation Index (SPI) and Effective Drought Index (EDI). The computation of these indices is based on monthly precipitation data for 103 stations and daily data over 70 stations over the 1961-2012 period. The results show that the SPI and EDI are the most suitable indices to detect the onset of the drought episode, its spatial and temporal variation consistently, and it may be recommended for operational drought monitoring. The EDI describes well the developing drought conditions (spatially and temporary). The SPI and MCZI are the most consistent indices in detecting drought episodes at all-time scales. This study shows that the use of an appropriate time scale is as important as the type of DI used to identify drought severity. The choice of indices for drought monitoring in a specific region should eventually be based on the quantity and spatial distribution of climate data available and on the ability of the index to consistently detect spatial and temporal variations during a drought episode.

P1.4: Detection of trends in precipitation during 1970-2010 in wadi wahrane basin, northwest Algeria

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Precipitation is an important component of the hydrological cycle and its change would be of great significance for water resources planning, irrigation control and agricultural production. The main purpose of this study was to investigate temporal variations in precipitation (P) for 4 stations in wadi Ouahrane basin in

northwest Algeria for the period 1970-2010. Significant trends were identified using the Mann-Kendall test, the Sen's slope estimator and the linear regression. Analysis of the precipitation data revealed a significant increasing trend in 42% of the stations at the 95% and 99% confidence levels. To put the changes in perspective, the trend in Precipitation averaged over all 4 stations was (+)80 mm per decade.

P1.6: Building and Analyzing a Solar Radiation Series for Girona, NE of Iberian Peninsula (1986-2013)

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Solar radiation measurements at the University of Girona (NE Iberian Peninsula) started in 1986, when the Catalan Institute for Energy (ICAEN) installed two pyranometers. Specifically, two Kipp & Zonen CM11 devices were set up, one of them provided with a shadowband in order to measure diffuse irradiance, while the other was intended for measuring the global horizontal irradiance. Since then, the radiometric station has been remarkably improved. Currently, there are two other pyranometers, which are conveniently ventilated; one of them is set up on a sun tracker with a shadowing sphere for measurement of the diffuse component. In addition, the direct (beam) component is also measured by means of a Kipp & Zonen CH1 pyrheliometer. All these instruments are periodically calibrated against traceable standards. The station is inspected daily, and all data are recorded at 1 minute resolution, according with the recommendations from the Baseline Surface Radiation Network (BSRN). The present work explains the building of a series for the whole period, by adding segments of data produced by the different instruments. Particular effort is put on the quality control of the data (for example by means of checking the consistency of the three irradiance components, when available) and the homogeneity of the obtained series. The diffuse component, when measured with shadowband, presents several issues, including the correct positioning of the band, and the correction for the part of the sky that is masked by the band. From the original data, series of hourly, daily, and monthly irradiation are generated. Subsequently, the temporal evolution of the obtained series is analyzed, in the framework of the recent brightening reported for other areas of the Iberian Peninsula and Southern France. Regarding global irradiance, a trend of about $+3\ Wm^{-2}$ per decade, mostly due to radiation increases in summertime, is found.

P1.6: Impact of climate change on several wine-growing regions of Spain

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Spain is one of the great wine producers worldwide: first in the ranking by plantings, third in production and the second largest exporter in terms of volume. Nowadays, many Spanish regions are close to their optimum growing season temperatures for vineyards, as these areas have experienced growing season warming trends since the mid-twentieth century. Evaluating the future suitability of the Spanish wine-growing regions has become an issue of crucial importance. To this end, we have assessed climate change impacts over six representative and well-known wine-growing regions in Spain. Daily observed series of 2 m maximum and minimum temperatures, precipitation, 2 m relative humidity, cloud cover and 10 m wind speed have been used in order to determine the present climate potential for wine over these areas. For future projections, daily averaged meteorological variables have been obtained from a set of regional climate models (RCMs) within the European ENSEMBLES project. The adoption of a multimodel ensemble strategy allows quantifying the uncertainties arising from model errors and boundary conditions. As climate change impacts are not likely to be uniform across different regions of Spain, we have applied a quantile-quantile adjustment in order to use simulated atmospheric parameters properly at local scales. Results indicate (i) a significant increase in the temperature ranges for the ripening period, (ii) a steady decrease on the available annual water resources and (iii) exceedence of climatic threshold for suitable growing of vineyards in these Spanish regions producing high-quality grapes at the margins of their climatic limits. Therefore, warmer conditions in these regions could lead to move grape growing and wine production towards more poleward or upward locations. In fact, results indicate that climate change could push northern Spanish regions into more optimal climatic regimes for the production of several varietals.

P1.7: Use of Statistical Methods for Spatialization of Climatic Parameters in Algeria

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The local climate influences the lifestyle of its inhabitants and its vegetation. In order to address this issue we conducted a study in which we present a cartographic analysis of the main elements of the climate of Algeria. To do this, we have relied exclusively on monthly weather data series from 1973 to 2009 from sixty six stations spatially located on Algerian territory and a series from 1973 to 2009.
In this paper, we tried to make a model based on the statistical method for multiple regression through a principal component analysis.

The examination of the influence of meteorological parameters used eight showed the share of each variable in the climate regionalization.
Zoning obtained showed a breakdown of Algeria in five homogeneous within which the behavior is similar climate zones.

P1.8: Analysis of the Occurrence of Extreme Temperatures in the Iberian Peninsula in a Recent 20-Years Period

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The occurrence of heat waves and cold spells is having a special attention in the last years due to their impact in human health, ecosystems and other aspects such as economy. This work focuses in the analysis of the extreme temperature events in the Iberian Peninsula for the period 1994-2013. To this end, we used the 12-hourly maximum and minimum temperatures at 2m height from the ERA-interim reanalysis database (ECMWF), with a 1°x1°horizontal resolution in a 10 x10 grid points domain covering the region. The hot (cold) extremes were defined as the maximum (minimum) temperatures above (below) the 99.9 th (0.1 th) percentile of the whole dataset.
High temporal variability was obtained, with years in which the frequency of extremes was high (2003 and 2012 for hot events, 2005 and 2012 for cold events) and others in which it was low (1997 and 2002 for hot events, 1998 and 2002 for cold events). August was the month with maximum frequency of hot extremes, while January and February were for the cold ones.
The influence of the climate variability in the occurrence of temperature extremes was also analyzed. Thereby, the Spearman and Kendall correlations between the frequency of extremes and the most influencing modes of climate variability affecting Western Mediterranean, the North Atlantic Oscillation (NAO), the Western Mediterranean Oscillation (WeMO) and the Arctic Oscillation (AO), were computed. These correlations were all negative for cold extremes (only significant with NAO and AO) showing that the wetter and less insolated conditions associated to the negative mode of the climatic indices in eastern Iberian Peninsula favors the occurrence of cold extreme episodes.
Atmospheric back-trajectories starting on the date of the extremes were computed using the Hybrid Single-Particle Lagrangian Integrated Trajectory model (HYSPLIT-4) of the National Oceanic and Atmospheric Administration (NOAA), in order to draw up the concentration fields corresponding to the provenance regions of the air-masses responsible of the extreme episodes.

P1.10: The flood event that affected Iraq on November 2013: a synoptic approach

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The flooding episode of November 2013 in Iraq was one of the most dramatic heavy rain evens in Iraq in 30 years; at least 11 people died and many material damages where reported including infrastructures and family possessions lost. The main purpose of this study is to assess the convective instability, the dynamic forcing, and the moisture sources involved in this severe weather episode. Daily and long term precipitation data from ECMWF and the Iraqi meteorological and seismology organization were analyzed in order to show the exceptionality of the flood event. Instability indices from available soundings for the region indicate marginally convective instable conditions. CAPE distribution from ECMWF reanalysis also indicates marginal to moderate instability conditions. This point out that convective instability conditions were not extraordinary. Geopotential distribution at middle (500 hPa) and upper troposphere (250 hPa) levels show that the region was affected by the low of a Rex Block which remained near stationary all along the flood event period. Horizontal air flow divergence and preliminary analysis of vorticity advection at 250 hPa level suggest an intense dynamical forcing, associated with the southeast portion of the Rex Block low. Coinciding with the Rex Block occurrence, a noticeable advection of specific humidity from the Persian Gulf was observed. Therefore, this preliminary analysis suggests that this flood event was mainly linked to an intense Rex Block related dynamic forcing, along with the advection of large amounts of moisture from the Persian Gulf whereas convective instability played a secondary role. A 10 year time series data are being analyzed in order to study the recurrence of this phenomena.

P1.10: Investigation on Heatwaves over Turkey and Leading Atmospheric Patterns

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Although there is no standard definition of heat wave, it is generally defined as uncomfortably hot and humid weather conditions, prolonged for more than three days. Since comfort level may vary depending on the local conditions and regular practice, the threshold of a heat wave event should be defined according to these familiarities. Heat waves are also classified, as extreme events such as heavy rainfall, flood, and droughts. Although

these events occur rarely their impact can be substantial. Depending on their severity and duration, heat waves can be a deadly threat on human health and on ecosystems. The recent IPCC report AR5 (2013) emphasizes that the magnitude, frequency, and the duration of heat waves may increase depending on the local effects due to the climate change. Therefore, the aim of this study is to determine heat wave events occurred over Turkey and categorize them in terms of their frequency, duration and intensity. Daily maximum temperature observations are used for the period between 1960 and 2013 at 238 stations. 90^{th} percentile of the maximum temperatures between 1970 and 2000 at each station is used as a threshold value to define the hot day, and if the temperatures continue to stay above the defined threshold for at least three days, it is called as heat wave. General tendency of the heat waves in terms of frequency and duration are investigated for last 53 years. For each heat wave category, the atmospheric conditions leading to the heat waves are explored by analyzing geopotential height, temperature, wind and specific humidity patterns at the pressure levels of 1000 hPa, 850hPa and 500hPa of ERA interim re-analysis data.

P1.11: Interannual Variations of Precipitation and Temperature Observations in Turkey

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The characterization of temperature and precipitation fields over Turkey presents a complicated spatial and temporal patterns due to the land sea contrasts and complex topography of the region. The goal of the study is to determine the temporal and spatial variability of temperature and precipitation fields to better understand Turkey's climate. The climatic effects of the NAO and other teleconnection indices in the North Atlantic region have been widely studied showing it to be the important reference of climate variability in Europe. However, there are very limited efforts in explaining the links related with climate variability in Turkey. The inter-annual variability of precipitation and temperature collected from 238 stations for the period of 1960-2013 is analyzed, and the link between the inter-annual variability and the teleconnection patterns is investigated using teleconnection indices such as NAO, ENSO, AO and NCP. Decompositions of the temperature and precipitation observations to the oscillatory components are accomplished by using a data adaptive method of Singular Spectrum Analysis (SSA). Maximum Entropy Method (MEM) is used to estimate the dominant periodicity of each temporal-principle-component. And then reconstructed time series obtained after filtering out high frequency oscillations and noise. Since SSA is a data adaptive technique, it performs well even on a short and noise time series. Filtered observations are correlated with indices of NAO, ENSO, AO and NCP. The correlation patterns are evaluated.

P1.12: The Regional Climatological Network of Sardinia

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Two decades of scientific activity on monitoring climate change urged meteorological services to comprehend the importance of reliable networks of climatological stations dedicated to long term unperturbed measures of meteorological quantities.
With that aim in mind, the Regional Environmental Defense Agency of Sardinia is creating the regional climatological network of Sardinia and is dedicating a significant investment to it.
The "Regional Climatological Network of Sardinia" is made of a few tens of stations that were selected one by one, according to the length of the time series of measures, to the position of the stations during the past decades and to the continuity of measures.
Many stations still exists and many more are going to be reinstalled in the precise historical site, if it is still available.
The network will be presented and the analyses leading to the choice of each station will be described.

P1.13: The Influence of the Mediterranean Sea on the Annual Lightning Distribution in Catalonia

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The highest lightning densities in the Iberian Peninsula occur over mountainous regions of the North-eastern part (Pyrenees and Sistema Iberico). This mountain ranges surround the region of Catalonia (32,000 km^2), which has an average lightning flash density of 2.0 CG flash $km^{-2}year^{-1}$ (ten years average, 2004-2013). High densities are also observed along the northern coastlines of the Mediterranean. While there is a clear preference for higher flash densities over land compared to the sea, the Balearic Sea (between the Iberian north-eastern Coast and the Balearic Islands) has lightning densities similar to the ones of the Catalan coast. The present work shows that, in spite of the similar figures, there is a land-sea contrast. The different distributions as well as the land-sea interactions are analysed here using two approaches: the monthly spatial distributions and the daily hour frequencies. Data used comes from the Total Lightning Location System operated by the Meteorological Service of Catalonia, which covers Catalonia as well as the majority of the Balearic Sea. The monthly analysis shows that lightning inland peaks during the

summer months, as surface heating becomes the main source of instability and convection. A switch in the distribution occurs during September, As the lightning activity moves to the sea, with a sharp increase, particularly along coastlines. October shows a similar pattern, but with lower values. In November the activity drops and is restricted to the sea and the coastline. The diurnal cycle of lightning activity in Catalonia shows a pattern clearly related to the solar heating cycle, with an increase around 12 UTC and a maximum at 15 UTC followed by a slow decrease. On the contrary, the diurnal cycle of the Balearic Sea is more homogeneous, with a minimum of activity at midday and a maximum at the evening and first night hours.

Session 6: Water Cycle and climate change

P6.1: Climate and Climate Change Analysis in the Lower Neretva River Basin, Croatia

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In the framework of EU project DRINK ADRIA (Programme IPA ADRIATIC CBC 2007-2013) climate and climate change have been analysed to provide an input for further assessment of present and future risks on water resources availability with emphasis on drinking water supply. The Prud spring catchment area in the lower Neretva River basin is selected as one pilot area out of two at the Croatian Adriatic coast. Air temperature and precipitation are analysed as basic input parameters used in hydrological calculations. Analyses of present climate (1961-1990) contain intra-annual variability and extremes and their temporal variations during 1961-2012 period on seasonal and annual scale for Opuzen climatological station within the catchment. An assessment of present and future climate (2021-2050) is based on numerical simulations of three regional climate models (RCMs) which participated in the ENSEMBLES EU FP6 project. Analysis of the model data is carried out for those model grid cells which were the closest to the Opuzen location. The RCMs were forced by the observed concentrations of the greenhouse gases (GHGs) from 1951 to 2000; from 2001 onwards by IPCC A1B scenario of the GHGs emissions. The initial and boundary data for each RCM were provided from different global climate models (GCMs): the ECHAM5 GCM data were used to force RegCM3, the Arpege GCM for Aladin and the HadCM3Q GCM for Promes. For the present climate, models are compared with the DHMZ and EOBS observations. For the projected climate changes of the RCMcorr data an increase in the mean air temperature by mid 21 century is simulated by all three RCMs (0.5°C to nearly 3.5°C) and in most cases is statistically significant. The amplitude of projected precipitation change varies greatly throughout the year from one model to the other (between -60% and +60%), but even so it is almost insignificant.

P6.2: Assessment of climate change scenarios for Agro-Pontino plain through a Non-homogeneous Hidden Markov Model

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This study regards an analysis of the possible changes in Agro-Pontino rainfall under different global warming scenarios for the 21st century. The Agro-Pontino plain (southern Lazio,Italy) is a reclamation region with the typical hydro-geological features of Mediterranean coastal environments. It is an important agricultural-industrial activities, densely populated, so that, climate changes could adversely affect the socio-economic development of the area. Currently, due to the coarse resolution of Global-Circulation-Models (GCMs), local climate variables simulations for limited size area are not accurate. Nonetheless, GCMs simulations of large-scale upper-air fields are generally considered reliable, therefore to bridge the gap between GCMs and local-scale processes different downscaling techniques are carried out. Here, a Hidden-Markov-Model (HMM) and a Non-Homogeneous-Markov-Model (NHMM) are developed using a 54-years record (1951-2004) of daily rainfall amount at 9stations in Agro-Pontino-plain and reanalysis fields of atmospheric variables. In HMM and NHMM runs, we directly consider the entire year, rather than an a priori demarcation of seasons. The idea is to identify, directly using the HMM, the seasonal precipitation characteristics which may be related to the temporal sequence of 'hidden states' of atmosphere, subsequently modeled as dependent on appropriate fields of selected atmospheric variables. Daily rainfall variability is described in terms of occurrence of 5 'hidden weather states' identified by the HMM and associated to variables representing the main characteristics of large-scale atmospheric circulation as obtained by re-analysis data, then, using NHMM, calibration and validation tests are made to identify the optimal predictors - GeoPotential Height and Temperature at 1000 hPa, Meridional and Zonal Wind at 850 hPa and Precipitable Water - to reproduce better the observed rainfall features on Agro-Pontino-plain. Then, the fitted NHMM is used for predicting future rainfall patterns (RCP8.5 scenario), using GCM predictors and simulations (CMCC- CM/ 1951-2100).

P6.3: A preliminary Study of the Infrared Spectrum of $^{34}SF_6$ (ν_4 and $\nu_2 + \nu_4$ combination band)

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The hexafluoride sulphur is one of the known heaviest gases, its mass specific to 20^0C and under pressure 0.1 Mpa (one atmosphere) is 139 kg/m^3 that is to say five times more than that of the air. Its molecular mass is 146.06 gr; it is colourless, odourless non-toxic and inflammable. It unfortunately presents a great disadvantage, its strong absorption in the infrared and its strong lifespan in the atmosphere. In fact, this molecule was classified among gases for strong purpose of greenhouse at the time of the conference on the climatic changes which was taken place in Kyoto, Japan in 1997. For that, we undertook a systematic study of the absorption of monoisotopic $^{34}SF_6$ (4.21% in the atmosphere), the prediction of these bands is based on the tensorial formalism and vibrational extrapolation methods developed in Dijon.
We used 10 parameters of the ground state, these parameters are fixed during the analysis and we have determined 22 others parameters for the [[Image:]] band at the six order of the rovibrational Hamiltonian and for Jmax = 95, using 1497 observed data with an root mean square equal to 0, 598.10^{-3} cm^{-1}.
We present a new contribution to this topic concerning $\nu_2 + \nu_4$ combination band. The effective Hamiltonian of this band contains contribution from the ground state level GS, ν_2 and ν_4 witch are known from previous studies. The analysis has been performed using nonlinear least squares fit procedure included in the XTDS program to Jup=112.

P6.4: Climate Change Effect on Snow-Cover Duration in Turkey

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Snow covered days depends upon the distance from shore, continentality, and elevation of a location. The snow line, the point above which snow or ice covers the ground all yearlong, increases from west to east and from shore to inland in Turkey. Being located in the Mediterranean Basin, snow-cover accumulates in Turkey mostly due to the cold polar air mass during winter. According to State Meteorological Service of Turkey, based on 226 weather stations, yearly the maximum snow-covered days has started to reduce in 2009. The greatest maximum snow covered days has been recorded as about 225 days in 2000, whereas there were only 112 snow-covered days in 2013, which is the minimum number has ever been recorded since 1980. On the other hand, from mid 80's, climate change has seriously started to be expressed, till today, each decade one can see how obvious the situation is. In every aspect of life on earth, affected from its consequences more and more every day. Increased greenhouse gas emissions, excessive usage of fossil fuels and many other anthropogenic causes combined with the natural processes and they are resulted with increased global mean temperatures about 1 °C in last century. This 1 °C change may cause an increase in extreme weather events, both in large and small scales according to the last IPCC report AR5 (2013). One of the biggest impacts of this phenomenon is observed on global ice and snow cover. Therefore our aim in this study is to determine the possible change in snow-covered days for Turkey by using 4 different RCP8.5 climate model projections (CMIP5). We compared the reference period results of climate models with the observations of Turkey to evaluate the biases of these models. Then we evaluated the climate model projections to see the effects on snow cover pattern especially on the Eastern part of Turkey by means of both seasonal change and the snow line throughout the years.

P6.5: Variability in Moisture Flux Convergence Rates on Turkey

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Precipitation amounts simulated by global climate models may not be reliable, since the horizontal resolution of these models might not fine enough to capture microphysical processes including local effects. On the other hand, precipitable water, which is the depth of water in a column of the atmosphere, can be a reliable parameter as an output of those global climate models. Moreover, horizontal moisture flux convergence (MFC), which is the columnar integration of the sum of advection and convergence terms of specific humidity, may be approximated to the precipitation rate depending on the magnitude of the moisture transport. Therefore, in this study, MFC rates on Turkey were investigated and their change according to the climate change model scenarios (CMIP5) are determined. The correlations of MFC and precipitation observations are also calculated. Moisture entrance zones are defined first and the bias on specific humidity of climate change models (CCM4, IPSL, and MPI) are determined by comparing NCAR/NCEP Reanalysis data. Probability density functions of MFCs for each moisture entrance zones are constructed for the Reference Periods and RCP8.5 Projection (2005-2100) scenario. The maximum MFC events were also modeled by using the high-resolution WRF model for the short term prediction purposes to emphasize the differences between climate model precipitation rates and downscaled precipitation rates of the WRF Model. Preliminary results show that intensity of local extreme precipitation events might need further investigation by running high resolution NWP models whereas frequency of those events can be estimated by using only MFC values calculated from climate model scenario results.

P6.6: Mediterranean sea level variability de-

rived by multiresolution wavelet analysis

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Using multiresolution wavelet analysis, the spectral content of monthly maps of sea level anomaly time series on the Mediterranean Sea derived from satellite altimetry over the period 1993 to 2013 is investigated in order to assess its seasonal changes and its nonlinear trend. The multiresolution decomposition has extracted useful the seasonal signals (annual and semi-annual) and nonlinear trend of the analysed time series by means of its signals of "details" and "approximations", respectively. Details and approximations signals represent, respectively, the high-frequency and the low-frequency contained in the analysed time series. The amplitude values for the annual signal are less than10 cm with an average of 6.74 cm, while those for the semi-annual signal are mostly less than 4 cm with an average of 1.79 cm. However, the successive smoothing of the analysed time series through the signals of approximations has allowed to better identify the rate and time spans of the increase and decrease of the Mediterranean Sea. The filtered trend has a slope about 2.30 mm/year compared to 2.46 mm/year of the original time series estimated by linear least squares regression.

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