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7th International Meeting on Meteorology and Climatology of the Mediterranean

Abstracts book

Co-organized by Tethys, Journal of Mediterranean Meteorology & Climatology, Center of Environmental Studies of the Mediterranean (CEAM) and University of Balearic Islands (UIB) with the support of Catalan Meteorological Association (ACAM)

Palma, March 4-6th 2019

7th International Meeting on Meteorology and Climatology of the Mediterranean

General information

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Location of the meeting

Universitat Illes Balears
Sala d'Actes de l'Edifici Gaspar Melchor de Jovellanos
Campus de la UIB
Ctra. Valldemossa km. 7,5
07122. Palma
www.uib.cat

Organization

Tethys, Jounal of the Mediterranan Meteoology and Climatology (www.tethys.cat)

Support

ACAM, Associació Catalana de Meteorologia (www.acam.cat)
Center of Environmental Studies of the Mediterranean (CEAM)
Universitat de les Illes Balears (UIB)

Chair of Conference

Jose Luis Palau (Fundación Centro de Estudios Ambientales del Mediterráneo, CEAM València)
Maria Antònia Jiménez (Universitat de les Illes Balears, UIB)

Secretary

Margalida Riutort (Universitat de les Illes Balears, Palma, Spain)
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Scientific Committee

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Vicente Caselles (University of Valencia, Spain)
Lluís Fita (Centro de Investigaciones el Mar y la Atmósfera, CIMA, Argentina)
Jordi Mazón (Polytechnic University of Catalonia, Spain)

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The Catalan Association of Meteorology (ACAM)

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Oral

Monday, 4th

8:30 : *Conference Registration, light Ice break*

Welcome

9:30-9:35 Dr. Maria Antònia Jiménez, on behalf of the Local Committee: *General information*

9:35-9:45 Dr. Jose Luis Palau, Chair of Conference, on behalf of the Organizing Committee: *Welcome and opening the 7th MetMed Conference*

9:45-9:50 Dr. Josep Calbó, Editor of Tethys:

9:50-10:00 Dr. Antoni Aguiló, Vice-rector de Campus, Cooperació i Universitat Saludable de la UIB: *Welcome words*

10:00-10:30 Coffee break

Session 3: Remote and in-situ measurements

Chairs: *Joan Bech and Vicent Caselles*

10:30-11:00: SAFE FLIGHT PROJECT: Detection and Identification of Aircraft Icing coinditions using multiplatform observtions.

[1]**J. L. Sánchez**, [1]**P. Melcón**, [1]**E. Garcia-Ortega**, [1]**A. Merino**, [2]**J. Díaz-Fernández**, [3]**M. L. Martin**, [2]**F. Valero**, [4]**S. Fernández-González**, [2]**P. Bolgiani**, [5]**L. Sánchez-Muñoz**, [1]**L. López** and [1]**J. L. Marcos**

[1]University of León, León, Spain
[2]Complutense University of Madrid, Madrid, Spain
[3]Department of Applied Mathematics, Faculty of Computer Engineering, University of Valladolid,, Segovia, Spain
[4]State Meteorological Agency (AEMET), Madrid, Madrid, Spain
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In the context of aviation, the detection of aircraft icing conditions is very important because of the numerous air crashes and incidents caused by this reason during the last decades. Severe in-flight aircraft icing is caused by the freezing of supercooled large droplets (SLD), which are drops with a diameter greater than 50 m that remain in a liquid state at temperatures below 0âĄřC. SAFEFLIGHT Project has two main goals: to develop new tools for icing conditions identification (nowcasting), and to implement an optimized high-resolution numerical model for the forecasting of icing conditions in the short-term, with the ultimate purpose of its application to improve air safety. Several scientific flights campaigns were carried out in Northwestern area of the Iberian Peninsula (Lugo- León) and in the Sierra de Guadarrama (Madrid - Segovia). A C 212-200 aircraft, with the Cloud, Aerosol, and Precipitation Spectrometer (CAPS) installed under the left wing, was used during the field project. The CAPS consist of five probes. First, the Cloud and Aerosol Spectrometer (CAS), measures aerosol particle and cloud hydrometeor size distributions from 0.51 to 50 μm. Subsequently, the Cloud Imaging Probe Grayscale (CIP-GS), can measure hydrometeors from 25 to 1550 μm and represent 2D images, differentiating between hydrometeors in liquid and solid phase. Eleven in-flights severe aircraft icing events were detected in different flights campaigns. Several meteorological instruments were installed in the CIAR (Center for Aeronautical Research in Rozas) placed in Lugo (Spain), and Sierra de Guadarrama in Madrid (Spain) (micro Radar, VPF, ceilometer). A hyperspectral, multichannel microwave radiometer (MMWR; MP-3000A) was used too. This instrument continuously measured vertical profiles of temperature, humidity, liquid water content (LWC), and water vapor density (with temporal resolution approximately 2.5 minutes) to 10 km height. This instrument allows us to detect supercooled liquid water (SLW) areas. The MSG images were used for detecting SLW areas and icing conditions by using distinct spectral channels and color schemes. In this work we present some of the tools developed to detect areas with high risk of severeicing conditions using indirect methods. These tools were validated with the data

collected by the CAPS installed on board the aircraft.

11:00-11:15: An application to Mediterranean Sea of the SEVIRI Level 2 Processor for Surface Parameters

[1]**G. Masiello**, [1]**C. Serio**, [1]**S. Venafra**, [2]**G. Liuzzi** and [3]**I. De Feis**
[1]School of Engineering, University of Basilicata, Potenza, Basilicata, Italy
[2]NASA Goddard Space Flight Center, Greenbelt, Maryland, United states of america
[3]Istituto per Applicazioni del Calcolo, IAC/CNR, Napoli, Campania, Italy

Surface emissivity and Temperature (Ts) are two key parameters to monitor climate and meteorological changes. Because of its high spatial resolution, repeat time and very long period of activity, SEVIRI (Spinning Enhanced Visible and Infrared Imager) on board of MSG (Meteosat Second Generation) geostationary platform, allows us to perform accurate retrieval of these parameters. To take advantage of the data information content, a Kalman filter methodology was developed and implemented for the the simultaneous retrieval of surface emissivity and temperature from SEVIRI infrared radiance measurements (channels at 8.7, 9.7, 10.8 and 12 μm, doi:10.5194/amt-6-3613-2013). That developed is one of the very few physical based approaches for the estimation of surface parameters from infrared instruments on board geostationary platforms and it has shown an accuracy of $\pm$ 0.005 and $\pm$ 0.2 K, for surface emissivity and temperature respectively (doi:10.5194/amt-8-2981-2015). Based on this Kalman filter methodology a L2 processor has been developed to provide emissivity and Ts in real time, making it very attractive for application in different fields. The processor was applied and tested comparing its results with other satellites retrievals and analysis over a geographic region in Southern Italy (doi:10.3369/tethys.2016.13.01). In this study we will present the application of the SEVIRI L2 processor to the Mediterranean sea. Results for the years 2013-2016 will be shown. The retrieved sea skin temperature fields are available on line at web site http://www2.unibas.it/gmasiello/assite/as/products.html.

11:15-11:30: Estimation of the chilling hours in Mallorca through satellite-derived surface temperatures

M. A. Jiménez, **A. Grau** and **J. Cuxart**
Universitat de les Illes Balears, Palma, Illes balears, Spain

Many plants need a certain amount of time under cold temperatures, especially during winter dormancy, when buds and seeds are unable to grow mainly due to hormonal factors. The chilling hours (CH) is a parameter that counts the number of hours below a certain temperature threshold during the cold period of the year. The number of CH that each plant needs depends on the species. Therefore, to know the amount of CH of a region is crucial to decided the crops that will be cultivated there and guarantee their quality. The main goal of this work is to identify the spatial and temporal varibility of the CH in the island of Mallorca through satellite-derived Land-Surface Temperatures (LST) from Meteosat Second Generation. Hourly LST fields are used for the period 2007-2018 and they are converted to 2-m air temperature through the lineal fit proposed by Simó et al. (2018) over the area of interest. Afterwards, for each pixel, it is counted the number of hours below a certain threshold (here taken as 8°C) from September to August next year. Results show that the largest number of CHs are found in the center of the three main basins, where cold pools are generated as it was described in Jiménez et al. (2015). Most of CH are accumulated between December and March, the coldest months of the season. During the 10 years analyzed, the CH averaged over the island are about 550 (for all the studied years the CH are between 400 and 650). The spatial and temporal variability of the CH estimated from satellite (at about 16km^2 resolution) are compated to those obtained through the surface observations at some locations in the center of the island, where agriculture is the main economical activity.

11:30-11:45: Are satellite-derived mesoscale sea surface winds useful in the Mediterranean?

[1]**M. Portabella**, [2]**W. Lin**, [1]**F. Polverari**, [1]**A. Trindade** and [3]**G. P. King**
[1]Institut de Ciències del Mar (ICM-CSIC), Barcelona
[2]Nanjing University of Information Science and Technology, Nanjing, China
[3]University of South Florida, Tampa, Usa

Satellite scatterometer-derived (radar-derived) sea-surface vector wind observations have been successfully assimilated into Numerical Weather Prediction (NWP) models over the last two decades. Moreover, they are being used in a wide variety of atmospheric, oceanic, and climate applications. For example, sea surface wind vectors are used as a forcing agent in ocean models to improve the modeling of waves, storm surges, and ocean currents. Moreover, they are fundamental for seasonal and longer range forecasting (e.g., El Niño). In nowcasting, storm and hurricane forecasting benefit from the near-real time availability of scatterometer winds. More recently, coastal wind forecasts and climatologies are used in applications, such as off-shore energy, shipping, or tourism, among others. Recent research has focused on improving scatterometer wind interpretation, both from the data processing (error characterization, wind inversion, quality control, extreme wind retrieval capabilities and coastal processing) and applications (improved rain-induced flow characterization, wind initialization in both global and regional NWP models, and ocean forcing) perspectives. Current scatterometer information content includes sea surface wind and wind stress fields, their associated uncertainties (random

errors) and derivatives (divergence and curl), and the sub-cell wind variability estimates. The latter can for example be very relevant in nowcasting for identifying moist convection areas and rapidly evolving storms in the Mediterranean. Moreover, recent scatterometer data products are focused on providing valuable coastal wind information (up to 15 km off the coast), by more effectively filtering the land contribution signal. Also relevant for the Mediterranean, recent research focuses on the inclusion of a cross-polarized radar beam in the next generation of European scatterometers to improve extreme wind retrievals (i.e., wind observations above 25 m/s). By early 2019, up to 7 scatterometers will be operating in orbit. This unprecedented coverage will certainly contribute to improve the characterization and evolution of the storms in the Mediterranean Sea.

11:45-12:00: A field work methodology for wind damage from strong-convective winds events

[1]**O. Rodríguez**, [2]**J. Bech**, [3]**J. Soriano**, [3]**D. Gutiérrez** and [4]**S. Castán**

[1]University of Barcelona - Department of Applied Physics - Meteorology, Barcelona, Catalonia, Spain
[2]University of Barcelona - Department of Applied Physics - Meteorology, Barcelona
[3]Agencia Estatal de Meteorología - Delegación Territorial en Andalucía, Ceuta y Melilla, Sevilla
[4]Agencia Pericial, Cornellà de llobregat

Tornadoes and downbursts are local phenomena that every year hit urban and forests areas in middle latitudes. Due to their strong winds, they can cause important social impact and economical losses damaging infrastructures, buildings and also injuring or even killing people. Due to the lack of visibility or the absence of a direct witness, reported damage is often not enough to know if it was caused by a tornado or a downburst. That is why damage assessments are necessary, also needed to characterize the phenomena calculating the length and width path and the intensity (see, for example, Burgess et al., 2014). In addition to this scientific interest, in Spain there is a necessity to know which phenomena caused the damage of an event. Depending on that, the field of insurance companies applies a wind velocity threshold or another to assume the cost of repairing the damaged insured properties. In order to carry out homogeneous and systematic strong-convective winds damage surveys, a methodology is proposed. It is based on Buting and Smith (1993) and Gayà (2015) works, and on the necessities that have been presented to the authors during the 105 damage assessments done since 2004. This includes using the enhanced Fujita intensity scale (see discussions in Doswell et al., 2009 or Feuerstein et al., 2011), which allow for specific analysis if enough details are available (Bech et al., 2009). The methodology proposed consists on collecting the testimony of direct witnesses, delimitating the affected area and the geolocation of the damage. With all this information three final deliverables are generated: (i). a summary of the studied event information; (ii). a summary of the witness enquires and, (iii). a map with the points-of-damage illustrated with available relevant photos. This study was performed within the framework of the HyMeX (HYdrological cycle in the Mediterranean EXperiment) programme, with partial funding from projects CGL2015-65627-C3-2-R (MINECO/FEDER) and CGL2016-81828-REDT (MINECO), and also from the Water Research Institute (IdRA) of the University of Barcelona. References: Bech J, Gayà M, Aran M, Figuerola F, Amaro J, Arús J. 2009. Tornado damage analysis of a forest area using site survey observations, radar data and a simple analytical vortex model. Atmospheric Research, 93: 118-130. https://doi.org/10.1016/j.atmosres.2008.10.016. Burgess D, Ortega K, Stumpf G, Garfield G, Kartens C, Meyer T, Smith B. 2014. 20 May 2013 Moore, Oklahoma, Tornado: Damage Survey and Analysis. Weather and Forecasting, 29: 1229-1237. doi: 10.1175/WAF-D-14-00039.1. Buting WF, Smith BE. 1993. A guide for conducting convective windstorm surveys. NOAA Technical Memorandum NWS SR-146. Doswell III CA, Brooks HE, Dotzek N. 2009. On the implementation of the enhanced Fujita scale in the USA. Atmospheric Research, 93(1-3): 554-563. doi: 10.1016/j.atmosres.2008.11.003. Feuerstein B, Groenemeijer P, Dirksen E, Hubrig M, Holzer AM, Dotzek N. 2011. Towards an improved wind speed scale and damage description adapted for Central Europe. Atmospheric Research, 100(4): 547-564. doi: 10.1016/j.atmosres.2010.12.026. Gayà M. 2015. Els Fiblons a Espanya: Climatologia i catàleg de tornados i trombes (Whirlwinds in Spain: Climatology and Catalog of Tornadoes and Waterspouts). Universitat de les Illes Balears: 441 pp. (in Catalan).

12:00-12:15: Observational analysis of the 18 October 2017 Valls severe weather thunderstorm

[1]**J. Bech**, [2]**O. Rodríguez**, [3]**P. Altube**, [3]**T. Rigo** and [3]**N. Pineda**

[1]University of Barcelona, Barcelona, Barcelona, España
[2]University of Barcelona
[3]Meteorological Service of Catalonia

The 18 October 2017 a severe thunderstorm affected Catalonia (NE Spain), an area where tornadic events are regularly reported, with 5 tornadoes/year during the 2000 to 2016 period as described by Rodriguez and Bech (2017). This particular event hit the city of Valls causing 13 injured people and damaging 30 lamp posts, 100 traffic signs and over 270 trees, with total costs estimated in about 1 Million Eur. According to a damage survey performed shortly after the event, wind damage was estimated up to EF1 in the Enhanced Fujita scale along a 6.2 km long linear path indicating a tornadic origin of the main damage. The synoptic framework was characterized by an upper level trough passage with a relatively small cut-off low at 500 hPa and a cold front passage at low levels favouring a southern warm and moist advection, in phase with the

solar daily cycle. Mesoscale conditions favoured the initiation and development of well organized convective storms, and in particular, of a mesoscale convective system moving NE with a leading convective line and trailing stratiform region which spawned the tornado responsible of the damage. The analysis is completed with operational in situ and remote sensing observations of satellite, total lightning and weather radar data, including the recently developed Doppler radar corrections described in Altube et al (2017), which allowed in this case to better characterise the radar observed radial velocity field. REFERENCES Altube P, Bech J, Argemí O, Rigo T, Pineda N, Collis S, Helmus J, 2017: Correction of dual-PRF Doppler velocity outliers in the presence of aliasing. Journal of Atmospheric and Oceanic Technology, 34, 1529-1543. DOI:10.1175/JTECH-D-16-0065.1 Rodriguez O, Bech J, 2017: Sounding-derived parameters associated with tornadic storms in Catalonia. International Journal of Climatology, (in press). DOI:10.1002/joc.5343

12:15-13:15 : *Poster session 3*

13:15-14:30 : *Lunch*

Session 1: Climatology

Chairs: *Vito Telesca, Josep Calbó and Jose A. Guijarro*

14:30-15:00: The Long Term Effect of a Growing Woodland on Measurements of Normalised Shear Stress

J. Price

Met Office Research Unit, Bedford, Beds, England

The Met Office Meteorological Research Unit (MRU), based at Cardington airfield near Bedford, UK, has collected regular measurements from a variety of instruments for a number of years, for the purpose of atmospheric research. Since the winter of 2005 a large area of land at Shocott Spring, to the southwest of the MRU field site, was planted with an area of community woodland. Saplings were planted in three phases from 2005 to 2011. The purpose of this study is to investigate whether or not the growing woodland is significantly affecting measurements of turbulence at the field site. Analysis of the normalised shear stress turbulence parameter (defined here as σu/U) has been conducted using data collected over an eleven year period, about two thirds of which are after some of the trees were planted. Results from carrying out a linear regression of σu/U against time reveal that, with a wind blowing from the direction of Shocott Spring, there appears to be an increase in σu/U over the last eleven years, particularly for the oldest section of woodland. Prior to the plantation of the oldest section of woodland, there appears to generally be no significant trend, whereas post-plantation the results suggest that there has been a significant increase. There also appears to be a seasonal signal in this increase.

15:00-15:15: Time and spatial differences on climate tendencies in the Balearics

[1]**A. Jansà**, [2]**J. A. Guijarro** and [1]**A. Maimo**

[1]University of the Balearic Islands (UIB), Palma, Balearic islands, Spain

[2]Spanish State Meteorological Agency (AEMET), Palma, Balearic islands, Spain

With regard to the climate change, the average thermal tendencies in the Balearic Islands are similar to those observed in the whole European continent, but, even being quite reduced the spatial extension of the Balearics, the differences from site to site are considerable. Different degree of influence of the marine stabilisation factor can be a cause of these differences. The thermal tendencies corresponding to different time sub periods of the available series are also very important, compared to the corresponding continental values. The tendencies for precipitation are so different that even changes on sign are observed for different periods: no general tendencies in precipitation can then be established.

15:15-15:30: Atribution of an anomalous summerization of the springtime detected over the Western Mediterranean

D. S. Carrió, **A. Maimó**, **V. Homar**, **S. Alonso**, **A. Jansà**, **R. Romero** and **C. Ramis**

Universitat de les Illes Balears, Palma, Illes balears, Spain

Recent papers highlight the extension of summer conditions into spring in the Western Mediterranean area. The months of May-June show a 2-m temperature tendency in Palma exceeding 0.7 °C over the 1973-2012 period, the maximum observed throughout the year. These tendencies are also observed across the Iberian peninsula and France and are consistent with a prominent 500-hPa geopotential height tendency over the 1973-2012 period. This study is the natural extension of those papers and explores possible dynamical and thermodynamical causes of the remarkable warming in the Western Mediterranean observed over the last 4 decades. In particular, we analyse the evolution of the large scale energy fluxes and follow the traces of a northward expansion of the subtropical ridge in the region, seeking for interdecadal differences. We will discuss the application of the tendency equation for the temperature to attribute the observed changes to specific terms and processes.

15:30-15:45: On the use of original and bias-corrected climate simulations: impact on the hydrological signal of small Apennines catchments

[1]**L. Sangelantoni**, [1]**A. Lombardi**, [1]**B. Tomassetti**,

[1]**V. Colaiuda**, [2]**M. Verdecchia**, [3]**G. Redaelli** and [4]**R. Ferretti**
[1]CETEMPS - Università dell'Aquila, L'aquila, Abruzzo, Italy
[2]Department of Physical and Chemical Sciences, Università dell'Aquila, L'aquila, Abruzzo, Italy
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Global warming is supposed to seriously impact the hydrological cycle, leading to an increase of severe events occurrence, such as floods and droughts. Changes in the precipitation pattern are expected to have a large impact on the river discharge regime of small Apennines catchments, which represent vulnerable systems to both dry and wet extremes. Regional Climate Models (RCMs) are the established tool for evaluating expected impacts on hydrology. However, due the relatively low resolution and systematic errors affecting RCMs, a preliminary statistical post-processing is routinely applied in impact studies. Nevertheless, statistical post-processing can impact the climate change signal produced by original RCMs and implicitly the impact model results. Whether or not this is a beneficial effect is still debated. In this work, we take advantage of 5 high-resolution (12.5 km) Regional Climate Model 3-hourly runs from EURO-CORDEX initiative, to study the response of hydrological cycle to the expected 21st-century climate change over the Aterno-Pescara catchment (Abruzzo region, Central Italy). Climate simulations consider two radiative forcing (RCPs 4.5 and 8.5). Precipitation and temperature simulations have been post-processed through widely used statistical bias correction/downscaling technique Empirical Quantile Mapping (EQM) to reduce systematic RCM errors and increasing the spatial resolution as well. EQM correction functions are derived considering point-scale weather-station observational time series, provided by the Abruzzo Region Hydro-graphic service. Original and bias-corrected climate simulations will be used to drive the CETEMPS hydrological model CHyM, operationally used over Abruzzo region to predict flood occurrences. Future hydrological trends in the Aterno-Pescara catchment and surrounding areas are assessed by means of mean discharge changes and a hydrological stress index, able to detect catchment segments where flood events are most likely to occur. The impact of the climate simulations bias correction will be investigated by comparing hydrological signals considering original and bias corrected climate simulations.

15:45-16:00: Future effects of climate change on the suitability of agricultural crop production over Europe

M. F. Cardell Martínez, **A. Amengual Pou** and **R. Romero March**
University of the Balearic Islands, Palma de mallorca, Balearic islands, Spain

Europe is one of the world's largest and most productive suppliers of fruit and fibre crop production. Owing to climate change, modified patterns of mean temperature and precipitation will likely affect agricultural crop production across Europe. Furthermore, the occurrence of extreme weather events (e.g. heavy precipitations, persistent droughts, heat waves, etc.) might be increasingly responsible for important agriculture-related economic losses and a redistribution of optimum growing conditions in many areas of the continent, specially in the Mediterranean region. Prospects on the future of mean regimes and extreme events (combined with temperature/precipitation-based climate indexes relevant to agriculture) are derived from observed and model projected daily meteorological data. Specifically, daily observed series of precipitation and 2-m maximum and minimum temperatures from the E-OBS data-set have been used as the regional observed baseline. For projections, the same daily variables have been obtained from a set of regional climate models (RCMs) included in the European CORDEX project, considering the rcp4.5 and rcp8.5 future emissions scenarios. The adoption of a multi-model ensemble strategy allows quantifying the uncertainties arising from the model errors and the GCM-derived boundary conditions. To project the RCM data at local scale properly, a quantile-quantile adjustment has been applied to the simulated regional scenarios. The method detects changes in the cumulative distribution functions (CDFs) between the recent past and successive future time-slices of the simulated climate and applies these changes, once calibrated, to the daily observed series. Results on the future impact of temperature and precipitation mean regimes and extremes over different crops (wine grape, tomato, chickpeas...) will be presented by applying different quantitative impact models adapted to regional contexts. With this information at hand, policy makers and stakeholders can support the adaptation of European agriculture to climate change by encouraging the flexibility of land use, farming systems and crop production.

16:00-16:15: Spatiotemporal analysis of drought characteristics in the Mediterranean based on Standardized Precipitation Index (SPI)

[1]**S. Mathbout**, [1]**J. Lopez-Bustins**, [2]**D. Royé**, [1]**J. Martin Vide** and [3]**M. Skaf**
[1]University of Barcelona, Barcelona, Barcelona, Spain
[2]University of Santiago de Compostela, Spain University of Porto, Portugal., Porto, Portugal
[3]Tishreen University, Lattakia, Lattikia, Syria

This study analyses the spatial and temporal characteristics of drought events across the Mediterranean using the Standardised Precipitation Index (SPI) at various time scales (1, 3, 6, 9, 12, 24 and 48 months). For this purpose, monthly precipitation data of the

European Climate Assessment & Dataset (ECA&D) of the Royal Netherlands Meteorological Institute (KNMI) has been used, and also the monthly Global Historical Climatology Network (GHCN-Monthly) dataset for 500 meteorological stations with a mean length of 78 years (1940-2018) in the Mediterranean basin. Preliminary results based on 400 stations have revealed several sever and extreme drought periods in the 20th century (in the 1980s, the 1990s, and the 2000s). The highest drought frequency and severity have been shown from the early 1990s onwards, especially in Southern Europe (Italy, Spain and Croatia), North Africa (Morocco and Algeria) and the eastern parts of the Mediterranean (Syria, Israel, Greece, Cyprus and eastern Turkey) with a continuous increase of the Mediterranean areas prone to drought from the early 1980s to the early 2011s. As the time step increases, frequency of the severe droughts increases as well especially along the Mediterranean cost and some central parts. Around the 1990s and the beginning of the 21st century, the drought intensity increased, and the Mediterranean region experienced several dry periods. The worst drought episodes were detected between December 1988 and October 1991 in Southern Europe (Spain, France and Croatia) and between January 2006 and April 2010 in the Eastern Mediterranean (Syria, Israel, Greece and Turkey). However, after 2013, the drought intensified again and the most extreme drought of the past 70 years occurred especially in the southern parts of the Eastern Mediterranean (Turkey, Syria and Lebanon)). The results of the non-parametric Mann-Kendall test have indicated prevailing significant negative trends in almost all the Mediterranean basin (about 75% of total stations) at 3, 6, 9, 12, and 48 time scales, particularly, in Southern Europe (north and north East Spain, south France, south Italy and Croatia), North Africa (Libya, Morocco and Algeria) and the Eastern Mediterranean (Syria, Israel, Greece and Turkey). The results have indicated that at longer time steps, the hydrologic drought is likely to occur at the coastal parts while the interior parts will suffer from agricultural drought under severe drought conditions especially in the eastern Mediterranean, which has long dry season in summer. The results obtained have confirmed that the SPI has statistical consistency advantages, and can describe both short-term and long-term drought impacts through different time scales of precipitation anomalies. These highlighted patterns of drought incidences and their behaviour would help policymakers to implement well-coordinated water resources planning and guiding several drought preparedness strategies over the Mediterranean to mitigate its possible adverse impacts. This study will be followed by a new study of high spatial resolution using CLICES Spanish database to accurately assess the spatial and temporal patterns of drought. This study is performed under the framework of the Climatology Group at University of Barcelona (2017 SGR 1362, Catalan Government) and the (CGL2017-83866-C3-2-R) Spanish project.

16:15-17:15 : *Coffee break & Poster Session 1*

17:15-17:30: Wetter trend within the Semi-Arid Iberian Southeast due to WeMO negative phases increasing

A. Halifa-Marín and **M. A. Torres-Vázquez**
University of Murcia, Cartagena, Murcia, Spain

The research literature suggests a generalized decrease in winter and spring rainfall in a large territory of the Iberian Peninsula (IP) since 1980, due to the reinforcement of the North Atlantic Oscillation (NAO). At the same time, other articles connect the Oscillation of the Western Mediterranean (WeMO) with different climatological phenomena in the Mediterranean coast of the IP. Precipitation in the southeast of the PI shows a very low correlation with the NAO, being significant only in January and December (-0.3), whereas it shows an intense correlation with the WeMO, which shows an intense tendency towards negative phases especially since 1985. Under the Pearson method, this connection has been studied in the Almanzora basin (Almería), obtaining a strong inverse correlation in winter and autumn (-0.4 - -0.6), and weaker in spring and summer (-0.3 - 0.1) for the period 1951-2010. On the other hand, the study of the changes in the mean rainfall, between the period 1951-1980 and 1981-2010, shows increases in winter (35%) and autumn (18%), while in spring and autumn it decreases 15%. On a monthly scale, the strongest positive change occurs in September (190%), February (108%) and June (86%), while in the negative, November (-35%), October (-29%) and May (-27%) stand out. Thus, the results point to: i) wetter winters and autumns in the most arid areas of the IP due to the recent weakening of the WeMO; ii) changes in the distribution of seasonal rainfall on a monthly basis; iii) weak Atlantic influence (NAO) on rainfall in the region. This study identifies the WeMO as a possible teleconnection with rainfall in the southeast of the IP, which has partly determined a disparate trend with the most of the territory of the IP since 1980.

17:30-17:45: Characterization of the sea-breeze in the Palma basin from in-situ and remote observations

A. Grau Ferrer, **M. A. Jiménez** and **J. Cuxart Rodamilans**
Universidad de las Islas Baleares, Palma de mallorca, Islas baleares, España

The Sea-Breeze (SB) in the island of Mallorca is a common regime that take place during most of the days of the warm months of the year (from April to October) and specially in the three main basins (Palma, Campos and Alcúdia). Previous numerical and observational studies have shown that this locally-generated wind has a clear-diurnal cycle (Cuxart et al., 2014; Jiménez et al., 2016). The different phases of the SB are strongly linked to surface temperature difference between land and sea, which is further analyzed in this work

through satellite-derived surface temperatures. Hourly Land-Surface and Sea-Surface temperature fields (LST and SST) are taken from Meteosat Second Generation during 5 years (2013-2017). The days with SB are selected through a proposed filter of the observations taken from two surface weather stations: near the coast (the Airport) and more inland (about 9km from the coast, at the University Campus). Results show a good correlation between this temperature difference and the intensity of the SB reported over the coast as well as its propagation through the land. Large-scale winds can also modify this temperature difference as well as the speed of the maximum and the initiation of the SB. To extend the years analyzed and better characterize the temporal variability of this regime, a new filter is taken considering only the observations at the Airport (the longest time series; records since 1997).

17:45-18:00: Climatological analysis of lightning jump tool in Catalonia (2006-2018)

T. Rigo Ribas and **C. Farnell Barque**
Servei Meteorològic de Catalunya, Barcelona, Barcelona, Catalunya

Before working with the algorithm operationally, we studied the performance of this tool in Catalonia, tunning some parameters according the conditions of our region and to the data available (total lightning flashes with a good detections of both intra-cloud and cloud-to-ground). This preliminary study was applied in severe weather episodes recorded from 2006 to 2013. In this period, we obtained very good skills scores like 73% of percent correct prediction and, only, 10% of false alarms. These good results allowed us to work with this tool operationally since 2016, when the forecast team of Servei Meteorològic de Catalunya (SMC) started to work operationally with lightning jump algorithm to nowcast severe weather. Nowadays, we have 13 years of data related to lightning jump which have allowed us to do a complete climatological study of its behaviour in Catalonia, considering some characteristics such the lead time, or the spatial, the monthly and yearly distributions, among others. These characteristics have been compared and related to severe weather observations recorded during this period in the same area. This analysis can help us to understand better the thunderstorms which have triggered the alert and the relationship between the alert and the severe weather surface observations.

18:00-18:15: Benchmarking and homogenization of daily Essential Climatic Variables within the INDECIS project

[1]**J. A. Guijarro**, [2]**E. Aguilar**, [2]**T. Caloiero**, [2]**G. N. Caroletti** and [2]**E. Al.**
[1]State Meteorological Agency, Spain, Palma de mallorca, Illes balears, Spain
[2]

The European project INDECIS* (Integrated approach for the development across Europe of user oriented climate indicators for GFCS high-priority sectors: agriculture, disaster risk reduction, energy, health, water and tourism) needs quality controlled and homogenized daily series of several essential climate variables to produce climate indices for their target economical sectors. Work Package 3 is the project team dedicated to provide these high quality series from their raw versions stored at the European Climate Assessment and Dataset (ECA&D). As a first step, a benchmarking exercise was designed in order to test available methodologies on two target areas: Southern Sweden and Slovenia. After considering other alternatives, RCM outputs were selected as primary homogeneous data-set because it provides the studied variables at daily resolution. Inhomogeneities and other perturbations are then applied to the homogeneous data-set to compile different benchmark flavors with varied difficulties. These benchmarks were released to be used by developers and users of homogenization packages in order to test their performances when applied to daily climatic series, not only of extreme temperatures and precipitation as has been customary in past benchmarking efforts, but also of cloud cover, wind speed, relative humidity, sea level pressure, sunshine duration and snow depth. The performance of the applied methodologies will be evaluated by comparing errors in the corrected series, their trends and monthly indices relevant to the project objectives. Then, best performing methods will be chosen to homogenize the complete set of ECA&D series and to provide high quality series to other INDECIS teams. Because of the high number of series involved, only automatic methods are expected to provide homogenized series in due time. As the Climatol package seems a plausible candidate, first results of its application to benchmark and real series are presented and discussed, showing the varied difficulties of homogenizing different variables.

18:15-19:15 : *Light Ice Breaker*

19:15-20:15 : *Tethys Editorial Board Meeting*

Tuesday, 5th

Session 2: Processes and applications

Chairs: *Maria Antonia Jiménez and Maja Telišman*

09:00-09:30: Fine scale dynamics over complex terrain

A. Paci
METEO-FRANCE & CNRS, Toulouse, France

Over the past years, METEO-FRANCE experimental and instrumental meteorology research group (CNRM/GMEI) has been involved in several mountain

meteorology field experiments. These projects are carried out in close collaboration with several partners, among them the Universities of the Balearic Islands. Our research focuses in particular on fine scale flows over complex terrain and their impacts. One objective is to contribute to improve their representation in fine scale numerical weather prediction models. This paper will give an overview of our current work concerning three projects. The first one (Passy-2015) took place in a narrow alpine valley of the French Alps, which is known to be one of the worst place in France regarding air quality. The analysis of flows within the valley from observations and high resolution numerical simulations highlights their role in the observed wintertime pollution events and reveals the mechanisms at play. The second one (Cerdanya-2017) took place in one of the largest valley of the Pyrenees mountain range, spreading across Spain and France (between Occitanie and Catalunya). Preliminary analysis of fine scale flows suggests they play a role on the minimum temperature record observed in the valley during the field experiment. The last one just took place last summer and fall in a narrow valley of the central Pyrenees (Vallée d'Aure) in which a jet forms under clear-sky conditions and can be observed several kilometers away from the valley exit. A few planned projects will be mentioned to conclude.

09:30-09:45: Surface thermal inversion evolution in the bottom of a Pyrenean valley studied by single-column modelling forced with observed surface fluxes

[1]**J. Cuxart**, [2]**L. Conangla**, [1]**D. Mariínez-Villagrasa** and [1]**M. A. Jiménez**

[1]UIB, Palma, Illes balears, Spain

[2]Polytechnic University of Catalonia, Applied Physics, Manresa, , Catalonia, spain

Two experimental campaigns have been carried out in the Cerdanya valley in the Pyrenees in 2015 and 2017 to study the cold pool that usually forms there at night. Conangla et al (2018, IJOC) showed that most cold pool events have a daily cycle, being formed in the evening and destroyed by solar heating of the surface the morning after. The cold pool forms locally by radiative cooling of the air layers in contact with the surface, and in this particular case, the air is essentially blocked in its way downvalley because of a terrain elevation located at a few kilometers downstream. This area collects also downslope and downvalley flows that cool the air contained in the valley along the night. The availability of vertical soundings performed by a tethered balloon and a WindRASS, together with measured surface fluxes of latent and sensible heat and momentum at the surface layer allows to inspect the establishment and evolution of the surface thermal inversion in the experimental site located at the Cerdanya aerodrome. The mesoscale influence of the downvalley flows is estimated from high-resolution mesoscale simulations made over the same area for similar cases. In the campaigns there are several measurements of temperature and humidity between 1.5 m and the surface. Single column simulations at a very high vertical resolution are performed for selected cases from 3 hours before sunset to the morning destruction by convective mixing. The surface fluxes are available every 10 minutes and their values are interpolated to provide a continuous evolution. The selected cases comprise nights with only locally-generated winds and small cloud cover, and with variable surface state including grass, fresh snow or old snow. The evolution of the strength and depth of the surface inversion as seen by the model are compared to the available data.

09:45-10:00: Investigation of Sea Breezes on the middle Aegean coasts of Turkey

G. Buğday, **S. S. Menteş**, **H. S. Topçu**, **Y. Ünal** and **T. Kaytanci**

Istanbul Technical University, Department of Meteorological Engineering, Maslak 34469, Istanbul, Levent, Türkiye

A sea breeze happens because of horizontal land/sea pressure gradient differences caused by the daily heating of the Earth's surface. In this study, sea breeze analysis over Middle Aegean coast has been investigated using eight station around Izmir and Kuşadası cities. The data used in the study were gathered using hourly meteorological records between the years of 2013 and 2015 from national meteorological field stations situated on the Aegean Coast. The analysis was carried out for six months (April-September) when the sea breeze was effective. The filter method was applied to find sea breeze days. In the method, six different filters explain physical processes of sea breeze. The first three filters are used to perform operations at 700 mb. The purpose of first three filter was to exclude days with probable large changes in synoptic conditions. Following three filters analyze surface parameters. The another purpose of this study is to evaluate the performance of the WRF model on sea breeze days and compare with observation. The WRF domains for these measurement points are constructed as 3 nested domains with the horizontal resolutions starting from 27 km by ratio 3. We evaluated the coupled model performance by using the hourly data for the year of 2015. To compare filter method and WRF model, 2 days was selected among sea breeze days passes through the filter method for Kuşadası and İzmir stations and the spatial distribution of the sea breeze was investigated using the WRF and model performance is examined. It is important to study the effect of sea breezes due the Etesian winds, which are effective in this season especially in the Aegean region. Consequently, results of the model shows variability between Kuşadası and İzmir depending on the measurement locations including the complexity of the terrain of the interest.

10:00-10:15: A computationally cheap atmosphere-ocean modelling system aimed at anticipating meteotsunami occurrence in Ciutadella harbour

R. Romero, **M. Vich** and **C. Ramis**
Grup de Meteorologia, Departament de Física, Universitat de les Illes Balears, Palma de mallorca, Illes balears, Spain

Ciutadella (Menorca, Spain) is well known for the large amplitude seiches of about 10.5 min period registered in its long narrow inlet, especially in the warm season. This phenomenon (locally referred to as "rissaga") might reach extreme wave heights in the range 1.5 - 4 m with a recurrence of only a few years, leading to damaging consequences in the port activities and moored vessels. The provision of as accurate as possible predictions of the rissaga risk hours or days ahead appears as a crucial element in helping to mitigate these consequences. We devise a chain of atmospheric and oceanic numerical simulation components aimed at capturing with low computational cost the key physical processes conducive to the vast majority of rissagas: (i) the genesis of high amplitude atmospheric gravity waves upstream from the Balearic Islands that propagate in the SW-NE direction; these mesoscale waves are synthetically triggered using a 2D nonhydrostatic fully compressible model within a vertical environment provided by a representative sounding; (ii) the oceanic response to the concomitant pressure fluctuations along the Mallorca-Menorca channel, in the form of long oceanic waves subject to Proudman resonance; these processes are simulated with a shallow-water model applied over a 80-m depth channel; (iii) shelf amplification, which according to theory (Green's law) accounts for a doubling of the wave amplitude; and (iv) harbour resonance within Ciutadella inlet, a crucial mechanism solved again with the shallow-water equations over an idealized 5-m deep channel. The prognostic system is successfully tested for the available set of 128 rissaga events and for a complementary set of 600 ordinary situations. Our approach discriminates fairly well non rissaga events from high-amplitude oscillations and tends to correctly categorize the meteotsunamis among weak, moderate or strong events. We now pursue the real time application of the method in a probabilistic context.

10:15-11:15 : *Coffee break & Poster Session 2*

11:15-11:30: Aerobiology of Artemisia pollen in Catalonia (NE Iberian Peninsula)

[1]**C. Periago**, [1]**M. Alarcón**, [1]**H. T. Majeed**, [2]**C. De Linares** and [2]**J. Belmonte**
[1]Universitat Politècnica de Catalunya, Barcelona, Catalonia, Spain
[2]Universitat Autònoma de Barcelona, Bellaterra, Catalonia, Spain

Airborne pollen grains constitute part of the biological components of the atmospheric aerosol. The airborne pollen levels over a specific location depend on the pollen production in the source areas and its dispersion. We have analysed the influence of meteorological conditions (precipitation, temperature and wind regime) in the Artemisia pollen levels in Catalonia (NE Iberian Peninsula). Artemisia is a common herb/shrub growing in ruderal wastelands and flowering mainly from late summer to early winter. Artemisia pollen concentrations were recorded daily by the Aerobiological Network of Catalonia at 6 stations: Barcelona, Bellaterra, Girona, Lleida, Manresa and Tarragona. Meteorological data were provided by the Meteorological Catalan Service and the Spanish Agency of Meteorology. The parameters that characterise the pollen levels and its phenology are: Annual Pollen Integral (APIn, sum of the mean daily pollen concentrations in a year) and the dates of the Start, the End and the Peak, as well as the Length, of the Main Pollen Season (MPS). Spearman's rank correlation coefficient has been applied to measure the relationship between pollen data and the meteorological variables. Results show that: •_x0001_Rainy and warm winters increase the APIn. •_x0001_High temperatures in spring and summer decrease the APIn, advance the Start and increase the Length of the MPS. •_x0001_Precipitations in autumn have a washing out effect on the pollen levels. •_x0001_High temperatures in summer and autumn delay the Peak date. •_x0001_The wind induced by the sea breeze has a cleaning and dispersion effect on the Artemisia pollen concentrations on the coastal stations. •_x0001_Positive correlations between winds coming from W and NW and pollen concentrations in Tarragona, suggest the contribution of pollen from a source inland (possibly from Lleida, where the highest APIn values are observed). We acknowledge the financial support from the Spanish Government (CGL2012-39523-C02-01, CGL2012-39523-C02-02, CTM2017-89565-C1-P and CTM2017-89565-C2-P)

11:30-11:45: A lagrangian approach to the study of the arrival of African air masses to the Mediterranean Spanish coast

J. A. García Orza and **P. J. Gómez Cascales**
Universidad Miguel Hernandez de Elche, Elche, Valencia, Spain

The study is based on a residence time analysis of air parcels over different areas (Africa, the Mediterranean, the Atlantic, the Iberian Peninsula and the rest of continental Europe) before reaching 9 coastal locations, from Huelva to Barcelona, at heights spanning from the surface to 9000 m in 250 m intervals. The nature of the reaching air parcels is assessed by their potential temperature and relative humidity. Kinematic backtrajectories are calculated with ERA-Interim data for the period 1995 - 2017 using the HYSPLIT model. Residence time over the Atlantic is the highest in the whole vertical profile with the exception of the SE Iberian Peninsula where Mediterranean flows are slightly more common at the lowermost heights. The African influence peaks below 2000 m in Huelva and Gibraltar, and above 2000 m over the Mediterranean,

with increasing height along the Alboran sea coast and to the NE. At the lowermost levels, residence over Africa is higher in winter as air parcels reside over the Mediterranean more frequently in summer. Besides seasonality, the residence time series show strong interannual variability. The assessment of monotonic trends by a number of non-parametric tests (which also considered seasonality and first order autocorrelation in the time series) does not find trends in the residence time over Africa. The most common situation during African dust outbreaks in the study area is the prevailing influence of Mediterranean air flows at the lowermost heights, while African masses are advected above the boundary layer primarily with southwestern pathways. This shows in a quantitative way that Mediterranean (a reservoir of aged pollutants) inflows are concurrently found in many African dust events and may be related to the adverse health outcomes which have been recently attributed to the African dust events. The African influence peaks at higher altitude than in the general case.

11:45-12:00: Can dust outbreaks condicionate precipitation over the Mediterranean? an evaluation of aerosol-radiation-clouds-precipitation interactions

[1]**L. Palacios-Peña**, [1]**P. Jiménez-Guerrero**, [2]**R. Baró**, [1]**S. Jérez**, [1]**J. M. López-Romero**, [1]**J. J. Gómez-Navarro**, [1]**R. Lorente-Plazas** and [1]**J. P. Montávez**

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There is a high frequency of dust intrusions from African desert regions over the whole Mediterranean Basin. These intrusions may cause an anomalous atmospheric aerosol concentration which may have the ability to modify eventually the Mediterranean precipitations. Under certain conditions, dust, as an aerosol and through the aerosol-radiation-clouds interactions, affects to cloud microphysical properties and may modify convective and large-scale precipitation, thus affecting the hydrological cycle. Simulations from the Spanish funded projects, REPAIR and ACEX were used with the objective of quantifying the influence of including aerosols-radiation-clouds interactions in a regional on-line coupled climate/chemistry model on precipitation. The WRF-Chem model (Grell et al. 2005) version 3.6.1 were run over the EURO-CORDEX at 0.22º/0.44º domain. However, for the purpose of this work, an area over the whole Mediterranean Basin were delimited. Simulations cover a present period between 1991 and 2010 and within this period, several case studies for desert dust outbreaks have been studied. The impacts on several clouds variables as convective precipitation, CLWP, CFRAC or CDNC has been evaluated with two different configuration runs: a base case, in which aerosol-radiation-clouds interactions were not taken into account (WRF-alone); and a simulation with the GOCART dust scheme in WRF-chem, in which aerosol-radiation-clouds interactions were taken into account online (ACI case). The comparison between simulation results and satellite observations from MODIS supports the skills of the model to estimate the African dust contribution over the Mediterranean. Differences between the ACI and the base case suggest variations around +/- 15 mm/day in total precipitation under certain dust outbreaks. These differences may be explained by a feedback produced by ACI interactions over the precipiation.

Session 4: Numerical modeling

Chairs: *Kristian Horvath, Lluís Fita and Víctor Homar*

12:00-12:30: Towards advances in modelling of extreme precipitation by the synergetic use of convection-permitting simulations and state-of-the-art observations

S. Khodayar

University of Valencia/Karlsruhe Institute of Technology, Valencia, Valencia, Spain

Extreme precipitation events greatly affect the Mediterranean societies. The Mediterranean basin is prone to heavy precipitation because of its distinctive topography and geographical location. Most of these events occur in autumn over the Western Mediterranean. With the goal of improving our understanding of the processes shaping these extremes and providing a better model representation, in this study we focus on two components of the water cycle: the soil and the atmospheric moisture. Several studies have shown that soil-atmosphere interactions and atmospheric water vapour evolution are important factors contributing and determining the occurrence and location of heavy precipitation extremes. Uncertainties associated with their model representation contribute to the uncertainty in modelling of heavy precipitation. In this study, we explore the sensibility of the western Mediterranean heavy precipitation to soil moisture conditions and atmospheric water vapour evolution. The sensitivity to soil moisture extreme dry and wet initial scenario conditions and soil moisture initialization are examined using high-resolution convection permitting simulations and state of the art soil moisture satellite observations, namely the SMOS disaggregated 1 km product over the Iberian Peninsula. Moreover, the relevance of an accurate representation of atmospheric water vapour distribution and evolution is investigated through assimilation of a state-of-the-art GPS-derived Integrated Water Vapour data set and radiosounding profile information.

12:30-12:45: Nowcasting precipitation techniques applied to the heavy rainfall event that flooded Sant Llorenç des Cardassar

[1]**A. Nagy**, [1]**A. Buil**, [1]**J. Cantero**, [2]**C. Alonso**, [1]**E. De La Rubiera**, [1]**J. De Juan**, [1]**O. Cabrera**, [1]**T. Salom**, [3]**V. Homar** and [3]**R. Romero**

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The Mediterranean area is exposed to intense and persistent precipitation events due to its climate and geomorphological characteristics. The presence of mountainous systems that extend parallel to the coast act as a natural barrier that causes wet air from the sea to ascend rapidly forming and intensifying the storms. Flash floods resulting from these storms are among the most severe natural hazards in this area. Such events are difficult to predict with Numerical Weather Prediction (NWP) models but can be anticipated using shorter-term nowcasting techniques. Nowcasting techniques based on radar observations (Eulerian and Lagrangian persistence) show significant skill in forecasting precipitation (location and intensity) for short lead times. This skill decreases with increasing lead time since only past precipitation trends are used to predict changes in precipitation. On the other hand, operational NWP models are now beginning to resolve important processes such as convection, however their predictive skill generally remains limited during the first time steps. Spin-up time is also an important issue, as it covers the time window of the nowcasting-scale forecasts. To improve the forecast skill of storms in the first six hours of the forecast, we implement a new nudging scheme in WRF. The method is based on the assimilation of radar reflectivity data, which is used for scaling the model profiles of latent heat. The process is applied throughout a pre-forecast period (two hours) which results in an increased adjustment to the real state of the atmosphere. In this study we analise and compare precipitation forecasts developed using different nowcasting techniques based on radar observations and NWP models for the heavy rainfall event that flooded the region of Sant Llorenç des Cardassar in Mallorca on October 9, 2018, which operational NWP models did not predict.

13:00-14:45 : *Lunch*

14:45-15:00: A hydrological early warning system over small Appennine's catchments trough an operational NWP-ensemble

[1]**R. Ferretti**, [2]**A. Lombardi**, [2]**L. Sangelantoni**, [3]**B. Tomassetti**, [2]**I. Maiello**, [3]**V. Colaiuda** and [3]**M. Verdecchia**

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CETEMPS recently implemented a regional scale ensemble forecast where the Advanced Research WRF (ARW) modeling system version 3.9.1 runs operationally at 9km over Italy using as initial conditions the 20 members from GFS ensemble, hence producing every day the same number of forecast members in addition to the control run. Besides the ensemble mean forecast and related uncertainty (ensemble members spread) for the key atmospheric variables (precipitation, temperature and sea level pressure), a distribution analysis, aimed at defining the probability of the occurrence of events above different thresholds, is produced on a daily basis. Then, individual ensemble members and the ensemble mean as well, are used to force the CETEMPS deterministic distributed hydrological model CHyM, which is operationally used over Italy, to predict flood occurrences on river segments. In this way, a "deterministic" hydrological run (forced by the ensemble mean) is performed and a set of 20 hydrological runs forced by each of the ensemble members. This latter configuration allows for a probabilistic approach applied also to the hydrological forecast as performed for the weather forecast. Preliminary results of an event occurred over Abruzzo region (Central Italy) on 13 November 2017 will be presented to the aim of comparing the improved ensemble forecast with respect to the deterministic one, both for the weather and the hydrological forecasts. To these aims, two different hydrological stress indices will be used: they are able to detect segments of the drainage network where floods are most likely to occur.

15:00-15:15: Radiative Transfer Simulation of Clouds and Aerosols in the Transition Zone: Weather Research and Forecasting Model (WRF)

B. Jahani and **J. Calbó**

Universitat de Girona, Girona, Catalonia, Spain

Solar radiation is a key component of the Earth atmosphere system, which controls a number of natural processes on the planet Earth. Furthermore, the amount of solar radiation reaching the Earth surface is mainly affected by the aerosols and clouds properties, which are two particular cases of a single phenomenon, i.e. a suspension of particles in the air. The differences between the radiative characteristics of cloud and aerosol are well known. However, in many cases the characteristics of the suspension are on the border between those corresponding to a cloud and those corresponding to an atmospheric aerosol (twilight or transition zone). As a result, it is hard to define the suspended particles as either aerosol or cloud. So that, this study aims to assess the ability of a number of radiative transfer parameterizations included in the Weather Research and Forecasting Model (WRF) in simulating the radiative effect of the suspended particles in the transition zone, by applying a sensitivity analysis approach. To this aim, several radiation parameterizations of WRF (New Goddard, RRTMG, FLG, ...) were isolated from the whole model and were applied to perform simulations under either "cloud" or "aerosol" modes, for different values of (i)

cloud optical thicknesses resulted from different sizes of ice crystals, liquid droplets, cloud height, mixing ratios and (ii) different aerosol optical thicknesses combined with various aerosol types. The optical thickness under both aerosol and cloud modes was considered to vary between 0.1 and 2, which is a common range of optical thickness for twilight zone. The analyzed results consisted of shortwave broadband global, beam and diffuse irradiances at the Earth surface.

15:15-15:30: Model for Prediction Across the Scales - Atmosphere (MPAS-A): A first view in the Mediterranean basin

A. Montornes Torrecillas
Vortex, Barcelona, Catalonia, Spain

Today, state-of-the-art of the regional or limited area models (LAM) assume a structured grid (ex. Arakawa C-grid staggering) covering a defined region in which dynamics and physics are solved. Under this approach, a dynamical downscaling is performed by assuming a set of nests from a global model or reanalysis to a grid resolution that resolves the scales required for the determined application (e.g. weather forecasting, wind resource or pollutants). Each nesting level resolves different atmospheric scales that can interact one to each other by using the two-way nesting method. Nevertheless, this modeling approach is awkward as a consequence of the computational limitations in 90s, when most of the dynamical cores for LAM were developed. Now, a new modeling approach is available for the atmospheric modeling community. The Model for Prediction Across Scales - Atmosphere (MPAS-A) is a non-hidrostatic atmospheric model, one component of known as Earth-system models denoted as MPAS. All these models use centroidal Voronoi tessellations for their horizontal meshes allowing uniform and quasi-uniform meshes with variable horizontal resolution. Therefore, nests and projections become out-dated, emerging a real seamless modeling chain covering all atmospheric scales. We propose a set of experiments to analyze the performance of MPAS-A in the Mediterranean region. Two meshes are tested: an uniform one at 60 km resolution and a quasi-uniform mesh with variable resolution from 92 km to 25 km focusing on the Mediterranean sea. Simulations are driven by the ECMWF ERA5 Reanalysis. The study includes an initial analysis of basic fields such as pressure, temperature, wind and humidity and a comparison with WRF 3-km simulations and measurements provided by surface stations and wind met-masts.

15:30-15:45: Solution of the Liouville equation for realistic atmospheric systems: limits and characteristics

A. Hermoso and **V. Homar**
Universitat de les Illes Balears, Palma, Illes balears, Spain

Understanding the fundamentals of weather forecasting is one of the most challenging problems the scientific community currently faces, not only for its academic value but also for civil protection and management of multiple socioeconomic assets. Numerical weather forecasts are inherently uncertain due to the lack of knowledge of the initial state of the atmosphere with infinite precision and deficiencies of numerical models in representing some physical processes. This uncertainty is quantified by means of probabilistic information expressed in terms of probability density functions (PDF), which can be depicted in the phase space of the system, whose dimensions are the state variables. In this context, the Liouville equation (LE) provides the temporal evolution of the state of the system, represented by the full PDF. The lack of analytical solution for the Navier-Stokes equations and the high dimensionality of the atmospheric system restrict this approach for real weather and climate applications. In practice, only an ensemble of discrete samples of the PDF can be considered operationally and a predicted PDF is -sometimes implicitly- inferred from the ensemble of samples of deterministically predicted states. The main objective of this work is to learn about the evolution of PDF in increasingly complex systems and identify aspects of its evolution that provide some guidance on the optimum generation strategy in real-world operational atmospheric ensemble prediction systems. To do so, we find the solution of the LE for low complexity systems of atmospheric interest. The solution for a low complexity barotropic model is presented. This solution displays interesting topological characteristics that question standard interpretations of ensemble prediction systems. Furthermore, these characteristics are also found for more complex and realistic systems. A discussion on the challenges weather and climate ensemble forecasts face when dealing with some intrinsic properties of LE solutions will be provided.

16:00-17:00 : *Coffee break & Poster Session 4*

17:00-17:15: Improving the Predictability of the 7 November 2014 Medicane Event: Impact of Remote Sensing RS-AMVs Using an EnKF Data Assimilation System.

[1]**D. S. Carrió**, [1]**V. Homar** and [2]**L. Wicker**
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[2]NOAA/OAR/National Severe Storms Laboratory, Norman, Oklahoma, United states

Most of the high-impact weather events affecting coastal areas in the Mediterranean are characterized to be initiated and developed mainly over the sea, where the atmosphere state is poorly represented due to the lack of in-situ observations. The uncertainty associated to the description of the initial state of the atmosphere is one of the key error sources that leads to a low predictability of such events. With the main aim of improving the estimate of the initial conditions over

the sea, and thus improve the predictability of extreme weather events, a high-resolution Ensemble Kalman Filter (HREnKF) data assimilation system is used. In this study is assessed the impact of assimilating both in-situ conventional observations (i.e., buoys, aircrafts, METAR or rawinsondes) and satellite derived observations, such as Rapid-Scan Atmospheric Motion Vectors (RS-AMVs). For this particular study, we evaluate the potential of such observations to improve the predictability of a MEDIterranean hurriCANE (MEDICANE) that took place on 7 November 2014 over the Sicilian channel, affecting the Islands of Lampedusa, Pantelleria and Malta. Gust wind values exceeding 42 m s-1 and a pressure drop above 20 hPa in 6 h were registered in Malta. The novelty of this data assimilation system in comparison with other data assimilation schemes, is that EnKF uses its own ensemble of forecasts to estimate flow-dependent background error covariance, instead of using static or climatological background error covariances. We discuss the performance of the EnKF system producing new analyses through statistical scores (RMSI, spread, BIAS sawtooth plots and consistency ratio plots). Then, we quantitatively verify the quality of the forecast using statistical verification methods. We discuss not only on the forecasts products but also in terms of the relevant physical mechanisms involved in this event.

17:15-17:30: Operational Numerical Ensemble Modelling of Storm Surges on the Northern Adriatic Shelf

[1]**M. Licer**, [2]**A. Fettich** and [2]**B. Strajnar**
[1]National Institute of Biology, Ljubljana, Slovenia, Slovenia
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We present a operational storm surge forecasting system on the Northern Adriatic Shelf, employing a spread-conservind 17 member subset of the 50-member ECMWF ensemble surface fields for winds and mean sea level (MSL) pressure to force a high resolution Adriatic setup of NEMO ocean model. Open boundary conditions to NEMO ocean model come from CMEMS MFS. The system is running operationaly at Slovenian Environment Agency twice per day for a 72 hour forecasting period and produces a forecast for Sea Level Anomalies. Tidal component to SLA is computed using a dedicated run of NEMO at zero wind and constant air pressure, forced only with TPXO8 tides at the open boundary. Combined SLA is then bias-corrected using a 24-hour running average from a tide gauge in the port Koper (Gulf of Trieste). This setup is demonstrated to produce accurate probabilistic forecasts of storm surge scenarios in the northern Adriatic. It is further shown that ensemble spread during surges can be significant, deterministic modelling of surges is therefore generally insufficient.

18:30 : *Palma City Tour*

21:00 : *Social Dinner*

Wednesday, 6th

Session 5: Atmosphere-surface interactions in semi-arid conditions

Chairs: *Joan Cuxart, Jose Luis Palau and Dani Martínez*

09:00-09:30: Land surface Interactions with the Atmosphere over the Iberian Semi-arid Environment (LIAISE) Project

[1]**A. A. Boone**, [2]**M. Best**, [3]**J. Cuxart**, [4]**J. Polcher** and [5]**P. Quintana Segui**
[1]CNRM - Université de Toulouse, Météo-France/CNRS, Toulouse, Occitanie, France
[2]UK Met Office, Exeter, United kingdom
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[4]LMD/CNRS, Paris, France
[5]Observatori de l'Ebre, Roquetes, Espagne

Climate projections predict that the Mediterranean region will be a so-called climate change "hot-spot", however, it is known that semi-arid regions show biases in model variables such as land surface temperature and components of the surface energy balance. In addition, the World Climate Research Programme has recognized that human activities and their interplay with natural processes are playing a key role in modifying the continental water cycle, and therefore must be better accounted for in projections. But the representation of such processes is currently at a nascent stage in earth system models. In order to address these issues, we have initiated the international initiative called LIAISE. The overarching objective of LIAISE is to better understand and model both the natural and the human imprint on the semi-arid energy and water cycles. Here we present the plans for an observational campaign as part of the HYdrological cycles in the Mediterranean Experiment (HyMeX) which will bring together ground-based and airborne measurements with modeling studies including data assimilation of remotely sensed data. The project will have an intensive observation period of approximately a growing season with a focus on the surface energy and water budgets for several representative land cover types, including irrigated surfaces. A Special Observing Period will take place during a 15-day period in summer 2020 over the Ebro basin in northeastern Spain when land surface heterogeneity is at a maximum, and will include measurements from a captive balloon, a lidar, UHF profilers, frequent radio-sounding releases and aircraft. The project will take a multidisciplinary approach using a suite of numerical models focusing on both using existing and improving parameterizations of anthropization and semi-arid surfaces. The main outcomes of this project is improved water resource

impact studies for both the present and under future climate change.

09:30-09:45: LIAISE: Land surface Interactions with the Atmosphere over the Iberian Semi-arid Environment

[1]**J. K. Brooke**, [2]**M. Best**, [2]**J. Price**, [3]**A. Boone** and [4]**J. Cuxart**

[1]Met Office, Exeter, Devon, United kingdom
[2]Met Office
[3]CNRM/Meteo France
[4]Universitat de les Illes Balears, Palma de mallorca, Spain

Semi-arid regions, of which the Iberian Peninsula is one, pose a significant challenge due to the highly heterogeneous nature of the land cover, whilst also being a region of higher atmospheric sensitivity to the land surface. The large diurnal/seasonal variability of precipitation impacts upon hydrological processes, soil moisture content, and vegetation characteristics, and the feedbacks to the atmosphere are still not well known. Currently the Met Office Unified Model (UM), similar to other modelling centres, has known model biases within these environments, but it is difficult to identify the cause of such biases, often due to the lack of critical observations. This implies that there is a need for a better observational understanding and modelling of the components of the surface energy and water balance. The LIAISE (Land surface Interactions with the Atmosphere over the Iberian Semi-arid Environment) campaign will bring together ground-based measurements and modelling studies to lead to an improved understanding of processes affecting soil moisture, evapotranspiration and precipitation coupling and the subsequent feedbacks to the Mediterranean boundary layer. A better quantification of the errors through a targeted observational campaign could lead to improvements in predictions at all scales. The Met Office plan to instrument a 50 m flux tower and our capability will be described. The observations will enable flux measurements at a number of heights, to be used to help understand how the surface fluxes are mixed within the lowest part of the boundary layer.

09:45-10:00: Significant disparity in ETo estimates (Penman-Monteith) according to the network of weather stations in Spain

J. M. Villar Mir, **J. Clarisó**, **R. Ochoa**, **A. Puntos** and **M. Pascual**

Universitat de Lleida, Lleida, Catalonia, Spain

It is necessary to improve estimates of daily crop evapotranspiration (ETc) to improve irrigation scheduling. Irrigation requirements are usually based on the FAO approach, which is calculated using daily estimates of ETo and crop coefficients (Kc). In recent years, there has, however, been a significant disparity between ETo-based (FAO Penman-Monteith method) estimates and the information provided by the SIAR (Spanish Ministry of Agriculture), via the agro-climatic information system for irrigation, and the data provided by the Department of Agriculture of the Generalitat de Catalunya (whose data is, in turn, provided by the Meteorological Service). The current study used meteorological data provided to users by these two public institutions. The study was carried out with data from weather stations located in the provinces of Huesca (SIAR), Zaragoza (SIAR), Lleida (Metocat) and Tarragona (Meteocat) and data from neighbouring stations were compared. In general, the ETo values supplied to users were higher for the SIAR network. For example, when comparing average annual ETo values between Fabara (Zaragoza) (253 m altitude and 1340 mm ETo) and Batea (Tarragona) (382m and 1101 mm) for the period 2007-2017, we found that the annual ETo value was 21% higher, despite these stations being only 14 km apart. These differences were slightly higher (24%) when monthly averages were compared (July avg. of 217 mm at Fabara versus 175 mm at Batea). This situation has particular implications for irrigators since differences of 40 mm in a given month imply 400 m3/ha. In addition, some irrigation districts use information from both networks, which confuses estimations of the need for irrigation water. It is necessary to unify criteria for calculating the daily ETo since the two networks use the same equation. The problem lies in the criteria used for estimations.

10:00-10:15: ET evolution along the drying transition season over a mesoscale Mediterranean island

D. Mariínez-Villagrasa, **B. Martí** and **J. Cuxart**

Universitat de les Illes Balears, Palma de mallorca, Spain

The characterization of the exchange processes of water and energy between the land surface and the overlying atmosphere is of fundamental interest to describe our climate system. An important part of the energy interchanged is usually not identified, leading to an imbalance on the energy budget at the land surface . The determination of water balance in semi-arid regions represents a challenge since it requires an accurate accounting of all components of the water cycle. In particular, evapotranspiration (ET) is of major importance, since it is responsible for returning back to the atmosphere a major part of the precipitated water. Moreover, ET is one of the main terms in the surface energy balance (SEB), so this exchange flux connects both processes, the hydrological cycle and the energy balance. The continuous drying process of the soil during the warmer seasons in semi-arid climates affects the water availability for evaporation and this has an impact on the energy and water balances. This communication will describe the evolution of both diurnal ET and nocturnal condensation/evaporation during the last drying transition season in an experimental site in Mallorca island during the year 2018. The experimental dataset will allow to relate this evolution with the other SEB components and with the vertical profiles

of temperature, humidity and wind within the first 2 meters above the surface. Finally, the determination of ET through the Eddy Covariance technique will be compared against its estimation by means of the Monin-Obukhov Similarity Theory (MOST) and the Maximum Entropy Production (MEP) model.

10:15-10:45 : *Coffee break*

10:45-11:00: Soil-Vegetation-Atmosphere Exchange Analysis during a Convective Summer Storm over the Túria River Basin (Eastern Spain) using the WRF Model

P. Benetó-Vallés and **J. L. Palau**
Fundación CEAM, Paterna, Valencia, Spain

The eastern coast of the Iberian Peninsula is characterized for the occurrence of short-lived and localized convective and orographically aided storms that can generate heavy rainfall during late spring and summer. The formation, development and triggering of the commonly-know as summer storms is connected to sea-breeze entrance and instability at upper levels of the troposphere, and it still remains a challenge for forecasters. Hence, this research intends to enhance the weather prediction of this particular events by providing a deeper comprehension of soil and vegetation effects in the generation, development and triggering of summer storms under Mediterranean conditions. In 2015, seven convective precipitation episodes were identify within the Túria River Basin (eastern Spain) during the period May-October. One of the most significant rain events occurred between the 18th and 22nd of July with a maximum precipitation accumulated of 41mm in less than three hours. This particular episode is studied using the Weather Research and Forecasting (WRF) mesoscale model with two different parameterizations of the soil-vegetation-atmosphere (SVA) exchanges: Pleim-Xiu and Noah-MP. Specifically, simulations with two domains of 1.14km (Valencia region) and 380m (Túria River Basin) horizontal resolutions, respectively, and 54 vertical levels are set to conduct this investigation. In this study, a detailed analysis of the SVA energetic exchanges before, during and after the convective precipitation episode is carried out in order to quantify the role that vegetation plays in the formation, development and triggering of summer storms, as well as to perform a comparison between the two WRF configurations. In particular, the mixing diagram approach has been used to disaggregate mean heat and moisture fluxes within the Planetary Boundary Layer (PBL) into three components (evaporation, advection and entrainment) along sea-breeze trajectories. Preliminary results show contributions of about 0.12 g/kg·km2 over pine areas for both Pleim-Xiu and Noah-MP LSMs before rainfall. ACKNOWLEDGEMENTS The CEAM Foundation is supported by the Generalitat Valenciana (Spain). This study is partially funded by the Spanish Ministry of Science and Technology, through the research project "VERSUS" - CGL2015-67466-R and by the Conselleria de Cultura (Generalitat Valenciana, SPAIN) research project "DESESTRES"– PROMETEOII/2014/038

11:00-11:15: Soil-atmosphere interactions in the Western Mediterranean: implications for local-to-regional extreme events and central European heat and drought.

S. Khodayar
University of Valencia/Karlsruhe Institute of Technology, Valencia, Valencia, Spain

As a result of global warming, the type, frequency and intensity of extreme events are expected to rise. Changes in some types of extreme events have already been observed, for example, increases in the frequency and intensity of heat waves and heavy precipitation events. These changes will be more drastic in certain areas of the globe. The Mediterranean region has been identified as a "hot-spot" of the climate change both in terms of warming and drying. The capability to predict such dramatic events is still a great challenge. Despite the significant progress made in terms of climate monitoring as well as weather and extreme event forecasting during recent years, extreme events and the underlying regional mechanisms through which these phenomena develop and persist are not fully understood and model uncertainties remain. Among the remaining uncertainties, soil-atmosphere interactions, in particular, soil moisture-precipitation feedbacks have been identified as key sources of uncertainty in weather forecast and climate modelling. Soil moisture feedbacks can regulate climate change and offer the potential for seasonal climate predictability, yet their strengths and regional importance are poorly understood. In this study, results from perturbation experiments on very high-resolution convection permitting regional climate model simulations (less than 3 km; COSMO model from the German Weather Service) on time scales from days to decades are examined to assess the impact of soil conditions on extreme events in the Western Mediterranean region and its controlling impact on summer temperature in central Europe.

11:15-11:30: An advanced method based on surface renewal theory to estimate the friction velocity and the surface heat flux

F. Castellví
Universitat de Lleida, Lleida, Lleida, Spain

The earlier formulations based on surface renewal (SR) analysis for estimating the sensible (or buoyant) heat flux (H) of a surface without requiring calibration involved canopy parameters to simultaneously estimate H and the friction velocity (u_*). The latter as a consequence that, in practice (i.e., for field applications) the wind log-law and the shear-scale at the canopy top involves canopy parameters such as roughness lengths and drag coefficients. Here, a new SR-based

formulation is proposed that allows estimating u_* and subsequently H that, at most, involves the zero-plane displacement. The SR-based formulation can operate at any height above the canopy (i.e., roughness and inertial sublayers). Moreover, it allows estimating the roughness sublayer depth and the turbulent Prandtl number in the roughness sub-layer which are crucial for unified mixing-length theories. Its performance to estimate u_* and H is shown for some experiments carried out over homogeneous or sparse (orchards) canopies in a Mediterranean climate (California, USA).

11:30-11:45: Modeling the impact of irrigation in the Ebro basin using the Meso-NH mesoscale model (preliminary study)

P. Le Moigne, **A. Boone** and **S. Donier**
Meteo-France/CNRS, Tulouse, France

One of the greatest challenges in environmental science is to understand and predict potential future changes in the water cycle and the impact on water resources. Climate projections predict that the Mediterranean region will be a hotspot of change with both warmer and dryer conditions. Irrigation has increased substantially and modified the landscape in this region due to limited water resources. The objective of the current research is to improve our understanding of the modeling of the impact of irrigation on the regional scale water balance of a highly anthropized region of the Mediterranean located in the Ebro basin in North East Spain. This study will contribute to the preparations of the observation strategy of the LIAISE Special Observing Period (SOP) as part of the international HyMeX project. In the current study, we intend to model the effects of irrigation, using the existing irrigation module of SURFEX coupled to Meso-NH mesoscale model in order to assess its potential impact on the boundary layer development and surface fluxes. Two experiments with and without irrigation will be considered and compared. This is a preliminary study that will drive our research within the LIAISE project on the impact of anthropization at mesoscale on cloud formation, PBL development and surface-atmosphere interactions.

Session 6: Extreme Events, from improved weather forecasts to better projections in a context of accelerated climate change

Chairs: *Romualdo Romero, Jordi Mazón and Elçin Tan*

11:45-12:15: About tropical-like cyclones in the Mediterranean: the Ionian Sea case of 28-29 September 2018

[1]**A. Jansà**, [2]**J. Campins**, [1]**D. S. Carrió**, [1]**V. Homar**, [2]**M. A. Picornell** and [1]**R. Romero**
[1]University of the Balearic Islands (UIB), Palma, Balearic islands, Spain
[2]Spanish State Meteorological Agency (AEMET), Palma, Balearic islands, Spain

A brief review about the concept and definition of tropical-like cyclones in the Mediterranean (or medicanes) is presented in this paper, as well as some details related to the observation and prediction of the Ionian Sea case of 28-29 September 2018. This case was quite well predicted by the European Centre deterministic model, although the EPS indicated poor predictability only a few days in advance. The case is clearly baroclinic at the beginning of the cyclone development and the initial satellite images are indicative of deep cyclone, but not the typical shape of a medicane or a genuine tropical cyclone. The contrary occurs with the satellite images during the last phase, when the cyclone is going to touch land in Greece. The traces of the passage of cyclone by the airport of Kalamata (Greece) (sea level pressure and wind) is closely similar to the land registrations of other and clear medicanes.

12:15-12:30: The October 9th 2018 flash flood in Mallorca. A preliminary study

[1]**C. Ramis**, [1]**V. Homar**, [1]**R. Romero**, [1]**A. Jansà** and [2]**J. Campins**
[1]Universitat de les Illes Balears, Palma, Illes balears, Spain
[2]Delegación de Baleares de AEMET, Palma, Illes balears, Spain

On 9th October 2018 an episode of very heavy rain affected the northeastern part of Mallorca island. Total precipitation in excess of 200 mm in a few hours was recorded at several locations. Such accumulations, presumably favored by the orography of the region, resulted in severe flash flood at several locations which most severely hit the village of Sant LLorenç des Cardassar. Damage on properties was very important and unfortunately 13 people were also killed. An analysis of the recorded precipitations based on raingauge data, radar based estimations of rainfall intensities and evolution of the event according to satellite images is presented. The meteorological situation is analyzed using information from GFS and ECMWF models. The interaction between low and upper level circulations is considered. The predictability of the event is discussed based on various mesoscale numerical simulations.

12:30-12:45: Extreme precipitation affecting eastern Iberia induced by unusual atmospheric-river-like structure coming from Africa

[1]**R. Lorente-Plazas**, [1]**J. P. Montávez**, [2]**A. M. Ramos**, [1]**A. Halifa-Marín** and [2]**R. M. Trigo**
[1]Universidad de Murcia, Murcia, Murcia, Spain
[2]Instituto Dom Luiz, Universidade de Lisboa, Lisboa, Portugal

Long filaments of integrated water vapor (IVT) over the oceans, coined by some scientists as atmospheric rivers (ARs), are widely assessed due to its relevance in the water cycle that, in some cases, are consequence of the most devastated flooding. In this work, we inspect

if similar structures can be found over the seas, focusing on the western Mediterranean. The methodology used here to detect these AR-like structures is based on ARs detection but imposing a strong IVT eastern component. The ERA-Interim global reanalysis and Spain02 gridded observational dataset are used during the period 1980-2017 to analyze composites of synoptic characteristics and impacts on rainfall. Results show that AR-like structures over the Mediterranean are scarce (approximately one per year) but they are associated to extreme orographic precipitation. Strong values of IVT are consequence of both an increase of horizontal winds and water vapor, coming form Africa in some cases. They are not associated to the pre-cold-frontal low-level jet as most of typical ARs, but they could be associated to post-cold front. Compared against global AR databases, 50% of ARs over the Mediterranean are coincident with typical ARs and, during all the events there are ARs over northern Africa. Although, the three years with maximum frequency of these events were during el Niño, there is not a clear relationship with this climatological mode of variability. But an increase of IVT over the Mediterranean has been found during la Niña.

12:45-13:00: An approach to forecast large hailstone

J. L. Sanchez, **J. L. Marcos**, **P. Melcón**, **A. Merino** and **E. Garcia-Ortega**
GFA, IMA, University of León, Leon, Leon, España

Since 1997, the Atmospheric Physics Group of the University of León (GFAUle) has been developing some studies on severe weather in the Middle Ebro Valley (MEV), in the northeast of Spain, with special emphasis on those events that carry associated hail precipitation. Different meteorological instrumentation was deployed on the area and as well as others facilities were used. Among them, we point out two hailpad networks placed in Zaragoza and Lleida provinces. These networks allow to detect and know the characteristics of "ground truth" of hailstones precipitated. The GFA has the technology and experience to measure the hailpads and some results have been previously published, analyzing the hail spectra of Argentina, France and Spain. In this presentation, initially the attention is focused on hailstone spectra and in particular on large and very large hailstone. Data sets analyzed contains 339 hail days in which 2497 hailpads were impacted by stones. The first step has been to determine the hail spectra. A bimodal distribution - both exponentials- had been detected in both networks. The discontinuity point has been named breakpoint. Therefore, the growth of the hailstone is different for small hailstones than for large sizes. In the second step, the main objective was to try to establish a relationship between some meteorological variables and the appearance of large hail sizes, above the breaking point. Therefore, this step was focused to advance in the knowledge of the meteorological conditions under which ""large or very large hail"" can be formed. To carry out this analysis, 71 hail days have been selected, in 27 days out of the 71 analyzed days, the hailpad maximum diameter was above the breakpoint. For each of them, the WRF simulation model was used: Making use of different statistical techniques, it has been possible to find the relationship between some meteorological variables obtained from the WRF and the maximum hail precipitated that can be expected.

13:00-14:30 : *Lunch*

14:30-14:45: Hindcast Study of Medicane Zorba by using the Hurricane WRF (HWRF) Model

E. Tan
Istanbul Technical University, Istanbul, Europe, Turkey

A Mediterranean tropical-like cyclone, called Medicane Zorba, is observed during the last days of September 2018 near Greece and Turkey. It brought heavy winds and heavy rainfall in the Southern Greece and its direction shifted to the Aegean Sea where Medicane Zorba traveled up to North losing its energy. Before its disappearance, It stayed diminished in the Northern Aegean Sea for more couple of hours because the northeasterly flow provided more moisture from Black Sea. Some parts of the Eastern Marmara Region of Turkey is flooded due to this moisture convergence zone. In this study, Medicane Zorba is going to be simulated by using the Hurricane WRF Model with several model setup. The setup includes simulations with standard WRF-ARW model and Hurricane WRF Model. Moreover, the nested domain approach will also be tested by using both stationary nested domains and moving nested domains. The results of wind and moisture fields and precipitation amounts are going to be compared with observations.

14:45-15:00: The lightning JUMP, an operational tool to forecast severe weather in catalonia, and the campaing pick up the stone.

C. Farnell Barque and **T. Rigo Ribas**
Servei Meteorològic de Catalunya, Barcelona, Barcelona, Catalunya

Farnell et al. (2017) and (2018) showed the high relationship between the triggering of a warning of the Lightning Jump (LJ) algorithm and the occurrence of severe weather (large hail, strong wind gusts, downbursts, and/or tornadoes). Those works indicate that more than 80% of the alerts were associated with at least one register in Catalonia (NE Iberian Peninsula). This percentage could be even larger because the lack of observations in some events occurred in low-density population areas or at night. The algorithm had been put in operative in the Meteorological Service of Catalonia (SMC) in 2016, considering exclusively lightning data. The LJ warnings have two levels: the

lower one is commonly associated with heavy rainfall and small hail, but can be used as an early precursor of the severe weather occurrence. On the other side, the higher one has a larger degree of correlation with the severe weather, mainly large hail. This higher level alerts will be used in an early future to warn population of severe weather. In order to collect surface registers that improve the information associated with the phenomena occurred in severe thunderstorms, on 2017 we started a citizen campaign (called "Plega la pedra", translated as "Catch the hail") using social networks (mainly, twitter -#meteocatpedra- and a whatsapp line). Thanks to the high contribution of the citizen campaign, the number of registers have been larger than the normal in similar situations for previous years. This presentation shows the main characteristics related to lightning jump algorithm, how it is working operationally in SMC, and, finally, the campaign results recorded during last year, 2018, which allows us to validate the alert considering some characteristics like lead time, spatial distance between the alerts and observations, skills scores, and among others.

15:00-15:15: Bred Vectors based tailored perturbations: application to mesoscale ensemble prediction system over the Western Mediterranean

A. Hermoso and **V. Homar**
Universitat de les Illes Balears, Palma, Illes balears, Spain

The absence of complete knowledge of the initial state of the atmosphere and the imperfect modelling of some physical processes make numerical weather forecasts inherently uncertain. The adequate theoretical framework to model uncertain physical systems is probability theory and the state of the system is described by means of a probability density function (PDF). For real applications, only a discrete sample of the PDF can be considered and thus choosing a sampling strategy is a key question for ensemble prediction systems (EPS). Moreover, underdispersion is a common deficiency of EPS forecasts, specially jeopardizing its value when forecasting extreme phenomena. A popular analysis PDF sampling technique is the Breeding Method, which uses the full nonlinear dynamics of the system to identify fast-growing modes in the analysis fields. Traditional bred vectors developed at the National Centers for Environmental Prediction are obtained from the difference between a control run and a previously perturbed run rescaled at regular time intervals with an Euclidean norm (e.g. fixed RMS amplitude). Nevertheless, these arithmetic bred vectors have been recently challenged by logarithmic bred vectors, which use a geometrical norm, more coherent with the average exponential growth of perturbations in atmospheric models. In this work, we explore the potential of the logarithmic bred vectors for a mesoscale EPS covering the Western Mediterranean region and propose a new technique EPS generation technique which makes use of bred-based tailored perturbations. The proposed technique possesses the persuading potential of allowing full control on ensemble spread and seamless scale representation of uncertainties in high resolution EPS.

15:15-15:30: Experiences in using conditional probability in short-range fog forecasting at Zagreb Airport

M. Zoldoš and **J. Jurković**
Croatia Control Ltd., Velika gorica, Zagreb, Croatia

Long-lasting fog events at major airports can cause significant delays. Therefore, studies of fog are important for aviation meteorology. During the last cold season a simple statistical model for probabilistic short-range visibility forecasting was put into use at the operational weather forecasting service in the Croatian Air Navigation Service. The model was originally proposed as a reference method for forecast verification, but in addition to that, it can serve as a helpful tool for low visibility forecasting. The data used in the model consists of half-hourly METAR reports spanning the period from 1994 to 2017. A first-order autocorrelation process is the theoretical foundation of the model, which combines climatology and persistence (CLIPER). From that, a simple forecast equation for a given variable can be defined. It links the correlation between values of the variable at different time steps with conditional probability for onset of pre-defined values. Hourly correlation coefficients, which describe the climatological persistence, are calculated for each month. These are then used to forecast visibility for each successive hour, 9 hours in advance. In addition to the median forecast, 50 % and 80 % confidence intervals are calculated as well. The forecast by percentile, which is more suitable for very rare events, is also provided for comparison. This conditional probability model was presented to forecasters at a 3-day seminar held in September 2017. After additional brief training with each forecaster, its use began in October. In February a short formative assessment was made, with the goal of determining how this new knowledge is being applied. Results of the assessment show that forecasters are able to accurately use conditional probability and related knowledge in fog forecasting. There are some minor issues that can be corrected, but in general, conditional probability theory can be successfully applied in short-range fog forecasting.

15:30-16:30 : *Coffee break and Poster Sessions 5 & 6*

16:30-16:45: Numerical analysis of an exceptional meteotsunami event in the Adriatic

[1]**K. Horvath**, [2]**J. Šepić** and [3]**M. Telišman Prtenjak**
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Meteotsunamis are long sea surface waves caused by propagating weakly dissipative atmospheric pressure perturbations formed by ducted internal atmospheric gravity waves and/or convection. Several high-amplitude meteotsunamis occurred in the northern Mediterranean countries during a major meteotsunami period from 23-27 June 2014. The largest sea level oscillations were recorded in Vela Luka Bay, Croatia, in the morning of 25 June 2014, where the amplitude of sea level oscillations reached 3 m. Sea level oscillations reaching more than 1 m were recorded also at Balearic Islands (Spain), Sicily (Italy), and Odessa (Ukraine). The large-scale setting during the meteotsunami period was characterized by an incoming upper-level trough as well as the upper-level jet aloft and warm low-level advection from the African continent. The numerical analysis of the event was carried out using the Weather and Research Forecasting (WRF) mesoscale non-hydrostatic model. The model was configured with four telescoping domains reaching 0.5 km grid spacing over the Adriatic. The model represents well environmental conditions during the meteotsunami period. The dynamically unstable mid-troposphere with Richardson number smaller than 0.25 capped the warm statically stable air in the lower troposphere. These environmental conditions were favorable for sustaining the internal gravity wave packet, as lower layer was statically stable and of sufficient depth. Around the time pressure perturbations affected the area, pressure distribution was affected by both convection and internal gravity waves, with both wave-CISK and wave-duct promoting maintenance of pressure perturbations. This makes the 2014 Adriatic event the first known meteotsunami event in the Mediterranean during which both of these maintenance mechanisms acted jointly. Finally, simulations performed in this event represented meteotsunami-related pressure perturbations at the adequate time and approximate location, which is a step forward in the ability of atmospheric models to assist early warning meteotsunami systems for the Mediterranean and the Black Seas.

16:45-17:00: Study of a tornadic supercell in Southern Italy

[1]**V. Mazzarella**, [2]**V. Capozzi**, [1]**I. Maiello**, [2]**Y. Cotroneo**, [3]**R. Ferretti**, [4]**M. M. Miglietta** and [2]**G. Budillon**

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"On 12 March 2018, an EF2 tornado hit the plain of Caserta over Southern Italy, causing relevant damages to houses, cars, infrastructures plus eight injuries. This work aims to provide a description of the evolution of a tornadic supercell through the reflectivity measurements acquired by an X-band single polarization weather radar operating in Naples metropolitan area and the analysis of the tornadogenetic environment using the Weather Research and Forecasting (WRF) model. The reflectivity volumes show the first signature of a convective cell at 16:30 UTC, near the Ausoni-Aurunci Mountains, close to Tyrrhenian coast (Gulf of Gaeta). Then, the convective system moved south-easterly with an estimated average translation velocity of 13 m/s. The analysis of reflectivity at low level proves that the transition of the convective cell in a supercell occurred from 17:40 UTC: more specifically, a clear Forward Flank Notch (FFN) signature appeared at 17:50 UTC, pointing out a strong updraft which caused a deflection of upper level winds around the core of the storm. The supercell approached the neighbourhood of Caserta at 18:00 UTC, when it showed a classic ""hook-echo"" signature. The Range Height Indicator (RHI) scan reveals that the supercell had two distinct downdrafts, the Forward-Flank Downdraft (FFD), which is located in the leading part of the supercell, and the Rear-Flank Downdraft (RFD). The presence of the mesocyclone was also associated with a bounded weak echo region (BWER), a vertical channel of weak radar echo, related to a very strong updraft. To the aim of better analyse the dynamics and thermodynamics of this event, several numerical simulations are performed with WRF Version 4.0 at 1 km horizontal resolution over Campania region. The new hybrid vertical coordinates that are terrain following near the surface and became isobaric at higher levels are used for this study. Preliminary results show a significant wind shear at low levels, a maximum Updraft Helicity (UH) greater than 100 m2 sâĹŠ2 and a tongue of air with high equivalent potential temperature moving inland from the sea. These factors may have determined a favourable environment for the supercell and tornado development."

17:15-17:45 : *Awards and Closing Session*

End of conference

List of posters

Session 1: Climatology

16:45-17:00: Synoptic features of Cold-Air Pool episodes in Cerdanya

[1]**J. R. Miró**, [1]**J. C. Peña**, [2]**N. Pepin**, [1]**A. Sairouni** and [3]**M. Aran**

[1]Servei Meteorològic de Catalunya, Barcelona, Catalonia, Spain
[2]University of Portsmouth, Portsmouth, United kingdom
[3]Servei Meteorològic de Catalunya, Barceloa, Catalonia, Spain

The Cerdanya basin experiences intense Cold-Air Pool (CAP) episodes especially in winter where the synoptic circulation plays an important role apart of the local circulations. In order to study the interaction between synoptic an local scales, a network of 40 temperature sensors was deployed from 2012 to 2015 along seven elevational transects. The data collected was hourly temperature and humidity measurements, enabling the characterization of CAP behaviour using different statistical tools. First of all, Empirical Orthogonal Functions (EOFs) of minimum temperature anomalies were examined to study the spatial distribution and the temporal variation of CAP events, obtaining zones and days prone to CAP and no-CAP. A further synoptic analysis, using Principal Component Analysis (factorization), cluster analysis (classification) and a Discriminant Analysis (reclassification). As expected, results showed CAP days are associated with high pressure and light winds, but also with south wind in front of a frontal passage. Whilst no-CAP days were associated with surface northerly flows behind frontal passage.

16:45-17:00: Evaluation of large-scale atmospheric teleconnection in the CMIP5 general circulation models

[1]**J. Bartholy**, [2]**E. Kristof** and [2]**R. Pongracz**
[1]Eotvos Lorand University, Budapest, Hungary
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Teleconnection patterns - oscillation phenomena in other words - are identified as the patterns of large-scale atmospheric fluctuation. These can be considered as areas over which atmospheric variables (e.g. air pressure, geopotential height) show a statistically significant relationship with each other. Various atmospheric teleconnection patterns were recognized in the 20th century. For example, the North Atlantic Oscillation (NAO) and the Mediterranean Oscillation (MO) were identified over the North Atlantic/European region both affecting the climatic conditions in the Mediterranean region. Because teleconnection patterns represent significant portions of the atmospheric variability, multivariate statistical methods, such as the computation of empirical cross-correlations and empirical orthogonal functions (EOF analysis) can be applied to detect their signs in the fields of atmospheric variables. We started to determine the locations of the above-mentioned teleconnection patterns the basis of the European Centre for Medium-Range Weather Forecasts' (ECMWF) ERA-20C reanalysis datasets. Then, simulations of general circulation models (GCMs) from the Coupled Model Intercomparison Project Phase 5 (CMIP5) are compared to the ERA-20C by using various model metrics.

16:45-17:00: The Cerdanya Cold Pool programme (CCP1x): an integrated study on cold-air pooling and drainage flows in the largest Pyrenean valley

[1]**D. Martinez-Villagrasa**, [1]**J. Cuxart**, [1]**G. Simó**, [1]**M. A. Jiménez**, [1]**B. Martí**, [2]**J. R. Miró**, [3]**L. Conangla**, [4]**B. Wrenger**, [5]**A. Paci** and [1]**R. Picos**
[1]University of the Balearic Islands, Palma, Balearic islands, Spain
[2]Meteorological Service of Catalonia, Barcelona, Catalonia, Spain
[3]Polytechnic University of Catalonia, Applied Physics, Manresa, , Catalonia, spain
[4]University of Applied Sciences, Hochschule Ostwestfalen-Lippe, Ostwestfalen-lippe, Germany
[5]Centre National de Recherches Météorologiques (METEO-FRANCE and CNRS), Toulouse, France

Official records from La Cerdanya valley (western Pyrenees, Catalonia) traditionally provide temperatures noticeably lower than the surrounding areas under anti-cyclonic weather conditions. The valley is a graben 35 km long and 9 km wide located at 1000 m above sea level (asl), bounded to the north by the main axis of the Pyrenees (peaks above 2900 m asl) and by the Cadí mountain range to the south (maximum high 2649 m asl). This topographical configuration leads to the development of strong cold-air pooling which is responsible for such low temperatures at night. A detailed programme to study the thermal structure and wind circulation of the air within La Cerdanya valley under fair-weather conditions has been developed in the last years to understand the behaviour of such observed extreme values. The Cerdanya Cold Pool programme (CCP1x) was initiated with a statistical study of a four-year long period of data from several meteorological stations operating around the area. This analysis allowed to identify the occurrence of the phenomena (almost 60% of the nights experienced the formation of a cold-air pool) and to select a representative case for a deeper study combining meteorological data, satellite information and a high-resolution mesoscale simulation. The numerical results for this three-day long selected case (CCP11) showed that radiative processes, together with turbulence in the lowest layers, dominate the evolution of the cold pool, while drainage flows developed over valley sidewalls and from the main tributary valleys carry cold air to the already settled pool. This previous study allowed to design a series of field campaigns that took place during autumn 2015 (CCP15) and winter 2017 (CCP17) seasons, in collaboration with several international institutions. This communication will provide an overview of the field campaigns and summarize the recent research results.

16:45-17:00: SST CEAMed: Mediterranean sea surface temperature web portal

F. Pastor, **J. Valiente** and **J. L. Palau**
Fundación CEAM, Paterna, Valencia, Spain

The analysis of sea surface temperature in the Mediterranean and its relationship with torrential rains in the Valencia region has been a main study field for the Meteorology department of CEAM. In this frame-

work, SST satellite data have been used to build a climatology for SST and for analysing its trends. A positive/warming trend has been found for the last 30 years in the Mediterranean. SST plays an important role in the intensification of torrential rain events in the Mediterranean area, so its trend can also influence trend for such rain events. Hence, it is worth monitoring SST as a potential forecast parameter but also as a climate change indicator. With this purpose in mind, a web portal has been implemented to monitor Mediterranean SST (http://www.ceam.es/SST). From different satellite data sources a range of products are continually updated, from daily maps to regularly updated climatologies and trend analysis.

16:45-17:00: An R package for computing a synoptic classification and spatial regionalization of precipitation data

M. Lemus Canovas, **J. Lopez Bustins** and **J. Martin Vide**
Climatology Group. University of Barcelona., Barcelona, Catalonia, Spain

Knowledge of spatial precipitation amounts associated with the most frequent circulation types during the year or during a specific period is essential with regard to developing strategies aimed at addressing avalanche risk, floods or any other hydrological hazard. Here we present an Open Source R package called synoptReg that combines these two approaches mentioned above to derive a precipitation regionalization. The synoptReg package contains a set of functions used (1) to perform a PCA-based synoptic classification using an atmospheric variable; (2) to create maps showing the spatial distribution of the precipitation amounts based on the weather types of the synoptic classification; and (3) to develop a spatial precipitation regionalization based on the previous maps. We illustrate the functions of the package for the Balearic Islands (Spain). We conclude reporting the potential improvements of the package.

Session 2: Processes and applications

16:45-17:00: African dust impact at two heights (2500 and 650 m asl) in SE Spain

[1]**P. J. Gómez Cascales**, [2]**L. Tositi**, [3]**A. Milena Pérez**, [3]**V. M. Expósito Suárez** and [3]**F. Piñero García**
[1]Universidad Miguel Hernández de Elche, Elche, Alicante, EspaÑa
[2]Universidad de Bolonia, Bolonia, Emilia-romaÑa, Italia
[3]Universidad de Granada, Granada, AndalucÍa, EspaÑa

The simultaneous aerosol sampling at two heights in southern Spain may provide valuable information on the vertical structure of the dust transport from North Africa to the Iberian Peninsula. It also allows the characterization of the ambient air at two sites with distinct anthropogenic influence. We present the results obtained from the first field campaign of the FRESA project (Impact of dust-laden African air masses and of stratospheric air masses in the Iberian Peninsula. Role of the Atlas Mountains), carried out in the period July-November 2017 at El Albergue Universitario in Sierra Nevada (2550 m asl) and the Faculty of Sciences of the University of Granada (650 m asl). The two sites were instrumented with (1) low-volume sampler with PM10 inlet for daily sampling and mass and chemical composition characterization, (2) high volume sampler for total suspended particles (TSP) for weekly sampling and radionuclide activity determination, and (3) a GRIMM 365 optical particle counter that provides continuously the aerosol size distribution. In Sierra Nevada, daily PM10 concentrations ranged from 0 to 104 ug/m3 depending mainly on the origin of the air masses reaching the site. Over a total of 124 sampling days, levels surpassed 50 ug/m3 on 5 days and were lower than 20 ug/m3 on 90 days. The impact of dust-laden African airflows at this elevated site is particularly intense as dust is transported in most cases into well-defined low mid-tropospheric layers. Clean Atlantic airflows, and particularly those associated to the polar front jet, strongly reduced concentrations. In Granada, daily PM10 levels are moderately high with values generally between 20 and 40 ug/m3 and mostly below 20 ug/m3 after the first snowfalls in Sierra Nevada. Only on 2 days levels surpassed 50 ug/m3. A detailed back-trajectory analysis shows that large-scale airflows reaching the two sites are quite often decoupled.

16:45-17:00: Extreme temperature warning system in the Valencia region (Spain)

F. Pastor, **J. Valiente**, **E. Mantilla** and **J. L. Palau**
Fundación CEAM, Paterna, Valencia, Spain

Since 2006 an early heat wave forecasting system is running in a joint effort from CEAM meteorology department and the Valencian health authorities in Spain. Through the years the early forecasting system evolved to a more complex one by establishing a regional thermoclimatic areal division. From the analysis of maximum and minimum temperature historical data a set of thermally homogeneous, both in terms of absolute values and annual cycle, areas were identified across the Valencia region. Grouping temperature data, both maximum and minimum, for each of those areas a set of thresholds have been identified for each thermoclimatic area that trigger the different warning levels. This work shows a description of the warning system, based on the operational running of a meteorological model for temperature forecasting, and performance statistics for the last 10 years.

16:45-17:00: Exit jet in a narrow Pyrenean valley: the Aure valley 2018 field experiment

[1]**A. Paci**, [2]**M. A. Jiménez**, [2]**J. Cuxart**, [3]**M. Lothon**, [2]**D. Martinez-Villagrasa**, [3]**C. Roman-Cascon**, [1]**G. André**, [1]**P. Aressy**, [1]**J. Barrié**, [3]**Y.**

Bezombes, [1]**G. Bouhours**, [1]**A. Dabas**, [3]**S. Derrien**, [3]**C. Dione**, [1]**J. M. Donier**, [1]**T. Douffet**, [3]**J. B. Estrampes**, [1]**O. Garrouste**, [3]**F. Lohou**, [1]**W. Maurel**, [1]**E. Moulin**, [3]**A. Philibert**, [3]**H. Raynal**, [1]**T. Rieutord**, [1]**A. Roy** and [1]**V. Unger**

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[2]Universitat de les Illes Balears
[3]Laboratoire d'Aérologie, University of Toulouse, CNRS, Tolouse, Occitaine, France

A field experiment took place from July to October 2018 in a narrow valley of the central Pyrenees in order to study local flows and their impacts. This field experiment is a joint effort by CNRM, Laboratoire d'Aerologie and University of the Balearic Islands. It takes its roots from a previous numerical study done by the University of the Balearic Islands (see companion paper by M.A. Jimenez et al.). This previous study suggests that under clear-sky conditions a jet forms in the valley and can be observed several kilometers away from the valley exit. Several instruments including a Doppler scanning lidar and three meteorological stations were deployed on the main site at the valley exit, where the jet maximum is expected, and on two other sites up valley. Data from the Atmospheric Research Center (CRA) in Lannemezan are also used. They include radio-soundings specifically planned for the field experiment. This instrumented platform of Laboratoire d'Aerologie, located about 10 km away from the valley exit, is an important asset for the project. An overview of the field experiment, the instruments and the meteorological situations observed will be presented first. Then some preliminary results regarding in particular the different types of jet observed will be shown.

16:45-17:00: Potential contribution of distant sources to the Betula pollen transport over Catalonia

[1]**M. Alarcón**, [2]**C. Periago**, [2]**H. T. Majeed** and [3]**J. Belmonte**

[1]Universitat Politècnica de Catalunya, Barcelona, Barcelona, Spain
[2]Universitat Politècnica de Catalunya, Barcelona, Catalunya, Spain
[3]Universitat Autònoma de Barcelona, Barcelona, Catalunya, Spain

Betula pollen is one of the most important causes of respiratory allergy in Northern and Central Europe. Birch trees are abundant in Central, North and East of Europe, but are scarce in the Mediterranean territories, especially in the Iberian Peninsula (IP) where they only grow in the northern regions and in urban areas when used as ornamental. In Catalonia, the allergy to birch is not frequent, but it occurs and the intensity of the derived health problems can be increased by distant transport outbreaks. The airborne birch pollen patterns in Catalonia show abrupt high concentrations in areas with usually low local influence. In previous works, France and Central Europe have been established as potential source areas of Betula pollen that arrives to NE IP. Moreover, the effect of the orographic barrier of the Pyrenees has also been evaluated in the Betula pollen long-range transport (LRT). Nevertheless, up to now, the differentiated potential contribution of the two main sources, Pyrenees and Central Europe, over Catalonia has not been evaluated. We have computed here the back-trajectories associated to the air masses leading to the main pollen peaks produced simultaneously at different Catalan monitoring stations and studied their provenance. The Vielha aerobiological station located in the Pyrenees has been used to identify the dates of pollination in the Pyrenees region and the pollen peaks have been classified in two groups, depending on its simultaneity with this pollination. This has allowed the quantification of the potential contribution of the regional pollen transport from Pyrenees and the LRT from Central Europe. For the 10-year period considered here (2005-2014), near 58% of the collected pollen corresponded to transport from distant sources. From this, about 20% corresponded to regional transport from Pyrenees and 38 % to LRT, mainly from France and Central Europe.

16:45-17:00: Analysis of particulate matter levels and temperature extreme events in the summer time: a study case

[1]**L. Casaletto**, [1]**M. Ragosta**, [1]**V. Telesca** and [2]**G. A. Giorgio**

[1]University of Basilicata, Potenza, Basilicate, Italia
[2]University of Basilicata, Pisticci, Basilicate, Italia

Climate change may affect human through a series of dynamic (increased frequency and intensity of heat waves, cold-related mortality and heat-related mortality, increased floods and droughts, changes in the distribution of vector-borne diseases and effects on the risk of devastating weather events). These extreme weather events, in increasing in recent years, can strongly affect surface air quality, which has become a major environmental factor to affect human health. In fact, meteorological conditions play a crucial role in ambient air pollution by affecting both directly and indirectly the emissions, transport, formation, and deposition of air pollutants. In the recent years, many works studied the relationships among various weather processes and air pollutants. The majority of studies analyze these correlations with bioclimatic indices, that combine air temperature, relative humidity and wind speed and are very important to determine the human thermal comfort. In order to improve the knowledge of excessive heat impact on public health, the understanding of relation between air pollution events and extreme weather events is a fundamental step. This study investigates particulate matter levels and temperature extreme events measured in different monitoring sites of Emilia Romagna region, Northern Italy, during the summer time (June-August) from 2015 to 2017. For 15 selected stations hot days (HDs) and heat waves (HWs) were identified respect to the base period CLINOs (Climatological Normals), the

daily average values of meteorological elements for a 30-year period (1971-2000). Moreover, for these sites, patterns of PM10 and PM2.5 daily concentrations were taken into account. PM trends and patterns of extreme events occurrence were analyzed for detecting a possible link between the persistence of maximum temperatures and particulate matter concentrations in atmosphere.

16:45-17:00: Influence of a valley exit jet on the nocturnal atmospheric boundary-layer at the foothills of the Pyrenees

[1]**M. A. Jiménez**, [1]**D. Martinez-Villagrasa**, [1]**J. Cuxart**, [2]**A. Paci** and [3]**M. Lothon**
[1]Universitat de les Illes Balears, Palma, Illes balears, Spain
[2]Meteo France, Toulouse, France
[3]Laboratoire d'Aerologie, Lannemezan, France

To study the evolution of the nocturnal atmospheric boundary layer in a nearly flat region at the foothills of a major mountain range, observations at the foothills of the Pyrenees during the Boundary-Layer Late Afternoon and Sunset Turbulence (BLLAST) experimental field campaign are taken together with high-resolution mesoscale simulations. The main site of the BLLAST campaign is Lannemezan, located on a nearly flat plateau at about 10 km from the exit of the Aura valley. This 40-km long valley is oriented to the north, with a width between mountain peaks of about 5 km in the middle of the valley, diminishing to 2 km at the end. Results show that under clear-sky conditions the evolution of the nocturnal boundary-layer in Lannemezan differs from what can be expected over an isolated flat terrain region due to the presence of thermally-driven winds. Locally-generated downslope winds are observed close to sunset over the plateau and as night progresses the thermal gradient between the plain and the mountains induce mountain-plain circulations. The organization of the flow in the Aura valley generates a valley exit jet close to midnight that travels through the foothills enhanced by the thermal gradient between mountain and plain already established. Once the valley exit jet propagates through the foothills, it interacts with the locally-generated circulations and decreases its speed and height. As a result, in Lannemezan a maximum of wind speed of about 5-10 m/s from the southern sector is found between 50 m and 200 m above the ground during nighttime. Results show that mesoscale winds can enhance or diminish the intensity of the valley exit jet and even advance or delay the arrival of the valley exit jet in Lannemezan. The temporal and spatial evolutions of the valley exit jet are further analyzed with observations taken during summer 2018 in the Aura valley.

16:45-17:00: Activity concentration of Be-7 and Pb-210 in aerosols at two heights (2500 and 650 m asl) in SE Spain

[1]**J. A. García Orza**, [2]**M. Ferro Garcia**, [3]**A. Camacho**, [4]**E. Brattich**, [5]**M. Hernandez-Ceballos** and [6]**C. Roman-Cascon**
[1]Universidad Miguel Hernandez de Elche, Elche, Valencia, Spain
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Be-7 and Pb-210 are natural radionuclides frequently used as tracers of aerosol particle transport and residence time in the atmosphere. Their different origin, crustal for Pb-210 and cosmogenic for Be-7, makes them well suited to study vertical exchange processes. The influence of African dust outbreaks and of stratosphere-to-troposphere (STT) transport connected with upper-level disturbances on the concentration activities of both radionuclides is studied at two heights in SE Spain: Sierra Nevada (2550 m asl) and Granada (650 m asl). We present results from the first field campaign of the FRESA project (Impact of dust-laden African air masses and of stratospheric air masses in the Iberian Peninsula. Role of the Atlas Mountains) in the period July-November 2017. The stratospheric influence at different heights has been estimated by the frequency with which air parcels cross the tropopause before reaching the study sites: when trajectories pass over a region of high potential vorticity (PV) at upper levels. Stratospheric influence has been compared with a higher latitude site, Barcelona. ERA-Interim data has been used for both trajectory calculations and PV analysis. Large-scale airflows are found to be quite decoupled at the two sites, not only residing at different heights (with much lower influence of the PBL in Sierra Nevada), but also with different origin. Weekly activity concentrations of Pb-210 were higher in Granada while the activities of Be-7 were higher at Sierra Nevada in accordance with their respective origin. High PV crossing was found at locations and heights associated to: (1) STT in high PV streamers at altitudes higher than 5 km in the vicinity of the Polar Front Jet, particularly to the north of the British Isles and 2-4 days before reaching the study area; and (2) low-levels over northwestern Africa and the Iberian Peninsula due to mountain-barrier effects and to diabatic processes.

Session 3: Remote and in-situ measurements

16:45-17:00: Multi-observations of an elevated rotor associated to a mountain wave event (The Cerdanya-2017 field experiment)

[1]**M. Udina**, [2]**S. González**, [3]**A. Paci**, [1]**J. Bech** and [1]**M. Soler**
[1]Universitat de Barcelona, Barcelona, Catalunya, Spain
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[3]Centre National de Recherches Météorologiques, METEO-FRANCE & CNRS, Toulouse, France

The 15 January 2017 a northern strong synoptic flow lead to the generation of mountain waves and large snow accumulation over the eastern Pyrenees. Measurements from several instrumentation deployed in the Cerdanya valley during The Cerdanya-2017 field campaign revealed the presence of mountain waves and the formation of an associated rotor underneath the first mountain wave crest. We use observations from the main instrumented site located at the Das aerodrome: a Doppler wind lidar (LIDAR), a Wind Radio Acoustic Sounding System (RASS), a Micro Rain Radar (MRR), a Parsivel Disdrometer, an automatic weather station (AWS) and atmospheric soundings (RS). In addition, we also explore the measurements from an ultra-high frequency wind profiler (UHF) radar located a few km to the north-west of the aerodrome site. According the satellite images and the RS profiles, mountain waves were formed, probably trapped in a thin layer and vertically propagated above. The evolution and positioning of the mountain waves are inferred given the continuous vertical velocity profiles from the UHF and a the MRR. A transient rotor is formed during the afternoon, when the mountain wave wavelength is shorter than in the morning. The rotor is disconnected from the surface flow, elevated 150 m above the ground, which is seen through the LIDAR and RASS observations. A strong turbulence zone is identified at the upper edge of the mountain wave, above the rotor, a feature observed in previous studies about rotors. The mountain wave and rotor induced circulation is favoured by the valley shape and the second ridge location, together with the weak and variable winds, established during the sunset close to the valley surface. This study is supported by projects MINECO/FEDER CGL2015-65627-C3-2-R and MINECO CGL2016-81828-REDT, the University of Barcelona Water Research Institute (IdRA) and was performed in the framework of the HyMeX program.

16:45-17:00: A method for the study of nocturnal clouds from images in the visible: implementation and validation in Girona

A. Enriquez-Alonso, **J. Calbó** and **J. González**
Universitat de Girona, Girona, Catalonia, Spain

Clouds play an important role in the global energy balance as they reflect a large fraction of shortwave radiation and at the same time absorb and emit longwave radiation. However, large uncertainties remain about the climatology and long-term trends of clouds, as well as about their response and feedbacks to the anthropogenic forcing. In this work, night-time whole-sky images in the visible range, taken with an all-sky camera (SONA from Sieltec SL) are analyzed. During the night, both the Moon (when it's present) and the artificial light coming from the ground act as sources of light that illuminate the clouds and allow to differentiate them in the images taken by the camera. An automatic image analysis method is implemented by establishing criteria in intensity and the ratio of red to blue components in each pixel, to be able to estimate the total cloud cover. In the second part of the work, this method is applied to the images taken in Girona by the SONA camera, with a temporal resolution of one minute, which generates approximately 400.000 images from June 2016 to May 2018. With this, the evolution of the nocturnal cloudiness during two years is presented. As longwave radiation highly correlates with total cloudiness, measurements from a pyrgeometer have been used to validate the estimations of nocturnal cloud cover. The use of the images to obtain an estimation of the cloud base height was also explored, by using ceilometer data as additional information.

16:45-17:00: BOU: a low-cost tethered balloon sensing system for monitoring the lower atmospheric boundary-layer

[1]**D. Mariínez-Villagrasa**, [1]**B. Martí**, [1]**A. López-Grifol**, [1]**G. Simó**, [2]**B. Wrenger**, [2]**J. Dünnermann**, [1]**R. Picos** and [1]**J. Cuxart**
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[2]University of Applied Sciences Ostwestfalen-Lippe, Germany

The study of nocturnal thermal inversions and thermally-driven flows often requires the observation of vertical profiles of the main meteorological variables for the first 500 m. Typically, these needs are covered with the use of captive balloons but the commercial version of such instrumental platforms are scarce and expensive. Recent advancements in electronics allow for low-cost alternatives like the device that we present in this communication: BOU (tethered Balloon sonde OWL-UIB). This system has been developed in the last years in a joined effort between the Universities of Applied Sciences of Ostwestfalen-Lippe (OWL) and of Balearic Islands (UIB). It has been configured to sample temperature, humidity, air pressure and wind speed at 1 second, although the system is easily reconfigurable, and more sensors can be added. The sonde is able to operate up to 1000 m and a polymer battery allow the device to work autonomously for more than 6 hours. This device has been successfully used in different campaigns, showing its potential for monitoring the lower atmospheric boundary layer (ABL) over complex terrain. In this poster, we will present details on the sensor package, data acquisition system and hardware aspects. Comparison with a ground-based remote sensing instrument and with an automatic weather station have shown that all measurements have a good accuracy at night. During daylight operation, improvements in the design of the radiation shield shall be implemented to prevent the effect of solar heating on the temperature and humidity records.

16:45-17:00: First results of the Meteorological field Interpolation based on Clustered Analysis (MICA)

[1]**E. Casellas**, [2]**R. Veciana**, [2]**A. Sairouni**, [2]**N. Pineda** and [3]**J. Bech**
[1]University of Barcelona, Barcelona, Catalonia, Spain

[2]Meteorological Service of Catalonia
[3]University of Barcelona

Two of the most common spatial interpolation techniques are kriging and least squares linear regression. The first one is based not only on the distance between the observations but also on how they are spatially distributed. The second one is based on how the observations variation can be explained by other variables. Both can be implemented separately or in a complementary way (first regression and then residues kriging) which usually yields better results for meteorological variables (Szymanowski and Kryza, 2012). The current operational real-time spatial interpolation of air and dew point temperature methodology in the Meteorological Service of Catalonia (SMC) is based on a Multiple Linear Regression (MLR) using all stations available in the automatic weather station network. Then, a residues correction accounts for local effects. The main objective of this study is to improve the current methodology considering MLRs for different groups of stations (clusters) rather than considering a unique MLR, similarly to previous study of Joly et al. (2011). This is the origin of MICA, the Meteorological field Interpolation based on Clustered Analysis. The philosophy of MICA is grouping weather stations not in a fixed number of clusters but in a range of them. The assumption here is that there is not a number of clusters that always perform better than other. For this reason, every time an interpolation is conducted, several numbers of clusters are considered. The number of clusters that performs the best will be selected for that specific moment. Performance is evaluated in terms of Root Mean Square Error (RMSE). Preliminary results for air and dew point temperature for 2017 show that there is a relative and notable improvement of RMSE, respectively, and reduction of high error cases. In addition, three different residues interpolation techniques (3D, Inverse of the Distance Weighted and Kriging) were evaluated. REFERENCES Joly, D., Brossard, T., Cardot, H., Cavailhes, J., Hilal, M., & Wavresky, P. (2011). Temperature interpolation based on local information: the example of France. International Journal of Climatology, 31(14), 2141-2153. Szymanowski, M., & Kryza, M. (2012). Local regression models for spatial interpolation of urban heat istalnd-an example from Wroclaw, SW Poland. Theroetical and applied climatology, 108(1-2), 53-71.

16:45-17:00: The ALEX17 field experiment: characterizing the flow over complex terrain for wind energy research

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The ALaiz EXperiment 2017-18 (ALEX17) is part of the series of field campaigns designed to validate the new wind atlas covering Europe and Turkey in the framework of the New European Wind Atlas (NEWA) project. The general objective of these campaigns is to characterise the flow over different kinds of complex terrain. In particular, ALEX17 is held in Elortz, a valley 10 km long and 5 km wide oriented in the east-west direction with the bottom at 500 m above sea level (asl). The valley, located to the south of the Atlantic Pyrenees (Navarre), is bounded to the north by a 150 m high ridge (Sierra del Tajonar) and to the south by the Alaitz mountain range (average altitude of 1100 m asl). On top of the latter there is a test site for large wind turbines, a CENER infrastructure that provides four 118 m high meteorological towers on a permanent basis. This instrumentation has been complemented for over a year with additional measurements covering part of the valley bottom and mountain slopes with the aim to describe the flow properties upstream of the wind turbines on top of Alaitz. This experimental layout includes six 80 m meteorological towers (four of them equipped with 3D sonic anemometers); nine surface layer stations to estimate the turbulent fluxes at the surface layer; five scanning lidar systems operating synchronously to provide 2D and 3D wind fields within the valley; and one RASS-Sodar that monitors the vertical profiles of both wind and virtual temperature up to 300 m above the valley ground. The current communication will give an overview of the field campaign together with some preliminary results.

16:45-17:00: Ortophotos: a source of information in tornado track and wind damage intensity studies

O. Rodríguez and **J. Bech**

University of Barcelona - Department of Applied Physics - Meteorology, Barcelona, Catalonia, Spain

To study tornadic events, a detailed field work is necessary. From an exhaustive analysis of the damage and its pattern the event can be characterized. Despite the most efficient way to study the consequences of a tornado is visiting the places that were hit using a systematic methodology to carry out a damage survey (Rodríguez et al., 2018), there are other tools that can be used to complement it. Satellite images (Chernokulskya and Shikhovb, 2018), ortophotos and images taken by a drone of the tornado damage path can contribute to collect more information. They are useful to locate damage in difficult access areas, and it is also a rapid way to have an overview from the damage along the entire tornado track, whatever its length. The Cartographic and Geologic Institute of Catalonia (ICGC) provide an open access collection of ortophotos taken during the last years with a maximum

resolution of 25 cm. The comparison of images before and after a tornado event enables to complete recent field works. It can also give new information from other cases studied in the past; even it is possible to detect new tornadic events about which there was not any information, making an accurate analyze from trees damage pattern (Bech et al., 2009). Here, three of the most intense tornadoes observed in Catalonia during the last ten years are re-analyzed (Bech et al., 2011, Rodríguez et al., 2018). It is studied the information given by ICGC ortophotos and how it can complement the previous damage surveys. The interest on a detailed analyse of tornadic events lies on the possibility to create a robust tornado database. This study was performed within the framework of the HyMeX (HYdrological cycle in the Mediterranean EXperiment) programme, with partial funding from projects CGL2015-65627-C3-2-R (MINECO/FEDER) and CGL2016-81828-REDT (MINECO), and also from the Water Research Institute (IdRA) of the University of Barcelona. References: Bech J, Gayà M, Aran M, Figuerola F, Amaro J, Arús J. 2009. Tornado damage analysis of a forest area using site survey observations, radar data and a simple analytical vortex model. Atmospheric Research, 93: 118-130. https://doi.org/10.1016/j.atmosres.2008.10.016. Bech J, Pineda N, Rigo T, Aran A, Amaro J, Gayà M, Arús J, Montanyà J, van der Velde O. 2011. A Mediterranean nocturnal heavy rainfall and tornadic event. Part I: Overview, damage survey and radar analysis. Atmospheric Research, 100: 621-637. doi: 10.1016/j.atmosres.2010.12.024. Chernokulskya A, Shikhovb A. 2018. 1984 Ivanovo tornado outbreak: Determination of actual tornado tracks with satellite data. Atmospheric Research, 207: 111-121. doi: 10.1016/j.atmosres.2018.02.011. Rodríguez O, Bech J, Castán S, Arús J. 2018. El tornado del 7 de gener de 2018: de l'Alt Empordà fins al Rosselló. Treball de camp i anàlisi de les destrosses. In XXIV Jornades Eduard Fontserè, Associació Catalana de Meteorologia, Barcelona, ES. [in Catalan] Rodríguez O, Bech J, Soriano JD, Castán S. 2018. A methodology for wind damage assessment from strong-convective winds events. A les XXIV Jornades Eduard Fontserè, Associació Catalana de Meteorologia, Barcelona.

Session 4: Numerical modeling

16:45-17:00: Comparison of RAMS and WRF short-term forecasts over Eastern Spain using distinct observational and modelling datasets

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The current study presents a comparison of the Weather Research and Forecasting (WRF) model and the Regional Atmospheric Modeling System (RAMS) over Eastern Iberian Peninsula during a selected period within July 2011. Hourly meteorological and surface variables produced by these two models are compared not only with in-situ measurements, but also with different surface remote sensing products, such as the Meteosat Second Generation (MSG) Spinning Enhanced Visible and Infrared Imager (SEVIRI) (MSG-SEVIRI), and uncoupled Land Surface Models (LSM) datasets, such as the Global Land Data Assimilation System (GLDAS). Results show a really good performance of RAMS in terms of temperature and moisture during the day, while WRF shows a cold bias at day-time. On the other hand, a better representation of the moisture field at night using WRF leads to general underestimation of the simulated night-time 2-m temperatures. This is true over stations influenced by Eastern flows from the sea, both synoptically forced or driven by mesoscale circulations. In this regard, WRF presents a moister environment than RAMS at night-time, closer to the observations, while alike results are found under Western synoptic advections. In terms of the downward radiation components, both models present rather similar results for the incident shortwave radiation, with WRF producing in general slightly higher RMSE values than RAMS. In contrast, larger downward surface longwave radiation values are obtained using WRF, more adjusted than RAMS to the SEVIRI Downward Surface Longwave radiation Flux (DSLF). Additionally, WRF is more windy than RAMS. The current study shows relevant differences when Eastern wind flows are developed over the region of study, due to higher moisture contents advected inland. In this regard, the corresponding Eastern wind field simulated by WRF reaches inland areas and comprises a larger sea breeze extension than RAMS.

16:45-17:00: Saharan Dust Transport Modeling for Turkey by using the WRF-Chem Model

G. Deniz, **C. Düzgün** and **E. Tan**
Istanbul Technical University, Istanbul, Europe, Turkey

Dust storms may have an impact on radiation balance, cloud microphysics, and atmospheric composition. Observations show that PM10 concentrations are the indicator for the dust storm events. In Turkey, during the Saharan or Arabic originated dust storms PM10 concentrations might be in excess of the air quality standards. The Eastern branch of Saharan Air Layer transports Saharan Dust to Turkey and this study mainly focuses on detecting Saharan Dust transport to Turkey by using the WRF-Chem Model. 5 Saharan Dust storm events are selected to study by using 3 nested domains with the resolutions of 27 km, 9km, and 3 km. The GOCART aerosol scheme is utilized for dust scheme. The emissions and background emissions data are based on the global emissions inventory. The results will be compared to the PM10 observations for the selected stations, Meteosat dust data, and MODIS Atmospheric Optical Depth (AOD) data.

16:45-17:00: Air Quality Impact By Aircrafts in LTO-number-Record Breaking Year 2016

at Istanbul Atatürk Airport by using the WRF-Chem Model

C. Düzgün, **B. Öztürk**, **E. Tan** and **O. Şen**
Istanbul Technical University, Istanbul, Europe, Turkey

Aviation has a significant effect on human health and climate by means of the emission of pollutants from aircraft. These emitted pollutants are greenhouse gases (GHGs), hydrocarbons (HC), volatile (sulphate and organic carbon) and non-volatile (soot) particulate matter (PM). Either an expansion of current airports or an inclusion of a new one might increase these pollutants. On the other hand, air quality impacts of Turkish Airports have not been investigated, in detail, yet. For instance, landing and take-off (LTO) numbers, thereby emission amounts, reached a peak at Istanbul Atatürk Airport in 2016. Therefore, in this study, WRF-Chem model, which fully couples the chemical and meteorological model online, is utilized to study the impact of Istanbul Ataturk airport in air quality of Istanbul. Three nested domains with horizontal resolutions of 27 km, 9km, and 3 km are used to simulate 5 hypothetical cases which are based on continuous and heavy photochemical pollution episodes occurred in Istanbul. These episodes are going to be simulated with the peak emission amounts occurred in 2016 at the Istanbul Atatürk Airport. CBMZ-MOSAIC, MOZART-MOSAIC, and RADM2- MADE/SORGAM gas-phase and aerosol mechanisms are included to the selected simulations, respectively. The results will be compared to the calculated air pollutant quantities (HC, NOx, CO, and SO2) by means of Tier 2 method and possible Landing and Take-off (LTO) numbers of the Istanbul Atatürk Airport.

16:45-17:00: Impact of land-atmosphere coupling on surface energy fluxes and meteorological variables simulated by the Regional Atmospheric Modeling System (RAMS)

[1]**I. Gómez**, [1]**V. Caselles**, [2]**M. Estrela**, [3]**J. Sánchez** and [4]**E. Rubio**
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A proper representation of the soil parameters used in the initialization of atmospheric numerical models plays a key role in the production of skillful forecasts of surface and atmospheric variables. The current study shows the results produced by the incorporation of heterogeneous soil moisture and temperature distributions derived from land surface models into the Regional Atmospheric Modeling System (RAMS). The model has been modified in order to permit using the Global Land Data Assimilation System (GLDAS) dataset for the initialization of the mentioned soil parameters. Original homogeneous RAMS initializations are compared to this heterogeneous initialization. To do this, a series of numerical experiments have been conducted for a 7-days period over Eastern Iberian Peninsula within the 2011 summer season, covering different typical summer atmospheric conditions typical for the region of study. In the model assessment, ground data from a portable weather station, together with the measurements registered by two FLUXNET stations are used including distinct vegetation covers. Initializing RAMS with the corresponding GLDAS soil state remarkably improves the representation of surface sensible weather parameters. Besides, relevant differences are observed in the simulated surface parameters when RAMS is applied to poor and/or sparsely vegetated regions in comparison to those obtained over well vegetated areas. Considering the better agreement found in the first case, we have performed different sensitivity tests considering the land-surface-atmosphere coupling over well vegetated areas so as to improve the original results obtained in this latter case.

16:45-17:00: Forecast sensitivity analysis of the November 7th 2014 medicane

A. Maimó and **V. Homar**
Universitat de les Illes Balears, Palma, Illes balears, Spain

Severe weather in the Western Mediterranean has important effects on population and socioeconomic assets. Cyclones produce a significant portion of severe phenomena in the region. A specific type of cyclone known as medicane (Mediterranean hurricane) shows very different characteristics from typical mid-latitude cyclones for its tropical-like features. This Mediterranean cyclone usually generates over the sea and affects the coast with intense winds and precipitation rates. A relevant case occurred during the morning of 7 th Novembre 2014 to the south and southeast of Sicily. Investigating the sensitivities of this medicane formation will shred light on the physical processes that drive the formation of this rare but hazardous systems. The WRF adjoint model (WRFPLUS) calculates sensitivities of specific forecast aspects of interest, which is quantified by means of a scalar response function. It is noteworthy that the model shows consistent sensitivity fields for various response functions representing cyclone intensity, which shows the robustness of the WRFPLUS model. However, this does not guarantee an accurate depiction of sensitivity fields in their physical interpretation and linearity tests show that this model accuracy is heavily dependent on the presence or absence of convection. A description of the most sensitive fields for the medicane formation and the physical interpretation will be provided.

16:45-17:00: Analysis of the contribution of the dynamical downscaling in the mesoscale modeling chain for wind resource assessment applications for ERA5 reanalysis by ECMWF

A. Bosch I Mas and **A. Montornes Torrecillas**

Vortex, Barcelona, Catalonia, Spain

With the fifth generation of the European Center for Medium-Range Weather Forecasts (ECMWF) Re-Analysis (ERA5), a new set of robust reanalyses is arriving while uncertainties about the future of the limited area models start appearing in the atmospheric modeling community agendas. In this paper, the added value of the mesoscale models for wind resource assessment applications is analysed by using 120 met-mast time-series provided by the wind industry. This observational data-set is used to be compared with ERA5 outcomes. This study has two parts. First, the mean wind speed is validated for ERA5 raw data, ERA5 surface data at 100 m and a dynamical downscaling with the WRF model. Second, a spectral analysis is used to evaluate the skills of each model in order to represent different atmospheric scales and examine its limitations. From the validation, the mean absolute error (MAE) is calculated leading to results of 10.63% for downscaled data and 16.07% for ERA5-raw and 13.69% for ERA5 surface data. The same analysis is presented for midlatitude and tropical sites. Furthermore, the spectral analysis shows an added value in the energy contribution when the dynamic downscaling is used. The analysis of the energy contribution has been performed for different atmospheric scales. From the set of analyses performed in this paper, it is concluded that a downscaling with WRF adds more dynamical information than ERA5-raw and ERA5-surface data for the wind industry usage.

Session 5: Atmosphere-surface interactions in semi-arid conditions

16:45-17:00: Observed atmospheric and surface variability on heterogeneous terrain at the hectometer scale and related advective transports

G. Simó, **J. Cuxart**, **M. A. Jiménez**, **D. Mariínez-Villagrasa** and **R. Picos**

Universitat de les Illes Balears, Palma, Illes balears, Spain

Land surface is usually heterogeneous and for each point the atmospheric variables are determined by the equilibrium between the air and the surface and the interaction with the neighbouring locations. Therefore these variables may vary significantly in short distances. It is a challenge to select a representative location for a wider area and to characterise the effect of these heterogeneities in the atmospheric and soil variables. In this work the variability of the air and soil variables is analysed for a number of stations at a typical distance of 150 m for a semi-rural area of roughly 1 km of side during the drying season in the island of Mallorca (Western Mediterranean Sea). For weak synoptic forcings, the nocturnal variability of the air temperature, humidity and wind direction is large, whereas turbulence manages to reduce significantly the atmospheric spatial differences in the daytime. The variability of the temperature and water content of the soil is large and essentially related to the soil characteristics and vegetation cover. The inspection of the vertical gradients of temperature and humidity between 2 m and 0.2 m reveals that their sign and intensity differ depending on the measuring point, indicating that the corresponding surface energy and water balances are very sensitive to the fine location of the instrumentation. The balances may depend very likely as well on the exchanges with the nearby areas, an issue that is explored by means of an estimation of the advection term for the air temperature and moisture, which show to be relevant in nights with clear skies and weak winds.

Session 6: Extreme Events, from improved weather forecasts to better projections in a context of accelerated climate change

16:45-17:00: Extremely weather in Croatia during the 2017 fire season

J. Ferina, **V. Vučetić** and **P. Sviličić**

Croatian Meteorological and Hydrological Service, Zagreb, Zagreb, Croatia

Croatian Meteorological and Hydrological Service has operated the Canadian Forest Fire Weather Index System (CFWIS shorter FWI) to estimate fuel moisture and fire weather indices based on weather observations since 1982. The spatial distribution of mean monthly (MSR) and seasonal severity rating (SSR), as products of the FWI, for the 2017 were compared with long-term averages 1981-2010. Maps of MSR from April to October 2017 show the maximum MSR of 54.7 in mid-Adriatic in August 2017. The maximum is also the absolute maximum since 1960 when estimates of MSR started. When comparing SSR in 2017 with long-term averages, SSR was 1.5-2 times above average, but in August it was 2-3 times above average in the whole Croatia. The wildfire risk is directly associated with long dry periods combined with the high air temperature, low relative humidity and strong wind. Therefore dry spells were analyzed for precipitation amount below 0.5 mm, 1.5 mm and 2.8 mm depending on the fuel materials: FFMC (Fine Fuel Moisture Code), DMC (Duff Moisture Code) and DC (Drought Code) respectively as well the warm and very warm spells with maximum daily air temperatures above 30°C and 32°C. In the conditions of above average warm spring and summer of 2017 and lack of precipitation in the winter, spring and summer periods, the longest and most pronounced warm (maximum of 39 days) and very warm (maximum of 15 days) periods appeared in the mid-Adriatic from the end of June to the first half of July and from the end of July to the first half of August 2017. The highest number of consecutive dry days for FFMC was 73 days, for DMC 78 days, and for DC 100 days. Therefore, with more than 4000 fires and 110,000 ha burned areas, 2017 was the most intensive fire season.

16:45-17:00: Classification of heavy rainfall

profiles for Barcelona city

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[1]Universitat Politècnica de Catalunya, Barcelona, Barcelona, Spain
[2]UPC, Barcelona, Barcelona, Spain

Rainfall episodes, with amounts exceeding or equalling to 25 mm and lengths above or equal to 60 min, recorded at 23 rain gauges of Barcelona city since September 1994 to November 2009, are analysed and classified according to their 5-min rain amounts profiles. The lengths of the selected episodes are normalized and divided in time deciles, being assigned the respective percentage of the recorded rain amount. The clustering process classifies the 5-min rain amount records into 11 clusters. The representative profiles for every cluster, together with maximum intensities and rainfall amounts permit to describe rainfall patterns. The 5% extreme events of these episodes are analysed with more detail and linked with the corresponding synoptic situations. They occur mainly in hot months, especially in September, and are related to flash floods. The correlation of these extreme episodes with the UHI phenomena is also studied. This analysis offers a quite complete description of heavy rainfall patterns in Barcelona city, complementing previous studies related with the normalized intensity curves and 5-min intensity return periods. These heavy rainfall analyses would be very useful when designing drainage systems in urban areas as Barcelona.

16:45-17:00: Medicane Qendresa forecast from EPS

M. A. Picornell and **J. Campins**
AEMET, Palma, Illes balears, Spain

Tropical-like cyclones rarely affect the Mediterranean region but they can produce strong winds and heavy precipitations. These warm-core cyclones, called MEDICANES, develop over the sea and are small and infrequent. For these reasons, the detection and forecast of medicanes are difficult tasks. Ensemble Prediction Systems (EPS) can be extremely useful to predicting medicanes with the necessary accuracy and anticipation, focusing the prediction on a probabilistic way. The large amount of information provided by probabilistic models must be presented in a concise and clear way, highlighting the predominant characteristics but still showing possible extreme values although they may have low probability. For this purpose specific tools have been developed in AEMET and are presented in this work for the Qendresa medicane (November 2014), forecasted by the ECMWF EPS.

16:45-17:00: Forecast of some intense mediterranean cyclones occurred in 2018

J. Campins and **M. A. Picornell**
AEMET, Palma, Illes balears, Spain

The present study examines the short and medium-range forecast of some intense Mediterranean cyclones developed in 2018. These cyclones are detected and tracked from analyses and short and medium-range (up to 5 days) forecasts of the deterministic ECMWF Integrated Forecasting System (IFS) by means a detection and tracking algorithm. Intense Mediterranean cyclones are identified and tracked along the forecast trajectories and they are compared with the analysed ones. Some graphics are generated to determine how forecasted cyclones deviate from their analyzed counterparts with increasing lead time. This method provides a measure of the skill in predicting the position, speed and intensity of intense Mediterranean cyclones. The consequences of forecast errors on the prediction of strong winds and heavy precipitation are also investigated.

16:45-17:00: A holistic approach to the analysis of the catastrophic flash flood event of 12 October 2016 in the Central Coast of Catalonia

[1]**M. Llasat Botija**, [1]**M. Cortès**, [2]**A. Del Moral**, [2]**M. Llasat-Botija** and [2]**O. Rodríguez**
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The Maresme county, placed in the Central Coast of Catalonia (NE of Spain), is usually affected by local and heavy rainfall events that produce flash-floods. Between 1981 and 2015, 114 events have been recorded in this region. Attending that the torrential streams cross the villages as well as the coastal railway and the highway, damages are usually considerable. Between 1996 and 2015 the "Consorcio de Compensacion de Seguros" has paid more than 27 million of euros for flood damages in this county. On 12 October 2016, catastrophic flash floods affected different villages, being one of the most remarkable events from the last years. Daily precipitation overpassed 200 mm in different places, with a maximum of 257.0 mm near the coast. The present study focuses on a holistic analysis of this event, in the framework of the M-COSTADAPT project. After the introduction of the main meteorological features, the diagnosis and the prognosis of the event from the meteorological radar network using a new algorithm has been done. The algorithm is able to foresee if the cells will suffer an anomalous movement. Results show that the event was mainly dominated by a warm rain process, with high precipitation efficiency. Convective cells were triggered over the sea by the formation of a convergence line in front of the coastline and the steeped orography of the region, generating cells that affected the region for more than 2 hours. The meteorological analysis has been completed with the diagnosis of the societal impact and early warning system. To do this, information obtained from a citizen science experiment has been included.

16:45-17:00: Analysis of regional climate change scenarios with respects to extremes

for the Med-CORDEX area

R. Pongracz, **J. Bartholy**, **I. Pieczka** and **T. Kalmar**
Eotvos Lorand University, Budapest, Hungary

Regional climate model simulations covering the MED-44 CORDEX area (i.e. the extended Mediterranean region of Europe: 30°-50°N, 10°W-45°E) are analyzed in this study. For this purpose, RegCM (which is a 3D primitive equation model using sigma-coordinates) simulations are used to evaluate the future climatic trends in temperature and precipitation conditions. In addition to the past historical period (1951-2005), simulations continue to 2006-2100 with two very different scenarios (RCP4.5 and RCP 8.5 - based on the radiative forcing change by 2100) using the HadGEM2 and MPI-ESM global climate model outputs as initial and lateral boundary conditions (ICBC). On the basis of our RegCM experiments at 50 km horizontal resolution we aim to provide detailed regional scale climate projection results for a selected subregion (using smaller model domain) with further downscaling using 10 km as horizontal resolution. Our analysis compares the estimated temperature and precipitation changes with special focus on extreme conditions using several climate indices for the following 10 subregions of the MED-44 CORDEX area: Iberian Peninsula, Apennine Peninsula, Balkan Region, Asia Minor, East European Plain, Middle European Plain, Carpathian Basin, Carpathian Mountains, Alps, Western Europe.

16:45-17:00: Storm surge modelling of Goksu Delta by using SWAN Model

I. Kurşun, **G. Deniz** and **E. Tan**
Istanbul Technical University, Istanbul, Europe, Turkey

Storm surge is a rising of the sea level during the storm occurrences and their periods, as well as their magnitudes, are expected to increase due to climate change. At the same time, recent observations indicate that water spout events are increased in the Mediterranean coast of Turkey, especially for the seasons when the atmospheric instability is high. Göksu Delta is one of the popular location of Turkish Mediterranean coasts for tourists because of its ecological diversity and recreational activities. On the other hand, Göksu Delta is adversely affected by storm surges such as flooding and extinction of species. Therefore, in this study, Storm surge levels of Göksu Delta coast are modelled for the selected 5 extreme cases by using Simulating Waves Nearshore (SWAN) Model. Simulations are performed on two nested domains with 2km and 150 m resolutions. For wind forcing, GFS Model results are utilized for Göksu Delta domain. The preliminary results indicate that severe storm surges may reach approximately to 4 m, including climate change effects.

16:45-17:00: Analysis and simulation of two hot extreme events in the Iberian Peninsula

D. Pino, **A. J. Mohammed** and **M. Alarcón**
Universitat Politècnica de Catalunya, Barcelona, Catalunya, Spain

Hot extreme events can have implications on human comfort, environment, agriculture and hydrology. Between 1880 and 2005, the length of summer heat waves doubled and the frequency of hot days almost tripled over Western Europe. Moreover, daily mean temperatures have been rising over almost all of Europe. At southern Europe and Iberian Peninsula (IP), the mean temperature increase is even higher than at central and western Europe. The dynamics, occurrence, and effects of extreme hot events have been the focus of recent research, while more thorough investigations using the WRF model targeted both hot and cold events, heat waves, and temperature anomalies. Over Europe, the main synoptic system associated with such heat waves is an omega blocking system, usually described as a tri-synoptic system of a central high-pressure ridge and double side-troughs distributed in the west-east direction and lasting from a single day up to weeks. This work focuses on the study of two different hot-extreme events in IP occurred in 2012. The events have been selected based on the 12-hourly maximum temperatures at 2 m height obtained from the ERA-Interim reanalysis database. Temperatures in the 1%-tails of the empirical distributions at each grid point have been considered for the period 1994 to 2013. From the 130 hot extreme episodes obtained, here we have focused on the one that affected the largest number of grid points, and the one that only affected a single grid point. The characterization of the meteorological conditions has been done by means of: 1) a Lagrangian approach to determine the air-mass pathways; 2) the study of the evolution of the physical variables along the back-trajectories; 3) the identification of the synoptic situations, and 4) WRF mesoscale numerical simulations.

Contributions