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Associació Catalana de Meteorologia

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General Information

Location of the Meeting

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Organization

Associació Catalana de Meteorologia (ACAM)

with the support of

Tethys, Journal of Mediterranean Meteorology & Climatology, University of Balearic Islands (UIB) and UIBcongres

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POSTER SESSION

1. Climatology

2. Processes and Applications

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Oral presentations, 25th May 2021

9h – 9h30: Welcome

Dr. Jordi Mazón, President of ACAM

Dr. Josep Calbó, Editor of Tethys

Dr. Maria A. Jiménez, Chair of the Conference

Dr. Enrique García, Vicerector d'Investigació i Internacionalització (UIB)

9h30 – 10h45: Session 1. Climatology

(Chair: J.A. Guijarro)

1O1. Climate Risk Information for SupportIng ADAptation Planning and operaTion (CRISI-ADAPT II): CMIP5-CMIP6 comparison

R. Monjo[1], C. Prado-López[1], D. Redolat[1], E. Gaitán[1], C. Paradinas[1], S. Rubio[2], L. Torres[2]

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[2] Meteogrid

The Mediterranean area is a climate hot-spot due to expected changes in regional circulation and in atmospheric available potential energy that could affect the hydrological cycle and its intensification. Under this context, most of the climate-sensitive sectors demand decision-support tools to manage risks and adaptation planning. The project Climate Risk Information for SupportIng ADAptation Planning and operaTion , supported by the EIT Climate-KIC, aims to monitor and improve the decision making and adaptation planning through a real-time implementation and validation according to near and seasonal range forecast of climate-related risks. Four strategic sectorial demonstrations are placed in four Mediterranean countries (Spain, Malta, Cyprus, and Italy): (1) Flooding and emergency response, (2) Water management for supply, agriculture and environment, (3) Energy planning and (4) Port infrastructures and operations. Climate scenarios were produced in CRISI-ADAPT II at a local scale thanks to a statistical downscaling of the Coupled Model Intercomparison Project – Phase 6 (CMIP6) - Earth System Models (ESM) available in the European Copernicus platform. The performance of the method, based on quantile-mapping, was compared with the dynamical downscaling outputs of the EURO-CORDEX platform (CMIP5). Particularly, scenarios of the Representative Concentration Pathways (RCP4.5 and RCP8.5) and the Shared Socioeconomic Pathways (SSP2-4.5, SSP3-7.0 and SSP5-8.5) of CMIP5 and CMIP6, respectively. The ERA5-Land reanalysis was selected as a reference baseline. The results of simulating extreme events showed that the CMIP5-CMIP6 difference is generally small for temperature (e.g. lesser than 2ºC for 30y-return events), but very remarkable in precipitation under the pessimistic scenarios.

1O2. Coastal impacts of Storm Gloria (January 2020) over the north-western Mediterranean

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Around one year ago, between 20 and 23 January 2020, Storm Gloria severely hit the Western Mediterranean beating several historical records, such as significant wave height or 24 h accumulated precipitation. Here we present the study of the ocean component and coastal impacts of Storm Gloria with a numerical simulation of the storm surges and wind waves. The storm surge that developed along the eastern coasts of the Iberian Peninsula, reaching values of up to 1 m, was accompanied by wind waves with a significant wave height of up to 8 m which are found among the largest events over the western Mediterranean basin. Along the coasts of the Balearic Islands, the storm footprint was characterized by a negligible storm surge and the impacts were caused by large waves. The comparison to historical records reveals that Storm Gloria is one of the most intense among the events in the region during the last decades and that the waves' direction was particularly unusual. Our simulation permits the quantification of the role of the different forcings in generating the storm surge. Also, the high spatial grid resolution down to 30 m over the Ebro Delta allows determination of the extent of the flooding caused by the storm surge. We also simulate the overtopping caused by high wind waves that affected a rocky coast of high cliffs on the eastern coast of Mallorca.

1O3. Extreme precipitation evolution in the western Mediterranean under climate change

P. Benetó, S.K. Pardo

Fundación Centro de Estudios Ambientales del Mediterráneo

In the Mediterranean coast of the Iberian Peninsula precipitation is characterized for presenting a strong seasonality and a non-uniform distribution due to complex topography. Projections of reduction of precipitation, an increase in precipitation extremes, but a significant reduction of summer storms characterize future scenarios of the western Mediterranean region. The latter is for example crucial for many sectors, agriculture, forests, recharge of aquifers, etc., particularly because it brings rainfall in the driest period of the year. Their reduction significantly affects the local climate and the hydrological cycle, e.g. favouring the accumulation of water vapour and air pollutants, a tad indirectly contributing to the intensification of torrential rain events over the Mediterranean coasts in autumn.

This research intends to advance knowledge regarding changes in precipitation spatio-temporal patterns and tendencies in eastern Spain. To illustrate our results we will focus on the Hydrographic Confederation of the Júcar and Segura (CHS). The product Spain02 of an approximately 5x5km spatial resolution and 1-day temporal resolution, covering from 1951 to

2019, is used to study precipitation pattern changes. Additionally, high-resolution convection permitting simulations (about 3km) with the COSMO model will be used to investigate the water cycle components evolution for the last two decades.

Overall, precipitation over CHJ and CHS presents a negative tendency of -0.4mm/year and an increase (decrease) in intensity (duration) of precipitation events according to duration-amount analyses, during the period 1951-2019. In addition, seasonal trend analyses show that the strongest precipitation reduction is observed during summer with a trend of -0.12mm/year.

1O4. Identifying storm nests and most conflictive areas in Barcelona for 2013 – 2018 period

L. Esbrí[1], T. Rigo[2], M.C. Llasat[1], B. Aznar[3]

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[2] Meteorological Service of Catalonia, Barcelona, Spain

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The typical climate in Barcelona, as well as in the Mediterranean basin, presents mid-warm temperatures and few annual precipitations. Nevertheless, rainfall accumulations are pretty high in localized episodes. Due to the city morphology and its complex orography, the drainage in some areas is inefficient when those episodes occur. This project has born within this context, as a collaboration between Barcelona Cicle de l'Aigua S.A., University of Barcelona and the Servei Meteorològic de Catalunya (SMC) to achieve better acknowledgement of intense rainfall episodes in Barcelona. The characterization of rainfall events from 2013 to 2018 period will support the further management and mitigation of flash floods over the city. Because of this, a new radar-based methodology has been developed to identify convective rainfall structures form radar reflectivity volumes (CAPPI and TOP products). The high computing speed of the procedure allows an efficient analysis of a large set of convective cells without scarifying temporal resolution of radar data. From one side, the project has enabled a comparison between radar data from SMC and rain gauge data from the warning system of BCASA. Then through the identified rainfall convective structures in the studied period, rainfall hot-spots over the city are determined.

1O5. Multi-ensemble and multi-scenario Mediterranean climate change projections

J. Cos, F. Doblas-Reyes, M. Jury

Barcelona Supercomputing Center

The Mediterranean has been identified as a climate change hot-spot due to increased warming trends and precipitation decline. Recently, CMIP6 was found to show a higher climate sensitivity than its predecessor CMIP5, potentially further exacerbating related impacts on the Mediterranean region.

To estimate the impacts of the ongoing climate change on the region, we compare projections of various CMIP5 and CMIP6 experiments and scenarios. In particular, we focus on summer and winter changes in temperature and precipitation for the 21st century under RCP2.6/SSP1-2.6, RCP4.5/SSP2-4.5 and RCP8.5/SSP5-8.5 as well as the high resolution HighResMIP experiments.

Additionally, to give robust estimates of projected changes we apply a novel model weighting scheme, accounting for historical performance and inter-independence of the multi-member multi-model ensembles, using ERA5, JRA55 and WFDE5 as observational reference.

Our results indicate a significant and robust warming over the Mediterranean during the 21st century irrespective of the used ensemble and experiments. Nevertheless, the often attested amplified Mediterranean warming is only found for summer. The projected changes vary between the CMIP5 and CMIP6, with the latter projecting a stronger warming. In contrast to temperature, precipitation changes show a higher level of uncertainty and spatial heterogeneity. However, for the high emission scenario, a robust decline in precipitation is projected for large parts of the Mediterranean during summer. First results applying the model weighting scheme indicate reductions in CMIP6 and increases in CMIP5 warming trends, thereby reducing differences between the two ensembles.

11h – 12h30: Session 2. Climatology

(Chair: J. Calbó)

1O6. The first assessment report on Mediterranean climate and environmental change

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The MedECC group published in November 2020 its first assessment report, concluding that all sub-regions of the Mediterranean Basin are impacted by recent anthropogenic changes in the environment. These changes are driven by climate, population increase, pollution, unsustainable land and sea use practices and non-indigenous species. Significantly enhanced efforts are needed in order to adapt to inevitable changes, mitigate change drivers and increase resilience. Annual mean temperatures are now 1.5°C above the preindustrial level and dry conditions are becoming more frequent. Sea waters are becoming warmer and saltier. The sea level has risen by 1.4 mm yr –1 similarly to the global trend.

Future regional warming might reach up to 5.6°C at the end of the 21st century. Warm temperature extremes will intensify. Total annual precipitation is expected to decrease over most of the region. However, magnitude and spatial distribution of changes are uncertain. Dry conditions will be further enhanced by increasing evapotranspiration over land. Extreme precipitation events will become more intense over large parts of the northern Mediterranean areas.

Mediterranean mean sea level is projected to be at the end of the 21st century in the range from 20 to 110 cm higher than at the end of the 20th century, depending on the scenario. Annual mean sea surface temperature will increase by 1 to 4°C depending on the scenario. Marine heat waves will become longer, more intense and their spatial extent will increase. Seawater acidification will continue, with a pH reduction that might larger than 0.4 units at the end of the 21st century.

1O7. A method to validate temperature homogenization techniques: the Slovenian network case study

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[3] Swedish Meteorological and Hydrological Institute

Establishing coherent data records has become increasingly relevant given the need to correctly attribute climate signals and discard possible instrumentation errors. However, since real values of measurements are not known, the assessment of homogenization results is not directly possible, and must be achieved studying their performance on homogeneous datasets subjected to controlled, artificial inhomogeneities.

Taking into account a temperature network of 30 ground stations in Slovenia for the 1950-2005 period, up to 7 artificial breaks and an average of 107 missing data per station were introduced, in order to determine that mean square error, absolute bias and factor of exceedance can be meaningfully used to validate the best-performing homogenization technique in a region.

Three techniques were tested, ACMANT and two versions of HOMER (HOMogenization software in R): the standard setup mode and a novel setup developed at the Swedish Meteorological and Hydrological Institute. The results showed HOMER techniques performing better with regard to the factor of exceedance, while ACMANT was best at absolute error and root mean square error level.

Homogenization quality always anti-correlated meaningfully to the number of breaks, while only ACMANT performance was affected by missing data, as these are almost always filled-in when using HOMER.

This study has been performed within the INDECIS Project (part of ERA4CS), an ERA-NET initiated by JPI Climate, and funded by FORMAS (SE), DLR (DE), BMWFW (AT), IFD (DK), MINECO (ES), ANR (FR) with co-funding by the European Union (Grant 690462).

1O8. Surface urban heat islands of Zagreb and Split (Croatia) – local climate zone based definition

M. Žgela, I. H. Bulić

Department of Geophysics, Faculty of Science, University of Zagreb

Urban heat island is a climate phenomenon whose negative effects are emphasised during the summer months, mostly due to accumulation of solar irradiation and various anthropogenic heat sources in the city's built-up area. During these months heat stress is high and can put at health risk a large number of people, especially the most vulnerable ones as elder and children.

In order to examine climate features of two biggest Croatian cities, Zagreb and Split, we defined their local climate zones (LCZ) which provided a relevant basis for further research. The link between LCZ's and temperature was investigated by deriving land surface temperature (LST)

from Landsat scenes using Google Earth Engine (GEE), a cloud based geospatial analysis platform. That allowed for a wide spatial coverage of surface urban heat island (SUHI) and its investigation on different spatial scales. Furthermore, LCZ's were characterised by normalized difference vegetation index (NDVI), which we derived from GEE as well. Comparison of SUHI between Zagreb and Split is valid as the Landsat passing time difference between cities is less than a minute.

Results revealed the highest LST in compact LCZ's in both of the cities and opposed to that, natural LCZ's such as LCZ A (dense trees), LCZ B (scattered trees) and LCZ G (water) had the lowest LST. Also, correlations between LST and NDVI proved to be significantly negative, which points out cooling effect of vegetation. This work also indicates the added value LCZ mapping has in SUHI investigation.

1O9. Uncertainties of observed surface temperature trends: the case of the Balearic Islands

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Two contradictory news in local newspapers appeared in the first weeks of this year 2021, stating that observed surface temperature trends in the Balearic Islands were the highest and the lowest of the whole Spanish territory. Both affirmations were allegedly derived from published reports issued by authoritative sources, rising the interest to investigate the reasons for such opposed conclusions.

In fact, trend evaluations of climatological series depend heavily on factors such as the involved number of observatories, the specific periods of computation, and whether the series consisted in raw data or had been homogenized to remove non climatic perturbations.

We analyze here several Balearic Islands temperature trends published in the past, adding our own calculations up to the year 2020, and compare them with trends obtained from several reanalyses.

Finally, we provide our estimations for the trends observed in different periods and their confidence intervals, and discuss the difficulties of communicating these uncertainties to the general public.

1O10. Urban Heat Island Effect on Convective Precipitation Event in Izmir, Turkey

F.B. Saka, D.H.D. Üstün, Y. Unal

Istanbul Technical University

The urban heat island effect is the temperature increase in the urban area due to the developed structure of the city. Changes in the urban atmosphere can affect the local circulation and in turn many meteorological parameters such as precipitation. In this study, the urban heat island effect on convective precipitation event were investigated by using Weather Research and Forecasting Model v3.8 with CORINE land use data for İzmir, Turkey. Izmir is located at the

Aegean shore of Turkey and the complicated sea-land structure and sharp elevation changes of the area interact with the weather systems. Therefore, precipitation forecast in terms of magnitude and location can be challenging particularly for convective precipitation events. In this study, sensitivity of the WRF model to the selection of different surface and microphysics parameterizations is tested for a convective rainy day to find out the best possible combination of the parameterizations. The model is forced by ERA5 re-analysis with one day spin up time. Our results indicate that WRF model underestimates the precipitation amount for all runs with current urban land use compared to observations. In order to search the affect of urban heat island on the precipitation event, urban areas in land use data are replaced by the most dominant land use category and simulations with the same parameterizations are carried out. Then, the change in the timing and the location of the maximum precipitation over İzmir are examined for all different parameterization combinations and also for the ensemble averages.

14h30 – 16h: Session 3. Climatology

(Chair: R. Romero)

1O11. Analysis of snow and fog events affecting aviation operations in selected airports of Turkey

M. Mutlu, B. Sönmez, Y. Unal, S.S. Menteş

Istanbul Technical University

Globalization of the world increased the demands in airline transportation. Operational disruptions in aviation often arise due to weather conditions. In this study, frequencies of meteorological events such as rain, snow shower, snow, haze, fog and thunderstorm, are examined between 2015 and 2019 at 59 airports over Turkey. Spatial and temporal variations of the dominant meteorological events are investigated for each season and region. Our results indicate that rain shower is the dominant category in the airports along the shorelines of Turkey while haze mostly dominates the inland airports. Rain showers are frequently seen at least three seasons over the north western and eastern Black Sea airports.

In this paper, we focus snow and fog events since they can be limiting factors for the airport operations. Atmospheric conditions causing these events are analyzed for two selected airports in which these events are frequently seen compared to the other airport locations. The airports in Bursa Yenişehir and Erzurum are selected for fog events and for snow events, respectively. We used geopotential height, temperature, relative humidity, zonal and meridional wind profiles obtained from ERA5 re-analysis data for the event days. The profile data consist of levels from 1000 hPa to 500 hPa for fog events and from 800 hPa to 300 hPa for snow events. These atmospheric profiles are classified by using hierarchical cluster analysis with average linkage and Euclidian distance. The synoptic and local conditions leading to snow and fog events at two selected airports are analyzed for each cluster group.

1O12. Characterization of the Iberian heat waves over the last 70 years

L. Paredes, J.P. Barceló, S.K. Pardo

Fundación Centro de Estudios Ambientales del Mediterráneo

Heat waves are an extreme event with potentially catastrophic consequences. The damaging effect of heat waves and its rising frequency makes heat waves events a necessary topic to advance knowledge. The Iberian Peninsula is a well-known hot spot for this kind of extreme events. Not only their frequency but also their intensity has been increasing during the last decades. A deep knowledge of this phenomena is required in order to better understand their future evolution and consequences.

With the focus pointed to the region of the Iberian Peninsula, we aim to characterize the heat waves occurred since 1951 and identify potential changes.

We use the observational data from the SPAIN02, from AEMET and the high resolution convection permitting COSMO model simulation (about 2.8km) covering the period from 1951 to 2019 the former, and the period 2000 to 2019 the later. To characterize the heat waves, the

size, intensity, maximum temperature, the trajectory of the center of mass and the heat wave magnitude index (HWMI) are investigated. Furthermore, their concurrence with droughts and the impact of precedent precipitation scenarios is examined. With this purpose, precipitation and the soil moisture patterns are examined by means of the effective drought index (EDI), the soil water index (SWI) and the standarised precipitation-evapotranspiration index (SPEI).

1O13. Evolution of synoptic patterns associated with north wind episodes (tramuntana) in northeastern Catalonia throughout the 21st century

M. Prohom, J.C. Peña

Meteorological Service of Catalonia

Based on maximum wind speed and wind direction thresholds applied to data from two automatic weather stations located in the northeast of Catalonia , 384 tramuntana (north wind) episodes have been identified within the period 1998-2019.

Three synoptic patterns causing tramuntana in the region have been obtained from the observed data: north cyclonic, northeast, and north anticyclonic. These synoptic patterns have been validated by nine simulations from the Climate Model Intercomparison Project during the historical period, capturing the monthly distribution and synoptic configuration of the identified episodes. The composites generated, represent reasonably well the variability of north wind episodes during the 21st century, showing the pulsations of the climate and the decadal trends probably related to external forcing in the climate.

Our results, conditioned by the climate models used, show a downward trend in tramuntana episodes in the RCP 8.5 scenario. Regarding the RCP 4.5 scenario, the trend is almost zero. The reason for this decrease can be related to the increase in global temperature and a lower presence of the jet-stream. Indeed, paleo-climatic models have observed that during warming periods in the northern hemisphere, the jet-stream moves to higher latitudes, and the opposite when cooling occurs. Applying these considerations to the 21st century, in which climate models demonstrate global warming, there will also be a migration of the jet-stream northward, causing northern flows to be less likely. Similarly, spring and winter seasons are expected to be warmer, and possible changes in seasonal precipitation regimes highly probable.

1O14. Implementation of the standardized precipitation index (SPI) for regional drought assessment in a Mediterranean area

O. Boulariah

University of Salerno

Drought is a natural disaster that has a major environmental, social, and economic impact worldwide, and the Mediterranean basin is considered a very vulnerable environment in this perspective. For this reason, the identification, monitoring, and characterization of droughts is of critical importance in the planning and management of water resources. The purpose of the presented research was to describe the drought conditions and their evolution for the Campania region, evaluated by the analysis of an in-situ measurements database covering a centennial period from 1918 to 2019. For different accumulation time scales (from 3 to 48 months), the SPI time series were reconstructed, and their trend and evolution over time were tested using the Modified Mann Kendall and Sen's slope. Most of the SPI time series was influenced by a significant negative tendency for a very large area of the region, particularly evident for scales of accumulation larger than 12 months. Drought characteristics were influenced by the accumulation scale, with a longer duration and higher severity, especially for large accumulation scales. The spatial characteristics of the drought were not consistent with the different time scales of the SPI; while the duration and severity were larger in the southern area, the peaks were most severe in the northern area of the investigated region. In contrast to the moderate drought events, extremely severe events were characterized by lower durations and larger severity but were very less recurrent and did not seem to focus on specific areas.

1O15. Longitudinal differences in long-term changes of Quasibiennial Oscillation

R. Öztürk, D. Demirhan, Y. Unal, S. Topçu

Istanbul Technical University

The quasi-biennial oscillation particularization of the stratosphere in the tropical region defined by a change in the phase of the zonal winds from easterly (QBO-E) to westerly (QBO-W) approximately in every 28 months. In most of the studies QBO is assumed to be zonally symmetric. Whereas investigating the easterly and westerly zonal wind phases separately till 2099, a significant change due to zonal asymmetries is apparent. In this study, easterly and westerly zonal winds at 30hPa for the latitudes between 5°S ile 5°N is examined using CMIP5 MPI-ESM-MR RCP4.5 scenario for the years between 2006 and 2099 for winter. The amplitude of the easterly winds show a significant increase by the year 2099. Additionally in winter and summer seasons the winds strengthen over the Pacific Ocean starting from the year 2030.

1O16. Synoptic patterns and mesoscale precursors of Italian tornadoes

R. Ingrosso[1], L. Bagaglini[2], P. Lionello[3], G. Salvadori[3], M.M. Miglietta[4]

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[4] CNR-ISAC, Padua, Italy

An analysis of synoptic patterns and mesoscale precursors is produced for Italian tornadoes for the period 2000–2018. Anomaly maps of different parameters are extracted from ERA-5 reanalysis. To highlight typical large-scale configurations, a clustering analysis is applied to define different regional clusters, representative of areas affected by a large number of tornadoes. The analysis shows that: a) significant anomalies of synoptic parameters and mesoscale precursors are generally present over and nearby the region where tornadoes occur; b) each cluster shows a peculiar synoptic configuration; c) pattern differences among clusters suggest different environmental conditions favorable to tornado development in the southern and northern Italian regions; d) tornadoes in southern regions are characterised by the highest anomalies in wind shear, storm relative helicity and CAPE; e) significant SST positive anomalies are observed for southern tornadoes. Statistical methods such as homogeneity tests, conditional probabilities, and a multivariate analysis via copulas are also performed. The analysis shows that the probability of tornado occurrence increases as wind shear increases, whereas the increase with CAPE is not statistically significant; the probability of occurrence is maximum when either wind shear or CAPE are large.

16h15 – 18h00: Session 4. Interdisciplinary studies

(Chair: J Mazon, J.P. Montávez, V. Telesca)

5O1. Precision irrigation system for agricultural water management in changing climate.

M. Mancini, C.Corbari, G.Ravazzani, A. Ceppi, M. Feki, G. Lombardi

DICA Politecnico di Milano

The conflicting use of water is becoming more and more evident, also in regions that are traditionally rich in water. With the world's population projected to increase to 8.5 billion by 2030, the simultaneous growth in income will imply a substantial increase in demand for both water and food. Climate change impacts will further stress the water availability also enhancing its conflictual use. The agricultural sector is the biggest and least efficient water user, accounts for around 24% of total water use in Europe, peaking at 80% in the southern regions. The presentation shows how a web-gis system for real-time operative precision irrigation water management at high spatial and temporal is able to monitor and forecast the crop water need reducing the irrigation losses without a reduction in crop production. This approach increases the water use efficiency according to different agronomic practices supporting different level of water users from irrigation consortia to single farmers. The system couples together satellite (land surface temperature LST and vegetation information) and ground data, with pixel wise hydrological soil water energy balance model using recent scientifically outcomes on soil moisture retrieval from satellite data and hydrological modelling. Discussion on the methodological approach based on the satellite LST, ground evapotranspiration measures, and pixel wise hydrological modelling is provided proving the reliability of the forecasting system and its benefits. The activity is part of the European Chinese collaborative project (SIM, Smart Irrigation Modelling, www.sim.polimi.it). The system is applied in different experimental sites which are located in Italy, China and Spain, which are characterized by different climatic conditions, water availability, crop types and irrigation schemes. Specific results are shown for two case studies in Italy: the Sud Fortore District of the Capitanata Irrigation consortium which covers an area of about 50'000 hectares with flat topography, hot summer and warm winter, mainly irrigated with pressurized aqueduct, mainly devoted to wheat, tomatoes and fresh vegetables cultivation; the Chiese irrigation consortium in Northern Italy with higher water availability, mainly cultivated with maize.

5O2. Assessment of the future climate potential for tourism over Spain using a combination of downscaling approaches and quantitative impact models

M.F. Cardell, A. Amengual, R. Romero

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Spain is recognized as one of the most visited tourist destinations worldwide but also as a climate change hot-spot. Climate is a key resource and even a limiting factor for many types of tourism. Owing to climate change, modified patterns of atmospheric variables such as temperature, rainfall, humidity, radiation and wind speed will likely affect the suitability of the Spanish destinations.

Quantifications of second-generation climate indexes for tourism are derived from observations and model projected daily atmospheric data. Specifically, daily observed series of 2-m maximum temperature, accumulated precipitation, 2-m relative humidity, mean cloud cover and 10-m wind speed from ERA-5 reanalysis are used to derive the present climate potential. For projections, the same daily variables are obtained from the DMI-HIRHAM5 regional climate model –included in the European CORDEX project– under the rcp8.5 future emission scenario. To properly derive CITs at local scale, a quantile–quantile adjustment is applied to the simulated regional scenarios. This adjustment method detects changes in the continuous CIT cumulative distribution functions (CDFs) between the recent past and future time slices and applies these changes, once calibrated, to the observed CDFs.

Results of the future climate potential for relevant tourist activities in Spain (cycling, cultural, football, golf, sailing and hiking) will be presented. With this information at hand, it is expected that main tourism stakeholders can respond more effectively through mitigation and adaptation strategies to the challenges imposed by climate change.

5O3. Atmospheric circulation patterns promoting the scarcity of near-natural Iberian hydrological resources since 1980s

A. Halifa-Marín[1], M.A. Torres-Vázquez[1], M. Lemus-Cánovas[2], E. Pravia-Sarabia[1], P. Jiménez-Guerrero[1], J.P. Montávez[1]

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Several studies have noticed an abrupt decrease of winter precipitation winter precipitation in the Iberian Peninsula since 1980s. Under this umbrella, the main aim of this contribution is to identify and analyze the potential links between the winter precipitation variability and near-natural Iberian hydrological resources. For this purpose, the dataset of Monthly Near-Natural Water Inflows to Reservoirs of Spain was created, including 65 series covering the period 1952-2017. The trends and the differences between 32yr-periods (1952-1984/1985-2017) of winter water inflows series have been analyzed for DJFM months. The results warn of an important reduction of winter water inflows (~20/40%) since 1980s, especially in the area most influenced by Atlantic flows. Henceforth, the variability of atmospheric circulation has been estimated in order to glimpse the causes of reductions of winter precipitation. A Circulation Types (CTs) classification has been conducted based on the SLP and Z500 from NCEP Reanalysis over the domain -10W, 6E, 44N, 36S. Then the changes of winter frequency of the resulting 72 CTs has been obtained. The results show a decrease in the frequency of some CTs promoting moisture fluxes coming from the SW. This permits to explain the behaviour of winter water inflows which correlated ~0.8 with winter precipitation and ~0.7 with the frequency of some CTs. Hence, these results shed some light on the causes of the reduction in the Iberian hydrological resources and winter precipitation, enabling the identification of mitigation and adaptation policies for optimizing the present/future regional water management strategies.

5O4. Temperature and absolute humidity as early predictors of COVID-19 first wave severity and transmission intensity in Spain

B. Hervella[1], M. Y. Luna[1], J. Díaz[2], C. Linares[2], F. Belda[1]

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Within the same country, Spain, with the same cultural aspects and containment policies, why in the initial moment of the COVID-19 first wave, given a significant number of infections, the disease prospered more intensely in some areas than in others? The hypothesis is that the outbreak weather conditions are relevant factors which could be used as early predictors of the COVID-19 first wave severity and transmission intensity. The study examines the associations between COVID-19 first wave severity and transmission intensity in 50 Spanish provinces, expressed as maximum daily incidence rate and outbreak incidence rate doubling speed, with outbreak moment average temperature and absolute humidity controlling for various socioeconomic factors. A principal component analysis and a linear regression model approach proved the existence of correlation between the variables; nevertheless, socioeconomic factors employed are less important than weather factors, particularly population density of most populated municipality and pre-lockdown intra-provincial movements. Temperature is the most important driver followed by absolute humidity and the correlation found in both cases is negative. The results show that the virus has harder time intensifying and spreading in warmer temperature and higher absolute humidity during the first wave. The model obtained could be used as an useful supplement to help authorities to act quickly taking preventive measures but its use is limited to future situations in which meteorological factors become relevant again; that is, when the current political and social restriction and health measures disappear when the disease becomes endemic and shows clearly its seasonal pattern.

5O5. Winds blowing across the Mediterranean: reanalysis vs reality

J. Ramon, Ll. Lledó, A. Soret, F. Doblas-Reyes

Barcelona Supercomputing Center

Actions devoted to reducing greenhouse gas emissions in Europe have resulted in the construction of new onshore and offshore wind farms. Still, further efforts are needed to meet the requirements set by the Paris and Green Deal agreements. The Mediterranean region is expected to face a substantial increase in the wind power installed capacity in the coming years, mainly thanks to the advent of floating wind turbines. In this sense, it is now crucial to evaluate the wind resource in the Mediterranean basin accurately.

Reanalysis datasets are routinely employed to draw a clear picture of the wind climatology and variability. These provide gridded observational estimates of multiple climate variables on a global scale. Various reanalyses coexist nowadays so that selecting the most suitable product appears challenging without a previous quality assessment. In this work, we compare the merits of different reanalyses such as the ECMWF ERA-Interim and ERA5 and the JMA JRA-55, the NCEP/NCAR reanalysis R1 and MERRA-2. Then, a comparison of monthly and seasonal wind speeds against on-site surface observations is performed. In this way, we will eventually elucidate which the most accurate reanalysis to represent wind speeds in the Mediterranean is.

5O6. Impacts of unpredictable climate variability on renewable energy deployment

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Renewable energy sources represent the future of electricity generation, being the fastest growing energy generation technology. However, its production is variable, even intermittent, which leads to structural, technological and economic issues. This variability is inevitable as renewable energy sources are entirely linked to climate and its inherent variability, which can be divided in its predictable and unpredictable components. The approach proposed in this work uses complementarity between different energy sources as the key element towards reaching the best mix of renewable installed capacity. The Markowitz portfolio theory constitutes the perfect tool for an analysis of this kind, allowing for the study of optimal renewable deployment for a specific climate. The e4clim model integrates portfolio theory with climate and electricity data in order to find the best allocation for the installation of different renewable energy sources. The model is used to carry out a mean-variance analysis and study the impacts of predictable variability on optimal energy mixes, especially on the risk definition. Results show important deficiencies in the current renewable mix and large room for improvements, which should be considered in near future new deployment plans. The proposed method targets the risk from unpredictable climatic variability in a more consistent and meaningful manner for system managers and users, rendering more relevant and consistent optimal energy mixes.

Oral presentations, 26th May 2021

9h – 10h45: Session 5. Processes and Applications

(Chair: J. Cuxart, P. Le Moigne)

2O1. High-precision weighable lysimeter - a holistic tool for quantifying and tracking water fluxes at the land surface and in the soil

J. Groh[1], H. H. Gerke[2], J. Vanderborght[1], H. Vereecken[1], T. Pütz[1]

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Quantifying and closure of the soil water balance is fundamental for understanding the site-specific hydrological cycle and for studying land-atmosphere interactions. We will present actual results from the Germany-wide lysimeter network TERENO-SOILCan that provide new insights into the quantification of day and night water fluxes and their importance for observing and simulating ecosystem services (i.e. yield, water quantity and quality), especially in the context of climate change. The benefit of such an observation system is that weighable high-precision lysimeter takes into account feedbacks across the entire hydrological cycle (soil, plant and atmosphere) at an intermediate scale (between laboratory and field) allowing for a more holistic view on water and nutrient dynamics. These observation systems are suitable tools for model development (calibration and validation) and provide soil related data for testing modelling of soil-vegetation-atmosphere processes under known boundary conditions and are prerequisite when transferring processes from the point to larger scales.

2O2. Upper-level large-scale precursors for African dust outbreaks over the Iberian Peninsula and the western Mediterranean

J.A.G. Orza[1], S. Dhital[2], M.L. Kaplan[2]

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[2] Desert Research Institute

The penetration of upper-level troughs into low latitudes and their amplification and thinning accompanying the equatorward breaking of Rossby Waves has been observed to trigger heavy precipitation events and massive dust storms over North Africa. We present an observational analysis of three extreme dust outbreaks involving anticyclonic RWB, which indicates a strong association of secondary RWB within the Polar Jet Stream (PJ) over the North Atlantic and Western Europe as a precursor to extreme African dust storms that impact the Iberian Peninsula and the western Mediterranean. The large-scale forcing on the low-level dynamics associated with the formation of the dust storms and the restructuring of upper-level air flows critical for the poleward transport of dust to the Iberian Peninsula after ablation is linked to a sequence of multi-scale adjustments initiated by the double anticyclonic RWB process in the PJ.

As a first step to assess the climatological relevance of the secondary RWB we have analyzed the large-scale irreversible overturning of high-PV contours on the 320K isentropic surface (PJ) for the period 2000-2009: the location of 2-PVU tongues extending equatorward and the remarkable poleward extension of the 2-PVU isolines as part of the amplified wave train

accompanying the building of the subtropical ridge over the Mediterranean. The work uses ERA interim reanalysis data and false-color Dust RGB composites from MSG SEVIRI.

Work partially supported by the Spanish MINECO and EU ERDF (CGL2015-70741-R, FRESA Project). J.A.G.O. acknowledges Valencian grant BEST/2018/091 partially supporting a research stay at the Desert Research Institute (USA).

2O3. Evaluation and calibration of Heat Ratio transpiration method using hand-made probes in a Mediterranean species under contrasted climatic conditions

Ana M. Sabater[1,2], A. Vilagrosa[1,2], J.A. Valiente[1]

[1] Fundación Centro de Estudios Ambientales del Mediterráneo

[2]Universidad de Alicante

Heat Ratio Method is commonly used in several scientific disciplines such as ecohydrology, forestry and meteorology to estimate transpiration of individual trees. This method is based on the ratio of the temperature increases at two equidistant points after an intermediate release of a heat pulse. Its implementation requires three probes vertically aligned (two thermocouples and a heater) inserted in the trunk at breast height. Several Mediterranean studies focused on Pinus halepensis sp. have already used hand-made probes for the HRM (Burguess et al., 2001 and Davis 2012), however a quantitative calibration using measured water losses has not yet been performed for this species. Our objectives are: i) the evaluation of the HRM as a technique to determine pine transpiration and its relation to water losses measured by load cells, ii) the study of the effect of environmental factors such as vapour pressure deficit (VPD) and soil water content (SWC) on pine transpiration. We report results from three juvenile individuals of P. halepensis sp. with an aerial biomass of 12.9kg, 9.9kg and 6.3kg, respectively. We have measured pine transpiration at different VPD (range: 0.26-2.65 kPa) and SWC (range: 0.13-0.37 m3/m3). Total daily transpiration from the HRM and load cells were highly correlated. On average transpiration was underestimated by at least 20% using the HRM with hand-made probes without a calibration factor. Our preliminary results suggest that a quantitative calibration factor can substantially increase the accuracy of the HRM. Future species-specific calibrations are needed to obtain wider and more accurate applications.

2O4. Assessment of similarity theory error in a semi-arid environment

B. Martí, D. Martínez-Villagrasa, J. Cuxart

Meteorology Group, Dpt. Physics, Universitat de les Illes Balears (UIB)

The similarity theory equations relate the vertical turbulent flux of a variable with its vertical gradient in the surface layer. The resulting expressions are of widespread use for multiple applications although they are supposed to be only valid over flat homogeneous terrain.

The current work applies the standard functions to a site in the centre of an east-west oriented valley, locally flat and at approximately 2 km from the mountain slopes at both sides. The area is surrounded by rain-fed agricultural fields with the upper soil layer getting dry during Summer. Momentum and sensible heat fluxes are derived with the standard similarity functions

considering the Obukhov length as the stability parameter, taking measurements of wind and temperature at 2 m and a supplementary temperature observation at 0.3 m, just above the roughness sub-layer. These results are compared against the turbulent fluxes observed with an eddy-covariance system located at the same site during 8 consecutive months in 2018.

Similarity theory provides a good performance for the momentum flux along the entire studied period. For the sensible heat flux, estimations are similarly good under unstable conditions over a dry soil, while it gets over-estimated when soil moisture and, consequently, the latent heat flux are important. The nocturnal values of the sensible heat flux are usually small and the similarity theory has a less robust performance.

2O5. Statistical analysis of the sea-breeze features in the island of Mallorca

A. Grau, M. A. Jiménez

Meteorology Group, Dpt. Physics, Universitat de les Illes Balears (UIB)

The physical mechanisms that take place under sea-breeze conditions in the island of Mallorca (western Mediterranean Sea) are analysed through the inspection of data from automatic weather stations (AWS) from the Spanish Meteorological Agency (AEMET) during the period 2009–2019. Hourly satellite-derived land-surface and sea-surface temperatures (LST and SST, respectively) are used to compute the surface temperature difference (LST–SST) in the three main basins. Besides, a method (Grau et al, 2020) is taken to select the SB events in the three main basins using data from AWS during the warm months of the year (from April to September).

Results from the statistical analysis of the selected SB events show that the temperature difference changes in the three main basins pointing that other physical mechanisms are present during SB conditions. For instance, it is explored the role of the large-scale winds, the influence of the shape of the basin in the propagation of the SB front and the vertical temperature gradient (T850hPa – LST). It is found that there are differences in the SB features of the three basins (maximum wind speed, initiation and duration of the SB) and SB conditions are not simultaneously met in the three basins.

2O6. Statistical analysis of meteorological drought in Antalya Basin, Turkey

M.H. Burgan[1], H.I. Burgan[2]

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[2] *Akdeniz University*

Meteorological droughts are observed for short term periods in a year. Because of this phenomena, the estimation of meteorological drought is difficult. For this aim, the magnitude and duration of the drought are assessed with together. If meteorological drought goes on, hydrological and agricultural drought can be triggered. Any measures and management strategies should be taken and developed. Standardized Precipitation Index is widely used to evaluate the meteorological drought especially in monthly scale. Statistical distributions can be used for future projection. In this study, Antalya Basin which has Mediterranean climate is selected for the application. The meteorological gauging stations are used in the basin and near

the basin according to Thiessen Polygon method for areal total precipitation. Then, SPI is calculated for each gauging station. The best statistical distribution of SPIs is investigated for the stations. Finally, the spatial scattering of the statistical distributions which is calculated from monthly precipitation data. The gauging stations (each with 10 years of observation at a minimum) have uninterrupted data during the observation.

As a result, a very basic statistical methodology is suggested and applied in the study. The study has good results in terms of the performance. So, it is applicable to the basins which have Mediterranean climate. The decision makers and policy makers can assess the meteorological drought results in coastal regions near the Mediterranean Sea located to the South of Turkey. For long term observation, hydrological and agricultural droughts should be observed carefully for the study areas considering meteorological events.

11h – 12h30: Session 6. Processes and Applications
(Chair: A. Boone, M.A. Jiménez)

2O7. Observed mesoscale patterns in the irrigated Eastern Ebro basin

J. Cuxart, A. Grau , M. A. Jiménez, D. Martínez-Villagrasa

Meteorology Group, Dpt. Physics, Universitat de les Illes Balears (UIB)

The Eastern Ebro basin is composed of an extensive lower irrigated area, surrounded by dry-fed slopes and wooden mountain ranges to the North, East and South, while to the West is open to the agricultural Western Ebro basin. Previous studies, based on research data or on statistics for one station, indicate that these features determine the local circulations in the area. A network of stations is used here to analyze a period of 15 years, taking representative data for the different units of landscape. A filtering procedure is developed which selects the events with predominance of local circulations, based on detecting stably stratified nights.

The analysis of the filtered data indicates the presence of a valley circulation between the lower plain and the slopes and mountains that reverses its sense of circulation between day and night, which intensity varies in summer due to an increasing thermal contrast between irrigated and rain-fed areas. The presence of sea-breeze in the late afternoon in the warm months is common, bringing cooler and wetter marine air to the area after crossing the mountain range at the South. At night in the centre of the basin, cold air pools are formed, which evolve to persistent fog events in winter, causing the statistics to be very different in that season compared to the rest of the year.

2O8. The role of storm motion in controlling hydrological response: the 28 September 2012 catastrophic flash flood in Murcia, south-eastern Spain.

A. Amengual[1] , M. Borga[2]

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Flash flooding is strongly modulated by the spatial and temporal variability in heavy precipitation. Convective system motion prompts a continuous change of variability in rainfall that interacts with the physical features of a basin. The impact of storm motion on hydrological response is assessed for the 28 September 2012 flash flood over the semi-arid and medium-sized Guadalentín catchment in Murcia, south-eastern Spain. Despite the numerous structural measures deployed, the death toll was six and estimates of flood damage were of EUR 64 million. The influence of storm kinematics on hydrological response is examined through the catchment-scale storm velocity. This variable quantifies the interaction between the convective system motion and flow-path network, assessing its influence on hydrograph shape. By comparing two hydrological simulations forced by rainfall scenarios of distinct spatial and temporal variability, it was possible to effectively isolate the role of precipitation system movement on basin reaction. Results show that: the combination of different amplifying processes led to the severity of this event; (ii) storm motion was the main factor controlling peak discharge and hydrograph timing; (iii) influence of storm kinematics on hydrological response was largest at basin extent ranging from 100 to 500 km2 and; (iv) impact on peak discharge enhanced with increased catchment-scale storm velocity. In the end, this extreme flash flooding provides a valuable study

case of how the interaction between storm motion and drainage properties modulate hydrological response at different spatial scales.

2O9. 50-year wind record and rissaga event associated with a winter squall line in the Balearics

A. Jansà[1], J. Campins[2], D. Carrió[3], C. Estarellas[2], V. Homar[1], B. Mourre[4], M.A. Picornell[2], C. Ramis[1], R. Romero[1], J. Tintoré[4]

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[3] School of Earth Sciences, The University of Melbourne

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During 22 January 2021, an active squall line associated with the intense cyclone Hortense, which travelled from the Atlantic to the Mediterranean region, was developed and swept across Mallorca and Menorca . Strong winds associated with this squall line affected the Balearic Islands. In particular, these intense winds broke the 50-year record wind at the Palma airport, with wind gusts of 130 km h-1. An outstanding long-lived pressure jump was associated with the squall line, giving rise to a moderate meteotsunami or rissaga event that reached 60 cm wave height in the port of Ciutadella (Menorca). Notably, this rissaga effect was also observed in other locations of the Balearics. An observational description of the event, using land-based and remote-sensing systems, is presented. In addition, an approach to the diagnosis of the processes involved is carried out. Finally, using atmospheric and marine numerical models, the predictability of the event is explored.

2O10. A neural network designed to predict meteotsunamis in Ciutadella harbour (Balearic Islands, Spain)

M. Vich, R. Romero

Meteorology Group, Dpt. Physics, Universitat de les Illes Balears (UIB)

Atmospherically-driven large-amplitude sea level oscillations in the tsunami frequency band are common in Ciutadella harbor . These meteotsunamis can lead to wave heights of around 1 m and several episodes in modern history have reached 2-4 m, with catastrophic consequences. A timely and skilled prediction of these phenomena could significantly help to mitigate the damages inflicted to the port facilities and moored vessels. This work tests the applicability of neural networks (NN) for forecasting rissagues (meteotsunamis local name). To feed the NN with suitable inputs, we explore the key physical mechanisms that drive meteotsunamis in Ciutadella harbour. Particularly, two different NNs are built: a dry and wet scheme. The dry scheme focuses on the development of atmospheric gravity waves (governed by temperature and wind profiles across the tropospheric column), while the wet scheme also takes into account the occasional influence of moist convection by incorporating the humidity variable. Both NNs are trained using resilient backpropagation with weight-backtracking method. Their performance is tested with deterministic verification indices. The NNs results show a skill comparable to that of computationally expensive approaches based on coupled ocean-atmosphere simulations. However, the expected greater versatility of the wet scheme cannot be clearly proved owing to

the training database limited size. Nevertheless, the results confirm the potential of a NN approach and encourage the operational implementation of a rissaga NN forecasting system. Moreover, this forecasting system could easily include probabilistic forecasting strategies thanks to the cheap computational cost of applying an already trained NN.

2O11. The convective evolution of Mediterranean Tropical-Like Cyclones

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The present work focuses on the diabatic processes during deep convection activity in Mediterranean Tropical-Like Cyclones (MTLCs) in order to better understand the processes leading to cyclone intensification periods. A major gap in the literature about the organization of DC during MTLCs has motivated us to investigate the structure and intensity of DC, and how it is connected with environmental shear and changes in vortex tilt. First, a prototype objective infrared satellite diagnostic was used along with microwave diagnostics and numerical reanalysis to detect DC during MTLCs that developed between 2005 and 2018. In addition, the vertical wind shear and vortex tilt were computed for the first time in a MTLCs' study, providing new insights into the organization of DC activity. As a second step, a state-of-the-art numerical model was employed in high-resolution mode to study the diabatic intensification of the MTLCs by using a modified version of the classical Pressure Tendency Equation. We further explored the vertical and horizontal distribution of Potential Vorticity (PV) during MTLCs by using an online PV-budget diagnostic. Results showed significant advances in the understanding of the contribution of diabatic processes in the intensification of MTLCs. By combining the findings in both the observational and numerical studies, a two-fold classification and a definition of MTLCs are finally proposed.

2O12. Meteorological and photochemical modeling analysis of extreme ozone episodes in Barcelona and surrounding region during summer 2019

M. Udina[1], J. Bech[1], C. Jaén[1,2], E. Pérez[3], C. Alonso[3]

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Very high concentrations of ozone were registered during the summer of 2019 in Catalonia . During summer high ozone concentrations occur inland in Catalonia, due to precursors advection (NOx and VOCs) mainly from Barcelona Metropolitan Area (AMB), limited by an eastern and a western valley. The analyzed ozone events occurred on June 28-29 and July 23 2019 and were characterized by synoptic anticyclonic conditions and surface temperatures over the 98th percentile (over the last 40 years), during heat waves declared by the government (Jaén et al. 2020). Ozone episodes are analyzed using the high-resolution forecast air quality ARAMIS system, which integrates WRF and CMAQ models. The analysis of measured and ARAMIS modeled concentrations showed that advection on June 28 and July 23 made its way through the eastern Barcelona valley and on June 29 through the western one. The model and trajectory analysis confirmed the precursor advection from AMB and the sea breeze recirculation between June 28 and June 29. In addition, NO2 concentrations measured in Barcelona was found to have influence in urban and rural ozone concentrations, 100 km away from AMB. Results provide a better understanding of different mechanisms involved in the extreme 2019 ozone episodes and may contribute to improve the management of future events.

Reference: Jaén, C., Udina, M., & Bech, J. (2020). Analysis of two heat wave driven ozone episodes in Barcelona and surrounding region: Meteorological and photochemical modeling. Atmospheric Environment, 118037.

14h30– 16h15: Session 7. Numerical modelling

(Chair: R. Romero)

4O1. What are the key elements to properly represent the surface and its processes in numerical models?

Patrick Le Moigne

Centre National de Recherches Météorologiques, Météo-France

The land surface is an important object because it is where biodiversity develops and where people live, especially in urban areas, where population density is sometimes very high. These same people have professional activities directly linked to nature, such as agriculture, fishing... the type of environment, such as foresters or stockbreeders, or recreational activities on lakes, rivers, green spaces. The land surface is also the condition at the lower limit of the atmosphere, the place where flows are significantly disturbed by natural obstacles like forests or unnatural obstacles like cities. It has a very marked heterogeneous character and it is important to represent it well in numerical models, because each type of surface has different physical properties and will therefore react in a specific way to external constraints. Moreover, these models are sensitive to the initial surface and soil conditions, all the more so if the forecast is for a few hours or days. Indeed, a bias in the initial conditions may affect the numerical simulation throughout its duration. Seasonal forecasting models, on the other hand, predict the likely state of the atmosphere several months ahead and are also very sensitive to initial conditions, particularly soil moisture. They also need to represent surface heterogeneity well, especially as their horizontal resolution is several kilometers and they therefore integrate several types of landscapes in the same model grid. In this presentation, we will show the importance of well representing spatial and temporal heterogeneity in surface models, as well as the primordial character of well initializing surface and soil variables and we will explain how this is generally integrated in the models, in particular, we will describe the modelled surface processes and how they can interact with the boundary layer. For this we will take the example of SURFEX used to model surfaces in Meteo-France models at all spatial scales, from the LES scale to the climate scale.

4O2. Land surface Interactions with the Atmosphere over the Iberian Semi-arid Environment (LIAISE): 1st modelling intercomparison

Maria A. Jiménez[1], J. Cuxart[1], A. Grau[1], A. Boone[2], S. Donier[2], P. Le Moigne[2], J.R. Miro[3], J. More[3], A. Tiesi[4], P. Malguzzi[4], J. K. Brooke[5], M. J. Best[5]

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Land surface-atmosphere interactions determine the atmospheric boundary layer features and, in the case of semi-arid regions, the water availability in the upper ground strongly conditions the surface energy balance. LIAISE is an observational campaign planned in summer 2021 designed to study the land/atmosphere interactions in a semi-arid environment enclosing a

large irrigated area in summer. Mesoscale simulations are planned over the region to contribute to understanding the processes affecting exchange fluxes between the surface and the atmosphere and its impact in the organization of the flow at lower levels.

A first mesoscale modelling inter-comparison for a summer event (16-18 July 2016) is under progress intended to evaluate the performance of the participating models compared to the observations and explore the differences between them. Four models participate in the inter-comparison: MesoNH, WRF, UKMO Unified Model and MOLOCH. They are run with similar horizontal (2km and 400m for the outer and inner domains) and vertical (2m at lower levels and stretched above) grid meshes and, in this first phase, using their default setup. Preliminary results show that each model has a different representation of the surface heterogeneities affecting the grid values of the surface fluxes. Nevertheless, the mesoscale circulations generated by them do not differ significantly. The challenge at this point is to relate the observed differences to the particularities of the parameterisations and of the physiographic data bases used by each model.

4O3. Evaluating the role of initial conditions and boundary layer parameterizations in the simulation of extreme heat events in the Valencia coastal region

I. Gómez[1], R. Niclòs[2], V. Caselles[2], M.J. Estrela[2], M.J. Barberà[2]

[1] *University of Alicante*

[2] *University of Valencia*

The Valencia coastal region is especially sensitive to extreme heat events. However, due to its geophysical characteristics and climatic conditions, the incidence of high and extreme temperatures may still be modulated over this area by means of sea breeze circulations, defining a Sea Breeze Convergence Zone (SBCZ). The current study analyses a week period in August 2010 over this area, which alternates the presence of meteorological conditions prone to high and extreme temperatures with sea breeze conditions that temper these extreme temperatures. The simulations were performed using the Regional Atmospheric Modeling System (RAMS). The analysis evaluates the sensitivity of the model to different initial conditions and two widely used Planetary Boundary Layer (PBL) parameterizations to forecast and reproduce the observed high and extreme temperatures, as well as to properly capture the main associated atmospheric patterns. It has been found that an increased horizontal resolution in the initial atmospheric fields produces a better representation of the regional and local wind flows simulated by the mesoscale model, leading to an accurate characterization of the temperature fields when these wind circulations dominate over the area of study. However, no significant differences are obtained within the intense-heat situations, associated with atmospheric synoptic-scale forcings. Regarding PBL parameterizations, the local PBL scheme tends to underestimate the daytime temperatures, while the non-local scheme produces higher temperatures than the local scheme, skilfully reproducing the observations.

4O4. The Sensitivity of WRF Parameterizations on Lightning Events in Istanbul

I. Kurşun, C. Düzgün, R. Öztürk, I. Kelkitli, Y. Ürkmez, S. Güneşlik, N. Ekinci, H. Toros

Istanbul Technical University

Lightning, one of the natural hazards, is a characteristic indicator of intense weather and usually related to hail or heavy precipitation. It is crucial to accurately predict lightning events that can be a potential threat to human life. In this context, new methods need to be developed and compared with observation data. The present study is aimed to analyze the effect of parameterization on model performance by looking at thunderstorm and lightning events for different dates with the arranged parameterization set. The lightning events that formed over Istanbul, which is the most populated city of Turkey, on 8 May 2017, 18 July 2017, 24 May 2019, 27 July 2017, and 17 August 2019 have been considered. The non-hydrostatic Weather Research and Forecasting model has been used in the study. WRF Single-Moment 6-Class Microphysics Scheme (WSM6), Kain–Fritsch Cumulus Scheme, Yonsei University (YSU) Planetary Boundary Layer Scheme, RRTMG Shortwave and Longwave Schemes, and Noah Land Surface Model Scheme are combined. The model is run with Global Data Assimilation System (GDAS) 0.25 x 0.25 resolution data. Simulations are performed on three nested domains with 9 km, 3 km, and 1 km resolutions. The preliminary results indicate that the choice of these schemes has a significant influence on the statistics of extreme events.

4O5. Development of combined statistical downscaling and machine learning models for the estimation of precipitation extremes

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The simulation of spatial distribution of rainfall amount at different scales is crucial for assessing the impact of climate change on agricultural activities, flood risk management, rain runoff processes, and surface and groundwater management. Downscaling methods as Non-homogeneous Hidden Markov Models, that link the statistical characteristics of precipitation to atmospheric predictors more robustly simulated by General Circulation Models (GCMs), are thus applied to overcome such a drawback. However, despite the positive results obtained from NHMM models in different kind of applications, NHMMs tend to (i) underestimate the intensity of rain in the autumn season and overestimate those of the spring season, (ii) have difficulty in representing the extremes of precipitation, and (iii) need of heuristic procedures for the identification of the optimum set of atmospheric predictors. Here a preprocessing of GPH and IVT data has been introduced by using a Stacking model to overcome such criticalities. PCA of GPH and IVT data were transformed by stacking directly into rain probability based on six rain percentiles; these were taken as an intermediate predictor in the NHMM model. The above described approach is developed and validated for the Agro-Pontino Plain, a coastal reclamation region very vulnerable to hydrological cycle changes. Atmospheric fields of IVT, GPH 850 hPa from the NCEP/NCAR, are assumed as atmospheric predictors and 55-years record (1951–2005) of daily rainfall measurements from 36 stations divided into 3 clusters (North - Est - South) in Agro-Pontino Plain are used for model training and validation.

4O6. Lightning Potential Index performance in convection-permitting simulations of hail events in Croatia – sensitivity to microphysics and PBL schemes

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Mediterranean Basin is struck every year with convective weather events that cause dozens of fatalities and millions euros of damage. Lightning activity is a characteristic phenomenon that often accompanies severe weather, and especially hailstorms. Lightning Potential Index is a measure of the potential for charge generation and separation, which results in lightning flashes during convective thunderstorms. Considering the relationship between significant lightning activity and deep convective processes, such as hail, we assessed the ability of LPI to represent the observed lightning activity that accompanied several hail events in Croatia.

Selected hail events are simulated using Weather Research and Forecasting (WRF) model at cloud permitting grid spacing (1 km). Using vertical profiles of liquid and ice water content and vertical velocity, LPI is determined directly from the model's output fields. Thus, LPI maps the area that has the potential for electrical activity based on both model's dynamical and microphysical fields. Moreover, we formed an ensemble of simulations with combinations of three different planetary boundary layer (PBL) and four different microphysics parameterization schemes for each analyzed hail event. Further, we assessed the sensitivity of LPI to parameterization scheme choice and investigated LPI's ability to reproduce the temporal and spatial characteristics of the lightning activity observed with LINET network. Our results indicate that LPI is more sensitive to microphysics than PBL parameterization schemes with one of the microphysics schemes systematically underperforming the others. Possible reasons for such discrepancies are addressed as well.

Oral presentations, 27th May 2021

9h – 10h45: Session 8. Numerical modelling

(Chair: E. Tan, K. Horvath)

4O7. Enhancement of orography-induced rainfall in presence of large-sized cloud condensation nuclei

E. Pravia-Sarabia, A. Halifa-Marín, J.P. Montávez, J.J. Gómez-Navarro, P. Jiménez-Guerrero

Universidad de Murcia

During the last days of 2009, the Southernmost part of the Iberian Peninsula was affected by a series of Atlantic fronts producing heavy rainfall in mountainous locations, fostered by the presence of an atmospheric river, which provided a strong entrainment of water vapor. The terrain-induced convection favoured the water vapor uptake by cloud condensation nuclei through adiabatic cooling, with aerosols-cloud interactions as a key factor in the formation of rain. In the present contribution, a number of simulations are carried out to study the microphysical processes governing the rain production, mainly droplet activation, droplet growth, and auto-conversion are studied. Specifically, the role of the Morrison double-moment microphysics scheme, with resolved supersaturation and droplet activation, is investigated under both the use of a bulk scheme with prescribed particle size distribution and interactive aerosols calculation with a bin size representation in WRF-Chem meteorology/chemistry coupled model. Results show that using prognostic aerosols concentrations for natural aerosols, namely sea salt (SSA) and dust, improves the model's skill for reproducing extreme rainfall, with respect to the default prescribed CCN in WRF-alone simulations. Moreover, prognostic aerosols increase upwind precipitation and reduce downwind rainfall, being the spatial variability of precipitation along the direction of the moisture flux largely amplified. Consequently, both the size and hygroscopic properties of aerosols have a crucial impact on the microphysical processes involved in such an event, being large-sized nuclei originating from natural aerosols, and with a high hygroscopicity, more prone to reach critical radius, thus enhancing the auto-conversion rate.

4O8. Performance Testing on Wind Forecasts of WRF Model with Analysis Data in Turkey

Y. Kara ,U. Dinç, Z.F. Ünal, N.G. Deniz, H. Toros

Istanbul Technical University

The wind speed is a problematic variable to forecast compared to other variables because of having more stochastic nature when it comes to the meteorological aspect. Atmospheric composition and meteorological variables, also complex terrain features (mountain ranges, valleys etc.) play great roles in determining not only wind speed but the direction in Turkey. Moreover, knowing and increasing the percentage of prediction consistency in wind speed and direction for the near future has high socio-economic value in many areas, especially in renewable energy sources. Accurate estimation of wind speed has big importance in wind power energy calculations since there is a complicated relationship between wind speed and output power energy. There are diverse statistical and atmospheric models to forecast wind speed in use, but forecasting with atmospheric models are better due to aspects of the atmospheric and physical process' in various scales. In this study, the WRF v4.2.2 model having 9 km spatial

resolution with NOAA's GDAS 0.25° resolution data as input data is simulated for Turkey to obtain hourly wind speed and direction values. To test the performance of the WRF model, RMSE, MAE, BIAS and Pearson Correlation Tests are done by using hourly wind speed and directional data gathered from the Turkish State Meteorological Service's 81 observation stations in Turkey and WRF model output data between the years 2017 and 2018. The assessments were issued separately for each month for 2 years and were presented with seasonal and annual performance values.

4O9. WRF simulation of the atmospheric conditions of the sightings of the Balearic mountain range from the central Catalan mountain range.

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The sighting of the mountain ranges of the island of Mallorca from the central Catalan coast is a fact reported for centuries, and systematically recorded by weather observers of the Observatory Fabra of Barcelona. Several historical local reports refer to these sightings to an extraordinary transparency of the air, which enhances large visibility. However, is the extraordinary atmospheric transparency the main condition for being able to observe the island? Is it also necessary any optical phenomenon to facilitate these sightings? What is the role of the SST in these sightings? This communication aims to answer these questions. By means of several WRF simulations and a sighting database from 2010 to 2020, we analyze the atmospheric dynamics during some days when sighting occurred. Previous to the WRF simulations, a statistical analysis has been made from this database to determine the spatial and temporal characteristics of 10-years sightings, and select some of them to be simulated. The sighting of 24-27 January 2019 has been chosen, which includes a non-sighting event on 24, the highest quality and lifetime sighting on 25, a regular event on 26, and a no sighting on 27. The results of the simulation of this period show that a marked thermal inversion layer near the sea surface is formed in the major sighting on 25 and the event on 26, which have not the best atmospheric features to improve the visibility in comparing with the non-sighting on 24 and 27.

4O10. Testing mesoscale ensemble generation strategies: Application to Mediterranean high-impact weather forecasting

A. Hermoso, V. Homar

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The Mediterranean region is regularly impacted by heavy precipitation episodes, causing substantial human and material losses. Despite recent progresses in the modelling and prediction of such extreme events, the generation of precise forecasts of socially relevant aspects of convective phenomena, such as intensity, location, and timing remains challenging and unsolved. The deficiencies of current numerical weather prediction models stem from inaccuracies in the estimation of the initial atmospheric state across the scale of interest and from the lack of full understanding of the small-scale highly nonlinear processes involved in the

genesis and evolution of deep moist convection. In this context, ensemble prediction systems represent a feasible approach to sample the inherent uncertainties of numerical weather forecasts.

In this work, we investigate the properties of perturbations to initial conditions and model parameterizations of subgrid processes in a convection-permitting setting for a set of heavy precipitation episodes over the western Mediterranean. In particular, (i) dynamical downscaling from a coarser resolution global model and (ii) tailored bred vectors, are applied to sample initial condition uncertainties; whereas (iii) stochastic parameterizations are introduced to perturb model parameterization. The characteristics of individual perturbations (i.e., initial conditions or model parameterizations) and combined perturbations, considering both error sources, are analysed in terms of ensemble diversity and skill. This study contributes to the identification of the most significant error sources for the prediction of Mediterranean heavy precipitation events, providing valuable guidance to design efficient and skilful convection-permitting EPSs.

4O11. Coastal risks induced by Mediterranean hurricanes

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Medicanes, for Mediterranean hurricanes, are mesoscale cyclones with morphological and physical characteristics similar to tropical cyclones. Although less intense, smaller and rarer than their Atlantic counterparts, Medicanes remain very hazardous events threatening islands and continental coasts within the Mediterranean Sea. The latest strong episode Medicane Ianos, resulted in severe damages in Greece and several casualties. This work investigates the oceanic response to these extreme events along the Mediterranean coasts under present-day and future (21st century) conditions. To this end, a coupled hydrodynamic-wave model is used to simulate both storm surges and wind-waves generation and propagation in the Mediterranean Sea at high resolution (~2 km) along the coastlines. A dataset of thousands of Medicanes synthetically generated from twenty global climate models and two reanalyses is used to derive the atmospheric forcing fields. Regional coastal risks assessment is performed for the present and future climate. We found increased coastal extreme sea levels in line to the reported changes in Medicane activity, with fewer events but of larger intensity projected by late 21st century.

4O12. TRAM with Physics: A New Numerical Model Suited for All Kinds of Atmospheric Applications

R. Romero

Meteorology Group, Dpt. Physics, Universitat de les Illes Balears (UIB)

A dynamical core of our own model in the context of a dry-adiabatic atmosphere, had been previously released. It uses a nonhydrostatic and fully compressible version of the Navier-Stokes equations. Advection terms are solved using a Reconstruct-Evolve-Average (REA) strategy over

the computational cells. These cells consist of equilateral triangles in the horizontal. The classical z-coordinate is used in the vertical, allowing arbitrary stretching (e.g. higher resolution in the PBL). Proper treatment of terrain slopes in the bottom boundary conditions allows for representing accurately the orographic forcing. To gain computational efficiency, time-splitting is used to integrate separately fast and slow terms and acoustic modes in the vertical are solved implicitly. For real cases on the globe, the Lambert map projection is applied and all Coriolis and curvature terms are retained. No explicit filters are needed.

Now we have completed TRAM with a proper set of physical parameterizations of cloud microphysics, cumulus convection, short and long-wave radiation, PBL processes and surface fluxes. The model is suitable to simulate circulations ranging from small-scale thermal bubbles ($\asymp$ 100 m scale) to synoptic-scale baroclinic cyclones (> 1000 km size), including orographic circulations, thermally-driven flows, squall lines, supercells, all kinds of precipitation systems and medicanes. Various examples of the great versatility offered by TRAM will be presented in this talk, with special emphasis on Mediterranean case studies. Besides opening a myriad of academic and research applications, TRAM regional forecasts at different resolutions will soon be disseminated in the web.

10h45 – 12h15: Session 9. Remote and in-situ measurements

(Chair: R. Niclòs)

3O1. The potential of Copernicus data for near-real-time monitoring of water and energy fluxes at continental, regional and local scales

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Evapotranspiration represents an important transfer of water vapour and energy from the land surface into the atmosphere, with key implications in meteorology and hydrology. A water balance requires knowing all inputs and outputs in the system, and as such, it is sensitive to uncertainties in precipitation, especially in case of localized rainfall and irrigation activities. One sound approach to overcome this issue would be to use remote sensing. A wide range of remote sensing models based on the energy balance have been proposed, in which the radiometric surface temperature (LST) becomes crucial in partitioning the available energy between sensible and latent heat fluxes. However easy access to reliable, operational estimates of LST with the sufficient spatio-temporal resolution becomes a challenge, as the only operational high-resolution thermal mission, onboard Landsat satellites, has a low revisit time. This is particularly relevant in irrigated schemes and regions where the agricultural fields are small and temporal patterns dynamic. Despite the current Sentinel constellation lacking a high-resolution thermal mission, recent studies showed the possibility of combining Sentinel-3 and -2 observations for providing daily ET estimates at 20 m while remaining consistent with regional estimates at coarser scales. We present the latest results regarding near-real time ET monitoring at different scales with Sentinel imagery. These products were tested and validated using ground-measured data in agricultural fields in shoutheastern Spain, including different crop types, annual and perennial, and different irrigation systems. A spatio-temporal robustness assessment in providing regional and/or continental estimates of ET is also presented.

3O2. Necessity for high resolution LST in the Mediterranean Agroecosystems. Bridging the gap by merging Sentinel-2 and Sentinel-3

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Land Surface Temperature plays a key role in soil–vegetation–atmosphere processes, and becomes crucial in the estimation of surface energy flux exchanges and actual evapotranspiration (ET). Modelling field-scale ET requires high spatio-temporal resolution in the thermal data. Disaggregation techniques offer a solution to the lack of high-resolution satellite Thermal InfraRed (TIR) data, and data fusion between Sentinel-2 (S2) and Sentinel-3 (S3) can bridge this gap until next generation of thermal satellites are launched. This work explores the

potential of this S2-S3 synergy in a typical semiarid agricultural area of the Mediterranean basin, the Barrax test site in Spain. This area provides a unique opportunity to evaluate downscaling techniques, due to the mixture of croplands with different field sizes and coverage conditions. Maps of LST with 20-10-m spatial resolution were obtained from the synergy S2-S3 images for a set of 15 different dates in the summers of 2018-2019. Ground measurements of LST transects, together with a set of Landsat-8/TIRS scenes, collocated with S3 overpasses were used for the assessment of two recent disaggregation approaches. Despite the large range of conditions and temperatures registered (295-330 K), differences with observed values resulted in an average RMSE

3O3. Analysis of thermal disaggregation techniques: machine learning and deep learning model comparison

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Applications such as crop monitoring require greater availability of thermal information, especially Land Surface Temperature with appropriate temporal and spatial resolutions for finer field scale. Many authors have developed or tested methods to extract the LST at the sub-pixel level by using complementary remote sensing products, with promising results. These approaches are generally based on correlations between vegetation indices, such as the NDVI, and the temperatures for a given cover, using regression techniques. The availability of additional indices and variables related to the LST, together with new models based on machine learning and deep learning methods offer new possibilities on this field. This work explores the application of some of these models to the combination of EOS-MODIS products (LST at 1000m and VNIR data at 500m) with Sentinel-2-MSI (VNIR data at 10m). As a first approximation to the search for a robust LST disaggregation model, this work shows an intercomparison of the results obtained by using different sets of spectral indices

3O4. Buoy sea-air temperature observations in the Balearic Sea

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In the coastal zone, the land surface temperature can be much warmer and also much colder than the sea surface temperature (SST) in an adjacent area, as can be clearly seen in Grau et al. (2020) for the case of the southern Mallorca Island. It is also clear that the air temperatures 2 m above land are less extreme than the corresponding LST. However, it remains unclear what happens with regard to the air temperature over sea, with reference to the SST. To explore this question, we have used available temperature data measured simultaneously at the air over sea (at 3m) and at the sea surface (SST) in the Dragonera buoy (SW of Mallorca), after analysing the representativeness of the buoy SST data. The daily oscillation of the air temperature over sea is not as reduced as the daily oscillation of SST but it is much smaller than the daily oscillation of the air over land and, even more, than the daily oscillation of LST. Another interesting result of the comparison between air temperature over sea and SST is that the air is almost always colder

than the sea. Finding air warmer than the sea below is very infrequent. Finally, the possible influence of warm and cold advections on the air-sea temperature difference is also considered.

3O5. Analysing trends in the Mediterranean sea surface temperature retrieved from Envisat-AATSR data

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Sea surface temperatures play a crucial role in showing past and predicting future climate trends and weather patterns. Other studies have highlighted the significant role that anomalous SSTs in the Mediterranean have played in extreme weather events in the region and a further understanding of the trends and spatial patterns of the SST in the region is essential in predicting and mitigating these.

In this study, a nine year period (2003-2011) is analysed using thermal infrared data from the Advanced Along Track Scanning Radiometer (AATSR) aboard the European Space Agency's Envisat satellite. Trends of 0.086 ± 0.005◦C/yr and 0.069 ± 0.005◦C/yr are found for night-time and daytime data respectively for the whole Mediterranean Sea for this period. Using clusters analysed in previous works, trends are shown in different regions and it is found that the Levantine Basin and Black Sea consistently display the highest rates of warming, whilst the lowest rates are in the Adriatic Sea in winter and autumn and the Tyrrhenian Sea and Gulf of Lion in spring and summer. Of the 172 clusters analysed, 77 showed positive SST trends and 26 showed negative trends. For the whole Mediterranean 7 of 12 months showed warming trends and five showed no detectable trend. None showed a negative trend.

14h30 – 15h30: Session 10. Remote and in-situ measurements
(Chair: M. Udina)

3O6. Land surface Interactions with the Atmosphere over the Iberian Semi-arid Environment (LIAISE) Project: Field Campaign Update

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The international initiative LIAISE was launched several years ago with the objective of obtaining a better understand of how the fluxes from highly contrasting surfaces, notably between irrigated and natural non-irrigated areas, exchange energy and mass within the atmospheric boundary layer and how this impacts local to regional scale circulation patterns. Here we present an update of the recently begun observational campaign as part of the HYdrological cycles in the Mediterranean Experiment phase 2. Since it's inception, many new groups have joined LIAISE with their corresponding instruments. The field campaign is taking place over the Pla d'Urgell region within the Ebro basin in NE Spain. A long observation period is underway with continuous measurements of the surface energy and water budget components for multiple representative land cover types, including irrigated surfaces. A Special Observing Period will take place during a 15-day period in July 2021 when land surface heterogeneity is at a maximum, and will include lower atmospheric measurements from tethered balloons, lidar, UHF profilers, frequent radio-sounding releases, UAVs and aircraft, along with detailed surface biophysical measurements. 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.

3O7. An overview of the Analysis of Precipitation Processes in the Eastern Ebro Subbasin (WISE-PreP) Project

J. Bech[1], M. Udina[1], B. Codina[1], S. Gonzalez[2], A. García-Benadí[1,3], P. Altube[4], J. Mercader[4], A. Callado[2], J. Arús[2], O. Rodríguez[1], E. Casellas[1], F. Roura-Adserias[1], A. Rosell[1], F. Polls[1], B. Kosovic[5], A. Montornès[6], P. Escribà[2], L. Trapero[7], A. Paci[8], B. Boudevillain[9], A. Tokay[10]

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Characterization of evapotranspiration and other key processes of water cycle in semi-arid environments are among the scientific objectives of the “Land surface Interactions with the Atmosphere over the Iberian Semi-arid Environment” international field campaign scheduled for 2021. The campaign is focused on a region with highly contrast surface characteristics (irrigated vs non-irrigated areas), particularly during summer. This presentation provides an overview of a specific project (WISE-PreP), designed to study precipitation processes within the framework of LIAISE aiming to characterize possible differences in precipitation induced by surface characteristics. For this purpose, planned instrumentation for the campaign includes the deployment of three sites equipped each with a vertical radar Doppler Micro Rain Radar (MRR) and a laser disdrometer (PARSIVEL), covering an irrigated, non-irrigated, and a transition site – in total, three disdrometers, model PARSIVEL-2, and three MRRs, one model MRR-2 and two MRR-PROs. Vertical precipitation profiles will be studied to characterize raindrop size distributions, microphysical processes, and related variables such as precipitation intensity or convective vs stratiform rainfall regimes. These data will be complemented with raingauge data, conventional weather radar observations, and satellite products, as well as high resolution deterministic numerical weather prediction model data and Ensemble Prediction Systems (EPS) runs to examine in detail selected case studies. This research is funded by project “Analysis of Precipitation Processes in the Eastern Ebro Subbasin” (WISE-PreP, RTI2018-098693-B-C32) and the Water Research Institute (IdRA) of the University of Barcelona.

3O8. Micro Rain Radar precipitation observations of cyclones Filomena and Hortense

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High impact cyclones affect regularly the Mediterranean region. In January 2021, two cyclones, Filomena and Hortense, caused respectively extreme snowfalls, and heavy rainfall and strong winds over the Iberian Peninsula. This communication focuses on the observation of precipitation caused by Filomena and Hortense over the city of Barcelona using measurements of a vertical profiler Doppler Micro Rain Radar, model MRR-Pro, and collocated Particle Size and Velocity disdrometers. MRR spectral data has been studied applying a dealiasing and post-processing methodology (Garcia-Benadí et al. 2020) adapted here to MRR-Pro features. This resulted in a better characterisation of radar reflectivity and Doppler velocity, together with an estimation of the bright band and precipitation particle type. Measures include valuable information about particle size distribution, convective columns with increased reflectivity, and bright band variation, among others, which can provide the basis for a better understanding of precipitation microphysical processes involved. The methodology developed here will be applied to study precipitation events during the "Land surface Interactions with the Atmosphere over the Iberian Semi-arid Environment" (LIAISE) field campaign scheduled for 2021. This study was partly funded by project "Analysis of Precipitation Processes in the Eastern Ebro Subbasin" (WISE-PreP, RTI2018-098693-B-C32) and the Water Research Institute (IdRA) of the University of Barcelona

3O9. Wind channeling along the largest Pyrenean valley and its impacts on the surface thermodynamic parameters

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The Cerdanya Cold Pool programme was designed to study the thermal structure and wind circulation of the air within La Cerdanya valley (Western Pyrenees, Catalonia) under fair-weather conditions. A first statistical study from the meteorological stations of the area, combined with numerical simulations, led to two experimental campaigns that took place in autumn 2015 (CCP15) and winter 2017 (CCP17). Along this period, a surface energy balance (SEB) station and a RASS-sodar from the Catalan Meteorological Service were in continuous operation to monitor, respectively, the surface energy fluxes and the vertical structure of temperature and wind within the first 300 m over the ground in the middle of the valley. La Cerdanya is an E-W oriented valley 35 km long and 9 km wide located at 1000 m above sea level (asl) and 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). Its topographical configuration favors the wind channeling along the valley under a wide range of synoptic conditions and its interaction with the valley surface is relevant for the evolution of the thermodynamic variables and its exchange fluxes at the surface interface. This communication will present a statistical analysis of the two-year-long data provided by the afore-mentioned instrumentation.

15h45 – 17h: Session 11. Remote and in-situ measurements

(Chair: J. Bech)

3O10. Towards an enhanced extreme-wind observation capability over the Mediterranean

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Satellite-derived, accurate high and extreme sea surface wind observations are essential for meteorological, ocean, and climate applications. In particular, these observations can potentially improve the monitoring and forecasting of extreme weather events, such as hurricanes or Medicanes. However, how strong does the wind blow in a hurricane proves a question that is difficult to answer, but has far-reaching consequences for weather forecasting and hurricane advisories. To properly assess and calibrate the current and future satellite-derived extreme winds, including those from the C-band scatterometers, building a consolidated high and extreme wind reference data set is crucial. In this work a new approach is presented to assess the consistency between moored buoy winds and those derived from the Stepped-Frequency Microwave Radiometer onboard the NOAA “hurricane hunters”. To overcome the absence of abundant direct collocations between these two data sets, the reprocessed Advanced Scatterometer, (ASCAT)-A, winds at 12.5 km resolution, from 2009 to 2018, have been used to perform an indirect SFMR/buoy winds inter-comparison. The ASCAT/SFMR analysis reveals an ASCAT wind underestimation for winds above 15 m/s. SFMR measurements are calibrated using GPS drop-wind-sondes (dropsonde) data and averaged along-track to represent ASCAT spatially. On the other hand, ASCAT and buoy winds are in good agreement up to 25 m/s. The buoy high-wind quality has been confirmed using a triple collocation approach. In comparing these results, both SFMR and buoy winds appear to be highly correlated with ASCAT at the high wind regime, however, they show a very different wind speed scaling. An SFMR-based re-calibration of ASCAT winds is proposed, the so-called ASCAT dropsonde-scale winds, for use by the extreme wind operational community. Moreover, the same approach is being used in the framework of the European Space Agency (ESA) project MAXSS to intercalibrate all scatterometer and radiometer wind speeds. However, further work is required to reconcile dropsonde (thus SFMR) and buoy wind measurements under extreme wind conditions. Finally, since also relevant for Medicanes, recent developments on enhanced-resolution, closer to the coast, satellite-derived winds will also be presented at the time of the conference.

3O11. Comparison of cloud base height from ceilometer and radiosonde data in Barcelona

Y. Sola, X. Martínez

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Clouds are a key factor in the Earth's energy budget due to the albedo effect and their absorption and emission of infrared radiation. Their influence is related to the cloud cover and type but also to cloud base height. The CBH can be estimated with different instruments, such as ceilometers that analyze changes in the vertical backscatter profile or radiosondes that consider thresholds in vertical humidity.

We have analyzed three different methods from the literature to estimate the CBH with radiosondes Meteomodem M10 launched twice a day in Barcelona and we have compared the results with a ceilometer Vaisala CL31, located at the same station. Two methodologies rely on relative humidity and one in dew point depression. The dataset spans from 2015 to 2020, a long time-series analyzed completely without selecting special cases.

The best agreement (R2=0.50) between radiosonde and ceilometer is found when the thresholds in relative humidity vary with altitude. Moreover, the proximity of the station to the coast results in high values of relative humidity in lower layers that, in some cases, are wrongly classified as clouds. The use of a minimum CBH improves the results but in some methodologies is not enough (R2=0.12).

The detection of low clouds (CBH Study funded by the Spanish Ministry of Science, Innovation and Universities (NUBESOL-2 PID2019-105901RB-I00)

3O12. Longwave Radiative Effect of the Cloud-Aerosol Transition Zone Based on CERES Observations

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Cloud and aerosol are two particular names for some specific particle suspensions in the atmosphere, which have been widely studied but continue to contribute the largest uncertainty to estimates and interpretations of the Earth's changing energy budget. One of the sources of this uncertainty is the fact that they are often differentiated in the atmospheric science. However, the decision on where the boundaries of the clouds should be put, is a point of debate and a suspension detected as cloud by one method may be labeled differently by another. This is due to the presence of a phase called the transition zone between the cloudy and so-called cloud-free skies, at which the characteristics of the suspension lay between those corresponding to the adjacent clouds and the surrounding aerosol suspension. However, as the information available about this phase is limited, the area corresponding to the transition zone is often assumed as an area containing optically thin layers of clouds or aerosols, which can potentially produce very different radiative effects [Jahani et al. (2020). https://doi.org/10.1029/2020GL090408]. The present study presents a methodology for quantification of broadband longwave radiative effects produced by transition zone conditions, at the top of the atmosphere. This methodology has an accuracy (RMSE) of ~1.9W/m2 and estimates the radiative effects through combining the top of the atmosphere observations of

the CERES and MODIS sensors onboard Aqua spacecraft with the corresponding clear-sky radiances simulated using the SBDART radiative transfer model which is fed with ERA5 reanalysis atmospheric profiles.

3O13. Improvement in Air Quality Index values on pandemics related lockdown days in Istanbul

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Recent studies reveal that air quality improvements have been observed in many major cities globally during the lockdown days due to the pandemics. Turkey is applied similar lockdowns due to pandemics, and air quality improvement is also observed. Therefore, this study aims to compare the air quality levels of pandemic restriction days with those values of previous years from 2015 to 2019 in Istanbul. For these analyses, ten air quality measurement stations are obtained from the Istanbul Metropolitan municipality. Common Air Quality Index values of the European Union are used in this study because Turkey follows European Union's air quality standards for determining the thresholds for public health. Homogeneity tests were applied to the observational data, and CAQI values for PM2.5, PM10, NO2, O3, SO2, and CO were evaluated. Preliminary results show during the periods of pandemic constraints, the overall averages of pollutants decreased by 20% for all stations except for ozone, and there was a significant decrease in the number of hours exceeding the standards. Moreover, SO2 and CO pollutants may increase depending on the location. These results suggest that traffic and industry-based practices might be restricted to bring the values to the limits that will not threaten public health on days when air pollution is above the medium range of CAQI.

Poster presentations – Session 1 – Climatology

1P1. A single scaling parameter to describe a rainfall regime: application on Málaga (Andalusia, Spain)

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As other natural phenomena, rainfall often presents statistical self-similarity, i.e., it looks the same regardless of the temporal scale considered, and its properties satisfy scaling relationships. In the simple scaling or monofractal case, a single scaling parameter is necessary to relate two different scales to each other. The value of this scaling parameter has been reported to be related to the characteristics of the rainfall regime of the place of study. To investigate the scaling behaviour of its different areas, Málaga is a very appropriate region, due to its climate diversity. It is located in an area where both processes of Atlantic and Mediterranean origin are affecting, having also a complex orography. Some of the meteorological stations of Málaga are placed almost at sea level while others are 900 m high. A simple scaling analysis has been performed on daily rainfall series from 65 stations, with an average length of 30 years, in the period between 1935 and 2018. Results clearly support the relationship between the values of the simple scaling parameter and the rainfall characteristics of the place, especially irregularity.

1P2. Analysis of cloud cover from ERA5 reanalysis and visual observations in Barcelona

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Cloud cover plays an important role on local energy balance and solar energy forecast, among other processes. Nevertheless, cloudiness still represents a source of uncertainty for climate and meteorological models and well-characterized cloud properties at high spatiotemporal resolution are crucial. Reanalyses provide long time series of cloud cover for different cloud types, but the data assimilation and physical parameterizations can introduce errors. Comparison of reanalysis products with ground-based observations are behind continuous improvements.

We have compared total and low cloud cover from the European Centre for Medium-Range Weather Forecasts (ECMWF) ERA-5 reanalysis with visual observations performed three-times a day (7, 13, 18 UTC) from the Fabra Observatory in Barcelona (41.4° N, 2.1° E, 412 m a.s.l.). The long dataset consists of 37 years from 1982 to 2018, allowing us to analyze the long-term evolution of cloudiness in the area. Data has been homogenized to cloud fraction between 0 and 1.

There is good agreement between visual observations and reanalysis, both for TCC and LCC at 13h with a root mean square error of 0.27 and 0.30, although ERA5 underestimates cloud clover, with a BIAS of -0.031. The highest differences are observed for clear-sky and overcast conditions.

ERA5 reanalysis captures the significant decrease in LCC at 13h at the 90% confidence level, according to the modified Mann-Kendall test, but with a smaller linear trend (-0.018 and -0.029 per decade, respectively). Moreover, the seasonal analysis of LCC reveals that the largest significant decline is observed in spring for both datasets.

1P3. Catalogue of the flooding events on the Croatian part of the eastern Adriatic coast

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The Adriatic Sea is a semi-enclosed part of the Mediterranean with the complex orography surrounding the basin and the orientation from NW to SE that tailor weather patterns. The coastline is highly indented and therefore very vulnerable to extreme wind and wave events. Heavy storms or other extreme weather conditions combined with high tides can cause sea levels to rise above normal and cause coastal flooding. The exceptional sea levels can be devastating with long lasting and varied consequences. In this work is presented an overview of different flooding events registered along the Croatian coast and the islands that can be associated with storm surge and meteotsunami phenomena, but excluding the flash floods events caused primarily by heavy rain. For this purpose, diverse documentation was collected and inspected for the period 1950-2020 such as chronicles, manuscripts, newspaper articles, scientific publications and databases available online. Furthermore, it is possible to add new entries so the development of the catalogue is ongoing. The results are available at https://iws.seastorms.eu/sea_storm_atlas/map designed within the I-STORMS project so the public reports and impacts of the coastal flooding events can be reported in the system. The availability of data online makes it easier to detect coastal flooding cases, but that is just one of the reasons why the number of the collected cases has been growing in the last 20 years compared to the mid-20th century data. Unfortunately, the climate situation in the future does not indicate a decrease of that number.

1P4. Climate predictions to forecast fire activity

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Physics of the Earth, Regional Campus of International Excellence "Campus Mare Nostrum", Campus de Espinardo, University of Murcia, Spain

Forest fires are one of the main threats in the Mediterranean region. It is important to apply efficient fire risk estimates at seasonal time scales. Forecast estimates can be a very useful tool in decision-making in the management and control of forest fires. We present our research project that aims to analyze the methodologies used for seasonal fire forecasting in the Mediterranean region under a climate change context. We plan to 1) to make a comparison between the different methods of seasonal forecasting to know their advantages and disadvantages, 2) to know the ability of each one and 3) to implement and evaluate a new seasonal forecast method for fire risk. As a first step in this direction, here we review some of the possible approaches to seasonal wildfire forecasting.

1P5. Supercell Pre-convective Environments in Spain: a dynamic downscaling of ERA-5 Reanalysis

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Supercell thunderstorms are often associated with severe weather conditions, such as tornadoes, hail, strong wind gusts, heavy rainfall, and flash-floods, producing damage to populations and assets. The goal of the study is to analyze and improve our understanding of pre-convective environments conducive for supercell development in the different regions of Spain. We use 2014-2020 data from the Spanish Supercell Database , ERA-5 reanalysis, and a dynamical downscaling with WRF-ARW model to a 9 km spatial resolution to be able to generate sounding-derived parameters at the moment of formation of each supercell. Results indicate that supercells are more common in high values of CAPE and Shear 0-6 Km, but in the south-western of Spain predominates supercells of HSLC (High Shear-Low CAPE) in the cold season.

Poster presentations – Session 2 – Processes and Applications

2P1. An approach to Storm Filomena severe snowfall and precipitation in Spain: preliminary results

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Between 7-10 January 2020, severe snowfall and precipitation event swept over south, center and eastern Spain, with a total amount of precipitation of more than 200 mm on the south, snowfall accumulations of 50 cm or more on widespread areas of center Spain and 25 cm on Zaragoza and Ebro valley.

The low, called Filomena, was an unusual event with excessive social impact. In this study we will present the synoptic framework, characterized by the presence of three different air masses: cold air mass on low levels, more humid Mediterranean air mass on low-mid levels, at around 2-3 kilometres from surface; and a wet and warm subtropical air mass from the south. The interaction of these three air masses lead to the exceptional precipitation and snow accumulations. For this end, ERA-5 reanalysis and satellite images will be used. For mesoscale analysis, WRF-ARW will be used with both GFS and ERA-5 reanalysis. This extreme event, although it was generally predictable, had key points of low predictability in some parts with high social impact, including very populated areas.

2P2. On the vertical distribution of African dust over the western Mediterranean

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SCOLAb, Dpto de Fisica Aplicada, Universidad Miguel Hernandez de Elche

The vertical structure of the poleward transport of African dust to the Iberian Peninsula and the western Mediterranean is studied by the combination of the vertically-resolved dust lidar retrievals from CALIOP on board the CALIPSO mission and an extensive back trajectory analysis for the period from June 2006 (beginning of the satellite data series) to June 2019.

The level-2 Vertical Feature Mask (VFM) V4 product provides an along-track record of layers data of cloud and aerosols. The occurrence frequency of dust observations has been analyzed, with data binned into 1^{o} x 1^{o} in the horizontal, by producing: (1) Vertical cross-sections of the fraction of times the WFM product indicates the presence of the aerosol subtype “Dust” at a given grid cell with respect to the total number of available measurements at that cell. (2) Vertical profiles of the frequency of “Dust” and “Polluted dust” observations.

Maps and vertical profiles of the residence time over North Africa of the air parcels reaching each grid cell and height (at 250 m intervals) provide the large-scale advection routes associated to the dust observations from 96-h back trajectories.

Substantial seasonal, latitudinal and longitudinal differences are found in the vertical distribution within the study area. The large-scale flow patterns capture well the dust layers observed by CALIOP over the south of the sub-basin. In the northern part, there are differences due to smaller-scale vertical motion and the accumulation of dust (and secondary pollutants) over the Mediterranean at low levels.

2P3. The influence of the summer tropospheric circulation on Ozone concentration levels over the Eastern Mediterranean.

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Air pollution is one of the challenging environmental problems in the East Mediterranean basin since most of air pollutants limits are often exceeded, in particular during summer. During these months, the intensive sunlight and high temperatures enhancing the secondary air pollution production in conjunction with the domination of north air flows enhancing the transported pollution result in the increase of air pollution levels over the Eastern Mediterranean. Finokalia station is a coastal station located at the top of a hilly elevation on the north coast of Crete in the Eastern Mediterranean. Due to its unique location, away from any human influence, the station is representative of Background Air Pollution over the Eastern Mediterranean. The first step of our analysis was to study the temporal relation between wind speed and Ozone at Finokalia station employing CWT analysis (Continuous Wavelet Transform). Cluster analysis of 72-h backward trajectory arriving over the site at the altitude of 150 m during the summer period 2011–2018 was also applied, to determine how the prevailing atmospheric circulation patterns during summer over the Eastern Mediterranean affect the observed Ozone concentrations at the station. Additionally, a method based on Potential Source Contribution Function (PSCF) is used in order to identify the source regions and their contributions to Ozone concentration levels recorded at the station. Results show that the low tropospheric circulation affects the Ozone concentration levels over the Eastern Mediterranean.

2P4. Rainfall instensity change in Region of Murcia (Spain)

D. Espín-Sánchez, R. García-Lorenzo, A. Martínez

University of Murcia

In the semi-arid environments are more at risk of being affected by climate change impacts, resulting in increased water stress, more frequent and prolonged droughts, and peak flows of greater magnitude, caused by the variations in intensity, duration, and frequency of precipitation events. In the semi-arid Mediterranean area of the southeast of the Iberian Peninsula, the rainfall intensity could not be recorded at various control and measurement points until twenty years ago. The succession of important events of intense precipitation and their comparison with older series suggests a change in the expected values with which different parameters have been elaborated for the calculation of rainfall intensity, torrentiality and flow. The Region of Murcia will be taken as the study area and 189 points of rainfall intensity measurement located in the Segura Hydrographic Basin will be analyzed, and the possible intensifications derived from climate change will be evaluated in the estimation of the curves of current intensity-duration-frequency (IDF).

Poster presentations – Session 3 – Remote and in-situ measurements

3P1. A high resolution satellite-derived Sea Surface Temperature (SST) climatological database for the operation of a real-time weather forecast system

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A daily climatology was performed using the database of the NOAA/NASA Advanced Very High Resolution Radiometers Oceans Pathfinder Project for a 25-year long period, with the aim of improving the SST field used for the initialization of a regional real-time Weather Forecast System (WFS) based on the Regional Atmospheric Modeling System (RAMS). The impact of SST has been evaluated in previous studies and has been found to be an essential feature in the forecast of sensible weather parameters, such as rainfall distribution and intensity related to torrential rain events. For this reason, a better representation of this parameter is expected to provide more accurate results in the prediction of these sort of weather events. As default, RAMS uses global monthly climatological data at 1 degree resolution (about 100 km). To improve this spatial and temporal resolution, the AVHRR 4 km SST product was used to substitute the original SST field used by RAMS. The current methodology uses this remote sensing dataset to obtain a daily value for each grid point within the whole simulation grid, computed as the climatological mean of the whole time series. An SST file for the simulation region and for each day of the year is then generated, being accessible at any time. Additionally, this information may be updated when more data is available. The corresponding product is then formatted to be directly incorporated into RAMS before a new simulation-cycle starts.

3P2. Evaluating the VIIRS land surface temperature operational product over a shrubland site using ground and sky sweeping measurements

Ll. Pérez-Planells[1], R. Niclòs[1], J.A. Valiente[2], E. Valor[1], C. Coll[1], J. Puchades[1]

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The Visible Infrared Imaging Radiometer Suite was launched on October, 2011 onboard the Suomi NPP spacecraft. The VIIRS sensor provide Land Surface Temperature (LST) data with a spatial resolution of 750 m. This product is produced using a biome-dependent split-window algorithm. For that, the algorithm uses the brightness temperatures measured with the thermal infrared (TIR) channels centered at 10.7 and 12.0 µm (channels M15 and M16, respectively) and a set of coefficients for each one of the 17 defined biomes. In this work, the operational VIIRS LST product was evaluated with in-situ LST data at the Cortes de Pallás (Valencia, Spain) validation site (shrubland plain area). An autonomous sweeping system installed at the site took in-situ LST data with a wide band radiometer. Cloudy pixels were filtered using the sky sweeping measurements with the VIIRS LST product quality flag. Evaluation results showed a bias and standard deviation (SD) of 0.9 K and 1.8 K, respectively. These results met the accuracy and precision threshold requirements for the VIIRS LST product (bias of 1.4 K and SD of 2.5 K) and

they were close to the objective requirements (bias of 0.8 K and SD of 1.5 K). In addition, these results were in agreement with other validations carried out over vegetated surfaces, e.g. at the Valencia rice paddy site with full vegetation cover.

3P3. Accurate ground measurements to calibrate Landsat-8 TIRS data for land surface temperature retrieval

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A robust set of reference ground thermal radiance data measured along transects in a rice crop site was used to evaluate the performances of the different re-calibrations implemented in Landsat-8 TIRS data. The site has very different land covers due to the crop changes through the year, from null to full vegetation cover at the same site, which makes it interesting as it includes different ground conditions. Thermal infrared emissivities were also measured at the site. The calibration results showed good performances for the current TIRS data in Collection 1, i.e., data after the 2017 reprocessing applied to remove out-of-field radiation, and they improved slightly for band 10 after applying the last calibration update announced for TIRS data in the next Landsat Collection 2. We also evaluated single-channel corrections and split-window (SW) algorithms to retrieve land surface temperature (LST) from TIRS data. SC corrections showed the best results when using TIRS band 10 data, both for the current TIRS values in collection 1 and after applying the last calibration update. After the valiation, three SW equations were mainly recommended for users of the current TIRS data (which obtained LST uncertainties lower than 1 K). Finally, bias differences were shown in the results of the SW algorithms after applying the last calibration update.

3P4. Surface thermal heterogeneities in the eastern Ebro basin and their impact on regional circulations

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In complex terrain regions, surface heterogeneities are the responsible of the generation of thermal gradients that finally condition the locally-generated circulations. The aim of this work is to quantify these thermal heterogeneities in the eastern Ebro river subbasin, mainly devoted to agriculture with four different zones: flood and drip irrigated regions in the lowlands, rainfed slopes and vegetated mountains. The methodology consists in computing the averaged surface temperature over these four zones using hourly satellite-derived Land-Surface Temperature fields from Meteosat Second Generation during ten years (2009-2019). Afterwards, the thermal gradients are computed among these zones to identify their diurnal and seasonal cycles.

It is found that during the daytime rainfed slopes are warmer than the plain (about 7ºC), especially in summer time when irrigation is common. Besides, the thermal gradient between the mountain and plain is inverted (changes from negative to positive). As a result, anabatic winds are enhanced, in agreement with the wind observations from a dense network of AWS (Servei Meteorològic de Catalunya). During nighttime, despite gradients are lower the effect of

the irrigation is noticeable. Results show that irrigation changes the surface energy balance of the region (evaporation is enhanced) determining the features of the locally-generated circulations. Finally, it is found that these patterns are commonly reported in the region and the strength of the thermal differences depend on the meteorological features of each year (the amount of irrigated water might change).

3P5. Characterizations of wind and temperature profiles in Cerdanya Valley (Pyrenees) using a Windrass profiler.

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The Cerdanya valley is an almost enclosed valley located in the Pyrenees oriented from South-West to North-East with a base at 1000 meters surrounded by ranges with peaks higher than 2000 m. With those orographic characteristics the valley circulation becomes often decoupled from the free atmosphere circulation, producing large differences of wind and temperature behaviours among the bottom valley and the higher peaks.
The Windrass profiler is able to measure wind and vertical temperature profiles from 40 meters up to 400 meters with a resolution of 10 meters and a time frequency of 15 minutes which permits to have a daily picture of the evolution of these vertical profiles. The analysis of these profiles was evaluated globally and separately for each governing synoptic situation. This will allow to see how every synoptic forcing affects the valley circulation during the day and the night time.

3P6. Evaluation of solar irradiance parameters retrieved from geostationary satellite data with ground measurements

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This paper evaluates the Global Horizontal Irradiance and Direct Normalized Irradiance (DNI) values determined from data of the geostationary satellites HIMAWARI-8 and MTSAT-2, using a method previously proposed for the European satellite METEOSAT-8. Ground data obtained by six meteorological stations distributed over the region covered by the satellite overpasses were used as reference data for the evaluations. The objective of this study is to test the soundness of the method previously defined for the METEOSAT-8 satellite, but adapted to be applied to the data of the abovementioned satellites. This involves expanding the area to which METEOSAT-8 is delimited to a large part of the Asian continent and Australia.
The retrieval of these parameters from satellite data means a significant advantage from the measurements taken by stations, although it requires validations against ground-truth data. In this study, the comparison between the satellite results and the station measurements were carried out through a full year for each satellite platform. The analysis of data was carried out on an hourly, daily and monthly basis.

The validation results showed median differences of -17.9 W/m2 and -14.0 W/m2 for the hourly GHIs retrieved from MTSAT-2 and HIMAWARI-8 data, respectively. Median differences of -35.1 W/m2 and -56.1 W/m2 were obtained for the hourly DNIs obtained from MTSAT-2 and HIMAWARI-8 data, respectively.

3P7. Cloud cover retrieval with four different techniques in a coastal site in Spain.

M.J. Marín, V. Estellés, J.L. Gómez-Amo, V. Matos, C. Peris, M.P. Utrillas

Universitat de València

Four different methods have been used for the estimation of the total cloud amount and partial cloud amount for low clouds at a site in Valencia during the period 2013-2017: visual meteorologist observations (registered in octas), the Long method applied on pyranometer measurements of downwelling shortwave irradiance, the APCADA method applied on pyrgeometers measurements of downwelling longwave irradiance, and ceilometer measurements of the cloud base height. The three automatic methods have been compared to the meteorological observer's estimations. Automatic methods agree with the visual method or differ in ±1 octa for 58–75% cases for partial low cloud amount and for 44-63% cases for total cloud amount. In general, partial low cloud amount agrees more with observer measurements than total cloud amount and also the automatic methods underestimated total cloud amount observer values possibly due to the difficulty in monitoring high clouds. Further, automatic methods report more cloudless (0-1 octa) and overcast skies (8 octas) than the observer. Finally, linear fits have been performed to find quantitative relations between the three automatic methods and the meteorological observations.

3P8. Study of cloud cover at different heights from measurements of a ceilometer.

M.J. Marín, V. Estellés, J.L. Gómez-Amo, J. Camarasa, P. Catalán, M.P. Utrillas

Universitat de València

This work has used a CL51 ceilometer from Vaisala, installed in Burjassot , a town 10 km from the Mediterranean coast. With this instrument it has been determined the cloud cover in different layers, up to 15 km high and with a resolution of 1 km, in the 2013-2017 period. In the analysis it has been determined how this coverage varies as we increase the height of the upper limit of the atmospheric layer considered, from 0-2km to 0-15km. The results are compared taking into account the cloud cover estimated by a meteorological observer at different synoptic times of the day. The study has distinguished between total cloudiness and low clouds, determining the differences between the coverage obtained with the ceilometer and the visual estimates of the meteorological observer. The results show that in the case of total cloud cover, the coincidences or differences in coverage of ± 1 octa increase as we add layers to reach 63% for heights greater than 12km. In the case of low clouds, the coincidences or differences in coverage of ± 1 octa exceed 75% when considering layers between 0-3km.

3P9. Analysis of the ground level BC concentration at an urban coastal site in Valencia, Spain, and its relation to dominant air masses

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Black carbon, a by-product of incomplete combustion, is the most prominent component of the atmospheric light-absorbing aerosol and plays a vital role in climate change, and has been identified as the second-largest contributor to anthropogenic radiative forcing (IPCC, 2007).

BC concentration was measured at a site located in western Mediterranean (Burjassot, Spain), in the suburbs of Valencia city, whose metropolitan area is about 1 million inhabitants. The site is affected mainly by local anthropogenic aerosols originated by traffic, and regional agricultural or forest fires, but also by natural aerosols of marine (Mediterranean Sea) and desert (Sahara) origin. A 7-wavelength aethalometer (AE31-Magee Scientific) was used to measure the BC concentration.

The purpose of this work is to analyze the BC concentrations during the 2011 – 2020 period, and to estimate the effect of the dominant air masses on the BC concentration. The air mass type can be identified by analyzing the backtrajectories calculated with the HYSPLIT Model (NOAA). The air mass type classification is done by dividing the source region into sectors, and by analyzing the fraction of time spent by the air parcel in each sector. In this way, we analyze the dependence of the absorption properties of aerosols and the BC concentration with the origin of the air masses. Although BC is mainly determined by local sources, we still expect to find a sufficiently distinguishable signature of remote sources in the values found at our site.

3P10. First evaluations of satellite-based estimation techniques of PMx concentrations in the Valencia Region

H. Cruañes, R. Niclòs, E. Valor, J. Puchades

Universitat de València

The aim of this work is the estimation of the Particulate Matter concentration by remote sensing. The PMx pollutant quantifies the concentration of suspended particles where x denotes the particle size threshold in micrometers. High concentrations of PMx have been related to an increment of several diseases like asthma attacks. The air quality is evaluated via a Quality Index (IQ) as recommended by the European Regulation.

Ground PMx measurements taken through the Xarxa Valenciana de Vigilància and Control de la Contaminaciño Atmosfèrica (XVVCCA) were used as reference data. Data acquired by 26 XVVCCA stations through the years 2018 and 2019 were first analyzed to study the evolution of the pollutant for cities with different population density and sea-coast distance. Seasonal patterns and yearly values were also studied.

In the line of studies previously done for other regions, the Aerosol Optical Depth (AOD) is correlated to the ground PMx concentration under diverse considerations. AOD is the absorption of the atmospheric aerosols for a wavelength. The AOD 0.55 micrometers data is provided by the MOD04 and MYD04 products generated from data of the MODIS sensor on board the EOS-Terra and EOS-Aqua satellites. We also evaluated the MODIS AOD values with AERONET data acquired near to Valencia city.

Correlation coefficients (r) of 0.45 and 0.42 were obtained for PM10 and PM2.5 in accordance to results of previous studies for other regions. A simple linear regression was shown to be a reasonable operative technique, since more complex techniques involved moderate improvements.

3P11. Remote sensing data analysis as support in convective fires: assessing the Haines Index

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Forest fires can sometimes be dangerous for people and can cause high material damages; with convective fires being very dangerous due to their erratic behavior. Temperatures and humidities in low atmospheric levels have been used to assess convective forest fire risk. Haines Index takes into account these two magnitudes. Radiosonde data are usually used to compute HI but their spatial and temporal resolutions are course and the HI assessment could be improved or complemented with remote sensing data. Therefore, the aim of this paper is to analyze remote sensing data acquired by the Atmospheric Infrared Sounder (AIRS) instrument on board the EOS-Aqua satellite, specifically the Level 2 V6 products (AIRX2RET and AIRS2RET), with a nominal spatial resolution of 50 km and two overpasses per day in Spain. First, we compared remote sensing data (ascending and descending overpasses) with radiosonde daytime and nighttime data measured in the Iberian Peninsula a whole year and no significant deviations were found. The correlation between AIRS and radiosonde data were better for temperature than humidity. When analyzing data for different atmospheric levels, the correlations were slightly better for top atmospheric layers than for low layers, and the results show good agreement between both products; slightly better for the AIRS2RET. Thus, these remote sensing data can solve the lack of global data in the atmospheric lower layers to evaluate convective forest fire risk. Finally, as an example, we mapped the result of the HI computed from AIRS data for a forest fire event.

Poster presentations – Session 4 – Numerical modelling

4P1. WRF-LES long-term real case simulation during BLLAST campaign: strengths and weaknesses

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The Weather Research and Forecasting model is used to perform a large-eddy simulation (LES) real case simulation of 25-day duration in order to explore the ability of the model to reproduce the turbulence magnitudes within the first tens of meters of the boundary layer. The WRF-LES modelling system is configured using 5 nested domains, where the innermost domain has a horizontal grid resolution of 111 m. Measurements from sonic anemometers installed in a 60-m tower during the Boundary Layer Late Afternoon and Sunset Turbulence (BLLAST) field campaign are used for verification, which is focused on the turbulent magnitudes in order to assess the success and limitations in resolving turbulent flow characteristics.

Mesoscale flows from north during daytime veering to south during night-time are quite well reproduced by both MESO and LES simulations. The general statistics for wind speed and direction are slightly better for MESO than for LES, although the differences are small, and statistics can harm LES because of the greater fluctuations of the time series. The turbulent kinetic energy is generally underestimated during the daytime in LES, mainly due to a vertical velocity standard deviation that is too low. The turbulent heat flux is misrepresented in the LES simulation, probably due to the inaccuracy of the sub-grid scheme. Only LES is able to reproduce the energy of eddies with lifetimes shorter than a few hours, while MESO produces a too strong decay of energy. Funding for this project was provided by grant RTI2018-098693-B-C32 (AEI).

4P2. Impact of the initial soil moisture content over two distinct vegetation covers using the Regional Atmospheric Modeling System RAMS

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Focusing on the daytime temperatures during the summer season, the Regional Atmospheric Modeling System has shown a general trend to overestimate the daytime temperatures over the Western Mediterranean Basin. This result seems to be related to the surface fluxes and the surface energy budget. Besides, varying the initial state of the soil moisture content within the simulation framework have shown the strong impact of this parameter on surface and near-surface variables. The present study aims to improve our understanding of the simulation of significant meterological variables during the summer season and their relation with modified initial soil moisture contents in the context of the RAMS mesoscale modelling framework. A 7-day period in July 2011 was selected and simulated over eastern Spain. Two different soil

moisture (high and low) distributions are used to initialize this parameter at a constant value for all land grid points and all soil levels. Ground data from two anchor FLUXNET stations, located over the region of study, were used for the result assessment. To perform a comprehensive evaluation of this model, the simulation results were also compared with different remote sensing products in those cases where no surface variables were available, such as the Land Surface Temperature (LST).

4P3. Supercell predictability on Iberian Peninsula using WRF-ARW model

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Spain, having a complex topography, has many climate and weather particularities, acting in many aspects like a mini continent. This is shown in many aspects, such as supercells, which count for more than 1000 in the last 10 years. This indicates that severe weather happens yearly, and supercell thunderstorms are one of the biggest threats, producing damage to population and economical assets, which makes reliable supercell forecast for risk management and mitigation a priority.

This research evaluates supercell forecasts from the Weather Research and Forecasting model over Spain. This first iteration analyzes 2018 supercells, trying to predict this events using three nested domains (15-3-1 km), feeded with GFS operational datasets. The configuration chosen for the model has been used in the past for a master's thesis, with great results, and thus this work aims to evaluate the operational usage of this configuration for prediction with 12-36 hours of anticipation. Results so far show that around 80% of supercells could be perfectly forecasted, and another 15% could have medium forecasting skill. This results show that risk alarms could have been issued if this forecasts had being operative at the moment.

4P4. Role of moist and dry advection in the development of Mediterranean tropical-like cyclones (Medicanes)

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Two cases of "tropical-like cyclones" in the Mediterranean are analyzed, making use of numerical simulations with the WRF model. The purpose is to determine the origin of the humid air present in the lower layers before the cyclones' formation, which creates favorable conditions for their subsequent development. In the first Medicane, the moist air present in the lower atmospheric layers in the days preceding the development of the cyclone played an important role in the intensification of the cyclone; these high values are due to the intense

latent and sensible heat fluxes from the sea surface, associated with the advection of dry/cool air from the Balkans. For the second Medicane (6-10 October 1996), which developed near the Balearic Islands, the role of pre-existing humidity in the development of the cyclone appears secondary; on the other hand, the intense surface fluxes from the sea, generated by the intrusion of the Tramontana and Mistral winds near the cyclone formation zone, determine its sudden intensification.

Finally, the role of the intrusion of dry air that descends from the upper troposphere towards the center of the cyclones in the early stages of their lifetime was analyzed. Through sensitivity simulations in which the moisture content was changed, it was found that for both cases the reduction of moisture associated with the "dry intrusion" has the effect of delaying the formation of the cyclone, producing less intense vortices.

Poster presentations – Session 5 – Interdisciplinary studies

5P1. Assessing the correlation between temporal trends of extreme winter rainfall indices and aerobiological variables in Catalonia (NE of the Iberian Peninsula)

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Rainfall has a twofold impact on some aerobiological variables, as pollen concentration: while prior to pollination rainfall favors the subsequent pollen production, during pollination it contributes to the pollen elimination by a wash-out process. To elude the possible washing effect, only winter rainfall, mostly previous to many pollination species, have been taken into consideration. Temporal trends of the extreme winter rainfall indices calculated for six meteorological stations of Catalonia between 1994 and 2018 have been assessed and compared to temporal trends of the aerobiological parameters corresponding to 27 pollen and fungal spore taxa.

5P2. Development of an integrated system to analyse interactions between climatic factors and the risk of potential exposure to Covid-19

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Many studies have shown that the occurrence, development and spread of diseases, particularly infectious diseases, are closely related to weather and climate conditions. Recent studies have shown that the Covid-19 epidemic is strongly correlated to climatic factors, at local and global scale. This work presents an integrated system for assessing the level of risk of exposure to the virus, in terms of infection and hospitalization in intensive care as a function of climatic variables. The system consists of coupled models based on Machine Learning techniques for the estimation of the correlation between all variables and on probabilistic nonlinear algorithms with time-Lags effects, for the estimation of the relative risk of virus exposure, at spatial and temporal (daily, weekly) scales. The modelling system has been applied to Italy and in particular to the regions of Lombardia, Emilia-Romagna and Puglia, analyzing the data from 24 February 2020 to 31 December 2020, of more than 300 Meteonetwork meteorological stations, and with the official data on Covid-19 provided by the Italian Civil Protection. The meteorological factors used are the daily and daytime data of temperature, humidity (relative and apparent), dew point, atmospheric pressure, solar radiation, wind speed. The results obtained show good correlations between climatic factors and Covid data for the development of warning alerts at

specific levels of exposure risk, that can allow local and national authorities to monitor the situation in the territories under observation, for the definition of mitigation and intervention policies.

5P3. The influence of the local weather conditions on seed germination of Hypericum balearicum L.

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The temperature, which is one of the most relevant abiotic factors affecting seed germination, is strongly influenced by the local conditions such as the topography, the prevailing winds of the region or the surface features, among others, especially in complex terrain regions, such as the island of Mallorca. Here, we collected seeds of Hypericum balearicum, an endemic shrub of the Balearic Islands, from 11 localities placed in different areas of Mallorca. We investigated variations in final germination percentage, germination rate (T50) and germination timing (T0) of seeds from different provenances according to the local conditions of each place (here classified in three groups: mountain, coast and valley) under a range of temperature treatments (from 12 to 24 ºC). An environmental data logger was installed in three of the localities to determine the temperature variability for each category. It is found that FGP was affected by temperature treatments but not by the local conditions. The coast group showed a narrower optimal T50 and a higher T0 in all temperatures tested compared to the mountain and valley group. These differences among groups were consistent with the temperature parameters recorded in each locality group. Hypericum balearicum germinates in the optimal temperature range of Mediterranean plants, although it may also germinate during the driest season (summer) under an input of soil moisture. Overall, this study demonstrates the importance of taking into account temperature local conditions effects in germination in order to know how plants will respond to environmental changes.