14th EGU Plinius Conference on Mediterranean sTORMS & MEDEX Final Conference

Programme

Palma de Mallorca (Spain) **13-15 November 2012**

Organizers & Sponsors:

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Dear participants in the 14th EGU Plinius Conference on Mediterranean Storms and MEDEX Final Conference:

It is a great pleasure for me to welcome you to the city of Palma, in the island of Mallorca, venue of the 14th EGU Plinius Conference on Mediterranean Storms.

This conference is the continuation of the series of EGU Topical Plinius Conferences, but the edition of this year adds the MEDEX Final Conference, as a particular objective. This is one of the reasons to have offered Palma de Mallorca to host this event, although another edition of the Plinius Conferences was held in Mallorca, in 2002. The MEDEX project was conceived during the large and successful "INM/WMO International Symposium on Cyclones and Hazardous Weather in the Mediterranean" held in Palma 15 years ago. On the other hand, MEDEX has been coordinated from Palma during its ten years of life.

The EGU Plinius Conferences on Mediterranean Storms were born in 1999, as an initiative of Prof. Franco Siccardi (CIMA, Italy), with the support of the EGU Natural Hazards Division, in those times directed by Maria Carmen Llasat (UB, Spain). The Plinius Conferences are interdisciplinary meetings in which the exchange of new ideas and results about the Mediterranean Storms and their hydrological, geological, marine or social consequences takes place.

During years the Plinius Conferences have been associated with the project MEDEX. MEDEX has been an international project on cyclones that produce high impact weather in the Mediterranean, endorsed by WMO-WWRP in its first phase and framed into the WMO-WWRP-THORPEX during its second phase. The objectives and topics of the Plinius Conferences and of MEDEX largely overlap. Most MEDEX results have been presented at the Plinius Conferences and various MEDEX meetings have been held during them. MEDEX finished in 2010 and now is time for a Final Conference on MEDEX. The committee found convenient to have this final conference together with the Plinius Conference.

The Plinius Conferences are usually organised in sessions, according to specific topics. The topics included in this 14th edition are:

1. Social impacts of the Mediterranean storms.
2. Mediterranean storms monitoring.
3. Diagnosis and prediction of the Mediterranean storms.
4. Hydrometeorology and hydrology of the Mediterranean storms
5. Geological and marine consequences of the Mediterranean storms.

A specific session is devoted to a compilation or review about MEDEX. It consists of a usual session of contributions and a round table, in which much of the members of MEDEX steering committee will participate.

Some time has also been reserved for an initial debriefing of the HyMeX SOP1, the first field phase of the HyMeX, which has been finished at the beginning of November.

The joint 14th Plinius Conference on Mediterranean storms and MEDEX Final Conference is co-organised by the Spanish State Meteorological Agency (AEMET) and the University of the Balearic Islands (UIB) and has the support of these institutions, the EGU Natural Hazards Division and the World Meteorological Organisation (WMO). WMO, in particular, finances the participation of people from Mediterranean developing countries and EGU finances part of the costs of participation of some young scientists. Special support has been granted by the Spanish Ministry of Economy and Competitiveness (CGL2011-15797-E grant).

I wish to thank the good work done by the members of the Programme Committee, the conveners of the six sessions and the members of the Organising Committee. I wish also thank the professional support given by the staff of Copernicus Meetings and UIB-Congrés.

I hope you will enjoy the conference as well as your stay in Palma de Mallorca.

Sincerely,

Agustí Jansà
Organizing Committee Chairman

Location

The 14th EGU Plinius Conference on Mediterranean Storms and MEDEX Final Conference is held in Palma de Mallorca, Spain, 13 – 15 November 2012. The congress is open to scientists of all nations.

Rules of Conduct

- Smoking is prohibited in the entire university except in the areas designated for smokers.
- It is prohibited to copy any presentation from the desktops in the lecture rooms.
- Please switch off any mobile phones in the lecture rooms.
- It is prohibited to take photos of any scientific material at the conference.

Official Language

The official language of the 14th EGU Plinius Conference on Mediterranean Storms and MEDEX Final Conference is English. Simultaneous interpretation is not provided. It is therefore expected that authors are able to present their research more or less fluently in the English language.

Insurances

The organizers cannot accept liability for personal accident, loss or damage to private property, which may be incurred as a result of the participation in the 14th EGU Plinius Conference on Mediterranean Storms and MEDEX Final Conference. Participants are, therefore, advised to arrange appropriate insurance cover. This should extend not only to travel but also to cancellation costs.

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Abstract Management

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Tuesday, 13 November 2012

Lecture Room: Sala Plutón

08:30–09:30 Registration

Geological and marine consequences of the Mediterranean storms

Chairperson: D. Gomis

09:30–10:00: Plinius14-55
21st century projections for the Mediterranean Sea (solicited)
Gomis D., Jordà G., Marcos M.

10:00–10:15: Plinius14-6
First interdisciplinary approach to the effects of an extreme climate event on Mediterranean coastal assemblages
Mateo M.A. and the Sant Esteve 2008 Team

10:15–10:30: Plinius14-34
Application of new climate change results to Venice tide statistics
Mel R., Lionello P., Sterl A.

10:30–11:00 Opening ceremony

11:00 Coffee Break

Diagnosis and prediction of the Mediterranean storms

Chairperson: E. Richard

11:30–12:00: Plinius14-56
An overview of a cyclone phase space and its application to eastern Atlantic and Mediterranean hybrid cyclones (solicited)
Hart R.

12:00–12:15: Plinius14-11
Current and future medicane risk based on the generation of synthetic storms
Romero R., Emanuel K. A.

12:15–12:30: Plinius14-31
Climate change effects on medicanes based on a dynamical downscaling method
Tous M., Romero R., Ramis C.

12:30–12:45: Plinius14-33
Medicanes of 2011 and Hurricane Rina
Tripoli G. J., Mugnai A., Smith E. A.

12:45–13:00: Plinius14-37
Impact of a North Atlantic hurricane on the predictability of a Medicane
Pantillon F., Chaboureau J.-P., Lac C., Mascart P.

13:00–13:15: Plinius14-51
A long-term climatology of medicanes
Cavicchia L., Gualdi S., von Storch H.

13:15 Lunch Break

Oral Poster Presentations

Chairperson: A. Jansa

Presentation Time: 15:15–15:33
Author in Attendance: 15:35–16:35

P1: Plinius14-32
Analysis of storm waves on the Black Sea
Gippius F.N., Arkhipkin V.S., Surkova G.V.

P2: Plinius14-50
Feasibility of a Common Approach to Coastal Flood Risk Assessment and Management in the Mediterranean Europe
Tinti S., Armigliato A., Pagnoni G., Zaniboni F.

P3: Plinius14-36
Detection and thermal description of medicanes from numerical simulations
Picornell M.A., Campins J., Jansa A.

P4: Plinius14-46
Study on the 3D structure of the squall line in North China with Doppler radar
Zhou H.

P5: Plinius14-22
Long-lasting deep convective systems occurring in the Mediterranean basin: a four years (2007-2010) study
Melani S., Pasi F., Gozzini B., Ortolani A.

P6: Plinius14-23
On the distribution and seasonal cycle of transient luminous events above Europe
Arnone E., Neubert T., Bòr J., Chanrion O., Dietrich S., Dinelli B.M., Labanti R., Makela A., Mezuman K., Odzimek A., Soula S., Van der Velde O., Yair Y., Eurosprite

15:35 Coffee Break &
Poster Viewing in Salas Urano y Mercurio

Diagnosis and prediction of the Mediterranean storms

Chairperson: G. Tripoli

16:35–17:05: Plinius14-54
Adriatic Extreme Weather - State of the Art (solicited)
Ivančan-Picek B.

17:05–17:20: Plinius14-9
Long-term trends and variability of precipitation extremes in North Africa
Tramblay Y., El Adlouni S., Servat E.

17:20–17:35: Plinius14-18
Bayesian trend analysis of extreme wind hazard using observed and hindcast series off Catalan coast, NE Mediterranean Sea
Egozcue J. J., Ortego M. I, Cunillera J., Tolosana-Delgado R.

17:35–17:50: Plinius14-24
Modelling and errors for short duration Mediterranean storm events: ranking of uncertainties
Sánchez-Arcilla A., Sairouni A., Bravo M., Gómez J., Tolosana-Delgado R.

17:50–18:05: Plinius14-26
Heavy rainfall episodes over Liguria: elements controlling forecast errors of quantitative precipitation
Buzzi A., Davolio S., Malguzzi P.

19:00–20:30 Icebreaking cocktail

Wednesday, 14 November 2012

Lecture Room: Sala Plutón

Mediterranean storms monitoring

Chairperson: A. Mugnai

09:00–09:30: Plinius14-57
Ubiquitous & Complex Nature of Diurnal Rainfall Processes from TRMM & CloudSat Measurements: Is Mediterranean Basin Representative of Rest of Earth? (solicited)
Smith E. A.

09:30–09:45: Plinius14-2
Modeling the flash rate in thunderstorms: an implementation into the CRAMS model
Federico S., Avolio E., Petracca M., Panegrossi G., **Dietrich S.**

09:45–10:00: Plinius14-3
Application of two passive microwave precipitation retrieval algorithms to heavy precipitation events in the Mediterranean region during 2011 and 2012 fall seasons
Panegrossi G., Casella D., **Dietrich S.**, Mugnai A., Petracca M., Sanò P., Smith E. A., Tripoli G. J.

10:00–10:15: Plinius14-13
Investigation on extreme daily rainfall estimation using MSG MPE approach for North Tunisia
Dhib S., Bargaoui Z., Mannaerts C.

10:15–10:30: Plinius14-20
Gravity wave characteristics in the middle atmosphere at Palma de Mallorca due to a Mediterranean tropical storm and fronts
Kramer R., Wüst S., Bittner M., Schmidt C., Jansá A.

10:30 Coffee Break

Hydrometeorology and hydrology of the Mediterranean storms

Chairperson: L. Brocca

11:00–11:30: Plinius14-58
The use of Spatially Distributed Soil Moisture Estimation for Hydrological Applications (solicited)
Brocca L., Melone F., Moramarco T., Wagner W.

11:30–11:45: Plinius14-10
Estimation of antecedent wetness conditions for flood modeling in Northern Morocco
Tramblay Y., Bouaicha R., Brocca L., Dorigo W., Bouvier C., Camici S., Servat E.

11:45–12:00: Plinius14-12
Study of IDF curves established by the property of scale invariance in Tunis
Ghanmi H., Barguaoui Z., Mallet C.

12:00–12:15: Plinius14-21
Calibration of two Alarm Indexes for Flood Alarm Mapping
Cerasani E., Lombardi A., Tomassetti B., Verdecchia M.

12:15–12:30: Plinius14-29
The CETEMPS Hydro-Meteorological chain during HyMex
Tomassetti B., Pichelli E., Lombardi A., Gentile S., Cerasani E., Ferretti R., Verdecchia M.

12:30–12:45: Plinius14-39
Multilinear approach to the precipitation-lightning relationship: a case of study in the northern part of Spain during local summer electrical storms of 2002-2009 period
Herrero I., Ezcurra A., Areitio J., Diaz-Argandona J., Ibarra G., Saenz J.

12:45–13:00: Plinius14-40
A hydro-meteorological description of the 25th October and the 4th November 2011 events in Liguria
Gabellani S., Giannoni F., Parodi A., Pignone F., Rebora N., Rudari R., Siccardi F., Boni G., Molini L., Silvestro S.

13:00–13:15: Plinius14-41
DRIHM Project: first year achievements
Parodi A., Rebora N., Kranzlmueller D., Schiffers M., Clematis A., Caumont O., Richard E., Garrote L., Llasat M.C., Harpham Q., Jagers B., Tafferner A., Forster C., Dimitrijevic V., Dekic L., Cros P.H., Hooper R., Galizia A., D'Agostino D., Morando M.

13:15 Lunch Break

Oral Poster Presentations

Chairperson: M.C. Llasat

Presentation Time: 15:15–15:36
Author in Attendance: 15:40–16:40

P7: Plinius14-16
Daily precipitation records over mainland Spain and the Balearic Islands
Ramis C., Amengual A., Romero R., Homar V., Alonso S.

P8: Plinius14-25
From past to present: the effects of historical damaging hydrogeological events in the current urban setting
Petrucci O., Pasqua A.A.

P9: Plinius14-44
Analysis of the intensity of rainfall events in Barcelona during 2011 and their social impact
Barberia L., Amaro J., Aran M., Llasat M.C.

P10: Plinius14-43
Measurements collected at the CNR ISAC atmospheric supersite in Rome during the HyMeX SOP 2012.
Baldini L., Panegrossi G., Adirosi E., Angelini F., Argentini S., Barnaba F., Campanelli M., Costabile F., Congeduti F., Dietrich S., Gobbi G. P., Gorgucci E, Liberti G., Mugnai A., Petracca M., Roberto N., Viola A.

P11: Plinius14-1
Scale-consistent model for assessment of trends in precipitation extremes
Hanel M., Vizina A.

P12: Plinius14-19
Hydrological response of a small vineyard catchment (D.O. Penedès, NE Spain) depending on rainfall intensity and antecedent soil moisture
Balasch Solanes J. C., Ramos Martín M. C., Martínez-Casasnovas J. A.

P13: Plinius14-52
High resolution wave model validation over the Greek maritime areas
Mazarakis N., Kotroni V., Lagouvardos K.,
Bertotti L.

15:40 Coffee Break &
Poster Viewing in Salas Urano y Mercurio

Social impacts of the Mediterranean storms

Chairperson: C. Ramis

16:40–16:55: Plinius14-4
A descriptive impact analysis of high impact weather related incidents in Greece for the period 2001-2011
Papagiannaki K., Lagouvardos K., Kotroni V.

16:55–17:10: Plinius14-8
Are flash floods increasing in Catalonia? The role of vulnerability versus hazard
Llasat M.C., Marcos R., Turco M., Llasat-Botija M., Gilabert J.

18:30–20:30 Visit old city

Departure from the conference venue by bus
Palma panoramic views from the Bellver Castle
Cathedral and old town
Back to the conference venue by bus

21:00 Bus leaves to the dinner

21:30 Conference dinner

Restaurant NAUTIC
Muelle de San Pedro, 1 Palma

23:30 Bus leaves to the conference venue

Thursday, 15 November 2012

Lecture Room: Sala Plutón

Mediterranean storms monitoring

Chairperson: E. Smith

09:00–09:15: Plinius14-27
On the effects of the cloud vertical structure on lightning production
Buiat M., Dietrich S., Porcù F.

09:15–09:30: Plinius14-38
Observation and modeling of the cloud electrical activity during HyMeX
Pinty J.-P., Coquillat S., Martin J.-M., Prieur S., Defer E., Rison W., Krehbiel P., Rodeheffer D.

09:30–09:45: Plinius14-42
Novel Meteorological Applications using Microwave Communication Networks & New emerging avenues in atmospheric research
Alpert P., Samuels R., David N.

Diagnosis and prediction of the Mediterranean storms

Chairperson: R. Romero

09:45–10:00: Plinius14-28
The Intensive Observation Period in Italy during the HyMex campaign
Ferretti R. and the HyMeX Italy Team

10:00–10:15: Plinius14-30
An analysis of three disastrous rain events occurred in Italy: Rome, Cinque Terre and Genoa
Ferretti R., Panegrossi G., Rotunno R., Pichelli E., Marzano F. S., Dietrich S., Picciotti E., Vulpiani G.

10:15–10:30: Plinius14-35
Hirlam forecast impact to extra observations for some Mediterranean high impact weather events
Campins J., Navascués B.

10:30 Coffee Break

11:00–11:15: Plinius14-45
Towards a new BOLAM-MOLOCH chain: Forecast evaluation over the MAP D-PHASE DOP and HyMeX SOP
Mariani S., Casaioli M., Malguzzi P., Speranza A.

11:15–11:30: Plinius14-47
Stationary nocturnal offshore precipitation near the coastline in the Mediterranean basin
Mazon J., Pino D.

11:30–11:45: Plinius14-48
The greatest recent flood in Spain: a WRF simulation of the 1962 Valles flood event
Mazon J., Pino D.

11:45–12:00: Plinius14-53
Numerical study of two convective lines observed during HyMeX
Hally A., Richard E.

12:00–13:00: HyMeX debriefing

13:00 Lunch Break

Specific session on MEDEX

Chairperson: P. Alpert

15:00–15:15: Plinius14-5
Extreme Value Statistics in highly resolved Climate Change Simulations for the Jordan River Area
Samuels R, Smiatek G, Krichak S, Kunstmann H, Alpert P

15:15–15:30: Plinius14-7
MEDEX: A general overview
Jansa A.

15:30–15:45: Plinius14-14
Ensemble prediction systems based on potential vorticity perturbations and multiphysics tested for MEDEX events. A medicane event application
Vich M., Romero R.

15:45–16:00: Plinius14-17
Sensitivities of Mediterranean High Impact Weather: From MEDEX to Ghostbusting?
Homar V., Garcies L., Jansà A.

16:00–16:15: Plinius14-49
Are current sensitivity products sufficiently informative in targeting campaigns? A DTS-MEDEX-2009 case study
Garcies L., Homar V.

16:15 Coffee Break

16:45–17:30: MEDEX round table

Plinius14-1

Scale-consistent model for assessment of trends in precipitation extremes

M. Hanel (1,2) and A. Vizina (2)

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(2) T. G. Masaryk Water Research Institute, p.r.i., Podbabská 30, Prague, Czech Republic

Detection of systematic changes in precipitation maxima is extremely difficult due to large year to year variability. The effects of natural variability can be reduced using spatial pooling of data from neighbouring stations over certain (homogeneous) region. Still, if the records are short, the sites are strongly dependent or only few stations are available, the estimates of the characteristics of precipitation extremes might be not very accurate.
In present paper we give an example of application of non-stationary index-flood model for assessment of precipitation extremes and their changes using 30-minute data from 54 stations over the Czech Republic. It is assumed that precipitation maxima followa Generalized extreme value (GEV) distribution with time dependent parameters and that each parameter vary with (spatially) common trend in time.
It is shown, that despite the application of regional frequency analysis, the results are not always consistent over different temporal aggregations. An extension of the model, which allows posing constrains on the scaling of the GEV model parameters withtime aggregation (smooth variation, monotonic trends etc.) is proposed and the effect on the standard errors of the estimates is assessed.

Plinius14-2

Modeling the flash rate in thunderstorms: an implementation into the CRAMS model

S. Federico (1), E. Avolio (2), M. Petracca (1), G. Panegrossi (1), and **S. Dietrich** (1)

(1) ISAC-CNR, UOS of Rome, Italy (s.federico@isac.cnr.it, +0039 0649934209), (2) CRATI Scrl, Università della Calabria, 87036 Rende (CS)

In this work it is described the implementation of a simplified form of the approach of Dahl et al. (2011) to simulate the flash rate of thunderstorms in the CRAMS (Calabria Regional Atmospheric Modeling System).
The CRAMS model is derived from the RAMS model (Pielke at al., 2002), the main difference being the inclusion of a data-assimilation system tailored for the model (Federico, 2012).
Simulating lightning is not new. Nowadays, advanced three-dimensional cloud models are equipped with sophisticated electrification schemes. These make use of results from laboratory experiments, which have revealed the magnitude and direction of charge transfer during hydrometeors' collisions. In these schemes, the dielectric breakdown is modelled explicitly by initiating lightning channels that exhibits realistic branches propagation. On the other hand, there are comparatively simpler schemes that provide the storm lightning frequency. The approach followed in this work also computes the lightning frequencies, without distinguishing between intra-cloud and cloud-to-ground flashes. The applications of these simulations are manifold. Lightning not only poses a threat to life and property, but it also influences the atmospheric chemistry by its ability to create nitrogen oxide. Moreover, the comparison between observed and simulated lightning provides a way to gain insight into how realistically the model is simulating convection. The theoretical approach is based on the idea that the flash rate is not only determined by the charging rate, but also by the geometry dependent strength of each lightning flash. The methodology, whose implementation in the CRAMS model will be discussed in detail, has been applied to a case study of intense precipitation occurred over Rome on 20 October 2011, in the morning. The modelled flash number and spatial distribution are compared with those measured from the LINET network (Betz et al., 2009). The network detects signals in the very-low frequency/low frequency (VLF/LF) range and uses the time of arrival technique to determine the three-dimensional position of the discharge. The comparison for the case study shows that the total number of flashes is well simulated by the model. Nevertheless, the measured pattern of the flashes shows convective activity over the sea, which is not properly modelled by CRAMS.

Bibliography

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H. D. K . Betz, K. Schmidt, P. Laroche, P. Blanchet, W. P. Oettinger, E. Defer, Z. Dziewit, and J. Konarsky. LINET-An international lightning detection network in Europe. Atmos. Res., 91, 2011, 564-573.
S. Federico. A General purpose analysis package. Atmospheric and Climate Sciences (ACS), 2012, Vol.2, 210-221.
R. A. Pielke Sr., "Mesoscale Meteorological Modeling," Academic Press, San Diego, 2002.

Plinius14-3

Application of two passive microwave precipitation retrieval algorithms to heavy precipitation events in the Mediterranean region during 2011 and 2012 fall seasons

G. Panegrossi (1), D. Casella (1), **S. Dietrich** (1), A. Mugnai (1), M. Petracca (1), P. Sanò (1), E. A. Smith (2), and G. J. Tripoli (3)

(1) Institute of Atmospheric Sciences and Climate (ISAC), Italian National Research Council (CNR), Rome, Italy (g.panegrossi@isac.cnr.it), (2) The Center for Research on the Changing Earth System (CRCES), Tallahassee, FL, USA, (3) Dept. of Atmospheric and Oceanic Sciences (AOS), University of Wisconsin-Madison, Madison, WI, USA

Within the H-SAF program (Satellite Application Facility on Support to Operational Hydrology and Water Management, http://hsaf.meteoam.it) we have developed two different passive microwave precipitation retrieval algorithms, one based on a physically-based Bayesian approach for conical scanning radiometers, and the other one based on Neural Network approach for cross-track scanning radiometers. The foundation of both algorithms is the use of a Cloud Dynamic and Radiation Database (CDRD) built for European and the Mediterranean regions. The database is generated upon the microphysical and dynamical output of 60 simulations of different precipitation events carried out using the cloud resolving model Non-hydrostatic Modeling System (NMS), coupled with a radiative transfer model. Brightness temperatures (TBs) are computed at the frequencies and spatial resolutions of cross track scanning radiometers (NOAA and MetOp-A AMSU/MHS) and of conical scanning radiometers (SSMIS, TMI), with different surface emissivity conditions, relative to the surface conditions of each simulation.

Since both algorithms use the same physical foundation (same cloud model simulations, microphysics parameterization, and radiative transfer model), it is reasonable to expect consistency of the precipitation retrievals from cross-track and conical scanning radiometers for the same event. This consistency, besides the accuracy of the retrievals, is necessary in order to be able to fully exploit all cross-track and conical scanning radiometer overpasses for a specific event (available at about 3 hour time interval), and to be able to use both algorithms for monitoring precipitation at higher spatial/temporal resolution (i.e., blending with IR observations), as well as for nowcasting and/or hydrological applications. The two algorithms are undergoing continuous development, such as the use of dynamical/meteorological variables, as well as topography, season, and geographical location, as ancillary information to characterize the observed event, and mitigate the ambiguity of the (many) cloud microphysical structures (and rainfall rates at the ground) associated to any given set of measured multichannel TBs.

A verification study of the latest versions of the two algorithms is being carried out within the H-SAF program, where the rainfall estimates are compared against radar observations and rain gauge network measurements. We will first present the main characteristics of the two algorithms, and then discuss the different use of the dynamical/meteorological/geographical variables in the two algorithms as ancillary information in the retrieval process. Finally, we will show our precipitation retrieval results for a series of heavy precipitation events in the Mediterranean region occurred during the fall season of 2011 and 2012, together with the relative verification studies based on available radar and/or rain gauge measurements.

Plinius14-4

A descriptive impact analysis of high impact weather related incidents in Greece for the period 2001 – 2011

K. Papagiannaki, K. Lagouvardos, and V. Kotroni

National Observatory of Athens, Institute of Environmental Research and Sustainable Development, Athens, Greece (kotroni@meteo.noa.gr)

The study introduces the development of a database of high impact weather related incidents that occurred in Greece since 2001. Data collection covers all the reported incidents of flood, flashflood, hail, snow/frost, tornado, windstorm, heat wave and lightning with adverse consequences (excluding those related to agriculture). The database includes, among others, the geographical distribution of the incidents, relevant meteorological data, a brief description of the induced impacts and references in the press. Based on the collected data, an extensive analysis of the temporal and spatial distribution of high impact weather events for the period 2001 – 2011 has been carried out, taking into account the estimated magnitude and intensity of weather conditionsand the consequent impacts on society.

The annual distribution of incidents showed considerable variations, while damaging cases were most frequently observed in October and November. Overall, 83 people lost their lives, half of which due to flash flood events. Half of the recorded high impactweather related events were flash floods, which constitute the most frequent type of the examined events throughout the period 2001 – 2011. In the examined period, flash floods are associated with incidents of moderate impact intensity with a percentage of 55% and with incidents of high impact intensity with a percentage of 26%. In what concerns the spatial distribution, Attica and Thessaloniki, the largest agglomerations of Greece, have been found to be the most

vulnerable areas to severe weather phenomena. Flash flood was the main event with catastrophic effects in both areas, representing 62% and 71% of total events, respectively. In general, all regions with high frequency of severe weather incidents are located in the coastal zone of the country, which tends to be more heavily populated and thus more vulnerable to weather related hazards compared to inland areas.
The constructed database of high impact weather related incidents is continuously updated so as to include systematic monitoring and the required data for future long-term analysis and risk management. In addition, it is available on-line for educational and scientific purposes.

Plinius14-5

Extreme Value Statistics in highly resolved Climate Change Simulations for the Jordan River Area

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Understanding and forecasting changing trends and frequency of extreme rainfall and temperature events are extremely important for optimal planning in many sectors including agriculture, water resource management, health and even economics. For people living in the Jordan River region of the Middle East such changes can have immediate devastating impacts as water resources are already scarce and over-exploited and summer temperatures in the desert regions can reach 45 degrees or higher. Understanding and forecasting shift in frequency and intensity of extreme events can provide crucial information for planning and adaptation. In this paper we present results from recently completed regional climate model simulations centered on the Eastern Mediterranean region and focused on changes in extreme temperature and rainfall events. We show that maximum daily summer temperature will increase by between 2.5 – 3 degrees Celsius with an increase in warm spell length.
Precipitation extremes will also increase with longer dry spells, shorter wet spells and increases in heavy rainfall (> 75% and 90% days). In addition, we notice that the chosen global model plays an important role in determining future temperature trends while the choice of regional climate model is critical for understanding how precipitation will evolve.

Plinius14-6

First interdisciplinary approach to the effects of an extreme climate event on Mediterranean coastal assemblages

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A severe storm hit the Catalan coast (NW Spanish Mediterranean) on December 26, 2008. The storm lasted for three days and generated waves up to 14m of Hmax, being the highest wave ever recorded instrumentally in the northern part of the Catalan coast since the last 50 years. This violent storm caused extensive damage in harbours, beach promenades, waterfronts, and other coastal infrastructures causing losses of millions of Euros and capturing national attention in the media. Over 45 marine biologists and engineers joined forces in an unprecedented collaborative attempt to investigate the ecological effects of this storm. The main goal was to shed light on the role of this infrequent and extreme event in shaping the structure and the dynamics of a variety of marine coastal communities and populations from 0 to 20m depth (rocky and sandy bottom communities, photophilic algae, deep algae, sea urchins, sponges, gorgonians, seagrasses, fishes, spiny lobsters, fan mussels, date mussels, etc.). The project benefited from long-term data series collected by some of the participating research groups. These series allowed to make invaluable detailed before/after storm comparisons. The methodological approach included direct field observations, modelling, and opinionpolls. This study evidenced impacts ranging from 0% to 100% loss of individuals or cover, and allowed to identify the main factors and mechanisms leading to damage, and to match the shear stress forces with the estimated impacts. Overall, the project has provided the first comprehensive assessment of the resistance and resilience of coastal communities to extreme climate events.

Plinius14-7
MEDEX: A general overview

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Although even now some activities related to MEDEX continue alive, MEDEX can be considered as a project limited in time, lasting from 2000 to 2010. In any case MEDEX does not arise from nothing. The most direct antecedent is the WMO-MCP (Mediterranean Cyclone Project) and the occasion was the INM/WMO International Symposium on Cyclones and Hazardous Weather in the Mediterranean.
On the other hand, HyMeX is the completion of MEDEX, although widely over passing this project.
MEDEX has had two phases. In the first phase (2000-2005) it was a Research and Development Project of the WMO World Weather Research Programme (WWRP). In the second phase (2006-2010) it has been related with WWRP through THORPEX, not directly.
Direct outputs of MEDEX are the MEDEX Data Base (cyclones databases, hazardous weather calendars and a list of selected cases), still accessible, a partial summary on scientific achievements of MEDEX, two reports for EUCOS and the 2009 DTS campaign, whichcan be reviewed through the ECMWF DTS archives. Specific contributions to the MEDEX Meetings are also direct products of the MEDEX activity. A singular event in this sense is a workshop on social impacts held in Barcelona, in 2004.
More indirect outputs are many scientific contributions and papers presented at different congresses and submitted to different journals. Many of them were presented to the EGU Plinius Conferences in Mediterranean Storms and published in AdGeo or in NHESS. The scientific production in general is partially a consequence of MEDEX and partially independent of the project. Dynamical aspects, numerical modelling, sensitivity computations, climatology or social impacts are the main matters of this production.

Plinius14-8
Are flash floods increasing in Catalonia? The role of vulnerability versus hazard

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A recent work (Turco and Llasat, 2011) has been performed to analyse the trends of the ETCCDI (Expert Team on Climate Change Detection and Indices) precipitation indices in Catalonia (NE Iberian Peninsula) from 1951 to 2003, calculated from a interpolateddataset of daily precipitation, namely SPAIN02, regular at 0.2° horizontal resolution. This work has showed that no general trends at a regional scale have been observed, considering the annual and the seasonal regional values, and only the consecutive dry days index (CDD) at annual scale shows a locally coherent spatial trend pattern. Simultaneously, Llasat et al (2009, 2010) have showed an important increase of flash-flood events in the same region. Although aspects related with vulnerability, exposureand changes in uses of soil have been found as the main responsible of this increase, a major knowledge on the evolution of high rainfall events is mandatory. Heavy precipitation is usually associated to convective precipitation and therefore the analysis of the latter is a good indicator of it. The present contribution analyses the evolution of floods in Catalonia with special incidence in the period 1981-2010 (although reference to longest periods will be done), as well as the evolution of the β parameter, related with the greater or lesser convective character of the precipitation (Llasat, 2001). Other factors like changes in population density or in land uses are also considered.

Plinius14-9
Long-term trends and variability of precipitation extremes in North Africa

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Maghreb countries in North Africa are highly vulnerable to extreme hydrological events, such as floods and droughts, driven by the strong variability of precipitation. There is a questioning about a possible increase in their intensity or occurrence, since a significant increase in the vulnerability of

the populations has been observed during the last decades in this region. While several studies have analyzed the presence of trends in precipitation records for the Euro-Mediterranean basin, this study provides the first assessment of trends in its southernmost shores. A database of 22 stations located in Algeria, Morocco and Tunisia with between 33 and 59 years of daily precipitation records is considered. Eleven climate indices describing several features of the precipitation regime are computed. The change points and trends are analyzed using robust statistics taking into account the serial and cross correlations present in the dataset. The issue of conducting multiple hypothesis tests is also addressedtrough the implementation of a false discovery rate procedure. In addition to the trend analysis, the inter-annual variability of the precipitation indices in the different stations is compared with large scale atmospheric circulation patterns, includingthe North Atlantic oscillation (NAO), Western Mediterranean oscillation (WEMO), Mediterranean oscillation (MO) and El Niño Southern Oscillation (ENSO). Results show a strong tendency towards a decrease of precipitation totals and wet days together with an increase in the duration of dry periods, mainly for Morocco and western Algeria. On the opposite, only a few significant trends are detected for heavy precipitation indices. The NAO and MO patterns are well correlated with precipitation indices describing precipitation amounts, the number of dry days and the length of wet and dry periods, whereas heavy precipitation indices exhibit a strong spatial variability and are only moderately correlated with large scale atmospheric circulation patterns.

Plinius14-10

Estimation of antecedent wetness conditions for flood modeling in Northern Morocco

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In northern Morocco are located most of the dams and reservoirs of the country, while this region is affected by rainfall events causing severe floods. To improve the management of the water regulation structures, there is a need to develop rainfall-runoffmodels to both maximize the storage capacity and reduce the risks caused by floods. In regions with limited data availability, event-based approaches are more suitable than continuous ones; however there is a need to define the catchment antecedent wetness conditions prior to the flood events. In this study, a model is developed to reproduce the flood events for a 655 km² catchment located upstream of the 6th largest dam of Morocco. Constrained by data availability, a standard event-based model, combining a SCS-CN loss model and a Clark unit hydrograph, was developed for hourly discharge estimation using 16 flood events that occurred between 1984 and 2008. The model was found satisfactory to reproduce the runoff and the temporal evolution of floods even with limited rainfall data, with a mean Nash efficiency coefficient of 0.81. Several antecedent wetness conditions estimators for the catchment were compared with the initial condition of the model. These estimators include: an antecedent discharge index, an antecedent precipitation index and a continuous daily soil moisture accounting model (SMA), based on precipitation and evapotranspiration. The SMA model performed the best to estimate the initial conditions, with R^2=0.9 between its output and the initial condition of the hydrological model. The daily output of the SMA model has been compared with ASCAT and AMSR-E remote sensing data of soil moisture, both were able to reproduce with accuracy the daily soil moisture dynamics at the catchment scale. Thesame approach could be implemented in other catchments for operational purposes. The results of this study indicate the potential usefulness of remote sensing data to estimate the soil moisture conditions in the case of ungauged catchments in Northern Africa.

Plinius14-11

Current and future medicane risk based on the generation of synthetic storms

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Medicanes are warm-core, surface flux-driven extreme windstorms potentially threatening the islands and coastal areas of the Mediterranean countries that have captured the attention of the research community. With an average frequency of only 1-2 events per year and given the lack of systematic, multidecadal databases, an objective evaluation of the long-term risk of medicane-induced winds is impractical with standard methods. A statistical-deterministic approach was developed by the second author in the context of the tropical cyclone risk over the great ocean basins. This approach entails the generation of thousands of synthetic storms with low computational cost, thus enabling a statistically robust assessment of the risk (e. g. calculation of

return periods for extreme winds at fixed locations). By using GCM transient climate simulations instead of reanalyses as input data, the capabilities of this technique can be expanded to account for the expected effects of global warming. This work presents an adaptation of the statistical-deterministic approach to the Mediterranean region with the aim of assessing the medicane risk under current and future climate conditions. These climates are represented by ERA-40 reanalysis (1981-2000) and four different GCMs under the SRESA2 emission scenario (2081-2100).
First, the spatial variability in 10-day synoptic evolutions of key ingredients for the environmental control of these storms (potential intensity, mid-tropospheric temperature and humidity, and winds in the low and upper troposphere) is converted via principal component analysis (PCA) into a new space represented by the resulting independent PCs. In a random sequence, states are selected from the new space, slightly perturbed in each PC, and then converted back into physical space. By construction, this is tantamount to generating 10-day sequences of spatiotemporal coherent fields which also respect the mutual covariances among the environmental ingredients. Thousands of climate realizations generated in this way are then scrutinised for the potential incubation of medicanes based on the presence of high values of an empirical index of genesis that have been shown to accompany the development of real events. Finally, tracks for all candidate storms are produced using the Beta and Advection Model and numerically simulated using a simple but accurate deterministic tropical cyclone intensity model, involving both atmospheric and oceanic elements. By this means, synthetic time series of storm intensity, including the radial distribution of wind, are producedwith an adequate population number and spatial coverage.
With this statistical-deterministic approach we attained unprecedented wind risk maps for the Mediterranean region, generally consistent with what can be inferred about the medicane phenomenology from the few documented real cases. In addition, GCMs tend to project fewer medicanes at the end of the century compared to present but a higher number of violent storms, suggesting an increased probability of major economic and social impacts as the century progresses.

Plinius14-12

Study of IDF curves established by the property of scale invariance in Tunis

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This work focuses on the study of intensity-duration-frequency (IDF) curves of Tunis-Manoubia station located in Tunis (Tunisia). The assumption of simple scale invariance combined with the Gumbel distribution was used to develop the formulas of IDF curves. Indeed, firstly, the scale exponent was derived using all analyzed reference periods (5, 10, 15, 20, 30, 40, 50, 60, 90, 120, 180 minutes and 24 hours). It should be noted that the daily rainfall intensities are corrected using the coefficient of Weissto obtain those of 24 hours. However, the study of probability weighted moments unveiled a scale break at 30 minutes. Hence, there are two intervals each one characterized by a simple scale invariance and a scale exponent namely [5 minutes - 30 minutes] and [30 minutes - 24 hours]. IDF curves obtained by simple scaling were compared with those experimental one determined by DGRE*. It proved that the maximum intensities estimated by DGRE for different return times (2, 5, 10, 20, 58, 100 years) are overestimated for durations of references less than 30 minutes which is oversize hydraulic works, whose design is based on these curves such as dams and sewage works. Since the rainfall data at high resolution (minutes to hours) are not available because most stations are equipped with non-recording gauges. Only totals are available, hence the interest of this method is the estimation of maximum intensity for periods less than one day using only daily data.
Keywords: IDF curves, scale invariance, extreme rainfall, Gumbel distribution, Directorate General of Water Resources of Tunisia.

Plinius14-13

Investigation on extreme daily rainfall estimation using MSG MPE approach for North Tunisia

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Evaluation of satellite-retrieved extreme precipitation is important for flood management, soil erosion assessment and other environment issues. Due to damage risk to houses, farms and buildings, heavy precipitation may have important social impacts. Thepaper aims to investigate the potential of the Meteosat Multi Sensor Precipitation or MSGMPE data which combine microwave rain rate estimations from the SSMI sensor and since mid-2009 the AMSU-A sounder with the SEVIRI thermal infrared channel from MSG-2using an EUMETSAT production chain in near real time mode. The data were analysed using ILWIS Open and extreme rainfall patterns across the north of Tunisia were generated. Rainfall events with at least 50 mm/day observed across the rainfall ground network were selected for the period 2007-2009. Kriging methods were applied to generate rainfall maps which were then compared to satellite estimations using the precipitation products available in the EUMETSAT UMARF archive and/or from GEONETCast. The summation of the MPE estimates and products available at 5 min and 15 minute time steps over 24h, gave rise to the comparison basis. Correlation coefficients were used to undertake the comparison. It was found that for some events pixels correlation coefficients of 0.65 were achieved while for other events however, the correlation was weak and non-significant. The MSGMPE data should be combined with other data or information in order to give more reliable extreme rainfall estimates for all weather situations inTunisia.

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Plinius14-14

Ensemble prediction systems based on potential vorticity perturbations and multiphysics tested for MEDEX events. A medicane event application

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The main goal of our regional ensemble prediction systems (EPSs) is to improve the current prediction skill of potentially hazardous heavy precipitation weather events in the western Mediterranean countries. Thanks to three different ensemble generation procedures we account for uncertainties present in both the numerical models and the initial conditions. The EPSs generation takes advantage of the connection between potential vorticity (PV) structures and cyclones, and of the different physical parameterization schemes present in the numerical model. First, we consider two PV-perturbed ensembles differing in the criteria used to locate the initial perturbation zones. One of them introduces the perturbations over the MM5 adjoint model calculated sensitivity zones (PV-adjoint), while the other one perturbs the PV field along the zones of the three-dimensional PV structure presenting the local most intense values and gradients of the field (PV-gradient). Second, a multiphysics EPS is built by incorporating different combinations of the physical parameterizations for boundary layer, cumulus and moist microphysics processes. The non hydrostatic MM5 mesoscale

model has been used to run all the ensemble members. The simulations are performed for a two-day period with a 22.5 km resolution domain, Domain 1 in http://mm5forecasts.uib.es, nested in the ECMWF large-scale forecast fields.
The performance of the ensembles is evaluated with a thorough verification process using 19 MEDEX cyclonic episodes as a testbench. These MEDEX events are associated with floods and strong winds over the western Mediterranean and represent the kind of phenomena we are targeting.
Besides ratifying the advantages of an EPS over a deterministic forecast, the results of the verification procedure show that the EPSs perturbing the PV field structures are more skillful than the Multiphysics ensemble, and that among those, the PV-gradient ensemble provides a more useful forecast than the PV-adjoint at a better cost, at least when our testbed is concerned. Encouraged by these results, we apply the three EPSs to the 8 November 2011 medicane event. This tropical-like cyclone reached its mature state after passing through Majorca Island and evolved towards the Gulf of Lion region where it dissipated. The results of our EPSs for this event reveal that all three systems are able to successfully capture the event. In fact, both the cyclone track and its intensity are reasonably well represented. If this detection skill could be extrapolated to the bulk of medicane-like events, the EPSs could be a very useful tool for examining the predictability of these dangerous meteorological situations and for implementing an automatic detection and warning issue method.

Plinius14-16
Daily precipitation records over mainland Spain and the Balearic Islands

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Heavy rainfall is the most important cause of flooding, far beyond tropical cyclones, monsoonal rain or tidal surges all together. In Spain, from 1953 to 2011, 26 exceptional floods have been registered with an estimated damage of 8100 million inflation-adjusted USD, 1287 people killed and about 750.000 people affected. A major climatic demand for multiple natural and social applications is the evaluation of the spatial distribution of daily precipitation extremes. This type of analysis requires direct observed values. A previous study of daily rainfall extremes observed over the Iberian peninsula (Spain and Portugal) has been updated by using data from 8184 rain gauge stations. Results show that heaviest daily precipitations have been observed mainly on the coastal Mediterranean zone, from Gibraltar to the Pyrenees. A total of 13 stations recorded maximum daily precipitation amounts exceeding 500 mm and 7 of them are located in the Valencia region. Despite orography is a well-documented mechanism for convection initiation -through direct uplift- and heavy rainfall anchoring in Mediterranean Spain, some of the most extreme records (817 mm and 720 mm) are found on the coastline, hardly above sea level. The systems that produce these coastal extreme rainfalls are most frequently organized as mesoscale convective systems (MCS), usually stationary, and bearing persistent and copious rainfall on the affected locations. The meteorological situations that produce heavy rain in eastern Spain are usually characterized by low sea-level pressures over inland north Africa and high pressures over central Europe that produce easterly flow over the western Mediterranean. The presence of very warm and moist air over the Mediterranean Sea favours advection of conditionally unstable air towards the eastern coast of Spain owing to the westward flow. At mid tropospheric levels, a cold deep trough to the west or southwest of the Iberian peninsula and a ridge over central Europe favours the enhancement of the low-level easterly circulation. This configuration promotes the impinging of unstable air over the coastal ranges, releasing its latent instability and initiating heavy rain bearing moist deep convection systems.

Plinius14-17
Sensitivities of Mediterranean High Impact Weather: From MEDEX to Ghostbusting?

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Back in the early 2000's, the idea of investigating the potential of forecast sensitivities for high-impact Mediterranean events persuaded the scientific community of MEDEX, under an ever increasing societal demand for cost cuts and more precise and oriented forecasts. Shortly after that, the coauthors of this communication bravely faced the exciting challenge of learning, computing and finally analyzing Mediterranean forecast sensitivities using a comprehensive approach and with the vision of providing support to both specific cases in targeting campaigns and also to long-term initiatives aimed at optimizing permanent observational strategies that accounted for the Mediterranean region, such as the European Composite Observing System (EUCOS) and eventually the Global Observing System. Since then, substantial progress has been done in this field, with a better understanding of the

challenges and limitations of using forecast sensitivity calculation techniques to guide observation-related decisions. In anycase, this research line has produced a collection of results, both end-products and methodological findings, that have contributed to better understand the fundamental predictability problem of Mediterranean high-impact weather (MHIW) phenomena.
The talk will provide an overview of the sensitivity calculation methods implemented or developed in recent years in order to identify the main climatologically sensitive areas for MHIW. On the one hand, an atmospheric adjoint model rendered the first climatology of forecast sensitivities of Mediterranean intense cyclones. These dynamical results were confronted with a new statistical method based on the definition of clusters of events recorded in a reanalysis. These works have provided a general vision of the most influential areas for the forecast of MHIW events. However, the pursue for a methodical and rigorous attempt to quantify the value of such sensitivity products has yielded unexpectedly discouraging results but also the blossom of fundamental questions regarding the strict disconnection between current sensitivity products and the most pragmatic objective that underlies targeting strategies. We will show a historical perspective of the findings along this research line obtained during the last decade within MEDEX, and also provide some evidences that we still have little idea of what we are really looking for.

Plinius14-18

Bayesian trend analysis of extreme wind hazard using observed and hindcast series off Catalan coast, NE Mediterranean Sea

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It has been suggested that climate change might modify the occurrence rate and magnitude of large ocean-wave and wind storms. The hypothesised reason is the increase of available energy in the atmosphere-ocean system. Forecasting models are commonly used to assess these effects, given that good quality data series are often too short. However, forecasting systems are often tuned to reproduce the average behaviour, and there is a doubt on their representativity for extremal regimes.
We present a methodology of simultaneous analysis of observed and hindcasted data with the aim of extracting potential time drifts as well as systematic regime discrepancies between the two data sources. The method is based on the Peak-Over-Threshold (POT) approach and the Generalized Pareto Distribution (GPD) within a Bayesian estimation framework. In this context, storm events are considered points in time, and modelled as a Poisson process. Storm magnitude over a reference threshold is modelled with a GPD. The GPD is a flexible model that captures the tail behaviour of the magnitude distribution, classifying it in three types (domains of attraction of extrema): bounded tail, exponentially decaying tail and heavy tail.
In a first step, one verifies that hindcasted and observed extremal data can be modelled with GPD's with a similar tail behaviour. The magnitudes are treated in two ways, in the original raw scale and in a logarithmic one. It is desired that GPD for both hindcasted and observed series belongs to the same domain of attraction in the same scale.
Once scale and domain of attraction are chosen, we introduce a time dependence in the model parameters. All model parameters, i.e. shape and location of the magnitude GPD and the Poisson occurrence rate, are affected by a trend in time. Moreover, a difference between parameters of hindcasted and observed series is considered. Finally, the posterior joint distribution of all these trend parameters is studied using a conventional Gibbs sampler.
This method is applied to compare hindcast and observed series of 10-minute average wind-speed at a deep buoy location off the Catalan coast (NE Spain, Western Mediterranean; buoy data from 2001; HIPOCAS wind hindcasting from 1958). Appropriate scale and domain of attraction are discussed, and the reliability of trends in time are addressed.
This research has received funding from the Spanish Government, projects COVARIANCE (CTM2010-19709) and CODA-RSS (MTM2009-13272).

Plinius14-19

Hydrological response of a small vineyard catchment (D.O. Penedès, NE Spain) depending on rainfall intensity and antecedent soil moisture

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The catchment of Hostalets de Pierola, a small tributary of the low course of the Anoia river (Llobregat basin), is located in the Catalan Prelitoral Depression (Penedès Depression) on Pliocene gravels and detritic Miocene substratum. The catchment size is 0.46 km2 with an average slope of 7.2 %. The main land use in the catchment is vineyards (62.3 %), with other crops and land uses

with minor occupation: olive trees 4.8 %, winter cereals 9.5 %, alfalfa 8.5 %, among other).
In order to carry out a research on the hydrological response and sediment transport in a representative catchment of vineyard areas in the Spanish Mediterranean region, the catchment was equipped with pluviographs to measure rainfall amount and intensity, soil moisture content sensors and a flume (HL 4" type) to measure water flow in the outlet. This water gauging allows to measure flows up to 3400 los-1, and it is equipped with two ultrasonic level sensors and a data-logger for data register. In parallel, monitoring of subsurface water flow of the catchment was carried out in the natural source called Can Flaquer.
During the springs of 2011 and 2012 several rainfall events occurred, which allow a preliminary analysis of the hydrological response of the catchment, in comparison with rainfall characteristics (depth and intensity) and the antecedent soil moisture content. The spring events include episodes up to 27 mm, with maximum intensities of 50 mmoh-1 and peak flows up to 1100 los-1. The surface runoff of the catchment ceases very quickly, in a few hours after the end of rainfall events, indicating a limited roleof soils in water retention and a very active percolation into the aquifer of the Pleistocene gravels. The runoff rates of the analyzed events were relatively low (between 1 - 12 %), depending on the rainfall characteristics and the antecedent soil moisture, indicating a high soil permeability. An important part of the infiltrated water follows a slow subsuperficial way to the water source, which maintains a continuous flow ranging between 0.2 and 0.6 los-1.
The analyzed floods occurred with important sediment yield generated in the agricultural fields of the catchment as well as in the unpaved paths that constitute the drainage ways. This causes important erosion problems in the fields and accumulation of sediments in the lower part of the catchment.

Plinius14-20

Gravity wave characteristics in the middle atmosphere at Palma de Mallorca due to a Mediterranean tropical storm and fronts

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Atmospheric waves, especially gravity waves, which are radiated from convective sources like an extratropical cyclone, are investigated to serve as a proxy for the changing energy content of the storm itself. This information, if available, regularly is of special importance for improving storm track and intensity forecast.
During a measuring campaign which was carried out at Mallorca as cooperation between AEMET and DLR in 2011 (September to December), 143 radio soundings (day and night) providing beneath others vertical temperature profiles were performed. Additionally, operational nightly mesopause temperature measurements with a time resolution of about 15s which were deduced by an infrared spectrometer (GRIPS) are available for Mallorca during the campaign period.
From these observations gravity wave activity in the stratosphere and mesopause related to significant weather conditions is derived and compared. A Mediterranean tropical storm in November 2011 as well as a strong cold front in December 2011 is used to discuss these results. Especially gravity wave momentum fluxes are deduced and investigated to point out the difference between steady and severe weather. They showed an increase of more than four times during convective events in comparison to a quiet period.

Plinius14-21

Calibration of two Alarm Indexes for Flood Alarm Mapping

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One of the main problem in the operational use of hydrologic model deals with the difficulties to actually calibrate or validate the prediction of the flow discharge because of the lack of observed discharge time series especially for small rivers.
To overcome this difficulties two different alarm indexes have been checked to test the possibility of an operational flood alert mapping based on the simulations of an hydrological model. Cetemps HYdrological Model (CHYM) is a distributed grid-based model, one of the main features of such model being the possibility to ingest different data sources to rebuild the precipitation field at hydrological scale. A first and most empirical CHYM flood alert mapping index is calculated as the ratio of the total drained rain and the total drained area of each grid point at a fixed time interval; such time interval corresponding to the average runoff time for the whole upstream basin for the selected grid point. A further approach consists in the comparison between the maximum discharge predicted by the model for each grid point and the hydraulic radius of the channel, the latter is calculated for as a function of the total area drained by each elementary cell. The alarm-values of these alarm

indexes have been calibrated using 15 different case studies affecting Italian territory in the last years. Detailed analysis shows that the proposed indexes allow the possibility to efficiently select the timing and the location where floods are observed to occur. The performances of different indexes for the different case studies are reported and the possibility to use these different approaches in an integrated system for operational flood alert mapping is also emphasized.

Plinius14-22

Long-lasting deep convective systems occurring in the Mediterranean basin: a four years (2007 – 2010) study

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A large part of natural disasters in the Mediterranean are directly or indirectly caused by convective systems (Funatsu et al., 2008). Since this basin has been identified as one of the most responsive to global climatic changes (Giorgi, 2006), the study of deep convective systems (DCS) is becoming a hot topic to deeply investigate. The major reason to go through the mechanisms driving such events is given by the growing need to have timely and precise predictions of severe weather events, especially in areas that show to be more and more sensitive to their occurrence.
When dealing with severe weather events, either for research purposes or operational forecasting activities, it is necessary to precisely know the conditions under which these events take place to upgrade conceptual models or theories, and consequently toimprove the quality of forecasts as well as to establish effective warning decision procedures (Brooks and Dotzek, 2008).
The spatial and seasonal variability of DCS occurrence have been investigated, as well as the most favourable synoptic precursors for their initiation, using geostationary Meteosat Second Generation (MSG) satellite data, supported by the European Centre for Medium-Range Weather Forecasts (ECMWF) analyses and severe weather reports recorded by the European Severe Weather Database (ESWD).
The analysis has shown the existence of some preferential areas of DCS genesis and development, mainly located in the western and central Mediterranean (i.e., around Balearic Islands and Ionic and Tyrrhenian seas, respectively), where these systems develop and grow preferentially in fall (i.e., September and October). The analysis of a selected set of Synoptic Precursors (SPs) has shown how the totality of the identified cases has occurred downstream a mid-tropospheric (500 hPa) disturbance (trough or cut-off) within a southerly flow, with high values of θe (at 850 hPa) and precipitable water. Moreover, the approaching of an upper level tropopause dynamical anomaly coupled with a local maximum of upper and low level horizontal wind speed, seems to play a very important role in triggering convection. Finally, a careful crosscheck of the detected cases with the ESWD reports has allowed to investigate the severity of these systems, as they often affect population and produce significant damages.
In a long-term perspective, this study aims at collecting a climatological database of long-lasting DCS occurring in the Mediterranean sea that may critically impact on the Italian peninsula and potentially affect population: an objective procedure able to support meteorological services in early decisions and accurate nowcasting has planned to be developed to fully respond to this issue.

Plinius14-23

On the distribution and seasonal cycle of transient luminous events above Europe

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In the year 2000, the first sprites were observed over European thunderstorms using low-light cameras. Since then, Eurosprite campaigns have been conducted to observe sprites and other transient luminous events (TLEs), expanding into a network covering large parts of Europe and coastal areas. Over 2009 to 2011, the number of optical observations of TLEs exceeded 1000 per year. Because of this unprecedented number of observations, it was possible to construct a climatology of 3931 TLEs observed above 500 thunderstorms, and study for the first time their distribution and seasonal cycle above Europe. The number of TLEs per thunderstorm was found to follow a 10 power law, with less than 10 TLEs for

388 thunderstorms and up to 147 TLEs above the most prolific one. The vast majority of TLEs were classified as sprites, 145 as elves, 112 halos, 30 upward lightning, 2 blue jets and 1 gigantic jet. The climatology shows that TLE activity in Europe is intense during summer over continental areas, and in late autumn over coastal areas and sea. The largest number of TLEs per month is recorded 15 in November, whereas in March and April TLE activity is almost completely halted.
An active November is consistent with the larger +CGs/-CGs ratio in autumn/winter maritime thunderstorms as compared to summer continental ones, although the peak in observed TLEs is surprisingly large. Elve activity is almost exclusively limited over autumn/winter maritime thunderstorms. The overall behaviour is well consistent among 20 individual years, therefore making the observed seasonal cycle a robust general feature of TLE activity over Europe.

Plinius14-24

Modelling and errors for short duration Mediterranean storm events: ranking of uncertainties

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Western Mediterranean, as many others semi-enclosed systems, is a region with sharp topo-bathimetric gradients that result in a strong local variability of mete-oceanographic patterns. This variability is super imposed to more permanent synoptic situations such as for instance the Mestral (North or North-West) wind fluxes. In addition the low pressure centres, depending on the atmospheric patterns over the Cantabric Sea and Central Europe, may show a tendency to recirculate in front of the Eastern Spanishcoast, producing a succession of storm events sometimes called twin storms. Because of this complex situation the relative errors of meteo-oceanographic models are much larger than elsewhere and there is a need to rank the various sources responsible forthese discrepancies between observations and simulations.
In the paper we consider two storm periods in 2010 and 2011, for which there are meteorological fields with two mesh resolutions (12 and 3 km respectively) and two different models (MM5 and WRF). We have run two different wave models (WW3 and WAM) with resolutions from 9 to 3km. This gives a combination of 4 wind-wave models, at 2 different scales. Finally we have compared the obtained simulations with six wave buoys along the Catalan coast, belonging to the XIOM network (Catalan Government) and to the Puertos del Estado network (Ministry of Public Works). The resulting error time series for the significant wave high have been analysed in statistical and physical terms, with emphasis on the best scale for the analysis (natural versus logarithmic) and the error levels for the different meteorological patterns (mainly from the Eastern, Southern and North Western sectors).
The paper will end with a ranking of error sources and some conclusions on how the fetch length, the storm duration and the coastal orientation, together with the employed modelling sequence, affect the overall robustness and accuracy of the local scale predictions. The overall behaviour in bias is a general underestimation of Hs for the storm peaks together with a slight overestimation for calmer conditions. In the framework used, WAM shows a similar bias independently of the wind model and scale, while WW3 bias improves in the higher resolution. In terms of root mean square error, better resolution winds generate better waves whichever wave model is used. Prediction at the central Catalan Coast is particularly bad in this regard, which can be attributedto the irregular coast geometry and the prevalence of transient patterns. Finally, in terms of prediction-observation correlation coefficients, WAM offers better results than WRF at all scales and for all wind sources (specially using log-scale, i.e. downweighting the storm peaks). These results suggest that WW3 might capture coastal phenomena leading to a storm prediction slightly better than WAM, while WAM is reproducing better the overall trend shapes in open sea, albeit not the "real" magnitude of wave height.

Plinius14-25

From past to present: the effects of historical damaging hydrogeological events in the current urban setting

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Damaging hydrogeological events (DHEs) are defined as the occurrence of destructive phenomena (as landslides and floods) which during bad weather periods cause severe damage to people and goods. These phenomena have to be analysed all together -as actually occur- even because their interactions can both amplify damage and hider emergency management actions.
The occurrence of DHEs depends on the interactions between climatic and geomorphological features: except for long-term climatic change effects, as time pass this interaction is averagely steady and for this reason some areas are systematically affected. What can change are

damage scenarios: other things being equal, the effects of past DHEs can vary according to the modifications occurred in the geographical distribution of vulnerable elements.
Basing on the assumption that areas affected in the past could be hit again in the future, we propose the historical re-enacting of a catastrophic DHE aiming to individuate: a) where damage could occur; b) what damage severity can be expected; and c) whatis the probability that rainfall able to trigger catastrophic events can occur. The final result is a semi-quantitative assessment of the susceptibility characterising the study area to be damaged during DHE.
The methodology was applied to Calabria (southern Italy): the catastrophic 1951 DHE (101 victims, 4500 homeless, about 1700 houses disrupted) was analysed in order to practically show the potentialities of the method.

Plinius14-26
Heavy rainfall episodes over Liguria: elements controlling forecast errors of quantitative precipitation

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Liguria and Tuscany regions, in Italy, were affected by heavy rainfall and flood episodes during autumn in 2010 and 2011. Heavy precipitation, leading to hydro-meteorological consequences, was associated with the development of intense and quasi-stationary convective systems, related to different mesoscale forcing systems combined with orographic lifting.
This study aims at identifying the main physical processes responsible for the onset, lifecycle, intensity and localization/propagation of the precipitating systems, in order to improve forecasting ability, using a convection-permitting model (MOLOCH) at different spatial resolutions. It is shown that the relatively satisfactory model behaviour in forecasting the localization of the systems critically depends on the accuracy in forecasting pre-existing cold air outflow from the Po Valley to the Ligurian sea, which reinforces the evaporative cold pool associated with the convective system. As a consequence, the strength of the resulting cold pool determines where the convergence with a southerly LLJ triggers the convection over the sea and where the emerging convective line, interacting with the Apennines coastal orography, produces the precipitation maxima. Recent upgrades in model physics (microphysics, radiation etc.) proved to be beneficial for QPF. Moreover, results of sensitivity experiments indicatehow the underestimation error of quantitative precipitation is alleviated by increasing model resolution.

Plinius14-27
On the effects of the cloud vertical structure on lightning production

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This work aims to study the role of the ice phase in the mechanism of cloud electrification and lightning formation. Despite thundercloud charge structure has been known since 1920, when C.T.R. Wilson measured Earth's electric field, the mechanisms responsible for the separation of charge regions and then for lightning are still uncertain. Over the various assumptions, the non inductive ice-ice interaction is one of the most accepted. This process requires the presence of large ice hydrometeors (i.e. graupel or hail pellets) that collide with ice crystals in a suspension of supercooled water droplets.
We used data from LINET, a VLF/LF lightning detection network, in relation to reflectivity, IWC and ice effective radius from Cloud Profiling Radar (CPR), a 94 GHz radar on Cloudsat, a polar satellite of the NASA Earth System Science Pathfinder (ESSP) program. LINET has been developed at the University of Munich in 2006 and consists of more than 90 sensors over 17 countries. The good sensitivity of the antenna, which detects signals smaller than 5 kA, attributes a total lightning quality to the network, while the Time Of Arrival (TOA) method allows the network to distinguish between IC and CG. The Cloudsat unique capability is to measure, for the first time, the cloud vertical structure in order to improve the microphysical characterization. In particular,it makes possible to individuate different cloud regions depending on the different values of IWC and effective radius.
Lightning data from one year and a half have been superimposed on the images of the corresponding cloud reflectivity data. A severe storm over Padua (eastern Po Valley) has been selected out of convective cases for detailed case study. The relationship between the higher flash rate areas and cloud microphysics has showed two different regions inside the cloud: one of them localized at altitudes around 10 km, characterized by high IWC values therefore a large number of ice crystals, and the other 7 km high, in which we found the higher effective radius values, that indicate the presence of large hydrometeors (hail and graupel), then confirming the hypothesis of the dipole cloud structure and the effectiveness of the non inductive mechanism.

Plinius14-28
The Intensive Observation Period in Italy during the HyMex campaign

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HyMeX (Hydrological cycle in the Mediterranean eXperiment) is a project aimed at a better understanding and quantification of the hydrological cycle and related processes in the Mediterranean. As a part of HyMeX, Special Observation Periods (SOPs) are dedicated to provide detailed and specific observations to study key processes leading to orographic precipitation (ORP), heavy precipitation events (HPEs), and flash flooding events (FFEs) in certain Target Areas (TAs). Informed by numerical weather forecasts and standard observations, Intensive Operation Periods (IOPs) are declared during the SOPs. Specific observations in the TAs are provided by operational measurements (ground meteorological networks, soundings, and remote-sensing instruments), coupled with specific measurements during IOPs from several instruments, such as disdrometers, sodars, lidars, research radars, extra soundings, etc. In this paper an overview is presented of the HyMeX IOPs in Italy during SOP1 (5 September – 6 November, 2012). The Hydro-Meteorological sites of interest were: Liguria-Tuscany (LT), northeastern Italy (NEI) and central Italy (CI). Typical situations encountered for HPEs in LT involved upper-level southwesterly flow with low-level moist southerly or west-southwesterly flow from the Tyrrhenian Sea. Highlights include a measurement of 300 mm/24h of rain at the border between Liguria and Emilia on Sept. 26, 2012 during IOP7b. For HPEs in NEI, typical situations also involved southwesterly flow ahead of advancing troughs, but in this region, low-level moist southerly flow comes from the Adriatic Sea. Highlights include 160 mm/24h of rain in Friuli on Sept. 12, 2012 during IOP2. For HPEs and FFE over CI, at the time of this writing a slowly propagating cut-off low with a center passing over southern Italy was observed; the associated easterly flow on the north side of the cut-off low would frequently bring moisture into east central Italy from the Adriatic Sea. Highlights include an event with very intense convectivecells producing more than 150 mm of rain in several hours in Abruzzo on Sept. 14, 2012 in IOP4; extensive flooding occurred in this case. The ongoing analyses of these cases will shed light on the complex chain of events that determines the timing, location and intensity of HPEs over complex orography in the vicinity of maritime air masses and on the forecasting ability of the different meteorological models implemented for the campaign.

Plinius14-29
The CETEMPS Hydro-Meteorological chain during HyMex

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The Cetemps Hydrological model has been offline coupled with WRF and MM5 models in order to estimate the possibility of flood occurrence. CHyM is a distributed grid based hydrological model implementing an explicit parameterization of different physical processes contributing to hydrological cycle, the model can be forced with temperature and precipitation scenarios predicted by MM5 and WRF model. In addition this model implements the calculus of two different alarm indexes providing a map of the segments of hydrological network where floods are more likely to occur. CHyM alarm maps are described and the results for the case study occurred during HyMex campaign are shown. The IOP4 event is used to this purpose. Heavy precipitation occurred in the morning over central Italy mainly along the Eastern Italian coast (Marche and Abruzzo regions), associated with the cut-off low over the Tyrrhenian Sea. The rainfall maxima reached more than 150 mm/24h producing floods over Marche and Abruzzo.
Emphasis is given to the possibility of coupling of WRF and CHYM model providing an effective tool for operational flood alert mapping.

Plinius14-30
An analysis of three disastrous rain events occurred in Italy: Rome, Cinque Terre and Genoa

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During autumn 2011, three dramatic floods occurred in Italy causing deaths and terrible injuries: in Rome on October 20, in Liguria and Tuscany on October 25, and in Genoa on November 4. One of

the hardest-hit areas was the Cinque Terre, a national park with a marine protected area; its landscape was completely changed by the landslide caused by the heavy precipitation. The three events are characterized by localized heavy precipitation occurring over short periods; the maximum recorded precipitation is approximately: 200 mm accumulated in 2 hours in Rome and 300 mm accumulated in 3 hours at Cinque Terre. At a few stations the 12-hour accumulated precipitation reaches 400 mm near Genoa, and approximately 500 mm at Cinque Terre.
The mechanisms causing the floods are analyzed in this study using both observations (rain-gauge, radar-reflectivity, and satellite data) and model simulations. The goal is to understand the mechanisms leading to the very heavy precipitation recorded in the three cases, analyzing the interaction between the large scale and the local circulation and to investigate the ability of our model to forecast the very rapid development of such events. The model simulations are carried out using the Weather Researchand Forecasting (WRF) model on two domains, one at 12 km horizontal resolution, over Europe, and one at 3 km, over Italy. The influence of high spatial resolution on the simulation, particularly on the enhancement and location of the heavy rain, is also addressed by performing simulations at 1 km and 500 m horizontal resolution.

Plinius14-31
Climate change effects on medicanes based on a dynamical downscaling method

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Mediterranean tropical-like cyclones (also called medicanes) are extreme events that occasionally occur over the Mediterranean sea and threaten the islands and coastal regions. These warm-core storms operate on the thermodynamical disequilibrium between the sea and the atmosphere, and although their dimensions and other meteorological parameters such as the attained maximum wind speed differ in magnitude with real tropical cyclones, their development mechanism and satellite images appear to be similar.
For projecting future climate-driven changes in medicane risk, a collection of GCMs have been used, but their typical coarse resolution make them inappropriate to deal explicitly with this kind of extreme phenomena of mesoscale size. For this reason, it is necessary to find a link between both scales, looking first for some large-scale parameters that are related with medicane genesis. An empirical genesis index for tropical cyclones which involves large-scale environmental ingredients like low-tropospheric vorticity, mid-tropospheric relative humidity, potential intensity and tropospheric wind shear, is revealed as an useful parameter to detect areas with a potential risk to develop a medicane. In second place, the ability of the MM5 numerical model tosimulate known cases of medicane storms has been proved. These control simulations have been run with a horizontal resolution of 7.5 km and are forced using large-scale analyses with a coarse resolution, similar to that of the current generation of GCMs.
Then, a dynamical downscaling method has been devised: areas presenting high values of the empirical genesis index are identified and numerically simulated with MM5. Results derived from ERA-40 are compared, on the one hand, against the satellite-based climatology of events and, on the other hand, against the GCM-derived results, thus permitting the assessment of the effects of climate change on the medicane frequency and intensity. As one would expect, the medicanes reported in the current climatology are well represented using this authomatic and objective method. In addition, the statistical distribution of the areas with the highest potential for the development of medicanes, using ERA-40 and GCMs (for the current and future time slices), are consistent with the current climatology of events, both in spatial and temporal distribution. At the time of this writing, possible medicane development in the simulations is checked manually, but an objective cyclone detection algorithm is going to be implemented to make the process fully automatic.

Plinius14-32
Analysis of storm waves on the Black Sea

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Waves in the Black Sea caused by gale-force wind are the main object of this study. The third-generation SWAN spectral wave model is used for wave simulation. NCEP/NCAR reanalysis fields for the period between 1948 and 2012 with a frequency of 6 hours arethe forcing input in these calculations. Such physical processes as quadruplet interactions, whitecapping, triads, bottom friction, depth-induced breaking and diffraction are considered in the model. A 5x5 km horizontal grid is used. The output of the model contains data about significant wave heights, wave propagation direction, wave length and period and wave energy transfer. The frequency of the output data is 3 hours. Modeling is performed out continuously for every year. Calculations are carried outon the supercomputer "Lomonosov" in the Moscow State University.
Waves higher than 2 m are defined as storm waves.

If waves higher than 2 m are found during one or several adjacent output steps, these steps are identified as a storm event. More than 1500 of such events were registered during 64 years of analysis. Following parameters of storm events are estimated: annual and monthly average quantity and duration, area and storm path length. Regions with most intense storms are identified – these are the western and north-eastern parts of the Black Sea.
Synoptic atmospheric situations (wind and pressure fields) during storms are analyzed. Two predominant types of such situations are identified. The first is a fast movement of a Mediterranean cyclone or its trough toward the Black Sea and, at the same time, a large and stable anticyclone over Eastern Europe. The second – an abrupt quasi-meridional intrusion of a cyclone or a trough from the north.
Extreme wave parameters of different probability are estimated using the logarithmically normal distribution. Thus, the maximal wave height possible once in 100 years is more than 14 m.
Study results are compared with similar researches and observation data.
NCEP Reanalysis data provided by the NOAA/OAR/ESRL PSD, Boulder, Colorado, USA, from their Web site: http://www.esrl.noaa.gov/psd/. For more information on this reanalysis refer to Kalnay et al., The NCEP/NCAR 40-year reanalysis project, Bull. Amer. Meteor. Soc., 77, 437-470, 1996.
The study is done at the Natural Risk Assessment Laboratory under contract G.34.31.0007.

Plinius14-33
Medicanes of 2011 and Hurricane Rina

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The late season tropical cyclone Rina moved through the western Caribbean between 23 – 28 October, 2011, peaking at Category 3 on 26 October off the coast of the Yucatan. 11 days Later, on 8 – 10 November, 2011, a medicane swept through the north western Mediterranean, bringing winds as high as 82 knots on Porquerolles Island and precipitation in excess of 400 mm. As with several other Mediterranean storms reported in last years Plinius meeting, there is evidence that this major medicane also developed froman upper tropospheric potential energy bubble emanating from an Atlantic basin tropical cyclone, namely hurricane Rina.
Evidence of this connection will be given at the oral presentation, and the physical mechanisms behind this this energy transfer will be presented.

Plinius14-34
Application of new climate change results to Venice tide statistics

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An accurate study of the future tide statistic due to climate changes for the Venice Lagoon is of great importance for the historical city and its maintenance.
In this paper an analysis of a future tide and weather scenario is presented, using new high resolution meteo data just developed by EC-Earth, a Earth System Model based on the operational seasonal forecast system of the European Centre for Medium-Range Weather Forecasts (ECMWF).
These data are used as input to a tide- model that solves the shallow water equations on the Adriatic Sea, forced by the wind stress and sea level pressure fields.
The results show that tide statistic does not change. However other parameters like wind, pressure and rain could have a different statistic distribution in the future. Finally, this study proves that to analyze the behaviour of the Adriatic sea in terms of tide and wind an high resolution dataset must be used.

Plinius14-35
Hirlam forecast impact to extra observations for some Mediterranean high impact weather events

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One objective of several of THORPEX-sponsored field experiments has been to determine the potential of targeted observations to improve forecast of high impact weather. The aim of observation targeting or data targeting (DT) is to deploy extra observations in specific regions in order to reduce the initial atmospheric state inaccuracies. In autumn 2008, the PREVIEW project has used DT to improve short-range forecast of Mediterranean high impact weather events and as a result several sets of additional radiosonde observations have been collected.
In the present study we focus on the usage of the

HIRLAM forecast and data assimilation system to test the added value produced by extra observations over some high impact weather events in the Mediterranean. The baseline system includes conventional and satellite observations (ATOVS). Two experiments are conducted. In the first one extra radiosonde data are assimilated. In the second one, ATOVS data thinning strategy in the HIRLAM data assimilation system is modified to increase the observations density in sensitive areas.
The forecast performance is assessed with respect to both verifying analyses and surface and radiosonde observations. Besides, model precipitation is verified with the novel object oriented SAL method using 24-h rain gauge data upscaled to the model resolution. In general, results show a significant improvement due to the extra observations, especially when sensitive regions are located in data sparse areas.

Plinius14-36
Detection and thermal description of medicanes from numerical simulations

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Tropical-like cyclones rarely affect the Mediterranean region and they can produce extremely strong winds. These warm-core cyclones, called MEDICANES (MEDIterranean hurriCANES) are small size, develop over the sea and are infrequent. For these reasons, the detection and forecast of medicanes are a difficult task and much effort have been devoted to identifying them.
The goals of this work are to contribute to a better understanding of these structures and to develop some criteria to identify medicanes from numerical model outputs. To do that, a method for detecting and tracking of the Mediterranean mesocyclones has been adapted to small-scale intense cyclonic perturbations. First, the algorithm has been modified to properly describe these small cyclones. Next, the parameters that define the Hart's cyclone phase diagram are calculated to examine their thermal structure. Five well-known medicane events have been described from numerical simulation outputs of the ECMWF operational model (T1279L91Cy36r1, grid length ~ 15km). The predicted cyclones and their evolution have been validated against available observational data and numerical analyses from literature.

Plinius14-37
Impact of a North Atlantic hurricane on the predictability of a Medicane

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The extratropical transition (ET) of a tropical cyclone is known as a source of forecast uncertainty that can propagate far downstream. The present study focuses on the predictability of a Mediterranean tropical-like storm (Medicane) on 26 September 2006 downstream of the ET of hurricane Helene from 22 to 25 September. While the development of the Medicane was missed in the deterministic forecasts from the European Centre for Medium-Range Weather Forecasts (ECMWF) initialized before and during ET, it was contained in the ECMWF ensemble forecasts in more than 10 % of the 50 members up to 108-h lead time. The 200 ensemble members initialized at 0000 UTC from 20 to 23 September were clustered into two nearly equiprobable scenarios after the synoptic situation over the Mediterranean. In the first and verifying scenario, Helene was steered northeastward by an upstream trough during ET and contributed to the building of a downstream ridge. A trough elongated further downstream towards Italy and enabled the development of the Medicane in 9 of 102 members. In the second and nonverifying scenario, Helene turned southeastward during ET and the downstream ridge building was reduced. A large-scale low over the British Isles dominated the circulation in Europe and only 1 of 98 members forecast the Medicane. The two scenarios resulted from a different phasing between Helene and the upstream trough. Sensitivity experiments performed with the Meso-NH model further revealed that initial perturbations targeted on Heleneand the upstream trough were sufficient at forecasting the warm-core Medicane at 84-h and 108-h lead time. The mid-range predictability of further cases of severe weather in the Mediterranean will be investigated in the framework of the DRIHM project.

Plinius14-38

Observation and modeling of the cloud electrical activity during HyMeX

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The PEACH (Projet en Electricité Atmosphérique pour la Campagne HyMeX) project is the Atmospheric Electricity component of the HyMeX (Hydrology in the Mediterranean Experiment) experiment aiming at documenting the lightning activity and electricalstate of thunderstorms over the Mediterranean Sea. During SOP1.1 (Special Observation Period; September-October 2012), records of the New Mexico Tech Lightning Mapping Array (LMA) were used to locate and to characterize the 3D lightning flashes over South-Eastern France at high resolution. These data were completed by observations provided by several European operational lightning detection networks. Other research instruments such as induction rings (to measure the charge of the raindrops), electric field meters and high-speed video cameras were also deployed to monitor the electrical characteristics of parent thunderclouds. All these observations are used to document the evolution of the storm electrical activity during the SOP in conjunction with microphysics and kinematics measurements available from many ground-based radars and airborne sensors.
We will present a short overview of the PEACH project. We will discuss some of the recorded cases. We will also introduce some results of the modeling project based on the use of an explicit electrical module which was developed in the 3D cloud-resolving mesoscale model MesoNH.

Plinius14-39

Multilinear approach to the precipitation-lightning relationship: a case of study in the northern part of Spain during local summer electrical storms of 2002-2009 period

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In this work we analyse the precipitation-lightning relationships in electrical storms of the Spanish Basque region occurring under local atmospheric flows during 91 summer days in the 2002-2009 period, and develop a new method that consists in a multilinear approach to estimate daily total rain in a rain gauge network using lightning measurements. Local data related to 22 different observatories of a rain gauge network, corresponding to daily rainfall depths and cloud to ground lightning counts 10 km around, permitted to analyse the spatial variations of those relationships. We found a general mean tendency of the precipitation/lightning ratio for the whole period but also observed the existence of different rain yields values in different days and observatories. We analysed the difference between the collected rain depth and the value given by the general tendency that relates lightning and rain, using PCA method. PCA results showed a first axe explaining 50% of the variability that related all local rainfall differences observed each day in the whole network. According to that, we could estimate daily differences between observed rain and expected value from lightning counts in the whole network using only a representative observatory. This permitted to develop a multilinear expression to estimate daily rain depth measured in every observatory, based on the main precipitation/lightning tendency and rain measured in a representative observatory. In particular, we found that rain depths estimations obtained this way accurately fit total rain cumulated in the whole network. Hydrological applications of this method are obvious, since it permits to estimate total precipitation during strong convective events based on a unique rain observatory and the lightning counts around.

Plinius14-40

A hydro-meteorological description of the 25th October and the 4th November 2011 events in Liguria

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In the course of about two weeks, from 25th of October to 4th of November 2011, two devastating flooding events affected the Liguria region in northern Italy, causing the death of 19 people and damages for tens of millions of euro to infrastructures, buildings, private and public goods. Some small towns changed their appearance and it has been estimated that, in some cases, several years are needed to return to the conditions prior to the flood.

The two events had some similar characteristics: they exhibited all the synoptic and mesoscale environments ingredients leading to heavy convective precipitation events (Doswell et al. 1998; Lin et al. 2001). They were both characterized by the formation of a well organized, very intense and localized finger-shape MCS (Mesoscale Convective System)–like precipitation structure - embedded within a general stormy synoptic weather scenario developed by a large Mediterranean perturbation. These convective fingers remained stationary for a significant number of hours on the same area (of few square kilometres) pouring very high rainfall quantities.

The meteoradar images, for the two events, recorded very similar shapes of such small intense structures. They both developed on the sea some tens of kilometres from the coast. They were very narrow and elongated towards the mainland Appennine range. Moving, few kilometres outside the "shadow" of the finger-shaped MCS the rainfall depth, at event time scale, was reduced by a factor two or three.

The hydrological consequences in terms of basin response were dramatic. Many creeks overflowed their banks, a large number of mud flows and landslides occurred, in the quite narrow area hit by each event.

The technical authorities in charge of hydro-meteorological forecast for the Liguria Region predicted the scenarios with a lead-time of two days. The Regional Civil Protection issued the maximum level of alert for most of the Region including the catchments eventually hit by the events.

Main topics of this works, also along the lines of the FP7 DRIHM (Distributed Research Infrastructure for Hydro-Meteorology, www.drihm.eu) project, are:

- the description of the events by using the very dense real time rain gauge network, the active mosaic of Italian Meteorological Radar Network, the sea surface temperature available from remote sensing and the large number of videos provided by the so-called citizen scientists;
- the results of the operative forecasting system used by regional Civil Protection, together with the interpretation of the decision makers; the usefulness of a probabilistic flood forecasting chain that contemplates also the multi-catchment approach (Siccardi et al., 2005; Silvestro et al., 2011) is made evident;
- the evaluation of the event's ground effects by using crowd sourcing/citizen scientist information and data, in order to check, also by use of recorded ground effects, the granularity of the atmospheric event.

Plinius14-41

DRIHM Project: first year achievements

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Hydro-Meteorology Research (HMR) is an area of critical scientific importance and of high societal relevance. It plays a key role in guiding predictions relevant to the safety and prosperity of humans and ecosystems from highly urbanized areas, to coastalzones, and to agricultural landscapes. Of special interest and urgency within HMR is the problem of understanding and predicting the impacts of severe hydro-meteorological events, such as flash-floods and landslides in complex orography areas, on humans and the environment, under the incoming climate change effects.

At the heart of this challenge, as also suggested by the FP7 DRIHMS (Distributed Research Infrastructure for Hydro-Meteorology Study, www.drihms.eu, 2009-2011) project, lies the ability

to have easy access to hydrometeorological data and models, and facilitate the collaboration between meteorologists, hydrologists, and Earth science experts for accelerated scientific advances in hydrometeorological research (HMR).
The FP7 DRIHM project (Distributed Research Infrastructure for Hydro-Meteorology, www.drihm.eu, 2011-2015) project intends to develop a prototype e-Science environment to facilitate this collaboration and provide end-to-end HMR services (models, datasets and post-processing tools) at the European level, with the ability to expand to global scale. The objectives of DRIHM are to lead the definition of a common long-term strategy, to foster the development of new HMR models and observational archives for thestudy of severe hydrometeorological events, to promote the execution and analysis of high-end simulations, using high performance community and grid computing, and to support the dissemination of predictive models as decision analysis tools.
First year main achievements will be presented and discussed with reference to critical hydro-meteorological events (e.g Genoa November 2011 flash flood).

Plinius14-42
Novel Meteorological Applications using Microwave Communication Networks & New emerging avenues in atmospheric research

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First, I will present the potential of performing a long-term rainfall monitoring and analysis employing Commercial Cellular Communication Networks (CCCN). Two different methodologies for calculating instantaneous rainfall utilizing CCCN will be compared.
The test site, located in central Israel, includes up to 70 commercial microwave links while 7 rain gauges are installed in the vicinity of these. The examination of 19 rainstorm events over a 2-year period will be presented.
Emerging new avenues in atmospheric research will be reviewed and discussed with a few preliminary examples for fog and water vapor monitoring as well as short-term warning for flash floods. These will include the following topics.
Mesoscale modeling with data assimilation of surface moisture derived from links; fog monitoring potential as demonstrated through a dense fog event that took place in central Israel during November 2010. CCCN measurements were translated into liquid water content measurements from which visibility estimations were derived and were found to be between 50 to 10 meters during the heavy fog episode. Examples for real-time flood warning in semi-arid area where coverage by rain gauges and/or radar is very limited will be presented. An advanced time for potential warning of about a few minutes to one hour will be shown to exist.
Other future potential avenues for atmospheric research to be discussed and partly exemplified are rainfall climatology over semi-arid to arid zones; urban rainfall; mountain rainfall, the potential of monitoring vegetation and dew detection based on CCCN data

Plinius14-43
Measurements collected at the CNR ISAC atmospheric supersite in Rome during the HyMeX SOP 2012.

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The atmospheric supersite of CNR-ISAC is composed of a set of technologically advanced instruments, dedicated to measuring parameters to support atmosferic science studies. The site is located in Central Italy, 30 km northeast from the coast of the Tyrrhenian Sea and 20 km southeast of the city of Rome. Instruments are installed in two large open areas: a grass field and the roof of the main building of ISAC. The site hosts measurement campaigns, during which instruments from partners can be deployed and properly managed.
The first HyMeX Special Observing Period (SOP), running from 5 September till 6 November 2012, has selected several hydrometeorological test beds, one of which is that of Central Italy, coordinated by the Sapienza University of Rome and CETEMPS L'Aquila. ISAC instrumentation involved in this campaign (ongoing at time of abstract submission) includes instruments aiming both at measuring precipitation and at investigating precipitation formation mechanisms. The dual- polarization C-band radar Polar 55C is expected to provide volume observations of clouds and precipitation within a 120 km distance running specific scanning strategies to compare radar measurements with precipitation measurements collected at other instrumented sites or during instrumented flights. Ground based precipitation measuring instruments at the supersite include laser disdrometers for estimating drop-size and fall-velocity distributions.
Wind speed and direction profiles with a time resolution of 10 minutes within a 30 – 800 m range and vertical resolution of 25 meters are provided by a sodar system. A second one has been installed in the Presidential Park in Castel Porziano, closer to

the Thyrrenian coast. In Rome downtown, the Prede photometer that estimates columnar precipitable water vapour amount and provides measurements of columnar optical and physical aerosol properties in the visible reagion. At ISAC supersite, a Lidar Ceilometer runs continuosly to provide information on aerosol vertical profile (0 – 5km), clouds altitude and mixing layer height and a sun photometer measures of the aerosol absorption coefficient in three different channels (blu, green, red).
A multiple receiver lidar using simultaneously Rayleigh-Mie and Raman (RMR) techniques profiles aerosol (from few hundreds of meters up to the stratosphere), temperature (mesosphere and upper stratosphere), or water vapour in the troposphere will be used depending on boundary conditions.
Finally, ISAC provides products based on the LINET lightning location network for high-precision detection of total lightning, ground strokes (CG) and cloud lightning (IC), with utilization of VLF/LF techniques. Examples of observations and preliminary results obtained in the HyMeX SOP will be illustrated.

Plinius14-44

Analysis of the intensity of rainfall events in Barcelona during 2011 and their social impact

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Since 2008, the Social Impact Research group has carried out several studies on the social impact of weather events using the requests received in Meteorological Services as a proxy indicator. First, a cumulative index (CI) was established, taking into account the following factors: maximum precipitation in 24 h, population affected by rainfall exceeding 60 mm, length of the event and coincidence with a strong wind event. The events with a higher number of requests should have a greater CI. Then, the following studies were aimed at improving the CI, as other factors had stood out as crucial. Because hazards are often magnified by urbanization, a lower threshold was suggested for municipalities exceeding 10,000 inh/km2. On the other hand, some factors thatwere included in the CI proved to be less significant, such as the length of the events and the coincidence with a strong wind event. Therefore, their importance was reduced, and a better adjustment was achieved.
The present study aims to improve the CI, focusing on the precipitation intensity. In order to achieve a better knowledge of the influence of this specific factor, only the rain events occurred during the year 2011 in the city of Barcelona have been analysed. Therefore, we can consider no changes in the population density or the urbanization during this period. The first results confirm that the threshold of 60 mm is too high for densely populated areas, as the rain event that had the biggest number of requests in Barcelona did not reach that threshold. Thus, the threshold of 40 mm in 24 h has been taken into account to select rain events. Applying this criteria there were eight events in 2011 in Barcelona. For these events, intensity as precipitation in 30 minutes has been considered. The first preliminary results show that the rainfall intensity needs to be included in the CI, as there is a clear correlation between that factor and the number of requests. Accordingly, this new factor is added to the index, using IDF curves for building categories of rainfall intensity. After that, a better adjustment of the CI should be achieved.
Future work will be aimed at applying the CI to more events and checking its accuracy. As it has been concluded in previous studies, it is necessary to define areas which have different responses to the same meteorological hazard. Hence, some of the CI factors will depend on the affected area. A major challenge is to optimize emergency management in collaboration with civil protection department.

Plinius14-45

Towards a new BOLAM-MOLOCH chain: Forecast evaluation over the MAP D-PHASE DOP and HyMeX SOP

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Since the beginning of the year 2000, an integrated meteo-marine forecasting chain called *Sistema Idro-Meteo-Mare* (SIMM) is operational at the Institute for Environmental Protection and Research (ISPRA). The SIMM forecasting system is based on a cascade of four numerical models, telescoping from the Mediterranean basin to the Venice Lagoon and it is initialized by means of 50 km ECMWF analyses and forecasts. Into the SIMM chain, it is also integrated, in a research configuration, a hydrological model over two Italian river basins.
Within the SIMM verification programme, the different components of such forecasting system

have been regularly assessed through subjective and objective methodologies. Such verification activity has been mainly focused on the meteorological model at the base of the chain, namely a 11 km BOLAM covering the entire Mediterranean basin, aiming at improving the forecast quality through both updating its numerical code and improving its configuration inside the SIMM forecasting system.
After a major increase of the BOLAM performance achieved this way in 2009, a massive "reforecast" campaign has been recently carried out with the purpose of identifying the best way to further improve the forecasting chain. Five reforecast datasets (experiments) have been defined over the MAP D-PHASE Operations Period (DOP), June to November 2007, by combining in different way the following model settings: horizontal grid spacing, domain extension, initial and boundary conditions, nesting design and theBOLAM code version. A general indicator of the experiments' performance has been provided by the assessment through a multi-method verification approach of the corresponding quantitative precipitation forecasts (QPFs) against the rainfall observational measurements collected for the DOP activities.
Results have evidenced that decreasing the BOLAM grid step (up to 7.8 km), increasing its domain extension (covering an area from 54°N to 25°N and from 18°W to 43°E) and using a 15-km ECMWF data package "upgraded" with respect to the one currently employed are effective in improving the QPF quality. This has brought to the definition of an "optimal" new BOLAM configuration that will be shortly implemented into the SIMM forecasting chain. In the meantime, such "optimal" configuration, coupled over the central-northern Italy to the non-hydrostatic 2.5 km MOLOCH model, has been employed and tested in an operational asset during the Special Observation Period (SOP), September to November 2012, of the international initiative "HyMeX - HYdrological cyclein the Mediterranean EXperiment".
A preliminary, subjective verification of the BOLAM-MOLOCH chain for the HyMeX SOP is presented here, together with a panoramic of the objective results associated to the above-mentioned BOLAM reforecast experiments evaluated over the MAP D-PHASE DOP.

Plinius14-46
Study on the 3D structure of the squall line in North China with Doppler radar

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A squall line passed through Beijing on 16 September 2008 from west to east. It caused gale and short time intensive precipitation. The baseline of Beijing dual-Doppler weather radar is about 22km. The mesonet observation data and the dual-Doppler radar retrieval wind are used to study the feature of the squall line. The wind structure in the horizontal and vertical cross section are analysed in detail. The conceptual model of the squall line in North China (i.e. midlatitude) is proposed.

Plinius14-47
Stationary nocturnal offshore precipitation near the coastline in the Mediterranean basin

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Nocturnal offshore precipitation near the coastline caused by the convergence between drainage winds and a synoptic flow has been well studied in the tropical areas by several authors (e.g. Yu et al., 2004; Frye, 2001; Oshawa et al., 2001; Mapes et al., 2003). However, the existence of this mechanism of precipitation in the Mediterranean basin has been scarcely studied (Callado et al. (2002) in the Northeast of the Iberian Peninsula; Mazón and Pino (in press) in the Mediterranean coast of the Iberian Peninsula; Greich et al. (2004) and Newman (1951) in Israel). Drainage winds lead offshore the cold inland air, which might form a coastal front. The relative warm and wet Mediterranean air lifts over this cold drained air mass, and convective clouds may appear if the air reaches the Level of Free Convection (LFC).
The focus of our presentation is the stationary nocturnal offshore precipitation in the Mediterranean basin. By using TRMM database and radar reflectivity images that cover some areas of the coastline, many nocturnal events have been detected. In order toanalyze and characterize this type of precipitation, the version 3 of the WRF mesoscale model has been used to simulate and analyze this type of events. The main precipitation detected and simulated in these events uses to be weak, last few hours, and moves offshore, as a difference than those produced in tropical areas,

where the nocturnal convective lines are longer, produce more intense precipitation, and move faster offshore. However, in some detected cases in the Mediterranean basin a convergence line is formed near the coastline, producing moderate precipitation, and due to a counterbalance between the drainage wind and the synoptic wind this line of convection remains stationary or quasi-stationary during the whole night and the early morning, disappearing at morning.
Two WRF simulated events of a nocturnal offshore stationary precipitation near the coastline will be shown. By using the parameters proposed by Miglietta et al. (2010) and Wang et al. (2000) we have quantified the stationarity of the convergence line according the values of the LFC, the relative horizontal wind against the drained cold air, and the Brunt-Väisäla frequency. In the first selected event, several cells were formed in a convective line with more than 100 km length from 22 UTC on 5th January to 09 UTC on 6th January several kms offshore the coastline of Israel and Lebanon, with an accumulated precipitation around 10 mm every hour many convective cell. Some of these cells moved onshore and the precipitation affected the coastline. The second selected and simulated event occurred in the Gulf of Geneva on 30th and 31st January 2008.

Plinius14-48

The greatest recent flood in Spain: a WRF simulation of the 1962 Valles flood event

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On 25th September 1962 an extreme event of intense precipitation occurred in the area of Vallès, 30 km from Barcelona. The accumulated precipitation reached 250 mm in less than 3 hours in many places that caused the greatest flood in Spain during the XX century, with more than 700 fatalities and a large number of damages.
This historical event cannot be only explained by analyzing the synoptic features. The NCEP Reanalysis at 500 hPa geopotential height on 25th September 1962 at 00 UTC shows a ridge from North Africa affecting the West Mediterranean basin. At 850 hPa a warm air mass from North Africa affected the Iberian Peninsula and the West Mediterranean basin, following the ridge present at 500 hPa. Over the Northeast of the Iberian Peninsula, the temperature was higher than 15°C at 850 hPa. At surface, the pressure was around 1015 hPa. A slight and small relative low pressure was placed over the Gulf of Valencia.
In order to analyze and to better understand the causes of this extreme precipitation event, the WRF mesoscale model has been used to describe the atmospheric conditions. To analyze the role of the local and regional factors as a triggering mechanism thatmay explain better the causes of this event, four nested domains have been defined, the smaller centered in the Terrassa (one of the most damaged cities), with 1 km of horizontal resolution.
The first results indicate that local orography may play an important role enhancing the depth convection and precipitation rates.

Plinius14-49

Are current sensitivity products sufficiently informative in targeting campaigns? A DTS-MEDEX-2009 case study

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Within the second phase of MEDEX, the DTS-MEDEX-2009 field experiment was carried out during the autumn of 2009 and the adaptive observation concept was applied to the operational radiosounding network and to commercial aircraft data (AMDAR). This targeting campaign focused on improving the forecast skill of HIW events linked to Mediterranean cyclones and used the Data Targeting System (DTS) from the European Centre for Medium-Range Weather Forecasts (ECMWF) to manage the main issues in the targeting observation process. However, the most crucial concern in any targeting campaign is to guide the decision about where additional observations would most benefit the quality of the forecast of each potential adverse event. To this end, five different sensitivity analysis techniques were carried out to provide targeting guidance: Singular Vectors (SV) from the ECMWF; Ensemble Transform Kalman Filter (ETKF) and Kalman Filter Sensitivity (KFS) from Météo France; and ensemble and adjoint sensitivities fromthe University of Balearic Islands. Despite not all sensitivity computations were available to the forecasters/scientific teams in real-time, all these sensitivity computations were devised to identify the best location for additional observations. Therefore one immediate question arises: which sensitivity method best advise decision makers on where to deploy an extra observation? This talk attempts to shed light on this question and other such observational and sensitivity concerns by analyzing the guidance provided by these five sensitivity analyses for one case study of the DTS-MEDEX-2009 campaign.
Since radiosonde and AMDAR profiles were the only observational means available during the DTS-MEDEX targeting campaign, this study tests the ability of each sensitivity product in identifying the region where a plausible sounding leads to a

greater impact on the forecast of a potential high impact cyclone over Southern Italy on December 5th 2009. All targetable radio-soundings sites are also tested and a severe weather meteorologist is used as a confronting reference. The verification testbed comprehends single sounding experiments and multiple sounding strategies by using the WRF Data Assimilation system. Single sounding tests reveal that sensitivity products fail to recognize the best location for a primary observation since most of the soundings addedover operational radio-sounding stations have a larger influence on the intense cyclone forecast than the areas indicated by the objective sensitivity calculation methods. Additionally, after evaluating available sensitivity information, human-based decisions are proved to be non optimal, neither in single nor in multiple sounding strategies. These results evidence the need for an improvement of the tools aimed at providing a more robust objective guidance to operations centers during targeting campaigns.

Plinius14-50

Feasibility of a Common Approach to Coastal Flood Risk Assessment and Management in the Mediterranean Europe

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Coastal zones can be impacted by risky sea waves and can be subject to inundation due to storm surges, storm waves and tsunamis. Although it is widely recognized that management of the coastal zone needs the integration of various disciplinary knowledges and experiences as well as the coordination of various institutional entities, nonetheless such an integration often remains at the level of documentary declarations and does not concretize in real actions and policies. The European Directive 2007/60/EC on the assessment and management of flood risks that entered into force on 26 November 2007 requires the member states to identify risky areas, to draw maps and to establish management plans for zones subject to flooding (river and marine) according to a roadmap with significant milestones in the 2013 and 2015. This can be a great opportunity also for the Mediterranean countries of Europe to identify suitable resources and to start implementing policies for an integrated intervention to protect the coastalenvironments and populations.
Scientists can give a strong contribution to this process especially in assessing risk and by providing the scientific tools for early warning. In this paper we perform a preliminary analysis for the Mediterranean countries of Europe and outline similarities and differences of risk assessment methods and of early warning systems for floods in the coastal areas due to weather storms and to tsunamis. Up to now these subjects have been examined separately by different groups of experts as if they were elements of different disciplines and were deserving different treatment. Here it is analyzed if a common approach can be more fruitful and efficient, in view of a common institutional management and of common targets and objectives.

Plinius14-51

A long-term climatology of medicanes

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Medicanes, strong mesoscale cyclones with tropical-like features (axis-symmetry, a warm core, a cloud-free eye surrounded by a spiral-shaped cloud cover, winds up to the hurricane speed), are known to develop occasionally over the Mediterranean Sea.
Medicanes are considered rare phenomena, since only a few have been directly observed - the number of cases well documented in the literature is around ten.
However, due to the scarcity of observations over sea and the coarse resolution of the long-term reanalysis datasets, it is difficult to construct homogeneous statistics of the formation of medicanes.
Using an approach based on the dynamical downscaling of the NCEP/NCAR reanalyses, we study in a systematic way the statistical properties of medicanes (annual cycle, decadal and interannual variability, geographical distribution, trends) over the last sixdecades, and we investigate the linkage between the frequency of medicanes formation and synoptic patterns.
Applying the same downscaling procedure on the atmospheric fields produced by a global model forced with future climate scenarios greenhouns gas concentration, we estimate the impact of climate change on the statistics of medicanes.

Plinius14-52
High resolution wave model validation over the Greek maritime areas

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The increasing maritime activity can be seriously affected by severe weather and sea conditions. To avoid serious damages to ships, marine structures and humans, a good weather and wave forecast is of primary importance. In general combined meteorologicaland the wave models are used to produce forecasts both at large scale and at medium-size inner seas. For much smaller environments like the Greek maritime areas, characterized by complicated features like the orography and the presence of numerous islands, the wave modeling is not a simple task.
This study is devoted to the validation of the performance of the WAM wave model over the Ionian and Aegean Seas. The period of validation refers to the first 12-months of operational use of the model at the National Observatory of Athens. The wave model is applied at a resolution of 1/16 degrees and is driven by the 10 m wind, produced by the BOLAM meteorological model operationally run over the same area. Two different sources of data have been used for the verification of the model results. The first data set is provided by a network of buoys deployed over the Greek maritime areas and the second consists of altimeter data, provided by the OSTM/Jason 2 satellite platform. Although the study area is characterized by complex topography and a large number of islands, the implementation of the WAM model provides very encouraging results. In general, with the exception of the two buoys located in the Ionian Sea, the WAM model tends to underestimate the wave energy in the region of the Aegean Sea. The comparison with the altimeter data over the Greek seas, shows that the model has a tendency to overestimate the height for waves lower than 2.5 m and to underestimate the waves higher than 3 m.

Plinius14-53
Numerical study of two convective lines observed during HyMeX

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The first Special Observing Period (SOP 1) of the Hydrological Mediterranean Experiment (HyMeX) recently took place in the northwestern Mediterranean area. The HyMeX SOP 1 was devoted to the observations of the meteorological and oceanic conditions that prevail before and during strong precipitation events. On the 24th and 26th of September, in relation with the passage of an elongated through, two convective lines crossed the Cevennes region and produced rain fall amounts close to 100 mm in 6 hours.
The presentation will focus on the numerical results obtained for these two cases with the Meso-NH model run with a 2.5 km resolution. In particular, the sensitivity of the model results to initial and forcing conditions (ARPEGE, ECMWF, AROME-WMED analyses/forecasts), and to physical parameterizations (cloud physics, turbulence scheme) will be investigated.

Plinius14-54
Adriatic Extreme Weather – State of the Art

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Cyclone activity in the Adriatic and the central Mediterranean provides a trigger mechanism for a range of extreme weather phenomena such as local downslope wind-storm bora, or bura in Croatian, strong southesterly sirocco, hevy precipitation and mesoscale convective systems. Spatial distribution of the frequency of cyclogenesis in the Mediterranean presents one of relative maxima in the Adriatic. Therefore, investigations of different cyclone types in the region and assessment of associated extreme weather, including heavy precipitation and severe local wind, are of great importance for a more complete undestanding of weather and climate impacts and for the improvement of wether forecasting in the Adriatic. The capability to predict such high-impact events remains weak because of the contribution of very fine-scale processes and their non-linear interactions with the larger scale processes. The general objectives for MEDEX are the better understanding and the better forecasting of the cyclones that produce high impact weather in the Mediterranean. Much work has been done, but many doubts still remain and new research is

needed in this field.
Recent progress and advances in the research of the Adriatic extreme weather are assessed. The link, even though complex, between heavy precipitation and synoptic scale troughs and cyclones has been well established by the past. Heavy precipitation occurred preferentially downstream of a cyclone aloft. Convection plays an important role in most such events in the region. Synoptic ingredients help to destabilise air mass and enhance convection. The key elements are a synoptic pattern inducing a southerly to easterly low-level flow that transports moist and unstable Mediterranean air masses towards the eastern Adriatic coast. Additionaly, at low-levels, a long fetch of flow over the sea interacts with terrain features, driving local low-level circulation favourable to triggering of deep convection and enhancement of precipitation.
There has been substantial progress in severe local wind observations and measurements, understanding, modelling and its more detailed prediction during the last 30 years. Wave breaking is identified as the primary mechanism for severe bora formation. Understandings of bora interactions and influences on other processes have taken place as well, most notably in the air-sea interaction, but are not completed yet. Moreover, the role of the boundary layer and waves on the upwind side of the bora evolution and the consequent lee side flow structures are inadequately understood. This is especially so for bora at the southern Adriatic coast. Adriatic region, uncovered by radar observation, has received little attention up to now. The success of high-resolution modelling however strongly depends on the initial conditions. At the current resolution, the operational numerical weather prediction models, although quite capable of predicting the general conditions for the onset and development of extreme event, are unable to simulate the small-scale details. This results in imprecise precipitation and wind forecast, which might lead to economic as well as ecologic losses in the area. Therefore, knowledge is needed to progress in the predictability of intense events though collaboration within the framework of the HyMeX.

Plinius14-55
21st century projections for the Mediterranean Sea

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This presentation will focus on the long-term evolution of air-sea fluxes from the perspective of the ocean processes. Changes in the ocean properties will obviously have a feedback on the atmosphere and particularly on the generation and evolution of Mediterranean storms, but this issue is not examined here.
Regarding mean values, all global and regional projections show a warmer Mediterranean Sea by the end of the 21st century. A vast majority of the projections also show a drift towards higher relative salinities. The warming derives from the projected decrease (in absolute value) of the surface heat losses to the atmosphere. The salinification would be a consequence of an increase in the freshwater deficit of the basin, which in turn derives from both a projected increase in the evaporation and a projecteddecrease in the precipitation averaged over all the catchment areas of the basin. We will briefly examine the impact of the expected changes on the thermohaline circulation of the Mediterranean Sea (and the related fluxes through the Strait of Gibraltar), on the frequency and intensity of ocean heat waves and on mean sea level rise.
Next we will examine changes in the storminess from the perspective of their impact on sea level and waves. Results indicate that the frequency of extreme sea level events would decrease, though there are also some evidences of a slight increase in their magnitude. Overall, the analysis indicates a progressive decrease in the return levels of storm surges under all climate scenarios that is not fully explained by the small negative trend obtained for the atmospherically induced mea sea level. The evolution of the mean and extreme wave regimes also points towards a decrease in the wind storminess.

Plinius14-56
An overview of a cyclone phase space and its application to eastern Atlantic and Mediterranean hybrid cyclones

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Since its inception in 2001, a generalized cyclone phase space for objective classification of the structure of cyclones (Hart 2003) has been utilized in operations and research internationally, while being aggressively compared to other metrics for cyclone evolution (Kofron et al. 2010). The diagnostic continuum has been used to officially and unofficially declare transitions of subtropical, tropical, and extratropical status – including the post-season addition of cyclones not advised during the tropical cyclone season. In terms of research, the diagnostics have been used to produce: 1) climatologies of extratropical transition in all basins of the northern hemisphere (Evans and Hart 2003; Kitabatake 2008; Wood and Ritchie 2012); 2) a

climatology of subtropical storms in the Atlantic (Guishard et al. 2009); 3) a diagnostic sensitivity in post-tropical evolution (Hart et al. 2006); and 4) objective cluster analysis of cyclone structure (Arnott et al. 2004). Finally, variants of the diagnostics have beenused to identify the potential for previously undiagnosed tropical cyclones in the 19th and early 20th centuries in state of the art reanalysis datasets (Truchelut and Hart 2011; Truchelut et al. 2012). In this presentation, an overview of the cyclone phase space is given, including examples of the various types of cyclone transitions and climatologies described above. The talk concludes with an examination of cyclones significant to the Mediterranean region and the insight the phase space provides into their structure and predictability.

Plinius14-57

Ubiquitous & Complex Nature of Diurnal Rainfall Processes from TRMM & CloudSat Measurements: Is Mediterranean Basin Representative of Rest of Earth?

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The datasets from TRMM and CloudSat satellites have enabled discovery of the multifaceted and ubiquitous nature of regional and global multimode / multiform diurnal rainfall variability and processes. These variability modes and processes can be parsed into five distinct mechanisms: 1) multiple mode diurnal variations; 2) continental-maritime primary diurnal mode differentiation; 3) spectral-vertical diurnal variations with concomitant coherent spatial signatures (where spectral signifies the spectrumof rain rate); 4) two-stage phase propagation of the diurnal maximum of rainfall, including a diurnally controlled stage, induced by north-south aligned mountain ridges; and 5) diurnal oscillations of tropical cyclone intensities. The intricacies of these five mechanisms are explained with emphasis on their impacts on weather and, more speculatively, on climate. Each of these mechanisms is a ubiquitous process of rainfall when examined at the global scale or regional scale. The specific topic of interest for the Plinius Conference is whether the diurnal rainfall processes within the Mediterranean basin are representative of the other portions of the Earth. It is shown, in fact, that in most ways the Mediterranean basin has its own very unique signatures of diurnal rainfall variability and diurnal rainfall processes. The implications of these different signatures are paramount to understanding how the concomitant diurnal heating signals manifest themselves in affecting atomspheric circulations on the weather and climate scales. Various of these implications are discussed.

Plinius14-58

The use of Spatially Distributed Soil Moisture Estimation for Hydrological Applications

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Soil moisture governs the partitioning of mass and energy fluxes between the land surface and the atmosphere, thus playing a fundamental role for many scientific and operational applications, including flood forecasting, climate modelling, landslide prediction, numerical weather prediction, irrigation scheduling, to cite a few. Nowadays, soil moisture estimates from satellite sensors are becoming more readily available with a spatial and temporal resolution that is suitable for hydrological applications. Moreover, the accuracy of the satellite-derived soil moisture retrievals is found to be satisfactorily in many countries worldwide and mainly in the Mediterranean region.

This study aims at showing the reliability of the satellite soil moisture product derived by the Advanced Scatterometer (ASCAT) over Europe and, mainly, to understand how these observations impact the modelling of extremes in the Mediterranean region by considering three different applications.

The first application addresses flood forecasting (Brocca et al., 2010; 2012a), by assimilating the ASCAT soil moisture into a multi-layer continuous and distributed rainfall-runoff model, named MISDc. The Ensemble Kalman filter is adopted to optimally incorporate the soil moisture data into MISDc. Several catchments located in different climatic regions over Europe are used as case studies. Results reveal that the ASCAT soil moisture product can be conveniently used to improve runoff prediction, mainly if the soil wetness conditions before a storm event are highly uncertain or unknown. However, reliability differs according to the climatic region, the soil/land use conditions and the size of the catchments under investigation. Therefore, the open issues that should be addressed in future studies are also given.

The second application investigates the use of the ASCAT soil moisture product for predicting the movement of a rock slope located in central Italy, the Torgiovannetto landslide (Brocca et al., 2012b). By using a statistical approach, the opening of the tension cracks, recorded by an extensometers network operating in the area, as a function of rainfall and soil moisture conditions prior the occurrence of rainfall, are predicted in the period 2007–2009. Results indicate that the regression performance (interms of correlation coefficient) significantly increases if the ASCAT soil moisture

product is included.
Finally, the third application aims at estimating rainfall starting from soil moisture observations (Brocca et al., 2012c). Specifically, by inverting the soil water balance equation, a simple analytical relationship for estimating rainfall accumulations from the knowledge of soil moisture time series is obtained. Satellite and soil moisture observations from three sites in Europe are used to test the developed approach that showed reasonable results thus opening new opportunities for rainfall estimation at catchment/global scale.

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