HyMeX Project Report for the GEWEX SSG Meeting

Hydrological cycle in the Mediterranean Experiment (HyMeX)

Reporting Period: 2010-2014
Starting date: 2010 (beginning of data collection)
End date (where appropriate): 2020

URL: http://www.hymex.org

Chair(s) and term dates:
Dr. Philippe Drobinski
HyMeX principal investigator (with Véronique Ducrcoq)
Chair of the HyMeX International Scientific Steering Committee[1]

Please report on the following:

1. Panel activities

The HyMeX (Hydrological cycle in the Mediterranean Experiment) programme is a 10-year international project (2010-2020) which aims at:

- improving our understanding of the water cycle, with emphases on extreme events by monitoring and modelling the Mediterranean coupled system (atmosphere-land-ocean), its variability (from the event scale, to the seasonal and interannual scales) and characteristics over one decade in the context of global change,
- evaluating societal and economical vulnerability and adaptation capacity to extreme meteorological and climate events.

In particular, HyMeX aims at addressing key issues related to (1) the water budget of the Mediterranean basin, (2) the continental hydrological cycle and related water resources, (3) heavy precipitation and flash-flooding and (4) intense air-sea exchanges produced by severe regional winds and cyclogeneses. HyMeX aims also at monitoring vulnerability factors and adaptation strategies developed by different Mediterranean societies to accommodate the impacts of climate change and intense events. A schematic of the main scientific topics of the HyMeX project is shown in Fig. 1 and a comprehensive description of the HyMeX underlying science is provided in the project International Science Plan (http://www.hymex.org/?page=key_documents) and in an overview article published in BAMS (Drobinski et al., 2014).

[1] 2 year mandate: 2008-2010 as vice chair; 2011-2012 as vice-chair and 2012-2013 as chair

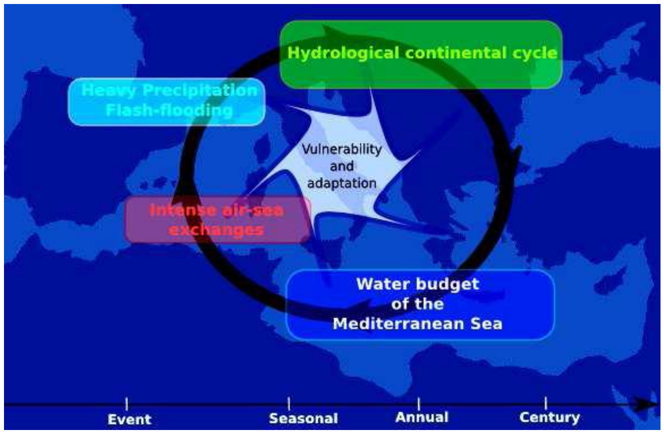

Figure 1: Schematic of the main scientific topics of the HyMeX project.

2. Science highlights

Series of coordinated observation periods are foreseen during the 2010-2020 time-window. They are based on measurement campaigns, the deployment of dedicated instrumentation, and the enhancement of existing operational systems. A comprehensive description of the HyMeX underlying science is provided in the International Science and Implementation Plans available at the HyMeX web site (www.hymex.org). Outcomes of the multi-disciplinary research conducted in HyMeX should be beneficial to the improvement of

- observational and modelling systems, especially of coupled (ocean-atmosphere-land) systems,
- the prediction capabilities of high-impact events,
- the accurate simulation of the long-term water-cycle,
- the definition of adaptation measures, especially in the context of global change.

3. Science issues

The Mediterranean basin has quite a unique character that results both from physiographic and climatic conditions and historical and societal developments. Because of the latitudes it covers, the Mediterranean basin is a transition area under the influence of both mid-latitudes and tropical variability (Fig. 2): to the north, a large part of the atmospheric variability is linked to the North Atlantic Oscillation (NAO) and other mid-latitude teleconnection patterns (e.g. Xoplaki, 2002), while the southern part of the region is under the influence of the descending branch of the Hadley cell materialized through the Azores High, with in addition El Niño Southern Oscillation (ENSO) influence to the east (e.g. Rodwell and Hoskins, 1996).

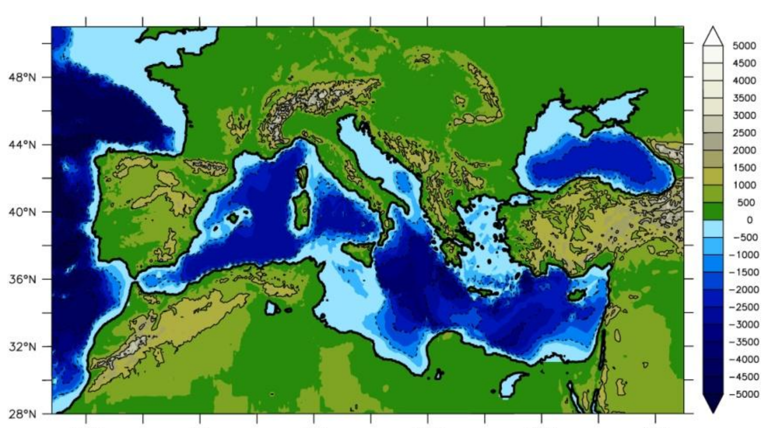

Figure 2: Mediterranean basin (also HyMeX/MED-CORDEX simulation domain)

Because in such transition area, the Mediterranean basin is very sensitive to global climate change at short (decadal) and long (millennial) time scales. Continental and marine paleorecords show that the climate and the sea state have widely varied in the past, sometimes very quickly (e.g. Combourieu Nebout et al., 2002). Regarding the projection of the Mediterranean climate in anthropogenic scenario, Giorgi (2006) defines the Mediterranean area as one of the two main “hot-spots” of the climate change with an increase in the interannual rainfall variability in addition to a strong warming and drying. Several authors have reported an increase of the mean annual temperature of about 0.005°C yr^{-1} in the Mediterranean basin. (e.g. Quereda-Sala et al., 2000) reaching in summer the value of 0.01°C yr^{-1} for 1976-2000, one of the highest rates over the entire globe.

In such context, the vulnerability of the Mediterranean population may increase dramatically with an expected increase of precipitation variability during the dry (warm) season (Giorgi, 2006) and of probability of occurrence of events conducive to floods and droughts (Gao et al., 2006). Heavy precipitation and flooding are among the most devastating natural hazards in terms of human life loss along with windstorms. For instance, the storm flooding in Algiers on 10 November 2001 caused 886 victims whereas in France, over the last two decades, more than 100 deaths and several billion of euros of damages were reported. In September 2002, flash floods in France brought additional losses of 1.2 billion € (Huet et al., 2003). Droughts and heat-waves can also have very serious consequences for society. A typical example is the summer 2003 in Europe, which was at the origin of 70 000 extra deaths in 12 European countries and 15 000 in France (Hémon and Jougla, 2003). This heat wave contributed to the reduction in productivity of natural and cultivated vegetation (Ciais et al. 2005), lower energy supply and electricity restriction (Fink et al., 2004), and an increase of air pollution (Vautard et al., 2007). In the context of global warming, heat waves and droughts may become not only more frequent but also longer and more intense (e.g. Gao et al., 2006). Climate change also leads to sea level rise through thermal expansion of the ocean and melting of ice sheets and glaciers. Global models project a global sea level rise between 190 mm and 590 mm by the end of this century (IPCC, 2007). Nevertheless, they do not agree on a trend for the Mediterranean Sea level change. It is thus of major concern to assess ongoing sea level change in the Mediterranean basin, whose tourism is fast becoming the dominant economy for coastal regions. With more than 146 million residents and another 100 million tourists in summer, the Mediterranean basin has one of the most crowded coasts in the world. Demographic projections from the Mediterranean Action Plan suggest that the urban coastal population could reach 176 million people and the number of tourists per year could grow up to 350 million by 2025. This continuing migration towards coastal areas makes the Mediterranean one of the most vulnerable region to risks inherent to rising sea level (e.g. coastal erosion, flooding).

It is thus crucial to characterize how regional climate, and especially precipitation and floods, droughts and heat waves and sea level mean will respond to climate change, in order to make decision on development of adaptation strategies to face risks related to changing climate. However, because the region features a nearly enclosed sea surrounded by very urbanized littorals and mountains from which numerous rivers originate (Fig. 1), many interactions and feedback result between ocean-atmosphere-land processes which are largely variable both in time and space. The ability to predict such high-impact climatic events and their consequences is thus still low.

4. New projects in place

None with respect to the HyMeX international science and implementation plans.

5. Workshops/meetings held

The HyMeX programme organizes an annual international HyMeX workshop:

- 1st HyMeX workshop, Toulouse, France (~250 participants) : 9-11 January 2007

- 2nd HyMeX international workshop, Palaiseau, France (~200 participants) : 2-4 June 2008
- 3rd HyMeX workshop, Heraklion, Greece-Crete (~100 participants) : 2-4 June 2009
- 4th HyMeX workshop, Bolonia, Italy (~180 participants) : 8-10 June 2010
- 5th HyMeX workshop, Minorque, Spain (~180 participants) : 16-20 May 2011
- 6th HyMeX workshop, Primosten, Croatia (~130 participants) : 7-11 May 2012
- 7th HyMeX workshop, Cassis, France (~200 participants) : 7-11 October 2013
- 8th HyMeX workshop, Valletta, Malta (~130 participants) : 15-18 September 2014

The ISSC meets twice a year (one meeting at the annual HyMeX workshop, and one through visioconference). Monthly video/teleconferences of the Executive Committee have been organized in 2012 and 2013 to prepare the special observation periods (September-November 2012; February-March 2013). Now the Executive Committee meets via videoconference to discuss the coming year budget. Since 2013, the HyMeX organization has changed and is structured along science teams:

- ST-IOPrain: Studies of IOPs (SOP1) - precipitation events *[WG3]*
- ST-microphysics: Microphysics in precipitating systems *[WG3]*
- ST-WV: Sources and transport of water vapour *[WG3]*
- ST-lightning: Lightning and atmospheric electricity *[WG3]*
- ST-flashflood: Flash-floods *[WG3]*
- ST-airseacoupling: Air-sea fluxes, marine and ocean boundary
- layers coupled processes *[WG3/WG4]*
- ST-DWF: Dense Water formation and ocean mesoscale
- processes *[WG4]*
- ST- vulnerability – flash floods *[WG5]*
- ST-medcordex: Regional climate modeling
- (MED-CORDEX) *[WG1/WG2/WG3]*
- ST-assimeps: Atmospheric convective-scale data assimilation
- and ensemble prediction [*WG3/WG4*]
- ST-WRD : water resources and droughts *[WG2/WG5]*

The science team also meet more or less regularly (it depends on the Science Team).

A cluster of HyMeX posters were presented at the WCRP Open Session Conference (24-28 October 2011, Denver - session C4 “Meeting the Needs for Integrated Climate Science, Information and Capacity Building with Regard to Climate Variability and Change in Europe”; http://www.wcrp-climate.org/conference2011/Posters_C4.html). Some HyMeX-related posters were also presented at the 7th International Scientific Conference on the Global Water and Energy Cycle du World Climate Research Program (14-17 June 2014, The Hague, The Netherlands).

The ST "Regional Climate Modelling" has organized the HyMeX/MED-CORDEX workshop in May 2014 (http://climserv.ipsl.polytechnique.fr/hymex-remember/hymex-med-cordex-meeting-26-28-may-2014).

6. Contributions to developing GEWEX science; fit to GEWEX imperatives

The HyMeX programme can be seen as direct implementation of the GEWEX imperatives in the context of the Mediterranean region. Indeed, HyMeX aims at "developing improved observational, diagnostic, and modelling capabilities for measuring and predicting global and regional energy and water variations, trends, and extremes, such as heat waves, floods, and droughts, and provide the science underpinning climate services." (quote from the GEWEX imperatives).

In details, HyMeX contributes to produce climate records of atmospheric and land variables over a decade (2010-2020) and to provide descriptions and analyses of these data. The data policy is available at www.hymex.org and the data base can be visited at http://mistrals.sedoo.fr/HyMeX/. HyMeX also aims at improving stand-alone and coupled atmosphere/land/ocean models for a better understanding and modelling the regional climate system models in the Mediterranean for better water-related risk prevention in the context of global change. Indeed risk prevention is addressed by including scientists from socio-economic sciences. Finally, since operational hydro-meteorological and climate services are partners in HyMeX, transition to operations is a key expected outcome of HyMeX.

7. New projects and activities being planned, including timeline

There is a clear objective to intensify the data collection in the Eastern and Southern Mediterranean (Fig. 3). Funding is sought to organize a Special and/or Enhanced Observation Period in Eastern Mediterranean in 2016-2017 (EU H2020 TEMPEST project submitted; ERANET-MED project in preparation). A Memorandum of Understanding (MoU) will be probably signed with the DESERVE project (which includes German, Isreali, Jordanian and Palestinian) for data sharing, as it is the case with the FP7-eartH2Observe project. Nothing is finalized and the risk that such activities fail to be funded is high.

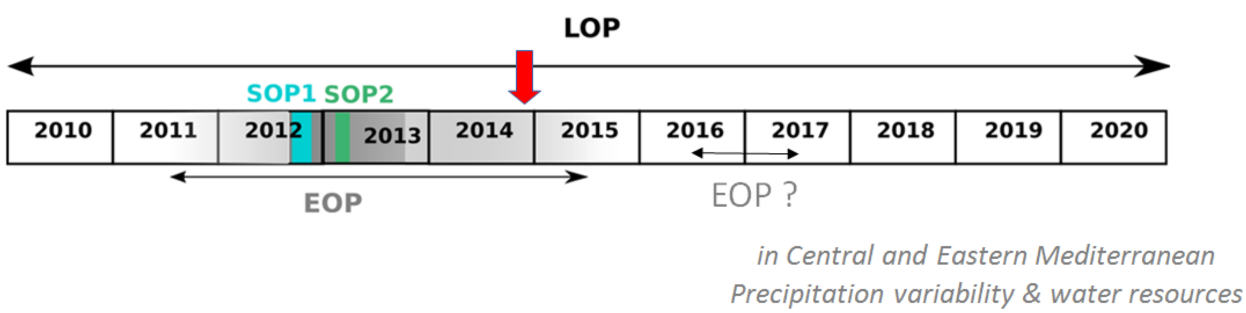

Figure 3: HyMeX timeline. The red arrow indicates where the project stands in 2014.

8. Workshops / meetings planned

The 9th HyMeX workshop will be held in Greece (Mikonos) in September 2015. Year 2015 is the HyMeX mid-term year. Therefore, the workshop will be dedicated to the review of the first 5 years achievements, the identification of our success and failures and the adjustment of the scientific and implementation plan for the last 5 year period. A book will probably be edited based on this review prepared for the workshop. Otherwise, the ISSC is planned to meet twice in 2014. The Executive Committee will also meet in 2015 to discuss the HyMeX budget, as well as the Science Team to discuss the results from the collaborative work.

9. List contributions to the GEWEX Grand Science Questions and plans to include these.

- **Observations and Predictions of Precipitation**

There are three HyMeX target areas (TAs) for the observation of heavy precipitation systems and flash-flooding (Fig. 3):

1. *Northwestern Mediterranean*—Heavy precipitation systems and flash-flooding occur over the Spanish, French, and Italian coasts during the autumn.
2. *Southeastern Mediterranean*—covers the Eastern and Southeastern Mediterranean area and consists of the western part of Crete Island, the transboundary river basin of the Evros River and three basins in Israel. This target area allows the study of intense rainstorms and flash floods in the dryer climate areas of the Mediterranean.

3. *Adriatic*—comprised of the Friuli and Veneto regions in Italy, and the Dinaric Alps in Slovenia and Croatia. It is a target area for the study of heavy precipitation events and flash-flooding.

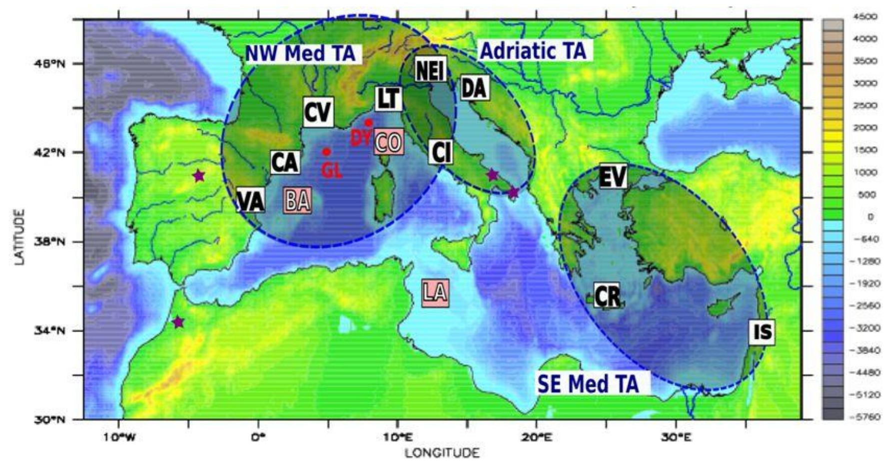

Figure 4: Location of the 3 HyMeX target area (TA) (NW Med: Northwestern Mediterranean; Adriatic; SE Med: Southeastern Mediterranean) (Source: HyMeX International Science Plan 2010). The "squares" indicate the locations of hydro-meteorological sites.

Special Observation Period (SOP) were performed in the Northwestern Mediterranean target area. The first SOP (SOP1) spanned 8 weeks (5 September - 6 November 2012) and was dedicated to documenting the heavy precipitating events (HPE) and associated flooding, in relation with the ocean heat content. In addition to the LOP and EOP measurements, their investigation involved dedicated platforms, including aircrafts (French Falcon 20 and ATR-42 and German Do128; see Fig. 4a,b), pressurized boundary layer balloons and the French buoy tender Provence. Additional radiosoundings completed those performed in the Cévennes-Vivarais, Corsica and Central-Italy sites, with some launched at sea from the buoy tender Provence. As a result were investigated 18 orographic or HPE and flooding over France, 11 over Italy and 6 over Spain. The detailed objectives of SOP1 and specific means deployed are described in a companion article (Ducrocq et al., 2014). The second SOP (SOP2) spanned 6 weeks (1 February -15 March 2013). It was dedicated to intense air-sea interactions, mainly under strong winds in the Gulf of Lions that cause ocean convection process resulting in dense water formation. Luckily, dense water formation occurred in winter 2013, and was intense enough to reach the sea floor (~2500 m). During the field campaign, the French research vessels Le Suroît (companion Marine Ecosystems Response in the Mediterranean Experiment - MerMeX), Tethys-2 and the buoy tender Provence (Fig. 4c) contributed to sampling the water column and the air-sea fluxes, complemented by Marisonde buoys SVP drifters, and ARGO profilers specifically modified to allow deeper and more frequent profiling when drifting in the area of oceanic convection. The French aircraft ATR-42 measured boundary layer fluxes and waves over the region of oceanic convection in synergy with pressurized boundary layer balloons measuring the temperature, pressure, humidity and wind along a quasi-lagrangian trajectory (Fig. 4d).

Figure 5: French (a) and German (b) aircrafts deployed during SOP1, R/V Le Provence operated during SOP2 (c) and pressurized boundary layer balloons launched from Candillargues during SOP2 (d) (c). French ATR42 (foreground) and Falcon 20 (background) were based at Montpellier airport and German Do128 was based in Corsica at Solenzara airport. (Source: panels a and d: P. Drobinski; panel b: C. Kottmeier; panel c: I. Taupier-Letage).

As part of the EOP, hydrological field campaigns have been carried on as well as Intensive Post event Campaigns (IPEC). The measurements are performed routinely and on alert each fall since 2012 (sampling of flood events for geochemistry analysis, gauging of flooding rivers, soil moisture measurements, field observations of runoff). The hydrometeorological forecast is operational 7days per week from September to mid-December (real time update of the HyMeX field campaign web site: sop.hymex.org). In 2014, many catastrophic events were documented (17-20 September,10-13 October, 3-4, 14-15 and 27-29 November) (Fig. 6).

Figure 6 : River flow measurement collected on October 11, 2014 over Claduegne river.

During the IPEC, estimation of peak discharge is carried on over ungauged rivers. It includes (i) collection of rivers cross sections data with flood mark levels; (ii) interviews of eyewitnesses for info on dynamics of the flood and flood levels; and (iii) exploitation of videos for estimation of flow velocities (see IPEC 2013 in Sardinia in Fig. 7).

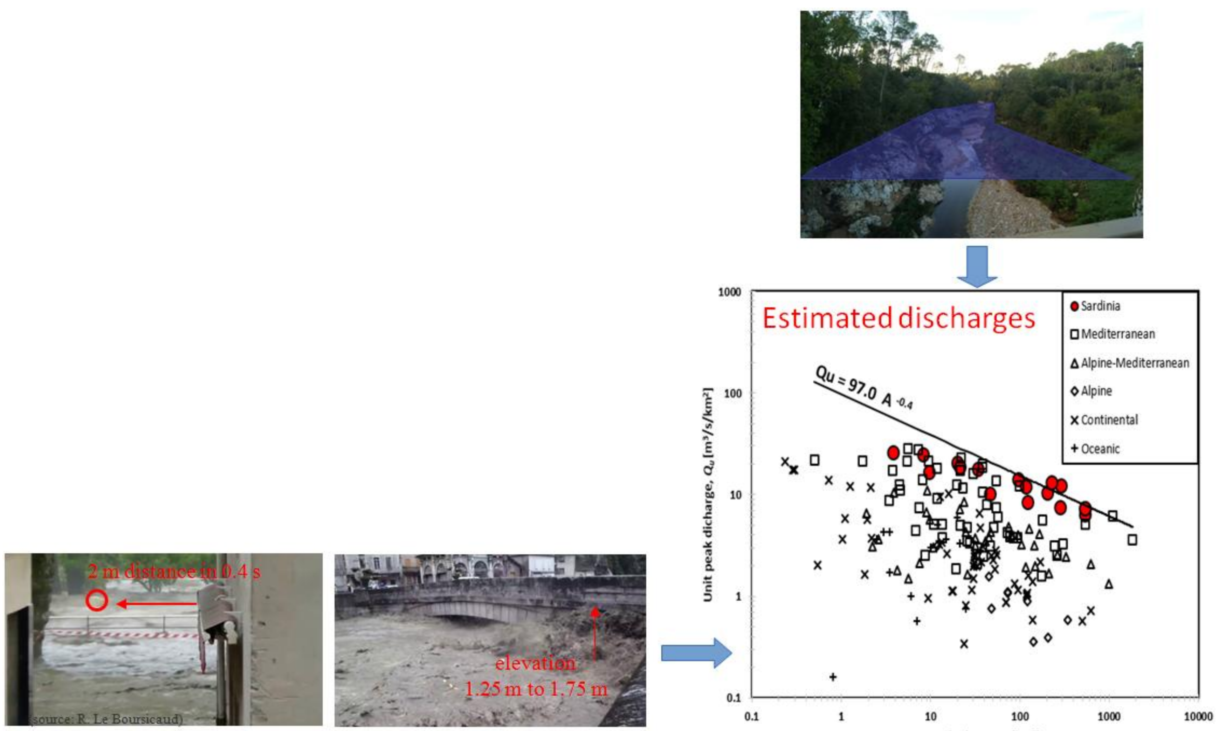

Figure 7 : IPEC in Sardinia in November 2013: Precipitation: 469 mm/12 hours
Estimated 1 billion € damage.

The HyMeX observation strategy is designed to serve the objectives of the modeling strategy. In the context of the SOP and EOP, it includes the improvement of convective-scale deterministic forecast systems to improve the capability to predict Mediterranean high-impact weather events;

and the design of high-resolution ensemble modeling systems dedicated to the study of the predictability of Mediterranean heavy precipitation. These ensemble forecast systems are coupled with hydrological models to issue probabilistic forecasts of the impact in terms of hydrological response. Advances in the knowledge of the hydrological and hydraulic responses, as well as of the soil water content state before and during precipitation events should help to improve the initialization and process representation within the hydrological models used. In the context of the LOP, the data are used to analyze the long-term water cycle variability including extremes (wet or dry periodes), to improve its modelling in coupled regional climate system models and to perform projections in future climate. The data collection from in-situ site is made difficult especially with Southern Mediterranean countries. It is also due in large part to the absence of a large international funding which would impose a contractual commitment to deliver the data. Conversely, satellite monitoring becomes successful with the funding of the FP7 eartH2Observe project in which the Mediterranean case study is coordinated by HyMeX, and the future support of ESA to produce a dedicated satellite data fusion to close the water cycle in the Mediterranean region.

- **Changes in Extremes**

A Long-term Observation Period (LOP) began in September 2010 and will continue until 2020. It includes the whole Mediterranean region, and the data will be used in developing a long-term time series required to study seasonal and interannual variability in a context of on-going global change. It relies on the collection of data from existing research and operational oceanic and hydro-meteorological instrumented sites and satellite data. This data set is completed by historical data. As for the SOP, the LOP observation strategy is designed to serve the objectives of the modeling strategy, which includes the development of regional coupled systems (ocean-atmosphere, land-atmosphere, ocean-land-atmosphere) to reduce uncertainties of the regional projections of future climate with a special focus on hydro-meteorological extremes (heavy precipitation, droughts and heat waves). This activity is conducted in the frame of HyMeX/MED-CORDEX regional climate modeling activities. As an example, Fig. 8 shows the impact of SST sub-monthly anomalies on heavy precipitation in Northwestern Mediterranean and the derivation from a model-based indicator of this sensitivity to a satellite data based indicator.

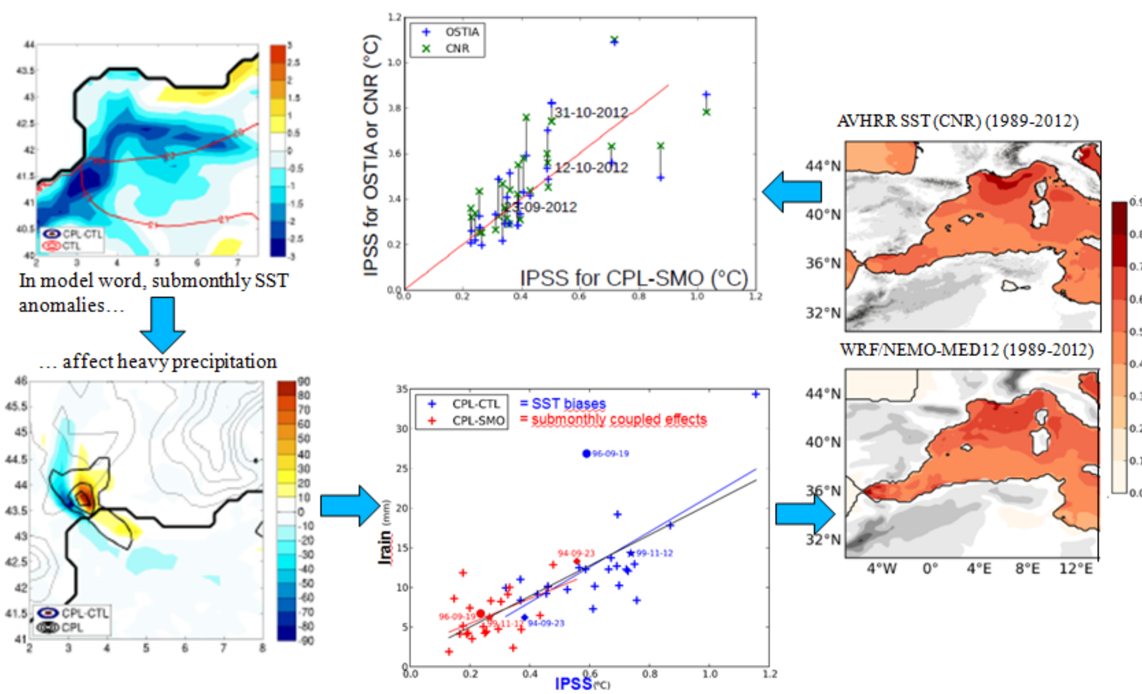

Figure 8 : Impact of SST sub-monthly anomalies on heavy precipitation in Northwestern Mediterranean (left column) and derivation from a model-based indicator of this sensitivity to a satellite data based indicator (middle and right columns). (Sources: Berthou et al., 2014a,b, 2015).

Another example is shown in Fig. 9 which shows the impact of MED-CORDEX regional climate model resolution and scenarios on the trend of the runoff in the Makhazine catchment in Morocco.

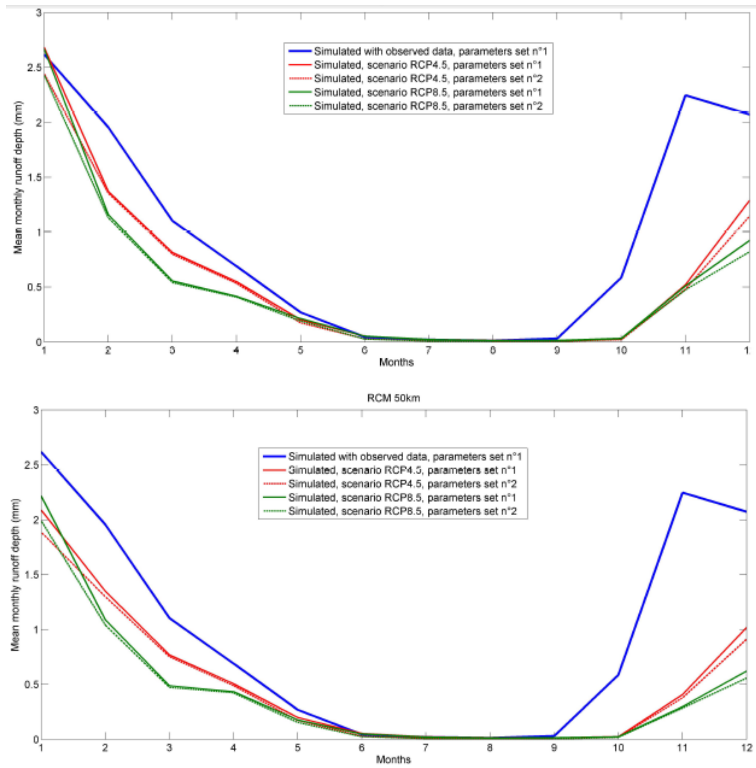

Figure 9 : Projected changes on runoff under scenarios 4.5 and 8.5 for the period 2041–2062 (the parameter set no. 1 is the one obtained when calibrating the hydrological model on all years, the parameters set no. 2 is the set obtained on calibration during dry years). (Source: Tramblay et al., 2013).

- **Water and energy cycles**

The HyMeX programme aims at monitoring and modeling the full water cycle in the Mediterranean with a special focus on the coupled processes between the different compartments (atmosphere/land/ocean) and at different time and spacial scales (from the extreme event, to the seasonal and interannual variability and trend). It includes routine measurements of the surface energy budget on various Mediterranean landscapes Fig. 10) to the different terms of the water cycle as processed from satellite data at the basin scale (Fig. 11).

(a) (b) (c)

Figure 10 : Three flux stations over orchards, irrigated meadow and dry meadow (coussouls). Source: (a) N. Bertrand, (b) and (c) S. Guarrigues.

The modeling approach of the Mediterranean water cycle relies on a seamless approach which combines models of the different compartments of the Earth system at very fine scale (typically kilometer-scale) to models of the regional climate system at about 20 km resolution.

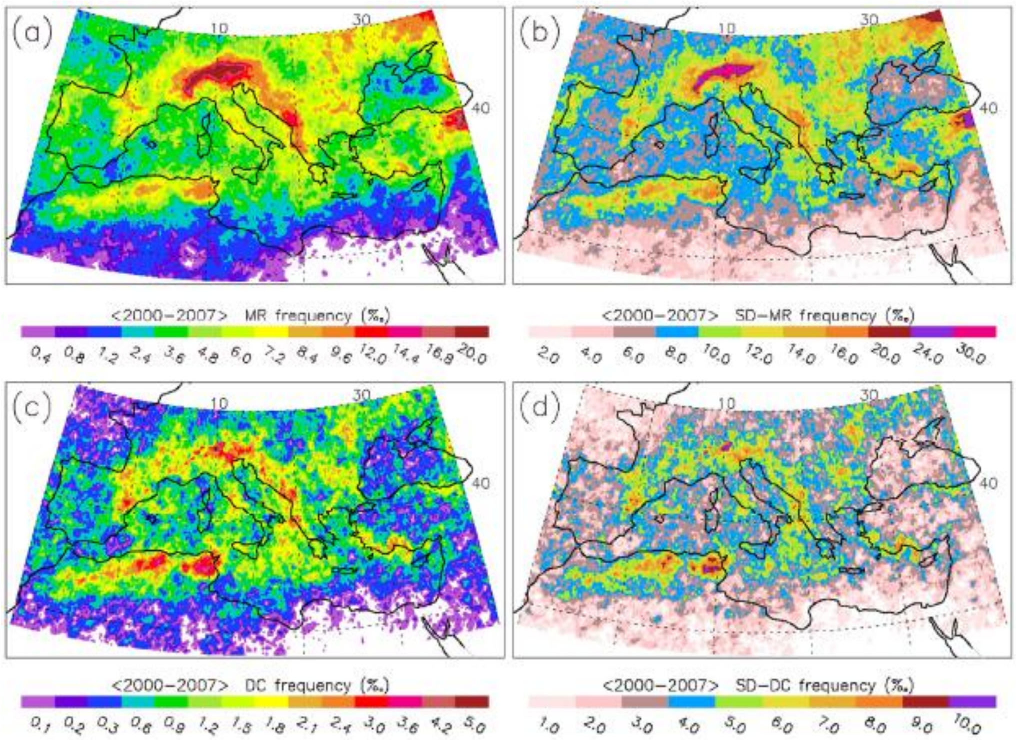

Figure 11 : NOAA-15 climatologies: (left) mean state and (right) interannual variability computed as standard deviation of the monthly means over the period 2000–2007. (a,b) moderate rain frequencies (‰), and (c,d) deep convection frequencies (‰). (Source Alhammoudet al., 2014).

More detailed can be found in the HyMeX international implementation plan (IIP).

10. Other key science questions that you anticipate your community would want to tackle in the next 5-10 years within the context of a land-atmosphere project (1-3 suggestions)

The key questions identified in HyMeX that should be tackled in the context of a land-atmosphere project are:

- the role of the ocean in coastal areas on land-atmosphere feedbacks and especially precipitation (advection of moisture over the continent), heat waves (modulation of temperature extremes due to coastal mesoscale meteorology).
- the impact of human activity (land-use, irrigation,...) on land-atmosphere feedbacks and their modelling
- the monitoring of vulnerability and adaptation capacity to hydro-meteorological extremes in a context of global change

11. Briefly list any specific areas of your panel's activities that you think would contribute to the WCRP Grand Challenges as identified by the JSC (not covered under 9).

- **Provision of skillful future climate information on regional scales (includes decadal and polar predictability)**

The fourth IPCC assessment report (AR4) forecasts an increase in the Earth's average temperature ranged between 1.4 °C and 5.8 °C over the 21st century, accompanied by a rise in sea levels between 190 mm and 590 mm (IPCC, 2007). This rapid change in the global climate may result in the modification of the frequency and intensity of extreme events and natural disasters (cyclones, droughts, floods, etc.) in certain parts of the world. This is indeed, particularly relevant for the Mediterranean region (Giorgi, 2006). These changes are also set to cause radical disruption to agriculture, large population movements as people abandon disaster-struck regions (such as flooded coastal plains and areas blighted by desertification) for less-affected areas, and heightened political tensions.

The development of accurate regional climate system models is thus a key issue to investigate regional climate variability and trend, quantify extreme occurrences and magnitudes and evaluate population vulnerability and adaptation capacity in the context of global change in the Mediterranean region by providing relevant indicators. A number of regional climate model (RCM) have been developed during the last two decades in order to downscale the outputs from large-scale global climate model (GCM) simulations and produce fine scale regional climate change information useful for impact assessment and adaptation studies. To date, most RCMs have been mainly composed of an atmospheric component coupled with a land surface model (LSM) scheme which is generally designed to only simulate the exchange of surface water and energy fluxes at the soil-atmosphere interface. RCMs have also been driven over ocean areas by prescribed sea surface temperature.

Although such RCM can be sufficient for many applications, there are cases in which the fine scale feedbacks associated with air-sea interactions can substantially influence the spatial and temporal structure of regional climates. Strong air-sea interactions also take place in the Mediterranean basin (e.g. Lebeaupin Brossier et al., 2009; Lebeaupin Brossier and Drobinski, 2009). In order to explicitly resolve the two-way interactions at the atmosphere-ocean interface in the Mediterranean region, Somot et al. (2008) coupled the global atmospheric model ARPEGE with the regional ocean model OPAMED. A similar development was conducted by Li et al. (2011) with the global atmospheric model LMDZ with the regional ocean model OPAMED, by Artale et al. (2009) with the PROTHEUS system integrating RegCM3 and the MITgcm models and by Drobinski et al. (2012) with the MORCE system integrating WRF and the NEMO-MED12 models as the atmospheric and oceanic component, respectively. Comparison of coupled and uncoupled experiments showed better simulated Mediterranean SST which is one factor responsible for significant differences in the regional climate simulation.

However, the Earth system is the physical, chemical, biological, and social components, processes, and interactions that together determine the state and dynamics of Earth, including its biota and human occupants. Developing regional Earth system models, also referred as regional climate system models (RCSMs) has two primary motivations: (i) with respect to climate science, to improve modelling capabilities and better understand coupled processes at regional scales and (ii) to support stakeholders who aim to use climate information for regionally-specific impact assessment and adaptation planning. There is thus a need to develop what amounts to an enhanced Earth system simulator to improve our ability to anticipate impacts of a given set of human actions or conditions on global and regional climate and on biological, geochemical, and hydrological systems on seasonal to decadal time scales. Most current efforts to build state-of-the-art whole-Earth system models consist in complementing sophisticated geophysical kernels (AORCMs based on exact dynamical equations like Navier-Stokes) by tools representing other parts of the planetary makeup, as for example vegetation models and river routing schemes. Indeed, the land surface plays a pivotal role in the Earth system through physical, biophysical and biogeochemical interaction with the atmosphere and oceans (e.g. Prentice et al., 2000). Land-atmosphere interactions include complex feedbacks between soil, vegetation, and atmosphere through the exchanges of water, momentum, energy, and greenhouse gases (e.g. Arora, 2002), as well as the emission/deposition of several compounds (e.g. Lathiere et al., 2006). This is true for the global Earth system simulator, but not fully achieved at regional scale, while it is needed to assess the potential impact of environmental changes on regional economic conditions, food and energy security, water supply, health and biodiversity.

Within HyMeX, models of the regional climate system have been developed and used to produce stream 1 simulations for the MED-CORDEX project. These simulations are currently validated with the HyMeX data. Figure 12 displays the precipitation change (°C^{-1}) for 3-hourly precipitation from surface weather stations, HyMeX/MED-CORDEX simulation (MORCE-MED modelling platform) and interpolated SAFRAN analysis.

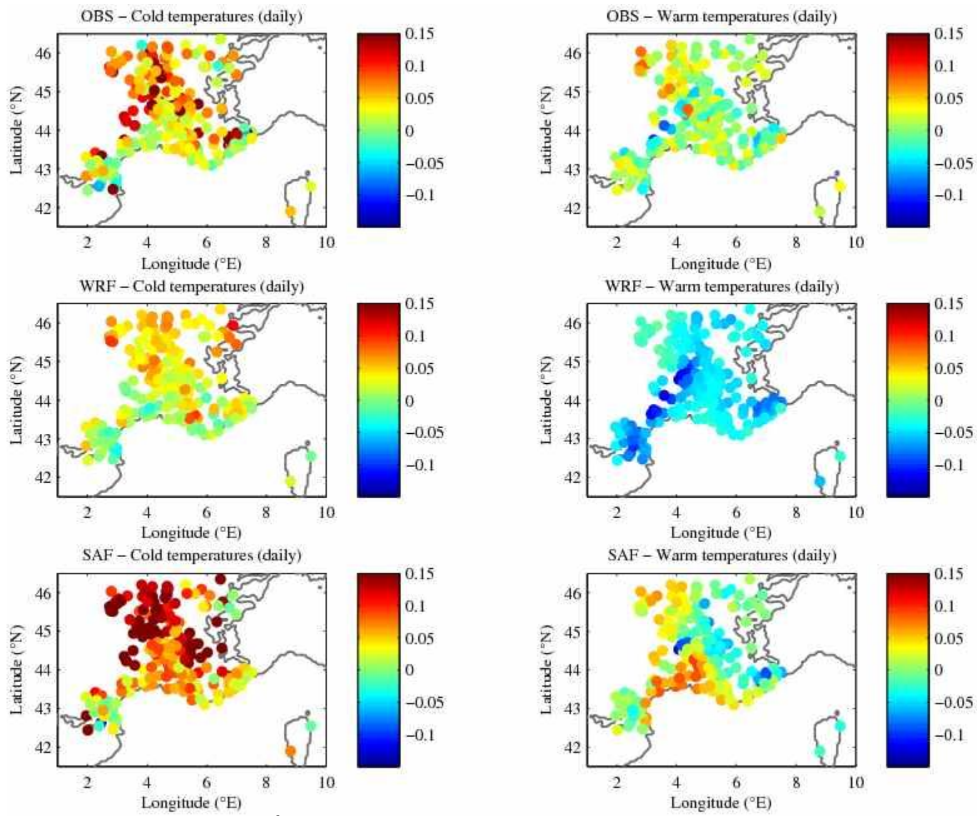

Figure 12: Precipitation change (°C^{-1}) for daily precipitation from surface weather stations (a), HyMeX/MED-CORDEX simulations (b) and interpolated SAFRAN analysis (c). The colorbar indicate the value of the slope between the logarithm of the 3-hourly precipitation extremes (99th centile) and the daily average temperature.

It shows the spatial pattern of the slopes computed over the temperature range below the 12°C threshold corrected for the altitude (6°C/1000 m) and above the threshold using three-hourly precipitation data (left) and daily mean precipitation data (right). We observe a pattern strongly related to the main geographic features of the region and very similar in the SAFRAN analysis and the HyMeX/MED-CORDEX simulations. Let us analyze the SAFRAN pattern first for temperature below the threshold. Over the mountain ridges and especially the Massif Central which strongly drives the precipitation intensity in this region (Bresson et al., 2012), the slope is the highest and the closest to the CC-scaling. In the Rhône catchment which as a large source of water for the atmosphere and soil through irrigation, the precipitation extremes/temperature scaling is also high and close to CC-scaling. However, elsewhere in the plain, the slope is sub-CC. Above the threshold, the slope is always sub-CC. *This work is part of the GHP cross-cutting activities.*

- **Regional Sea-Level Rise**

Climate change also leads to sea level rise through thermal expansion of the ocean and melting of ice sheets and glaciers. Global models project a global sea level rise between 190 mm and 590 mm by the end of this century (IPCC, 2007). Nevertheless, they do not agree on a trend for the Mediterranean Sea level change. It is thus of major concern to assess ongoing sea level change in the Mediterranean basin, whose tourism is fast becoming the dominant economy for coastal regions. With more than 146 million residents and another 100 million tourists in summer, the Mediterranean basin has one of the most crowded coasts in the world. Demographic projections from the Mediterranean Action Plan suggest that the urban coastal population could reach 176 million people and the number of tourists per year could grow up to 350 million by 2025. This continuing migration towards coastal areas makes the Mediterranean one of the most vulnerable region to risks inherent to rising sea level (e.g. coastal erosion, flooding). Mediterranean sea level is influenced by mass fluctuations (e.g. water input, salinity fluctuation), density variations (steric effect), changes in circulation, waves, atmospheric pressure variations and changes of the hydrographic conditions of incoming Atlantic water. These different components contribute to sea level change at different time scales, from daily to interdecadal. So far, the question about future sea level change in the Mediterranean remains open. Climate modelling attempts to assess future sea level change in the Mediterranean were unsuccessful. Global models do not agree on a trend, as shown in Fig. 13. The main reason is that their rather low resolution does not allow an accurate representation of important small scales processes controlling the sea level. Global models also parameterize water exchange at Gibraltar, influencing the circulation and sea level changes. Finally, the global steric component is often not included in global models (Marcos and Tsimplis, 2008).

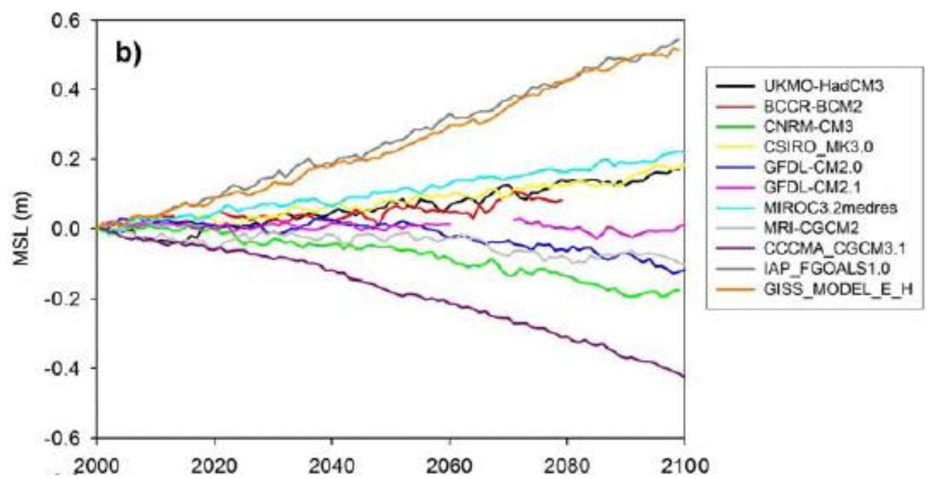

Figure 13: Yearly steric sea level averaged over the Mediterranean Sea under SRES A1B scenario for various global models. From Marcos and Tsimplis (2008).

The strong socio-economic impacts of sea level change on the Mediterranean coasts raise the need to use high resolution regional climate models which could include all the contributing processes controlling the sea level which up to now are not represented (e.g. the outcome of the 2011 workshop hold by IMEDEA about the "Unresolved issues in Mediterranean Sea Level"[2]). In the framework of HyMeX (through the French project REMEMBER), the main goals are (1) to assess the existing reference products (in-situ, satellite, past reconstructions) used to evaluate the representation of the regional ocean model sea level, (2) to develop new reference products such as an ocean regional reanalysis and new datasets reconstructed from observations, (3) to include the various physical processes important for simulating the sea level variation in the models, (4) to evaluate the new ocean model configurations for multi-decadal hindcast simulations to improve the understanding of the past Mediterranean sea level variability at climate–scale (from monthly to multidecadal time scale).

[2] See http://imedea.uib-csic.es/proyecto/sealevel/index.html

- **Past and future changes in water availability (with connections to water security and hydrological cycle)**

In the Mediterranean region, water is a scarce resource, fragile, highly variable in time and unevenly distributed in space as shown in Fig. 14a. Water demand has doubled in the second half of the 20th century, reaching, in 2005, 280 km^3 per year for all riparian countries. In many Mediterranean countries, water use approaches the limit of available resources as shown in Fig. 14b. The resource is for a large part designed to meet the needs for agriculture (agriculture accounts for 64% of the total water demand; Source Plan Bleu), causing water shortages, cyclical or structural. In 2005, the Mediterranean population with less than 1000 m^3 $inhab^{-1}$ yr^{-1}, amounted to 180 million, including 60 million living with less than 500 m^3 $inhab^{-1}$ yr^{-1}. Twenty million Mediterraneans do not have access to drinkable water, especially in countries in the South and the East. This is caused by overuse of a part of the renewable groundwater and the exploitation of non-renewable resources. Degradation and pollution of human origin further limits the possibilities of water use since presenting health risks.

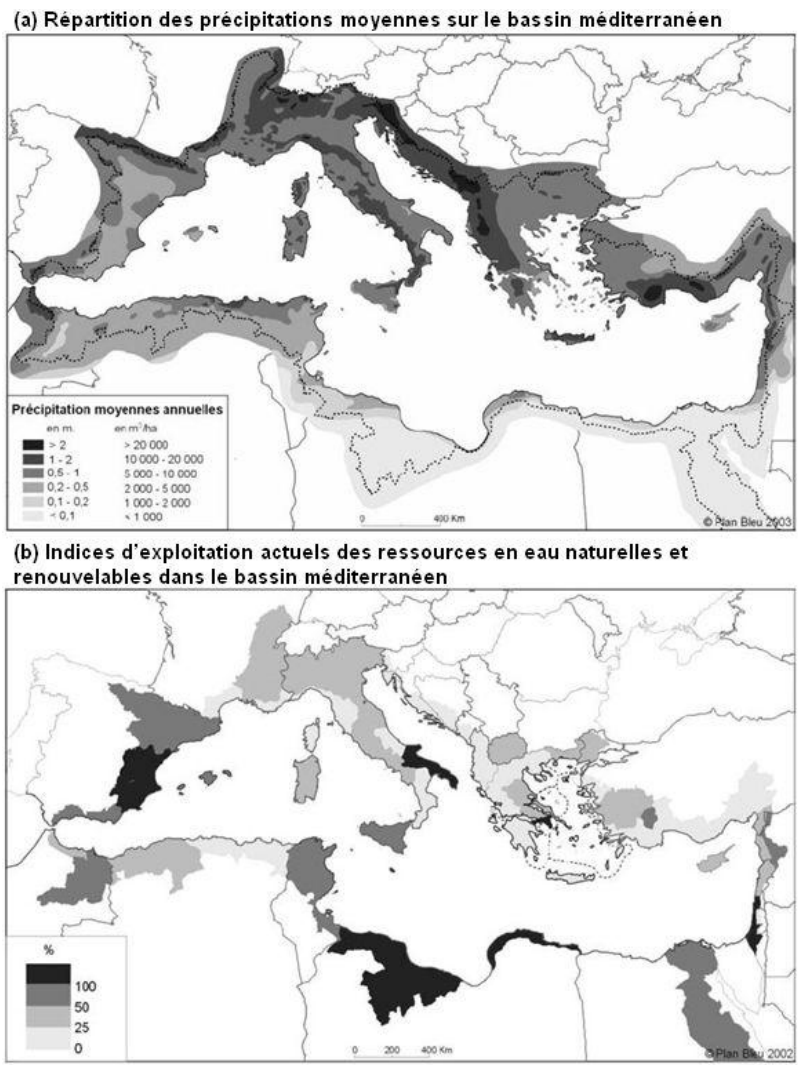

Figure 9: (a) Distribution of average precipitation in the Mediterranean basin and (b) ratio of water use to natural and renewable water availability in the Mediterranean basin (Source Plan blue 2004).

In HyMeX, the work focuses on the evaluation of the variability of the different terms of the water budget, of the the droughts and heatwaves in their relationship through coupled surface/atmosphere mechanisms and water resources (Stéfanon et al., 2012a,b,c). Representation in regional climate models of the variability of the water budget associated with river runoffs, relevant indicator for the study of droughts has significantly progressed (Szczypta et al., 2012). The analysis of satellite data and regional modeling also showed that drought leads to a few weeks shift of the phenological cycle that controls the development of vegetation and evapotranspiration (Szczypta et al. 2012; Stéfanon et al., 2012a, 2014) . Figure 15 shows the normalized anomalies (-3 to +3 standard deviations) of leaf area index in 2003 (year of exceptional drought and heat-wave in Europe), compared to the 10-year period 1999-2008. It shows a negative anomaly LAI first observed in the east (in May), and moving westward. The agreement between satellite observations (geoland2 product derived from SPOT-VGT instrument) and ISBA-A-gs and ORCHIDEE land-surface models that simulate photosynthesis and growth of vegetation in relation to climate and soil humidity is good except in October when a situation close to normal is observed, while the models show a persistent abnormality of leaf area index. This shows that it is possible to improve the representation of soil moisture models and satellite observations provide the opportunity to validate future versions of the models.

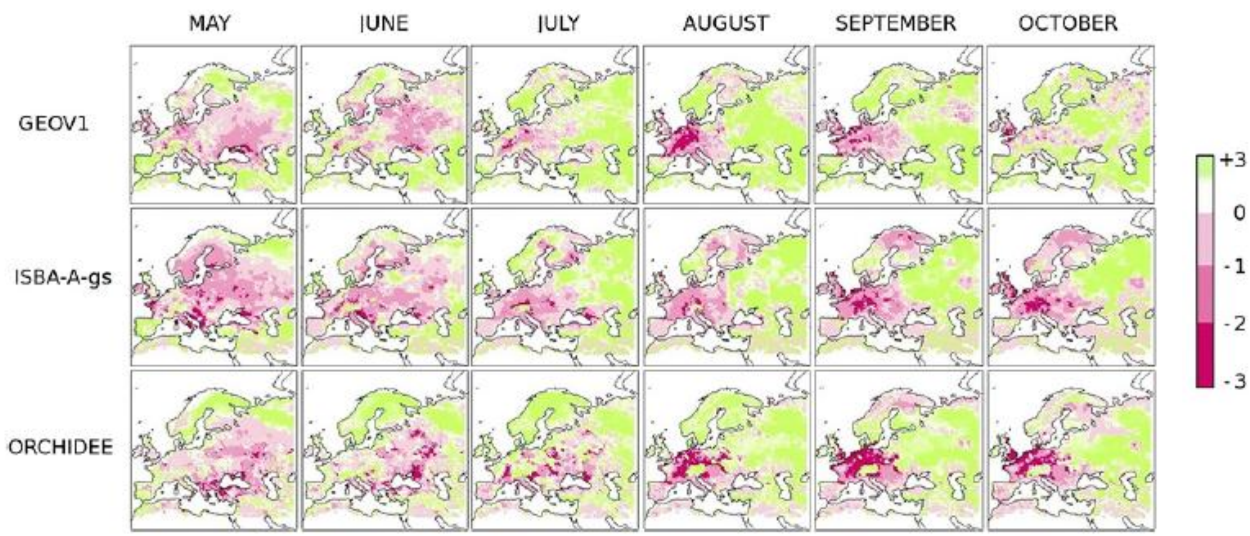

Figure 15 : Scaled LAI monthly anomalies from May to October 2003. From top to bottom: GEOV1 satellite observations, detrended ISBAA-gs and ORCHIDEE simulations. Units are dimensionless and correspond to standard deviations. (Source Szczypta et al., 2014).

Water deficit in the soil during drought results in a modification of the hydrological cycle specific in terms of rainfall. This response differs between continental plains where surface temperature and evaporation are largely controlled by local convection, and coastal and mountain breezes where mountains and sea control the advection of cool, moist air and the formation of precipitation (Stéfanon et al., 2012b). In the Mediterranean, the occurrence of droughts is important and significant impact on water use. In HyMeX, the particular case of Crau-Camargue area is studied in detail, as this area has a variety of surfaces ranging from steppe zones (the Crau coussouls) to wetlands (Camargue) (Fig. 10). Environmental and societal issues related to the water sustainability of the Crau is closely related to the irrigation by the Durance and the salty coastal aquifer affected by rising sea level. A detailed representation of anthropogenic water flow (irrigation, domestic and industrial use) is underway in HyMeX and should allow a better understanding of the local water cycle. A number of flux stations have been implemented over a vegetation poorly described at this stage (steppe, orchards, wetlands of the Rhône delta).

- **Science underpinning the prediction and attribution of extreme events**

The core of the scientific objectives of HyMeX is a better forecast and projections in future climate of hydrometeorological extremes (heavy precipitation and floods, heat wave and droughts). This relies on models of the regional climate system developed and operated in HyMeX. The attribution of the extreme events is addressed (1) by conducting process studies (relying on observations performed during the LOP, EOP and SOP) which should help identifying the "key elements of the recipe" which produce extremes; (2) by improving the representation of these processes in parameterizations for the regional climate models and (3) by analyzing in the stream 2 HyMeX/MED-CORDEX simulations the origin of the modifications of the controlling processes in a changing climate.

12. Cooperation with other WCRP projects (CLIVAR, CliC, SPARC), outside bodies (e,g. IGBP) and links to applications

HyMeX is a programme which contributes to different WCRP projects:

- GEWEX: HyMeX is an official RHP of GEWEX and also contributes to GLASS. Indeed, Pere Quintana Segui is the HyMeX representative in GLASS and at the last GLASS meeting has been proposed to become a member of the GLASS panel
- CLIVAR: HyMeX aims at understanding the variability and trend of the regional climate in interaction with the Mediterranean Sea, and thus contributes to the specific MedCLIVAR program, chaired by Piero Lionello, member of the HyMeX ISSC.
- CORDEX: The regional climate modeling group of HyMeX is at the origin of the selection of the Mediterranean region as an official domain of the CORDEX program. The coordinator of the MED-CORDEX project is Paolo Ruti, who chairs with Samuel Somot the HyMeX regional climate modelling group.

HyMeX is also endorsed by WWRP and its subprogram THORPEX. Véronique Ducrocq, co-PI of the HyMeX programme, is the HyMeX representative at the WWRP scientific committee.

The European FP7 project EartH2Observe has started in January 2014. This project aims to integrate available earth observations, in-situ datasets and models and construct a consistent global water resources re-analysis dataset of significant length (several decades). The resulting datasets will be made available through an open Water Cycle Integrator: the European contribution to the GEOSS/WCI approach. The available datasets will be analysed, and reliable EO data will be integrated with models and in-situ data to provide a holistic quantification of the available global water resources (the water cycle climatology). The results will be downscaled to regional and local levels and matched to metrics needed for water management decisions. The Mediterranean region is coordinated through the HyMeX program.

Finally, an ESA call will be issued early 2015 to construct a satellite-based product closing the water cycle in the Mediterranean area for the HyMeX RHP (including the atmosphere, the land and ocean contributions to the water cycle).

13. List of key publications (*not complete*)

Articles in peer-reviewed journals

2015

Manzato, Agostino, Davolio, Silvio, Miglietta, Mario Marcello, Pucillo, Arturo and Setvák, Martin, 2015: 12 September 2012: A supercell outbreak in NE Italy? Atmospheric Research, 153, 98 - 118.

Ehmele, F, Barthlott, C and Corsmeier, U, 2015: The influence of Sardinia on Corsican rainfall in the western Mediterranean Sea: a numerical sensitivity study. Atmospheric Research, 153, 451-464.

Zampieri, Matteo, Scoccimarro, Enrico, Gualdi, Silvio and Navarra, Antonio, 2015: Observed shift towards earlier spring discharge in the main Alpine rivers. Science of The Total Environment, 503–504, 222 - 232

2014

Adamovic, M., Braud, I., Branger, F. and Kirchner, J. W., 2014: Does the simple dynamical systems approach provide useful information about catchment hydrological functioning in a Mediterranean context? Application to the Ardèche catchment (France). Hydrology and Earth System Sciences Discussions, 11, 10725-10786.

Adirosi, E., Gorgucci, E., Baldini, L. and Tokay, A., 2014: Evaluation of Gamma Raindrop Size Distribution assumption through comparison of rain rates of measured and radar-equivalent gamma DSD. Journal of Applied Meteorology and Climatology, 53, 1618-1635.

Alhammoud, B., Claud, C., Funatsu, B., Béranger, K. and Chaboureau, J.-P., 2014: Patterns of Precipitation and Convection Occurrence over the Mediterranean Basin Derived from a Decade of Microwave Satellite Observations. Atmosphere, 5, 370-398.

Adler, B. and Kalthoff, N., 2014: Multi-scale Transport Processes Observed in the Boundary Layer over a Mountainous Island. Boundary-Layer Meteorology, 153, 515-537.

Barthlott, C., Adler, B., Kalthoff, N., Handwerker, J., Kohler, M. and Wieser, A., 2014: The role of Corsica in initiating nocturnal offshore convection. Quarterly Journal of the Royal Meteorological Society.

Beck, J., Bousquet, O. and Nuret, M., 2014: Model Wind Field Forecast Verification Using Multiple-Doppler Syntheses from a National Radar Network. Weather and Forecasting, 29, 331-348.

Berthou S., Mailler S., Drobinski P., Arsouze T., Bastin S., Béranger K., Lebeaupin Brossier C., 2014: Prior History of Mistral and Tramontane Winds Modulates Heavy Precipitation Events in Southern France. Tellus, 66, 24064

Berthou, S., Mailler, S., Drobinski, P., Arsouze, T., Bastin, S., Béranger, K. and Lebeaupin-Brossier, C., 2014: Sensitivity of an intense rain event between an atmosphere-only and an atmosphere-ocean regional coupled model: 19 September 1996. Quarterly Journal of the Royal Meteorological Society, in press.

Bousquet, O., Berne, A., Delanoë, J., Dufournet, Y., Gourley, J. J., Van-Baelen, J., Augros, C., Besson, L., Boudevillain, B., Caumont, O., Defer, E., Grazioli, J., Jorgensen, D. J., Kirstetter, P.-E., Ribaud, J.-F., Beck, J., Delrieu, G., Ducrocq, V., Scipion, D., Schwarzenboeck, A. and Zwiebel, J., 2014: Multiple-frequency radar observations collected in southern france during the field phase of the hydrometeorological cycle in the mediterranean experiment (HyMeX). Bulletin of the American Meteorological Society, in press.

Braud, I., Ayral, P.-A., Bouvier, C., Branger, F., Delrieu, G., Le Coz, J., Nord, G., Vandervaere, J.-P., Anquetin, S., Adamovic, M., Andrieu, J., Batiot, C., Boudevillain, B., Brunet, P., Carreau, J., Confoland, A., Didon-Lescot, J.-F., Domergue, J.-M., Douvinet, J., Dramais, G., Freydier, R., Gérard, S., Huza, J., Leblois, E., Le Bourgeois, O., Le Boursicaud, R., Marchand, P., Martin, P., Nottale, L., Patris, N., Renard, B., Seidel, J.-L., Taupin, J.-D., Vannier, O., Vincendon, B. and Wijbrans, A., 2014: Multi-scale hydrometeorological observation and modelling for flash-flood understanding. Hydrology and Earth System Sciences, 18, 3733–3761.

Buzzi, A., Davolio, S., Malguzzi, P., Drofa, O. and Mastrangelo, D., 2014: Heavy rainfall episodes over Liguria of autumn 2011: numerical forecasting experiments. Natural Hazards and Earth System Sciences, 14, 1325–1340.

Casaioli, M., Catini, F., Inghilesi, R., Lanucara, P., Malguzzi, P., Mariani, S. and Orasi, A., 2014: Towards an operational forecasting system for the meteorological, hydrological and marine conditions in Mediterranean coastal areas. Advances in Science and Research, in review

Chazette, P., Marnas, F. and Totems, J., 2014: The mobile Water vapor Aerosol Raman LIdar and its implication in the frame of the HyMeX and ChArMEx programs: application to a dust transport process. Atmospheric Measurement Techniques, 7, 1629-1647.

Chazette, P., Marnas, F. and Totems, J., 2014: Comparison of IASI water vapor retrieval with H_2O-Raman lidar in the frame of the Mediterranean HyMeX and ChArMEx programs. Atmospheric Chemistry and Physics, 14, 9583–9596.

Chiriaco, M., Bastin, S., Yiou, P., Haeffelin, M., Dupont, J.C. and Stéfanon, M., 2014: European heatwave in July 2006: Observations and modeling showing how local processes amplify conducive large-scale conditions. Geophysical Research Letters, 41, 5644-5652.

Davolio, S., Ferretti, R., Baldini, L., Casaioli, M., Cimini, D., Ferrario, M. E., Gentile, S., Loglisci, N., Maiello, I., Manzato, A., Mariani, S., Marsigli, C., Marzano, F. S., Miglietta, M. M., Montani, A., Panegrossi, G., Pasi, F., Pichelli, E., Pucillo, A. and Zinzi, A., 2014: The role of the Italian scientific community in the first HyMeX SOP: an outstanding multidisciplinary experience. Bull. Am. Meteorol. Soc., in review

Defer, E., Pinty, J.-P., Coquillat, S., Martin, J.-M., Prieur, S., Soula, S., Richard, E., Rison, W., Krehbiel, P., Thomas, R., Rodeheffer, D., Vergeiner, C., Malaterre, F., Pedeboy, S., Schulz, W., Farges, T., Gallin, L.-J., Ortéga, P., Ribaud, J.-F., Anderson, G., Betz, H.-D., Meneux, B., Kotroni, V., Lagouvardos, K., Roos, S., Ducrocq, V., Roussot, O., Labatut, L. and Molinié, G., 2014: An overview of the lightning and atmospheric electricity observations collected in Southern France during the HYdrological cycle in Mediterranean EXperiment (HyMeX), Special Observation Period 1. Atmospheric Measurement Techniques Discussions, 7, 8013-8065.

Defer, E., Pinty, J.-P., Coquillat, S., Martin, J.-M., Prieur, S., Soula, S., Richard, E., Rison, W., Krehbiel, P., Thomas, R., Rodeheffer, D., Vergeiner, C., Malaterre, F., Pedeboy, S., Schulz, W., Farges, T., Gallin, L.-J., Ortéga, P., Ribaud, J.-F., Anderson, G., Betz, H.-D., Meneux, B., Kotroni, V., Lagouvardos, K., Roos, S., Ducrocq, V., Roussot, O., Labatut, L. and Molinié, G., 2014: An overview of the lightning and atmospheric electricity observations collected in Southern France during the HYdrological cycle in Mediterranean EXperiment (HyMeX), Special Observation Period 1. Atmospheric Measurement Techniques Discussions, 7, 8013-8065.
Delrieu, G., Bonnifait, L., Kirstetter, P.-E. and Boudevillain, B., 2014: Dependence of radar quantitative precipitation estimation error on the rain intensity in the Cévennes region, France. Hydrological Sciences Journal, 59, 1-12.
Delrieu, Guy, Wijbrans, Annette, Boudevillain, Brice, Faure, Dominique, Bonnifait, Laurent and Kirstetter, Pierre-Emmanuel, 2014: Geostatistical radar–raingauge merging: A novel method for the quantification of rain estimation accuracy. Advances in Water Resources, 71, 110-124.
Di Luca, A., Flaounas, E., Drobinski, P. and Lebeaupin-Brossier, C., 2014: The atmospheric component of the Mediterranean Sea water budget in a WRF multi-physics ensemble and observations. Climate Dynamics, 43, 2349-2375.
Drobinski, P., Ducrocq, V., Alpert, P., Anagnostou, E., Béranger, K., Borga, M., Braud, I., Chanzy, A., Davolio, S., Delrieu, G., Estournel, C., Filali Boubrahmi, N., Font, J., Grubisic, V., Gualdi, S., Homar, V., Ivančan-Picek, B., Kottmeier, C., Kotroni, V., Lagouvardos, K., Lionello, P., Llasat, M. C., Ludwig, W., Lutoff, C., Mariotti, A., Richard, E., Romero, R., Rotunno, R., Roussot, O., Ruin, I., Somot, S., Taupier-Letage, I., Tintoré, J., Uijlenhoet, R. and Wernli, H., 2014: HyMeX, a 10-year multidisciplinary program on the Mediterranean water cycle. Bulletin of the American Meteorological Society, 95, 1063-1082.
Ducrocq, V., Braud, I., Davolio, S., Ferretti, R., Flamant, C., Jansà, A., Kalthoff, N., Richard, E., Taupier-Letage, I., Ayral, P.-A., Belamari, S., Berne, A., Borga, M., Boudevillain, B., Bock, O., Boichard, J.-L., Bouin, M.-N., Bousquet, O., Bouvier, C., Chiggiato, J., Cimini, D., Corsmeier, U., Coppola, L., Cocquerez, P., Defer, E., Delanoë, J., Di Girolamo, P., Doerenbecher, A., Drobinski, P., Dufournet, Y., Fourrié, N., Gourley, J. J., Labatut, L., Lambert, D., Le Coz, J., Marzano, F. S., Molinié, G., Montani, A., Nord, G., Nuret, M., Ramage, K., Rison, B., Roussot, O., Said, F., Schwarzenboeck, A., Testor, P., Van-Baelen, J., Vincendon, B., Aran, M. and Tamayo, J., 2014: HyMeX-SOP1, the field campaign dedicated to heavy precipitation and flash flooding in the northwestern Mediterranean. Bulletin of the American Meteorological Society, 95, 1083-1100.
Estournel, C., Testor, P., Taupier-Letage, I., Bouin, M.-N., Coppola, L., P., Durand, Conan, P., Beguery, L., Belamari, S., Béranger, K., Beuvier, J., Bourras, D., Canut, G., Doerenbecher, A., Drobinski, P., Ducrocq, V., Giordani, H., Hauser, D., Labatut, L., Lebeaupin Brossier, C., Nuret, M., Prieur, L., Roussot, O. and Somot, S., 2014: HyMeX-SOP2, the field campaign dedicated to dense water formation in the north-western Mediterranean. Oceanography, submitted
Ferretti, R., Pichelli, E., Gentile, S., Maiello, I., Cimini, D., Davolio, S., Miglietta, M. M., Panegrossi, G., Baldini, L., Pasi, F., Marzano, F. S., Zinzi, A., Mariani, S., Casaioli, M., Bartolini, G., Loglisci, N., Montani, A., Marsigli, C., Manzato, A., Pucillo, A., Ferrario, M. E., Colaiuda, V. and Rotunno, R., 2014: Overview of the first HyMeX Special Observation Period over Italy: observations and model results. Hydrology and Earth System Sciences, 18, 1953-1977.
Flaounas, Emmanouil, Raveh-Rubin, Shira, Wernli, Heini, Drobinski, Philippe and Bastin, Sophie, 2014: The dynamical structure of intense Mediterranean cyclones. Climate Dynamics, 1-17.
Gajić-Čapka, Marjana, Cindrić, Ksenija and Pasarić, Zoran, 2014: Trends in precipitation indices in Croatia, 1961–2010. Theoretical and Applied Climatology, 1-11.
Garambois, P. A., Larnier, K., Roux, H., Labat, D. and Dartus, D., 2014: Analysis of flash flood-triggering rainfall for a process-oriented hydrological model. Atmospheric Research, 137, 14-24.
Garambois, P., Roux, H., Larnier, K., Labat, D. and Dartus, D., 2014: Characterisation of catchment behaviour and rainfall selection for flash flood hydrological models calibration: catchments of the eastern Pyrenees. Hydrological Sciences Journal.
Hally, A., Caumont, O., Garrote, L., Richard, E., Weerts, A., Delogu, F., Fiori, E., Rebora, N., Parodi, A., Mihalovic, A., Ivkovic, M., Dekic, L., van Verseveld, W., Nuissier, O., Ducrocq, V., D'Agostino, D., Galizia, A., Danovaro, E. and Clematis, A., 2014: Hydrometeorological multi-model ensemble simulations of the 4 November 2011 flash-flood event in Genoa, Italy, in the framework of the DRIHM project. Natural Hazards and Earth System Sciences Discussions, 2, 6653-6701.
Hally, A., Richard, E. and Ducrocq, V., 2014: An ensemble study of HyMeX IOP6 and IOP7a: sensitivity to physical and initial and boundary condition uncertainties. Natural Hazards and Earth System Sciences, 14, 1071-1084.

Herrmann, Marine, Estournel, Claude, Adloff, Fanny and Diaz, Frédéric, 2014: Impact of climate change on the northwestern Mediterranean Sea pelagic planktonic ecosystem and associated carbon cycle. Journal of Geophysical Research: Oceans, 119, 5815-5836.

Houpert, L., Testor, P., Durrieu de Madron, X., Somot, S., D Ortenzio, F., Estournel, C. and Lavigne, H., 2014: Seasonal cycle of the mixed lauer depth, of the seasonal thermocline and of the upper-ocean heat rate in the Mediterranean Sea: an observational approach, Progress in Oceanography, in review

Huza, J., Teuling, A. J., Braud, I., Grazioli, J., Melsen, L. A., Nord, G., Raupach, T. H. and Uijlenhoet, R., 2014: Precipitation, soil moisture and runoff variability in a small river catchment (Ardèche, France) during HyMeX Special Observation Period 1. Journal of Hydrology, 516, 330-342.

Ivančan-Picek, B., Horvath, K., Strelec Mahović, N. and Gajić-Čapka, M., 2014: Forcing mechanisms of a heavy precipitation event in the southeastern Adriatic area. Natural Hazards, February, Online.

Jansa, A., Alpert, P., Arbogast, P., Buzzi, A., Ivančan-Picek, B., Kotroni, V., Llasat, M. C., Ramis, C, Richard, E., Romero, R. and Speranza, A., 2014: MEDEX: a general overview. Natural Hazards and Earth System Science, 14, 1965-1984.

Jansà, A., Campins, J., Picornell, M.A. and Guijarro, J.A., 2014: Heavy rain and strong wind events over Spain during HyMeX SOP1. Thetys, Revista de meteorologia i climatologia mediterrània, 11, 25-38.

Bech, J., Arus, J., Castan, S., Pineda, N., Rigo, T., Montanya, J. and Van den Velde, O., 2014: A study of the 21 March 2012 tornadic quasi linear convective system in Catalonia. Atmospheric Research, -.

Metzger, Jutta, Barthlott, Christian and Kalthoff, Norbert, 2014: Impact of Upstream Flow Conditions on the Initiation of Moist Convection Over the Island of Corsica. Atmospheric Research

Krichak, Simon O., Barkan, Joseph, Breitgand, Joseph S., Gualdi, Silvio and Feldstein, Steven B., 2014: The role of the export of tropical moisture into midlatitudes for extreme precipitation events in the Mediterranean region. Theoretical and Applied Climatology, 1-17.

Le Coz, J., Renard, B., Bonnifait, L., Branger, F. and Le Boursicaud, R., 2014: Combining hydraulic knowledge and uncertain gaugings in the estimation of hydrometric rating curves: A Bayesian approach. Journal of Hydrology, 509, 573 - 587.

Lebeaupin Brossier, C., Arsouze, T., Béranger, K., Bouin, M.-N., Bresson, E., Ducrocq, V., Giordani, H., Nuret, M., Rainaud, R. and Taupier-Letage, I., 2014: Ocean Mixed Layer responses to intense meteorological events during HyMeX-SOP1 from a high-resolution ocean simulation. Ocean Modelling, 84, 84-103.

Lebeaupin Brossier, C., Bastin, S., Béranger, K. and Drobinski, P., 2014: Regional mesoscale air–sea coupling impacts and extreme meteorological events role on the Mediterranean Sea water budget. Climate Dynamics, 1-23.

Legrand, Raphaël and Michel, Yann, 2014: Modelling background error correlations with spatial deformations: a case study. Tellus A, 66.

Mariani, S., Casaioli, M. and Malguzzi, P., 2014: Towards a new BOLAM-MOLOCH suite for the SIMM forecasting system: implementation of an optimised configuration for the HyMeX Special Observation Periods. Natural Hazards and Earth System Sciences Discussion, 2, 649-680

Marsigli, C., Montani, A. and Paccagnella, T., 2014: Provision of boundary conditions for a convection-permitting ensemble: comparison of two different approaches. Nonlinear Processes in Geophysics, 21, 393-403.

Martinet, P., Lavanant, L., Fourrié, N., Rabier, F. and Gambacorta, A., 2014: Evaluation of a revised IASI channel selection for cloudy retrievals with a focus on the Mediterranean basin. Quarterly Journal of the Royal Meteorological Society.

Miglietta, M. M. and Rotunno, R., 2014: Numerical simulations of sheared conditionally unstable flows over a mountain ridge. Journal of the Atmospheric Sciences, n/a, n/a.

Ménétrier, B., Montmerle, T., Berre, L. and Michel, Y., 2014: Estimation and diagnosis of heterogeneous flow-dependent background-error covariances at the convective scale using either large or small ensembles. Quarterly Journal of the Royal Meteorological Society, n/a, n/a-n/a.

N'Guyen, C. C., Payrastre, O. and Gaume, E., 2014: Regional flood frequency analyses involving extraordinary flood events at ungauged sites: further developments and validations. Journal of Hydrology, 508, 385-396.

Nabat, P., Somot, S., Mallet, M., Michou, M., Sevault, F., Driouech, F., Meloni, D., Di Sarra, A., Di Biagio, C., Formenti, P., Sicard, M., Léon, J.-F. and Bouin, M.-N., 2014: Dust aerosol radiative effects during summer 2012 simulated with a coupled regional aerosol–atmosphere–ocean model over the Mediterranean. Atmospheric Chemistry and Physics Discussions, 14, 25351-25410.

Nabat, P., Somot, S., Mallet, M., Sevault, F., Chiacchio, M. and Wild, M., 2014: Direct and semi-direct aerosol radiative effect on the Mediterranean climate variability using a coupled Regional Climate System Model. Climate Dynamics.

Pantillon, Florian, Chaboureau, Jean-Pierre and Richard, Evelyne, 2014: Remote impact of North Atlantic hurricanes on the Mediterranean during episodes of intense rainfall in autumn 2012. Quarterly Journal of the Royal Meteorological Society, n/a-n/a.

Poljak, G., Prtenjak, M. T., Kvakic, M., Strelec Mahovic, N. and Babic, K., 2014: Wind patterns associated with the development of daytime thunderstorms over Istria. Annales geophysicae, 32, 401-420.

Rainaud, R., Lebeaupin Brossier, C., Ducrocq, V., Giordani, H., Nuret, M., Fourrié, N., Bouin, M.-N., Taupier-Letage, I. and Legain, D., 2014: Characterization of air-sea exchanges over the Western Mediterranean Sea during the HyMeX SOP1 using the AROME-WMED model. Quaterly Journal of the Royal Meteorological Society.

Romero, R., Ramis, C. and Homar, V., 2014: On the severe convective storm of 29 October 2013 in the Balearic Islands: observational and numerical study. Quarterly Journal of the Royal Meteorological Society, n/a-n/a.

Ruin, I., Lutoff, C., Boudevillain, B., Creutin, J.-D., Anquetin, S., Bertran Rojo, M., Boissier, L., Bonnifait, L., Borga, M., Colbeau-Justin, L., Créton-Cazanave, L., Delrieu, G., Douvinet, J., Gaume, E., Gruntfest, E., Naulin, J.-P., Payrastre, O. and Vannier, O., 2014: Social and Hydrological Responses to Extreme Precipitations: An Interdisciplinary Strategy for Postflood Investigation. Weather, Climate, and Society, 6, 135–153.

Schleiss, M., Chamoun, S. and Berne, A., 2014: Non-stationarity in intermittent rainfall: the “dry drift”. Journal of Hydrometeorology, n/a, n/a.

Soto-Navarro, J., Somot, S., Sevault, F., Beuvier, J., Criado-Aldeanueva, F., García-Lafuente, J. and Béranger, K., 2014: Evaluation of regional ocean circulation models for the Mediterranean Sea at the Strait of Gibraltar: volume transport and thermohaline properties of the outflow. Climate Dynamics, 1-16.

Stéfanon, M., Drobinski, P., D’Andrea, F., Lebeaupin-Brossier, C. and Bastin, S., 2014: Soil moisture-temperature feedbacks at meso-scale during summer heat waves over Western Europe. Climate Dynamics, 42, 1309-1324.

Szczypta, C., Calvet, J.-C., Maignan, F., Dorigo, W., Baret, F. and Ciais, P., 2014: Suitability of modelled and remotely sensed essential climate variables for monitoring Euro-Mediterranean droughts. Geoscientific Model Development, 7, 931-946.

Caloiero, Tommaso, Pasqua, Angela Aurora and Petrucci, Olga, 2014: Damaging Hydrogeological Events: A Procedure for the Assessment of Severity Levels and an Application to Calabria (Southern Italy). Water, 6, 3652-3670.

Ullmann, A., Fontaine, B. and Roucou, P., 2014: Euro-Atlantic weather regimes and Mediterranean rainfall patterns: present-day variability and expected changes under CMIP5 projections. International Journal of Climatology, 34, 2634-2650.

Winschall, A., Sodemann, H., Pfahl, S. and Wernli, H., 2014: How important is intensified evaporation for Mediterranean precipitation extremes? Journal of Geophysical Research: Atmospheres, n/a-n/a.

2013

Barthlott, C. and Kirshbaum, D. J., 2013: Sensitivity of deep convection to terrain forcing over Mediterranean islands. Quarterly Journal of the Royal Meteorological Society, 139, 1762-1779.

Beck, J. and Bousquet, O., 2013: Using Gap-Filling Radars in Mountainous Regions to Complement a National Radar Network: Improvements in Multiple-Doppler Wind Syntheses. Journal of Applied Meteorology and Climatology, 52, 1836-1850.

Bousquet, O. and Tabary, P., 2013: Development of a nationwide real-time 3-D wind and reflectivity radar composite in France. Quarterly Journal of the Royal Meteorological Society, n/a, n/a-n/a.

Casaioli, M., Mariani, S., Malguzzi, P. and Speranza, A., 2013: Factors affecting the quality of QPF: a multi-method verification of multi-configuration BOLAM reforecasts against MAP D-PHASE observations. Meteorological Applications, 20, 150-163.

Caumont, O., Foray, A., Besson, L. and Parent du Châtelet, J., 2013: An Observation Operator for Radar Refractivity Change: Comparison of Observations and Convective-Scale Simulations. Boundary-Layer Meteorology, 148, 379-397.

Créton-Cazanave, L. and Lutoff, C., 2013: Stakeholders' issues for action during the warning process and the interpretation of forecasts' uncertainties. Natural Hazards and Earth System Science, 13, 1469-1479.

Delrieu, G., Boudevillain, B., Wijbrans, A., Faure, D., Bonnifait, L., Kirstetter, P.-E. and Confoland, A., 2013: Prototype de ré-analyses pluviométriques pour la région Cévennes-Vivarais. La Météorologie, 83, 35-41.

Diodato, N. and Fiorillo, F., 2013: Complexity-reduced in the hydroclimatological modelling of aquifer's discharge. Water and Environment Journal, 27, 170-176.
Drobinski, P., Ducrocq, V., Arbogast, P., Basdevant, C., Bastin, S., Beguery, L., Belamari, S., Béranger, K., Bock, O., Bouin, M.-N., Boudevillain, B., Bousquet, O., Bouvier, C., Braud, I., Calvet, J.-C., Champollion, C., Chanzy, A., Claude, M., Cocquerez, P., Coppola, L., Coquillat, S., Courault, D., Defer, E., Delanoë, J., Delrieu, G., Doerenbecher, A., Dorfliger, A., Estèves, M., Estournel, C., Flamant, C., Fourrié, N., Garrouste, O., Gaume, E., Giordani, H., Gomes, L., Roberts, G., Jourde, H., Labatut, L., Lambert, D., Coz, J. Le, Ludwig, W., Lutoff, C., Mahfouf, J.-F., Martin, E., Mastrorillo, L., Mathys, N., Michel, Y., Nuret, M., Orain, F., Perez, S., Prigent, C., Radakovitch, O., Ramage, K., Richard, E., Roujeau, J.-L., Roussot, O., Ruin, I., Saïd, F., Schwarzenboeck, A., Sellegri, K., Somot, S., Taupier-Letage, I., Testor, P., Van-Baelen, J. and Vandervaere, J.-P., 2013: HyMeX, le cycle de l'eau méditerranéen à la loupe. La Météorologie, 80, 23-36
Ducrocq, V., Belamari, S., Boudevillain, B., Bousquet, O., Cocquerez, P., Doerenbecher, A., Drobinski, P., Flamant, C., Labatut, L., Lambert, D., Nuret, M., Richard, E., Roussot, O., Testor, P., Arbogast, P., Ayral, P.-A., Van-Baelen, J., Basdevant, C., Boichard, J.-L., Bourras, D., Bouvier, C., Bouin, M.-N., Bock, O., Braud, I., Champollion, C., Coppola, L., Coquillat, S., Defer, E., Delanoë, J., Delrieu, G., Didon-Lescot, J.-F., Durand, P., Estournel, C., Fourrié, N., Garrouste, O., Giordani, H., Le Coz, J., Michel, Y., Nuissier, O., Roberts, G., Said, F., Schwarzenboeck, A., Sellegri, K., Taupier-Letage, I. and Vandervaere, J.-P., 2013: HyMeX, les campagnes de mesures : focus sur les événements extrêmes en Méditerranée. La Météorologie, 80, 37-47.
Ducrocq, V., Drobinski, P., Lambert, D., Molinié, G. and Llasat, M. C., 2013: Preface: Forecast and projection in climate scenario of Mediterranean intense events: uncertainties and propagation on environment (the MEDUP project). Natural Hazards and Earth System Sciences, 13, 3043-3047.
Duffourg, F. and Ducrocq, V., 2013: Assessment of the water supply to Mediterranean heavy precipitation: a method based on finely designed water budgets. Atmospheric Science Letters, 14, 133-138.
Dumas, P., Hallegatte, S., Quintana-Seguí, P. and Martin, E., 2013: The influence of climate change on flood risks in France – first estimates and uncertainty analysis. Natural Hazards and Earth System Science, 13, 809-821.
Durrieu de Madron, X., Houpert, L., Puig, P., Sanchez-Vidal, A., Testor, P., Bosse, A., Estournel, C., Somot, S., Bourrin, F., Bouin, M.-N., Beauverger, M., Beguery, L., Calafat, A., Canals, M., Cassou, C., Coppola, L., Dausse, D., D'Ortenzio, F., Font, J., Heussner, S., Kunesch, S., Lefevre, D., Le Goff, H., Martín, J., Mortier, L., Palanques, A. and Raimbault, P., 2013: Interaction of dense shelf water cascading and open-sea convection in the northwestern Mediterranean during winter 2012. Geophysical Research Letters, 40, 1379-1385.
Flaounas, E., Drobinski, P. and Bastin, S., 2013: Dynamical downscaling of IPSL-CM5 CMIP5 historical simulations over the Mediterranean: benefits on the representation of regional surface winds and cyclogenesis. Climate Dynamics, 40, 2497-2513.
Flaounas, E., Drobinski, P., Vrac, M., Bastin, S., Lebeaupin-Brossier, C., Stéfanon, M., Borga, M. and Calvet, J.-C., 2013: Precipitation and temperature space–time variability and extremes in the Mediterranean region: evaluation of dynamical and statistical downscaling methods. Climate Dynamics, 40, 2687-2705.
Frasier, S., Kabeche, F., Figueras, J., Ventura, I., Al-Sakka, H., Tabary, P., Beck, J. and Bousquet, O., 2013: In-situ Estimation of Wet-Radome Attenuation at X-band. Journal of Atmospheric and Oceanic Technology, 30, 917-928.
Garambois, P.-A., Roux, H., Larnier, K., Castaings, W. and Dartus, D., 2013: Characterization of process-oriented hydrologic model behavior with temporal sensitivity analysis for flash floods in Mediterranean catchments. Hydrol. Earth Syst. Sci., 17, 2305-2322.
Garcies, L. and Homar, V., 2013: Are current sensitivity products sufficiently informative in targeting campaigns? A DTS-MEDEX-2009 case study. Quarterly Journal of the Royal Meteorological Society, n/a, n/a-n/a.
Gaume, E. and Borga, M., 2013: State of the art on the knowledge recently acquired on flash floods in Europe: results of the European research project HYDRATE (2006-2010). La Houille Blanche - Revue internationale de l'eau, n/a, 24-30.
Gualdi, S., Somot, S., Li, L., Artale, V., Adani, M., Bellucci, A., Braun, A., Calmanti, S., Carillo, A., Dell'Aquilla, A., Déqué, M., Dubois, C., Elizalde, A., Harzallah, A., Jacob, D., L'Heveder, B., May, W., Oddo, P., Ruti, P., Sanna, A., Sannino, G., Scoccimarro, E., Sevault, F. and Navarra, A., 2013: The CIRCE Simulations: Regional Climate Change Projections with Realistic Representation of the Mediterranean Sea. Bulletin of the American Meteorological Society, 94, 65-81.

Hally, A., Richard, E., Fresnay, S. and Lambert, D., 2013: Ensemble simulations with perturbed physical parametrizations: Pre-HyMeX case studies. Quarterly Journal of the Royal Meteorological Society, n/a, n/a-n/a.

Herrmann, M., Diaz, F., Estournel, C., Marsaleix, P. and Ulses, C., 2013: Impact of atmospheric and oceanic interannual variability on the Northwestern Mediterranean Sea pelagic planktonic ecosystem and associated carbon cycle. Journal of Geophysical Research: Oceans, 118, 5792–5813.

Jordà, G. and Gomis, D., 2013: Reliability of the steric and mass components of Mediterranean sea level as estimated from hydrographic gridded products. Geophysical Research Letters, 40, 3655-3660.

Kalthoff, N., Adler, B., Wieser, A., Kohler, M, Träumner, K., Handwerker, J., Corsmeier, U., Khodayar, S., Lambert, D., Kopmann, A., Kunka, N., Dick, G., Ramatschi, M., Wickert, J. and Kottmeier, C., 2013: KITcube - a mobile observation platform for convection studies deployed during HyMeX. Meteorologische Zeitschrift, 22, 633-647.

Lagouvardos, K., Kotroni, V., Defer, E. and Bousquet, O., 2013: Study of a heavy precipitation event over southern France, in the frame of HYMEX project: Observational analysis and model results using assimilation of lightning. Atmospheric Research, 134, 45-55.

Lebeaupin-Brossier, C., Drobinski, P., Béranger, K., Bastin, S. and Orain, F., 2013: Ocean memory effect on the dynamics of coastal heavy precipitation preceded by a mistral event in the northwestern Mediterranean. Quarterly Journal of the Royal Meteorological Society, 139, 1583-1597.

Legain, D., Bousquet, O., Douffet, T., Tzanos, D., Moulin, E., Barrie, J. and Renard, J.-B., 2013: High Frequency Boundary Layer Profiling with Reusable Radiosondes. Atmospheric Measurement Techniques, 6, 2195-2205.

Llasat, M. C., Boni, G., Deidda, R., Mugnai, A. and J. Salat, 2013: Preface: 11th Plinius Conference on Mediterranean Storms. Nat. Hazards Earth Syst. Sci., 13, 2871–2882.

Llasat, M. C., Llasat-Botija, M., Petrucci, O., Aurora Pasqua, A., Rosselló, J., Vinet, F. and Boissier, L., 2013: Floods in the north-western Mediterranean region: presentation of the HYMEX database and comparison with pre-existing global databases. La Houille Blanche - Revue internationale de l'eau, n/a, 5-9.

Llasat, M. C., Llasat-Botija, M., Petrucci, O., Pasqua, A. A., Rosselló, J., Vinet, F. and Boissier, L., 2013: Towards a database on societal impact of Mediterranean floods within the framework of the HYMEX project. Natural Hazards and Earth System Science, 13, 1337-1350.

L'Hévéder, Blandine, Li, Laurent, Sevault, Florence and Somot, Samuel, 2013: Interannual variability of deep convection in the Northwestern Mediterranean simulated with a coupled AORCM. Climate Dynamics, 41, 937-960.

Marsigli, C., Montani, A. and Paccagnella, T., 2013: Test of a COSMO-based convection-permitting ensemble in the Hymex framework. COSMO Newsletter, 13.

Martano, P., Elefante, C. and Grasso, F., 2013: A Database for Long-Term Atmosphere-Surface Transfer Monitoring in Salento Peninsula (Southern Italy). Dataset Papers in Geosciences, 2013, 4.

Martinet, P., Fourrié, N., Guidard, V., Rabier, F., Montmerle, T. and Brunel, P., 2013: Towards the use of microphysical variables for the assimilation of cloud-affected infrared radiances. Quarterly Journal of the Royal Meteorological Society, 139, 1402-1416.

Michel, Y., 2013: Estimating deformations of random processes for correlation modelling: methodology and the one-dimensional case. Quarterly Journal of the Royal Meteorological Society, 139, 771-783.

N'Guyen, C. C., Payrastre, O. and Gaume, E., 2013: Inventories of extreme floods at ungauged sites and regional flood frequency analyses: methodological reflections and evaluation of performances. La Houille Blanche - Revue internationale de l'eau, n/a, 16-23.

Naulin, J.-P., Payrastre, O. and Gaume, E., 2013: Spatially distributed flood forecasting in flash flood prone areas: Application to road network supervision in Southern France. Journal of Hydrology, 486, 88-99.

Omrani, H., Drobinski, P. and Dubos, T., 2013: Optimal nudging strategies in regional climate modelling: investigation in a Big-Brother experiment over the European and Mediterranean regions. Climate Dynamics, 41, 2451-2470

Osca, J., Romero, R. and Alonso, S., 2013: Precipitation projections for Spain by means of a weather typing statistical method. Global and Planetary Change, 109, 46-63.

Pantillon, F., Chaboureau, J.-P., Mascart, P. J. and Lac, C., 2013: Predictability of a Mediterranean tropical-like storm downstream of the extratropical transition of hurricane Helene (2006). Monthly Weather Review, 141, 1943-1962.

Payrastre, O., Gaume, E. and Andrieu, H., 2013: Historical information and flood frequency analyses: which optimal features for historical floods inventories? Houille Blanche-revue Internationale De L Eau, 3, 5-11.

Pinty, J.-P., Barthe, C., Defer, E., Richard, E. and Chong, M., 2013: Explicit simulation of electrified clouds: From idealized to real case studies. Atmospheric Research, 123, 82 - 92
Ramis, C., Homar, V., Amengual, A., Romero, R. and Alonso, S., 2013: Daily precipitation records over mainland Spain and the Balearic Islands. Natural Hazards and Earth System Sciences, 13, 2483-2491.
Romero, R. and Emanuel, K., 2013: Medicane risk in a changing climate. Journal of Geophysical Research: Atmospheres, 118, 5992-6001.
Rysman, J.-F., Verrier, S., Lemaître, Y. and Moreau, E., 2013: Space-time variability of the rainfall over the western Mediterranean region: A statistical analysis. Journal of Geophysical Research: Atmospheres, 115, 8448-8459.
Schroeder, K., Millot, C., Bengara, L., Ben Ismail, S., Bensi, M., Borghini, M., Budillon, G., Cardin, V., Coppola, L., Curtil, C., Drago, A., El Moumni, B., Font, J., Fuda, J.-L., Garcia-Lafuente, J., P., Gasparini G., Kontoyiannis, H., Lefèvre, D., Puig, P., Raimbault, P., Rougier, G., Salat, J., Sammari, C., Sanchez Garrido, J. C., Sanchez-Roman, A., Sparnocchia, S., Tamburini, C., Taupier-Letage, I., Theocharis, A., Vargas-Yáñez, M. and Vetrano, A., 2013: Long-term monitoring programme of the hydrological variability in the Mediterranean Sea: a first overview of the HYDROCHANGES network. Ocean Science, 9, 301-324.
Tous, M. and Romero, R., 2013: Meteorological environments associated with medicane development. International Journal of Climatology, 33, 1-14.
Tous, M., Romero, R. and Ramis, C., 2013: Surface heat fluxes influence on medicane trajectories and intensification. Atmospheric Research, 123, 400-411.
Tramblay, Y., Ruelland, D., Somot, S., Bouaicha, R. and Servat, E., 2013: High-resolution Med-CORDEX regional climate model simulations for hydrological impact studies: a first evaluation of the ALADIN-Climate model in Morocco. Hydrology and Earth System Sciences, 17, 3721-3739.
Trapero, L., Bech, J., Duffourg, F., Esteban, P. and Lorente, J., 2013: Mesoscale numerical analysis of the historical November 1982 heavy precipitation event over Andorra (Eastern Pyrenees). Natural Hazards and Earth System Science, 13, 2969-2990.
Trapero, L., Bech, J. and Lorente, J., 2013: Numerical modelling of heavy precipitation events over Eastern Pyrenees: Analysis of orographic effects. Atmospheric Research, 123, 368 - 383.
Vannier, O., Braud, I. and Anquetin, S., 2013: Regional estimation of catchment-scale soil properties by means ofstreamflow recession analysis for use in distributed hydrological models. Hydrol Process, n/a, n/a-n/a.
Vervatis, V., Sofianos, S., Skliris, N., Somot, S., Lascaratos, A. and Rixen, M., 2013: Mechanisms controlling the thermohaline circulation pattern variability in the Aegean–Levantine region. A hindcast simulation (1960–2000) with an eddy resolving model. Deep-Sea Research Part I: Oceanographic Research Papers, 74, 82-97.
Willis, P., Mertikas, S., Argus, D. F. and Bock, O., 2013: DORIS and GPS monitoring of the Gavdos calibration site in Crete. Advances in Space Research, 51, 1438-1447.
Zampieri, Matteo, Scoccimarro, Enrico and Gualdi, Silvio, 2013: Atlantic influence on spring snowfall over the Alps in the past 150 years. Environmental Research Letters, 8.

2012

Amengual, A., Homar, V., Romero, R., Alonso, S. and Ramis, C., 2012: statistical adjustment of regional climate model outputs to local scales: Application to Platja de Palma, Spain. Journal of Climate, 25, 939-957.
Ben Ismail S, Sammari C, Gasparini G-P, Béranger K, Brahim M, Aleya L (2012) Water masses exchanged through the Sicily Channel: evidence for the presence of new water masses on the Tunisian side of the Channel, Deep-Sea Research I (63), 65–81, doi:10.1016/j.dsr.2011.12.009.
Besson, L., C. Boudjabi, O. Caumont and Jacques Parent du Chatelet, 2012: Links Between Weather Phenomena and Characteristics of Refractivity Measured by Precipitation Radar, Boundary Layer Meteorology, 143, 77-95.
Beuvier, J., Béranger, K., Lebeaupin-Brossier, C., Somot, S., Sevault, F., Drillet, Y., Bourdallé-Badie, R., Ferry, N. and Lyard, F., 2012: Spreading of the Western Mediterranean Deep Water after winter 2005: Time scales and deep cyclone transport. Journal of Geophysical Research: Oceans, 117, n/a-n/a.
Boniface, K., Champollion, C., Chery, J., Ducrocq, V., Rocken, C., Doerflinger, E. and Collard, P., 2012: Potential of shipborne GPS atmospheric delay data for prediction of Mediterranean intense weather events. Atmospheric Science Letters, 13, 250-256.
Bouin, M.-N., Caniaux, G., Traullé, O., Legain, D. and Le Moigne, P., 2012: Long-term heat exchanges over a Mediterranean lagoon. Journal of Geophysical Research: Atmospheres, 117, D23104.

Bresson, E., Ducrocq, V., Nuissier, O., Ricard, D. and de Saint-Aubin, C., 2012: Idealized numerical simulations of quasi-stationary convective systems over the Northwestern Mediterranean complex terrain. Quarterly Journal of the Royal Meteorological Society, 138, 1751-1763.
Ceresetti, D., Ursu, E., Carreau, J., Anquetin, S., Creutin, J.-D., Gardes, L., Girard, S. and Molinié, G., 2012: Evaluation of classical spatial-analysis schemes of extreme rainfall. Natural Hazards and Earth System Science, 12, 3229-3240.
Chaboureau, J.-P., Nuissier, O. and Claud, C., 2012: Verification of ensemble forecasts of Mediterranean high-impact weather events against satellite observations. Natural Hazards and Earth System Science, 12, 2449-2462.
Chaboureau, J.-P., Pantillon, F., Lambert, D., Richard, E. and Claud, C., 2012: Tropical transition of a Mediterranean storm by jet crossing. Quarterly Journal of the Royal Meteorological Society, 138, 596-611.
Claud, C., Alhammoud, B., Funatsu, B. M., Lebeaupin-Brossier, C., Chaboureau, J.-P., Béranger, K. and Drobinski, P., 2012: A high resolution climatology of precipitation and deep convection over the Mediterranean region from operational satellite microwave data: development and application to the evaluation of model uncertainties. Natural Hazards and Earth System Science, 12, 785-798.
Drobinski, P., Anav, A., Lebeaupin-Brossier, C., Samson, G., Stéfanon, M., Bastin, S., Baklouti, M., Béranger, K., Beuvier, J., Bourdallé-Badie, R., Coquart, L., D'Andrea, F., de Noblet-Ducoudré, N., Diaz, F., Dutay, J.-C., Ethe, C., Foujols, M.-A., Khvorostyanov, D., Madec, G., Mancip, M., Masson, S., Menut, L., Palmieri, J., Polcher, J., Turquety, S., Valcke, S. and Viovy, N., 2012: Model of the Regional Coupled Earth system (MORCE): Application to process and climate studies in vulnerable regions. Environmental Modelling & Software, 35, 1-18.
Dubois, C., Somot, S., Calmanti, S., Carillo, A., Déqué, M., Dell'Aquilla, A., Elizalde, A., Gualdi, S., Jacob, D., L'Hévéder, B., Li, L., Oddo, P., Sannino, G., Scoccimarro, E. and Sevault, F., 2012: Future projections of the surface heat and water budgets of the Mediterranean Sea in an ensemble of coupled atmosphere–ocean regional climate models. Climate Dynamics, 39, 1859-1884.
Flaounas E., Drobinski P., Borga M., Calvet J.C., Delrieu G., Morin E., Tartari G., Toffolon R., 2012: Assessment of Gridded Observations Used for Climate Model Validation in the Mediterranean Region: the HyMeX and MED-CORDEX Framework. Env. Res. Lett., 7, doi:10.1088/1748-9326/7/2/024017
Fresnay, S., Hally, A., Garnaud, C., Richard, E. and Lambert, D., 2012: Heavy precipitation events in the Mediterranean: sensitivity to cloud physics parameterisation uncertainties. Natural Hazards and Earth System Science, 12, 2671-2688.
Guérémy, J.-F., Laanaia, N. and Céron, J.-P., 2012: Seasonal forecast of French Mediterranean heavy precipitating events linked to weather regimes. Natural Hazards and Earth System Science, 12, 2389-2398.
Heslop, E.E., Ruiz, S., Allen, J., López-Jurado, J.L., Renault, L. and Tintoré, J., 2012: Autonomous underwater gliders monitoring variability at "choke points" in our ocean system: A case study in the Western Mediterranean Sea. Geophysical Research Letters, 39, n/a-n/a.
Koulali, A., Ouazar, D., Bock, O. and Fadil, A., 2012: Study of seasonal-scale atmospheric water cycle with ground-based GPS receivers, radiosondes and NWP models over Morocco. Atmospheric Research, 104, 273-291.
Lavaysse, C., Vrac, M., Drobinski, P., Lengaigne, M. and Vischel, T., 2012: Statistical downscaling of the French Mediterranean climate: assessment for present and projection in an anthropogenic scenario. Natural Hazards and Earth System Science, 12, 651-670.
Le Coz, J., Camenen, B., Peyrard, X. and Dramais, G., 2012: Uncertainty in open-channel discharges measured with the velocity-area method. Flow measurement and instrumentation, 26, 18-29.
Lebeaupin-Brossier, C., Béranger, K. and Drobinski, P., 2012: Sensitivity of the northwestern Mediterranean Sea coastal and thermohaline circulations simulated by the 1/12°-resolution ocean model NEMO-MED12 to the spatial and temporal resolution of atmospheric forcing. Ocean Modelling, 43-44, 94-107.
Lumbroso, D. and Gaume, E., 2012: Reducing the uncertainty in indirect estimates of extreme flash flood discharges. Journal of Hydrology, 414, 16-30.
Molinié, G., Ceresetti, D., Anquetin, S., Creutin, J.-D. and Boudevillain, B., 2012: Rainfall Regime of a Mountainous Mediterranean Region: Statistical Analysis at Short Time Steps. Journal of Applied Meteorology and Climatology, 51, 429-448.
Montmerle, T., 2012: Optimization of the Assimilation of Radar Data at the Convective Scale Using Specific Background Error Covariances in Precipitation. Monthly Weather Review, 140, 3495-3506.

Nuissier, O., Joly, B., Vié, B. and Ducrocq, V., 2012: Uncertainty of lateral boundary conditions in a convection-permitting ensemble: a strategy of selection for Mediterranean heavy precipitation events. Natural Hazards and Earth System Science, 12, 2993-3011.

Parent du Châtelet, J., Boudjabi, C., Besson, L. and Caumont, O., 2012: Errors Caused by Long-Term Drifts of Magnetron Frequencies for Refractivity Measurement with a Radar: Theoretical Formulation and Initial Validation. Journal of Atmospheric and Oceanic Technology, 29, 1428-1434.

Parodi, A., Boni, G., Ferraris, L., Siccardi, F., Pagliara, P., Trovatore, E., Foufoula-Georgiou, E. and Kranzlmueller, D., 2012: The “perfect storm”: From across the Atlantic to the hills of Genoa. EOS, Transactions American Geophysical Union, 93, 225-226.

Petrucci, O. and Pasqua, A. A., 2012: Damaging events along roads during bad weather periods: a case study in Calabria (Italy). Natural Hazards and Earth System Science, 12, 365-378.

Quintana-Seguí, P., Homar, V., Llasat, M. C., Jansà, A., Font, J. and Aran, M., 2012: Research perspectives: a look to the Hperspectives. Tethys, 9, 53-63.

Ramis, C., Homar, V. and Romero, R., 2012: Sobre las anomalías de precipitaciones en las Islas Baleares durante 2008. Territoris, 8, 213-226.

Ricard, D., Ducrocq, V. and Auger, L., 2012: A Climatology of the Mesoscale Environment Associated with Heavily Precipitating Events over a Northwestern Mediterranean Area. J. Appl. Meteor. Climatol., 51, 468-488.

Rogge, D., Rivard, B., Deyholos, M. K., Levesque, J., Ardouin, J.-P. and Faust, A. A., 2012: Potential Discrimination of Toxic Industrial Chemical Effects on Poplar, Canola and Wheat, Detectable in Optical Wavelengths 400-2450 nm. IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing, 5, 563-573.

Ruiz-Villanueva, V., Borga, M., Zoccatelli, D., Marchi, L., Gaume, E. and Ehret, U., 2012: Extreme flood response to short-duration convective rainfall in South-West Germany. Hydrology and Earth System Sciences, 16, 1543-1559.

Stéfanon, M., Drobinski, P., D'Andrea, F. and de Noblet-Ducoudré, N., 2012: Effects of interactive vegetation phenology on the 2003 summer heat waves. Journal of Geophysical Research: Atmospheres, 117, D24103, doi:10.1029/2012JD018187.

Szczypta, C., Decharme, B., Carrer, D., Calvet, J.-C., Lafont, S., Somot, S., Faroux, S. and Martin, E., 2012: Impact of precipitation and land biophysical variables on the simulated discharge of European and Mediterranean rivers. Hydrology and Earth System Sciences, 16, 3351–3370.

Vich, M.-D.-M., Romero, R., Richard, E., Arbogast, P. and Maynard, K., 2012: Perturbing the potential vorticity field in mesoscale forecasts of two Mediterranean heavy precipitation events. Tellus Series A - Dynamic Meteorology and Oceanography, 64, 17224.

Vié, B., Molinié, G., Nuissier, O., Vincendon, B., Ducrocq, V., Bouttier, F. and Richard, E., 2012: Hydro-meteorological evaluation of a convection-permitting ensemble prediction system for Mediterranean heavy precipitating events. Natural Hazards and Earth System Science, 12, 2631-2645.

Vrac, M., Drobinski, P., Merlo, A., Herrmann, M., Lavaysse, C., Li, L. and Somot, S., 2012: Dynamical and statistical downscaling of the French Mediterranean climate: uncertainty assessment. Natural Hazards and Earth System Science, 12, 2769-2784.

Zunino, P., Schroeder, K., Vargas-Yáñez, M., Gasparini, G. P., Coppola, L., García-Martínez, M. C. and Moya-Ruiz, F., 2012: Effects of the Western Mediterranean Transition on the resident water masses: pure warming, pure freshening and pure heaving. Journal of Marine Systems, 96, 15-23.

2011

Beaulant A.-L., Joly B., Nuissier O., Somot S., Ducrocq V., Joly A., Sevault F., Déqué M., Ricard D., 2011: Statistico-dynamical downscaling for Mediterranean heavy precipitation, QJRMS, doi: 10.1002/qj.796, available online.

Dramais, G., J. Le Coz, B. Camenen, A. Hauet, 2011: Advantages of a mobile LSPIV method for measuring flood discharges and improving stage-discharge curves, Journal of Hydro-Environmental Research, 5(4), 301-312.

Duffourg, F., V. Ducrocq, 2011 : Origin of the moisture feeding the Heavy Precipitating Systems over Southeastern France. Nat. Hazards Earth Syst. Sci., 11, 1163-1178

Elguindi N., Somot S., Déqué M., Ludwig W., 2011: Climate change evolution of the hydrological balance of the Mediterranean, Black and Caspian Seas: impact of climate model resolution. Clim. Dyn., 36, 205-228

Godart, A., Anquetin, S., Leblois, E., Creutin, J.D., 2011. The contribution of orographically driven banded precipitation to the rainfall climatology of a mediterranean region, Journal of Applied Meteorology and Climatology, 50, 2235-2246.

Herrmann M., Somot S., Calmanti S., Dubois C., Sevault F., 2011: Representation of daily wind speed spatial and temporal variability and intense wind events over the Mediterranean Sea using dynamical downscaling : impact of the regional climate model configuration, Nat. Hazards Earth Syst. Sci., 11, 1983-2001

Josey, S. A., S. Somot, and M. Tsimplis, 2011: Impacts of atmospheric modes of variability on Mediterranean Sea surface heat exchange, J. Geophys. Res., 116, C02032, doi:10.1029/2010JC006685.

Meyssignac B., Calafat F., Somot S., Rupolo V., Stocchi P., Llovel W., Cazenave A., 2011: Two-dimensional reconstruction of the Mediterranean sea level over 1970-2006 from tide gauge data and regional ocean circulation model outputs. Global and Planetary Change, doi:10.1016/j.gloplacha.2011.03.002

Nuissier, O., B. Joly, A. Joly, V. Ducrocq, P. Arbogast, 2011 : A statistical downscaling to identify the large-scale circulation patterns associated with heavy precipitation events over southern France. Q. J. R. Meteorol. Soc., 137, 1812–1827

Ourmières Y, Zakardjian B, Béranger K, Langlais C, 2011: Assessment of a NEMO-based downscaling experiment for the North-Western Mediterranean region: impacts on the Northern Current and comparison with ADCP data and altimetry products. Ocean Modelling 39, 386-404.

Szczypta, C., J.-C. Calvet, C. Albergel, G. Balsamo, S. Boussetta, D. Carrer, S. Lafont, and C. Meurey, 2011: Verification of the new ECMWF ERA-Interim reanalysis over France, HESS, 15, 647-666.

Roux, H., Labat, D., Garambois, P.-A., Maubourguet, M.-M., Chorda, J. and Dartus, D., 2011. A physically-based parsimonious hydrological model for flash floods in Mediterranean catchments. Nat. Hazards Earth Syst. Sci. NHESS, 11, 2567-2582.

Sanchez-Gomez E., Somot S., Josey S.A., Dubois C., Elguindi N., Déqué M., 2011: Evaluation of the Mediterranean Sea Water and Heat budgets as simulated by an ensemble of high resolution Regional Climate Models. Clim. Dyn., 37:2067-2086

Vincendon, B., V. Ducrocq, O. Nuissier, B. Vié, 2011 : Perturbation of convection-permitting NWP forecasts for flash-flood ensemble forecasting. Nat. Hazards Earth Syst. Sci., 11, 1529-1544

2010

Aznar R., M.G. Sotillo, M.L. Martín, S. Somot, F. Valero, 2010: Comparison of model and satellite derived long-term precipitation databases over the Mediterranean basin: a general overview. Atmospheric Research, doi:10.1016/j.atmosres.2010.03.026

Béranger, K., Y. Drillet, M-N. Houssais, P. Testor, R. Bourdallé-Badie, B. Alhammoud, A. Bozec, L. Mortier, P. Bouruet-Aubertot, and M. Crépon, 2010: Impact of the spatial distribution of the atmospheric forcing on water mass formation in the Mediterranean Sea, J. Geophys. Res., 115, C12041, doi:10.1029/2009JC005648.

Beuvier, J., Sevault F., Herrmann M., Kontoyiannis H., Ludwig W., Rixen M., Stanev E., Béranger K., Somot S., 2010: Modelling the Mediterranean Sea interannual variability over the last 40 years: focus on the EMT, J. Geophys. Res., 115, C08017, doi:10.1029/2009JC005950.

Colin J., Déqué M., Radu R., Somot S., 2010: Sensitivity study of heavy precipitations in Limited Area Model climate simulation: influence of the size of the domain and the use of the spectral nudging technique. Tellus-A, DOI: 10.1111/j.1600-0870.2010.00467.x

Farda, A., M. Déqué, S. Somot, A. Horanyi, V.Spiridonov, H. Toth, 2010: The ALADIN Model as Regional Climate Model for Central and Eastern Europe, Studia Geophysica et Geodaetica, 54, 313-332

Herrmann M., Sevault F., Beuvier J., Somot S., 2010: What induced the exceptional 2005 convection event in the Northwestern Mediterranean basin ? Answers from a modeling study. JGR-O, doi:10.1029/2010JC006162

Articles in GEWEX Newsletter

Drobinski P., Ducrocq V. and the International Scientific and Executive Committees, 2012: HyMeX, Towards Special Observations Periods. GEWEX newsletter, 22, 13

Drobinski P., Ducrocq V., Lionello P., V. Homar, 2011: HyMeX, The Newest GEWEX Regional Hydroclimate Project. GEWEX newsletter, 21, 10-11

Drobinski P., Ducrocq V., Lionello P. and the HyMeX ISSC, 2009: HyMeX, a Potential New CEOP RHP in the Mediterranean Basin. GEWEX newsletter, 19, 5-6

Presentations at WCRP Open Science Conference

HyMeX – HyMeX: The WCRP perspective, links with GEWEX, MED-CLIVAR and MED-CORDEX; P. Drobinski, V. Ducrocq, P. Lionello, J.T. Allen, P. Alpert, E. Anagnostou, K. Béranger, I. Braud, N.F.

Boubrahmi, A. Chanzy, S. Davolio, G. Delrieu, A. Dörnbrack, C. Estournel, J. Font, J. Freer, M. Gacic, S. Gualdi, V. Grubisic, H. Hoff, V. Homar Santaner, S. Josey, C. Kottmeier, K. Lagouvardos, M.C. Llasat, W. Ludwig, C. Lutoff, A. Mariotti, A. Montanari, E. Ozsoy, B. Ivancan Picek, C. Prigent, E. Richard, R. Romero, R. Rotunno, I. Ruin, P. Ruti, D. Sauri, S. Somot, I. Taupier-Letage, R. Therrien, J. Tintore, R. Uijlenhoet, H. Wernli

HyMeX - Evaluation of dynamical and statistical methods for downscaling of extreme precipitation and surface temperature in the Mediterranean region in the frame of HyMeX and MED-CORDEX; E. Flaounas, P. Drobinski, M. Vrac, S. Bastin, K. Béranger, M. Borga, J.C. Calvet, G. Delrieu, C. Lebeaupin-Brossier, E. Morin, H. Omrani, G. Tartari, R. Toffolon

HyMeX - The regional coupled system WRF-NEMO over the Mediterranean (MORCE plateform): impacts of mesoscale coupled processes on the water budget estimation; C. Lebeaupin-Brossier, K. Béranger, P. Drobinski, S. Bastin, S. Mailler, G. Samson, S. Masson, G. Madec, S. Valcke, L. Coquart, E. Maisonnave

HyMeX - Intense weather events and air-sea interactions in the regional WRF-NEMO coupled simulation (MORCE plateform) over the Mediterranean; C. Lebeaupin Brossier, K. Béranger, P. Drobinski

HyMeX - Impact of the wind maximum distribution on the deep convection in the North-Western Mediterranean; K. Béranger, C. Lebeaupin Brossier, M.-N. Houssais, P. Drobinski, M. Crépon, J. Beuvier, R. Bourdallé-Badie, Y. Drillet, N. Ferry, F. Lyard

HyMeX - Model of the Regional Coupled Earth system (MORCE): application to process and climate studies in the Mediterranean region; P. Drobinski, A. Anav, C. Lebeaupin Brossier, G. Samson, M. Stéfanon, S. Bastin, M. Baklouti, K. Béranger, J. Beuvier, R. Bourdallé-Badief, L. Coquart, F. D'Andrea, N. de Noblet, F. Diaz, J.C. Dutay, C. Ethe, M.A. Foujols, D. Khvorostiyanov, G. Madec, E. Maisonnave, M. Mancip, S. Masson, L. Menut, J. Palmieri, J. Polcher, S. Valcke, N. Viovy

HyMeX – Mediterranean High Impact Weather on the Convective and Synoptic Scale – Real-world Measurements and COSMO Model Simulations; C. Kottmeier, N. Kalthoff, U. Corsmeier

HyMeX – Representation of heat waves and drought in MED-CORDEX-ERA Interim simulations at IPSL using WRF and MORCE models; M. Stéfanon, C. Lebeaupin Brossier, P. Drobinski, S. Bastin, K. Béranger, F. D'Andrea

HyMeX – Vegetation/atmosphere coupled processes in heat waves and droughts as simulated with the MORCE numerical plateform; M. Stéfanon, P. Drobinski, F. D'Andrea, N. de Noblet; M. Mancip, J. Polcher

HyMeX - Contribution of on Social Impact; M. Carmen Llasat, J. Amaro, M. Aran, L. Boissier, B. Boudevillain, J.D. Creutin, C. Lutoff, M. Llasat-Botija, O. Petrucci, J. Roselló, I. Ruin, D. Saurí, F. Vinet

HyMeX - Eastern Adriatic trend and variability analysis in precipitation extremes; M. Gajić-Čapka, K. Cindrić

HyMeX - HyMeX and the Med-CORDEX experiment: new coupled regional projections and tailored impact analysis; P.M. Ruti, S. Somot, F. Sevault, C. Dubois, L. Li, P. Drobinski, S. Bastin, F. Giorgi, M. Gaertner, C. Gallardo, A. Carillo, G. Sannino, B. Ahrens, A. Dobler, V. Dj, B. Rajkovic, S. Gualdi, A. Elizalde Arellano, D. Jacob, K. Béranger, B. Onol, P. Galán

HyMeX - HyMeX and the Med-CORDEX experiment: Regional Climate System Modelling of the Mediterranean region at CNRM: a multi-component approach to study climate variability; Somot S., F. Sevault, C. Dubois, M. Déqué

HyMeX - Coincident lightning activity and dual polarization radar observations over the Greek peninsula: preliminary data analyses; T.G. Chronis, F.S. Marzano, M.N. Anagnostou, W. Petersen, C. Schultz, E.N. Anagnostou, M. Montopoli, E. Picciotti, G. Alexakis, M. Sioutas

HyMeX - Experimental investigation of precipitation structure, dynamics and microphysics in Eastern Mediterranean: HYDREX; M.N. Anagnostou, J. Kalogiros, F.S. Marzano, T.G. Chronis, J.A. Nystuen, M. Montopoli, E.N. Anagnostou, E. Picciotti

Theses

Beuvier, J., 2011 : Modélisation de la variabilité climatique de la circulation et des masses d'eau en mer Méditerranée : impact des échanges océan-atmosphère. Ecole Polytechnique, Palaiseau.

Bresson, E., 2011 : Mécanismes de formation des systèmes convectifs quasi-stationnaires en Méditerranée nord-occidentale - Application au cas du 15 juin 2010 sur le Var. Université Paul Sabatier, Toulouse.

Casado, A., 2011 : Simulation du climat en Méditerranée dans un modèle couplé régional. Université Pierre et Marie Curie, Paris.

Colin, J., 2011 : Etude de la variabilité climatique des événements précipitants intenses en Méditerranée : approche par la modélisation climatique régionale. Université Paul Sabatier, Toulouse.

Omrani, H., 2012 : De l'utilisation de la technique de guidage pour la représentation des processus de fine échelle dans la modélisation climatique régionale : Applications aux programmes HyMeX et MED-CORDEX. Ecole Polytechnique, Palaiseau.
Stéfanon, M., 2012 : Canicules et sécheresses en Méditerranée: contributions des processus couplés surface-atmosphère à méso-echelle. Ecole Polytechnique, Palaiseau.
Szczypta, C., 2012 : Hydrologie spatiale pour le suivi des sécheresses du bassin méditerranéen. Institut National Polytechnique de Toulouse, Toulouse.

14. List of members and their term dates (including changes) where appropriate:

More than 400 scientists from 20 countries contribute to HyMeX in the scientific working groups and task teams. The HyMeX programme is structured as shown in Fig. 11. It is composed of a:

- an International Scientific Steering Committee (ISSC) which is responsible for the formulation of well defined and coherent scientific objectives and ensures the fulfillment of HyMeX objectives.
- an Executive Committee for Implementation and Science Coordination (EC-ISC) which ensures consistency and communication between the cross-cutting activities lead in the scientific working groups (WG), task teams (TT) and task support (TS) as well as the link with the ISSC. It is composed of WG leaders and TSs leaders for aircraft and ocean operations, major sites, and operation centers. Executive Committees at the national level coordinate HyMeX activities in participating countries. The mandate of the Task Teams ended after SOP2 in spring 2013. The scientific animation is now organized along Science Teams, the list of which is (in bracket the link with the HyMeX working groups/topics):
    - ST-IOPrain: Studies of IOPs (SOP1) - precipitation events *[WG3]*
    - ST-microphysics: Microphysics in precipitating systems *[WG3]*
    - ST-WV: Sources and transport of water vapour *[WG3]*
    - ST-lightning: Lightning and atmospheric electricity *[WG3]*
    - ST-flashflood: Flash-floods *[WG3]*
    - ST-airseacoupling: Air-sea fluxes, marine and ocean boundary
    - layers coupled processes *[WG3/WG4]*
    - ST-DWF: Dense Water formation and ocean mesoscale
    - processes *[WG4]*
    - ST- vulnerability – flash floods *[WG5]*
    - ST-medcordex: Regional climate modeling
    - (MED-CORDEX) *[WG1/WG2/WG3]*
    - ST-assimeps: Atmospheric convective-scale data assimilation
    - and ensemble prediction [*WG3/WG4*]
    - ST-WRD : water resources and droughts *[WG2/WG5]*
- a HyMeX Project Office (PO) which provides support to the coordination and communication of the programme by assisting the committees.

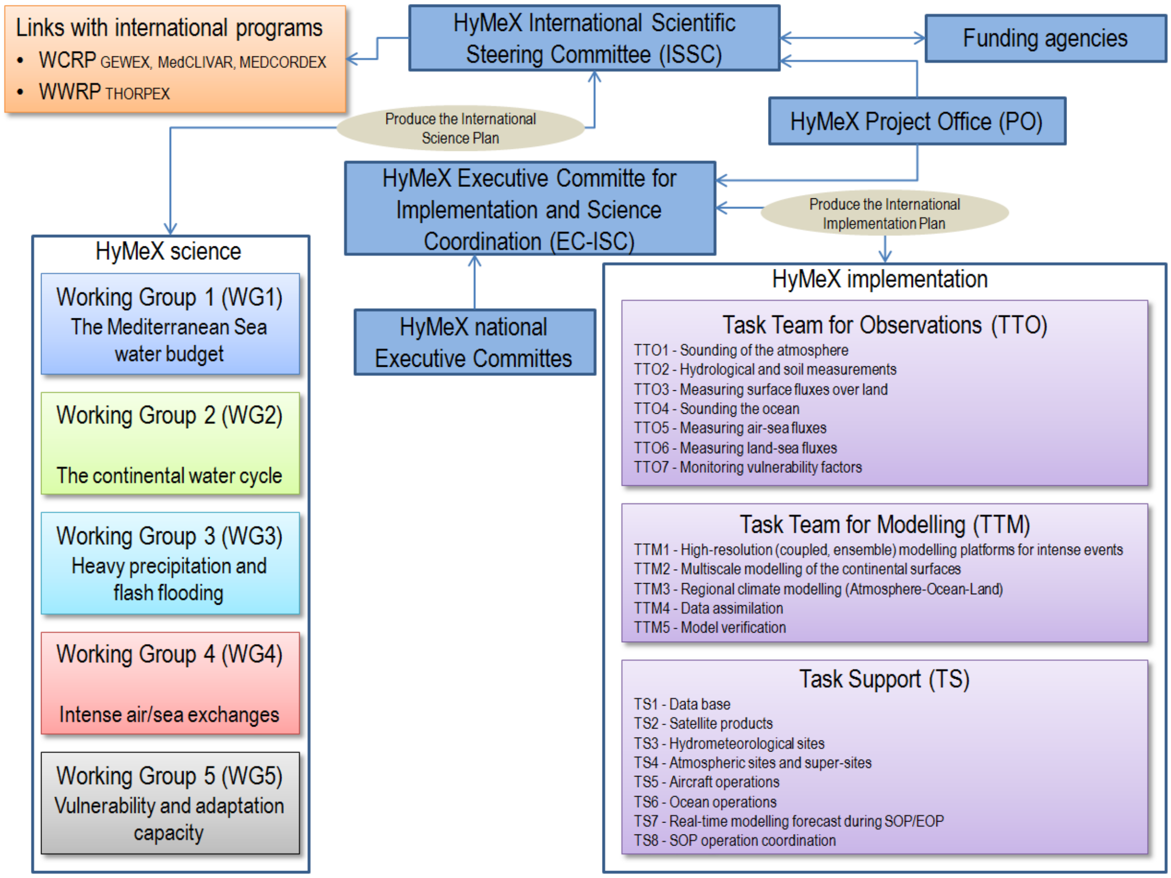

Figure 11: HyMeX programme organization.

The list of the members of the different HyMeX committees (ISSC, Executive Committee, Project Office) can be found at the HyMeX web page:

http://www.hymex.org/?page=icoordination

The committees have a two year mandate.

The contributors to the different working groups and task teams of HyMeX can be found at the HyMeX web page:

http://www.hymex.org/?page=working_groups