Report of the 12th HyMeX Workshop

Split, Croatia
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Introduction

The 2019 HYdrological cycle in the Mediterranean EXperiment (HyMeX) Workshop was the twelfth in a series of annual workshops, held this year in Split, Croatia, between 20 and 23 May. The general objectives of the HyMeX workshops are to present and discuss recent scientific progress in the understanding of the Mediterranean water cycle, from multiscale and multidisciplinary approaches, and to foster further collaborations within the HyMeX community. The HyMeX and Mediterranean water cycle science topics encompass heavy precipitation, flash floods and social vulnerability, integrated prediction of heavy precipitation and impacts, Mediterranean cyclones, ocean circulation and processes, drought and water resources, the water cycle and renewable energy. The 12th HyMeX Workshop consisted of plenary and parallel sessions, both oral and poster, as well as meetings on future work within HyMeX and beyond. Sessions and meetings were dedicated to recent and future field campaigns: Exploiting new Atmospheric Electricity Data for Research and the Environment (EXAEDRE), Pelagic Ecosystem Response to dense water formation in the Levant Experiment (PERLE) and Land surface Interactions with the Atmosphere over the Iberian Semi-arid Environment (LIAISE). Over 100 scientists from more than 10 countries participated in the event (Fig. 1).

Continuum Scale and Integrated Analysis

About 60 talks and 35 posters presented scientific results on the main HyMeX topics in plenary and parallel sessions. The sessions included heavy precipitation, ocean circulation processes, cyclones and strong winds, flash floods and vulnerability, flash-flood prediction, the water budget, drought and water resources and integrated prediction. Seven parallel working sessions for each HyMeX science team enabled transdisciplinary discussion and promoted exchange on current and future field campaigns.

This year, the regional climate modeling community attended a number of Mediterranean Coordinated Regional Downscaling Experiment (Med-CORDEX) workshops, as the second modeling exercise is underway. This group was therefore underrepresented with respect to previous years.

The workshop program, presentations and more information about HyMex are available at: *http://www.hymex.org*.

Ongoing and Future Field Campaigns

Three current or planned campaigns were designed within the framework of HyMeX to complement finished field experiments from the Enhanced Observation Period (Braud et al., 2014) and Special Observation Periods (SOP1, Ducrocq et al., 2014; Ferretti et al., 2014 and SOP2, Estournel et al., 2016) (see Drobinski et al., 2014 for a full overview). The new field experiments are (Fig. 2):

- EXAEDRE, which took place between September and October 2018 and centered on atmospheric electricity, completing the activities of SOP1 (Defer et al., 2015)
- PERLE, an oceanic experiment that was initiated in October 2018 with the PERLE-1 cruise and continued in March 2019 with the PERLE-2 cruise, complementing

***Figure 1**. Participants of the 12th HyMeX workshop in Split, 20-23 May 2019. Source: P. Drobinski.*

***Figure 2.** Location of the three recent and future field campaigns planned within the HyMeX framework.*

the activities of SOP2 (Estournel et al., 2016) but in the Levantine region in the Eastern Mediterranean

- LIAISE, which will be conducted between April 2020 and March 2021 with a focus on land surface interactions over the Iberian semi-arid environment

The EXAEDRE campaign objectives are to: (1) provide in situ measurements to characterize the electrical and microphysical cloud properties for a better understanding and modeling of microphysical, dynamical and electrical processes in thunderstorms; and (2) validate new airborne and ground-based instrument concepts developed within EXAEDRE. The campaign took place between 13 September and 8 October 2018 with a primary regional target: Corsica (<150 km). About 26 flight hours were completed, with weather forecast guidance provided by the students and teachers of the Météo-France Meteorology School. On the ground, a super site was set up at San Guiliano. Figure 3 shows an example of a cross-section of Radar Aéroporté et Sol de Télédétection des propriétés nuAgeuses (RASTA) cloud radar measurements (wind velocity, reflectivity, etc.) on board the French Falcon 20 during a thunderstorm of the Intensive Observation Period #7. The airborne measurements were made in the vicinity of the ground-based site, and included Doppler cloud radar measurements, in situ measurements, electric field mills, 3D-wind retrieval from the Doppler radar (3 antennas looking up and 3 antennas looking down) and microphysical properties (ice water content, etc.).

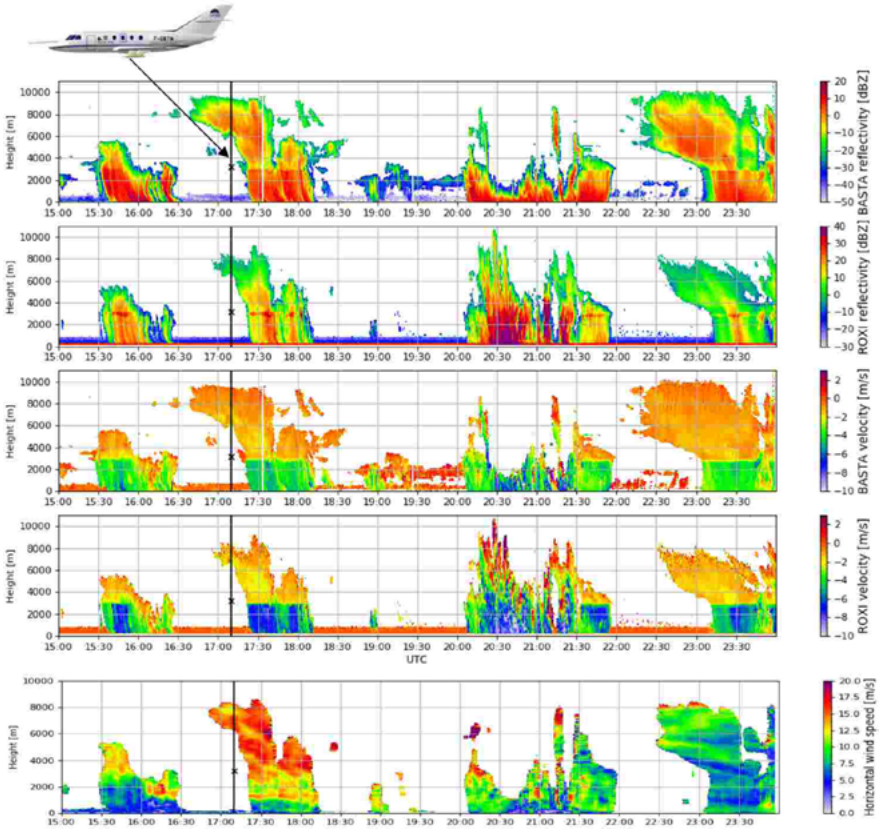

Figure 3. *Cross-section of RASTA cloud radar measurements onboard the French Falcon 20 during the IOP 7 (courtesy of E. Defer).*

In brief, the field campaign was very successful. Different young, mature and old electrical cloud systems were documented. Most airborne data have been quality controlled and are ready for scientific investigation. The data set is available in the HyMeX database. In the case with most electrical activity (IOP2), an electric field up to 50 kV/m was measured in cloud regions with graupels measured at flight level (8-10 km) and with a large variety of lightning flashes at different altitude ranges. Observational- and modeling-based scientific and instrumental studies are ongoing at lightning flash, electrical cell, storm and regional scales based on the EXAEDRE special, enhanced and long observation period (SOP, EOP, LOP) data sets. EXAEDRE is promoted on Youtube at *https://youtu.be/eYT2VsBOwRo*.

The PERLE action, shared between the HyMeX and Marine Ecosystem Response in the Mediterranean Experiment (MerMeX) programs, aims at describing the formation and spreading of Levantine Intermediate Water and determining its role in the distribution of nutrients and in the structuration of the planktonic ecosystems in the eastern Mediterranean. It is a complement to the SOP2 experiments conducted in the northwestern Mediterranean in winter 2013 with similar objectives. The first two cruises started in October 2018 and March 2019 with profiling floats deployed during the PERLE-1 cruise in October 2018 and moorings deployed during the PERLE-1 (October 2018) and PERLE-2 cruises (March 2019). Glider sampling started in October 2018 and will be repeated until June 2020. Figure 4 shows one cross-section of the temperature, salinity and oxygen measurements collected by a glider between 10 December 2018 and 14 February 2019.

Finally, the LIAISE field campaign will explore the surface/atmosphere interactions over the Iberian Peninsula. Specifically, its goal is to achieve better understanding of the dry down of soils after the winter rainfall has ended, as this is a critical season for the Mediterranean climate. Funding is currently being secured (e.g., the recent support of the French National Research Agency, ANR), so the campaign schedule stands. It will be held in 2020 and will end in the summer, following the vegetation phenological cycle (Boone et al., 2019).

HyMeX Activities in 2020

HyMeX was designed as a 10-year program starting in 2010 and ending in 2020, and wrap-up activities are planned for its final year. A joint special issue is being organized, and as decided during the workshop, each science team will contribute one or two scientific review papers in addition to the overview

paper on HyMeX's greatest achievements.

The 2020 HyMeX workshop will contain plenaries, a limited number of parallel and poster sessions and sessions with a specific scope, including: 10-year achievements with final syntheses and review, transfer to society, and beyond 2020. The workshop scientific committee, composed of Science Team Leaders, will be set up by October 2019. This committee will also be responsible for the reviews that will be presented at the workshop.

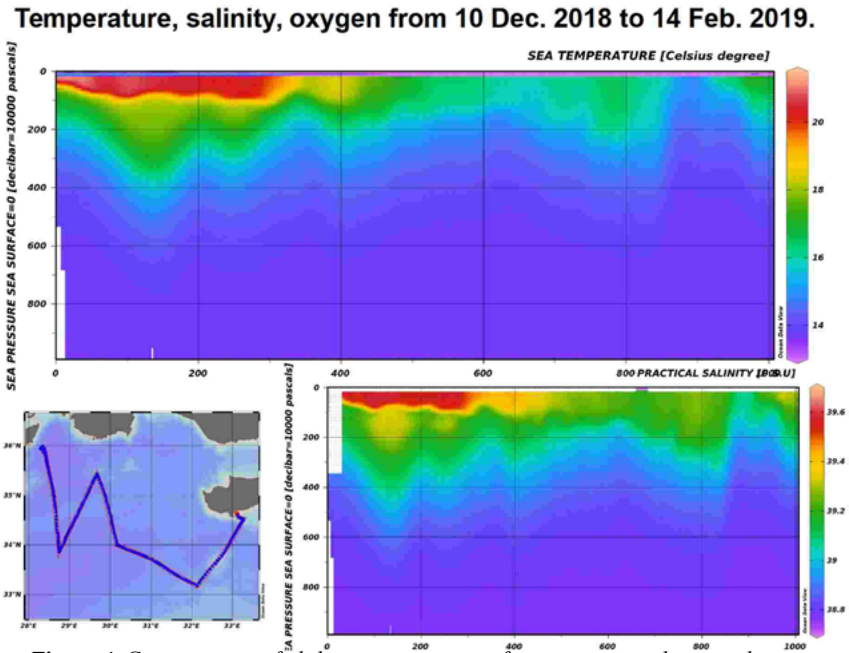

Figure 4. *Cross-section of glider measurements of temperature, salinity and oxygen measured during the 2018-2019 survey between 10 December 2018 and 14 February 2019 (PERLE-1 cruise) (courtesy of P. Testor).*

HyMeX Beyond 2020

The duration of HyMeX is 10 years, with the program set to conclude in 2020. Some activities will end next year while others will continue. A transition is planned to bridge the current version of HyMeX to a program that will extend beyond 2020.

Some projects with campaigns and their exploitation phase, as well as existing collaborations within Science Teams, will continue past 2020. The community has also expressed its interest in regular workshops as meeting points.

The form of the representation of HyMeX within the World Weather Research Programme (WWRP), the World Climate Research Programme (WCRP) and GEWEX has yet to be discussed. The current iteration of HyMeX will end as a GEWEX Regional Hydroclimate Project (RHP), without excluding the possibility that the governance of the future program will propose a new RHP. Discussions with the WCRP Joint Scientific Committee (JSC) should be organized, with GEWEX as an intermediary, as the JSC has launched four core programs where regional activities are key. As other Mediterranean programs will soon or have already ended [e.g., the Mediterranean Experiment (MEDEX), Mediterranean Climate and Ocean–Variability, Predictability, and Change (Med-CLIVAR), Med-CORDEX, Impact of Climate Change (IMPACTCC), Mediterranean Experts on Climate and environmental Change (MEDECC), Mediterranean Science Commission (CIESM), etc.], discussions should be organized to envisage, if relevant, a more integrated or at least coordinated effort in the region.

A new preliminary coordinating board was put in place at the 12th HyMeX Workshop, which will coexist during the 2019–2020 transition period with the exiting coordinating board, the HyMeX International Scientific Steering Committee. The group gathers experts of various disciplines and is composed of Aaron Boone, Eric Defer, Emmanouil Flaounas, Samiro Khodayar, Cindy Lebeaupin Brossier, Olivier Payrastre, Pere Quintana-Segui, Hélène Roux, Alexandre Stegner and Yves Tramblay. Other volunteers are welcome to join the board. Its tasks will be to set up a process to engage with other communities or program steering groups, provide a synthesis of the tangible (database, website, mailing lists) and intangible assets of HyMeX, define new and updated objectives to be possibly compiled in a new whitebook and to define a platform to meet and present the new scope and configuration options at the 2020 HyMeX workshop.

The HyMeX database is being transferred under the umbrella of the French Data and Services Cluster for the Atmosphere (AERIS), a new service building a general portal for geophysical data. The HyMeX data policy will first be extended and then a review of the data sets will be carried out to check the provider, access level and terms, preparing for an evolution of the data policy and access granted on a data set basis.

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