A Mediterranean atmospheric observatory in Corsica within the framework of HyMEx, ChArMEx and MERMEx

HyMEx (Hydrological cycle in the Mediterranean Experiment), ChArMEx (Chemical-Aerosol Mediterranean Experiment) and MERMEx (Marine Ecosystems Response in the Mediterranean Experiment) are 3 experimental programs dedicated to the study of the Mediterranean sea.

- **HyMEx** (http://www.hymex.org) aims at a better quantification and understanding of the hydrological cycle and related processes in the Mediterranean, with emphases on how long-term weather events and regional impacts of the global change are going to impact those on ecosystems and the human environment.

- **ChArMEx** is a regional project on tropospheric chemistry and aerosols which proposes an integrated modelling and observational approach to study budgets of species, chemical and dynamical processes, intense events, trends, and impacts.

- **MERMEx** aims to deepen the current understanding of the marine ecosystems to better anticipate their upcoming evolution. It is focused on the response of ecosystems to modifications of physico-chemical forcing at various scales, both in time and space, linked to changing environmental conditions and increasing human pressure.

**HyMEx actions proposed in Corsica**

In the framework of HyMEx, several initiatives are proposed in Corsica to are proposed:

- Improvement of the existing data network with ground-based conventional weather stations, radiosonding stations (profiles of temperature, humidity, wind speed and direction), and O3 measurement, radars, etc.
- Deployment of a wind profiler network around the western Mediterranean basin enabling to study the impact of atmospheric deposition on primary production.

- **MERMEx and MERMEx studies**/Corsica is:
- located near the most Western Mediterranean cyclones area.

- **MERMEx** is affected by intense weather events (windstorms, heavy precipitation, Saharan dust events, MEDITAN 1960-1970, rain showers and coastal erosion, drought, forest fire, lightning...).
- located upstream of the most intense precipitation event affecting the continental South-Eastern France and the Northern South of the Alps.
- located in the oligotrophic zone of the Mediterranean western basin enabling to study the impact of atmospheric deposition on primary production;

- **MERMEx** due to the presence of various aerosol types over the Mediterranean region, such as mineral dust particles (mostly Sahara), smoke, sea-salt particles, continental, marine, anthropogenic and biomass burning particles, is of great interest for investigating different scientific questions related to aerosols and gases over the Mediterranean basin.

- **Location** of fixed sites (MOOSE):

  - IMK supersite/KITCube:
    - Location of airports, radar, radiosounding station, oceanographic station and PAES + aerosol measurement station.
    - Location of fixed sites at Ersa well located to follow long-term changes of different gaseous compounds on the Mediterranean Basin.
  - C-band radar
  - Research aircraft HALO
  - CH located upstream of the most intense precipitation event affecting the continental South-Eastern France and the Northern Italy South of the Alps;

- **Large-scale transport episodes are well seen at Ersa**

  - episode 2: 2011-09-05 to 2011-09-06
  - episode 3: 2011-09-22 to 2011-09-23
  - episode 4: 2011-10-19 to 2011-10-20

- **ChArMEx actions proposed at Ersa**

  - Characterization of aerosol chemical, physical, optical (both shortwave and longwave) properties and their vertical profiles
  - Monitoring of trace gaseous species (Ozone, NOx, ... ) and greenhouse gases (CO2, CH4)
  - Study of the mixing state of polluted, biomass burning and mineral dust aerosols
  - Impacts of aerosols and gases on the radiative budget (both shortwave and longwave)
  - Air quality and dynamic processes: import-export budgets
  - Chemical processes: secondary matter formation
  - Deposition measurements: fine and particulate mass flux (Saharan dust particles)

- **MERMEx and MOOSE actions proposed at Ersa**

  - Impact of atmospheric inputs, in particular during extreme events (such as massive Saharan events)
  - Maintain time series (LOP) of cost parameters relevant over Corsica (Ersa site):
    - Atmospheric inputs measurements (dry and wet) for Al, Na, C1, Fe, P and Hg in the frame of MOOSE
    - Effect of solar radiation variation (UV/PAR) due to aerosols on solar penetration in Mediterranean waters?
    - Effects of solar penetration variations on ecosystems: primary production, organic pollution production, CO2 fluxes?

- **More recent proposals interested in the Corsican observatory**

  - Coastal oceanographic modelling and measurements
  - Investigation of dynamic and thermodynamic processes of western Mediterranean cyclones leading to high impact weather by the Institute for Meteorology and Climate Research (IMK) from Karlsruhe Institute of Technology

- **Proposed strategy at Ersa during ChArMEx**

  - LOP from 2010: set-up of a long-term monitoring observatory at Ersa with standardised automated low frequency routine measurements: \( \text{Main objectives} \): satellite and model validation, inter-annual variability and trends.
  - 2-year EOP from mid 2011 to mid 2013: enhanced observation period with high temporal resolution optical and chemical measurements: \( \text{Main objectives} \): seasonal variability and budgets.
  - KOPs in summer 2012 and summer 2013: intensive observation periods with additional surface measurements: \( \text{Main objectives} \): aging of continental plumes, column closure and radiative impacts of ozone, aerosols, and chemical and dynamical processes.

- **Mediterranean climate in Corsica**

  - **Precipitation**: The Mediterranean climate is characterized by moister winters and drier summers. However, severe weather occurs during the inter-seasons. Though the total annual precipitation ranges between 300 and 1000 mm, the frequency of rainy days is under 100 per year. Half of the annual precipitation can be locally fall in 24 hours during heavy precipitation events.

  - Figure on the left shows the annual number of rainy days characterized by a total rainfall within 24 of 100 mm or more from 1958 to 2007 in Corsica.

  - **Wind**: At the most northerly and southerly points of Corsica and where the valleys open out towards the sea from the eastern side, wind speeds can be very strong. Windstorm events are frequent (78 days with wind gusts greater than 25 m/s (100 km/h) in 2007 at the Ersa xenuerat in the northern tip of Cap Corse (43.04°N, 9.56°E)). Fifty to the right presents the compass map of the daily instantaneous maximum 10 m wind for 2007 at the Ersa synopstation. The Leibovici wind (westerly - south westerly) is the most frequent. For example, winds of over 28 m/s occurred 21.4% of the time during 2007. The anemometers regularly stall as speeds reach 60 m/s (216 km/h). Heavy precipitation events tend to be associated with westerly winds.

- **Actions**

  - * Contact: dominique.lambert@aero.obs-mip.fr

\[ \text{MOOSE} \text{ (Mediterranean Ocean Observing System on Environment) is an integrated multi-sites system of marine and atmospheric observatories in the NW Mediterranean. One of the objectives is to observe long-term changes of the NW Mediterranean Sea in the context of the climate change and anthropogenic pressure.} \]

- **MOOSE**

  - Impact of atmospheric inputs, in particular during extreme events (such as massive Saharan events)
  - Maintain time series (LOP) of cost parameters relevant over Corsica (Ersa site)
    - Atmospheric inputs measurements (dry and wet) for Al, Na, C1, Fe, P and Hg in the frame of MOOSE

- **IMK equipment to be deployed in Corsica**
  - * Aircrafts
  - + Surface instrumentation IMK-supersite/KITCube:

\[ \text{Research aircraft HALO} \]