



Chantier Méditerranée

ChArMEX summary

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1. The main stakes

The project ChArMEX (Chemistry-Aerosol Mediterranean Experiment) aims at a scientific assessment of the present and future state of the atmospheric environment and of its impacts in the Mediterranean Basin (*NB: The generic term "chemistry" used hereafter implicitly concerns gaseous reactive species and aerosol particles*). ChArMEX is one of the sister projects of the new regional multidisciplinary initiative "[Chantier Méditerranée](#)" from INSU and French Agencies, which aims at an understanding of the future of the Mediterranean region in a context of strong regional anthropogenic and climatic pressures. In this frame, the target of ChArMEX is short-lived (<~1 month) particulate and gaseous tropospheric trace species which are the cause of atmospheric pollution and have two-way interactions with climate.

Two examples illustrate our present poor knowledge of the regional chemistry-climate system in the Mediterranean region: (i) the Mediterranean background in tropospheric ozone remains very high despite an important decrease in anthropogenic emissions in Europe ; (ii) at the regional scale anthropogenic aerosol radiative forcing seems to dominate (with an opposite sign) the forcing by additional anthropogenic greenhouse gases, but the forcing by short-lived species is much more variable both in space and time, remains uncertain, and is not well taken into account in climate simulation.

Large international scientific programmes have addressed regional chemistry-climate interactions throughout the globe since about 15 yrs, with intensive field experiments. The French scientific community had an important or leading role in major international programmes (e.g. INDOEX and AMMA) and observation systems (e.g. AERONET and MOZAIC/IAGOS), and in smaller scale experiments (e.g. PYREX, ESCOMPTE, ...). In the Mediterranean, several targeted programmes in the last two decades have addressed specific questions on air pollution and transport mechanisms (e.g. MECAPIP, PYREX, MEDUSE, ESCOMPTE, MINOS ...). However, despite major expected climatic and anthropogenic changes in the Mediterranean and high levels of tropospheric loads in gaseous and particulate pollutants, especially in summer, we are still missing an integrated view of the environmental status of the Mediterranean atmosphere, of its impacts on the regional climate, and of their recent and possible future evolution. In addition, no background Mediterranean atmospheric observatory was established yet in the western Mediterranean basin. The French ChArMEX initiative proposes to set up a coordinated experimental and modelling international effort based on most updated tools, for an assessment of the regional budgets of tropospheric trace species, of their trends, and of their impacts on air quality, marine biogeochemistry, and regional climate. It is proposed to focus experimental campaigns in the western basin in a first phase of the programme and to shift towards the eastern basin afterwards.

2. The main scientific questions

In terms of the present state of the atmospheric Mediterranean environment, ChArMEx proposes to address four main questions:

- What is the regional budget of tropospheric ozone? This requires an assessment of atmospheric dynamics-chemistry interactions and import and export processes at the regional scale.
- What is the regional budget of secondary particulate and gaseous, organic and inorganic, matter? This requires a description of chemical processes occurring during transport of continental air masses over the basin.
- What is the soluble input of key elements possibly limiting (P, N, Fe) or contaminating (e.g. Hg) the marine trophic chain? This includes an apportionment of natural and anthropogenic sources.
- What are the respective contributions from the various natural and anthropogenic sources for the species of interest to above questions? This requires to revisit or complete regional emission inventories.

In terms of past/present trends and future projections, two specific objectives are defined:

- Perform an integrated assessment of seasonal and long term chemical trends over the basin. This will be based on the exploitation of time series of multiple parameters from space and observation networks, with the help of chemistry-transport or chemistry-climate models.
- Simulate future evolution of the Mediterranean tropospheric chemistry. This includes intercomparison of coupled chemistry-climate models based on emission scenarios.

In terms of impacts, the three main questions are the following and concern both the present and the future:

- What are the impacts of the radiative forcing by particulate and gaseous species ? This includes an assessment of direct impacts of atmospheric chemistry on oceanic evaporation, atmospheric heating, and consequences on the dynamics and climate. Indirect forcing through clouds and aerosol impact on precipitation is considered under the coordination of the sister project [HyMeX](#).
- What is the impact on particulate and gaseous Mediterranean air quality of long-range transport and vertical exchanges?
- The impact on the marine biogeochemistry of atmospheric deposition and of perturbed surface solar radiation is considered under the coordination of the sister project [MERMEX](#).

3. The implementation strategy

ChArMEx proposes a multi-scale model-observation integrated strategy with satellite and field observations. The experimental set-up is based on a nesting strategy with three types of observation periods as deployed during [AMMA](#):

- LOP (long observation period): trends will be studied using long times series from satellite remote sensing and surface stations; existing observation networks (e.g. AERONET) will be reinforced in the basin and a network of a few background super sites will be set-up on remote Mediterranean islands including, e.g., a Balearic Island, Corsica, Lampedusa, Crete and Cyprus;
- EOP (enhanced observation period): daily to seasonal scale variability will be studied based on a denser network of stations with additional parameters and/or more frequent observations including detailed chemistry and column observations; stations will be deployed to monitor east-west and north-south gradients over a period of a 2-3 years (e.g. 2011-2013 in the 1st phase);
- SOP (short observation period) : detailed process studies will be performed during intensive campaigns including research aircraft and balloons presently targeted for summer 2012 and 2013 ; studies will include continental plume transport and aging, chemical and optical closures in the column, and satellite validation; detailed operations will be planned with the help of real-time forecasts and satellite products.

4. Project organisation

Even if FP7 funding may be sought, it is necessary that a significant part of ChArMEx funding comes from national agencies (first commitments have already been taken in France). It is therefore proposed to organize ChArMEx initiatives at the national level and to set-up an international coordination committee. A first [ChArMEx international workshop](#) will be held in Toulouse (29 June-1 July 2009).