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The project ChArMEx - Chemistry Aerosol Mediterranean Experiment

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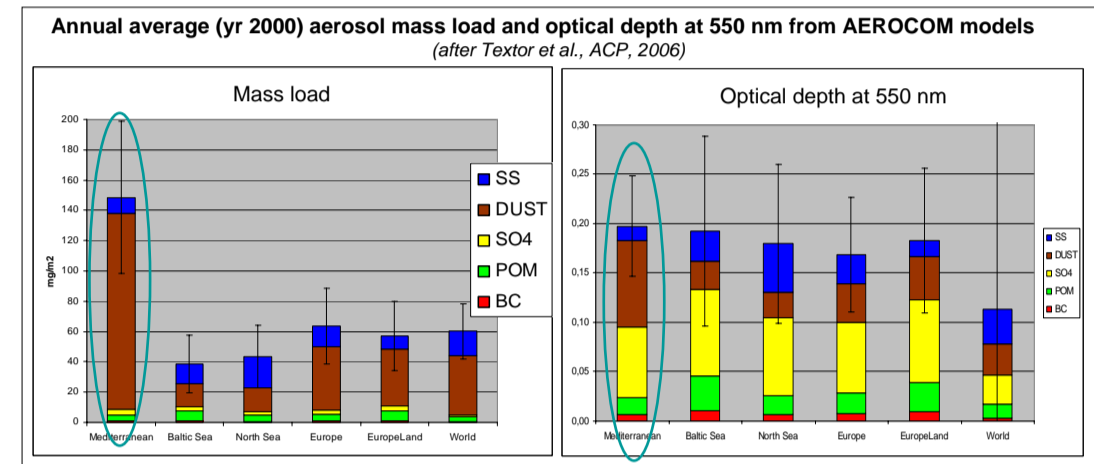
1. Abstract.

ChArMEx is a new regional project on tropospheric chemistry and aerosols in the Mediterranean proposed by the French community, calling for international cooperation. ChArMEx proposes an integrated modelling and observational approach to study budgets of species, chemical and dynamical processes, intense events, trends, and impacts. The objectives include an assessment of the recent past, present and future states of the atmospheric chemistry and of related impacts on air quality, regional climate and marine biogeochemistry.

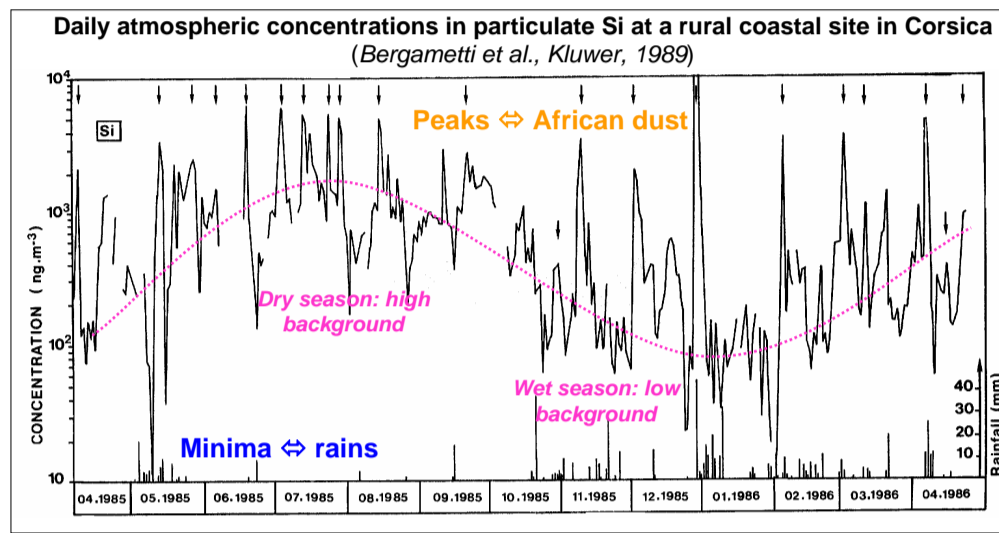
The experimental strategy includes long-term monitoring, 2 years of enhanced surface observations, and summer intensive campaigns with research aircrafts and drifting balloons to study the aging of continental air masses over the basin when pollutants and desert dusts are at their maximum and likely impact the regional climate. Focus is presently put on the western basin. Synergies are built with other Mediterranean projects on the hydrological cycle (HyMEX) and marine ecosystems (MERMEX).

2. Some facts

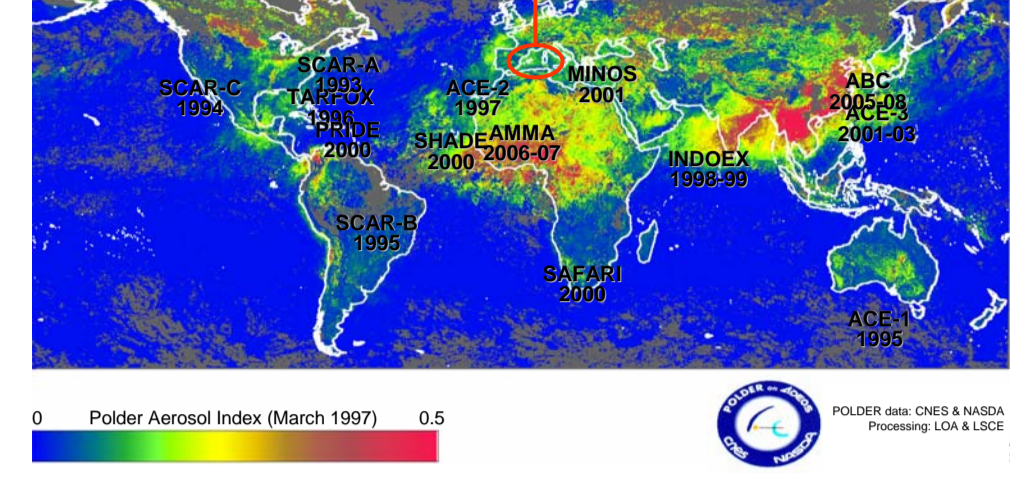
A. All types of continental (soil dust, soot, anthropogenic and biogenic organics, pollution sulfate/nitrate) and marine particles (seasalts, biogenic sulfates) are present at high concentrations. Trends are uncertain.



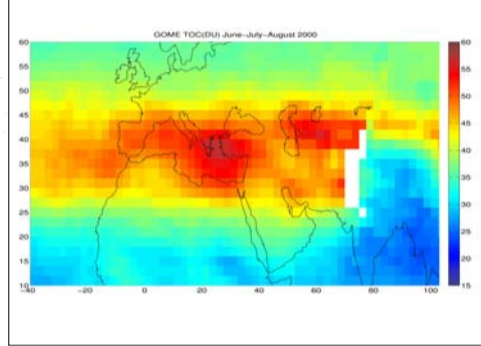
B. Strong seasonal maxima in aerosol and gaseous pollutants are found in the Mediterranean in summer



Due to the variability of aerosol properties, aerosol-climate interactions are addressed through extensive regional programs and campaigns. The western Mediterranean is still missing a large scale experiment!

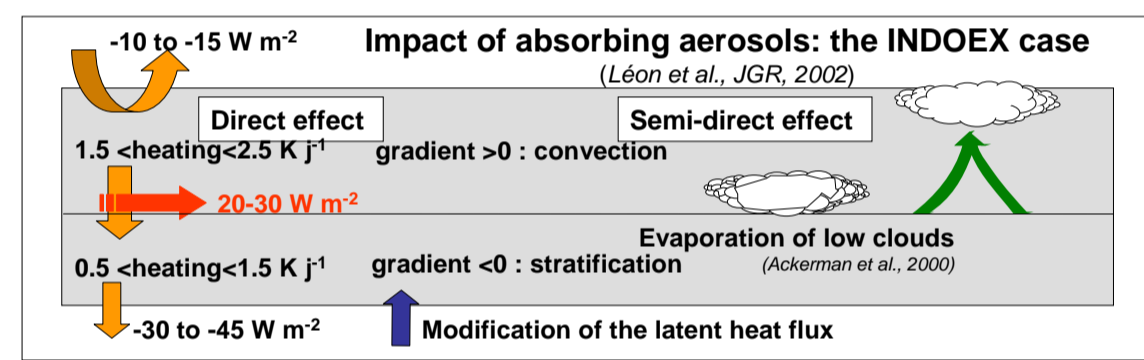


C. Strong gradients in aerosol load

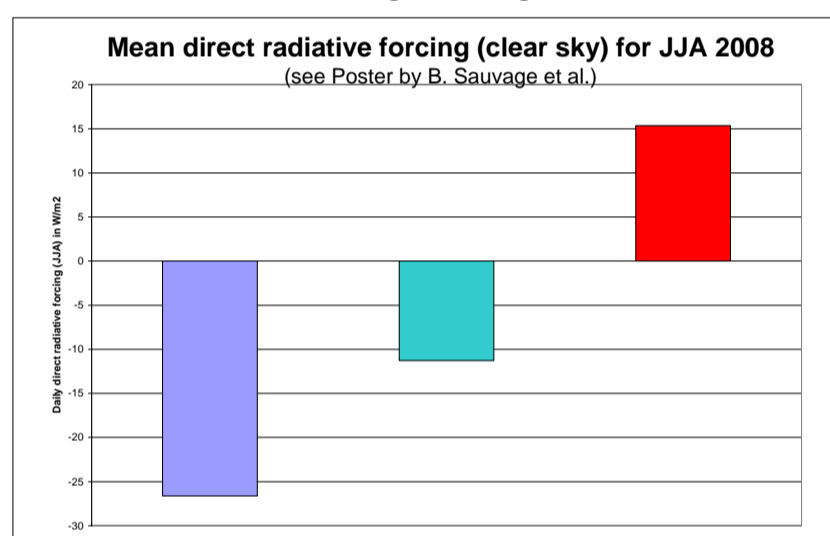


D. African dust significantly impacts air quality in rural and even urban sites of southern Europe (e.g. Léon et al., Appl. Opt., 1999; Moreno et al. Atmos. Env., 2005).

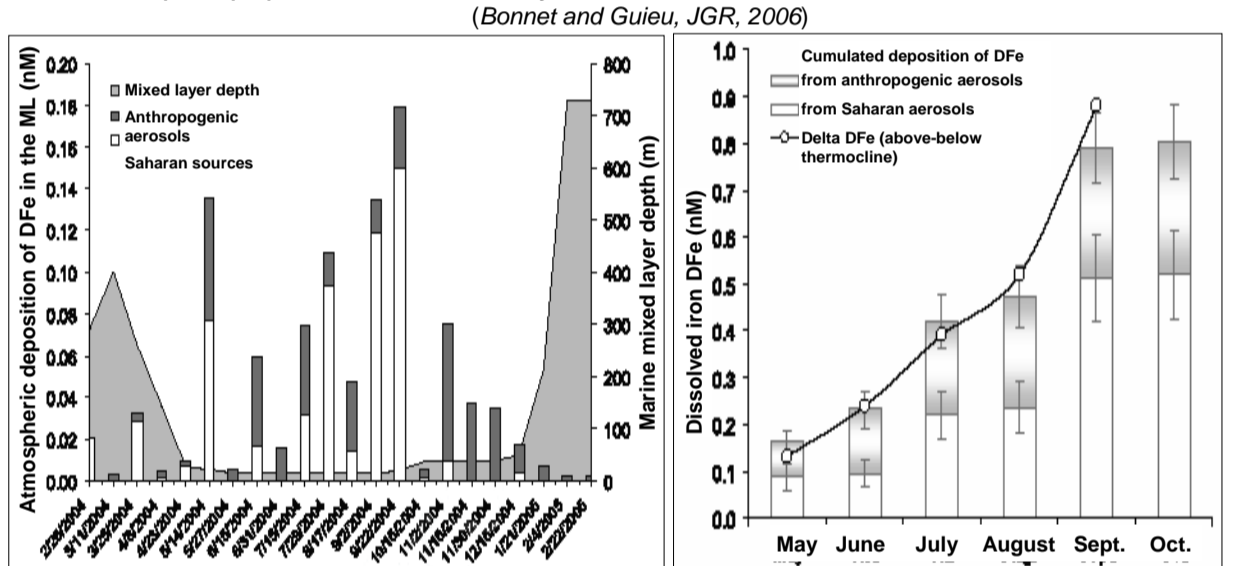
E. In summer, in addition to dust transport, forest fires contribute to the maximum load of absorbing aerosols (ω_0 down to 0.8, Meloni et al., ACP, 2005) which decrease surface evaporation and modify the thermal vertical gradients



F. Aerosol radiative forcing is strong



G. In the period of surface water stratification, atmospheric deposition explains the dissolved iron (DFe) enrichment above the thermocline. This likely favours diazotrophic populations such as cyanobacteria (Bonnet and Guieu, JGR, 2006)



3. ChArMEx proposed work packages

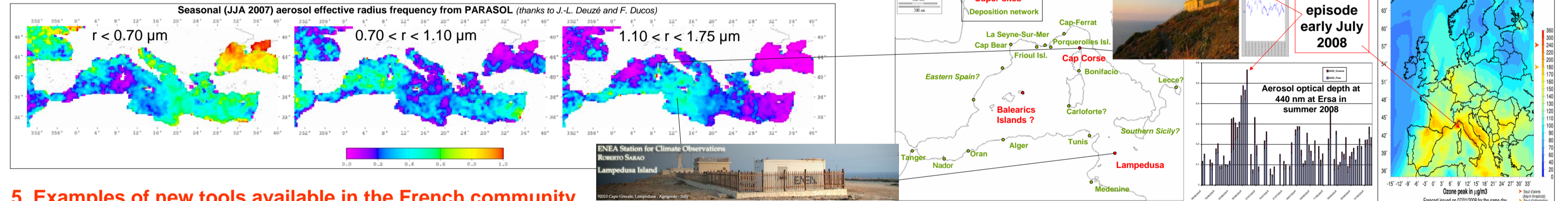
- Air quality and dynamic processes: import-export budgets
- Chemical processes: secondary matter formation
- Lagrangian experiments
- Seasonal and long-term trends
- Radiative budget and Impacts
- Deposition: Fe, P, Hg inputs
- Emission inventories and source inversion
- Model intercomparison and future scenarii

4. Proposed strategy

A 4-yr large scale integrated programme in the western basin (2010-2013) with a multistage experimental strategy:

- LOP from 2009 on: set-up of a long-term monitoring observatory in Corsica and collaboration with Mediterranean countries for establishing a network of stations covering N-S and E-W gradients with standardized automated low frequency routine measurements (e.g. sunphotometer, lidar, deposition, PM, O₃, ...).
Main objectives: satellite and model validation, inter-annual variability and trends.
- 2-yr EOP from mid 2010 to mid 2012: enhanced observation period with high temporal resolution optical and chemical measurements (e.g. COVs, size distributed aerosol composition, ...) at selected stations throughout the basin.
Main objectives: seasonal variability and budgets.
- IOPs in summer 2011 and summer 2012: intensive observation periods in 2011 and 2012 with aircrafts, balloons and additional surface measurements, based on real time spaceborne observations and model forecasts.
Main objectives: aging of continental plumes, column closure and radiative impacts of ozone and aerosols, chemical and dynamical processes.

In regards to the aerosol observations from satellite sensors (PARASOL, MODIS), a strategy of 3 main super sites and 10-15 deposition stations is proposed during ChArMEx to cover the S-N and E-W transects. It will complete existing stations (EARLINET, AERONET, background air quality and research stations, ...).



5. Examples of new tools available in the French community

Updated aerosol-climate and -transport models

Quasi-real time spaceborne monitoring and model transport forecasting of aerosol for intensive field observations on alerts

Direct atmospheric radiative forcing by anthropogenic aerosols (BC, POM, SO₂), averaged from nine global models (Schulz et al., ACP, 2007)

Improved parameterization of the aerosol size distribution for both deposition and optical depth (Foret et al., JGR, 2006)

CHIMERE-DUST (http://euler.lmd.polytechnique.fr/menut/chimeredust/index.html)

LMZD-INCA: aerosol and reactive gases (http://www.lscinca.cea.fr/welcome_real_time.html)

GIRAFFE: smoke plumes from active fires (http://aoc.amma-international.org/archive/researchProduct/aerosol-chemistry/giraffe/)

MSG/SEVIRI hourly quicklooks and products (http://www.icare.univ-lille1.fr/)

Research aircraft and airborne payloads

Isokinetic probes for in situ aerosol sampling and measurements of submicron and dust particles, and cloud interstitial particles

AVIRAD (3-λ nephelometer, 7-λ aethalometer, optical counter/sizer, impactor + 2 filters)

CVI and Community Inlet (Lyman-α, CN & CCN counters, PSAP, DMSP, V-DMSP, OPC, AMS)

PLASMA sunphotometer

Vaisala dropprobes system

Instrumented high-perf. Ultra Light Aircraft

A variety of CNES drifting balloons with GPS, ozone, aerosol, radiative or flux measurements

Boundary layer balloons (~800m)

Pressurized balloons (up to 3 km)

Aeroclipper (surface)