The Aerosol FPS was initiated to better apprehend the regional climatic effect of aerosol over the Mediterranean basin, with scientific questions ranging from exploring the feedback mechanisms to aerosol perturbations, to assessing the impact of aerosol trends in the regional climate change signal. The domain of interest initially defined as the Med-CORDEX region has been now extended to encompass the EURO-CORDEX region as well since the two domains are strongly inter-connected from an aerosol and climatic point of view. The FPS activity is based on different protocols detailed on the wiki page (https://www.hymex.org/cordexfps-aerosol/wiki/doku.php?id=start), involving different modeling options (aerosol prescribed data base vs on-line interactive aerosols) and analysis (event to climatic scales, past period and future projections).
Scientific highlights

Aerosol FPS at the November 2019 Med-CORDEX meeting

As part of the last Med-CORDEX meeting, a special session was organized focusing on the aerosol FPS. General presentations dealing with the importance of including aerosol trends for climate change assessments have been made, as well as more specific group presentations relating individual model results, development or interest to join different protocols. Admittedly, the Aerosol FPS have had some difficulties to identify and aggregate many participants in its first phase, but this meeting showed a growing interest for aerosol related questions within CORDEX community. The meeting also helped to clarify protocol advancements, difficulties and priority to achieve concrete intercomparison analysis.

Aerosol trends and the Euro-Mediterranean Climate change signal

While the majority of Global Climate Models (GCMs) account for these trends, most Regional Climate Models (RCMs) have not considered evolving aerosol and their effect on radiative budget in the CORDEX downscaling of CMIP5 (see Annexe of Gutierrez et al. 2020, for a description of the aerosol representation in CORDEX RCMs to date). This can partly explain difficulties to represent past climate trends in RCM evaluation runs (Nabat et al. 2014) and a part of the climate change signal discrepancy between GCMs and RCMs (Boé et al. 2020) over specific domains such as Europe. In protocol 1.B a multimodel assessment of aerosol trend impact, based on prescribed climatologies, is carried out. So far 6 regional models are involved, and the results are presently being analysed. Figure 1 gives a fresh example of protocol 1.B outcome for the solar surface radiation evolution where most of the RCM simulate an increase of incoming solar radiation, driven in large part by aerosol surface radiative forcing reduction.

![Solar radiation evolution at the surface for 6 RCMs models between the historical (1971-2000) and future period (2021-2050) with evolving aerosols (EVO-HIST) and with constant climatology (CST-HIST). Corresponding climate change signal in driving GCMs (RCP8.5-HIST).](image-url)
**Intercomparison of on line natural aerosol modelling in RCMS**

As part of protocol 2.a, a detailed analysis of natural aerosol processes simulated by RCMs and chemistry transport model is carried out. The study focuses on a three month period (June-August 2013) covering the ADRIMED experiment during which several in-situ observations of aerosol properties have taken place. The case study shows notably intense dust and sea-salt aerosol events over the Euro Mediterranean domain. The intercomparison assess the ability of RCMs participating in protocol 2 to simulate natural aerosol on short time scales, using both observations and comparisons with state of the art air quality and meso-scale models. Figure 2 illustrates such a comparison for the primary sea spray aerosol emissions for June 2013.

**Interactive aerosol climate projections**

In protocol 2.c, aerosol interactive modelling is used to investigate change in Euro-Mediterranean aerosol content and the future climate sensitivity to aerosol. Up to know only single model studies have been carried out using this approach as for example in Drugé et al., 2020. Using the CNRM Aladin model and following Shared Socioeconomic Pathways (SSP 1-1.9, SSP 3-7.0 and SSP 5-8.5) anthropogenic emissions scenarios, it is shown that a total AOD decrease between 30 and 40 % over Europe for the three scenarios is foreseen, mainly due to the sulfate AOD decrease (between −85 and −93 %), only partly offset by a nitrate and ammonium particles AOD increase (between +90 and +120 %) and a weak increase of natural aerosol. The resulting direct aerosol radiative forcing decrease explains about 65 % of the annual shortwave radiation change but also about 6 % (in annual average) of the warming expected over Europe by the middle of the century. Regional circulation is also effected showing localised feedback patterns (e.g. over the Iberian Peninsula) involving also semi-direct cloud response, and not seen so far in protocol 1.B. For robustness assessment of such regional scale responses it is expected that other RCM with on-line aerosol capabilities join the protocol 2.c in a near future.
Aerosol FPS dissemination

The FPS is involved in providing advices and technical guidelines for the use of realistic aerosol climatologies by RCM involved in the next phase of CORDEX (collaboration G. Nikulin). It is expected that the outcome and experience gathered within the Med-CORDEX aerosol FPS will be of use for other CORDEX domains, notably where significant aerosol trend have been, or are expected to be, important. For more info see the shared document at:

https://docs.google.com/document/d/1Ueyx6U97asbO-bn7XxPXvneYPnTTr2A3B4dLiCUvZ-o/edit

Conferences/Papers

See also aerosol FPS wikpage:


General


Protocol 1A


Protocol 1B


Protocol 2B


Protocol 2C

### Planned activities for next year

**Med-CORDEX dissemination**

- We hope that scientific exchanges between partners will start again.
- Med-CORDEX FPS aerosol conference, fall 2021 if possible.

**Med-CORDEX simulations**

- Availability of large ensemble of scenario simulations for phase 2 (FPS)
- CORDEX Baseline runs including evolving aerosol based on Aerosol FPS collaboration.

### Additional relevant information