Climate-aerosol interactions over the Mediterranean region: a regional coupled modelling approach

01 | Why study aerosols over the Mediterranean?

A crossroads of air masses bringing aerosols from different sources (Lelieveld, 2002).

Important impact on radiative budget and climate. High spatio-temporal variability.

02 | Methodology

A fully coupled regional climate system model (CNRM-RCSM) has been developed for ten years at CNRM, including the following components: atmosphere, ocean, land surface, rivers, and more recently aerosols.

The CNRM Regional Climate System Model (CNRM-RCSM) - ALADIN-Climat (atmospheric model, 50 km, ERA-Interim forcing)

2 possibilities to represent aerosols in CNRM-RCSM:
- Direct aerosol forcing: represent aerosols explicitly (CNRM-RCSM)
- Semidirect aerosol forcing: represent aerosol indirect effects (CNRM-RCSM)

03 | Impact of aerosols at the daily scale

Several effects of aerosols on regional climate have been shown at different time and spatial scales using the Forward Modeling and the Atmosphere-Ocean-Ground models.

In order to study the mean impact of aerosols on regional climate, simulation ensembles have been carried out using CNRM-MRCSM with and without AOD aerosols.

Aerosol radiative forcing over the Mediterranean Sea: results from the CNRM-MRCSM model.

04 | Impact of aerosols on mean climate

In collaboration with Aruyòno Sanchez-Lorenzo and Martin Wald.

2 simulations using CNRM-RCSM have been carried out during the 1980–2012 period: REF (with any aerosol trend) / TRANS (including the sulfate aerosol trend).

Monthly AOD climatologies

05 | Contribution of aerosols to the climate trends

In collaboration with Aruyòno Sanchez-Lorenzo and Martin Wald.

2 simulations using CNRM-RCSM have been carried out during the 1980–2012 period: REF (without any aerosol trend) / TRANS (including the sulfate aerosol trend).

Surface aerosol radiative forcing calculated as in CASAL

Semi-direct aerosol forcing (due to changes in atmospheric profile and circulation) is slightly positive. Increase of surface density in the Mediterranean Sea (cooling prevails over the decrease in salinity).

Future work:
- More detailed analysis on the consequences of the choice of the aerosol representation in climate modeling (aerosol, AVHRR, and climatology)
- Further development in the prognostic aerosol scheme Regional climate scenarios using prognostic aerosols.

06 | Conclusion

Several effects of aerosols on regional climate have been shown at different time and spatial scales using the Forward Modeling and the Atmosphere-Ocean-Ground models.

- Impact of aerosol daily variability on surface radiation and temperature.
- Impact of aerosols on mean regional climate: negative radiative forcing at the surface with ensuing cooling and decrease in the activity of the hydrological cycle (importance of using a fully coupled regional climate system model for aerosol-climate studies).
- Impact of contribution of aerosols to the regional climate trends since 1980.

Results are confirmed in the other stations.

References


