Atmospheric Composition
Variations in atmospheric pollutants such as ozone and aerosols affect air quality, weather and climate. The Atmospheric Chemistry research group addresses this goal through the development and use of the Multiscale Nonhydrostatic Atmosphere Chemistry model (NMMB-MONARCH). The group is the research backbone of the well-known CALIOPE system, which provides high-resolution short-term air quality forecasts for Europe, with a special focus on Spain and its main urban areas using the in-house HERMES emission model. The group is also the research backbone of the WMO Regional Specialized Meteorological Center for Atmospheric Sand and Dust Forecast, the Barcelona Dust Forecast Center. Our models and forecasts are enhanced by an intensive use of up-to-date observations, both for model evaluation and to support improved understanding of the processes affecting atmospheric chemistry, aerosols and aerosol species, as well as meteorological parameters, and covering multiple time scales, from days to months.

Dust and the Earth System
Objectives
Atmospheric chemistry research and model developments
Refinement of model schemes (e.g. on-line natural emissions, dry and wet deposition, aerosol size distributions, optical properties, convective transport, stratospheric boundary conditions).
Development and implementation of currently missing species and processes (e.g. marine POA, anthropogenic OA, dust mineralogy, heterogeneous chemistry, cold pools for dust emission).
Enhancement of the HERMES emission model by integrating global and regional emission inventories, implementing new sources, pollutants and methodologies.

Observations, evaluation and data assimilation
Development of a standardized model evaluation procedure including data from satellites, and lidar, Sun-photometer and ground-based observatories assessing vertical distributions of aerosol species, as well as meteorological parameters, and covering multiple time scales, from days to months.
Enhancement of the ensemble-based data assimilation system for aerosols using data from both satellite and ground-based instruments.

Forecast systems and reanalysis
Delivery of global air quality forecasts at ~50 km resolution with nested regional domains at ~10 km resolution (Northern Africa, Europe and Middle East) and ~4 km resolution (Spain).
Generation of aerosol forecast and reanalysis products using ensemble-based data assimilation.

Air quality in urban areas: enhanced modeling approaches, emissions, source attribution and impacts
Combination of air quality mesoscale simulations with street canyon models to accurately reproduce the dispersion of pollutants along streets in urban environments.
Use of crowd-sourced data (floating car data) and microscale models (PTV Vissim + EnViVer) to improve the estimation of urban traffic emissions at the street level.
Determination of the origin of air pollution problems through source apportionment and source sensitivity techniques.
Assessment of the impact of air pollutants on human health over urban areas, in collaboration with health specialists.

AXA Chair on Sand and Dust Storms
Expand our understanding of dust sources, emission, transport, and variability across multiple time scales
Better understand and quantify dust effects upon weather, climate, atmospheric chemistry and ocean biogeochemistry
Improve and develop dust forecasts, predictions and reanalysis datasets
Assess and mitigate dust impacts on key sectors of society and economy
Promote capacity building, technology transfer, dissemination and public engagement.