nextGEMS aerosols

nextGEMS is a European research project developing and applying a new generation of global coupled Storm-Resolving Earth System Models (SR-ESMs) to the study of anthropogenic climate change. The project is funded by the European Commission's H2020 program. The nextGEMS consortium is made up of 26 institutes from 14 countries (Denmark, Finland, France, Germany, Italy, The Netherlands, Norway, Poland, Portugal, Senegal, Spain, Sweden, Switzerland, the UK).

SR-ESMs are distinguished by their fine, 5 km (or finer), grid in the atmosphere and ocean. This allows a more physical representation of atmospheric and oceanic circulation systems, including their coupling to Earth-system processes such as the carbon, nutrient, water and atmospheric particulate (aerosol) cycles. nextGEMS will develop two prototype SR-ESMs into production systems and produce multi-decadal (30 y) projections of future climate change. Improved resolution is expected to reduce biases and enhance the realism of these simulations. Ensembles of simulations will address scientific puzzles such as the impact of convective organization on climate sensitivity, the magnitude of aerosol forcing, and the changes in extremes associated with tropical air-sea interaction (including the African Monsoon and Atlantic Hurricanes) and land-surface interaction in the mid-latitudes (dry-spells and links between hydrology and carbon).

The simulation of aerosols and their interactions with clouds and radiation is computationally expensive. Their inclusion and coupling in SR-ESMs therefore requires the development of a computationally efficient aerosol module. Our approach is to begin with the aerosol module HAM that is widely used in coarse-scale simulations and to reduce its complexity such that kilometre-scale simulations become feasible. Our simplified module will remain fully traceable to the complex module HAM. HAM was originally published in Stier et al. (2005), improved in various publications over the last years, and recently coupled with the coarse-scale version of the climate model ICON in Salzmann et al. (2022). Together with our aerosol module, nextGEMS will deliver the first storm-resolving aerosol-climate model that is capable of representing the complex interactions of aerosols and convective clouds.