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Ambrosia artemisiifolia L. pollen simulations over the Euro-CORDEX domain: model description and emission calibration

li liu (1,2), Fabien Solmon (1), Filippo Giorgi (1), Robert Vautard (3), and the ATOPICA WP2 Team

(1) Earth System Physics Section, The Abdus Salam International Centre for Theoretical Physic, Trieste, Italy, (2) Guizhou Key Laboratory of Mountainous Climate and Resources, Guiyang, China, (3) National Center for Scientific Research, Paris, France

Ragweed Ambrosia artemisiifolia L. is a highly allergenic invasive plant. Its pollen can be transported over large distances and has been recognized as a significant cause of hayfever and asthma (D'Amato et al., 2007). In the context of the ATOPICA EU program we are studying the links between climate, land use and ecological changes on the ragweed pollen emissions and concentrations.
For this purpose, we implemented a pollen emission/transport module in the RegCM4 regional climate model in collaboration with ATOPICA partners. The Abdus Salam International Centre for Theoretical Physics (ICTP) regional climate model, i.e. RegCM4 was adapted to incorporate the pollen emissions from (ORCHIDEE French) Global Land Surface Model and a pollen tracer model for describing pollen convective transport, turbulent mixing, dry and wet deposition over extensive domains, using consistent assumption regarding the transport of multiple species (Fabien et al., 2008).
We performed two families of recent-past simulations on the Euro-Cordex domain (simulation for future condition is been considering). Hindcast simulations (2000∼2011) were driven by the ERA-Interim re-analyses and designed to best simulate past periods airborne pollens, which were calibrated with parts of observations and verified by comparison with the additional observations. Historical simulations (1985∼2004) were driven by HadGEM CMPI5 and designed to serve as a baseline for comparison with future airborne concentrations as obtained from climate and land-use scenarios.
To reduce the uncertainties on the ragweed pollen emission, an assimilation-like method (Rouĭl et al., 2009) was used to calibrate release based on airborne pollen observations. The observations were divided into two groups and used for calibration and validation separately. A wide range of possible calibration coefficients were tested for each calibration station, making the bias between observations and simulations within an admissible value then finding calibrations within this range with the root-mean-square-differences at the minimum. The calibration coefficients were then interpolated on RegCM grid with Ordinary Kriging method.
Calibration simulations showed generally a good performance in reproducing the total seasonal counts, capturing both the spatial and temporal patterns in pollen concentrations. The correlation coefficient between simulations and observations increased from 0.301 to 0.725. The uncertainties from model internal processes could be considered lower than those in the emission term. The distribution of ragweed was among the most uncertain parts of the current model.