Adaptive method of lines for multi-component aerosol condensational growth and cloud droplet activation

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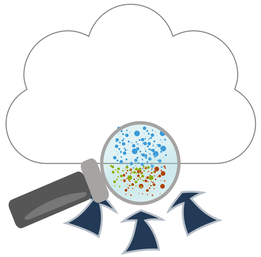
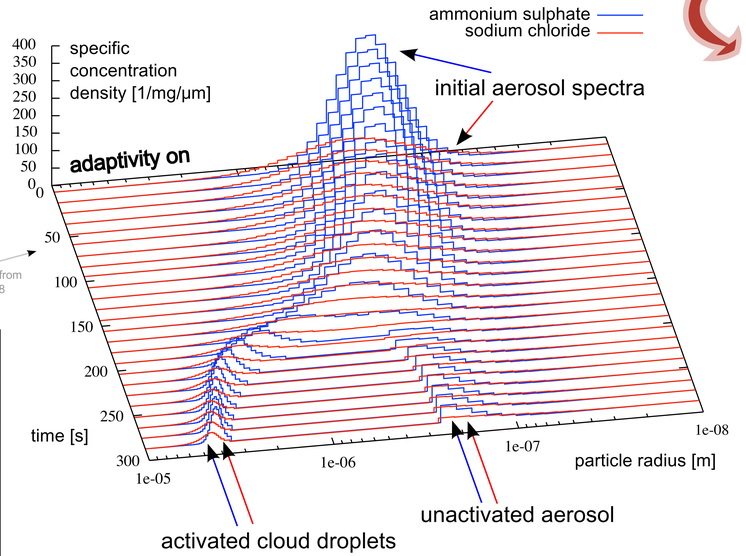
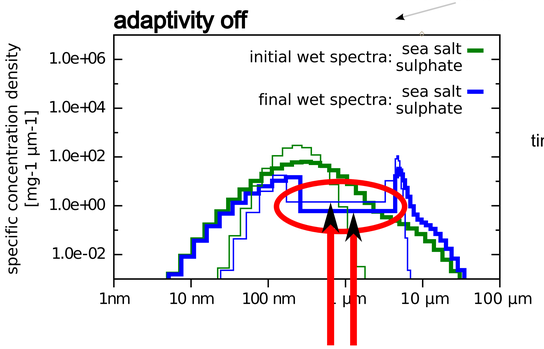


Cloud droplet activation is the very process linking atmospheric thermo- and hydrodynamics with aerosol chemistry and physics.
In the process, the characteristics of the cloud droplet size spectrum are determined by the physicochemical properties of aerosol and the water vapour supersaturation, evolution of the latter being coupled to the vertical velocity of the air.

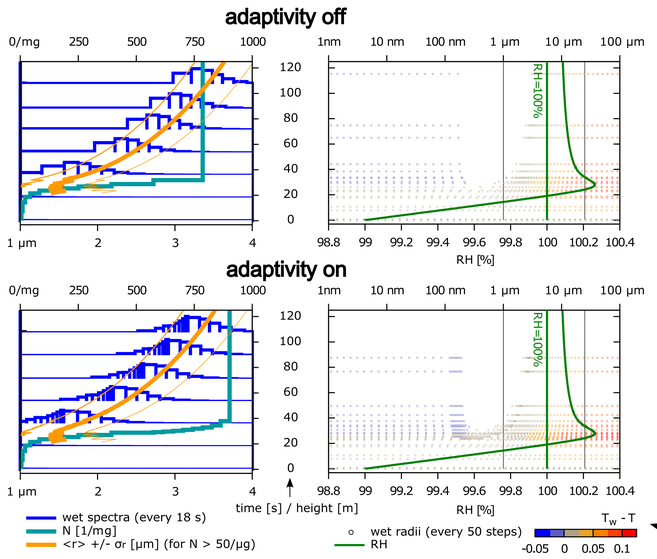
Activation is modelled by numerous investigators using the method of lines (MOL) involving discretization of the aerosol size spectrum into bins whose positions evolve with time.



simulations set-up from Ghan et al. 1998



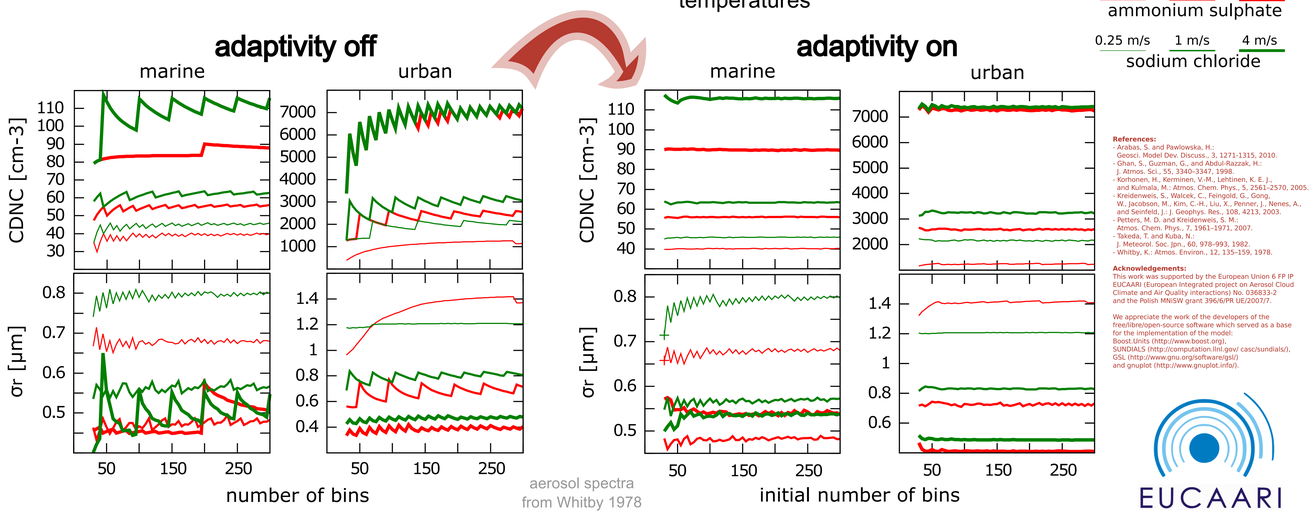
One of the drawbacks of the method is its poor representation of the aerosol size spectrum shape in the region between the unactivated aerosol mode and the activated cloud-droplet mode. Takeda and Kuba (1982), Kreidenweis et al. (2003) and Korhonen et al. (2005) reported sensitivity of model-predicted cloud droplet concentrations to the spectrum discretization parameters (number of bins).



Employment of the adaptive MOL results in reduction of the sensitivity of the calculated drop number concentrations to the initial bin layout (Arabas and Pawlowska, 2010).

model code: http://gna.org/projects/drops/

The developed air-parcel model uses the κ-Köhler representation of aerosol chemical composition (Petters & Kreidenweis, 2007). The drop growth formulation in the model features explicit treatment of the drop temperature evolution, as opposed to the approximate Maxwell-Mason approach.



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