2.032 Development of top-down emission inventories and models for non-anthropogenic sources; examples of vegetation fires, biogenic aerosols, sea salt, and wind-blown dust.

Presenting Author:

Mikhail Sofiev, Finnish Meteorological Institute, mikhail.sofiev@fmi.fi

Co-Authors:

Joana Soares, Finnish Meteorological Institute

Julius Vira, Finnish Meteorological Institute

Marje Prank, Finnish Meteorological Institute

Rostislav Kouznetsov, Finnish Meteorological Institute

Pilvi Siljamo, Finnish Meteorological Institute

Abstract:

Top-down emission estimation via inverse dispersion modelling can be used for problems, where bottom-up approaches are difficult or uncertain. Emission from wild-land fires, biogenic aerosols from vegetation, wind-blown dust and sea salt, all strongly depend on environmental forcing and ecosystem state, which limits the value of static emission inventories. In combination with dispersion modelling, the satellite and/or in-situ observations can be used to constrain the time- and space-resolving emission fields. The approach then refines the a-priori emission (inventories, lab studies, etc) for real-life situations using the inverse-modelling technique.
The emission calculation includes two steps:

- top-down calibration of emission factors and model parameters via inverse problem solution that is made once using training dataset from the past,
- bottom-up application of the obtained emission model in dispersion computations using the appropriate input data, such as individual-fire radiative energy observations.

This procedure can be extended with a dynamic adjustment of the emission model via assimilation of available observations.
However, the approach also has significant uncertainties. One of them refers to inaccuracies of the inverse problem solution that originate from imperfect observations, shortcuts in the model formulations and assimilation algorithm, etc. Using examples of the SILAM CTM applications to several fire episodes, and vegetation blossoming and dust outbreaks, it is pointed out that the top-down system calibration performed for a limited number of comparatively moderate cases (often the best-observed ones) may lead to errors in application to extreme events.
Our experience also showed that “second-class” effects, which are usually ignored or simplified, can easily bring a few times difference in the model-measurement comparison: sea surface temperature and salinity for sea-salt emission, fire aerosol size distribution, diurnal variation and injection height, sand size and composition in deserts, vegetation treatment and anthropogenic stress on plants, are among the most-significant factors.