Comparing three sea salt emission parameterizations in the North-Western European domain

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In coastal and marine regions, sea salt particles significantly contribute to the particulate coarse mode. Some air pollutants, such as ammonia and nitrous acid, which form new Aitken mode particles in the absence of particles, condense onto sea salt particles. This affects the particle size distribution and the residence times of these pollutants in the atmosphere. In addition to this, Sea salt contains sulfate and thus contributes to atmospheric particulate sulfur, one of the main constituents of anthropogenic aerosols. Thus, when modeling air pollution in coastal regions, a realistic estimation of sea salt particles is important.

In the Institute of Coastal Research, studies about air quality in North-West Europe are carried out by the means of the Community Multiscale Air Quality (CMAQ) modelling system. In the current CMAQ version (5.0.2) the parameterization published by Gong (2003) is included. It represents wind dependent (Monahan et al., 1986) film and jet droplet generated sea salt particle production. In the surf zone, which is a 50 m wide slice along the coast line, increased emissions are assumed (Kelly et al., 2010).

The approach by Gong (2003) does not include the effect of sea surface temperature (SST) and salinity on the sea salt emissions. Also, the included wind speed dependence does not cover sea salt emissions by waves that are not generated by present wind. In the here presented study two alternative parameterizations were implemented in CMAQ and investigated: combination of Martensson et al. (2003) (MA03), Monahan et al. (1986) (MO86) and Smith et al. (1993) (SM93) proposed by Spada et al. (2013) and one more recent one by Ovadnevaite et al. (2014) (OV14). The first approach includes spume droplet generation at high wind speeds (SM93), SST dependent emissions (Martensson et al., 2003) and the classical wind dependence adapted from MO86. Sea salt emissions were scaled using the salinity in order to cover reduced sea salt emissions above the Baltic Sea. The second approach by Ovadnevaite et al. (2014) includes waves, salinity, SST and wind data.

In the presented study these three parameterizations (GO03, SP13, OV14) were compared in terms of modeled particulate matter concentrations. The results were evaluated by means of measurements of European Monitoring and Evaluation Programme.

Figure 1 shows monthly number emissions of coarse sea salt particles in January and July 2013 generated by GO03 and SP13. The spatial patterns between clearly differ whereas the magnitude is similar . During July wind speeds are lower than during January which leads to considerably reduced sea salt emission in summer. The effect of increased SST during July is negligible because the SST dependence of MA03 affects mainly accumulation mode sea salt emissions.

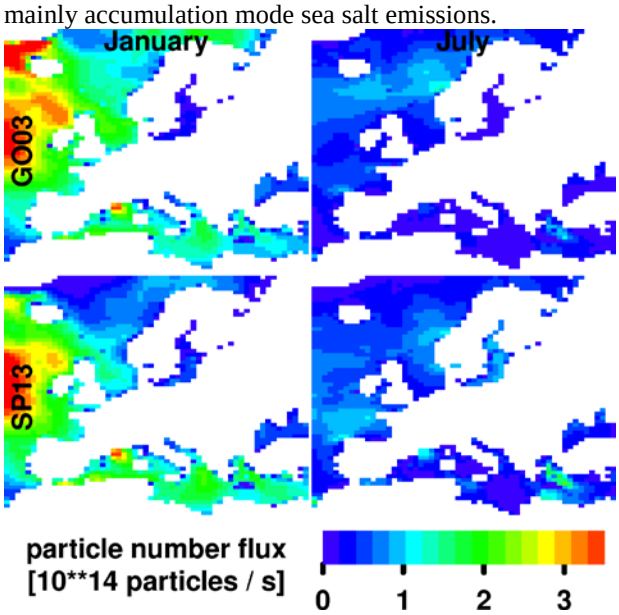

Figure 1: Sea salt number emissions of coarse particles (> 2.5 µm) produced by the GO03 and SP13 parameterizations in January and July (monthly sum).

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