

Performance evaluation of the Regional Air Quality Model CMAQ during the EMeRGe-Asia aircraft observations in spring 2018

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To mitigate climate change efficiently, accurate emissions estimates of SLCFs (short-lived climate forcers) are required as well as greenhouse gases. Controlling SLCF emissions is also relevant to air quality management. However, still, large uncertainties are associated with the estimates of SLCF emissions from Asia. Observations of atmospheric SLCFs could provide meaningful constraints on the emission estimations –in our ERTDF 2-2201 project, we focus on developing methodologies to rapidly estimate Asian emissions of combustion-related SLCFs (black carbon (BC), carbon monoxide (CO) and nitrogen oxides (NO_x)) by combining observations and atmospheric chemistry-transport model simulations. EMeRGe-Asia aircraft observations (Andrés Hernández et al., 2021) during March–April 2018 provided an excellent dataset over the Asian continental outflow region to evaluate the emission estimates. With the identification of the model's overestimation (underestimation) about the concentration levels of certain species, correction factors needed for the used emissions might be derived. However, this must be valid when the transport, dispersion and loss are well represented in the model. In this context, we initiated a basic evaluation of the performance of our CMAQ regional air quality model in terms of the three-dimensional distributions of the target substances along the aircraft observations. The superior performance of the model simulations was demonstrated over most of the flights from Taiwan heading both south and north, especially for the boundary layer across Taiwan. We focused on several flight segments of EMeRGe-Asia, around Taiwan, Jeju, and the coastal regions of East Asia. For the air masses from China, the model's BC overestimation and CO underestimation were evident, pointing to the possibilities of emission biases (at most +1.62 mg m⁻³ BC, -400 ppbv CO). These features are consistent with our previous studies compared with ground-based observations at Fukue Island. We will illustrate more results about the emission biases per air mass origin areas during the presentation.

Keywords: SLCF, CMAQ, EmeRGe-Asia, Regional Air Quality model, aircraft measurement