Numerical Simulations of Smoke Haze Transport over Southeast Asia by using WRF-Chem

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Accurate representation of hazardous smoke haze forecast and assessment is critical for environmental management and planning purposes. Singapore is affected by severe smoke haze due to forest fires and open biomass burning to clear land for agricultural uses in the region. In the present study, an attempt has been made to simulate the South-East Asia (SEA) hazardous smoke case (September 2019), which affected several countries in SEA. We conducted simulations using the Weather Research and Forecasting model coupled with Chemistry (WRF-Chem) at a spatial resolution of 9 km ×9 km to simulate the formation and transport of biomass-burning hazardous smoke case in SEA. High-resolution simulations are conducted using 1x1 degree, 6 hourly Final Analysis (FNL) data and 0.5x0.5 degree, 3 hourly Global Forecasting System (GFS) data for meteorological fields for initial and boundary conditions for event. The Naval Research Laboratory’ s Fire Locating and Modeling of Burning Emissions (FLAMBE) emission inventory with 800 m injection height is used for model simulations. There are many uncertainties in the mesoscale modeling of smoke transport over the study region because of persistent cloud cover, high relative humidity, urban topography and the complexity of the tropical meteorology. Results show that WRF-Chem is able to capture the hazardous smoke haze reasonably well for both FNL and GFS. A slight under prediction of the PM2.5 mass concentration for FNL_30days simulations and overprediction with FNL_4days and GFS_4days simulations compare to five available observation stations over Singapore region is observed. Qualitative and quantitative comparisons between the model results reveal that the FNL_30days best simulated the hazardous smoke haze event over the study region, followed by FNL_4days and GFS_4days.

Keywords: South-East Asia (SEA), WRF-Chem, FLAMBE, FNL, GFS

