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Quantitative assessment of Methane concentration using WRF-GHG model over Middle East and Iran

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Methane (CH_4) is the second most important greenhouse gas after carbon dioxide (CO_2). It helps to increase the mixing ratio of these gases and accounts for 18% of the atmospheric greenhouse effect. Based on all measurements (both ground and satellite) the concentration of greenhouse gases such as CO_2 and CH_4 are increasing in the world. For an accurate evaluation of the significance of their dispersion, quantitative monitoring of greenhouse gas emissions in areas with urban and human sources is essential.

The WRF-GHG model is used in this work to better understand the contributions of different methane sources in Iran. In the simulation we have considered the Middle East as the first domain with a resolution of 30 km and Iran as the second domain with a resolution of 10 km.

The main sources of methane are taken into consideration: burning biomass, anthropogenic emissions, and emissions from wetlands. The warm (Aug) and cold (Feb) seasons in 2010 are contrasted in order to examine the impacts of the seasonal variations of natural sources and meteorological conditions.

Surface observations from synoptic stations are used to evaluate the simulated meteorological fields, showing that the model can accurately represent variations in wind, relative humidity, and surface temperature over time.

Compared to GOSAT data, the average bias error for methane concentration simulations in the warm and cold seasons, according to the results, is -24.99 and 7.50 ppb, respectively., the predicted methane concentration is often underestimated in August and overestimated in February. The WRF-GHG model performs statistically better in the cold season than in the summer season.

The monthly average of methane fluxes in Iran, shows the maximum methane occurs throughout the late night to early in the morning hours in February and August. Iran contributes significantly to the Middle East's methane emissions production. According to an analysis of the spatial distribution of emission sources for the months of February and August, the presence of oil refineries and rice-growing wetlands in the north and west of Iran contributes significantly to the concentration of gasses in the center of Iran.