Modeling of Na airglow emission and first results on the nocturnal variation at midlatitude

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The ablation of meteors at the mesopause region results in the formation of sodium layer. Due to the fact that it has a large scattering cross section and also that it acts as a tracer for the thermal and dynamical states of the atmosphere in the mesosphere region, the mesospheric sodium has been studied extensively among the meteoric metals. A model for sodium airglow emission is developed by incorporating all the known reaction mechanisms. The neutral, ionic and photochemical mechanisms are successfully implemented into this model. The values of reaction rate coefficients are based upon the theoretical calculations as well from experimental observations. The densities of major species are calculated using the continuity equations, whereas for the minor, intermediating and short lived species steady state approximation method is used. The modeled results are validated with the rocket, lidar and photometer based observations for a branching ratio of 0.04. The inputs have been obtained from other physics-based models and ground- and satellite-based observations to give the combined volume emission rate (VER) of Na airglow between 80 and 110 km altitude. In the present study, the model is used to understand the nocturnal variation of Na VER during the solstice conditions. The model results suggest a variation of peak emission layer between 85 and 90 km during summer solstice condition, indicating a lower value of peak emission rate during summer solstice. The emission rates bear a strong correlation with the O3 density during summer solstice, whereas the magnitude of VER follows the Na density during winter solstice. The altitude of peak VER shows an upward shift of 5 km during the winter solstice.

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