Geophysical Research Abstracts
Vol. 21, EGU2019-4002, 2019
EGU General Assembly 2019

The Mesospheric Nickel Layer: Observations, Laboratory Studies and Global Modelling

John Plane (1), Michael Gerding (2), Thomas Mangan (1), Shane Daly (1), David Bones (1), Juan Diego Carrillo Sanchez (1), and Wuhu Feng (3)

(1) University of Leeds, School of Chemistry, Leeds, United Kingdom (j.m.c.plane@leeds.ac.uk), (2) Leibniz-Institute of Atmospheric Physics, University of Rostock, Kühlungsborn, Germany, (3) National Centre for Atmospheric Science & School of Chemistry, University of Leeds, Leeds, United Kingdom

Ni atoms are produced by the ablation of cosmic dust particles entering the atmosphere. During six nights between January and March 2018, the mesospheric Ni layer was observed by lidar from Kühlungsborn, Germany (54°N, 12°E). Most of the soundings used a transition from the low-lying excited Ni(^{3}D) state at 341 nm (the first time an excited state has been used for a lidar). The Ni layer peaks around 85 km, with nightly mean Ni peak densities ranging from 280 - 450 cm^{-3}. The ratio of the Fe to Ni abundance is $\sim$38, which is a factor of 2 larger than the ratio in CI chondrites (and a factor of 32 larger than the Fe/Ni ratio observed by the only previous measurement of mesospheric Ni). In the laboratory, three experimental systems were used to interpret these observations: a Meteoric Ablation Simulator, to study the ablation of Ni relative to Na and Fe; a Pulsed Laser Photolysis/Fluorescence system to measure the reaction kinetics of neutral Ni and NiO; and a Fast Flow Tube to measure the ion-molecule kinetics of Ni$^+$ and NiO$^+$. A new version of the Chemical Ablation Model – containing an Fe-Ni phase as well as the standard silicate phase – was combined with the ZoDy astronomical dust model to predict the injection rate of Ni into the mesosphere. This Ni Meteoric Input Function, together with the new reaction rate coefficients, was then added to the Whole Atmosphere Community Climate Model to perform global simulations of the Ni layer for comparison with the lidar observations.