High Energy Particle Precipitation in the Atmosphere
(October 6-8, 2009 Meeting)

Outstanding Issues

1) There is a need to quantify the medium and high energy electron precipitation information, especially regarding:
   a) Precipitating fluxes;
   b) Temporal distribution;
   c) Spatial distribution;
   d) Atmospheric impact.

2) Energetic particle precipitation (EPP) constituent influence issues:
   a) Incorrect model predictions of HNO_3 (ion chemistry, look-up table for HNO3, etc. needed?), N_2O_5, $ClONO_2$, and ClO, when compared with Envisat MIPAS measurements. Model predictions of NO2 and HOCl are in better agreement with MIPAS measurements. How do we resolve these model/measurement discrepancies?
   b) There are MIPAS measurements of N2O, CO, H2O2, CH4, HNO4, which need further investigation regarding their EPP influences.
   c) EOS Aura MLS measurements of OH and HO2 during EPP need further study, especially with respect to HNO3 and diurnal variations.

3) Energetic particle precipitation (EPP) dynamical influence issues:
   a) Is mesospheric or stratospheric temperature changed directly (within days) of particle input? A recent paper [Salby, M., and L. Matrosova, Geophys. Res. Lett., 34, L23702, doi:10.1029/2007GL029586, 2007] shows derived temperature changes from SABER measurements as a result of solar proton events. Such changes need to be compared with other measured as well as computed temperature changes due to particle precipitation.
   b) Are the mesospheric and stratospheric temperature changes due to ozone and/or Joule heating influences?
   c) Are winds changed due to particles?
   d) Model predictions and measurements of surface air temperature (SAT) changes suggest that EPP may be responsible for some variations. What is the physical mechanism responsible for this EPP/SAT correlation?

4) Transport of thermospheric NO to the middle atmosphere:
   a) Can NO created in the lower thermosphere (~105-110 km) be transported down into the middle mesosphere (~70-80 km) in winter?
   b) Is the vertical neutral wind direction and speed supportive of this NO transport?
   c) How effective is this process of NO transport and how is it regulated?

5) Nitrate in ice from solar proton events (SPEs): Measurements suggest large spikes in nitrate in polar ice (both Arctic and Antarctic) as a result of large flux and large energy SPEs, however, models are not able to simulate either the observed nitrate or the speed of nitrate deposition from the atmosphere to the ground.

6) It appears that there is some disagreement among energy deposition computations. Is an intercomparison of energy deposition methods needed?