D Region meteoric smoke and neutral temperature retrieval using the poker flat incoherent scatter radar

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This presentation describes the first measurement of the microphysical properties and variability of meteoric smoke particles (MSPs) at high latitude using the Poker Flat ISR (65.1N, 147.5W). In addition, we present a novel technique for determining height resolved daytime D region neutral temperatures, which takes into account the presence of charged dust. We discuss the temporal/spatial variability and the relation to meteoric input observed and MSP microphysical properties in the polar mesopause region.

The derived nanometer sized MSPs are consistent with size profiles derived previously using radar/rocket techniques and we note that our results imply a lack of heavy cluster ions below 85 km during the observing period. The hourly variability in size of approximately 0.5 to 1.5 nm as a function of altitude is more variable than previously observed at Arecibo's equatorial latitude, the cause for this variability is as of yet unclear. However, we believe that there is evidence for production via meteor ablation during the period near sunrise where the size triples during a 1 hour period from 15-16 UT; but, transport likely plays a major role in smoke evolution.

The temperatures generally agree with other model and observational results, although the derived temperatures are more dynamic and variable than MSIS, WACCM, or SABER temperatures. This is not surprising considering the climatological nature of models and observations that do not capture highly-variable small-scale temporal/spatial local dynamics. Noting that these observations were not originally intended to optimize the measurement of neutral temperature. However, these results offer a promising new technique for range-resolved daytime neutral temperature, a quantity of great importance that has been provided only sparingly from several lidar sites and satellite observations.

Further investigation and multi-site measurements in conjunction with global models and neutral wind measurements are required to assess the relative contribution from transport versus local production. This work provides a template for potential use at many other radar sites for the determination of microphysical properties of MSPs and day-time neutral temperature in the D region that show good general agreement with other temperature data during the observing period.