

Observations of Polar Dynamics in the Mesosphere and Lower Thermosphere from the Polar Environment Atmospheric Research Laboratory.

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A suite of instruments capable of observing phenomena in the polar mesosphere and lower thermosphere has been established at the Polar Environment Atmospheric Research Laboratory (PEARL) situated in the Canadian high Arctic at Eureka, Nunavut, Canada (80N, 86W). Observations with some instruments started in 2007 but the full suite started operation in 2008. Instruments located at this site include a meteor radar, a Rayleigh lidar, a Spectral Airglow Temperature Imager (SATI), an all sky airglow imager and an E-Region Wind Interferometer (ERWIN II). The meteor radar provides hourly wind profiles (82 to 97 km), SATI provides rotational temperatures (~ 2K precision) and airglow irradiance for O₂ and hydroxyl on a 4 minute cadence, the all sky imager provides airglow irradiance images for hydroxyl, sodium, oxygen green and red line and N₂⁺ (10 minutes for a full cycle through all emissions with hydroxy alternating with the other emissions), and ERWIN II provides horizontal and vertical winds (~1-2 m/s accuracy) and airglow irradiance for hydroxyl, O₂ and oxygen green line on a two minute cadence. The lidar has the potential to provide temperatures up to ~70 km but has not been operational on a consistent basis. The observation footprint of each instrument in the sky is shown in Figure 1 and a hydroxyl image from the all sky camera is shown in Figure 2.

In this paper, results from this site are presented. The data analysis algorithms for the ERWIN II instrument were finalized in 2012 so full scientific advantage of the co-location of these instruments is only now starting to take place. Of interest are studies of the tidal signatures observed using the meteor radar, temperature and irradiance observations with SATI taken during the 2009 Sudden Stratospheric Warming and wind and irradiance variations over a variety of scales taken using the all sky imager and ERWIN II. These observations provide a detailed view of the dynamics which are present in the high Arctic. They also provide the first direct observations of vertical wind and airglow signatures for gravity waves with periods down to ~60 minutes. Puzzles remain as to how to relate these signatures to the horizontal motions at the same periods.

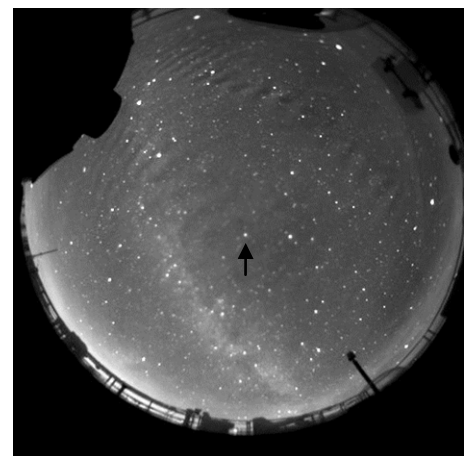
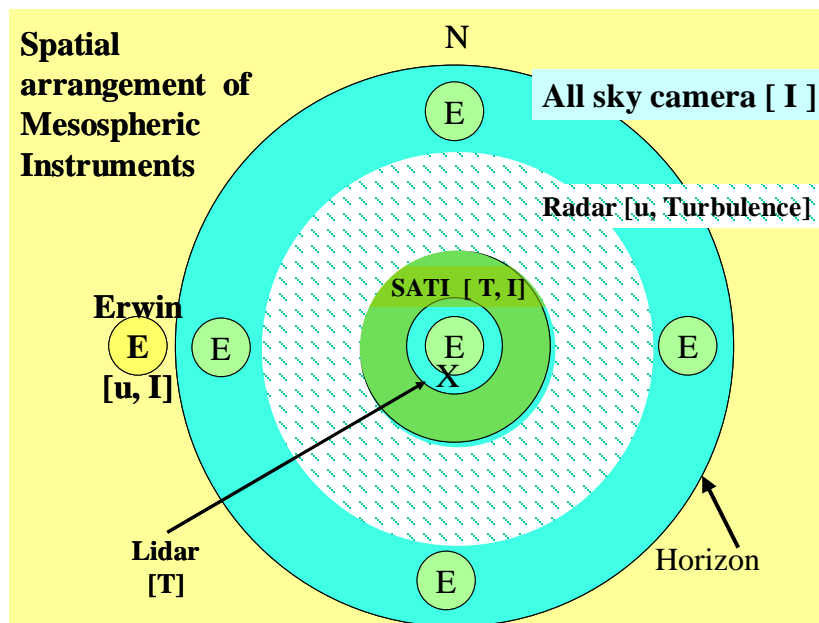


Figure 2. A hydroxyl image from the all sky imager showing gravity wave signatures. This figure shows the full sky as observed at Eureka. Polaris is indicated by the arrow.

Figure 1. A schematic showing the relative observation sites in the sky of the instruments located at PEARL. Light green disks with the letter E represents the ERWIN II observations, SATI observations are indicated by the bright green disk, the radar observations by the texture disk and the all sky imager observes the full sky.