Rayleigh/Mie/Raman Lider (RMR) (Mentor: T. Duck) will measure profiles of tropospheric aerosols, clouds, and some information about its distribution (profile information). These measurements will be used by this system, and are needed to produce the full variety of data products: 355 nm and 532 nm.

All-Sky Imager (All-Sky Imagery) (Mentor: T. Duck) is a two-channel, Fabry-Perot interferometer. It monitors the dynamics and temperature in the upper mesosphere by alternate observations of the O2 atmospheric (0-1) nightglow emission layer at 94 km and the OH Meinel (6-2) layer at 87 km. In meteor-detection mode horizontal winds (80-100 km) are measured, effectively continuously in time, with data resolution of 3 km and 1 hour. All-Sky Imager (Mentor: W. Ward) is an interferometer for measuring mesospheric winds through a measurement of airglow emission, specifically OH, O2, and O. This combination yields wind speed and radial direction for 3 attitudes in the range of 87-97 km.

Fourier Transform Spectrometer (FTS) (Mentor: K. Strong) will be used to record UV-visible absorption spectra that will yield the amount of an atmospheric constituent (column amount) and wave anisotropy at the height of the tropopause. In meteor-detection mode horizontal winds (80-100 km) are measured, effectively continuously in time, with data resolution of 3 km and 1 hour.

The PEARL facility at Eureka

The Polar Environment Atmospheric Research Laboratory (PEARL) is a sophisticated observatory in the Canadian Arctic at Eureka (60°N, 93°W). It houses a suite of instruments including radars, lidars, spectrometers, radiometers and imagers which allow measurements of Arctic conditions from the ground to the lower thermosphere. One scientific theme being investigated at the observatory is the wave environment in this region and the coupling of the dynamics between atmospheric layers and locations. Instrumentation pertinent to these investigations include the E-Region Wind Interferometer, the meteor radar, the Spectral Airglow Temperature Imager, the PEARL All-Sky Imager, the ozone and Rayleigh/Mie/Raman lidar, the VHF and cloud radar, the Fourier Transform Spectrometer and the Atmospheric Emitted Radiance Interferometer. Together these instruments provide the means to determine the mean fields, and wave signatures associated with tides, planetary waves and gravity waves from the stratosphere to the mesosphere region. Interpretation of these results will be supported with satellite observations, model results and analyses from data assimilation. Collaborations are being developed with other polar observatories so that a global view of these processes in the Arctic middle atmosphere can be developed. This effort will peak during International Polar Year. In this paper the capabilities of the observatory will be described and some early results presented.

Instrumentation Relevant to the Waves and Coupling Theme

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Science Questions

• What are the relative roles of waves, and solar and magnetospheric processes, in providing and coupling variability in the Arctic atmosphere? The suite of instruments at PEARL allows for extensive examination of wave properties of the various types of waves over Eureka.

• What are the characteristics of gravity waves, tides and planetary waves near the arctic pole and how are these characteristics correlated with season, in altitude and with large-scale dynamical events? The suite of instruments at PEARL allows for extensive examination of wave properties of the various types of waves over Eureka.

• What are the characteristics of gravity waves observed at Eureka? How do these waves evolve with height and dissipate and what role do they play in the coupled variability and transport in polar regions?

• What are the effects of sudden stratospheric (winter) warmings upon the dynamical and chemical (e.g. ozone loss) characteristics of the lower and middle/upper atmospheres, and how do they differ from other polar locations e.g. Europe and Antarctica?

• What are the relative roles of waves, and solar and magnetospheric processes, in providing coupling and variability in the Arctic atmospheric circulation (10-100 km) above Eureka? What is the related evidence for “Solar Influences upon Climate”?

• What are the processes involved in the coupling between major equatorial processes (QBO and ENI) and the variability of the Arctic atmospheric circulation above Eureka?

Observations of Waves and Coupling at the Polar Environment Atmospheric Research Laboratory (PEARL) in Eureka, Canada

The figure to the left shows the sampling of the various instruments observing the mesopause region in an all-sky view. This schematic shows the instrument sampling location relative to the horizon. These instruments will provide information on the background wind, temperature and airglow fields, the wave amplitudes and long and short term variability in these fields. Correlations with PEARL observations and satellite/assimilated fields at lower altitudes will provide information on the coupling from below.

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Initial Results and Analyses

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