

Observations of Gravity Waves over Eureka using the All Sky Imager

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Instrument

The PEARL (Polar Environment Atmospheric Research Laboratory) All Sky Imager (PASI), a CCD imaging system with six different narrow band interference filters, is located at PEARL at Eureka, Nunavut (80N). The filters used for the analysis on this poster are: sodium (at 589.3 nm), atomic oxygen green line (at 557.7nm) and hydroxyl (at 720.91nm notched at 865nm to mask molecular oxygen). PASI takes an image on average every minute while cycling through the different filters with the hydroxyl filter interleaved between the other filters in the sequence.

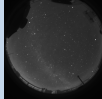
The PASI has been operating at PEARL since November 2007 where it has been used to examine gravity waves in the airglow. The filters isolate the airglow emissions which occur at the following heights in the atmosphere: the hydroxyl emission occurs around 87km, the atomic oxygen green line emission occurs around 97km and the sodium emission occurs around 90km.



Picture of the PASI in 2007



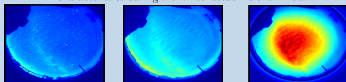
Schematics of the PASI



Example of images that the PASI captures

Analysis

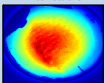
The steps outlined below are implemented in order to determine the presence of gravity waves. After the Fourier Transform is taken for the whole season, the variation of wave characteristics during the winter season is examined.



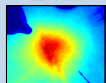
Raw image with no corrections

Median Filter for star removal

Van Rhijn effect correction



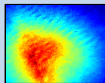
Atmospheric Extinction effect correction



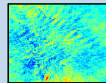
Interpolation and conversion to Geographical Coordinates



Selection of region of interest



Close up of the selected region

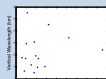
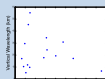
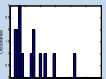


Signals with a period longer than two hours are normalized and filtered out of the image



Resulting Power Spectrum

The spikes in the power spectrum are identified as possible wave candidates. These candidates are then selected based on the power relative to the mean power at that wavenumber, if they are the largest spike in a local area, and if the signal is persistent over multiple images. The vertical wavelength is determined from taking the difference in phase between the different emissions. The waves are filtered according to the criteria: $\lambda_n > 10\text{km}$, $\lambda_m > 7\text{km}$, $\omega_{\text{period}} < 2\text{ hours}$, $\Omega < N$



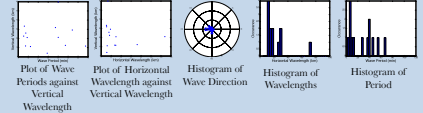
Sample results from upper left to lower right: Wave direction, histograms of intrinsic period and horizontal wavelength, and plots of vertical wavelength against intrinsic period against horizontal wavelength for 1 January 2009

Results

After running this process for a season, we can track the change on a daily, monthly and seasonal basis and identify patterns in the wave characteristics.

Months	Days (Hours) Observed	Gravity Waves Observed	Months	Days (Hours) Observed	Gravity Waves Observed
November	12 (135)	13	January	18 (285)	111
December	19 (356)	20	February	13 (109)	14

Monthly Results for November 2008



Plot of Wave Periods against Vertical Wavelength

Plot of Horizontal Wavelength against Vertical Wavelength

Histogram of Wave Direction

Histogram of Wavelengths

Histogram of Period

Plot of Wave Periods against Vertical Wavelength

Plot of Horizontal Wavelength against Vertical Wavelength

Histogram of Wave Direction

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