Optical Mesospheric Instruments During Deepwave

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Boston University multi-spectral all-sky imagers (ASI) at Mt John Obs., Lake Tekapo and Lauder, Otago
Nightly mesospheric OH, Na, O₂, and OI (557.7 nm) emissions 87, 90, 94, & 97 km. Also OI (630.0 nm).
Single wavelength time resolution: 30-90 s, depending on emission.
Multi-wavelength time resolution: 3-8 minutes, depending on chosen observation profile.
All-sky Instrumentation

All-sky imagers (180° fov), imaging spectrographs (OH & O₂ temperatures), FPI.

Collimating system – also new telecentric systems.

Filter-wheel housing six 4” interference filters.

1. OH 695 nm broadband red-NIR.
2. Na (589.0, 589.6 nm)
3. O₂(0-1) band 865.0 nm
4. O(¹S) 557.7 nm,
5. O(¹D) 630.0 nm FWHM (1.2 - 1.8 nm)
6. Offband: 572.9 nm (MJO) 605.0 nm (LDR) (1.4 nm)

Nominal integration times: 30–120 secs, can be altered.

Imagers operate nightly during moonless periods with filters being used in a repeating sequence throughout the night.

Images of a given emission every 6-8 minutes.
Locations of all-sky imagers at Mt John Obs. (MJO) and Lauder (LDR) (proposed).

Field of views for the OH, O(1S) & O(1D) emissions down to 10° elevation shown.

Sampling areas of OH emission by FPS.
Example of raw and unwarped images in OI 557.7 nm emission at 97 km altitude. Mt John Observatory 4 March 2009.

Frontal gravity wave disturbance in OI 557.7 nm emission at Mt John Observatory on 6 August 2013.
U. of Washington Fabry-Perot Spectrometers

PI: Prof. Gonzalo Hernandez  University of Washington

Two U. of Washington FPS at Mt John Observatory

**MJO:**
- OH 840.0 nm  87 km
- O(\(^1\)S) 557.7 nm  97 km

**MKO:**
- O\(_2\)(0-1) 865.0 nm  94 km
- O(\(^1\)D) 630.0 nm  250 km

Samples N, E, S, W at 20° elevation and zenith in cyclic sequence during course of night.

Yields horizontal neutral winds, temperatures and emission radiance measurements to ±1% every 3-4 minutes in each direction.
U. Of Canterbury Meteor Radar

PI: Prof. Jack Baggaley
University of Canterbury
TX 42.5 MHz (~7m)

~2000 returns per day at 80-120 km
Diurnal variation ~1 every 5s dawn at
~1 every 5 minutes at dusk.
<1 km height res.
During each night: The ASI will each yield ~80 images in each emission (~6pm – 7am NZST)
Start time: ~6UT (Boston 2am)
End Time: ~19UT (Boston 3pm)

Semi-real-time mode:
• Provide unwarped images showing presence (or not) of GW’s in MLT images)
• 2-D context, propagation direction, origin, speed, horizontal scale-sizes.

In conjunction with co-located meteor radar and FPS data:
• Propagation direction, mode, phase and group speeds, horizontal and vertical scale-sizes during each night
• Vertical flux of horizontal momentum estimates associated with GW’s in OH, O₂, and O(¹S) emissions at 87, 94, 97 km.
• Emission radiance measurements.
• Tomographic sections of wave field.