Airglow, Gravity Waves and Dynamical Studies of the MLT Region in Conjunction with TIMED

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Coordinated Image Measurement with TIMED

• **Mid-latitude**
  – Rocky Mountain Imager Chain
  – Coordinated investigation short-period wave propagation and dissipation over large geographic region.
  – Primary wave sources: orography and convection
  – Tidal signatures and seasonal variability in the airglow emissions.

• **Low-latitude**
  – Maui instrument cluster
  – Gravity wave and temperature measurements
  – Primary wave sources: convection
  – Seasonal and intra-seasonal oscillation

• **Future High-latitude**
  – Mesospheric temperature and gravity wave study
Large Field Gravity Wave Dynamics

Rocky Mountain Imager Chain

- BLO (USU)
- Gnd. Jun. (UCB)
- Socorro (UIUC)
- Ft. Co/Plat (CSU)

Site | Institute | All-sky Imager
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BLO | USU | multi-spectral
Gnd Jun | UCB | OH/O2
Socorro | UIUC | OH
Ft. Co/Plat | CSU | OH

August 12-13, 2002
BLO-TIMED Imaging Studies

BLO All-Sky Images
June 4-5, 2002

Airglow Emission Geometry

Total: 184 Nights (1250 Hours)

Total: 152 Nights (975 Hours)

# Observing Hours


2002

2003
Dramatic Gravity Wave Frontal Events
Evidence for Non-linear Wave Interactions?

Feb. 10, 2002 (UT day 041) NIR OH (710-900 nm)
Duration: 4.5 Hrs (8:10-12:40 UT)
SABER Measurements of OH Emission Peak Altitude and VER

Peak Altitude

Volume Emission Rate

OH(λ 1.65 µm)
10 Feb 2002

Courtesy D. Baker et al, USU
Long Range Mesospheric Bore Propagation

Coordinated measurements with Ft. Collin/Platte instrument cluster

Site separation 600 km

Evidence for large scale temperature inversion

$\lambda_h$: 27-30 km
v: 74 m/s
t: 5:55 UT

Bore Wave Event

Site separation 600 km

$\lambda_h$=22 km
t=8:10 UT, v=74 m/s
T=10:10 UT, v=40 m/s

Courtesy C. Y. She
BLO Long-Period/Tidal Wave Studies

![Graph showing various wave patterns and durations](image)

Courtesy C. Y. She
Sudden Reduction in [O] Emission Data

Sep. 26, 2003
UT day 269
Low-Latitude Mesospheric Temperature Investigations

- High Sensitivity CCD Imager
- Site: AEOS, Maui, HI (20.8N, 156W)
- Measurements since Nov. 2001.
- Sequential observations of:
  - NIR OH (6,2) Band ~ 87 km
  - $O_2(0,1)$ A Band ~ 94 km
  - Background (~857.5 nm)
- Field of view ~110 km (circular).
- Cycle time: ~ 3 min.
- Temperature precision ~1-2K.

Over 400 nights of quality data (4-9 hours duration)
Semi-Annual Oscillation in OH and O₂ Temperature and Intensity
SAO in Mesospheric Temperature

- O₂ Amplitude = 4.8K
- OH Amplitude = 7.3K

15 day average
Least Square Sinusoidal Fit
Evidence for Asymmetry in Mesospheric SAO Temperature?

Garcia & Clancy, 1990

(Takahashi et al, 1995)

Courtesy H. L. Liu and R. Roble
New IR Temperature Mapper for ALOMAR (69°N)

Photo Courtesy Armin Schoch
ALOMAR
Mesospheric Temperature Mapper

Objective:
Coordinated mesospheric temperature measurements at high
latitudes with TIMED/SABER and ground-based lidar, radar
soundings.

Instrumentation:
• Closed cycle cryogenically cooled (77 K) imaging system.
• Measurements of OH(4,2) and (3,1) band at ~1.5-1.6 µm, identical
to the wavelength used by SABER for OH emission.
• Signal ~ 70 times stronger than the OH(6,2) band.
• High signal-to-noise ratio images (~100:1) in <5 sec.
• Measurements possible in presence of aurora.
• Currently under development at Utah State University.
Coincident BLO-Ft Collins Wave Measurements
Semi-Annual Oscillation in OH and $O_2$
Temperature and Intensity

HAWAII; USU-MTM data, 2001-2003

Maui-MALT; USU MTM data, 2001-2003