OBSERVATIONS OF MESOSPHERIC GRAVITY WAVES OVER THE ANDES

Jonathan Pugmire
Center for Atmospheric and Space Sciences
Utah State University

Student Research Symposium
April 9, 2015
Atmospheric Gravity Waves
- Mountain Waves

Andes Lidar Observatory
- Ground measurements

SABER measurements
Andes Mountains
Cerro Pachon, 2715 m

Andes LIDAR Observatory
Installed Aug 2009: 65+ months
1100+ nights of data

CCD imager

ANDES LIDAR OBSERVATORY
EXAMPLE OH ANALYSIS

Variance

Time (hours)

Band Intensity (counts)

20k

20

40k

60k

80k

-2

0

2

4

6

8

10
Increased temperature variance during winter months

(Jiang et al., 2002)
Increased wave activity in winter observed from ground.
SABER INSTRUMENT

Sounding of the Atmosphere using Broadband Emission Radiometry

Aboard the TIMED satellite
Measure temperature in zone

Method from John and Kumar, 2012 and Jiang, 2002
INSTANTANEOUS PROFILES
BACKGROUND TIDAL PROFILE

![Graph showing background tidal profile](image-url)
Gravity wave perturbation revealed.

Growing wave travelling upward.
Increased wave activity observed from space during the winter along with fall and spring.

87 km average: 9.6
COMPARE SABER WITH GROUND MEASUREMENTS
REFERENCES


• John, S.R., and Kumar, K.K. (2012), TIMED/SABER observations of global gravity wave climatology and their interannual variability from stratosphere to mesosphere lower thermosphere, Climate dynamics, 39(6), 1489-1505


Into the Mesosphere

All-sky Images courtesy of Alan Liu, University of Illinois compiled by Neal Criddle

23:00 UT
$T_{OH} = \frac{\text{SomeNumber}}{\ln[\text{stuff} (P_1(2)/P_1(4))]}$

Goldman et al., 1998

2 K Precision
STEP 3: AT EACH HEIGHT ESTIMATE WAVES WITH WAVENUMBER 0-6.
STEP 3: AT EACH HEIGHT ESTIMATE WAVES WITH WAVENUMBER 1.
STEP 3: AT EACH HEIGHT ESTIMATE WAVES WITH WAVENUMBER 2.
STEP 3: AT EACH HEIGHT ESTIMATE WAVES WITH WAVENUMBER 3.
STEP 3: AT EACH HEIGHT ESTIMATE WAVES WITH WAVENUMBER 0-6.
Mesospheric Temperature Mapper

- Sensitive bare CCD Imager developed to measure mesospheric temperature variability using airglow emissions.
- Field of view ~90°, (180 x 180 km at 90 km altitude). Sequential observations (30 sec. exposure) of:
  - NIR OH (6, 2) Band ~87 km
  - Background (~857.5 nm)
- Cycle time: ~3 min per OH temperature determination. (Precision ~2K).

CCD Imager
90° Field of View
NIR OH (6,2) Band
~87 km
Background
3 min Cycle
~2K Precision