Combining AIRS and MLS for 3D Gravity Wave Detection

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1. Combining AIRS and MLS
Example – 6th May 2008

Wright et al (GRL, 2016)
Combining Satellites for 3D MF

Constrained 3-vector -> **directional** MF
Example – 6th May 2008

Wright et al (GRL, 2016)
2. 3D MF over the Andes
Test Region – Andes/Peninsula in August

Strong Zonal Winds

Major N-S Orographic Barriers
MLS-derived $\sum |MF|$, August 2008

MLS-only

MLS, Aug 2008

40km altitude

Computed using method of Wright and Gille (GRL, 2013)
AIRS-derived $\sum |MF|$, August 2008

AIRS-only*

*assumes orographic waves; amplitudes scaled

40km altitude

AIRS/MLS Combined $\sum |MF|$, August 2008

Combined

40km altitude

Wright et al (GRL, 2016)
Net Directional GW MF (per satellite pass)

Upwind wavevector – consistent with orographic generation

Wright et al (GRL, 2016)
Orographic

Non-Orographic?

Wright et al (GRL, 2016)
3. Comparisons to 2D GW MF
Subregion
Geographic Coverage

(a) COSMIC, HIRDLS, MLS and SABER

(b) AIRS, SAAMER and sondes
Data Availability

Height Series for Each Instrument, August

August

SAAMER
Meteor Radar
raw data courtesy D Fritts, D Janches

SABER (1)
Limb Sounder

MLS
Limb Sounder
analysed data courtesy M Ern

COSMIC
GPS Occultation

HIRDLS
Limb Sounder

AIRS
Nadir Sounder
Mt Pleasant
Radiosondes

Wright et al 2016b
in prep for Atmos. Meas. Tech.
Absolute Magnitudes at 40km, all Augusts

MF [mPa] 0.16  0.4  1  2.51  6.31  15.85

* monthly means only
μ oro. assumption, attenuation-scaled

not at this height!
AIRS and MLS can be combined to measure gravity waves in 3D. Assuming upward propagation, we can infer net GW MF, with |MF| comparable to previous studies. Preliminary results suggest that Andean MF is orographic and directed south-westerly, and that MF downstream of the Andes may be non-orographic.
Further Reading

**MLS/AIRS 3D Analysis Method**
Wright, Hindley, Mitchell  
GRL, January 2016, doi:10.1002/2015GL067233

**2D S-Transform Method**
Hindley, Smith, Wright, Mitchell  

**Inter-Instrument Comparisons: GWPE**
Wright, Hindley, Moss, Fritts, Janches, Mitchell  

**Inter-Instrument Comparisons: GWMF**
Wright et al, in prep for AMT (hopefully out soon!)