

# Combining AIRS and MLS for 3D Gravity Wave Detection

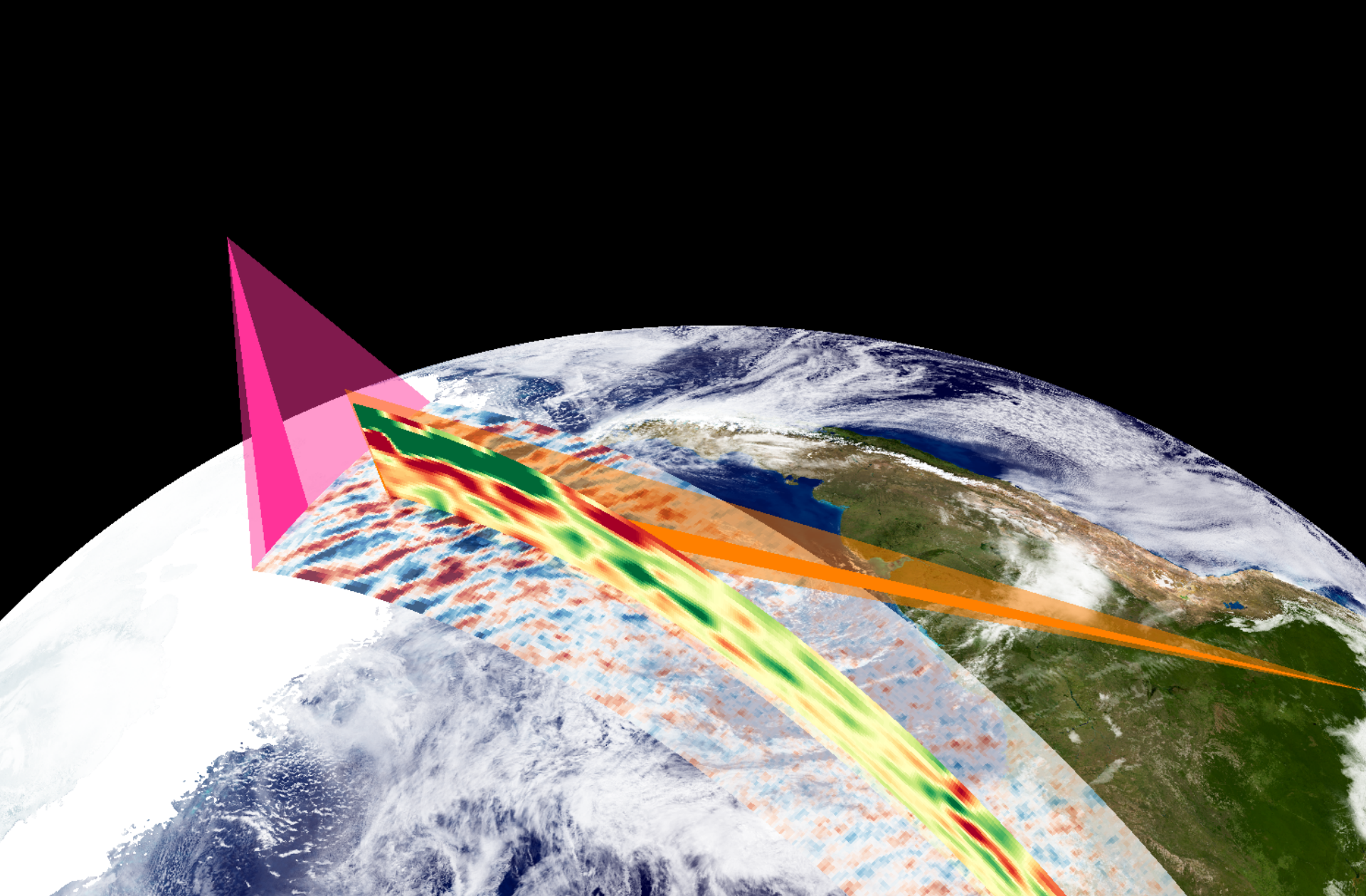
**2016 SPARC Gravity Wave  
Symposium**

State College, Pennsylvania, USA  
19<sup>th</sup> May 2016

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Andrew Moss, and Nick Mitchell**  
*University of Bath, UK*



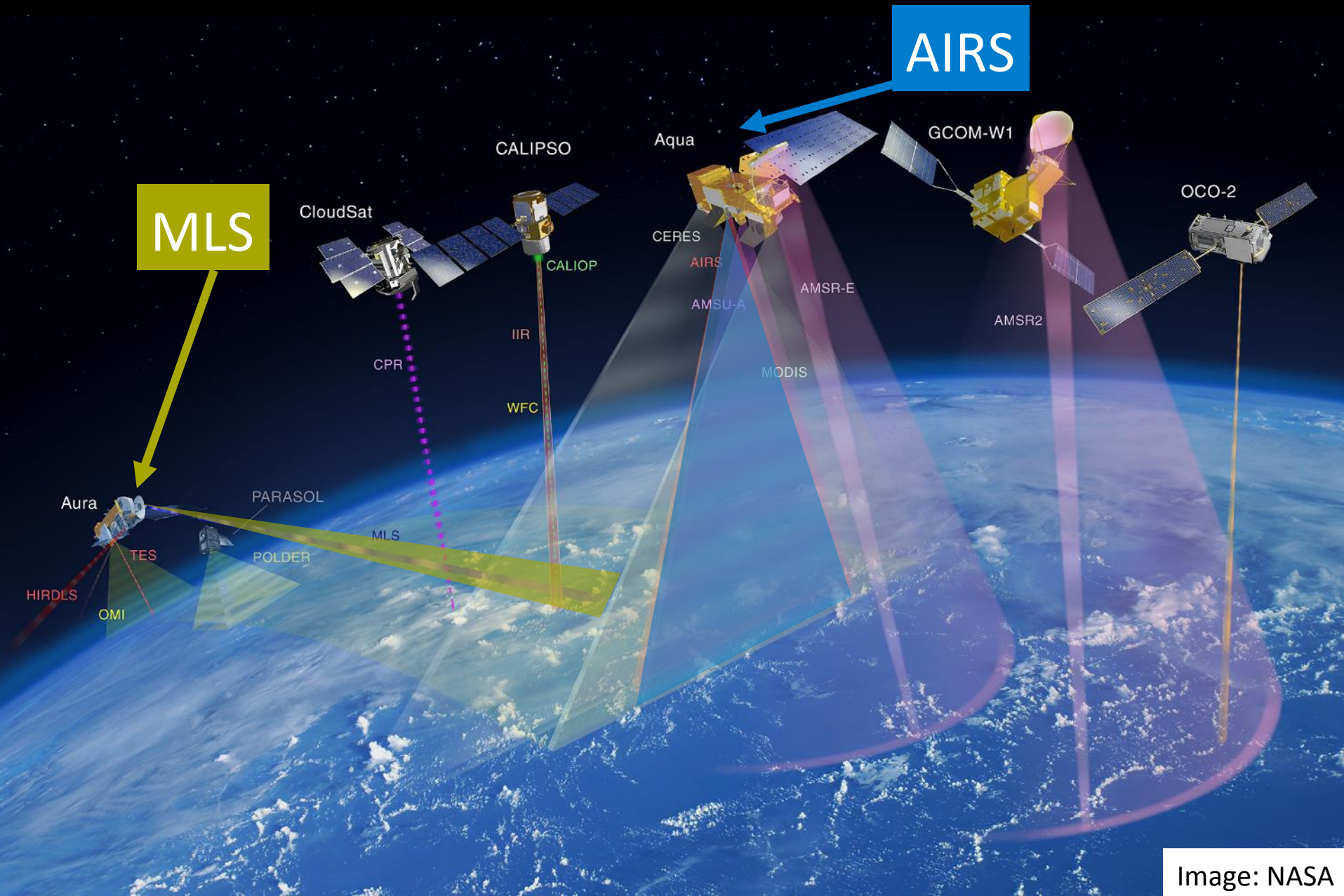




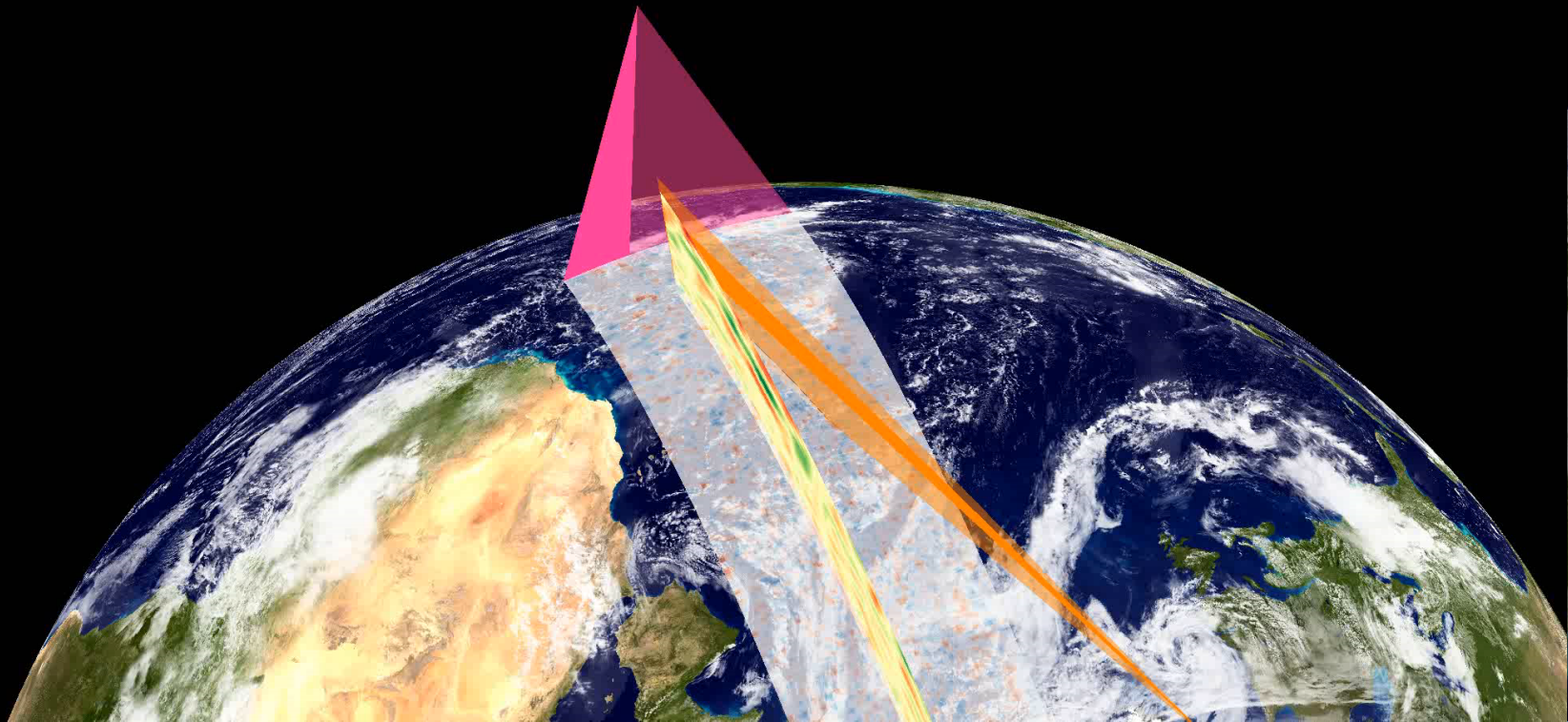
# 1. Combining AIRS and MLS



# The A-Train Constellation



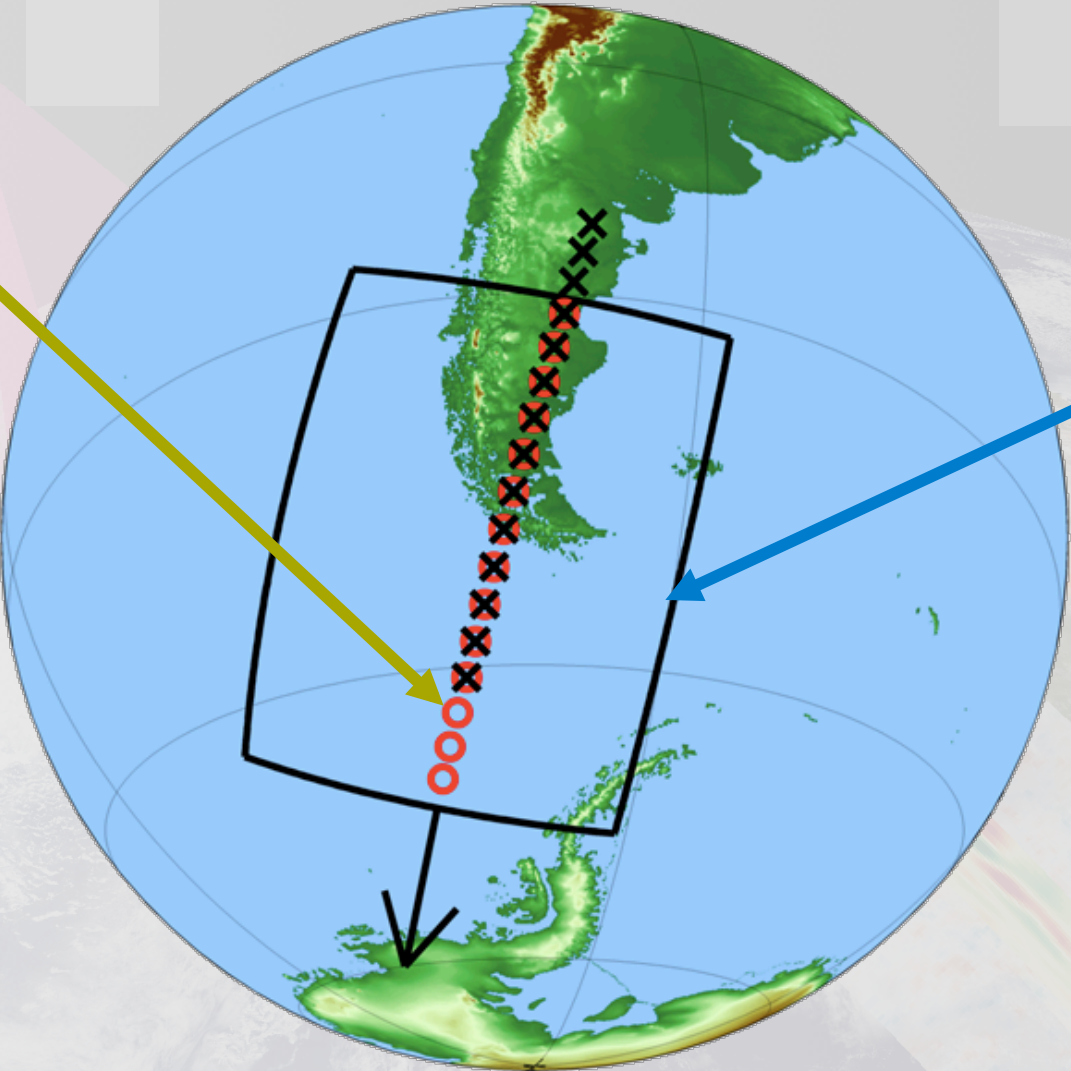
# Example Orbit



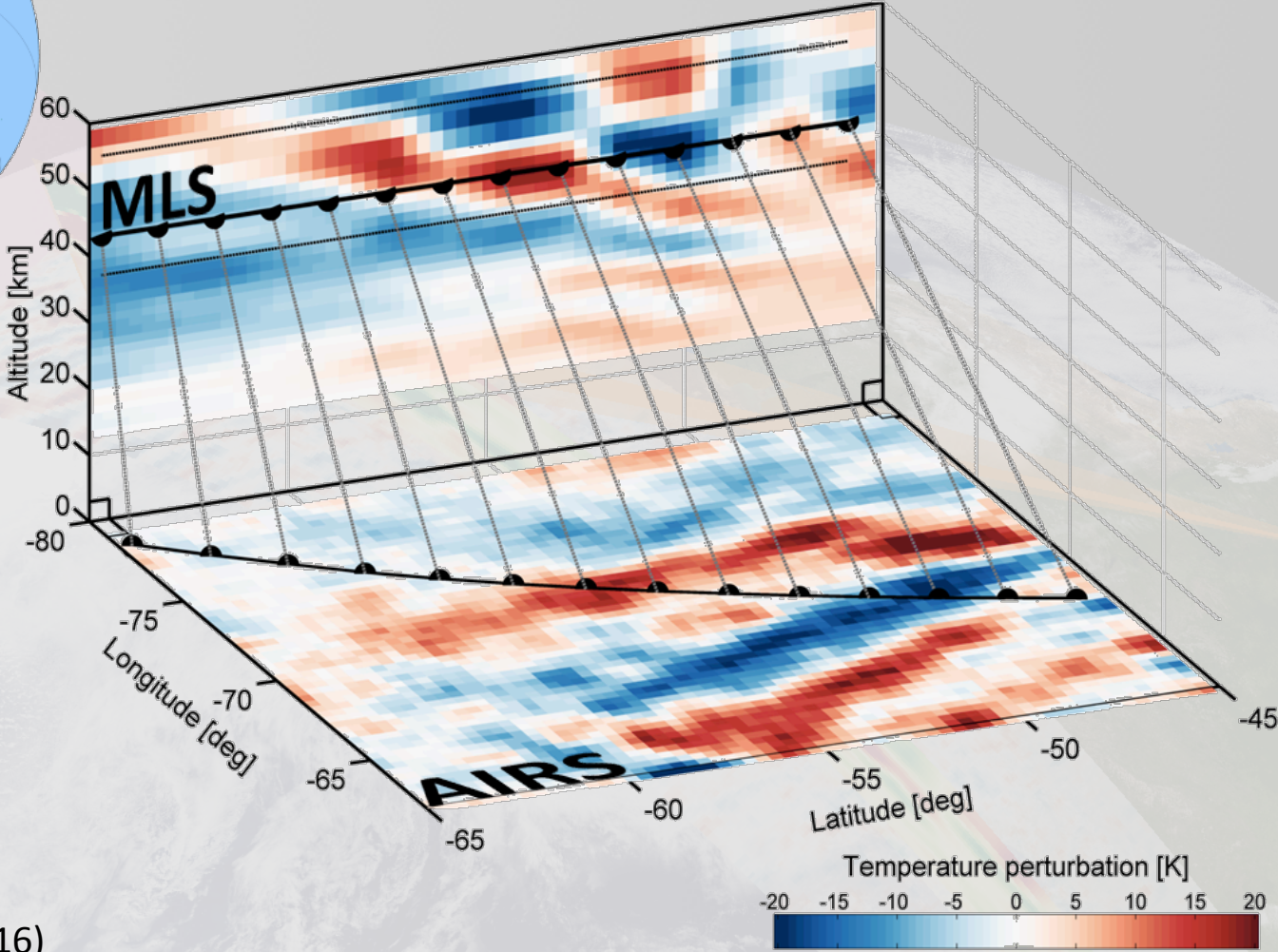
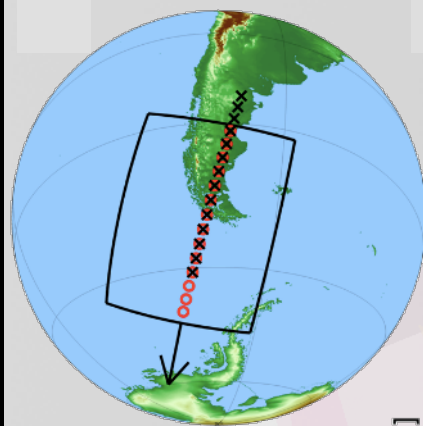


MLS

AIRS



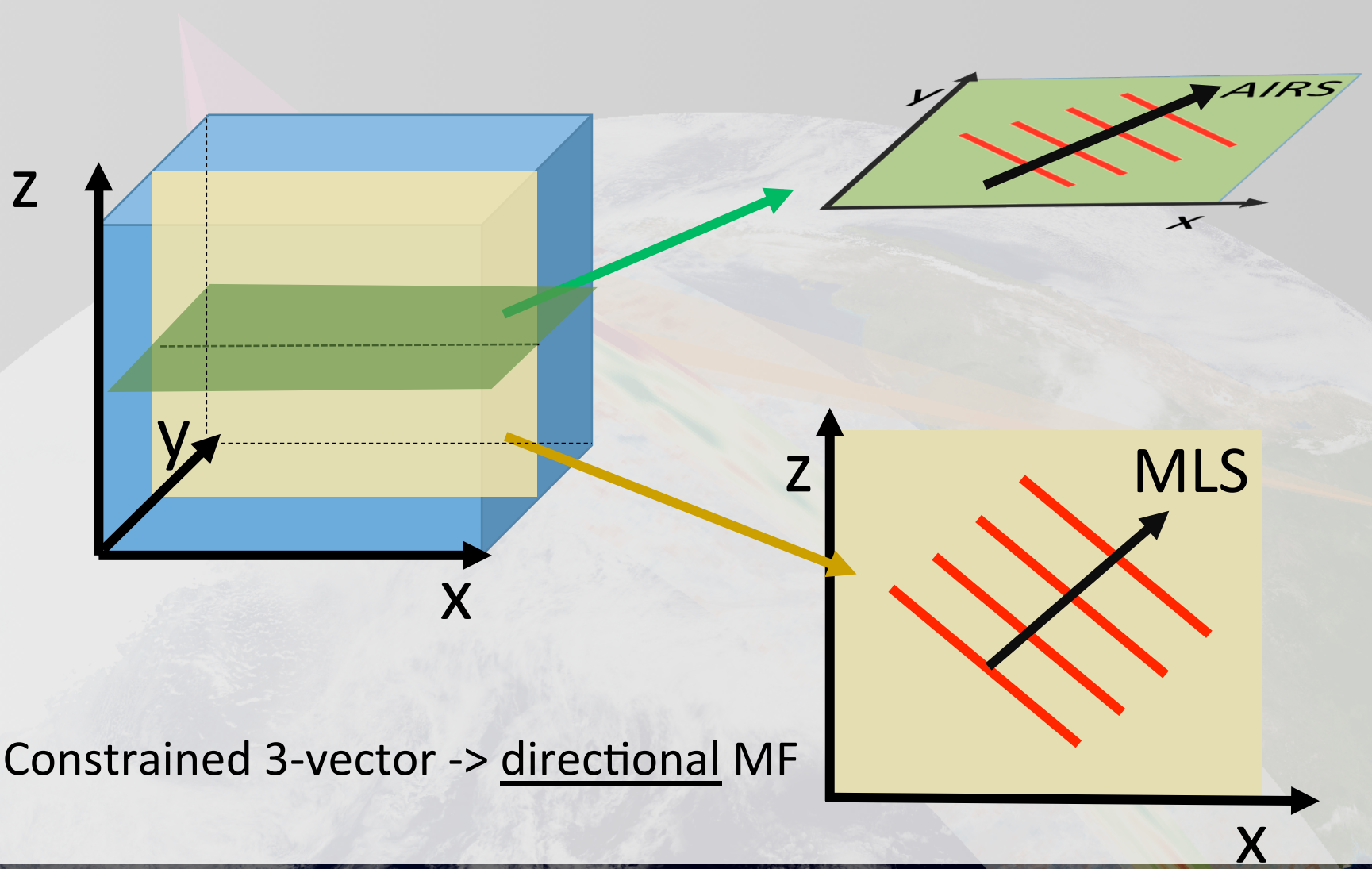
# Example – 6th May 2008



Wright et al (GRL, 2016)

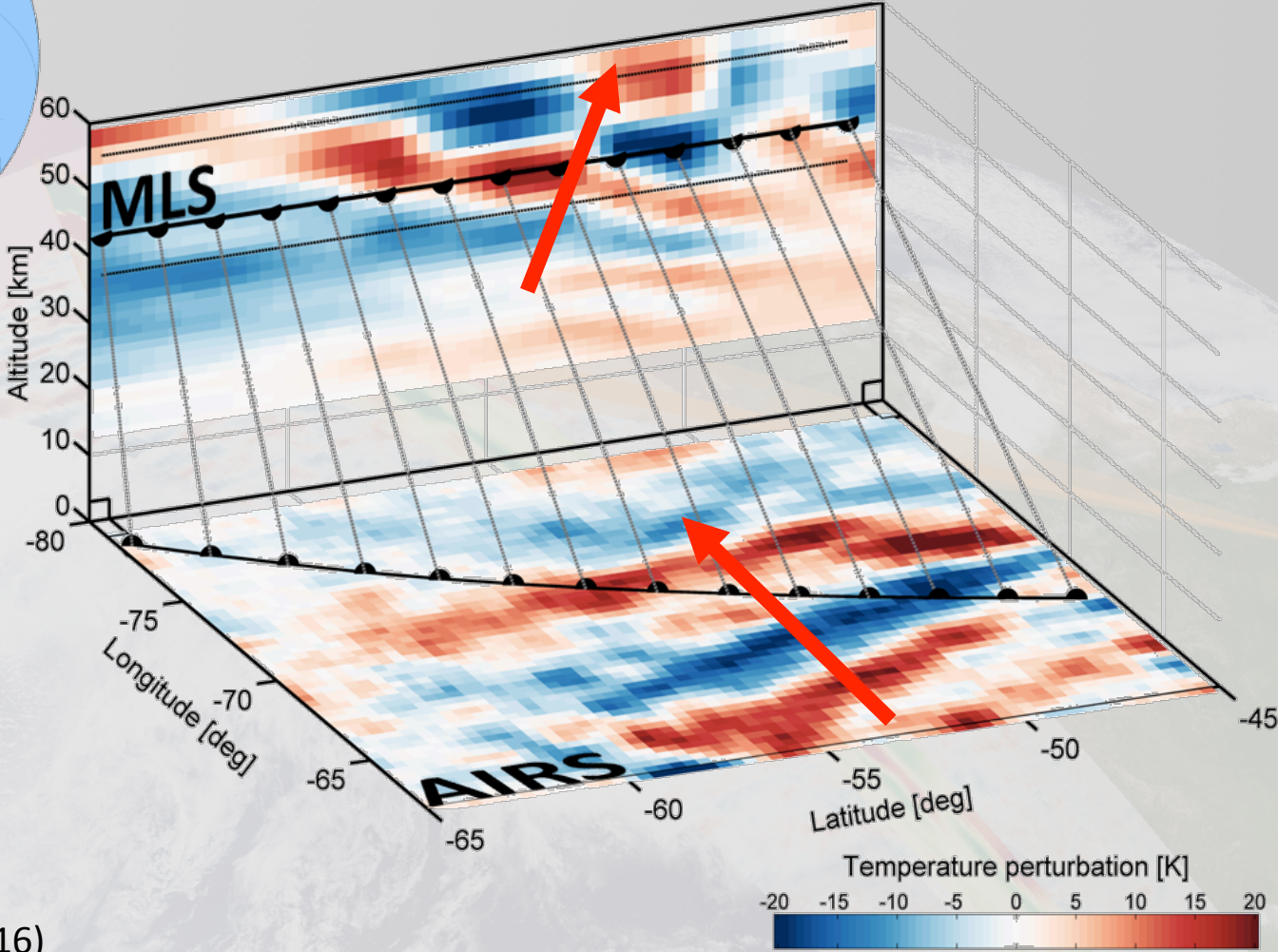
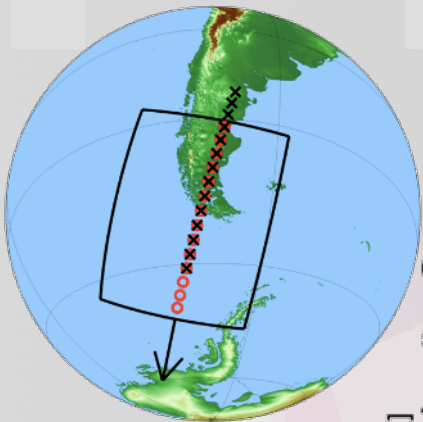


# Combining Satellites for 3D MF



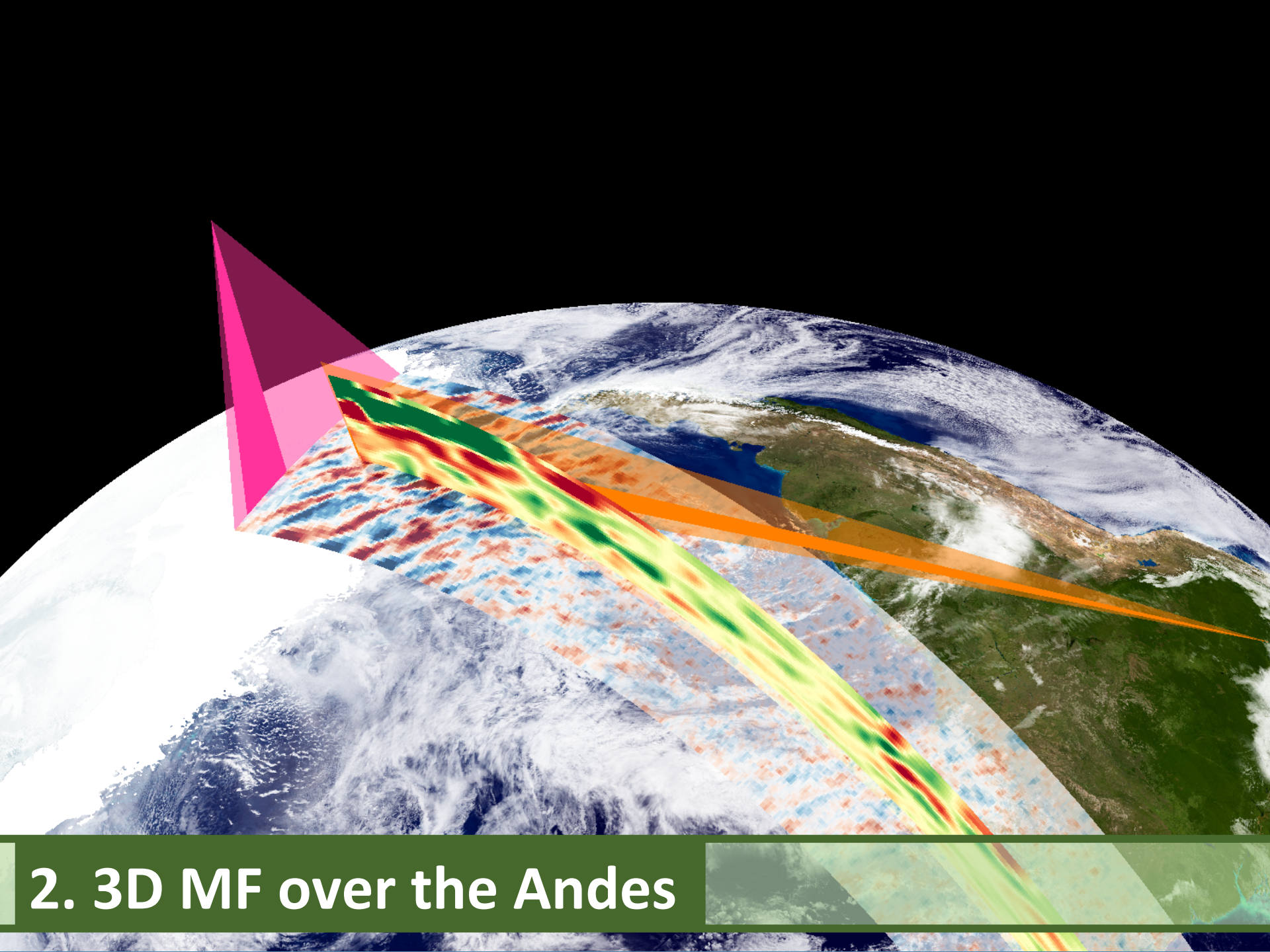
Constrained 3-vector -> directional MF

# Example – 6th May 2008



Wright et al (GRL, 2016)



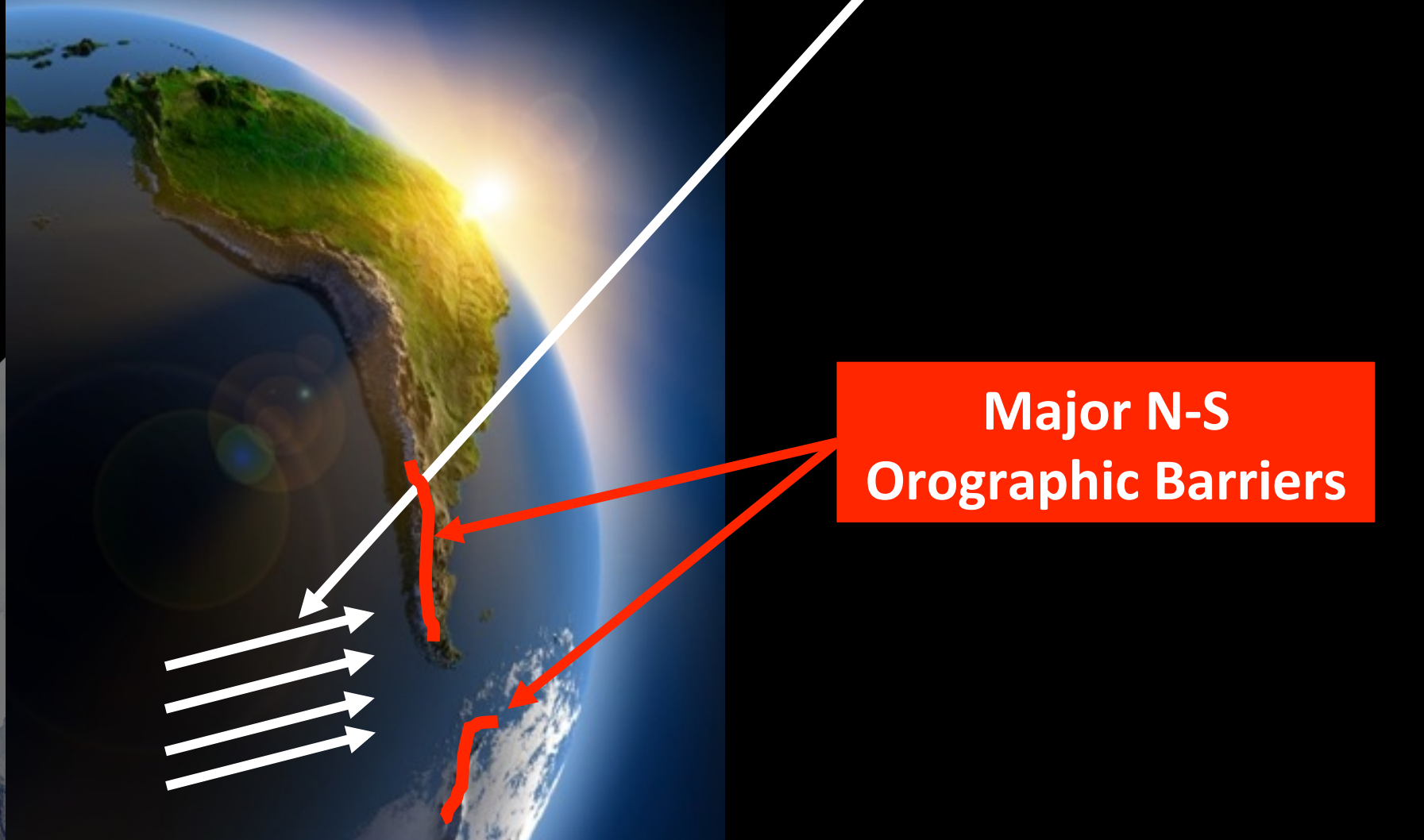


## 2. 3D MF over the Andes

# Test Region – Andes/Peninsula in August

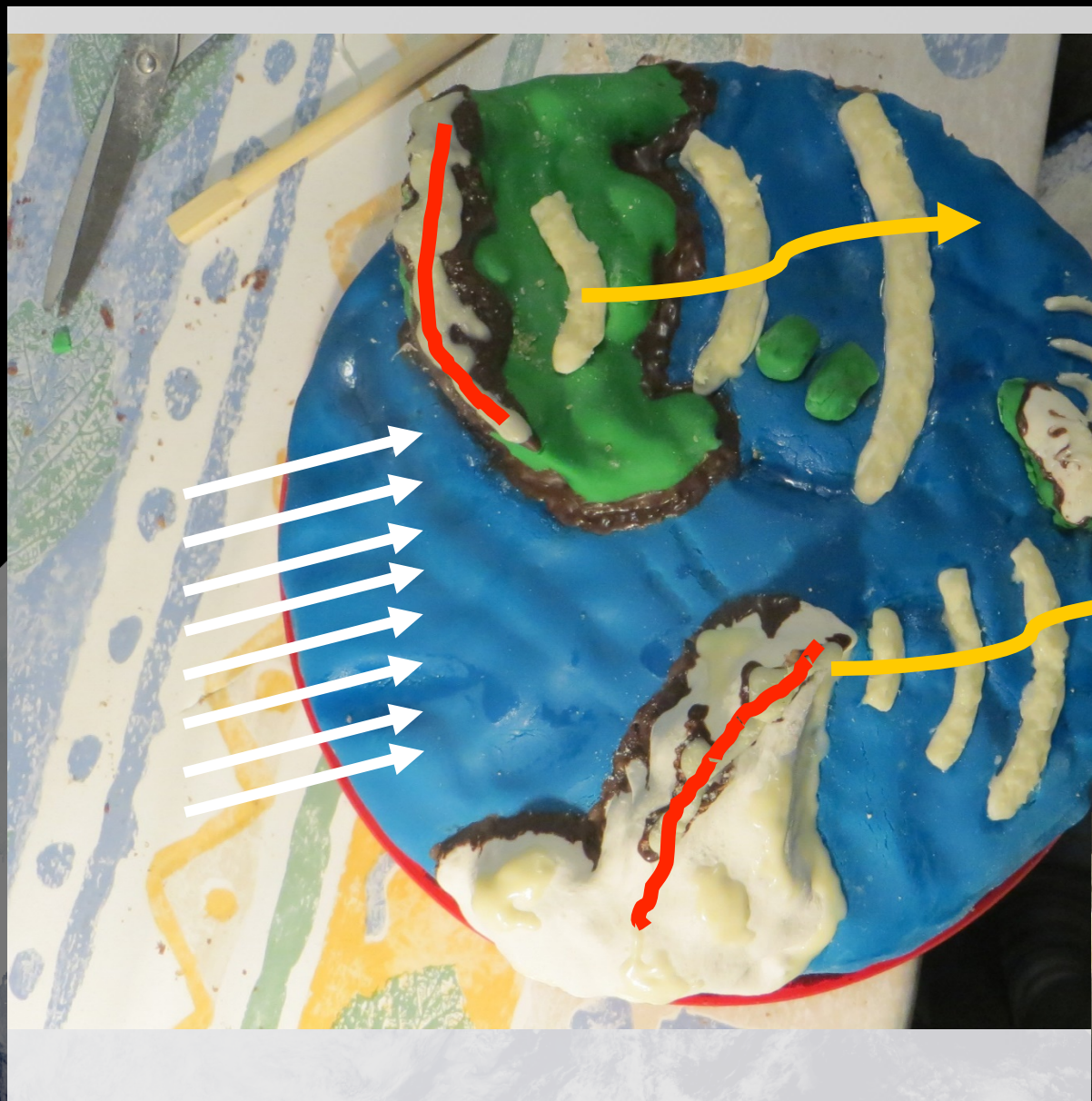
**Strong Zonal Winds**

**Major N-S  
Orographic Barriers**



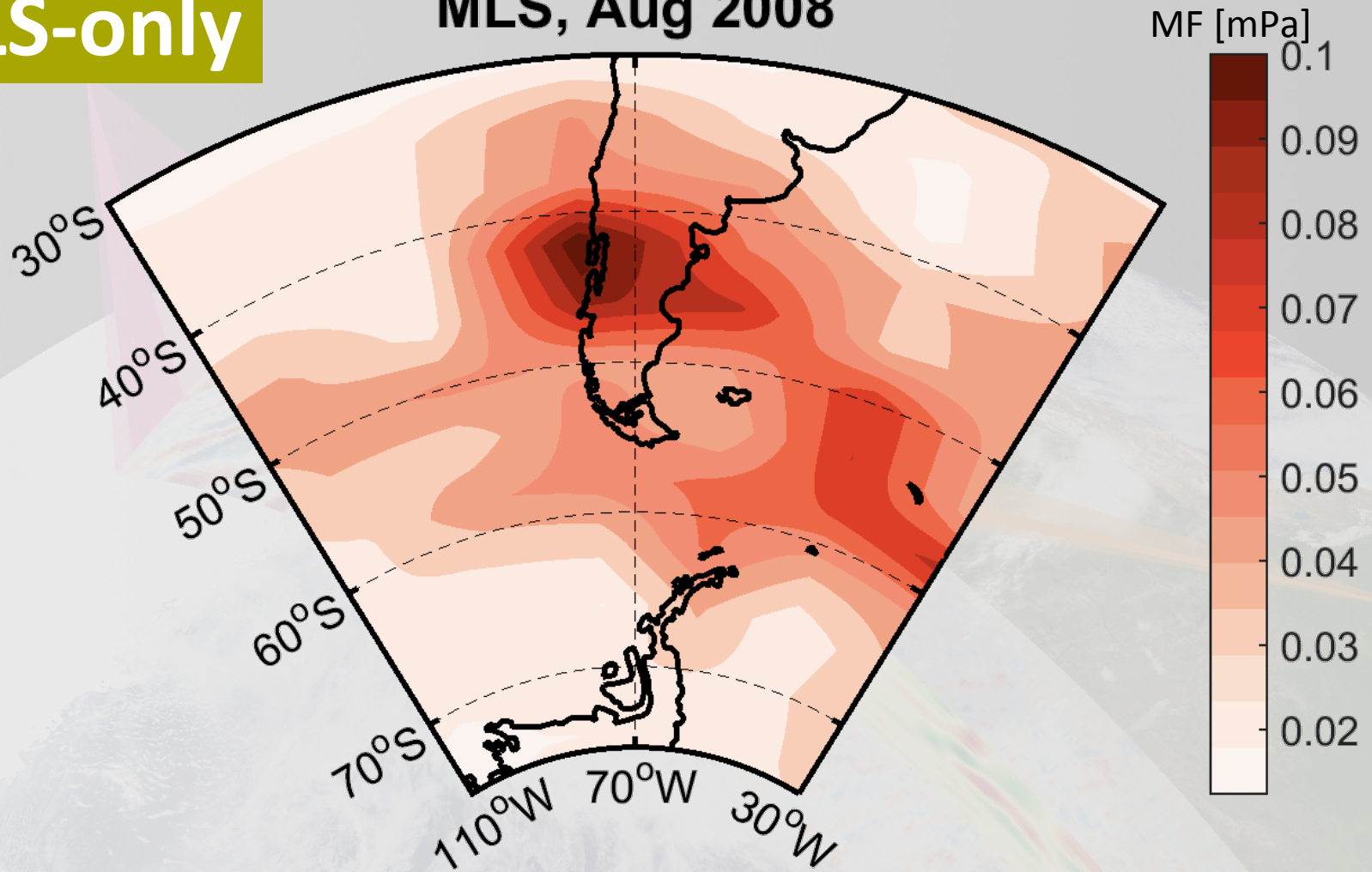


# Expected Results



MLS-only

MLS, Aug 2008



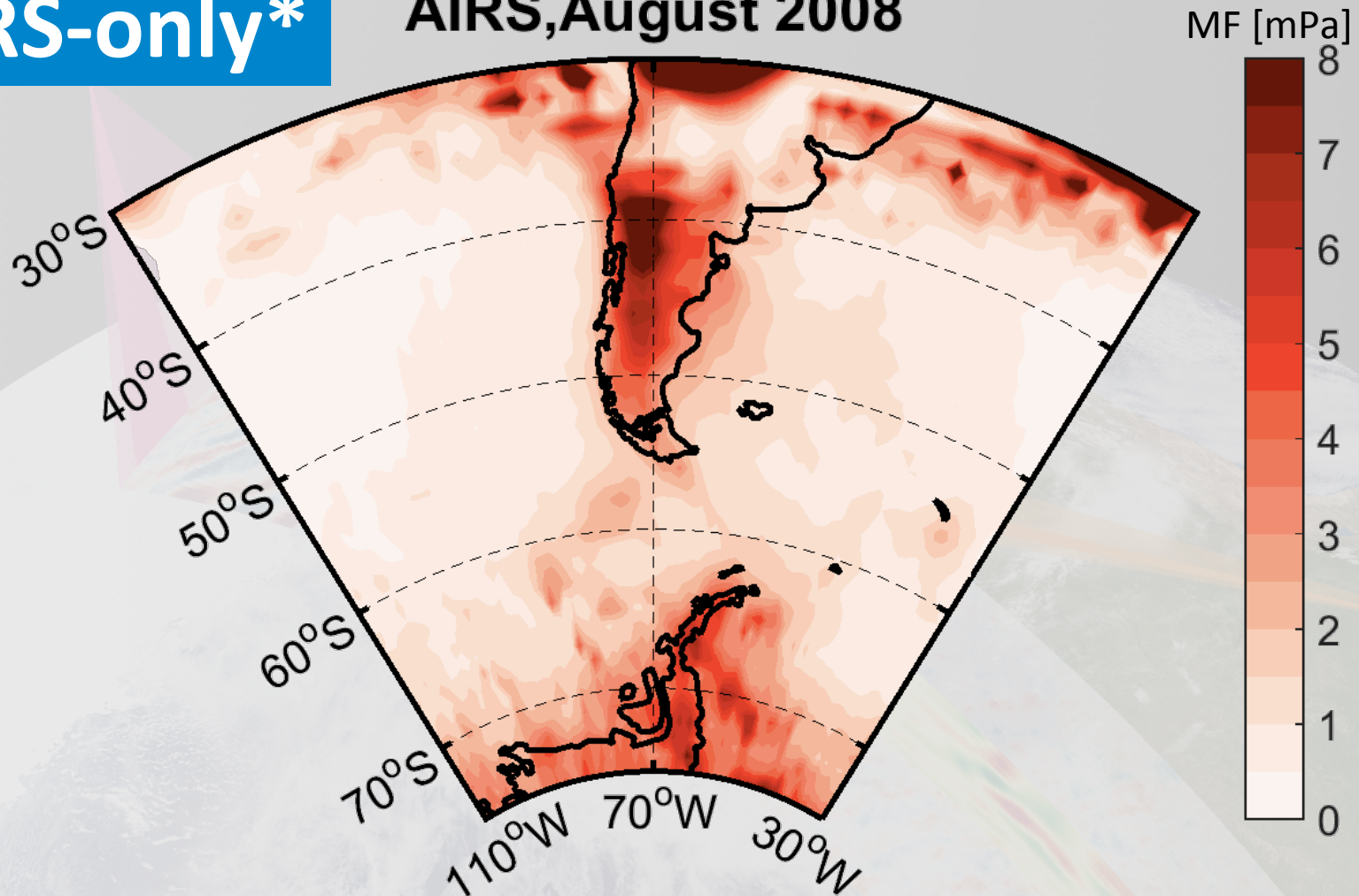
40km altitude

Computed using method of  
Wright and Gille (GRL, 2013)



**AIRS-only\***

**AIRS, August 2008**

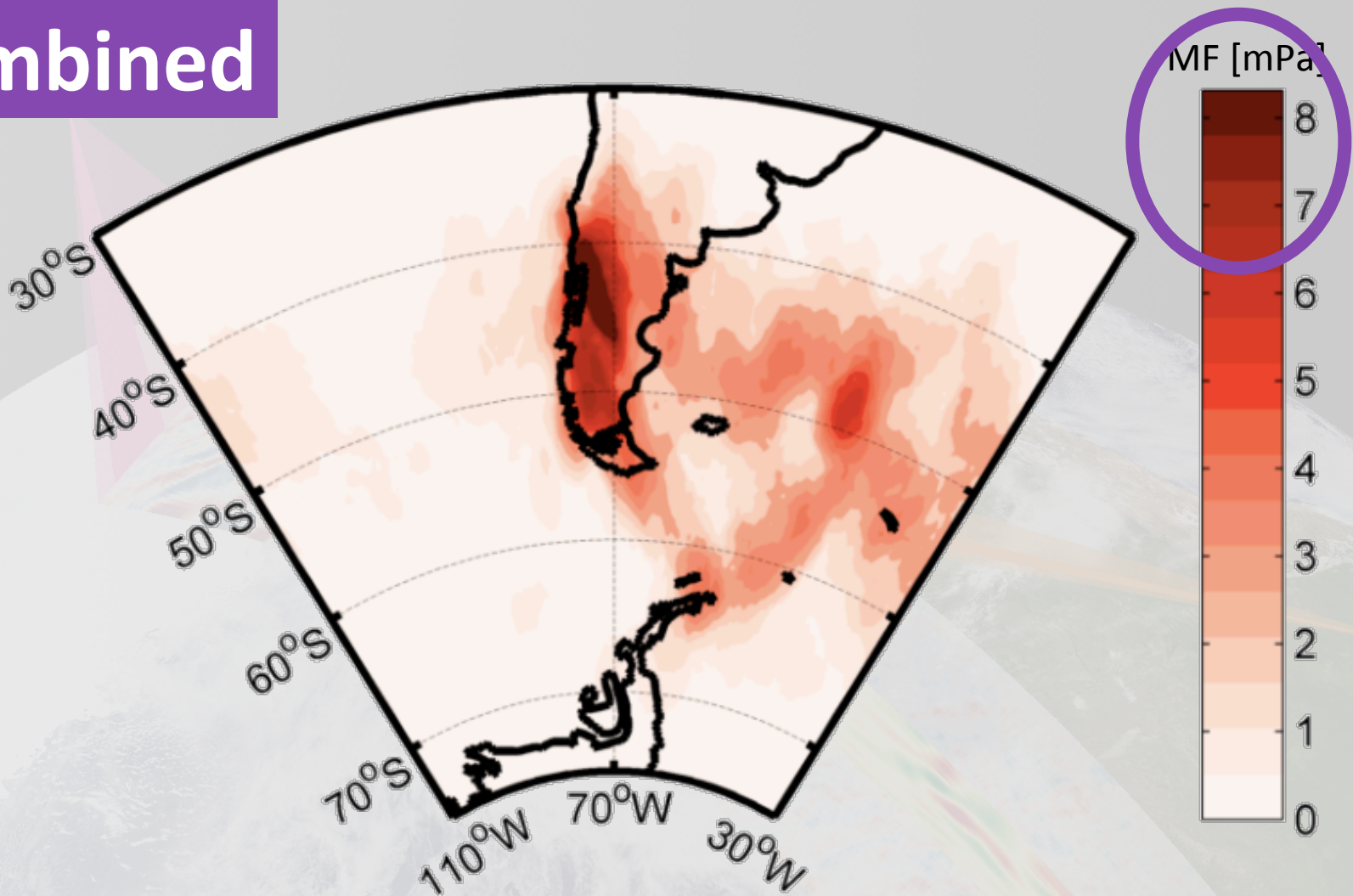


40km altitude

\* assumes orographic waves; amplitudes scaled

Computed using method of Hindley et al (AMTD, 2016) and Alexander et al (GRL, 2009)

Combined



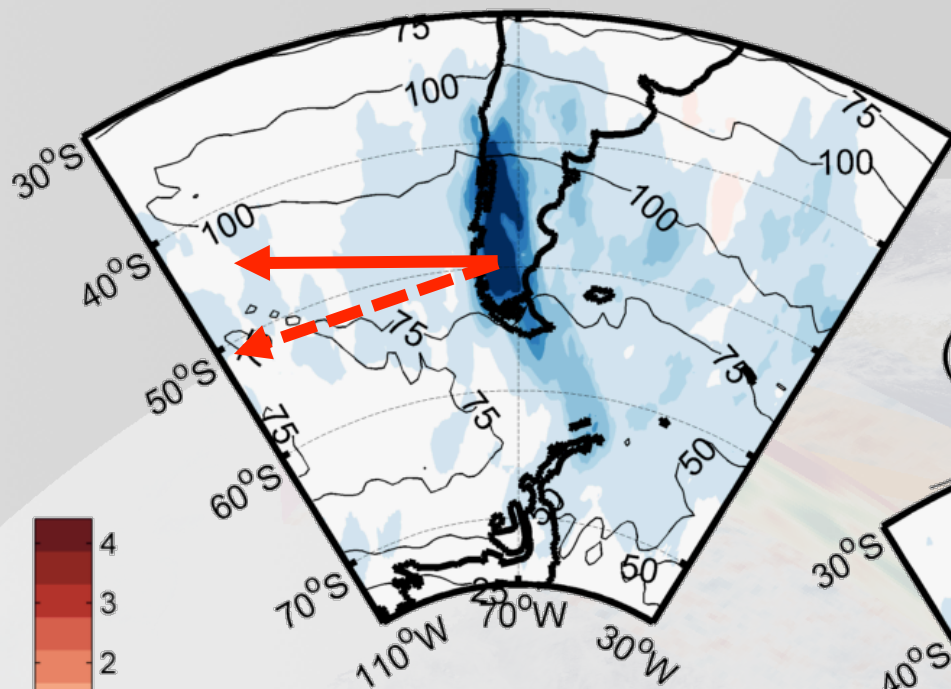
40km altitude



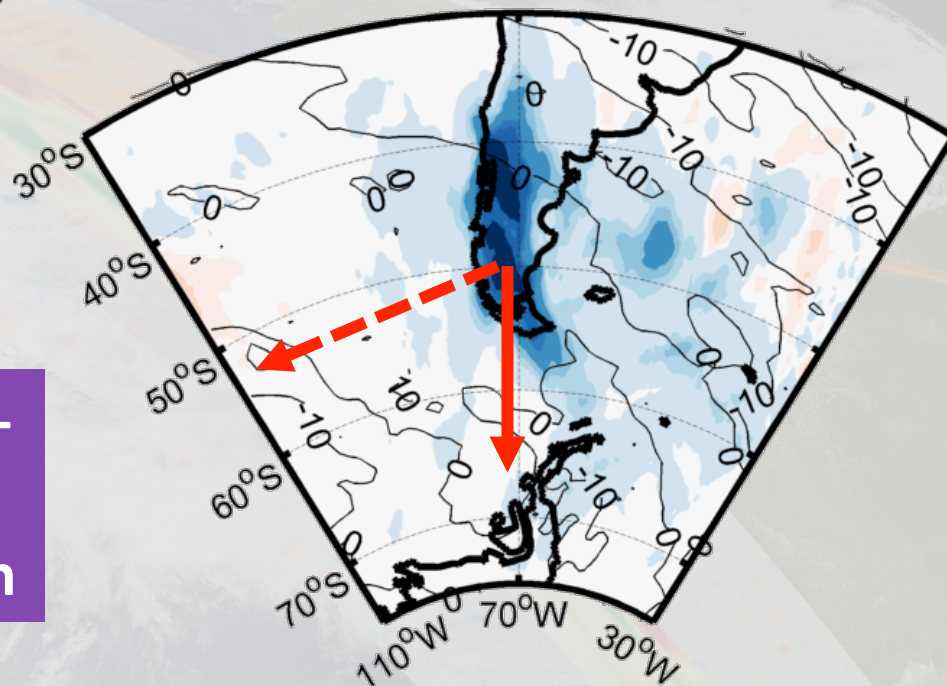
# Net Directional GW MF (per satellite pass)

(a) Net Eastwards Flux [mPa]

40km altitude



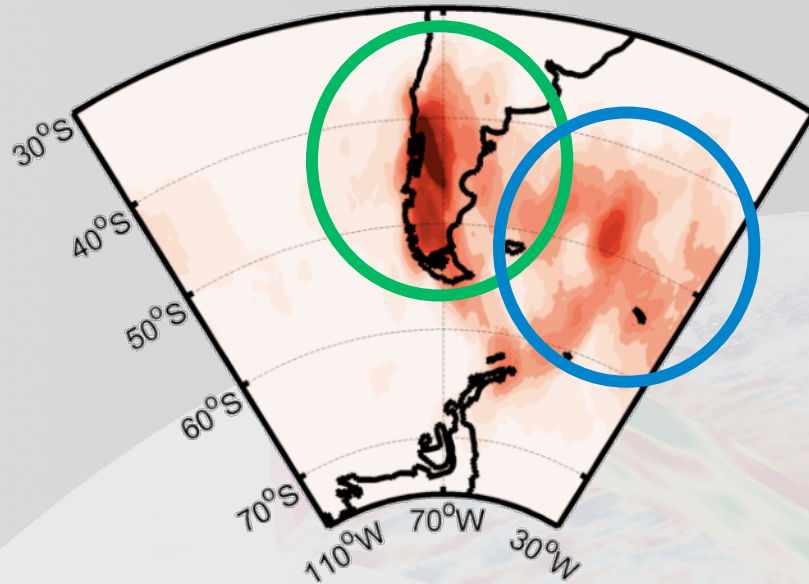
(b) Net Northwards Flux [mPa]



Upwind wavevector –  
consistent with  
orographic generation

|MF| ≠ MF!

(d) Total Absolute Flux [mPa]

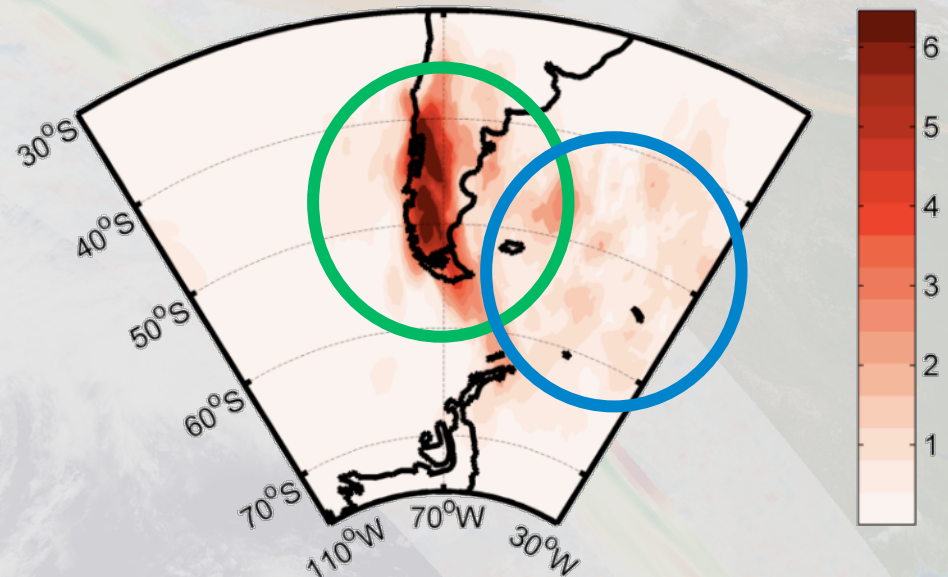


40km altitude

Old

New

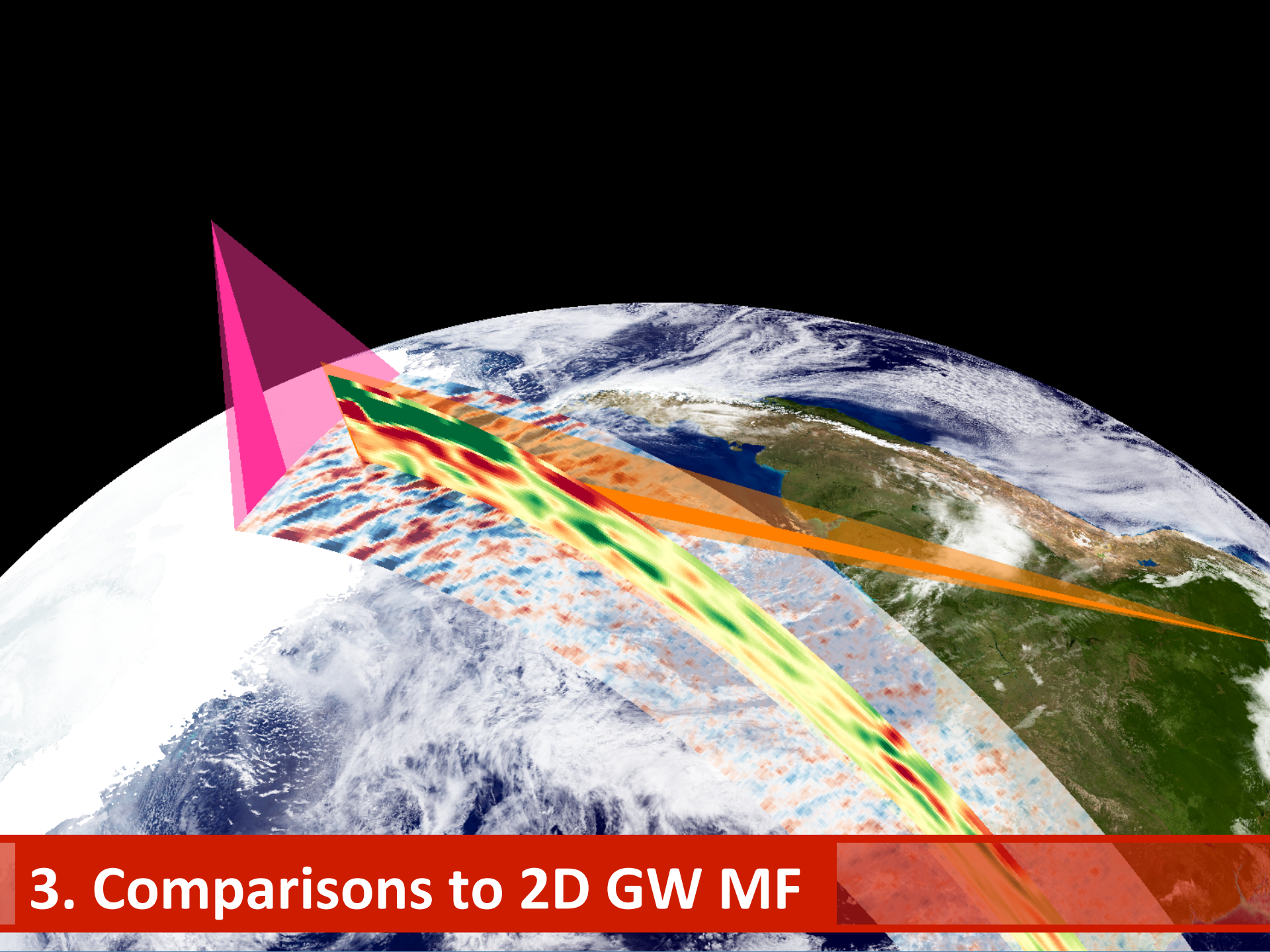
(c) Total Net Flux [mPa]



Orographic

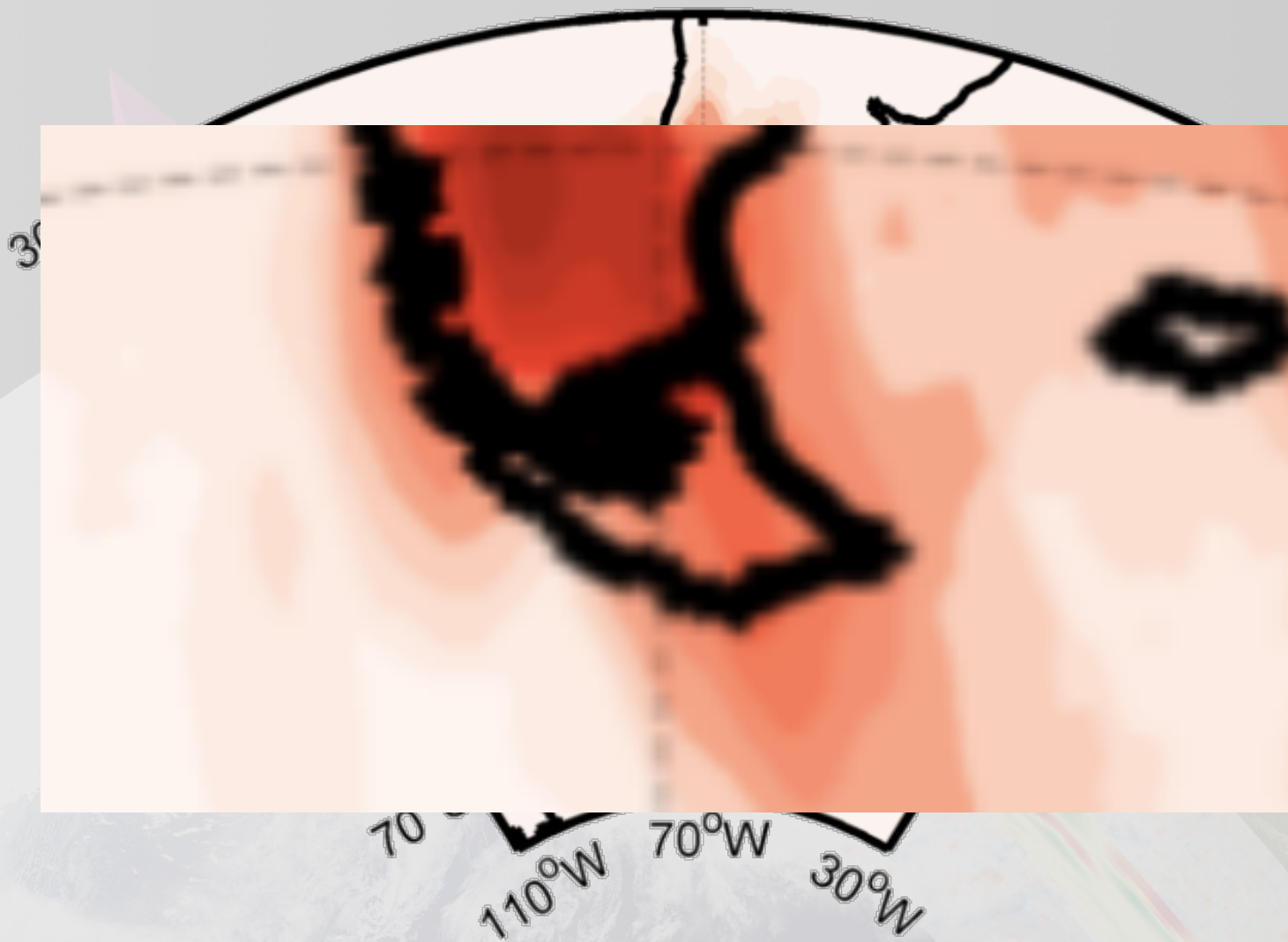
Non-Orographic?





### 3. Comparisons to 2D GW MF

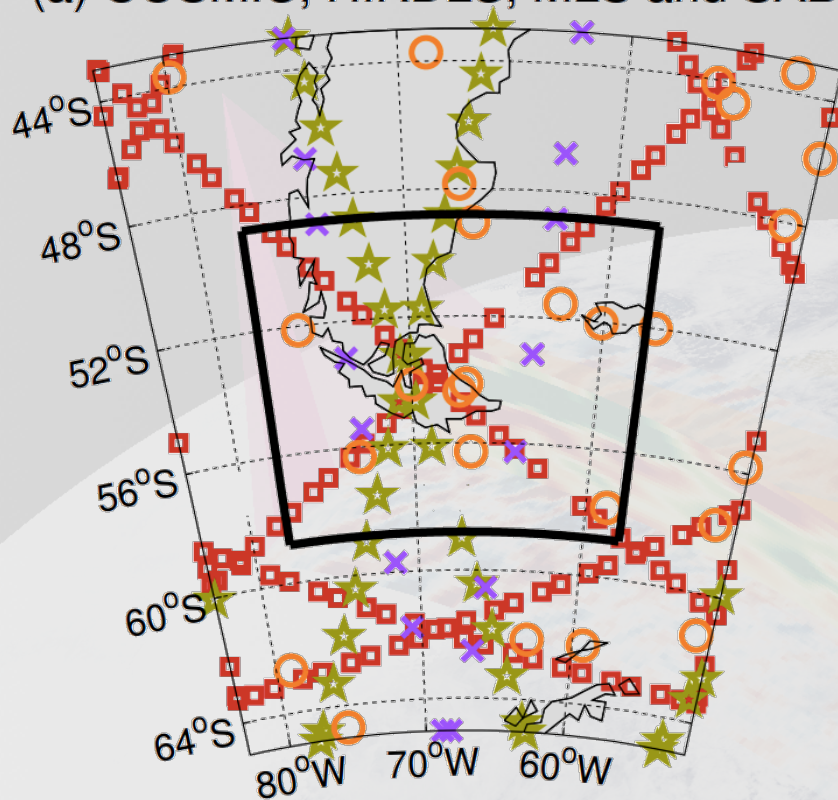
# Subregion





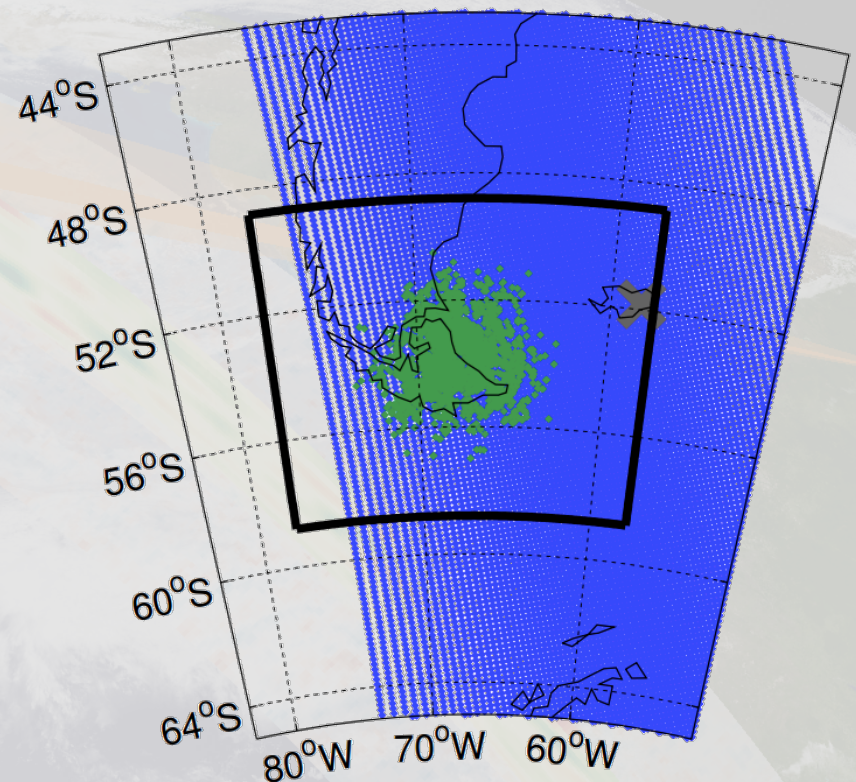
# Geographic Coverage

(a) COSMIC, HIRDLS, MLS and SABER

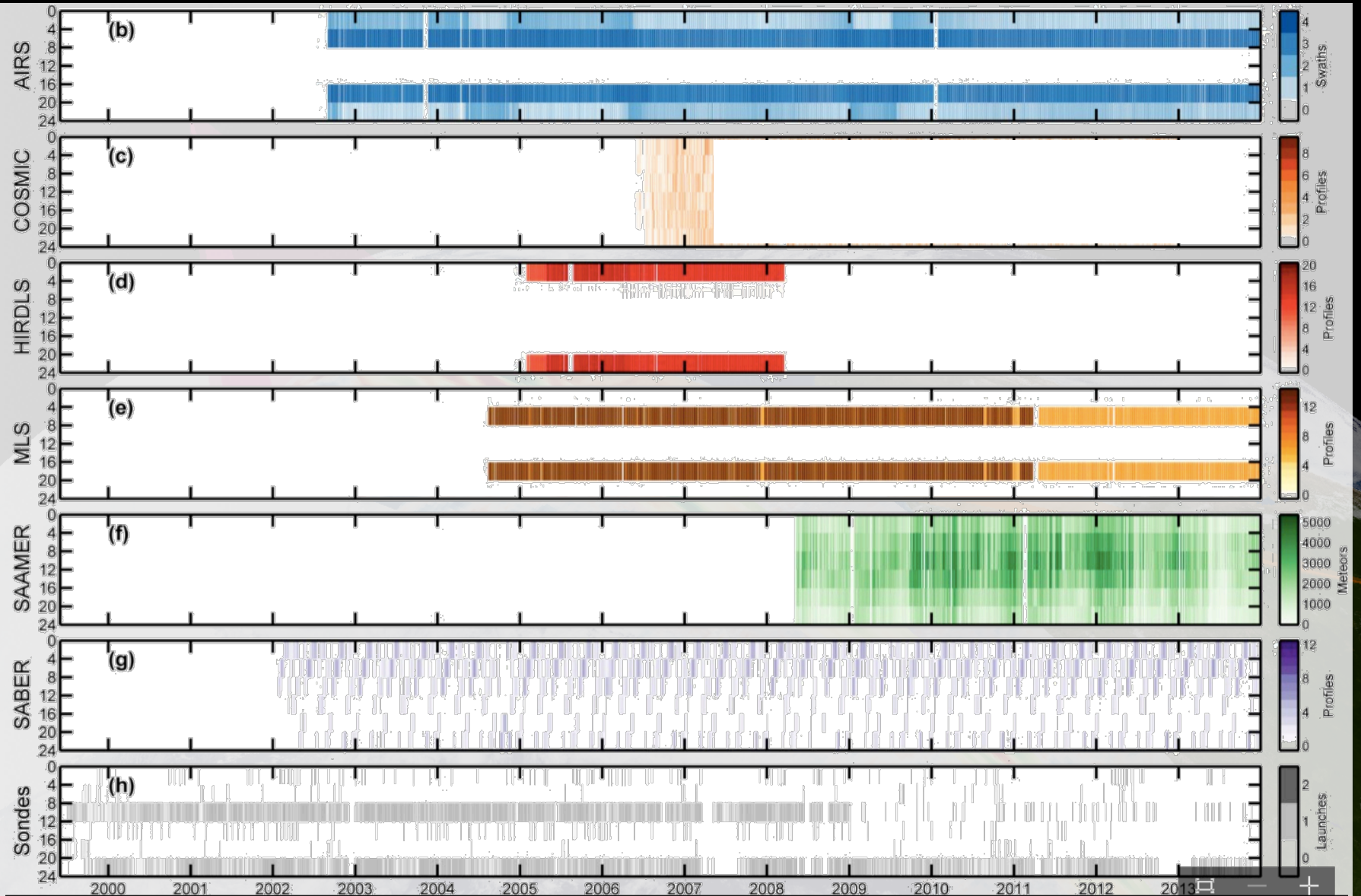


AIRS  
COSMIC  
HIRDLS  
MLS-Aura  
SAAMER  
SABER  
Sondes

(b) AIRS, SAAMER and sondes

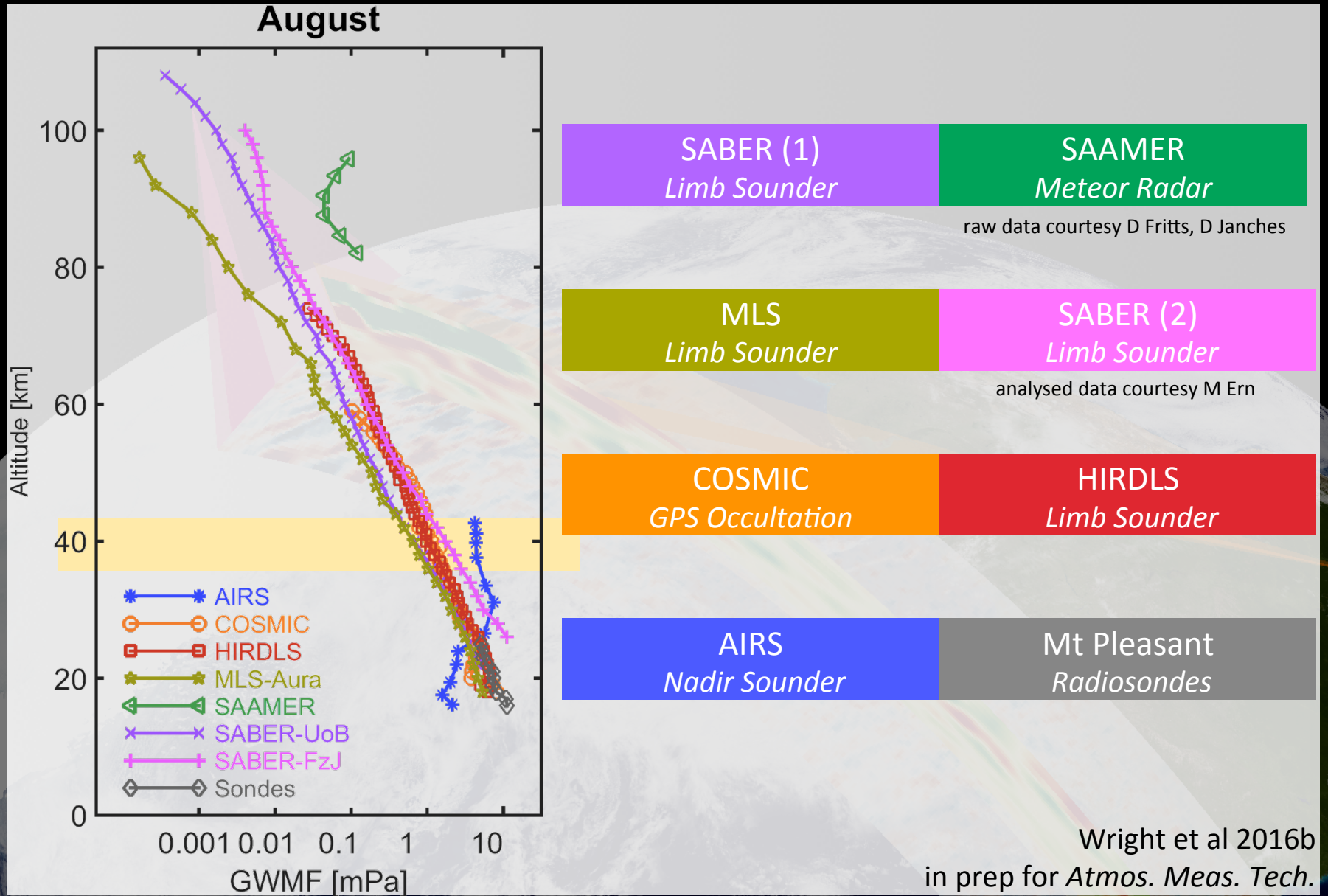


# Data Availability

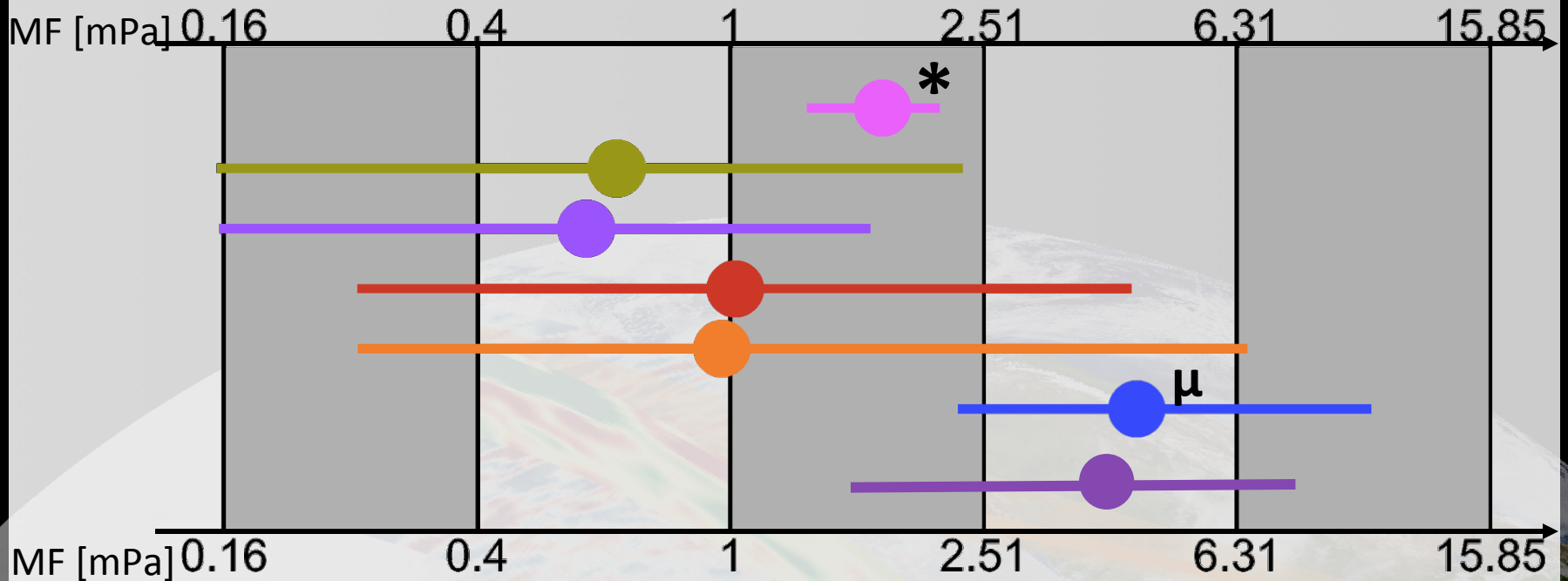




# Height Series for Each Instrument, August



# Absolute Magnitudes at 40km, all Augusts



MLS <i>Limb Sounder</i>	COSMIC <i>GPS Occultation</i>	HIRDLS <i>Limb Sounder</i>
SABER (1) <i>Limb Sounder</i>	SABER (2) <i>Limb Sounder</i>	AIRS <i>Nadir Sounder</i>
Combined AIRS/MLS <i>Nadir + Limb</i>		

\* monthly means only

μ oro. assumption,  
attenuation-scaled

<del>SAAMER <i>Meteor Radar</i></del>	<del>Mt Pleasant <i>Radiosondes</i></del>
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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

AMTD, January 2016, doi:10.5194/amt-9-877-2016

## **Inter-Instrument Comparisons: GWPE**

Wright, Hindley, Moss, Fritts, Janches, Mitchell

AMT, March 2016, doi:10.5194/amt-2015-383

## **Inter-Instrument Comparisons: GWMF**

Wright et al, in prep for AMT (hopefully out soon!)