

# Southern Hemispheric Gravity Wave Sources

Ray-Tracing AIRS Data in the Southern  
Hemisphere

Jon Perrett, Corwin Wright, Neil Hindley & Nicholas Mitchell  
University of Bath



# Talk Outline

What are gravity waves and why are they important?

How can we measure gravity waves from satellite data?

How can we trace these measurements to their source?





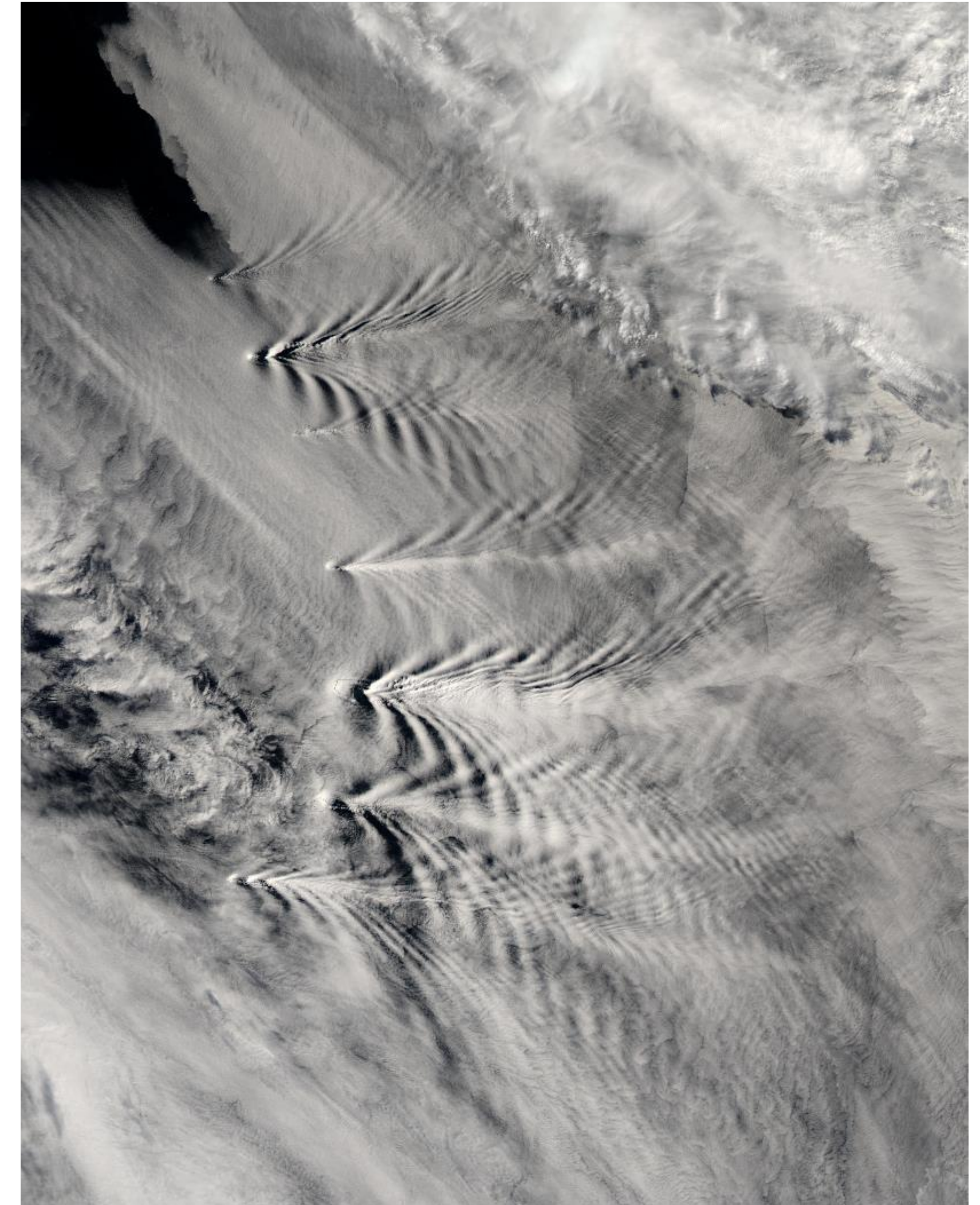
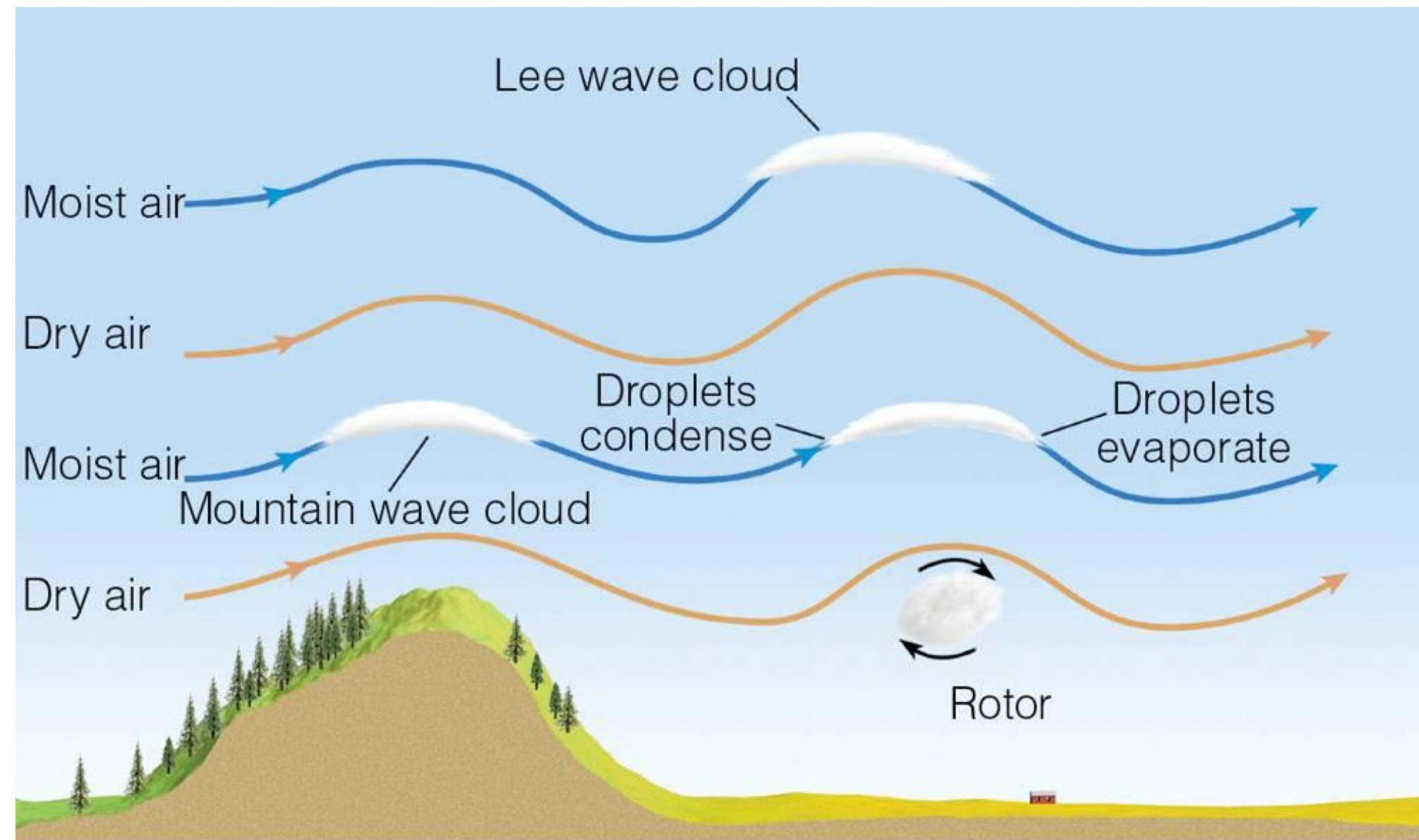
# Gravity Waves

Waves in the atmosphere formed by:

Wind blowing over mountains

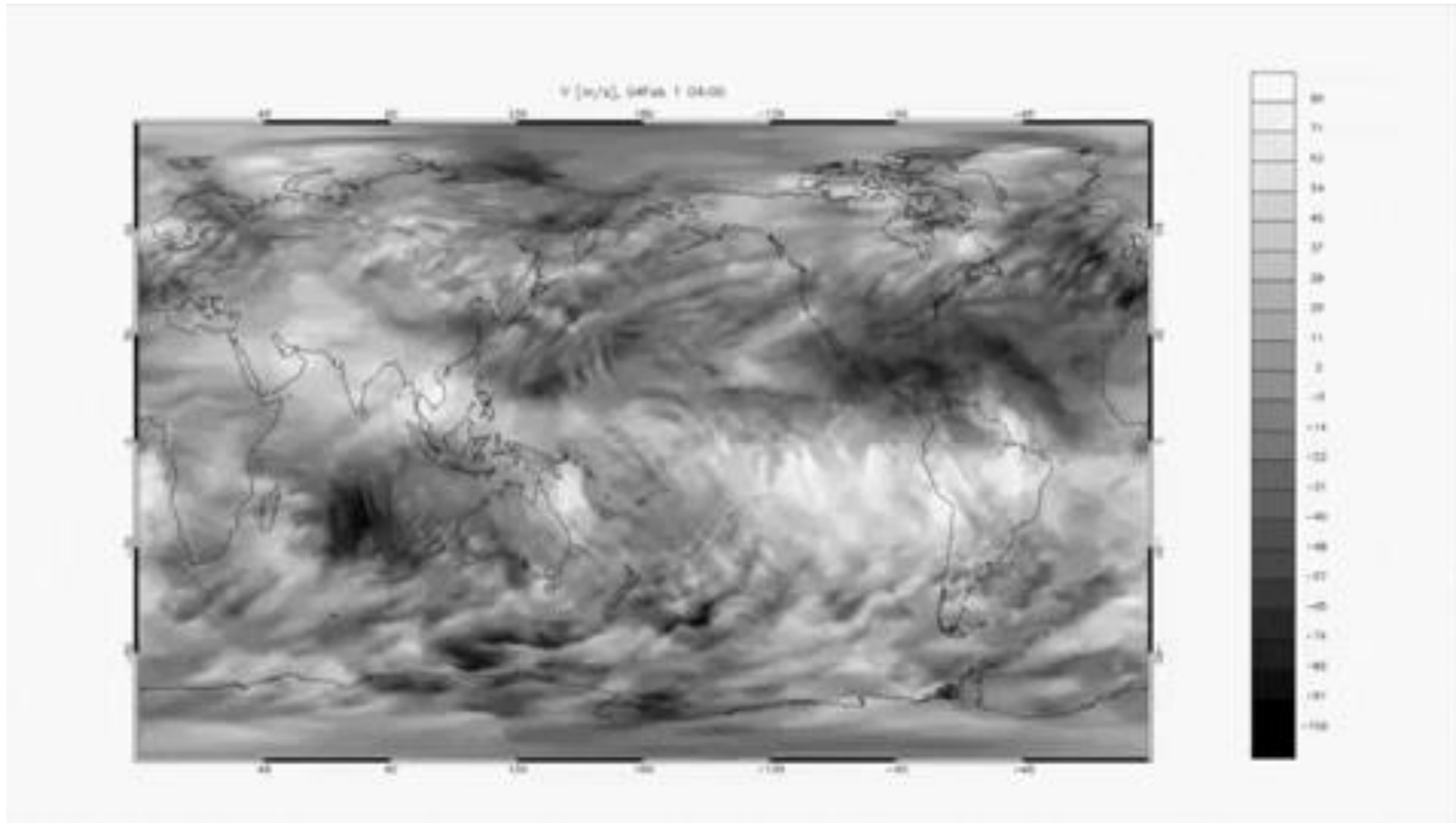
Convective storms

Jet stream instabilities





# Motivation



Large drivers of atmospheric circulation

Knowing sources will improve global climate models – ‘cold pole’ problem

# The Atmospheric InfraRed Sounder (AIRS)

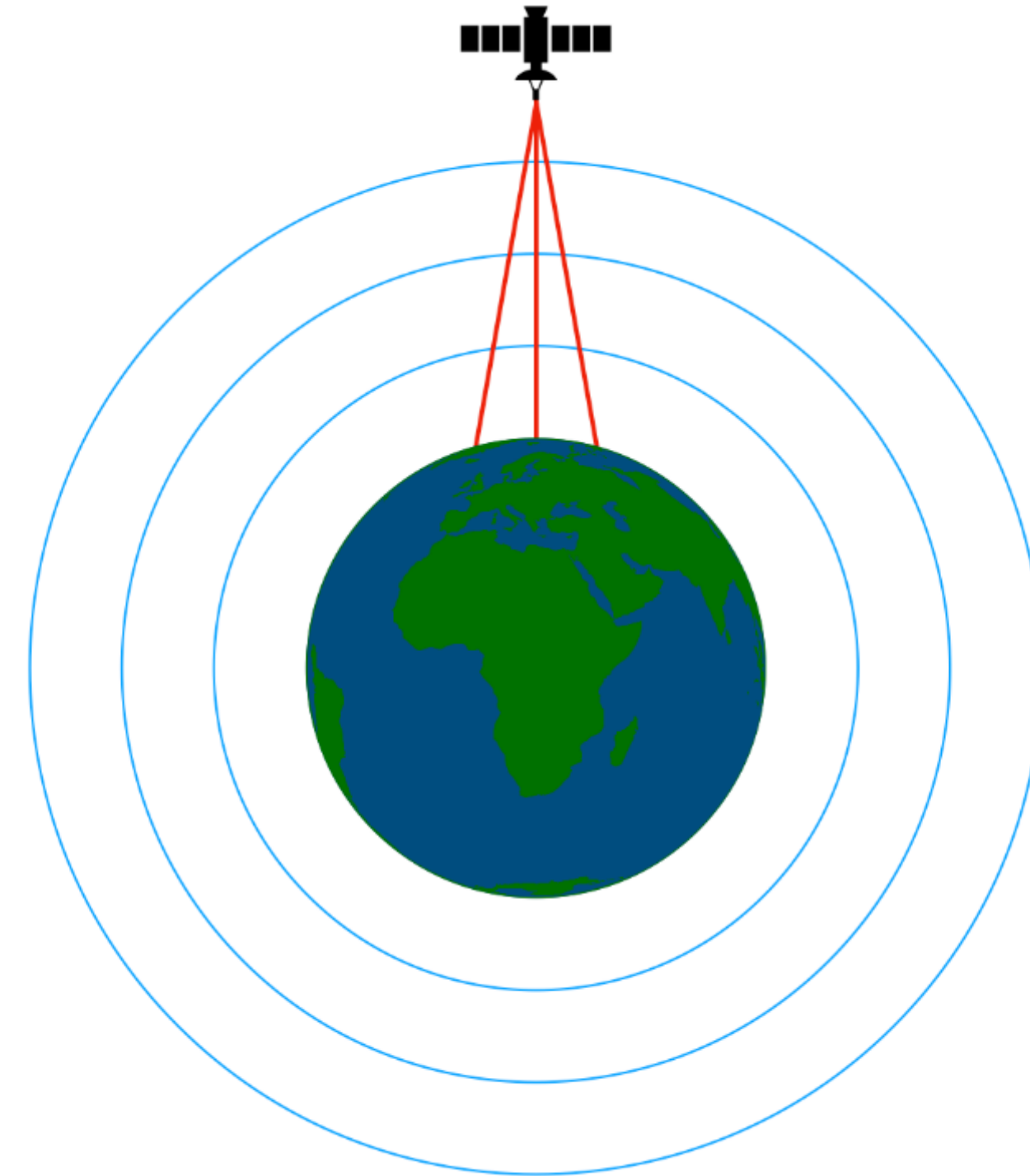
Measure infrared radiation → determine atmospheric temperature

“Sounder” - Vertical profiles of atmospheric properties

Data split into ‘granules’



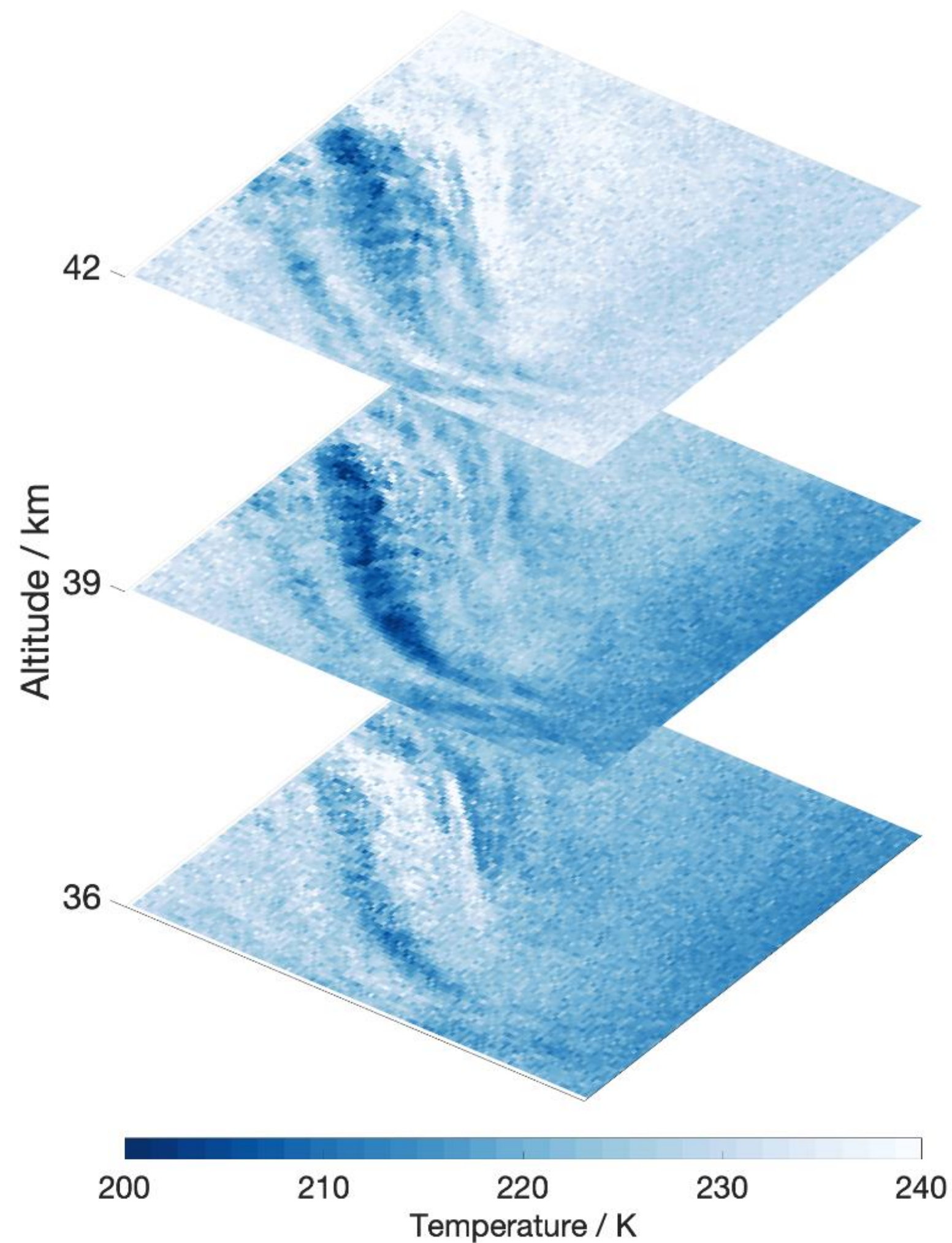
**AQUA Satellite**



**AIRS Viewing Geometry**



# 3D AIRS Temperature Retrievals



**AIRS Granule**  
**36 - 42 km**

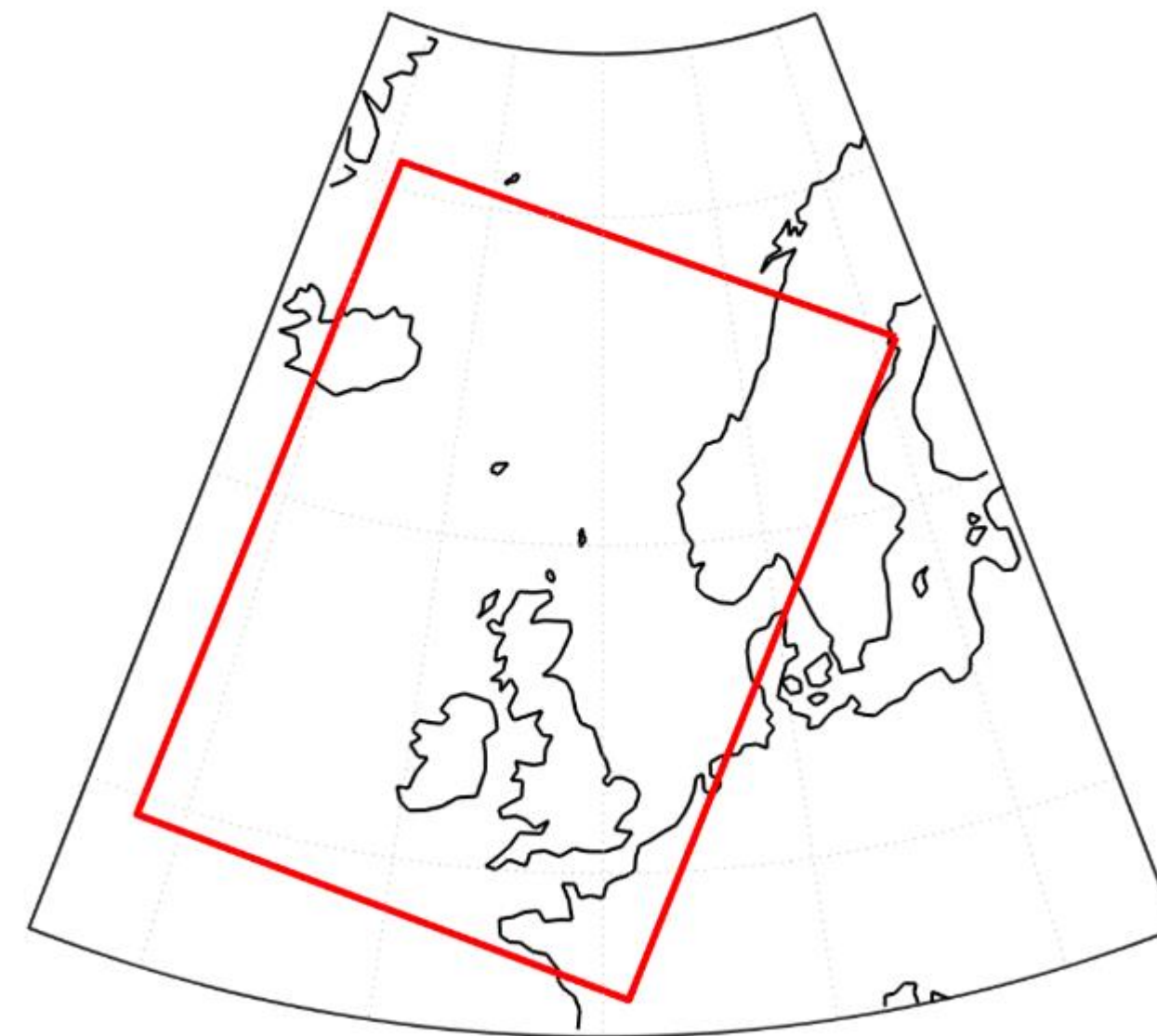
See GWs as **temperature perturbations**

Minimum Horizontal Wavelength ~**40 km**

Minimum Vertical Wavelength ~**10 km**

Noise ~ **1.5 K**

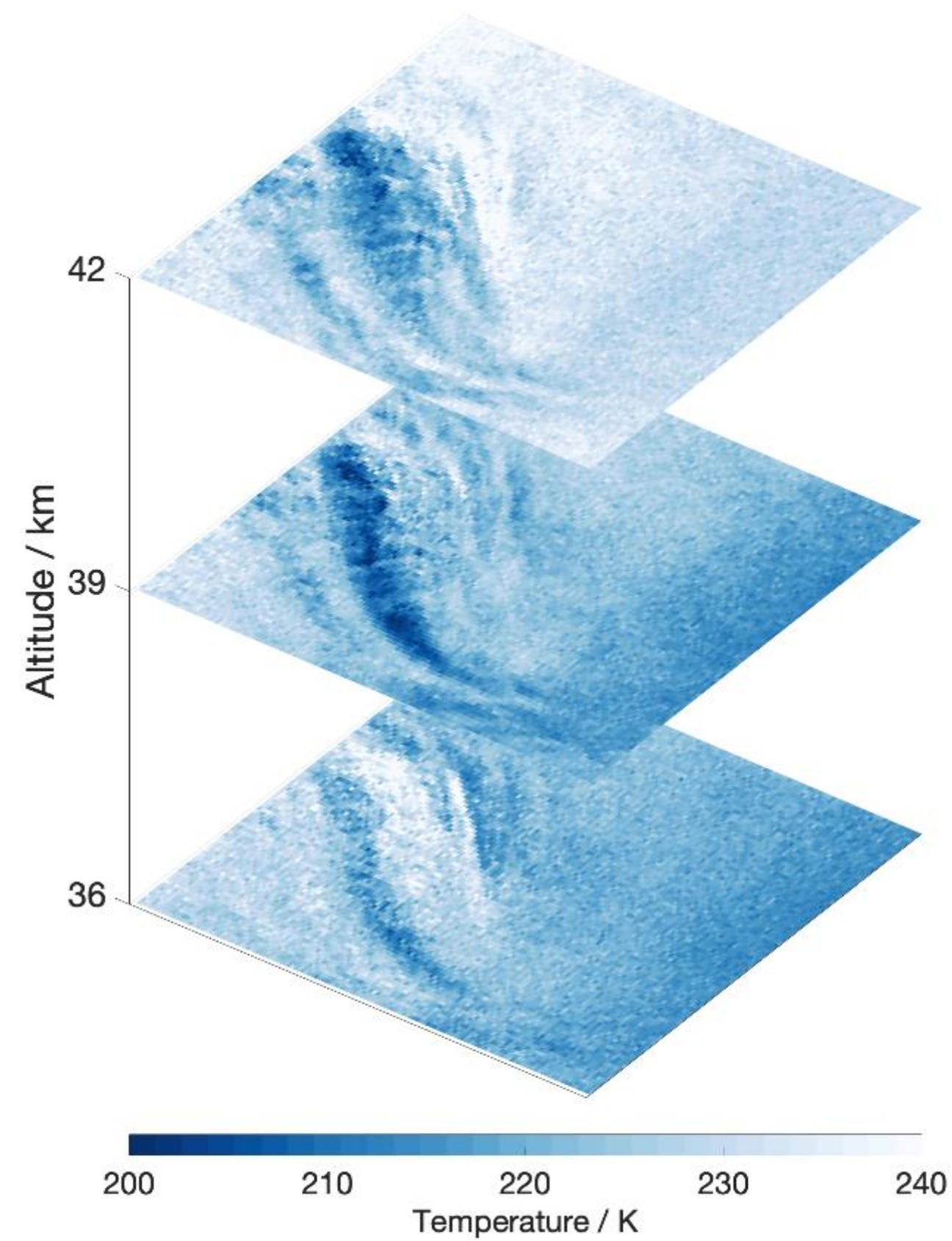
Global coverage ~ **14 orbits / day**



**AIRS Granule Footprint**

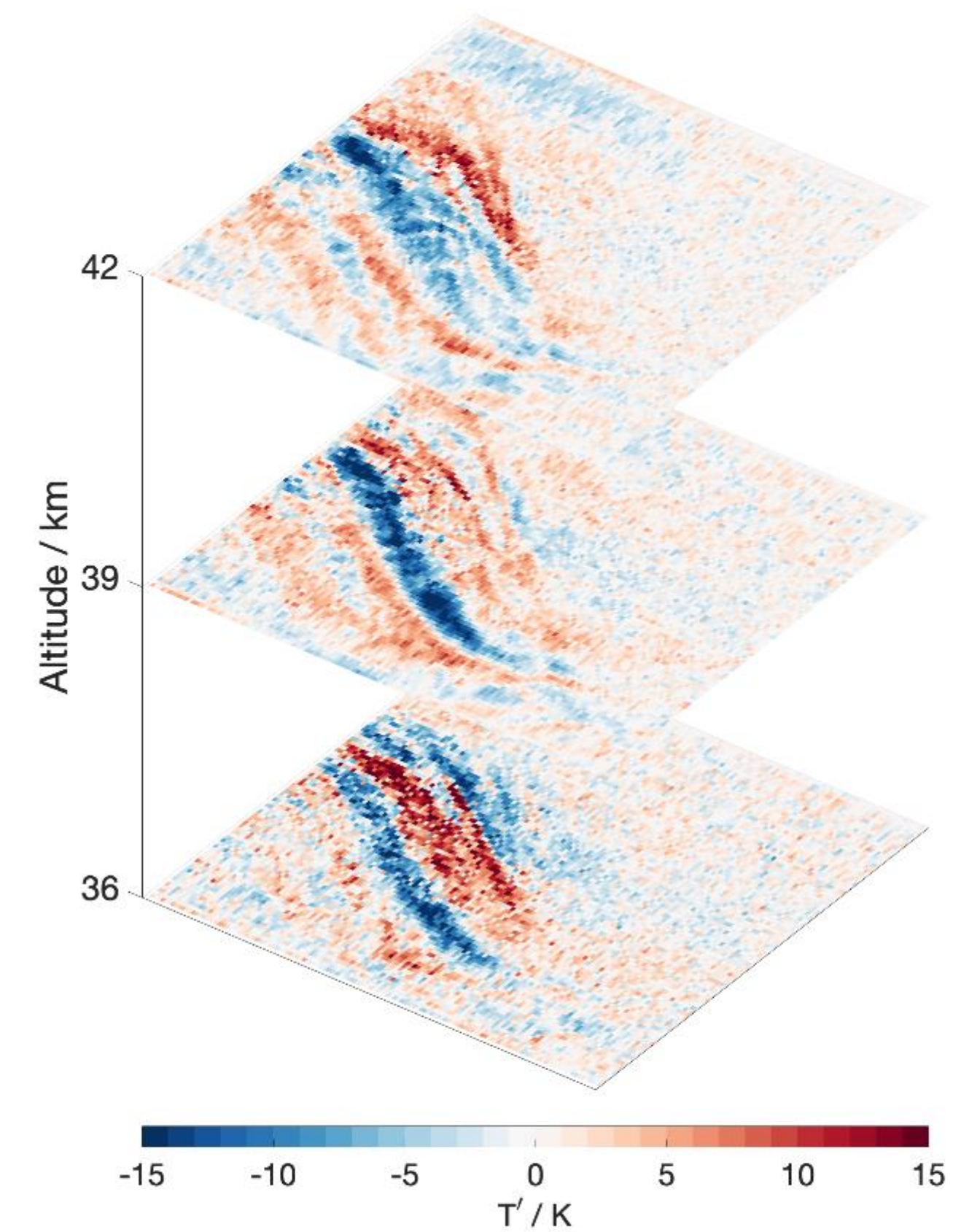


# Method Outline



**AIRS Granule  
36 - 42 km**

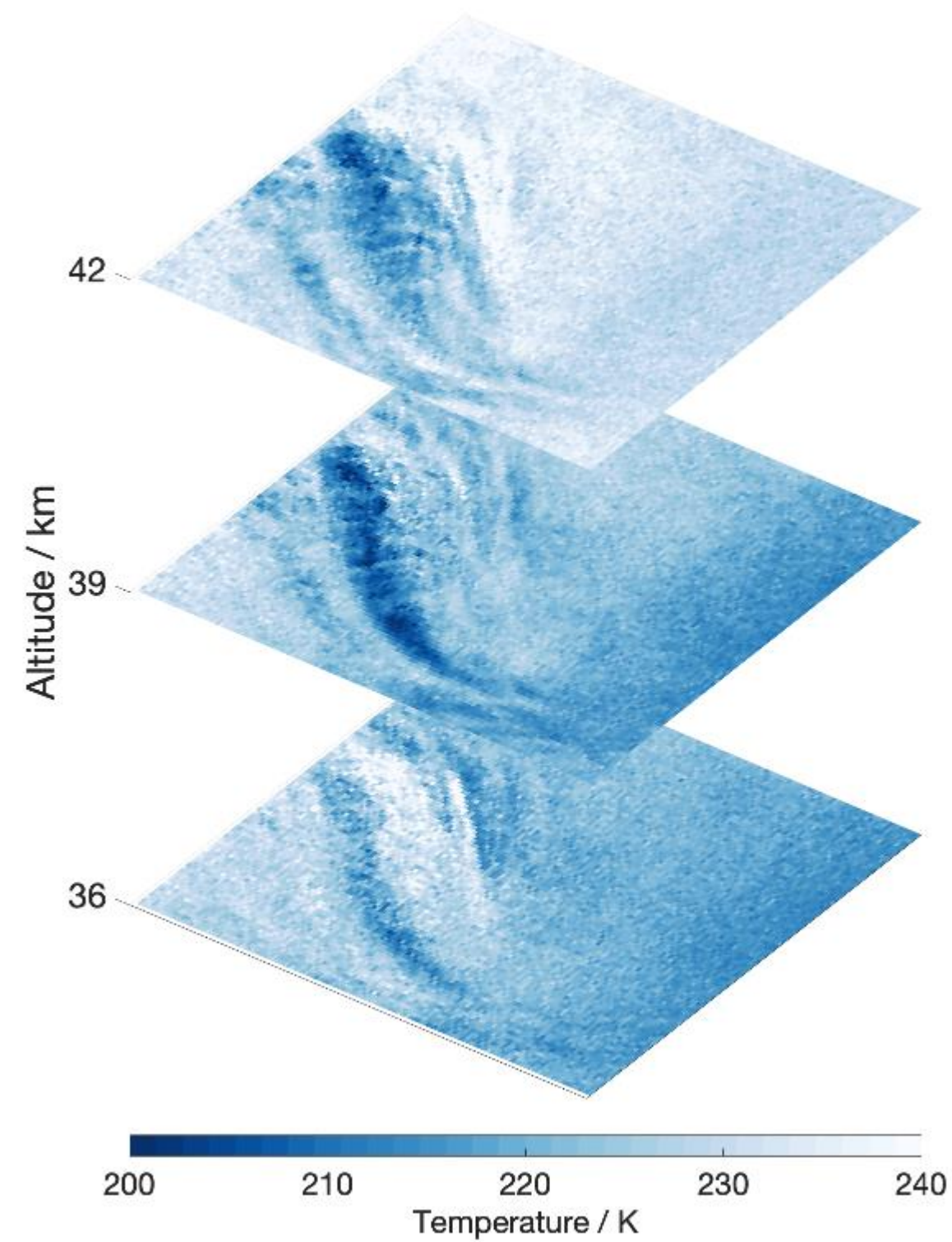
1.  
→  
**Background  
Removal**



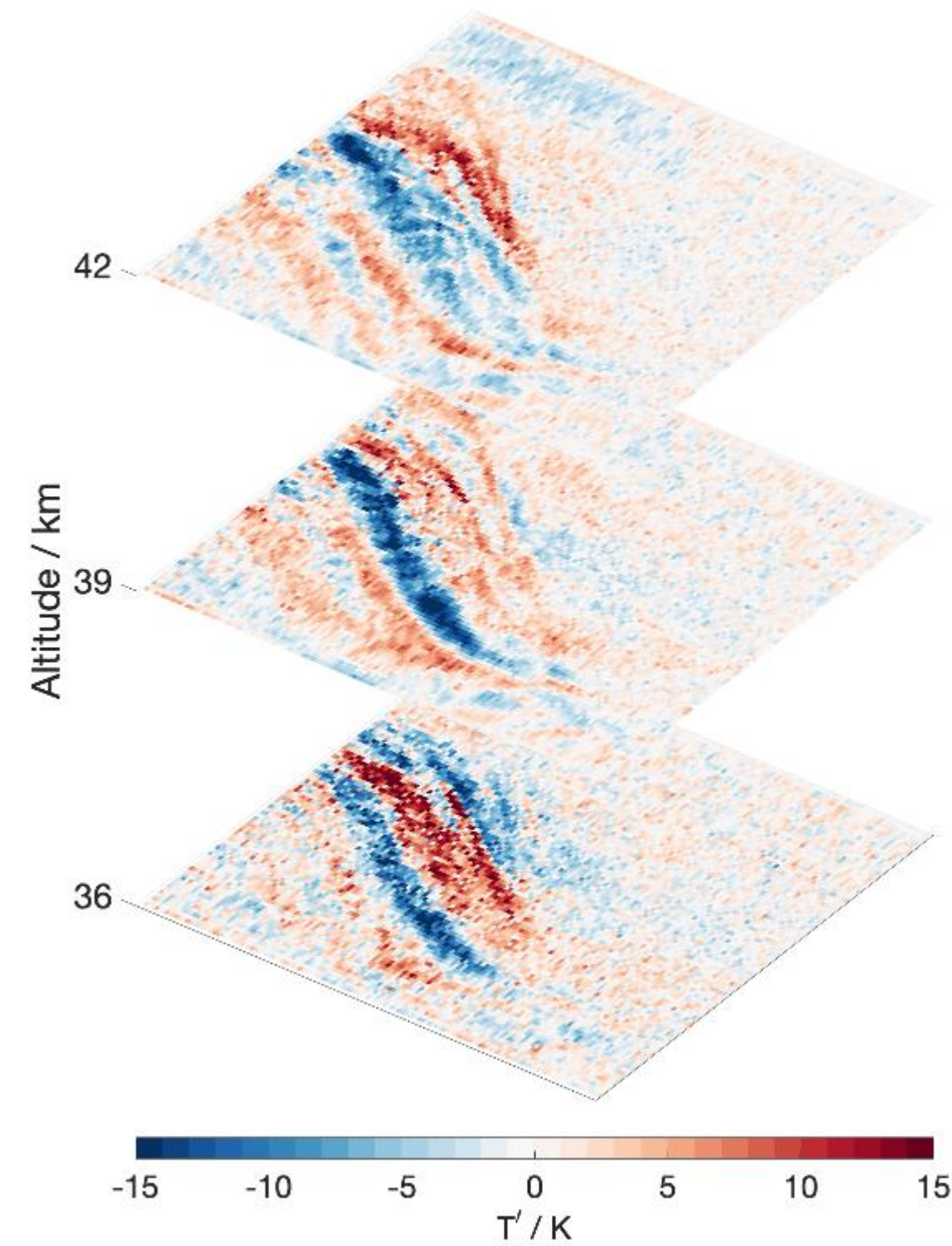
**Temperature Perturbation  
36 - 42 km**



# Method Outline



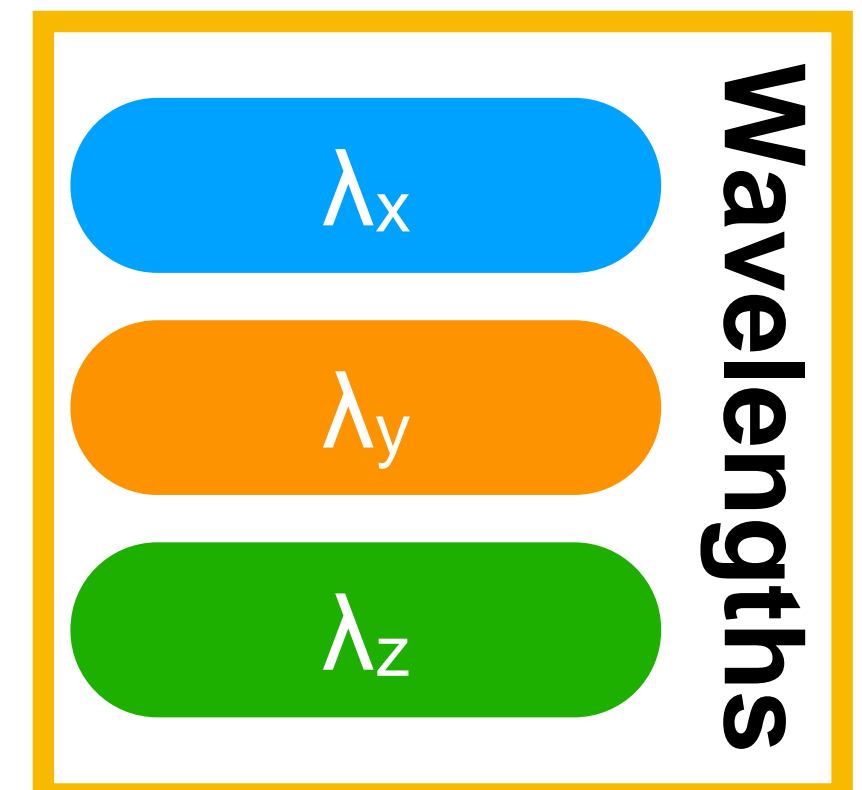
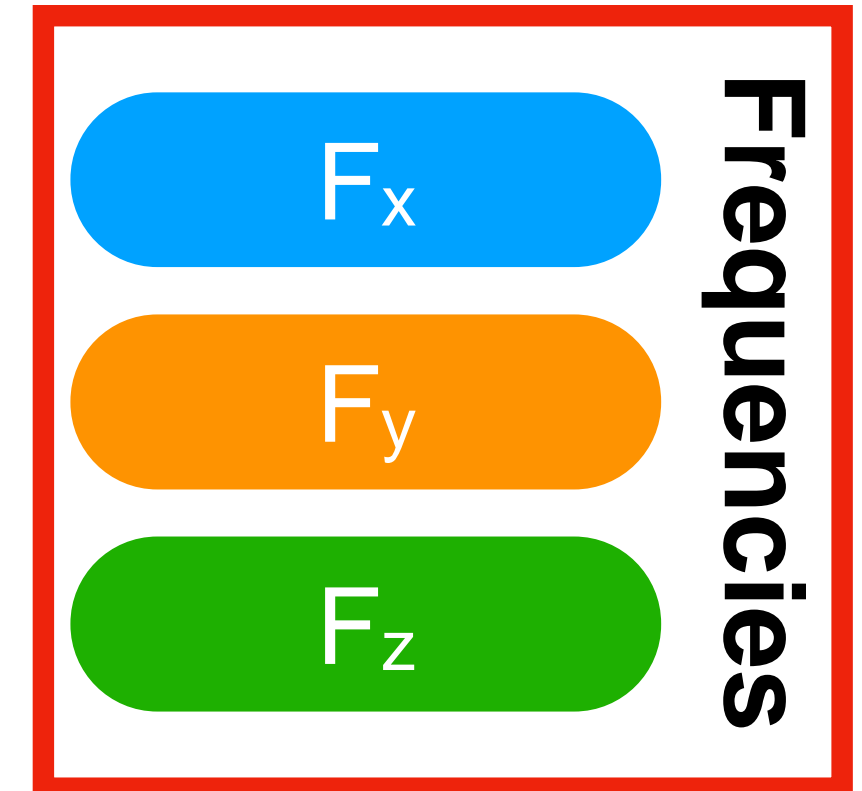
1.  
Background  
Removal



36 - 42 km

2.  
S Transform

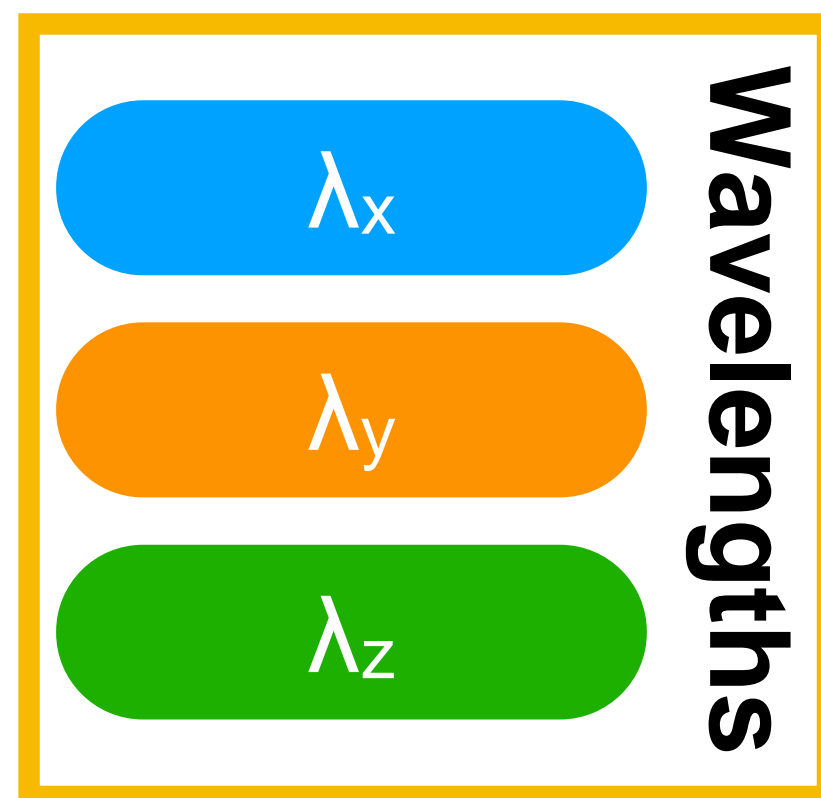
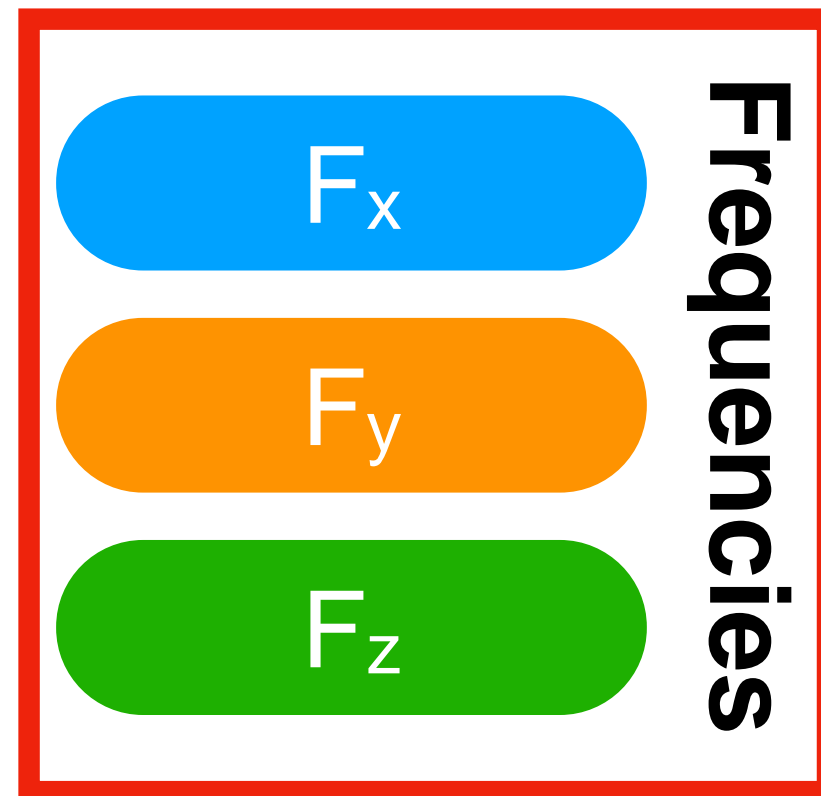
For Each Point





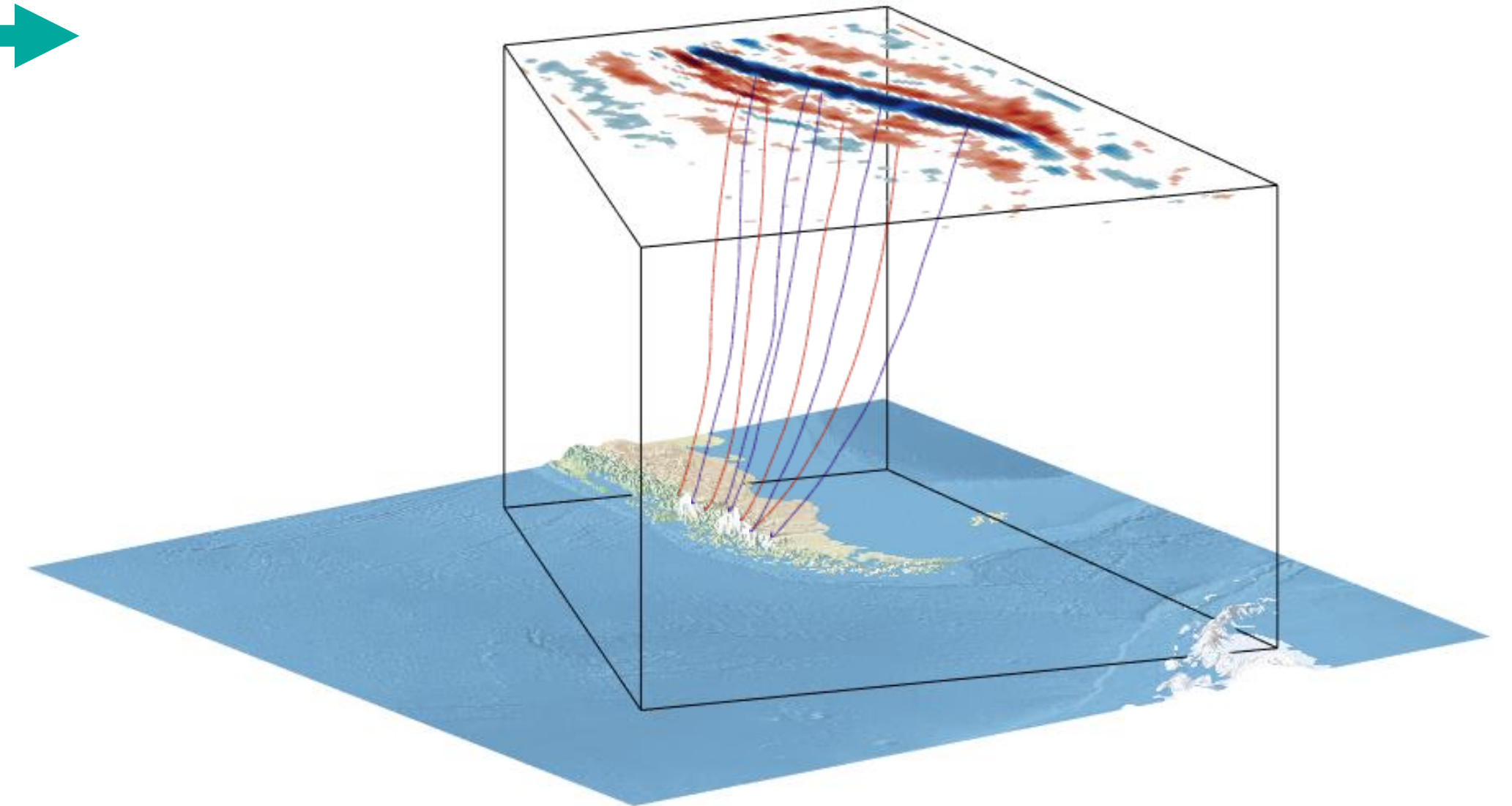
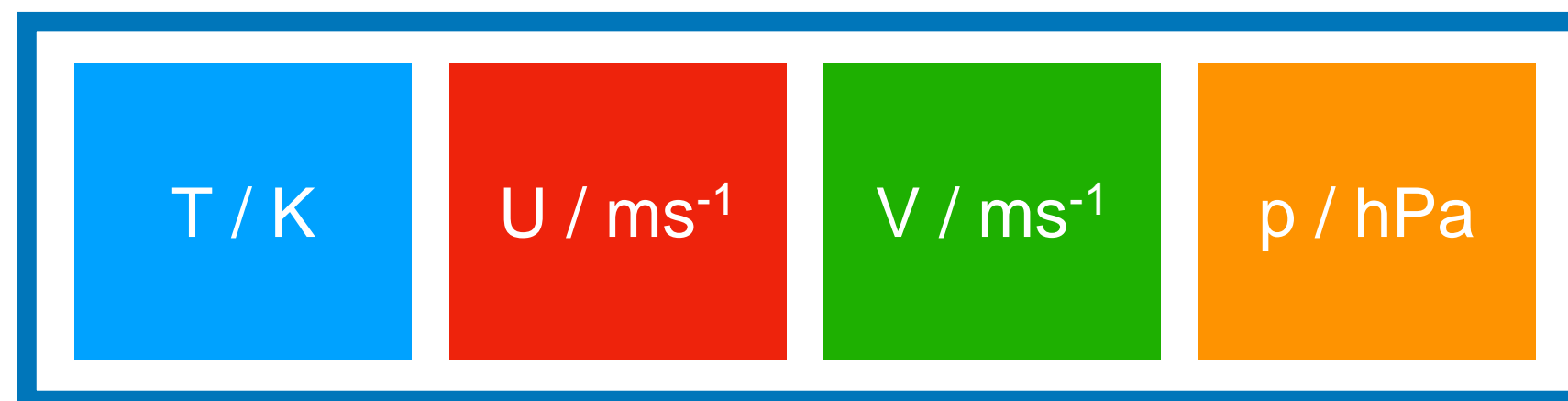
# Method Outline

For Each Point



3. Ray-Trace

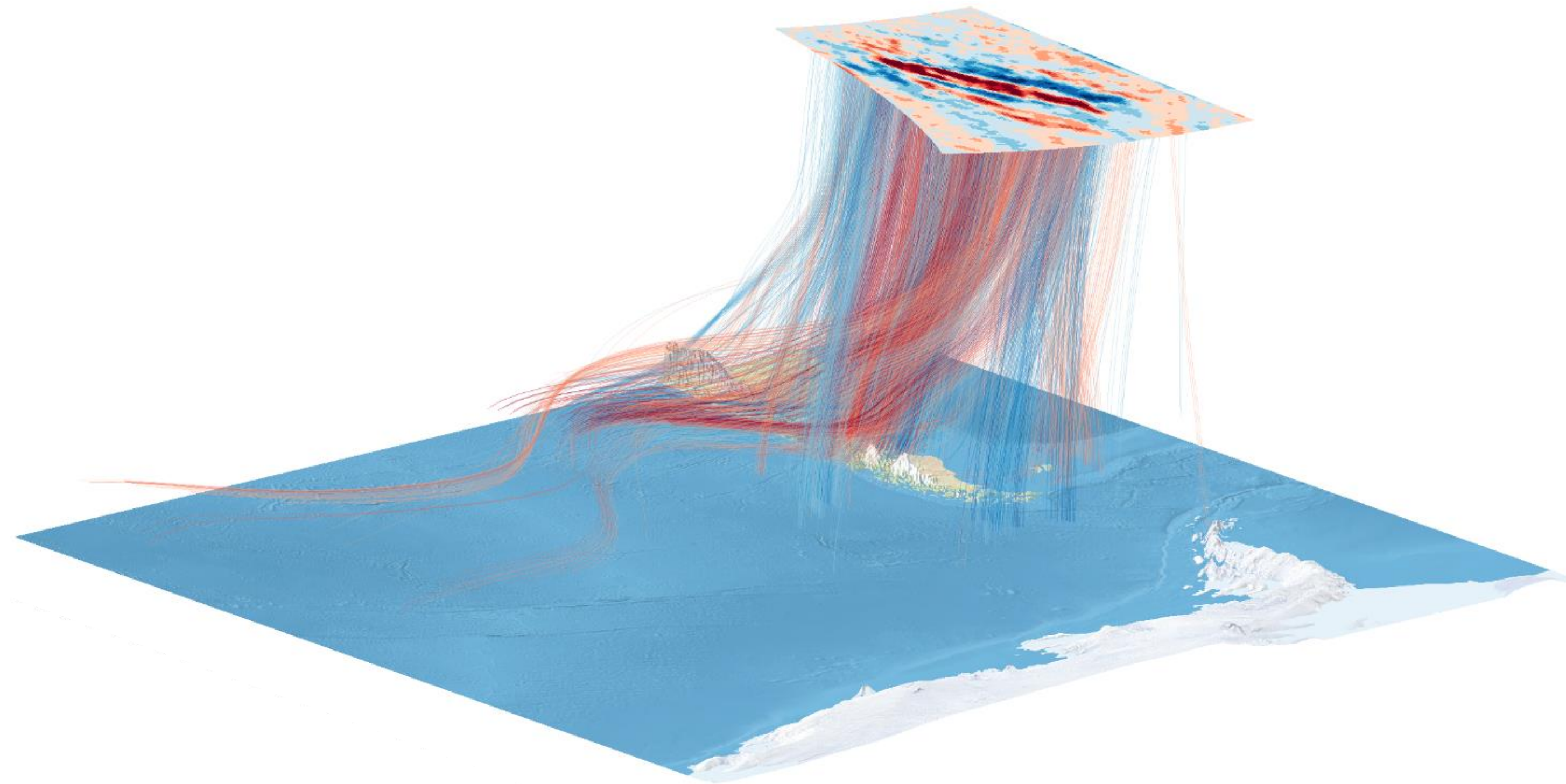
Background  
Fields





# Ray Tracing Results

June 2010: ~38 million individual measurements ray-traced

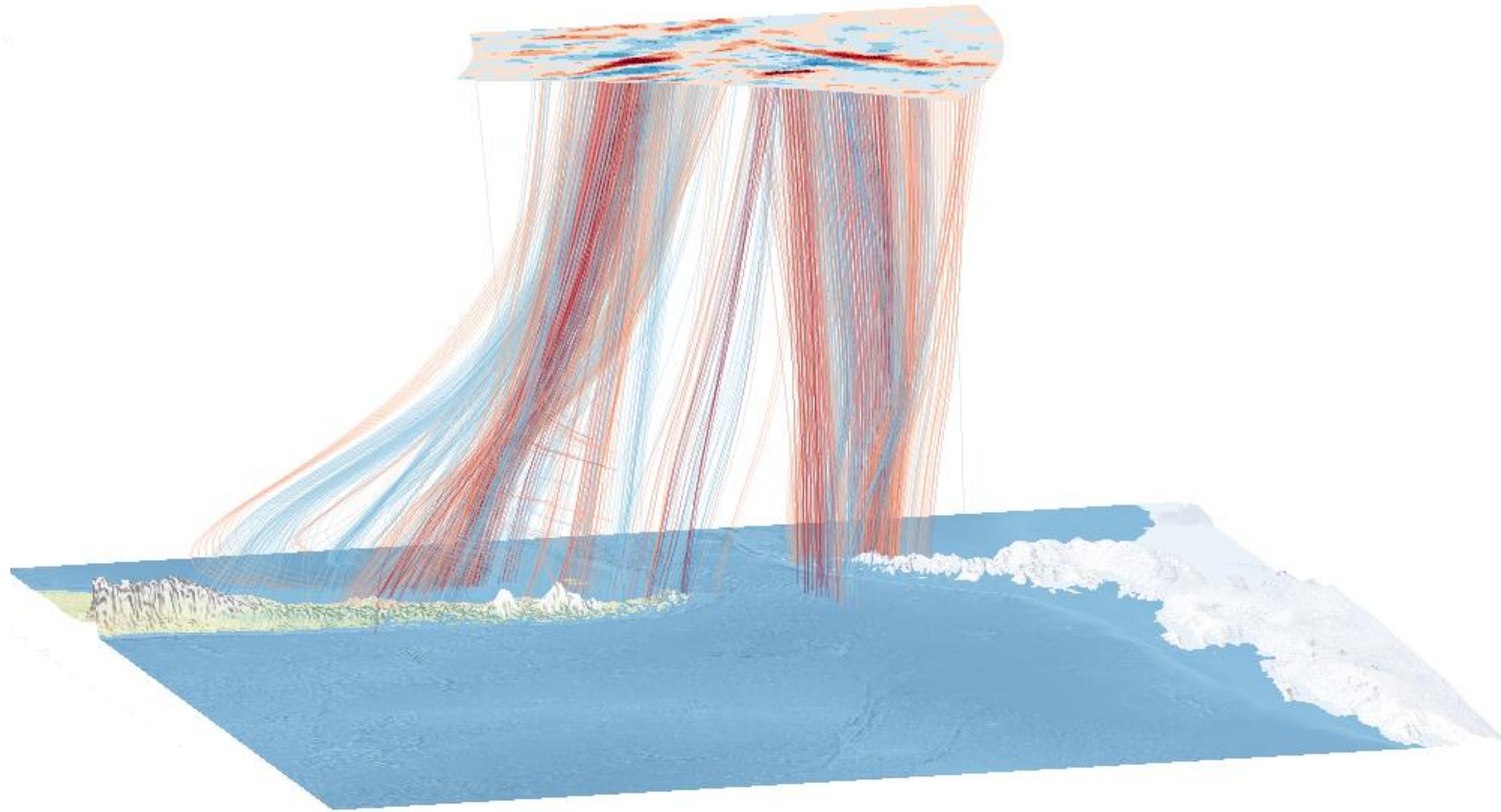


Our guesses about sources are correct!



# Ray Tracing Results

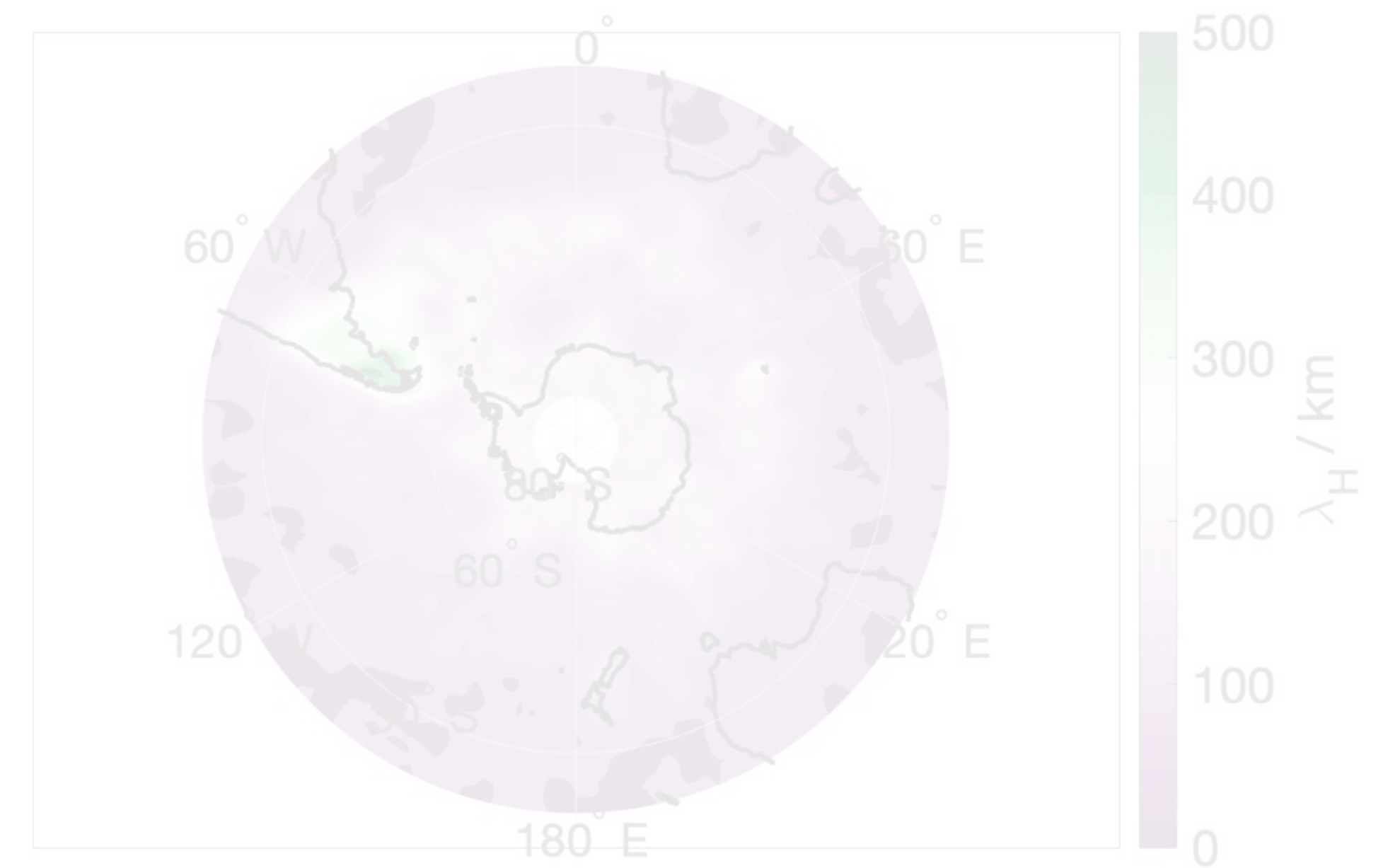
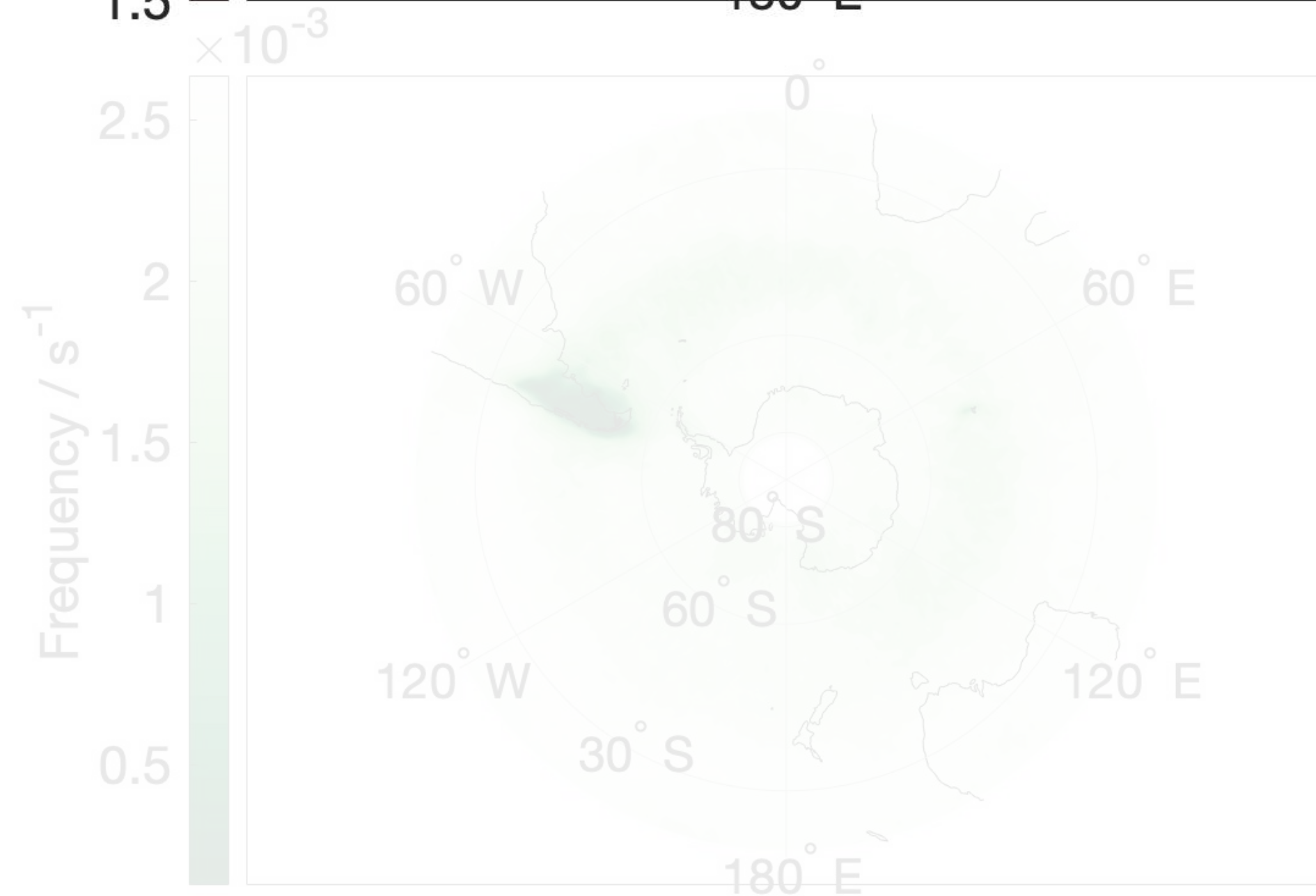
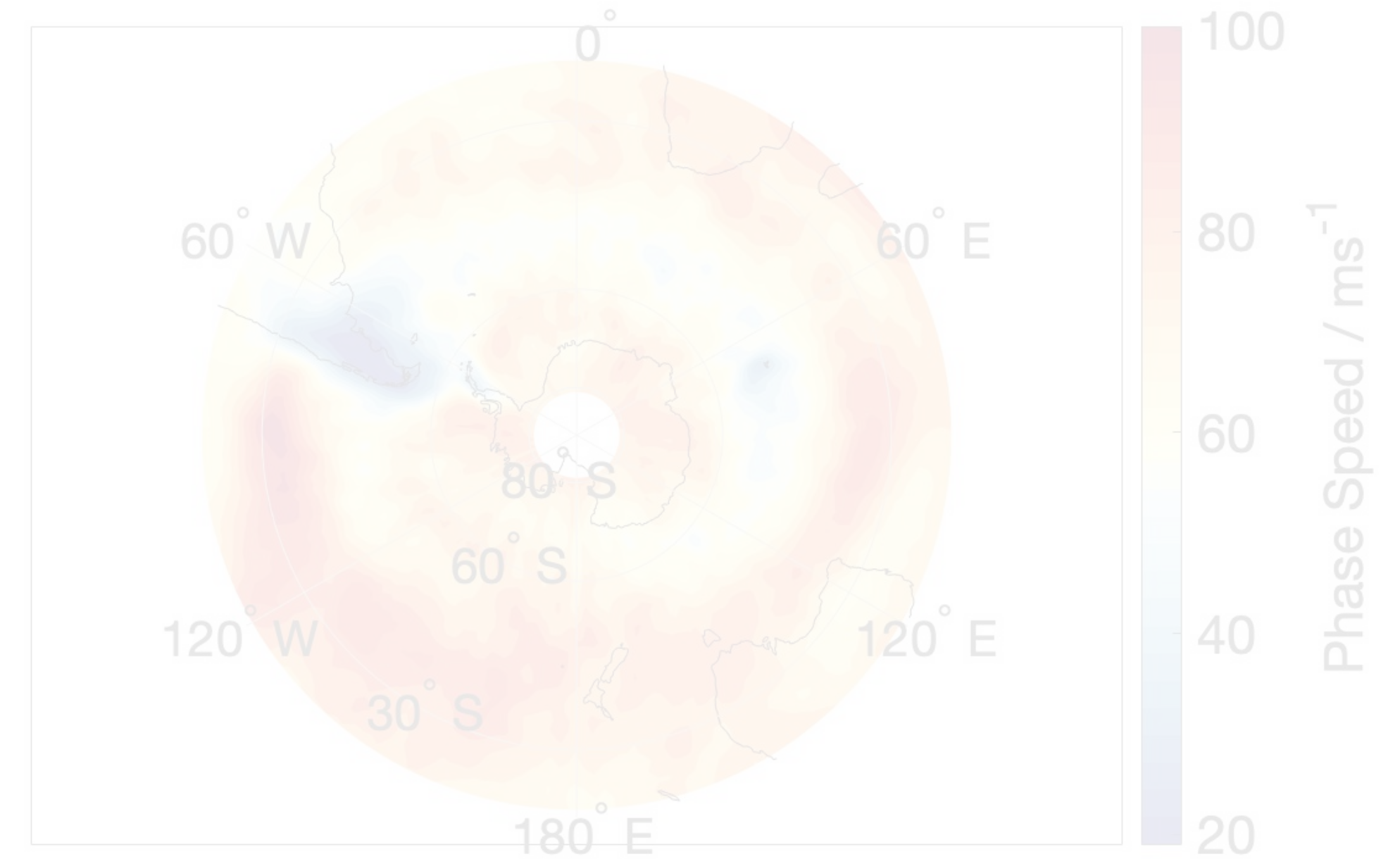
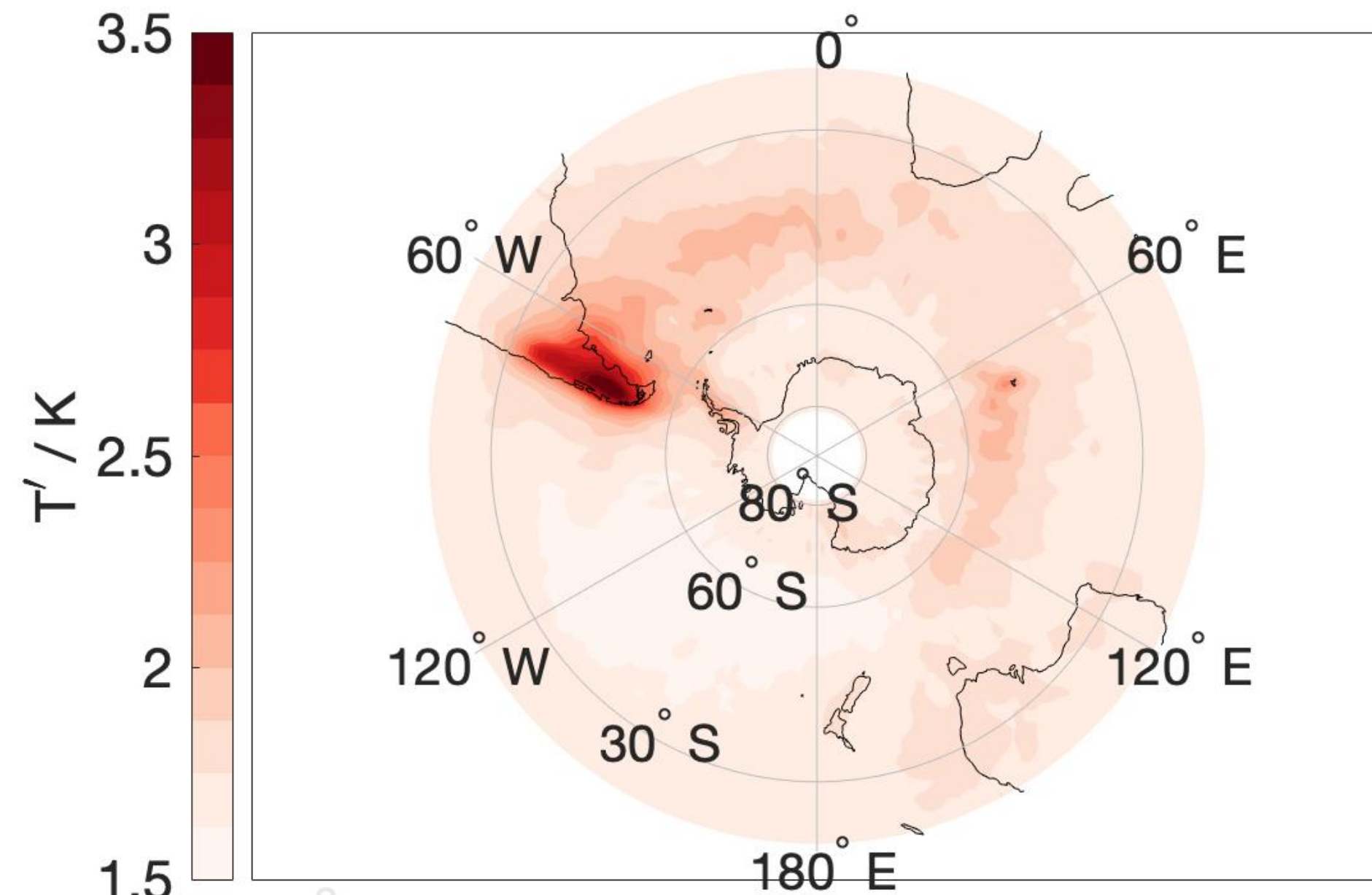
June 2010: ~38 million individual measurements ray-traced



Our guesses about sources are correct!

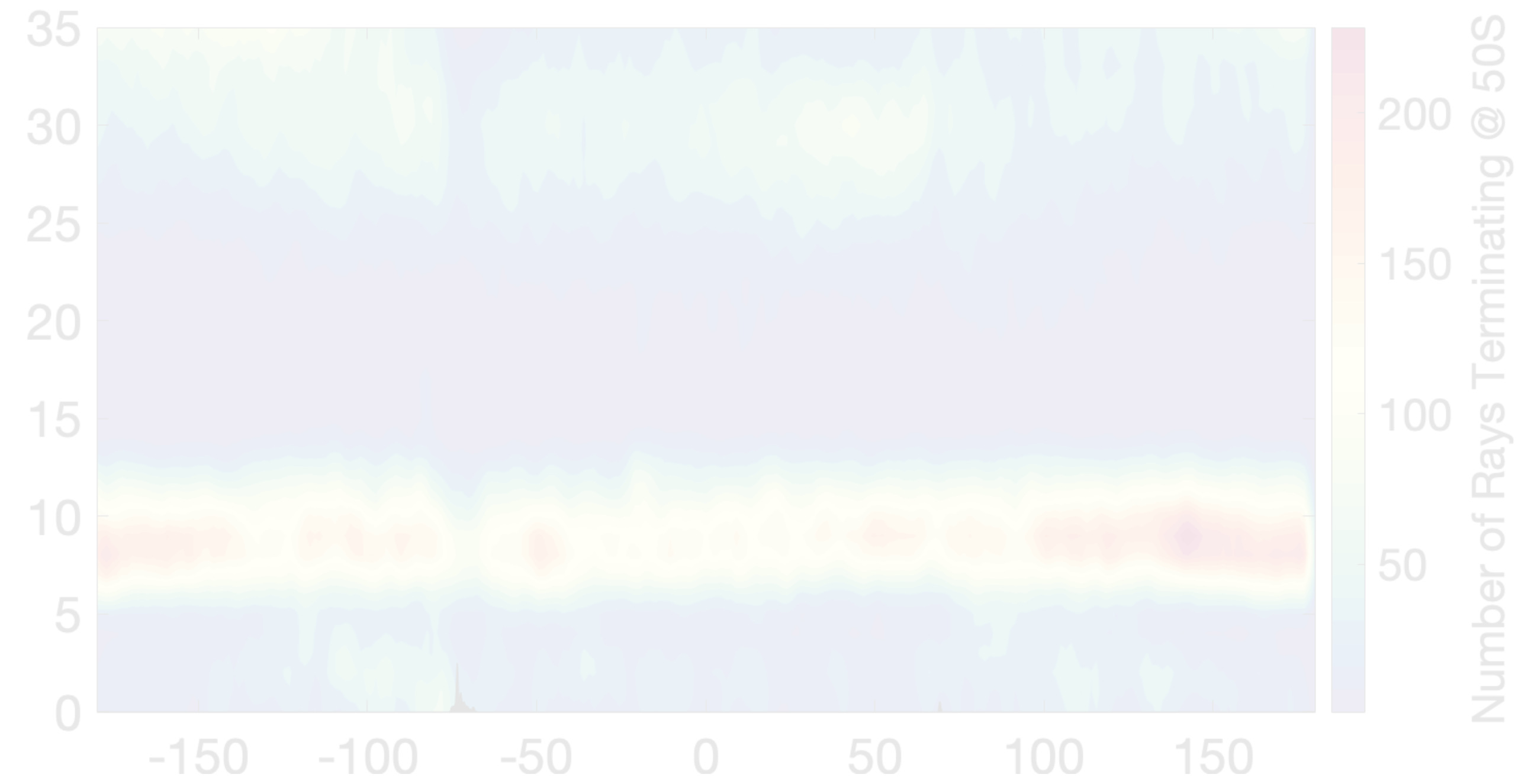
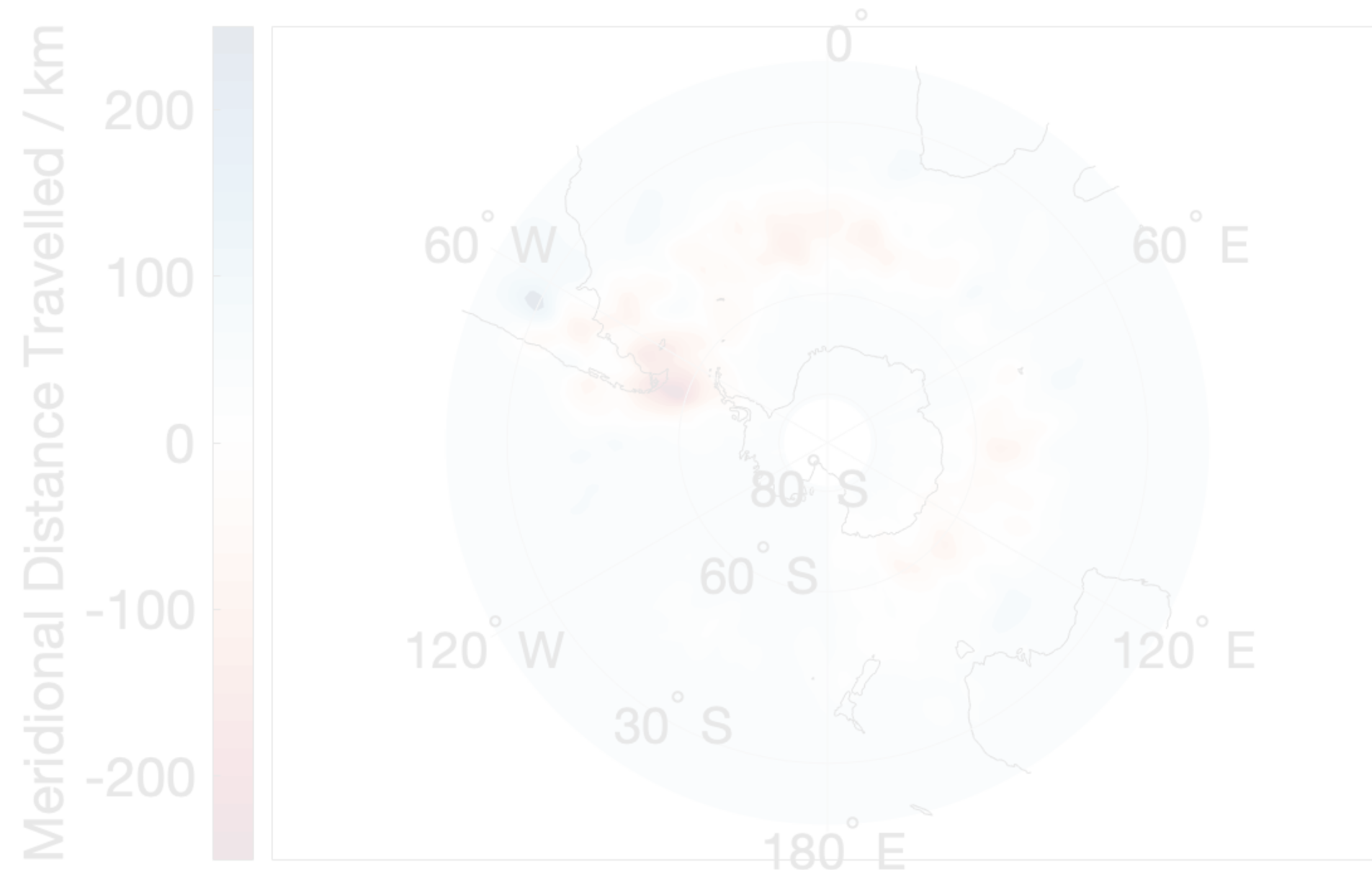
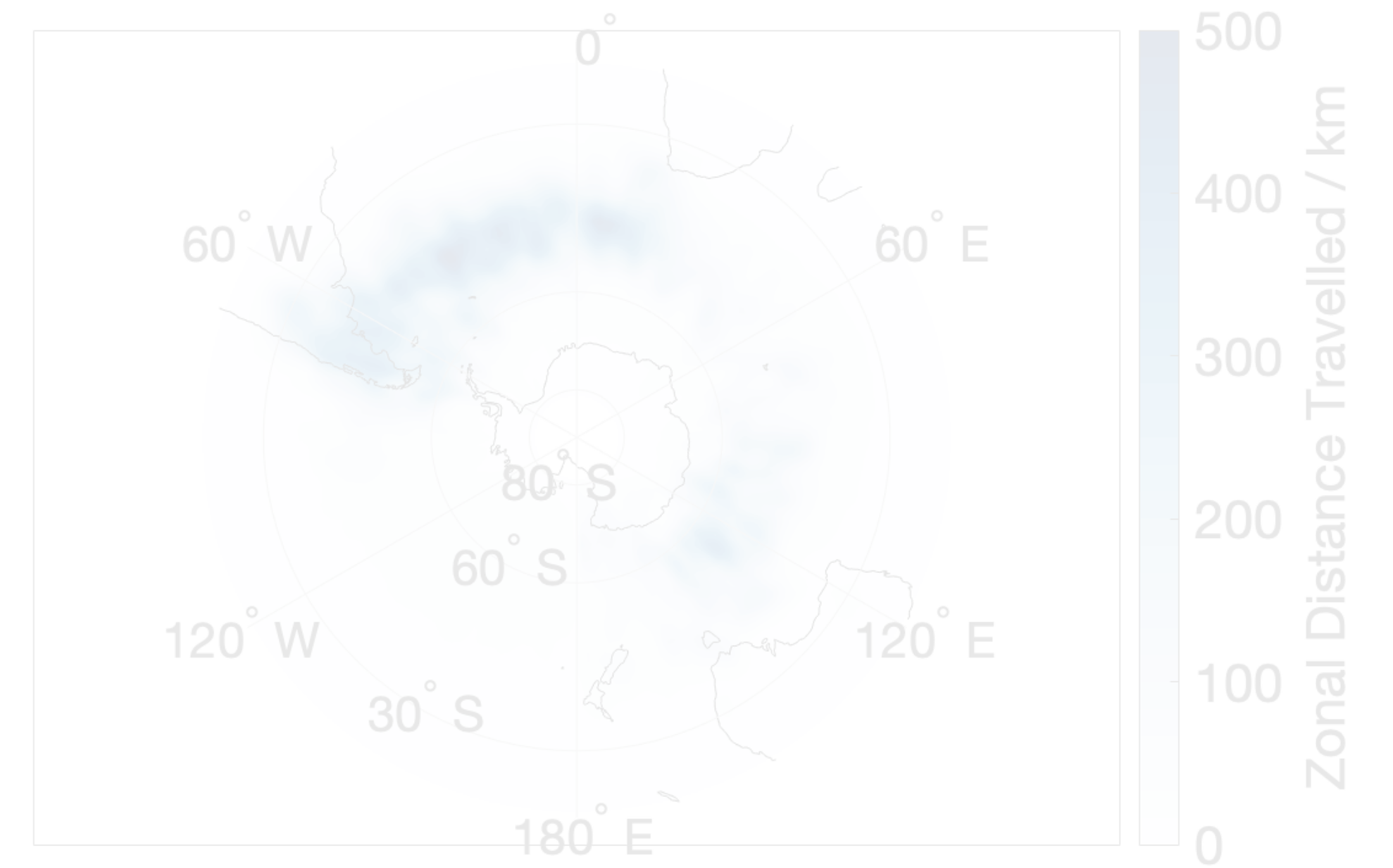
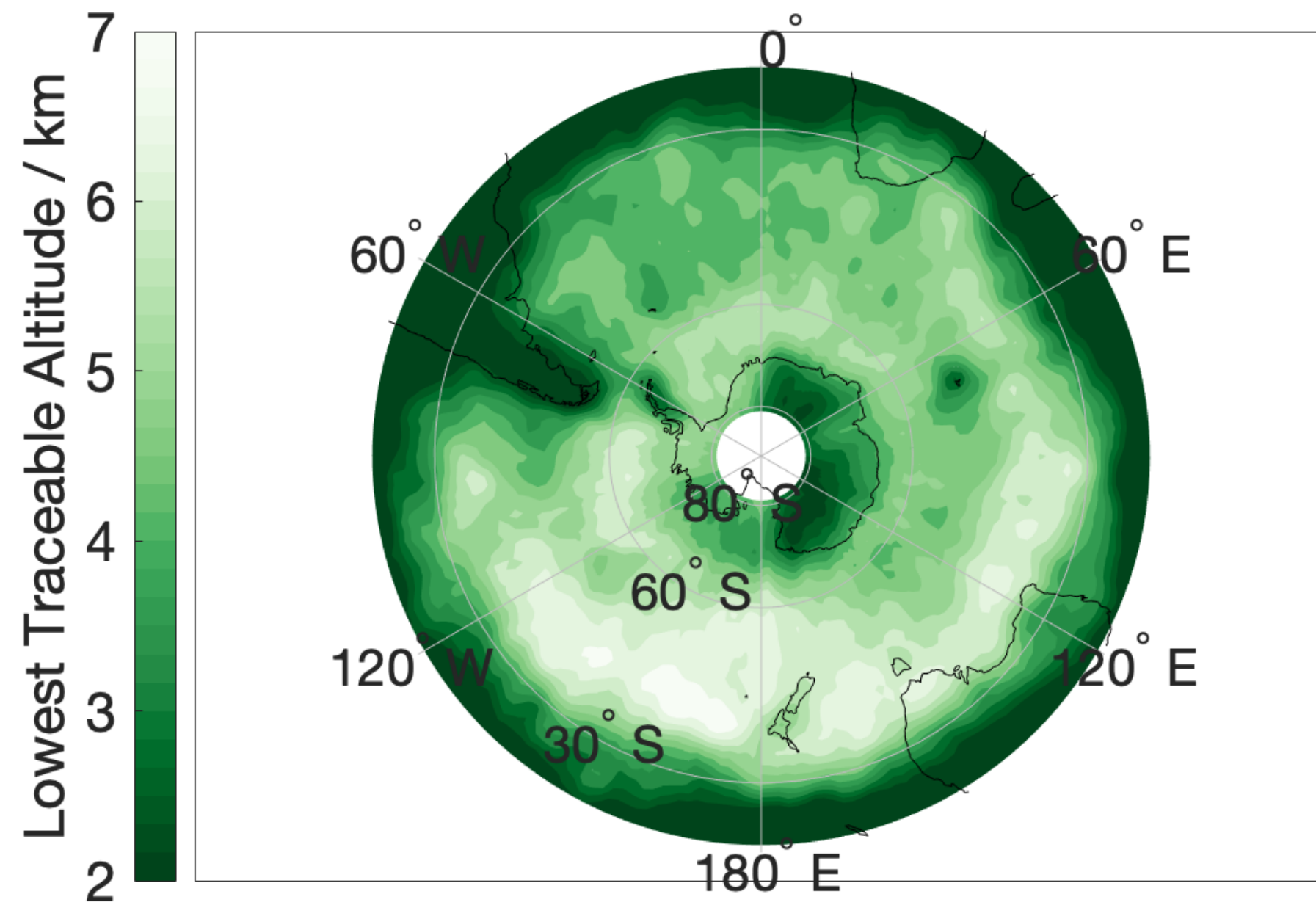


# June 2010 - Southern Hemisphere Input





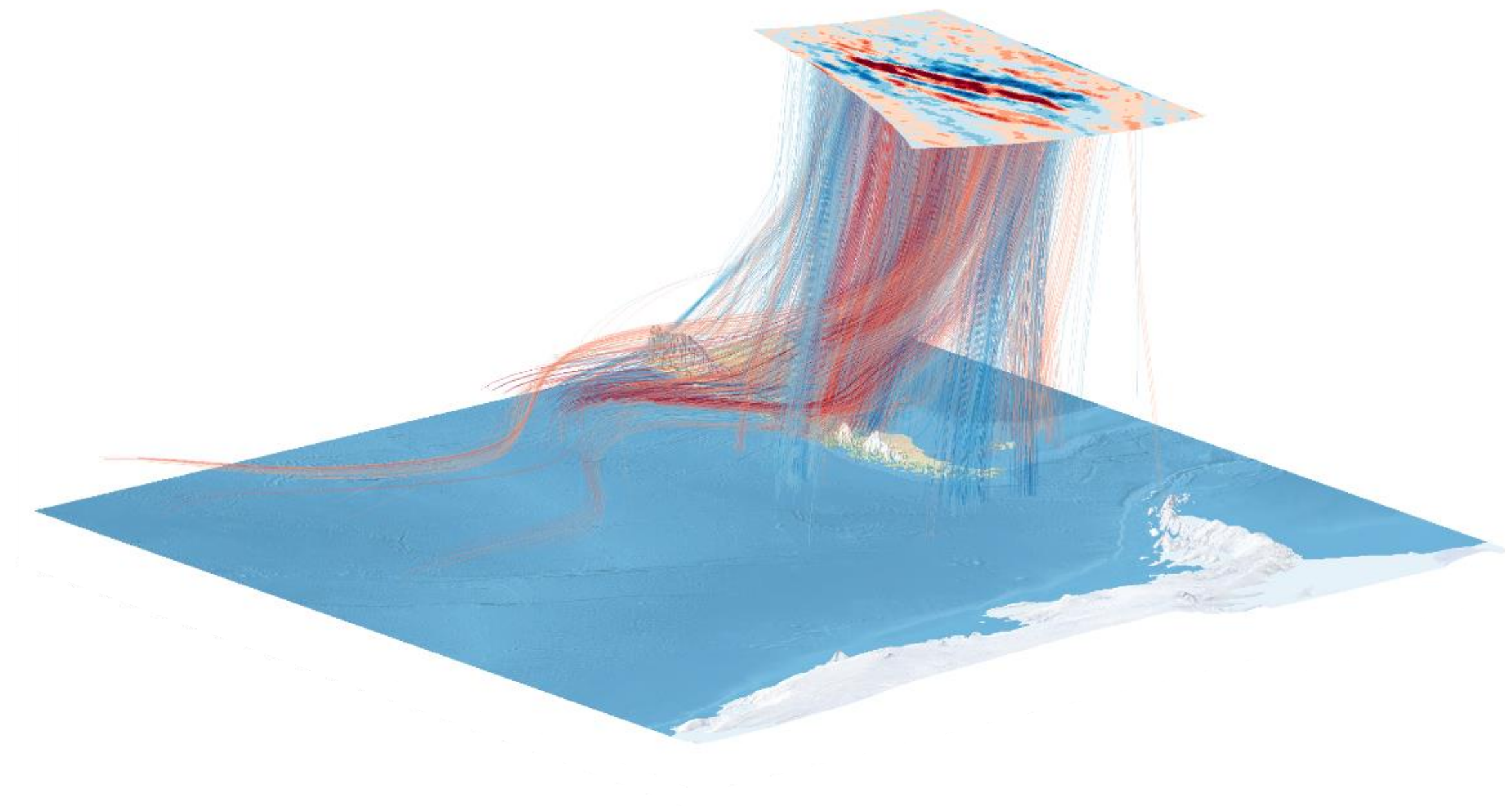
# June 2010 - Southern Hemisphere Output





# Conclusions

- Largest ray-tracing study of gravity waves ever performed (~ 38 million rays)
- Sources determined over the Andes, Antarctic Peninsula, and Kerguelen Islands
  - Meridional propagation of waves into 60 °S - 'missing' momentum flux



j.perrett@bath.ac.uk



@\_jonperrett