Toward a Simulation - Retrieval System for Demonstrating Tomography of Internal Gravity Waves

Jennifer Hegarty (AER), Stephen Leroy(AER), Kerri Cahoy (MIT), Riley Fitzgerald (MIT) and Lucy Halperin (MIT)

Science Motivation : Gravity Wave Tomography using RO

- RO obtains high vertical resolution to resolve gravity waves (GWs) invisible to all other remote sensing techniques.
- With satellite clusters, you can do 3D tomography thereby inferring GW momentum fluxes
- But how well can you infer momentum fluxes?

Approach: Simulations with MPAS and Wave-Optics Propagator

- The Model for Prediction Across Scales (MPAS) is a global model with a stretchable horizontal grid to provide higher spatial resolutions in some regions with computational efficiency.
- MPAS can resolve small-scale gravity waves regionally.
- MPAS meteorological fields input to existing multi-phase screen wave optics propagator to simulate RO retrievals of refractivity, bending angle, and temperature profiles
- Interpolating MPAS data from horizontal Voronoi tessellations grid is challenging.

Progress

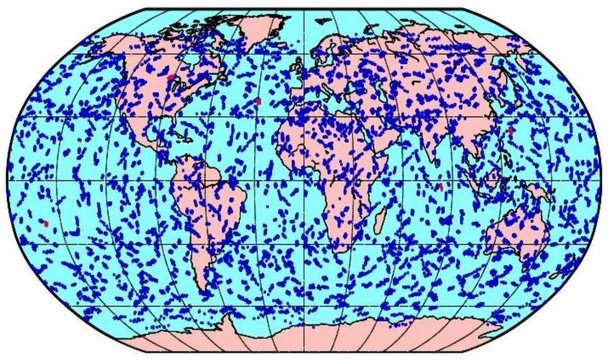
- Performed test runs of MPAS
- Developed code to interpolate MPAS data to wave optics space
- Incorporated the MPAS interpolator into the multi-phase screen wave optics propagator code

Next Steps

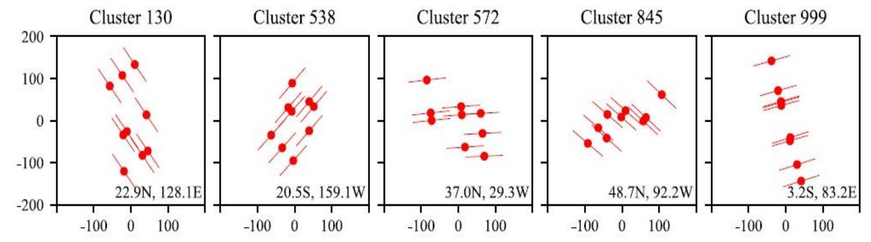
- Simulate gravity wave with MPAS with high resolution over the convective western Pacific Warm Pool
- Simulate clusters of RO using MPAS fields and multi-phase screen wave optics propagator
- Infer momentum fluxes from ensemble of clusters
- Compare to true momentum fluxes

Intended Results

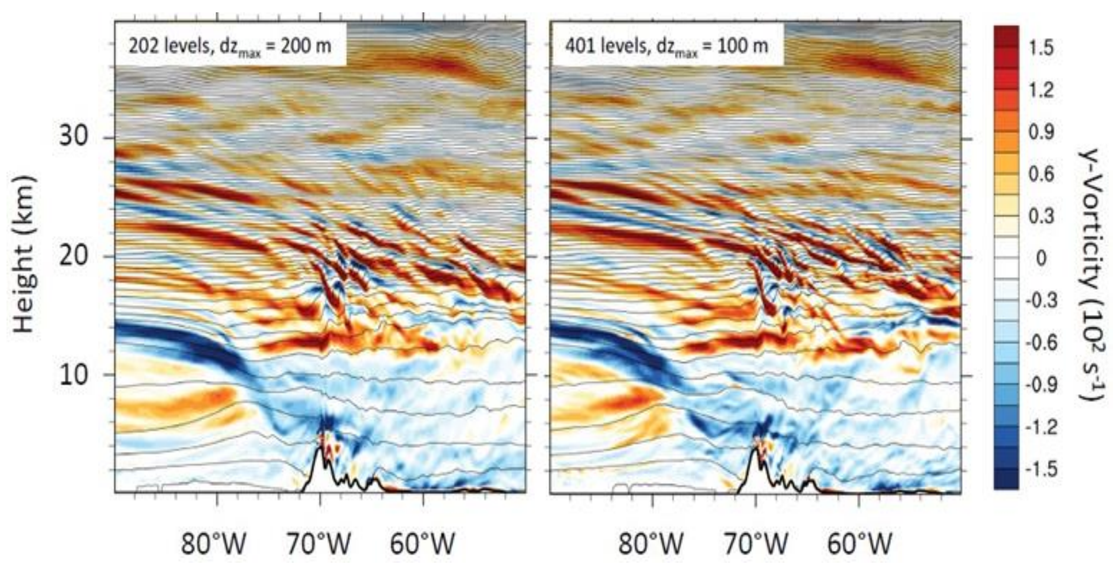
- Gravity wave filter function
- Prospective mission simulation-demonstration



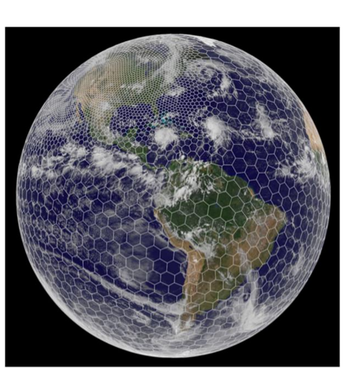
Simulated global distribution of satellite clusters

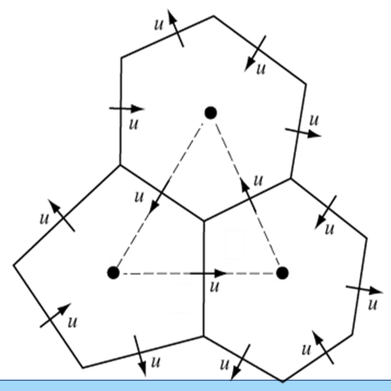


Simulated dedicated 9-satellite clusters



MPAS simulation of gravity waves over the Andes Mountains
Figure courtesy of William Skamarock (NCAR)





MPAS Voronoi tessellation grid: high-resolution portion can be rotated to other regions of globe. Figures from NCAR

Email: jhegarty@aer.com

NSF Large-Scale Dynamics Program, NSF Grant 1850276

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