2017 DEEPWAVE Workshop

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Modeling Mountain Wave Breaking over the Andes: Early High-Resolution Compressible Results

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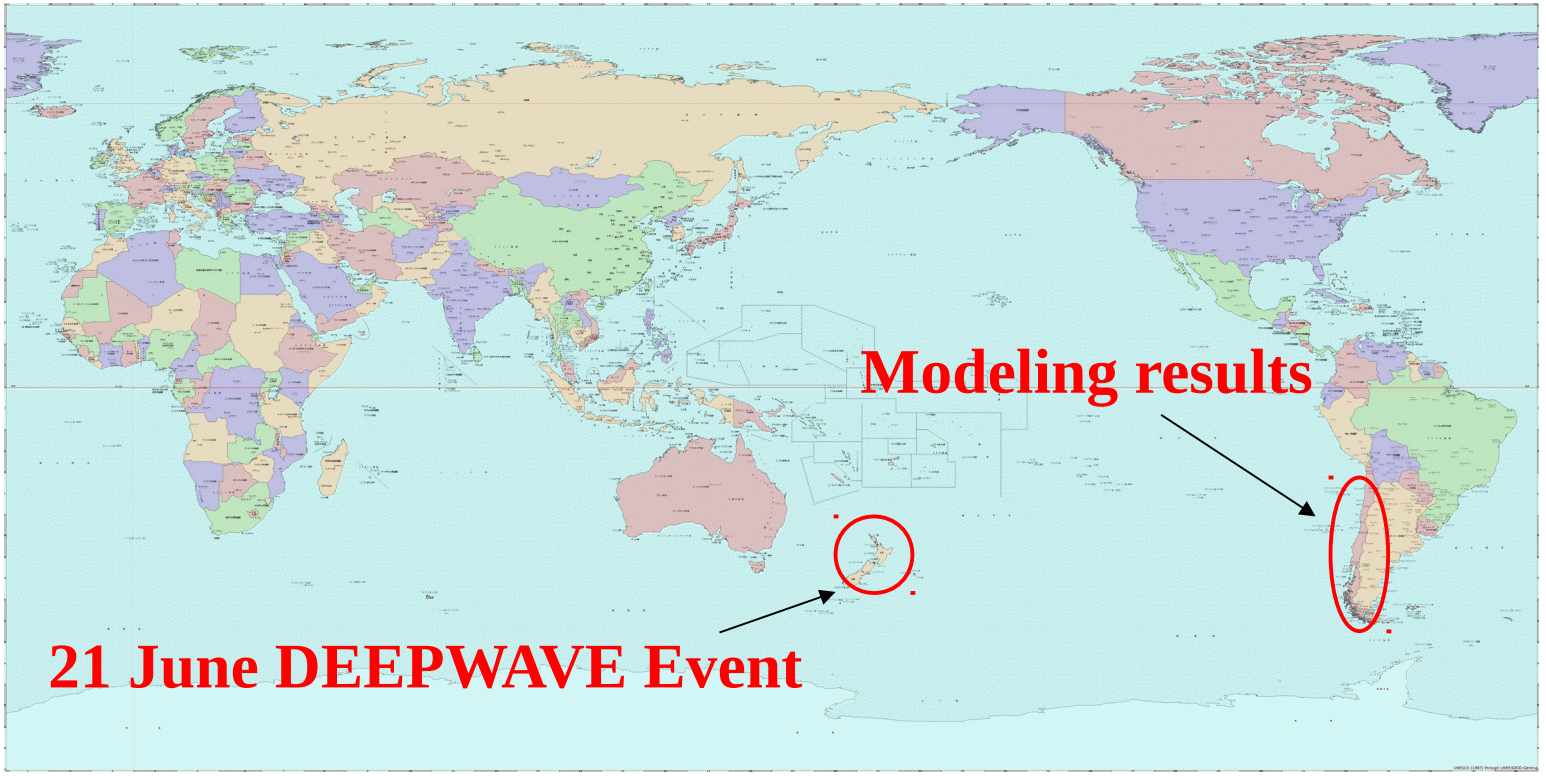
Yes, the Andes...

- Early compressible results
- Isolated mountain
- GW hot spot
- Acronym issues



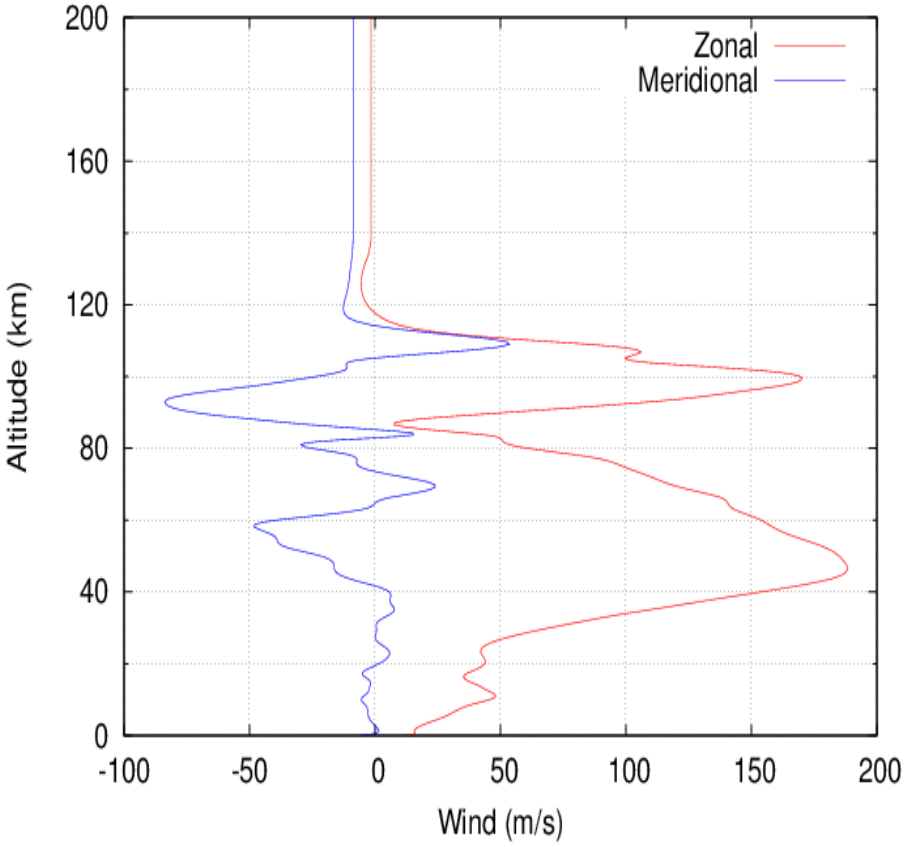
Mountain Wave Breaking over the Andes

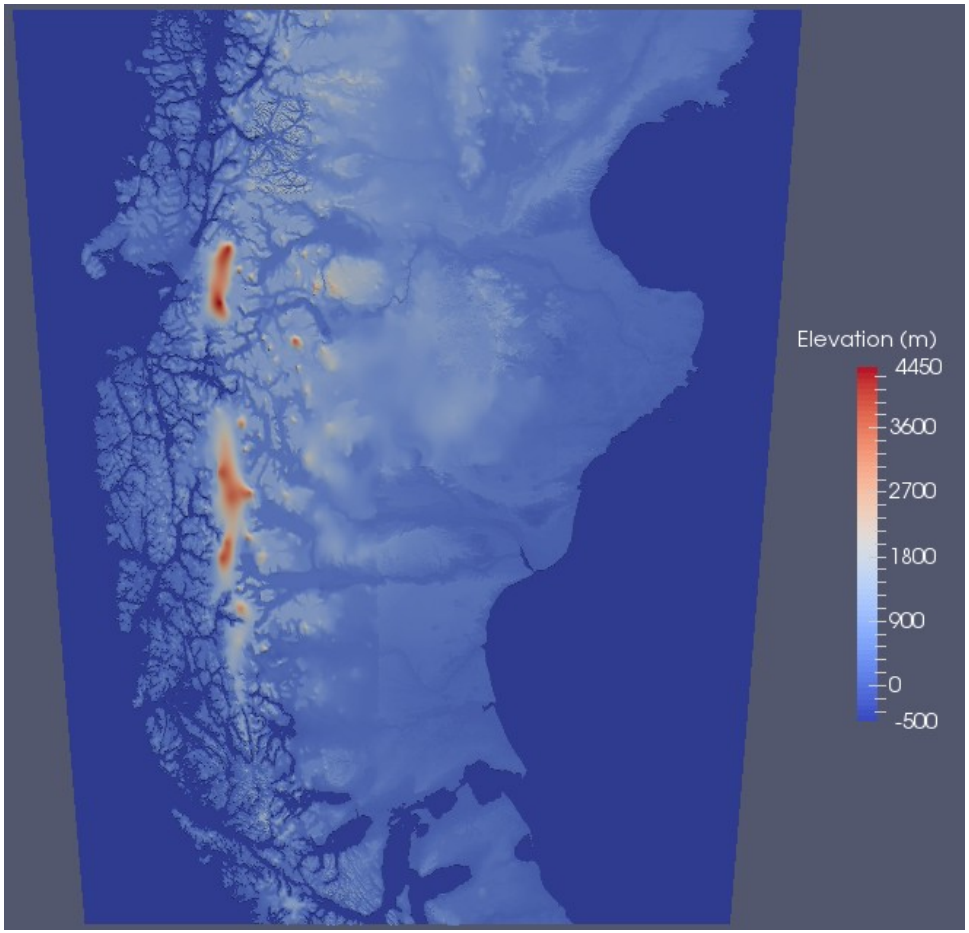
- Initial Conditions and Numerical Model
- Mostly Movies
- 21 June Event
- Conclusions

Modeled Environment: Winds and Topography

Goal is to simulate airflow over topography

Winds taken from WACCM

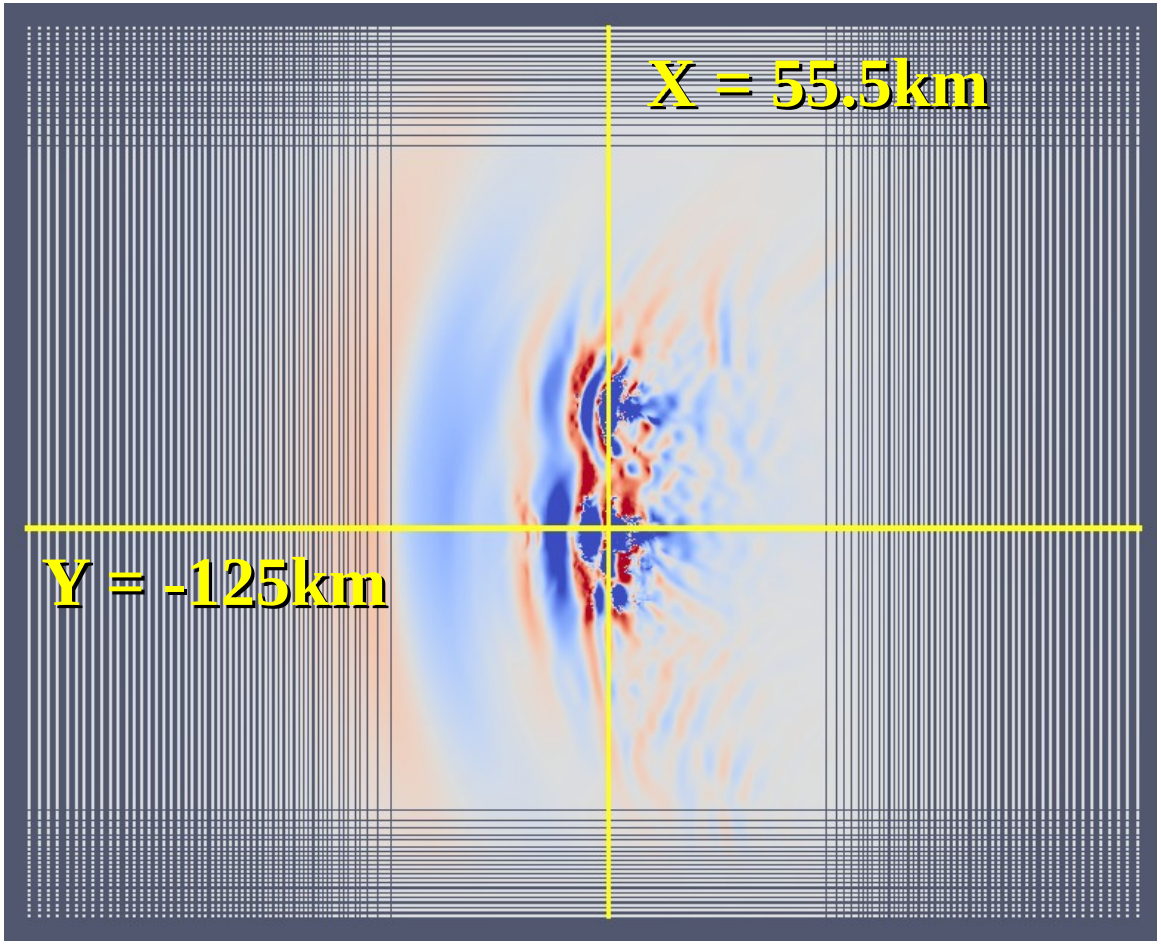




Airflow

Topography

Domain and Resolution



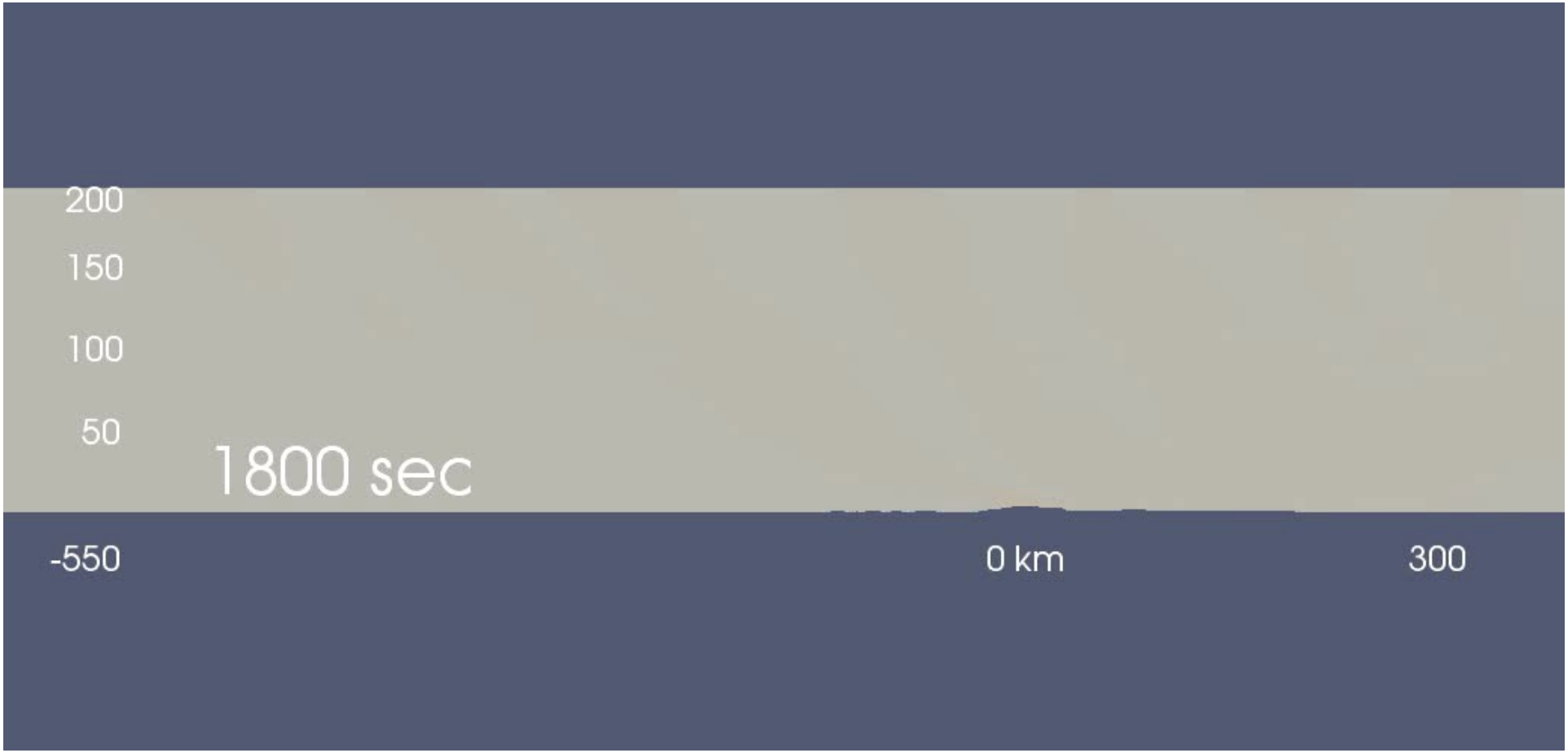
Simulation at 5250 s

Impact of two major peaks obvious

- xy plane at z = 65 km
- Yellow lines denote vertical cross sections
- Oceans are flat, domain is extended

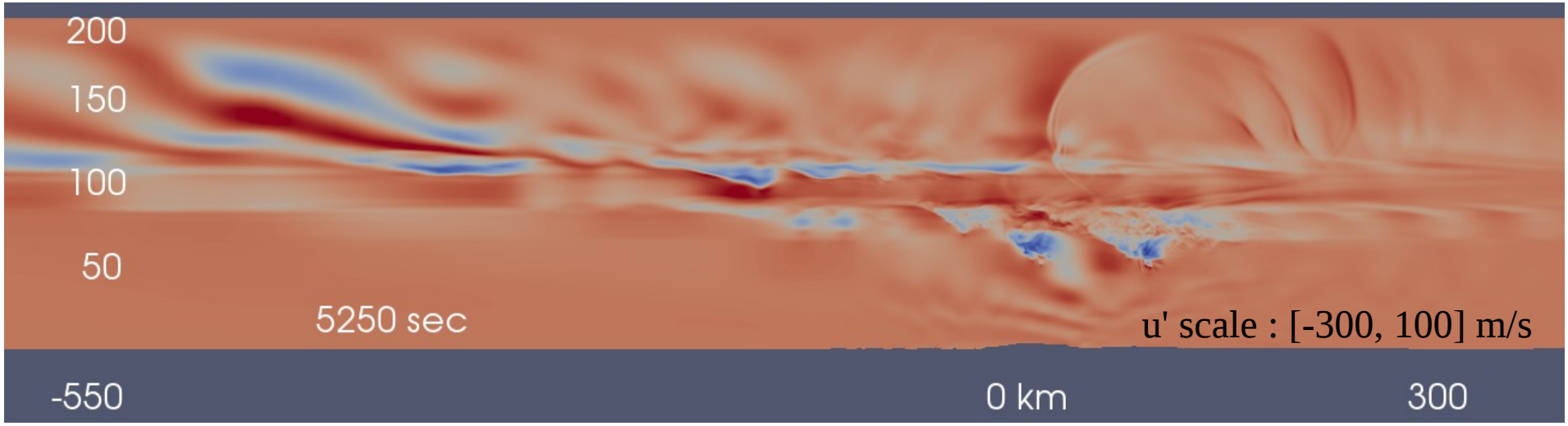
- 2500 km zonal by 2000 km meridional by 200 km vertical
- Stretched grid with interior resolution of 500 m, isotropic
- Prior results in smaller domain with 2 km meridional resolution

Time Evolution: Zonal Domain *(xz)*



u' scale : [-200, 200] m/s

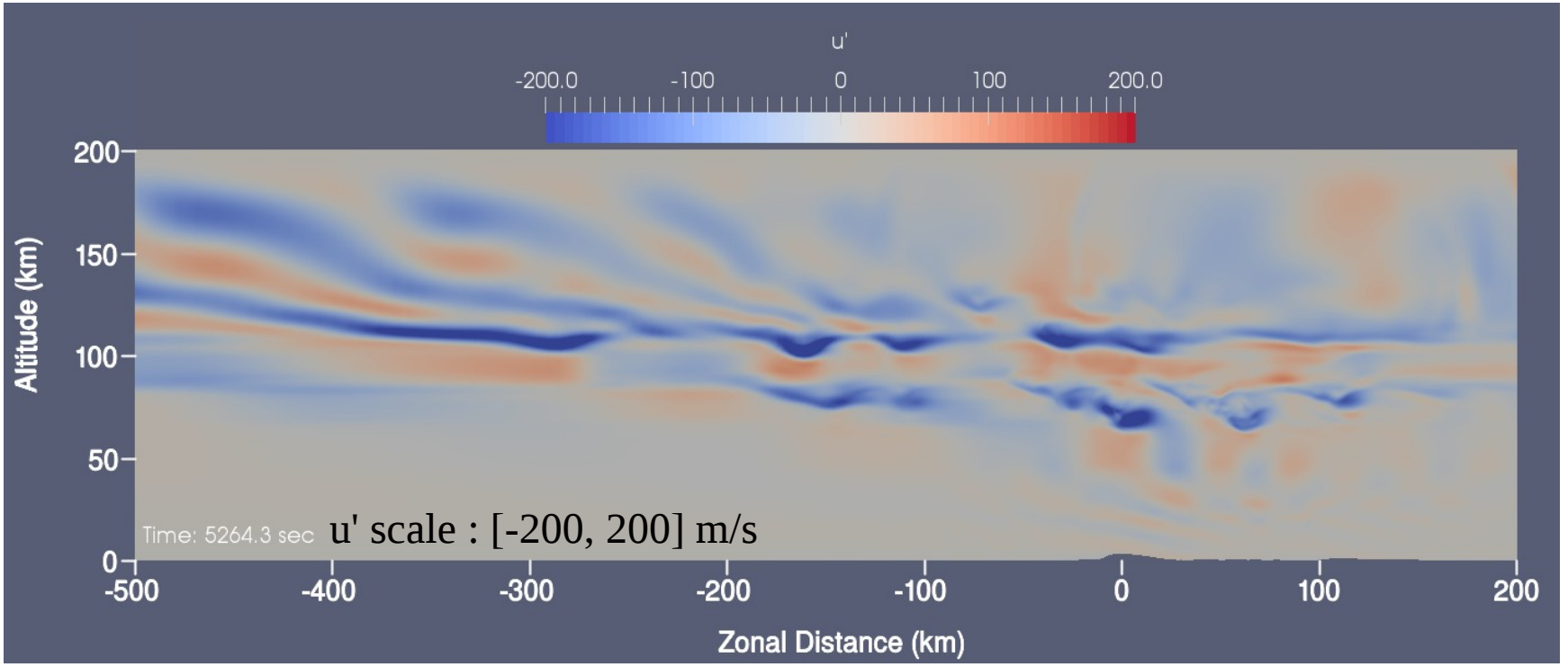
Wealth of phenomena to analyze

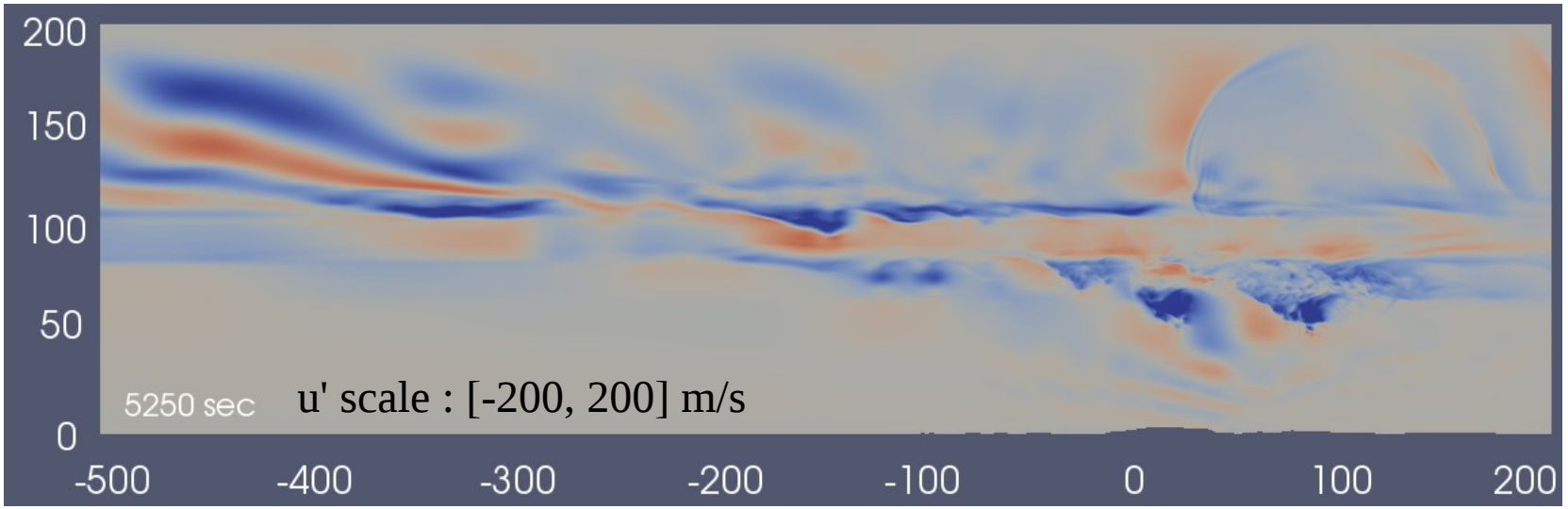


Large variety of waves and wave activity created

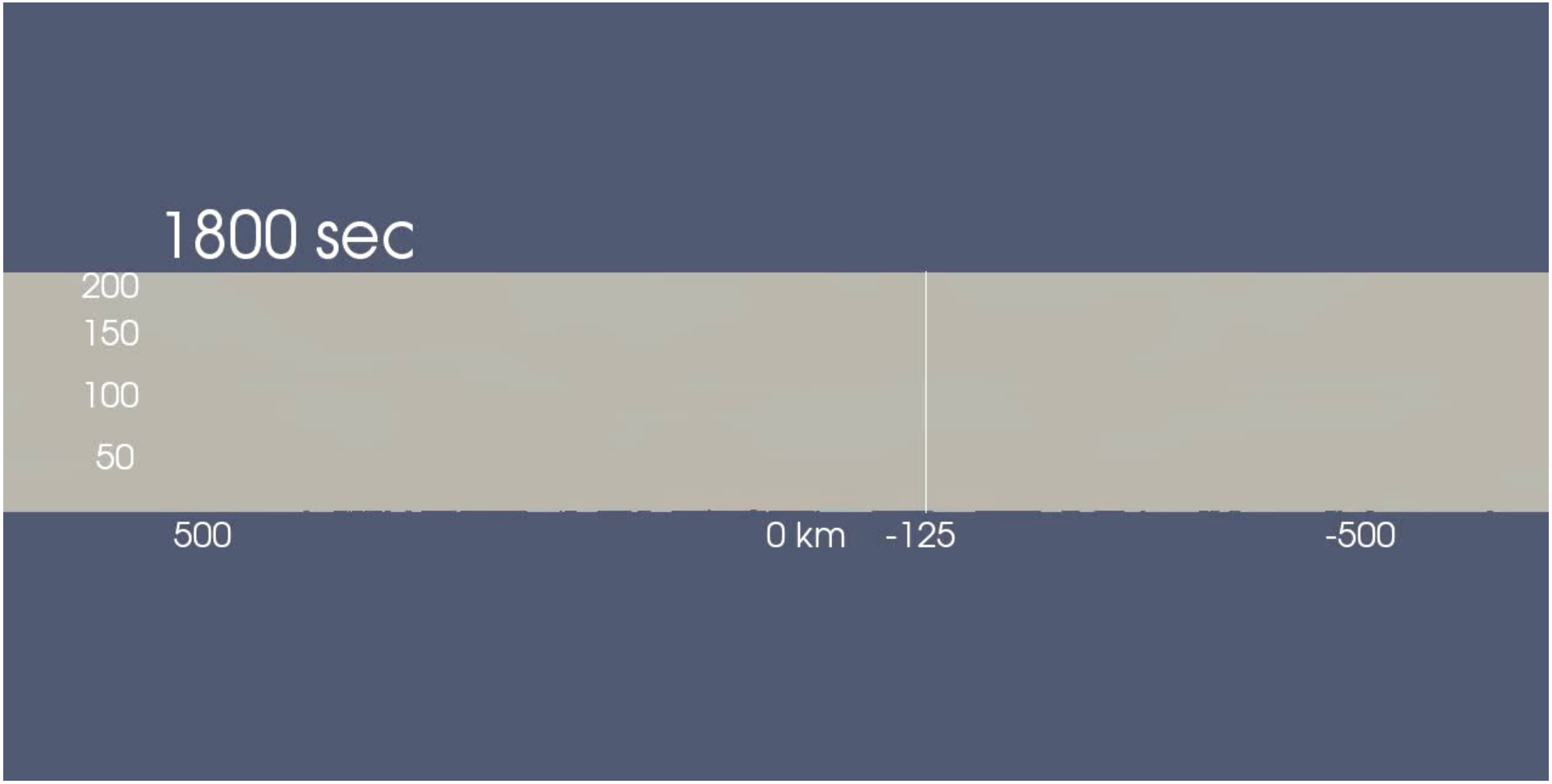
- Persistent breaking MW at ~ 80 km
- Upstream propagating and breaking waves
- Filtering effects of mean wind
- Secondary wave generation
- Acoustic waves

Meridional resolution: 2000 m *vs* 500 m



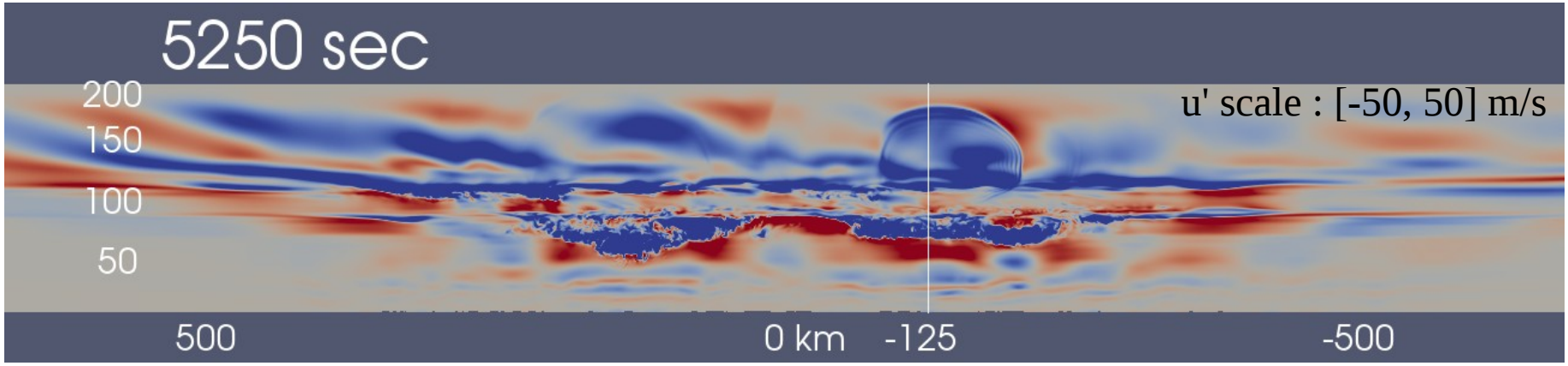


Time Evolution: Zonal Domain *(xz)*



u' scale : [-200, 200] m/s

Meridional domain considerations

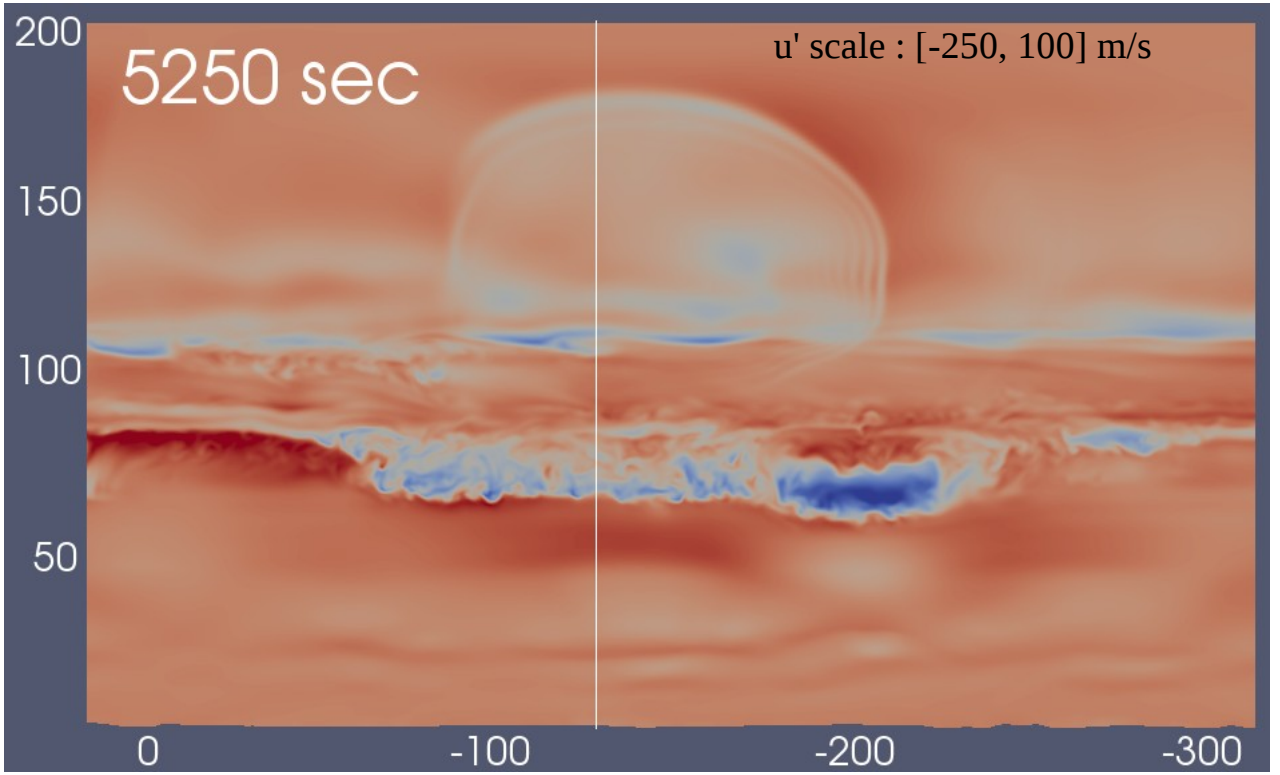


2 distinct forcing regions

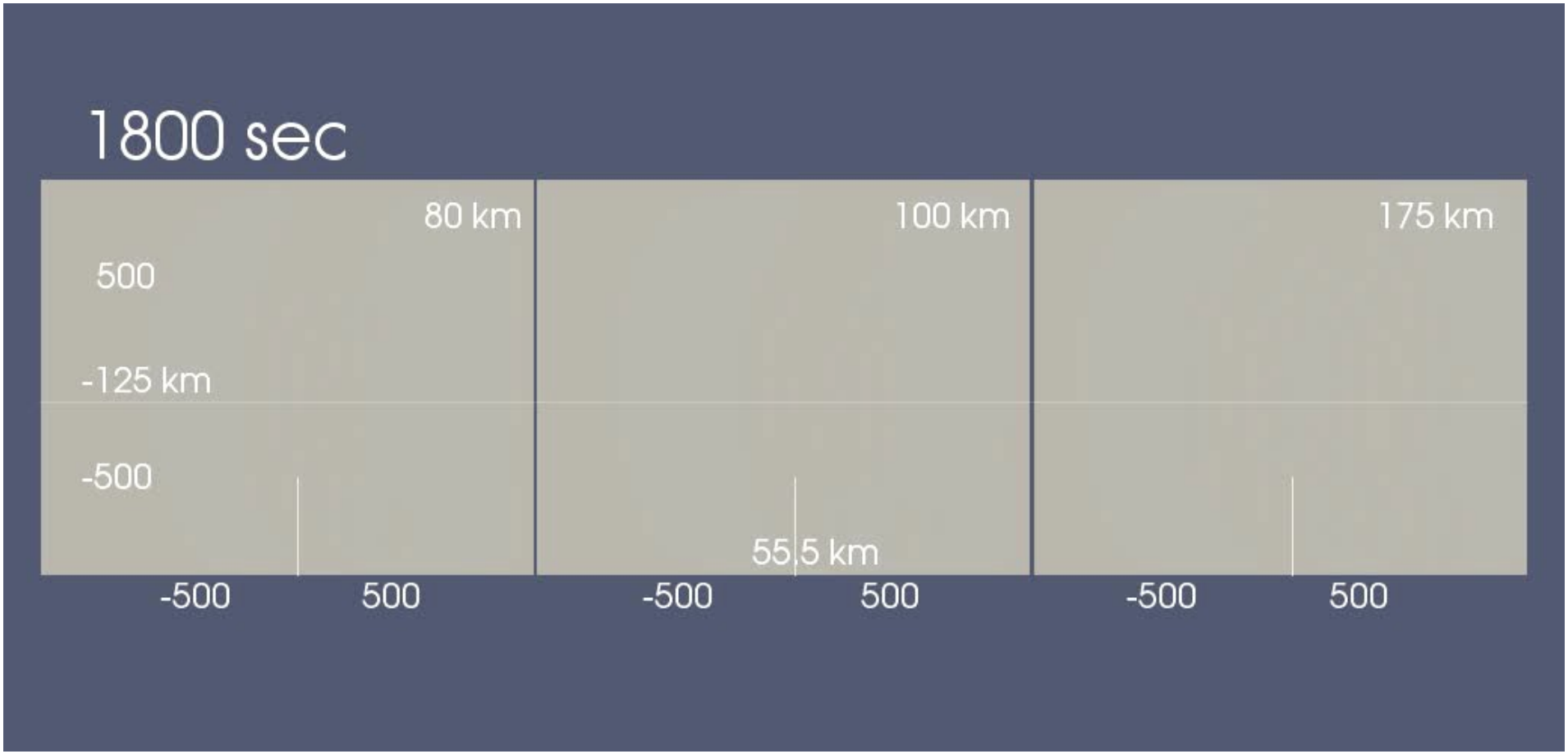
Wave breaking

Acoustic waves

Meridional flow



Time Evolution: Horizontal Slices *(xy)*



u' scale : [-110, 110] m/s

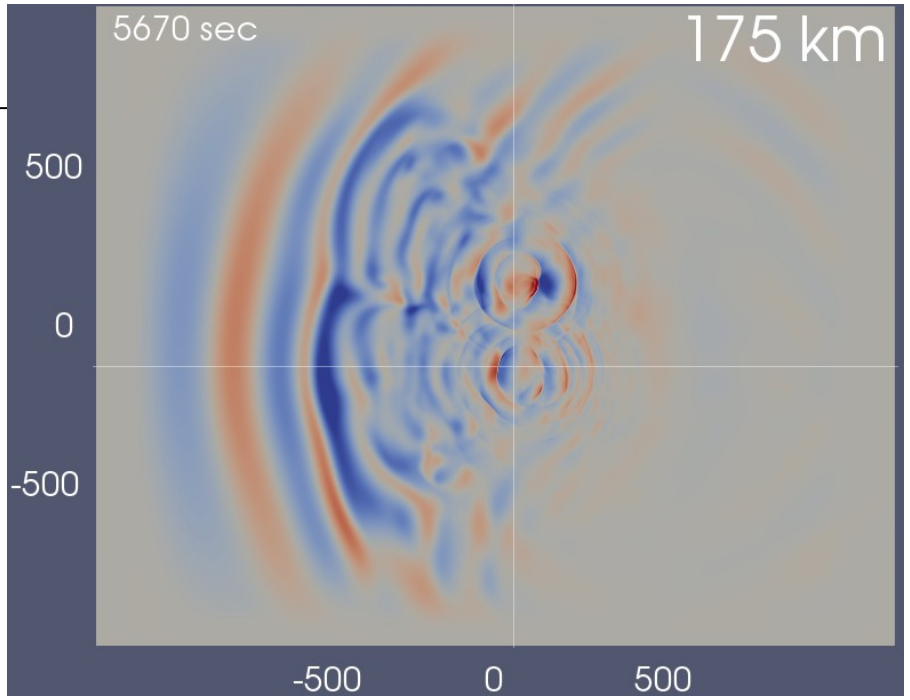
Altitude effects

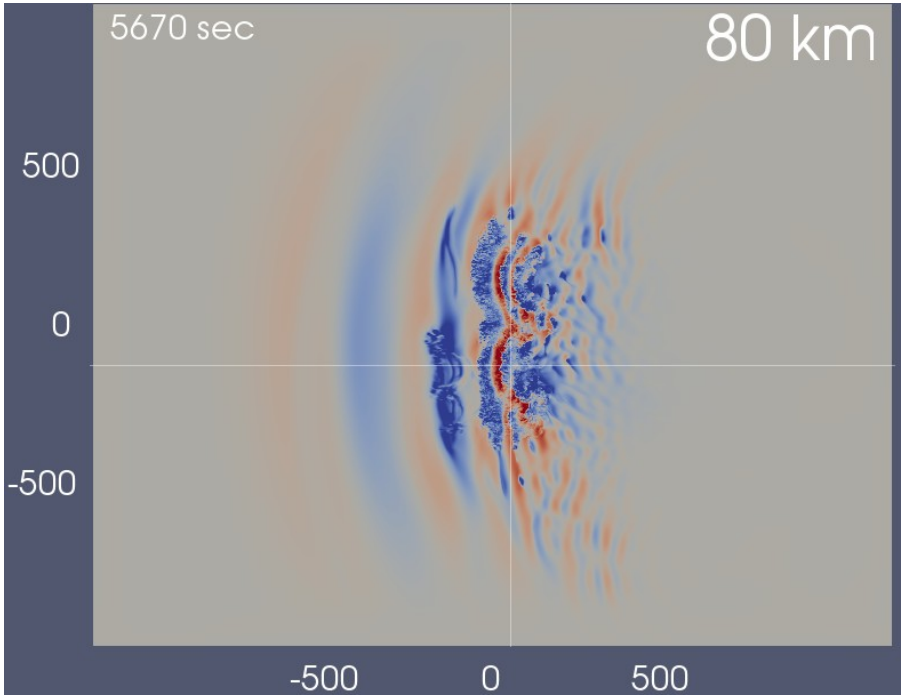
Smaller scales at lower altitudes;
filtering and viscosity

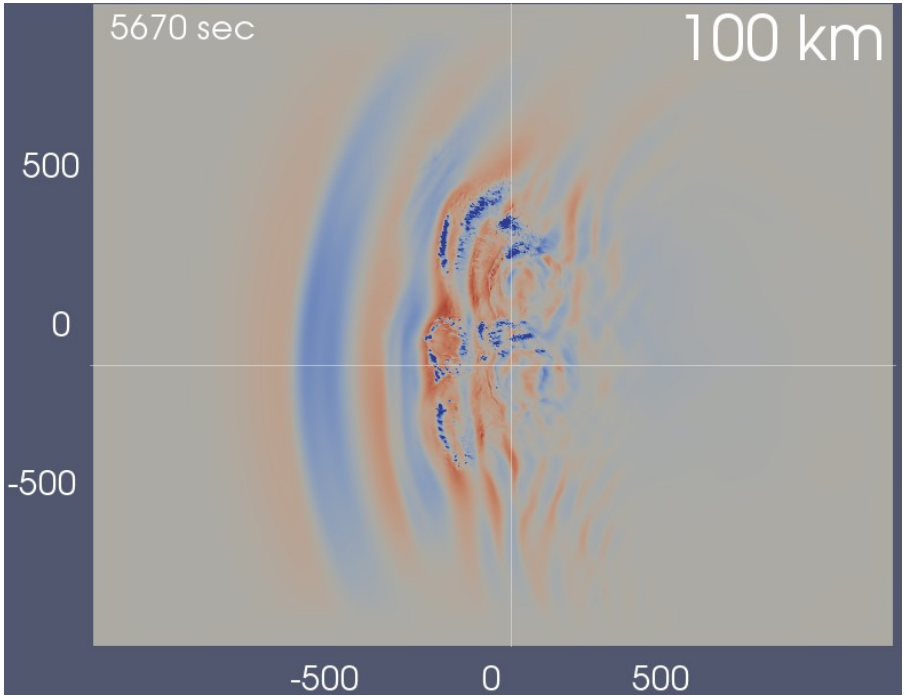
Acoustic waves more prominent at higher altitudes

Meridional variation

u' scale : [-110, 110] m/s







Implications for Modeling of 21 June event

Weak forcing / no RF

AMTM (80 km) / lidar data

Quasi-stationary waves

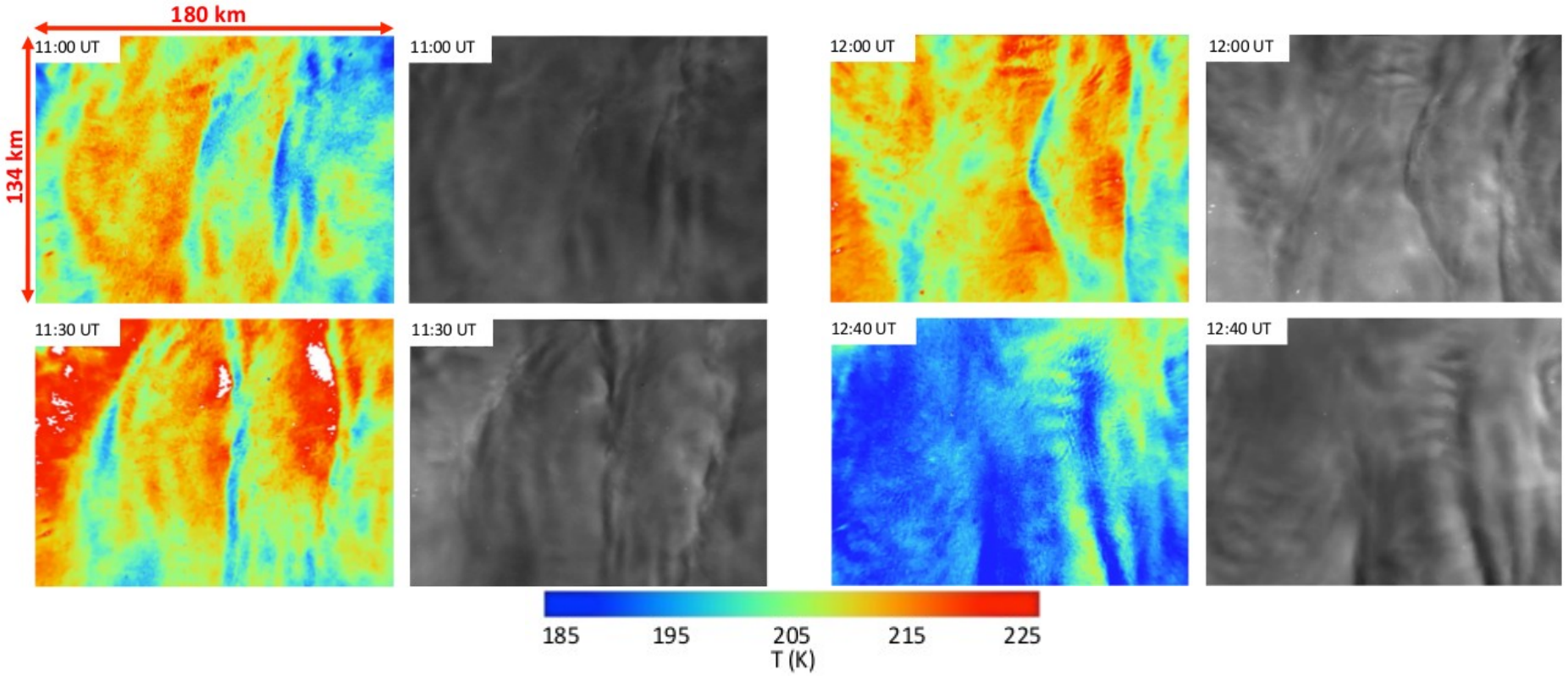
λ_h ~ 10-80 km

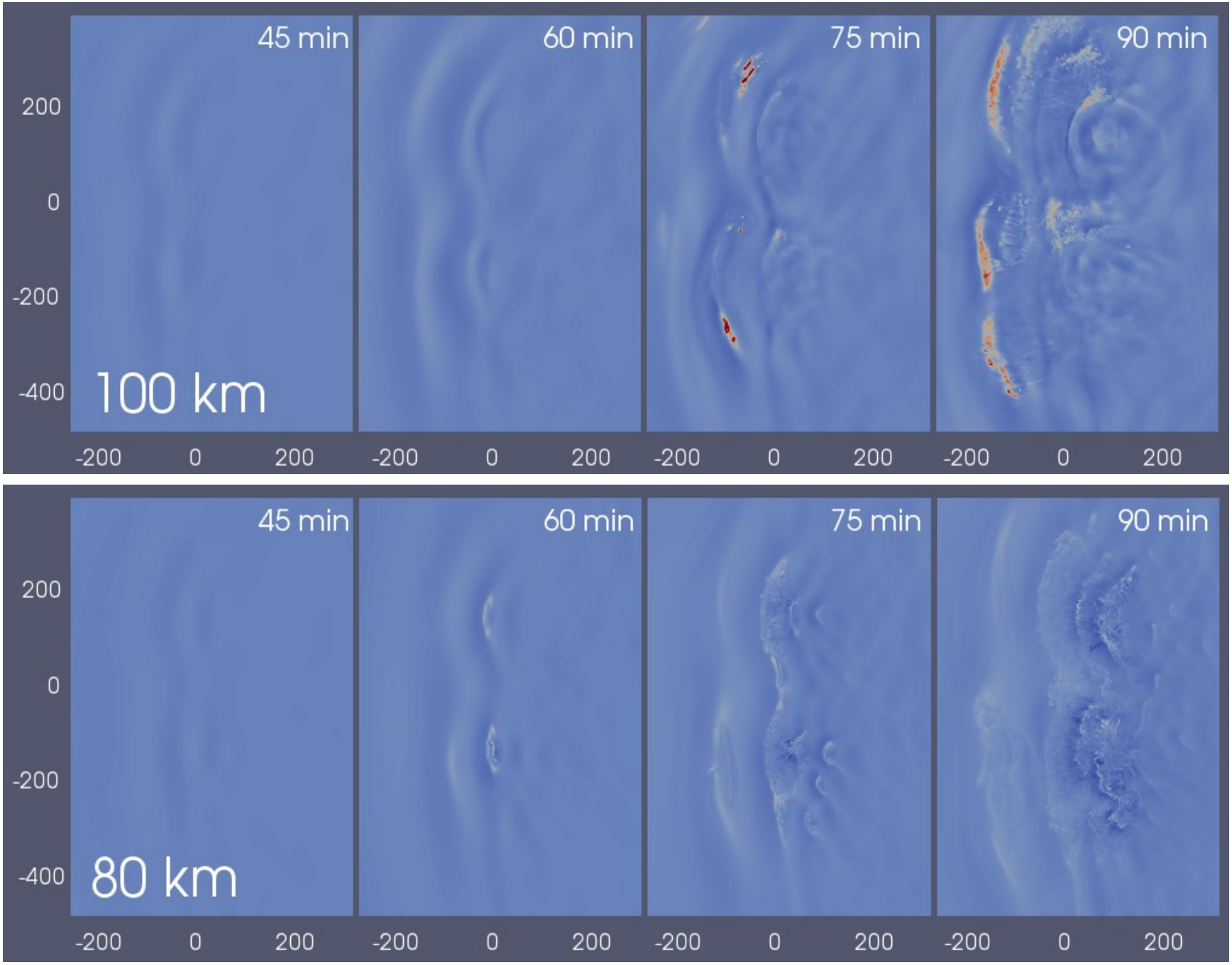
Increasing Eastward wind

Large sawtooth wave:

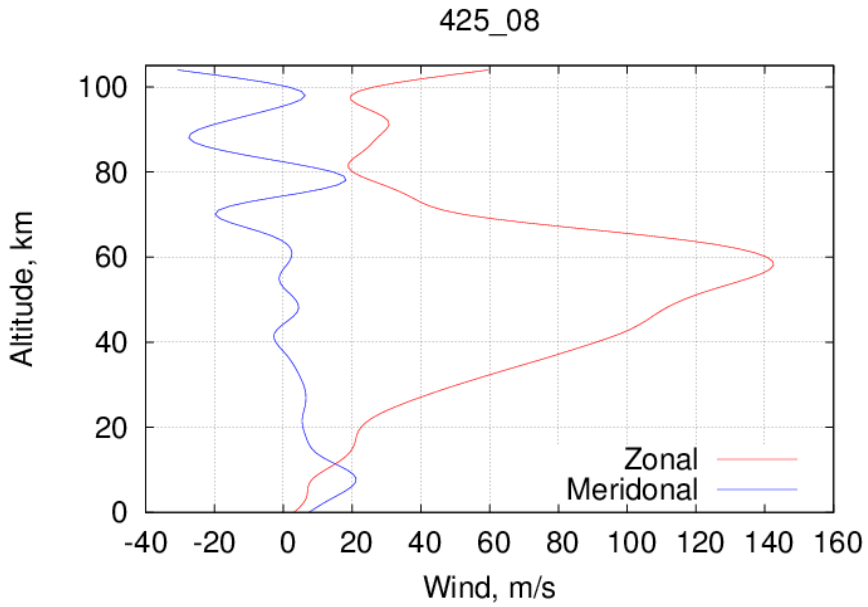
– T' ~25-30 K

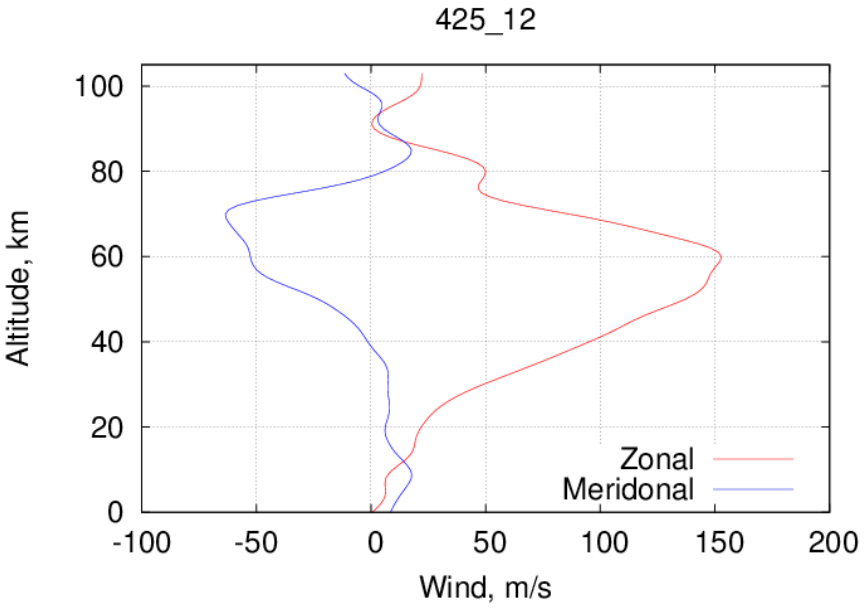
– λ_h ~ 40-80 km

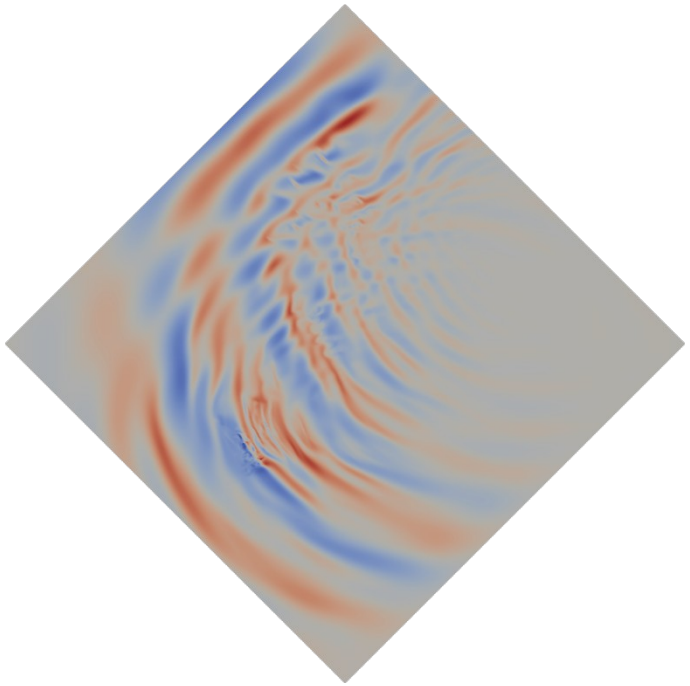



45 min
60 min
75 min
90 min
200
0
-200
-400
100 km
-200
0
200
80 km

Current simulation results not there yet







Island-aligned domain

Conclusions

Wealth of processes to examine

- Large-scale transient upstream propagating wave
  - *Real? Common? Physically significant?*
- Mean flow impacts
  - *Quantify energy and momentum deposition*
  - *Mean flow acceleration and heating?*
- Resolution investigation
  - *Acoustic wave dependence?*
  - *20, 50, 200 m resolution MIL study comparison*

Time Evolution: Zonal Domain (Zoomed in)