Atmospheric properties influence on propagating Lamb waves from Tonga eruption

Shirin Wyckoff
Master's student, University of Hawaii at Manoa
Milton Garcés
University of Hawaii at Manoa

Introduction

- Hunga-Tonga submarine volcano eruption resulted in atmospheric Lamb waves propagating around the earth multiple times
- First digital recording on this scale (~200 MT TNT)
- Similarities with other volcanic eruptions and nuclear explosions

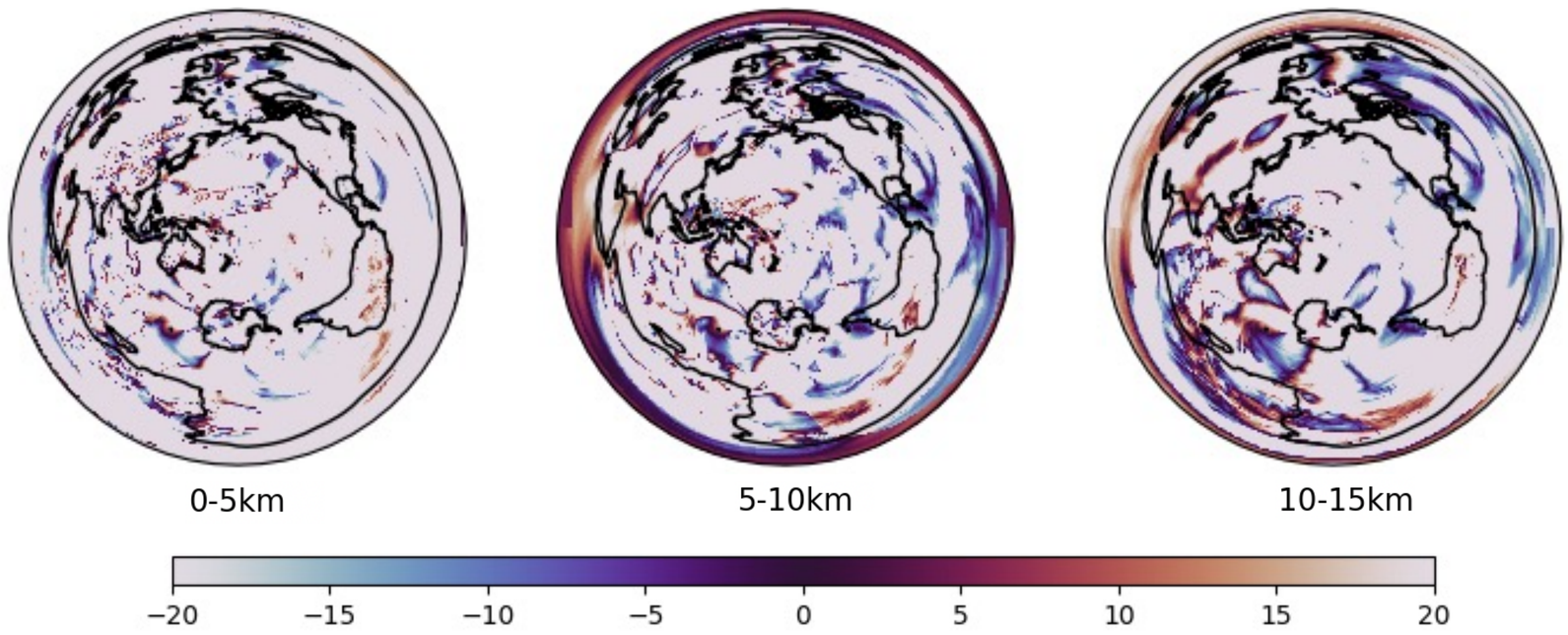
Relevance

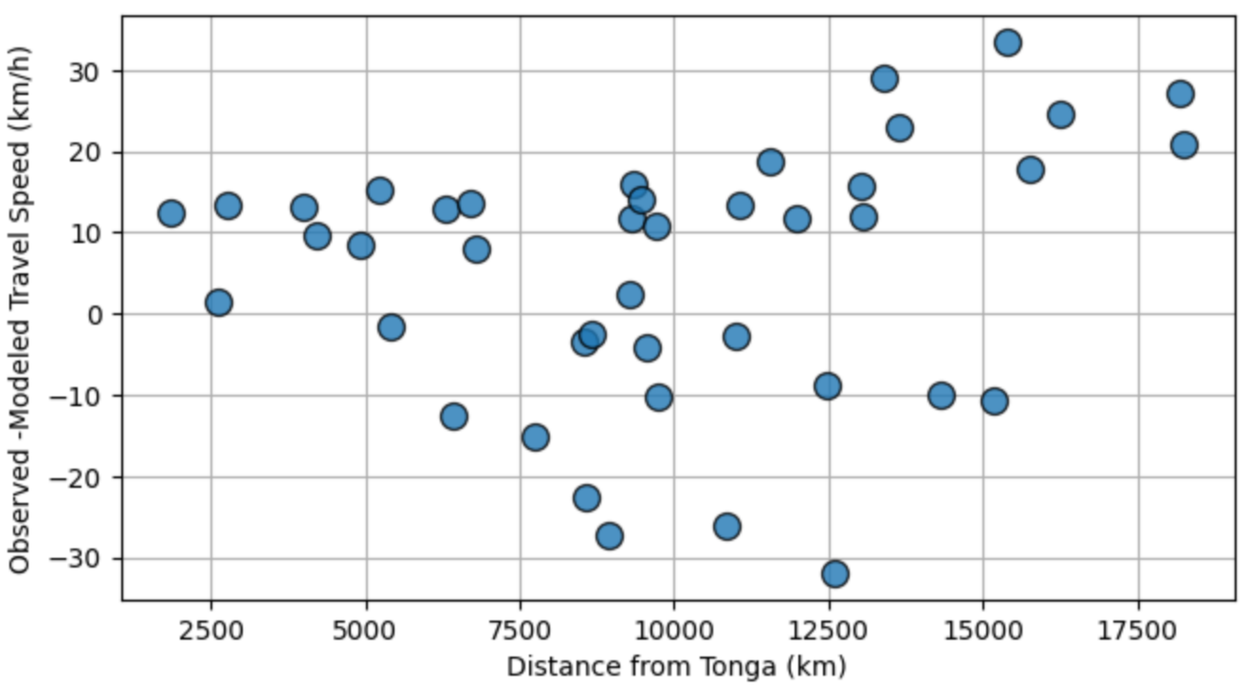
- 53 out of 60 IMS infrasound stations detected Lamb waves
- Data from 47 of the 53 stations used in this work

Approach

- Estimate mean global temperature and wind using Fifth-generation European Centre for Medium-Range Weather Forecasts Atmospheric Reanalysis (ERA5) to analyze wave propagation
- Estimate areas where Lamb wave propagation and wind direction align

Results





Observed global mean speed	310 m/s
Calculated global mean speed	313 m/s
Calculated source to receiver mean speed	317 m/s

Impact

- Improve surface and airborne explosion monitoring systems
- Better propagation models at higher energy ranges
- Improve explosion early warning systems
- Modernize understanding explosive events in the megaton range

Conclusion

- The maps estimate areas where Lamb wave propagation speed might be affected by wind
- As distance increases (~6000km) the arrival times start to diverge from the predicted times

Next Steps

- Filter results by maximum path length to gauge significance on overall propagation speed
- Apply calculated averages to a sophisticated wave equation and recreate Lamb wave to confirm regions where wind affected propagation

This work was funded in-part by the Consortium for Monitoring, Technology, and Verification under DOE-NNSA award number DE-NA0003920

National Nuclear Security Administration