



Hunga Tonga Eruption Signatures in the Context of Nuclear Explosion Monitoring

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Introduction

- The Hunga Tonga submarine volcano erupted on 15 January 2022, producing the largest explosion ever digitally recorded
- Atmospheric Lamb waves propagated around the earth multiple times
- Propagating pressure waves from the primary Lamb wave had equivalent TNT yield of ~200 megatons

Mission Relevance

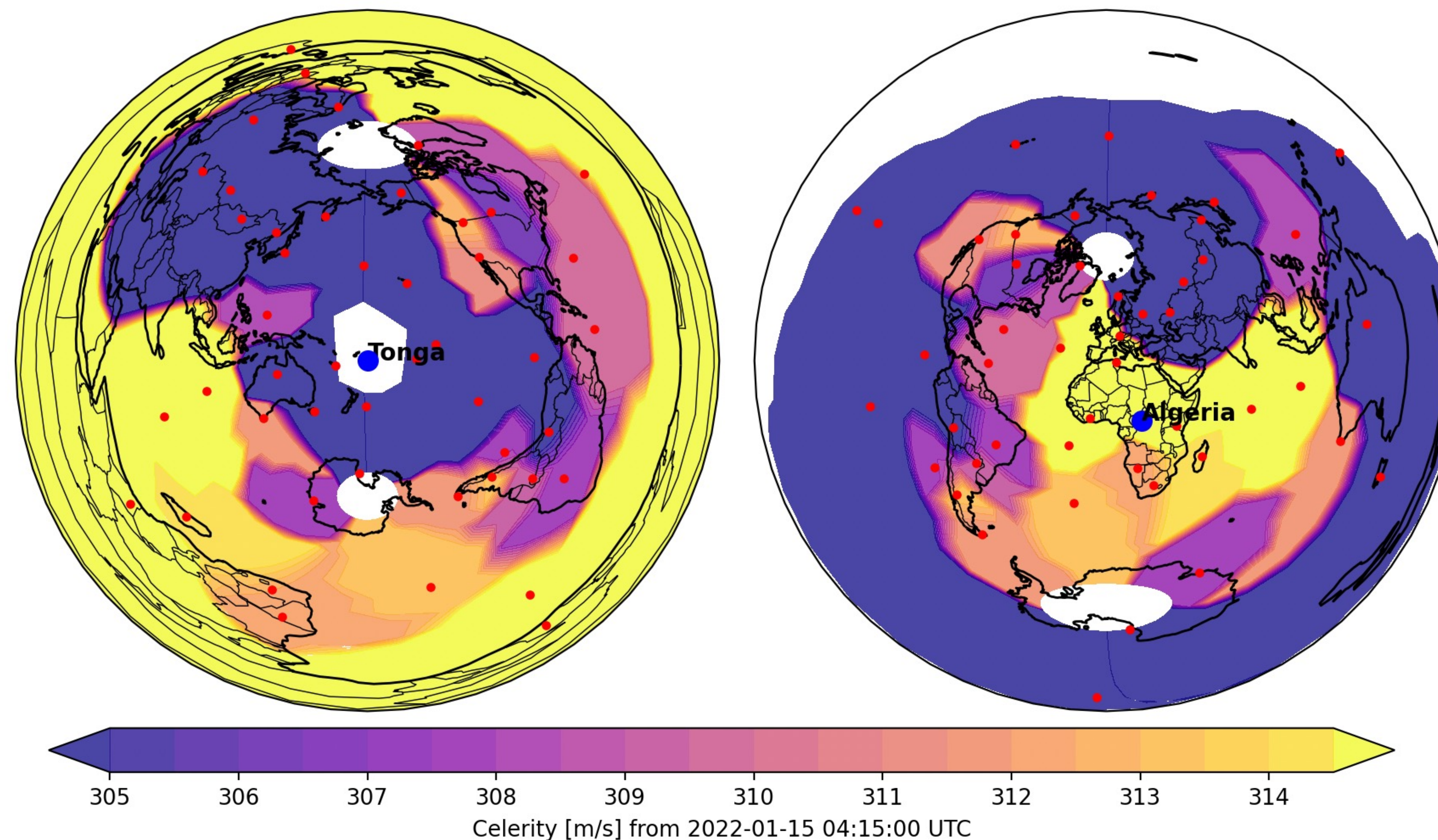
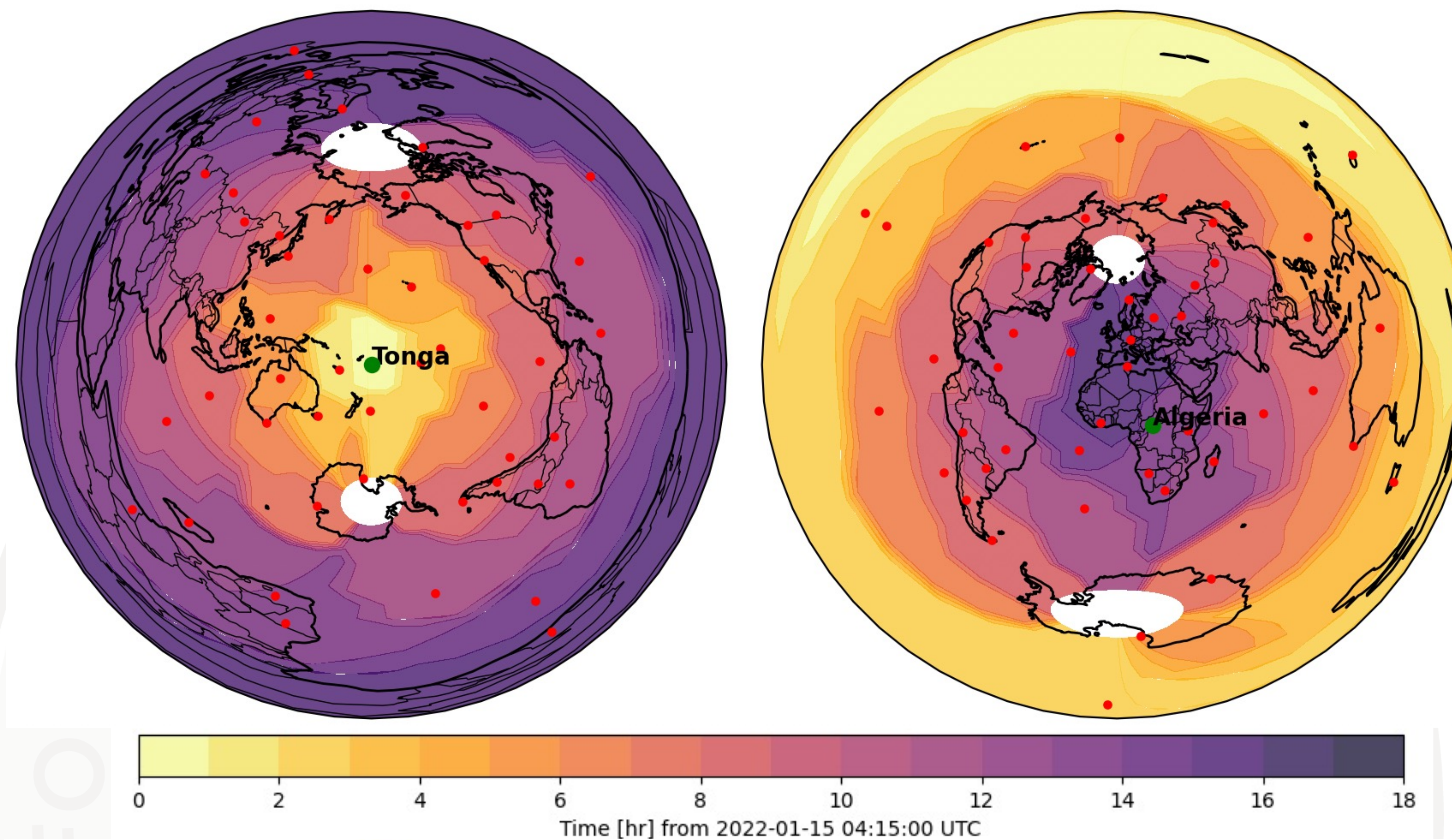
- Lamb waves detected by the International monitoring system (IMS)
- IMS is operated by the Comprehensive Nuclear-test-Ban Treaty (CTBTO)
- 60 infrasound stations around the world. (47 used in map), data provided by Vergoz.

Technical Approach

- Isochron map to estimate the time of the lamb wave propagated around the Earth
- Use interpolation to estimate the Lamb wave propagation time for areas between the stations
- Celerity map to estimate the speed of the Lamb waves between the stations

MTV Impact

- Infrasound signals on this scale haven't been studied in over 40 years
- Modernize our understanding of the propagation of explosive events in the megaton range



Expected Impact

- Improvement of monitoring systems from the surface or airborne explosions
- This knowledge can be applied to potential future nuclear explosions

Conclusion

- Volcanic eruptions and nuclear explosions are different sources but both emit Lamb waves
- Comparing historical nuclear test data to the data from the Tonga eruption we see recognizable propagation patterns and infrasound signal durations (e.g. Vergoz et al., 2022)
- Similarities between analog data from the largest nuclear test (Tsar Bomba) and digital data from Tonga would allow us to use the Tonga data to make estimates of nuclear explosions in the 10 megaton range

Next Steps

- Investigate effects of circulation and weather patterns in the atmosphere on Lamb wave propagation
- Use a climatological model to investigate the effects of the presence of Lamb waves in the atmosphere



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

