

SnT Panel 2021

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Waxler leads the infrasound research group at the NCPA

Group accomplishments:

- Sensor design (Talmadge)
 - The Hyperion sensor was designed and prototyped at NCPA
 - UM licenses the technology to Hyperion: improvements have been made
- Sensor calibration (Talmadge)
 - Laboratory methods and techniques were developed at NCPA
 - The technology has been transferred to Sandia National Lab and Hyperion
 - Remote calibration methodologies have been developed at NCPA/Hyperion
- Propagation modeling software development (Waxler): open source packages
 - NCPAprop: full wave models derived from work by Waxler and Assink
 - InfraGA (LANL): geometrical acoustics derived from work by Blom and Waxler
 - Both packages are under continual development
- Array signal processing (Frazier)
 - Large-N array processing for noise mitigation
 - Subspace methods for multiple source detection
 - Real time data analysis
- Wind noise (Raspet)
 - Physics of wind noise generation to inform array placement / manifold design

Status of Ground-based Infrasond Sensing Technologies

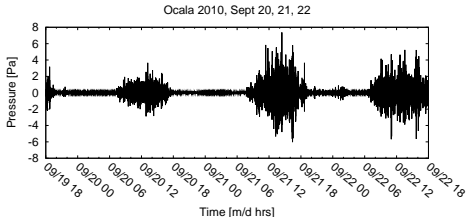
Much progress has been made in the last decade

High fidelity sensors now exist

- Stable, low noise, low seismic sensitivity

Sensor calibration is reaching maturity

- International standards are now under development
- *In-situ* field calibrations are becoming standardized



Remaining issues

Wind noise remains an impediment to signal detection

- Turbulent pressure fields in the vicinity of a sensor
- Wind noise reducing manifolds provide ~ 20 dB signal enhancement
 - This is not sufficient in windy environments

The IMS network is sparse

- On average 2000 km between stations
 - The directionality (due to winds) of infrasond propagation further limits coverage

Recomendations

Large-N arrays for wind noise mitigation

- Low cost / low power sensors are under development
 - The technology is under rapid development across the community
- Replacing a single sensor with an array of sensors is quite promising
 - With advanced signal processing methodology one can potentially beat $1/\sqrt{N}$

Allow the use of auxiliary infrasound stations

- The number of research arrays in the world is increasing rapidly
 - Many are in regular use by various groups
- This would aid in both localization and association

Add realistic propagation modeling capability

- Geophysics-user friendly model packages are under rapid development
 - Improvements in speed (basic algorithms and parallel processing)
 - The science of atmospheric profiling is under rapid development
- This would aid in both localization and association

Incorporate probabilistic uncertainties in modeling and geolocation

- These would feed down from the atmospheric profile uncertainties
 - Such uncertainties are beginning to become available
 - Rigorous connection to an empirical statistical model is critical