

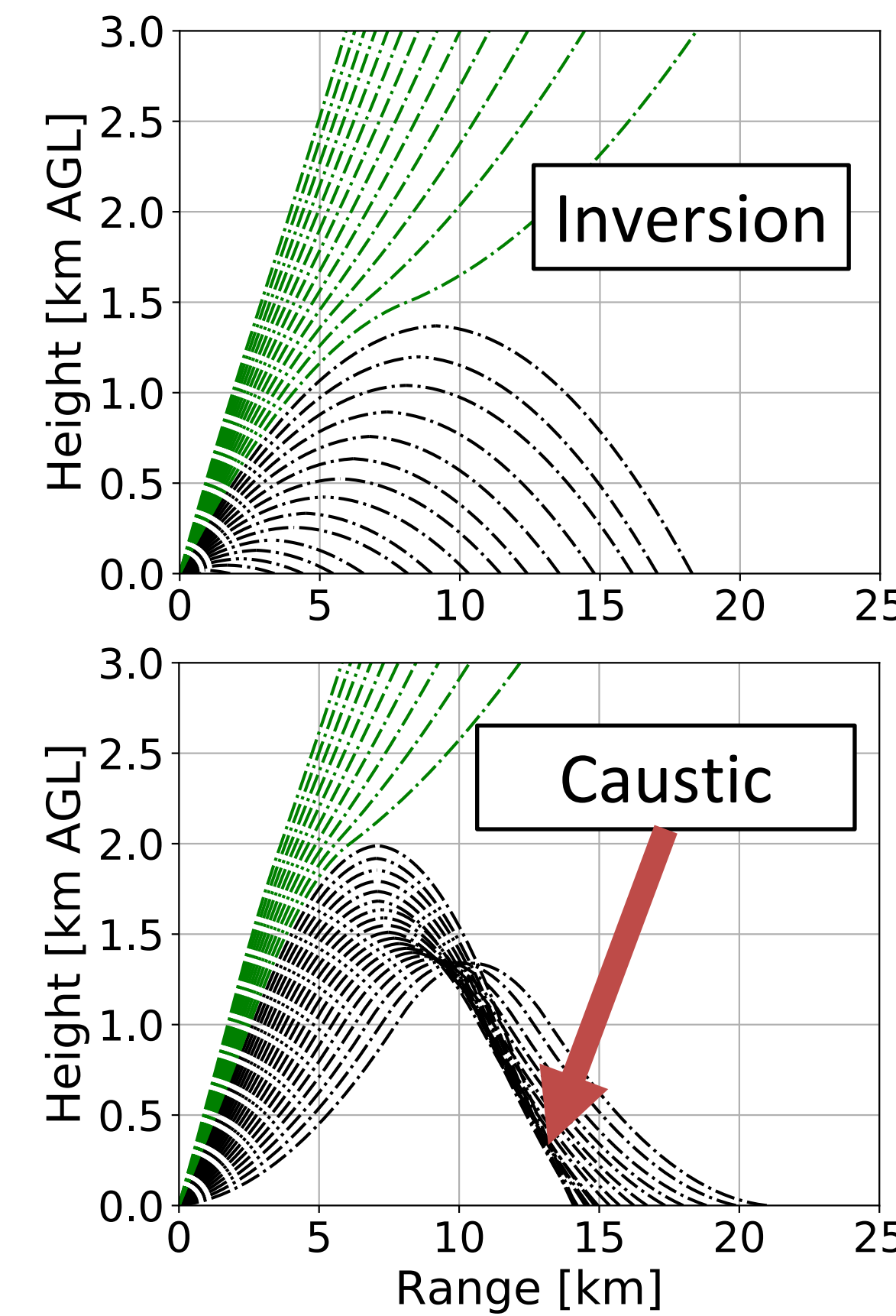
Understanding the Impact of Meteorological Spatiotemporal Variability on Distant Focusing Overpressure Risk

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Introduction

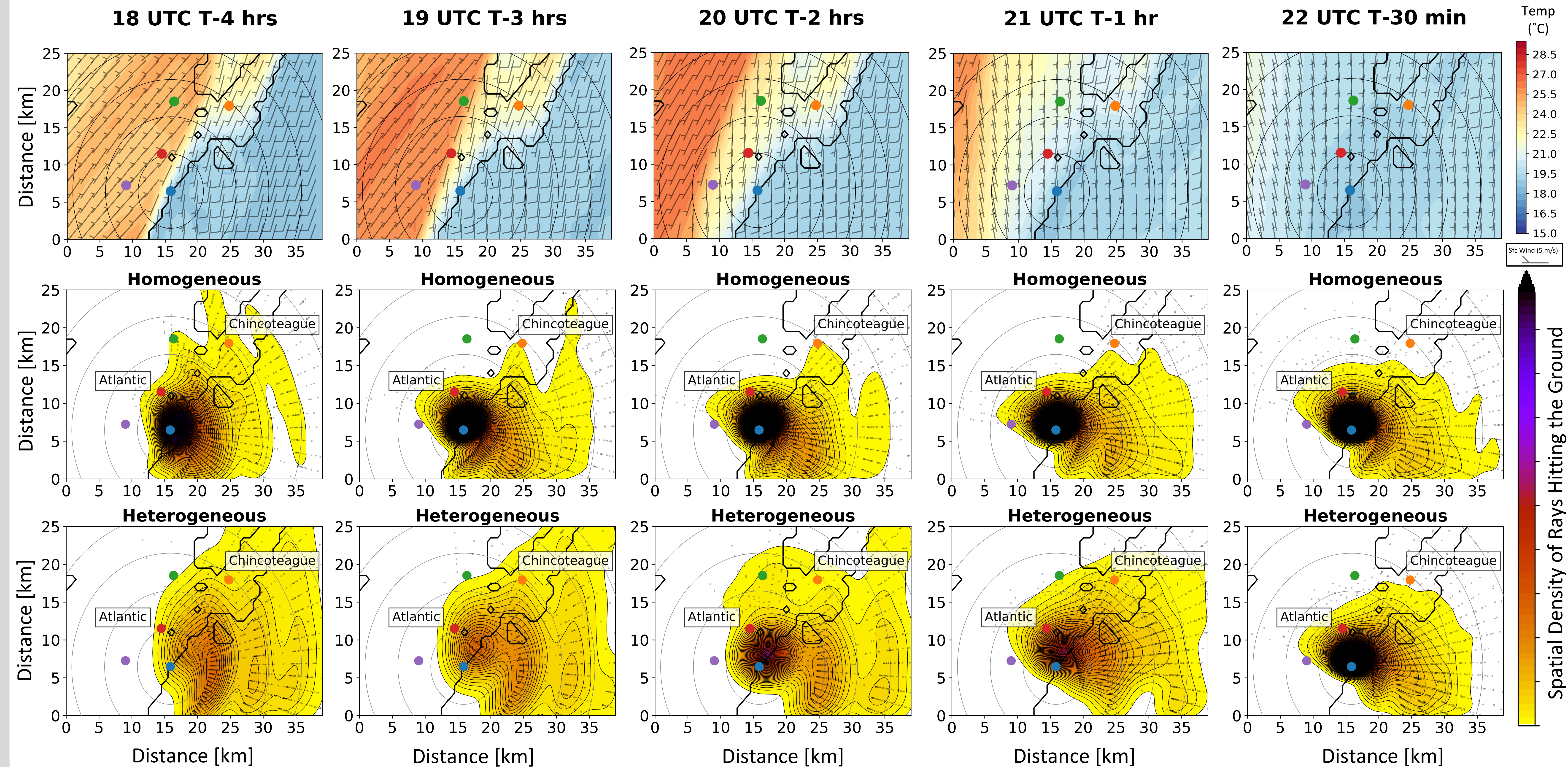
- Distant focusing overpressure (DFO) is a meteorological driven phenomenon where blast waves from explosions may focus to hazardous levels far from the source.
- At launch ranges, radiosondes are released near the launch site at scheduled times leading up to T-0 to gather the meteorological data needed to assess DFO risk.
- Acoustic ray-tracing models (e.g. BlastDFO) assess the potential for DFO by identifying caustics and inversion conditions.



What is the impact of neglecting the spatiotemporal heterogeneity inherent in the atmosphere on DFO risk?

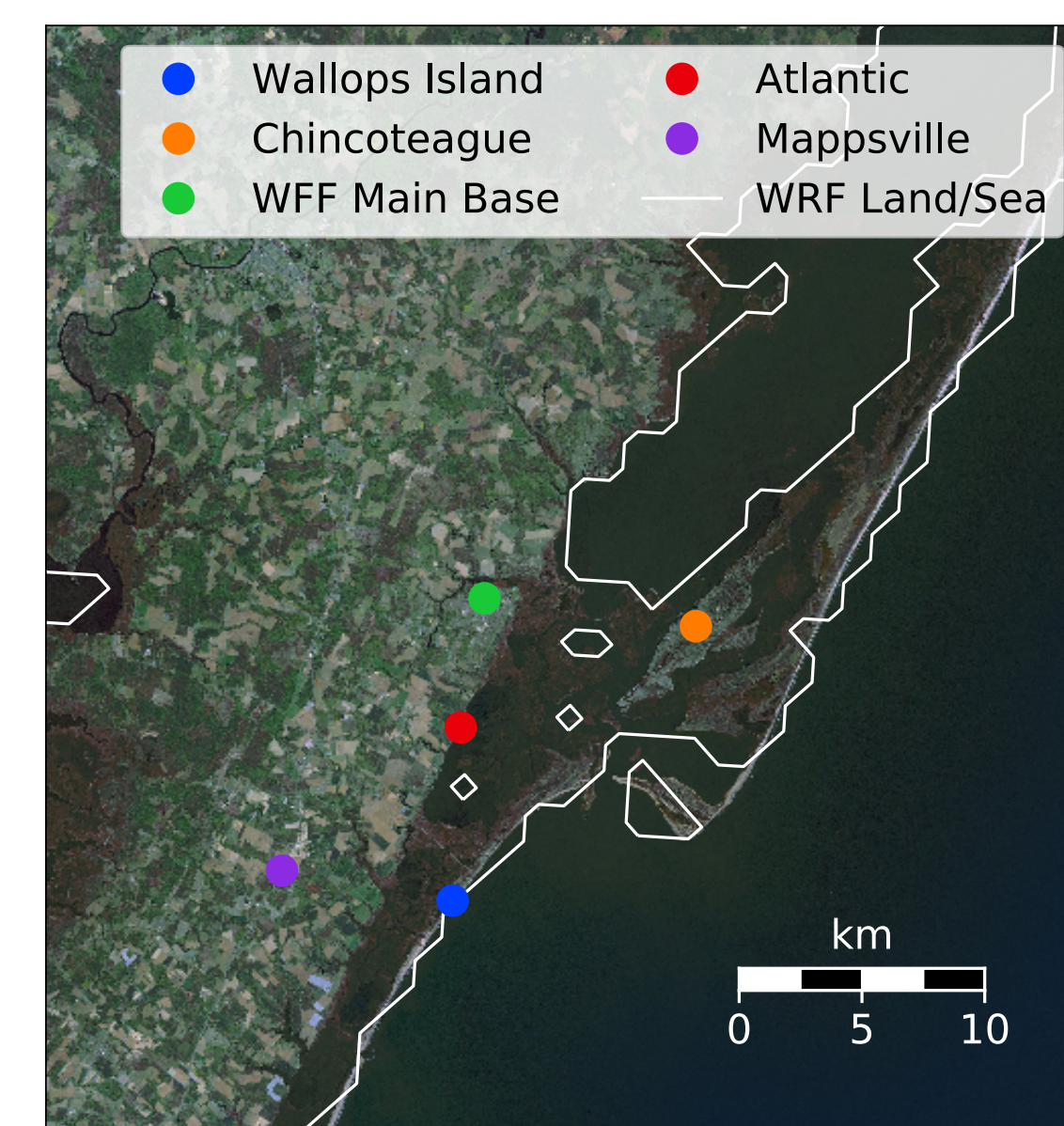


Ray Tracing Sensitivity to Spatiotemporal Variability



Method

- Use NASA Unified WRF (NU-WRF) to simulate the coastal environment during ORB-3 accident at Wallops Flight Facility (WFF):
 - 10/28/2014 12z to 10/29/2014 06z
 - 1 km grid, 351 × 351 × 61
 - Initialized using MERRA2
 - MYNN PBL, Goddard 4ICE Microphysics, Goddard Short/Longwave Radiation
 - NASA Land Information Surface (LIS) Land Surface Model



- Compare acoustic ray tracing for 1D "homogeneous" and 3D "heterogeneous" atmospheres using kernel density estimation (KDE):
 - 1D – vertical profile from WRF at Wallops Island represents entire domain
 - 3D – full 3D environment (provided by WRF)
- Launch rays at 0.5° elevations 1°-50°; 5° azimuths 0°-360°; 4 reflections and no terrain.

Conclusions

- Neglecting the spatiotemporal heterogeneity can lead to overestimation (Atlantic) and underestimation (Chincoteague) of the DFO risk.
- Daytime heating on the land can deflect sound waves upwards and away from populated areas.
- Coastline geography in WRF is poor and may cause an underestimation of DFO risk to coastal communities.
- Adaptative sampling of the environment leading to T-0 may help establish better DFO risk guidance (e.g., measurements at Chincoteague).

Future Work

- Vary WRF grid spacing to study coastline impact on ray tracing.
- Develop observation gathering strategy for DFO risk assessments.
- Analyze observations from Wallops Island (730' tower) to understand temporal variability along the coast line.

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