

Advanced processing of Airborne Doppler Wind Lidar wind measurements to resolve PBL circulations and near surface wind fields over the open ocean



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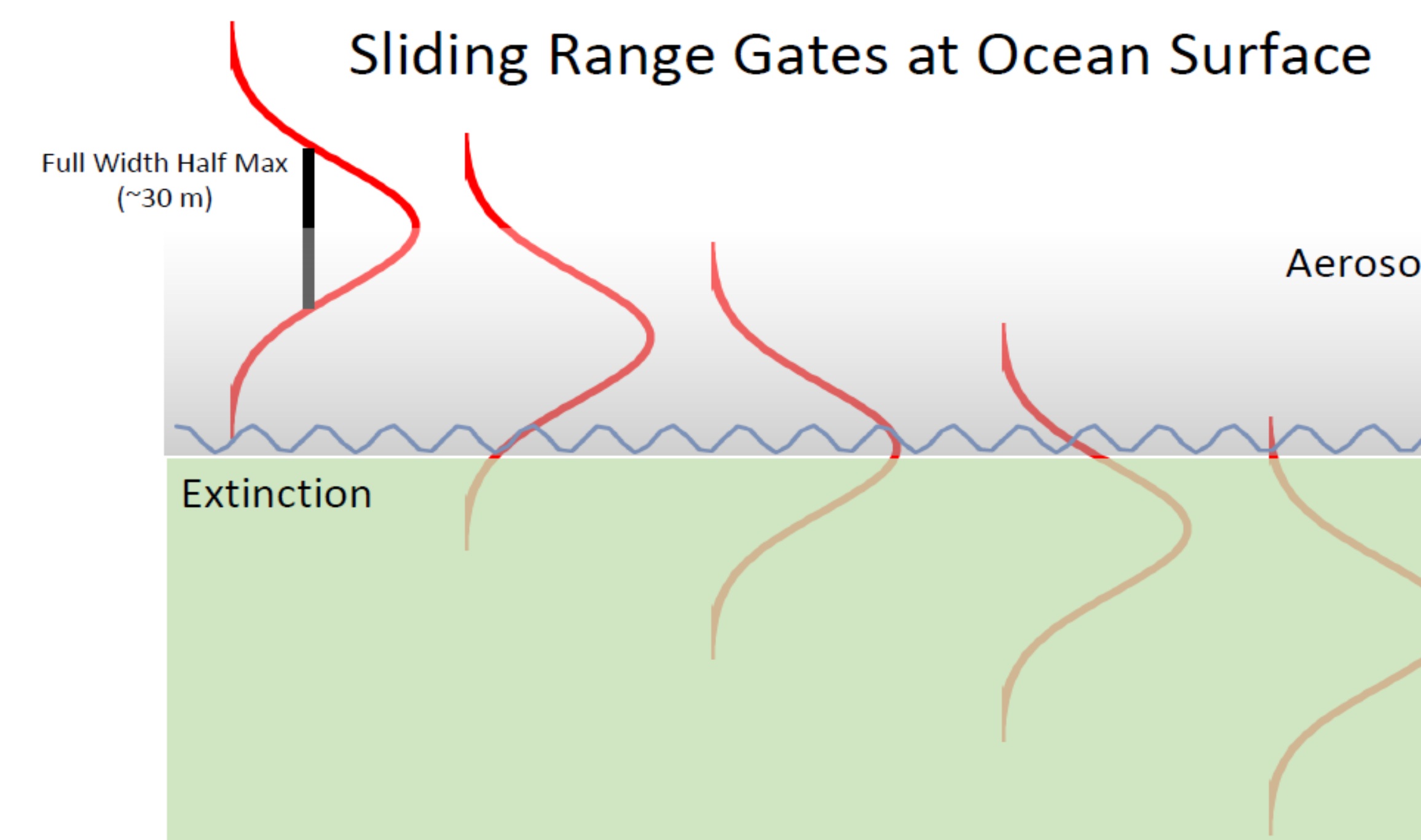
PBL Investigations

The lowest 200m of the PBL is just one focus area of a more comprehensive series of multi-agency (NASA, ONR and NOAA) funded investigations of the PBL (mostly over water) using Airborne Doppler Wind Lidars (ADWL), dropsondes and other remote sensing capabilities. Two recent investigations funded by NASA were the Convective Processes Experiment (CPEX) 2017 which flew over the Gulf of Mexico, the Caribbean Sea and the western Atlantic Ocean and the April 2019 Aeolus Cal/Val preparatory field campaign (AEOL) with missions in the eastern Pacific Ocean. Both campaigns flew **NASA's Doppler Aerosol WiNd (DAWN)** lidar system on a DC-8 aircraft for over 100 (CPEX) and 50 (AEOL) flight hours.

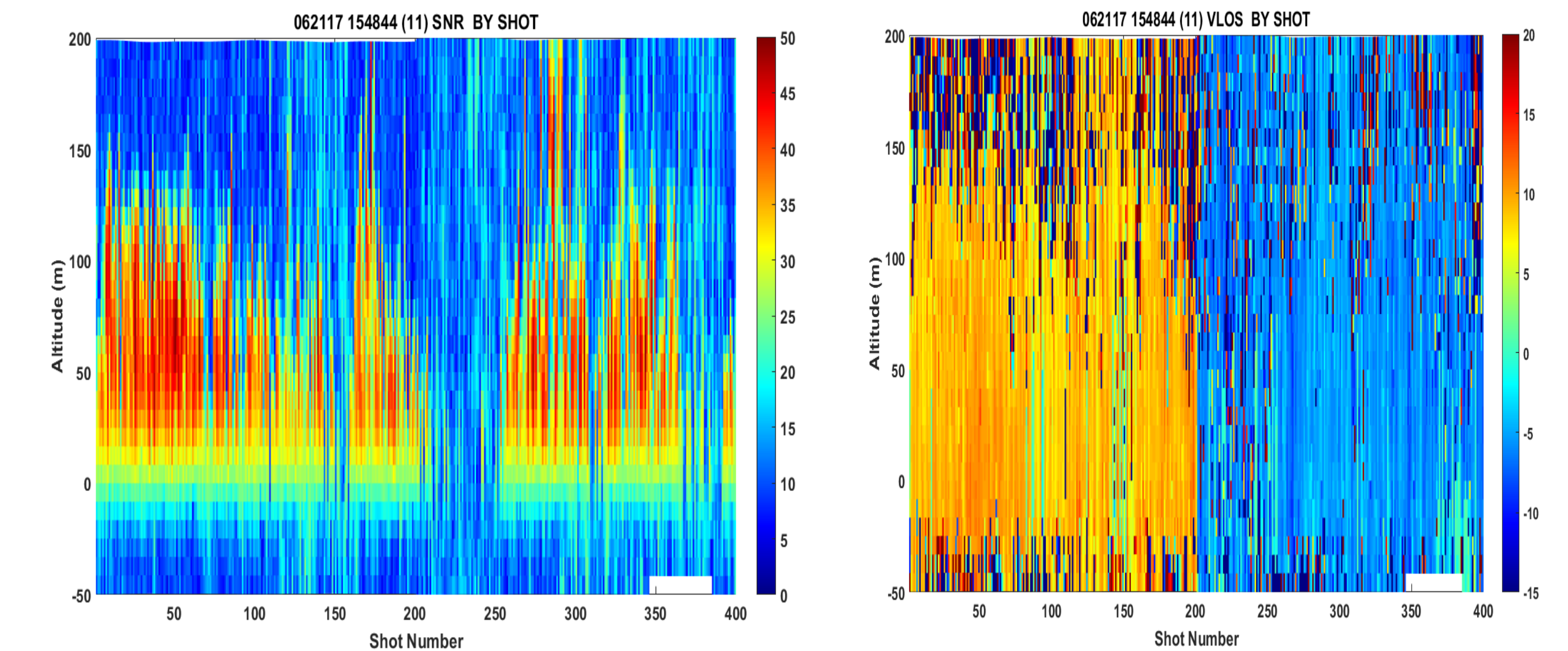
Questions And Solutions

- What does an ADWL have to offer to investigations of the Marine Atmospheric Boundary layer (MABL)?
 - Depth of the MABL defined by aerosols (backscatter), wind profiles and turbulence (spectral width)
 - MABL features – LLJs, OLEs, Sea salt spray distribution
 - Ocean surface properties - Breaking waves (whitecaps), Foam coverage, Ocean wave spectra, Surface currents
- What is the “true” wind at the traditional 10 m reference height over water? Log and power wind profiles not suitable for high winds (>15m/s) with highly non-linear interactions between the ocean surface and the lower PBL
- How close to the ocean surface can we observe the winds with a 180nm pulse ADWL and can the wind retrievals below 50m be used in studies of the Marine Boundary Layer under >15m/s winds?
- Can single shot processing be used to resolve highly variable wind/aerosol structures in the MABL?

SLIDING RANGE GATE APPROACH

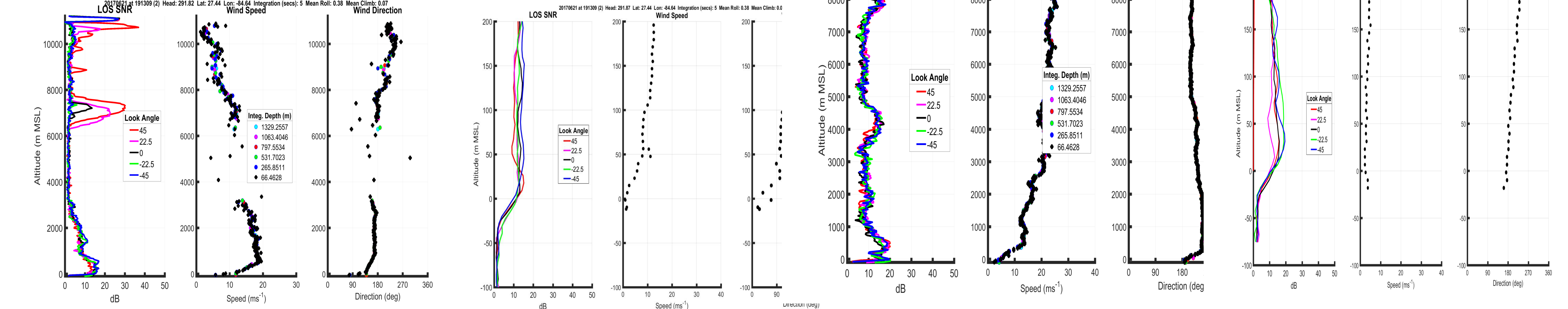


Single Shot

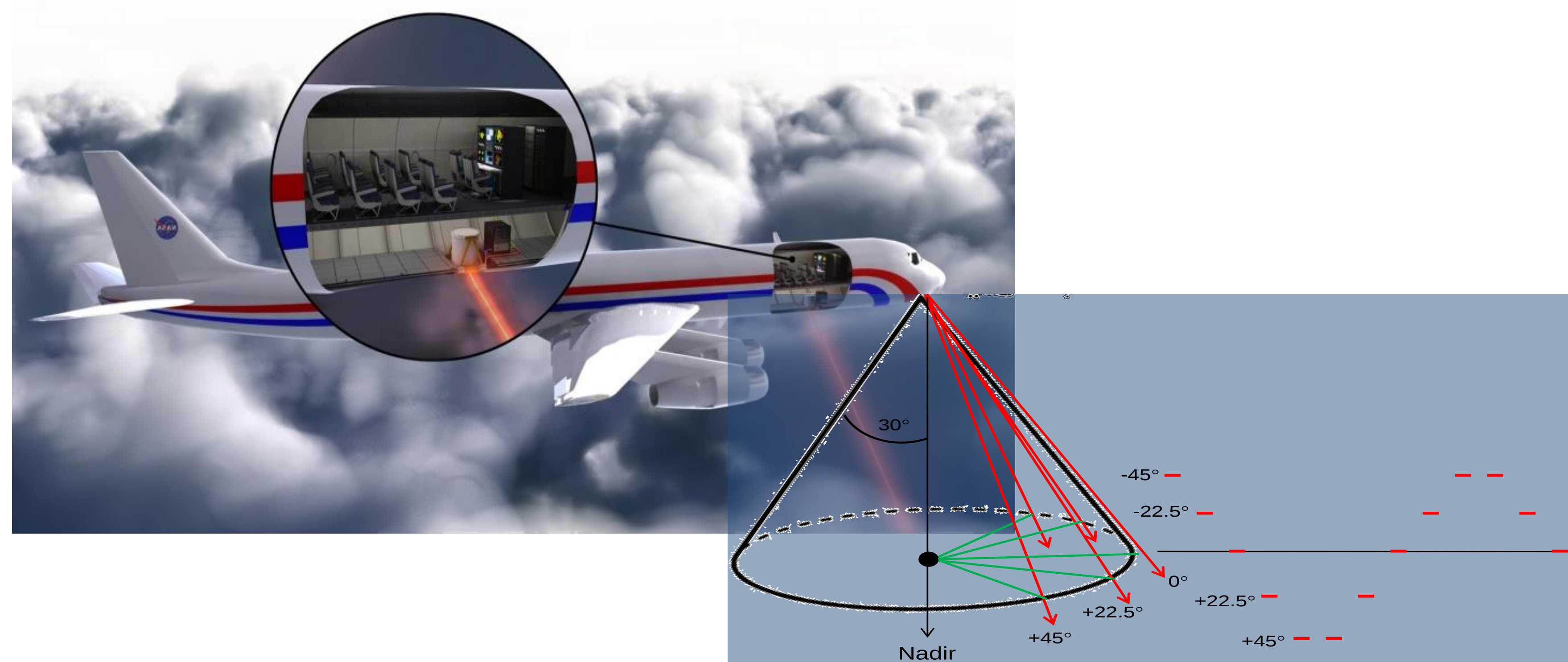


EXAMPLES

Lowest 200m under white cap conditions

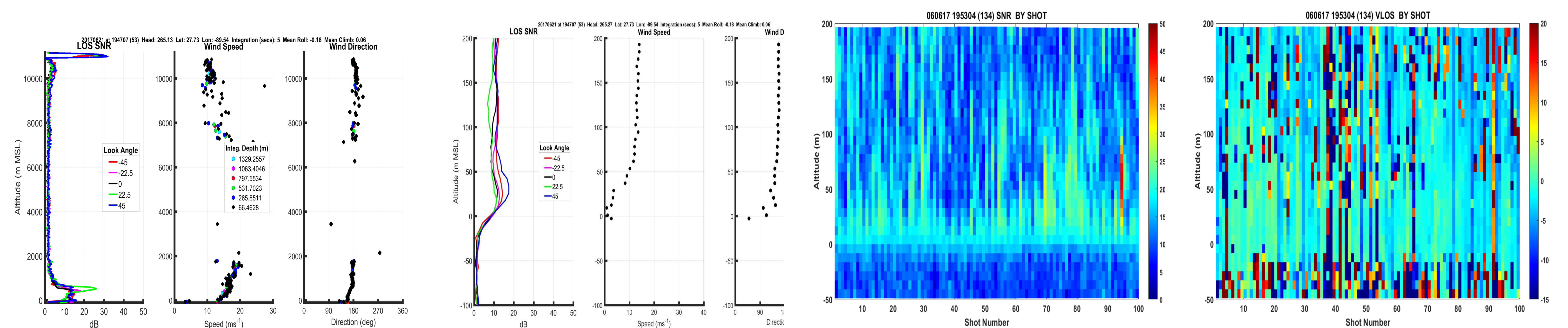


The Doppler Aerosol WiNd (DAWN) Lidar System



NASA's 100mJ, 10HZ, 180ns coherent lidar with < 1 m/s LOS precision and variable vertical resolution based on range gates. Single shot horizontal resolution in PBL is < 20m and full profiles up to 12 km every 3-12 km.

Using a new processing algorithm with sliding range gates, useful winds can be retrieved ~10m from the surface and every 9 m in the vertical.



Summary

Using a new CDWL processing algorithm, we can obtain “useful” DAWN retrievals within a few meters of the ocean surface using sliding variable and adaptable gates on the raw digitized return.

- Below 50 meters above the water surface the retrievals are heavily dependent upon the backscatter structures, gradients and floating foam.
- At low wind speeds the near surface (< 10m) values are reported at heights below the surface (can be adjusted after the processing)
- At high winds speeds with whitecaps and sprays, the speed of the spray is reported starting at gate altitudes between 50 and 150m.
- Single shot processing of the DAWN data within the lowest 200 meters reveals aerosol and wind structures consistent with rolls and highly variable (in space) sea salt spray features.