Lidar observations of fine-scale gravity waves in the nocturnal boundary layer above an orchard canopy

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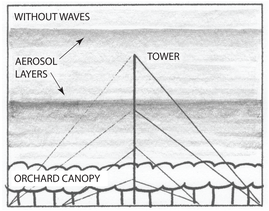
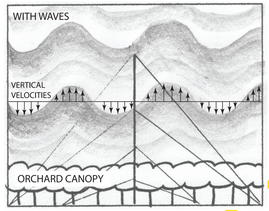
Raman-shifted Eye-safe Aerosol Lidar (REAL)

The REAL was deployed in CHATS. It was located 1.61 km north of the NCAR ISFF 30 m tower. It operated nearly continuously for three months. Nearly-horizontal scans over the canopy at night often reveal fine-scale waves.

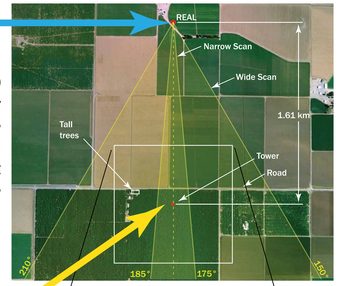
REAL Specs:
λ=1.543 µm
PRF = 10 Hz
Pulse = 6 ns
Energy = 170 mJ
Digitizer = 100 MSPS





We hypothesize the REAL is able to detect waves when aerosol strata are displaced vertically by the vertical air motion caused by the waves. In situ data (below) confirm the presence of vertical air currents during the wave episodes.

Experiment: CHATS, March - June 2007, Dixon, CA.



The REAL was programmed to collect horizontal (PPI) scans directed over a sector to the south and as shown by the region shaded in yellow to the left.

A scan requires between 10 s and 30 s to complete and can be repeated quickly. PPI scans were directed to pass through the ISFF tower at 1.61 km range.

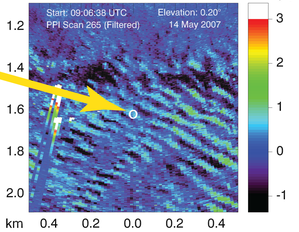
Wave episodes were identified by visual inspection of more than 1800 hours of time-lapse REAL data.

Example scans from 52 wave episodes are shown (right). Many scans for each case exist. Time-lapse animations are available.

For a wave episode to be included in our study, it must have a duration greater than 1 minute and passed over the CHATS vertical tower.

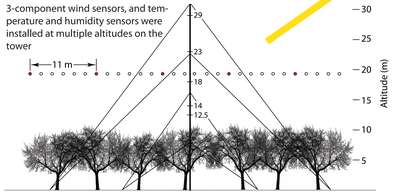
A high-pass median filter (500 m window) was applied to the range-corrected back-scatter intensity in the radial dimension of the lidar data in its native spherical coordinate system to produce the images shown.

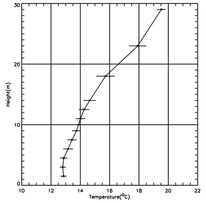
Wavelength can be obtained from the wide and narrow scans. Phase speed can be determined from the narrow scans with fast frame rate as shown below:

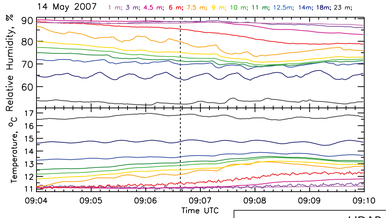


NCAR Integrated Surface Flux Facility (ISFF) 30-m tower

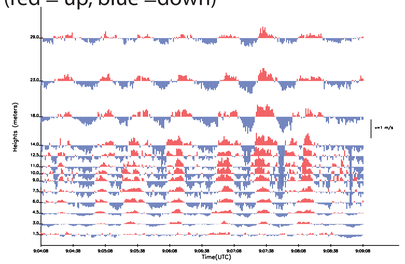
3-component wind sensors, and temperature and humidity sensors were installed at multiple altitudes on the tower







Vertical wind speed from sonic anemometers (red = up, blue =down)



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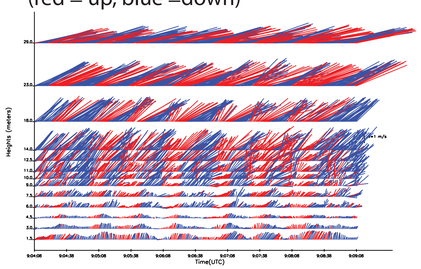
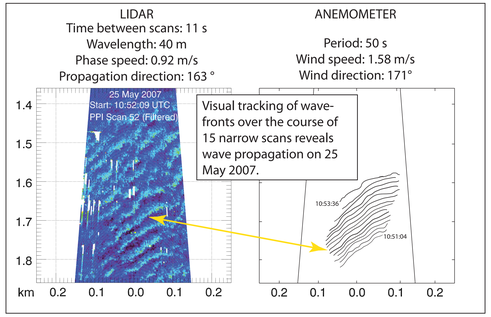
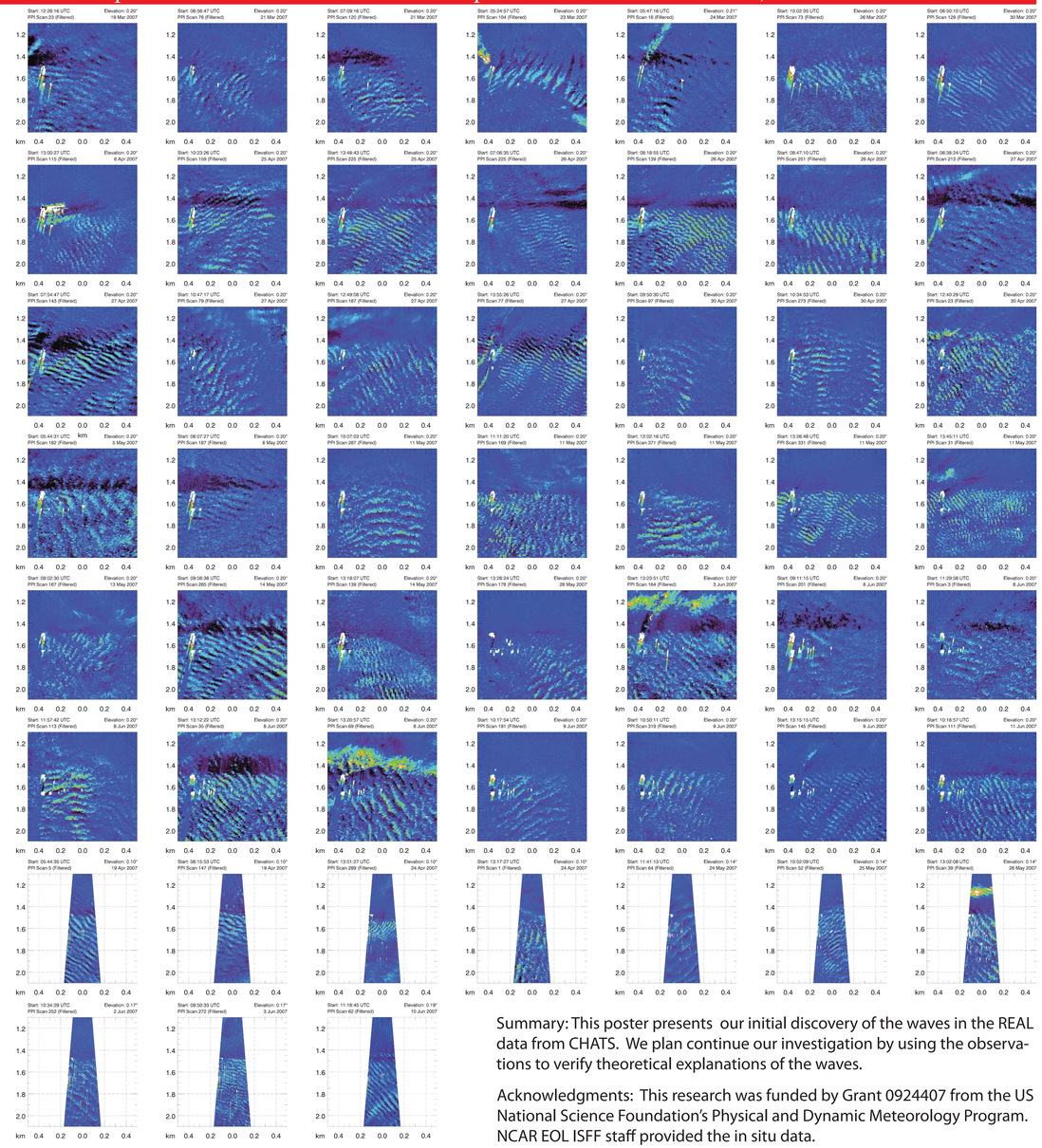




52 wave episodes discovered over a 3 month period. 42 with wide scans; 10 with narrow scans.



Summary: This poster presents our initial discovery of the waves in the REAL data from CHATS. We plan continue our investigation by using the observations to verify theoretical explanations of the waves.

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