Using Integrated Sounding Systems to observe boundary layer evolution and structure in the Southern Ocean and on the Great Plains.

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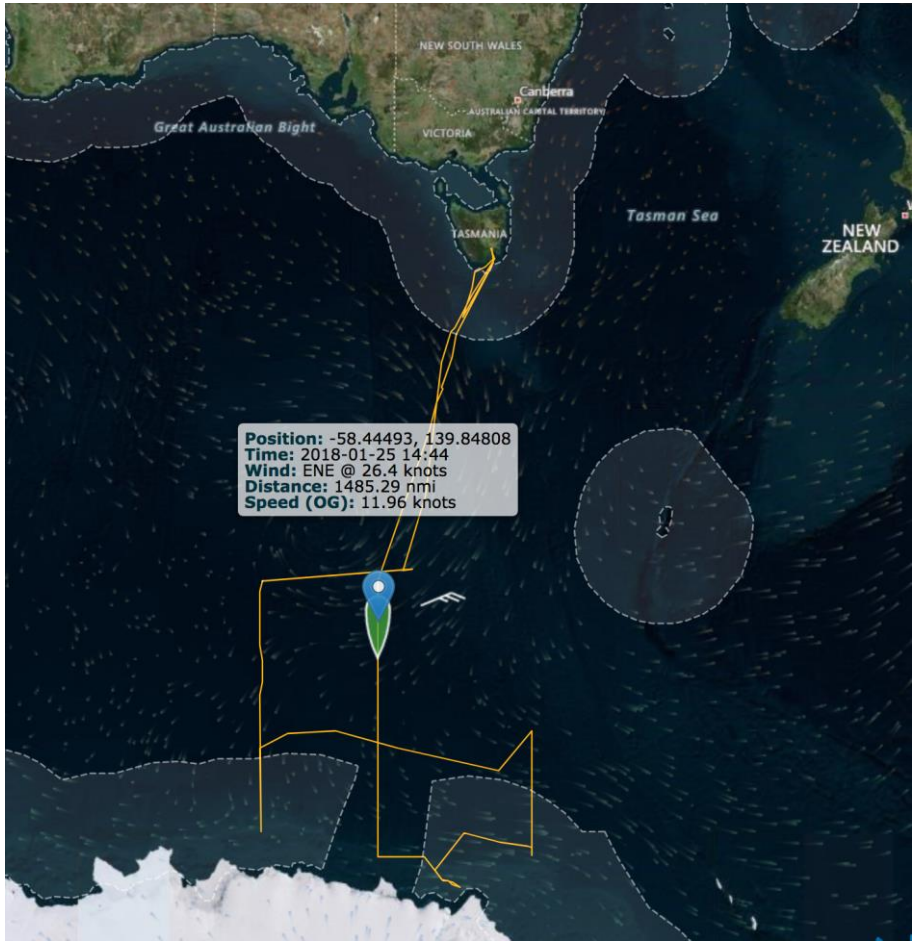
Earth Observing Laboratory (EOL)

Aircraft, radars, lidars, surface fluxes and energy balance, soundings, wind profilers, data system, project management

SOCRATES

Southern Ocean Clouds, Radiation,
Aerosol Transport Experimental Study

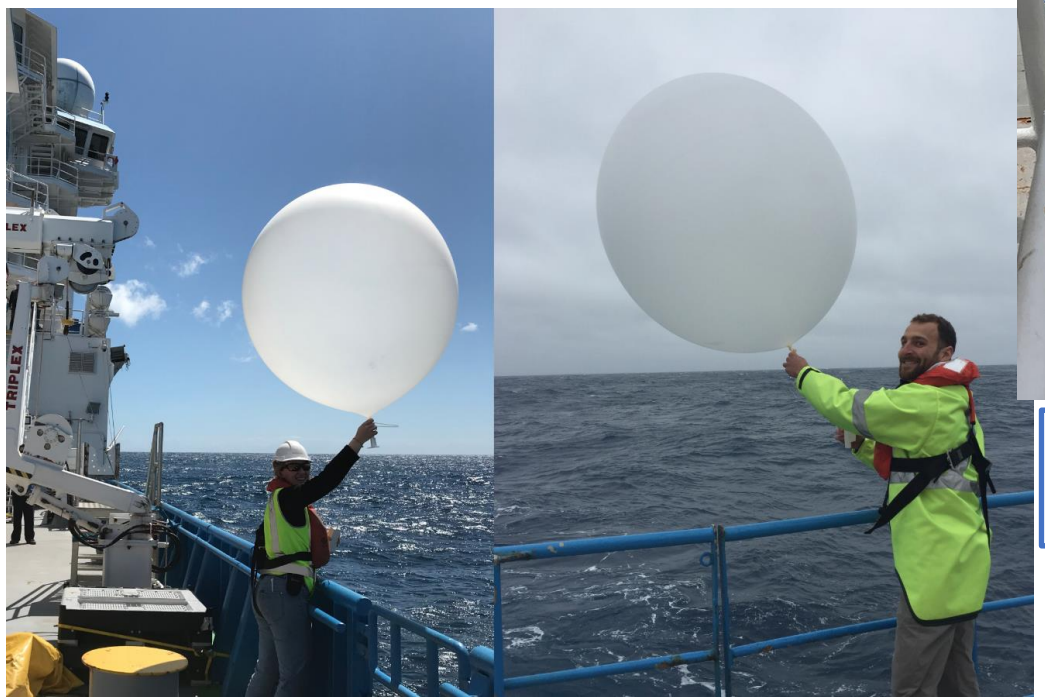
PI: Greg McFarquhar (Uni OK),
co-PIs: Chris Bretherton, Rob Wood, Roj Marchand (U.WA)
Alain Protat (Australian Bureau Met), CSIRO, Ant. Div.

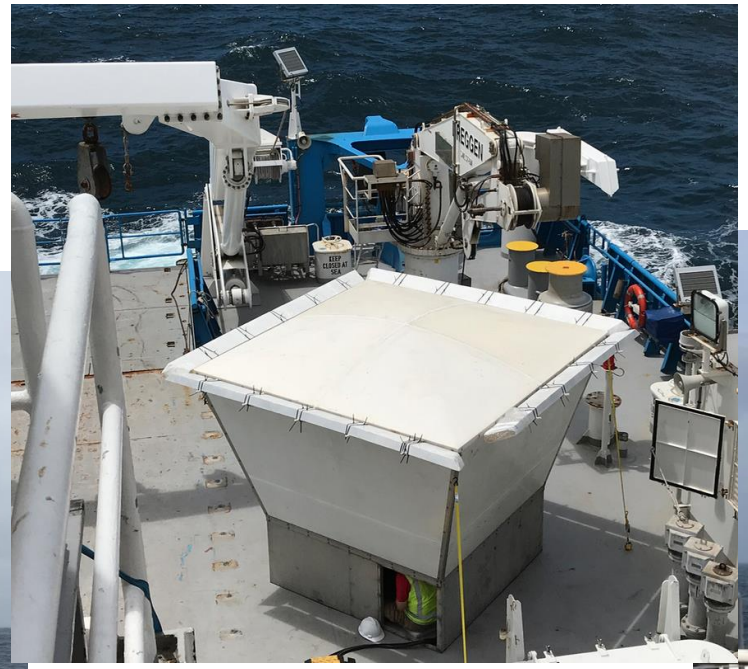


R/V Investigator
Photo: Kendall Sherrin (CSIRO)

- Study of clouds, aerosols, air-sea exchanges and their interactions over the Southern Ocean.
- Included NCAR GV aircraft, two ships, ground sites Antarctica and Island.

Integrated Sounding System on RV Investigator





915 MHz Radar Wind Profiler on stabilized platform

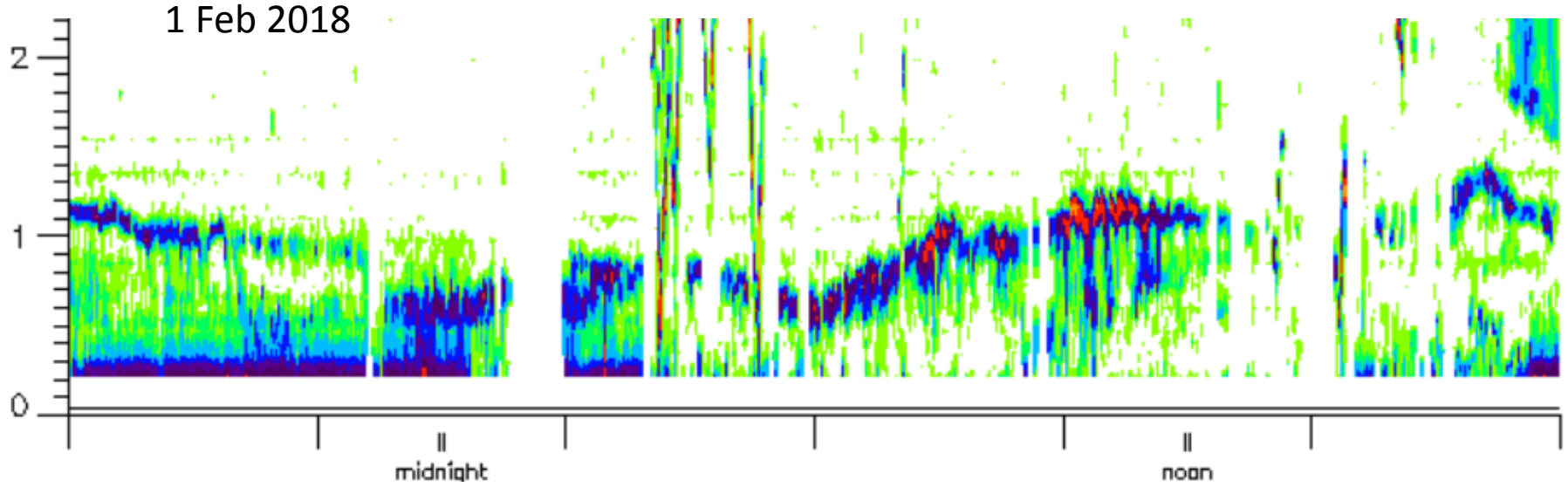
Ceilometer and ZephIR Wind Lidar

Radiosonde Soundings
Isabel Suhr and Dan Buonome

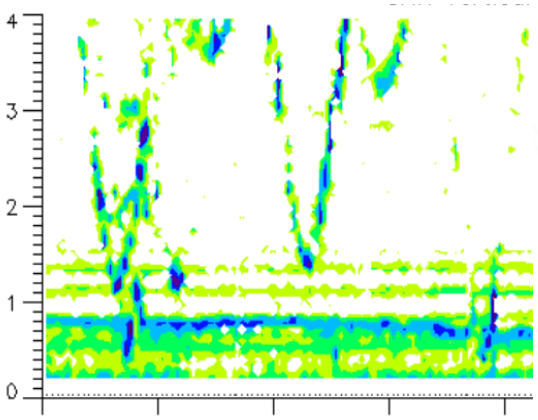
Boundary layer winds, depth and evolution
Six-week voyage
234 radiosonde soundings

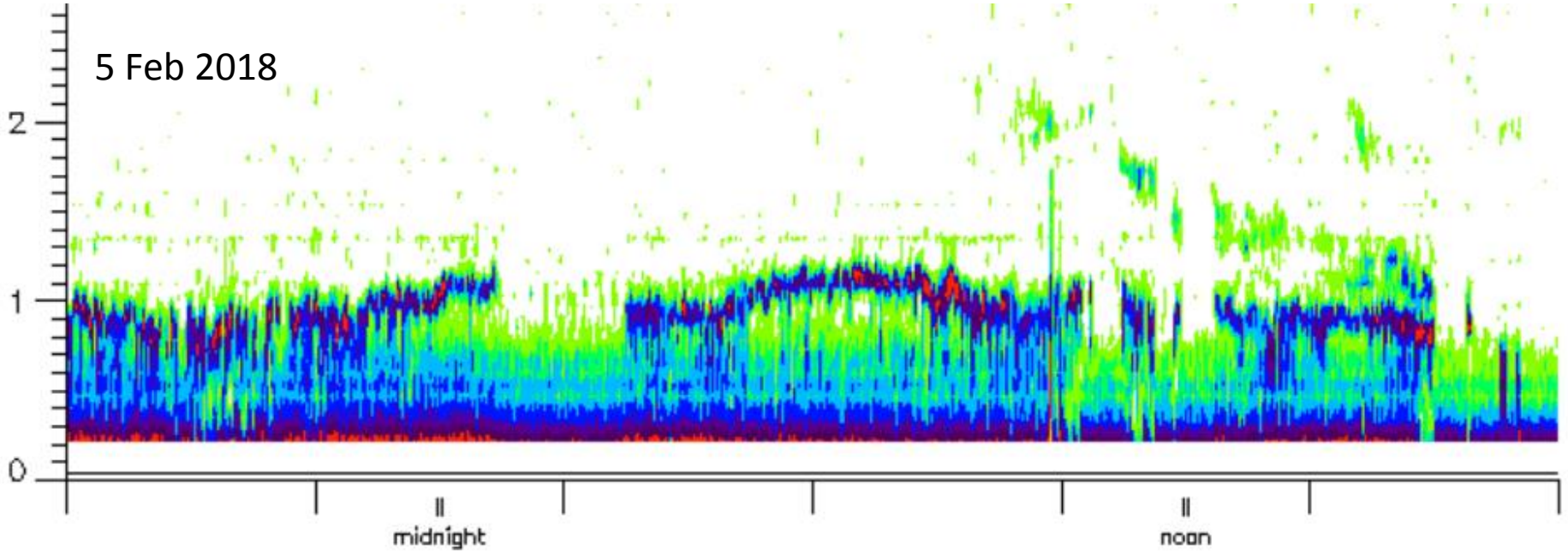
Radar Wind Profiler

BL Structure,
Sea clutter
Ice bergs



Ice bergs

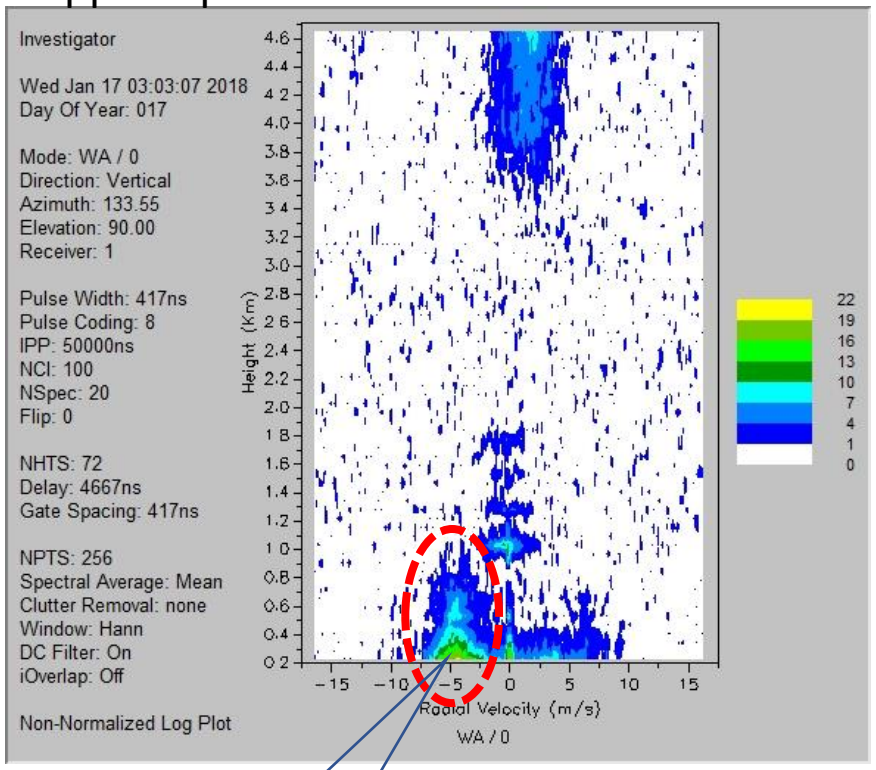




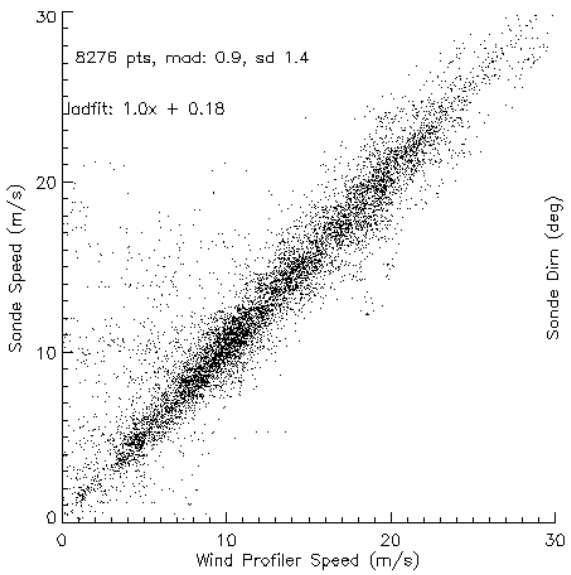
Radar Wind Profiler

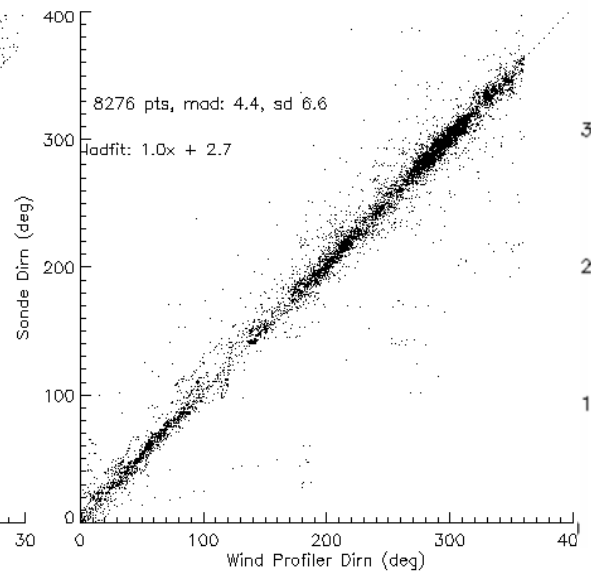
- Adjust for ship motion and orientation
- However lots of sea clutter in the Southern Ocean
- Doppler spectra height plot (clutter and atmosphere)
- NIMA (NCAR Improved Moment Algorithm) filtered out clutter
- Allowed wind measurements down to about 300m level

Doppler Spectra

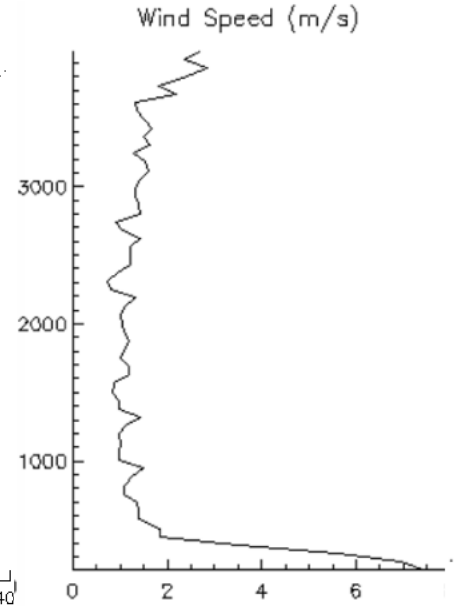


Sea clutter



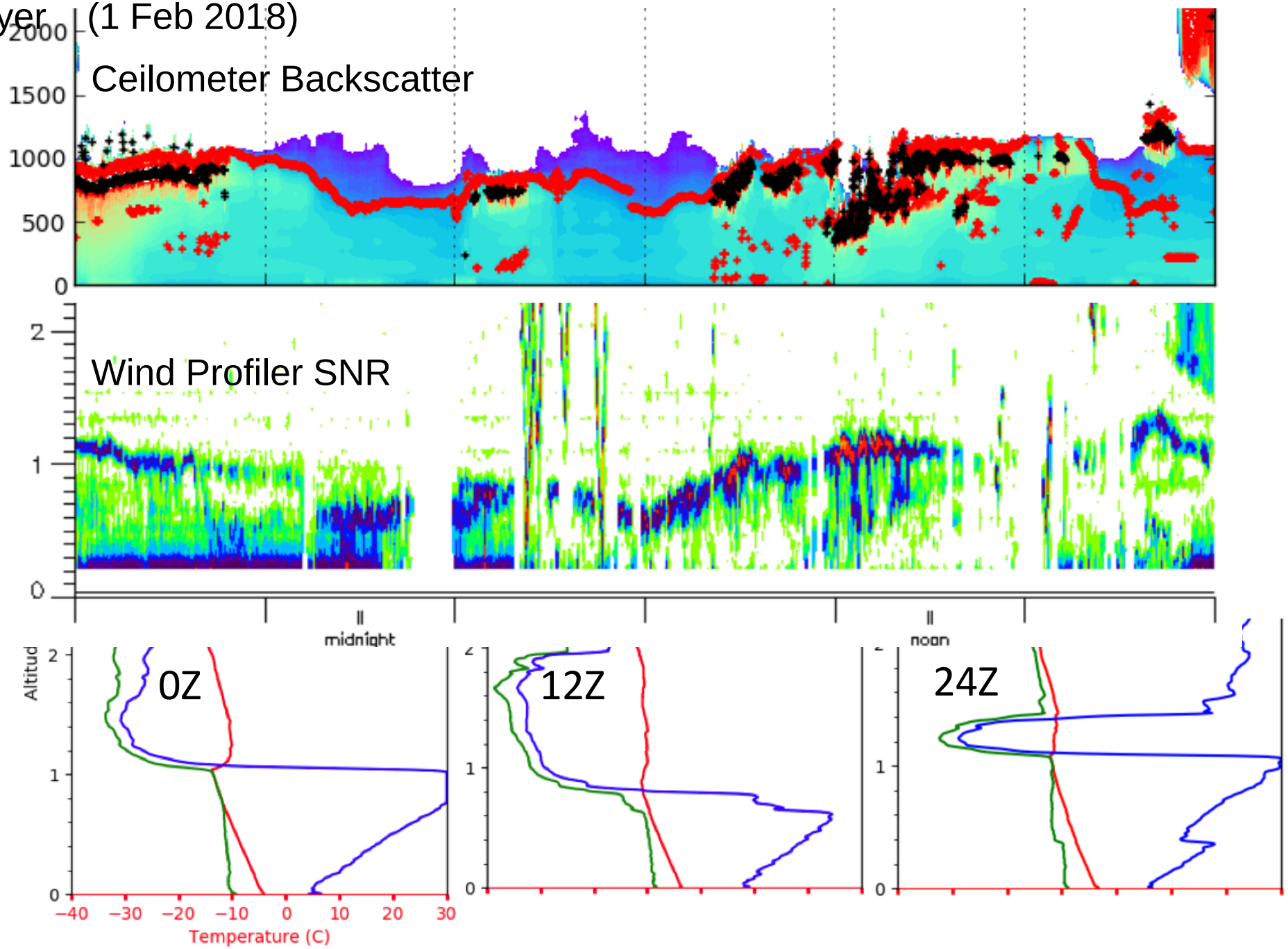


Comparison with soundings

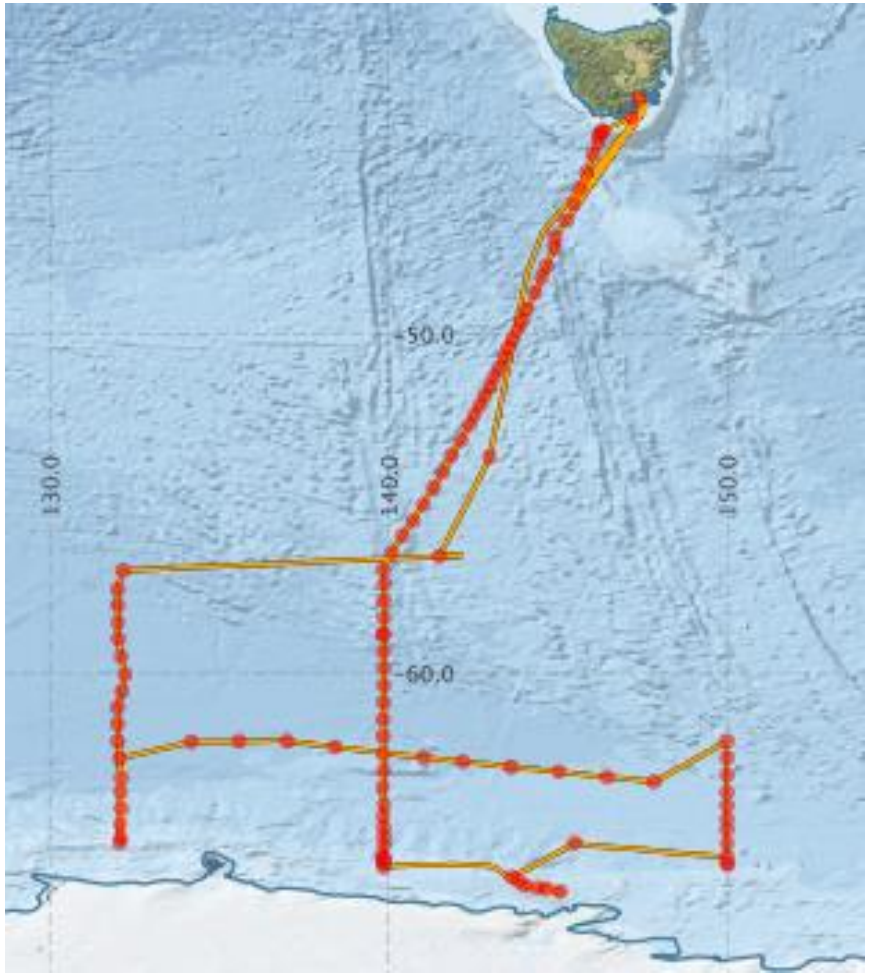


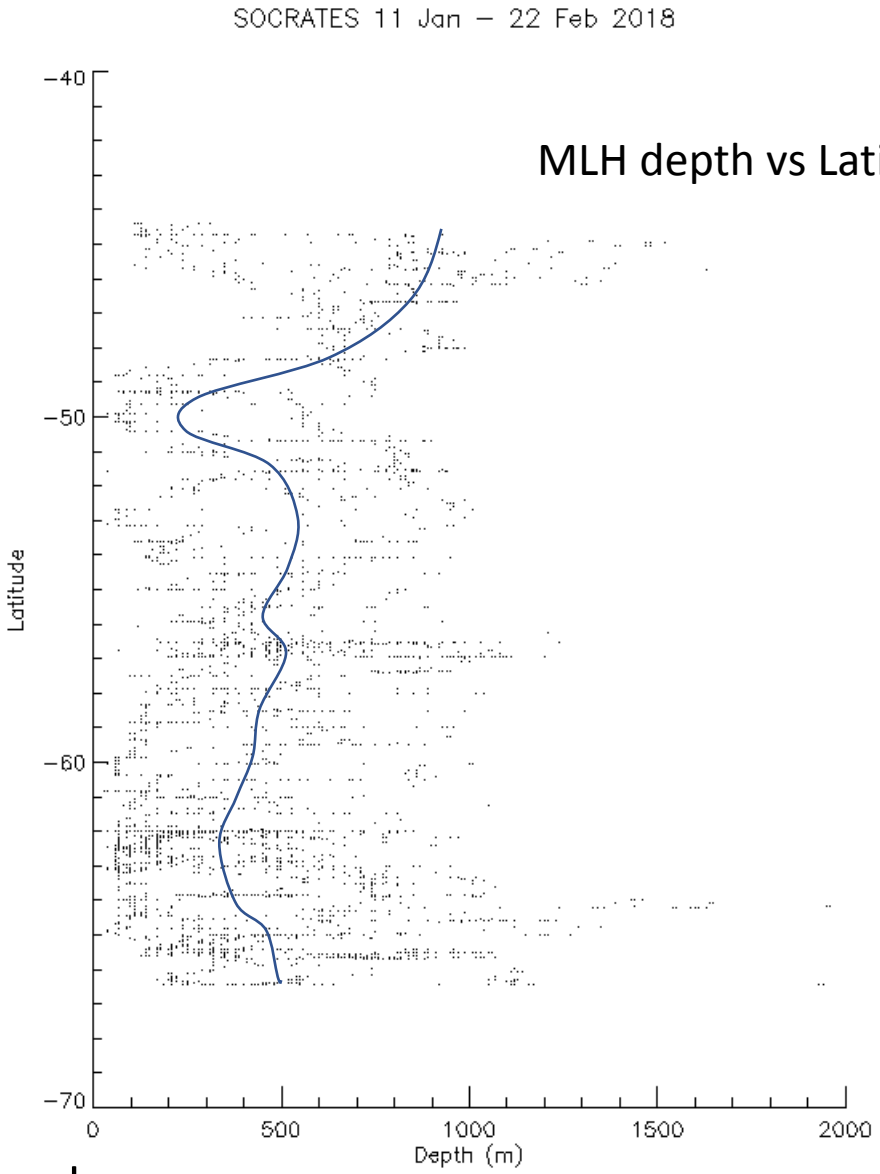
Std Dev

Boundary Layer (1 Feb 2018)



Boundary Layer Depth with Latitude



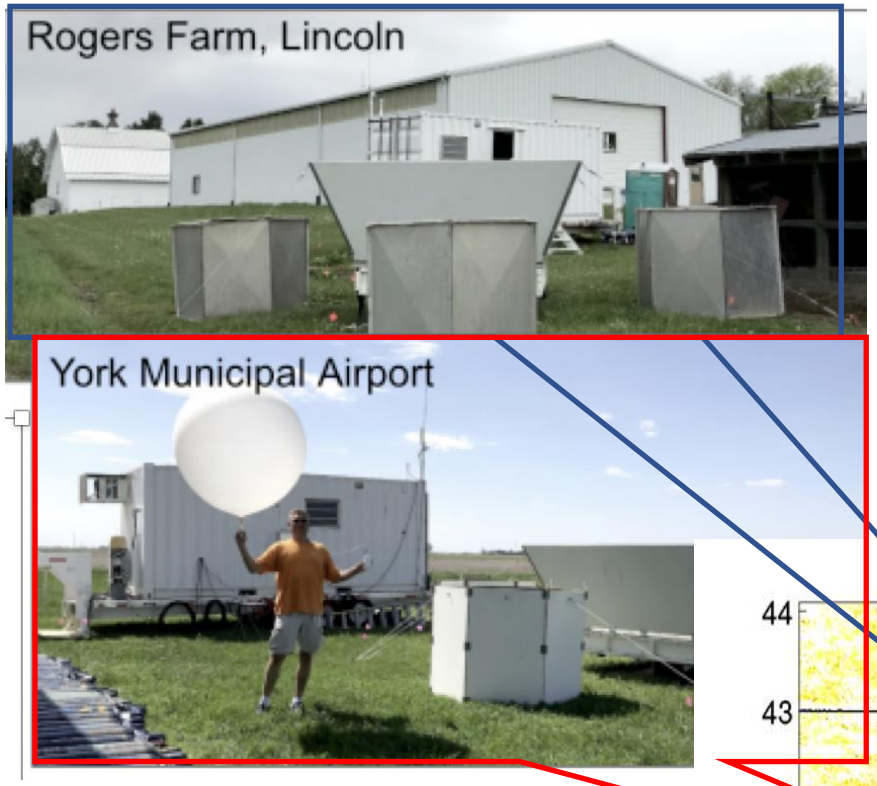


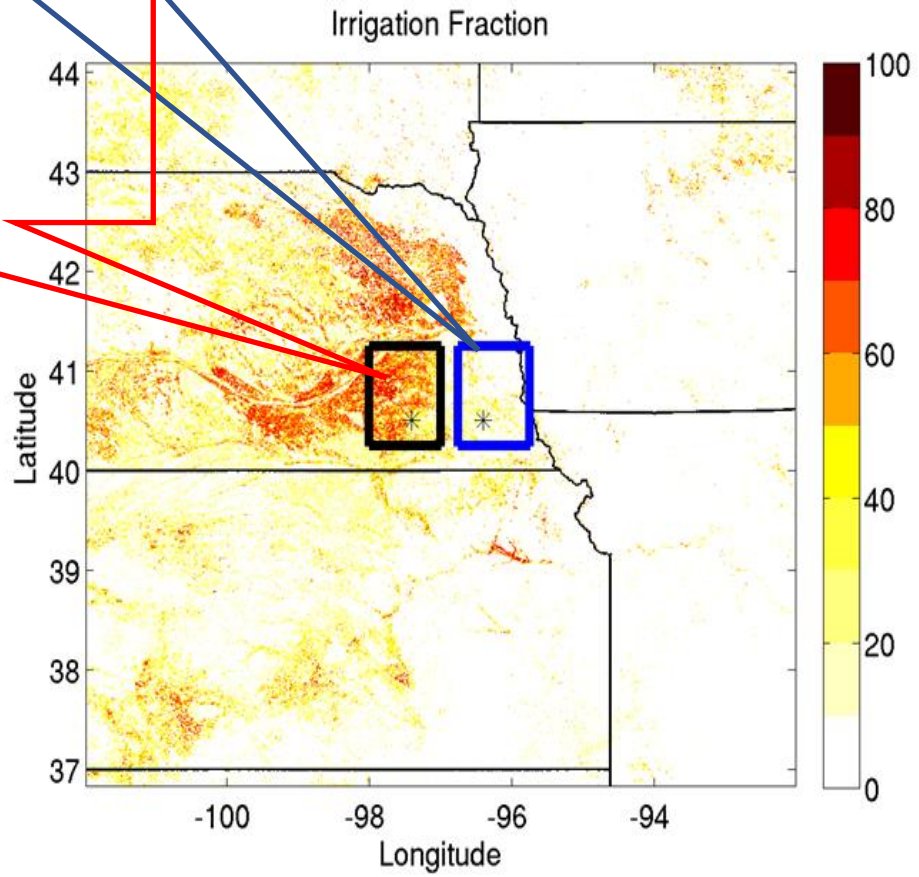
Ceilometer Mixed Layer Depth algorithm.
Implies shallower boundary layer to south as seas get cooler.
Working on comparisons with soundings

GRAINEX

The Great Plains Irrigation Experiment

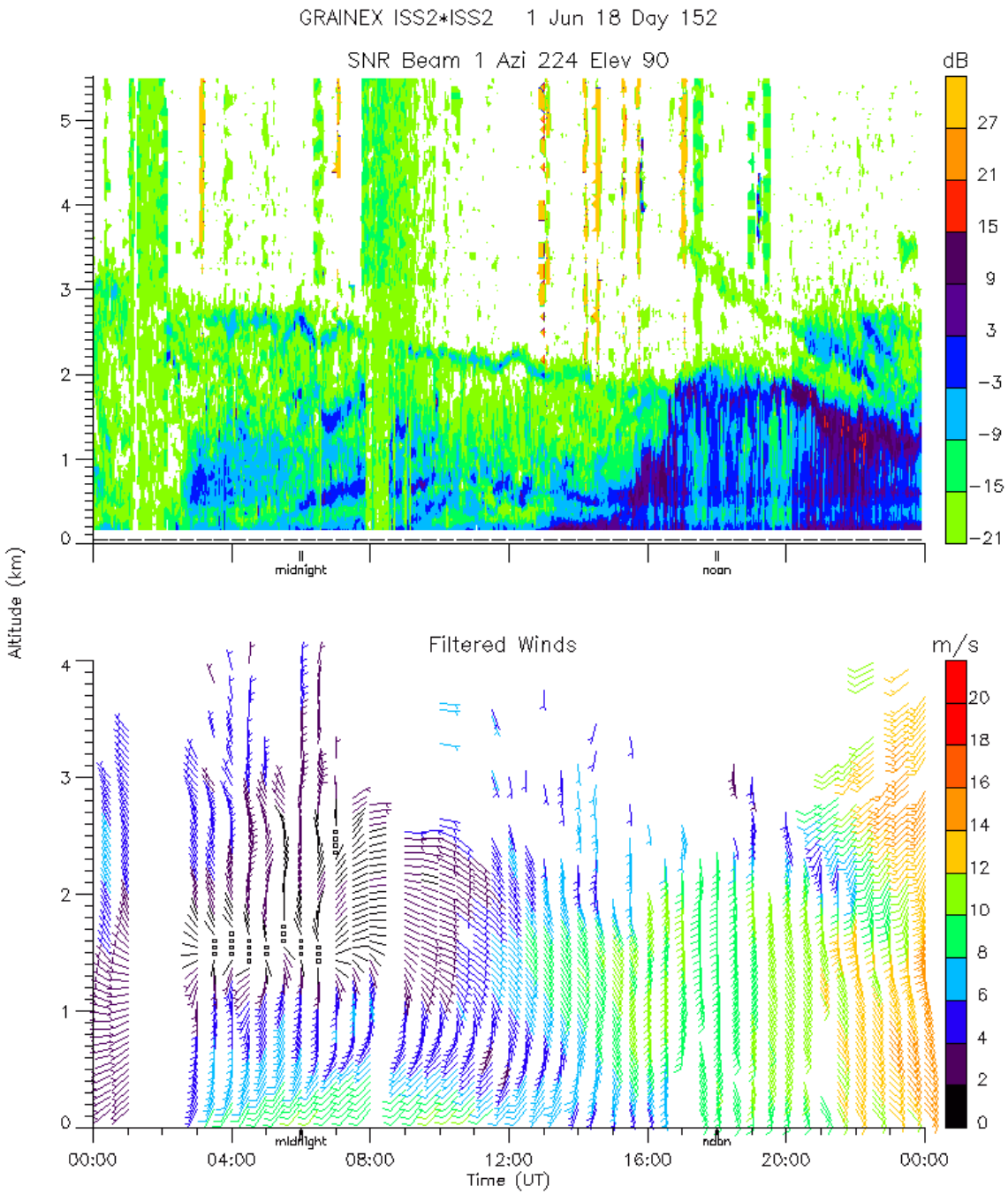
Rezaul Mahmood (Uni. NE)
Udaysankar Nair (UAH)
Eric Rappin (WKU)
Roger A. Pielke, Sr (CU)

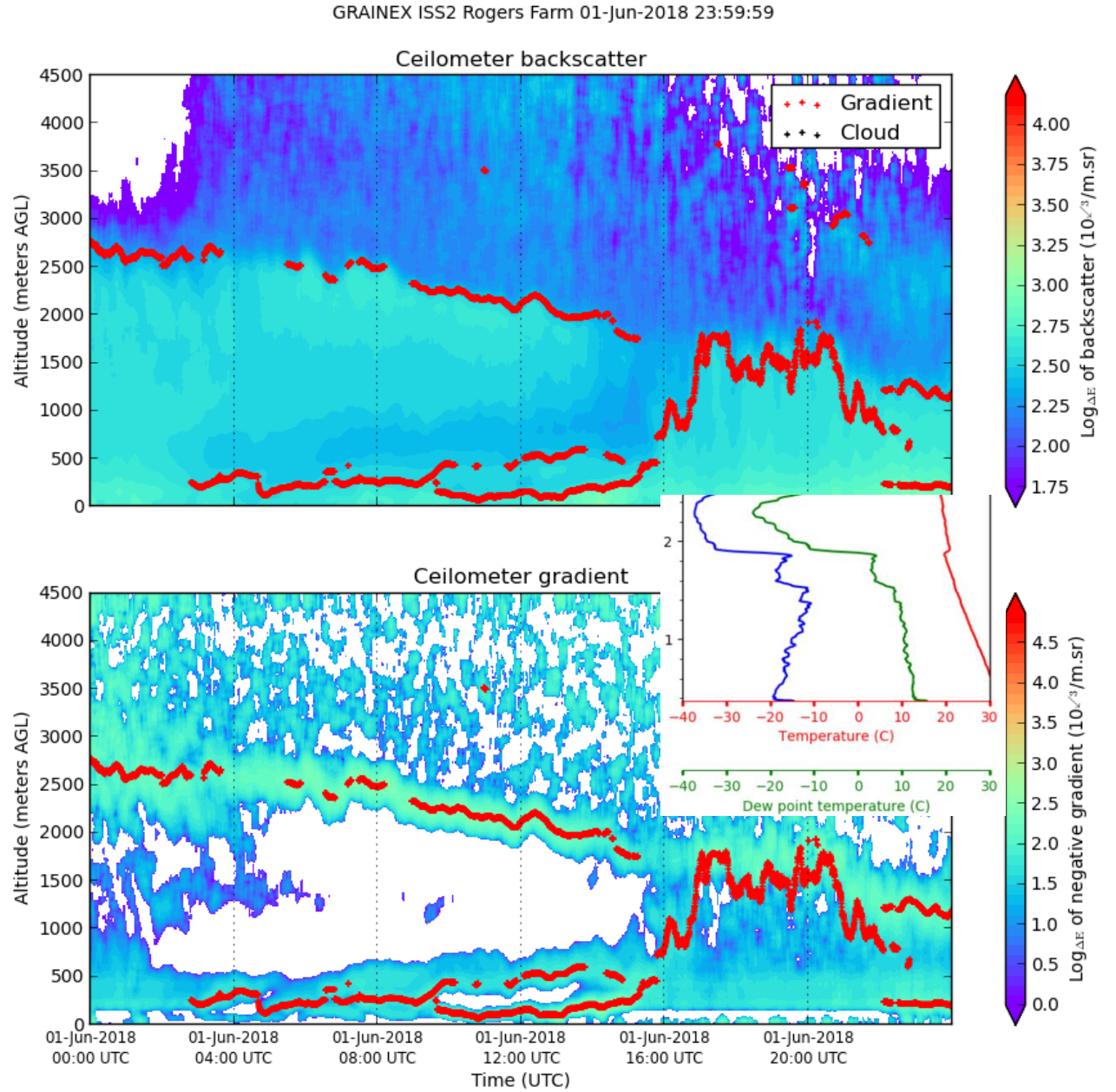




Aims to understanding the influence of irrigation on the Planetary Boundary Layer and Weather Events.

Two study areas in Nebraska USA.
Western area is heavily irrigated starting in July.
Eastern area is not irrigated at all.
ISS and other instrumentation positioned in both areas,
Intensive Observation Periods (IOP) in June (pre-irrigation) and in July (irrigation started in Western area).
480 radiosonde soundings.


GRAINEX ISS2*ISS2 1 Jun 18 Day 152
SNR Beam 1 Azi 224 Elev 90
dB
27
21
15
9
3
−3
−9
−15
−21
midnight
noon
Altitude (km)
Filtered Winds
m/s
20
18
16
14
12
10
8
6
4
2
0
00:00
04:00
08:00
12:00
16:00
20:00
00:00
Time (UT)


GRAINEX ISS2 Rogers Farm 01-Jun-2018 23:59:59
Ceilometer backscatter
Gradient
Cloud
Altitude (meters AGL)
Log$_{\Delta E}$ of backscatter (10^{-3}/m.sr)
Ceilometer gradient
Temperature (C)
Dew point temperature (C)
Log$_{\Delta E}$ of negative gradient (10^{-3}/m.sr)
01-Jun-2018 00:00 UTC
01-Jun-2018 04:00 UTC
01-Jun-2018 08:00 UTC
01-Jun-2018 12:00 UTC
01-Jun-2018 16:00 UTC
01-Jun-2018 20:00 UTC
Time (UTC)
CL51 Ceilometer BL-VIEW Analysis
Site: GRAINEX ISS2 Lincoln NE

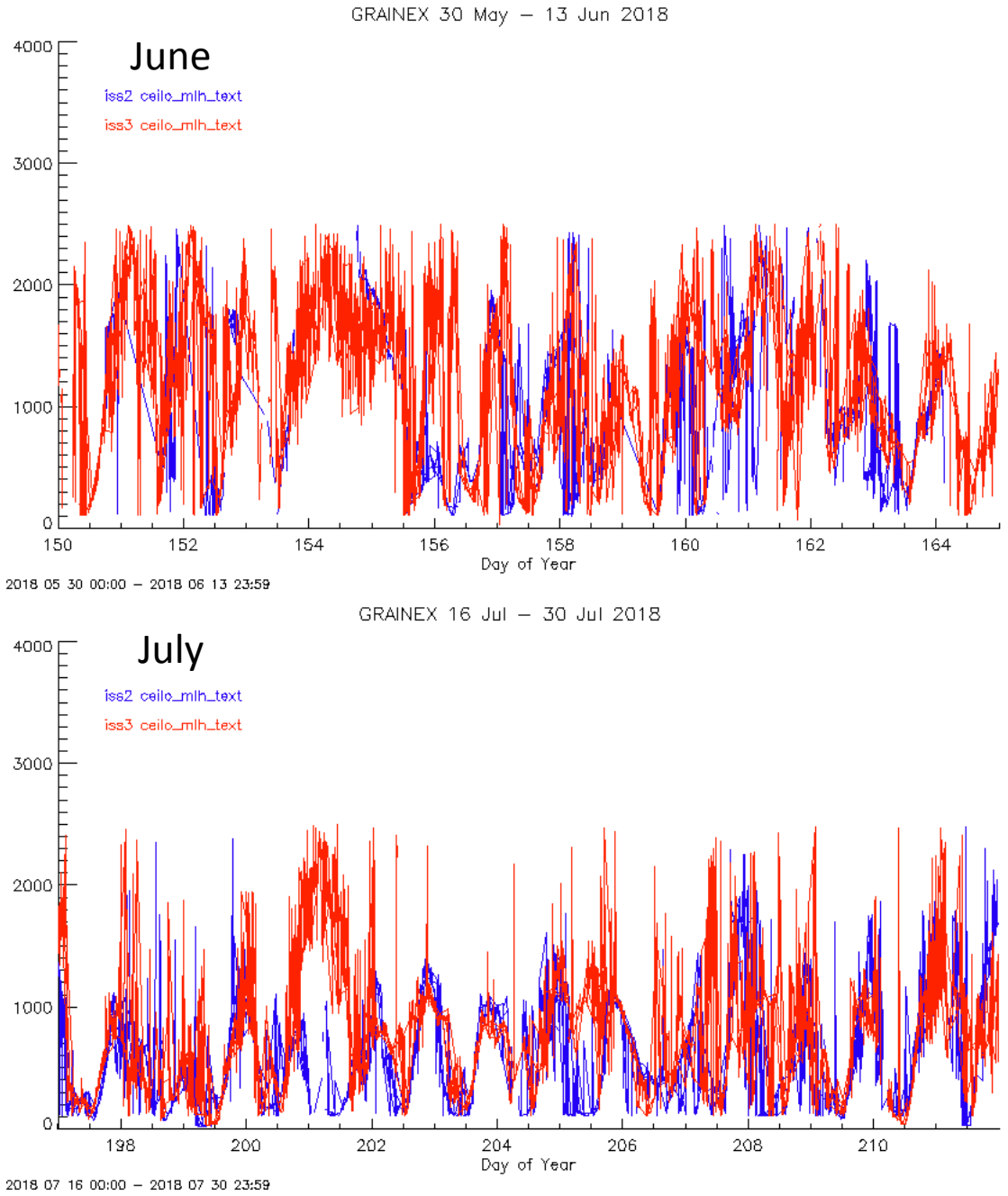
Time series of Ceilometer MLH

Ceilometer Mixed Layer Height algorithm

Blue is eastern site (non-irrigated)
Red is western site (irrigated in July)

Clear diurnal cycle

July appears lower

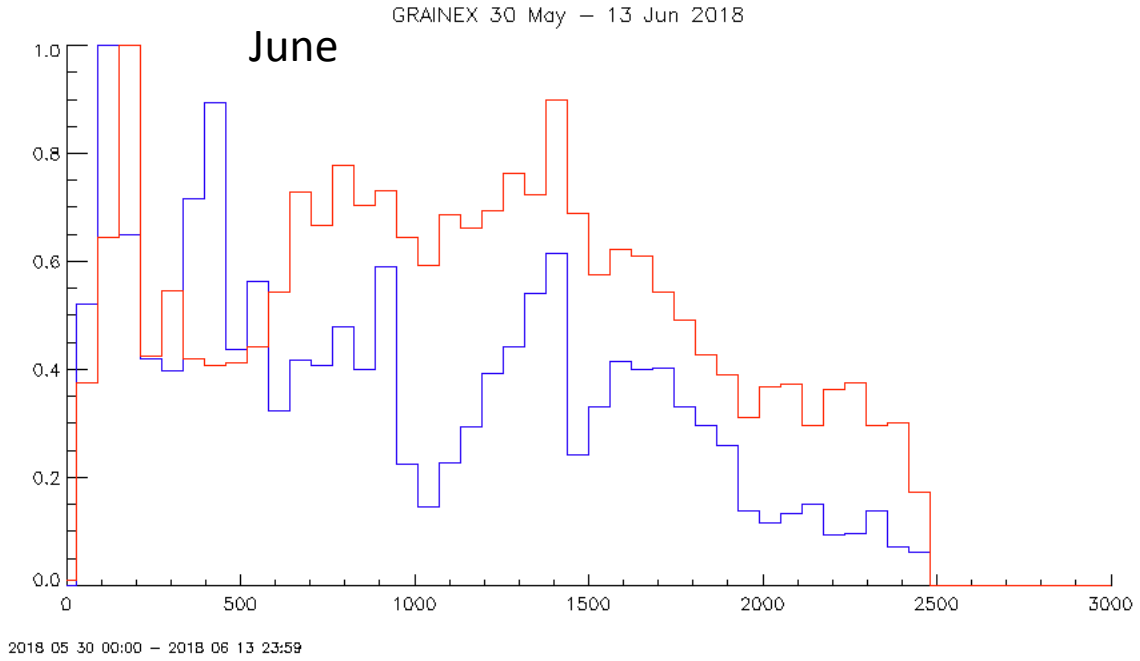


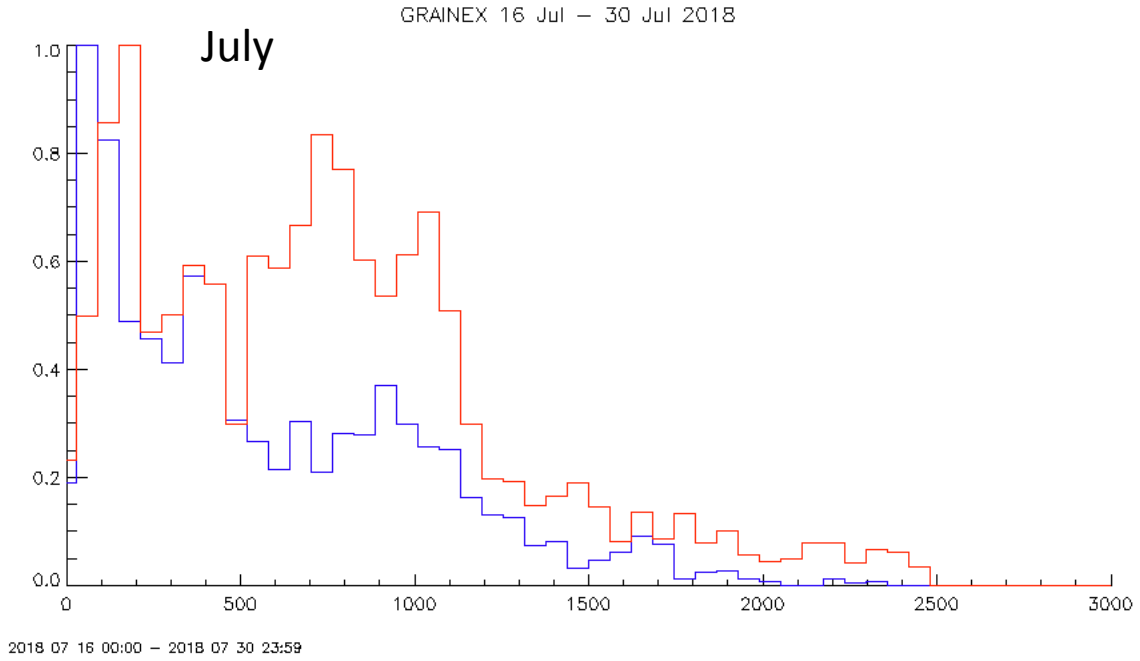
Histograms of MLH

Ceilometer Mixed Layer Height algorithm

MLH at both sites lower in July than June

Need to examine diurnal cycle and compare with soundings





Profiles:

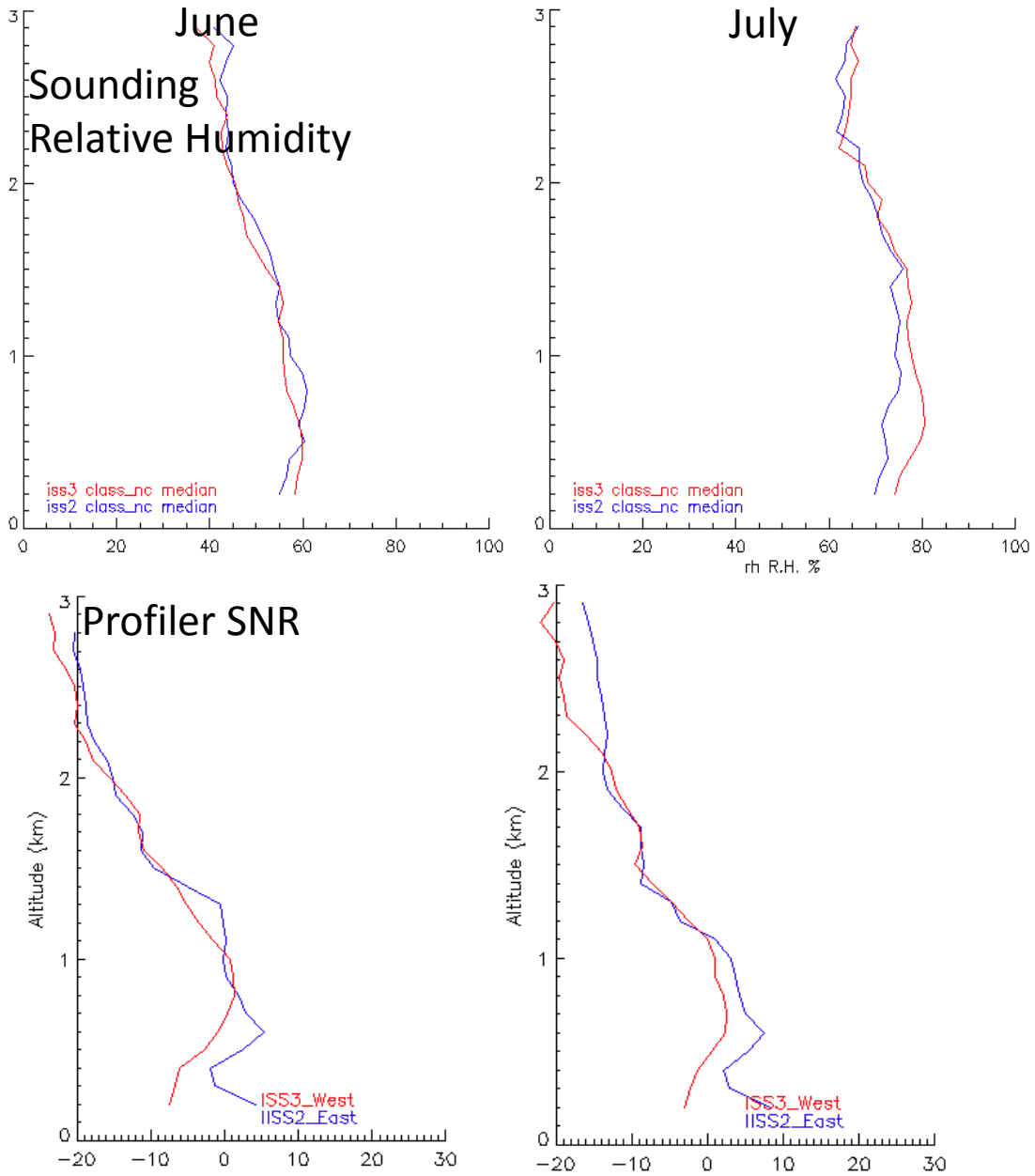
Median profiles of Relative Humidity (from soundings) and Profiler SNR (noon).

Relative humidity is higher at western site in July

Peak SNR drops to lower altitude at western site in July

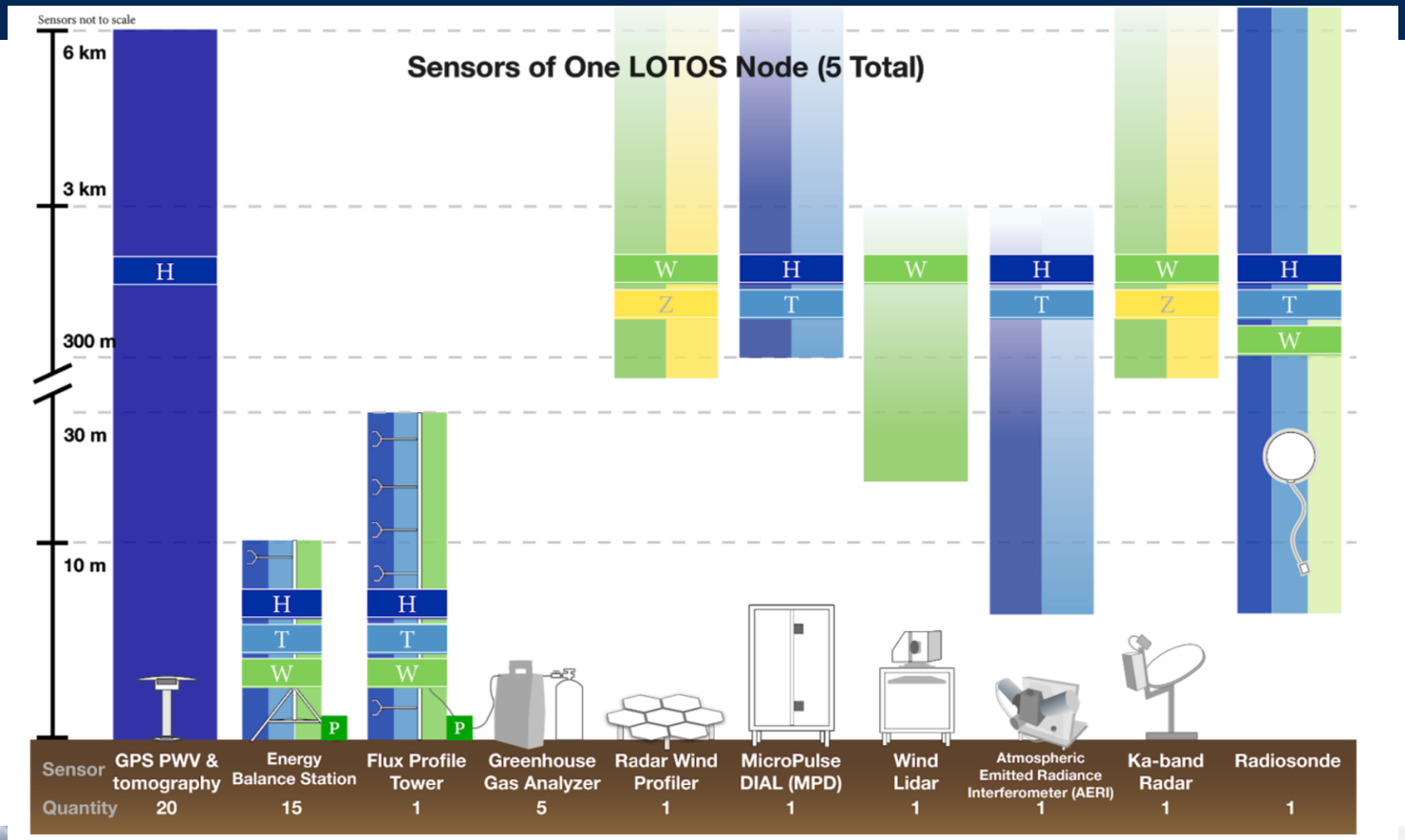
Irrigation may be moistening local atmosphere and lowering boundary layer

- more analysis needed to confirm this.



LOTOS

Will include the ISS (radar wind profiler, soundings, lidar) along with many other sensors



Summary

- Similar instrumentation at two very different field campaigns (ultimately plan to expand the instrument suite in LOTOS)
- Southern Ocean and Great Plains
- Wind profilers, ceilometers, and soundings
- Comparison of boundary layer depth from various instruments
  ~730 radiosonde soundings (opportunity for algorithm testing)
- Examining influence of surface (SST and irrigation) on boundary layer depth