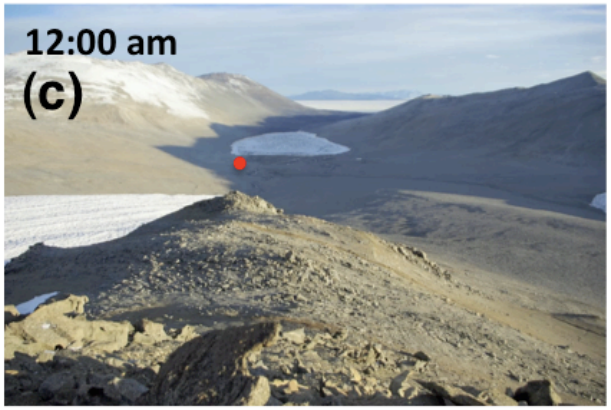
Surface-layer response to topographic shading in Miers Valley, Antarctica

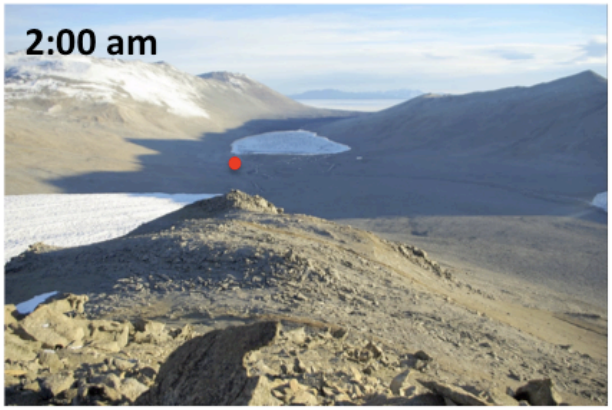
8th Antarctic Meteorological Observation, Modeling, and Forecasting Workshop

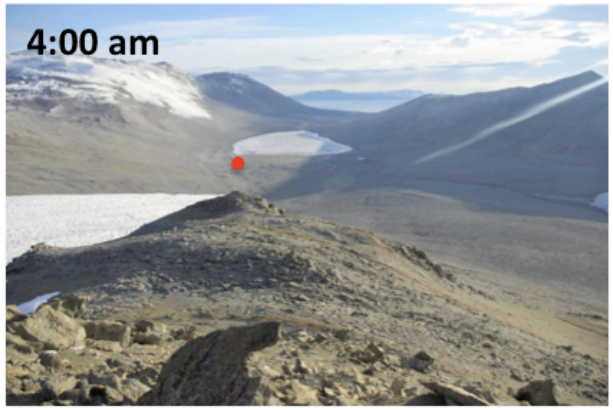
Marwan Katurji [1, 2]

Peyman Zawar- Reza[1] & Sharon Zhong [2]

Topographic Shadow







Research Significance

Topographic **S**hading → TS

Micro-climate variability (space and time)

Spatial micro-climate variations could surmount variations from one site [Whiteman et al. 1989]

TS could delay or speed-up temperature inversion onset or breakup

… from numerical simulations [Colette et al. 2003]

TS for extended periods of time is similar to early evening transition (EET)

[Mahrt 1981, Acevedo and Fitzjarrald 2001, Busse and Knupp 2012, Nadeau et al. 2012]

The lack of atmospheric and soil moisture, and vegetation make the Miers Valley data set suitable for "undisturbed" TS effects

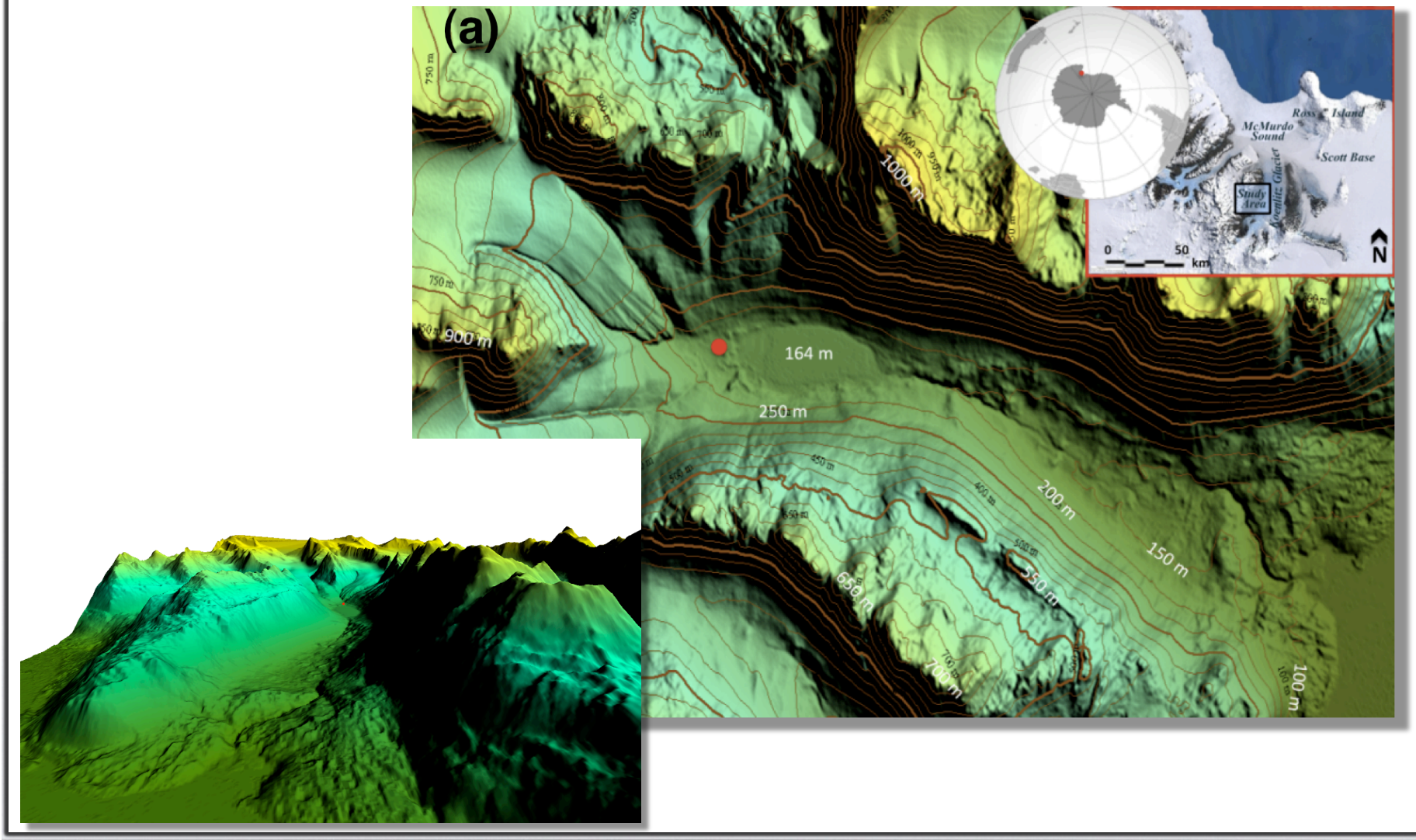
Research Objective

Investigate the mean and turbulent characteristics throughout the depth (surface to 250 m AGL) of a transitioning (unstable towards stable) valley-atmosphere surface layer

Focus on:

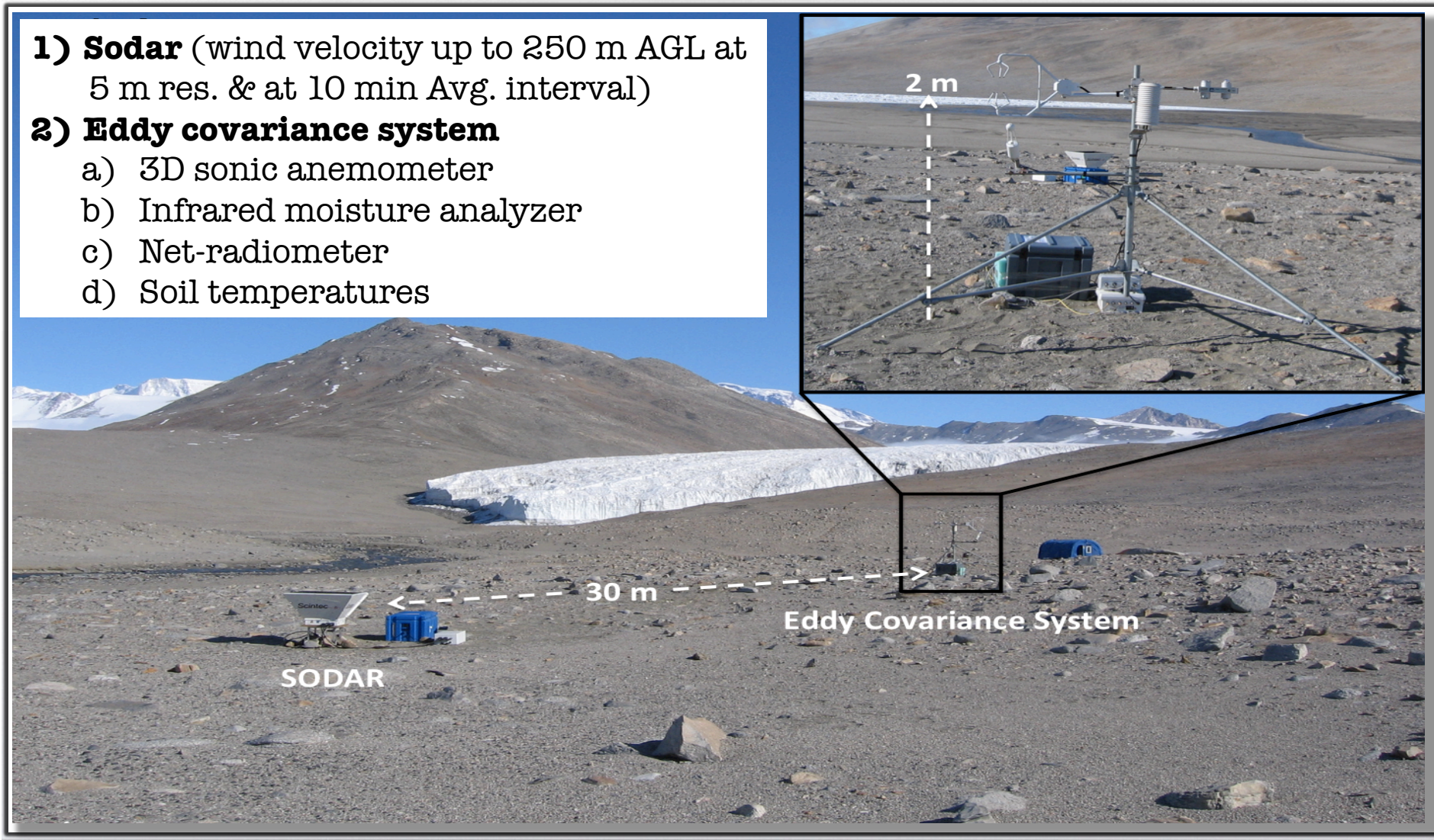
- Surface energy balance components
- Skin and air temperature
- Low frequency oscillations of velocity fields

Location – Miers Valley

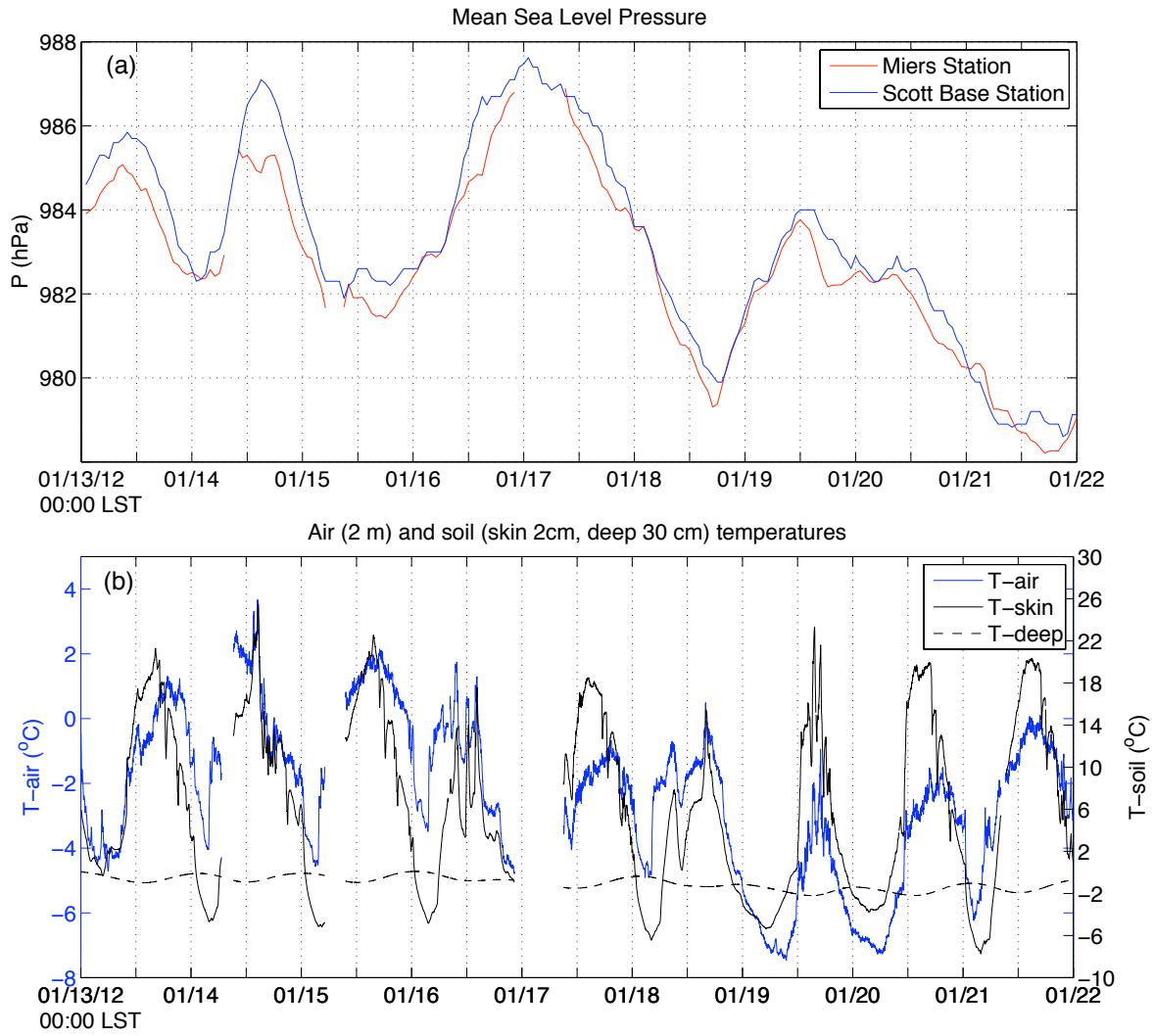


Research Tools

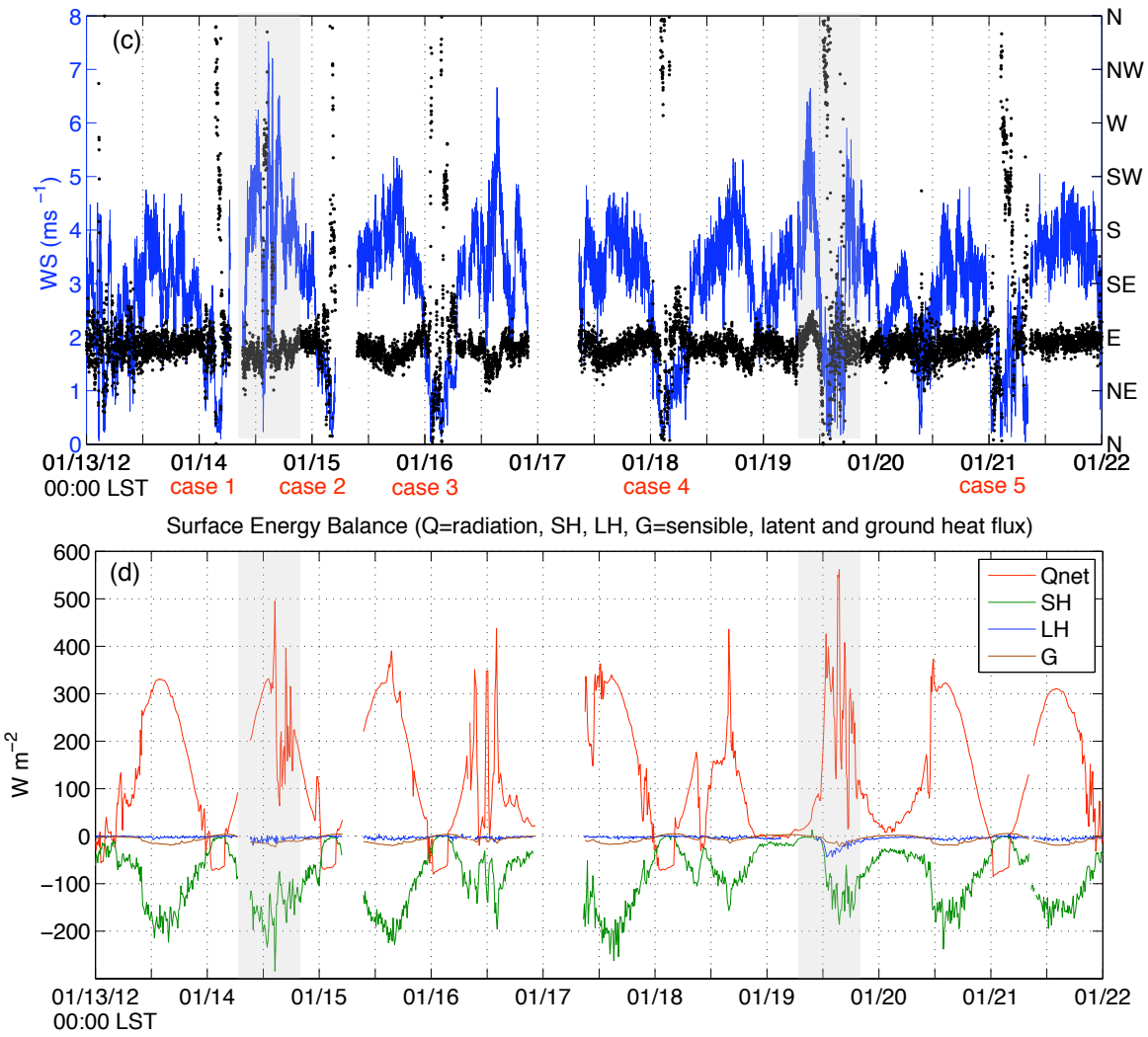
1) **Sodar** (wind velocity up to 250 m AGL at 5 m res. & at 10 min Avg. interval)
2) **Eddy covariance system**
   a) 3D sonic anemometer
   b) Infrared moisture analyzer
   c) Net-radiometer
   d) Soil temperatures



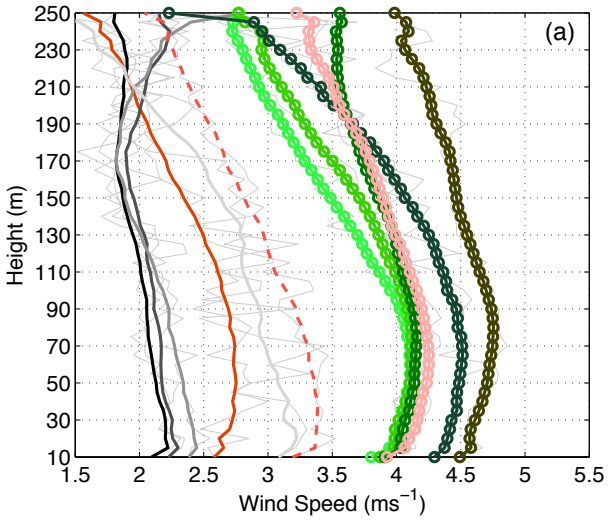
2 m T (°C) and P (hPa) trends

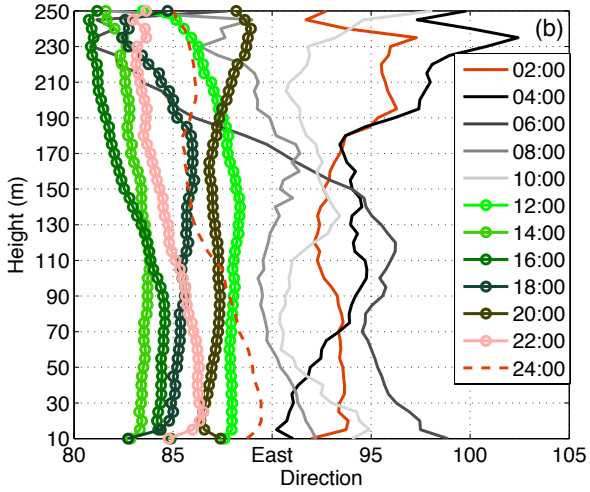


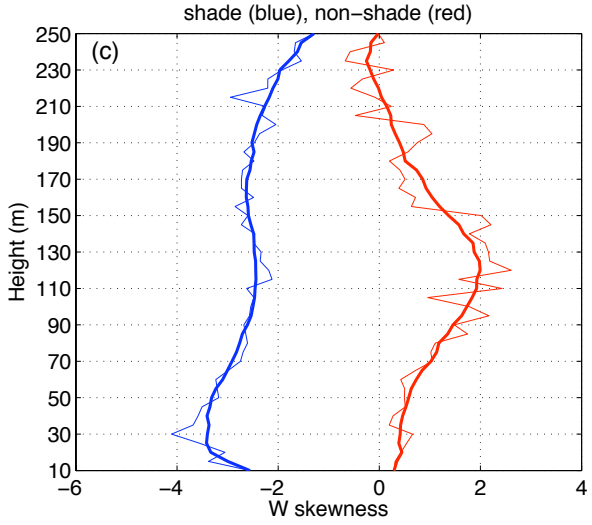
2 m Winds and Surface Energy Balance



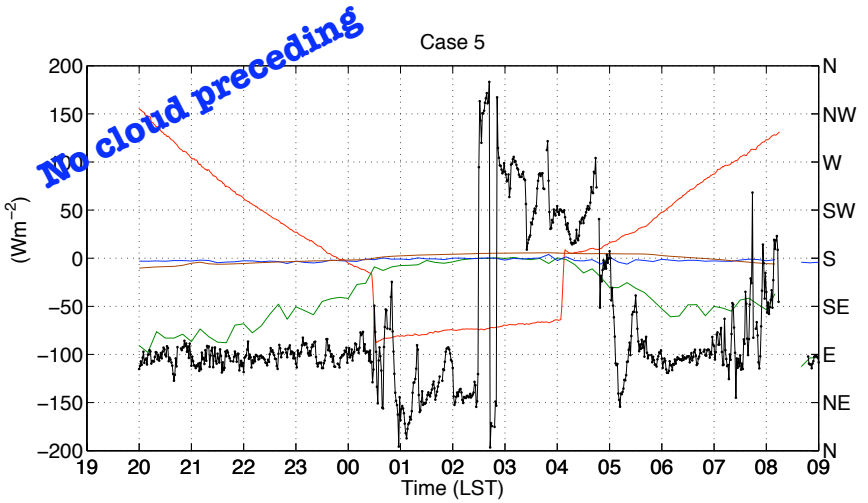
Upper Level Winds and Stability

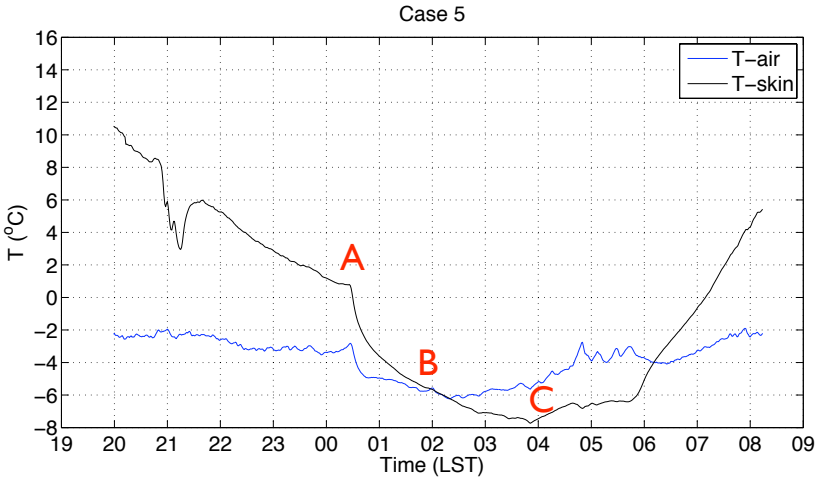


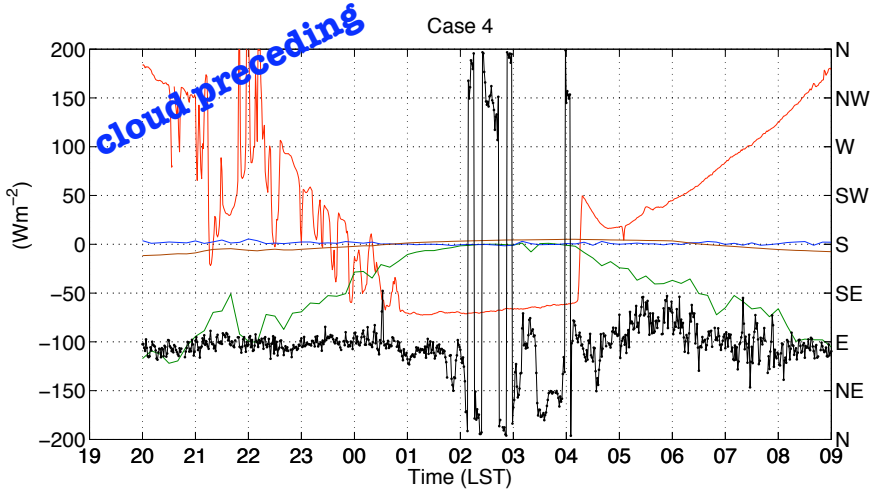


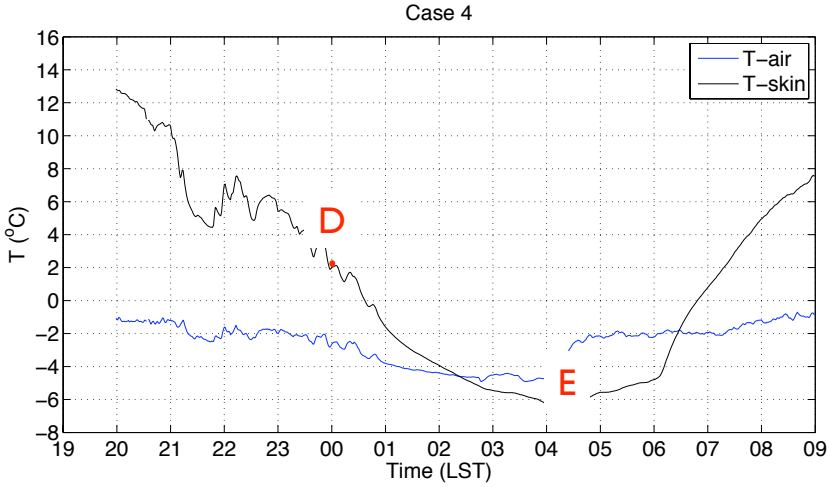


Non-shadow to Shadow Transition

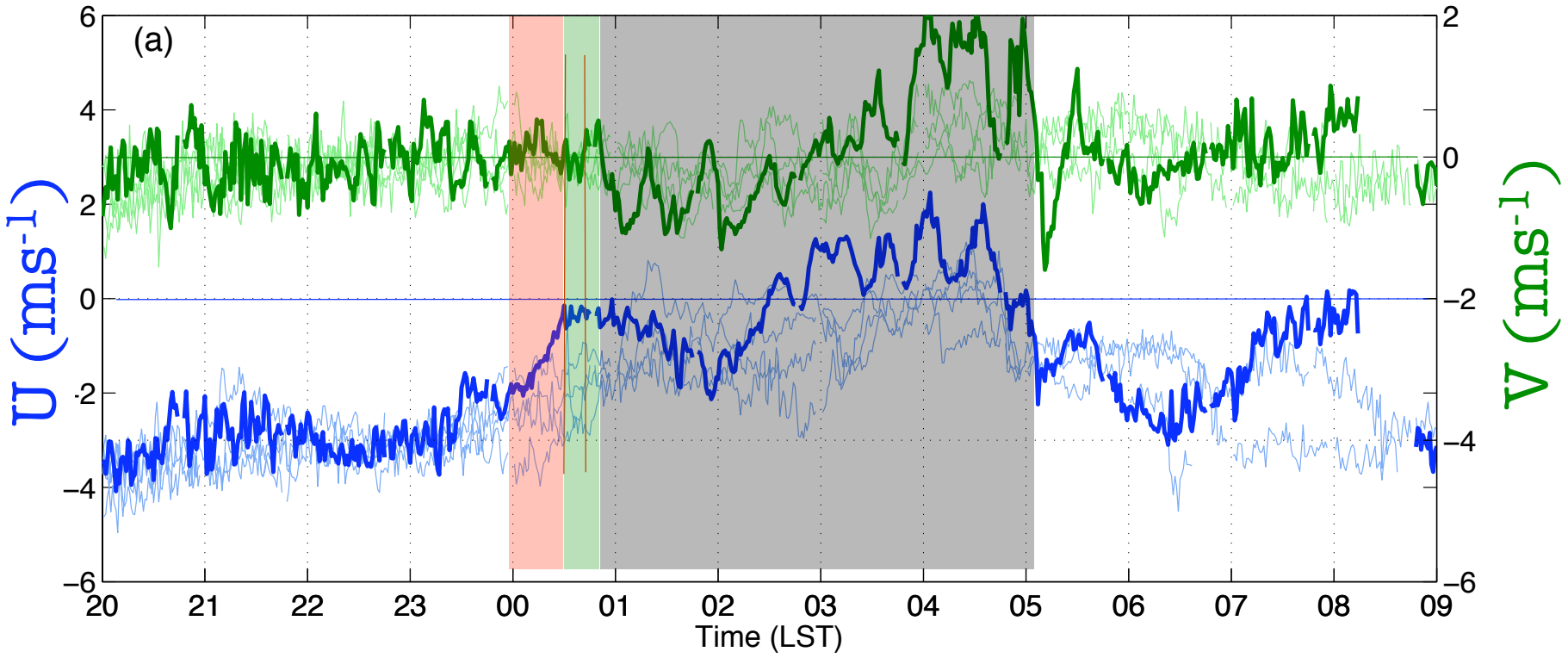








Non-shadow to Shadow Transition Velocity Oscillations



Blue line: Along valley velocity

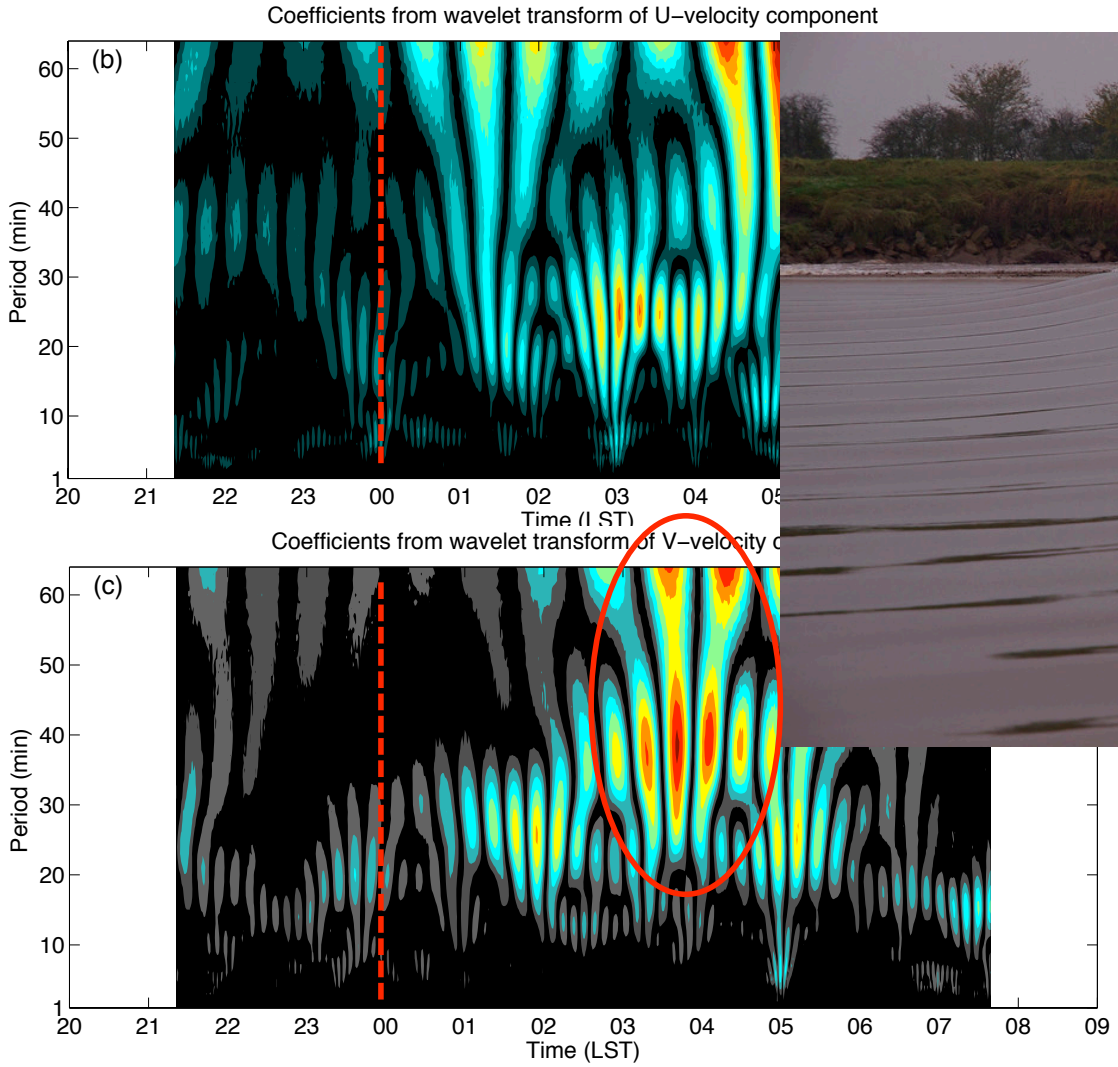
Green line: Cross valley velocity

deceleration

near stagnation

oscillation

Non-shadow to Shadow Transition
Low Frequency Wavelet Transform



Conclusions

- Valley surface-layer appears to respond quickly to fluctuations in solar radiation
- Surface temperatures can drop by 10 °C in 4 hours due to TS
- Influence of TS extends to 250 m AGL
- Shade onset temperature response depends on cloud cover
- Along and cross valley surface velocity oscillations could be used as a proxy to EET predictions and boundary layer transition modeling

On going research, collaborators welcomed!

Analysis of data from Lake Vida (Victoria Valley) – Jan. 2013

- Radio acoustic sounding system (RASS) + SODAR
- Lake and valley boundary layers

Thank You!