Observations and Experiences While Studying Long Lake-Axis-Parallel Lake-effect Snow Storms with the Doppler on Wheels

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Introduction – Why Oswego?

So we can have a drink up high?

We get a lot of snow!
And there is a lot we don't know about lake-effect!

Mean: **110.4** "
Std. Dev: **45.5** "
Skew: **1.0**

1960-2008
Mean: **144.2** "

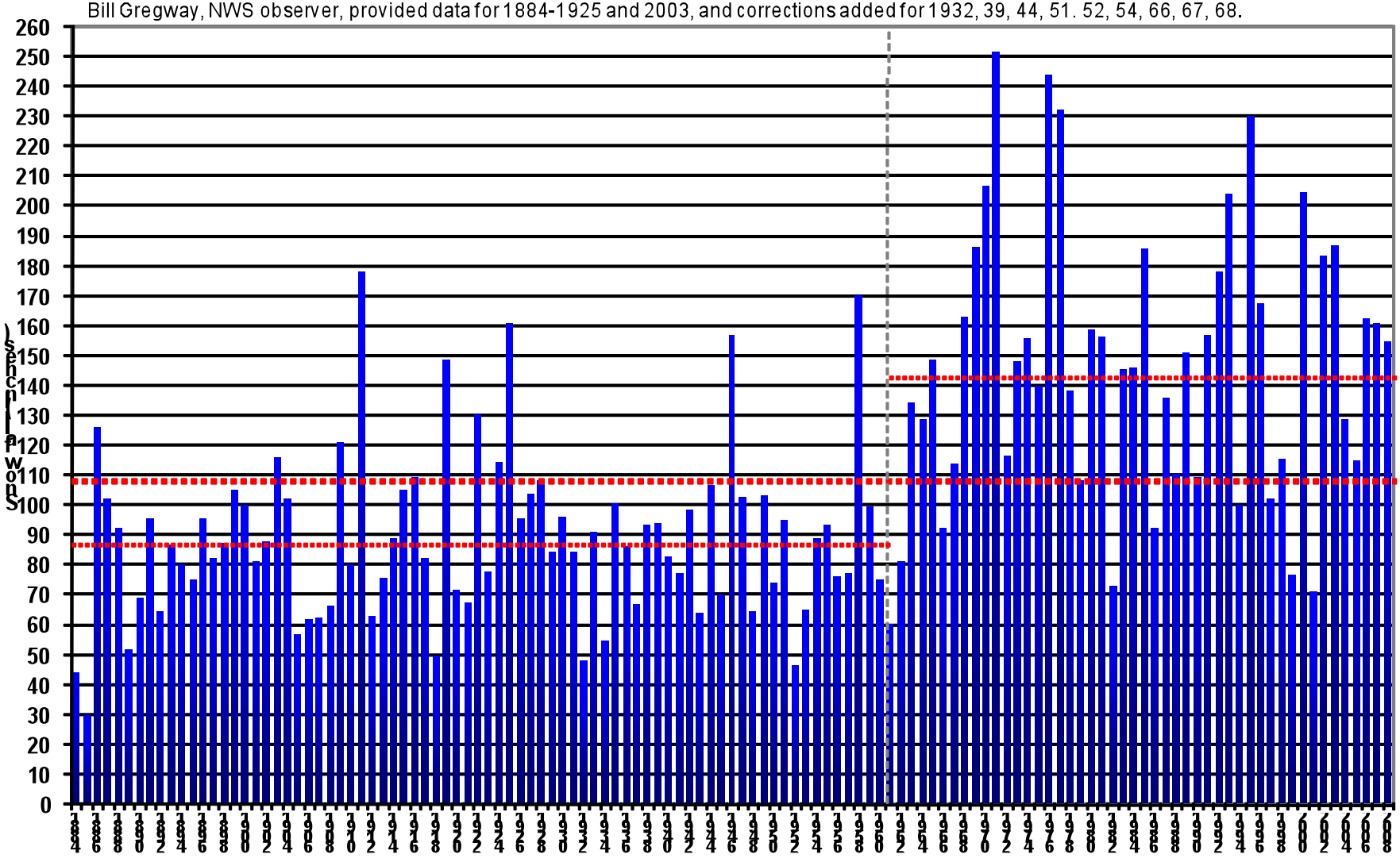
Oswego, NY, Snowfall 1884 - 2008

Data source: http://www.ncdc.noaa.gov/oa/climate/stationlocator.html

1884-1960
Mean: 88.5

43 28'N 76 30'W

Bill Gregway, NWS observer, provided data for 1884-1925 and 2003, and corrections added for 1932, 39, 44, 51. 52, 54, 66, 67, 68.

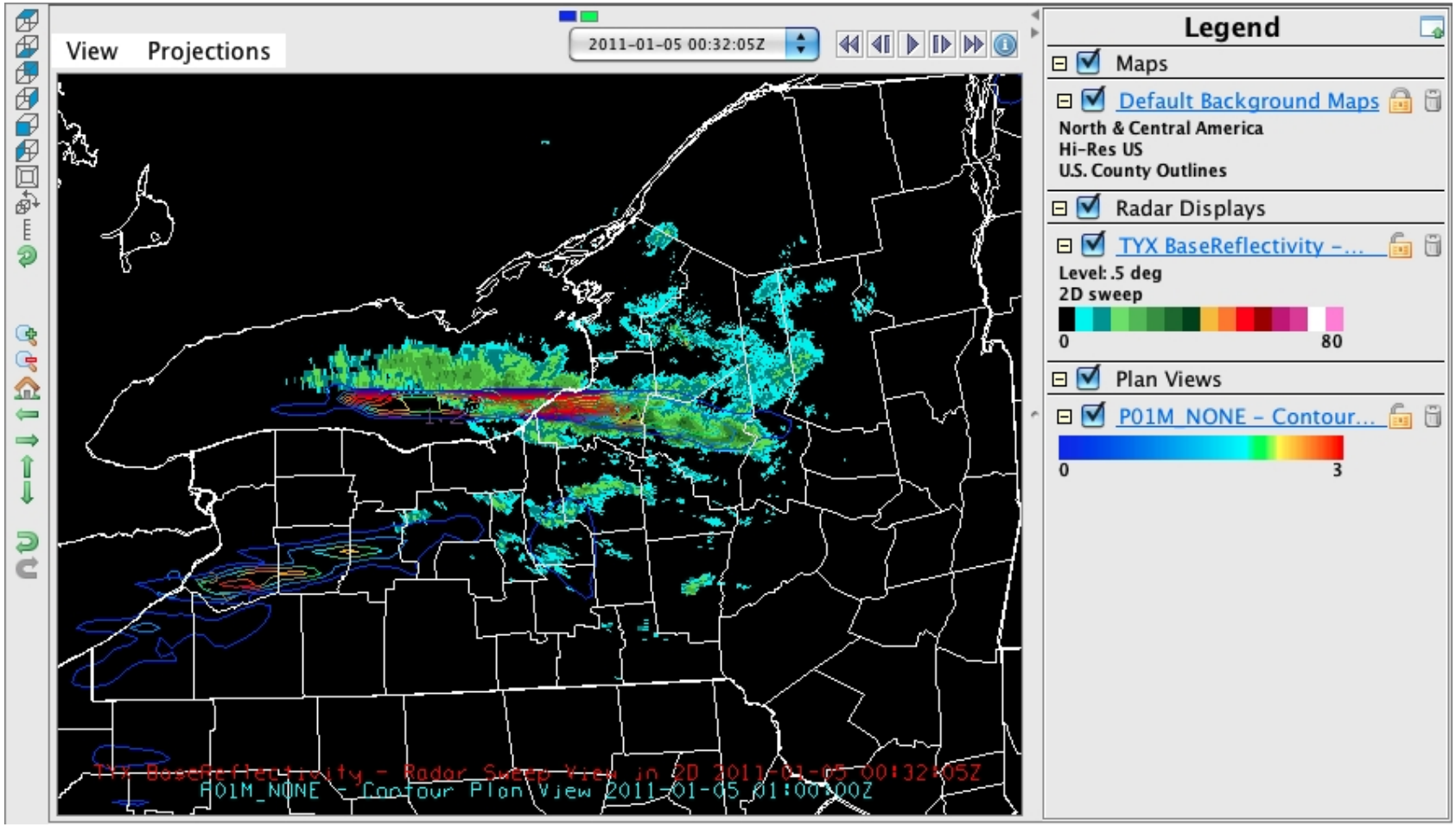


Basically a winter season snowfall: June to July

Ex. 2006 snowfall ? June 2006 to July 2007

Courtesy of S. Skubis

Some Background:
Long Lake-Axis-Parallel Storms (LLAP)



Why are we so EAGER?

- Eastern Great Lakes (Erie & Ontario) lake-effect storms are under-studied compared to the Western Great Lakes storms, especially with regards to field work.
- LLAP storms occur more frequently over the eastern lakes (Kristovich and Steve 1995) and are the most intense lake-effect storms (maybe the most intense snow storms overall).
- The Doppler-on-Wheels (DOW) has recently been upgraded to take dual-polarization measurements. This NSF EArly concept Grant for Exploratory Research (EAGER) is a proof-of-concept that the mobile dual-pol X-band radar can adequately sample lake-effect snow storms. If successful, the results will be used to propose a larger field campaign planned for studying these storms.
- Involve ten undergraduates in field research!

Equipment, Data, and Methods

Pictures courtesy of J. Frame

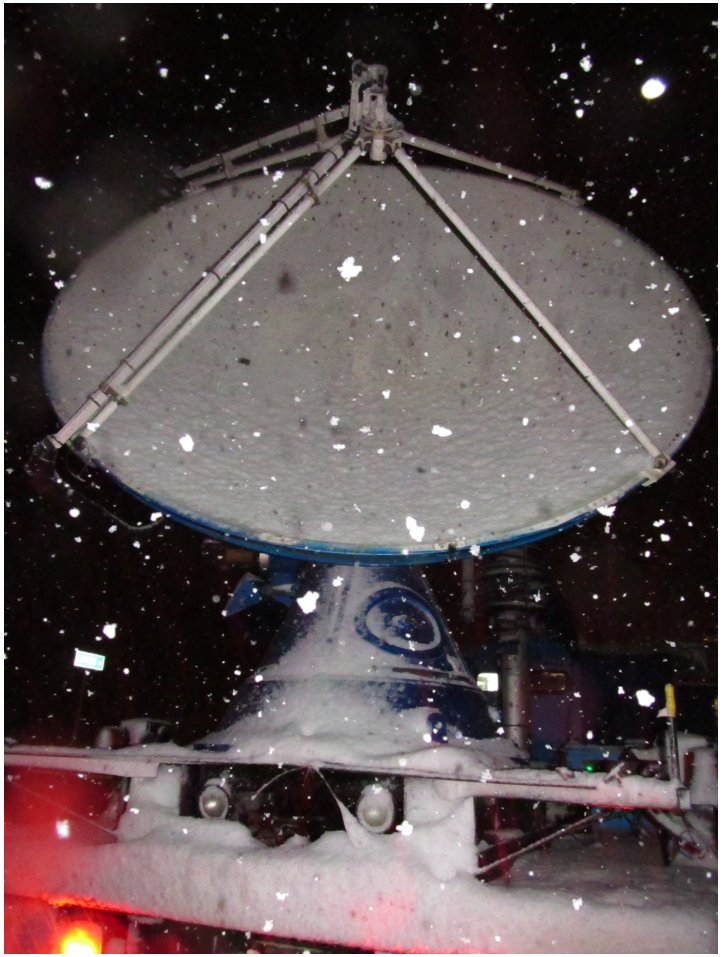
The Team (at least a part of)

Fair Haven Beach, 4 January 2011, heavy lake-effect snow storm (with lightning) in backgound

The DOW

- X-band dual-polarimetric
- Sector volume scans every 2-3 minutes, 50 km range
- PPIs, RHIs
- One dual-Doppler case happened serendipitously (2 January 2011)!
- Surface station mast

Some issues…



Rawinsonde launches

Picture courtesy of L. Pitman

- On edges and in core of band
- Students (at sonde, radar, and probe locations) also recorded surface conditions, snowfall, and crystal types (dendrites, pellets); used Formvar slides

Probe Transects

Pictures courtesy of student researchers

Measured uncorrected (for altitude) pressure drops of 5-10 hPa in band core

Returning home from operations, 2 am

Picture by J. Frame

How a typical event worked…

- T-48 hours: Called operations by this time; CSWR staff flew to Syracuse to run the radar; take DOW out of storage facility
- T-12 hours: Research meeting with students; assigned them to radar, probe, or rawinsonde teams
- T-2 hours: Position DOW so will be within 5-10 km of the band, but outside of it
- During event: monitor radar, change scan strategies, cell phone communications with other teams
- Post event meeting

Initial Results I: Vortices

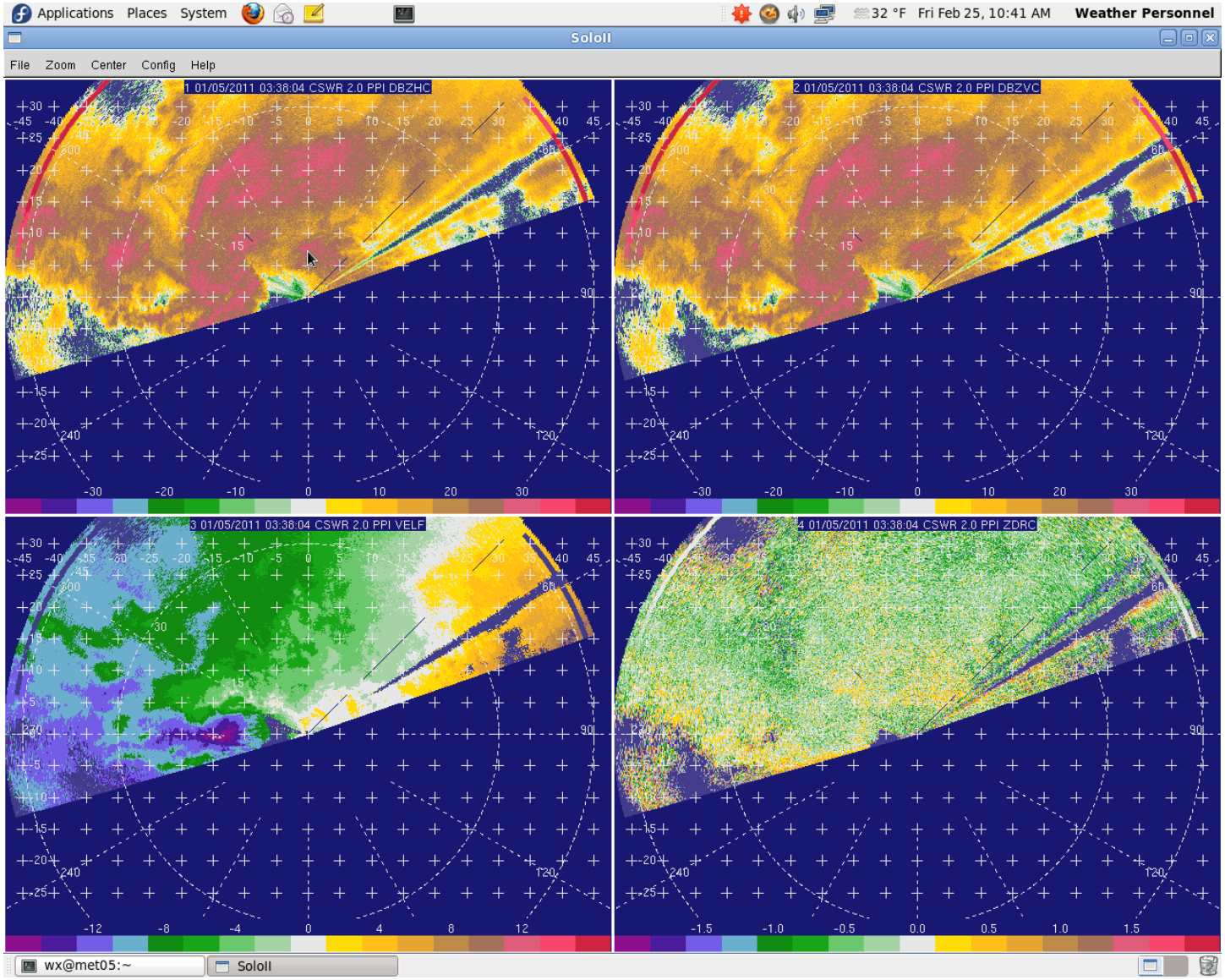
Also see http://www.vortex2.org/lap

DBZH

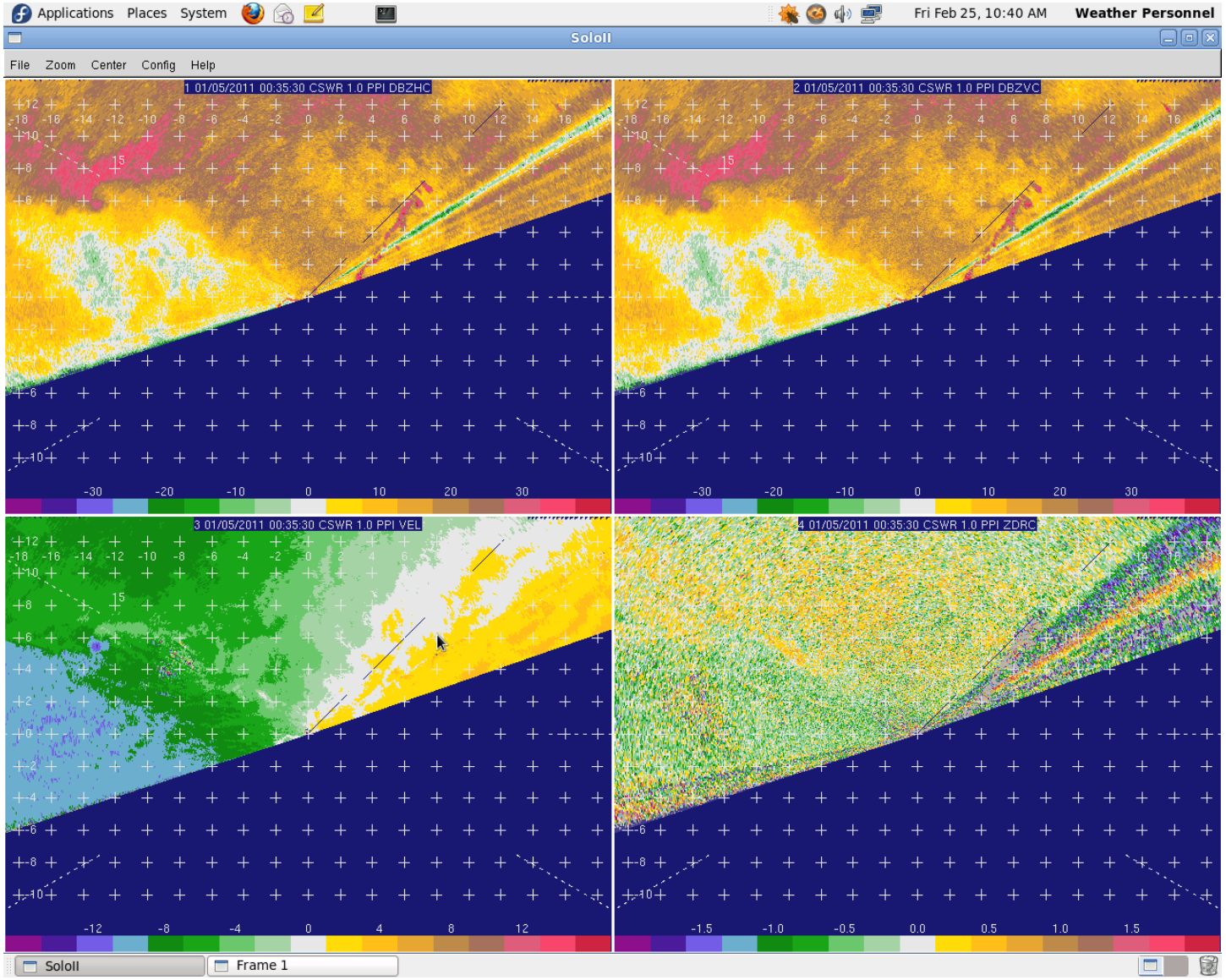
DBZV

VEL (m/s)

ZDR

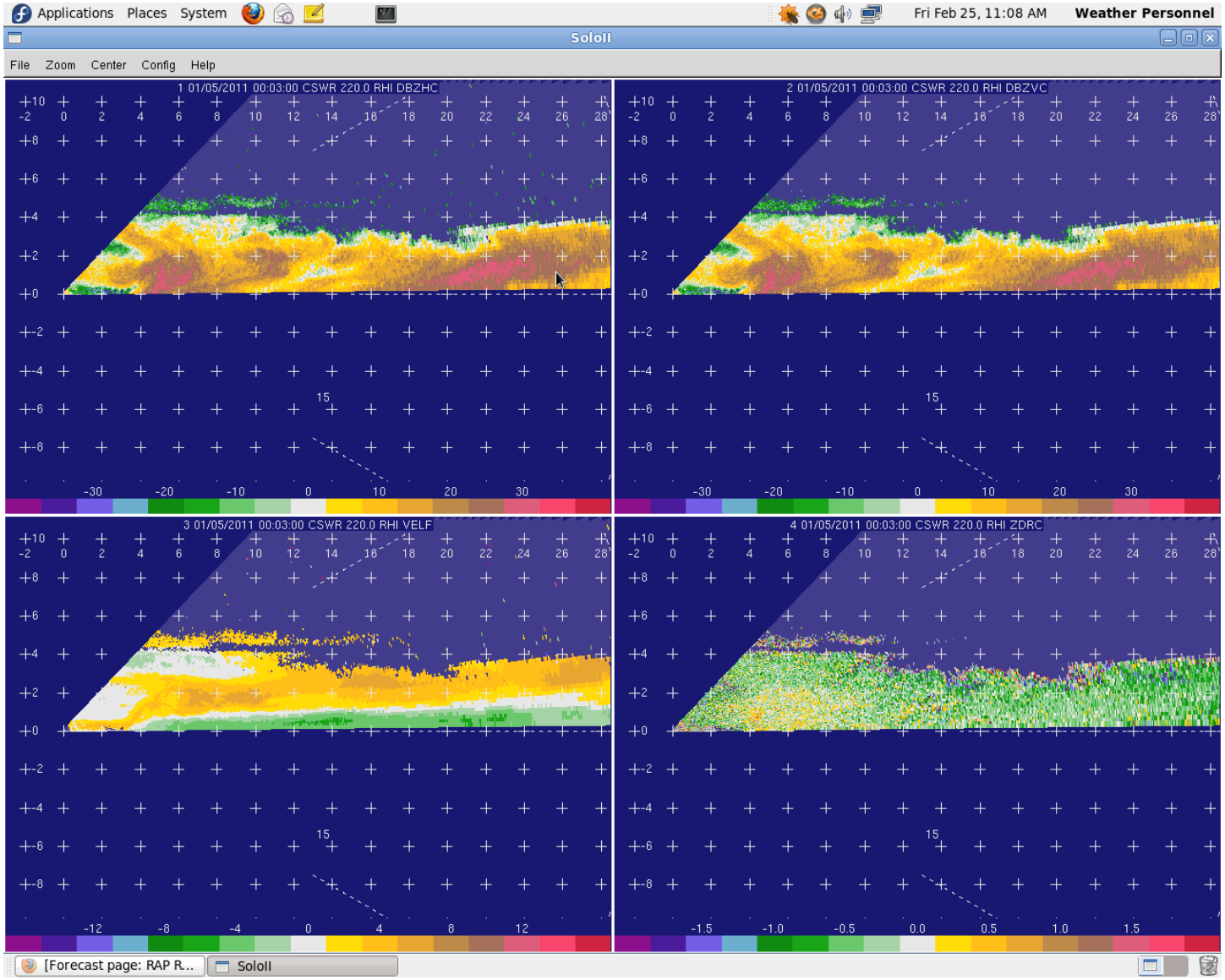


Vortices cont.



Initial Results II: RHIs of Reflectivity, multi-layer flow, and dual-pol obs.

Across band



Discussion

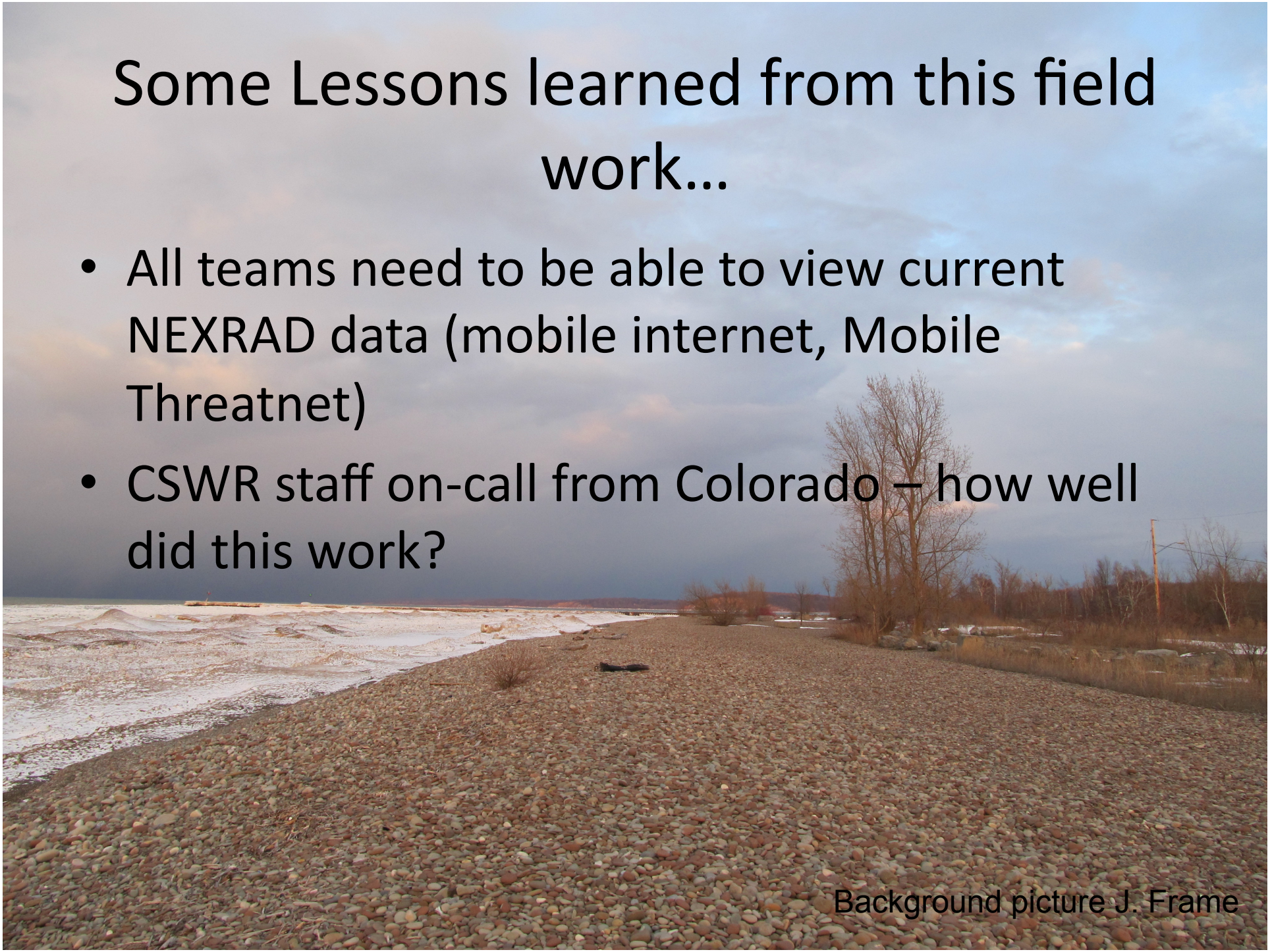
- Pease et al. (1988) and Grim et al. (2004) observed and modeled vortices within lake-effect bands over Lake Michigan.
- LLAP bands form with significant prevailing winds; different conditions than during the above studies.
- Shearing instability (smaller vortices along shear line)? Tilting of low-level shear (hypothesis for larger vortex)? Mesocyclone (look for pressure drops as passed overhead)?
- Land breeze effects?
- Waterspouts/steam devils?
- Unprecedented detail with the DOW!

Conclusions and Future Work

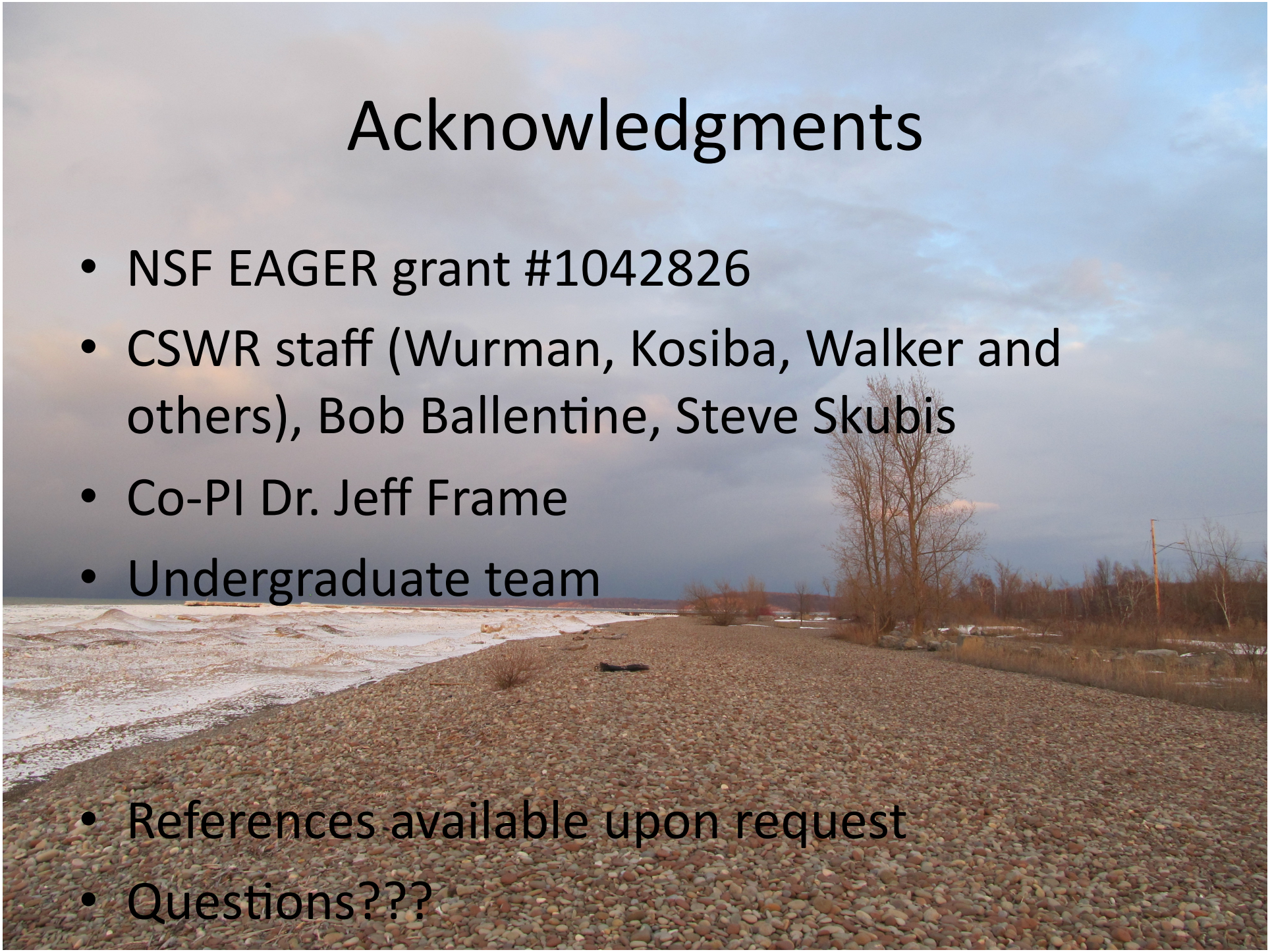
- Very successful field campaign with undergraduates! Hopefully our results will spur future field work in this area (OWLES)
- Collected high resolution radar data, probe, and rawinsonde data (and tornado pod data for one case)
  - Vortices, dual-pol analysis to understand precipitation processes in bands (long-term goal: better diagnose snowfall rates using radar data)
- Summer analysis with four undergraduate students; develop manuscript for publication and submit Fall 2011

Some Lessons learned from this field work…

- All teams need to be able to view current NEXRAD data (mobile internet, Mobile Threatnet)
- CSWR staff on-call from Colorado – how well did this work?



Background picture J. Frame



Acknowledgments

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- Co-PI Dr. Jeff Frame
- Undergraduate team

- References available upon request
- Questions???