OWLeS Orographic (O_2)

Adventures on the Tug Hill Plateau

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Great Salt Lake/Wasatch Range

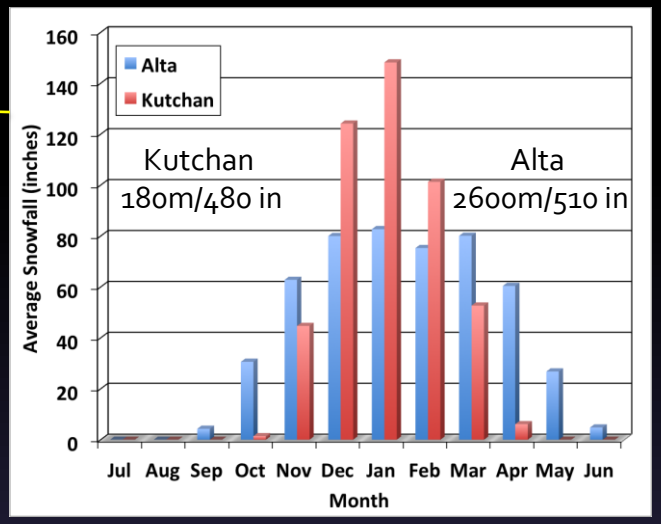
Lake Ontario/Tug Hill Plateau

Questions

- How does the interplay between environmental (i.e., atmospheric, lake, and land cover) conditions, cloud processes, lake shape and size, and terrain scale and geometry affect orographic precipitation enhancement during lake-effect storms?

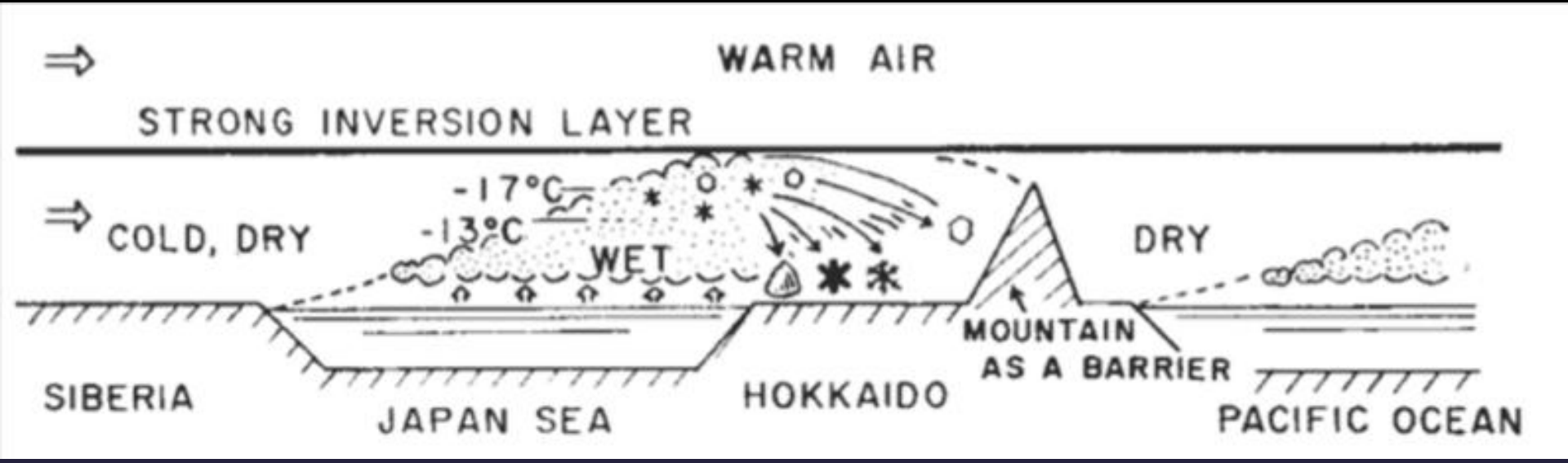
- Under what conditions does orography modify the morphology of lake-effect systems and the generation, distribution, and intensity of precipitation over lowland areas?

Japan (Big "Lake"/Big Mountains)



Steenburgh (2014), JMA, Wikipedia User Uryah

Enhancement Variations



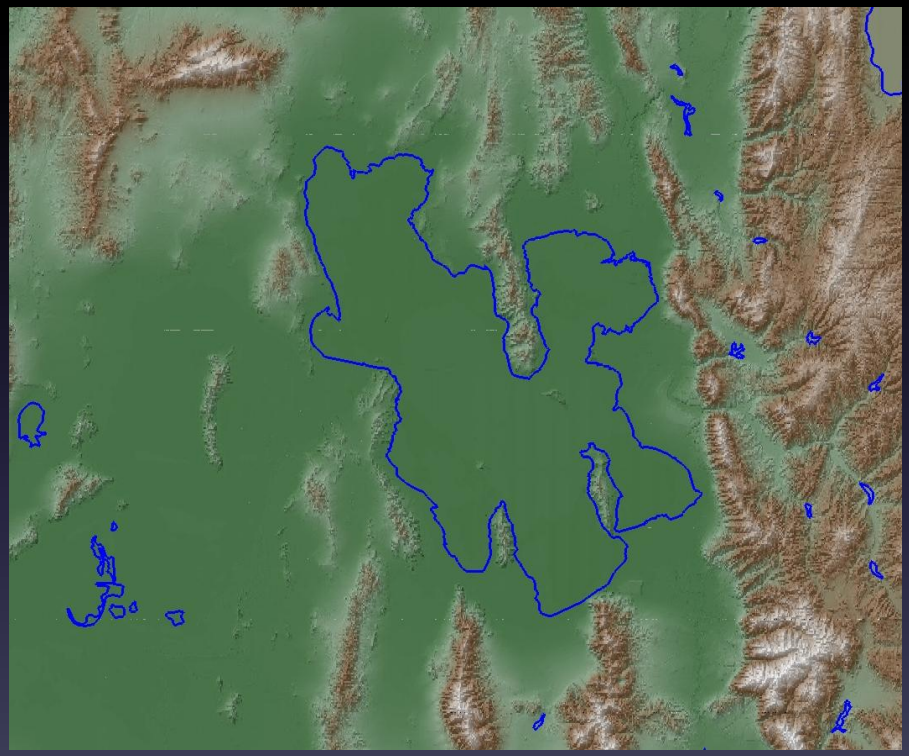
Schematic of Satoyuki Storm

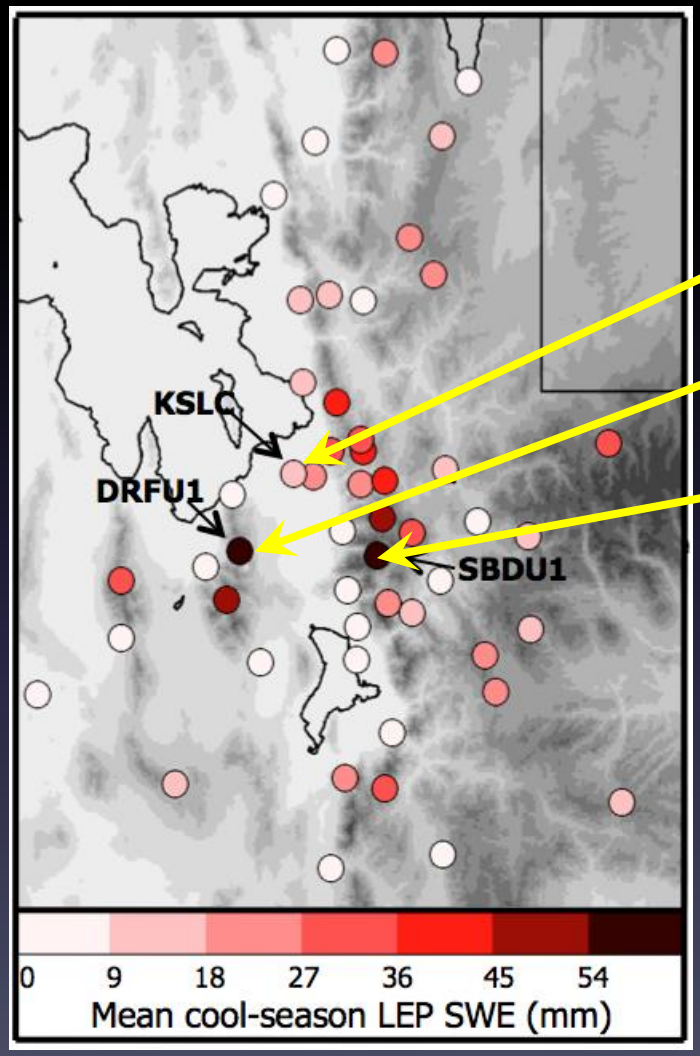
Satoyuki (lowland snowfall) – Heavier snow in lowland areas

Yamayuki (mountain snowfall) – Heavier snow in mountain areas due to orographic lift

Magono et al. (1966)

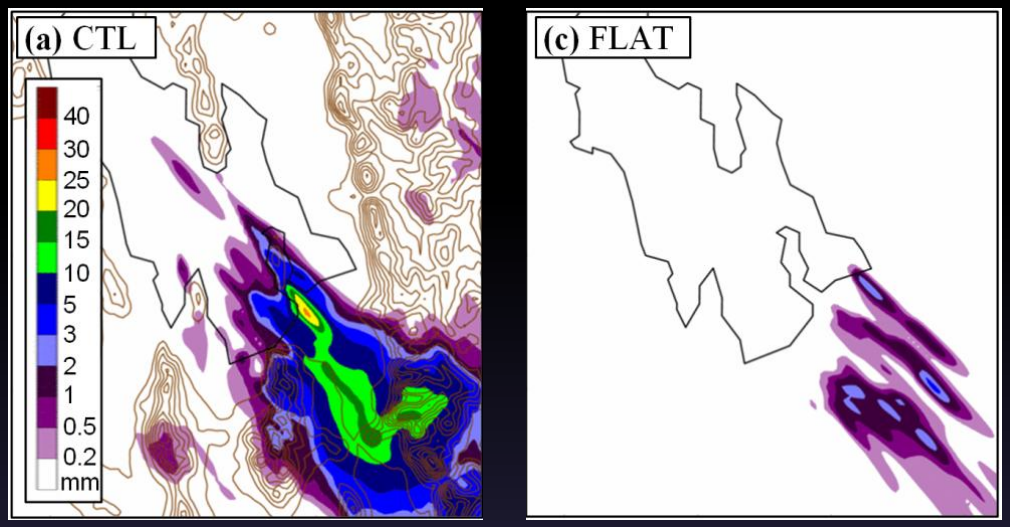
Utah (Little Lake/Big Mountains)



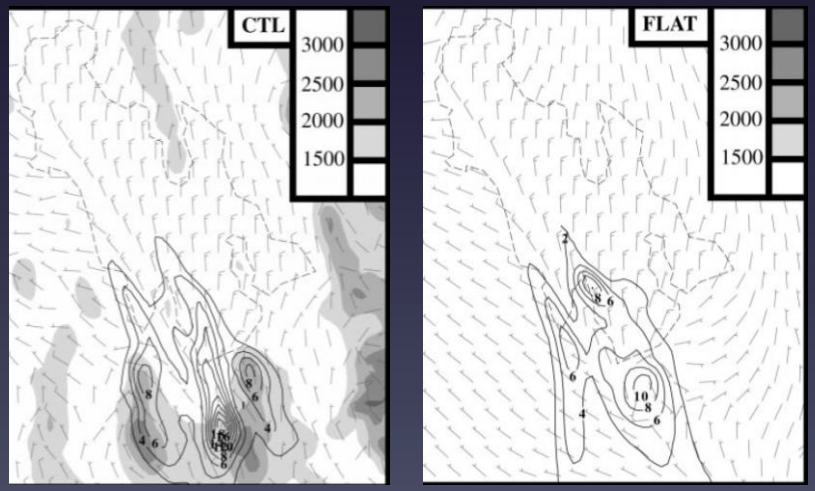


Yeager et al. (2013)

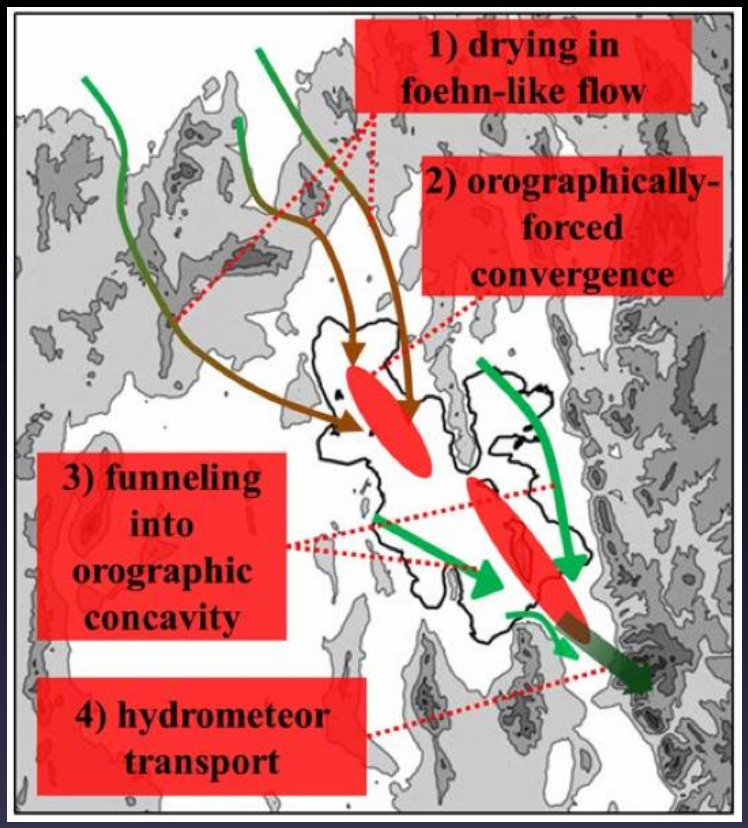
Complex Enhancement Variations



Lake–Mountain Synergy (27 Oct 2010)

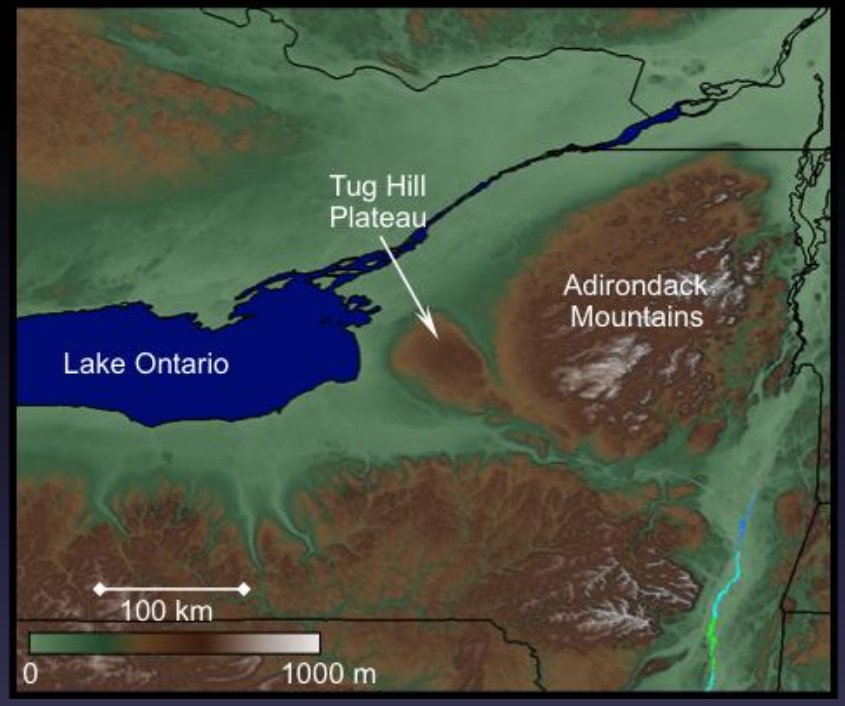


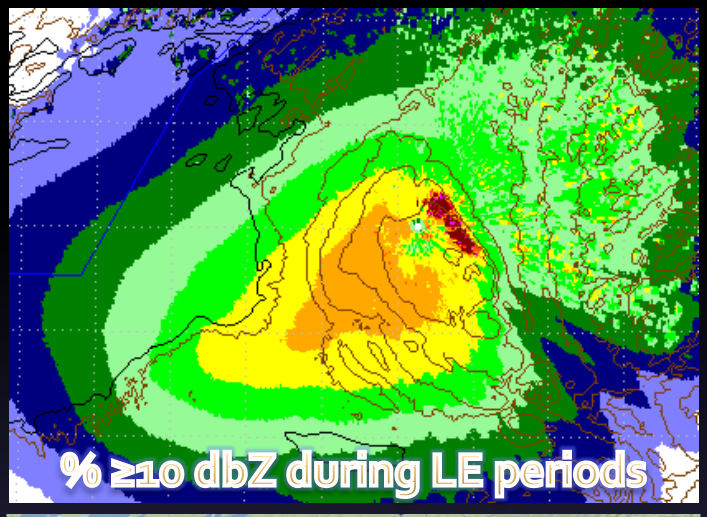
Lake Dominated w/ Enhancement (7 Dec 1998)

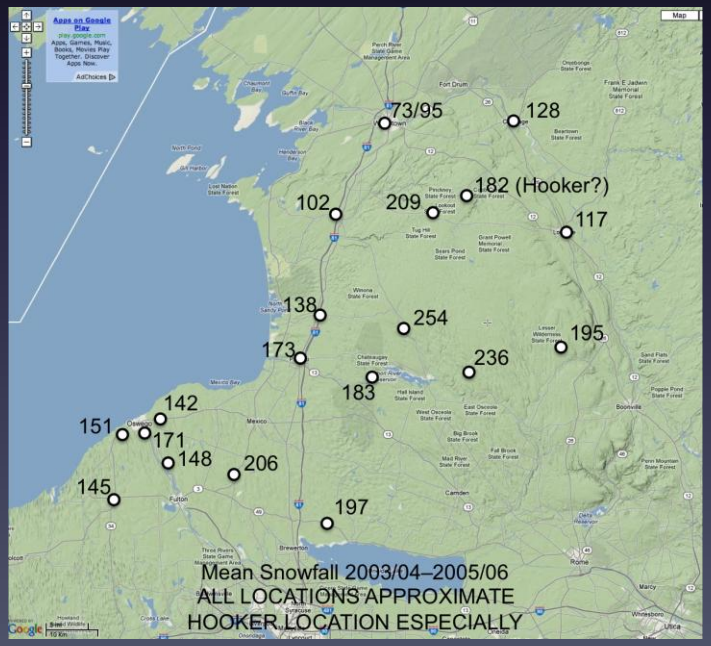


Onton and Steenburgh (2001), Alcott and Steenburgh (2013)

NY ("Big" Lake/Little Mountains)







Veals, unpublished

Big Enhancement Storm

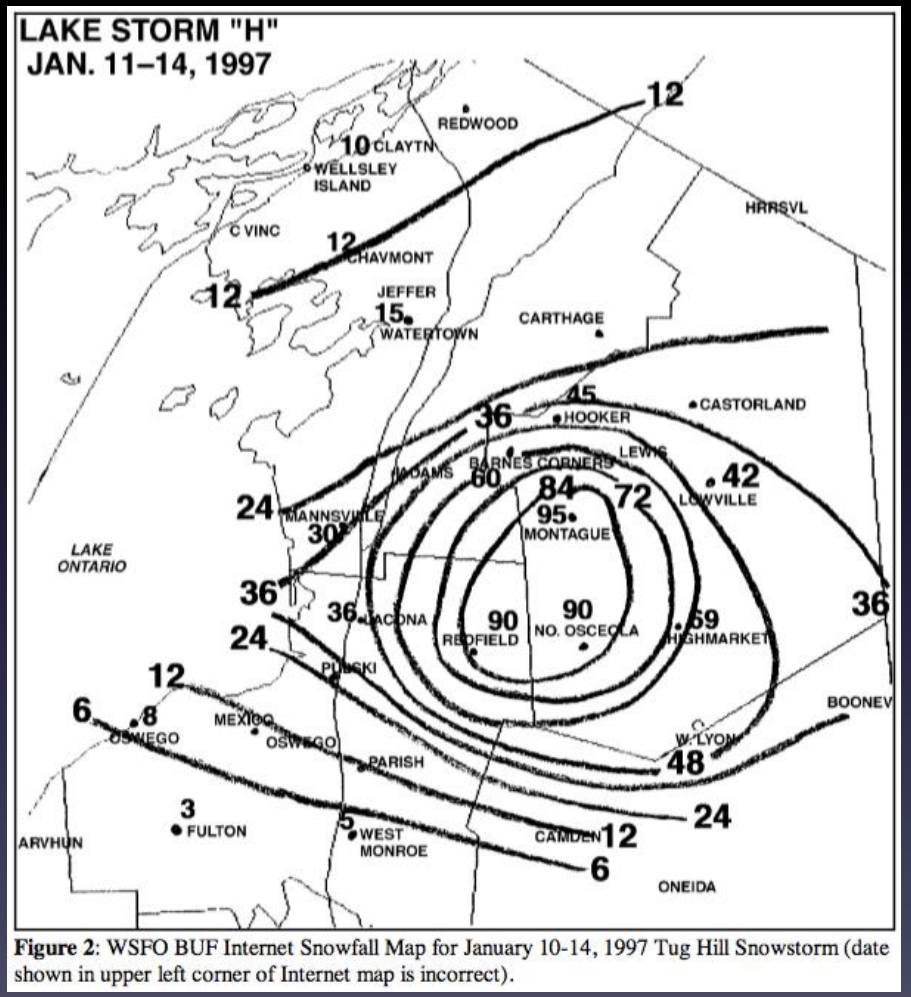
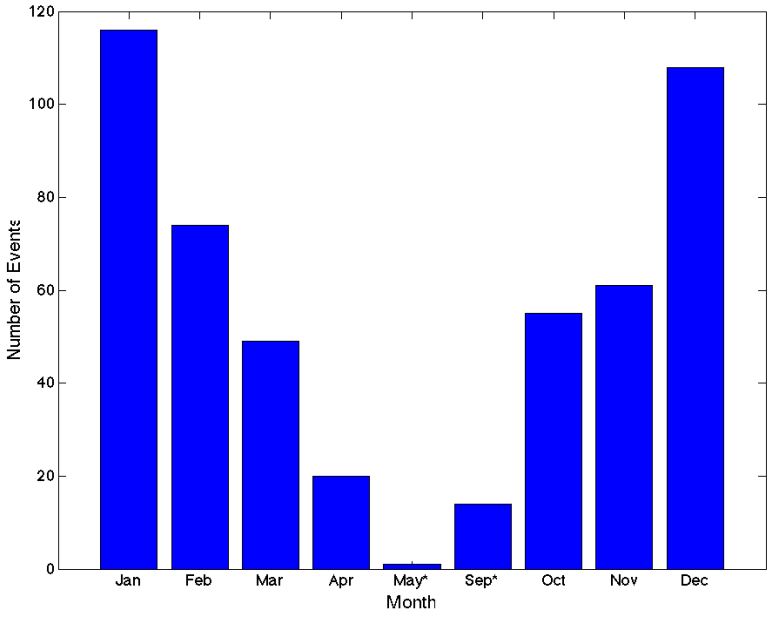


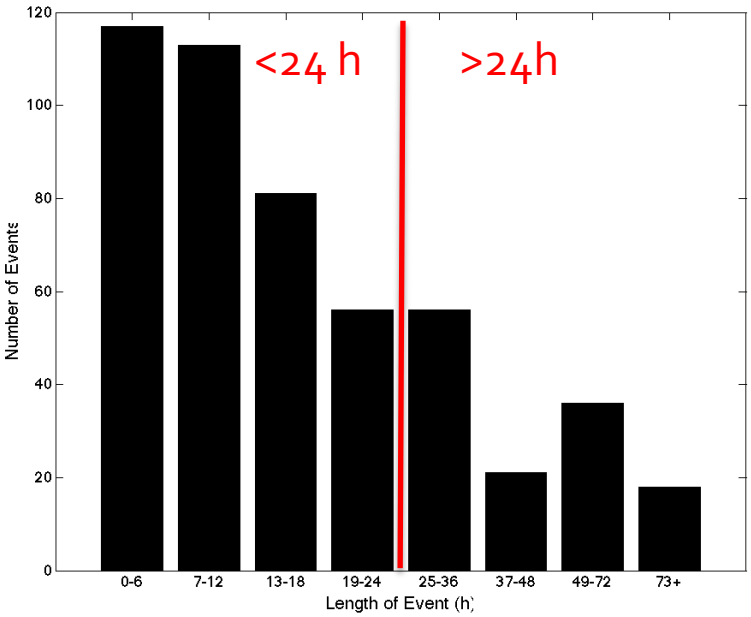
Figure 2: WSFO BUF Internet Snowfall Map for January 10-14, 1997 Tug Hill Snowstorm (date shown in upper left corner of Internet map is incorrect).

NOAA (1997), WSFO Buffalo

Climatology



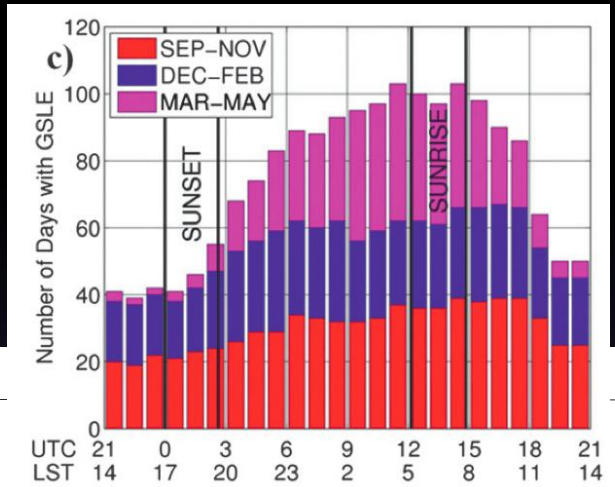
Monthly Frequency

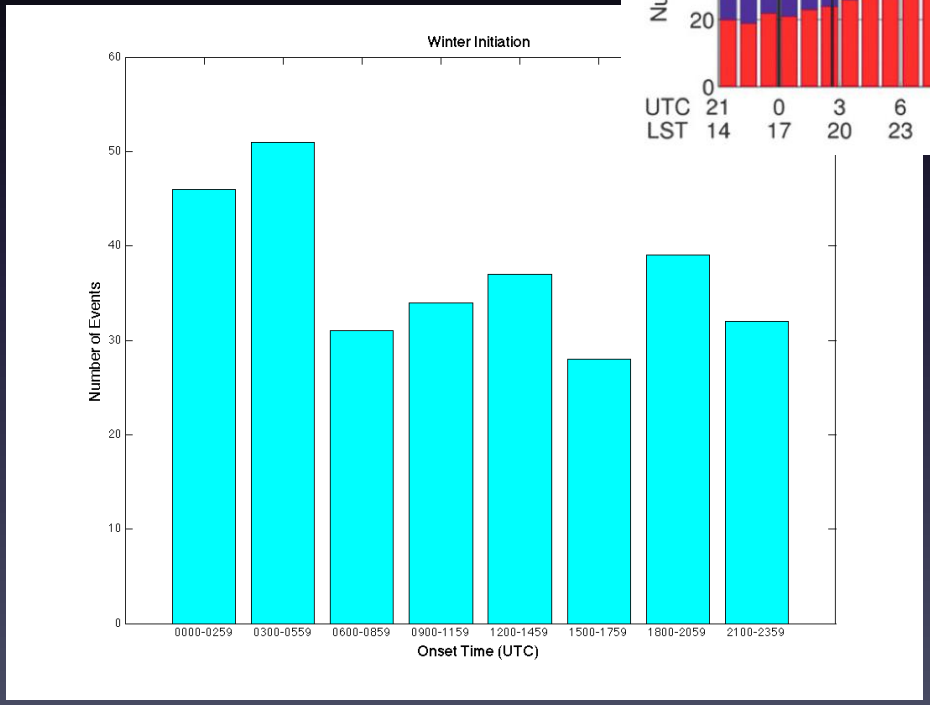


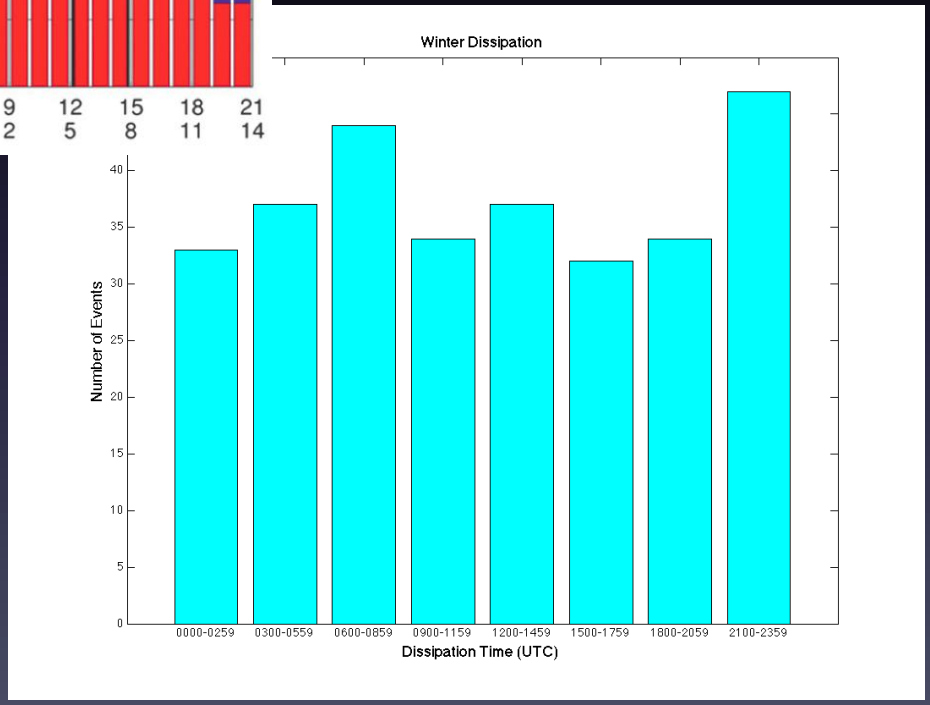
Duration

Veals, unpublished

Climatology





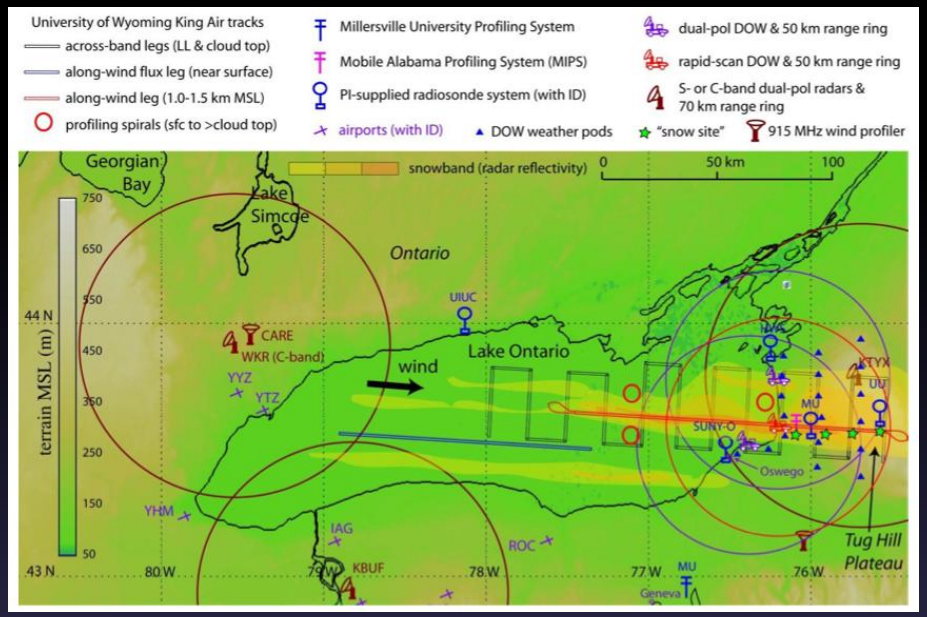


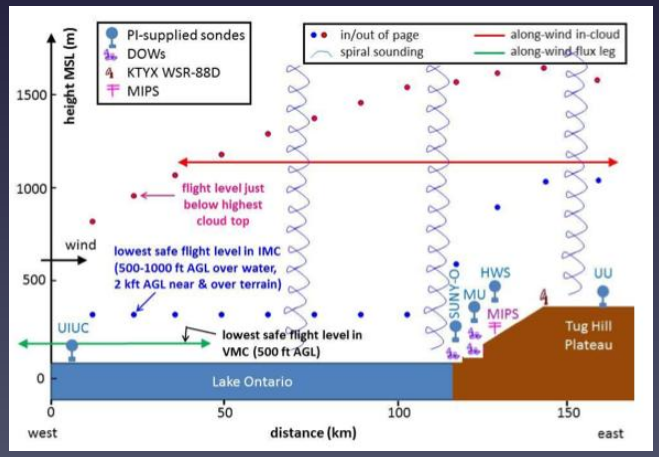
Onset (UTC)

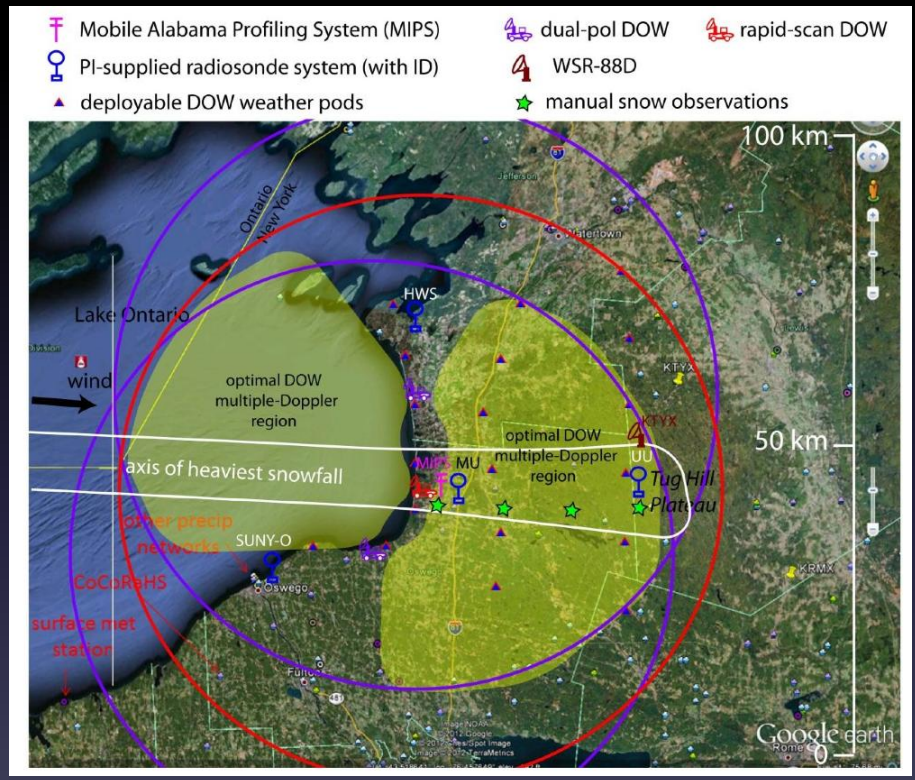
Dissapation

Alcott et al. (2012); Veals, unpublished

Observing Plans

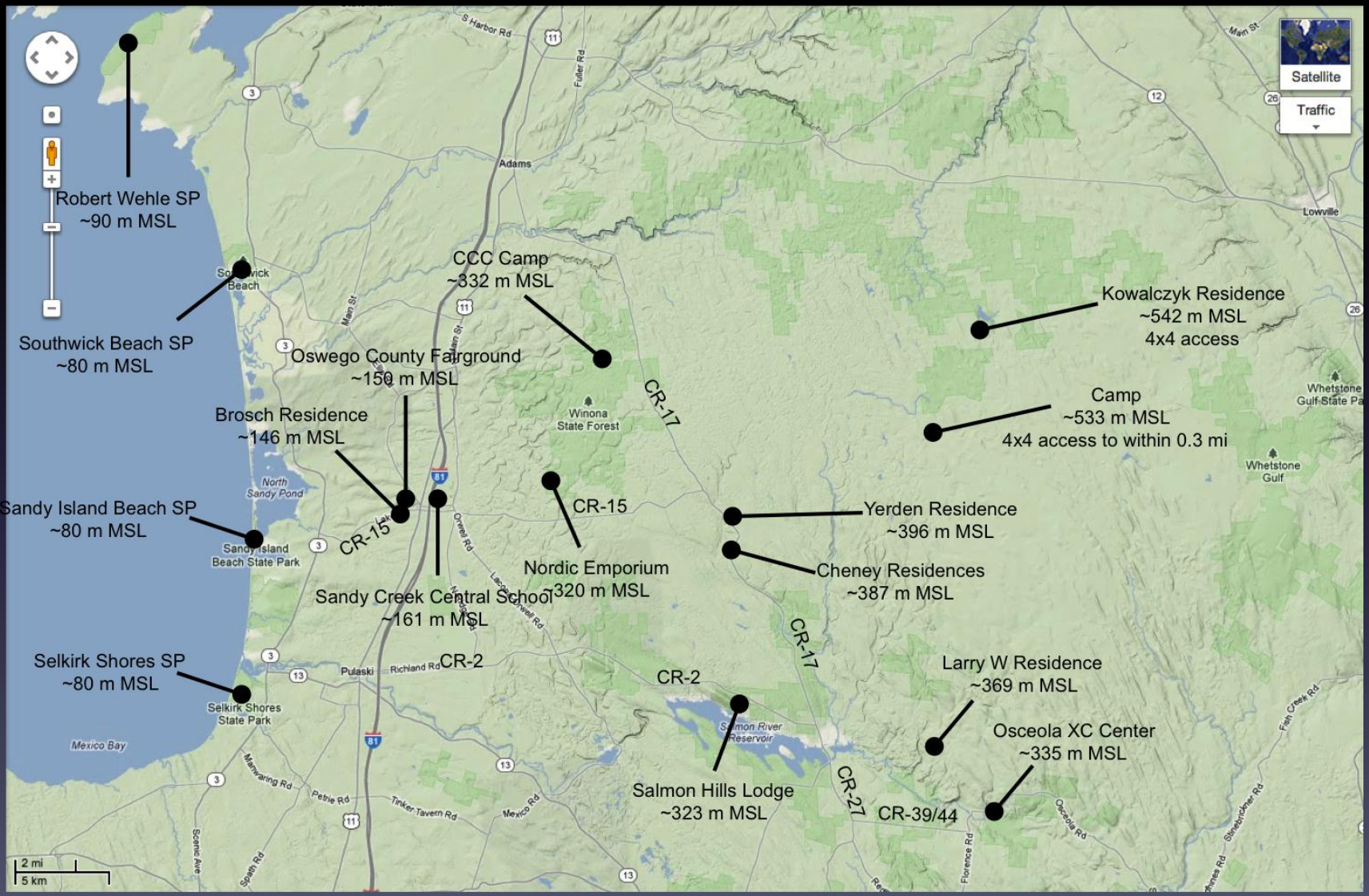




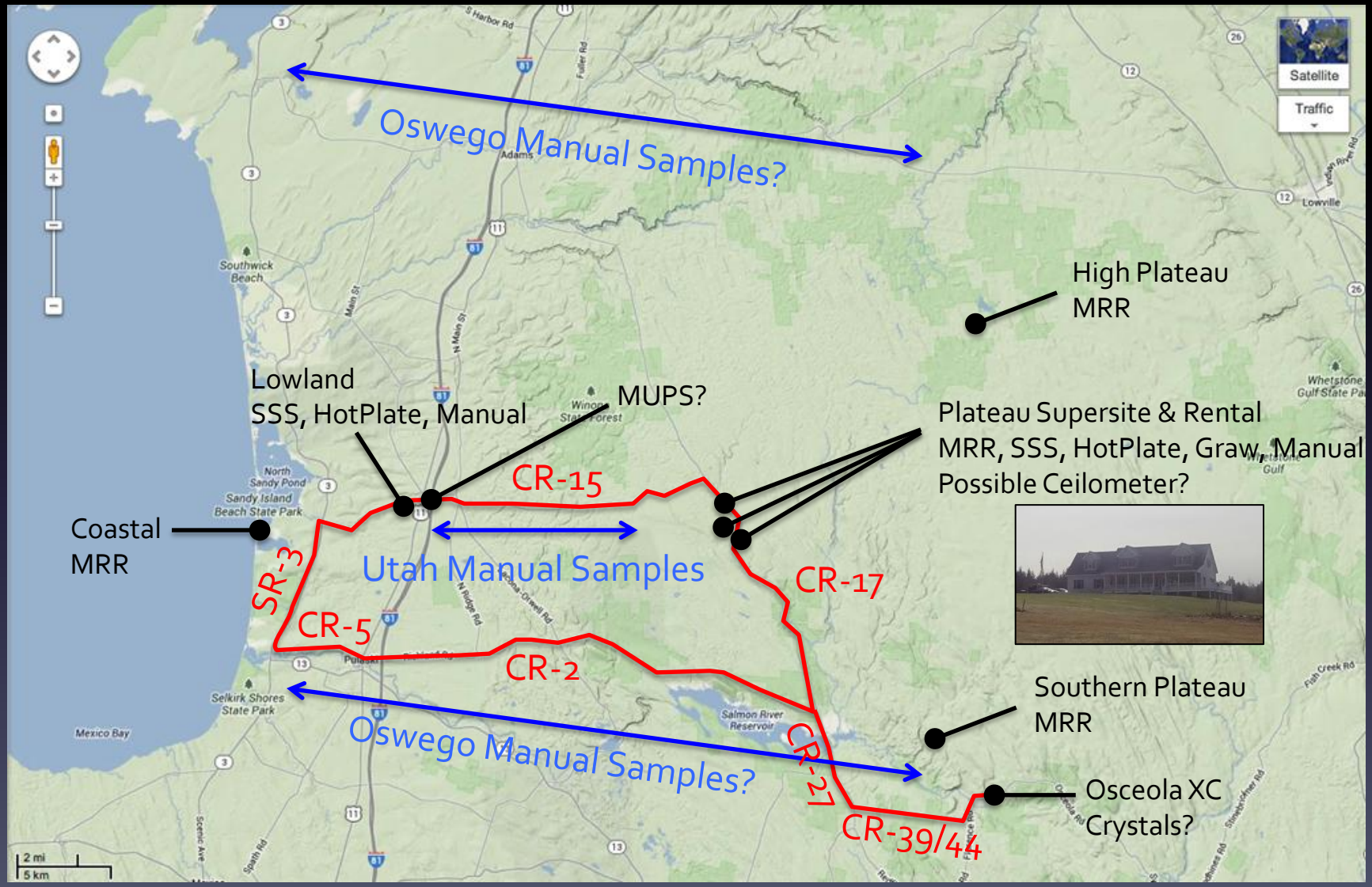


Kristovich and Geerts (2012)

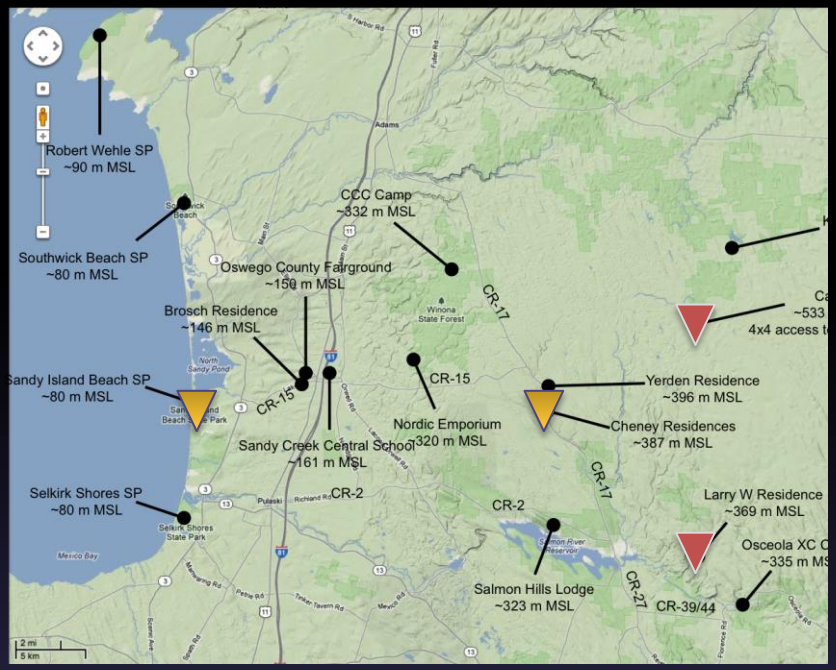
Observing Plans

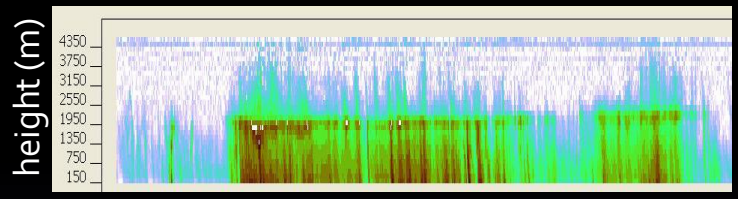


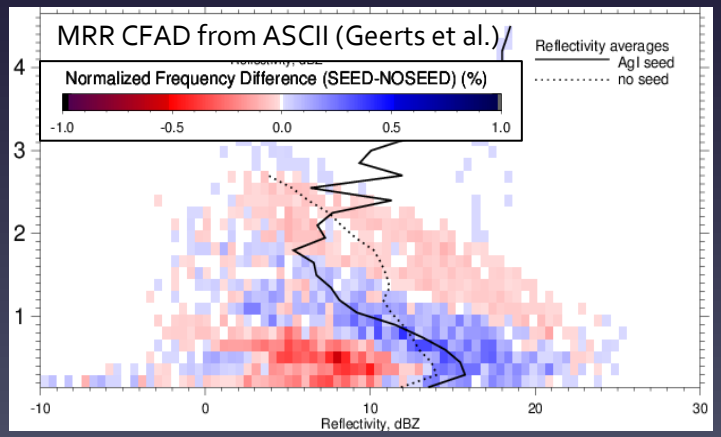
Observing Plans



MRR (Climo and IOPs)







Reflectivity (dBZ)

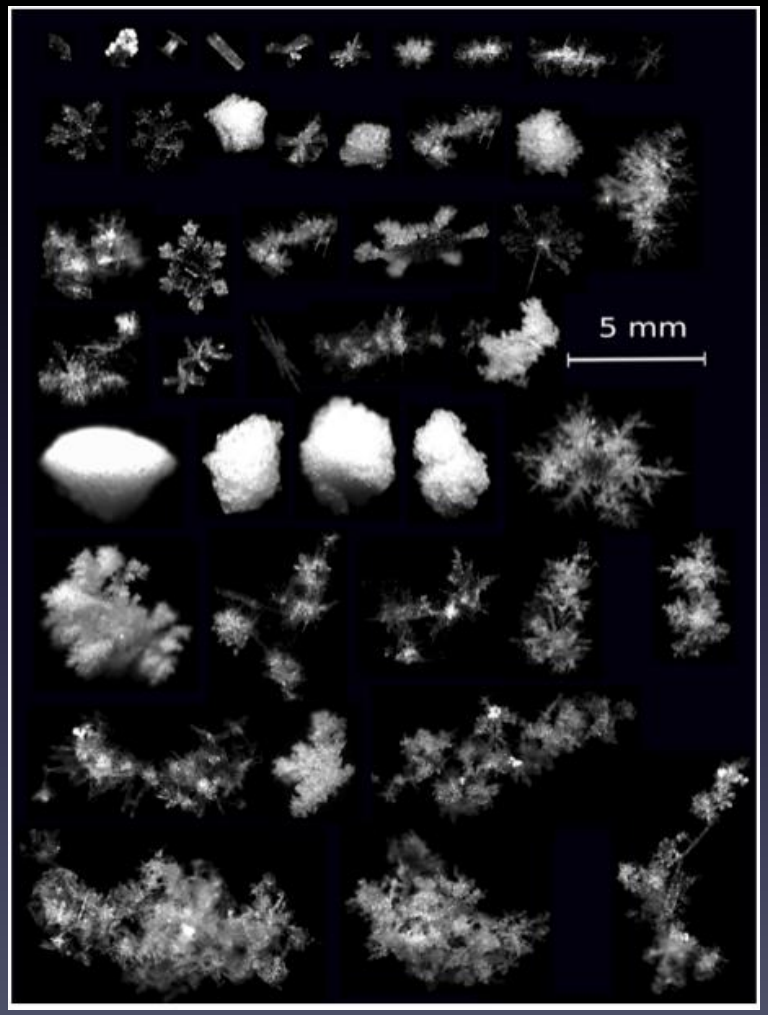
- 24 GHz, FM-CW profiling, Doppler radar
  - 31 range gates
  - Δt =10 s
- 4 MRR's (2-UAlbany, 2-UUtah)
- Useful for:
  - High vertical and temporal resolution structures (dBZ & velocity)
  - Identifying orographic effects by comparing sites (e.g., via CFADS)
- Deployment
  - Intensive: Oct-Jan (UAlbany & UUtah)
  - Extended : Oct-Mar …*& beyond?* (UAlbany)

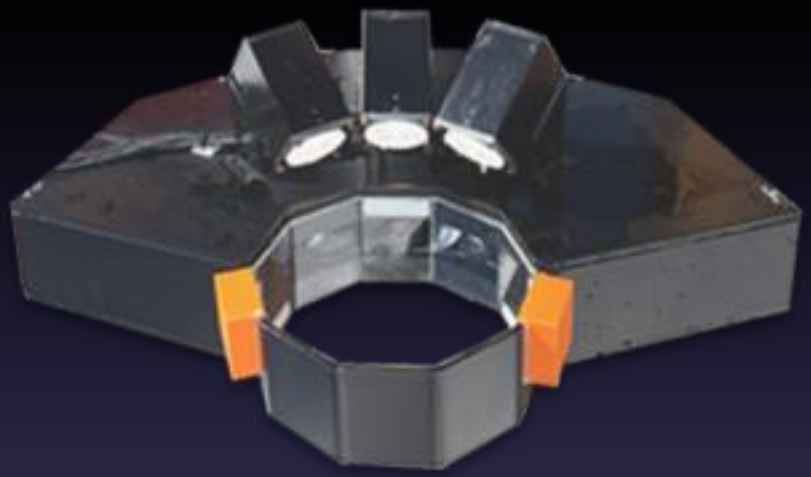
Snow Study Stations/Manual Obs

+ Crystal Photos

NCAR, Yes Inc., MesoWest, J. Steenburgh

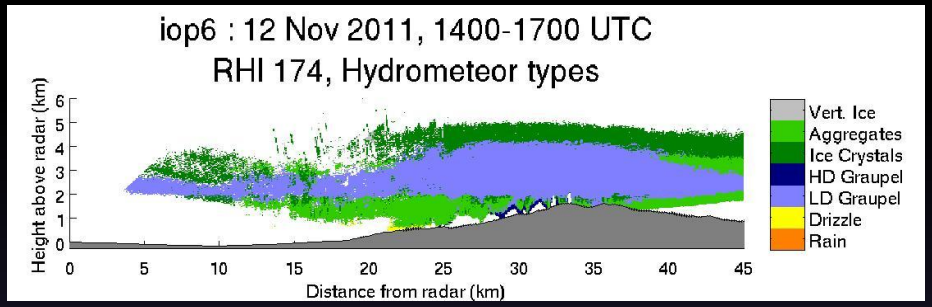
MASC

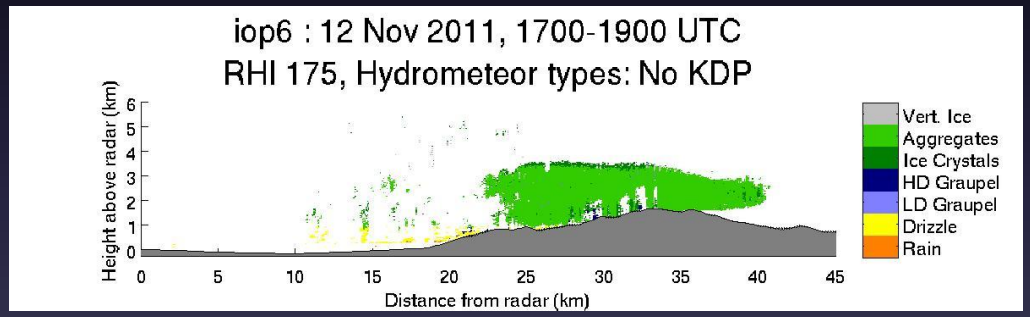


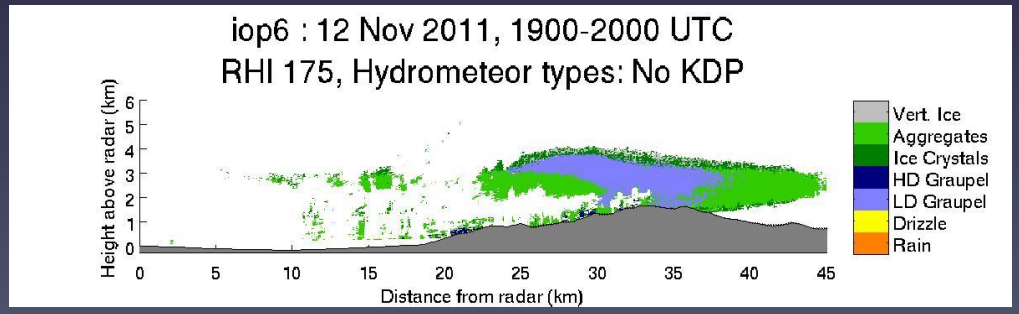


Garrett et al. (2012); Fallgatter Technologies

Old Hyvis


iop6 : 12 Nov 2011, 1400-1700 UTC
RHI 174, Hydrometeor types
Height above radar (km)
Distance from radar (km)
Vert. Ice
Aggregates
Ice Crystals
HD Graupel
LD Graupel
Drizzle
Rain


iop6 : 12 Nov 2011, 1700-1900 UTC
RHI 175, Hydrometeor types: No KDP
Height above radar (km)
Distance from radar (km)
Vert. Ice
Aggregates
Ice Crystals
HD Graupel
LD Graupel
Drizzle
Rain


iop6 : 12 Nov 2011, 1900-2000 UTC
RHI 175, Hydrometeor types: No KDP
Height above radar (km)
Distance from radar (km)
Vert. Ice
Aggregates
Ice Crystals
HD Graupel
LD Graupel
Drizzle
Rain

Synergy with Others

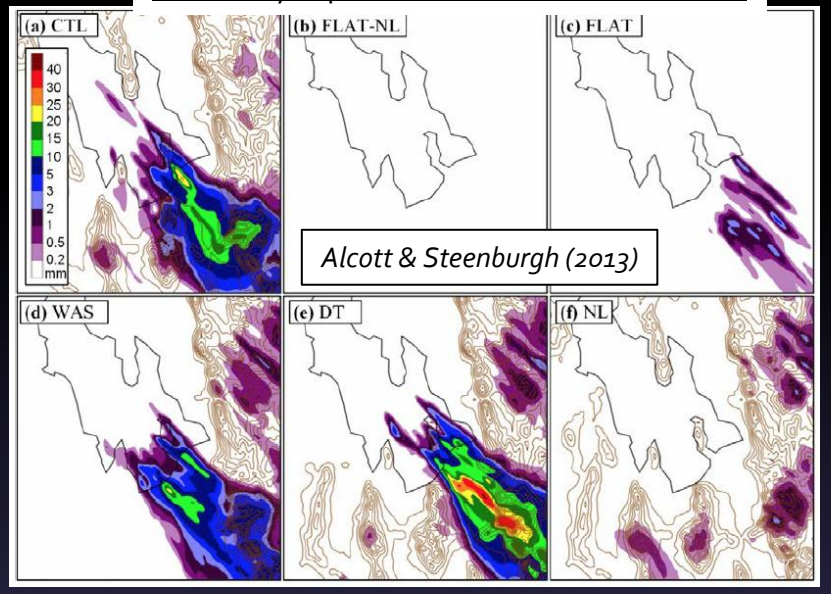
- UWKA
  - Cloud radar/lidar from lake to plateau over/near ground sites
  - Over lake and over plateau spirals
- MIPS
  - Profiler for near band upstream flow, hotplate for additional precip, other ground-based remote sensing (various applications)
- MUPS
  - Soundings for wind/thermodynamic profiles to compare with those over plateau for orographic lifting of CAP and mixed layer
- DOW
  - Yup
- Oswego
  - Manual sampling
- Wyoming
  - Hotplate and WXT520 station (if deployed for long axis bands)
- Others
  - We are happy scavengers

Numerical Modeling

Goals:
- Model & param. evaluation
- Detailed diagnostics
- Sensitivity experiments
- Identification of control parameters

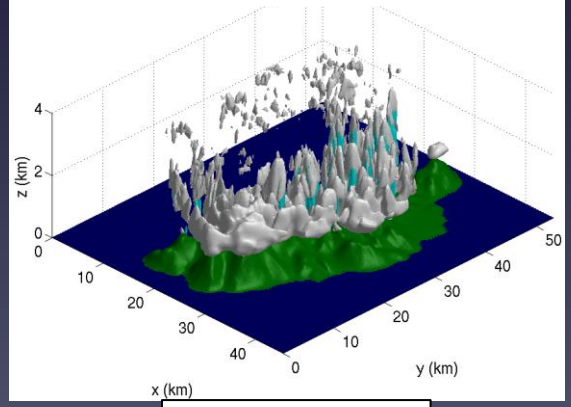
Tools:
- Realistic simulations of IOP cases (WRF)
- Multi-month realistic simulations (WRF)
- Idealized mesoscale simulations (WRF or Bryan model)
- Idealized LES (WRF or Bryan model)

Sensitivity experiments with Salt-Lake-Effect



Alcott & Steenburgh (2013)

LES of orog. convection over Dominica



Minder et al. (2013)

Questions and Discussion