OWLeS: Lake Ontario Long Fetch Systems

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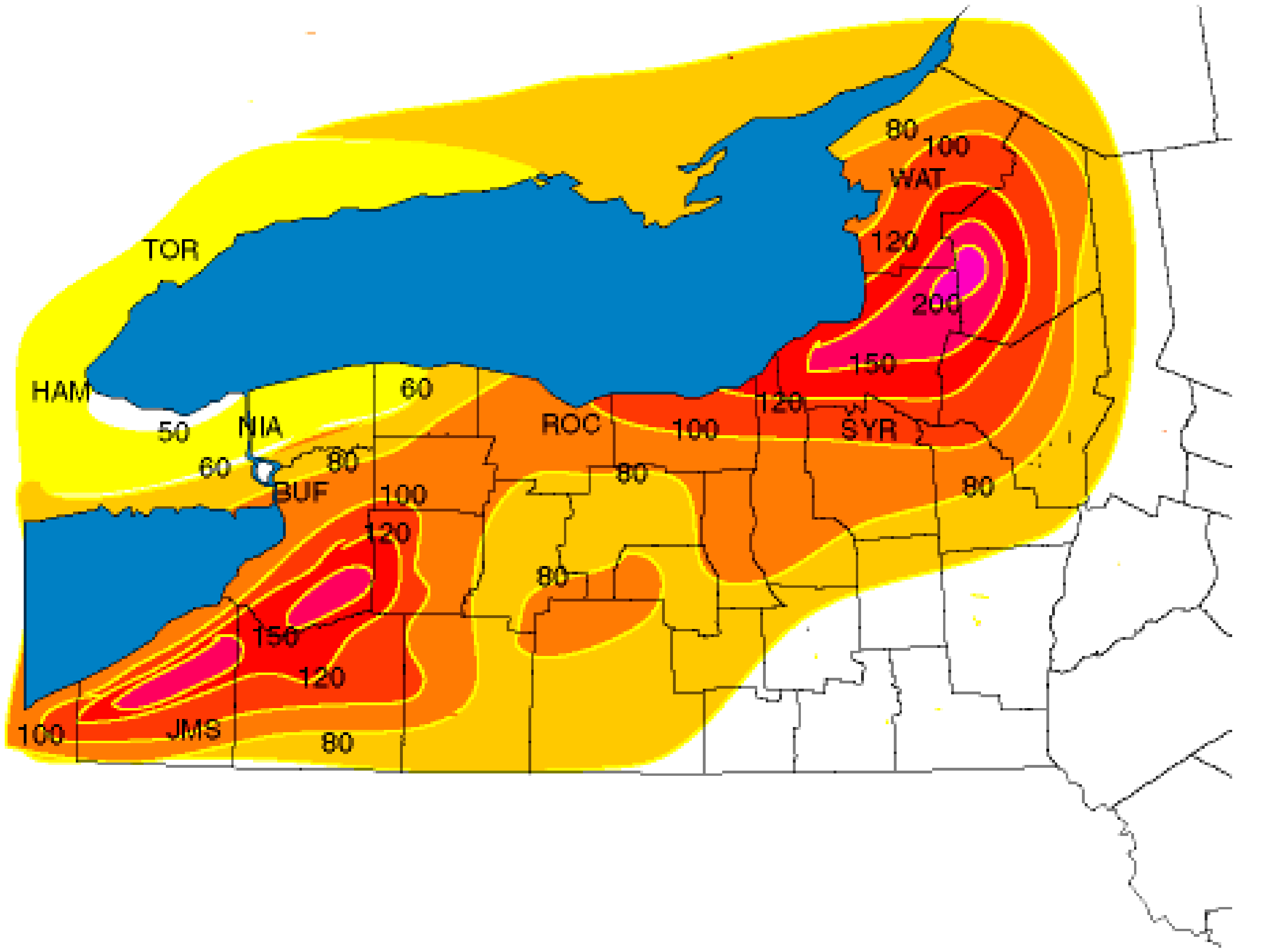
Photo: J. Keeler

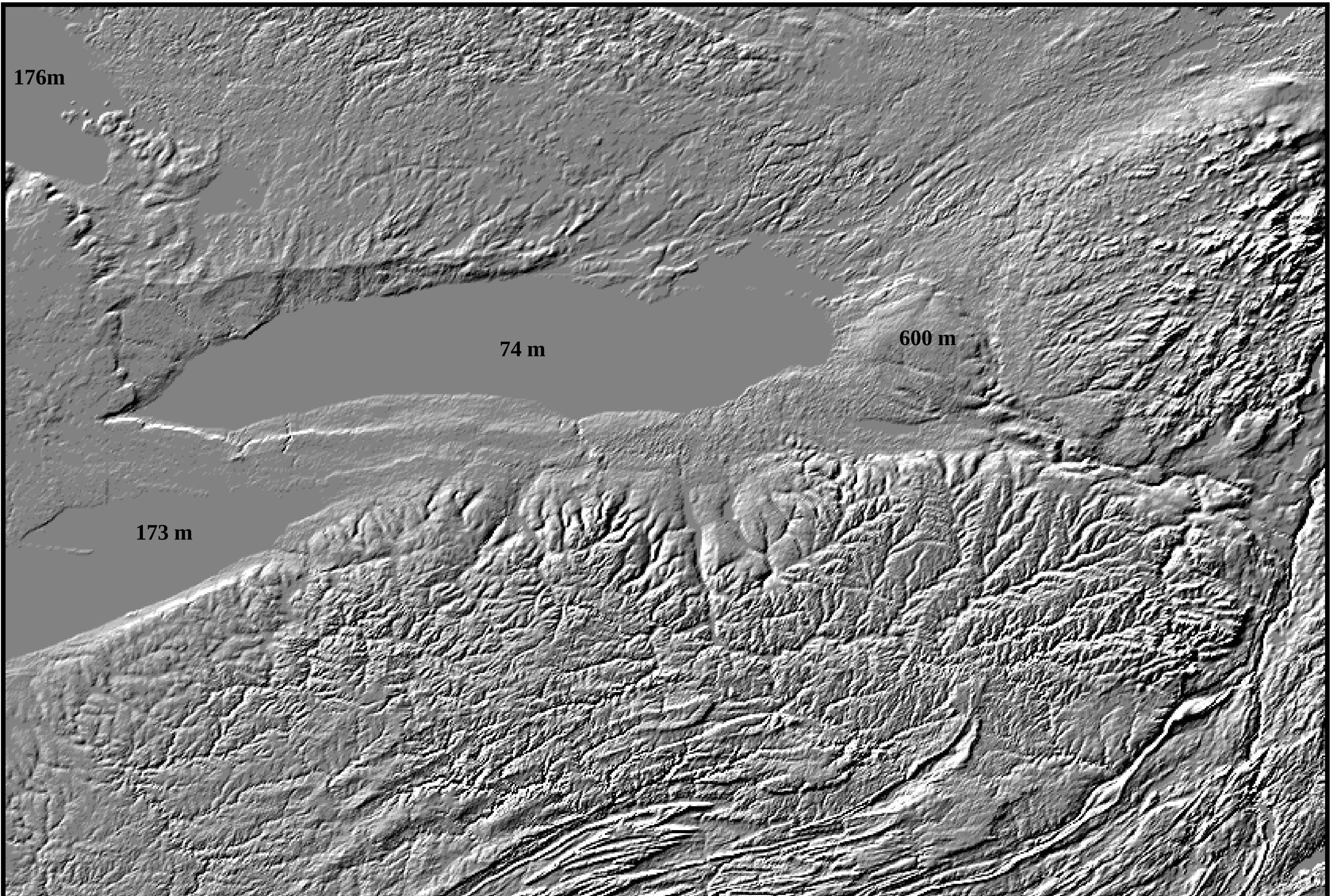
Year: 1920s: Looking North on West First Street, Oswego, NY

Courtesy of Bill Gregway

AVERAGE
SEASON SNOWFALL



http://www.erh.noaa.gov/er/buf/lakeffect/snowseason.html http://edcdaac.usgs.gov/gtopo30/gtopo30.asp



Oswego, NY, Snowfall 1884 - 2008

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

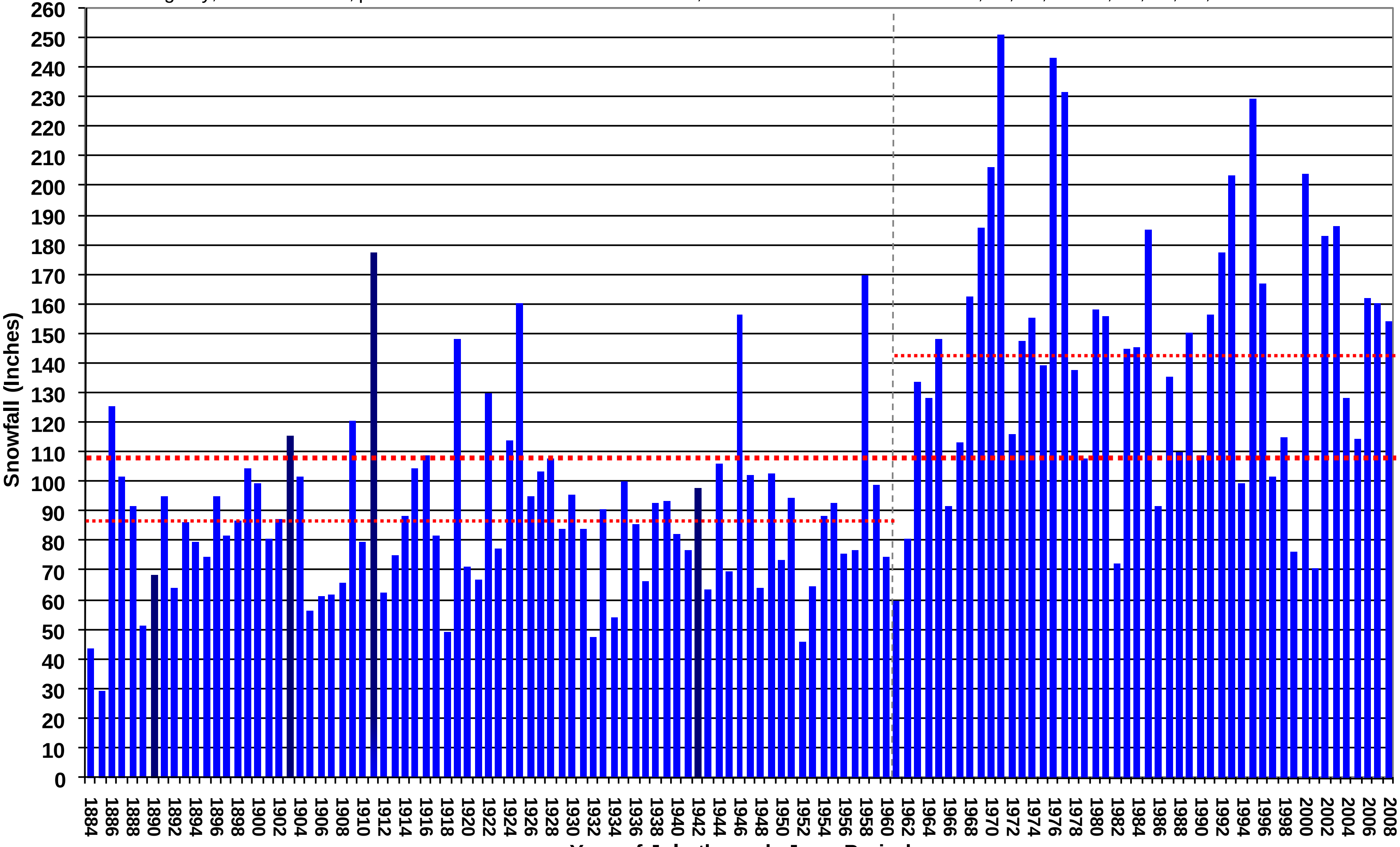
1960-2008
Mean: **144.2** "

1884-1960
Mean: 88.5

43 28'N 76 30'W

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

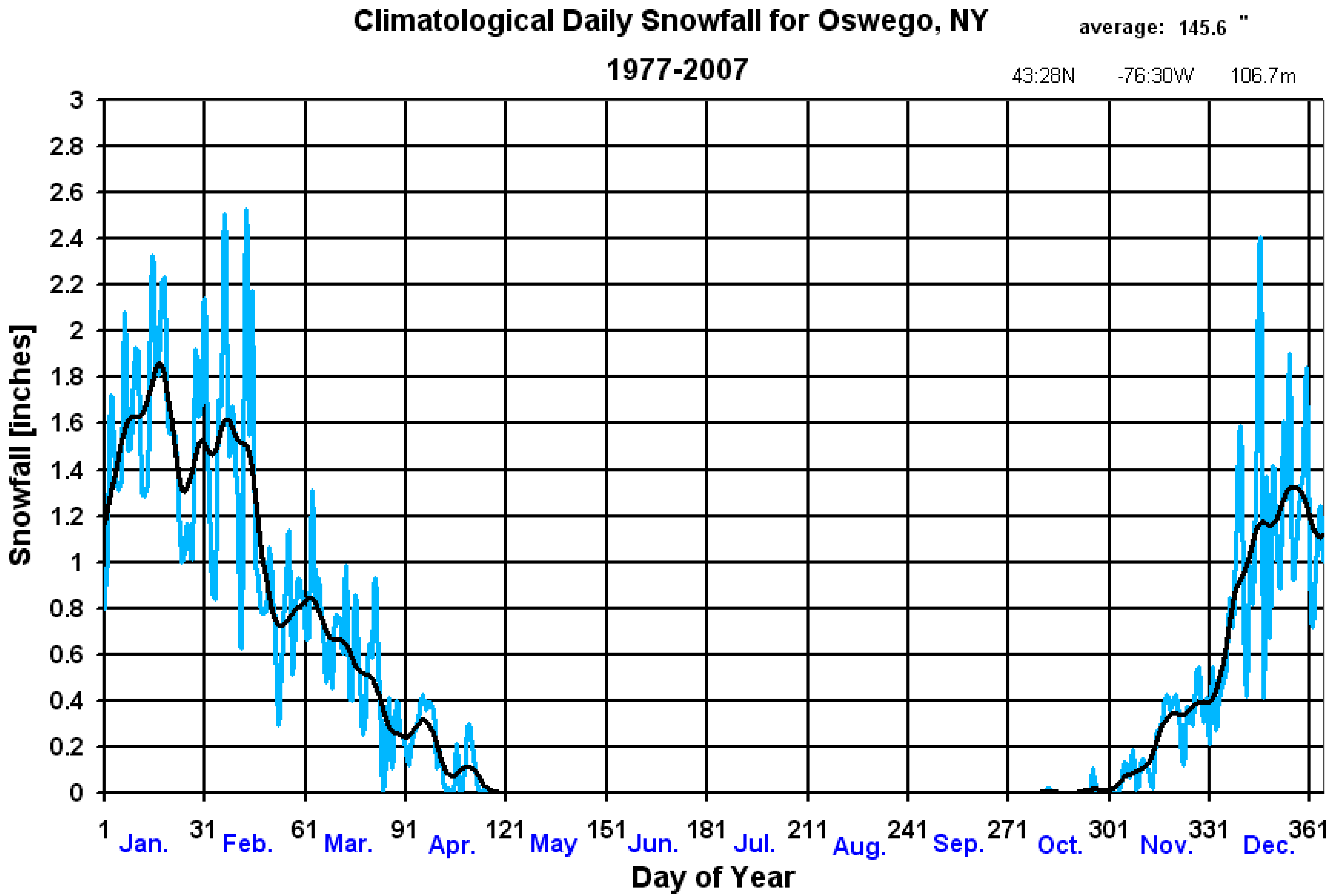
Bill Gregway, NWS observer, provided data for 1884-1925 and 2003, and corrections added for 1932, 39, 44, 51. 52, 54, 66, 67, 68.



Basically a winter season snowfall: June to July

Ex. 2006 snowfall → June 2006 to July 2007

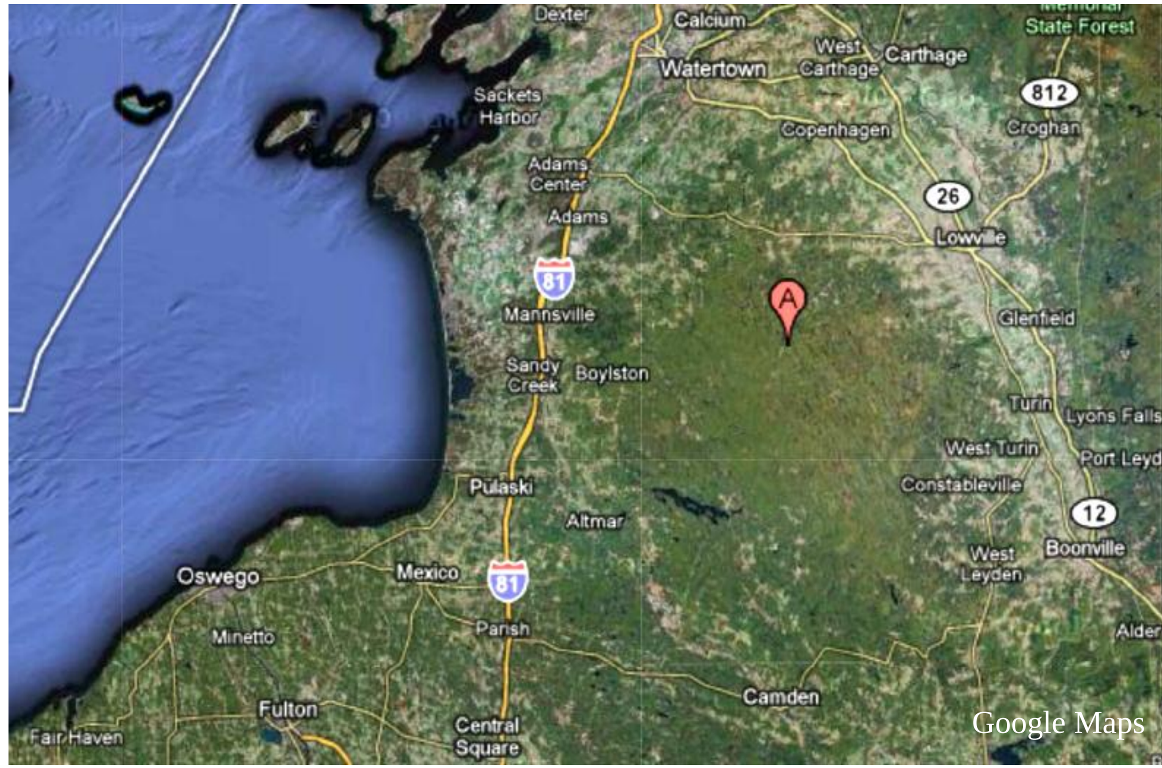
Courtesy: S. Skubis (and next 2 slides)


Climatological Daily Snowfall for Oswego, NY
1977-2007
average: 145.6 "
43:28N -76:30W 106.7m
Snowfall [inches]
3
2.8
2.6
2.4
2.2
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
1 Jan.
31 Feb.
61 Mar.
91 Apr.
121 May
151 Jun.
181 Jul.
211 Aug.
241 Sep.
271 Oct.
301 Nov.
331 Dec.
361
Day of Year

Hooker, NY

Number of Days with Daily Snow Cover >= 5.0"

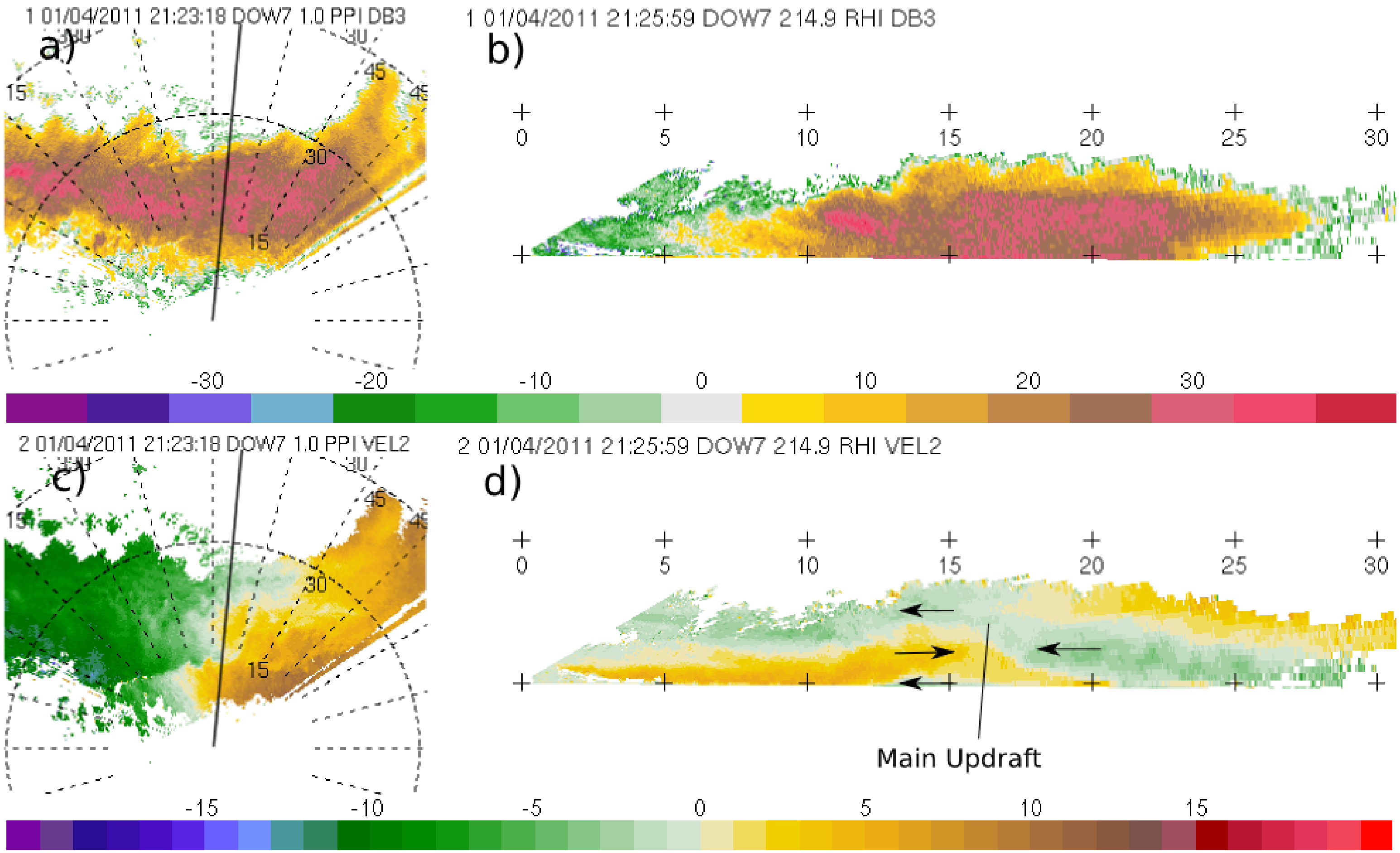
Month/Season	Mean
January	25.1
February	27
March	27
April	5.8
May	0
June	0
July	0
August	0
September	0
October	0
November	4.2
December	21.1
Winter	66
Spring	33.3
Summer	0
Autumn	7.2
Annual	100.5
August-Jul	115



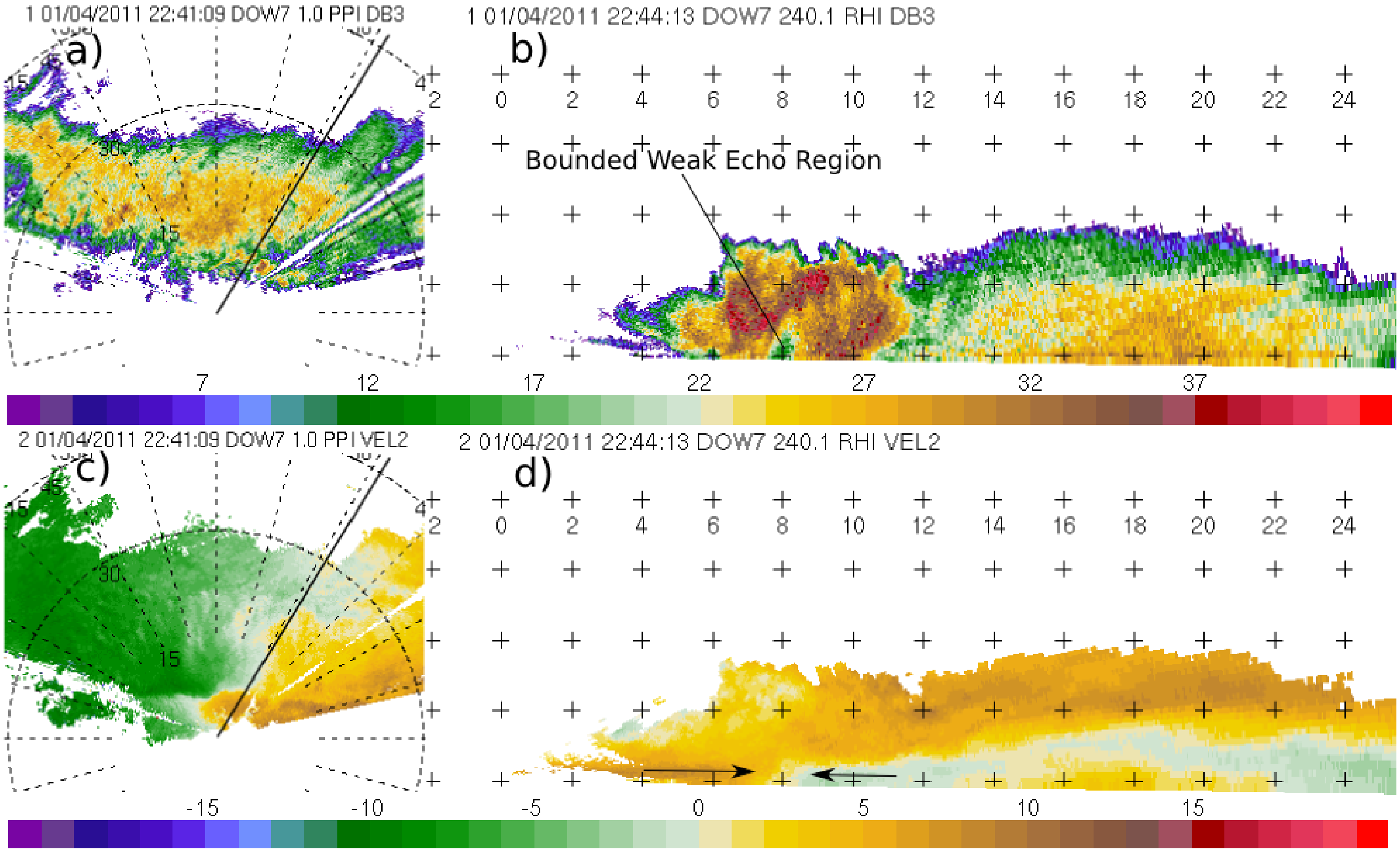
Annual Snow: **226"**

http://www.ncdc.noaa.gov/ussc/USSCAppController?action=options&state=30

Previous Research: LLAP 2010-11



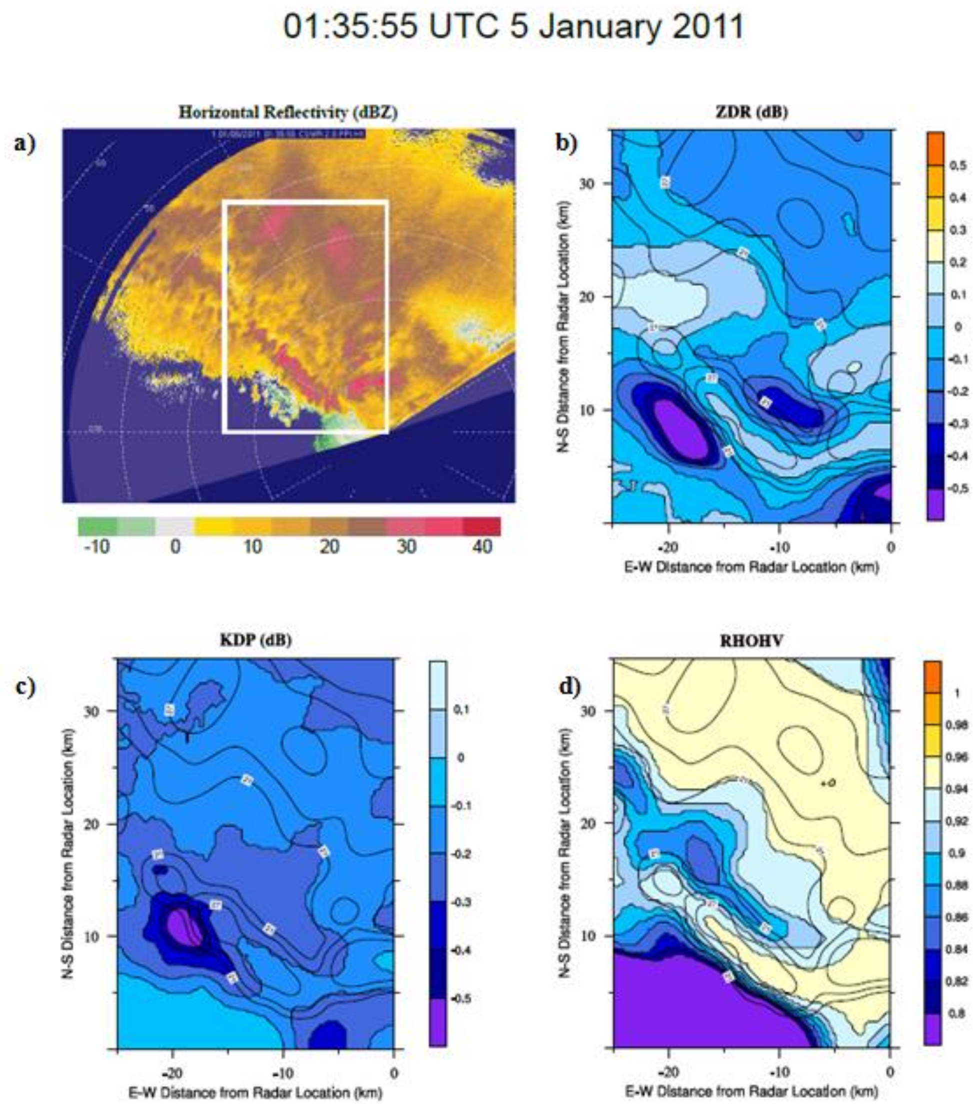
LLAP 2010-11 Cont.



LLAP 2010-11 Cont.

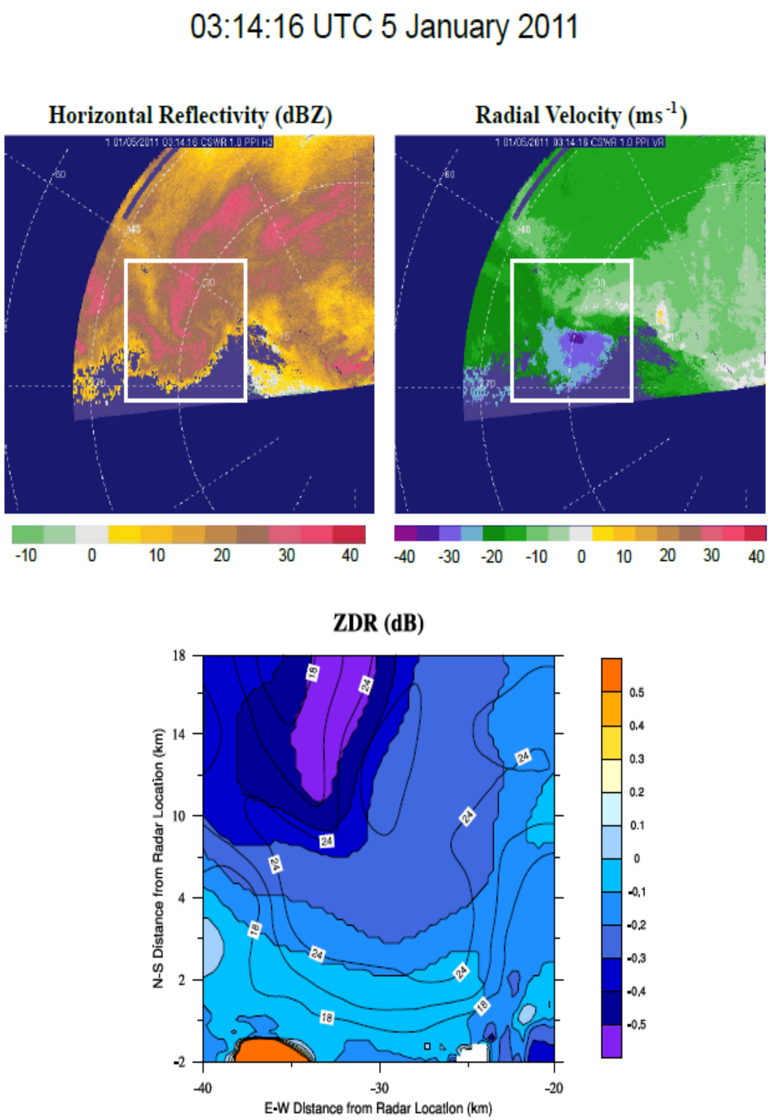
- Differential reflectivity (ZDR):
  - Pellets (nearly spherical hydrometeors) returned ZDR near zero (mean -0.04)
  - Aggregates returned slightly higher ZDR (mean 0.10)
  - Mixtures of aggregates and pellets fell in between these values
- Correlation coefficient (ρhv)
  - Pellets and mixtures returned mean values near 0.96
  - Aggregates returned higher values (mean 0.98)
  - Consistent with mixed phases of water necessary to form pellets
- KDP questionable

LLAP 2010-11: Convection and Dual-Pol



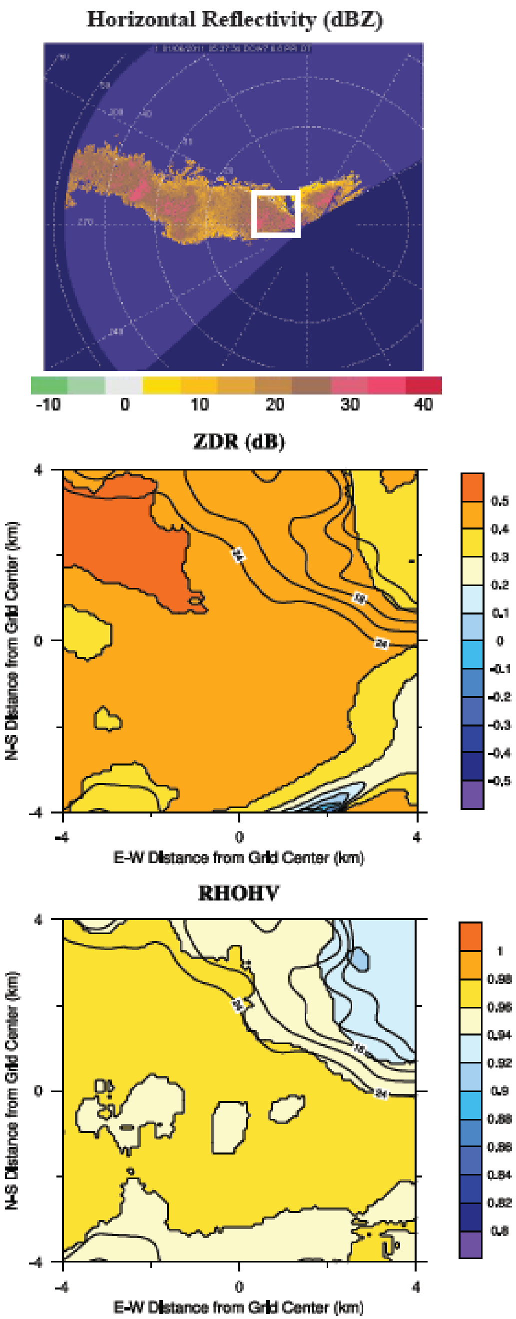
- ZDR, ρhv enhanced within convective cells, suggesting primarily aggregates forming in stronger updrafts

LLAP 2010-11: Vortices and Dual-Pol



- ZDR enhanced on leading edge of mesovortex (possibly more convection), suppressed elsewhere
- Consistent with observation of aggregates on leading edge, pellets in center
- Role of vortex in precip. type?

05:37:34 UTC 6 January 2011



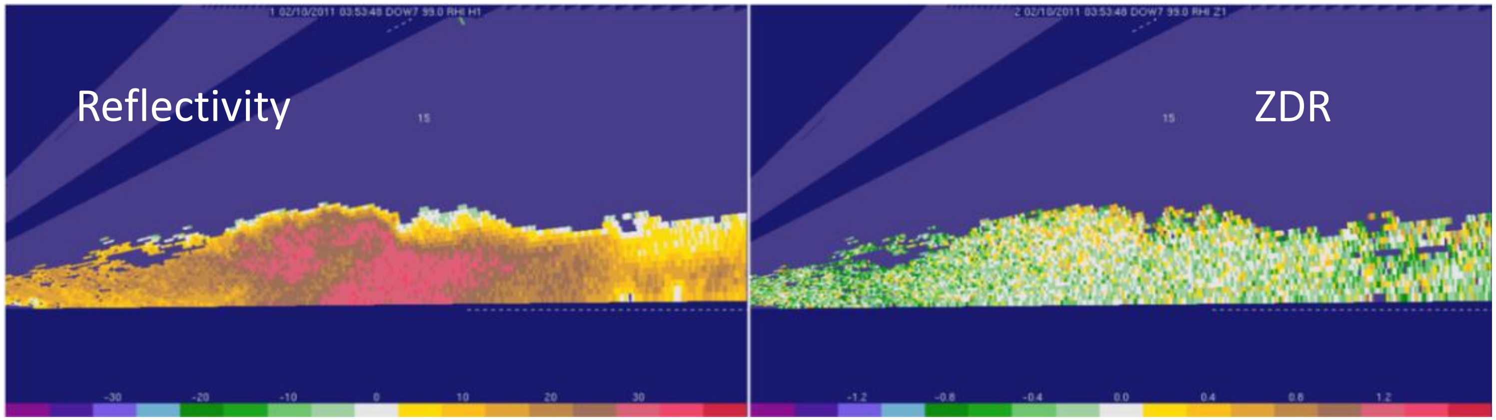
LLAP 2010-11: Precipitation Type Observations

- Precipitation type observations only collected at radar site (no reliable radar data) or at Oswego campus (beam blocked by trees)
- Forced to extrapolate upstream radar data
- More students, more collection sites

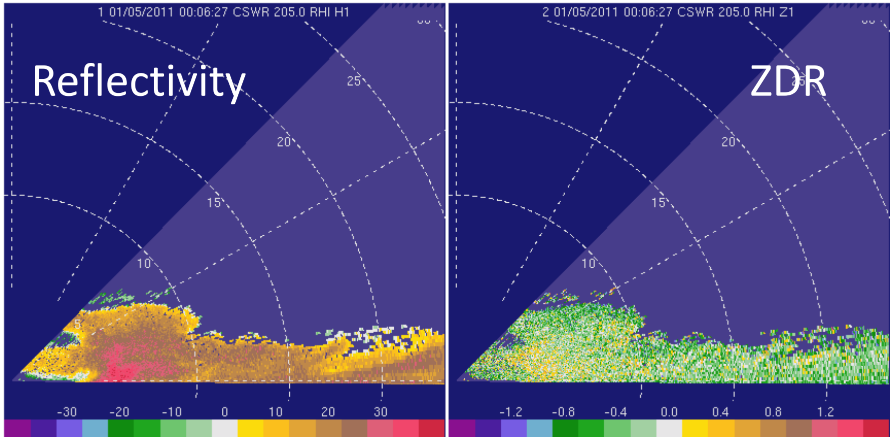
LLAP: RHI Dual-Pol

- How are hydrometeors changing as they fall?

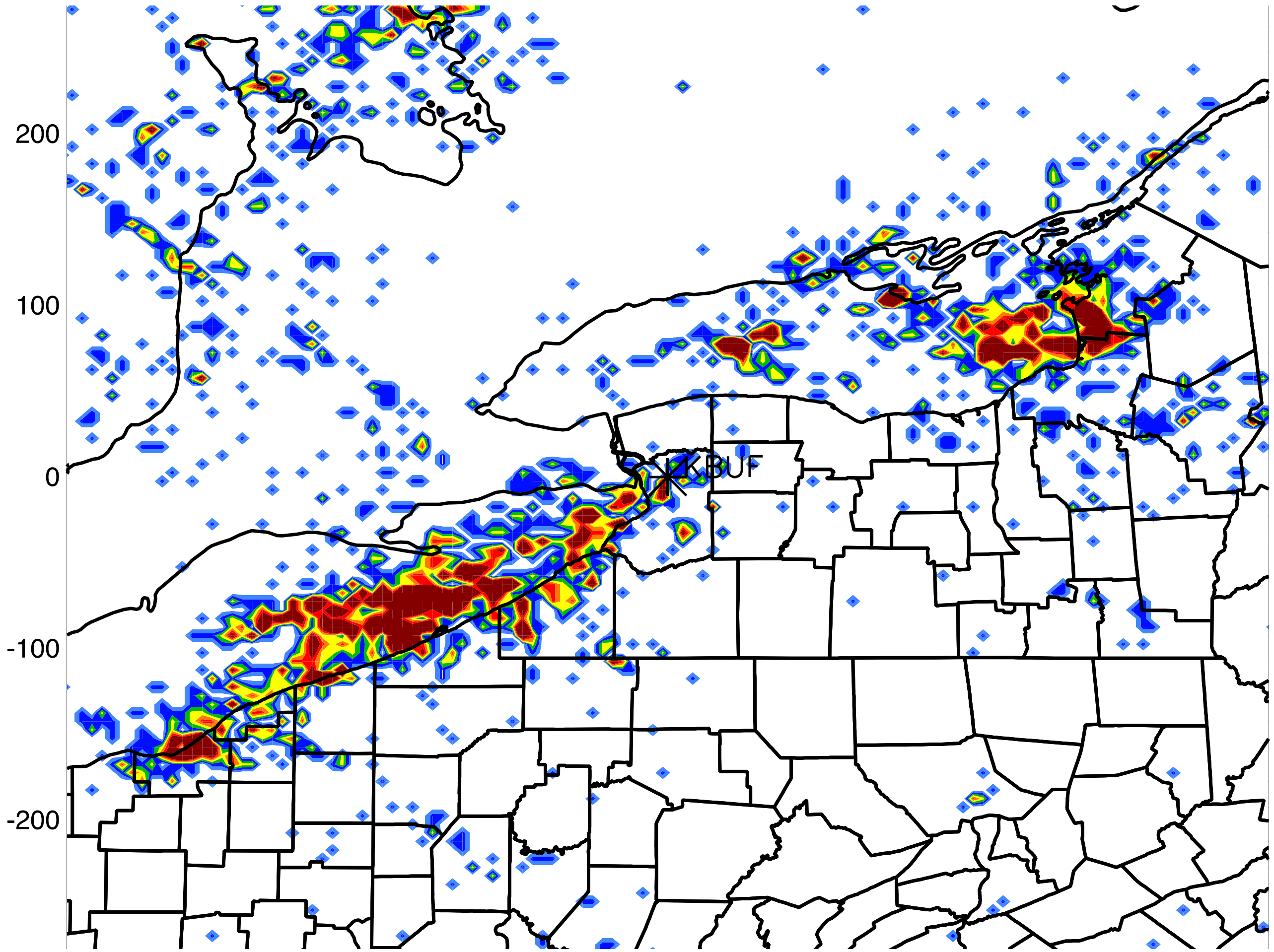
Aggregates



Pellets and aggregates



Previous Research: Lightning



OWLeS – Long Fetch: Objectives

- To document and understand how Lake Ontario long-fetch LeS evolve from the westerly shore to downwind of the lake (Steiger)
- To document and understand cloud and dynamical processes contributing to the occasional lightning observed in these storms (Steiger)
  - Represents threshold for electrical breakdown in storms
- To examine how radar dual-pol variables at X- and S-band reveal precipitation processes in LeS, and how well dual-pol particle ID and QPE algorithms perform in LeS (Frame)
  - How representative were LLAP results?
  - Small sample size
- Perform dual-Doppler analyses of lake-effect storms to investigate supercellular structures and other mesoscale in-band structures (various)

OWLeS – Long Fetch: Hypotheses

- Moist convection and mesoscale lifting produce stratiform-like precipitation with embedded cells that contribute to the precipitation field observed in long lake-axis-parallel (LLAP) storms.
- The reduction to a single, intense, deep LLAP band is mainly the result of solenoidally-driven currents (land breezes from S & N shores).
- The intensity of LLAP bands is controlled by upwind conditions (humidity and stratification, preexisting circulations), heat & moisture fluxes, strength and height of any stable layers, and environmental wind shear.

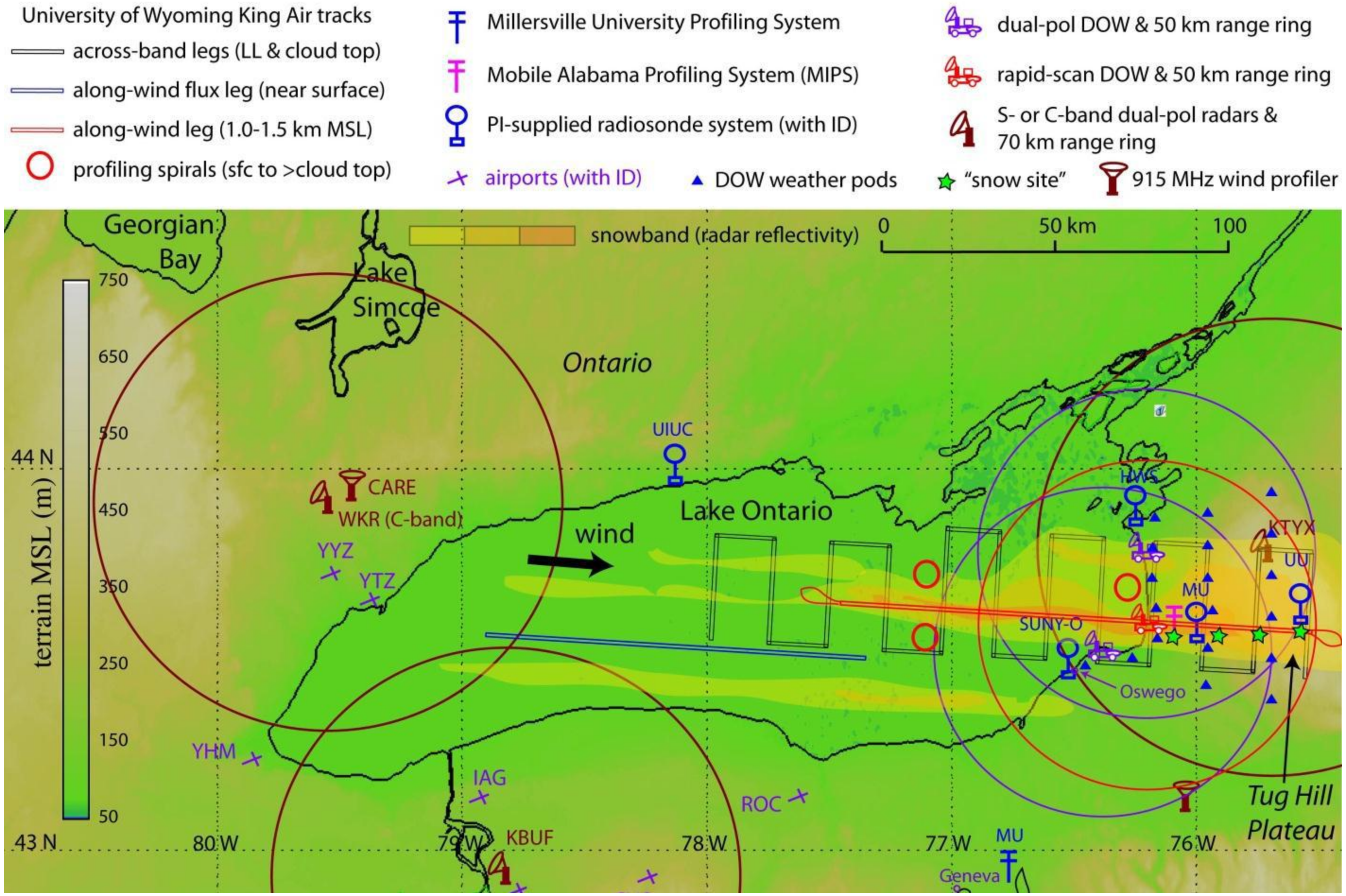
Hypotheses Cont.

- LLAP bands contain internal boundaries created by combined convective outflows. Vortices of miso- to meso-gamma-scale form along these boundaries due to horizontal shear instability, and/or tilting and stretching effects.
- Some LLAP cells have supercellular structures and dynamics.
- Lightning occurs in regions of stronger updraft and significant riming within the band.

OWLeS – Long Fetch: Facilities

- Three DOWs (10-20 km baselines)
  - How to use RS-DOW?
- MIPS
  - Electric field
- Snow sites, weather pods
  - How to measure state variables (1 Hz) at snow sites?
  - How to measure snow density?
  - How to categorize hydrometeor types?
- Soundings
  - Mobile or deployable ("sit & fire" for an entire event)?
  - Can measure land breeze system? If not, how measure this system?
- Wyoming King Air
  - Cloud imaging probe, cloud droplet probe, WCR, WCL (how measure riming?)
  - Along-wind leg; how realistic is this?
  - How measure heat & moisture fluxes off lake? Over-lake, near-surface air temperature pattern (within & outside band – e.g., is it cooler behind "outflow boundaries?")? Dynamic pressures in cells (test supercell hypothesis?)?

Facilities Cont.



Where is PEO on map? Syracuse profiler still working? SUNY-O may have a sodar in time.

Example Dual-Doppler

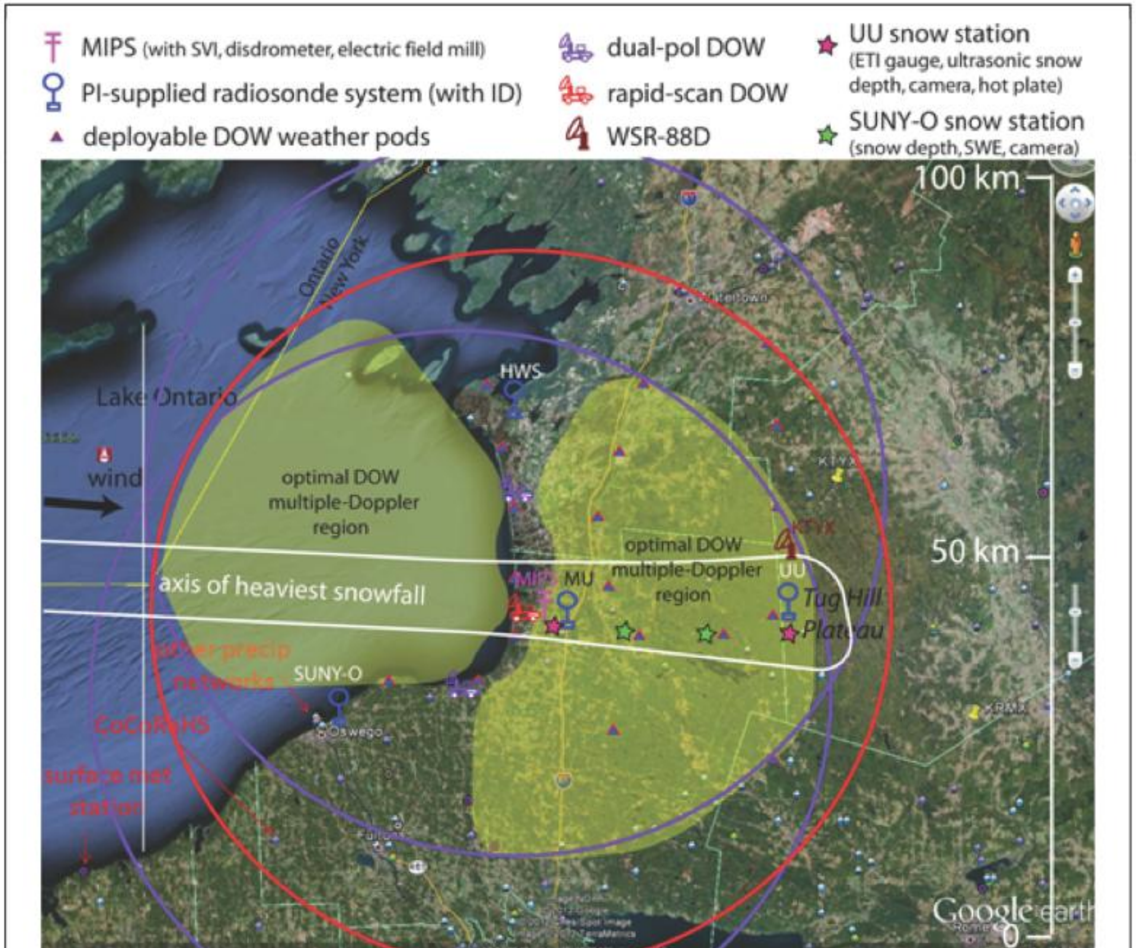


Figure 6. Map showing schematic OWLeS ground-based observations of long-fetch lake-effect systems interacting with the Tug Hill Plateau.

OWLeS – Long Fetch: Still to Do

- Siting for dual-Doppler (10-20 km baselines; want variable baselines for variable resolutions?)
- DOW staffing
- Meet with NWS offices