Characterizing the Impacts of 2024 Total Solar Eclipse Using New York State Mesonet Data

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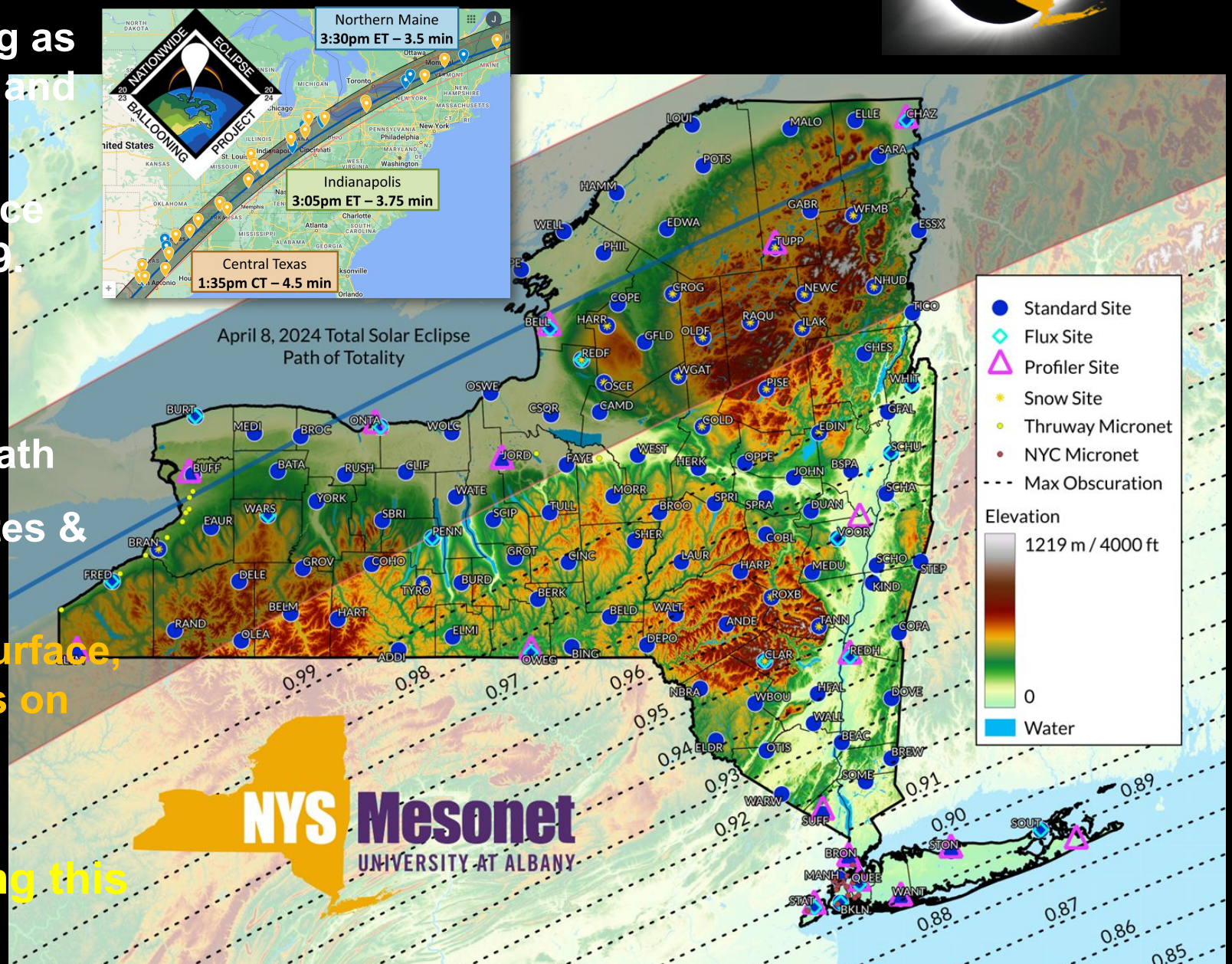
Overview of 2024 TSE

- Across NA; lasted twice as long as that on 8/21/2017; more visible and larger sun's corona.
- Rare TSE for NYS: first one since 1925 and the last one until 2079.
- Totality in western NYS; >88% obscuration in the rest of NYS.
- 55 NYSM sites on the totality path
- 7 profiler, 9 flux and 3 super sites & 1-min camera images.
- First time to have co-located surface, profiler and flux measurements on mesoscale during the TSE.
- Goal: Characterizing the atmospheric responses using this natural "laboratory".

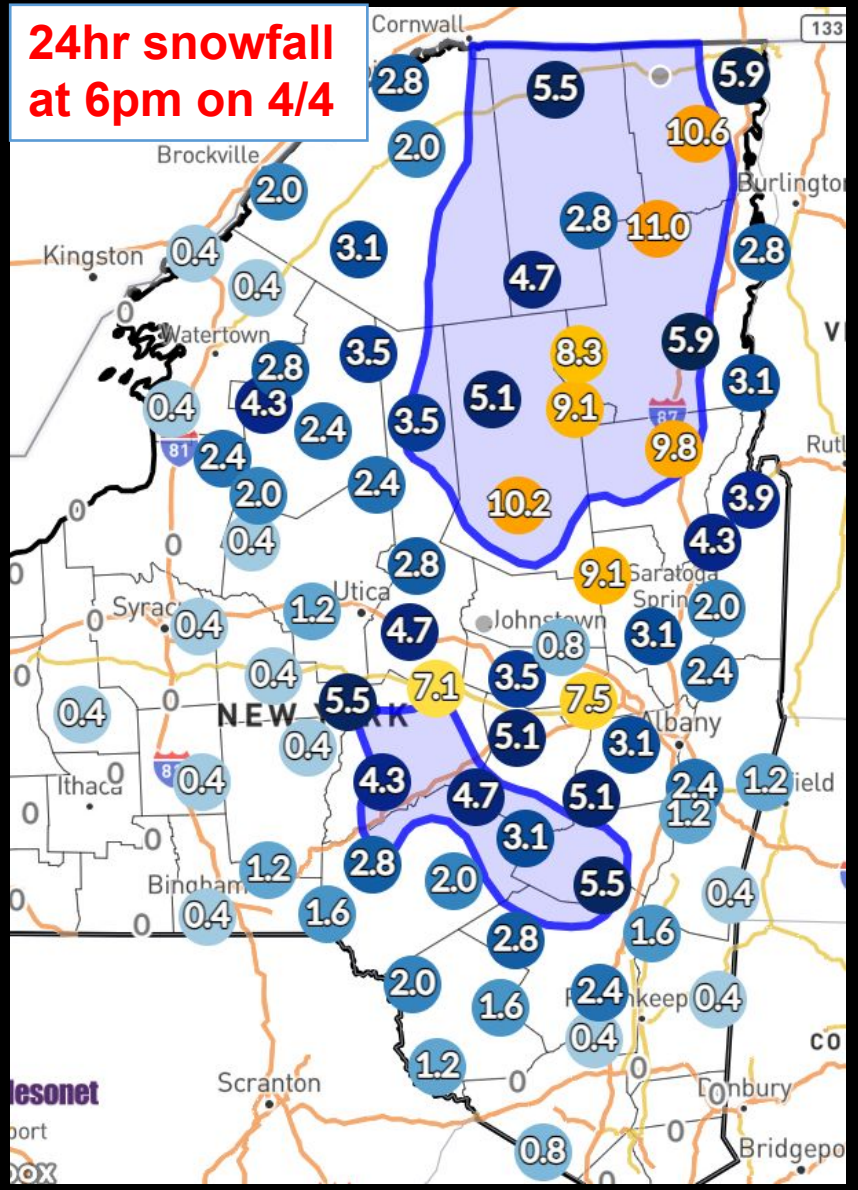


Synoptic Conditions (4/3-4/4)

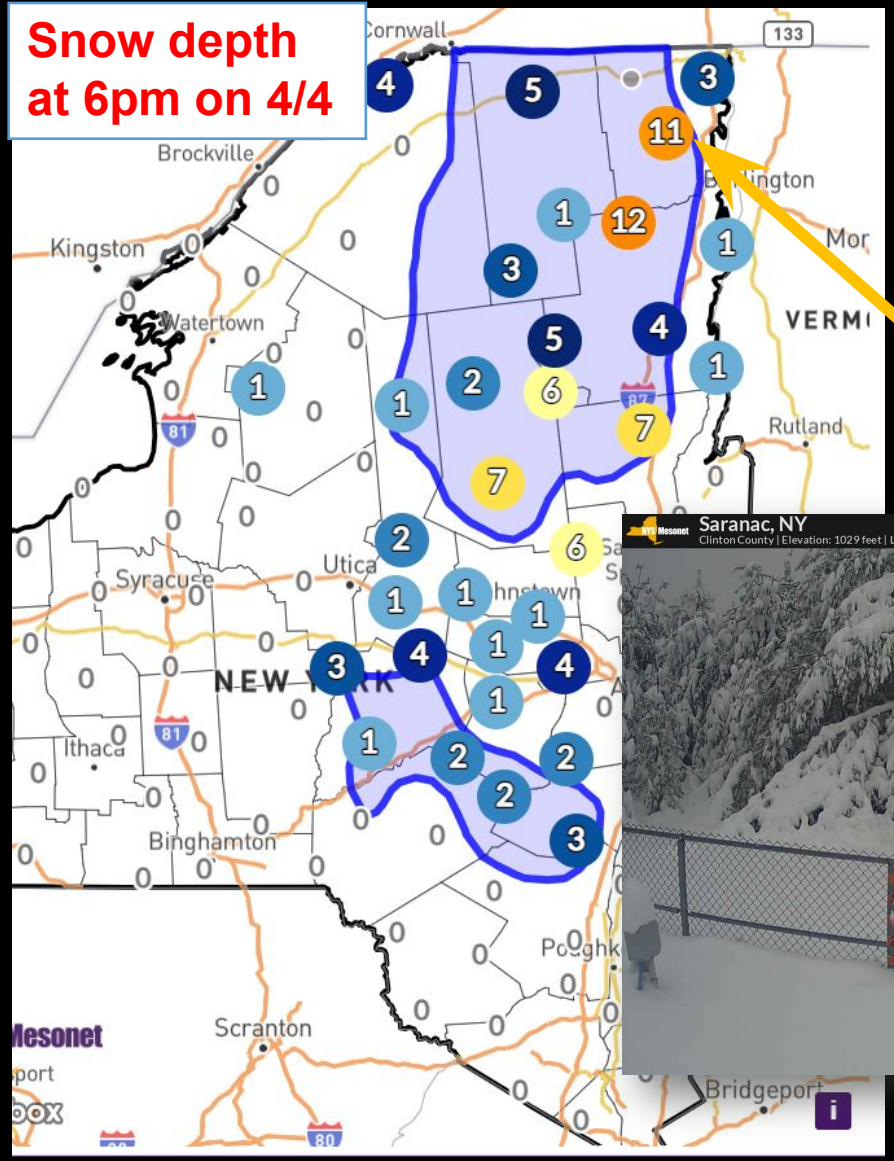
- 4/3-4/4: Snowstorm for ~5-11” snow in ADK

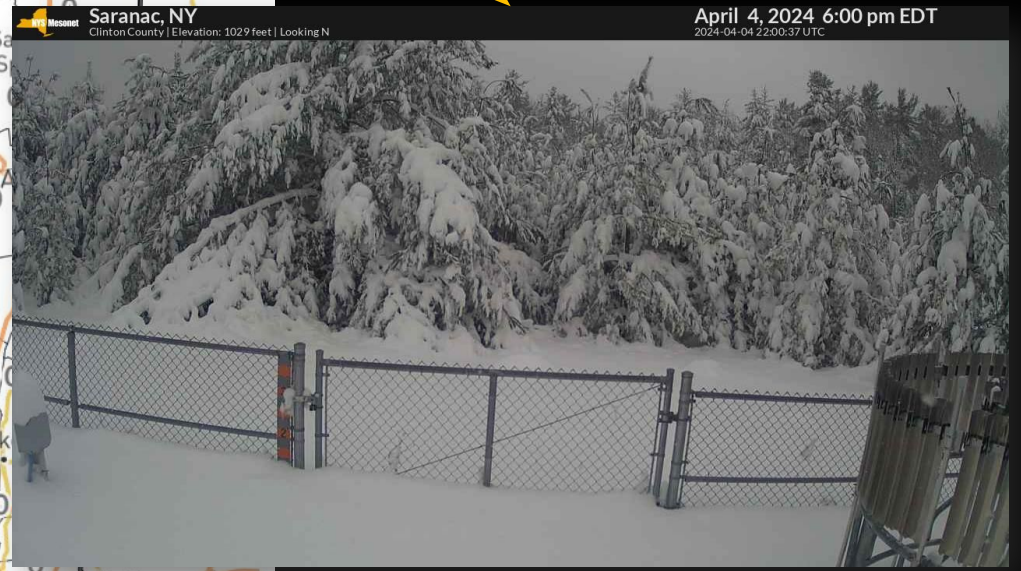
NYS Mesonet
UNIVERSITY AT ALBANY

24hr snowfall at 6pm on 4/4



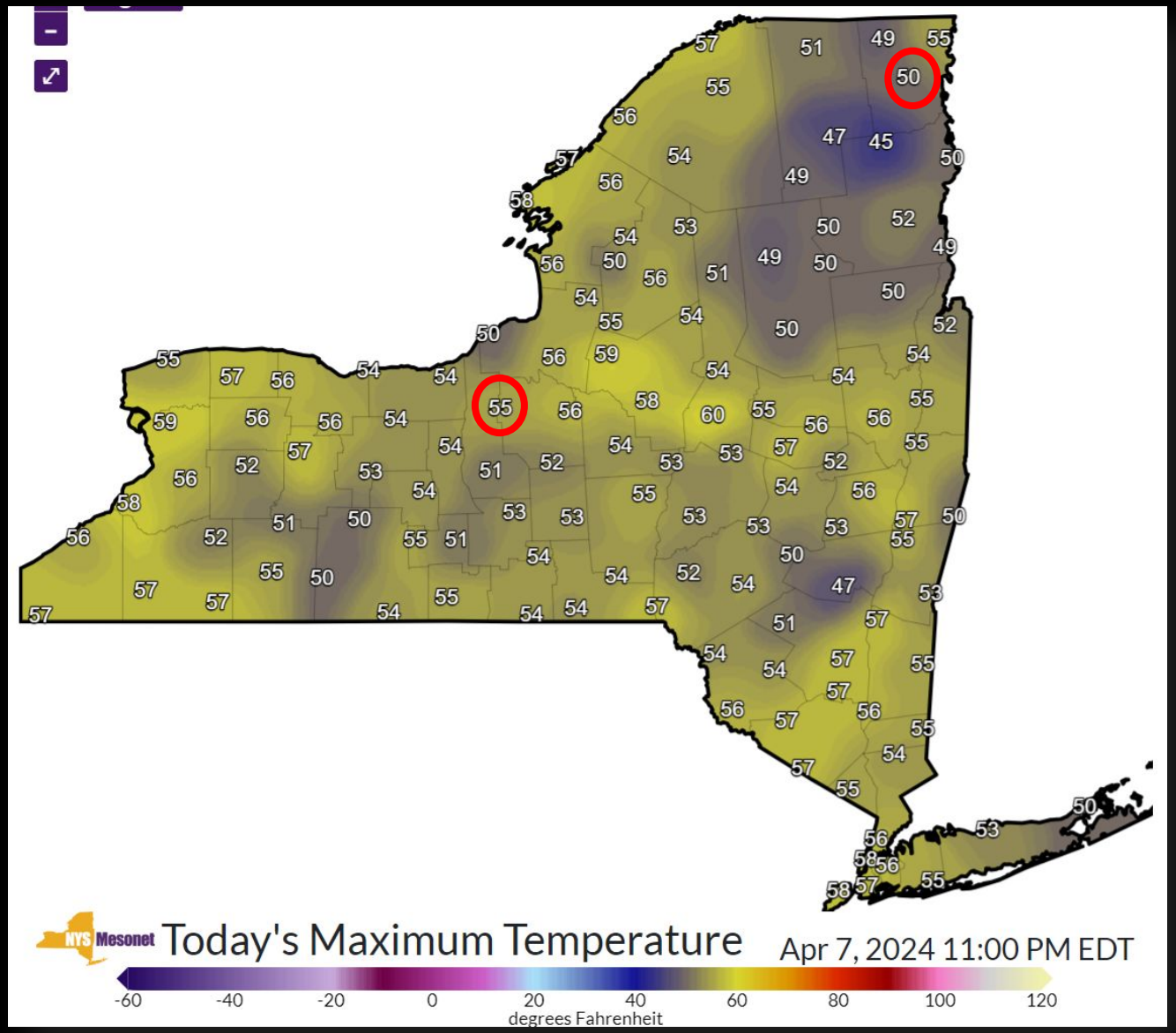
Snow depth at 6pm on 4/4

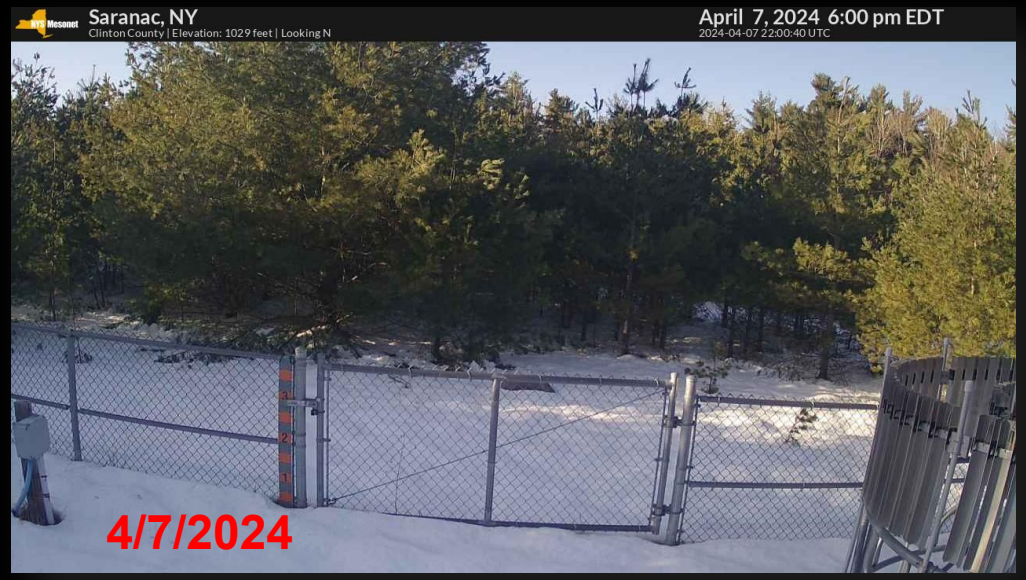




Synoptic Conditions (4/7)

- 4/7: high pressure system, clear sky, warm T & snow melting

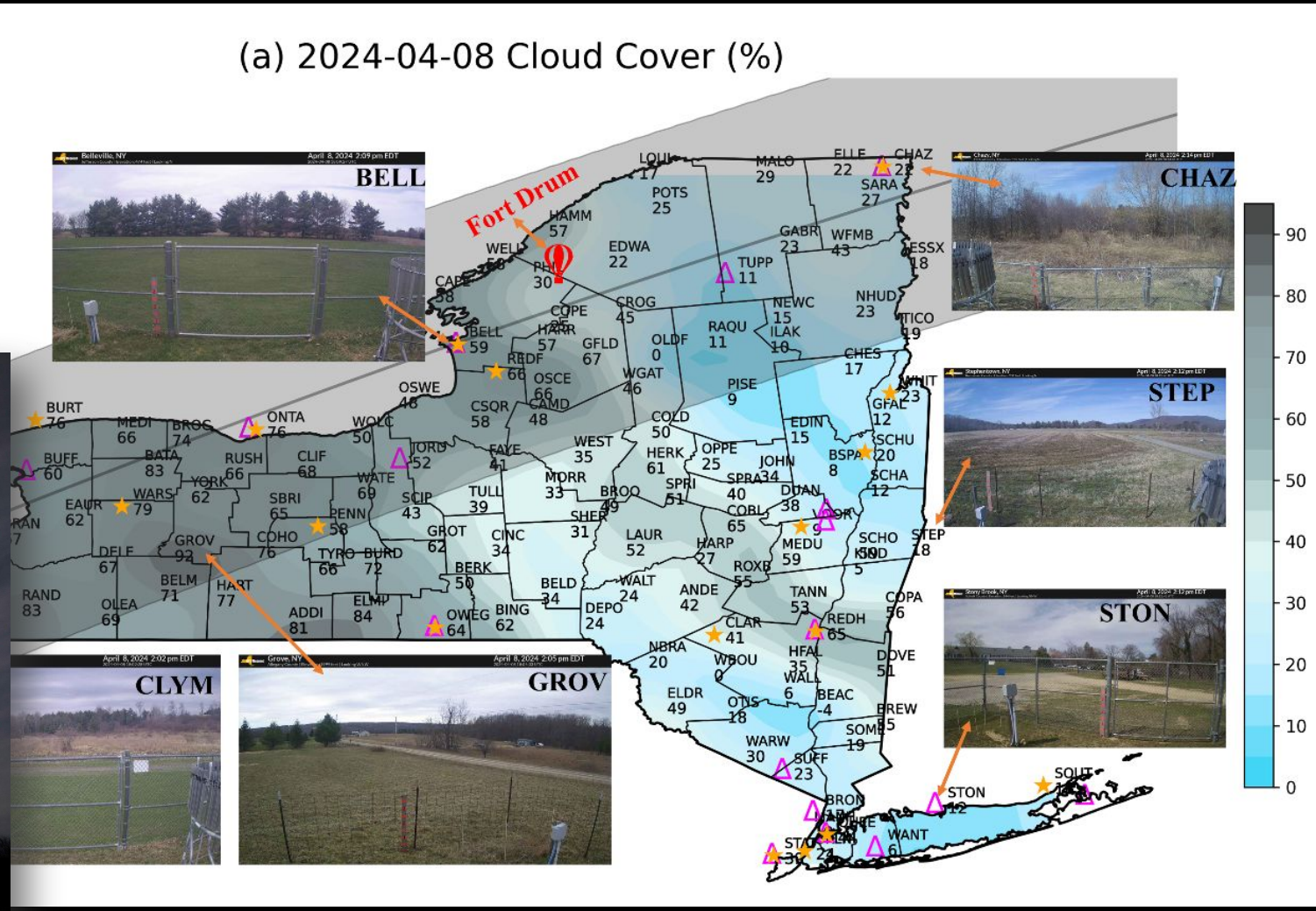




Synoptic Conditions (4/8)

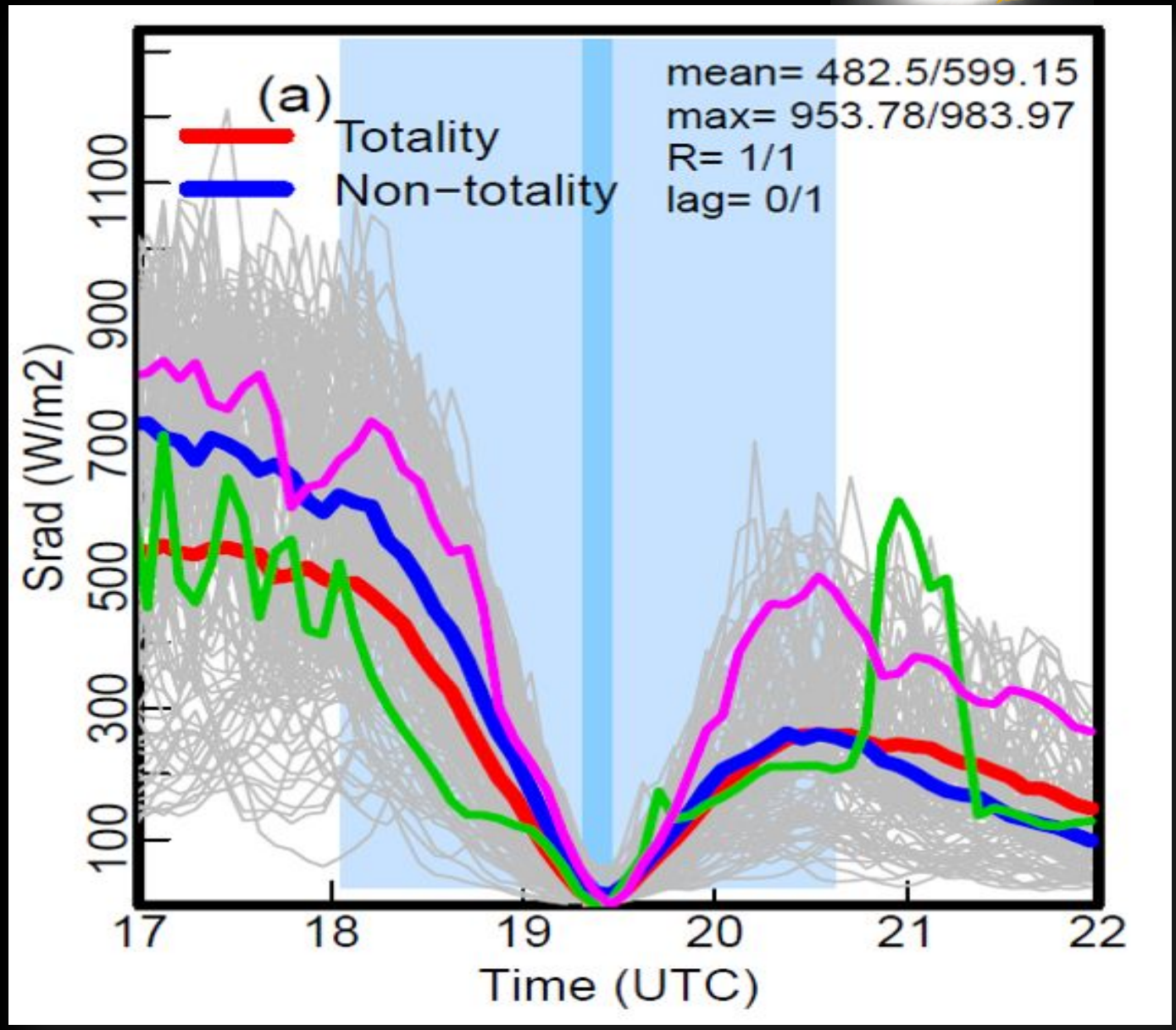
- 4/8 before TSE: low pressure
  from the Ohio valley
- 4/8 during TSE: best view in
  ADK but cloudy in other total

Photo courtesy of Patrick Dodson at UAlbany



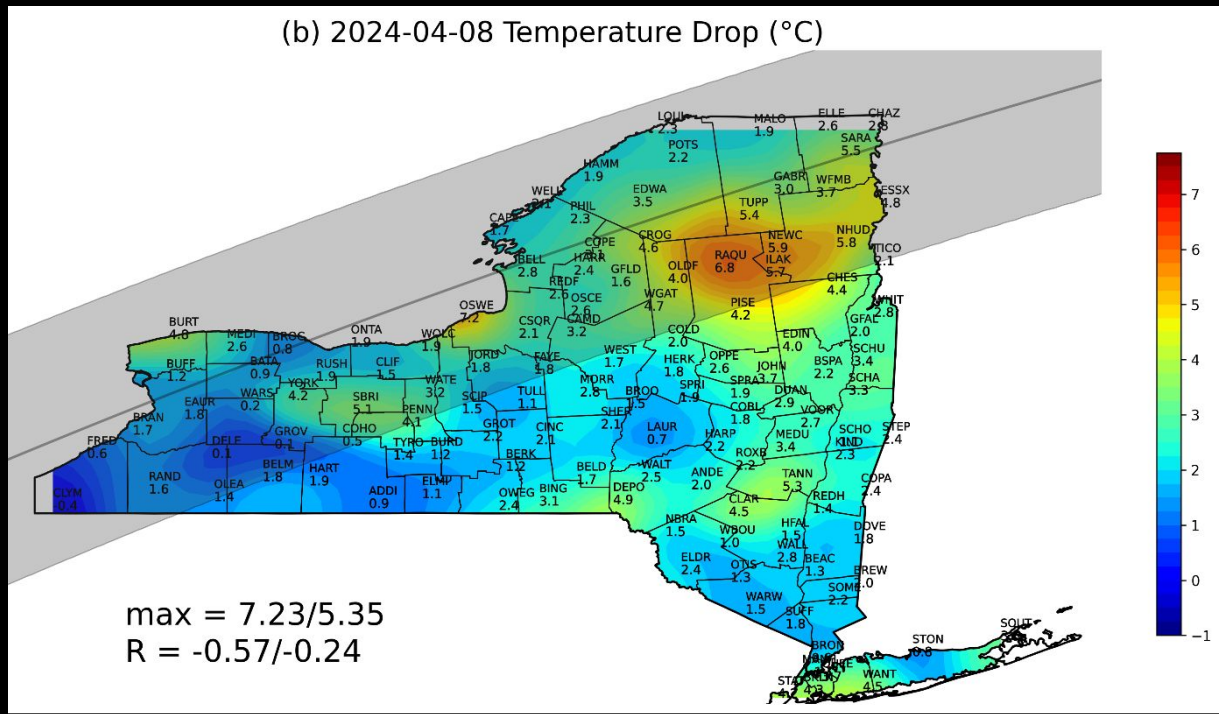
Time evolution of the TSE

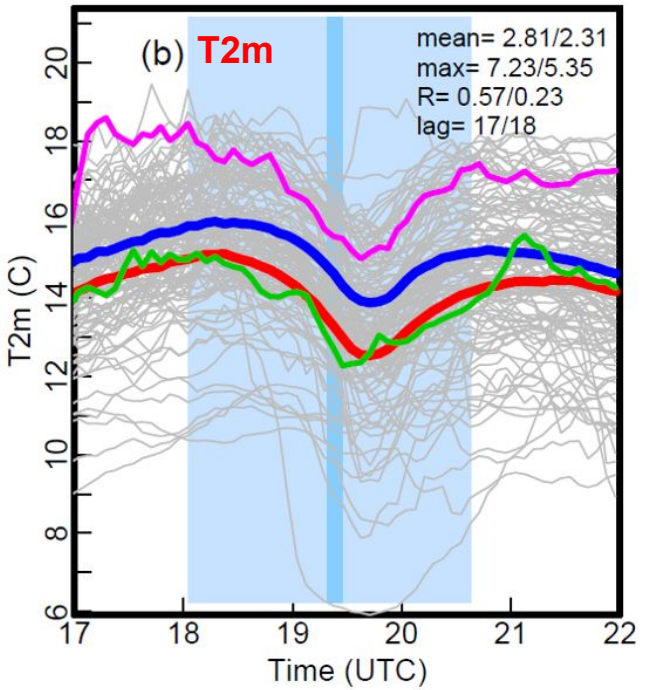
- 126 stations
- Mean for 55 totality stations
- Mean for 71 non-totality stations
- CHAZ (clear)
- BELL (cloudy)

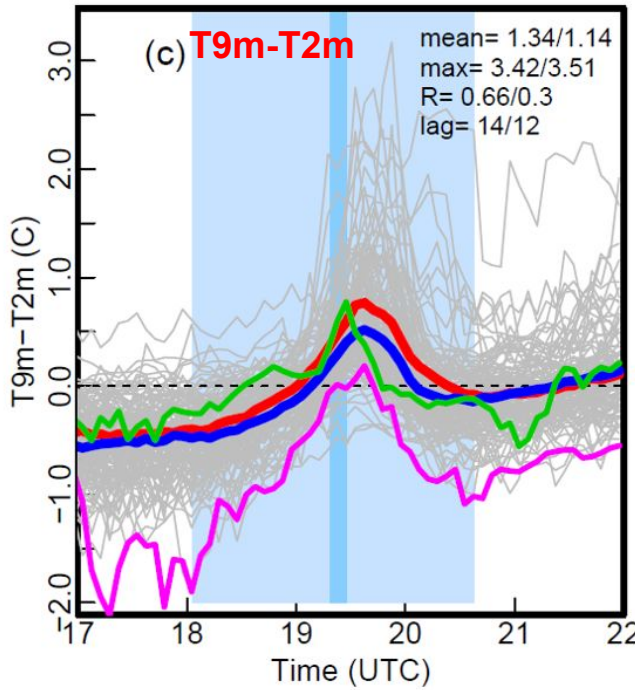


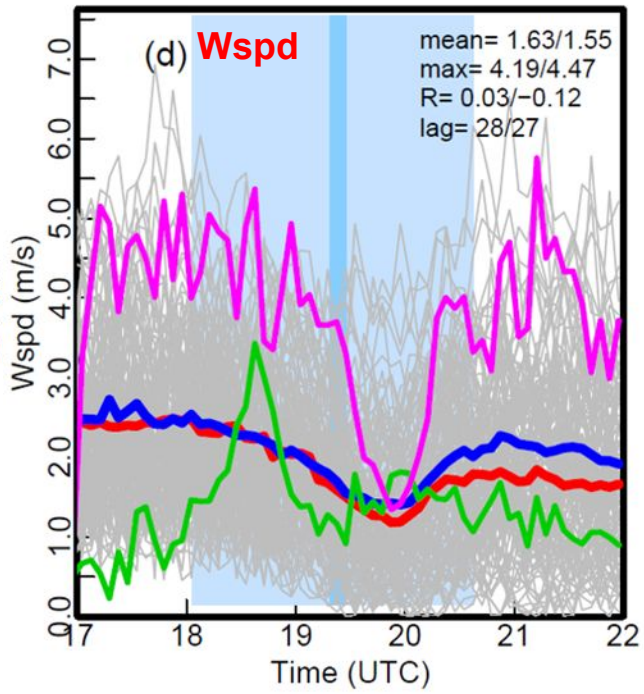
Surface Responses

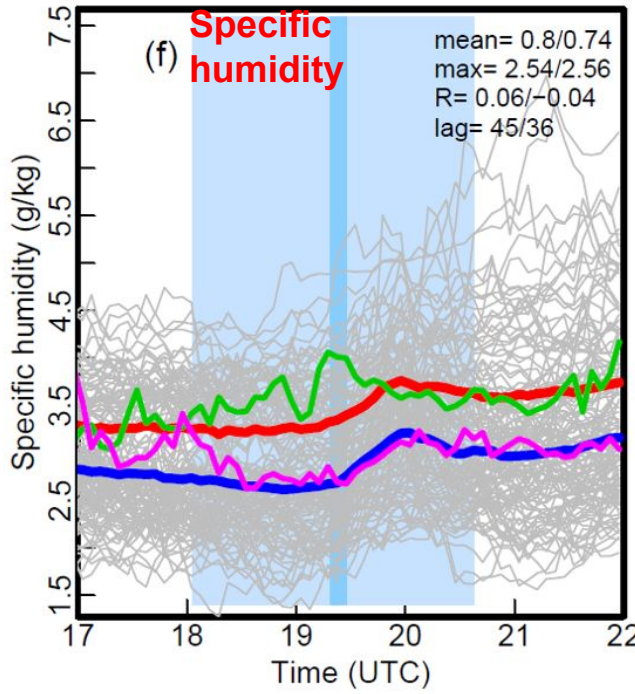
- Cooling, night-like surface inversion, calmer winds and moistening.
- 2.8°C cooling on average with a maximum of 6.8°C (RAQU) with a lag of 17 minutes.
- Lags: Tinv < T2m < Winds < Humidity
- Temperature drops and surface inversion increasing are well correlated to the cloud cover.



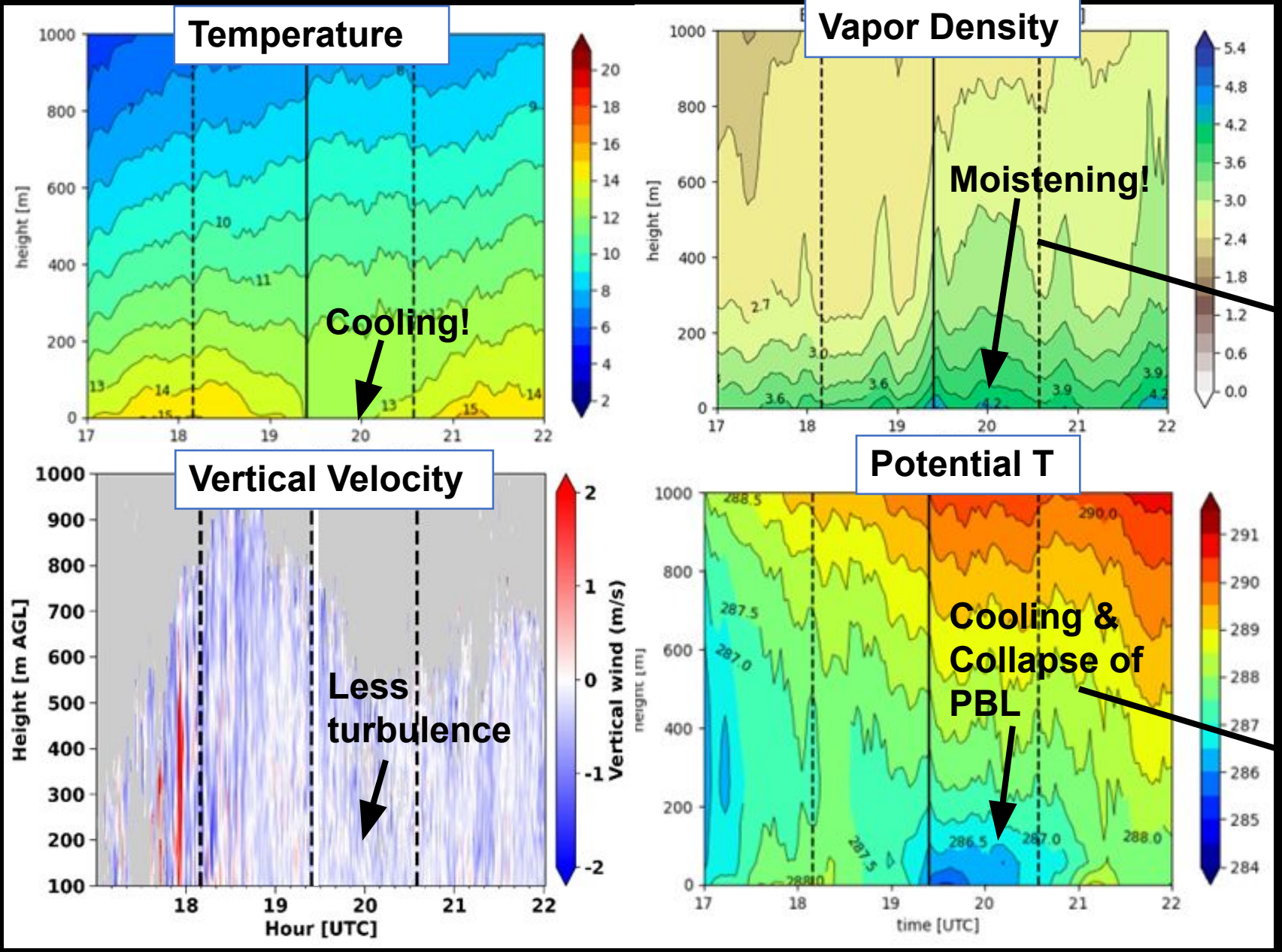


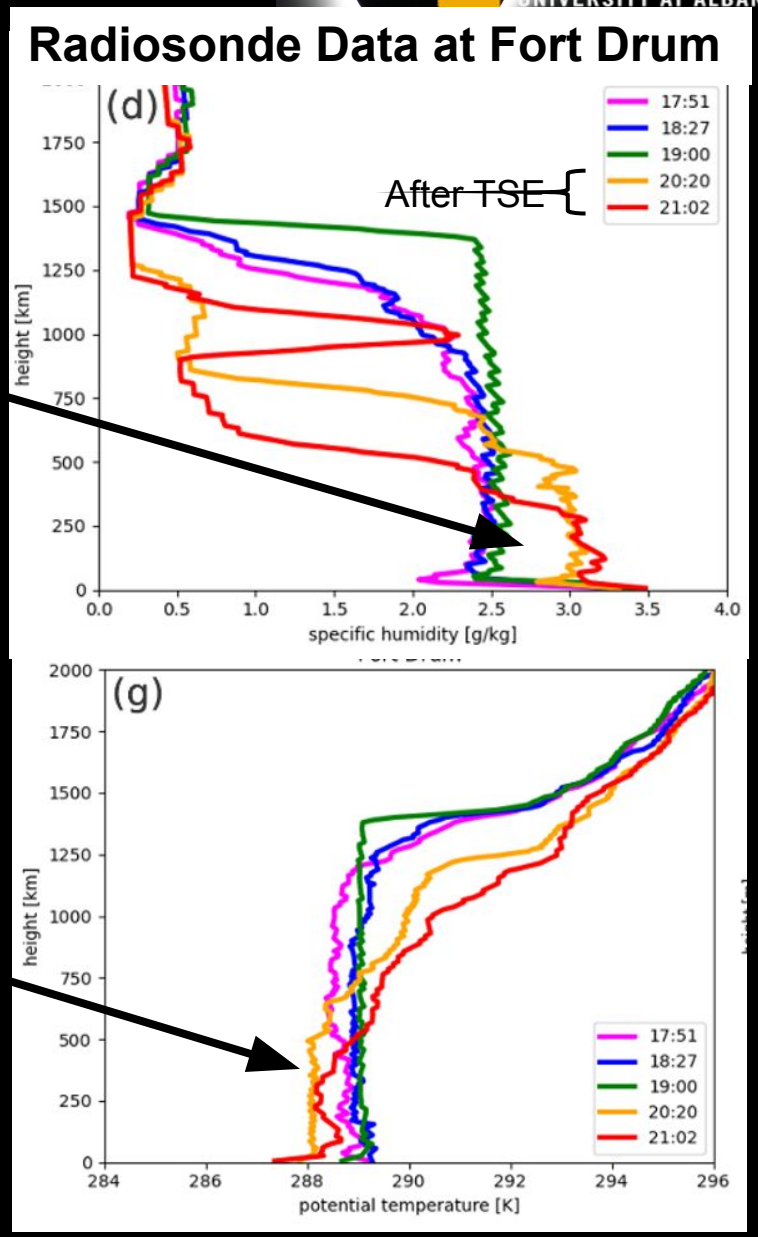






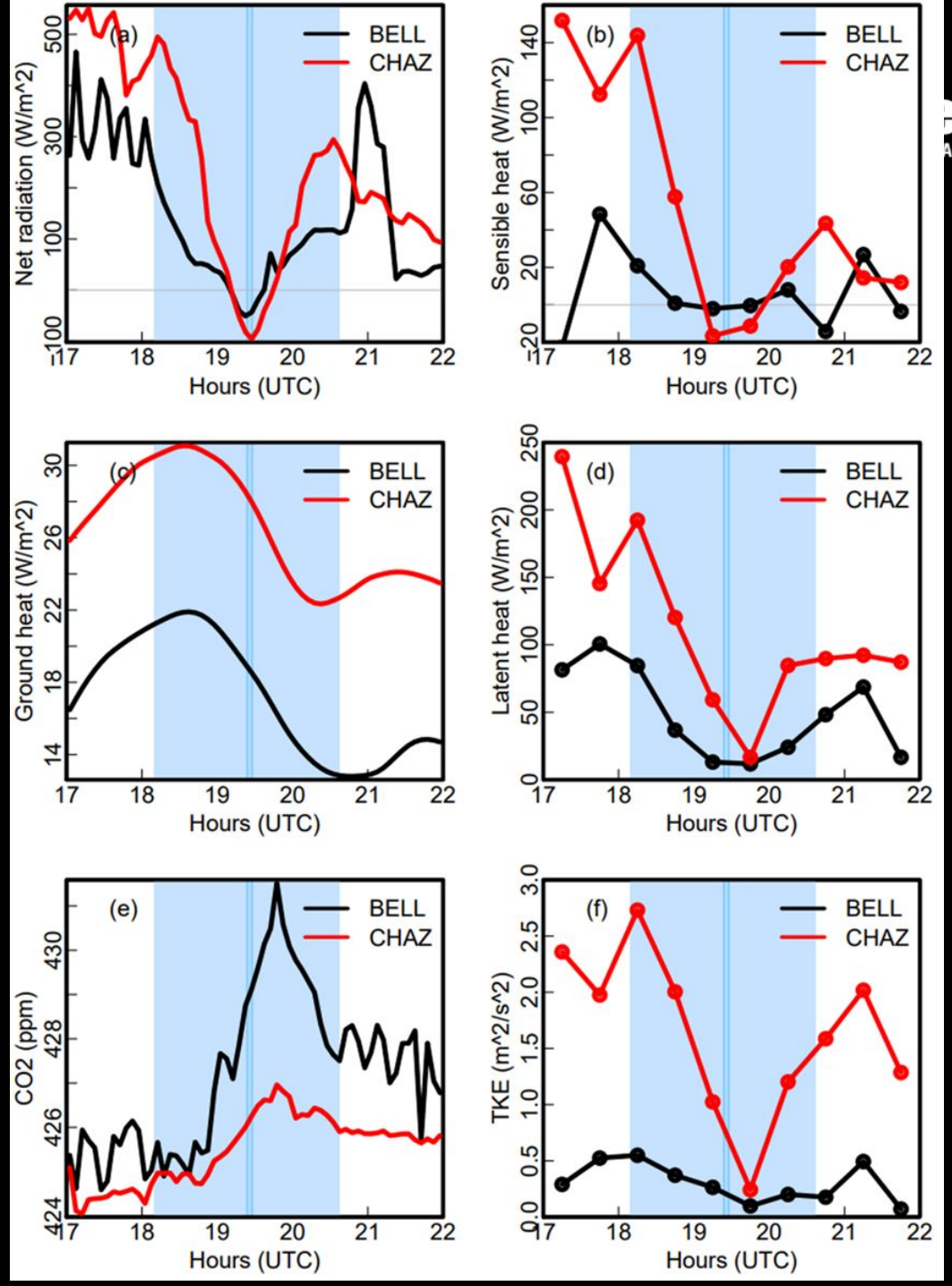
PBL Responses (BELL)





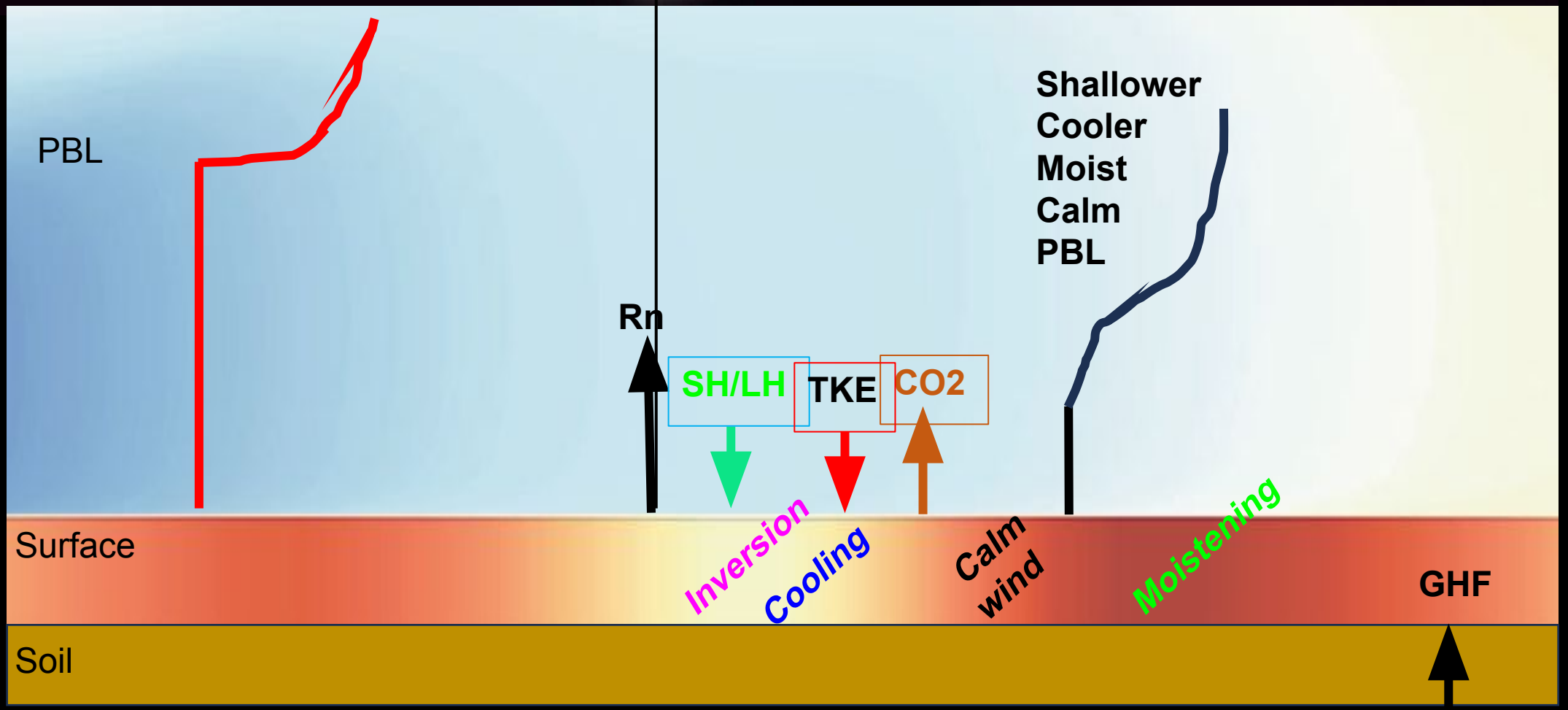
Flux Responses

- Net radiation dropped from C1, reached negative values during the totality, and then recovered afterwards.
- Both surface sensible and latent heat fluxes decreased and reached minimum around totality.
- The ground heat flux also decreased but with lags.
- The TSE calms the atmosphere down and weakens turbulence as shown by the TKE drop.
- CO2 concentration rises about an hour after C1 and reaches a maximum at ~30 min after the totality as a result of reduced solar radiation, PBL height and vertical mixing.
- Differences between BELL & CHAZ can be explained by sky and ground conditions.



Summary


Courtesy of Gretchen Howard and Jim and Janie Schwab


PBL
Shallower
Cooler
Moist
Calm
PBL
Rn
SH/LH
TKE
CO2
Inversion
Cooling
Calm
wind
Moistening
GHF
Surface
Soil

Future work

NYSM Supersites:

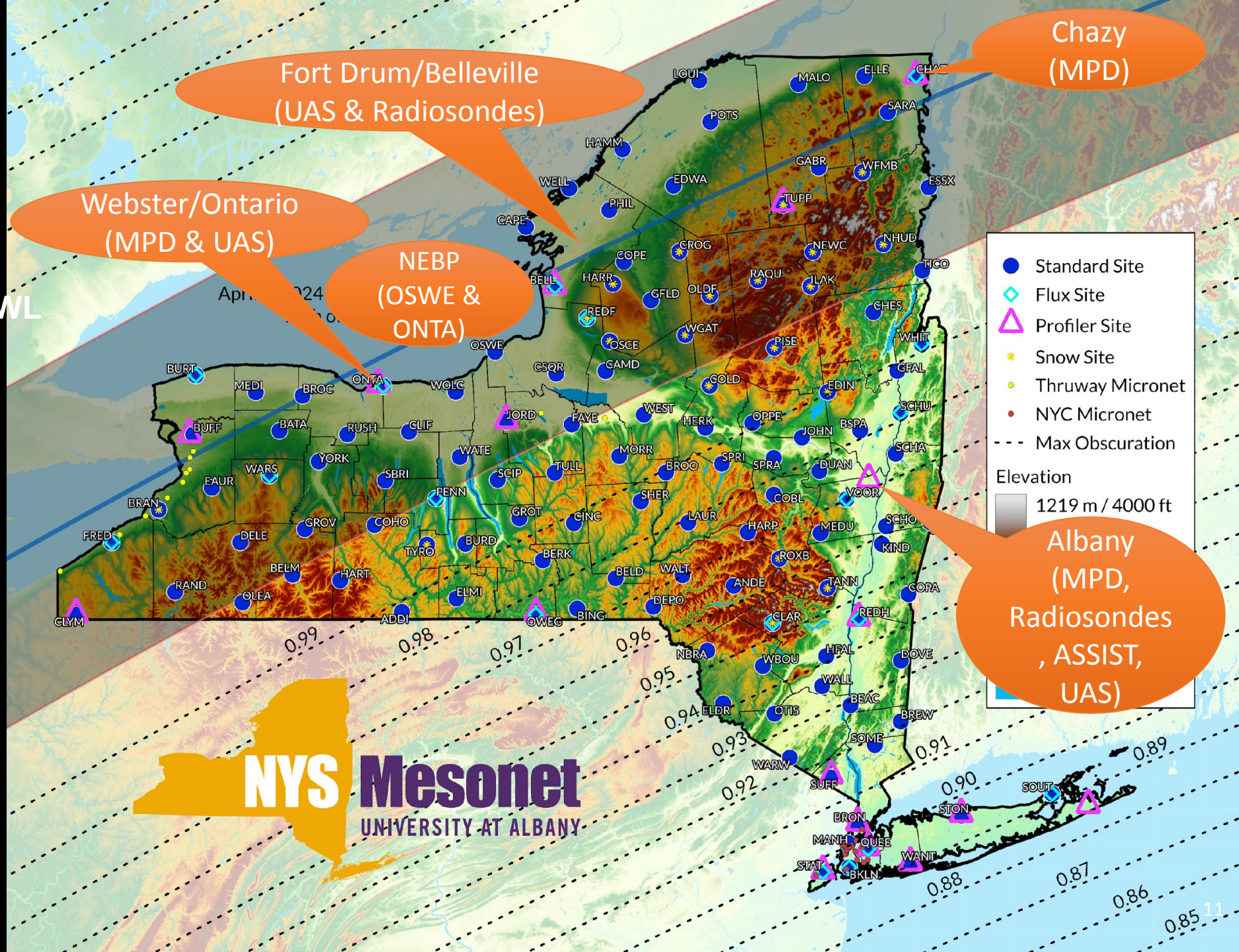
- Surface met
- Profiler: MWR & DWL
- Flux

Additional instruments:

- MPDs
- Radiosondes
- ASSIST
- Drones

Model evaluation:

- HRRR
- WRF-Eclipse




April 8, 2024 2:00 PM EDT
Chazy, NY
https://operations.nysmesonet.org/public/references/20240408_TotalSolarEclipse/Chazy_20240408.mp4
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