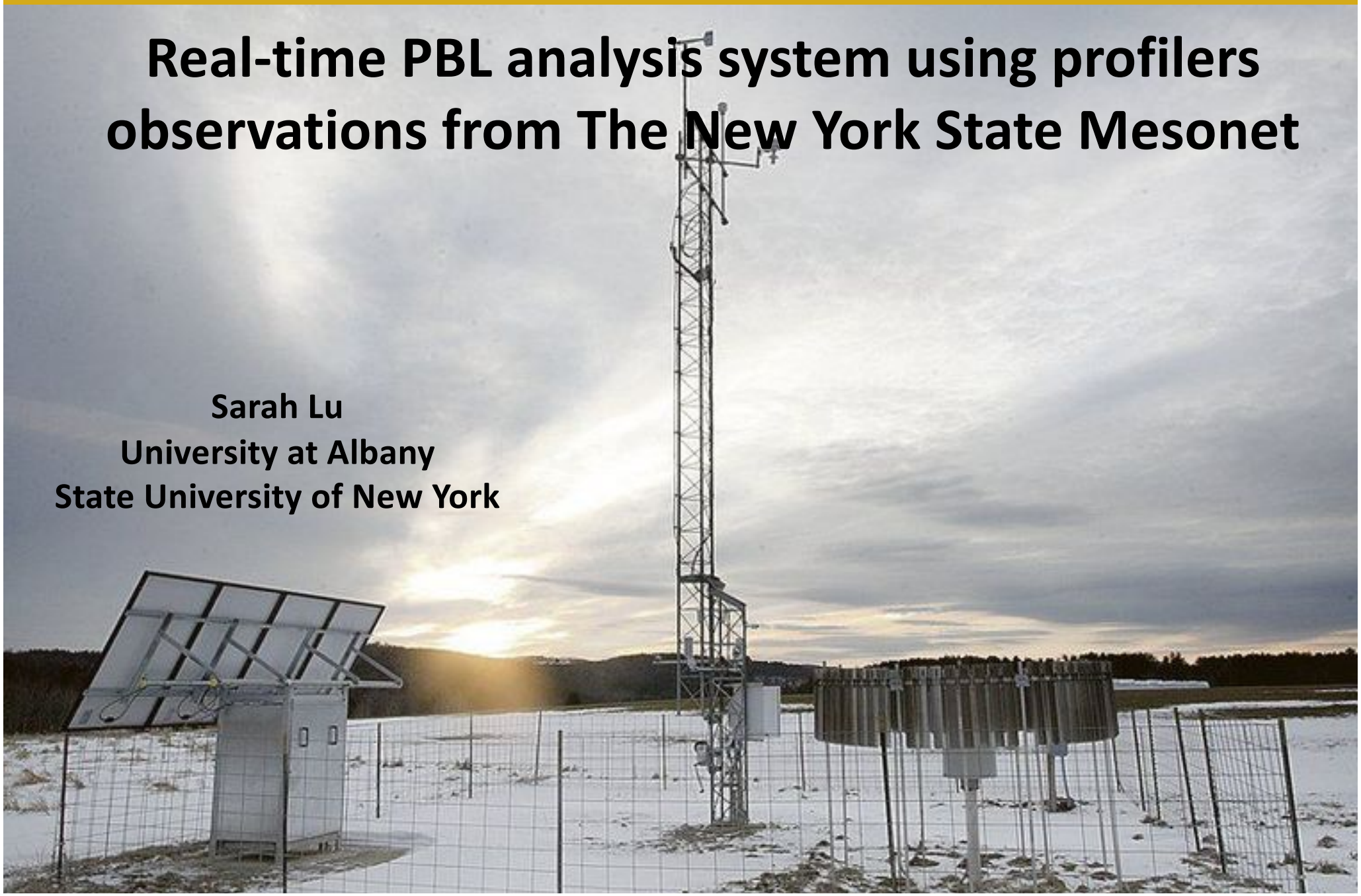
The NYS Early Warning
Weather Detection System

Real-time PBL analysis system using profilers observations from The New York State Mesonet

Sarah Lu
University at Albany
State University of New York



The NYS Early Warning Weather Detection System

Outline

- Background
- System description and progress
- Enhanced sites
- PBL Pilot with NCEP

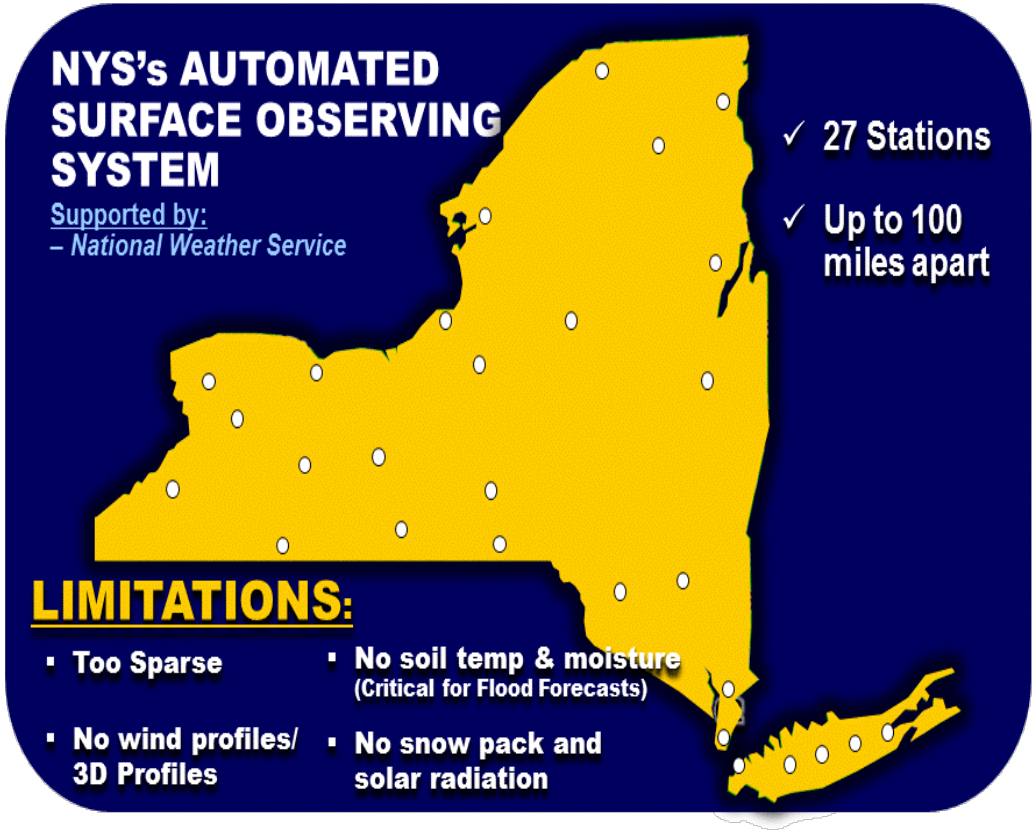
Why a Mesonet in New York?

- Scarcity of weather observations in NY
- Long-term trends of heavier rainfall
- Recent history of very expensive high-impact events
- State economy is especially sensitive to weather
- Valuable for emergency management, utilities, ground transportation (roads, rail), aviation, agriculture, etc.

Why a Mesonet in New York?

Scarcity of weather observations in NY

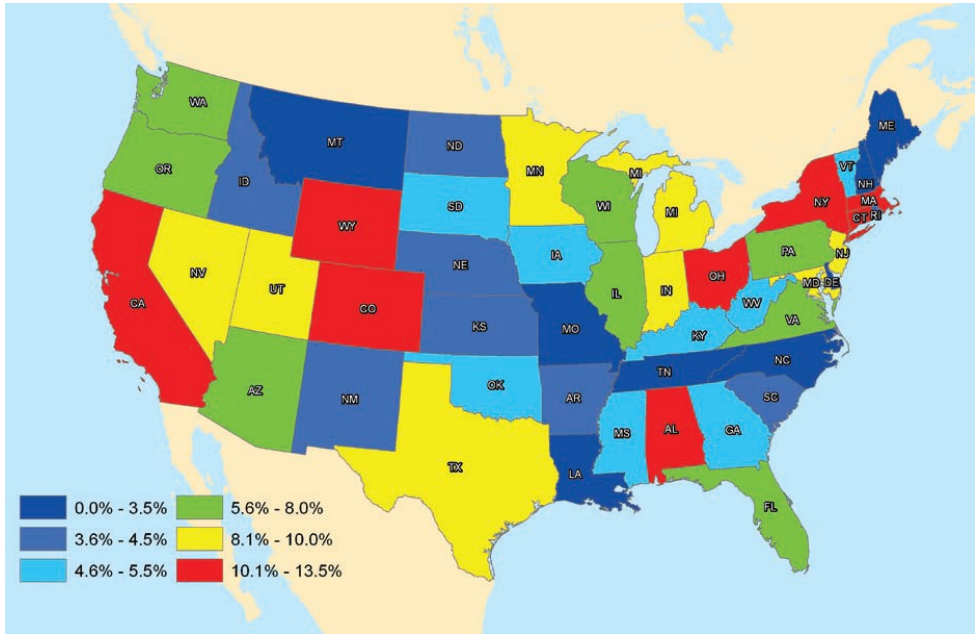
- **27 Automated Surface Observing Stations (ASOS)**
- **Some Gaps in Radar Coverage**
- **NWS & Emergency Managers are often Blind**



Why a Mesonet in New York?

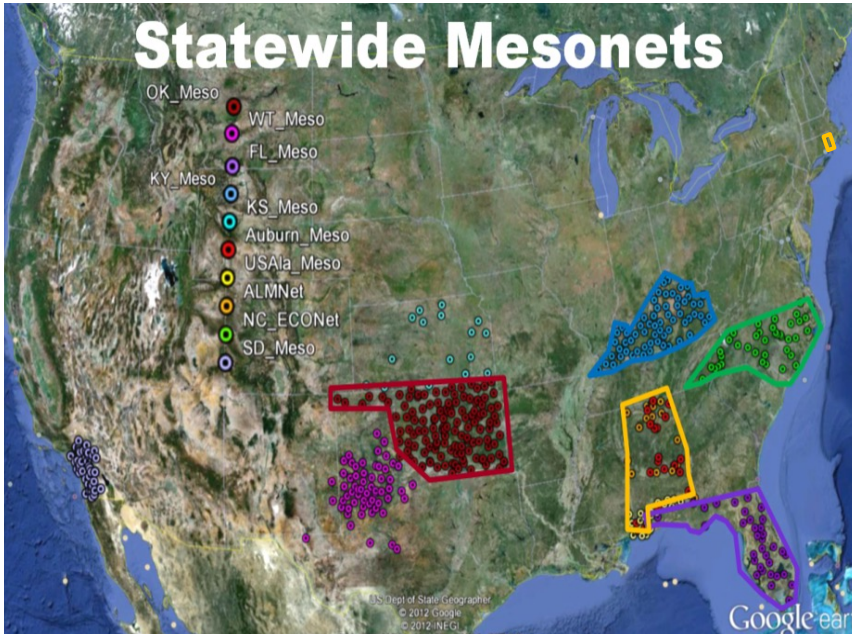
State economy is especially sensitive to weather

State Economic Sensitivity to Weather Variability by GSP



* Lazo et al., 2011 (BAMS)

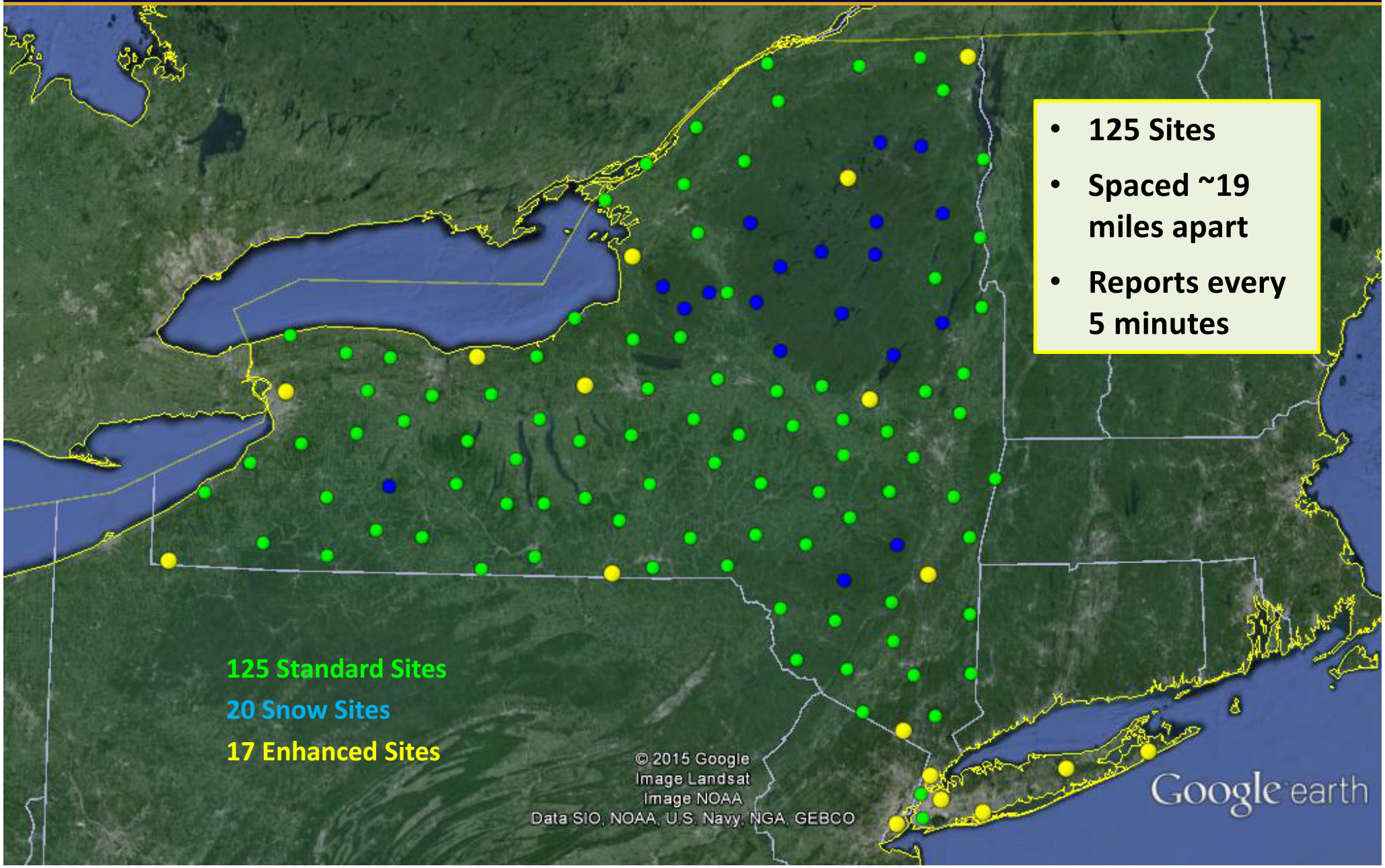
Other states have realized the economic value



Brief Overview

- NYS Mesonet awarded 1 April 2014
- Comprised of 125 stations, including:
  - Soil moisture/temperature at 3 depths
  - Camera (still images)
  - 20 snow sites
  - 17 profiler ("enhanced") sites
  - 17 flux sites
- Data collected, quality-controlled, and disseminated every 5 min
- Have 50+ sites now operational
- All 125 sites operational by 31 December 2016

The NYS Early Warning Weather Detection System



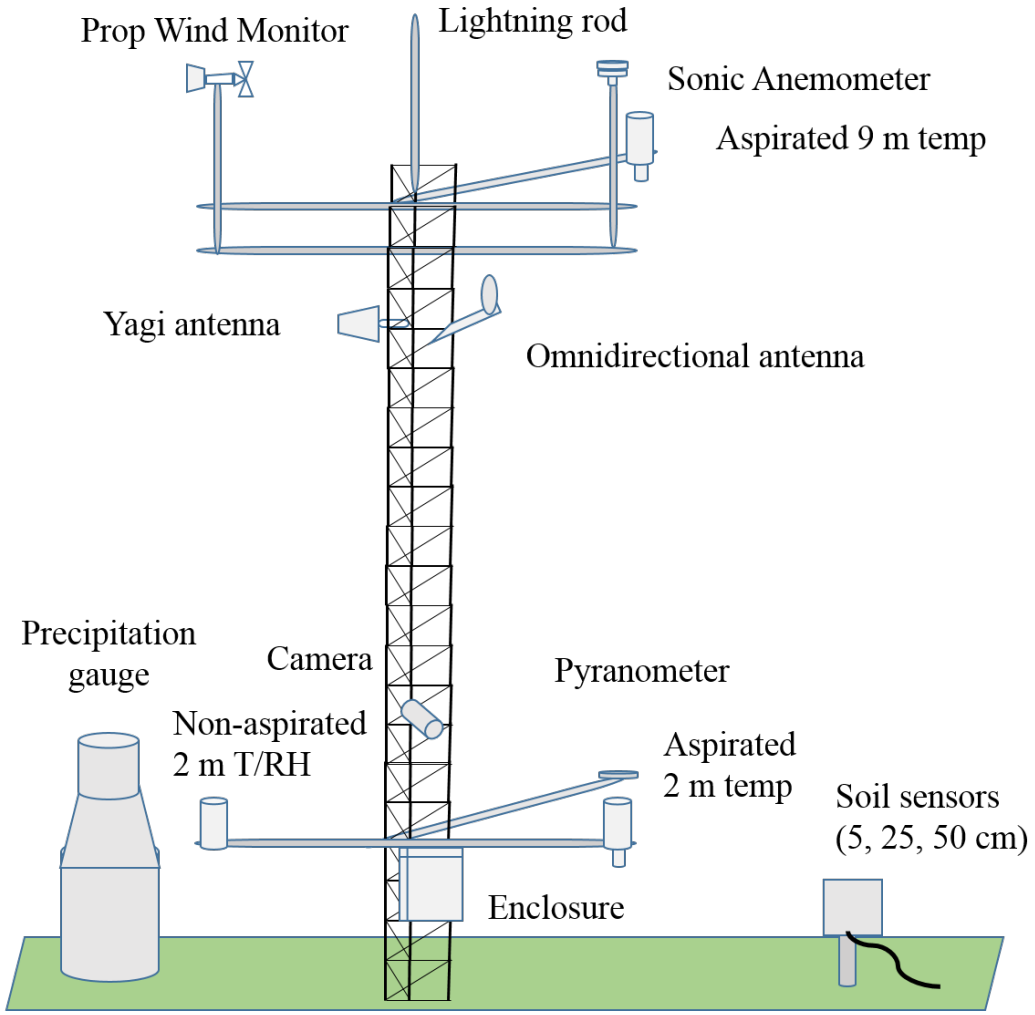
Some Site Selection Considerations

- General network configuration with 19 mile spacing
- Area representativeness – valley, high terrain, crops, forests
- NWS input – areas prone to flooding; gaps in observations
- WMO standards:
  - Generally flat terrain
  - No obstructions (no trees, pavement) within 300 ft
- FEMA guidelines:
  - No flood zones, no wetlands
  - No historical property
  - No archaeologically sensitive areas
- Require a 33’ x 33’ area

Standard Site

Standard Observations

- Precipitation
- Temperature
- Humidity
- Wind Speed and Direction
- Solar Radiation
- Barometric Pressure
- Soil Temperature (5, 25, 50 cm)
- Soil Moisture (5, 25, 50 cm)
- Site Photos



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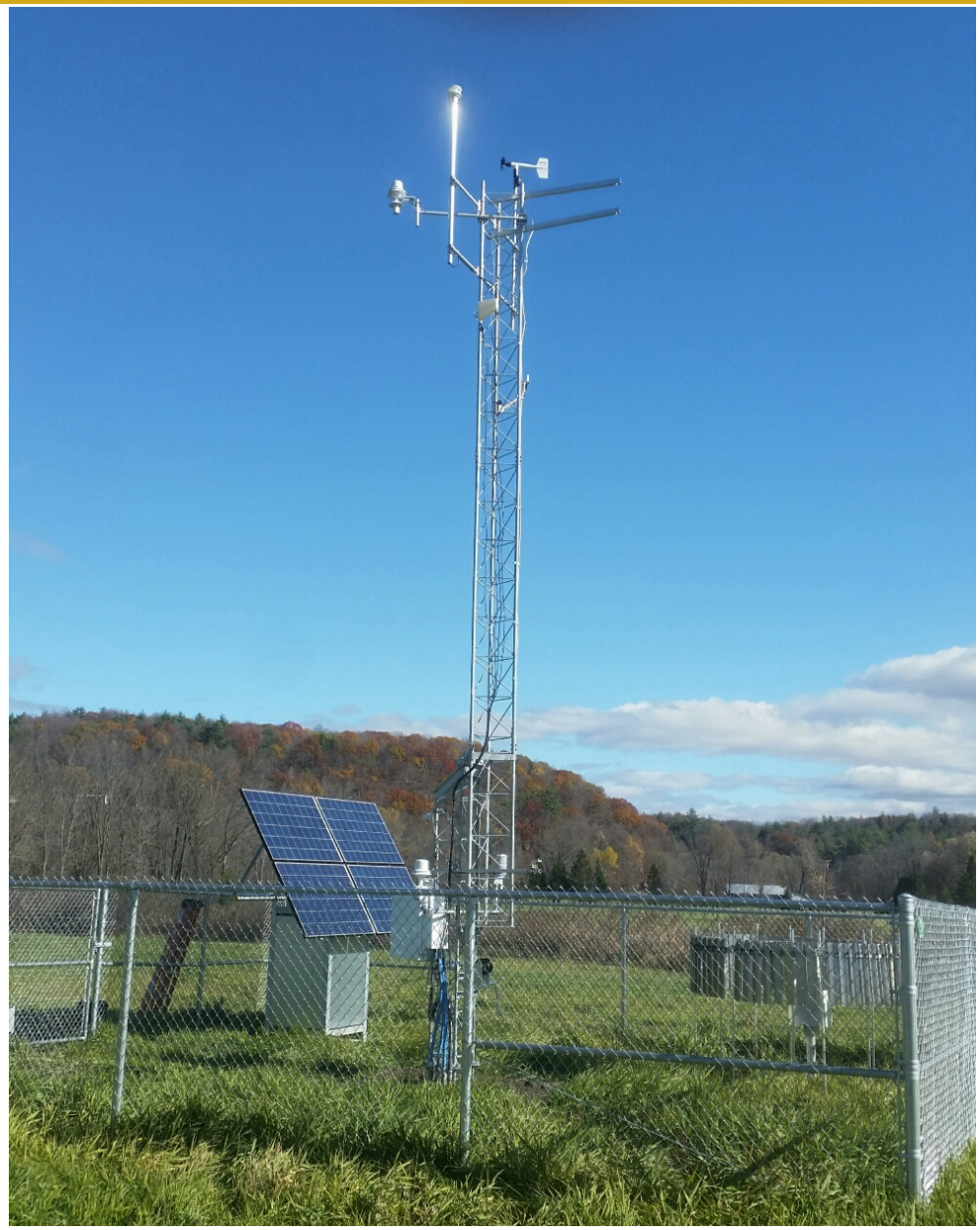


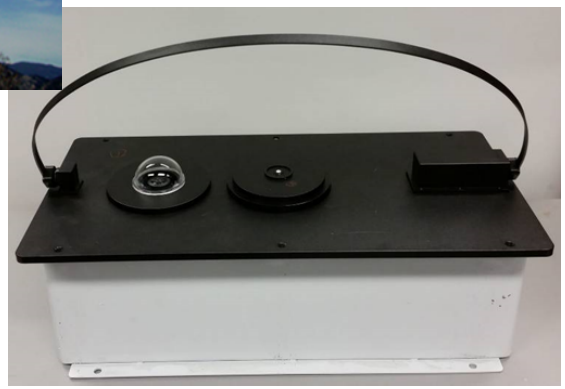
17 Enhanced Station

- **Located within 500 m of Standard Site**

- **LIDARs**
  - Vertical wind profiles up to 3 km AGL
  - Selected RNRG/Leosphere 100S

- **Microwave Radiometers**
  - Vertical temperature and moisture profiles up to 10 km AGL
  - Selected Radiometrics MP-3000A

- **Sun Photometer** (MMR/SSI)
  - Multi-scan Multi-channel Radiometer
  - Shadowband Sky Imager
  - Designed/built by Mesonet/ASRC



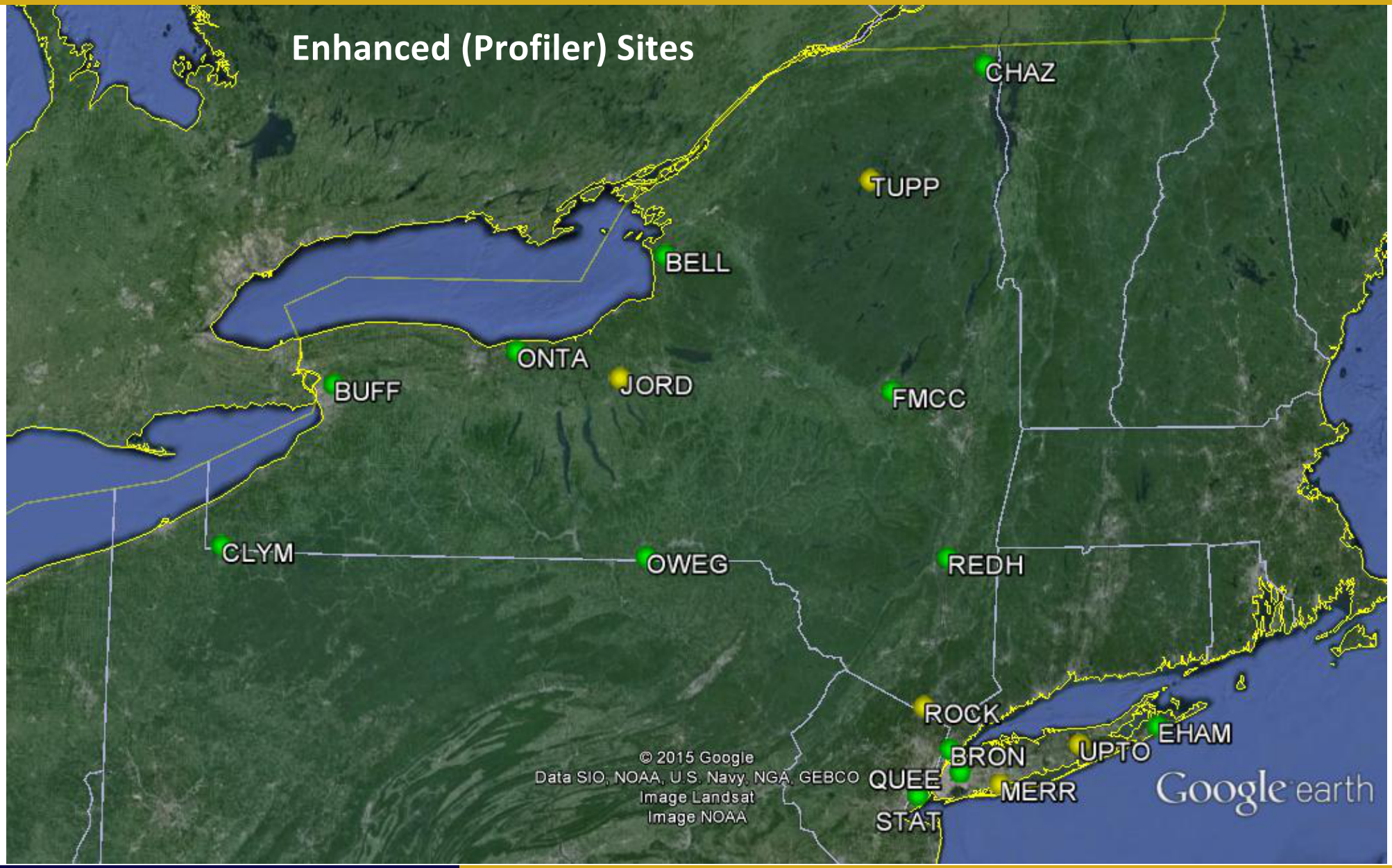
Enhanced Station

Output from Enhanced/Standard data:

- Clear sky/cloud classification --- sky condition
- Accurate radiation (spectral, direct/diffuse)
- Profiles: Temp., RH, Wind, and aerosols
- PBL height, cloud base height, LCL
- Aerosols: AOD & profile, SSA, Angstrom Coefficient
- Clouds: cloud fraction, COD, Effective radius
- Forecast indices (CAPE, k, etc)

Complex process:

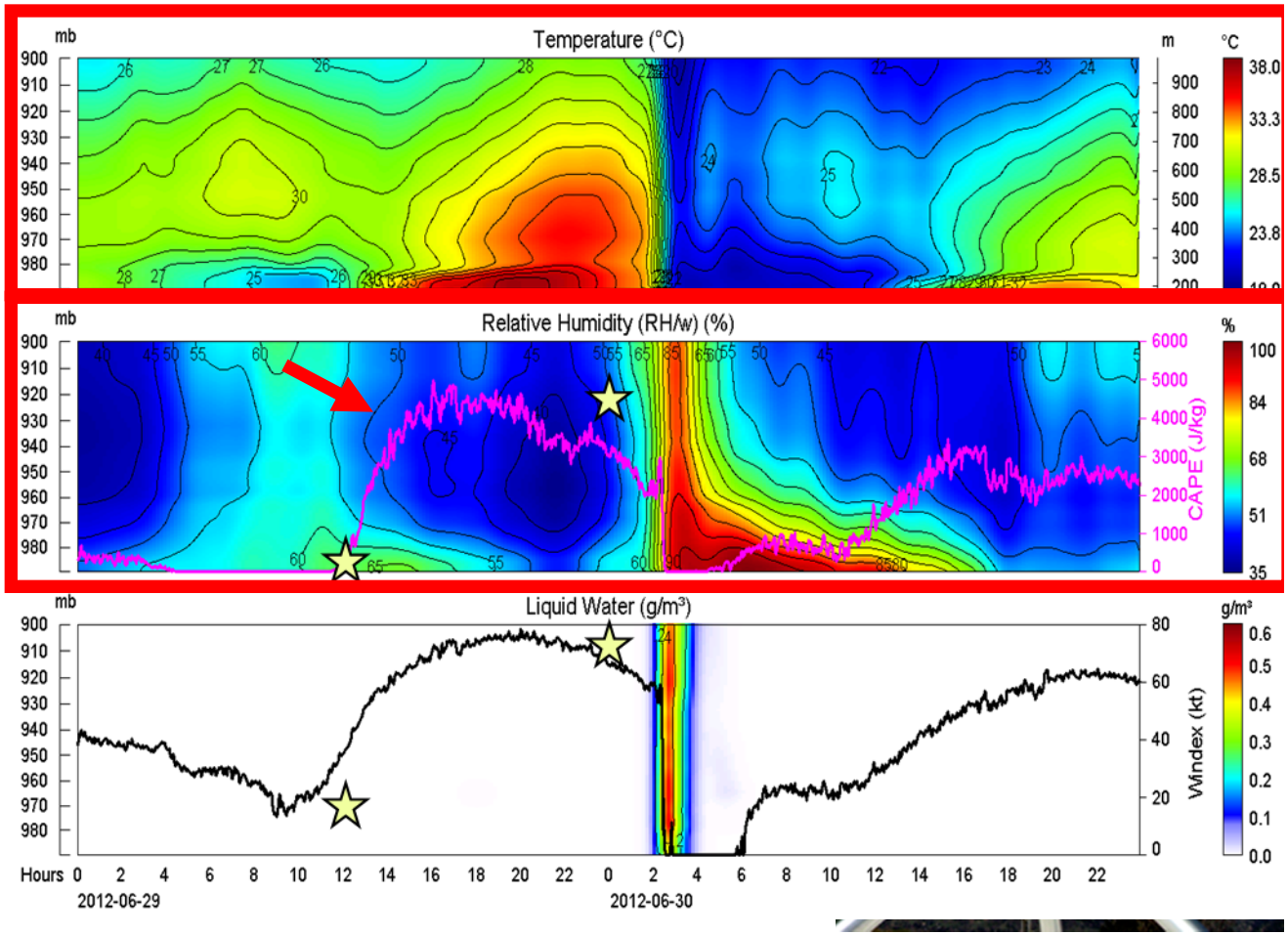
- Characterize measurement, retrieval uncertainties
- Develop robust retrieval algorithms
- Products developed from synergistic retrieval/analysis approach (multiple sensors)


Enhanced (Profiler) Sites
CHAZ
TUPP
BELL
ONTA
JORD
BUFF
FMCC
CLYM
OWEG
REDH
ROCK
EHAM
BRON
UPTO
QUEE
MERR
STAT
© 2015 Google
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image Landsat
Image NOAA
Google earth

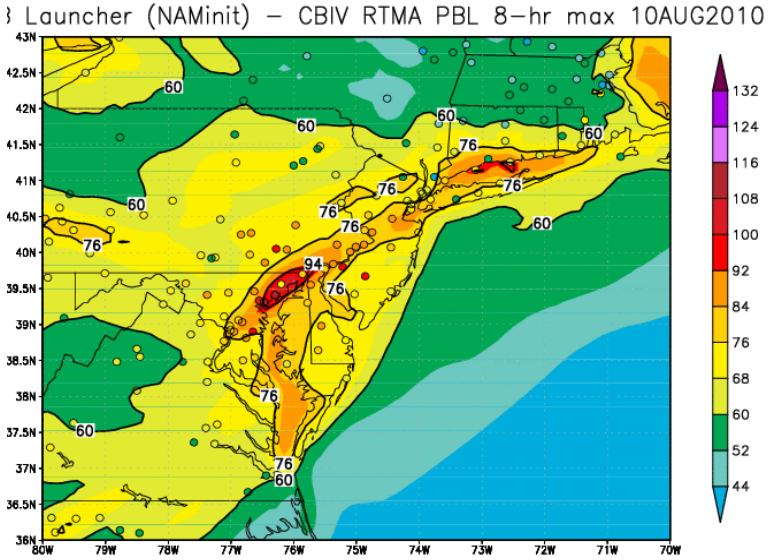
Profiler data of atmospheric temperature and stability

Weather balloon derived CAPE value from 12Z on June 29th evolved from near zero to 3,000 J/kg in just a couple of hours demonstrating the advantage of continuous profiling

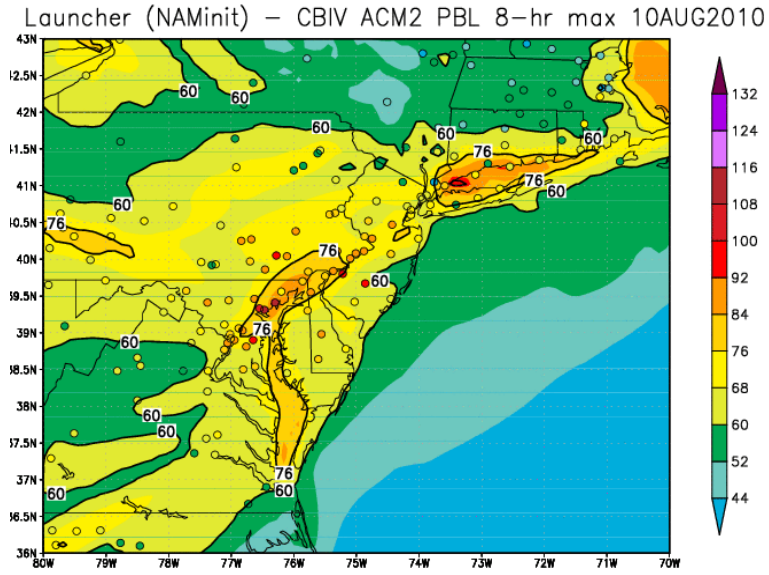
Novakovskaia et al 2013



a)



b)

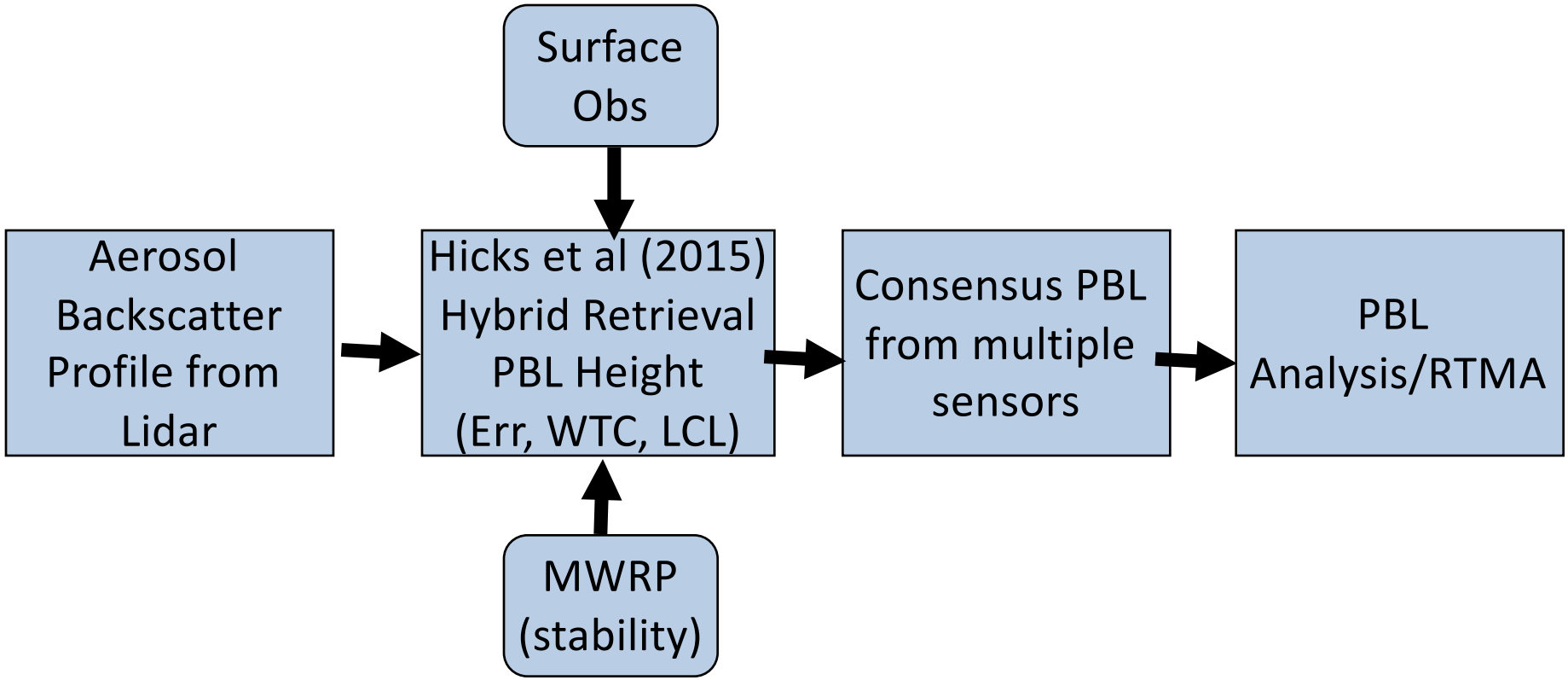


The impact of improved boundary layer on CMAQ ozone forecasts

- Comparison of daily 8hr max ozone prediction from the NAM-CMAQ with the operational CB-IV chemical mechanism to observations from the monitoring networks (e.g., EPA AIRNow, colored circles, ppb) using
  - a) the CMAQ default derived PBL height
  - b) the RTMA PBL height valid August 10, 2010
- The ozone simulation shows improvement over the Baltimore-Washington urban corridor when using the PBL analysis.

Jeff McQueen

Example of product (PBL) developed from multiple sensors and algorithms



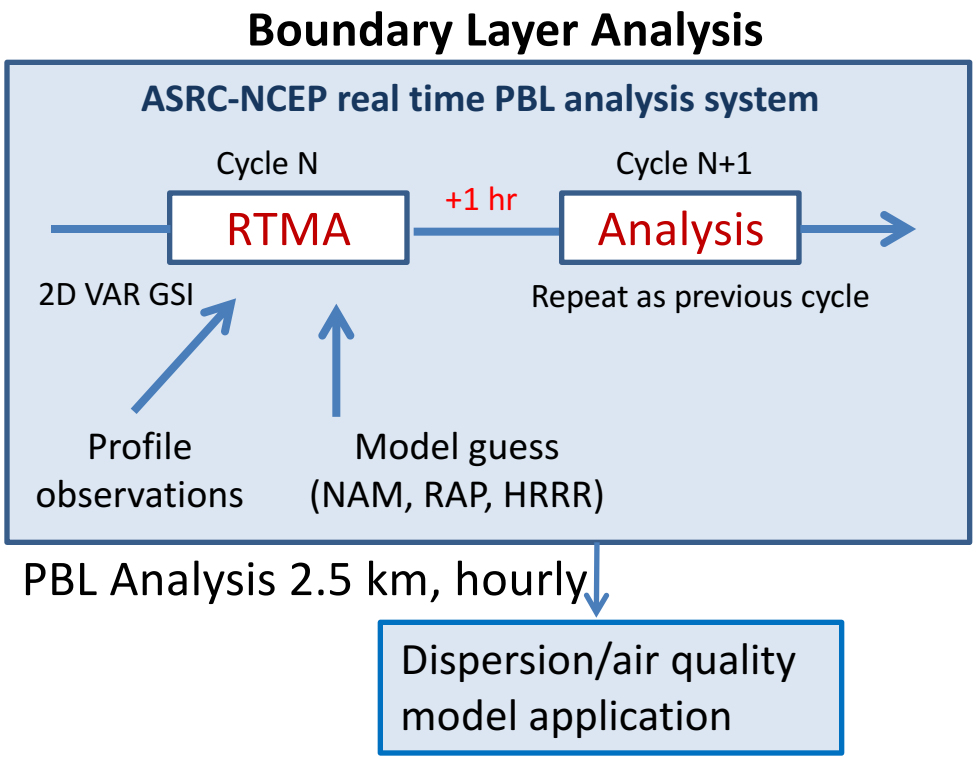
UAlbany/ASRC-NCEP Collaboration on Real-Time PBL Analysis Study

- Developing unified PBL analysis system -- ASRC for NYS and NCEP CONUS

- Leverage prototype PBL analysis established by NOAA-NASA-Howard ROSES project in 2007 (McQueen)

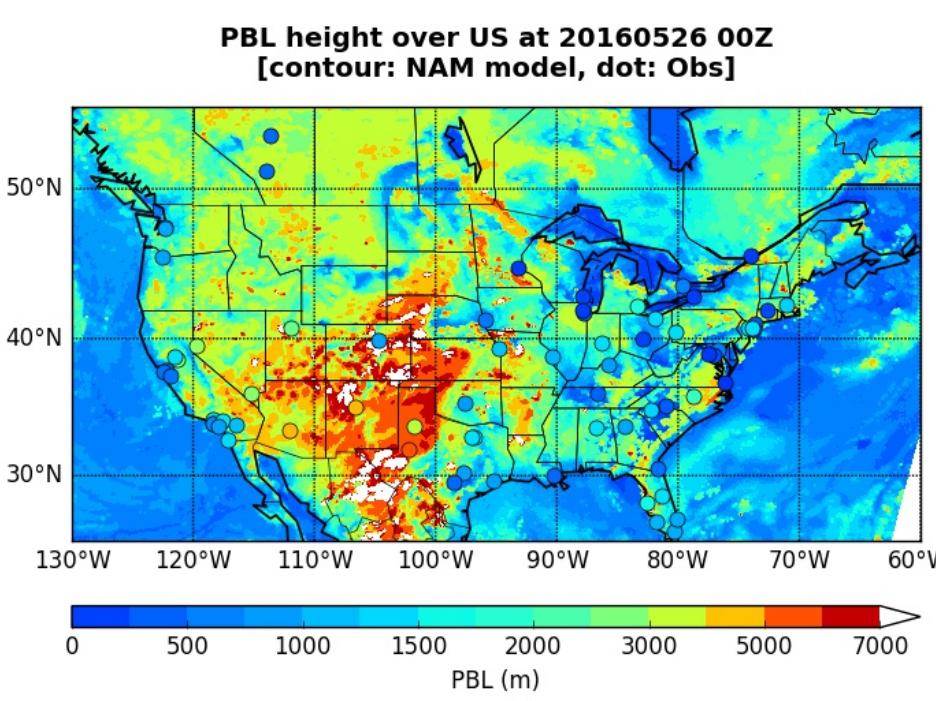
- **Objectives:**
  - Develop near real time PBL products by blending model estimates and multi-platform profile observations (aircrafts, radiosonde, and NYS mesonet).
  - Demonstrate use of NYS mesonet vertical profiles for real-time PBL analysis.
  - Demonstrate the impact of PBL analysis on air quality/dispersion modeling.

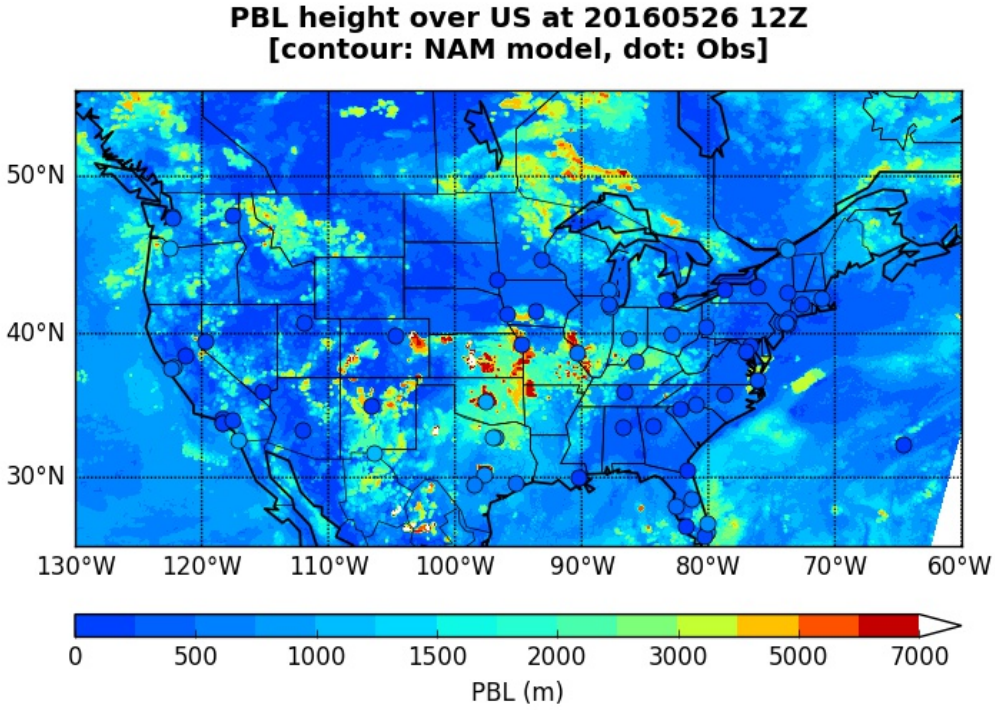
Real-time PBL analysis system using multi-platform profile observations



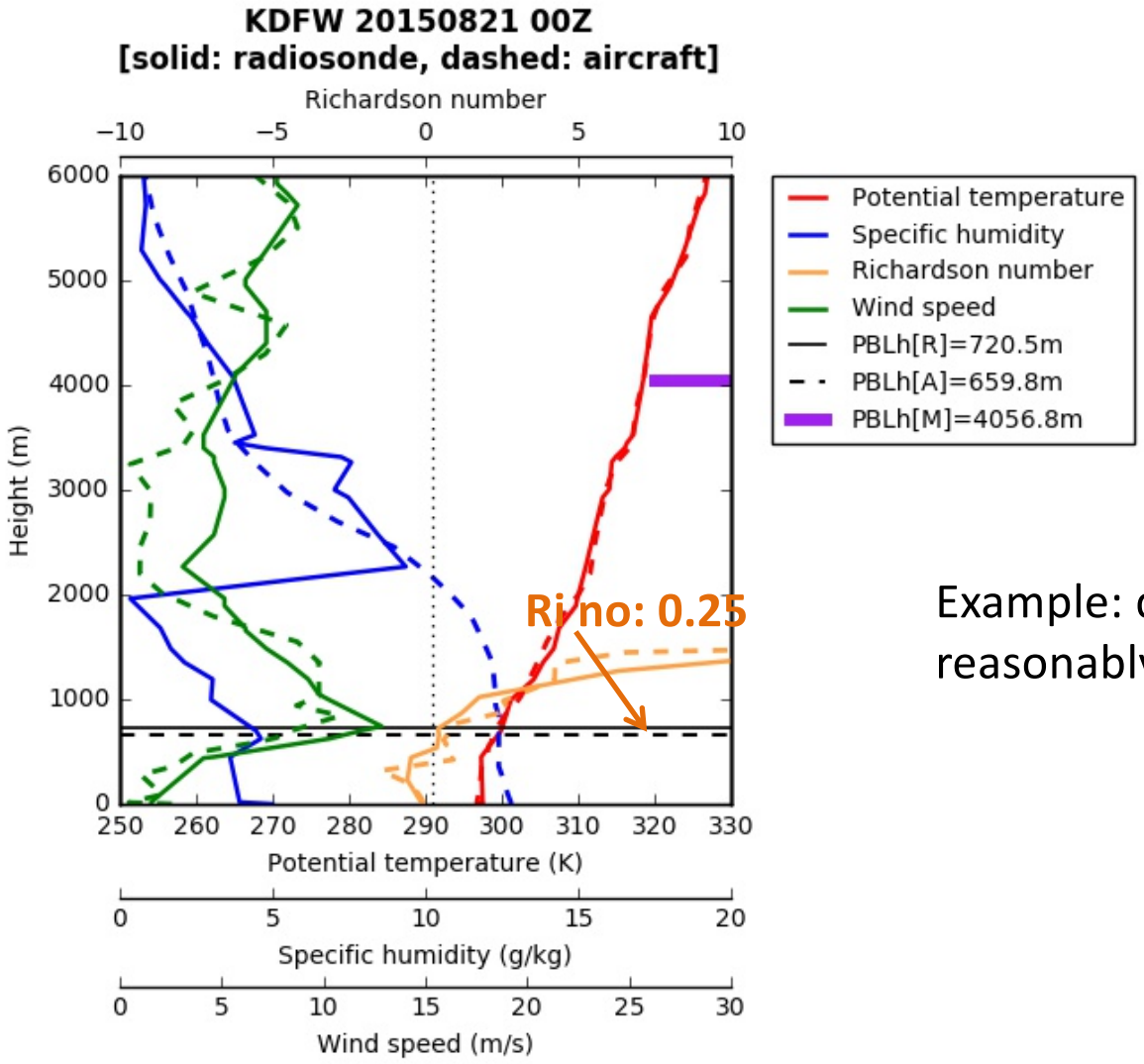
- Derivation of PBL heights from the following observation data:
  - Radiosondes, aircraft profiles, and NYS mesonet lidar profiles
  - optional data: MPLNET lidars, ceilometer, and CALIPSO, if resource is available
- Evaluation of model 1st guess used for RTMA:
  - NAM
  - RAP
  - HRRR
- Assimilation of PBL heights into Real-Time Mesoscale Analysis (RTMA), which is 2D VAR Gridpoint Statistical Interpolation (GSI) analysis system
- Final product will be PBL height analysis (2.5 km resolution, hourly)

PBL heights from NAM model and aircraft observations





PBL height defined using radiosonde and aircraft (Dallas-Fort Worth airport)



Example: defined PBL height reasonably with Ri no.

QUESTIONS, THOUGHTS, COMMENTS

NYS Mesonet
UNIVERSITY AT ALBANY

Jerry Brotzge, PhD
Program Manager
jbrotzge@albany.edu

Chris Thorncroft, PhD
Chair, UAlbany DAES
cthorncroft@albany.edu

Everette Joseph, PhD
Director, UAlbany ASRC
ejoseph@albany.edu