Implementation Of A Data Assimilation System In Conjunction With The New York State Mesonet

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Presentation Overview

• Introduction of the New York State Mesonet
• Incorporation of Numerical Weather Prediction
• Examination of a test case: 10\textsuperscript{th}-20\textsuperscript{th} February 2016
• Conclusions
Overview of the New York State Mesonet

- Originally inspired by flooding events relating to Hurricane Irene and Tropical Storm Lee of 2011
- Funding was eventually allocated as part of the Sandy Supplemental relief bill (after Hurricane Sandy (2012))
Overview of the New York State Mesonet

Standard Observations (125 Sites):
- 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

Additional Observing Networks
- Vertical Profiler Network (Microwave Radiometer, LIDAR) – a first!
- Snow Network (Depth, Water Equivalent)
- Flux Network (~17 – TBD)
Numerical Weather Analysis & Prediction

• A 512 core computing cluster will soon be made available to the NYS Mesonet for real-time operations

• One primary goal will be to create high temporal (~1 h) and spatial (~3 km) resolution analyses for the state of New York

• This will be done within a WRF/DART framework

• Eventually, short-term forecasts may be incorporated, computer-permitting
Current Expected Configuration

• Two domains – 15 km & 3 km, with 56 members
• Perturbed GFS boundary conditions
• Physics:
  – Goddard MP, MYJ PBL, Noah LSM, RRTM & Dudhia radiation (chosen after testing high-impact test cases)
• Inputs:
  – ACARS, METAR, Radiosonde, SSEC Satellite Wind, Marine, (NYS) Mesonet, possibly Radiometer/Lidar as available (future?)
Inner and Outer Domains (15/3 km)
Current Experiment Configuration

• Outer domain only (15 km)
• Perturbed GFS initial conditions and boundary conditions unique to each member and each cycle
• Perform 3 hourly assimilation cycles
  – Adaptive Anderson Inflation
  – Gaspari Cohn localization, .05 (~600 km) horizontal localization
• Inputs for **Experiment 1**:  
  – ACARS, METAR Altimeter, Radiosonde, SSEC Sat Winds, Marine  
  – Evaluate Only: NYS Mesonet, Metar wind/temp
• Inputs for **Experiment 2**:  
  – Experiment 1 + NYS Mesonet winds/temp
• Using METAR obs as “truth” will allow us to assess the impact of adding NYS Mesonet data
• Only the final 9 days will be used for comparison purposes
NY
METAR_U_10_METER_WIND @ 1 surface

- Exp 1 Posterior
- Exp 2 Posterior

analysis rmse

# of obs (o=possible, *=assimilated)

10–Feb–2016 22:30:01 through 20–Feb–2016 01:30:00
Experiment 1 (left)  
Experiment 2 (below)  

1°x1° Binned METAR Biases
NY Area Biases (a-o):
Exp. 1  ->  Exp. 2
0.1131° C  ->  0.0983° C
Experiment 1 Mesonet Temperature Biases (a-o)
Experiment 1 Mesonet Temperature Biases (a-o)
WHIT
LAND_SFC_TEMPERATURE @ 1 surface
forecast: mean=−0.14764  analysis: mean=−0.045191
SCHU
LAND_SFC_TEMP @ 1 surface
forecast: mean=1.3009  analysis: mean=1.3645
Conclusions

- Data from the NYS Mesonet, currently undergoing installation, will be used in conjunction with other data sources to create high-quality analyses for New York.
- *Very* preliminary tests suggest possible value added by this data, but significant work remains to be done.
- Future work:
  - Test additional cases (the current Mesonet has > 2x sites)
  - Add inner domain to test cases
  - Understand observation error characteristics of different Mesonet data (bias and observation error)
Actual Mesonet temperatures were between -25°C and -34°C across the state.
Experiment 1: Acars Temperature
Experiment 2: Acars Temperature

ACARS_TEMPERATURE

# of obs (o=possible, *=assimilated) x1000

- bias pr=-0.22046
- bias po=-0.12774

- rmse pr=1.2046
- rmse po=1.0702

- totalspread pr=1.3573
- totalspread po=1.2793

Data file: /network/rit/lab/tornlab_rit/kylo/work/rundir/experiment2/obs_diag_output.nc
Experiment 1 (left)
Experiment 2 (right)
Metar zonal wind
Test Case Overview

• February 10-20\textsuperscript{th} was an extremely active period across NY
• February 13-15\textsuperscript{th} was noteworthy for extreme cold weather (as cold as -30° F across operating mesonet sites)
• February 15-16\textsuperscript{th} featured a dramatic “warm-up” as temperatures rose across the state roughly 60° F from their lows just 36 hours earlier
• This was accompanied by significant precipitation, ranging across a number of types (FZRA, RA, SN)
• After a brief cool-down, the 19-20\textsuperscript{th} experienced strong southerly winds, with portions of the state reaching 60° F