

Evaluating Tools for Diagnosing & Nowcasting Precipitation Type & Freezing Rain: Results from the 3–4 February 2022 Winter Storm in the Hudson Valley

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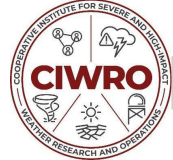
a
b
d



c



e



f

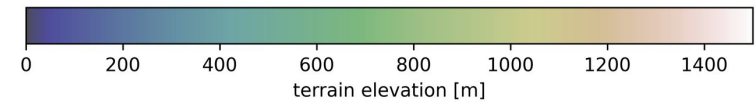
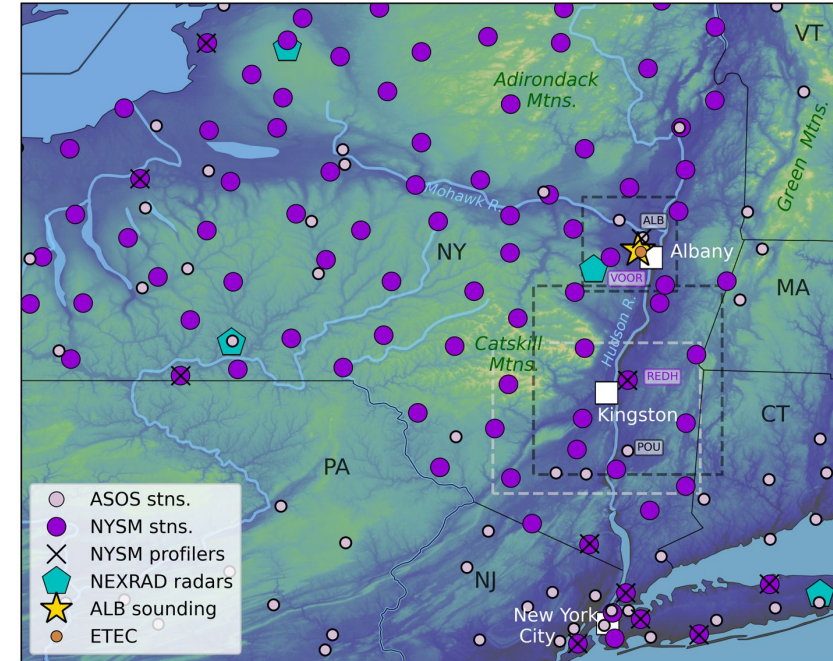


'Ground zero': More than 47,000 Central Hudson customers lost power in Ulster County



Lucas Avenue by Forsyth Park in Kingston on Friday, Feb. 4, 2022. (William Marchetti photo)

Lucas Avenue by Forsyth Park in Kingston on Friday, Feb. 4, 2022. (William Marchetti photo)

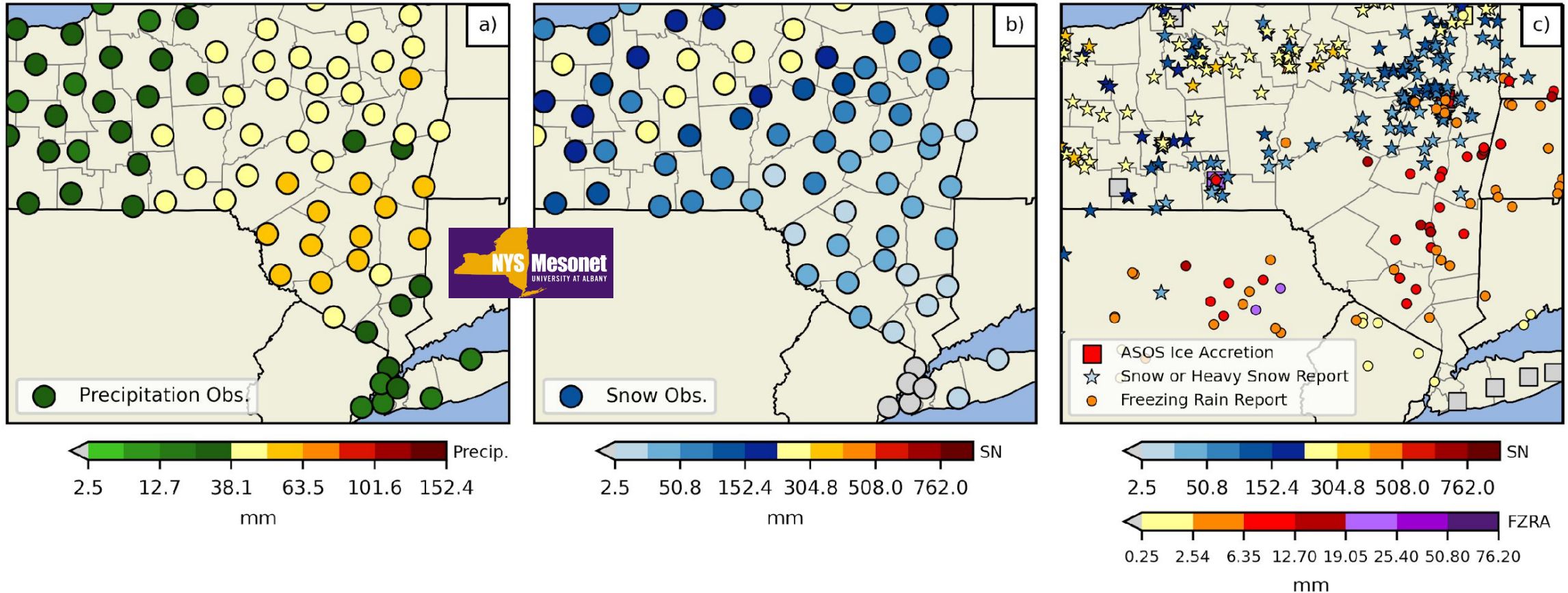


By **DAILY FREEMAN**

UPDATED: February 4, 2022 at 8:28 PM EST

Storm-total accumulations

0000-1800 UTC 4 February 2022

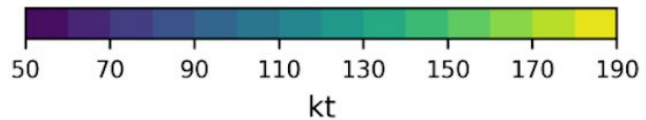
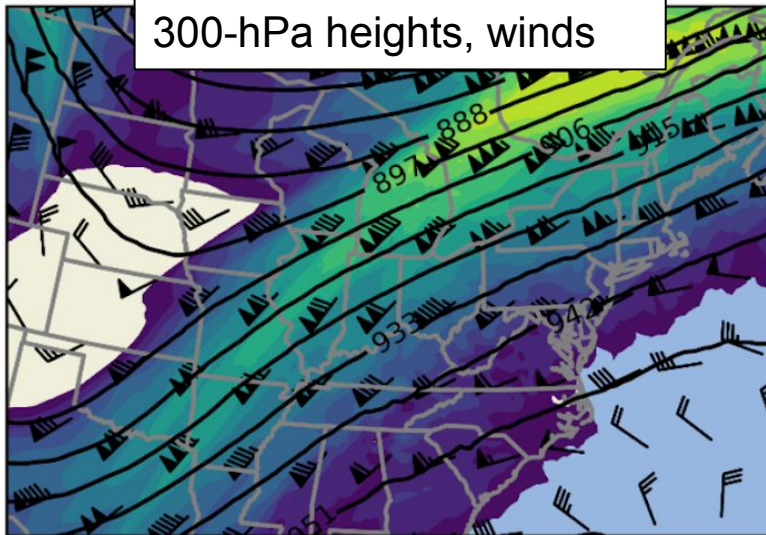


Synoptic setting

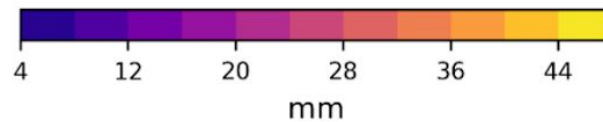
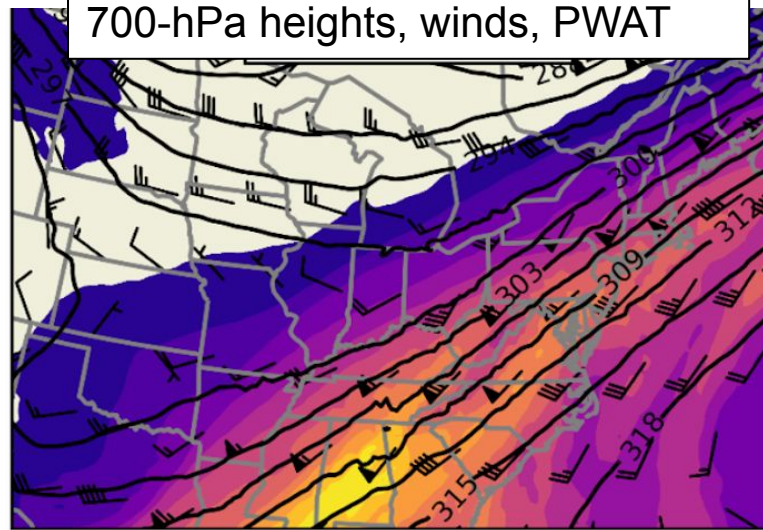
GFS analysis

0000 UTC 4 February 2022

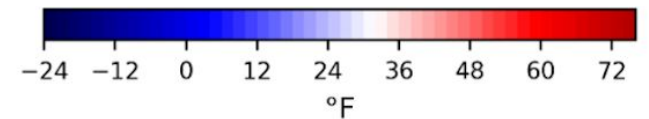
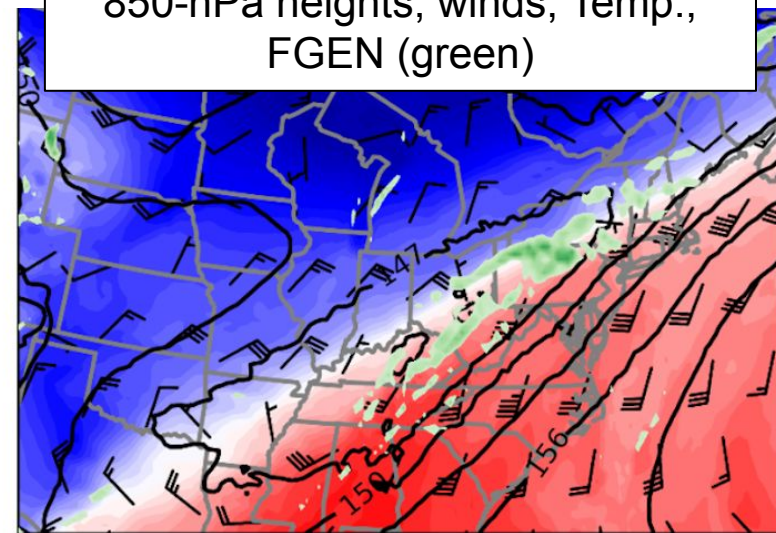
300-hPa heights, winds



700-hPa heights, winds, PWAT

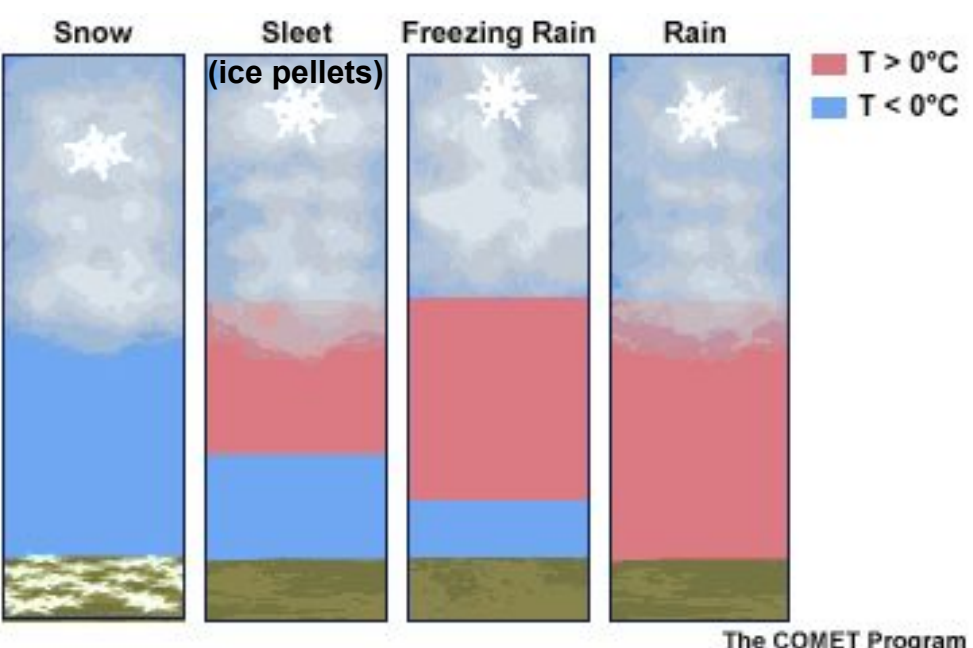
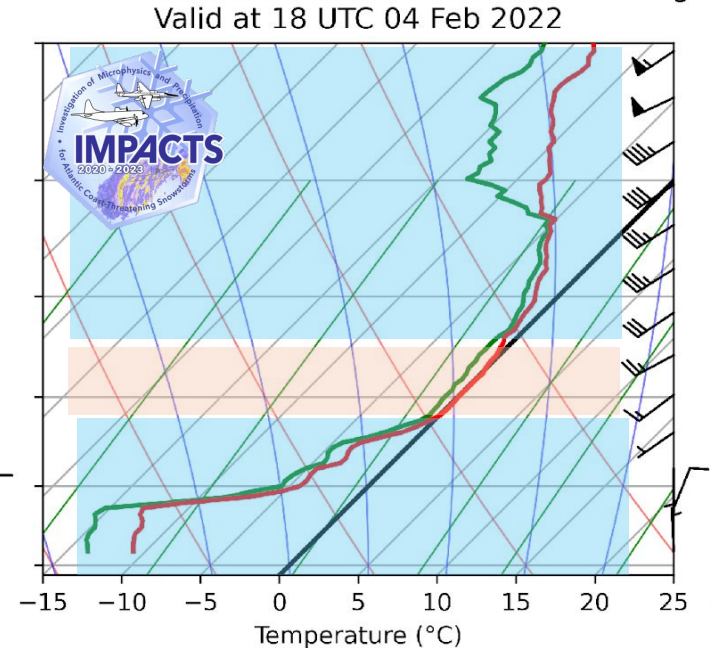
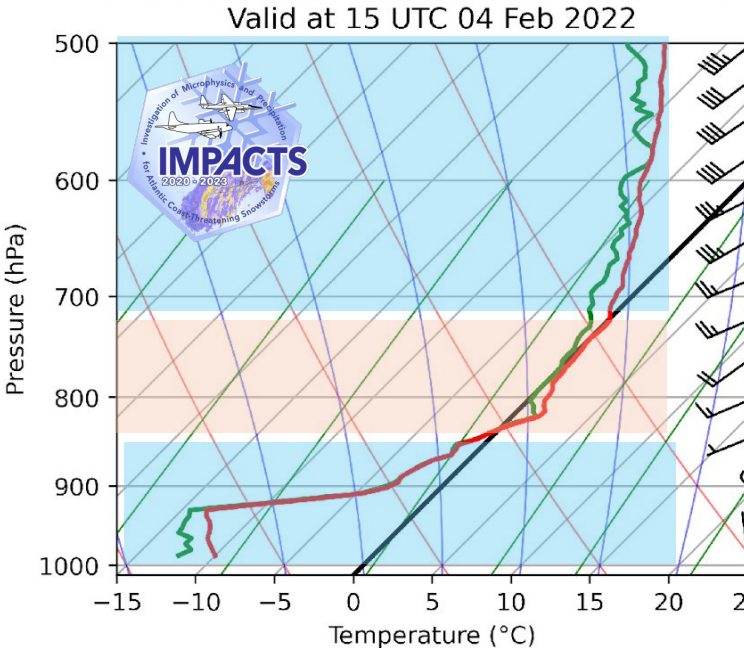
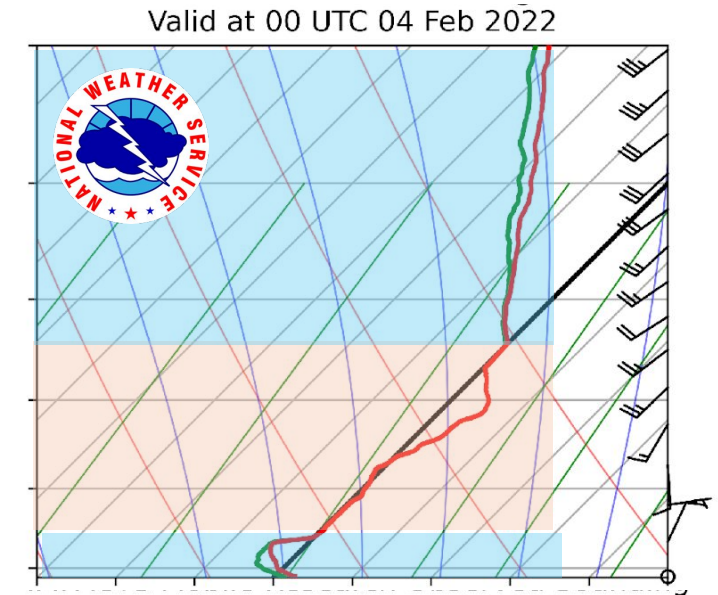
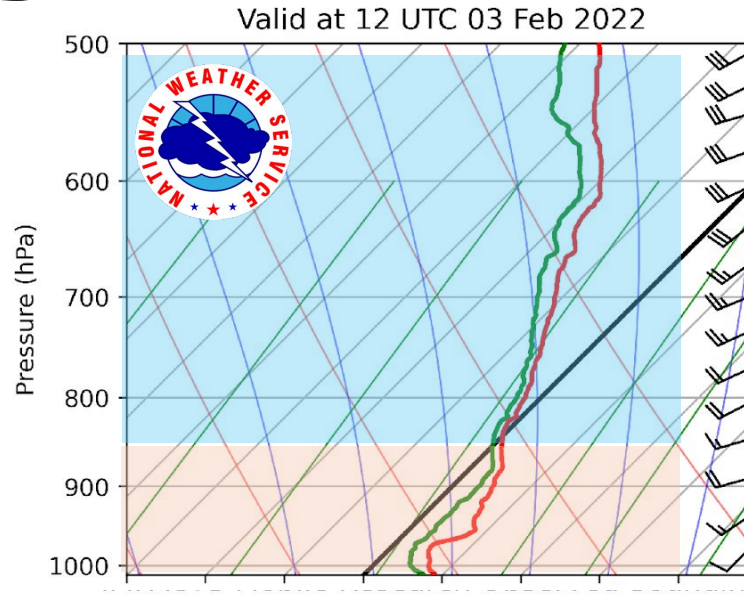


850-hPa heights, winds, Temp.,
FGEN (green)



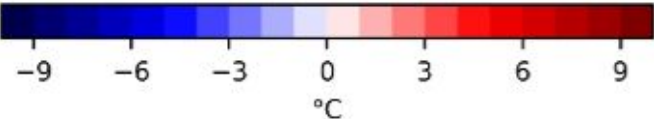
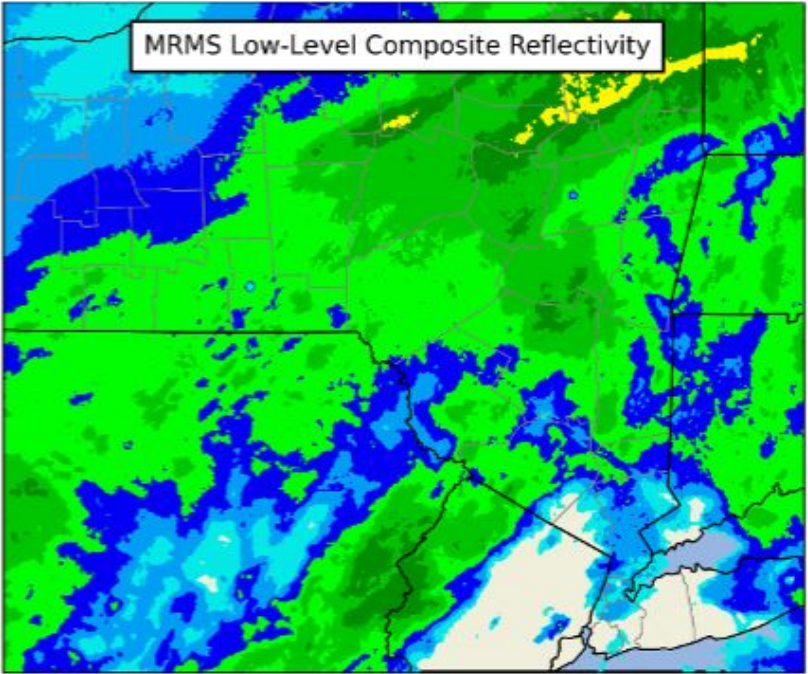
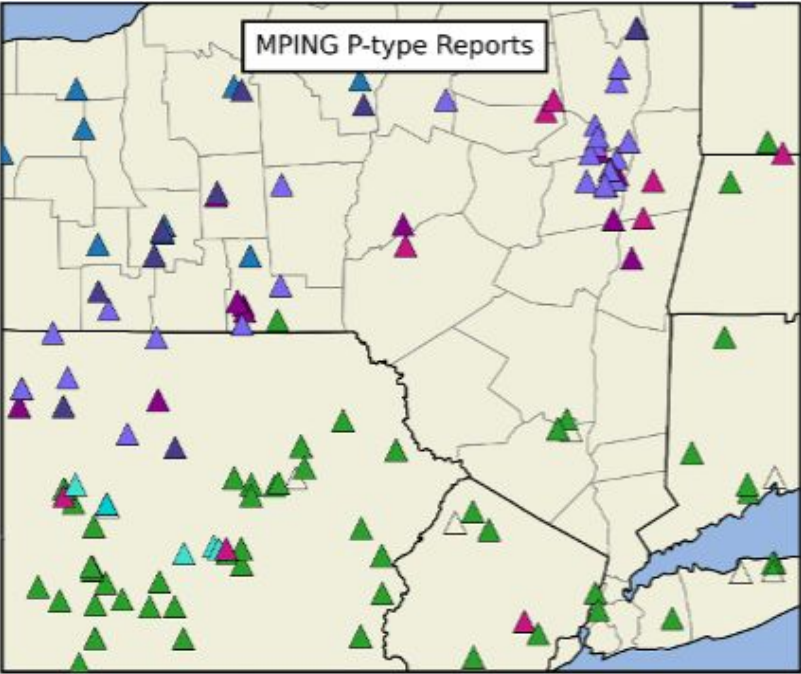
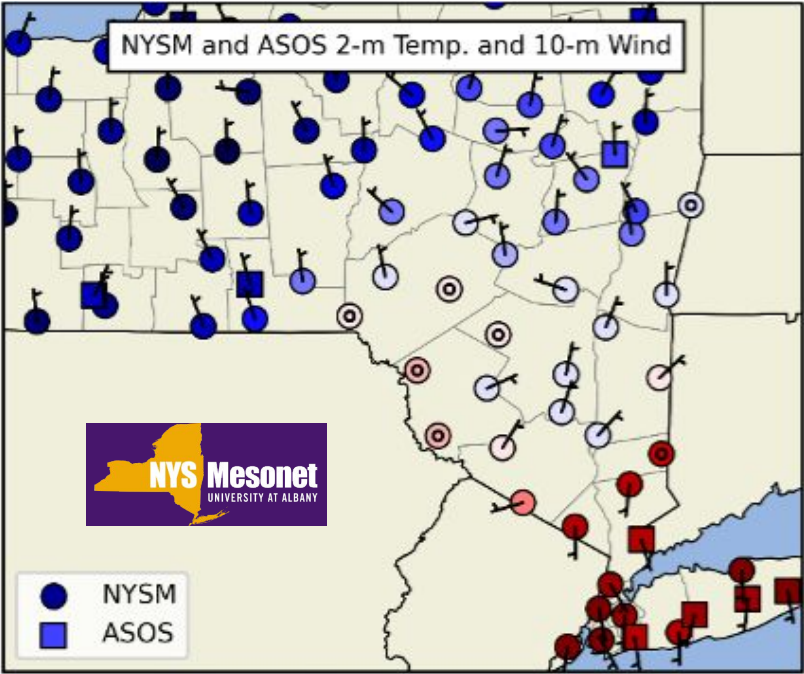
Observed soundings

Albany, NY

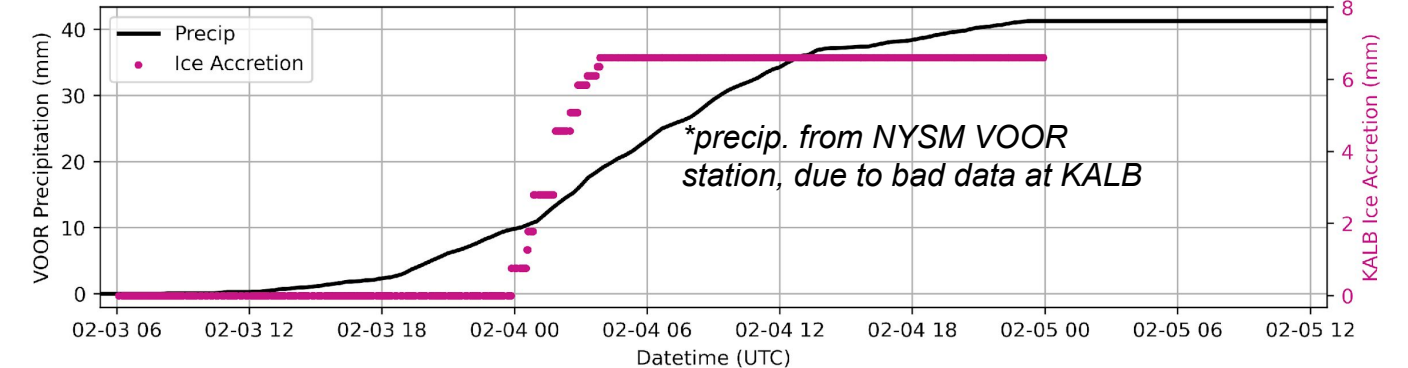
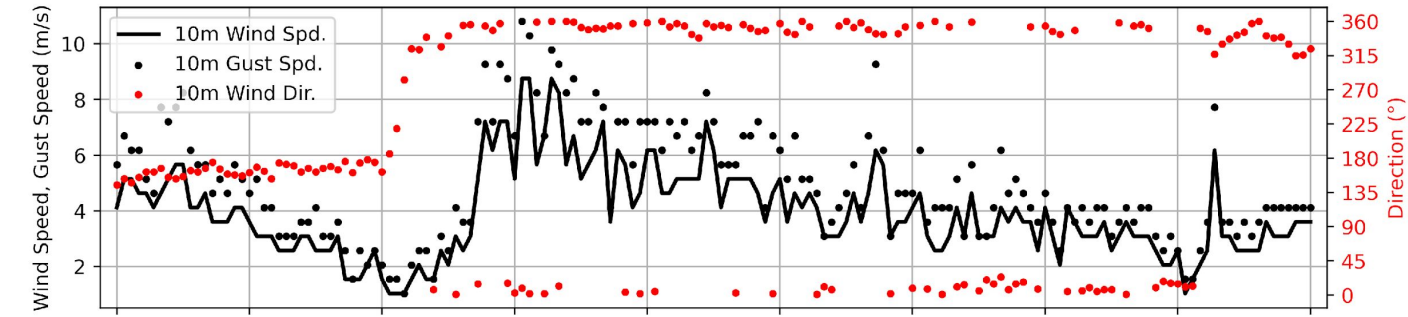
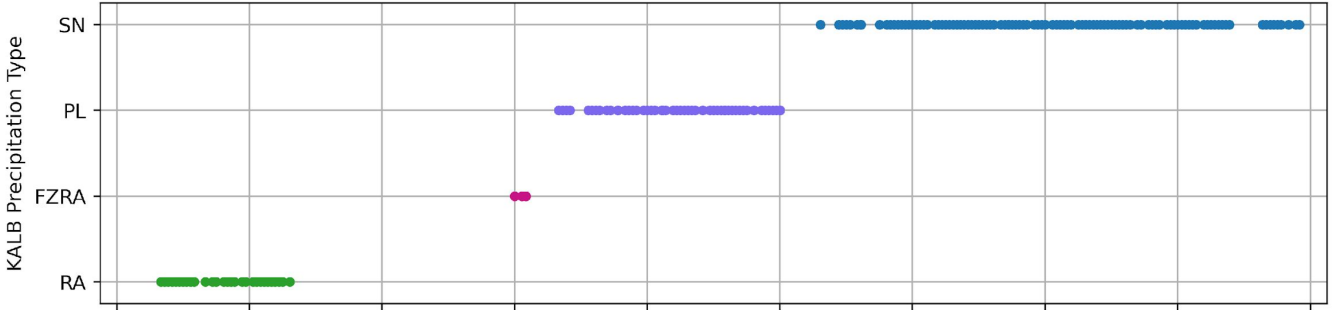
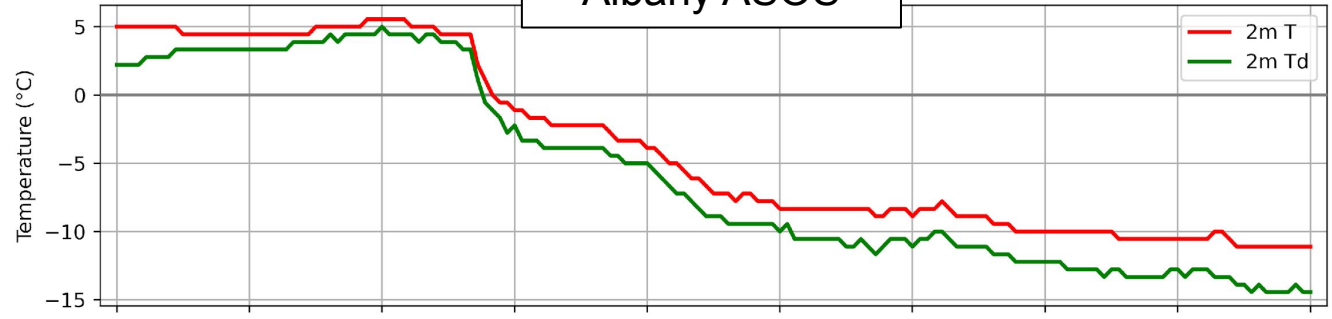


Mesoscale structures

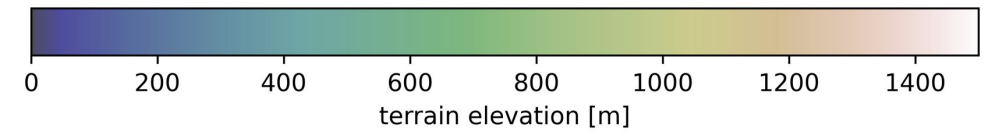
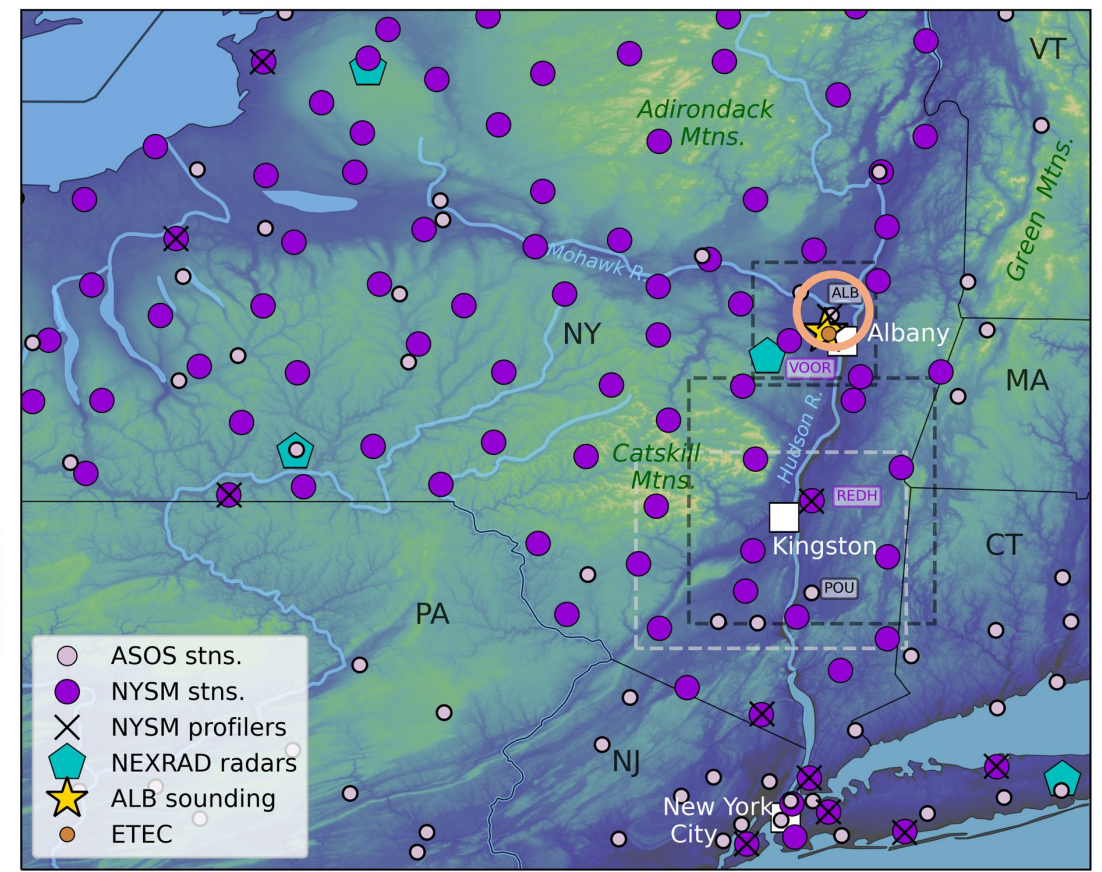
0600 UTC 4 February 2022



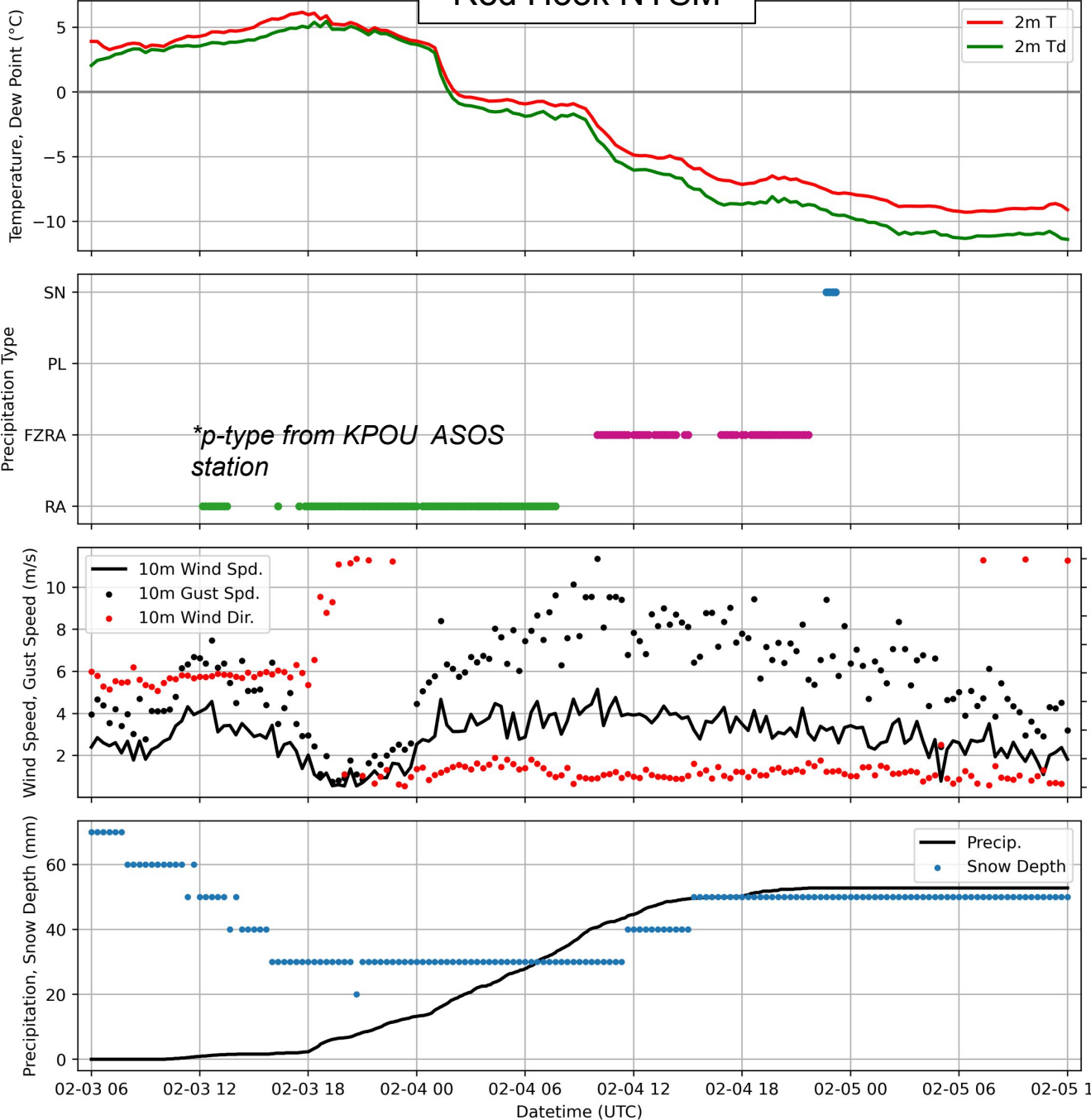
Albany ASOS



Temporal evolution *Albany ASOS*

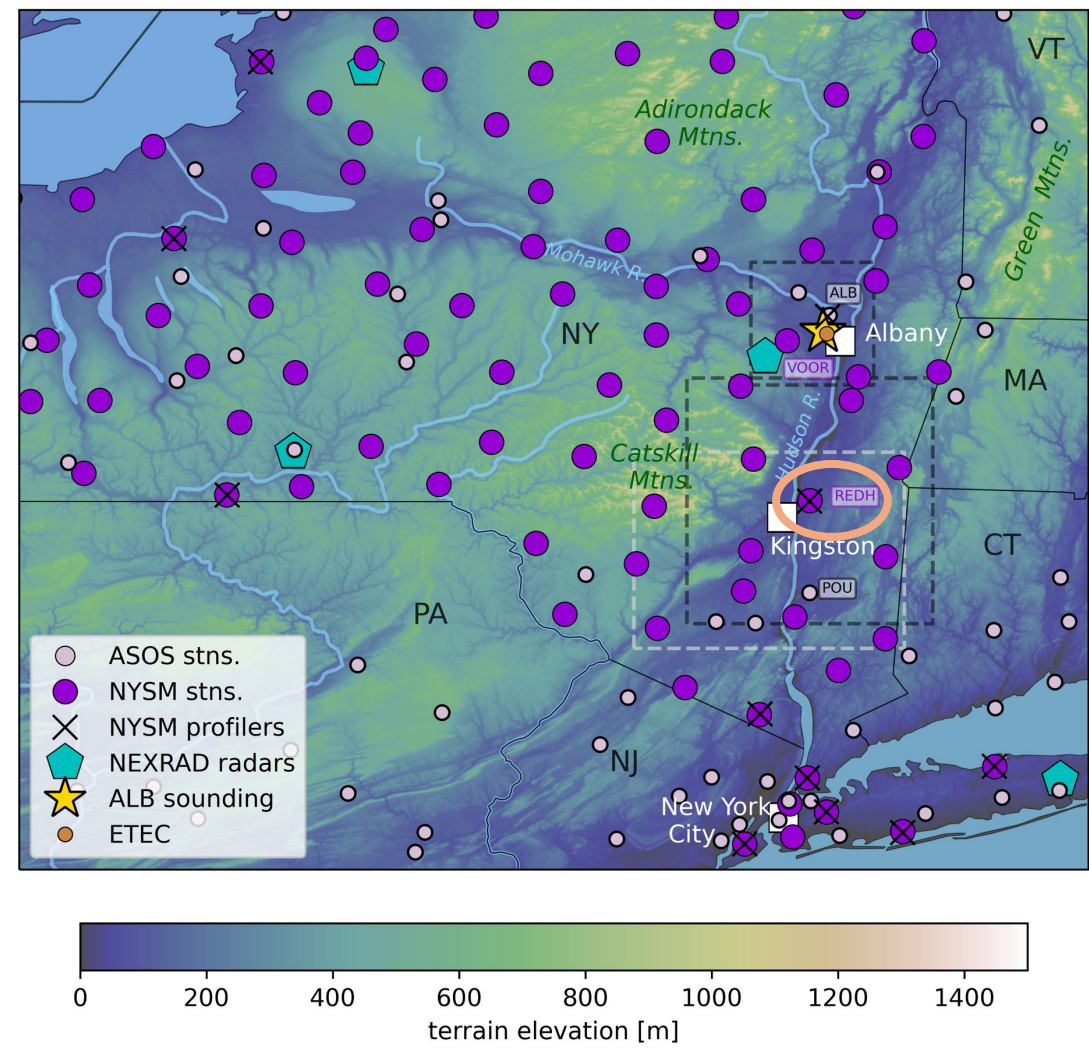


Red Hook NYSM



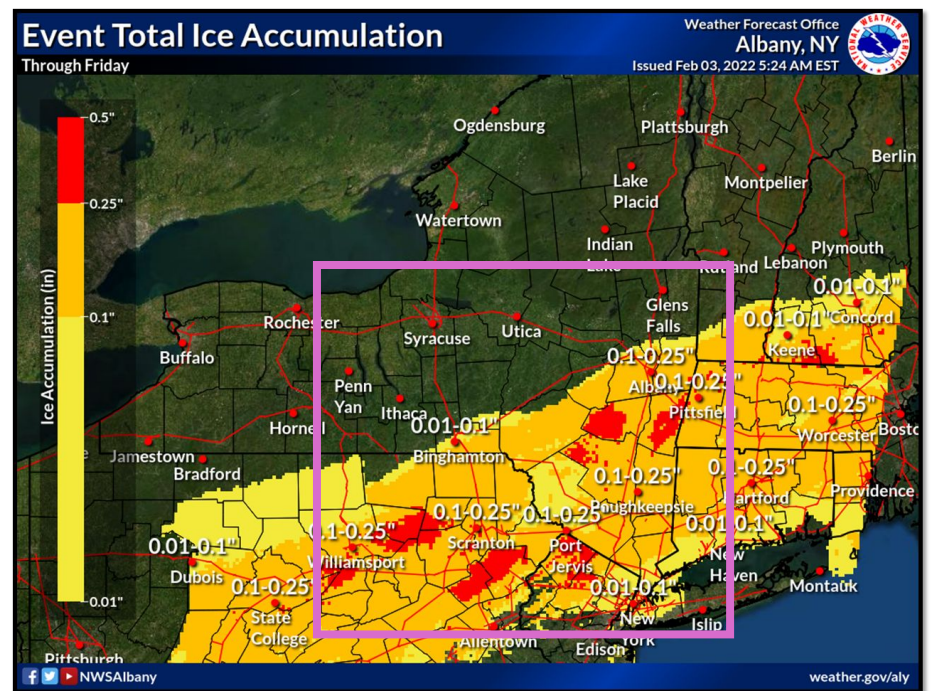
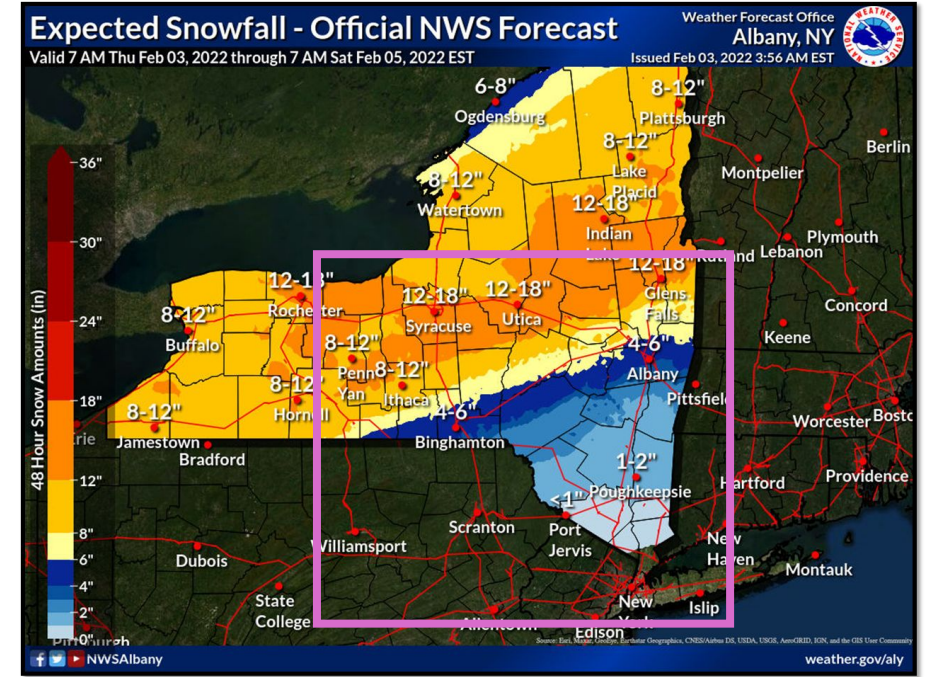
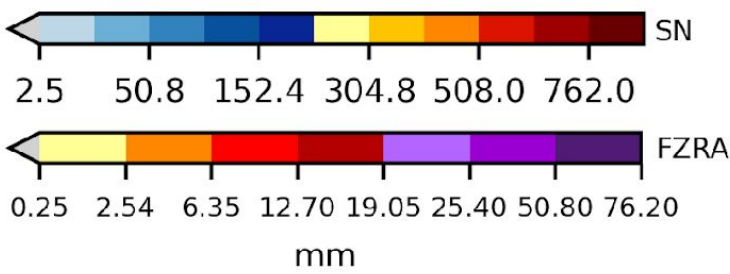
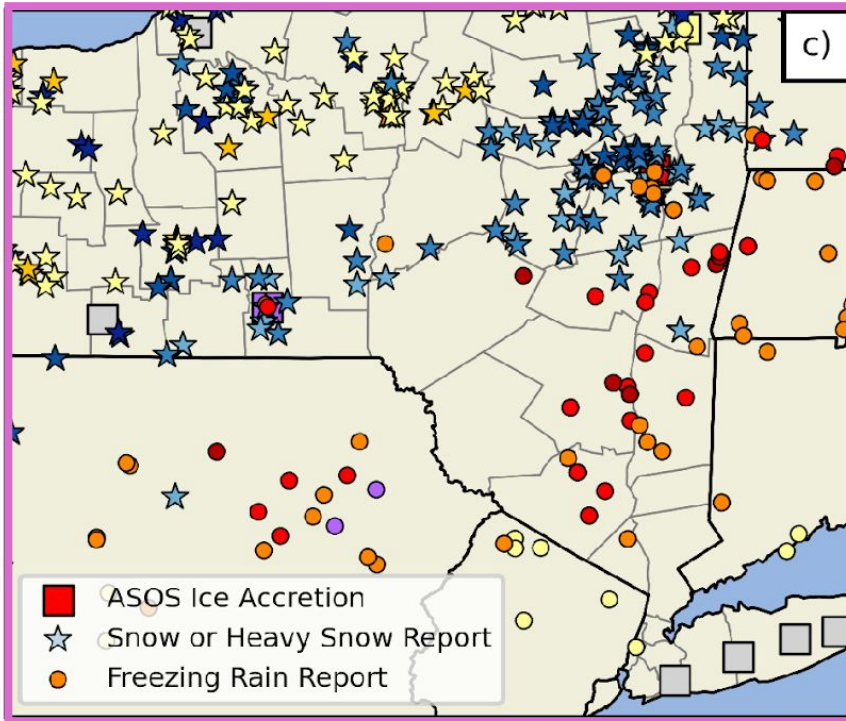
Temporal evolution

Red Hook NYSM



NWS Forecast

Snowfall & ice accumulation



New products to aid in nowcasting?

NYSM-based products

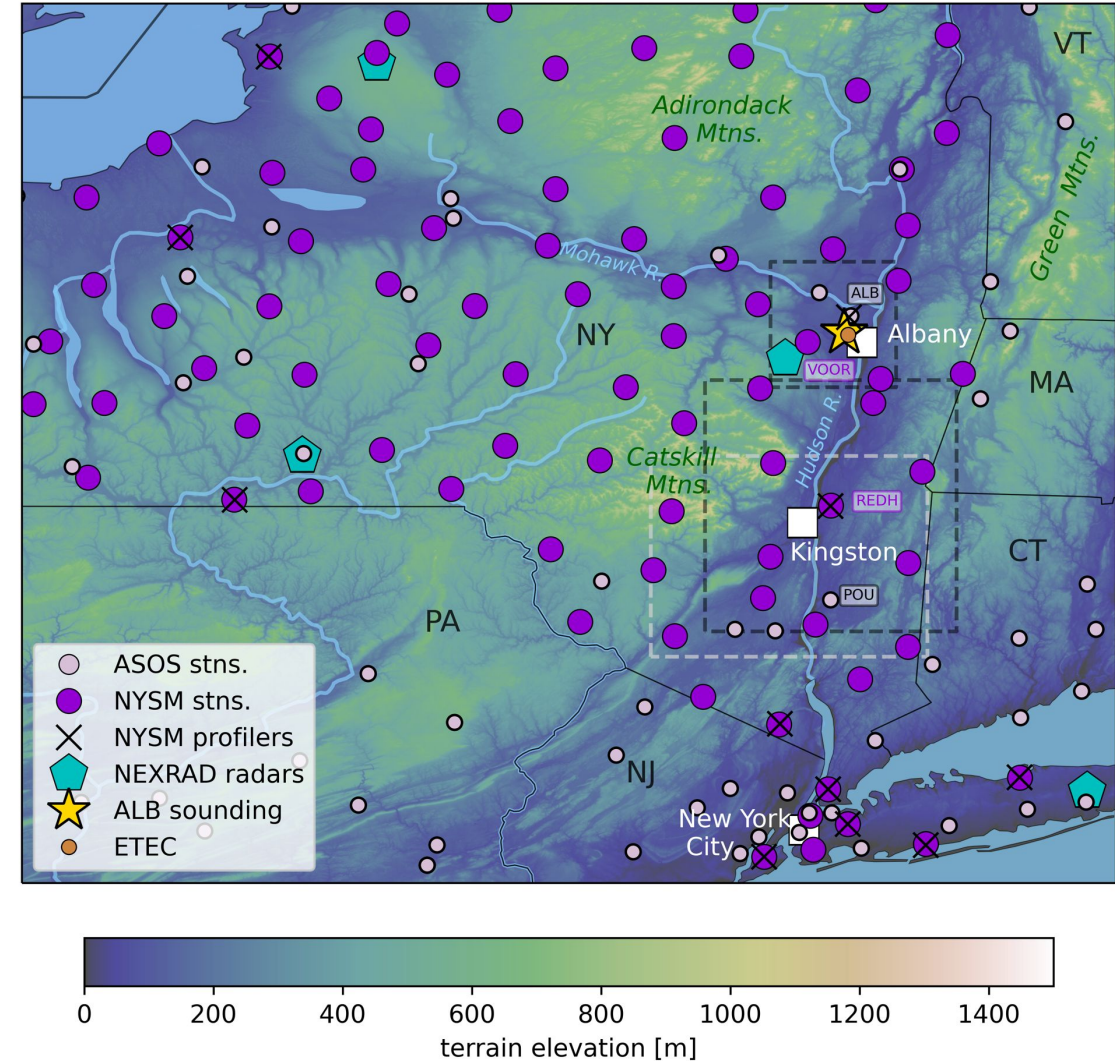
- Standard station **p-type**
 - Uses: *T*, *precip.*, *snow depth*, *sonic & prop. wind speeds* (Wang et al. 2021)
 - SN, RA, FZRA, (no PL)
- Standard station **ice accumulation**
 - Uses: *T*, *RH*, *precip.*, *wind*, *FRAM model* (Sanders & Barjenbruch 2016)
 - Only applied when p-type = FZRA (from above method)
- Profiler station **p-type** (Shrestha et al. 2023)
 - Uses: *microwave radiometer T(z)*

NSSL gridded products

- Spectral Bin Classifier (SBC) **p-type** (Reeves et al. 2016)
 - Uses: *MRMS QPE*, *1-h HRRR forecasts*
- Freezing Rain National Analysis (FRANA) **ice accumulation**
 - Uses: *SBC p-type*, *MRMS QPE*, *HRRR analyses*, *FRAM*

Machine learning model

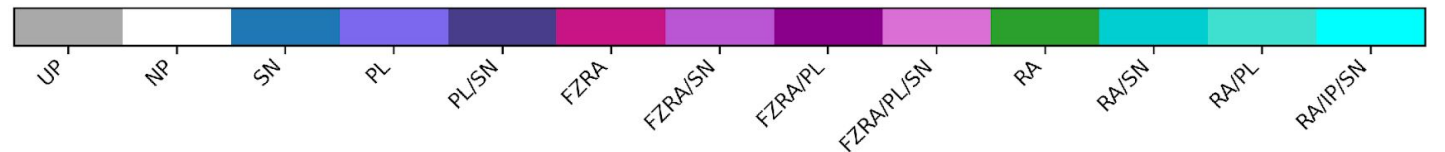
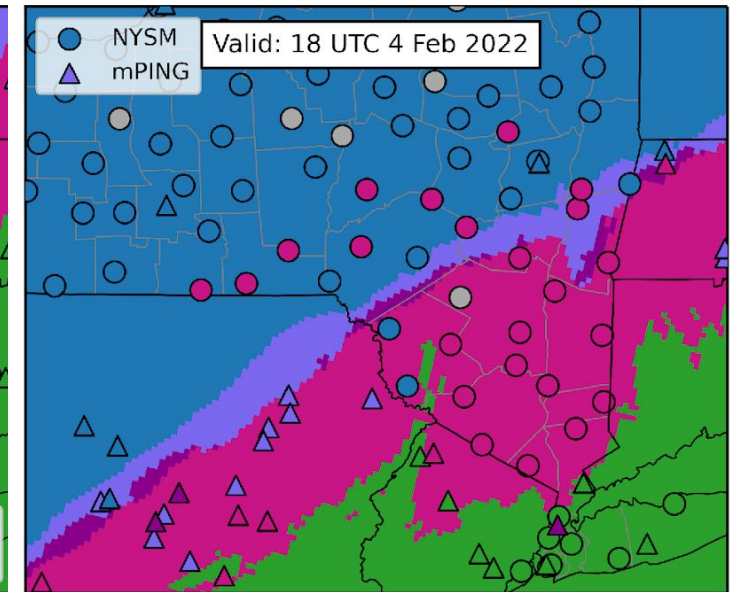
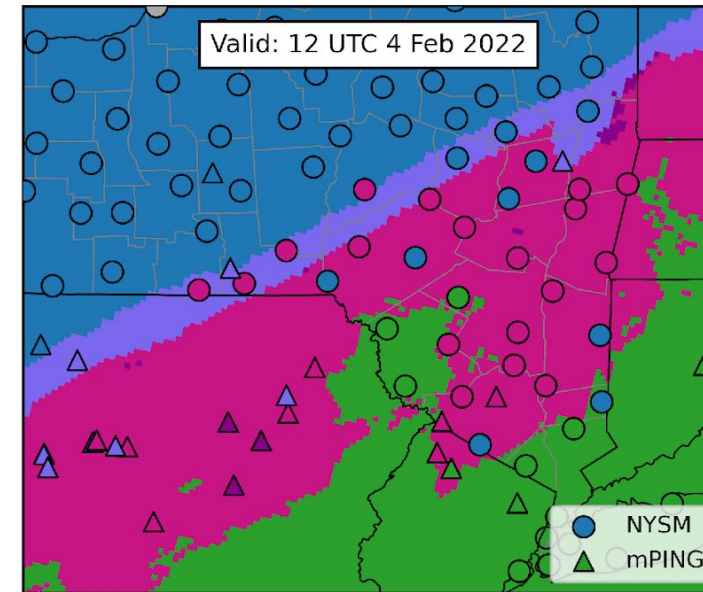
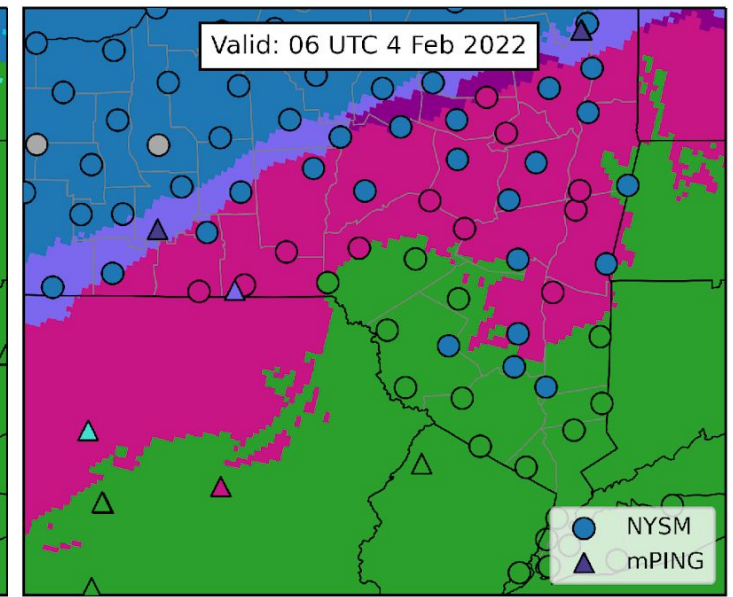
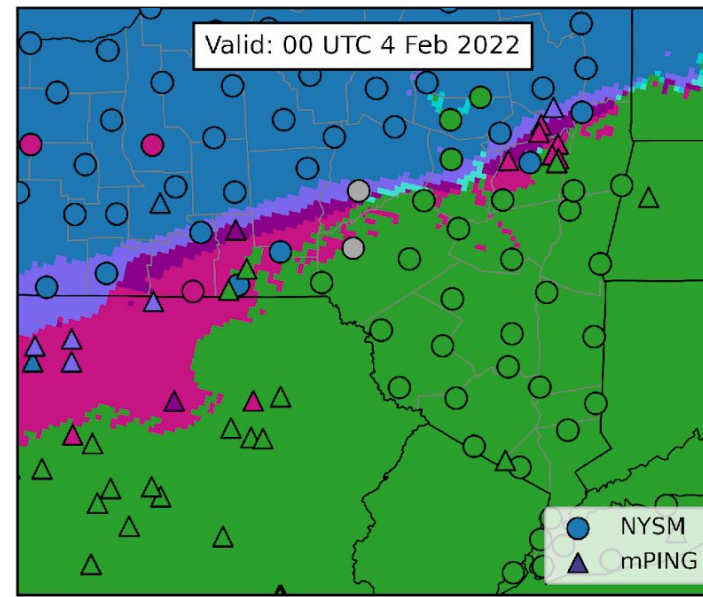
- Random forest **p-type** model (Filipiak et al. 2023)
 - Trained on CoCoRaHS observations
 - Uses: *NYSM station data*, *short-term NAM forecasts*



Comparing products

NYSM (standard) & SBC p-type

[vs. mPING]
lack of ground truth makes verification difficult

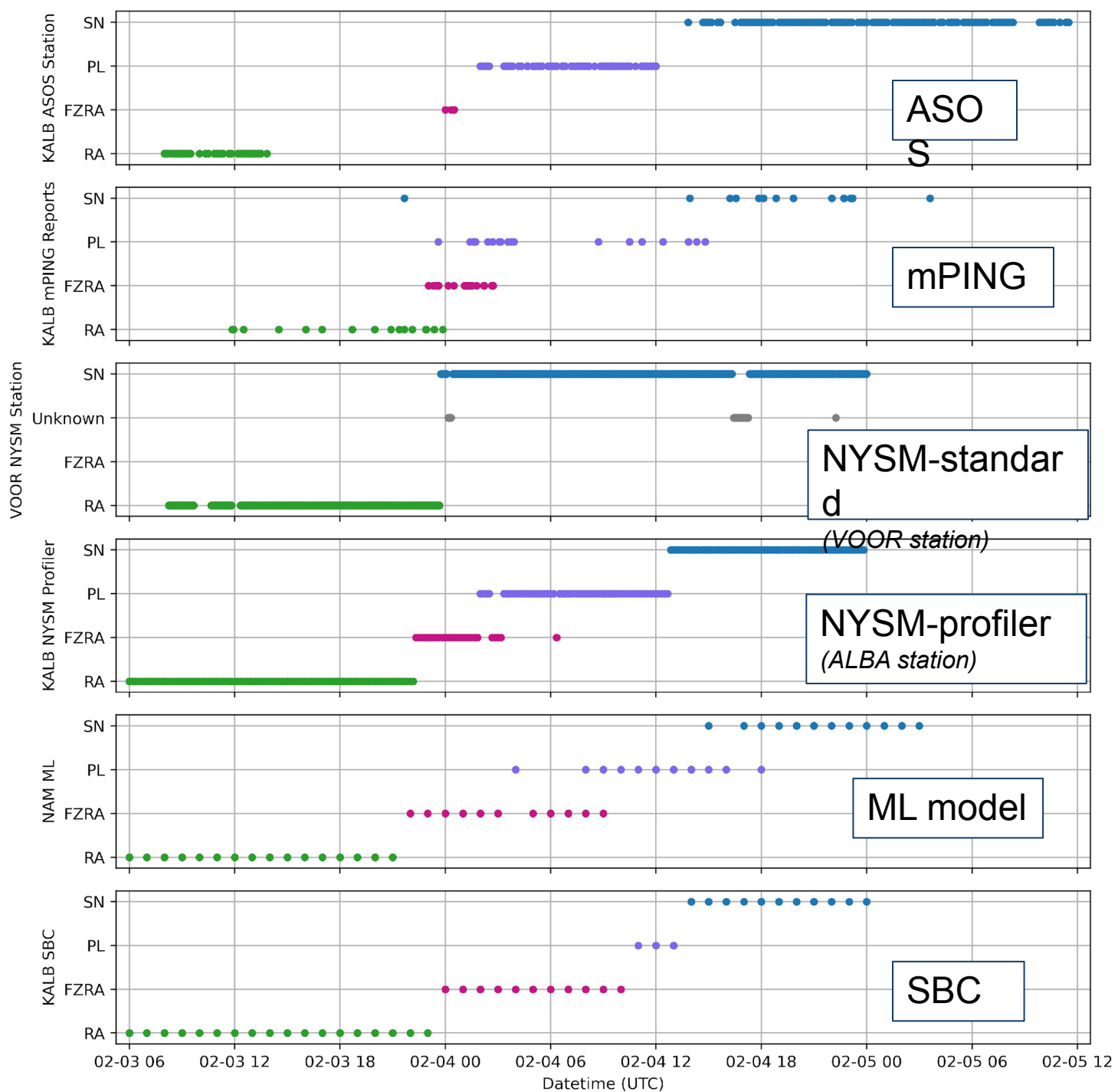
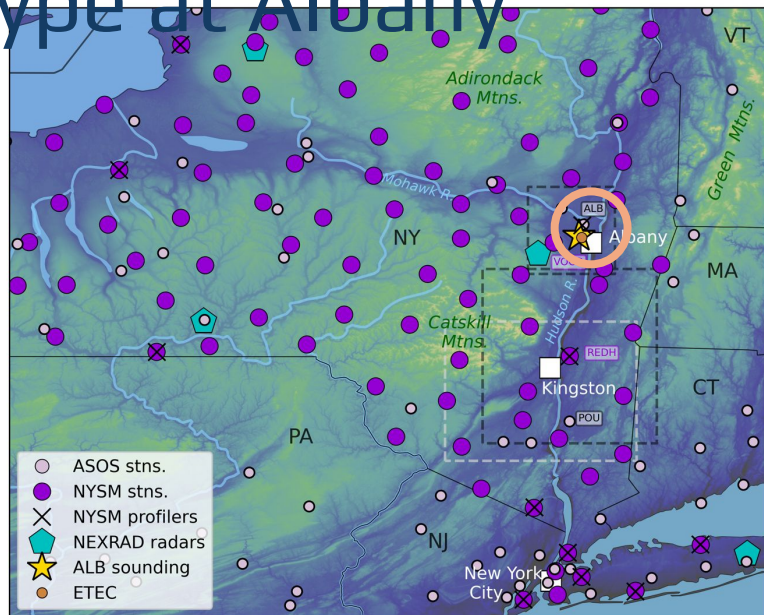


Tentative results:

- SBC PL duration/extent too small near Albany
- NYSM misdiagnoses PL (mostly as SN?)
- NYSM lag in FZRA-to-SN transition

Comparing products

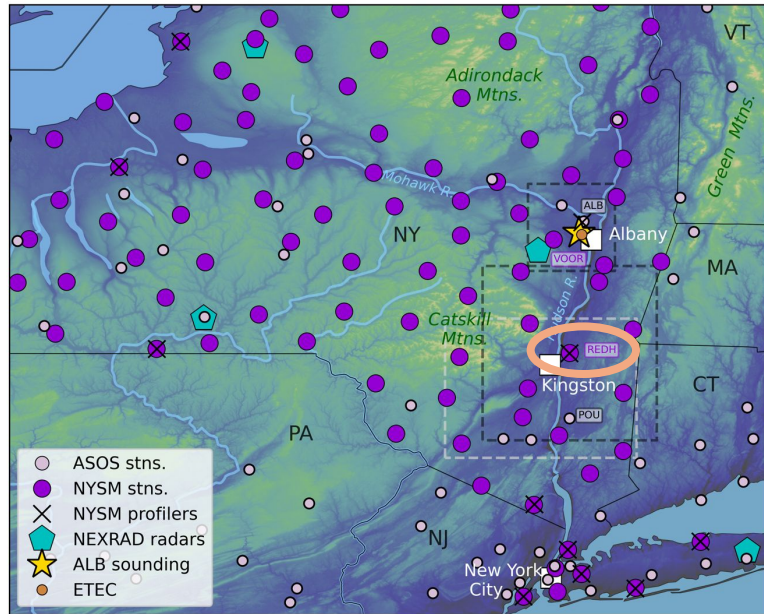
P-type at Albany



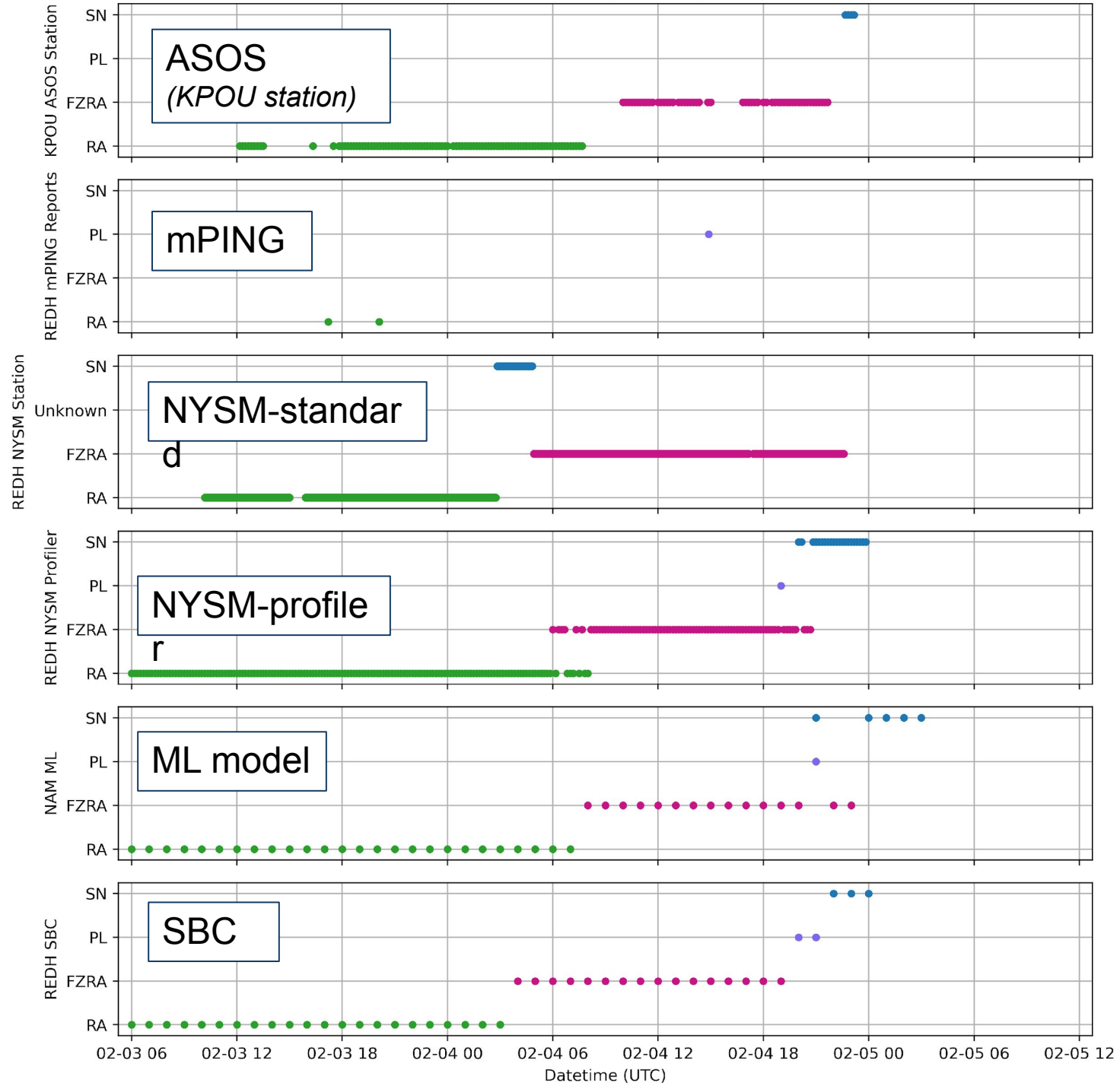
- NYSM-standard misdiagnoses PL/FZRA as SN (?)
- NYSM-profiler performs well
- SBC and ML PL duration too short (FZRA lasts too long)

Comparing products

P-t

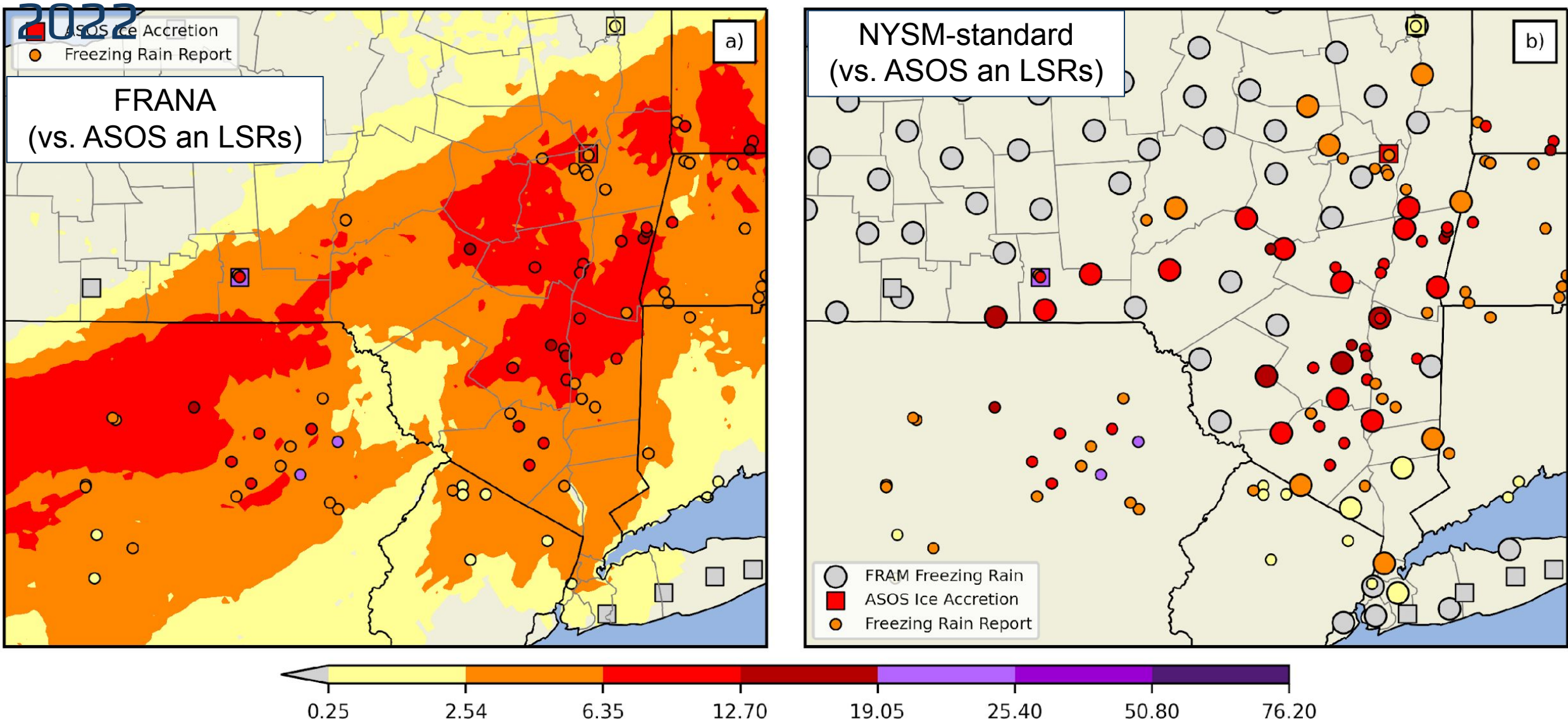


- Lack of nearby ASOS and mPING obs.
- Generally good agreement in RA to FZRA transition
- NYSM-standard seems to have spurious SN ~0400 UTC
- All but NYSM-standard transition to SN at end of event

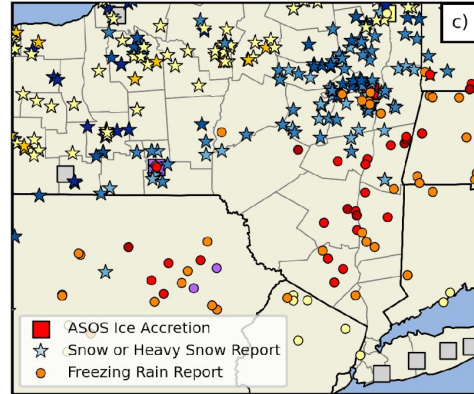


Comparing products

48-h ice accretion; valid at 0000 UTC 5 February



Conclusions

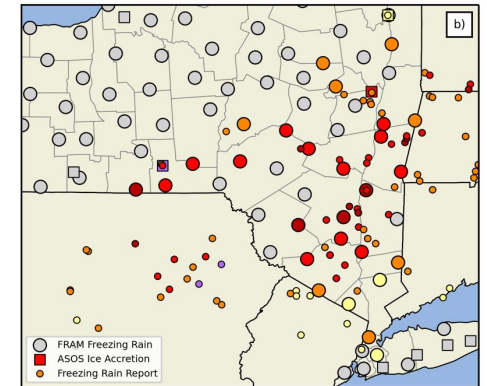
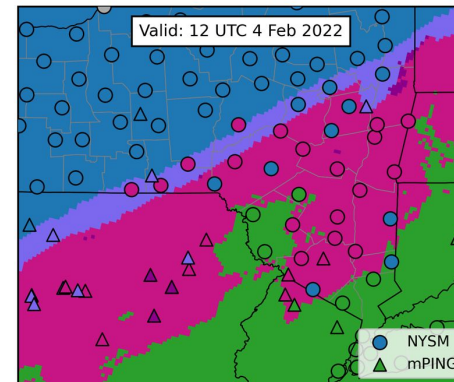


Nowcasting p-type and ice accretion remains challenging

- Complex mesoscale variations
- Gaps and uncertainties in observations
- *NWP uncertainties*

Various novel products show promise for improving monitoring and nowcasting

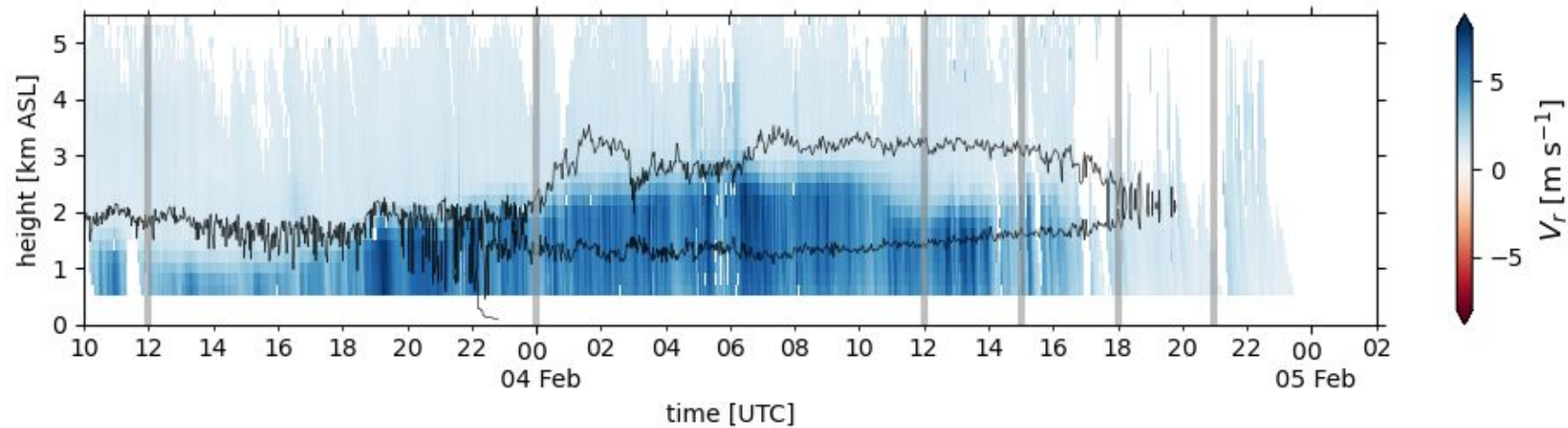
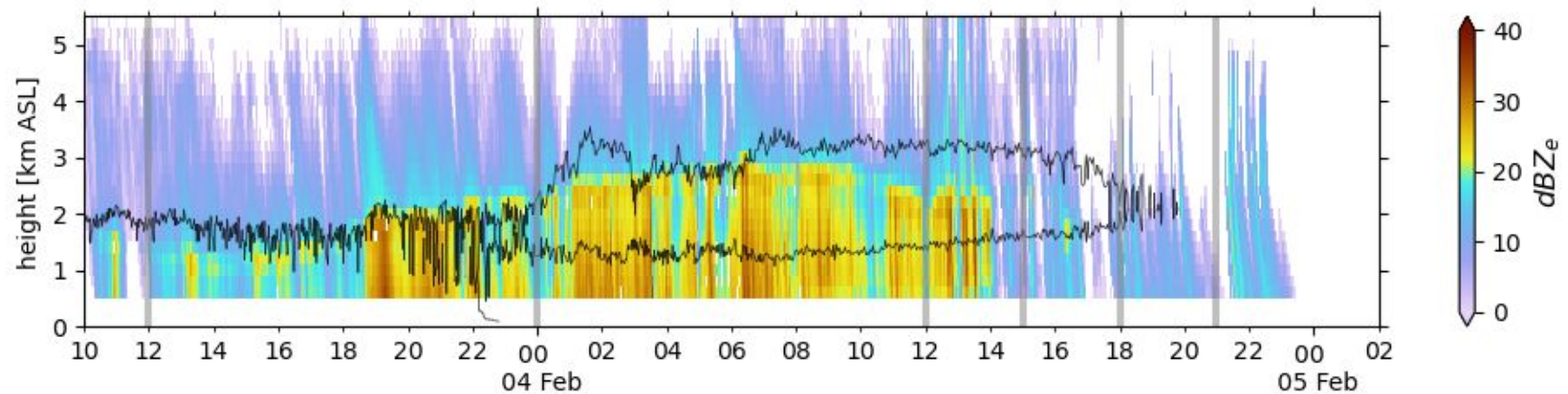
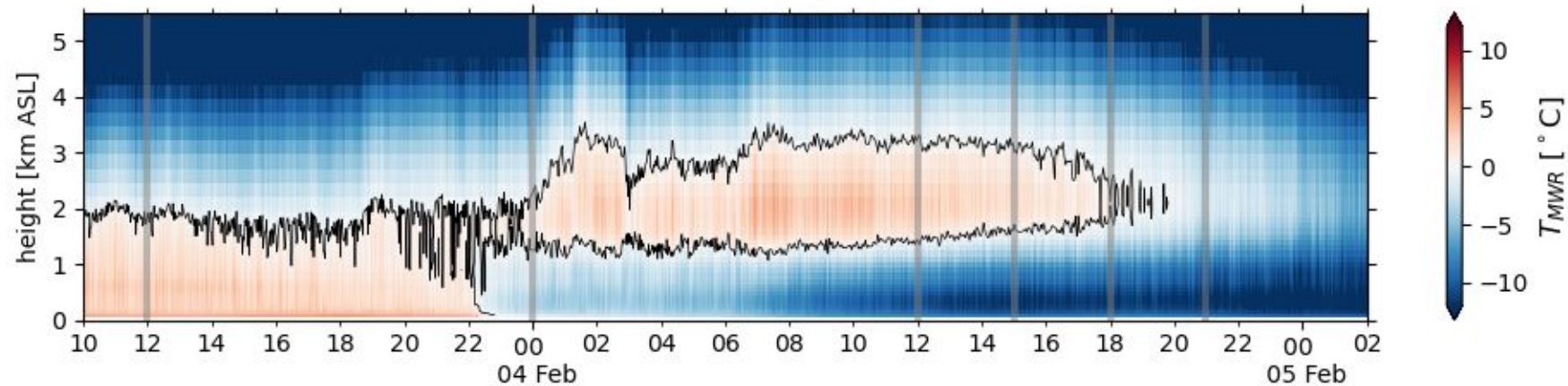
- Surface station-based estimates (w/ NYSM data)
- Profiler diagnostics (e.g., from NYSM radiometers)
- Gridded radar/NWP blended products (SBC, FRANA)
- Machine learning models



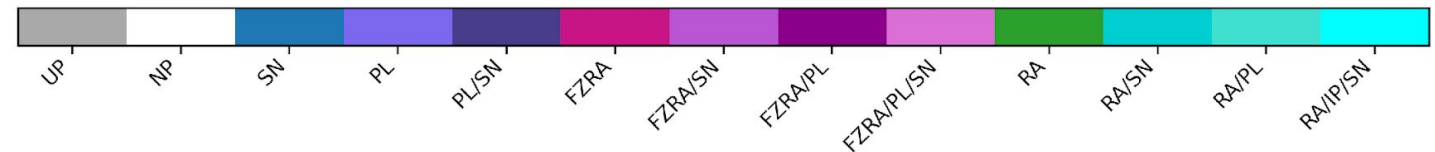
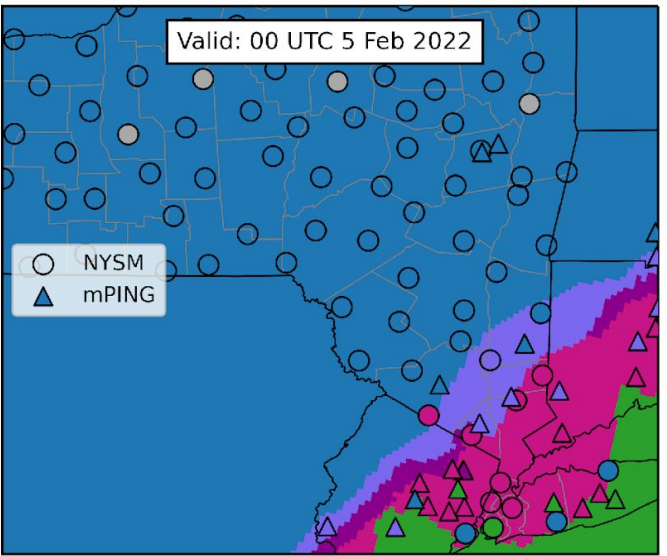
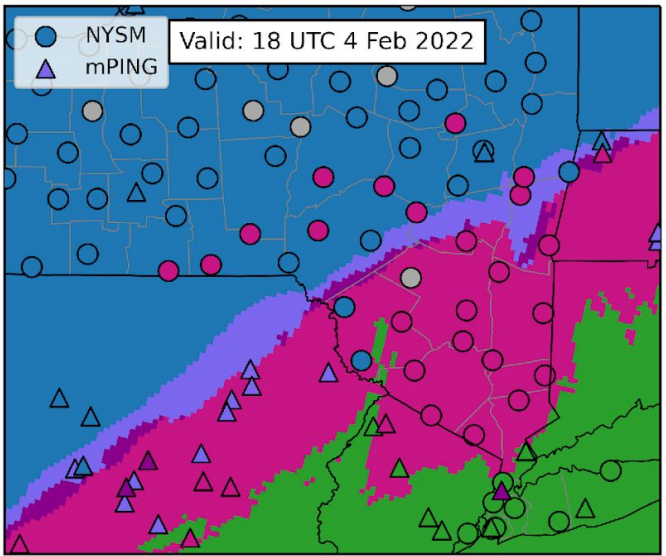
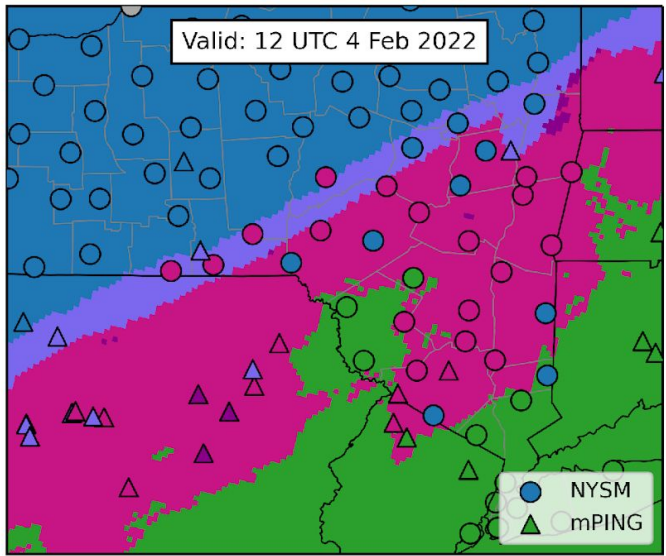
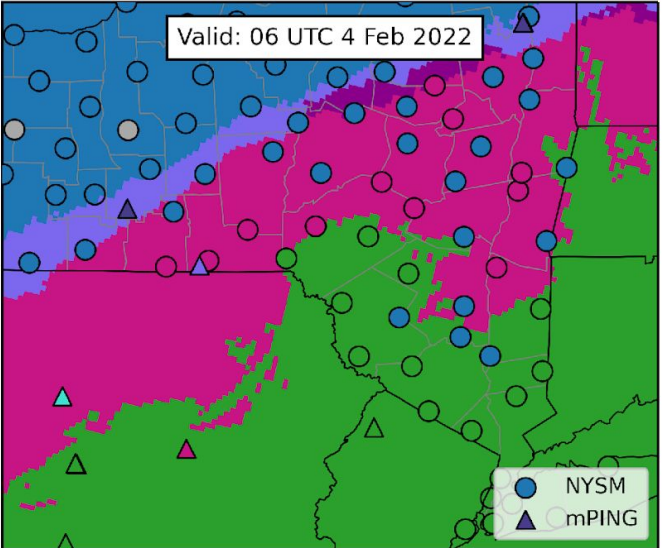
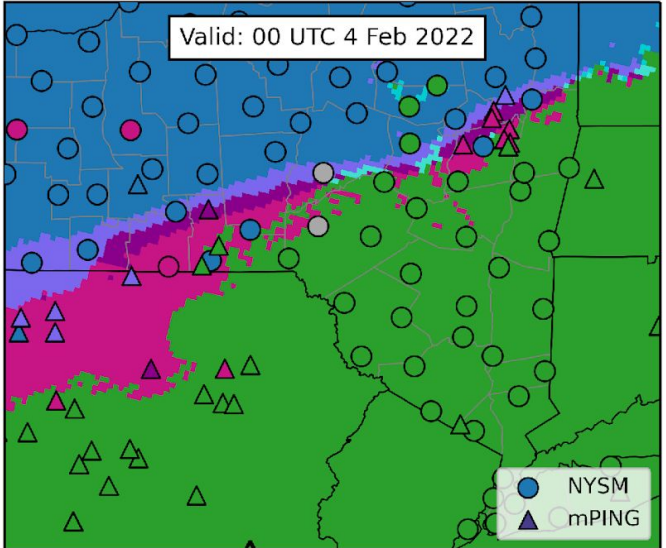
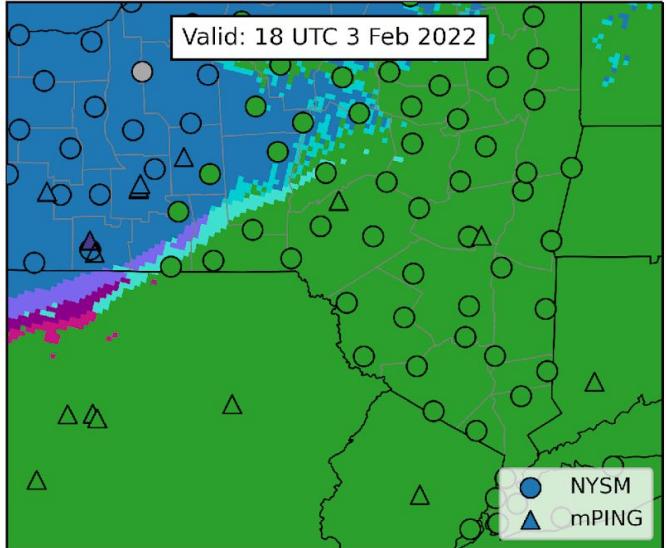
Some remaining challenges

- Limited “ground truth” data makes evaluation of products challenging
- Transitions between ice pellets and freezing rain remain difficult to represent
- How to use observational diagnostics in synergy with high-resolution NWP in operational setting?

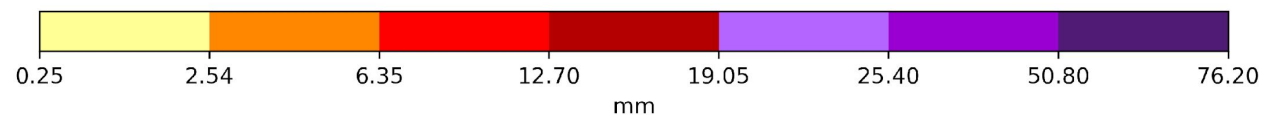
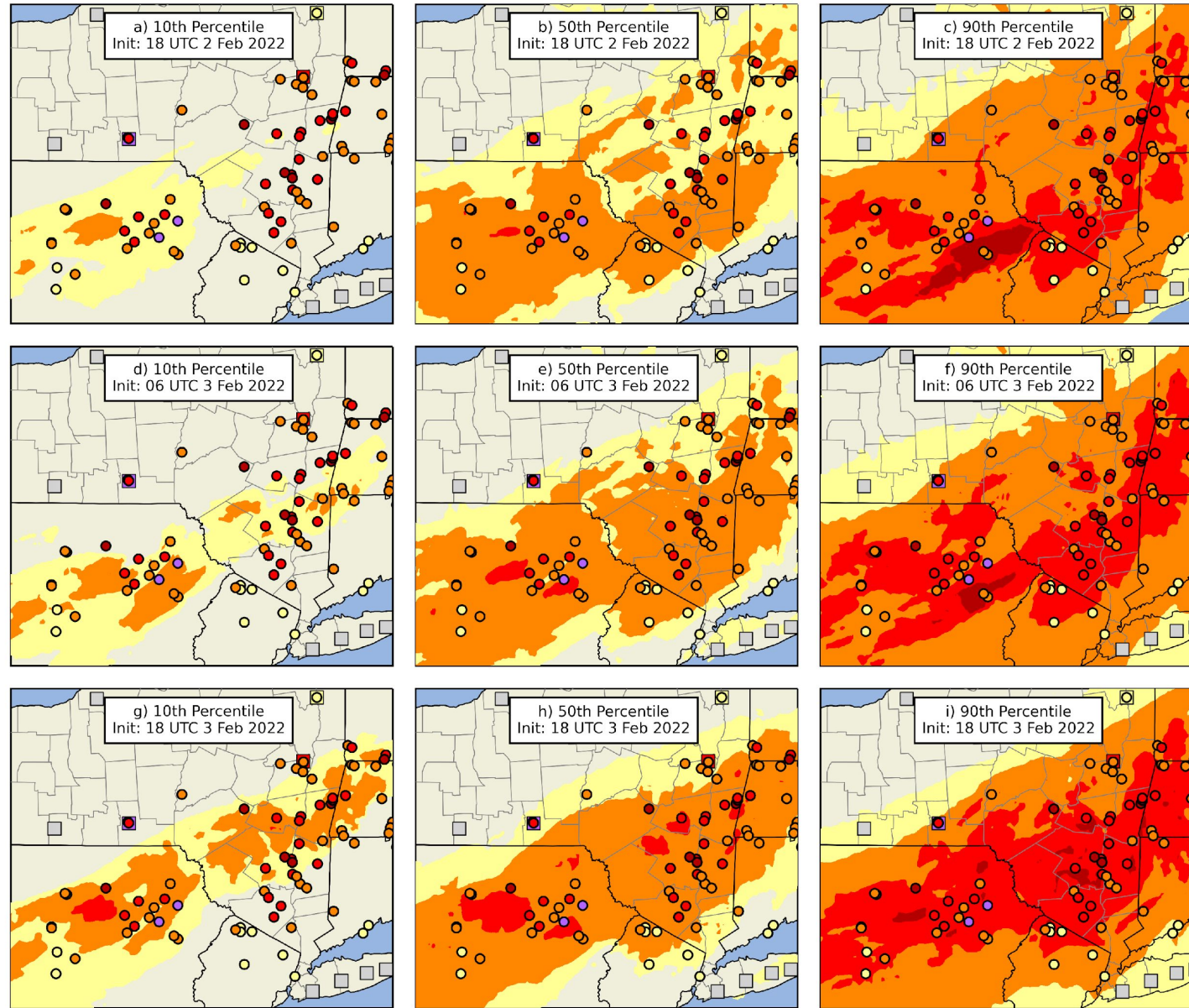
Extra slides



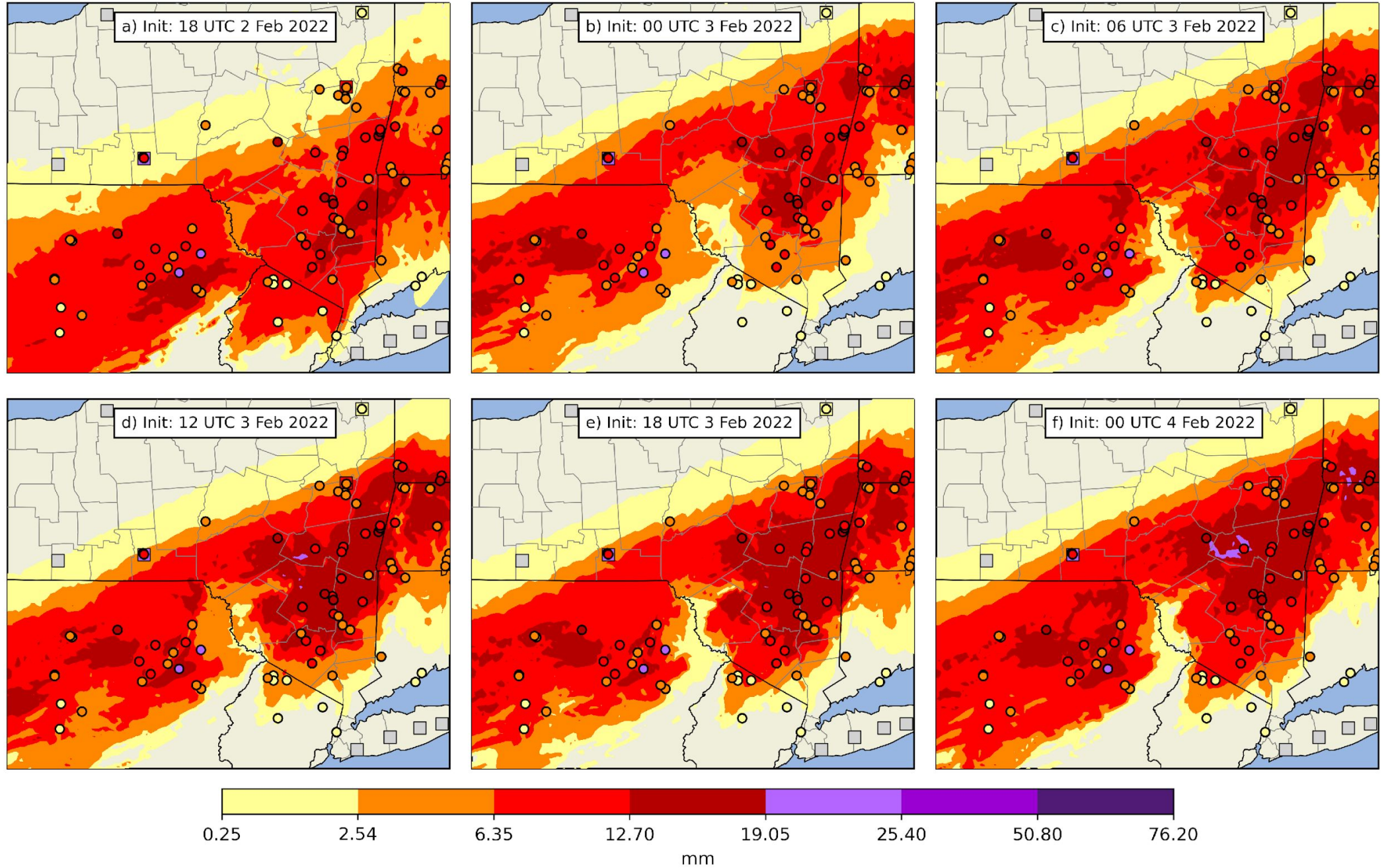
SBC Precipitation Type
 NYSM Precipitation Type
 mPING Report Precipitation Type



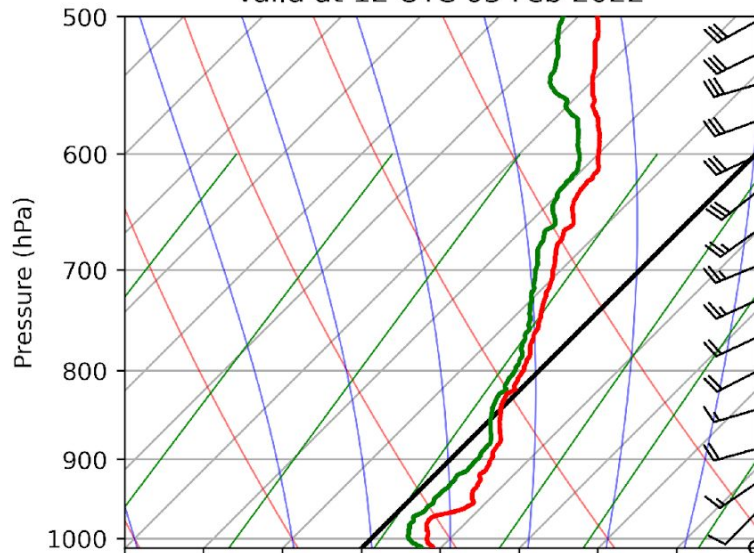
NBM 48-h Freezing Rain Accumulation, FRAM Estimate
LSR Freezing Rain Reports and ASOS Ice Accretion
Valid at 18 UTC 4 Feb 2022



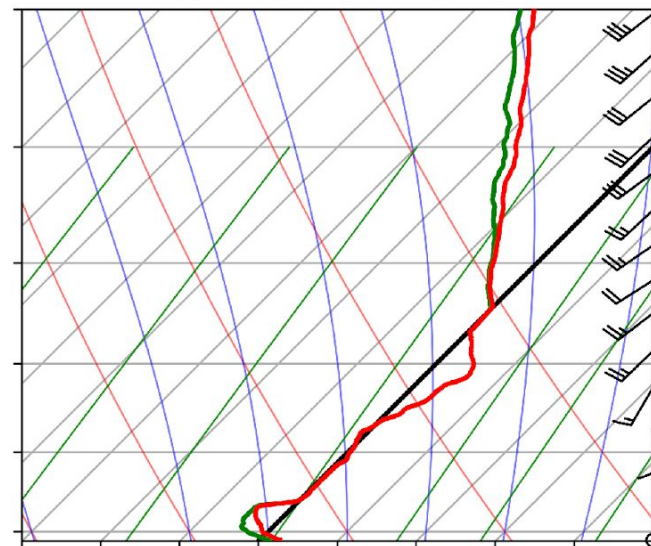
HRRR Freezing Rain Accumulation, FRAM Estimate
LSR Freezing Rain Reports and ASOS Ice Accretion
Valid at 18 UTC 4 Feb 2022



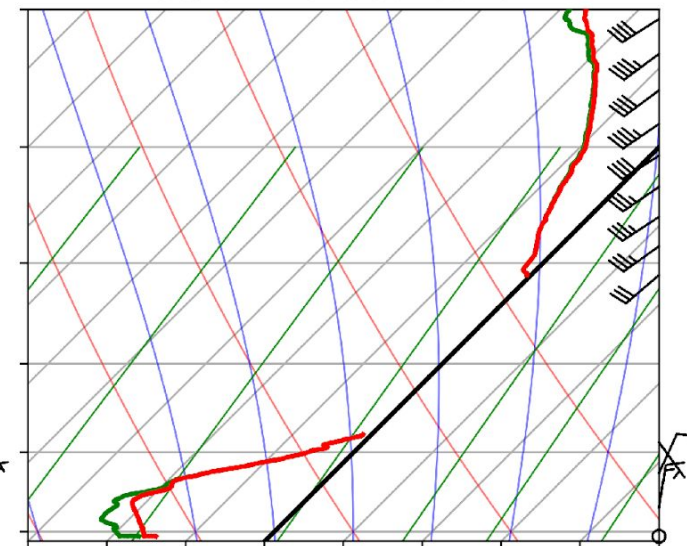
KALY Observed Sounding
Valid at 12 UTC 03 Feb 2022



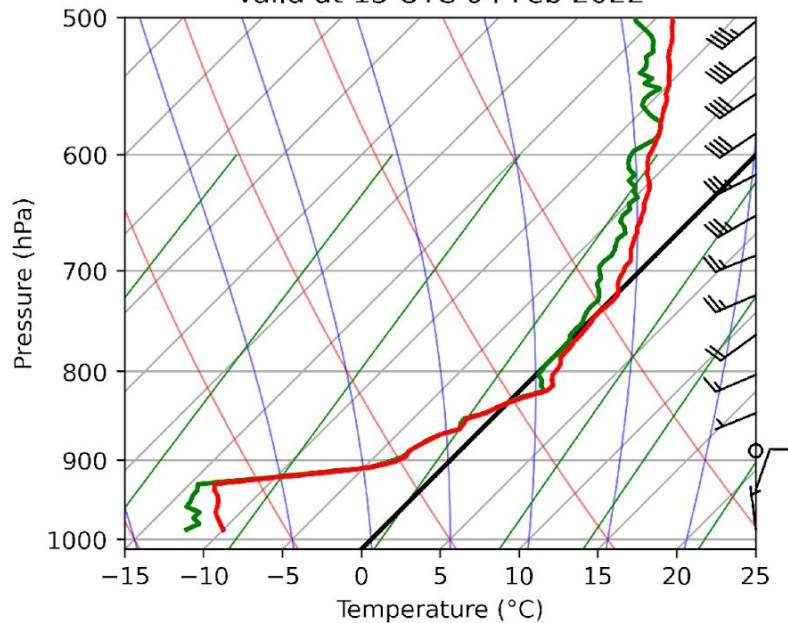
KALY Observed Sounding
Valid at 00 UTC 04 Feb 2022



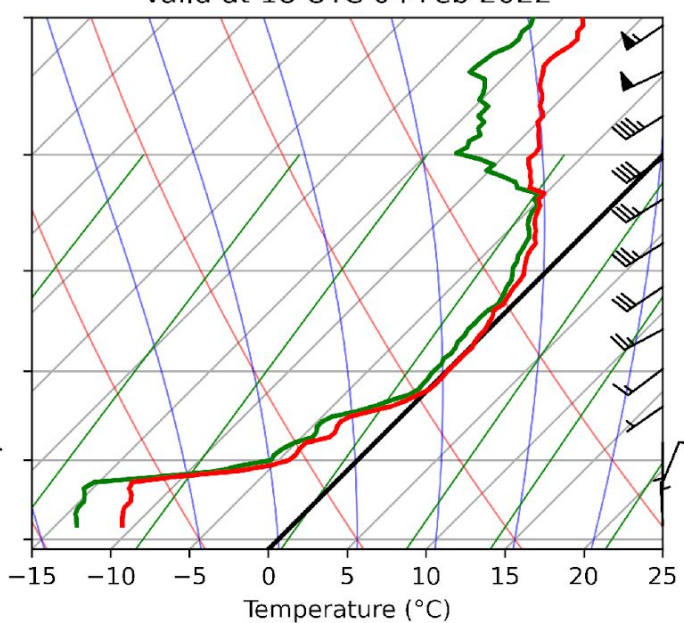
KALY Observed Sounding
Valid at 12 UTC 04 Feb 2022



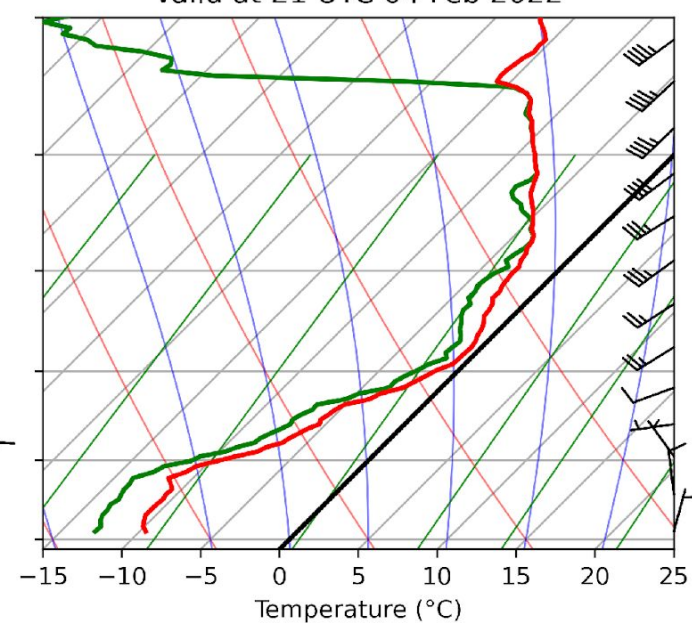
IMPACTS Mobile Research Observed Sounding
Valid at 15 UTC 04 Feb 2022



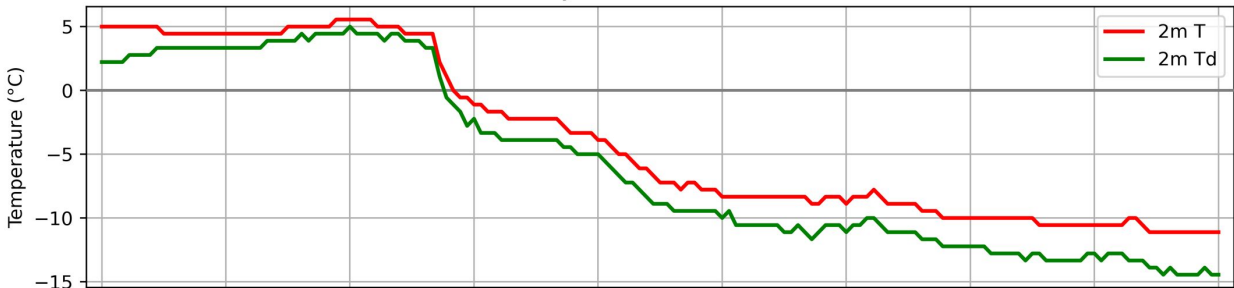
IMPACTS Mobile Research Observed Sounding
Valid at 18 UTC 04 Feb 2022



IMPACTS Mobile Research Observed Sounding
Valid at 21 UTC 04 Feb 2022



Albany Surface Observations



Redhook Surface Observations

