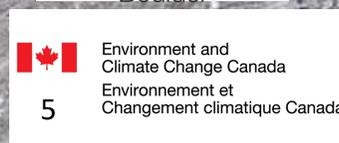


# P-type Processes and Predictability: *Initial results from the Winter Precipitation Type Research Multiscale Experiment (WINTRE-MIX)*



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Ismail Gulpepe<sup>5</sup>, John Gyakum<sup>2</sup>, David E. Kingsmill<sup>4</sup>, Karen A. Kosiba<sup>6</sup>,  
Mathieu Lachapelle<sup>7</sup>, Daniel Michelson<sup>5</sup>, Leonid Nichman<sup>8</sup>, Cuong  
Nguyen<sup>8</sup>, Julie M. Thériault<sup>7</sup>, Andre C. Winters<sup>4</sup>, Mengistu Wolde<sup>8</sup>,  
and Josh Wurman<sup>6</sup>

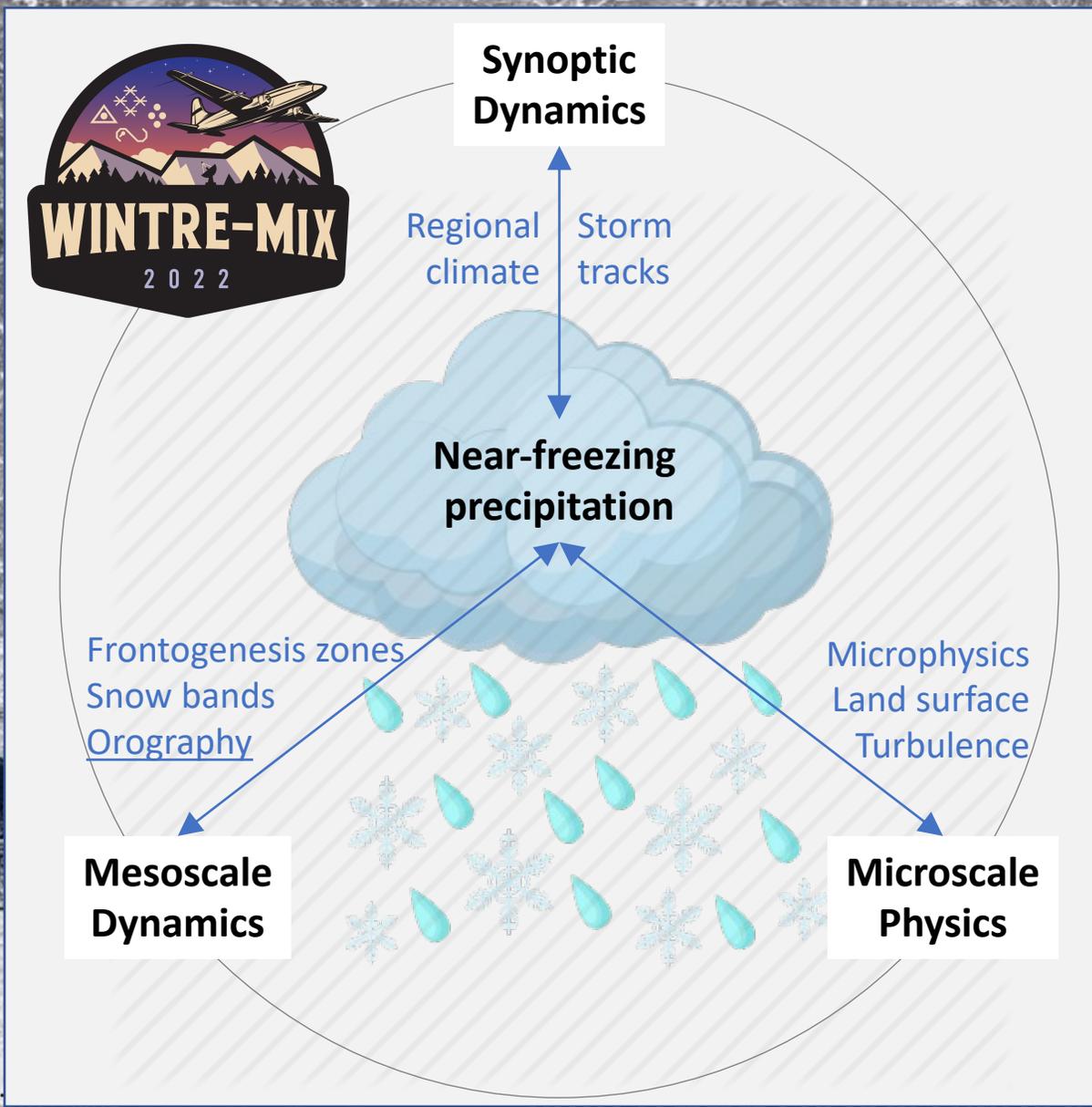


# Project Overview



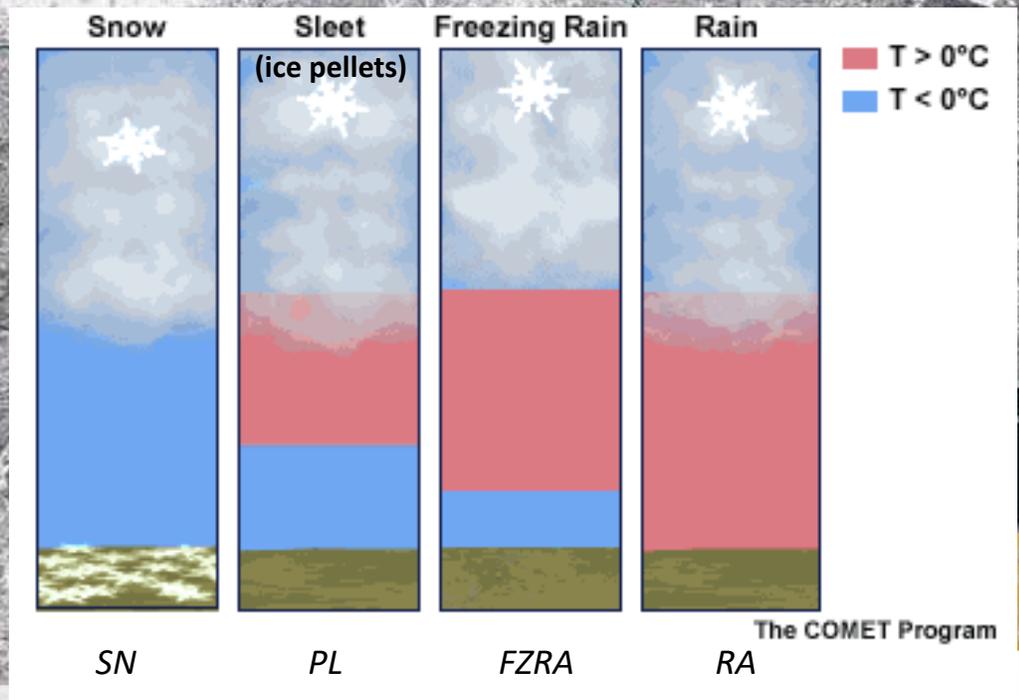
Minder, J. R., and Coauthors, 2023: P-type Processes and Predictability: The Winter Precipitation Type Research Multiscale Experiment (WINTRE-MIX). *Bull. Amer. Meteor. Soc.*, <https://doi.org/10.1175/BAMS-D-22-0095.1>.

# Winter Precipitation Type Research Multi-scale Experiment

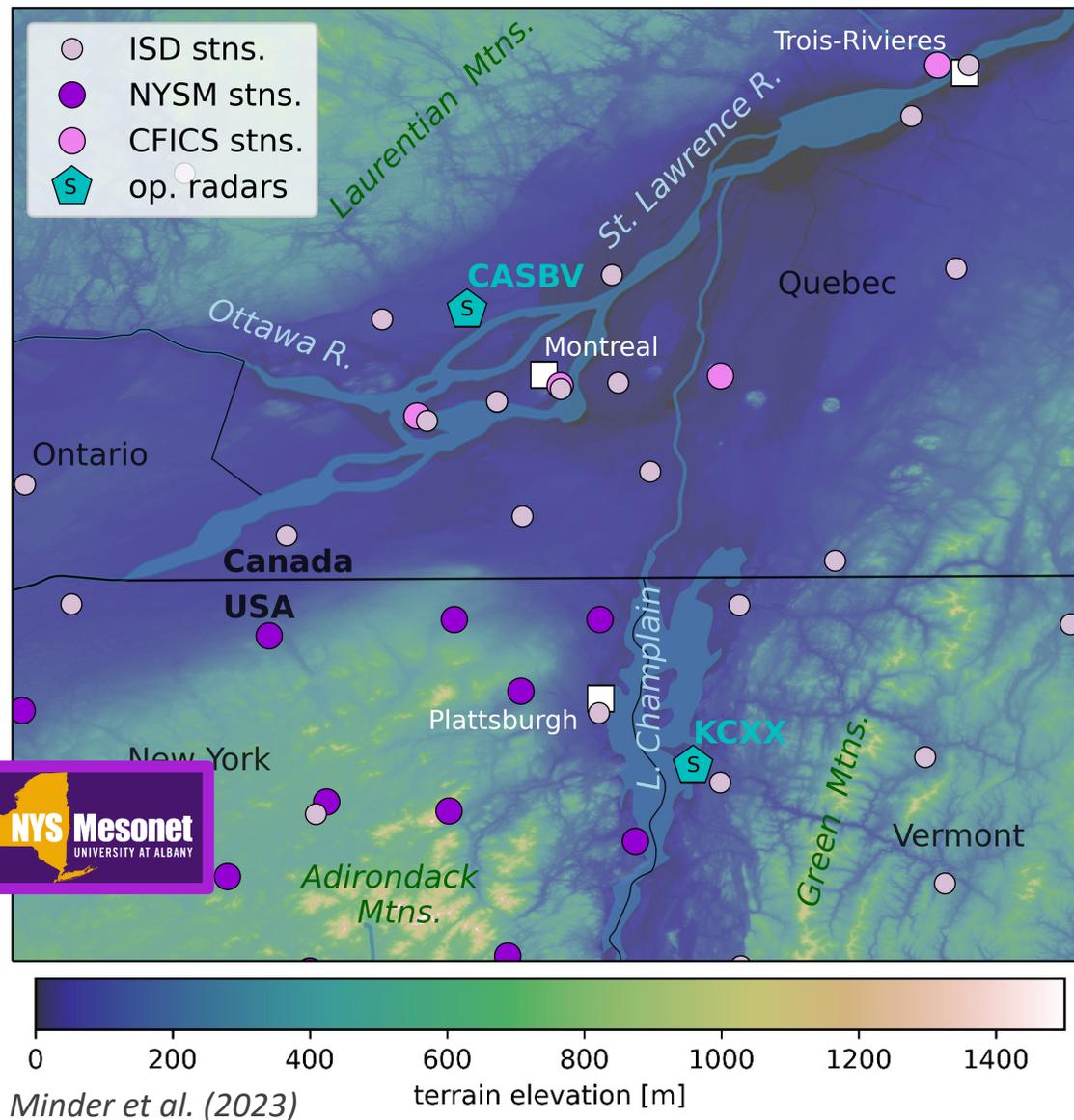


## Focus & Goal

*To better understand how multi-scale processes influence the variability and predictability of precipitation type and amount under near-freezing surface conditions.*



# Project Overview: *Where & When?*

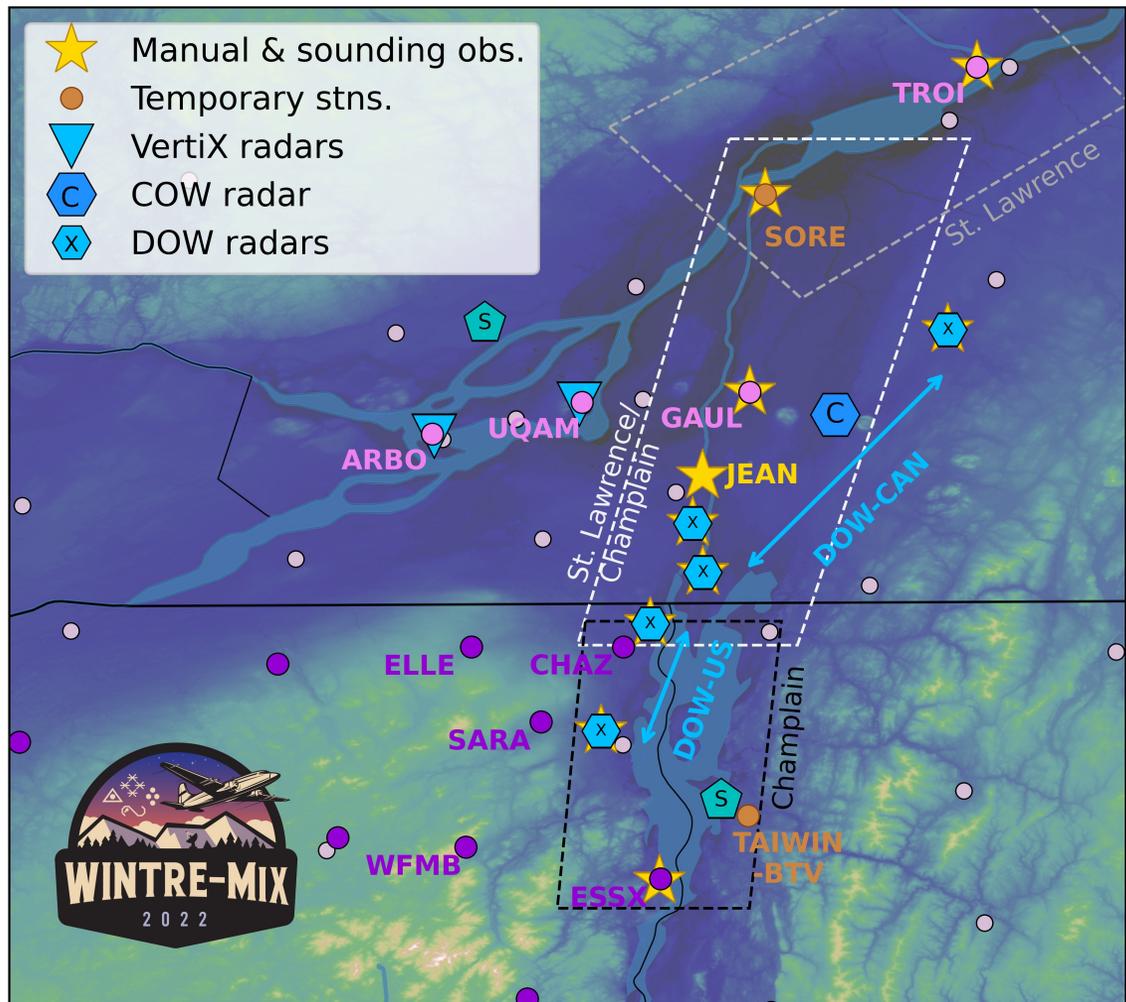


- US (NY) – CAN (QC) boarder region
- St. Lawrence / Champlain Valleys
- Excellent backbone of existing observations
- Plentiful & diverse near-freezing winter precipitation

- 1 February – 15 March 2022
- 11 intensive observing periods (IOPs)



# Project Overview: *Deployment strategy*



# Results:

## *Example case study*

### Intensive observing period #5 (IOP5)

- 22–23 February 2022
- Warm air advection over persistent shallow cold air in St. Lawrence Valley
- (PL to) FZRA to RA transition

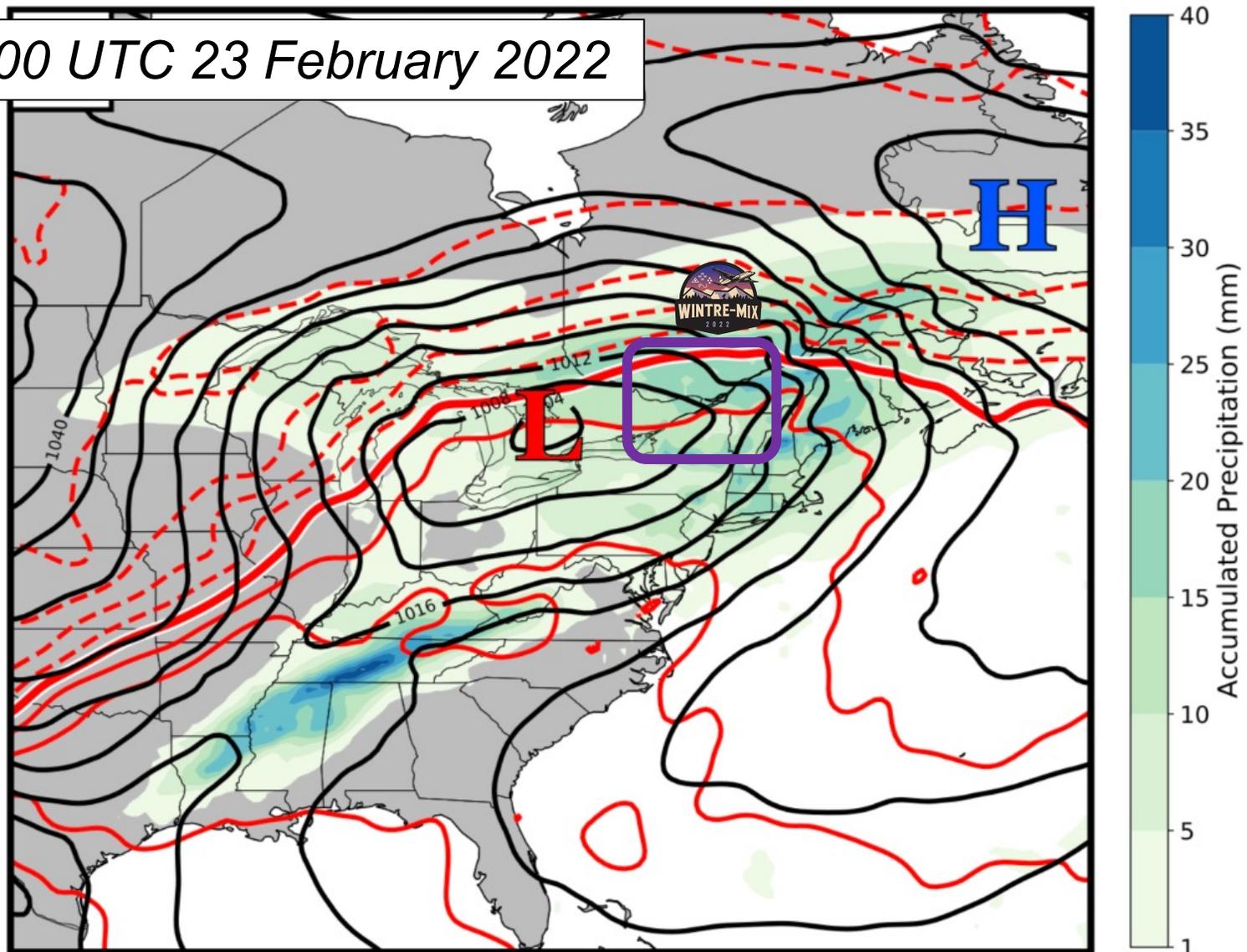


Minder, J. R., and Coauthors, 2023: P-type Processes and Predictability: The Winter Precipitation Type Research Multiscale Experiment (WINTRE-MIX). *Bull. Amer. Meteor. Soc.*, <https://doi.org/10.1175/BAMS-D-22-0095.1>.

IOP5:  
*Synoptic environment*  
*(ERA-5)*

0000 UTC 23 February 2022

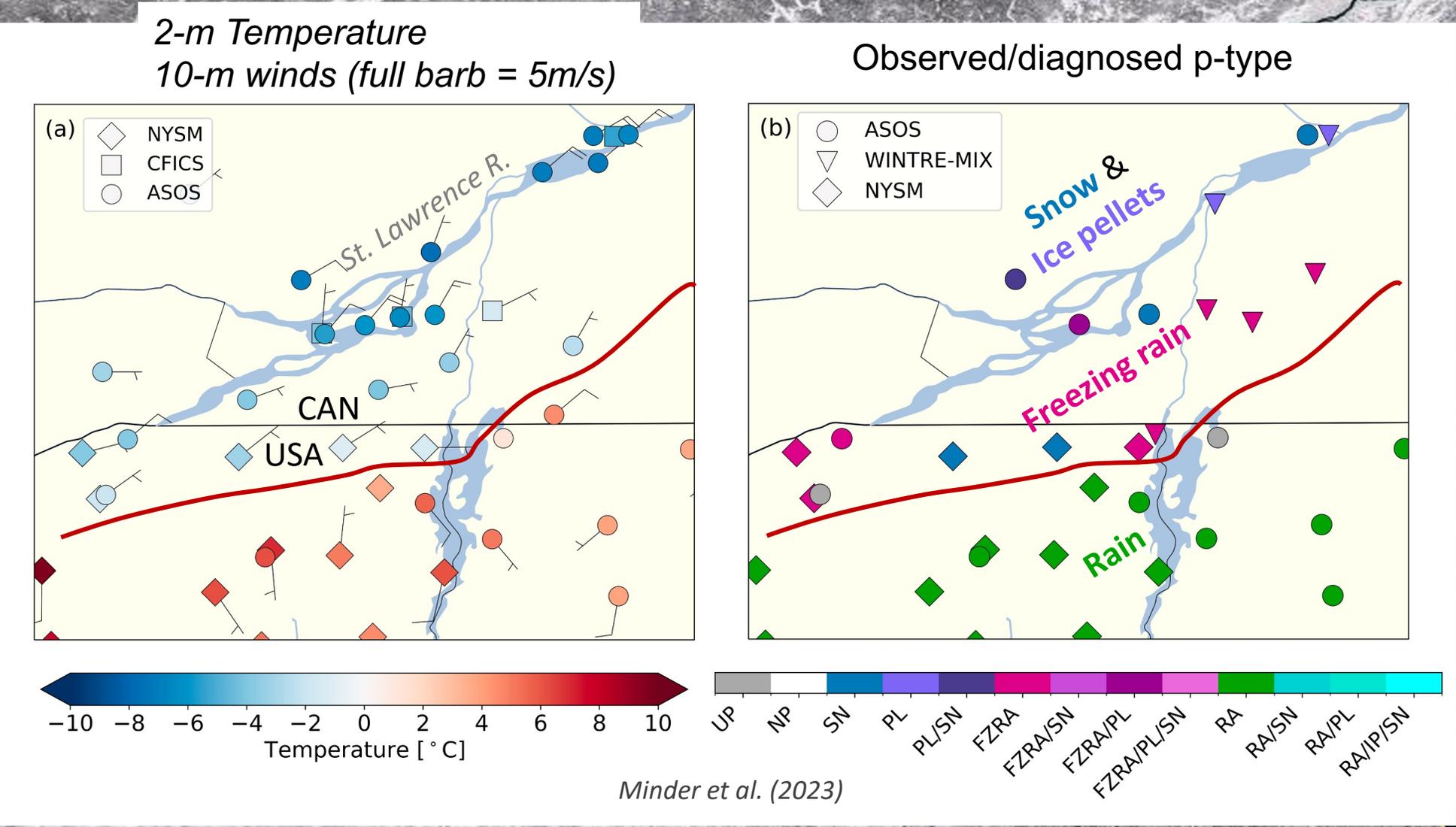
SLP (black contours)  
850-hPa T (red, dashed where  $<0^{\circ}\text{C}$ )  
Event-total precipitation (shaded)



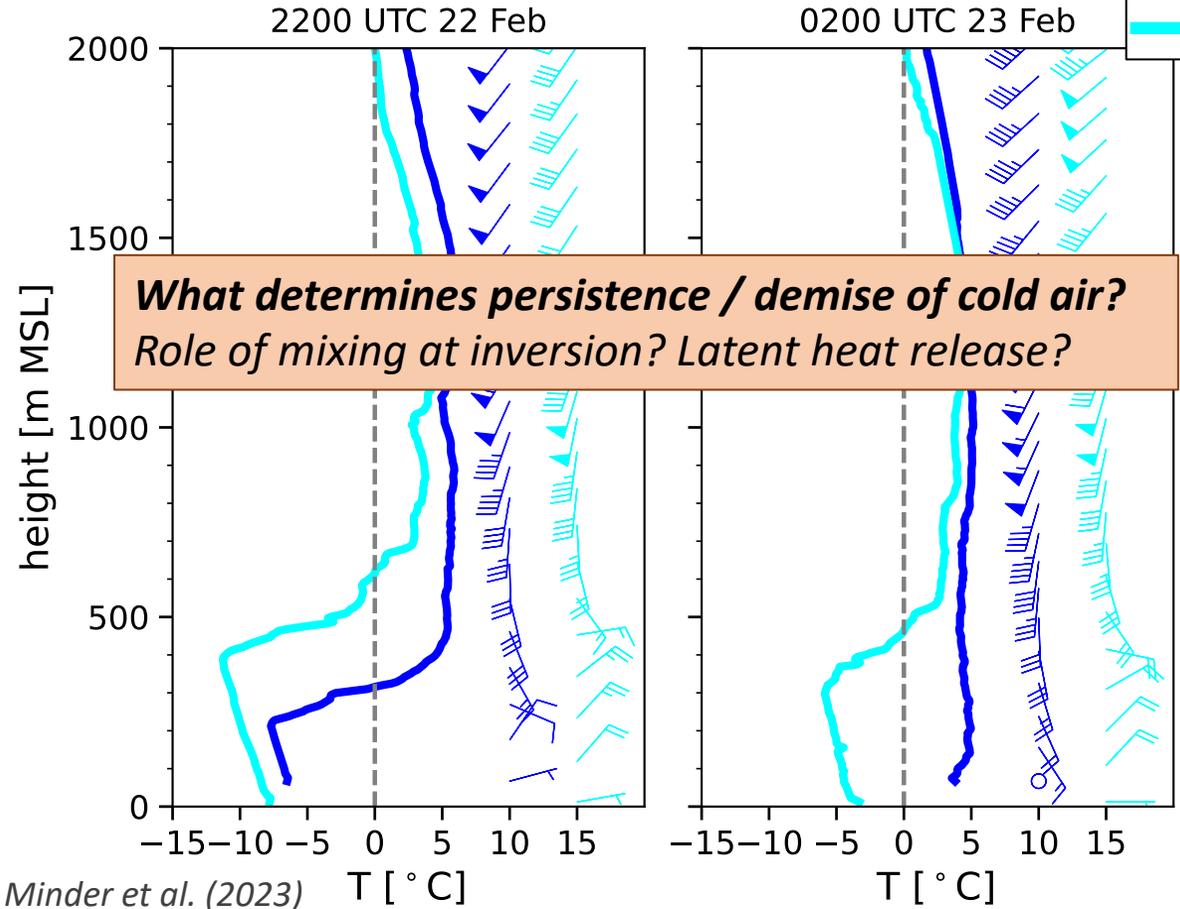
Minder et al. (2023)

# IOP5: Mesoscale overview

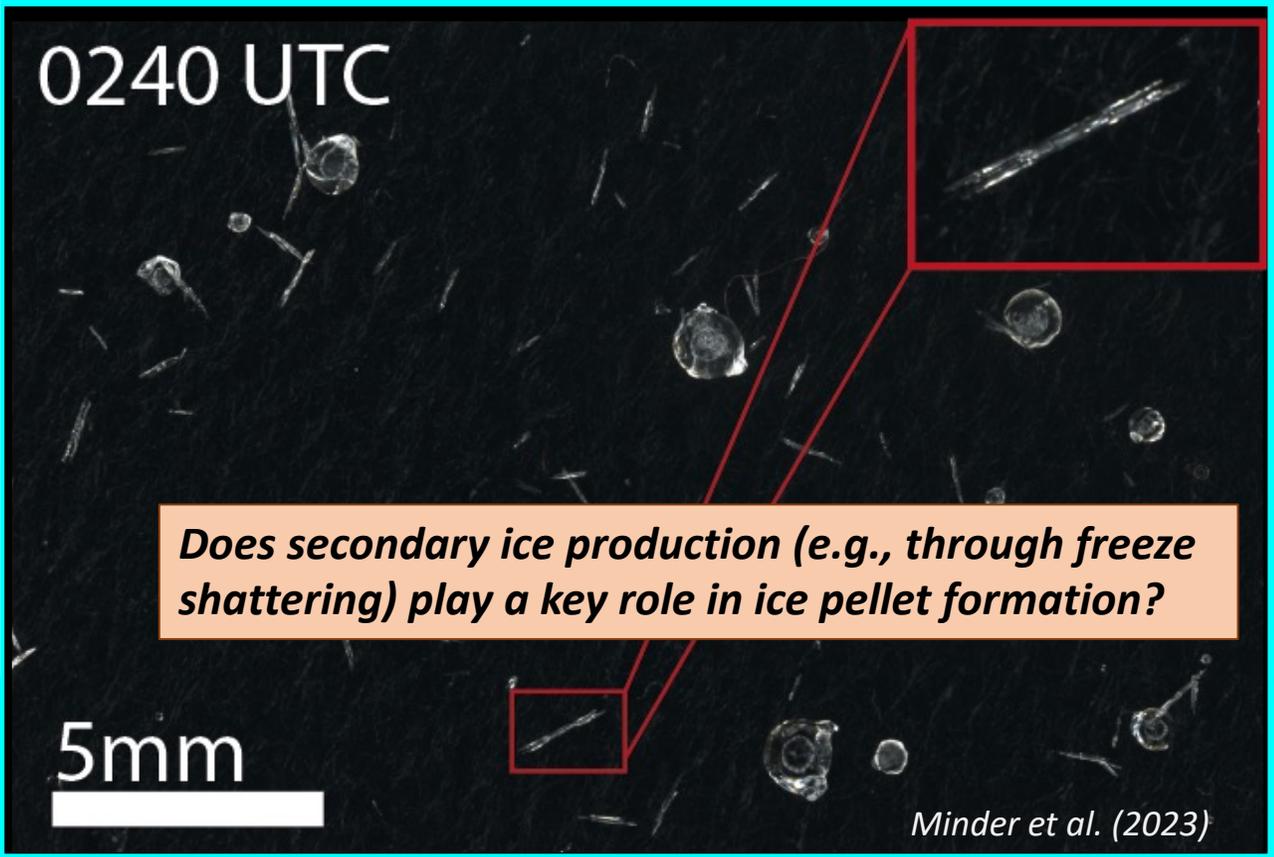
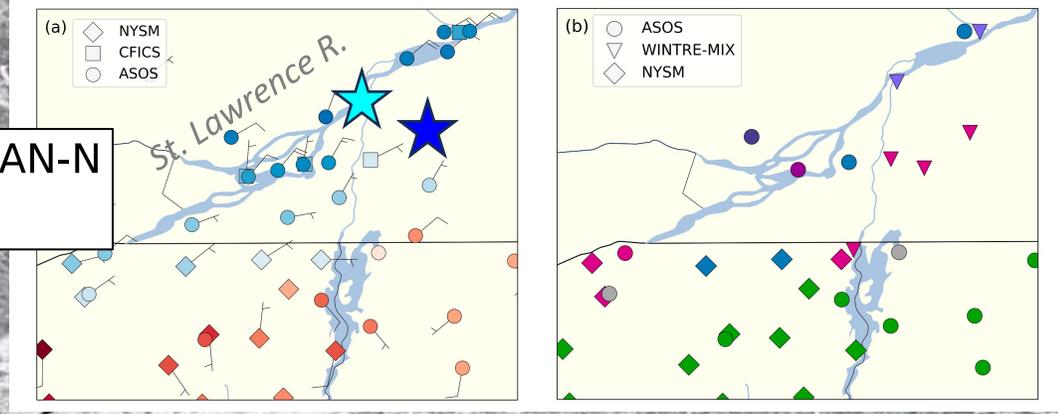
0000 UTC 23 February 2022



# IOP5: Soundings & hydrometeor obs.



— DOW-CAN-N  
— SORE

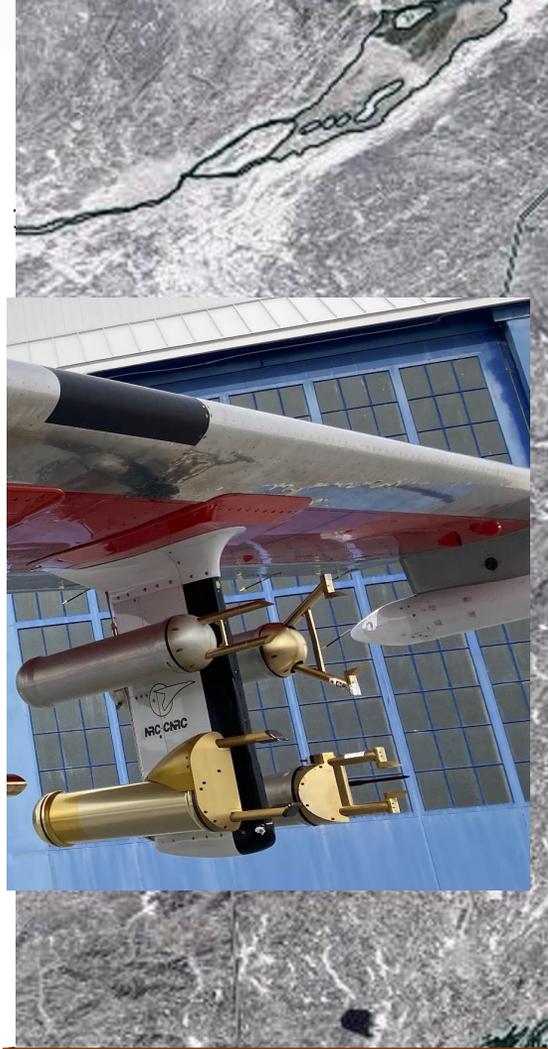
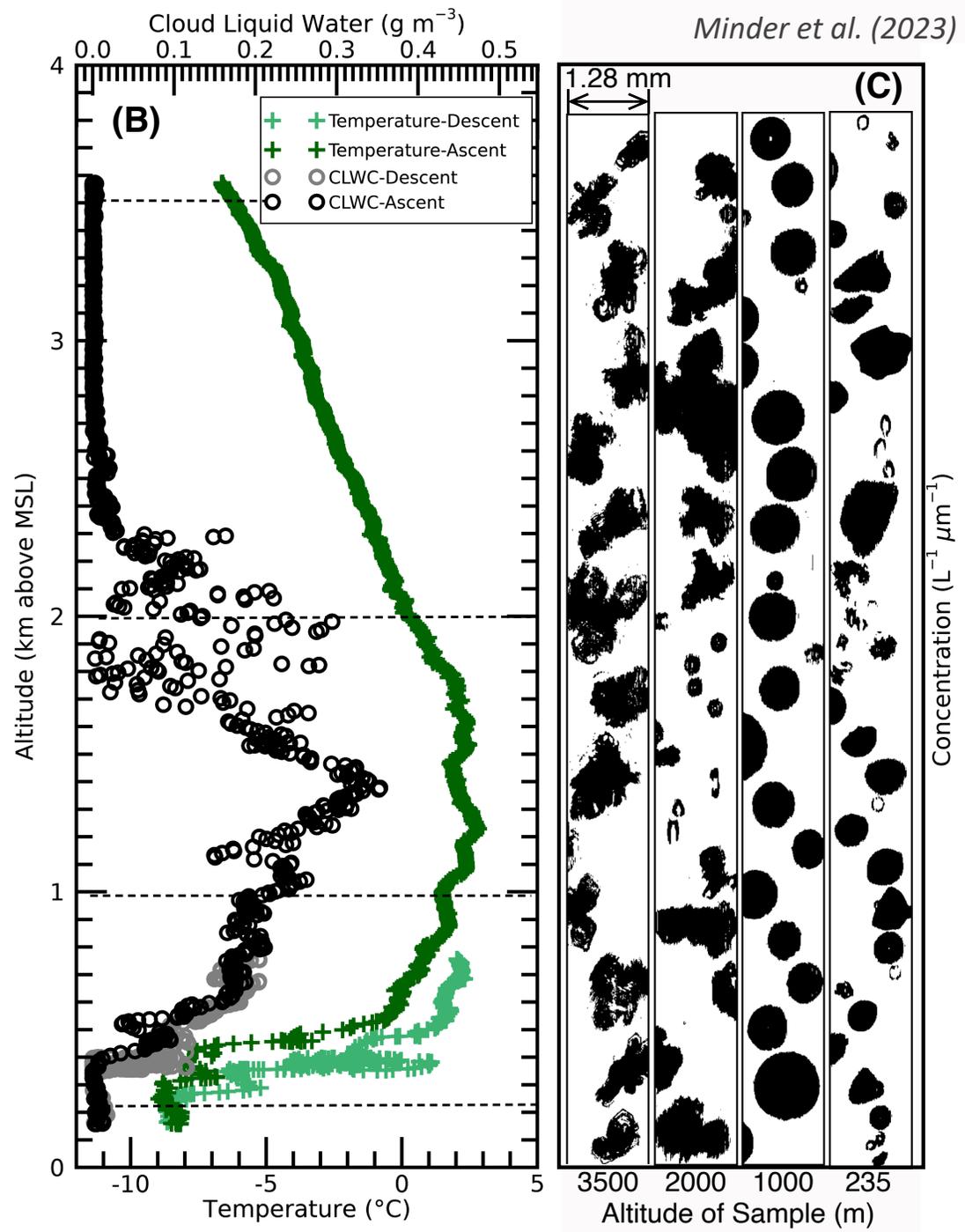
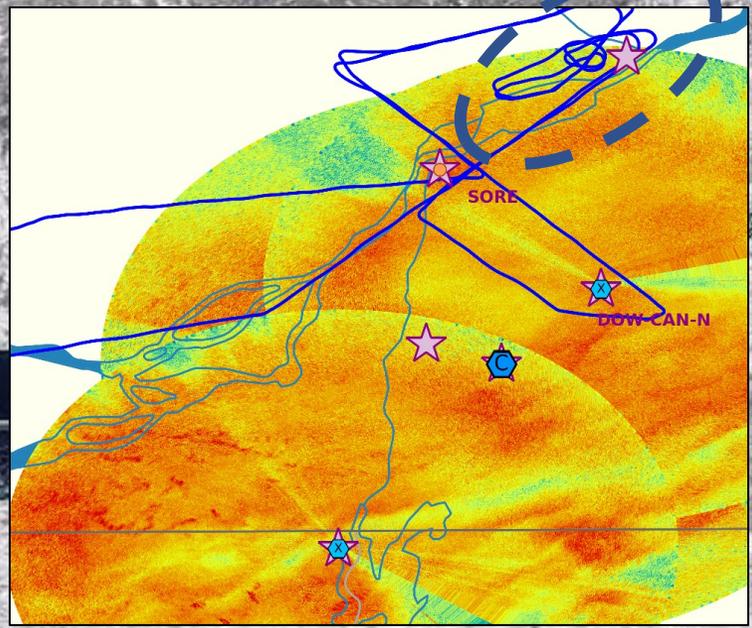


Minder et al. (2023)

Minder et al. (2023)

# Observations: *Research aircraft*

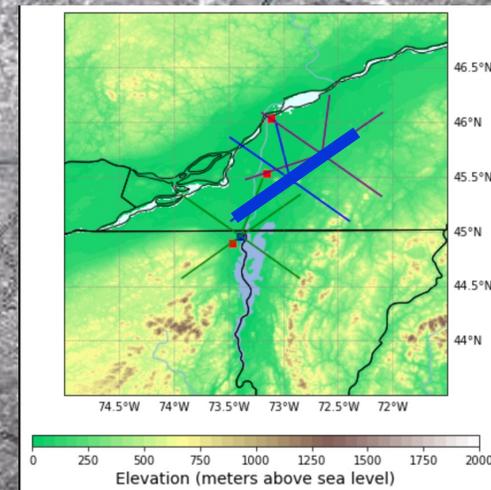
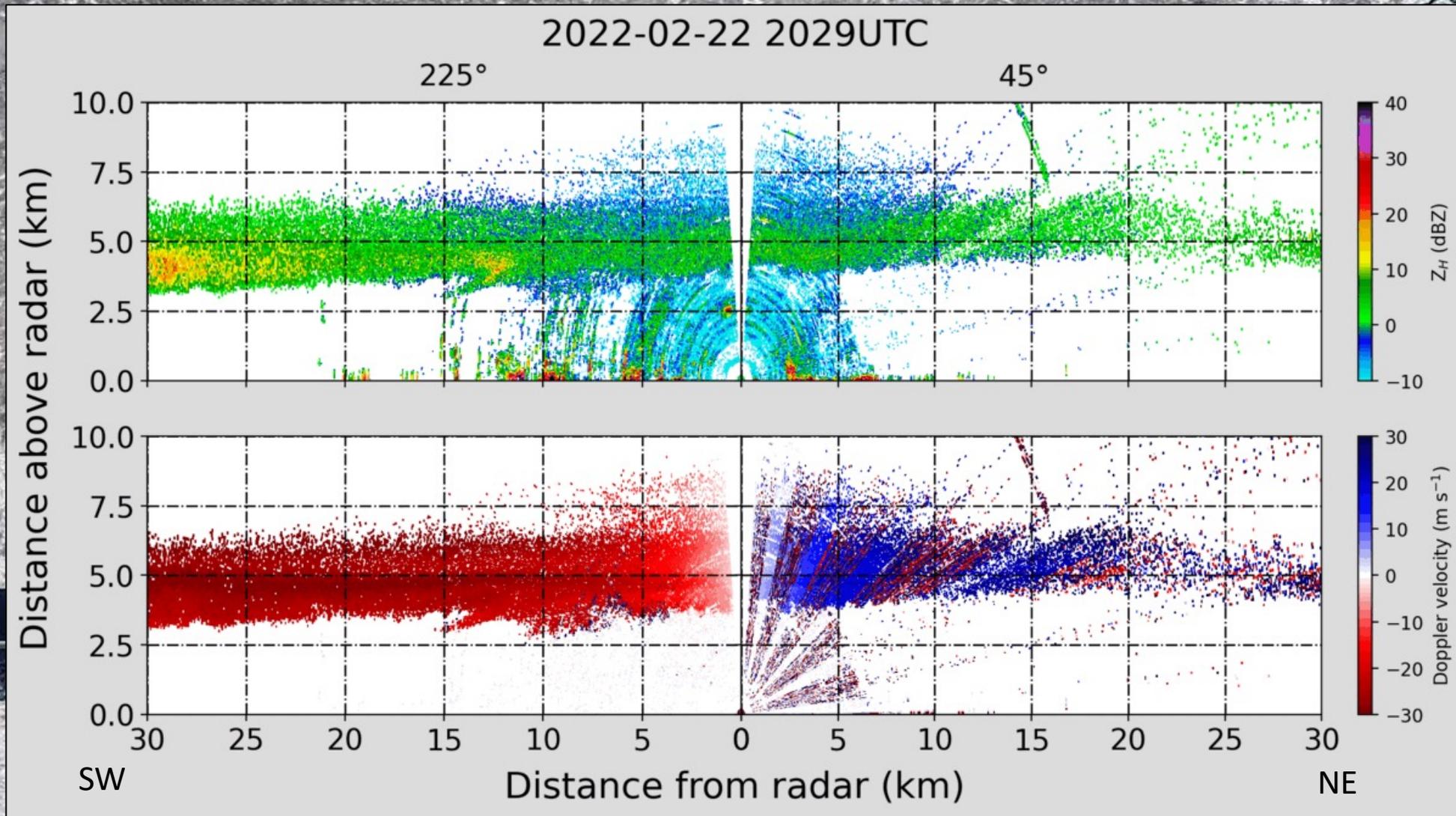
Data from missed approach  
at Trois-Rivieres



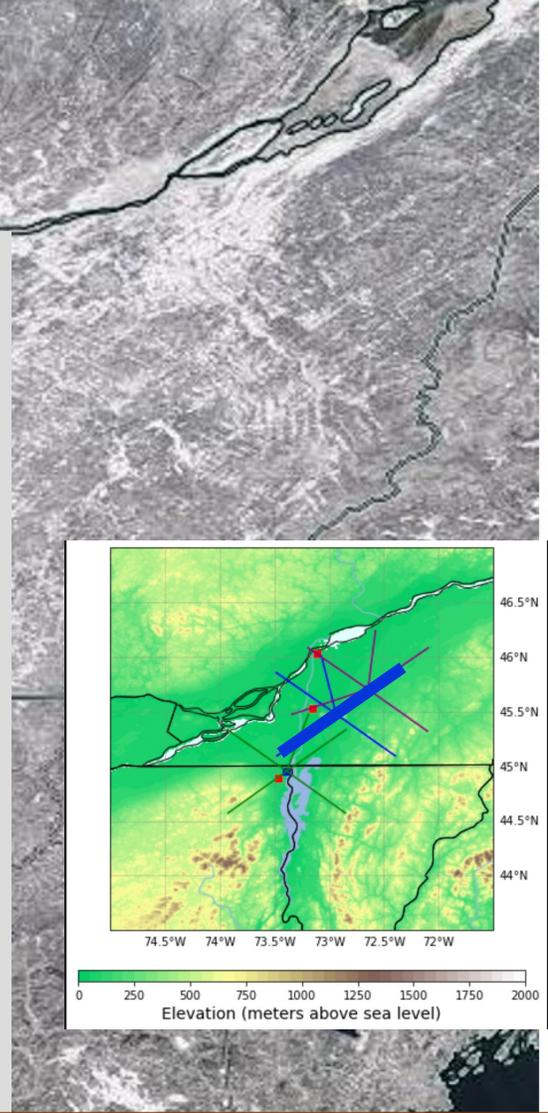
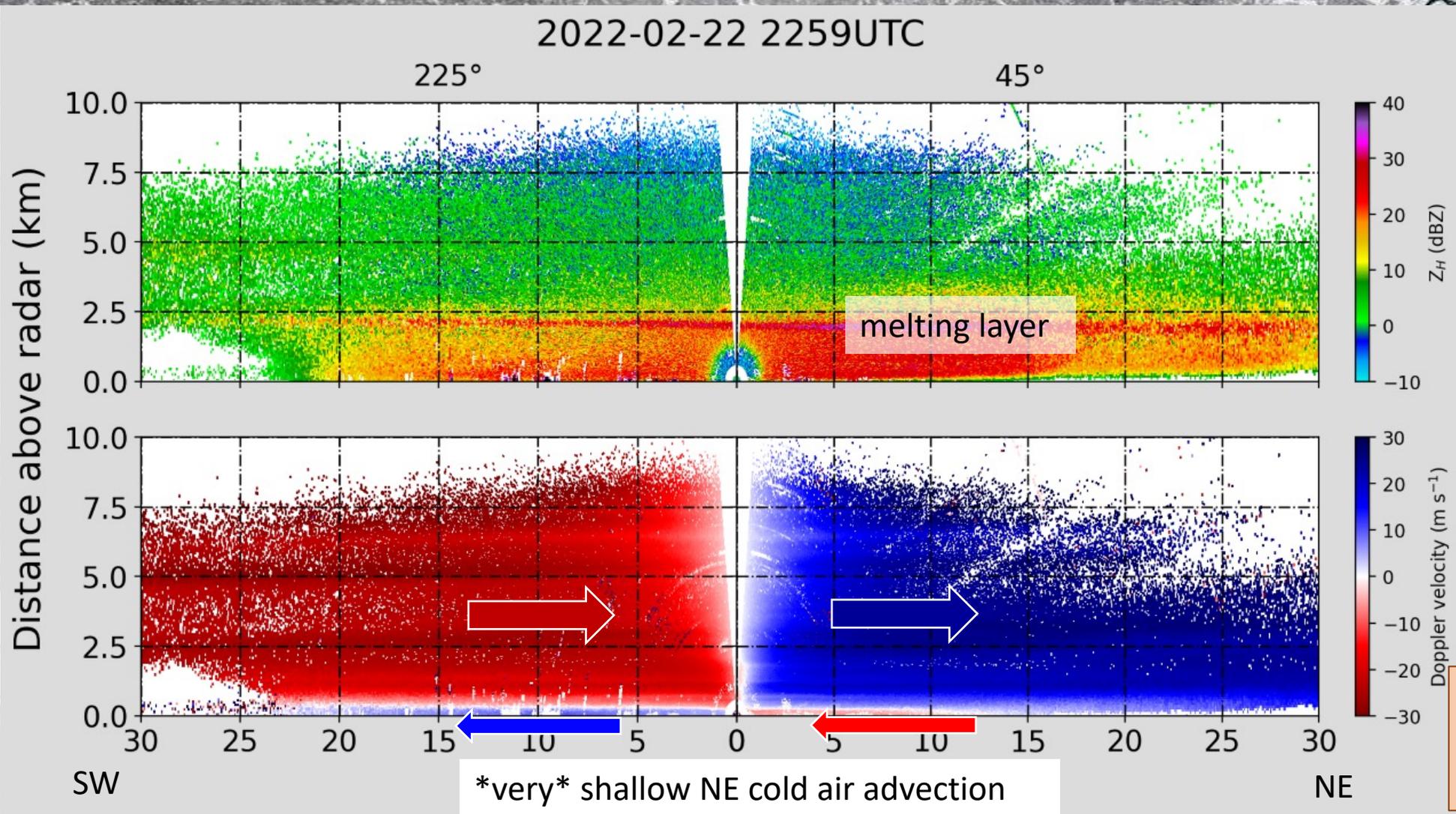
*What is the mechanism for ice pellet freezing?*

*What determines persistence / demise of surface cold air?*

# IOP5: COW radar – along-valley RHIs



# IOP5: COW radar – along-valley RHIs

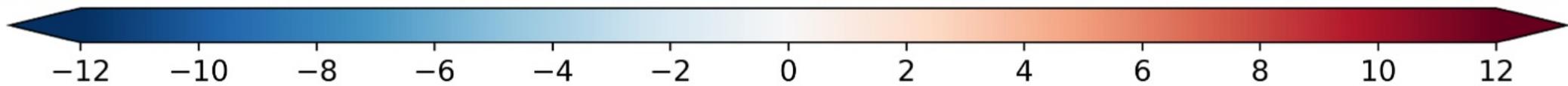
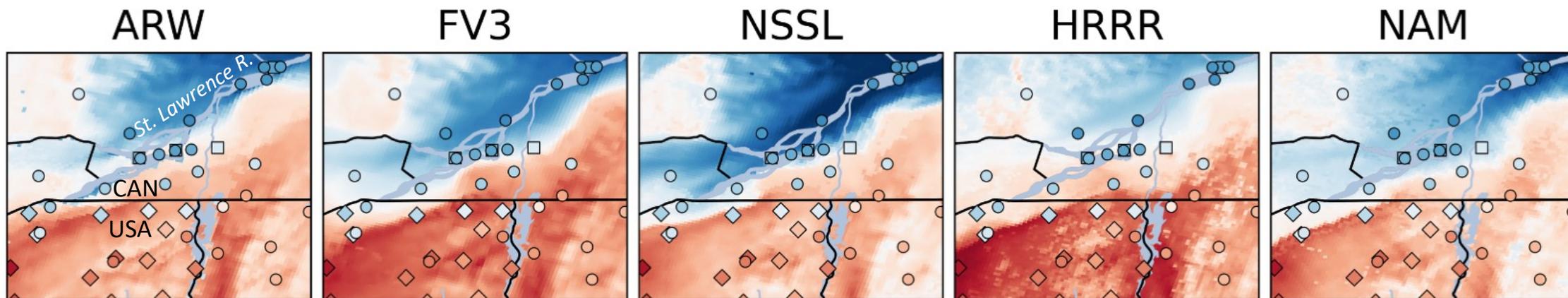


**What determines persistence / demise of surface cold air?**

# IOP5: *High-res. Model evaluation*

*Sources of temperature and p-type biases in the St. Lawrence Valley?  
Inadequate vertical resolution? Biases in PBL? Biases in microphysics?  
Dependence on synoptic regime?*

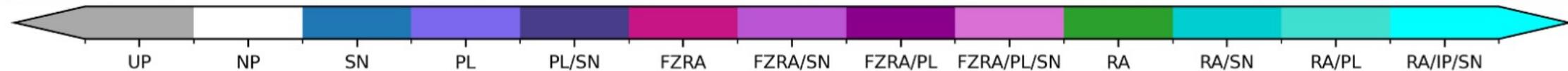
0000 UTC 23 February 2022



2-m Temperature [ ° C]

Minder et al. (2023)

Minder et al. (2023)



# Results:

## *Ongoing work*



# Synoptic-scale controls on p-type predictability

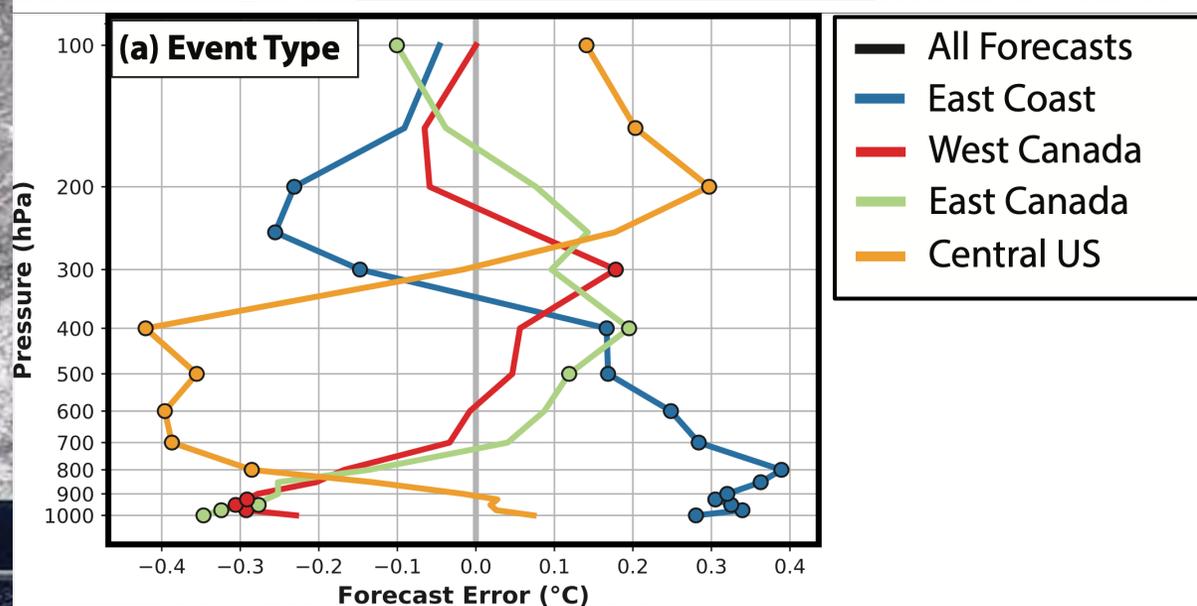


Andrew Winters

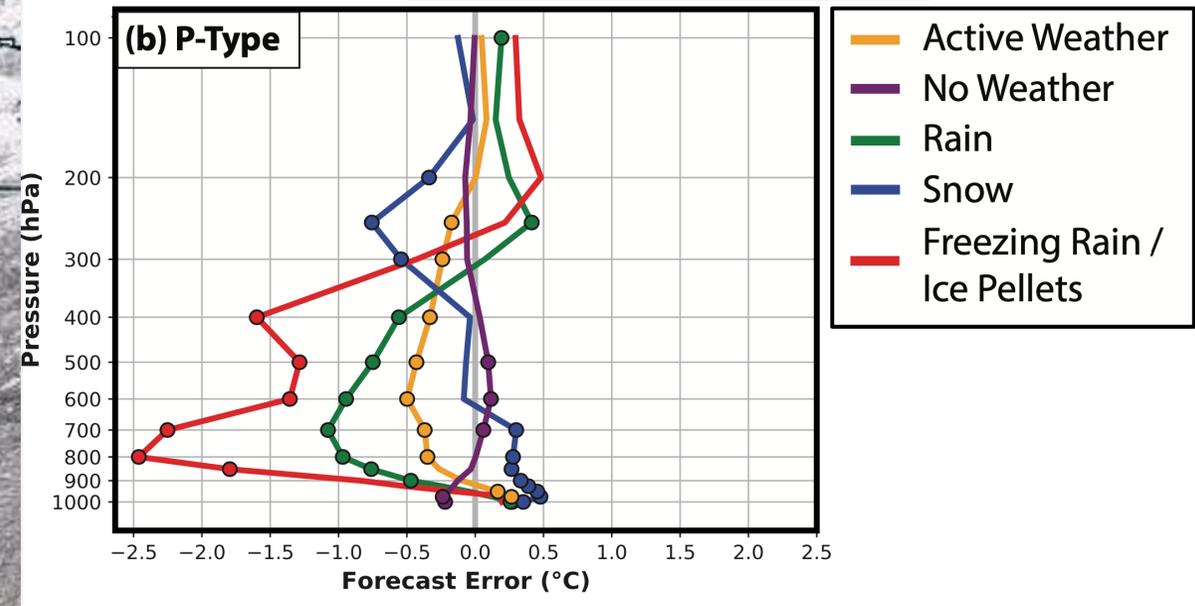


## Mean 120-h GFSv12 reforecast errors

... by cyclone track



... by observed p-type



Near-surface temperatures are biased warm during East Coast events relative to West Canada and East Canada events

Lower-tropospheric temperatures are biased cold, and near-surface temperatures are biased warm during periods of rain freezing rain, and ice pellets relative to periods of other weather types

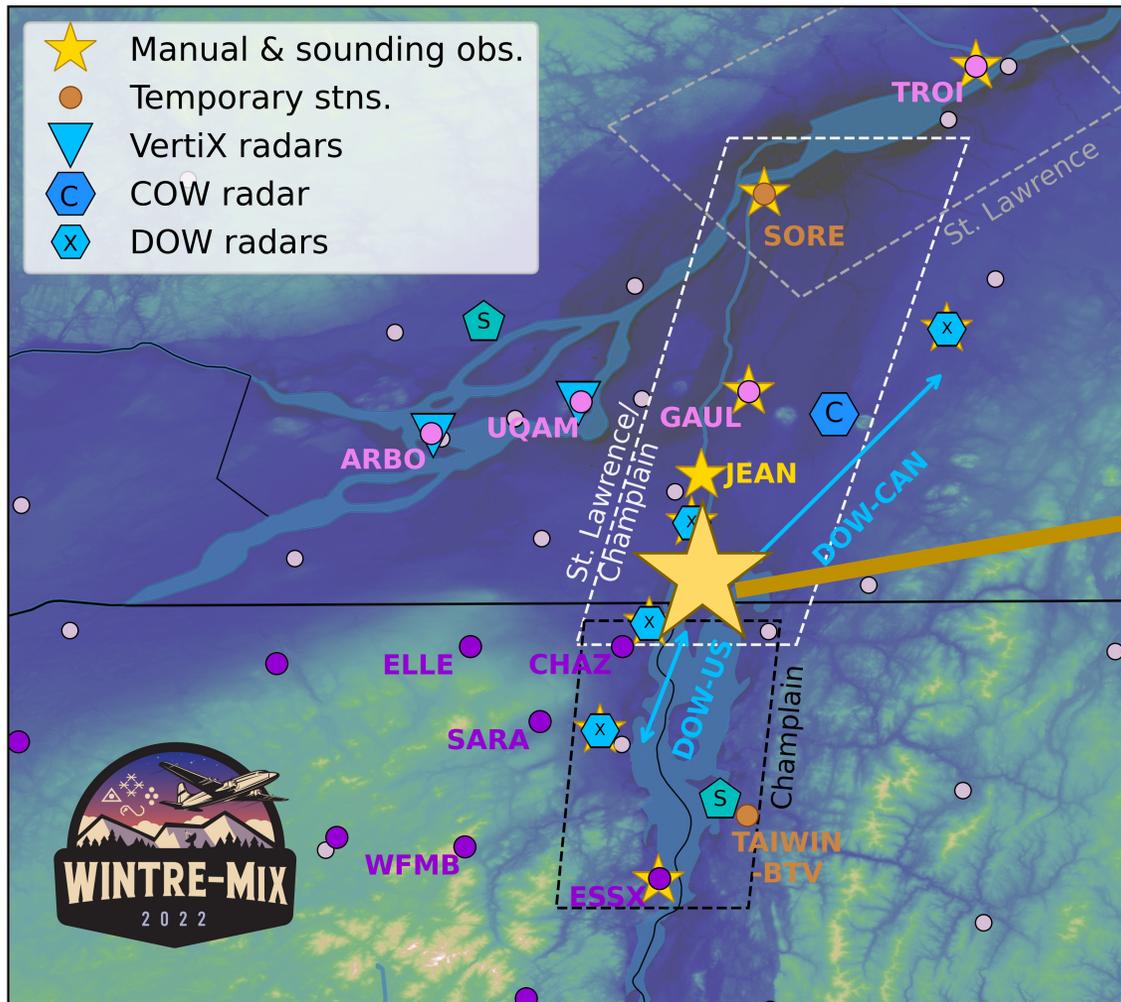
# Frontal structures over the St. Lawrence River Valley



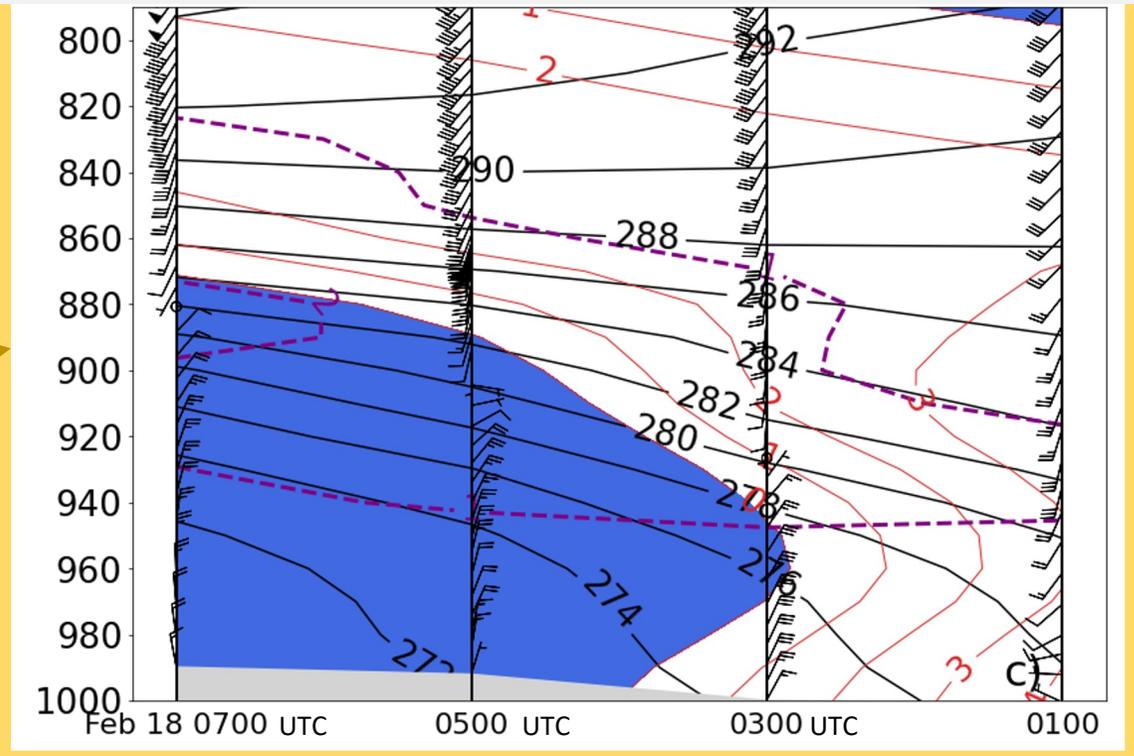
Juliann Wray



John Gyakum



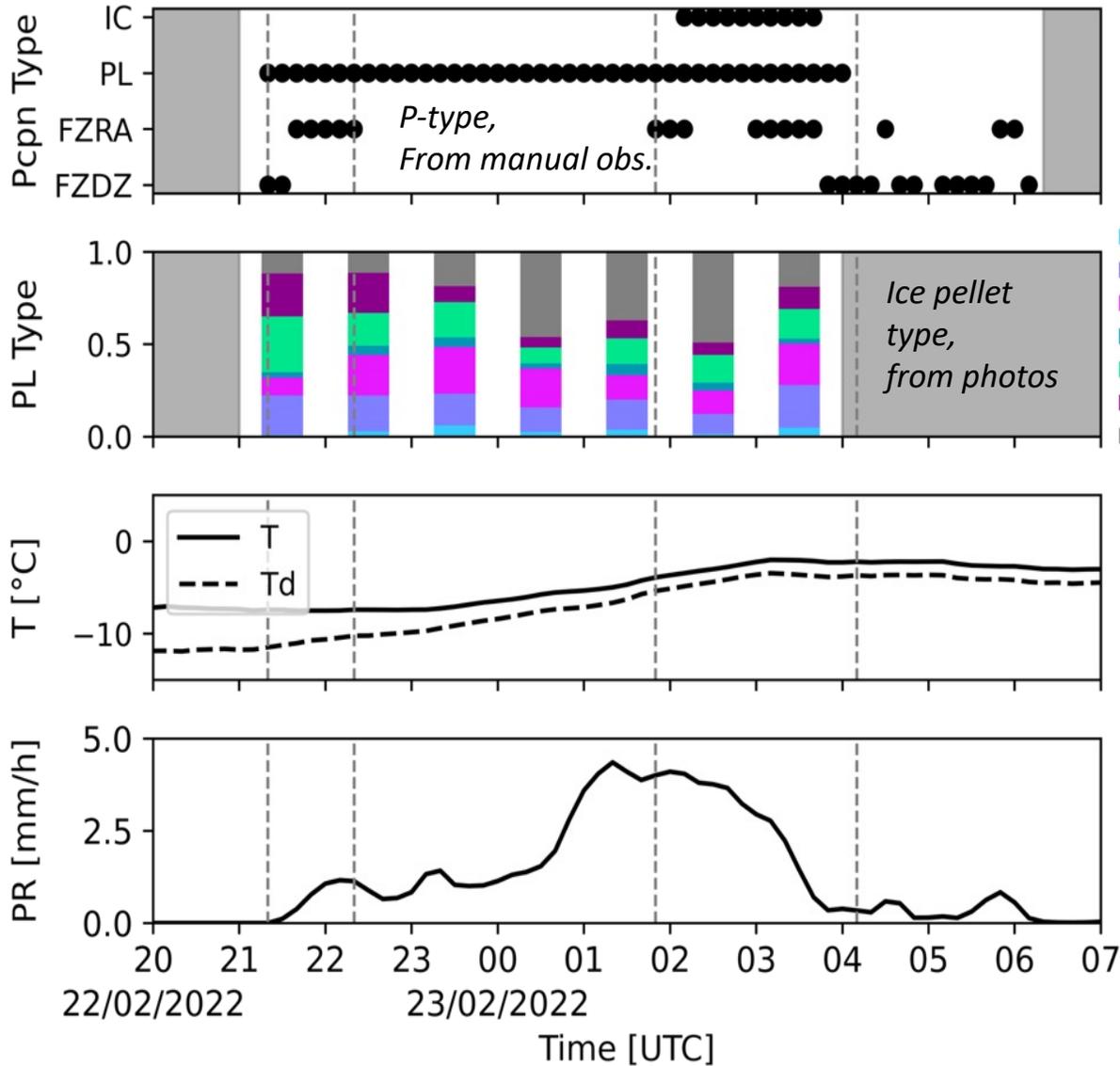
## Frontal evolution from soundings at DOW-CAN site



IOP 4 Vertical Cross-Section with Time (UTC):  
 $\theta$  (K, black), winds (kt), T ( $^{\circ}$ C, blue shading < 0, red contours > 0), PV (PVU, purple dashed)

# Microphysics of FZRA / Ice Pellet transitions

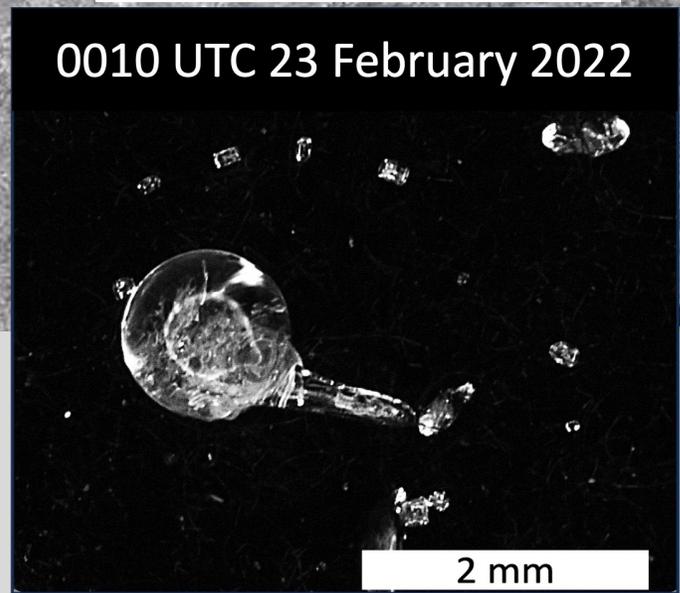
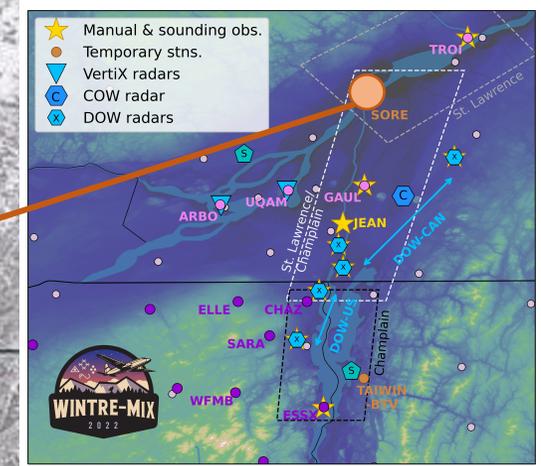
## Surface observations at Sorel, QC



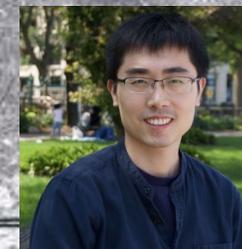
Julie Theriault



Margaux Girouard

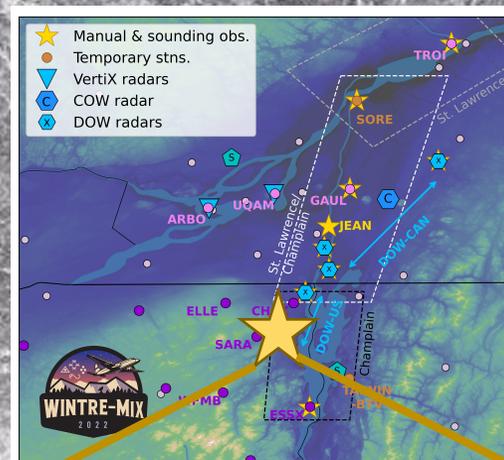


# Simulating FZRA / Ice Pellet transitions

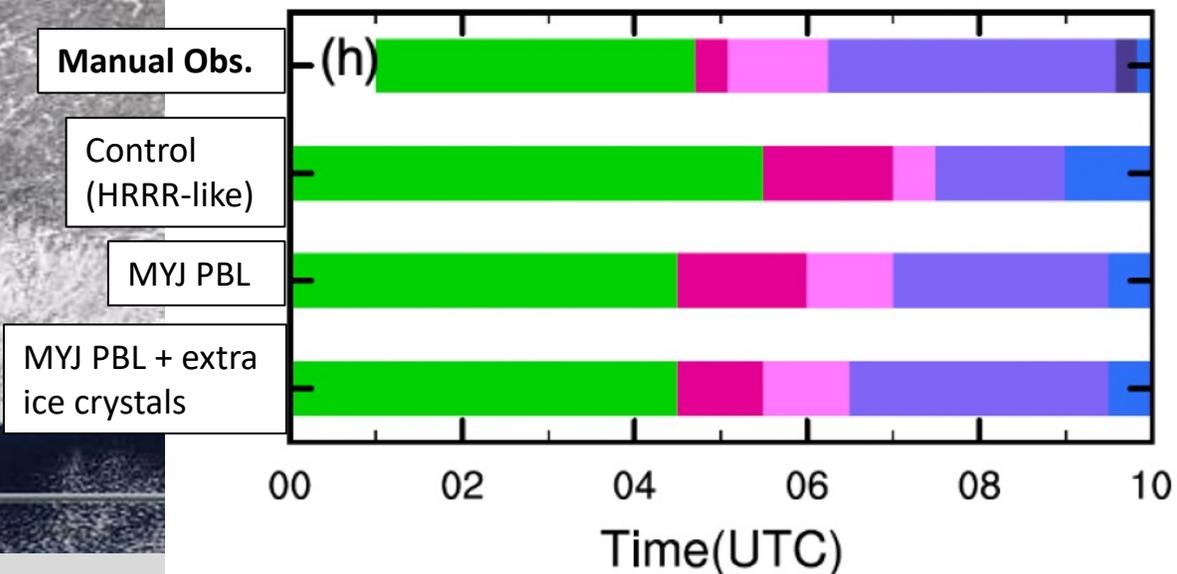


UNIVERSITY  
AT ALBANY  
State University of New York

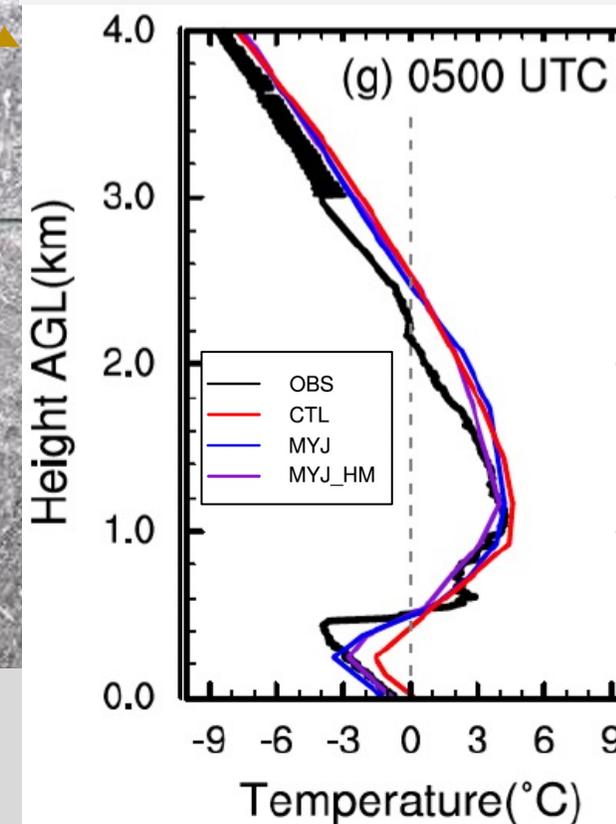
Bin Han



### Observed and WRF-simulated p-type



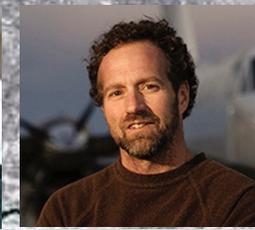
### Obs. & simulated temp. profile



# Airborne perspectives on p-type transitions



Eden Koval



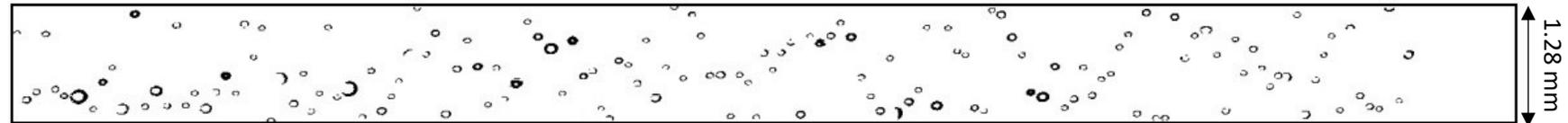
Jeffrey French



## Select 2DS particle images during IOP 9

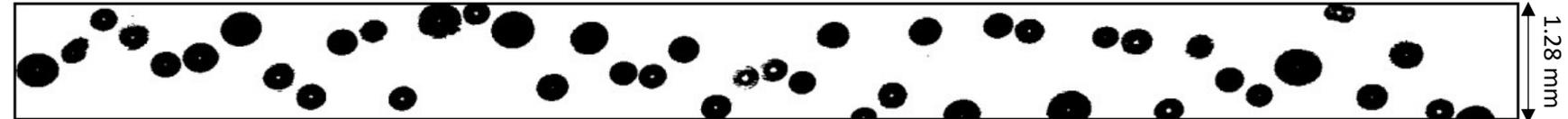
*Small, supercooled liquid droplets near cloud top (despite cold temps)*

4.6km -12°C



*Supercooled drizzle drops (hazardous for aircraft icing!)*

4.1km -10°C



*Ice crystals (secondary ice production?)*

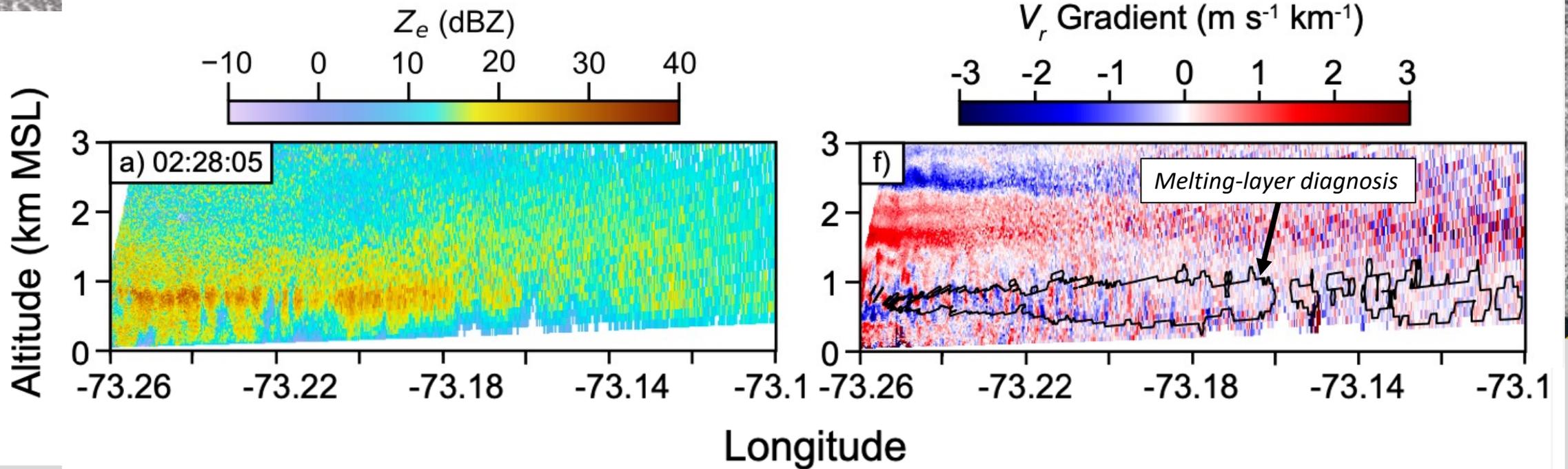
3.6km -4.4°C



# The role of turbulence in melting layers



Troy Zaremba





# Summary



- WINTRE-MIX is studying the variability and predictability of precipitation type and amount under near-freezing surface conditions
  - Multi-faceted observations in northern NY and southern QC
  - Examining roles of synoptic & mesoscale dynamics, turbulent motions, microphysics
- Initial analysis shows
  - Importance of very shallow and persistent cold air in valleys
  - Potential role for ice crystals in ice pellet formation
  - Mesoscale NWP struggles in simulating low-level cold air and p-type in valley
- Data published to EOL archive, publicly available

Justin Minder  
jminder@albany.edu

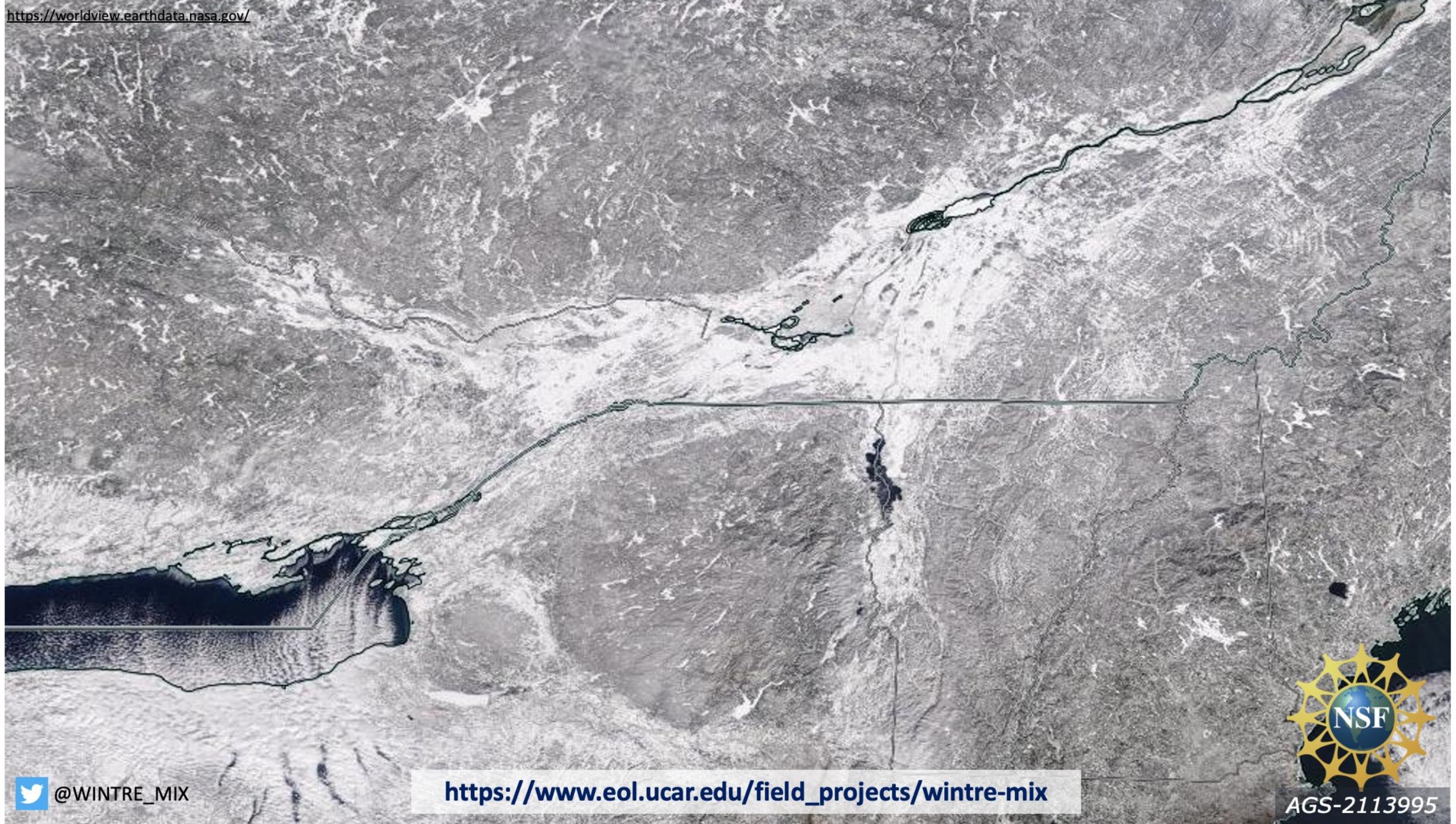
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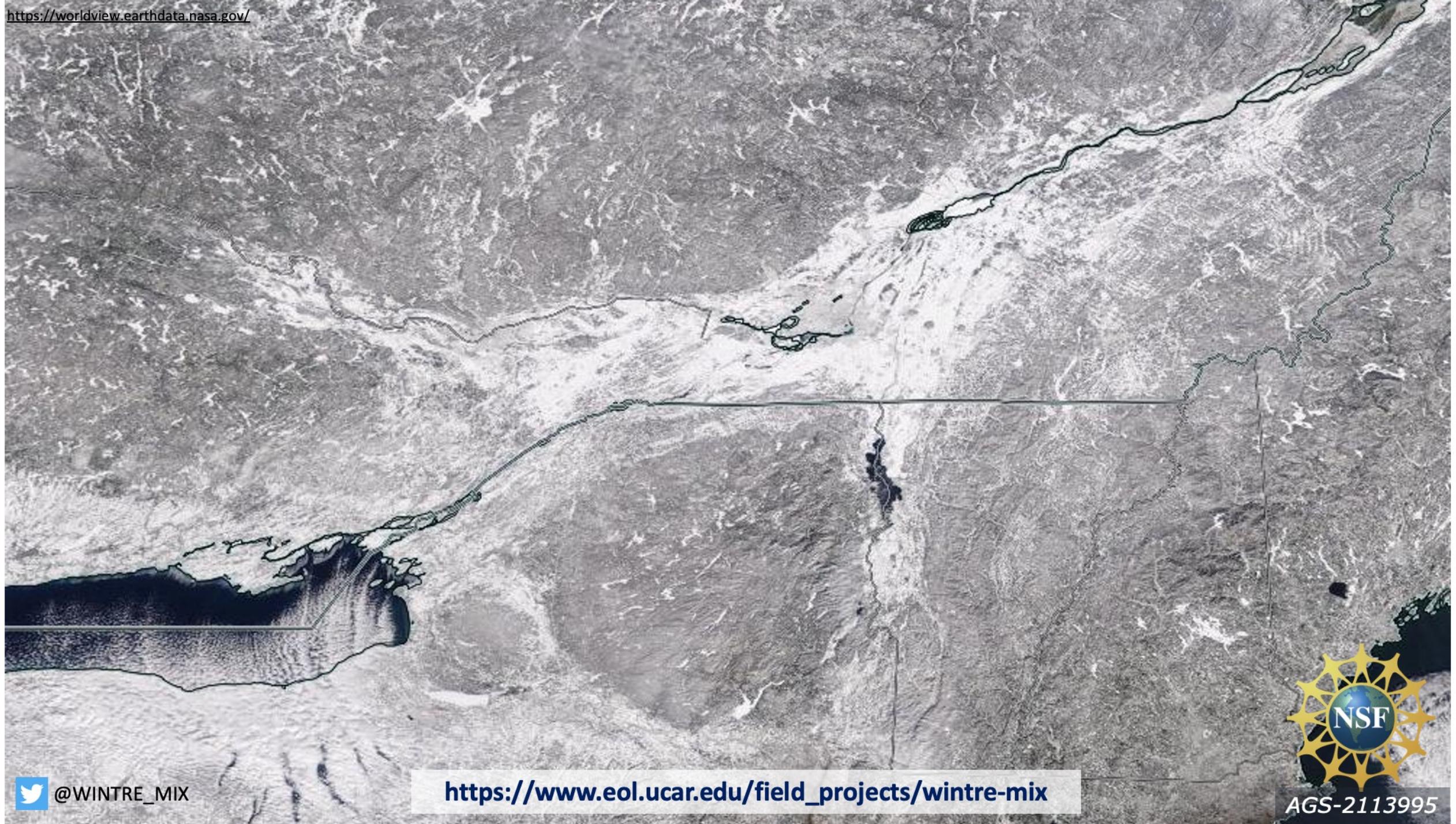
 @WINTRE\_MIX

[https://www.eol.ucar.edu/field\\_projects/wintre-mix](https://www.eol.ucar.edu/field_projects/wintre-mix)



AGS-2113995





# Extra slides