

Meteorological Linkages Between the Field Campaigns of January-February 2026

Chris Davis

University of Massachusetts Amherst
Paros Center for Atmospheric Research

NSF NCAR

World Weather Research Programme (WWRP)

July 1, 2026

Acknowledgements:

All the great teams leading and supporting field campaigns in 2026

This work was supported by the California Department of Water Resources through grant 4600015671, subaward 706906, and by NASA grant 80NSSC25K7786.



AR Recon 2025-2026 Season

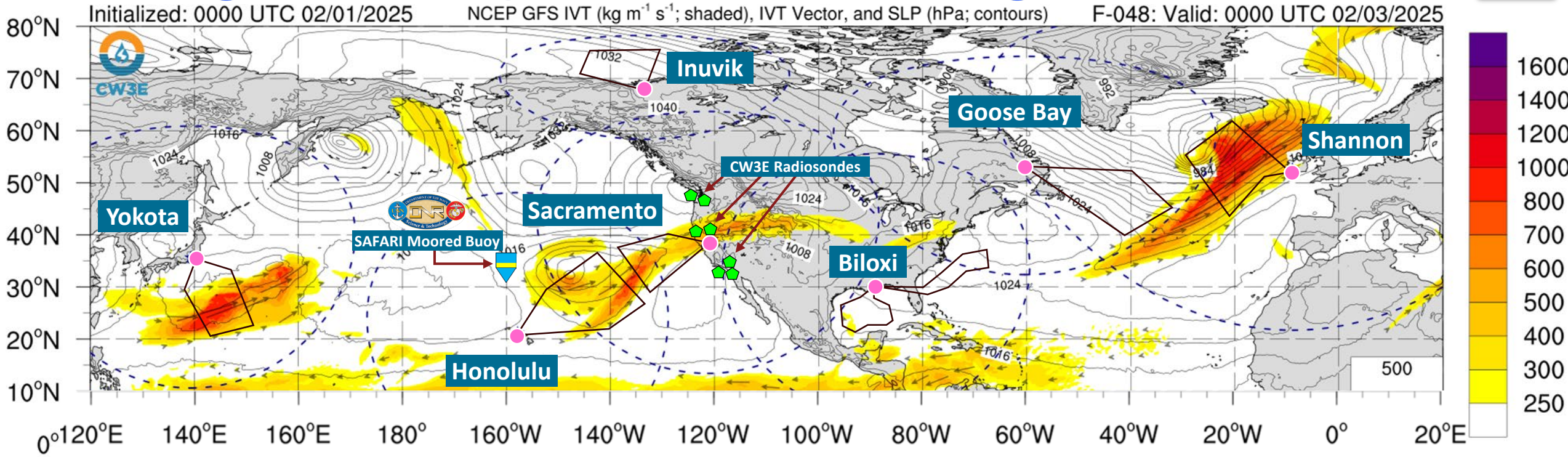
Northern Hemispheric GARRP* Demo

F. M. Ralph, AR Recon PI, Vijay Tallapragada Co-PI

*Global Atmospheric River Reconnaissance Program



West Pacific
Cent/East Pacific
Arctic
Gulf/East Coast
High Latitude
East Atlantic



AR Recon Command Center La Jolla, CA	Western Pacific USAF C-130 Jan 2024: Guam Jan 2025: Yokota, Japan Jan 2026: Yokota, Japan	Central/East Pacific NOAA G-IV, USAF C-130 Nov-Mar each year, On Station Jan-Feb; C-130: Sacramento, CA G-IV: Honolulu, HI	Gulf/East Coast USAF C-130 Nov-Mar each year upon request C-130: Biloxi, MS
--	--	---	---

Arctic NCR Convair-580 8 Jan – 28 Jan 2026 Inuvik, Canada	Western Atlantic NASA G-III 12 Jan – 6 Feb 2026 Goose Bay, Canada <i>Future flights (2027) by</i> NASA B-777	High Latitude G-550 & ATR42 12 Jan – 20 Feb 2026 Shannon, Ireland G-550: German HALO ATR42: French SAEIRE
---	--	---

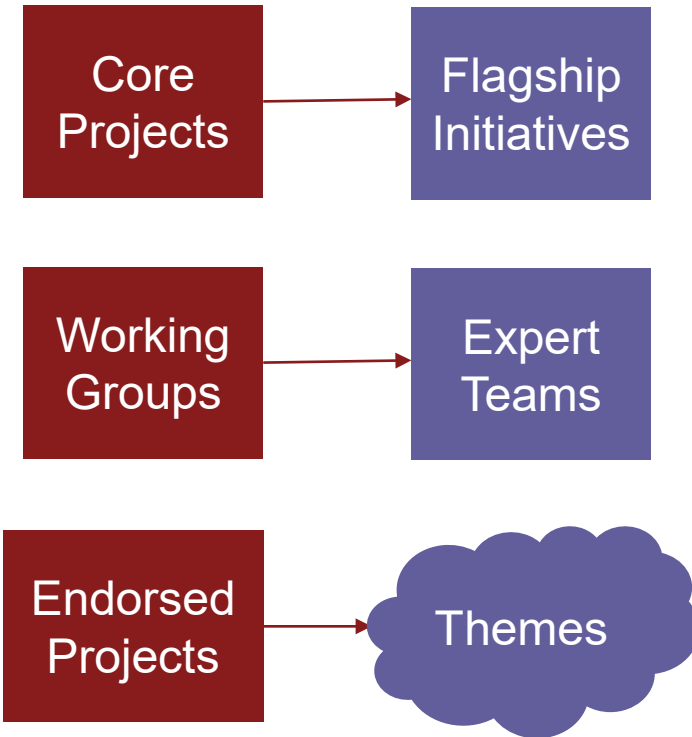
The World Weather Research Programme

New Implementation Plan 2028-2031

WWRP Goal 1: Observations and Data Foundations (both physical and social systems)

WWRP Goal 2: Prediction Science, Verification and Uncertainty (strong emphasis on physical modeling and machine learning)

WWRP Goal 3: Impacts, Warnings and Action (emphasis on effectiveness of warnings, inclusiveness of multi-hazard warnings)



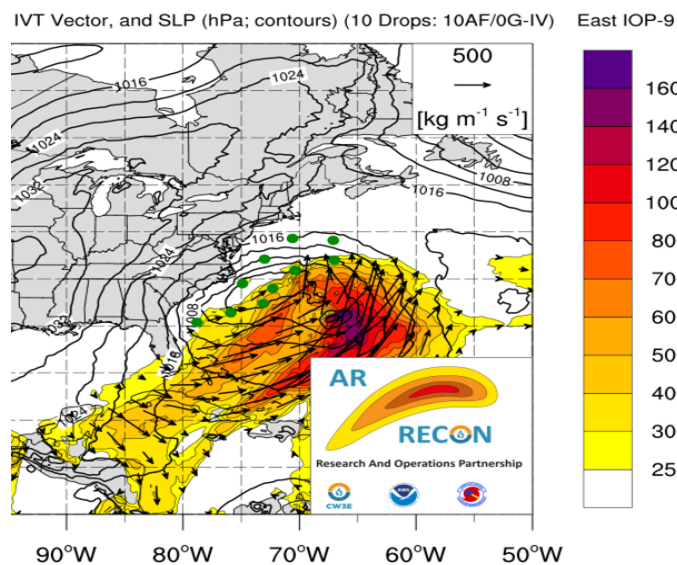
Coordination Efforts among Projects Endorsed by WWRP

- Atmospheric River Reconnaissance (AR-Recon)
- NURTURE (North American Upstream Feature-Resolving and Tropopause Uncertainty Reconnaissance Experiment)
- NAWDIC (North Atlantic Waveguide, Dry Intrusion, and Downstream Impact Campaign)
- PONEX (Polar Night Experiment)
- Global Drifter Program

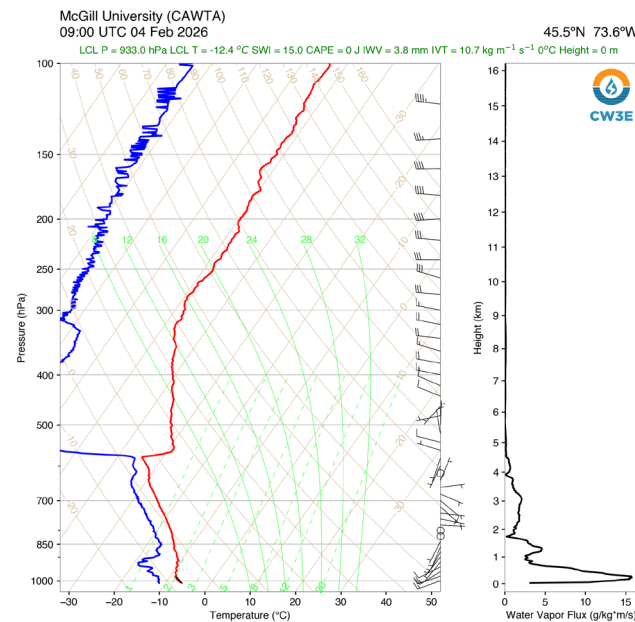
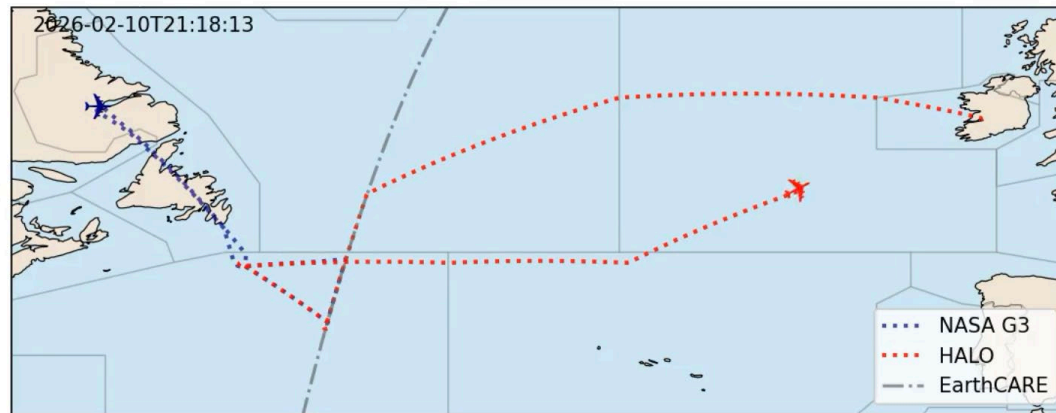
Coordination Group included:

- AR Recon Pis
- NURTURE Pis
- NAWDIC Pis
- PONEX Pis
- ECCC representative
- GPEX Pis
- ESA representatives
- EUMETNET representatives
- WWRP SSC members (ECMWF, DWD, NCEP, NCAR)

AR Recon flight into East Coast "Bomb"

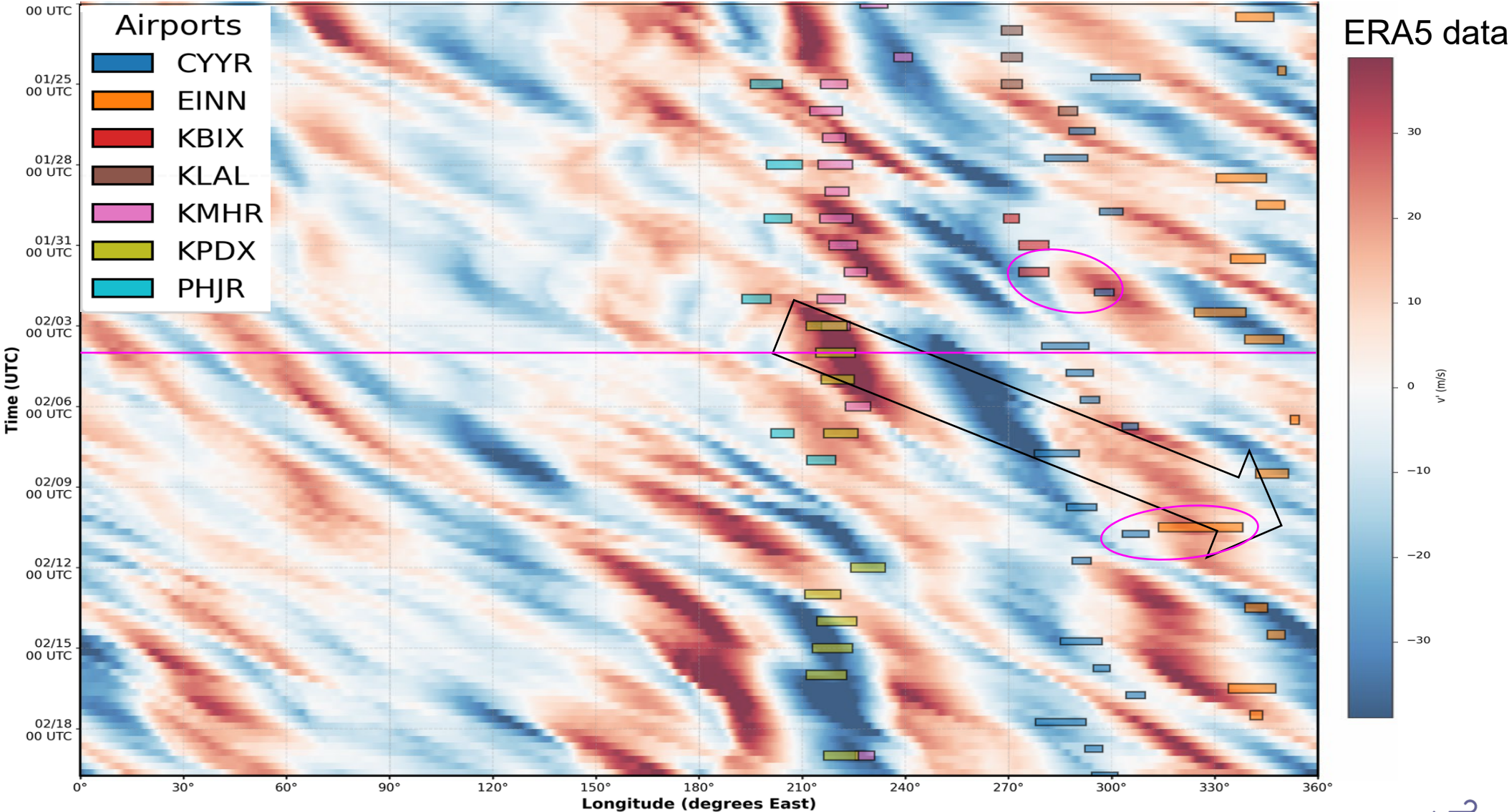


NAWDIC IOP14 "Ballina" on Tuesday, February 10, coordination with NURTURE



Tropopause
Polar Vortex
sampled by
rawinsonde
launched by
McGill
University,
Feb. 4 2026

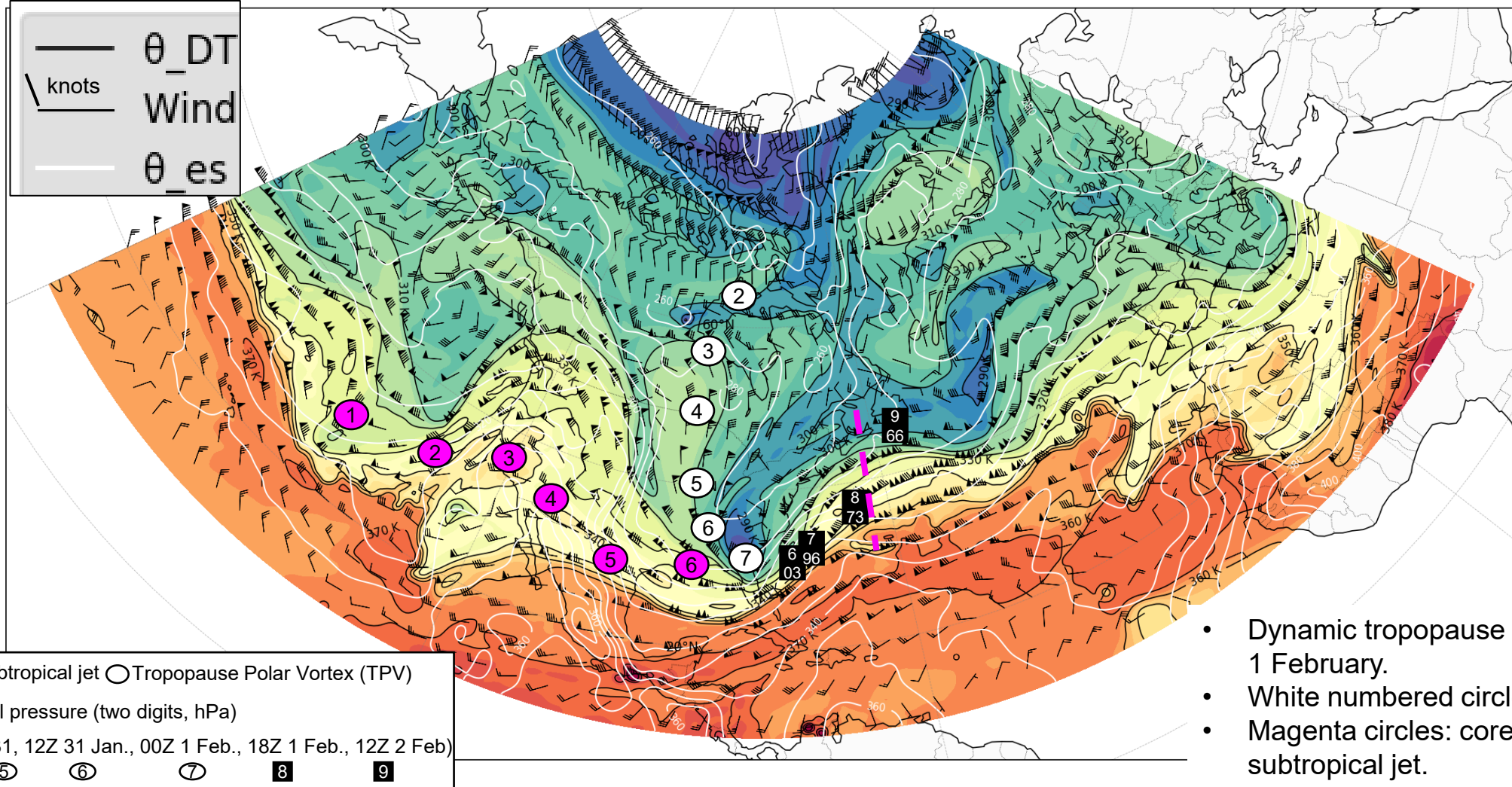
Meteorological Linkages: DT Hovmoller Diagrams (v')



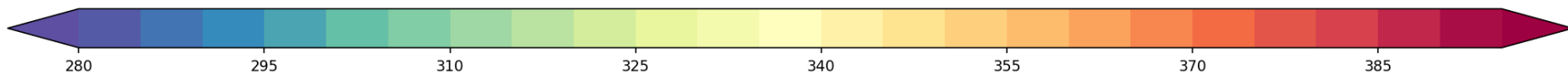
Thanks to Peyton Capute and Jay Cordeira for flight data



Explosive East Coast Cyclone: 1 February 2026

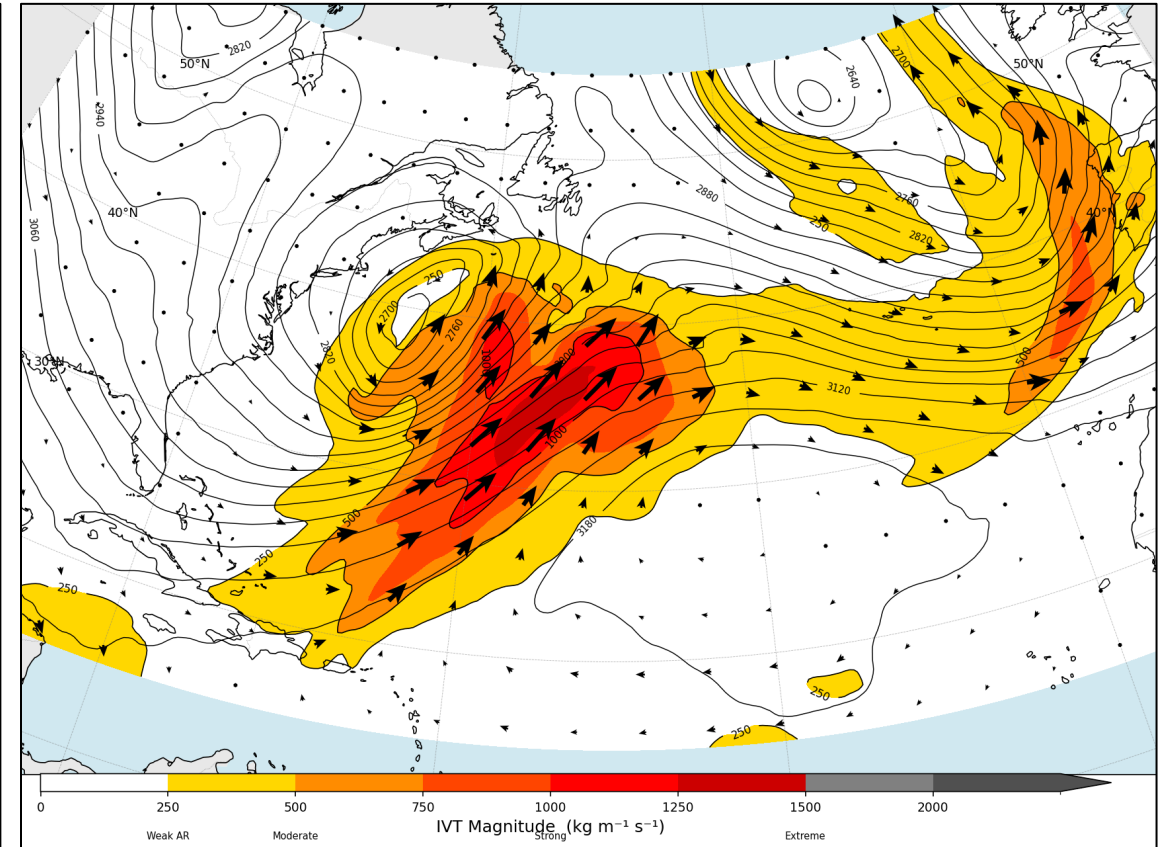
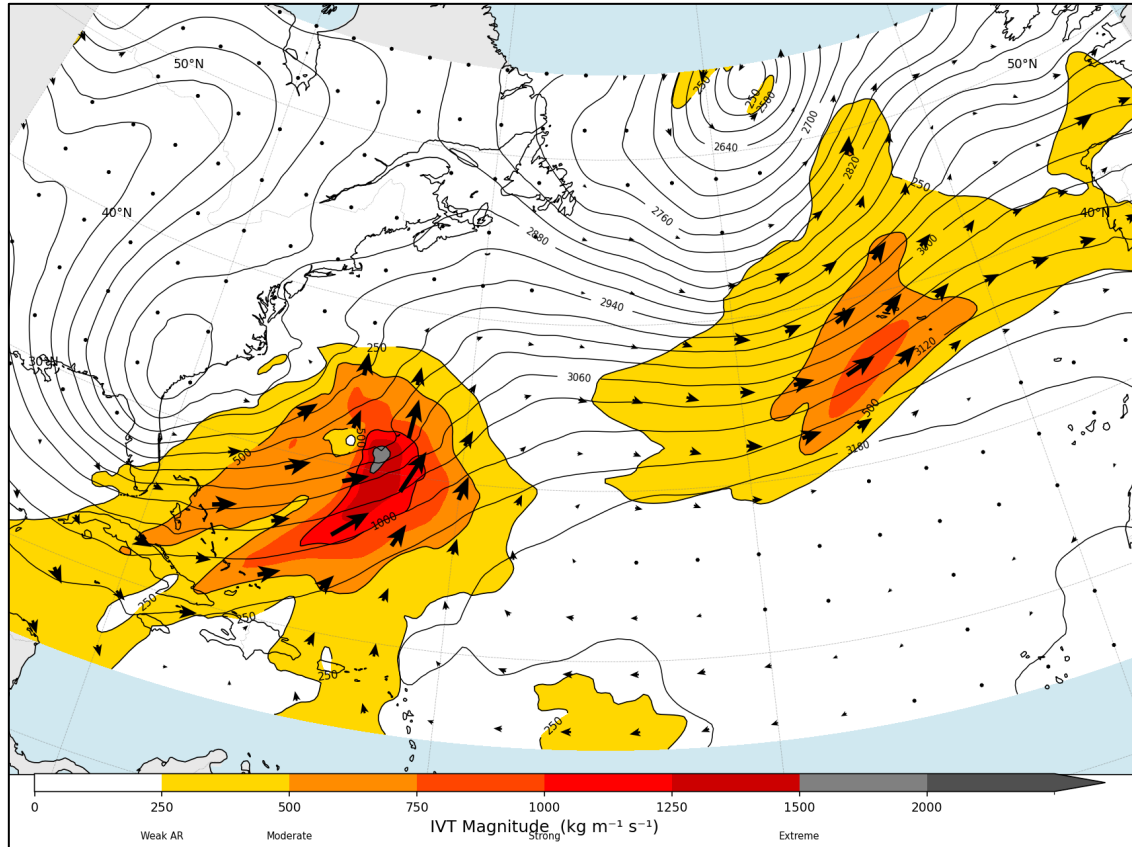


- Dynamic tropopause map: 18 UTC 1 February.
- White numbered circles: TPV
- Magenta circles: core of trough on subtropical jet.



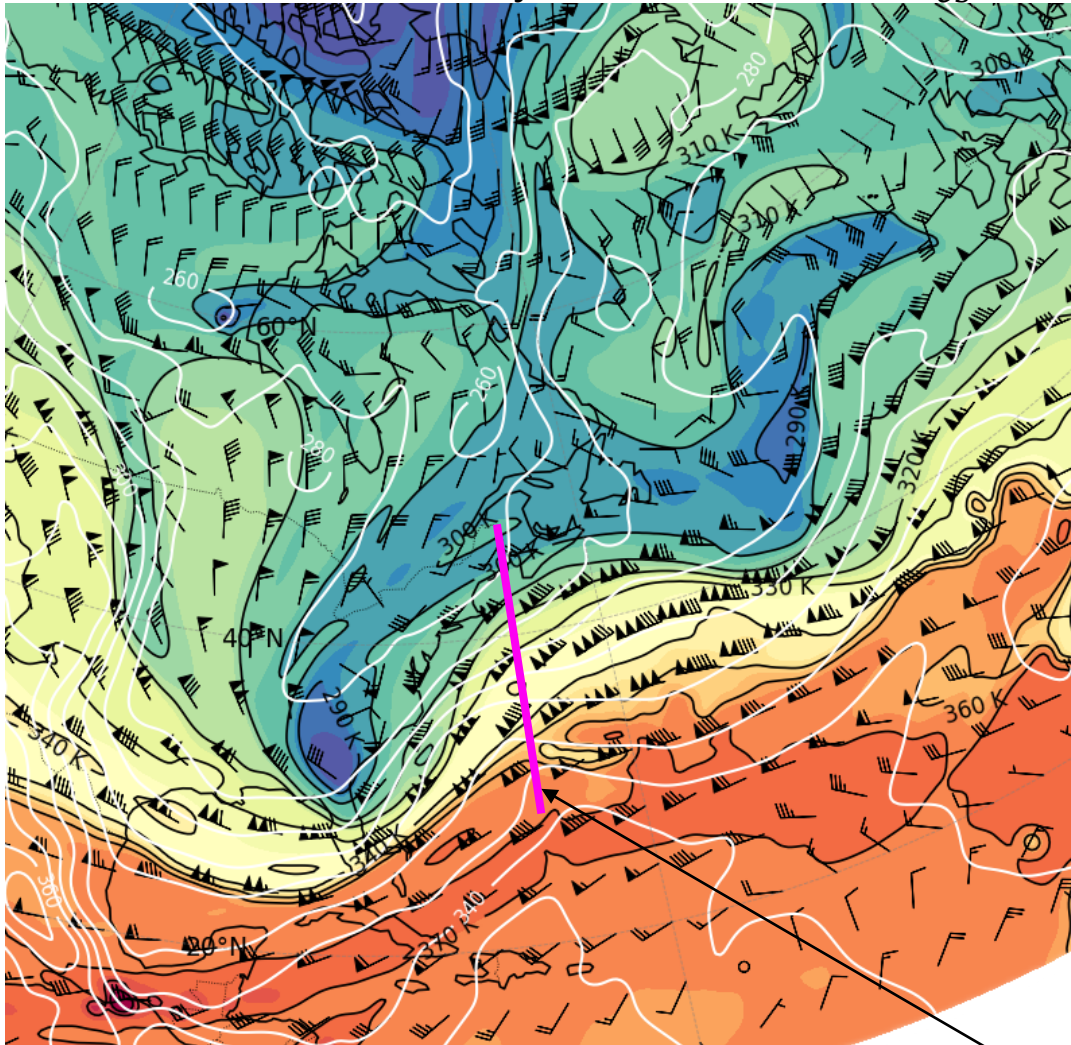
Integrated Vapor transport (IVT) for 00 UTC and 21 UTC 1 February

- IVT Exceeds 1500 kg/(m*s) at 00 UTC
- IVT pattern “splits” by 21 UTC

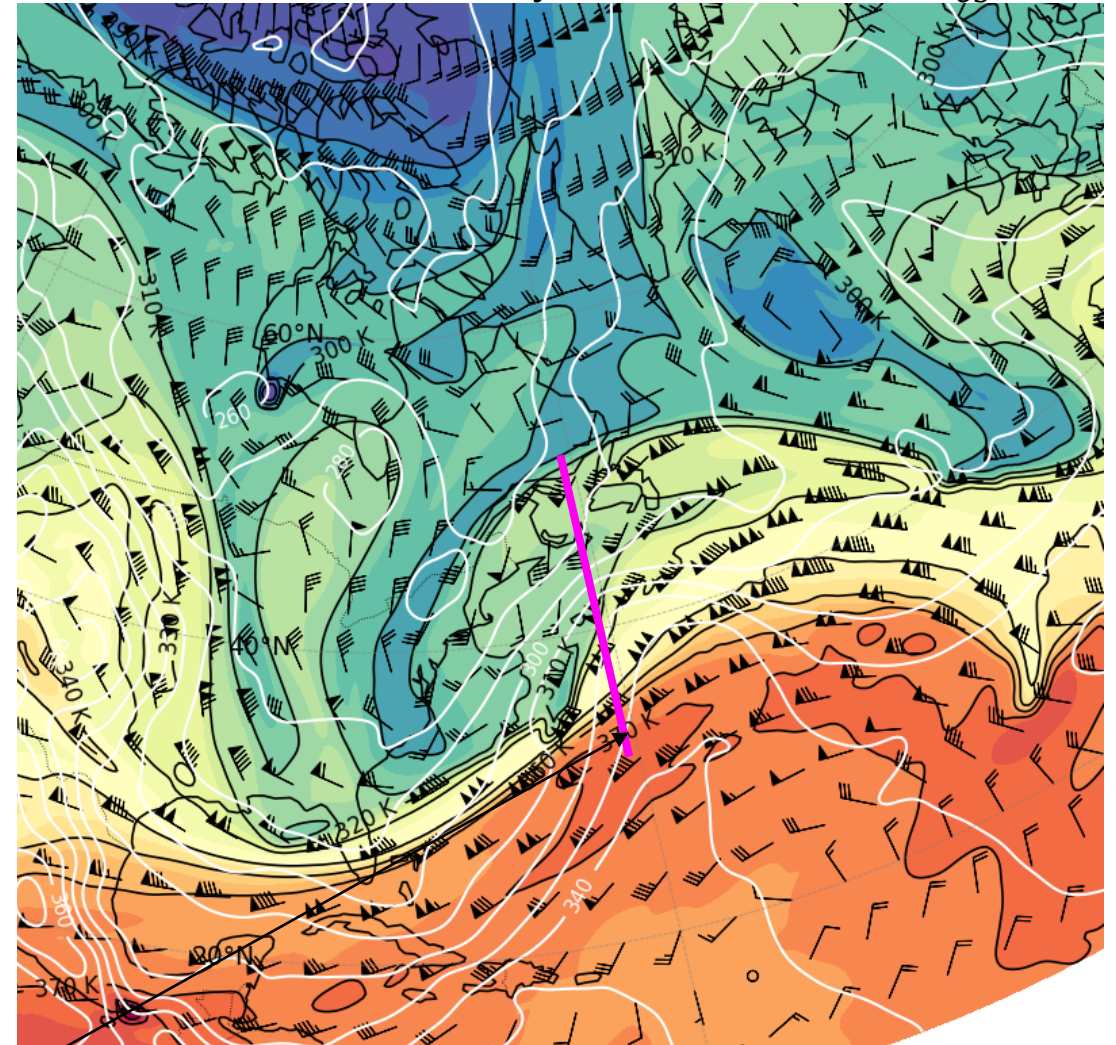


Dynamic Tropopause Evolution During Cyclone Development

00 UTC 01 February DT and 925 hPa θ_{es}



21 UTC 01 February DT and 925 hPa θ_{es}



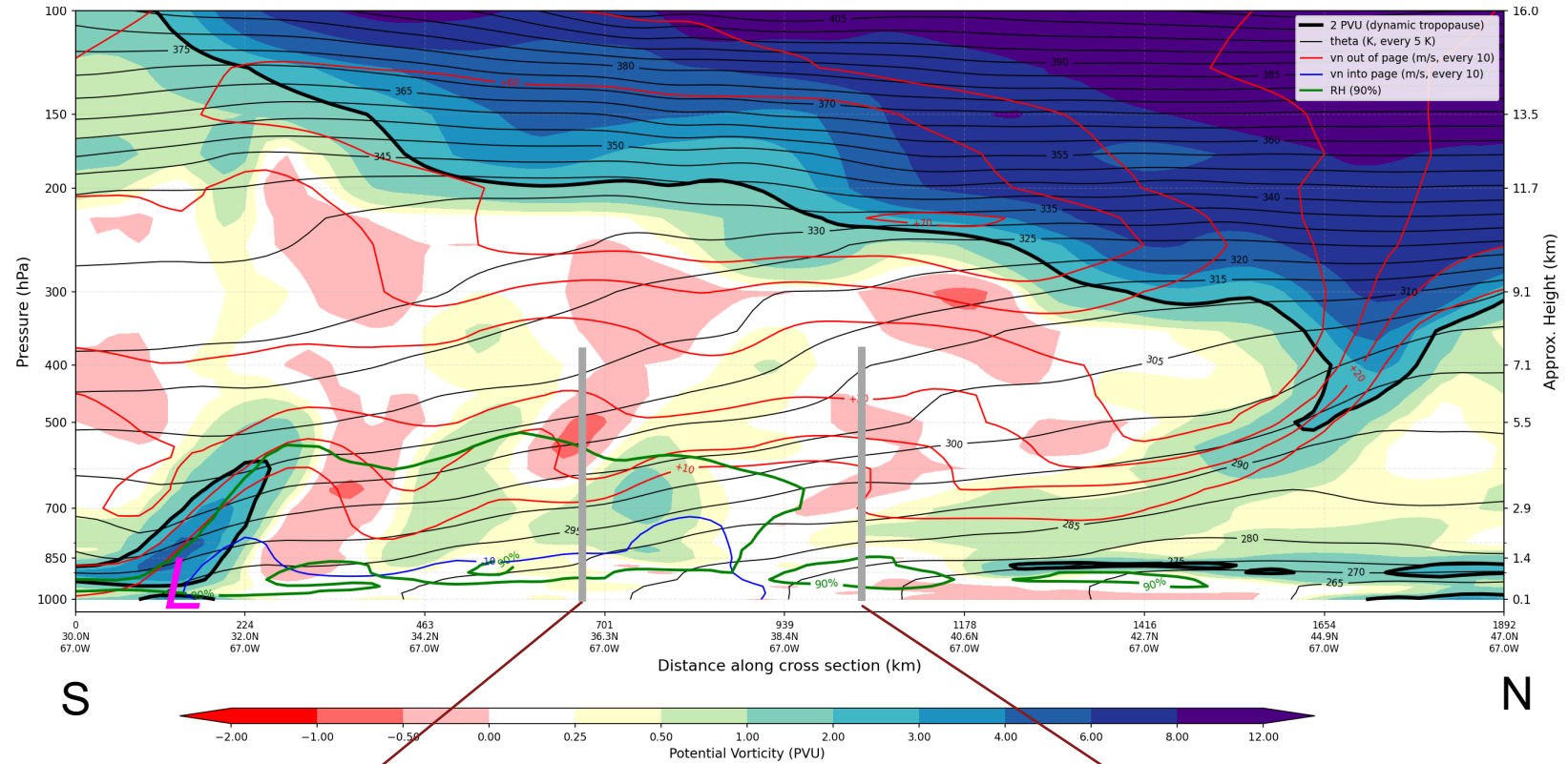
Cross Sections Where Dropsondes were Deployed



North-South Cross-Section in Developing Cyclone – Warm Front

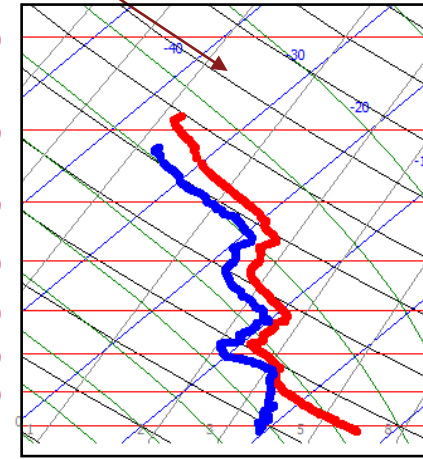
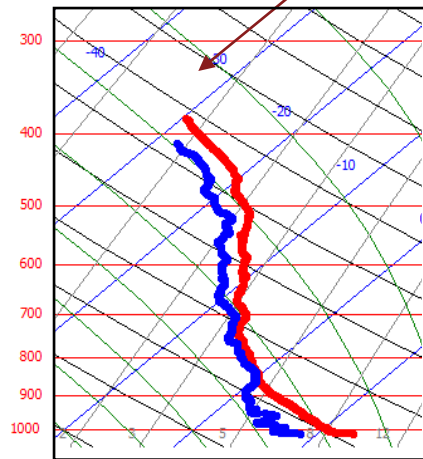
AR-Recon flight

Developing cyclone
over western Atlantic



S

N

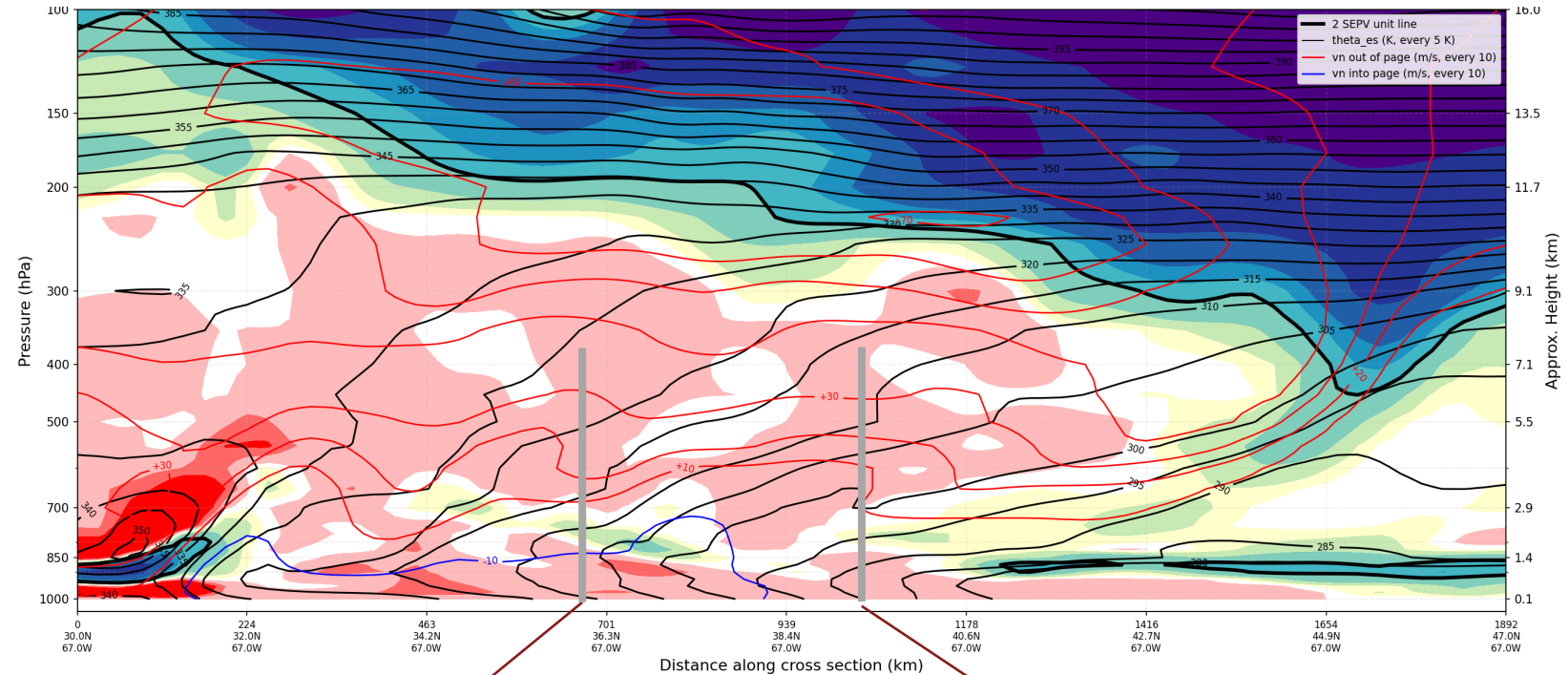


North-South Cross-Section in Developing Cyclone – Warm Front

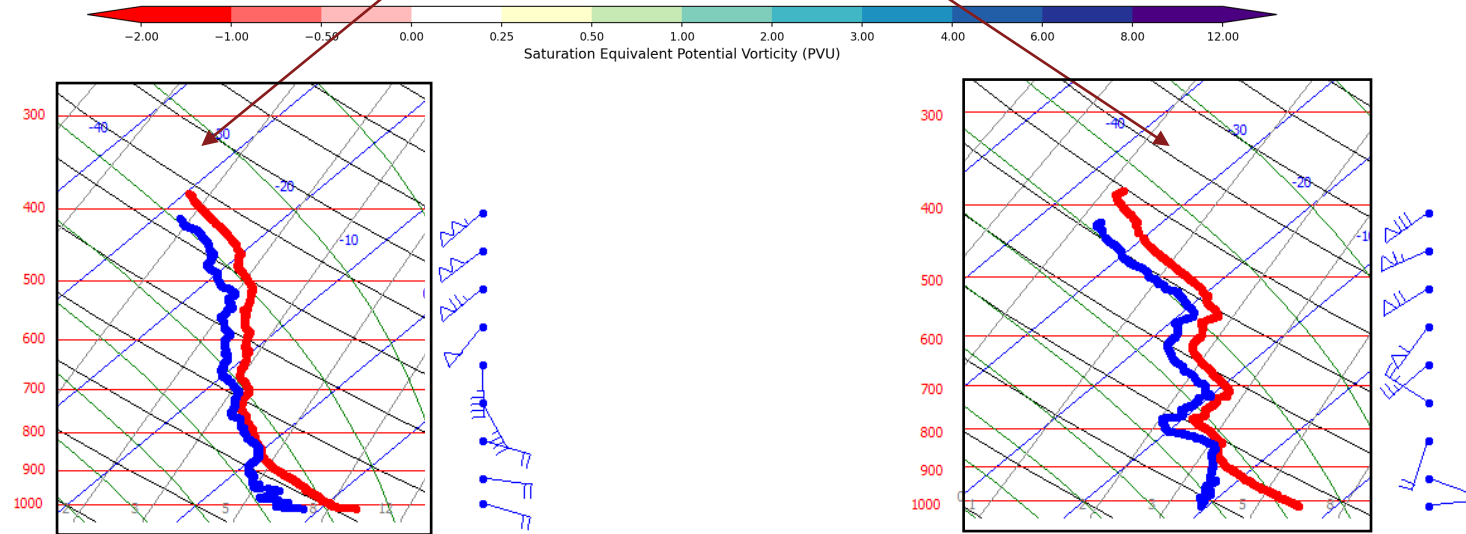
$$q_{esi} = \frac{1}{\rho} \vec{\eta} \cdot \nabla_{3D} \theta_{esi}$$

θ_{esi} is saturation equivalent potential temperature with respect to ice

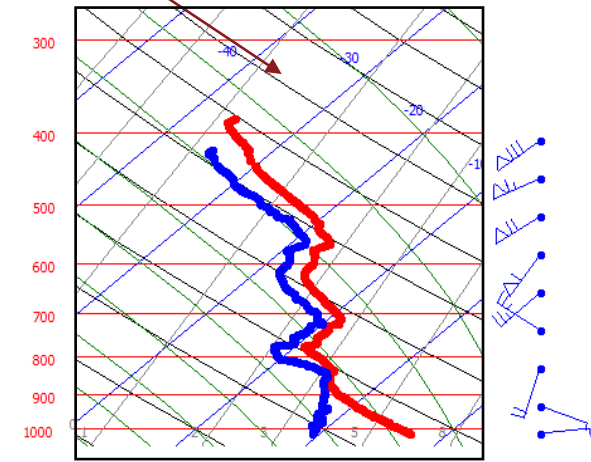
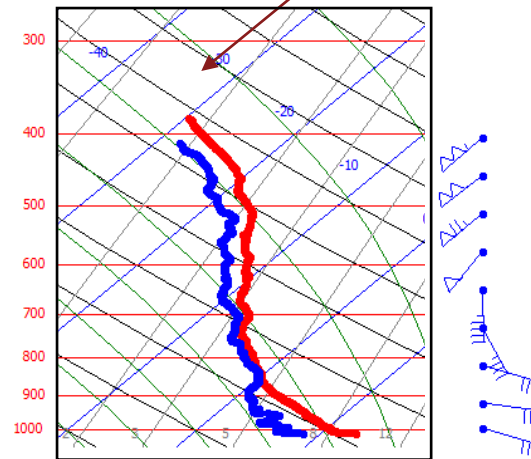
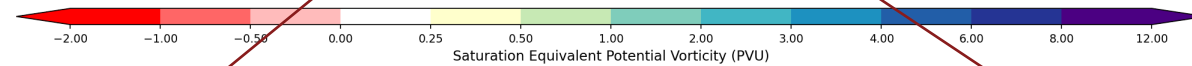
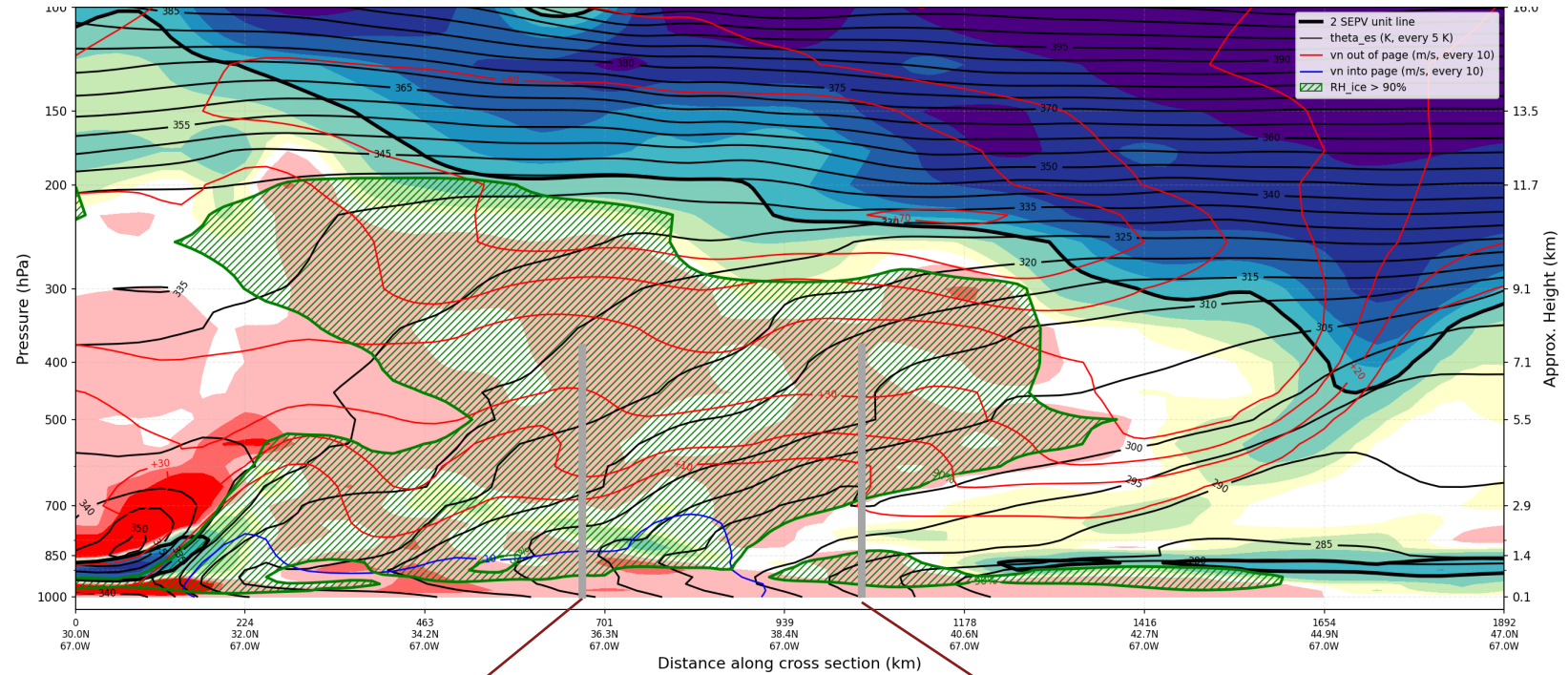
θ_{esi} surfaces link DT with boundary layer, across 1000-1500 km



Bennetts and Hoskins 1979: QJRMS
 Emanuel, 1985: JAS
 Novak et al. 2004, W&F

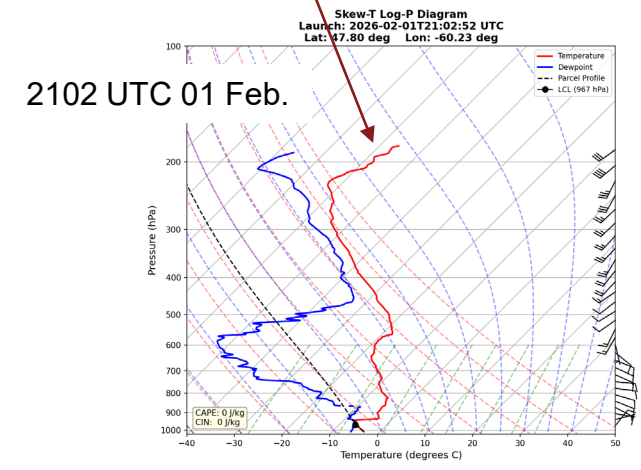
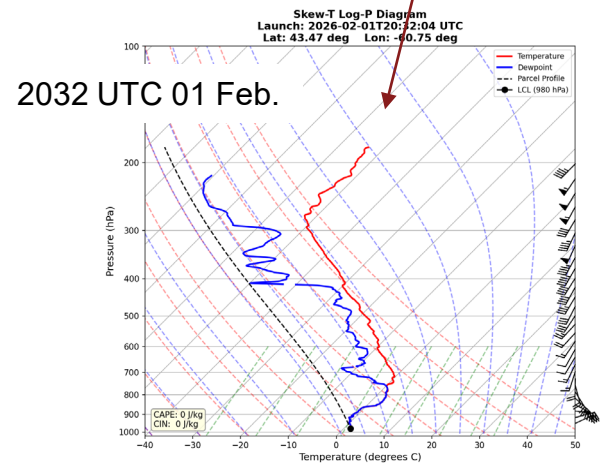
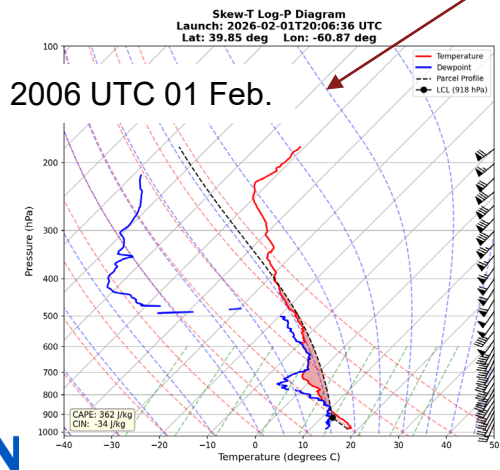
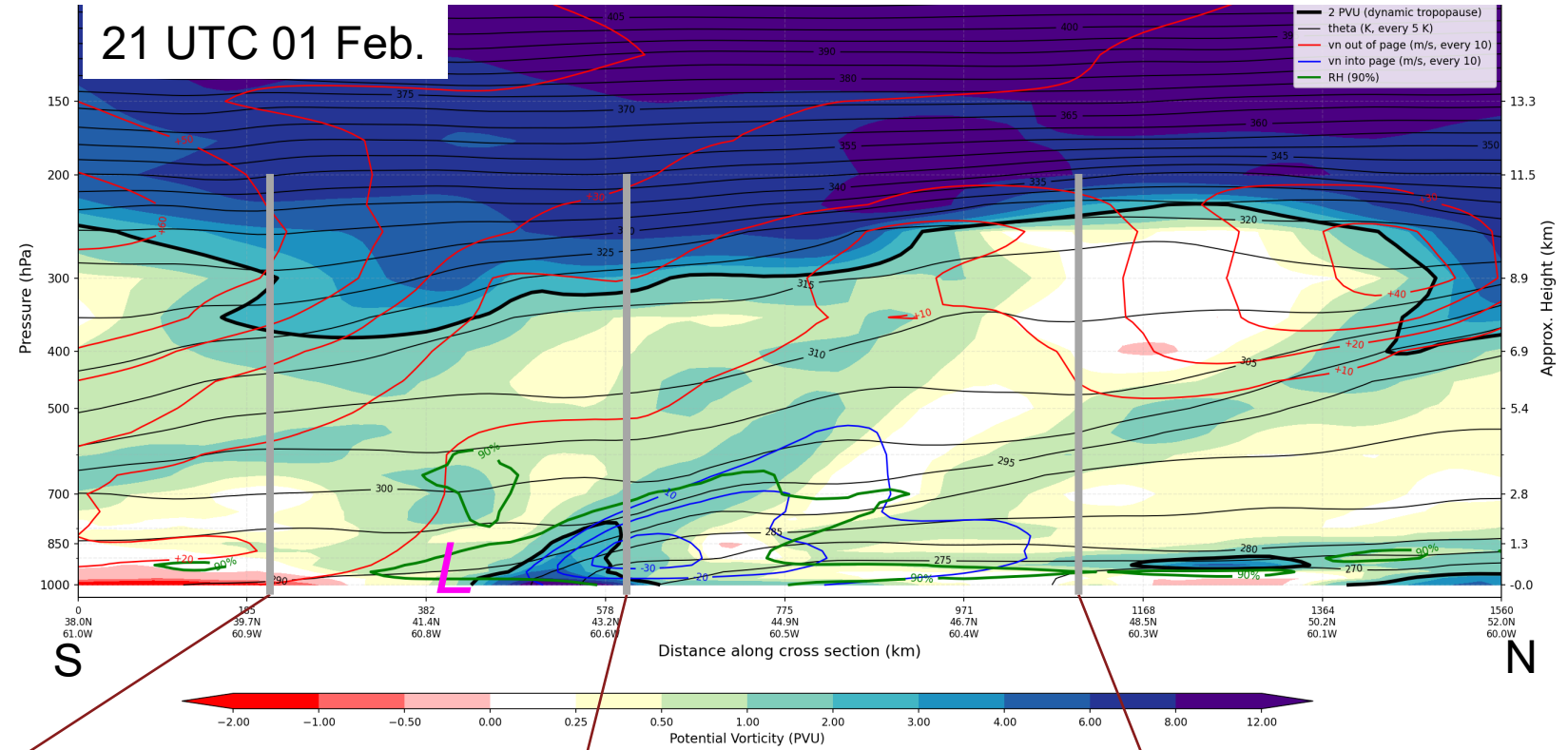


North-South Cross-Section in Developing Cyclone – Warm Front

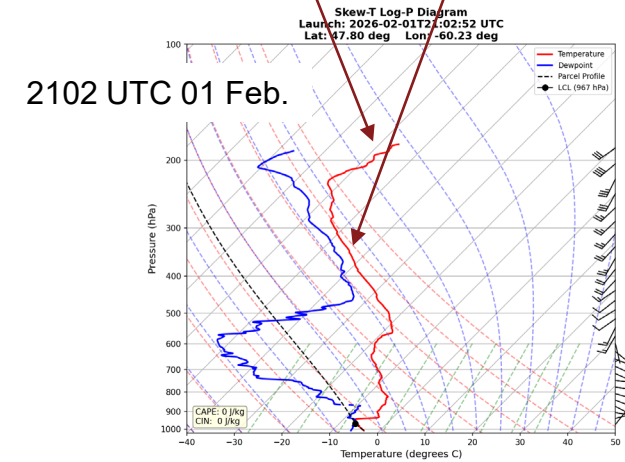
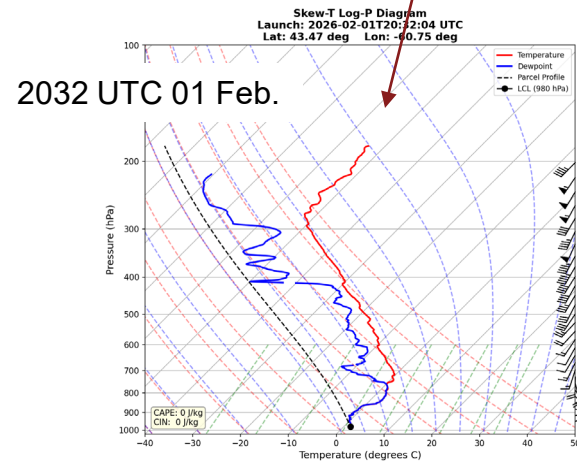
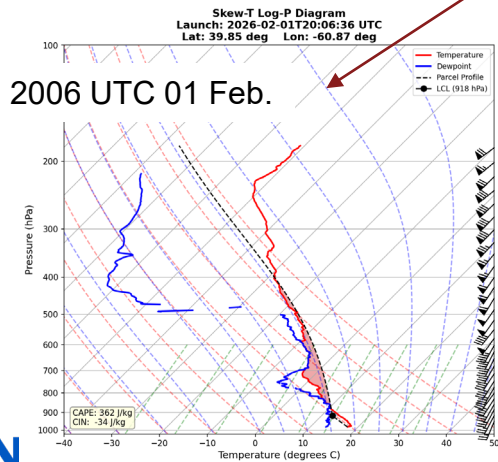
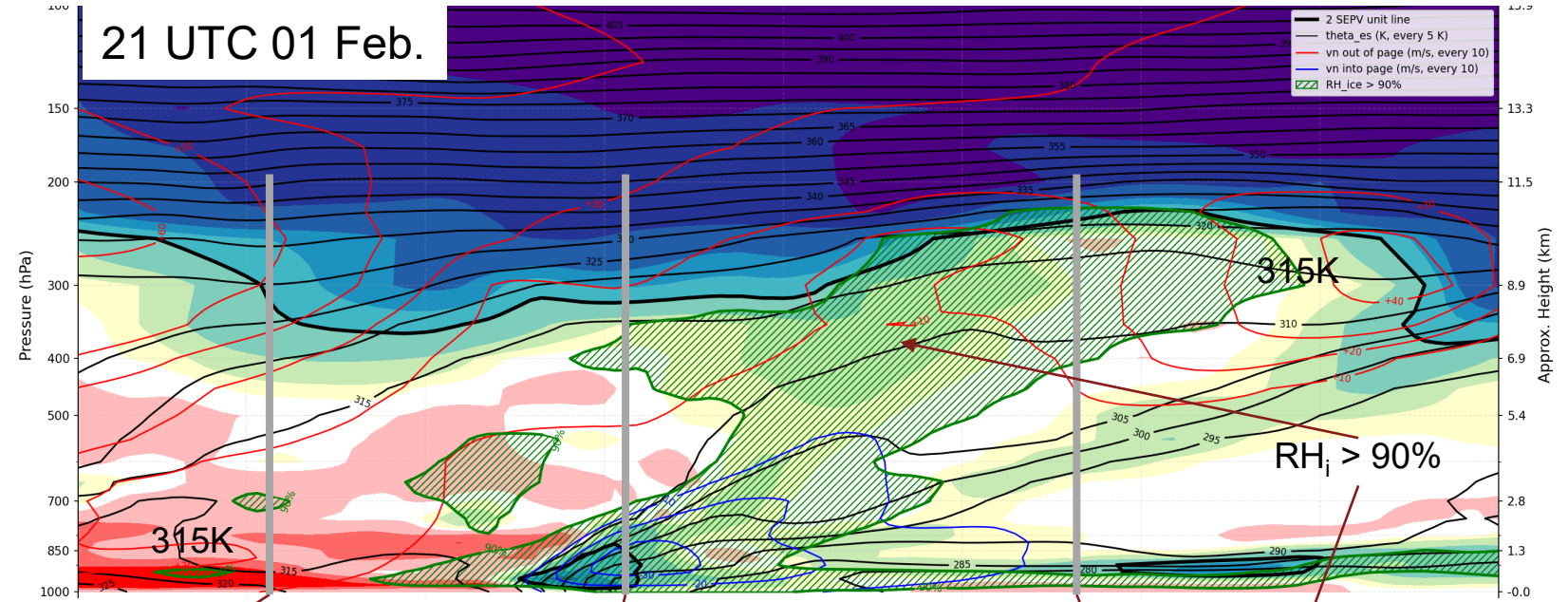


North-South Cross-Section in Intense Cyclone – Warm Front

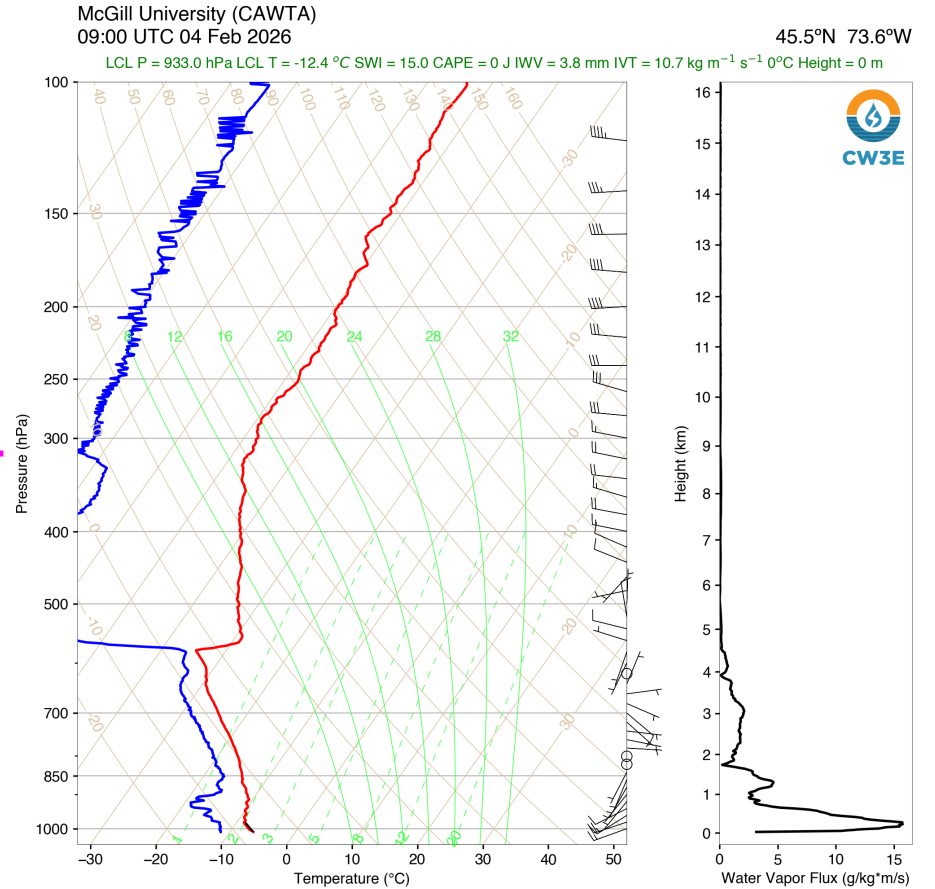
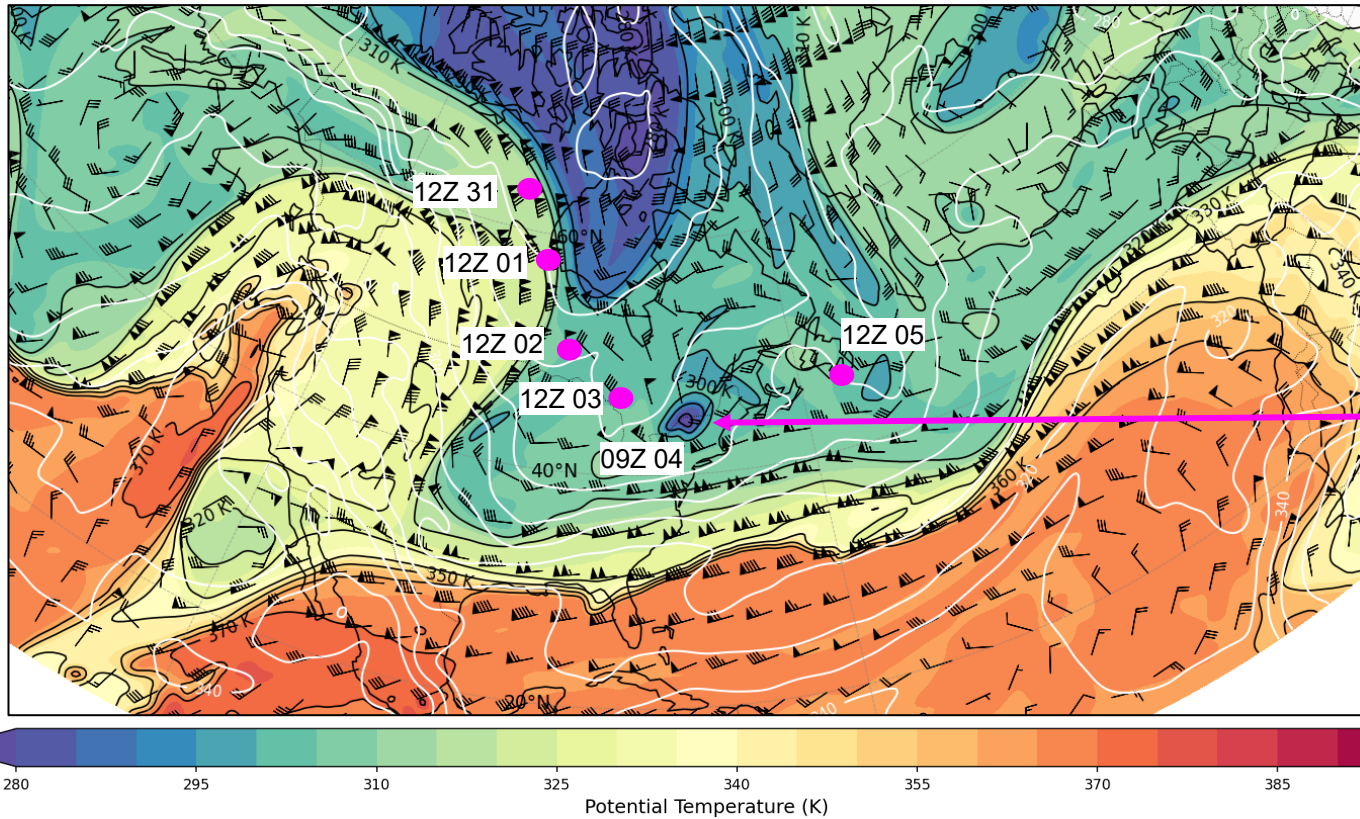
NURTURE flight
Intense cyclone over western Atlantic



North-South Cross-Section in Intense Cyclone – Warm Front



A Small Tropopause Polar Vortex Sampled by CUSP Sounding

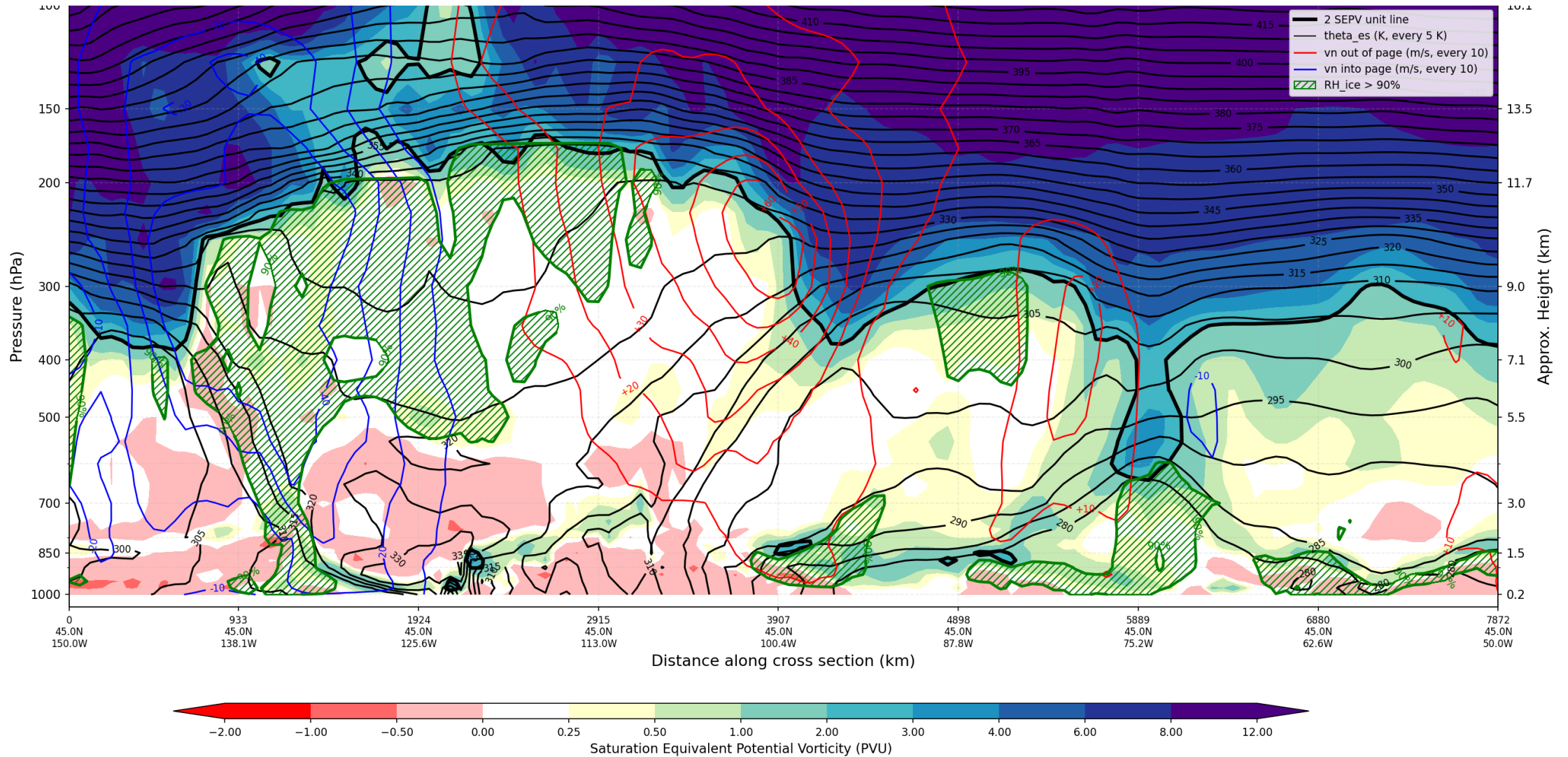


- Very sharp thermal and dynamic tropopause
- Light winds at 500 hPa: center passed just south of sounding location

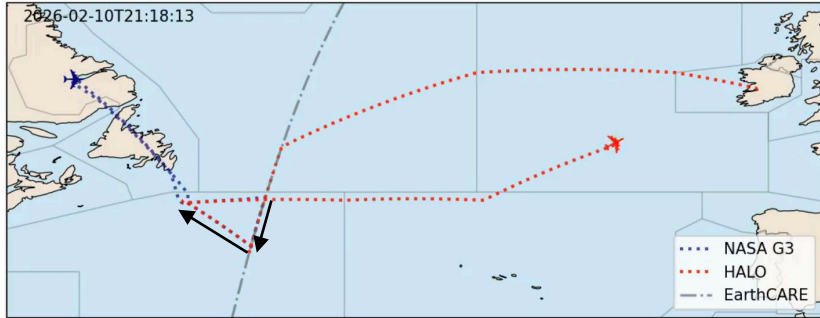
Tropopause Polar Vortex
sampled by rawinsonde
launched by McGill University,
Feb. 4, 2026

Cross Section on 4 Feb., 09 UTC

Western US Ridge and Downstream Influences

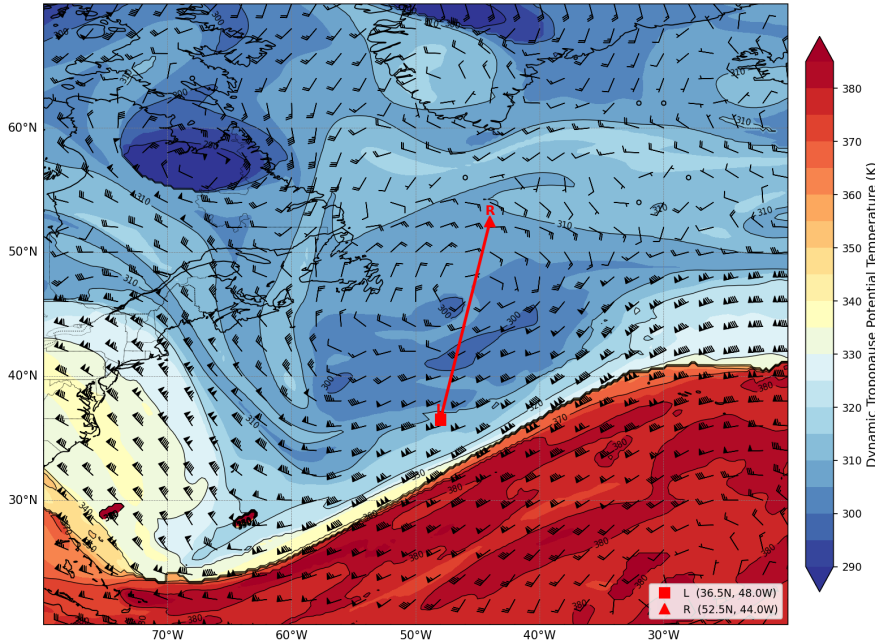


NAWDIC IOP14 "Ballina" on Tuesday, February 10, coordination with NURTURE

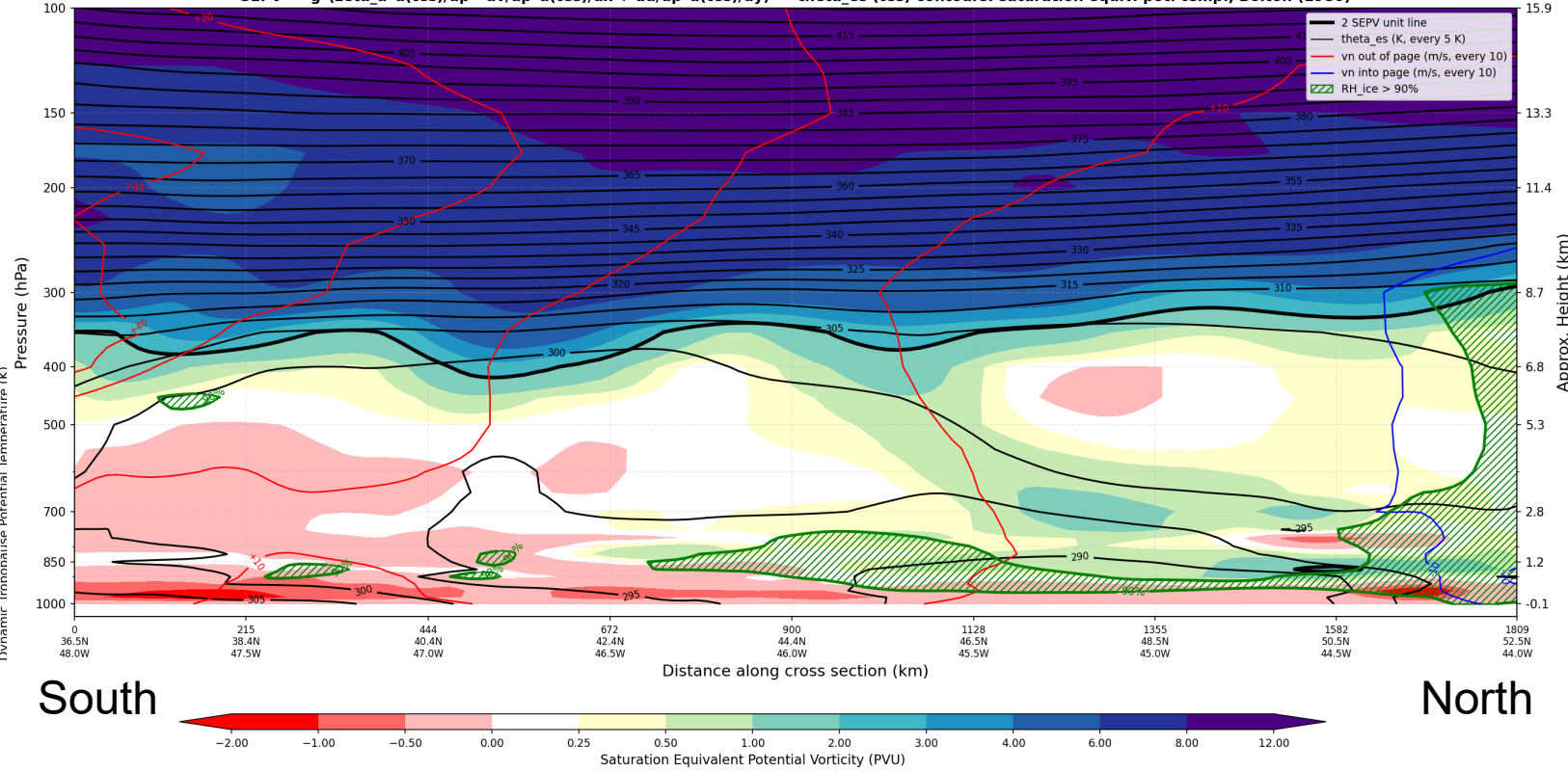


Sampling Through a Low-Tropopause Marine Environment: 10 Feb.

Dynamic Tropopause (2 PVU) * Potential Temperature and Wind * ERA5 0.25 deg * 2026-02-10 18:00 UTC
Cross section: (36.5N, 48.0W) -> (52.5N, 44.0W) [1809 km, 10 deg from north]



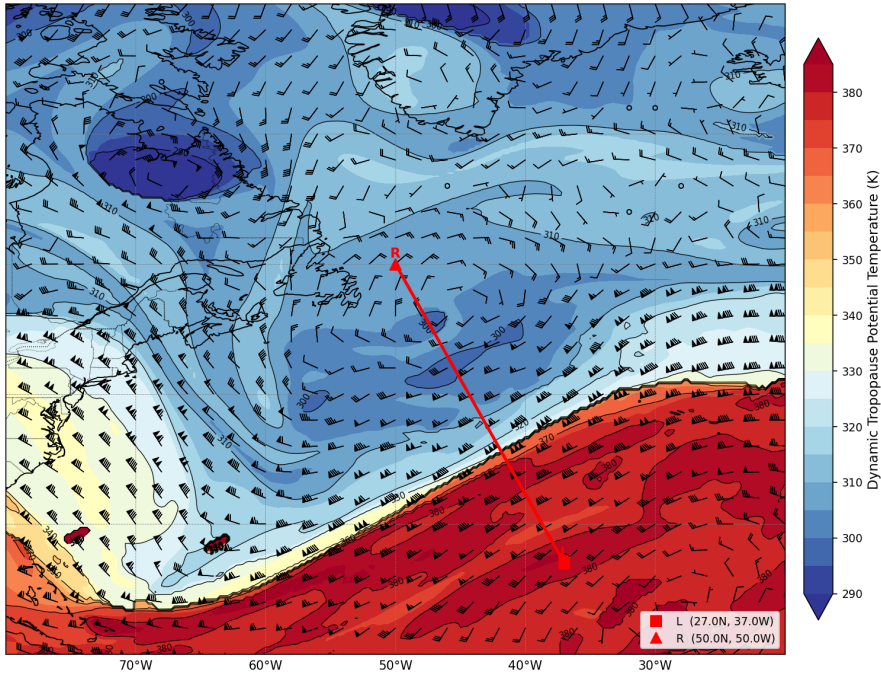
Vertical Cross Section * Saturation Equivalent PV * ERA5 0.25 deg * 2026-02-10 18:00 UTC
Left: (36.5N, 48.0W) -> Right: (52.5N, 44.0W) [1809 km, 10 deg from north] * Normal avg: 200 km, 25 strips
SEPV = $-g*(zeta_a*d(tes)/dp - dv/dp*d(tes)/dx + du/dp*d(tes)/dy)$ * theta_es (tes) contours: saturation equiv. pot. temp., Bolton (1980)



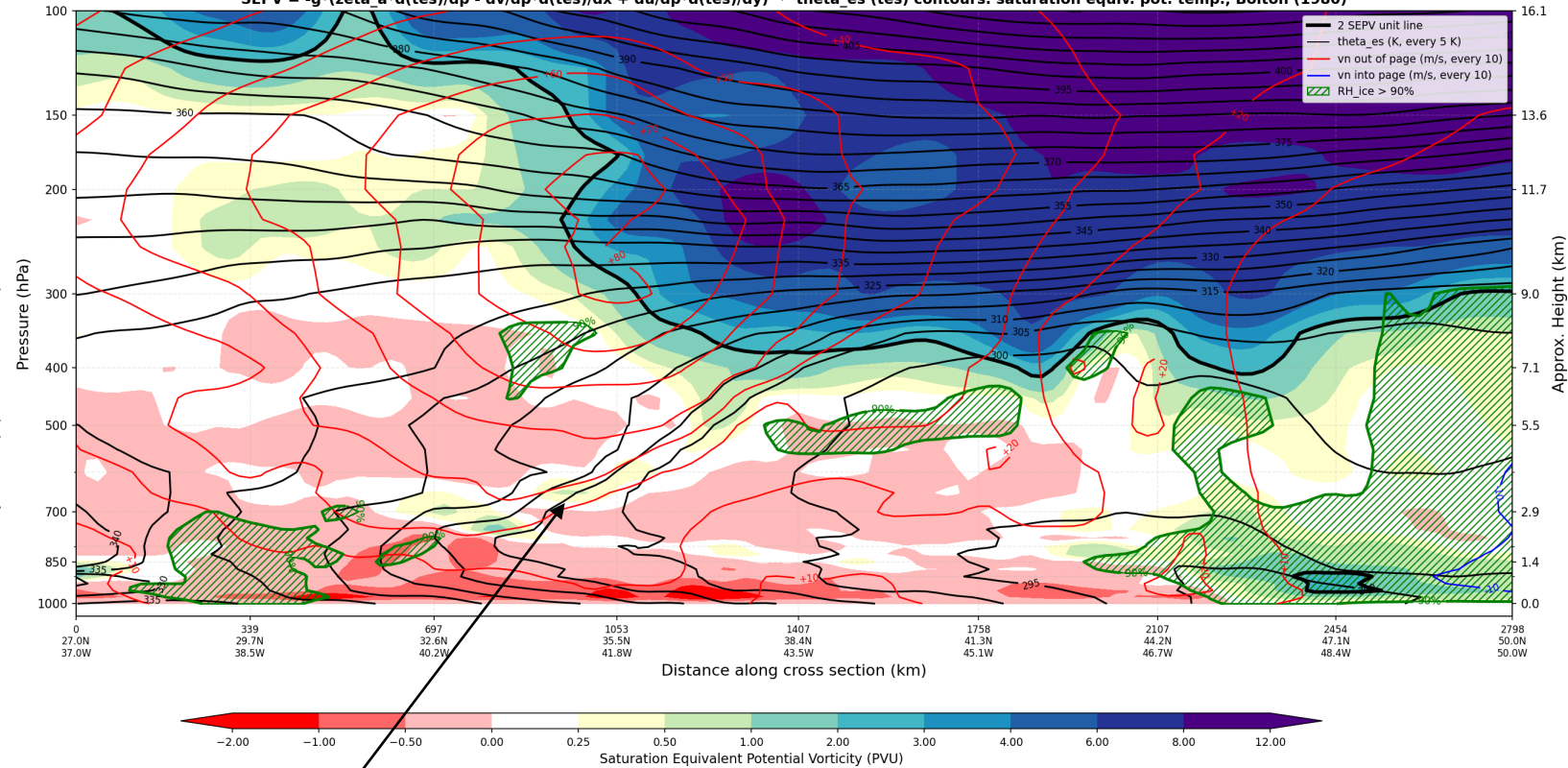
Nearly zero q_{esi} in troposphere.

Jet Superposition

Dynamic Tropopause (2 PVU) * Potential Temperature and Wind * ERA5 0.25 deg * 2026-02-10 18:00 UTC
 Cross section: (27.0N, 37.0W) -> (50.0N, 50.0W) [2798 km, -24 deg from north]



Vertical Cross Section * Saturation Equivalent PV * ERA5 0.25 deg * 2026-02-10 18:00 UTC
 Left: (27.0N, 37.0W) -> Right: (50.0N, 50.0W) [2798 km, -24 deg from north] * Normal avg: 200 km, 25 strips
 $SEPV = -g*(zeta_a*d(tes)/dp - dv/dp*d(tes)/dx + du/dp*d(tes)/dy)$ * theta_es (tes) contours: saturation equiv. pot. temp., Bolton (1980)



- Deep “tropopause wall”; > 80 m/s jet
- Frontal zone evident as narrow region of $q_{esi} > 0$, with generally zero or slightly negative values in troposphere

Concluding Thoughts

- Multiple types of connections across projects
- Planning jointly helps take advantage of combined observing opportunities
- Processes: utility of moist PV framework
- Looking ahead: more AR-Recon and NURTURE connections possible in 2027

