Air-sea interactions yielding rapid Beaufort Sea ice losses during the 2021 ONR THINICE Pilot Field Campaign

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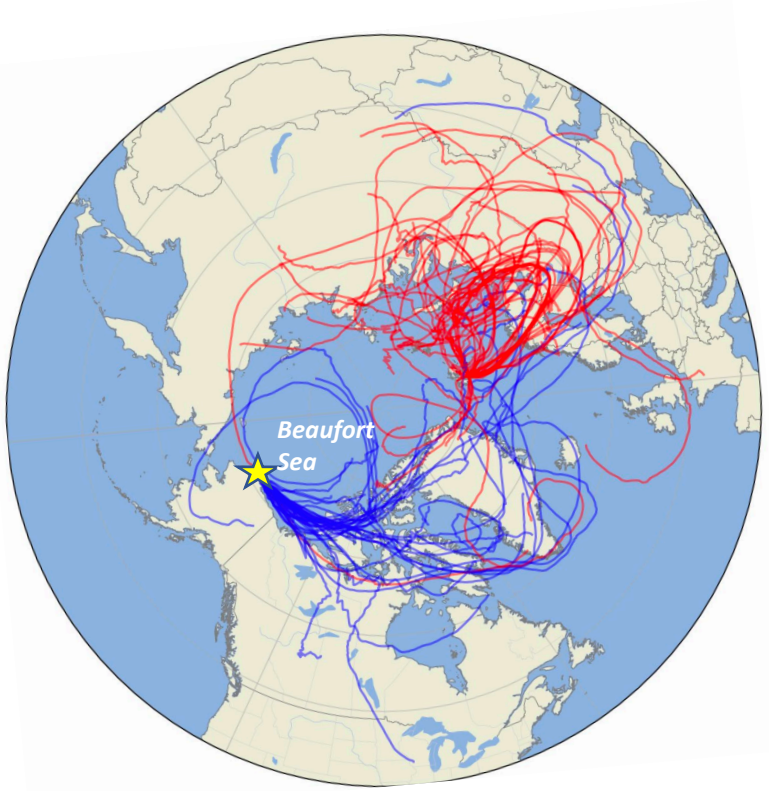
ONR THINICE Pilot Campaign: 19 August – 13 September 2021

- Forty WindBorne long-endurance sounding balloons were launched from Utqiagvik, AK (star)
  - More details about field program can be found in Rivière et al. (2024).

- During the campaign, stormy, windy conditions and rapid ice loss occurred in the Beaufort Sea

- Our overarching question: *How did cyclones and air-sea interactions during/between their passage influence the ensuing ice losses?*



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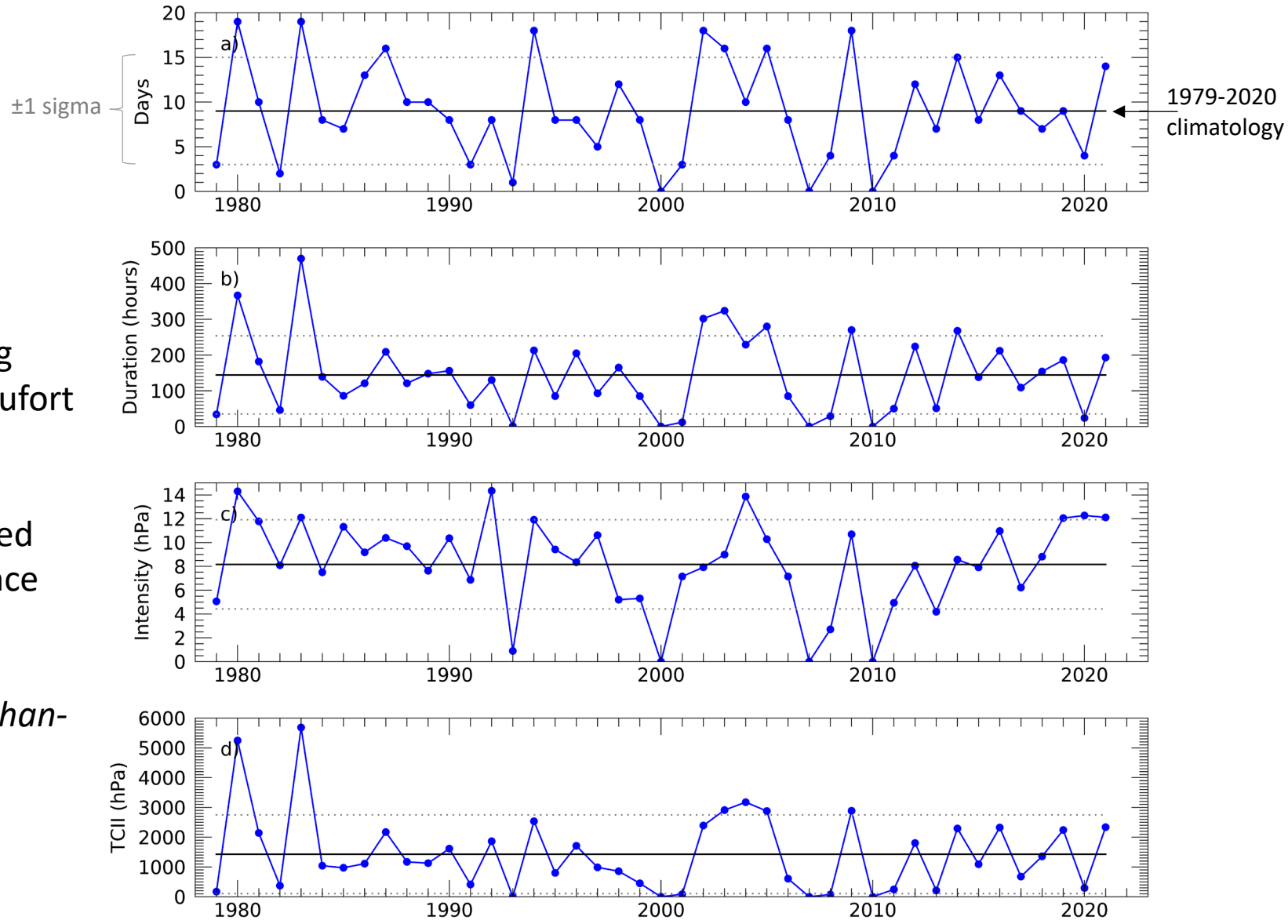
Cyclone climatology

for ONR THINICE dates 19 August to 13 September (n=26d)

Used Sprenger et al (2017) cyclone tracking algorithm to identify systems entering Beaufort Sea region (68-85°N, and 111-163° W)

Note: TCII (panel d) reflects the accumulated intensity of **each cyclone** during its residence time within a domain.

Take homes: Stormy period with stronger-than-normal Arctic cyclones.



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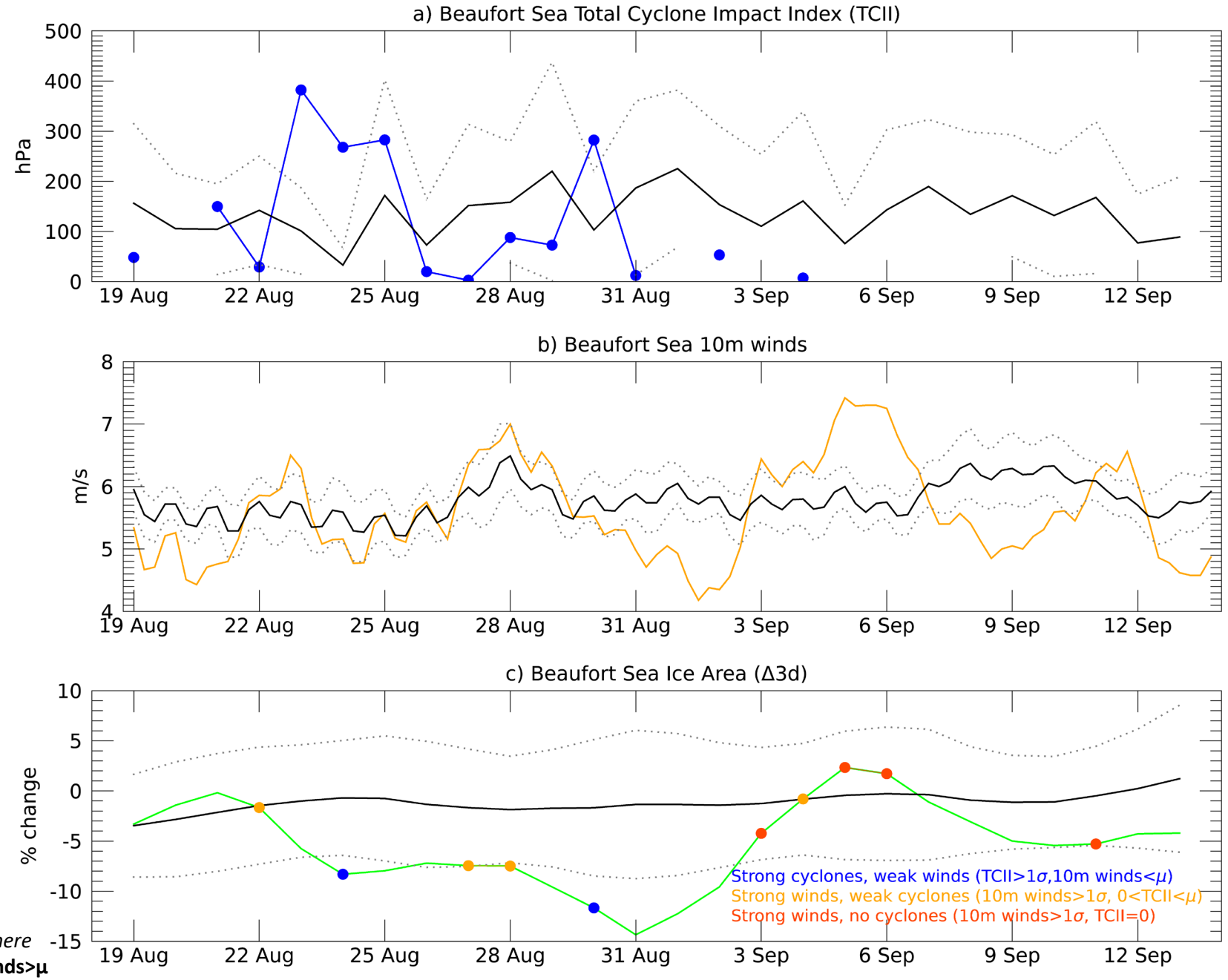
During 2021, extreme winds did not coincide with extreme cyclones (and vice versa)!

For the campaign, looked at daily Beaufort TCII, 10m winds (from ERA5), and 3d Beaufort Sea ice area changes; the latter akin to Finocchio et al. (2020)

Take homes: There's a tale of two halves of the field campaign…



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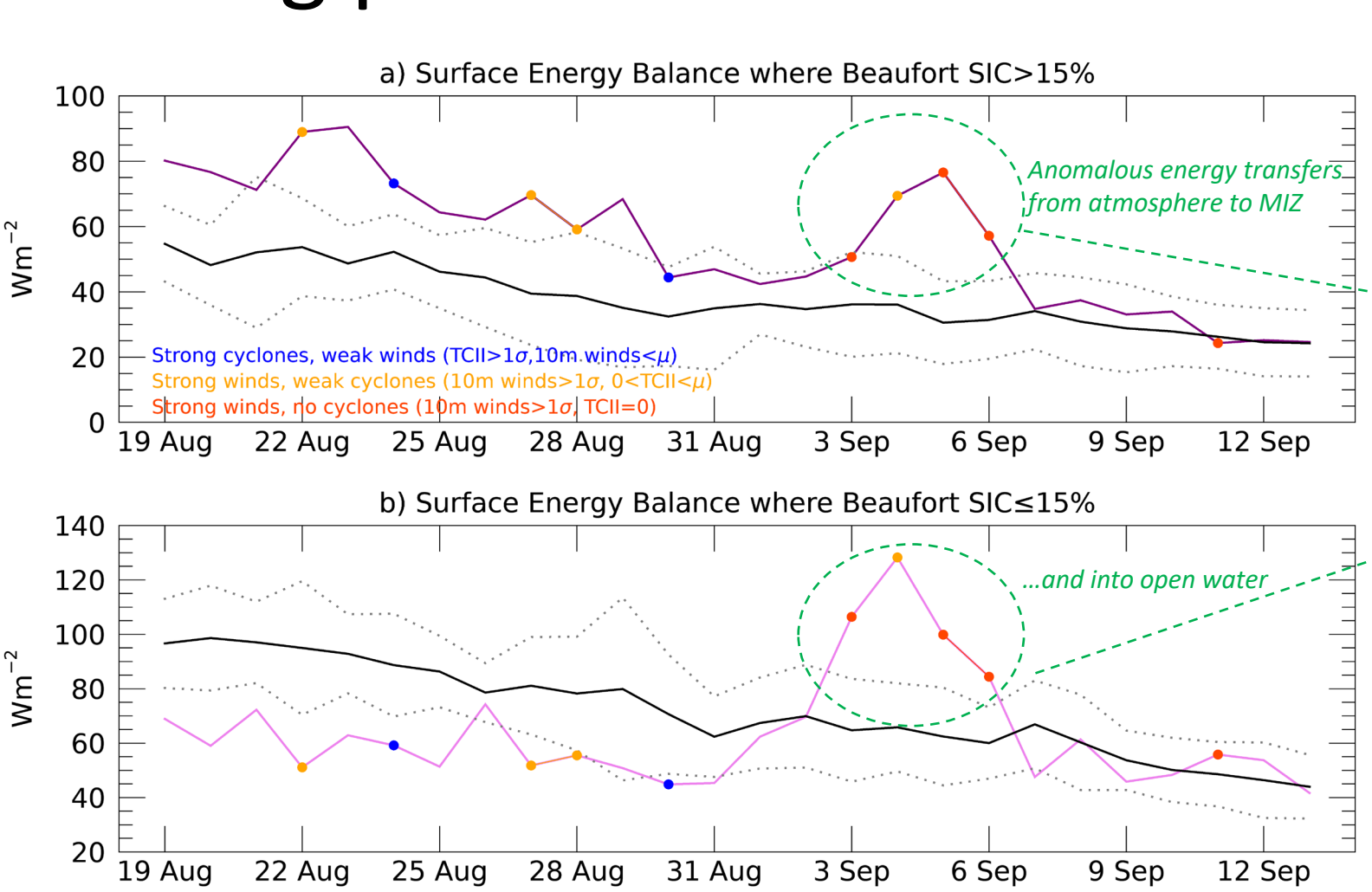
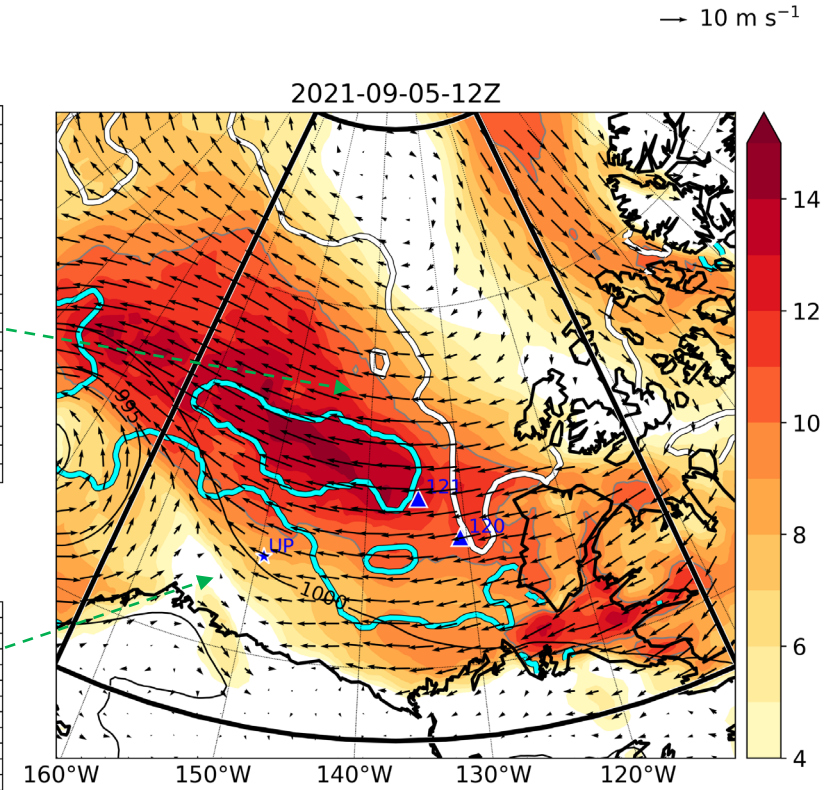
Note: No days where **TCII>1σ, 10m winds>μ** *or* **10m winds>1σ, TCII>μ**

Storms, winds "precondition" the ice pack

Winds fuel ice losses through air-sea interactions

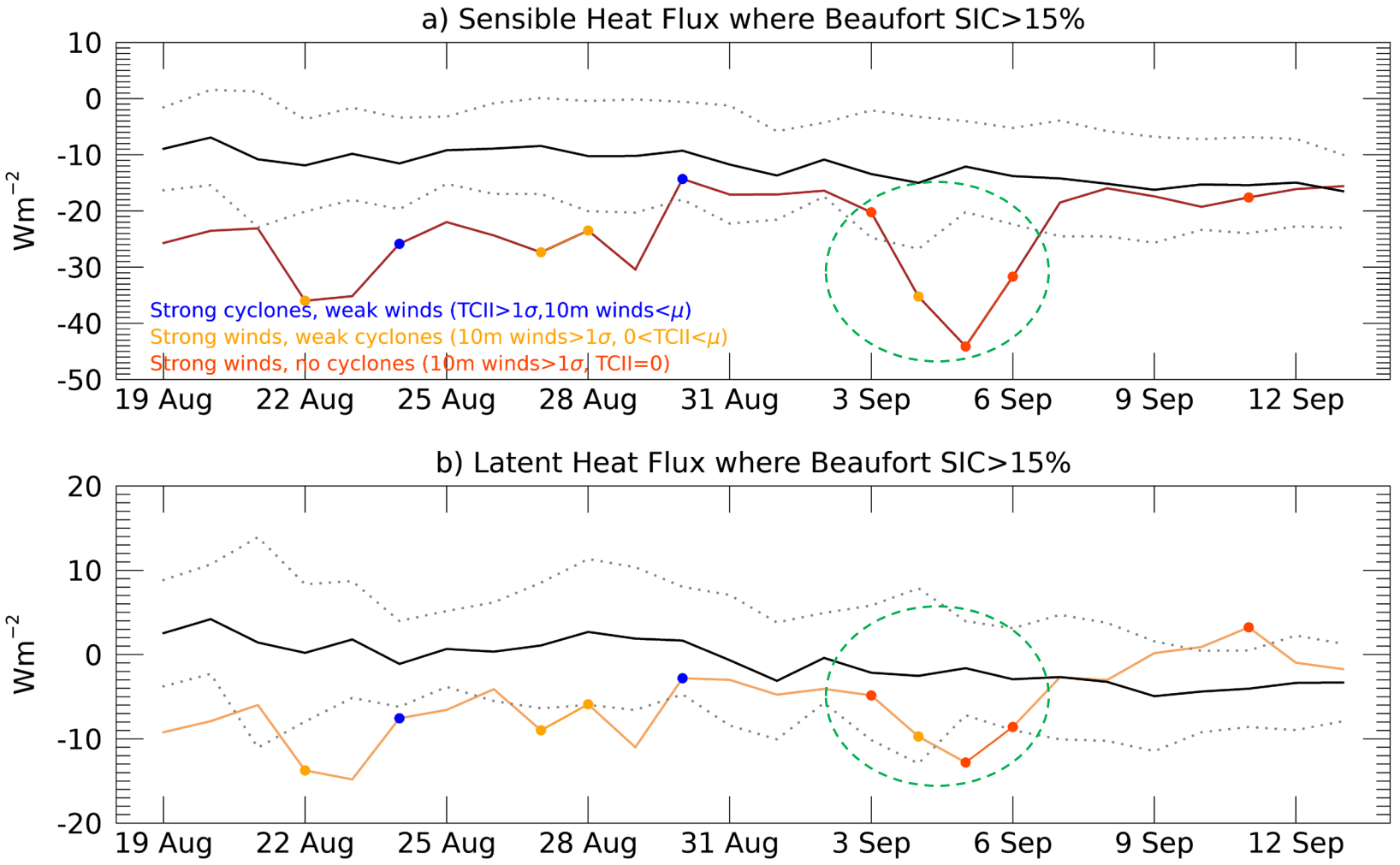
Energy fluxes into MIZ and open ocean during period of interest





80% SIC

15% SIC



Isolating the MIZ, when the SEB is deconstructed, the sensible heat flux (top) and, to a lesser extent, latent heat flux (bottom) show anomalous negative departures from climatology indicative of *heat and moisture transfers into the MIZ.*

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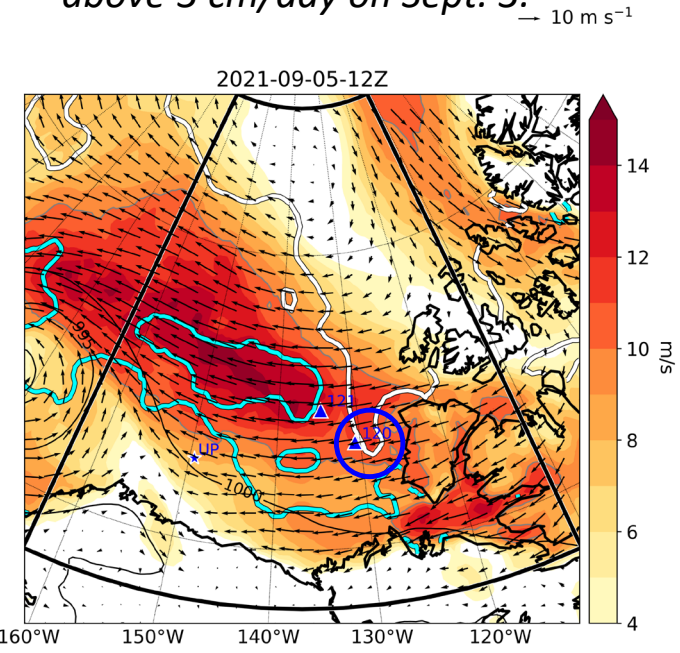
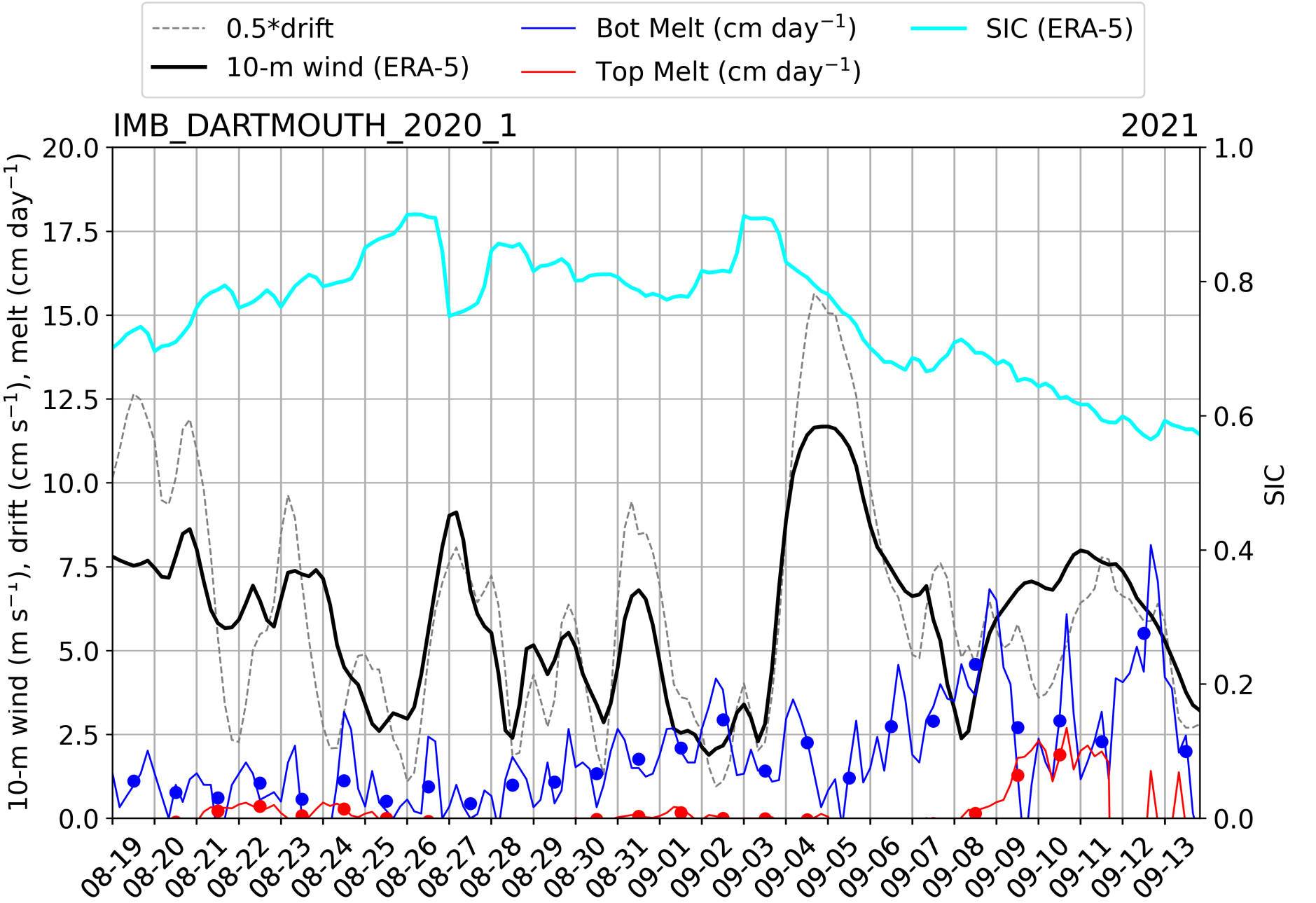
A seasonal ice mass balance v3 (SIMB3) buoy was co-located with ITP120. The blue and red lines on the time series show the ice bottom and top melt rates measured from this buoy. The dots represent daily averaged melt rates. Despite the anomalous downward atmospheric energy fluxes, *the daily bottom melt rate is generally < 3 cm/day before Sept. 3 and increases to well above 3 cm/day on Sept. 3.*





Summary

- Rapid ice losses occurred within the Beaufort Sea during the ONR THINICE Pilot Campaign
  - Moderate cyclone activity characterized the first-half of the campaign; second half saw several consecutive high wind events

- SEB analysis showed stints of anomalous atmospheric energy transfers into the MIZ
  - Ice losses, namely due to basal melt, during second half of the campaign may be associated with enhanced ice pack motion into, and/or entrainment of, warmer waters

Feel free to email Tom Ballinger (tjballinger@alaska.edu) with any feedback.

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References and Additional Reading

Finocchio, P., J.D. Doyle, D.P. Stern, and M.G. Fearon, 2020: Short-term impacts of Arctic summer cyclones on sea ice extent in the marginal ice zone. *Geophys. Res. Lett.*, **47**, e2020GL088338, https://doi.org/10.1029/2020GL088338.

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Sprenger, M., and Coauthors, 2017: Global climatologies of Eulerian and Lagrangian flow features based on ERA-Interim. *Bull. Amer. Meteor. Soc.*, **98**, 1739-1748, https://doi.org/10.1175/BAMS-D-15-00299.1.

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