

UNSUPERVISED STATISTICAL CLASSIFICATION OF THE ANTARCTIC MARGINAL ICE ZONE

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ANTARCTIC MARGINAL ICE ZONE (MIZ)

- The marginal ice zone is an interface between the open ocean and the consolidated inner pack
- Ocean surface waves can fracture ice floes 100s of km from the ice edge¹, and contribute to the formation of pancake ice in the marginal ice zone²

¹ Kohout, A. *et al.*, Nature, (2014).

² Wadhams, P. *et al.*, JGR, (1987).



Credit: NASA/Nathan Kurz.

MOTIVATION

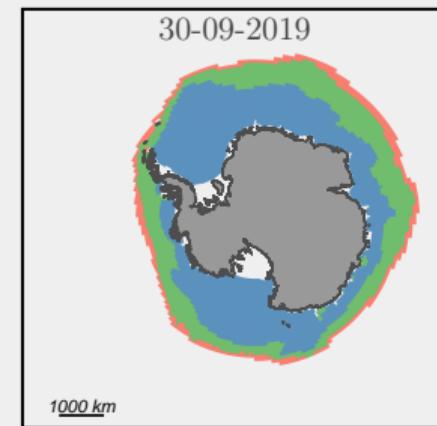
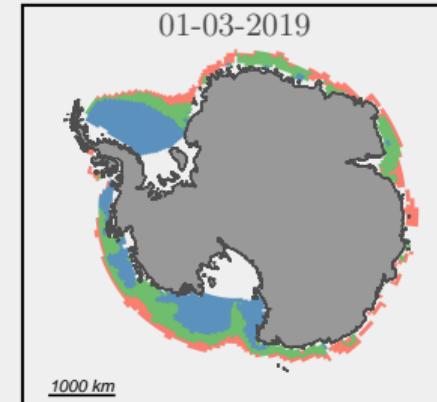
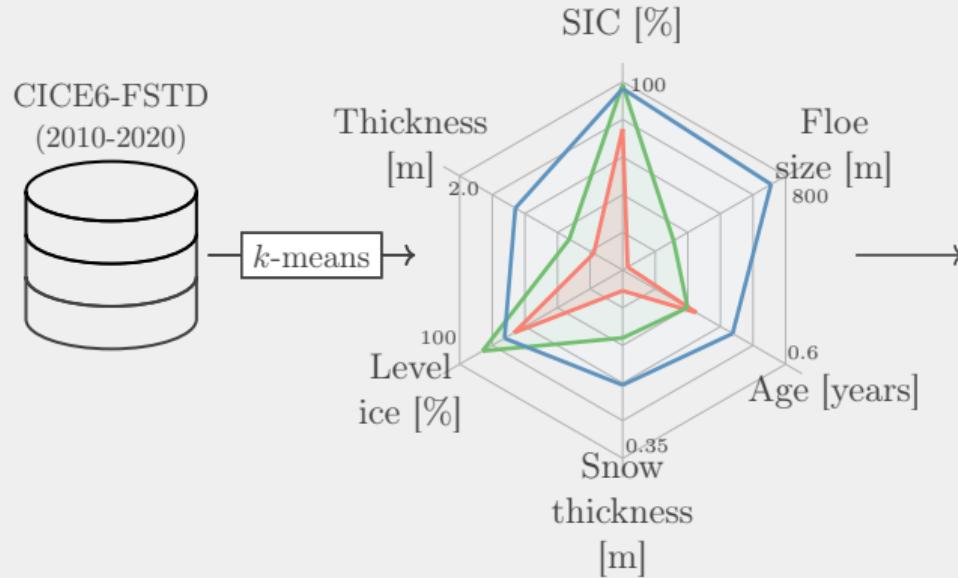
- Traditionally, a 15-80% sea ice concentration range has been used to quantify the marginal ice zone
- However, this is not appropriate for the winter Antarctic MIZ, where waves and pancake floes have been measured in high-concentration ice covers
- We use CICE with a floe size distribution (CICE6-FSTD) to model the variance of sea ice types



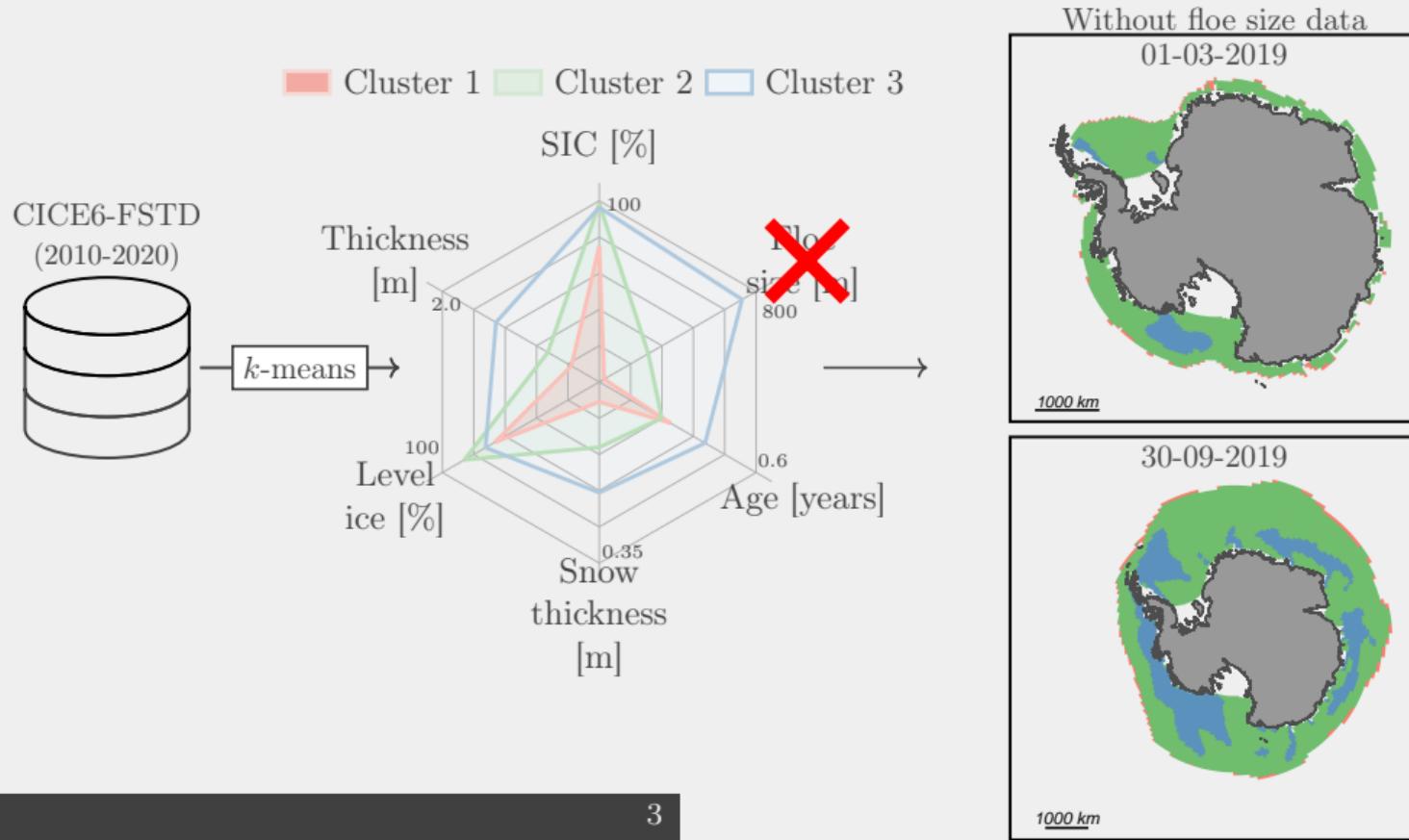
Credit: Kurt Martin (@kurt_artin).

UNSUPERVISED CLASSIFICATION OF SEA ICE DATA

Cluster 1 Cluster 2 Cluster 3

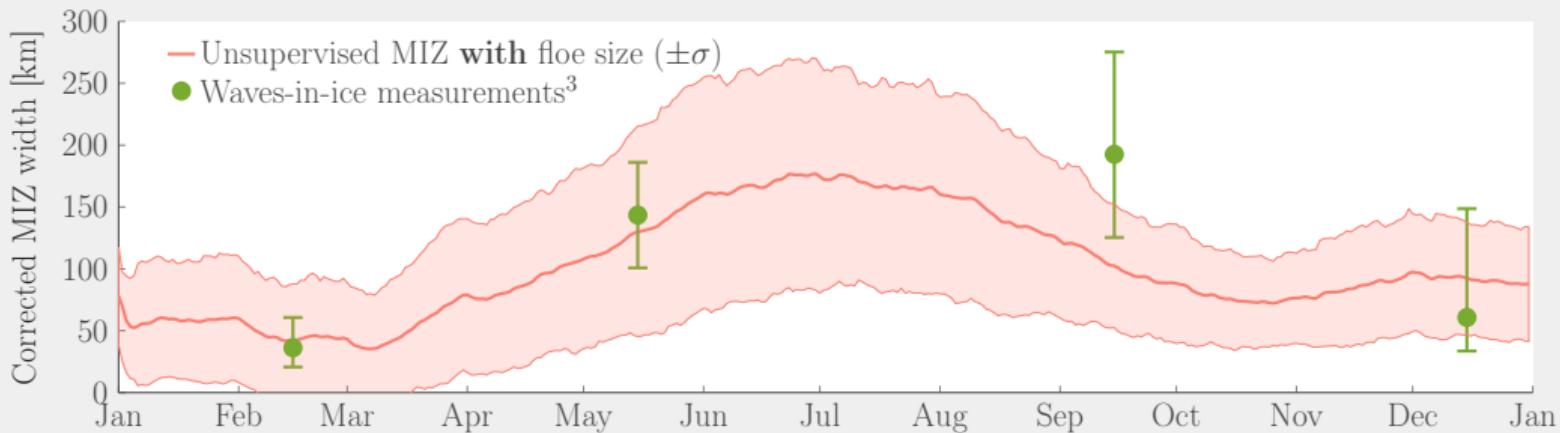


UNSUPERVISED CLASSIFICATION OF SEA ICE DATA



MARGINAL ICE ZONE WIDTH

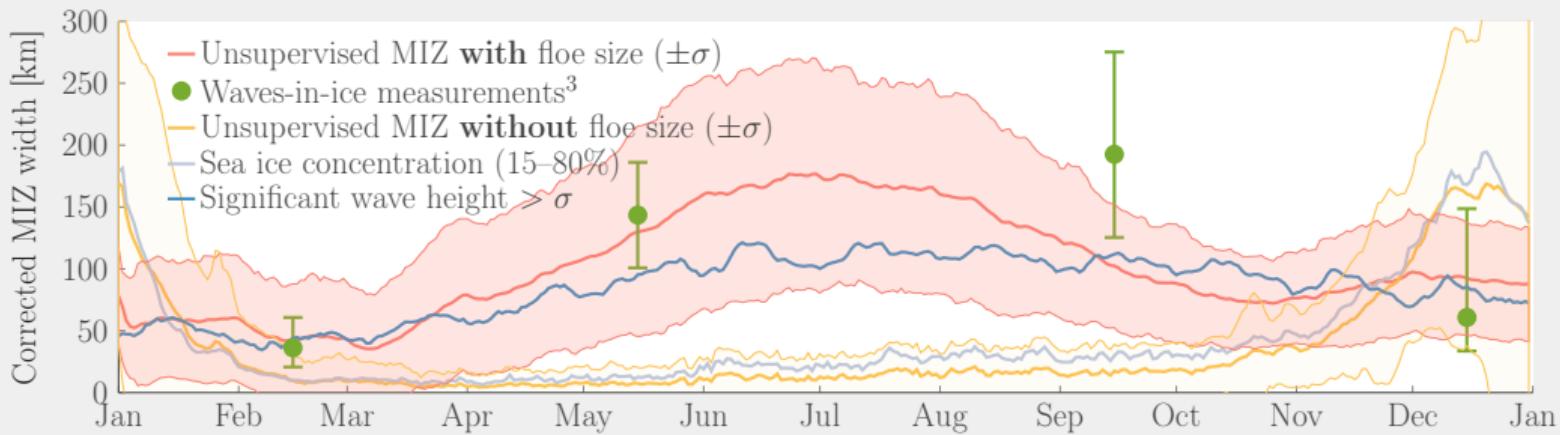
- The extent of the **unsupervised MIZ** is validated with altimetric observations of significant wave heights in sea ice³
- Floe size data allows us to capture the high-concentration wave affected regions



³Brouwer, J. et al., *The Cryosphere*, (2022).

MARGINAL ICE ZONE WIDTH

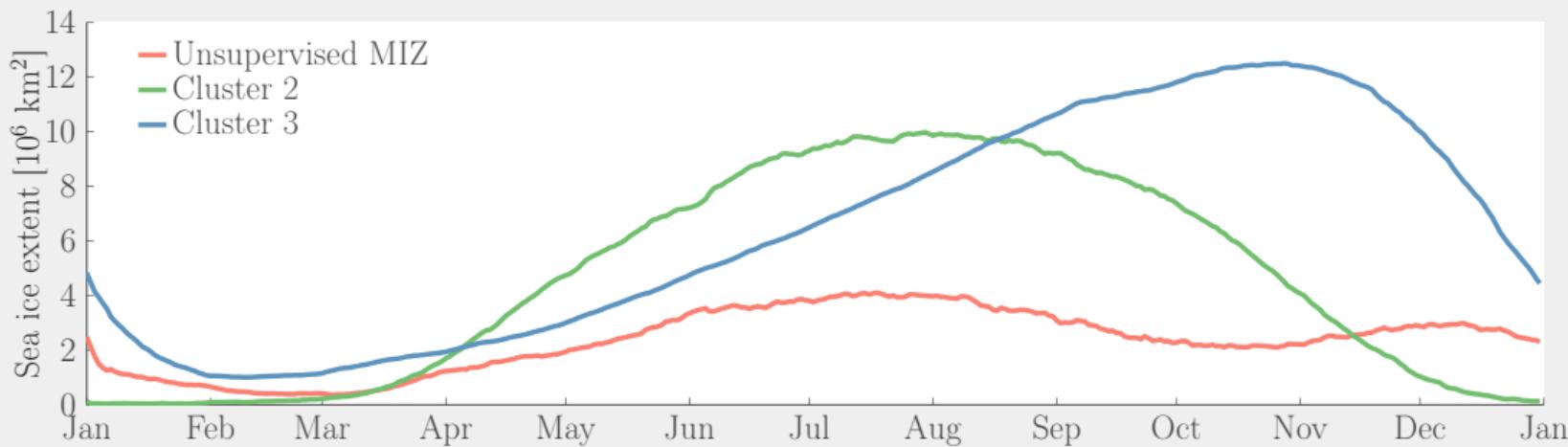
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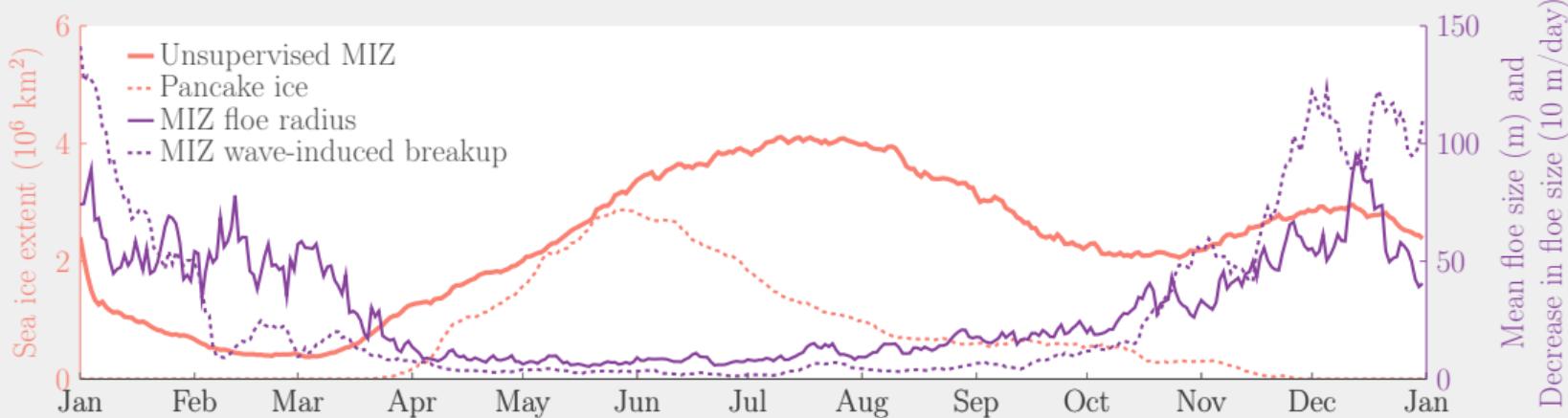
SEASONALITY OF THE SEA ICE CLUSTERS

- Thin sheets of ice form rapidly over the winter before becoming either thicker and larger, or risk becoming broken by waves (MIZ)



SEASONALITY OF THE MARGINAL ICE ZONE

- Unlike with a threshold, the floe size of the **unsupervised MIZ** is allowed to change over the season
- This captures both the pancake ice formation in the winter and broken floes in the summer



CONCLUSIONS

- An unsupervised algorithm (k -means) has quantified the Antarctic wave affected marginal ice zone from simulated sea ice data
- The extent of this region agrees with satellite derived waves-in-ice measurements
- This further validates the importance of floe size for identifying areas of wave affected ice, including pancake ice

THANKS FOR LISTENING!

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