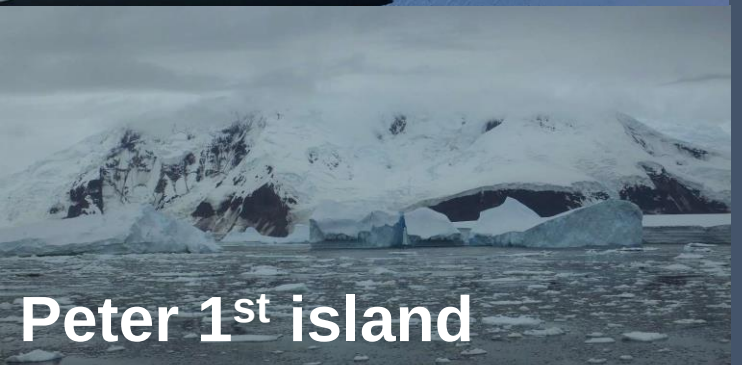


OSPP contest!

EGU General Assembly 2022

23 – 27 May 2022 online

Halogens in sub-Antarctic ice cores modulated by wind forcing, sea ice and primary productivity

Delia Segato, Elizabeth R. Thomas, Dieter Tetzner, Amy King, Dorothea Elizabeth Moser, Rachael H. Rhodes, Clara Turetta, Alfonso Saiz-Lopez, Bradley Markle, Joel Pedro and Andrea Spolaor

Sharing is encouraged

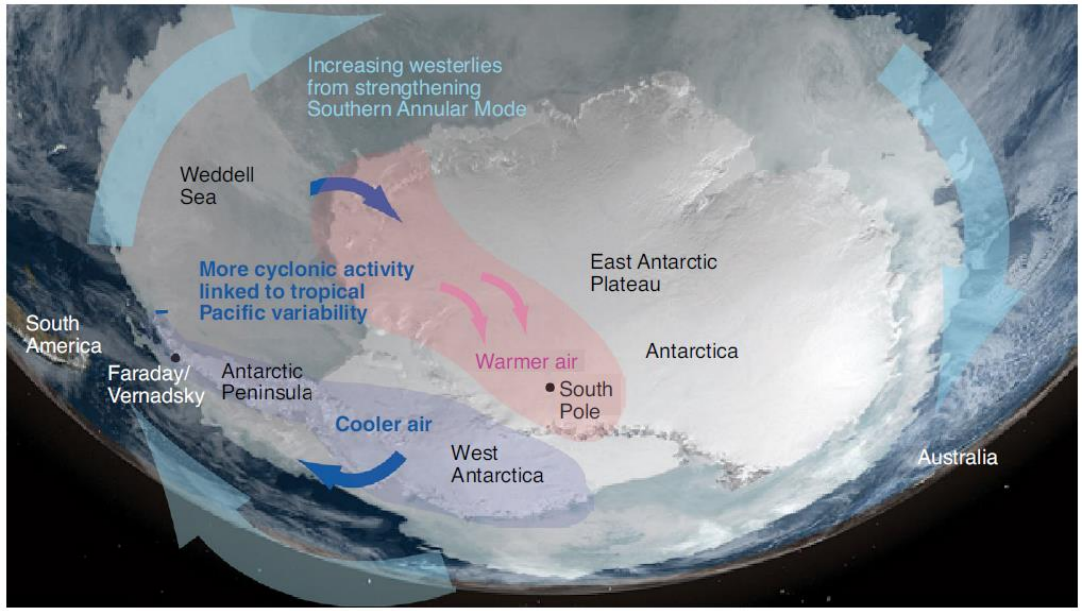
ISP Istituto di Scienze Polari
Consiglio Nazionale delle Ricerche

Università Ca'Foscari Venezia

Aim of the study and scientific questions

Increase strength Westerly Winds in sub-Antarctica from positive Southern Annular Mode

Bromine, iodine, sodium and MSA in sub-Antarctica are a complex interplay of wind strenght variability, sea ice and primary productivity

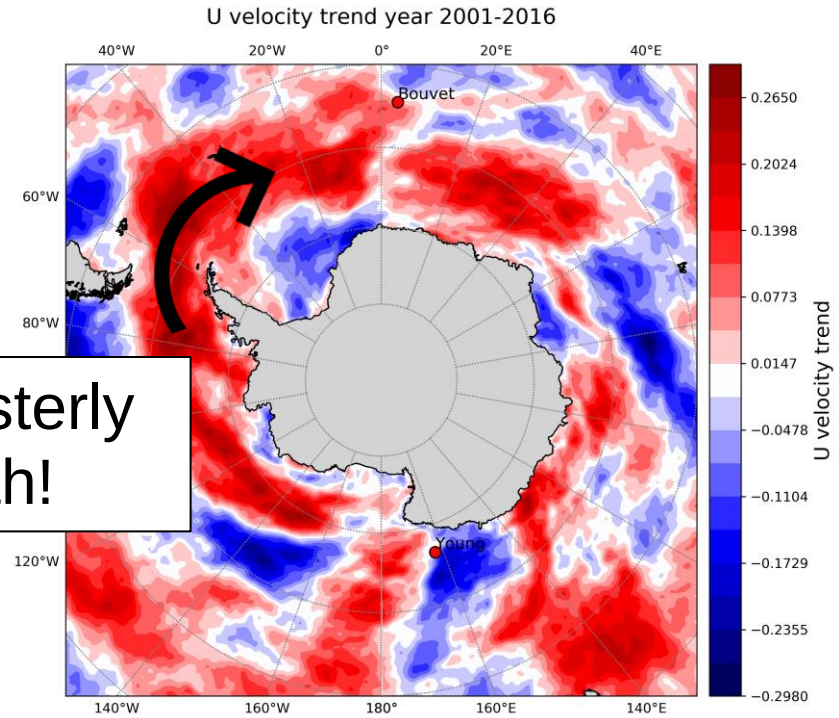


Stammerjohn et al., 2020

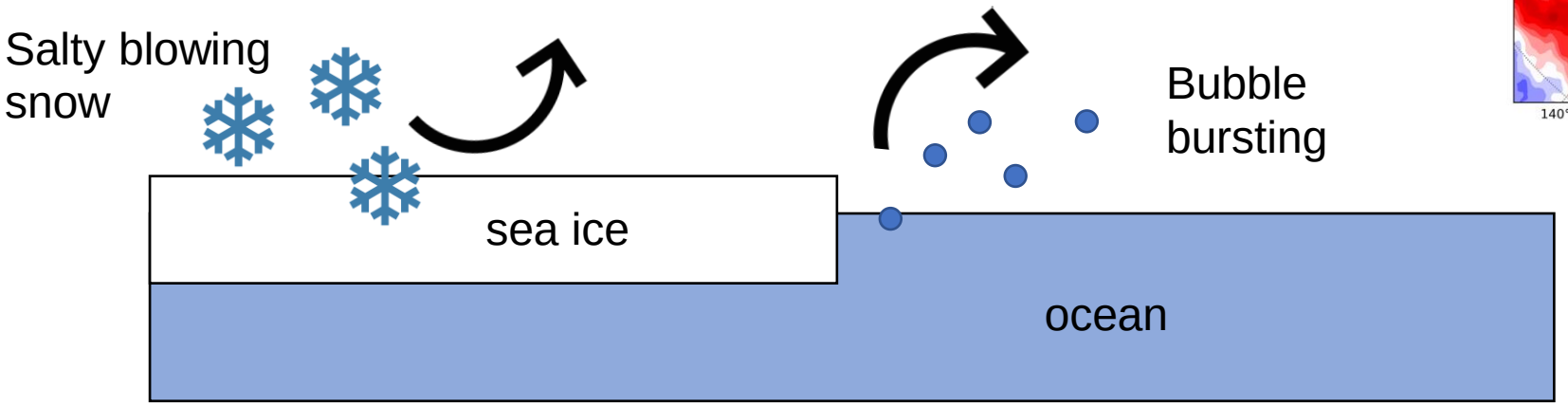
Could (and how) do recent changes in atmospheric circulation in the Southern Hemisphere influence the processes of emission, transport and deposition of **bromine, iodine, sodium and MSA?**

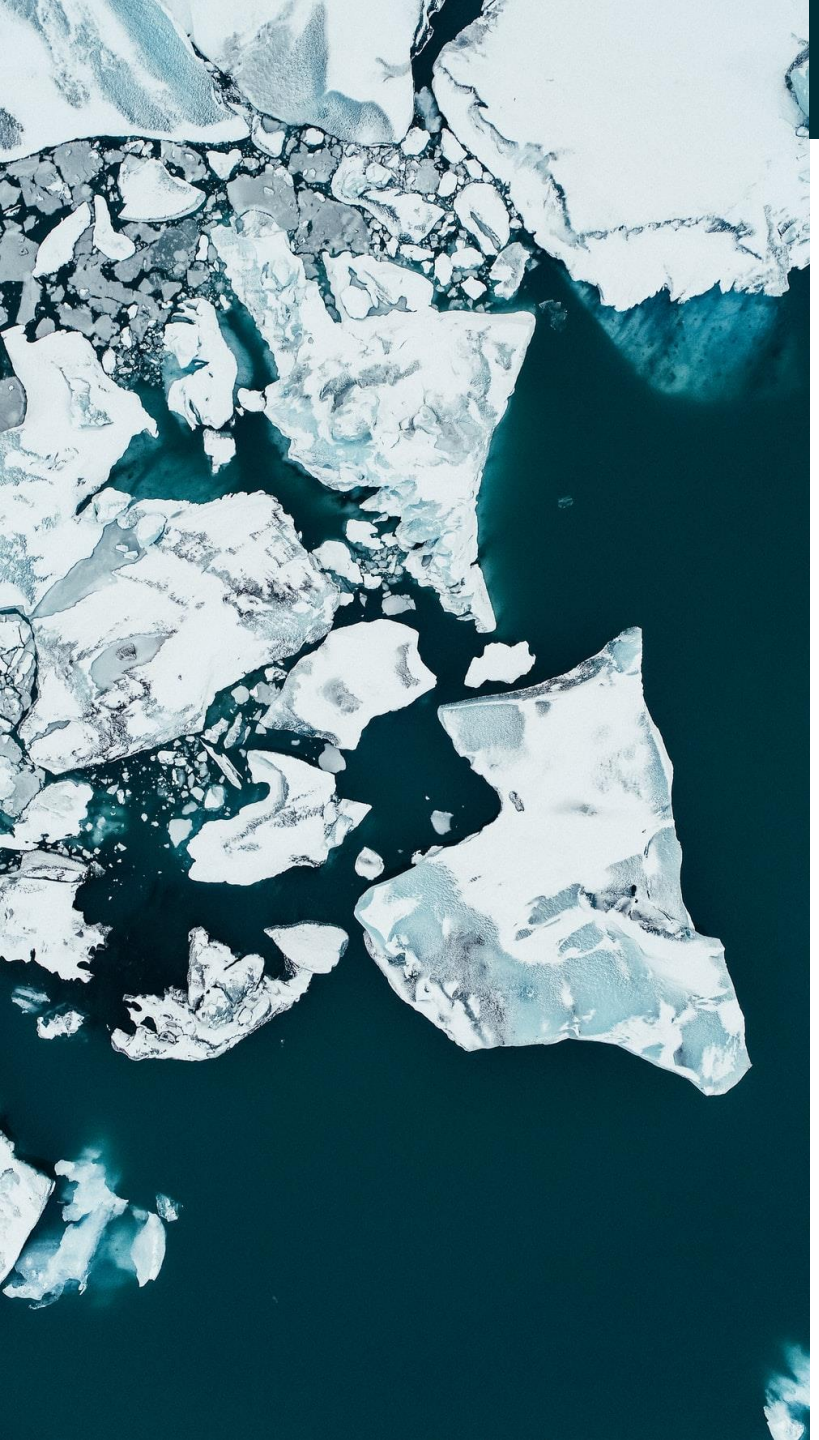
Wind forcing modulates bromine and iodine

Bromide and sodium associated with sea salt aerosols are injected to the atmosphere at rates dependent on wind strength



Increase Westerly winds strength!





Seasonal sea ice

Seasonal sea ice modulates the emission of gas-phase reactive bromine through bromine explosions during polar spring.

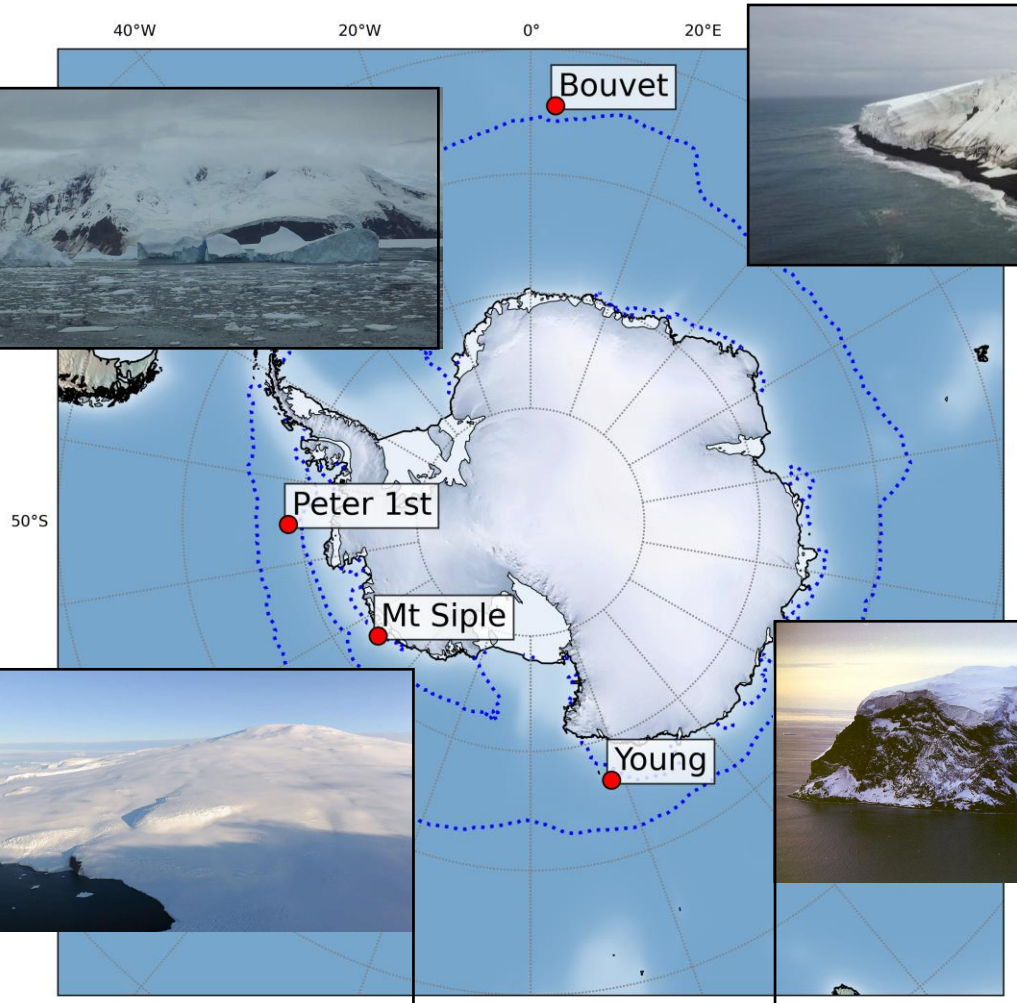
Iodine is emitted by algae living within and underneath sea ice. Iodine is transported to the atmosphere through brine channels.

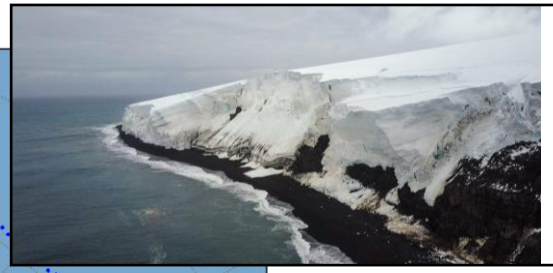
Methanesulphonic acid (MSA) is produced from the oxidation of dimethylsuphide by sea ice algae. Southern Ocean waters seasonally covered by sea ice are a greater source of DMS (hence MSA) than waters without sea ice.

The study sites

4 sub-Antarctic ice cores with very different conditions as regards to wind patterns and sea ice cover

Peter 1st located in the seasonal sea ice zone in the B&A seas





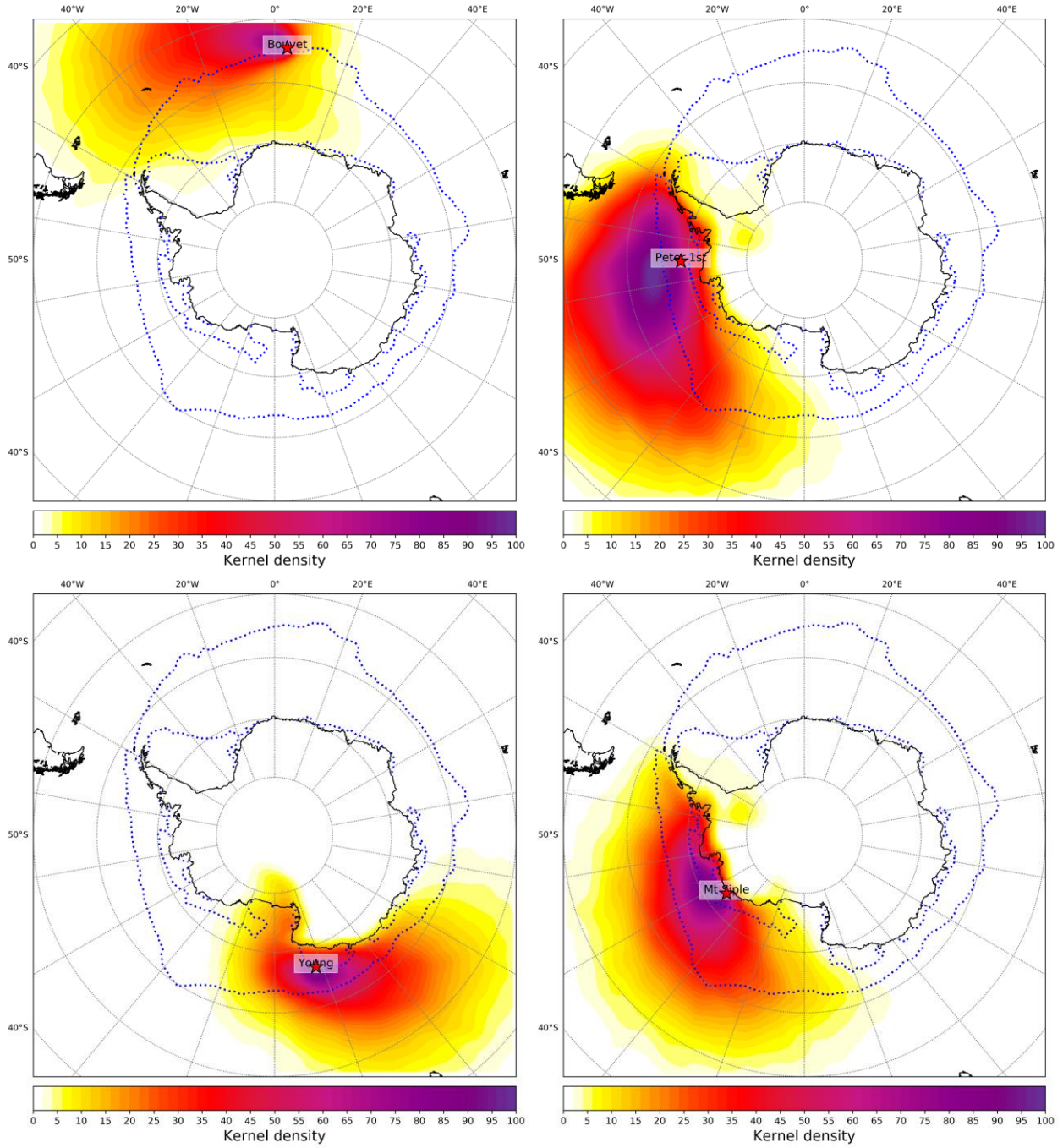
Bouvet at the margin of winter sea ice. Strong influence of Westerly winds.

Mount Siple is a volcanic island surrounded by Getz ice shelf. Impurities potentially influenced by changes in the Amundsen Sea Low.

Young covered by sea ice for 3-4 months per year.
Wind patterns are an interplay of WWs, Antarctic Easterlies and katabatic winds. Frequent melt layers.

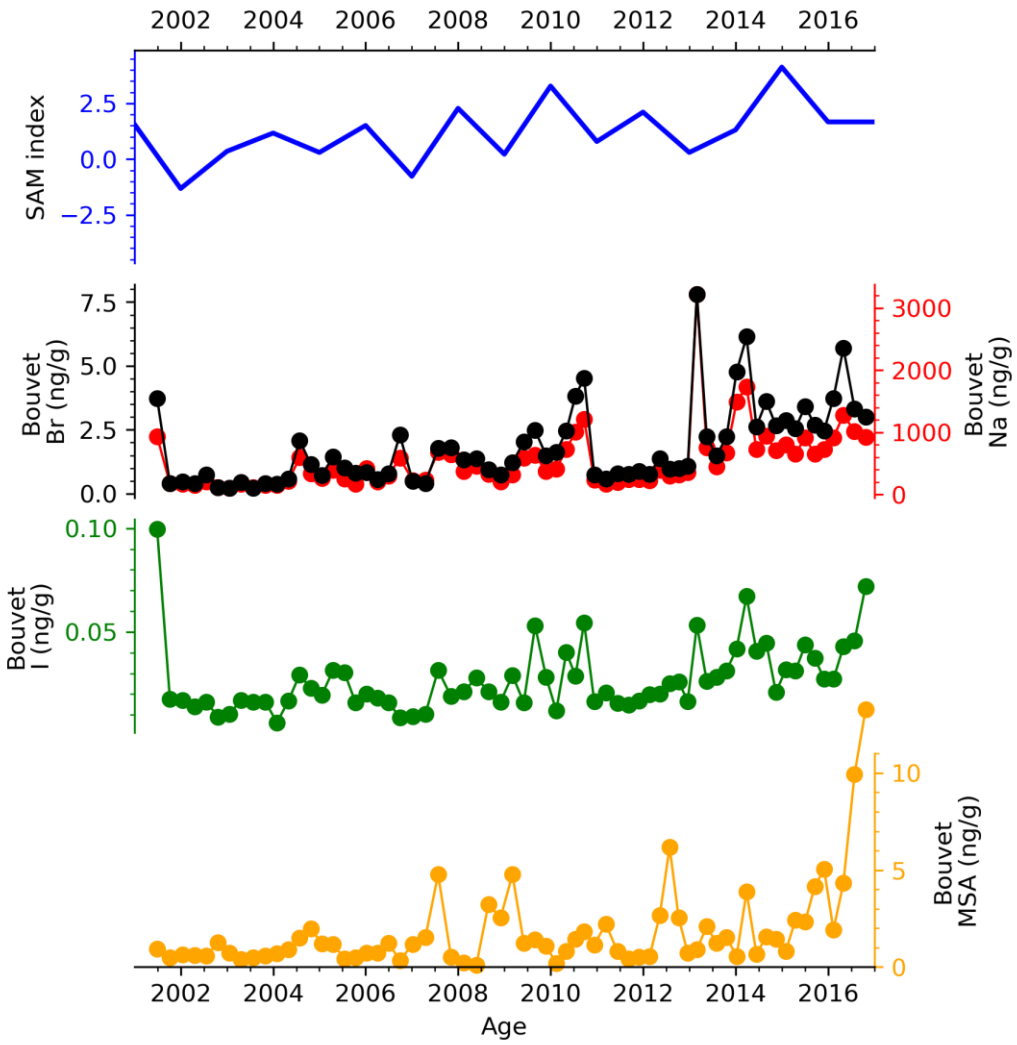
Backtrajectory analysis

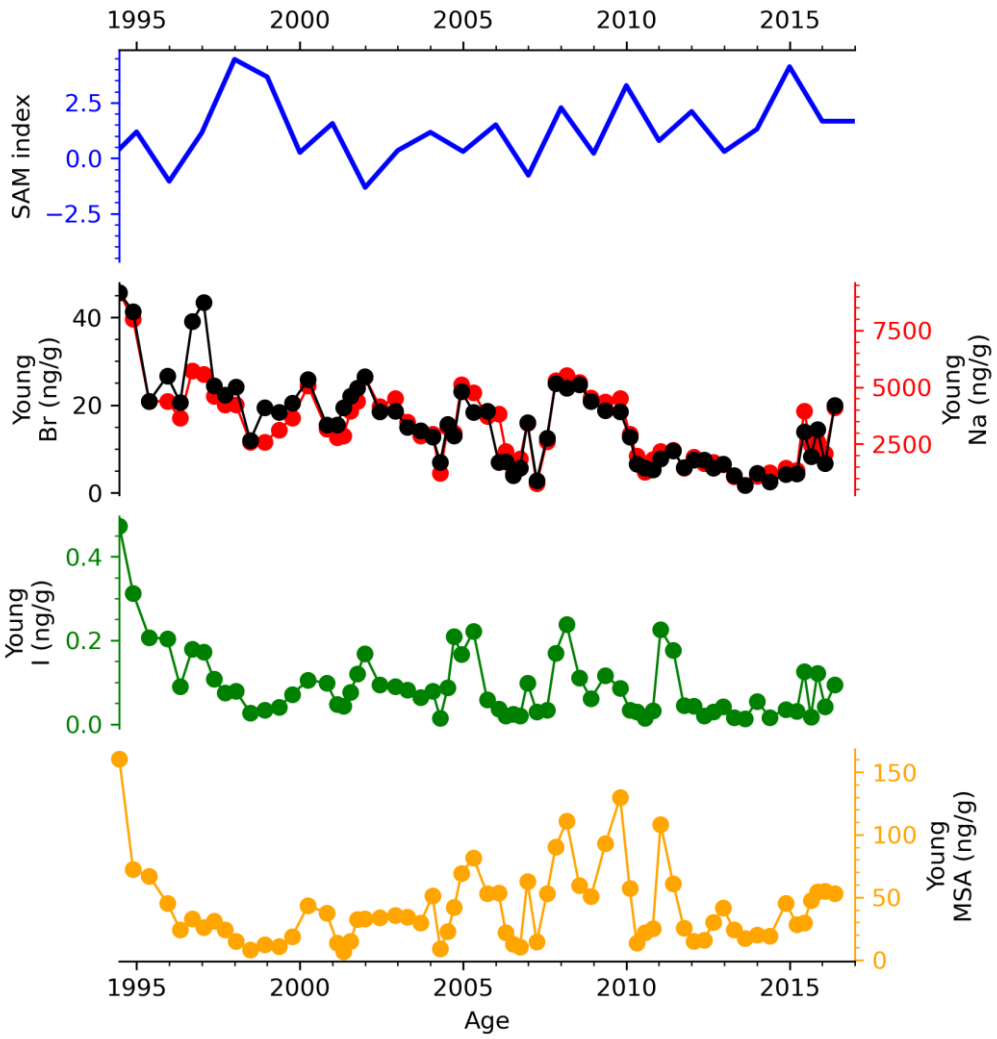
The 4 sub-Antarctic islands are mostly inflenced by areas located to the East of the sites due to Westerly Winds



Influence of WWs on Br and Na deposition

Br and Na trends affected by atmospheric circulation changes in the sub-Antarctic region

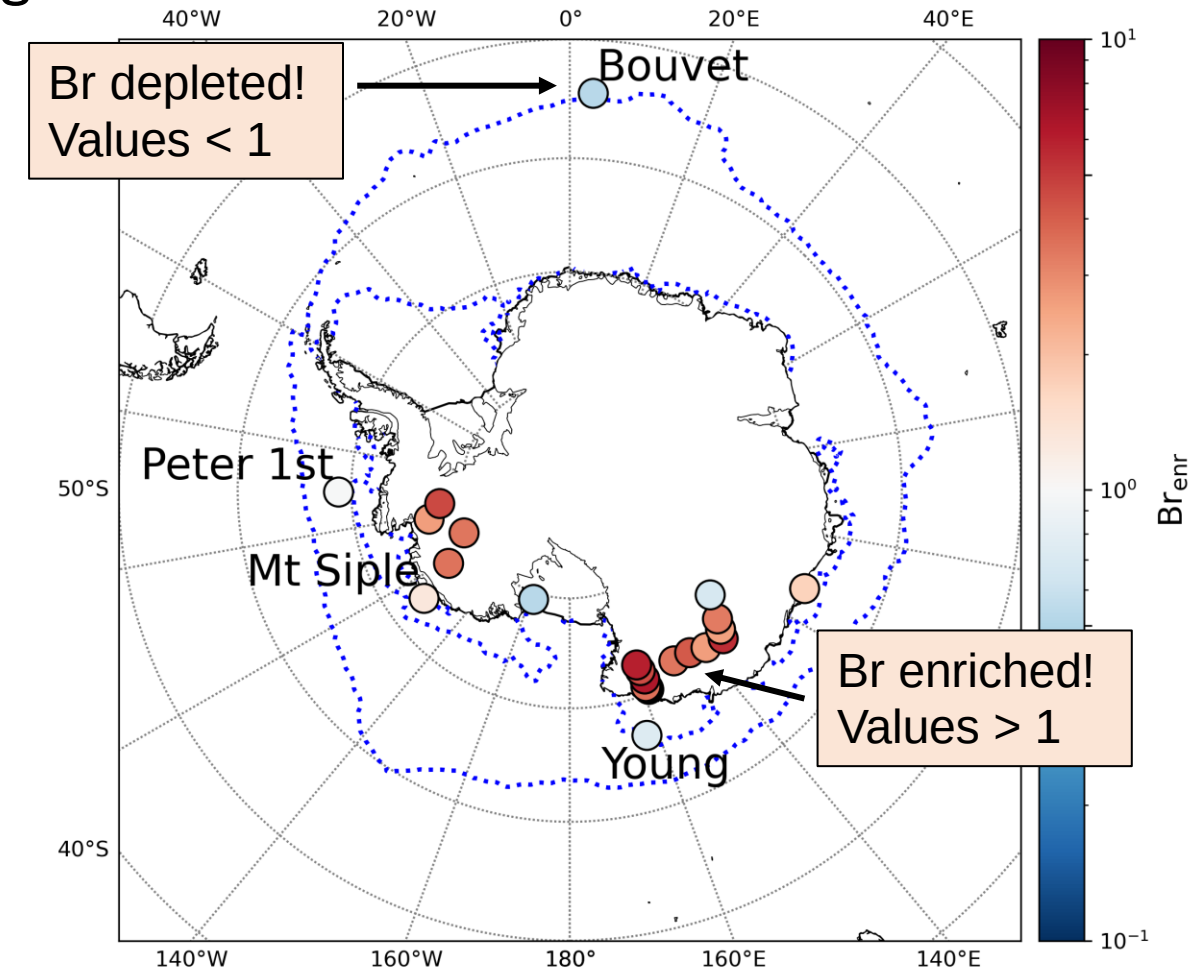


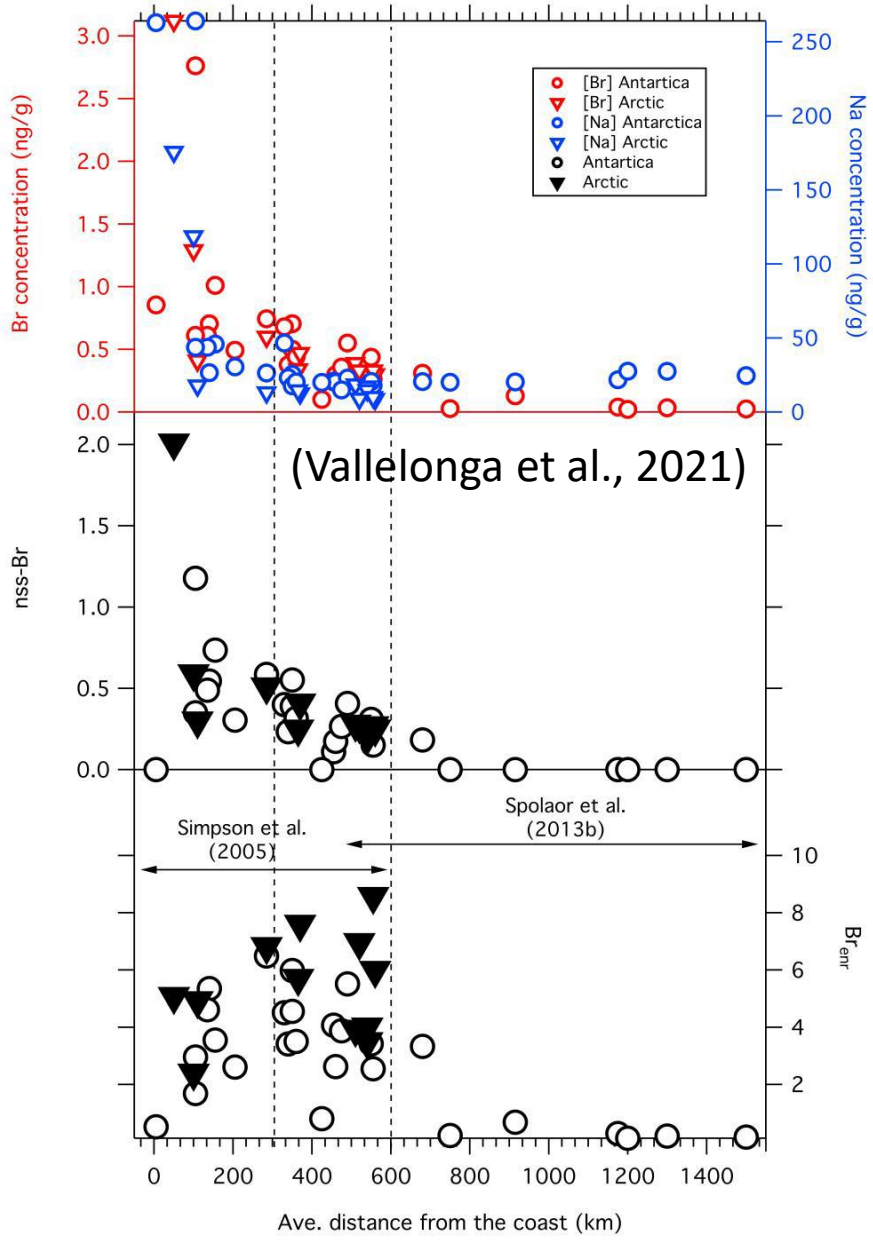


Bromine enrichment

Is bromine enriched in sub-Antarctica? No, it's depleted.

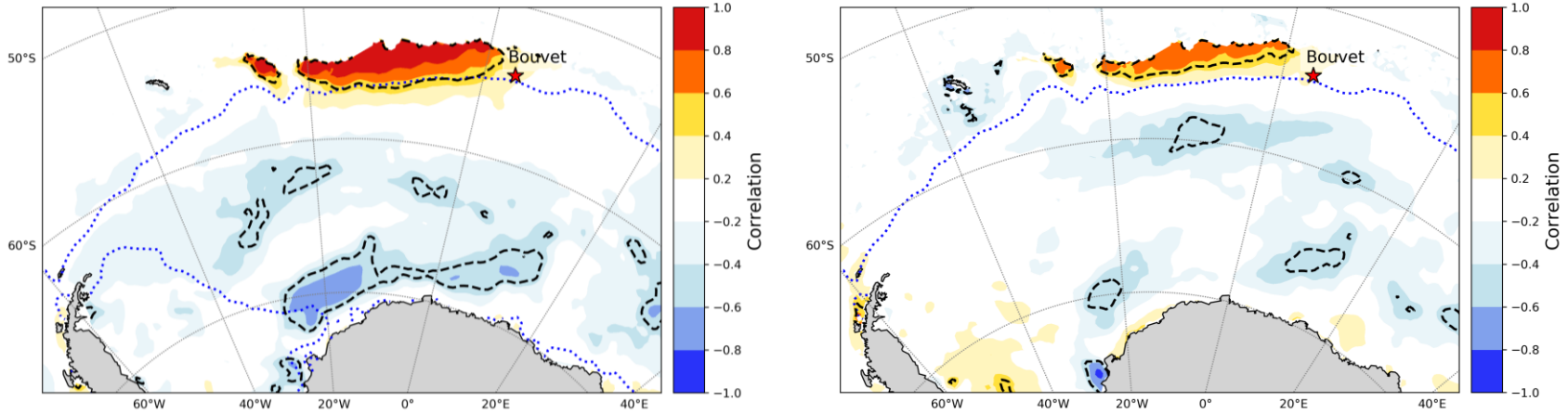
Why? Reactive bromine species are likely to be sustained in the atmosphere by heterogeneous reactions



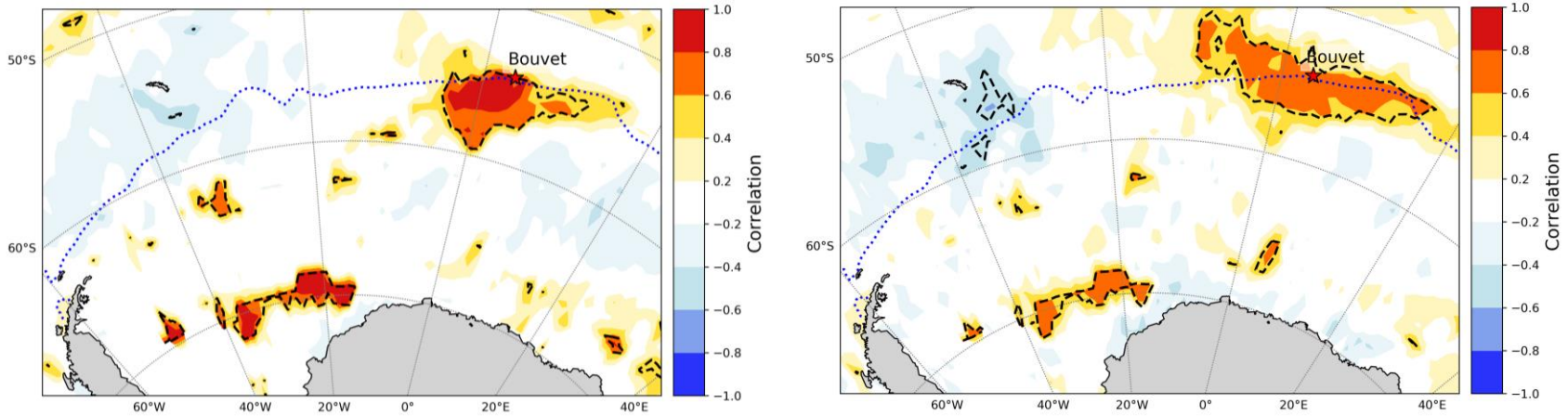


MSA and iodine

Spatial correlation plot
of MSA and I with Dec-Mar sea ice



Spatial correlation plot
of MSA and I with Dec-Mar chlorophyll



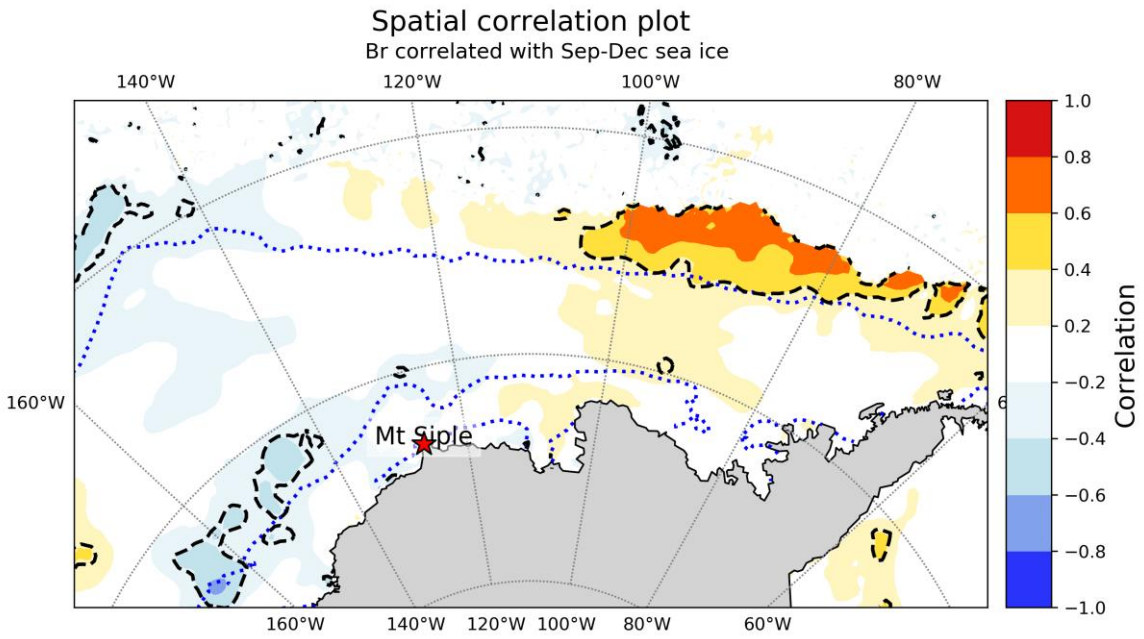
At Bouvet, iodine record is correlated with marginal sea ice.

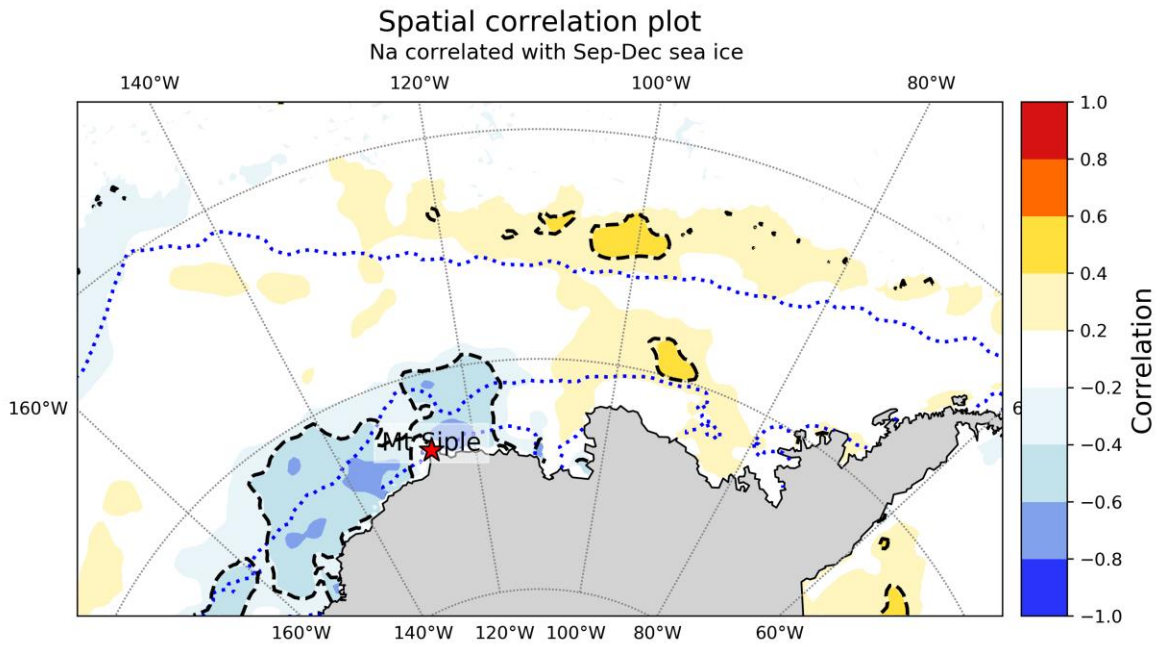
Indication of **ice-edge blooms**

I is significantly correlated with chlorophyll at the marginal sea ice.

With a retreating of sea-ice margin, global displacement of high-productivity areas to higher latitudes will likely reduce their size.

Amundsen Sea Low





In the Bellingshausen and Amundsen seas the atmospheric circulation is dominated by the **Amundsen Sea Low.**
Dipole pattern where the positive area indicate northerly winds compressing sea ice toward the Antarctic pensinsula, whereas in the negative area the wind forces sea ice way from the coast.

Conclusions

Sub-Antarctic islands unique sites for investigating processes in the Southern Ocean

Bromine is depleted at all sites (Br_{enr} < 1). In the sub-Antarctic region **reactive bromine is sustained in the atmosphere by photochemistry** and can be transported away from the source.

Br and Na trends might reflect changes in wind strenght

Spatial correlation plots of iodine and MSA reproduce **ice-edge blooms**

Questions or suggestions?

Contact me!

delia.segato@unive.it