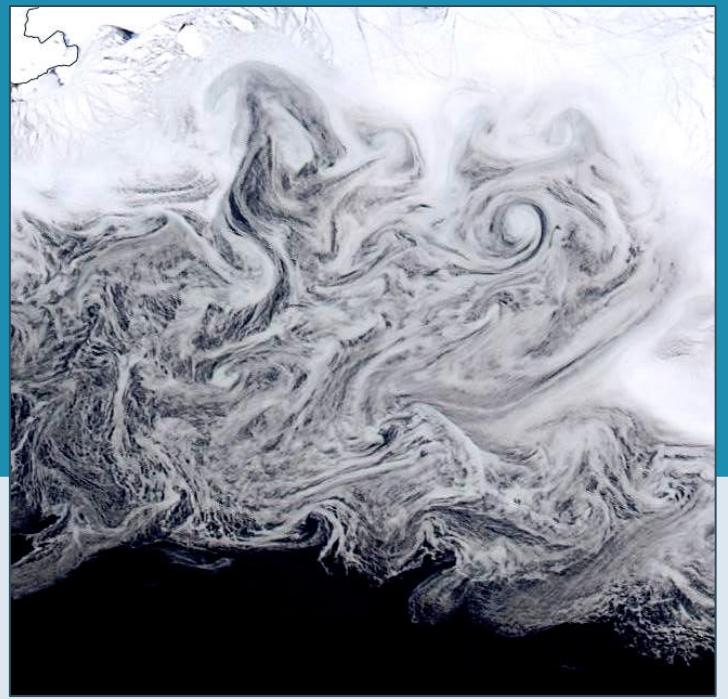
UCLouvain

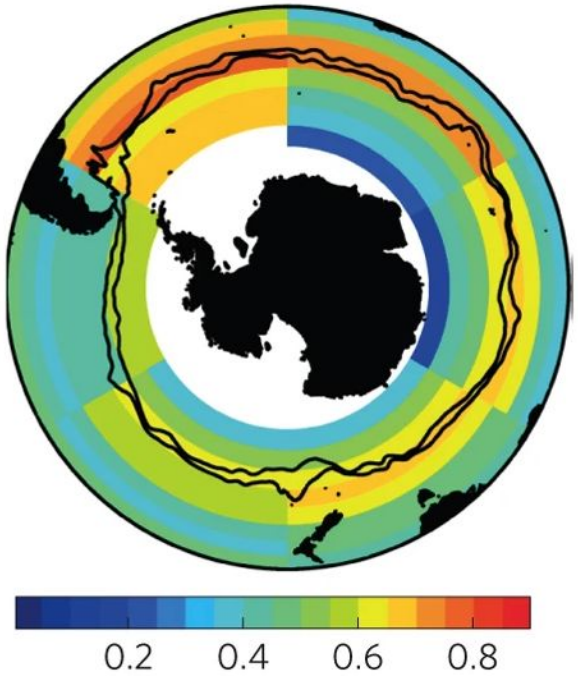
KU LEUVEN

Oceanic drivers of air-sea-ice interactions: the imprint of mesoscale eddies and ocean heat content on the sea ice, atmosphere, and ice sheet



P.-V. Huot, C. Kittel, T. Fichefet, N. Jourdain, X. Fettweis, N. Van Lipzig, H. Goosse, D. Verfaillie, F. Klein, S. Marchi

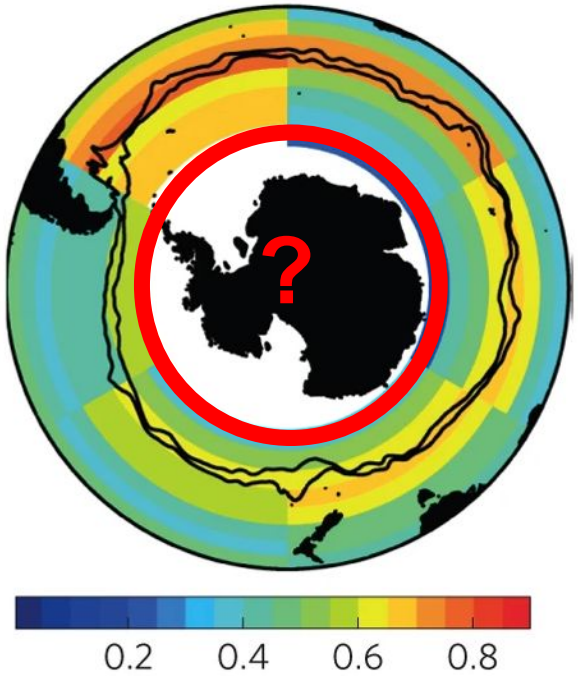
Air-sea interactions are modulated by mesoscale eddies



← Observed correlation between small-scale SST anomalies and wind anomalies in the Southern Ocean

courtesy of I. Frenger
(Frenger et al. 2013, Nature)

Air-sea interactions are modulated by mesoscale eddies



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What about the ice-covered Southern Ocean ?

An eddy-resolving ocean-sea ice-atmosphere model

Assess the sensitivity of air-sea ice interactions to mesoscale eddies in a **high-resolution coupled** ocean-atmosphere-sea ice model.

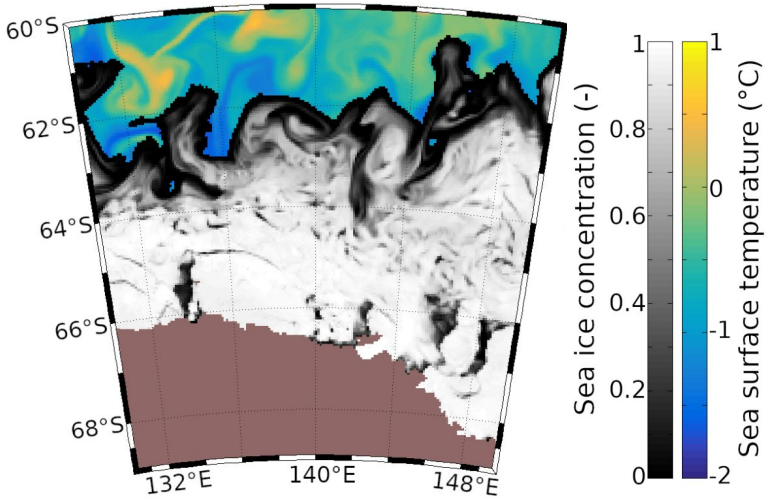
The model: NEMO-LIM 3.6 x MAR

ocean-sea ice *atmosphere*

1/24° (2 km) 5 km

Zone of interest: Adélie Land sector

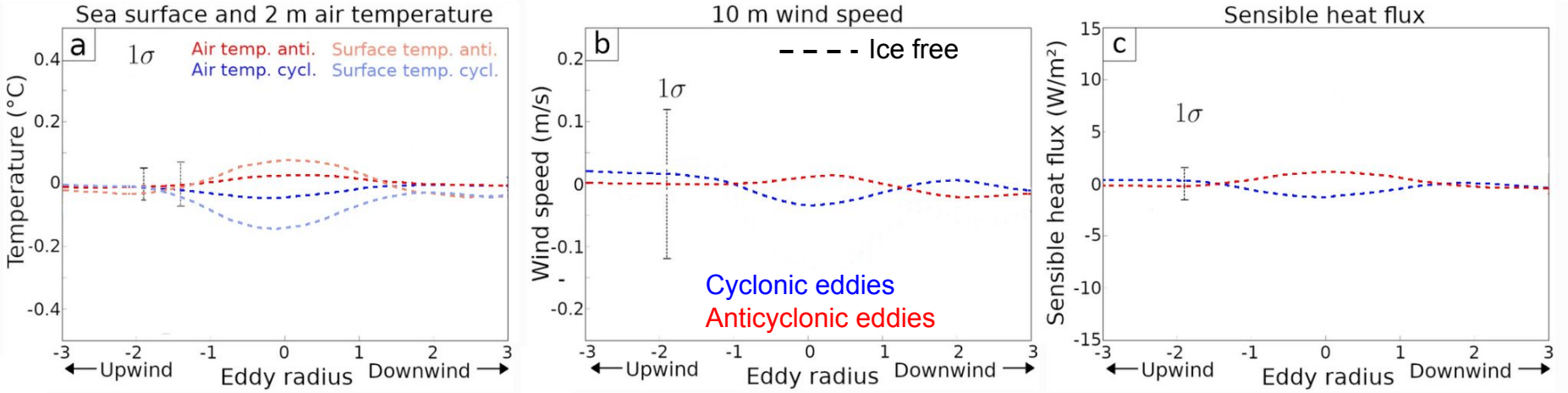
2-year simulations



Snapshot on 23rd Aug. 2013

Eddies' imprint on the atmosphere

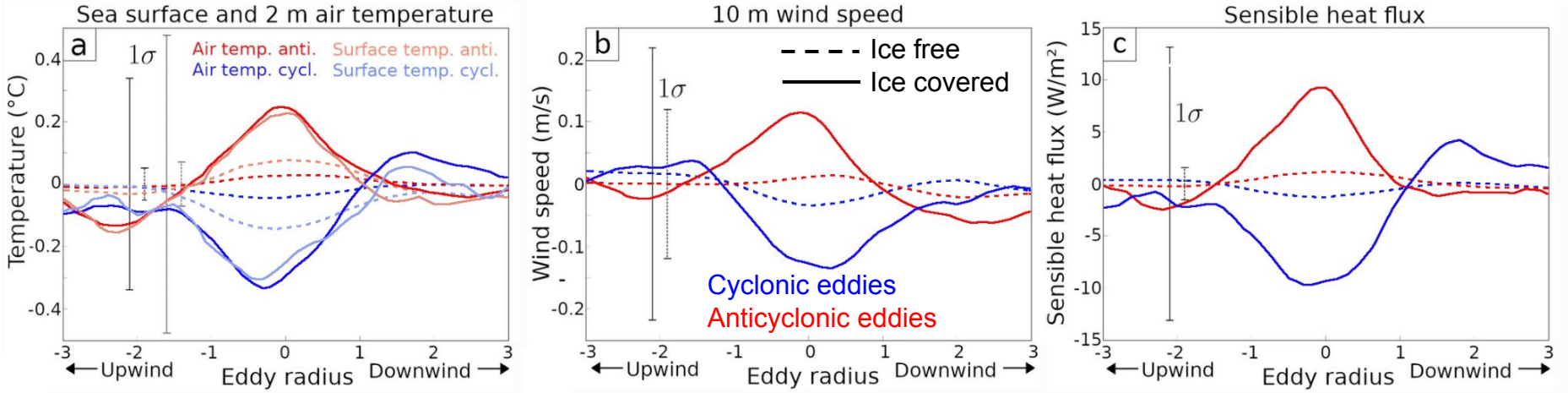
Cross eddy composites of near surface air temperature, wind speed, and sensible heat flux:



→ Weak imprint of eddies on atmosphere in ice-free conditions.

Eddies' imprint on the atmosphere

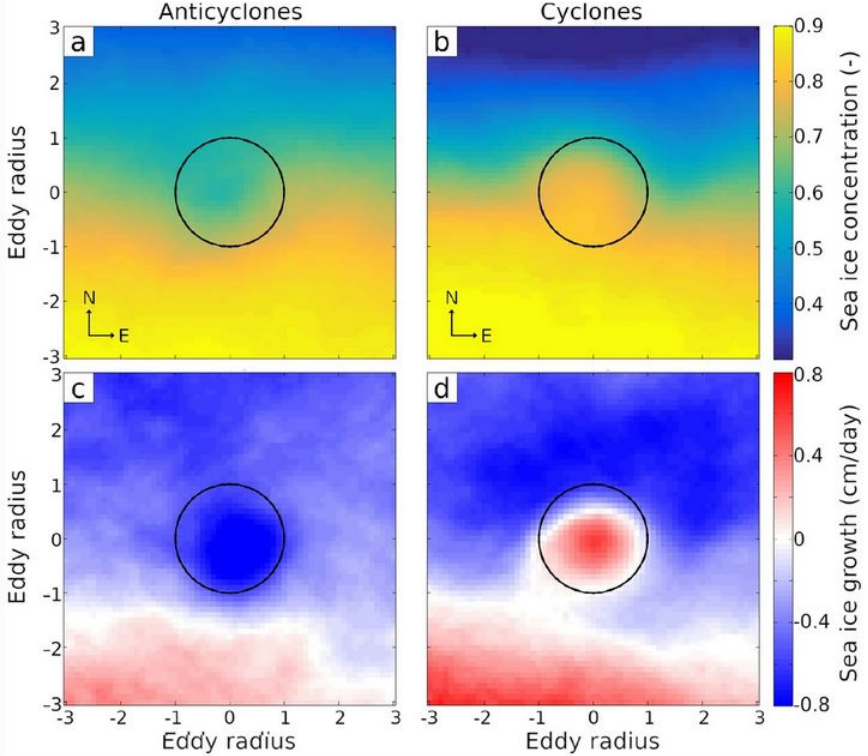
Cross eddy composites of near surface air temperature, wind speed, and sensible heat flux:



→ Weak imprint of eddies on atmosphere in ice-free conditions.

→ Notable imprint of eddies on atmosphere for ice-covered eddies.

Eddies' imprint on the ice cover



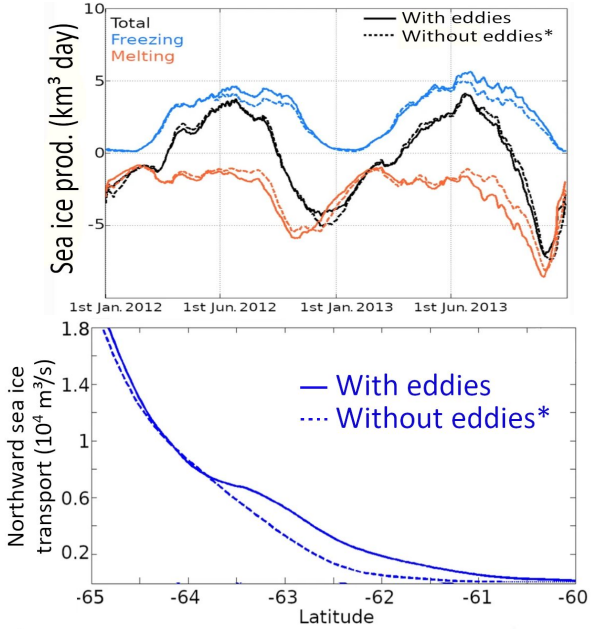
Sea ice melting above anticyclonic eddies (lowers sea ice concentration).

Sea ice growth above cyclonic eddies (increases sea ice concentration).

→ Eddies' imprint on the atmosphere is amplified by their imprint on sea ice concentration.

Eddies modulate air-sea-ice interactions… But does it matter ?

➔ Compensating changes in sea ice freezing / melting, and contribution to sea ice transport.



* oceanic fields are smoothed before the calls to the sea ice and atmosphere models.

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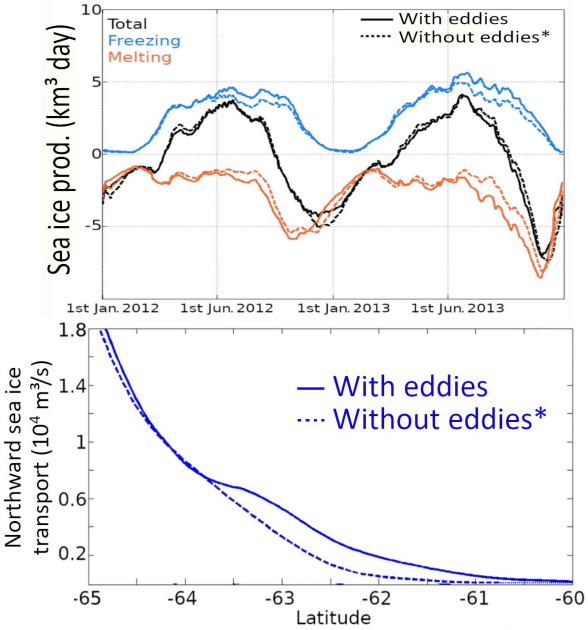
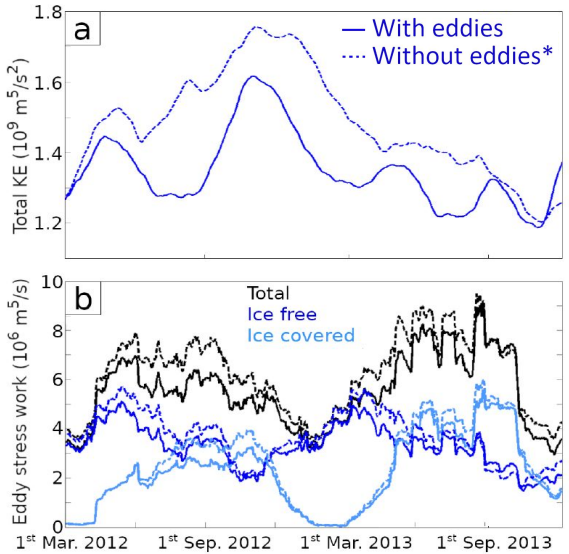


➔ Lower wind work and ocean KE with eddies.

Area integrated momentum transfer and 0-200 m ocean Kinetic Energy:



* oceanic fields are smoothed before the calls to the sea ice and atmosphere models.

Moving on to longer/ larger scales

Ongoing work (PARAMOUR* project):

Can ocean memory leads to predictability of the Antarctic Ice Sheet mass balance changes ?

→ using an ocean-sea ice-ice sheet-atmosphere fully coupled model

* Checkout S. Marchi's presentation on Friday !

Thank you for your attention !

Mesoscale eddies' influence on air-sea-ice interactions:

Effects of ocean mesoscale eddies on atmosphere–sea ice–ocean interactions off Adélie Land, East Antarctica

P.-V. Huot[1,2] · C. Kittel[3,4] · T. Fichefet[1] · N. C. Jourdain[4] · X. Fettweis[3]

The PARASO Ocean-Sea ice-Ice sheet-Atmosphere model:

PARASO, a circum-Antarctic fully-coupled ice-sheet - ocean - sea-ice - atmosphere - land model involving f.ETISh1.7, NEMO3.6, LIM3.6, COSMO5.0 and CLM4.5

Charles Pelletier[1], Thierry Fichefet[1], Hugues Goosse[1], Konstanze Haubner[2], Samuel Helsen[3], Pierre-Vincent Huot[1], Christoph Kittel[4], François Klein[1], Sébastien Le clec'h[5], Nicole P. M. van Lipzig[3], Sylvain Marchi[3], François Massonnet[1], Pierre Mathiot[6,7], Ehsan Moravveji[3,8], Eduardo Moreno-Chamarro[9], Pablo Ortega[9], Frank Pattyn[2], Niels Souverijns[3,10], Guillian Van Achter[1], Sam Vanden Broucke[3], Alexander Vanhulle[5], Deborah Verfaillie[1], and Lars Zipf[2]

References:

Frenger et al. (2013), "Imprint of Southern Ocean eddies on winds, clouds and rainfall" in Nature

Supplementary material