IS-ENES3 has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 824084

EGU - **May 23, 2022**

Drivers of Antarctic sea-ice advance

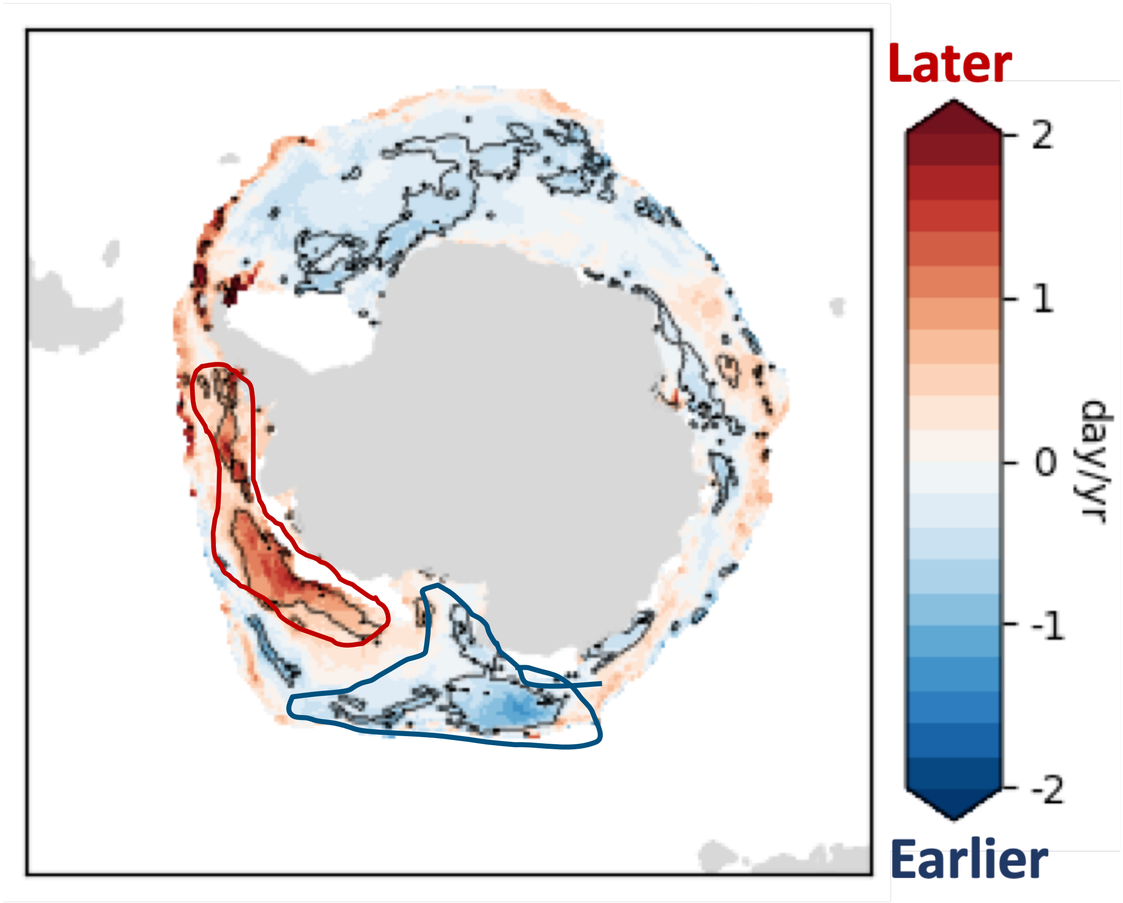
Kenza Himmich

Sorbonne Université, Laboratoire d'Océanographie et du Climat, CNRS/IRD/MNHN, Paris, France

Contributors: M. Vancoppenolle, G. Madec, J-B. Sallée, M. Lebrun, P. Holland, C. De Lavergne

Drivers of observed changes in Antarctic sea-ice advance date : limited understanding

Trends on dates of advance (1982-2018)



Stammerjohn et al., 2012 (updated)

Ocean heat feedbacks

Perovich et al., 2007;
Stammerjohn et al., 2012

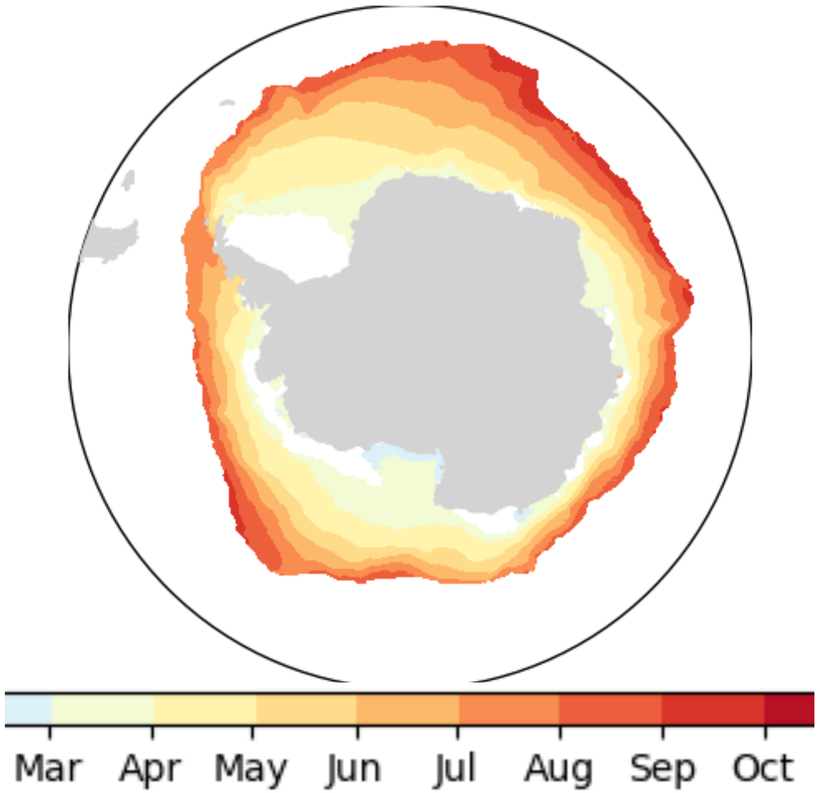
Wind-driven ice transport changes

Holland & Kwok 2012
Stammerjohn et al., 2008; 2012

What drives the observed climatology of Antarctic sea ice advance ?

PMW
1st day ice conc. > 15%
1982 - 2018 climatology

Date of advance



1. **Which role for upper-ocean thermodynamics ?**

2. **Which role for sea-ice transport ?**

Role of upper ocean thermodynamics

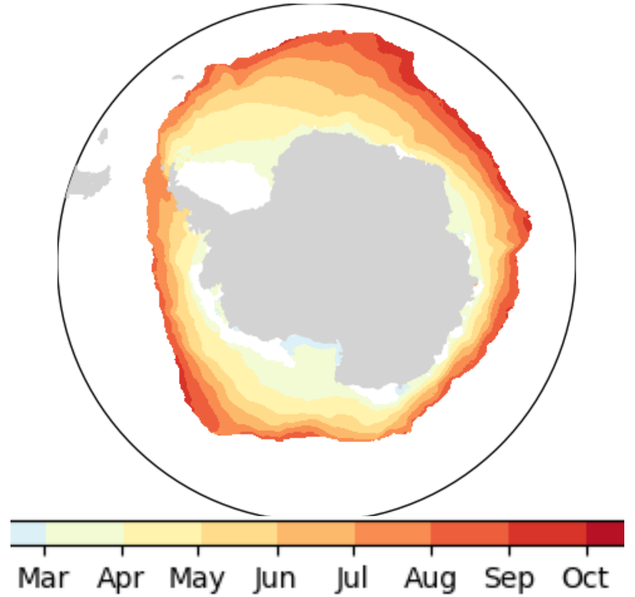
*Mixed Layer Heat content (**MLH**)*

$$MLH = MLD.(SST - T_f)$$

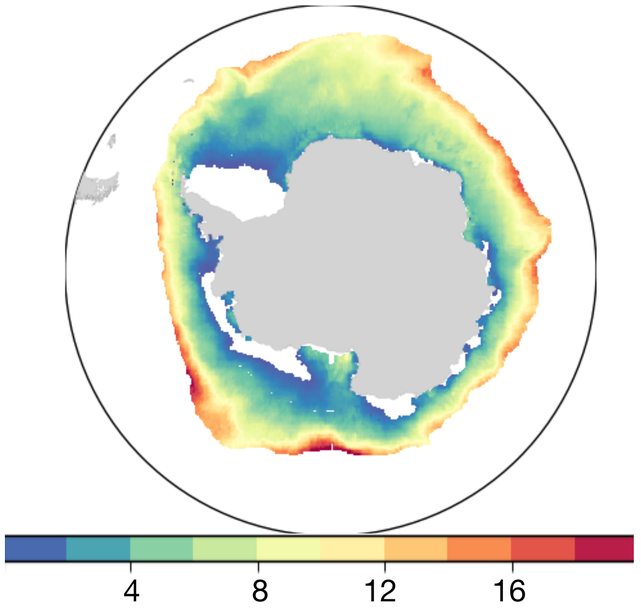
In situ **MLD** (Sallée et al. 2021)
1970 - 2018 climatology

SST analysis (ESA CCI)
1982-2018 climatology

Date of advance

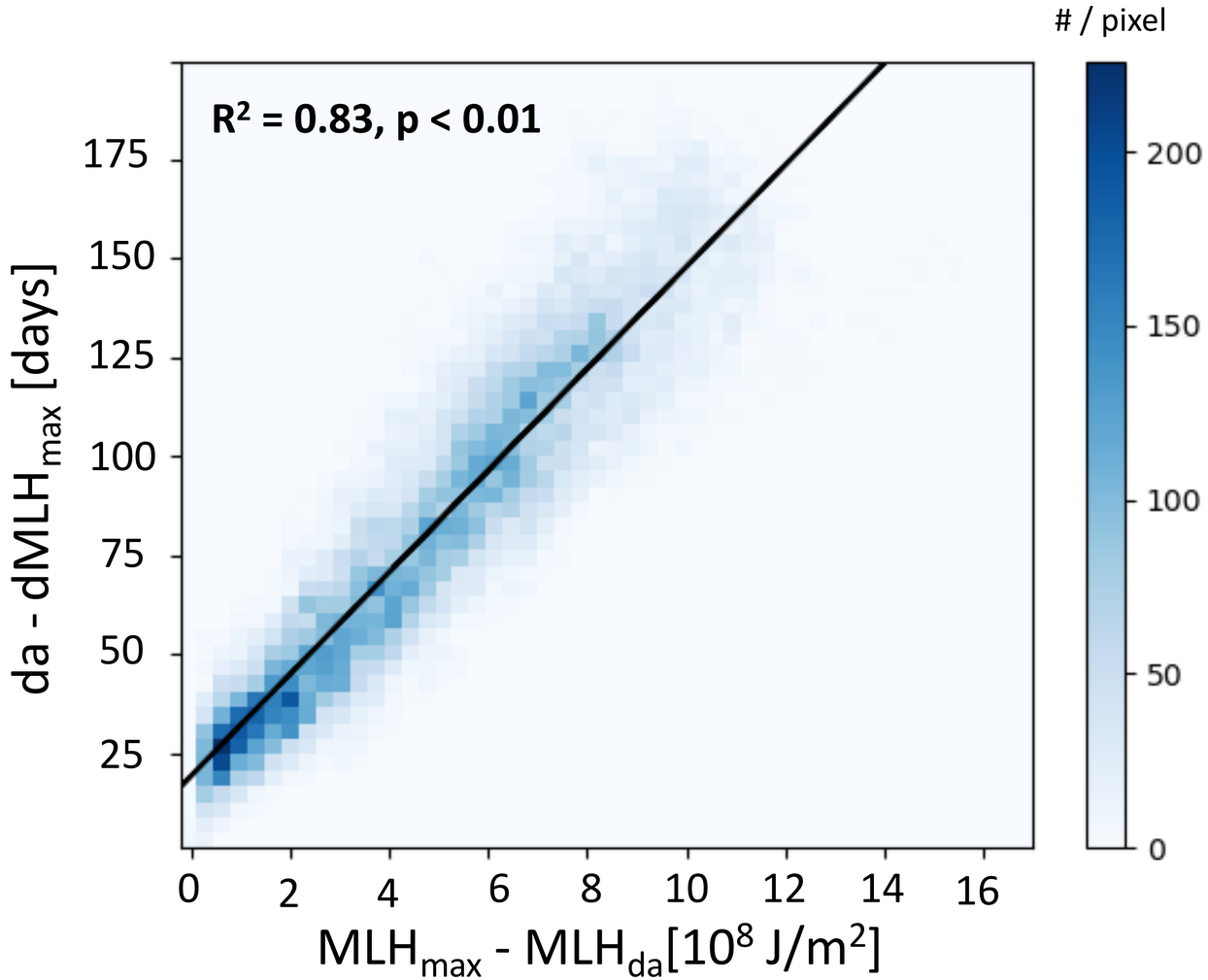


MLH_{max} [10^8 J/m^2]



Spatial relationship ?

The date of advance is strongly linked to the maximum of ML heat content



The ML heat content is the main driver of sea-ice advance

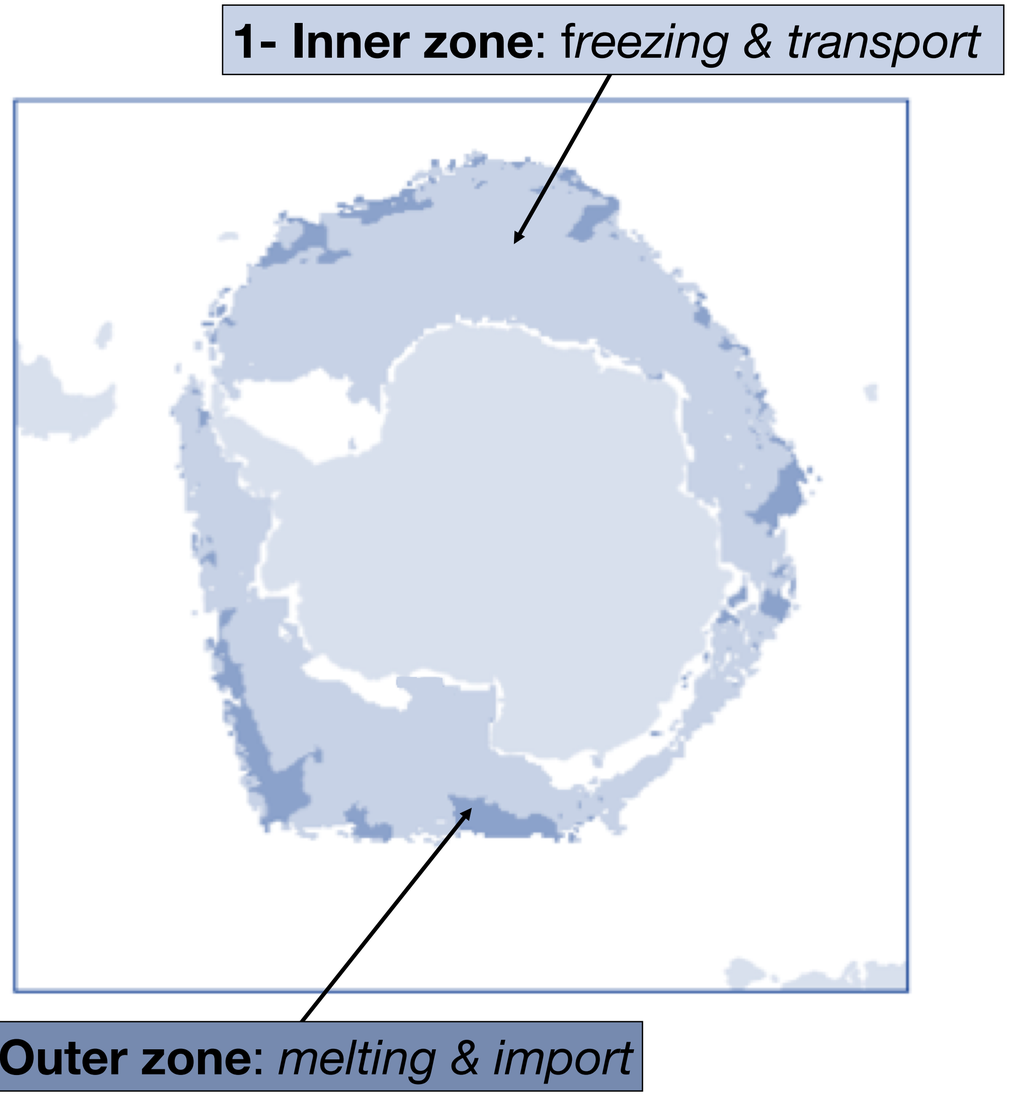
Role of sea ice transport

Sea ice concentration budget decomposition

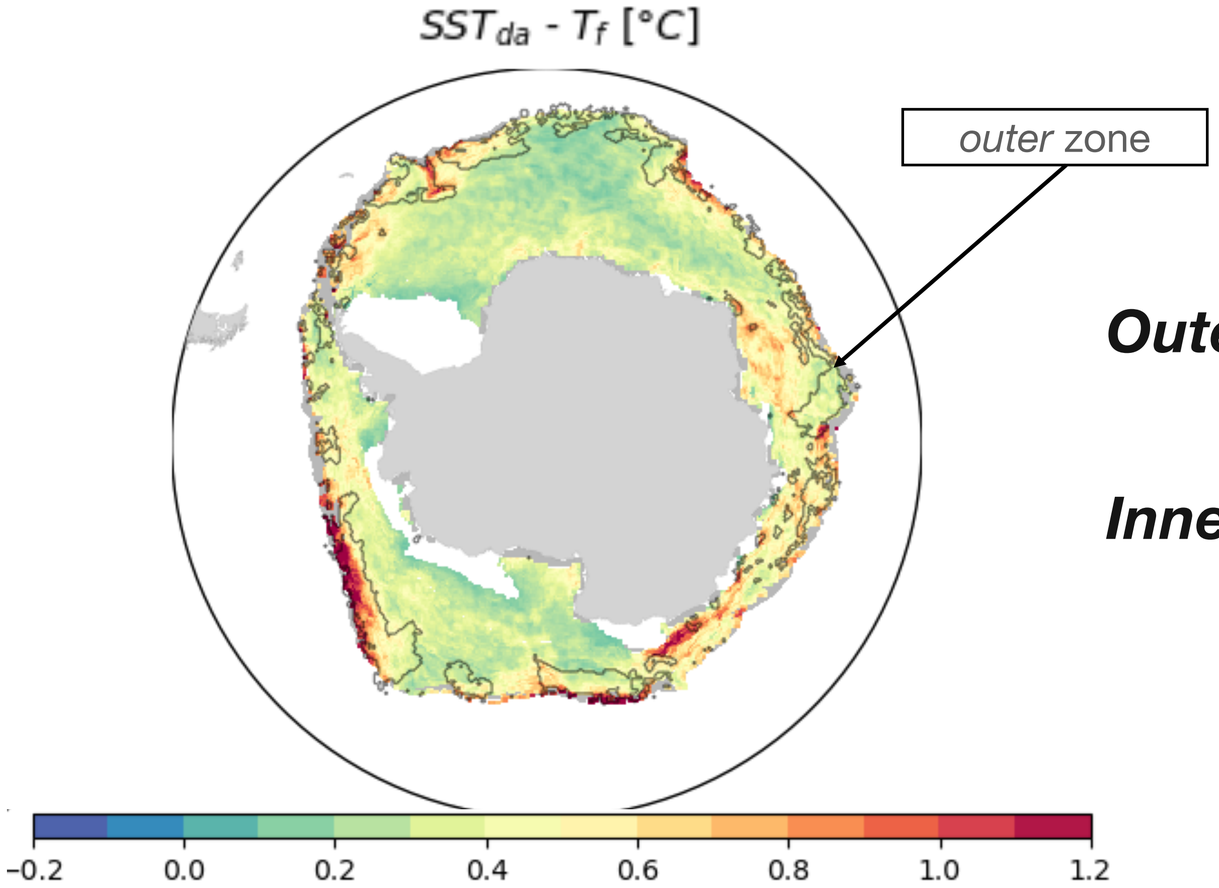
$$\frac{\partial C}{\partial t} = \underbrace{-\mathbf{u} \cdot \nabla C}_{\text{Dynamic}} \underbrace{- C \nabla \cdot \mathbf{u}}_{\text{Thermodynamic}} + \text{residual},$$

Holland & Kwok (2012); Holland & Kimura (2016)

2 regions with distinct processes



Highest SST@d_a –T_f correspond to region of ice melt / import



Outer zone: *no freezing, ice transport only*

Inner zone: *freezing, driven by maximum MLH*

Spatial variability → temporal variability ?