



Coupling an atmospheric model to an ocean model  
to study air-ice-ocean interactions in Antarctica:  
challenges and applications

7<sup>th</sup> Belgian Geography Day, Liège

# Introduction

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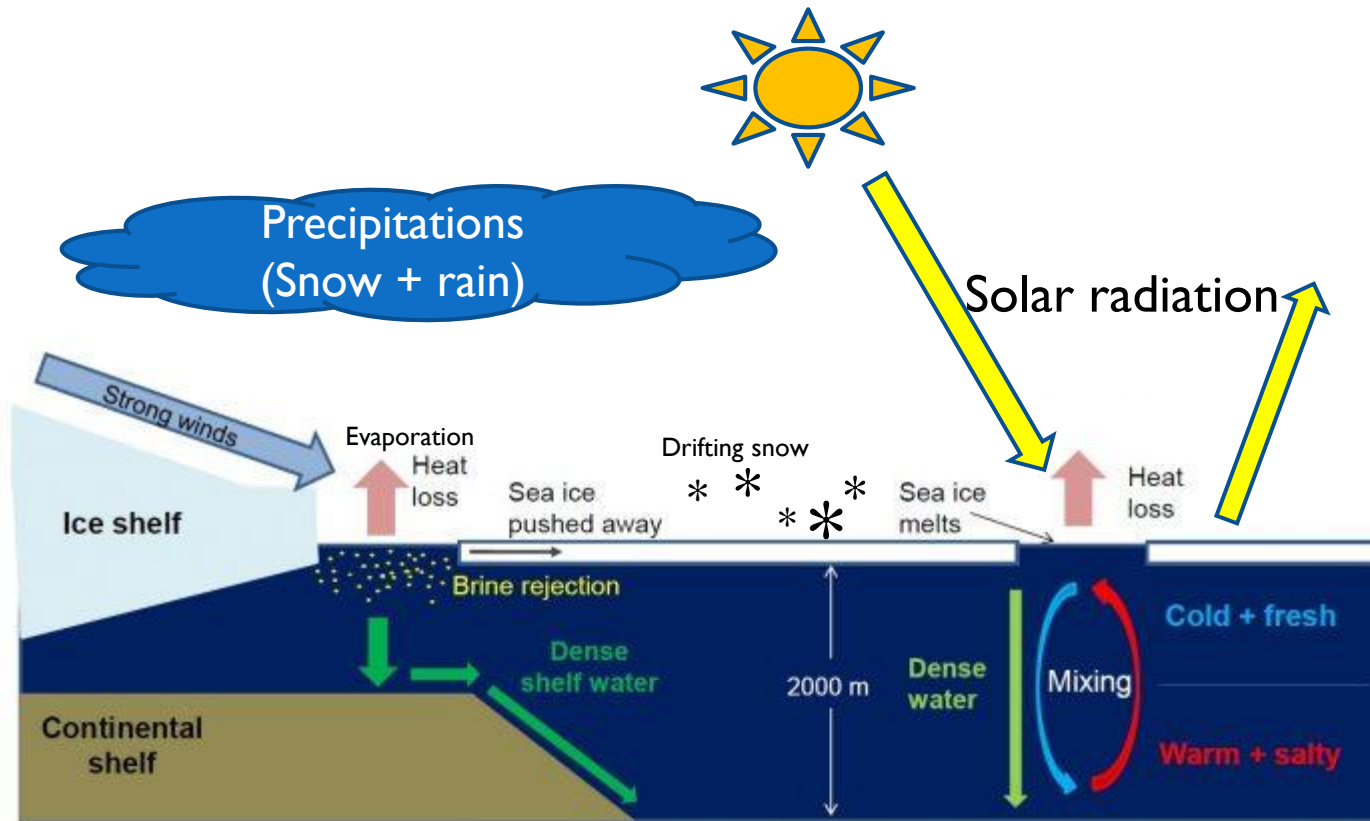
- ▶ High variability of ocean surface properties
  - ▶ Parameters
    - ▶ Sea Surface Temperature (SST)
    - ▶ Sea Ice
      - Concentration, extent, thickness
  - ▶ Temporal
    - ▶ Seasonal (winter vs summer)
    - ▶ Annual
  - ▶ Spatial



Source: NASA animation <https://svs.gsfc.nasa.gov/3862>

⇒ High variability of air-sea-ice interactions

# Air-sea-ice interactions

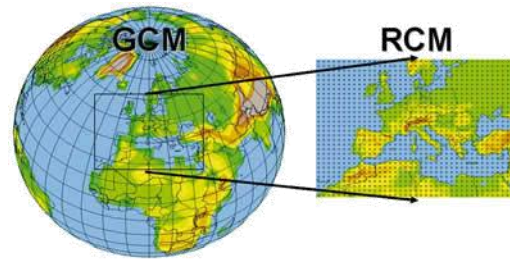


Credit: Céline Heuzé, [http://blogs.egu.eu/divisions/crif/files/2016/11/Schematic\\_polynya\\_Celine-700x294.jpg](http://blogs.egu.eu/divisions/crif/files/2016/11/Schematic_polynya_Celine-700x294.jpg)

# How to study the air-sea-ice system?

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- ▶ Atmosphere-Ocean General Circulation Model (A-O GCM)
  - ▶ To low resolution inadequate to study air-sea-ice interactions

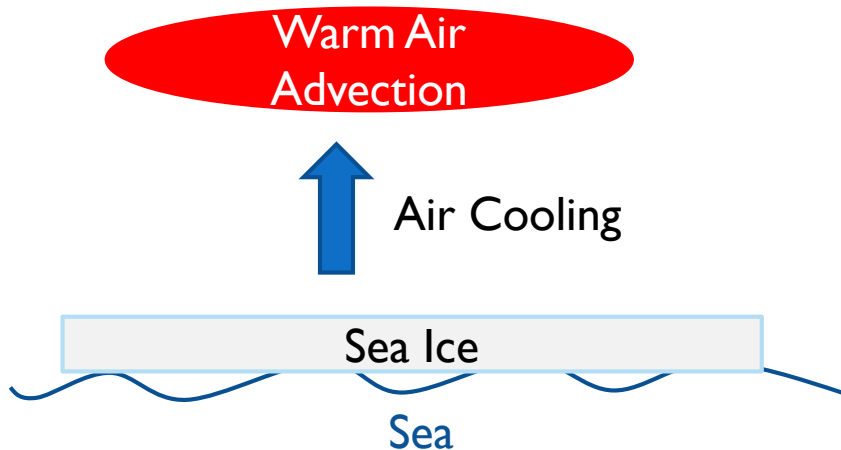


- ▶ Atmosphere-Ocean Regional Climate Model (A-O RCM)
  - ▶ High resolution and polar processes adapted
  - ▶ But lateral boundaries conditions are required...
  - ▶ In practice, Atmosphere RCM with prescribed sea surface conditions
    - ▶ (and inversely Ocean RCM with prescribed atmospheric conditions)

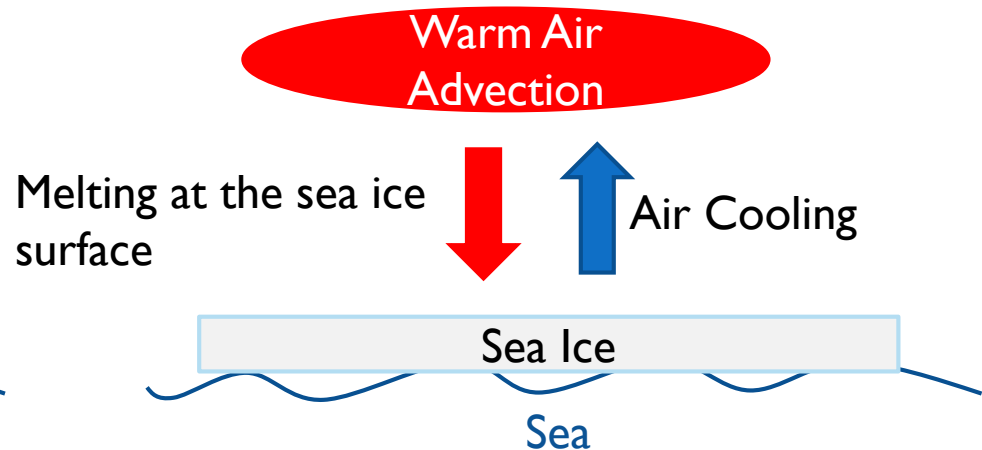
# Approximations in an atmosphere RCM

- ▶ Prescribed sea surface conditions or “Swamp ocean”
  - ▶ Less temporal variability of SSC
    - ▶ For example, SSC are prescribed and constant during 6 hours
  - ▶ No feedbacks between atmosphere and ocean

Swamp ocean

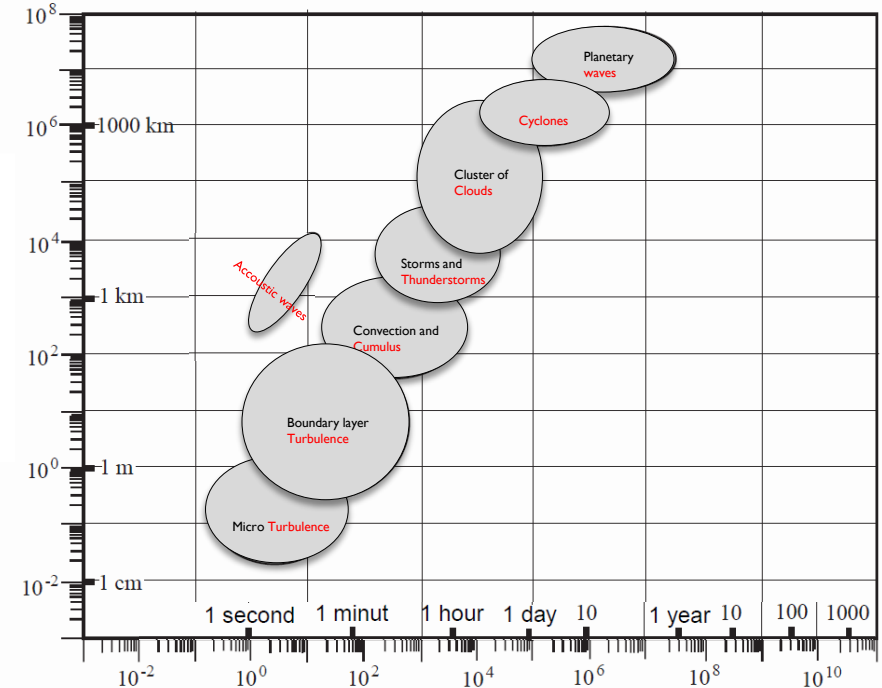
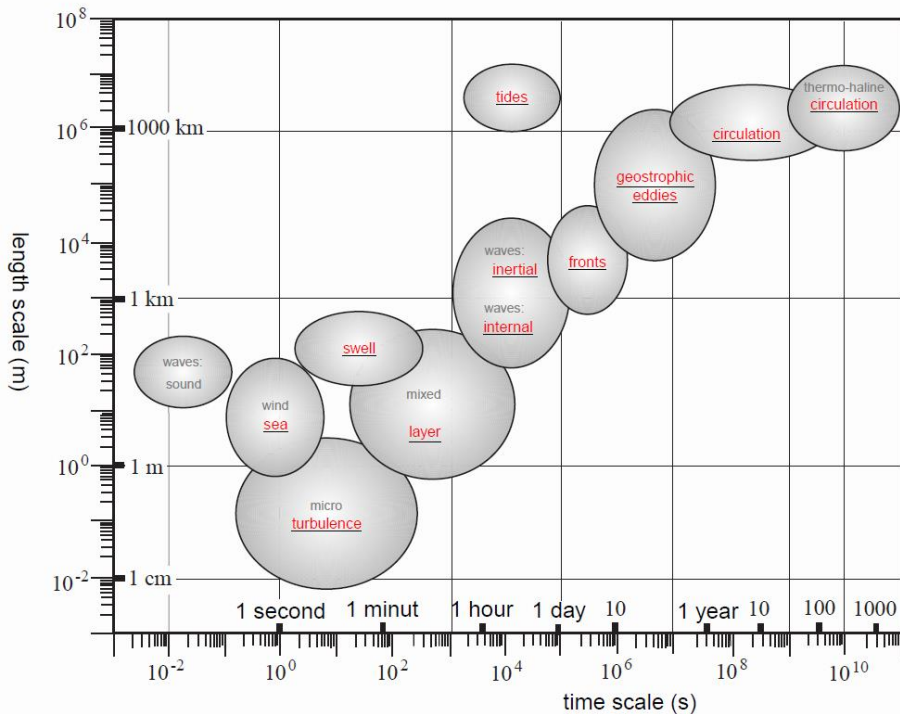


Simplified reality



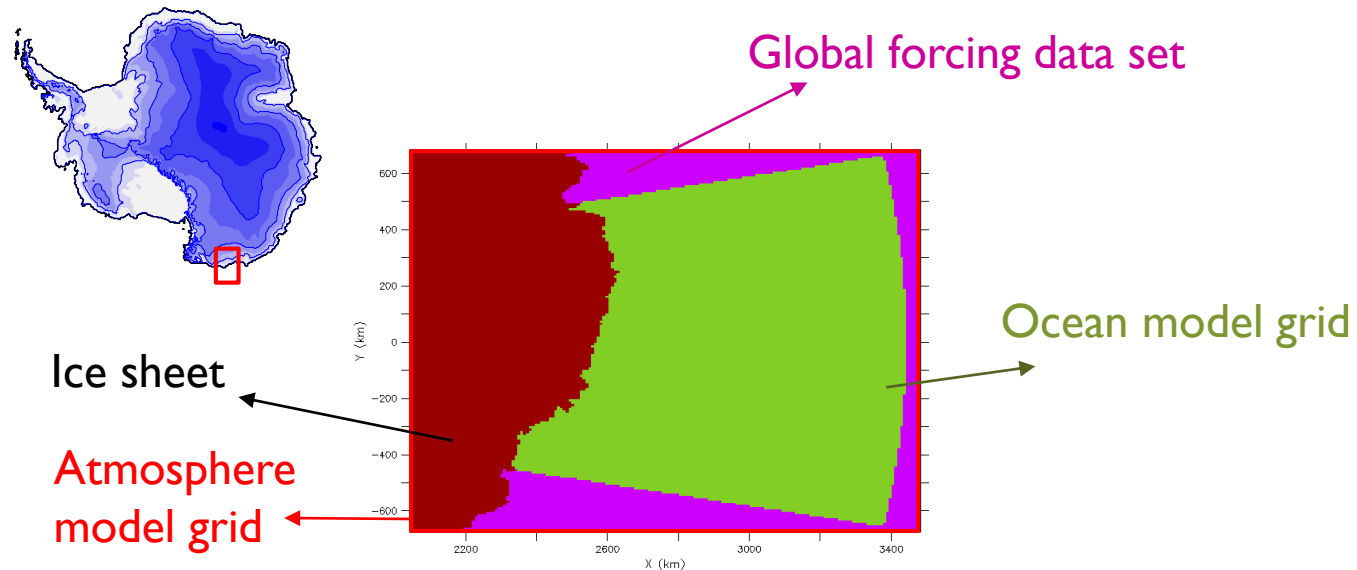
# Physical challenges of a coupling

- ▶ Differences of spatial and temporal scales between the ocean and the atmosphere
  - ▶ Ocean: smaller and slower
  - ▶ Atmosphere: larger and faster



# Technical challenges of a coupling

- ▶ Models have different resolutions (horizontal and temporal) and different grids
  - ▶ Interpolation
    - ▶ Errors, especially near the coastline
  - ▶ One of the two grid has to fully cover the other one
    - ▶ Combine data from forcing sets and coupled models



# Conclusion and perspectives

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- ▶ Current models use major approximations
  - ▶ Less reliable results
- ▶ Coupling an ocean model to an atmospheric model
  - ▶ Essential but physical and technical challenges
- ▶ High resolution simulations of sea ice atmosphere interaction
  - ▶ Predictability of sea ice for operational purposes
    - ▶ Navigability for supply mission by ships for coastal bases
  - ▶ Modelling not/difficult measurable key parameters
    - ▶ Assessment of blowing snow over sea-ice covered surface

***Thank you for your attention!***

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