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

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Introduction

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

⇒ High variability of air-sea-ice interactions

Source: NASA animation [https://svs.gsfc.nasa.gov/3862](https://svs.gsfc.nasa.gov/3862)
Air-sea-ice interactions

How to study the air-sea-ice system?

- **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)
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

Approximations in an atmosphere RCM
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

![Image of model grids and forcing data set]
Conclusion and perspectives

- 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!