Day 1: Morning

Southern Ocean sea ice variability in a warming climate: observations and modeling approach

Datasets to check out: Sea Ice-thickness product Inter comparison exercise (SIN'XS); AVISO Sea Ice Dataset; Nuyina – OSIA underway observatory; WMO WWRP: Polar Coupled Analysis and Prediction Services

Key Topics:

- recent changes and trends in Antarctic sea ice coverage, distribution, thickness and dynamics and their drivers and consequences in the Earth system; it is striking how the systems is behaving as a whole, why is it changing?
- Can we name a trigger/cause for the abruptness of the change?
- 'Antarctic sea ice paradox': traditionally obs have show a slight increase in sea ice extent, but models have show a decrease.
- Estimating sea-ice production needs to consider 'warm' vs 'cold' shelf, winds (e.g. 0.8 m/day in 30 m/s katabatic winds; 0.2-1.1 m/day in other conditions)
- Coastal Exposure: where sea ice isn't around Antarctica

Main Developments:

- Variance and persistence of monthly sea ice extent increased prior to the sudden ice loss in 2015/16.
- Record low sea ice in 2022 and 2023 are not driven by interannual variability or natural processes and may indicate a regime shift or threshold being passed (potentially in 2016).
- Evidence for a longer-term variability imprinting on short-term variability
  - ocean warming and salinity changes -> stratification changes -> redistributes heat vertically. IPO?
  - some multi-decadal variability that we have not fully observed)
  - Long-term subsurface warming may have influenced abruptness of change
- Sea ice production difficult to measure, but significantly different on cold vs. warm continental shelves due to influence of CDW.
- Coastal Exposure can impact sea ice formation and breakout locally and remotely.

Open Questions:

- Impacts: Will Antarctic sea ice recover from recent record lows? Over what timescale? What will be the consequences of the recent rapid changes for ocean ecosystems and physics?
- Drivers: How is the IPO related with the sub-surface salinity and sea ice? Did the atmosphere provide a trigger?
- Obs: How do snow and sea ice properties evolve around Antarctica

Future Directions:

- More (sustained + circumpolar) observational data on how thick sea ice is and what the level of snow cover is.
- Need for coupled earth-system model development.