Mini-Projects ocean

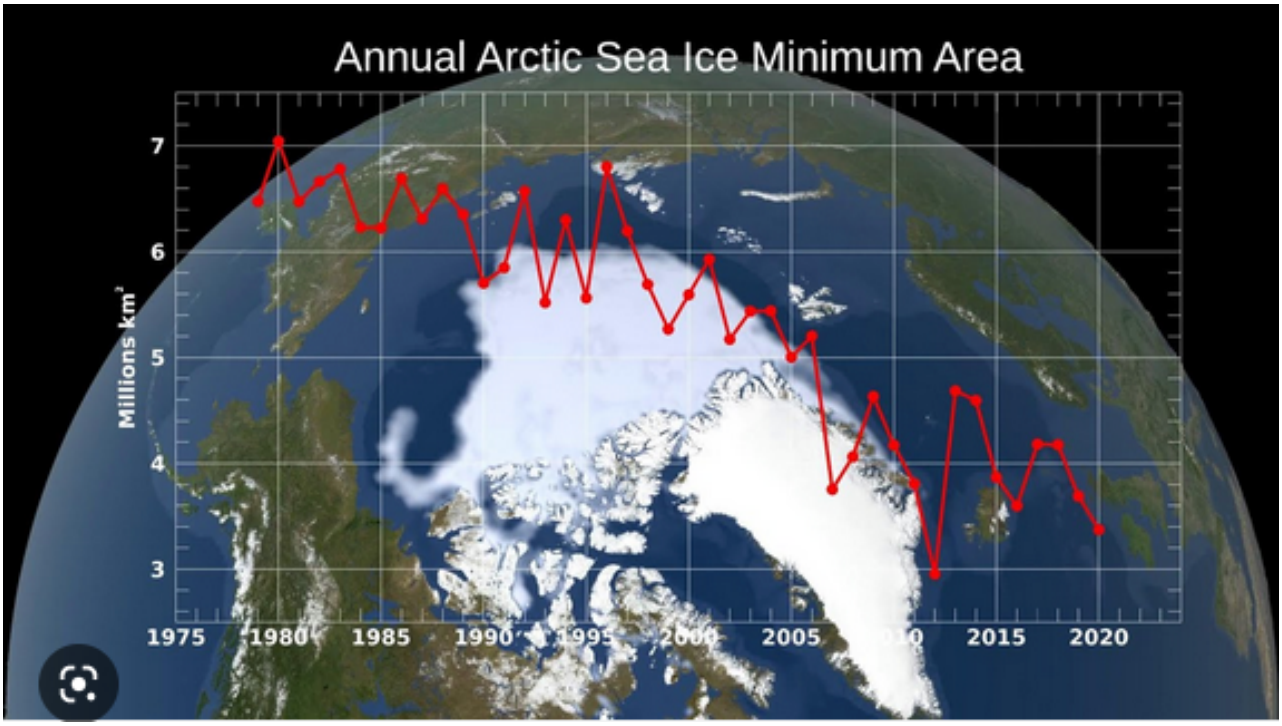

Figure: Arctic sea ice area in Sept. since 1979 (from NSIDC).

First of all, let's make a brief introduction on the goals of this "mini-project". It is designed to make you understand some theoretical concepts you have learned during the year. It's one thing to understand the equations, it's another thing to understand how they apply in real world. Basically an ocean model resolves the equations of fluid dynamics that have no analytical solutions (except if you simplify them to the extreme). You can twist, modify, transform, refashion, simplify a model to better comprehend a specific process. Here we propose to study the ocean and sea ice system of the arctic ocean since it is the most affected by climate change.

We have designed for you an Arctic box (called ARCTIC2) which is an extraction of a global model at low resolution (2 deg in longitude). We first suggest you to run it on your laptop to produce a climatology (i.e. an averaged numerical representation of the arctic ocean during a certain period of time). You will study different states of the arctic (past, present, future) and analyze the sensitivity of the simulations to different physical or numerical processes.

This is an ongoing project, not fully elaborated so it's kind of freestyle.

1. Arctic reference simulation

The simulation uses the ocean model NEMO with imposed surface boundary conditions (i.e. no coupling with an atmospheric model). The simulation spans XX years

- What is required to run the model?
  - domain, initial state, surface and lateral boundary conditions? => check that you have all the files needed.
  - the default parameters of the model (common to all type of simulations) are written in

the file namelist_ref. And the specific parameters for this particular Arctic Box configuration are overwritten by namelist_cfg. In particular you will find the time step of the model (here rn_Dt=5400s), the time integration (from nn_it000 to nn_itend), the name of domain file (cn_domcfg) etc.

- Run the model for some years by changing nn_itend. See the document "how-to-survive-NEMO" for more info
- Characterization of the present day conditions
  - Characterize the sea ice circulation, area, thickness…
  - Can you correlate the sea ice dynamics with the winds ?
  - …

2. Arctic in a warmer climate

Find the CO2 content in the present, last glacial maximum, and future (say 2100).

Find a correlation between CO2 content and downward longwave radiation (if it exists…)

3. Arctic in a colder climate

4. Understanding Arctic Amplification

=> sensitivity to albedo

5. Contribution of the ice to ocean circulation

=> sensitivity to freshwater and salt water fluxes

To be continued…

- sensitivity to snow cover

- sensitivity to melt ponds

- impact of the winds vs currents

- sensitivity to the formulation of the bulks

Notes

- nsidc: https://nsidc.org/arcticseaicenews/sea-ice-tools/
- piomas: https://psc.apl.uw.edu/research/projects/arctic-sea-ice-volume-anomaly/
- observation, reanalysis and forecast: https://climatereanalyzer.org/
- near real time reanalysis: https://earth.nullschool.net
- netcdf viewers
  - panoply: https://www.giss.nasa.gov/tools/panoply/
  - ncview
  - python, matlab, ferret…
- netcdf manipulations:
  - cdo (type cdo -h ou cdo -h xxx for help)
  - nco (ncra, ncks, ncrcat, ncap2…)