Arctic Cyclone Climatology: Present and Future

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Motivation

- Event based detection of cyclones
  => Contrast to ‘proxy’ analysis

- Non-downscaled data
  => GFDL global high-res model runs

Method

- Event based detection of cyclone tracks
  => Melbourne Cyclone tracking scheme
  (Murray and Simmonds, 1991)

- GFDL high-res model runs (50km)
  => HIRAM (C180 also C360)

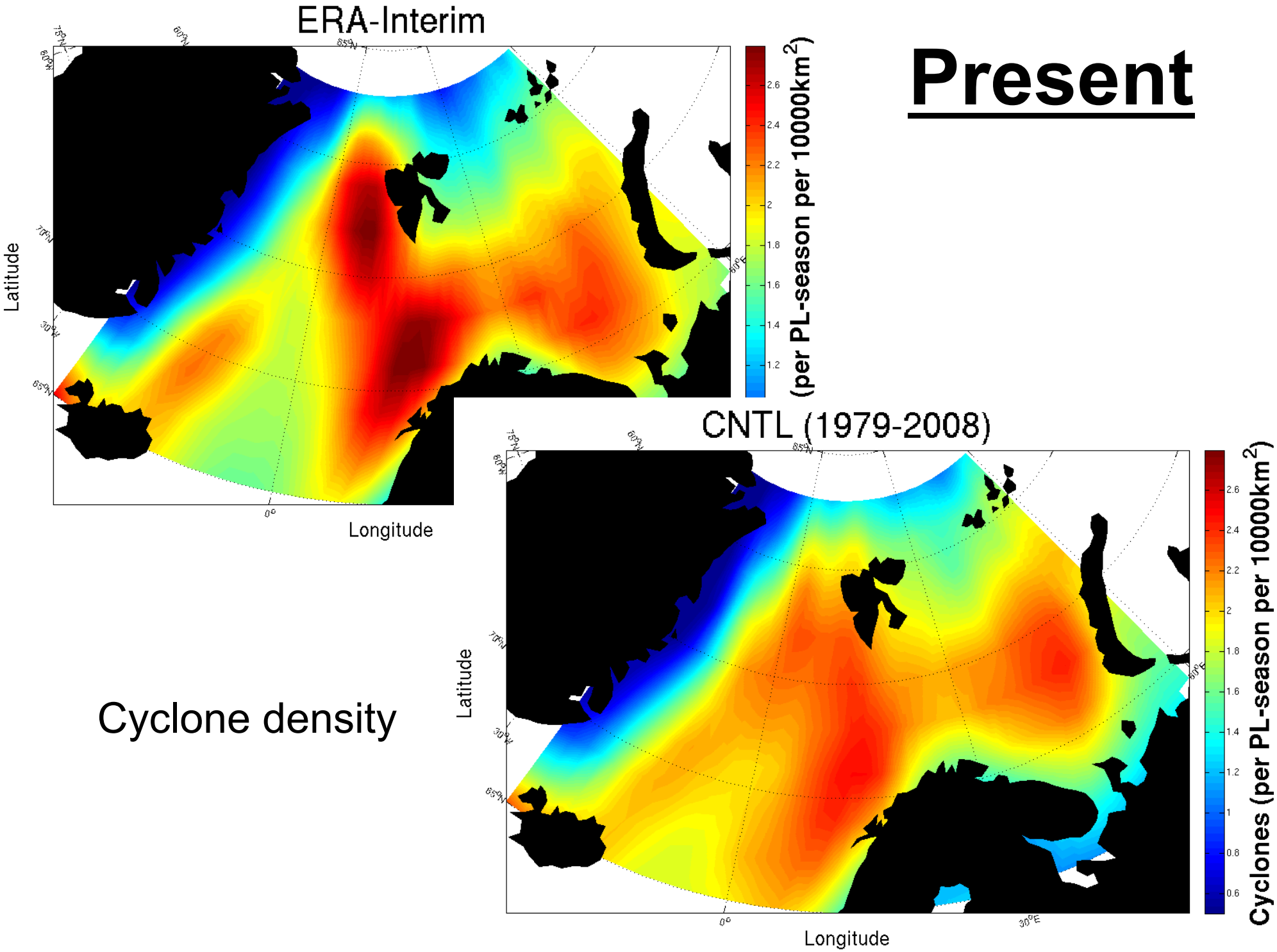
- Two climate realizations (CM3, ESM2M)
- Two different forcing (rcp45, rcp85)

Present

- ERA-Interim from ECMWF

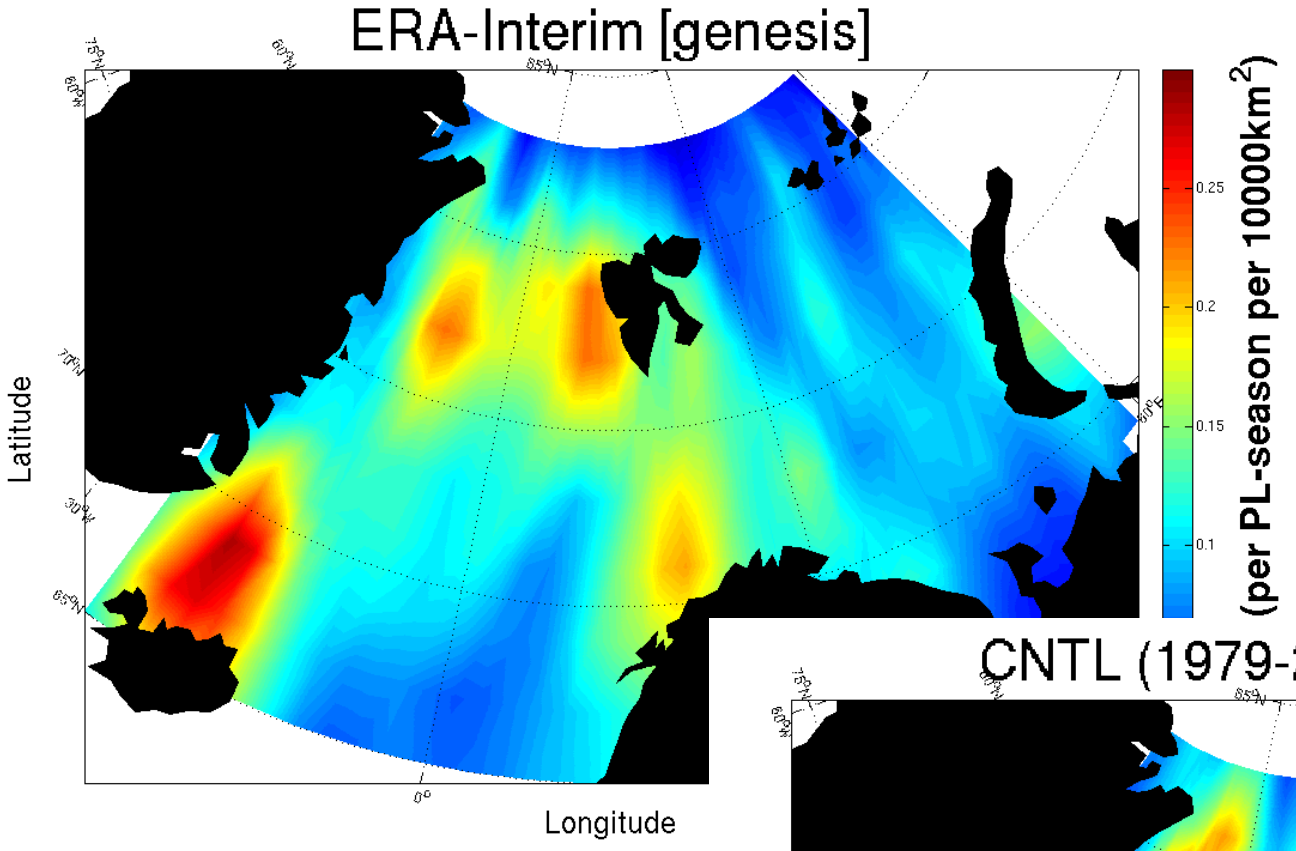
- Control climate run with high-res model
- Recurrent annual cycle
  => statistically more robust

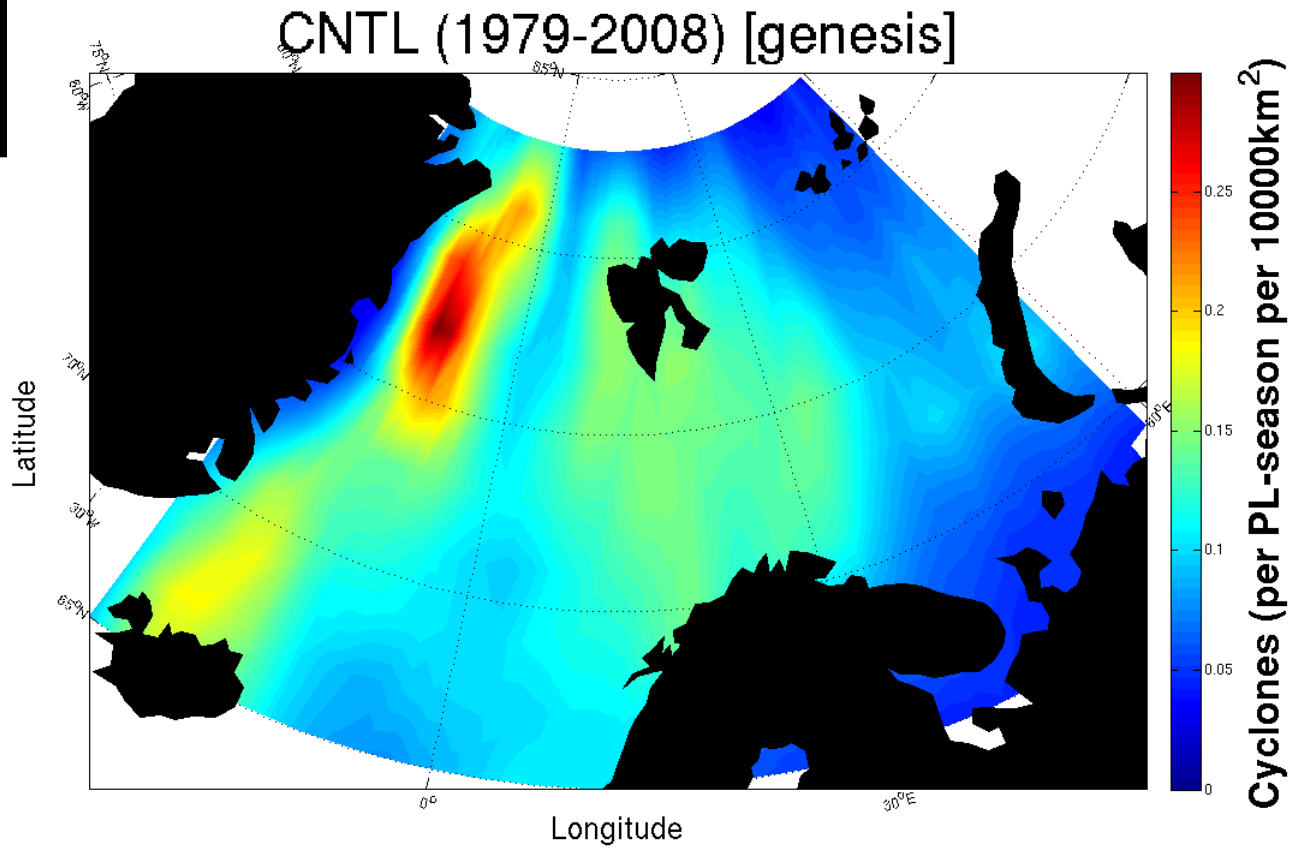
Present



Cyclone density

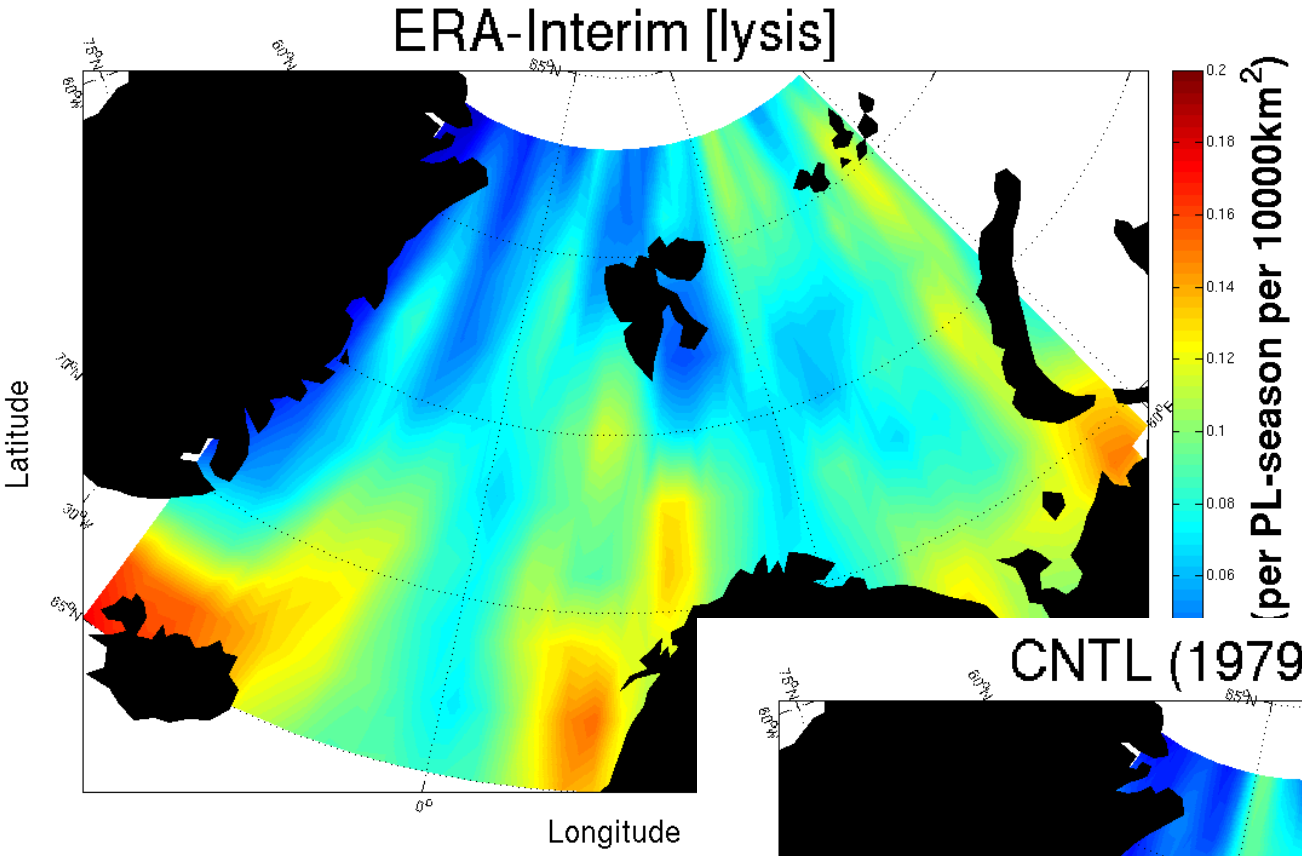
Present

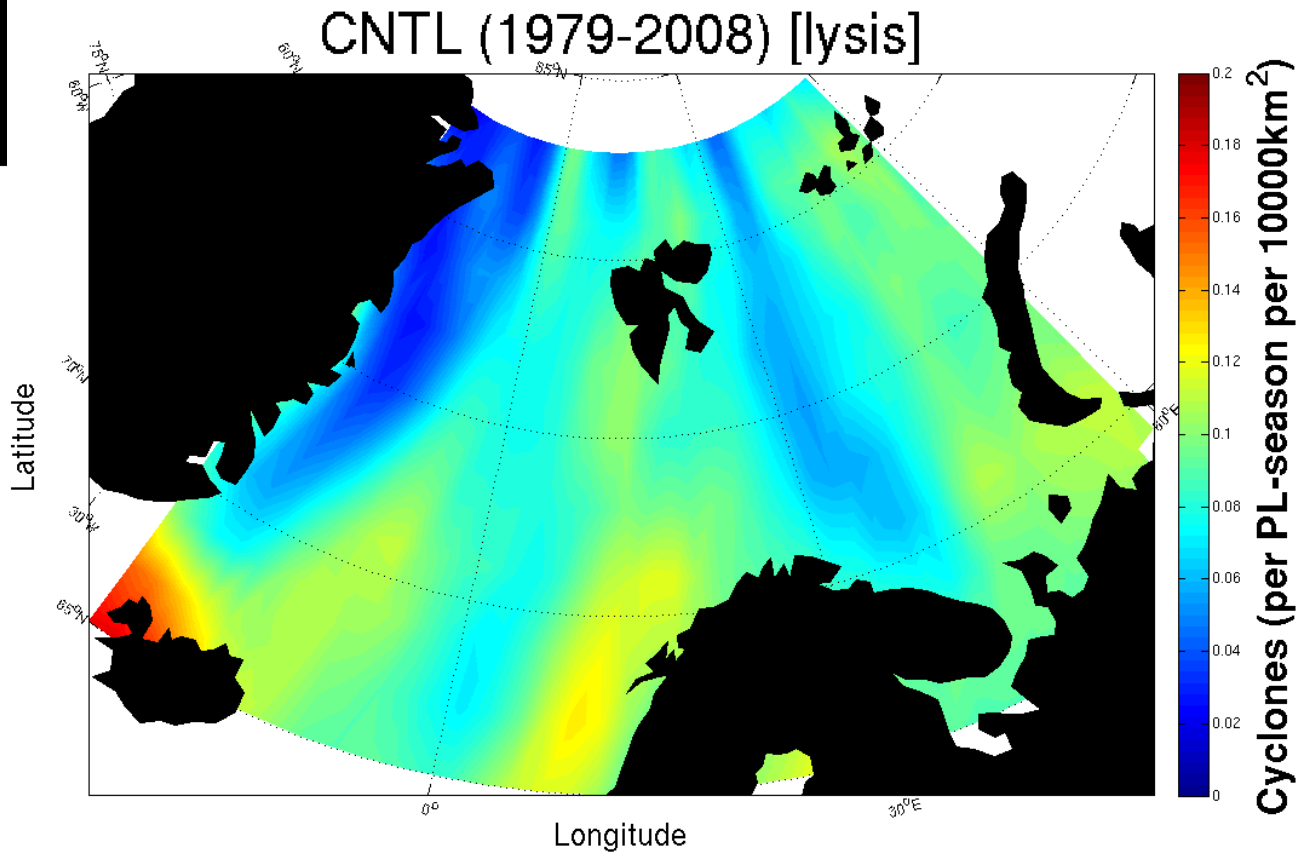




Genesis density

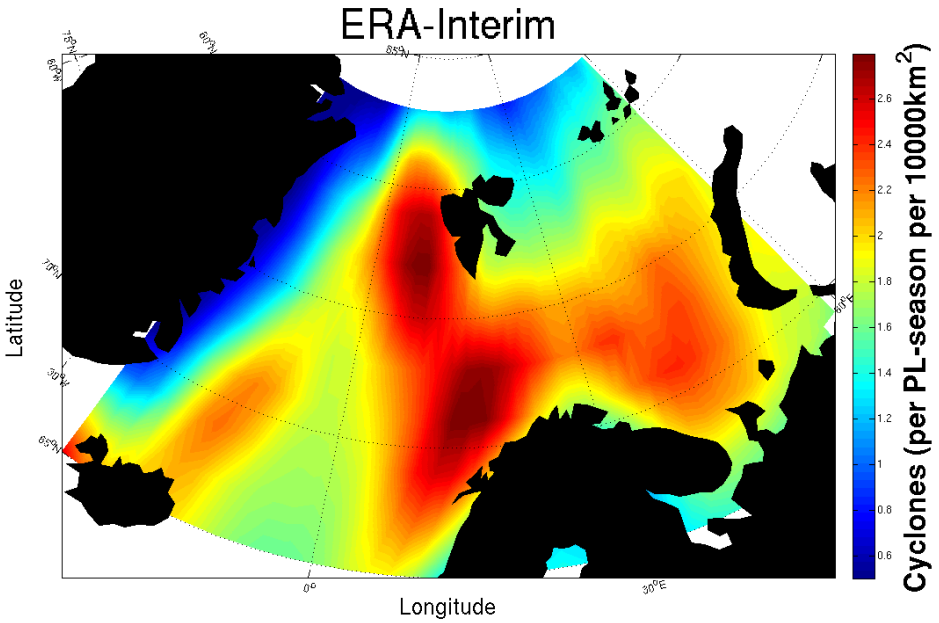
Present

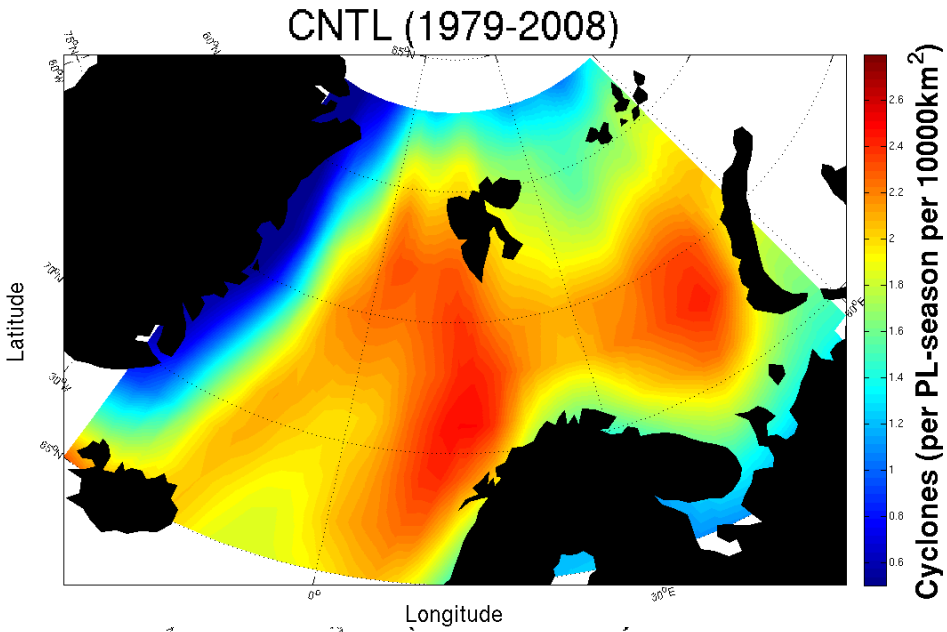


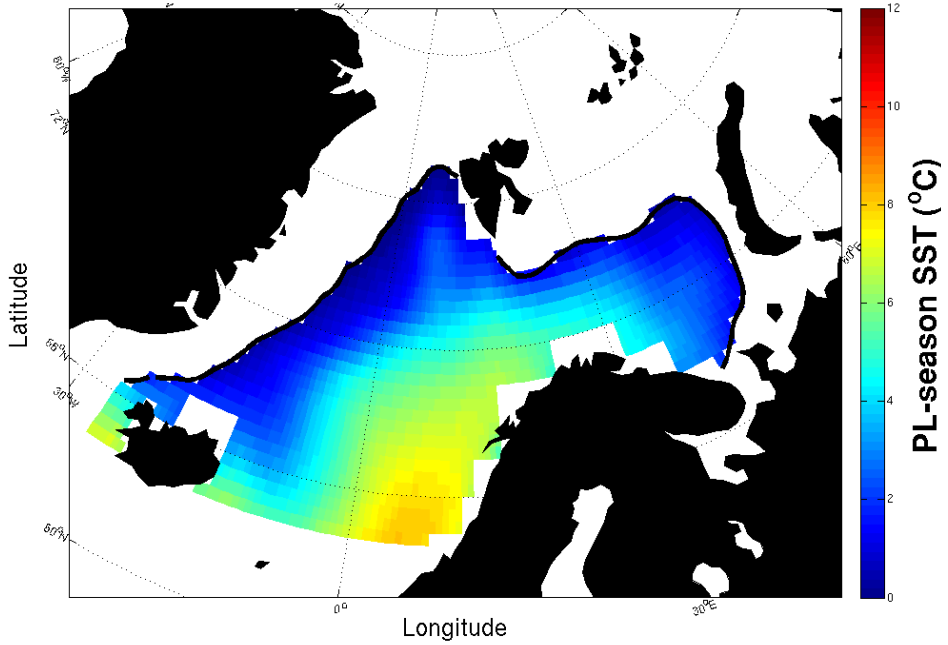


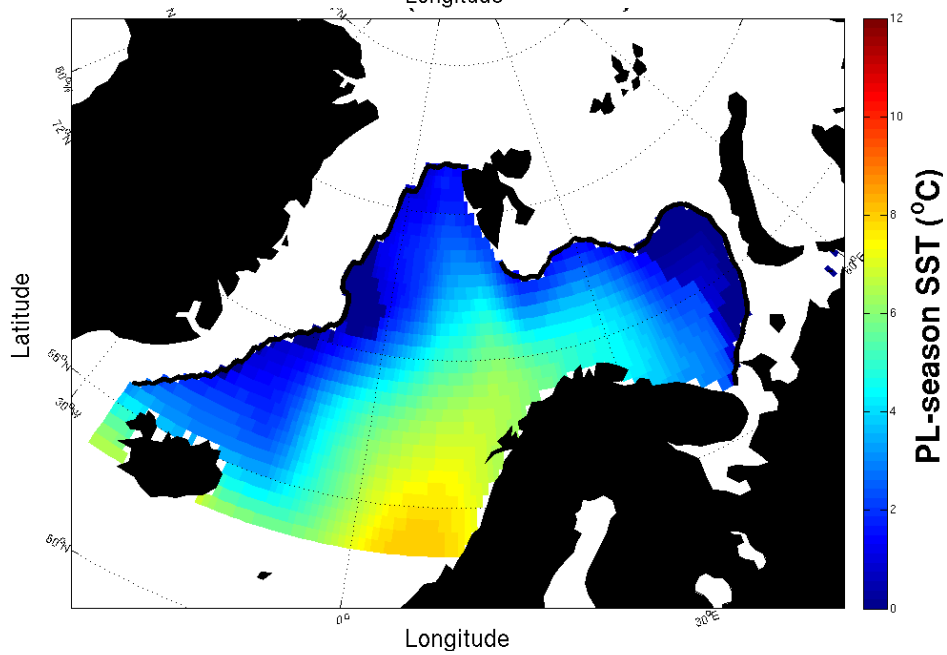
Lysis density

Present: Cyclones, SST&Sea Ice









Future?

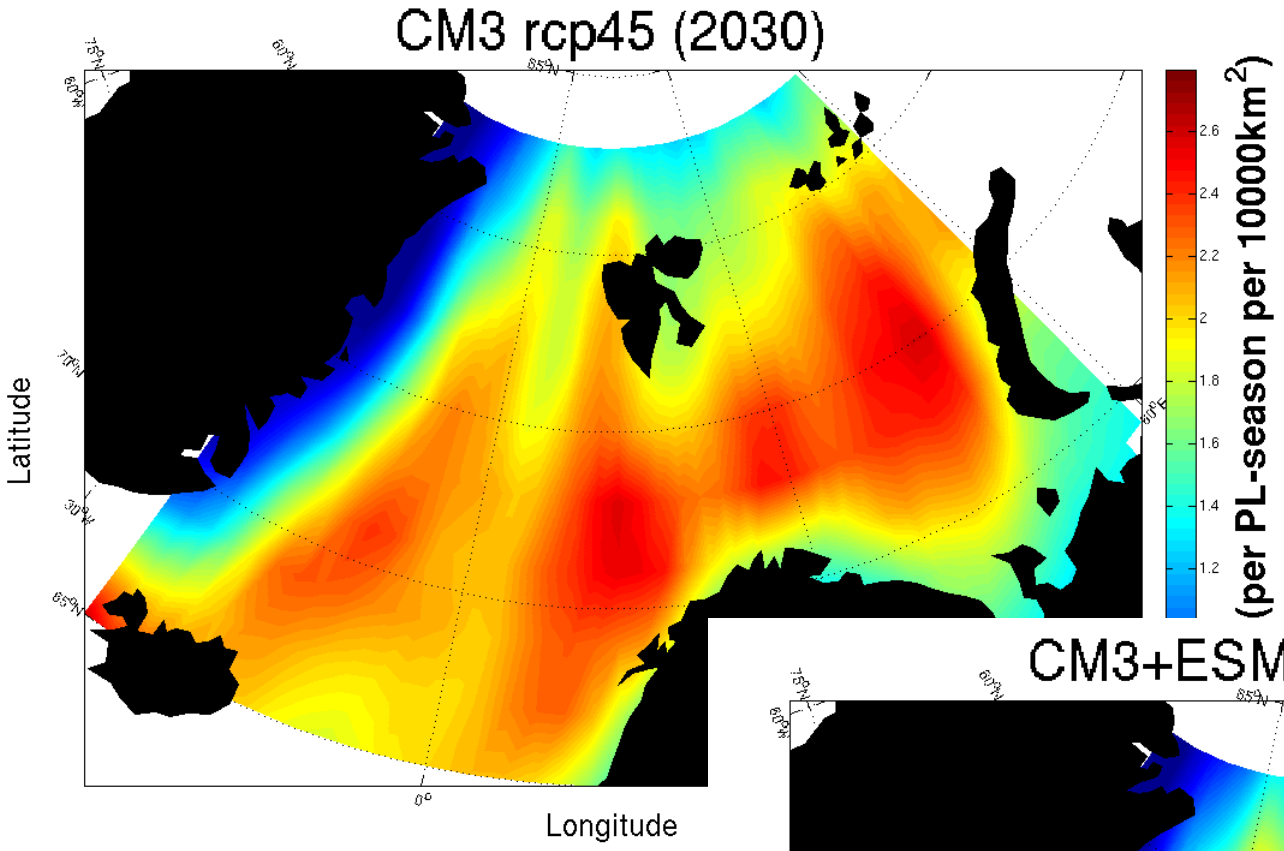
- So far only limited amount of runs available

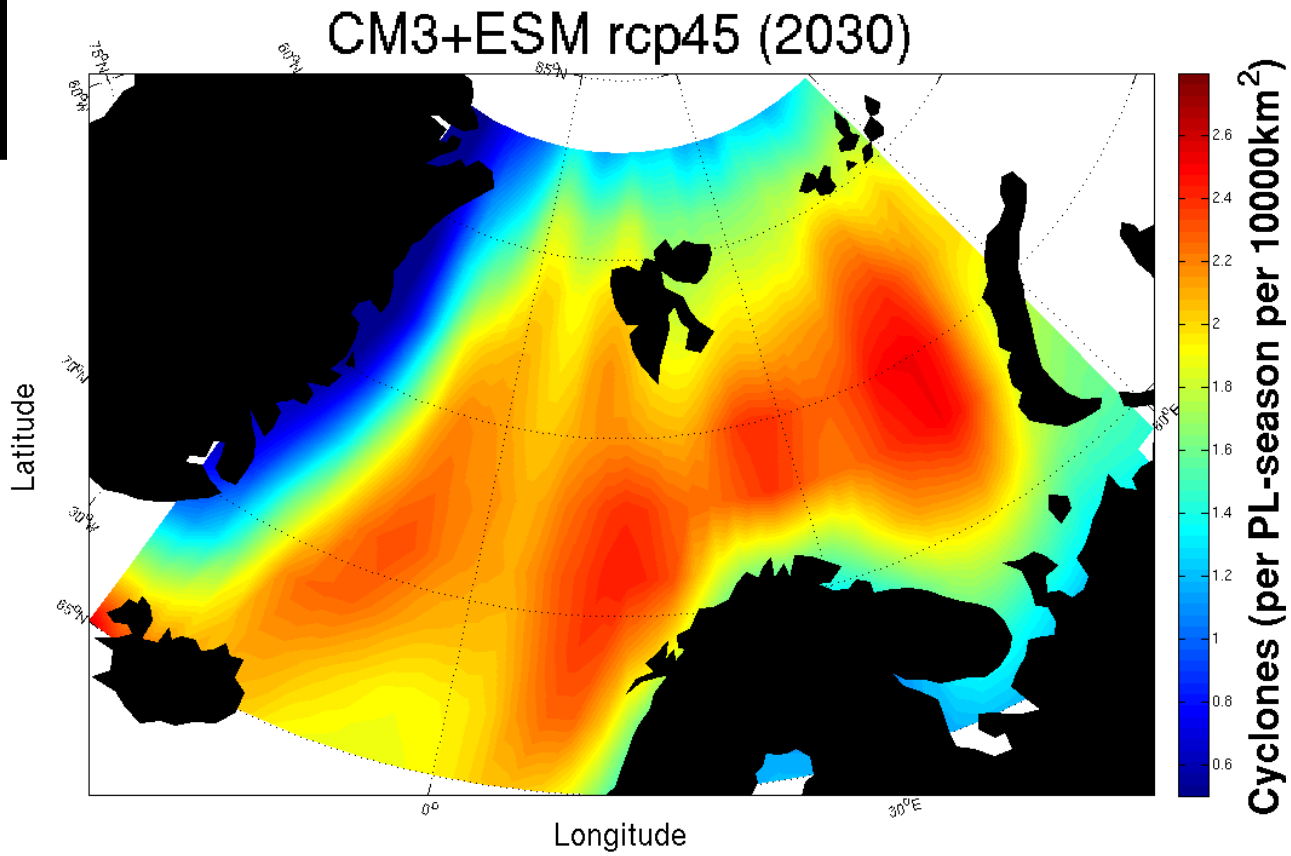
- rcp45 for 2026-2035 (recurrent annual cycle)
- rcp85 for 2086-2095 (recurrent annual cycle)

- Two climate realizations by CM3 or ESM2M
- Three high-res member ensembles for each

- Total of 6 runs for each period

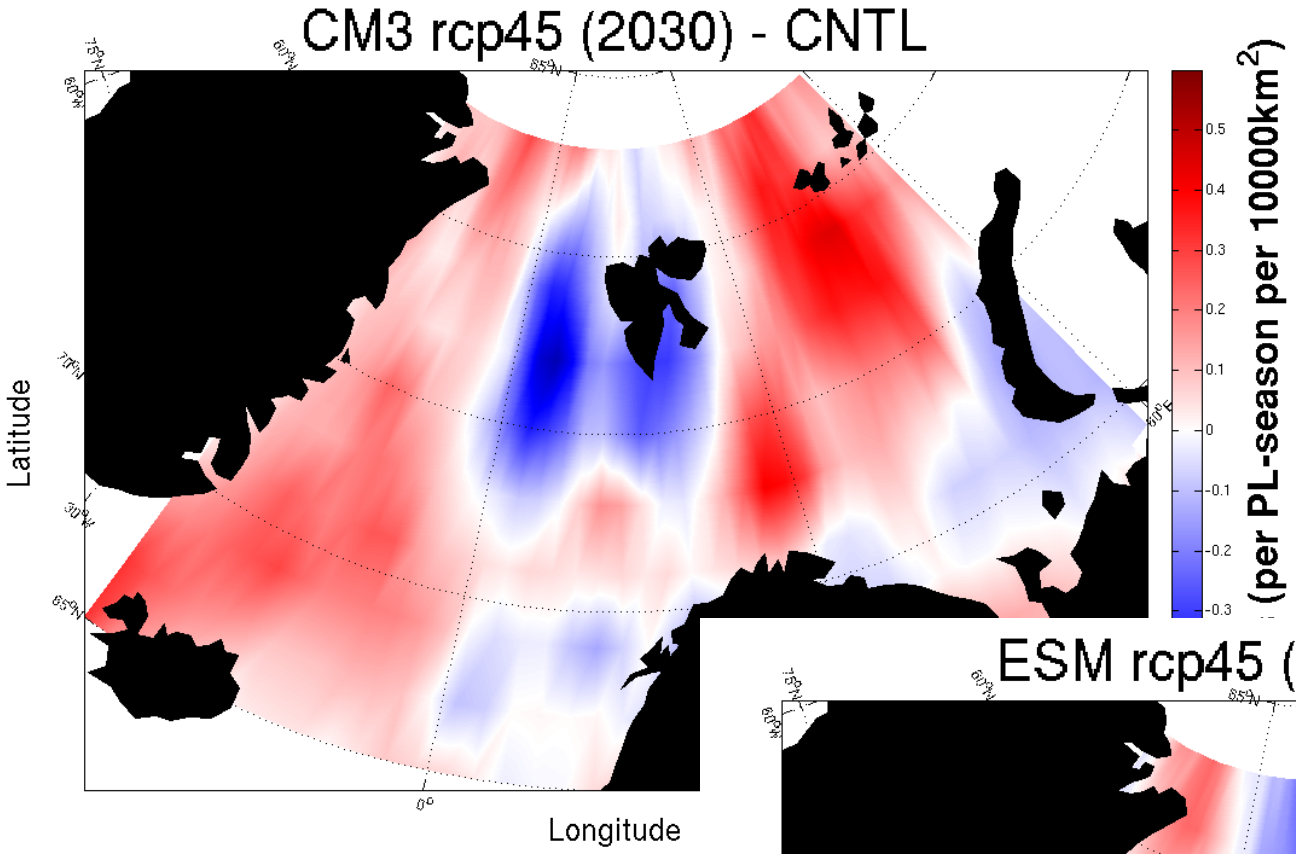
Future 2030

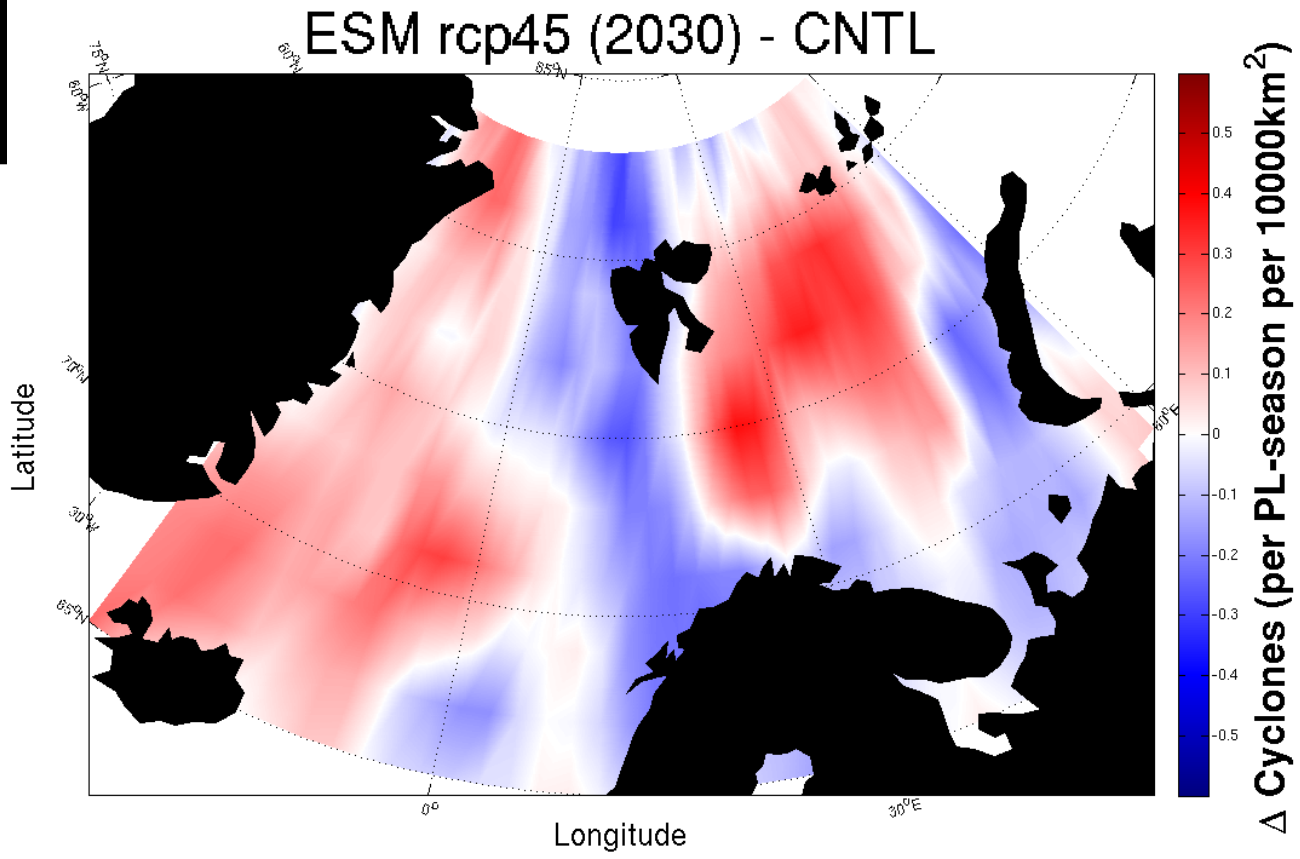




Cyclone density

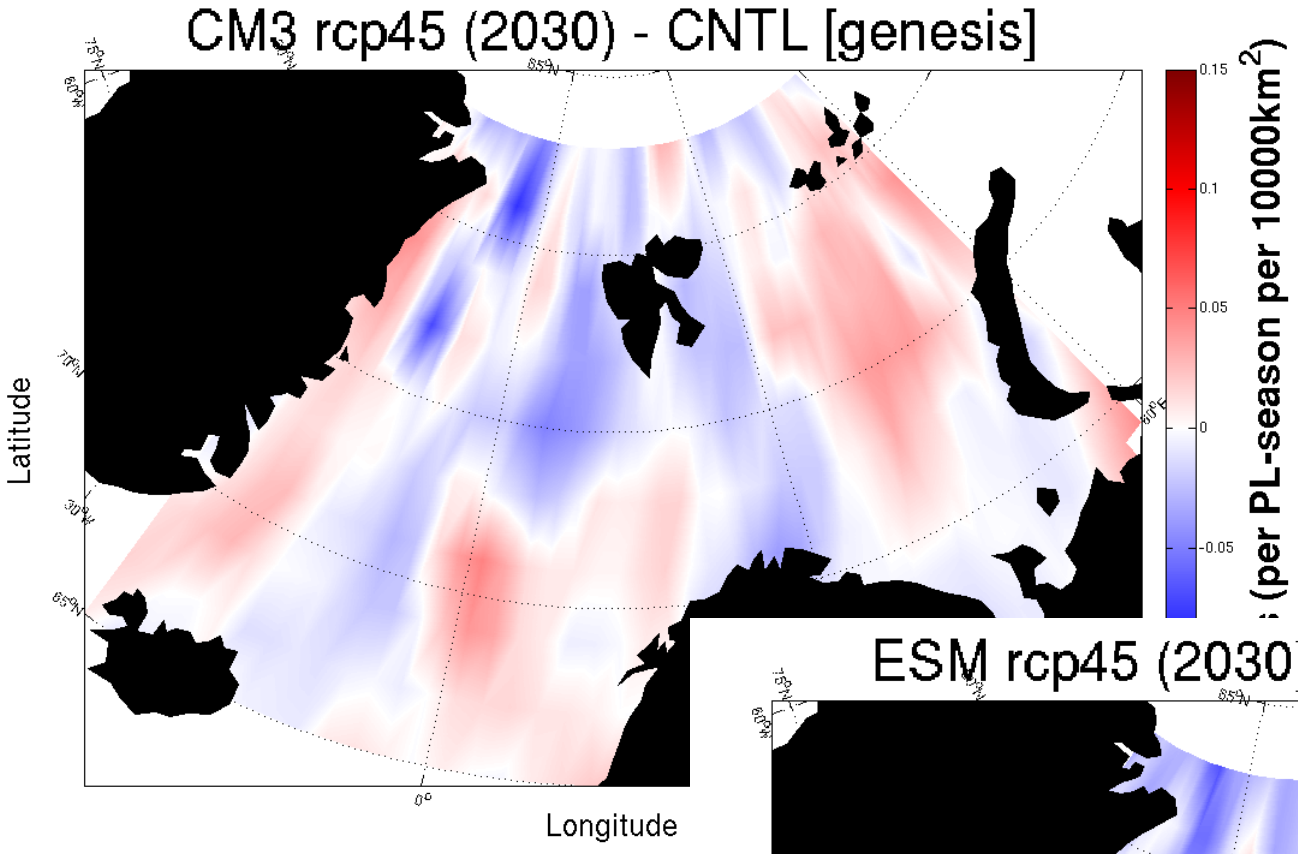
Future 2030

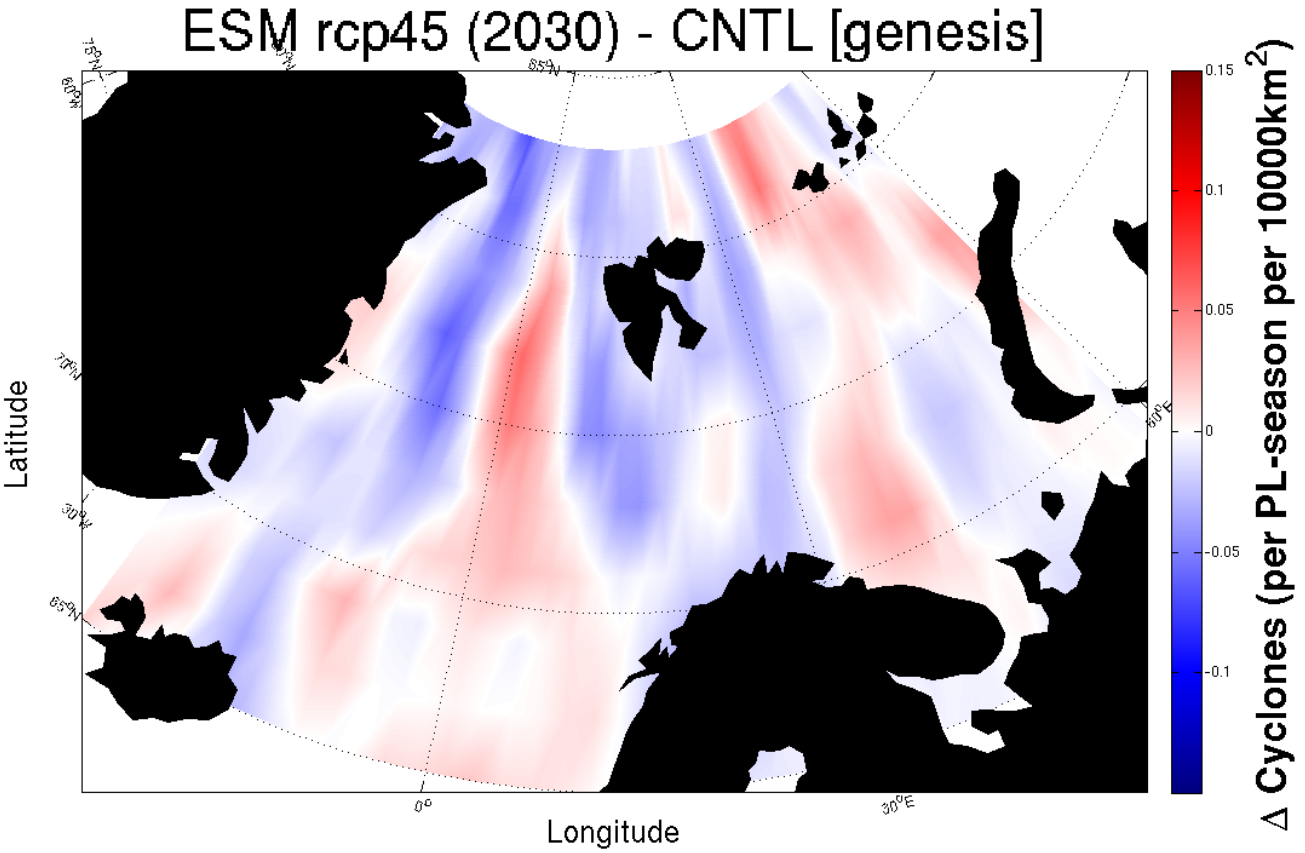




Cyclone density difference to CNTL

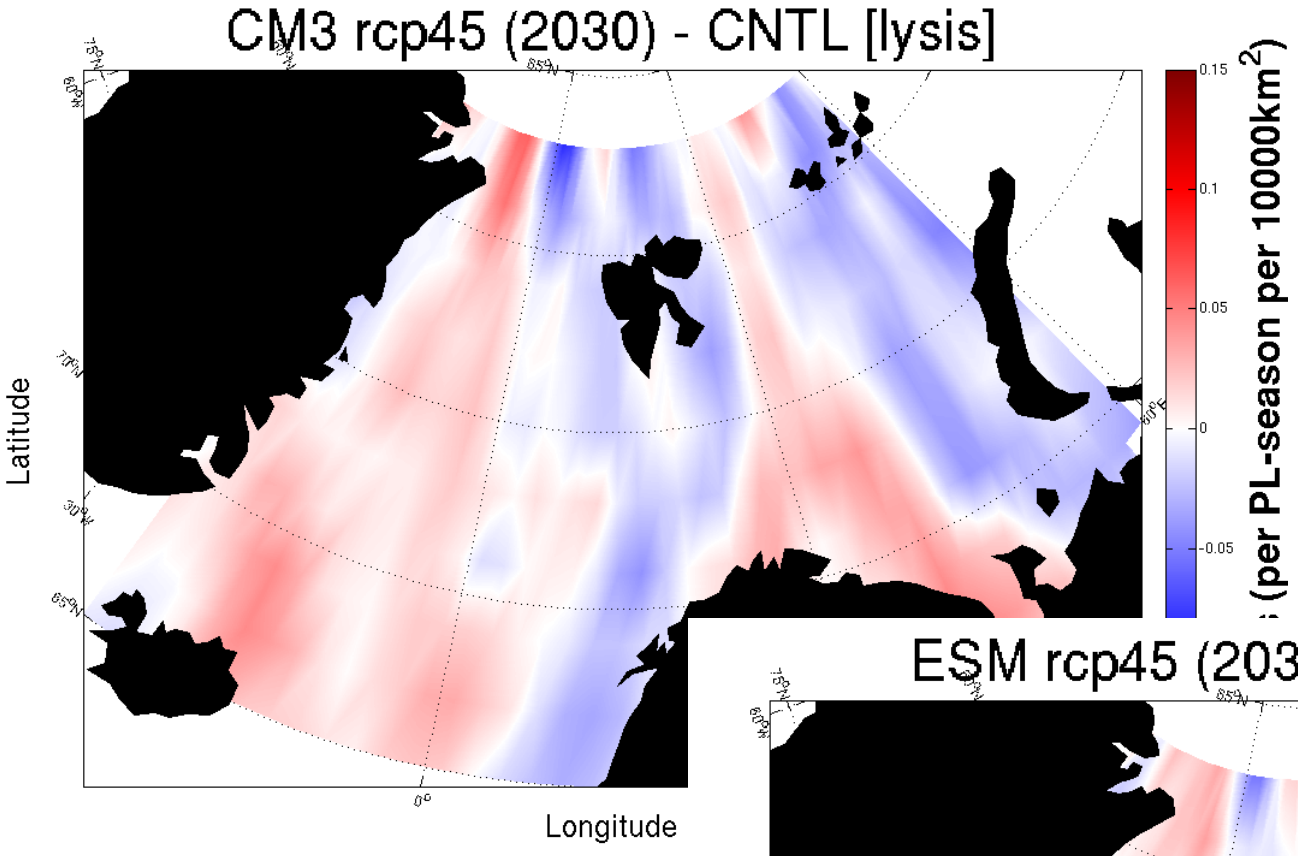
Future 2030

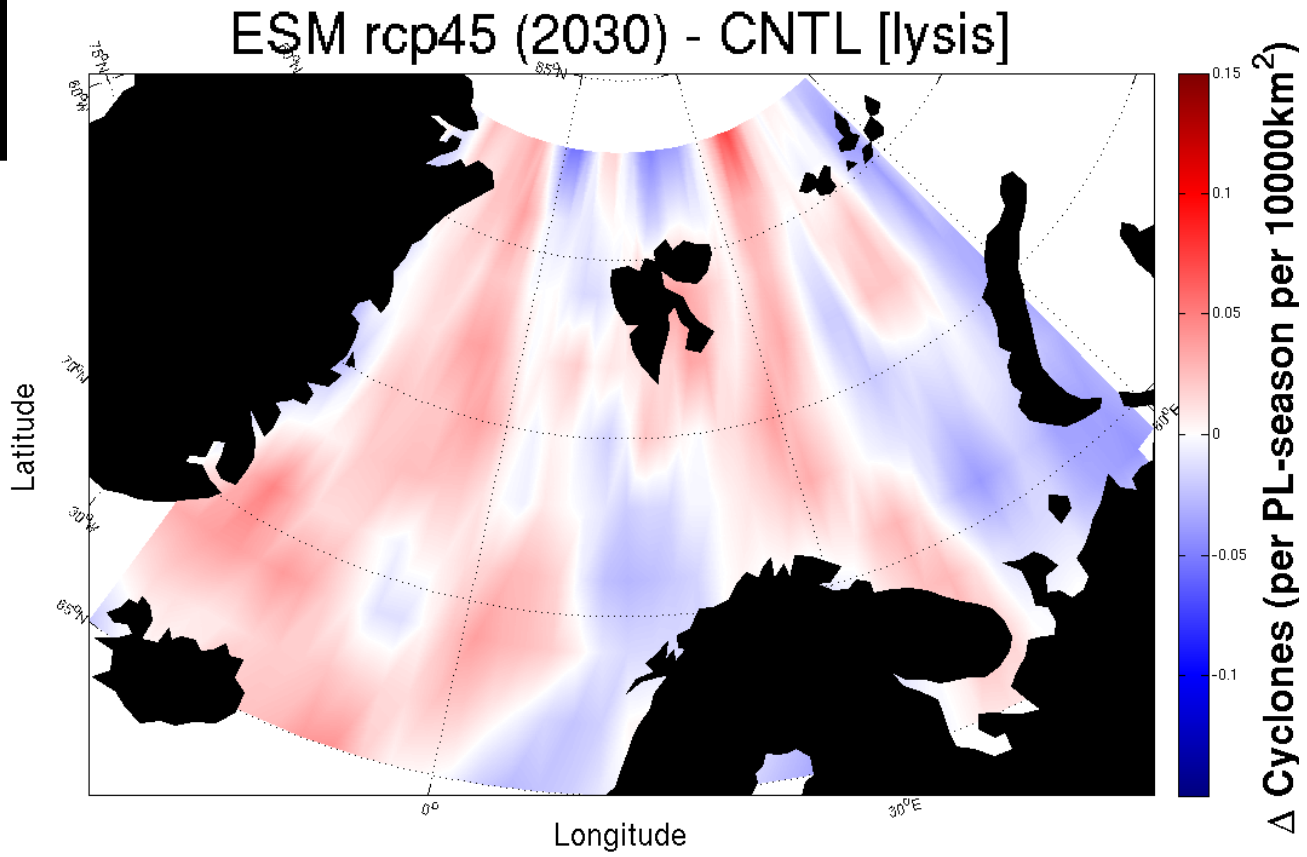




Genesis density difference to CNTL

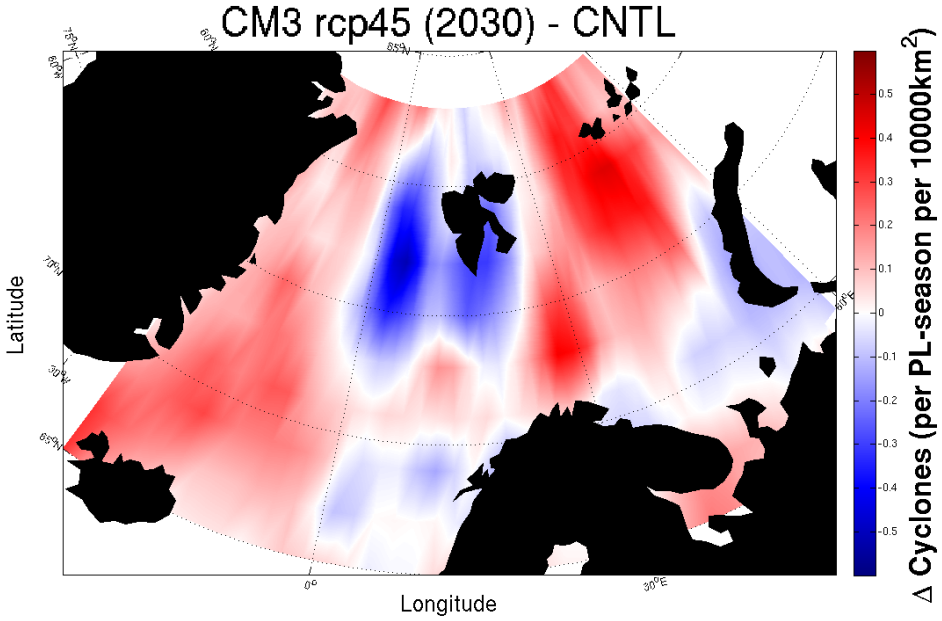
Future 2030

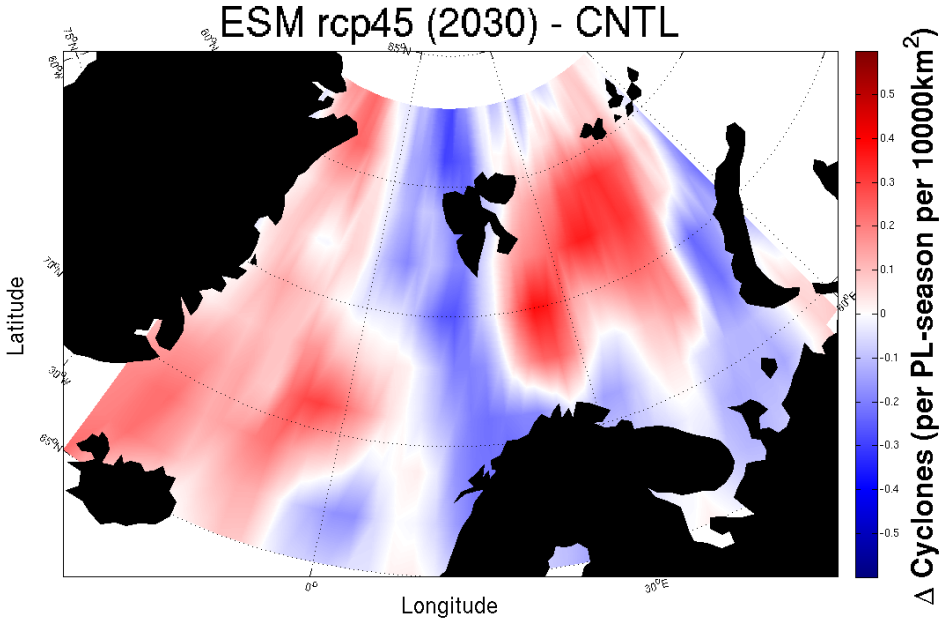


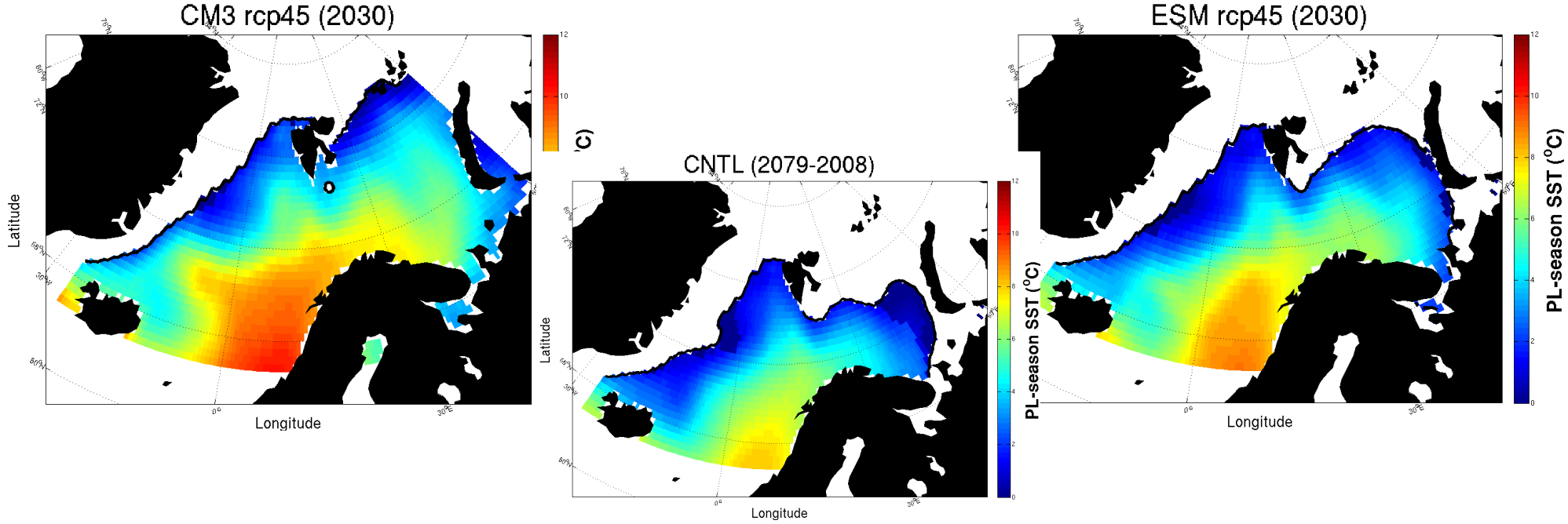


Lysis density difference to CNTL

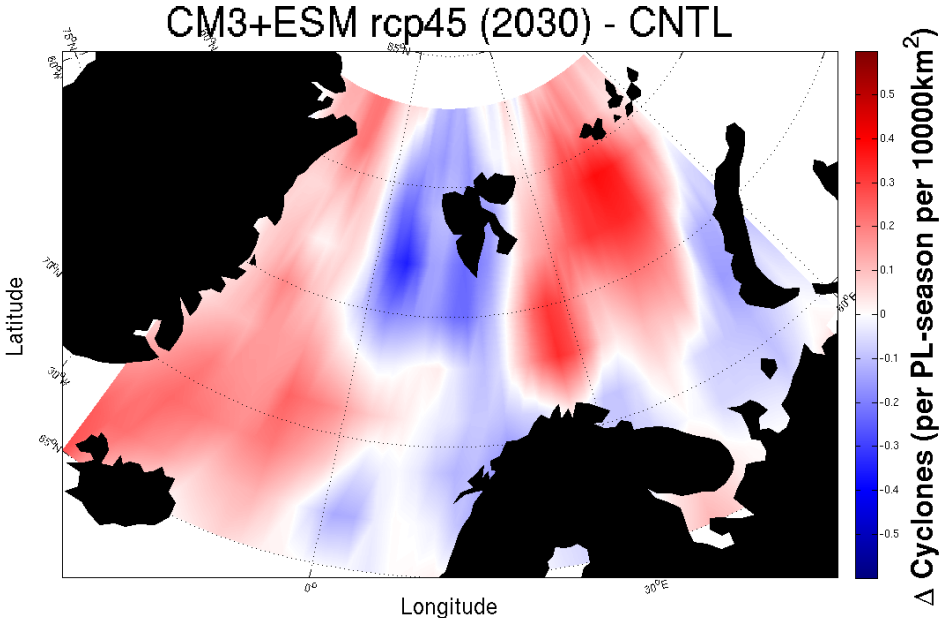
Future 2030: Cyclones, SST&Sea Ice

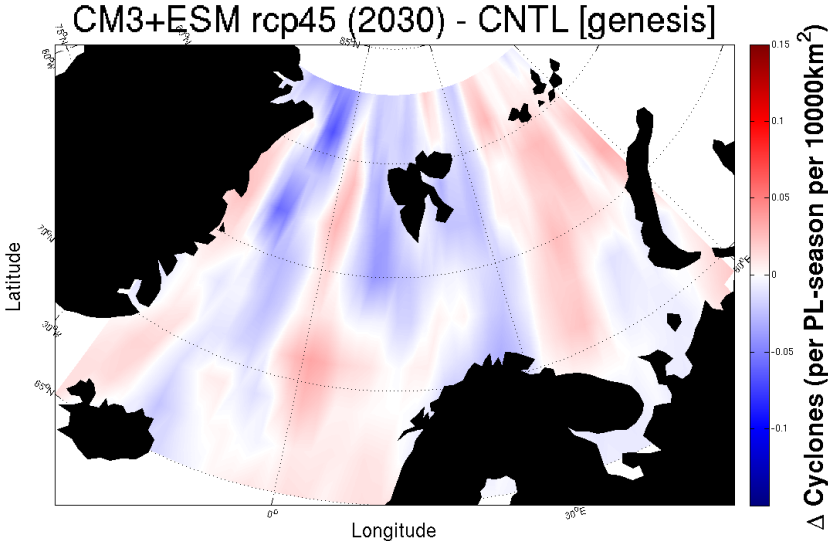


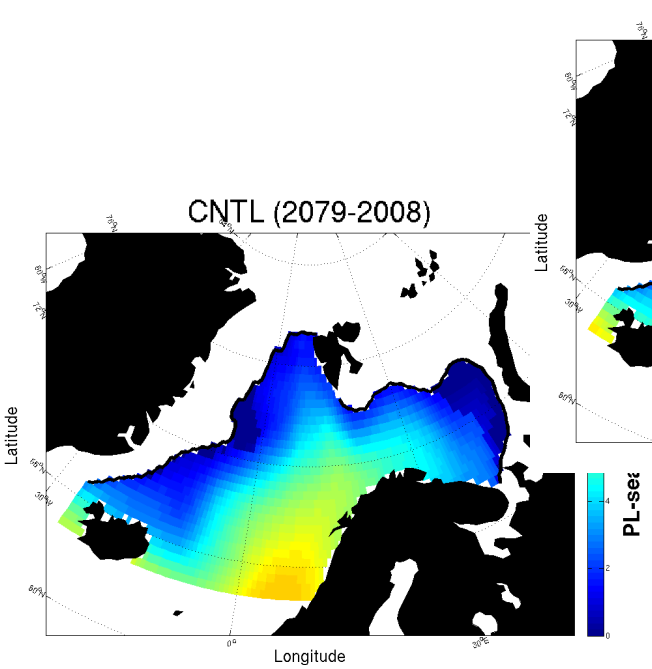


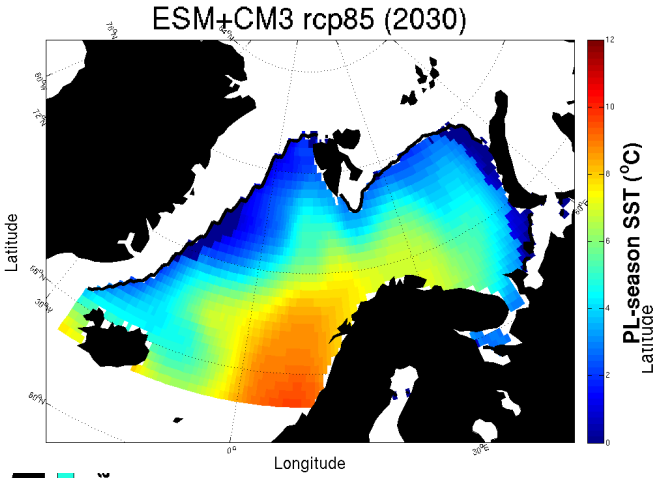


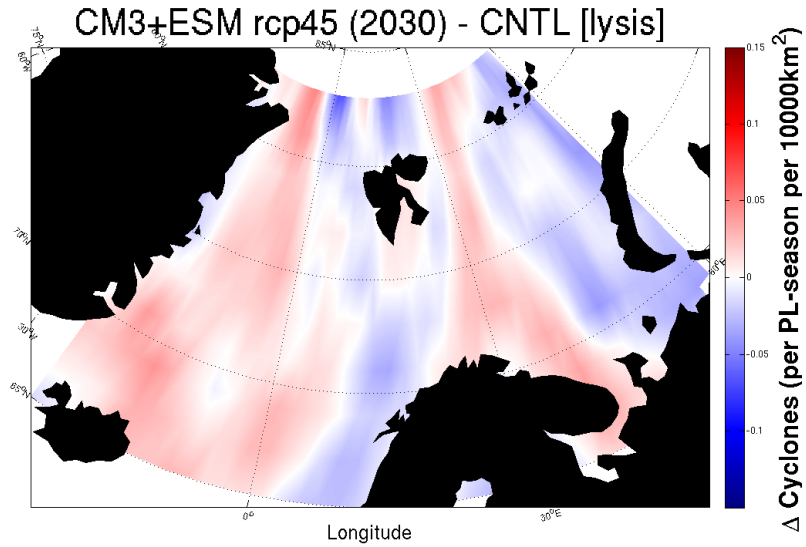
Future 2030 (large ensemble): Cyclone density, SST&Sea Ice



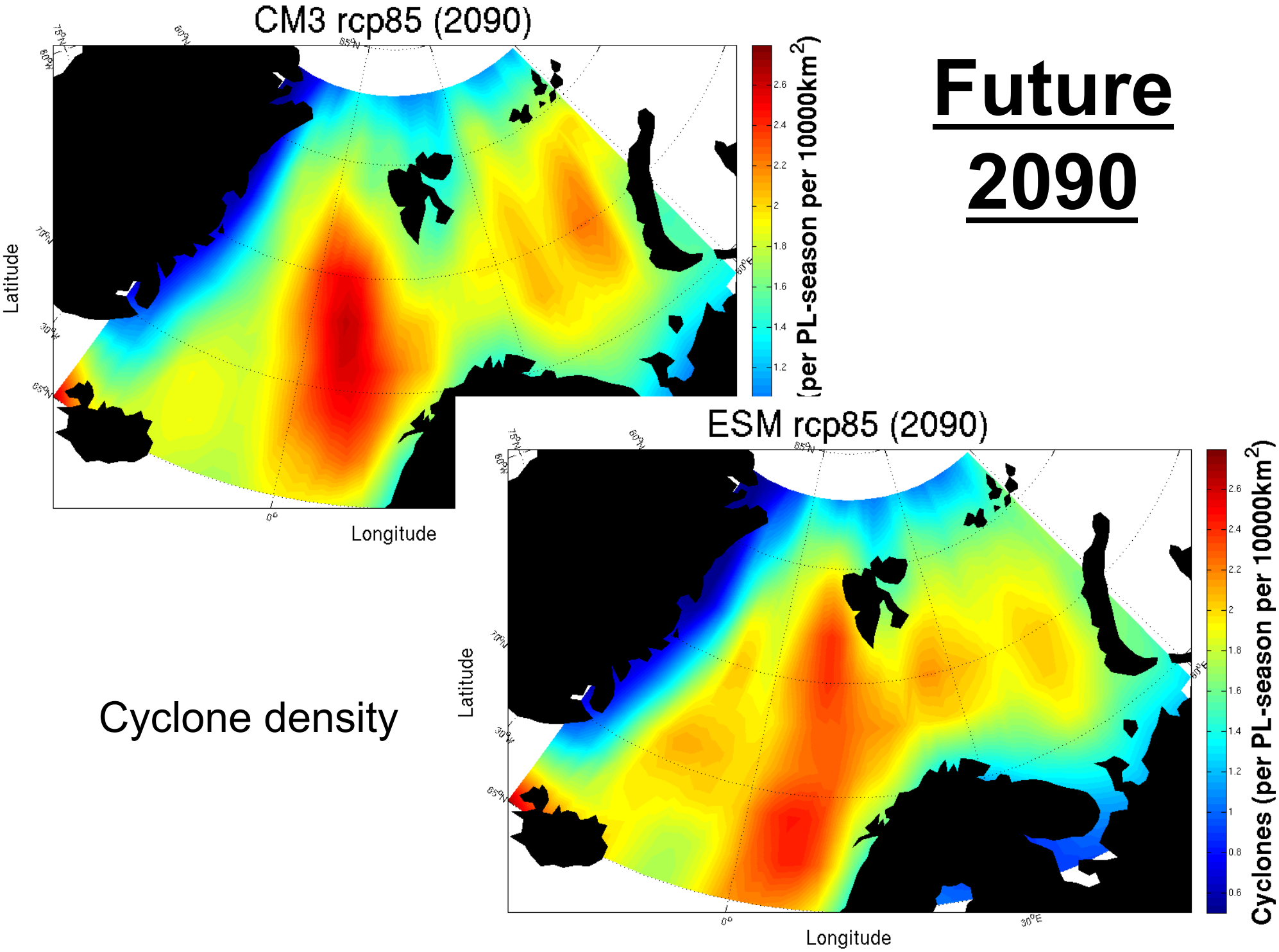






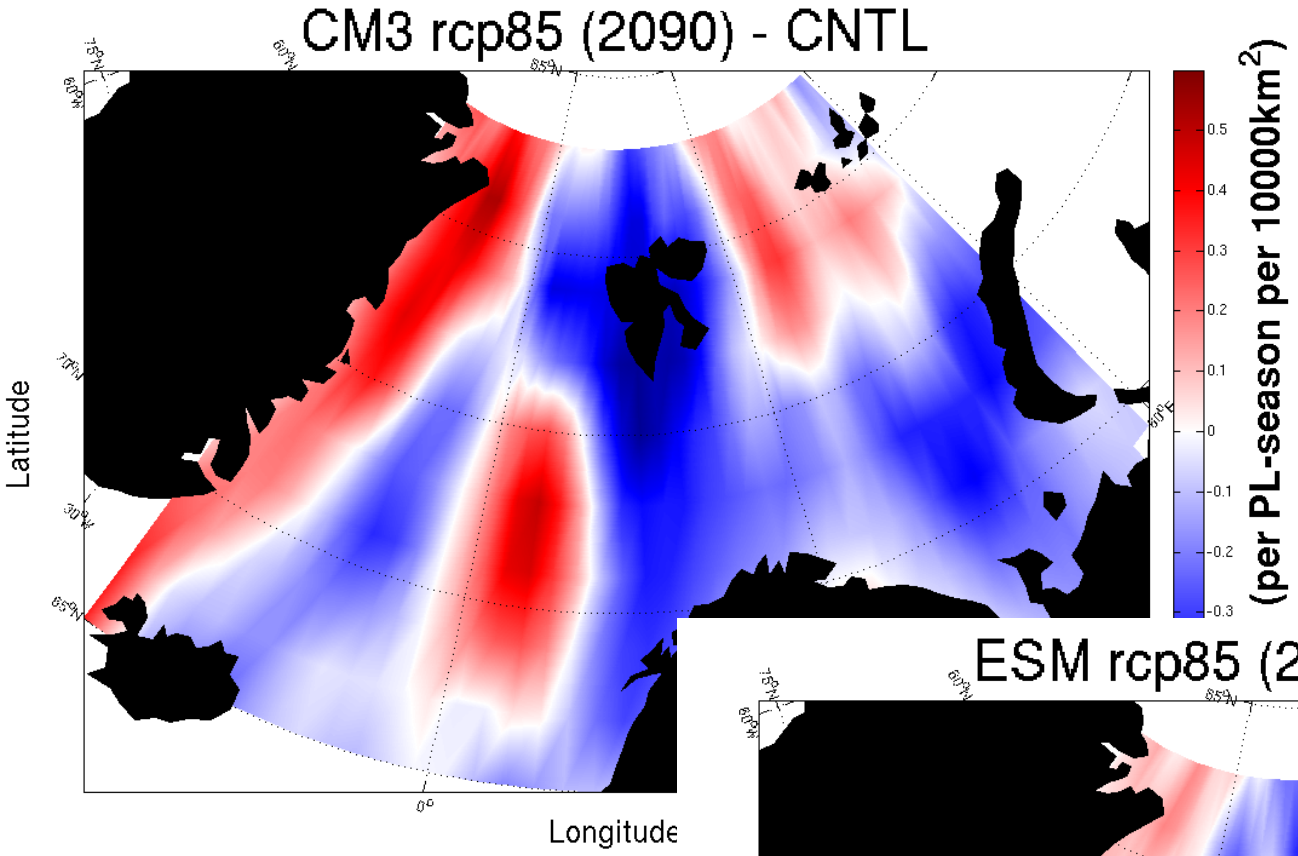


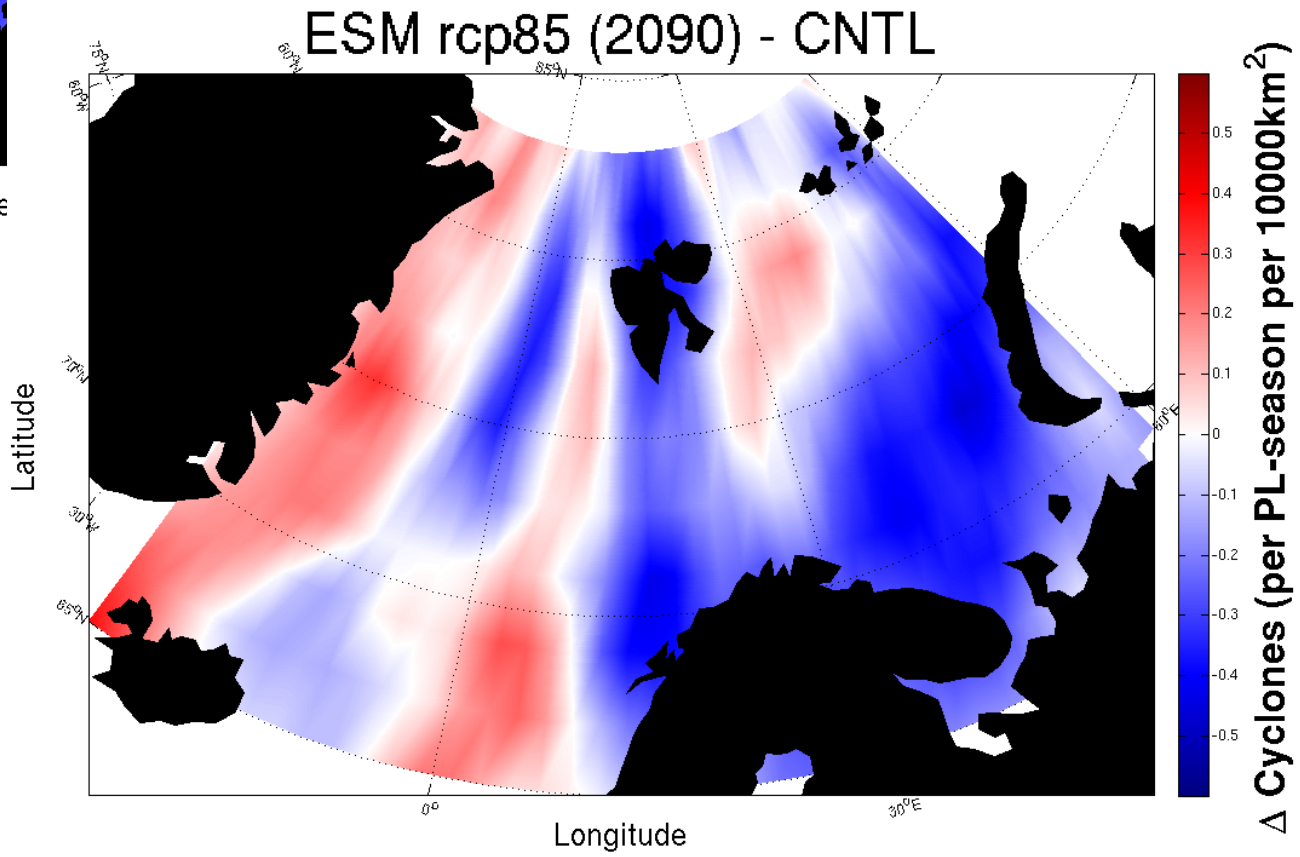
Future 2090



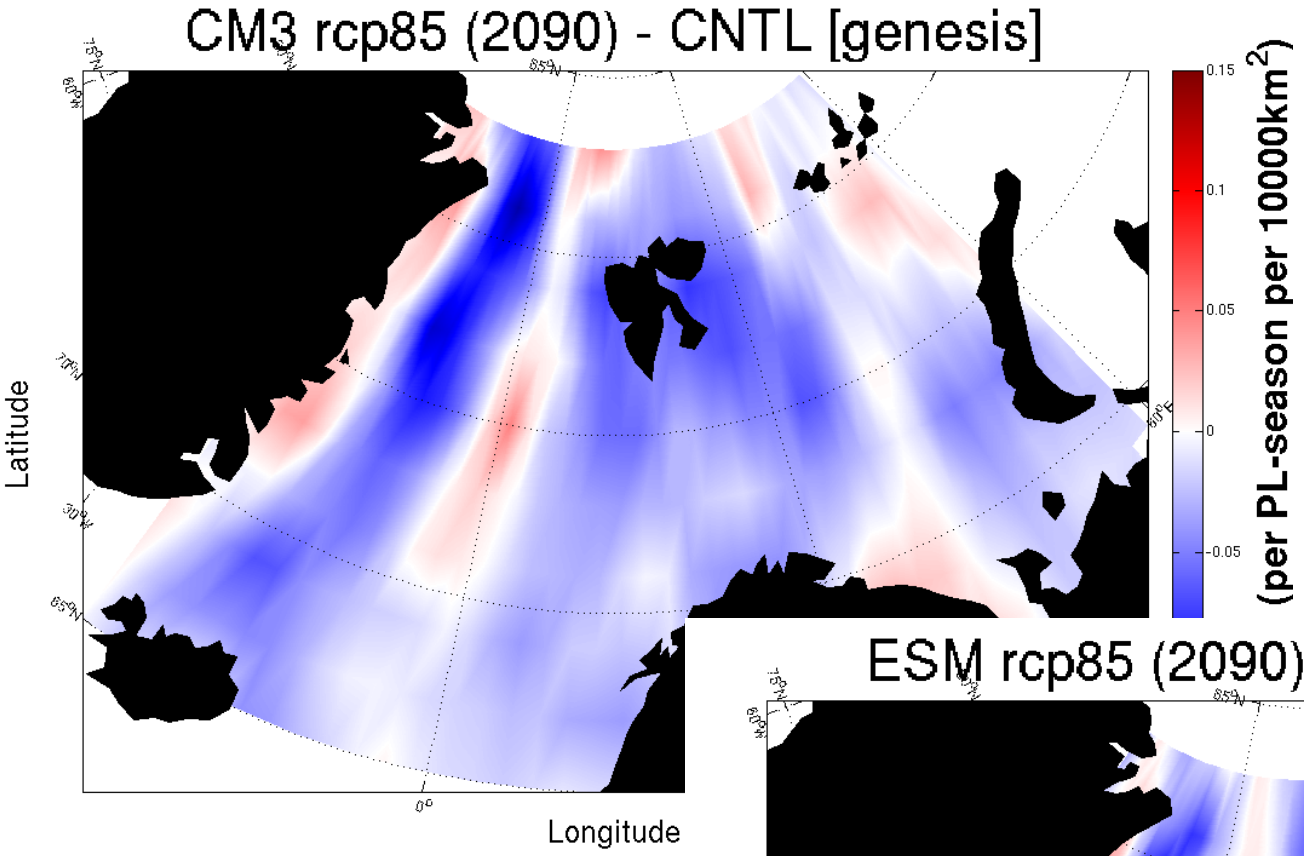
Cyclone density

Future 2090

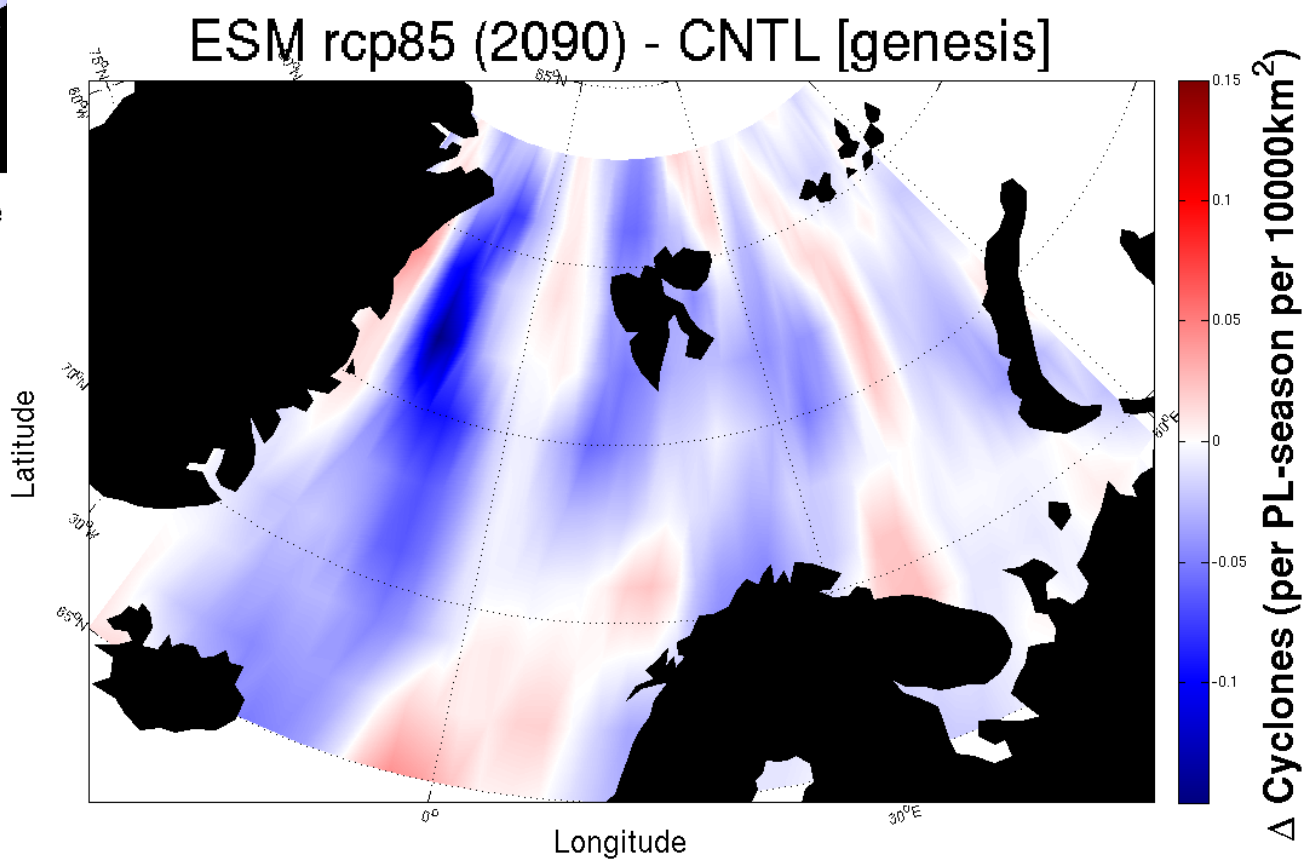




Cyclone density difference to CNTL

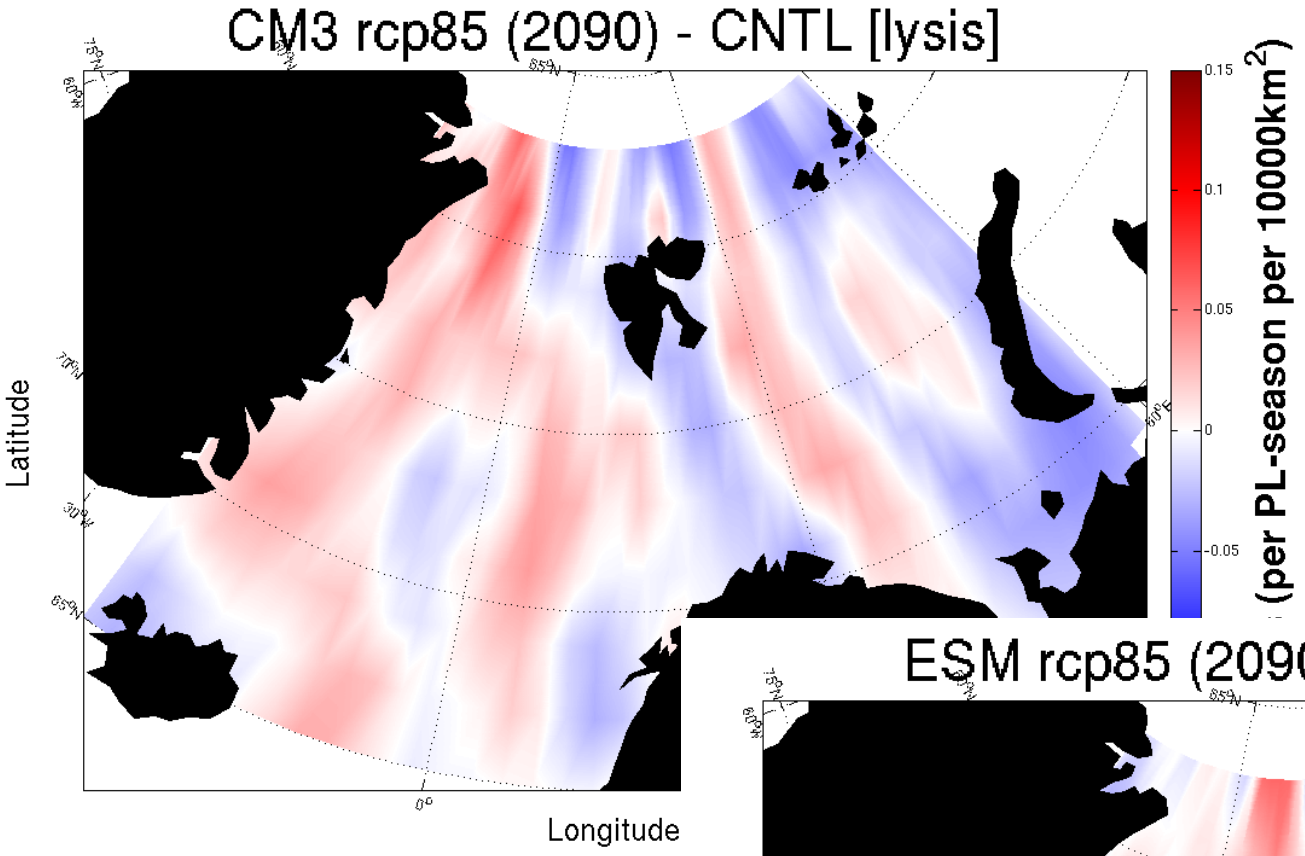


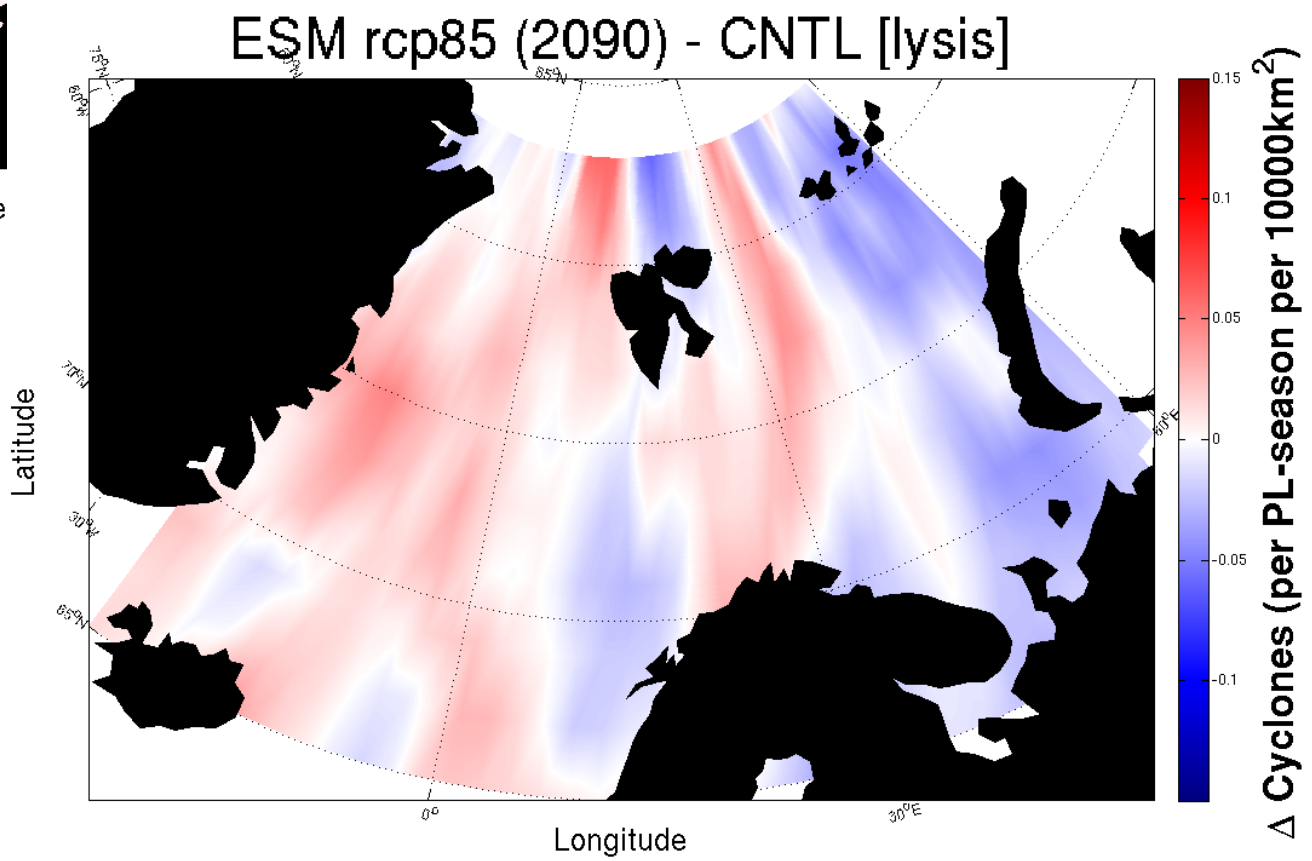
Future 2090



Genesis density difference to CNTL

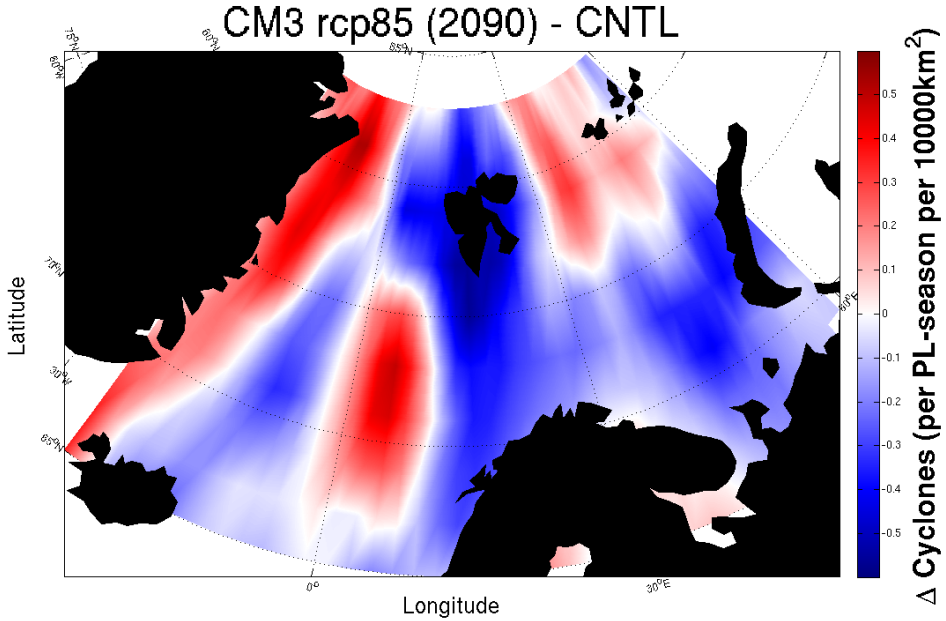
Future 2090

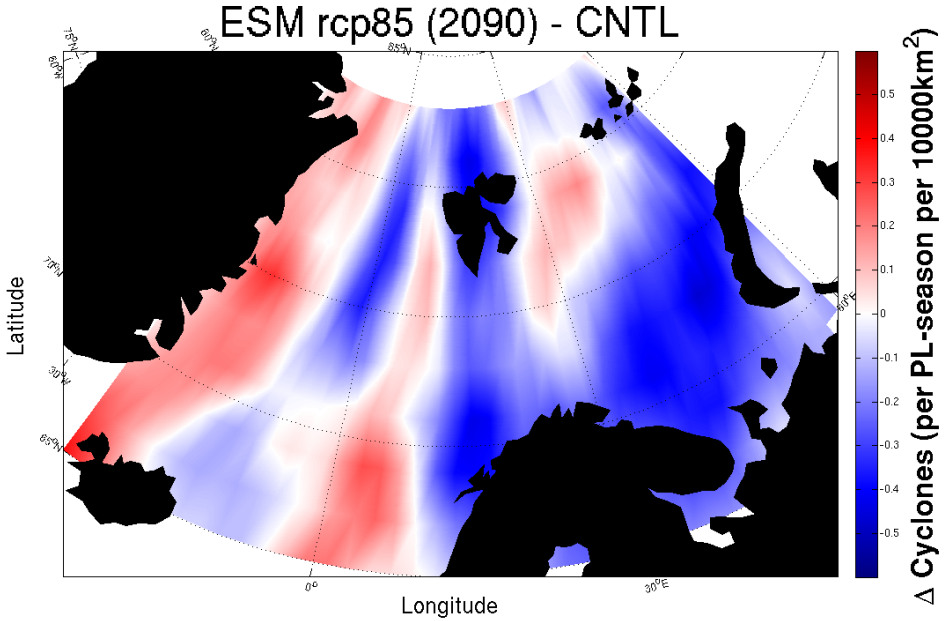


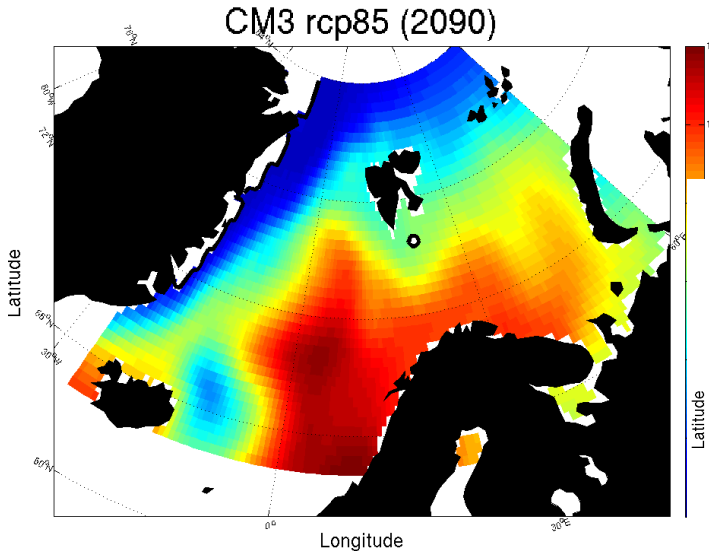


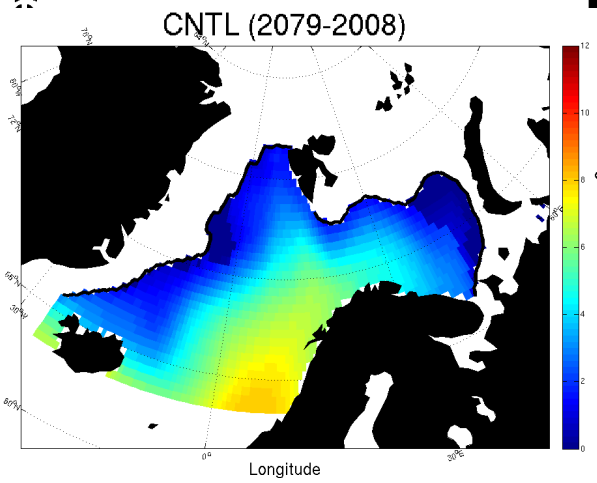
Lysis density difference to CNTL

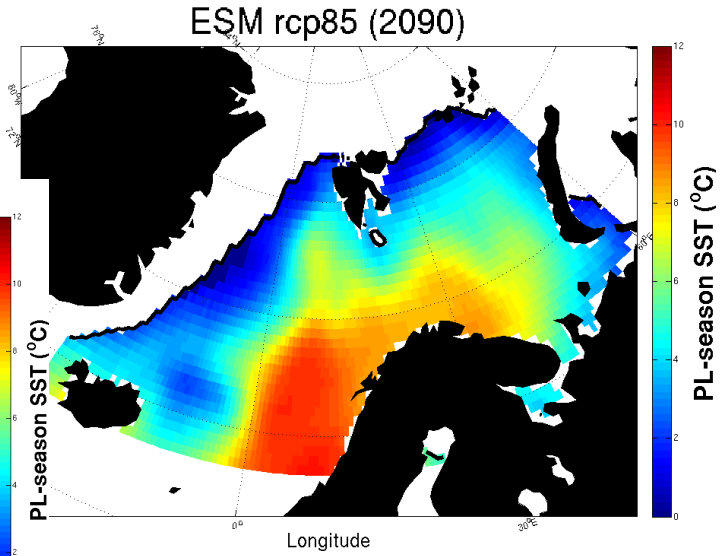
Future 2090: Cyclones, SST&Sea Ice



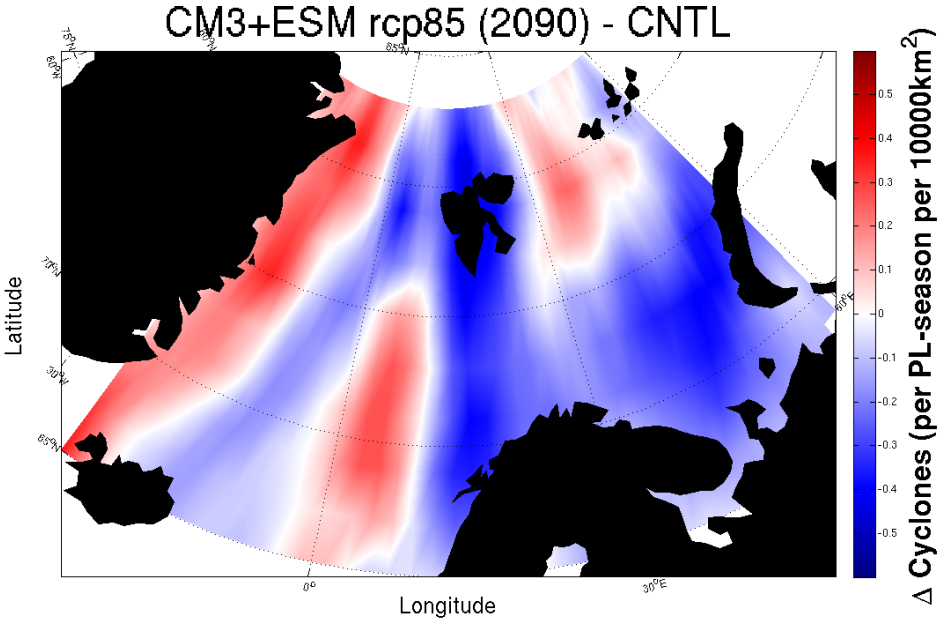


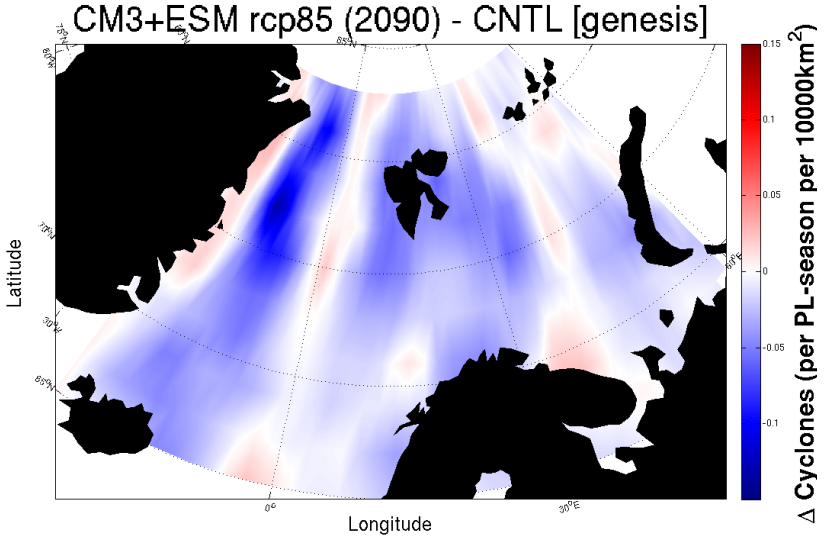


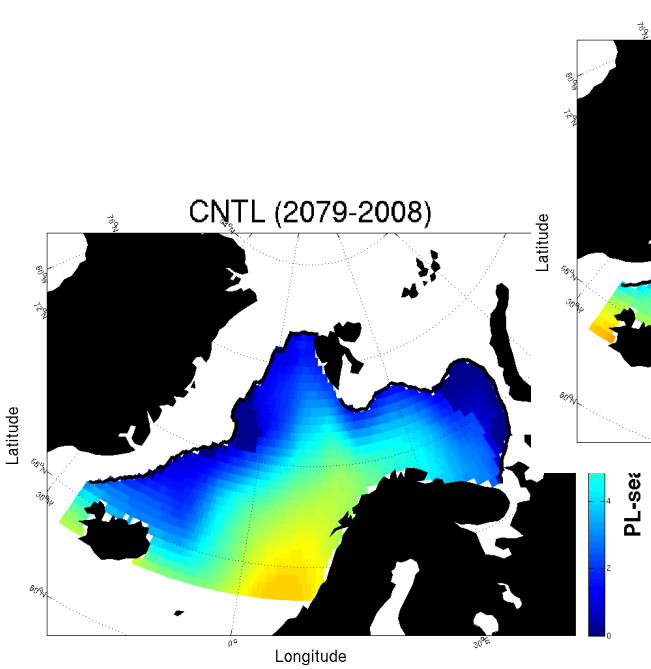


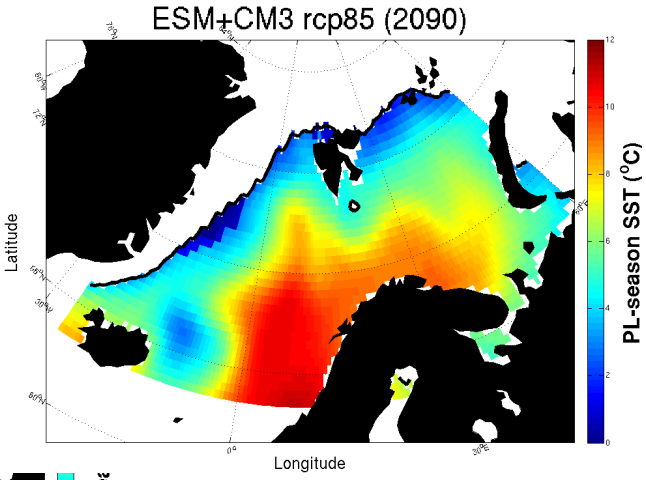


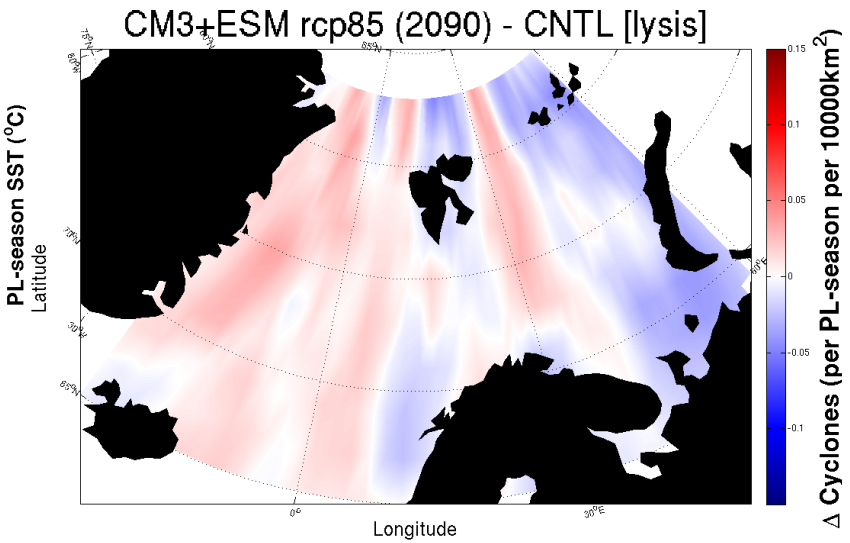
Future 2090 (large ensemble): Cyclone density, SST&Sea Ice



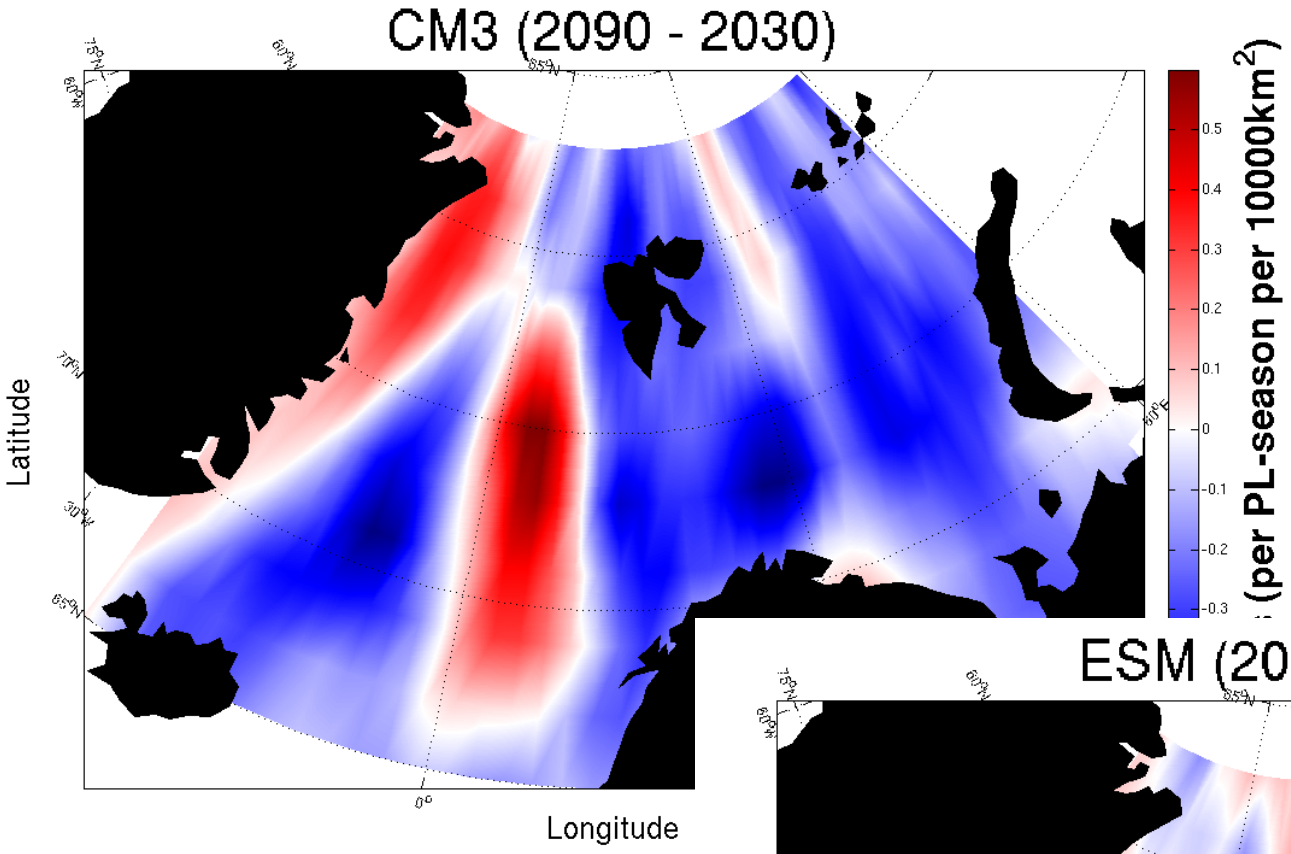


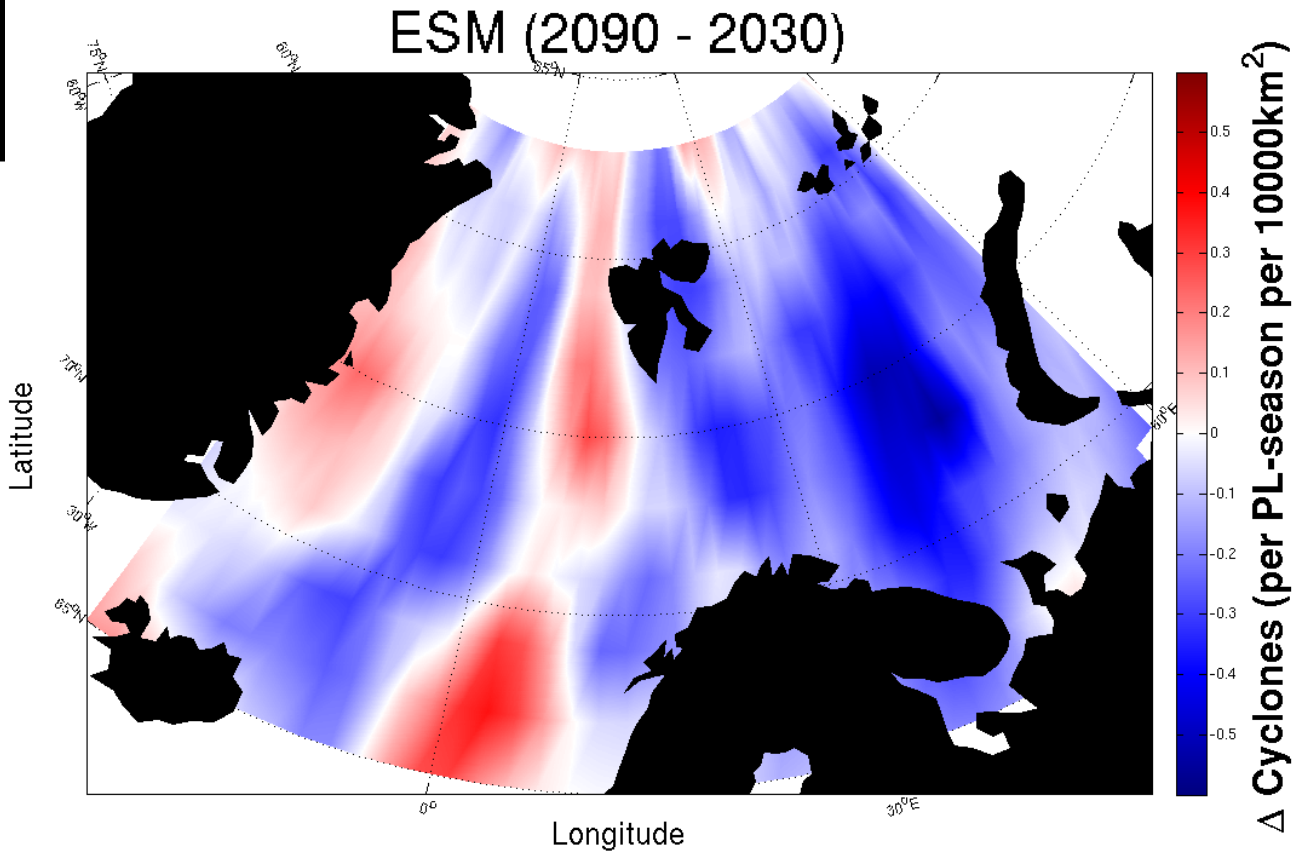




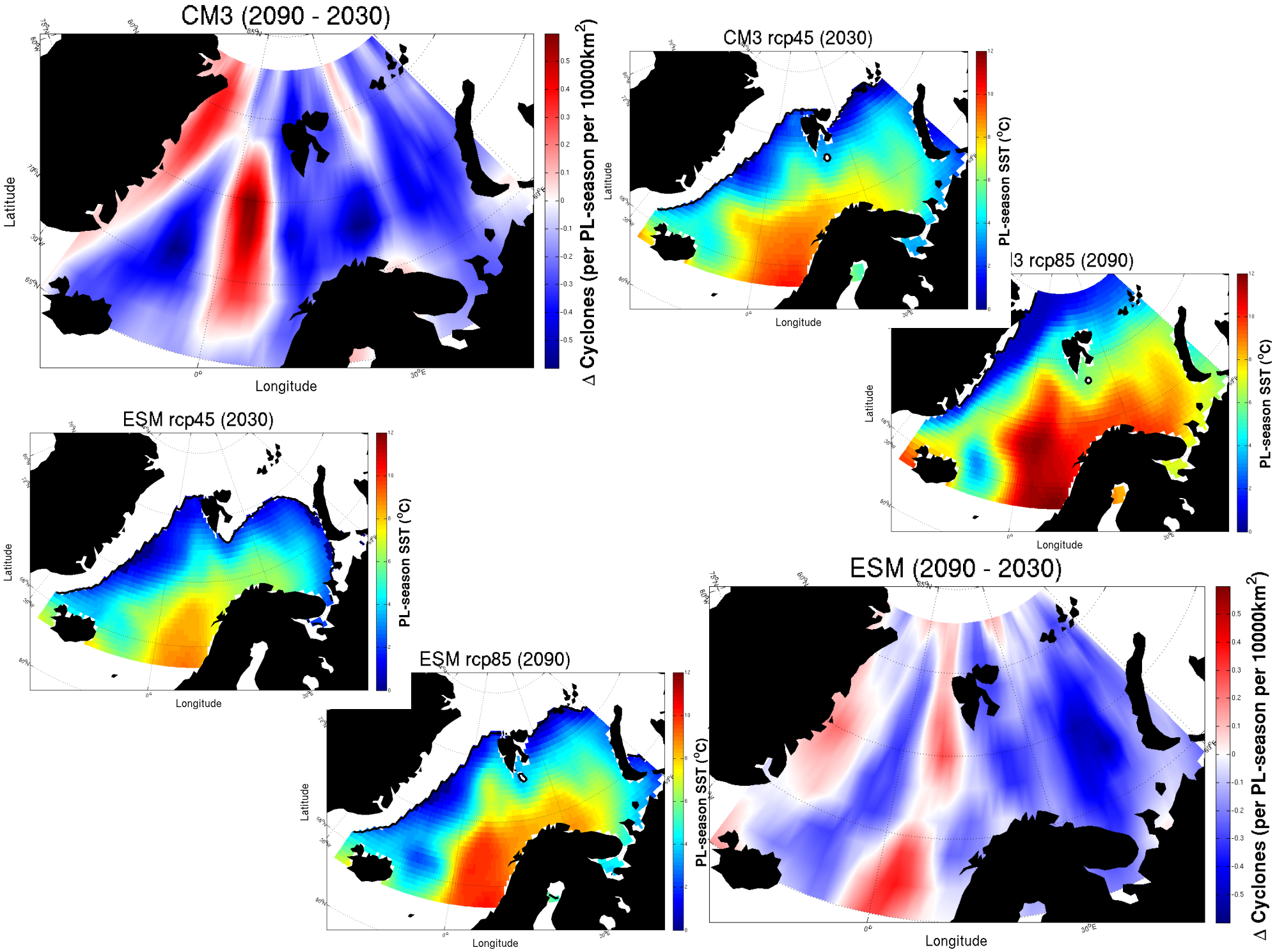


Future
2090-2030





Cyclone density
Difference
2090-2030


CM3 (2090 - 2030)
Latitude
Longitude
Δ Cyclones (per PL-season per 10000km^2)
CM3 rcp45 (2030)
PL-season SST (^{o}C)
3 rcp85 (2090)
ESM rcp45 (2030)
ESM rcp85 (2090)
ESM (2090 - 2030)

Summary

- Pattern of change non-trivial

- Areas with significant decrease AND increase in activity

- Impact of Sea-Ice?
- Impact of SST change?
- Large scale flow change?

  => impact on Polar Lows still unclear

Outlook

- Analyze more model simulations with different forcing pathways
- Sensitivities to Sea-Ice edge and SST
- Causal explanations of patterns of changes
- … Grapple with statistical issues …