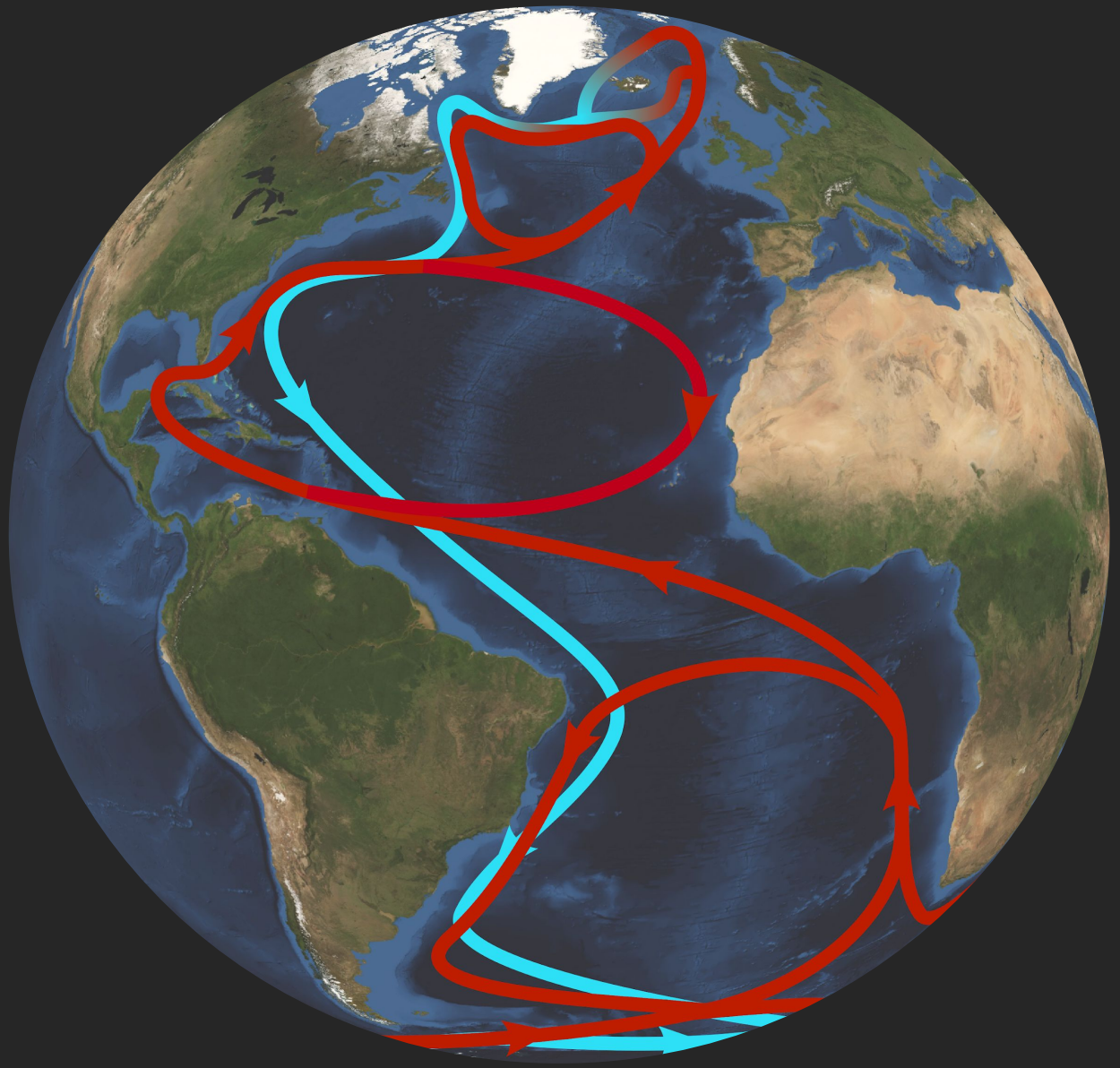
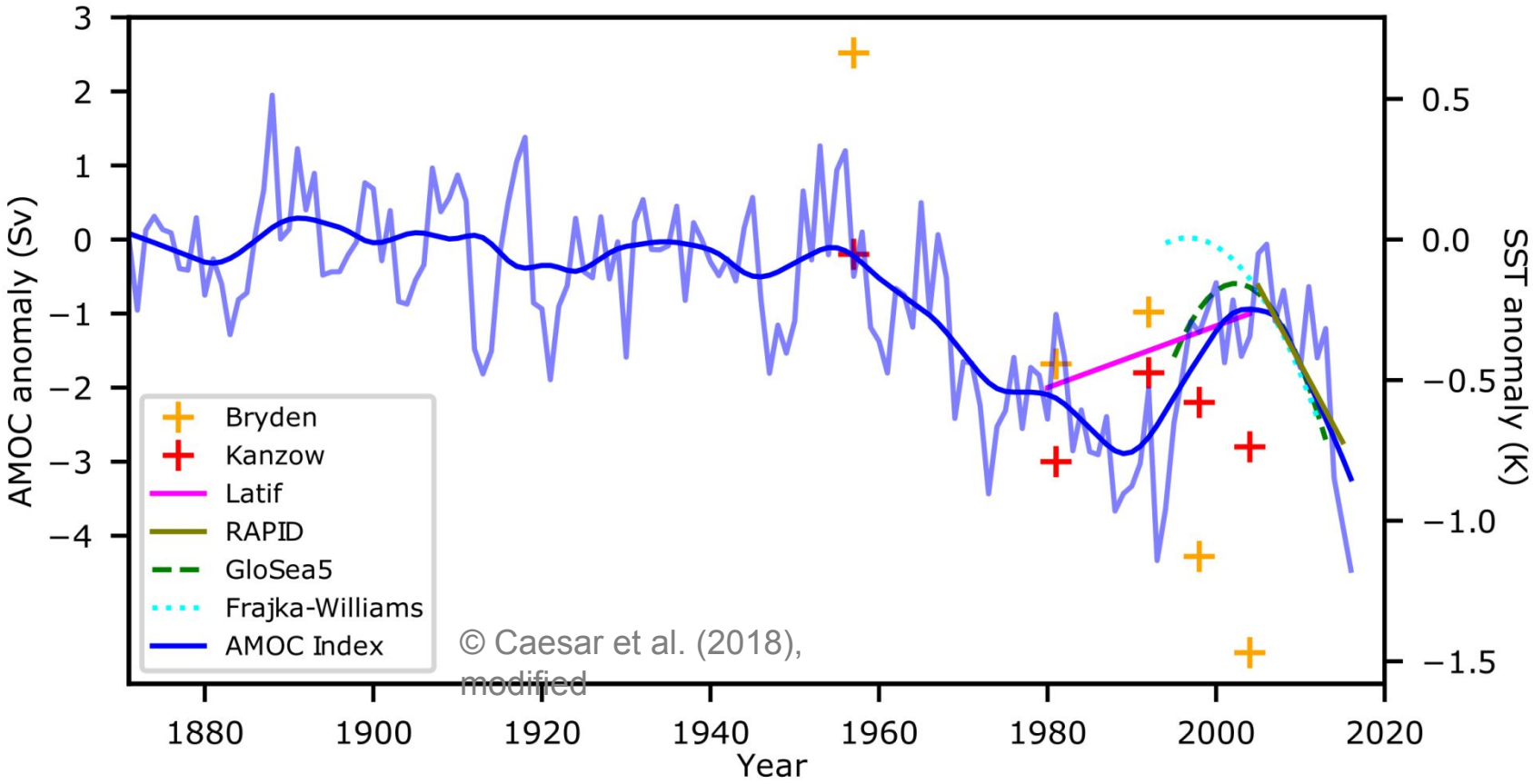


https://www.dreamstime.com/

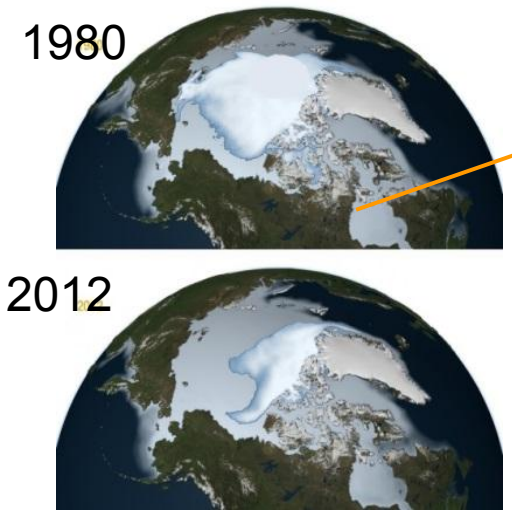
AMOC has already weakened under global warming

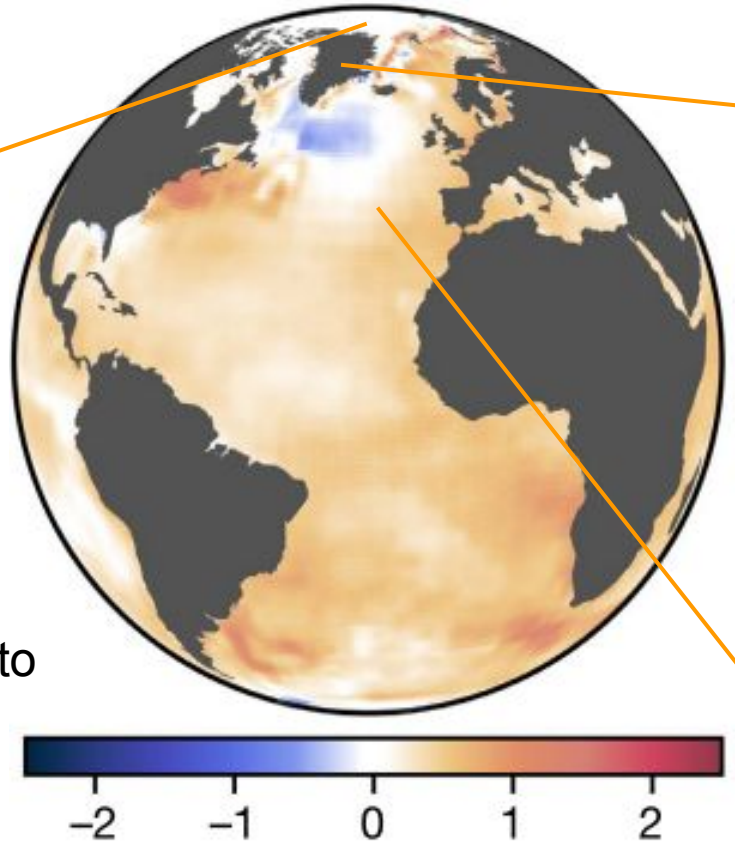


- calibration between SST signal and AMOC strength is determined using the CMIP5 ensemble
- resulting temporal evolution of the AMOC fits to previous AMOC reconstructions

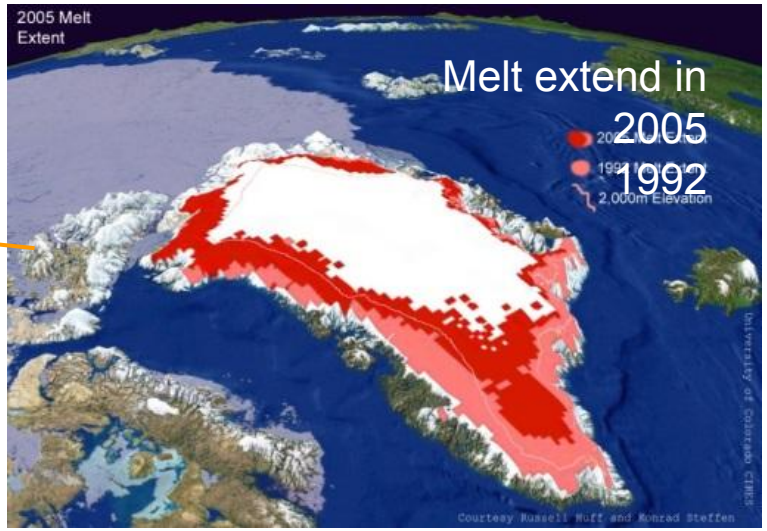
→ **it shows a slowdown of the AMOC of about 3 Sv (15%) since the mid-20th Century**

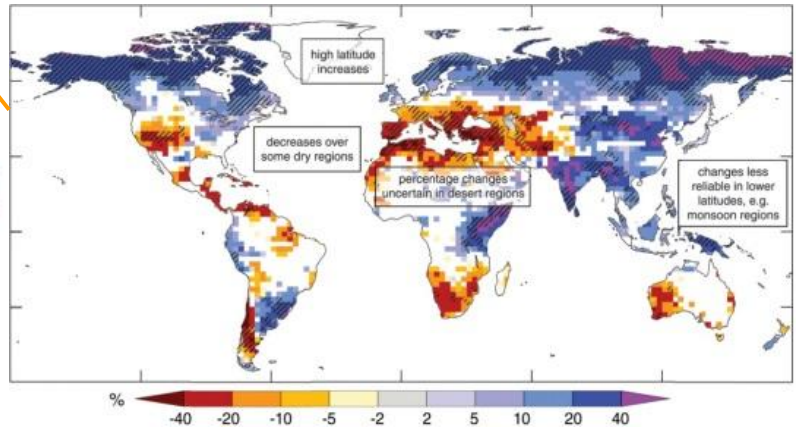
What causes the slowdown?





SST trend 1870-2016 (K)





Causes are an increased freshwater flux into the subpolar North Atlantic

- Arctic sea ice loss (Liu et al., 2019)
- Greenland Ice Sheet melting (Böhning et al., 2016)
- an increase in high latitude temperature and high latitude precipitation (Meehl et al., 2007)
- Warming of the ocean at the convection site (Swingedouw et al. 2014)

Seasonal cycle of the cold patch

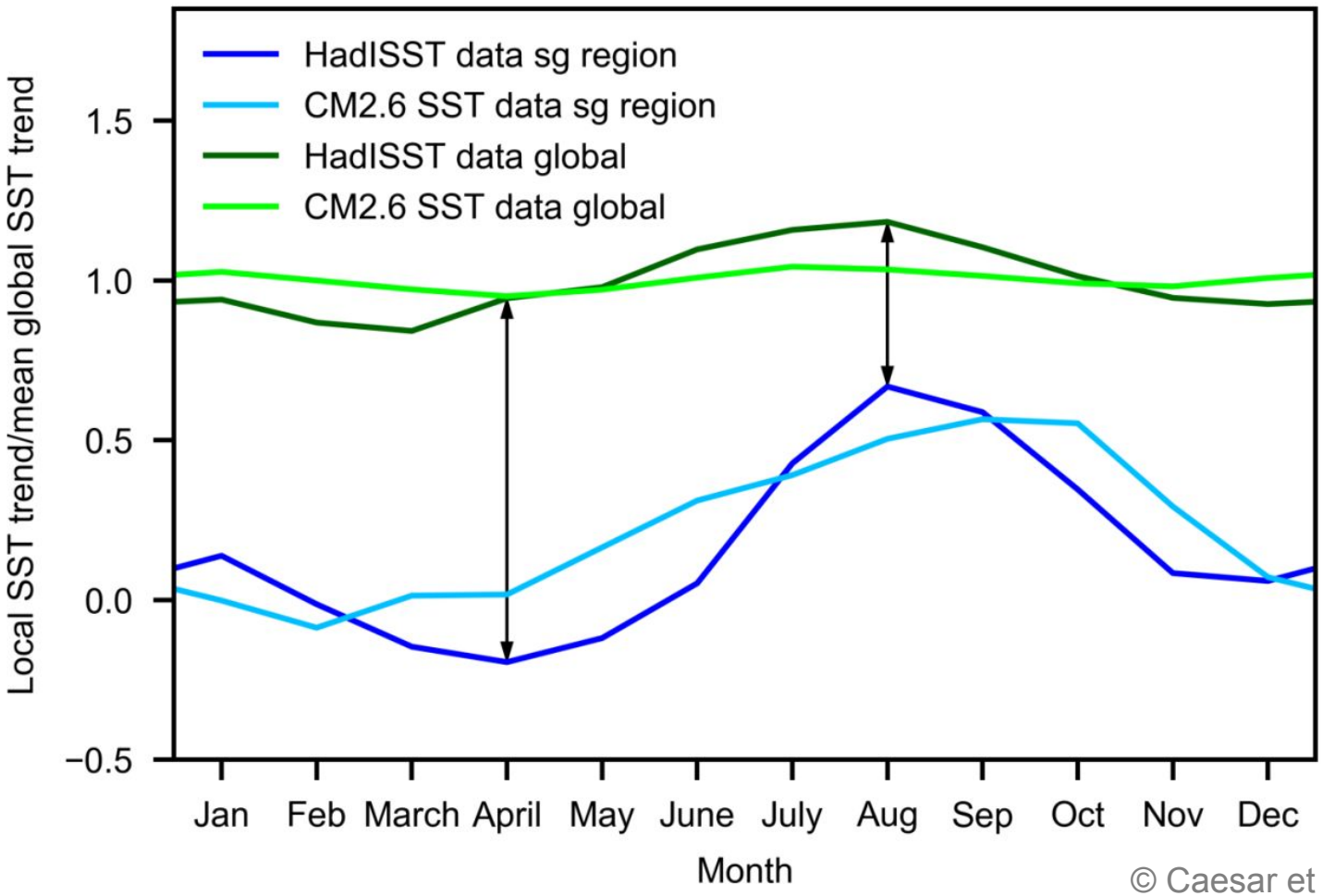
Atmosphere

⬇

SST

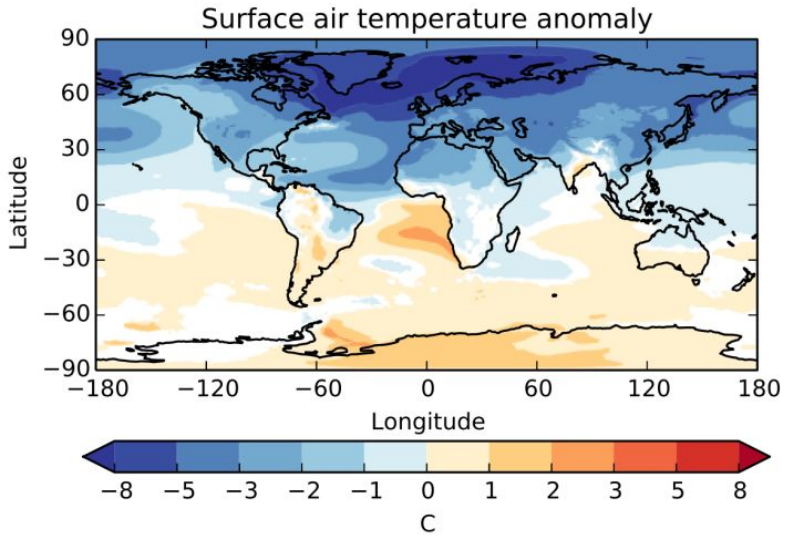
⬆

Ocean



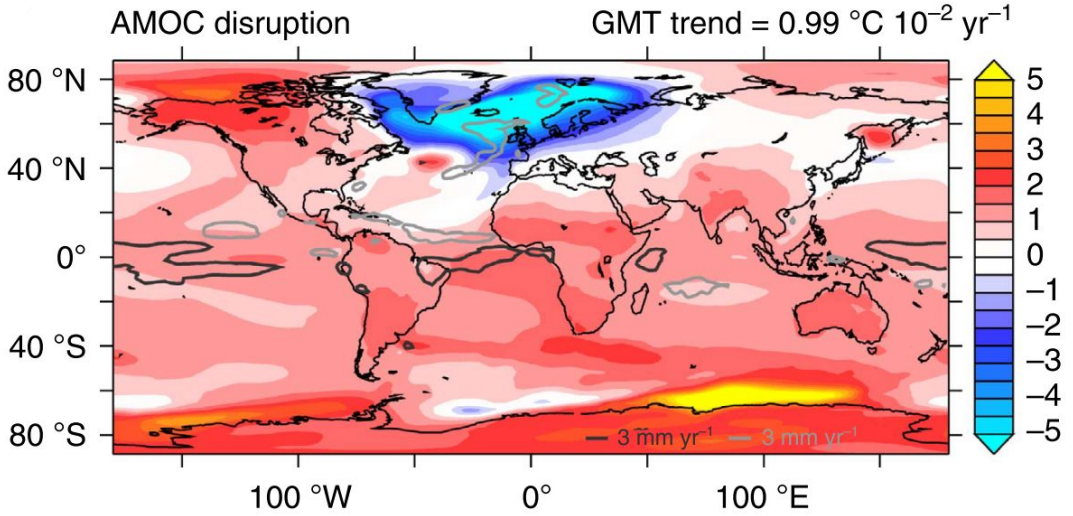
© Caesar et al. (2018)

Widespread cooling throughout the North Atlantic and northern hemisphere following a large AMOC reduction

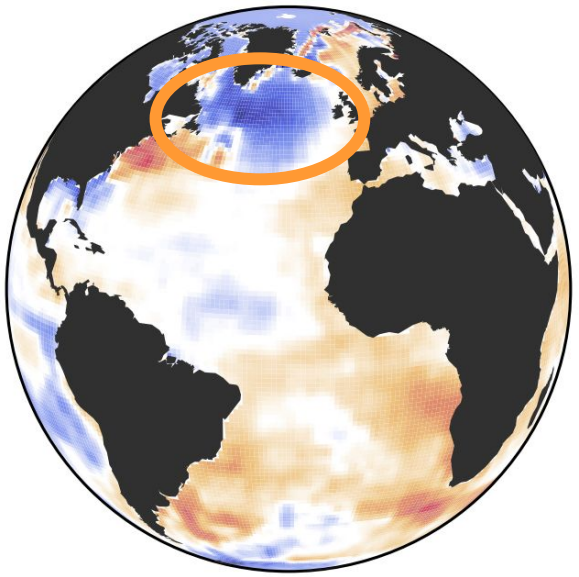


Temperature response to an AMOC collapse without increased greenhouse gas concentrations.

Temperature trend over the 21st century under the RCP4.5 scenario.



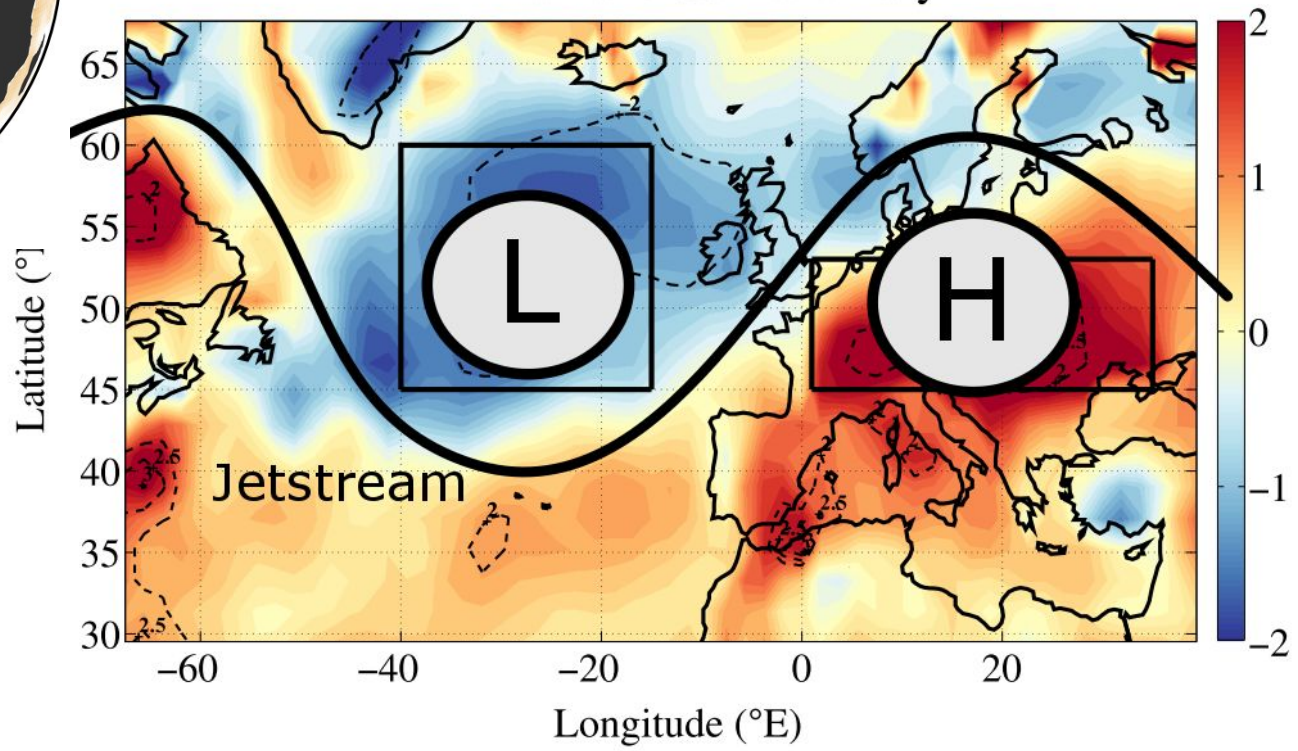
Linking the cold blob to European heat waves

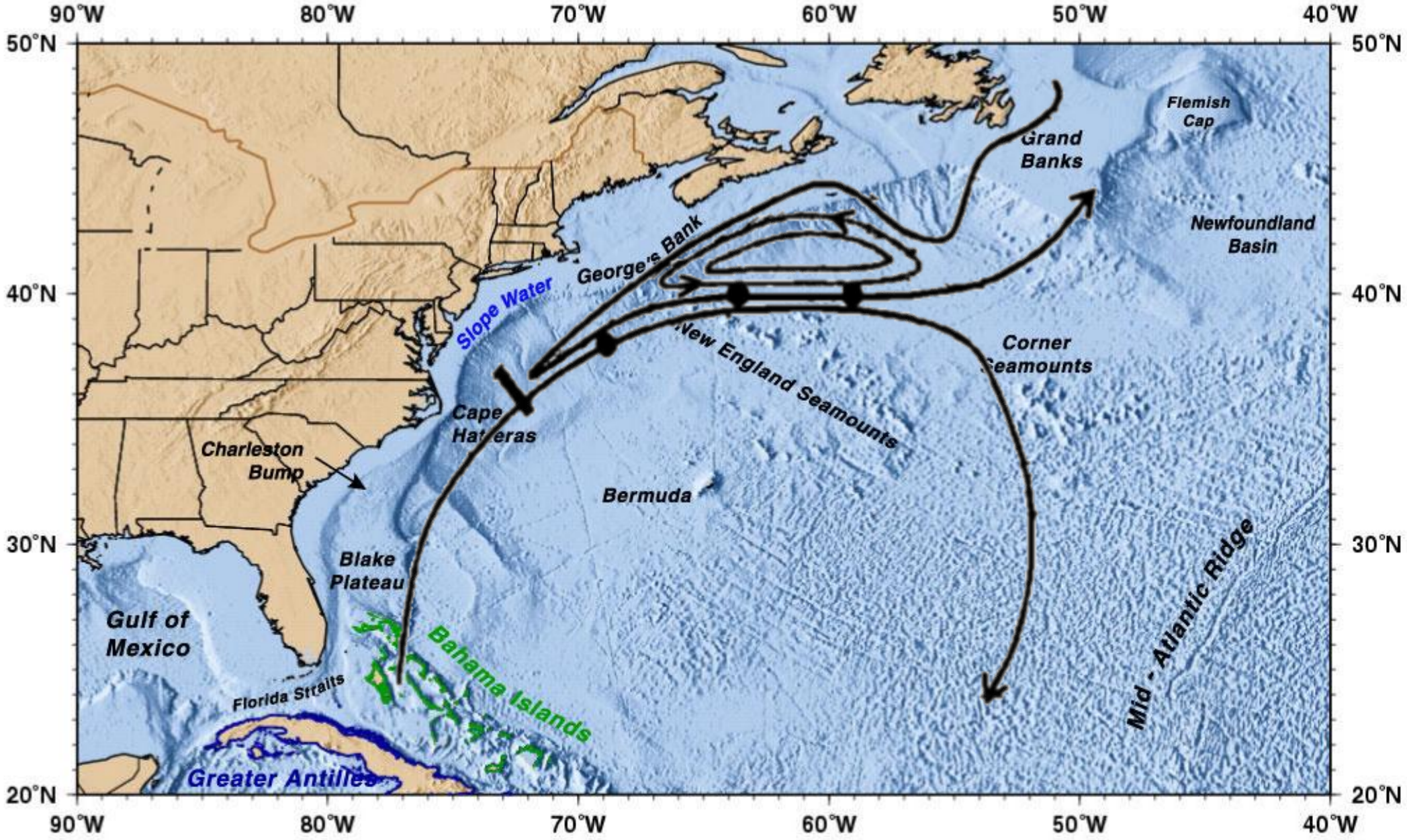


Long-term trend in sea surface temperatures

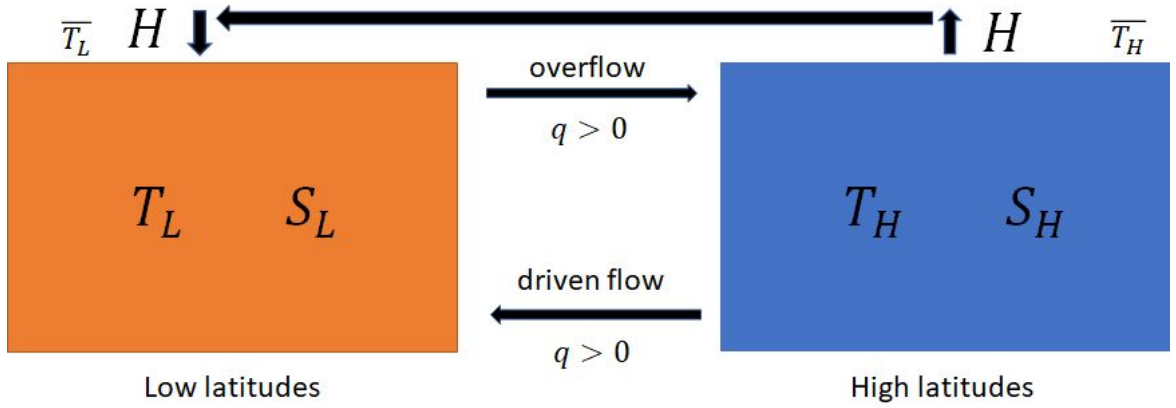
Summer 2015:

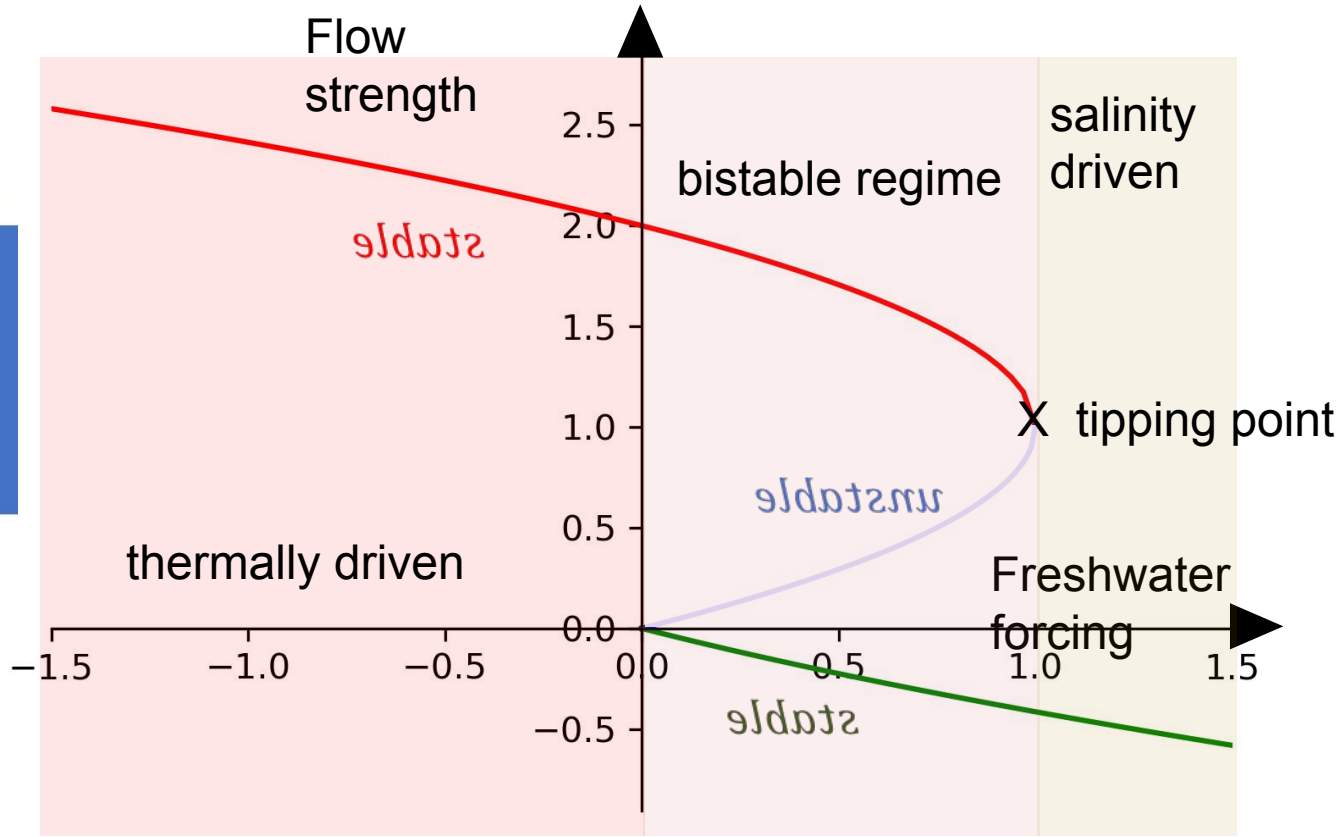
Tmax and SST anomaly




90°W
80°W
70°W
60°W
50°W
40°W
50°N
40°N
30°N
20°N
Flemish Cap
Grand Banks
Newfoundland Basin
George's Bank
Slope Water
New England Seamounts
Corner Seamounts
Cape Hatteras
Charleston Bump
Bermuda
Blake Plateau
Gulf of Mexico
Bahama Islands
Florida Straits
Greater Antilles
Mid - Atlantic Ridge

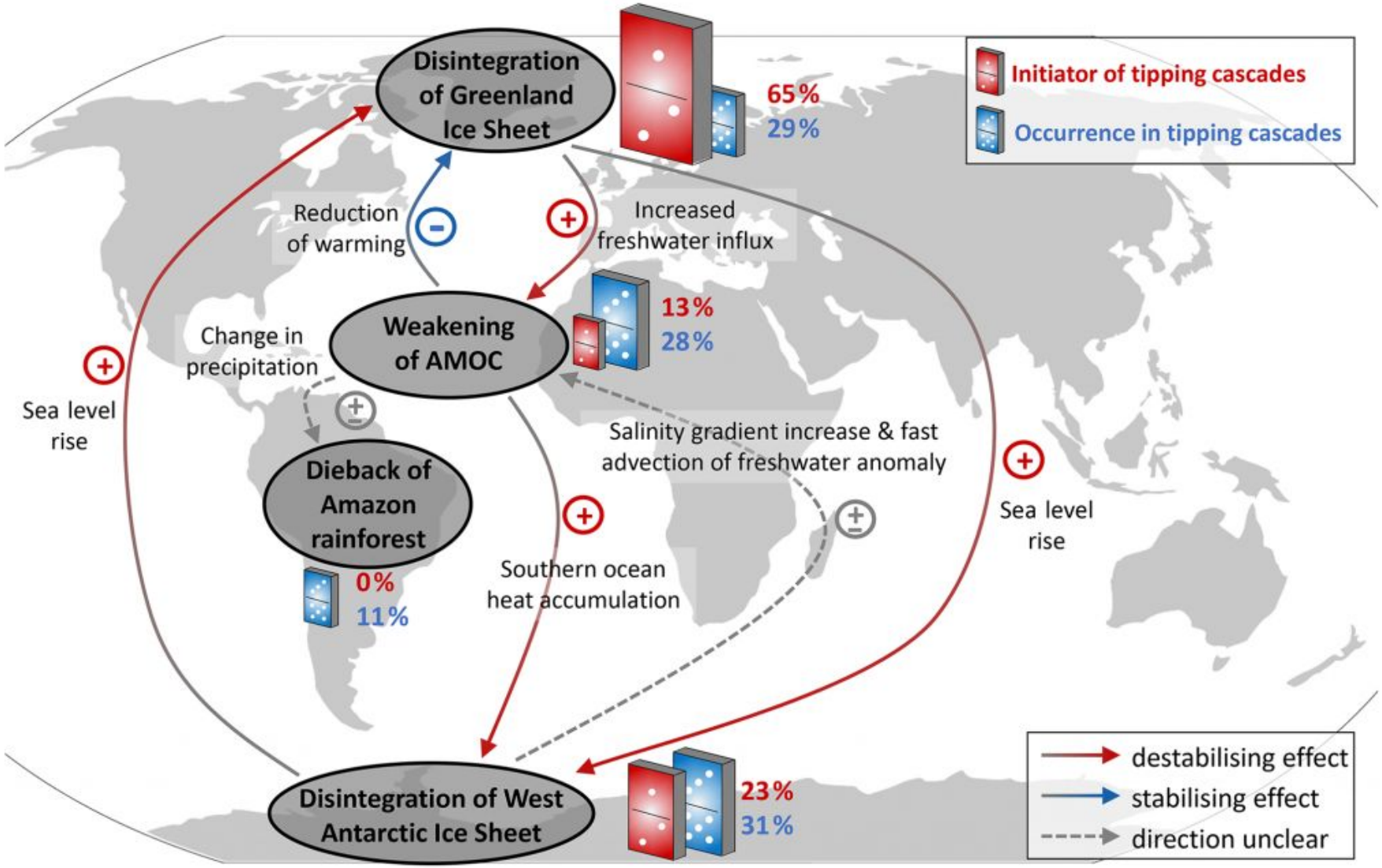
AMOC as a tipping element

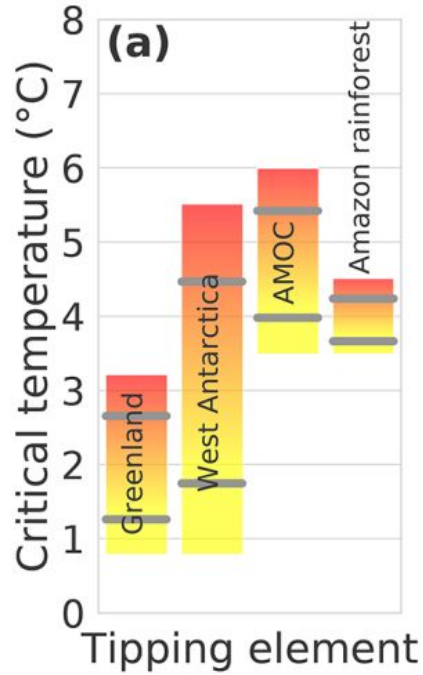


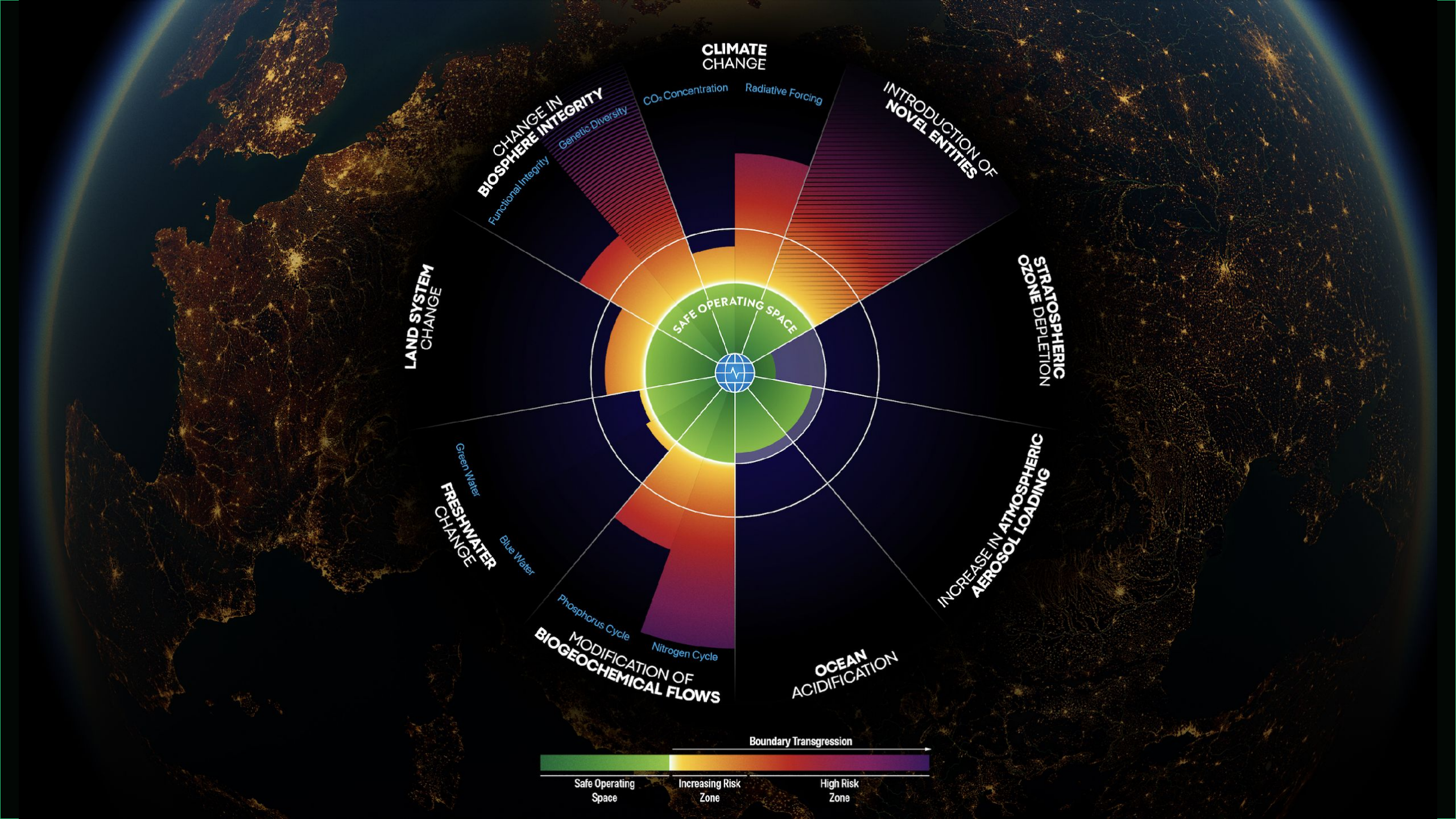


A tipping element is a large-scale component of the Earth system that may pass a tipping point, i.e., a critical threshold at which a tiny perturbation can qualitatively alter the state or development of the system.

The AMOC as part of a Domino effect






CLIMATE CHANGE
CO_2 Concentration
Radiative Forcing
CHANGE IN BIOSPHERE INTEGRITY
Genetic Diversity
Functional Integrity
INTRODUCTION OF NOVEL ENTITIES
LAND SYSTEM CHANGE
STRATOSPHERIC OZONE DEPLETION
SAFE OPERATING SPACE
FRESHWATER CHANGE
Green Water
Blue Water
INCREASE IN ATMOSPHERIC AEROSOL LOADING
Phosphorus Cycle
Nitrogen Cycle
MODIFICATION OF BIOGEOCHEMICAL FLOWS
OCEAN ACIDIFICATION
Boundary Transgression
Safe Operating Space
Increasing Risk Zone
High Risk Zone