



Consiglio Nazionale
delle Ricerche

Dipartimento Scienze del Sistema Terra
e Tecnologie per l'Ambiente

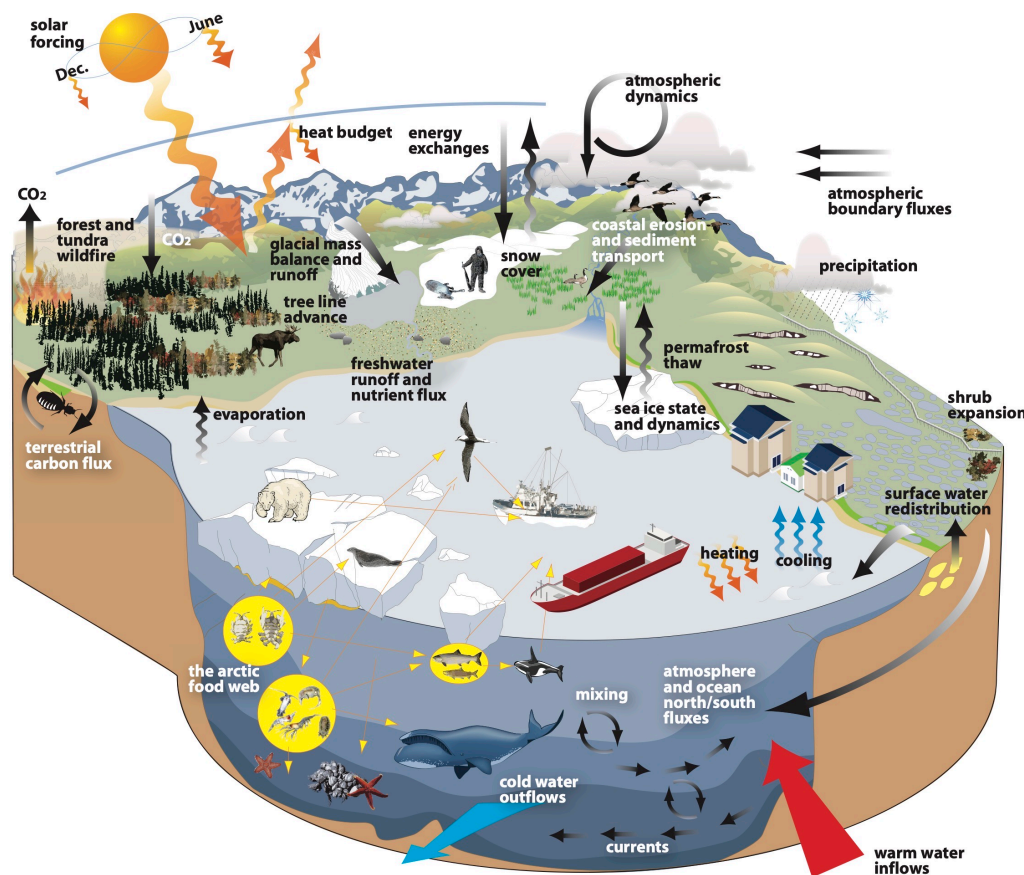


Climate Changes: the Poles Matter

Conferenza annuale di Dipartimento 12/12/2023

Carlo Barbante & ISP Team

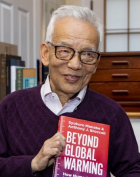
Climate Change: The Poles Matter



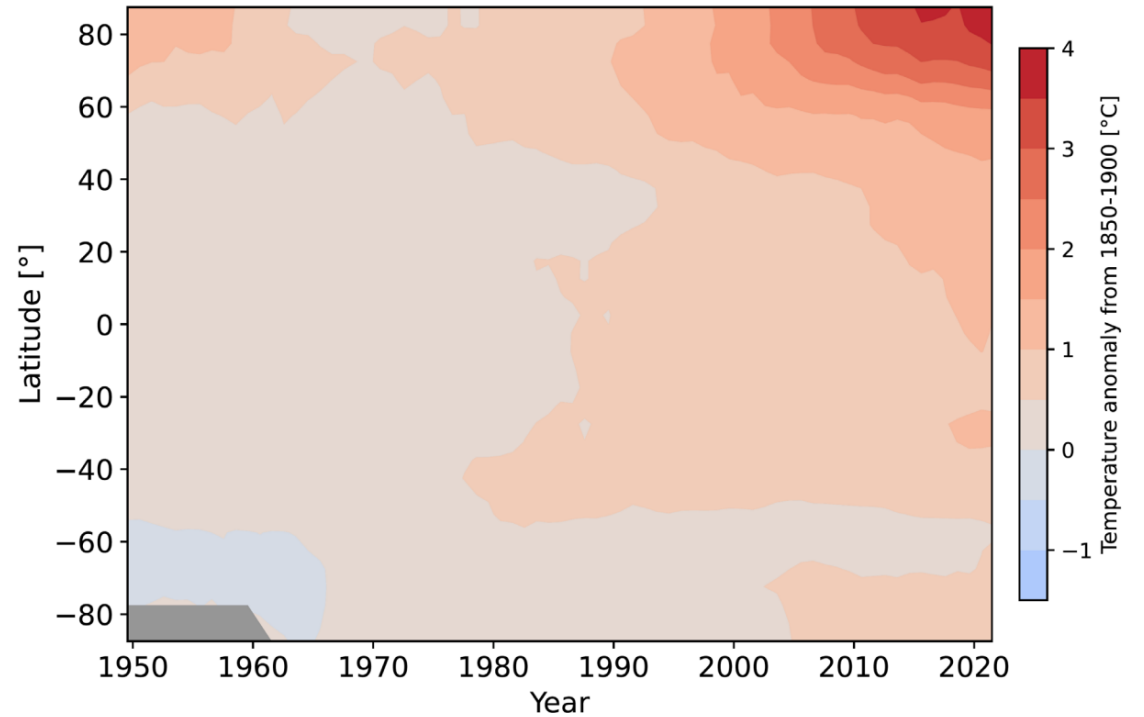
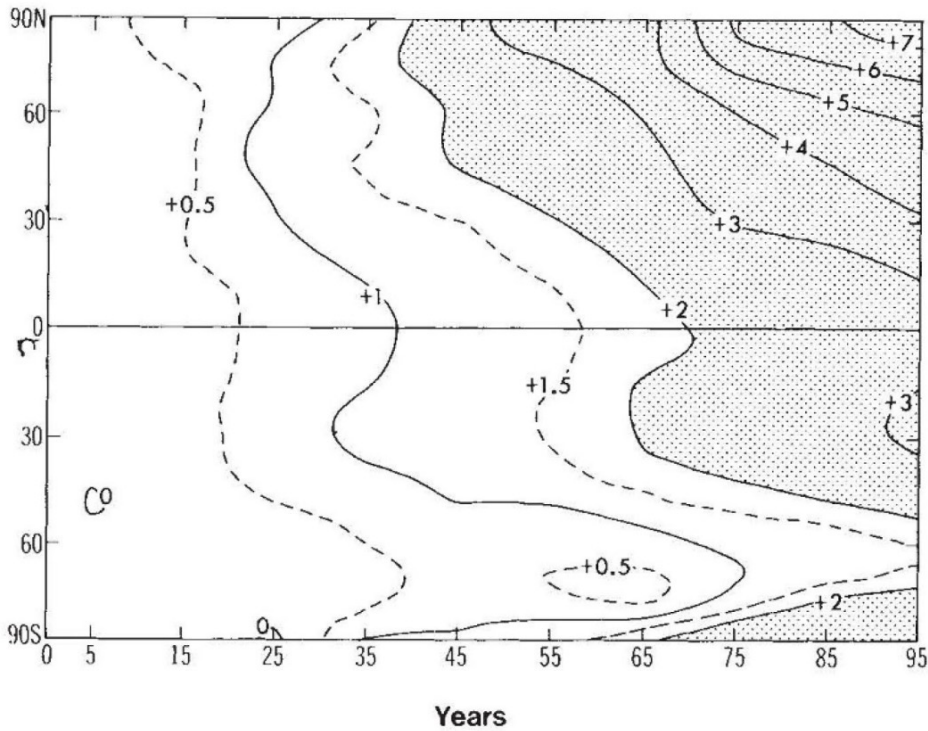
- 1. Pillars of climate sciences**
The Arctic is warming at more than three times the pace of the global average
- 2. Hot spot of anthropogenic change**
Sea ice is continuously melting over all months of the year
- 3. A niche of biodiversity**
The range of polar species is contracted
- 4. Close to climate tipping points**
Most of known tipping points are located in polar regions
- 5. The race for the grail**
The cradle of climate sciences
- 6. Science Diplomacy**
Lands of peace and science



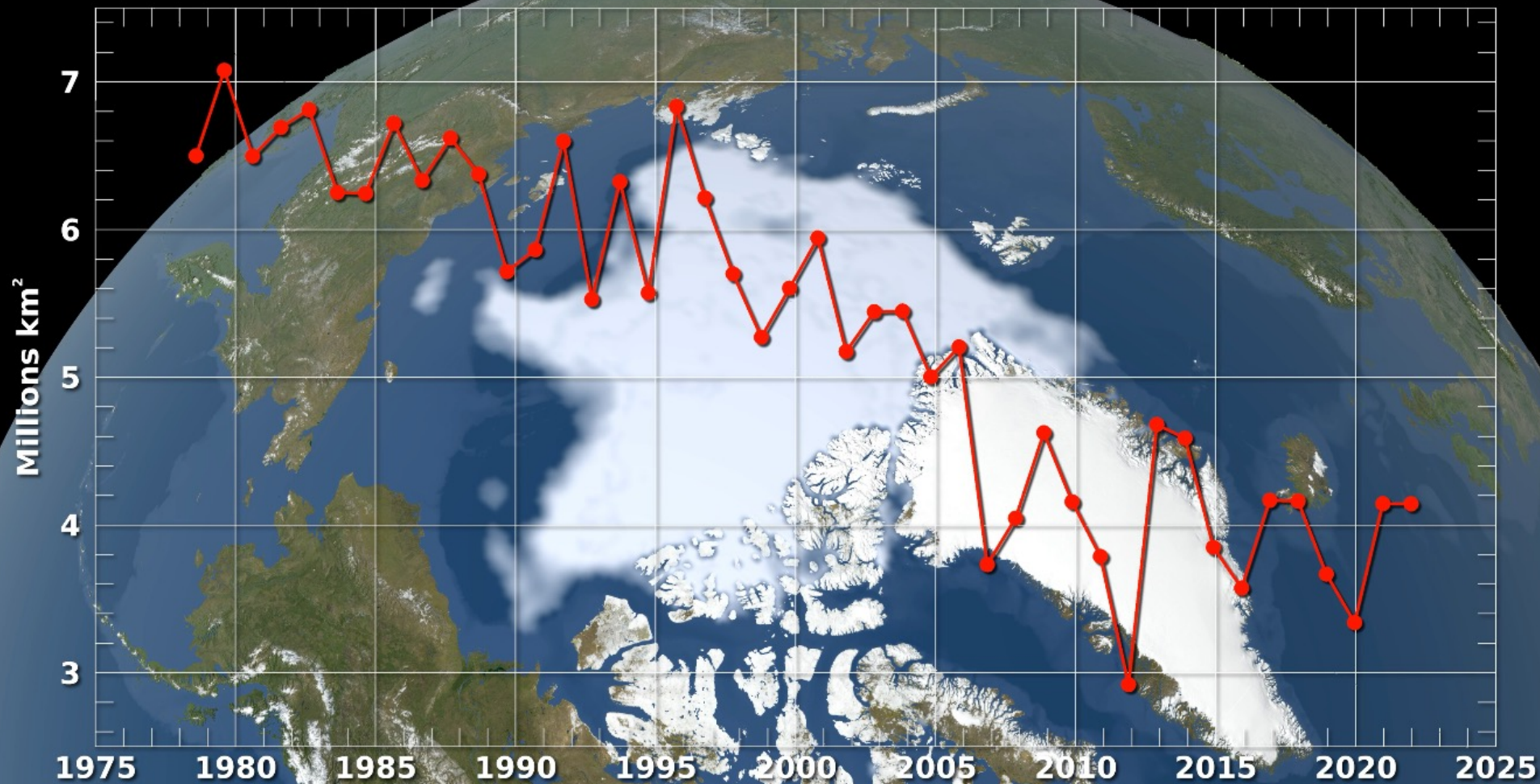
Hot spot of anthropogenic change



Interhemispheric asymmetry in climate response to a gradual increase of atmospheric CO₂

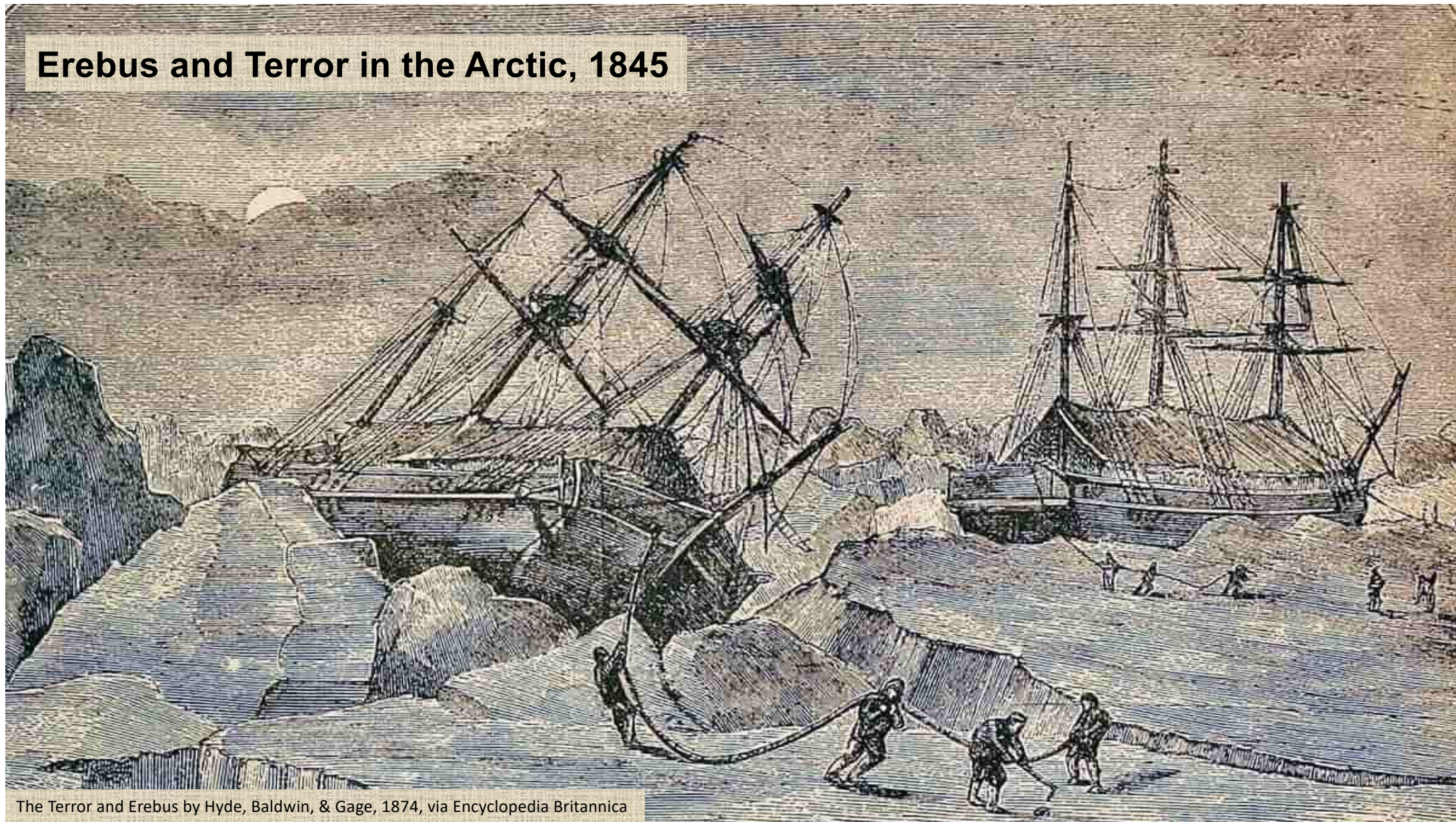


Annual Arctic Sea Ice Minimum Area



NASA's Goddard Institute for Space Studies (GISS), 2023

Erebus and Terror in the Arctic, 1845



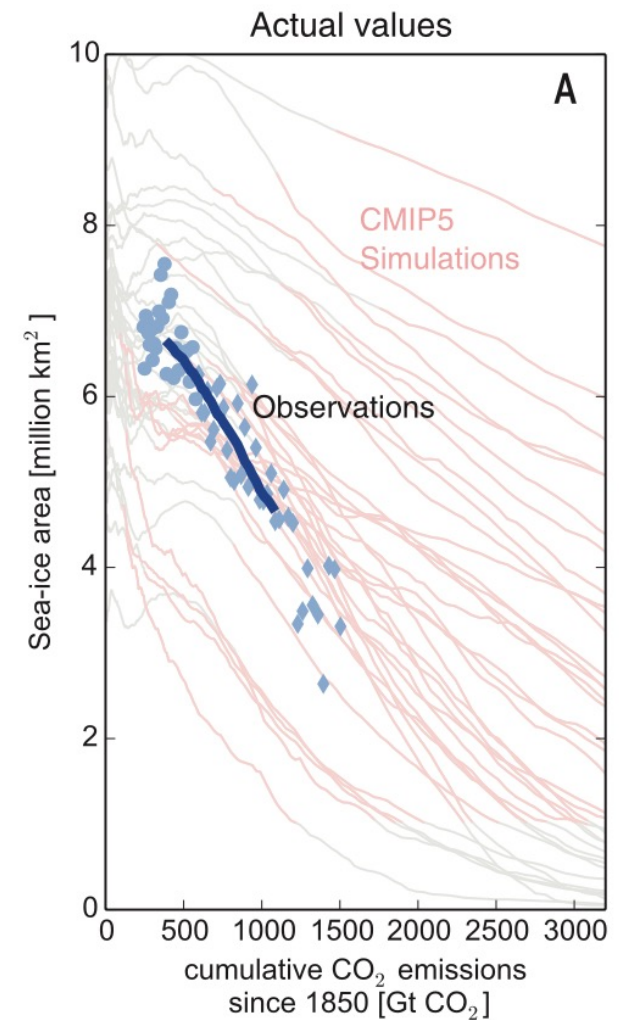
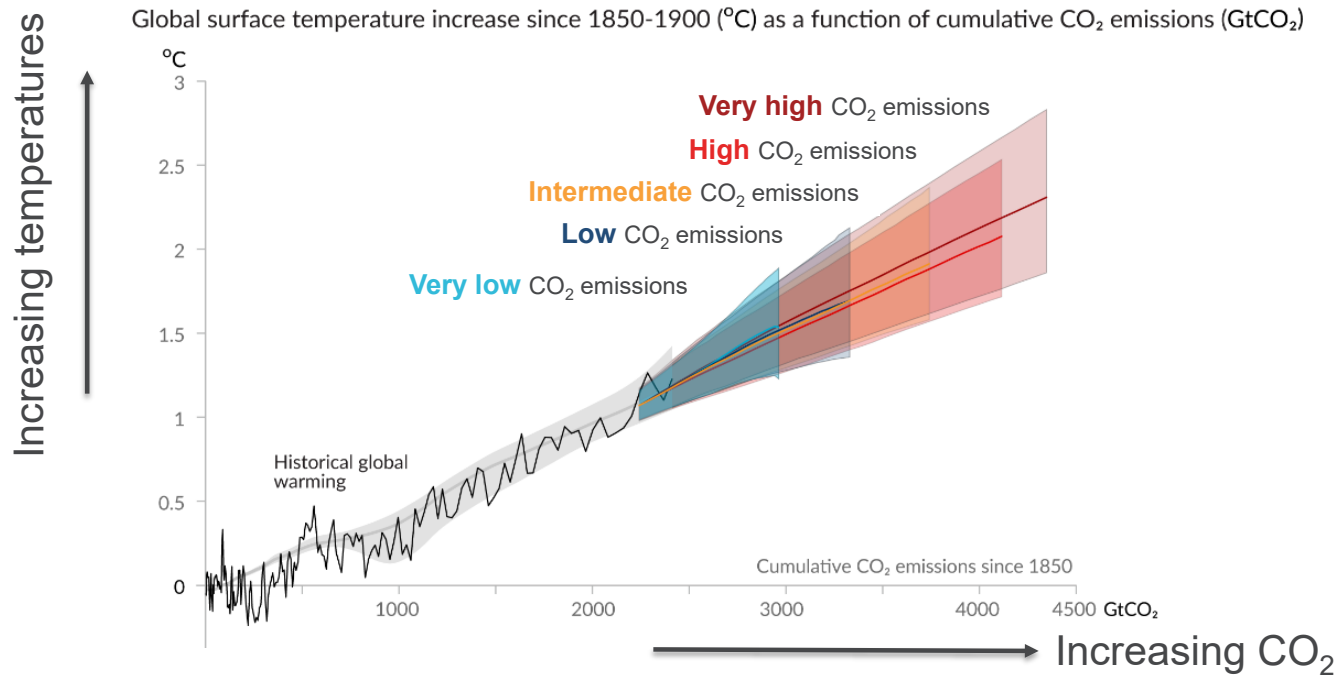
The Terror and Erebus by Hyde, Baldwin, & Gage, 1874, via Encyclopedia Britannica



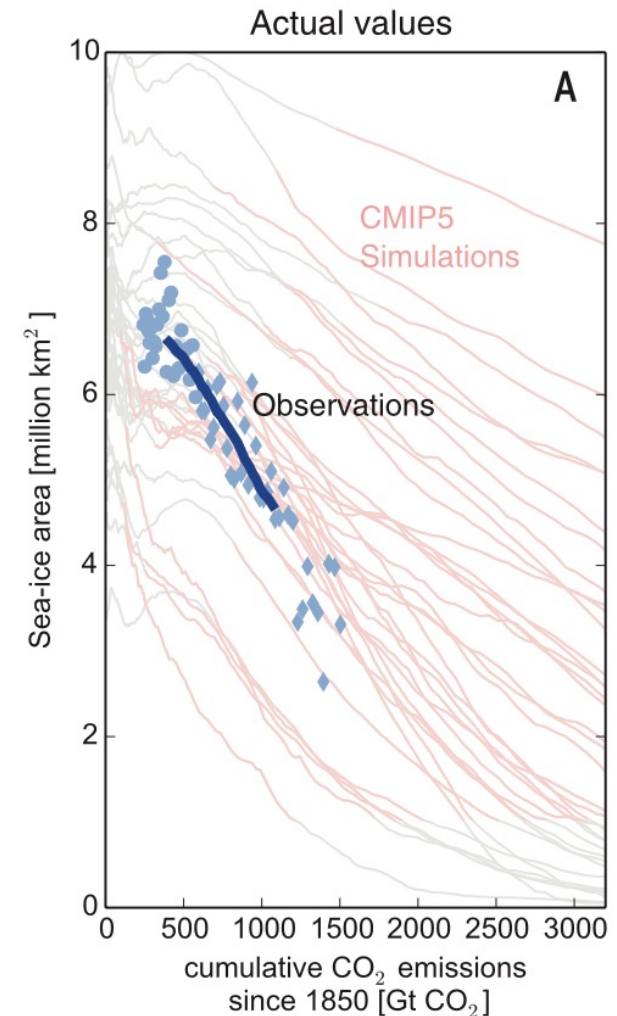
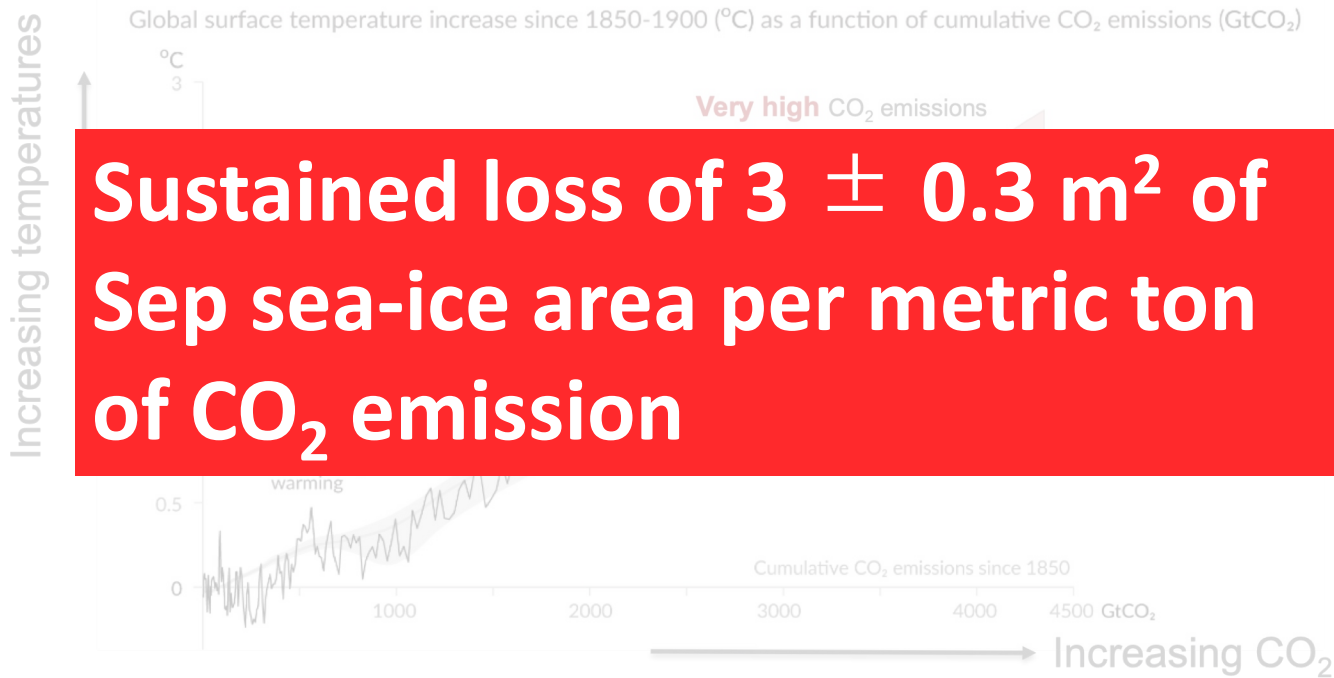
90° North, Aug 31st 2023

Courtesy, Odd Sveinung Hareide, NTNU, 2023

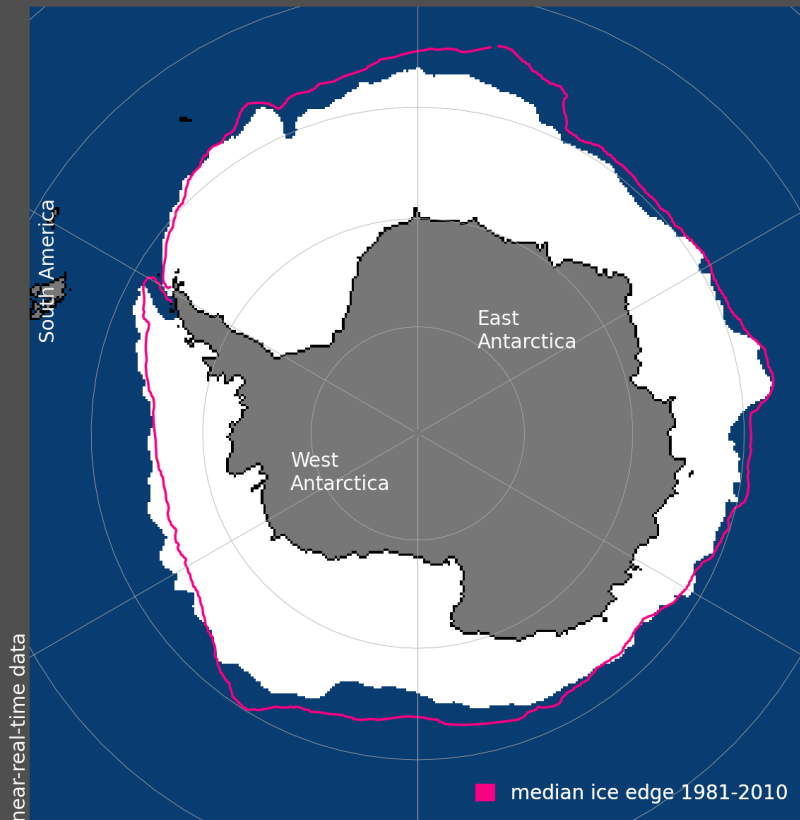
CO₂ and Arctic sea-ice



CO₂ and Arctic sea-ice

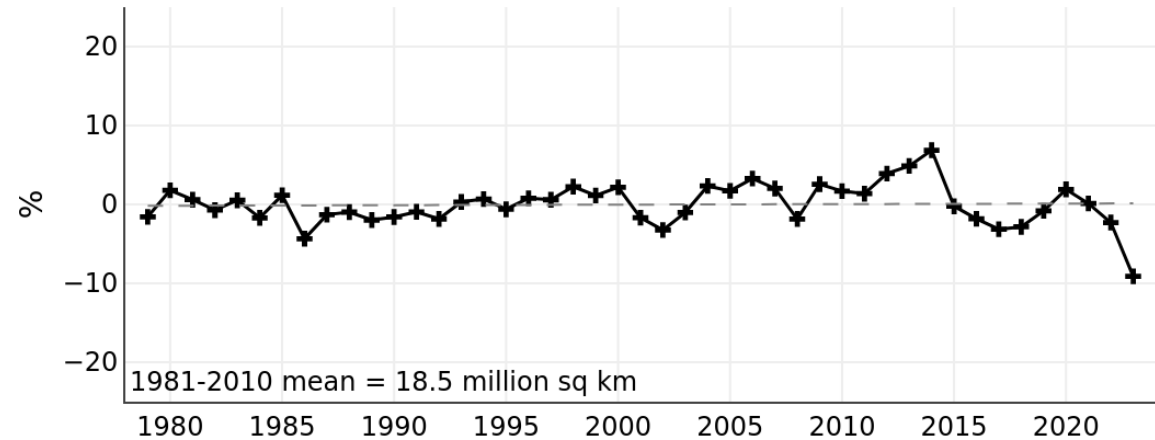


Sea Ice Extent, Sep 2023



Total extent = 16.8 million sq km

Extent Anomalies Sep 1979 - 2023



slope = 0.1 ± 0.6 % per decade

Biodiversity of Polar Regions

The Polar Regions host **a rich variety of species** adapted to their unique and extreme environmental conditions

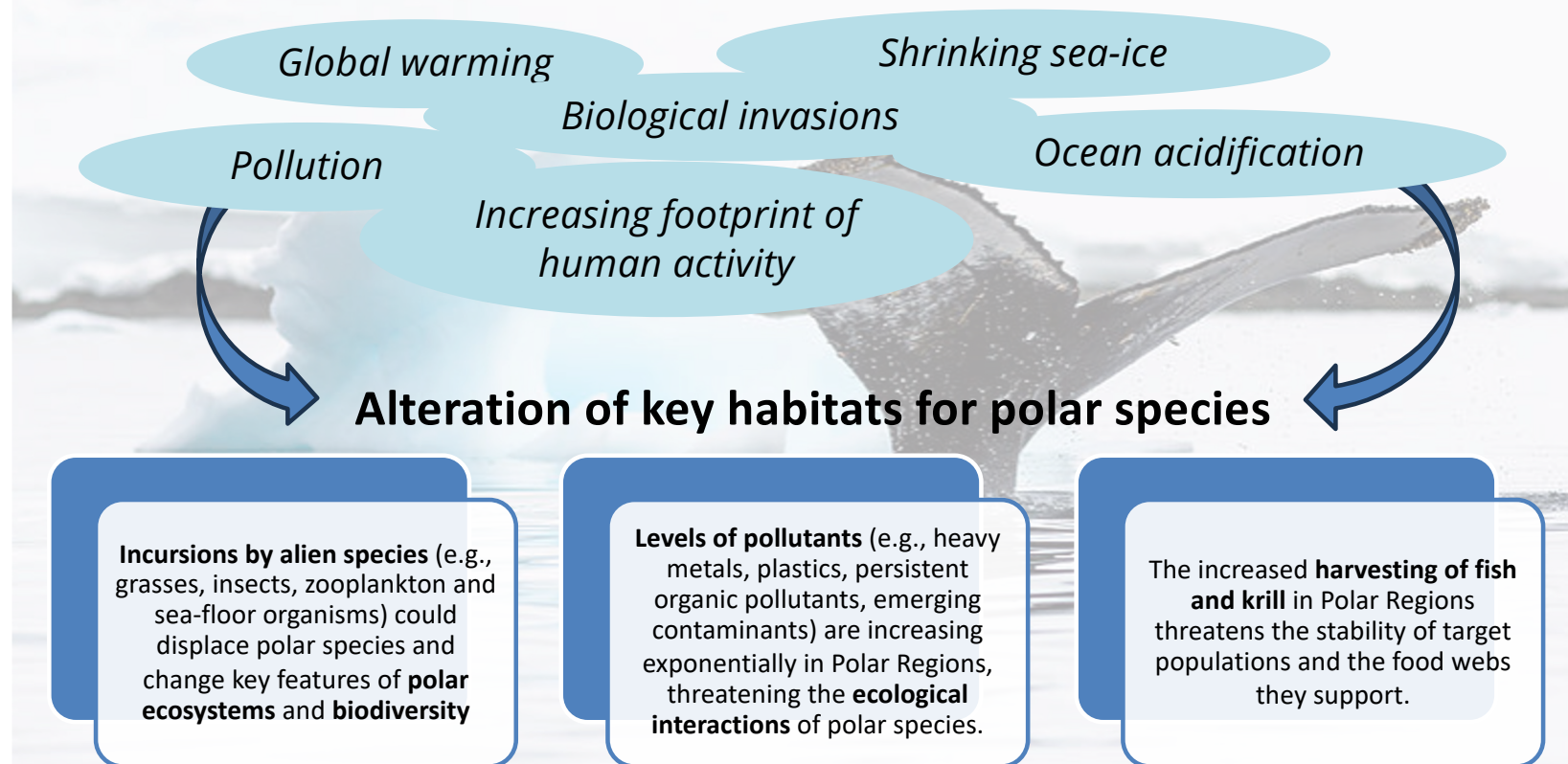
Cold-adapted (micro)organisms show peculiar morphological and physiological adaptations of interests in **biotechnological applications** and **astrobiological implications**

Many of the species (from microorganisms to mammals) inhabiting Polar Regions are involved in the **global cycles of carbon and nutrients** (on which we depend) or in the **ecosystem stability**

A **knowledge gap** exists on the description of biodiversity at lower trophic levels, as well as on the interactions between species and their actual role in the polar ecosystems

Threats to Polar ecosystems and biodiversity

Polar Regions are experiencing rapid and significant changes, which impact polar biodiversity into the future



The Scientific Challenge

To preserve biodiversity in the Polar Regions in the face of environmental stressors

Targets of the scientific community

Examine the interactions between species and environmental conditions to quantify the impact of multiple stressors on biodiversity

Ensure conservation measures by predicting polar ecosystem response to climate change and fisheries

Apply modelling tools to improve the understanding of polar biodiversity and its threats

Explore under-investigated habitats to capture the full extent of polar biodiversity

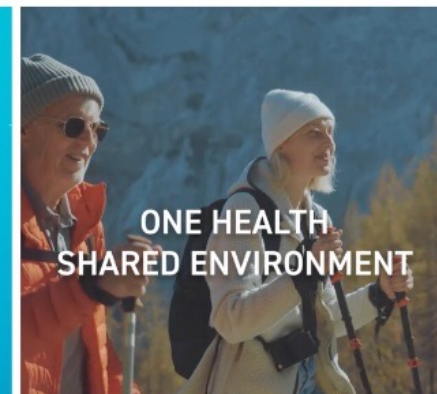
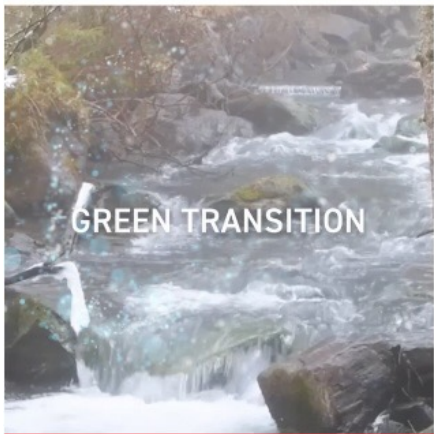
Demonstrate the importance of polar biodiversity at a global scale to address global policy to protect it





ALMANACCO DELLA SCIENZA

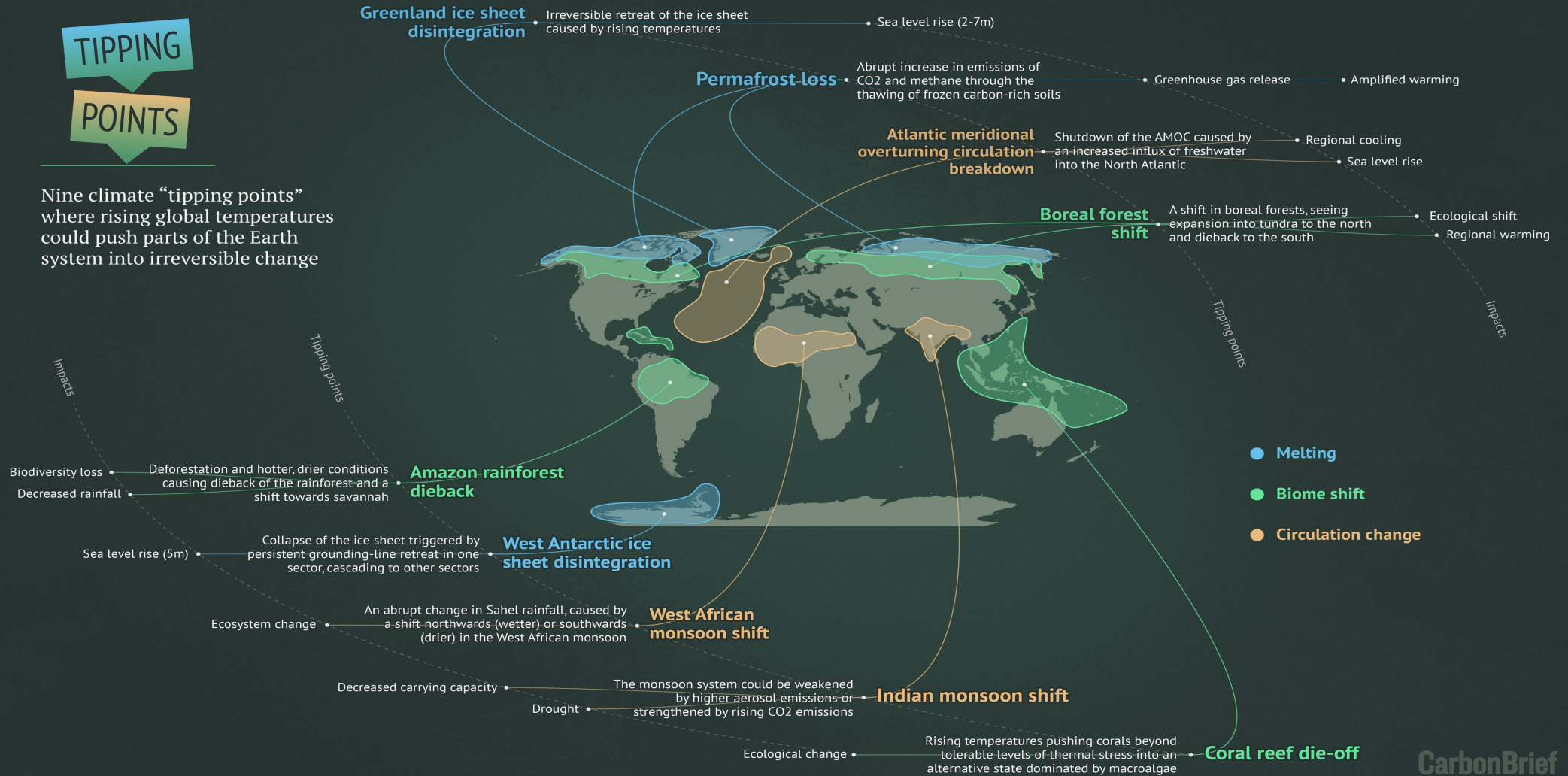
www.almanacco.cnr.it 16/11/2023



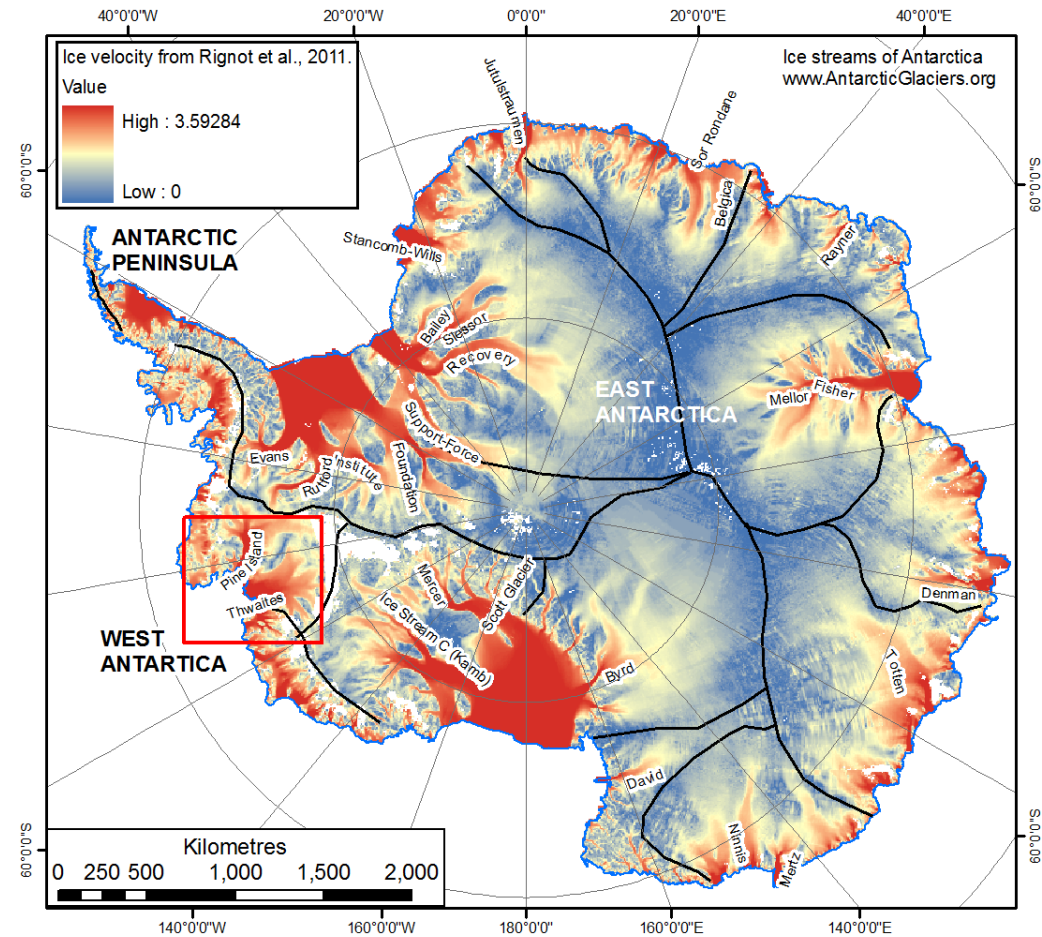
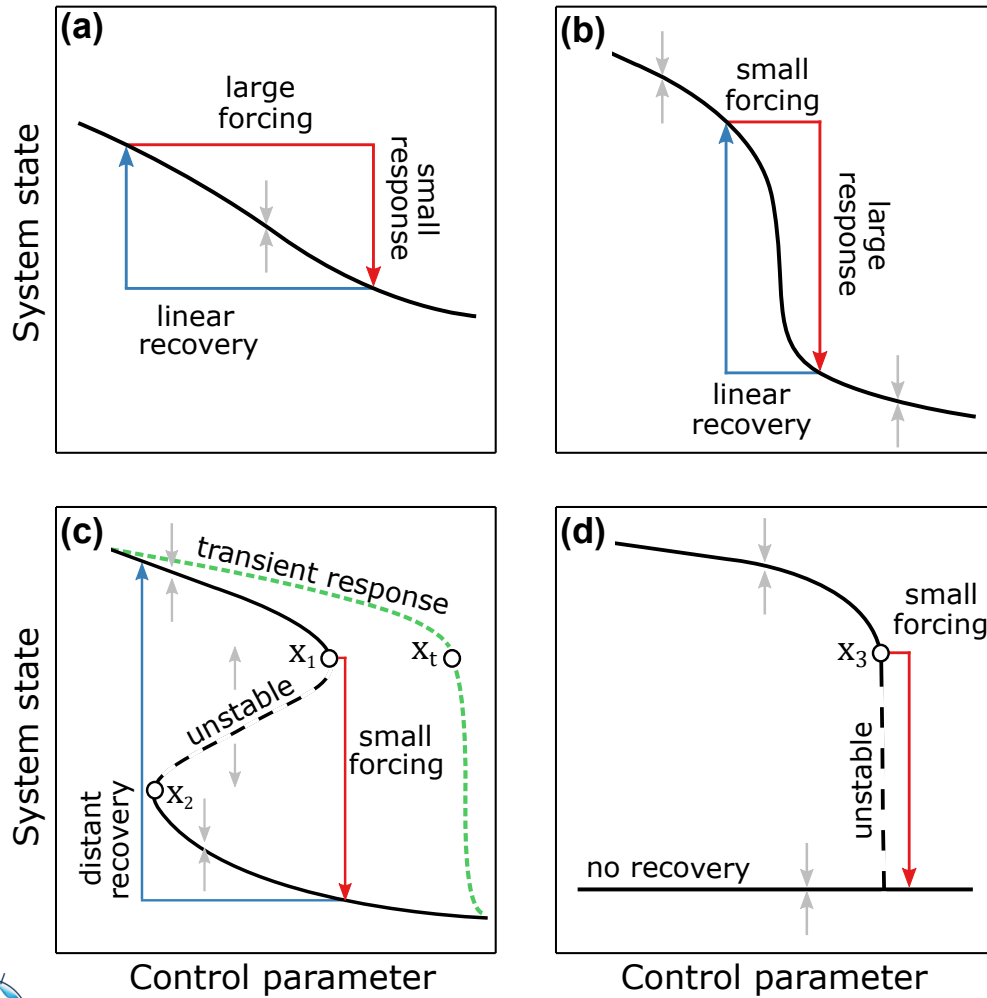
Surprises in the climate system – Tipping Points

TIPPING POINTS

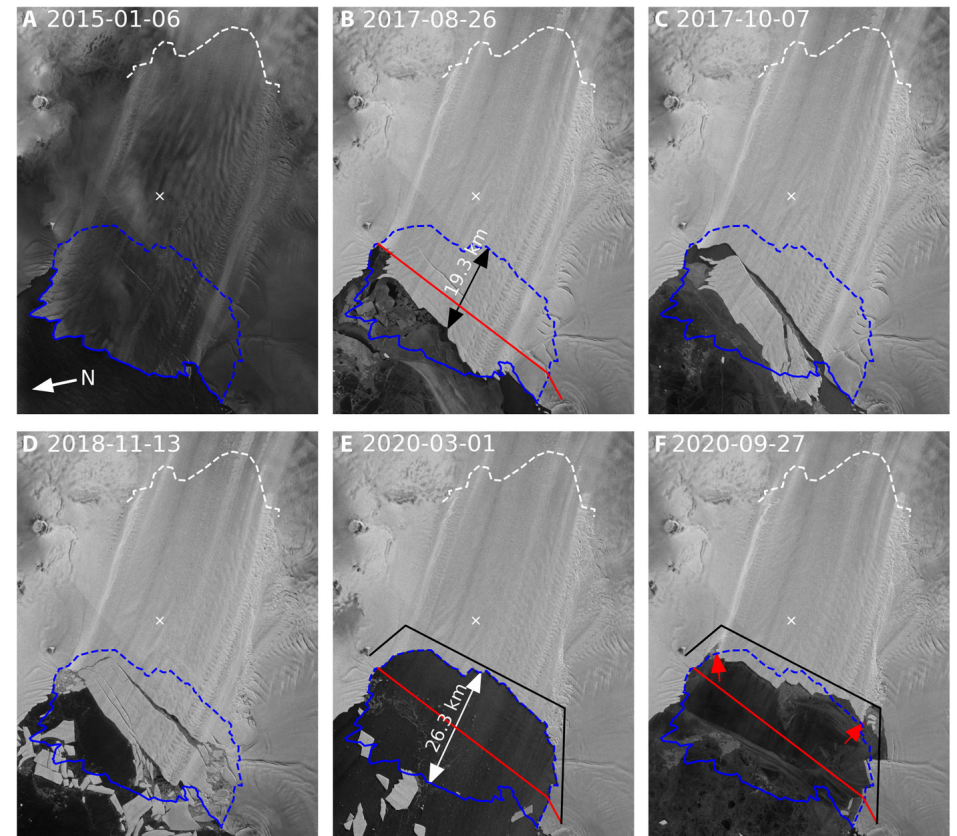
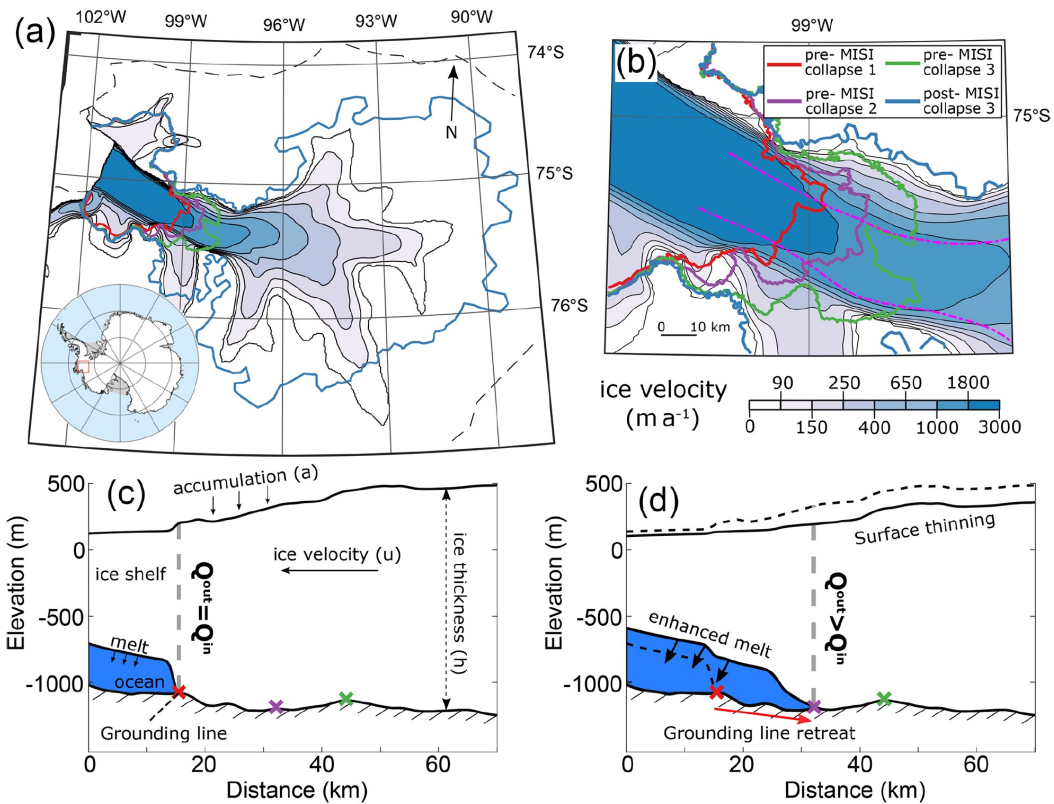
Nine climate “tipping points” where rising global temperatures could push parts of the Earth system into irreversible change



Tipping points in Antarctica: Pine Island Glacier is a candidate



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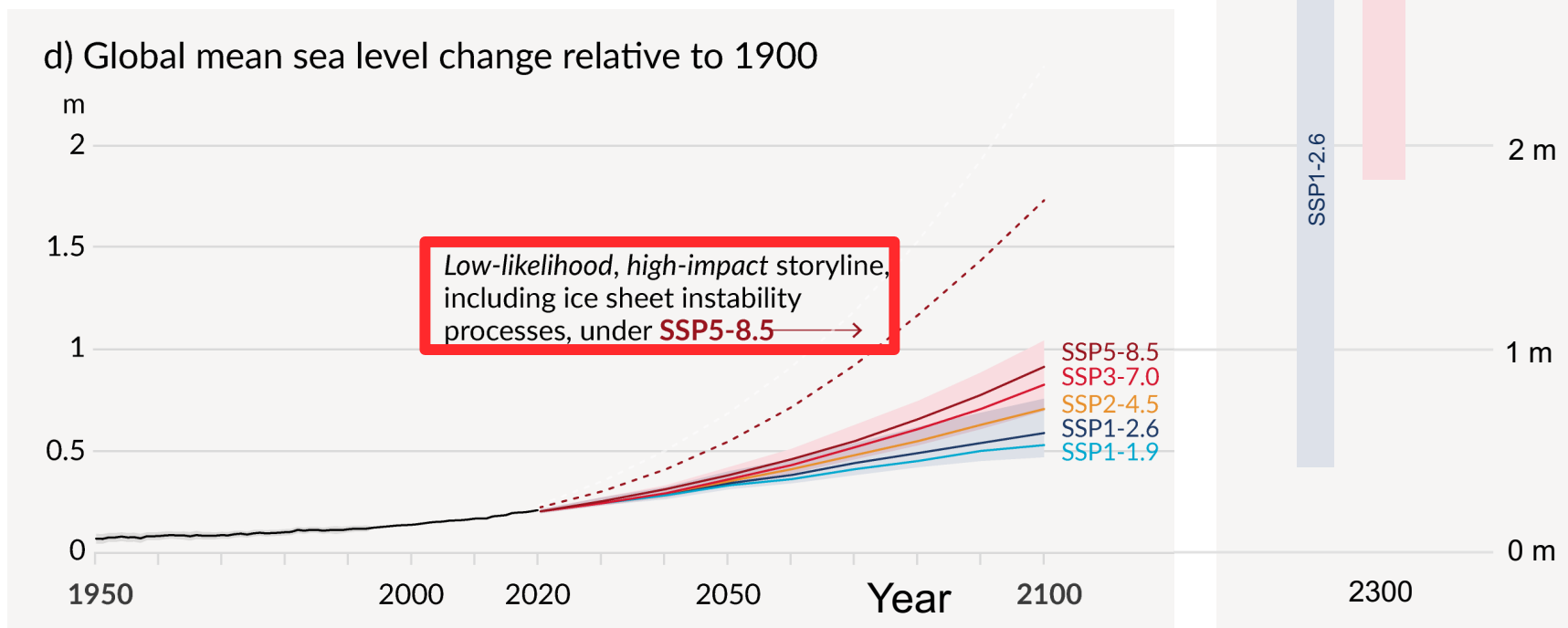


Velocity data show a >12% speedup over the past 3 years, coincident with a 19-km retreat of the ice shelf

What about the future ?

Sea level

Future emissions cause future increase of sea level



IPCC, 2021: Summary for Policymakers. In: Climate Change 2021: The Physical Science Basis.

INSTITUTE OF POLAR SCIENCES CNR

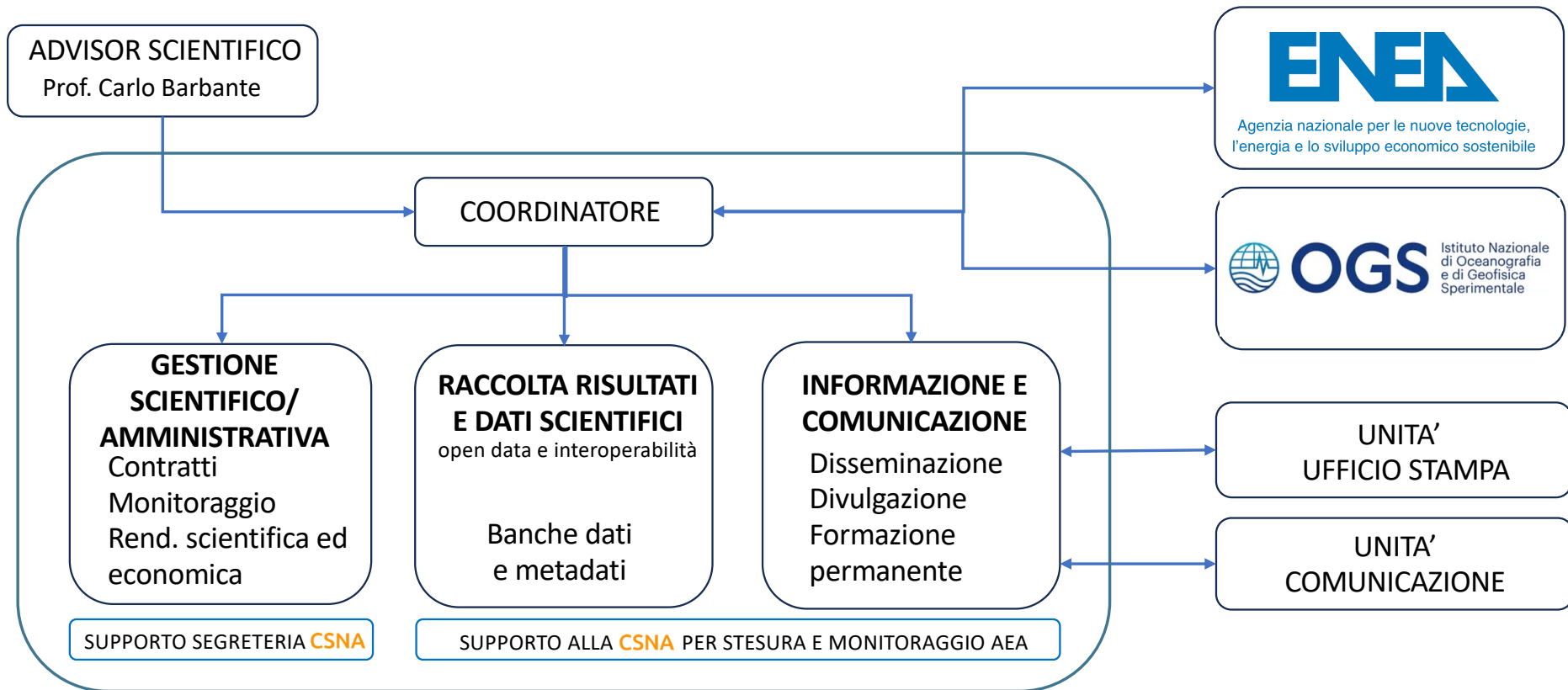
ISP Istituto
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2.0



POLAR HUB

ORGANIZZAZIONE A REGIME





Happy Holidays!