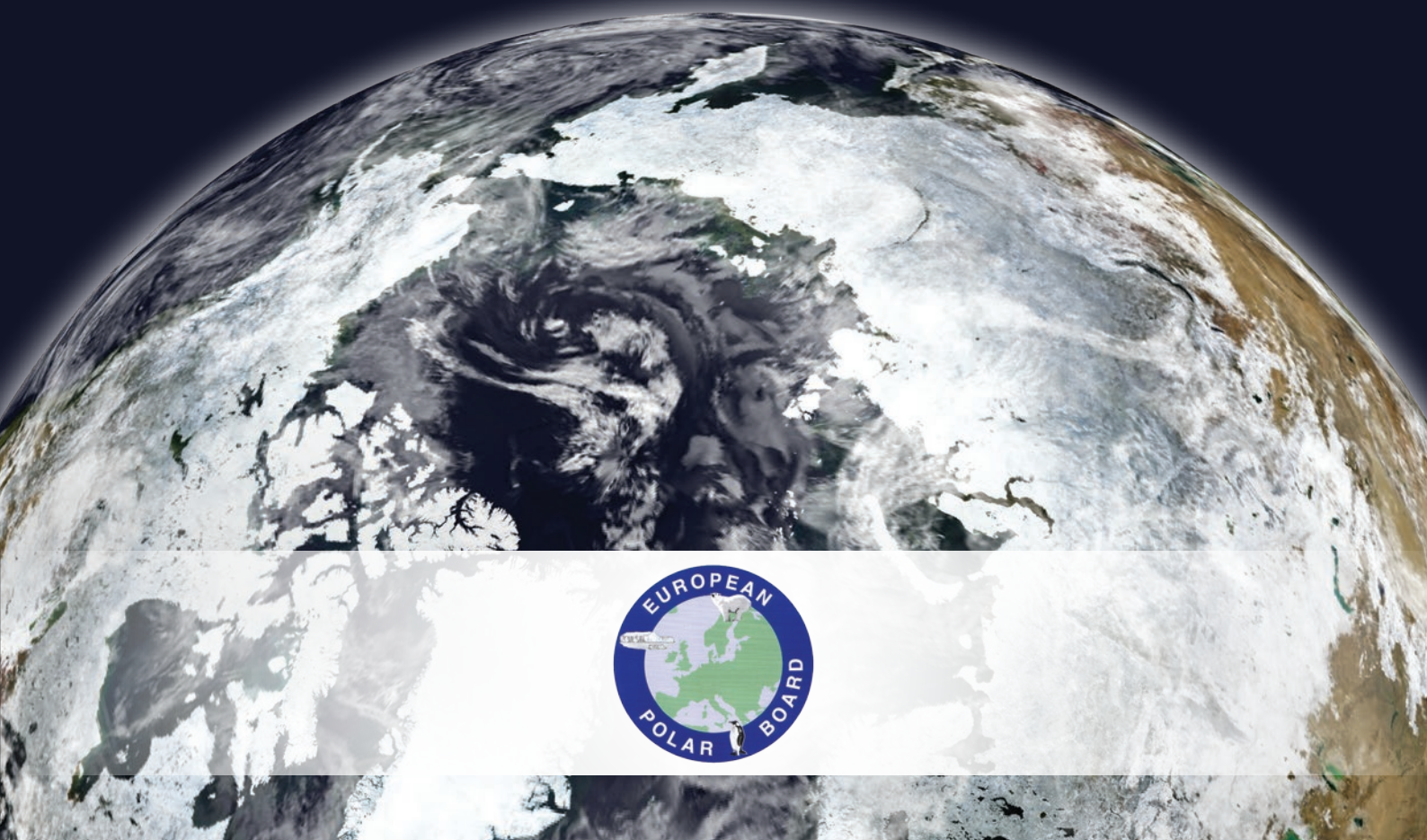


Arctic and Antarctic Science for Europe

The Polar Regions in a Connected World
– a challenge for Horizon 2020



THE WARMING POLAR REGIONS

The Polar Regions may seem remote but the rapid changes now affecting both these areas have resulted in significant consequences for the weather and climate elsewhere, including Europe. Those environmental changes being observed, particularly in the Arctic, are a clear indication of the threats to European environments, society and industry in the future.

Changes in the Polar Regions present societal challenges but also economic opportunities for Europe and the world. Science is a vital tool in establishing what is driving this rapid change. Science is also necessary to make our climate models and forecasting more realistic by identifying and reducing the many sources of uncertainty that can degrade reliable prediction. It is essential that Europe works to benefit in a sustainable manner from the opportunities of change in the Polar Regions. The high rate of change demands an early response and Horizon 2020 presents a timely opportunity and an effective mechanism for Europe to address polar issues.

INNOVATION EUROPE

Whereas Antarctic mineral and hydrocarbon resources are currently subject to an international moratorium, a changing Arctic brings new opportunities for exploitation of natural resources. This also brings significant technological and environmental challenges, but Europe is a leading source of innovative solutions. The Polar Regions could be a catalyst for technological developments that help conserve these Regions, sustainably where possible, whilst safely accessing important resources.



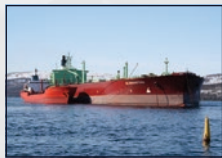
POLAR CHANGES, GLOBAL CONSEQUENCES

- a) **Decreasing summer sea-ice extent** leads to more solar energy being captured by open water in an accelerating feedback process. It also leads



to less temperature differential between high and mid latitudes affecting the jet stream and resulting in changing weather patterns that can strongly impact on Europe causing damage to property and infrastructures, loss of agricultural production, transport disruption, and health issues.

- b) **Increased open water in the Arctic seas and more frequent large storms** accelerate coastal erosion and pose threats to shipping. The decreasing sea ice,



however, also opens up new shipping routes and increases opportunity for exploitation of living and non-living resources in the Arctic Ocean.

- c) **Melting of ice sheets and glaciers in both Polar Regions** is raising global sea-levels, with severe consequences for Europe's coastal communities.



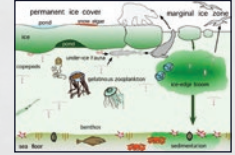
The increase in freshwater is also potentially impacting Atlantic Ocean circulation, leading to more uncertainties in mid-latitude weather and changes in biodiversity and ecosystems in the Arctic Ocean.

- d) **Climate variability will affect ecological processes** in a multitude of ways. For example, 15% of the world's migratory bird species breed in the Arctic,



making them highly vulnerable to changes in tundra habitat and ecosystem. Studies of polar marine ecosystems have projected shifts in bio-climatic habitats of species and concluded that new species will colonize polar ecosystems at a faster rate than in other regions of the globe. Changing dynamics of polar marine ecosystems have substantial implications for abundance and distribution of commercially relevant fish and shellfish stocks, for critical food web components such as krill and for iconic polar species such as polar bear.

- e) **The Southern and Arctic Oceans are warming and becoming more acidified.** Such changes



could make these oceans sources of, rather than sinks for, greenhouse gases, significantly impacting the global carbon cycle. Acidification will be an early climate related threat to marine food chains and ecosystems with important consequences for polar biodiversity, commercial fisheries and indigenous societies.

- f) **Summer thawing of Arctic permafrost** has seen increasing release of the greenhouse gases methane and carbon dioxide from both land and shallow shelf seas. As terrestrial permafrost retreats northwards, the overlying tundra habitat will be replaced by shrubland and forest, profoundly affecting Arctic-adapted wildlife.



- g) **Thawing permafrost** also presents significant challenges for land based transport and building infrastructure, with increased incidence of landslides, subsidence and flooding, whilst loss of Arctic marine methane (gas hydrate) from sediments could initiate underwater landslides generating possible tsunami threats for Europe.



- h) **Black carbon** (soot) is a short lived climate forcer (SLCF) contributing to Arctic atmospheric haze and a significant Arctic pollution and health issue.



It also decreases the albedo (reflectance) of snow and ice, and so accelerates melt. Various other long range pollutants, including mercury, are already impacting Arctic food chains and human health.

- i) **Space weather** is a key security issue for Europe that is most effectively studied through platforms in both Polar Regions. The same polar instrumentation also facilitates better understanding of the entire atmosphere and will lead to more reliable forecasting of climate and weather with societal and economic benefits for European countries.





European Polar Board membership

UNCERTAINTIES & OPPORTUNITIES

In our connected world, rapid change in the Polar Regions has implications for the rest of the globe. Our increasing knowledge of polar processes still has substantial uncertainties, including possible environmental tipping points (e.g. sea-ice, ice sheets, methane). Identifying and reducing these uncertainties is essential for more effective modeling and forecasting. The challenges and opportunities arising from the Polar Regions can be very effectively addressed by Europe through mechanisms such as the upcoming Horizon 2020 programme.

Europe has the European Polar Board (EPB) operating in both Polar Regions. It is the forum for all European polar science interests, including all key national ministries and agencies involved in funding polar science and the operators of polar logistics and infrastructures. With its recent reorganization and new Terms of Reference the EPB can play a valuable facilitator role for activities in both the Arctic and Antarctic under Horizon 2020.



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