WMO, Polar Code & Climate Change

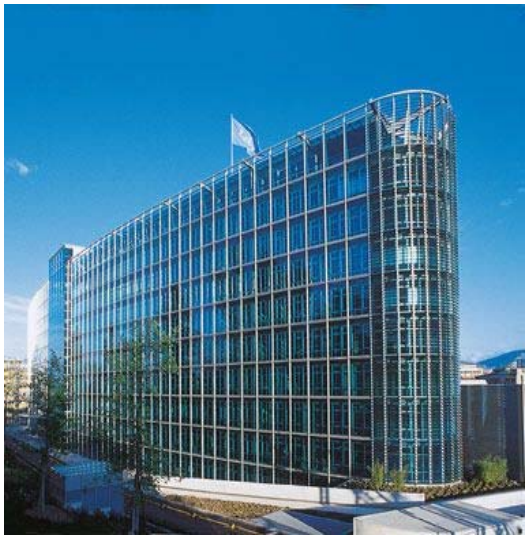
Prof. Petteri Taalas
Secretary-General

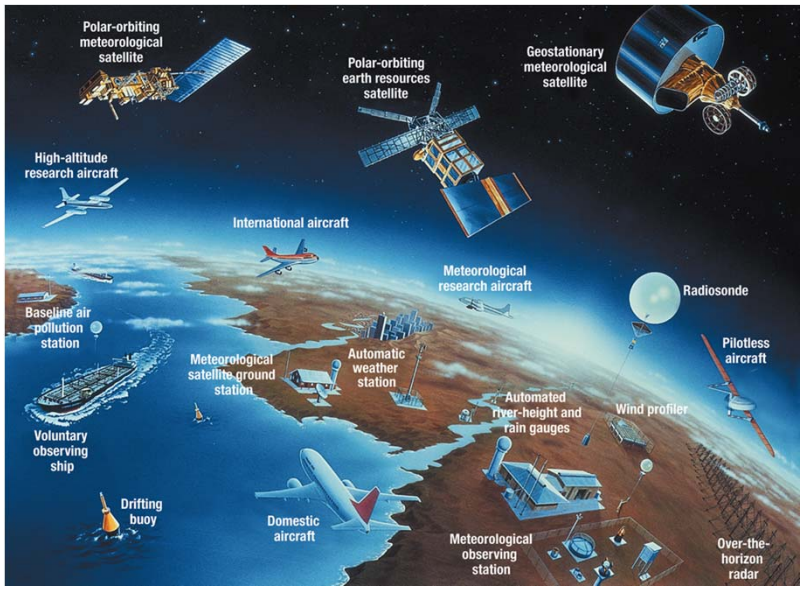
WEATHER CLIMATE WATER
TEMPS CLIMAT EAU

WMO OMM

World Meteorological Organization
Organisation météorologique mondiale

World Meteorological Organization





- UN Specialized Agency on weather, climate & water
- 191 Members, HQ in Geneva
- 2nd oldest UN Agency, 1873-
- Coordinates work of > 200 000 national experts from meteorological & hydrological services, academia (& private sector)
- Co-Founder and host agency of IPCC (1st World Climate Conference)
- Co-Founder of UNFCCC (2nd World Climate Conference)

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WMO Mission/key activities

1. World climate
2. Weather, disasters & safety
3. Water resources
4. Data & technology
5. Strengthening of the national service capabilities
6. Earth system research
7. Efficient governance

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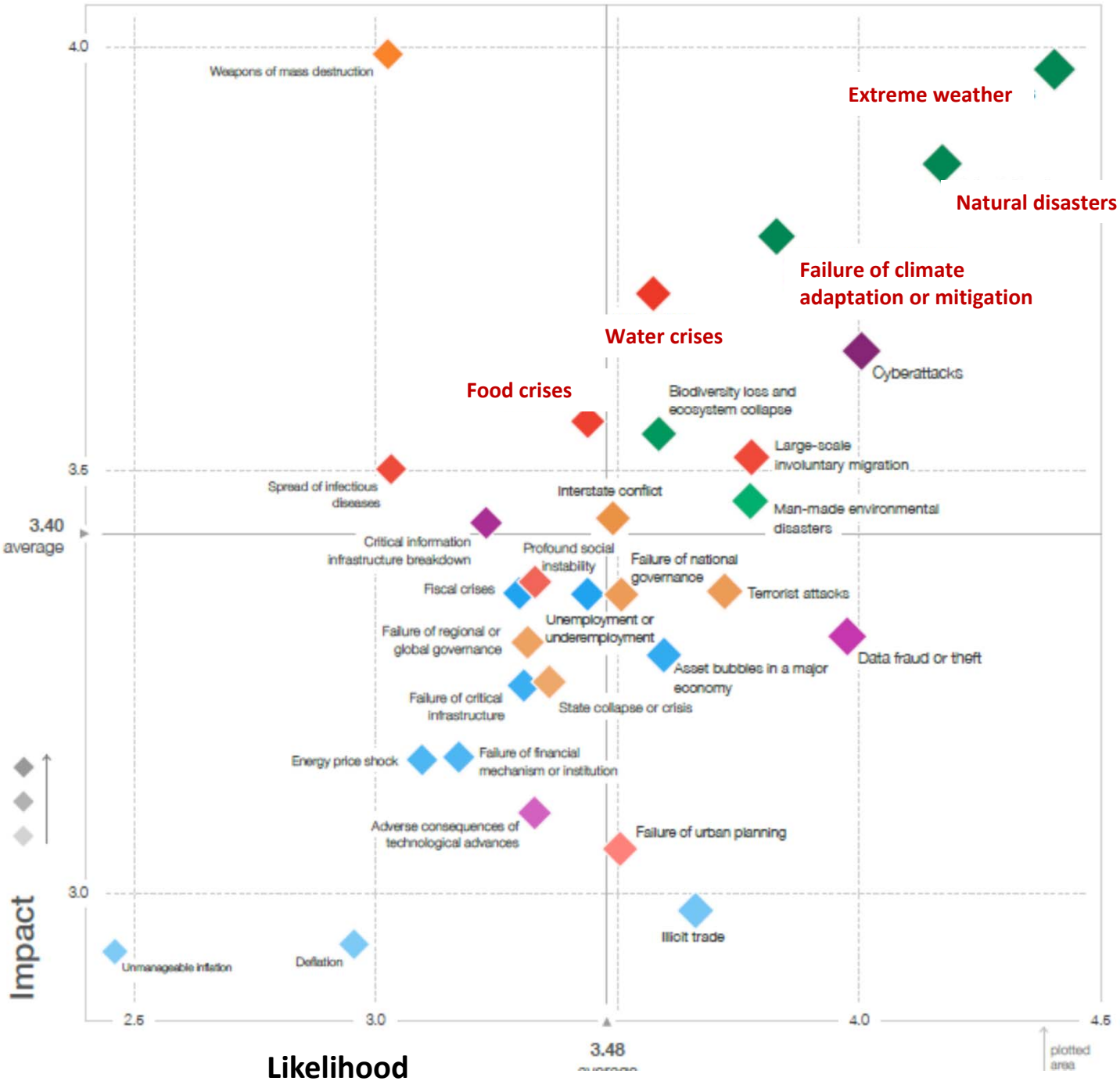
Global risks landscape 2018

World Economic Forum



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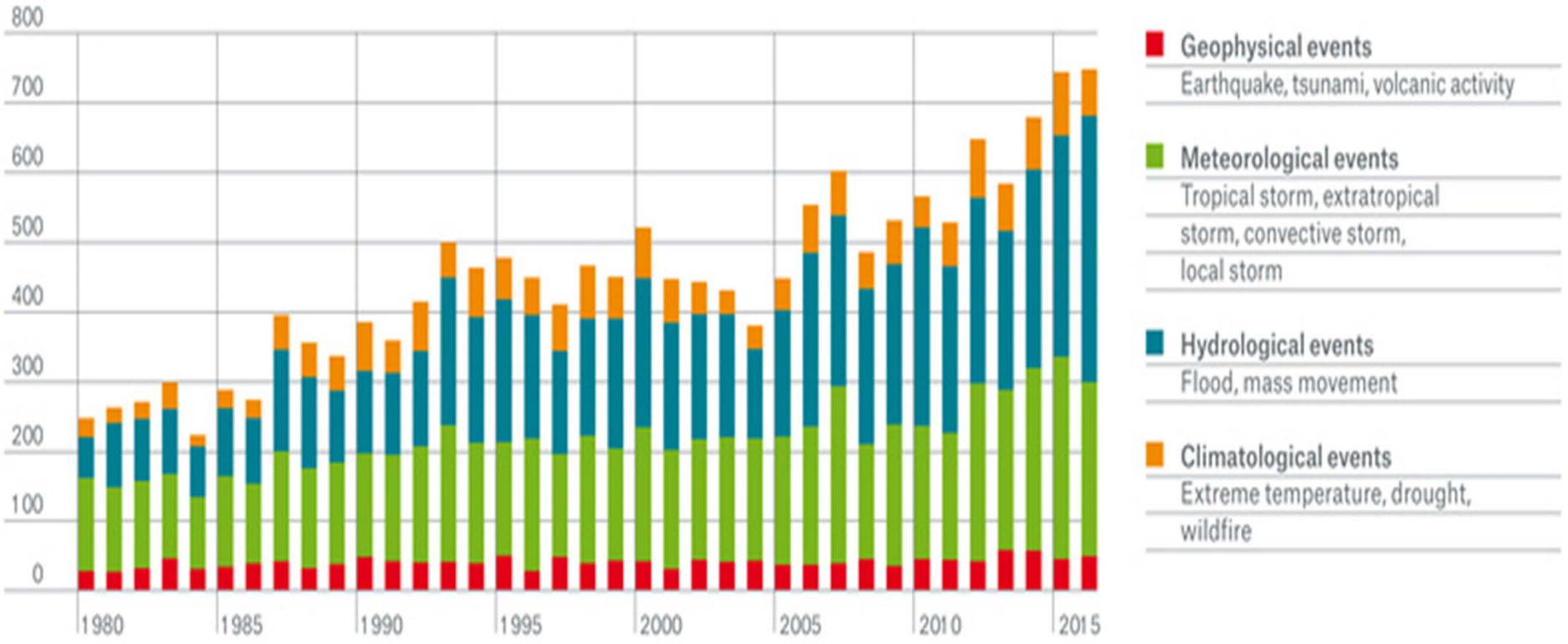
Growing number of weather related disasters 1980-2016



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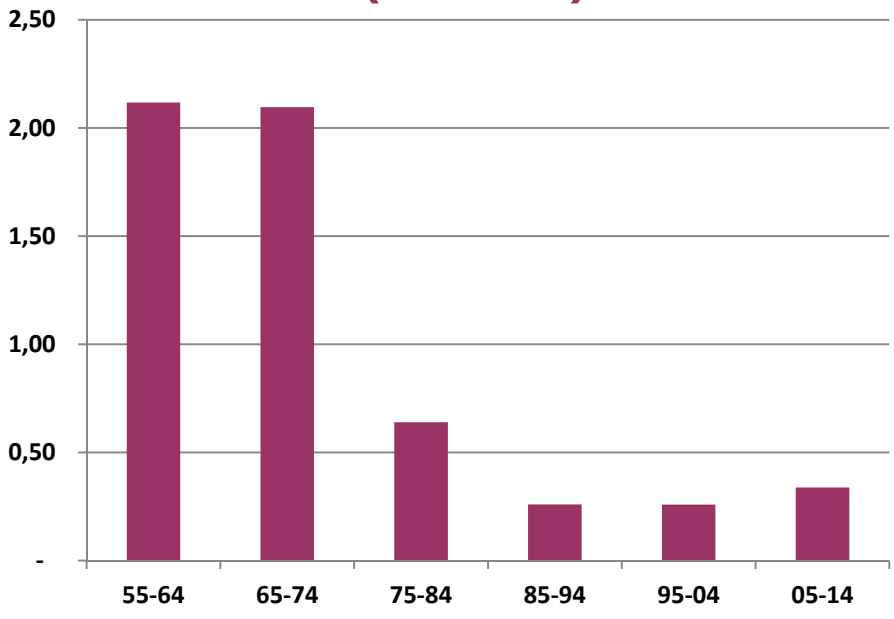
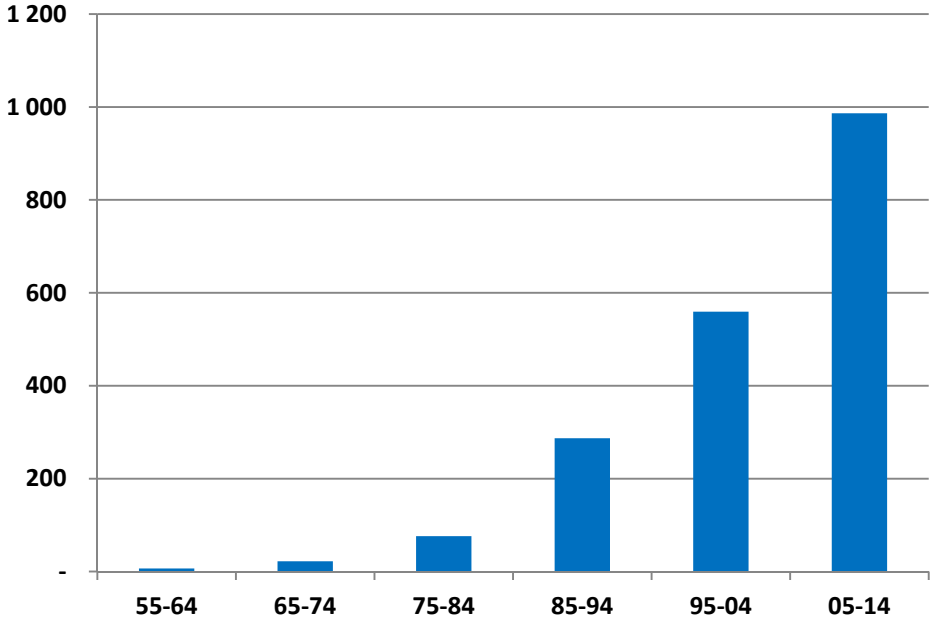
Impacts of hydrometeorological and climatological hazards (1955–2014)

Human losses by decade (millions)



Economic losses by decade (billions of US$ adjusted to 2013)



Reduction of the number of victims thanks to greater effectiveness of early warning systems and prevention measures

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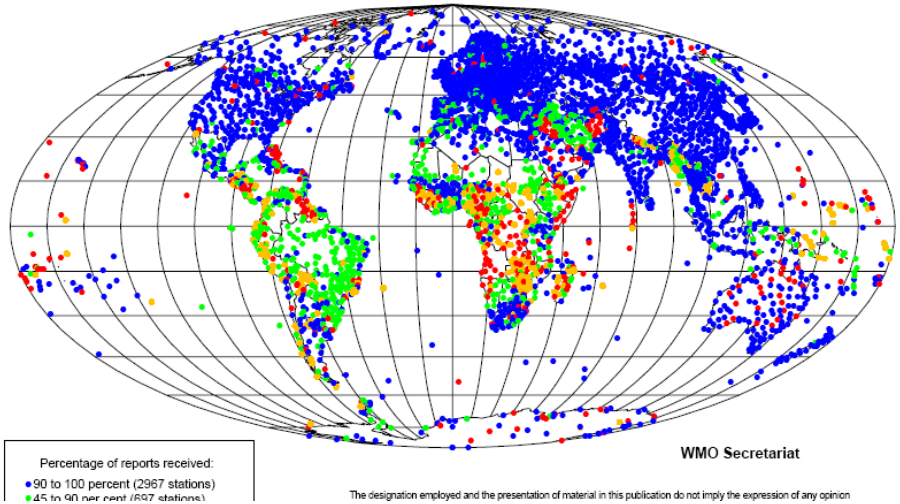
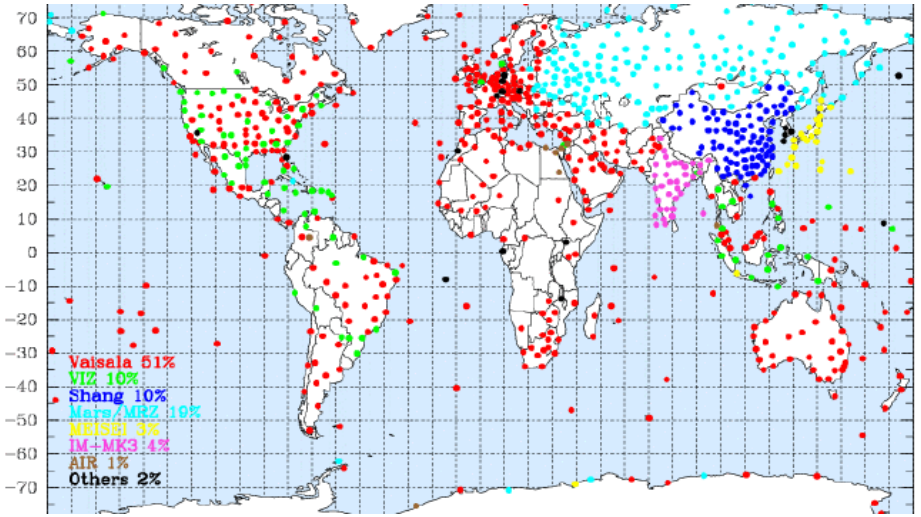
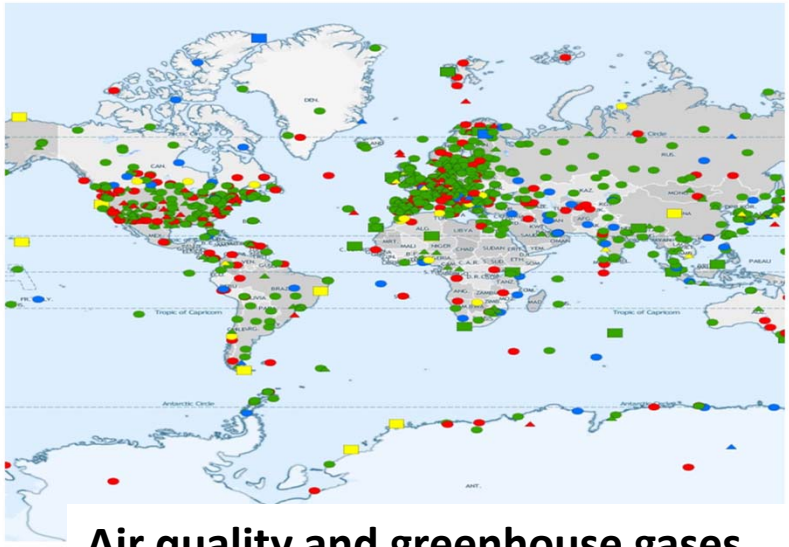
WMO Global Observing Networks >10000 stations



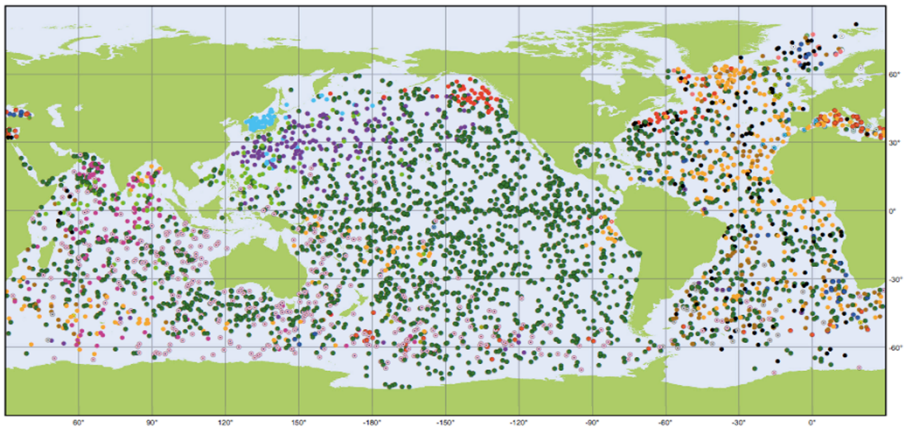
Surface observations



Balloon soundings

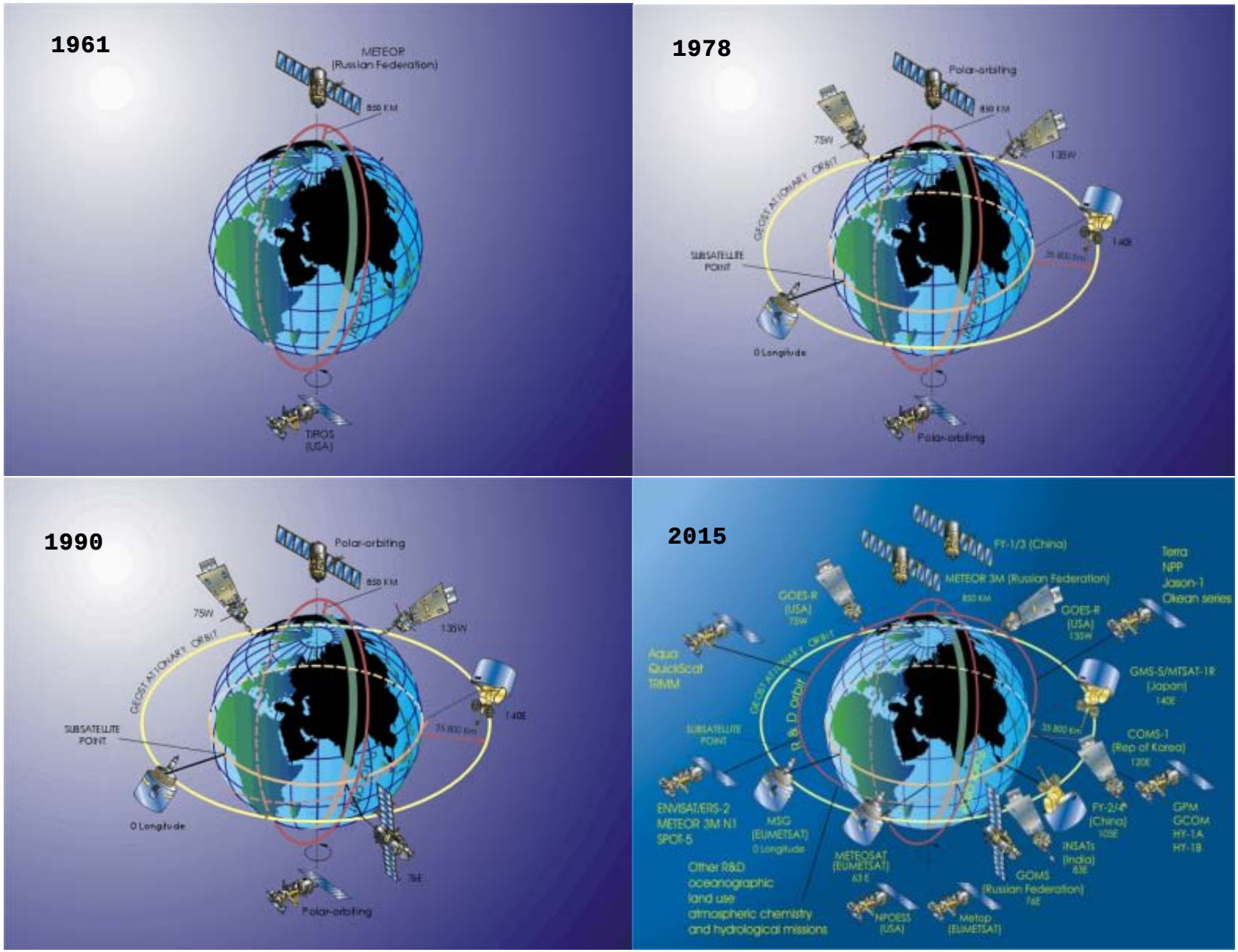


Air quality and greenhouse gases

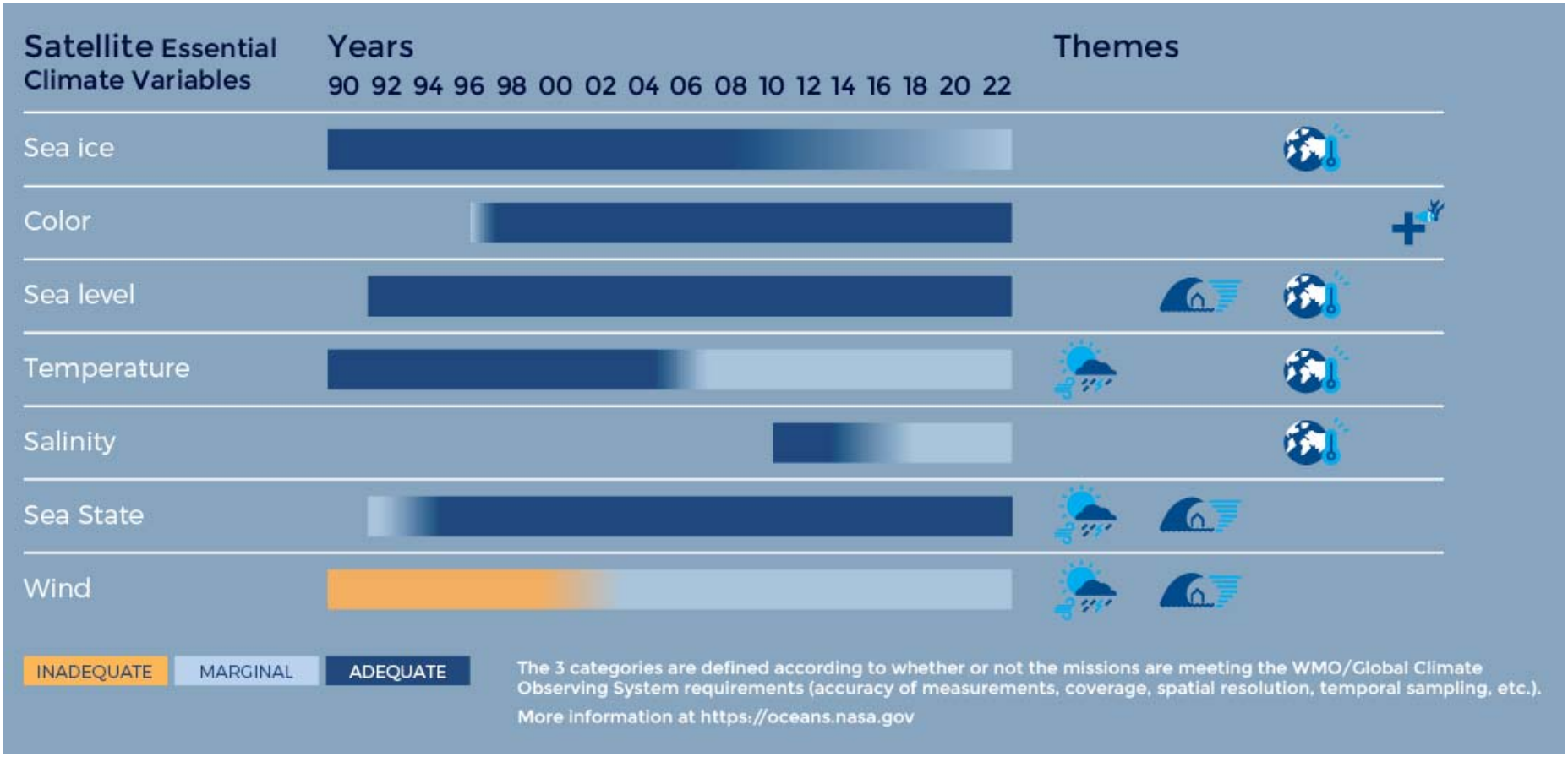


Ocean weather (with IOC UNESCO)

WMO Satellite Observations



Status of satellite essential variables



jcommops

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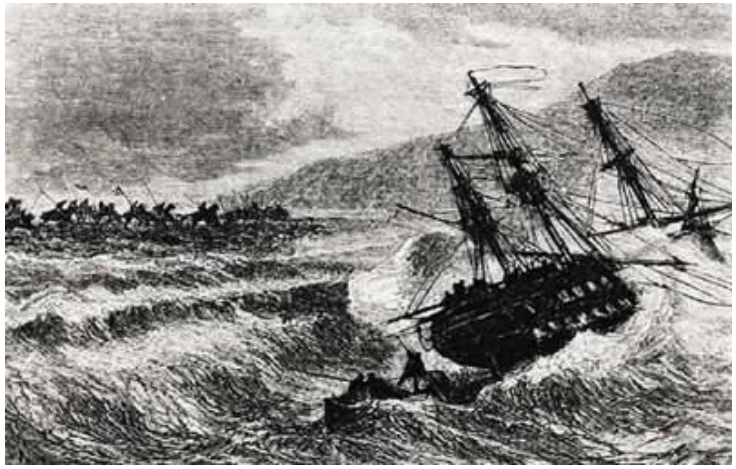
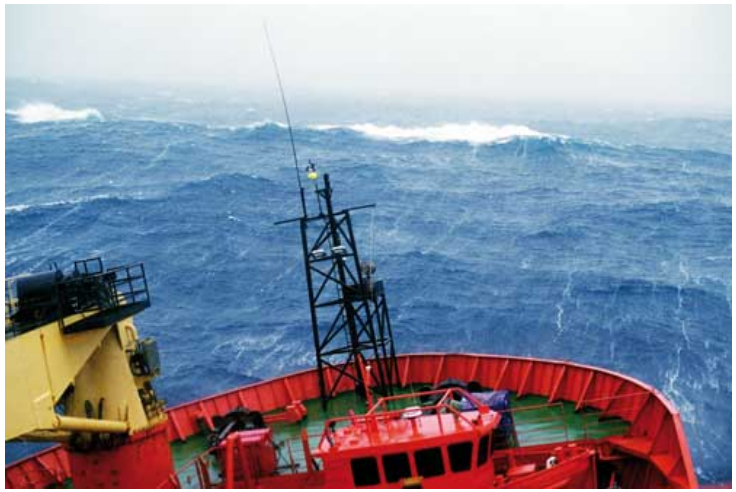
History of IMO/WMO – Safety at sea





- One of major original drivers for the organization concerned the **weather over the sea areas of the world for the maritime safety**
- The need for **reliable and regular information** about the weather over the sea areas of the world led to the recognition of the need for **international cooperation**, and hence the organizing of the First International Meteorological Conference, which took place in Brussels in August 1853

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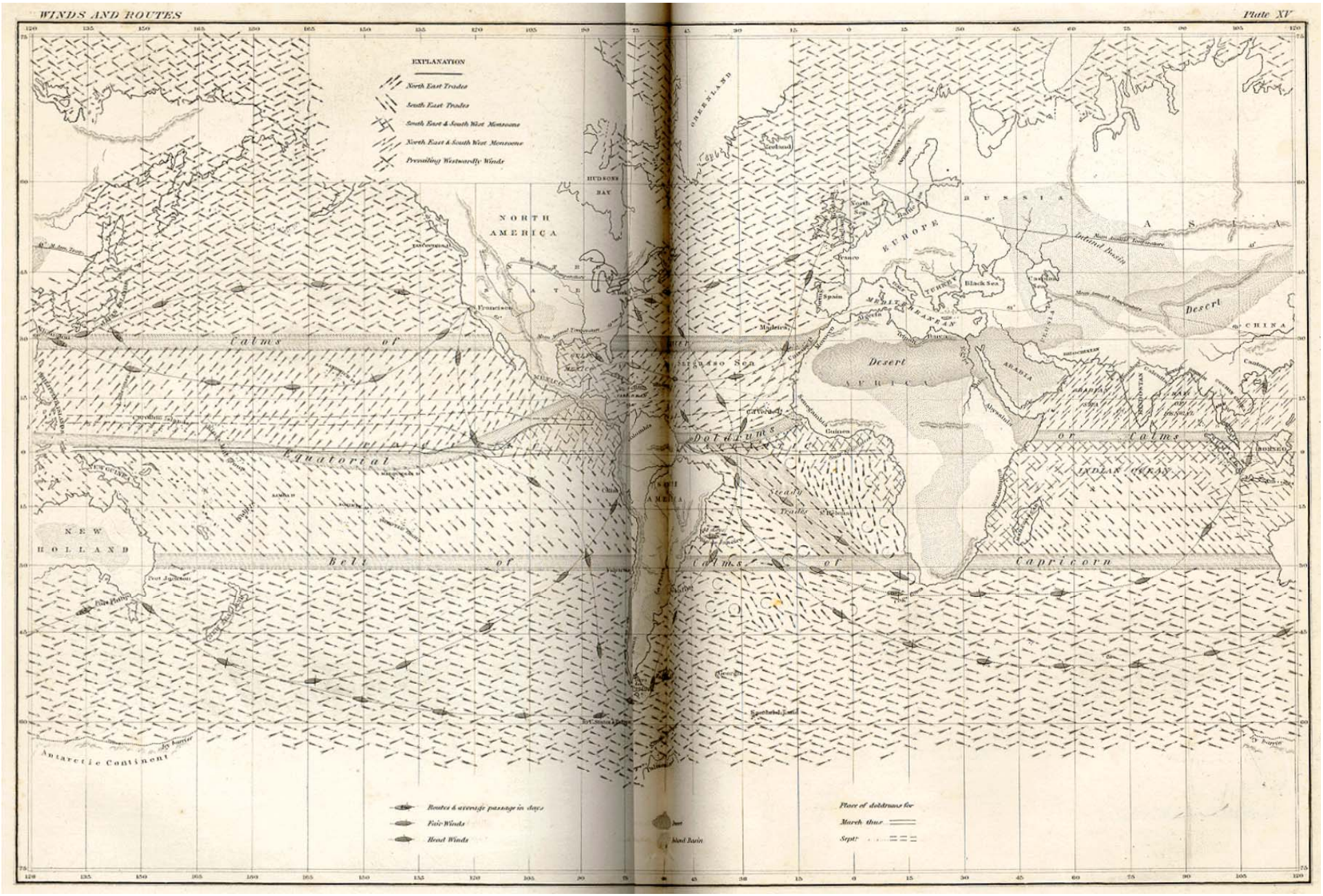
Lt. Maury's (1806-1873) chart of winds and ocean routes



Importance of meteorology for safe shipping in polar waters

- Climate change and accelerating sea-ice melt in polar regions are:
  - Opening up new polar shipping routes and increasing summer availability to traditionally ice-locked areas
  - Increasing polar tourism
- Reliable marine weather forecasts and knowledge of state of the sea and sea-ice are crucial for safe navigation and planning voyages in Polar waters
- Specialist skills in ice navigation are needed to support safe passage of ships in polar waters
- Challenges of weather, communications and positioning (e.g. poor satellite coverage) - the polar regions may become one of the highest risk areas in the world for safety of life and property at sea

United Nations General Assembly 2017
Resolution 72/73 – Oceans and the law of the sea

159. *Also recognizes* the importance of navigational warning services based on marine meteorological data for the safety of ships and lives at sea and the optimization of navigation routes, and notes the collaboration between the World Meteorological Organization and the International Maritime Organization for the enhancement of these services and their extension to the Arctic region;

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SOLAS and WMO's role

- *UN International Convention for Safety of Life At Sea* (SOLAS): **WMO's obligation** is to support the provision of *Maritime Safety Information* (MSI) via the *Global Maritime Distress Safety System* (GMDSS), and more specifically delivered by the *IMO/WMO WorldWide Met-Ocean Information & Warning Service* (WWMIWS).

- To effectively manage this provision of MSI, the world's oceans are divided into regions - METAREAS – to which specific warnings are delivered

- A METAREA Coordinator is responsible to coordinate the provision of the WWMIWS for their METAREA. The National Meteorological and Hydrological Services (NMHS) in each METAREA are the responsible issuing service, for forecasts and warnings to reach vessels in their METAREA

- 10 METAREAS (out of 21) cover polar waters, with Coordinators from Norway, Russian Federation, Canada, Chile, Argentina, South Africa, Australia, New Zealand

- WMO METAREAS align directly with the IMO/IHO NAVAREAS (areas for issuing navigation warnings)

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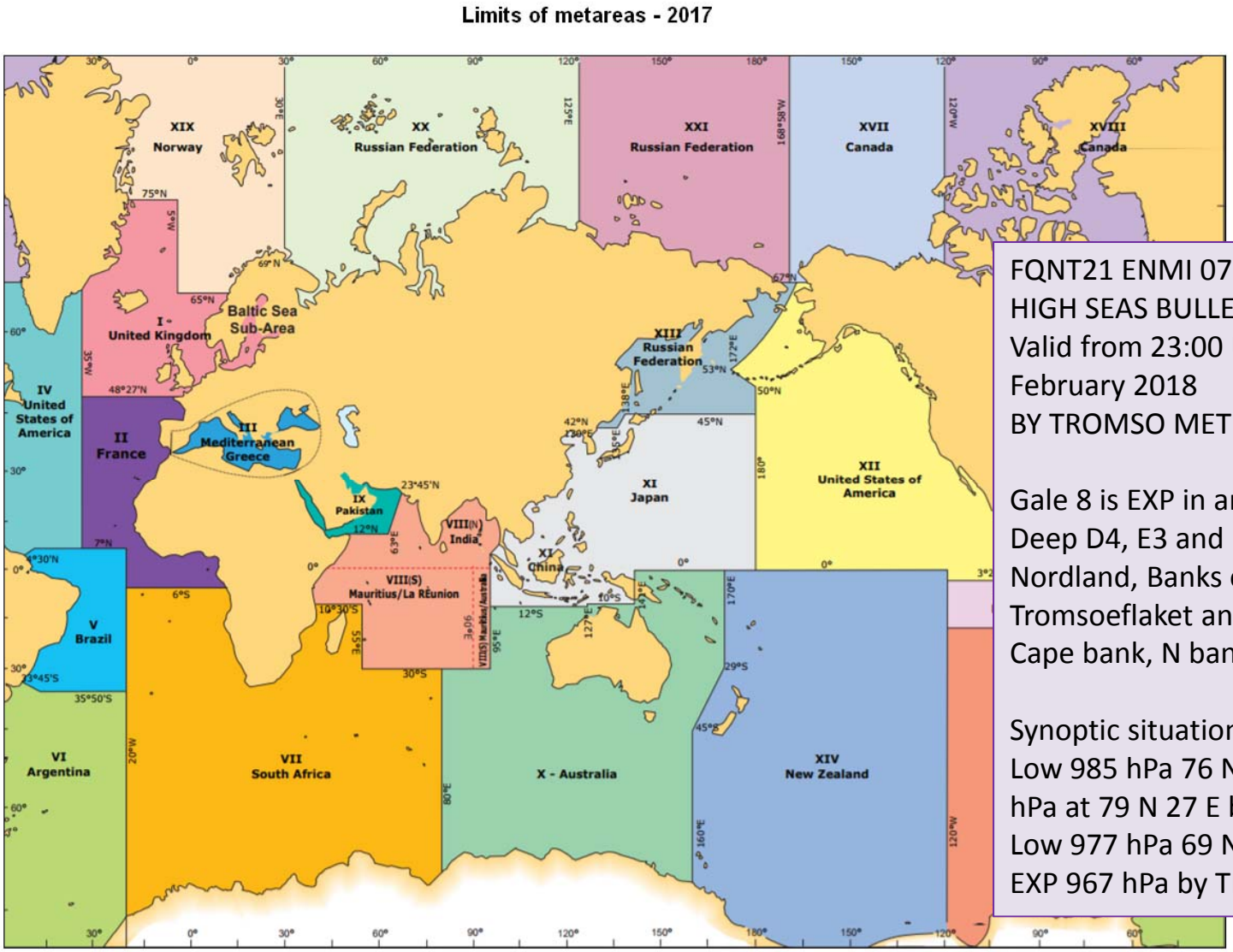
Global Maritime Distress and Safety System



FQNT21 ENMI 072300
HIGH SEAS BULLETIN FOR METAREA 19
Valid from 23:00 UTC on Wednesday 7 February 2018
BY TROMSO METEO, NORWAY

Gale 8 is EXP in areas: B1, B2, C2, D2, D3, Deep D4, E3 and Deep E4, Banks outside Nordland, Banks outside Troms, Tromsoeflaket and Hjelmsoey bank, N Cape bank, N bank and Kildinbank

Synoptic situation at 18 utc
Low 985 hPa 76 N 13 E Mov Ne, EXP 990 hPa at 79 N 27 E by THU 18 utc.
Low 977 hPa 69 N 17 W almost STNR, EXP 967 hPa by THU 18 utc.

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WMO METAREAS align with IMO NAVAREAS

International Convention for the Safety of Life at Sea, SOLAS

Chapter V , Safety of navigation, Regulation 5 - Meteorological services and warnings

Parties are obliged to provide meteorological information and warnings to shipping:

- **Warning ships** of gales, storms and tropical cyclones
- Issuing, at least twice daily, **weather information suitable for shipping** containing data, analyses, warnings and forecasts of weather, waves and ice
- **Publications for the efficient conduct of meteorological** work at sea and daily weather charts for the information of departing ships.
- Ships to be equipped with **marine meteorological instruments** and to take, record and transmit meteorological observations at standard times for surface synoptic observations
- In case of a **tropical cyclone**, ships to take and transmit their observations at high intervals
- Masters to inform ships in the vicinity and also shore stations whenever they experience a **wind speed of 50 knots or more**
- A **uniform procedure for international meteorological services already** specified and conformity with to the technical regulations and recommendations made by WMO.
- Forecasts, warnings, synoptic and other meteorological data intended for ships to be issued and disseminated by the NMS in the best position to serve various coastal and high seas areas, as defined by the **WMO System for the Preparation and Dissemination of Meteorological Forecasts and Warnings for the High Seas under the Global Maritime Distress and Safety System (GMDSS)**

IMO

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Polar Code and WMO

- The Polar Code specifically targets safe ship operation and protection of the Polar environment by addressing risks present in Polar waters and not adequately mitigated by other instruments.

- Chapters 9 and 11 most relevant to WMO, related to:
  - Safety of Navigation – ensuring ships are able to receive up to date marine weather and in particular sea-ice conditions; &
  - Voyage Planning – ensuring ship Master and crew have adequate information to plan a voyage, especially related to extent and type of ice and icebergs in the vicinity of the intended route; and statistical information on ice and temperatures from former years;

- Training and capacity development for the shipping community, and how to interpret and understand met-ocean information is essential

Polar Code: challenges

- The Polar Code DOES NOT contain competency standards for ice-navigation. This should be addressed in the future, and could link to WMO's current mission to introduce and ensure Member's meet marine forecasting competency standards

- The area of the Polar Code is geographically limited and could be extended to include other areas of high traffic density, also subject to ice-conditions

- Independent communication systems and data accessibility should be harmonized to ensure the best and most up to date met-ocean (especially sea-ice) information is available to all ships in the Polar Region

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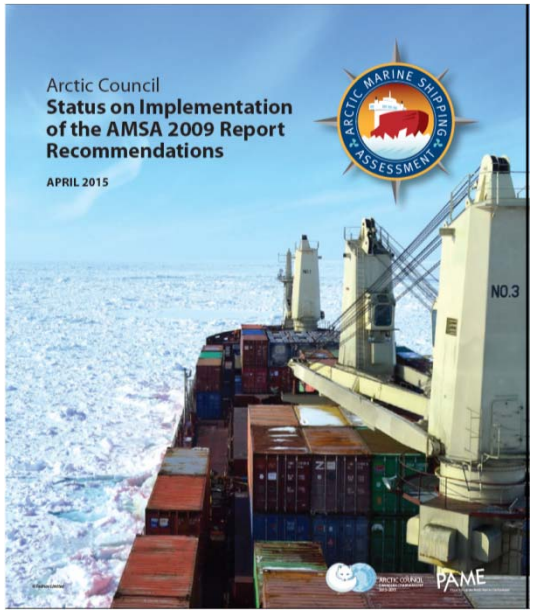
Implementation of AMSA 2009 recommendations



A WORKING GROUP OF THE ARCTIC COUNCIL

THEME I — Enhancing Arctic Marine Safety

I(A). Linking with International Organizations

Arctic states to identify areas of common interest and develop unified positions and approaches with respect to IMO, IHO, WMO and IMSO to advance the safety of Arctic marine shipping …

THEME III — Building the Arctic Marine Infrastructure

III(A). Addressing the Infrastructure Deficit

Arctic states to recognize that improvements in Arctic marine infrastructure are needed to enhance safety and environmental protection in support of sustainable development.

USA, Canada, Iceland, Norway and Sweden submitted an information paper (NCSR 1/27/3, 25 April 2014) to the 1st session of the IMO's Sub-Committee on Navigation, Communications and Search and Rescue providing information on the WMO Voluntary Observing Ship (VOS) Scheme in the Arctic and encouraging increased participation in the VOS Scheme by all flag States.

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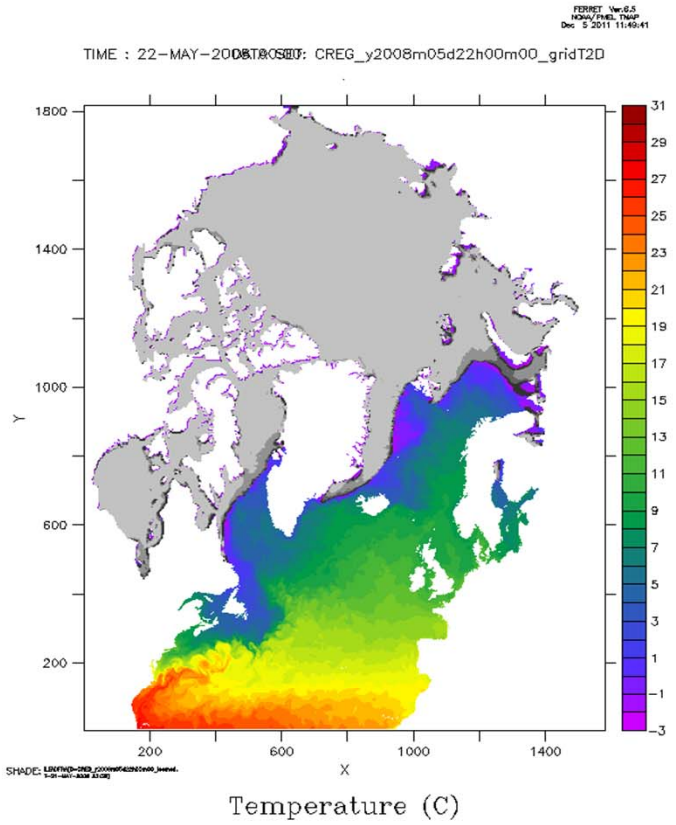
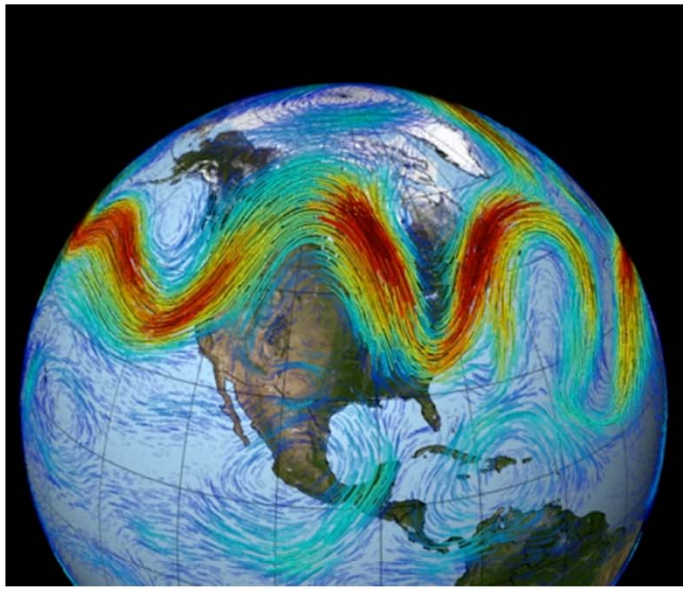
Designing an Arctic Prediction System

The Year of Polar Prediction



WMO Polar Prediction Project is launching a modelling and field campaign (Year of Polar Prediction, mid-2017 to mid-2019) assist planning an Arctic observational network for improving predictive capabilities



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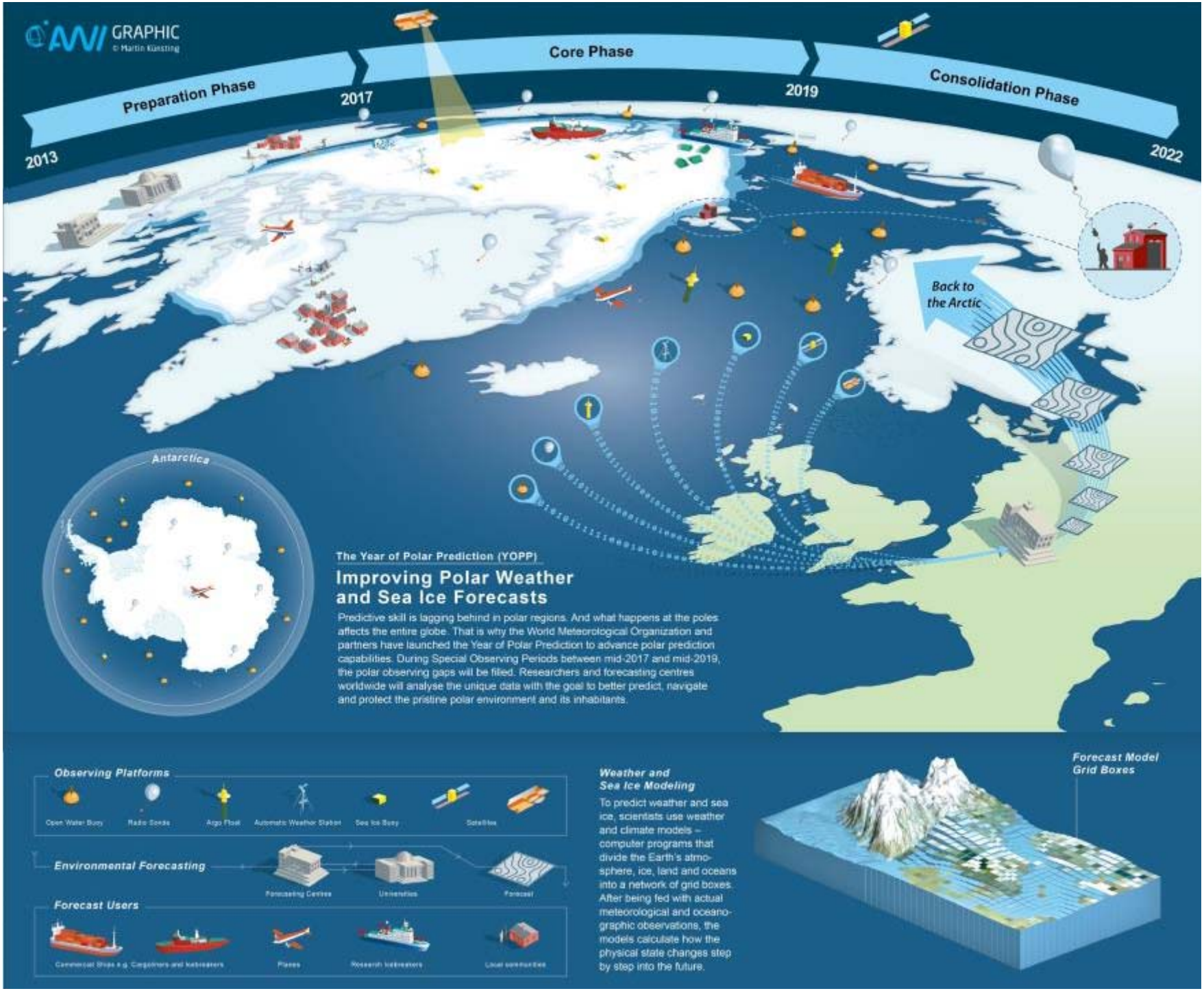
The field campaign



Recent WMO actions to support the Polar Code/1

- **Polar regions are normally data sparse** while additional data collected from these regions can have substantial impact on numerical weather forecasting and other WMO applications.

- In order to improve services provided by WMO Members to society, e.g. support to maritime transportation and safety, WMO welcomes changes that could be introduced in the polar code to promote (or make mandatory) the making of **cryosphere and weather observations from ships sailing in polar regions**.

- The WMO Executive Council Panel of Experts on Polar and High-mountain Observations, Research and Services (EC-PHORS), at its 7th meeting (Ushuaia, March 2017) requested its Observations Task Team to **collaborate with IMO to effect changes in Polar Code** to make cryosphere and weather observations mandatory.

Recent WMO actions to support the Polar Code/2

- International Ice Chart Working Group (IICWG) contributed to the development of the Polar Code
- At 40th Antarctic Treaty Consultative Meeting (Beijing, June 2017) WMO invited the ATCM and the Parties to consider promoting the concept of making the **collection and reporting of weather data mandatory in the Polar Code**.
- WMO have been working closely with the Protection of the Marine Environment (PAME) Secretariat to provide **information for the Arctic Shipping Best Practices Information Forum** in support of the Polar Code

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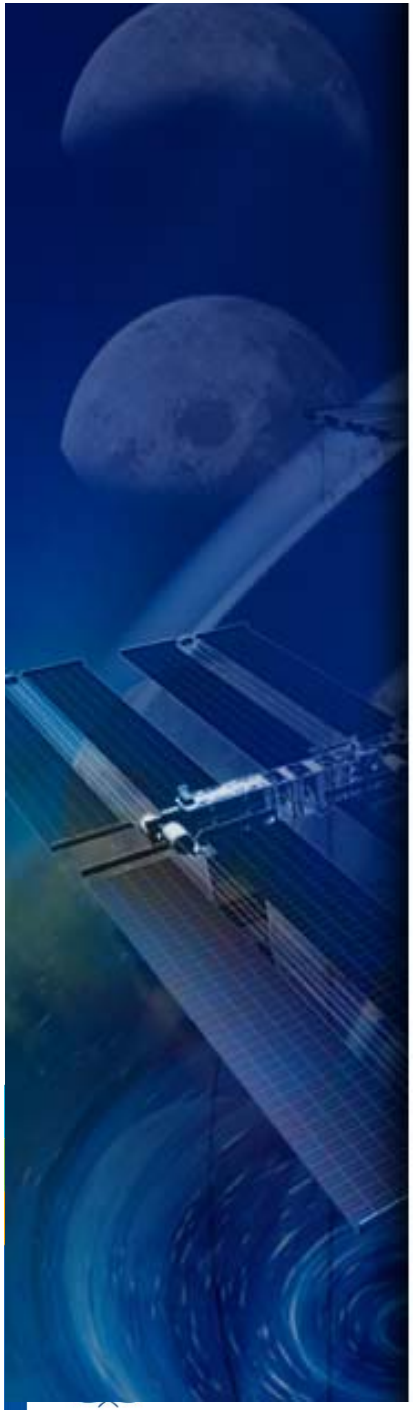
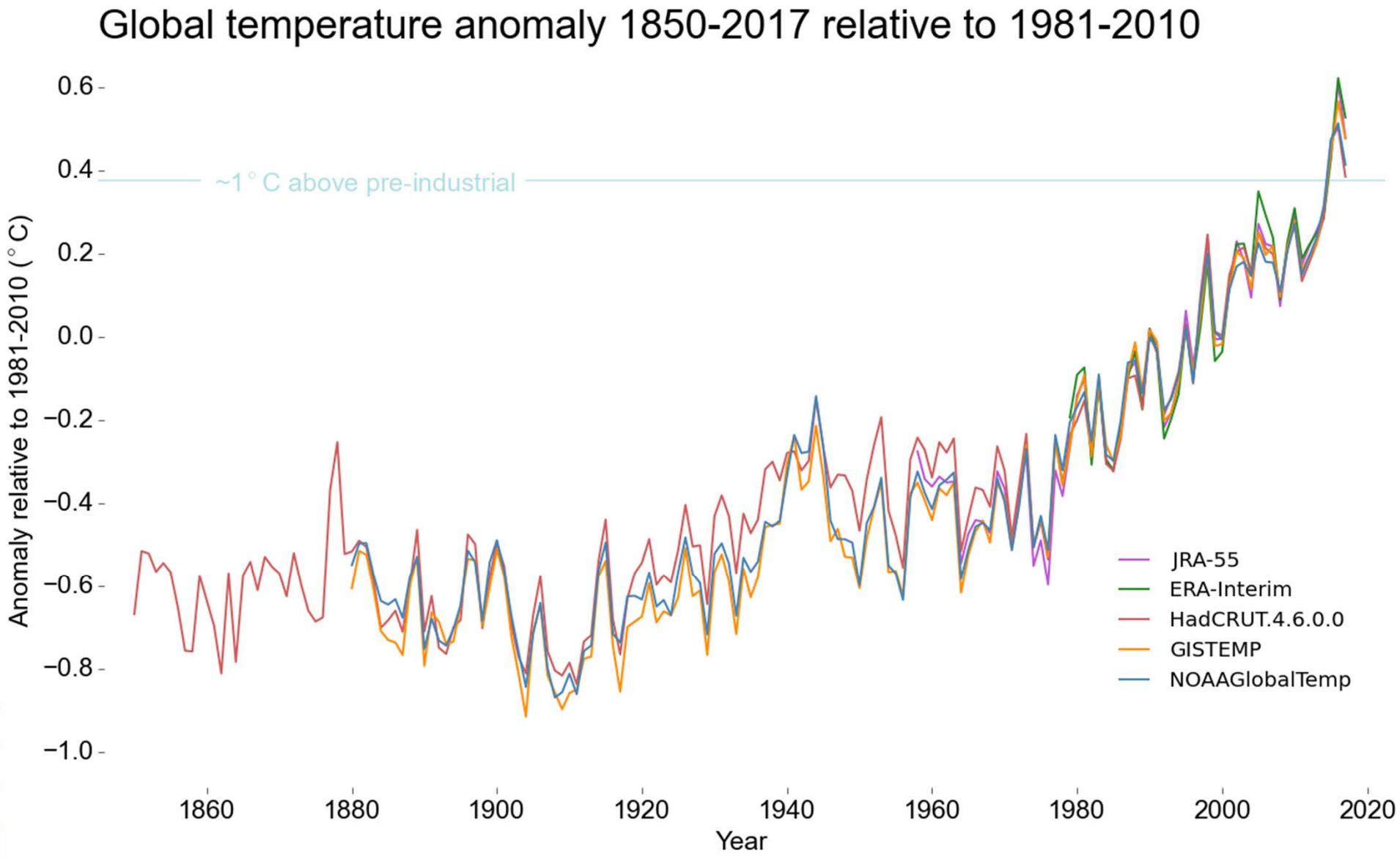


POLAR COMMUNICATIONS & WEATHER (PCW)/ POLARSAT MISSION

Canadian Space Agency | Agence spatiale canadienne

Canada

Global temperature 1850-2017



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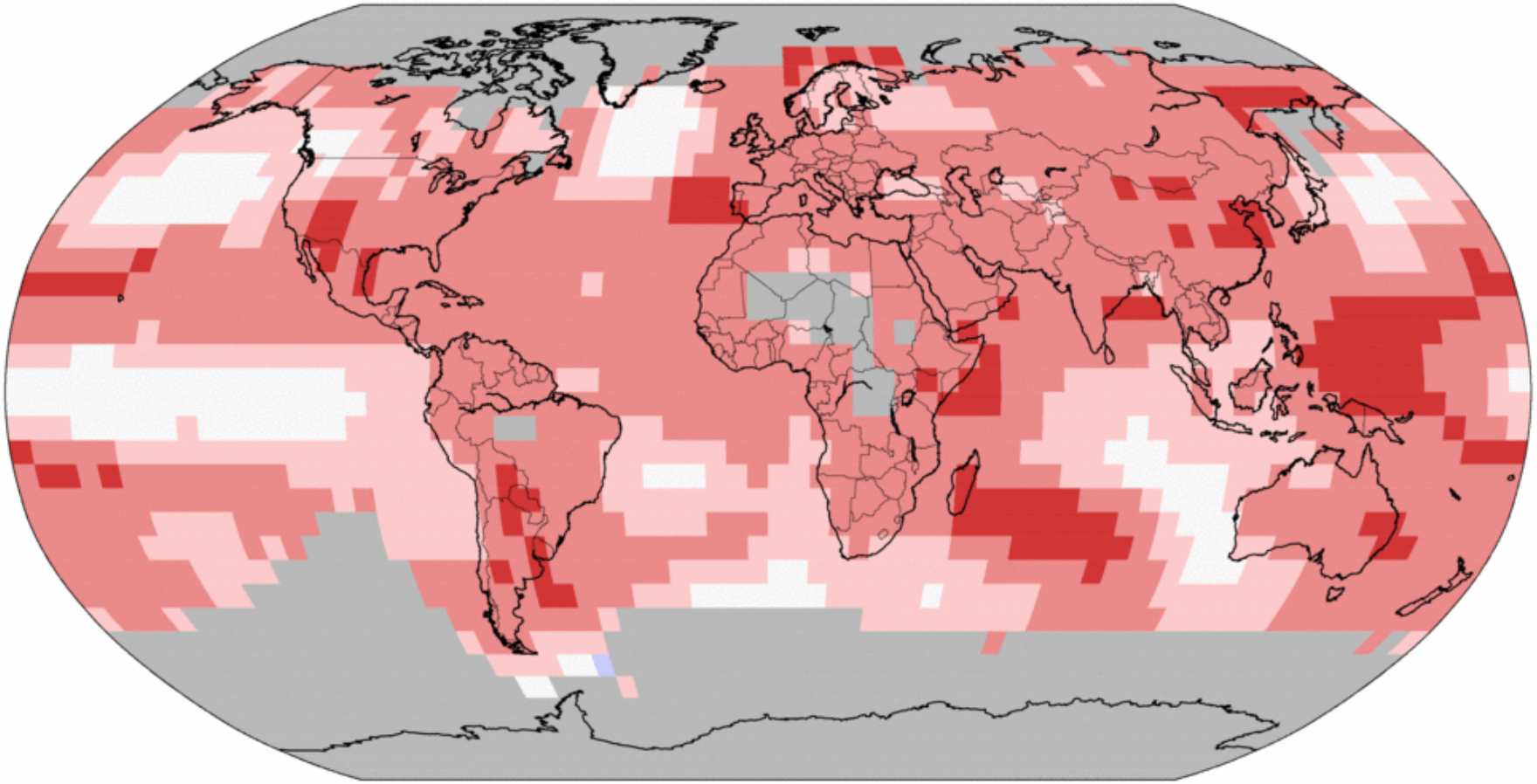
Land & Ocean Temperature Percentiles Jan–Dec 2017

NOAA's National Centers for Environmental Information

Data Source: GHCN–M version 3.3.0 & ERSST version 4.0.0

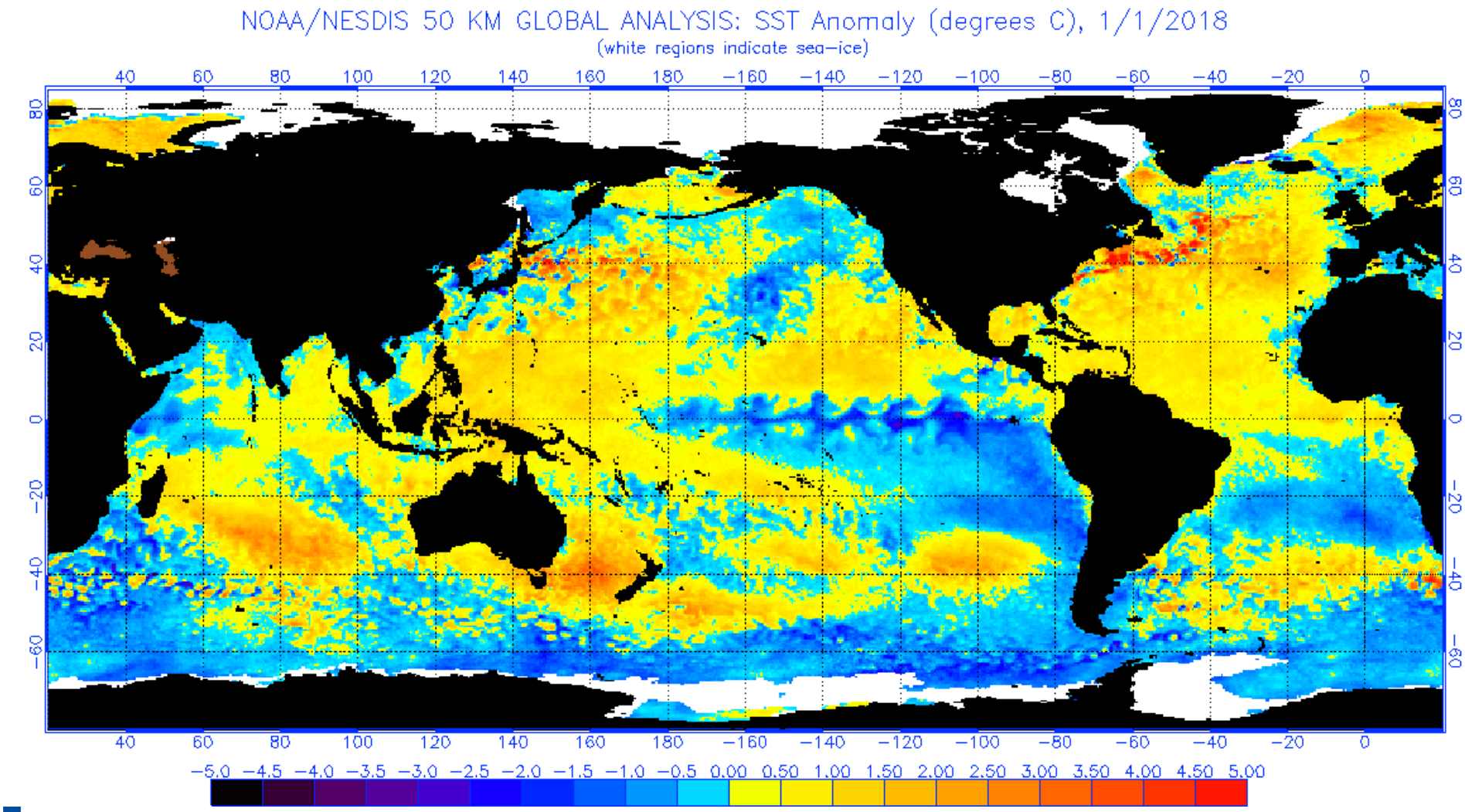


Record Coldest | Much Cooler than Average | Cooler than Average | Near Average | Warmer than Average | Much Warmer than Average | Record Warmest

Tue Jan 16 07:02:31 EST 2018

Sea surface temperature anomaly

Compared to long-term mean



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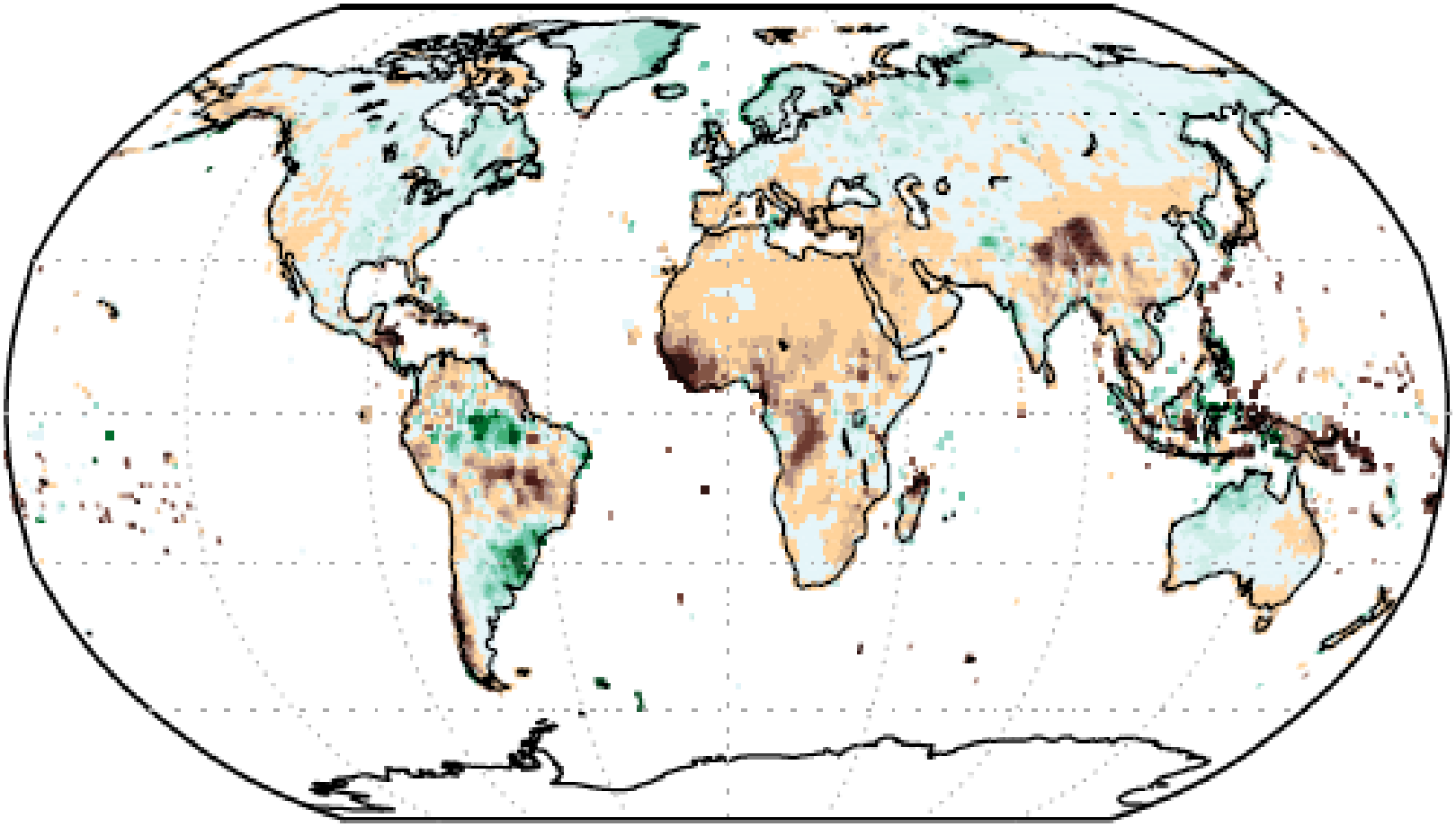
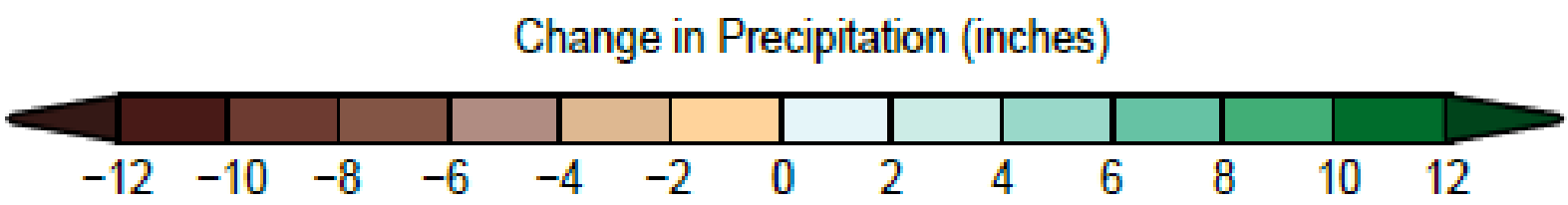
Global precipitation 1986–2015 vs. 1901–1960





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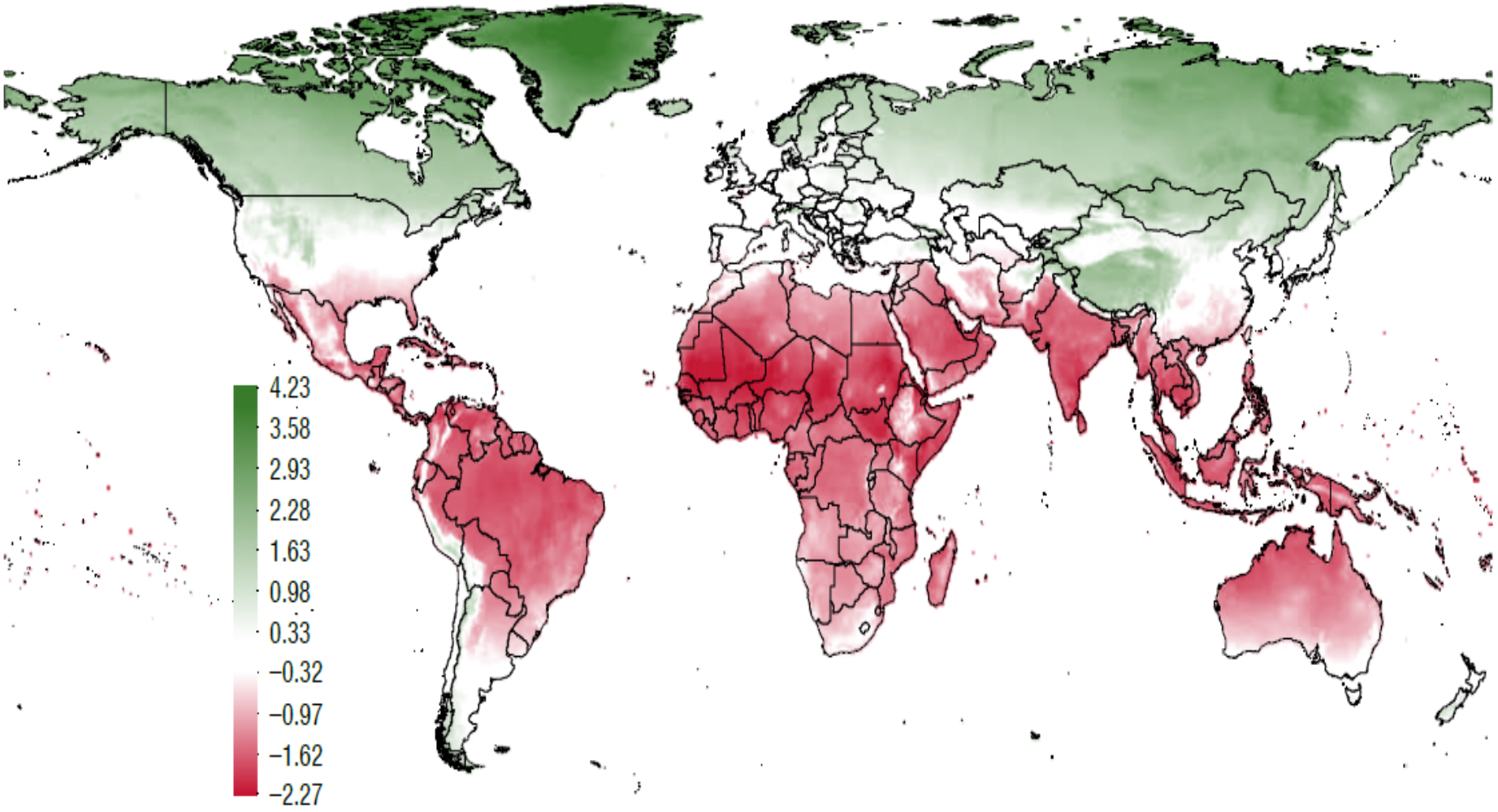
Effect of 1°C temperature increase on per capita output



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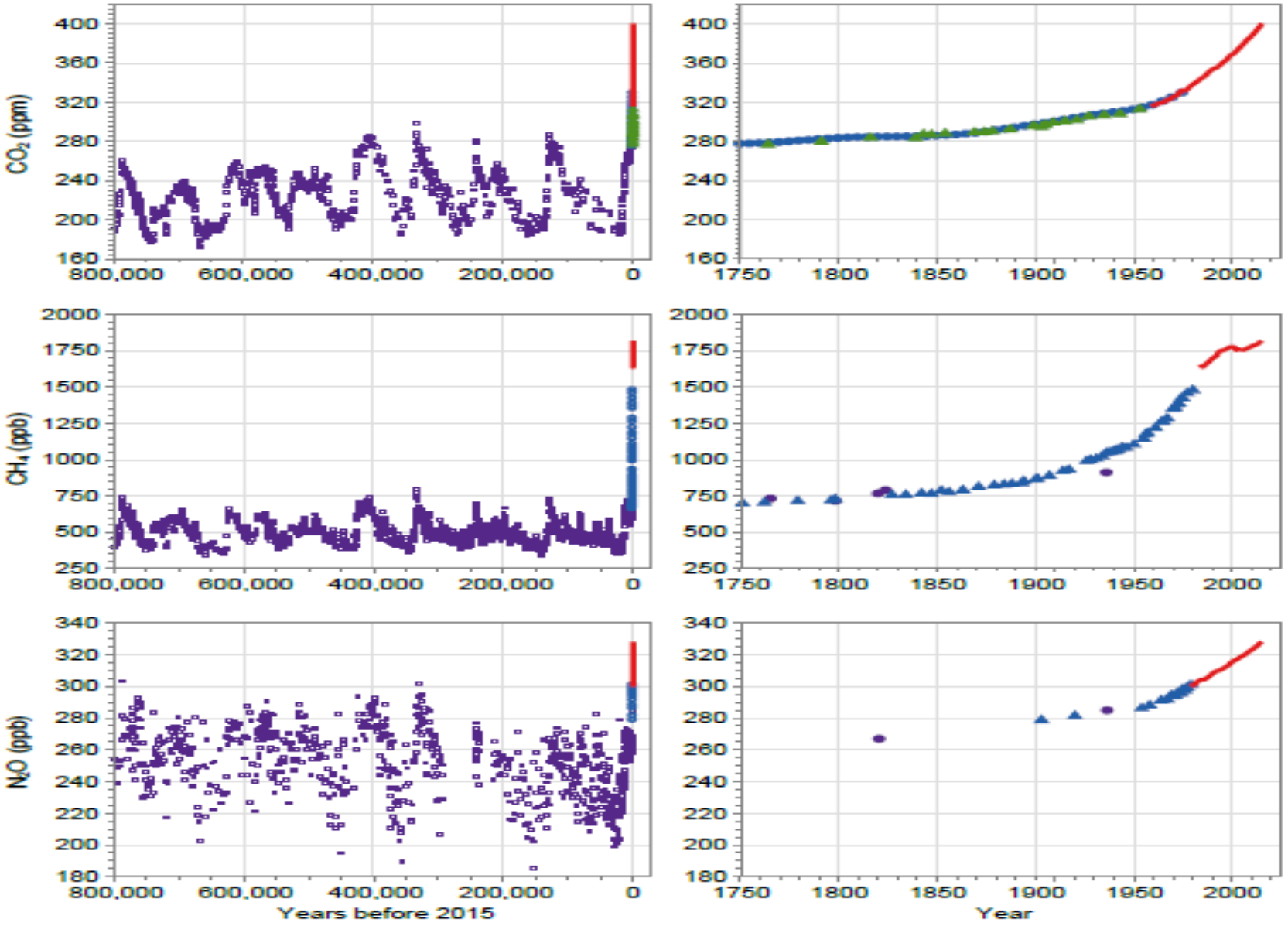
Source: International Monetary Fund (IMF) World Economic Outlook

CO_2, CH_4 & N_2O 800 000 BC-2016 AD



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GLOBAL CARBON PROJECT

Fate of anthropogenic CO_2 emissions (2007–2016)

Sources

34.4 $GtCO_2$/yr

88%

12%

4.8 $GtCO_2$/yr

= Sinks

17.2 $GtCO_2$/yr

46%

30%

11.0 $GtCO_2$/yr

24%

8.8 $GtCO_2$/yr

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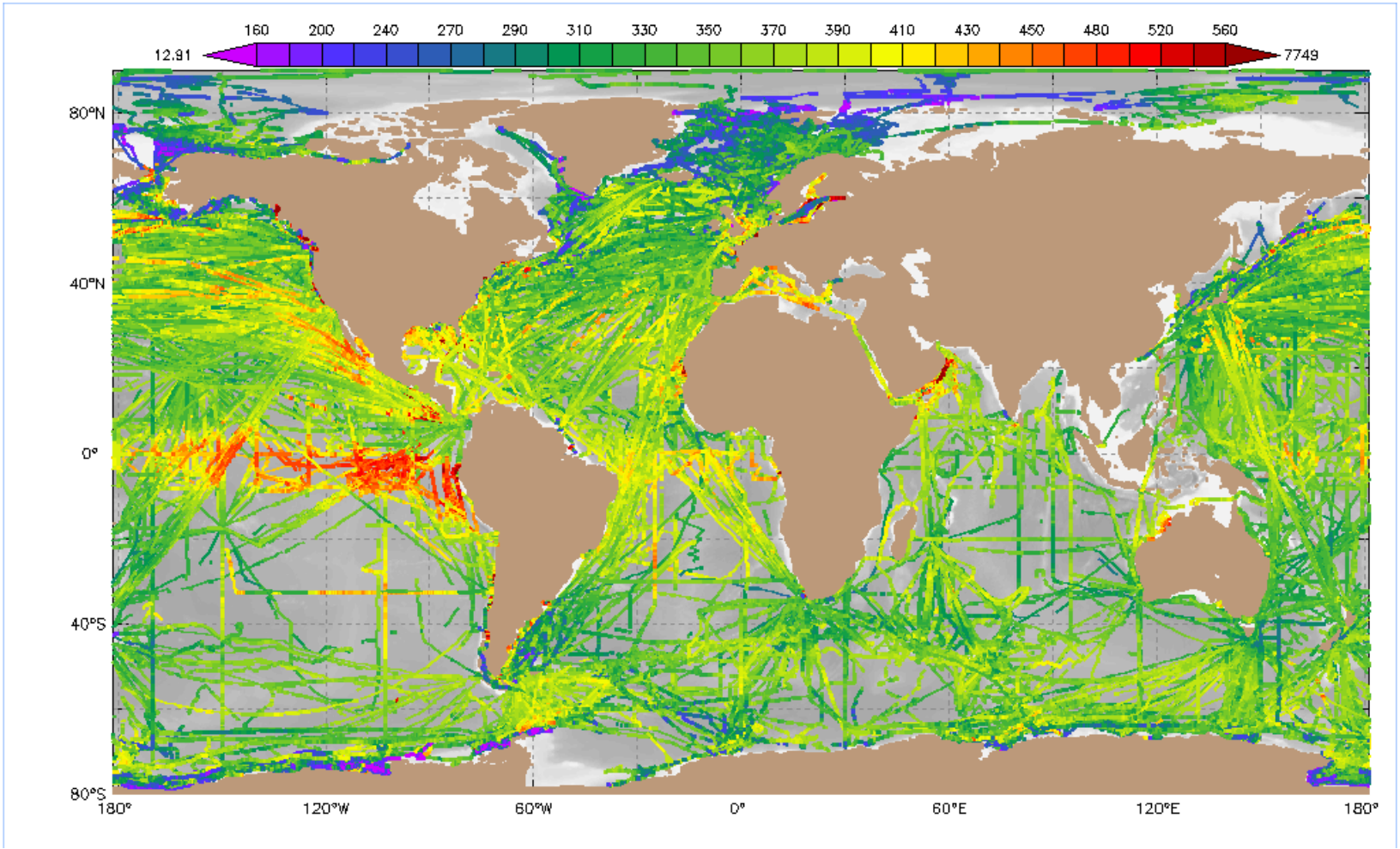
Budget Imbalance:

(the difference between estimated sources & sinks)

6%

2.2 $GtCO_2$/yr

Ocean Acidification



Ocean acidification is a global problem that threatens marine organisms, ecosystems, services and resources and that has potentially considerable ecological and socio-economic consequences (food security, livelihood of fishing communities)

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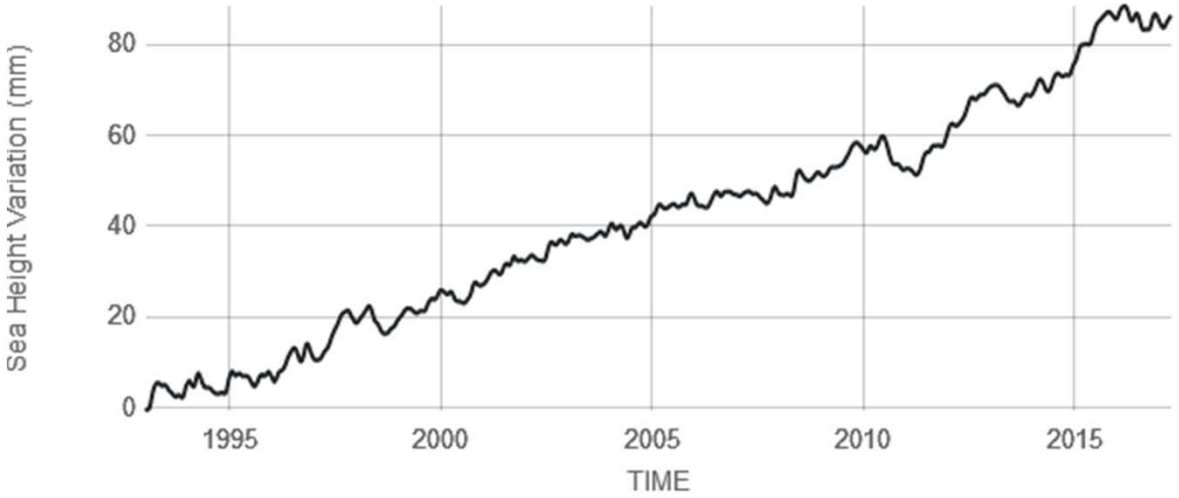
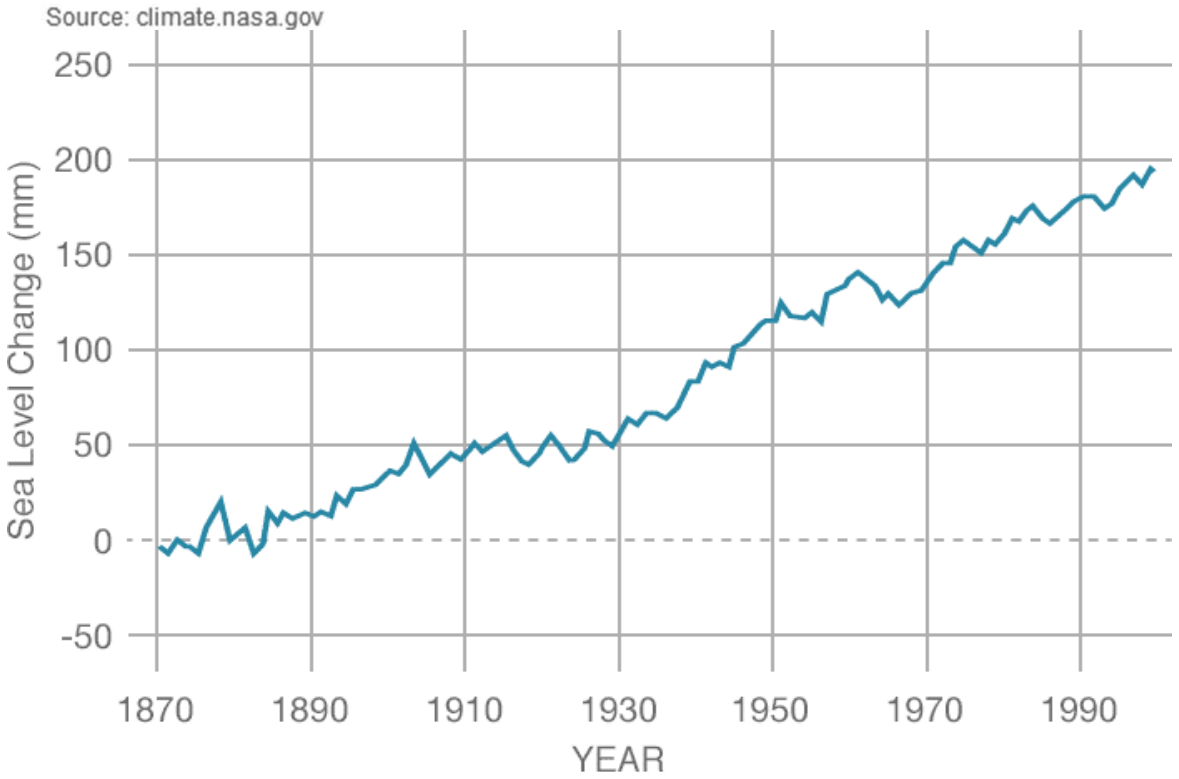
DATA SET: SOCAT v4 Data Collection
VARIABLE: fCO2 recommended (µatm)
01-Jan-1957 00:00 to 31-Dec-2016 00:00

Global sea level rise: + 26 cm 1870-2017

NASA-EUMETSAT Satellites (1993-present)



Tide gauges (1870-2000)



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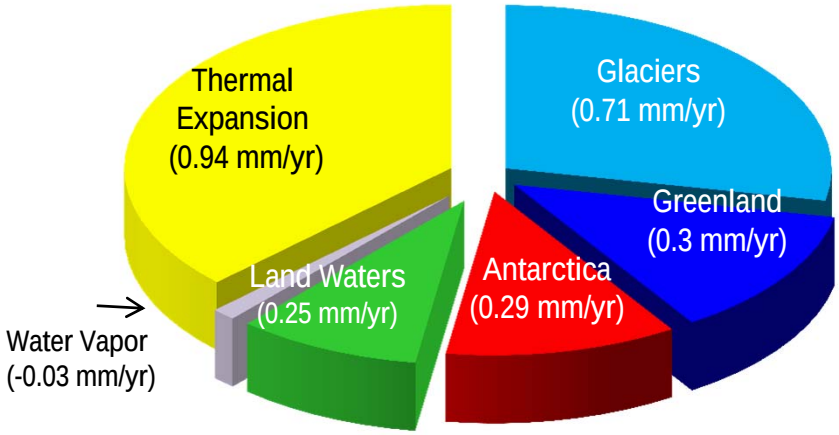
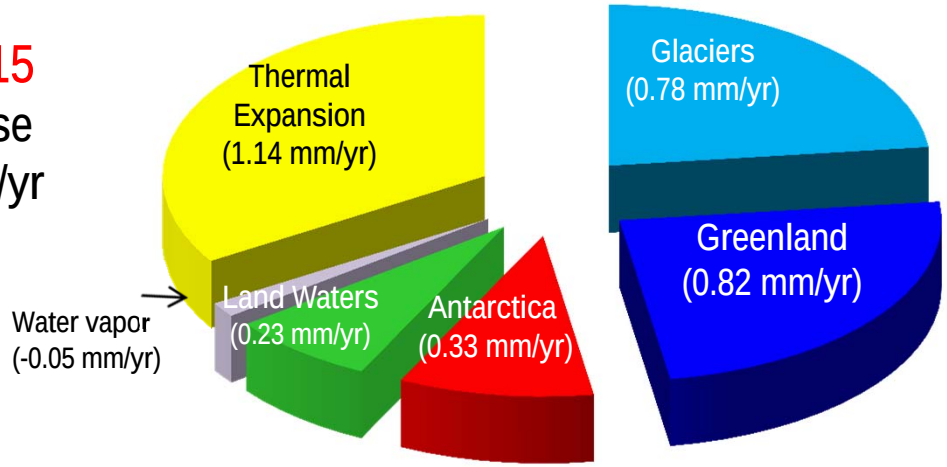
Contributions to global sea level rise

1993-2004
GMSL rise
= 2.7 mm/yr



→ *Total land ice: 47%*

2004-2015
GMSL rise
= 3.5 mm/yr



→ *Total land ice: 55%*

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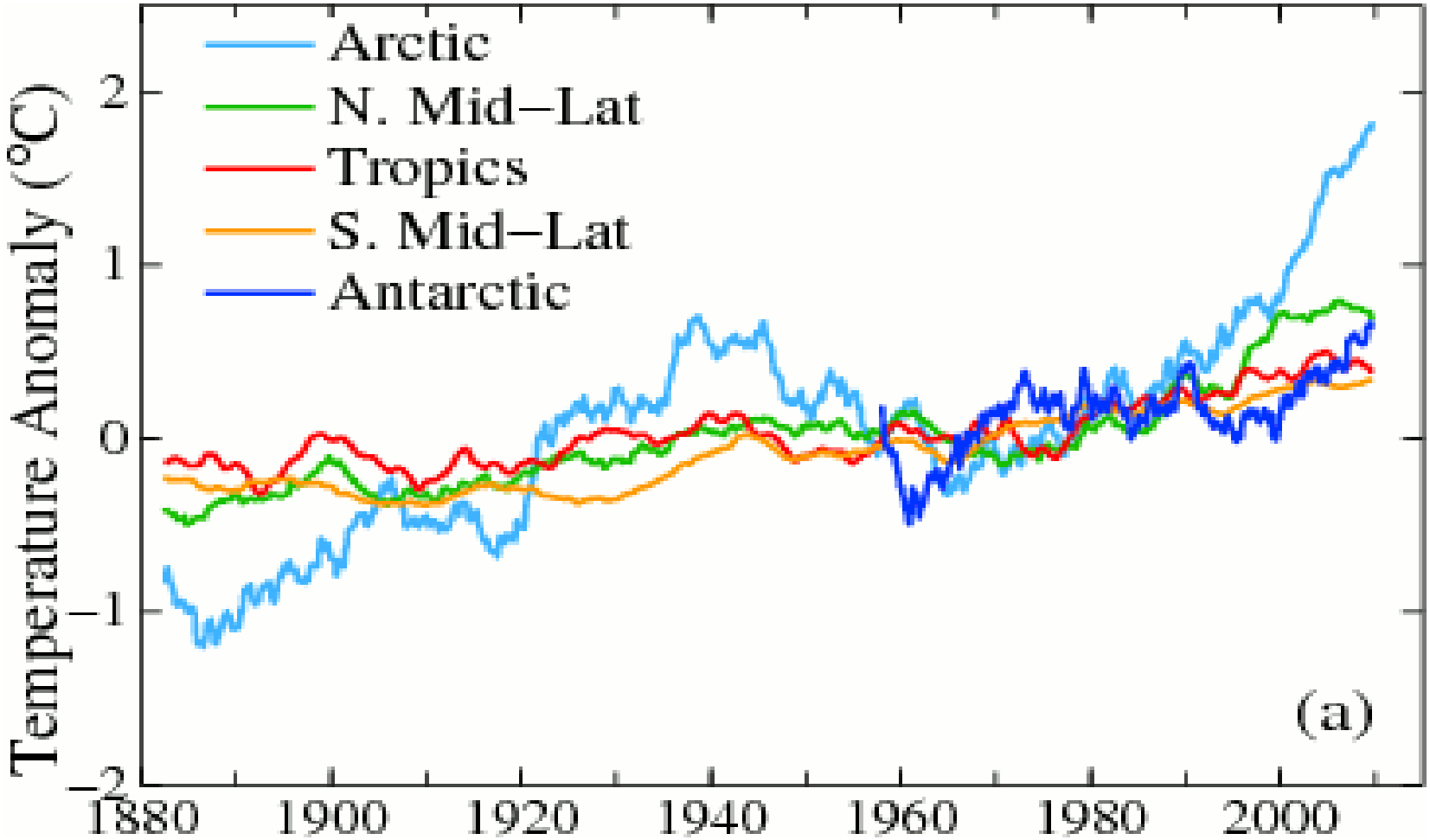
Source: LEGOS

Arctic has warmed twice as fast as the global mean



Sato and Hansen (2016)

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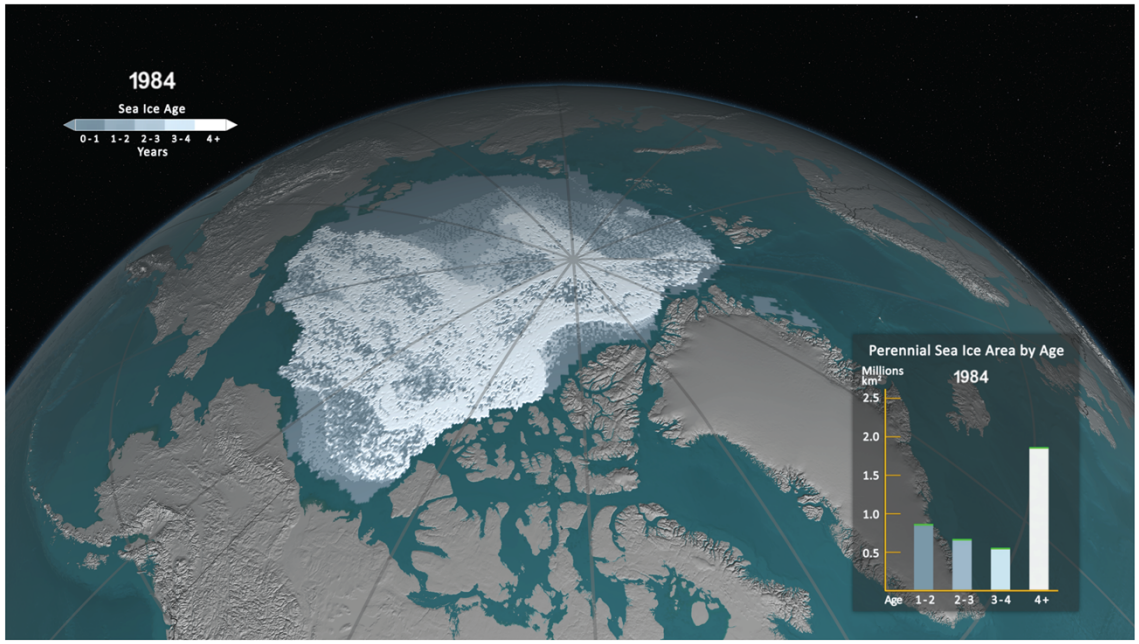
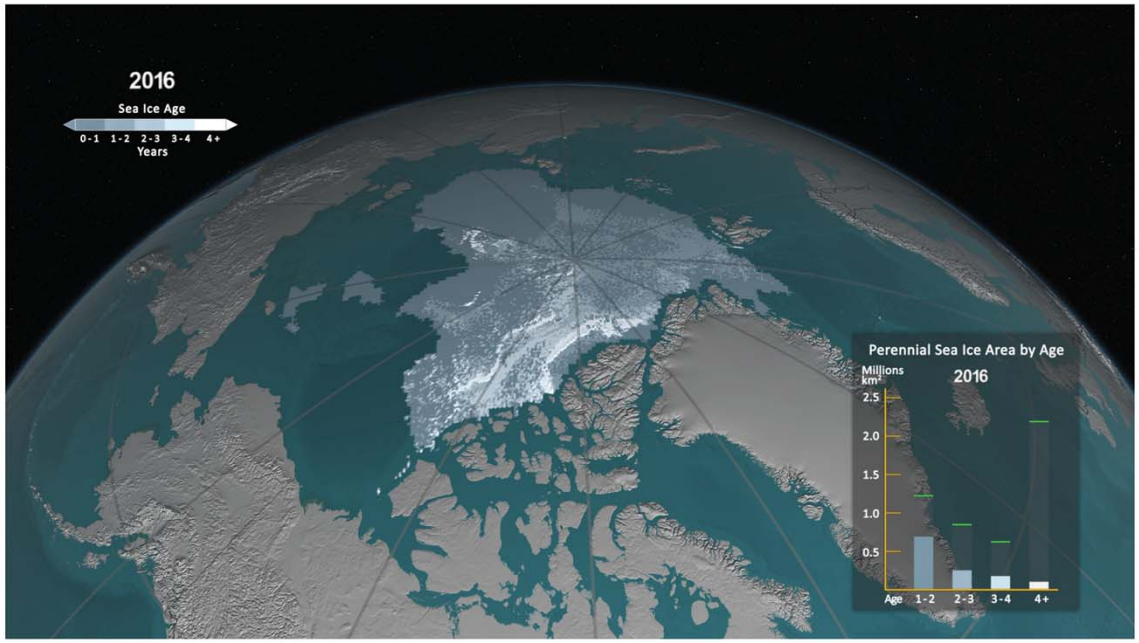
Multi-year ice 1984 and 2016





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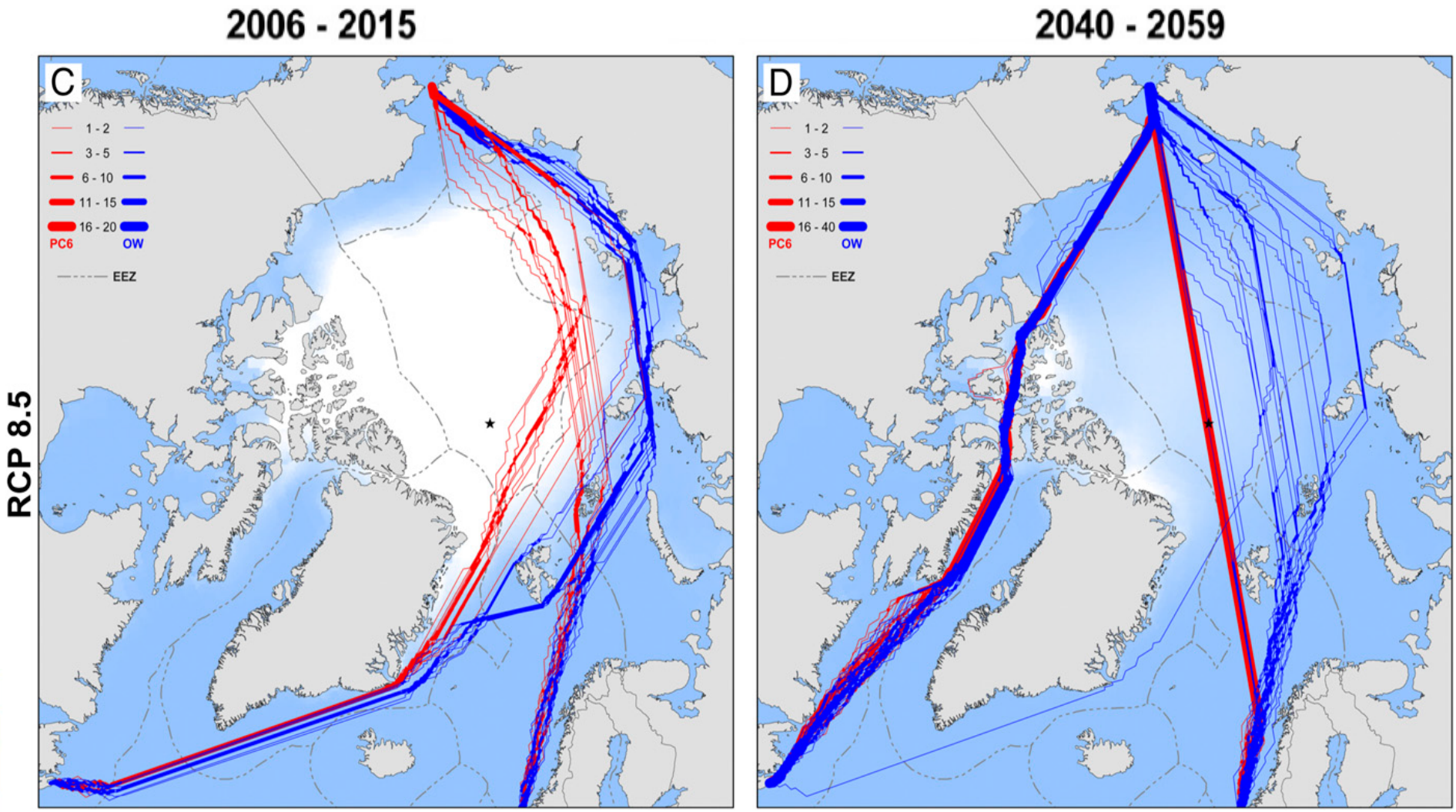
ARCTIC SEA ROUTES IN SEPTEMBER 2006-2059

RED=ICE STRENGHTENED VESSEL, BLUE=NOT



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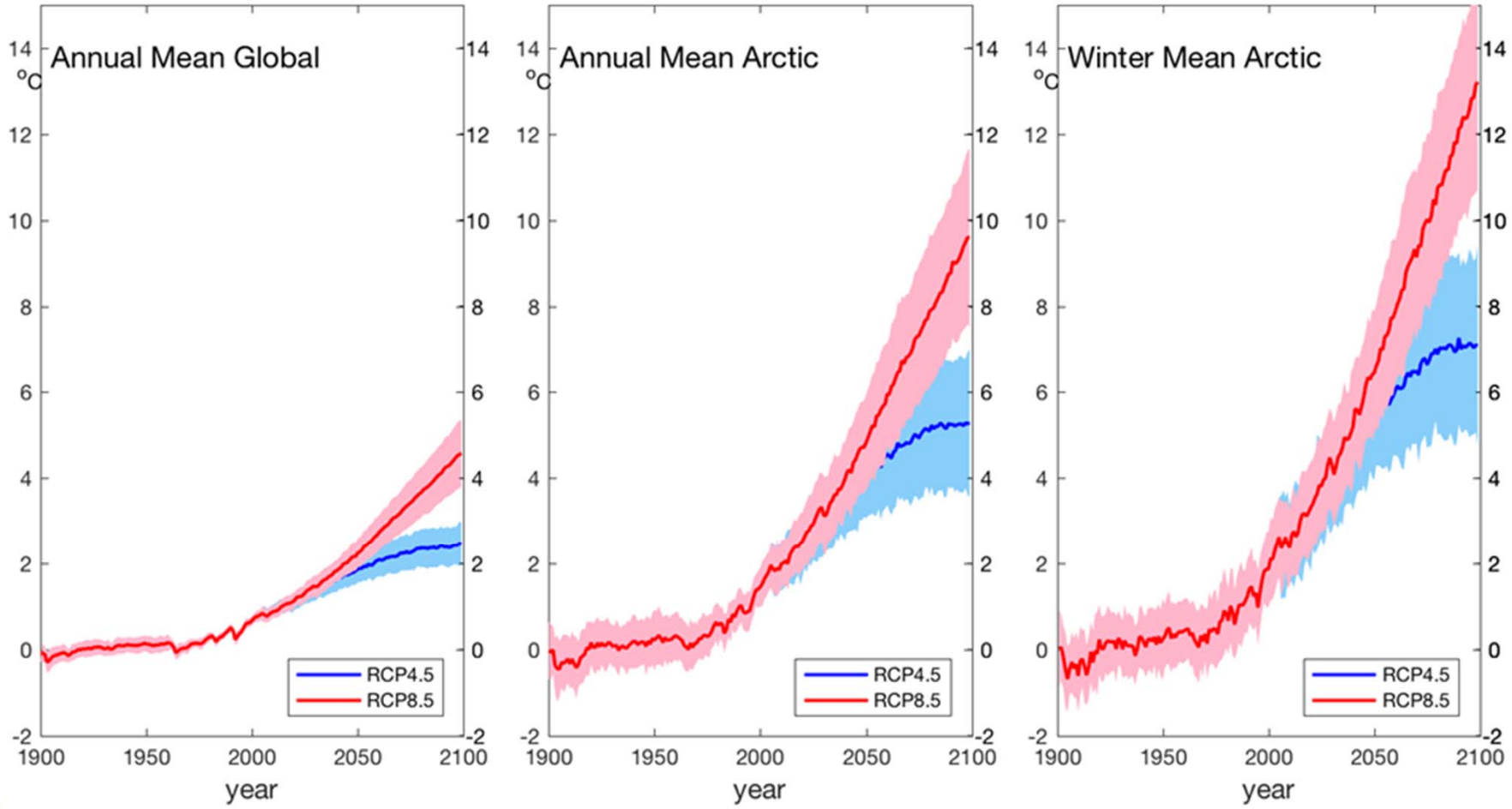
Arctic and global temperatures 1900-2100

Averaged over 36 global climate models
RCP 4.5 (blue)= upper end of Paris COP21 Agreement , RCP 8.5 (red)= business as usual



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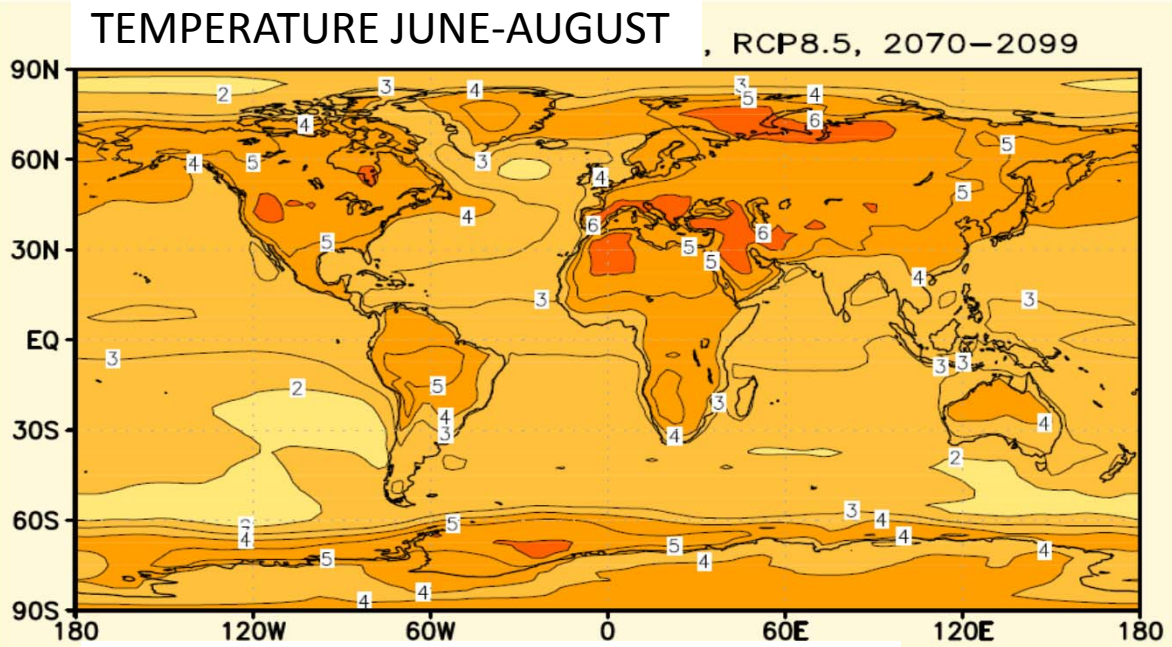
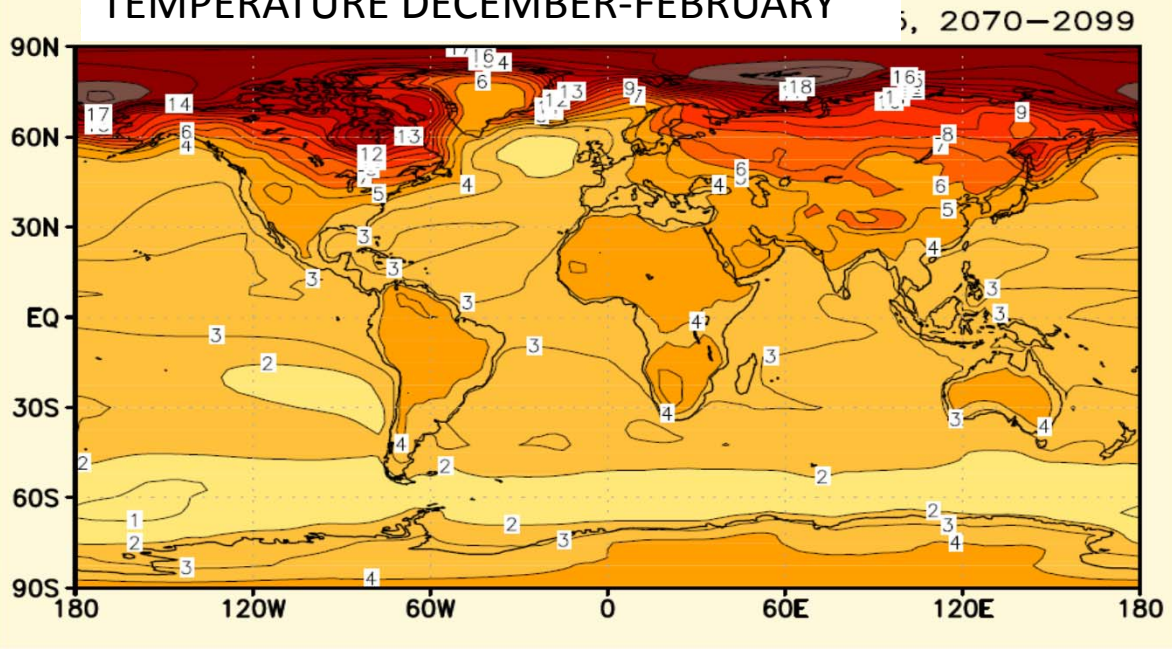
(modified from AMAP/SWIPA2017)

Temperature change =>2070-99, RCP 8.5

TEMPERATURE JUNE-AUGUST

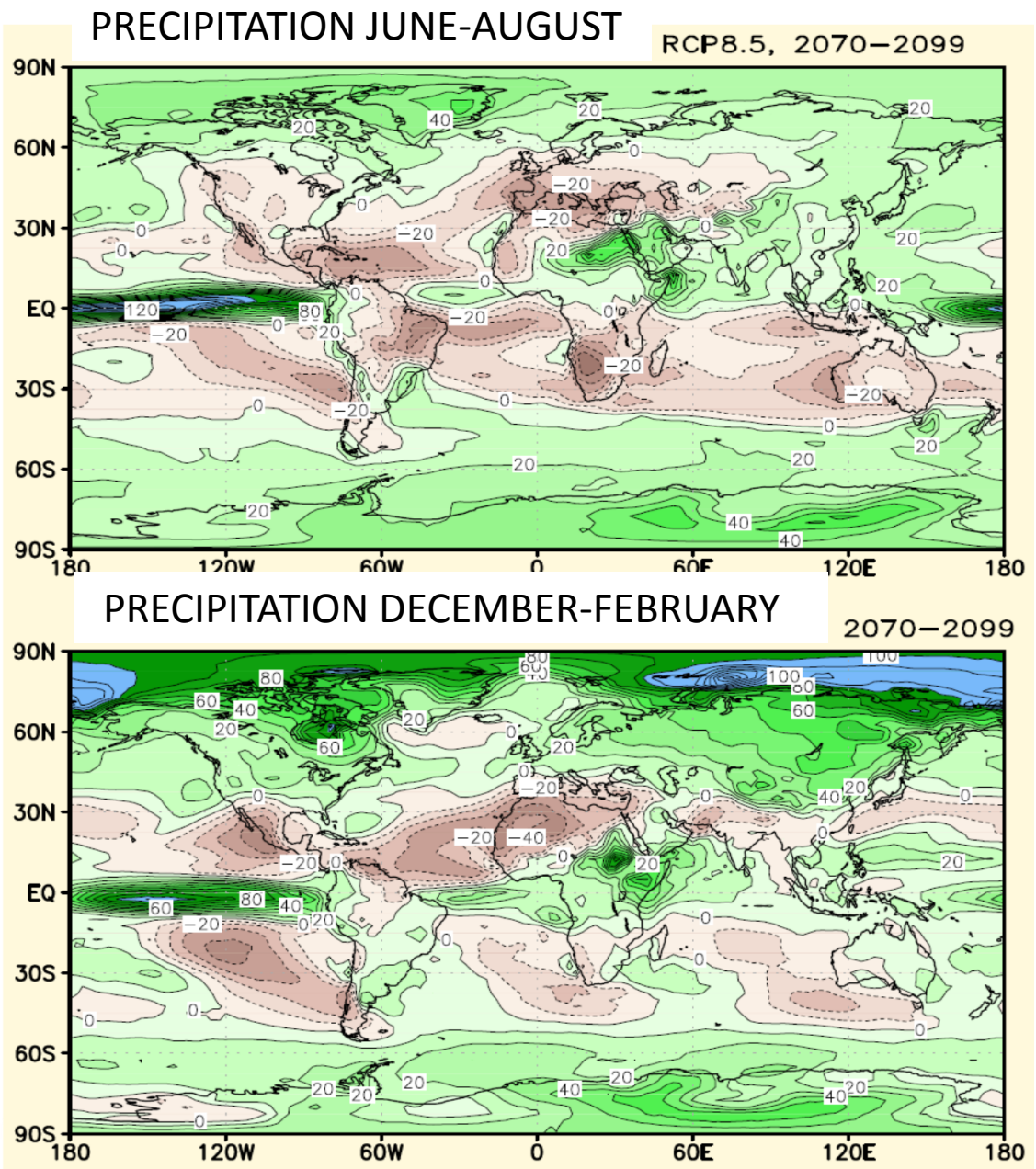


TEMPERATURE DECEMBER-FEBRUARY



WMO

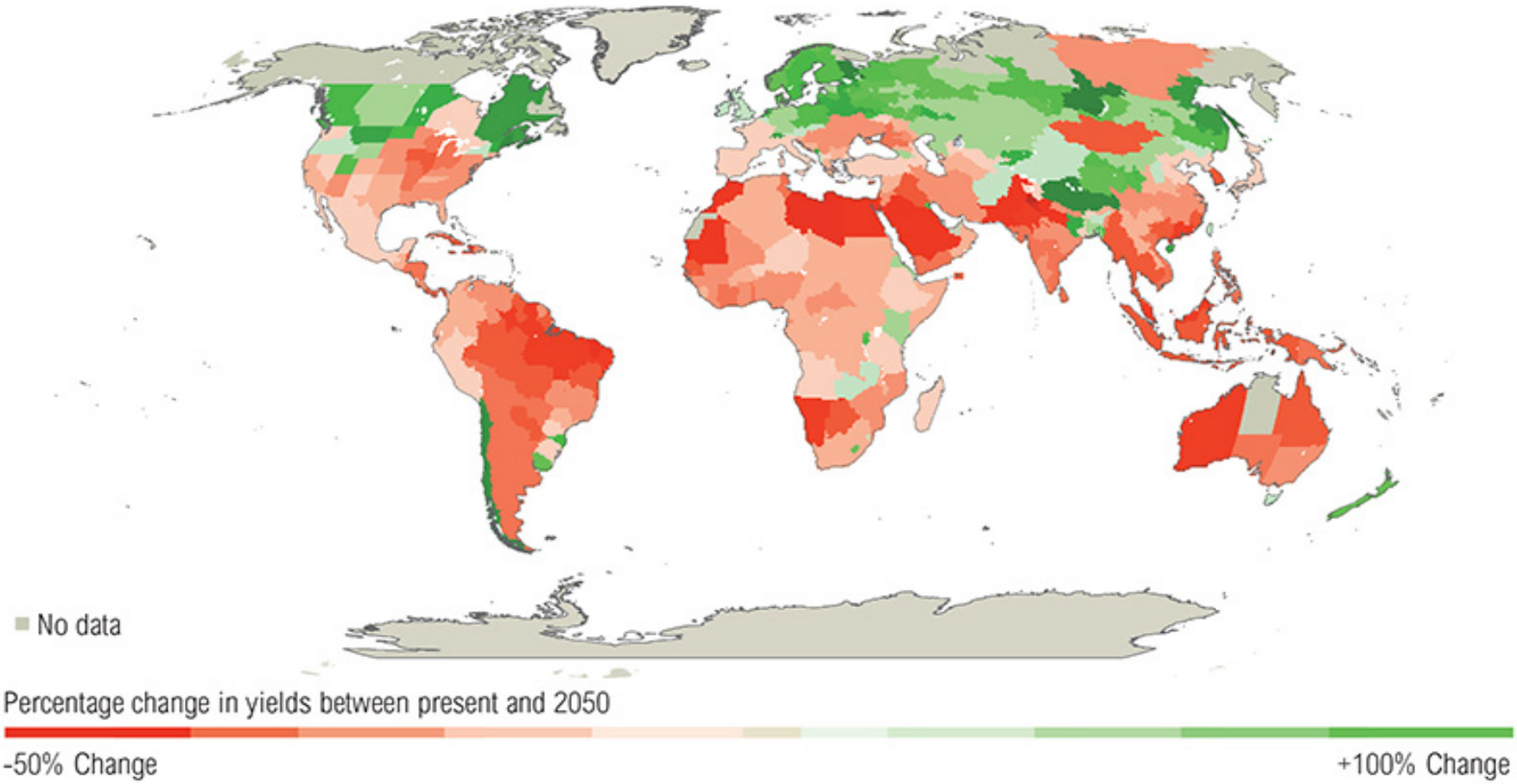
Precipitation change =>2070-99, RCP 8.5



WMO

Impact of 3 C warming on crop yields

Most studies now project adverse impacts on crop yields due to climate change (3°C warmer world)



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Sources: http://ow.ly/rpfMN

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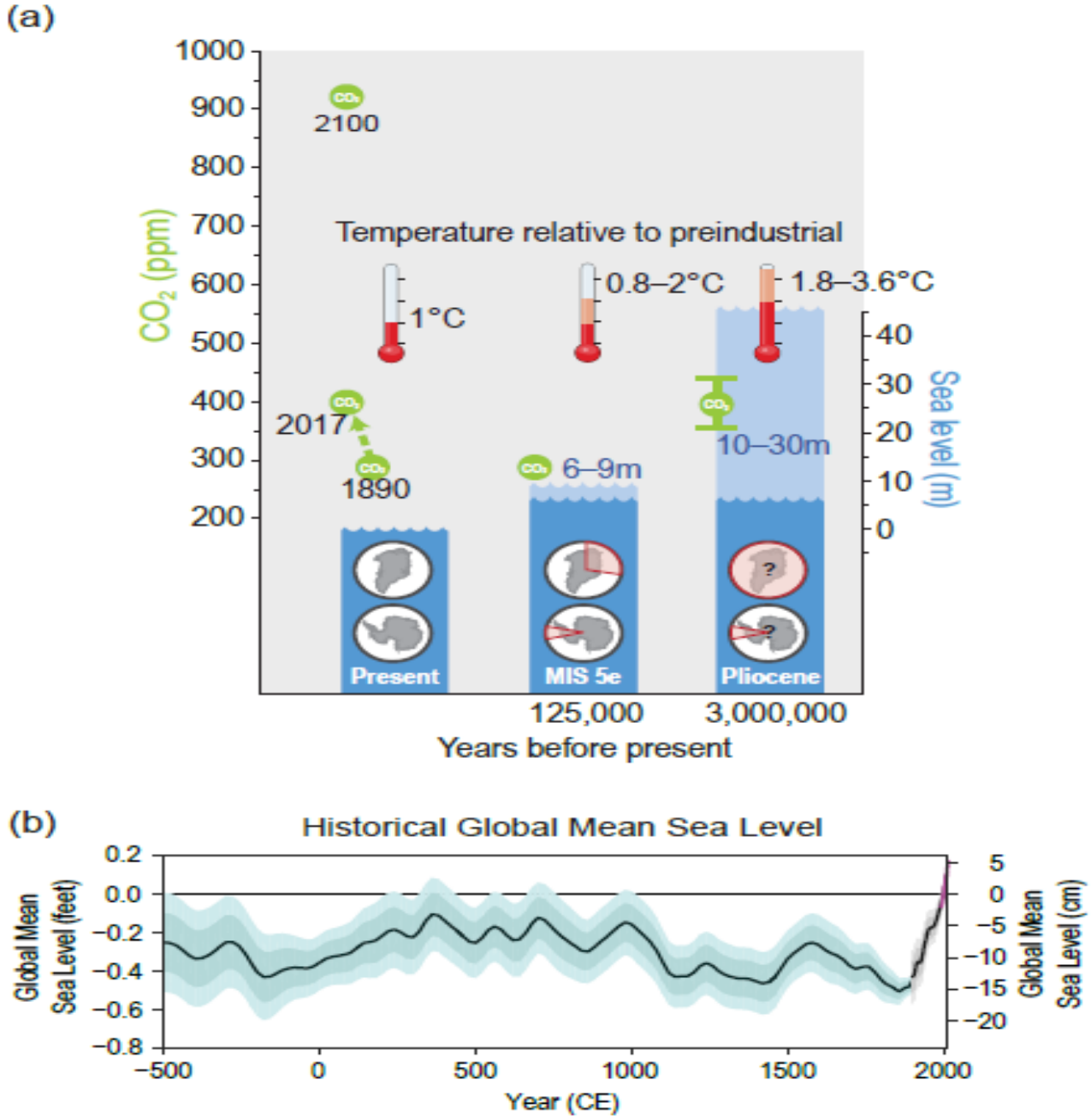
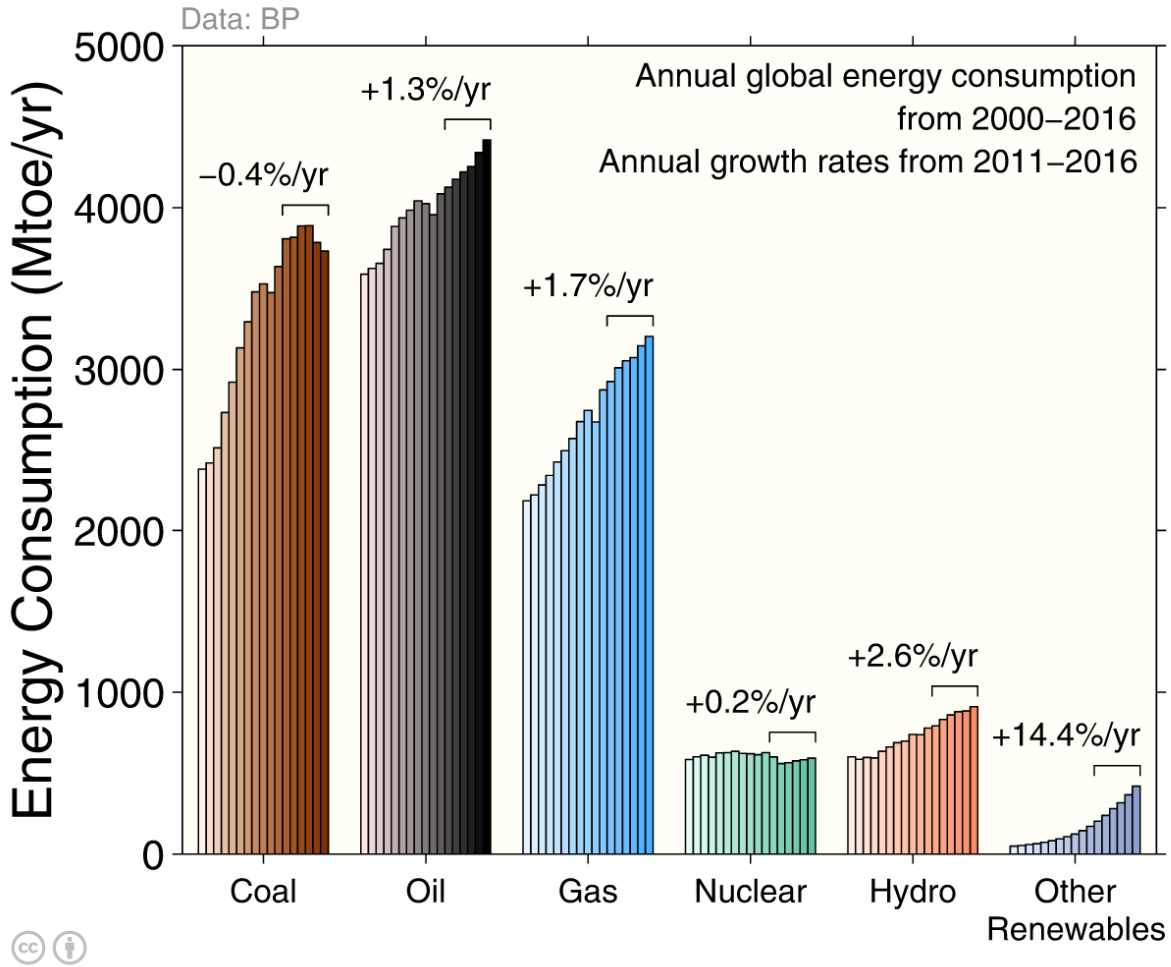
Historical CO_2-temperature-sea level



WMO OMM

Energy consumption by energy type

Energy consumption by fuel source from 2000 to 2016, with growth rates indicated for the more recent period of 2011 to 2016



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Source: BP 2017; Jackson et al 2017; Global Carbon Budget 2017

WEATHER CLIMATE WATER

Thank you

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