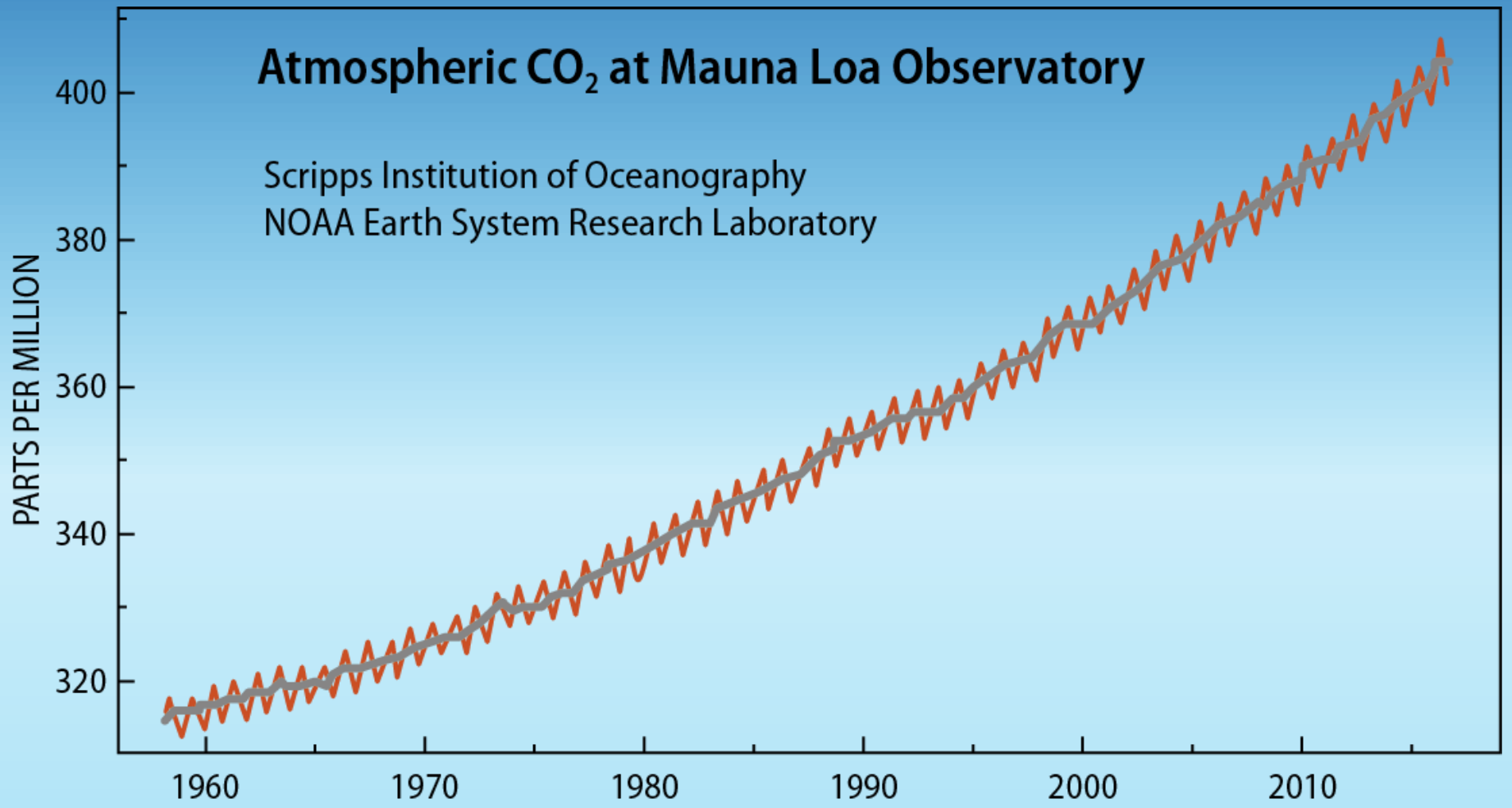
The Global Observing System for Climate

Agreement PARIS

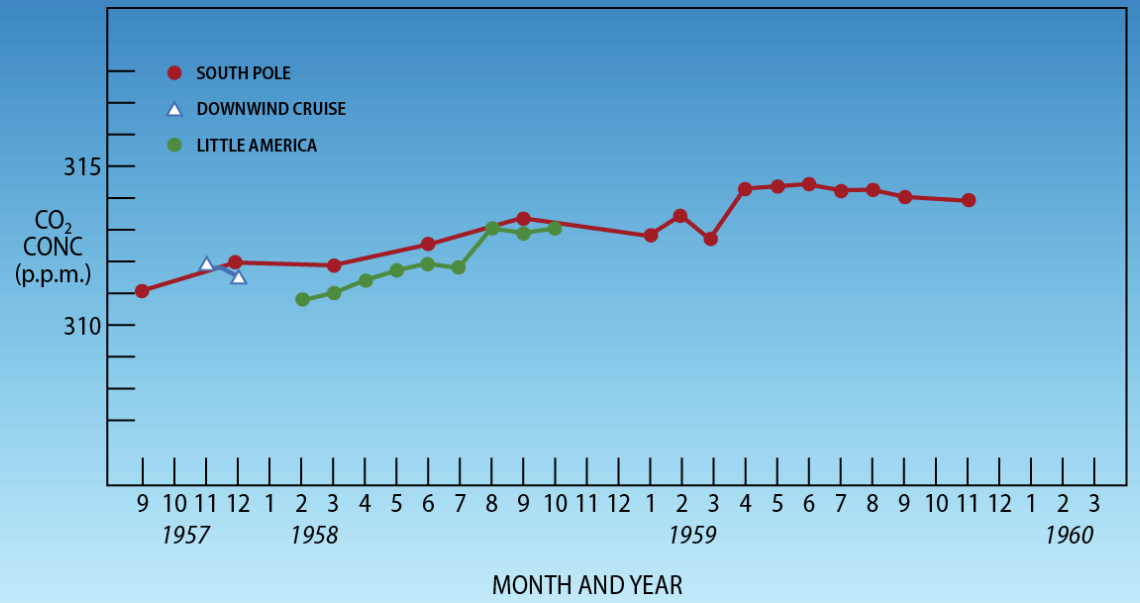
Earth Observations: How to support the Paris Agreement goals

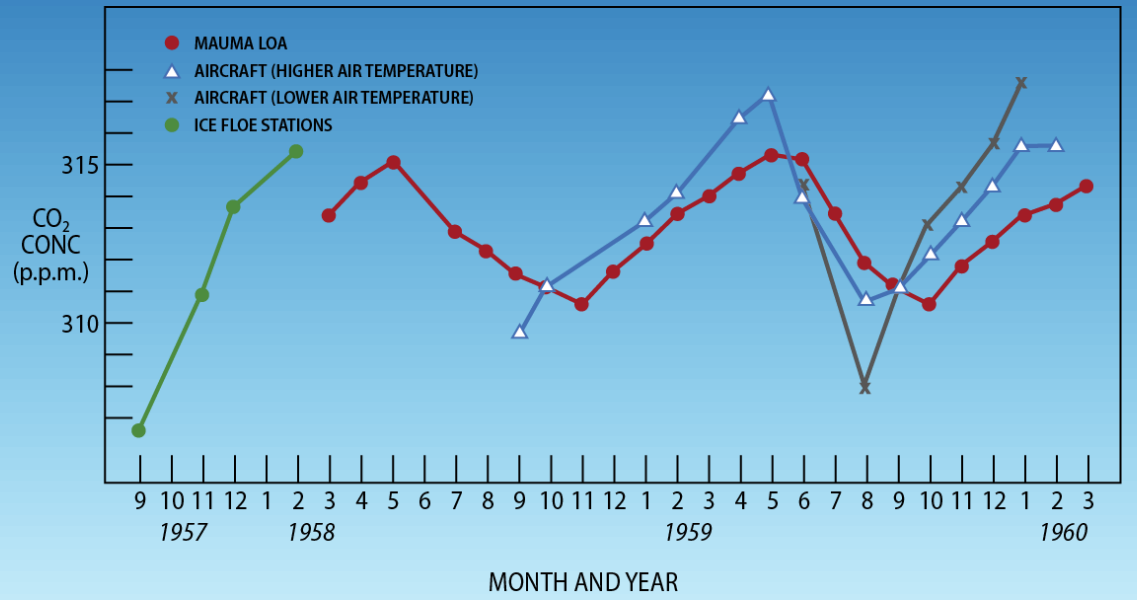
GCOS Secretariat, WMO

Carolin Richter

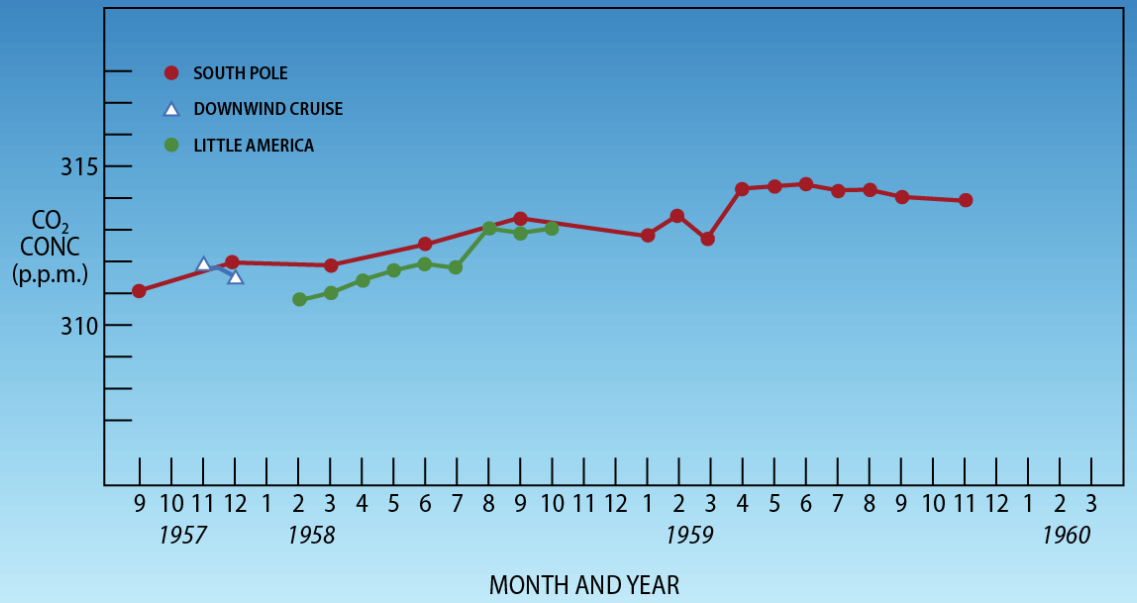


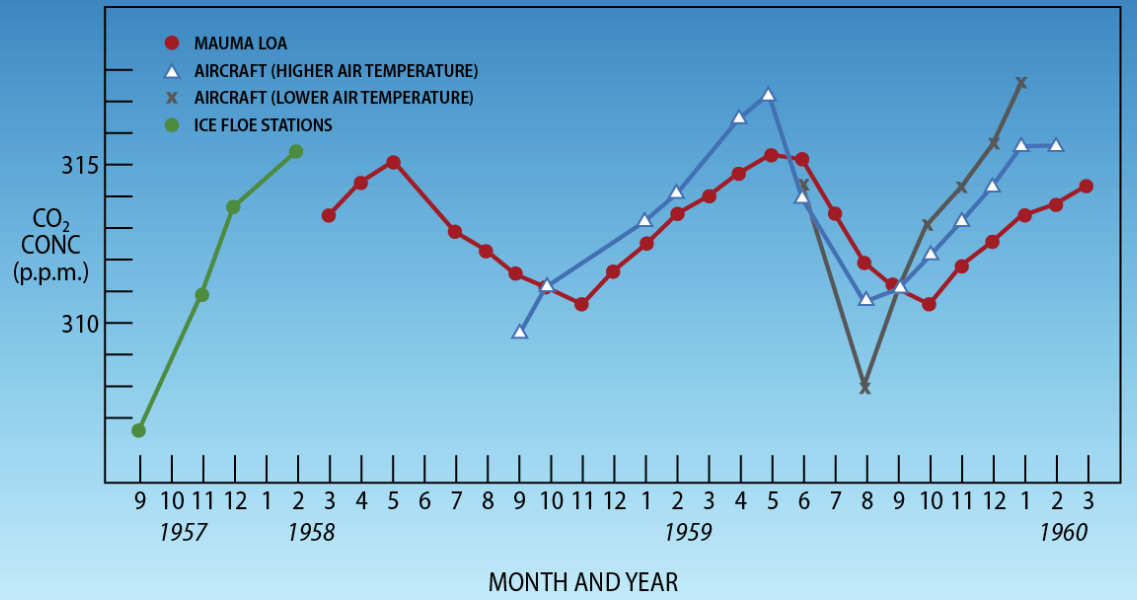
A scientific icon: The Keeling Curve

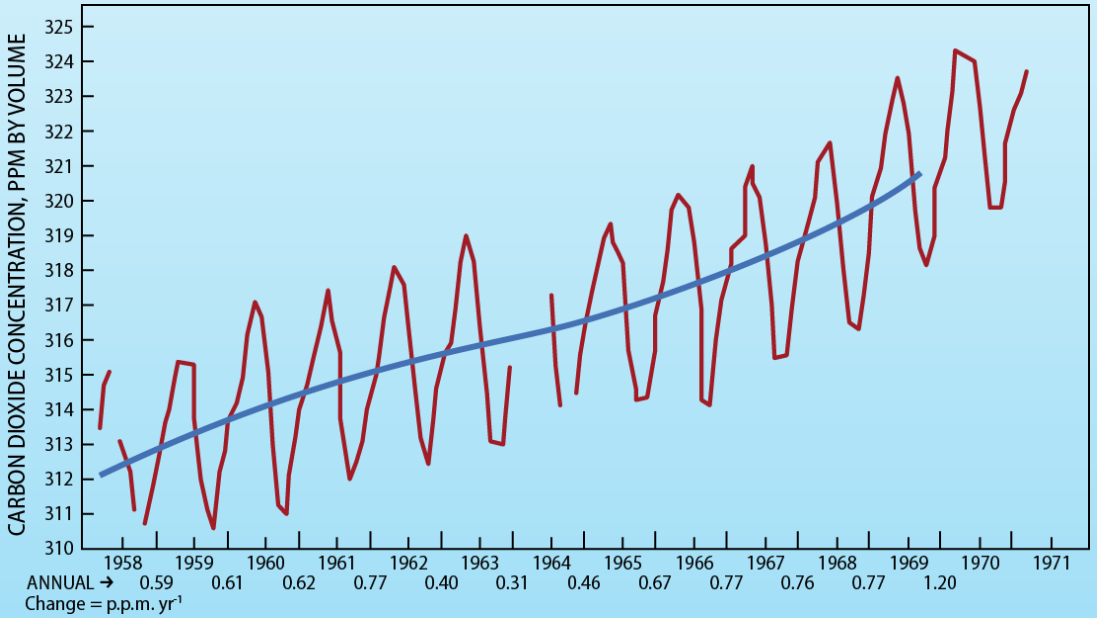


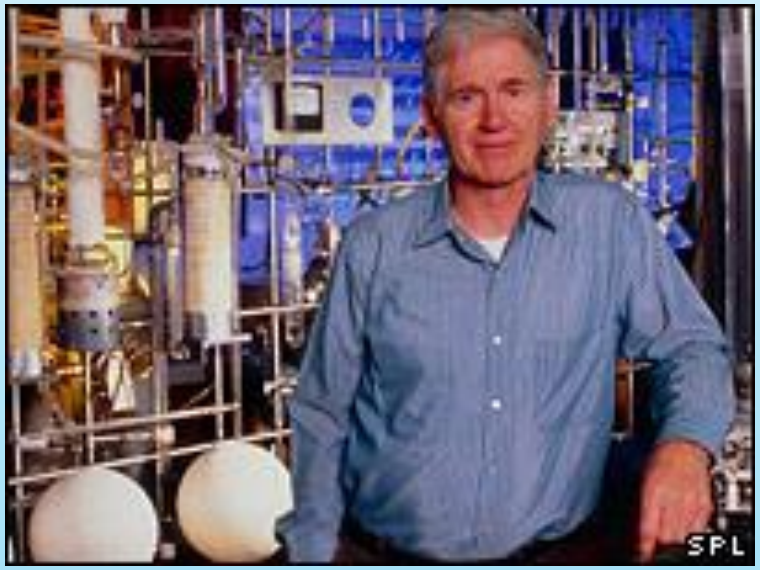


When Dave Keeling started his measurements in 1958, CO2 levels were around 315 ppmv (parts per million by volume - that is 315 molecules of CO2 for every one million molecules in the air); by the year 2016 they had risen for a first time to over 400 ppmv.

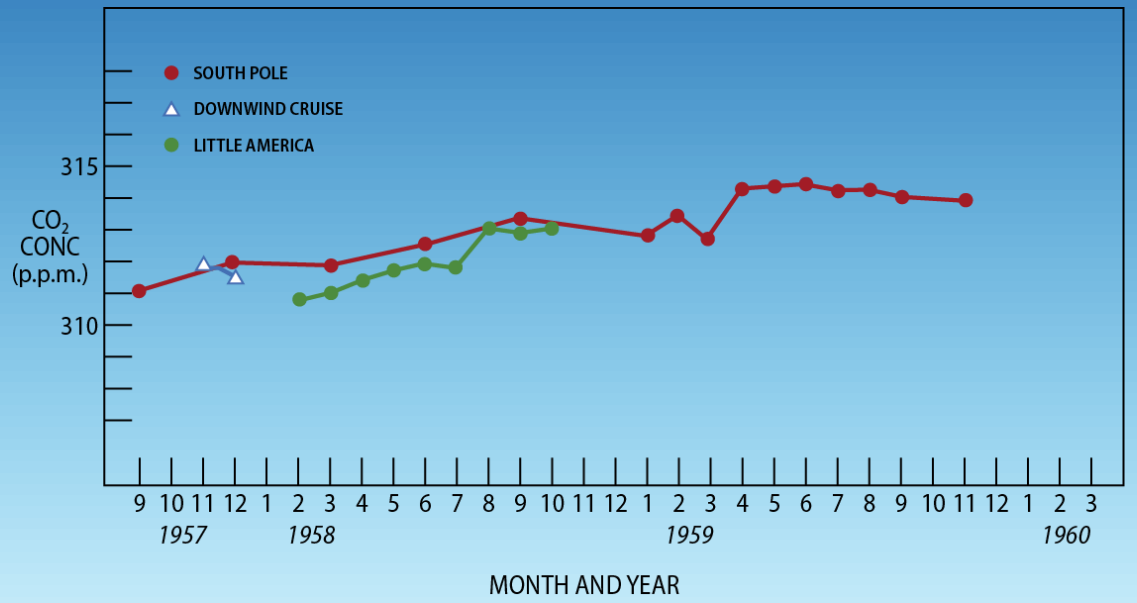


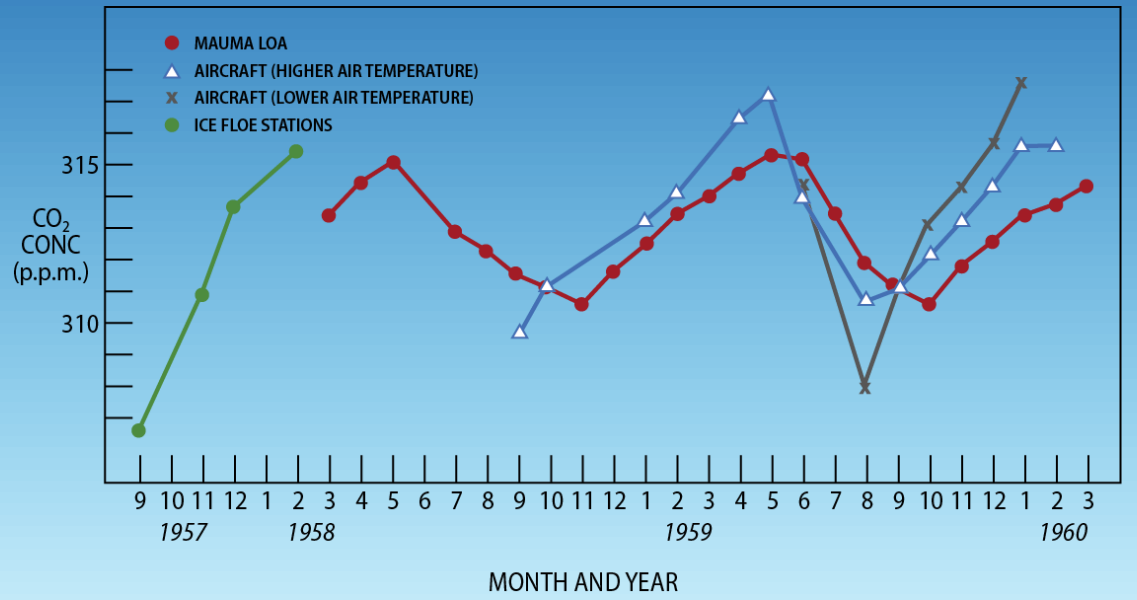


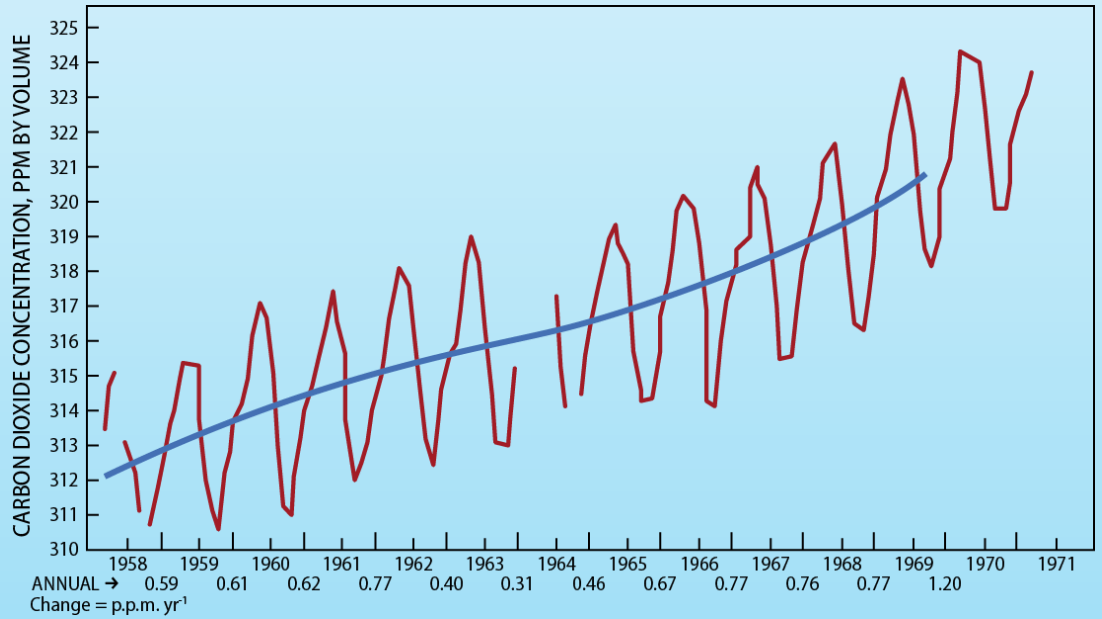


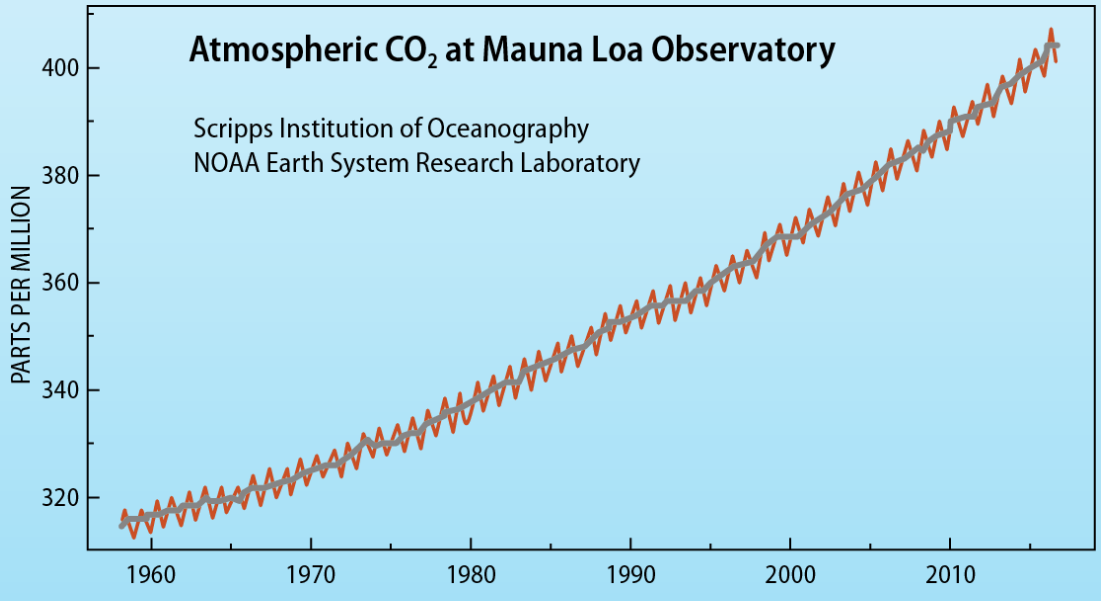


"Dave Keeling suffered many sleepless nights, even as late as in the 1990s, being forced again and again to justify continued funding of his programme," recalls Dr Manning.


SOUTH POLE
DOWNWIND CRUISE
LITTLE AMERICA
CO_2 CONC (p.p.m.)
315
310
9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3
1957
1958
1959
1960
MONTH AND YEAR


MAUMA LOA
AIRCRAFT (HIGHER AIR TEMPERATURE)
AIRCRAFT (LOWER AIR TEMPERATURE)
ICE FLOE STATIONS
CO_2 CONC (p.p.m.)
315
310
9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3
1957
1958
1959
1960
MONTH AND YEAR


CARBON DIOXIDE CONCENTRATION, PPM BY VOLUME
325
324
323
322
321
320
319
318
317
316
315
314
313
312
311
310
1958 1959 1960 1961 1962 1963 1964 1965 1966 1967 1968 1969 1970 1971
ANNUAL → 0.59 0.61 0.62 0.77 0.40 0.31 0.46 0.67 0.77 0.76 0.77 1.20
Change = p.p.m. yr⁻¹


Atmospheric CO_2 at Mauna Loa Observatory
Scripps Institution of Oceanography
NOAA Earth System Research Laboratory
PARTS PER MILLION
400
380
360
340
320
1960
1970
1980
1990
2000
2010

GCOS is assuring the availability of systematic climate observations, in partnership with WCRP, underlying the needs of the Parties to the UNFCCC and the IPCC:

Research

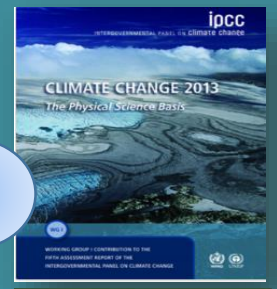
WCRP
World Climate Research Programme

Assessment

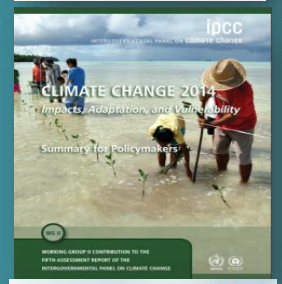
ipcc
INTERGOVERNMENTAL PANEL ON climate change
WMO UNEP

Observations

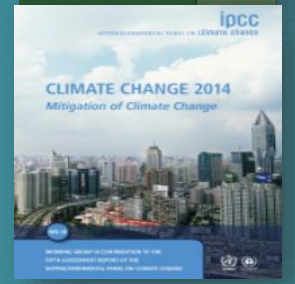
GCOS
GLOBAL CLIMATE OBSERVING SYSTEM
CEOS
CGMS



WG I:
Physical Science Basis



WG II:
Impacts, Adaptation and Vulnerability



WG III:
Mitigation of Climate Change

Observations

GCOS
GLOBAL CLIMATE OBSERVING SYSTEM

CEOS

CGMS

Research

WCRP
World Climate Research Programme

Assessment

ipcc
INTERGOVERNMENTAL PANEL ON climate change

WMO UNEP

From “observations and science informs policy” to “policy directs scientific focus”

COP21 · CMP11
PARIS 2015
UN CLIMATE CHANGE CONFERENCE

Climate observations also support:

SUSTAINABLE DEVELOPMENT GOALS

- Energy & Temperature
- Other Physical Properties
- Carbon Cycle and other GHGs
- Hydrosphere
- Snow & Ice
- Biosphere
- Human Resource Use

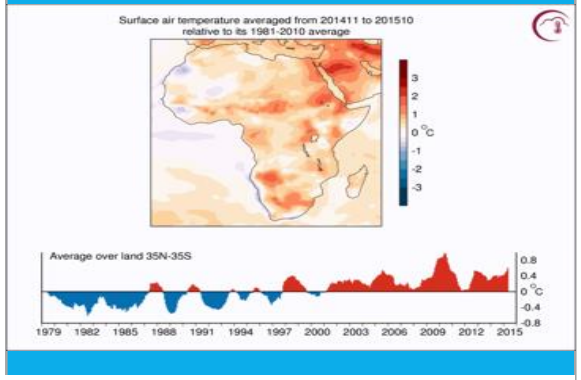
From observations to implementation

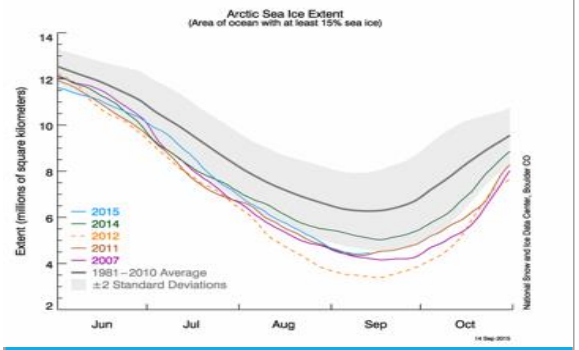
Sensing

- Observation of the Earth System

Data Records

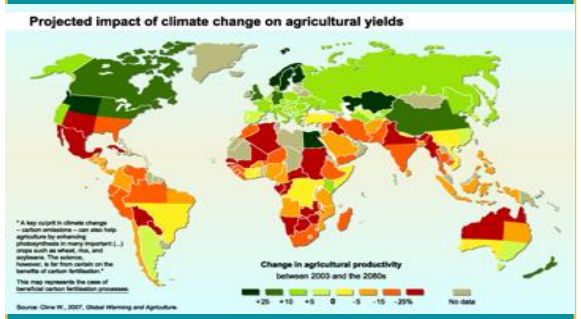
- Preparation of Climate Data records
- Archiving,
- Reanalysis,
- Production of long datasets





Delivery of Services

- Delivery of targeted information for specific applications or to inform decisions

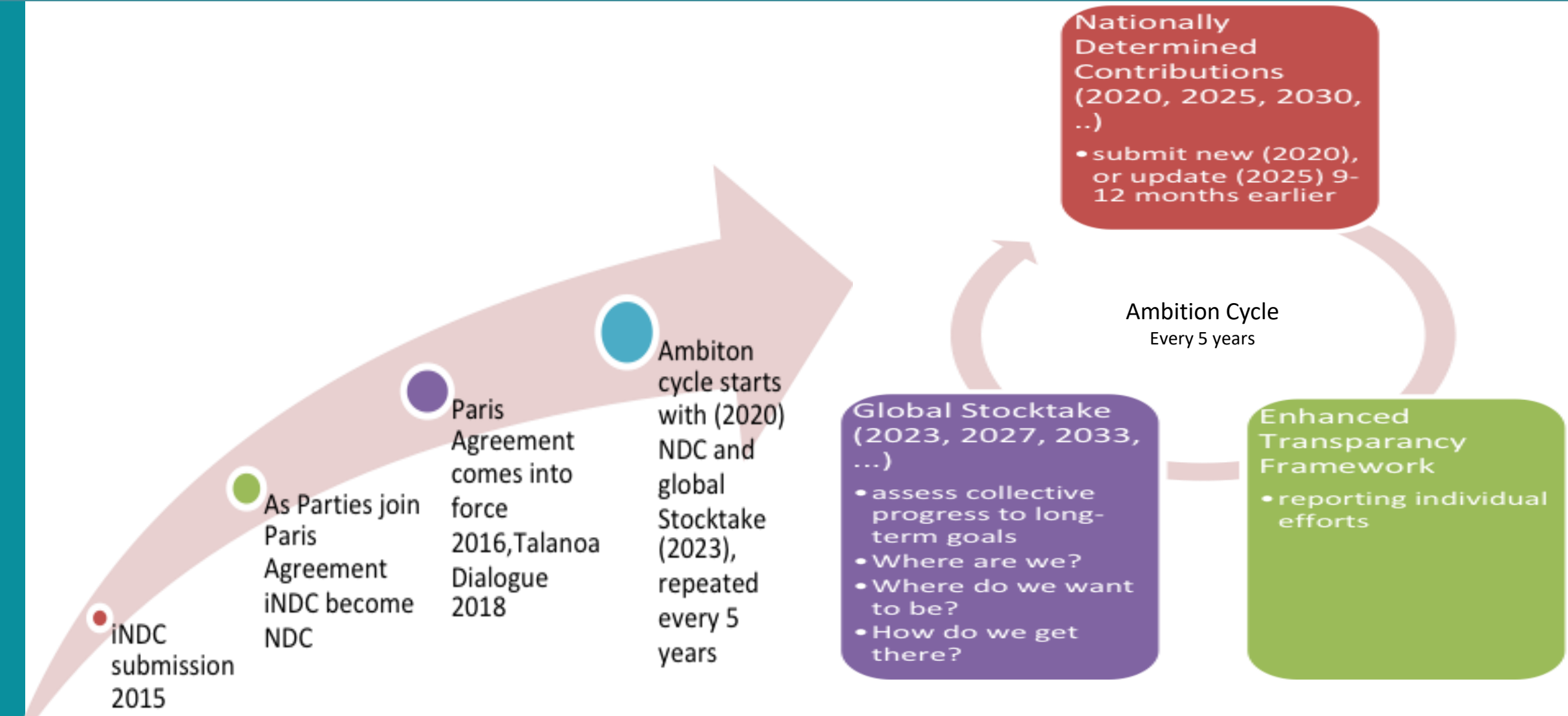


Decision Making and Implementation

- Implement actions based on the information

Feedback from users

The road to the Global Stocktake



Source: GCOS Task Team on Paris Agreement; Florin Vladu (UNFCCC), 2018

Financial Support

Systematic Climate Observations

Capacity Building

Monitoring for planning adaption to climate change: projections and risk estimation

Monitoring of implementation of adaption (urban change, infrastructure, agriculture, …)

Monitoring of Land categories and forests: Mitigation, Adaptation, …

Monitoring for Early Warning systems, projections and risk assessments

Monitoring anthropogenic fluxes of GHGs, natural sources and sinks, & carbon cycle

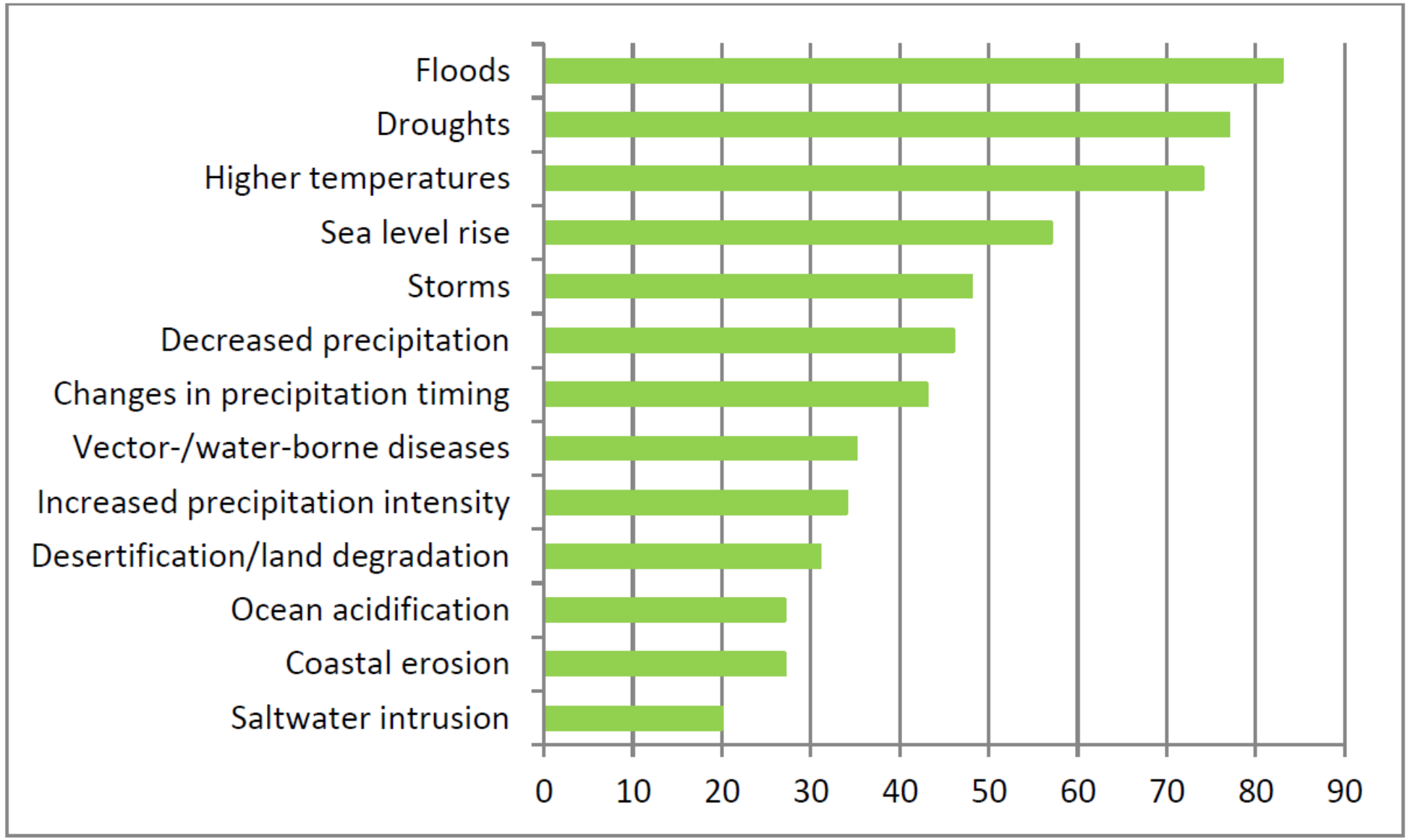
Monitoring global temperature

Overall impact of NDCs: state of the climate, global water cycle and energy fluxes

Monitoring to support renewable energy, winds, water etc.

Paris Agreement and its Global Stocktake

Key Climate Hazards identified in the adaptation component of the communicated intended nationally determined contributions (iNDCs)

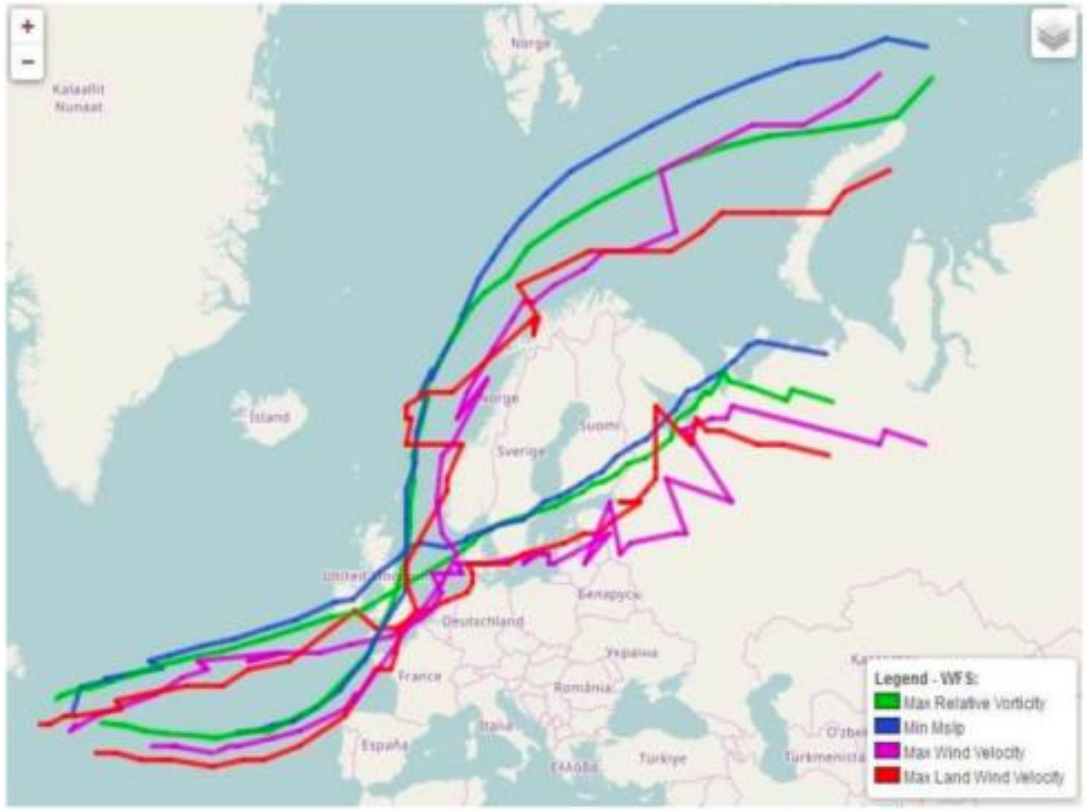


Case studies show how the global climate observing system is essential to adaptation and how global observations, and products derived from them, can support local planning and adaptation.

Adaptation Case Study 2 The Copernicus Windstorm Information Service (WISC)

(SOURCE https://wisc.climate.copernicus.eu/wisc/#/)

WISC has generated several historic datasets that can be used to analyse the range and severity of windstorms in the past as well as their impact.



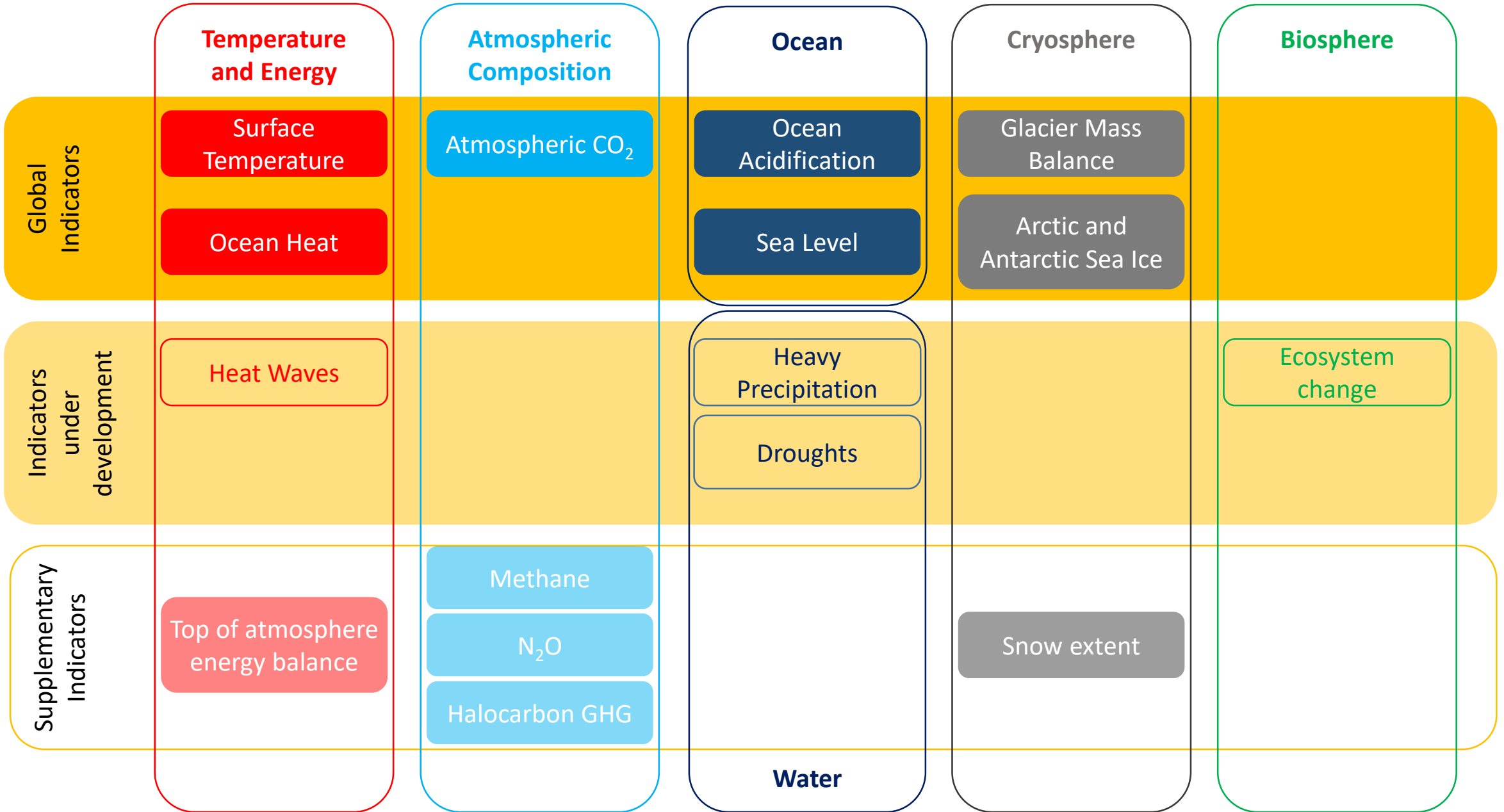
Great storm of 1987 and Storm Daria of 1990 showing four key variables

Indicators

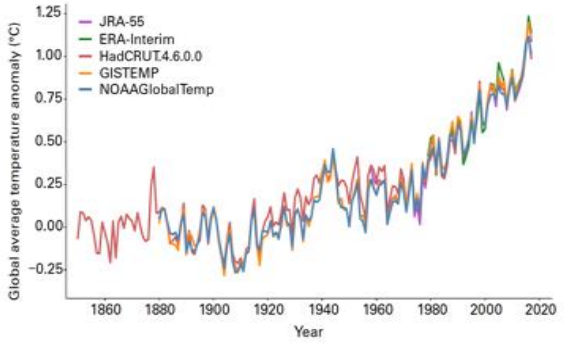
Part of the Communication Strategy.

For describing the rate and range of climate changes, and also becoming an input to the Global Stocktake

Climate Indicators

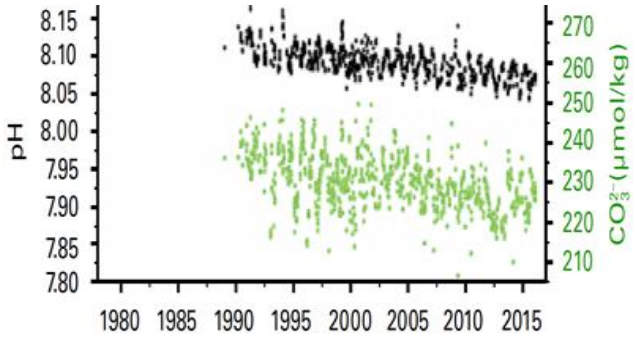


Mean Temperature



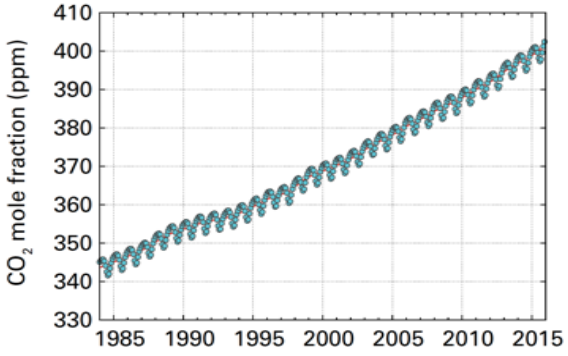
Global mean temperature anomalies, with respect to the 1850–1900 baseline, for the five global datasets (Source: UK Met Office Hadley Centre)

Ocean Acidity



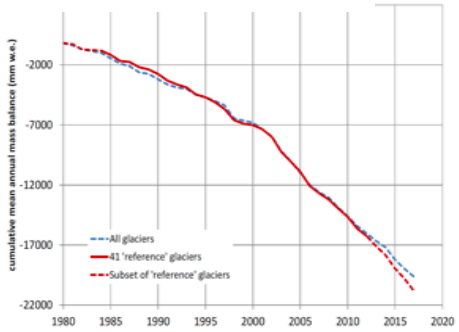
Trends in surface (< 50 m) ocean carbonate chemistry calculated from observations obtained at the Hawaii Ocean Timeseries (HOT) Program in the North Pacific over 1988–2015. Seawater pH (black points, primary y-axis) and carbonate ion concentration (green points, secondary y-axis). Ocean chemistry data were obtained from the Hawaii Ocean Timeseries Data Organization & Graphical System (HOT-DOGS). (Source: US National Oceanic and Atmospheric Administration (NOAA), Jewett and Romanou, 2017)

Atmospheric CO_2



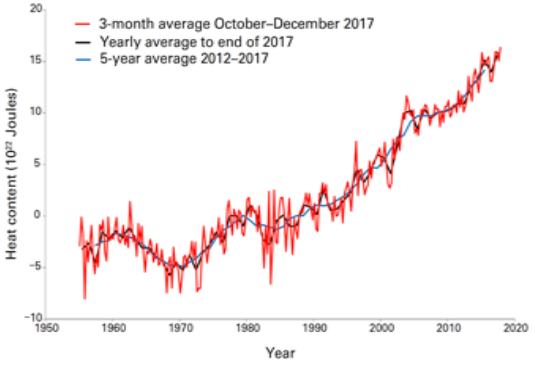
Globally averaged mole fraction (measure of concentration), from1984 to 2016, of CO2 in
parts per million (left), CH4 in parts per billion (middle) and N2O in parts per billion (right). The red line is the monthly mean mole fraction with the seasonal variations removed; the blue dots and line depict the monthly averages. (Source: WMO Global Atmosphere Watch)

Glacier Mass Balance



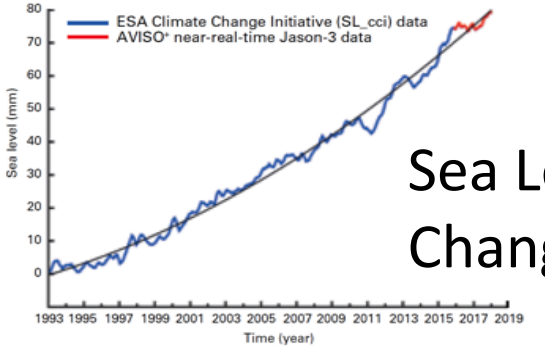
Mean cumulative mass balance of all reported glaciers (blue line) and the reference glaciers (red line). SOURCE: **world glacier monitoring service** http://wgms.ch/

Ocean Heat Content



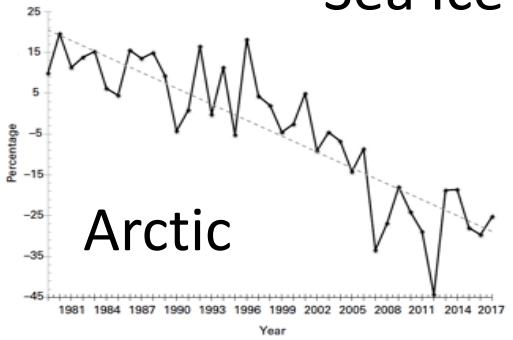
Global ocean heat content change (x 1022 J) for the 0–700 metre layer: three-monthly means (red), and annual (black) and 5-year (blue) running means, from the US National Oceanic and Atmospheric Administration (NOAA) dataset. (Source: prepared by WMO using data from NOAA National Centers for Environmental Information)

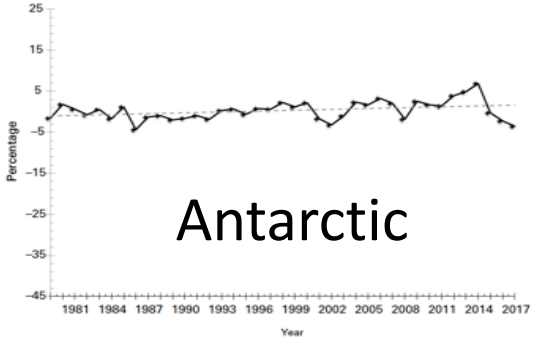
Sea Level Change



Global mean sea-level time series (with seasonal cycle removed), January 1993–January 2018, from satellite altimetry multi-missions. Data from AVISO
(Source: Collecte- Localisation-Satellite (CLS) – Laboratoire d'Etudes en Géophysique et Océanographie Spatiales (LEGOS))

Sea Ice Extent

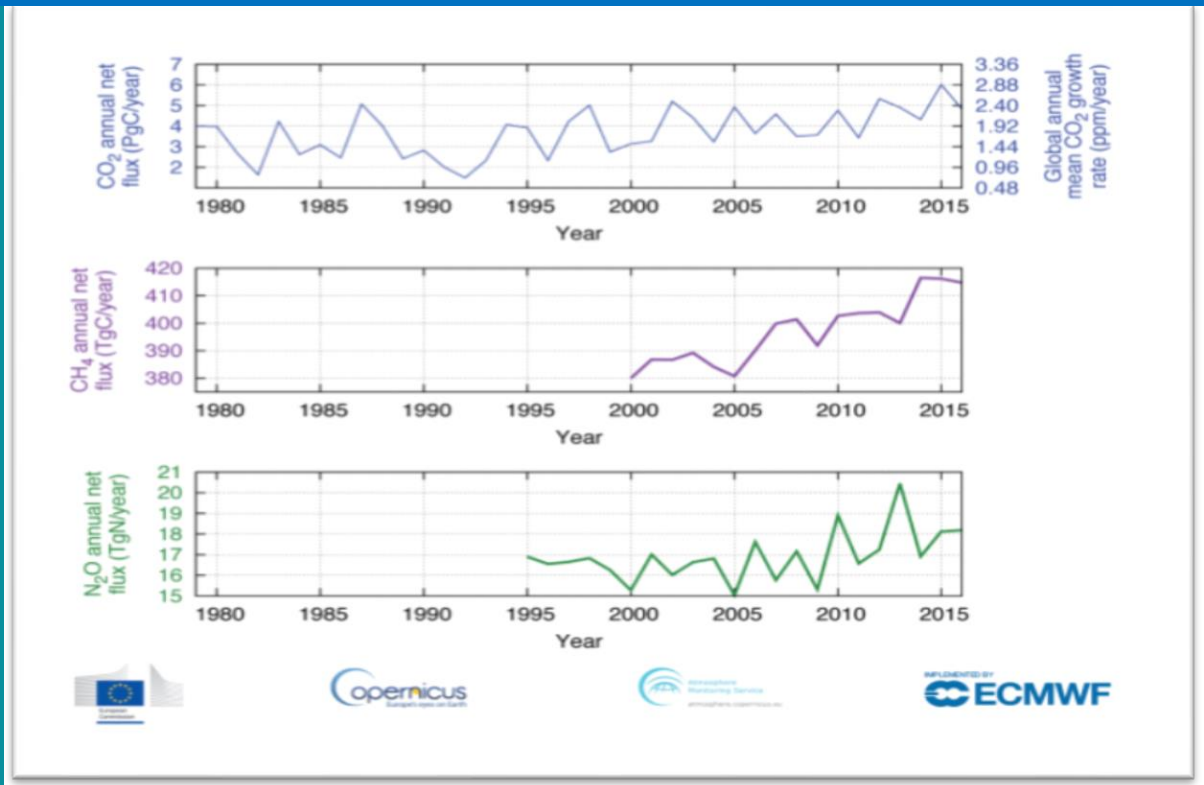


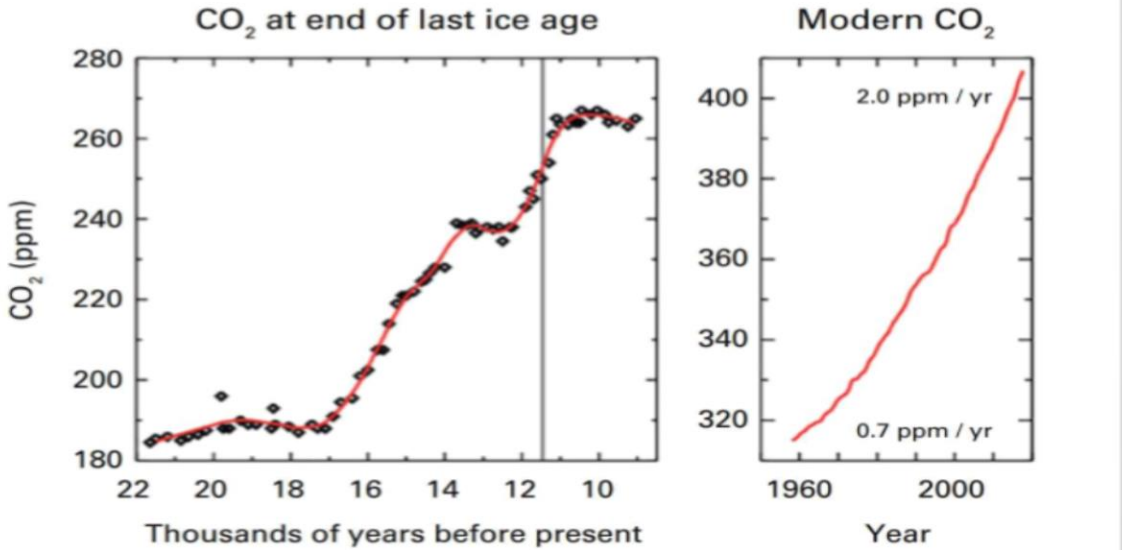


September sea-ice extent for the Arctic, and (right) September sea-ice extent for the Antarctic. Percentage of long-term average of the reference period 1981–2010 (Source: prepared by WMO using data from the US National Snow and Ice Data Center)

Global Climate Indicator - Composition

Net global annual fluxes of CO_2, CH_4 and N_2O into the atmosphere are estimated by the Copernicus Atmosphere Monitoring Service flux atmospheric inversion systems.
Data source: CAMS greenhouse gas flux data, Credit: Copernicus Atmosphere Monitoring Service/ECMWF



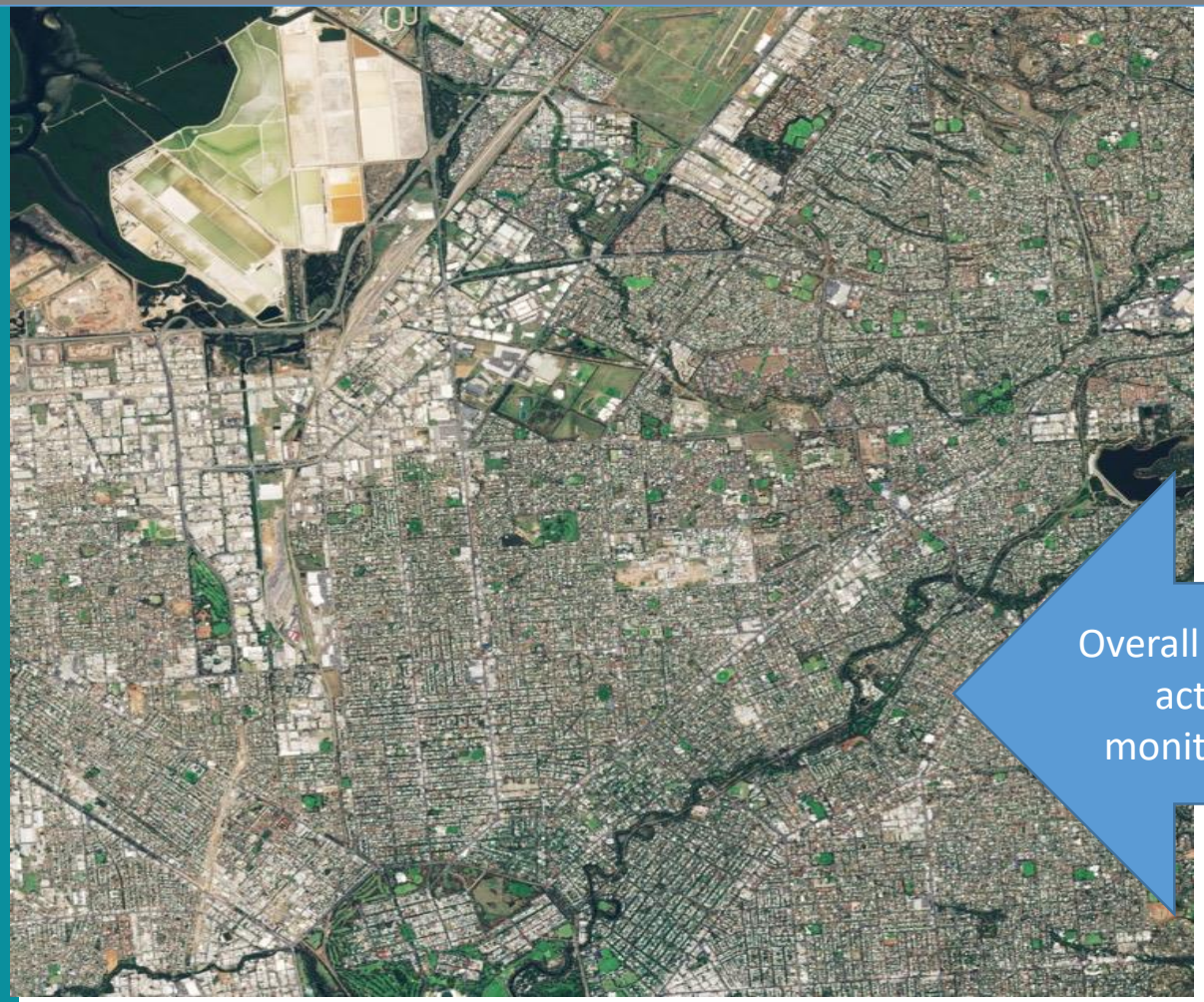


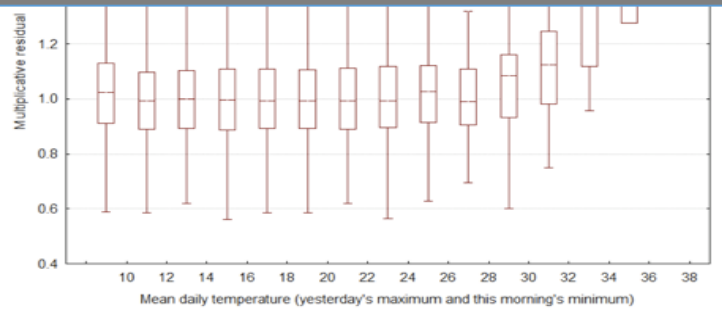
The figure on the left shows the CO_2 atmospheric content at the end of the last ice age, and the figure on the right shows recent atmospheric CO_2 content. Credit: WMO Global Atmosphere Watch (GAW) Program.

Potential remote sensing of implementation of adaption actions

Adelaide.

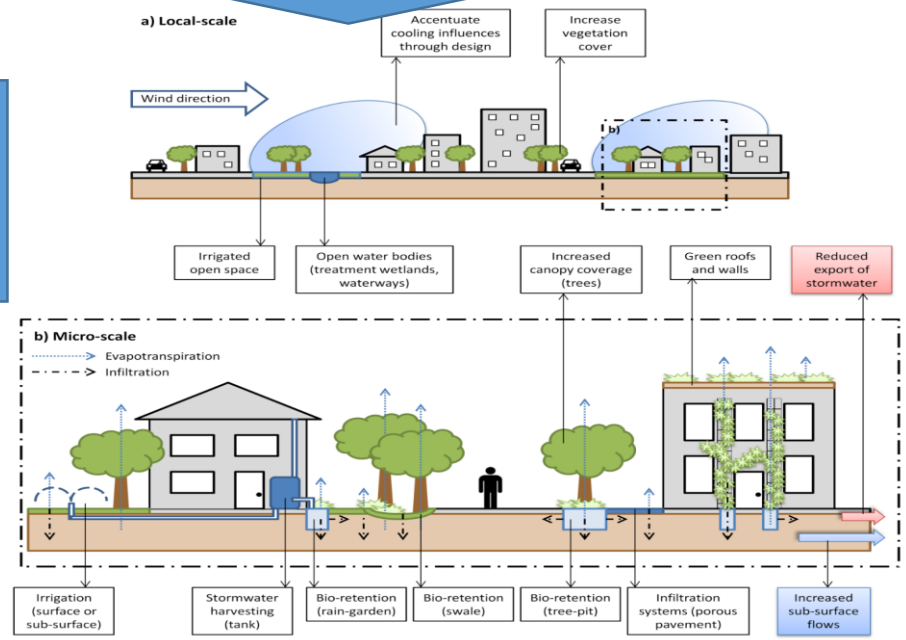
SOURCE: modified Copernicus Sentinel data (2017), processed by ESA, CC BY-SA 3.0 IGO





Expected Mortality leads to Actions to cool Cities

Overall impact of these actions can be monitored remotely



GCOS Task Team on EO monitoring adaptation measures of a changing climate, Terrestrial Observation Panel for Climate, Nigel Tapper, 2018.

The Global Climate Observing System. Summary of the talk:

The Paris Agreement established a science-based cyclical system of assessment (the Global Stocktake) and improvement (updating NDC), with the ambition of limiting the impacts of climate change.

Observations are vital to the success of the Paris Agreement and their continuing acquisition should be supported. The costs of observations are small compared to the amounts envisaged for adaptation and mitigation.

Many of the details of the Paris Agreement are still being discussed, and GCOS will need to undertake a detailed consideration of adaptation efforts, however a series of improvements to the current global climate observing system can already be identified, both to report on the state of the climate system or to underpin specific actions in the Agreement. They have been identified in a working document.

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Summary of the monitoring needs identified by GCOS