WEATHER CLIMATE WATER
TEMPS CLIMAT EAU

WMO contributions to SBSTA

Focus on Systematic Observation

WMO OMM

World Meteorological Organization
Organisation météorologique mondiale

Elena Manaenkova
Deputy Secretary-General
Maxx Dilley
Director, Climate Prediction and Adaptation
Carolin Richter
Director, Global Climate Observing System
Pavel Kabat
Chief Scientist

WMO Contributions to SBSTA

- State of the Climate Indicators
- Systematic observation for climate action
  - Climate science inputs for adaptation and mitigation
  - Global Framework for Climate Services (GFCS)
  - Integrated Global Greenhouse Gas Information System
- Global Climate Observing System (GCOS)
- Climate research (WCRP)

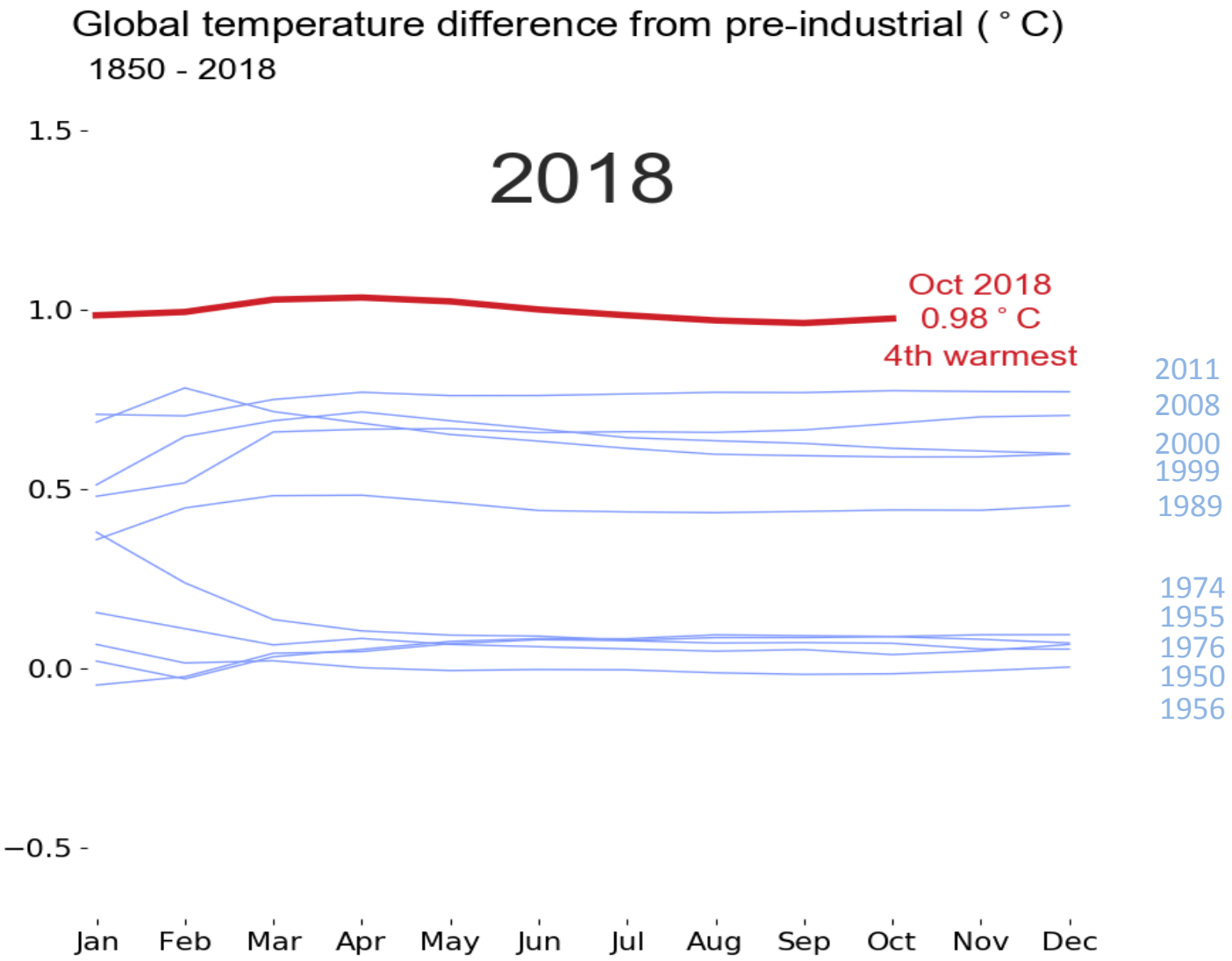
State of the Climate Indicators

- Annual Statement on the State of the Global Climate 2018 (provisional)
- Greenhouse Gas Bulletin

WMO OMM

State of the Climate Indicator	Annual 2018	5 year 2014-2018	10 year 2009-2018	10 year 2006-2015	Other
Global Temperature (change from 1850-1900, pre-industrial period)	**0.98**±0.12°C	1.04±0.09°C	0.93±0.07°C	0.87°C	2015,2016,2017,2018 four warmest years
Greenhouse Gases (atm. concentrations)					
– CO2 (ppm, data to 2017)	**(2017) 405.5**±0.1 ppm	(2013-17) 400.5 ppm	(2008-2017) 394.7 ppm	(2006-2015) 390.3 ppm	highest on record
– CO2 (rate of increase)	(2016) 2.2 ppm/yr	(2012-16) 2.5 ppm/yr	(2007-2016) 2.2 ppm/yr	(2006-2015) 2.1 ppm/yr	
Cryosphere (sea ice extent)					
– March Arctic sea ice extent change % wrt 1981-2010	**-7.4%**	-6.7%	-5.2%	-3.9%	
– September Arctic Sea ice change %	**-27.7%**	-26.6%	-27.5%	-25.1%	
– September Antarctic Sea ice change %	**-4.8%**	-2.1%	-0.6%	+0.9%	
Sea Level					
– Global average rate/year	n/a	4.5±0.3 mm/yr	4.6±0.15 mm/yr	3.8±0.1 mm/yr	3.1±0.1 mm/yr (1993-2017)
– Total change since 1993	**78mm**	70mm (2015)	60mm (2014)	42mm (2009)	
– SE-Asia rate per year					4.5±0.4 mm/yr (1993-2017)
– Caribbean rate per year					2.9±0.2 mm/yr (1993-2017)
Ocean heat content					
– 700 meters (10^{22} J wrt 1981-2010)	**12.8**	11.1	9.1	7.4	1st/2nd highest each qtr
– 2000 meters (10^{22} J wrt 1981-2010)	**18.2**	16.5	13.2	10.2	1st/2nd highest each qtr
Ocean acidification					
pH from open ocean stations HOTS and BATS, annual decrease (data up to 2016)					1995-2016 0.001-0.002

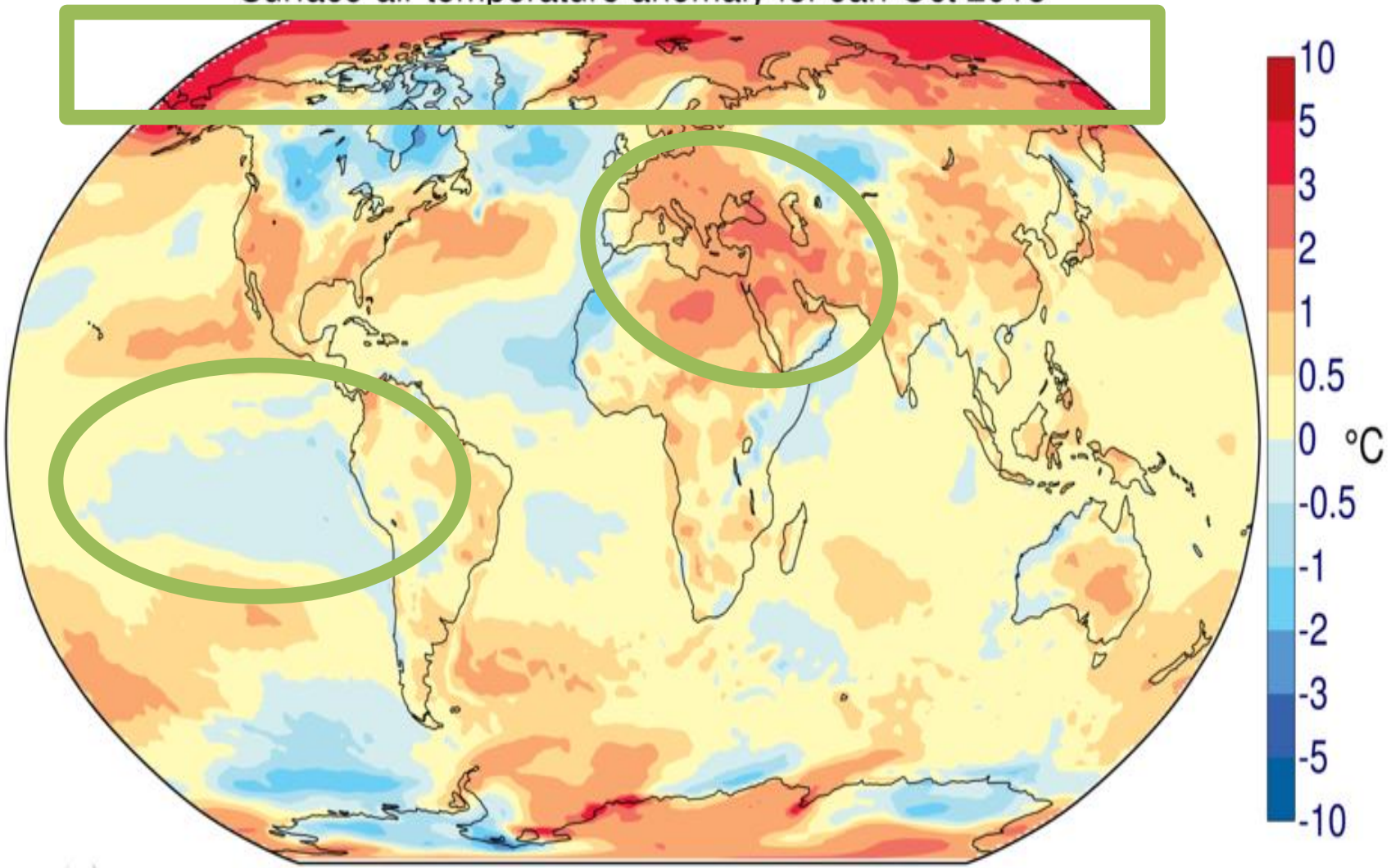
2018 compared with years influenced by La Niña



WMO OMM

WORLD METEOROLOGICAL ORGANIZATION

Surface-air temperature anomaly for Jan-Oct 2018



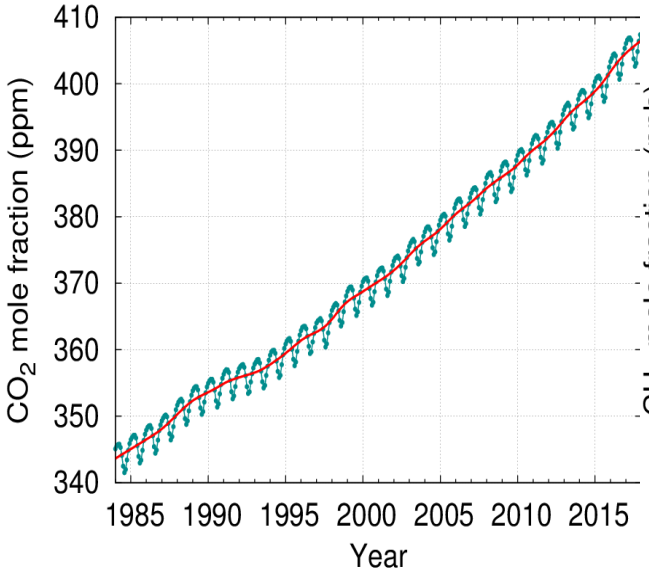
Copernicus Europe's eyes on Earth

Climate Change Service

ECMWF

2017 carbon dioxide level highest in 3 million years

CO_2

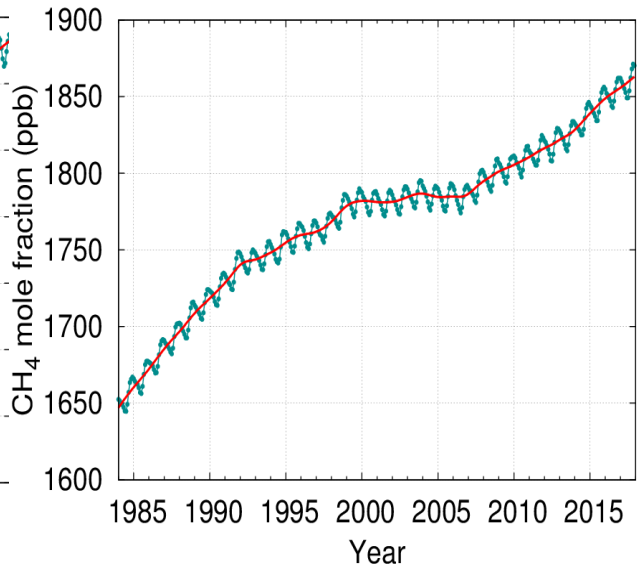


Increase 146 %

Residence time several thousands years

Contribution to warming since pre-industrial times 66 %

CH_4

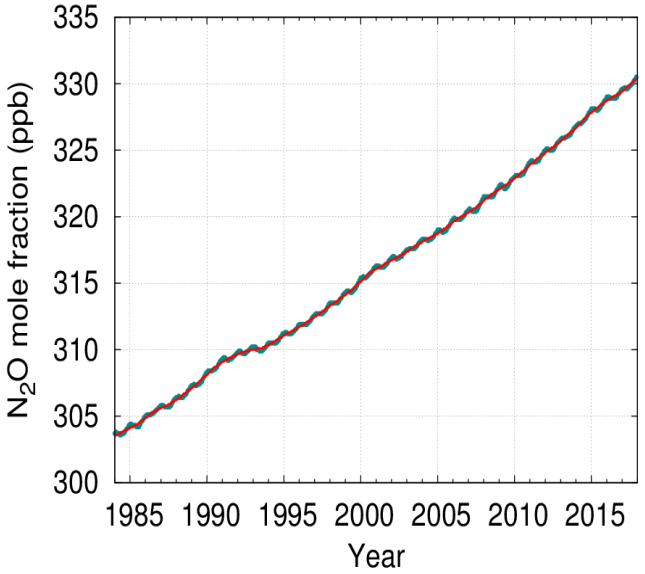


Increase 257 %

Lifetime 12 years

Contribution to warming since pre-industrial times 17 %

N_2O



Increase 122%

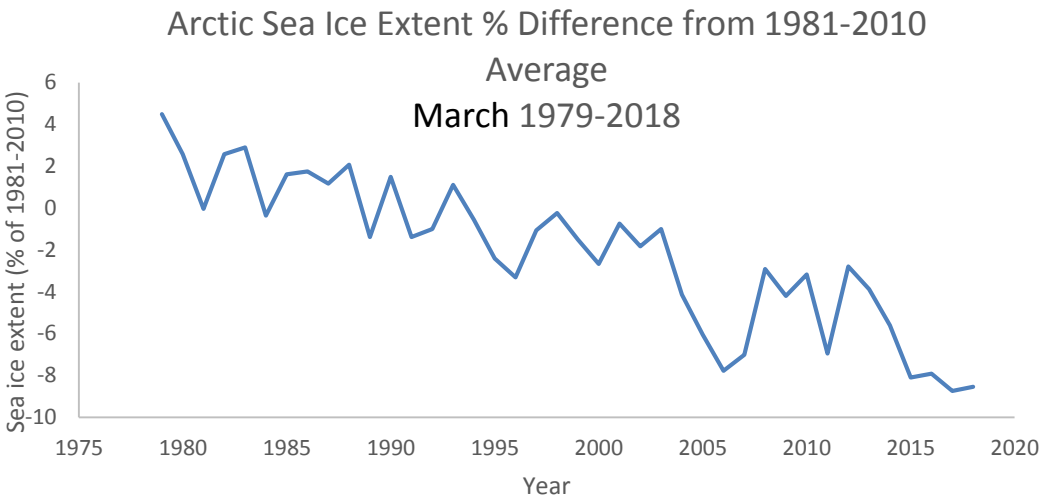
Lifetime 114 years

Contribution to warming since pre-industrial times 6 %

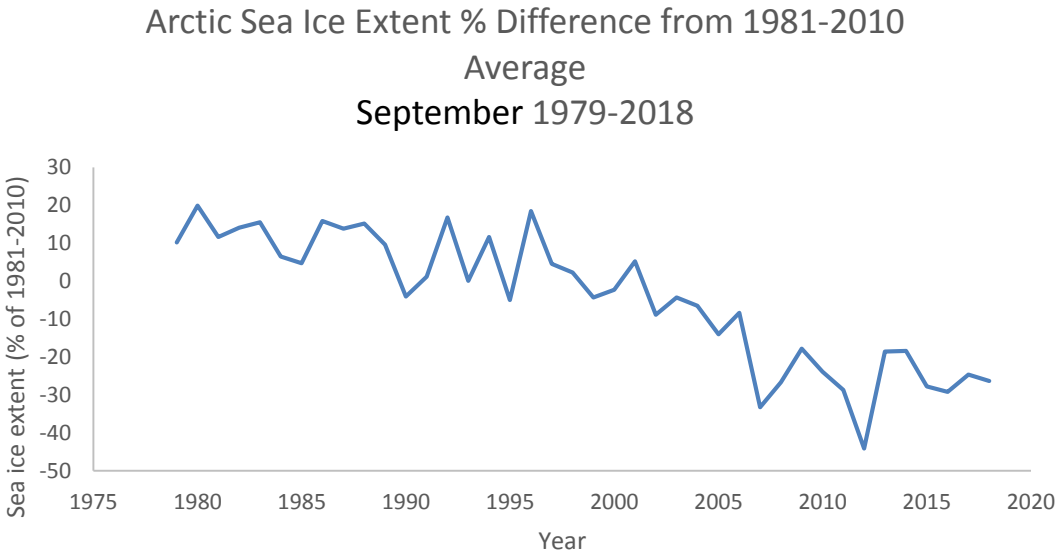
WMO OMM

Arctic sea ice in 2018

March maximum extent 14.48 million square kilometres, approximately 7% below the 1981-2010 average (15.64 million square kilometres), the 3rd smallest extent on record

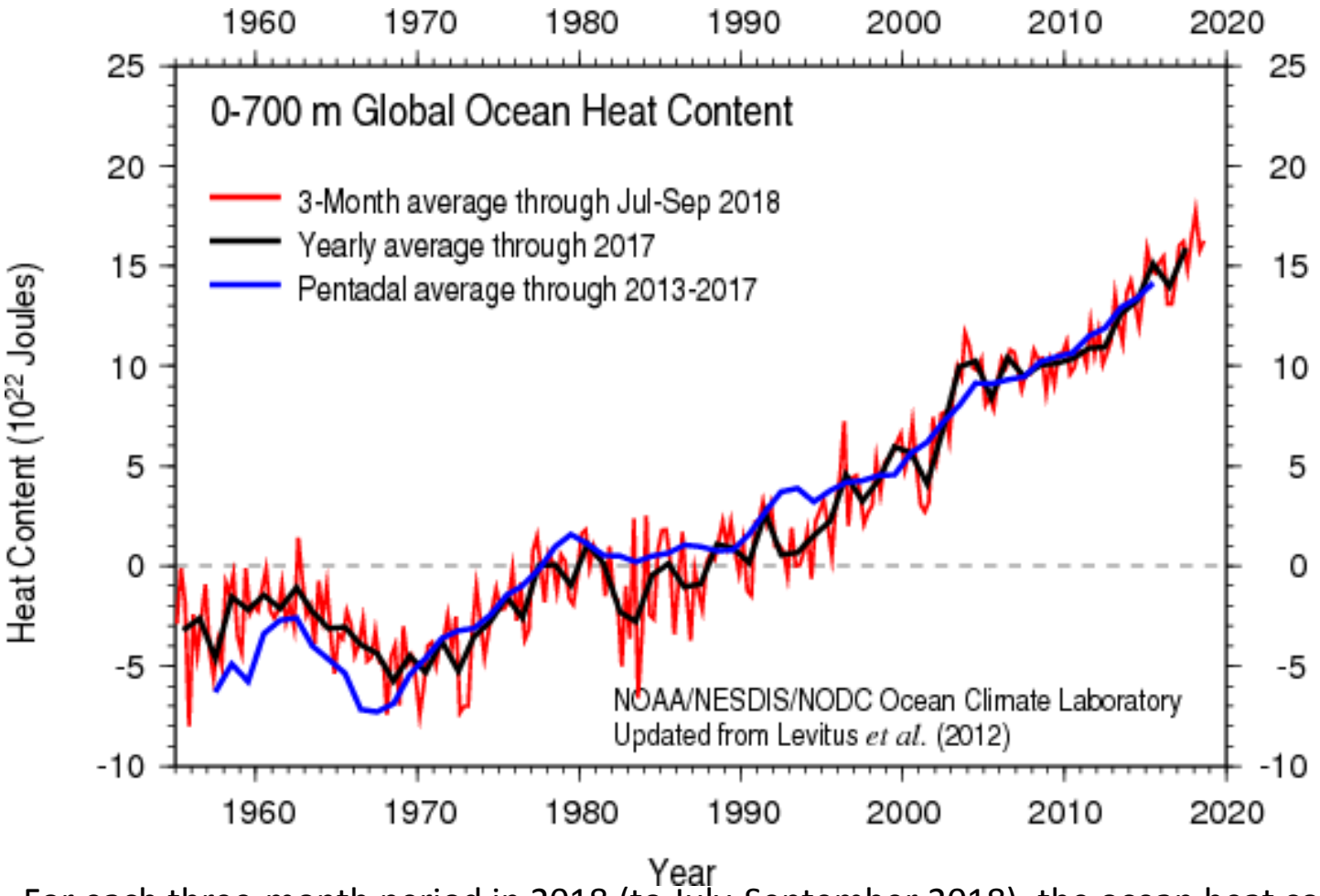


September minimum extent 4.62 million square kilometres, approximately 28% below 1981-2010 average (6.40 million square kilometres), the 6th smallest September extent on record



WMO OMM

Heat content of oceans



For each three-month period in 2018 (to July-September 2018), the ocean heat content in the upper 700m (data from 1955) and upper 2000m (data from 2005) were the highest or 2nd highest on record. In each case, where 2018 was 2nd highest, the highest was recorded in 2017.
Data from National Oceanic and Atmospheric Administration, National Ocean Data Center

WMO OMM

State of the Climate Indicator	Annual 2018	5 year 2014-2018	10 year 2009-2018	10 year 2006-2015	Other
Global Temperature (change from 1850-1900, pre-industrial period)	**0.98**±0.12°C	1.04±0.09°C	0.93±0.07°C	0.87°C	2015,2016,2017,2018 four warmest years
Greenhouse Gases (atm. concentrations)					
– CO2 (ppm, data to 2017)	**(2017) 405.5**±0.1 ppm	(2013-17) 400.5 ppm	(2008-2017) 394.7 ppm	(2006-2015) 390.3 ppm	highest on record
– CO2 (rate of increase)	(2016) 2.2 ppm/yr	(2012-16) 2.5 ppm/yr	(2007-2016) 2.2 ppm/yr	(2006-2015) 2.1 ppm/yr	
Cryosphere (sea ice extent)					
– March Arctic sea ice extent change % wrt 1981-2010	**-7.4%**	-6.7%	-5.2%	-3.9%	
– September Arctic Sea ice change %	**-27.7%**	-26.6%	-27.5%	-25.1%	
– September Antarctic Sea ice change %	**-4.8%**	-2.1%	-0.6%	+0.9%	
Sea Level					
– Global average rate/year	n/a	4.5±0.3 mm/yr	4.6±0.15 mm/yr	3.8±0.1 mm/yr	3.1±0.1 mm/yr (1993-2017)
– Total change since 1993	**78mm**	70mm (2015)	60mm (2014)	42mm (2009)	
– SE-Asia rate per year					4.5±0.4 mm/yr (1993-2017)
– Caribbean rate per year					2.9±0.2 mm/yr (1993-2017)
Ocean heat content					
– 700 meters (10^{22} J wrt 1981-2010)	**12.8**	11.1	9.1	7.4	1st /2nd highest each qtr
– 2000 meters (10^{22} J wrt 1981-2010)	**18.2**	16.5	13.2	10.2	1st/2nd highest each qtr
Ocean acidification					
pH from open ocean stations HOTS and BATS, annual decrease (data up to 2016)					1995-2016 0.001-0.002

Systematic Observation for Climate Action

- Climate science inputs for adaptation and mitigation
- Global Framework for Climate Services
- Integrated Global Greenhouse Gas Information System

WMO OMM

Systematic observation for climate action

Support for country level adaptation and mitigation

WORLD METEOROLOGICAL ORGANIZATION

Climate science inputs (past/ present & future)

Applications

- National Adaptation Plans
- Adaptation and mitigation projects

State of the climate indicators

examples: temperature, sea level

Specific hydrological, meteorological, and climate indices **of relevance to GCF adaptation and mitigation results areas**

examples: soil moisture, wind speed

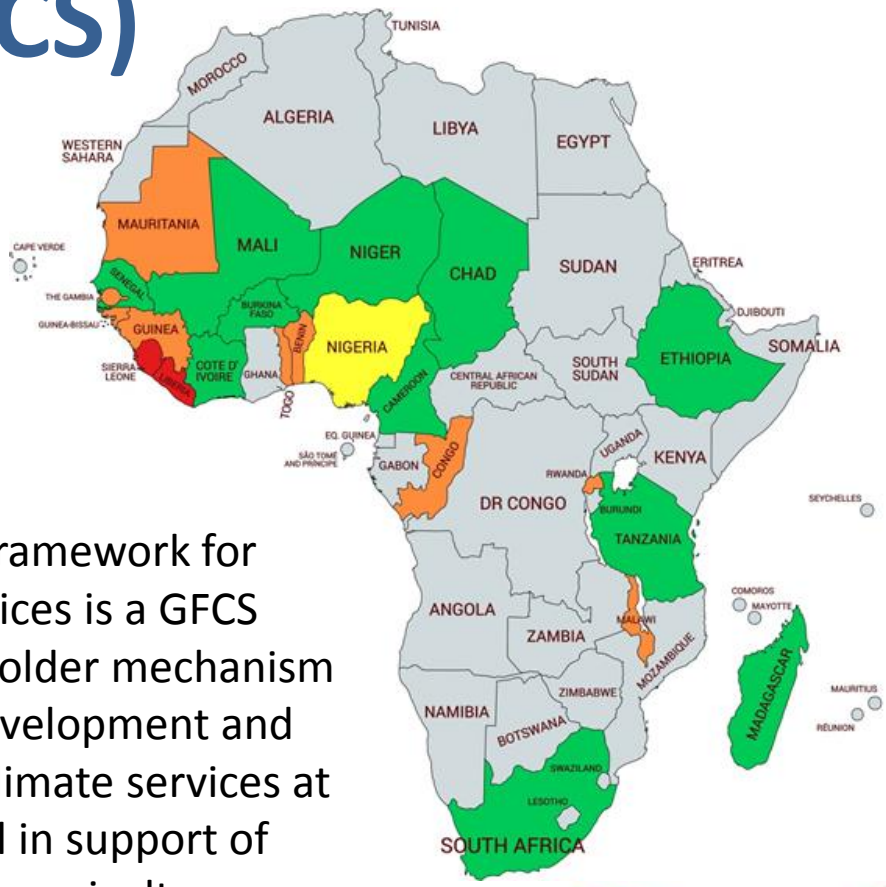
High impact events with widespread, multi-sector impacts

examples: flash flood, drought

Data sets

Methods and tools

Global Framework for Climate Services (GFCS)



A National Framework for Climate Services is a GFCS multi-stakeholder mechanism to enable development and delivery of climate services at country level in support of adaptation in agriculture, water resource management, health, energy, disaster risk reduction and other climate-sensitive sectors

Integrated Global Greenhouse Gas Information System

Goal: Support the success of post-COP21 actions of nations, sub-national governments, and the private sector to reduce climate-disrupting GHG emissions through a sound-scientific, **measurement-based approach** that helps guide solutions:

- Supports improved knowledge of the national emissions
- identifies emission reduction opportunities
- provides nations with information on progress towards their emission reduction strategies and pledges (NDCs)

IG^{3}IS uses tiered approach of observations (in situ and remote sensing), socio-economic activity, and diverse analysis methods in a common framework

WMO OMM

Example of the IG3IS national objective

Side events:

4 December, 1830-2000
Bieszczady

5 December, 0815-0945
WMO-IPCC pavilion (zone H)

Increasing model complexity

Increasing measurement complexity

		Tier 1 Use established (global) model and inversion system, operated by external experts	Tier 2 Use established (global) model and inversion system; develop local expertise to operate the system	Tier 3 Taylored high-resolution modeling and inversion system, operated by local experts
Tier 1	Single representative station in country or station every 500-1000 km	Trend in total emissions in area of influence of site(s)	Total emissions and their trend in area of influence of site(s)	Total emissions and their trend with higher accuracy in area of influence of site(s)
Tier 2	Network of sites covering all parts of country, simple measurement infrastructure	Trend in country total emissions, no separation between anthropogenic and biospheric fluxes	Total country emissions and their trend, no separation between anthropogenic and biospheric fluxes	Total country emissions and their trend with higher accuracy, no separation between anthropogenic and biospheric fluxes
Tier 3	Network of sites covering all parts of country, additional tracers (radon, radiocarbon, isotopes)	Trend in country total emissions, separation between anthropogenic and biospheric fluxes, sector-specific information	Total country emissions and their trend, separation between anthropogenic and biospheric fluxes, sector-specific information	Total country emissions and their trend with higher accuracy, separation between anthropogenic and biospheric fluxes, sector-specific info.

WMO OMM

WEATHER CLIMATE WATER
TEMPS CLIMAT EAU

Thank you

WMO OMM

World Meteorological Organization
Organisation météorologique mondiale