Earth's System Approach to Climate, Weather and Environment

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(WCRP, WWRP, GAW)

WEATHER CLIMATE WATER
TEMPS CLIMAT EAU

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World Meteorological Organization
Organisation météorologique mondiale

2015: A Landmark Year

PARIS2015
UN CLIMATE CHANGE CONFERENCE
COP21·CMP11

UN World Conference on
Disaster Risk Reduction
2015 Sendai Japan

- Over 190 countries signed up to reduce emissions, with the target to stay within a 2ºC world.
- 15-year agreement for the substantial reduction of disaster risk and losses in lives, livelihoods and health.
- 2030 agenda with 17 goals to end poverty and hunger, improve health and education, making cities more sustainable, combating climate change, and protecting oceans and forests.

Understanding and Quantifying Weather and Climate Risk are at the Core of these Actions

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A little preamble....

Where do we stand today ?

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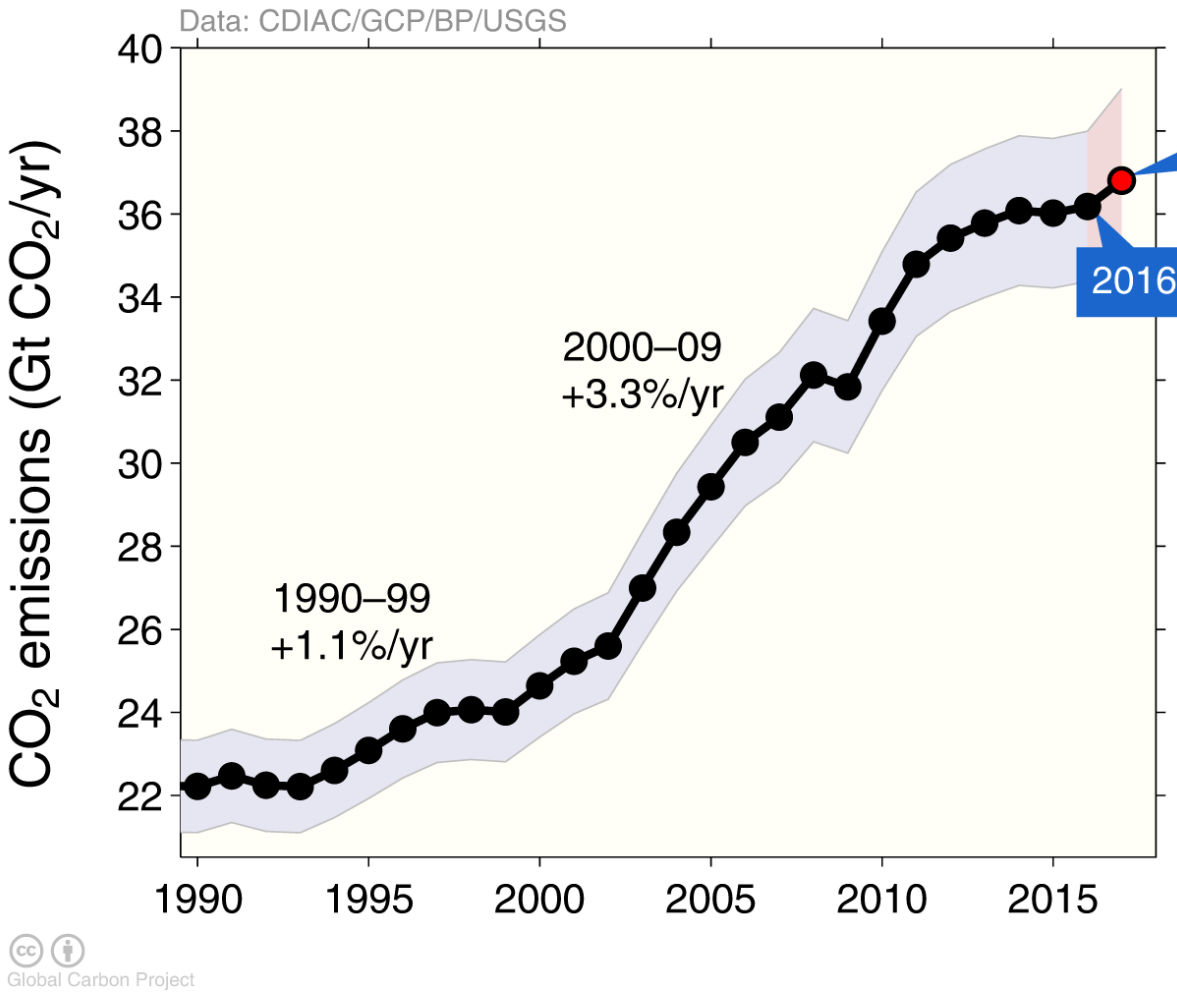
Emissions from fossil fuel use and industry

Global emissions from fossil fuel and industry: 36.2 ± 2 $GtCO_2$ in 2016, 62% over 1990

- Projection for 2017: 36.8 ± 2 $GtCO_2$, 2.0% higher than 2016



Uncertainty is ±5% for one standard deviation (IPCC "likely" range)

Estimates for 2015 and 2016 are preliminary. Growth rate is adjusted for the leap year in 2016.

Source: CDIAC; Le Quéré et al 2017; Global Carbon Budget 2017

WMO GREENHOUSE GAS BULLETIN NOVEMBER 2018

	CO_2	CH_4	N_2O
Global abundance in 2017	405.5 ± 0.1 ppm	1 859 ± 2 ppb	329.9 ± 0.1 ppb
2017 abundance relative to year 1750*	146%	257%	122%
2016-17 absolute increase	2.2 ppm	7 ppb	0.9 ppb
2016-17 relative increase	0.55%	0.38%	0.27%
Mean annual absolute increase of last 10 years	2.24 ppm yr^{-1}	6.9 ppb yr^{-1}	0.93 ppb yr^{-1}

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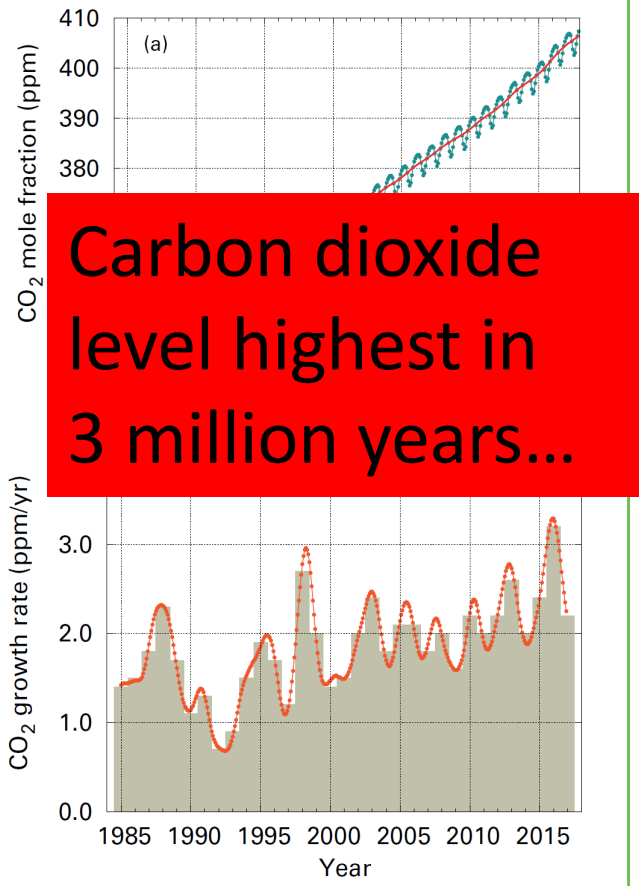
The number of stations used for the analyses is 129 for CO_2, 126 for CH_4 and 96 for N_2O. Assuming a pre-industrial mole fraction of 278 ppm for CO_2, 722 ppb for CH_4 and 270 ppb for N_2O.



Carbon dioxide level highest in 3 million years…

Figure 4. Globally averaged CO_2 mole fraction (a) and its growth rate (b) from 1984 to 2017. Increases in successive annual means are shown as the shaded columns in (b). The red line in (a) is the monthly mean with the seasonal variation removed; the blue dots and line depict the monthly averages. Observations from 129 stations have been used for this analysis.

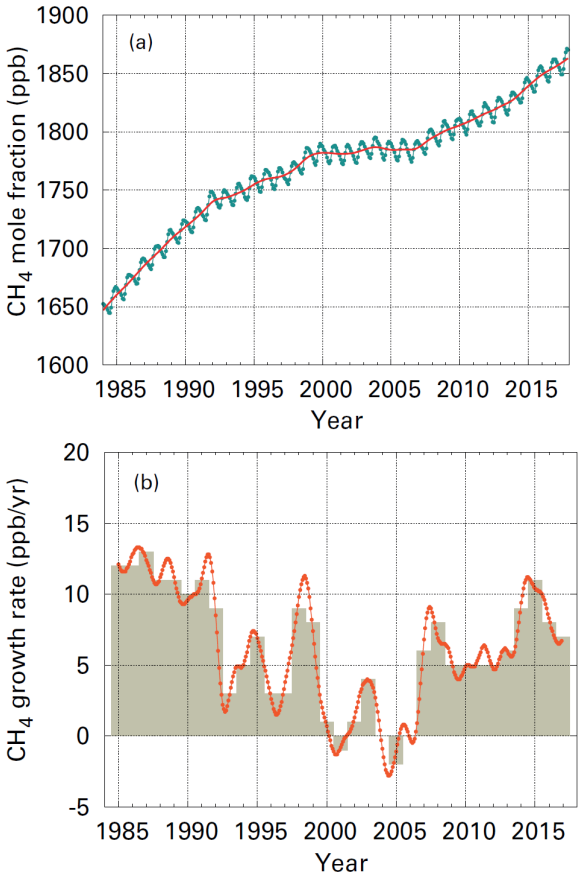


Figure 5. Globally averaged CH_4 mole fraction (a) and its growth rate (b) from 1984 to 2017. Increases in successive annual means are shown as the shaded columns in (b). The red line in (a) is the monthly mean with the seasonal variation removed; the blue dots and line depict the monthly averages. Observations from 126 stations have been used for this analysis.

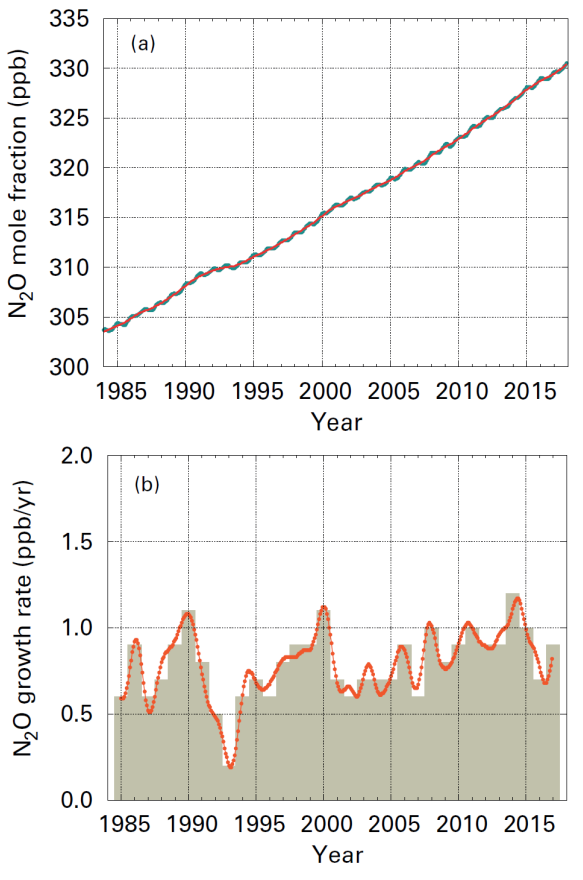


Figure 6. Globally averaged N_2O mole fraction (a) and its growth rate (b) from 1984 to 2017. Increases in successive annual means are shown as the shaded columns in (b). The red line in (a) is the monthly mean with the seasonal variation removed; in this plot it is overlapping with the blue dots and line that depict the monthly averages. Observations from 96 stations have been used for this analysis.

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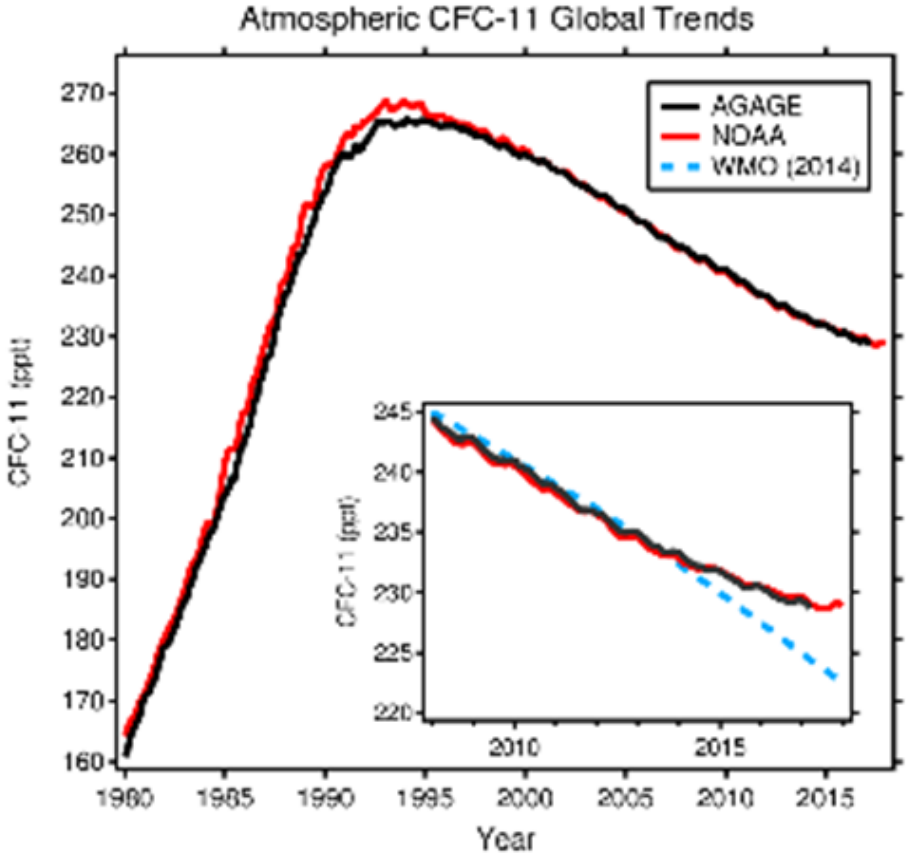
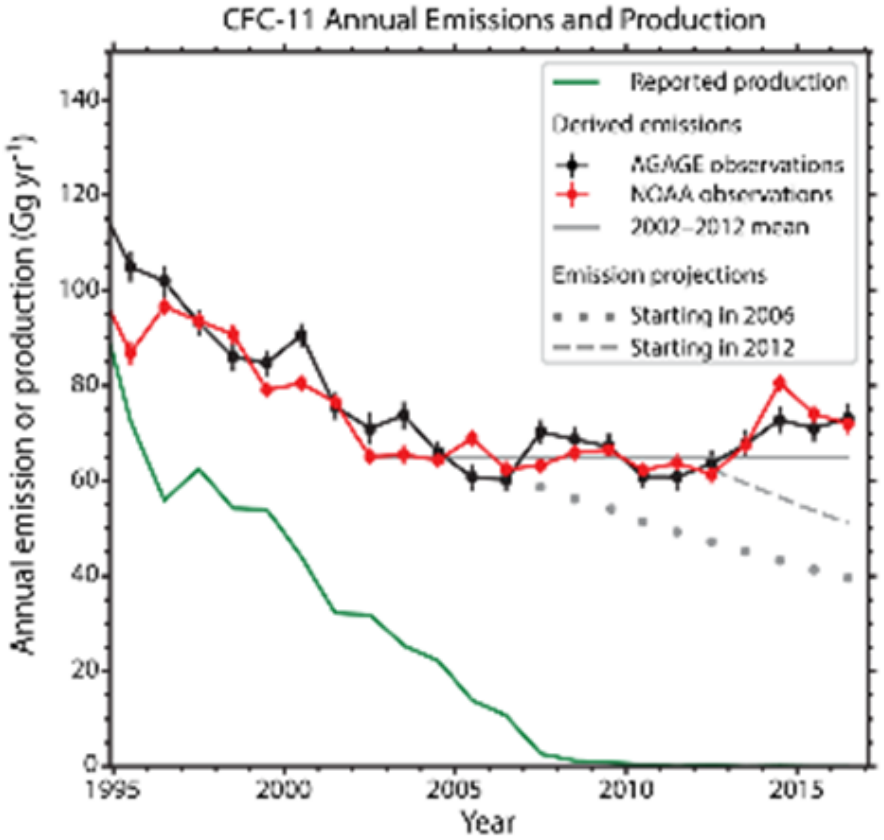
Atmospheric “discoveries”





New emissions of CFC-11 from East Asia

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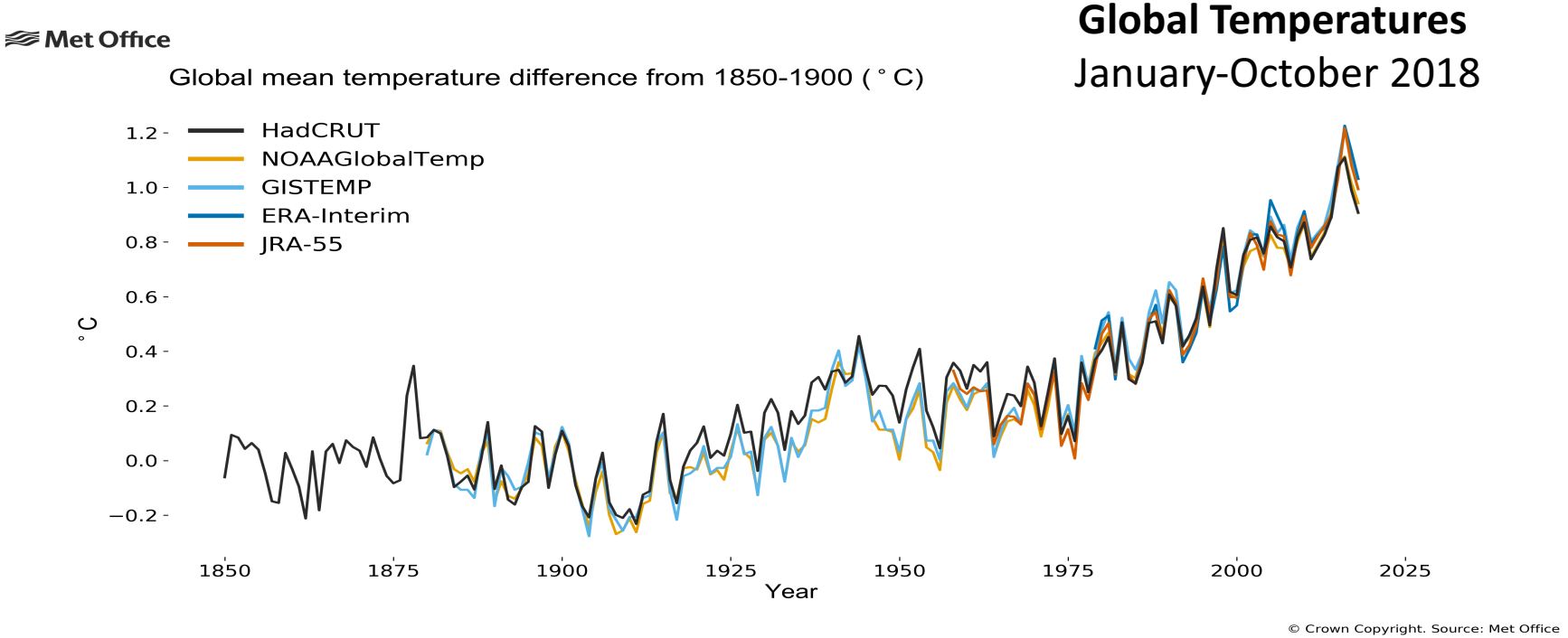
WMO State of Climate 2018

(pre-release yesterday in Geneva)



Global Temperatures
January-October 2018

- 2018 0.98±0.12°C above pre-industrial (1850-1900), 2018 set to be 4th warmest year on record
- . 2015 and 2016 were affected by strong El Nino2015, 2016, 2017 and 2018 are the 4 warmest years on record
- In contrast to the two warmest years, 2018 began with weak La Niña conditions, typically associated with lower global temperatures.
- By October, sea-surface temperatures in the eastern Tropical Pacific were showing signs of a return to El Niño conditions. If El Niño develops, 2019 is likely to be warmer than 2018.

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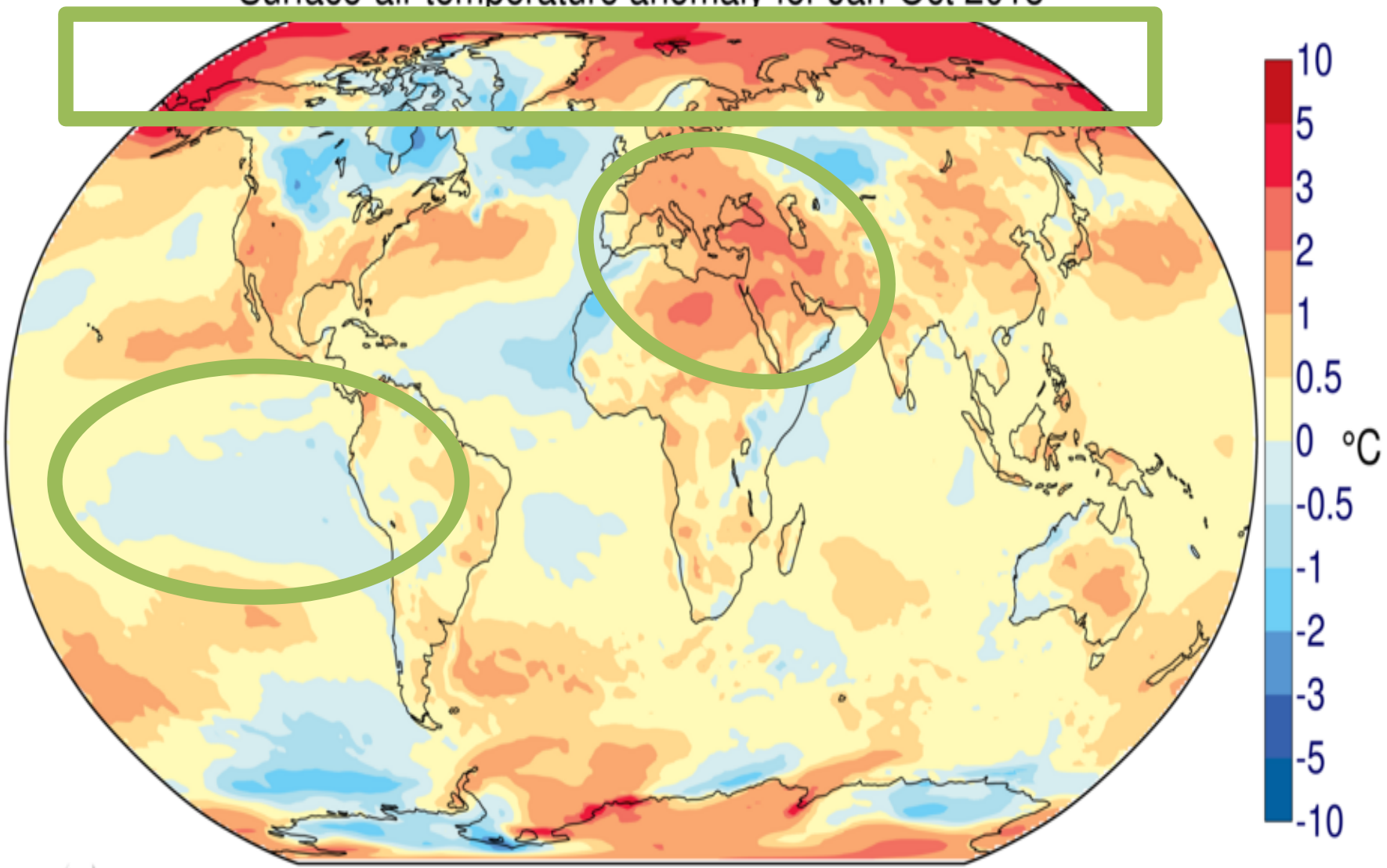
Surface-air temperature anomaly for Jan-Oct 2018



European Commission

Copernicus
Europe's eyes on Earth

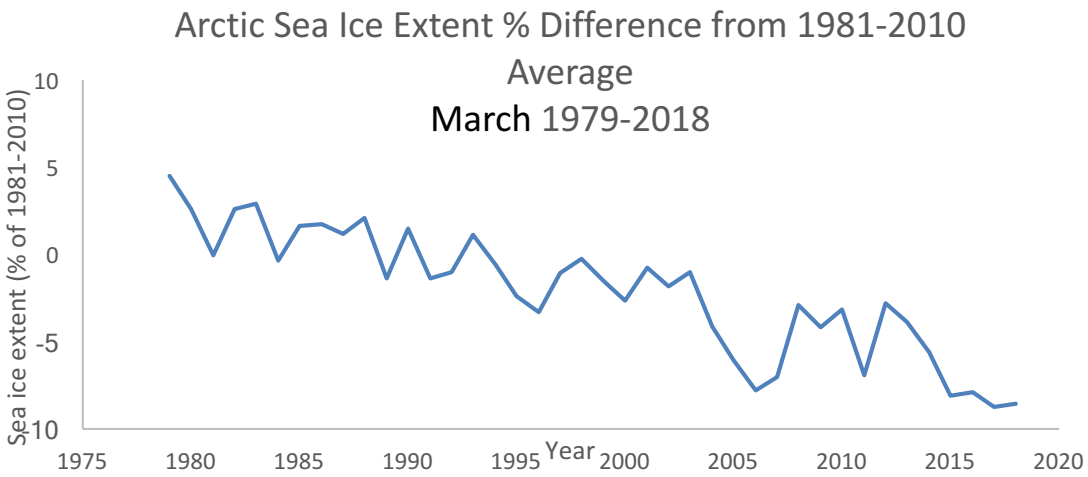
Climate Change Service
climate.copernicus.eu

IMPLEMENTED BY ECMWF

Arctic Sea Ice in 2018

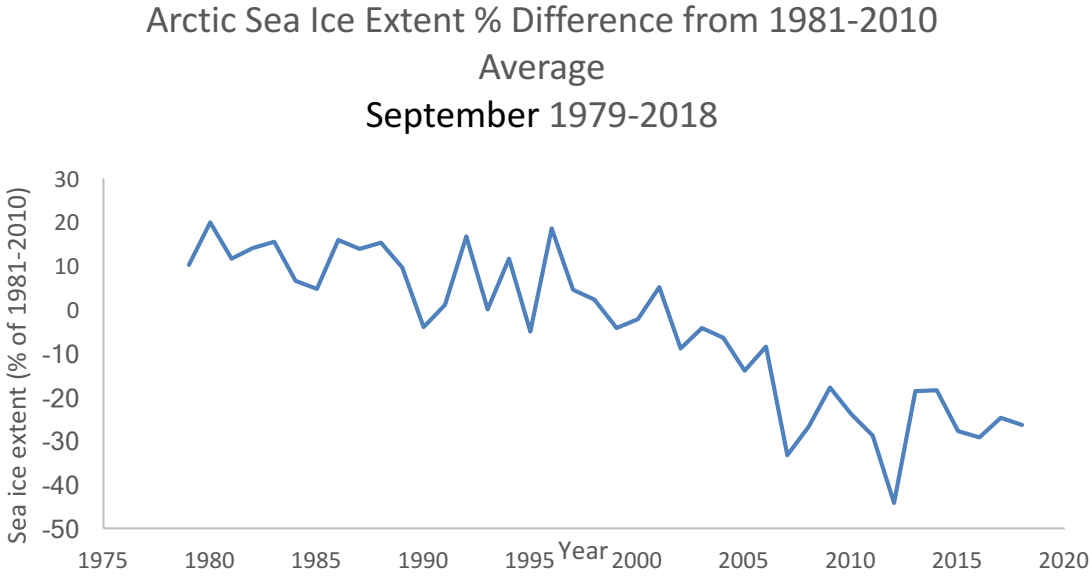
March

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



September

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



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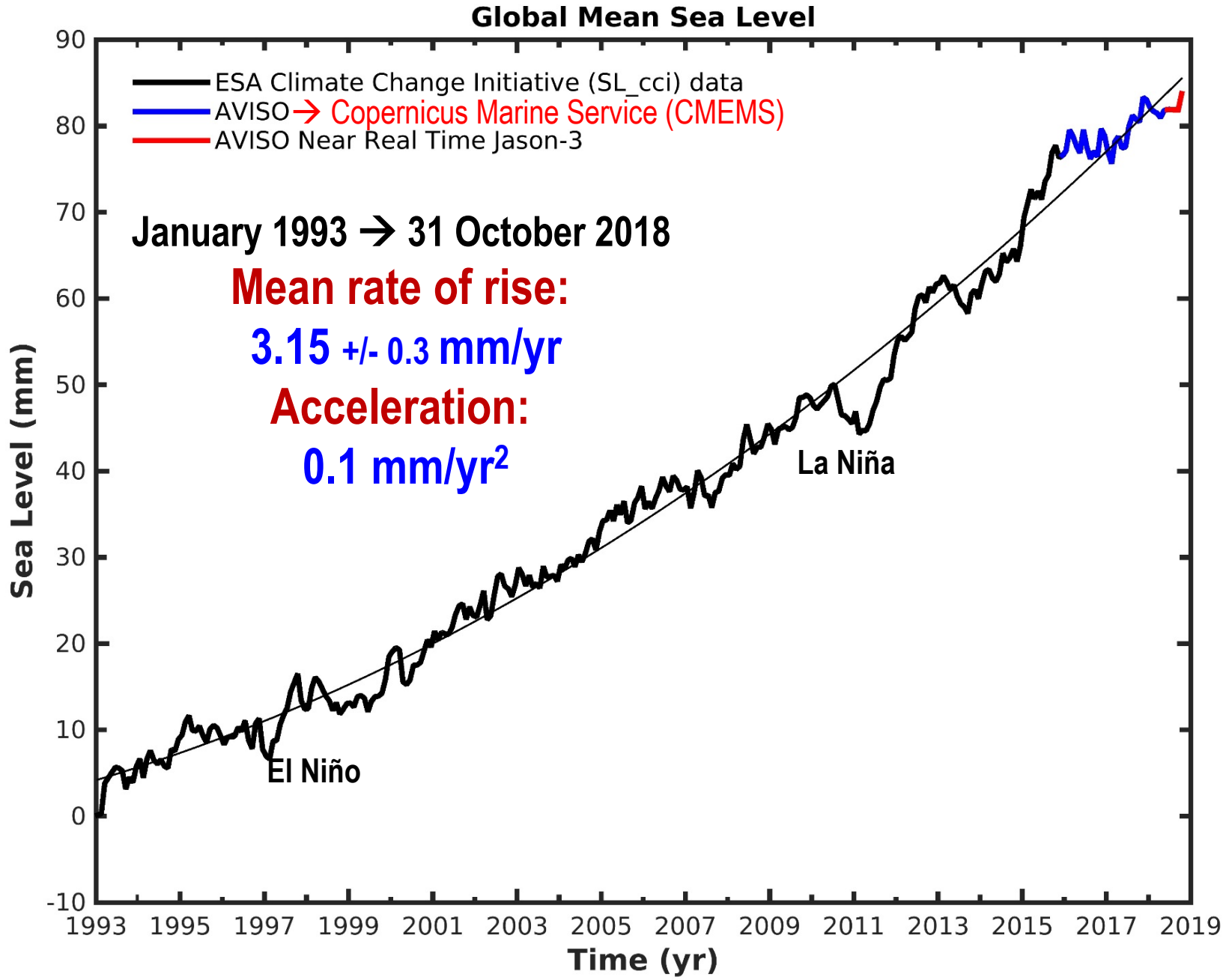
Global Mean Sea Level (Altimetry Era)



WORLD CLIMATE RESEARCH PROGRAMME
WCRP

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The Future of WCRP…. (and the role of CMIP)

Terms of Reference for WCRP Review

- To ascertain the effectiveness of WCRP in delivering its mandate to determine:
  - To what extent climate can be predicted;
  - The extent of man's influence on climate.
- To assess how well it partners with other organisations.
- To advise on the future structure, governance and resourcing of the programme.

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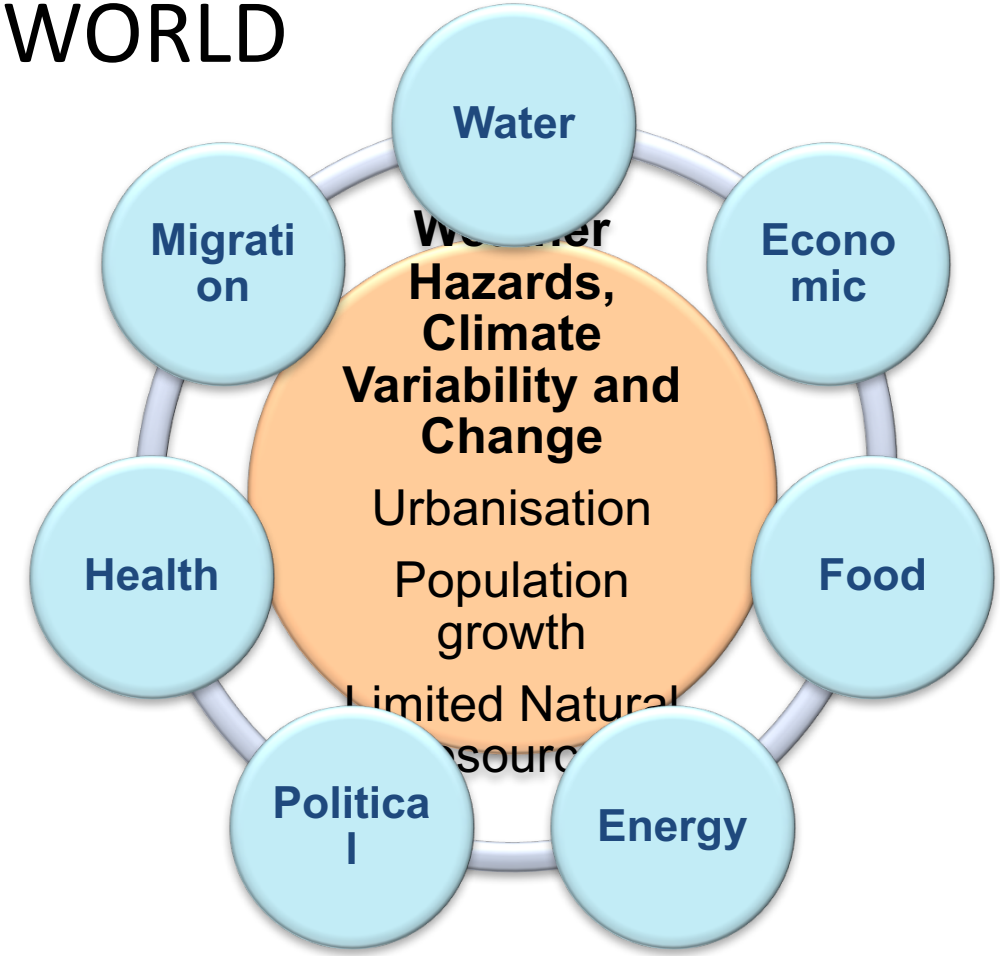
21st CENTURY CHALLENGES IN AN INTERCONNECTED WORLD

Exposure to extreme weather and climate events threatens to derail the sustainability of economic development and social welfare across the globe, and to threaten the securities on which we rely for our health and well-being.



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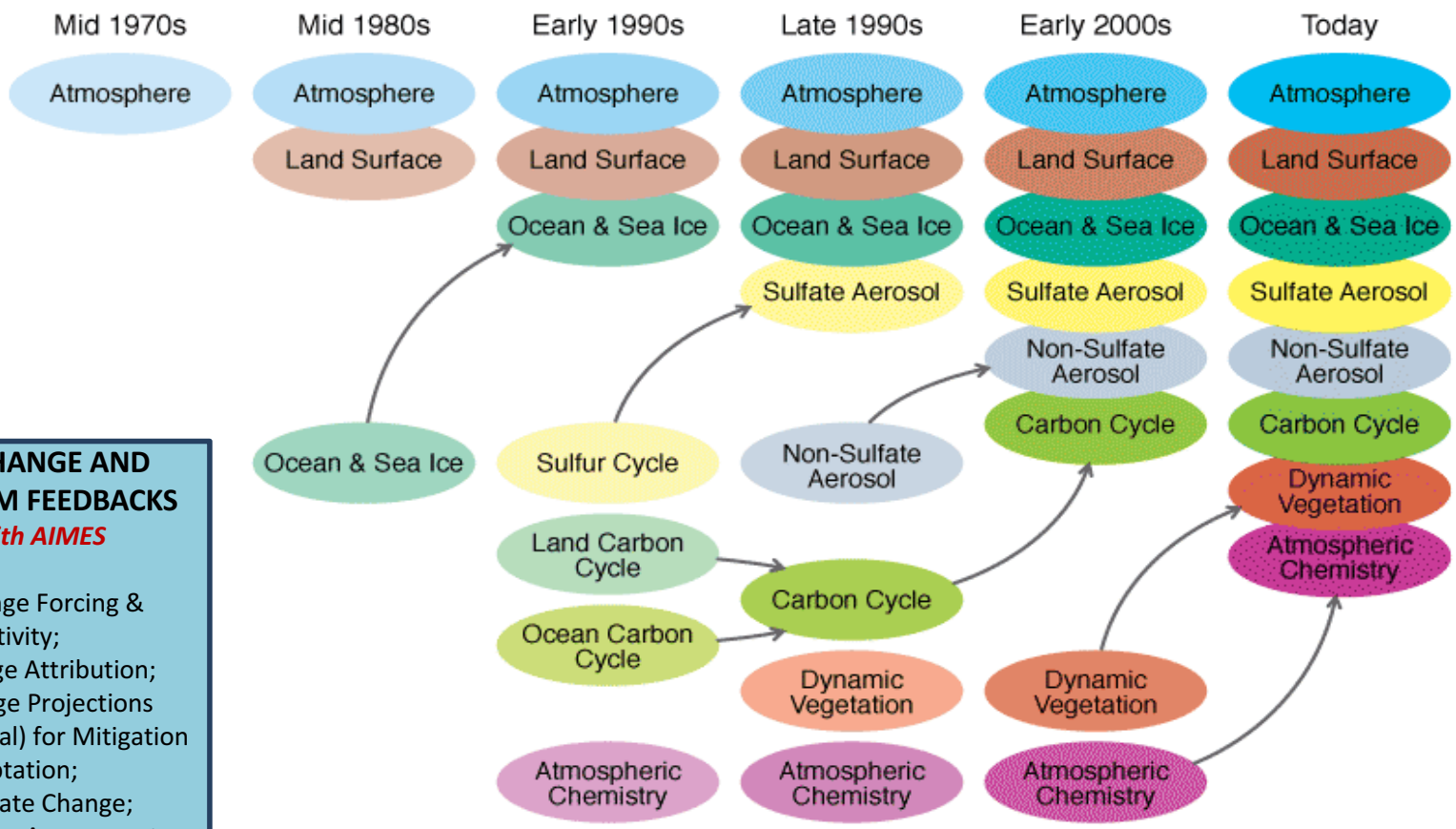
There is no logical scientific argument for separating the physical climate system from full Earth system science

Evolution of Climate Models to Earth System Models



CLIMATE CHANGE AND EARTH SYSTEM FEEDBACKS

Jointly with AIMES

Climate Change Forcing & Sensitivity;
Climate Change Attribution;
Climate Change Projections (Global & Regional) for Mitigation & Adaptation;
Abrupt Climate Change;
Geoengineering Assessment

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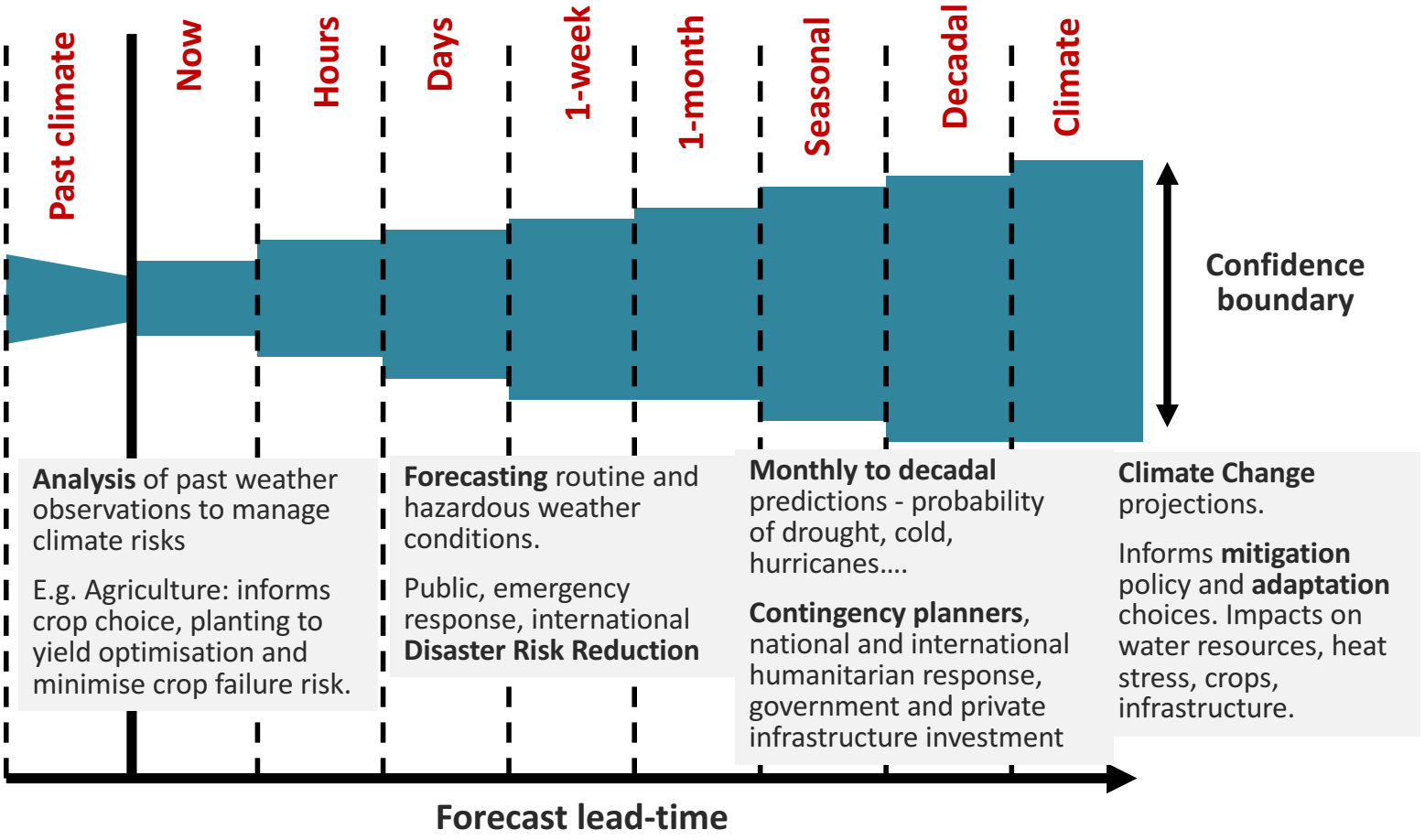
New Tools in the Toolbox:

Seamless Prediction Across Timescales



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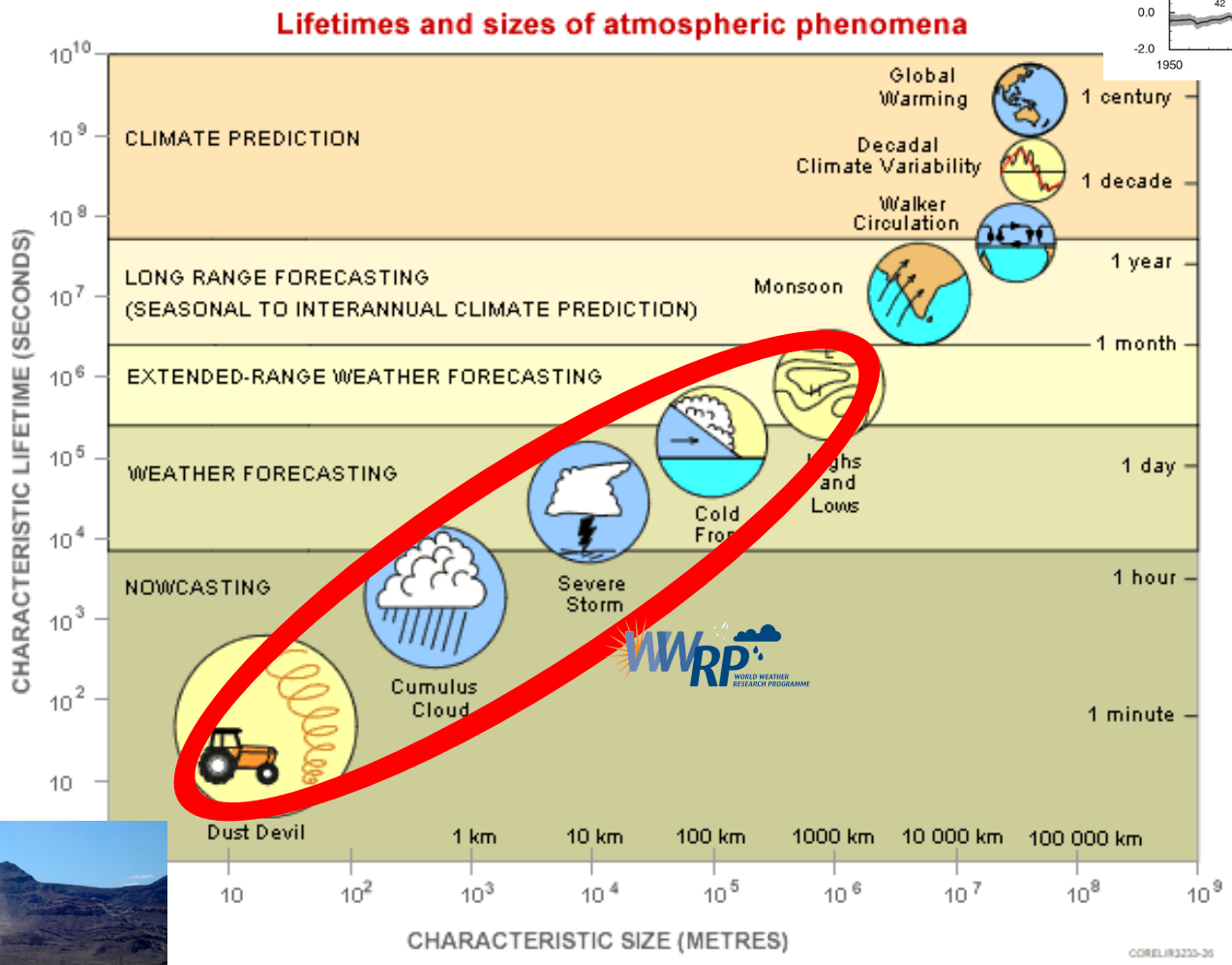
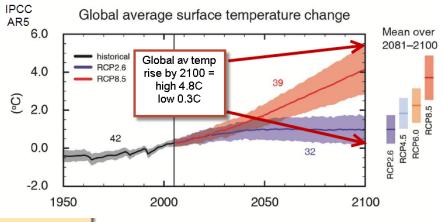
Weather and Climate Research





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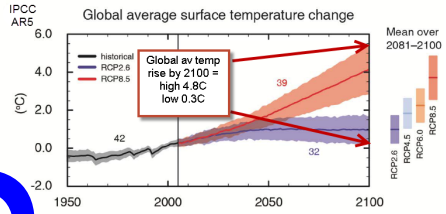
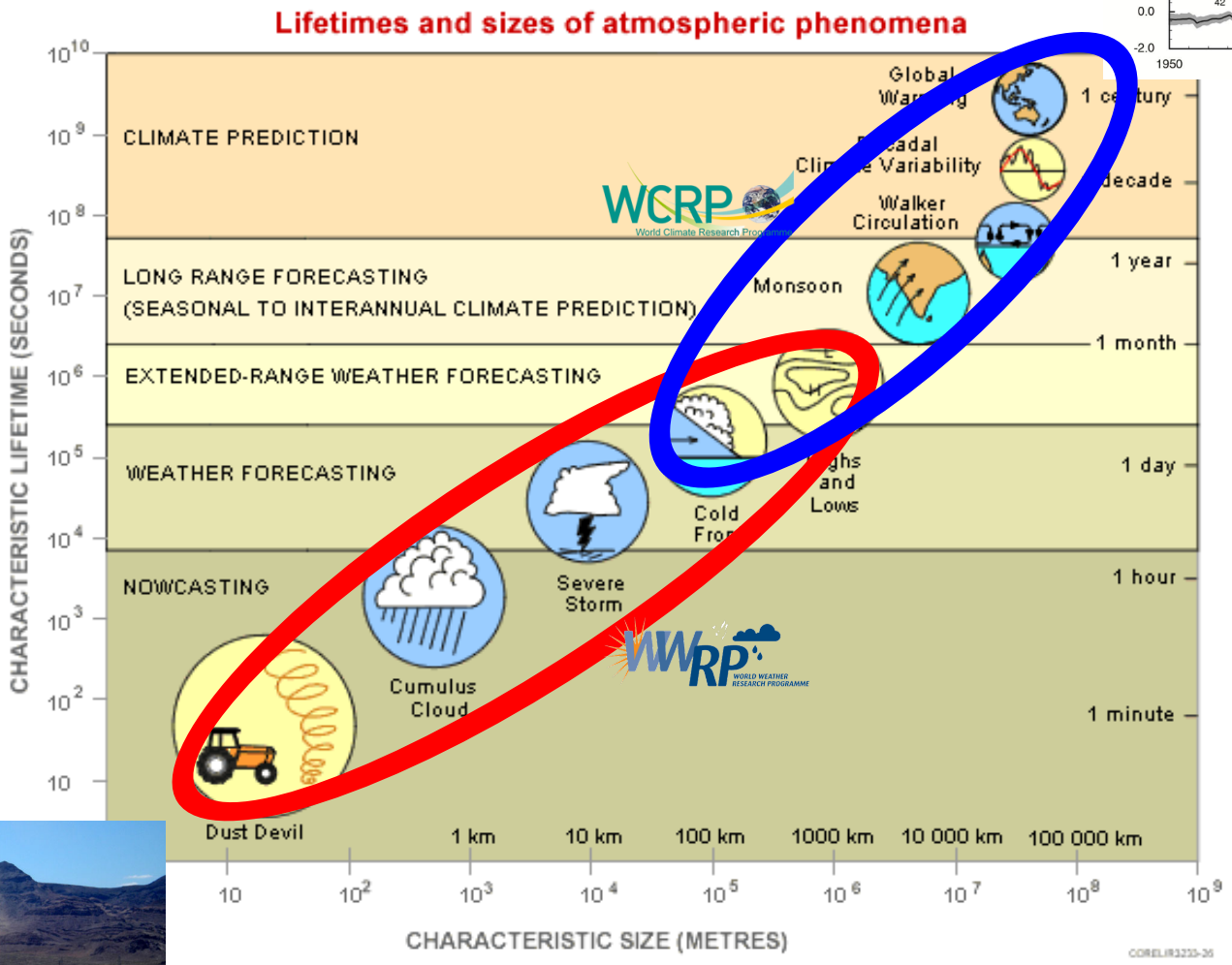
Weather and Climate Research





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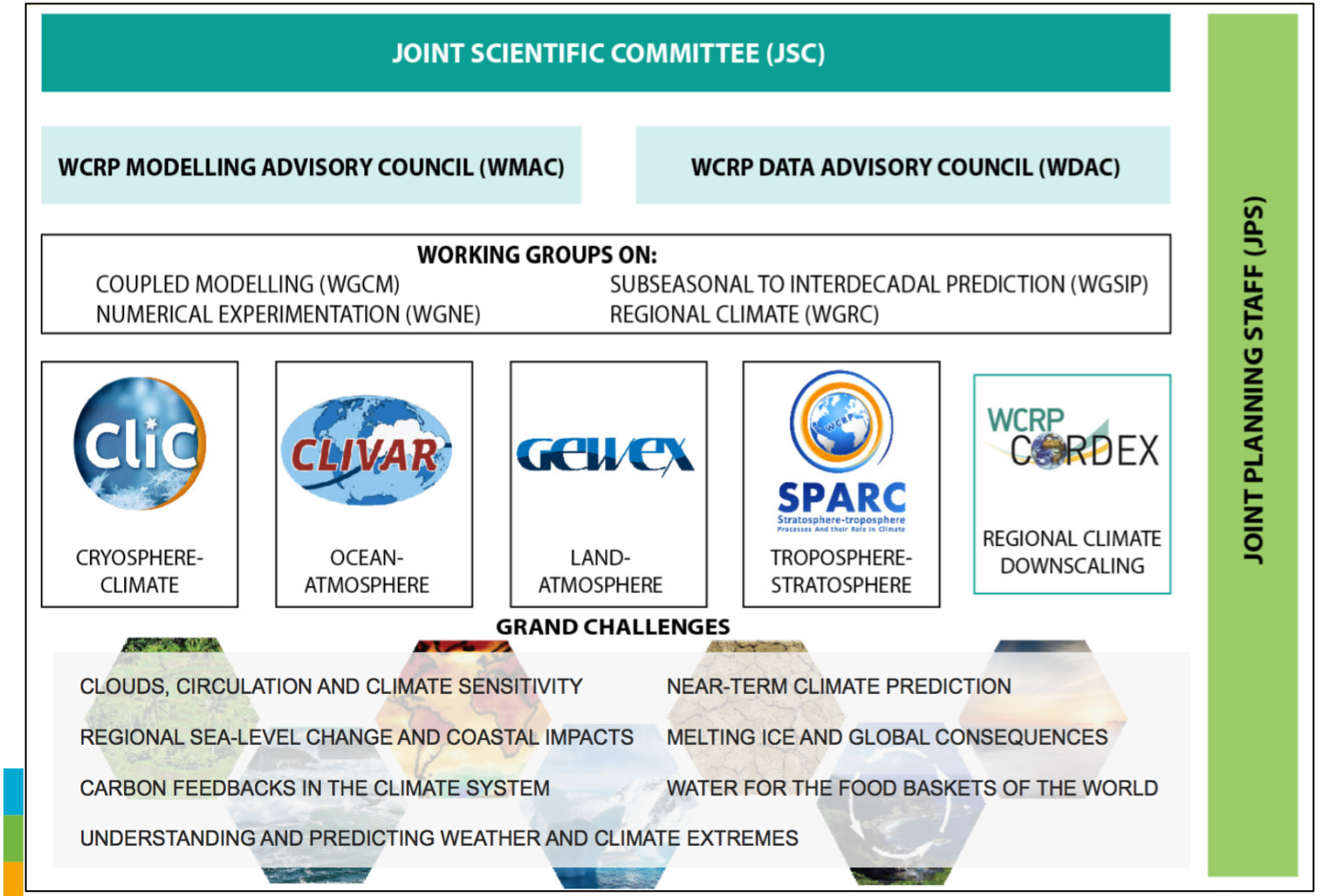
Overarching Conclusions of the Review Panel

- WCRP is at a critical point in its history, and **significant changes are required in its governance, structure and delivery** for it to fulfil its mission in the context of 21st century challenges.
- Without a strong foundation in climate science and prediction, none of these challenges can be addressed in a robust, cost-effective and durable way.
- Since its inception, the key strength of WCRP has been its focus on cutting-edge physical climate science **where international coordination enables scientific advances that would not happen otherwise**. This must continue to be its focus; that means prioritising what it does and recognising where **its unique role as a facilitator and integrator of climate research makes a difference**.
- WCRP needs to articulate and demonstrate its core values more effectively, along with the societal relevance of its work. It is **not the role of WCRP to deliver the end products and services**, but it should provide the bedrock knowledge on which these can be developed.



CURRENT WCRP STRUCTURE

Unwieldy, complex and confusing.

Core Projects stuck in the past?

Where is whole system approach?

Where is next generation model development?

Where is the pathway to climate services?

Where is climate change?

CURRENT STRUCTURE IS NOT THE STRUCTURE FOR THE FUTURE

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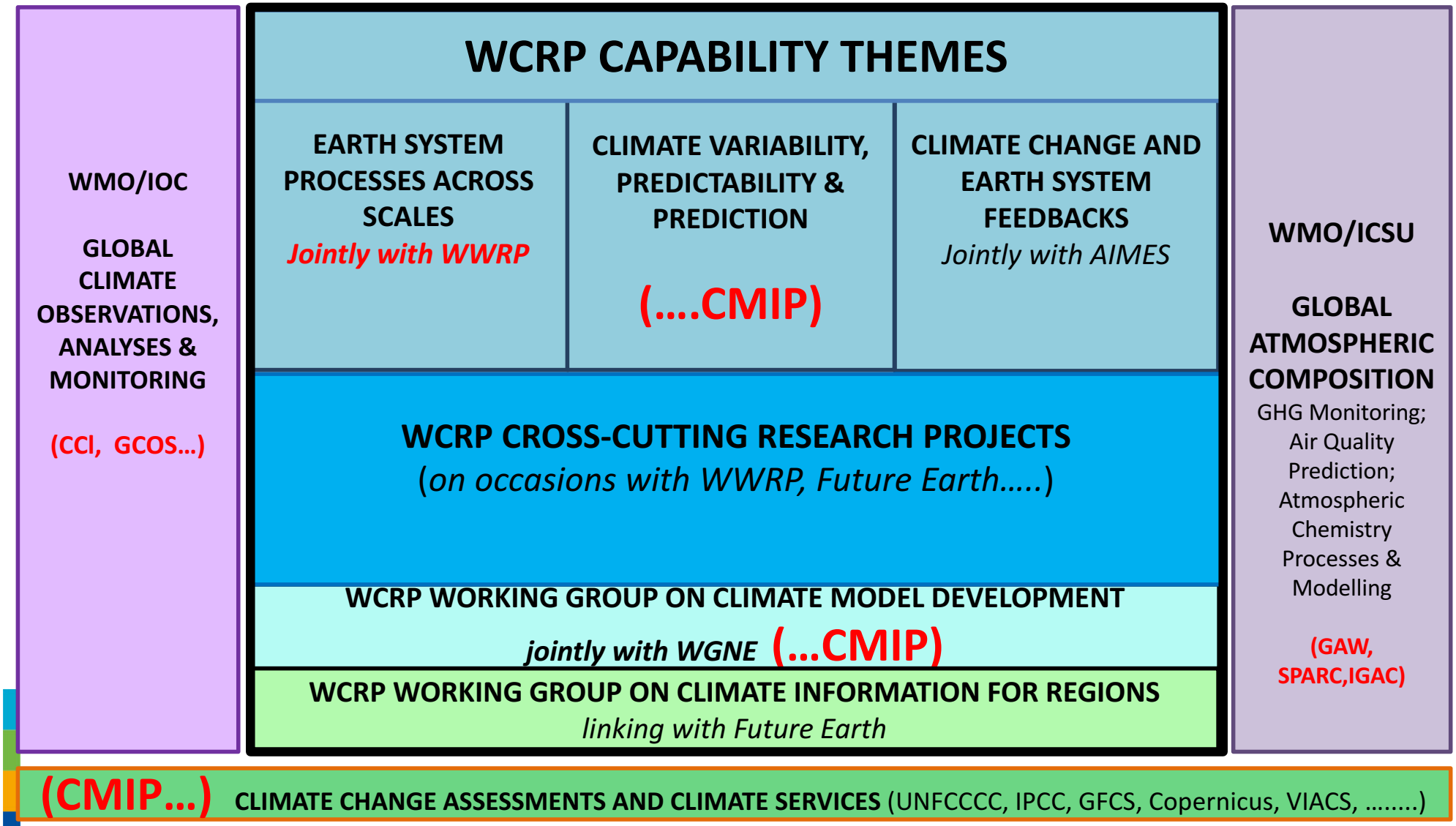
WMO/IOC
GLOBAL CLIMATE OBSERVATIONS, ANALYSES & MONITORING
(CCI, GCOS…)
WCRP CAPABILITY THEMES
EARTH SYSTEM PROCESSES ACROSS SCALES
Jointly with WWRP
CLIMATE VARIABILITY, PREDICTABILITY & PREDICTION
(….CMIP)
CLIMATE CHANGE AND EARTH SYSTEM FEEDBACKS
Jointly with AIMES
WCRP CROSS-CUTTING RESEARCH PROJECTS
(on occasions with WWRP, Future Earth…..)
WCRP WORKING GROUP ON CLIMATE MODEL DEVELOPMENT
jointly with WGNE (…CMIP)
WCRP WORKING GROUP ON CLIMATE INFORMATION FOR REGIONS
linking with Future Earth
WMO/ICSU
GLOBAL ATMOSPHERIC COMPOSITION
GHG Monitoring; Air Quality Prediction; Atmospheric Chemistry Processes & Modelling
(GAW, SPARC,IGAC)
(CMIP…) CLIMATE CHANGE ASSESSMENTS AND CLIMATE SERVICES (UNFCCCC, IPCC, GFCS, Copernicus, VIACS, ……..)

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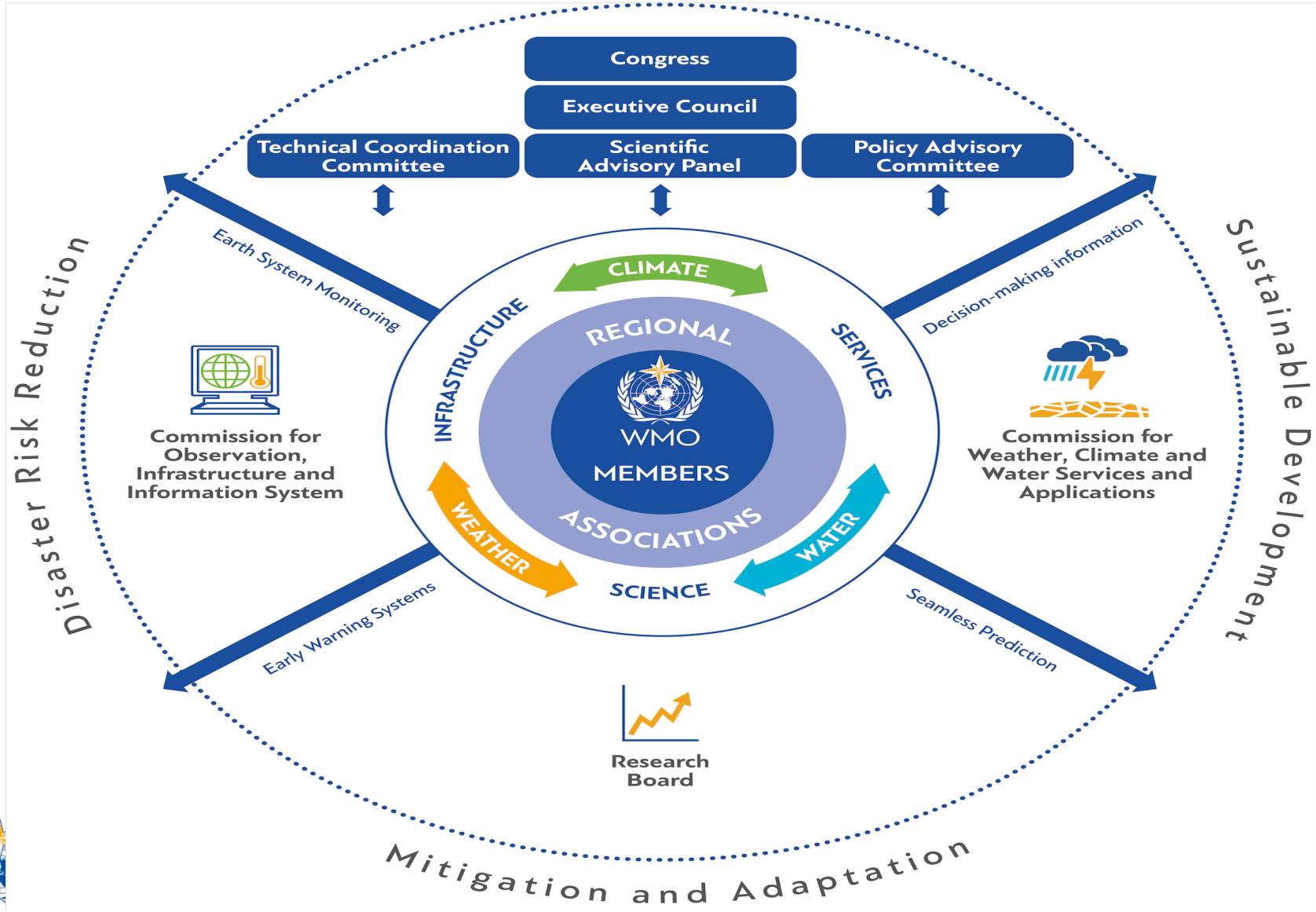
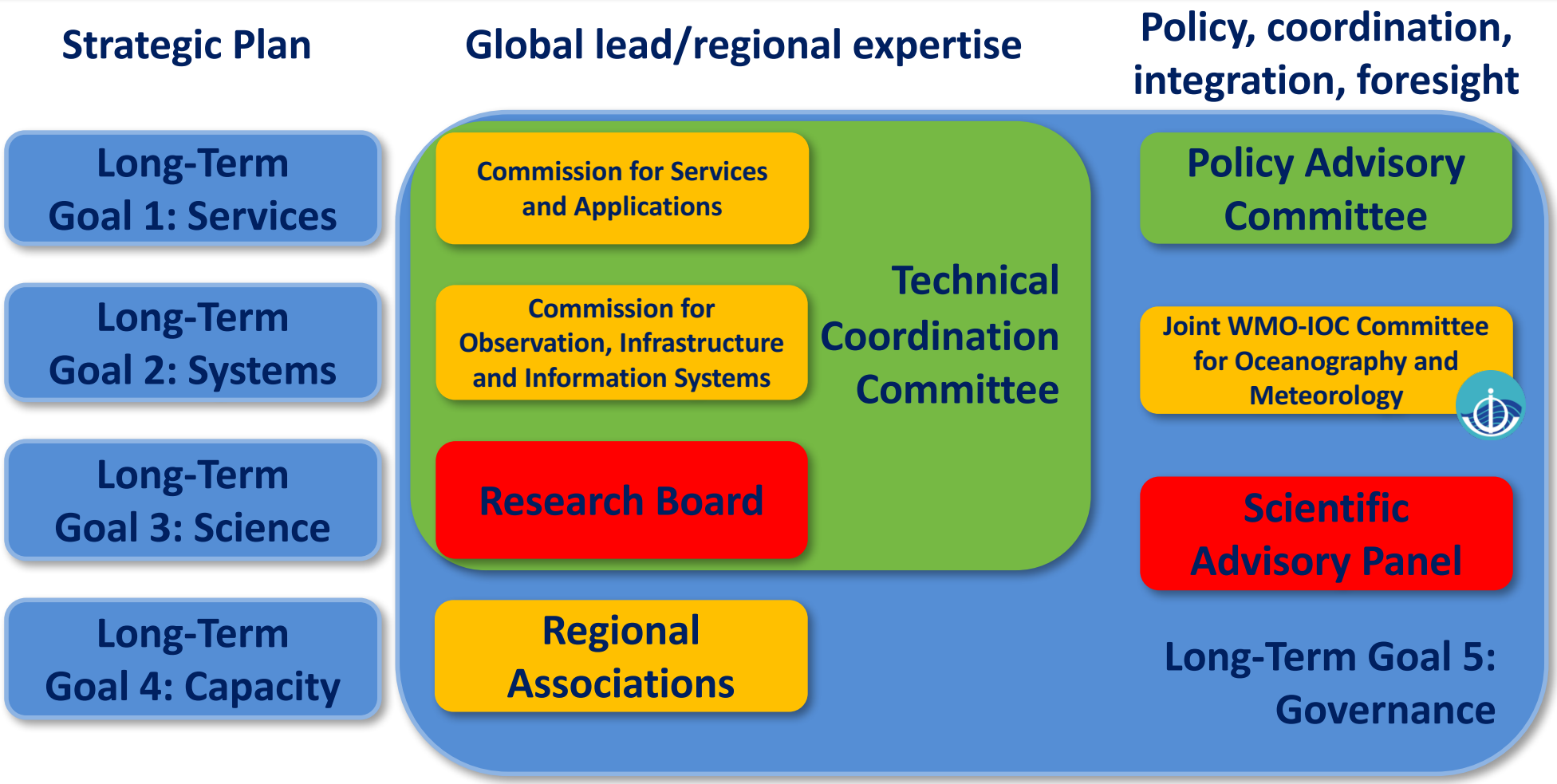
Future WMO: Integrated seamless Earth-system science and science for services approach



Alignment of WMO Structure



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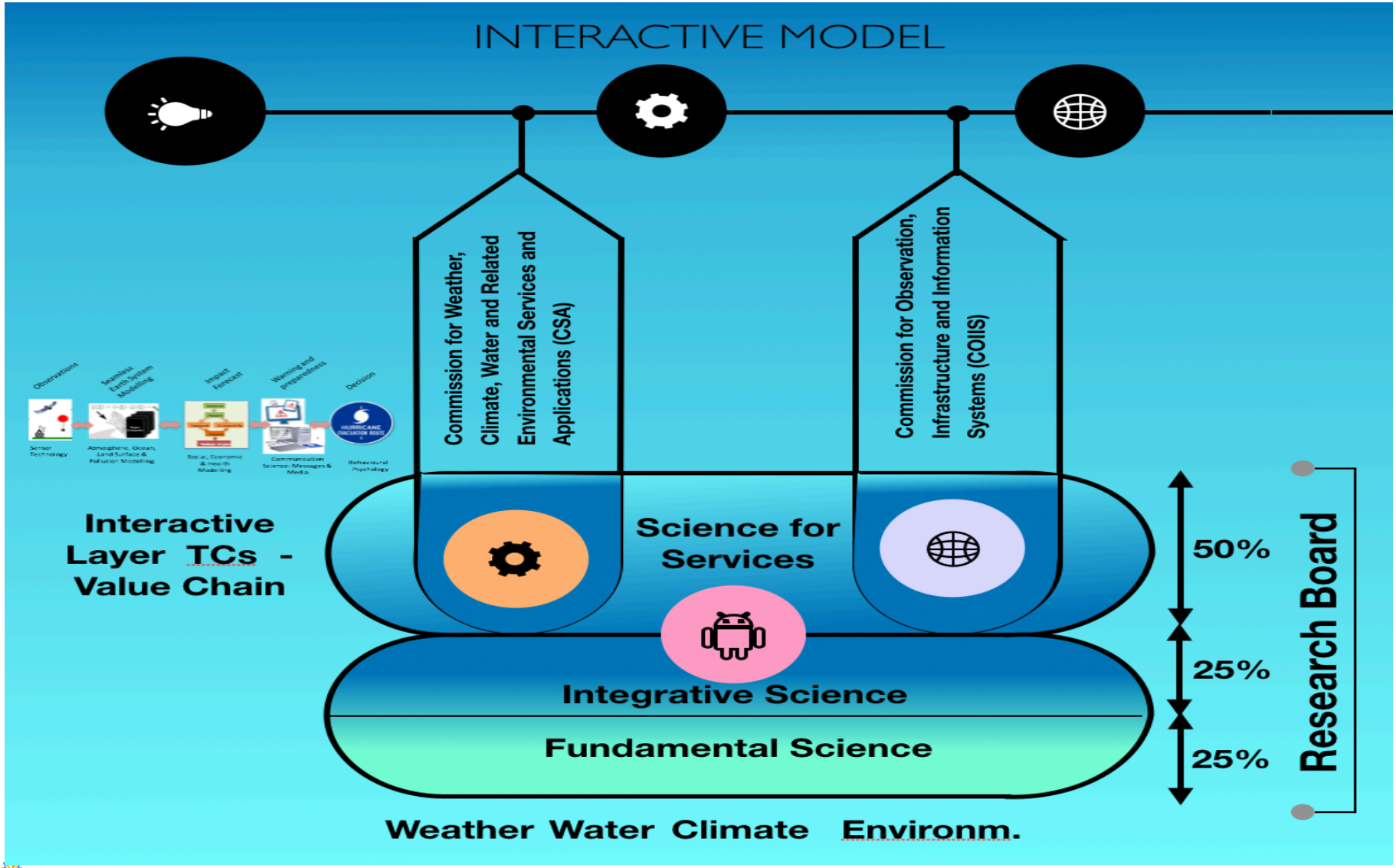
Interactive Model for Supporting Seamless Science and Science for Service & Innovation



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Opportunities for CMIP

- (1) Climate research (convening) activity….
- (2) Climate and Earth System Models advancement and development nucleus
- (3) Operational & science to policy delivery activity (WCRP-CMIP->IPCC->SBSTA->UNFCC)

WEATHER CLIMATE WATER
TEMPS CLIMAT EAU

Thank you
Merci

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Organisation météorologique mondiale