



WORLD CLIMATE RESEARCH PROGRAMME

*Based on presentation from
Guy Brasseur and Amanda Lynch*

February 2019



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With the beginning of 2019 a significant change in the WCRP leadership came about.

Large part of the previous JSC rotated of.

Both chair Guy Brasseur and co-chair Amanda Lynch left the JSC.

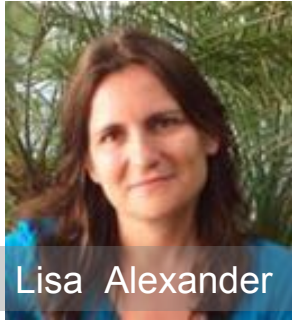
We all thank both Guy and Amanda for their tremendous impact on the planning of the future WCRP and the establishment of WCRP new strategic plan 2019 – 2018 .



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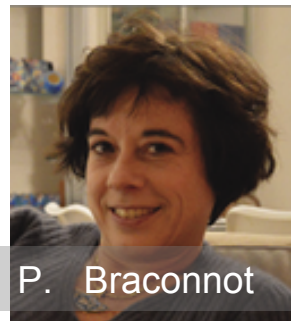
2019 JSC



Lisa Alexander



Tercio Ambrizzi



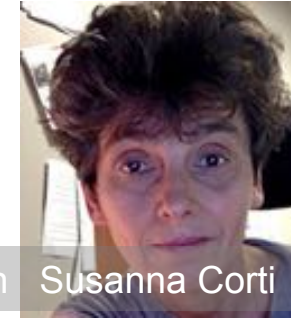
P. Braconnot



Helen Cleugh



J. H. Christensen



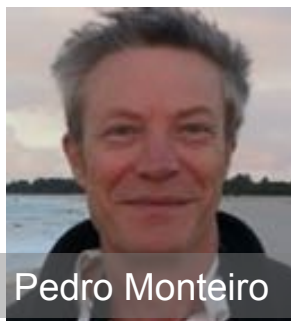
Susanna Corti



P. Friedlingstein



Jim Hurrell



Pedro Monteiro



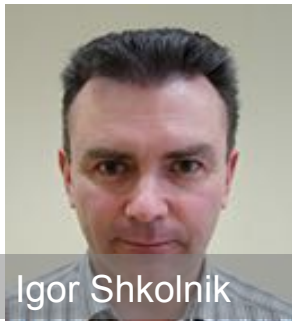
Masa Kimoto



Thomas Peter



Krishnan



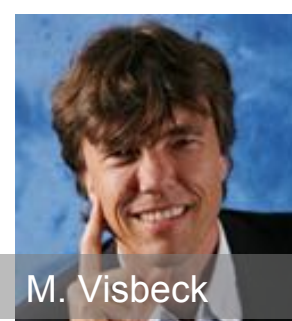
Igor Shkolnik



D. Stammer



Ken Takahashi



M. Visbeck



Huijun Wang



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NEW JSC/WCRP Leadership

- As of Febr. 20, new JSC/WCRP Leadership:
- Chair: D. Stammer,
- Co-Chair: Helen Cleugh
- Remaining officers to be elected during JSC 40 in May



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The World Climate Research Programme

Established in 1980

Sponsors

- World Meteorological Organization (WMO)
- International Science Council (ISC, previously ICSU)
- Intergovernmental Oceanographic Commission (IOC) of UNESCO

Joint Scientific Committee

18 members representing the scientific community

Joint Planning Staff (Programme Office)

Established at WMO in Geneva, Switzerland



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Current Strategic Mission

The World Climate Research Programme (WCRP) mission is to facilitate the analysis and prediction of Earth system variability and change for use in an increasing range of practical applications of direct relevance, benefit and value to society.

The two overarching objectives of the WCRP are:

- to determine the **predictability of climate**; and
- to determine the **effect of human activities** on climate



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Main Foci

The main foci of WCRP research are:

1. **observing** changes in the components of the Earth system (atmosphere, oceans, land and cryosphere) and in the interfaces between these components;
2. **improving our knowledge** and understanding of global and regional climate variability and change, and of the mechanisms responsible for this change;
3. **assessing and attributing significant trends** in global and regional climates;
4. **developing and improving numerical models** that are capable of simulating and assessing the climate system for a wide range of space and time scales; and
5. **investigating the sensitivity of the climate system** to natural and human-induced forcing and estimating the changes resulting from specific disturbing influences.



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JOINT SCIENTIFIC COMMITTEE (JSC)

WCRP MODELLING ADVISORY COUNCIL (WMAC)

WCRP DATA ADVISORY COUNCIL (WDAC)

WORKING GROUPS ON:

COUPLED MODELLING (WGCM)
NUMERICAL EXPERIMENTATION (WGNE)

SUBSEASONAL TO INTERDECADAL PREDICTION (WGSIP)
REGIONAL CLIMATE (WGRC)



CRYOSPHERE-
CLIMATE



OCEAN-
ATMOSPHERE

GEWEX

LAND-
ATMOSPHERE



SPARC
Stratosphere-Troposphere
Processes and their Role in Climate
TROPOSPHERE-
STRATOSPHERE

WCRP
CORDEX

REGIONAL CLIMATE
DOWNSCALING

GRAND CHALLENGES

CLOUDS, CIRCULATION AND CLIMATE SENSITIVITY

REGIONAL SEA-LEVEL CHANGE AND COASTAL IMPACTS

CARBON FEEDBACKS IN THE CLIMATE SYSTEM

UNDERSTANDING AND PREDICTING WEATHER AND CLIMATE EXTREMES

NEAR-TERM CLIMATE PREDICTION

MELTING ICE AND GLOBAL CONSEQUENCES

WATER FOR THE FOOD BASKETS OF THE WORLD

JOINT PLANNING STAFF (JPS)



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Grand challenges



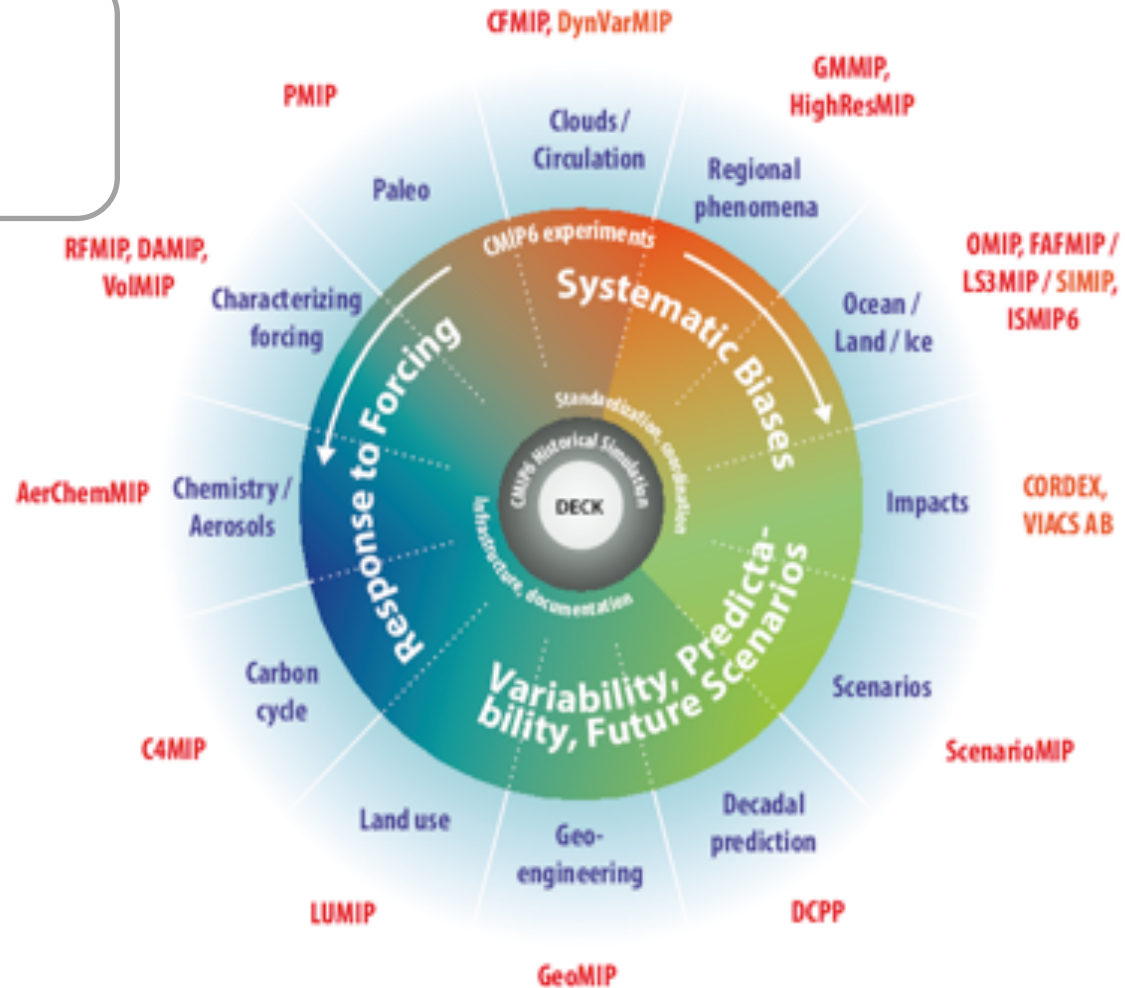
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CMIP is a project of WCRP's Working Group on Coupled Modeling (WGCM)

CMIP has led to an improved understanding of past, present and future climate change and variability in a multi-model framework

CMIP defines common experiment protocols, forcings and output



21 CMIP6-Endorsed MIPs



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➔ Advancing the science and application of regional climate downscaling, for improved regional climate information

CORDEX scientific challenges:

- **Added value** of downscaling, scales, bias and uncertainties, user-oriented metrics
- Understanding and simulating **human elements**, e.g. land use, urban development, climate and coastal cities
- Coordination of regional **coupled modeling**
- Precipitation, e.g. convective systems, monsoon
- Local wind systems



Model downscaling. NCAR dr. Andrew Wood

2015: A Landmark Year



- Over 190 countries signed up to reduce emissions, with the target to stay within a 2°C 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

The Future of WCRP



**The Science
Requirements are
Changing.**

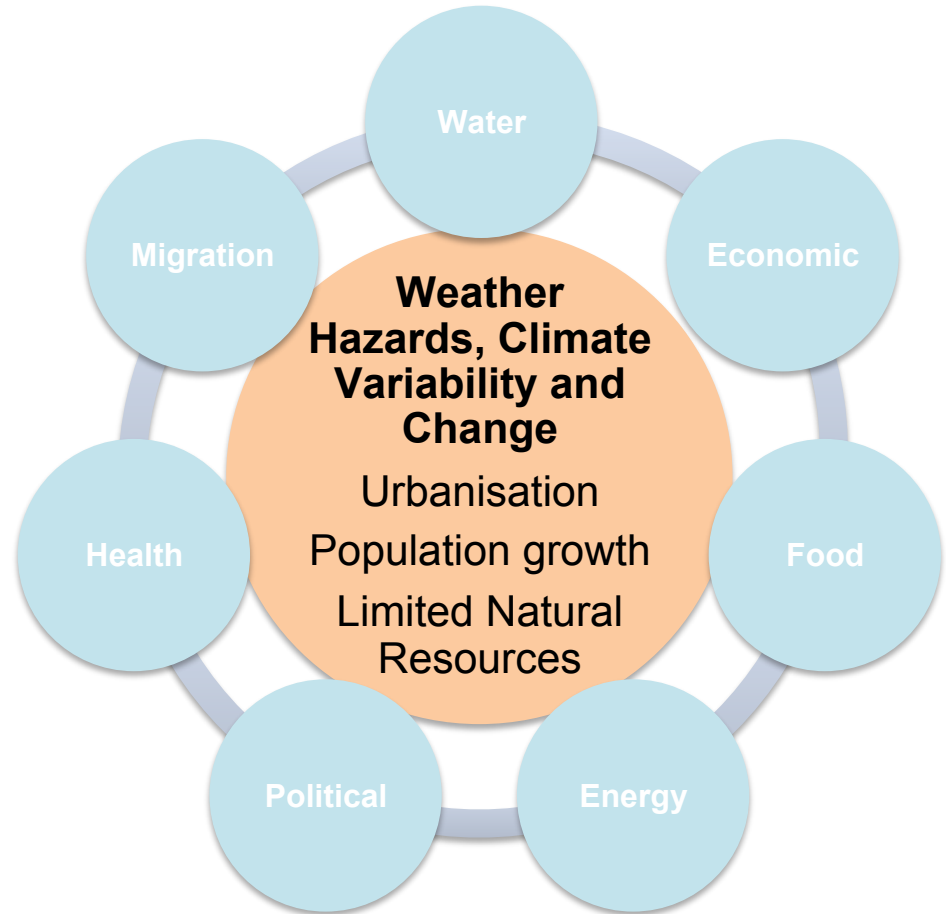


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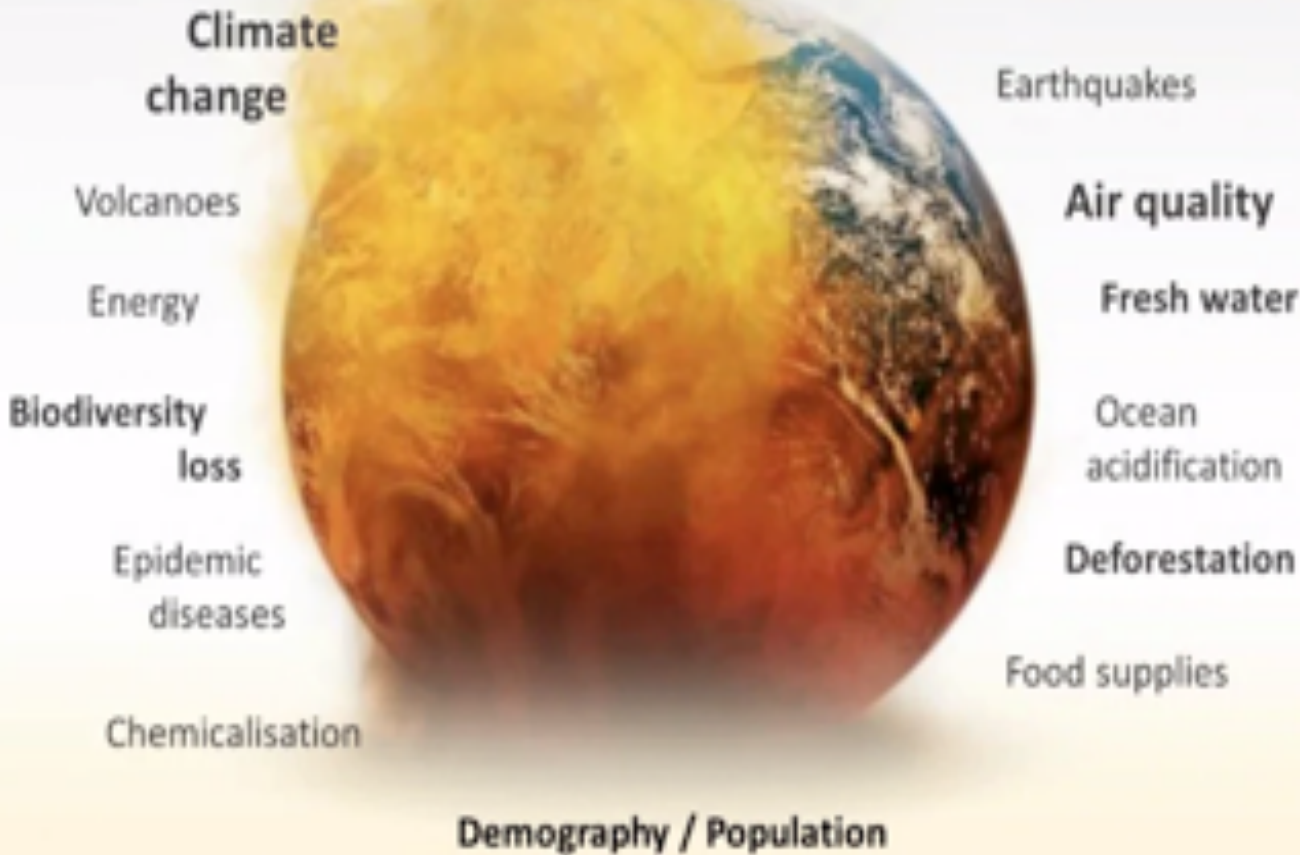


21st CENTURY CHALLENGES IN AN INTERCONNECTED WORLD

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.



CONTRIBUTION TO Solving GRAND CHALLENGES ^{*}



DISCIPLINES

Natural Sciences

Social Sciences

Medicine

Technology

Climate Change cannot be seen in isolation. It must be addressed together with the other grand challenges facing society

From ideas

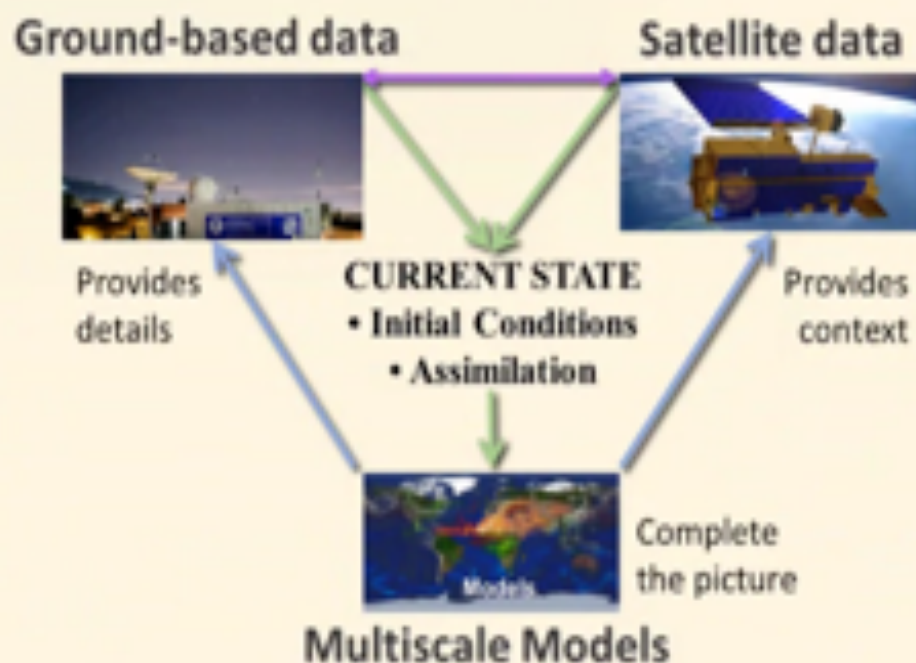
To implementation

MULTIDIMENSIONAL, MULTIDISCIPLINARY, MULTISCALE APPROACH TO ANSWER GRAND CHALLENGES

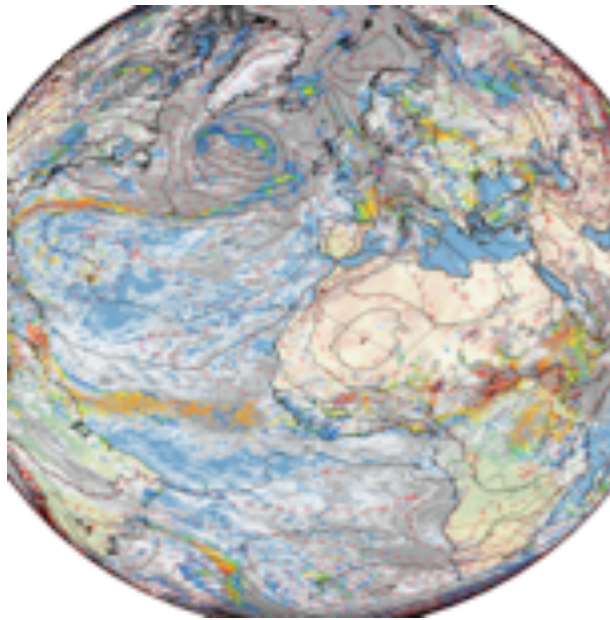
Clear and ambitious vision / from deep understanding to practical solutions

Empirical measurements and modelling / from observations to new theories

From research to innovations / economic growth and human wellbeing



New Tools in the Toolbox: Seamless Prediction Across Space Scales



N x Global predictions at ~10km
with lead times of days to years:

Synoptic drivers

<N x Regional predictions at
<1km with lead times of hours to
years:

Local meteorology

Probability of local
hazards:
**Impact Scenarios &
Narratives**

GLOBAL IMPACT / INTEGRATED SYNTHESIS



The Future of WCRP



The Review of WCRP



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JOINT PLANNING STAFF (JPS)

CURRENT WCRP STRUCTURE

Unwieldy, complex and confusing.

Core Projects stuck in the past?

Where is whole system approach?

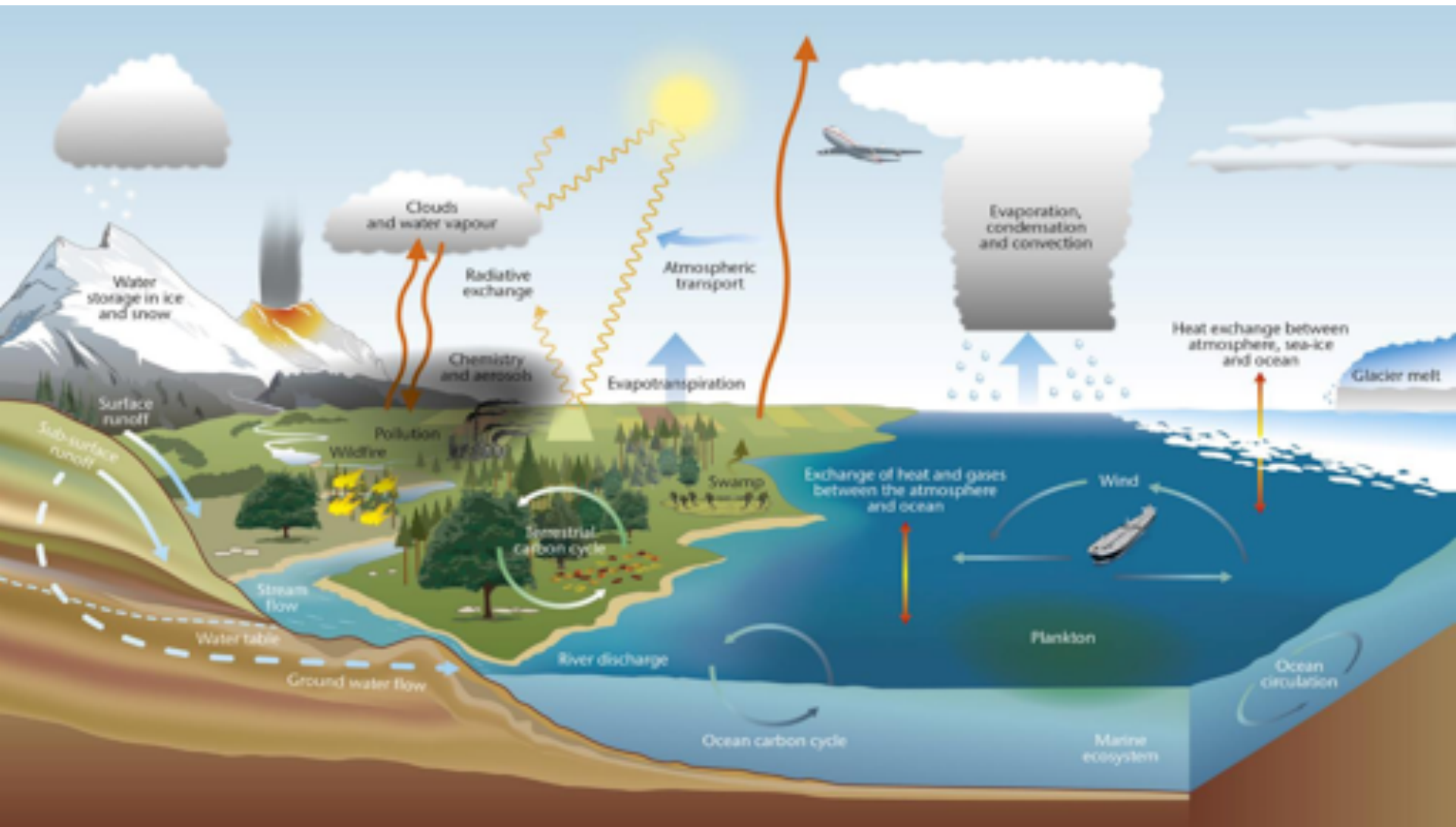
Where is next generation model development?

Where is the pathway to climate services?

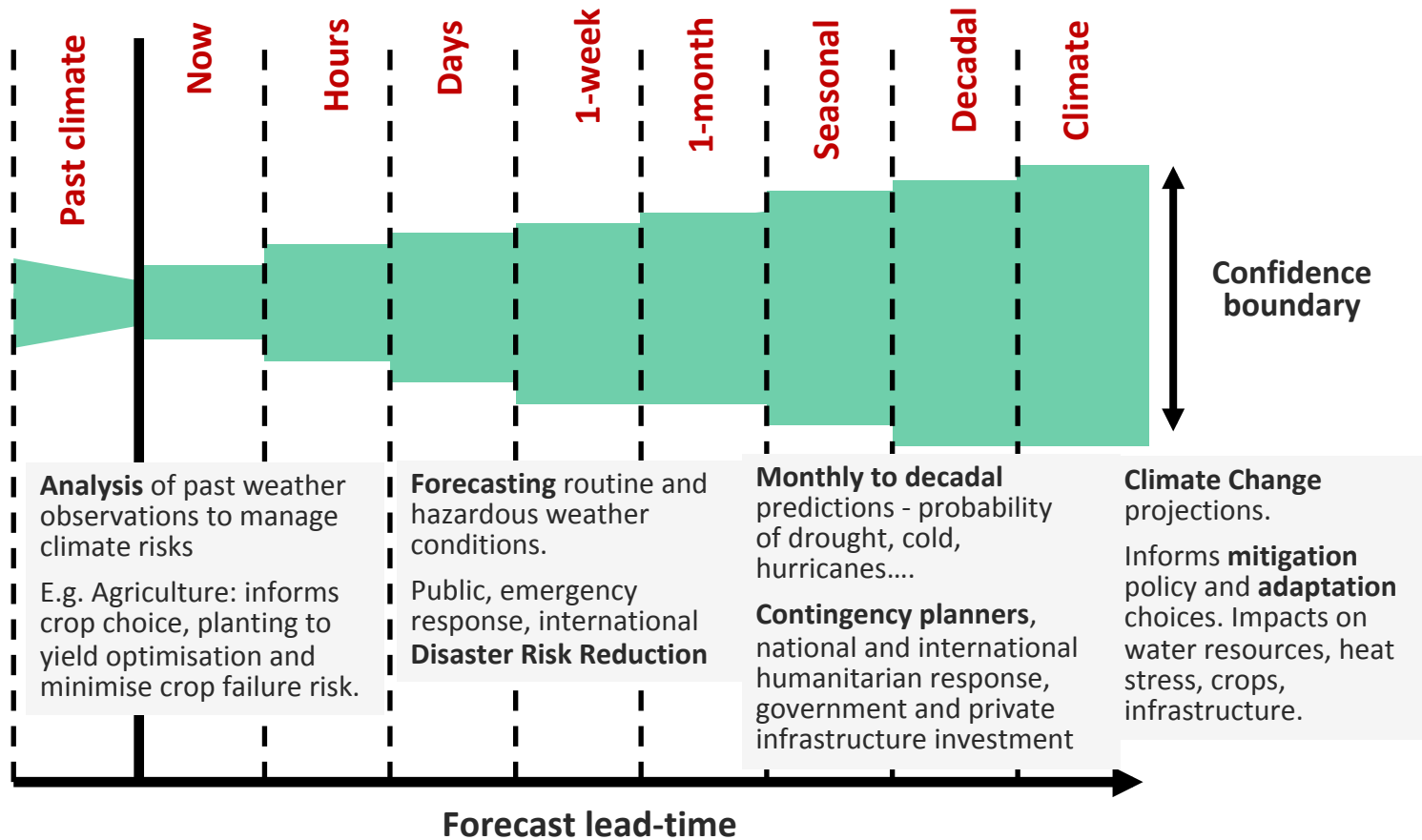
Where is climate change?

CURRENT STRUCTURE IS NOT THE STRUCTURE FOR THE FUTURE

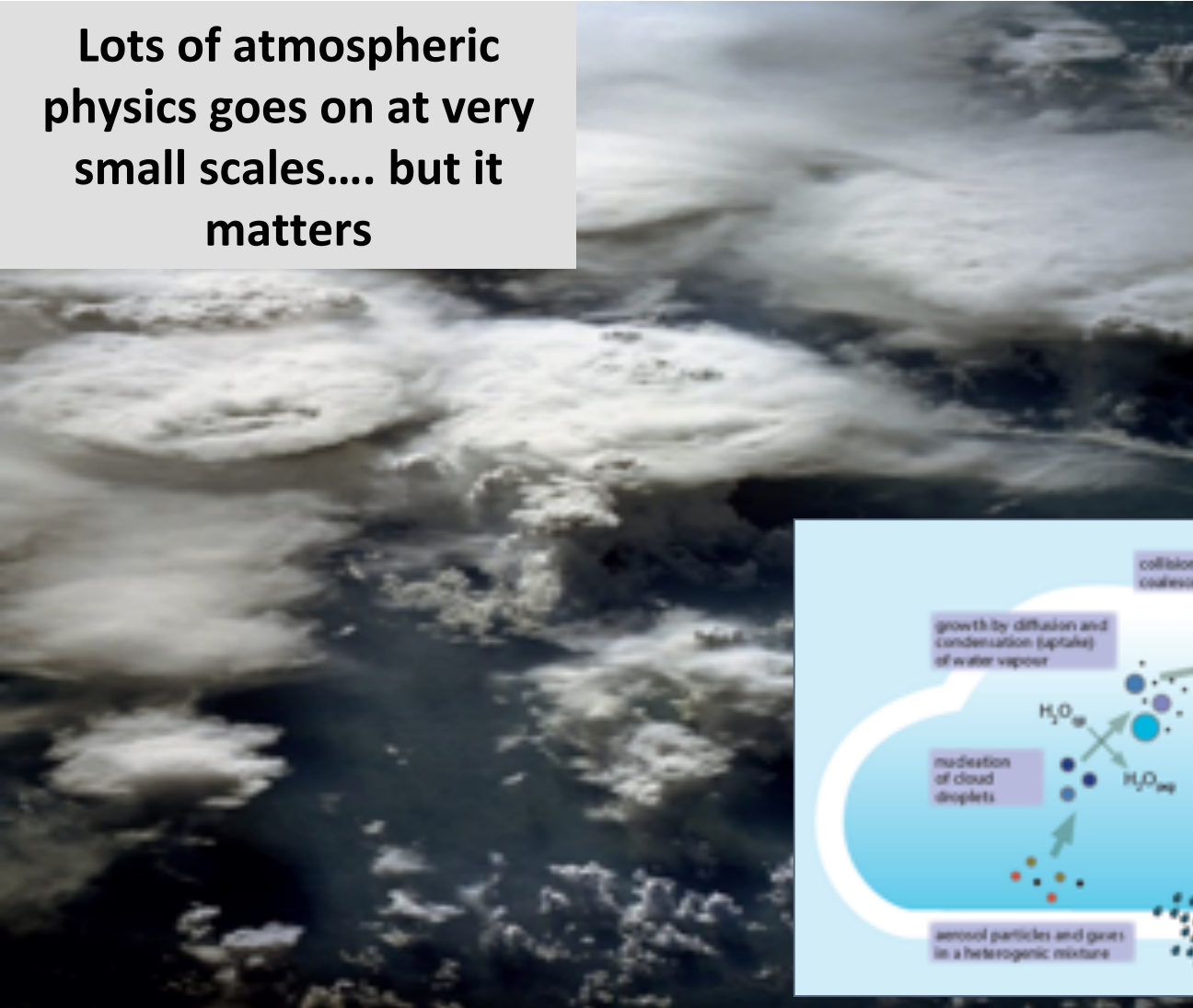
TAKING A HOLISTIC VIEW OF THE EARTH SYSTEM



New Tools in the Toolbox: Seamless Prediction Across Timescales



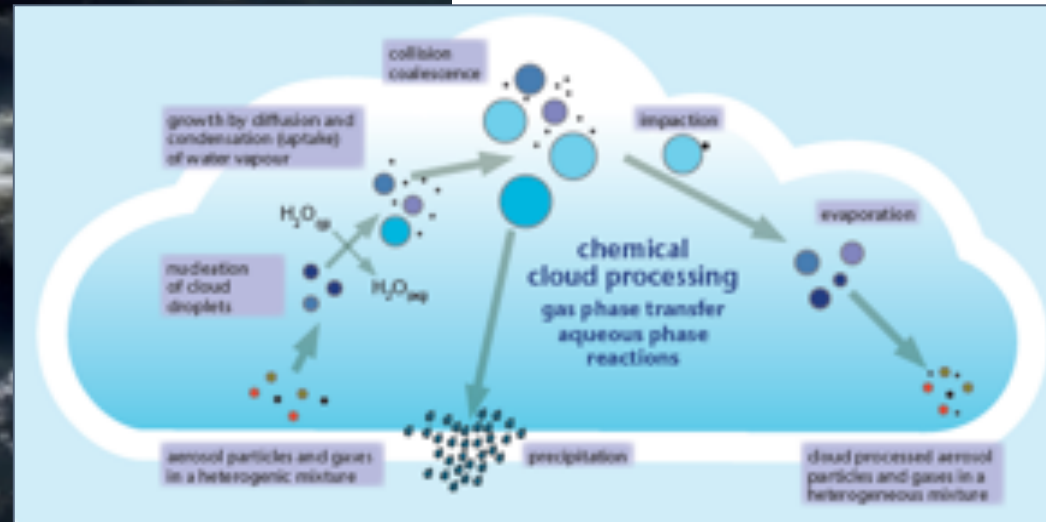
Lots of atmospheric physics goes on at very small scales.... but it matters



EARTH SYSTEM PROCESSES ACROSS SCALES

Jointly with WWRP

Energy, Water & Carbon Cycles;
Fundamental Atmospheric
Physics (e.g. Convection);
Land Surface Processes & Land-
Atmosphere Coupling;
Ocean Processes & Ocean-
Atmosphere Coupling;
Cryosphere Processes

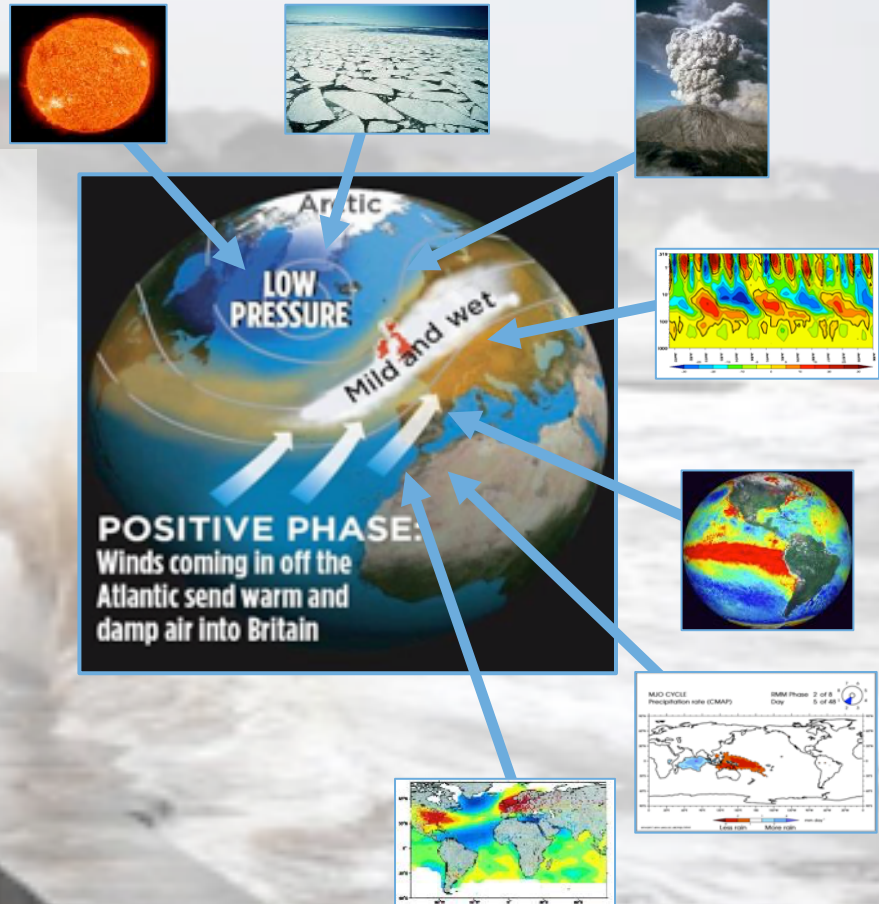


Monthly to Decadal Prediction: Understanding near-term risks

There are many drivers of seasonal weather and each 'loads the dice' in a different way.

CLIMATE VARIABILITY, PREDICTABILITY & PREDICTION

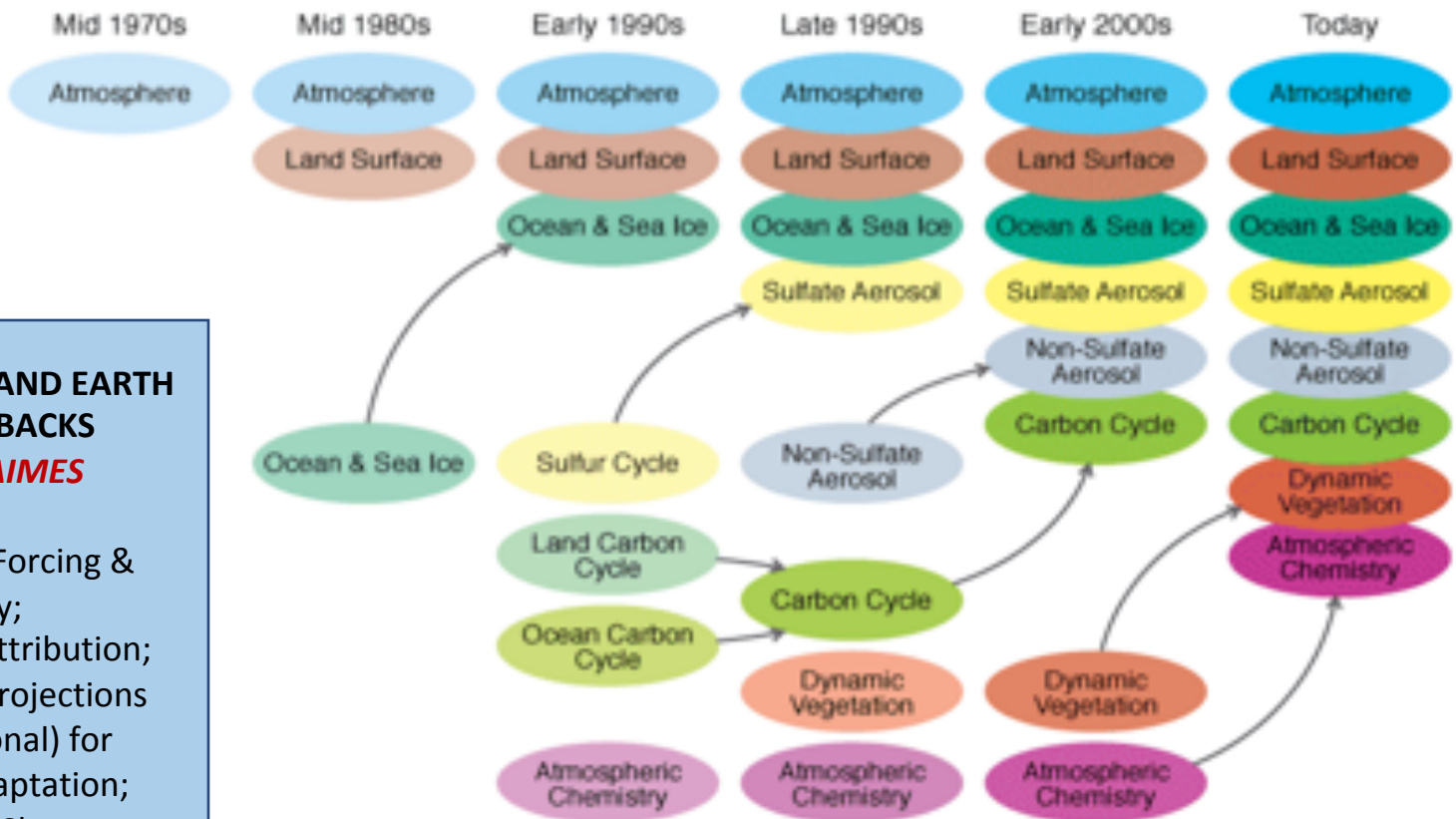
Ocean, Land, Cryosphere,
Atmosphere & Solar Drivers;
Climate Dynamics, Modes of
Variability & Teleconnections;
Monthly to Decadal Predictability &
Prediction





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



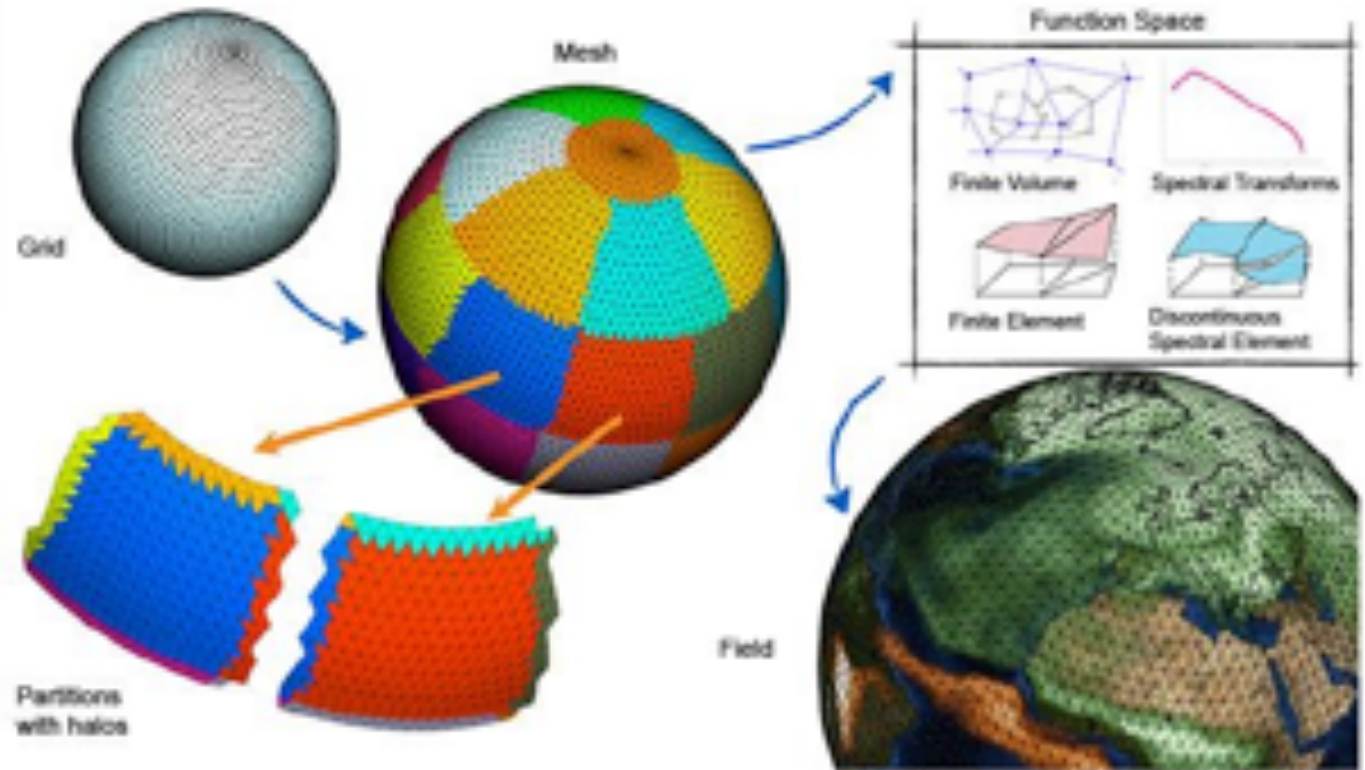
CLIMATE CHANGE AND EARTH SYSTEM FEEDBACKS

Jointly with AIMES

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

Is there a need now to distinguish between science for model development and using models for science?

Next Generation
Codes and Exascale
Computing



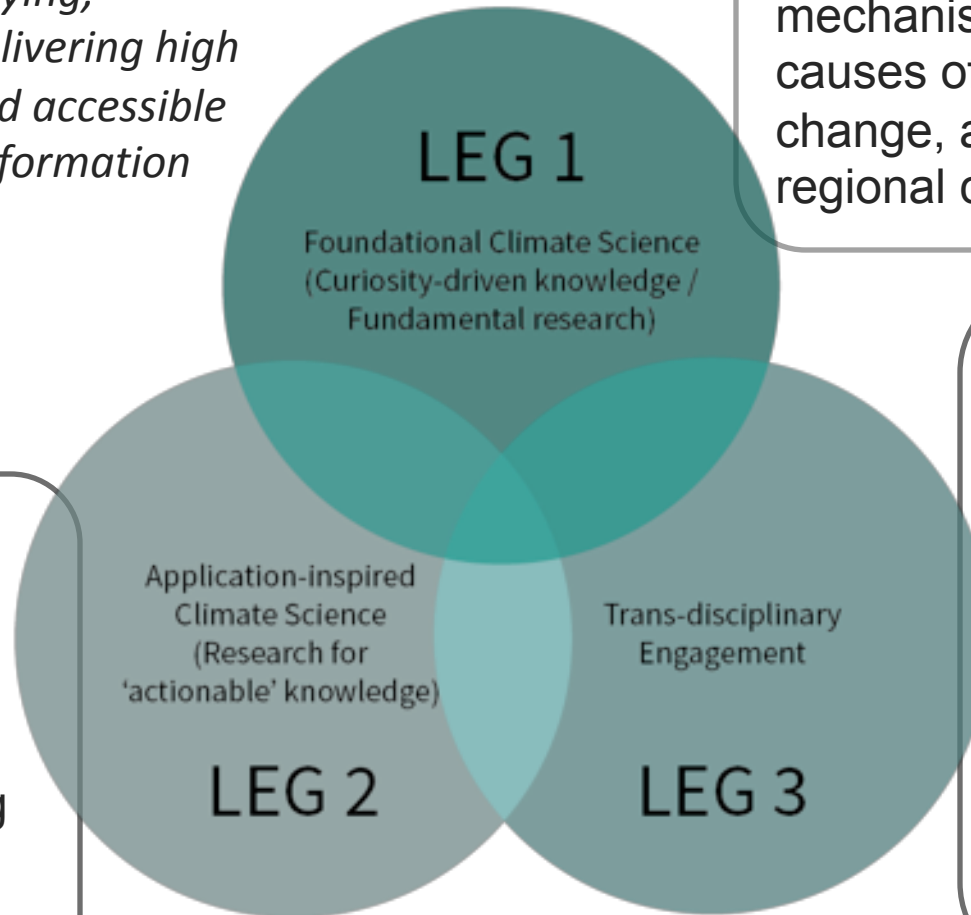
WCRP WORKING GROUP ON CLIMATE MODEL DEVELOPMENT *jointly with WGNE*

Identifying Systematic Errors; Improving Climate Models & Building Next Generation Earth System Models; Planning for Exascale Computing

WCRP's Regional Approach

Climate information for regions

Enhancing the scientific basis to understand regional climate and its changes; identifying, quantifying and delivering high quality, reliable and accessible regional climate information



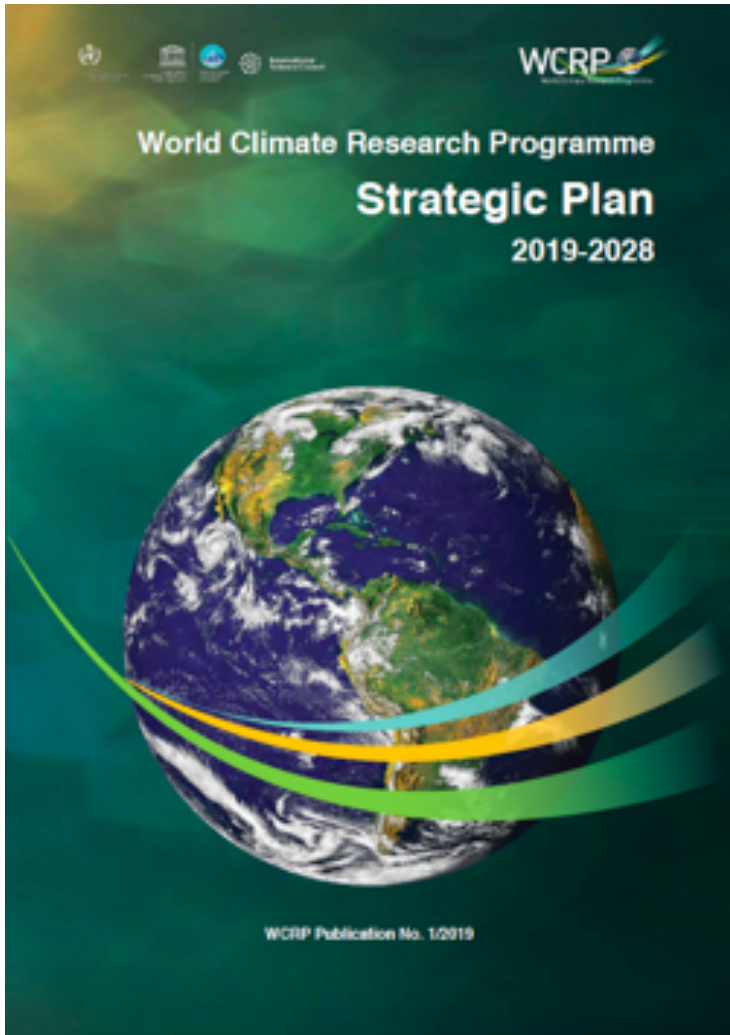
Leg 2: research to gain the integrated knowledge or understanding necessary to inform actions and decisions

Leg 1: fundamental science aiming to understand mechanisms of climate and causes of its variability/ change, and to produce regional climate projections

Leg 3: identify user requirements and needs that may guide research directions, and to determine the implication and relevance of climate knowledge derived from Legs 1 and 2 to applications/ services.



The Future of WCRP



The New Strategic Plan of WCRP



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Our Engagement

- The WCRP research community is geographically, disciplinarily, culturally and socially **diverse**. Training, capacity building, higher education, and facilitated collaboration are of paramount importance to sustain and grow this community, particularly through opportunities for **early career, underrepresented, and developing country** researchers.
- Joint strategic planning, joint execution of coordinated experiments, and the sharing of data and information require a well networked research community. Furthermore, our mission to **facilitate science in support of society demands** broad enabling of **natural-social science collaborations** and globally coordinated citizen science.
- **Open engagement with civil society, governments, and the private sector** – across regions and in United Nations processes, programs, and activities – is central to the activities conducted by WCRP. Effective communication of scientific advancements, with a variety of **stakeholders**, is also key, as are high-level and vigorous research dialogues through widely inclusive and open science conferences.

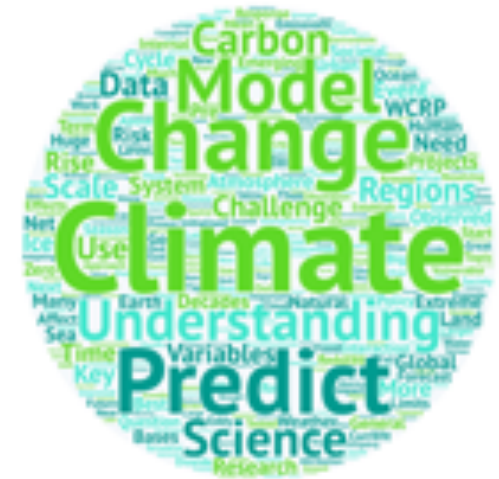


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WCRP Strategic Plan

- WCRP developed a new **Strategic Plan**, covering a 10-year time horizon (2019-2028)
- Takes into account the outcomes of the **co-sponsors review** (finalized in June 2018)
- Importance of **basic science**, **seamless** approach (time, space, ESM, R-O) and **links to services and policy** emphasised
- Accompanying **Implementation Plan** under development



Vision and Mission

- **New Vision**

A world that uses sound, relevant and timely climate science to ensure a more resilient present and sustainable future for humankind.

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- **New Mission**

The World Climate Research Programme (WCRP) coordinates and facilitates international climate research to develop, share and apply the climate knowledge that contributes to societal well-being.

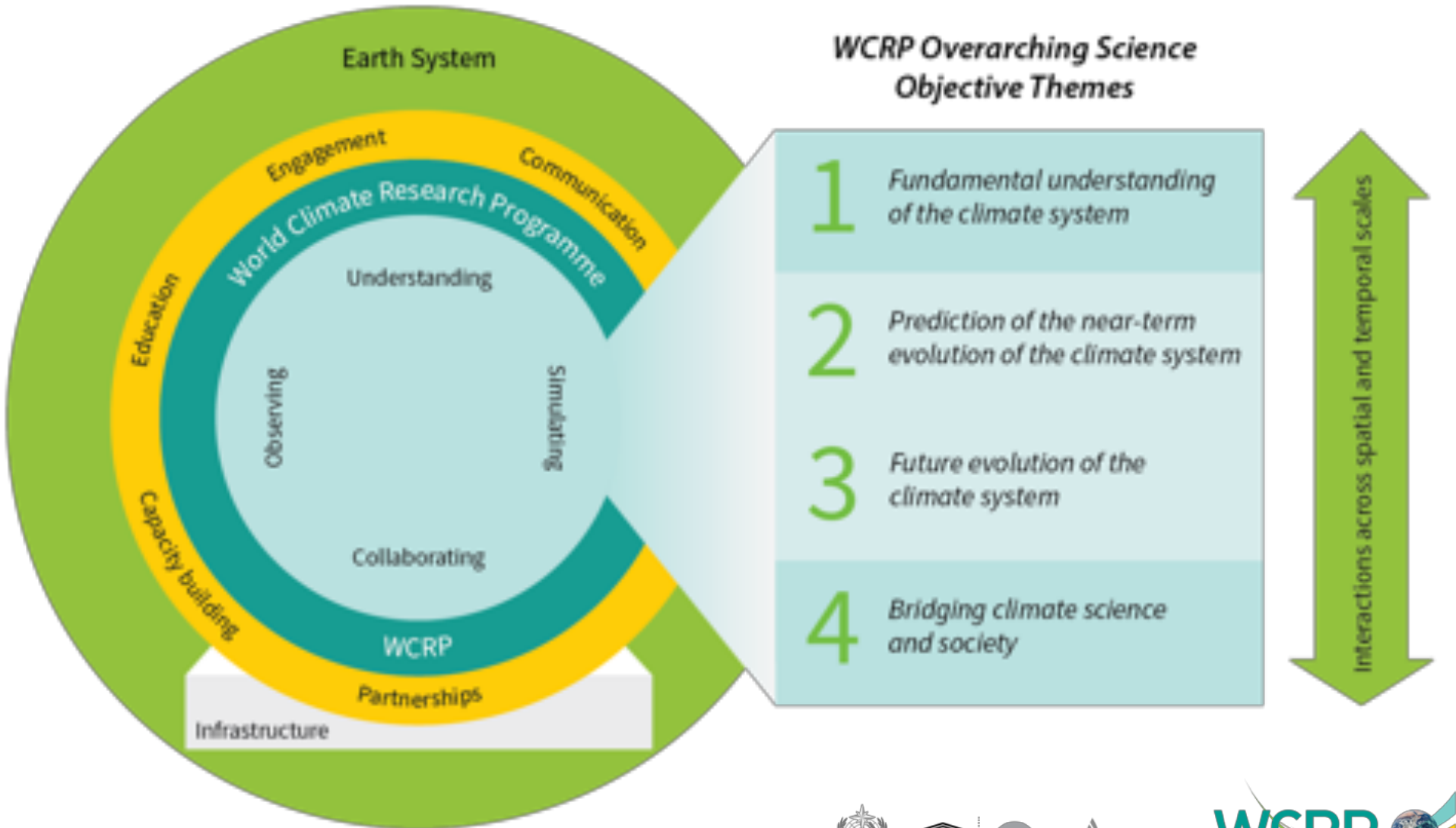
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WCRP Strategic Plan



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WCRP Strategic Plan

Objective 1

Advancement of sciences that enable an integrated and fundamental understanding of the climate, its variations and its changes, as part of a coupled physical, biogeochemical, and socio-economic system.

Emphases:

- Climate dynamics: past and future global and regional changes in oceanic and atmospheric circulations
- Reservoirs and flows: radiative, hydrologic, cryospheric and biogeochemical changes on energy, water, carbon, and other climate-relevant compounds

We need fundamental
science to prepare
society for unknown
challenges.



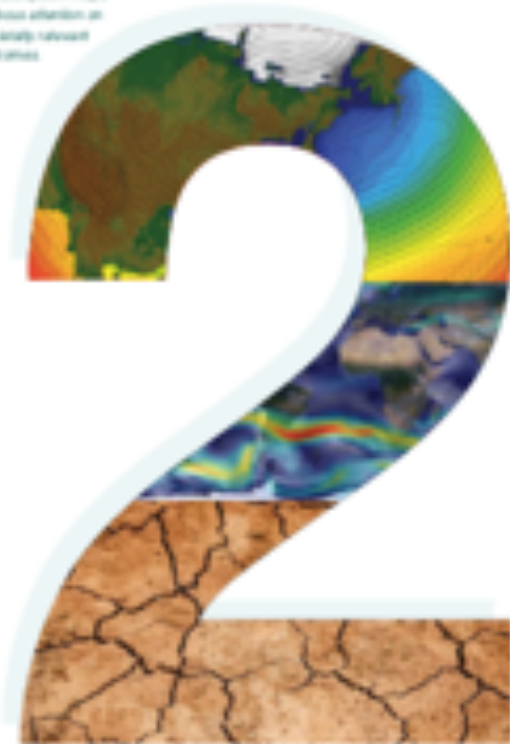
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Objective 2

Understanding
predictability in the
climate system helps
to focus attention on
scientifically relevant
outcomes



Frontiers of predictions and quantify the associated uncertainties for sub- seasonal to decadal time scales across all climate system components.

Emphases:

- Simulation capabilities of component systems and their coupling. Deterministic, statistical and machine learning approaches. Data assimilation and ensemble generation
- Predicting extreme events: regional climate hotspots and potential for crossing thresholds. Interactions between fast and slow extremes

WCRP Strategic Plan

Objective 3

Quantify the responses, feedbacks and uncertainties intrinsic to the changing climate system on longer timescales.

Emphasis:

- Earth system models. Development and integration. Representation of complex interactions between aquifers, vegetation and soil carbon, between permafrost, glaciers, and ice-sheets. Dynamical and statistical downscaling



WCRP Strategic Plan

Objective 4

Innovation in the generation of decision-relevant information and knowledge about the evolving Earth system.

Emphasis:

Interactions with social systems: Social processes and emergent behaviour in the Earth System. Interactions and feedbacks between climatic and socioeconomic systems

Engaging with society: Actionable climate information, scientific assessments, educational approaches and public communication strategies.

Climate information provides innovative opportunities to collaborate with civil society, government and private industry to safeguard lives and natural assets.



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WCRP Strategic Plan

Critical Infrastructures

- I. A hierarchy of simulation tools
- II. Observations for process understanding
- III. Sustained observations
- IV. High-end computing and data management



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The Future of WCRP

The Implementation Plan



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Implementation Plan

Setting the Strategic Plan in motion, following its the logic.

Topics to be addressed:

- Resources
- Structures
- Milestones
- Deliverables
- Measures of Success
- Risk assessment, etc...

An effort that must be transparent and to a large extent «bottom-up». Importance of involving the scientific community, the agencies, academies, sponsors and other stakeholders.



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Critical Questions

How can WCRP organize itself to address more contemporary research questions without creating a major disruption the current research structure?

How can WCRP organize itself to reflect the supported research activities by the funding agencies?

What role should WCRP play to provide to the agencies a broader access to international science?

How should WCRP generate its “strategic partnerships” with other international research programs (such as Future Earth) and with national activities?



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Implementation Time Line

- Establishment of a time line for an implementation; to be presented to the 2019 WMO Congress in June 2019
- During 2019: establish a first draft of the structure required to implement the new strategic plan taking into account the community views as well as sponsors suggestions and requirements.
- During 40 year anniversary: discuss and reflect on implementation plan.
- Until mid 2020: revision of implementation plan; presentation to all three sponsors by mid of 2020.
- Implementation of result over 2 year period following a final acceptance by community and sponsors.



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First steps

Around JSC 40 (May 2019): start discussions between JSC and leaders of all WCRP core-projects and other activities about possible ways to implement the WCRP SP.



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