WCRP
World Climate Research Programme

World Climate Research Programme

WGNE 28th session
November 2012
Toulouse, France

Michel Rixen, WCRP JPS, Geneva

WMO IOC ICSU

- WCRP Mission and Objectives
- ICSU Visioning Process, WMO GFCS, OSC
- WCRP Structure
- Grand Challenges
- WDAC, WMAC
- Outcomes from JSC-33

WCRP
World Climate Research Programme

Sandy…

WHO IOC ICSU International Council for Science

Sandy…

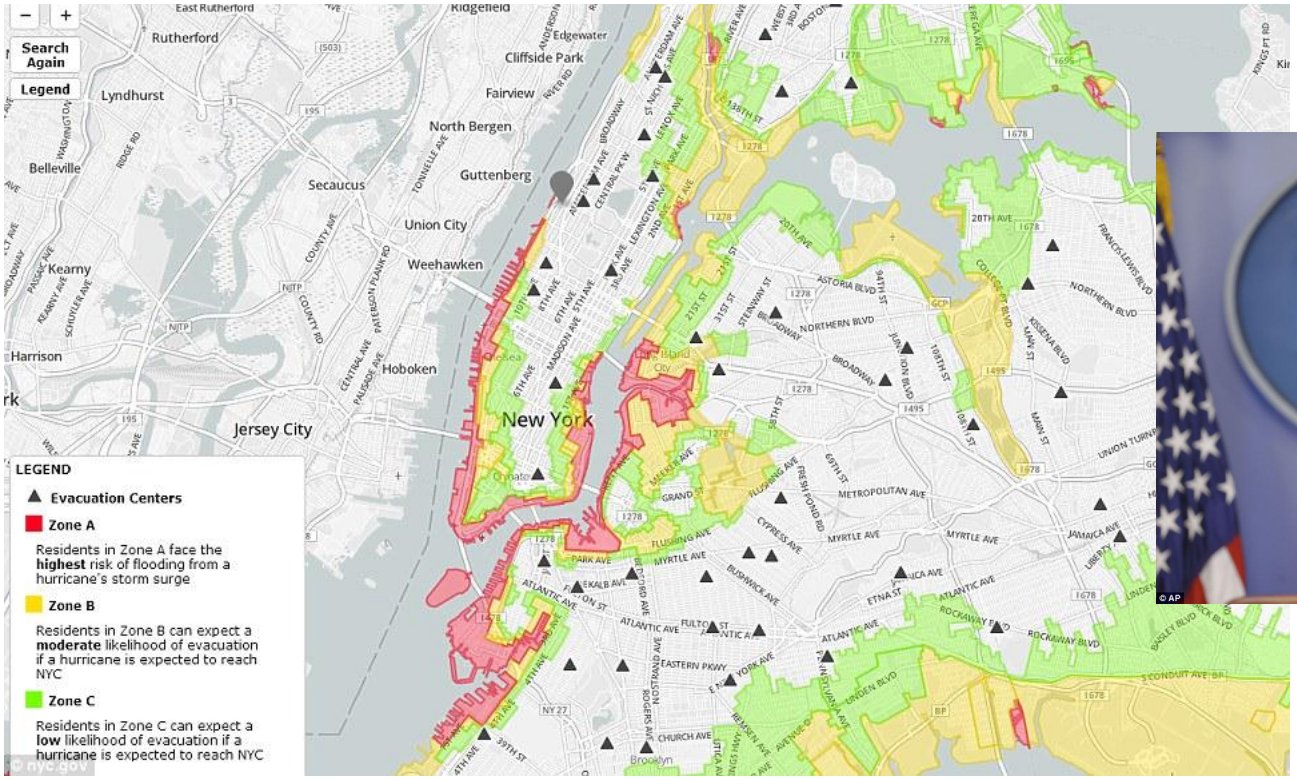

KY
VA
TN
NC
SC
GA
AL
2 AM Sun
2 AM Mon
Bermuda
2 AM Sat
FL
2 AM Fri
Bahamas
Cuba
2 AM Thu
Puerto Rico
Jamaica
5 AM Wed
Honduras


SANDY'S TRACK
WIDE RANGE OF POSSIBILITIES
FRIDAY
HIGH CONFIDENCE
SANDY


WV
VA
KY
TN
NC
SC
GA
AL
8 AM Mon
Bermuda
8 AM Sun
8 AM Sat
FL

Sandy…

Decision-making



1 Nov 2012

- …several climate scientists made some initial points. A likely contributor to the intensity of Sandy, they said, was that surface temperatures in the western Atlantic Ocean were remarkably high just ahead of the storm — in places, about five degrees Fahrenheit higher than normal for this time of year
- Kevin E. Trenberth, a scientist with the National Center for Atmospheric Research in Boulder, Colo., said that natural variability very likely accounted for the bulk of that temperature extreme. And many of Sandy's odd features derived from its origin as a "hybrid" storm — a merger of several weather systems, including a hurricane and a midlatitude storm that had earlier dumped snow in Colorado.
- "My view is that a lot of this is chance," Dr. Trenberth said. "It relates to weather, and the juxtaposition of weather systems. A hybrid storm is certainly one which is always in the cards and it's one we've always worried about."
- But, he added, human-induced global warming has been raising the overall temperature of the surface ocean, by about one degree Fahrenheit since the 1970s. So global warming very likely contributed a notable fraction of the energy on which the storm thrived — perhaps as much as 10 percent, he said.

Mission & Objectives

World Climate Research Programme supports **climate-related decision making** and **adaptation planning** by coordinating research required to improve

(1) climate predictions and

(2) understanding of human influence on climate

"for use in an increasing range of practical applications of direct relevance, benefit and value to society"

(WCRP Strategic Framework 2005-2015).

The Interdisciplinary Nature of Climate Science

- Atmosphere, Oceans and Climate
- Cryosphere and Climate
- Atmospheric Chemistry and Dynamics
- Water, Energy and Climate

Meeting the Information Needs of Society

Activities in Support of Key Deliverables

- Decadal Variability, Predictability and Prediction
- Sea-Level Variability and Change
- Climate Extremes
- Atmospheric Chemistry and Dynamics
- Centennial Climate Change Projections
- Seasonal Climate Prediction
- Regional Climate

Activities in Support of WCRP Integrating Themes

- Climate-Quality Data Sets and Analyses
- A New Generation of Climate/Earth System Models
- Next Generation of Climate Experts: Developing Capacity Regionally and Globally

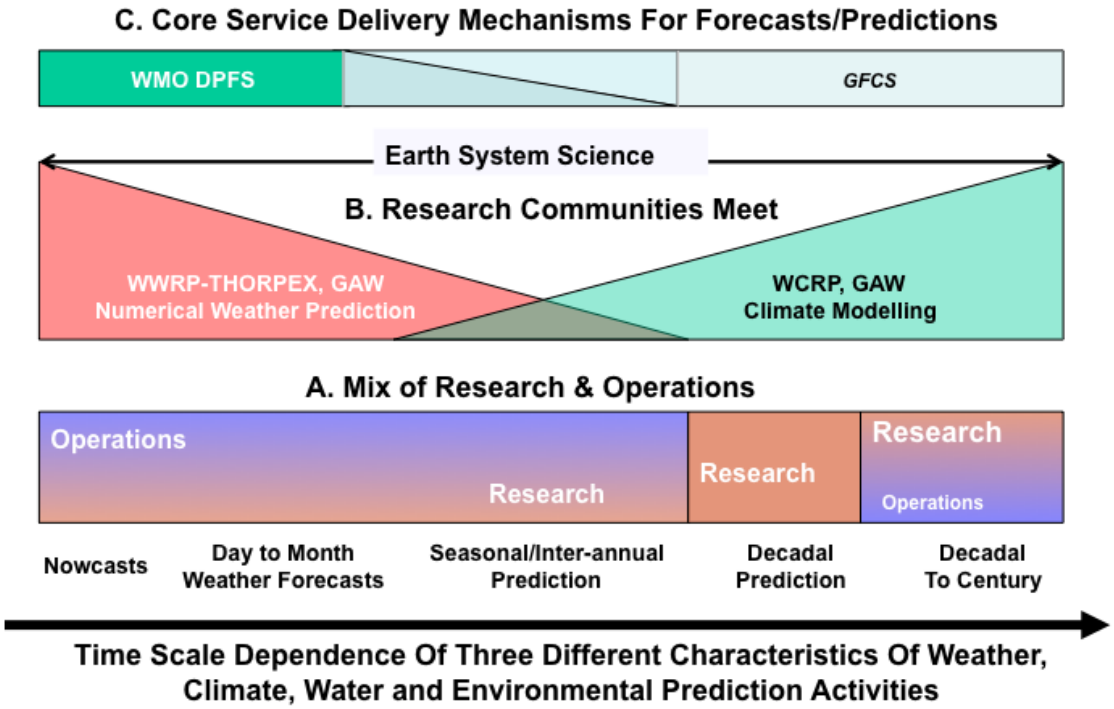
Future Directions: Actionable Science

Defined as: "data, analysis, and forecasts that are sufficiently predictive, accepted and understandable to support decision-making, including capital investment decision-making."

•World Climate Conference-3, OceanObs '09, ICSU Review and Visioning, Open Science Conference, acknowledging WCRP past contributions and identifying future challenges and opportunities

•Need for more flexibility/agility to respond to expanding users needs, that includes information:

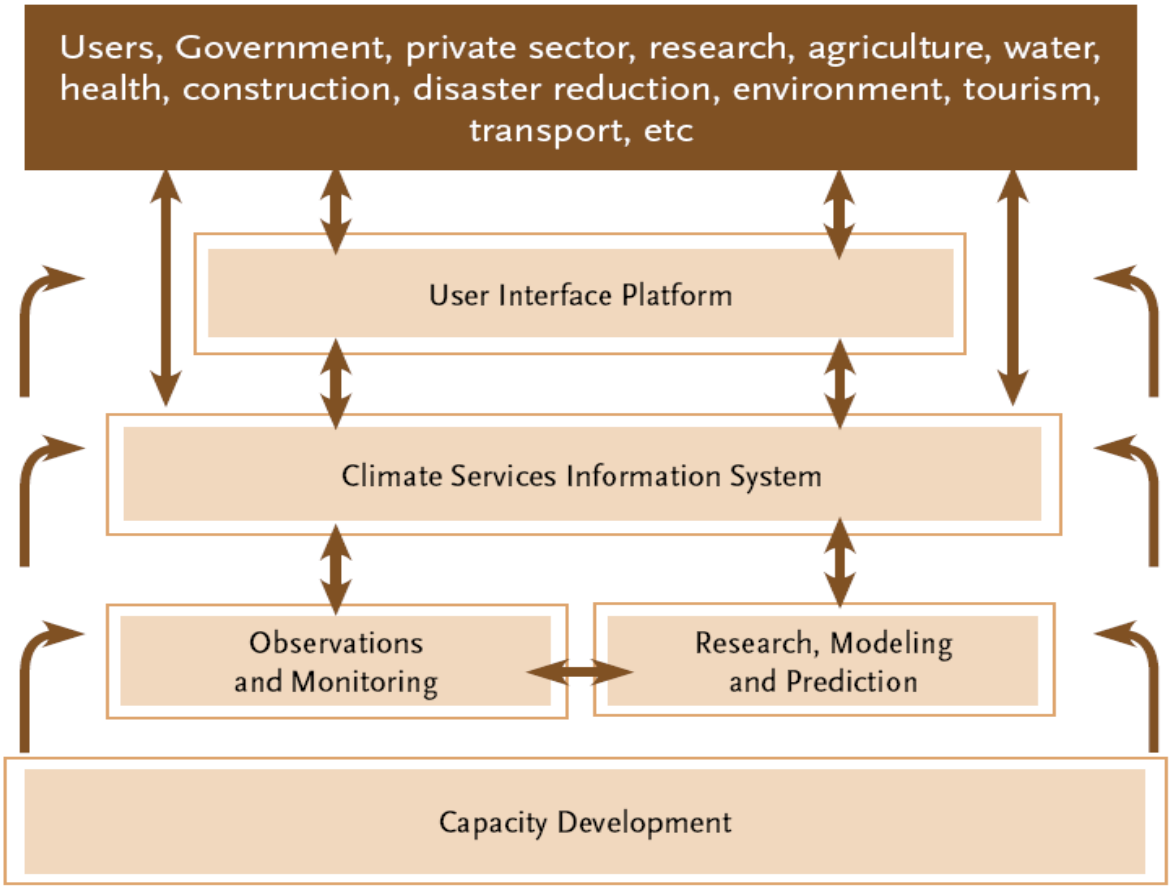
- At regional scale
- For key sectors of global economy
- For adaptation, mitigation and risk management



Increased WWRP-WCRP collaboration between weather and climate communities, e.g.:

- Subseasonal to Seasonal Prediction initiative
- Polar Prediction Project
- THORPEX post 2014: some plans under discussions
- YOTC/MJO
- Grey-zone

Global Framework for Climate Services (GFCS)



WCRP
World Climate Research Programme

Global environmental change research: a long, successful history

four Global Environmental Change Programmes

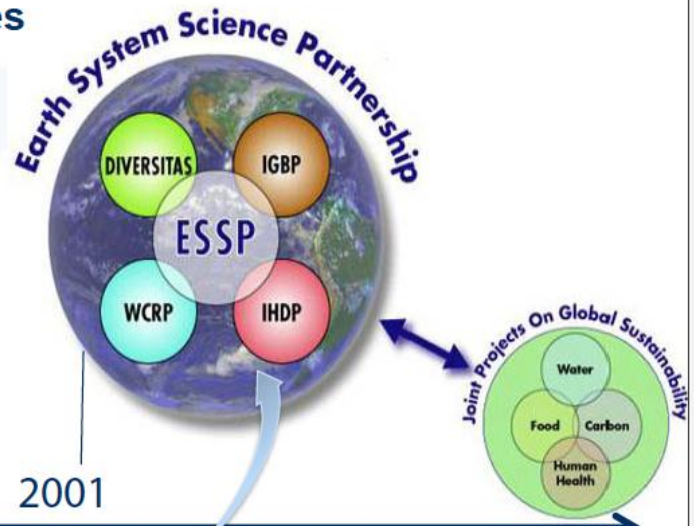
WCRP World Climate Research Programme

DIVERSITAS an international programme of biodiversity science

GLOBAL CHANGE IGBP International Geosphere-Biosphere Programme

IHDP International Human Dimensions Programme on Global Environmental Change

1980 1986 1991 1996 2001

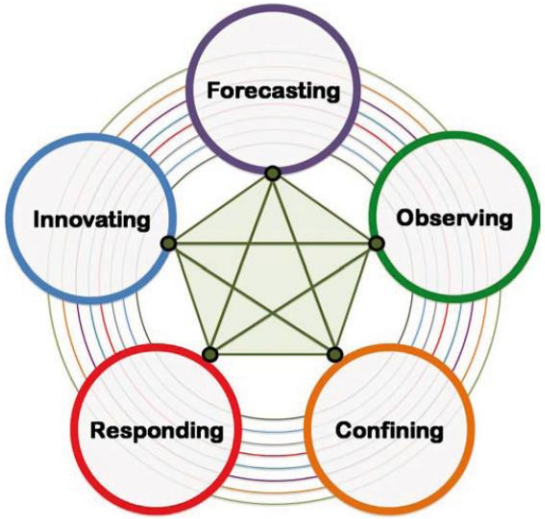


and their partnership

all co-sponsored by ICSU

WMO IOC ICSU

Future Earth



Grand Challenges in Earth System Science for Global Sustainability. The concentric circles represent the disciplinary research needed in the social, natural, health and engineering sciences and the humanities that must be carried out alongside interdisciplinary and transdisciplinary research in order to address the challenges. The lines linking the grand challenges show that progress in addressing any challenge will require progress in addressing each of the others.

A global alliance

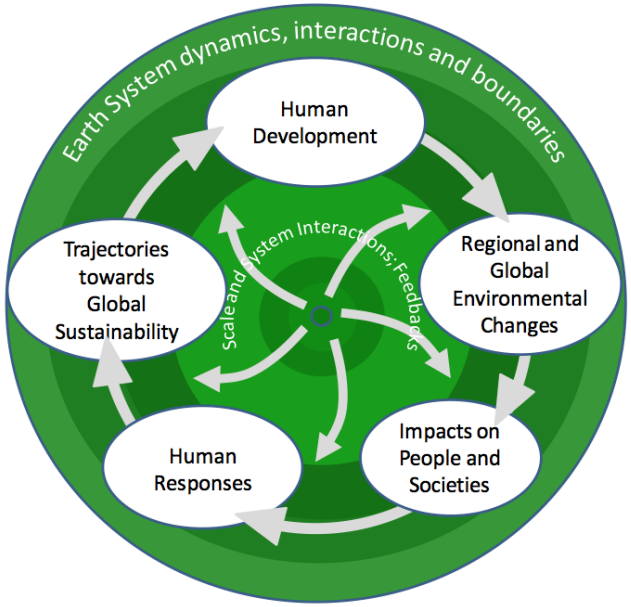
BELMONT FORUM
ICSU International Council for Science
UNITED NATIONS UNIVERSITY
Future Earth
ISSC international social science council
UNESCO
UNEP
IGFA INTERNATIONAL GROUP OF FUNDING AGENCIES FOR GLOBAL CHANGE RESEARCH
WMO as an observer

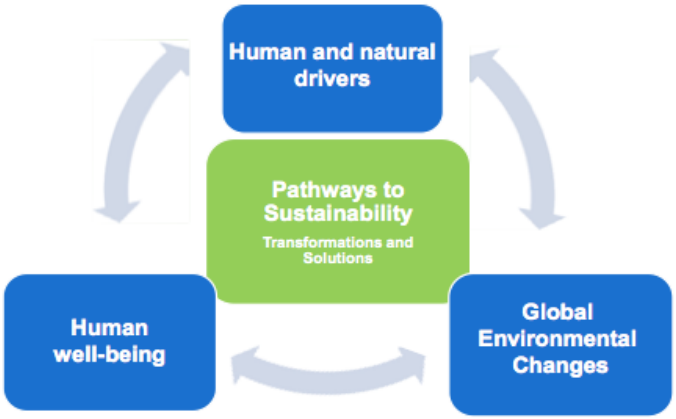
Launched at RIO+20

WCRP: global & regional information, prediction and impact of CC

WCRP
World Climate Research Programme

Future Earth conceptual framework





Proposed Research Strategy:

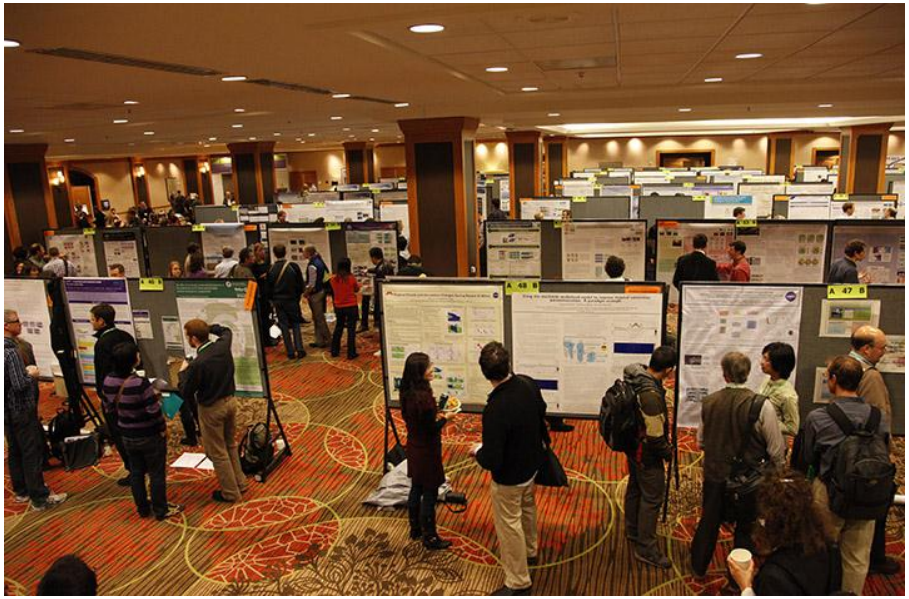
At the simplest level, Future Earth must answer fundamental questions about *how and why the global environment is changing, what are likely future changes, what the implications are for humans and other species, and what choices can be made to reduce harmful risks and vulnerabilities, enhance resilience, and create prosperous futures.*

	Proposed Cross Cutting Capabilities
C1	**Observing Systems**
C2	**Data Systems**
C3	**Earth System Modeling**
C4	**Theory Development**
C5	**Synthesis and Assessments**
C6	**Capacity Development and Education**
C7	**Communication and the Science-Policy Interface**

WMO IOC ICSU

WCRP
World Climate Research Programme

WCRP Open Science Conference: Climate Research in Service to Society 24-28 October 2011, Denver USA



Registered Participants:

- **1907 from 86 countries**
- **541 Early Career Scientists & Students**
- **332 from Developing Countries**

WMO IOC ICSU

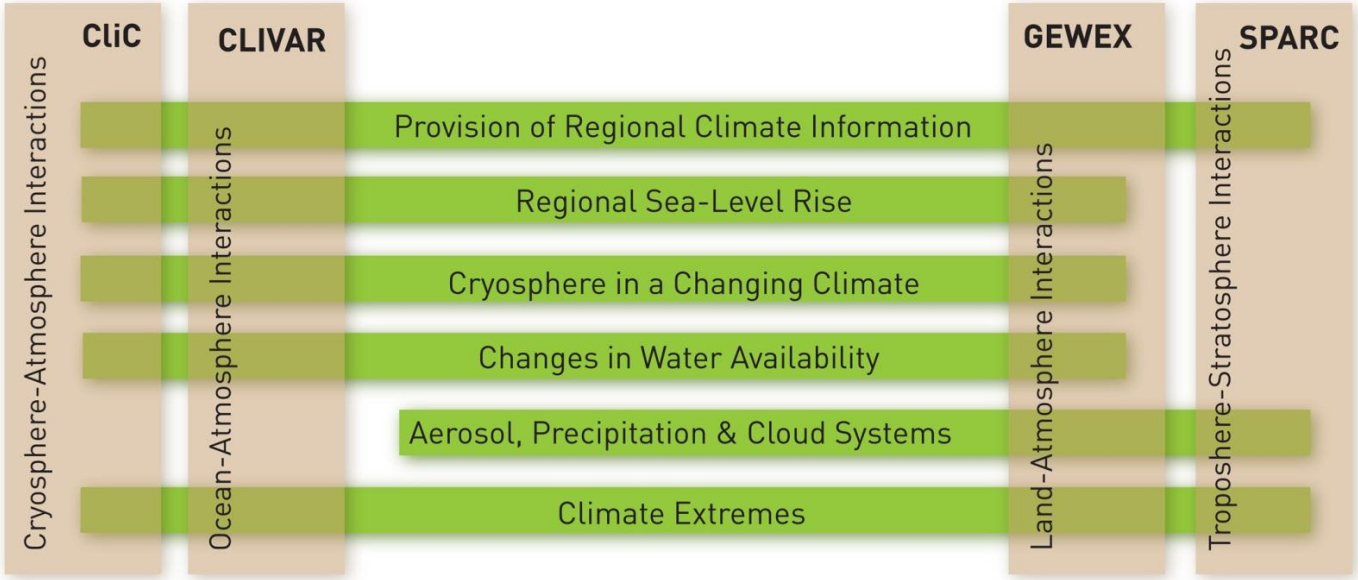
WCRP
World Climate Research Programme

WCRP Organization

Joint Scientific Committee | **Joint Plannig Staff**

Modeling Advisory Council | **Data Advisory Council**

Working Groups on: Coupled Modelling (WGCM), Regional Climate (WGRC), Seasonal to Interannual Prediction (WGSIP), Numerical Experimentation (WGNE)



WMO IOC ICSU

WCRP Grand Challenges

- **Skilful regional climate information (mainly CLIVAR lead with WGRC and core projects)**
- **Regional Sea-Level (CLIVAR lead, with CliC and GEWEX)**
- **Cryosphere in a changing climate (CliC lead)**
- **Cloud and Climate Sensitivity (WGCM lead, with GEWEX and SPARC)**
- **Changes in water availability (GEWEX lead)**
- **Prediction and attribution of extreme events (GEWEX lead)**

GC1:"Provision of skillful future climate information on regional scales (includes decadal and polar predictability)"

Barriers to the Grand Challenge 1:

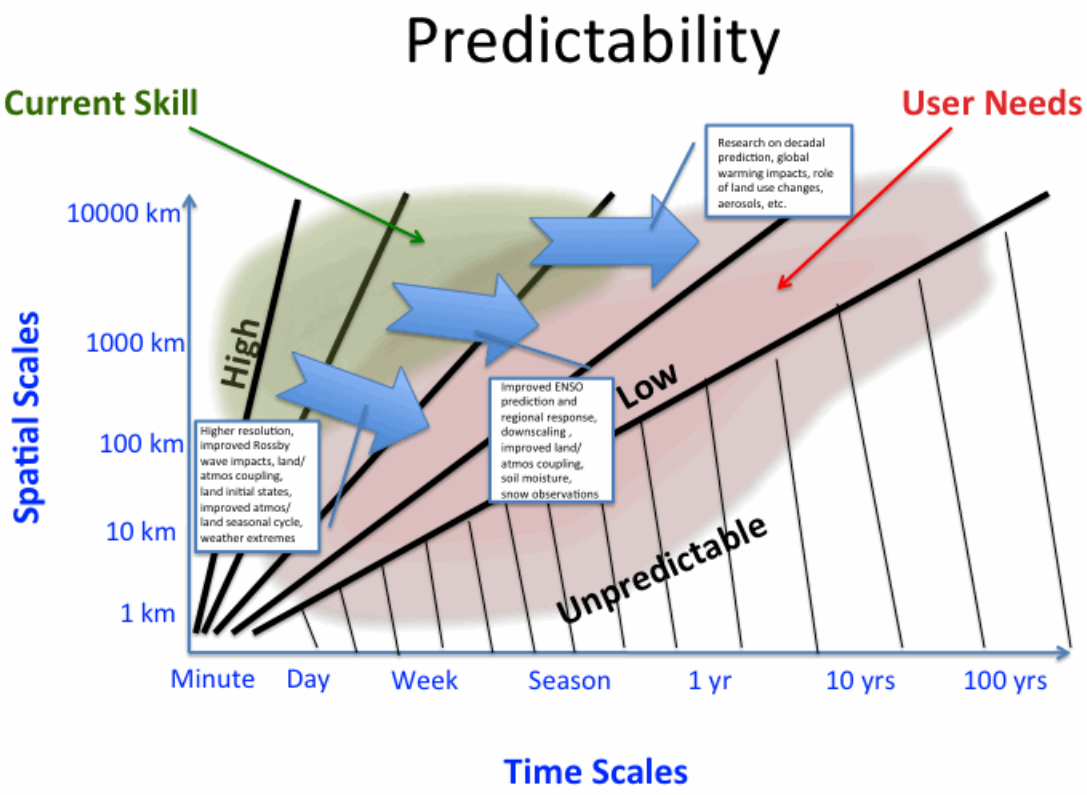
- Less decadal predictive skill over the Pacific compared to the Atlantic
- Less decadal predictive skill for precipitation than temperature
- It is still unclear what the best initialization strategy yields the best predictions
- Bias adjustment remains a major factor in decadal predictions and all groups do it somewhat differently
- The concept of "near term" climate prediction typically extends to roughly 30 years, but the focus of most decadal climate prediction studies until now has been on the next decade
- Need for model development
- Need for large samples to obtain robust forecast quality estimates
- Relevance of decadal predictions for climate services
- Limited skill over land regions
- Very limited skill for extratropical atmospheric circulation

GC4 : "Clouds and climate sensitivity"

- Revisited since the last JSC in Beijing with inputs from GASS, GEWEX, CFMIP, PMIP, WGNE and others and will be overseen by WGCM.
- Current barriers pertain to the inability to constrain the effects of clouds on climate sensitivity estimates, the lack of understanding of regional circulation and precipitation changes (especially over land) and unreliable representation of the coupling between cloud processes and large-scale dynamics.
- Rapid progress could be achieved by the critical mass of MIPs efforts, emerging new models (e.g. LES, CRMs over large domains and super-parameterization), and golden age of Earth Observations.
- It is proposed to develop targeted research efforts around 5 initiatives:
  - Climate and Hydrological Sensitivity
  - Leveraging the Past Record
  - Coupling Clouds to Circulations
  - Changing Patterns
  - Reliable Models

WCRP
World Climate Research Programme

Droughts: Prediction and Predictability



Planning for an experimental Global Drought Information System (GDIS) that builds upon the extensive worldwide investments in drought monitoring, drought risk management, drought research, and climate prediction capabilities.

11-13 April 2012 – Global Drought Information System Workshop

WMO IOC ICSU

WCRP 4th International Reanalysis Conference

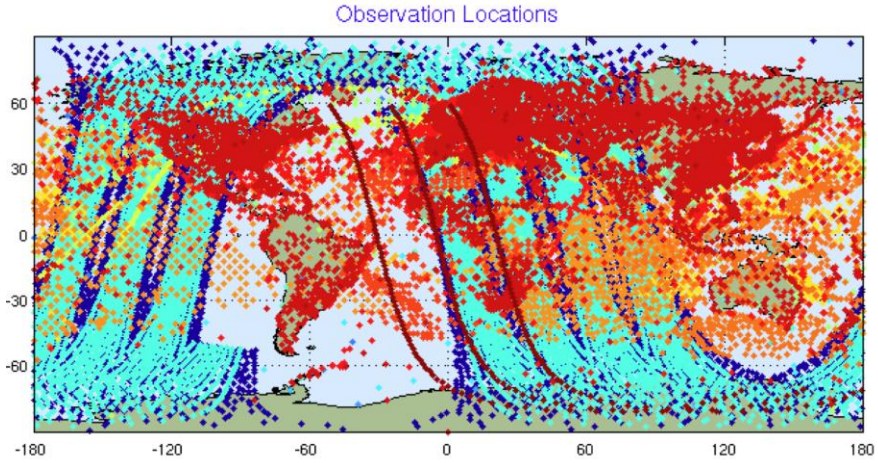
7-11 May 2012

Silver Spring, Maryland USA

270+ participants

42 countries

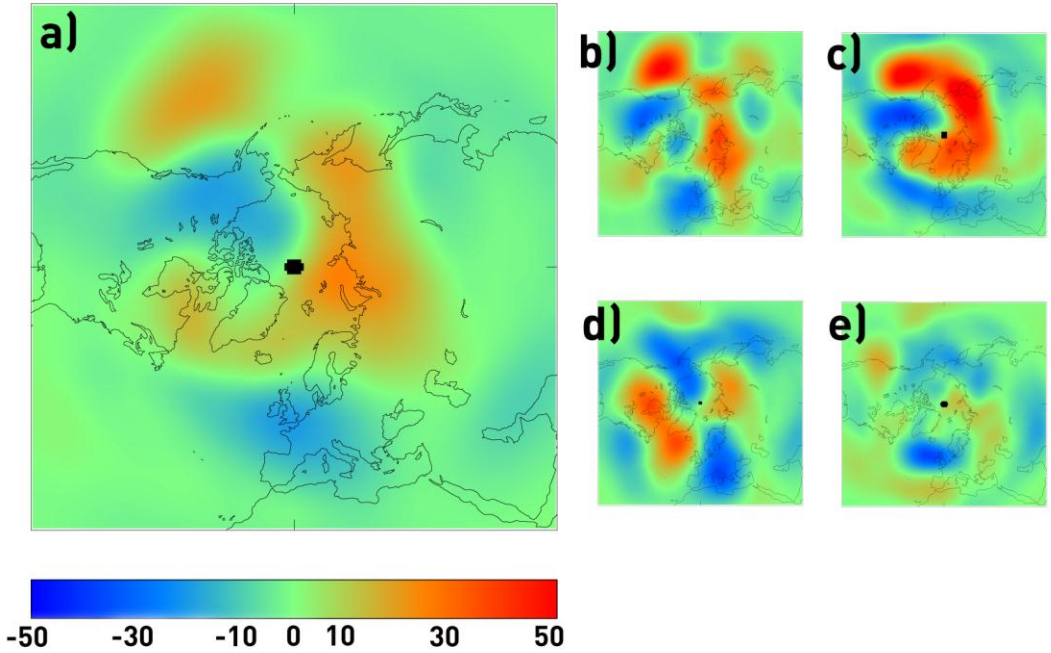
Agency Priorities: An Open Panel Discussion with Conference Participants



- ***Quantitative Uncertainty Estimation: families of reanalyses***
- ***Qualitative Uncertainty Estimation*: *reanalysis.org*, *climatedataguide.ucar.edu***
- ***Earth System Coupling: interdisciplinarity, synergies between communities***
- ***Reanalyses, Observations and Stewardship*: seamlessness of data discovery and access, ESG**

WCRP
World Climate Research Programme

Seasonal-Interannual Climate Prediction

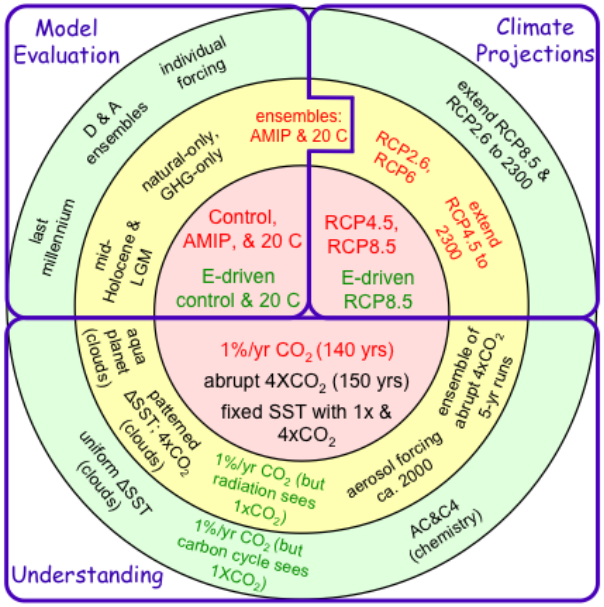


Early results from CHFP experiment on sea ice suggest that the recent decline in sea ice is forcing negative Arctic Oscillation and that this would be predictable in seasonal forecast systems. (Courtesy of Drew Peterson, Matthieu Chevallier, Bill Merryfield, Dirk Notz, Adam Scaife).

WCRP is coordinating a multi-model, multi-institutional set of hindcast experiments – the Climate system Historical Forecast Project (CHFP). The CHFP aims to explore the untapped sources of predictability on seasonal to interannual timescales due to interactions and memory associated with all the elements of the climate system (Atmosphere-Ocean-Land-Ice).

WMO IOC ICSU

A rich set of modeling experiments, drawn from several predecessor MIPs, focuses on model evaluation, projections, and understanding

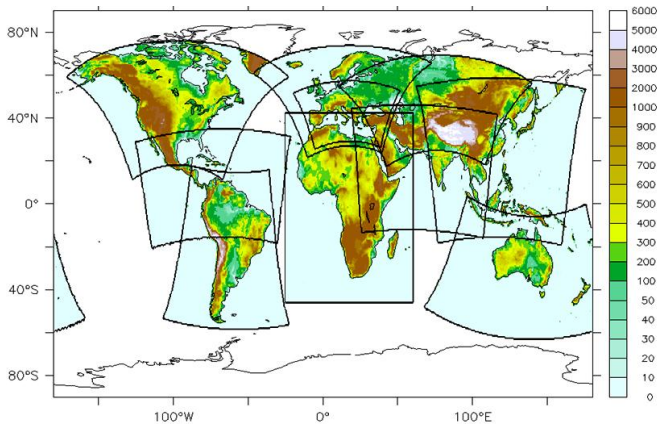


Red matches CMIP3 experimental suite

Green coupled carbon-cycle climate models

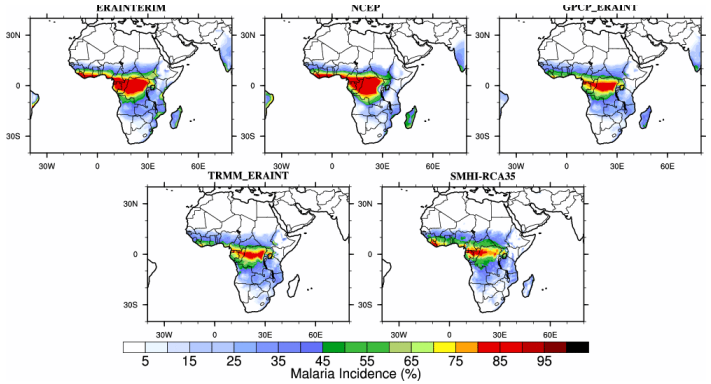
- 1+ Petabyte on ESG
- Between 15 and 22 AOGCMs, 4 to 8 decadal prediction simulation sets, about 6 high-top models, and 3 to 8 ESMs
- Considerable interest and excitement in analyzing model data to learn new things about the climate system
- Spread of projections in CMIP5 AOGCMs comparable to CMIP3, most first generation ESMs are well-behaved and produce comparable first order results to AOGCMs, but with all their additional capabilities
- Many studies contributing to the IPCC AR5 report
- Several papers in Nature and Nature Climate Change

Coordinated Regional Climate Downscaling (CORDEX)

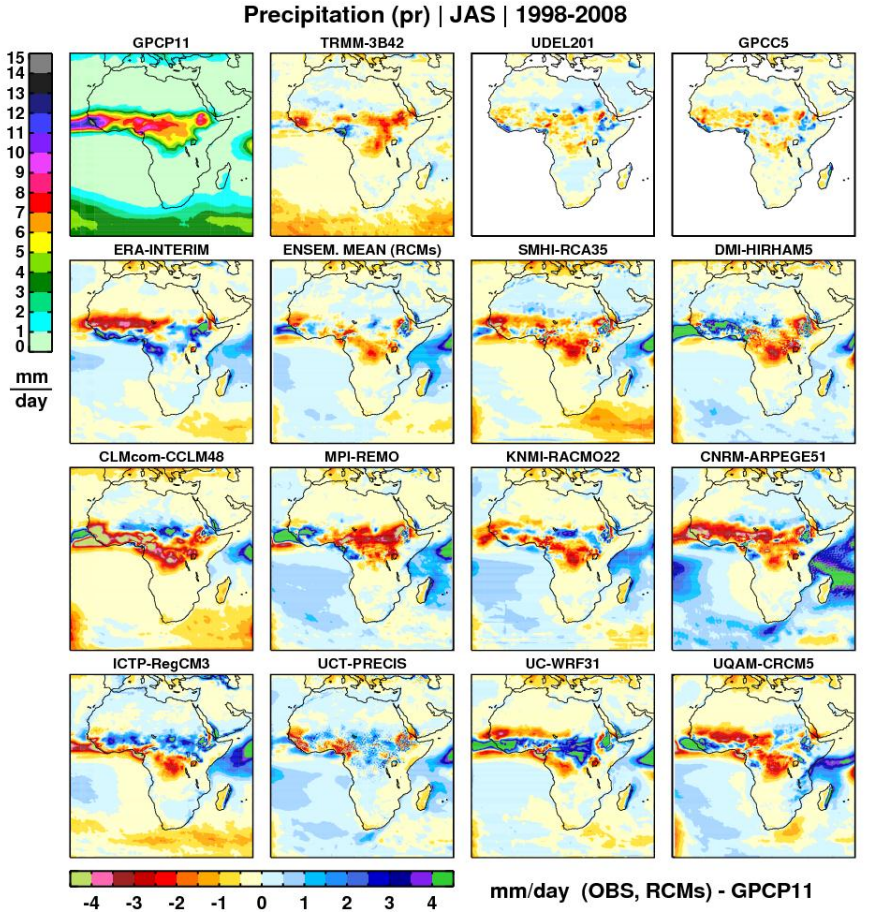


- 12 domains with a resolution of 0.44° (approx. 50x50km²), focus on Africa
- High res ~0.11° x0.11° for Europe (by some institutions)

Dynamic Malaria Model driven by climate observations & CORDEX simulations (mean annual prevalence (%)



SMHI (50km²) reproduces well the mean annual malaria incidence pattern with respect to TRMM-ERAINT & GPCP-ERAINT control experiment

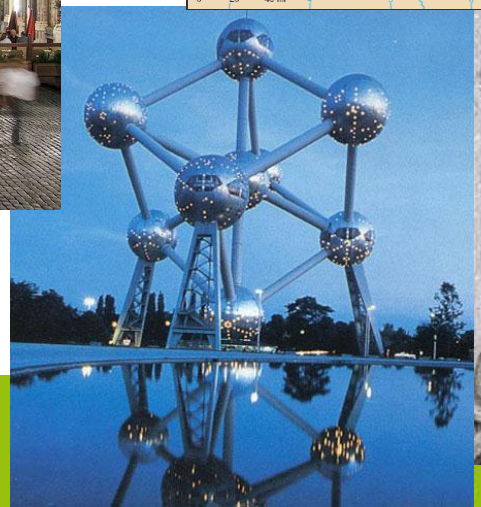


Example of CORDEX multi-model data available for Africa. From Top to bottom and left to right: GPCP mean July-August-September precipitation for 1998-2008 and differences compared to GPCP in the other gridded observations, and the individual RCMs with their ensemble average.

Nikulin, G., et al, J. Clim, 2012

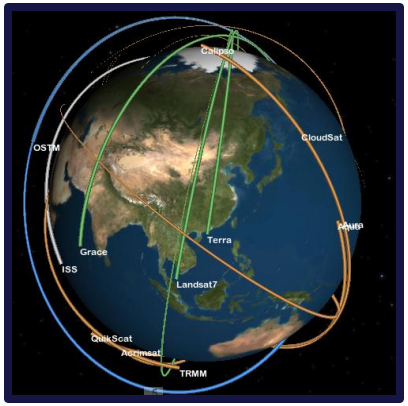
International Conference on Regional Climate - CORDEX 2013

- 4-7 November 2013, Brussels, Belgium
- Partnership between WCRP, IPCC and EC
- Timed between IPCC WGI and WGII releases
- 1st day: High Level Session, Stakeholder dialogue
- 2-4th days: Scientific Conference
- http://cordex2013.wcrp-climate.org/

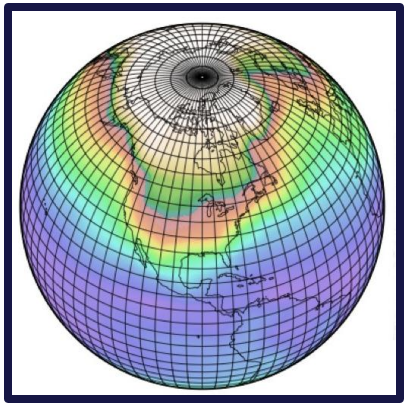


Intercomparison Models-Observations

Coordinated with CMIP5 are parallel efforts to collect and make available observationally-based products



Obs4MIPs



A pilot effort to improve the connection between data experts and scientists involved in climate model evaluation. Aligned with CMIP5, with encouragement from the WGCM, WGNE, WDAC.

NASA and the U.S. DOE have initiated the project with significant contributions of appropriate NASA products.

Communities to contribute data to Obs4MIPs such as cryosphere, biogeochemistry, etc.

Tools

- Models and observations: Earth System Grid, http://www.earthsystemgrid.org/

ESGF Gateway : Side by Side Archive with CMIP

Regional Climate Model Evaluation System

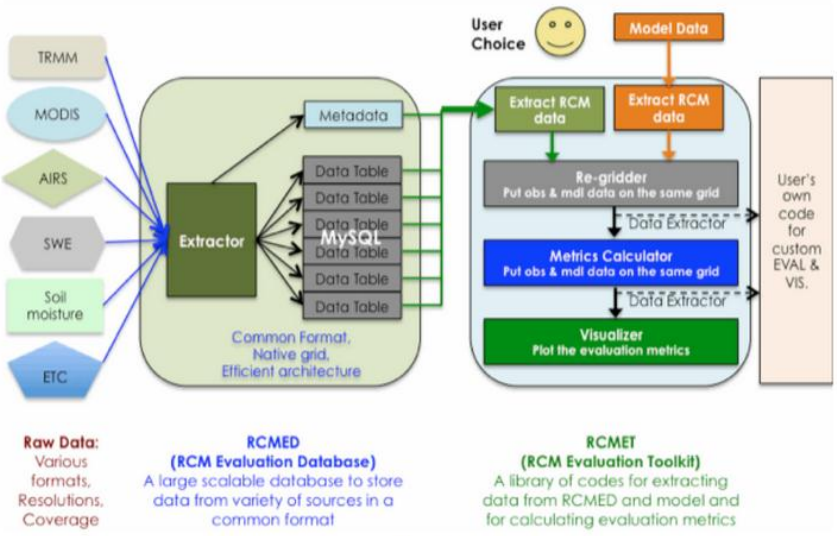


Figure 2. A schematic illustration of the outline and data flows within RCMES.

WDAC: Obs4MIPs

- Background: WDAC was briefed on the ongoing initiative Obs4MIPs, which makes observing datasets available in an ESGF accessible format.

- Recommendation: WDAC encourages broadening of contributions from the WCRP core projects, CEOS, CGMS, IGBP, SOLAS and the Reanalysis community to this activity, so as to populate the ESGF and further facilitate model-data comparisons

WDAC: Next meeting

- 4-5 March, EUMETSAT, Germany
- Suggested topics:
  1. Briefing on Obs4MIPs
  2. Workshop on observations for reanalysis
  3. CEOS and GOSIC to brief on ECV inventories including maturity matrix approach
  4. Four core projects to brief on their best data assessment practices in guiding users to specific data sets
  5. SCOPE-CM presentations on the outcome of phase 1 considering specific ECV data records
  6. Network design, OSSEs
  7. Data needs to initialize models to provide seasonal ice outlooks
  8. Bio-geochemical data brief for Earth system models by IGBP representative
  9. Surface fluxes
  10. ESGF governance – follow-up from various meetings

Meetings

- 20-23 March, Pasadena, USA, Workshop on the Physics of Climate Models, http://climatesciences.jpl.nasa.gov/workshop/model-physics-2012
- 16 July, Beijing, CHINA, 1st Session of the WCRP Modeling Advisory Council, http://www.wcrp-climate.org/WMAC/WMAC1.html
- 16-20, July, Beijing, CHINA, 33rd Session of the WCRP Joint Scientific Committee, http://www.wcrp-climate.org/JSC33/

- 19-22, March, Washington DC, USA, GODAE/WGNE Workshop: Short- to Medium- Range Coupled Prediction for Atmosphere-Wave-Sea-Ice-Ocean: Status, Needs and Challenges, https://www.godae-oceanview.org/outreach/meetings-workshops/coupled-prediction-workshop-gov-wgne-2013/
- 15-19, April, Exeter, UK, 4th WGNE Workshop on Systematic Errors in Weather and Climate Models, http://www.metoffice.gov.uk/conference/wgne2013

WGNE brief to JSC:

“Transpose-AMIP was testing climate models in NWP mode. The CMIP5 protocol was being used to accommodate that community; Prof Jacob was pleased to report that the data was being used and publications were expected in time for use in the IPCC 5th assessment.

The Grey zone project was studying the model range where features are not resolved but also not parameterized. The case study was on a cold air outbreak and sought to determine how well do models represent convection and the evolution of the boundary layer in a cold air outbreak and to explore the use of high resolution ‘truth’ to investigate parameterization issues for coarser resolution models.

Prof Jakob closed with some reflections on his career with WGNE. He concluded that
“climate is the PDF of weather” and hence WGNE had never been more important than today in bringing research in the two areas closer together. He looked forward to WGNE’s important contribution to the WMAC.”

WCRP
World Climate Research Programme

Special thanks to

WWF

WMO IOC ICSU

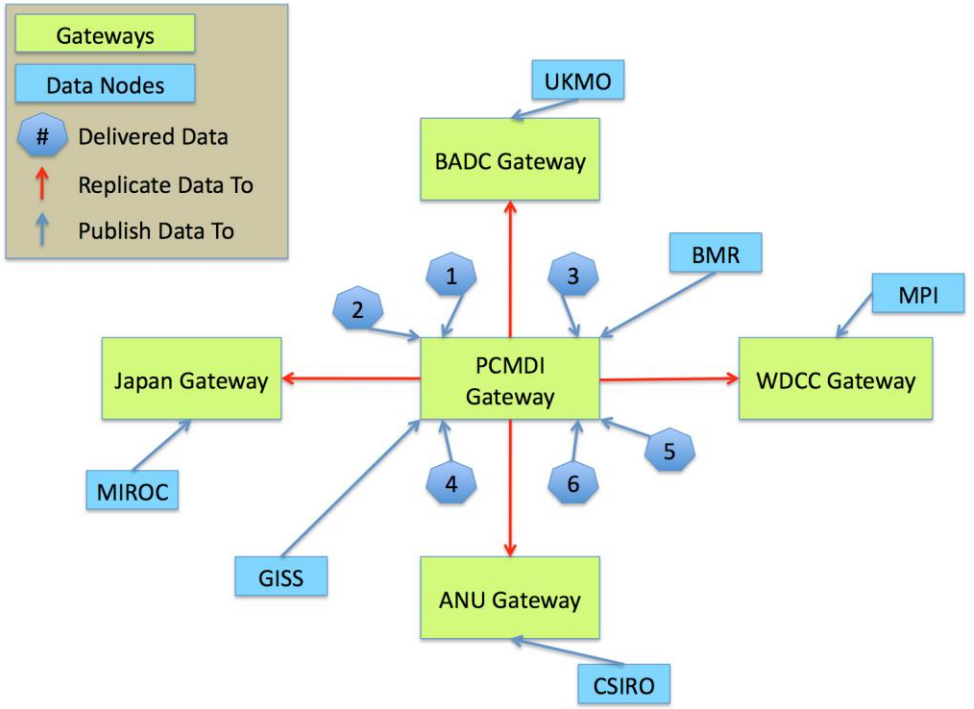
Thank you for your attention!

Earth System Grid: International Coordination

CMIP5 participating groups (20+ groups; ~40 models).

2.3Pbytes of model output expected - 100 times greater than CMIP3.

Model data will be accessed by the Earth System Grid - output will be served by federated centers around the world and will appear to be a single PCMDI archive.



CORDEX participating groups