WCRP
World Climate Research Programme

World Climate Research Programme

Moving Towards Future

WCRP Progress and Plans

Ghassem R. Asrar

WMO IOC ICSU International Council for Science

Mission & Objectives

World Climate Research Programme coordinates climate research, modeling and analysis to improve;

(1) climate predictions and
(2) our 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).

Earth System Science Approach

The Earth System Science Partnership consists of four international global environmental change (GEC) research programs for the integrated study of the Earth system, the changes that are occurring to the system and the implications of these changes for global and regional sustainability.

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WCRP Core Projects

Climate Variability and Predictability

Mission: To identify the physical processes involved in the Climate dynamics, including anthropogenic effects, and develop models and predictive capabilities

Climate and Cryosphere

Mission: To assess and quantify the impacts that climatic variability and change have on components of the cryosphere and its overall stability

Stratospheric Processes and their Role in Climate

Mission: To focus on climate-chemistry interactions; detection, attribution and prediction of stratospheric change; stratospheric-tropospheric dynamical coupling

Global Energy and Water Cycle Experiment

Mission: To observe, analyze, understand and predict the variations of the global energy cycle and hydrological regime and their impact on atmospheric and surface dynamics

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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

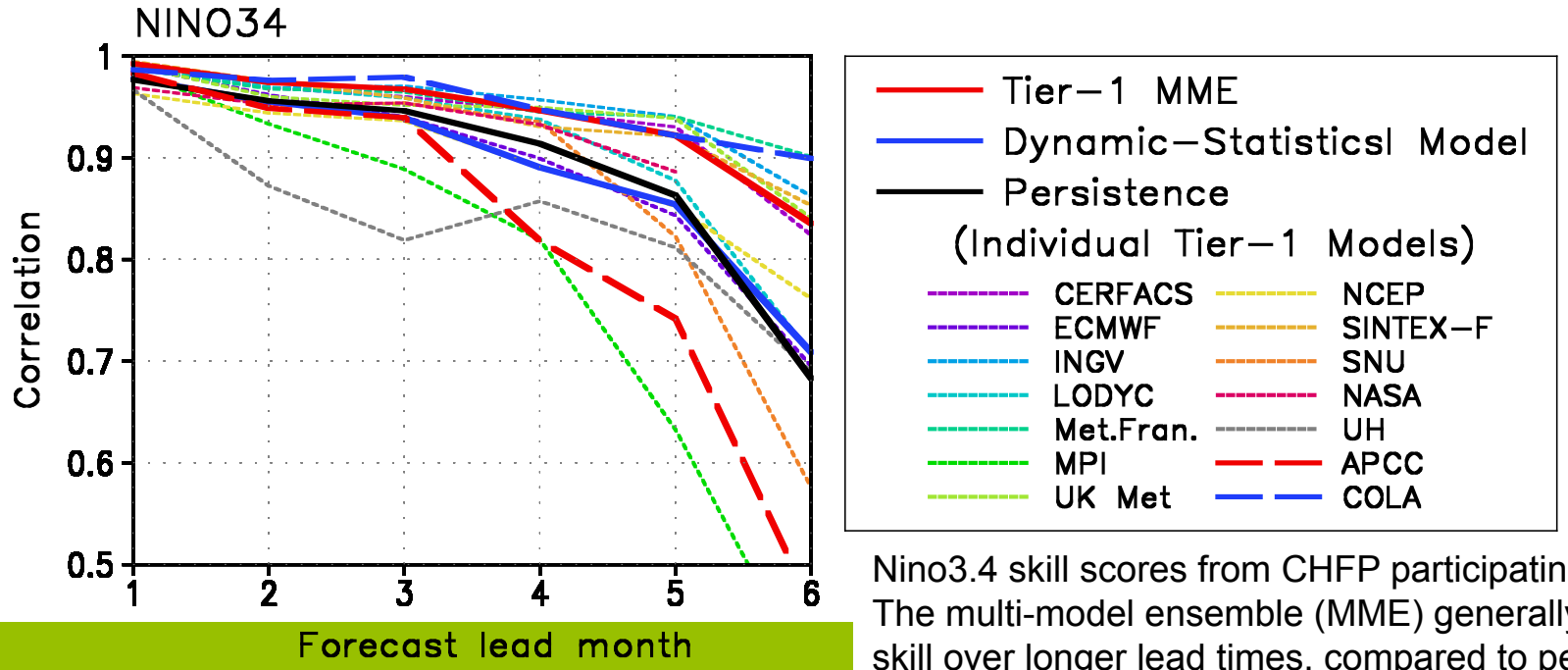
Activities in Support of WCRP Integrating Themes

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

Seasonal Forecast

WCRP Climate-system Historical Forecast Project (CHFP)

- Assess seasonal prediction capabilities using the best available models and data for initialization;
- Experimental framework for focused research on how various components of the climate system interact and affect one another; and
- Testbed for evaluating IPCC class climate models in seasonal prediction mode.

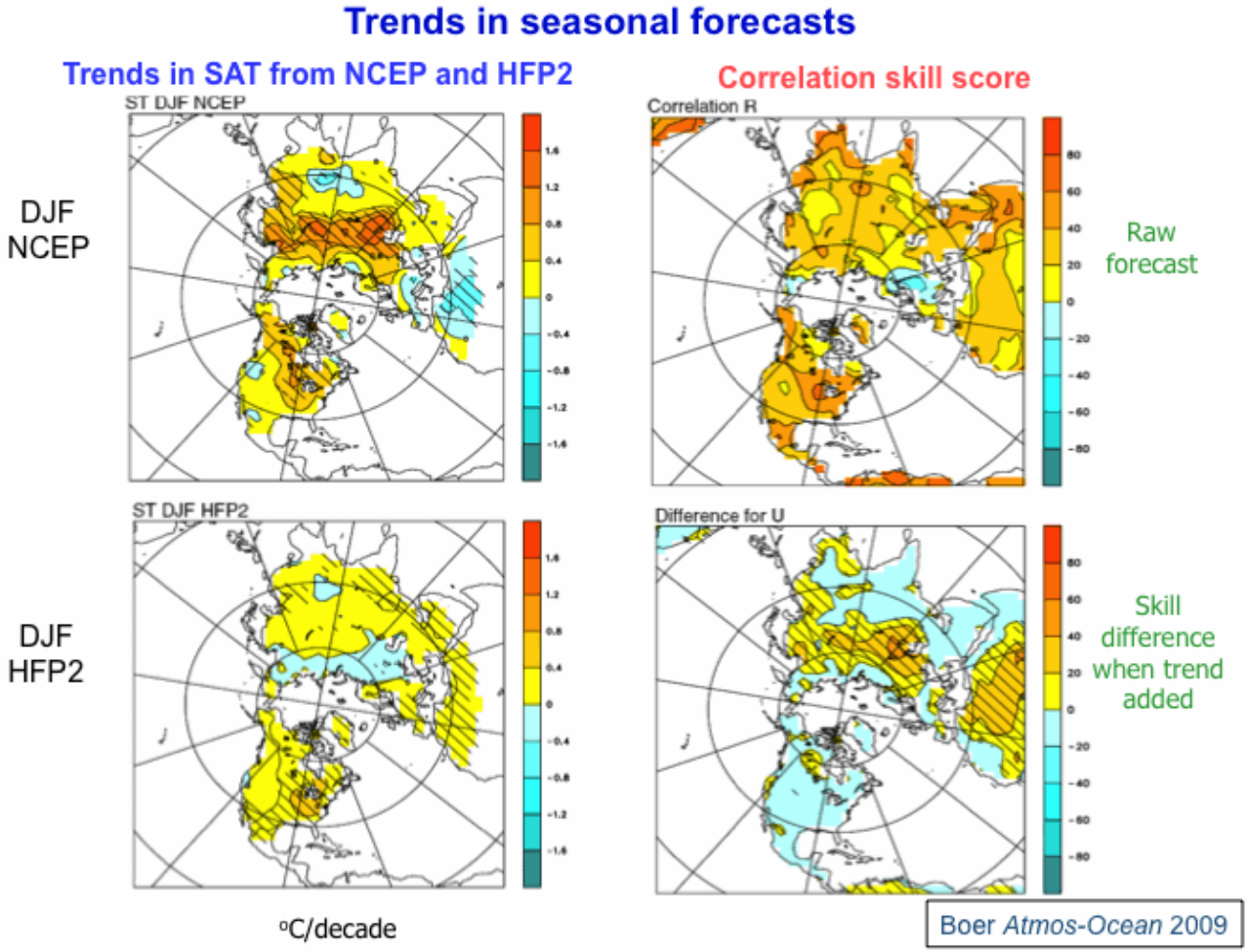


Nino3.4 skill scores from CHFP participating groups
The multi-model ensemble (MME) generally give improved skill over longer lead times, compared to persistence and individual models

Seasonal Forecast

Example of how CHFP data can be used to understand impact of surface air temperature trends on seasonal forecast skill.

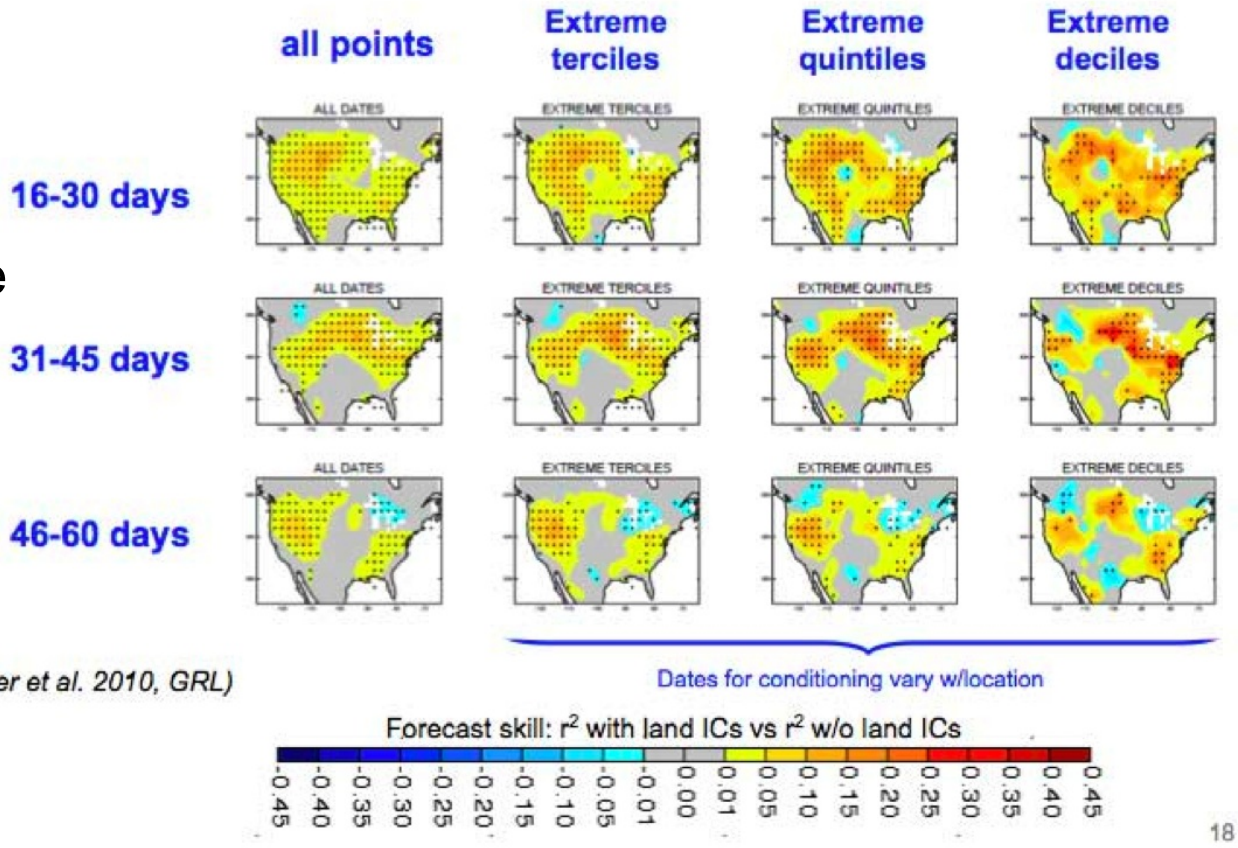
The upper right shows the raw forecast skill and the lower right show how much of the skill is due to the trend.



Seasonal Forecast

Land initialization impacts on skill increase dramatically when conditioned on the size of the initial soil moisture anomaly

Temperature forecasts: Increase in skill due to land initialization (JJA)
(conditioned on strength of local initial soil moisture anomaly)



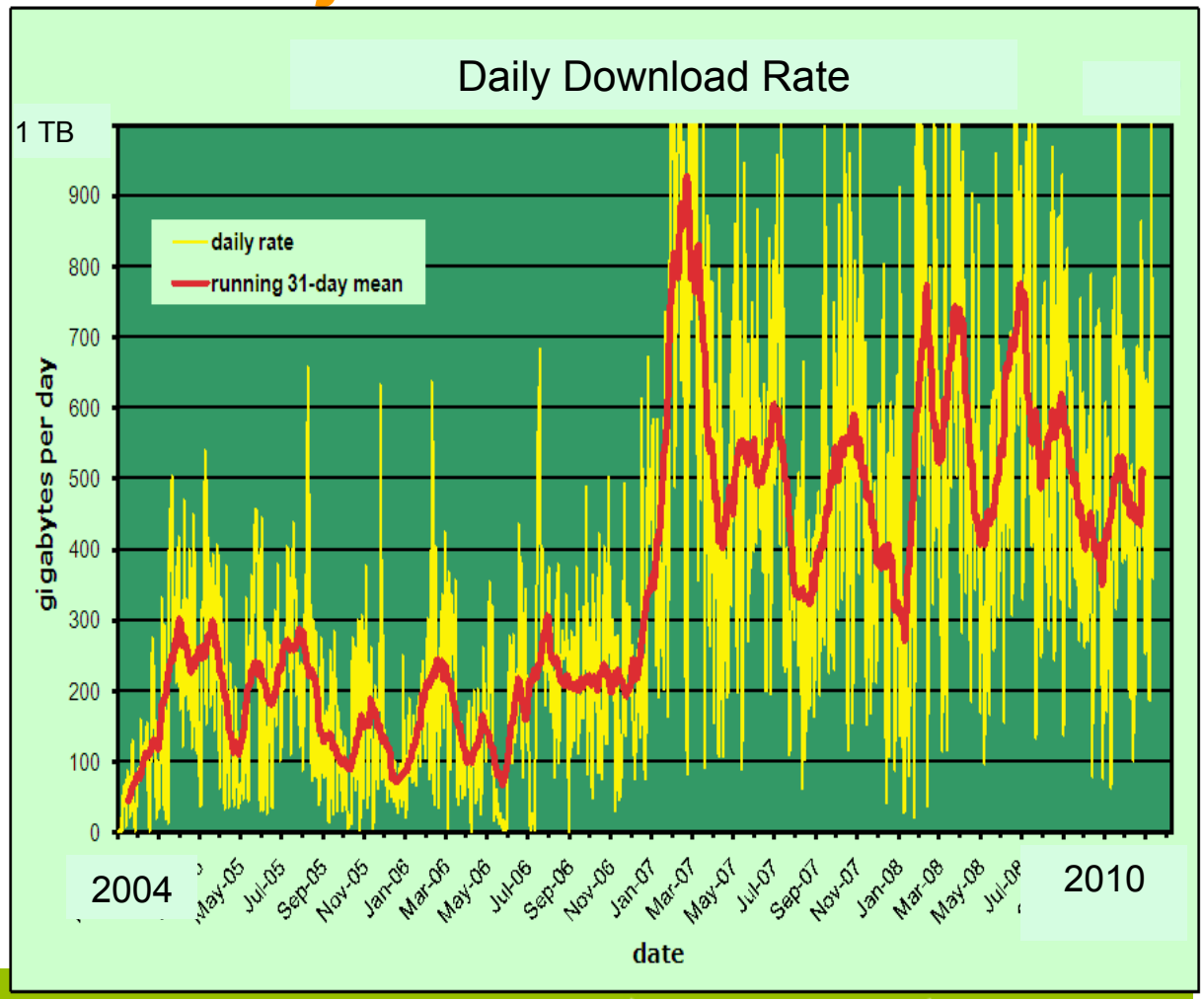
(Koster et al. 2010, GRL)

The results highlight the potential usefulness of improved observational networks for prediction!

Climate Projections

Interest in CMIP3 results continues unabated!

- More than 550 peer-reviewed publications.
- ~1 Pbyte of data downloaded.
- More than 3,000 registered users.



Climate Projections

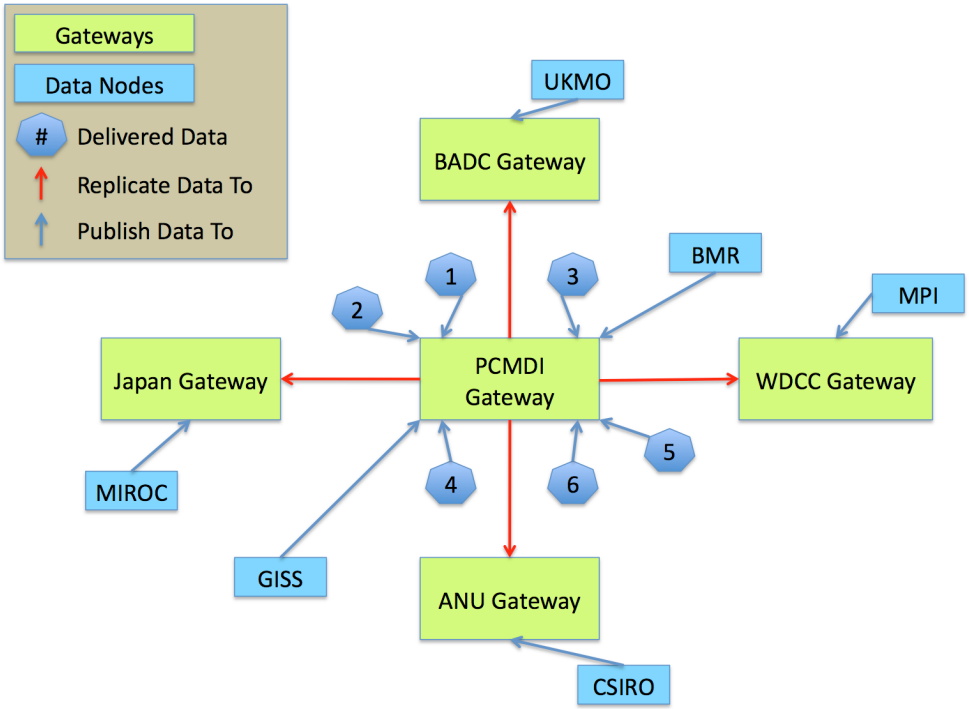
CMIP5 - Unprecedented International Coordination

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

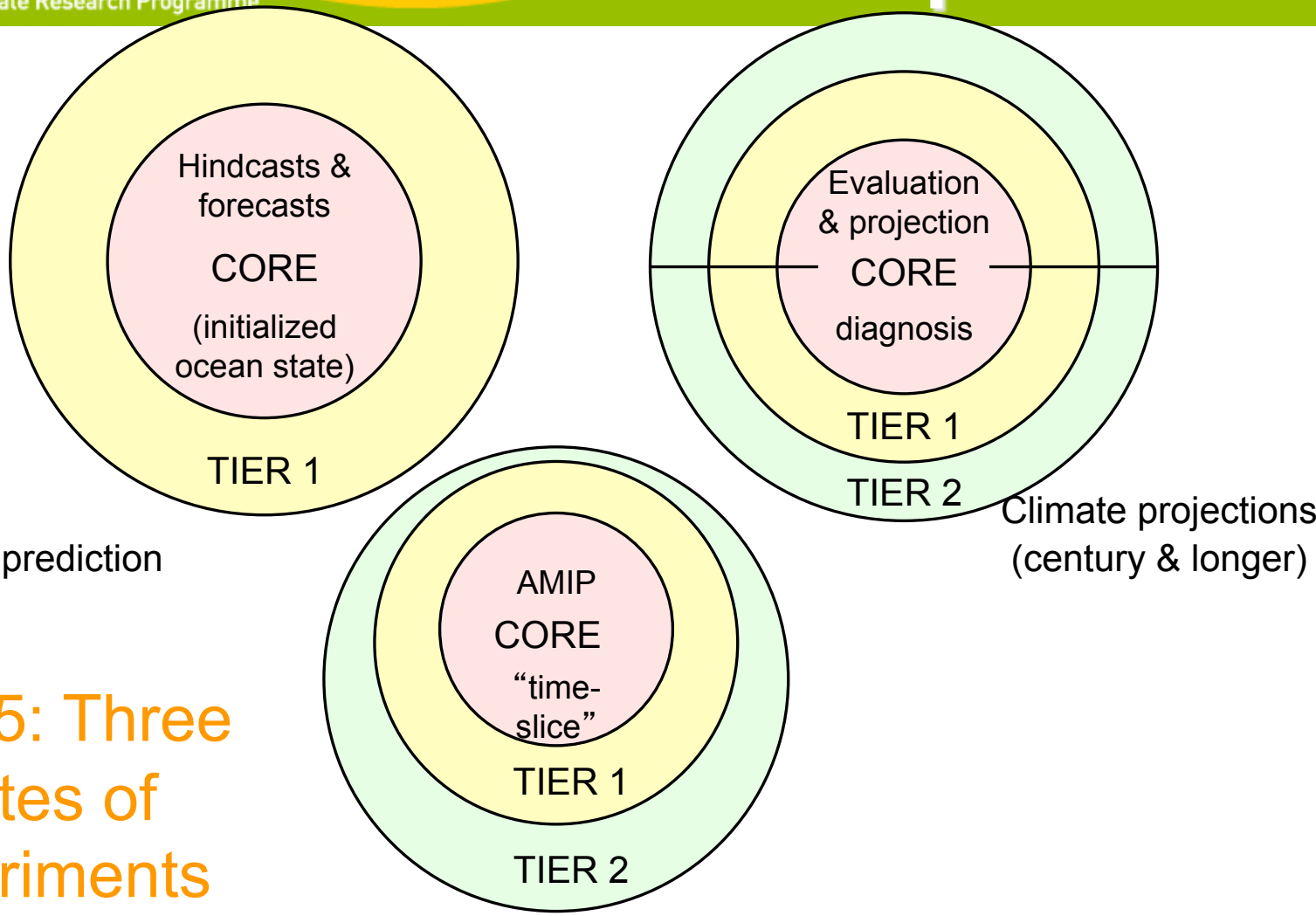
2.3Pbytes of model output expected - 100 times greater than CMIP3.

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.

The archive will become available to analysts from Spring 2011.



Accomplishments



CMIP5: Three Suites of Experiments

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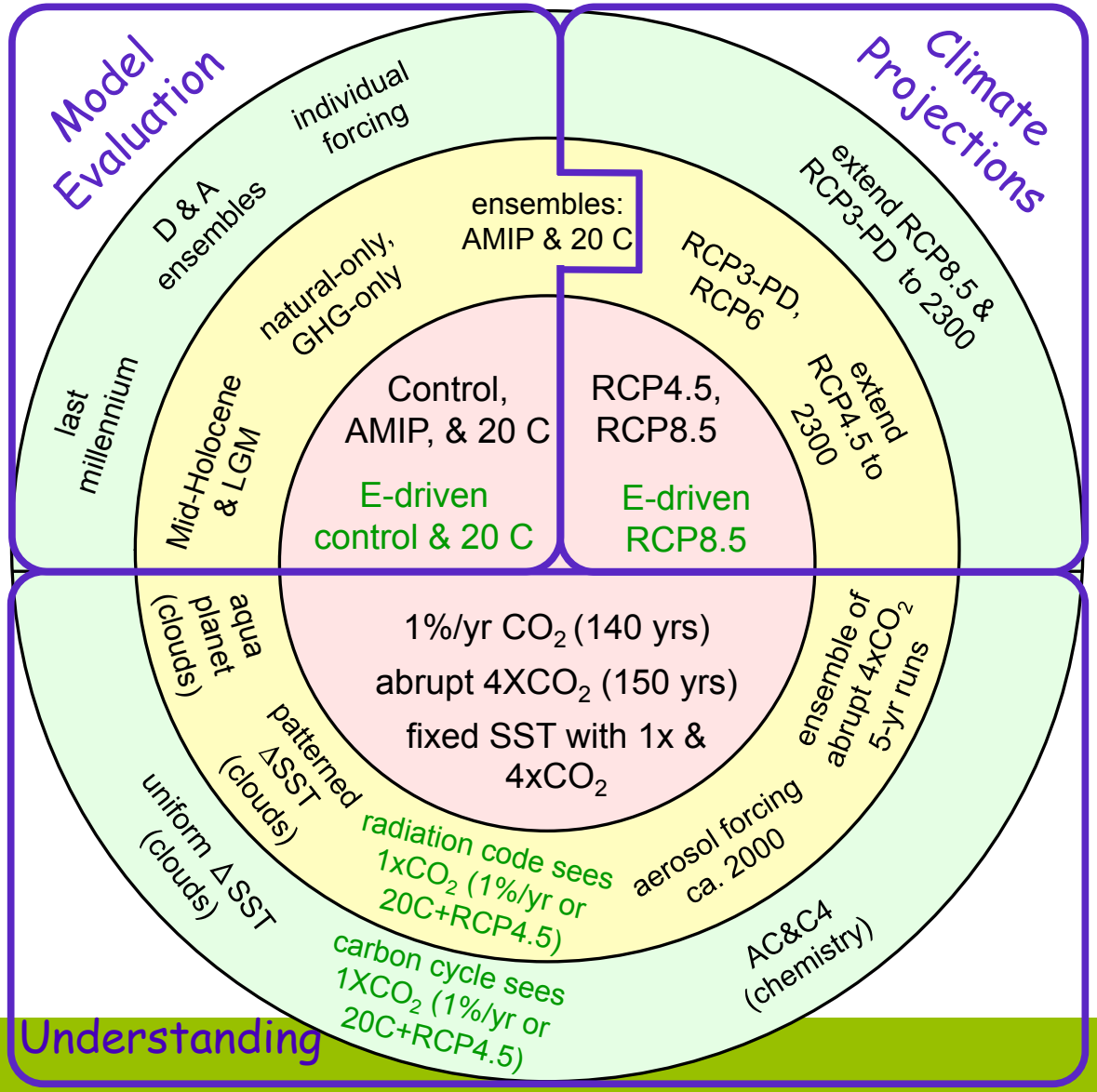
Accomplishments



CMIP5 Long-term Simulations

Cloud feedback experiments

Paleoclimate experiments

ESM carbon cycle feedback experiments with concentration-driven ESMs as well as emission-driven ESMs

SPARC interactive atmospheric chemistry, ozone and aerosols, air quality

Fast and slow feedback experiments

Green: Coupled carbon-cycle climate models only

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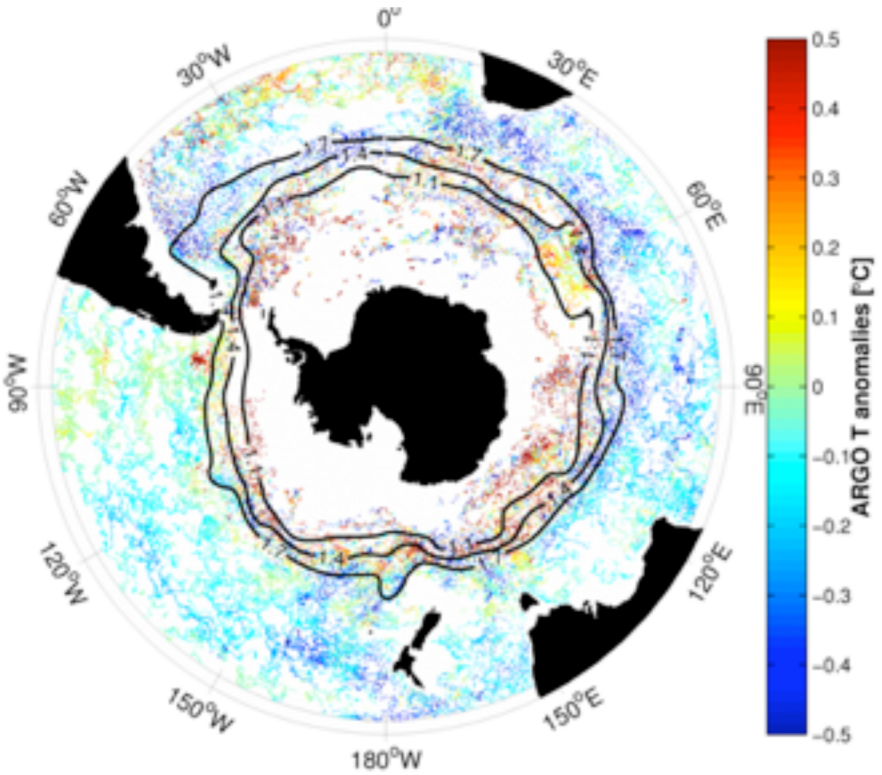
Climate Projections

Progress Since CMIP3:

- More experiments to quantify model sensitivity and feedbacks.
- Earth System Models - interactive carbon cycle, atmospheric chemistry, ozone chemistry, land-surface schemes.
- Increased Resolution - including NWP models, eddy permitting ocean models, stratosphere-resolving atmospheric models
- Decadal prediction experiments to test a variety of initialization techniques

Observations



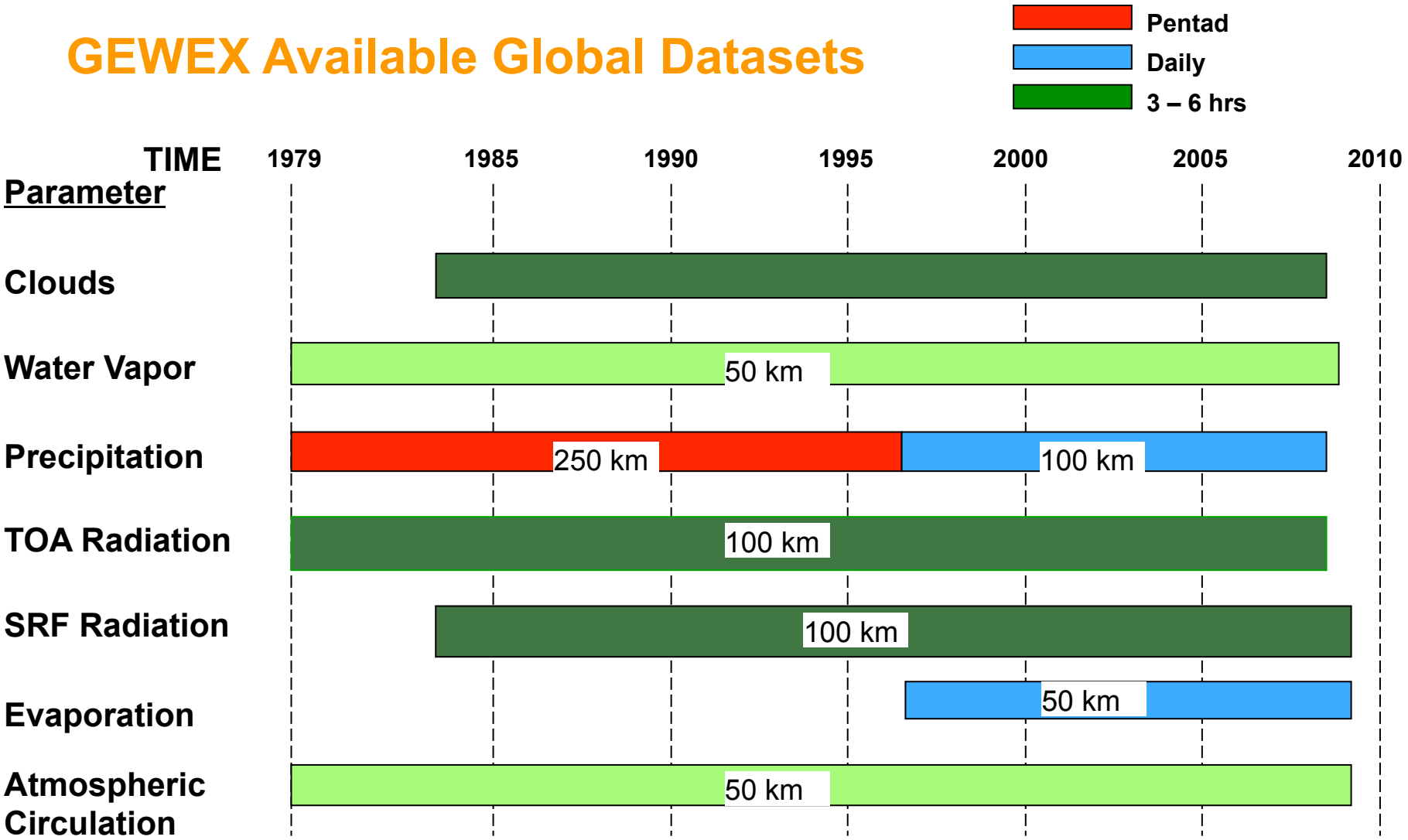
Boening et al., Nature Geosciences, 2008

Argo floats deployed in the Antarctic Circumpolar Current (ACC) detect coherent hemispheric-scale warming and freshening trends that extend to depths of more than 1000 m.

Southern Hemisphere westerlies between 30S and 60S have increased over the past decades and results suggest that the ACC transport and meridional overturning in the Southern Ocean are insensitive to decadal changes in wind stress.

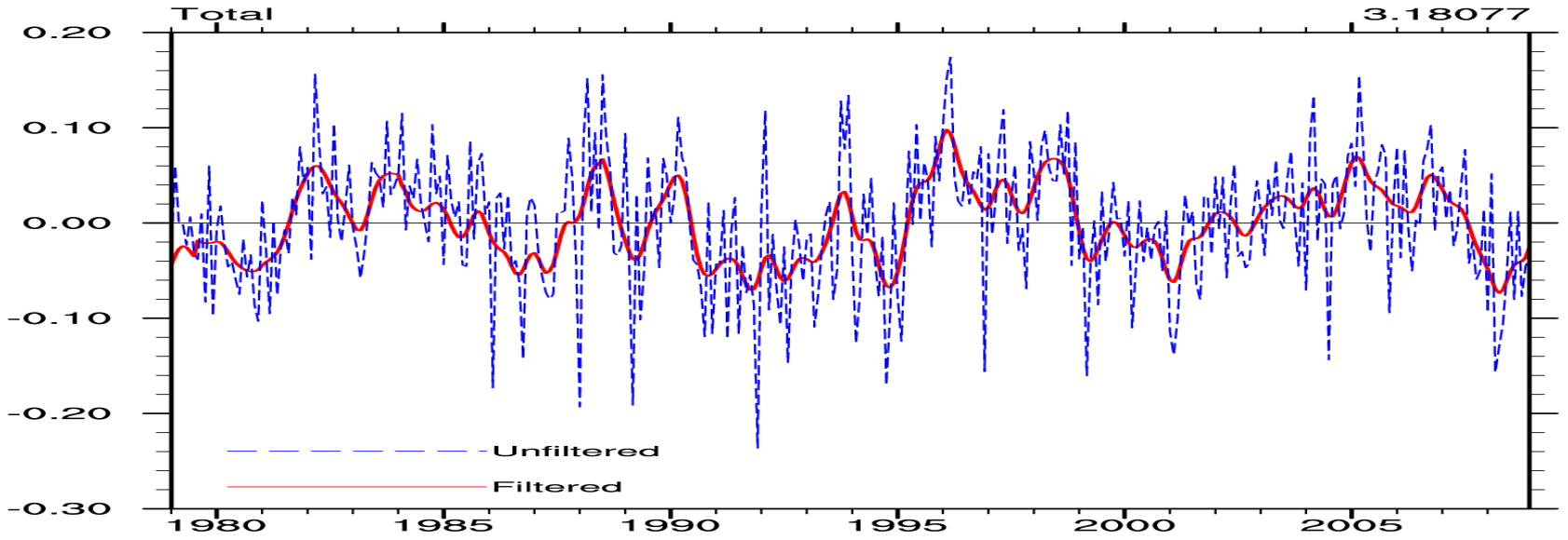
Accomplishments

GEWEX Available Global Datasets



Accomplishments

GPCP Global precipitation 1979-2008



GEWEX the Radiation Panel develops climate data records of global water and energy variables such as clouds, radiation, aerosols, precipitation etc., complete with metadata and error analysis.

These are the best global observations consisting of a blend of satellite and in-situ observations covering in most cases more than 25 years.

These products are periodically compared and assessed against other products in an open and transparent fashion and are available to everyone without restrictions.

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Accomplishments

Global Multi-Year Averages

Parameter	Ohmura & Gilgen (1993) *GEBA Surf. Obs.*		Trenberth et al. (2009) CERES and Models		Zhang & Rossow (2004) *21-Year Mean (1984-2004)*		NASA/GEWEX SRB Release 3.0/2.5* (NASA LaRC) *24-Year Mean (July 1983 - June 2007)*			
							SW, LW		SW, LW QC	
	Flux	% F_0	Flux	% F_0	Flux	% F_0	Flux	% F_0	Flux	% F_0
SW Down	**169.0**	**49.4**	**184**	**53.9**	**189.2**	**55.4**	**188.7**	**55.2**	**182.2**	**53.3**
SW Net	**142.0**	**41.6**	**161**	**47.2**	**165.9**	**48.5**	**166.6**	**48.7**	**159.7**	**46.7**
LW Down	**345**	**100.9**	**333**	**97.6**	**343.8**	**100.6**	**343.2**	**100.4**	**347.5**	**101.7**
LW Net	**-40.0**	**-11.7**	**-63**	**-18.5**	**-49.6**	**-14.5**	**-52.8**	**-15.4**	**-51.2**	**-15.0**
Total Net	**102.0**	**29.8**	**98**	**28.7**	**116.3**	**34.0**	**113.8**	**33.3**	**108.5**	**31.7**
SW CRF	--	--	--	--	**-53.0**	**-15.5**	**-58.8**	**-17.2**	**-60.9**	**-17.8**
LW CRF	--	--	**46**	**13.5**	**29.5**	**8.6**	**35.3**	**10.3**	**34.3**	**10.0**
Total CRF	--	--	--	--	**-23.5**	**-6.9**	**-23.5**	**-6.9**	**-26.6**	**-7.8**

S_0 = 1365 Wm^{-2} for Trenberth et al. and 1367 Wm^{-2} for all others
****GEWEX LW values are Rel.-2.5 and 23-year averages (Jul1983-Jun2006)***

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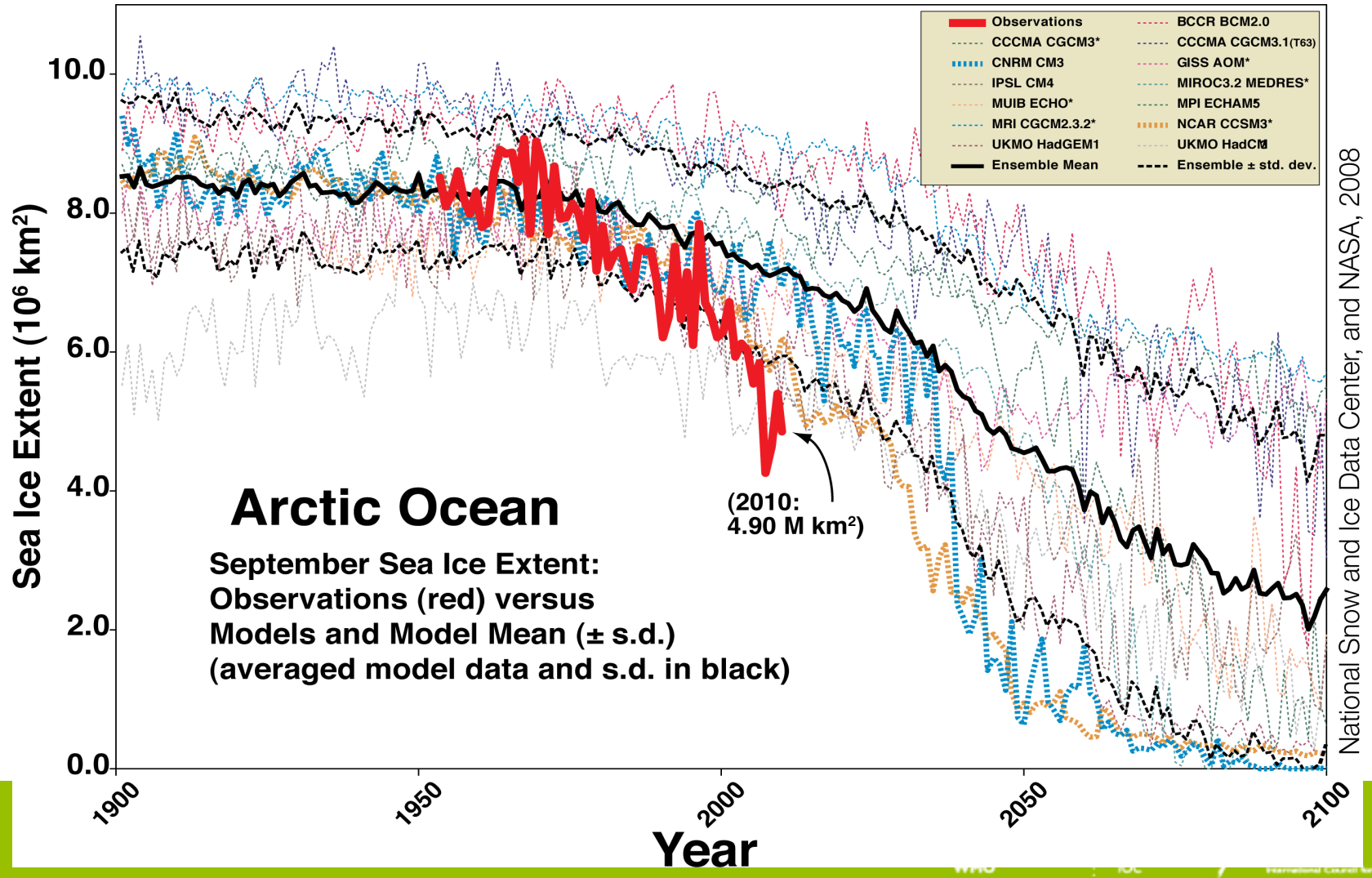
Arctic Sea-Ice Variability and Change



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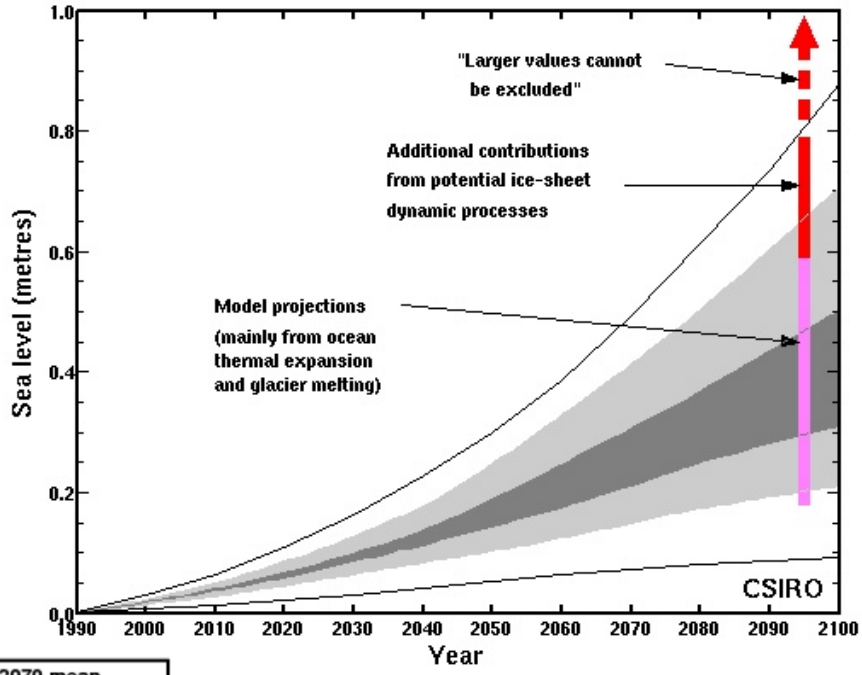
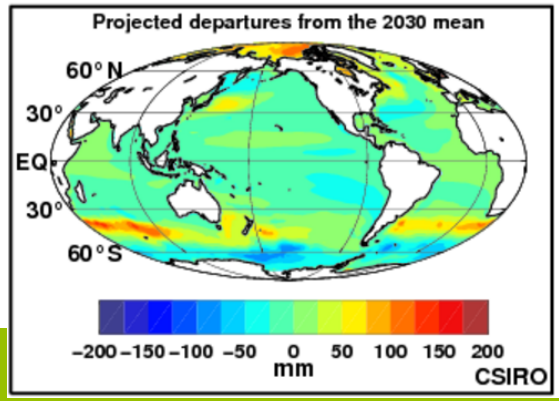
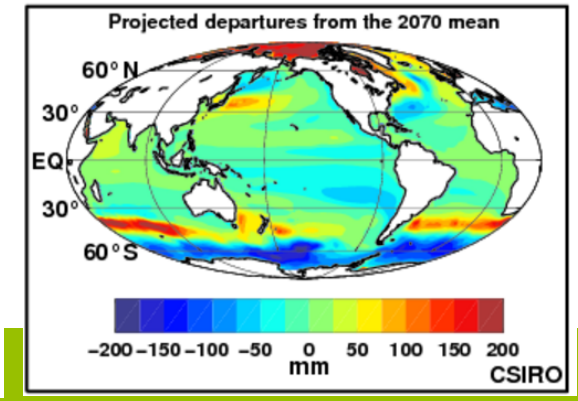
Accomplishments

Sea-Level Variability and Change

Focus 1 :
Improve understanding of the risk of higher mean sea-level rise in the 21st century, and Antarctica and Greenland contributions.







Focus 2 :
Regional sea-level rise and coastal impacts.

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Accomplishments

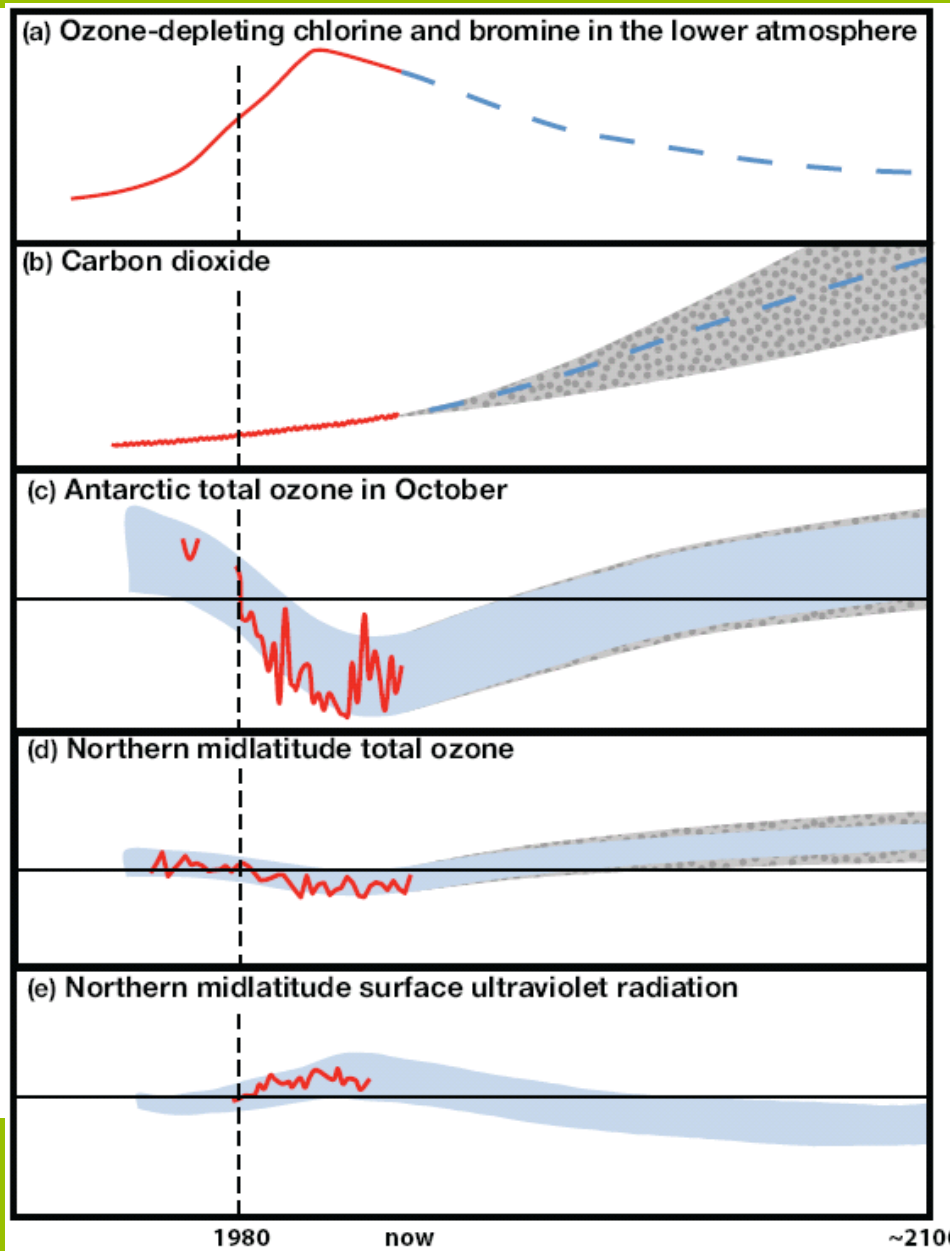
World Meteorological Organisation

UNEP

Scientific Assessment of Ozone Depletion 2010

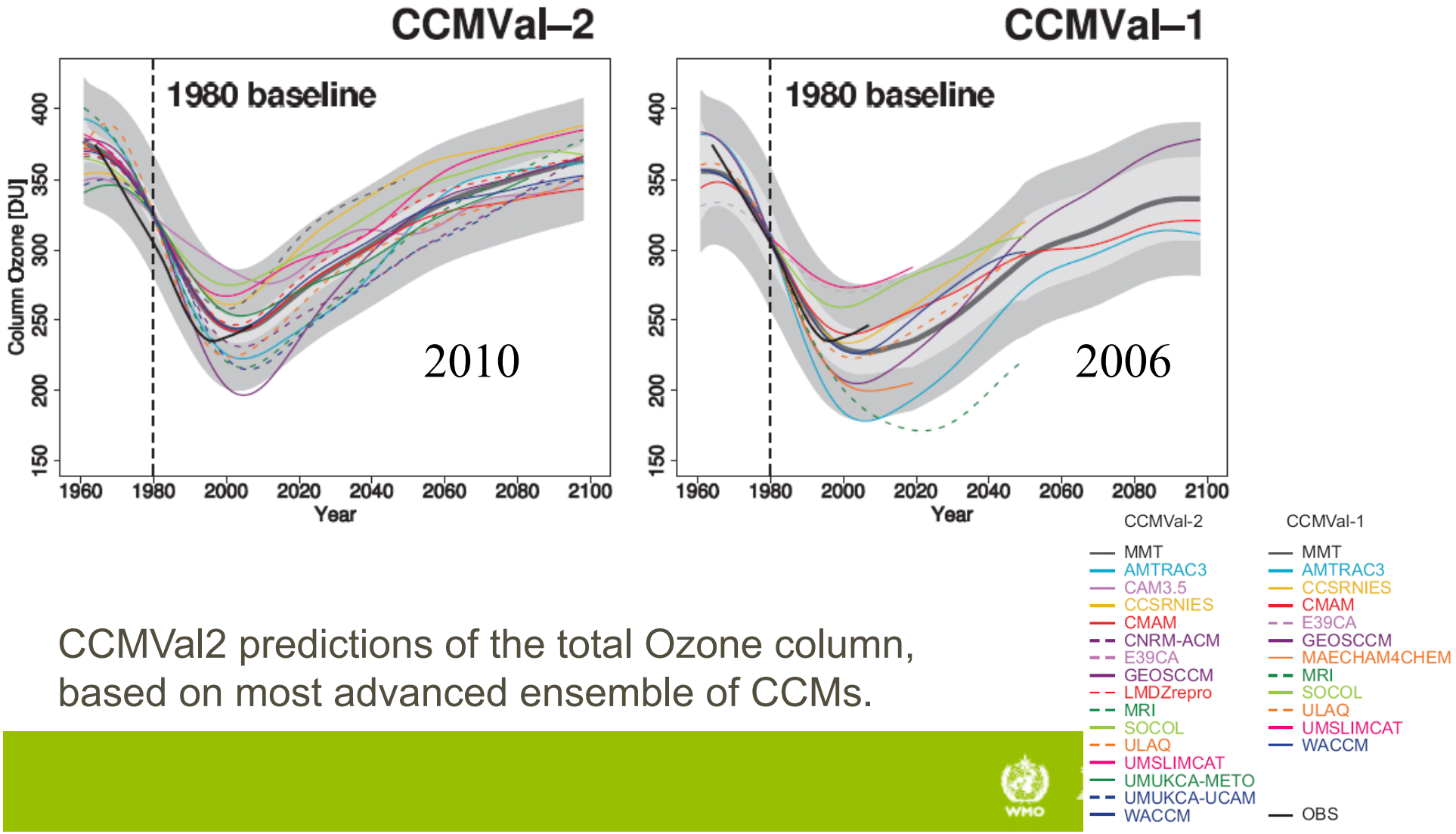
The shaded areas in panels (c)-(e) came from CCMVal based on sophisticated statistical analysis of model variability and trends

In past Assessments, estimates of model ranges had been pure guesswork



Accomplishments

October O_3 Column 60°S–90°S



CCMVal2 predictions of the total Ozone column, based on most advanced ensemble of CCMs.

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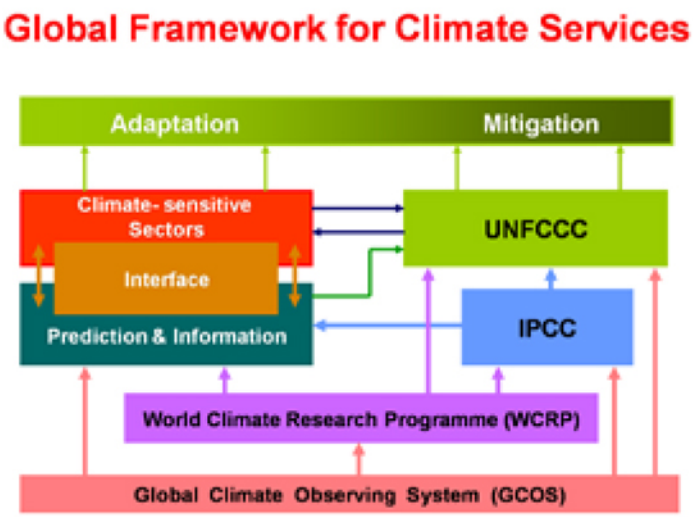
World Climate Conference • 3

WCC-3 Conference Statement

- **Great recognition of scientific progress made through WCRP and its associated activities**
- **Call for major strengthening of observations and research**

Support the development of the Global Framework for Climate Services



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WCC3 – Expert Segment

Called for major strengthening of the essential elements of a global framework for climate services:

- **The Global Climate Observing System and all its components and associated activities; and provision of free and unrestricted exchange and access to climate data;**
- **The World Climate Research Programme, underpinned by adequate computing resources and increased interaction with other global climate relevant research initiatives.**
- **Climate services information systems taking advantage of enhanced existing national and international climate service arrangements in the delivery of products, including sector-oriented information to support adaptation activities;**
- **Climate user interface mechanisms focussed on building linkages and integrating information, at all levels, between the providers and users of climate services; and**
- **Efficient and enduring capacity building through education, training, and strengthened outreach and communication.**

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Conference Objective

"Ocean Information for society: sustaining the benefits, realizing the potential"

Strengthen and enhance the international framework under GCOS, GOOS, WCRP, IGBP and supporting regional and national frameworks for sustained world ocean observing and information systems supporting the needs of society about ocean weather, climate, ecosystems, carbon and chemistry

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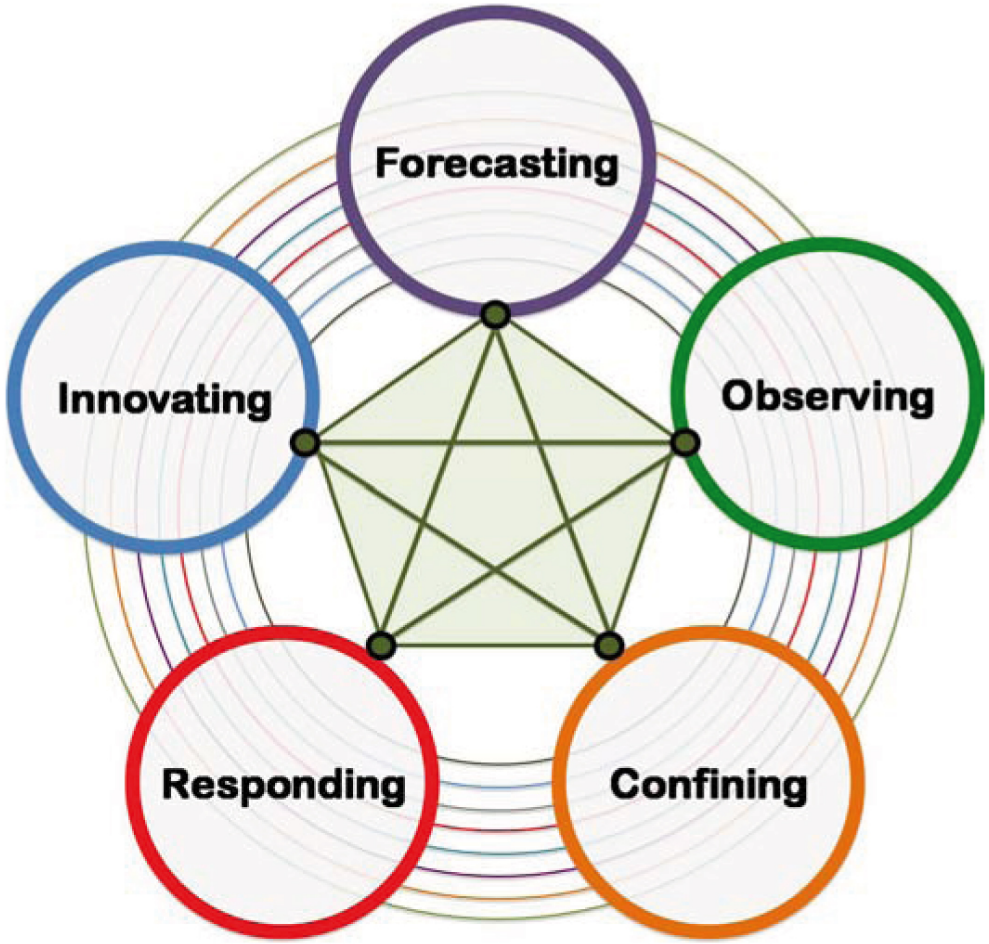
ICSU Grand Challenges



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.

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Future Directions

- **World Climate Conference-3, OceanObs '09, acknowledge WCRP past contributions and identify challenges and opportunities for the future.**

- **Need for more flexibility/agility to respond to expanding climate information needs:**

  - **At regional scale**
  - **For key sectors of global economy**
  - **For impacts, adaptation, vulnerability, and risk assessment.**

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Need Coordination of:

- Observations and analysis
- Model development, evaluation and experiments
- Processes and understanding
- Climate Information/applications & education

Observations & Analysis

- Form an Observations & Analysis Council
  - Communicate and coordinate with GCOS, WMO,… on observations requirements for climate research;
  - Advocate and advise on standards, ensure data availability, identify data needs,…
  - Catalyze interactions between observation and modelling communities
  - Enable production, documentation and inter-comparison of CDRs/EDRs

- Maintain existing structures (AOPC, OOPC, TOPC..) for disciplinary data stewardship, but *greater emphasis on re-analyses and use* of observations.

Processes & Understanding

- Three types of process studies identified
  - To test and evaluate models
  - To study underlying phenomena
  - Overarching, often with regional focus
- JSC-31 consensus
  - Core projects, with JSC oversight, to manage process studies, better coordination across Projects
  - Regional issues to be dealt with within Projects

Modelling

- Formation of a Modeling Council
  - Coordination among WCRP modeling groups
  - Promote/support seamless approach and Earth system framework (communication platform w/ WWRP, IGBP, other partners)
  - Reports to the Joint Scientific Committee

- Maintain WGCM, WGSIP, WGNE until further discussion by Modelling Council

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Summary

WCRP Research Priorities Include;

- Quantify and communicate uncertainties in climate change information/knowledge;
- Focus on regional and intera-seasonal to inter-annual, and decadal climate prediction/projection;
- Address climate information needs for adaptation planning, mitigation strategies, and assessing risks of climate variability and change;
- Promote and enable timely, reliable, and easy access to climate information and knowledge; and
- Support education, training and development of next generation of climate experts.

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WCRP Open Science Conference

24-28 October 2011

Denver, Colorado, USA

http://conference2011.wcrp-climate.org

Promoting, Facilitating and Coordinating

Climate Research in Service to Society

WCRP Open Science Conference

- Assembly of entire WCRP research community
- Will also engage other key international programs
- Exclusive opportunity for exchange and collaboration across diverse research communities (e.g., WCRP, WWRP, IGBP, IHDP, …) working to advance understanding and prediction of climate variability and change across scales
- 1,500 to 2,000 or more participants anticipated
- Strong effort to attract ECS and students

The Conference will:

- Appraise current state of climate science (→ IPCC AR5)
- Identify most urgent scientific issues and research challenges
- Ascertain how WCRP can best facilitate research and develop partnerships critical for progress
- Facilitate growth of future, diverse workforce

http://conference2011.wcrp-climate.org

WCRP Open Science Conference

Daily Conference Themes:

Emphasizing the integrative aspects of WCRP

Monday: Climate Research in Service to Society

Monday: The Climate System Components and their Interactions

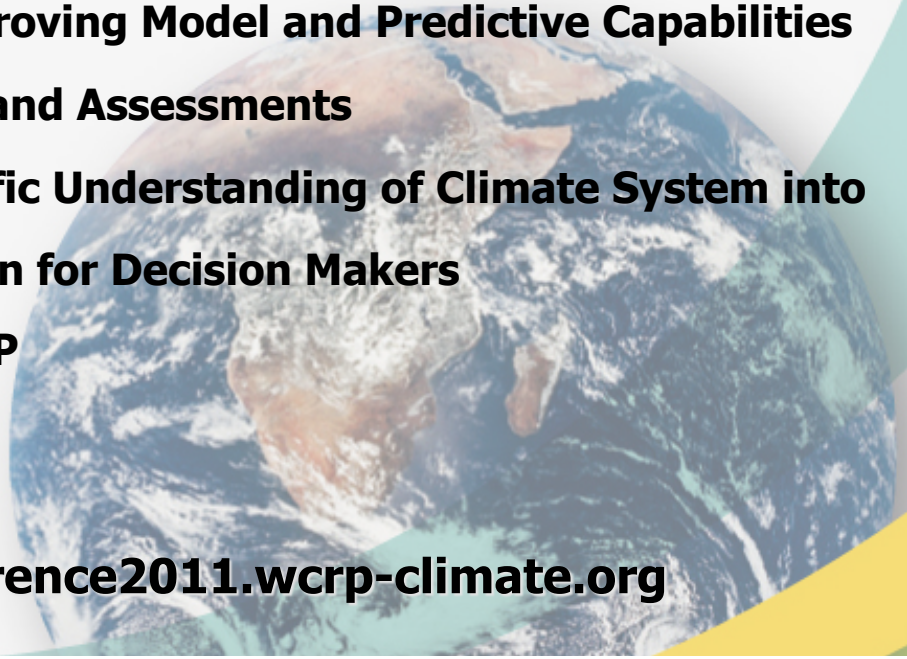
Tuesday: Observation and Analysis of the Climate System

Wednesday: Assessing and Improving Model and Predictive Capabilities

Thursday: Climate Synthesis and Assessments

Friday: Translating Scientific Understanding of Climate System into Climate Information for Decision Makers

Friday: The Future of WCRP



http://conference2011.wcrp-climate.org

WCRP Open Science Conference

- Registration is now open
  - ✓ Early-bird registration until 30 June
  - ✓ Regular registration until 24 October; on site after
  - ✓ Discounted rates for students and Early Career Scientists (ECS)
  - ✓ Nominal fee for spouse/guests (includes Receptions and Gala)
- Abstract submission now open
  - ✓ Deadline: 30 April (31 March for those requesting travel support) or needing US Visas)
  - ✓ Spread the word and encourage participation!
- Travel grants
  - ✓ Based on financial need and scientific merit of abstract
  - ✓ Priority will be given to:
    1) Students: those pursuing their graduate studies (MSc, PhD)
    2) ECS: post-graduates and researchers (degree in 2005 or later)
    3) Scientists from emerging and developing economies
  - ✓ Grantees must attend the entire conference
  - ✓ Includes waiver of abstract and registration fees

http://conference2011.wcrp-climate.org