



WORLD CLIMATE RESEARCH PROGRAMME

Current and Future Priorities for Climate Research

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WCRP

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Budapest, Hungary



World Climate Research Programme



WCRP's mission....

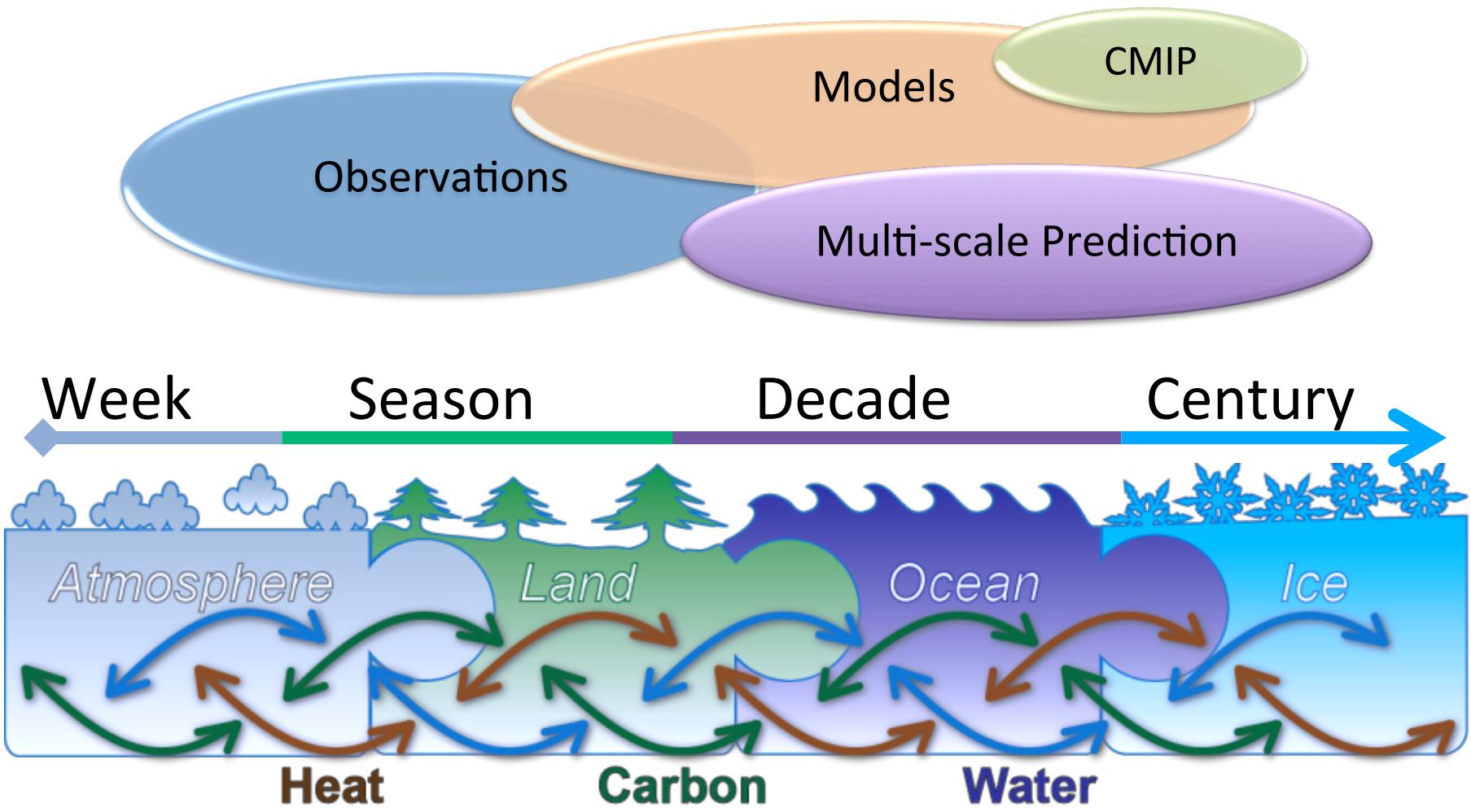
... is to facilitate analysis and prediction of Earth system variability and change for use in an increasing range of practical applications of direct relevance, benefit and value to society.

The two overarching objectives of WCRP are:

to determine the predictability of climate

to determine the effect of human activities on climate

Role of WCRP



Post COP-21 Science

COP-21: A major political achievement, based in large part on the knowledge provided by the scientific community.

For our scientific community:

After decades of active investigations (e.g., WCRP) and the efforts to communicate the findings (e.g., IPCC):

1. The science is now *widely accepted*:

All key nations accept the concept of human-induced climate change, even if some large uncertainties remain.

2. The focus of the research must *evolve* from “making the case” for “greenhouse warming” to **development and dissemination of information for regions** needed to minimize risks and to build resilience.

a strong fundamental research component
integrating interdisciplinary knowledge

A future of WCRP: thinking out of box...

Three primary questions in defining key topics
confronting the research community:

(WCRP “out of box” workshop, June 2016)

- Where will the carbon go?
- How will weather vary with climate?
- How will climate change impact the habitability of our planet and its regions?



WCRP Structure

Joint Scientific Committee

Modeling Advisory Council

Joint Planning Staff

Data Advisory Council

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

CliC

Cryosphere



CLIVAR

Ocean-
Atmosphere



GEWEX

Land-
Atmosphere



SPARC

Troposphere -
Stratosphere



CORDEX

Regional
Climate
Downscaling

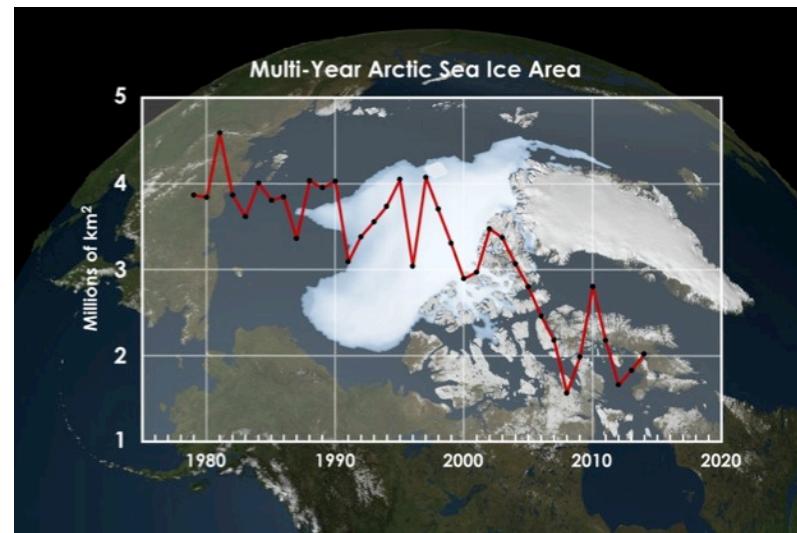




→ Understanding the changing cryosphere and its climate connections

Overarching research needs guiding CliC activities:

- Improved understanding and quantification of the **role of the cryosphere in the global climate system**, its variability and change
- Improved utilization of **cryospheric observations** as indicators of global and regional climate change
- Improved understanding of the physical, chemical and other **processes** that govern behavior of the cryosphere, and the **representation of these processes in Earth System Models**
- Improved ability to make **quantitative predictions and projections** of the cryosphere in a changing climate



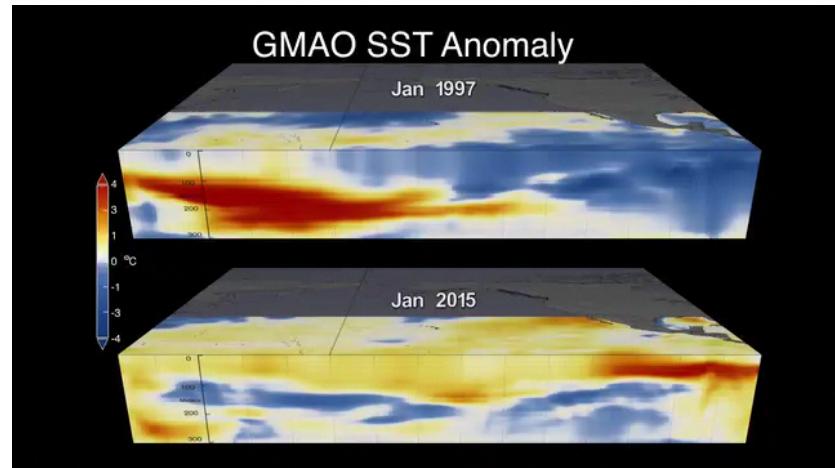
NASA visualization Lab



Understanding the dynamics, the interaction and the predictability of the coupled ocean-atmosphere system

Research Foci:

- **Decadal variability and predictability** of ocean and climate variability
- Marine **biophysical interactions** and dynamics of upwelling systems
- **Regional sea level change** and coastal impacts
- Consistency between planetary energy balance and **ocean heat storage**
- **ENSO** in a changing climate
- Intraseasonal, seasonal and interannual variability and **predictability of monsoon systems**

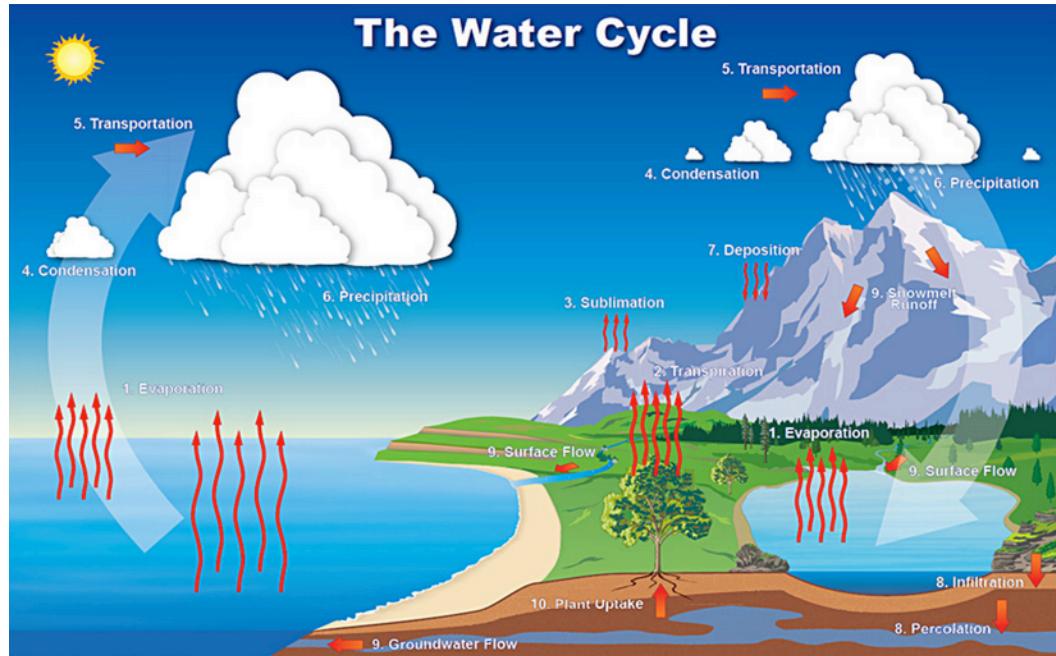


El Niño comparison 1997 vs. 2015, NASA Visualization Lab

→ Understanding Earth's water cycle and energy fluxes at the surface and in the atmosphere

GEWEX science questions:

- Observations and predictions of **precipitation**
- Global **water resources** systems (land use and hydrology)
- Changes in **extremes** (esp. droughts, flood, heat waves)
- **Water and energy** cycles and processes



GEWEX Panels: Global Land/Atmosphere System Study (GLASS), Global Atmospheric System Studies (GASS), Hydroclimatology Panel (GHP), GEWEX Data and Assessments Panel (GDAP)



SPARC
Stratosphere-troposphere
Processes And their Roles in Climate

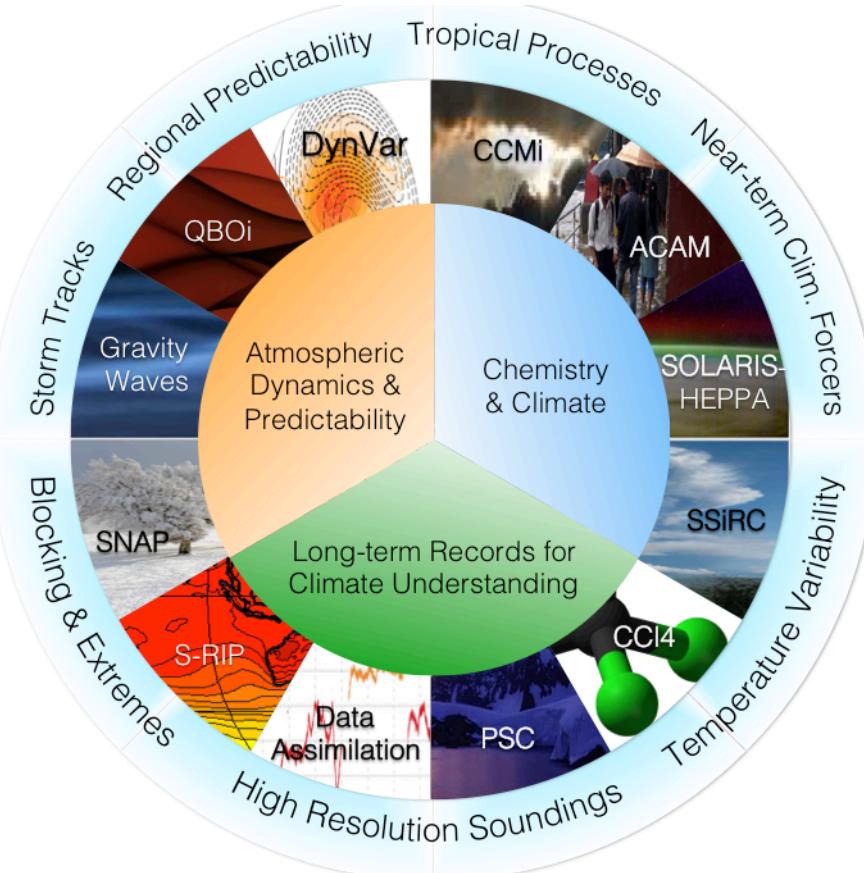
SPARC

Stratosphere-troposphere Processes And their Roles in Climate

→ Coordinating international efforts to bring knowledge of the atmosphere to bear on issues regarding climate variability and prediction

Themes:

- **Atmospheric Dynamics and Predictability**
climate variability, near-term climate predictions, stratosphere-troposphere interactions
- **Chemistry and Climate**
coupling of climate-dynamical-radiative processes, gas emissions
- **Long-term records for Climate Understanding**
construction, analysis, and interpretation of long-term climate records

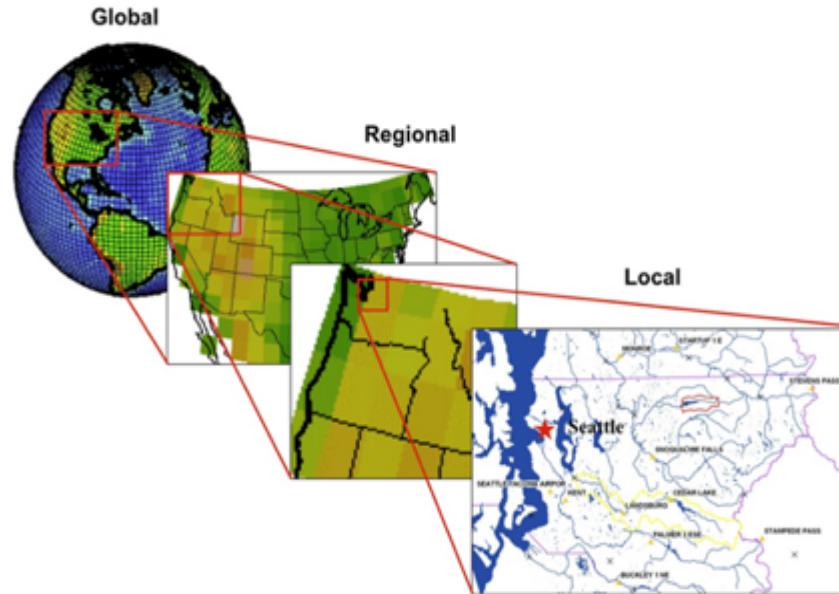


WCRP
World Climate Research Programme

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

CORDEX scientific challenges:

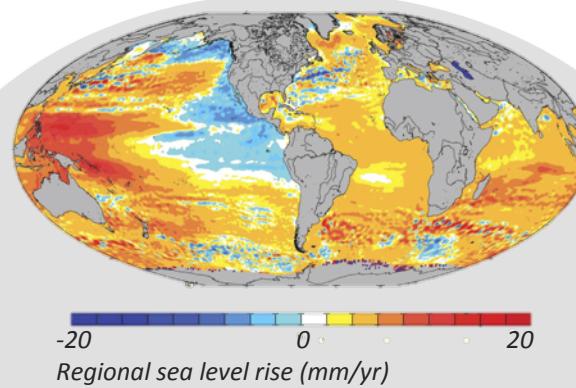
- **Added value** of downscaling, scales, bias and uncertainties, user-oriented metrics
- Understanding and simulating **human elements**, e.g. land use, urban development, climate and coastal cities
- Coordination of regional **coupled modeling**
- Precipitation, e.g. convective systems, monsoon
- Local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



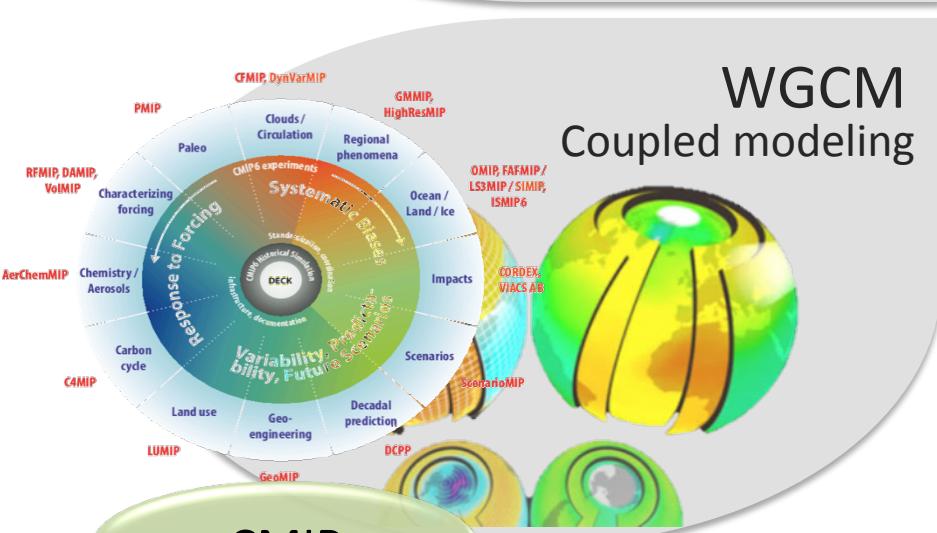
Working Groups



Numerical Experimentation
WGNE

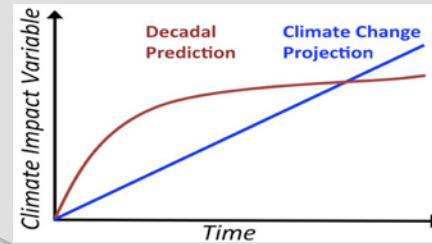


Regional Climate
WGRC



WGCM
Coupled modeling

WGSIP
Subseasonal to Interdecadal
Prediction

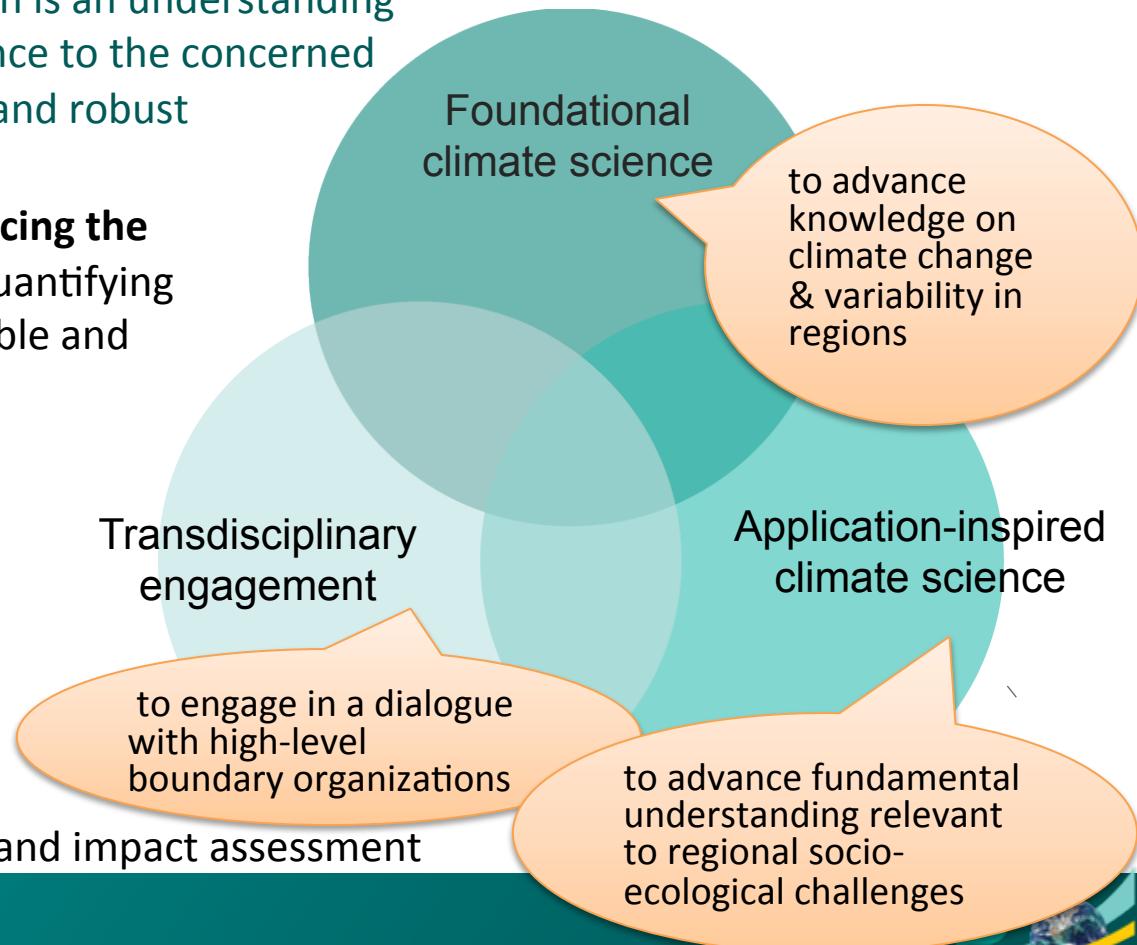


A scope for WCRP regional activities

- WCRP focuses on facilitating **creation of reliable climate information for regions**, from climate data of verified sources based on observations, assessments and predictive models.

Information ≠ data: information is an understanding that builds messages of relevance to the concerned users that are backed by clear and robust physical analyses

- WCRP's focus remains on **enhancing the scientific basis** for identifying, quantifying and delivering high quality, reliable and accessible climate information.
- WCRP recognizes the **substantial gaps in climate data** to be ready to produce climate information in need, particularly of different regions.
- WCRP **works with partners** contributing to climate services and impact assessment



WCRP in the global community



World Meteorological
Organisation



International Council for Science



WCRP Grand Science Challenges





Columbia Glacier, Alaska

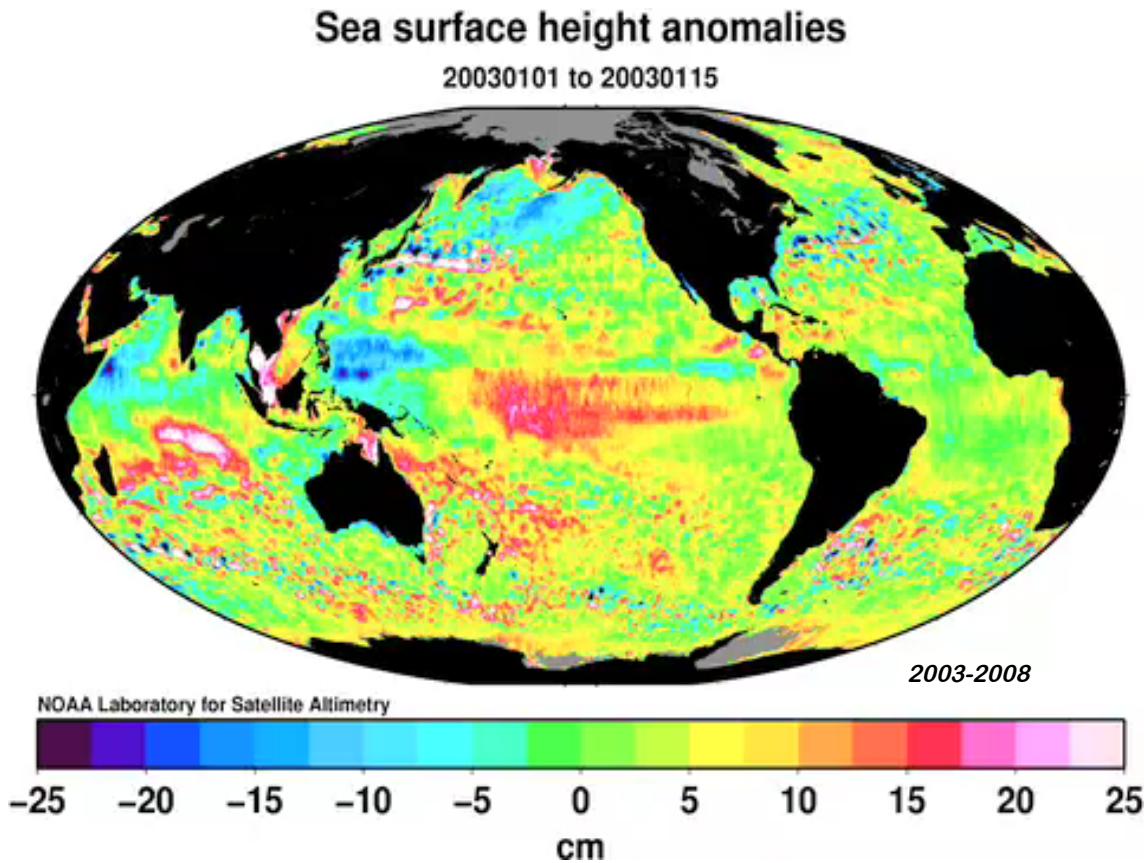
Snow and ice are seen as bright blue, while vegetation appears green and bedrock brown. Gray stripes on the glacier surface represent rocky debris. NASA visualization Lab

How will melting ice respond to, and feedback on, climate change and what will the impacts be on:

- *Permafrost and the global carbon cycle*
- *Ice sheets*
- *Glaciers*
- *Rising sea level*
- *Sea ice and snow interaction*



Regional Sea Level Change



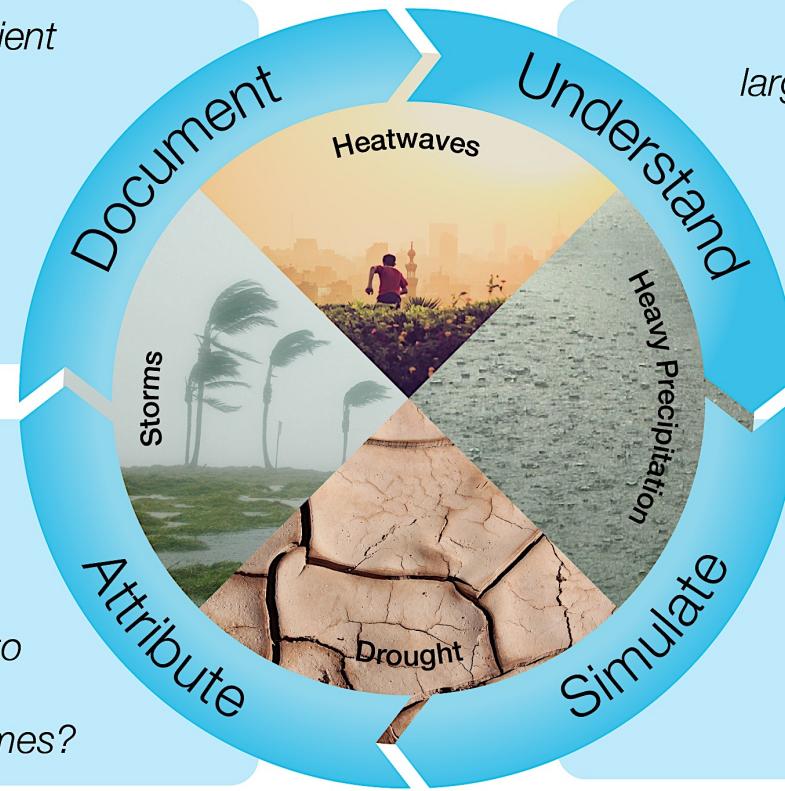
What are the main causes of contemporary regional sea level variability and change?

What is the degree of decadal variability in sea surface height observations and in forecasts?



Weather & Climate Extremes

Are existing observations sufficient to underpin the assessment of extremes?



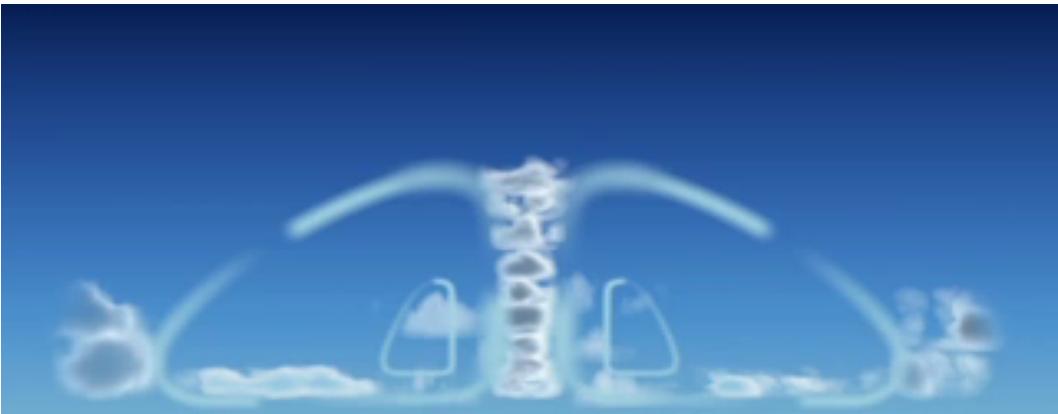
What are the relative roles of large-scale, regional and local scale processes, as well as their interactions, for the formation of extremes?

What are the contributors to observed extreme events and to changes in the frequency and intensity of the observed extremes?

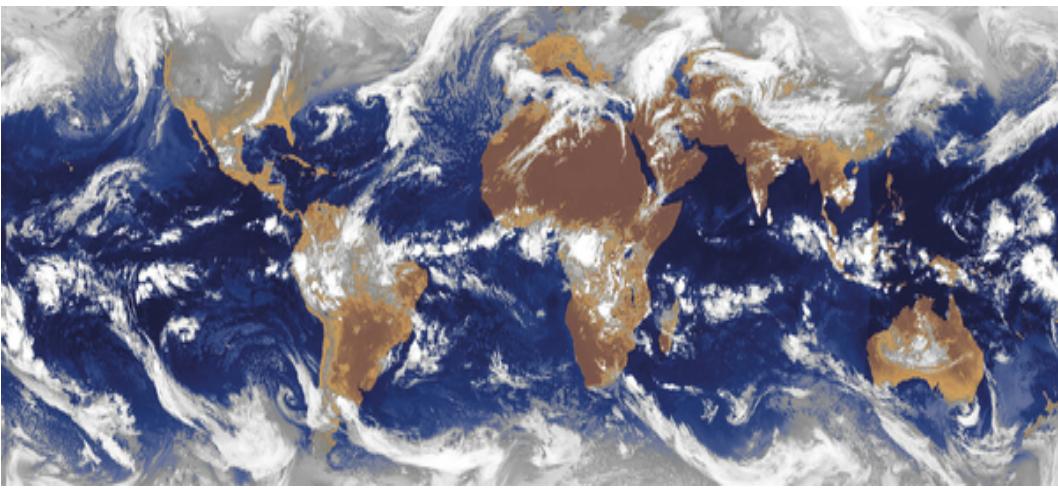
Are models able to reliably simulate extremes and their changes, and how can this be evaluated and improved?



Clouds, Circulation & Climate Sensitivity



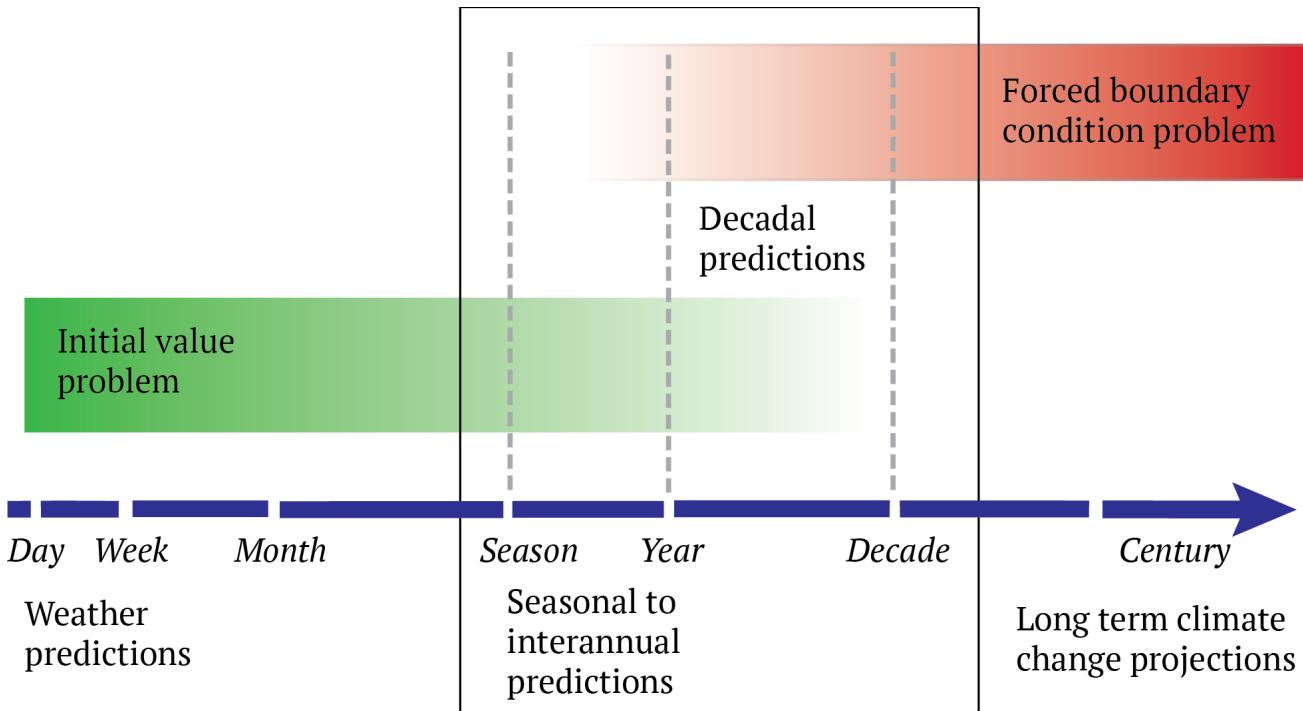
How will clouds and circulation respond to global warming or other forcings?



How do clouds couple to circulations in the present climate?



Near Term (decadal) Prediction

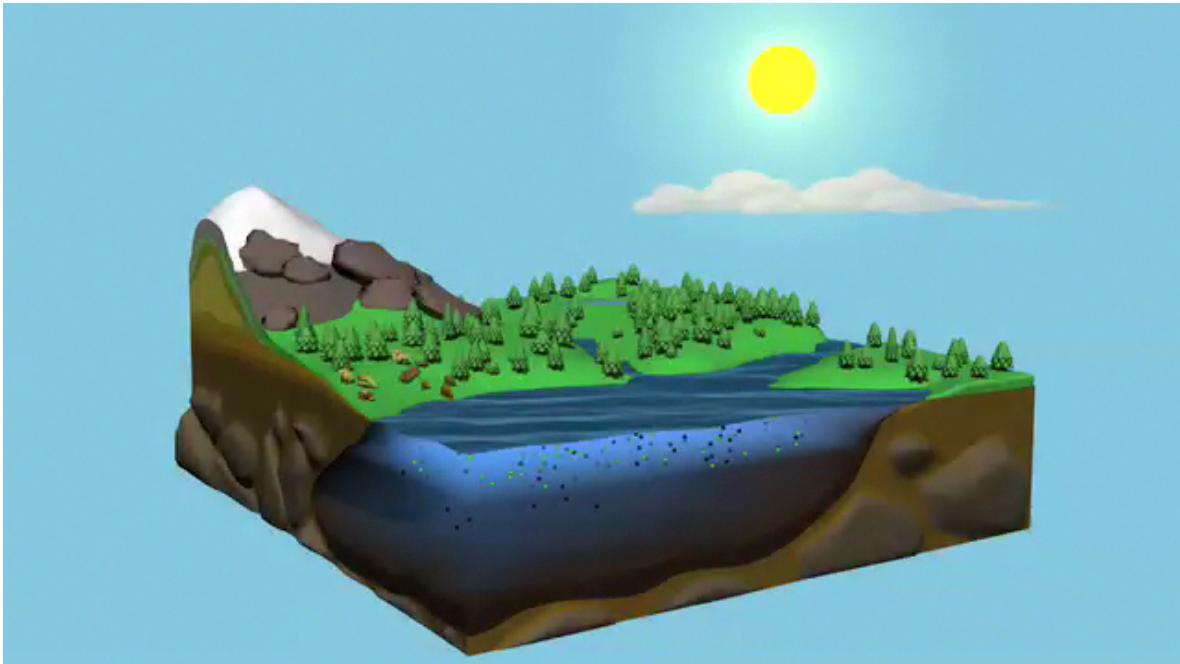


How can we enhance the understanding of sources of decadal predictability?

How can we serve decadal prediction information as is already done for seasonal prediction?



Climate & Carbon



A conceptual animation illustrating the various parts of the Carbon cycle. Purple arrows indicate the uptake of Carbon; yellow arrows the release of Carbon. NASA/Goddard Space Flight Center/UMBC.

What are the drivers of land and ocean carbon sinks?

What is the potential for amplification of climate change over the 21st century via climate-biogeochemical feedbacks?

How do greenhouse gases fluxes from highly vulnerable carbon reservoirs respond to changing climate?



Water for Food Baskets

“Reliable access to sufficient quantities of affordable, nutritious food to maintain healthy, active lives.” – 1996 World Food Summit

Four main dimensions of **food security**:

- **Availability** – Supply of food as determined by production, stock level and net trade
- **Access** - Affected by income, expenditure, markets and prices
- **Utilisation** – Nutritional status of what we produce
- **Stability** – Inadequate access to food on periodic basis



Water for Food Baskets

Key questions



How will a warming world affect the available fresh water resources globally, the human interactions with these water resources, as well as their value to society?

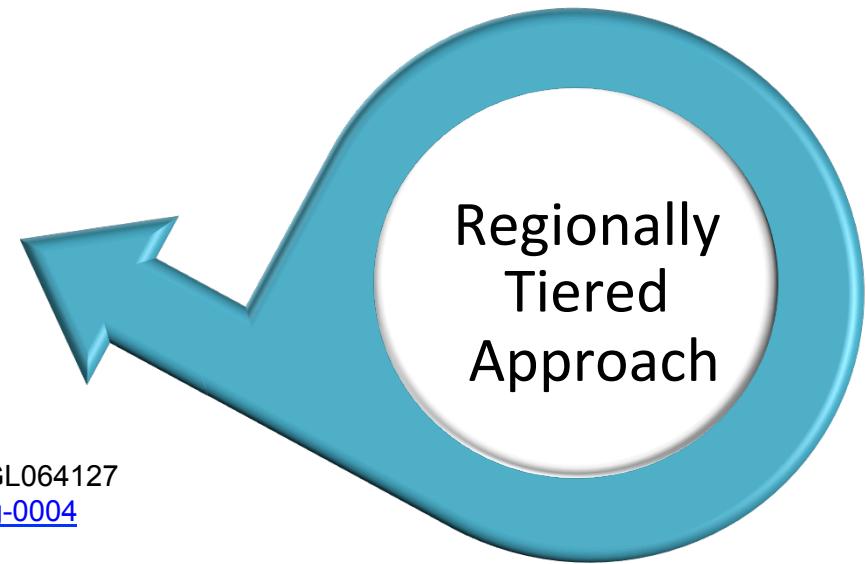
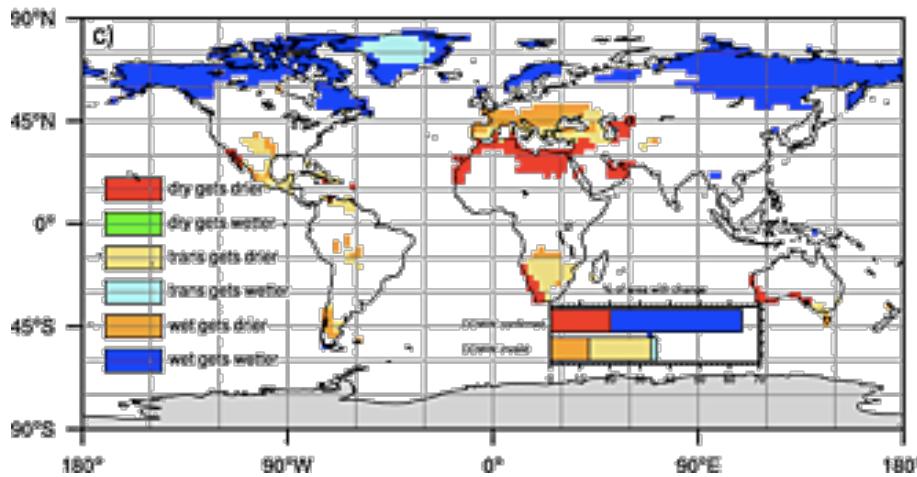
How does this translate specifically to the food basket regions of the world?

*Within the context of the World Climate Research Programme the focus will be on **the geophysical processes and the anthropogenic influences** on these processes



Water for Food Baskets

Methodology



Geophysical Research Letters

Volume 42, Issue 13, pages 5493-5499, 4 JUL 2015 DOI: 10.1002/2015GL064127

<http://onlinelibrary.wiley.com/doi/10.1002/2015GL064127/full#grl53101-fig-0004>

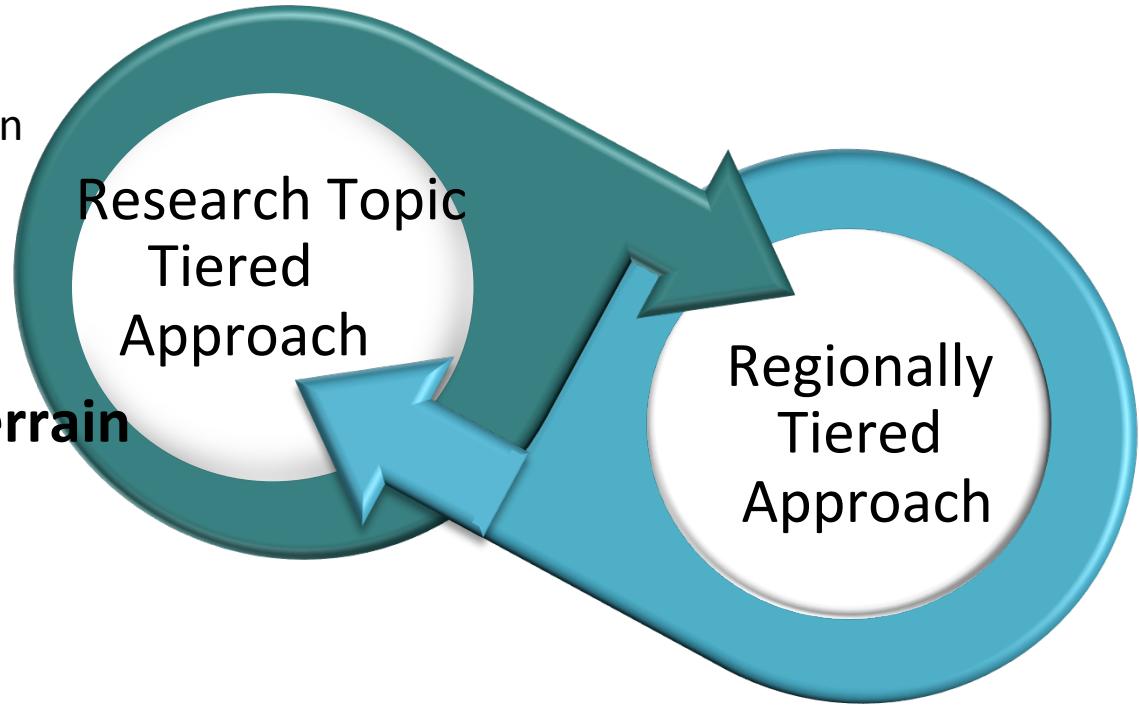
Focus on major food producing regions of the world
in the context of climatic change



Water for Food Baskets

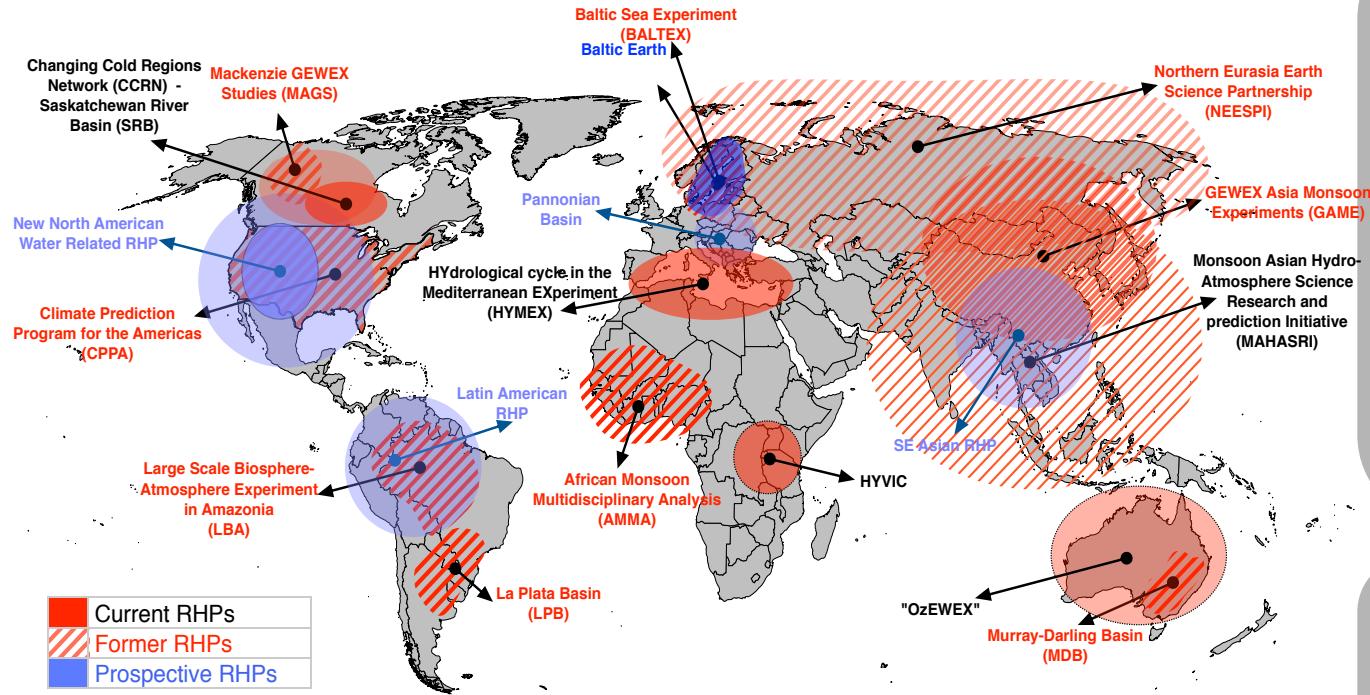
Methodology

- Human Dimension
(including water management in large scale models)
- High Resolution Convection Permitting Modeling / **Complex Terrain**
- Representation of land use effects on regional and global climate
- Build upon Existing Efforts within and beyond WCRP (UNESCO IHP, HYDROMET Services, iLEAPS, etc.)





Water for Food Baskets



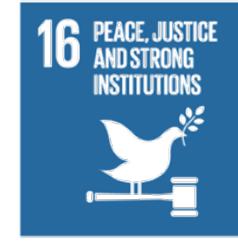
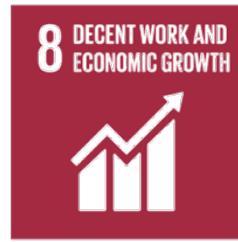
How will a warming world affect the available fresh water resources globally?
(Focus on the geophysical processes and the anthropogenic influences on these processes)

How does this translate specifically to the food basket regions of the world?



Water for Food Baskets

Links with SDGs



Thank You



World Climate Research Programme



<http://wcrp-climate.org>

