

# CLIVAR: CLIMATE & OCEAN variability, predictability and change

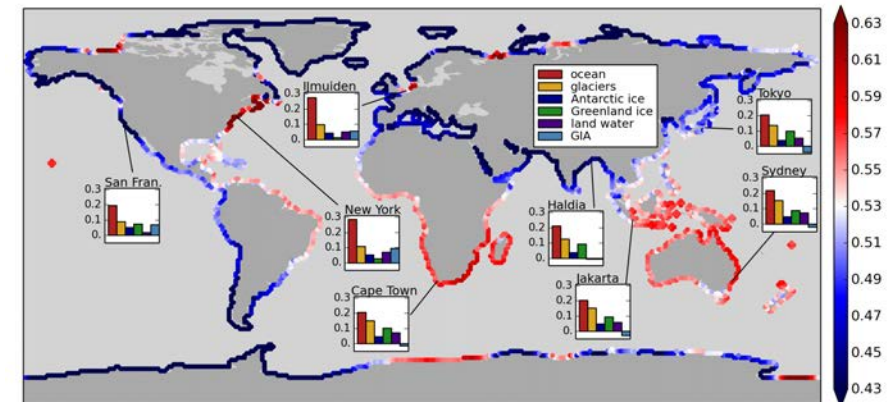
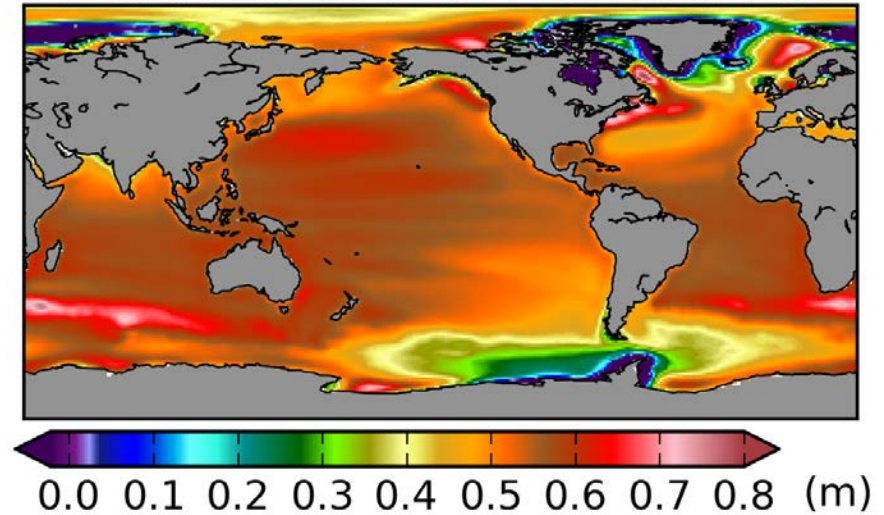
- **Background on CLIVAR Research Foci**
  - Objectives
  - Activities
  - Governance
- **Climate Dynamics and Monsoons Panels**
  - Initial thoughts on objectives and activities

# CLIVAR Research Focus/ WCRP Grand Challenge Regional Sea Level Change and Coastal Impacts

## ***Objectives for Execution Phase (January 2015-December 2024)***

1. Periodically review the state of knowledge and corresponding research on regional sea-level rise, identify gaps and research needs across WCRP, other Programs and relevant parties;
2. Foster the improvement of the observing system and development of modeling techniques necessary to properly observe and simulate sea level variations and changes.
3. Advise on the development of in-situ and satellite observing systems required to improve our understanding and projections of sea-level rise.
4. Promoting interdisciplinarity, across science fields (cryo, hydro, geo, etc.) but also methodologies (data, models, state estimation), and advocating for appropriate funding resources and support at national and international levels.
5. Foster the development for the scientific understanding necessary to assess and predict regional sea-level evolution;
6. Facilitate development of a basis for quantification of future regional extreme sea levels due to superposition of mean sea-level rise, high tides and storm surges;
7. Facilitate the use of improved observations, understanding and projections of sea level rise by various groups assessing the impacts of sea-level rise and the associated risks.

a.) CMIP5 RCP4.5 + GIA + Terrestrial + Ice



(Carson et al., 2014)

# Regional Sea Level Change and Coastal Impacts

## Work Program – 5 parallel but interacting work packages:

- An integrated approach to historic sea level estimates (paleo time scale)
- Process understanding of fast ice sheet dynamics (contemporary)
- Causes for contemporary regional sea level variability and change
- Predictability of regional sea level
- Sea level science for coastal zone management

## Deliverables:

- Improved data sets and models for sea level analyses and predictions/projections.
- Improved understanding of global, regional and local sea level budgets.
- Improved knowledge of physical processes and the nature of their causes at global, regional and local scales, and over different timescales.
- Improved integrated monitoring system for sea level variability and change.
- Baseline information about extremes.

## Planned activity:

Sea Level science conference in 2016/17, 500-600 participants

| Expertise  | Name               | Country                     | Partner Organization |
|--|--------------------|-----------------------------|----------------------|
| Geodesy/<br>Geophysics   | Natalya Gomez      | Harvard, USA                |                      |
|  | Mark Tamisiea      | NOC, UK                     |                      |
| Glaciology/<br>Ice sheets  | Roderik van de Wal | U. Utrecht, The Netherlands | co-chair             |
|  | Tony Payne         | U. Bristol, UK              | CLiC                 |
|  | Ayako Abe-Ouchi    | Japan                       | PAGES                |
|  | David Holland      | Courant, USA                | CLiC                 |
| Regional<br>processes,<br>Reconstructions<br>Climate modes<br>Climate<br>modeling            | Rui Ponte          | AER, USA                    |                      |
|  | Detlef Stammer     | CEN, Germany                | co-chair             |
|  | Catia Domingues    | U. Tasmania, Australia      | CLIVAR               |
|  | Benoit Meyssignac  | LEGOS, France               |                      |
|  | Jianjun Yin        | U. Arizona, USA             |                      |
|  | Jonathan Gregory   | U. Reading, UK              |                      |
| Subsidence,<br>Extremes, storm<br>surges, waves<br>and coastal<br>impacts and<br>adaptation. | A.S. Unnikrishnan  | NIO, India                  |                      |
|  | Gonéri Le Cozannet | BRGM, France                |                      |
|  | Kathy McInnes      | CSIRO, AU                   |                      |
|  | Kevin Horsburgh    | NOC                         | IOC/WMO JCOMM        |
|  | R. Nicholls        | U. Southampton, UK          | co-chair             |
|  | Pietro Teatini     | U. Padova, Italy            |                      |



1<sup>st</sup> Sea Level Steering Team Meeting, March 18-19, 2015, Utrecht, NL

# CLIVAR Research Focus

## ENSO in a changing climate

### ***Implementation Strategy and timeline***

**Deliverable:** peer-reviewed paper on ENSO in a changing climate providing latest estimates of likely ENSO changes over the next few decades.

### ***Governance***

- Term: 3 years + 2 years possible extension
- Meet: Videoconference 3 times a year + community workshops

#### **Planned activity:**

“4th CLIVAR ENSO workshop on the evaluation of ENSO in climate models: ENSO in a changing climate” in Paris, France, July 8–10 2015, alongside with “Our Common Future” conference.

### ***Proposed membership***

| Name              | Expertise                       | Affiliation, Country            | Liaison for the group |
|-------------------|---------------------------------|---------------------------------|-----------------------|
| Eric Guilyardi    | ENSO metrics                    | IPSL, France & NCAS-Climate, UK | Co-chair              |
| Andrew Wittenberg | ENSO metrics, data assimilation | GFDL, USA                       | Co-chair              |
| Wenju Cai         | ENSO and climate change         | CSIRO, Australia                | CLIVAR PP             |
| Mat Collins       | ENSO and climate change         | Uni. of Exeter, UK              | CLIVAR PP             |
| Ben Kirtman       |                                 | RSMAS, USA                      | WGSIP                 |
| Mike McPhaden     | ENSO observations               | PMEL, USA                       | CLIVAR IOP            |
| Tony Lee          | ENSO impacts                    | JPL, USA                        | CLIVAR GSOP and IOP   |
| Soon-Il An        | ENSO-mean state, non-linearity  | Yonsei Uni. Korea               |                       |
| Masahiro Watanabe | ENSO in CGCMs                   | Uni. of Tokyo, Japan            |                       |
| Pascale Braconnot | Paleo ENSO, modelling           | IPSL, France                    |                       |
| Lisa Goddard      | ENSO impacts                    | IRI, USA                        |                       |
| Jaci Brown        | ENSO regional impacts           | CSIRO, Australia                |                       |
| Lei Han           | Ex officio                      | CLIVAR ICPO, China              |                       |

# CLIVAR Research Focus

## Consistency between planetary energy balance and ocean heat storage (CONCEPT-HEAT)

The **overall goal** is to bring together seven climate research communities all concerned with the energy flows in the Earth's climate System to advance on the understanding of existing uncertainties through physical budget constraints:

- Atmospheric radiation
- Surface fluxes
- Ocean heat content
- Ocean reanalyses
- Atmospheric reanalyses
- Climate models
- Global sea level

### Proposed membership

| Name                          | Affiliation/Country            |
|-------------------------------|--------------------------------|
| Karina von Schuckmann (chair) | University of Toulon, France   |
| Richard Allan                 | University of Reading, UK      |
| Bernard Barnier               | University of Grenoble, France |
| Pierre Brasseur               | University of Grenoble, France |
| Carol Anne Clayson            | WHOI, USA                      |
| Catia Domingues               | ACE CRC, Australia             |
| Sergey Gulev                  | IORAS, Russia                  |
| Keith Haines                  | University of Reading, UK      |
| Simon Josey                   | NOC, UK                        |
| Norman Loeb                   | NASA, USA                      |
| Pierre-Philippe Mathieu       | ESA, Italy                     |
| Benoit Meyssignac             | LEGOS, France                  |
| Matthew Palmer                | UK MetOffice, UK               |
| Anne-Marie Treguier           | IFREMER, France                |
| Kevin Trenberth               | NCAR, USA                      |
| Maria Valdivieso              | University of Reading, UK      |
| Martin Visbeck                | GEOMAR, Germany                |
| Martin Wild                   | ETH, Switzerland               |



# Consistency between planetary energy balance and ocean heat storage (CONCEPT-HEAT)

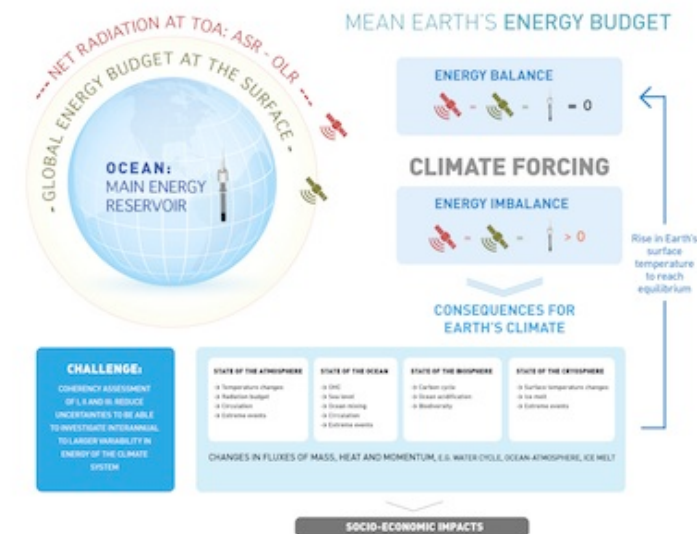
## Main objectives:

- 1) Quantify Earth's energy imbalance, the ocean heat budget, and atmosphere-ocean turbulent and radiative heat fluxes, their observational uncertainty, and their variability for a range of time and space scales using different observing strategies (e.g., in-situ ocean, satellite), reanalysis systems, and climate models.
- 2) Analyze the consistency between the satellite-based planetary heat balance and ocean heat storage estimates, using data sets and information products from global observing systems (remote sensing and in situ) and ocean reanalysis, and compare these results to outputs from climate models to obtain validation requirements (for model and observations).

## Planned activities:

29 Sep – 02 Oct 2015: Workshop on  
“Energy flows in the Earth’s climate system”  
MetOffice (Exeter, UK)

co-sponsored by CLIVAR, EU-COST, ESA



# CLIVAR Research Focus

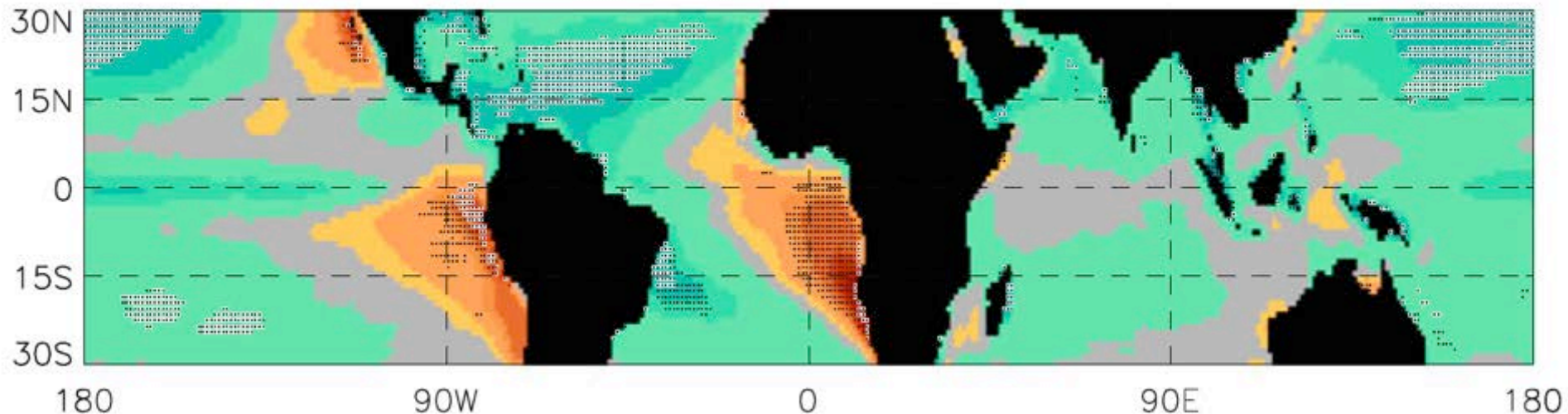
## Marine biophysical interactions and dynamics of upwelling systems

### Major research themes \*

- Identifying the key physical and biogeochemical processes and impacts on ecosystem dynamics in upwelling regions and improving their representation in models
- Addressing upwelling related biases in climate models
- Exploring how upwelling systems will respond to change in climate

\* These themes will be refined at the planning workshop in Oct 2015

(a) AR5 (25 models): SST – HadISST [°C]  
Annual mean 1960–2004



# Marine biophysical interactions and dynamics of upwelling systems

## Activity leader:

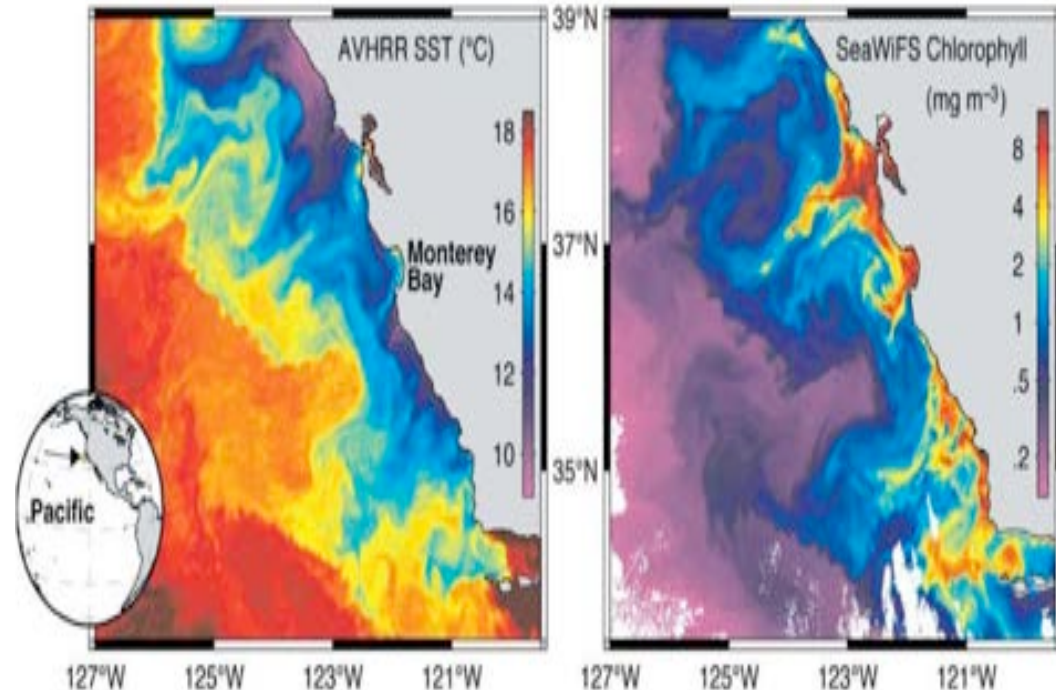
Enrique Curchitser (Rutgers University, USA)

## Recent activities:

- Pan-CLIVAR meeting, The Hague, The Netherlands
- Upwelling systems under future climate change workshop (*Third International Symposium "Effects of Climate Change of the World's Oceans, Santos, Brazil – 21-22 March 2015"*)

## Planned activities:

- Planning workshop (Ankara, Turkey - 2-3 October 2015)



Satellite remote sensing imagery of the central California Current upwelling system. (a) Sea surface temperature (SST) from the Advanced Very High Resolution Radiometer (AVHRR) on August 14, 2000, and (b) surface chlorophyll from the Sea-viewing Wide Field-of-view Sensor (SeaWiFS) on August 16, 2000. Source: Ryan et al. (2005). *Marine Ecology Progress Series*, 287:23-32.



# CLIVAR Research Focus

## Decadal Climate Variability and Predictability

**Objectives:** Characterize, understand, attribute (e.g., intrinsic vs. external), and predict global and regional multi-year to multi-decade observed climate anomalies

### DCVP Working Group:

Coordination to better understand near term climate on both global and regional scales considering internal variability and naturally forced variability. Involves modeling, observations and reconstructions of climate back in time (including high resolution proxies)

**Leading design of DCP MIP Component C experiments:** Coordinated multi-model investigations of a restricted number of mechanism/predictability/case studies believed to be of broad interest to the community.

- **Hiatus+:** An investigation of the origin, mechanisms, and predictability of long timescale variations in global mean temperature (and other variables) including periods of both enhanced warming and cooling
- **Case study** of mid-1990s Atlantic subpolar gyre warming
- **Volcanoes and prediction:** An investigation of the influence and consequences of volcanic eruptions on decadal prediction and predictability

# CLIVAR Research Focus

## Decadal Climate Variability and Predictability

On-going activities:

Design of Decadal Climate Prediction Project (DCPP) Component C

*-> Predictability, Mechanisms, and Case Studies*

- **Hiatus+**: An investigation of the origin, mechanisms, and predictability of long timescale variations in global mean temperature (and other variables) including periods of both enhanced warming and cooling
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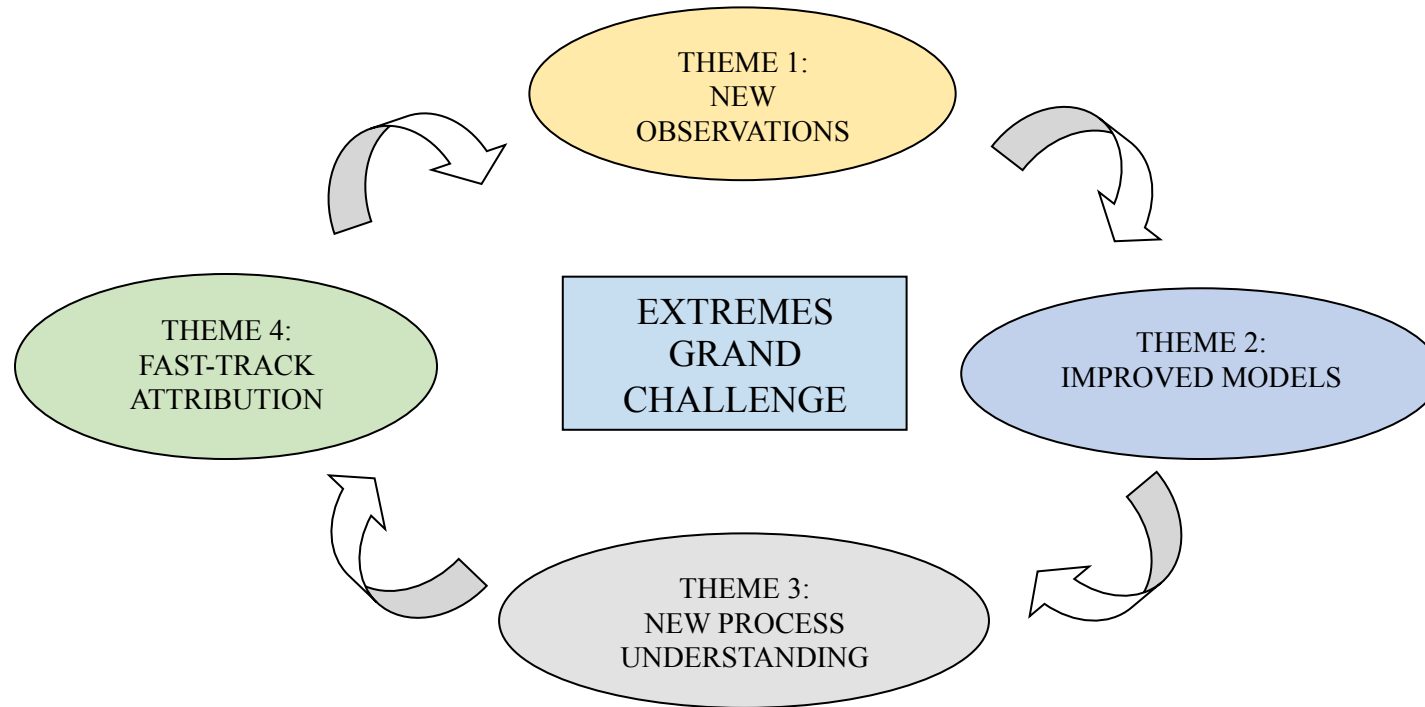
Upcoming meetings:

Aspen Global Change Institute workshop on Decadal Climate Predictions – June 2015, USA

Workshop on Past and Climate Shifts – 16-20 November 2014, Trieste, Italy

# CLIVAR Research Focus/ WCRP Grand Challenge

## Understanding and Predicting Weather and Climate Extremes



The CLIVAR Research Focus contributes predominantly to #1, #2, and #4.

# EXTREMES RF/GC implementation activities include:

Develop and test approaches for proper comparison of extremes in observations (mostly obtained from point observations) with model simulations (area average). Develop a “best practice” guidance document on gridding data to best represent extremes

Review ETCCDI indices, revise ETCCDI software to ensure consistency in indices computation using observational and model data and to incorporate new indices (e.g. marine climate indices such as wind, wave, and sea level extremes).

Joint with GEWEX and other organizations to organize M-CLIX workshop (Oslo late 2015) on process (or storyline) based evaluation of climate models with emphasis on extremes

Interaction with IDAG and event attribution activities on fast-track attribution.

CLIVAR Climate Dynamics Panel: addressing prediction/predictability of the frequency/intensity of extremes at seasonal and longer scales and large-scale phenomena (e.g. monsoons) and modes of variability connections to extremes. It is also anticipated that CLIVAR-GEWEX Monsoons Panel would also contribute to these questions.



# Climate Dynamics Panel

- This panel will focus attention on aspects of climate dynamics related to large-scale phenomena, processes, and mechanisms of climate variability and change on seasonal to centennial time-scales.
- The dynamical role of the atmosphere and its forcing by, and coupling with, the ocean will be central. Climate 'modes' and teleconnection patterns will be a focus.
- Initial activity will be in three areas,
  - (i) storm tracks, jet streams and weather systems,
  - (ii) processes for mid-latitude air-sea interaction and
  - (iii) modes of climate variability and their relevance for regional climate change.

## Anticipated impacts of the panel

The panel activity will **advance our understanding of climate variability and change**, and facilitate international collaboration. It is intended that the panel will build a new bridge across the broad collection of basic and applied climate dynamics research.

# Monsoons Panel - Goals

- More **thorough understanding of sub-seasonal monsoon variability** and its effect on the various monsoons
- **Exploit new understanding in the role the land surface plays on the atmosphere**, at time scales of days to months, as has been demonstrated in Africa and the central US
- A **renewed effort in improved relationships between the monsoon research community and various end-users**, including meteorological services

# Monsoons Panel - Specific Goals

- Status report on the ability of GCMs to simulate monsoon subseasonal variability
- Actively support utilisation of the subseasonal-to-seasonal (S2S) initiative including use of the ICMPO Monsoons Web-portal (to be developed)
- Better understand the effect of large-scale modes and mid-latitude interactions on subseasonal monsoon variability
- Identify key new observations and their locations to better understand monsoon land-atmosphere interactions and better constrain land models for the monsoon tropics
- Propose bulk metrics for better understanding how monsoon land-atmosphere interactions behave in GCMs in contrast to observations
- Promote community relationships across the monsoon regions and with end-user group, engaging to determine user needs
- Support for the CMIP6 Global Monsoon Model Inter-comparison Project (GMMIP)