

## CLIVAR GRAND CHALLENGES:

### Decadal variability in the climate system and its predictability

TT members: Yochanan Kushnir, Sang-Wook Yeh, Andrew Turner, Gokhan Danabasoglu, Scott Power, Anne Marue Treguier, Tianjun Zhou, Ben Kirtman

#### 1. DESCRIPTION (Elaboration of the primary concerns)

##### *Processes:*

- What are the key sources of and processes responsible for internally generated and externally forced decadal climate variability?
- Can we distinguish between internal and externally forced decadal variability and what are the methods needed to achieve such distinction?
- How is decadal variability communicated from region to region and from ocean/land surface to atmosphere?
- How is decadal variability linked with the statistics of climate and weather extremes?
- How does decadal variability modulate the monsoons and other key components of the annual cycle? How are their predictive relationships such as teleconnections with ENSO modulated?

##### *Characterising, monitoring, observing:*

- How does the magnitude and relative importance of decadal variability vary from region to region?
- How can we use proxy data to improve the representation of decadal variability in the pre-instrumental era?
- Where should decadal variability be monitored? What variables should be monitored? At what rate? Is closer monitoring of a key component of the variability required?
- How to implement and sustain an effective decadal variability (and its forcing agents) observing system

##### *Modelling:*

- Do models correctly represent observed decadal variability **from region to region** and if not, why? Why do different models display different decadal characteristic and related processes?

- What improvements are needed to models and the representation of forcing to improve the simulation of forced and internal decadal variability?
- How should we improve the decadal climate prediction model system? What are the relative importance of ocean/land memories and external forcings?

*Predictability and prediction:*

- Is decadal variability predictable and to what extent? Can its evolution be predicted in key regions and can its impacts be predicted?
- What practical methods and procedures should be used to produce credible and useful decadal predictions? In particular, how can the products of a decadal prediction system be used to benefit society?
- Who are the potential users and clients of the decadal prediction and information and how should the scientific best engage them in developing the necessary and effective information formats and tools?

(cite key references)

**2. THE MAJOR THEMES** (Discuss areas primed for progress in the next 5-10 years that will benefit significantly from CLIVAR coordination):

- Continued improved physical understanding of decadal variability and its predictability, including internal and forced (external natural and anthropogenic forcing agents including solar, volcanoes, GHG, aerosols,) variations
- Improve models to better represent key processes associated with decadal variability.
- Develop critical evaluations of proposed geoengineering methods.
- Achieve comprehensive analysis of current prediction potential based on CMIP5 hindcasts and improve the decadal prediction model system
- Develop best practices for decadal prediction (based on dynamical and statistical methods) – including their verification - and apply decadal prediction to address specific societal needs
- Maintain and enhance observing systems and establish key monitoring networks and methods

- Advance the use of past instrumental and proxy data for scientific understanding as well as addressing specific societal needs.
- Enhance ties to users of decadal climate information and begin development of information products geared to specific societal use.

### **3. THE WAY FORWARD** (How to implement a strategy to address the issues):

- Maintain international collaboration in all areas in design of experiments (modelling and field studies), monitoring and observing systems (evaluate effectiveness, identify gaps and improve design), model and forcing development, and sharing information on scientific progress and lesson learned (conferences, panels).
- For forecast activities develop effective relationships between users and clients of decadal information and scientists/prediction centres on all levels from national to international
- Maintain links between different CLIVAR panels/working groups and GEWEX panels for effective use of decadal information and impacts.
- Identify areas that need focused research efforts and support such efforts by encouraging countries to fund them (including sponsoring dedicated workshops and symposia in these areas).

### **4. COMMUNICATION CHALLENGES**

There is a risk that the ability of the scientific community to predict decadal changes in the climate system is overestimated by the wider community and that predictions will be used when the estimated skill does not justify their use in a particular application. A communication challenge is therefore to try and ensure that the predictions and their skill are communicated effectively to help increase the likelihood of prudent use and continued scientific progress.

Also needed are better bridges to potential user communities to develop effective methods of information dissemination. In other word there we should not leave the effort on decadal prediction to climate science alone but involve social science as well as effective links to the clients of such information.

## 5. SELECTED REFERENCES

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