

## 2<sup>nd</sup> steering team meeting CONCEPT-HEAT, 18. September 2016, Qingdao, China

<http://www.clivar.org/events/2nd-session-concept-heat-research-focus>

### Agenda:

#### Saturday, 17. Sept. 2016:

meeting co-chairs CONCEPT-HEAT

19h30 informal dinner for CONCEPT-HEAT steering team members (TbC)

#### Sunday, 18. Sept. 2016:

#### 08h30-12h30: CONCEPT-HEAT steering team meeting

08h30-08h40: **Welcome** and overview on progress and discussions since the CONCEPT-HEAT implementation (Karina)

*Discussions: Speakers lead discussion points, at least 10 minutes open discussion*

08h40-09h10: **Discussion topic 1:** Current status advancements on recent research activities for the evaluation of the Earth's Energy Imbalance (Kevin)

09h10-09h40: **Discussion topic 2:** Sensitivity of Global Upper-Ocean Heat Content Estimates: Overview on recent experiment results and future plans to quantify & reduce uncertainties & IQuOD current activities (Catia)

09h40-10h10: **Discussion topic 3:** Overview on assessing mapping methods (statistical, reanalysis) for improved OHC uncertainty estimates and cross-cutting activities for C-H/GSOP (preparation discussion for joint C-H/GSOP meeting) (Matt)

#### 10h10-10h30: Coffee break

10h30-11h00: **Discussion topic 4:** Advancements for the surface budget, and future opportunities/challenges (Sergey)

11h00-11h30: **Discussion topic 5:** A new opportunity for CONCEPT-HEAT: A regular synthesis and quantification of the Earth's Energy Imbalance, related methodologies and current research outcomes within ESSD (Karina)

11h30-12h00: **Discussion topic 6:** Cross-cutting activities

- Preparation for joint GSOP / C-H meeting
- Preparation for joint DCVP / C-H meeting: important to assess the fate of VOS data for the use in multi-scale variability of surface fluxes, especially on long-term (multidecadal). Next week there will be MARCDAT meeting in Southampton

- Other potential interfaces: GSOP-IQuOD; WCRP Grand Challenge - Sea Level (Energy & SL budget)
- (Sergey): Atlantic panel as well as with GSOP is essential on CAGE issues. Also a dialogue with the OMDP would be useful on understanding the potential of ocean reanalyses in capturing OHC and its changes. Finally, discussions with model communities needed on the scaling issues in surface flux data sets, specifically those used for forcing functions.

12h00-12h30: [Discussion topic 7](#): Future actions, contributions to meetings, review on steering team members, ...

### **12h30-13h30 Lunch break**

### **13h30-15h30: Joint CONCEPT-HEAT / GSOP meeting**

Cross-link (GSOP/CONCEPT-HEAT) discussions:

Diagnostics/topics for ORA-IP that are relevant for CONCEPT-HEAT (start discussion in advance, collection of ideas):

- Comparison of cross-equatorial heat and moisture transports (both oceanic and atmospheric), and including the annual cycle and cross-cutting CLIVAR/GEWEX research activity (already discussed with Graeme Stephens + others (Tony))
- Discuss recommendations from C-H for future (& RT) metrics / diagnostics for ORA-IP: global OHC, regional OHC, ocean heat divergence, ocean heat transports

### **Agenda:**

13:30-13:40: Updates of ORA-IP and realtime ORA-IP (Magdalena Balmaseda and Yan Xue)

13:40-14:00: CONCEPT-HEAT Task Team activities update and summary of CONCEPT-HEAT/GSOP Steering committee discussion (Karina and Kevin)

14:00-14:15: Consistency of surface flux estimations from atmospheric and ocean reanalysis and satellite-based analysis (Lisan Yu)

14:15-14:30: Next stage on ocean reanalysis comparisons: first thoughts on approaching the goal of narrowing the sources of discrepancy to build confidence in 4DDA using models (Tony, Kevin, Magdalena, Karina)

14:30-15:30: Discussion:

The way forward for ORA-IP that's synergistic with CONCEPT-HEAT activities and GEWEX, and other items of potential collaborations between GSOP and CONCEPT-HEAT (e.g., cross-

equatorial heat transports and inter-basin heat transport, relevant to GEWEX; control experiments intercomparison – using same forcings, or datasets, etc.)

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**15h30-16h00 coffee break**

## 16h00-17h30: Joint CONCEPT-HEAT / DCVP meeting

The objectives of Decadal Climate Variability and Predictability (DCVP) are to advance the mechanistic understanding of (specifically) Pacific and Atlantic ocean-atmosphere interactions that lead to decadal and longer climate variability; determine and quantify their predictability and contribute to improving the tools and methods that enable actual prediction of the respective phenomena. CONCEPT-HEAT has the main objective to build up a multi-disciplinary synergy community for climate research aiming to work on two different issues:

- 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.
- 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).

The collaboration between the two working groups provides an effective way for CLIVAR to achieve its long-term goal of understanding ocean-atmosphere interaction and its impact on climate. Two key points follow:

1. There is an **energy imbalance** at the top-of-atmosphere associated with the increasing heat-trapping gases in the atmosphere, such as carbon dioxide from human activities. Some 93% of this excess heat ends up in the ocean, while the rest warms the land and atmosphere, and melts both land and sea ice. The heat gets sequestered for varying times, moved around, but may come back into the atmosphere and have profound influences on regional climate. The best example is the El Niño phenomenon.
2. Certain preferred patterns of variability in the ocean-atmosphere system occur on multi-year time scales and may be **predictable**. An example is the AMOC: the Atlantic Meridional Overturning Circulation, which is responsible for over 90% of the northward heat transport in the North Atlantic Ocean including into the Arctic. Not only these patterns (modes), but also any anomalous heat in the ocean can influence subsequent atmospheric evolution and thus climate. It is essential to track and predict this variability and separate it out from the relentless climate change associated with human influences in order to make better decisions concerning adapting and building resilience to, and understanding impacts of climate change

These 2 points are common to C-H and DCVP.

### **Proposed discussion topics:**

- 1) **Discussion on joint key scientific questions:** DCV can act as a strong and significant modulator of global and regional mean surface and associated energy balance at the surface (e.g. recent hiatus). In particular, the breakdown of global scale signal in EEI and OHC in relation to change in ocean dynamics (AMOC, heat uptake etc....) can be discussed and the role of observations, analyses and reanalyses, and models. We propose here a number of joint key scientific questions for both CLIVAR research foci:

- Is there a joint activity related to analysis or model diagnostics that would throw light on the identification of key regions for heat sequestration into the deep ocean related to DCV? (i) Various studies have highlighted key regions and mechanisms for the sequestration of heat into the deeper layers of the ocean (below thermocline). (ii) Advancements in the quantification of this vertical heat distribution, understanding of these mechanisms, and the further identification of key regions are one of the core aspects for CONCEPT-HEAT helping to understand and quantify warming of the deep ocean (below 2000m depth), which in turn can improve the quantification of the absolute value for EEI estimates. (iii) It has been shown that DCV plays a central role for these mechanisms, and a joint discussion on advancements in this field of research are important to improve our estimates, understanding and prediction capabilities.
  - What is the respective role of the DCV modes on global EEI/OHC changes, and related regional energy budgets? What are the implications for decadal prediction? Is there a way to promote these kinds of studies?
  - Can we promote studies on the impact of DCV on heat transport? The evaluation of ocean heat transports was identified as one of the key priorities for CONCEPT-HEAT during the last workshop. Improved knowledge on the impact of DCV and joint discussion with DCVP can further unravel observed changes, and improve our understanding of uncertainties.
  - How can we promote evaluation of DCV imprint on regional sea level patterns (steric, mass)?
  - How can we encourage analysis and diagnostics of decadal variability in terms of regional energy balance and the distribution of heat in the vertical in the ocean, how it gets moved around and implications for predictability?
- 2) **The Earth Energy Imbalance (EEI) and Ocean Heat Content (OHC) should be priority metrics for climate model diagnostics in the context of CMIP6 activities.** The current EEI is mostly caused by human activity, and is driving global warming. The absolute value of EEI represents the most fundamental metric defining the status of global climate change, and will become more useful than using global surface temperature. The net surface energy flux in models should match EEI globally but the surface fluxes could be a valuable diagnostic. The aim of the discussion could be to discuss about best uses and best practices of the CMIP6 climate model simulations to better understand EEI, OHC change and DCV. It takes only one paper to produce the right kind of diagnostics to set an example. The principal objective here could be to develop a joint recommendation to the CMIP community, and our joint discussion here could aim to implement this activity (e.g. guidelines for specific diagnostics such as on-the-fly computation of OHC at different levels etc.).

#### Agenda:

1. Opening comments from Cassou, Kushnir
2. Opening comments from von Schuckmann, Trenberth
3. Short presentations (TBD)? (Based on earlier meetings and what each project is doing)
4. Open discussion led by 4 co-chairs of points above