

Research Focus on Tropical Basin Interaction (TBI)

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RF overview

Start date: March 1, 2020
Planned end date: December 31, 2024

Background

The interactions among the tropical Pacific, Atlantic, and Indian Ocean basins are increasingly recognized as a key factor in understanding climate variability on interannual to decadal timescales. While recent years have seen progress toward understanding tropical basin interactions, much remains to be learned. This includes a deeper understanding of the mechanisms, the preferred pathways, and the potential benefits for seasonal-to-decadal prediction. The RF TBI aims to make progress in these areas by fostering research activities and holding workshops and summer schools. Specific outcomes will include the coordination of new climate model experiments and community review papers.

Status of the RF in relation to the proposed timeline

Setting up the coordinated experiments is taking much longer than anticipated. This is partly due to concerns by some modeling groups about potential problems with the experiment design. To address these issues, several test runs were performed and results discussed. It seems that a consensus is forming and that the full-scale experiments can start in early 2023.

A second TBI workshop will be held in February 2023 in conjunction with the Pacific Region Panel. Furthermore, a Summer School will be held in the summer of 2023, together with a third TBI workshop. These activities follow relatively closely the proposed timeline.

2021-2022 activities

Several online TBI meetings have been held to coordinate activities. In addition, the four working groups (WGs) have independently pursued their goals and held their own meetings.

WG1 (GCM Experiments), led by Ingo, has held several meetings to discuss the experiment design and the outcome of several test runs. The next meeting will be held in mid-December.

WG2 (Conceptual and Intermediate Complexity Models and Statistical Approaches), led by Dietmar, has formed a group of 10 researchers with various backgrounds to address the theoretical and conceptual understanding of TBI. The WG2 had a series of

brainstorming meetings to discuss ideas for theoretical concepts, statistical approaches, experimental design and conceptual model developments.

WG3 (Observations), led by Greg, has met to discuss observational gaps in the context of TBI. Team members are identifying existing multidecadal (100+ years) datasets that can be used for TBI studies, with the goal of making recommendations for additional datasets that can aid TBI research. WG3 is also compiling a list of major recommendations from the tropical Pacific, Atlantic, and Indian Ocean observing system reviews, which will be used to determine those that are most important for TBI, identify gaps, and make recommendations for integration across individual basins.

WG4 (Paleo Data), led by Yuko, has collaborated with NCAR scientists (Dave Schneider and Clara Deser) to develop a paleoclimate section in the Climate Data Guide (<https://climatedataguide.ucar.edu/>). The goal is to promote the use of paleoclimate proxy data for TBI research by increasing awareness of available datasets and their strengths and limitations. This will also benefit the broader climate research community. The group has provided a list of key datasets (ranging from archives of raw proxy records to reanalysis products) and experts who can provide guidance on these datasets.

In addition, the RF has assisted the Pacific Region Panel in the organization of the joint PRP-TBI workshop in Melbourne (February 13-17). Approximately 25 participants are expected to meet in person. Cross-panel activities will take centerstage at this workshop, with several plenary sessions to be held. In addition, there will be an RF TBI meeting to focus on organizational matters and future plans. The meeting will include a hybrid component to allow the participation of members who cannot make it to Melbourne.

The RF has submitted an application for a CLIVAR-ICTP Summer School in 2023 but, unfortunately, the proposal was not selected. In coordination with Riccardo Farneti, we have submitted a separate proposal for an ICTP Summer School. While there is no official result yet, it seems likely that this Summer School will be funded. In that event, we will aim to have another TBI workshop back-to-back with the summer school. A funding request for this workshop is included in Annex A.

Achievements for 2021-2022

- **Workshops and conference sessions**

Two workshops are in the planning, as outlined under “2021-2022 activities” above.

A session on TBI was held at the 2021 AGU Fall Meeting, with RF members Yuko, Andrea, Chunzai and Ingo as conveners.

- **Scientific results from activities**

Many RF members have participated in TBI-related research activities.

- **Scientific capacity building and career support**

A summer school will likely be held at ICTP (Trieste, Italy) in the summer of

2023. The topic of the summer school is very relevant to students from developing countries, given the importance of TBIs in influencing weather and climate across the globe, especially in the tropics where many of these countries are located. We will ensure participation of students from these countries working with ICTP. Furthermore, we are keen to work with the WCRP LHA academy to preserve and disseminate the course materials from the summer school. The paleoclimate section of the Climate Data Guide (<https://climatedataguide.ucar.edu/>) being developed in collaboration with WG4 will increase the awareness of available proxy data and benefit the broader climate research community.

A German Masters' student (Luisa Aviles) visited JAMSTEC for two months in 2022 to work with Ingo on machine learning tools for the detection of atmospheric teleconnection pathways.

Ingo has supervised postdoctoral researcher Shoichiro Kido's work on the use of linear inverse models (LIMs) for the study of TBI (Kido et al. 2022).

- **Knowledge exchange**

The RF TBI is linked to other CLIVAR activities through co-memberships of the following members: Andrea (Pacific Region Panel), Ingo and Regina (Atlantic Region Panel), Noel (Climate Dynamics Panel), Dietmar, Malte, Mike, and Chunzai (ENSO Conceptual Model group), Roxy and Mike (Indian Ocean Region Panel), and Malte (Tropical Pacific Decadal Variability group). Furthermore, Regina is co-chairing one of the WCRP lighthouse activity (LHA) teams.

The PRP and RF TBI have held several meetings to coordinate the 2023 workshop in Melbourne.

Ingo has presented RF TBI activities at the Japan CLIVAR Committee Meeting.

Plans for 2023 and beyond

Advancing the coordinated experiments will have high priority in 2023. This will also require the writing of an article that describes the experiment design. We will use the workshop in February 2023 to discuss the coordinated GCM experiments in general and the article in particular.

Roxy Mathew Koll is co-convening a Poster Cluster on "Changes in sea surface temperature patterns in the Tropics" at the WCRP Open Science Conference 2023 (OSC 2023). The poster cluster will address the issue of changes in sea surface temperature patterns in the tropics as a response to climate change.

Articles published in 2021/22 as part of RF activities (if any)

Although RF members have published numerous peer-reviewed articles on TBI, these cannot be attributed unequivocally to RF activities and are therefore not listed here.

Budget and other needs for 2023 (in CHF)

In addition to carrying over the unused funds from 2022 to help fund the workshop in Melbourne, we request CHF 5,000 for the workshop that is planned to be held back-to-back with the 2023 Summer School at ITCP (Trieste, Italy). These funds will be used to support travel costs of international participants, preferably from low-income countries.

Annex A

Proforma for CLIVAR Research Focus requests for SSG approval for meetings

Note: If your group has approved funds in 2022 that were not used because of Covid19 and any other unexpected issues, and you propose to use them in 2023, they should be included again in this request, in addition to any new request.

1. **RF name:**
Tropical Basin Interaction (TBI)
2. **Title of meeting or workshop:**
Atlantic Variability and Tropical Basin Interactions at Interannual to Multi-decadal Timescales: Mechanisms, Drivers and Impacts
3. **Proposed venue (or indicate if online):**
International Centre for Theoretical Physics (ICTP), Trieste, Italy
4. **Proposed dates:**
2.5 days in late July or early August (before or after the ICTP Summer school on the same topic)
5. **Proposed attendees, including likely number:**
We anticipate 40-50 attendees in person, with the potential for additional remote participants. Efforts will be made to ensure diversity in terms of career stage and background.
6. **Rationale, motivation and justification, including: relevance to CLIVAR science & WCRP Strategic Plan and Lighthouse Activities, and any cross-panel/research foci links and interactions involved:**
The workshop will bring together experts on low-frequency variability and change on the one hand and tropical basin interaction on the other. This should provide fertile ground to advance our understanding of how slowly evolving mean state changes influence interaction among the ocean basins and what long-term implications this has for the predictability of climate variations.
The goals of this workshop are closely linked to the CLIVAR goals of predicting variability of the oceans on a wide range of time scales. It is being organized together with the CLIVAR Climate Dynamics Panel.
The workshop goals are also linked to the wider WCRP objectives of better understanding, and reliably projecting, future climate change. Specifically, the workshop should contribute to the goals of the Lighthouse Activity (LHA) Explaining and Predicting Earth System Change (EPESC). We will invite members of this LHA to attend the workshop.
7. **Specific objectives and key agenda items:**
The workshop will be centered around the following scientific questions:

- 1) How does low-frequency variability, such as the Atlantic Multidecadal Variability (AMV), modulate the linkage among the three tropical basins?
- 2) What is the role of the Atlantic meridional overturning circulation (AMOC) in setting the spatial patterns and timescales of the AMV?
- 3) How do climate models simulate low-frequency variability (in particular the AMOC and AMV) and its impact on tropical basin interaction?
- 4) How will low-frequency variability and tropical basin interaction change under global warming?

In addition to the plenary scientific sessions, there will also be a meeting of the Research Focus TBI to discuss organizational matters, and to discuss the ongoing coordinated GCM experiments.

8. Anticipated outcomes (deliverables):

We plan to publish a workshop report in EOS or BAMS. Depending on the progress made at the meeting, we might also aim for a special issue on this topic, e.g., in the Journal of Climate.

9. Format:

Each of the scientific questions will be addressed in a dedicated plenary session. There will be one invited keynote lecture for each plenary session, as well as contributed presentations. In addition, there will be breakout groups for discussing emerging topics, and poster sessions.

10. Science Organizing Committee (if relevant)

Ingo Richter (JAMSTEC, Japan, co-chair), Riccardo Farneti (ICTP, Italy, co-chair), Aixue Hu (NCAR, US, co-chair), Natalie Burls (George Mason University, US), Sarah Kang (Ulsan National Institute of Science and Technology, South Korea), Noel Keenlyside (University of Bergen, Norway), Yuko Okumura (University of Texas at Austin, US), Rhys Parfitt (Florida State University, US)

11. Local Organizing Committee (if relevant)

Riccardo Farneti (ICTP, Italy); TBD

12. Proposed funding sources and anticipated funding requested from WCRP:

Since this workshop will be held back-to-back with the ICTP Summer School on the same topic, we hope that participants of the latter will be able to extend their stay in Trieste to attend the workshop. This would increase the number of participants at low additional cost.

We have also applied to US CLIVAR to fund US-based participants. Furthermore, TBI Member Belen Rodriguez-Fonseca may be able to contribute workshop funding through a Spanish government grant.

In addition to the above funding sources, we would like to request CHF 5,000 from WCRP to support travel costs of international participants, particularly those from low-income countries.