

RF Report: Decadal Climate Variability and Predictability

Co-Chairs:

Yochanan Kushnir, kushnir@ldeo.columbia.edu

Rym Msadek, msadek@cerfacs.fr

RF overview

Date when RF started; planned ending date; summary of whether the RF is on track with the original time line

- DCVP RF started in the fall of 2014. The planned ending date is early 2020
- In our 2017 report we laid out the following plan for 2018-2019:
 1. Complete DCVP contribution to CLIVAR Science Plan.
 2. Participate in analysis of DCP experiments, particularly component C results and contribute to publications of the results.
 3. Continue participation in the planning of the WCRP international workshop on Subseasonal to Decadal variability planned for September 2018 and represent DCVP work in that meeting.
 4. Present DCVP science in the 2019 Ocean Observations Conference.
 5. Plan and execute a final DCVP Science Symposium and Summer School and publish outcome.

Overview of where the RF is on the time line proposed

We have achieved goal 1 and 3. Goal 2 is in progress as a result of delays in the entire CMIP 6 endeavor. A survey of WG member activities following a teleconference reveals that DCVP members from modeling centers have all been involved in modeling activities that meet the DCP protocols and more, as described below.

Achievements for 2017-18

- Workshops
 - A few DCVP WG members participated in the International Conferences on Subseasonal to Decadal Prediction. The following members made presentations
 - Rym Msadek: “Dynamical and thermodynamical impacts of the Atlantic Multidecadal Variability on the European climate”
 - Matt Newman: “How important are ENSO and the MJO to tropical subseasonal predictability”
 - Masahide Kimoto: “Predictability of blocking and tropical cyclone activities? An assessment with a large ensemble simulation”
 - Karspeck, Alicia: “Expert perspectives on the practice of decadal prediction from CMIP5 and beyond CMIP6”
 - DCVP members Christophe Cassou, Francisco Doblas-Reyes and Holger Pohlmann, organized and participated in the “Workshop on the analysis of the AMV in the CMIP6 context”, held in BSC, Barcelona, on the 3rd of July 2018. The conference objectives were to discuss the plans for the analyses of the Atlantic Multidecadal variability (AMV) features and predictability

and the level of coordination of these analysis efforts in the context of CMIP6/DCPP. Workshop attendees decided on a list of future simulations based largely on the DCP component C model and focused on the Atlantic. They also tentatively decided on a list of papers that will describe the outcome of these experiments. The workshop agenda and summary are included in the following documents:

<https://docs.google.com/document/d/1r8sNOJSIo1SfSUrXHIQi0wvBGuq-xElwzZW2RTWCV7w/edit#heading=h.pohinkgzm8td>

and

<https://docs.google.com/document/d/1D9SuMGY6jsRk1xd98Ue01mHffnLTkQ8eCqANawdv9gl/edit?ts=5b5f2181>

- The CLIVAR Pacific Region Panel held a short ENSO and Tropical Pacific Decadal Variability (EDV/TPDV) Workshop during its recent (October) meeting in San Pedro de Manglaralto, Ecuador. The goal of this workshop was to review the state of the science of these phenomena and produce a written report. Two Panel members, Scott Power and Mat Newman are also DCVP WG members and represented the DCVP interest in this activity.
- Activities and Scientific results:
 - China:
 - Tienjun Zhou reported that a decadal climate prediction system named as IAP-DecPreS was constructed in the Institute of Atmospheric Physics (IAP), Chinese Academy of Sciences, based on a fully coupled model FGOALS-s2 and a newly developed initialization scheme, referred to as EnOI-IAU (references: Wu et al., 2015 and 2018a).
 - Zhou also reported that the group at Chinese Academy of science also developed an effective statistical-dynamical model to predict spatial and temporal evolutions in Northern-Hemisphere (NH) summer land SAT (reference: Wu et al., 2018b). This study identifies two dominant interdecadal variability modes of the NH summer land surface air temperature (SAT), whose evolutions are synchronized with forced climate change and AMV, respectively. Based on statistical relationships with physical interpretations, time series of the forced responses and the AMV skillfully predicted by GCMs, the land SAT over the past one hundred years is predicted retrospectively with significantly improved skill compared to that predicted by the DPEs. The results indicate that the decadal variability of the NH land climate is predictable, with predictability rooted in atmospheric interdecadal circumglobal teleconnection (CGT) forced by the AMV.
 - Also studied was the interdecadal variability of basin-wide SST anomalies in the tropical Indian Ocean. This is referred to as interdecadal Indian Ocean basin mode (hereafter ID-IOBM), is caused by remote forcing of the Interdecadal Pacific Oscillation (IPO), as demonstrated by the observational datasets and tropical Pacific pacemaker experiments of the CESM model. The growth of the ID-IOBM shows a season-dependent characteristic, with a maximum positive tendency of mixed layer heat anomalies occurring in the boreal early winter but a negative tendency in the early summer. In early winter, the ID-IOBM is intensified by IPO-driven anomalous Walker circulation. In early summer, the anomalous Walker circulation is shifted eastward and the tropical Indian Ocean is out of control of the IPO remote forcing. (reference: Huang et al., 2018).
 - France:
 - Rym Msadek reported on decadal variability research at CERFACS. The activities included studies of the impacts of AMV on the winter response over the Euro-Atlantic

region and on the summer response over the Mediterranean. These studies were based on results from DCPD-protocol C runs with the CNRM-CM5 model.

- CRFACS is currently repeating the DCPD-protocol C experiments but using a forcing of present day instead of the original preindustrial forcing and from a quick look it seems to impact the results. Msadek also reported that CERFACS started the official DCPD-C experiments using their CMIP6 model CNRM-CM6. It is an interesting model because it has a marked multidecadal and centennial variability in the Atlantic so the research team is interested to use it as a tool to look at Atlantic predictability.
- CERFACS is running DCPD-C like experiments for the PRIMAVERA/HighresMIP, which differs from the DCPD because these runs are based on a 1950 control run that use a 2XAMV forcing. These experiments are run with CNRM-CM6 in both low and high-resolution. We will probably won't be able to do as many members with the high-res than the low res.
- Finally, CERFACS is submitting several large proposals (one in collaboration with other research groups in France) to study mechanisms, predictability and impacts of climate variability and change in the Atlantic and Europe.
- Italy:
 - Davide Zanchettin reported on publications that address DCPD topics (Zanchettin et al., 2017a and b).
 - Zanchettin also reported that VolMIP is progressing slower than expected. Zanchettin Claudia Timmreck and Myriam Khodri are testing the core experiments and hope to start soon with the production runs.
 - Zanchettin and Timmreck have performed some Tambora experiments to compare forcing and initial-conditions uncertainties. They are working on a paper which is mostly targeted at the paleoclimate reconstruction problem and comparing the reconstruction with the simulations. This paper will also discuss implications for predictability of the impacts of a future eruption.
- Japan:
 - Masahide Kimoto is reporting that after struggling to fix their systems for CMIP6 experiment the MRI and MIROC groups are now running with an initialization scheme that uses incremental analysis updates of 3D ocean T & S. MIROC is using anomaly initialization and MRI model will likely using full-field initialization. Both groups have an ensemble Kalman filter as an option, but the costs is high and is given up for DCPD. The resolution of models for DCPD experiments is for MRI: ~100km both for the atmosphere and ocean and for MIROC ~150km atmosphere and 1-deg ocean.
- USA:
 - Gokhan Danabasoglu reported that NCAR is fully engaged in Decadal Prediction activities. They recently completed a 40 ensemble-member initialized decadal prediction set to complement their existing historical large ensemble with CESM. A BAMS article by Steve Yeager (reference: Yeager et al., 2018) introduces this new Decadal Prediction ensemble.
 - NOAA Climate Program Office has solicited this year proposal dealing with studying mechanisms and predictability of decadal variability in the Pacific and Atlantic Basins. At the Lamont-Doherty Earth Observatory, Yochanan Kushnir and Richard Seager each submitted a proposal in response to this call. Kushnir et al.'s proposal is focused on studying mechanisms of North Atlantic climate variability. Seager et al.'s proposal is looking at the Pacific and its impact on North American droughts.

- Matt Newman reported that he is interested in prospects for a Year 2 forecast (i.e., Months 13-24). Newman lead a discussion about this topic at the PPAI panel meeting in October that would lead to the development of a white paper.
- Scientific capacity building and career support. N/A
- Knowledge exchange: Through shared membership DCVP contributed to activities of DCP, the Grand Challenge on Near-Term Decadal Prediction, the CMIP6 VolMIP, and the CLIVAR panels for the Pacific Region and Climate Dynamics.

Plans for 2019 and beyond

As is evident from the summary above, the DCVP WG members were mostly occupied in parallel activities in the countries they represent or in synergetic activities in other panels/working groups within CLIVAR and WCRP. In 2019, as the results of these separate modeling and analysis activities emerge, we plan to work toward a synthesis of all this work through organizing a workshop in early 2020 that will facilitate a meeting of the WG members and representatives from CLIVAR panels with mutual interest, in particular the Climate Dynamics, Pacific Regional and Atlantic Implementation panels. The goal of the workshop will be to summarize DCVP (and CLIVAR) contribution to the study of decadal climate variability and predictability and publish a workshop summary. We currently do not have firm plans regarding the format and venue of the workshop but we plan to discuss this in early 2019 in the WG and with the other participating panels. This workshop will mark the sunset of the CLIVAR DCVP activity and the “handover” of the subject of decadal variability to the Climate Dynamics Panel.

Articles published in 2017/18 as part of RF activities (if any)

Huang, Y., B. Wu, T. Li, T. Zhou, B. Liu, 2018: Interdecadal Indian Ocean Basin Mode Driven by Interdecadal Pacific Oscillation: a season-dependent growth mechanism, Submitted to Journal of Climate

Wu, B., T. Zhou, F. Zheng, 2018a: EnOI-IAU initialization scheme designed for decadal climate prediction system IAP-DecPreS. *Journal of Advances in Modeling Earth Systems*, 10(2), 342-356,

Wu, B., T. Zhou, C. Li, W. A. Müller, J. Lin, 2018b: Improved decadal prediction of Northern-Hemisphere summer land temperature, Submitted to Climate Dynamics

Yeager, S. G., and Coauthors, 2018: Predicting Near-Term Changes in the Earth System: A Large Ensemble of Initialized Decadal Prediction Simulations Using the Community Earth System Model. *Bull. Am. Meteorol. Soc.*, **99**, 1867-1886, doi: 10.1175/bams-d-17-0098.1.

Zanchettin, D. (2017a) Aerosol and Solar Irradiance Effects on Decadal Climate Variability and Predictability. *Current Climate Change Reports*, 3, 150, doi:10.1007/s40641-017-0065-y. In topical collection “Decadal Predictability and Prediction”

Zanchettin D., Gaetan C., Arisido M. W., Modali K., T. Toniazzo, N. Keenlyside, Rubino A. (2017b) Structural decomposition of decadal climate prediction errors: A Bayesian approach. *Sc. Rep.* 7, 12862, doi:10.1038/s41598-017-13144-2

Budget and other needs for 2019

TBD