

Report of Working Group 29 on *Regional Climate Modeling*

The third business meeting of Working Group (WG 29) on *Regional Climate Modeling* (RCM) was held in Yeosu, Korea, on October, 17, 2014. With 10 members and observers in attendance (*WG 29 Endnote 1*), the meeting began with an introduction to Working Group activities, and progress and plans by Co-Chairmen, Drs. Enrique Curchitser and Chan Joo Jang. After short presentations by the RCM Working Group members, a brief introduction was given by Japanese member, Dr. Shin-ichi Ito, focusing on items relevant to WG 29. Finally, the members discussed some emerging RCM issues, plans and schedule of future activity and preparation of the group's final report, and next phase of the Working Group. Below are the agenda items (*WG 29 Endnote 2*) and the corresponding discussions during the meeting.

AGENDA ITEM 2

WG 29 activities

Dr. Jang overviewed WG 29's activities including convening relevant sessions and workshops, including the second meeting in Nanaimo, Canada (2013) and Open Science Meeting in Hawaii (April 15–18, 2014). In addition, Dr. Curchitser introduced the third 3rd PICES/ICES/IOC Symposium on “*Effects of climate change on the world's oceans*” (Santos, Brazil, March 21–27, 2015) and the RCM session therein.

WG 29 proposals for PICES-2015

WG 29's proposal for a 1-day Topic Session on “*Past, present, and future climate in the North Pacific Ocean: Updates of our understanding since IPCC AR5*” (*WG 29 Endnote 3*) to be convened mostly by WG 29 members including Drs. Jang, was accepted for PICES-2015 (October 15–25, 2015, Qingdao, China).

AGENDA ITEM 3

Updates on national RCM activities

1. **Michael Foreman (Canada):** *Regional ocean climate model projections and their ecosystem implications for British Columbia, Canada*

Dr. Foreman discussed the results from two papers that were published in *Atmosphere–Ocean* and focus on regional projections for the British Columbia coast. His presentation was closely linked to WG 29 TOR #3:

- The RCM projects stronger eddy kinetic energy, stronger Vancouver Island coastal current, and little change in upwelling in the coast;
- The Haida eddies, an important contributor to ecosystem changes, are projected to become stronger.

2. **Angelica Peña (Canada):** *A regional ocean climate model with biogeochemistry for the British Columbia continental shelf*

Dr. Peña presented one-way downscaling of physics and biogeochemistry on the British Columbia continental shelf for detecting, understanding, and projecting climate change impacts on plankton productivity, nutrient supply, oxygen and carbon content, as well as for evaluating the potential risk (likelihood) for the development of hypoxia events and corrosive conditions. Specifically she talked about:

- A coupled physical–biogeochemical model that has been used in which ROMS was implemented as a circulation model. The biogeochemical model includes NPZD, O₂, DIC and Alkalinity;
- Future projections experiments are planned by using CRCM or CGCM forcing and increasing atmospheric pCO₂ and DIC at the lateral boundaries.

3. ***Shin-ichi Ito (Japan): RCM developments in Japan***

Dr. Ito spoke about status of RCM development in Japan, including MRI models, AORI model, CHOPE-eNEMURO, eNEMUROMS, and Mutsu Bay modeling. He also mentioned the possibility of providing simulation data from each RCM to PICES.

4. ***Hiroshi Kuroda (Japan): Recent update of regional ocean modeling: Lower-trophic ecosystem modeling***

Dr. Kuroda described the modeling activities with the FRA implementation of the ROMS model coupled with eNEMURO or a NPZD model. Specifically he described:

- An operation ocean forecast system (FRA-ROMS) for mesoscale variation over the Kuroshio–Oyashio region;
- The importance of nutrient supply by submesoscale eddies for enhanced chlorophyll concentration on the shelf-slope region.

5. ***Yang-Ki Cho (Korea): Climate change projection in the Northwest Pacific marginal seas through dynamic downscaling***

Dr. Cho showed future climate change for seas around Korea using dynamic downscaling with a ROMS model forced with three different GCM forcing from three CMIP3 global models. Main results are as follows:

- The RCM project a rapid warming in the Yellow Sea in contrast to a slow warming along the Kuroshio path;
- Future work includes dynamical downscaling forced with CMIP5 models, and inclusion of ecosystem modelling.

6. ***Chan Joo Jang (Korea): CMIP5 analysis: preliminary results***

Dr. Jang presented results from CMIP5 analysis focusing upper-ocean processes including sea surface temperature (SST), mixed layer depth (MLD), and Pacific Decadal Oscillation (PDO), as described below:

- Horizontal resolution of most of the CMIP models is about 1–1.5° for ocean components and 1.5– 2° for atmosphere components, indicating almost no improvement compared with CMIP3 models. (Dr. Peña suggested investigating changes in vertical levels of CMIP5 models, which might be more influential on simulation of biogeochemical processes by CMIP5 models.);
- Common SST biases: a cold bias in the North Pacific and a warm bias in the Southern Ocean;
- MLD biases in CMIP5 show nearly same patterns as in CMIP3, indicating almost no improvement in MLD simulation by CMIP5 models compared with CMIP3 models;
- CMIP5 models seem to improve the PDO spatial pattern mainly due to better simulated atmospheric link between tropics to extra-tropics.

7. ***Young Ho Kim (Korea): Data assimilative modeling system of KIOST***

Dr. Kim introduced the KIOST climate model focusing on ocean data assimilation system (DASK):

- Ensemble Optimal Interpolation – Cost effective System;
- Compared with global SST and SSS climatology and heat content;
- Data released through KIOST LAS/OpenDAP server (<http://las.kiost.ac>).

8. ***Enrique Curchitser (USA): Multi-scale modeling of boundary currents***

Dr. Curchitser extended his RCM implementation to several boundary current regions, including the California coast, Northwest Atlantic and the Benguela region to reduce significant SST biases from GCMs. He discussed the role of wind interpolation and some difficulties with land–sea masks when embedding a high-resolution model within a global framework.

9. ***Dimitry Stepanov (Russia, presented by Dr. Olga Trusenkova): Numerical modeling of circulation in the Okhotsk Sea: Preliminary results***

- The ocean model (INMOM) is a 3-dimensional, sigma coordinate model of 1/20 degree horizontal resolution;
- INMOM was applied to the Okhotsk Sea and simulated some prominent features, including two branches of the East Sakhalin Current.

AGENDA ITEM 4

FUTURE evaluation report

Dr. Ito reviewed the report of the FUTURE Evaluation Team, focusing on some issues relevant to WG 29.

Suggestions were to include:

- Ecosystem modelling in climate forecasting to investigate climate change impacts on commercial fisheries;
- Short-term (seasonal to inter-annual) forecasting.

AGENDA ITEM 5

WG 29 final report, and specific plans and schedule

Dr. Curchitser presented ideas for a final WG report and, along with specific section assignments, will email them to the members.

- Each member needs to submit about a 5–10 page summary;
- Experts outside the WG 29 members can be invited if needed;
- Possible topics for the next phase of WG 29 could be related to the role of eddies and upwelling, which are associated with biological activity.



WG 29 meeting participants (left to right): Shin-ichi Ito, Enrique Curchitser, Young-Ho Kim, Hal Batchelder, Olga Trusenkova, Michael Foreman, James Christian, Angelica Peña, Hiroshi Kuroda, Chan Joo Jang

WG 29 Endnote 1**WG 29 participation list**Members

James Christian (Canada)
 Enrique Curchitser (USA, Co-Chairman)
 Michael Foreman (Canada)
 Shin-Ichi Ito (Japan)
 Chan Joo Jang (Korea, Co-Chairman)
 Young Ho Kim (Korea)
 Hiroshi Kuroda (Japan)
 Angelica Peña (Canada)
 Olga Trusenkova (Russia)

Observers

Harold (Hal) Batchelder (PICES)

WG 29 Endnote 2

WG 29 meeting agenda

1. Welcome and self-introduction (Co-chairs)
2. Introduction to WG 29 activity (Jang, Curchitser)
 - a. Brief introduction of WG activities, progress, and plans (Jang)
 - b. Introduction to the third 3rd PICES/ICES/IOC Symposium on “*Effects of climate change on the world’s oceans*” in Brazil, 2015 (Curchitser)
3. Short update by each member of their nation RCM activity (WG 29 members)
4. Brief introduction of FUTURE evaluation report (Ito)
5. Discussion on preparation and timeline of WG 29 final report, and specific plans and schedule (Curchitser)

WG 29 Endnote 3

Proposal for a 1-day POC/BIO/TCODE Topic Session on “*Past, present, and future climate in the North Pacific Ocean: Updates of our understanding since IPCC AR5*” at PICES-2015

Co-Convenors: Chan Joo Jang (Korea), Ho-Jeong Shin (Korea), Zhenya Song (China), Sukgeun Jung (Korea), Anne Hollowed (USA), Kyung-Il Chang (Korea), Angelica Peña (Canada), Shin-ichi Ito (Japan)

Climate has been changing and is highly likely to have been influenced by human activities. These changes, which have greatly affected the Earth’s environment, have been manifested in oceanic ecosystems. Social demands for information on future projections are increasing the need to adapt to and mitigate climate change. The objective of this session is to update our understanding since IPCC AR5 on the past, present and future climate for the North Pacific Ocean and its marine ecosystems, focusing particularly on climatic change in ecosystem-relevant upper ocean and atmospheric variables. Climate change and its impact have been widely investigated using global climate models, while adaptation and mitigation issues have been studied using mostly regional climate models. While this session invites papers on various topics related to both climate simulations and observations, we also encourage presentations on the development and results of regional climate models (RCMs) and Earth System Models (ESMs), and assessment of hindcast simulations and their application to the projection of future climate or marine ecosystems using coupled general circulation models (CGCMs) in the North Pacific Ocean. Future projections of the North Pacific Ocean and its ecosystems, as obtained from global climate models (including CMIP5 standard experiment data for comparison with RCM results) will also be an important contribution to this session.