Minutes of the Meeting
The First Workshop of the SEACLID/CORDEX-SEA
BMKG, Jakarta, Indonesia, November 18-19, 2013

1. Background

The first workshop of the Southeast Asia Regional Climate Downscaling (SEACLID) / CORDEX Southeast Asia (or SEACLID/CORDEX-SEA) was held on November 18-19, 2013 in Jakarta, Indonesia and hosted by the Indonesian Agency for Meteorology, Climatology and Geophysics (BMKG). The aim of this workshop is to formulate an agreement among SEACLID member countries and potential collaborators on how to implement SEACLID/CORDEX-SEA activities. The workshop program is attached as **Appendix I**. The workshop was attended by participants from Indonesia, Malaysia, Thailand, Vietnam, the Philippines, Singapore, UK, Australia, South Korea and Hong Kong. The participants came from various institutions including BMKG, MAIRS, CSIRO, CORDEX, UK Met Office, the Pukyong National University, the National University of Malaysia, VNU Hanoi University of Science, Ramkamhaeng University, Chulalongkorn University, Syiah Kuala University Kopelma, Thailand Research Fund, Malaysian Meteorological Department, Meteorological Service Singapore, Manila Observatory, City University of Hong Kong and APEC Climate Center (APCC). The list of participants is provided in **Appendix II**. The workshop was sponsored by BMKG, which also covered local accommodation to most participants from the Southeast Asia countries. These organizations: MAIRS, UK Met Office, the National University of Malaysia, Thailand Research Fund, VNU Hanoi University of Science, Malaysian Meteorological Department, Meteorological Service Singapore, Manila Observatory, City University of Hong Kong and APCC, and Syiah Kuala University Kopelma, provided travel funding to their respective participants. This document provides a summary of the minutes. The pdf version of presentations can also be accessed at http://www.ukm.my/iklim/seaclid-cordex-sea.

2. Opening

2.1 Opening Remarks from Dr. Andi Eka Sakya, Director General of BMKG

The Director General of BMKG was represented by **Dr. Widada Sulistya**, Deputy Director General for Climatology of BMKG. He welcomed all participants and officially opened the workshop. In his remarks he emphasized the prominent role of climate models, particularly regional climate downscaling, in understanding future mean climate and extreme events over the Southeast Asia region. He acknowledged the need for scientists from within the region to work together and build capacity in regional climate downscaling. He praised the establishment of SEACLID/CORDEX-SEA and was grateful that Indonesia and BMKG were chosen to host the first workshop.

2.2 Keynote Address from Dr. Michel Rixen, CORDEX, WCRP WMO

The keynote address of **Dr. Michel Rixen** (CORDEX, WCRP) introduced WCRP, which coordinates research on improving climate prediction and our understanding of the human influence on climate to help decision-making and adaptation planning. He also discussed CORDEX, currently covering 14 regions, which aims to provide actionable regional climate information and to promote stronger engagement with the user community. About 480 participants and 97 countries attended the recently held CORDEX 2013 international conference in Brussels, Belgium. CORDEX-SEA is welcomed to the CORDEX network, especially with the importance and significant interest on monsoon Asia. Dr. Rixen acknowledged the contribution of BMKG in organizing this workshop and all institutions that contributed in sponsoring the participants to attend this workshop.

2.3 Introduction to SEACLID / CORDEX-SEA by Prof. Fredolin Tangang, SEACLID/CORDEX-SEA Coordinator

Prof. Fredolin Tangang provided an overview of SEACLID/CORDEX-SEA from the perspectives of its historical development, its vision and the purpose and expected outcome of the workshop. SEACLID is the first regional collaborative project under the Southeast Asia Regional Climate Initiative (SEARCI), a platform for collaboration that was established during a workshop hosted by VNU Hanoi University of Science on August 2-3, 2012. Funded by APN, the key aspect of this project is to downscale 5 GCMs, 3 RCPs (2.6, 4.5 and 8.5) over a common domain of 15^{o}S- 40^{o}N, 80^{o}E – 145^{o}E at 36 km resolution using RegCM4, on a task-sharing basis among participating countries. SEACLID also emphasizes on capacity building, scientific publications, establishment of a data center and engagement with stakeholders and policy makers. Prof. Tangang was chosen as the SEACLID coordinator and the National University of Malaysia as its secretariat. Initial country members of SEACLID include Indonesia, Malaysia, Thailand, Vietnam and the Philippines with two additional countries i.e. Cambodia and Lao PDR, as recommended by APN. The first phase of the project is a coordinated sensitivity experiment to determine the best physics options by forcing the RegCM4 with ERA-Interim. A total of 18 runs were distributed to the initial five member countries of SEACLID. With the recommendation of APN, SEACLID was eventually incorporated into the CORDEX network as SEACLID/CORDEX-SEA, following communications between Dr. Michel Rixen of CORDEX and Prof. Tangang, between participating SEACLID member countries (Malaysia, Indonesia, Vietnam and the Philippines), Dr Arsar Ghassem, Director of WCRP, and several potential collaborators during a side meeting in the ADB-RETA Workshop in Bangkok June 27-28, 2013 as well as further consultations among SEACLID members. As SEACLID/CORDEX-SEA, the original domain was retained but the resolution was further refined from 36 km to 25 km. Only two RCPs i.e. RCP4.5 and RCP8.5 will be considered to be consistent with CORDEX. Prof. Tangang outlined the expected outcome of this workshop including: 1) Preliminary results of the sensitivity experiment, 2) agreement on domain, resolution, 3) what and number of GCMs, 4) identification of collaborators, 5) better coordination. Finally, Prof. Tangang, on behalf of SEACLID/CORDEX-SEA, expressed deep appreciation to BMKG for its generosity and commitment to host this workshop, particularly to Dr. Andi Eka Sakya, the Director General of BMKG, Dr. Widada, Deputy Director General and the strong leadership of Dr. Edvin Aldrian and Dr. Dodo Gunawan and their LOC members that guarantee the excellent organization of the workshop.

3. **Session I: Existing Initiatives and coordination**

This session discussed the current initiatives and activities on regional climate modeling in Asia. These presentations identified areas for possible collaboration of these groups/research institutes with SEACLID/CORDEX-SEA.

3.1 *Downscaling for practical purposes*

Prof. Dr. Michael Manton (MAIRS) gave an introduction on MAIRS, including its motivation, research themes and activities. MAIRS promotes the links between research groups across Asia, including CORDEX. He identified lessons learned from the modeling evaluations of GCMs and RCMs in IPCC AR5. With CORDEX, RCMs and statistical downscaling (SD) are used to support impact and vulnerability studies. However, Prof. Manton emphasized the need to recognize issues such as the cascade of uncertainties in model output, the potential benefits of using SD to reduce variation in model output, and the need for high-resolution observations for regional downscaling to be successful.

3.2 *SEACAM Project and Coordination of the SEACAM and SEACLID/CORDEX-SEA projects towards more useful scientific outputs*

Mr. Raizan Rahmat and **Mr. David Hein** introduced the SEACAM project and their activities, including workshops, climate simulations and paper/report writing. Results from the "Durian" experiments, which are downscaled climate projections for SEA, showed different model performance per region. With the continued involvement of the UK Met Office with CORDEX, they emphasized the benefits of coordination between SEACAM and SEACLID/CORDEX-SEA, such as the sharing of lessons learned, established network with meteorological agencies and universities and sharing of expertise and downscaling activities for the region.

3.3 *A proposal for Global CORDEX Data Center-Projection of the Climate Change for South Asia region with high-resolution AGCM based on the RCP scenarios*

Prof. Jaiho Oh noted that the regional climate community is becoming more organized, e.g. CORDEX, to provide probabilistic assessments of changes in the regional climate that can be used by different sectors. He introduced the Global Science experimental Data hub Center (GSDC) and the Korea Institute of Science and Technology Information (KISTI) and their proposal to be an official data center of CORDEX.

3.4 *Dynamical downscaling of climate projection over Maritime Continent*

Dr. Hongwei Yang presented the results of the dynamical downscaling conducted by APCC over SEA region at 50 km resolution. WRF was used to downscale ERA-40, historical and 2 RCP scenarios (RCP4.5 and RCP8.5) from HadGEM2. Forced by ERA-40 and historical output of HadGEM2, WRF model showed a good performance over the Maritime Continent. The projection downscaling showed a relatively strong signal of climate change in the far future, especially for RCP8.5. It was also found that WRF could enhance or weaken the CC signal from HadGEM. The results also showed that there is a higher uncertainty in the variability than in the mean precipitation, and that the variability change in WRF is higher than in the GCM. The change in HadGEM2-AO was more likely enhanced by the WRF in the far future than the near future.

3.5 Regional climate modeling for CORDEX and SEA using a variable-resolution model

Dr. John McGregor discussed the variable-resolution model, CCAM, and their model simulations for CORDEX and SEA. In downscaling the climate projections, 9 out of the 24 CMIP5 models were used following the GCM selection requirements, such as good performance in simulating present climate, good SSTs and spread of climate change signals. Global runs at 50 km were conducted, providing outputs for 4 CORDEX domains, while 14 km runs over SEA have also been done.

3.6 Regional climate model simulations of diurnal rainfall variations and extreme events in Asia

Dr. Francis Chi Yung Tam presented their recent modeling studies using RegCM3 to examine its capability to simulate the diurnal variation in rainfall over Hong Kong and Southeastern China and the tropical cyclone (TC) genesis over the Western North Pacific basin. Sensitivity tests with the RegCM3 showed that the best convection scheme depends on the variable of interest. They also found a higher skill of the regional model in forecasting landfalling TCs over SEA region, and can outperform the GCM (i.e. NCEP CFS) based on which the lateral boundary conditions are obtained.

4. **Session II: Regional Climate Modeling within SEACLID member countries and their needs**

This session discussed the climate downscaling activities carried out in each SEACLID member country. It also highlighted the needs for climate change information in each country. Presentations were conducted by Indonesia, Thailand, Malaysia, Vietnam, and the Philippines in this session. Representatives from Cambodia and Lao PDR were absent due to funding limitation.

4.1 Regional Climate Modeling and Needs in Malaysia

Prof. Fredolin Tangang, Mr. Ling Leong Kwok and Dr. Liew Juneng jointly presented the regional climate downscaling activities and needs in Malaysia. In Malaysia, the National University of Malaysia (NUM), Malaysian Meteorological Department (MMD) and the National Hydraulic Research Institute of Malaysia (NARHIM) carried out regional climate downscaling based on the CMIP3 products. The downscaling carried out at NUM and MMD were based on PRECIS system of the Hadley Centre, UK Met Office. Validation of HadCM3 downscaled products indicated reasonable performances, although there are large biases both in mean temperature and precipitation in some areas in Malaysia. Both the HadCM3 and ECHAM5 projections showed an increasing trend of surface temperature over Malaysia in the future. However, downscaled HadCM3 projections for the region showed no significant increase in precipitation, while those from ECHAM5 implied an increasing trend. Results also indicate model sensitivity to the land surface component. Compared to MOSES 2.1, the use of MOSES 2.2 gives a warmer surface temperature, which offsets part of the cold biases in the model. Bias correction of the regional model rainfall was also done to improve its realism, but such kind of posterior treatment needs to be applied with caution because the correction might not be statistically stable. Rainfall projections based on HadCM3 suggested that the chance of extreme rainfall is projected increase in the future, especially at locations north of Borneo. Since these results are based on CMIP3 products, there is a need to have high-resolution downscaled products based on CMIP5 models for immediate climate change impact assessments, in line with the latest IPCC AR5 report.

4.2 Regional Climate Modeling and Needs in Indonesia

Dr. Dodo Gunawan and colleagues at BMKG discussed dynamical downscaling and sectoral needs for high-resolution climate change information. By superimposing the MIROC climate change anomalies with the current background climate, dynamical downscaling has been carried out for the region using WRF. The higher resolution products were also used for air quality studies, and further statistical downscaling was performed for station-scale temperature and rainfall projections at selected locations. With the assistance from their Japanese counterpart, a GUI-based "downscaler" was developed so as to provide a user-friendly platform for handling downscaling data from WRF, and was tested for analyzing climate data for the Jakarta area. In addition, RegCM4 was also used for operational seasonal climate predictions as well as long-term climate projections. Finally, both regional models were used to study the impacts of urbanizations on the local climate.

4.3 Regional Climate Modeling and Needs in the Philippines

Dr. Faye Cruz presented the regional climate modeling efforts in the Philippines. The Regional Climate System program of the Manila Observatory performs regional climate modeling, studies climate impacts at the high-resolution/local scale, and forecasts for disaster risk management. The MRI non-hydrostatic regional climate model was used to simulate the atmospheric conditions over the Philippines. Albeit with some warm and dry biases, the seasonal cycle of the regional climate was well captured by the model. The RegCM3 was also run at 40 km resolution to provide local climate information for different provinces and at 10 km resolution for selected locations, using lateral boundary data from ECHAM5. The local precipitation can be over- or underestimated, depending on the climate type of the location of interests. Finally, the MM5 (with the NOAH land surface model) at 1-km resolution was used to study the impact of urbanization on the southwest monsoon rainfall over the Manila area. Among the needs identified are observations for model validation, appropriate model configuration for the area of interest and better computing facility, e.g. parallel system, database organization, etc.

4.4 Regional Climate Modeling and Needs in Vietnam

Dr. Ngo-Duc Thanh presented the dynamical downscaling activities in Vietnam. A variety of regional models have been used for downscaling global model products, for instance the Norway ESM was downscaled for the regional climate using WRF, HadCM3 was downscaled to 25 km resolution using the PRECIS system, and RegCM, CCAM (at 10-km resolution) etc. Dynamical downscaling activities were also carried out under the National Response Program to Climate Change in Vietnam. On-going activities also include sensitivity tests on model physics, inter-comparison between downscaling results with various regional models using lateral boundary data input from different global models, and climate projections of extreme values. Dr. Ngo-Duc also expressed the needs for downscaled climate products based on latest CMIP5 models for local climate projections and adaptations.

4.6 Regional Climate Modeling and Needs in Thailand

Dr. Jerasorn Santisirisomboon presented the statistical and dynamical downscaling efforts in the past and those currently taking place in Thailand. The history of dynamical downscaling for the country went back to 1999 when CO_2 doubling experiments using GISS and UKMO models were downscaled for the region. Since then, dynamical and statistical downscaling have been employed based on outputs from ECHAM4, ECHAM5, CCSM3, and GFDL R30. Current activities include downscaling of the HadCM3 products, and also RegCM4 simulations for the SEA domain. The need for comparing different downscaling techniques was emphasized.

5. Session III: Results from sensitivity experiments over SEACLID / CORDEX-SEA domain

This session discussed preliminary results of sensitivity experiments over the SEACLID/CORDEX-SEA 36 km-resolution domain conducted by member countries that included Malaysia, the Philippines, Indonesia, Thailand and Vietnam. Members evaluated RegCM4 simulations for rainfall, mean temperature, maximum and minimum temperature (Tmax and Tmin), circulation fields, and extremes respectively under different combinations of convective parameterisation, closure and ocean flux physics schemes, with the aim of arriving at the “best” physics options for actual simulations. A total of 18 experiments over a 20-year period (1989-2008) and driven by ERA-interim reanalysis (1.5 deg) had been planned (see **Appendix III**). The tasks of running the experiments were distributed among members and the outputs were uploaded to a server maintained by VNU Hanoi University of Science and then downloaded by all members for subsequent analyses. At the time of the workshop, not all experiments were completed, while some experiments needed to be re-done. **Appendix III** also provides the current status of the experiments. The tasks to evaluate the model performances were also divided among countries: Malaysia (rainfall), the Philippines (temperature), Indonesia (Tmax, Tmin), Thailand (circulation fields) and Vietnam (Extremes). For a uniform evaluation across all experiments and across variables, twenty sub-regions were created (Figure IV.1 in

Appendix IV). For the initial evaluation, the gridded observation datasets listed in Table IV.1 have been used. However, observed station data may also be used for the subsequent analyses that will be done by each member country (Table IV.2). Table IV.3 lists the recommended evaluation metrics; some of which have already been done at the time of the workshop.

5.1 Evaluation of Simulated Rainfall
Malaysia presented preliminary findings of Exp 03-06, Exp 10-13, and Exp 15-17. Observations against which the model simulations were evaluated were from Global Precipitation Climatology Center (GPCC v6), Climate Research Unit (CRU v3.21), Asian Precipitation - Highly-Resolved Observational Data Integration Towards Evaluation of Water Resources (APHRODITE v1101), and Tropical Rainfall Measuring Mission (TRMM v3B42). For rainfall evaluation, spatial plots of rainfall distribution over the domain, the annual rainfall cycle plots, and the Taylor's diagrams were analysed.

Key Findings

- There were large variations among the 'observed' gridded dataset, due largely to the drier APHRODITE data. Thus to avoid over-reliance on specific datasets with known issues, Dr. Juneng had recommended using more than one dataset for evaluation purposes.
- The reanalysis dataset ERA-Interim carried wet biases over the Indo-China regions and dry biases over the equatorial areas.
- RegCM4 generally produced too much rainfall compared to the observations in particular for experiments using Emanuel/Kuo schemes.
- None of the RCM simulations out-perform the ERA-interim, and the Dr. Juneng wondered if this presented a problem for the RCM.
- Among the analysed experiments, Exp 15 (Grell(L)/Emanual(O)) appeared to be the best option thus far.
- Some of the sub-regions were observed not to be sensitive to changes in physics options used (e.g. R17).
- Specific/expert tuning of parameters in RegCM4 may be required and merit further discussions.

Discussions / Comments

- On the question from Dr. Tam (City University of Hong Kong) whether the averaging in the analyses included ocean on top of land values, Dr. Juneng clarified that values were considered for land areas only. Dr. Juneng further clarified that the correlation scores for which Taylor's diagram were constructed were based on grid-to-grid comparisons.
- Dr. McGregor (CSIRO) suggested considering the Tiedtke convection scheme, if available, as it may provide interesting insights into the choices of GCM-RCM relationships.

- On the issue of whether the general inability of the different experiments to perform better than the ERA-interim runs, both Prof. Tangang and Dr. Juneng remarked that SEACLID would benefit from including additional RCMs. To the question from Dr. Ngo-Duc (Hanoi University of Science) if ERA-interim runs were uniformly better in all regions, Dr. Juneng replied that it was not necessarily so and cited mountainous regions in some sub-regions (R19-20) where some schemes performed better.
- Prof. Manton (MAIRS) commented that while simulations may show inconclusive results in terms of precipitation, it may not be so for temperature (which was subsequently presented by the Philippines).
- In exploring additional schemes and RCMs, Prof. Tangang remarked that the group was resource-constrained to do so and thus asked if the current combinations would be a good enough basis to proceed with selecting the best option. Dr. McGregor added that in some experiments, other groups have used their favourite schemes and models, and this could be an approach for the SEACLID group to consider.

5.2 Evaluation of Mean Temperature

The Philippines conducted analyses on the spatial distribution of seasonal mean temperature, seasonal cycle of regional means, distribution of monthly regional means, and time-series of regional temperature anomalies. The simulations were evaluated against APHRODITE data but other observation datasets may be considered in subsequent analyses.

Key Findings

- In the spatial distribution of seasonal temperature, there was a consistent cold bias (> -5°C) over Tibetan plateau and Indochina, especially during boreal winter. Consequently, simulations had the smallest biases during boreal summer. There was minimal temperature bias observed for the Emanuel scheme, and there were minimal temperature variations across the ocean schemes.
- The seasonal cycle was generally well-captured by simulations with the exception of the Grell-FC scheme combination which underestimated the cycle in some instances. The Emanuel, Grell+Emanuel, Kuo schemes (except Zeng=2) demonstrated relatively good performance. It was also observed that the Zeng ocean scheme tended to produce colder biases in temperature and this had an influence on the Kuo convective parameterisation scheme.
- In terms of distribution of monthly regional means, there were clear discrepancies in the distribution of Grell schemes in most regions when compared to the observations, whereas Emanuel, Grell (land)+Emanuel (ocean), and Kuo (except Zeng=2) closely resembled the observed distributions. Simulation from Grell-AS+Zeng=1 combination looked spurious in comparison and may require a re-run.

- For the analyses of temperature anomalies, large discrepancies between the Grell-AS scheme and observations were observed. For some sub-regions, all schemes show opposite signs to the observed anomalies.

Discussions

- Dr. Cruz expressed concern that any domain changes in the future could affect the relative performance of scheme combinations for temperature (and also for other variables) and also noted that the scheme-combinations that worked well for temperature did not necessarily work well for precipitation.
- Prof. Tangang noted that the spatial biases were lesser in the maritime continent (MC) than in Indo-China (IC) and wondered if that had to do with the dataset being used (APHRODITE) or to do with region specific biases in places closer to the Tibetan plateau. Dr. Ngo-Duc noted that the RegCM4 tend to have cold biases around 1-2°C in Vietnam.
- Prof. Manton suggested to consider analysing if there are links between the biases in temperature and rainfall (especially over the IC), to which Dr. Juneng confirmed that regions with wet biases in general coincided with regions that had cooler biases. This raised the issue on the possibility of the deep convection schemes generating too much precipitation. On this, Dr. McGregor and Prof. Manton pointed out that shallow-convection schemes could be a potential option to reduce these observed model artefacts.
- Questions were asked by Prof. Manton and Dr. Cruz if there were a generally accepted, default scheme for RegCM4 that could (or should) be applied to particular regions such as SEACLID. Dr. McGregor noted that in some RCMs the use of a single-combination of physics schemes across different regions was being practiced.

5.3 Evaluation of Tmin and Tmax

Indonesia presented findings on the evaluation of maximum temperature (Tmax) and minimum temperature (Tmin) for 9 experiments (2, 3, 4, 5, 6, 10, 13, 15, and 17) against CRU dataset and for each of the 20 sub-regions. For this set of analyses, the annual cycle plots of Tmax and Tmin were provided.

Key Findings

- Dr. Gunawan noted that the model biases could be due to systematic errors in the model. Another possible contributing factor to the biases is the uneven distribution of station data in different sub-regions, which could compromise the quality of the CRU data for the Southeast Asia region. The way that the sub-regions were partitioned (e.g. borders cutting across mountainous regions) could also have an effect in the performance of the different experiments.
- In general, Tmax values in some sub-regions have been observed to cluster together into up to 3 groups, where each group would have similar magnitudes in their cycles. Tmin on the other hand, generally clusters into 2 such groups.

- Tmin and Tmax values from Exp 02 and Exp 03 stood out as outliers in most sub-regions showing large deviations from the ensemble average.
- In most cases, Tmax values had been underestimated compared to the CRU dataset, whereas Tmin had been overestimated, which implied that the model's diurnal cycle was weaker than the observed diurnal range.

Discussions/Comments

- On Dr. McGregor's question if the variables were being evaluated over land or over the whole area of the sub-region, Dr. Gunawan clarified that for the model variables, the areal average of sub-region had been used. To this Dr. McGregor suggested masking only model values of over land areas for evaluation. Prof. Manton added that this could have contributed the observed weak diurnal range in the models compared to observations.
- Responding to Prof. Manton's question on the schemes used in Exp 02 and 03 that could have resulted in them having the same characteristic outlier Tmin, Dr. Gunawan informed that these used the Grell-Arakawa Schubert-Zeng scheme-combination.
- To Prof. Tangang's question if other similar experiments outside SEACLID showed similar weak diurnal temperature simulations, Dr. Juneng clarified that analyses for SEACAM project's (PRECIS) output for Tmin and Tmax showed weak simulations of the diurnal range as well.

5.4 Evaluation of Circulation Fields

Thailand presented their findings from the analyses of circulation fields using four of the experiments (10, 11, 12, and 18) that were assigned to them. Two types of plots were presented; firstly, the cross-sectional (zonal) wind strength along the 100 °E longitude and secondly, the vector wind plots over the domain at 200 hPa and 850 hPa level. Each of these plots was generated for the months January (boreal winter) and also July (boreal summer). The model outputs were evaluated against ERA-Interim dataset.

Key Findings

- The experiments analysed were generally able to reproduce the regional circulation patterns produced by the ERA-Interim dataset for all aspects of analyses and for both months, although in some local areas some discrepancies could be observed (e.g. in terms of directional wind patterns over equatorial regions).
- For cross-sectional zonal wind in July, models tended to have the westerly jet present (in the higher northern latitudes) further south than the jet in the ERA-Interim dataset.

Discussions / Comments

- Dr. McGregor asked if the discrepancies in the low-level jet in both the 850 hPa wind plots and the zonal, cross-section plots, as well as the stronger model winds for the southern part of Java, were features that were expected or an artefact. Prof. Tangang suggested that by plotting the difference between the model and the ERA-Interim, the model biases in different experiments could be seen more clearly.

- Dr. McGregor also inquired if the stronger winds over Thailand corresponded with more precipitation in the region, which was subsequently confirmed by Dr. Juneng. Dr. Juneng added that the rainfall patterns between Exp 17 and 18 were very different; thus Exp 18 might need to be checked again since the two runs only differed in terms of the Zeng ocean flux scheme's roughness value.
- Prof. Manton and Dr. McGregor suggested looking at the divergence field and also the moisture flux field as these could explain relationships between observed wind and precipitation anomalies in specific regions.

5.5 Evaluation of Extremes

Vietnam informed that analyses were done for some rainfall-based extreme indices, namely RX1day[1], RX5day[2], R50mm[3], CDD[4] and CWD[5], and some temperature-based indices, namely Txx[6] and Txn[7]. These were evaluated against APHRODITE (V1003R1) for rainfall, and CRU TS 3.2 and APHRODITE (V1204R1) for temperature. For the presentation, only results for rainfall-based indices were shared. The time series of rainfall-based indices for the 10 experiments considered (01, 02, 03, 04, 05, 06, 13, 15, 16, and 17) were first evaluated against the observation's time-series. Of which, six were considered 'good' experiments and these were then further analysed using temporal correlation method. Seasonal correlation scores were also provided in the form of the Taylor's diagram.

Key Findings

- Exp 01, 02, 03, 06 seems to show erratic behavior in some of the time-series plots and may require re-runs.
- For the temporal correlation, the Indo-China region showed better correlation than other parts of the assessed domain. For most locations around the equator, correlations were either poor or negative.
- In terms of seasons, correlation scores of Exp 13 and 15 were generally better than other experiments.
- Exp 17 and 05 tend to cluster together with similar scores and likewise for Exp 16 and 04.

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[1] Monthly maximum 1-day precipitation
[2] Monthly maximum consecutive 5-day precipitation
[3] Annual count of days when precipitation≥ 50mm
[4] Maximum length of dry spell, or maximum number of consecutive days with precipitation < 1mm
[5] Maximum length of wet spell, maximum number of consecutive days with precipitation ≥ 1mm
[6] Monthly maximum value of daily maximum temperature (≈warmest daytime temperature in the month)
[7] Monthly minimum value of daily maximum temperature (≈coolest daytime temperature in the month)

- Based on the analyses that have been done for extremes, Dr. Ngo-Duc recommended to use the schemes Grell (over land), Emanuel (over ocean), and the Zeng ocean flux.

Discussions / Comments

- On Prof. Manton's question if the Exp 13 and 15 were good only for certain seasons, Dr. Ngo-Duc clarified that they were good for all seasons in general.
- Prof. Manton remarked about the performance differences between mean precipitation and extreme precipitation, that if model had biases in mean precipitation and yet did well in extremes, the model could get extremes right for the wrong reasons.
- Prof. Tangang commented on the fact that generally the Indo-China region had better correlation scores compared to the maritime continent and this could be due to more rainfall stations being represented in the gridded dataset. Dr. Ngo-Duc added that they could explore evaluating against indices derived from stations if individual countries could provide the indices.

Open Discussions / comments

- Prof. Tangang noted that a few experiments were still pending while others need to be repeated. Prof. Tangang opined that having additional RCM to be included in SEACLID could be useful for comparisons against RegCM4.
- Prof. Manton suggested once all experiments had been done and improvements to analyses as suggested in this session had been considered, it might be worth writing up a report to document the outcomes of the analyses as this would guide in making the decision for the 'best' configuration or justify strategies for the chosen configuration. Parts of the report could then be turned into publications.
- Prof. Tangang estimated that the remaining runs could be done in the next 3 months. Thus, by around April 2014 the group would be in a position to decide the physics options to be adopted and the actual simulations could be started possibly by June 2014. This would be further discussed in the following session. For the remaining runs, Prof. Tangang suggested that the team take stock of finished/pending runs and coordinate further.
- The issues of whether to use more than one RCM or to use multiple options within RegCM4 will be discussed in detail in the following session.

6. Session IV: Open Discussion on SEACLID/CORDEX-SEA Follow-up Actions and Coordination with Potential Collaborators

Prof. Tangang highlighted six issues that are important for follow-up actions in SEACLID/CORDEX-SEA and coordination with potential collaborators.

6.1 Domain and Resolution

Participants raised a number of issues related to the proposed SEACLID / CORDEX-SEA domain and resolution of 25 km. However, it was collectively agreed that the domain proposed earlier i.e. $80^oE – 145^oE$ and 15^oS to 40^oN and grid resolution of 25 km will be the domain and resolution specification for all SEACLID / CORDEX – SEA related downscaling activities. Details of domain and resolution specifications will be provided to members and potential collaborators.

6.2 Selection of GCMs, RCMs and RCPs

Participants had a consensus that selection of GCMs could be guided by Dr. John McGregor's work that was highlighted in his presentation as well as the more recent work by Prof. Tangang's group. Mr. David Hein strongly advocated the selection of HadGEM2. It was also agreed that member countries of SEACLID/CORDEX-SEA would be using RegCM4 while potential collaborators would be encouraged to use different RCMs as well as different GCMs. The final consensus was the SEACLID / CORDEX-SEA member countries would commit to downscale 7 GCMs [Malaysia 3; Indonesia 1; Thailand 1; Vietnam 1 and the Philippines 1]. Potential collaborators also indicated their commitment and participation to SEACLID/CORDEX-SEA, using computing facilities and resources at their respective institutions, as follows: Dr John McGregor (CSIRO), 3 GCMs using CCAM; David Hein (Hadley Centre UKMO), 1 GCM (HadGEM2) using PRECIS2; Dr Hingwei Yang (APCC), 1 GCM (HadGEM2-AO or other CGMs) using WRF; Dr Francis Tam (City University Hong Kong), 1 GCM (CCSM) using WRF. All pledged downscaling runs would be for the RCP8.5 and 4.5 except for those of CSIRO, which would only for RCP8.5. There could be other potential collaborators that will be part of this project particularly a group from Germany that would be using COMSO and/or REMO. Follow-up communication will be made to all members and collaborators and the final GCMs and RCMs selection will posted to the SEACLID/CORDEX-SEA website.

6.3 Selection of best physics options

The presentation on sensitivity experiments by member countries indicated that the task has yet to be completed both in terms of runs and analyses. This activity will continue until early next year. **Appendix III** provides the latest information on re-assigned tasks to member countries for speedy completion of these experiments.

6.4 Inter-comparison between SEACLID/CORDEX-SEA and SEACAM

Raizan Rahmat of Meteorological Service Singapore proposed products inter-comparison between SEACLID / CORDEX-SEA and SEACAM. Given the experimental setups of the two projects are not identical, fully objective comparisons may not be possible. However, it could be useful to see if there are any common spatial bias patterns in the different RCMs used, and if the range of future projections of variables such as rainfall and precipitation are comparable despite different experimental configurations.

6.5 Data Sharing

Participants agreed that since these activities are undertaken under CORDEX umbrella, data-sharing would follow CORDEX data-sharing policy. For SEACLID/CORDEX-SEA, a datacenter will be established. However, hardware and internet bandwidth limitation faced by member countries could be a major problem in establishing such a data center. As a potential solution, SEACLID/CORDEX-SEA would pursue a proposal made by Prof. Jaiho Oh of Pukyong National University for his institution to become the official CORDEX data center for Asia region.

6.6 Implementation schedule

There is a need to have a schedule, which indicates the activities and milestones as a reference to members and collaborators (as well as other potential collaborators). A revised version of the timetable in the SEACLID APN proposal is found in Table V.1 in Appendix V. Table V.2 lists the schedule of the workshops. This information will also be distributed through email and uploaded to SEACLID / CORDEX-SEA website.