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GLOBAL CHANGE RESEARCH

FINAL REPORT

SEACLID/CORDEX Southeast Asia Phase 2:
High-resolution analysis of climate extreme over key
areas in Southeast Asia

CRRP2016-02MY-Santisirisomboon

2022



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the material contained herein. The use of geographic names, boundaries and related data on maps, and in lists and tables within this publication are not warranted to be error-free, nor do they imply any endorsement by APN.

1. Summary

The second phase of the SEACLID/CORDEX Southeast Asia project examined extreme climate events in key Southeast Asian areas through active engagement and collaboration with stakeholders/end-user groups. Key vulnerable areas in the region (e.g. megacities, coastal/low-lying urban areas, areas of frequent flooding or drought) were identified based on their exposure and vulnerability to climate extremes and through consultation with stakeholders/end-user groups. Further downscaling over these key vulnerable areas was carried out using the multi-model, multi-scenarios and informed by key findings from the project's first phase to generate high-resolution (5 km) climate projection data. This newly generated dataset will be archived as part of the Earth System Grid Federation (ESGF), allowing free user community access. Model performances, biases and projection uncertainties were examined, and data usage guidelines incorporating this information were developed and disseminated to users at the end of the project. Five face-to-face and two online technical workshops of SEACLID/CORDEX Southeast Asia Phase 2 were conducted along with the Stakeholder Engagement workshops in Thailand, Malaysia, Philippines, Vietnam and Indonesia. Moreover, two regional training workshops on the Regional Climate Model and one local training workshop on data access were conducted in Vietnam and Thailand. This project will strongly support APN's research agendas on climate change and variability, risk reduction and resilience at regional scale and have direct relevance to international processes such as the IPCC, UNFCCC and IPBES.

2. Objectives

- 1) To provide high-resolution multi-model, multi-scenario climate change and climate extremes projection for selected key vulnerable areas in Southeast Asia region
- 2) To establish stronger collaboration with stakeholders through user needs assessment and guiding usage of climate information created from the project

3. Outputs, Outcomes and Impacts

Outputs	Outcomes	Impacts
<p>Completed six face-to-face and two online workshops</p> <ul style="list-style-type: none"> - The Inception Workshop of Southeast Asia Regional Climate Downscaling (SEACLID)/CORDEX Southeast Asia Project Phase 2: High-resolution analysis of climate extremes over key areas in Southeast Asia at RU-CORE, Bangkok, Thailand on 10 – 11 July 2017 - The Second Technical Workshop of the Second Phase of the Southeast Asia Regional Climate Downscaling (SEACLID)/CORDEX Southeast Asia Project at Universiti Kebangsaan Malaysia, Bangi, Selangor on 7 – 9 May 2018 	<p>Project outreach</p>	<p>Established stronger collaboration with stakeholders</p>

Outputs	Outcomes	Impacts
<ul style="list-style-type: none"> - The Third Technical Workshop of the Second Phase of the Southeast Asia Regional Climate Downscaling (SEACLID)/CORDEX Southeast Asia Project in Manila, Philippines on 10 – 11 July 2019 - The CORDEX Southeast Asia Outreach and Capacity Building Workshop (4th Technical Workshop) Via Online organised by USTH, HUS, RU-CORE and UKM on 17 – 19 November 2020 - The CORDEX Southeast Asia Outreach and Capacity Building Workshop Via Online organised by BMKG, RU-CORE and UKM on 15 – 17 November 2021 - The Technical Workshop of SEACLID/CORDEX Southeast Asia Phase 2 in Quy Nhon, Vietnam on 7 – 11 August 2022 - The CORDEX Southeast Asia Workshop in Bangkok, Thailand on 8 – 9 November 2022 - The CORDEX Southeast Asia ESD Workshop in Bangkok, Thailand on 10 November 2022 		
<p>Conducted two regional training workshops</p> <ul style="list-style-type: none"> - The Second Training Workshop on Regional Climate Modelling for Southeast Asia at VNU University of Science, Hanoi, Vietnam on 22 – 26 October 2018 - 2017 NCAR/Ramkhamhaeng University WRF Regional Weather/Climate Modelling Workshop at RU-CORE, Bangkok Thailand on 16 – 18 October 2017 	Capacity building for young climate researchers	- Researchers using climate modelling to study climate change
<p>Conducted one local training workshop collaborated with the Rice Department, Ministry of Agriculture and Cooperatives, Bangkok, Thailand on 22 – 24 July 2020</p>	Capacity building for young climate researchers	Researchers using CORDEX-SEA data to study the impacts of climate change on rice production
<p>Conducted one local stakeholder workshop</p> <ul style="list-style-type: none"> - The 1st DOST-CORDEX Stakeholder Workshop on Climate Information for Local Adaptation in the Philippines, in 	Project outreach	Established stronger collaboration with stakeholders

Outputs	Outcomes	Impacts
<p>Manila, Philippines, on 11 – 12 July 2019</p>		
<p>Completed downscaling 3 GCMs and 2 RCPs over CORDEX SEA domain region 14 with 25 km resolutions using RegCM4.7 for the following period</p> <ul style="list-style-type: none"> - RF (baseline): 1970 – 2005) - Projection (RCP4.5 and RCP8.5): 2006 - 2100 	<ul style="list-style-type: none"> - Climate data set to support climate change studies - Used as inputs to 2 research projects and three national projects headed by Asst. Prof. Dr Jerasorn Santisirisomboon and funded by the Thailand Research Fund (TRF), National Research Council of Thailand (NRCT), Office of Natural Resources and Environmental Policy and Planning (ONEP), United Nations Development Programme (UNDP) and Rice Department - Used as inputs to a collaboration research project with the Thailand Development Research Institute (TDRI) and funded by United Nations Children's Fund (UNICEF) 	<p>CORDEX-SEA data (25-km version) have been used</p> <ul style="list-style-type: none"> - to build the national climate change scenarios of Vietnam by the Ministry of Natural Resources and Environment (MONRE) - to compile the National Action Plan for Climate Change Adaptation of Indonesia by BMKG and the National Development Planning Agency (Bappenas). (https://lcdi-indonesia.id/wp-content/uploads/2020/10/Proyeksi-Iklim-Atmosferik.pdf) - to build the national climate change scenarios of Thailand by the Ministry of Natural Resources and Environment (MNRE) - to prepare Thailand's Fourth National Communication (NC4) by the Ministry of Natural Resources and Environment (MNRE) - The projects would lead to the formulation of policy on the impacts, adaptation and vulnerability of climate change in Thailand
<p>Completed downscaling 3 GCMs and 2 RCPs over four vulnerable subdomains in CORDEX SEA domain region 14 with 5 km resolutions (1970 – 2005, 2080 – 2100)</p> <ul style="list-style-type: none"> - The downscaled 5km resolution model outputs over Peninsular Malaysia 	<ul style="list-style-type: none"> - Used as inputs to a national project headed by Prof Fredolin Tangang and funded by the Malaysia Ministry of Higher Education 	<ul style="list-style-type: none"> - The project "Assessment of Impacts of Global Warming of 1.5°C and 2.0°C on Water Balance, Health and Socio-Economic Implications in the Kelantan and Muda River Basins" would lead to

Outputs	Outcomes	Impacts
<ul style="list-style-type: none"> - Downscaled data using RegCM4.7 at 5km for the Lower Mekong region (joint region between Thailand and Vietnam) for three models: EC-EARTH, HadGEM2-ES, MPI-ESM-MR for the historical period 1971–2005 and the future projection period until 2100 under RCP4.5 and RCP8.5 - Downscaled data using RegCM4.7 at 5km for Mindanao for three models: EC-EARTH, HadGEM2, MPI-ESM-MR for the following periods RF (baseline): 1971-2005 RCP 4.5: 2021-2050; 2079-2099 RCP 8.5: 2021-2050; 2079-2099 - Downscaled data using NHRCM at 5km for the Philippines and 2km for Mindanao for MRI-AGCM3.2 for the following periods: RF (baseline): 19810401 – 20010430 RCP8.5: 20790401-20990430 - Downscaled data using RegCM4.7 at 5km for Java Islands, Indonesia for three models: EC-EARTH, HadGEM2, MPI-ESM-MR for the following periods historical (baseline): 1971-2005 future projection: RCP 4.5: 2006-2099 RCP 8.5: 2006-2099 	<ul style="list-style-type: none"> - High-resolution climate data set to support climate change studies - Capacity building of students, researchers and end-users - Stronger collaboration with end-users in the academe and vulnerability, impacts, adaptation (VIA) sector through workshops and meetings 	<p>the formulation of policy briefs/papers on the impacts of climate change in Malaysia, specifically over the two basins (https://www.ukm.my/globwarm/)</p> <ul style="list-style-type: none"> - Researchers using data for research projects on the impacts, adaptation and vulnerability of climate change - Undergraduate thesis using data for wind turbine design assessment in Mindanao

4. Key facts/figures

3 GCMs downscaled to 25km for Southeast Asia, then further downscaled to 5km for 4 key vulnerable areas in the region using two (2) RCP scenarios

Indonesian team:

- Hosted the CORDEX Southeast Asia Outreach and Capacity Building Workshop (5th Technical Workshop) via online on 15 – 17 November 2021
- CORDEX-SEA 25 km data have been used to design the National Action Plan for Climate Change Adaptation of Indonesia by BMKG and the National Development Planning Agency
- Working on publication with a title of “Evaluation of rainfall bias-corrected in high resolution CORDEX-SEA over Java Island”

Malaysian Team:

- Hosted the Second Technical Workshop of the Second Phase of the Southeast Asia Regional Climate Downscaling (SEACLID)/CORDEX Southeast Asia Project in Selangor, Malaysia on 7 – 9 May 2018
- Early career scientist (1: Dr Chung Jing Xiang)
- 1 PhD graduated (Ngai Sheau Tieh),
- 1 MSc student (Nurul Ain)
- Generated data used for other national project (Assessment of Impacts of Global Warming of 1.5°C and 2.0°C on Water Balance, Health and Socio-Economic Implications in the Kelantan and Muda River Basins, LRGS 1.5/2.0 – Global Warming (ukm.my))

Philippines team:

- Hosted the Third Technical Workshop of the Second Phase of the Southeast Asia Regional Climate Downscaling (SEACLID)/CORDEX Southeast Asia Project in Manila, Philippines on 10 – 11 July 2019
- Hosted the 1st DOST-CORDEX Stakeholder Workshop on Climate Information for Local Adaptation in the Philippines, in Manila, Philippines on 11 – 12 July 2019
- Sensitivity analysis presented in ICRC CORDEX 2019 (poster presentation)
- Results of Phase 2 presented in 2021 CORDEX Southeast Asia Outreach and Capacity Building Workshop (online)
- CORDEX-SEA data (Phase 1) have been used as part of the model ensemble for the national climate change scenarios of the Philippines

Vietnam team:

- Hosted the RegCM training workshop in Hanoi, Vietnam on 22 – 26 October 2018
- Hosted the CORDEX Southeast Asia Outreach and Capacity Building Workshop (4th Technical Workshop) via online on 17 – 19 November 2020
- Hosted the 6th technical Workshop of SEACLID/CORDEX Southeast Asia Phase 2 in Quy Nhon, Vietnam on 7 – 11 August 2022
- 2 PhDs graduated (Trinh Tuan Long, Nguyen Thi Tuyet)
- 2 PhD on-going (Nguyen Ngoc Bich Phuong, Vu Thi Nhung)
- 01 Master (Hoang Cong Huy)

- CORDEX-SEA data have been used to build the national climate change scenarios of Vietnam by the Ministry of Natural Resources and Environment (MONRE)

Thai team:

- Hosted the Inception Workshop of Southeast Asia Regional Climate Downscaling (SEACLID)/CORDEX Southeast Asia Project Phase 2: High-resolution analysis of climate extreme over key areas in Southeast Asia at RU-CORE, Bangkok, Thailand on 10 – 11 July 2017
- Hosted the CORDEX Southeast Asia Workshop (Final Workshop) in Bangkok, Thailand on 8 – 9 November 2022
- Hosted the CORDEX Southeast Asia ESD Workshop in Bangkok, Thailand, on 10 November 2022
- Hosted the 2017 NCAR/Ramkhamhaeng University WRF Regional Weather/Climate Modelling Workshop at RU-CORE, Bangkok, Thailand on 16 – 18 October 2017
- Hosted the local training workshop collaborated with the Rice Department, Ministry of Agriculture and Cooperatives in Thailand on 22 – 24 July 2020
- 1 MSc on-going (Ratchanan Srisawadwong)
- CORDEX-SEA data (25-km version) have been used
 - + to build the national climate change scenarios of Thailand by the Ministry of Natural Resources and Environment (MNRE)
 - + to prepare Thailand's Fourth National Communication by the Ministry of Natural Resources and Environment (MNRE)
 - + to develop the wNetCDF2DSSAT library on Python environment to convert climate data set in NetCDF file format to DSSAT
 - + to prepare the draft final manuscript entitled "wNetCDF2DSSAT tool for assessing impacts of climate change with CSM-DSSAT models: SEACLID/CORDEX Southeast Asia data set."
- CORDEX-SEA data (25-km version) have been used as input to the following projects
 - + "Variability Characteristics and Mechanism of Extreme Events in South Asian Monsoon Region under changing climate" funded by the Thailand Research Fund (TRF)
 - + "A comparative study on the change of hydrological processes and fluxes in the Jiulong River and Chao Phraya River basins under changing climate" funded by the National Research Council of Thailand (NRCT)
 - + "Climate change projections in vulnerable areas for rice production in Thailand" funded under the annual government statement of expenditure of the Rice Department
 - + "Development of Database System for Geospatial Risks from Climate Change" funded by the Office of Natural Resources and Environmental Policy and Planning (ONEP)
 - + "Increasing resilience to climate change impacts in marine and coastal areas along the Gulf of Thailand", funded by the United Nations Development Programme (UNDP)
 - + "Impact Assessment of Climate Change and Environmental Degradation on Children in Thailand", a collaboration project headed by the Thailand Development Research Institute (TDRI) funded by the United Nations Children's Fund (UNICEF)

5. Publications

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- Hoang-Cong, H., Ngo-Duc, T., Nguyen-Thi, T., Trinh-Tuan, L., Jing Xiang, C., Tangang, F., Jerasorn, S., & Phan-Van, T. (2022). A high-resolution climate experiment over part of Vietnam and the Lower Mekong Basin: performance evaluation and projection for rainfall. *Vietnam Journal of Earth Sciences*, 44(1), 92–108. <https://doi.org/10.15625/2615-9783/16942>
- Magnaye, A. M., Narisma, G. T., Cruz, F. T., Dado, J. M., Tangang, F., Juneng, L., Ngo-Duc, T., Phan-Van, T., Santisirisomboon, J., Singhruck, P., Gunawan, D., Aldrian, E. (2021). Potential influence of sea surface temperature representation in climate model simulations over CORDEX-SEA domain. *Int. J. Climatol.* 42, 3702–3725 <https://doi.org/10.1002/joc.7440>
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- Vu, D.Q., Q.V. Doan, T. Ngo-Duc, N. Dinh, D.D. Nguyen, 2022: Offshore wind resource in the context of global climate change: a case study of a tropical sea. *Applied Energy*, 308, 118369, <https://doi.org/10.1016/j.apenergy.2021.118369>.
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- [Book chapter] Tangang, F., J.X. Chung, F. Cruz, Supari, S.T. Ngai, E. Salimun, F. Cruz, G. Narisma, T. Ngo-Duc, J. Santisirisomboon, L. Juneng, A. Spaheluwakan, M.F. Akhir, M.S.F. Mohd, 2021: Progress in Climate Change Downscaling Simulations in Southeast Asia. Springer book chapter in "Climate Resilience and Environmental Sustainability Approaches – Global Lessons and local Challenges" (edited by A. Kaushik, C.P. Kausick, and S.D. Attri), Springer, 12–36.
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- Supari, F. Tangang, L. Juneng, F. Cruz, J.X. Chung, S.T. Ngai, E. Salimun, M.S.F. Mohd, J. Santisirisomboon, P. Singhruck, P.V. Tan, T. Ngo-Duc, G. Narisma, E. Aldrian, D. Gunawan, A. Sopaheluwakan, 2020: Multi-model Projections of Precipitation Extremes in Southeast Asia based on CORDEX-Southeast Asia simulations. *Environmental Research*, 184, 109350, <https://doi.org/10.1016/j.envres.2020.109350>.
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6. Media reports, videos and other digital content

- <http://www.rucore.ru.ac.th/SARCCIS>
- <https://climate.onep.go.th/th/topic/database/riskmaps/>
- <http://www.rucore.ru.ac.th/SARCCIS/DSSAT/>
- <http://www.rucore.ru.ac.th/SARCCIS/Riskmaps/>
- Philippine Climate Extremes Report 2020 (<https://climate.gov.ph/news/645>)
- <https://lcdi-indonesia.id/wp-content/uploads/2020/10/Proyeksi-Iklim-Atmosferik.pdf>
- https://ditjenppi.menlhk.go.id/reddplus/images/adminppi/adaptasi/dokumen/Roadmap_NDC_API_opt.pdf
- https://unfccc.int/sites/default/files/resource/Indonesia_LTS-LCCR_2021.pdf
- <https://www.youtube.com/watch?v=mT5H5gl8POQ>
- <https://www.youtube.com/watch?v=Tc53ts5uz-M>

7. Pull quotes

Prof Dr. Fredolin Tangang

Universiti Kebangsaan Malaysia
CORDEX SAT Member

“This project delivers regional climate information required to address the impacts of climate change at the basin scales”

Prof. Dr. Attachai Jintrawet,

Chiang Mai University,
Expert in DSSAT model.

“wNetCDF2DSSAT library/interface, a CORDEX's product, will play a key role in linking the climate and crop modelling communities to collaborate in planning for climate change adaptation and mitigation.”

Dr. Faye Abigail Cruz

Manila Observatory
CORDEX-SEA POC, IPCC AR6 WGI Lead Author

“In the Working Group I contribution to the Sixth Assessment Report of the IPCC, there is notably more information on the regional-scale observed and projected changes in climate, and CORDEX Southeast Asia has significantly contributed to this more robust climate change assessment in this region.”

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- National Research Council of Thailand (NRCT)
- Office of Natural Resources and Environmental Policy and Planning (ONEP), Ministry of Natural Resources and Environment (*Thailand*)
- United Nation Development Programme (UNDP)
- Rice Department, Ministry of Agriculture and Cooperatives (*Thailand*)
- Thailand Development Research Institute (TDRI)
- United Nations Children's Fund (UNICEF)

9. Appendices

Not available