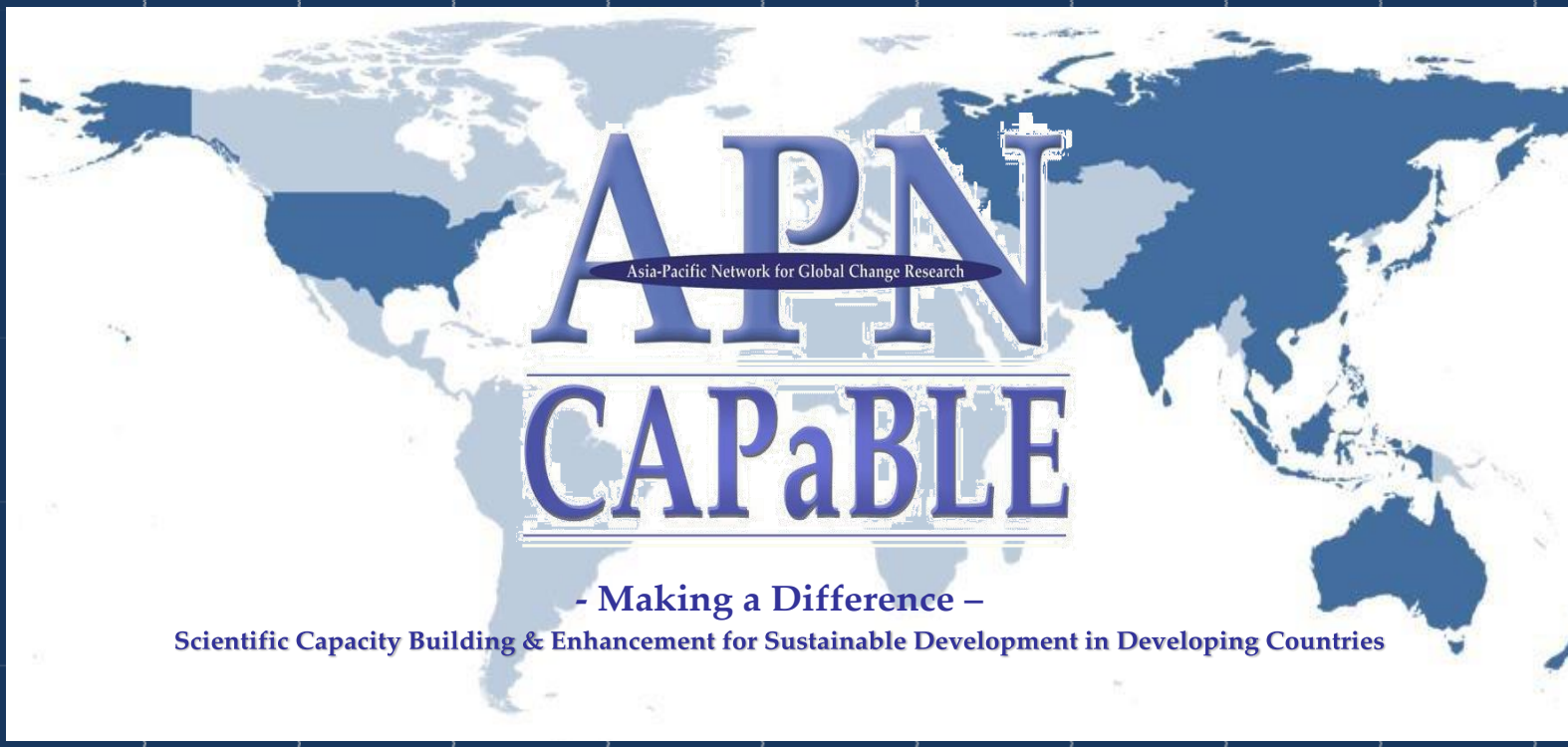
Project Reference Number: CBA2019-12SY-Jiang

Facilitating the attendance, interaction and training of young and developing nation scientists from Asia-Pacific at the WCRP Institute of Advanced Studies in Climate Extremes and Risk Management



The following collaborators worked on this project:

Project Leader Zhihong Jiang, Nanjing University of Science and Technology (NUIST), zhjiang@nuist.edu.cn

Collaborator Xuebin Zhang, Environment and Climate Change Canada (ECCC), xuebin.zhang@canada.ca

Collaborator Boram Lee, World Meteorological Organization (WMO), blee@wmo.int

Collaborator Qunli Han, Integrated Research on Disaster Risk (IRDR), qunli.han@irdrinternational.org

Facilitating the attendance, interaction and training of young and developing nation scientists from Asia-Pacific at the WCRP Institute of Advanced Studies in Climate Extremes and Risk Management

Project Reference Number: CBA2019-12SY-Jiang
Final Report submitted to APN

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OVERVIEW OF PROJECT WORK AND OUTCOMES

The **Institute of Advanced Studies in Climate Extremes and Risk Management** (https://www.wcrp-climate.org/extremes-risk-summer-school-overview), held in Nanjing, China from 21 October to 1 November 2019, was organized by the World Climate Research Program (WCRP) in collaboration with the Nanjing University of Science and Technology (NUIST), Integrated Research on Disaster Risk (IRDR), and the SysTem for Analysis, Research and Training (START). The initiative was endorsed by the International Panel for Climate Change (IPCC) and the International Science Council (ISC).

This event was conducted in the format of a summer school, attended by 29 participants from 17 countries as well as ~10 local students from the NUIST. All participants were provided with lodging and meals by the NUIST, and thanks to the sponsors such as APN, about 70 percent of the participants were supported financially for their travels.

The Institute/summer school brought together the world-lead experts from the two communities in order for future leaders in the two disciplines to become familiar with aspects of the other disciplines. The participants as well as the expert lecturers enjoyed significant benefits from the interactive training during the course, to learn from each other on a mutual topic of extremes and risk management. This event provided the basis of collaborative research on the following key topics:

- Attribution of changes in the frequency and intensity of extremes
- Climate risk from compound events
- Projections and predictions of extreme events
- Climate risk reduction and management

Keywords

Climate Extremes and Risk Management, Vulnerability, Impact and Adaptation, Interdisciplinary training, World Climate Research Programme, WCRP Grand Challenge, International Research on Disaster Risk

Amount received and number of years supported

The Grant awarded to this project for 2019 was **US$30,000.** The APN grant was implemented by the Nanjing University of Science and Technology (NUIST).

Amount executed and projected spending, as of December 2019

- **US$ 2,000** was disbursed for the engagement of a summer school coordinator.
- **US$ 7,910** (equivalent to Chinese Yuan 54,161) was executed for the reimbursement of air tickets for selected participants.

(As indicated in the final proposal, **US$ 6,000** will be used for the publication of the report and journal articles.)

TECHNICAL REPORT

Introduction

Overall statistics of economic losses incurred by natural disasters are in an upward spiral. Many of these natural disasters are weather and climate extremes related. Yet, the impacts and disasters are the results of the complex interplay of climatic, environmental, and human factors. The severity of impacts from weather and climate extremes depend not only on the extremes themselves but also on exposure and vulnerability. Weather and climate extremes are and will be changing due to human-induced climate change. Exposure and vulnerability are also changing because of social and economic development and as responses to weather and climate extremes. These collective variables impose a bigger challenge than ever before to manage disaster risks.

The climate research community has made significant contributions to the advance of the comprehension of past and future changes in weather and climate extremes. The disaster management community has also significantly developed their understanding of causes of disaster risk. Yet, there is a barrier to the flow of knowledge between the aforementioned two communities. Disaster risk management towards reducing exposure and vulnerability and increasing resilience to the potential adverse impacts of weather and climate extremes requires the integration of knowledge from both communities.

The Institute of Advanced Studies in Climate Extremes and Risk Management (https://www.wcrp-climate.org/extremes-risk-summer-school-overview) was organized with a view to bridging this gap by promoting active knowledge exchanges and integration across climate research and disaster risk reduction research communities. It took the academic approach to young scientists to:

- Provide a forum and environment in which world-lead experts from the two communities are brought together to learn from each other on weather and climate extremes and disaster risk reduction.
- Train future leaders in the two disciplines such that they both are familiar with aspects of the other disciplines

This Institute of Advanced Studies is organized by the World Climate Research Program (WCRP), led by the WCRP Grand Challenge on Weather and Climate Extremes (GC-Extremes), in collaboration with Future Earth, Integrated Research on Disaster Risk (IRDR) and Nanjing University of Science and Technology (NUIST). This activity was endorsed by the International Science Council (ISC).

- Dates: 21 October - 1 November 2019
- Venue: Nanjing University of Science and Technology (NUIST), China

Activity undertaken and results: Methodology and Results

The WCRP received 439 applications for participation, out of which 389 applications were requesting financial support. The distribution of applicants is as follows:

Regional Statistics	
Africa	177
Asia	183
China	25

Europe	10
America	33
Australia, New Zealand, SIDS	6
CIS	5
TOTAL	439

Gender Statistics	
Male	318
Female	121
TOTAL	439

Early Career Statistics	
Yes	318
No	121
(unanswered)	3
TOTAL	439

A review process to evaluate these applications was carried out by a group comprising all the lecturers and the representatives of WCRP, IRDR, START and NUIST (and led by the co-chair of the WCRP Grand Challenge on Weather and Climate Extremes). Taking primarily the career stage (early career scientists) into account, the group assessed the applications based on the following major criteria:

- Excellence; relevant scientific expertise; relevant areas are equally considered, from the fundamental climate research to risk management.
- Clarity in the research plan that was submitted as part of the application.
- Gender and regional diversity; at the second stage of review, the final selection considered the distribution of region and gender balance.

From the total pool of applicants, 49 applicants were identified as eligible for participation and to receive financial support for travel (upon request). Out of this firstly-selected pool, 23 applicants from outside China were finally invited to the summer school together with a small number of young climate scientists from China (Among them, 4 international selectees could not travel due to visa and other national administrative issues). 8 of the final selectees from the international pool were supported by the APN grant and the remaining selectees were sponsored by the WCRP, IRDR and START, and the other sponsors to their scientific activities.

The final list of participants is shown in *Appendix 1* to this report. The list of APN-funded participants, with the details of financial support, is shown in *Appendix 2*.

The summer school, Institute of Advanced Studies in Climate Extremes and Risk Management, aimed to provide a forum and environment in which world-lead experts from two communities were brought together to learn from each other on the subjects of weather and climate extremes and disaster risk reduction. The lectures and project works were designed to train future leaders in the two disciplines such that they both are familiar with aspects of the other disciplines.

The final programme of the summer school is as follows:

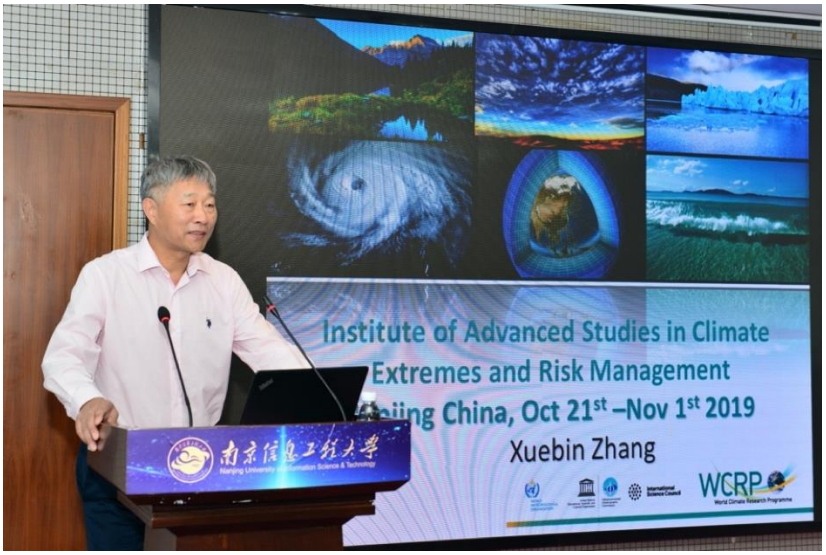
	Day 1 (Oct 21)	Day 2 (Oct 22)	Day 3 (Oct 23)	Day 4 (Oct 24)	Day 5 (Oct 25)
Session 0 (8:30-8:40)	Registration (from 8:00)	Summary of previous day by students	Summary of previous day by students	Summary of previous day by students	Summary of previous day by students
Session 1 (8:40-10:00)	· Welcome and Introduction (UNIST, WCRP, IRDR) · Introduction of the institute and logistics (Xuebin Zhang and local host) · Introduction of lectures and students	Compound event I (Bart van den Hurk)	Drivers of climate extremes; why it is important to understand them II (Erich Fischer)	compound event II (Bart van den Hurk)	Game play (led by Erich Fischer)
Break (10:00-10:30)					
Session 2 (10:30-12:00)	Temperature extremes (Erich Fischer)	Drivers of climate extremes; why it is important to understand them I (Erich Fischer)	Student posters discussion (group I)	Student posters and discussion (group II)	Progress report by students (10 minutes + discussion per project)
Lunch (12:00-13:30)					
Session 3 (13:30-15:00)	Project assignment and project meeting *	Project work, meet the lecturers	Project work, meet the lecturers	Risk framework: hazard, exposure and vulnerability (Reinhard Mechler, remote)	Science-policy for climate and DRR discourses (Reinhard Mechler, remote)
Break (15:00-15:30)					
Session 4 (15:30-17:00)	Project work	Project work	Project work	Project work	Project work

* Students are grouped into projects: Each project supervisor will introduce to the respective group the details of the project. Note that project description will be provided to students in advance and students are required to fill in their preference. Students will be grouped taking region/gender/expertise balance into consideration.

	Day 6 (Oct 28)	Day 7 (Oct 29)	Day 8 (Oct 30)	Day 9 (Oct 31)	Day 10 (Nov 1)
Session 0 (8:30-8:40)	Summary of previous day by students	Summary of previous day by students	Summary of previous day by students	Summary of previous day by students	
Session 1 (8:40-10:00)	Climate information (Bart van den Hurk)	Introduction to event attribution (Francis Zwiers)	Estimation of large return values (Francis Zhang)	Big data (Alexis Hannart)	Causal framework and event attribution (Alexis Hannart **)
Break (10:00-10:30)					
Session 2 (10:30-12:00)	Extreme value theory (Alexis Hannart)	Changes in extreme precipitation I (Xuebin Zhang)	From climate to adaptation: a few case studies (Alexis Hannart)	Changes in extreme precipitation II (Xuebin Zhang)	Project report and follow-up work planning
Lunch (12:00-13:30)					
Session 3 (13:30-15:00)	Project work	Project work	Project work	Project work	· Project report and follow-up work planning · Closing (15:00)
Break (3:00-3:30)					
Session 4 (15:30-17:00)	Project work	Project work	Project work	Preparation for project report	

** Note that this seminar will be given at college of Atmospheric Sciences, location TBD. All participants are welcome to attend. Students may also work on their projects.

As the participants come from very diverse backgrounds from climate science to engineering to risk management, it was important to cover some basics. Lectures held in the mornings did so by covering the basics of climate science, fundamentals of risk evaluation and management. In-depth excursions to the current frontiers of some aspects of research on extremes have been provided with the latest case studies and research methods and results; these include the past changes in temperature and precipitation extremes and their causes, and future projections, compound extreme events, future projection of flood relevant to hydro-power operation, the IPCC risk framework, etc. The afternoons and remaining evenings were devoted to the practical application of the material covered in the lectures, by four groups; a set of research problems have been deliberated by different teams to produce an important part of its long-term legacy.



Dr Xuebin Zhang during one of his morning lecture.

A group working on its research problem, under the supervision of Dr Bart van den Hurk.

An afternoon session: groups looking into their data to explain the research problems.

These research problems, for which their descriptions are reproduced in *Appendix 3*, were carefully selected by the summer school lecturers and leading programmes' representatives in order to ensure the traceability and teamwork. Each group was guided by one or two lecturers/advisors to advance the problems over the 2-week duration of the school, aiming to publish the results (with some follow-up work) in a peer-reviewed journal.

Together with the pre-study material, lecture materials and research problems were developed in view of the integration of WGI/II knowledge – for example, climate event attribution has been explained in connection with the impacts and their management. Particular attention has been drawn to compound events, their diversity and impacts. And projection of future climate extremes was linked to impact application such as heatwave and health impacts, as well as extreme precipitation and engineering design for flood prevention. Additionally, risk reduction and management were linked to science policy.

As a part of the summer school activities, all participants presented the posters on their research activities (ongoing and planned).

All the pre-study material and lecturer material were made available online, for all participants and those who are interested in follow-up from a distance: https://www.wcrp-climate.org/extremes-risk-summer-school-resources.

In addition to the increased knowledge and information on the dealt subject, the activity has resulted in the following:

- Enhanced understanding by the participants on the current frontiers in the subjects covered by the summer school through lectures, questions/answers, and research projects.
- Mutual recognition and awareness of the progress made within the climate research and the risk management communities, on individual, regional and global scales.
- Facilitating the development of cross-disciplinary partnerships and collaborations to support and enhance ongoing and future scientific progress in risk reduction and resiliency building against climate change and extremes, particularly among young scientists.
- Creation of joint and collaborative research initiatives for early career scientists for extreme research and for risk analyses/management.
- Increasing the visibility of APN and its goals/priorities to young scientists in the areas of climate extremes and risk management.
- Providing opportunities for networking and interaction of early career scientists with their peers across the world and also with high level scientists.

Relevance to the APN Goals, Science Agenda and to Policy Processes

This activity has been designed and conducted in line with all APN's goals and research agenda, most notably; 1) Climate Change and Climate Variability, and; 5) Risk Reduction and Resilience. Knowledge and information built up through the WCRP Grand Challenge on Weather and Climate Extremes (GC-Extremes) have been effectively shared through this summer school. Taking advantage of the location where the activity took place, and the sponsorship of the APN, the young Asian-Pacific region scientists de facto expanded its network to the other regions and to global partners/programmes, to plan for in-depth and joint research activities in coming years that are streamlined by many international entities

including the IPCC, WCRP, IRDR and Future Earth.

Furthermore, the activity has addressed the high priority topics of APN sub-regions, including; a) Extreme events related to monsoon and climate change (South Asia); b) New Technology to enable local climate resilience (Southeast Asia) and; c) Extreme events in a changing climate (Temperate East Asia). In line with the highest priority APN goal, the enhanced scientific leadership in Asia-Pacific region would accelerate the knowledge creation in a cross-disciplinary manner, and empower the responding ability to the increasing vulnerability to a changing climate.

It is expected that the outcome of the summer school will further enhance the capacity of APN countries to closely participate in and contribute to the evolving global change arena, particularly the Sustainable Development Goals (including the Goal 11: Sustainable cities and communities, Goal 13: Climate Action, as well as the Goal 4: Quality Education) as well as the Sendai Framework for Disaster Risk Reduction 2015–2030.

Conclusion: Self-evaluation

Our firm belief and conviction are that the summer school was a big success in achieving the objectives for instance; demonstrating and sharing the latest knowledge and tools for future science leadership, sharing best practices and featuring discussions to further develop joint studies. All of those aforementioned would have not been attainable without the financial support from several contributors, among them APN. Various constraints on travel for many institutions worldwide prevented a few selectees from attending, nevertheless the event met its objectives in overall attendance. In addition to the selected and sponsored by APN and other partners, a number of young scientists from NUIST actively contributed to the success of the activity. They pitched in by attending the lectures and group activities, and actively interacting with the international participants.

This summer school has received great appreciation not only from the participants but also from the partners and sponsors, for elevating international visibility of the subjects. As for the coverage of the research discipline, it has provided an excellent overview of the state-of-art research in some areas of extremes, including methods and theories, mechanisms (e.g. heat and precipitation extremes, compound events), attribution, impact and risk management/mitigation, along with immersive experience of decision-makers through the game and group activities. In particular, the game on the extremes/seasonal forecast/investment/insurance/decision have provided a stimulating experience on how to cope with extremes and to face uncertainties that always exist in decision making.

All participants have been assigned projects of which the initial work has started at this summer school; they serve as the channel to apply what have been learnt on extreme analyses, and to get involved in and extend the international joint activities among the scientists with different backgrounds. The still on-going post-workshop activities with an aim to produce a publishable paper shall enhance the bond among the participant and shall have lasting positive effect on their career development.

Group photo of the summer school participants, lecturers and organizers, 21 October 2019

Regarding the points for improvement, we felt that further engagement of policy development / decision making may enhance the outcome of such activities in the future. This year's activity has well covered the theories and case studies, and the situational exercise through games – meanwhile, a more ground-based exercise could be used to elaborate the learning. This will need more thorough preparation in advance, to analyse as per the most relevant extremes and risks, and to identify and engage not only the academic experts but also the experienced practitioners in the field. While there is an increased need to facilitate dialog and communication between climate science and risk management communities, filling such a gap is a huge challenge. For example, it was difficult to attract high-calibre experts from risk management community to lecture at the summer. It was planned to have two or three lectures from that community but at the end, only one lecturer participated in the summer school.

In order to produce fresh examples and case studies, the whole line of activity should include more extensively advanced preparation for data and initial analyses. It is proposed that the future planning could include not only the conduce of the summer school but also the collection of (regional) data and associated pre-studies in group. Meanwhile, it requires a larger commitment by individual lecturers, which potentially makes the engagement of top experts more difficult.

All participants have provided thorough evaluation reports, for their reflection and for improvement of such initiatives in the future. Those from the APN-funded participants are provided in *Appendix 4*.

Future Directions

WCRP and partner programmes evaluate all project components over the short (post event reflection

report), medium (publication of collaborative work through the summer school) and long term (new research collaborations and job prospects) to determine the capacity development achieved by each supported individual.

The key method for tracking and assessing the short-term impact will be through a post event reflection survey for all supported participants; this will determine, albeit subjectively, the benefit of attendance experienced in terms of opportunity to discuss current research, new connections and collaborations built, new skills gained during training and networking, interaction with impacts and decision-making communities, and impact on their future work. All the training material and collaborative work during the summer school were uploaded to the conference website (https://www.wcrp-climate.org/extremes-risk-summer-school-overview) offering continued availability of learning opportunity to those interested young scientists.

This summer school is a strong communicative interactive activity even as a standalone, and will stimulate active exchanges of global and regional research on extremes and risk management, particularly of the Asia-Pacific region. The project activities and the results would be disseminated and communicated to stakeholders at scientific, policy and academic levels.

All participants are requested to summarise their activities during the summer school and to reflect on their new knowledge gained during the project, to maximize the exchange of knowledge and communication with the community beyond the summer school participants. They all agreed to participate in the post-activity research based on the research problems assigned for group studies, to submit the scientific work presented at the conference to peer-reviewed journals with a full open-access.

Publications

All information on the summer school, including pre-study material and lecture material are available from the summer school web site at https://www.wcrp-climate.org/extremes-risk-summer-school-overview. In addition, all the posters of the participants will be made available at the same web site.

During the conduct of the summer school, numerous subjects relating to those research problems were discussed. Related material relating to the research problems are expected to evolve.

As a lasting legacy, results of research project will be published as peer-reviewed journal papers.

Acknowledgments

We would like to acknowledge the Nanjing University of Science and Technology (NUIST), and its Training Center, for their significant contribution to the success of the summer school. We thank the lecturers, Drs Erich Fischer (ETH Zurich), Alexis Hannart (Ouranos), Bart Van Den Hurk (Deltares), Reinhard Mechler (IIASA), Francis Zwiers (Pacific Climate Impacts Consortium) and in particular Dr Xuebin Zhang (Environment Canada) who volunteered their time and have put a lot of effort into developing the lecturers, overall programme and deliberating the selection of the participants. We thank the young scientist volunteers from the NUIST who supported the conduct of the courses and looked after all the aspects of participants.

Last but not least, we are grateful for the financial support from APN in particular, and the partners of the

WCRP (IRDR and START), that made this important activity possible.

Appendix 1 List of participants
Appendix 1 List of APN-funded participants
Appendix 3 Description of research problems dealt with during the summer school
Appendix 4 Evaluation reports by the APN-funded participants

Appendix 1: List of participants

Family Name	Given Name	Affiliation	Nationality	Gender	Study topic / research interest	Email
Alam	Md Mahmudul	Universiti Utara	Malaysia	Male	Adaptation, finance and policy under changing climate	rony000@gmail.com
Ali	Shaukat	Global Change Impact Studies Centre, Ministry of Climate Change	Pakistan	Male	Impact of Convective Schemes on Regional Climate and The Hydroclimate Projections in Typical Regions / extreme events	pirshauki@gmail.com
Kumar	Amit	Hohai University, Collage of Hydrology and Water Resources, Nanjing, China	India	Male	Estimation of the carbon stock and its GHG potential in the constructed and under constructed reservoir catchment located in Uttarakhand state of India	amit.agl09@gmail.com
Andlib	Zubaria	Department of Economics, Federal Urdu University of Arts, Science and Technology (FUUAST), Islamabad, Pakistan.	Pakistan	Female	Economic impact of natural disasters in Asia Pacific countries in three different dimensions; 1) Impact of Natural disasters on Remittances; 2) Impact of Natural Disasters on Human Capital; 3) Impact of Natural Disasters on Migration.	economist243@gmail.com
Arce Mojica	Teresa De Jesús	Uni Passau / TH Koeln	Mexico	Female	Assessing forest ecosystems vulnerability / Eco-DRR in the context of Disaster Risk Reduction	teresa.arcemoj@gmail.com
Arshad	Adnan	Department of Meteorology, China Agricultural University	Pakistan	Male	Applications of climate information/ decision support tools to mitigate the expected disaster by extreme climate and weather events (heat stress) in Asia	ad@cau.edu.cn
Casas Prat	Mercè	Environment and Climate Change Canada	Spain	Female	effects of climate change on the ocean wave climate and consequent coastal impacts	merce.casasprat@canada.ca
Cheng	Chin Hsein	NUIST	Singapore	Male	Decadal varian mechanism and projection. Energy Model	20185102001@nuist.edu.cn
Dahal	Piyush	The Small Earth Nepal	Nepal	Male	Climate/weather extremes and their impact on water resources	piyush@smallearth.org.np
Dong	Yinghua	NUIST	China	Female	Extreme value theory	dongyinghua1@163.com
Fang	Jiayi	East China Normal University	China	Female	Coastal flood risk assessment in China	jyfang822@foxmail.com
Hina	Saadia	Institute of Atmospheric Physics, CAS	Pakistan	Female	Climate variability	saadiahina@yahoo.com
Husain	Najafi	International Committee on Irrigation and Drainage (ICID))	Iran, Islamic Republic of	Male	Seasonal forecasts of temperature and precipitation for distributed hydrological modeling at river basin scale.	husain.najafi@alumni.ut.ac.ir

Islam	Muktarun	Sylhet Agricultural University	Bangladesh	Female	Modelling for freshwater/aquifer management in coastal zones	muktarun.iwfm@gmail.com
Kabore/Bontogho	Patricia Emma	University of Fada N'Gourma	Burkina Faso	Female	Local water management (Loumbila dam) under different climate change scenarios	bontoghopatricia@yahoo.fr
Li	Mei	NUIST	China	Female	Projection and Possible causes of Summer Precipitation in Eastern China using Self-organizing map	592331632@qq.com
Li	Wei	NUIST	China	Male	Regional climate change detection and attribution	weili@nuist.edu.cn
Lian	Fang	IRDR	China	Female	Crop Salinity Vulnerability Curve Construction Based on EPIC Model	fang.lian@irdrinternational.org
Lovino	Miguel	Universidad Nacional del Litoral	Argentina	Male	Climate variability and extreme events (EE) and its impact on northeastern Argentina	miguellovino@yahoo.com.ar
Muhammad	Ashraf	Public Sector Employee (Higher Education)	Pakistan	Male	Assessing the spatio-temporal characteristics of drought and the local communities' exposure in Balochistan.	mashrafh75@gmail.com
Odoulami	Romaric Christel	University of Cape Town / African Climate and Development Initiative	Benin	Male	Climate modelling and analysis in Africa / characteristics of extreme climate events over different ecological zones.	romaric.odoulami@uct.ac.za
Salcedo-Castro	Julio	Universidad de Playa Ancha	Chile	Male	Estuarine circulation and sediment transport. Climate change and coastal systems	julio.salcedo@upla.cl
Saleem	Farhan	Institute Of Atmospheric Physics, CAS	Pakistan	Male	Detect, attribute and predict the extreme events (especially the compound events) using the combination of the state-of-art statistical and dynamical approaches.	farhan@mail.iap.ac.cn
Seong	Min-Gyu	Pohang University of Science and Technology	Republic of Korea	Male	Past and future changes in risk of climate extremes at global to regional scales / Multi-variate approach for identifying concurrent extreme events / Atmospheric circulation patterns responsible for compound events.	gravityseong@postech.ac.kr
Thotapitiya Arachchillage	Jeewanthi Gangani Sirisena	PhD student	Sri Lanka	Female	Hydrological modelling to assess the impacts of climate change and relevant human activities on fluvial sediment supply to coasts	j.thotapitiyaarachchillage@un-ihe.org
Vignotto	Edoardo	University of Geneva	Italy	Male	Extreme value theory / improving machine learning classifiers	edoardo.vignotto@unige.ch
Wang	Dongqian	National Climate Center, CMA	China	Male	Major features of the south-westerly low-level jet (LLJ) and its possible impact on precipitation. Extreme events detection and attribution.	wangdq@cma.gov.cn
Zengchao	Hao	Beijing Normal University	China	Male	Monitoring and prediction of compound dry-hot event	haozc@bnu.edu.cn
Zhu	Lianhua	NUIST	China	Male	Statistical Modelling and Probabilistic Projection of Extreme Precipitation over China	ahualian@126.com

Appendix 2: List of APN-funded participants

The following participants were selected to receive the APN travel grant (see Appendix 1 for complete contact details information):

Family Name	Given Name	Nationality	Gender
Alam	Md Mahmudul	Malaysia	Male
Husain	Najafi	Iran, Islamic Republic of	Male
Islam	Muktarun	Bangladesh	Female
Lovino	Miguel	Argentina	Male
Muhammad	Ashraf	Pakistan	Male
Odoulami	Romaric Christel	Benin	Male
Salcedo-Castro	Julio	Chile	Male
Thotapitiya Arachchillage	Jeewanthi Gangani Sirisena	Sri Lanka	Female

* Evidence of payment, etc. are provided separately.

Appendix 3: Description of research problems dealt with during the summer school

1. Differences in long-term changes in precipitation events of different intensities

Supervisors:
Xuebin Zhang, Environment and Climate Change Canada, Xuebin.Zhang@canada.ca
Chao Li, East China Normal University, cli@geo.ecnu.edu.cn

Context:
There is accumulating body of observational and modeling evidence that precipitation is changing in response to anthropogenic global warming (e.g., Zhang et al., 2007; Min et al., 2011; Westra et al., 2013). Changes in extreme precipitation is mainly governed by changes in atmospheric moisture. Based on the Clausius-Clapeyron (C-C) relation, a warmer atmosphere can hold more water vapor, increasing at a rate of ~7%/°C. In contrast, the response of global mean precipitation to warming is mainly governed by energy balance and is at a much lower rate than expected from the C-C relation, ~2-3%/°C. Climate modeling studies have suggested that changes in precipitation from local to global scales depend on precipitation intensity (e.g., Pendergrass, 2018; Li et al., 2019). This means that there must be a reduction in the frequency of precipitation events, or a reduction of precipitation intensity for less intense events.

Objective:
Here we study the historical changes in different percentiles of the probability distributions of daily precipitation in regions with sufficient and high-quality observations around the world. Our particular interest is to investigate whether and how different parts of the probability distribution of daily precipitation have exhibited different rates of change during the historical period.

Suggested data:
We use daily weather station measurements of total precipitation (in mm) from 1 January 1961 to 31 December 2018 for North America, Europe, and Australia obtained from the Global Historical Climatology Network (GHCN), which are available at ftp://ftp.ncdc.noaa.gov/pub/data/ghcn/daily/. We normalize the estimated changes in different precipitation percentiles with respect to global mean annual surface temperature derived, for example, from the CRUTEM4 dataset available at https://crudata.uea.ac.uk/cru/data/temperature/.

Suggested reading materials:
1) Zhang X., Zwiers F., Hegerl G., Lambert F., Gillett N., Solomon S., Stott P., & Nozawa T. (2007). Detection of human influence on twentieth-century precipitation trends, Nature, 448, 461-465.
2) Min S., Zhang X., Zwiers F., & Hegerl G. (2011). Human contribution to more-intense precipitation extremes. Nature, 470, 378-381.
3) Westra S., Alexander L., & Zwiers F. (2013). Global increasing trends in annual maximum daily precipitation. Journal of Climate, 26, 3904– 3918.

4) Pendergrass A. (2018). What precipitation is extreme? Science, 360(6393), 1072-1073.
5) Li C., Zwiers F., Zhang X., Chen G., Lu J., Li G., Norris J., Tan Y., Sun Y., & Liu M. (2019) Larger Increases in More Extreme Local Precipitation Events as Climate Warms. Geophysical Research Letters, 46, 6885-6891
6) Schär C., Ban M., Fischer E., Rajczak J., Schmidli J., Frei C., Giorgi F., Karl T., Kendon E., Tank A., O'Gorman P., Sillmann J., Zhang X., & Zwiers F. (2016), Percentile indices for assessing changes in heavy precipitation events. Climatic Change, 137, 201-216.

2. Temperature extremes and their drivers under climate change

Supervisor:
Erich Fischer, ETH Zürich erich.fischer@env.ethz.ch

Motivation
There is observational evidence that heatwaves have become more frequent and intense with climate change at the global scale. According to global climate models this trend is projected to continue with increasing atmospheric greenhouse concentrations. However, since particularly at regional scale this long-term intensification is superimposed by internal variability, model evaluation with observations and reanalysis as well as regional projection of extremes are challenging. The near-term regional signal-to-noise ratio is small for extremes as their variability is high and their occurrence is by definition rare. As a result, extremes are not expected to change gradually and the identification of climate change signals is challenging. For example, over a certain region there could be no heatwaves for 2-3 decades despite a long-term trend to more heatwaves.

Based on single realizations of a climate model it is often not possible to identify robust forced signals in changes of extremes at the regional scale. However, single model initial condition large ensembles provide a method to quantify changes of heatwaves in the past, present and future in a given model. Furthermore, such large ensembles provide insights in high return level extremes and allow to investigate potential changes in drivers of extremes.

Objectives:
1) to evaluate ability of a single model large ensemble to represent regional trends in reanalysis as well as to investigate drivers of past hot extremes
2) to explore the range of near-term projected changes of temperature extremes
3) to quantify long-term projected changes in very rare extremes
4) to investigate the potential changes in driving mechanisms in heatwaves

Data availability:

(1) 84-member NCAR CESM1.2 initial condition large ensemble for the period 1940-2100 (21 members starting in 1850). Data includes annual 7-day maxima of regional daily mean temperatures averaged over the SREX region East Asia and South Africa. Regarding potential drivers, area-average 500hPa geopotential height (Z500), total daily precipitation (tot_prec) during the event as well as temperature, precipitation and 500hPa geopotential height in the 7 days prior to the event are available. Likewise, monthly average soil moisture (SOILLIQ), evaporative (evap_fraction), shortwave downward radiation at the surface (FSDS), and shortwave net radiation at surface are available (FSNS)

(2) ERA5 reanalysis covering the period 1979-2018 with annual maxima of area-average temperatures for the same period

3. Computing return levels in the context of a changing climate: how to deal with uncertainty and non-stationarity?

Supervisors
Alexis Hannart (alexis.hannart@mail.mcgill.ca)
Chao Li (cli@geo.ecnu.edu.cn)

Context

Southeastern Canada has been affected by two massive fluvial Spring floods consecutively in 2017 and 2019, with costly damages. In that part of the world, climate change mainly has two opposite effects on Spring floods, with a simultaneous increase in Spring rainfall and a decrease in snow cover. The intensity and even the sign of the overall resulting effect varies across space and time, and is uncertain due to observational and climate modeling imprecisions.

The provincial government requested to update the maps of flood hazard in use for regulatory purpose across Quebec by taking climate change into account. Similarly, hydroelectric power companies wish to reevaluate the compliance of their infrastructures in light of potentially changing flood return levels.

This requires to compute streamflow levels associated to a return period of 50 and 100 years for the former, and of 1,000 and 10,000 years for the latter.

Problem and goal

The standard engineering practice to estimate return levels for flows essentially consists in fitting a statistical extreme value distribution to observed river flows and compute the corresponding quantiles. While apparently simple, this short description hides several difficulties that professional engineers face in practice, in particular short-time observational series implying large sampling uncertainty, non-stationarity in both the past record and future projections, as well as spread in future trends simulated by hydro-climate models.

Computing streamflow levels, like many similar practical requests in the context of decision-making for adaptation to climate change, thus raise in particular two questions: (i) how to deal with uncertainty associated to sampling but also to climate change itself ? (ii) how to deal with non-stationarity in the definition and computation of return levels associated to a return period? Hence climate change adds a layer of complexity as engineers are increasingly asked to demonstrate that infrastructures are climate-proof. How this should be carried out in practice has not yet crystallized into methods and standards.

The goal of this project is to compute the aforementioned streamflow return levels for three basins in Quebec (Rivière Rouge, Rivière Moisie, Rivière Chaudière), and in doing so, to debate and propose solutions to address the above two questions.

Data available

For the three basins, the following data is provided:

- observed daily streamflow,
- ensemble of simulated daily streamflow obtained by forcing a hydrological model with simulations of temperature and precipitation obtained from CMIP5 (historical, RCP4.5, RCP8.5 experiments, for several climate models).

Expected tasks

1) Exploring the data, in particular observed and simulated trends, as well as univariate PDF tails.
2) Selecting a statistical model (e.g. GEV, Pearson, Lognormal, Normal, with/without trend), fitting it while dealing with sampling uncertainty.
3) Comparing results on observations and simulations. Proposing an approach to account for both observations and simulations to represent the PDF of streamflow at future time horizons.
4) Selecting an approach to deal with non-stationarity in the definition and computation of return levels associated to a return period (Salas et al. 2018).
5) Computing return levels.
6) Preparing research paper outline. Summarize the analyses done and the results obtained in a research paper form. Attention should be given to the research question investigated, hypotheses tested, and results obtained. Discuss advantages and limitations of the methods adopted.

Software requirements

R software. Packages to install: tbc

Suggested reading material

1) Giuntoli, I., Villarini, G., Prudhomme, C., & Hannah, D. M. (2018). Uncertainties in projected runoff over the conterminous United States. Climatic Change, 150(3-4), 149–162. https://doi.org/10.1007/s10584-018-2280-5
2) Asadieh, B. and Krakauer, N. Y. (2017). Global change in streamflow extremes under climate change over the 21st century, Hydrol. EarthSyst. Sci., 21, 5863–5874, https://doi.org/10.5194/hess-21-5863-2017 , 2017.
3) Krysanova V., C. Donnelly, A. Gelfan, D. Gerten, B. Arheimer, F. Hattermann and Z. W. Kundzewicz (2018) How the performance of hydrological models relates to credibility of projections under climate change, Hydrological Sciences Journal, 63:5, 696-720, DOI: 10.1080/02626667.2018.1446214
4) J. D. Salas, J. Obeysekera & R. M. Vogel (2018) Techniques for assessing water infrastructure for nonstationary extreme events: a review, Hydrological Sciences Journal, 63:3, 325-352, DOI: 10.1080/02626667.2018.1426858

4. Benefits and limitations of statistical models for assessing compound flooding

Supervisors:
Bart van den Hurk (Deltares): Bart.vandenHurk@deltares.nl
Elisa Ragno (TU Delft): e.ragno@tudelft.nl

Flood events in coastal regions can be the result of (non-)extreme meteorological conditions: storm surges prevent the ability to discharge water to the open sea causing inland water level to rise when local precipitation occurs. In this context, Van den Hurk et al. (2015) investigated the effect of the co-occurrence of precipitation events and storm surges on inland water level at a control gauge in Noorderzijlvest (north of the Netherlands). They used a meteorological model coupled with a local water balance model run in ensemble mode to quantify the effect of the correlation between rainfall and storm surge on inland water levels. The ensemble was designed to extend a 50 years current-climate time series by a factor 16, allowing enhanced sampling of natural variability consistent with current climate conditions. They showed that storm surges and heavy precipitation events are likely to co-occur . This correlation causes Inland water levels at long return times to be higher than when rainfall and surge are assumed to be uncorrelated.

The goal of this training school project is to investigate the ability of statistical methods, i.e. copula and regression functions, to model and simulate the interdependence between hydro-meteorological data by retracing the work presented in van den Hurk et al. (2015). The meteorological model will be replaced by a copula function to model the dependence between precipitation and storm surges. It will be trained on a pseudo observational dataset extracted from the model. The local water balance model will then be replaced by an impact function calibrated on the outputs of the coupled meteorological/water balance model, as defined by Bevacqua et al. (2017). This allows estimation of the water level at the control gauge as a function of the sea level and the magnitude of the precipitation event.

The comparison between the results from the two approaches in terms of water level at the control gauge will provide the basis to discuss opportunities and limitations of the application of statistical methods to investigate compound events. Moreover, the project will place emphasis on the importance of compound events for flooding risk assessment.

Data available for the study

- *Precipitation (P)* Model simulations adjusted based on observations. From 1951-01-01 to 2000-12-28. 16 member runs. Hourly data.
- *Storm Surges (S):* Model simulated based on wind speed. From 1951-01-01 to 2000-12-28. Simulation period comprises 16 member runs. Hourly data.
- *Inland Water Level (WL):* Model simulated using RTC tools forced by precipitation and storm surges simulations for the same 16 members. Hourly data.

Expected tasks

(1) Exploring the data. Investigate the data provided. Identify their statistical properties and also their dependence. Relate these results to the known characteristics of the geographical area under study (details in van den Hurk et al. 2015). Sample (extreme) events from the data to remove autocorrelation. However, remember that the objective of the study is to look into (extreme) events that occur at the same time (or very close in time). For this reason, the sampling procedure should be done accordingly.

(2) Selecting copula function. Select the 2d copula function that best models the dependence between P and S (after sampling). Use the notions learned in class. Additional material could be found in Salvadori and De Michele (2007) and Genest and Favre (2007).

(3) Training the impact function. Following the work of Bevacqua et al. (2017), define an impact function which relates the WL to P and S. Investigate possible regression functions and select the one that best fits the data.

(4) Applying copula and impact function to estimate WL. Based on the previous modelling choices, simulate pairs of (P,S) from the 2d copula chosen as the best model. Afterwards, estimate WL by forcing the impact function with the random generated pairs (P,S).

(5) Return Level curve of WL. Using the WL obtained from the impact function, derive a return level curve and compare it with Figure 6 in van den Hurk et al. (2015).

(6) Preparing research paper outline. Summarize the analyses done and the results obtained in a research paper form. Attention should be given to the research question investigated, hypotheses tested, and results obtained. Discuss advantages and limitations of the methods adopted.

Possible alternatives. Variations to the tasks delineated above are possible. Some examples are: (i) including the time dependence of the P and S data in the copulas by considering autoregressive functions; (ii) modelling the interdependence between the three variables (P,S, and WL) using pair-copula constructions and/or a 3d copula. The water level will be then represented via a conditional distribution function.
Bevacqua et al. (2017) and Salvadori and De Michele (2007) provide insights on how to deal with the alternative methods suggested.

Outcome and expected work schedule
The outcome of the project is providing the basis for a research paper to be published few months after the training school. With this objective in mind, the group is expected to deliver tasks (1), (2), and (3) during the first week of the school. The second week will be dedicated to applying the models selected and drafting the outline of the research paper.

Software requirements
R software. Packages to install: *copula, CDVineCopulaConditional*

Suggested reading material
van den Hurk, Bart, Erik van Meijgaard, Paul de Valk, Klaas-Jan van Heeringen, and Jan Gooijer. *"Analysis of a compounding surge and precipitation event in the Netherlands."* Environmental Research Letters 10, no. 3 (2015): 035001 https://iopscience.iop.org/article/10.1088/1748-9326/10/3/035001/pdf

Salvadori, Gianfausto, and Carlo De Michele. *"On the use of copulas in hydrology: theory and practice."* Journal of Hydrologic Engineering 12, no. 4 (2007): 369-380. https://ascelibrary.org/doi/pdf/10.1061/%28ASCE%291084-0699%282007%2912%3A4%28369%29

Genest, Christian, and Favre, Anne-Catherine. *Everything you always wanted to know about copula modeling but were afraid to ask.* Journal of hydrologic engineering 12.4 (2007): 347-368. https://ascelibrary.org/doi/full/10.1061/%28ASCE%291084-0699%282007%2912%3A4%28347%29

Bevacqua, Emanuele, Douglas Maraun, Ingrid Hobæk Haff, Martin Widmann, and Mathieu Vrac. *"Multivariate statistical modelling of compound events via pair-copula constructions: analysis of floods in Ravenna (Italy)."* Hydrology and Earth System Sciences 21, no. 6 (2017): 2701-2723. https://www.hydrol-earth-syst-sci.net/21/2701/2017/hess-21-2701-2017.html

Appendix 4: Evaluation reports by the APN-funded participants

(See *Appendix 2* for the list of the APN-funded participants):

1 Participant information

1.1 Name: Dr. Md Mahmudul Alam

1.2 Affiliation: Universiti Utara Malaysia

1.3 Contact information (Email): rony000@gmail.com

2 Session:

2.1 General scope:

2.1.1 Overview and conclusions

This summer school covered many issues related to various extreme climate events and their predictions such as extreme precipitation, extreme temperature, compound events etc.

2.1.2 Highlights

This is very remarkable to mention that the summer school focused on the measurement method and precautions of the measurement of extreme event. The event also focused on the practical research works of measuring extreme events under the supervision of some qualified researchers, which will bring some good output, such as publication in top journal articles, collaboration among participants, huge scope of networking and continuity of the networking. The learning game is also very interesting and instructive.

2.2 Practical utility of the event:

2.2.1 Your presentations and posters

I have presented a poster entitled of *"Adaptation to Climate Change Risk in Stock Market: Investigation on Malaysian Public Listed Agro and Plantation Companies"*.

2.2.2 Assigned research subject / problems studied during the summer school

I was assigned in the research group 3, who are working on "Computing return levels in the context of changing climate: how to deal with uncertainty and non-stationarity?

2.2.3 Lessons learnt and networking opportunities

The participants are from different academic background which made this gathering amazing for networking and collaboration. Through this summer school, now I have contact with people from different regions and from different disciplines that will help me to seek knowledge or feedback from different discipline, when needed, and utilize my resources in better ways. Now I found some people who are expert in R software and can analyze data from different angels. Finally, I already made some collaboration with other participants regarding our future joint publication and project funding application.

2.2.4 Follow-up / immediate research plan

We have already decided to continue our research work that we had started in the summer school. Now we are working for journal publication from that research.

2.2.5 Long term plans for research and application

As I have developed few networks from this summer school, I hope this will help to continue our joint research for long term through article publications and project development and grant application. I have made some strong connection with other participants from Bangladesh, Pakistan, India, China and Nepal. We can work in the area of climate change vulnerability, risk, and adaptation from science and policy perspectives.

3 Any suggestion to make this particular session more beneficial for south Asian region

I am working as a lecturer of Finance and Economics in Malaysia and a citizen of Bangladesh. My researches are based on these two countries. For both of these countries, it is very difficult to link the scientific evidences with policy as well as interaction between policy and science people. Therefore, it is highly recommended for future program to include some sessions on interactions among climate change science, socioeconomic, and policy. As I have already participated in this summer school, if anything comes as a continuity of this training, that will benefit me lots.

Finally, I am thankful to the organizer and funder agency to support me to join such a wonderful event of learning and networking. I will also be very happy if I get such an opportunity in future to continue of my learning and collaborations.

1 Participant information

1.1 **Name:** Husain Najafi

1.2 **Affiliation:** International Commission on Irrigation and Drainage (ICID)

1.3 **Contact information (Email):** najafi.hos@gmail.com

2 Session:

2.1 General scope:

2.1.1 Overview and conclusions

I have been attended several workshops on climate sciences during the last five years organized by ICTP, APCC, ECMWF and other leading institutes. I believe that WCRP's workshop in Nanjing has been ranked as one of the most successful workshops among others I have been to. WCRP played a successful role as a focal point of the event having several organizers. The host (NUIST) provided a generous hospitality during the whole two weeks. The workshop had several outcomes for me in terms of both social interactions and academic achievements.

2.1.2 Highlights

✓ The workshop covers a wide range of advanced topics on climate extremes from detection and attribution to climate change projections.

✓ Invited speakers provided different aspects of science and policy relevant issues which was a key strength of the event.

✓ The workshop was organized at a very high level. This aspect encourages participants to try harder to gain the leadership within the field.

✓ Cultural aspects of the workshop were well organized. All attempts have been made so that the language not become as a significant barrier.

2.2 Practical utility of the event:

2.2.1 Your presentations and posters

Unfortunately, I haven't received any feedback from my poster from participants. The poster session planning was not as organized as other parts of the workshop. It was better to ask for people to provide an abstract of their work and disseminate that as a booklet of the workshop to maximize the poster session efficiency.

The first sessions of poster presentation was long and it was not easy for people to follow up as they were standing for more than an hour. I suggest that organizers provide some general formats for the poster sessions indicating the size of the poster or any other important information for improving the outcome of poster sessions. Note that organizers have attempted to improve the rest of sessions by changing the location which improves the presentations.

2.2.2 Assigned research subject / problems studied during the summer school

Assigned projects were very well organized. Problems were well-established and the corresponding data was prepared nicely. There were supposed to be a session which all participants discussed about their research subjects together and the main organizers were supposed to put that in schedule which was neglected unfortunately.

2.2.3 Lessons learnt and networking opportunities

The information of participants was disseminated in the middle/end of the first week which has made the networking somehow challenging. On the badges, the affiliation of the participants was not written; only their nationality which was not a common act. Fortunately, the workshop was long enough to socialize and make connections with other participants especially during the sightseeing.

2.2.4 Follow-up / immediate research plan

In addition to the paper that is going to be published based on our work in Nanjing, I am going to work on compound events based on the recent events which have been occurred in Iran on April 2019. I have discussed with some main organizers to support me in publication and methodology development.

2.2.5 Long term plans for research and application

I am going to apply the ideas I gained during the workshop for my future career development in sub-seasonal and seasonal hydrological forecasting.

3 Any suggestion to make this particular session more beneficial for south Asian region

I suggest inviting more graduate participants rather than lecturers, assistant and associate professors. But it must be compromised based on the predefined level of the workshop the main organizers have in mind.

1 Participant information

1.1 Name: Dr. Muktarun Islam

1.2 Affiliation: Sylhet Agricultural University

1.3 Contact information (Email): Muktarun.iwfm@gmail.com

2 Session:

2.1 General scope:

2.1.1 Overview and conclusions

Various extreme climate events such as extreme precipitation, extreme temperature, compound events are briefly discussed with various statistical approach.

2.1.2 Highlights

Case studies of different extreme event and compound effect. Drivers of climate extreme and risk analysis. Science-policy for climate and disaster risk reduction in case of Bangladesh and India is presented. Game play for different climate extreme was really interesting.

2.2 Practical utility of the event:

2.2.1 Your presentations and posters

I have presented poster entitled of Effect of climatic variability on land use changes in Hakaluki Haor of Bangladesh.

2.2.2 Assigned research subject / problems studied during the summer school

I was assigned in research group 1 "Differences in long-term changes in precipitation events of different intensities

2.2.3 Lessons learnt and networking opportunities

Handling and analysis using R-software is understood. This training program helps me gain knowledge and latest scientific input from oral and posters presentation from the other regions. Definitely this training program creates a platform to collaborate research and publish jointly to other participants for different country

2.2.4 Follow-up / immediate research plan

I worked in research Group 1 entitled of Non-uniform changes in different percentile precipitation over North America. Preliminary I committed to do work on data and methods chapter. We have a planning to submit 1st draft to our surpervisor Professor XUebin Zhang by 16th December.

2.2.5 Long term plans for research and application

The main threats of climate change to Bangladesh are in water sector such as expanded flooding, prolonged drainage congestion, increased runoff and erosion, wetland losses, damage of water infrastructures, salt water intrusion, drinking water supply, and inundation of treatment infrastructures, frequent cyclone and storm surge flooding. I have plan to collaboration project and publish research article jointly in South Asia region. After finished the research paper that we committed in summer school I have a plan to do work jointly with Pakistan, Nepal and Bangladesh using climate data of extreme precipitation. I can help in research areas of hydrology, water management, disaster and risk management.

3 Any suggestion to make this particular session more beneficial for south Asian region

I working as an assistant professor in Sylhet Agricultural University which is one of public university in Bangladesh. I understand every statistical methods and climatic models which are described in summer school. But in case of Bangladesh there is no scope of learning the statistical software and climatic models. R-software is freely available software. Analysis of advanced regression modeling, bootstrapping is really new term for me. In case of Bangladesh we don't have sufficient financial support and don't get opportunity for such advanced statistical methods and climate models. So, it would be highly appreciated if training on hands on the statistical method and climate models in addition to the discussion of various methods.

1 Participant information

1.1 Name: Miguel Lovino

1.2 Affiliation: Universidad Nacional del Litoral - Argentina

1.3 Contact information (Email): miguellovino@yahoo.com.ar

2 Session:

2.1 General scope:

2.1.1 Overview and conclusions

The institute was an excellent opportunity to increase my previous knowledge in reference to climatic extremes. The summer school was very well organized, in every detail. The keynote presentations were really very instructive. In my case, they allowed me to incorporate a wide range of new knowledge. Just to number a few: compound events, concepts of risk and vulnerability, temperature extremes and heatwaves, attribution of climate changes and events, historical and projected climatic trends, among many others.

A special paragraph deserves the group work we have done in research projects. In particular, I found it a very productive initiative for students. In our case, we were able to make good progress in obtaining results in precipitation trends for North America. We hope to have a paper sent in the next 6 weeks (below I presented a photo of our work group, along with our director Xuebin Zhang).

2.1.2 Highlights

The highlights of the institute in reference to the contents taught could be the following:

- Understanding the changes in extreme events requires breaking down in different characteristic while impact studies requires indices tailored to the problem.
- Human induced changes in the climate has resulted in detectable change in extreme precipitation, at least at the global and perhaps continental scale. The expected changes at the local scale is so small when compared with natural variability; therefore, changes in precipitation at such scale is difficult to quantify.
- Typology of compound events exit, each requiring a specific analysis method. Many events have compounding drivers.
- Heat stress is a multivariate problem. Urban heat island can substantially amplify nighttime temperatures.
- As climate change has become real, real actions are required.

2.2 Practical utility of the event:

2.2.1 Your presentations and posters

The oral presentation of my poster (photo attached) allowed me to share the work I have been doing with the rest of the students. After the presentation, I was able to discuss with several of them the contents of my research and even establish possible mutual cooperation.

2.2.2 Assigned research subject / problems studied during the summer school

The assigned research subject for the project work has been of particular interest to me. With the entire group, we have achieved good results from precipitation trends in North America with a high potential for publication. The work was organized and very well coordinated by our advisor Xuebin Zhang. We hope to have a manuscript of a paper shortly (within 6 weeks).

The problem that we studied during the summer school was "Non-uniform changes in different percentile precipitation over North America". The research question is How the different percentile

precipitation changes contribute to total precipitation change? Our main findings include:

- The contribution from below moderate precipitation to total precipitation shows decrease trend;
- The contribution from moderate precipitation to total precipitation did not show obvious change;
- The contribution from very wet precipitation to total precipitation show increase trend.
- More stations showing significant increase trend for the frequency of moderate precipitation and very wet precipitation.
- Trends trend for the frequency of below moderate precipitation over the space are noisy with increase and decrease trends scatted everywhere
- The non-uniform increases trends in the frequency associated with different precipitation may result in the different changes in their contribution to total precipitation change.

2.2.3 Lessons learnt and networking opportunities

The institute allowed me to incorporate very varied new knowledge (listed above). We will continue with the project work in these weeks. In addition, I have been able to establish personal relationships that will allow me to participate in projects and publications with other summer school students.

2.2.4 Follow-up / immediate research plan

The immediate plans are to continue with the group research work to write a paper within a maximum period of 6 weeks.

2.2.5 Long term plans for research and application

My long-term personal plans include addressing the study of vulnerability and risk to variability and climate change in northeastern Argentina. These themes have been widely addressed during the institute, allowing me to incorporate new tools that could be very useful for a region frequently affected by severe extreme events.

3 Any suggestion to make this particular session more beneficial for south Asian region

Without being directly involved in South Asia, I would like to say that the participation of several students from that region in the institute will provide useful tools for the implementation of science in the socio-political contexts of those countries. As a suggestion, and not only for South Asia, it seems to me that the idea of granting more places in WCRP institutes to students from developing countries is appropriate. In this way, the training of young leaders who can extrapolate their knowledge to regions most vulnerable to the effects of climate change is ensured.

1 Participant information

1.1 Name: Dr MUHAMMAD ASHRAF

1.2 Affiliation: Assistant Professor in the Department of Disaster Management and Development Studies, University of Balochistan Quetta, Pakistan

1.3 Contact information (Email): ashraf.dmds@uob.edu.pk, mashrafh75@gmail.com,

2 Session:

2.1 General scope: Overview and conclusions

It has been evident that natural disasters that are related to weather and climate extreme are increasing day by day around the globe and caused huge economic losses in both developed and developing countries. This summer school did a great job to link the climate research and disaster risk reduction communities to exchange their expertise in order to reduce exposure and vulnerability of the communities at risk through effective use of climate information. Sessions in the schools are well-organized and important aspects of climate extremes and risk management such as temperature extremes, drivers of climate extremes and their importance, changes in extreme precipitation, compound events, climate information, extreme value theory, event attribution and its causal framework have been discussed in detail. Moreover, Risk framework that include hazard, exposure and vulnerability along with science policy for climate and disaster risk reduction have also been discussed during different sessions. In nutshell, these sessions enabled the participant to enhance their knowledge regarding disaster risk reduction. Moreover, participant also learned how these changes in climate extremes and weather are occurring and how they can be projected using different tools and more importantly, how this knowledge can be used in the local as well as regional scale to reduce risk reduction in the context of natural hazards.

2.1.1 Highlights

Sessions highlights are:

- Climate extremes that include:
  Drivers of climate extreme and extreme value theory, Temperature extreme, compound events, changes in extreme precipitation, event attribution and its causual framework
- Risk management that include
  Risk framework, extreme: from climate to adaptation, and science-policy for climate and disaster risk reduction

2.2 Practical utility of the event:

2.2.1 Your presentations and posters

During the poster presentation session, participants presented their work in the context of climate change ranging from compound event, extremes in precipitation and temperature, drought and its impacts on agricultural productivity etc. My poster (Spatio-temporal characteristic of precipitation and drought in Balochistan province Pakistan) aim was **(1)** to address multi dimensions of drought with its various features; frequency of drought occurrences and its spatial and temporal pattern at multiple time scales, such as 3-, 6-, and 12- months. **(2)** Critical (threshold) precipitation and medium term annual and seasonal precipitation trends are also studied to identify areas susceptible to droughts. **(3)** Farmers' perception and understanding of drought is also assessed in order to see how these changes are perceived by farmers. (detailed can be seen in the attached soft copy of poster).

2.2.2 Assigned research subject / problems studied during the summer school

Participant have been divided into four different groups during the summer school. I was in group four and the problem/project assigned to our group is about compound event. We investigated the problem based on compound events i.e. how storm surge and precipitation are affecting water level in Netherland. We have used 50 years of hourly data for these indicators. During the project activity time, our group has analyzed the data and fitted GEV model to the data in order to study the impact of storm surge and precipitation on water level at different time scale. Also, we tried to investigate the impact model along with return period.

2.2.3 Lessons learnt and networking opportunities

Summer school is a wonderful venue especially for early career researchers. I have learned many things during the school that include how one can work in the team environment. I also learned R and observed that this tools is very powerful for those researcher who are working in climate extreme field. Most important thing which I would like to mention here is networking opportunity. I created a network which can be utilized for future research collaboration.

2.2.4 Follow-up / immediate research plan

My immediate research plan is to follow up our project/problem assigned to us during the summer school and convert that work into a research article at my earliest.

2.2.5 Long term plans for research and application

My long-term research plan is to disseminate the knowledge, which I have gained during this school among my colleagues as well as scholars who are enrolled in M.Phil/Ph.D in the department of Disaster management and Development Studies. Moreover, I am planning to extend my research work in climate extreme such as extreme changes in precipitation and extreme heat waves in future.

3 Any suggestion to make this particular session more beneficial for south Asian region

Overall, the summer school was well organized in every aspect. I would like to suggest that there should be some practical sessions (R Studio) included in the future summer schools in order to enhance the knowledge of those participant who have less expertise in such tools.

1 Participant information

1.1 Name: Romaric Christel ODOULAMI

1.2 Affiliation: University of Cape Town (South Africa)

1.3 Contact information (Email): christound@gmail.com / romaric.odoulami@uct.ac.za

2 Session:

2.1 General scope:

2.1.1 Overview and conclusions

The Institute of Advanced Studies in Climate Extremes and Risk Management hosted by the Nanjing University of Information, Science, and Technology gave young and early career researchers from across the world the opportunity to improve their understanding of climate extremes and risk management in the climate change context. The institute offered each participant a ground for interaction with their peers and also with instructors. It was a unique opportunity, through the network it created among participants to interact and share their personal experiences. Also, the support and advice from instructors were of great use. Overall, this summer school was an open door to the career development of early career researchers like me who have interest in climate extremes assessment and risk management.

2.1.2 Highlights

Some major highlights of the Institute of Advanced Studies in Climate Extremes and Risk Management hosted by the Nanjing University of Information, Science, and Technology are as follow:

- The lectures and the quality of the talks;
- The poster presentation sessions;
- The group projects organization and presentations;
- The gathering activities (city sightseeing, banquets)

2.2 Practical utility of the event:

2.2.1 Your presentations and posters

The Institute of Advanced Studies in Climate Extremes and Risk Management gave me and other participants the opportunity to present some preliminary findings associated with our ongoing research activities.

I gave a poster presentation on how likely the use solar radiation management as a climate mitigation approach would influence the likelihood of future droughts in Southern Africa. The focus was mostly on the Cape Town region in South Africa, which recently experience a three year drought that nearly caused the City of Cape Town to run out of water (referred to as the "day zero drought"). The research I presented during the poster session focused on assessing whether using solar radiation Management would increase the risk of similar drought in future. The whole work was based on the analysis of climate model simulations.

2.2.2 Assigned research subject / problems studied during the summer school

My assigned group project during the institute aimed to assess changes in extreme temperature events over Southern Africa and East Asia, two regions of the world that are very vulnerable to temperature extremes. Our project wants to assess and understand drivers of extreme temperature events, potential future changes in their odds under climate change. We have performed significant analysis during the institute and we will continue working on it remotely as a group to make sure we complete for submission as soon as possible.

2.2.3 Lessons learnt and networking opportunities

During the Institute of Advanced Studies in Climate Extremes and Risk Management in Nanjing, I developed a number of research ideas I am expecting to build up my future research works. I have even approached one or two of the instructors for further collaboration on the development of new research ideas.

Also, with other participants, I made a couple friends during the institute for further research collaboration. My participation in this institute was, therefore, fruitful in term of networking opportunities.

2.2.4 Follow-up / immediate research plan

On the short term, I planned to get in touch with some of the fellow participant and instructors to set up research ideas we discussed during the institute in order to develop an excellent research network for further research work.

2.2.5 Long term research plan and application

On the longer term, my aim is to make sure that I keep my network with the other fellow participants to the 2019 Institute of Advanced Studies in Climate Extremes and Risk Management in Nanjing in order to take advantage this large research network to develop multidisciplinary research proposal to submit to research fund.

3 Any suggestion to make this particular session more beneficial for south Asian region

I am not if I understood correctly what is expected from me in this section of the evaluation form. In the case the answer I provided here is not appropriate with the assignment I am asked here, I would appreciate, if you provide me with more details so that I can revised my answer.

On a general note, I can say that the different sessions during the Institute, provide essential tools to answer important research questions related to climate extremes, vulnerability and risk assessment. These tools could be useful to answer important research and development questions in the developing countries including those in South Asia.

1 Participant information

1.1 Name: Julio Salcedo-Castro

1.2 Affiliation: Universidad de Playa Ancha

1.3 Contact information (Email): julio.salcedo@upla.cl

2 Session:

2.1 General scope:

2.1.1 Overview and conclusions

The summer school was an exciting experience from the point of view of sharing with different backgrounds. Most importantly, meeting people from different countries and cultures was an amazing experience. The subjects undertaken during the course were highly relevant and I found many novel approaches to climate extreme events. Methodologies about analyzing climate and model data were presented and their limitations discussed.

2.1.2 Highlights

This summer school provided me new ideas about taking advantage of climate model to assess the implications of extreme events in a regional context.

Analytical methods like attribution and detection were particularly new concepts.

Discussions about GEV and GPD and their limitations were encouraging.

2.2 Practical utility of the event:

2.2.1 Your presentations and posters

My poster presentation was an opportunity to show my current research and how some land-ocean processes are relevant. I wanted to show the necessity of applying an integrate focus when adopting management measures. This topic (river-coast) was broadly discussed in many lectures related to coastal flooding.

2.2.2 Assigned research subject / problems studied during the summer school

The assigned research subject during the summer school was about extreme high temperature events. This topic gave us the chance of familiarizing ourselves with this type of phenomena and their consequences. We had the opportunity of working with time series and model data. We also learned concepts related to climate modeling and extreme value analysis, like return period, block size, GEV, etc. On the other hand, we learned about limitations and different alternatives when dealing with this type of tools.

2.2.3 Lessons learnt and networking opportunities

I learned the importance of climate extremes and their consequences for current and future situations. The many tools of attribution, modeling, detection and methods like GEV and GPD are very useful but we also understood that they have many limitations and have many assumptions that must be taken into account.

I met many people with whom I expect to have collaboration in the future, including lecturers (Bart and Alexis). I hope to keep in touch with my colleagues from Italy and Argentina, as their research is especially interesting to me. Moreover, I learned that interdisciplinary research is extremely valuable, so I expect to learn more from economists that attended the course.

2.2.4 Follow-up / immediate research plan

I hope to keep in touch with my group and finish the paper we started during the summer school. Some of them are very knowledgeable about GEV and return period so I will keep contacting them to learn more about these concepts.

2.2.5 Long term plans for research and application

I plan to continue working on climate extreme events, especially in coastal areas. My goal is to keep a research line related to coastal cities, extreme waves and coastal flooding. In this sense, I hope to apply for national and international funding in collaboration with some of my colleagues I met at the summer school. In particular, I expect to work my colleague from Argentina and create a network in Latin America.

3 Any suggestion to make this particular session more beneficial for south Asian region

Probably more examples focused on this region would have been more beneficial. A climate background on this region as a study case would have been a useful component of the summer school.

1 Participant information

1.1 Name: T.A. Jeewanthi Gangani Sirisena

1.2 Affiliation: IHE Delft Institute for Water Education, The Netherlands

1.3 Contact information (Email): j.sirisena@un-ihe.org/ jeewanthisri@gmail.com

2 Session:

2.1 General scope:

2.1.1 Overview and conclusions

This is my first summer school. All the lectures were set under theme of "Climate extremes and risk management". Overall, summer school was well organized in terms of all the aspects (pre preparations, lectures, logistics, projects, etc). The four projects introduced were well matches with the theme and all the lectures were also aligned with them. Therefore, we were able to understand the main idea of each project.

However, I was unable to grab few parts of one or two lectures since they were quite dense (some quite heavy theory parts).

2.1.2 Highlights

Very diverse lecture series were delivered by different lecturers, covering theme of our summer school. Our lecturers had unique way of deliver the lectures. For example, Bart introduced some stretching exercises to awake us and keep on engage with the lecture. Assigned project is a very good team work. Of course, it is a challenging task as we are from different background and we can't finish within two weeks. It emphasizes the clear idea of the target of any summer school. Besides the lecture series, we had a game play and attended to two talks by our lectures. Rather than continuous lecture series, our time schedule was well balanced with different activities.

2.2 Practical utility of the event:

2.2.1 Your presentations and posters

I did presentations for our project work and poster. We all received quite good comments and suggestions to improve my/ our work. It was a great opportunity to present my work to get some feed-back.

2.2.2 Assigned research subject / problems studied during the summer school

I was assigned for a project on "Computing return levels in the context of a changing climate" with six other group members. We have to deal with stationarity and non-stationarity concept with simulated streamflow data given for different stations in Qubec, Canada. According to the given data, very large variability was identified in simulated streamflow data. I didn't had any idea on non-stationarity analysis. But, while I was working with other group members, I got the idea. We don't have much details on data, ex. GCM data are bias corrected or not, hydrological model is calibrated or not. We had to make some assumptions. In the future, our supervisor will provide more details to verify our assumptions. We couldn't finish our project during this two weeks, but we are very clear on what will do in our project.

It's a team work

2.2.3 Lessons learnt and networking opportunities

In terms of learning, this was a great opportunity me to reinforce my knowledge on climate extremes and different on going applications with statistical approaches. One day, we played a game. It was a replica of a negotiations among science and policy or different stakeholders. I understood that how uncertain the future climate and how difficult to make decision as a region/state/country for climate adaptation.

Participants had diverse background. I personally believe that this was a great opportunity to make new friends and collaborate with them. For example, I got one invitation to join for APN project next time as they are seeking for a person from Sri Lanka.

2.2.4 Follow-up / immediate research plan

As a follow up, we have an ongoing research project assigned during the school. Partly, I'll work on that to produce a journal paper. I'm in final few months of my PhD study and very busy time ahead. Therefore, I don't have any immediate research plans or application of this gained knowledge at the summer school. However, my research is also about climate change aspects (streamflow and sediment) and I may can continue it by addressing extremes which I gained in-depth knowledge here.

2.2.5 Long term plans for research and application

After my PhD study, I would like to start post-doc or job in a research institute. Therefore, I will continue to work on hydrology and changing climate. Further, I will effectively utilize the knowledge gained from this summer school in the future.

Extra

Besides all studies, we had a city tour on first Saturday. Further, we had free time to explore the Nanjing city bit more on Sunday as well. One of the most interesting experience I had that I was able to handle the chopsticks well during this two weeks as I never used them before.

Few Happy Moments

3 **Any suggestion to make this particular session more beneficial for south Asian region**

I have seen that many of the research work has been done for North America, Europe, and China. Those are very impressive work. This kind of summer schools are surely beneficial for knowledge sharing. Once someone see others' research and he/she also can apply for own case study or reinforce the understanding of context. In that sense, if you can select the people from relevant/ specific background, it will be more worthwhile rather than selecting people from different background.

South Asia can be broadly categorized as data poor region in terms of spatial and temporal coverage of climatic variables. Thus, climate studies are quite problematic for this region in my view. Therefore, to address the data scarcity, we need some knowledge on data handling for climate studies. Furthermore, access to available data is difficult. If we can initiate a data bank by collecting all climatic data, this would be a great support for future researchers.

None of the climate models (GCM or RCM) can catch the climate pattern of South Asia. For example, I have an experience with this for one basin in Sri Lanka. Furthermore, as I heard from one of summer school participants, this problem has also been discussed in CORDEX meeting held in Beijing few weeks ago. If this kind of sessions, resource persons and funding can be provided, we may have better climate model simulations for South Asia.

Suggestion for APN

It is worthwhile if you can reimburse the air tickets via bank transfer or book the flight for participants. Handling lots of cash in hand is extra burden.