

2018 APEC CLIMATE SYMPOSIUM

Overcoming the Challenges of an Uncertain Future
with Enhanced Climate Information and Services

DATE

August 21 - 23, 2018

LOCATION

**International Convention Center,
Port Moresby, Papua New Guinea**



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WELCOME MESSAGE

On behalf of the organizers, the APEC Climate Center (APCC) is delighted to welcome you to Port Moresby, Papua New Guinea (PNG) for the APEC Climate Symposium (APCS) 2018. Based on the APEC Host Economy, PNG, priority of enhancing food security and sustainable agriculture in the face of climate change, APCC has developed this event, in close cooperation with the government of PNG, to advance climate science to better strengthen water and food security in the face of large scale environmental change. By bringing together policy makers, practitioners, and scientists in various sectors, APCS aims to tackle key climate issues through discussions on cutting edge science, sharing of best practices, and policy advancement.

While climate change certainly increases the intensity and frequency of extreme weather events which has critical impacts on human security, there is great uncertainty around how much influence climate change will bring to human systems such as livelihoods, assets, health, as well as water and food security. In a global sense, recent advances in science and technology make it possible to produce more reliable climate prediction information, and therefore, a better chance to respond to vulnerability. However, while scientific information is available, its complexity and the lack of understanding of real needs prevent decision-makers and local communities from actually adopting the scientific information.

With such a diverse group of participants bringing together expertise and experiences from research, application, and policy, APCS provides a unique opportunity to link innovations in science with decision-making processes in climate science and climate-sensitive sectors. Particularly during APCS 2018, we believe active and vigorous discussions will take place in producing more reliable region-specific climate information and their potential actionable use for enhancing water and food security as well as linking climate information and decision making. As the APEC Policy Partnership on Science, Technology and Innovation (PPSTI) working group highlights in its mission statement, we trust that APCS will contribute to more effective science, technology, and innovation policy recommendations in the region.

APCS 2018 would not have been possible without the strong support of our valuable partners. I would like to offer our sincere gratitude to all of the members of the Organizing Committee and our co-hosts at the Climate Change and Development Authority, National Weather Service, and Science & Technology Secretariat of Papua New Guinea; Central Weather Bureau of Chinese Taipei; the APEC Secretariat; and of course, to all of the APCS speakers and participants.

Dr. Jin Ho Yoo

Acting Executive Director, APEC Climate Center

ORGANIZERS

APEC Climate Center

The APEC Climate Center (APCC) was established in 2005 with the unanimous endorsement of the Asia-Pacific Economic Cooperation (APEC) senior officials and leaders at the first APEC Senior Officials Meeting in Seoul, Korea, to enhance the socio-economic well-being of APEC member economies by utilizing up to date scientific knowledge and applying innovative climate prediction techniques. Since then, APCC has provided value-added, reliable, and timely climate prediction to nations in the APEC region and beyond, while serving as a key climate information center to distribute climate data, prediction and related tools. APCC is a unique organization that catalyzes climate information-based solutions through three interconnected pillars of work: climate prediction and information services; climate information application and climate change response; and capacity building.

APCC hosts the annual APEC Climate Symposium, which provides a forum for various scientists, academics, policy-makers and other stakeholders to share the latest science innovations in climate prediction and explore climate information applications.

Papua New Guinea National Weather Service

The PNG National Weather Service (NWS) was developed in 1975. The Service currently operates about 14 official stations located mainly at airports throughout the economy. Currently, PNGNWS functions as a division of the Department of Transport and covered under the Civil Aviation Act (2000) as amended 2010. The four basic missions that form the functions of the NWS include: i) Monitoring: Observation and data collection to meet the needs of future generations or reliable homogeneous national climatological data; ii) Services: Provision of meteorological and related data, information, forecast, warning, investigation and advisory services on a national basis; iii) Research: Research directed towards the advancement of meteorological science and the development of comprehensive description and scientific understanding of Papua New Guinea's weather and climate; iv) International: Co-ordination of Papua New Guinea's involvement in international meteorology; in particular contributing towards various global data collection efforts.

Climate Change and Development Authority

Climate Change and Development Authority is the National Designated Authority responsible for all Climate Change related activities in Papua New Guinea and was established under the Climate Change Management Act 2015.

The roles of Authority are to manage all climate compatible development through climate change mitigation and adaptation activities and implement any relevant obligations of the State under applicable rules of the international agreements related to climate change such as the United Nations Framework Convention on Climate Change (UNFCCC).

The mission of the Authority is to build a Climate Resilient and Carbon Neutral Pathway through Sustainable Economic Development.

Papua New Guinea Science & Technology Council Secretariat

Papua New Guinea Science & Technology Secretariat (PNGSTS) was recently set up in 2014 as a national statutory body. The Secretariat was established to develop 'science, technology and innovation' (STI) policies, support and coordinate research & development in public and private sectors, and assume a leading role in the creation of a science and technology culture. PNGSTS plays an important role in informing the PNG Science & Technology Council who subsequently provides science advice to the government. Furthermore, in the APEC circle, PNGSTS is currently engaged in the Policy Partnership on Science, Technology and Innovation (PPSTI) fora.

Central Weather Bureau of the Chinese Taipei

The Central Weather Bureau (CWB) is the government agency in charge of all weather and climate-related services in Chinese Taipei. Because weather affects all aspects of life on both individual and institutional levels, the CWB's services are vital on a daily basis. As the economy's unique geological conditions pose unique challenges such as typhoon and earthquake, the CWB is not only responsible for meteorological, seismological, marine and astronomical observations, forecasting and research, but also actively involved in the national disaster prevention and mitigation effort by providing information and warnings which are fast, reliable, and science-based.

PROGRAM

Tuesday August 21, 2018

08:00-09:00	Registration	
09:00-10:00	OPENING CEREMONY	MC: MS. SANGWON MOON Head of External Affairs Department, APEC Climate Center
09:00-09:10	Opening Remarks	PROF. DONGIN LEE Chairman of Board of Trustees, APEC Climate Center
09:10-09:20	Welcome Remarks	HON. JOHN THOMAS PUNDARI Minister, Ministry of Environment & Conservation and Climate Change of PNG
09:20-09:30	Congratulatory Address	AMB. IVAN POMALEU SOM Chair 2018, Office of Prime Minister and National Executive Council of PNG
09:30-09:40	Congratulatory Address	DR. TIEN-CHIANG YEH Director-General, Central Weather Bureau of Chinese Taipei
09:40-10:00	Commemorative Plaque Presentation and Photo Session	
10:00-10:30	Coffee Break	
10:30-12:30	KEYNOTE SESSION Climate Change and Our Challenges	Chaired by DR. JIN HO YOO APEC Climate Center
10:30-11:10	Climate Change: Connecting Knowledge and Action	PROF. MARK HOWDEN Director, Climate Change Institute, Australian National University
11:10-11:50	Is It Time to Think about Climate Change as Weatheronomics?	MR. EDWARD VRKIC Senior Advisor – Climate Change, United Nations Development Programme
11:50-12:30	Wrap-up and Discussion	
12:30-13:30	Luncheon	
13:30-18:00	SESSION I Enhancing Climate Information Applications	Chaired by PROF. SIMON S. Y. WANG Utah State University
13:30-14:00	Gaps and Opportunities in Climate Information Services	DR. WONMOO KIM Research Fellow, APEC Climate Center
14:00-14:30	Capturing Where People Aren't Looking - in Enhancing Climate Prediction Information	PROF. SIMON S. Y. WANG Associate Professor, Utah State University
14:30-15:00	Dynamical, Statistical and Traditional Climate Forecasting in the Pacific Island Countries: What We Do Now and Challenges for Future	MR. PHILIP MALSALE Climatology Officer, Secretariat of the Pacific Regional Environment Programme
15:00-15:30	Coffee Break	
15:30-16:00	Developing a Regional Drought Outlook Product Using Seasonal Forecast Information	DR. REBECCA A. BOLINGER Research Associate III, Colorado Climate Center, Colorado State University
16:00-16:30	AgroClimate for Climate –Smart Agriculture	PROF. DAVID LETSON Professor, University of Miami
16:30-17:00	What Can European Climate Services Offer to the Energy and Water Resource Sector?	PROF. ALBERTO TROCCOLI Co-founder and Managing Director, World Energy & Meteorology Council
17:00-18:00	Wrap-up and Discussion	
18:00-20:00	Welcome Reception	

Wednesday August 22, 2018

09:00-13:15	SESSION II Improving Water and Food Security with Climate Information and Services	Chaired by DR. JONG AHN CHUN APEC Climate Center
09:00-09:30	Global Crop Yield Forecasting using Seasonal Climate Information from a Multimodel Ensemble	DR. TOSHICHIKA IIZUMI Senior Researcher, National Agriculture and Food Research Organization, Japan
09:30-10:00	Incorporating CO2 Responses into Crop Simulation Models	DR. DENNIS TIMLIN Research Soil Scientist, United States Department of Agriculture
10:00-10:30	Adaptation Options for Climate Sensitive Development	DR. RAMAKRISHNA AKKINAPALLY Deputy Director-General, National Agriculture Research Institute, PNG
10:30-10:45	Coffee Break	
10:45-11:15	Impacts of Climate Change on Turkey's Special Water Resources	PROF. NUKET SIVRI Professor, Istanbul University
11:15-11:45	Use of Climate Information in Nepal for Water and Food Security	PROF. RIJAN BHAKTA KAYASTHA Associate Professor, Kathmandu University
11:45-12:15	Water, Climate Change, and 4 th Industrial Revolution	PROF. JOON HA KIM Director, International Environmental Research Institute, Gwangju Institute of Science and Technology
12:15-13:15	Wrap-up and Discussion	
13:15-14:00	Luncheon	
14:00-18:00	SESSION III Linking Climate Information and Decision-Making	Chaired by PROF. CHALAPAN KALUWIN University of Papua New Guinea
14:00-14:30	Closing Actionability Gaps of Climate Services for Farmers, Agriculture Planners and Advisors – Southeast Asian examples	DR. ELISABETH SIMELTON Climate Change Scientist & CCAFS Project Manager, World Agroforestry Center
14:30-15:00	Robust Decision Making Process under Scientific Uncertainty on Climate Change	PROF. HOJEONG PARK Professor, Korea University
15:00-15:30	Linking Climate to Water Security: Case Studies from the Western Desert of Egypt and the Ganges Delta Region of Bangladesh	PROF. JAGATH J. KALUARACHCHI Professor, Utah State University
15:30-16:00	Coffee Break	
16:00-16:30	Climate Change, Variability and Sea Level Changes Poses Long Term Disasters in Achieving Responsible Sustainable Development in the APEC and Pacific Island States	PROF. CHALAPAN KALUWIN Professor, University of Papua New Guinea
16:30-17:00	Connecting Users' Needs for Climate Information with Climate Services by Using Economic Benefit Evaluation: The Experiences in Chinese Taipei	DR. HEN-I LIN Director, Center for Technology Policy Evaluation and Research, Chung-Hua Institution for Economic Research
17:00-18:00	Wrap-up and Discussion	
18:30-20:30	Dinner hosted by PNG Ministry of Education, Research, Science and Technology	

Thursday August 23, 2018

09:00-12:00	SESSION IV Wrap-up and Panel Discussion	
09:00-09:30	Session I Wrap-up	PROF. SIMON S. Y. WANG Associate Professor, Utah State University
09:30-10:00	Session II Wrap-up	DR. JONG AHN CHUN Research Fellow, APEC Climate Center
10:00-10:30	Session III Wrap-up	PROF. CHALAPAN KALUWIN Professor, University of Papua New Guinea
10:30-10:45	Coffee Break	
10:45-12:00	Panel Discussion	Chaired by PROF. ALBERTO TROCCOLI World Energy & Meteorology Council
12:00-12:20	CLOSING CEREMONY	
12:00-12:10	PROF. DONGIN LEE Chairman of Board of Trustees, APEC Climate Center	
12:10-12:20	MR. SAMUEL MAIHA Director, PNG National Weather Service	
12:20-13:20	Luncheon	

OVERVIEW & SESSION INFORMATION

APEC CLIMATE SYMPOSIUM 2018

Since 2005, APCC has hosted the annual APEC Climate Symposium (APCS) in partnership with the APEC Host Economy on priority topic with important linkages to climate science. Despite recent advances in climate science and related applications, there are often large gaps in its use in the implementation or management of relevant issues. By bringing together climate scientists and policy makers, APCS aims to bridge these gaps through discussion on cutting edge science, sharing of best practices, and the advancement of policy.

While climate change is one of the greatest challenges to human society, a significant gap exists between needs for climate risk management and our lack of understanding and ability to respond. Thus, this Symposium aims to improve understanding and utilization of climate science and applicability in ensuring water and food security with theme of regional scale climate forecast information and services. It will explore the challenges and success stories to produce more accurate region-specific climate information, applicable to agriculture and water resource and decision-making practices. Moreover, various applications of climate information and services for different sectors and making region-specific climate information available for decision-making will be investigated. It will also feature a panel discussion to wrap-up and articulate policy to better equip regional decision-makers in policy development, based on science.

KEYNOTE SESSION

Climate Change and Our Challenges

will provide an overview of regional and global issues of enhancing climate forecast and service and promoting the utilization of climate science in various application sectors including water resources and agricultural sector as well as adaptation to climate change, etc, to better equip participants in sustainable development and help tackle climate change with climate science-based approach.

SESSION I

Enhancing climate information applications

will cover the topics about the challenge and success for more accurate climate forecast information and the efforts for producing region-specific climate forecast information to be applicable to agricultural and water resource sectors and decision-making practices.

SESSION II

Improving water and food security with climate information and services

will discuss the strengths and limitations of current climate forecast systems with respect to various application sectors and a wide variety of application status of climate information and services for water and agricultural sectors in various regions.

SESSION III

Linking climate information and decision making

will discuss topics to connect climate information and decision-making from frameworks to region-specific application that enables utilization of uncertain climate information in policy development. Also, the way of getting benefits from climate forecast and projection in practice will be discussed.



KEYNOTE SESSION

CLIMATE CHANGE AND
OUR CHALLENGES

PROF. MARK HOWDEN

DIRECTOR, CLIMATE CHANGE INSTITUTE,
AUSTRALIAN NATIONAL UNIVERSITY

MR. EDWARD VRKIC

SENIOR ADVISOR – CLIMATE CHANGE,
UNITED NATIONS DEVELOPMENT PROGRAMME

**MARK HOWDEN**

DIRECTOR,
CLIMATE CHANGE INSTITUTE, AUSTRALIAN NATIONAL UNIVERSITY

CLIMATE CHANGE: CONNECTING KNOWLEDGE AND ACTION

As climate change gains pace, the need for informed decision-making in relation to both mitigation and adaptation increases. There is a relatively clear linkage between enhancing the understanding of how greenhouse gas (GHG) emissions relate to changes in climate and ocean systems as a key rationale for global action such as that in the Paris Agreement. The current IPCC 1.5 degrees Special Report process is an example of how knowledge can be synthesized to answer large-scale mitigation questions such as what is the relationship between accumulated emissions and temperature increases or sea-level rise over multi-decadal scales. This then is connected into policy that establishes broad-scale emission-reduction targets. This connection is aided by several simplifying factors – the global nature of the science knowledge, the confined nature of the key groups (a relatively small number of key researchers and key policymakers) and the constrained sources of knowledge outside of these, synthesis processes to bring scientific knowledge together (e.g. the IPCC reports) and a degree of ubiquity in terms of response measures (e.g. establishing a solar photovoltaic farm is a similar process in very different economies). This analysis does not, however, try to diminish the complexity of moving from existing economic models to a more sustainable model. Climate change adaptation, in contrast, remains a much more complex area in which to connect knowledge with action. Some of the challenges here include the highly contextual nature of both climate impacts and the knowledge needed for effective adaptation decision-making, an extraordinarily broad array of stakeholders (arguably every human alive plus non-human systems), the distributed nature of adaptation knowledge where the stakeholders are often the majority knowledge holders not the researchers and the frequent focus on the short to mid-term rather than the long-term where climate analyses are more robust. All these result in difficulty in synthesis and in aggregation of costs and benefits. These factors have likely contributed to a growing gap between the required climate adaptation actions and what actually happens in practice. Furthermore, the way in which adaptation science tends to be implemented also can be limiting. This can include provision of scientific information that is 1) supply driven rather than demand driven, 2) that does not align with users values, needs or capability, 3) that is presented as suitable for operational use when it is not. There are ways however, to better connect knowledge and action. For example, relatively well-established approaches of co-learning that link closely the users and producers of climate information so as to address the correct time and spatial scales and climate variables and embed this information into the social and institutional processes through which decisions are made. A key step towards better connection between knowledge and action would be to use decision-centered framing of adaptation rather than the past climate-centered framing which continually refocuses attention on the component of the system that is least tractable for the adaptation decision-makers involved: the global climate. Accompanying this there is a need to redesign climate change scenarios to be more relevant to adaptation decision-makers, to be more inclusive of different levels and dimensions of adaptation such as incremental to transformative adaptation, to maximise learning from adaptation studies and to develop clear adaptation policy rationales.

BIOGRAPHY

Prof. Mark Howden is Director of the Climate Change Institute at the Australian National University, an Honorary Professor at Melbourne University, a Vice Chair of the Intergovernmental Panel on Climate Change (IPCC) and a member of the Australian National Climate Science Advisory Committee. He was on the US Federal Advisory Committee for the 3rd National Climate Assessment and contributes to several major national and international science and policy advisory bodies. Mark has worked on climate variability, climate change, innovation and adoption issues for over 30 years in partnership with many industry, community and policy groups via both research and science-policy roles. Issues he has addressed include agriculture and food security, the natural resource base, ecosystems and biodiversity, energy, water and urban systems. He helped develop both the national and international greenhouse gas inventories that are a fundamental part of the Paris Agreement and has assessed sustainable ways to reduce emissions. He has been a major contributor to the IPCC since 1991, sharing the 2007 Nobel Peace Prize.

**EDWARD VRKIC**

SENIOR ADVISOR – CLIMATE CHANGE,
UNITED NATIONS DEVELOPMENT PROGRAMME

IS IT TIME TO THINK ABOUT CLIMATE CHANGE AS WEATHERNOMICS?

Meteorological metaphors are often used to convey a sense of how economies are performing. They are perhaps most colourful during times of economic instability or crisis. The Asia-Pacific – the world's economic engine – is among the most exposed to the impacts of climate change and its associated disruption. Yet despite the advocacy, the struggle for climate action continues. While the science is clear, we have yet to fully socialise climate action as a value among decision makers. This raises a range of questions, namely why with the weight of evidence, does this continue? It is time to ask whether our approach has helped or hindered efforts to ensure climate action is a first consideration among decision makers and what failing to achieve this will mean for the region, its economies and most importantly, its people.

BIOGRAPHY

Mr. Vrkic is currently serving as the UNDP's Senior Adviser – Climate Change, to Papua New Guinea. In this role, he heads the UNDP's Environment, Energy and Climate Change portfolio. Prior to this, he was the Head of Aid Operations and Climate Change for Australia's High Commission to Port Moresby where he also served as the Australian Government's humanitarian response coordinator to PNG.

Mr. Vrkic has previously served as a senior political adviser to the Australian Government on PNG and Pacific foreign policy, overseas development assistance and climate change. He has held the position of Chief-of-Staff at the Pacific Islands Forum and a range of other diplomatic, program and policy positions with the Australian Agency for International Development, the Australian Department of Foreign Affairs and Trade, and the Private Sector.

He has a Masters degree in international relations from the Australian National University. He is passionate about development and in particular, action to address climate change.

SESSION I

ENHANCING CLIMATE INFORMATION APPLICATIONS

DR. WONMOO KIM
RESEARCH FELLOW, APEC CLIMATE CENTER

PROF. SIMON S. Y. WANG
ASSOCIATE PROFESSOR, UTAH STATE UNIVERSITY

MR. PHILIP MALSALE
CLIMATOLOGY OFFICER, SECRETARIAT OF THE PACIFIC
REGIONAL ENVIRONMENT PROGRAMME

DR. REBECCA A. BOLINGER
RESEARCH ASSOCIATE III, COLORADO CLIMATE CENTER,
COLORADO STATE UNIVERSITY

PROF. DAVID LETSON
PROFESSOR, UNIVERSITY OF MIAMI

PROF. ALBERTO TROCCOLI
CO-FOUNDER AND MANAGING DIRECTOR,
WORLD ENERGY & METEOROLOGY COUNCIL

**WONMOO KIM**

RESEARCH FELLOW,
APEC CLIMATE CENTER

GAPS AND OPPORTUNITIES IN CLIMATE INFORMATION SERVICES: LESSONS LEARNED FROM OUR SEASONAL PREDICTION AND SECTORAL APPLICATION IN THE PACIFIC

Climate and its variability is a fundamental component of human activity, as it profoundly impacts the environment surrounding human. Our collaborative and continuous effort enabled us to foresee the future state of major climate phenomena, and now we are able to predict the climate drivers of various range, e.g., the dominant interannual climate variability, El Niño-Southern Oscillation (ENSO), can be forecasted several seasons ahead with high confidence and the largest tropical intraseasonal variability, Madden-Julian Oscillation (MJO), is predictable a few weeks ahead. Climate information including its prediction information is regularly serviced through various operational centers world-wide, however, in many cases, the end-users may still suffer from interpreting climate information for their sectoral application.

Climate scientists and sectoral application scientists have been closely working together in APEC Climate Center (APCC) to enhance the socio-economic well-being of member economies by utilizing up-to-date scientific knowledge and applying innovative climate prediction techniques through climate prediction, interdisciplinary research, climate information services, and international cooperation. APCC has identified huge gaps between climate information and its end-users through the interdisciplinary climate prediction and information service projects. For example, current operational prediction skill is generally highest in the tropical Pacific region where the climate information is least utilized; climate prediction information is sometimes incorrectly transferred to application sectors to mislead their policy and decision making; unidirectional flow of climate information causes climate-based decision making less sustainable; most likely, the end-users expect to have ready-made climate information for the sectoral use, rather than raw ingredient that climate centers provide.

Here, we would like to share APCC's ongoing effort on bridging climate information and interdisciplinary application, and present some examples from our Pacific projects. They include a tailored seasonal prediction system for the national meteorological services in the Pacific as well as sectoral applications in agriculture and water management. The APEC member economies generally possess advanced technology and infrastructure for the dissemination of climate information, the lessons learned from our Pacific climate information services should provide relevant example of practice in general climate information services.

BIOGRAPHY

Dr. WonMoo Kim is a research scientist in Climate Service Development Team, Climate Services and Research Department of APEC Climate Center (APCC). He completed his Ph.D. in atmospheric science in 2011 from Seoul National University, Korea, where he focused on the long-term change of monsoon climatological intraseasonal oscillation. He continued his research on El Niño-Southern Oscillation (ENSO) dynamics while working in Korea Institute of Ocean Science and Technology (KIOST, Korea) and in Commonwealth Scientific and Industrial Research Organisation (CSIRO, Australia). Before joining APCC in 2016, he had been working as a research professor at Ewha Womans University, Korea, and extended his research topics to climate services as well as climate dynamics. In APCC, Dr. Kim has been actively leading climate information service projects for the Pacific Islands and developed the Pacific Island Countries Advanced Seasonal Outlook (PICASO) system with his team. He is also leading in developing a tailored seasonal climate prediction system and built Expert Seasonal Prediction System for Seasonal Outlook in Korea (ESPreSSO) which has been demonstrating an outstanding prediction skill for the last few years.

**SIMON S. Y. WANG**

ASSOCIATE PROFESSOR,
UTAH STATE UNIVERSITY

ENHANCING CLIMATE PREDICTION INFORMATION BY CAPTURING WHERE PEOPLE AREN'T LOOKING

Many sectors of society need prediction information of climate anomaly, yet there is usually only one entity (the government) that has the means to generate nationwide climate forecast. Such an imbalance between supply and demand of climate information makes most national services powerless in meeting the diverse user needs. This presenter will introduce the work of two local, semi-academic, semi-governmental climate services in developing and disseminating climate prediction information, one in the American West and the other in subtropical Asia. This talk is focused on the subseasonal-to-decadal timescale, or S2D, that ranges from a few weeks to a few years. The prediction examples include crop management, extreme weather, air pollution events, and water resource in which S2D variability is a dominant forcing.

The S2D timescale affects day-to-day operation and planning for most of our society. The subseasonal timeframe (2-4 weeks) is crucial to the formation of extreme weather events. The natural drivers for S2S variability is mixed with both trackable and random sources. Trackable source includes atmospheric energy propagation, ocean heat anomaly, land surface feedback, etc. making long-range prediction possible. But most computer forecast models are only capable of simulating part of these underlining physics, hindering their forecast performance. Thus, it is critical to harvest skillful forecast outputs that are meaningful to the event and/or location of interest. Doing so inevitably requires expert analysis through the so-called climate diagnostics and forecast attribution techniques, as well as proper communication with the end users. The time and cost involved in such venture are prohibitive to any national weather and climate services, so trying to develop "usable forecast products" within any weather service to satisfy everyone often ends up a losing game.

It is proposed that economies or even APEC should consider establishing local "climate hubs" to communicate among end users and forecast providers. These climate hubs could be embedded in universities, branches of government, or NGOs with a carefully designed communication channel net. Recruiting and training the next-generation climate scientists who are also effective communicators is paramount and could also be a mission of the climate hubs.

BIOGRAPHY

Shih-Yu (Simon) Wang is an associate professor of climate at Utah State University, USA in the Department of Plants, Soils and Climate. He is also the associate director of the Utah Climate Center, a state climate office. Simon's research is focused on the variability, dynamics and prediction aspects of regional climate pattern, including extreme weather and climate events. He also develops climate application research in tree rings and agriculture. Simon publishes extensively in academic journals such as Nature Climate Change, Nature Communications, Bulletin of the American Meteorological Society, Journal of Climate, Climate Dynamics, Geophysical Research Letters, etc. with over 100 papers. He also published a monograph on climate extremes for the American Geophysical Union. Simon received his PhD in meteorology from Iowa State University in 2008 and became a faculty member at Utah State University in 2011. He served in the Science Steering Committee for the US Climate Variability and Predictability (CLIVAR), a national research program that fosters understanding and prediction of climate variability and change. Currently, Simon serves in the Scientific Organizing Committee of the Second International Conference on Seasonal to Decadal Prediction, held in September 2018 in Colorado, USA by the World Climate Research Programme (WCRP).

**PHILIP MALSALE**

CLIMATOLOGY OFFICER,
SECRETARIAT OF THE PACIFIC REGIONAL ENVIRONMENT PROGRAMME

DYNAMICAL, STATISTICAL AND TRADITIONAL CLIMATE FORECASTING IN THE PACIFIC ISLAND COUNTRIES: WHAT WE DO NOW AND CHALLENGES FOR FUTURE

The Pacific Island communities are facing increased exposure to extreme climate events. In most economies, seasonal climate forecasts are available through national meteorological services (NMSs). However, this information were derived from Global climate models that have very low resolutions that often not suitable for decision making at the provincial and community level. Often with this, the uptake of NMS forecasts can be limited in communities due to low literacy level, isolation of communities and the lack of the information being translated to sectoral actions. To address this, NMSs need of a higher resolution climate models and a clearer understanding of types of information local communities currently use, to enable them to modify their products to better meet community needs. Based on what Secretariat of the Pacific Environmental Programme (SPREP) provided through various projects, dynamical models such as CLIK-P and PICASO, and statistical climate models such as SCOPIC were tailored and provided to NMSs in 11 Pacific economies (PNG, Solomon Islands, Vanuatu, Marshall Islands, Fiji, Kiribati, Tuvalu, Tonga, Samoa, Niue and Cook Islands). In addition to this, Traditional Knowledge on climate indicators is also incorporated into these services so remote communities who mainly relied on weather and climate forecasts based on traditional knowledge (TK) alone or in combination with contemporary (NMS) forecasts can effective use this information. The NMSs that have benefited from the projects and from using these tools in providing climate forecasting systems for their communities indicated that they can now provide better climate forecast compared to ten years ago especially in the lead up to and during extreme events such as ENSO related events, to assist their decision-making both at the national and community level. Recent climate extremes events in the Pacific have shown self-reliant economies, with knowledge of using dynamical and statistical forecast along with traditional ways of forecasting, and responding to extremes, experience better response from NMS and from communities, particularly when combined with contemporary warnings. Therefore, there is need to continue improving the climate forecast capabilities in the Pacific region, better understand the role of NMSs climate forecasts, warnings and responses and inclusion of temporary climate forecasts to reach the communities.

BIOGRAPHY

Philip is a climatologist with a master's degree in Environmental Science and a degree in Geography and Population studies. He specialises in weather, climate, and climate change along with traditional knowledge. Currently works with Secretariat of Pacific Environment programme (SPREP), previously employed with the Vanuatu Meteorology and Geo-Hazards Department (VMGD). He is an author of the Protocols and partnerships for engaging Pacific Island communities in the preservation of traditional climate knowledge and co-author on several climate science journal and publication including climate change in the Pacific; Scientific Assessment and New Research (2011). His work has been recently published in the American Meteorological Society, International Journal of Climatology, Royal Meteorological Society.

**REBECCA A. BOLINGER**

RESEARCH ASSOCIATE III,
COLORADO CLIMATE CENTER, COLORADO STATE UNIVERSITY

DEVELOPING A REGIONAL DROUGHT OUTLOOK PRODUCT USING SEASONAL FORECAST INFORMATION

The National Integrated Drought Information System (NIDIS) was implemented to foster collaboration with the ultimate goal of creating a national drought early warning information system for the United States. It was recognized that drought, in terms of definition, indicators, and impacts, varies greatly from region to region, leading to the creation of the NIDIS regional Drought Early Warning Systems (DEWS). Improvements in regional drought monitoring have propagated into the drought depictions published by the U.S. Drought Monitor and have resulted in increased on-the-ground user involvement and more informed decision making. Moving forward from monitoring, potential applications still remain to be explored within the prediction side of "early warning."

Currently, the National Oceanic and Atmospheric Administration's Climate Prediction Center (NOAA – CPC) releases national monthly and seasonal drought outlook products. But the product has its limitations with regard to regional decision making. With the intricacies of the Intermountain West (including complex topography, irrigated croplands, and a snowmelt driven water supply), this research highlights the importance of a regional drought outlook that satisfies both spatial and temporal needs. Combining the use of the North American Multi-Model Ensemble (NMME) with current operational drought monitoring efforts, results presented here show how the DEWS can provide probabilistic seasonal drought forecasts as a decision-making tool.

BIOGRAPHY

Becky Bolinger received her B.S. in meteorology from Metro State University of Denver, M.S. in meteorology from Florida State University, and her Ph.D. in atmospheric science from Colorado State University. She is now the Assistant State Climatologist at the Colorado Climate Center (within CSU's department of Atmospheric Science). Her research interests are focused on climate variability and extremes, drought, and seasonal forecasting. She spends her spare time with her husband and daughter, hiking, cycling, running, and enjoying Colorado's beautiful outdoors.

**DAVID LETSON**

PROFESSOR,
UNIVERSITY OF MIAMI

AGROCLIMATE FOR CLIMATE – SMART AGRICULTURE

AgroClimate is an innovative web-resource for decision-support and learning, providing interactive tools and climate information to improve crop management decisions and reduce production risks associated with climate variability and change. AgroClimate was developed by the Southeast Climate Consortium (SECC) which was a coalition of eight universities: Florida State University, University of Florida, University of Miami, University of Georgia, Auburn University, North Carolina State University, Clemson University and University of Alabama-Huntsville. It is currently maintained and operated by the University of Florida. AgroClimate is regularly used during training events for County Extension faculty and during workshops with agricultural producers. Its modular platform allows for an easy replication in other geographies and for content expansion. AgroClimate prototypes are currently under development for economies in Africa and South America.

BIOGRAPHY

David Letson is Professor of Marine Ecosystems and Society at the University of Miami/RSMAS. His research focus is on the economics of extreme weather and climate change adaptation. In particular, he is interested in how predictions from the geosciences are used to create societal value. He serves as editor for the journal *Weather, Climate and Society*, and contributed to the recent World Meteorological monograph, *The Economic Benefits of Meteorological, Hydrological and Climatological Services*.

**ALBERTO TROCCOLI**

CO-FOUNDER AND MANAGING DIRECTOR,
WORLD ENERGY & METEOROLOGY COUNCIL

WHAT CAN EUROPEAN CLIMATE SERVICES OFFER TO THE ENERGY AND WATER RESOURCE SECTOR?

The energy sector is undergoing a major transformation. This transformation in the energy sector is taking place against a variable and changing climate. Given the weather- and climate-dependency of both renewable energy and demand (even in the case of large storage uptake), it is important to develop robust climate-based tools to advise energy planners and policy makers.

This talk will describe how the EU Copernicus Climate Change Service (C3S) European Climatic Energy Mixes (ECEM) project can assist in this energy transformation. ECEM produced, in close collaboration with prospective users, a proof-of-concept climate service, or demonstrator, whose purpose is to enable the energy industry and policy makers to assess how well different energy supply mixes in Europe will meet demand, over different time horizons (from seasonal to long-term decadal planning), focusing on the role climate has on the mixes.

Energy time series were modelled and computed at national level and daily time step for the whole of Europe. Bias-adjusted Essential Climate Variables from ERA-Interim over a European domain for 1979-2016 produced by ECEM were used to calculate energy variables, namely electricity demand and generation from wind, solar and hydro power. Different approaches were adopted depending on the target variable, and the availability of measured data to calibrate and validate the energy models.

Examples from the C3S ECEM Demonstrator – an interactive and visual tool which allows users to view and explore energy supply and demand profiles for each European economy (and for ca 100 clusters) and generation type, as well as climate variables, in map and/or time series format – will be used to illustrate the power of climate services in supporting the energy industry. The C3S ECEM Demonstrator is being developed according to user needs and integrates the energy and climate variables being produced in C3S ECEM on historic, seasonal forecast and climate projection timescales. Data can also be downloaded directly from the Demonstrator.

The presentation will conclude with an outlook for future developments of climate services for the energy, but also water, sector, and what benefits they could provide to the energy and other industries and decision makers at different levels.

BIOGRAPHY

Prof. Alberto Troccoli is a visiting Professor at the University of East Anglia's School of Environmental Sciences and Managing Director of the World Energy & Meteorology Council. He has about 25 years of experience in several aspects of meteorology and climate and, in the last decade, their applications, particularly to the energy sector. He has worked at several leading institutions such as NASA, ECMWF (UK), the University of Reading (UK) and CSIRO (Australia). He has led a number of projects and capacity building activities, particularly in the area of meteorology and energy. He is currently the leader of the EU H2020 project *The Added Value of Seasonal Climate Forecasting for Integrated Risk Management (SECLI-FIRM)* project, and of the C3S Energy activity. He served as a leader of the Australian Solar Energy Forecasting System project in collaboration with the Australian Energy Market Operator (AEMO), the US National Renewable Energy Laboratory, the Bureau of Meteorology and two Australian Universities, which has produced an operational system run by AEMO. Alberto is the chief editor and an author of four books: *Seasonal Climate: Forecasting and Managing Risk* (2008), *Management of Weather and Climate Risk in the Energy Industry* (2009), *Weather Matters for Energy* (2014), *Weather & Climate Services for the Energy Industry* (2018). He is the main author of the UN-led *Global Framework for Climate Services (GFCS) Energy Sector implementation plan*. He attended the May 2015 WMO Congress as an invited expert on energy sector matters and he is regularly invited internationally to give talks on energy and climate. He is the convener of the *International Conference Energy & Meteorology (ICEM)* series. Alberto holds a PhD in physical oceanography from the University of Edinburgh (UK).

SESSION II

IMPROVING WATER AND FOOD SECURITY WITH CLIMATE INFORMATION AND SERVICES

DR. TOSHICHIKA IIZUMI
SENIOR RESEARCHER, NATIONAL AGRICULTURE AND
FOOD RESEARCH ORGANIZATION, JAPAN

DR. DENNIS TIMLIN
RESEARCH SOIL SCIENTIST,
UNITED STATES DEPARTMENT OF AGRICULTURE

DR. RAMAKRISHNA AKKINAPALLY
DEPUTY DIRECTOR-GENERAL,
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PROF. NUKET SIVRI
PROFESSOR, ISTANBUL UNIVERSITY

PROF. RIJAN BHAKTA KAYASTHA
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PROF. JOON HA KIM
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**TOSHICHIKA IIZUMI**

SENIOR RESEARCHER,
NATIONAL AGRICULTURE AND FOOD RESEARCH ORGANIZATION, JAPAN

GLOBAL CROP YIELD FORECASTING USING SEASONAL CLIMATE INFORMATION FROM A MULTIMODEL ENSEMBLE

Forecasting year-to-year variations in the yields of major crops globally is expected to have utility in strengthening the ability of societies to better respond to food production shocks and food price spikes triggered by climate extremes. However, substantial improvements to the methodology used in global crop forecasting are required to realize a reliable operational service. A joint research "Development of seasonal-climate-forecast-based global forecasting system of crop yield variability and crop forecast information services for world food agencies" has been conducting by National Agriculture and Food Research Organization (NARO) and APEC Climate Center (APCC). In my talk, I present the outcomes from the project on the reliability of global within-season and pre-season predictions of yield variability obtained by applying statistical yield models to seasonal temperature and precipitation hindcast data derived from a multimodel ensemble (MME). Four major crops, maize, rice, wheat and soybean are studied. The mosaic method that is a recently proposed MME approach reliably predicts the yield variability over a large portion (25–38%) of the global harvested area three months before harvesting. Using the method, reliable within-season predictions of national yield variability can be produced in 36%, 24%, 25% and 30% of the maize-, soybean, rice- and wheat-producing economies, respectively. The pre-season predictions are found to be reliable in 23–32% of the crop-producing economies. As yield variability at the national level is of interest to commodity and food security specialists, the mosaic method provides a basis for developing an operational global yield forecasting service.

BIOGRAPHY

Dr. Toshichika Iizumi is an agricultural meteorologist and Senior Researcher at the Institute for Agro-Environmental Sciences, a research center for climate change adaptation and mitigation at NARO. His global crop studies aim to provide outlooks how changes in technology and climate would contribute to global food security in coming decades. He serves as Editor of Climate Research and board member of the Society of Agricultural Meteorology of Japan.

**DENIS TIMLIN**

RESEARCH SOIL SCIENTIST,
UNITED STATES DEPARTMENT OF AGRICULTURE

INCORPORATING CO₂ RESPONSES INTO CROP SIMULATION MODELS

Crop models can be useful for assessing effects of temperature and CO₂ on yields using combinations of these variables that would be difficult or impossible to manage in field or growth chamber experiments. The objective of this talk is to describe some mathematical methods of calculating the plant response to CO₂ and temperature in crop simulation models. The effects of temperature on growth process in most models are quantified as growing degree days (GDD) in order to linearize the response. However, GDD responses can be affected by the mean temperature at which the GDD response was parameterized. We will discuss how non-linear temperature functions such as the beta-function can be a useful alternative. Simpler models quantify carbon assimilation by using the concept of Radiation Use Efficiency (RUE). This concept relates carbon uptake (g C per day) to solar radiation (MJ radiation per day). This relationship is adjusted by a 'response factor' that increases carbon assimilation rate over a baseline as a function of atmospheric CO₂ content. Another, slightly more realistic method is to use a non-linear, asymptotic function such as a Mitscherlich function or non-linear rectangular hyperbolic function to model the relationship between light intensity and carbon assimilation rate. The slope and asymptote of the relationship can be adjusted for atmospheric CO₂ content. The parameters for these relationships are developed from CO₂ and crop yield studies, and leaf or canopy level photosynthesis data. The effects of water relations and temperature are added empirically. More mechanistic models use a coupled model of photosynthesis and stomatal conductance. This type of model relates carbon assimilation rates to enzyme (rubisco) kinetics and light response functions. The advantage is that they allow feedback between internal CO₂ sinks and external CO₂ sources and can mechanistically incorporate the effects of relative humidity, temperature and water relations. Light interception is calculated as a function of leaf area index. Mechanistic crop models with realistic CO₂ responses are capable of representing key physiological processes to simulate plant responses to CO₂, temperature and water. These models are necessary to enhance our ability to forecast crop yields and develop adaptive cropping solutions for achieving food security in a changing climate. They are somewhat weaker in their simulation of nutrient, temperature and water effects and more research is needed in this area.

BIOGRAPHY

Dennis Timlin is a Research Soil Scientist with the USDA-ARS Adaptive Cropping Systems Laboratory at the Beltsville Agricultural Research Center, Beltsville, MD. He has been at Beltsville since 1991. He earned his B.A. Degree in Biology from SUNY Buffalo, NY in 1974 and his M.S. and Ph.D degrees in Soil Physics from Cornell University in 1987. He is a fellow of the American Society of Agronomy and the Soil Science Society of America. His program is directed toward quantifying the effects of environmental variables on crop growth and soil processes. Current research involves development of plant and soil simulation models for use in climate change and agricultural management assessment, and in research. His interests are in how plants and their environment (soil, temperature, and carbon dioxide) interact and how to quantify that interaction in simulation models. His experimental research utilizes sunlit growth chambers to study carbon assimilation, growth and development of plants. Some of the models that he has worked on include 2DSOIL and GLYCIM and two new models for maize (MAIZSIM) and potato (SPUDSIM).



RAMAKRISHNA AKKINAPALLY

DEPUTY DIRECTOR-GENERAL,
NATIONAL AGRICULTURE RESEARCH INSTITUTE, PAPUA NEW GUINEA

ADAPTATION OPTIONS FOR CLIMATE SENSITIVE DEVELOPMENT

Agriculture is under threat from climate change. Climate change will mean higher average temperatures, changing rainfall patterns resulting in droughts, frost, floods and rising sea levels. Papua New Guinea (PNG) is particularly vulnerable to these changes as the economy is closely linked to agriculture, and a large proportion of populations depend directly on agriculture and natural ecosystems for their livelihoods. Climate change has the potential to act as a 'risk multiplier' particularly in agricultural and other natural resource-based systems which are already failing to keep pace with the demands on them. Analysis suggests that the average cost of coastal flooding could increase from \$20 million per year to \$90–\$100 million by 2030 and the economic loss due to malaria from \$130 million to \$210–\$250 million per year, due to the interaction of climate change with the increased value of assets at risk as a result of economic growth. It has been calculated that cost-effective adaptation measures could avert 65%–85% of these losses.

The impacts of climate change on the hydrological cycle are also expected to influence the productivity of irrigated and rainfed agriculture in PNG. As a result, the livelihoods of rural communities and the food security of population are at risk from water-related impacts linked primarily to climate variability. The rural poor, who are the most vulnerable, are likely to be disproportionately affected. Adaptation measures that build upon improved land and water management practices will be fundamental in boosting overall resilience to climate change. And this is not just to maintain food security: the continued integrity of land and water systems is essential for all economic uses of water.

This paper summarizes current knowledge of the anticipated impacts of climate change on agriculture and examines the implications for local and national food security. It analyses expected impact of climate change and makes the case for immediate implementation of 'no-regrets' strategies which have both positive development outcomes and make agricultural systems resilient.

BIOGRAPHY

Dr. Ramakrishna Akkinapally obtained his B.Sc (Agri) and M. Sc (Agri) from the Andhra Pradesh Agricultural University, Hyderabad and Ph.D (Agronomy with specialization in Dryland Research) from the Hisar Agricultural University, Haryana. He has served in various capacities as scientist and senior scientist in the Natural Resource Management Program and as Deputy Coordinator-Cereals and Legumes Asia Network (CLAN); Coordinator for ADB, IFAD, FAO and other donor funded projects in South and South-East Asia at the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT). He joined Papua New Guinea National Agricultural Institute (NARI) in 2005 as Research Program Leader and currently serving as the Deputy Director General of since 2014. He won several awards and author of about 150 papers published in the journals of international repute.



NÜKET SIVRI

PROFESSOR,
ISTANBUL UNIVERSITY

IMPACTS OF CLIMATE CHANGE ON TURKEY'S SPECIAL WATER RESOURCES

Being one of the most important key elements influencing social health, wellbeing, preservation of ecosystem, and the economic development of a nation, water is a natural, yet limited resource. Population growth, industrialization and urbanization in the 20th century have resulted in a substantial increase in water consumption. While the world's population has grown three fold, water use has increased six fold during the same period. Due to "Global warming effects" and its adverse impact on climate many economies of the world will be facing serious shortages on this limited resource.

Contrary to the general perception, Turkey is not a nation rich in water resources; neither the richest economy of the region, in this respect. Furthermore, given its growing population, rapid urbanization and industrialization; it is anticipated to become a water-stressed economy by 2030. Most of the economy is situated in a semi-arid region. The available water per capita per year in Turkey is about 1/5 of the water-rich economies.

The climate of Turkey is semi-arid with extremities in temperature. Climate and precipitation figures exhibit great variance throughout the economy. Average annual precipitation is 643 mm, ranging from 250 mm in the south-eastern part of the economy, to over 3000 mm in the north-eastern Black Sea coastal area. This average annual precipitation figure for Turkey corresponds to an average of 501 billion m³ of water per year and 274 billion m³ is assumed to evaporate from surface and transpire through plants.

But the economy's water resources are very sensitive to drought conditions and drought is seen in every fifteen year period which means annual water yield decreases to one third of annual average value of long period. Beside irregular regime character; flood events, which are threatening natural life and other activities, are creating great hazards. As in other economies in the world, irrigation also has a great share in water consumption. To counter this consumption, in Turkey, there is a great deal of effort in adopting and exercising an integrated approach to water resources management.

There are several public institutions and organizations in Turkey working on the development of land and water resources of 26 river basins. Duties and working areas of each of these institutions are determined by laws. The most efficient solution for overcoming existing problems in order to allow natural occurrence of water cycle, well-designed and "Basin Management Plan" is implemented in our economy for planning, managing and preserving water on a basin wide scale.

For these purposes, various projects have been developed in agricultural irrigation, environment and water management in Turkey so far. For an example, to minimize water loss through distribution networks, to use water more conservatively during the operation and to increase irrigation efficiency, modern irrigation methods such as, sprinkler or drip irrigation are established.

BIOGRAPHY

Prof. Nüket Sivri is a Professor in Environmental Engineering Department at Istanbul University, where she has been a faculty member since 2004. During 1991-2004 she was a research assistant at Faculty of Marine Sciences in Karadeniz Tech University, which has a research institute for environmental-marine studies in Black Sea.

She received her PhD in relation between coastal area- marine-river studies from Karadeniz Tech University in 1999. Her current research interests lie in coastal area impact assessment on marine ecosystem at regional and global scales. In recent years, she has focused on antibacterial resistance, water sanitation, and the development of novel technologies for promoting microalgal growth. In addition, her team studies mainly on understanding the role of microorganisms in the coastal area using genomic approaches and developing fast acute toxicity methods used to determine the toxic effects of industrial wastewater. She is also in editorial board for more than 10 journals in her field of study.



RIJAN BHAKTA KAYASTHA

ASSOCIATE PROFESSOR,
KATHMANDU UNIVERSITY

USE OF CLIMATE INFORMATION IN NEPAL FOR WATER AND FOOD SECURITY

The history of climate data used in Nepal for water resources goes back to 1962 when the government of Nepal started collecting hydrological and meteorological data under a section in the Department of Electricity. Now such activity is carrying out by the Department of Hydrology and Meteorology (DHM). DHM has a mandate from Government of Nepal to monitor all the hydrological and meteorological activities in Nepal. The scope of work includes the monitoring of river hydrology, climate, agro-meteorology, sediment, air quality, water quality, limnology, snow hydrology, glaciology, and wind and solar energy. General and aviation weather forecasts are the regular services provided by DHM. Nepal is increasing its climate data acquisition through upgrading automatic data collecting system, launching weather balloon daily and installing weather radar system in near future. Using these climate data Nepal is increasing its flood forecasting capacity mainly during monsoon season (June-September) and providing climate data to farmers so that they can plan agricultural activity accordingly. Observed climate data and available downscaled future climate data are also used in glacio-hydrological modeling for predicting future variations in discharge from glacierized rivers and its impact in hydropower production and fisheries.

BIOGRAPHY

Dr. Rijan Bhakta Kayastha, an Associate Professor and Coordinator of the Himalayan Cryosphere, Climate and Disaster Research Center (HiCCDRC), Kathmandu University has 24 years of experience on the Himalayan glaciology, glacio-hydrological modeling, mountain hydrology and meteorology. His current research areas includes understanding of glacier mass balance by field and model calculations, impacts of climate change impact on glaciers and water resources, understanding of glacier variation by field observation, remote sensing and modeling techniques, estimation of ablation by energy balance and positive degree-day models, estimation of current and future discharges from glacierized river basins using different glacio-hydrological models and future climate data, glacier-climate interaction, snow and glacier hydrology of mountain region, extreme weather events, glacial hazard such as glacier lake outburst flood (GLOF), flood and GLOF early warning systems and water and climate induced disaster risk reduction. His two on-going projects are the Cryosphere Monitoring Project (CMP) since August 2011 supported by the Royal Norwegian Government through the International Centre for Integrated Mountain Development (ICIMOD) and Contribution of High Asia Runoff from Ice and Snow (CHARIS) since April 2012 supported by USAID through the University of Colorado at Boulder, CO, USA.



JOON HA KIM

DIRECTOR,
INTERNATIONAL ENVIRONMENTAL RESEARCH INSTITUTE,
GWANGJU INSTITUTE OF SCIENCE AND TECHNOLOGY

WATER, CLIMATE CHANGE, AND 4TH INDUSTRIAL REVOLUTION

The world is changing faster than ever. The frequency of unusual weather phenomena due to the climate change is increasing, and technological innovations triggered by the fourth industrial revolution are reforming societal structures. These 'big changes' are not unusual anymore. Everything we used to consider 'the ab-normals' is turning into 'the new-normals', and all the things that we took for granted are no more just ours.

Water is one of such things. A stable water supply is becoming more difficult as the impact of climate change grows greater. Therefore, we need a novel approach for stabilizing the water supply rather than conventional water management strategies. Likewise, many natural and societal issues are becoming more serious due to the climate change, and new solutions are required for solving those issues. In this context, to cope with the threat of climate change, we should understand the 'big changes' of today further, and know the keywords of a new age (3C: creativity - convergence - communication).

Among such big changes, the fourth industrial revolution might provide a solution for the water problem and the climate change. The technological innovations in the age of the fourth industrial revolution will enable the 'intelligent cyber-physics system' by blurring the boundary between the cyber domain and the physical domain. Through the convergence of those two domains, many societal problems including the water problem would be solved. Therefore, we should be accustomed to the big changes, and learn how we can harness the upcoming future.

In this presentation, we will be invited into the background story and the present status of climate change firstly. Subsequently, the identity and features of the fourth industrial revolution will be shown. Then lastly, a way to harness the big changes as an opportunity for our future will be introduced. The contents of this presentation are expected to play a key role in reorienting a path that we should take in 'the new-normals' age.

BIOGRAPHY

Joon Ha Kim is a professor in the school of Environmental Science and Engineering at the Gwangju Institute of Science and Technology (GIST), and director in International Environmental Research Institute (IERI), Korea. Professor Kim has a background in Chemical & Environmental Engineering disciplines from Korea University and the University of California, Irvine, in the US. He has researched for more than 20 years, studying the academic area of environmental systems engineering associated with complex environmental systems. He has published more than 120 papers in many prominent international journals in the field of environmental science and engineering. He is one of the leading experts in environmental data analysis and mining, statistical and deterministic modeling, and optimization to mitigate the problems caused by the intrinsic complexities of environmental systems.

SESSION III

LINKING CLIMATE INFORMATION AND DECISION MAKING

DR. ELISABETH SIMELTON

CLIMATE CHANGE SCIENTIST & CCAFS PROJECT MANAGER,
WORLD AGROFORESTRY CENTER

PROF. HOJEONG PARK

PROFESSOR, KOREA UNIVERSITY

PROF. JAGATH J. KALUARACHCHI

PROFESSOR, UTAH STATE UNIVERSITY

PROF. CHALAPAN KALUWIN

PROFESSOR, UNIVERSITY OF PAPUA NEW GUINEA

DR. HEN-I LIN

DIRECTOR, CENTER FOR TECHNOLOGY POLICY EVALUATION AND RESEARCH,
CHUNG-HUA INSTITUTION FOR ECONOMIC RESEARCH



ELISABETH SIMELTON

CLIMATE CHANGE SCIENTIST & CCAFS PROJECT MANAGER,
WORLD AGROFORESTRY CENTER

CLOSING ACTIONABILITY GAPS OF CLIMATE SERVICES FOR FARMERS, AGRICULTURE PLANNERS AND ADVISORS – SOUTHEAST ASIAN EXAMPLES

By climate services I refer to the value-chain of “production, translation, transfer, and use of climate knowledge and information for climate-informed decision making”¹. The actionability of these services depend on a range of factors: the availability of, and access to, timely, understandable, and useful climate information. Limited actionability may be ascribed gaps and inefficiencies between the steps in this value-chain.

The presentation highlights some key actionability gaps and how we have approached them within the project Agro-Climate Information Systems for women and ethnic minority farmers (ACIS) in Vietnam, Laos and Cambodia. Where relevant for the SEA region, I will also draw on constructive examples from other CCAFS-projects globally. The presentation focuses on

- producers of climate services, and overcoming lack of downscaled weather information
- three main user groups of climate services, and attempts at connecting them: (1) public planners with different intermediate functions, such as translating climate information into plans or recommendations, and (2) advisors, such as extension service, who may translate and transfer (communicate) climate information to (3) end users: female and male smallholder farmers whose decisions may be based on none or to a range of climate services sources; who have diverse farming systems for which there are no inclusive smartphone apps.

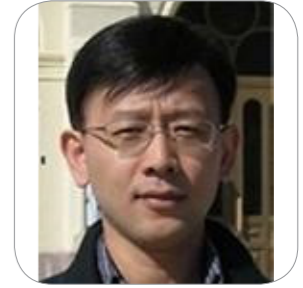
I will show how farmers’ knowledge contributes to seasonal agro-advisories and how their feedback helps meteorologists evaluating their seasonal forecasts; how various formats of farming advice reach farmers and help them using resources more efficiently. Lastly, I will share some (unexpected) turning points and lessons learned that contributed to the buy-in from local policymakers.

1. Climate Services Partnership <http://www.climate-services.org/>

BIOGRAPHY

Elisabeth Simelton is a climate change scientist and CCAFS project leader at World Agroforestry Centre (ICRAF) based in Vietnam since 2010. Currently, she is involved in adaptation projects across Southeast Asia and leads the My Loi climate-smart village project in central Vietnam.

Holding a PhD in Geography, her current work is oriented towards climate impact-land use-food security assessments and exploring interfaces between scientific and farmers’ knowledge.



HOJEONG PARK

PROFESSOR,
KOREA UNIVERSITY

ROBUST DECISION MAKING PROCESS UNDER SCIENTIFIC UNCERTAINTY ON CLIMATE CHANGE

It is well known that climate change policies often involve a tradeoff between irreversible environmental investment and irreversible environmental impacts. This tradeoff creates opposing incentives between delay and earlier adoptions of climate change policies. In addition, uncertainty plays a critical role in climate change policies: uncertainty on environmental investment which comes with large sunk cost reduces investment incentives. Scientific assessment tools are addressed for climate change policies in consideration of irreversibility and uncertainty, particularly focusing on robustness techniques to allow limited information. Several directions of possible applications will be discussed.

BIOGRAPHY

Hojeong Park received Ph.D. degree in Economics from Department of Agricultural and Resource Economics, University of Maryland. Before joining the faculty at Korea University in 2007, Dr. Park worked at Korea Energy Economics Institute (KEEI), Korea Development Institute (KDI) and Chonnam National University. His research focuses investment modeling under stochastic environment: real options analysis and decision making in environmental investment. He served as a project head for Korean emission trading program by Ministry of Environment and as a chief editor of Energy Economics Journal. Recent research includes optimal management of invasive disease, biodiversity and fishery economics while considering climate change impacts. In addition, he is actively working on energy policies through various governments’ advisory groups.



JAGATH J. KALUARACHCHI

PROFESSOR,
UTAH STATE UNIVERSITY

LINKING CLIMATE TO WATER SECURITY: CASE STUDIES FROM THE WESTERN DESERT OF EGYPT AND THE GANGES DELTA REGION OF BANGLADESH

Two study cases are presented to identify the influence of climate change and variability on water security. The first is Siwa Oasis, an arid groundwater-dominated region in the Western Desert of Egypt which is a part of a national project to reclaim 1.5 million acres of agricultural land. The objective here is to understand the agricultural water security under climate change using four regional climate models (RCMs) and two emission scenarios. The water use pattern from the low emission RCP 4.5 meets the government policy of annual groundwater water use of 4000 m³/acre in this century. Exceeding this limit can deplete the transboundary Nubian Sandstone Aquifer System (NSAS) as depicted in the high emission RCP 8.5 scenario. As a consequence, it can affect water security of the region. The second study is the lower Ganges delta of Bangladesh which is a humid subtropical region. It is also a groundwater-dominated region but with entirely different climatic conditions. The latter study identifies the changes in existing climatic pattern to address the current water security issues. A total of 14 climatic indices representing temperature and rainfall were computed from in-situ data (1961-2015) to provide insight on climatic variability and trend. This study found statistically significant increasing trends in temperature and evapotranspiration. Sixty-four percent of stations show a statistically significant increase of heating degree days, cooling degree days and extremely hot days (temperature > 30°C). Although there is no detectable change in overall rainfall trend, consecutive dry days and consecutive wet days are increasing. High-intensity rainfall of short duration is also increasing. These results indicate the increasing numbers of extreme hydrological incidents, which influences the occurrence of floods and droughts and leading to water insecurity.

BIOGRAPHY

Dr. Jagath Kaluarachchi is the Dean of the College of Engineering at Utah State University (USU) and Professor of Civil and Environmental Engineering. Dr. Kaluarachchi has a PhD in Environmental Sciences and Engineering from Virginia Tech. He has been active in the area of hydrology, water resources, and water quality for more than 25 years. He has published close to 80 journal publications in reputed scientific journals and more than 100 conference proceedings and presentations. He taught many short courses related to hydrology and water resources to proposal writing in Europe, Middle East and Asia. He was a visiting professor at Swiss Federal Institute of Technology, Zurich, Switzerland and Royal Institute of Technology, Stockholm, Sweden. Dr. Kaluarachchi has conducted many international development projects related to water management in arid regions including Iraq, Ethiopia, Ghana, Sri Lanka, Palestine, Jordan among many other economies. Dr. Kaluarachchi's accomplishments include Fellow recognition from both ASCE and EWRI, and Diplomate in Water Resources Engineering from the American Academy of Water Resources Engineering and numerous research awards from USU including the Robin's award for Outstanding Faculty Researcher in 2007. He is a licensed professional engineer in the State of Utah.



CHALAPAN KALUWIN

PROFESSOR,
UNIVERSITY OF PAPUA NEW GUINEA

CLIMATE CHANGE, VARIABILITY AND SEA LEVEL CHANGES POSES LONG TERM DISASTERS IN ACHIEVING RESPONSIBLE SUSTAINABLE DEVELOPMENT IN THE APEC AND PACIFIC ISLAND STATES

The short term studies and research in improving the understanding the science of climate change, variability, sea level changes and deep sea/ocean explorations in APEC economies and the Pacific Island States poses the greatest long term disasters to the livelihoods of the communities in managing long term resilience and responsible sustainable measures will be presented and discussed.

Since 1980s scientific and environment results, studies (mainly desk top models) and reports carried in the many APEC economies and states in Pacific region submitted to the UN Sustainable Development Goals, APEC leaders and their governments for consideration should be treated with caution and precautionary principles must be applied until full scientific proof is available. Application of adaptation measures and technology in the tropical marine ecosystem has very serious limitation on States around the Pacific oceans, atmosphere and coastal areas must be evaluated and monitored for its mitigation measures.

Our studies and results since 1990 on climate change and sea level rise (6-8 mm/yr), managing a 1.5 to 2 C degrees change before 2030 (Paris Agreement), influence of Monsoons, El Nino/La Nina and other drives such warm pool and deep oceans currents impacts on resources and include; species extinction and loss of biodiversity; sediment plumes and tailings pollution of the entire water column; absorption of heavy metals and toxins by marine animals, including commercial fisheries; the disturbance of marine mammals from constant noise and light in the water; the risk of oil spills and accidents from increased vessel and surface traffic; the destruction of coral reefs through increased acidity of water; increased carbon emissions and temperature.

In addition introduction of new technology (SEAFRAME, Satellites, Gliders etc) to support research with partners such as France, USA, Australia, Japan governments to obtain long term data and information to improve our models and support the decisions/policies processes.

Given the recent approved UN Sustainable Development Goals and Responsible Sustainable Development policies by APEC states (Governance, economic, environment and livelihoods) scenarios and assessments of PNG and its neighbors coupled with too many questions and uncertainties will pose a long Term disaster for small Island economies and the health of its people. A comprehensive hazard risk and Management (CHARM) and Resilience and Sustainability models will be discussed as important policy options in mitigating climate change, variability and sea level changes.

BIOGRAPHY

Currently working in the University of Papua New Guinea as an academic, researcher and adviser to the Papua New Guinea government and Pacific Island states in areas of sciences and sustainable development policies. For more than 35 years have worked internationally and the Pacific region in the areas of scientific research, leadership, management, technical and policies in the areas of capacity building, human resource development, research and training in the areas of technology, communication, environment and sustainable development in the field of natural and physical sciences policy and management of institutions and organizations in regional and international organizations (UN agencies, such as UNEP, UNDP, FAO, UNESCO, WMO). More importantly worked with governments of Australia, New Zealand, Papua New Guinea and 22 Pacific Island economies and their Governments on technical and policy advisor on oceans, atmosphere and terrestrial environmental issues to important regional organizations covering sustainable development applications integrating comprehensive hazards and risk management principles such as climate change and variability as regional and global issues.

**DR. HEN-I LIN**

DIRECTOR,
CENTER FOR TECHNOLOGY POLICY EVALUATION AND RESEARCH,
CHUNG-HUA INSTITUTION FOR ECONOMIC RESEARCH

CONNECTING USERS' NEEDS FOR CLIMATE INFORMATION WITH CLIMATE SERVICES BY USING ECONOMIC BENEFIT EVALUATION: THE EXPERIENCES IN TAIWAN

Following the Global Framework for Climate Services (GFCS) of World Meteorological Organization (WMO), Central Weather Bureau (CWB) has initiated many action plans since 2012. Climate service evaluation for the societal and economic benefits and impacts have been one of the CWB's major tasks under a four-year national master policy project, which is named "capacity building for climate services", through a special funding source from central government since 2014. For more than five years, CWB has continuously funded our CIER research team to explore the potential social benefits and economic value of applying meteorological information in agriculture which is selected as one of the five priority areas by WMO. We use contingent valuation method (CVM) to evaluate the economic benefits of the non-market goods (eg. CWB's climate services) for agricultural producers. Based on our findings in the national survey in 2013, a pilot program cooperated with Erlin Farmers Association and Taiwan Agricultural Research Institute (TARI) has begun since 2014. Using our CVM baseline value surveys in 2014 with a user panel of selected 254 farmers, we have the preliminary results of users' needs, communication channels, and economic valuation results in this pilot program. To enhance CWB's climate services and products for agricultural users, our research team has been working with the experts from CWB and TARI in the last five years, and designs many activities and tools in the last three years. Those activities and tools include holding a workshop by teaching farmers how to use the current climate service products in the farm level management, a guideline for agricultural researcher to teach their students in their agricultural extension classes, a very unique design of advertisement pages in farmers' year calendar booklet, and a teaching class material to teach farmers how to use CWB's application software on smartphones. Recently, another master project from central government for CWB has been granted in 2018. It authorized CWB to conduct more research on better innovations of climate services for agriculture and fishery in the next four years.

BIOGRAPHY

Lin receives his Ph.D. degree in Agricultural Economics at Texas A&M University in 2010, and begins his career at the Third Research Division of Chung-Hua Institution for Economic Research (CIER) as an assistant research fellow since then. He has become the director of the Center for Science and Technology Policy Evaluation at CIER since October, 2017. He has participated in the multi-year research projects funded by Central Weather Bureau (CWB) as Co-Principal Investigator for the works on economic evaluation for applied meteorological information services in the various sectors in Taiwan since 2013. With his economic evaluation and social pilot studies, his team has been continuously assisting CWB with identifying the users' needs in agricultural sector and enhancing its meteorological information services for Taiwanese farmers in the last few years. In addition to agriculture, Lin's team is also beginning their economic evaluation research for applied meteorological information services in the sectors of fishery, livestock, forestry, health, and energy in Taiwan.

APEC CLIMATE SYMPOSIUM 2018 PROGRAM BOOK

OVERCOMING THE CHALLENGES OF AN UNCERTAIN FUTURE WITH ENHANCED CLIMATE INFORMATION AND SERVICES



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