APEC Climate Symposium 2012

St. Petersburg, Russia
October 8-11, 2012

This document summarizes the presentations and discussions from the APEC Climate Symposium (APCS) 2012, held in St. Petersburg, Russia on October 8-11, 2012

Acknowledgements

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APEC Climate Symposium 2012 Proceedings

Summary

1. The APEC Climate Symposium (APCS) 2012 was conducted from October 8-11, 2012 at the Park Inn Pulkovskaya Hotel in St. Petersburg, Russia. Meetings of the APCC Science Advisory Committee and Working Group were also held in conjunction with the event.

2. The event was attended by around 80 participants from 15 APEC economies – Australia, Chile, China, Chinese Taipei, Hong Kong, Indonesia, Japan, Korea, Malaysia, Mexico, the Philippines, Russia, Thailand, USA, and Vietnam and 5 other economies - Bangladesh, Brazil, Germany, Italy, and the Netherlands. The participants included distinguished keynote & invited speakers, representatives from National Meteorological and Hydrological Services (NHMSs), government officials, and academics. Experts in atmospheric dynamics and agricultural sciences were invited to the conference to discuss the importance of climate information and its application to the agriculture sector. **A complete list of participants can be found in Annex I.**

Opening Ceremony

3. The APEC Climate Symposium 2012 opened on Monday, October 8, 2012. The Opening Ceremony began at 9:00 a.m. with Opening Remarks by Dr. Chin-Seung Chung, the Director of APEC Climate Center. The first Congratulatory Address was given by Mr. Igor Shumakov, the Deputy Head of the Russian Federal Service for Hydrometeorology and Environmental Monitoring (Roshydromet). The second Congratulatory Address was given by Dr. Vladimir Popov, the Chair of the Presidium of the North-West Regional Science Centre, Russian Academy of Agricultural Sciences. Dr. Vladimir Kattsov, the Vice Chair Elect of the World Climate Research Programme Joint Scientific Committee and Director of Voeikov Main Geophysical Observatory (MGO) also gave a Congratulatory Address. The final Congratulatory Address was delivered by Dr. Bin Wang, Chair of the Department of Meteorology at the University of Hawaii and Co-Chair of the APCC Science Advisory Committee.

Session I: Keynote Presentations (Plenary Session)

4. Session I commenced at 10:00 a.m. and consisted of keynote presentations by three distinguished scientists with expertise in applying climate information to the agriculture sector. The session was chaired by Dr. Vladimir Kattsov from the Main Geophysical Observatory, Russia. Dr. Flaviana Hilario of the Philippine Atmospheric, Geophysical and Astronomical. Services Administration (PAGASA) served as rapporteur for the session.

5. **Prof. Kees Stigter, Agromet Vision, "Coping with climate change: an active agrometeorological learning approach to resource farming"**

   Dr. Stigter discussed the establishment of Climate Field Schools (CFS) in Indonesia less than a decade ago. The aim of CFSs is to help farmers cope with the consequences of climate change and to equip them with practical adaptation skills, such as the handling of pests, diseases, droughts and floods. However, preliminary evaluation of CFSs showed that CFSs were not able to answer questions that go beyond local climate issues because the instructors had not been trained for it. Giving and discussing answers and predictions demands a real dialogue and an agrometeorological learning approach to response farming. Dr. Stigter's team uses a new extension approach through "Science Field Shops" to temporarily bridge the gap in availability and training of extension intermediaries (EIs) and farmer facilitators (FFs). In these "Shops", farmers and scientists/scholars meet to discuss and solve vulnerabilities expressed by farmers through real dialogues, with the EIs and FFs participating. To make this approach participatory and, in the end, largely independent, there must be trust between the parties. We are on our way to have a group of rice farmers who believe in their attempts to understand and reduce yield differences with the past and who are actively learning about consequences of climate change and how we can jointly fight these challenges. In upscaling, this must create a rural response with permanent agrometeorological learning patterns and climate field services in farmers' fields. The latter will be established by better trained extension intermediaries.

   During the open forum, the success in applying the uncertainty during the 1997-98 El Nino in the Philippines was raised by one the participants. Dr. Kees emphasized that the main issue for success is that there are people who can explain the consequences

of climate change to farmers. The Science Field Shops were initiated by the University of Indonesia but will be expanded with the help of the government. In Indonesia, the Climate Field Schools were changed to Science Field Shops to reflect the experience of the farmers. Although the name was changed, the goal is still the same, to help the farmers in dealing with the consequences of climate variability and change.

6. **Dr. Mark Howden, the Commonwealth Scientific and Industrial Research Organisation (CSIRO), "The changing role of science in climate adaptation in the agriculture sector"**

   Dr. Howden asserted that adaptation of food systems to climate variability and change will likely increase in importance but may require progressive changes in the type of science that is undertaken and how it is integrated into decision-making domains. According to him, substantial research has already been generated but there is increasing evidence that this rarely leads to actual adaptation. This involves a move from a climate-centered to a decision-centered approach and moving from problem definition to co-developing solutions. New partnerships (especially with industry and policy), new agendas (from a science-gap model to an economic policy focus) and new institutions (especially boundary spanning) may be needed.

   During the open forum, Dr. Howden explained that there are different dimensions of food security; stability and food supply are two important factors. On the issue of time scales for decision making, farmers are not interested what will happen 100 years from now but rather on what will happen in a few days or months. Regarding the effect of El Nino/La Nina on exports and global cereals trade, the volatility of prices is due to many factors, climate change is one of them, but how much it contributes is very hard to say. On the issue of prediction skill of seasonal climate forecasts, forecasts are more relevant now.

7. **Dr. Roger Stone, University of Southern Queensland, "Climate forecast information has no value unless it changes a management decision"**

   Dr. Stone presented on how climate forecasting can be highly effective in assisting risk management in agricultural production systems for many world regions. He quoted Neville Nicholl, who said "the value of climate information and seasonal

climate forecasts will not only depend on climate forecast accuracy but also on the management options available to the user to take advantage of the forecast". To achieve success in integrating climate forecasting into 'real-world' decision making requires careful targeting of the climate forecast output to the key decision-points in farm management and also to other important aspects of the whole value chain in agricultural production. Participatory approaches, involving 'discussion-support systems', have been demonstrated to be highly effective. He also discussed a systematic approach in applying climate forecasts to agricultural decision-making to achieve best practices. He concluded that climate forecast information has reached a mature stage but care must be taken in relation to scale issues – spatial but especially temporal (e.g. 3 month seasonal or intra-seasonal). He also emphasized that decision-support systems (DSS) and tools are useful, but often more valuable to the scientist than to the agriculturalist: the best application of DSS seems to be as a tool to be used within a broad discussion environment (small or large groups, workshops, or even electronic media). Lastly, he reiterated to give as much 'ownership' as possible of the climate forecast system to the user and create a sense of empowerment.

During the open forum, the issue of lead time for decisions to be made was raised. The value of the forecast becomes enormous instead of zero if there is enough lead time. On the issue of scale, the station level is better but 2 degrees is also useful. On the use of models with different scales, it depends on the size of the country. On the question of how quantify the value of climate information, show examples of simulation/modeling and case studies.

Session II: Climate and Agriculture: Bridging the Information Gap

8. The afternoon session of October 8 commenced at 1:30 pm. Session II discussed bridging the information gap between climate and agricultural sciences and was chaired by Prof. Kees Stigter from Agromet Vision. Dr. June-Yi Lee from the University of Hawaii served as rapporteur.

9. **Dr. Gerrit Hoogenboom, Washington State University, "Climate and Agriculture: Bridging the Information Gap"**

   Dr. Gerrit Hoogenboom, the keynote speaker, spoke about how for climate information and forecasts to be useful in agriculture, it is important to understand

how farmers make decisions and if weather and climate play a role in this decision making process. Integrating climate forecasts and associated information into the agricultural sector will require new scientific approaches in which atmospheric scientists will have to collaborate with social scientists and application scientists and engineers in concert with stakeholders. Dr. Hooogenboom answered one inquiry about Washington State University's provision of digital data of numerical weather forecasts. It was suggested that users need to determine threshold of action given local alarm information, such as temperature threshold for frost protection. It was also suggested that a simple alert system can be provided via mobile, such as a fire text message, that would be very helpful for famers.

10. **Dr. Nidhi Nagabhatla, Gottfried William Leibniz University, "Rice and climate variability: a point of interest from the context of food security, agro-biodiversity, and socioeconomics"**

    Dr. Nidhi Nagabahatla gave a talk on the multi-level impact of climate variability on rice. She presented an inter-disciplinary study that takes regional (South and South East Asia) and local (Wayanad-Kerela, India) level settings of rice crop and employs a mix of modeling, projections, seasonality, assessment and observations to put forth science-based evidence for planning adaptation strategies to cope with and respond to change. Dr. Vladimir Kattsov pointed out that there were a lot of uncertainties in the results that could impact on the results. Dr. Ding suggested that before using future projection, models' historical simulation should be assessed to estimate uncertainty (or confident level) of model simulation.

11. **Ms. Daisy Ortega, Philippine Atmospheric, Geophysical and Astronomical. Services Administration, "Seasonal climate forecast as a decision support tool in Philippine agriculture and water resources management"**

    Ms. Daisy Ortega demonstrated that seasonal climate forecast can be used as a decision support tool in Philippine agriculture and water resources management. She showed the recent impacts of extreme climate variability, including drought and El Nino events, in the Philippines. PAGASA issues categorical seasonal climate forecasts based on global climate forecasts from IRI, APCC, and other international actors. This information is then is integrated into decision-making at the national

level for reduction risk management of vulnerable areas. After her talk, the importance of prediction for monsoon onset was raised for agricultural management in Vietnam.

12. **Dr. S.M. Fakhruddin, RIMES, "A decision support framework for flood risk assessment: An application to the Brahmaputra River in Bangladesh"**

    Dr. SM Fakhruddin described a decision support framework (DSS) for flood risk management using 1-10 days multiple weather ensemble (EPS) forecasts from the European Center for Medium Range Forecasts (ECMWF), integrating hydrological models, and combining GIS and user needs. It is designed to interpret, translate, and communicate science-based risk information into user-friendly early warning information products to assist emergency managers and decision makers. Since the DSS framework utilizes weather forecasts, Dr. Jim O'Brien questioned whether there is any relationship between interannual climate variability and flooding (or related disasters). He suggested that the decision framework should utilize APCC multi-model ensemble or ECMWF seasonal climate prediction data with a longer time scale.

13. **Dr. Jim O'Brien, Florida State University, "Targeted seasonal climate information delivery in the Southeast USA"**

    Dr. Jim O'Brien introduced targeted seasonal climate information delivery in the Southeast USA. Important remarks were made on the difference between climate and weather forecasts as follows. First, only probability forecasts are allowed, no matter how insistent the users are. Second, information needs to be delivered in time to influence decisions. Third, trust will only be built over a long time. Finally, a climate scientist always goes with a social scientist on each field encounter. A question was posed whether there is any correlation between El Nino and crop growth. Dr. O'Brien answered that tomato, potato, and peanuts are significantly related with ENSO, with 60% to 70% correlation.

14. **Ms. Hongmei Xu, China Meteorological Administration, "Use and Communication of Climate Data: Experience Sharing Based on the ACCC (Adapting to Climate Change in China) Program**

    Ms. Hongmei Xu shared her experiences from the ACCC (Adapting to Climate

Change in China) project which builds user-friendly climate scenarios. Descriptions of the current and future climate and impacts are necessary, but often insufficient. The data and information need to be relevant, interpreted in the context of the decision required and able to be integrated with other relevant information within the decision or policy making processes. Both access to the data and information and user-provider support are necessary. Experience has also shown that sustained engagement of users and providers and supporting continuous learning and sharing offers some potential for effectively addressing the limitations. The Chair pointed out that some Chinese farmers have very specific approach issues that differ from the talk given by the speaker. The Chair argued that there are several levels of application and most difficulties are at the local level, not the national level. At the local level, both climate providers and local farmers have misunderstandings surrounding the application of climate information that make local level application difficult.

15. **Dr. Md. Rejaur Rahman, Rajshahi University, "Cropping pattern planning for a flood prone area: A study using remote sensing and GIS to reduce the losses of climate change impact"**

    Dr. Md. Rejaur Rahman introduced a study which used remote sensing, geographic information system and spatial multi criteria evaluation based land suitability analysis for crops to suggest suitable cropping patterns to combat the adverse effects of flood due to climate change. The study results depicted which cropping patterns were most suitable for different tracts of land, given flooding hazards. About 19 percent of the total area was additionally suggested for rice, and 23.36 and 23.05 percent of the total area were suggested for mustard and potato, respectively, which could increase total crop production and could minimize the rice production losses or crop failures due to climate change. Questions were raised on how to average economic and physical factors in models and how much uncertainty arises from remote sensing data. It was suggested that other factors, rather than only flooding, need to be addressed.

16. **Dr. Yanling Song, China Meteorological Administration, "Effect of climate change on winter wheat yield in North China"**

    Dr. Yanling Song showed effect of climate change on winter wheat yield in North China using the crop model World Food Studies (WOFOST). The model was

calibrated and validated with meteorological as well as winter wheat growth and yield data at 24 stations in 5 provinces of North China from 1997 to 2003. The influence of drought induced by short rain on winter wheat yields was simulated using crop model WOFOST and the projections of future climate for the scenario A2 and A1B in North China. The results showed that drought index seemed to decrease by 9.7% and 10.3% with the projected increasing rain and temperature at the same period for A2 and A1B scenarios during 2012-2100, which indicated the drought influence on winter wheat yields would be relieved considering the projected more rain and increasing temperature as well as the growth stage of winter wheat at the same period over North China from 2012-2100. Problems were raised in his approach. First, the intended receiver/beneficiary of this information was not clear. Second, the speaker's assumption that there will be no changes in species, farmers, and other factors for the next 19 years was called into question.

17. **Dr. Julian Adams, University of Michigan, "Climate change and agriculture: Strategies for answering the challenges with biotechnology"**

    Dr. Julian Adams presented a brief introduction to agricultural biotechnology, including differences and similarities to conventional plant breeding. Much research in both the private as well as the public sector is being carried with a goal to develop new crops which will serve to both mitigate as well as to adapt to climate change. In some cases such crops are in advanced stages of development with commercialization expected in the near future. Regulation of agricultural biotechnology within APEC, as well as in the rest of the world can challenge the development of such new crops. Most recent biotechnology developments may offer new opportunities in terms of the development of new crops as well as the possibility of the easing of the regulatory hurdles that such new crops face. Dr. Ding pointed out that cost of the biotechnology is very important factor for stakeholders in the agriculture sector so cost regulation seems very considerable.

18. **Prof. Oleg Sirotenko, All-Russia Scientific Research Institute for Agricultural Meteorology, "Impact of climate change on the agriculture sector of the Russian economy"**

    Prof. Oleg Sirotenko delivered a presentation on the impacts of climate change to the

Russian agriculture sector. The current Russian climate is quite harsh for agricultural production, especially in comparison to other EU countries. Anticipating and adapting to climate change is one of Russia's top priority policies. The All-Russia Scientific Research Institute for Agricultural Meteorology is working on models which simulate agro-ecosystems productivity, the water-heat regime and moisture of the agrosphere, the carbon cycle for arable soils, climate risks for agriculture, and optimizing crop allocation. The Institute also continuously monitors agroclimatic indicators, carbon balance components and crop productivity. Prof. Sirotenko's presentation was delivered in Russian and translated into English by a simultaneous translator.

19. **Dr. Wei Xiong, Chinese Academy of Agricultural Sciences, "Using climate change information in ecosystems services for poverty alleviation research in China"**

    Dr. Wei Xiong gave a presentation about ecosystems services for poverty alleviation research in China. Many research groups do not have the skills and tools to use climate change information in ESPA research. Through a structured programme of knowledge exchange, his project addresses the skills needs of two major stakeholder groups in China – potential ESPA researchers in universities and research institutes and the poor communities actually living in ecosystems vulnerable to climate change. To build capacity, workshops to disseminate and build understanding of climate information have been held. Another activity has been raising awareness of climate change issues and exploring how climate change issues can be better communicated between different stakeholders within the ESPA programme through sending teams of scientists to administer questionnaires. The continued engagement of researchers will be encouraged by setting up an ESPA climate network.

20. The floor was opened for discussion after the session presentations. During the discussion, Dr. Shukla shared his experiences meeting with farmers in India over the last seven years and made some comments. First, he addressed that it was very difficult to provide better prediction or basic information on predictability that was requested by local farmers. Second, he argued that adaptation to climate change may lead to misunderstandings. Before analyzing models' future projection, we may need to investigate and understand large interannual variability that is currently being experienced.

21. Based on the session presentations and his own experience with Indonesian farmers, Chair Stigter summarized that major issue is farmers in developing countries and it is important for use to think about how to improve the situation in these countries. For example, formal education may be helpful for farmers to understand the consequence of climate change impacting their planning. Currently, we have no way to make most of farmers in developing country fully understand importance of climate variability/change. Director Chung of APCC emphasized that APCC strives to provide opportunities for them to learn the information; however, the important thing is their willingness to learn. Thus, we need to persuade farmers that it is worthwhile to learn the information. Dr. Vladimir Kattsov also emphasized that climate information has value only once it reaches users.

22. Dr. Moura pointed out the issue of scale, climate information could be targeted to the larger agriculture sector or individual farmers. There is no single answer on since issues will differ between the different type of user groups. In addition, users' trust in the information is also important. Because of probabilistic characteristics, there may be a gain overall, but at the individual level, some would win and some would lose.

23. One example of forum in Philippines was given. In the forum, farmers interacted with each other and expressed their needs. Chair finalized the discussion saying that the amount of educated farmers is increasing. If we teach farmers in urban areas first, the effect will spread.

Session III: Climate and Agriculture: Case Studies and User Experiences

24. The morning session of October 9 commenced at 9:00 am. Session III discussed specific case studies where climate information was used for the agriculture sector. The session was chaired by Dr. Mark Howden from CSIRO. Dr. Nidhi Nagabhatla from Gottfried William Leibniz University served as rapporteur.

25. **Dr. Selvaraju Ramasamy, Food and Agriculture Organization of the United Nations, "Climate information services for food and agriculture: Opportunities and constraints for information providers and users"**

The keynote address introduced the Climate Information Services (CIS) for food and

agriculture provided by the FAO. The elaborative talk was an attempt to set the tone of the session and described the efforts and initiatives of FAO linked with agriculture and climate change adaptation at the global, regional and local levels. Focusing on demand, security, and risks related with land and water resources, the keynote speaker emphasized global issues of concern related to hunger, poverty, and food security. He further elaborated how these issues, in return, are aggravated by climate variability and change. An attention-grabbing point to note from the talk was the crop yield projection for 2050 that showed increasing yields in the northern hemisphere in comparison to the southern half. It was also emphasized that food security can be interpreted in terms of availability, access, utilization and stability of resource systems. Food production is generally understood as dependent on rainfall and temperature variability and, apart from other technological drivers, it will face a challenging situation in terms of yield gaps. Small holder farming systems will be most affected. The concluding point was that CIS delivered at the grassroots (farm) level, considering a farm as the management unit, could be a good start. Reaching remote communities with information that can help them with their production systems is pertinent. Application of real-time climate data for crop monitoring and yield forecasts can serve appropriately for effective decision making. An example of a success story with a Famine Early Warning System was quoted. Mention of risk insurance and public private partnerships as an instrument to deal with such situations was proposed.

The keynote speech stirred a good discussion among the audience. An important question about the trend in global agricultural production was raised by Prof. Jagadish Shukla. The speaker answered that the trend was stagnant. Other queries about the need to build the capacity of stakeholders at all levels in order to use climate based information effectively were answered appropriately.

26. Dr. Toschicika Iizumi, National Institute for Agro-Environmental Sciences, "Forecasting global crop failures to prepare for climate-induced food security"

Dr. Toschicika Iizumi highlighted climate variability as significant with respect to crop systems. It was emphasized that extreme climatic events are by and far the determinants for changing food prices. Pre-season prediction and intra-seasonal variability for different crops is central to managing yields. One can study the yield

trends by relating hindcast data with yield statistics. Apart from the impact of rainfall variability, the importance of temperature variability was spotlighted. The speaker also talked about tailoring climate information for end-user needs. The audience was curious to know about methods of information dissemination to end-users.

27. **Dr. Prasanna Venkatraman, APEC Climate Center, "Impact of monsoon rains on the total food grain production over India"**

Dr. Prasanna Venkatraman talked about the impact of monsoon rains on the total food grain production in India. He began his talk by showing the historical and current climatic trends in India, he re-iterated the fact that India is primarily an agrarian economy with annual spread of Rabi and Kharif crops (wheat, rice and groundnut among the most produced). Given this situation, factors such as soil moisture, rainfall anomalies, number of rainy days, rainfall spread and gradient in a season are among the most significant to determine productivity. Positive and negative anomalies in the southwest and northeast monsoon tracks govern the dry or wet year and suitable conditions for optimum crop production. Knowledge and timely information on monsoon breaks becomes crucial to re-plan cropping patterns in synchrony with climate variability. The audience was curious to know more about the monsoon break phenomenon, which the speaker explained is governed by local boundary forcing and internal atmospheric dynamics. A question was raised to clarify if spatial variability of monsoon is enough to understand the local level monsoon condition. To this concern, the speaker confirmed that seasonal and inter-seasonal variability are equally pertinent.

28. **Mr. Antoyo Setyadipratikto, Indonesian Agency for Meteorology, Climatology, and Geophysics, "The use of climate information and prediction in cropping patterns for agricultural field extension officers as an anticipation and mitigation of climate variability and change in Indonesia"**

Mr. Antoyo Setyadipratikto presented the use of climate information and prediction in cropping patterns for agricultural field extension officers. The speaker highlighted two main concerns in the implementation of climate information services: first the lack of availability of reliable data and second the lack of access to the available information. The mention of 'field schools' as a model to disseminate information to ground level stakeholder was applauded by the audience. In response to a question

inquiring how do they measure the impact of the field schools, the speaker answered that they have monitored that 60-70% people have gathered better understanding to interpret climate-related information. The speaker also explained to the audience that his organization is primarily engaged with statistical dynamical forecast downscaling and tailoring of this information for local needs.

29. **Dr. Shitangsu Kumar Paul, Rajsahi University, "Determinants of post-cyclone household food insecurity under changing climate in Coastal Bangladesh: A case study of the cyclone 'Sidr'"**

    Dr. Shitangsu Kumar Paul highlighted the history of cyclonic events and the increase in the frequency of such events, especially after the 1990's. The focus of the talk was to show per capita decline in agriculture production. Following a case study approach, the speaker explained income groups, household level food availability and calorie consumption per capita for Bangladesh. In connection with the themes of food production, food availability and food requirements, his talk concerned projected food insecurity in Bangladesh, mainly in connection with the mounting dynamics of climate variability and change. While there are other factors that govern the overall food security in the region, the impact of climate variations is certainly key. An audience member questioned whether the speaker was surprised by the results of his analysis, as the situation sounds so alarming. He responded that he was not surprised; rather the situation in actuality reflects the results.

30. **Dr. Ching-Cheng Chang, APEC Center for Typhoon and Society, "The role of weather information on carrot yield performance – An empirical evidence from field data in Chinese Taipei"**

    Dr. Ching-Cheng Chang talked about the role of weather information on carrot yield performance, based on empirical analysis. It was an interesting case of explaining the impact of climate variability on vegetables, a sector that is often ignored or underrepresented in the agriculture sector. A point of interest about the talk was that a group of smallholder farmers engaged with the cultivation of carrots had approached the local weather monitoring station to procure information about temperature and rainfall (humidity) conditions and seasonal forecast in order to target export of their crop to Japan. With the understanding that they can control and monitor the growth of

their crops (based on temperature and precipitation threshold for the crop) these farmers led the initiative, which is a good case study of stakeholders' initiation to utilize climate knowledge. Empirical analysis by the speaker indicated that while the temperature threshold for a crop can be calculated (using Pearson's Correlation Coefficient), it is often difficult to assess the rainfall threshold. This is because water supplied by rainfall and irrigation facilities (method of irrigation further affects the process) is difficult to separate.

31. **Dr. Abiar Rahman, Bangabandhu Sheikh Mujibur Rahman Agricultural University, "Effect of climate change on agro-ecosystem and rice production in coastal region of Bangladesh"**

Dr. Abiar Rahman's talk on the effect of climate change on rice production and food security for the coastal region of Bangladesh focused on seasonal climatic variability. An important point was to reflect the impact of technological and non-technological factors, including climate, on rice crop productivity. He explained that increasing salinity in coastal regions is a main determinant for the reduction in cultivated rice area, as most arable lands are being rendered unusable for crop production. The speaker explained about the use of indices such as DTR (Diurnal Temperature Range) and SPI *(*Standardized Precipitation Index). DTR shows an increasing trend, which is kind of fair for crop production. However, other factors such as pest, (water) pollution, farming system, and management practices are equally important in influencing crop productivity. Both speakers from Bangladesh focused on coastal agro-ecosystems and related extreme climatic events that, to a major extent, affect national production dynamics and livelihood dependence.

32. **Ms. Vyta W. Hanifah, Indonesian Center for Agricultural Technology Assessment and Development, "Public awareness for agricultural extension through Training of Trainers (TOT) on climate change"**

Ms. Vyta W. Hanifah, the second speaker from Indonesia, highlighted the role of public awareness for agricultural extension through training of trainers (TOT). Some interesting interventions to provide climate information services to people and communities include; visits by stakeholders to the nearest climatological station and re-working the extension service at different levels to suit the needs of the users. The

speaker also explained the importance of integrating local knowledge/wisdom on how people adapt and respond to change in climate change related planning and decision making. She also mentioned utilizing conventionally used biological indicators as a mechanism to forecast seasonal change. Dr. Stigter questioned what language was used for the Training of Trainers, as Indonesia has many languges spoken in different areas. Ms. Hanifah answered that "Bahasa Indonesia" was used for the curriculum, as it is most widely understood. An interesting point was raised by the audience about the impact of changing climate on bio-indicators that have traditionally been used for forecasting local weather conditions and how climate change could possibly impact farmer's capacity to react, to which the speaker agreed.

Session IV: State-of-the-art Climate Prediction for Agriculture

33. The afternoon session of October 9 commenced at 1:30 pm. Session IV discussed research in climate prediction that can be applied to the agriculture sector. The session was chaired by Prof. Jagadish Shukla from the Center for Ocean-Land-Atmosphere, George Mason University. Dr. Michael Tippett from IRI served as rapporteur. Chair Shukla opened the session by commenting that in the agricultural context, it important to address climate variability, not climate change because farmers will not feel climate change. Rather the ENSO will change; storms will change. The real challenge is to adapt to climate variability. In order to do so, it would is important to have a reliable climate prediction. Therefore an important theme is predictability.

34. **Prof. Bin Wang, International Pacific Research Center, University of Hawaii, "Subtropical high predictability establishes a promising way for monsoon and tropical storm predictions"**

Precipitation is an important climate factor, impacting food and water resources but it's prediction is tough. One approach is to improve models; another is the multimodel approach. But the current level of skill remains unsatisfactory. 9 models, (5 European, 4 APCC) show very little skill over land during the JJA season (1981-2005). The main idea of this work is to use the high predictability of the circulation to improve rainfall prediction. The western Pacific subtropical high (WPSH) is a major player in the climate of the region but its variability and predictability needs to be determined. A

WPSH index is defined using a box average of 850 mb geopotential height. The resulting time series is very similar to that resulting from a MEOF analysis of precipitation, winds at 850 mb, 200 mb and SLP. One of important facts is that a strong WPSH is associated with there being few TCs. This has a strong impact on coastal areas. It is important to note that the WPSH has little correlation with ENSO. To diagnose WPSH variability we consider the first 2 PCs of H850, which account for 75% of the variability of the WPSH. EOF1 is explained as a local air-sea interaction involving the WPSH and the Indo-Pacific SST dipole. EOF2 is a forced response to central Pacific cooling. This hypothesis is supported in experiments using the ECHAM5. Summer time not related to ENSO. How predictable? A physically based empirical model was constructed to address the question of the predictability of the WPSH. The 3 predictor are the: IO-WNP, Central Pacific SST, the NAO. Simple regression model gives r=0.81, and cross-validated r=0.75. The dynamical models also have very good skill in predicting the JJA WPSH starting in late May. Since the WPSH is highly predictable, we can use it to predict other quantities such as the EASM index, TC storm days or the number of TCs impacting the East Asia coast. Very high correlation is found. Predicting rainfall from index gives better results than model, 0.5 vs 0.25 correlation.

Q: Is the WPSH part of NP high?

A: Yes. A Semi-permanent system.

Q: You apply a model for past cases. For future cases do you need a model?

A: No, it is based on observations.

Q: Explain the relation of the NAO?

A: The NAO has a tropical part. When the tropical Atlantic becomes warm it generates a circulation that reduces the trade winds and the central Pacific becomes warmer.

Comment from Chair Shukla: There is the danger of artificial skill, you need double cross-validation, or an independent data set.

A: Took 7-years out. The correction decreased from 0.82->0.75.

35. Prof. Jagadish Shukla, George Mason University, "Predictability and prediction of summer monsoon rainfall over India"

How do you move forward? In the great famine of 1876-78, 6-8 million died. Despite

this, Brittan imported food from India. This was an EL Niño year, in fact one of the largest. This was one of the reasons Walker was sent to India to the IMD. Adaptation is also a function of social institutions. Democracies don't' have famines. Despite strong trend, food production is correlated with monsoon. Strong impacts on GDP despite the decrease of agriculture. Walker discovered the SOI. IMD has a repression forecast. DelSole has shown that there is screening and, most of the skill is artificial. We finally found some genuine skill. We have found skill for the AIR index. We have not yet found skill on a regional or interseasonal basis. The problem with the ENSO/monsoon relation is that all of the correlation between ENSO and monsoon is during the monsoon not before. Most of the droughts are during El Nino with a notable exception being 1997. We think that we understand the reason for this. Has the ENSO monsoon relation broken down? No what we are seeing can be explained by sampling fluctuation. Statistical predictions of AIR by the IMD have errors that are larger than climatology. That is, the operational forecasts have no skill. Statistical methods that use May SST have no skill in predicting the AIR. State of the art models cannot simulate the climatology correctly. Therefore, it is not surprising that they cannot get the variability right either. Predictability comes from the ability of the model to predict ENSO correctly. This is because there is a correction between predicted Nino3 and observed rainfall. This is the first demonstration that dynamical models have some skill in predicting the Indian summer monsoon. There is not skill in predicting subdivision rainfall. May SST has no skill (1960-2005) in sample or out. Finally, India is dropping statistical models and will use dynamical models. Models still need to handle IO SST.

Q: Can the models advise how to take observations?

A: The models are bad but we are not afraid to say so. Models are way behind observations. Need to build models that can capture the variability. Not yet to the point where we need more data to initialize the models.

Q: Is there predictability in the start and end of monsoon?

A: No. Onset is unpredictable related to weather predictability.

36. Dr. Oscar Alves, Australian Bureau of Meteorology, "Dynamical seasonal forecasting for agriculture in Australia"

The latest version of the BoM's operational forecast model, POAMA-2M, has been

designed to provide seamless forecasts across a range of timescales. A key innovation is the use of the ensemble Kalman filter for ocean data assimilation and couple bred vectors for initialization of seasonal forecasts. There are 33 members/week and forecasts go seamlessly from 1 week to 9 months. The hindcaset data consists of 33 ensemble members 3 times per month over the period 1980-2012. Improvements in the ENSO forecast since 2000 are due to increased supercomputing resources, improved system and observing system. Skill in the Indian Ocean has shown less improvement. There have been improvements in reliability on long and short timescales include forecasts of the MJO, the Southern annular mode, tercile probabilities PDF of daily max temp forecast and climatology. The skill of rainfall forecasts in wheat belt is useful since if you know the rainfall you know how much fertilizer to apply.

37. Prof. Jin-Il Yun, Kyung Hee University, "Agroclimatic zoning for winter barley in Korea under the RCP8.5 projected climatic condition"

It is necessary to downscale climate data to the subgrid level. Decadal average of Tmin values from the RCP8.5 were used to estimate the regions where winter barley could be grown in North and South Korea. We find that the boundaries migrate northward and the region available for cultivation increase.

38. Dr. June-Yi Lee, International Pacific Research Center, "Multi-model ensemble prediction for the Boreal Summer Intraseasonal Oscillation"

There is a forecasting gap between weather and climate forecasting. To help address this issue, we have identified dominant modes of summer ISO (BSISO; paper in press Climate Dynamics). We analyze the BSISO in multimodel ensemble predictions. Intraseasonal variability is larger than interannual variability. The standard RMM index has limitations in explaining ISO off of the equator during boreal summer. MEOFs were used to develop a new index BSISO which better captures northward and northeastward propagation. We find that the BSISO can be predicted skillfully out to about 15 days and that the skill level depends on the initial phase.

39. Dr. Jianping Li, Institute of Atmospheric Physics, Chinese Academy of Sciences, "A time-scale decomposition statistical downscaling model"

In the climate system variability on different time-scales are controlled by different factors. Here we introduce a statistical method that explicitly takes this into account and apply to Jul-Aug rainfall Northern China. This method predicts observations with a skill of 0.82. In the future rainfall values will decline.

40. Dr. Hirofumi Sakuma, Japan Agency for Marine-Earth Science and Technology, "Applications of seasonal climate forecast to crop yield prediction: International & domestic collaborations"

The SINTEX-F model is a combination of the ECHAM4.6 atmosphere and French ocean model OPA. A new bias correction is proposed and demonstated to have great success in correcting time-dependent bias in forecast time series. The method is based on maximum entropy and seems very promising.

41. Dr. Lijuan Chen, China Meteorological Administration, "Prediction of first frost dates in Northern China"

Operational forecasts are made in Aug-Oct for the first frost date in Northern China. Wheat yield in North China is important. There is also a relation between yield and first frost date for corn. An online system for operational frost monitoring and prediction, as well as a station data archive has been established. REOFs are used to select 11 predictors and construct a skillful statistical predictor of the first frost date.

42. Dr. Soo-ock Kim, National Center for Agro-Meteorology, "Outlook on freeze risk in major peach growing regions in Korea under the RCP8.5 projected climate condition"

Peaches have poor cold tolerance. Here we consider the change in freeze risk under the RCP 8.5 scenario. Produce catchment scale climate variables at 30m resolution, monthly temperature maps for current and future decades. Daily temperature values generated by a stochastic weather generator. A thermal time-based dormancy index is used in a freeze risk index. We find that the occurrence of freezing events decreases in the future

Q: RCP 8.5 this is very high, what is the reason?

A: To maximize the signal.

43. **Prof. Cheng-Ta Chen, National Taiwan Normal University, "Climate change impact on typhoon affecting Taiwan using MRI-20km Mesh AGCM time slice simulations"**

So far, most research on the impact of climate change on TCs has focused on global or basin scales. Here consider regional scales, a problem that is not easy. Typhoons account for more than 90% of annual hazard risk. MRI 20km 1979-2003 vs 2075-2099. This model does well with the present climate producing tracks that match global and regional observed characteristics. The climatological wind/pressure relation is well-reproduced, as is the rainfall pattern. We find a 20% reduction in annual number of TCs for the whole domain and this change is significant at the 90% level.There is a reduction in the number of weak TCs and increase in the number of strong ones. Overall, the main impact is seen in rainfall, and there is an increase in rainfall extremes.

44. **Prof. Mikhail Sall, Voeikov Main Geophysical Observatory, "Climate change: risks for Russian agriculture"**

The climate of Russian is becoming less continental. We expect a reduction in cold season precipitation and less change during the warm season. There will be some reduction in populated growing regions, though. The problem is in sub-tendencies not tendencies. There will be more days with temperatures > -30C and more active growing days with temperatures > 10C. With regard to drought, different models give different results. Overall, Russia is coming up short for adaptation.

Session V: Climate Information Services for Agricultural Applications

45. The morning session of October 10 commenced at 9:00 am. Session V discussed climate information services for agricultural applications. The session was chaired by Dr. Prasanna Venkatraman from the APEC Climate Center. Dr. Qingguo Wang from the APEC Climate Center served as rapporteur.

46. **Ms. Hye-Jin Park, APEC Climate Center, "Introduction of APCC Climate Information Services and the Climate Information Tool Kit (CLIK)"**

Ms. Hye-Jin Park made a presentation about the Climate Information Tool Kit (CLIK). CLIK is an innovative web-based tool created by APCC that allows users to create

customized Multi-Model Ensemble (MME) schemes and use statistical downscaling to tailor the predictions to their local geographic region. While CLIK delivers sophisticated climate information products, it is designed in such a way that even users who are not from traditionally scientific backgrounds are able to implement and understand the tool. All data and processing is hosted by APCC servers, operators need only a web connection to access this user-friendly tool. In this way, developing economies will be able to access state-of-the-art technology without significant or costly upgrades to local infrastructure.

47. The audience posed several questions about the implementation and abilities of CLIK.

Q: Can CLIK be used for regions outside the Asia Pacific, such as Mexico?

A: Yes, the MME forecasts show the global 3-month mean forecast, which is plotted over Google Maps. If you want to see the forecast for your region, you can zoom in on the map. As far as downscaling the forecast, if you have observational station data, you can downscale the forecast for your region through CLIK.

Q: Is there any evaluation of the predictions from CLIK? Can we gauge the quality of the forecasts?

A: No, CLIK doesn't provide verification for actual forecast. Hindcast verification is available in order to check which of the MME methods has the best skill for your region.

Q: Can CLIK forecast other variables, such as solar radiation or wind speed?

A: Currently we do not plan to add other variables.

Q: Can CLIK provide forecasts with lead-times of more than 3 months?

A: For the MME forecast, CLIK also provides a 6-month forecast.

Q: Can CLIK provide monthly forecasts?

A: Currently, CLIK provides 3-month mean forecasts. However, on the APCC homepage, we provide the figures for each monthly forecast. So, we could conceivably provide monthly forecasts through CLIK. We don't have any plan to add monthly forecasts at this time, but we will consider your suggestion.

Q: How can one do downscaling through CLIK?

A: As I explained earlier, to downscale the forecast for your region, first you should upload the observational station data for your region onto the CLIK web interface. Once the data is entered, you can downscale the forecast through the CLIK web

interface. We don't have access to observational station data for all locations, which is why users must upload it themselves.

Q: Can you obtain high resolution data through CLIK?

A: We provide global climate model data with 2.5degree X 2.5degree resolution. You can download the individual global climate model data on the 'Data Library' page on the APCC website.

Session VI: Panel Discussion and Wrapping-Up

48. The Panel Discussion and Wrapping-Up Session commenced at 9:00 am. The session was chaired by Dr. Bin Wang from the International Pacific Research Center at the University of Hawaii. The panelists were Dr. Bin Wang, Dr. Jagadish Shukla, Dr. Kees Stigter, Dr. Roger Stone, Dr. Mark Howden, Dr. Gerrit Hoogenboom, and Dr. Selvaraju Ramasamy. Dr. Julian Adams from the University of Michigan served as rapporteur.

49. Dr. Kees Stigter opened the discussion by noting that scale is important; at one end there are the developed economies and at the other lend the less developed economies. The issue is that in the more developed economies there are relatively few farmers with high levels of formal education. On the other hand, in the less industrialized economies, there are a large numbers of farmers with a low level of formal education, which presents greater challenges to reaching all of the individuals in this latter group. There is the challenge of sheer numbers, and in transmitting climate to this latter group. We need to work on this issue.

50. Dr. Mark Howden noted that there has been success in climate information transfer in India and Indonesia because there has been much work using well-established engagement principles in these countries. He felt that APCC needs to work on adapting these models to other economies, and that it is important to utilize stakeholder wisdom. He also noted that when transmitting this type of information, receptiveness to the information presented differs between the genders. FAO has been effective in developing information delivery mechanisms at the national and village levels.

51. Prof. Jagadish Shukla noted that the state of the art models on climate prediction still have many problems, included large systematic errors that still remain, but they continue to improve, even though the progress is slow. This point was also echoed by participants in the audience during the subsequent open discussion. He noted that climate change will manifest itself in changes in seasonal and interannual phenomena; these are interlinked issues, which is why seamless prediction has been proposed. He also expressed that the transmission of information to the farmers is a challenge and that we need a need class of workers – climate interpreters. This was also an issue that found much support among participants – that climate interpreters could play an important role in transmitting information.

52. Dr. Roger Stone noted that there is a challenge in the number of stakeholders, that there are many actors involved in agriculture besides farmers, and the necessity to address all links in the value chain.

53. Dr. Selvaraju Ramasamy spoke of the need to engage policy makers and the need to make use of existing institutions, rather to create new structures. APCC should work to build the capacity of intermediary institutions to interpret climate information.

54. Dr. Gerrit Hoogenboon noted that we must think multi dimensionally and engage with many different groups to make progress.

55. The discussion was then opened up to the audience. Dr. Julian Adams noted that one theme in many of the papers was that the projections of future yield under climate change conditions assumed no change in the crops or varieties being planted over the next few decades. However, the development of biotech crops, which will address climate change mitigation as well as adaptation, could change those predictions substantially. Dr. Kees Stigter noted that rice yields are decreasing in Indonesia due to heat and that heat tolerant varieties will be needed to ensure food security in Indonesia.

56. Dr. Fakhruddin noted that it is important to reach out to policy makers in the individual economies to apprise them of the important issues regarding climate

change, and to inform them of the role of APPC in climate forecasting and the transmission of information. A major challenge will be affecting policy and institutionalizing information, especially as government officials are less willing to take risks.

57. Dr. Md. Rahman emphasized that prediction is important and that APCC needs to improve the seasonal predictions. Similarly, Ms. Flaviana Hilario noted that the predictions needed to have a higher resolution, while another participant felt that they should focus on extreme events.

58. Returning to the issue of scale Dr. Stigter pointed out that the number of farmers is decreasing and that it is necessary for member economies' food security to provide them with incentives to stay in farming. Dr. Stigter further noted that it would be valuable to generate a handbook (which could be web-based) which documents case-studies and the successful application of climate change information. There then ensued a discussion concerning such successful applications. Although it was agreed that such stories exist, it was also agreed that the information may not be readily accessible to these who may benefit from it. A further suggestion was that parliamentary fora in individual APEC economies may be useful vehicles to transmit such success stories.

59. A general theme which was echoed by the panel as well as by many in the audience was the importance of a dialogue between the providers of the forecasts and users of the information at the individual economy level.

60. In his concluding remarks, Dr. Vladimir Kattsov thanked the participants for attending and emphasized the need for a multidisciplinary approach to disseminate information to farmers. Dr. Stigter echoed these comments and stressed the need for the APCC to continue to focus on the agricultural sector

ANNEX: Participants List

APEC Climate Symposium 2012				
No.	**Nation**	**Affiliation**	**Title**	**Name**
1	Australia	Bureau of Meteorology	Dr.	Oscar Alves
2	Australia	Commonwealth Scientific and Industrial Research Organisation (CSIRO)	Dr.	Mark Howden
3	Australia	Univ. Southern Queensland	Dr.	Roger Stone
4	Bangladesh	Bangabandhu Sheikh Mujibur Rahman Agricultural University	Dr.	Abiar Rahman
6	Bangladesh	University of Rajshahi	Dr.	Md. Rejaur Rahman
7	Bangladesh	University of Rajshahi	Dr.	Shitangsu Kumar Paul
8	Brazil	Instituto Nacional de Meteorologia	Dr.	Antonio Moura
9	Chile	Dirección Meteorológica de Chile	Mrs.	Claudia Villarroel
10	Chile	Dirección Meteorológica de Chile	Mr.	Luis Serrano
11	China	Chinese Academy of Sciences	Dr.	Jian Liu
12	China	Chinese Academy of Sciences	Dr.	Jianping Li
13	China	Chinese Academy of Agricultural Sciences	Dr.	Wei Xiong
14	China	China Meteorological Administration	Ms.	Hongmei Xu
15	China	China Meteorological Administration	Dr.	Lijuan Chen
16	China	China Meteorological Administration	Ms.	Song Yanling
17	China	Institute of Atmospheric Physics	Prof.	Lin Zhaohui
18	China	China Meteorological Administration	Dr.	Ding Yihui
19	Chinese Taipei	APEC Center for Typhoon and Society	Dr.	Ben Jou
20	Chinese Taipei	APEC Center for Typhoon and Society	Dr.	Ching-Cheng Chang
21	Chinese Taipei	Central Weather Bureau	Dr.	Jyh Wen Hwu
22	Chinese Taipei	National Taiwan Normal University	Prof.	Cheng-Ta Chen
23	Chinese Taipei	National Science and Technology Center for Disaster Reduction	Dr.	Yi-Chiang Yu
24	Germany	Gottfried Wilhelm Leibniz University	Dr.	Nidhi Nagabahatla
25	Hong Kong	Hong Kong Observatory	Dr.	SM Lee
26	Indonesia	Agency for Meteorology, Climatology, and Geophysics	Mr.	Antoyo Setyadipratikto
27	Indonesia	Indonesian Center for Agricultural Technology Assessment and Development	Ms.	Vyta Hanifah
28	Italy	Food and Agriculture Organization of the United Nations	Dr.	Selvaraju Ramasamy
29	Japan	Japan Agency for Marine-Earth Science and Technology	Dr.	Hirofumi Sakuma
30	Japan	Japan Agency for Marine-Earth Science and Technology	Dr.	Yukio Masumoto

31	Japan	Japan Meteorological Agency	Mr.	Kazutoshi Onogi
32	Japan	Nat'l Institute for Agro-Environmental Sciences	Dr.	Toshichika Iizumi
33	Korea	APEC Climate Center	Dr.	Chin-Seung Chung
34	Korea	APEC Climate Center	Dr.	Hyejin Park
35	Korea	APEC Climate Center	Dr.	Jin Ho Yoo
36	Korea	APEC Climate Center	Dr.	Jong-Ahn Chun
37	Korea	APEC Climate Center	Ms.	Nina Horstmann
38	Korea	APEC Climate Center	Dr.	Prasanna Venkatraman
39	Korea	APEC Climate Center	Dr.	Qingguo Wang
40	Korea	APEC Climate Center	Dr.	Soo-Jin Sohn
41	Korea	APEC Climate Center	Ms.	Sooyang Joo
42	Korea	Korea Meteorological Administration	Dr.	Suhee Park
43	Korea	National Center for Agro-Meteorology	Dr.	Soo-Ock Kim
44	Korea	Pukyong National University	Prof.	Jai-Ho Oh
45	Korea	Seoul National University	Dr.	Soonchang Yoon
46	Malaysia	Malaysia Meteorological Department	Mr.	Kok Foo Kwan
47	Mexico	Servicio Meteorológico Nacional	Mr.	Ildefonso Hernandez-Alcaide
48	Mexico	Servicio Meteorológico Nacional	Mrs.	Martín Ibarra Ochoa
49	Netherlands	Wageningen Univ.	Dr.	Kees Stitger
50	Philippines	Philippine Atmospheric, Geophysical and Astronomical Services Administration	Ms.	Daisy Ortega
51	Philippines	Philippine Atmospheric, Geophysical and Astronomical Services Administration	Dr.	Flaviana Hilario
52	Russia	All-Russia Scientific Research Institute for Agricultural Meteorology	Prof.	Oleg Sirotenko
53	Russia	Bioengineering Centre of Russian Academy of Sciences	Dr.	Dmitry Dorokhov
54	Russia	Hydrometeorological Research Center of Russia	Dr.	Alla Yur'evna Yurova
55	Russia	Hydrometeorological Research Center of Russia	Dr.	Vladimir Kryjov
56	Russia	Voiekov Main Geophysical Observatory	Dr.	Vadim Matyugin
57	Russia	Voiekov Main Geophysical Observatory	Prof.	Mikhail Sall
58	Russia	Voiekov Main Geophysical Observatory	Dr.	Tatyana Pavlova
59	Russia	Voiekov Main Geophysical Observatory	Dr.	Victoria Mirvis
60	Russia	Voiekov Main Geophysical Observatory	Dr.	Vladimir Kattsov
61	Russia	Russian Federal Service for Hydrometeorology and Environmental Monitoring	Ms.	Anastasia Pikaleva
62	Russia	Russian Federal Service for Hydrometeorology and Environmental Monitoring	Dr.	Anna Peters

63	Russia	Russian Federal Service for Hydrometeorology and Environmental Monitoring	Ms.	Cherevan Vera
64	Russia	Russian Federal Service for Hydrometeorology and Environmental Monitoring	Mr.	Efimov Sergey
65	Russia	Russian Federal Service for Hydrometeorology and Environmental Monitoring	Ms.	Elena Stafeeva
66	Russia	Russian Federal Service for Hydrometeorology and Environmental Monitoring	Dr.	Igor Shkolnik
67	Russia	Russian Federal Service for Hydrometeorology and Environmental Monitoring	Mr.	Igor Shumakov
68	Russia	Russian Federal Service for Hydrometeorology and Environmental Monitoring	Dr.	Khlebnikova Elena
69	Russia	Russian Federal Service for Hydrometeorology and Environmental Monitoring	Ms.	Oxana Trofimova
70	Russia	Russian Federal Service for Hydrometeorology and Environmental Monitoring	Dr.	Tatyana Lvova
71	Russia	Russian Academy of Agricultural Sciences	Dr.	Vladimir Popov
72	Thailand	Kasetsart University	Prof.	Hansa Vathananukij
73	Thailand	Regional Integrated Multi-Hazard Early Warning System for Africa and Asia	Dr.	SM Fakhruddin
74	USA	Center for Ocean-Land Atmosphere	Prof.	Jagadish Shukla
75	USA	Florida State University	Dr.	Jim O'Brien
76	USA	International Pacific Research Center	Dr.	June-Yi Lee
77	USA	International Research Institute for Climate and Society	Dr.	Michael Tippett
78	USA	Washington State Univ.	Dr.	Gerrit Hoogenboom
79	USA	University of Hawaii	Prof.	Bin Wang
80	USA	University of Michigan	Dr.	Julian Adams
81	Viet Nam	National Center for Hydro-Meteorological Forecasting	Mr.	Nguyen Dang Quang
82	Viet Nam	Vietnam Academy of Science and Technology	Mr.	Dao Van Tuyet
83	Viet Nam	Vietnam Academy of Science and Technology	Prof.	Nguyen Xuan Man