APEC Climate Symposium 2014

Managing Climate Extremes and Hydrologic Disasters

Session VI – Wrap Up Session

Session II

Climate Forecasting for Water Management

Chair: Dr. Yuriy Kuleshov
National Climate Centre, BOM

Climate Forecasting for Water Management

The Global Earth Observation System of Systems (GEOSS) Water Strategy (“From Observations to Decisions”) recognizes that “water is essential for ensuring food and energy security, for facilitating poverty reduction and health security, and for the maintenance of ecosystems and biodiversity”, and that water cycle data and observations are critical for improved water management and water security – especially in less developed regions.

The GEOSS Water Strategy has articulated a number of goals for improved water management, including flood and drought preparedness.

A Seamless Framework for the Global Monitoring and Prediction of Droughts

Prof. Eric Wood (Princeton University/USA)

Climate Forecasting for Water Management

From Prediction To Scenario Analysis: An Australian Perspective
Dr. Bryson Bates (Centre for Environment and Life Sciences, CSIRO/Australia)

A Seasonal Streamflow Forecasting Service for Australia: Methods, Implementation and Way forward
Dr. Julien Lerat (Environment and Research – Forecast Systems, BOM/Australia)

Ensemble Forecasting Of Seasonal Streamflow Using Climate Forecasts as Inputs
Dr. Quan Jun Wang (Water for Healthy Country Flagship, CSIRO/Australia)

Seasonal Forecasting of Climate Extremes: Droughts and Floods
Dr. Yuriy Kuleshov (National Climate Centre, BOM/Australia)

A Seamless Framework for the Global Monitoring and Prediction of Droughts
Prof. Eric Wood (Princeton University/USA)

The Available Water Climatology (AWC) and its Applications
Prof. Hi-Ryong Byun (Pukyong National University/Korea)

From Prediction To Scenario Analysis: An Australian Perspective

Dr. Bryson Bates (Centre for Environment and Life Sciences, CSIRO/Australia)

Concern is growing that anthropogenic climate change is and will increase the number and severity of water-related disasters. In response, dialogue between climate information providers and water managers and planners has continued to grow over the last years. While substantial progress has been made, a number of fundamental problems still remain.

Recommendations

- The purpose of assessments of climate change impacts on and vulnerability to water-related disasters should be to reach robust prevention and mitigation strategies that work well under present as well as a wide range of plausible future conditions.
- The focus should be on preparedness rather than prediction.
- Consideration needs to be given to a modest number of projections.
- Consideration of the implications of plausible events that have a low probability and high impact.

A Seasonal Streamflow Forecasting Service for Australia:
Methods, Implementation and Way forward

Dr. Julien Lerat (Environment and Research – Forecast Systems, BOM/Australia)

- The Seasonal Streamflow Forecasting service has been developed to assist water managers with improved decision making for water resource allocation planning and environmental flow management in river basins with intensive water uses.
- The service produces three months ahead forecasts of streamflow volumes for 74 locations in eastern Australia.
- After nearly four years of continuous operation, the service is now undergoing a major upgrade with an expansion of the coverage across Australia and a refinement of the modelling method using a combination of the statistical and dynamic approach.
- The analysis of retrospective forecasts results suggested that statistical and dynamic methods have complementary model performance, which will be harnessed by the development of a merging method able to retain the best of both approaches at individual forecast location.

Ensemble Forecasting Of Seasonal Streamflow Using Climate Forecasts as Inputs

Dr. Quan Jun Wang (Water for Healthy Country Flagship, CSIRO/Australia)

- A model for generating forecast guided stochastic scenarios (FoGSS) is developed.
- The model includes a module for post-processing GCM climate forecasts and a module for hydrological modelling including uncertainty.
- It generates forecasts of monthly volumes of streamflow for up to 12 months ahead in the form of ensemble time series.
- The performance of the FoGSS model is evaluated on 20 catchments in Australia.
- Forecasts of cumulative streamflow are much more skilful than forecasts of monthly streamflow.
- As cumulative streamflow is more relevant to water planning, skilful forecasts of the cumulative streamflow are valuable.
- The FoGSS model adequately represents the rainfall forecast uncertainty, hydrological uncertainty (other than rainfall forecast uncertainty), persistence in streamflow, and uncertainty propagation for up to 12 months ahead.

Seasonal Forecasting of Climate Extremes: Droughts and Floods

Dr. Yuriy Kuleshov (National Climate Centre, BOM/Australia)

Droughts and floods frequently affect island countries in the Western Pacific. The impacts of such climate extremes on the countries are severe and the costs of damage can amount to large fractions of gross domestic product.

- The 2011 severe drought in Tuvalu.
- Seasonal climate predictions based on outputs of dynamical climate models can be efficiently used for forecasting regional dry or wet conditions.
- The developed seasonal climate prediction products are now disseminated to the NMHSs of 15 island countries in the Western Pacific through a range of web-based information tools.
- Seasonal climate predictions could provide governments and local communities of small island countries with vulnerable economies with valuable assistance for informed decision making for adaptation to climate variability and change.

A Seamless Framework for the Global Monitoring and Prediction of Droughts

Prof. Eric Wood (Princeton University/USA)

- Seamless monitoring and prediction framework at all time scales that allows for consistent assessment of water variability from historic to current conditions, and from seasonal and decadal predictions to climate change projections.
- At the center of the framework is an experimental, global water cycle monitoring and seasonal forecast system.
- The system is based on land surface hydrological modeling that is driven by satellite remote sensing precipitation to predict current hydrological conditions, flood potential and the state of drought.
- Seasonal climate model forecasts are downscaled and bias-corrected to drive the land surface model to provide hydrological forecasts and drought products out 6-9 months.
- Examples of real-world applications to flood and drought events, with a focus on Africa and South America, demonstrate efficiency of the system.

The Available Water Climatology (AWC) and its Applications

Prof. Hi-Ryong Byun (Pukyong National University/Korea)

New approach to the AWC has been presented.

- The Existing Precipitation Climatology (EPC) considers the water-related environment based on daily, monthly and annual precipitation.
- An approach is proposed based on using Available Water (AW) which is remaining water after runoff and evapotranspiration.
- It was suggested that AW climatology which describes danger of the water-related disasters such as droughts, floods, inundation etc. could be applied for the early warning.

Session III

Managing Risk from Droughts and Water Scarcity

Chair: Dr. Ximing Cai
University of Illinois

Session IV

Changes in Hydrological Extremes: Floods and Typhoons

Chair: Dr. Eric Salathe

University of Washington

Session IV: Changes in Hydrological Extremes: Floods and Typhoons

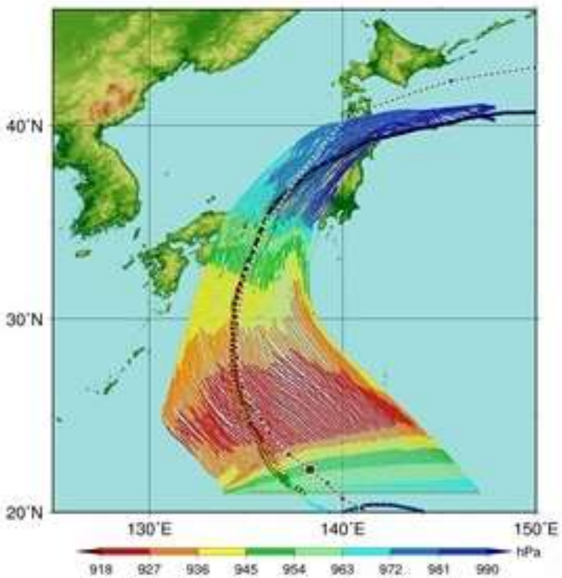

Figure 3 Minimum central pressure of typhoon Vera by track perturbation

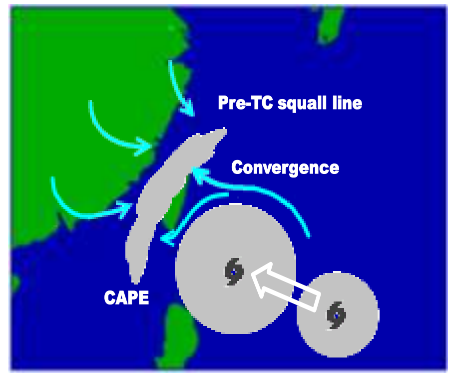

Figure 1. Schematic diagram on genesis c the pre-TC squall line

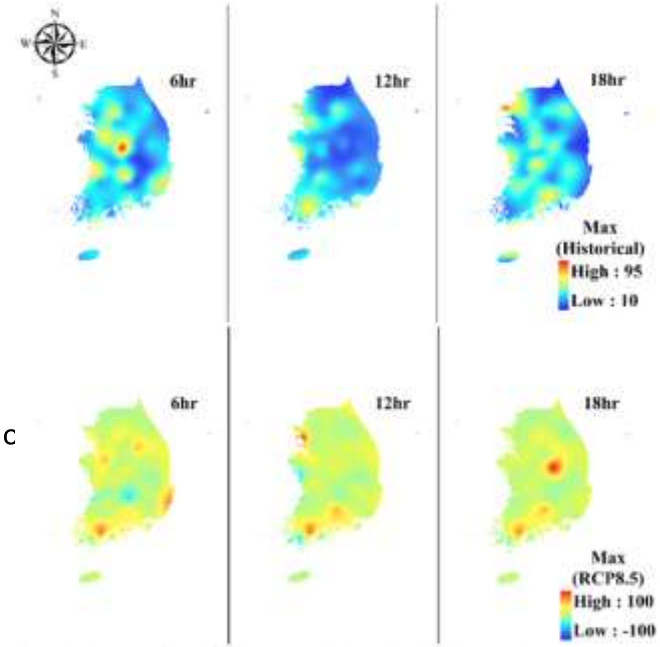

Figure 2. Historical hourly maximum precipitation (top panels) and its difference (bottom panels) from RCP8.5 for 6th hour (left panels), 12th hour (middle panels), and 18th hour (right panels)

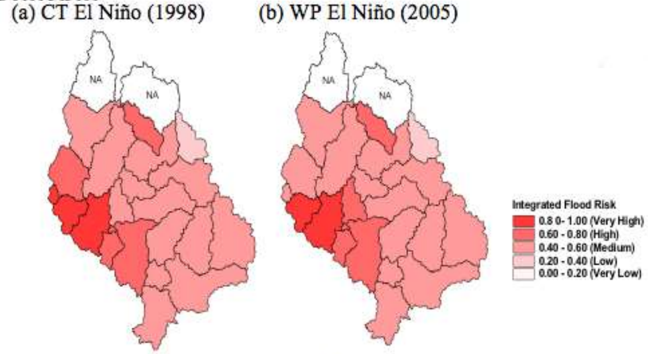

Figure 2. Assessment of the integrated flood risk index (IFRI) over the Han River basin, Korea. (a) shows the strongest CT El Niño phase in 1998, and (b) shows the strongest WP El Niño phase in 2005.

Session IV: Changes in Hydrological Extremes: Floods and Typhoons

Some Common Themes

- Creating scenarios of future risks of extremes for management decisions (all)
- Bringing climate to the house scale: downscaling, hourly disaggregation, extreme precipitation mechanisms (Lee, Chen)
- Analysis of large-scale controls on local extremes to improve climate predictability and climate change guidance (Yoon Behera Mori)

Session V
Climates Impacts on Water Quality

Chair: Dr. Heejun Chang
Portland State University

Author	Study area	Water/health system	Climate info.	Hydrology/ impact assess	Major findings
Chang	Pacific Northwest of USA (small streams)	7day average of daily max stream temperature	Representative GCMs Incremental	Temporal regression ; WHM; CE-QUAL-W2	Vulnerable areas expand; Impacts vary over place; need land manage.
Van der Linden	Lakes in Australia & Taiwan	Temperature DOC, DO, conductivity, etc.	Incremental	ELCOM CE-QUAL-W2	Seasonal difference; No catastrophic trends projected
Cho	Watersheds in South Korea	Sediment Nitrogen Phosphorus	MME; stat. downscaling (climate index reg)	SWAT	Need for MME; NPSP sensitive to CC; uncertainty
Jain	Maine Coasts & Lake South Korea	storm runoff (culverts); Ice out dates, Lake phytoplankton; Environ. Flow	Extreme rainfall; Pacific Ocean SST (seasonal); Typhoon frequency	Nonparametri c statistics; nonlinear dynamic lake model	Need to incorporate extremes into planning; varying impact; coproduction of knowledge
Basu	West Bengal, India	Heat wave death; disease vector (Malaria, Diarrheoa ,etc.)	Climate extremes (daily max temp, prcp.)	Regression	Heat waves and death (+); prcp. and malaria (+); regional differences
Lee	Large shallow lake Taihu, China	Water temperature; algae; other pollution	Air temp; wind, GHG in water (CO_2, CH_4, NO_2); CLM 4.5	Eddy covariance mesonet	Air temp and evaporation fraction (+); CH_4 close to GM; CO_2 uptake at night;

Session V: Main Points

- Climate information (what type for whom at what scale; useful vs. useable)
- Climate impact assessment across spatial and temporal scales

- Process-based vs. statistical model (pros. Vs. cons)
- Cascading uncertainty (sources, quantification)
- Boundary condition issue (non-stationarity)

- Need for developing integrated models (seasonal forecast, water allocation, economic models)
- Cross-scale integration (local to global, feedback)

- Communication (mobilization of diverse knowledge)
- Water stewardship/governance (community partners, local knowledge)
- Adaptation plan (Infrastructure, soft/hard eng., education, other land management)