WMO Forecasting Infrastructure for Predicting Climate Variability and its Potential for Anticipating Changes in Extremes

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Outline

• Defining weather and climate extremes

• Prediction of climate extremes

• WMO infrastructure for long-range forecasts
Defining extremes

- Variability is an inherent part of climate.
- A meteorological definition for extremes could be based on the events that occur on the tails of the frequency distribution of a variable; an impact independent definition.
- A societally relevant definition could be: climate extremes are events that stress various facets of society (risk human and livestock health, incur economic losses, cause damage to infrastructure etc.); extreme event + vulnerability
- Examples – heat/cold waves (health; energy), droughts (economic), floods (life and property).
Defining extremes

Frequency distribution of temperature at a location (daily, monthly, seasonal, ...)

95.44%
68.26%
13.59% 34.13% 34.13% 13.59%
Types of extremes

• Correlated (or compound) extremes
  – Hot, dry, windy $\rightarrow$ fire danger;
  – Hot, moist, stagnant $\rightarrow$ health danger;
  – Sea level rise, astronomical tides, storm surge $\rightarrow$ coastal erosion.

• Correlated extremes can worsen chances of societal stresses.

• The societal impact of extreme events also depends on the characteristics of local climate (e.g., onset of rainy season).
Losses from extremes are increasing

Weather-Related Natural Catastrophes across the world (by type) 1980-2018 (based on insured losses)

https://www.iii.org/fact-statistic/facts-statistics-global-catastrophes
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Influence of changes in climate variability on extremes

- Positive change in the mean
- More hot extremes; less cold extremes

- No change in mean; increase in spread
- More hot and cold extremes
Examples of extremes and interactions across time-scales

- El Niño and extreme rainfall/mudslides in Peru.

- El Niño and extreme fire season in Indonesia.

- North Atlantic Oscillation (NAO) and extreme cold over eastern US.
Predicting climate extremes

• Links between modes of climate variability and local extremes can be used for the prediction of extremes.
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Current status of operational sub-seasonal to decadal (S2D) infrastructure within WMO

- Global Producing Centers for Long-Range Forecasts (GPC-LRFs) – Seasonal.
- Global Producing Centers for Annual to Decadal Climate Predictions (GPC-ADCPs).
- Regional Climate Centers (RCCs).
- Regional Climate Outlook Forums (RCOFs).

• These “operational” entities provide support for the infrastructure for various components of WMO’s Climate Services.
Operational infrastructure for seasonal forecasts

• 13 Global Producing Centers for Long-Range Forecasts (GPC-LRFs).

• On a monthly basis, seasonal forecast data is provided to the WMO Lead Center for Long-Range Forecast Multi Model-Ensembles (LC-LRFMME) hosted by the Korean Meteorological Administration (KMA).
Lead Center for Long-Range Forecast Multi Model Ensembles (LC-LRFMME)
https://www.wmolc.org/

- LC-LRFMME provides a conduit for dissemination of seasonal forecast information between GPCs-LRF and NMHSs, RCCs etc.
Lead Centre – Long-Range Forecasts Multi-Model Ensembles

Temperature

Precipitation
Infrastructure for Annual to Decadal Climate Predictions (ADCP)

- An effort led by the UK Met Office.
- Outlooks updated once a year.
- Outlooks for year 1 and years 2-5 average.
- Plans to release “Global Annual to Decadal Climate Update (GA2DCU)”.
- [https://www.wmolc-adcp.org](https://www.wmolc-adcp.org)
Sub-Seasonal to Seasonal (S2S) Project

- Currently a joint WWRP/WCRP research project.
- Collects hindcast and (delayed) real-time sub-seasonal forecast data.
- Efforts are under way to develop a formal operational infrastructure (similar to LRF and ADCP) within WMO.
- [http://s2sprediction.net/](http://s2sprediction.net/)
WMO Infrastructure for LRF

- WMO long-range forecast infrastructure for LRF is a tiered concept.
Utilizing WMO operational infrastructure for the prediction of extremes

• In the context of long-range forecasts, currently the most readily available information is
  – change in the time-mean average, and
  – the probability of its occurrence.

• Based on historical data, this information can also be utilized to develop an outlook for the changes in local extremes.
Thanks!