HEPEX

a community of research and practice to advance hydrologic ensemble prediction

# Workshop on Seasonal Hydrological Forecasting
# 21-23 September 2015

Monday 21st, 15.30 - 17.00, Workgroup/discussion:

# Summary of discussions

## Models/systems

- Anything is possible! BUT
  - At a cost
  - Uncertainty can be large
  - There are limits: e.g. the longer the lead time, the large the spatial scale (i.e., cannot provide information at local scale)
- Products and needs can be conflicting (e.g., spatial scale: users wants local; forecasts are at large scale)
- Holly grail: integrated end-to-impact forecast
- Hydrological seasonal forecasts depend on accuracy of climatic seasonal forecasts
  - Are they good enough?
  - How can we use better the information: i.e., not use rainfall forecast but use mslp/ NAO prediction to inform our hydrological models?
  - We need to know better the limitations of climate forecasts and how to make the best use of them: i.e. what is the best source of predictability? E.g. NAO?

# Products

- Probabilistic forecasts
- Confidence intervals around our estimates
- About timing, volume or duration depending on the need (flood; reservoir management; droughts)
- Depends on lead-time: e.g. can only look at threshold for short range; for longer range it is about anomalies
- Should be associated with verification metrics e.g. skills, reliability etc..
- Should be a forecast without any statistically significant skill be issued? Depends on the impact of the decision e.fg. Extreme tropical cyclone better to have a false alarm than a miss

## Users' need

- Diverse!
- Different users - different needs
  - technological capability to understand/ digest seasonal forecasts / different lead time needs
- Some users (e.g. large hydropower companies) have enough funding/ resource to can produce/buy seasonal forecast and interpret them themselves
- Some users (e.g. local authorities) rely on gov. agency information/ middle man/ technical advisors to translate high level information/ simple information
- Use of forecast might be links to possible economic benefit (e.g., hydrocompanies)
- Other users can use seasonal forecast for damage limitation, but this might have a less direct economic benefit hence less funded
- Hydrological forecasts are only one part of the decision making!
- Interpreted information linked to impact is the real value of the information

## Uncertainty

- Important note: decisions are already taken despite the presence of uncertainty  (small or large), however we need its quantification in a consistent way
- Not clear answer on what is uncertainty? How to quantify and how to represent uncertainty?
- Understanding of uncertainty varies between end-users, modellers, depending on experience and education
- Despite the ability to represent uncertainty efforts are needed on improving communication between modellers and end-users
- Tolerance of uncertainty depends on:
  - the user (some users are happy to only take guidance)
  - lead time, which again leads back to the lead time that the end-users are most interested in

## Uncertainty (cont.)

- **Modellers should not focus on generating results but need to take into account the impact of their decision. The biggest challenge is to make a decision that avoids risk (i.e. financial or vulnerability of landscape)**
- **Various sources of uncertainty exist (initial conditions, climate forecasting, impact model structure and parameters, observations, data used for data assimilation). It is important to represent the full range of uncertainty and then assess how uncertainty propagates (and also try to reduce) from each source to the impact model result**
  - **Introduce probability in the forecasted results and for example present the probability distribution (that can assist on assessing the reliability of the system)**
- **Scientific question:**
  - **In which situation a hydrological model would amplify uncertainty and which is not?**

## Uncertainty (cont.)

- The importance of different sources of uncertainty depends on:
  - Spatial scale  and lead time
  - Regime (dominant processes vary regionally; presence of process with long memory)
  - Presence of large scale controls, i.e. ENSO
- Accept that even when taking the entire range of uncertainty, extreme cases (due to natural phenomena) can occur and modelling systems do not necessarily need to change.
- Need for a decent length of historical records (hindcast period) to allow analysis of system behaviors and hence better understanding of uncertainty

## Challenges – usability of forecasts

- Communication!
- Conflicting interests from different users
- Need to increase transparency in methods and decisions to the user
- How do we make new forecasts/improvements useful! – Limitation in data and computations
- Institutional barriers
- Improving  the decision making process

## Challenges – technical improvements

- Seamless forecasting
- Non-stationarity
- Increasing reliability in dynamical seasonal forecasts - calibration
- Scaling issue
- Reducing epistemic uncertainty
- Improving forecast skill

## Opportunities

- Communication
- Increasing knowledge (more studies, papers, growing community)
- Developments driven by financial risk/gain
- Increasing need for seasonal hydrological forecasting in the future
- Seamless forecasting
- Improve uncertainty  and reliability handling
- Impact-base forecasts
- Improving forecast skill
- Reliable forecasts on new horizons – products, time scales,
- More operational examples needed