Water

Peter May

Water remains as a key cross-cutting issue for both WWRP and WCRP. As such it is a key component for many of the WWRP and WCRP activities .

Water is a key issue for verification and represents an exemplar for the issues facing the verification team as well as HIW and PPP. This is expanded on below.

Technical issues remain key areas for further research and development. Precipitation modelling error correction and de-biasing for different scales and applications, such as inputs to hydrological modelling remain as key challenges. This is particularly the case with increased focus on extremes. Water availability will remain a key challenge. Drought and the cessation of drought are key societal issues across the world.

The summary presented in 2014 remains current

Strong themes around water issues for the HIW and S2S projects.

Users of precipitation information (either viewing data to make decisions or inputting to downstream applications) need to better understand the uncertainties in the measurements/forecasts. For non-meteorological users this must be communicated in an easy to digest way that gives them confidence to go ahead and use the data. Approaches could include:

- Quality flags on data
- Greater personal engagement between providers and users
- Increased data accessibility and ease of usage

Make precipitation data available as quickly as possible to enable their use in many applications.

Create high spatial/temporal resolution global (or at least continental) observation-based precipitation datasets for use in downstream applications, assimilation into NWP, and verification of NWP and operational precipitation forecasts and warnings.

Weather services are increasingly focussed on high impact events and small spatial scales. Need to have this focus across the working groups (e.g GEWEX and WGNE). Deal with heavy rain over small catchments - uncertainty

Medium range to multi-week and season predictions are being increasing used and include applications such as streamflow. Model issues include rapid growth of SST biases that in turn affect convection and teleconnections. Links to S2S applications and usage.

Coupled model experiments at short-medium range in extreme weather situations to understand importance (or not) of atmosphere-surface coupling on the precipitation simulation. We know, for

example, that TCs interact with ocean mixed layer. Numerous mesoscale experiments with striped land surface also show some impact on convection. But how important is it for real-life NWP?

Encourage work on methods for efficient assimilation of remotely sensed moisture (radar, satellite) to close the gap between nowcasting and very short range NWP.

Work with social scientists to understand how best to present and communicate warnings for heavy rain, especially from high resolution ensembles. If presented at grid scale then probabilities of very heavy rain are so small that people may not take action, and they might not understand probabilities anyway. Need to present risk in a way that people will understand and be better able to respond, which involves psychology of decision making.

Continue to build links with downstream precipitation data users through scientific engagement and funded projects. Adherence to geospatial data and IT standards strongly encouraged to facilitate end-to-end system development. Make greater effort to involve downstream users in FDPs and RDPs (e.g., success of MAP D-PHASE is that regional and local water/flood agencies lobbied to keep enhanced precipitation services going after the FDP).

Verification

Peter May

With great input from Beth Ebert and Marion Mittermaier

Key messages:

Ensemble forecasting is likely to replace conventional deterministic forecasting over the next few years. This transition from traditional NWP (with global verification scores etc) to a new era ensemble based nowcasting and prediction out to seasonal scales is a significant area of research both in terms of optimal use of ensembles and product development focussed on user needs as well as verification.

- Seamless forecasting (both in terms of modelling and products from NWP to seasonal will require new verification methods.

Verification will need to be much more specific to end user needs (there was a need to demonstrate the benefit to the end user).

Input from Verification Committee

Encourage sharing of observations for verification purposes. GTS only goes so far, much more could be done with the much richer data available to national met services, especially when quality observations from external parties are included (e.g., rain gauges from municipal water agencies).

Encourage use of 3rd party data, social media (Twitter), for subjective verification of forecasts for high impact weather events. WOW (Weather Observation Website http://wow.metoffice.gov.uk/) is being taken up around the world, especially in UK, Europe and Australia, for sharing data and photos of weather. Recent research suggests that due to sampling biases and measurement quality issues, quantitative use of crowd-sourced data should be done with extreme caution. Methods are needed for extracting useful quantitative information, perhaps temporal trends, spatial gradients

Encourage research on the impacts of observation uncertainties on forecast verification results and interpretation. New MesoVICT experiment (Mesoscale Verification In Complex Terrain, follow-on for Spatial Verification Methods Intercomparison) includes high resolution ensemble forecasts and analyses in its dataset (slide 3). This community project is now in full swing (http://www.ral.ucar.edu/projects/icp/). First results will be shown in a special session at the European Meteorological Society/European Conference on Applied Meteorology in October.

Encourage model verification to be done in “observation space”, i.e., satellite radiance or brightness temperature for cloud, radar reflectivity for rain, to help get over retrieval errors for remotely sensed observations. This is mainly useful for model developers rather than forecast users.

Verification in PPP may well need to heavily use this approach due to sparsity of direct measurements in polar regions. User-oriented verification efforts will have to live with the data

sparsity, making maximum use of special in situ datasets obtained as part of YOPP and PPP. We must not suggest that it is OK to use satellite obs for user-oriented verification just because obs data is sparse, unless it is accompanied by model-independent ground-truthing against in situ data i.e. an estimate of the errors inherent in the satellite data.

Encourage development and use of new verification methods and scores (ex. Extreme dependency) that handle rare/extreme events better than the traditional ones. These scores are now starting to be reported at WGNE for verification of NWP precipitation.

How to deal with small scale intense features and their impacts (e.g convective rain and flood forecasts with small catchments) where small errors in location can have big impacts. There are analogous issues in S2S on seasonal timescales – edge between deterministic and probabilistic approaches. Convective scale ensembles are being promoted and used for predicting small-scale intense precipitation, wind, etc., but appropriate verification methods are still being tested. AWS data is now considered appropriate for verification for precip since scale mismatch between grid and point is reduced compared to years past. MesoVICT (see above) will look at this issue. Spatial verification methods will be applied in S2S.

Need better communication of forecast uncertainty (accuracy, as opposed to ensemble-based probability) so that users have the confidence to make appropriate decisions based on expected forecast quality. This may mean converting from “weather space” into “user space”. A good example is UKMO’s flight time error – drive the plane through model winds, compare to actual flight time to get error. As part of the HIWeather project the JWGFVR will conduct a global competition for the best new user-oriented metric, which we hope will encourage activity in this area. The Aviation RDP (joint with CAeM) is a potentially important user of new metrics.

Verification of environmental forecasts (including ocean) are not nearly as advanced as weather forecast verification. Look to apply similar rigor to these areas. JWGFVR's verification workshops have had a little bit of participation from ocean and environmental prediction communities. The connections should be strengthened to build the verification capability through the relevant WMO programs – JWGFVR could help, but expanding its scope would need to be tested with CAS.

Warnings increasing given as spatial maps – need some attention on how to verify timing (lead time, onset, cessation) and intensity of spatial warnings. In spite of flagging this area for some time, it still hasn't received very much attention – it may need to be pushed along. It could be an activity of HIWeather to promote work in graphical warning verification.