Uncertainties in flash-flood forecasting

Hydrometeorological prediction is affected by several uncertainties:

- soil moisture initial conditions,
- hydrological model error,
- meteorological uncertainties forecasting.

Mediterranean areas are often affected by heavy rain events and devastating flash-floods ⇒ French Cévennes-Vivarais region is well known to be prone to those hazards.

Larger uncertainties for the flash-flood forecast due to:

- Non-linearity of hydrological processes
- Temporal/spatial scales of precipitating systems leading to flash-floods

⇒ Need to develop methods that quantify these uncertainties

The AROME deterministic QPF uncertainties

AROME deterministic operational quantitative precipitation forecasts (QPF) uncertainties were assessed through a comparison with radar based quantitative precipitation estimate (QPE):

- Focus on hourly precipitation,
- On a sample of significant rainy days (>70 mm / day) within the period of AROME forecasts achieve from (sep, 2008),
- Using an object-based approach (to avoid double penalty problem).

Objects identified with convex subsets where hourly rain exceeds:

- 2 mm / hour (rainy objects),
- 9 mm / hour (convective objects).

Results of the comparison:

- Determination of probability density functions (pdf) of QPF errors for amplitude and location of both types of objects:
  - In 70% of the cases, the location errors do not exceed 50km
- Use of SALT diagnostic:
  - Median for A component close to 0 ⇒ no bias.
  - L component values generally weak
  - A and S signs mostly identical

- Parameters of the method:
  - Geographical shift
  - X Y = 50 km
  - Number of members
  - N = 50
  - Precipitation scenarios obtained ingested ISBA-AROME ⇒ ensemble streamflow forecasts.

- Sensitivity of the method to its degrees of freedom:
  - 50 (N parameter) members ensemble ⇒ better median and ensemble spread than ensemble with fewer members.

- Location perturbation step has the strongest impact on the results but best ensemble streamflow simulation obtained with the three perturbation steps.

Conclusions

Assessment of the high resolution meteorological simulations ⇒ no biases of the AROME forecasts. General drawback of heavy precipitation underestimation of convour NWP models not found for convecting permitting AROME model. Location errors can however highly affect the hydrological response at the catchment scale.

Design of an ensemble discharge forecasting method based on perturbations generation ⇒ results as good as the ones obtained using a state-of-art research convective scale NWP ensemble. Cheaper computer time cost with respect to convective-scale NWP ensemble ⇒ see Vincendon et al. 2010 submitted to WEHSS

Future work

Further verification on a larger sample on flash-flood cases needed to confirm the promising results ⇒ Hymex SOP et EOP good framework

Method can be applied to each members of the convective scale NWP ensemble to increase its size.

Focus on the other sources of uncertainty (hydrological modelling, initial soil water contents).

Tuning of the final method and choice of the assessment criteria together with end-users.