Absolute versus relative outliers: identifying catchments which are outliers for all models and catchments which are outliers for some models only

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1. Context and objectives of the study

Hydrological models sometimes (often?) fail to produce satisfactory simulations. The causes of failures can be manifold: model structure, calibration difficulties, spatial variability, catchment boundary definition, data errors or representativeness, determination of initial conditions, etc. Among these, **model structure** may be one of the most important sources of uncertainty. However, modelling studies often use a single model, so it is difficult to evaluate the part of the total error due to the model structure only. In case of model failure, should the model be systematically blamed for that?

2. Results

- **Does a bad model result mean a monster catchment?**
  
  Figure 1 shows that, for a given catchment, the spread between the best and the worst model can be large. Among the 200 catchments for which the efficiency of the worst model is below 0.2, there are 60 catchments for which the efficiency of the best model is above 0.7. Clearly, some catchments are monsters for some models and not for others. This results was expected as some conceptualization may better fit some catchments and not others.

- **Can a catchment be a monster for all but a single model?**
  
  Figure 2 shows that the a majority of catchments, the difference between the two best models is limited. For a few catchments, the difference may be large. However the largest differences (>0.1) appear for catchments where all models fail (best model efficiency < 0.7). Therefore it is very likely that if a model works well on a catchment, other models will provide similar level of performances.

- **Are there regions that can be considered as black holes for modelling?**
  
  Figure 3 shows maps of the efficiencies obtained by four different models. For each models, catchments were classified into three categories (bad, medium and good performances). Some regions seem to be more densely populated by hydrological monsters but they are not systematically the same for all models.