Hydrol. Earth Syst. Sci. Discuss., 12, C2860–C2864, 2015
www.hydrol-earth-syst-sci-discuss.net/12/C2860/2015/

Hydrology and Earth System Sciences
Open Access
Discussions

Interactive comment on "Initial assessment of a multi-model approach to spring flood forecasting in Sweden" *by* J. Olsson et al.

P. Krahe (Referee)

krahe@bafg.de

Received and published: 27 July 2015

Seasonal streamflow forecasting becomes an increasing interest for water resources management as well as for water related economy. Together with the rapid increasing availability of data sets of seasonal meteorological forecast products as well as the increasing knowledge about the climate system generated by the global climate change debate the article are in line to bring these knowledge together with some empirical attempts further to water related decision making. Starting from the current (pragmatic) practice for spring flood forecasting at the Swedish Meteorological Institute by combining an analogue climatological ensemble approach (CE) with a hydrological model and by communication the forecasting result as the median of the generated hydrological ensemble (three-monthly discharge volumes for three different forecast issuing times) three approaches are developed tested, and evaluated aiming to improve hydrological spring flood forecasting. Comparative analyses of the results of the various approaches and its variants, including two versions of a combination of the applied methods which is based on three to four selected robust (= user-friendly) performance measures allow an evaluation of the forecast skill compared with the current forecasting practice. The results are presented in 6 tables and one map (Fig.1) which shows three examined river basins together with the grid of the ECMWF dynamical seasonal meteorological forecasting system. The article promises on a first glance the development and application of interesting empirical as well as dynamical approaches covering this complex and ambitious interdisciplinary topic. The methods ranging from two improved variants of the analogue method by using free available indices of atmospheric teleconnection or circulation patterns (TCI) of NOAA as well as a well-known objective classification method (CP) up to the use of the output of one to two dynamical seasonal meteorological forecasting models. From one of the models the forecasted daily precipitation and temperature data are used to force the hydrological model (DM). Furthermore, the upper air data of the two models (seasonal averages) are used for a regression between these data and the target value (Spring Flood Volume, SFV) named Statistical Downscaling Method (SD). In general the article attains the defined objectives by describing the selected approaches and the results in an appropriate manner and the reader can follow the main computation stepsas well as the discussion of the results. The main scientific value of the paper will be the attempt to work out the potential forecast skill of this large span of possible seasonal forecasting methods (empiric-statistical to dynamical modelling) for the specific snow-melt induced forecast problem. Unfortunately, this study suffers some shortcomings which are partly addressed by the authors itself but which still limit the produced forecasting results and their interpretation. They can be summarized as follows: - Please clarify the wording lead times. Starting in the abstract “lead times between 0 and 4 months” are mentioned. E.g. on Page 6082 and later on forecast times for issuing the forecast are mentioned as 1st of January, 1st of March and 1st of May and three monthly volumes of runoff (SFV) are calculated for each of the months. - Only eleven years (2000-2011) are available and used for the comparative analysis of methods, which provides only a small statistical basis. - By applying the climatological ensemble (CE) I miss the discussion about stationarity in observed climatic and hydrological time series. I expect that also in swede river basins over last 40 to 50 years temperature has been changed, eventually precipitation, too. This can be attributed partly to global climate change. Therefore, is it still allowed to use e.g. data of 1961 to 1990 for actual seasonal forecasting? This issue has to be discussed a bit. This is also related to new variants of the analogue ensemble method (AE). - In Table 2 where the results of CE are depicted I miss the MAE's for the simulated values. Only one value for SIM is listed of which it is not clear which period is captured. I expect that MAE will strongly depend from the analysed periods. Therefore, MAESim 1/1, ...SIM1/3 and ...Sim1/5 are of interest. - Within this short evaluation period inhomogeneities in the seasonal forecasts are present, e.g. the change from ERA40 to ERA 15 (2003), Meteorological ensemble consisting of ECMWF IFS-Hope with 11 members up to 2006 and 41 members later on, the role and the range of ARPEGE-ORCA is unclear (this model is only used in SD and only 1 member is available ?). - Application and discussing the Analogue Ensemble (AE), is based on period 1961-1999 and station data while gridded data are used for hydrological modelling (calibration and validation ?, cp. 3.2 versus cp.2.1) - The daily precipitation and temperature data of the ECMWF-IFS model is used, but no bias correction is applied even the necessity to do this is known by the authors (see cp.1, p. 6079 and 6080), at least in the context of climate models. Furthermore, the mapping process to downscale the raw output to the grid and/or station location required by the hydrological models is not well described. - Concerning the dynamical meteorological models (DM and SD) it has to be noted that the analysed system (at least ECMWF system 3) is replaced by system 4 since 2011. Furthermore, hindcasts exist for a 20 year period for this system. Therefore, the findings based on system 3 are of limited value. However quotations should be added concerning system 3 on p.6083 and on p. 6097, assuming system 4 of ECMWF is the new system which becoming available for SMHI? - Due to the mentioned restrictions concerning the application and interpretation of the dynamical models, both the DM and SD, the results should be interpreted carefully. Please take more care for this in the discussion. - I see a limitation by applying the SD-Method without considering the previous period, e.g. the snow accumulation in the wintertime is not taken into account. This is although reflected in the results of Table 3 for forecast times 1/3 and 1/5. On the other side you have the best result of all methods for SD and forecast time 1/1. This issue should be discussed a bit more. - For better readability in cp.3 p.6098 the first paragraph concerning the predictors should be depicted in a table. - By applying the CP approach the criteria for selection are the two most frequently occurring CPs in the previous months 1 to 6. What is justification for selecting 2 and e.g. not 3 or 4 CP's? Please, explain a bit more. - It may be an added value as well as it will support the interpretation of the results if you give some more information of occurred CPs in cp.5.1.2 in form of a table or a histogram, e.g. for CP3. It may be interesting to see e.g. for a certain forecast time that always the same CP's dominate the 2 leading CP's or not. - Concerning hydrological modelling/processes the following remarks has to be noted: o What are the catchment sizes of the sub-basins of the HBV Model, e.g. add in Table 1 number of sub-basins. o Some more words to calibration and validation strategy are needed especially taking into account the water resource management systems in at least two of the rivers. Some remarks about the temporal stationarity of the hydrological modelling may be helpfully. o What is the role of natural lakes in the system. E.g. characterize the lakes by their number, total area or volume in Table 1. o Furthermore, the mean catchment elevation as well as some basic climatic data characterizing the catchments (e.g. mean annual or seasonal precipitation and air temperature) will be helpful. o Hydrographs characterizing the streamflow regime in the considered seasons will be helpful (e.g. 31-day moving average of daily runoff of the three basins). Although it may be interesting if there are changes in the precipitation –runoff process are obvious in the observed data. o The results depicted in Table 3 show a large variety between the river basins. Therefore, it may be interesting to calculate and to show the correlation matrix between the river basins for the various forecast periods.

Some technical/linguistic remarks: - A table with an overview of the applied methods and data including the required temporal resolution will be helpful. - Figure 1is not very illustrative at time. Due to the fact that the seasonal forecasting methods, especially CP and SD require information from a larger area, these areas should be depicted in the map. - p. 6080, line17: skip “in” for impacts” - p. 6082, line 14: change to 900 x 106

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 12, 6077, 2015.