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Hydrology and Earth System Sciences Discussions

Interactive comment on "A water availability and low-flow analysis of the Tagliamento River discharge in Italy under changing climate conditions" *by* L. N. Gunawardhana and S. Kazama

Anonymous Referee #2

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Review of the paper 'A water availability and low-flow analysis of the Tagliamento River discharge in Italy under changing climate conditions' by L. N. Gunawardhana and S. Kazama

Recommendation: Major Revisions

The paper deals with an evaluation of possible changes in the discharge and water availability of the Tagliamento River in North-Eastern Italy under scenario conditions. The results are obtained starting from ensembles of CGCM climate projections, down-

scaled to the local scale using a statistical weather generator and high resolution local observations. Impacts on local hydrology are evaluated using a tank rainfall-runoff model.

The paper is focussed on a very crucial impact of climate change: the water availability under scenario conditions. The single instruments used to evaluate these impacts are sound and fitted to the problem. All the same, the application of the methods to the specific problem remains unconvincing and the final impression is that although the results are in general realistic, their usefulness for the specific small basin considered is hampered by problems in the evaluation of local climate characteristics.

In the following, are suggested several changes which should done in order to make the paper publishable.

General Comments:

Several data-sets are used in order to evaluate different aspects of local climate.

For river discharge, data the extension of the data-set is unclear, possibly it is only available from January 2008 to September 2009. For snow cover, data are available only from 2001 to 2003. The fact that the last two data-sets do not refer to the same period is obviously a problem: interannual and inter-decadal variability is very pronounced in this region both in term of precipitation and of temperature. As a consequence any statistical model built using these data as they were describing different aspects of the same climate, might not be credible.

Furthermore some of the described aspects of the climate presents difficulties. Although the data-set of surface meteorological parameters covers a long period up to 31 years (from 1980 to 2010), the evaluation of some climate characteristics is done using data over very short periods up to 5-6 years (see lines from page 143 line 18 to 144 line 8). The secular trend in temperatures is evaluate in a very unusual way, by comparing the trends obtained over short time periods (1980-89 and 2000-2009) in

HESSD

9, C234–C238, 2012

stead of evaluating a long term trend. None of the two short term trends is actually comparable with that reproduced by CGCM in their control run (1961-1990). Furthermore, the local average temperature and its vertical lapse rate is evaluated only using 5 years of data (2006-2010). This might be a problem by itself, since the control experiments of CGCM used in order to evaluate climate change projections are normally run over the period 1961-1990, which presented locally and globally very different characteristics from the short period 2006-2010 which might also have been influenced by strong components of interannual and inter-decadal variability. Furthermore, the local vertical lapse rate is mentioned to be 4°C per 1000m. This value is not very convincing. It is possibly the mean value of a bi- or multi-modal distribution: in this region, especially during winter, are observed temperature inversions which extends very often only to the night and the early daytime, when convection allows mixing. Only in extreme cases the inversion extends to the whole day. The authors should understand what are they actually modelling, and decide if they are interested in 'mixed' cases, with a lapse-rate closer to the adiabatic or moist theoretical value of the lapse rate, or to 'inversions'. Under inversions conditions, the vertical extension and the intensity of the inversion layer may differ from case to case. The authors might be better off by evaluating separately the climatology minimum and maximum temperature, the second one being often less affected by inversions even in extreme years. Finally the region considered is often very exposed to extremely cold easterly winds from the continent. The frequency of these conditions should be evaluated at present and scenario conditions.

Another aspect of climate is the climatological extension of snow and glaciers presented in Figure 3. This part of the Alps is known to present the lowest limits of permanent snow over the Alps thanks to the particularities of the local climate, characterised by strong time variability. Maintenance of such a low limit of permanent snow is thought to depend especially on the frequency of occurrence of cold spells even in warm seasons. A correct evaluation of the extension would need a data-set more extended in time, and possibly a more detailed climate evaluation.

HESSD

9, C234–C238, 2012

One final problem is related to the results for local scenario projections reported in page 152 lines from 7 to approximately 15. The sentence ‘ the warming during winter and autumn. . ..periods.’ is difficult to interpret. Are summer and spring considered the other two intermediate seasons? Furthermore, results reported by several earlier projects like STARDEX and PROVOST, using similar models and scenario with respect to those here used, are not consistent with these results. In particular, in Northern Italy. summer is reported to be the season experiencing the strongest temperature increase under scenario conditions. How these results are related to these studies? This aspect of the paper, namely the comparison between the results here presented and those obtained for the same region by other studies, should be in general expanded.

Specific comments:

The abstract is too detailed. Should be rewritten so as to avoid the use of acronyms and detailed information on the methods, leaving space to a general description of the results and to the innovative part of the study.

Figure 1 – The map of the basin is very difficult to read and the map used to locate the basin within a more general geographic map, remains focussed to the Friuli-Venezia Giulia, but should be extended to the entire Alpine region, so as to help readers who might not be expert of local geography.

The authors do not include in the text a detailed description of the CGCM runs used in the study. The description should include also list of scenarios considered and of their characteristics. Furthermore the description of the three time periods for which scenario results are obtained is never given in the text, and can be inferred only from the figures.

The descriptions of the low-flow results in page 154 is not very clear. I think that it should be rewritten more clearly.

One final comment is on the conclusions in page 157 from line 25 onward. The authors

HESSD

9, C234–C238, 2012

say that climate change may increase the length of the growing season. It would be more correct to say that climate change may produce an increase in the length of the vegetative season. For many agricultural species, included vines, tomatoes and others typical of this region, climate change may produce an anticipation and shortening of the growing season.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 9, 139, 2012.