Hydrol. Earth Syst. Sci. Discuss., 8, C6013–C6015, 2012
www.hydrol-earth-syst-sci-discuss.net/8/C6013/2012/

Hydrology and Earth System Sciences Discussions

Interactive comment on "Global patterns of change in discharge regimes for 2100" *by* F. C. Sperna Weiland et al.

B. Fekete (Referee)

bfekete@ccny.cuny.edu

Received and published: 6 February 2012

Weiland et al. presented a detailed assessment of climate change on the hydrological systems. They carried out global hydrological model simulations using climate forcings from 12 GCM simulations following the 20C3M (contemporary) and A1B (future) emission scenarios. One has to note that the new CMIP5 simulations for AR5 are already available, and this work would be more relevant if the authors used more recent GCM results.

The findings presented in the paper largely confirm previous similar studies with a few exception. This work will undoubtedly be regarded as important contribution by the majority of the scientific community. Unfortunately, I am probably in the minority, which

has serious concerns. Before I delve into my comments, I would like to emphasize, that I came across other works of the presenting authors and I have deep respect for their scientific contributions in the past. My current criticism is targeted more to the scientific community in general than to the authors in particular. According to my understanding, ensemble simulations first were introduced in weather forecast to assess the impact of uncertainties in initial conditions on the predictions. In that context, the same meteorological model is driven by different initial conditions and a suite of simulations are carried out as an ensemble to characterize the robustness of the prediction.

Ensemble GCM simulations appear to be a result of model inter-comparison exercises that were carried out to better understand the differences in different GCMs. It is widely realized that the differences between GCMs are often bigger than the change that individual GCMs predict as the authors also pointed out. It is less emphasized that these large differences between GCMs have little to do with uncertainties in the climate system and rather they are clear evidences of the glaring wholes in our current understanding of global circulations.

The considerable differences between the different realization using the same GCM (presented in the supplement) seem to fly in the face of multi-decadal simulation being a boundary value problem, where the uncertainties in the initial conditions from the present diminishes over time and the dominant forces dictating future climate is the anticipated change in the boundary conditions (such as the geochemical composition of the atmosphere).

At some point, one has to ask the question of what level GCM future simulations can be taken seriously. While GCM undoubtedly capture fundamental processes in the climate system, they are clearly not up to the task to provide quantitative estimates that policy makers could use. GCMs have serious difficulties reproducing the past which led to a whole new "science" of GCM bias corrections, where GCM bias appears to be a euphemism for error. The various approaches that apply the changes derived from the GCM simulations on top of contemporary observed climate are meant to provide future predictions that are somewhat relevant for policy makers. In reality, these “bias corrections” just hide the fact that the underlying GCM simulations are clearly not up to the task of real world application.

In this respect the authors approach to accept GCMs as they are, apply the GCM output in a hydrological model and than look at the differences in the predicted runoff and discharge in a relative term and use that relative change with respect to contemporary observed hydrography is not any better than correcting the climate forcings (air temperature and precipitation) before applying in hydrological simulations. To some degree, one could argue that it is actually worse given the perceived non-linearities in the runoff response. In reality, the hydrological system response is quite linear particularly in wet regions, which leads to a fairly uniform precipitation elasticity of one percent change in precipitation causing 2-3 percent change in runoff, which is the equivalent of a the change in precipitation translating the the same absolute change in runoff where the runoff ratio is about 1/3 (which is the global average).

In a summary, I have no objection to publish the paper in its present form, which is well written, consistent and informative, but I have strong reservations for taking this word seriously.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 8, 10973, 2011.