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Hydrology and Earth System Sciences
Discussions

Interactive comment on "HESS Opinions: The need for process-based evaluation of large-domain hyper-resolution models" *by* L. A. Melsen et al.

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The authors present an opinion paper arguing that the factor time has received too little attention in the call for hyper-resolution models.

In principal, I fully agree with the authors. They make a compelling case that if we want to present model results at relevant resolution for local users at sufficient accuracy, we do need to run models at higher temporal resolution to resolve processes that are needed for this purpose.

However The authors are not very precise in their definition of scale, which is needed

to make their case more compelling.

1. When they talk about scale they refer to the spatial or temporal support (or grain or resolution) of the model, and not the extent (catchment, basin, country, continent, globe). Also, sometimes they seem to refer to "temporal coverage", i.e. the time intervals between reported states or available input data. The authors should be more precise in this. They may refer to the scale triplet in Bloschl and Sivapalan (1995) or Bierkens et al (2000): Upscaling and Downscaling Methods for Environmental research.

2. Now, using "scale" synonymous to "support": The authors come back to this later in section 3, but this is needed earlier. We need to distinguish between the "model time scale" (could be divided into process time scale, numerical time scale, output time scale), "observations time scale" (determines input and calibration time scale) and "policy time scale" (which the authors call interpretation time interval) (See Bierkens et al., 2000). This is important because the arguments on page 13361 (lines 25-27) and on page 12262 (lines 23-26) are not entirely valid in that what the policy scale requires for time scale may be out of sink with the spatial scale. For instance, daily soil moisture at the scale of a single parcel is still very relevant for a farmer. He/she rarely needs hourly soil moisture data, even if the spatial scale is small.

3. The authors should elaborate more on the limited data-availability for higher temporal resolutions. This is probably the major reason why we fail to simulate at higher resolutions. There are not many in-situ data sets of global extent (note that hyper-resolution modeling also aims at a global extent) that have resolutions higher than 1 day. Remote sensing data are rarely an alternative because as a general rule the higher the resolution of remote sensing images, the longer the revisit times and vice versa. So, the authors should not only make a case for higher temporal resolution but also try to speculate how we can obtain the data of calibrate/validate our models at that resolution for larger areas.

4. A factor not considered (apart from data availability and computational issues) when considering hyper-resolution models is the cost of storage. For instance, if we run our global hydrological model 50 years at 5 arcminute resolution (about 10 km) and report our total system state every month (note we run the hydrology daily and the surface water routing with variable sub-daily time step), a single 50-year run would require approximately 1 Terabyte of storage. So daily reporting would amount to 30 Terabyte and hourly reporting 720 Terabyte. If you buy top notch storage disks with backup facilities you pay about 10,000 euro for 30 Terabyte. So if you want to do hourly reporting and store everything on a storage facility, about 240,000 euro is required. You can quickly see that this inhibits high time frequency outputs. It should be noted of course that it always possible to store the state at lesser frequencies and then warm-start the model and report at higher frequencies for limited integration times.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 12, 13359, 2015.