Geophysical Research Abstracts
Vol. 17, EGU2015-6182, 2015
EGU General Assembly 2015

Tools for Virtual Collaboration Designed for High Resolution Hydrologic Research with Continental-Scale Data Support

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Using a series of recent examples and papers we explore some progress and potential for virtual (cyber-) collaboration inspired by access to high resolution, harmonized public-sector data at continental scales [1]. The first example describes 7 meso-scale catchments in Pennsylvania, USA where the watershed is forced by climate reanalysis and IPCC future climate scenarios (Intergovernmental Panel on Climate Change). We show how existing public-sector data and community models are currently able to resolve fine-scale eco-hydrologic processes regarding wetland response to climate change [2]. The results reveal that regional climate change is only part of the story, with large variations in flood and drought response associated with differences in terrain, physiography, landuse and/or hydrogeology. The importance of community-driven virtual testbeds are demonstrated in the context of Critical Zone Observatories, where earth scientists from around the world are organizing hydro-geophysical data and model results to explore new processes that couple hydrologic models with land-atmosphere interaction, biogeochemical weathering, carbon-nitrogen cycle, landscape evolution and ecosystem services [3][4]. Critical Zone cyber-research demonstrates how data-driven model development requires a flexible computational structure where process modules are relatively easy to incorporate and where new data structures can be implemented [5]. From the perspective of “Big-Data” the paper points out that extrapolating results from virtual observatories to catchments at continental scales, will require centralized or cloud-based cyberinfrastructure as a necessary condition for effectively sharing petabytes of data and model results [6]. Finally we outline how innovative cyber-science is supporting earth-science learning, sharing and exploration through the use of on-line tools where hydrologists and limnologists are sharing data and models for simulating the coupled impacts of catchment hydrology on lake eco-hydrology (NSF-INSPIRE, IIS1344272). The research attempts to use a virtual environment (www.organicdatascience.org) to break down disciplinary barriers and support emergent communities of science.

[1] Source: Leonard and Duffy, 2013, Environmental Modelling & Software; [2] Source: Yu et al, 2014, Computers in Geoscience; [3] Source: Duffy et al, 2014, Procedia Earth and Planetary Science; [4] Source: Shi et al, Journal of Hydrometeorology, 2014; [5] Source: Bhatt et al, 2014, Environmental Modelling & Software ; [6] Leonard and Duffy, 2014, Environmental Modelling and Software.