Panta Rhei – Everything Flows
Change in Hydrology and Society
IAHS Scientific Decade 2013-2022
www.iahs.info/pantarhei

Details of the Proposal

Title of the Working Group

Process-based hydrologic modeling for decision making

Abstract of the proposed research activity

Integrated, process-based models seek to represent a full spectrum of hydrologic and interacting processes using deductive, bottom-up, reductionist approaches. Despite controversy, it does offer the opportunity to elucidate the spatiotemporally continuous hydrologic dynamics in measurable quantities, embracing real-world complexities and rapid changes. Collective successful experiences help us build credible models that are accepted in decision making. We propose to use this working group as a synthesis opportunity to help bridge the gap between process-based hydrologic, ecosystem and land surface models and water resources decision making. To achieve this goal, the working group will convene special sessions in international conferences, host synthesis workshops, organize stakeholder engagement and contribute journal articles. Special activities may include:

1. Review and synthesize past successful applications of process-based models that address real-world needs and provide science to societally-important questions.
2. Identify key processes and gaps in socio-economic dynamics that can be integrated into process-based models, potentially via coordination with other groups under the Panta Rhei umbrella. Possibly develop benchmarking problems.
3. Synthesize progress in dealing with key challenges and barriers facing process-based modeling and its acceptance by decision makers, including, large data demand, high computational cost, resolution and scaling issues, uncertainty quantification and insufficient ease of use.
4. Promote conversations with stakeholders at various levels, from local communities to international organizations.
5. Establish international collaborative networks and assemble modeling expertise to prepare for large-team international science projects.

Panta Rhei Research Themes, Targets and Science Questions addressed by the Working Group

This WG will contribute to all three of Panta Rhei's targets (understanding, estimate and predict and science in practice)

The activities of the WG will directly address science questions SQ1. Through proposed activity 2, we also address SQ2, SQ3, SQ4 and SQ6. When process-based modeling is concerned, we always indirectly deal with SQ5.

Research themes: Transdisciplinarity, Water and energy fluxes in a changing environment, Global Change in Hydrology and Society; Possibly a new research theme on process-based modeling and hydrologic scaling for decision making.

Societal impact of the Working Group activity

The activities proposed provide an alternative, bottom-up, verifiable approach to address the Panta Rhei science questions. Some process-based models work as integral components of the earth system models, providing directly feedbacks to climate simulations. This allows newly developed processes to interact with the environment and climate. Process-based models also offer information for modeling derived variables, e.g., pollutant, heat and sediment, which are essential for understanding impacts of human water management on the environment and vulnerabilities. The work of this WG is expected to provide tools for other WGs.

The full spectrum of physics represented, especially groundwater, surface water and their interactions, often prove valuable for ecosystem- and societally-important questions. Groundwater has been shown by various methods to be over-exploited and depleting in many parts of the world. Process-based models can provide accurate estimates of the impacts of on groundwater sustainability. This can be crucial information for decision making for arid and semi-arid regions.

List of Participants

Please include at least 6 members from 3 different countries. Make an effort to ensure interdisciplinarity. Add rows at the Table if necessary.

Name of Participant	Affiliation (full address and email)	Role in Working Group (Chair or Member)	Main expertise
1. Chaopeng Shen	Civil and Environmental Engineering, 206C Sackett Building, Penn State University, University Park, PA16802 cshen@engr.psu.edu	Chair	Process-based trans-disciplinary modeling, hydrologic scaling and multi-scale modeling, water-carbon

			interactions, land-channel interactions
2. Marc Bierkens	Physical Geography, Faculty of Geosciences, Utrecht University, P.O. Box 80115 3508 TC Utrecht M.F.P.Bierkens@uu.nl	Member	Hyper-resolution modeling, Geostatistics, Stochastic hydrology, Ecohydrology, Large-scale hydrology
3. Okke Batelaan	School of the Environment, Flinders University, GPO Box 2100, Adelaide SA 5001, Australia okke.batelaan@flinders.edu.au	Member	Spatially distributed hydrological modelling; groundwater-surface water interaction
4. Binayak Mohanty	Biological and Agricultural Engineering Department. 301C Scoates Hall, Texas A&M University, College Station, TX. bmohanty@tamu.edu	Member	Vadose Zone Hydrology; Water, heat, and solute transport process modeling; Soil moisture variability and scaling; Soil hydraulic properties and effective parameter estimation; Remote sensing
5. Mukesh Kumar	Nicholas School of Environment, Campus Box 90328, Duke University, Durham, NC mukesh.kumar@duke.edu	Member	Watershed Processes, Snow Hydrology, Vegetation-Snow Interactions, Surface water-Groundwater Interactions, Numerical Modeling, Geographic Information Systems (GISs), High Performance Computing, Optimization Methods, Non-Linear Dynamical Analysis.
6. Yi Zheng	College of Engineering, Peking University Room 1001, Wangkezhen Building, Peking University, Beijing 100871, China Email: yizheng@pku.edu.cn	Member	Integrated hydrological modeling; uncertainty analysis; water resources management
7. Matteo Camporese	Department of Civil, Environmental and Architectural Engineering, University of Padua, Italy matteo.camporese@unipd.it	Member	Process-based hydrological modeling and data assimilation
8. Salvatore Manfreda	Department of European and Mediterranean Cultures,	Member	Ecohydrology; Stochastics Processes

	Architecture, Environment and Cultural Heritage University of Basilicata, via Lazazzera, Matera - Italy salvatore.manfreda@unibas.it		in Hydrology; Space-time processes; Hydrological distributed modeling; Flood prediction and theoretically derived probability distribution; Vegetation Patterns;