PONTIFICIA UNIVERSIDAD CATÓLICA DE CHILE
ESCUELA DE INGENIERÍA
DEPARTAMENTO DE INGENIERÍA HIDRÁULICA Y AMBIENTAL

Invitación Seminario N°01/2017

Floods, cities and networks: Opportunities for an integrated approach

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Miércoles 08 de Marzo de 2017, 13:00

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Dr. Mejia's research team is currently performing research in the following three areas: hydrological forecasting, food-energy-water (FEW) nexus, and urban hydrology. I will talk about some of our recent efforts in these three areas and, at the end of the talk, I will offer some suggestions for further integrating these areas. In hydrological forecasting, we have been developing and verifying a new regional hydrological ensemble prediction system (RHEPS). We are using the RHEPS as a research forecast emulator to prototype and test system components, physical model parameterizations, and data assimilation strategies. Although the RHEPS could be implemented in other regions around the globe, we have used it thus far to forecast streamflow in basins across the U.S. middle Atlantic region. From this implementation, we have found that probabilistic (ensemble) streamflow forecasts are more skillful and reliable than deterministic ones, ensemble forecasts tend to remain skillful up to 7 days, and statistical flow post-processing is essential for realizing the benefits of ensemble forecasts. Regarding the food-energy-water (FEW) nexus, our efforts have been focused on understanding and characterizing, as a network system, the water-food component of the U.S. FEW. We have, recently, been able to identify community structure in the U.S. food-water network, which appears largely determined by historical trends in economic geography, and urban-water scaling relationships (e.g., water footprint versus population) for the U.S. city nodes of the network, which suggest that an apparent urban water-efficiency may be the result of international trade. In terms of urban hydrology, our efforts have been concentrated on two main fronts: developing new impact metrics that are more suitable for analyzing nonstationary time series records, and understanding and characterizing spatial scaling features. The latter is trying to adapt and develop a scaling framework for urban basins, following the tremendous empirical and theoretical developments achieved for natural basins. Two avenues for integration, among many, are proposed: developing hybrid models that combine numerical hydrological prediction with network science, and enhancing urban (flash) flood prediction.

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