Northeastern

Department of Civil and Environmental Engineering

Understanding the Implications of Climate Change and Seasonal Climate Variations on Regional Hydrology

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Abstract

Among the most pressing issues facing the hydrologic community is understanding the hydrologic and water resources implications of global change, and providing information to the water management community that can be used in the design of adaptation strategies. A major challenge is that projections of climate change are mostly provided by global climate models, which run at spatial resolutions much coarser than the scale of even large river basins. Furthermore, while there are some consistencies in the projections (e.g., almost all models predict long-term warming over the global land areas), the model predictions are highly uncertain for precipitation, a key driver of land surface hydrology. I review recent work by a number of groups in the Western U.S. that attempts to understand the sources of uncertainties in predictions of the effects of climate change on the future discharge of the Colorado River, a key source of water for the rapidly growing, and mostly arid, U.S. Southwest. I discuss, in addition to the uncertainty in global climate model predictions, uncertainties in the land surface models used to infer the hydrologic consequences of predicted climate change, methods of resolving the scale mismatches between climate and land surface models, and the manner in which the land surface models represent topographic heterogeneities. In addition to climate change applications, variations of the same global models used for predicting the consequences of long term (decades to centuries) climate change are now widely used for climate predictions at much shorter (seasonal) time scales. I review recent work that seeks to evaluate the relative contributions of hydrologic initial conditions (mostly soil moisture and snow water content) on hydrologic (soil moisture and runoff) forecasts at lead times of one to several months, relative to the contribution of climate forecast accuracy over the same lead times. While climate models demonstrate forecast skill at relatively short lead times, under most conditions this skill, at least as manifested in soil moisture prediction skill, is dominated by hydrologic initial conditions.

Bio

Dennis Lettenmaier received his B.S. in Mechanical Engineering (summa cum laude) at the University of Washington in 1971, his MS in Civil, Mechanical, and Environmental Engineering at the George Washington University in 1973, and his PhD at the University of Washington in 1975. He joined the University of Washington faculty in 1976. In addition to his service at the University of Washington, he spent a year as visiting scientist at the U.S. Geological Survey in Reston, VA (1985-86) and was the Program Manager of NASA's Land Surface Hydrology Program at NASA Headquarters in 1997-98. He is a member of the American Geophysical Union, the American Water Resources Association, the European Geosciences Union, the American Meteorological Society, and the American Society of Civil Engineers, and the American Association for the Advancement of Science. He was a recipient of ASCE's Huber Research Prize in 1990, and the American Geophysical Union's Hydrology Section Award in 2000. He is a Fellow of the American Geophysical Union, the American Meteorological Society, and the American Association for the Advancement of Science, and is a member of the International Water Academy. He is an author or co-author of over 250 journal articles. He was the first Chief Editor of the American Meteorological Society Journal of Hydrometeorology, and is the President of the Hydrology Section of the American Geophysical Union. He is a member of the National Academy of Engineering. His areas of research interest are large scale hydrology, hydrologic aspects of remote sensing, and hydrology-climate interactions.