Increases in greenhouse gas concentrations are expected to impact the terrestrial hydrologic cycle through changes in radiative forcings and plant physiological and structural responses. As a result, projections of future changes in water resources become complicated due to the tight coupling between the biosphere and terrestrial hydrologic cycle. In recent years a number of physically based integrated hydrologic models are developed to simulate terrestrial hydrologic processes from atmosphere to the land surface and subsurface. Despite their complex structure, integrated hydrologic model predictions suffer from the same elements of uncertainty in hydrologic modeling. In the first part of this talk, I will discuss the issue of uncertainty in model initialization in integrated hydrologic model predictions by presenting case studies from catchments in Denmark and Australia. In the second part, I will discuss development of a computationally efficient modeling toolkit (SMART) for large scale hydrologic predictions.

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