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Documenting the uncertainty of the terrestrial water cycle across NESSPI and its effect on trend and attribution studies

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In the past century, northern Eurasia has experienced warming air temperatures and increasing streamflow discharge, both of which can significantly affect the water cycle. Consequently, a body of literature has focused on documenting and attributing the trends in precipitation, streamflow, and evapotranspiration. The studies vary in spatial scales, varying from the local to continental scale, and cover different temporal periods, making synthesis difficult. Despite the number of studies focusing on changes in the terrestrial water cycle, few studies document the uncertainty that exists in our current estimates of the mean and variability of the terrestrial water cycle. To fill this gap in our understanding, this presentation uses reanalysis, hydrologic modeling, remote sensing, and in-situ observations to document the spread in estimates of precipitation, evapotranspiration, runoff, and terrestrial water storage changes. Large spread exists in many of the components of the water cycle, and a methodology is developed that uses multiple sources of data and observed discharge to improve estimates of precipitation, evapotranspiration, and storage changes. The method also provides a framework to evaluate the accuracy of a dataset's estimate of a variable that has no large-scale in-situ measurements, such as evapotranspiration and storage changes. Using these data sources, as well as the merged data sets weighted by the uncertainty of individual data sets, trend analyses are carried out to assess the consistency in the derived trends. A framework is provided for carrying out attribution studies, with examples for selected water cycle variables.