Evaluating the effects of institutional change on regional hydrometeorology

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The twentieth-century witnessed some of the most extensive and abrupt land cover / land use changes (LCLUC) in human history. In the mid-1950s, Khrushchev's Virgin Lands Program rapidly expanded the intensive cultivation of grains across the Eurasian steppes. The collapse of the Soviet Union in the early 1990s is now recognized as another rapid, widespread LCLUC event. The principal mechanism of LCLUC across this region was the disintegration of the institutions of centralized control over the agricultural sector. Without these controls and subsidies the agricultural sector contracted sharply during the 1990s throughout the Former Soviet Union and its client states. There were significant consequent changes in biogeophysical processes, including the onset and timing of land surface phenology (LSP) that links the ecological dynamics of the vegetated surface with the atmospheric dynamics of the boundary layer. Have these changes in LSP affected the regional hydrometeorology? A region of particular interest is the grain belt of central Eurasia. This semi-arid region is ecotonal-poised between forest and desert-and thus is especially sensitive to anthropogenic desertification and global climate change. What has happened to the regional hydrometeorology in the wake of fundamental institutional changes and what are the "alternative presents" and future scenarios, given the current state and trends of the land surface and the atmosphere? Building on our prior LCLUC work in Kazakhstan and Central Asia, we seek to engage the NASA objective "What are the current patterns and attributes of land use and land cover at national to global scales that affect atmospheric and surface hydrological processes?" by exploring the linkages between LCLUC, land surface phenology (LSP), and regional hydrometeorology in a food-producing region of global significance. This interdisciplinary collaborative proposal combines retrospective change analysis of meteorological and remotely-sensed data with simulation modeling using a proven regional scale numerical weather prediction model (MM5) coupled to a land surface model (NOAH). We will explore "alternative presents" by changing LSP while using forcings from NCAR Reanalyses and we will explore possible futures by using forcings from selected GCMs. Analyses of the retrospective data and the proposed suites of simulations should be able to address which conditions lead to enhancement of vulnerability versus enhancement of resilience in this semi-arid region in which anthropogenic activities are limited by water availability and challenged by the high interannual variability of meteorological conditions. This research falls within the general purview of NASA's NEESPI program.