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Impacts of Land Cover and Land Use Change on Water and Energy Cycle in Caspian Sea Drainage Basin

The Caspian Sea basin is rich with diverse aquatic, avian and terrestrial wildlife, and has a variety of ecosystems with unique and fragile hydrological and ecological characteristics. However, this natural and complex system has been under significant environmental pressures over the past century, arising from anthropogenic activities such as coastal urban developments, oil explorations, unsustainable resource management, and agricultural and industrial pollution. Unprecedented land use change and rapid climate fluctuations have had significant impacts on land ecosystem degradation, loss of biodiversity and open water eutrophication. Since the Caspian is a closed basin, the water and biogeochemical cycles over the sea and surrounding lands are intimately linked. Any changes in the hydrologic regime over land and any major shifts in land use and land ecosystem health will directly impact the water and energy balance of the Caspian Basin.

The objective of the proposed project is to develop a hydrological analysis system by integrating in situ and remote sensing observations with models capable of addressing key issues related to the Caspian Sea environment and its future course. The system is designed to evaluate the relative roles of human activities on the Caspian Sea Basin. Specifically, the objectives of the proposal are: 1. To quantify changes in land cover and land use in Caspian Sea Basin, using a combination of Geocover Landsat imagery from three periods of 70s, 90s, and 2000, and recent MODIS data up to the end of the 2010. 2. To integrate the land use change with the regional hydrological model to examine the impact of anthropogenic changes on water and energy cycle variables. 3. To perform simulations for extreme climatic scenarios during to assess the relative impact of climate variability in comparison to land cover and land use change.

NEESPI Relevance: Caspian Drainage Basin falls within the NEESPI region of study and is considered one of the most vulnerable part of the NEESPI domain of the study to human and climate impacts. The proposed study will provide a unique opportunity to understand and quantify how climate changes in Northern Eurasia interact with the changes in the interior of the region where anthropogenic changes are dominant. The Caspian basin also provides an opportunity to study the changes of closed hydrological system that may have an a strong feedback to the larger Eurasian ecosystem function. The results of this research, in terms of quantifying the land cover and land use changes and the simulation of the water and energy cycle and be readily integrated into the larger NEESPI objectives.

NASA-LCLUC Relevance: This proposal is a direct response to NASA LCLUC announcement that calls for research on regional scale studies with spatial and temporal characteristics of land use/land cover change related to change of climate and its variability in the past three decades. In addition, the proposal is primarily concerned with one of the largest watersheds in the world with strong focus on land-use change in mountainous regions, arid/semiarid and coastal zones. The research makes use of NASA satellite data and performs modeling inferences related to the hydrological cycle and the societal consequences of changes to the regional water and energy balance.