Diagnosis of changes in alpine water storages and land surface degradation in Pamir mountains and Amu Dariya River basin

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ABSTRACT

The proposed research relates to the Projection component, focused on modeling and predicting environmental, social, and economic consequences of snow/glacier/lake cover loss on land degradation and agricultural resources in Amu Dar'ya River basin (Takikistan, Uzbekistan, Pamir mountains) by integrating NASA Remote Sensing products and in situ long-term terrestrial data.

Problem statement Amu Dar'ya River originates in the Pamir mountains (Tajikistan), providing 65% of inflow to the Aral Sea basin and supporting agriculture in dry land areas populated by over 60 million people. Amu Dar'ya R. Basin is characterized by complex social and economic problems ensuing from extensive resource consumption and natural responses to global climate change. Human activity contributes to land degradation via poorly constructed and maintained irrigation systems, salinisation of irrigated lands, and poor pasture management. The feedback effects of extended desertification are increased wind erosion, atmospheric contamination, and dust loading, which accelerate snow and glacier melt.

The main goal of the proposed research is to simulate and predict the dynamics and feedbacks of a half-century of changes in seasonal snow/glaciers/lakes water resources and their effects on land degradation in the Amu Dar'ya River basin. Predicted changes in global climate will force the Amu Dar'ya hydrological system to cross ecological thresholds. The research will improve our understanding of global change consequences and their prediction, and will help to answer the questions: How well we can predict when and where the thresholds will be crossed? How well we can predict their ecological consequences? How will the local and regional changes in glacier/snow cover feed back to the land degradation? The project will develop simulations with evaluations and predictions of 1) Water resources changes and land degradation, 2) location and time of the thresholds; 3) hydro-ecological consequences; and 4) hazards protection plan including a prioritized recommendations.

Approaches: The proposed project continues the UI-led team, multi-year research in central Asia on glacio-hydrological, climatic, and environmental changes. Predictions of social-economic consequences of natural water storage loss and human-forced land degradation will be based on integrating RS products with extension of Central Asian Data Base adding *new remote-sensing*, topographic, DEM, glacio-hydro-meteorological, socioeconomic, and demographic data for the Pamir. *New multiple simulations* of glacio/hydrological and social process will be developed through modeling/predicting snow/glacier/lake area and land degradation distribution, river runoff according to LCLUC, floods/droughts place and time and demographic statistics.

The proposed research will use *NASA RS products*: Landsat TM (1984-present), ETM+ (1999-present), ASTER (1999-present) with resolution of 15-30 m; high resolution (2.5-1.6 m) ALOS/PRISM (2006-present), Corona (1962-1982), and ALOS/PRISM. Sub-pixel *snow-covered area* maps will be generated using AVHRR (1981-present) and MODIS Snow Cover product (2000-present). The LCLU information will be obtained from MODIS NDVI time series (250m).

The proposed research is an important unifying component of the US GCRP, WCRP, CLIVAR, IGBP, IHDP, CliC and CVPR Programs and will *contribute* to NASA LCLUC, GOFC-GOLD, IGBP/IHDP, NEESPI programs and UNEP PALM Project by assessing and predicting climate/human driven impact on future water resources, hazards, and social economic consequences.

Expected massive crop yield reductions, and reduced and polluted water supply are expected to increase human mortality rates. To formulate effective mitigation approaches, the causes of degradation have to be evaluated and predicted. Our research will accomplish this. *The project is ultimately about improving people's collective ability to withstand the forces of nature.*