

An International, Regional Meeting on Land-Cover/Land-Use Changes, Water-Energy-Food Security, and Sustainability in Central Asia and Caucasus

16-18th September, 2019, Nur Sultan, Kazakhstan

Meeting Summary

Several countries in Central Asia are undergoing rapid land use/cover changes due to industrial development. In addition, agriculture and water resources are highly impacted due to land degradation and climate change in the region. Agriculture in these countries is highly dependent on the irrigated water. There are two defining characteristics of water in Central Asia; one is the endorheic nature of the region - Central Asia's rivers either enter terminal lakes that lack outlets or they simply disappear before reaching any larger water body. Evaporation and infiltration

exceed precipitation in the arid plains. This leads to the second defining characteristic: the region's unusual dependence on precipitation that falls at high elevations. Some of this water is retained in glaciers, but much



of it flows down to the arid, more heavily populated lower elevations. Climate change, glacial retreat, dam construction, water use for irrigation, and infrastructure development have significantly altered hydrological processes in the region, imposing a major threat to water-energy-food (WEF) security. The additional character was the dissolution of the Soviet Union in 1991, before which resources utilization was coordinated to balance water-energy-food through centralized governance. Independence allowed the individual states to monetize rather than trade their resources across international boundaries. In the face of these threats, the region is facing a number of outstanding challenges. To address these issues, an international LCLUC Regional Science Joint Meeting involving Central Asia and Caucasus countries focusing on "Water-Energy-Food Security and Sustainability", was organized in collaboration with Kazakhstan Space Agency, Agritech Hub, Kazakhstan and several other regional and international partners which included the NASA Land Cover/Land Use Change Program, GOCF-GOLD program, START Inc., USA, Michigan State University, USA, University of Maryland College Park, USA, South/Southeast Asia Research Initiative (SARI), Monsoon Asia Integrated Research for Sustainability (MAIRS), International Finance Corporation, World Bank, Capital Normal

University, China, Asian Development Bank, Xinjiang Institute of Ecology and Geography, China, Future Earth, Nanjing Agricultural University, etc. Nearly 85-participants from the US, Europe, and Central Asian countries attended the meeting.

The meeting focused on the following questions: Where are the land-cover and land-use changes occurring in Central Asia and Caucasus countries? What is the extent and over what time scale? How do the changes vary from year to year? What are the causes of land use/cover changes in Central Asian and Caucasus countries? How are they impacting Water-Energy-Food (WEF) security in the region? How can we best develop sustainable pathways for the WEF systems in light of rapid climatological and differential socioeconomic changes? What geospatial technological tools, information, and knowledge do we have/need to assist decision-makers to achieve sustainable goals? How can underlying ecosystems best be managed to achieve long term sustainability?

The main objectives of the meeting were: a). To present the state-of-the-art remote sensing methods and technologies to quantify the spatial and temporal dynamics of natural resources including land, water, soil, and environment; b). To present ongoing research on the understanding of the underlying drivers and socioeconomic consequences; c). To explore regional synergies in collaborative efforts to holistically address the regional issues through GOC-GOLD Central Asia Regional Information Network (CARIN) and Caucasus Regional Information Network (CaucRIN). d). To build regional capacities in the use of advanced observations, models, and theories to develop resources information base for long-term sustainable development in the region.

The meeting was organized into highly interactive workshop sessions. Each workshop followed a typical pattern starting with a). Setting the stage on the topic by an expert researcher; b). Highlighting the big issues in the topic area; c). State of the practice in remote sensing; d). How remote sensing can currently be used to address the selected issue; e). Regional expert presentations and examples of how regional groups are currently using remote sensing through a Case study; f). Open discussion on technologies, regional gaps and Priorities.

Day-1 included programmatic session entitled: Global, Regional and National Land-Use and Land-Cover Change Science Programs – Initiatives & Challenges in the morning and two different parallel workshops in the afternoon entitled “Remote Sensing and Central Asia Rangelands and Agriculture” and “Remote Sensing in Urban and Regional Planning”.



Day-1 session presenters highlighted the need for improved land use/cover change inventories in the region through synergistic use of remote sensing data such as Landsat, Sentinels, RADAR including very high resolution spatial data from the commercial sources. Specifically, Dr. Garik Gutman (NASA HQ) stressed that several global products such as on forest cover change, urban, fires, and others are being developed and they need calibration and validation involving regional scientists and that NASA LCLUC program is committed to working with international partners. He emphasized that that the international partnership is mandatory to maximize our Earth observations which can benefit large communities. He also urged researchers to focus on latest advancements in the land use change science such as fusing observations from: Optical remote sensing data at nested multi-spectral resolutions (300m→30m→3m→0.3m); Optical mid-resolution (10-30m) from different sources, e.g. Landsat+Sentinel2; and Optical and microwave (radar), e.g. Landsat & Sentinel-1.

Specific to rangelands, Central Asian countries have huge areas with future livestock potential. Geospatial technologies and modeling tools to assess the potential livestock production in rangelands is an important area of research useful to locals. In Kazakhstan, US Department of Agriculture (USDA) in collaboration with Michigan State University is working on integrating satellite observations, drones, and field-level data for rangeland and livestock assessment. A preliminary assessment of compiling the baseline data such as on the historical climate, topography, vegetation data has already been collected. Grazing suitability maps and forage indicator maps were generated. In overall, the session highlighted the potential of vast rangelands and livestock potential in Kazakhstan and Central Asian countries.

Remote sensing in urban and regional planning session highlighted typical urban planning issues in the Central Asian countries and more specifically Kazakhstan. After the initial presentations, most of the discussion focused on urbanization in Kazakhstan. The big cities in Kazakhstan face pollution problems; mainly because of the power stations (Coal is used to heat water in the winter and air is getting polluted). Specific to Almaty city, it has more inhabitants and densely populated; the city and the surrounding areas are vulnerable to landslides. The city of Nur Sultan is a newly developed city; the infrastructure is good, however, one cannot go anywhere without a car (walkability issues). The city also has low drinking water quality which provokes health problems. Kazakhstan (KZ) operates 3 very good airborne sensors, and 2 satellites. Kazakhstan monitors land cover/ use on a wall to wall basis (forest, agriculture, etc.) by a national company with VHR satellite images (e.g. operated by Planet, DigitalGlobe) in tandem with images acquired by the two KZ satellites. Geoeye, Worldview, and other VHR data are accumulated in a big archive to generate a big orthomosaic for the country. Also, KZ started creating – selectively -3D models of the cities with 5-10cm resolution (e.g. Almaty for city monitoring and identification of places that develop in a more fast pace than others. For the mountains around Almaty there is a project implemented to generate a 3D model of the mountains with the intention to create ski resorts. A geoportal for KZ will be created and everyone will have access to buy or to see data and products. Knowledge gaps: There is a need to monitor permanently land deformation, for example with InSar technology. There is no historical

data for monitoring the urban environment and patterns; also, there are no solutions to monitor heat efficiency of the buildings (e.g. like Building Information Management system or Urbanfluxes EU project: <http://urbanfluxes.eu/>). Night lights research is interesting for the audience. Specific to data, it is difficult to access; difficulty to fly drones, as there are many regulations and it is not easy to get permissions; and data may be kept confidential.

Day-2 focused on the GOFC-GOLD regional networks, with three different morning sessions a). "Caucasus Regional Information Network (CaucRIN) Presentations", b). "Experience from the existing GOFC-GOLD networks" and c). "Central Asia Regional Information Network (CARIN), Revival of Network and Way Forward Presentations". In the afternoon, two different parallel workshops were organized – "Hydrological modeling, flood and water quality assessment" and "Urban monitoring and Illegal Waste Disposal".

The GOFC-GOLD sessions highlighted the need for improved data sharing, broad participation of engagement of local agencies, governments, institutions, NGO's and international organizations. Several presentations stressed the need for strengthening regional networks through research, capacity building and training opportunities through active engagement/partnership enhancements. The Hydrological modeling, flood and water quality assessment workshop

highlighted the importance of water resource research in the Central Asian countries and integrating remote sensing, ground-based data and modeling studies for addressing Food-Water-Energy nexus issues. Specific to urban monitoring and illegal waste dumping, several participants agreed that not much has been done on the topic and there is a



huge potential to integrate very high resolution satellite to address the issue. In this session, two different workshops were organized a). change detection methods and technologies; b).remote sensing map accuracies and best practice guidelines - which showcased the potential of geospatial technologies for urban mapping/monitoring studies.

On the Day-3, a mini-conference entitled "Central Asian Conference on Space Technology and Regional Issues" was organized at the Astana Hub, Kazakhstan. The conference was attended by the Minister, Aerospace, Kazakhstan and several other high level dignitaries.

Regional presentations included the NASA LCLUC program, GEOGLAM agriculture, USDA/Michigan State University collaborative project presentation on rangelands and livestock, presentation and demonstration on the open source software developed by the FAO for land monitoring and field data collection, including report back presentations from the previous two day workshops. Most important, the session included high level recommendations that came from the previous day breakout sessions for the local managers, policy makers, space agency representatives and researchers. The recommendations include: a). Active participation of local agencies and researchers in the international programs such as CEOS, GEOGLAM, GOF-C-GOLD to have higher visibility on the international stage and leadership in the Central Asia region. It was inferred that increased participation in international programs will help to see how other countries organize and manage common problems e.g. data management and dissemination, public-private-partnerships and common satellite applications. B). Developing pilot projects, training programs, joint proposals, e-learning modules involving local, regional and international scientists; C). Improved data access and visibility to Kazakh data for national benefit through reducing the permission obstacles, remove data silos within agencies and free and open access to Kazakh satellite data to enable research and innovation on data processing and analysis; this will fuel private sector to generate value added products to serve the community; D). Kazakhstan government and space agency to provide support to enable the above recommendations to be realized through in-kind support, national funding and international co-funding. All the above recommendations were received by the attendees and the Minister.

The meeting ended with the vote of thanks to all the meeting sponsors including the Kazakhstan Space Agency, Aerospace committee, local, regional and international organizations and specifically participants for their expertise and discussion on how to enhance the use of Earth Observations in Central Asia. All presentations will be uploaded to the GOF-C-GOLD website.
