Report on:

UNESCO Joint Training Course:

Geospatial Methods, Technologies, and Applications in Monitoring Land Cover, Land Use, Fire and Water in semi-arid regions Central Asia

Jointly with

NASA LCLUC Science Team Meeting and GOFC-GOLD/NERIN, NEESPI and MAIRS Workshop:
Monitoring land cover, land use and fire in agricultural and semi-arid regions of Northern Eurasia

held on

September 19-21, 2009

at the

National Center of Space Research and Technologies, National Space Agency, Almaty, KAZAKHSTAN

by

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&
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October 14, 2009

Trainers:

Dr. Tatiana Loboda, University of Maryland
Prof. Mutlu Ozdogan, University of Wisconsin
Dr. Pontus Oloofsson, Boston University
Dr. Xin Li, Chinese Academy of Science in Lanzhou
Dr. Gensuo Jia, Institute of Atmospheric Physics, of Chinese Academy of Sciences
Dr. Phil Heilman, Southwest Watershed Research Center of USDA-ARS
Prof. Jiaguo Qi, Michigan State University and NASA LCLUC's MAIRS Project Scientist

Organizers:
Dr. Jiaguo Qi, Professor, Michigan State University, East Lansing, Michigan, USA
Dr. Ailikun, Director, MAIRS's Internationa Project Office, Institute of Atmospheric Physics

Participants:

Total participants of the workshop: ~60

Introduction
The growth of human population, increasing demand for agricultural production and concerns about food security in the world are among the reasons for growing interest in land monitoring based on satellite remote sensing. The semi-arid regions are also very sensitive to global climate change and all vegetation there depends strongly on weather conditions and water availability. Land cover, land use change, state of agriculture and various natural/ artificial phenomena such as fire, drought, flooding, soil erosion by water and wind, are all critical issues facing the arid and semi-arid regions around the world.

Central Asia is atmospherically unique with its climate controlled primarily by the Siberian system to the north, Indian Ocean to the south, the Mediterranean to the west and pacific monsoon system in the east. Within the region, the natural resources, especially water resources, are very scarce. Under current and predicated future changes in climate and enhanced human activities, particularly land use and land cover change, there is a critical need to develop adaptation strategies.

Adaptation to climate, and human induced changes, requires a system approach that should include the use of advanced technologies and development of sound policies. One of the key space technologies available to international community is the geospatial tools and methods that would allow resources managers to acquire timely information about resources distribution, uses, and changing trend. It is the objective of this UNESCO training course to train local people about the availability, application, and interpretation of geospatial products and information, so that they can be equipped with the need tools and methods for improved resources management and therefore adaptation to future climate change.

To equip the local people with such tools, methods, and technologies, the training workshop invited speakers from both universities and research institutions from USA and China, who covered a range of topics that were specifically suited for applications in Central Asia. There were about 60 people attended the training workshop representing 15 countries of the region. The participants were actively involved in discussion and hands-on exercises that covered several key thematic areas detailed in this report.

Training Themes
The training started with a short introduction by Dr. Jiaguo Qi, the NASA LCLUC's MAIRS project scientist and Professor at Michigan State University, about the objectives and goals of the training. He emphasized that the training is composed of two parts. The first part was to expose the trainees to a much broader but more technical aspects of land use and land cover dynamics, including fires monitoring and assessment. This part was jointly with the final day agenda of the NASA LCLUC ST meeting, GOFC-GOLD, NEESPI, NERIN, and MAIRS workshops (see the detailed agenda in Appendix A). The second part consisted of lectures and demonstrations by individual trainers (Dr. Tatiana Loboda of University of Maryland, Prof. Mutlu Ozdogan of University of Wisconsin, Dr. Pontus Oloofsson of Boston University, Dr. Xin Li of Chinese Academy of Science in Lanzhou, Dr. Gensuo Jia of Institute of Atmospheric Science of Chinese Academy of Sciences, Phil Heilman of Southwest Watershed Research Center of USDA-Agricultural Research Services, and Prof. Jiaguo Qi of Michigan State University and NASA LCLUC's MAIRS Project Scientist). The detailed agenda is attached but here is a summary of the thematic areas covered during the training:

a. Geospatial Products Availability – This included relatively high resolution Landsat imagery, moderate resolution data from MODIS, particularly fire and land use and land cover, products for the Central Asia region. Dr. Mutlu Ozdogan and Tatiana Loboda provided technical details regarding 1) where to go and locate the images, 2) pre-processing needed to ensure the quality of the data, 3)software availability, and 4) general understanding of the nature of these datasets.

b. Tools and Methods – This session included first specific training on how to develop a land use and land cover product, and more importantly, on how to use local, fine resolution imagery such as Ikonos and QuickBird images, as well as ground based data, to validate land use and land cover product. To do this, Pontus Olofsson provided the software and had a hands-on demonstration how to use the software with a sample image from Almaty.

A second major tool learned in this training was the fire information access through MODIS webpages. Dr. Loboda went through length discussion on the nature of fire, products availability, and tools to use to access the information. She further lectured on the interpretation of the fire product and future development.

c. Applications – Applications of geospatial products in the Central Asia focused on several important natural resources. They included
   1) Land use and land cover change processes in Central Asia. Dr. Mutlu Ozdogan used case studies to demonstrate how the time series of Landsat type of images can help understand the land use and land cover dynamics, monitor the rate of change, and ways of assessing accuracy. This information allows the local resources managers to use the technology and imagery to assess the utilization of land resources.
   2) Hydrological processes, water resources assessment. Dr. Xin Li went through a thorough discussion on the use of space borne technologies to monitor water resources in arid and semi-arid regions, particularly on the large-scale measurement methods and technologies for soil moisture and precipitation. In related to water resource issues, Dr. Gensuo Jia provided a state-of-the-art research on the current and future climate change. He demonstrated the spatial and temporal variability of the climate in the Central Asia and how they would affect the water resources and land use and land cover. The training on hydrological processes, consequences as a result of climate change and human induced land use changes, provided an important information to the resource managers as one of the critical issues facing the Central Asia countries is (will be) the shortage of water for both human consumption as well as for agricultural production.
   3) Rangeland degradation is another area of training. Dr. Jiaguo Qi provided an overview of the methods on land degradation assessment using satellite images and particularly he presented an advanced approach to focus on a long-term degradation measure – soil organic carbon change, spatially and temporally. He presented a modeling approach in conjunction with near real time remote sensing observations. Dr. Phil Heilman provided an case study demonstrating how ranchers in the US Southwest applied the remote sensing products from MODIS and Landsat images to determine the grazing density and grazing patterns.

Feedback

At the end of the training session, Dr. Jiaguo Qi led a discussion on ways that can improve future training. In particularly, the attendants expressed a desire to have fewer sessions but more hands-on training. An example was brought up to the attention of the trainers that the attendants would like to have a training session on how to use specific software and process satellite images. It appears that information access is still an issue of the region. Further, the trainees would like to have examples of how one would use such information in decision-making. Some detailed feedback is included in Appendix B.

Conclusion

In conclusion, the training workshop was a success. The workshop brought together well-known experts in various fields, including geospatial technologies and resource applications, which are critical in addressing sustainable resources assessment and management in arid and semi-arid regions like Central Asia. Participants expressed their appreciation and acknowledged that the training was very useful and they are planning to use the knowledge learned when they return to their countries.

At the same time, the trainers felt very happy that their research and methods can be used to address some practical issues. The interaction among the participants and trainers also promoted for some future collaboration possibilities.

Certificates were issued to the participants at the conclusion of the training workshop.

Acknowledgments

Appendix: Detailed Training Agenda

Sept. 19 (Saturday)
Training Session One – Jointly with NASA LCLUC's Science Team Meeting, GOFC/GOLD, NEARIN, and MAIRS Workshops.

8:30 – 10:30 Session 4a. Fire Monitoring and Fire Science in Dryland Ecosystems of Northern Eurasia – Chair Tatiana Loboda

8:30 GOFC-Fire Program Goals and Initiatives – Chris Justice

8:50 Global Fire Monitoring Center activities in drylands of Northern Eurasia - Johann Goldammer

9:10 Regional Central Asia and Northeast Asia Wildland Fire Networks – Leonid Kondrashov

9:30 Satellite Monitoring of Fire in Kazakhstan - Oleg Arkhipkin

9:50 Remote sensing approach for forest and steppe fire monitoring in Mongolia – M. Erdenetuya

10:10 NASA MODIS Global Fire Monitoring and its applications in Northern Eurasia – Tatiana Loboda

10:30 – 10:45 Coffee Break

10:45 – 13:05 Session 5a . Water Resources and Monitoring. Chairs - Alex Shiklomanov and Jiaguo Qi *20 min. each*

10:45 Water Resources of Central Asia: Contemporary Status and Future Projections – Natalia Agaltsova, Alex Shiklomanov

11:05 Investigating the Relationship Between Land Use/Land Cover Change, Hydrologic Cycle, and Climate in Semi-Arid Central Asia – Mutlu Ozdogan

11:25 Review of water problems and undertaking decisions in Central Asia - A. Nikolaenko

11:45 Effects of Land Use Change on the Energy and Water Balance of the Semi-Arid Region of Inner Mongolia – Jiquan Chen

12:05 Impacts of Land Cover and Land Use Change on Water and Energy Cycle in Caspian Sea Drainage Basin – Sasaan Satchi

12:25 The modern problems of using, management and protection of land-water resources of Aral Sea basin - Rashid Kulmatov

12:45 Monitoring and research on watershed scale hydrological cycle in drylands in Northern China - Li Xin

Lunch 13:05 – 14:15

14:15 – 15:30 pm Poster Sessions 4b and 5b (and coffee break 15:15- 15:30)

Fire
Satellite Monitoring of Fire in Russia - Anatoly Lagutin (Russia)

Development of Fire Monitoring and Early Warning System for Wildfire Disaster Mitigation in Nepal – Sundar Sharma (Nepal)

Recent trends of the fire induced vegetation change in Kazakhstan dry lands – Alexey Terekhov et al. (Kazakhstan)

Burned lands as source of dust in arid regions of Turkmenistan – Madina Batyrbayevav et al. (Kazakhstan)

Water:
Land Use Ecosystem Climate Interactions in Monsoon Asia – Hanqin Tian

Using satellite remote sensing to study and monitor the Aral Sea and Adjacent Zone -- Phil Micklin

Approach to the assessment of the climate change impact to the water availability and water demand for area of the intensive runoff use - Natalia Agaltsova (Uzbekistan)

Monitoring the water level in Balkhash Lake and discharge of the Ili River: application of remote sensing – Pavel Propastin (Germany)

Irrigation requirement estimation using MODIS vegetation indices and inverse biophysical modeling - Bounoua Lahouari (USA)

15:30 – 17:30 Concluding session

15:30 Synopsis of Presentations and Discussion for Session 4: Regional Research Priorities for Fire Science (Chris Justice)

16:00 Synopsis of Presentations and Discussion for Session 5: Regional Research Priorities for Water Resources and Monitoring (Alex Shiklomanov/ Jiaguo Qi)

16:30 Panel on Regional Research Priorities (5 min comments from a panel of regional experts); General Discussion of Regional Research Priorities and Formation of Regional GOFC-GOLD Network (Chris Justice, moderator)

17:10 Summary Presentations on future plans and funding opportunities *(Gutman, Ailikun, Justice)*

Special Issue Announcement – Jiaguo Qi, Solicit papers for a special issue in a peer reviewed journal

17:20 Wrap-up – Garik Gutman

Sept. 20 (Sunday) – Training Session One

8:30 – 8:40 Introduction and Overview of Training Sessions (Jiaguo Qi)

8:40 – 10:30 Thematic data analysis of Landsat TM and ETM+ imagery (Tatiana Loboda)

10:30 – 11:00 Break

11:00 – 13:00 Geospatial tools and methods for fire monitoring and management (Tatiana Loboda)

13:00 – 14:00 Lunch

14:00 – 15:00 MODIS technical overview and products (Tatiana Loboda)

15:00 – 18:00 Geospatial applications in land-use/land-cover change processes in Central Asia (Mutlu Ozdogan)

16:30 – 17:00 Coffee break

18:00 – 18:05 Issues and overview/update of the second day of training (Jiaguo Qi)

Sept. 21 (Monday) Training Session Two

8:30 – 10:30 Land cover validation exercise (Pontus Olofsson)

10:30-11:00 Coffee Break

11:00 – 13:00 Water and its management in arid regions (Xin Li)

13:00 - 14:00 Lunch

14:00 – 15:30 ***Remote sensing methods for rangeland degradation and climate change studies***

    A. Climate change and land cover linkages (Gensuo Jia)
    B. Remote sensing methods for rangeland degradation (Jiaguo Qi)
    C. Addressing rangeland degradation issues (Phil Heilman)

16:30-17:00 Coffee Break

17:00 – 17:30 Discussion and training workshop summary - Jiaguo Qi
17:30 – 18:00 Awarding Certificates of completed training - Jiaguo Qi and Olga Krankina

Appendix B: Comments from the training sessions

1. It would be a great idea to provide various software sessions as well as some modeling sessions among the training sessions
2. GPS system use for watershed modeling and observations; how to process and analyze GPS data
3. Hands-on experience during the training: working with imagery data
4. Separate practical sections from the theoretical
5. Separate some sections by interest groups:
   a. General information
   b. Groups with different areas of interest
6. More application examples: decision making vs. technology application examples
7. Training right after the field trips: incorporate the real data with a hands-on experience
8. List of participants; since not everybody has access to internet then a CD or flash-drive with information on the training could be very useful
9. Invite back the same participants and get their feedback on introduced methods during the previous meetings
10. Hand out printed hand-out material to participants during the sessions
11. Conduct training sessions before the workshop
12. Field trips on specific topics and separate sections by interest groups:
    a. Practical examples on each country's participant
    b. How everybody deals with the similar issues
    c. Smaller groups on specific topics
    d. More discussions to facilitate decision making process

Questionnaires to get feedback from the participants: electronic format