BioTopic

Forest Monitoring Based on Remote Sensing Methods in Armenia

With the permanently increasing pressure on biodiversity resources in the Republic of Armenia, sustainable management of biodiversity becomes more and more important. In the RA pressure on biodiversity is especially high in forest ecosystems. There is a high demand on timber, firewood and other forest products such as nuts, herbs, fruits and berries. Development of infrastructure and mining projects take an additional toll on forests. To maintain the various products and services forests provide for the benefits and the wellbeing of the Armenian society, the concept of sustainable management of forests has to be introduced into the national forest policy, forest legislation and the implementing administration.

Precondition for sustainable use and management of biodiversity is an accurate qualitative and quantitative knowledge of biodiversity resources. Therefore a compre-

hensive and reliable biodiversity monitoring system has to be established. An obligation to set up a nationwide biodiversity monitoring system also derives from the United Nations Convention on Conservation of Biological Diversity (UN-CBD) which the Government of Armenia has signed in 1993. According to UN-CBD the national biodiversity monitoring system should be designed according to the State-Pressure-Response-Modell. It should reflect the current state of biodiversity (state indicators), assess various pressures on biodiversity (pressure indicators) and observe how biodiversity responds to management measures (response indicators).

As requested by the State Forest

Monitoring Board, GIZ-Sustainable Management of Biodiversity Programme (SMB) supported the RA Government in developing a nationwide Forest Monitoring System based on the interpretation of high resolution multispectral satellite images (remote sensing methods). Compared with other monitoring methods, remote sensing has various advantages:

- RS-Methods produce results with high accuracy.
- RS-Methods are very cost-effective. By using satellite images and modern interpretation software, huge areas can be processed semi-automatically.
- RS-Methods are low in individual or systematic interpretation errors.
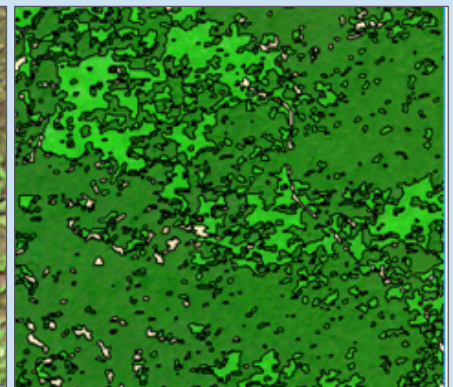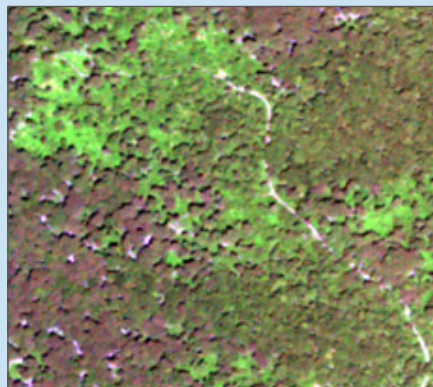
Left: very high resolution multispectral satellite image of forest
Right: result of forest cover interpretation
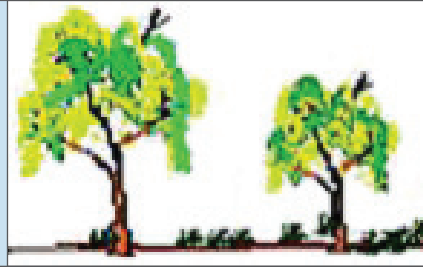
- RS-Methods can also reflect and analyse developments in the past (as long as suitable satellite images are available) and show changes over the time.
- RS-Methods provide a big advantage in monitoring of remote mountainous areas which are hardly accessible.

In cooperation with the State Forest Monitoring Centre GIZ-SMB-Programme defined 8 indicators which are best suitable to reflect the situation of the forests in Armenia and to provide the RA Government a data base to meet all important political decisions on forest management. The indicators are defined as:

1. Forested area (in ha and % of total area of the RA)
2. Percentual part of most important tree species
3. Age groups (mature and not mature stands)
4. Intensity of tree cuttings
5. Forest density
6. Reforestation and afforestation
7. Extent of forests impacted by forest fires
8. Extent of forests impacted by forest diseases and pests

Supported by international and national experts SMB has developed methods and rule sets for the assessment of the defined indicators. In the year 2010 indi-

cators have been tested in a pilot area based on very high resolution multispectral satellite images (Geoeye 1, Ikonos). Based on the positive results high resolution multispectral satellite images have been ordered (Rapideye) for the whole territory of the RA for nationwide assessment of defined indicators.

Satellite Images have been preprocessed (atmospheric and haze correction) with ERDAS IMAGINE including the ATCOR extension. The corrected satellite images have been interpreted and processed using eCognition- and ArcGIS software. For the verification of the resulting base map sampling plots in different regions of Armenia were defined and assessed.
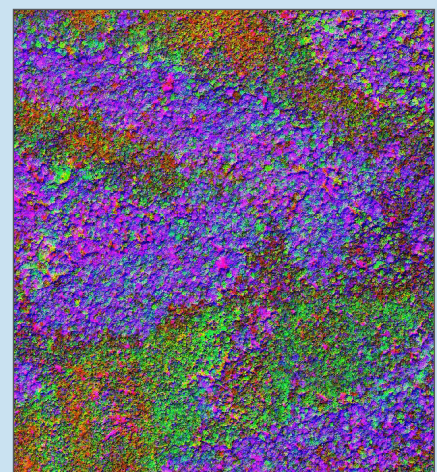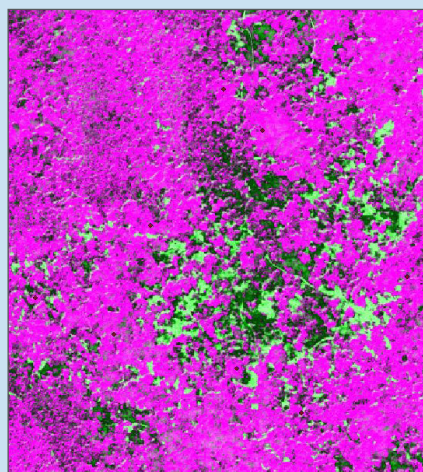
Results show that
- Total forested area can be assessed with high accuracy according to international standards and definitions.
- Age groups of the most important forest tree species can be differentiated (young, middle age,

Left to right: Geoeye 1 multispectral image scene, schematic sketch and photo of under stocked and degraded stand

mature stands).
- Tree species such as oak, beech and hornbeam can be differentiated.
- Forest density can be classified.
- Cutting of individual trees can be detected.
- Areas of afforestation can be detected and measured.
- Stands damaged by diseases and insects can be identified.
- Fire control can be implemented.

Remote sensing tools have been identified and tested to be a cost effective and accurate method for forest monitoring. Based on the overall very good results it is recommended to use remote sensing methods also for the monitoring of other ecosystems in the Republic of Armenia.

Left: result of under stocked mature stand interpretation Right: result of multispectral image scene interpretation by tree species (beech, oak, hornbeam)