PRELIMINARY ASSESSMENT OF THE LAND USE AND LAND COVER CHANGES IN CASPIAN SEA BASIN USING MODIS DATA

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1. INTRODUCTION

The Caspian Sea basin, the world's largest inland water body, has a high rank among the earth's 25 major hotspots in terms of biological diversity, hydrological and biogeochemical complexity, natural resources, and in terms of threats to the environment and vulnerability to climate change [1]. 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. It is commonly believed that any major environmental changes in the Caspian Sea Basin from human and/or climate perturbations will have dire consequences for the global environment.

We present the first high-resolution (250 m) land use/cover maps covering the entire Caspian Sea drainage basin. The land cover map is produced using spectral bands and Enhanced Vegetation Index (EVI) from MODIS data extended over 10 years (2000-2009). The resulting map has been assessed for its type and spatial accuracy using samples of available Landsat, ASTER, and IKONOS imagery distributed over the region. The results have been further analyzed to provide estimates of areas of each land cover types and the changes due to deforestation and agricultural expansion.

2. METHODS AND RESULTS

To generate the baseline map over the entire Caspian Sea Basin, we use the Moderate Resolution Imaging Spectroradiometer (MODIS) 250 m NDVI (Normalized Difference Vegetation Index), EVI (Enhanced Vegetation Index), and 500 meter spectral bands. MODIS data are known for very high quality and high temporal resolution (16 day), which remove problems of cloud-cover, while allows using the phonological differences, especially in Alborz and Caucasus mountainous forests and agricultural lands. We will combine the 250 m 16-day composite NDVI and EVI and 500 m and 16-

day composite surface reflectance data, to develop a set of cloud free seasonal data sets over the region. A classification approach, based on both the magnitude and temporal changes of pixel values, has been developed to create a thematic map of the region by separating forest types (conifer, Deciduous, and mixed), wetlands, crops, and grasslands. The methodology combines image segmentation and decision rule approach [2,4,5]. The algorithm relies on hierarchical classifiers that predict class membership by recursively partitioning the dataset into more homogenous subsets based on reducing the deviance.

The changes in land cover types were detected subsequently by aggregating the cover types to four classes of forest, crops, grassland, and bare land (urban) and by quantifying the changes of classes over a period of 10 years from 2000 to 2009. The detection algorithm relies primarily on the changes of MODIS derived EVI over the four class types by using a normalized ratio approach between two dates [3]. The ratio $((EVI_{2001} - EVI_{2000}) / (EVI_{2001} + EVI_{2000}))$ between two or several years is used as an index of change with positive or negative values. This index will be produced using seasonal or annual cloud free EVI values available for each period. By comparing maps for 2000 and 2009 and the land use change maps derived from the change index on annual or seasonal time scales, the overall rate of change, the type of change, and the errors associated with the methodology are quantified.

3. DISCUSSION

The final products can be used for a large number of different purposes, including:

- Simulating the Caspian Basin hydrology
- Land use planning on the national and regional scales
- Conservation / restoration plans for biodiversity protection, reforestation, re-establishment and expansion of the current network of protected areas
- Developing of hydrological / climate models for watershed management, and soil erosion / flood prevention
- Sustainable planning and management of the coastal zones
- Estimation of carbon stocks for Southern Caspian and Caucasus Forests for REDD projects (Reducing Emissions from Deforestation and Degradation)

- **REFERENCES**

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