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Spatial modelling of greenhouse gas compartments for GIS-based terrestrial carbon accounting in boreal ecosytems

D. Knorr (1), A. Shvidenko (2) and C. Schmullius (1)

(1) Department of Geoinformatics and Remote Sensing, Friedrich Schiller University, Jena, Germany (daniela.knorr@uni-jena.de), (2) International Institute for Applied Systems Analysis, Laxenburg, Austria

An important consequence of the Kyoto Protocol is the need of development of a comprehensive and consistent system to measure sources and sinks of greenhouse gases (GHG). In the framework of the EU-funded project SIBERIA-II the International Institute of Applied Systems Analysis (IIASA) developed a Geoinfomation System (GIS)-based landscape ecosystem model, which provides diagnostic predictions of the carbon storage and GHG fluxes in the 3 Million km^2 study region in Central Siberia. The input data set for the IIASA model is represented by a GIS-based vegetation map with an attributive database holding all information needed for a terrestrial biota full carbon accounting (FCA). The database was compiled by manual digitizing in GIS by Russian regional vegetation experts who identified and delineated homogenous polygons based on a variety of information sources (in situ measurements, forest inventory, soil and landscape maps, remote sensing data etc.). Since this very accurate procedure is extremely labour and time consuming, and forest inventory is only conducted every 10 to 15 years, IIASAs vegetation database is a snapshot land cover description for the year 2003 only. An extension of it to other years is not possible. For an application of IIASAs landscape model for FCA to other years, it is necessary to delevelop a method for the compilation of the needed vegetation database with less effort. The only cost effective data source offering the required temporal resolution comes from remote sensing. This study deals with the development of an automated method for generating a vegetation database over the project study region, for the purpose of full terrestrial carbon accounting. Hierarchical decision rules were developed specifically for this region to indicate vegetation distribution. In contrast

to traditional satellite-based approaches to land cover classification over large areas, which rely upon one main input dataset, this method relies on several satellite-derived datasets such as land cover, digital elevation models, Vegetation Continuous Fields, and a forest disturbance dataset, as well as a unique soil database in combination with inherent landscape-ecosystem regularities for the region. Comparison of the resulting spatial vegetation model with IIASA's inventory based vegetation database shows up to 40% spatial agreement depending on ecoregion. Considering the different data representations of generalised polygons in IIASA's database and scattered pixels of the remote sensing based land cover product these results are acceptable. Additionally, compared to the initial land cover product with unsufficient classification depth for GHG estimations, this study indicates that an automated approach, which combines a priori information specific to a region greatly enhances the value of the final result. The developed method could be adapted and applied to other large boreal regions.