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Spatial modelling of greenhouse gas compartments for GIS-based greenhouse gas accounting in boreal ecosystems

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A major requirement of the Kyoto Protocol is the development of a comprehensive and consistent system to measure sources and sinks of greenhouse gases (GHG). The EU-funded project Siberia-II tries to demonstrate the viability of full carbon accounting on a regional scale using data from several Earth Observation instruments, and detailed existing databases of field information. The study region is Central Siberia, covering an area of about 3 Mio km^2 and representing a significant part of the Earth‘s boreal biome which plays a critical role in the global climate. In the framework of Siberia-II land surface parameters, like land cover, wetlands, disturbances, phenology, Fapar, LAI etc., are produced and used as input parameters for two Global Dynamic Vegetation Models (DGVM) and a GIS-based landscape model for full greenhouse gas accounting. The latter is an empirical model by the International Institute of Applied Systems Analysis (IIASA), which provides diagnostic predictions of the status quo. In this work we present the development of geographical methods for spatial delineation of the modelling units of the GIS-based IIASA model. The final product shall be a vector data set with polygons (Greenhouse Gas Compartments) having the same characteristics concerning pools of carbon and nitrogen, and fluxes of CO_2, CH_4 and N_2O. The period of investigations are the years 2002 and 2003.The delineation of Greenhouse Gas Compartments (GGCs) will be realized by GIS overlay analysis. Since this shall be possible on several spatial scales the used datasets must prior be aggregated after rules defined for each scale. The regional scale covers the entire SIBERIA-II study region with a minimum polygon size of 2000 km^2. These polygons must be uniform with respect to climate, soil properties, and vegetation formations. The next

finer regionalisation scale is subregional and corresponds to the size of one administrative region. Krasnoyarsk Kray serves as test region with about 707.000 km^2. The minimum polygon size is 150 km^2. These polygons are uniform with respect to the requirements of the regional scale and additionally to the disturbance regime and vegetation groups. For this purpose the GGCs of the regional scale are divided in smaller polygons by overlaying remote sensing products with finer resolution. The most detailed local scale is test site based. For the development of the local regionalisation concept three different 1:50.000 test sites at the Yenisey River in Krasnoyarsk Kray were selected. The minimum polygon size of this local scale is 50 km^2. At this scale polygons have to be additionally uniform in respect to the topographic position, which plays a crucial role in micro climate and transportation of matter, and forest parameters like age of stand, relative stocking and species composition, which is important for ecosystem productivity. Since the amount of greenhouse gases, respectively of C and N is calculated for the area of the derived polygons, the real area of each polygon has to be taken into account for all three scales. This can be realized by calculating the surface area from digital elevation models (DEMs) with different resolution (100 m to 1 km). First investigations of the soil carbon pool of Krasnoyarsk Kray showed a difference of 49 Mt C between calculations of soil carbon content not including relief (18445 Mt C) and considering the real surface area using the GTOPO30 (?) DEM with 500 m raster resolution (18494 Mt C).