Geophysical Research Abstracts
Vol. 14, EGU2012-5925, 2012
EGU General Assembly 2012

A world freshwater assessment using Landsat multispectral data from GeoCover

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Oceanic observation networks are being increasingly developed around the world, for instance by integrating advance remote sensing techniques and monitoring measurements. However, freshwater systems have received less attention. Surprisingly, although recent studies demonstrated that inland waters play a significant role in the carbon cycle, estimation of carbon stocks and fluxes may often be biased mainly because inventories and archives are incomplete, or hard to access. In particular, the total number and total area of lakes remain highly uncertain, particularly for the small lake size category. Usually, indirect probability-based approaches (e.g. power law, Pareto, log-normal) are used to predict the global lake abundance in each size category. Only, Lehner and Döll (2004, Journal of Hydrology, 296, 1–22) provided a substantial canonical GIS platform called Global Lake and Wetland Database (GLWD) which combines different data sources such inventories, registers, archives, but also remote sensing acquisitions for various sensor types. Despite all these efforts there is still no accurate global sensus of inland waters. Satellite remote sensing is the only practical way to determine the spatial and temporal patterns of inland water on a large scale. Such inventory requires at least a precise enumeration and measurements including basically: (1) the geographical distribution (latitude and altitude); (2) the abundance, (3) the morphometric aspects (e.g., size, shape, mean depth, maximum depth, volume, or outlet elevation, etc.) of inland water bodies. We developed a semi-automatic and reproducible method over 8,500 Landsat 7 Enhanced Thematic Mapper Plus (ETM+) scenes also called GeoCover Circa2000. For this research, we proposed a “global” algorithm based on different aspects of digital images processing techniques which combined (1) the spectral signature and texture analysis for water body boundary delineation and (2) the Geographical Information System (GIS) platform to extract various statistic attributes as abundance, relative sizes, or their respective morphometry. To test the reliability of our direct approach, results were also confronted to the pre-existing statistical world equations developed in literature. Despite the poor spectral resolution inherent to the GeoCover data, the algorithm appears to be a reasonable water discriminator for most studied areas. Some well-known limitations remain in imagery over mountain areas and cloud shadow occurrence which are occasionally mistaken for water bodies. Until the future Landsat satellites generation, effort should continue to focus on quantifying and understanding the distribution of water bodies by aggregating different scales of observation.