Geophysical Research Abstracts
Vol. 12, EGU2010-12067, 2010
EGU General Assembly 2010

The effect of water availability on the remotely sensed net primary productivity

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Since the early stages of the Kyoto-protocol implementation, remote sensing is considered as an important method providing basic input data to establish inventories and to quantify ecosystem carbon fluxes. Though remote sensing enables the provision of regional to global scale data sets, it cannot be considered operational yet in more than a handful of applications related to the Kyoto Protocol.

The net primary productivity (NPP) expresses the net amount of carbon fixed in vegetation and is the difference between the carbon uptake by photosynthesis and the autotrophic respiration. Water availability will clearly affect the amount of carbon uptake by vegetation. The ratio of NPP and the amount of water lost by evapotranspiration (ET) is also known as the Water use efficiency (WUE). Thus, WUE links the carbon cycle and the hydrological cycle. As such, the use of WUE as proxy parameter might be a promising tool to better estimate the impact of vegetation on the environment.
Remote sensing stands alone in being able to provide spatially and temporal explicit datasets at regional to global scales and hence it might be a promising technique to assess regional and global WUE by the joint estimation of net primary productivity (NPP) or net uptake of carbon by plants and (ET) at various spatial and temporal resolutions.

In this study we demonstrated the effect of water limitation on the ecosystem uptake and release of carbon using the C-Fix model with validation data of the EUROFLUX sites. Moreover, we show how the water household of the ecosystem influences the balance between NPP and anthropogenic carbon emissions (ACE) over Europe. Using the water limited NPP at the country scale reveals that many nations in Europe such as Czech/Slovakia, Hungary, Ireland, Italy and Switzerland turn from a positive NPP-ACE balance towards a negative balance based on 1997 data.