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The effect of soil moisture on the ratio of anthropogenic carbon emission to carbon sequestration determined with remote sensing

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Carbon emission and fixation fluxes are key variables to guide climate change decision makers and emission traders on the use of remediation techniques. To develop Kyoto Protocol support tools, a sound application perspective is offered by expert systems based on earth observation (EO). This allows estimates of vegetation carbon fixation using a minimum of meteorological and additional data. The core module of this type of expert systems is a Monteith based production efficiency model C-Fix. This model estimates gross primary productivity (GPP), net primary productivity (NPP) and net ecosystem productivity (NEP) for various spatial scales. Continental scale carbon sequestration studies are dominated by temperature effects that suggest a positive feedback of increased ecosystem respiration to global warming. Though the strong coupling between carbon assimilation and water availability is a longstanding acquisition, the effect of short term water limitation, i.e. soil moisture, on continental scale carbon sequestration has not been properly investigated. We have assessed the effect of soil moisture on the NEP in ecosystem carbon modelling using the ERS Scatterometer derived Soil Water Index as water limiting factor in the C-Fix model that assimilates satellite based fAPAR data computed from NOAA/AVHRR and VGT NDVI imagery. C-Fix is optimized with data of 1998 for nine EUROFLUX sites and ran for 1997 to analyze the ecosystem carbon uptake and emission over Europe. World Meteorological Organization (WMO) met datasets were used. Including soil moisture

as short term water limitation factor at the EUROFLUX sites scale leads to a decreased (increased) NEP depending on whether soil respiration is increased (or decreased) or gross primary productivity is decreased or both. With short term water limitation, NEP reduces with more than 20% compared to the long term water limitation results. Using remote sensing data and assessing the fully water limited NEP, less than 30% of all European countries (more than 70% of the European continental surface area) is capable of recapturing their anthropogenic CO2 emissions of 1997. Including soil moisture as short term water limitation factor some ecosystems revert from a net carbon source to a net sink and vice versa. Hence soil moisture singles out as a quite important determinant for carbon sequestration and proves to have a strong impact on carbon sequestration spatial patterns. The European Net Biome Productivity of 229 plus minus 109 Tg C is estimated, constituting 5.5% of the European anthropogenic CO2 emissions of 1997.