



The satellite-inferred European carbon sink

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Atmospheric carbon dioxide (CO_2) is the most important anthropogenic greenhouse gas responsible for global warming. A significant fraction of the emitted CO_2 is taken up by northern hemispheric extra-tropical vegetation. Unfortunately, despite decades of research, it is not clear where exactly this carbon sink is located, how it varies in space and time and how plants will respond to a changing climate. We analysed satellite retrieved dry-air column-average mole fractions of atmospheric CO_2 with a regional inversion set-up based on STILT short range (days) particle dispersion modelling, rendering it insensitive to large scale retrieval biases and less sensitive to long-range transport errors. Our results suggest that the European vegetation (from the Atlantic to the Urals) removes 1.02 ± 0.30 GtC/a (in 2010) from the atmosphere. This is qualitatively consistent among an ensemble of five different inversion set-ups and five independent satellite retrievals (BESD, ACOS, UoL-FP, RemoTeC, and NIES) using data from two different instruments (SCIAMACHY and GOSAT). The difference to in situ based inversions, whilst large with respect to the mean reported European carbon sink (0.4 GtC/a for 2001–2004), is similar in magnitude to the reported uncertainty (0.42 GtC/a). The highest gain in information is obtained during the growing season when satellite observation conditions are advantageous, a priori uncertainties are largest, and the surface sink maximises; during the dormant season, the results are dominated by the a priori.