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# Integration of ground-observations, ecosystem modeling and MODIS/TM remote sensing for biogeochemical cycle observation in alpine grasslands

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Ecosystem modeling, remote sensing and ground observation of biogeochemical cycles have made great progress during the previous years, but only in an integrated view these elements provide the optimal information of biogeochemical cycles. Modern computational statistic provide excellent formal means for such integration. Here we show a case study for integrated observation and analysis of carbon cycle components in alpine grasslands. Here we integrate intensive ground observations of LAI and multi-temporal multi-scale remote sensing estimates from MODIS and Landsat TM at managed grassland sites in the Austrian Alps (Stubai Valley), into a canopy flux-growth model (PIXGRO). By observing the NDVI time series, three cuts of grassland during the year 2002 are clearly identified. Among different remote sensing indices, we found the simple ratio (SR) providing the best link to ground observations (r2 = 0.89 for MODIS data and r2 = 0.94 for Landsat TM data). The canopy flux-growth model, PIXGRO, responded sensitively to management measures, e.g., to periodic harvests, and it simulated GPP, allocation to aboveground biomass compartments, and LAI development well for intensively managed meadows in agreement with remote sensing observations. Thus, consistent results between modeled LAI, remote sensing based LAI, and measured LAI were achieved. The importance of remote sensing for assimilating hardly predictable (e.g. stochastic) disturbance events (e.g. grassland cutting, but also fires in forest) is stressed.