Open-path mid-range remote sensing techniques for GHG emission fluxes – A suitable approach to improve up-scaling of spot measurements?

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We want to initiate a campaign in Stordalen in northern Sweden, setting up an open-path remote sensing experiment consisting of a sensor and a set of retro-reflectors in a certain distance from the sensor covering different landscapes. Making use of the existing infrastructure and monitoring instruments, we want to contribute to a better understanding of the GHG emissions from these landscapes. In this context 'remote sensing' means measurements over a more or less horizontal distance of up to 2-5 km over different kind of landscapes, such as lakes, forests of different kind, and wetland with and without permafrost.

The existing international research on climate change and climate impact going on in the Abisko region in Northern Scandinavia has gathered research data over many decades back in time, based on in-situ (spot) measurements. However, in the process of developing a larger, regional or even global picture modelling uncertainties, mainly due to the problem of up-scaling of very local observations, are inevitable. Here a remote sensing technique covering several tens of square kilometer could close a gap and improve up-scaling of local concentrations and fluxes of greenhouse gases, mainly CO_2 and CH_4, over varying terrain.

The established environmental pan-European research infrastructure ICOS (Integrated Carbon Observation System) has more than 100 measurement stations in twelve European Countries, of which Sweden operates seven stations between Lund in Southern Sweden and Abisko in the northernmost part representing the different climate zones found in Sweden. The existing infrastructure at the field site 'Stordalen' close to Abisko (an ICOS station) is rather mature and provides all supplementary measurements which might be necessary for feasible remote sensing methods, such as for instance temperature, wind, turbulence, radiation.

So 'Stordalen' would be a perfect location for validation of open-path remote sensing methods deploying new laser heterodyne technique. This technique has already passed proof of concept studies and could be deployed at the field site during a campaign phase. With the supplementary information from the eddy-covariance towers installed in Stordalen, not only GHG concentrations but fluxes could be estimated. These fluxes should be representative for the landscape under the laser beam and could significantly improve the up-scaling process in modelling regional emission fluxes.