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Remote sensing of greenhouse gases for source/sink quantification

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Spectroscopic remote sensing of the greenhouse gases carbon dioxide and methane is a promising tool to gain insight into their sources and sinks at the Earth's surface. These sources and sinks are key to our understanding of climate and climate change. For, it is the anthropogenic greenhouse gas emissions that drive climate change and it is the climate feedbacks of the natural carbon cycle that induce major uncertainties for projecting future climate. Remote sensing, however, faces the challenge that atmospheric concentration gradients of CO_2 and CH4 are small fluctuations on top of a large background. Thus, advanced spectroscopic instruments and radiative transfer tools have to be developed to meet the accuracy requirement which typically amounts to discriminating gradients that are as small as one permille of the background. Here, I showcase some examples in satellite and ground-based remote sensing which illustrate the potential of the technique. These examples include space-borne detection of the carbon cycle response to heat waves and anomalous precipitation events. For ground-based remote sensing, I will focus on quantification of emissions from point sources such as volcanoes and coal mines.