UP 7: Greenhouse Gases: Remote Sensing

Time: Thursday 11:00–12:15 Location: MOL/0213

Invited Talk UP 7.1 Thu 11:00 MOL/0213

Towards monitoring of anthropogenic greenhouse gas emissions from satellites — •Hartmut Bösch[1,2], Antonio Di Noia[1], Neil Humpage[1], Alex Webb[1,3], Harjinder Sembhi[1], Robert Parker[1], Michael Buchwitz[2], Max Reuter[2], Oliver Schneising[2], Stefan Noel[2], and Heinrich Bovensmann[2] — [1]University of Leicester, Leicester, UK — [2]IUP, University of Bremen, Bremen, Germany — [3]Oklahoma University, Oklahoma, USA

To limit global warming to well below 2C compared to pre-industrial levels requires a decarbonization of the economy and many countries have pledged to reach net-zero emissions by 2050 but progress has been slow so far. Satellite observations of CO2 and CH4 will play a key role for tracking progress towards emission reduction targets and for verifying the effectiveness of mitigation policies. Satellites also provide information on natural sinks which store large amounts of carbon and play a potentially important role in the pathway towards net-zero emission.

In this presentation, I will introduce the key concepts for satellite observations of CO2 and CH4 and present examples how we use current, dedicated satellite missions to quantify regional surface fluxes of natural and anthropogenic sources. I will discuss how such dedicated missions can be complemented by hyperspectral satellites with high spatial resolution that allow constraining individual emission sources. The presentation will end with an outlook to the upcoming Copernicus CO2 Monitoring (CO2M) Mission, the space component of the European anthropogenic CO2 Monitoring & Verification Support Capacity.

UP 7.2 Thu 11:30 MOL/0213

Seasonal and Interannual Variability of Australian Carbon Fluxes Seen by GOSAT — •Andre Butz[1], Eva-Marie Metz[1], Sanam Vardag[1], Sourish Basu[2], Martin Jung[3], and Stephen Sitch[4] — [1]Institut für Umwetlphysik, Universität Heidelberg, Germany — [2]NASA Goddard Space Flight Center, University of Maryland, USA — [3]Max Planck Institute for Biogeochemistry, Jena, Germany — [4]University of Exeter, Exeter, UK

The semi-arid Australian continent significantly influences the interannual variability of the global terrestrial carbon sink. The sparsity of in-situ CO2 and flux measurements, however, leads to large uncertainties in estimated carbon fluxes for the continent. Satellite measurements of CO2 offer an independent and spatially extensive source of information about the Australian carbon cycle. Here, we examine the decadal data set (2009-2018) of atmospheric CO2 mole fractions delivered by the Greenhouse Gases Observing Satellite (GOSAT). We find previously undected CO2 pulses at the end of the dry season that we attribute to the quick onset of respiration after the dry period. These pulses dominate the seasonal and the year-to-year variability of Australia's carbon balance.

UP 7.3 Thu 11:45 MOL/0213

Emission estimates of carbon dioxide and methane with a ground-based imaging spectrometer — •Marvin Knapp[1], Leon Scheidweiler[1], Felix Külheim[1], Ralph Kleinschek[1], Jaroslaw Necki[2], Pawel Jagoda[2], and Andre Butz[1] — [1]Institute of Environmental Physics, Heidelberg University, Im Neuenheimer Feld 229, 69120 Heidelberg — [2]Faculty of Physics and Applied Computer Science, AGH University of Science and Technology, Krakow, Poland

Carbon dioxide (CO_2) and methane (CH_4) emissions into the atmosphere are the strongest anthropogenic drivers of global climate change. Mitigation strategies rely on precise knowledge of the strength and distribution of these greenhouse gas sources. Spectroscopic techniques emerge that enable imaging of atmospheric CO_2 and CH_4 plumes from strong point sources and thus, facility-scale emission estimates.

We show results of CO_2 and CH_4 emission plume images from ground-based observations with a NEO HySpex SWIR-384 hyperspectral camera. The camera takes images of sky-scattered sunlight in the shortwave-infrared range (1-2.5 μm) at kilometer distance to point sources. An adapted matched filter retrieval is used to calculate atmospheric enhancements of CO_2 and CH_4 from their 2 μm absorption bands. We present CO_2 emission plumes of a medium-sized power plant (>4.9 MtCO2/yr), which we detect reliably in hourly averaged spectral images. Furthermore, we successfully observed methane plumes from a coal mine shaft in Silesia, Poland, with a temporal resolution of roughly 1 minute, discovering emission dynamics on time scales from minutes to days.

UP 7.4 Thu 12:00 MOL/0213

Ozonmessungen auf der Zugspitze 1978-2020: Woher stammt der Ozonanstieg? — •Thomas Trickl[1], Cédric Couret[2], Ludwig Ries[2] und Hannes Vogelmann[1] — [1]Karlsruher Institut für Technologie, IMK-IFU, Kreuzeckbahnstr. 19, 82467 Garmisch-Partenkirchen — [2]Umweltbundesamt II 4.5, Schneefernerhaus, 82475 Zugspitze

Die Meßserie des troposphärischen Ozons auf der Zugspitze (2962 m) von 1978 bis 2011 zeigt bis 2003 einen deutlichen Konzentrationsanstieg auf, der im Vergleich mit anderen Langzeit-Serien besonders herausragt. Die Erklärung hierfür liegt an einer Zunahme des Absinkens von Stratosphärenluft, die mit einem Austrocknen der freien Troposphäre einhergeht. Kaum verzögert zum Rückgang der Sonnenaktivität seit ca. 20 Jahren hat der Ozonanstieg deutlich abgenommen. Die Messungen am 0.3 km tiefer gelegenen Schneefernerhaus (2660 m) haben die Trendänderung bis 2020 bestätigt. Ferner wurde eine klare Abnahme des troposphärischen CO gefunden, wohingegen der Trend für CO aus der untersten Stratosphäre leicht positiv ist. Die CO-Abnahme bestätigt die Verbesserung der Luftqualität in der Troposphäre.