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Passive remote sensing of large-scale methane emissions from Oil Fields in California's San Joaquin Valley and validation by airborne in-situ measurements - Results from COMEX

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The CO_2 and MEthane EXperiment (COMEX) was a NASA and ESA funded campaign in support of the HyspIRI and CarbonSat mission definition activities. As a part of this effort, seven flights were performed between June 3 and September 4, 2014 with the Methane Airborne MAPper (MAMAP) remote sensing instrument (operated by the University of Bremen in cooperation with the German Research Centre for Geosciences - GFZ) over the Kern River, Kern Front, and Poso Creek Oil Fields located in California's San Joaquin Valley. MAMAP was installed for the flights aboard the Center for Interdisciplinary Remotely-Piloted Aircraft Studies (CIRPAS) Twin Otter aircraft, together with: a Picarro fast in-situ greenhouse gas (GHG) analyzer operated by the NASA Ames Research Center, ARC; a 5-hole turbulence probe; and an atmospheric measurement package operated by CIRPAS measuring aerosols, temperature, dew-point, and other atmospheric parameters. Three of the flights were accompanied by the Next Generation Airborne Visual InfraRed Imaging Spectrometer (AVIRIS-NG), operated by the Jet Propulsion Laboratory (JPL), California Institute of Technology, installed aboard a second Twin Otter aircraft. Large-scale, high-concentration CH4 plumes were detected by the MAMAP instrument over the fields and tracked over several kilometers. The spatial distribution of the MAMAP observed plumes was compared to high spatial resolution CH4 anomaly maps derived by AVIRIS-NG imaging spectroscopy data. Remote sensing data collected by MAMAP was used to infer CH4 emission rates and their distributions over the three fields. Aggregated emission estimates for the three fields were compared to aggregated emissions inferred by subsequent airborne in-situ validation measurements collected by the Picarro instrument. Comparison of remote sensing and in-situ flux estimates will be presented, demonstrating the ability of airborne remote sensing data to provide accurate emission estimates for concentrations above the detection limit. This opens new applications of airborne atmospheric remote sensing in the area of anthropogenic top-down emission monitoring as well as for atmospheric CH4 leakage monitoring during accidents like the Elgin blow-out (March 2012) in the North Sea or the recent Aliso Canyon gas leak incident (2015/2016) in California.