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Using a new divergence method to quantify methane emissions with TROPOMI on Sentinel-5p

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The high-resolution Tropospheric Monitoring Instrument (TROPOMI) satellite observations of atmospheric methane offer a powerful tool to identify emission hot spots and quantify regional emissions. The divergence of horizontal fluxes of NO_2 has already been proven to be an efficient way to resolve and quantify high sources on a global scale. Since the lifetime of CH_4 is in the order of 10 years, the sinks can be ignored at the synoptic time scale which makes the divergence method even more applicable to CH_4 than to short-lived NO_2.
Because plumes of newly emitted CH_4 disperse within the Planetary Boundary Layer (PBL), we first convert the satellite observed total column average (XCH_4) to a regional enhancement of methane in the PBL (ΔXCH_{4_PBL}) by using the CAMS global methane background reanalysis fields above the PBL. These model fields represent the transport- and chemically-modulated large-scale distribution of methane. Secondly, the divergence of ΔXCH_{4_PBL} is derived by the use of the wind speeds halfway within the PBL. Based on the divergence, methane emissions are estimated on a 0.25°× 0.25° grid. We tested our new method for Texas in the United States and quantified methane emissions from the well-known oil-gas fields in the Permian Basin, as well as from – less well quantitatively established – oil-gas fields located in southern coastal areas.
Compared to traditional inverse methods, our method is not restricted by an a priori emission inventory and so far unidentified local sources (i.e. emissions from livestock in feed yards) may be found. Due to its computational efficiency, the method might be applied in the near future globally on the current spatial resolution.