



Coal mine emission studies at the U.S. Geological Survey

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Methane emissions and coal mines

Methane is the second most predominant anthropogenic greenhouse gas.

- More potent than CO₂ in Global Warming Potential (GWP; 27 non-fossil CH₄, 29.8 fossil CH₄), over a 100-year timeframe⁺
- The energy sector is responsible for nearly 37% of total anthropogenic methane emissions^{*}
- Coal mines account for about 11.5% of global anthropogenic methane emissions^{*}

⁺Intergovernmental Panel on Climate Change 2021, Sixth Assessment Report, <https://www.ipcc.ch/assessment-report/ar6/>

^{*}International Energy Agency, Global Methane Tracker 2024, <https://www.iea.org/reports/global-methane-tracker-2024>

Coal Mine Emissions Working Group

Described in 2023 National Strategy to Advance an Integrated U.S. Greenhouse Gas Measurement, Monitoring, and Information System*

- Formed in 2023, members include: USGS, BLM, OSMRE, EPA, DOE, NIST, NOAA, and NASA
- Agreements with UNEP IMEO and Buchanan Minerals LLC
- Objective: Reconcile methane emissions estimates from satellite and airborne approaches with activity-based approaches at active underground coal mines

* <https://www.whitehouse.gov/wp-content/uploads/2023/11/NationalGHGMMISStrategy-2023.pdf>

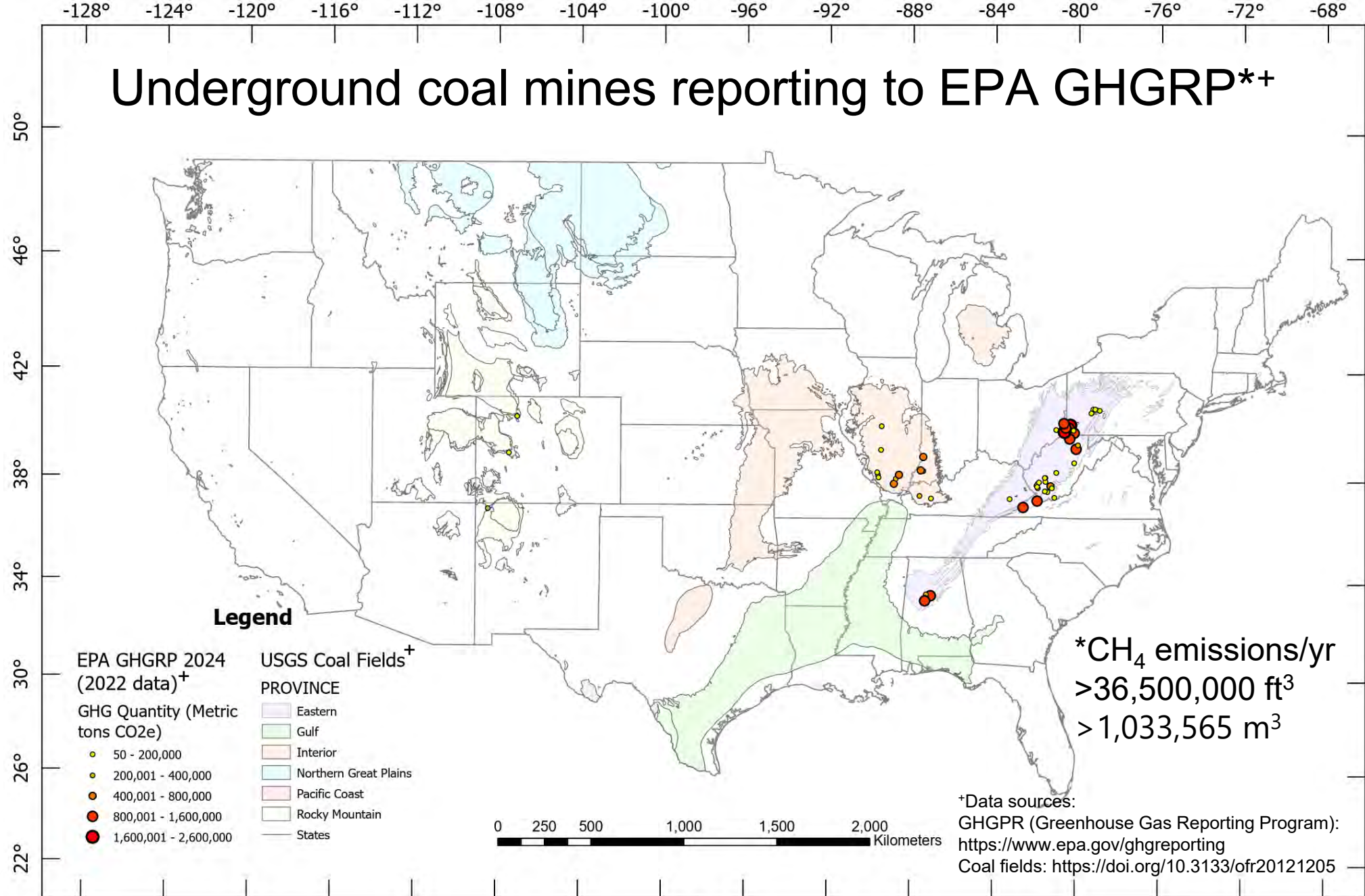
USGS: U.S. Geological Survey; BLM: Bureau of Land Management; OSMRE: Office of Surface Mining Reclamation and Enforcement; EPA: Environmental Protection Agency; DOE: Department of Energy; NIST: National Institute of Standards and Technology; NOAA: National Oceanic and Atmospheric Administration (NOAA), NASA: National Aeronautics and Space Administration; UNEP IMEO: U.N. Environment Programme International Methane Emissions Observatory

Objectives

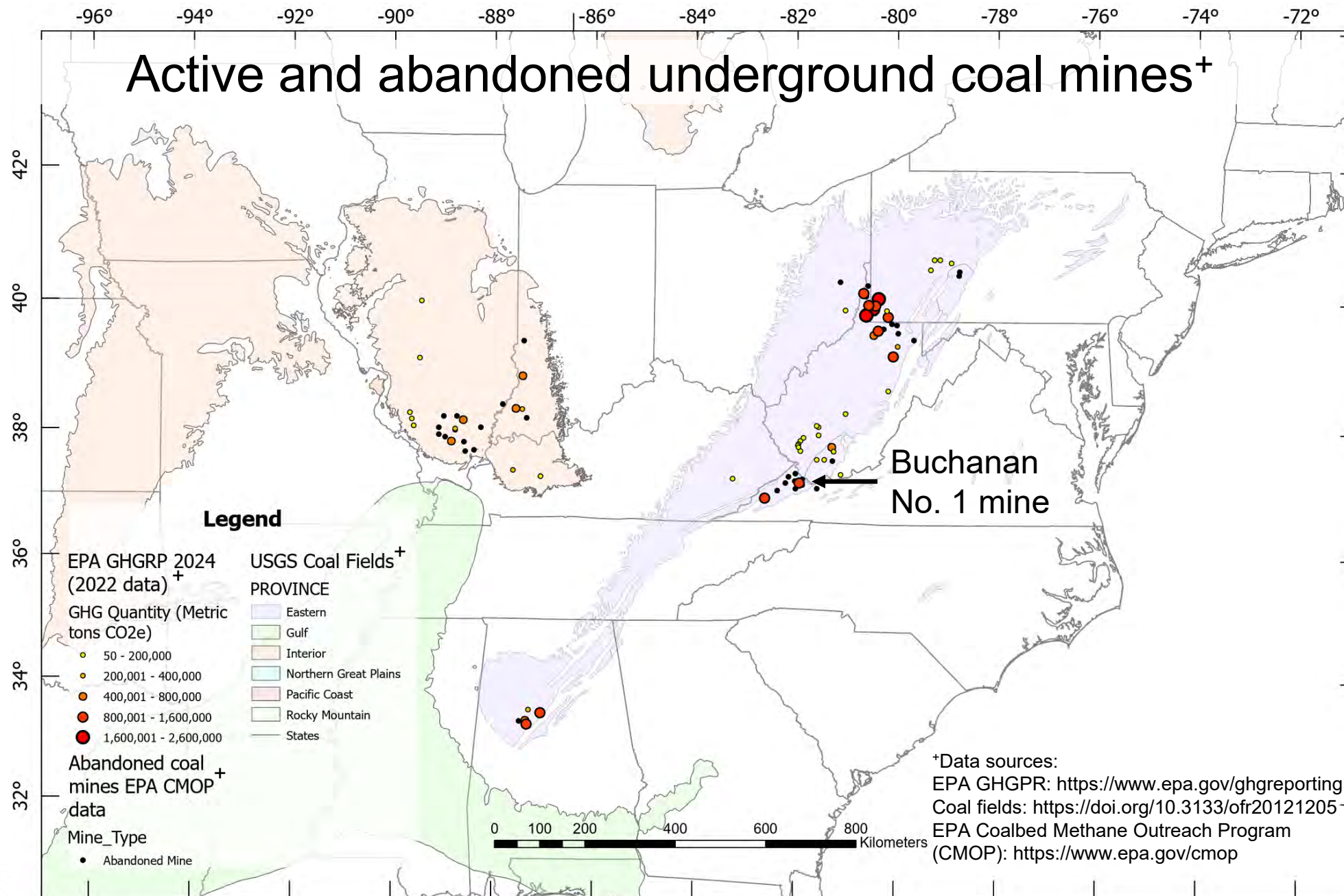
- Acquire coal mine measurement data and satellite/airborne monitoring at multiple mine locations
- Estimate concurrent bottom-up (BU) and top-down (TD) methane fluxes from mine ventilation exhaust fans
- Compare methane emission fluxes
- Reconcile BU and TD quantified results

USGS leads the Coal Mine Emissions Working Group and coordinates BU data collection and interpretations

Underground coal mines reporting to EPA GHGRP*+



Active and abandoned underground coal mines⁺



Buchanan Ventilation air monitoring - V16 Shaft

- VAMOX unit is connected to the VS16 mine vent through a coupling and long ducting that places oxidizer outside of 30 m buffer zone
- ~30% of flow is diverted to VAMOX - depending on methane concentration.
 - ~90% of incoming methane is oxidized
- VAMOX has its own sensors to monitor flow every minute
 - Two Neo Monitor open path laser spectrometer with transmitters and receivers placed 1.5 m from the coupling to mine vent.
 - Flow into VAMOX unit is controlled by a variable frequency pump and flow sensor



Open path laser monitors



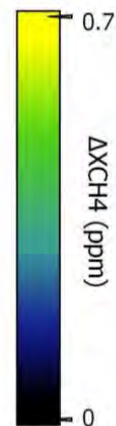
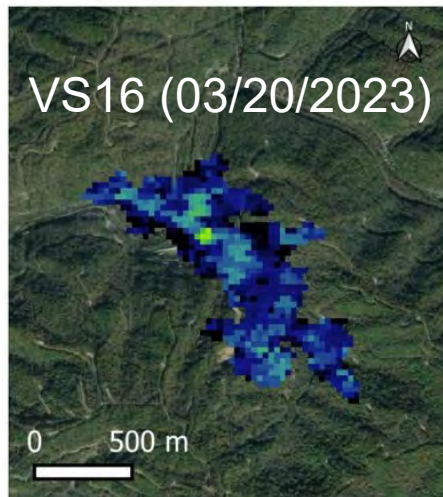
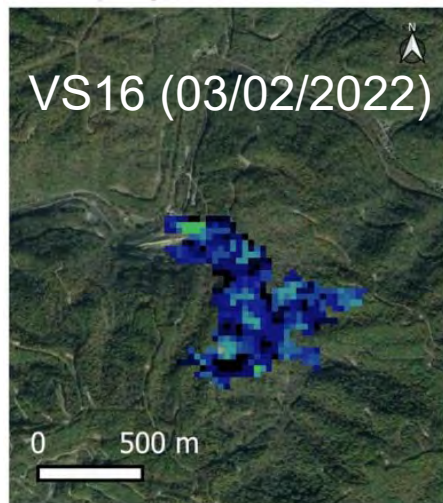
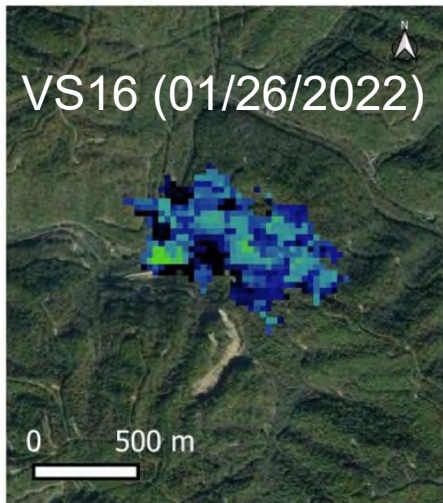
V16 with VAMOX unit



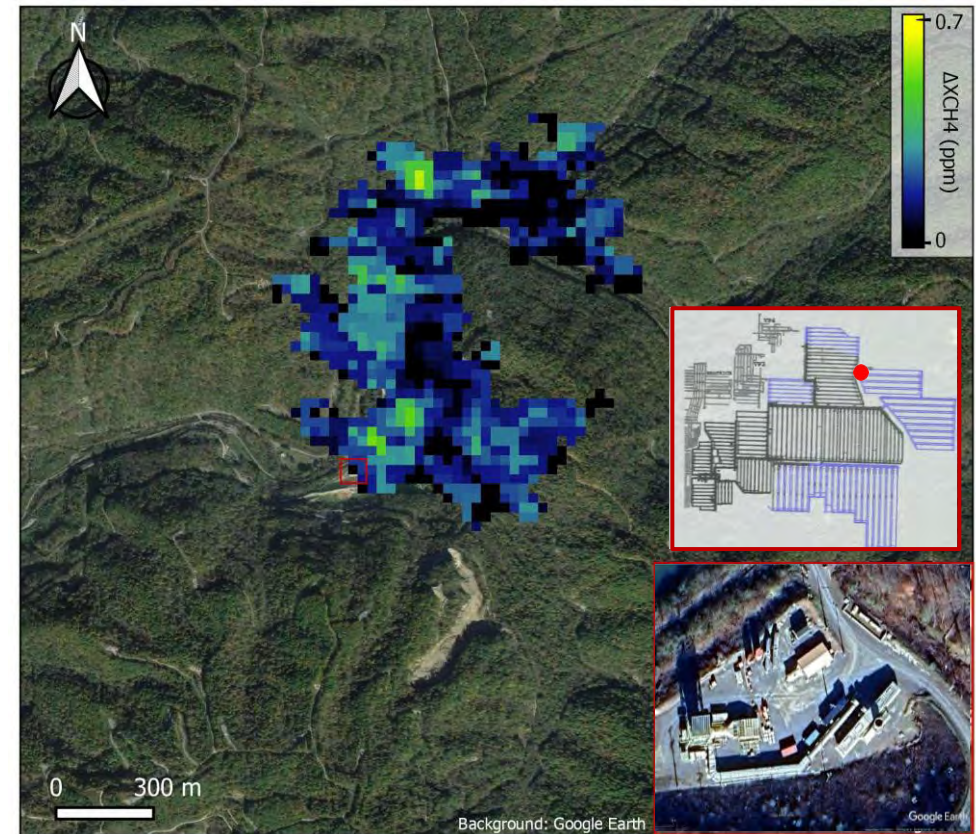
Pump pulling air into the oxidizer

Results

- Plumes with minimum 90 pixels were quantified (PRISMA satellite data provided by UNEP IMEO)

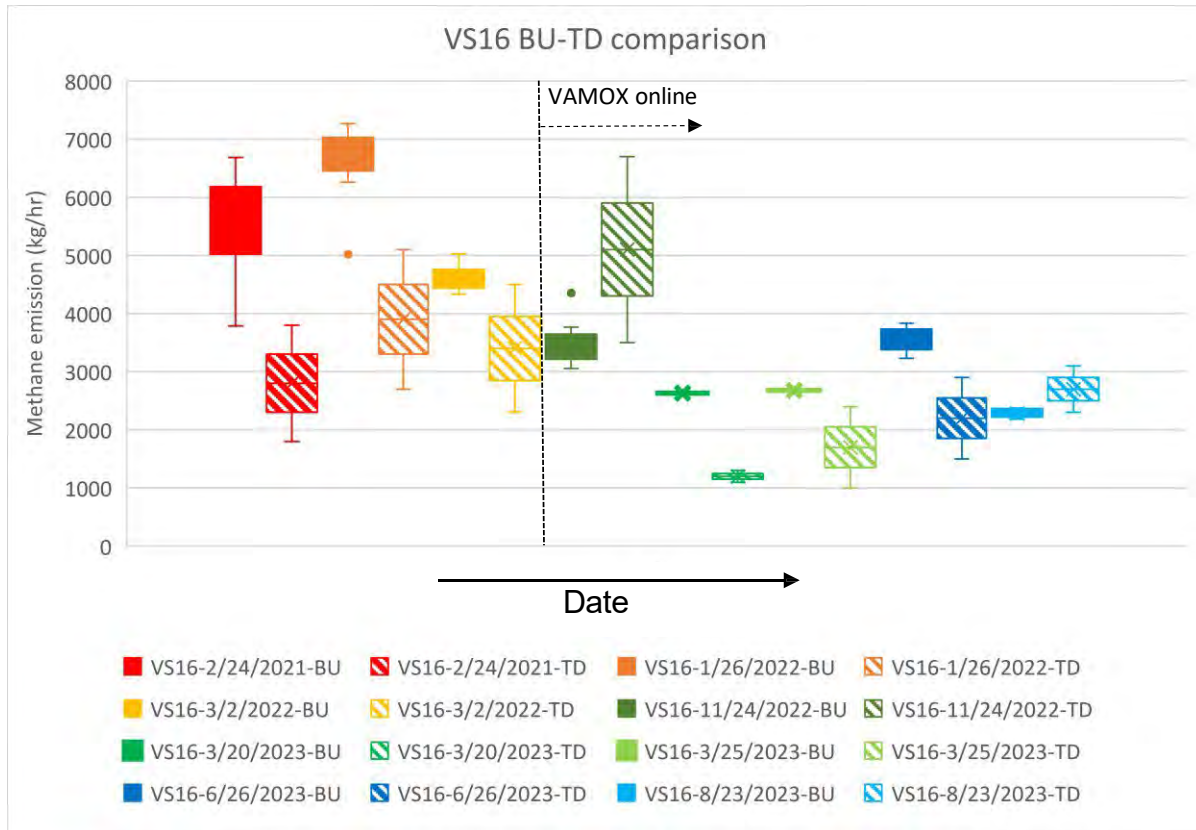


Background map:
Google Earth



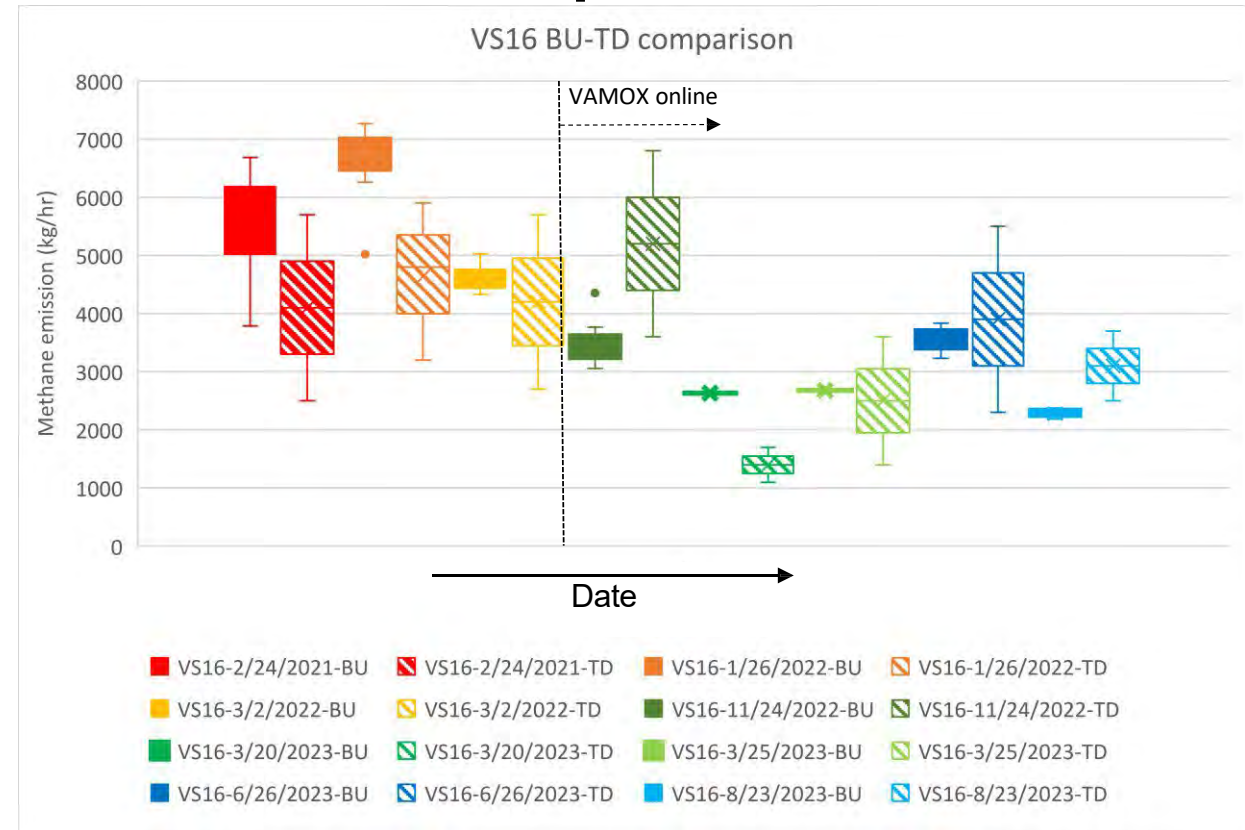
VS16 (11/24/2022)

Results – VS16 BU and TD comparison



GEOS-FP

- TD estimates are lower than BU
- Data centers and ranges are closer
- ERA5 results are improved over GEOS-FP
- Effect of VAMOX unit is visible in BU and TD estimates



ERA5

Wind reanalysis products:

- GEOS-FP by NASA
- ERA5 by European Centre for Medium-Range Weather Forecasts

Summary

- Monitoring, reporting and verification of coal mine emissions at the facility level is important to inform policy makers and project developers
- Top-down (TD) methods can be effective global monitoring and emission quantification tools in support of independent bottom-up (BU) methods through a reconciliation process
- More coal mine facility level studies are needed to better reconcile methane emissions estimates from TD approaches with BU measurements at active underground coal mines

Thank you!

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