Imperial College London

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How useful are TROPOMI XCH_4 measurements for the UK?

Using CAMS methane products to understand UK CH_4 spatial patterns measured by TROPOMI

Eric Saboya[1], Anna Agusti-Panareda[2], Heather Graven[1]

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[1]Department of Physics, Imperial College London, UK

[2]ECMWF, UK

ess17@ic.ac.uk

UK TROPOMI XCH_4 spatial patterns differ from CH_4 emission inventory

- 2018-2020 TROPOMI retrievals have poor UK data coverage with a retrieval success rate of ~2.9 %
- 2018-2020 averaged TROPOMI XCH_4 UK gradients differ from UK National Atmospheric Emissions Inventory (NAEI) CH_4 emission gradients
  - High CH_4 emissions over London but low XCH_4 observed
  - Low CH_4 emissions over East UK but high XCH_4 observed

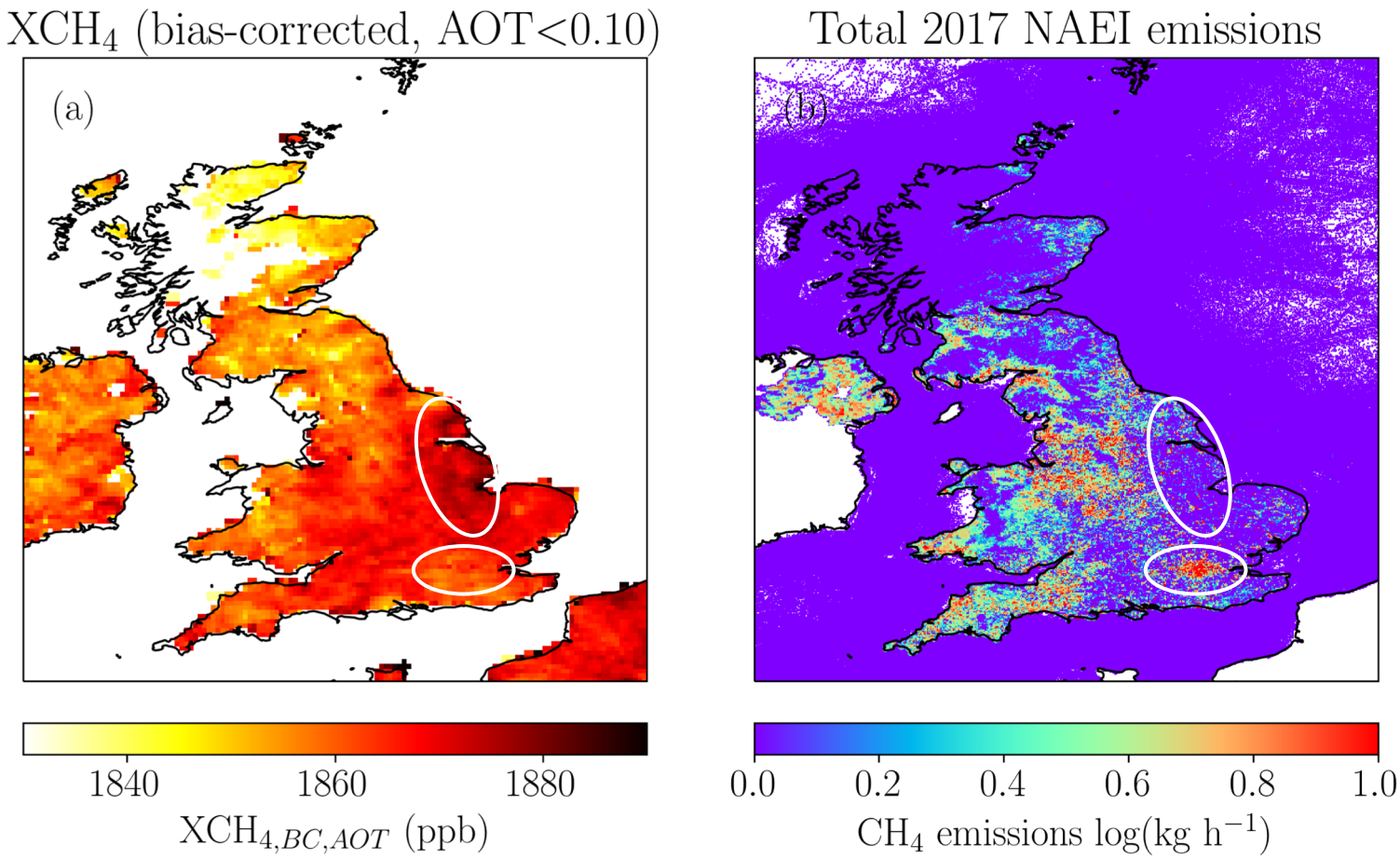


Fig. 1 *(a) 2018-2020 averaged TROPOMI XCH_4 bias-corrected operational product. (b) UK NAEI 2017 CH_4 anthropogenic emissions*

CAMS atmospheric methane column forecasts and reanalysis datasets

- CAMS (**C**opernicus **A**tmosphere **M**onitoring **S**ervice) models global atmospheric XCH_4 composition using a data assimilation approach
- **Reanalysis** EGG4 XCH_4 CAMS product: previous forecast combined with ground-based measurements and atmospheric model to provide an updated state of atmosphere
- **Forecast** XCH_4 CAMS product: previous forecast, satellite measurements, emission inventories and atmospheric model used to determine evolution of XCH4 over the next 5 days
- Negative global bias in CAMS XCH_4 compared to TCCON (Ramonet et al., 2019) means we adjust by +50 ppb

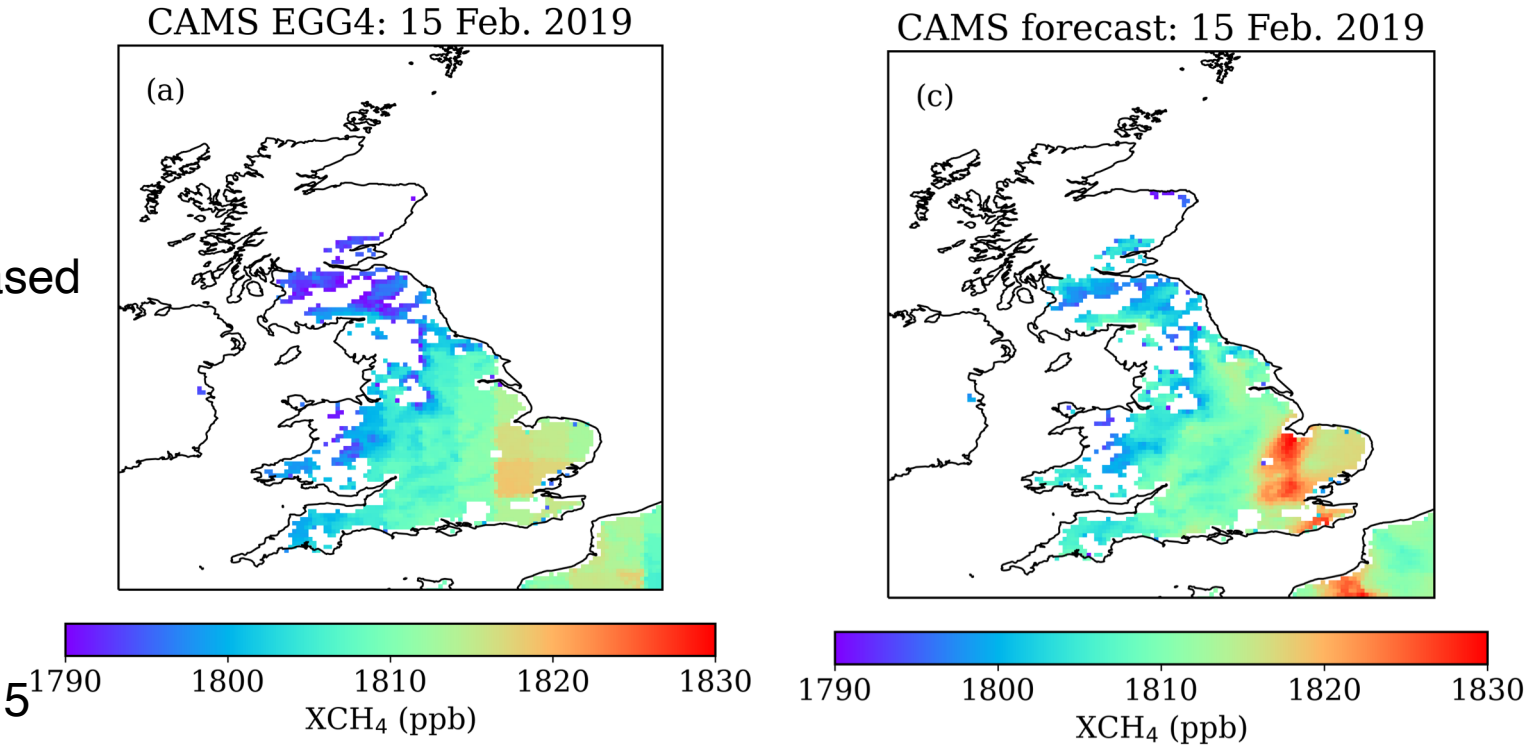


Fig. 2 *15 Feb. 2019 12:00 CAMS XCH_4 (a) reanalysis and (c) forecast for over the UK*

Homogenous spatial patterns over the UK in TROPOMI & CAMS XCH_4

- Comparison of average over 8 days between 2018-2020 that have UK-wide TROPOMI XCH_4 pixels with CAMS XCH_4 products
- London-southeast XCH_4 gradient of ~5 ppb in CAMS reanalysis and ~10 ppb in forecasts
- High XCH_4 feature in east UK in TROPOMI does not appear in CAMS CH_4

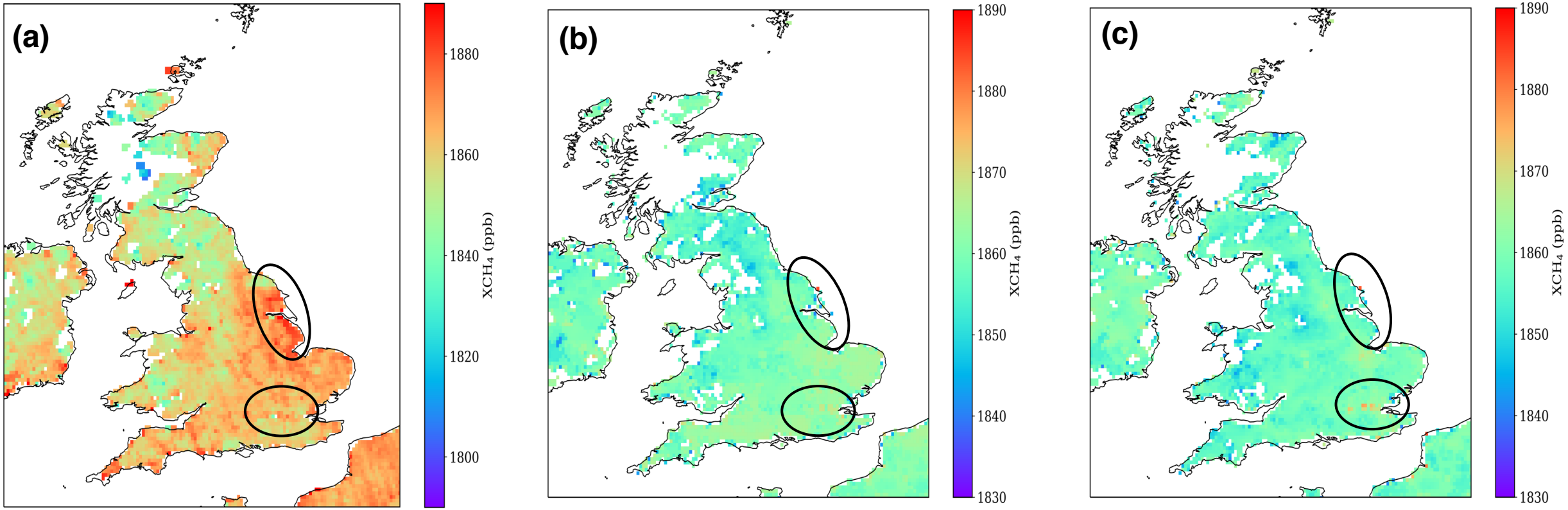
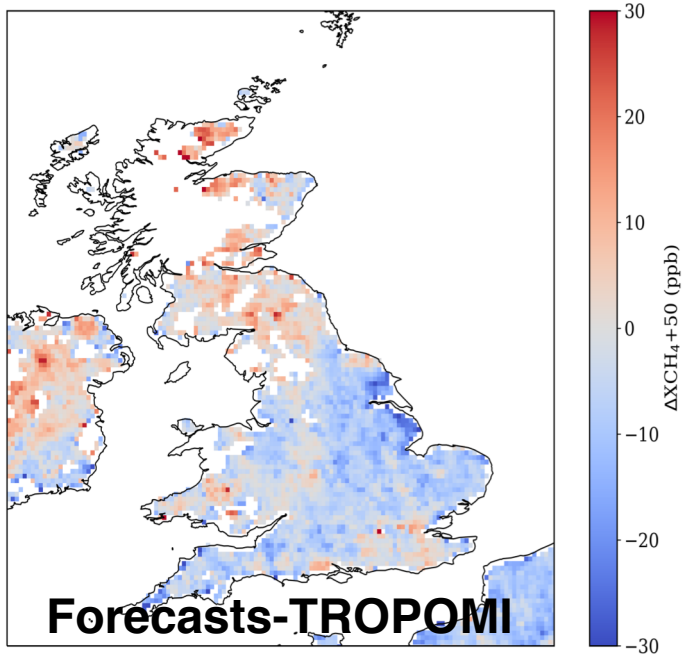
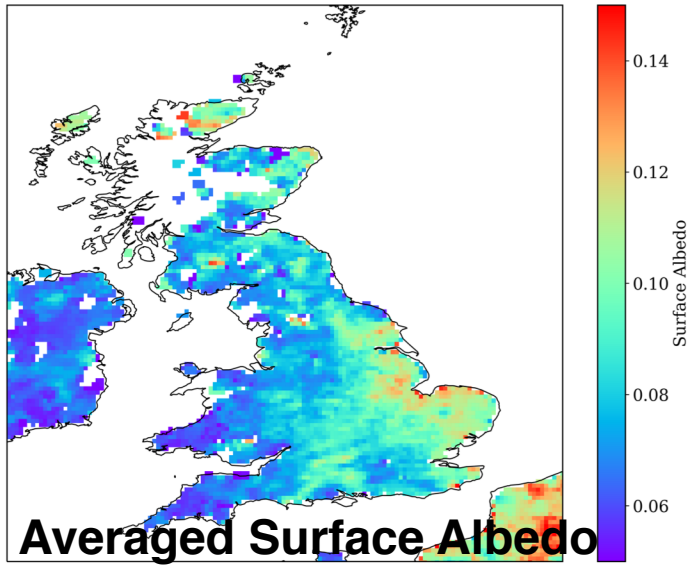


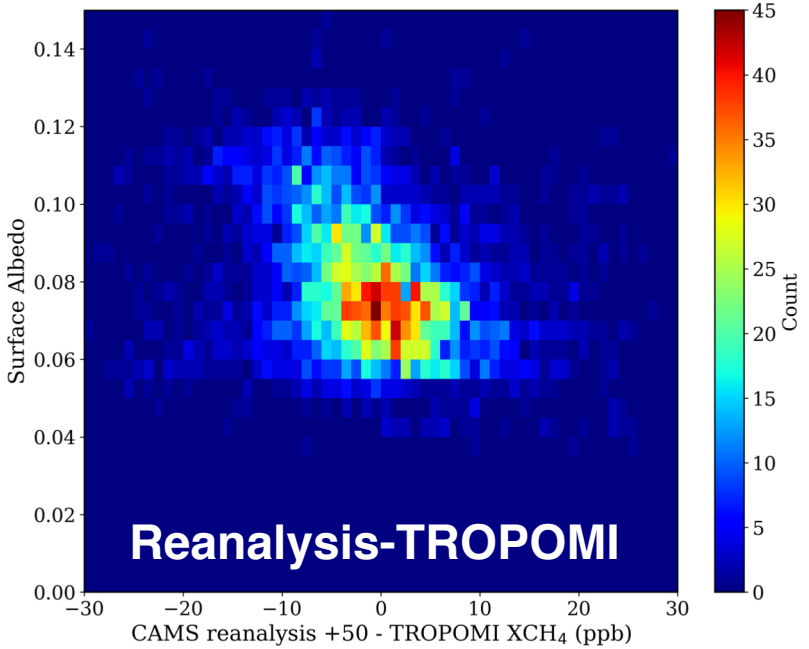
Fig. 3 ***(a)*** *TROPOMI* ***(b)*** *CAMS reanalysis* ***(c)*** *CAMS forecast XCH_4 averaged using the 8 TROPOMI observations from 2019-2020 that have UK-wide coverage*

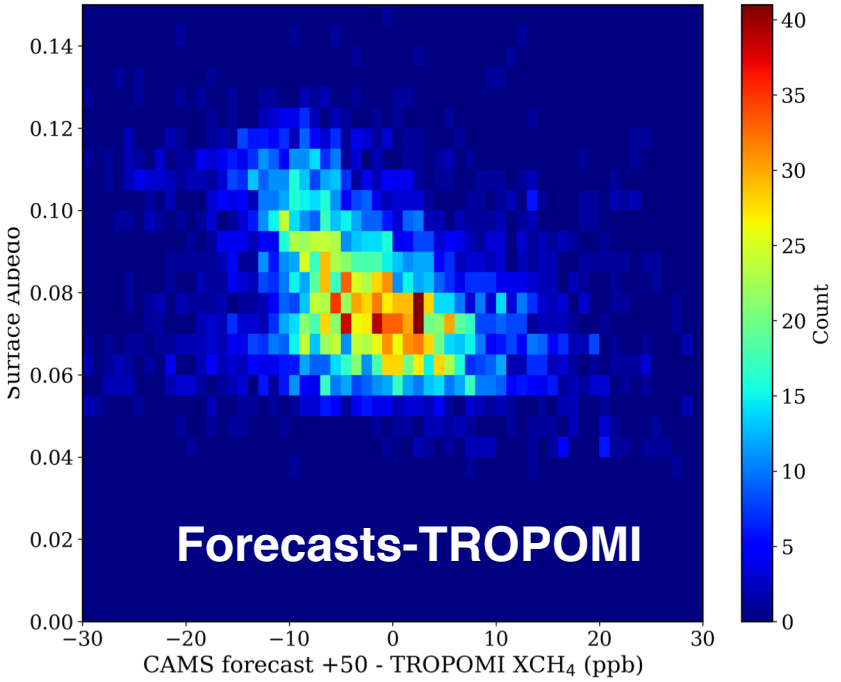
Larger TROPOMI XCH_4 values are correlated with higher surface albedo





- Large negative CAMS-TROPOMI XCH_4 values linked to higher surface albedo across the UK
- Surface albedo does not explain the lack of observed XCH_4 gradient between London and the southeast
- Most CAMS-TROPOMI biases are ±5 ppb





Conclusions

- Low number of TROPOMI retrievals with UK XCH_4 data coverage
- UK TROPOMI XCH4 spatial patterns differ from UK CH_4 emissions inventory
- TROPOMI instrument precision (~11 ppb) likely not sufficient for discerning UK XCH_4 gradients
- CAMS-TROPOMI XCH_4 differences correlate with surface albedo