

Background & Motivation

To monitor methane (CH_{4}) emissions from disperse and extensive sources, researchers are challenged to devise tools which may adapt to the spatial and temporal challenges of monitoring. Networks of sensors are one potential method to perform this onerous task. Current CH₄ emissions monitoring networks are rare and purpose-built installations.



We ask the following:

- What can we learn from historical CH_4 networks?
- Do extant CH_4 networks meet current and future-forward emissions monitoring needs?
- What gaps exist for new networks to address challenging CH_{A} problems?

Methane Emission Sensing Network Definition

Methane emissions monitoring networks are tools which assess atmospheric CH_4 with large potential spatial scope, collect observations as a collective (rather than singletons), and possess some mathematical "glue" to model observations as measurements.

A Notable Exclusion...

Our definition excludes Internet of Things (IoT) fenceline monitors which observe independent sources at relatively small scales.

Physical- and Cyber-space Representation



Networks sample the atmospheric boundary layer (ABL) in at least one spatial simplified domain: Spaceborne,

Aerial,

Terrestrial; represented as vertical layers here.

A horizontal layer indicates the "*network-ness*" quality. In physical terms, this impacts spatial extent of the measurement. In cyberspace terms, this impacts how the network operates as a collective installation.

Analysis of Networks for Methane Emissions Monitoring

Wesley T. Honeycutt,^{1,*} Khosrow Namjou,¹ Parisa M. Khiabani,² Sean M. R. Crowell,³ Chenghao Wang,^{4,5} Erkan Kayacan,⁶ Binbin Weng¹ ¹School of Electrical and Computer Engineering; ²Data Institute for Societal Challenges; ³LumenUs Scientific Solutions; ⁴School of Meteorology; ⁵Department of Geography and Environmental Sustainability; ⁶Aerospace and Mechanical Engineering

University of Oklahoma, Norman, OK, USA (Email: <u>honeycutt@ou.edu</u>)





Gaps: Where do we go from here?



G1 – There is a lack of non-scientific networks. G2 – There is a lack of mobile sensing networks which adapt responses in physical space. G3 – For intercomparison we need parity. Payload standards like Method 21 or NEON would help. G4 – Siting and deployment inconsistent; we need "rules" for how to measure plumes in ABL. G5 – Industry IoT tools combined could become a useful network if they are incentivized to share. G6 – Multi-domain "smart" networks like exist for fire detection would aid rapid response of a complicated landscape. G7 – Simultaneous policy and tech innovation.

An Analysis of Extant Networks



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End Matter

