# Visualizing anthropogenic methane plumes from the California Methane Survey
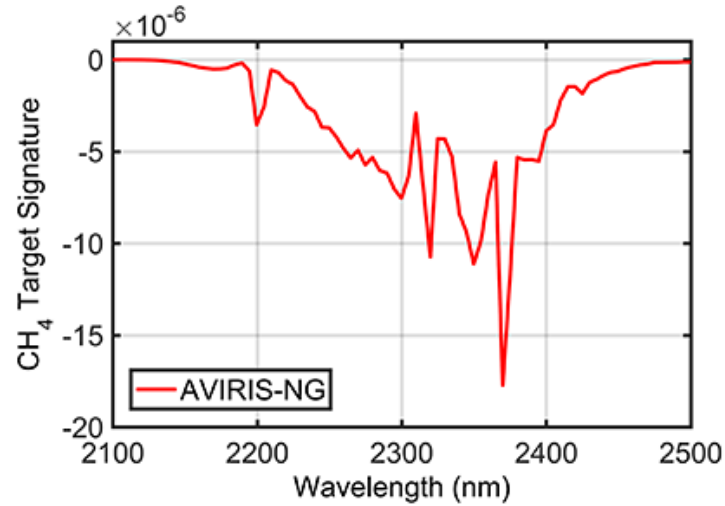
Andrew K. Thorpe[1*], Riley M. Duren[2,1], Robert K. Tapella[1], Brian D. Bue[1], Kelsey T. Foster[3], Vineet Yadav[1], Talha Rafiq[4], Francesca M. Hopkins[4], Kevin M. Gill[1], Joshua D. Rodriguez[1], Aaron Plave[1], Daniel Cusworth[1], Charles E. Miller[1], AVIRIS team, et al.

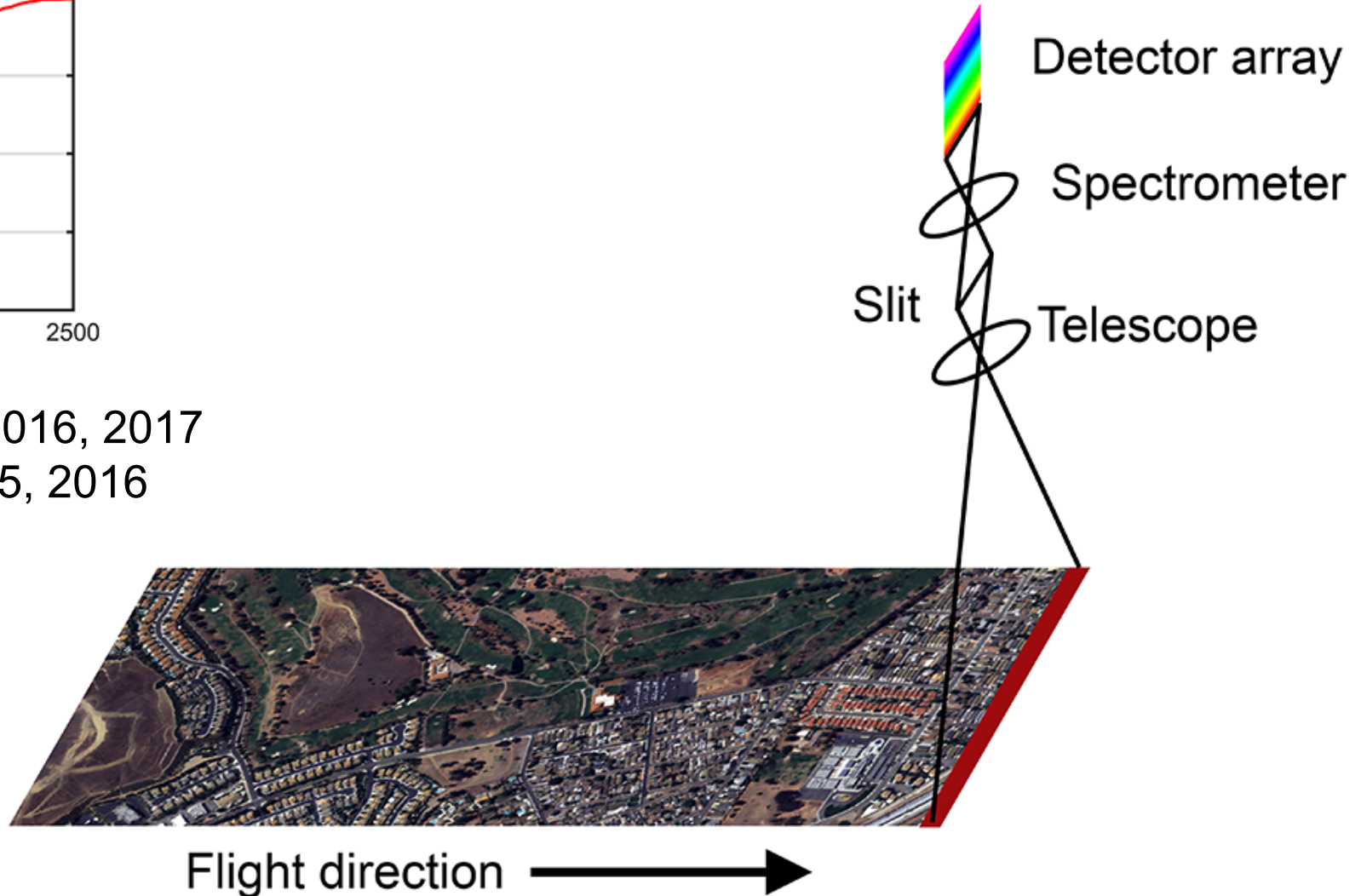*Andrew.K.Thorpe@jpl.nasa.gov, [1]Jet Propulsion Laboratory, California Institute of Technology, [2]University of Arizona, [3]Stanford University, [4]University of California Riverside
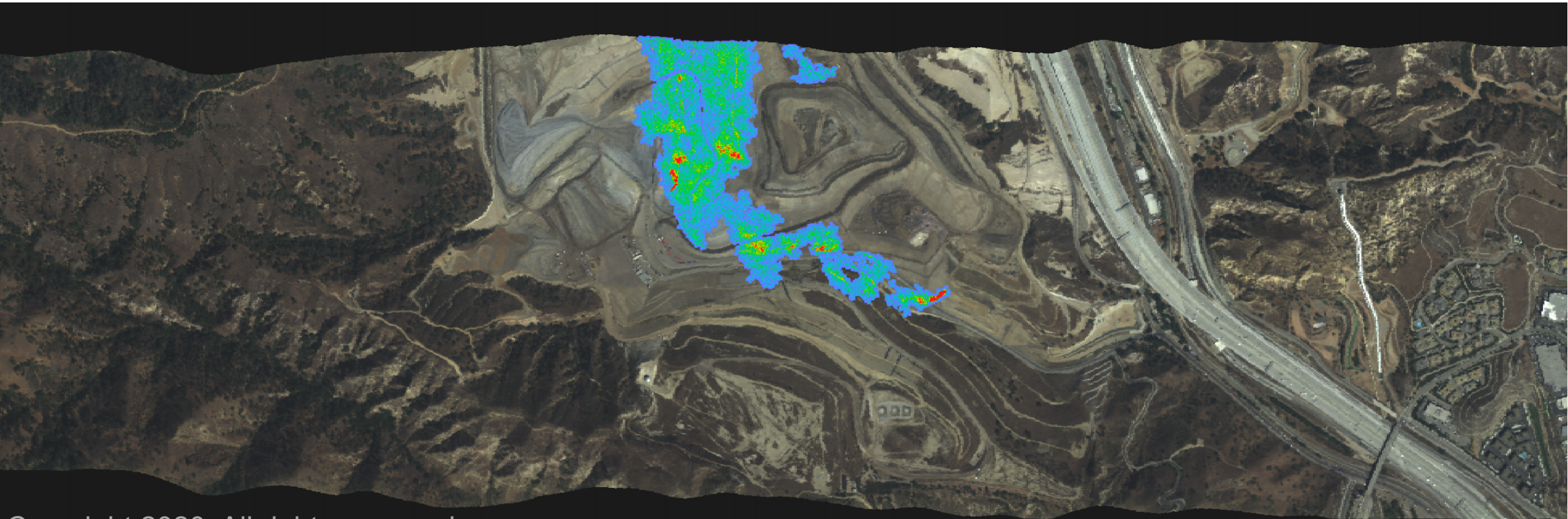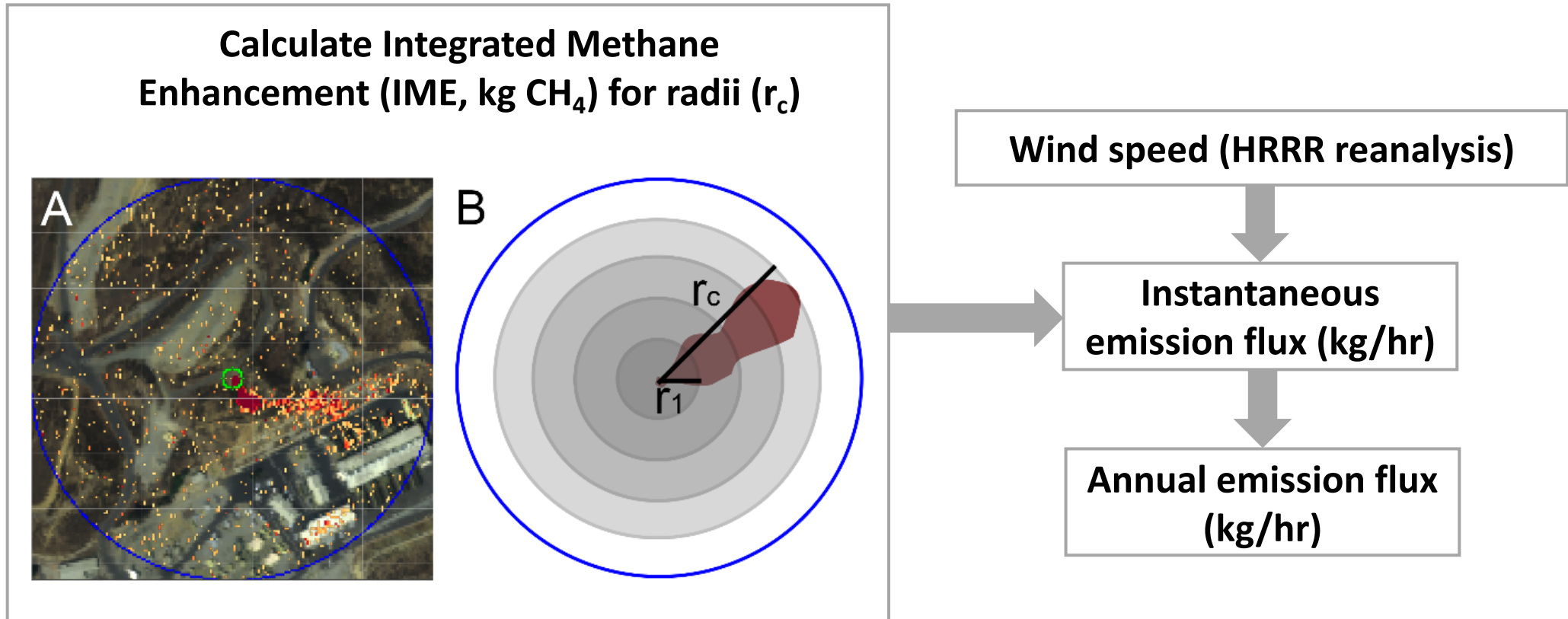
AVIRIS-NG for CH$_4$ plume mapping


Thorpe et al., 2014, 2016, 2017
Thompson et al., 2015, 2016

Detector array

Spectrometer

Slit

Telescope

Flight direction

AVIRIS-NG for CH_4 emission flux quantification

Calculate Integrated Methane Enhancement (IME, kg CH_4) for radii (r_c)

Wind speed (HRRR reanalysis)

Instantaneous emission flux (kg/hr)

Annual emission flux (kg/hr)

Duren et al., 2019

California Methane Survey

- AVIRIS-NG flights funded by the California Air Resources Board (CARB) and California Energy Commission (CEC)

- Targeting CH_4 hotspots from the energy, agriculture, and waste management sectors
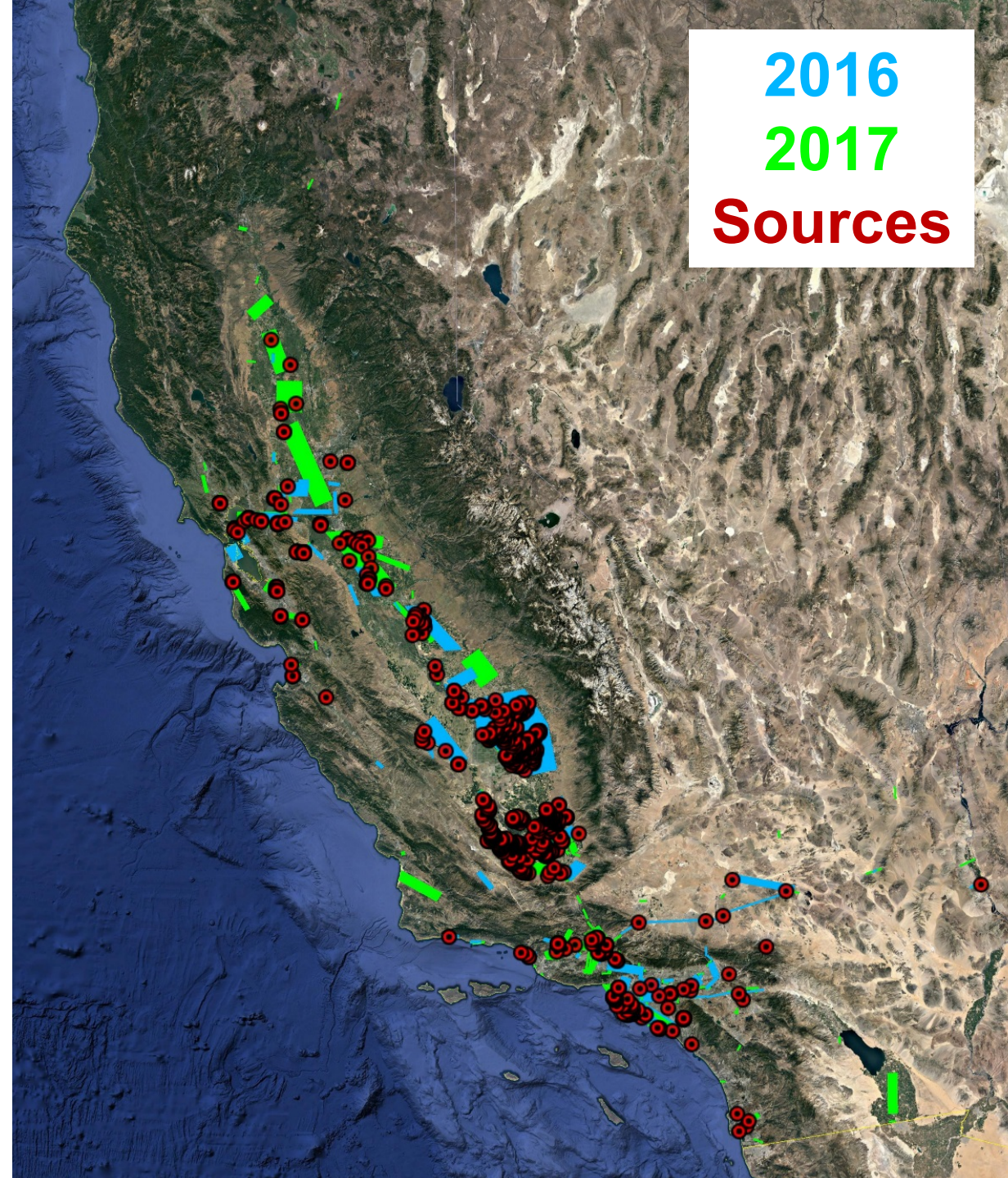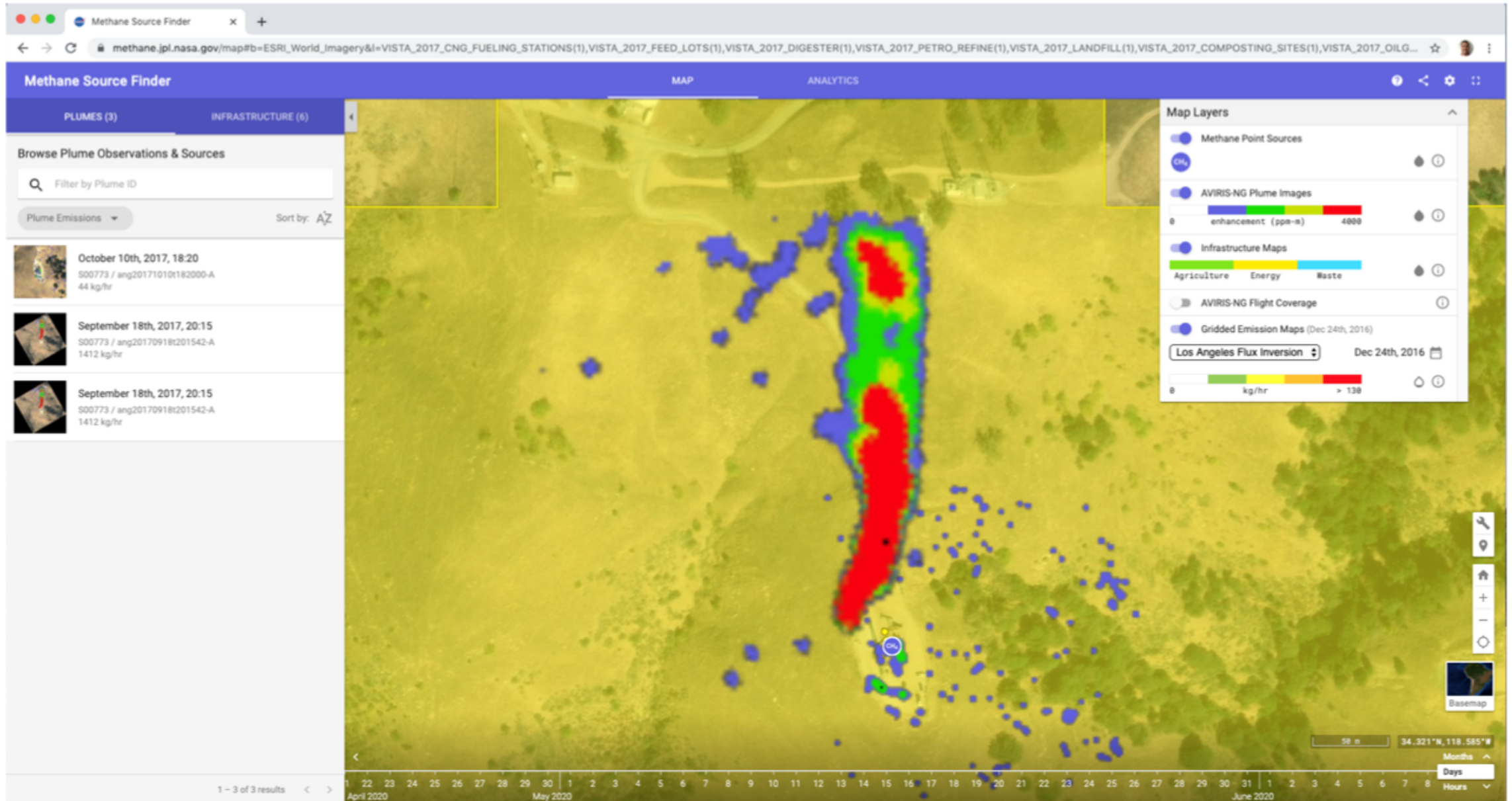
Methane Source Finder data portal

- Publicly available: https://methane.jpl.nasa.gov/
- Developed under NASA's ACCESS and CMS programs to explore CH_4 data
- Data includes:
  - Remote sensing (AVIRIS-NG imaging spectrometer CH_4 plume results; Thorpe et al., 2017)
  - Surface monitoring (in situ towers for CH_4 flux inversions for the LA basin; Yadav et al., 2019)
  - Bottom up CH_4 emissions inventories (EPA)
  - Infrastructure database (potential CH_4 sources; Carranza et al., 2018)
- Goals:
  - Provide CH_4 dataset to a diverse range of stakeholders to improve understanding of regional CH_4 emissions
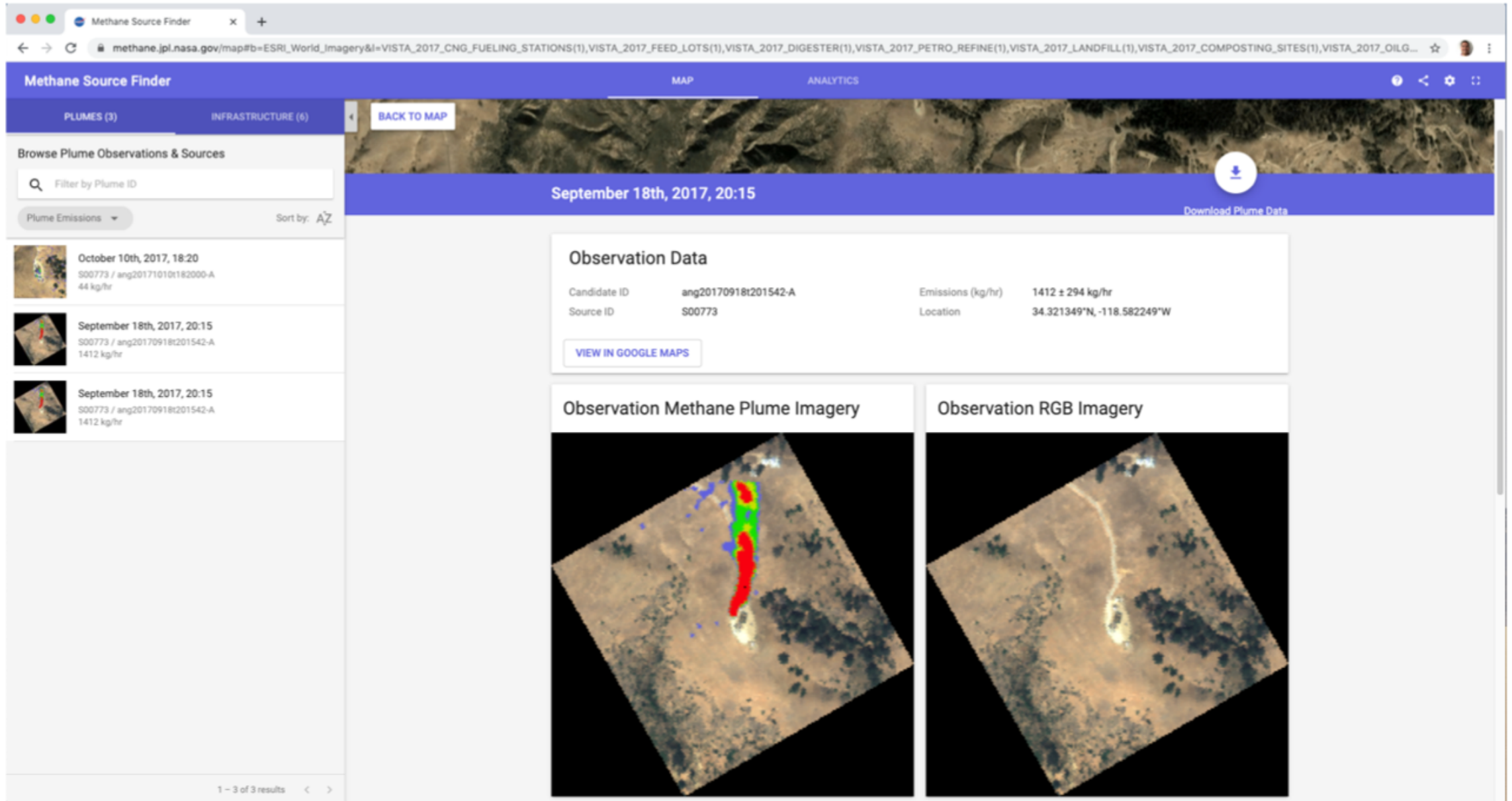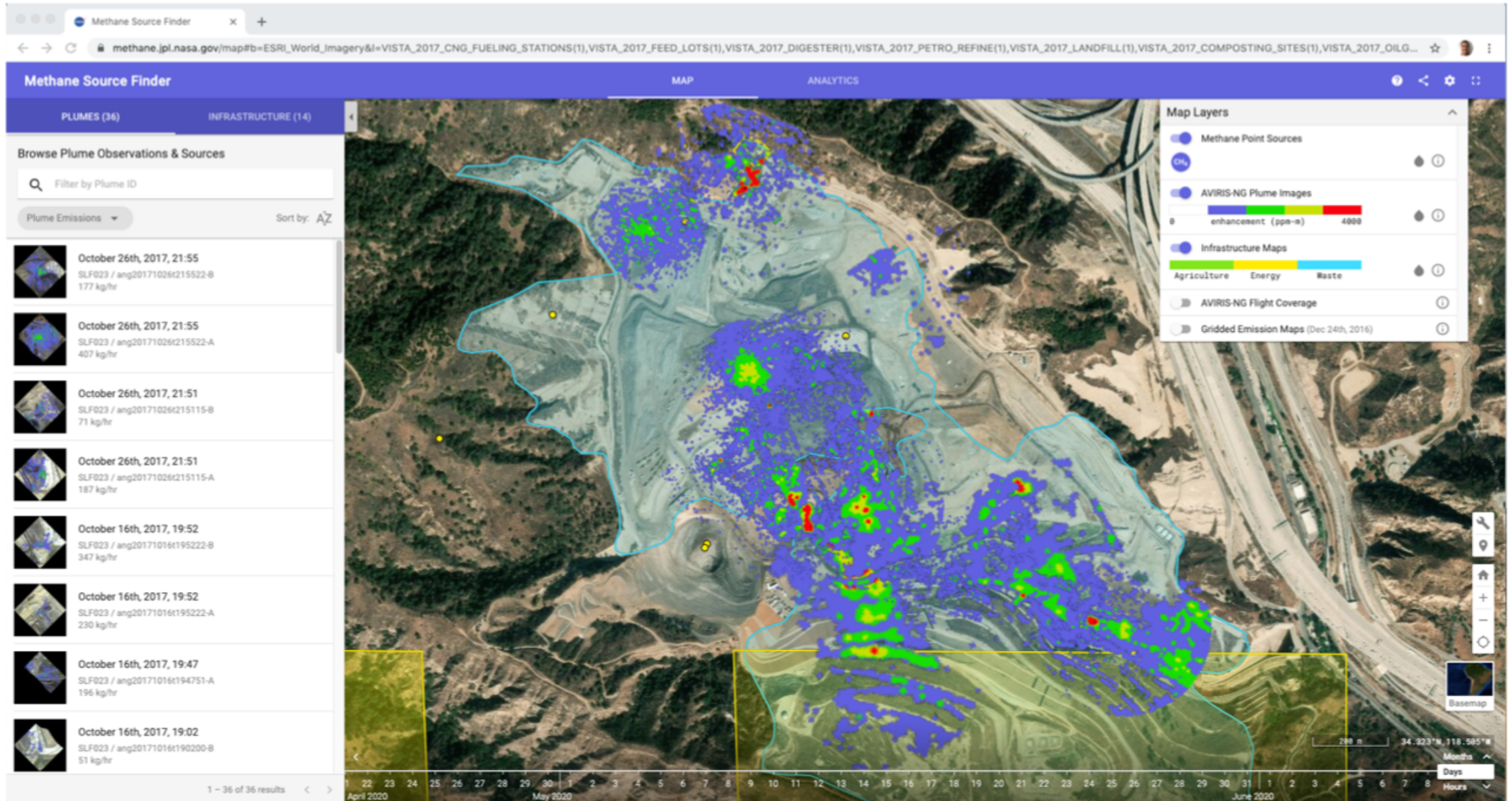 - Provide opportunities for mitigation

Methane Source Finder: LA Basin CH$_4$ hotspots
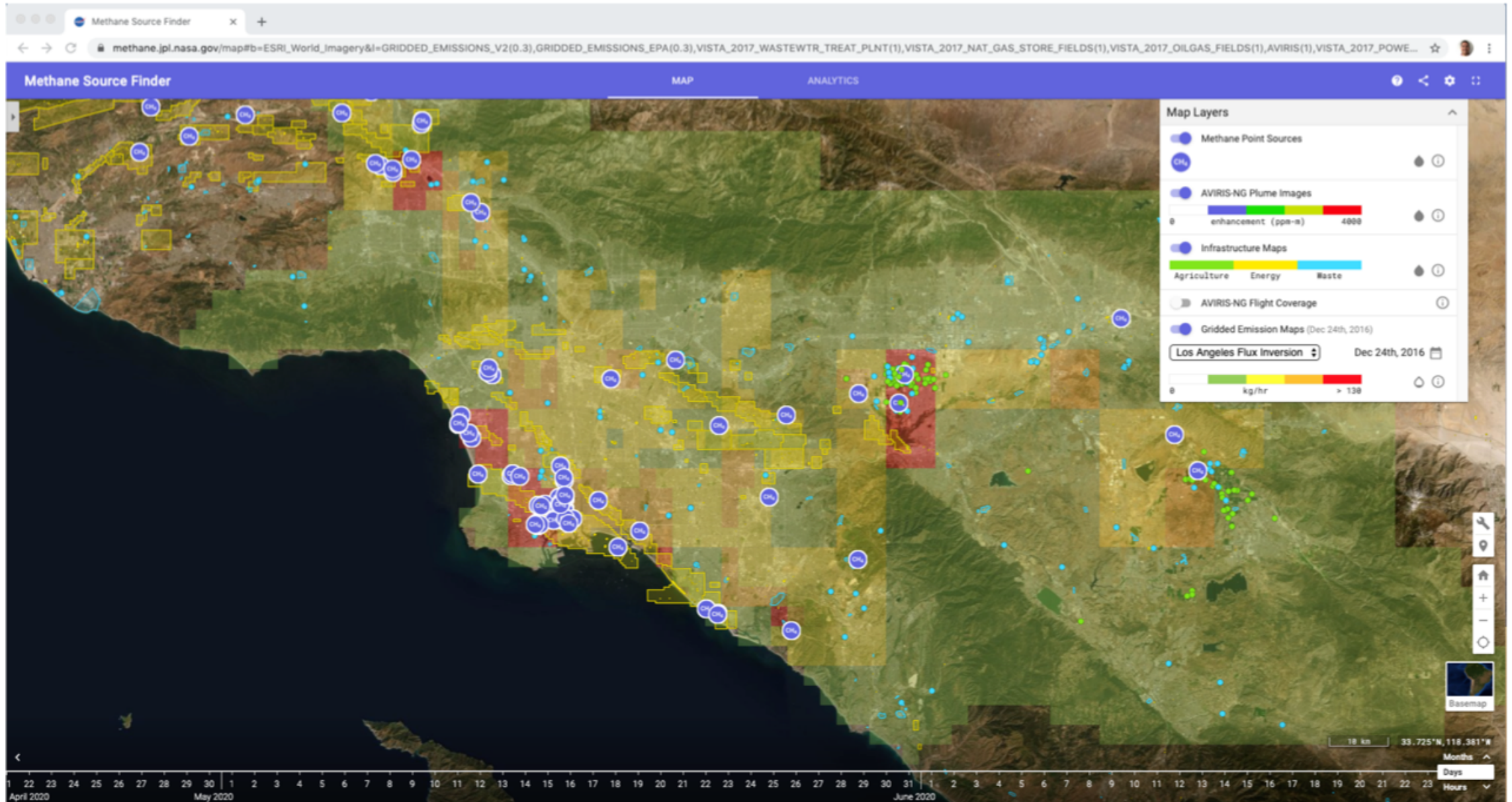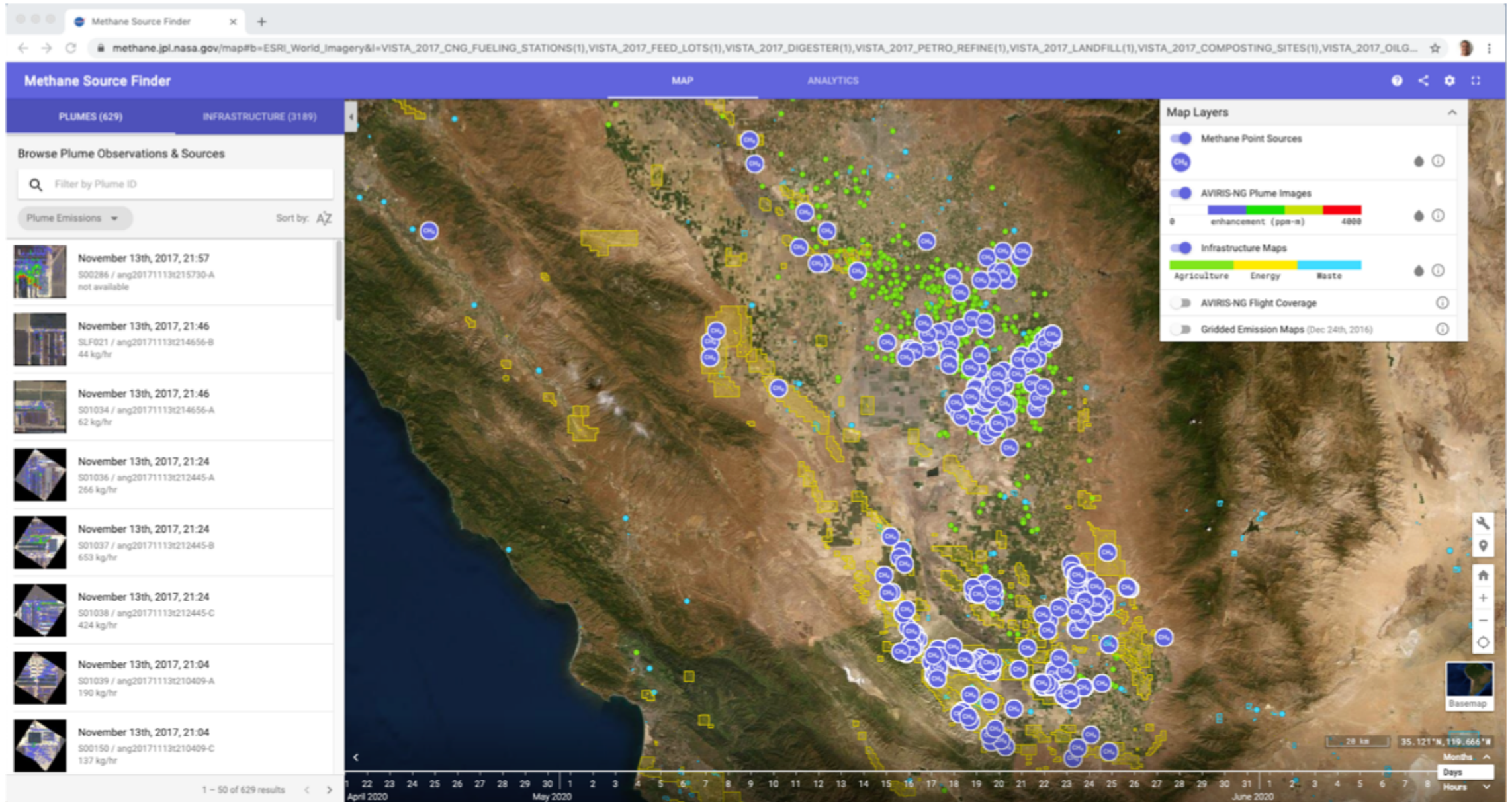
LA Basin CH$_4$ from energy sector

LA Basin CH$_4$ from energy sector

LA Basin CH$_4$ from landfill

San Joaquin Valley CH$_4$ emissions

San Joaquin Valley CH$_4$ from energy sector

San Joaquin Valley CH$_4$ from dairy digester

Methane Source Finder facilitates stakeholder engagement

CA Methane Survey

Energy sector

Waste management sector
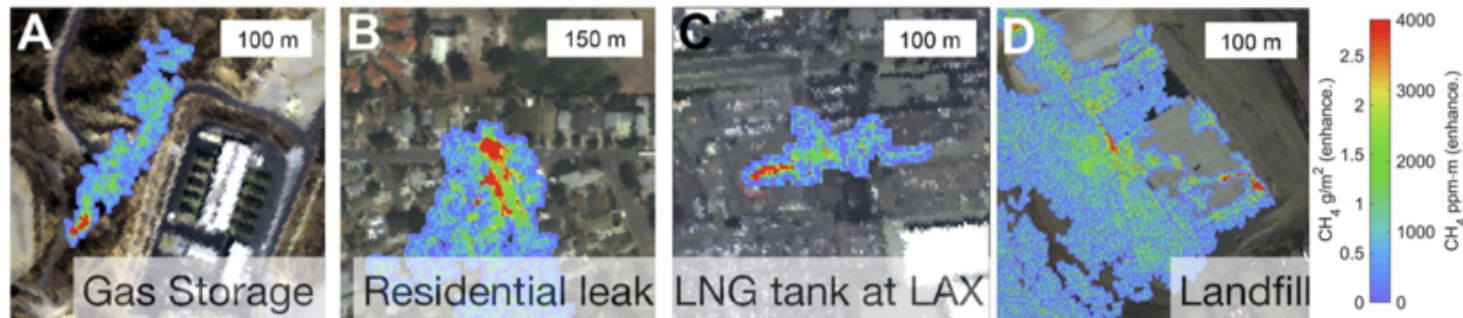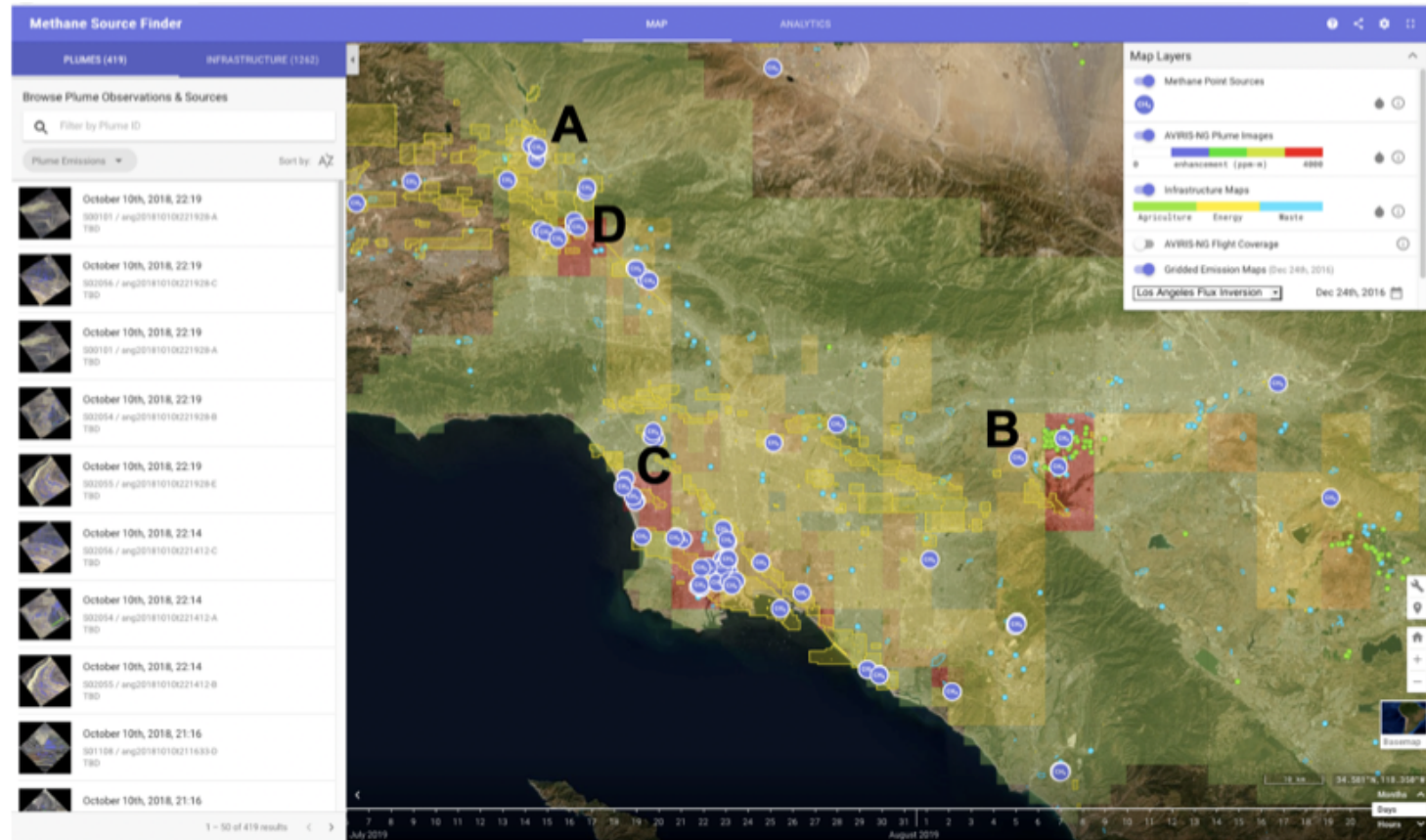

Dairy groups

Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not constitute or imply its endorsement by the United States Government or the Jet Propulsion Laboratory, California Institute of Technology.

Methane Source Finder facilitates mitigation

California Methane Survey scientific findings

1) Multiple revisits of facilities permitted assessment of persistence:

   - Oil & gas, dairy: 20-35% (mean) persistence

   - Landfills: 100% persistence

2) Emissions were calculated for 564 methane point sources

3) Estimated emissions from methane point sources in California:

   - 0.618 $TgCH_4$ yr^{-1} (95% confidence 0.523-0.725)

   - Equivalent to 34-46% of 2016 methane inventory

4) Super-emitter activity occurs in every surveyed sector (10% of point sources contributed ~60% of point source emissions)

nature > articles > article

nature

Article | Published: 06 November 2019

California's methane super-emitters

Riley M. Duren ✉, Andrew K. Thorpe, Kelsey T. Foster, Talha Rafiq, Francesca M. Hopkins, Vineet Yadav, Brian D. Bue, David R. Thompson, Stephen Conley, Nadia K. Colombi, Christian Frankenberg, Ian B. McCubbin, Michael L. Eastwood, Matthias Falk, Jorn D. Herner, Bart E. Croes, Robert O. Green & Charles E. Miller

Future work: AVIRIS-NG CO_2 and CH_4 (complete carbon footprint)

Cusworth et al., in prep