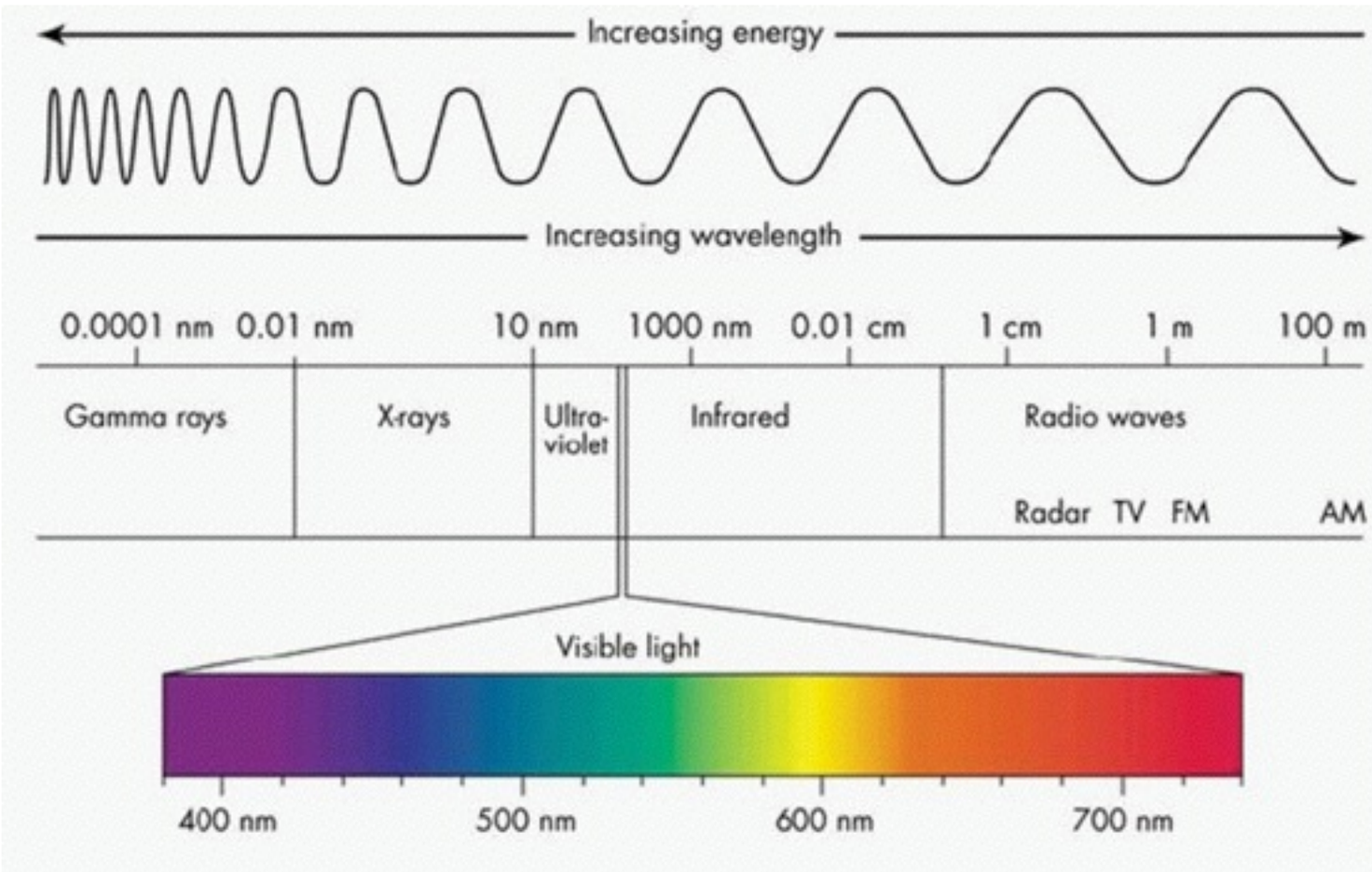
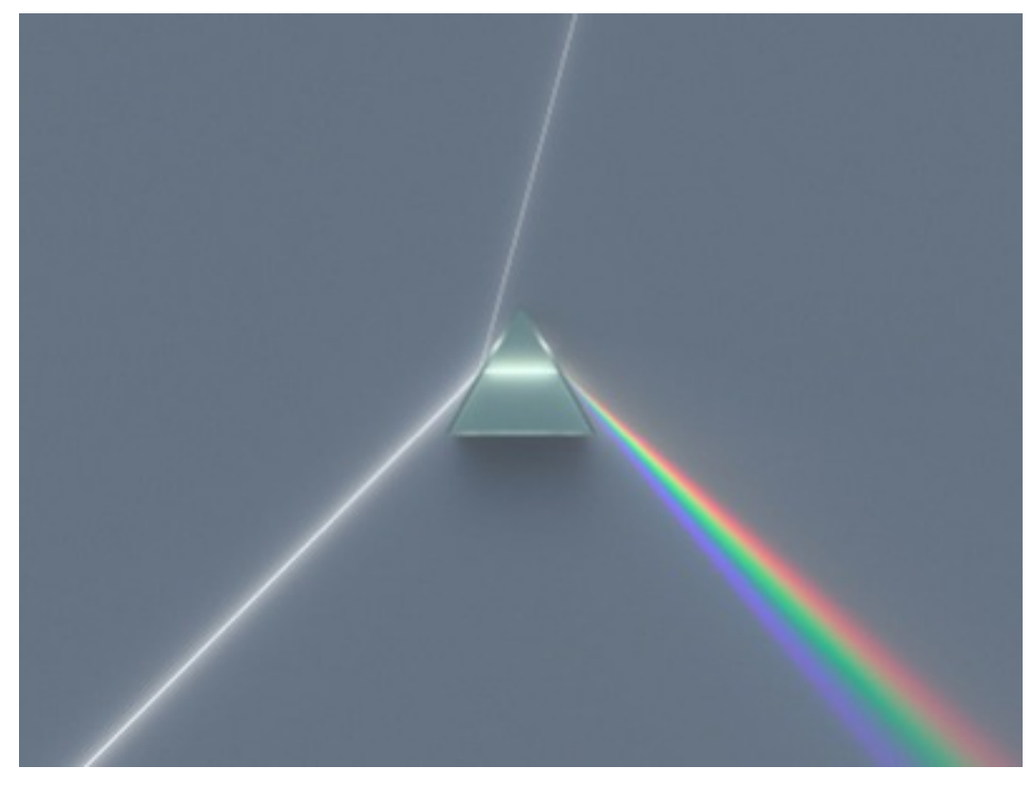
Jet Propulsion Laboratory
California Institute of Technology

Space and airborne remote sensing of atmospheric methane — 4-Corners case study

Christian Frankenberg and the AVIRIS-NG and HyTES instrument teams
Jet Propulsion Laboratory / Caltech

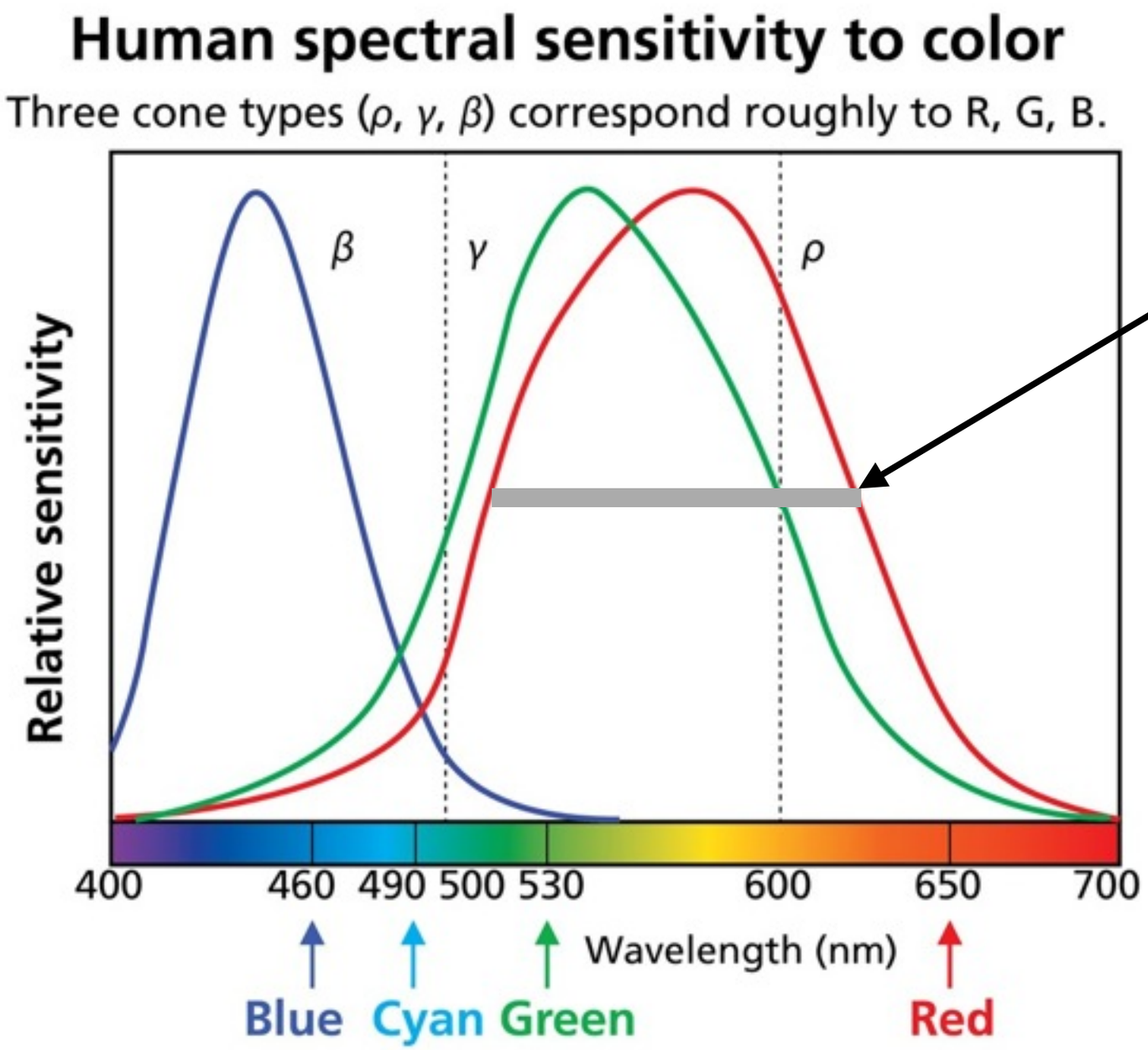
Spectra of light



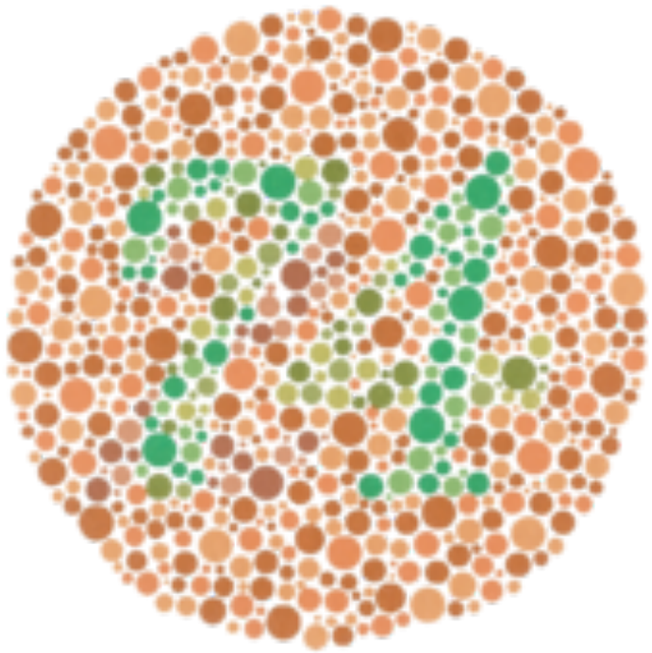


http://www.masterflex.com/TechLibraryArticle/1396

Human Eye — a simple 3-band spectrometer



Resolution
(50-100nm)



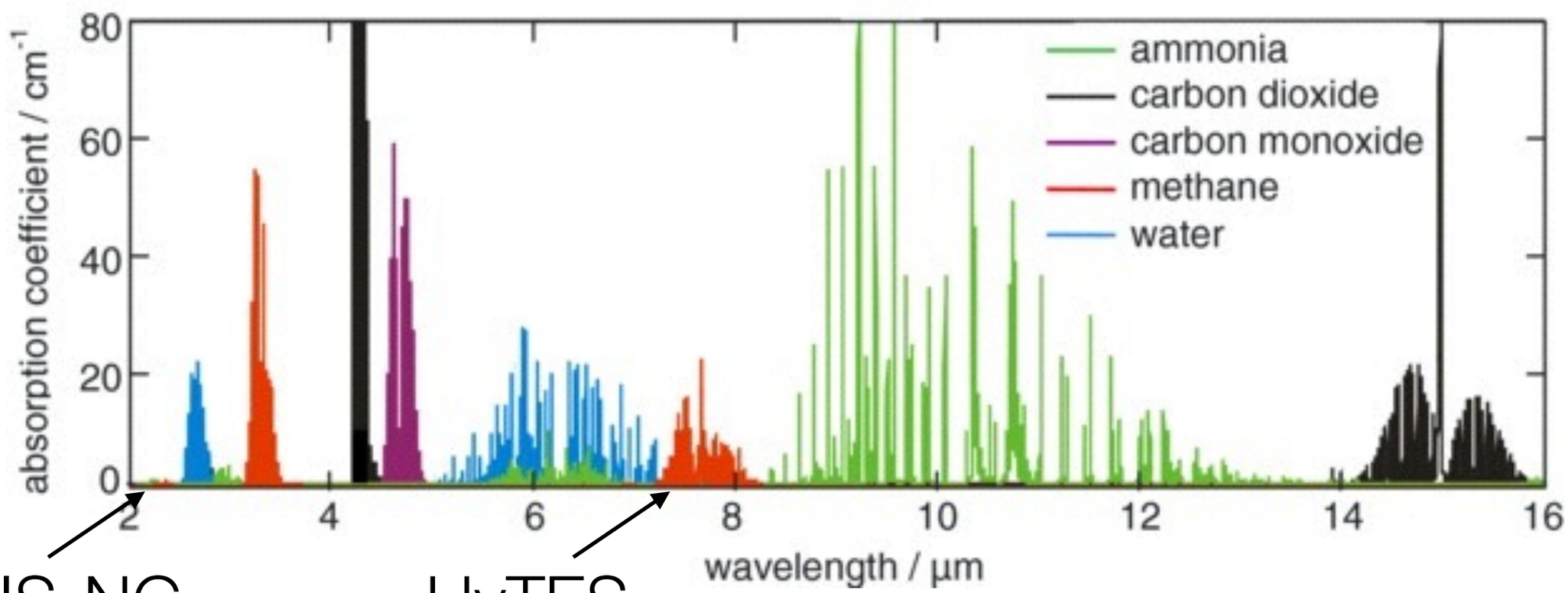
http://oceanoptics.com/wp-content/uploads/human_spectral_sensitivity_to_color-01.jpg

High Performance Spectrometers

- We are measuring light with “hundreds to thousands” of colors, in the visible and short-wave infrared (AVIRIS-NG) as well as Thermal Infrared (HyTES)

- This enables us to see “fingerprints” of methane, caused by specific absorption features (same principle that causes radiative forcing)

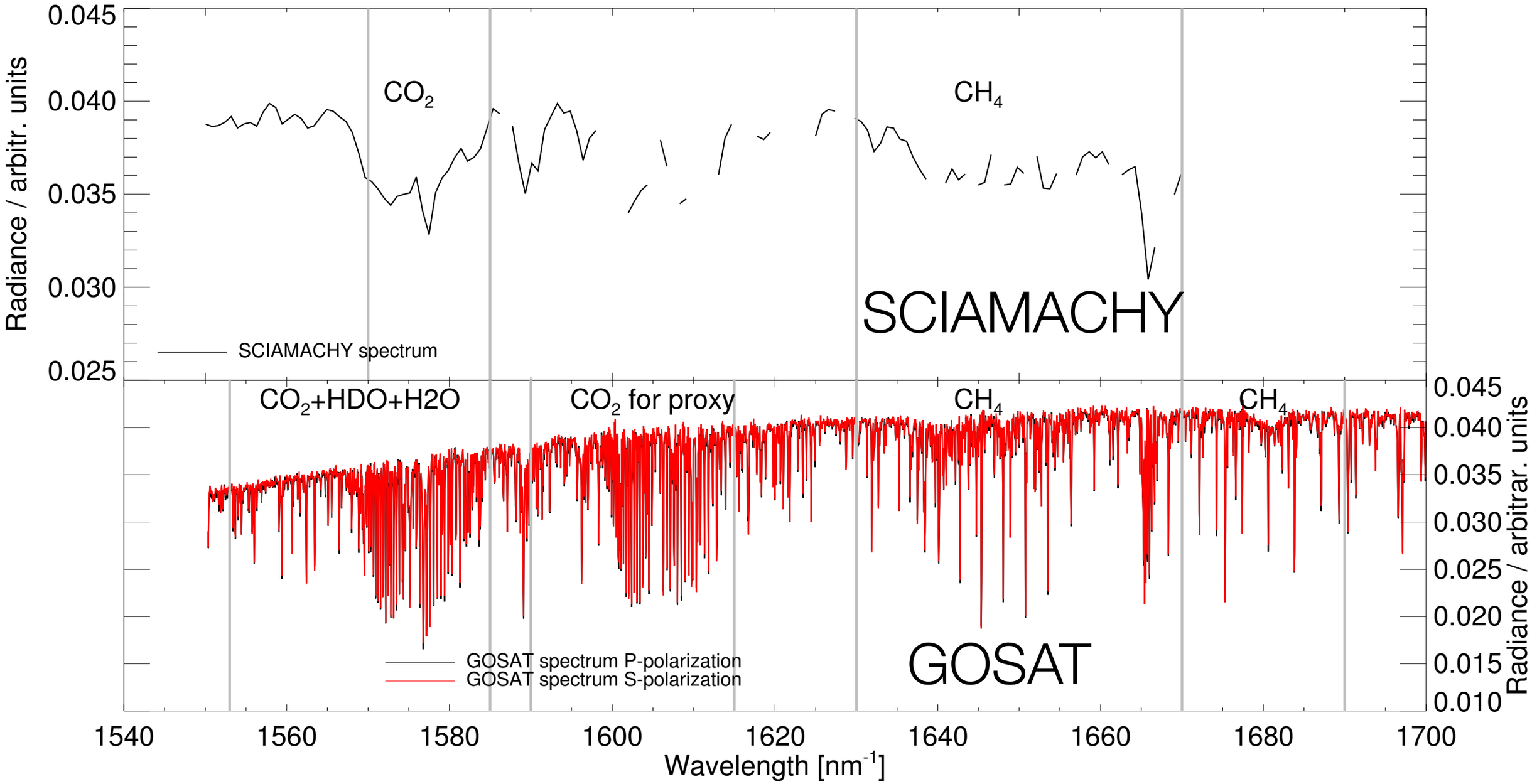
Figure 1 from Jane Hodgkinson and Ralph P Tatam 2013 Meas. Sci. Technol. 24 012004



AVIRIS-NG

HyTES

Spectra —> Concentrations —> global maps

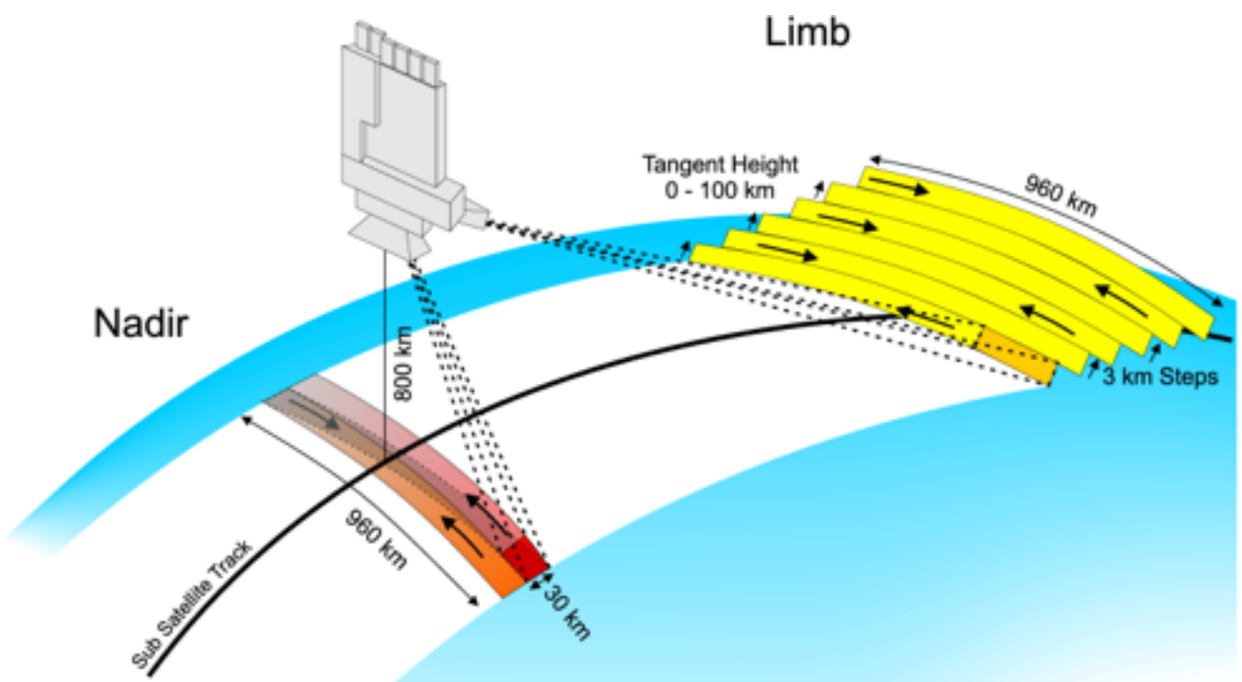


How do we measure methane?

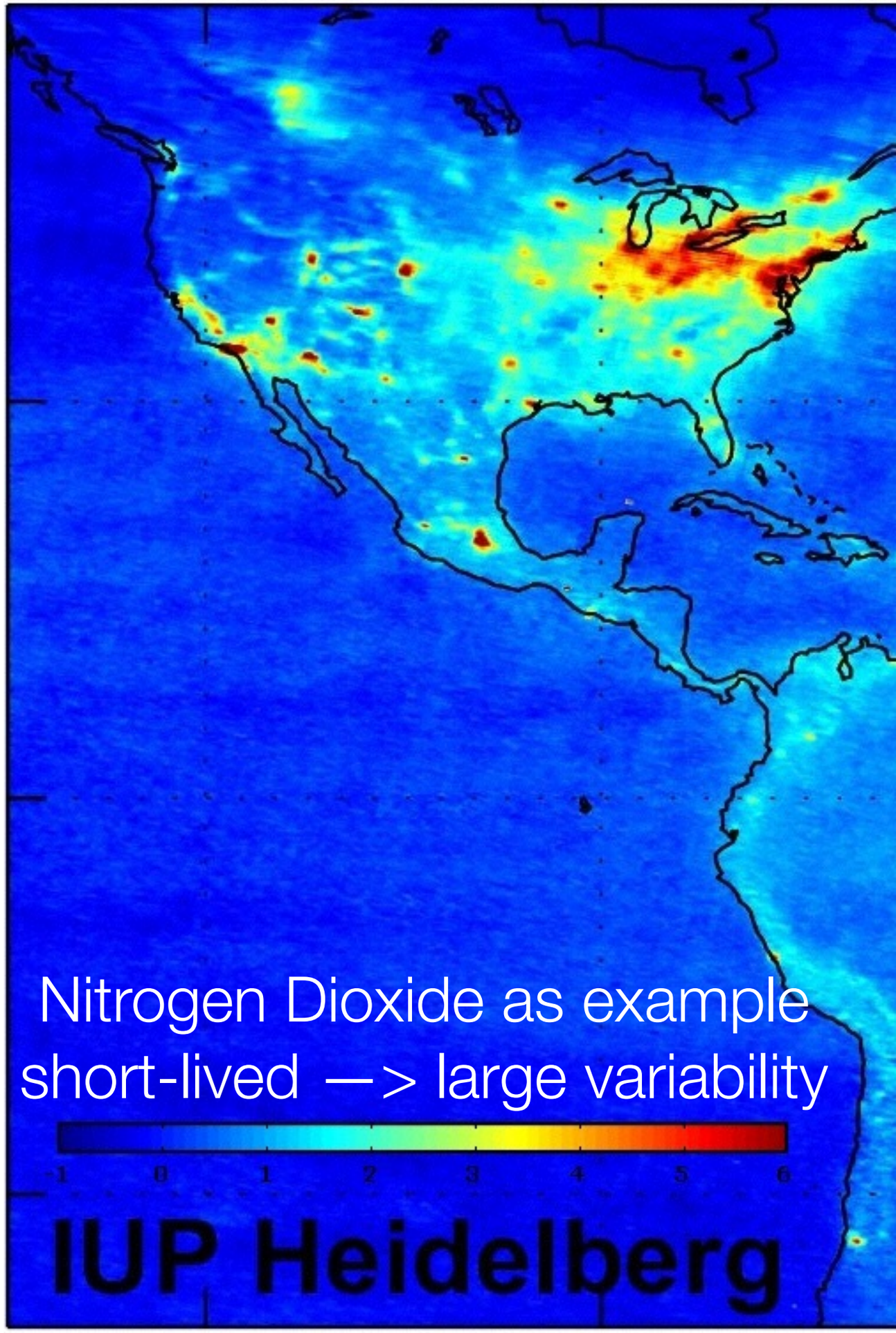
Absorption Spectroscopy

SCIAMACHY

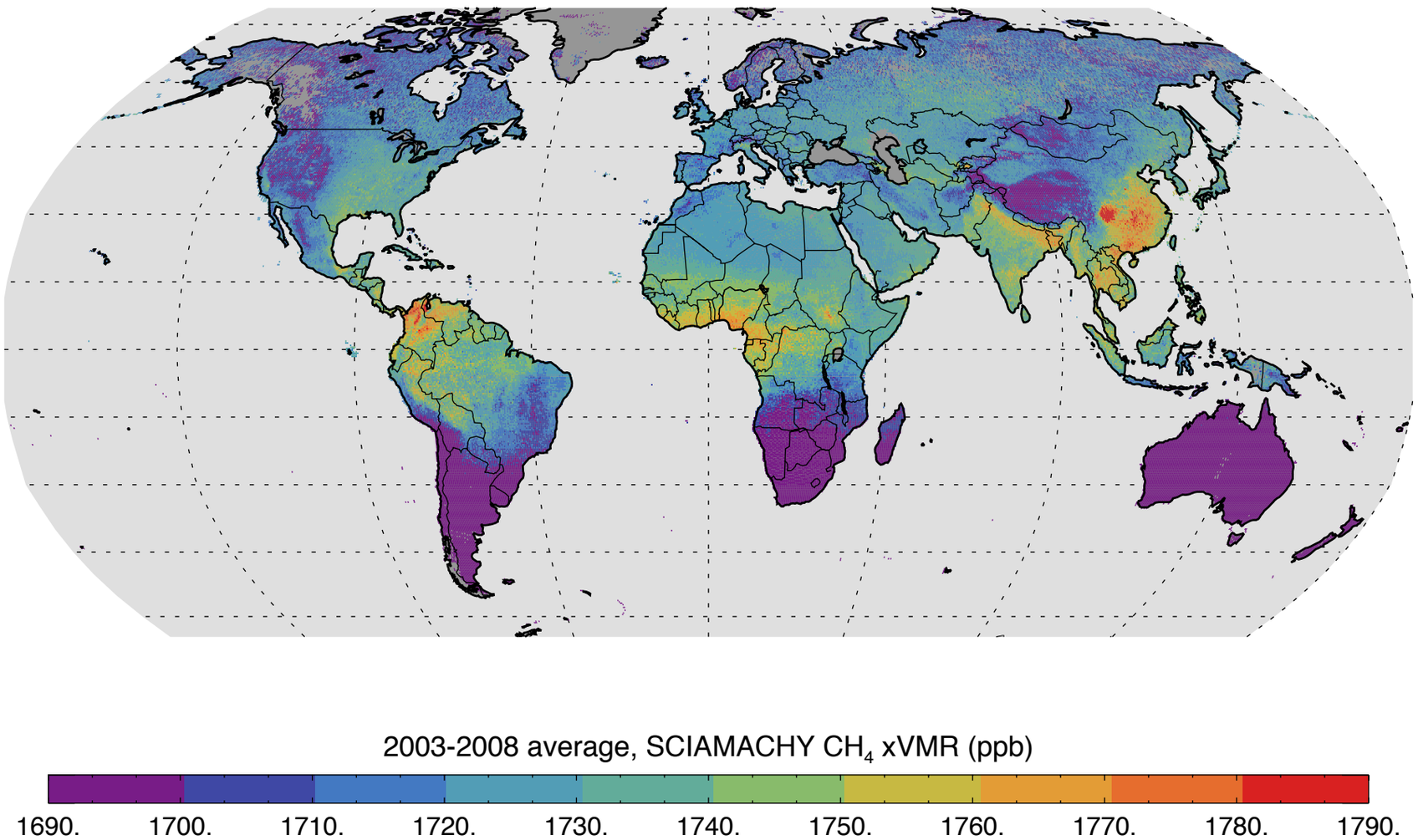
Scanning Imaging Absorption Spectrometer for Atmospheric Chartography



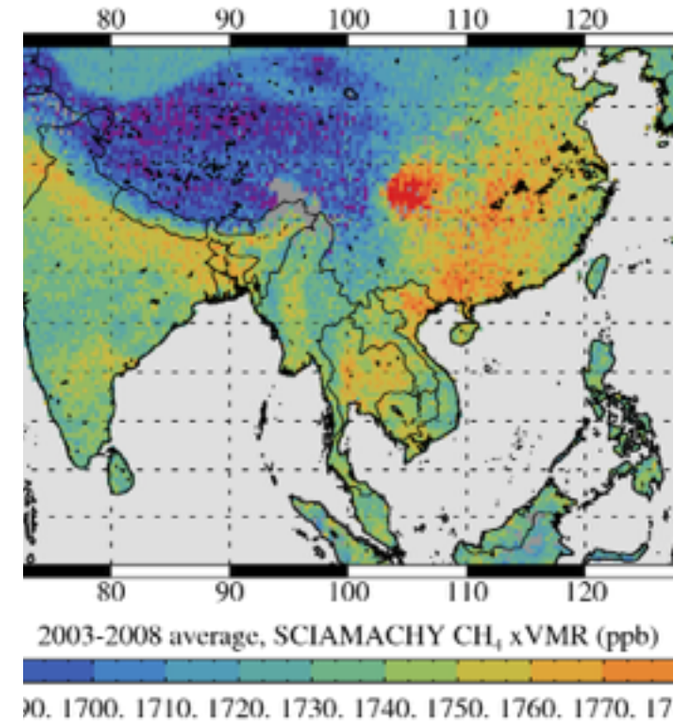
http://en.wikipedia.org/wiki/SCIAMACHY

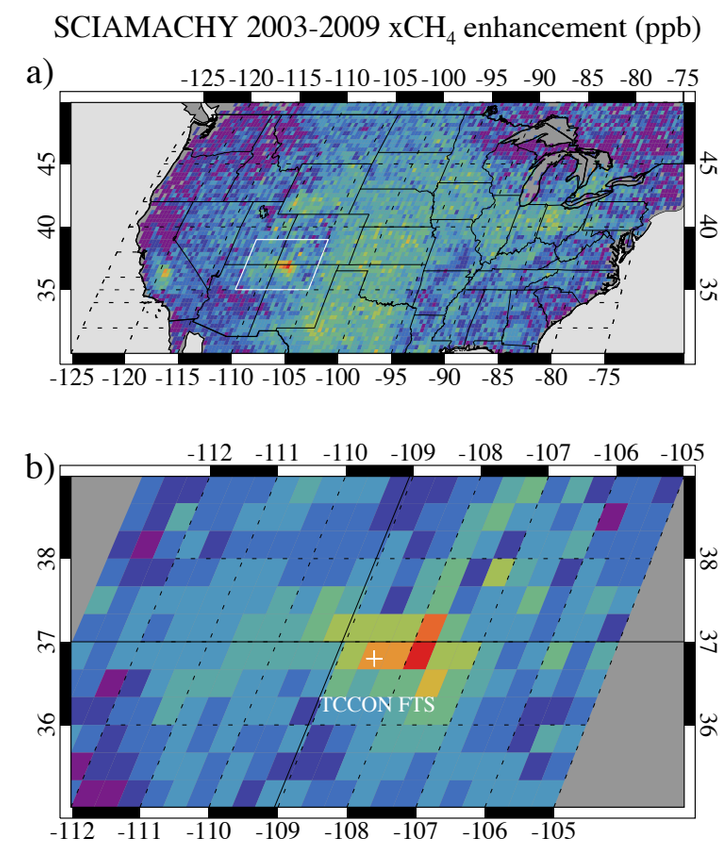


CH_4 Examples



Frankenberg et al, JGR 2011

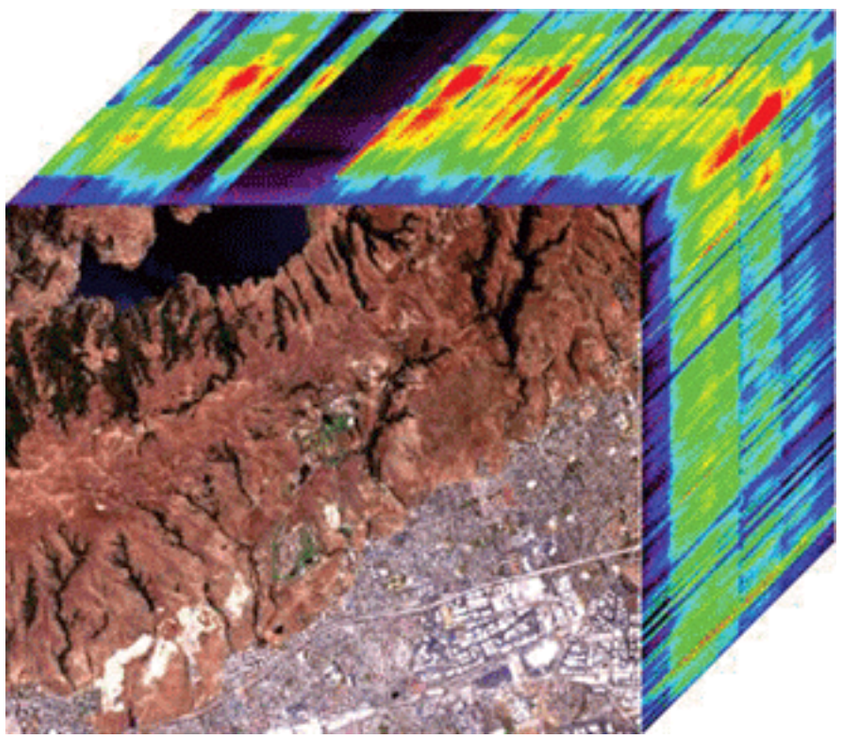


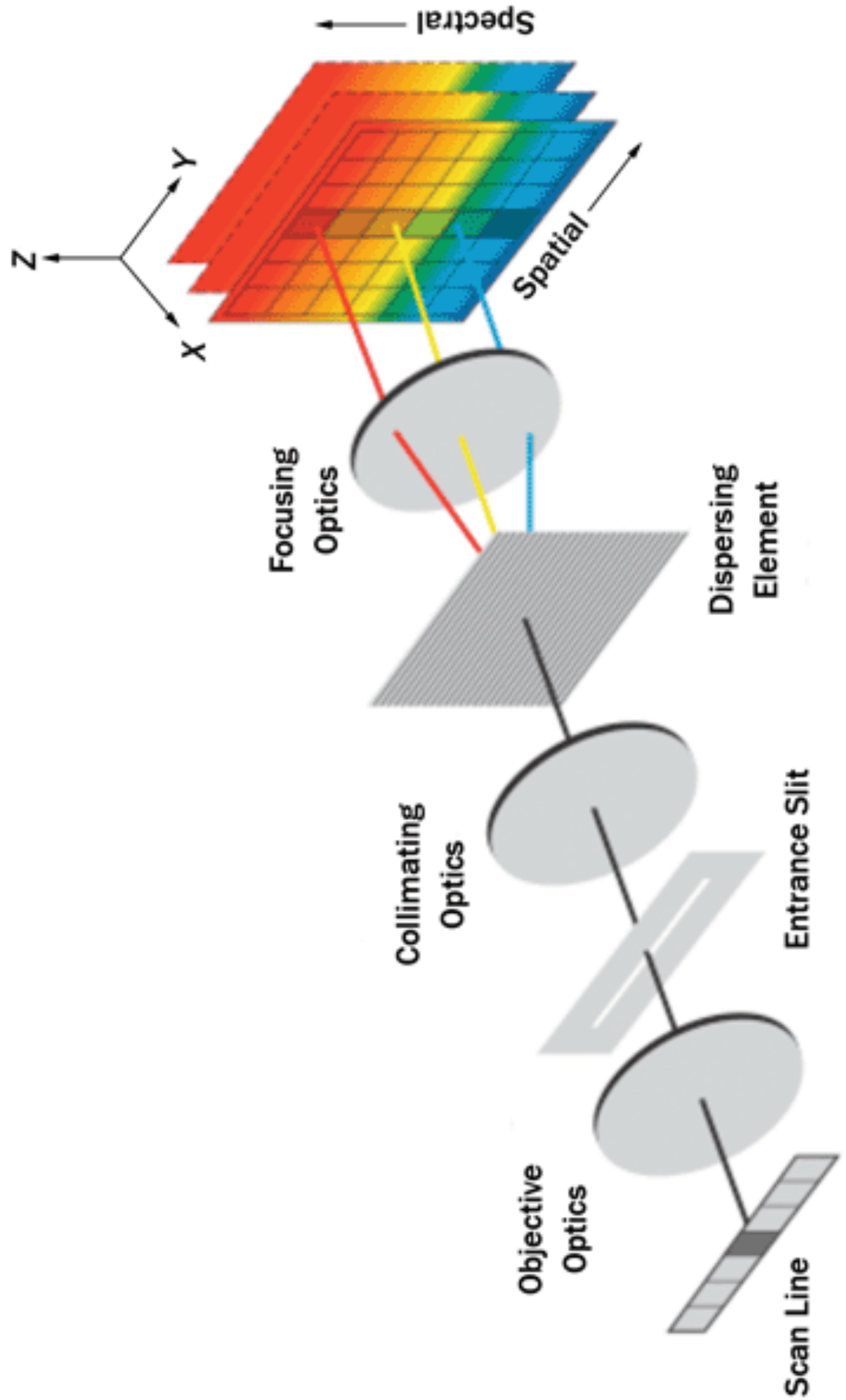


Kort et al, GRL 2014

4-Corners
Airborne remote sensing

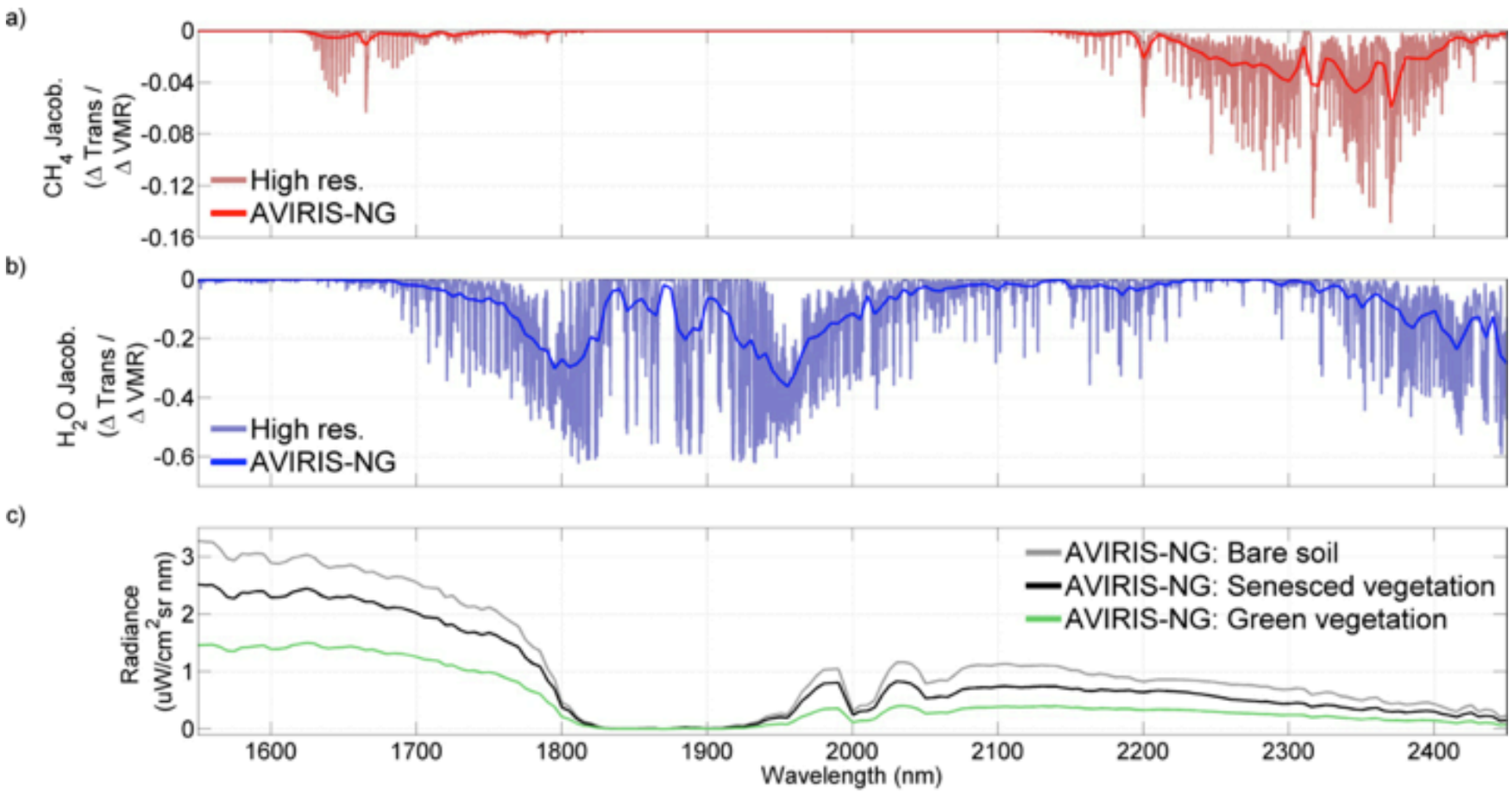
- Similar principle as satellites
- Take Hyperspectral Images from the aircraft in the short-wave (AVIRIS-NG) and thermal range (HyTES)

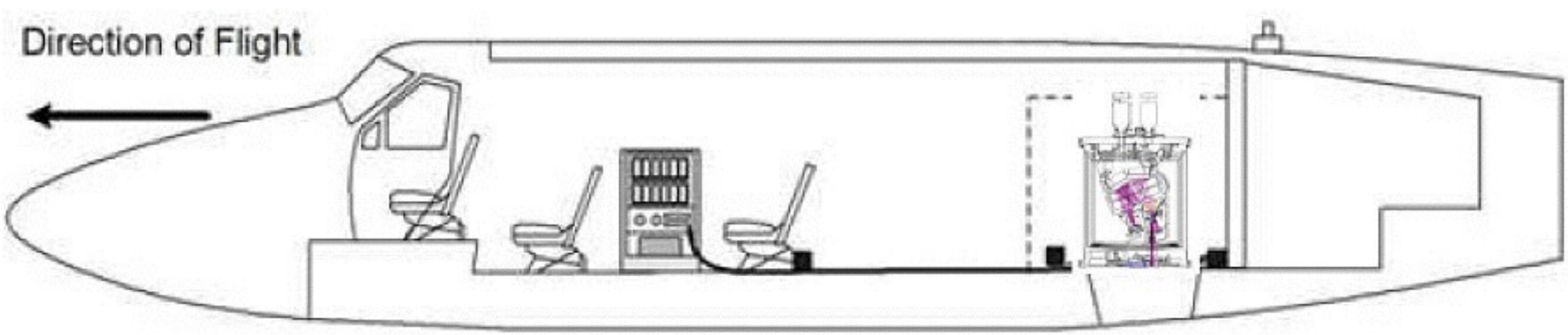




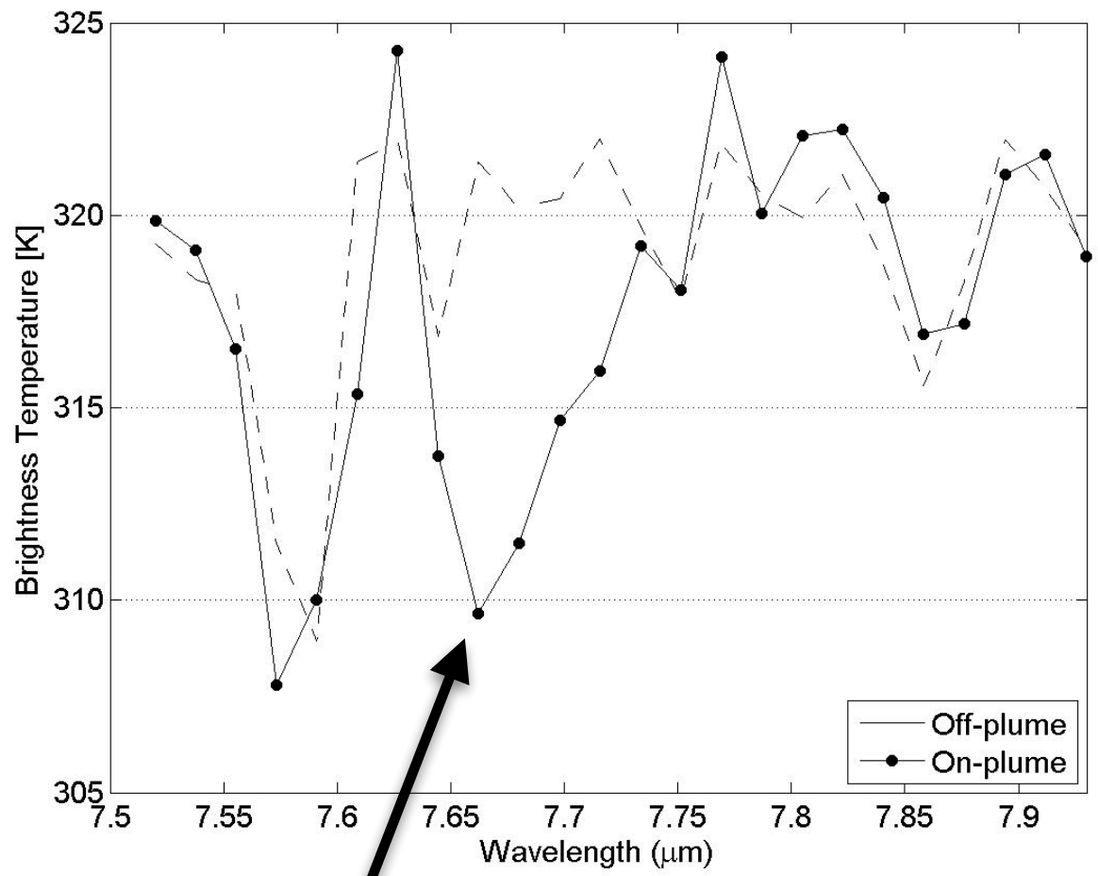
AVIRIS-NG Next-Generation Airborne Visible/Infrared Imaging Spectrometer

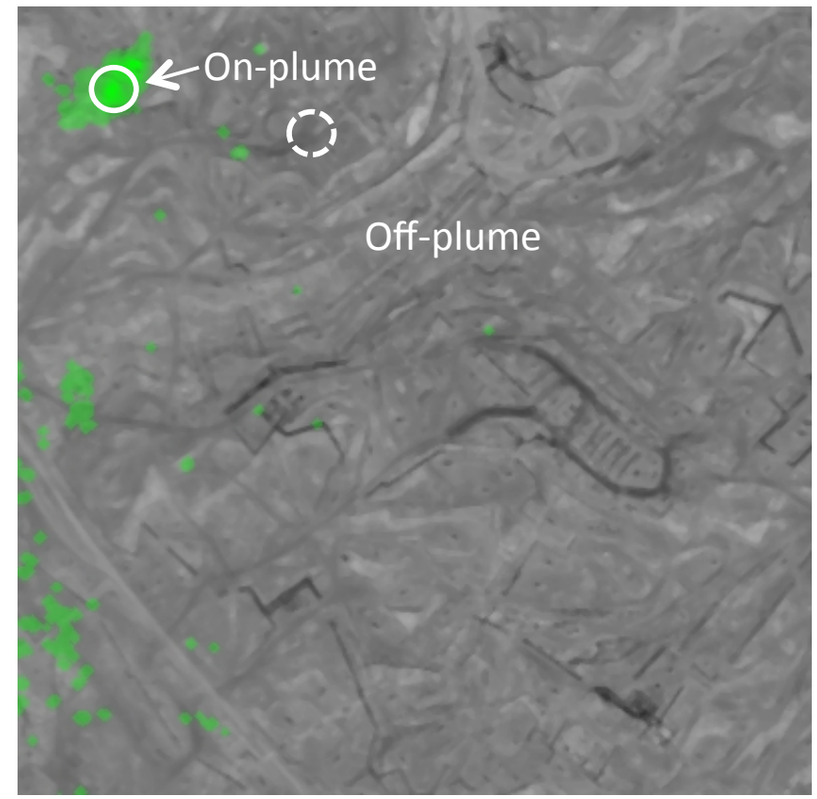
http://airbornescience.jpl.nasa.gov/instruments/avirisng



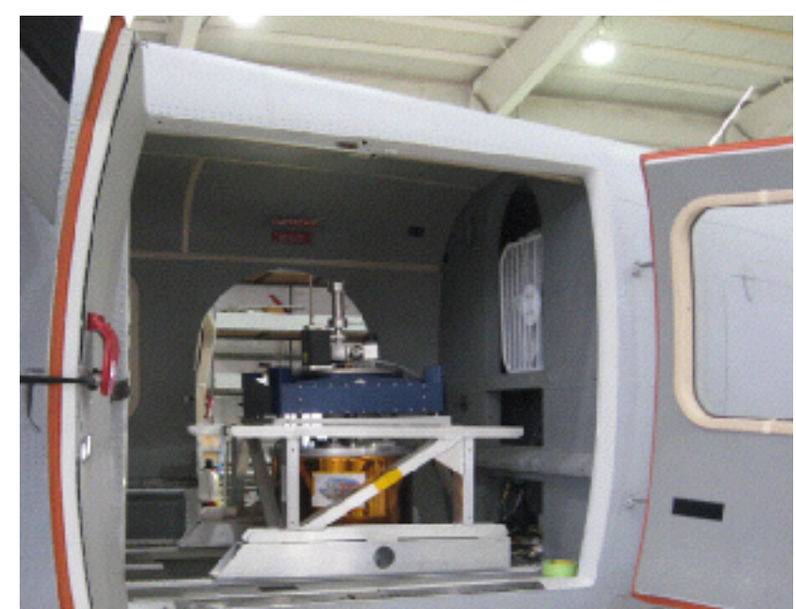


HyTES Hyperspectral Thermal Emission Spectrometer — http://hytes.jpl.nasa.gov/

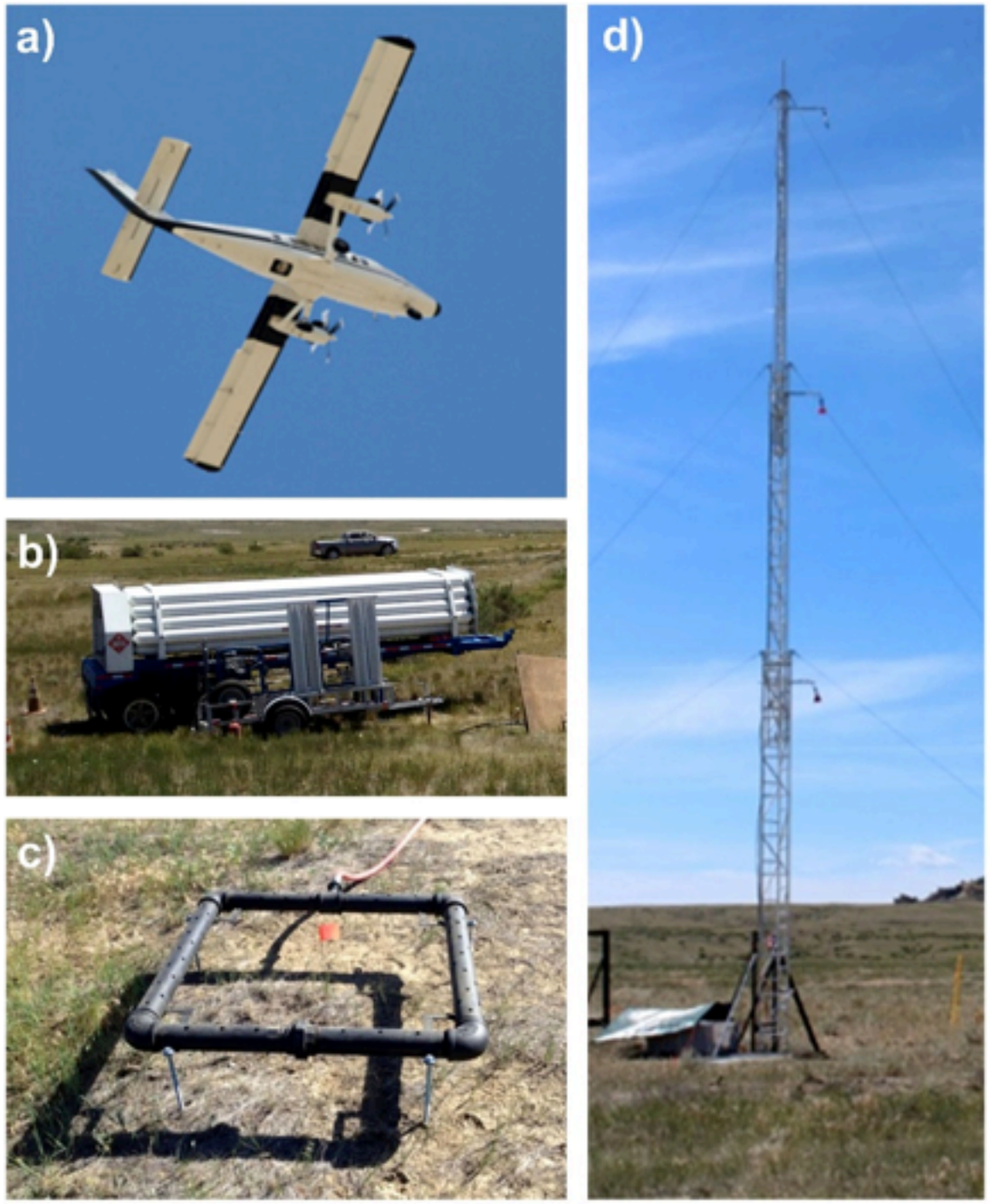


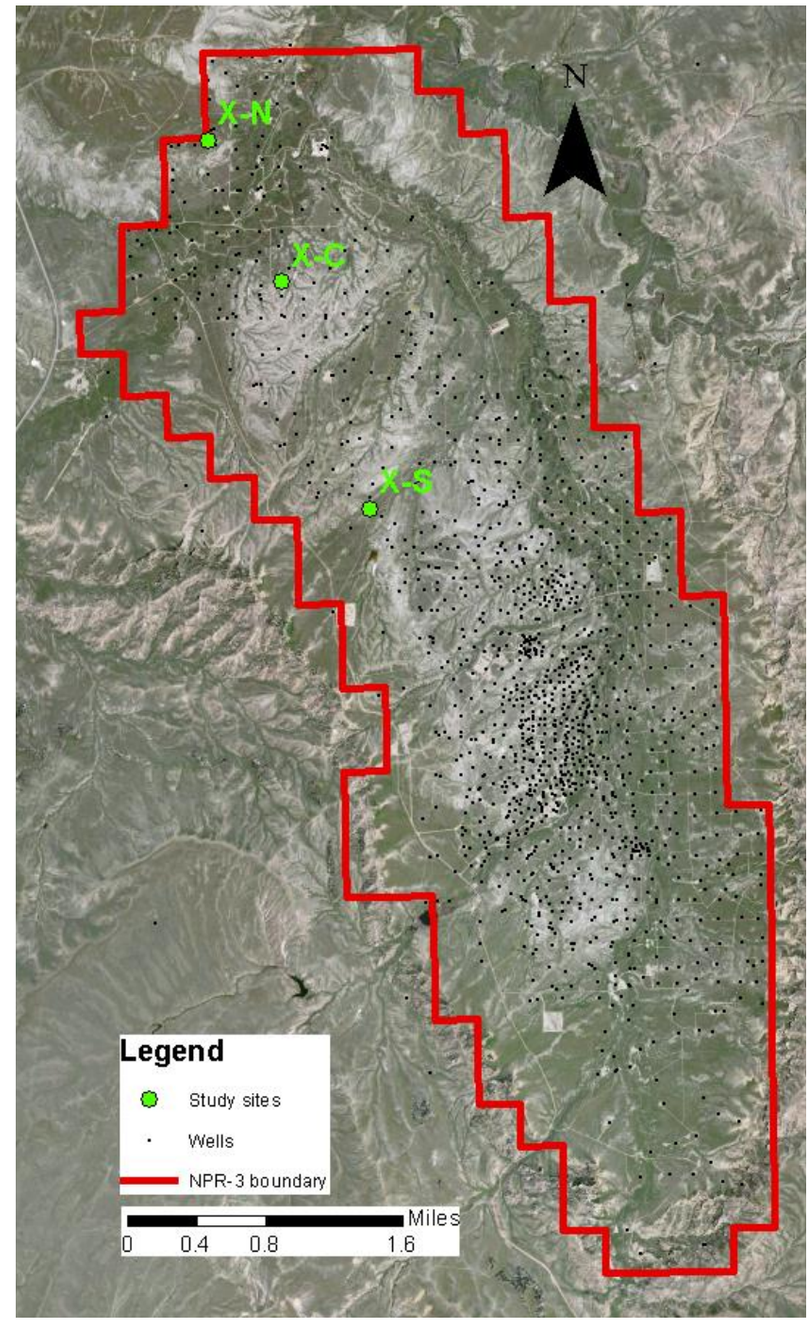


Methane absorption feature



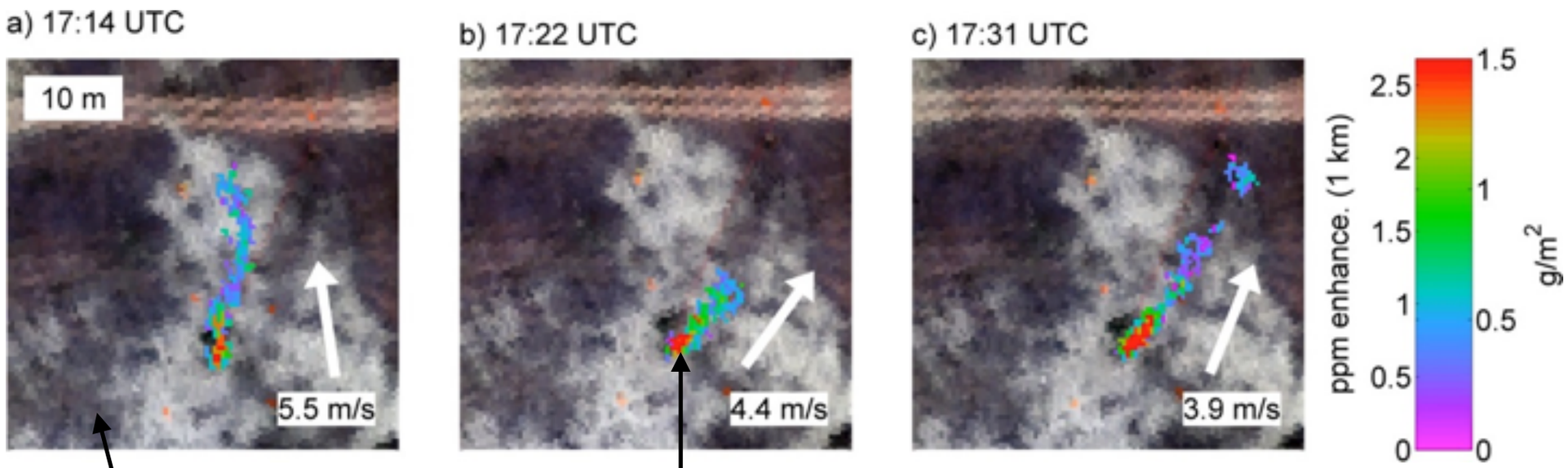
A controlled release experiment in Wyoming
RMOTC — Rocky Mountain Oilfield Testing Center





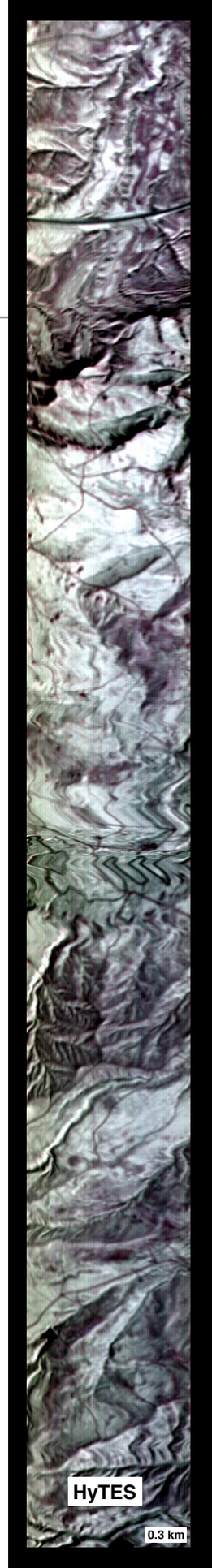
Fluxes ranging from 100-2500 scfh (cubic feet per hour methane)

Mapping Methane — AVIRIS-NG

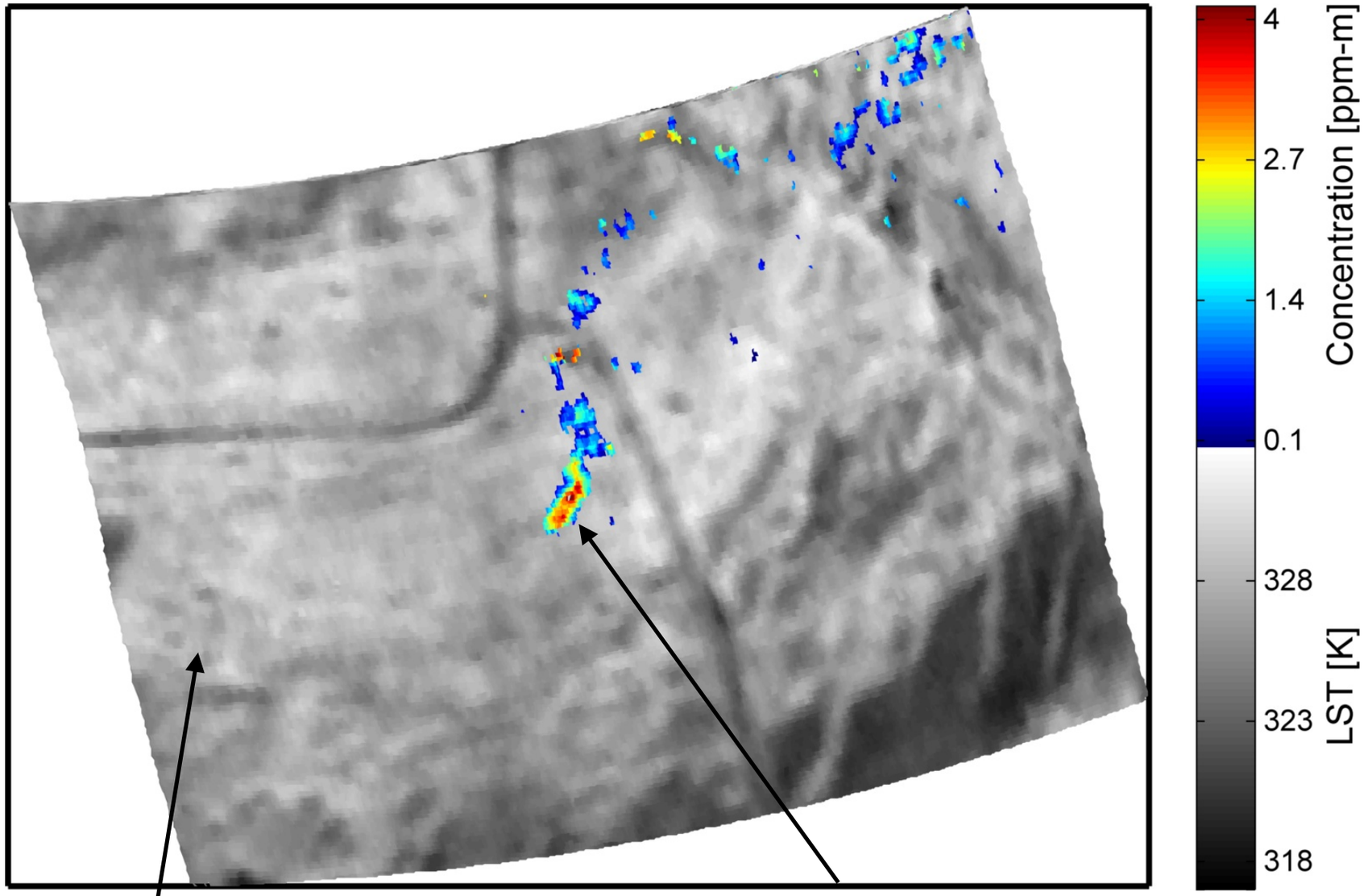


Plume is color-coded

Background is False Color image
(similar to how your eye would perceive it)

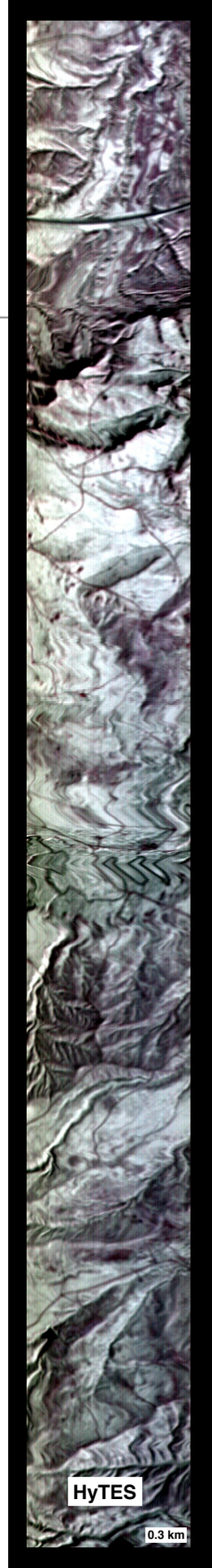


Mapping Methane —HyTES



Plume is color-coded

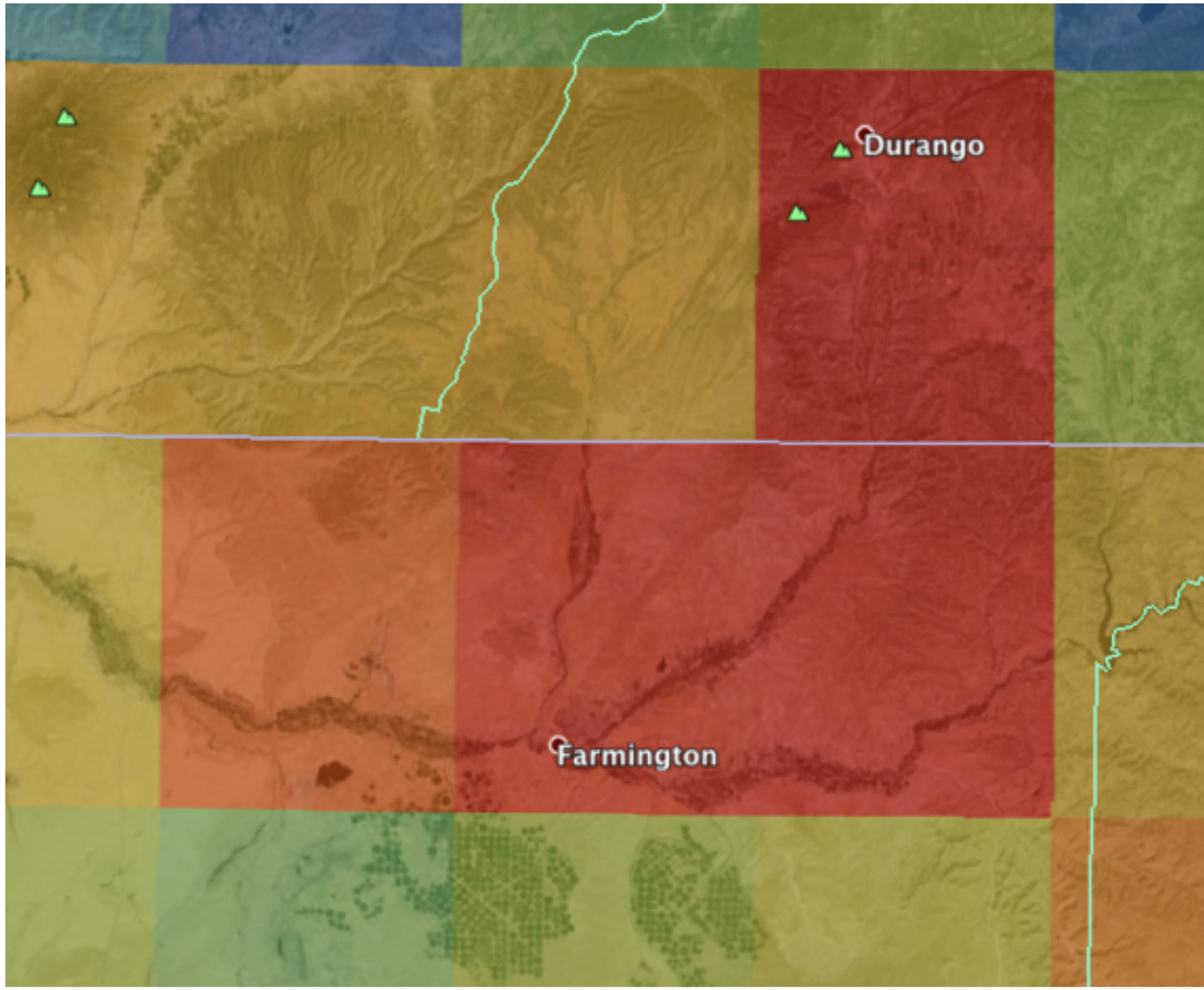
Background is Surface Temperature
(Thermal Emission Spectrometer)



Our role at 4-Corners

Provide a zoom into the region

SCIAMACHY had 60x30km ground pixels

We have 1x1m

Spectrometers not optimized for methane but will be able to detect point sources