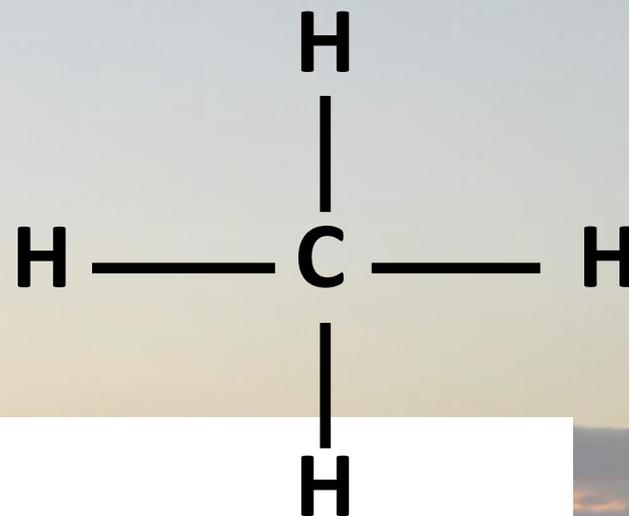


# Methane Hot Spot in the Four Corners Region

Eric Kort, University of Michigan  
+ many other collaborators from NOAA, JPL, LANL,  
Caltech and elsewhere  
<http://aoss-research.engin.umich.edu/faculty/kort/>

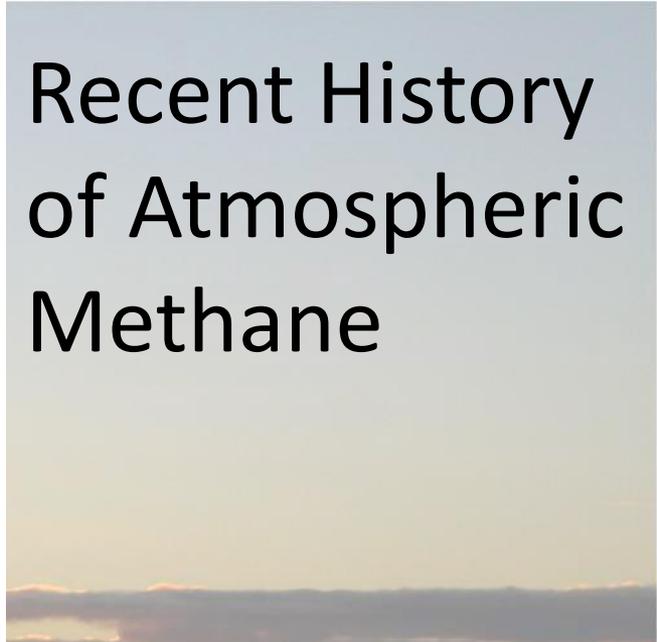
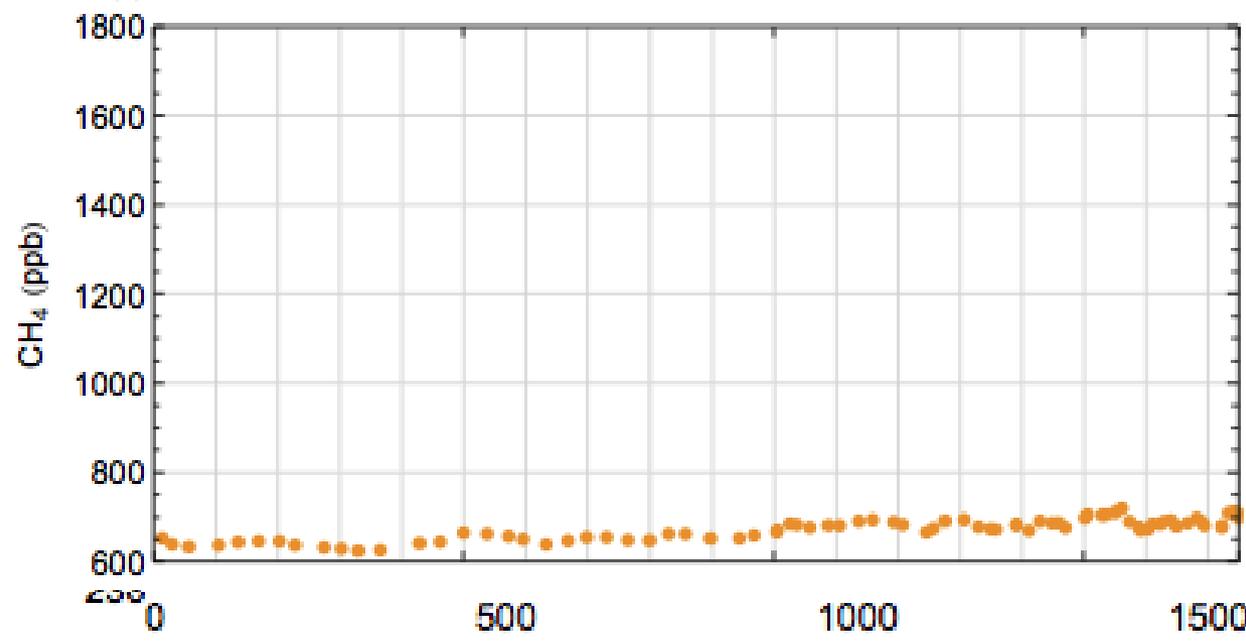


Context: What is methane and why are we interested in it?

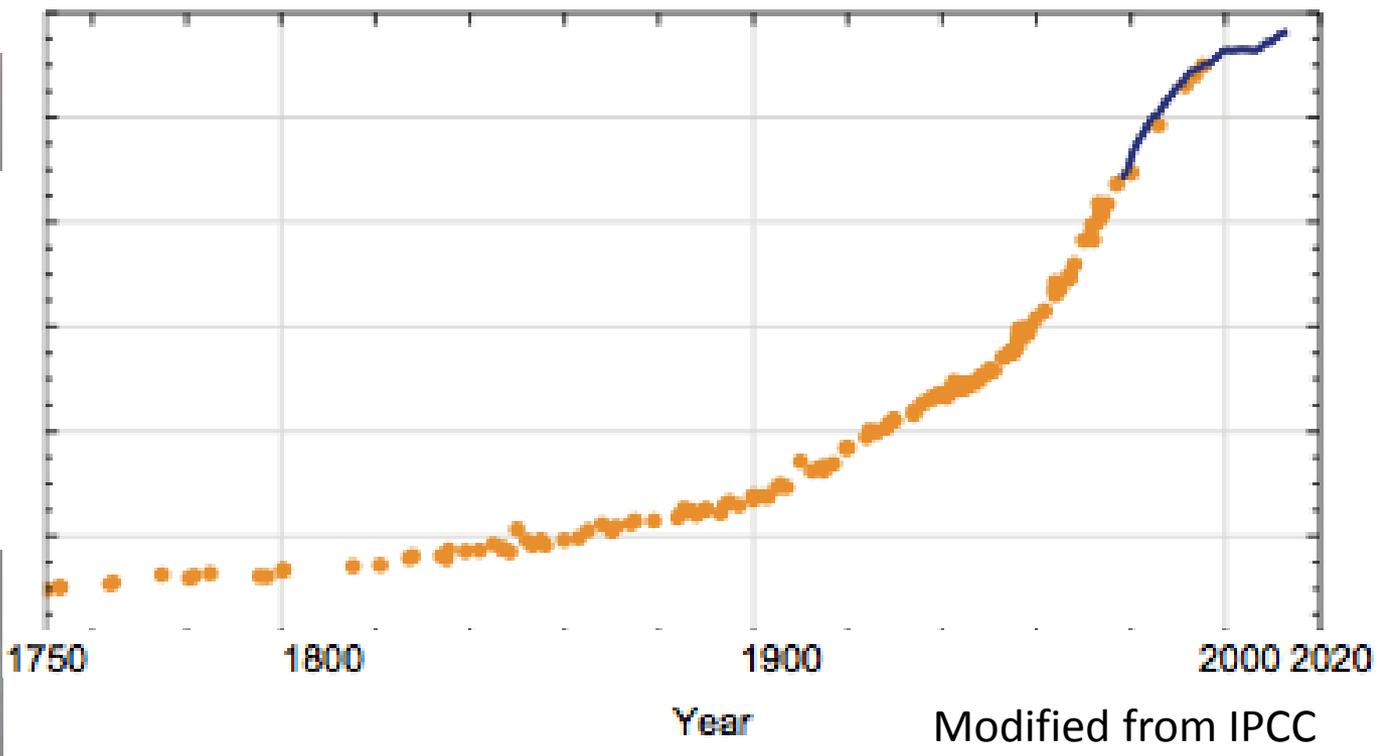


- Methane: CH<sub>4</sub>
- Importance Atmospheric Greenhouse Gas
  - Increasing atmospheric concentrations increases temperature
- On 100-yr time frame, 1 kg of methane released equivalent to ~30 kg of CO<sub>2</sub>

# Recent History of Atmospheric Methane



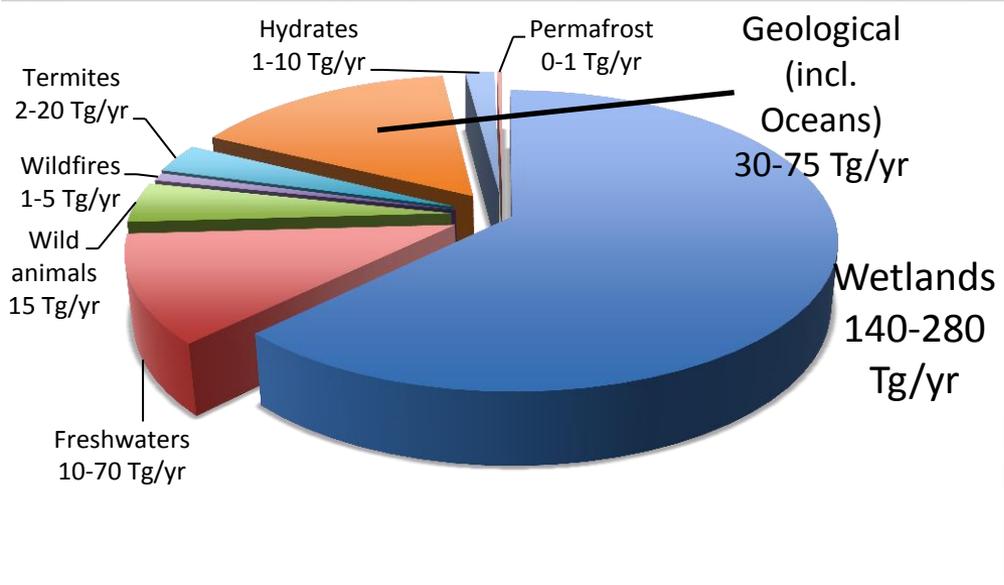
From ~700 ppb pre-industrial  
To ~1800 ppb presently



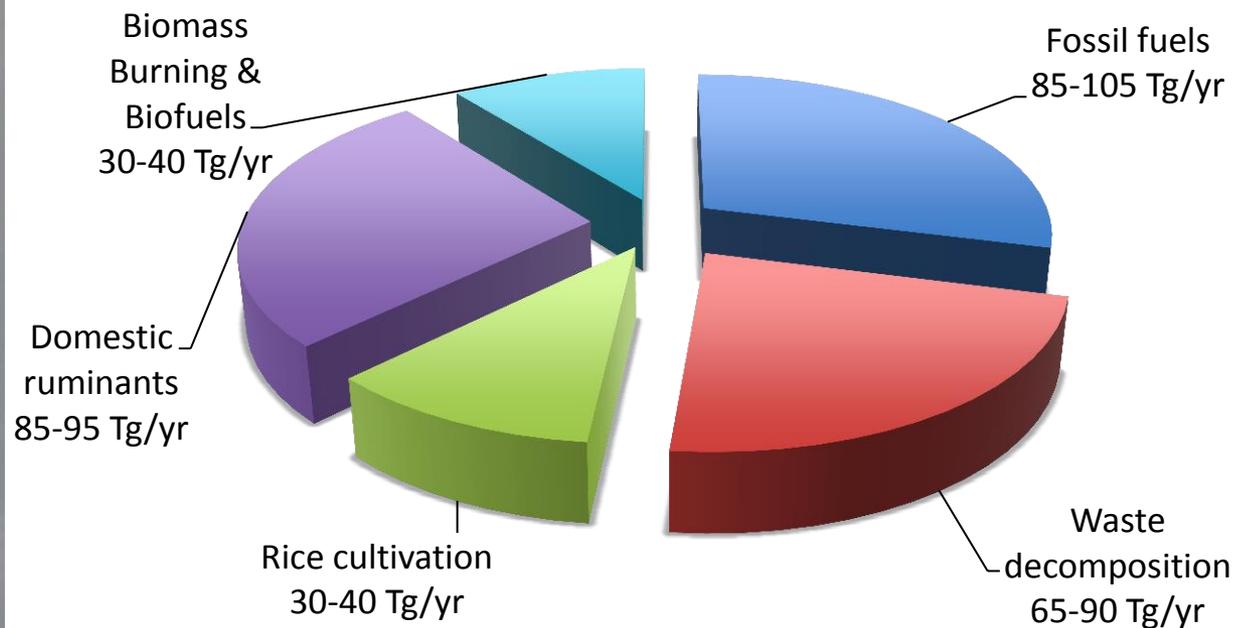
Modified from IPCC

# Sources of Methane

## Natural



## Human-Caused



# Methane emissions in the US: Current State of knowledge

ENERGY AND ENVIRONMENT

## Methane Leaks from North American Natural Gas Systems

Methane emissions from U.S. and Canadian natural gas systems appear larger than official estimates.

A. R. Brandt,<sup>1\*‡</sup> G. A. Heath,<sup>2</sup> E. A. Kort,<sup>3</sup> F. O'Sullivan,<sup>4</sup> G. Pétron,<sup>5,6</sup> S. M. Jordaan,<sup>7</sup> P. Tans,<sup>5</sup> J. Wilcox,<sup>1</sup> A. M. Gopstein,<sup>8†</sup> D. Arent,<sup>2,9</sup> S. Wofsy,<sup>10</sup> N. J. Brown,<sup>11</sup> R. Bradley,<sup>12</sup> G. D. Stucky,<sup>13</sup> D. Eardley,<sup>13</sup> R. Harriss<sup>14</sup>

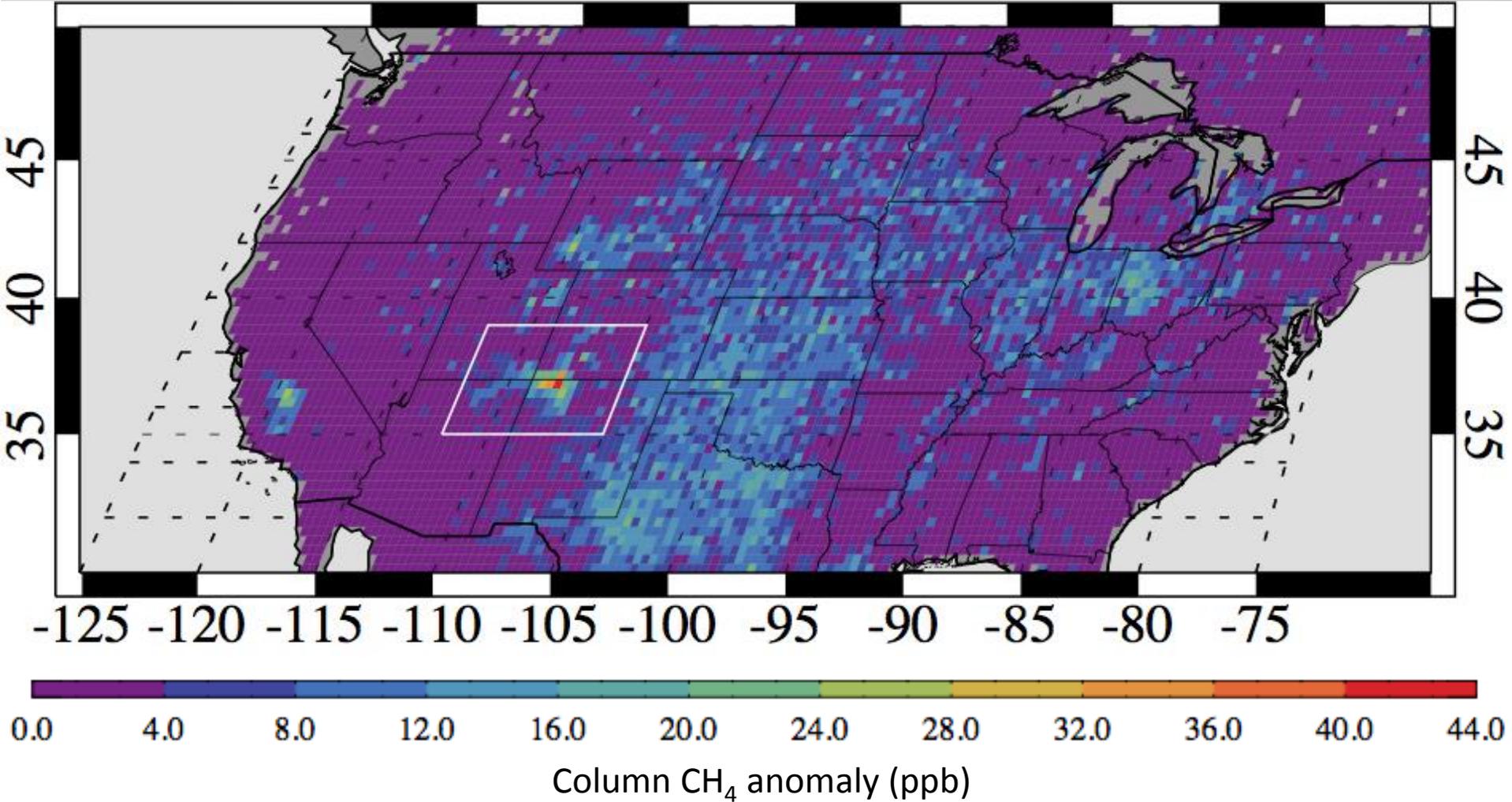
- Reviewed ~200 references from scientific and technical literature
- Reviewed studies at all scales: individual sources (e.g., NG compressors) to continental atmospheric studies
- Focused on studies with original measurements

### Major Findings:

- official inventories consistently underestimate actual methane emissions, with natural gas and oil sectors as important contributors
- assessments using 100-year impact indicators show system-wide leakage is unlikely to be large enough to negate climate benefits of coal-to-NG substitution.

# Four Corners

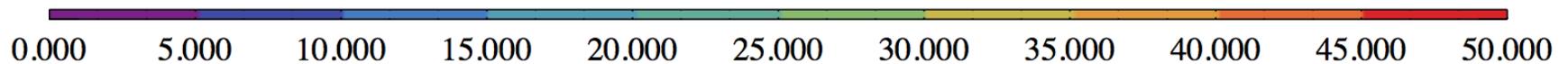
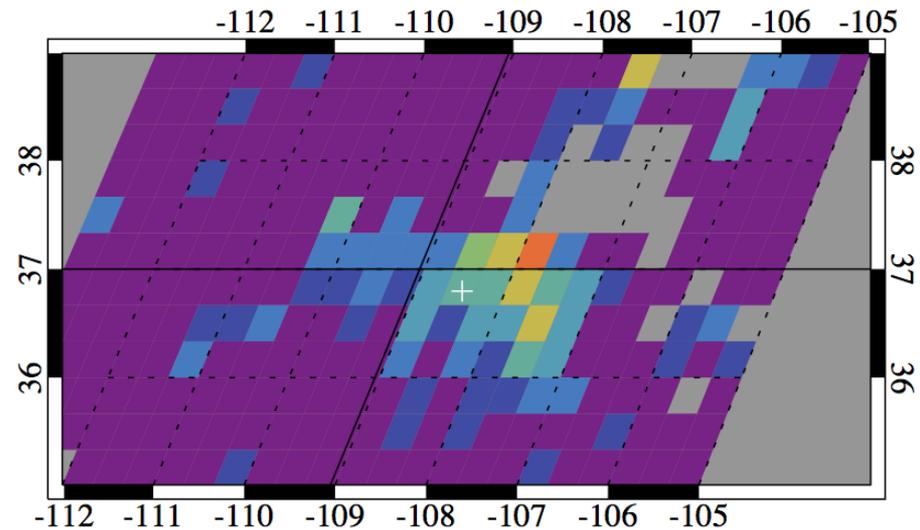
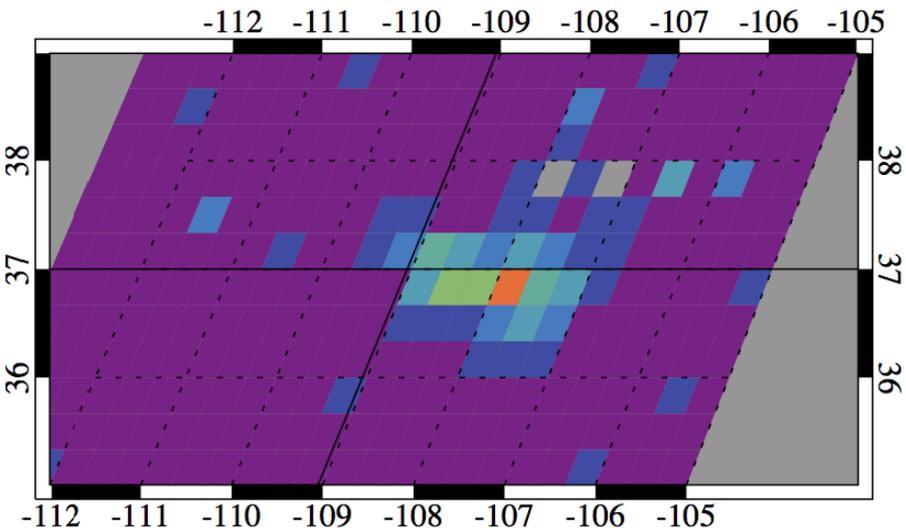
SCIAMACHY 2003-2009



# Signal has persisted since 2003

SCIAMACHY 2003-2005 xCH<sub>4</sub> enhancement (ppb)

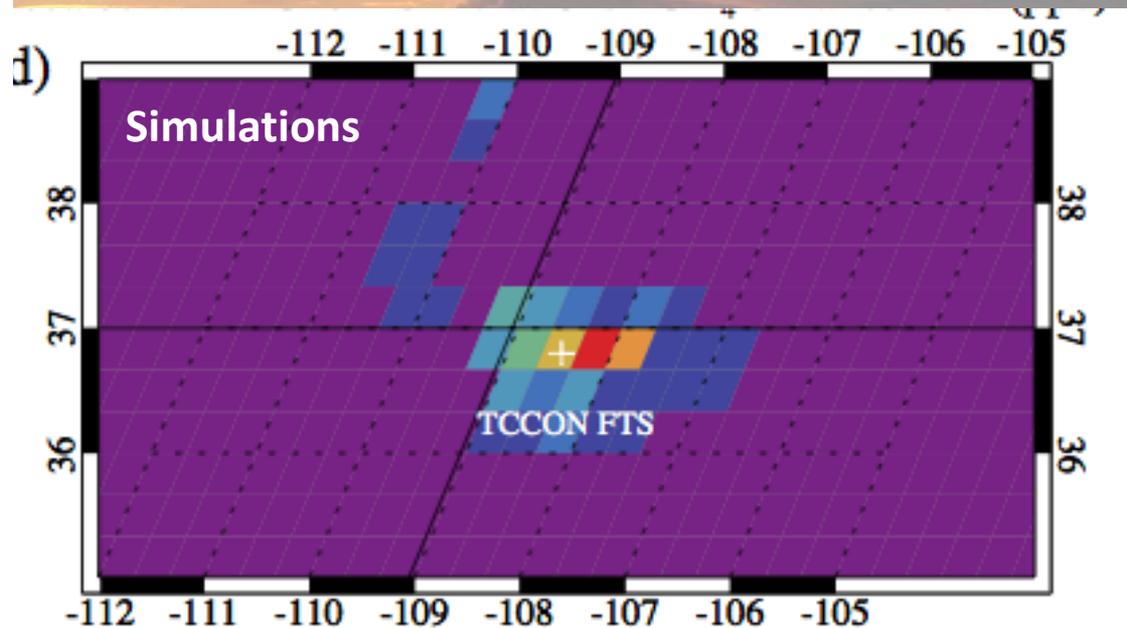
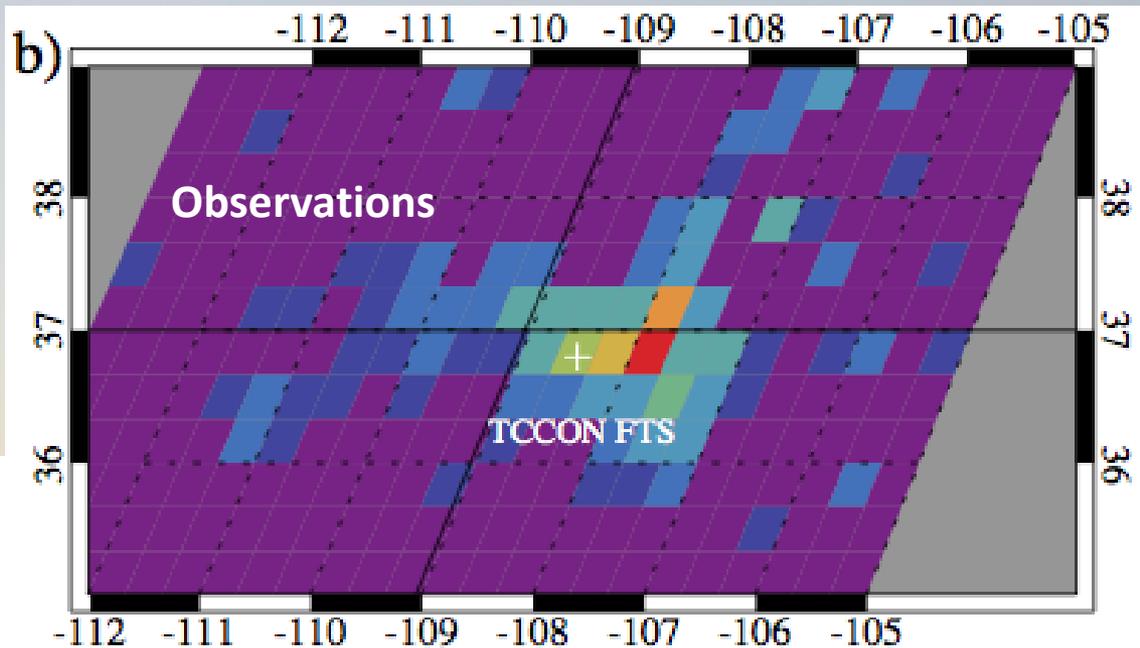
SCIAMACHY 2007-2009 xCH<sub>4</sub> enhancement (ppb)



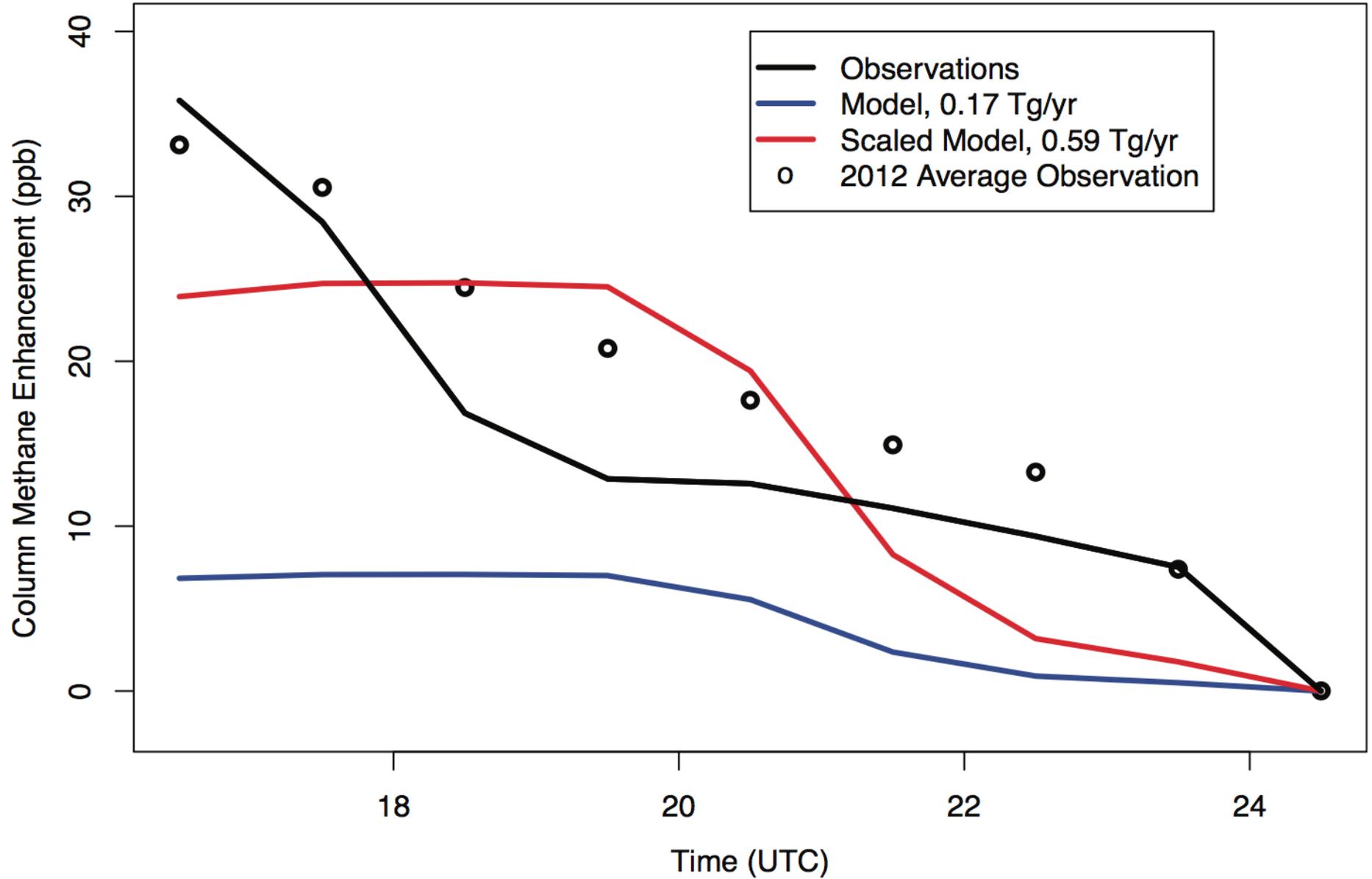
Column CH<sub>4</sub> anomaly (ppb)



Simulations match observations when we use emissions of 0.59 Tg/yr (greater than in inventory)



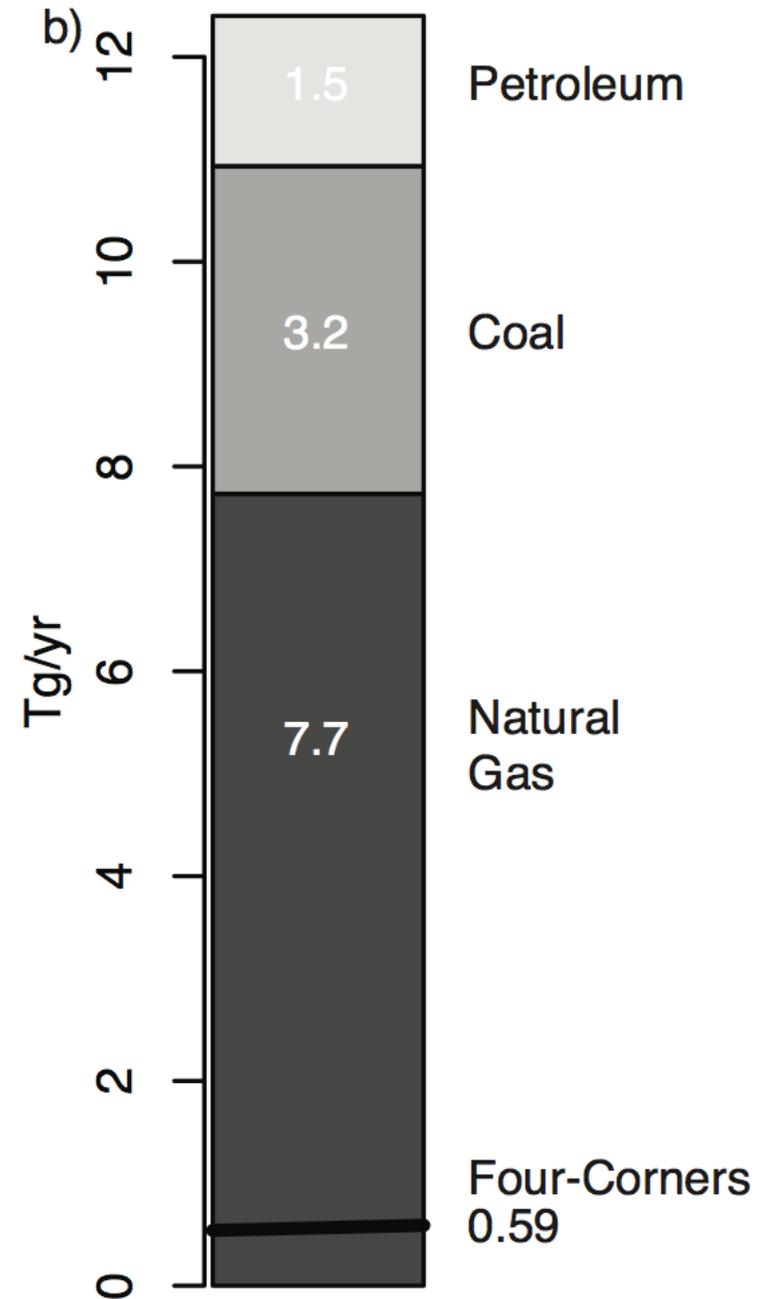
# Ground-based validation: Four Corners total column observations



## US EPA Inventory & this study

We find Four Corners to be a source of  $\sim 0.59$  Tg  $\text{CH}_4/\text{yr}$ , approaching 10% of total US Natural Gas emissions as estimated by EPA

Thinking globally this is only  $\sim 0.1\%$  total global emissions



# I live here in Four Corners, is this methane hot spot dangerous?

- The lower explosive limit for methane is 5%
- That is equivalent to 50,000,000 ppb.
- From space we are seeing signals of ~50 ppb on top of a background of ~ 1,800 ppb. Interesting and important for climate, but not an explosive hazard

# Four Corners: why do we see such a big signal from space & what is the source?

- This is part of why we are here!
- From space- we see all the methane from all sources in the region and cannot say which source contributed how much.
- Isolated location and local winds play a role
- We do know this is a tremendously productive region for natural gas: number 1 coalbed methane production site in the US
- Within basin exist oil and gas wells, coal mines, as well as locations of geologic seepage

Thank you for your interest, I am  
happy to answer questions

