

# Methane Isotopologues by Solar Occultation

*A GHG emission services enabling mission*

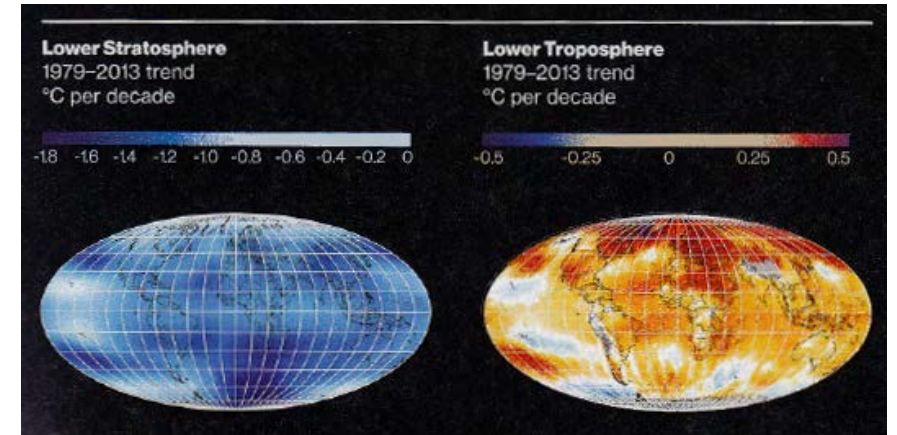
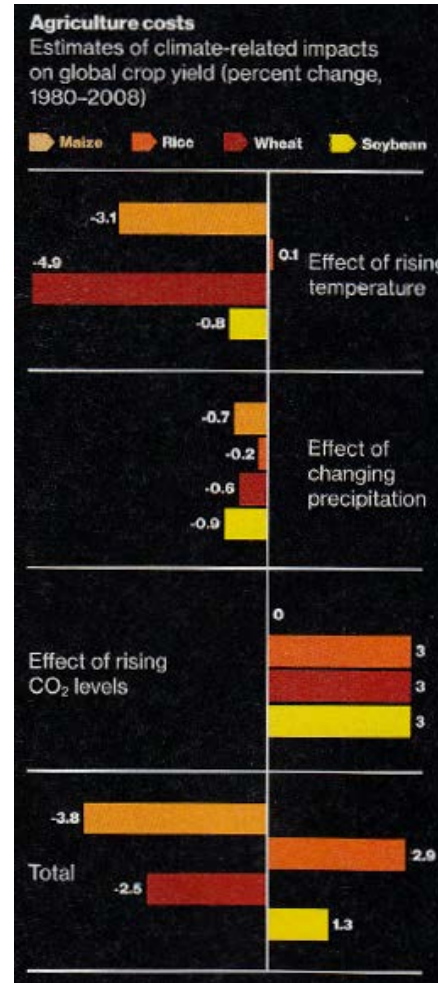
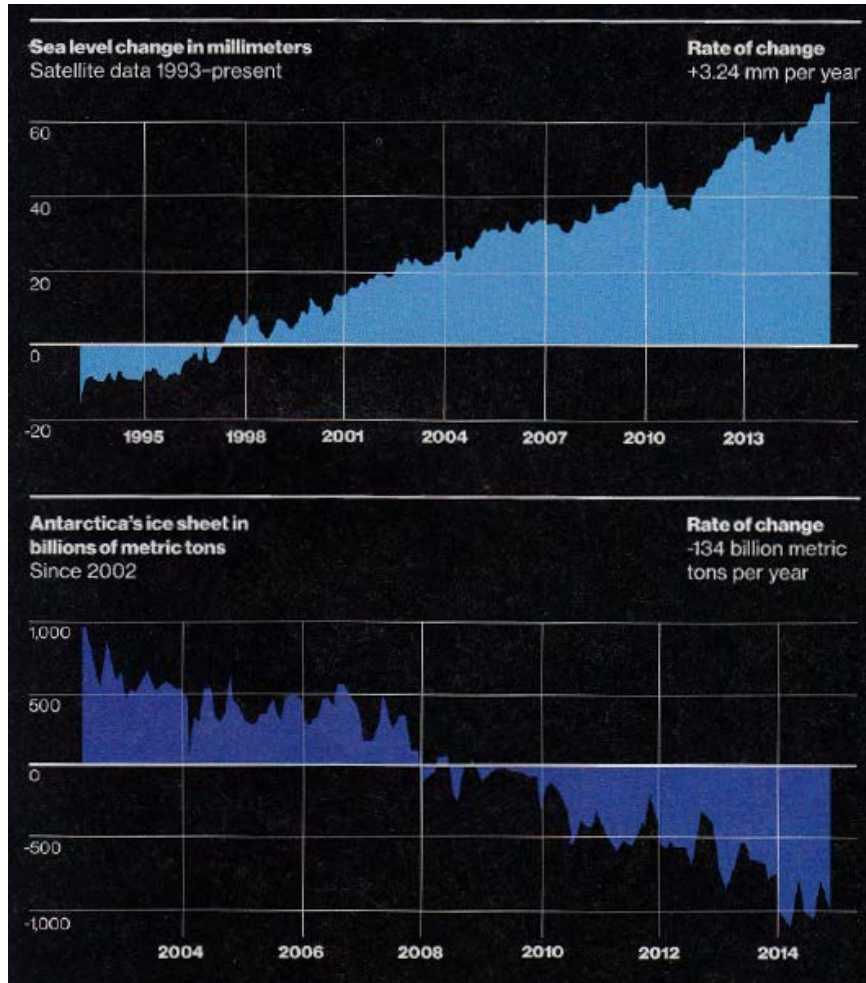
Damien Weidmann  
on behalf of the MISO team



Science & Technology Facilities Council  
Rutherford Appleton Laboratory

# Underpinning Case – GHG Emission

## Evidence and Impacts



**5,000,000**  
Approximate number of deaths the World Health Organization expects climate change to cause between 2030 and 2050, from malnutrition, malaria, diarrhea, and heat stress.

**\$2 billion to \$4 billion**  
Estimated annual health-related costs of climate change by 2030.

Source: Ken Caldeira, MIT TECHNOLOGY REVIEW Vol 119, No 1, 2016

# Building a GHG Emission Service

## UPSTREAM → DATA → INVERSION → EXPLOITATION

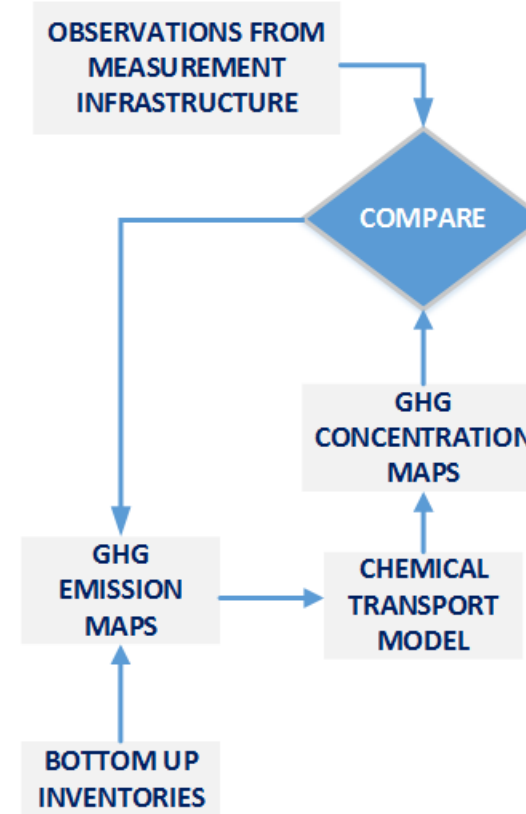
### UPSTREAM

- Observing infrastructure
  - Space borne (CH<sub>4</sub>)
    - JAXA GOSAT 1 & 2
    - ESA SENTINEL 5P & 5
    - METOP IASI and IASI NG
    - CNES MICROCARB
    - Suomi NPP & JPSS CrIS
  - Airborne
    - Aircraft, balloon, UAV, HAPs
  - Ground-based
    - E.g. TCCON
- Imagery
- Telecom
- New sensors

### DATA

- Collection
- Archival
- Processing
  - Level 1 & 2
- Dissemination
  - Access
- Quality Assurance
  - Validation

### INVERSION

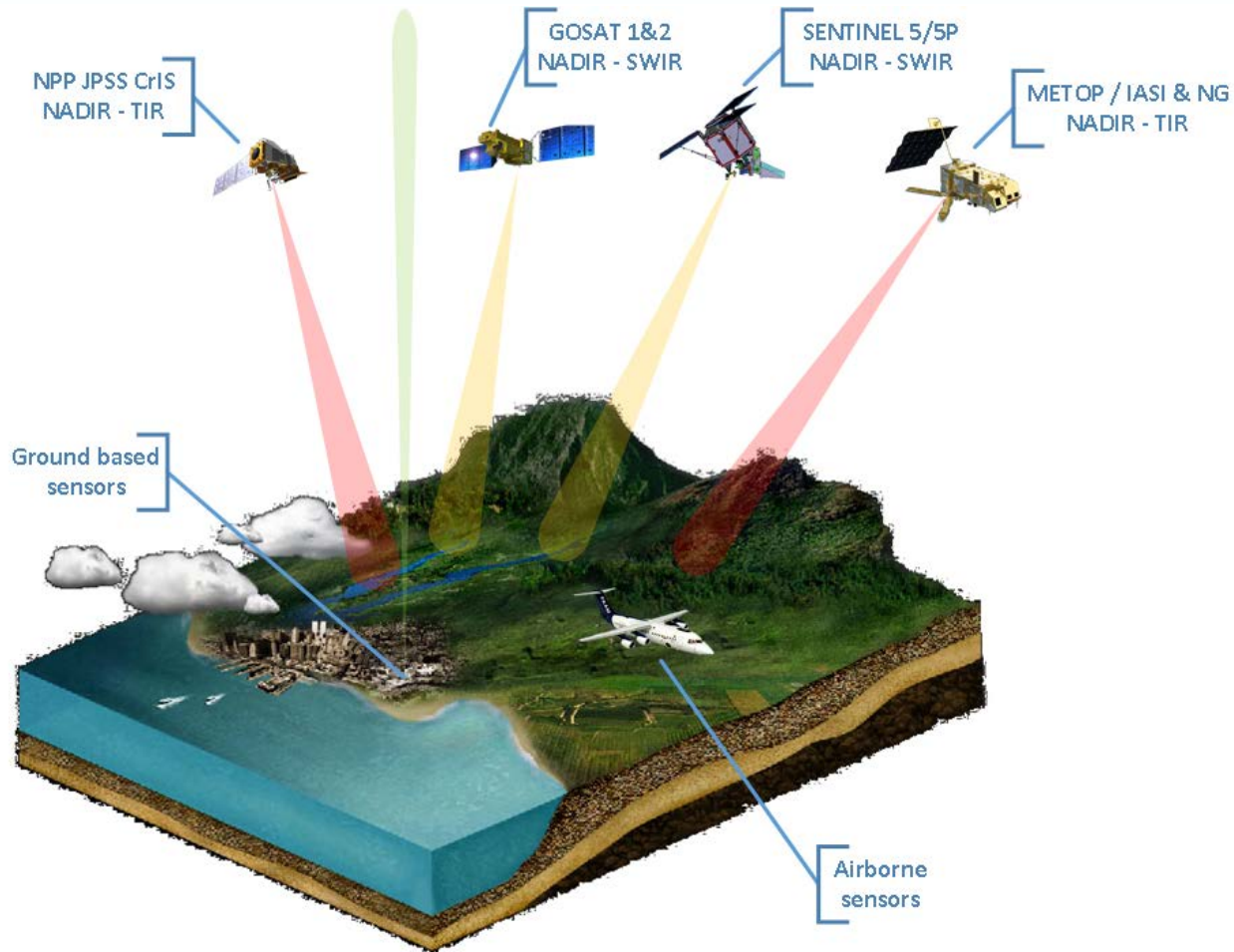


### EXPLOITATION

- Services
  - Reporting
  - Verification
  - Accounting
  - Informing
  - Enforcing
- Customers
  - Industries
  - Governments
  - Local authorities

# Methane Observing Infrastructure

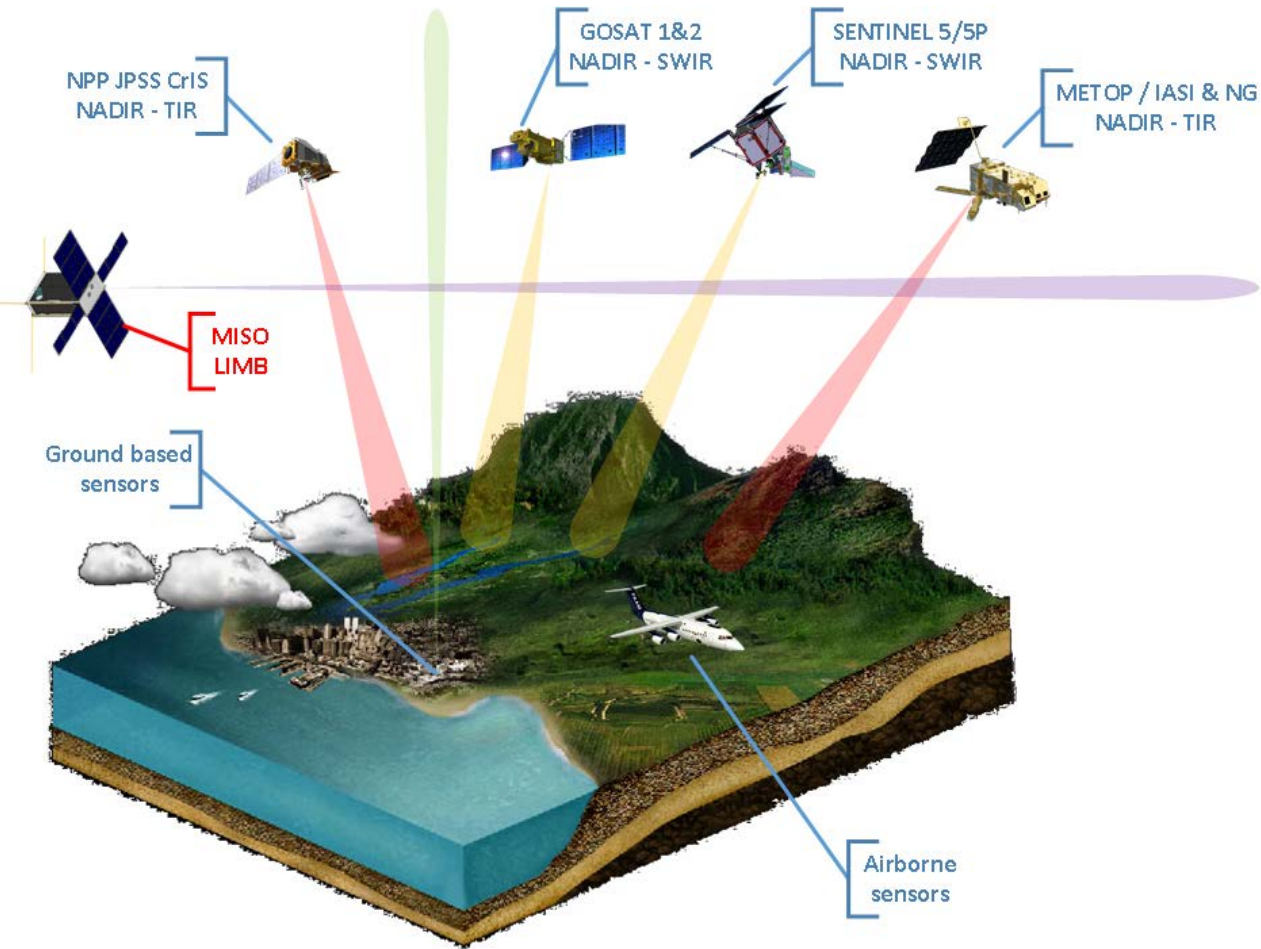
## MISO addresses the missing component



- Measures CH<sub>4</sub> total columns
  - Averaged CH<sub>4</sub> over the whole atmosphere
- Errors in vertical distribution representation
- Need to constraint high altitude CH<sub>4</sub> better

# Methane Observing Infrastructure

## MISO addresses the missing component

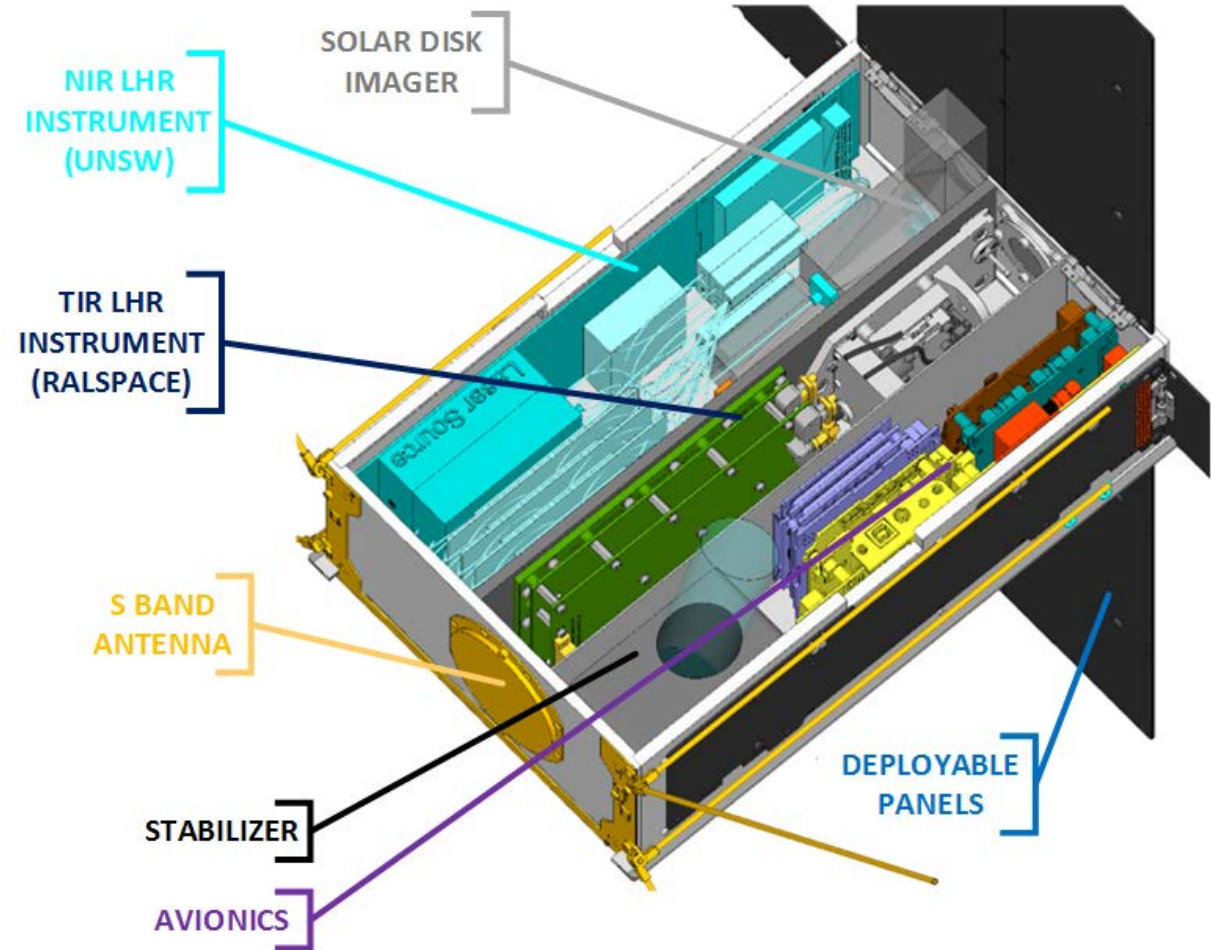
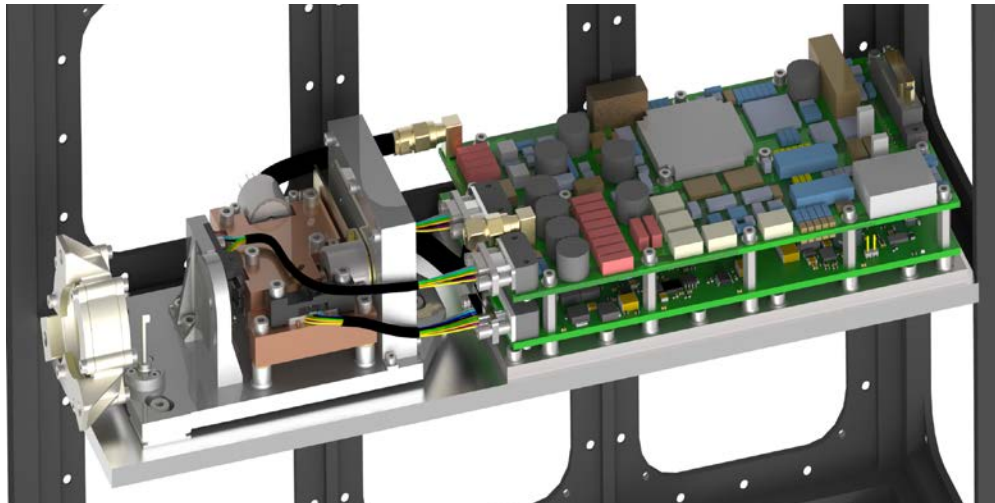


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  - Averaged CH<sub>4</sub> over the whole atmosphere
- Errors in vertical distribution representation
- Need to constraint high altitude CH<sub>4</sub> better
  
- **MISO is addressing these needs**
  - Limb sounding to capture high altitude distribution
  - Solar occultation for high sensitivity
  - Microsatellite platform
    - Cost effective
    - Constellation for coverage
    - No performance compromise

# MISO Spacecraft

## Methane Isotopologues by Solar Occultation

- 6U Cubesat IOD mission for GHG monitoring
  - Precursor to constellation
- New spectrometer technology
  - Enables ultra-high spectral resolution from a compact package
- Miniaturization technologies



# Service Benefits Enabled by the Technology

- Cost-effective improvement of GHG monitoring service
  - Very low cost/observation
  - Complement to Copernicus
  - Complement to start up endeavours – Bluefield or GHGSat
- Added value though improved GHG emission data
  - Improve emission accuracy
  - Improve geographical resolution of emission source
- Business/commercial analytics needed

# Acknowledgements & Reference

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- Chris Howe

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- Russell Boyce
- Igor Dimitrijevic
- Mark Aizengendler

## ➤ Funding



## ➤ Further reading

Weidmann et al., Remote Sensing, 2017, 9, 1073.  
<http://www.mdpi.com/2072-4292/9/10/1073>