Geostationary Remote Infrared Pollution Sounder

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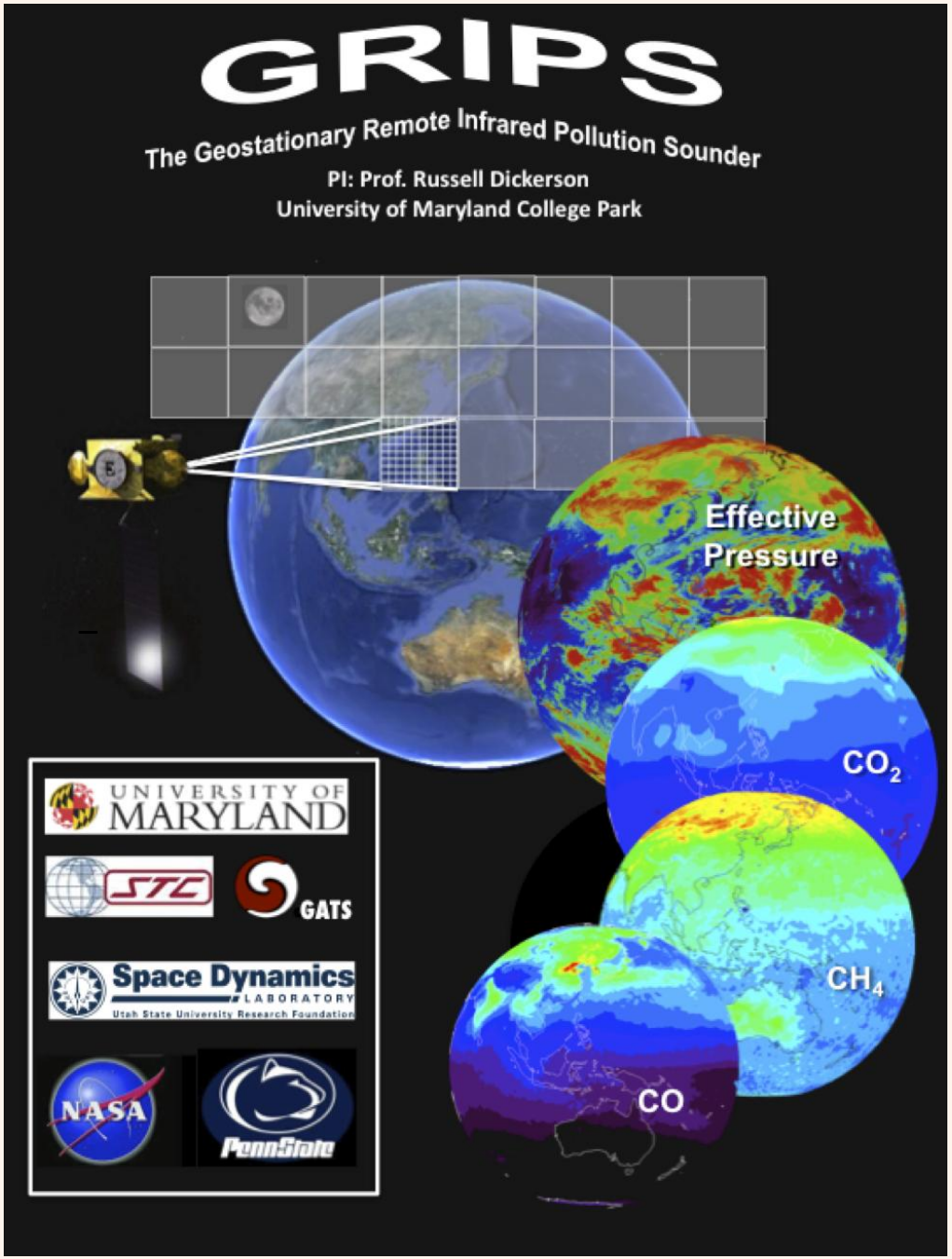
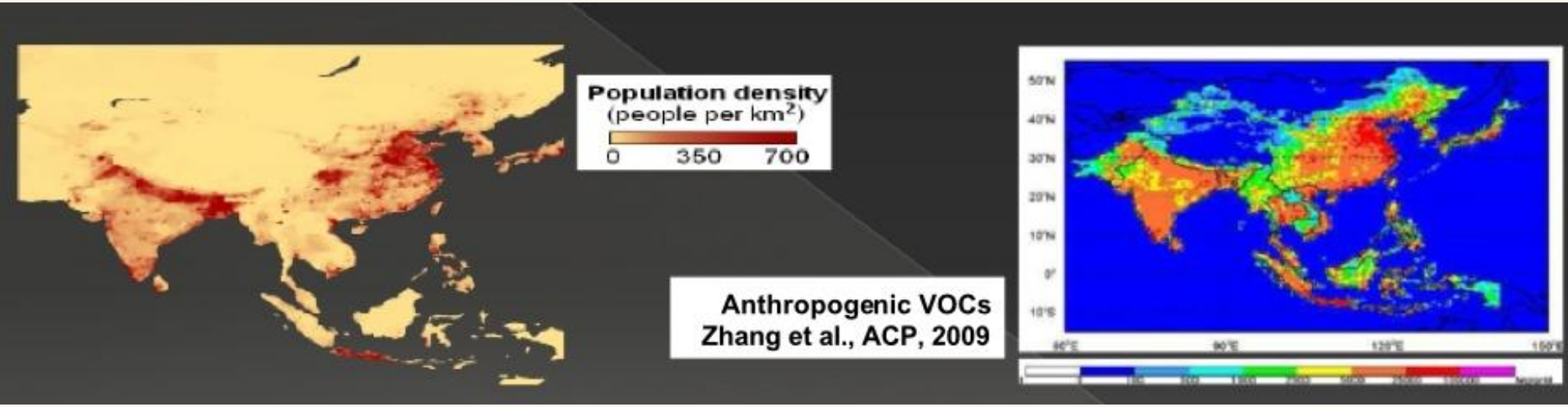


Climate and Pollution

Why measure CO_2, CH_4, and CO?

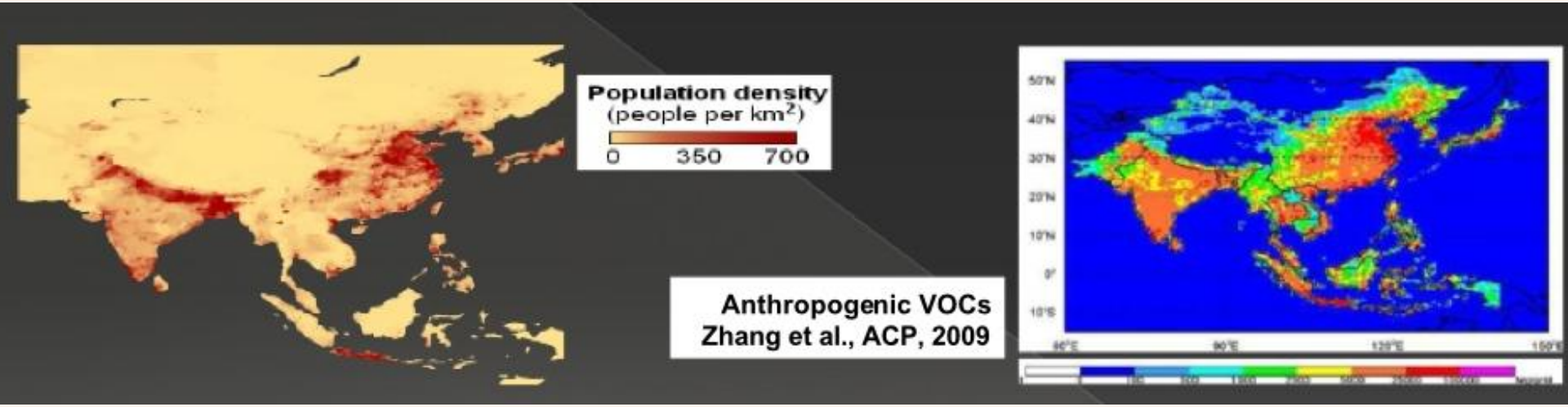
1 – Industrialization in Asia is leading to dramatic increases in emissions of toxic pollutants (NO_2, SO_2, HCHO, CO), aerosols, and climate change gases (CO_2, CH_4)
2 – These toxic pollutants directly affect human health
3 – Climate change affects every aspect of our society – food production, natural disasters, economic development, commerce, etc



Climate and Pollution

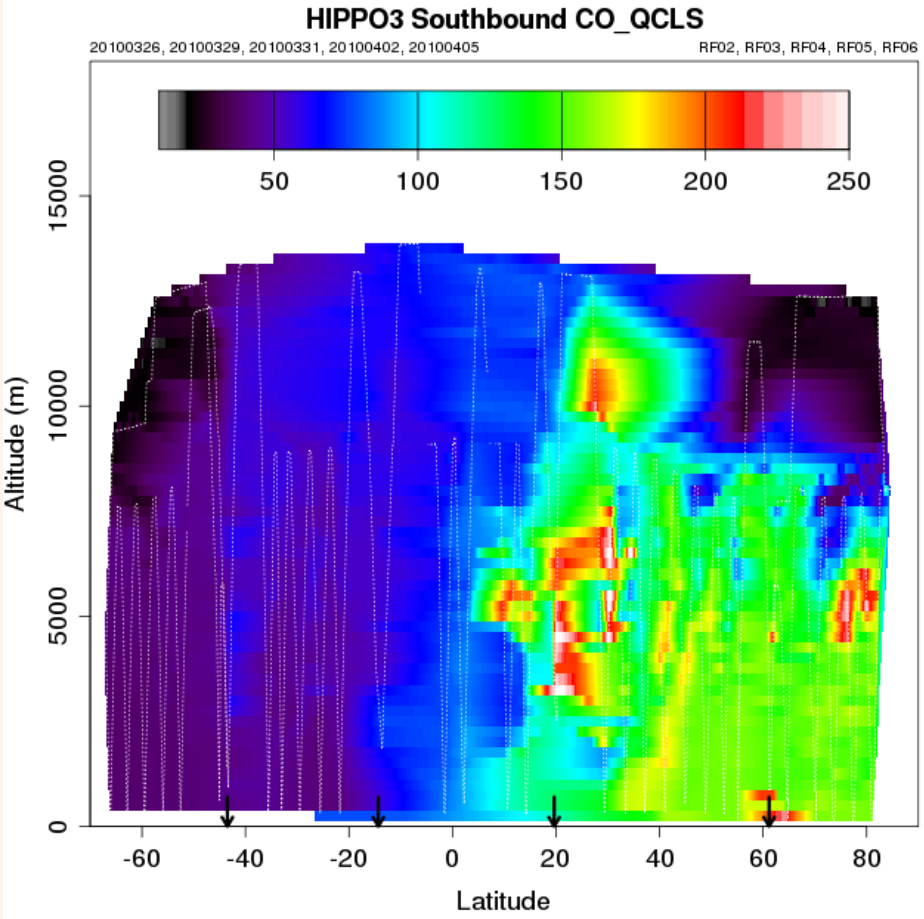
Limited spatially-temporally resolved measurements prevent models from zeroing in on the source/sink regions:

GRIPS will make measurements of CO_2, CH_4, and CO to examine flux, diurnal variations, and export from East and South Asia

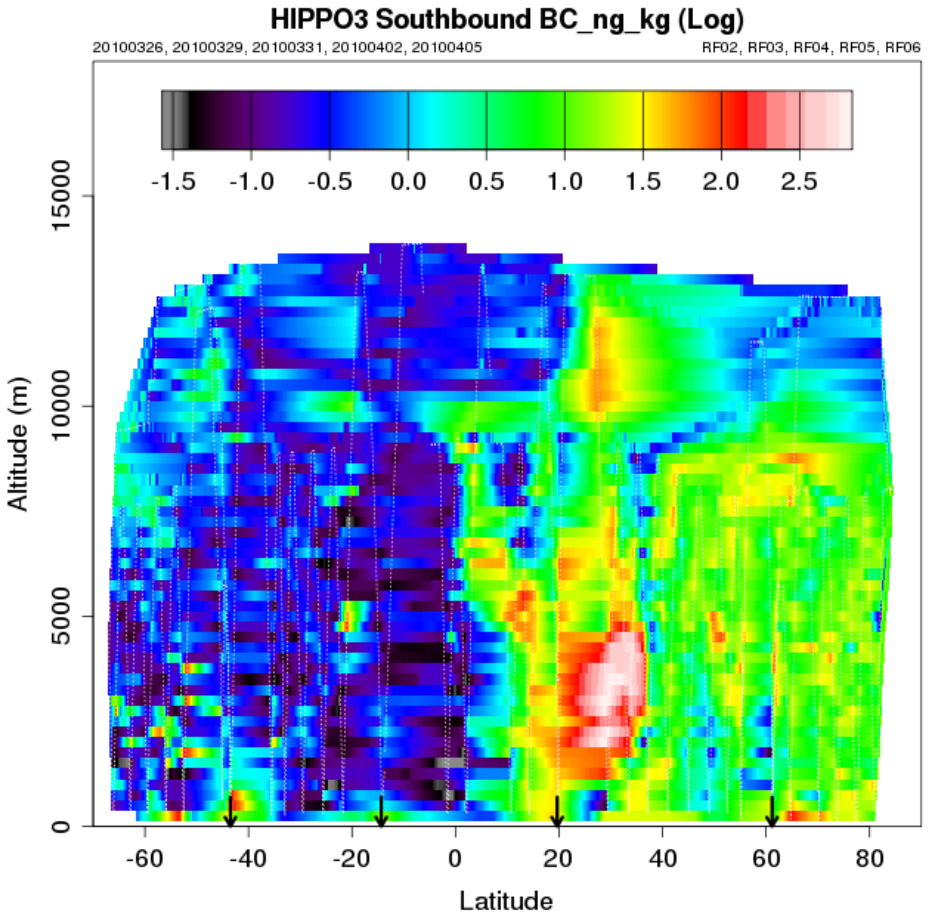


HIAPER Pole-to-Pole Observations (HIPPO) of Carbon Cycle and Greenhouse Gases Study

CO
26 Mar – 5 Apr 2010

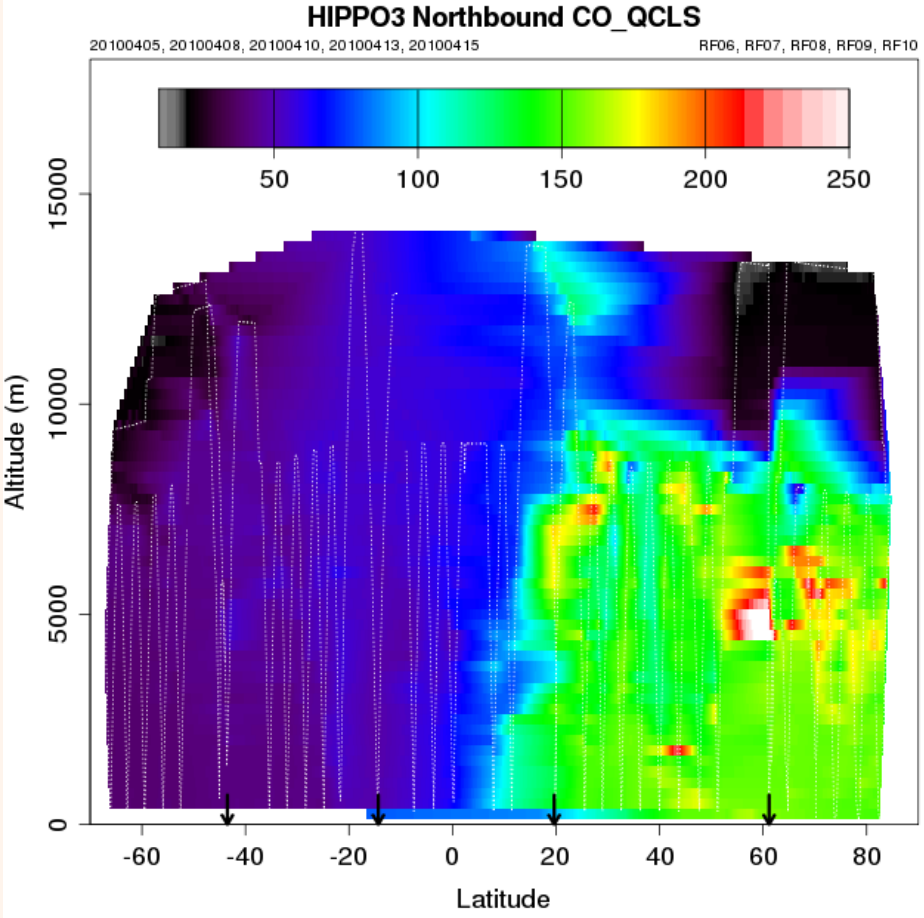


Black Carbon
26 Mar – 5 Apr 2010



HIAPER Pole-to-Pole Observations (HIPPO) of Carbon Cycle and Greenhouse Gases Study

CO
5 – 15 Apr 2010



Black Carbon
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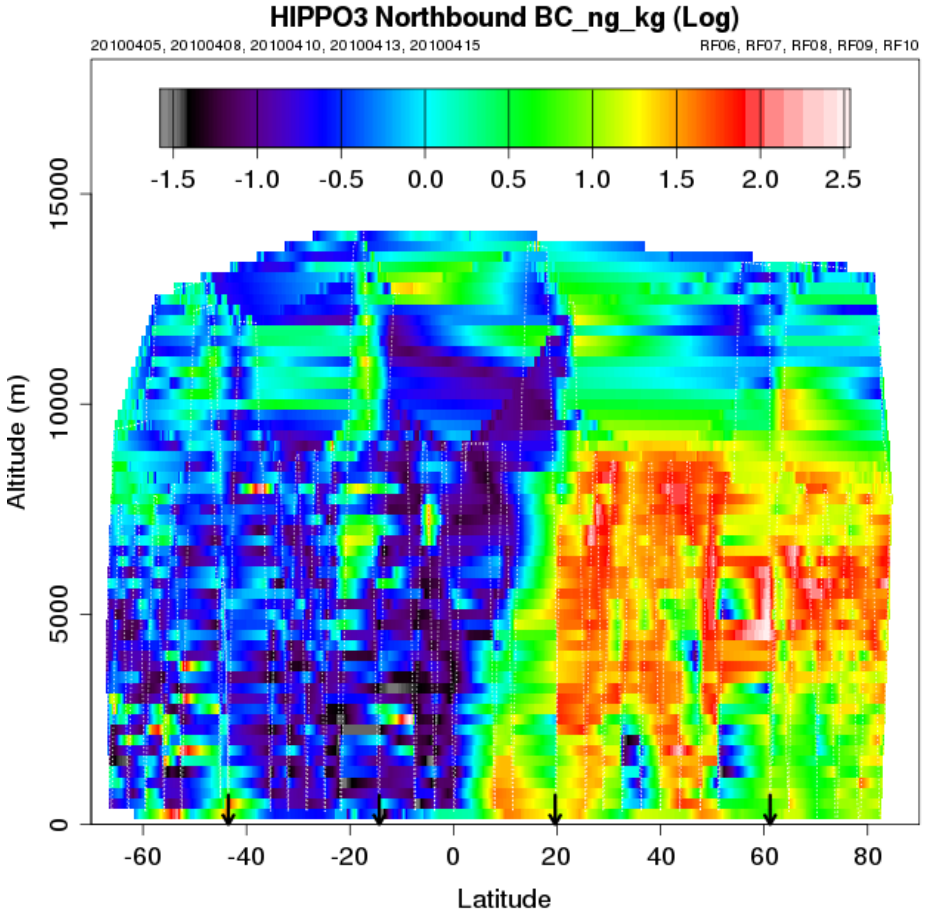


GRIPS Science Objectives

Specific Science Questions:

- What and where are the strongest emissions of CO_2, CH_4 and CO?
- How do the sources and sinks of CO_2, CH_4 and CO vary diurnally and seasonally?
- Why CO? CO is a non-soluble tracer of pollution. With a ~30 day lifetime it is an excellent indicator of transport processes. Our science question is: What fraction of CO (and analogous) emissions are lofted out of a polluted boundary layer and exported?

In order to answer these questions we need:

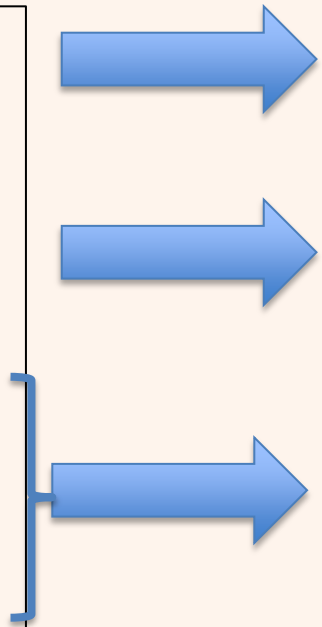
1 – A high precision observing system that can get data into the PBL

2 – As many cloud free measurements as we can make

3 – Measurements at different times of day to sample diurnal variations

GRIPS Science Traceability

Requirements	Instrument/Mission Design
1. Trace gases CO_2, CH_4, CO	1. Thermal or short wave IR absorption bands for these gases
2. A high precision observing system that can get data down into the PBL	2. Solar reflected short wave IR
3. As many cloud free measurements as possible	3. Multiple LEOs or GEO
4. Measurements at different times of day	1. Multiple LEOs or GEO



* Multiple LEOs is cost prohibitive so from here we focus on GEO *

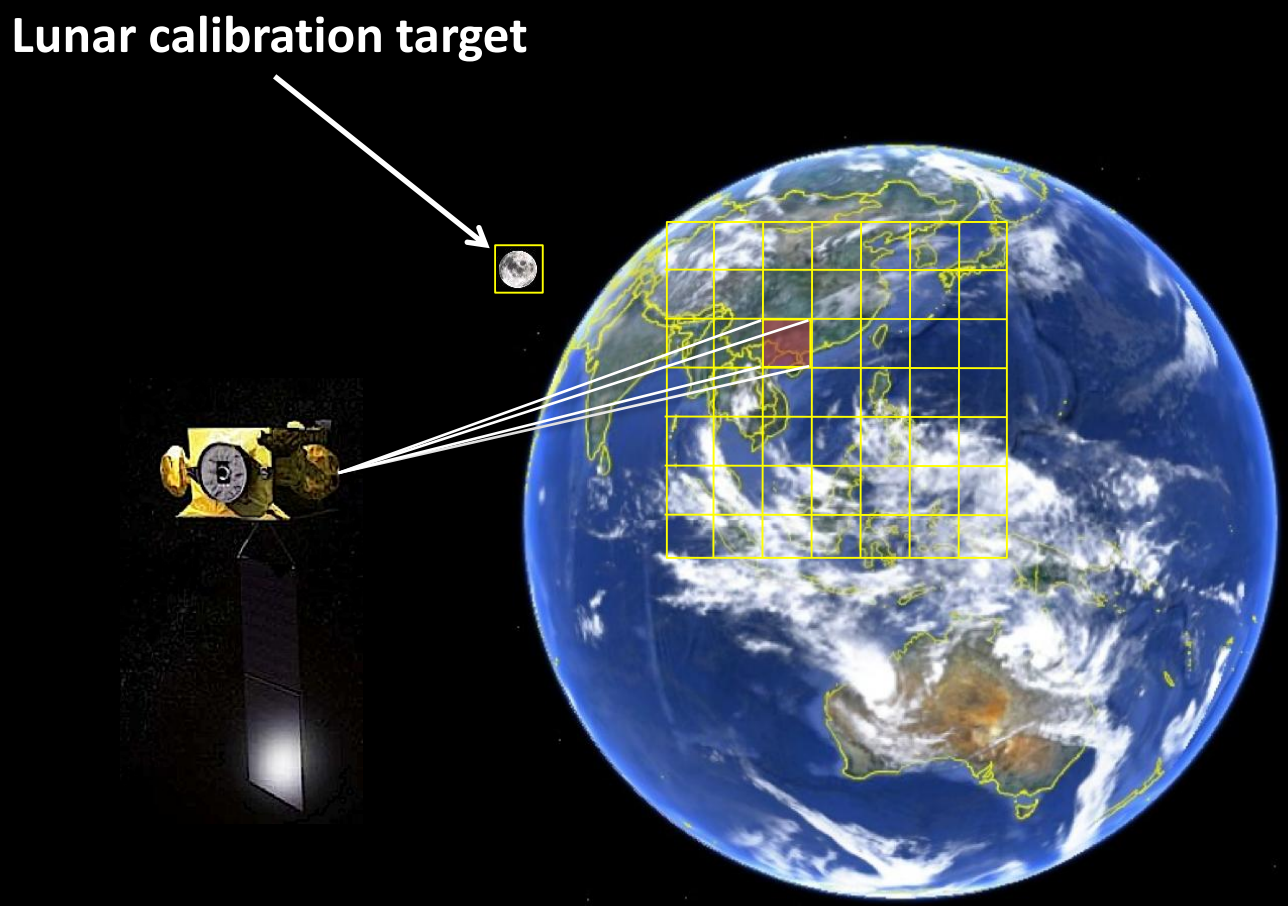
GEO Orbit

- Geostationary orbit has several advantages:
  - Instruments can “stare” at the same scene longer increasing S/N
  - GEO instruments can harvest more cloud free pixels than LEO orbiters since clouds move during the day
  - GEO instruments can observe the diurnal cycle
- Geostationary orbit disadvantage:
  - No global coverage (target the most critical regions)
  - No polar coverage (OCO should do that better)
- Geo orbits are 36,000 km from Earth and populated by communication, surveillance and weather satellites

GEO Opportunities and Science

- East Asia (GeoKOMPSAT 2B)
  - Rapid industrialization and biomass burning
  - Pollution moves from China across Japan and Korea to Northwest US, Canada and Alaska
- Europe-Africa (Sentinel 4)
  - Biomass burning, in-place industrial activity
- N/S America (GOES–S)
  - Deforestation and reforestation
  - Industrial growth (Brazil, Mexico) and changes in industrial patterns

GRIPS Scan Pattern



GRIPS Quad-Telescope Detailed Design

Mass

60 kg

Power

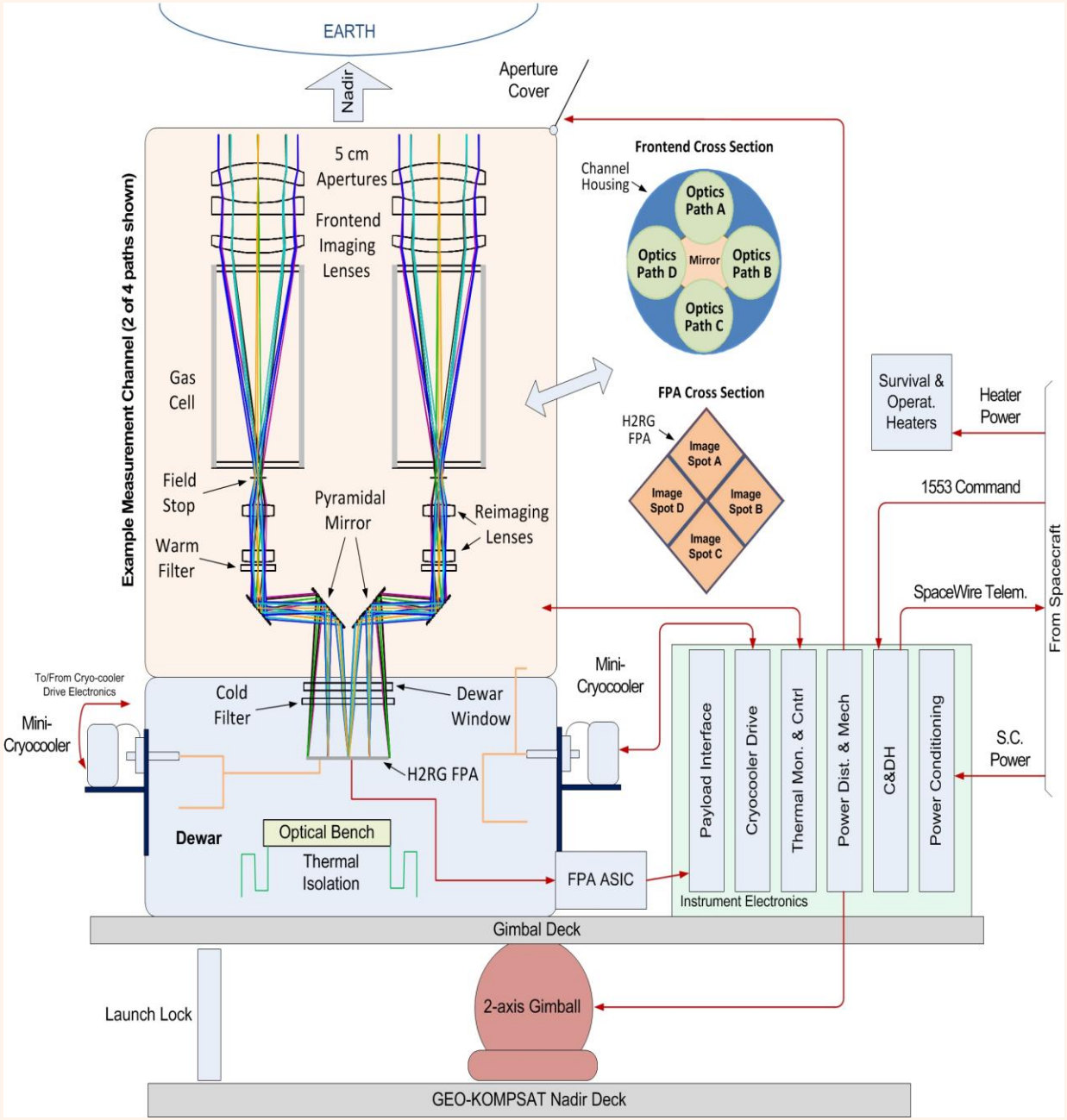
47 WDC

Volume

0.217 m^3

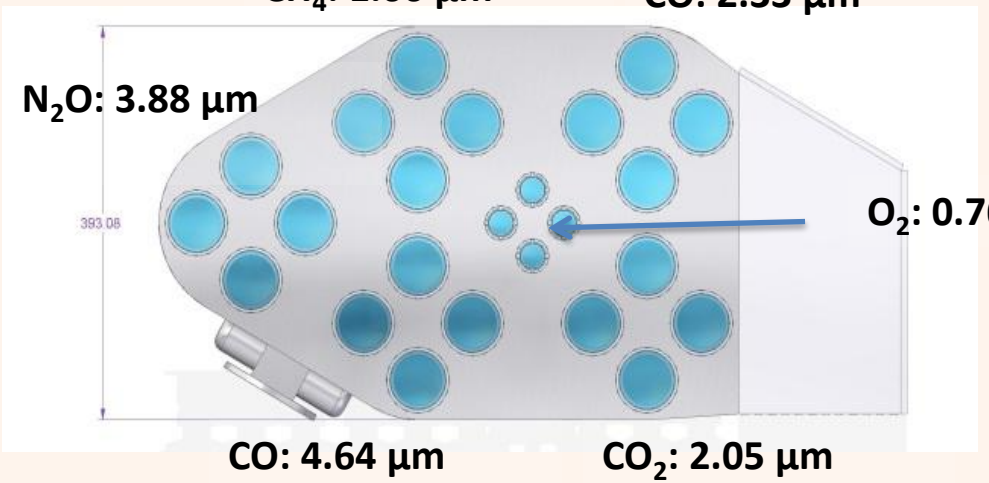
Data Rate

5.6 Mbit/s

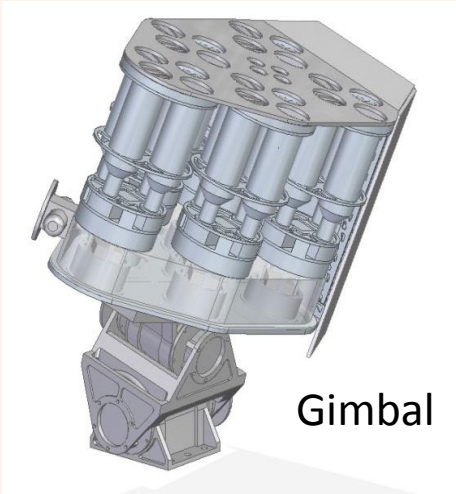


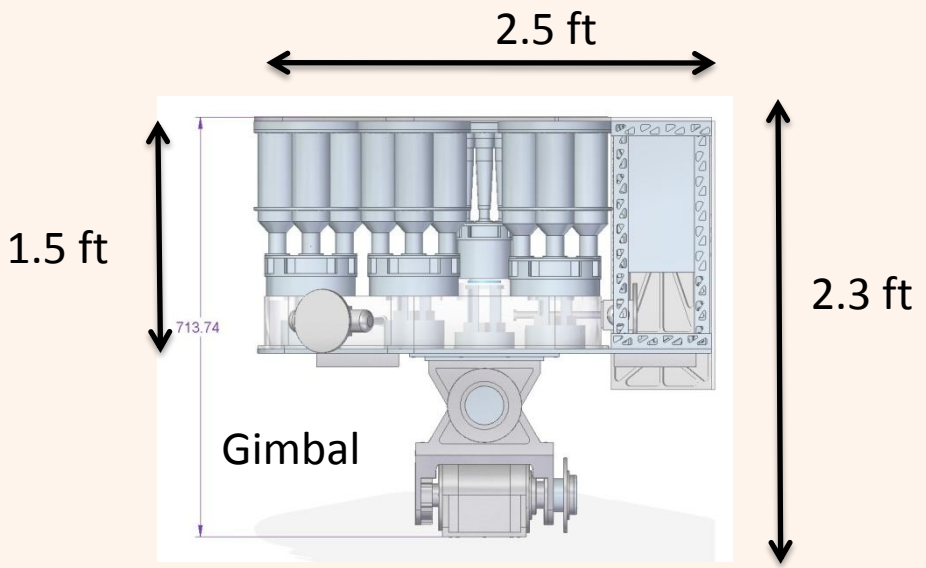
GRIPS Quad-Telescope Modules

Top View

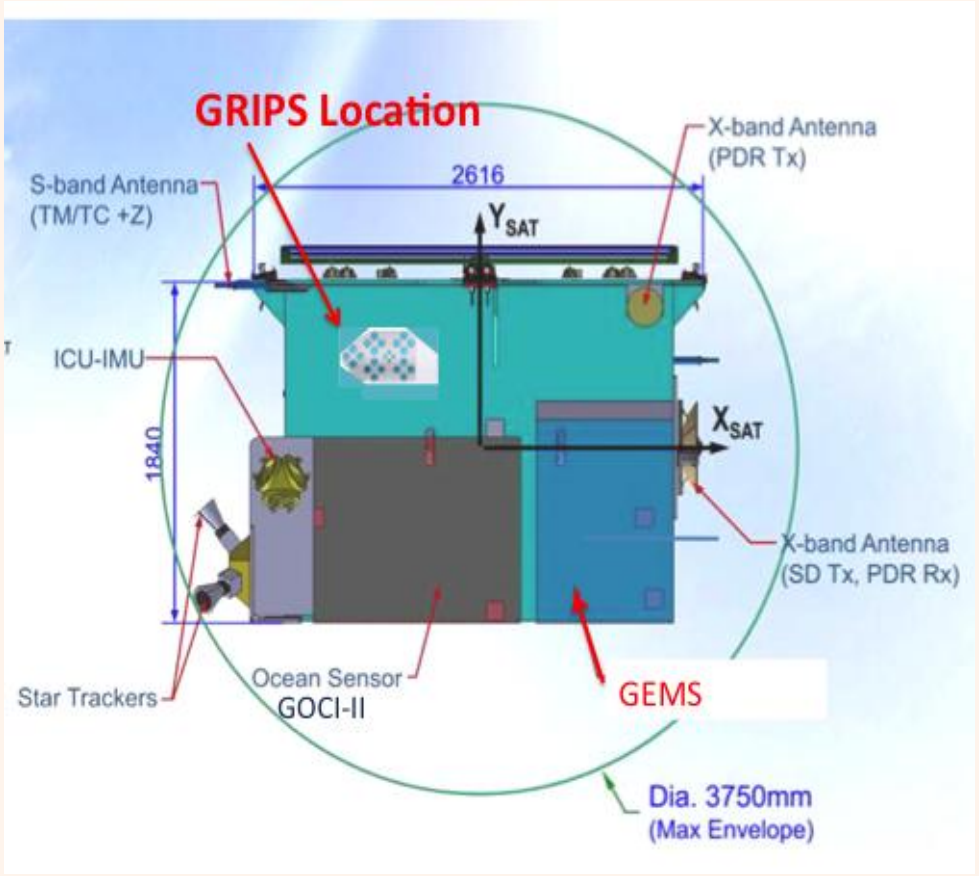


Quad telescope bundles





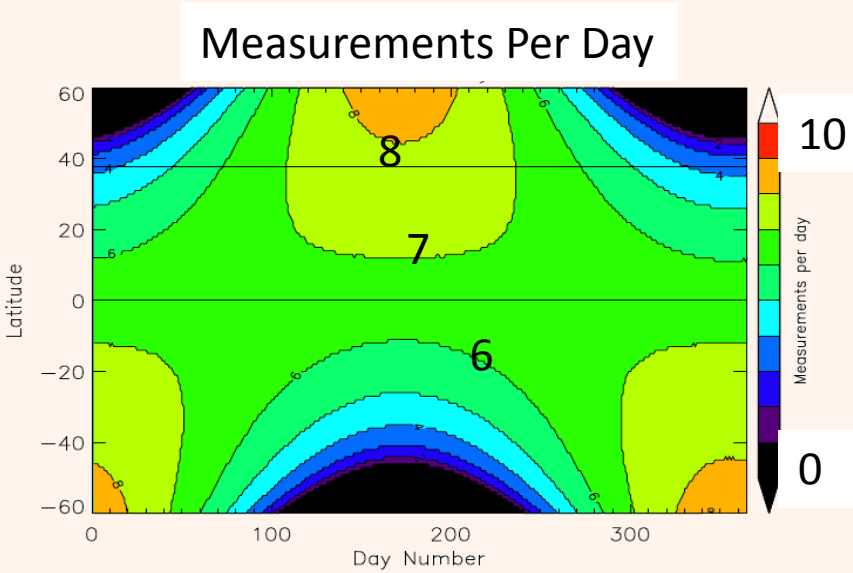
GRIPS on Geo-KOMPSAT 2B

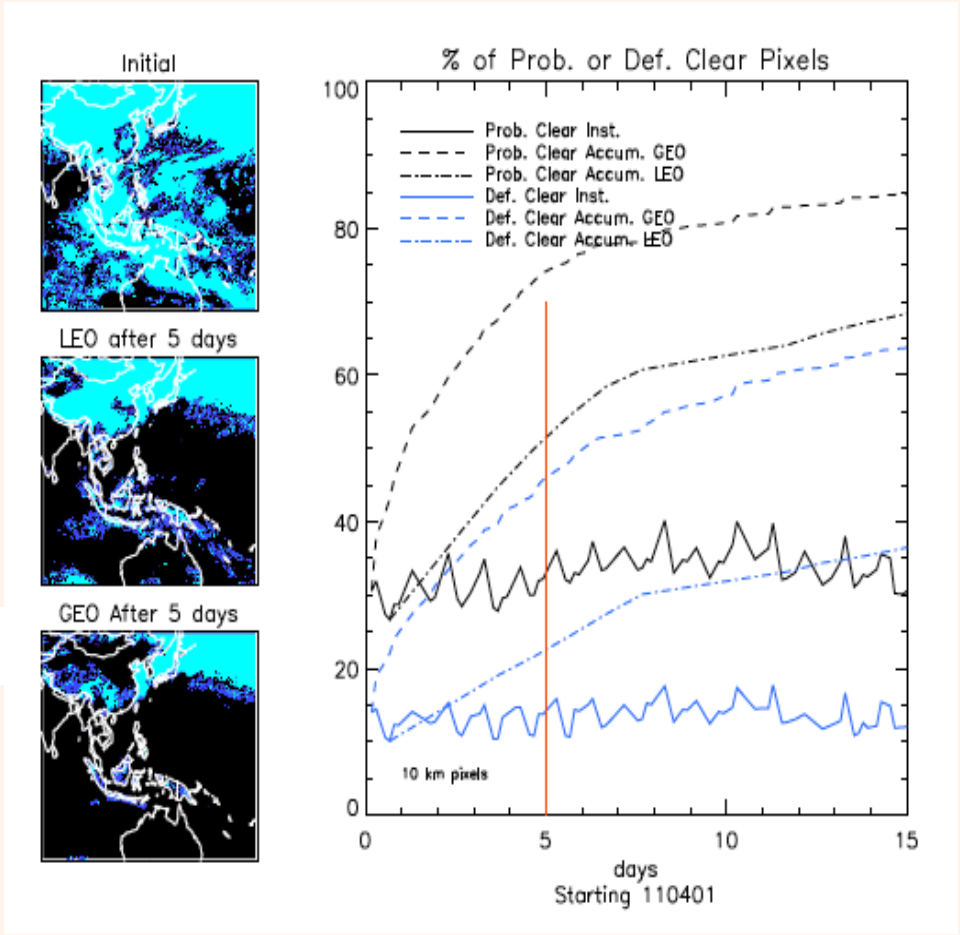


- East Asia location
- Complementary instruments
  - GOCI 2 (clouds and aerosols)
  - GEMS (UV-Vis, trace gases)
- ABI on GK2A
  - Clouds and aerosols

Cloudy vs Cloud Free Regions

GRIPS measurements from GEO allow for more measurements per day and more cloud free observations than from LEO after 5 days





8 x 8 km pixels

GOSAT, OCO-2, and GRIPS

Characteristic	GOSAT	OCO-2	GRIPS
Measurement Gases	CO_2, CH_4, O_2, O_3, H_2O	CO_2, O_2	CO_2, CH_4, CO, O_2, N_2O
Technique	FTS	Grating Spect.	GFCR
Pixel size (km)	80	5.2	8 x 8
Coverage	Global	Global	Regional
Coverage Type	Swath	8 parallel pixel lines	±60º EW, ±60º NS
Revisit	3 days	16 days	90 minutes

Summary

- GRIPS is an innovative climate gas sensor that will provide unique data from GEO
- GRIPS will be able to track pollution flow, identify sources and sinks of CO_2, CO and CH_4
- GEMS, GOCI-2 and ABI are highly complementary with GRIPS
- GRIPS can be used on GK2B as well as Sentinel 4 and GOES-S