Measuring Atmospheric Carbon Dioxide from the NASA Orbiting Carbon Observatory-2 (OCO-2)

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for the OCO-2 Science Team

November 6, 2018

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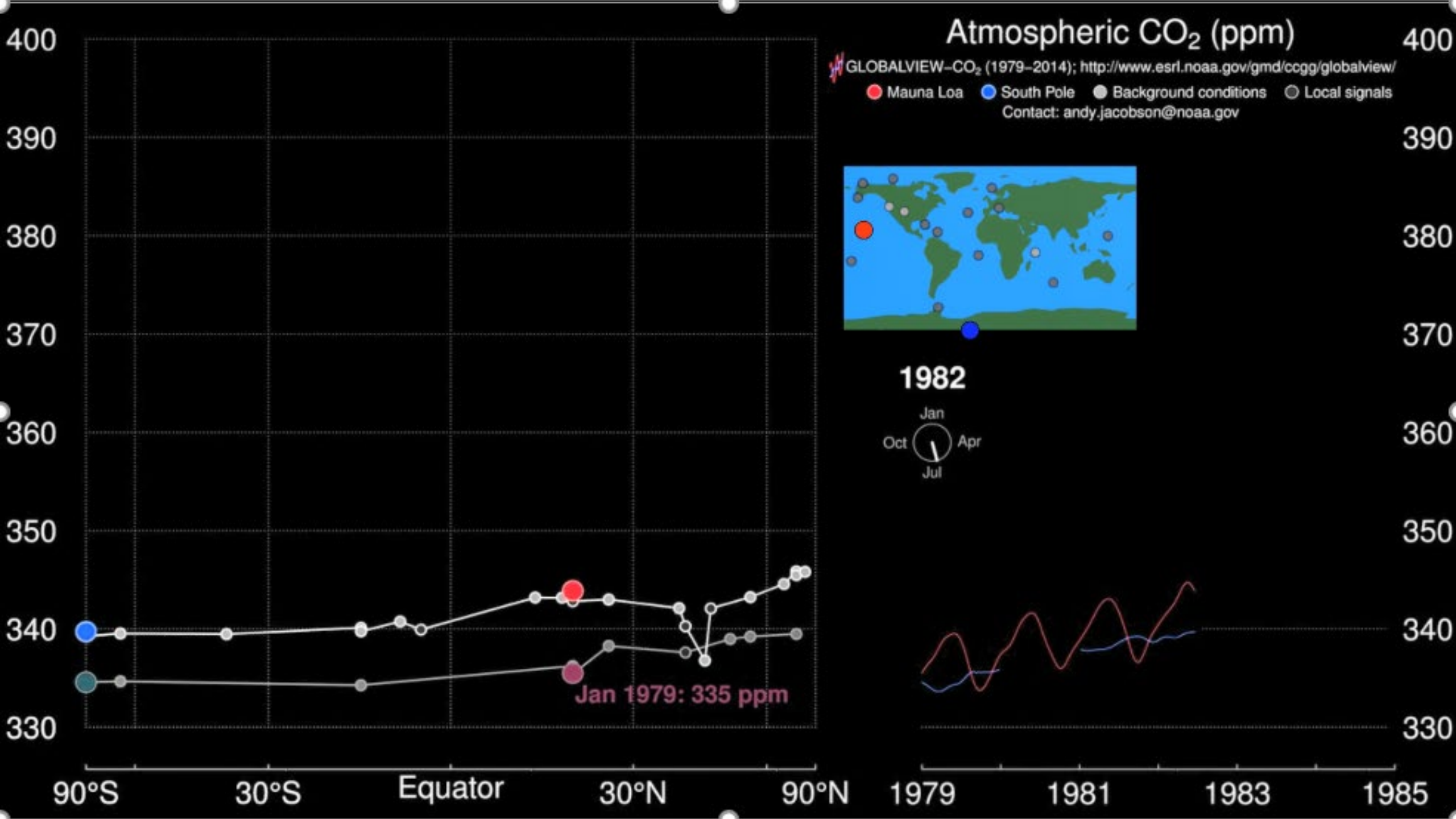
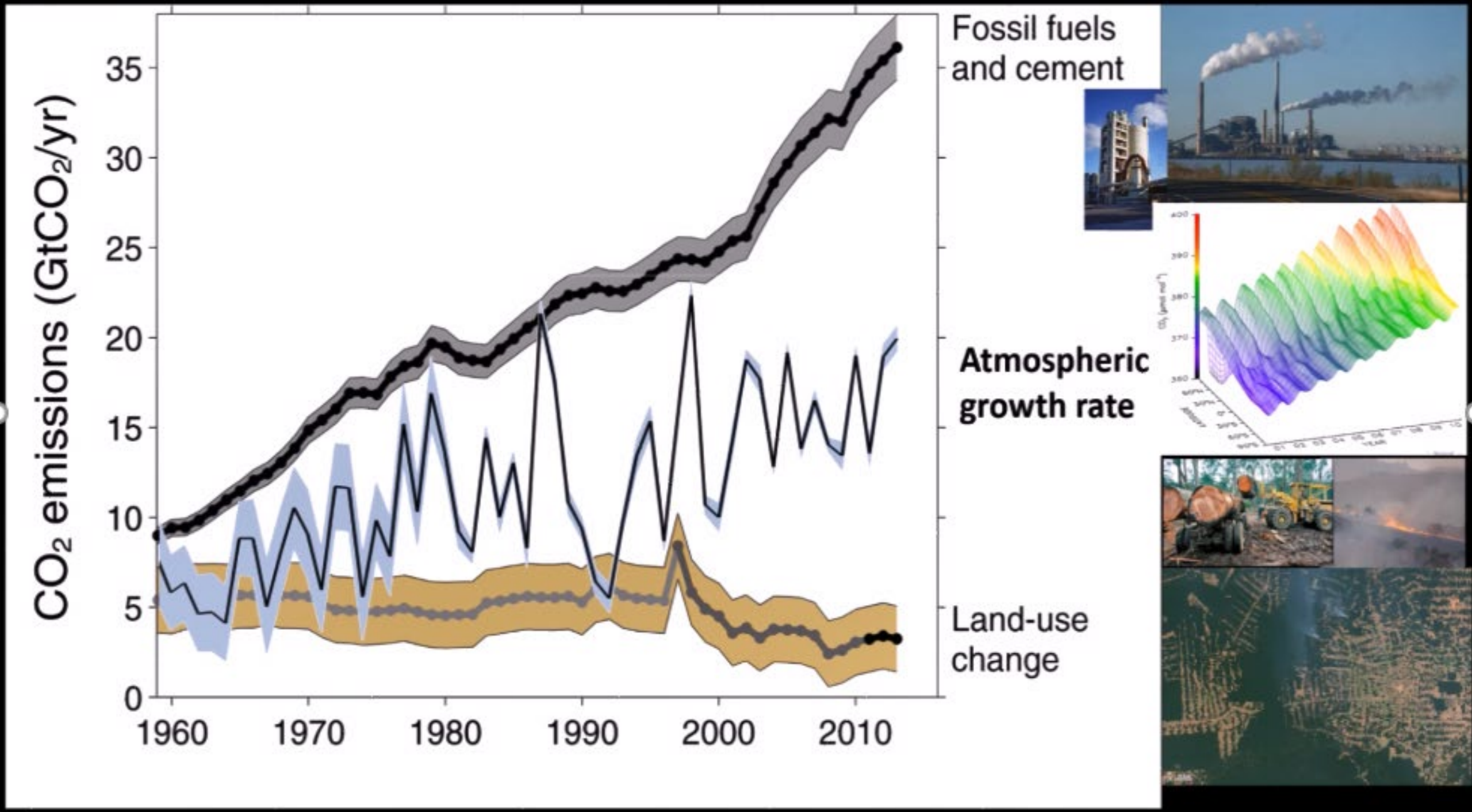
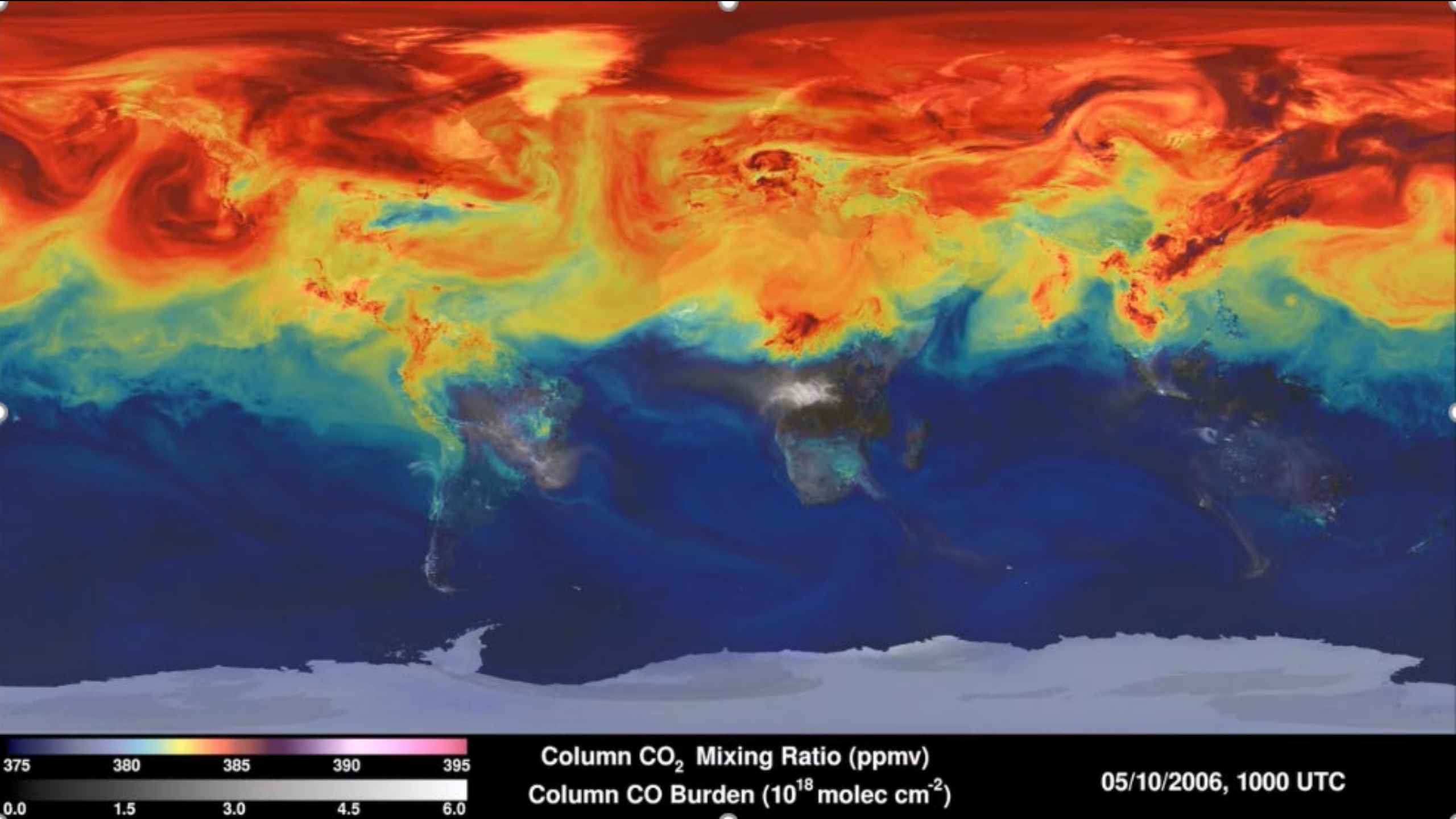
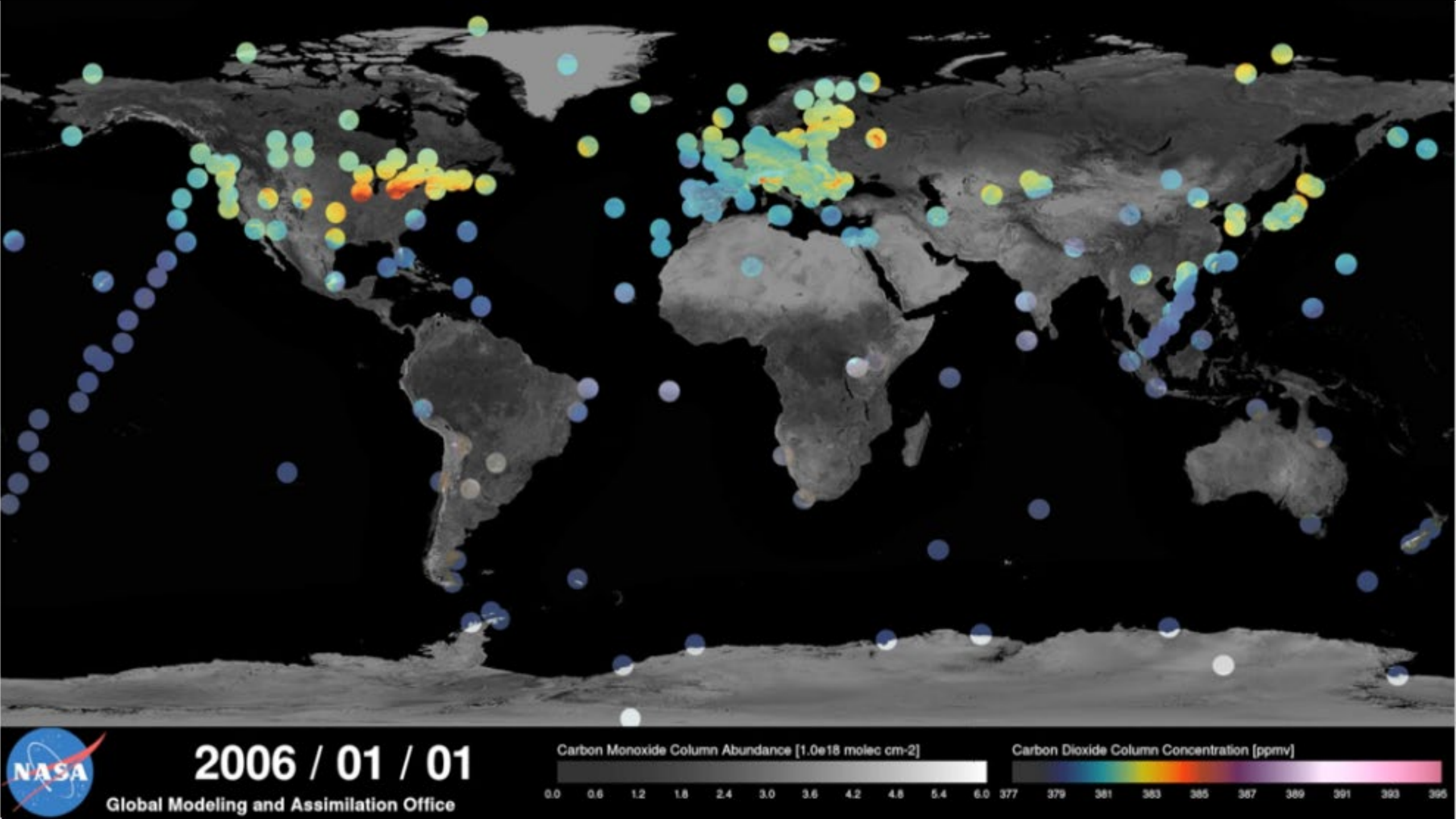
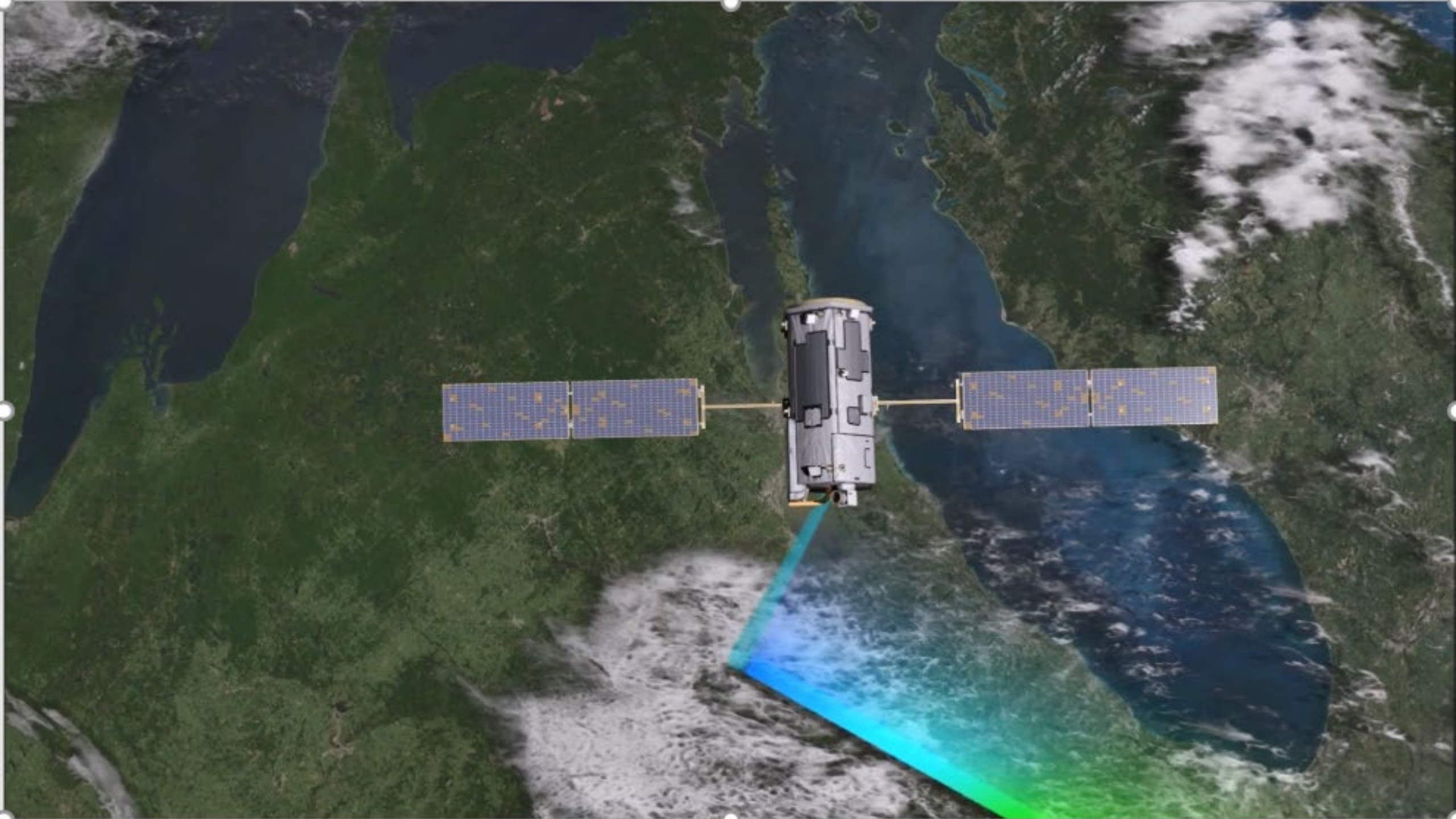
Government sponsorship acknowledged.

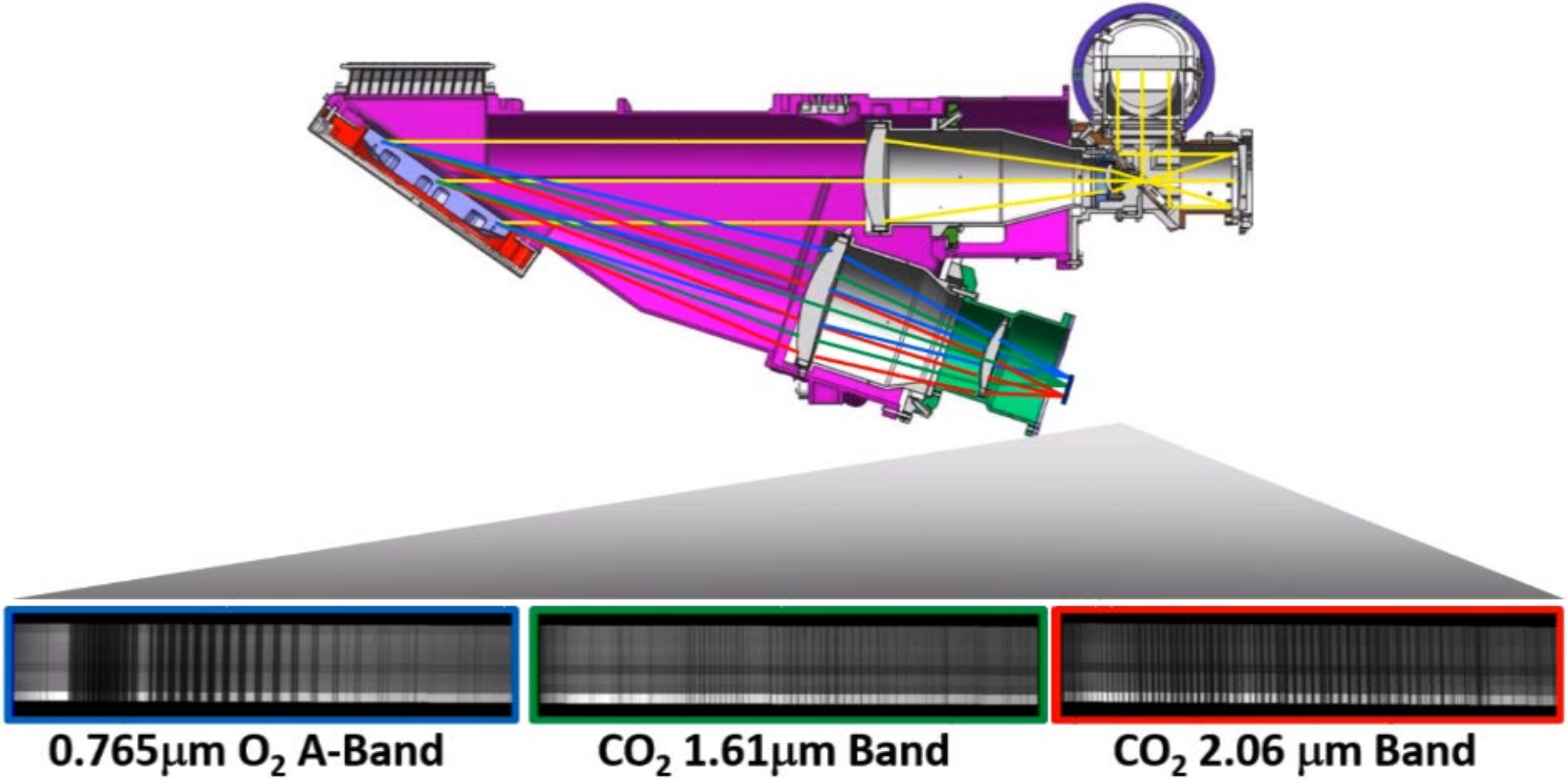

Atmospheric CO_2 (ppm)
GLOBALVIEW–CO_2 (1979–2014); http://www.esrl.noaa.gov/gmd/ccgg/globalview/
Mauna Loa
South Pole
Background conditions
Local signals
Contact: andy.jacobson@noaa.gov
1982
Jan
Oct
Apr
Jul
Jan 1979: 335 ppm
400
390
380
370
360
350
340
330
90°S
30°S
Equator
30°N
90°N
1979
1981
1983
1985

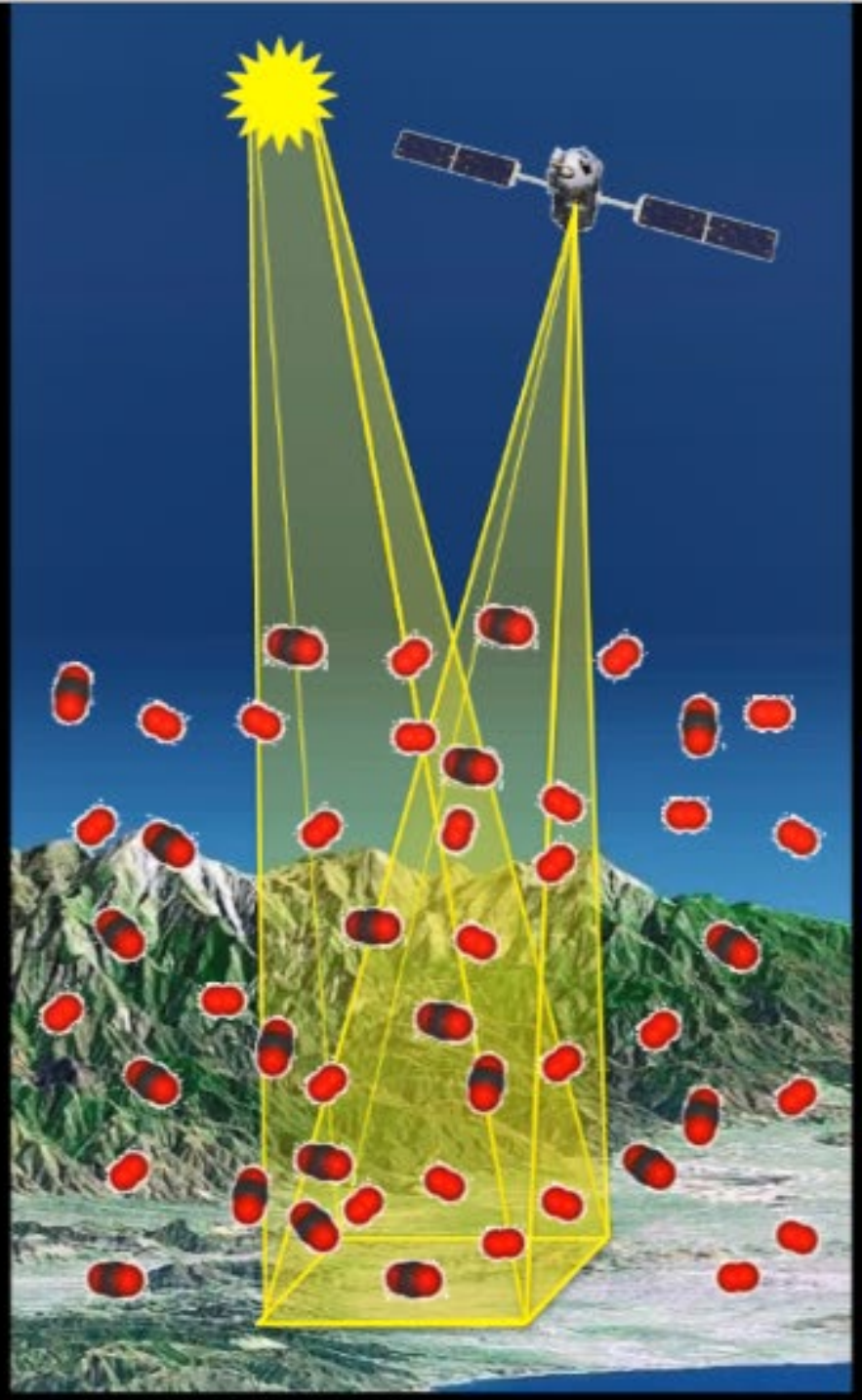

CO_2 emissions ($GtCO_2$/yr)
35
30
25
20
15
10
5
0
1960
1970
1980
1990
2000
2010
Fossil fuels and cement
Atmospheric growth rate
Land-use change

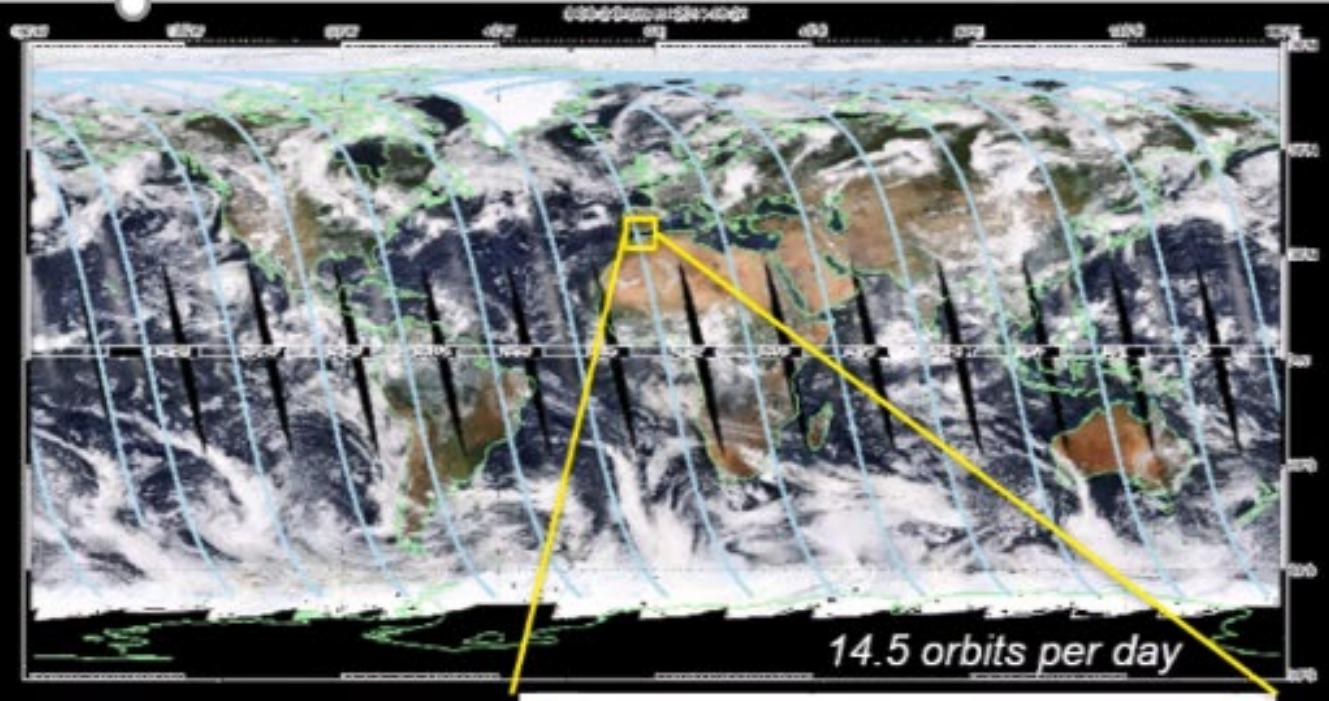

375
380
385
390
395
0.0
1.5
3.0
4.5
6.0
Column CO_2 Mixing Ratio (ppmv)
Column CO Burden (10^{18} molec cm^{-2})
05/10/2006, 1000 UTC

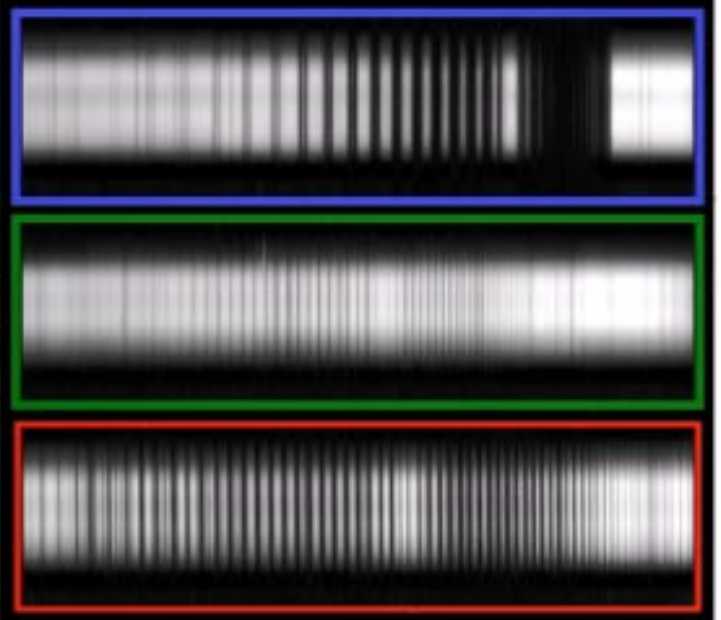

2006 / 01 / 01
Global Modeling and Assimilation Office
Carbon Monoxide Column Abundance [1.0e18 molec cm-2]
0.0 0.6 1.2 1.8 2.4 3.0 3.6 4.2 4.8 5.4 6.0
Carbon Dioxide Column Concentration [ppmv]
377 379 381 383 385 387 389 391 393 395

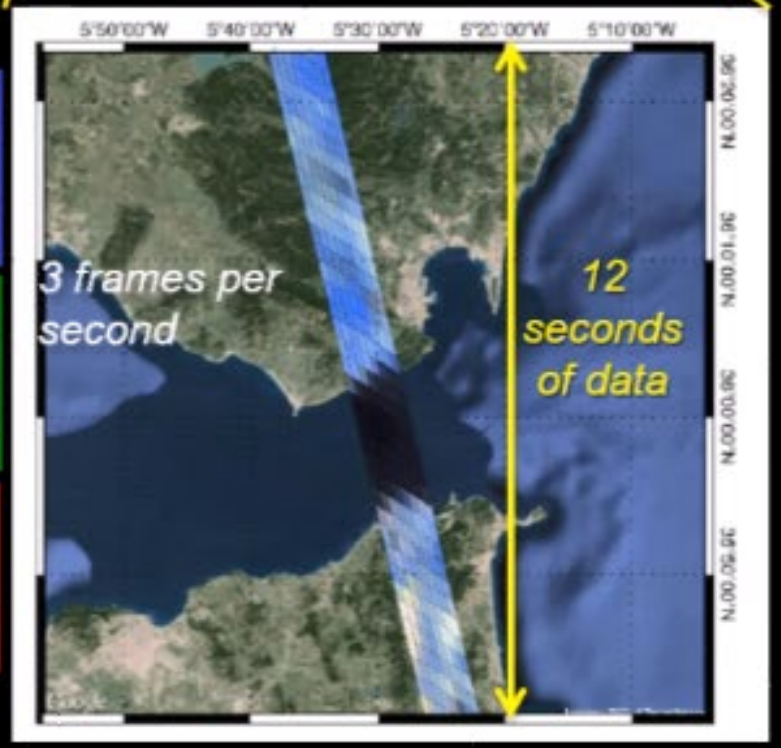


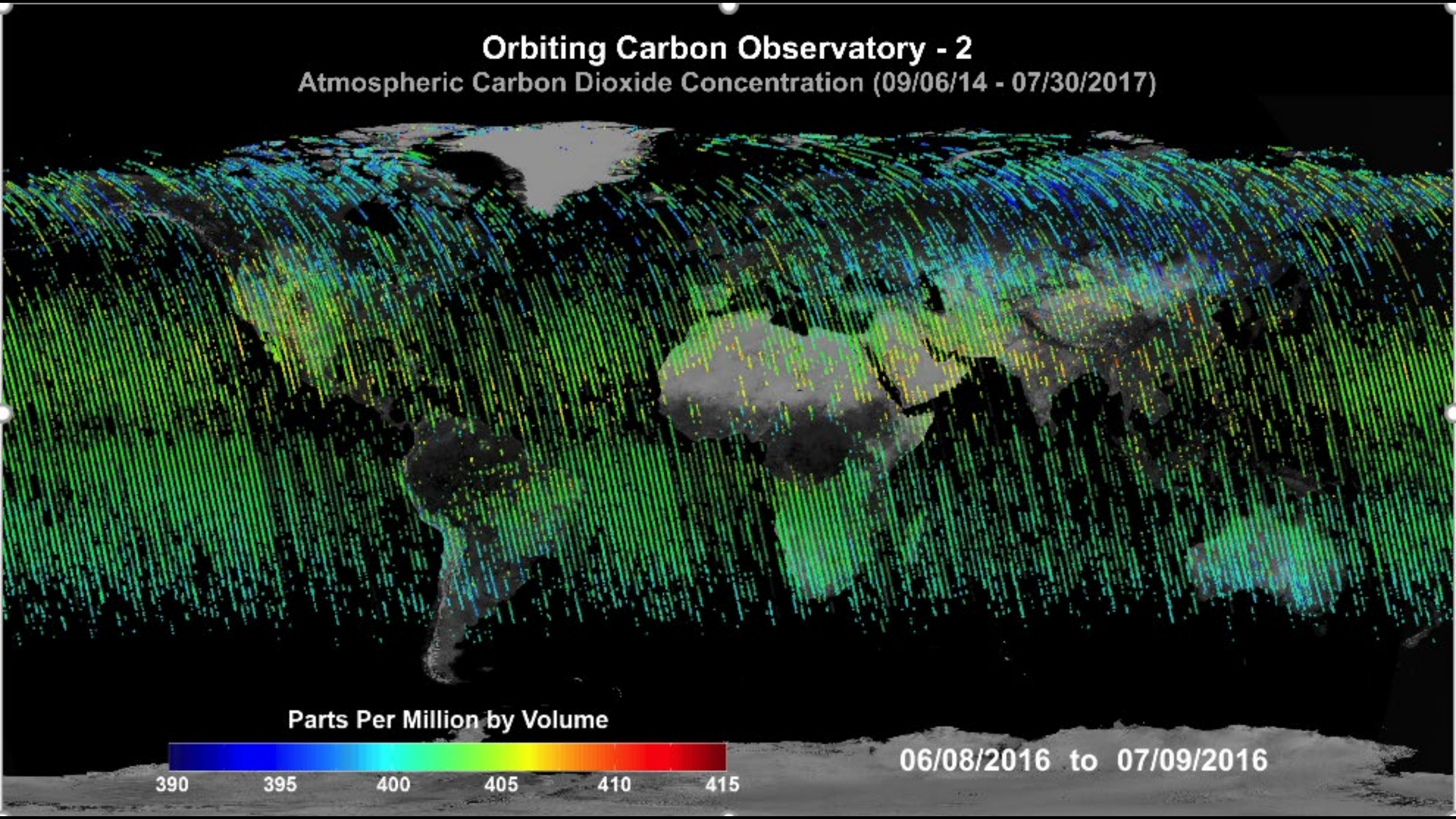

0.765μm O_2 A-Band
CO_2 1.61μm Band
CO_2 2.06 μm Band

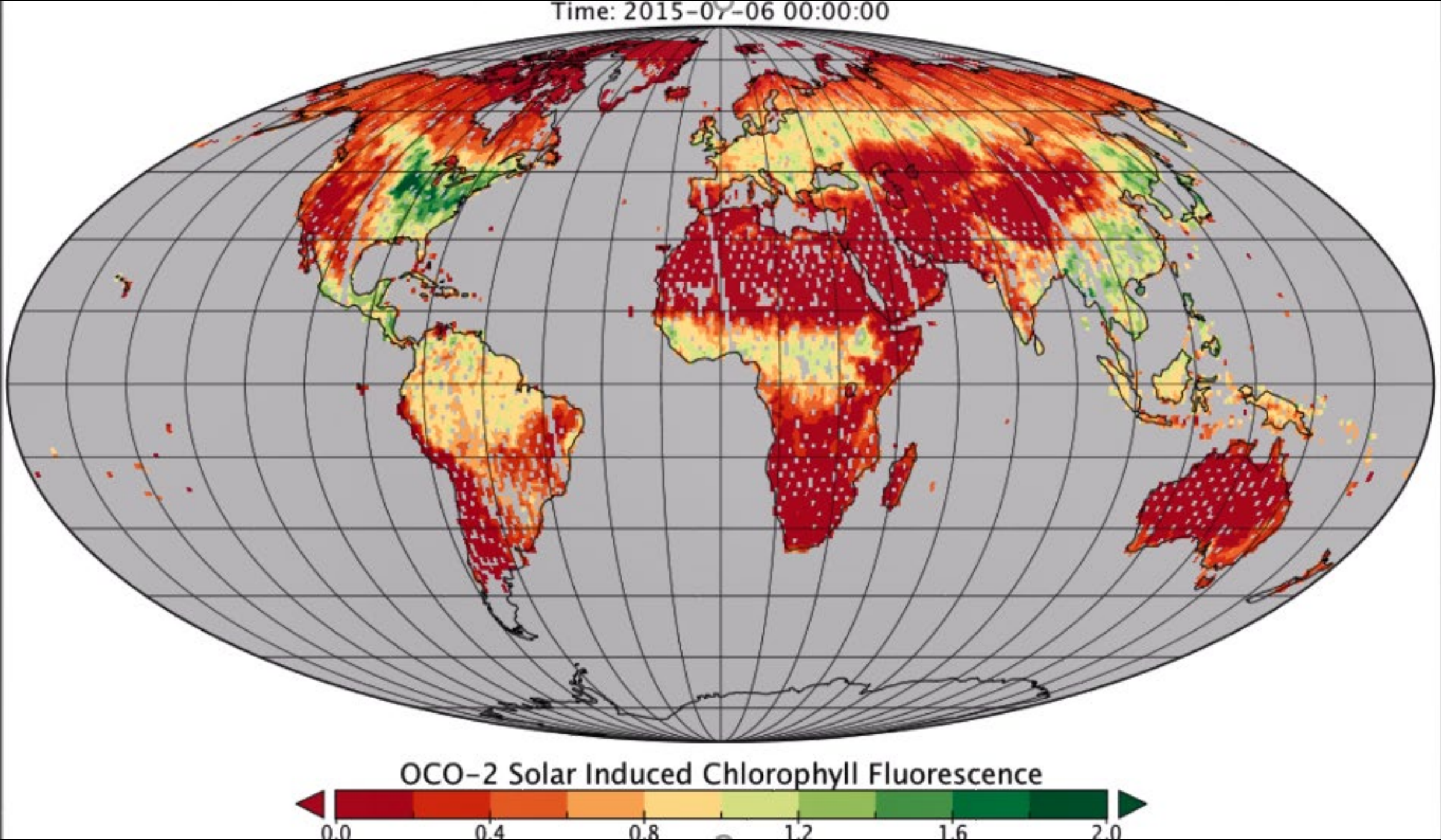


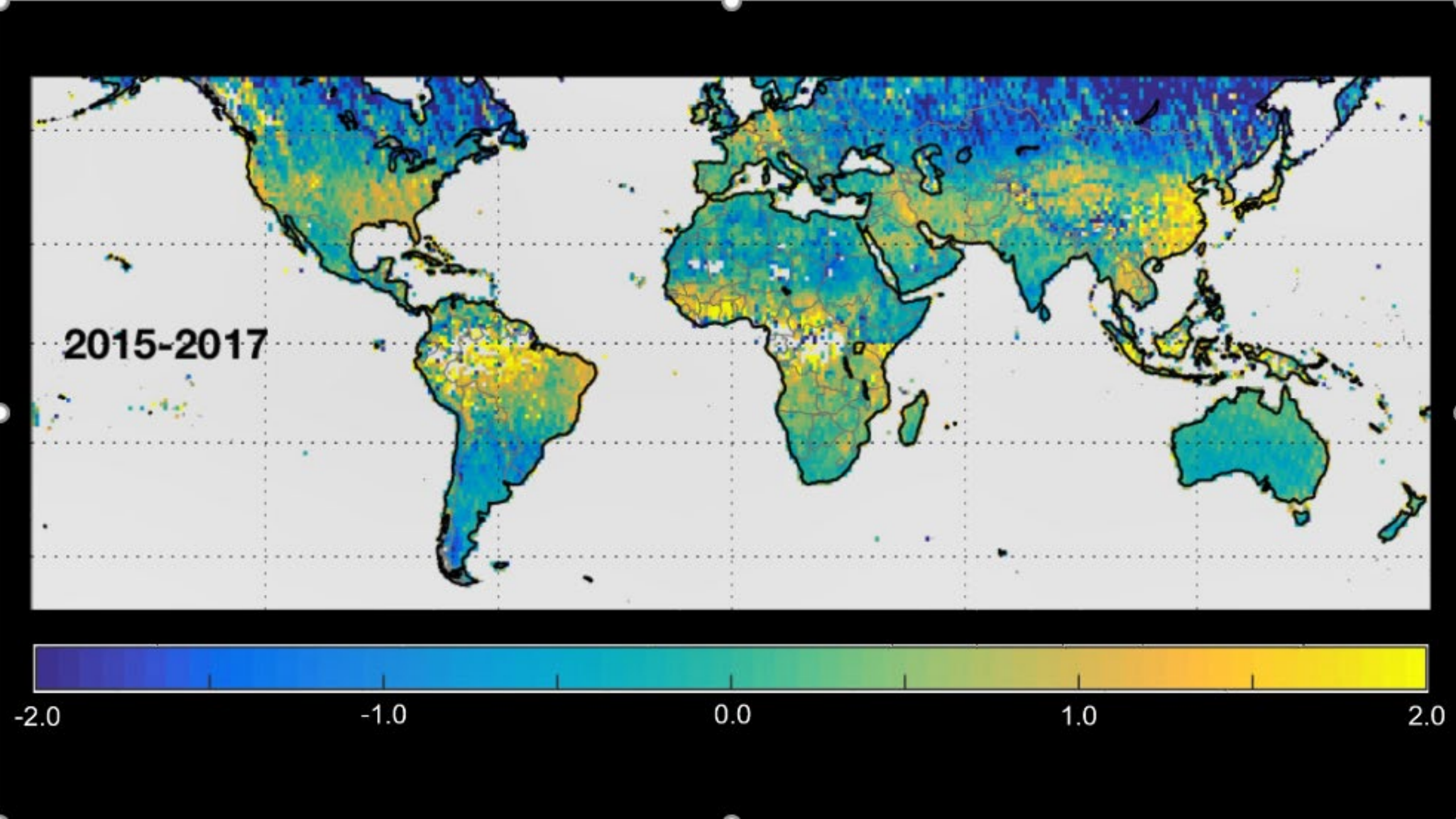

14.5 orbits per day

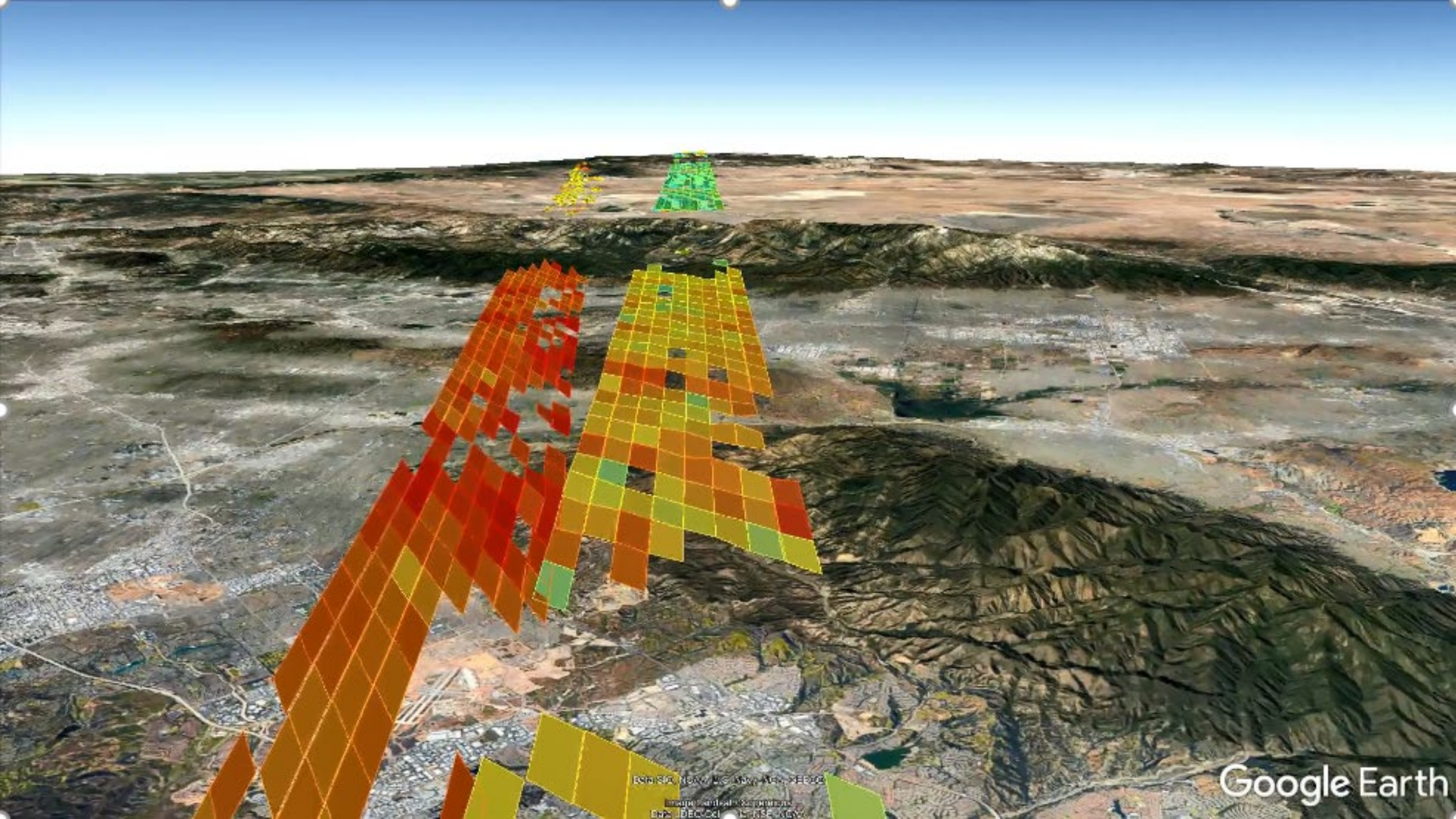


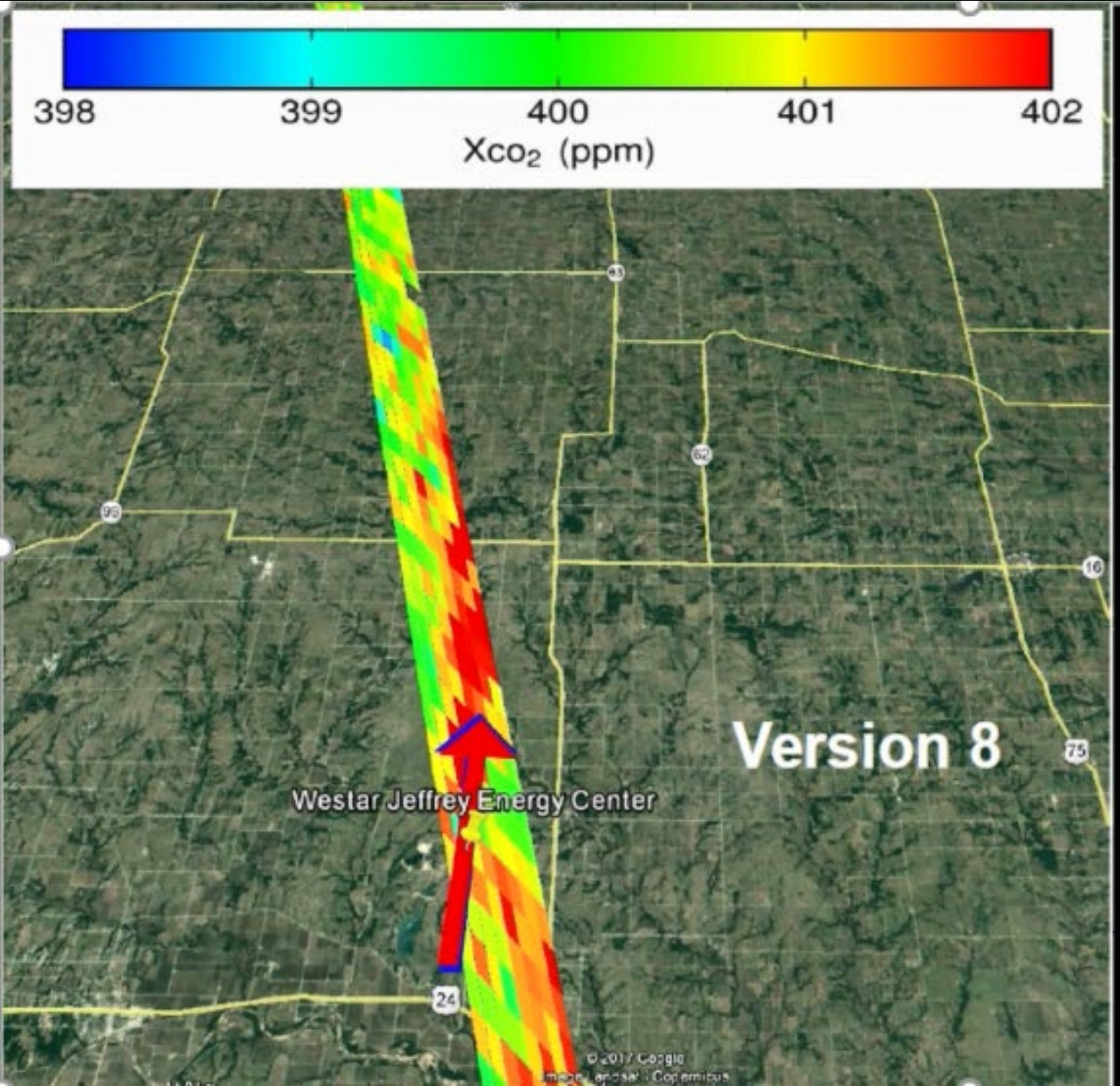

3 frames per second
12 seconds of data


Orbiting Carbon Observatory - 2
Atmospheric Carbon Dioxide Concentration (09/06/14 - 07/30/2017)
Parts Per Million by Volume
390
395
400
405
410
415
06/08/2016 to 07/09/2016

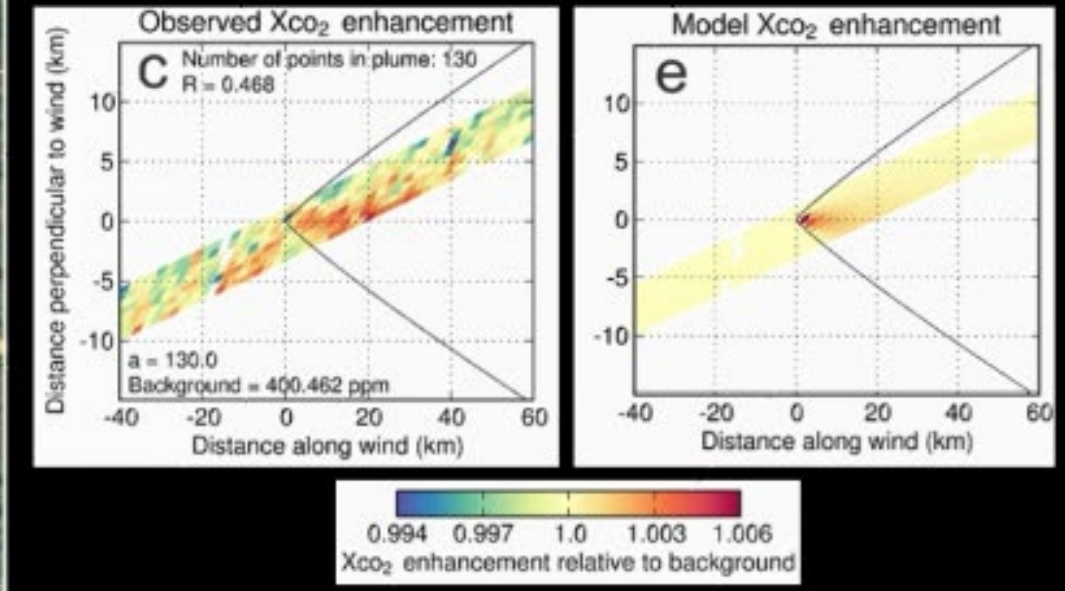

Time: 2015-07-06 00:00:00
OCO-2 Solar Induced Chlorophyll Fluorescence
0.0
0.4
0.8
1.2
1.6
2.0


2015-2017
-2.0
-1.0
0.0
1.0
2.0


Google Earth

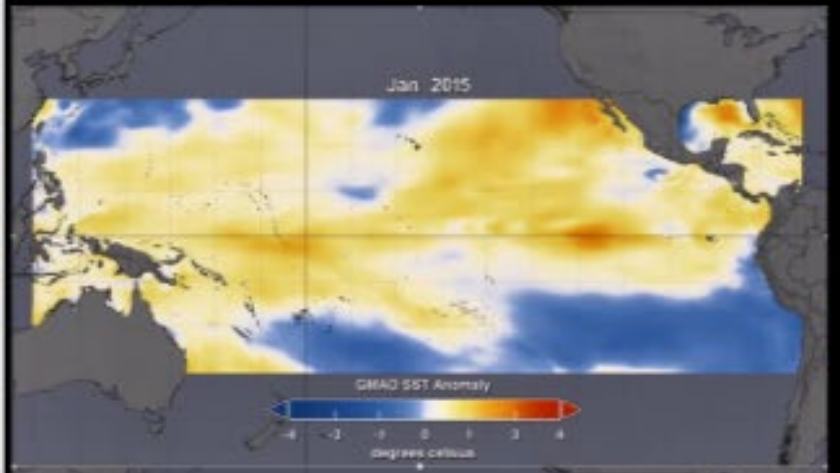


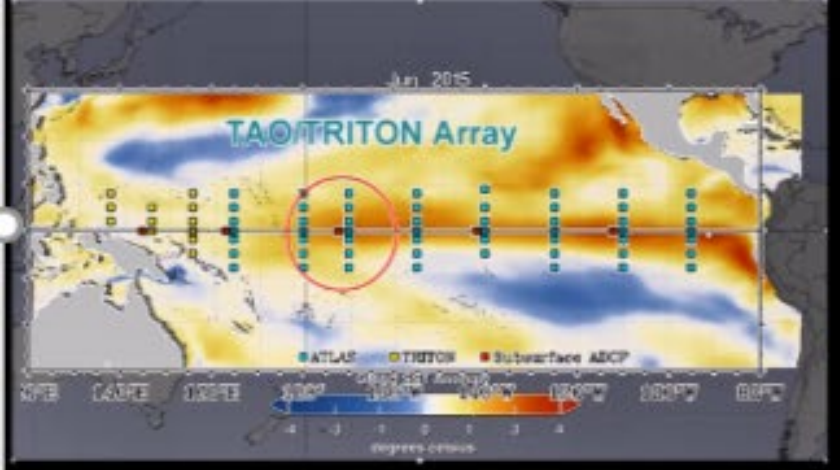
Westar Jeffrey Energy Center, Kansas, USA December 4, 2015

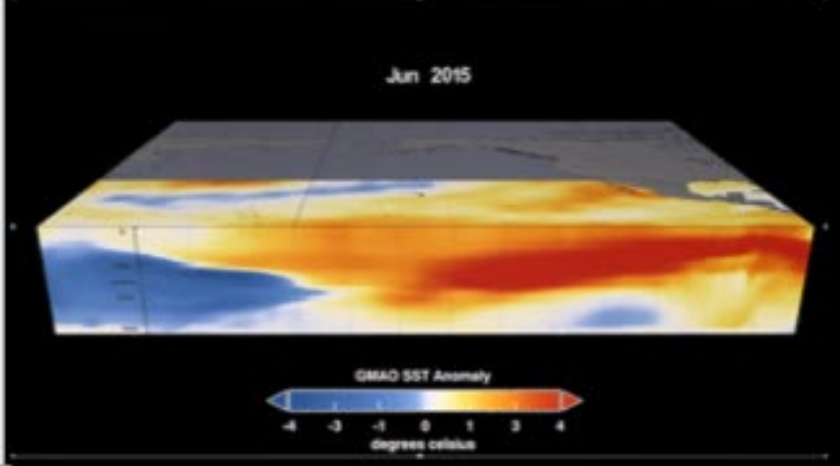


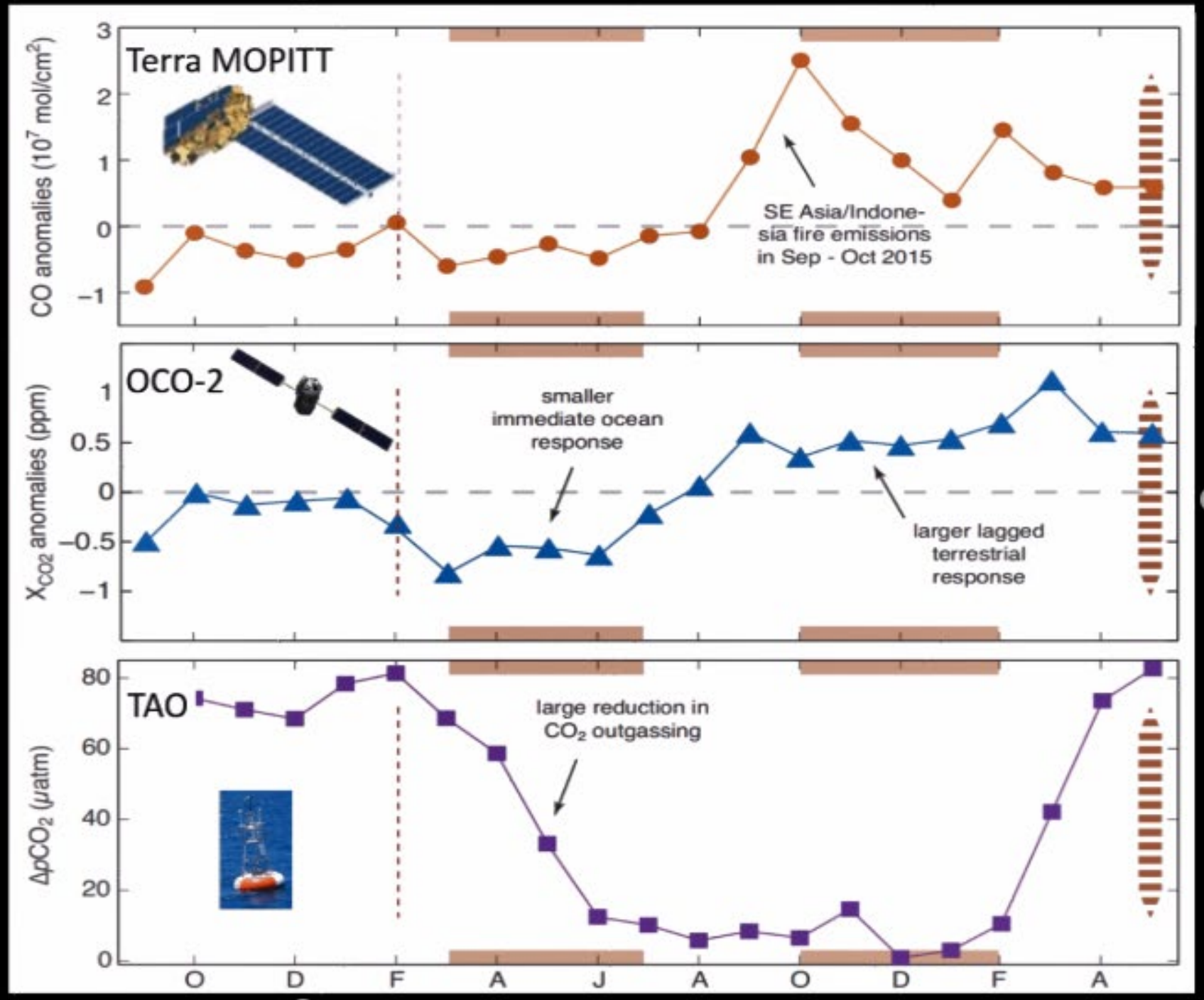
Reported: 26.7 kT/d

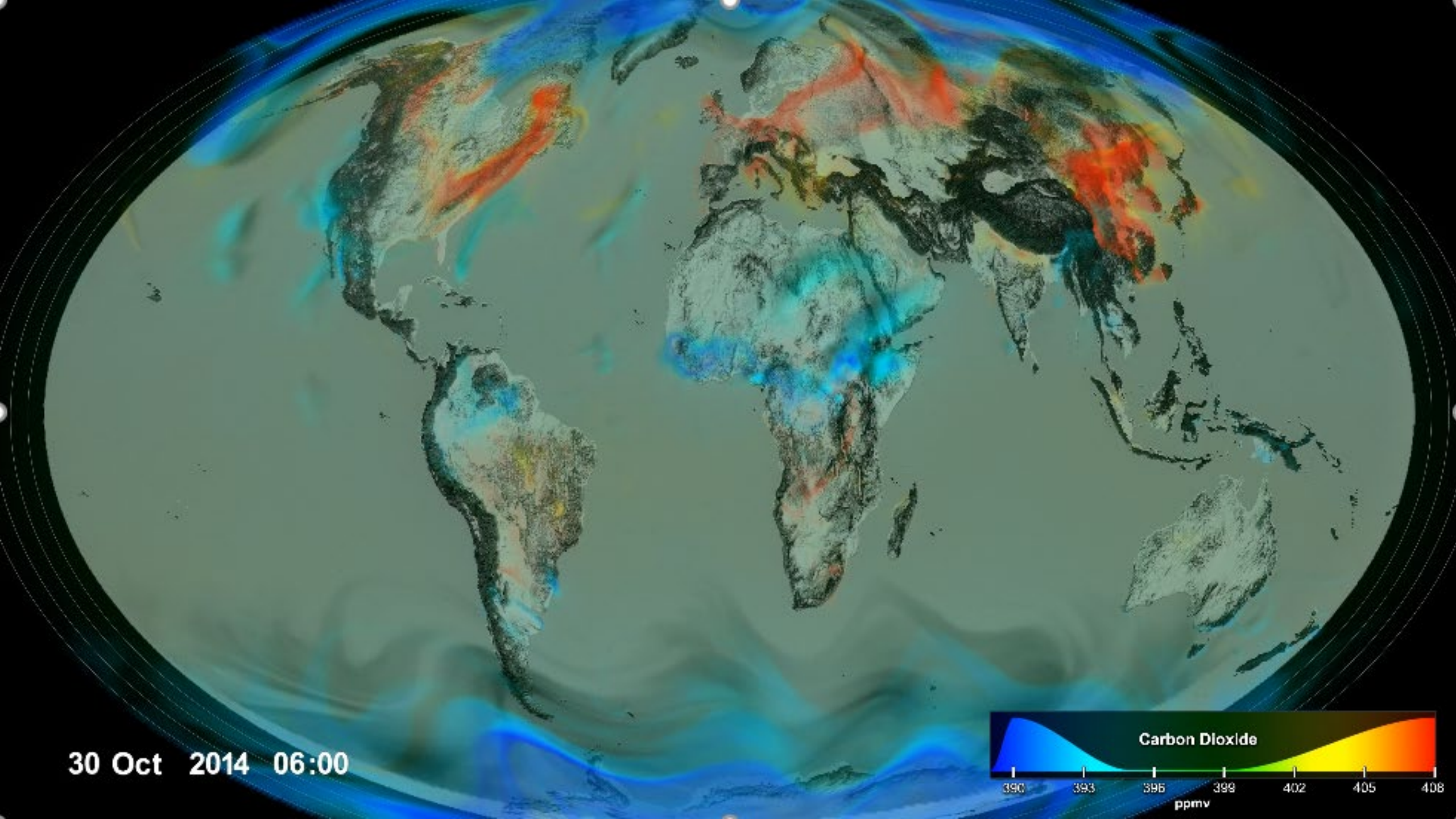
Estimated: 31.2 ± 3.7 kT/d

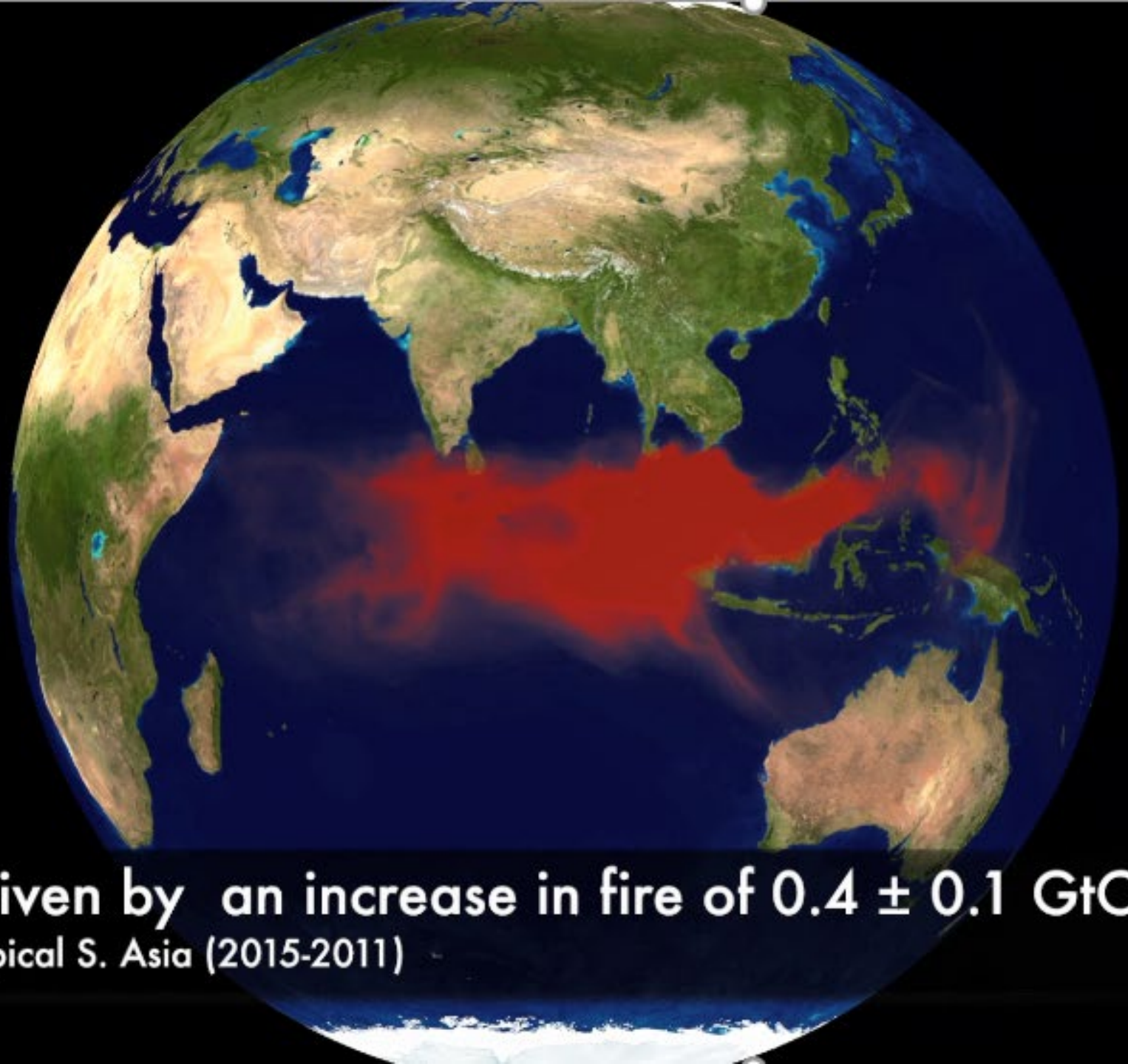

Jan 2015
GMAO SST Anomaly
degrees celsius


Jun 2015
TAO/TRITON Array
ATLAS
TRITON
Subsurface ADCP
degrees celsius


Jun 2015
GMAO SST Anomaly
degrees celsius


Terra MOPITT
CO anomalies (10^7 mol/cm^2)
SE Asia/Indonesia fire emissions in Sep - Oct 2015
OCO-2
X_{CO2} anomalies (ppm)
smaller immediate ocean response
larger lagged terrestrial response
TAO
ΔpCO_2 (μatm)
large reduction in CO_2 outgassing
O D F A J A O D F A

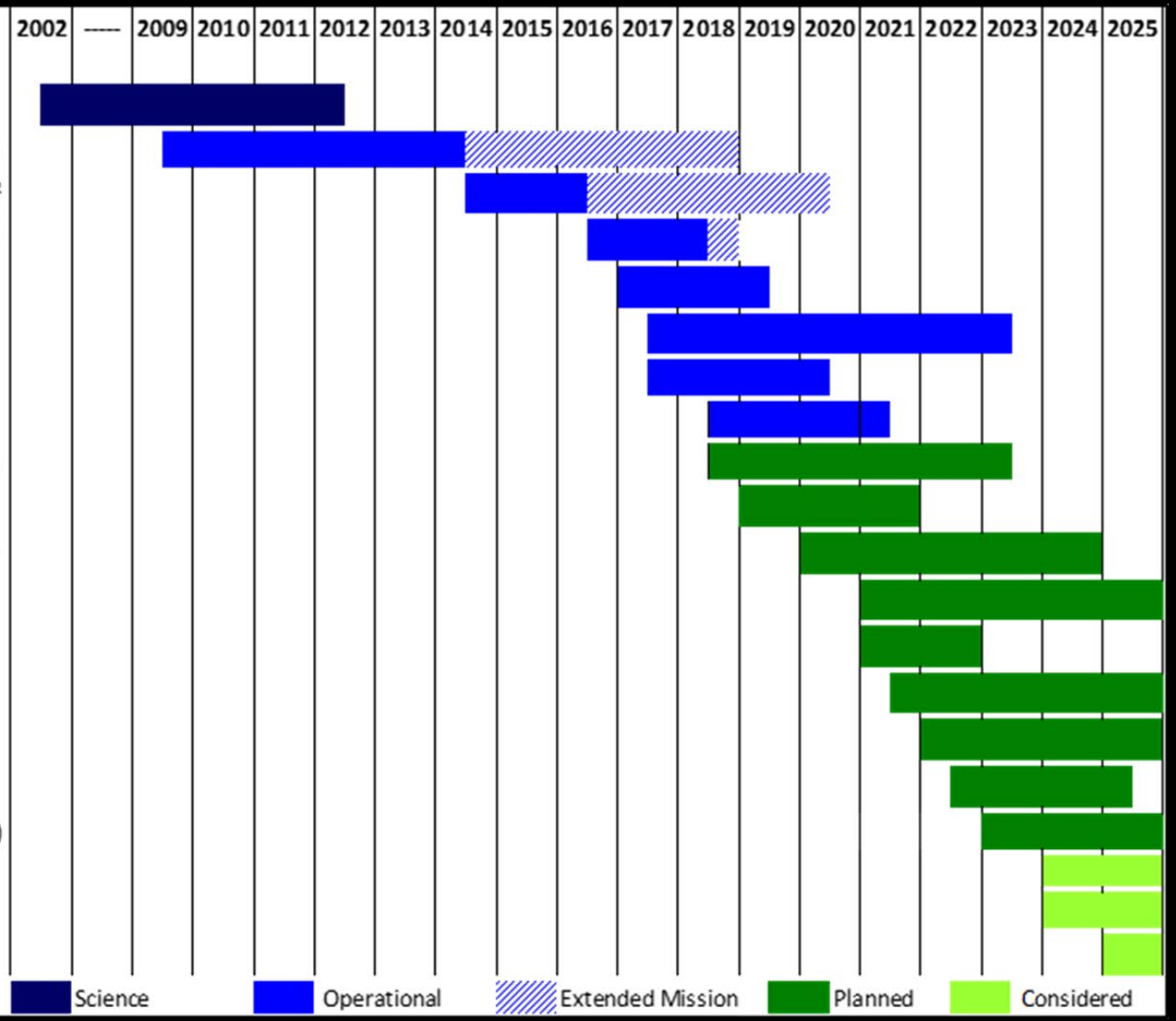
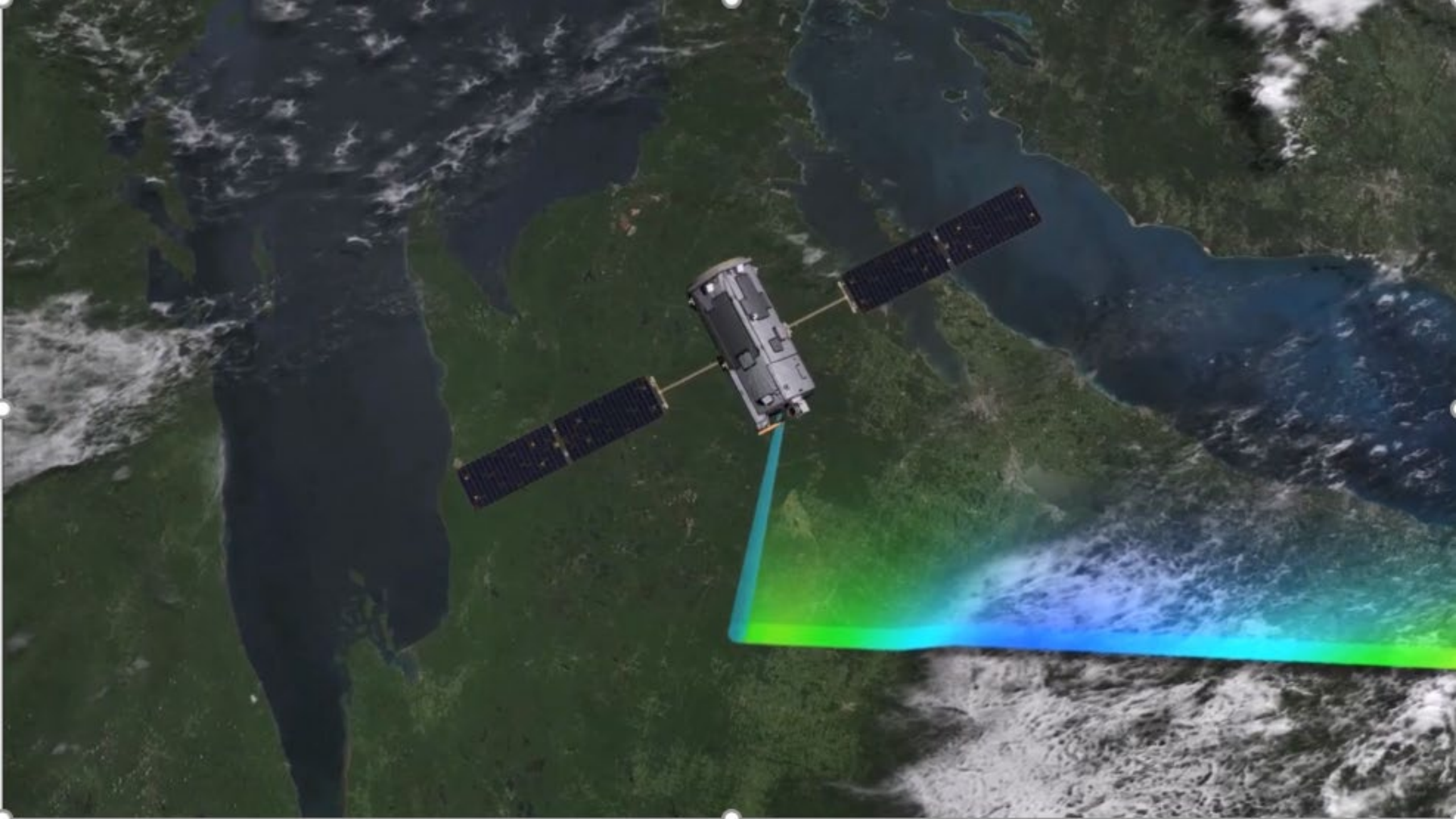

30 Oct 2014 06:00
Carbon Dioxide
390
393
396
399
402
405
408
ppmv



Driven by an increase in fire of 0.4 ± 0.1 GtC

Tropical S. Asia (2015-2011)

Satellite, Instrument (Agencies)	CO_2	CH_4	Swath	Sample
ENVISAT SCIAMACHY (ESA)	●	●	960 km	30x60 km^2
GOSAT TANSO-FTS (JAXA-NIES-MOE)	●	●	3 pts	10.5 km (d)
OCO-2 (NASA)	●		10.6 km	1.3x2.3 km^2
GHGSat (Claire)		●	12 km	0.0004 km^2
TanSAT (CAS-MOST-CMA)	●		20 km	1x2 km^2
Sentinel 5P TROPOMI (ESA)		●	2600 km	7x7 km^2
Feng Yun 3D GAS (CMA)	●	●	7 pts	10 km (d)
GaoFen-5 GMI	●	●	5-9 pts	10 km (d)
GOSAT-2 TANSO-FTS (JAXA-MOE-NIES)	●	●	5 pts	10.5 km (d)
OCO-3 (NASA)	●		11 km	4 km^2
Bluefield Technologies		●	25x20 km	0.0004 km^2
MicroCarb (CNES)	●		13.5 km	40 km^2
MethaneSAT (EDF)		●	200 km	1 km^2
MetOp Sentinel-5 series (Copernicus)		●	2670 km	7x7 km^2
Feng Yun 3G (CMA)	●	●	100 km	< 3 km^2
GEOCARB (NASA)	●	●	2800 km	4x4 km^2
MERLIN (DLR-CNES)		●	100 m	0.14 km (w)
TanSat-2 Constellation	●	●	3x100 km	2x2 km^2
GOSAT-3 (JAXA-MOE-NIES)	●	●	TBD	TBD
CO2 Sentinel (Copernicus)	●	●	3x250 km	2x2 km^2



OCO-2