Overview of the NOAA Geostationary Program

(with a slight Wisconsin bias)

Gary S. Wade and Timothy J. Schmit

Research Satellite Meteorologists

NOAA/NESDIS/ORA(STAR)

Advanced Satellite Products Branch (ASPB)

Madison, WI

and many, many others

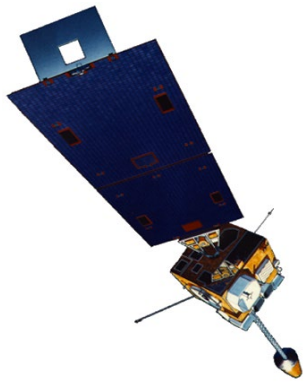
Cachoeira Paulista - São Paulo

26-30 November 2007

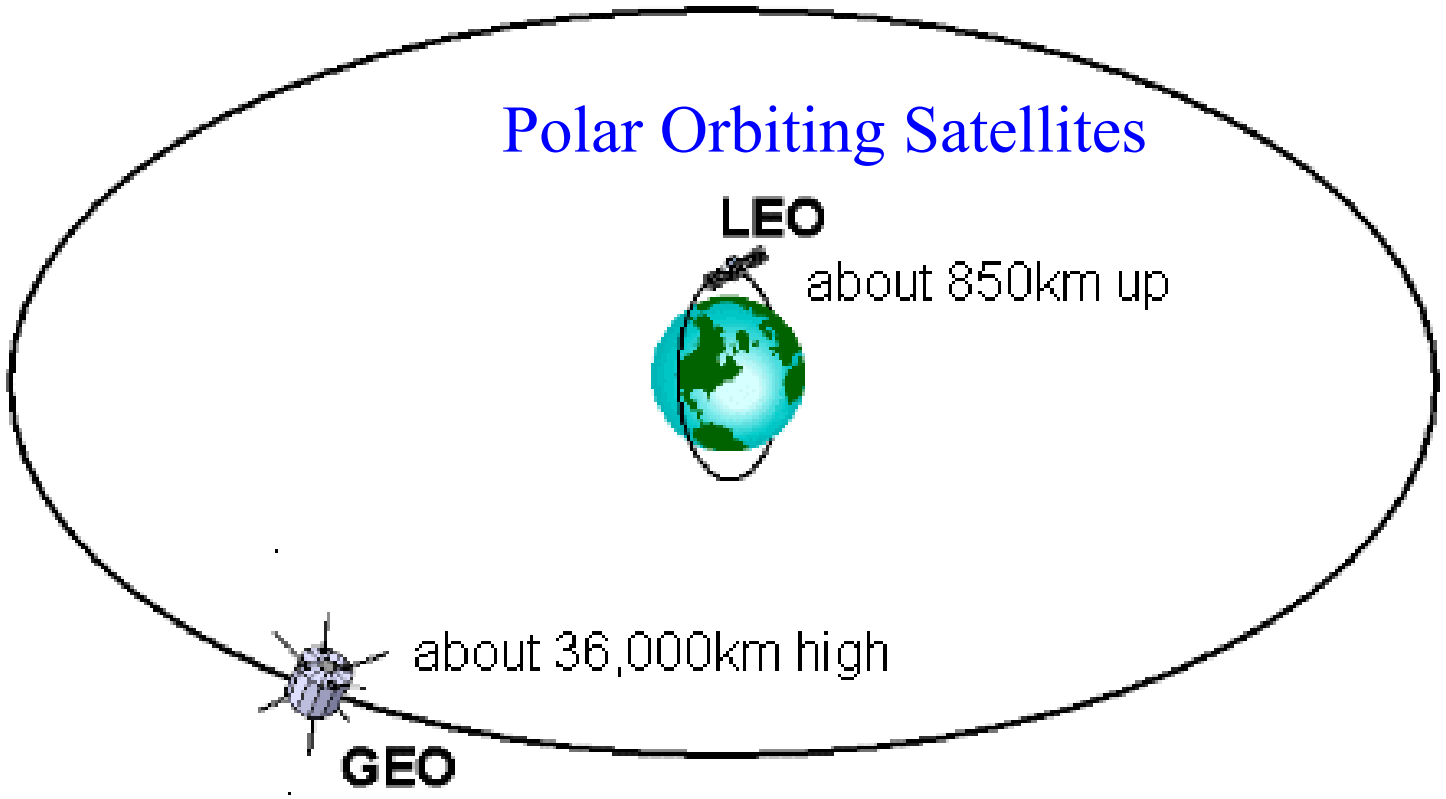
CIMSS

UW-Madison

Geostationary
Operational
Environmental
Satellite

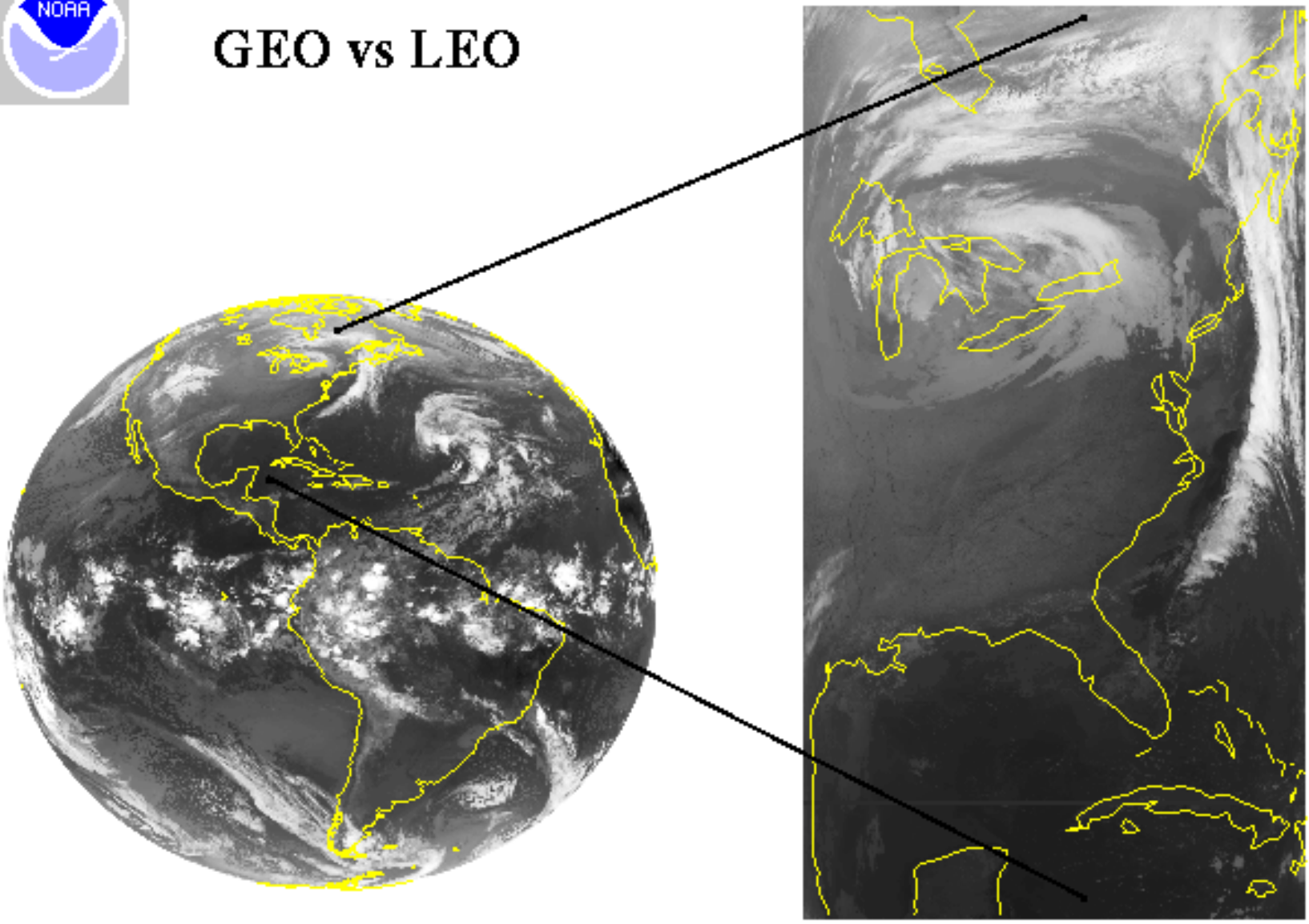


LEO and GEO orbit elevations



Geostationary Satellites
(approximately 1/10th the distance to the moon)

GEO vs LEO

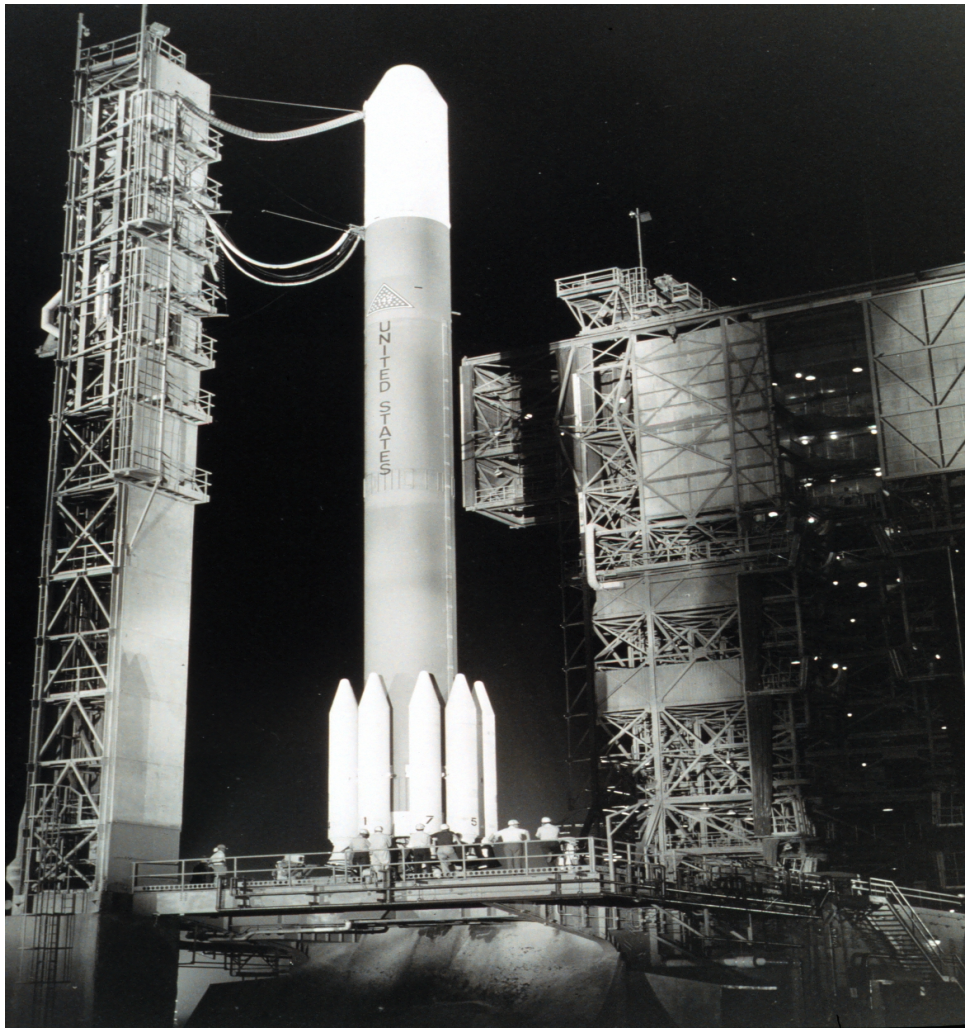


GOES-8 IMAGER 12UTC 02APR98

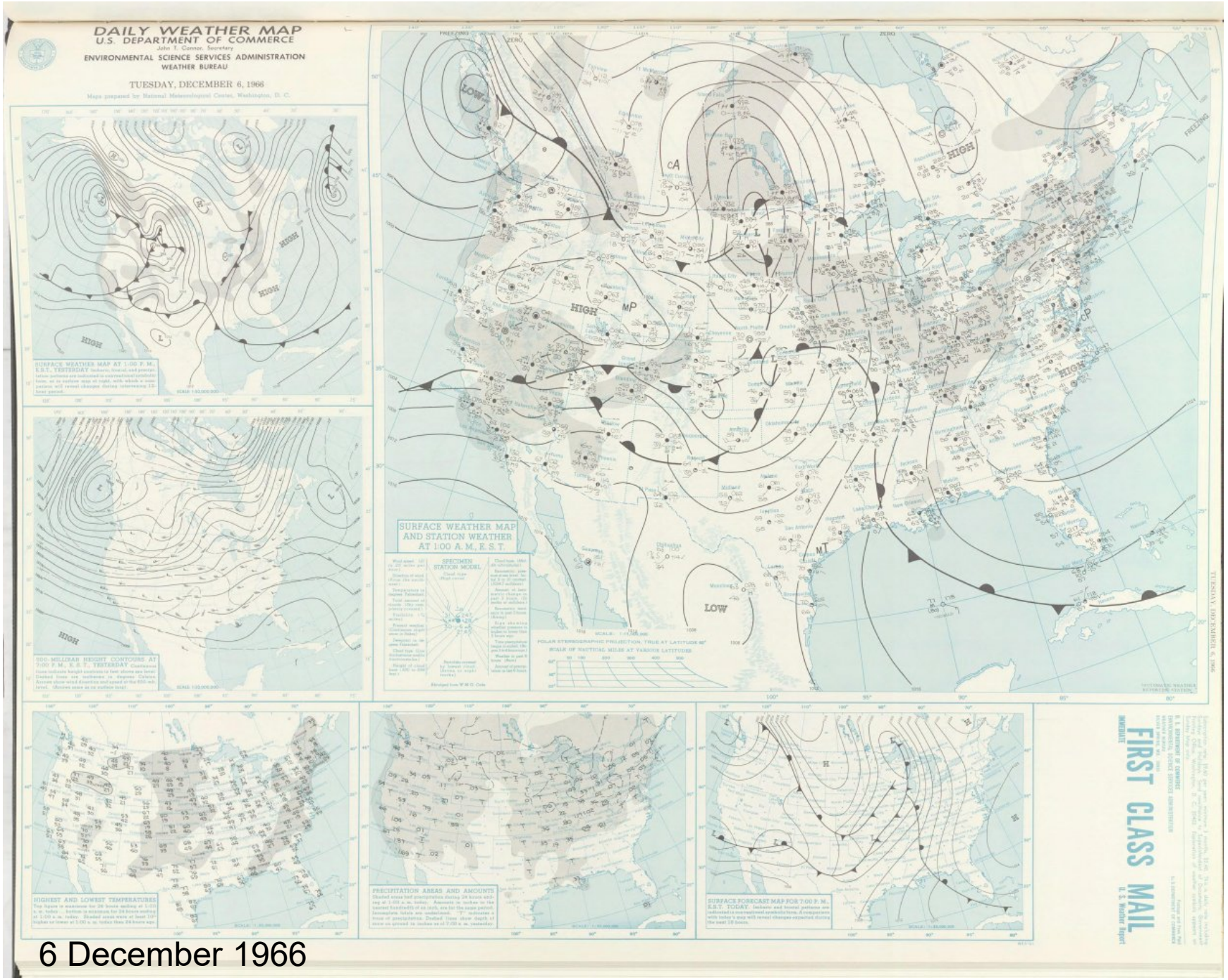
NOAA-12 AVHRR 12UTC 02APR98

Verner E. Suomi and Robert J. Parent

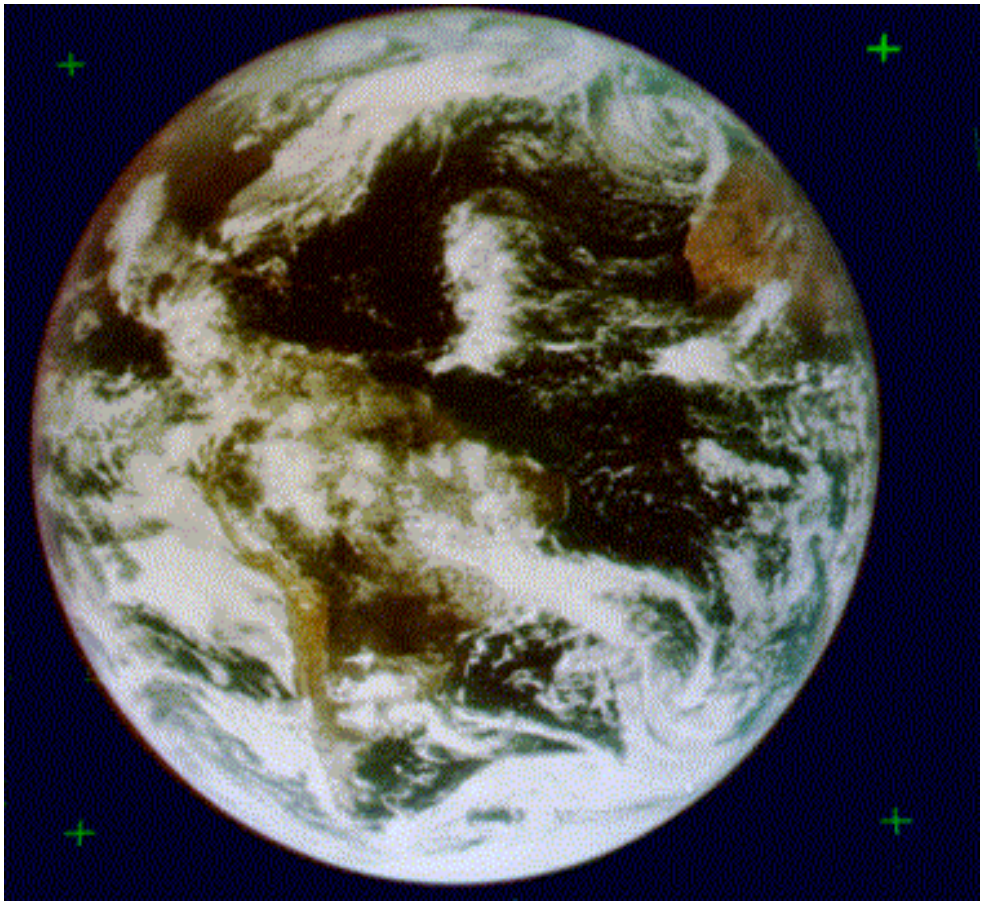
On 6 December 1966, the Applications Technology Satellite (ATS-1) was launched. We have had the benefit of the geostationary perspective for 40 years!



ATS-1's spin scan cloud camera (UW's Suomi and Parent 1968) provided full disk visible images of the earth and its cloud cover every 20 minutes. The spin scan camera on ATS-1 occurred because of an extraordinary effort by Verner Suomi and Homer Newell, when the satellite was already well into its fabrication.



6 December 1966



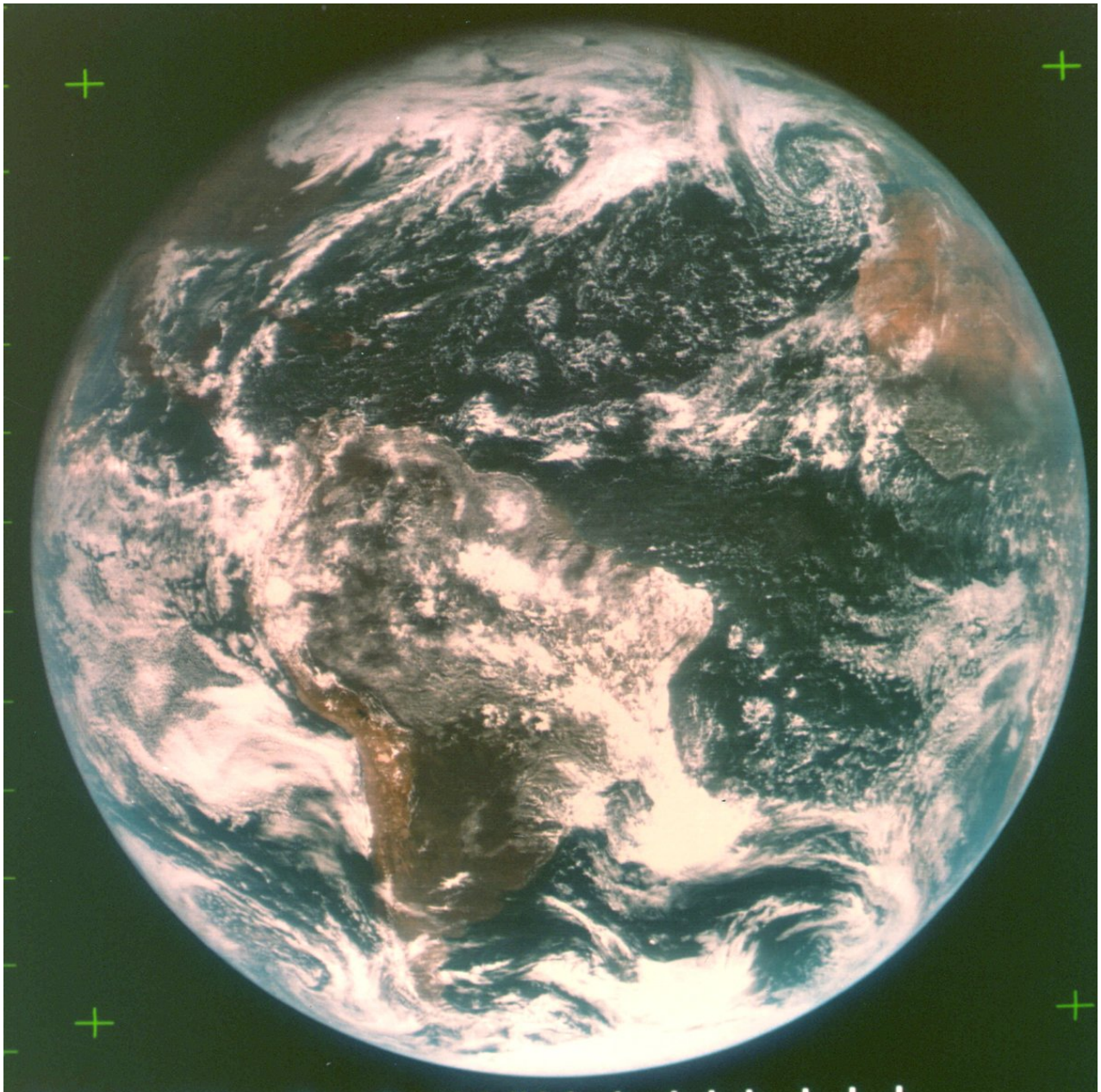
ATS-III

“the clouds moved - not the satellite”

Verner Suomi

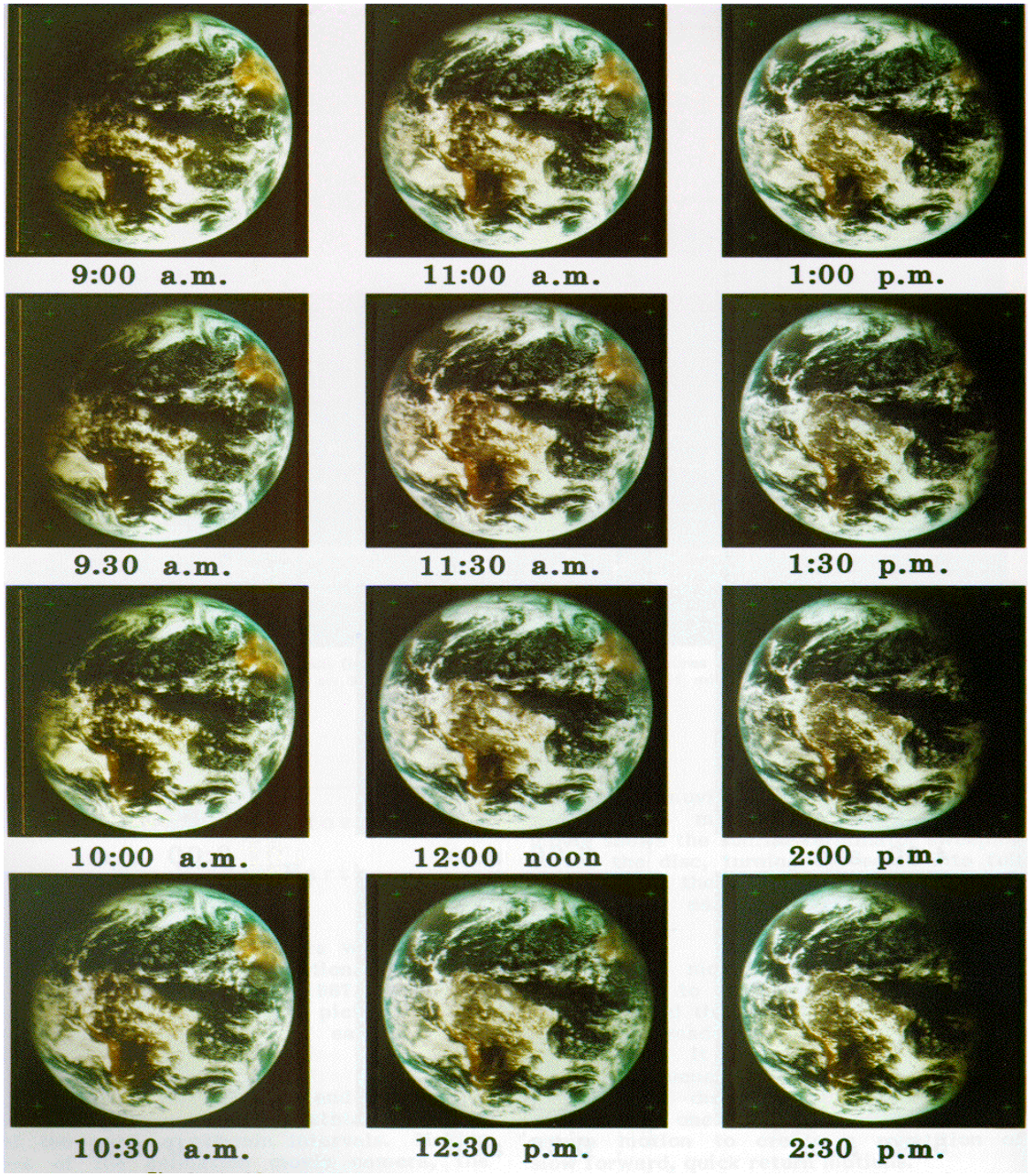
From 6 Dec 1966, ATS-1's geostationary spin scan cloud camera provided full disk visible images of the earth and its cloud cover every 20 minutes

ATS-III 18Nov1967 15:03Z



Suomi, Parent, and Fujita

create first color movie of planet Earth with ATS-III pictures



Professor Suomi and McIDAS

(Man computer Interactive Data Access System)

earth observatory

home • data & images • features • news • reference • missions • experiments • search

ON THE SHOULDERS OF GIANTS

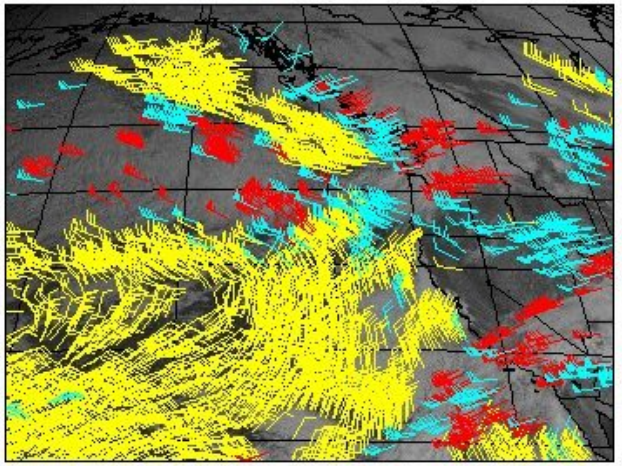
"As he watched a football game on television, he realized that what he really wanted was an instant replay of weather pictures."

Verner Suomi (1915-1995)

1972 – "McIDAS" ⟶ 2007 – "McIDAS-V"
Including VIS-AD and HYDRA

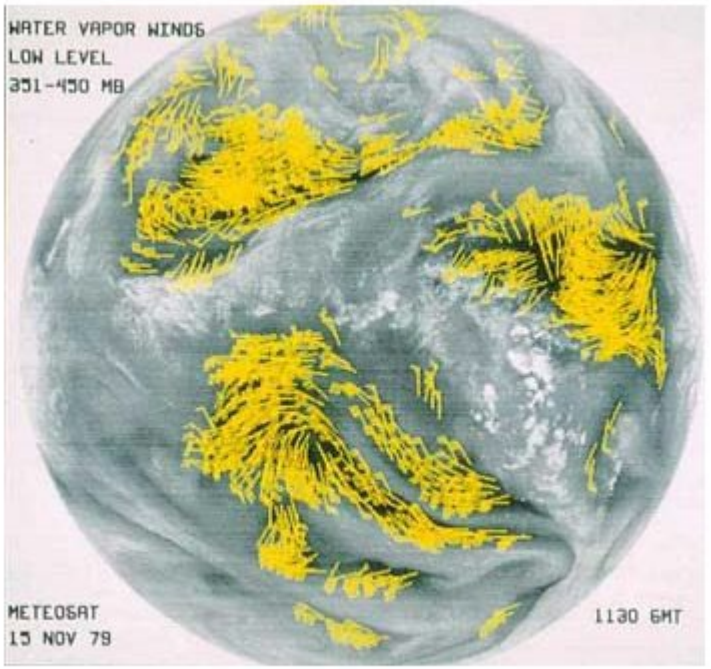
The Man-computer Interactive Data Access System (McIDAS), like so many of his ideas, just popped into his head. As he watched a football game on television, he realized that what he really wanted was an "instant replay of weather pictures." He wanted to slow them down, replay them, and have a computer analyze them. With this simple concept, he went to SSEC's engineers and programmers. In 1972 Suomi introduced McIDAS.

McIDAS proved invaluable in analyzing wind data collected during the First GARP Global Experiment (FGGE) in 1978. Instrumental in planning the experiment's objectives and processes, Suomi came up with the idea of using observed cloud movement to determine wind speed and direction, especially over the tropics. McIDAS is in use today by the National Storm Prediction Center, the National Weather Service, the National Transportation Safety Board, NASA Goddard Space Flight Center, and many other government agencies and private companies, including meteorological centers in Spain, Australia, and Japan.

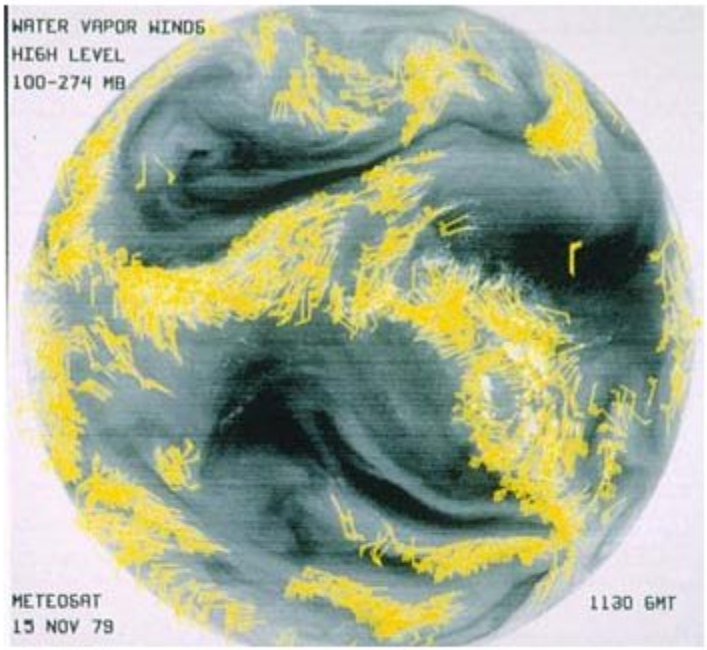


Verner Suomi developed methods of calculating wind speed and direction from a series of pictures of moving clouds. The image above shows wind vectors over the U.S. West Coast derived from Geostationary Operational Environemntal Satellite (GOES) imagery. Color corresponds to altitude (Red indicates high winds, blue mid-level winds, and yellow low altitude winds), while the number of bars on each line indicates velocity. (Image courtesy NOAA Experimental High Density Winds)

Water vapor tracked “winds” from Meteosat during FGGE (the **F**irst Global Atmospheric Research Program (**G**ARP) **G**lobal **E**xperiment)



FGGE-Meteosat-winds-low.jpg

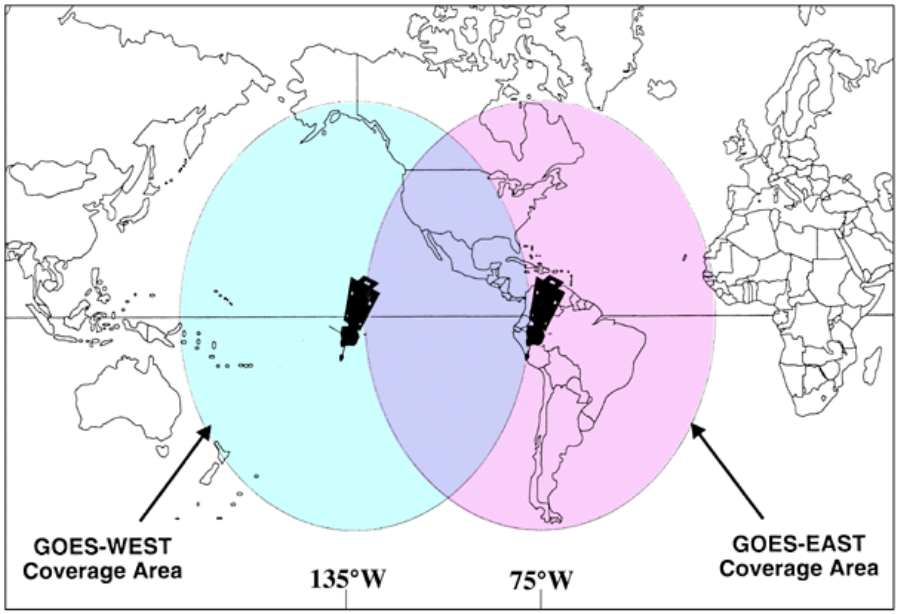


FGGE-Meteosat-winds.jpg

(15 Nov 1979)

The GOES are launched by NASA at Cape Canaveral, Florida.

The GOES are operated by the National Oceanic and Atmospheric Administration (NOAA) at 75° and 135° west longitude .



Physical vertical retrievals from geostationary orbits – another NOAA and Wisconsin connection

Bill Smith - Suomi student at UW; NOAA researcher, expanding physical iterative sounding retrievals from POES (HIRS) to GOES/VAS, as NOAA/NESDIS Development Lab moved to UW-SSEC (mid 1970s); became first director of CIMSS (early 1980s); went to NASA Langley to continue development of a geostationary hyper-spectral sounding capability; now at Hampton University as well as part time at UW-SSEC, still promoting geo hyper-spectral

Kit Hayden – NOAA/NESDIS DL member and retrieval developer (*retired*)

Paul Menzel – Suomi colleague; multi-spectral remote sensing expert and teacher at UW-SSEC; senior scientist for NOAA/NESDIS/ORA; first Suomi Distinguished Professor at UW-AOS

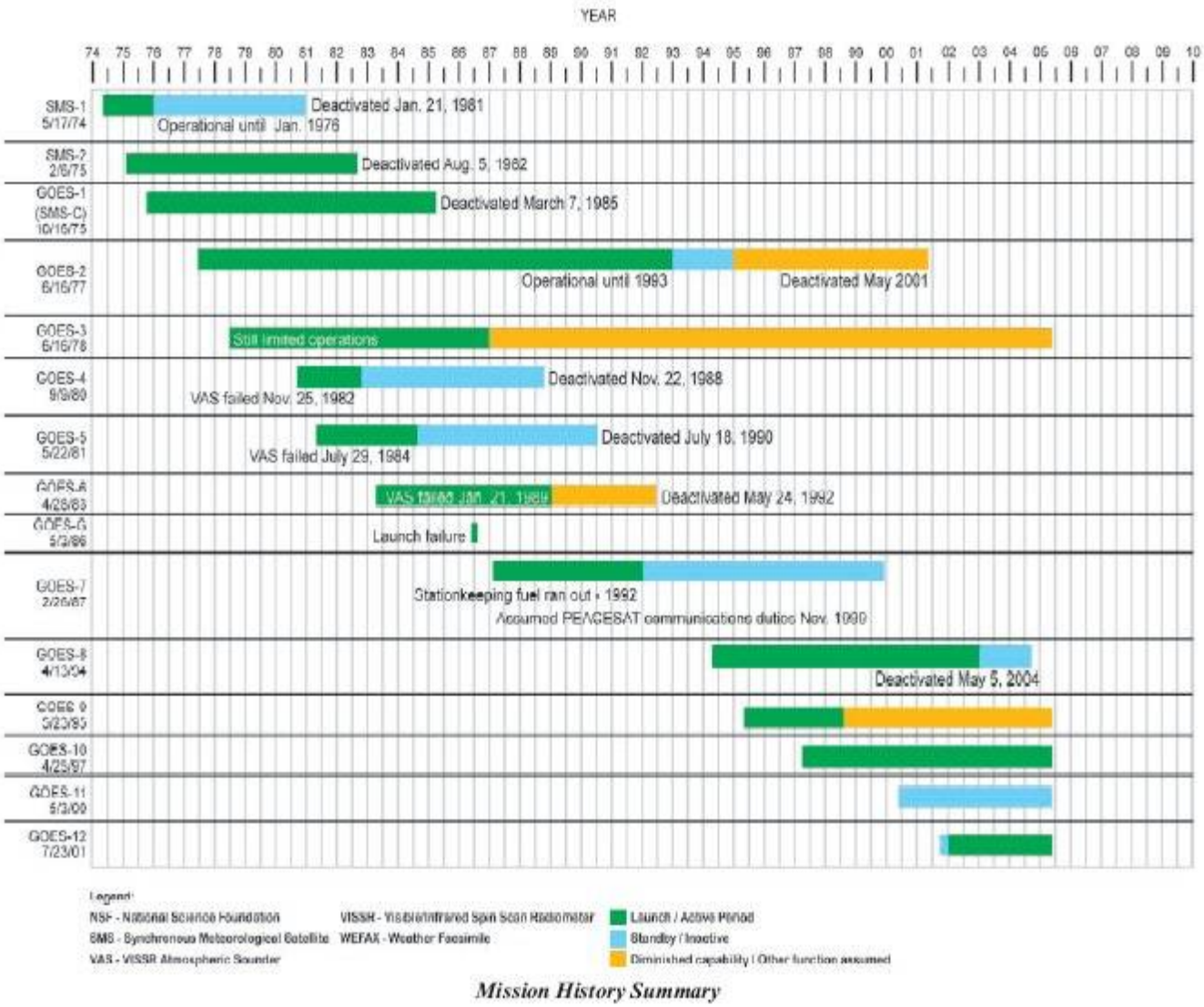
Ma Xa Lin – SSEC geo retrieval algorithm developer (*California*)

Allen Huang – Suomi student at UW; hyper-spectral remote sensing advocate and expert extraordinaire

Jun Li – SSEC geo retrieval algorithm developer

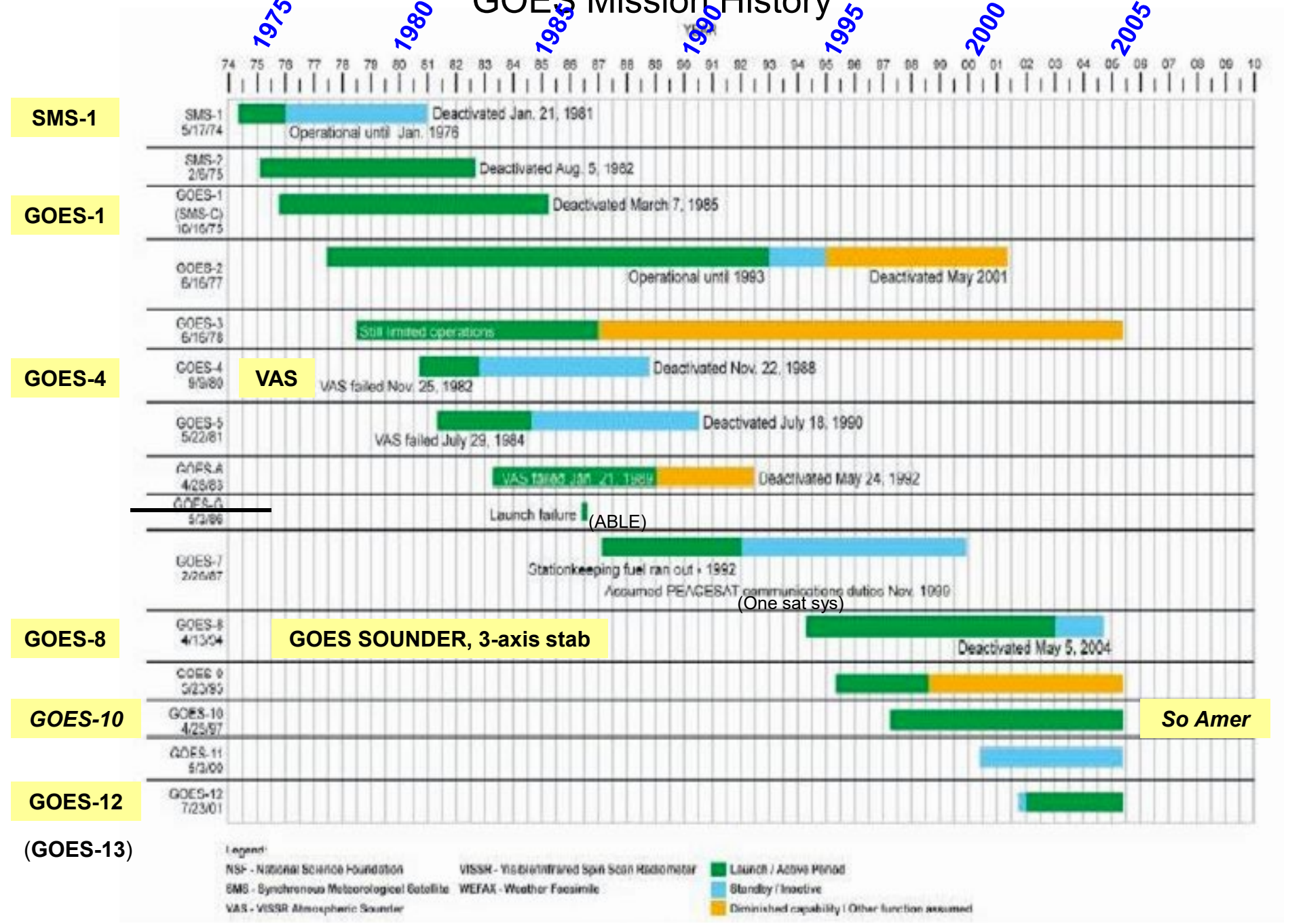
GOES Mission History

{from "*NOAA GOES-N,O,P – The Next Generation*" (NASA, NOAA)}



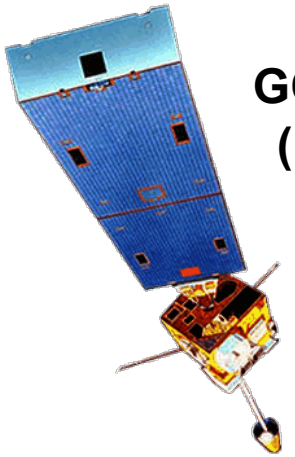
Mission History Summary

GOES Mission History

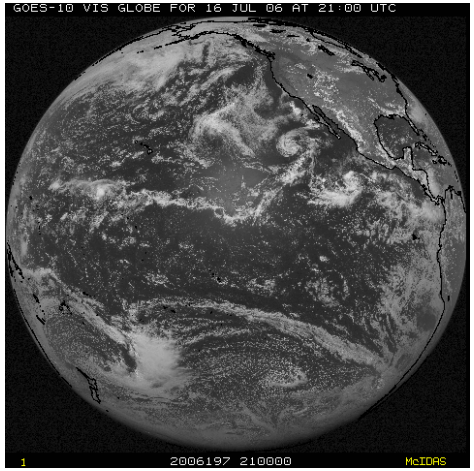


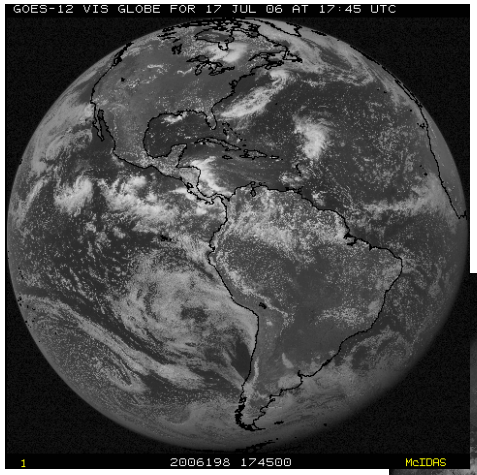
GOES Constellation

Operational

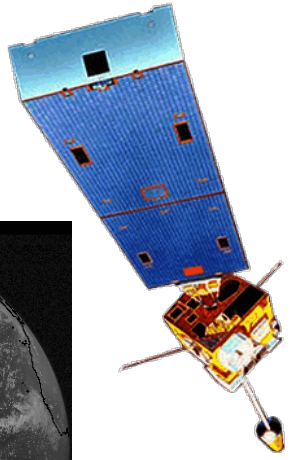


GOES-11
(135W)

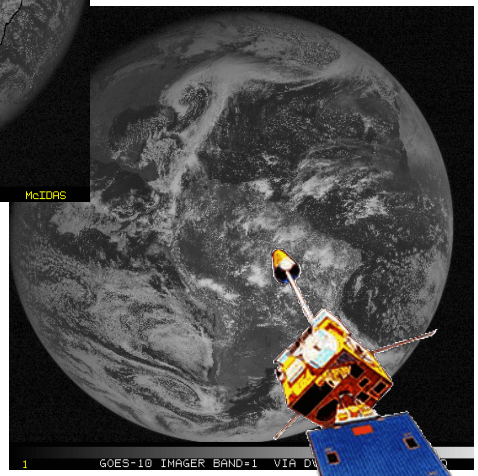


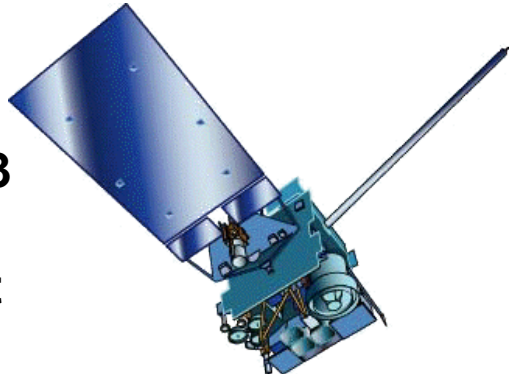


GOES-12
(75W)

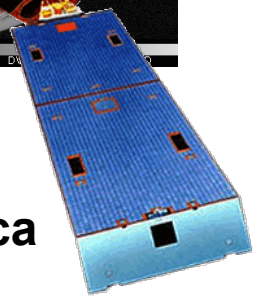


Operational





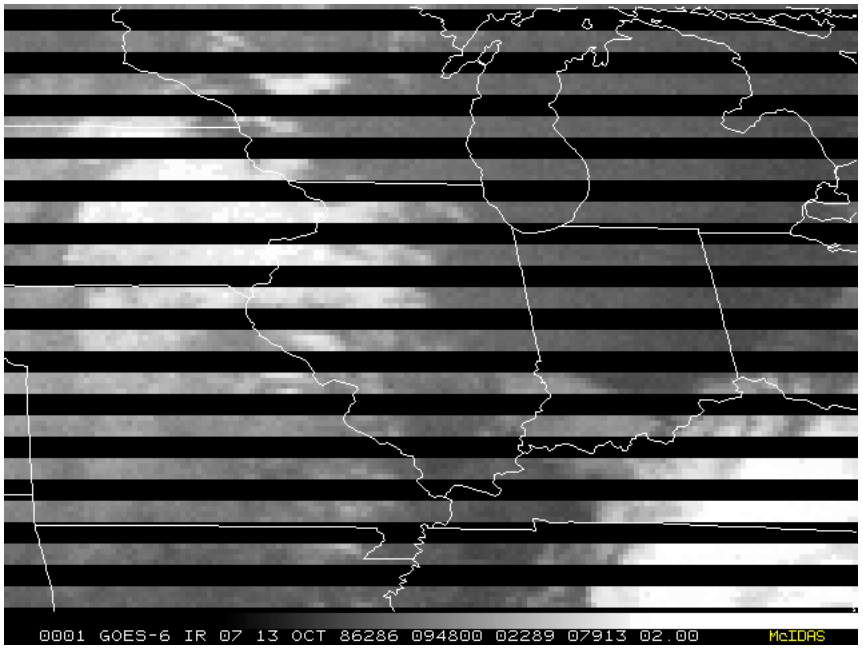
GOES-13
(105W)
On-orbit
Storage



GOES-10
(60W)
South America

GOES VAS

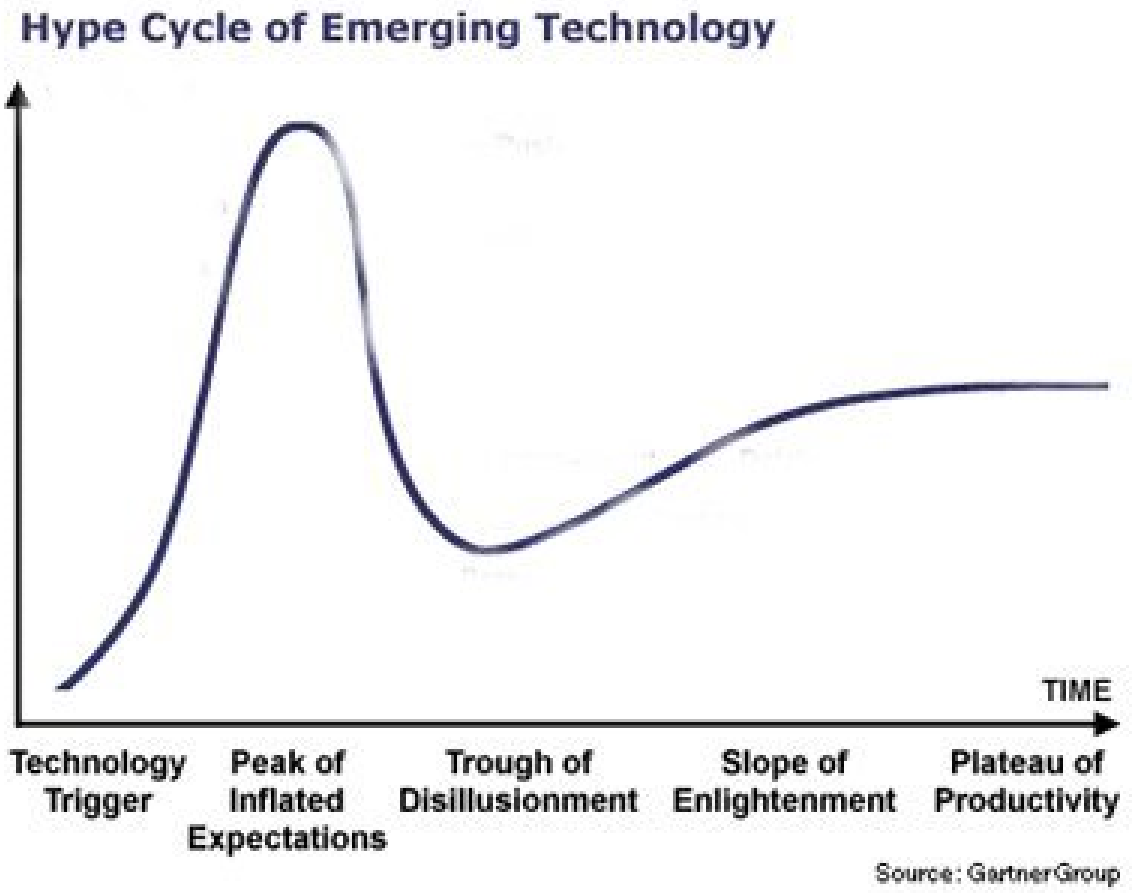
12 Infrared Channels (1 Visible Channel)
Filter Wheel Radiometer, operating in Dwell Sound or MSI modes



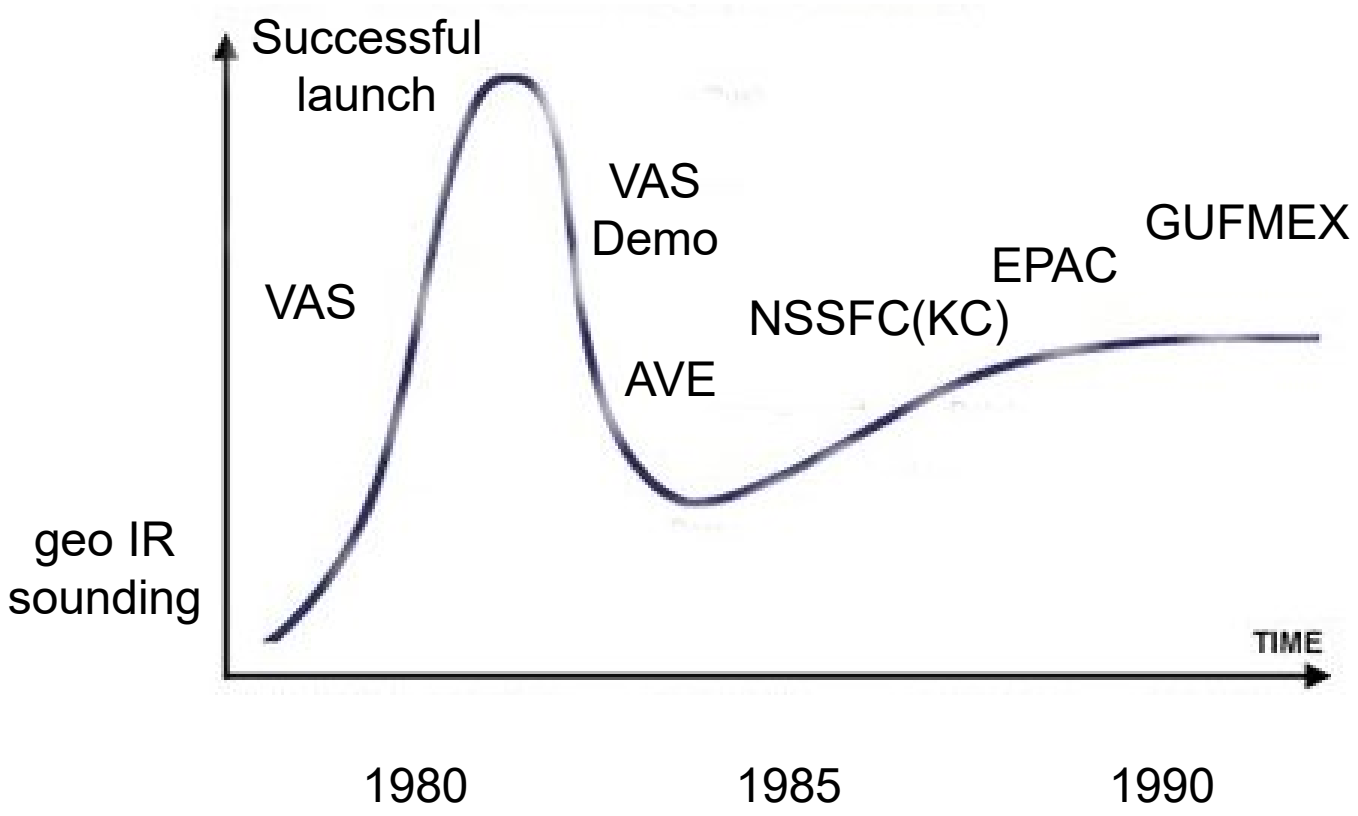
- Not Operational (precluded by RISOP)
- Venetian Blinding
- Noisy (due to reduced spin budget)

(VAS – **V**ISSR {Visible and Infrared Spin Scan Radiometer} **A**tmospheric **S**ounder)
(MSI – Multi-Spectral Imaging RISOP – Rapid Imaging Special Operation)

The Ups and Downs of Progress

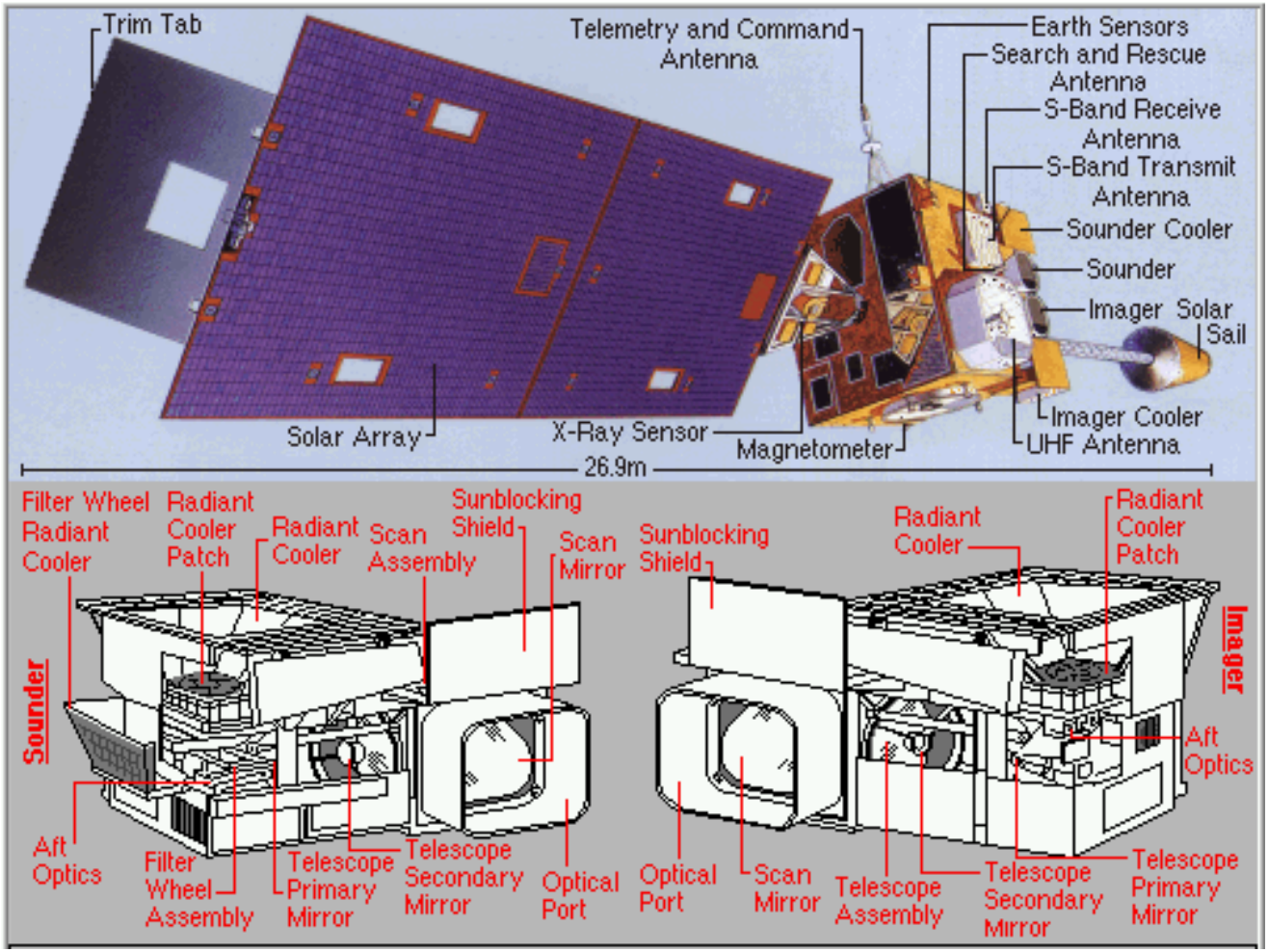


The Ups and Downs of Satellite Advances



GOES-8/M Sounder

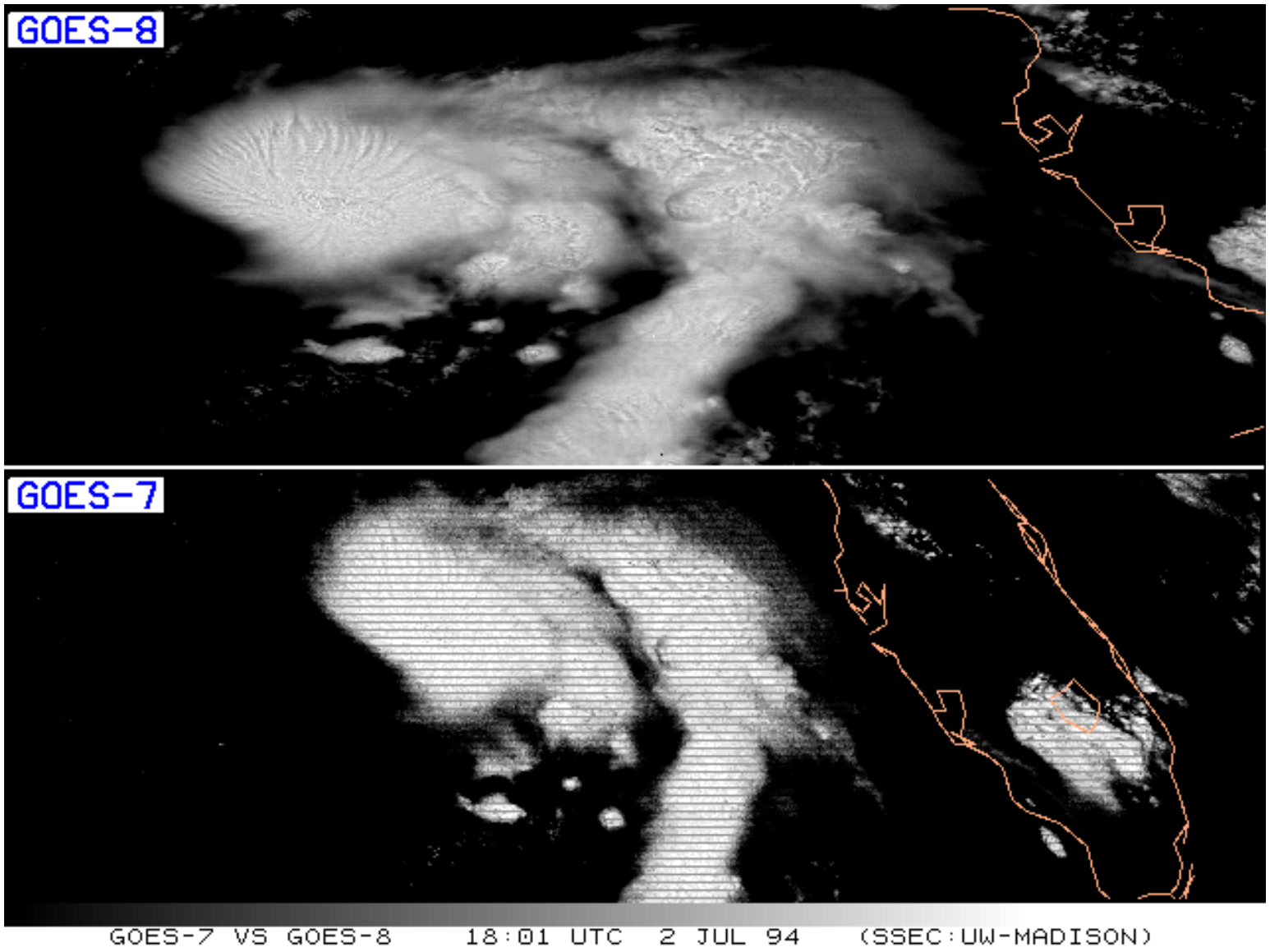
18 Infrared Channels (1 Visible Channel)
Filter Wheel Radiometer



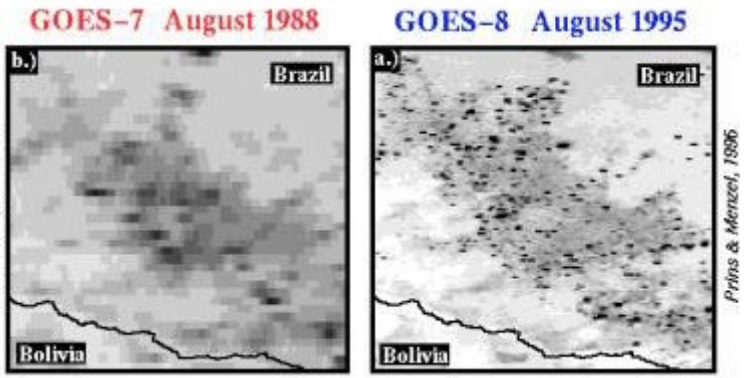
- Operational
- Higher Signal-to-Noise

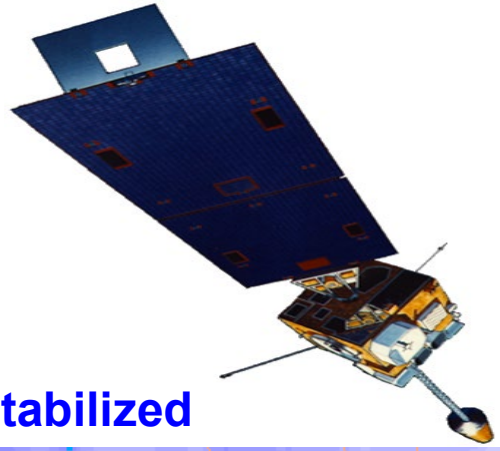
Similar spatial resolutions, but many other differences:
- bit depth, detector type, noise, dwell time, etc.

Note additional cloud-top structure is seen in the GOES-8 data.

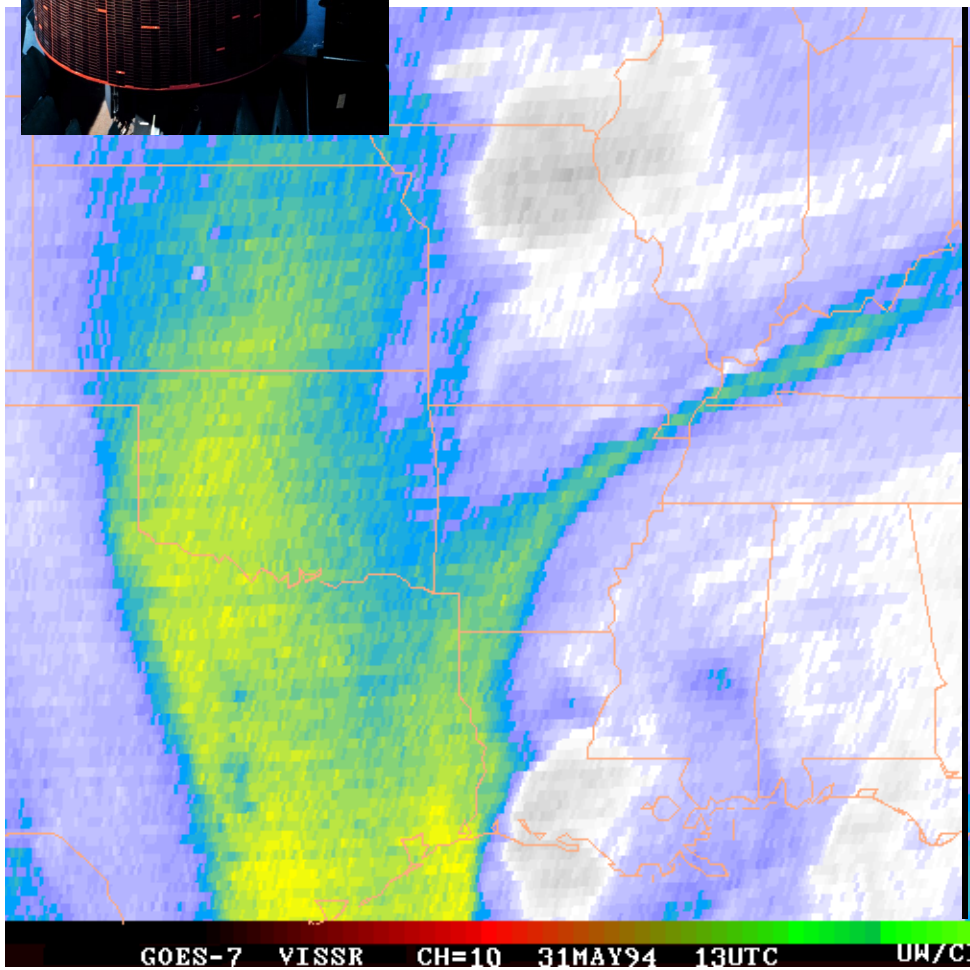


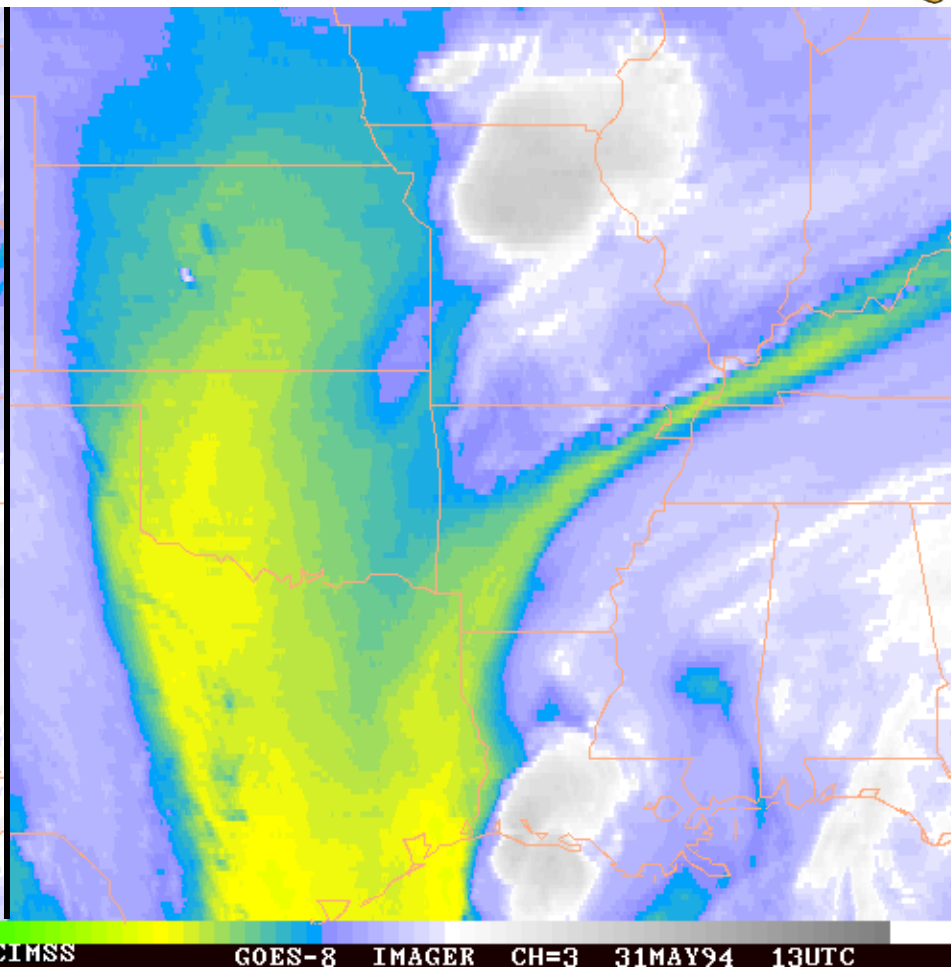
Spinner





3-axis Stabilized

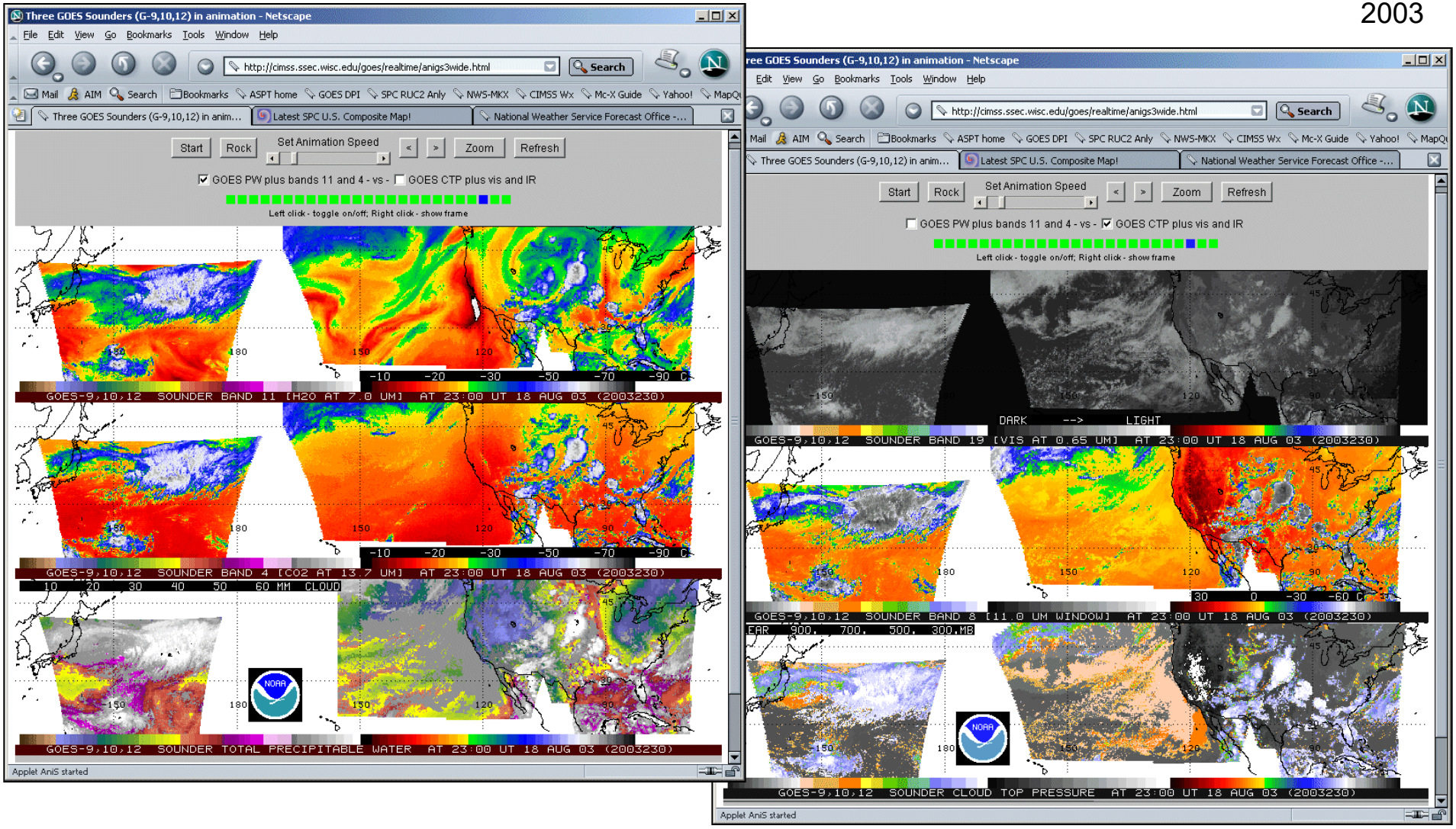




Three GOES wide Sounder coverage across the northern mid-latitudes from Japan to Maine

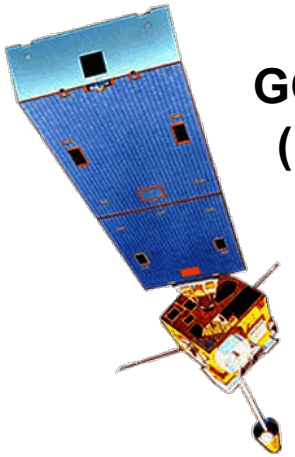
For GOES-**9** (far Pacific), GOES-**10** (West US), and GOES-**12** (East US),
DPI and imagery include (on left) TPW, band 4 (CO2), and band 11 (H2O)
and (on right) CTP, band 11 window, and band 19 visible.

2003

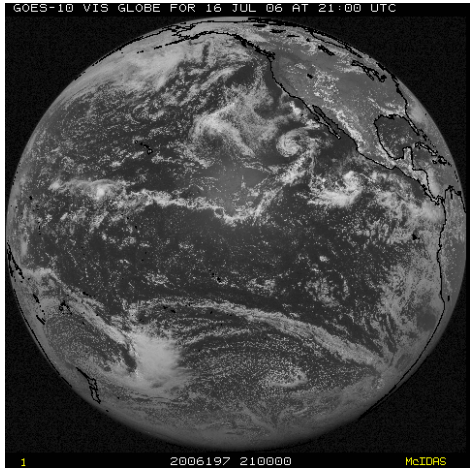


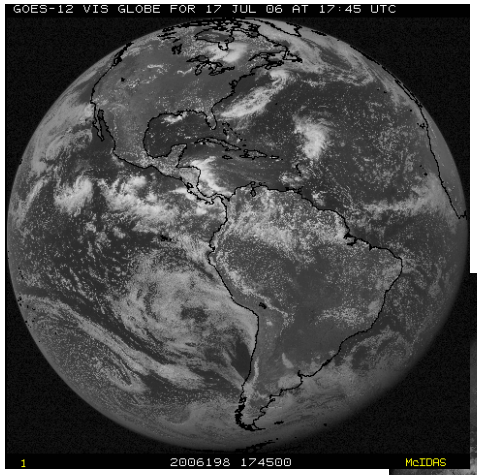
GOES Constellation

Operational

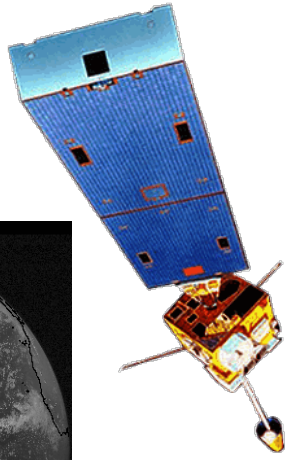


GOES-11
(135W)

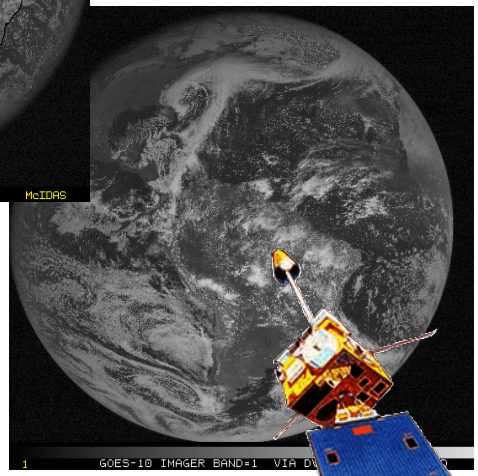


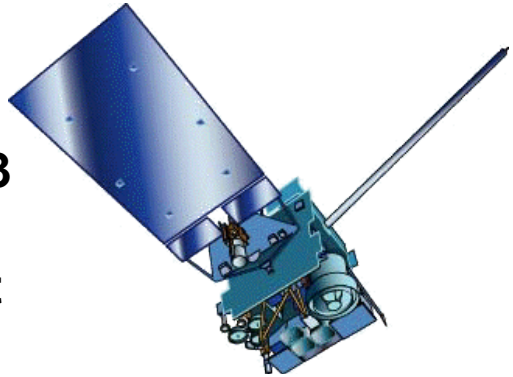


GOES-12
(75W)

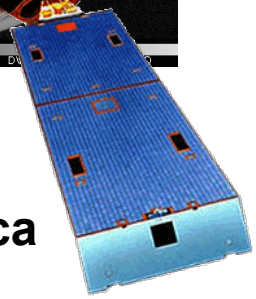


Operational



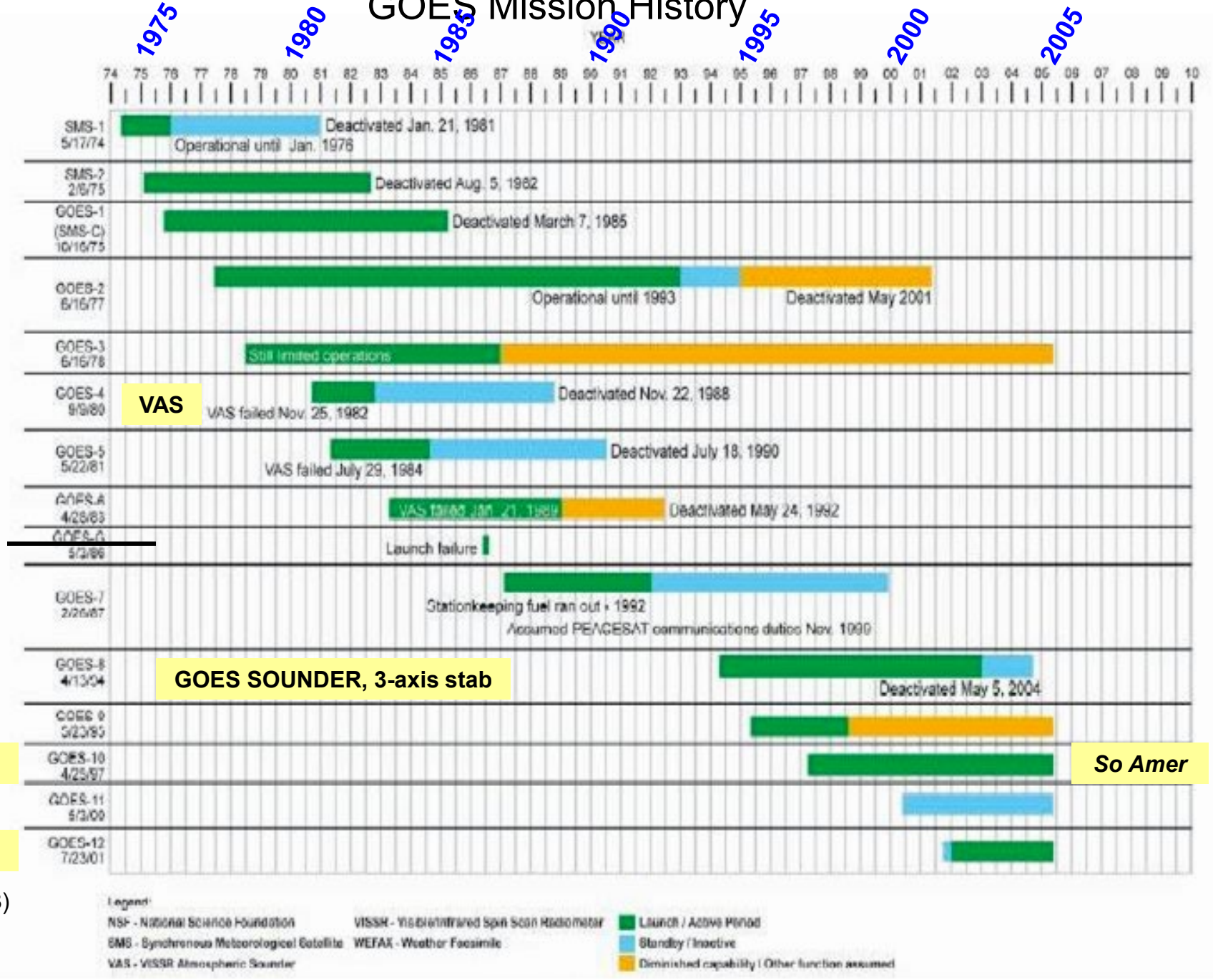


GOES-13
(105W)
On-orbit
Storage



GOES-10
(60W)
South America

GOES Mission History



SMS-1

GOES-1

GOES-4

GOES-8

GOES-10

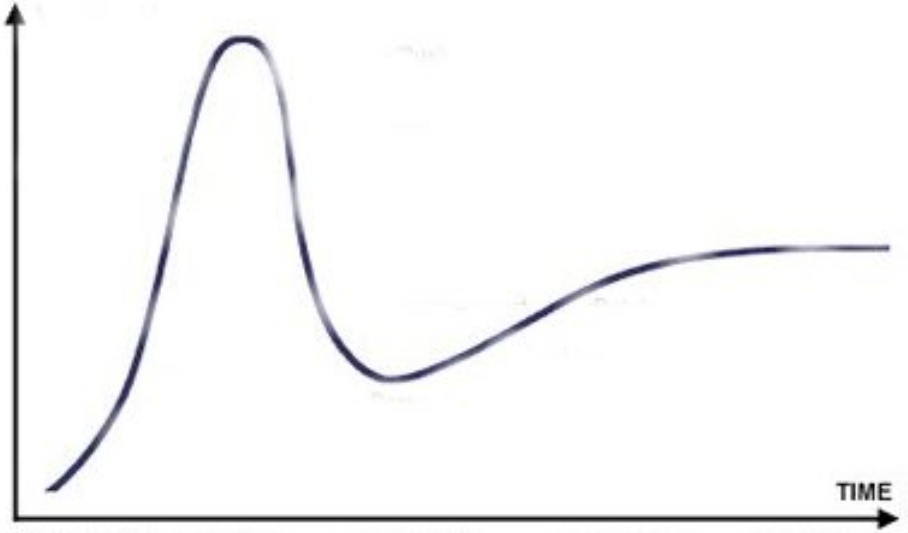
GOES-12

(**GOES-13**)

Expectations and reality

GOES-4 +

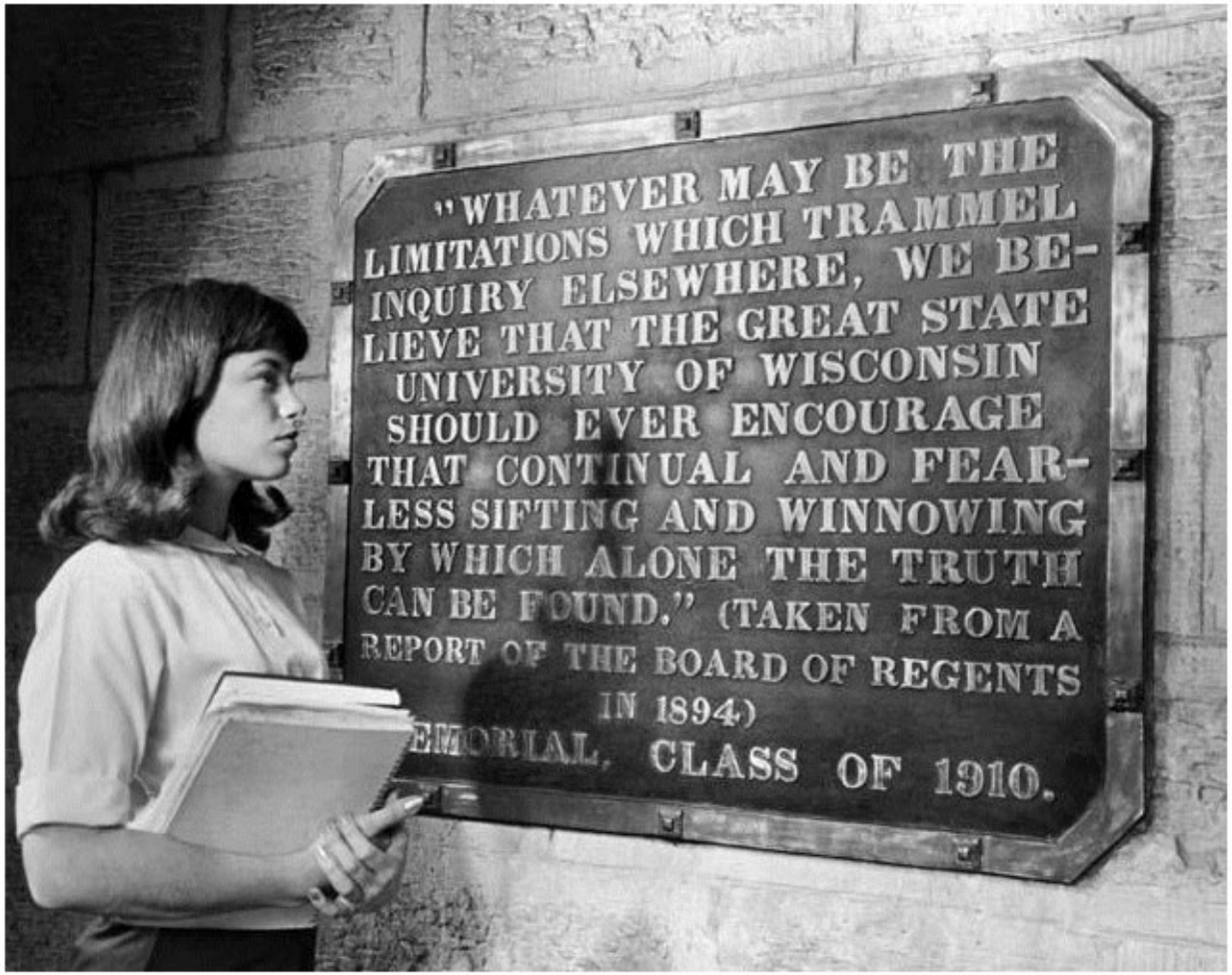
GOES-8 +



GOES-R +

1980 → 1994 → 2014

"Sift and Winnow" – a Wisconsin idea



Sifting and Winnowing plaque at the entrance to Bascom Hall
(Photo courtesy of UW-Madison Archives)