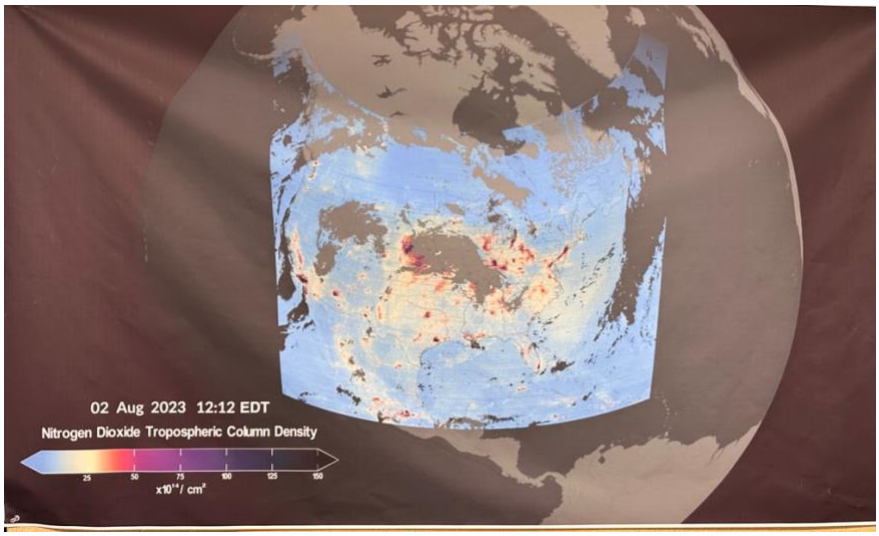
Harvard Smith: Center for Astrophysics

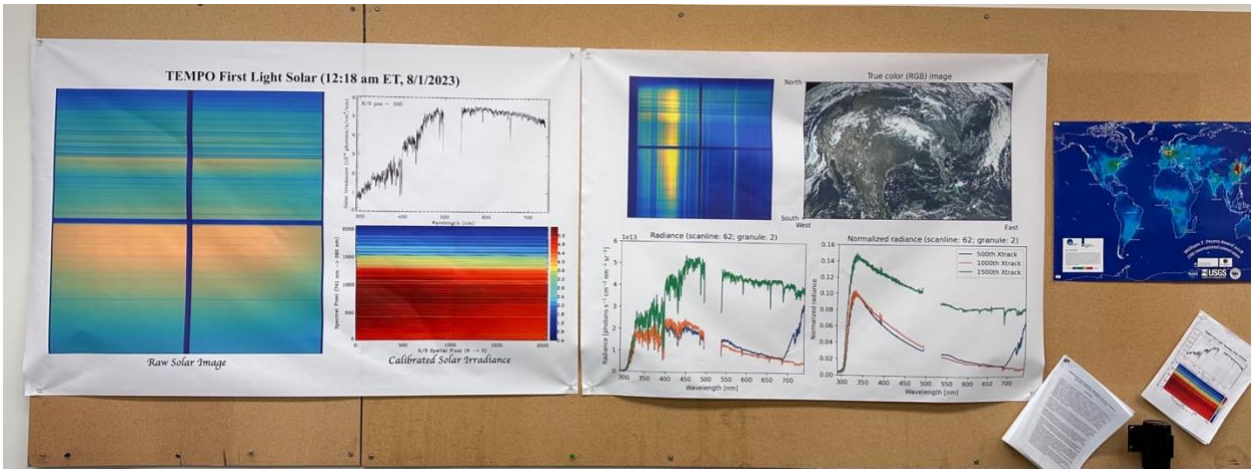
Frank Liu Dec. 02. 23

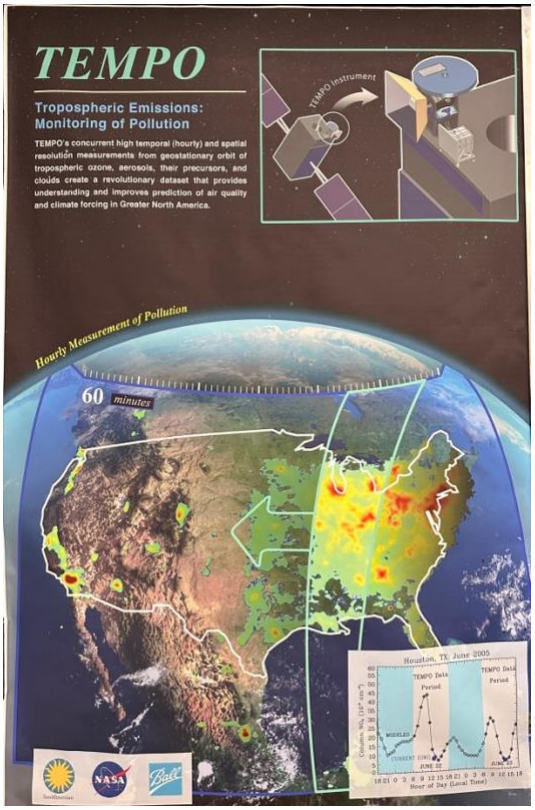
Have you ever heard of TEMPO before? When you look at it, you might think that the term music means the speed or rhythm of a piece of music. However, it is a geostationary communications satellite, which stands for Tropospheric Emissions: Monitoring of Pollution. It is a satellite that measures pollution throughout the United States and was launched in April this year. TEMPO is an excellent advancement in meteorological satellites. The improvement of the TEMPO is demonstrated in its ability to measure. In the past, meteorological satellites would take a day or more to finish scanning and analysis. Still, in this satellite, it would only take an hour to finish the measurement for the whole territory of the US, and it can give the report instantly. Thus, this satellite made an outstanding contribution to people's health, playing a significant role among all the satellites orbiting around the Earth.

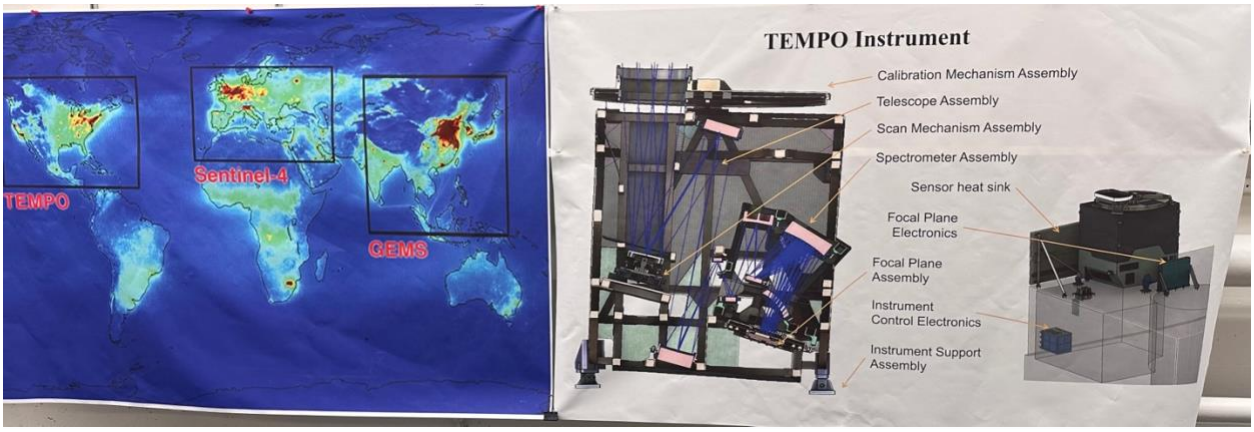
On the day of Nov. 25, we went to the Harvard Smith Center for Astrophysics. The Harvard-Smithsonian Center for Astrophysics is a collaborative project between the Harvard University Observatory and the Smithsonian Astrophysical Observatory. It is one of the world's largest astrophysics research and education centers. It conducts a wide range of research, including theoretical and observational astrophysics, cosmology, and astronomical instrument development.

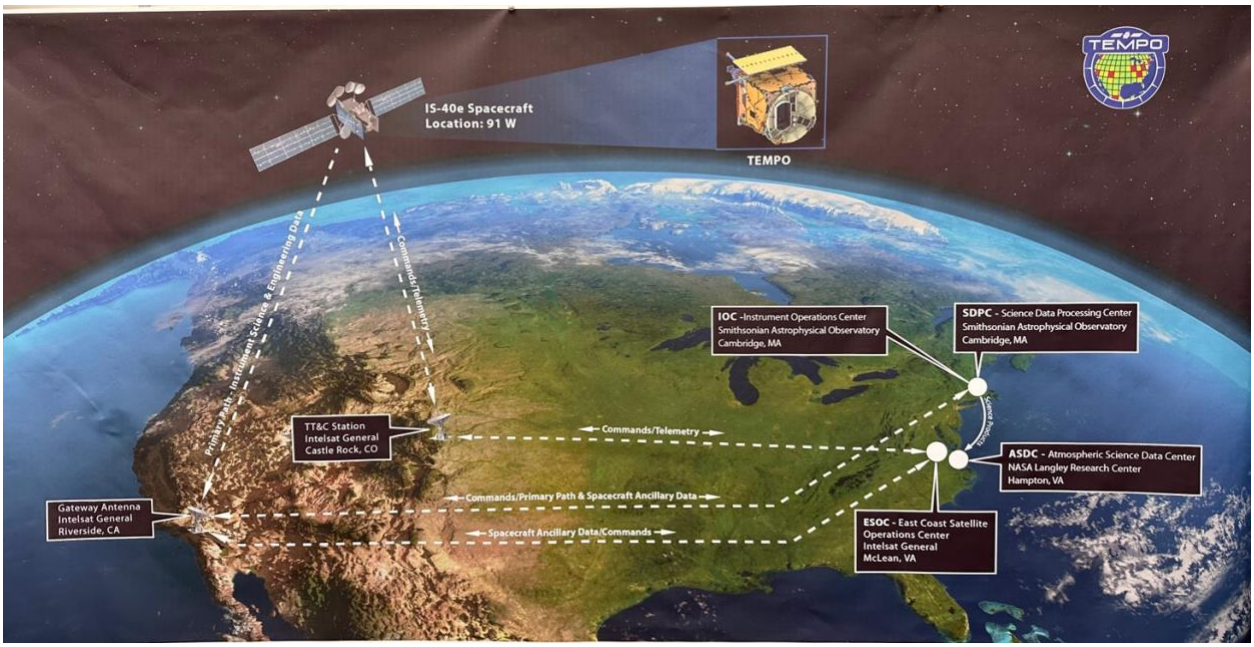
In a department here, they happen to oversee the operation of the TEMPO satellite. The following graph shows the density level of NO2 in the US, Nitrogen dioxide is a toxic pollutant involved in the formation of ground-level ozone and particle pollution, primarily released by burning fuels. Nitrogen dioxide can cause a range of harmful effects on the lungs, and exposure to nitrogen dioxide may cause asthma in children. Thus, with the help of TEMPO, people can swiftly detect the treatment of NO2 so that the government can make the reaction quicker.

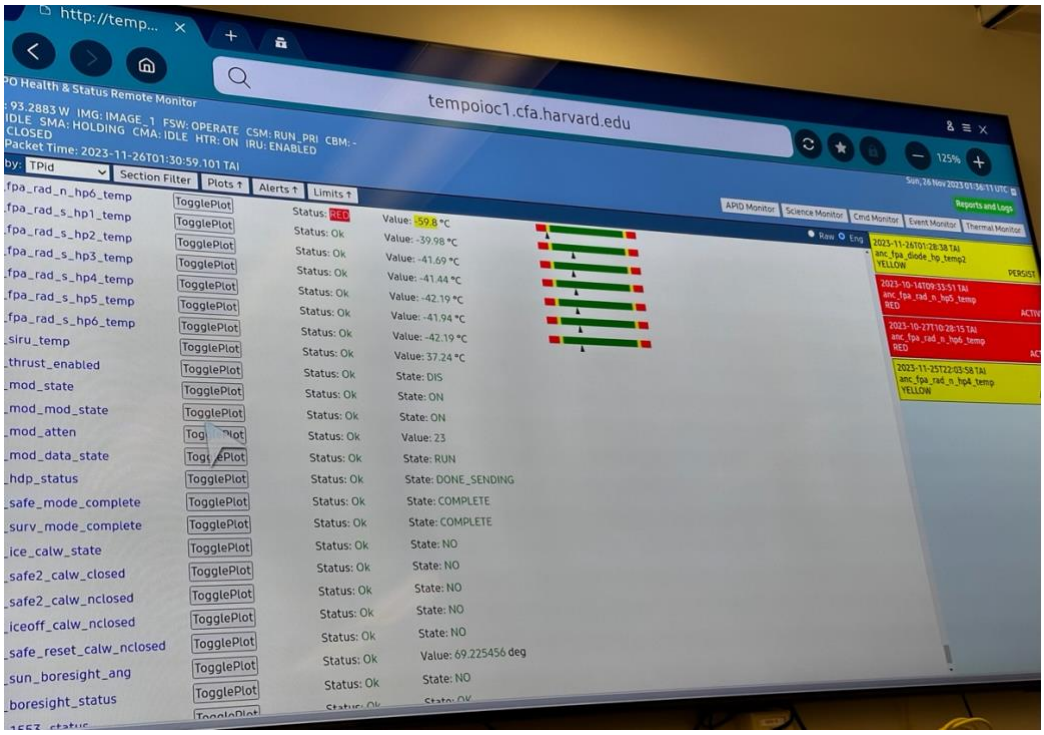




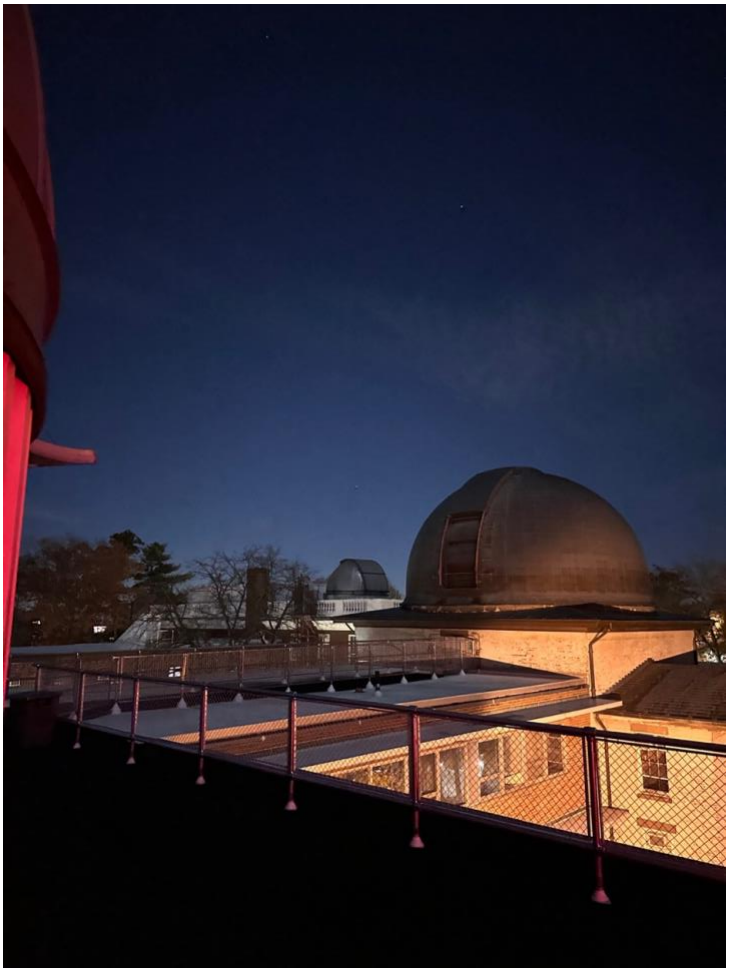

TEMPO
Tropospheric Emissions:
Monitoring of Pollution
TEMPO's concurrent high temporal (hourly) and spatial resolution measurements from geostationary orbit of tropospheric ozone, aerosols, their precursors, and clouds create a revolutionary dataset that provides understanding and improves prediction of air quality and climate forcing in Greater North America.
TEMPO Instrument
Hourly Measurement of Pollution
60 minutes
Houston, TX June 2005
TEMPO Data Period
TEMPO Data Period
MODELED
CURRENT (UNC)
JUNE 22
JUNE 23
Hour of Day (Local Time)


TEMPO
Sentinel-4
GEMS
TEMPO Instrument
Calibration Mechanism Assembly
Telescope Assembly
Scan Mechanism Assembly
Spectrometer Assembly
Sensor heat sink
Focal Plane Electronics
Focal Plane Assembly
Instrument Control Electronics
Instrument Support Assembly


IS-40e Spacecraft
Location: 91 W
TEMPO
TEMPO
Primary Path: Instrument Science & Engineering Data
Commands/Telemetry
IOC –Instrument Operations Center
Smithsonian Astrophysical Observatory
Cambridge, MA
SDPC - Science Data Processing Center
Smithsonian Astrophysical Observatory
Cambridge, MA
TT&C Station
Intelsat General
Castle Rock, CO
Commands/Telemetry
Science Data
ASDC - Atmospheric Science Data Center
NASA Langley Research Center
Hampton, VA
Gateway Antenna
Intelsat General
Riverside, CA
Commands/Primary Path & Spacecraft Ancillary Data
Spacecraft Ancillary Data/Commands
ESOC - East Coast Satellite
Operations Center
Intelsat General
McLean, VA


http://temp...
tempoioc1.cfa.harvard.edu
PO Health & Status Remote Monitor
Packet Time: 2023-11-26T01:30:59.101 TAI
Section Filter
Plots ↑
Alerts ↑
Limits ↑
APID Monitor
Science Monitor
Cmd Monitor
Event Monitor
Thermal Monitor
Reports and Logs
fpa_rad_n_hp6_temp
fpa_rad_s_hp1_temp
fpa_rad_s_hp2_temp
fpa_rad_s_hp3_temp
fpa_rad_s_hp4_temp
fpa_rad_s_hp5_temp
fpa_rad_s_hp6_temp
siru_temp
thrust_enabled
mod_state
mod_mod_state
mod_atten
mod_data_state
hdp_status
safe_mode_complete
surv_mode_complete
ice_calw_state
safe2_calw_closed
safe2_calw_nclosed
iceoff_calw_nclosed
safe_reset_calw_nclosed
sun_boresight_ang
boresight_status
TogglePlot
Value: 69.225456 deg

Later, we visited the museum and the Great Refractor. It was built in 1847 by Alvan Clark & Sons, a well-known telescope manufacturer. The main telescope has an aperture of 15 inches (38 cm) and a focal length of 22 feet (6.7 m). The tube is about 28 inches (71 cm) in diameter and 38 feet (11.6 m) long. The telescope was used for various critical astronomical observations, including Asaph Hall's 1877 discovery of the moons of Mars, Phobos, and Deimos.



Citing:

1. American Lung Association, "Nitrogen Dioxide," https://www.lung.org/clean-air/outdoors/what-makes-air-unhealthy/nitrogen-dioxide#:~:text=Nitrogen%20dioxide%2C%20or%20NO2,are%20burned%20at%20high%20temperatures.
2. Harvard-Smithsonian Center for Astrophysics. "TEMPO Instrument Captures Its First Images of Air Pollution over Greater North America." Harvard-Smithsonian Center for Astrophysics. URL: https://www.cfa.harvard.edu/news/tempo-instrument-captures-its-first-images-air-pollution-over-greater-north-america
3. Harvard-Smithsonian Center for Astrophysics. "About the Great Refractor." January 15, 2023. https://pweb.cfa.harvard.edu/about/about-harvard-college-observatory/about-great-refractor.
4. Tempo: A Multimedia Journey Through the Smithsonian. https://tempo.si.edu.