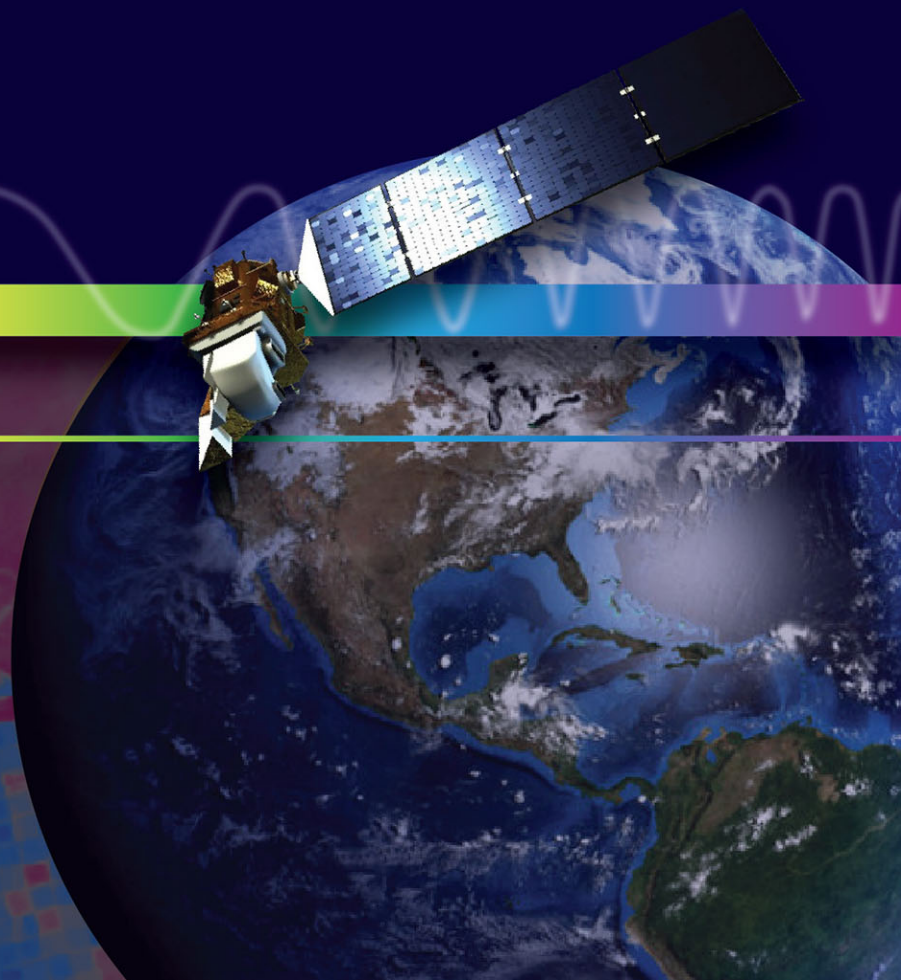
National Aeronautics and Space Administration

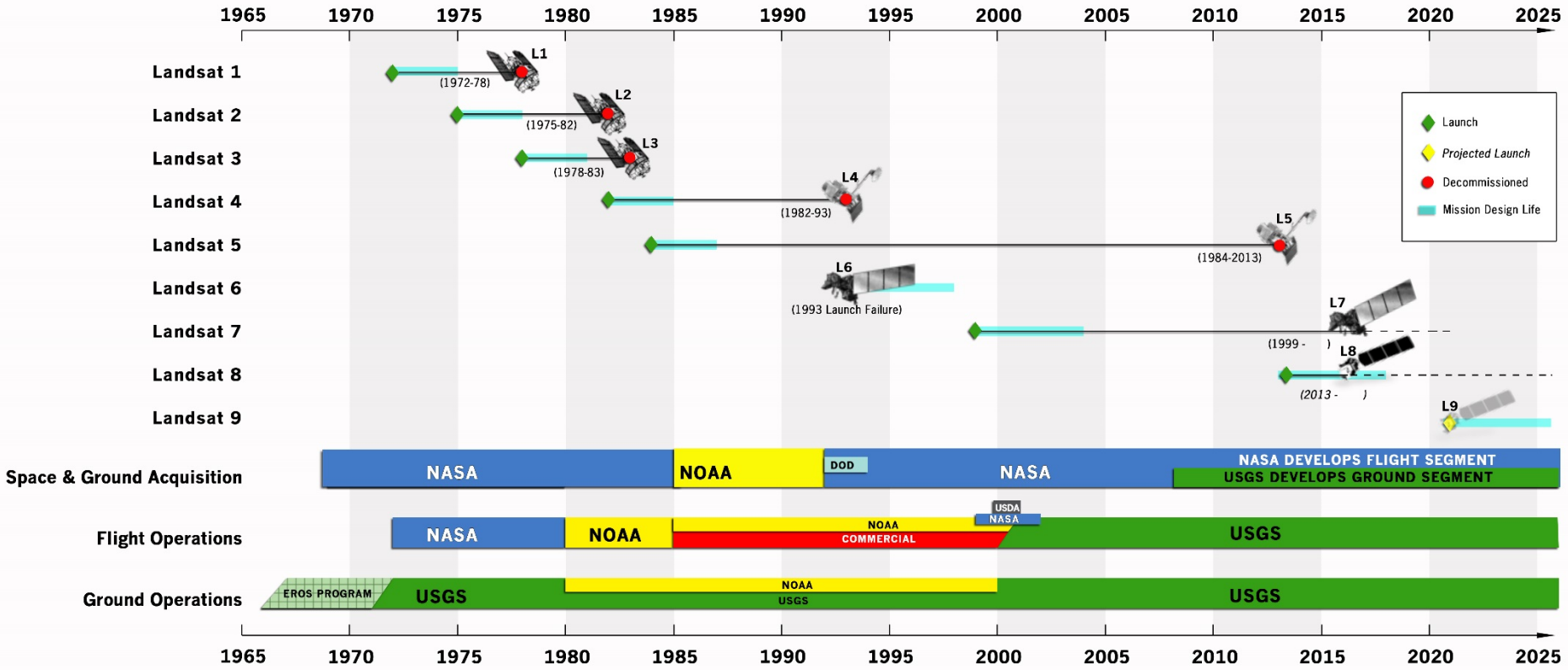
Thermal Infrared Sensor - 2 • Landsat 9



Jason Hair, NASA GSFC

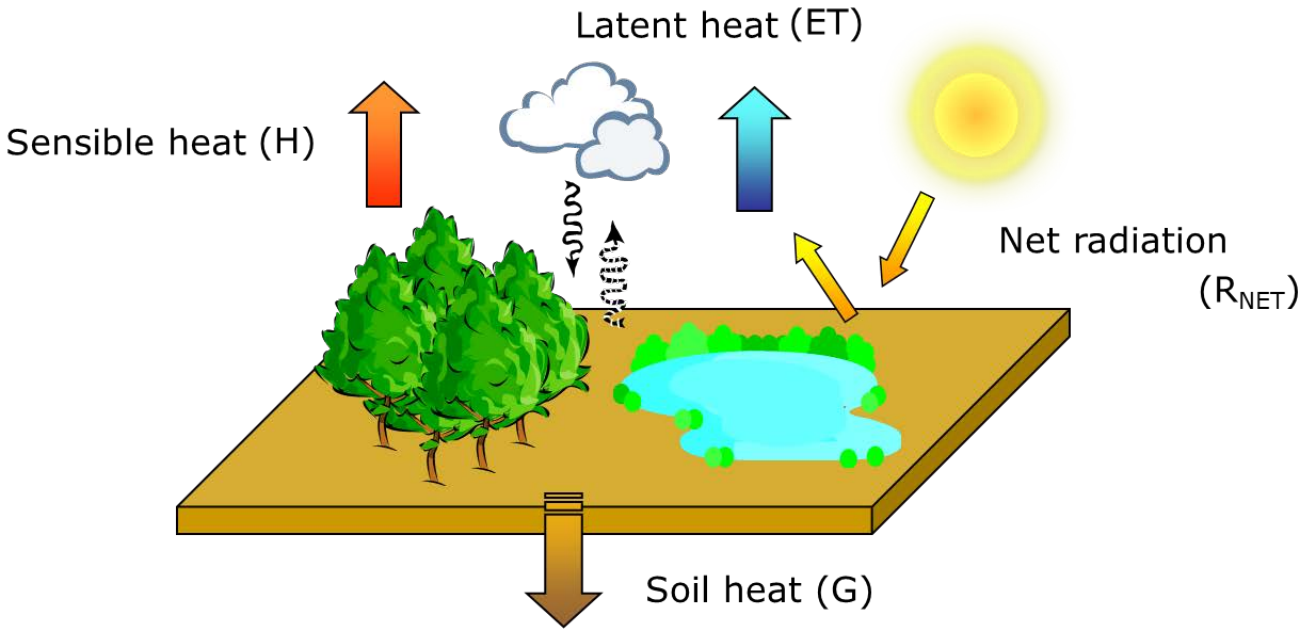
NASA Goddard Space Flight Center

Landsat History

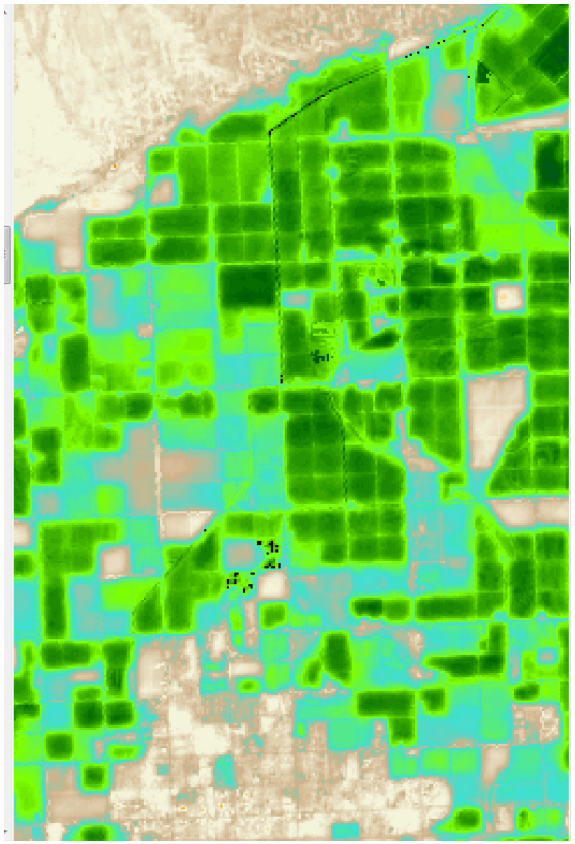


TIRS-2 Science Objectives

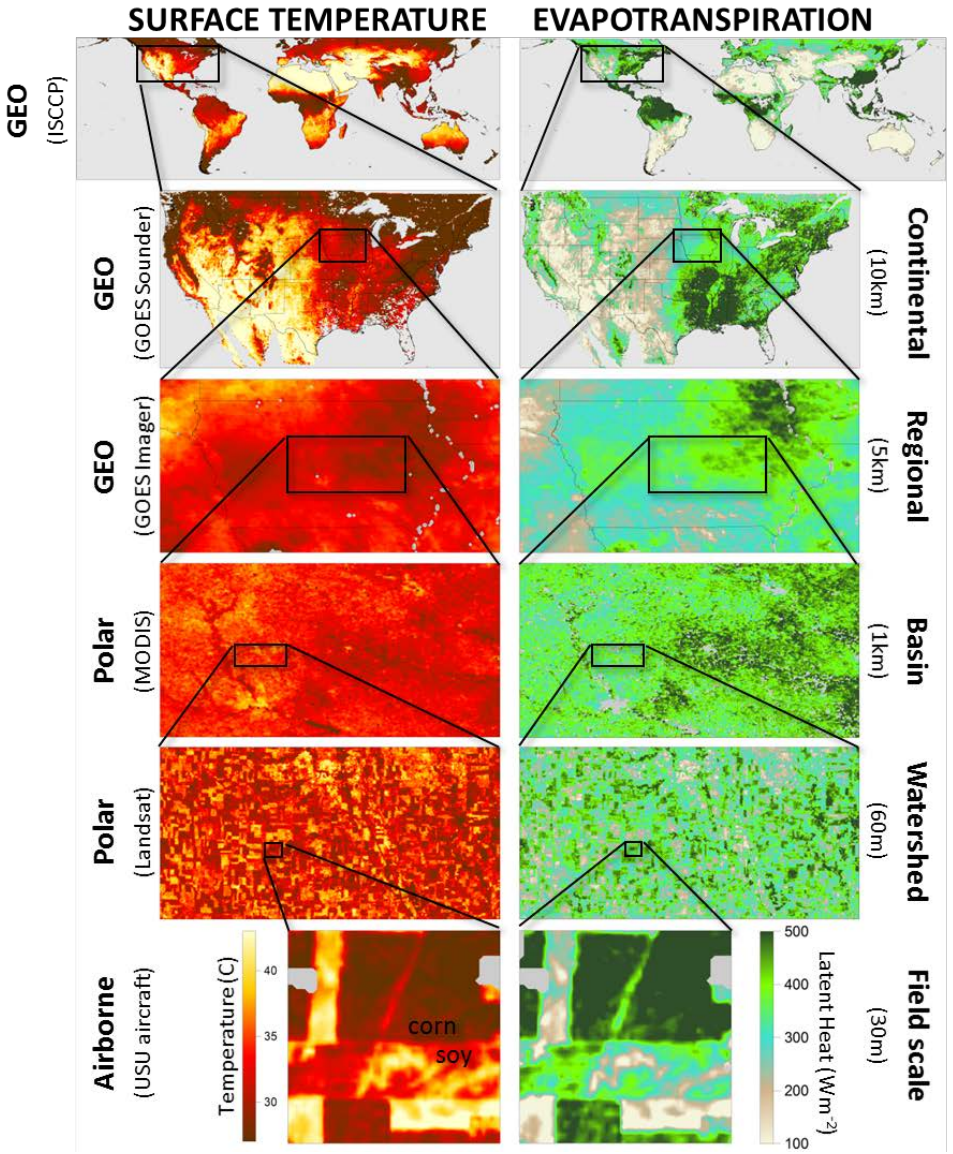
- Monitoring of evapotranspiration, water use on a regional and field-by-field basis in the U.S. and internationally
- Mapping urban heat fluxes for air quality modeling
- Volcanic hazard assessment, monitoring, and recovery
- Cloud detection, screening to process OLI-2 image data
- Mapping waterway thermal plumes from power plants
- Burnt area mapping / Wildfire risk assessment
- Identifying mosquito breeding areas, vector-borne illness potential
- Forestry and land use management



Evapotranspiration and Surface Temperature



Typical TIRS Evapotranspiration Data Product – Darker Green shows Fields with more Irrigation



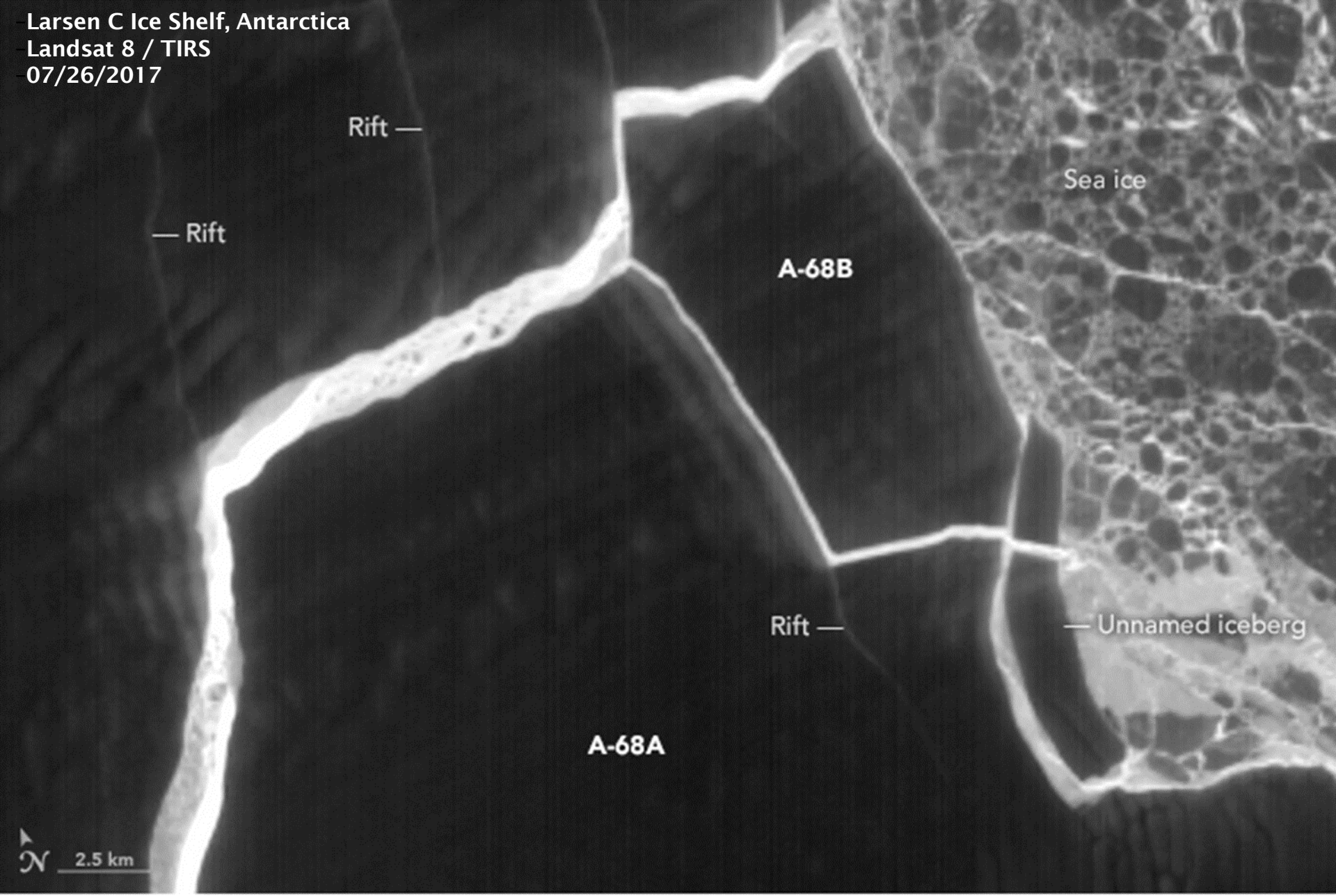
Hourly

Daily

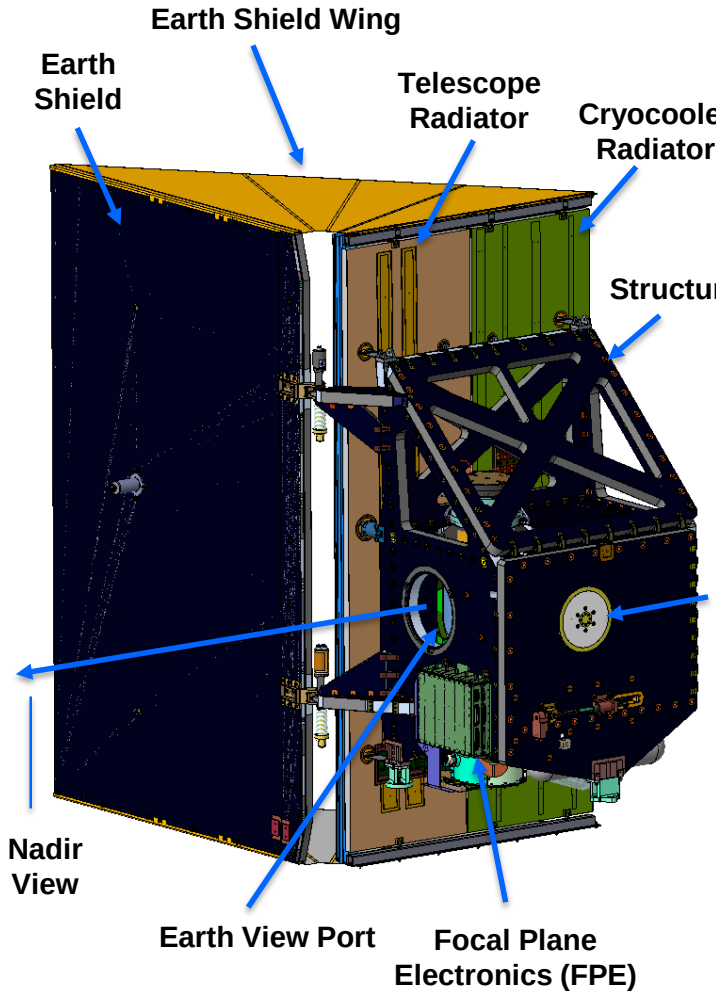
1 LS – 16 day

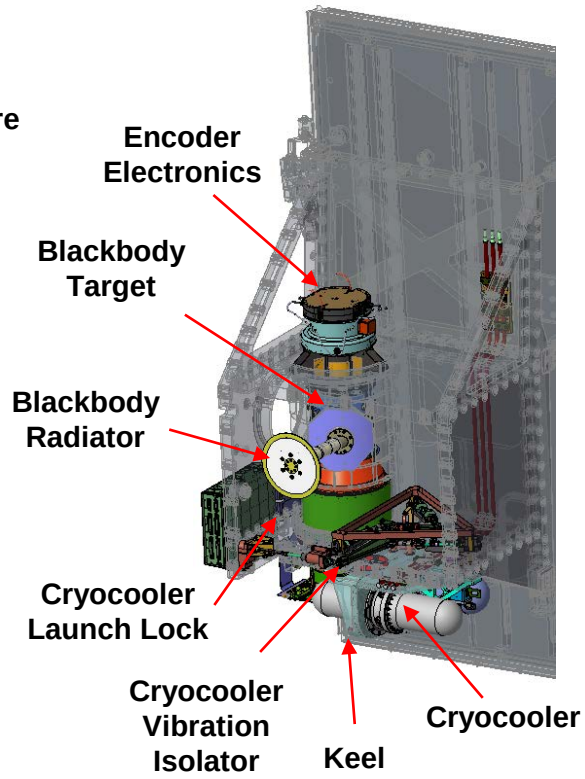
2 LS – 8 day

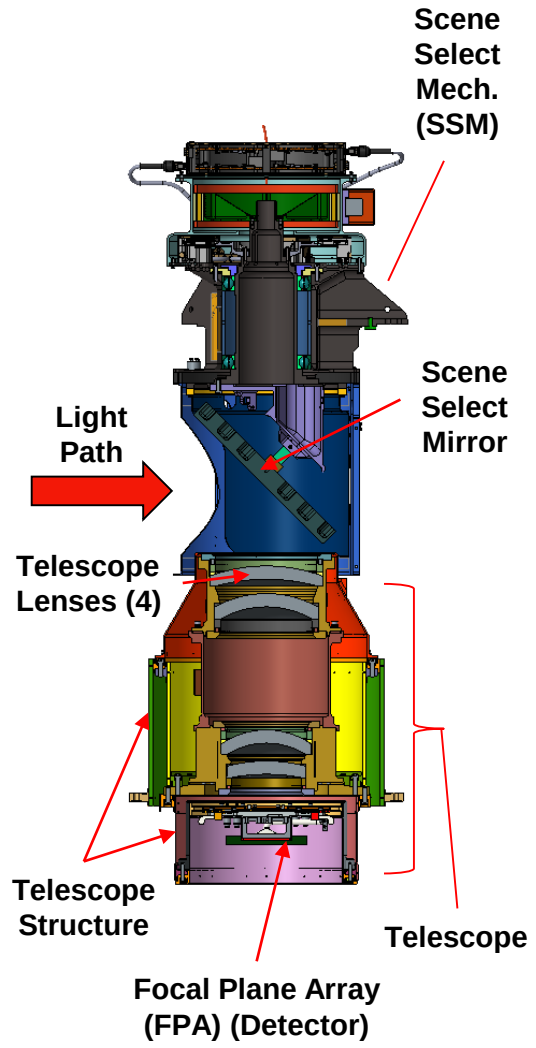

Active fires
Interstate 15
San Bernardino
5 km
N


Larsen C Ice Shelf, Antarctica
Landsat 8 / TIRS
07/26/2017
Rift
Rift
Sea ice
A-68B
Rift
Unnamed iceberg
A-68A
2.5 km
Thermal Signature
Colder
Warmer

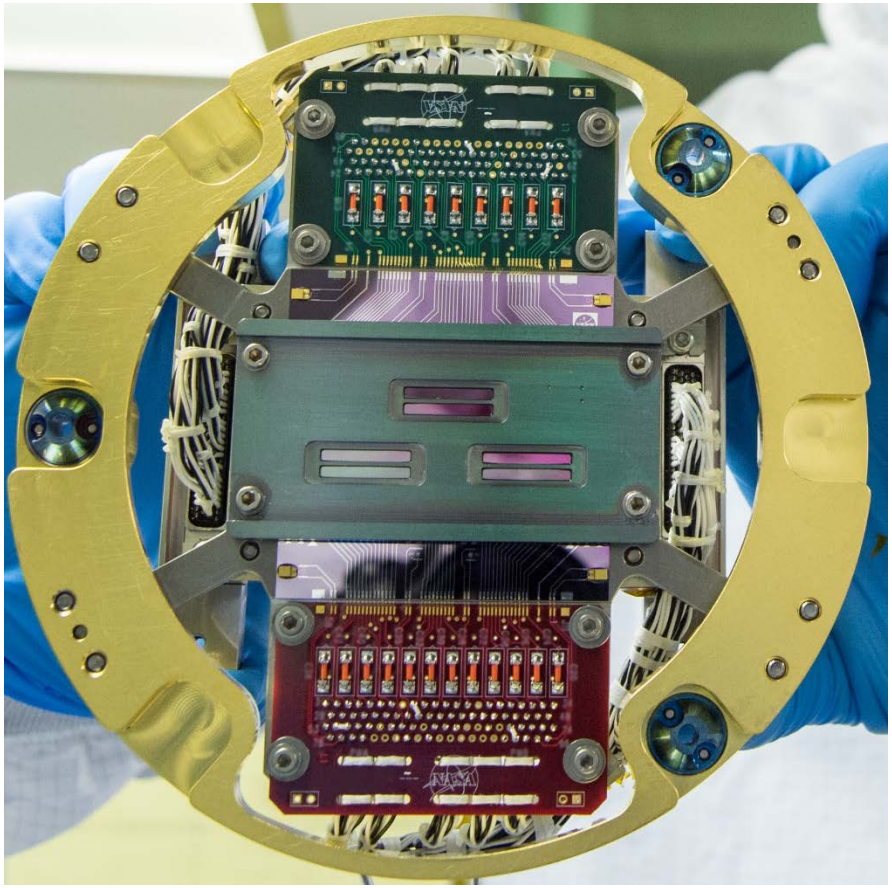
TIRS-2 Sensor Unit Design Overview





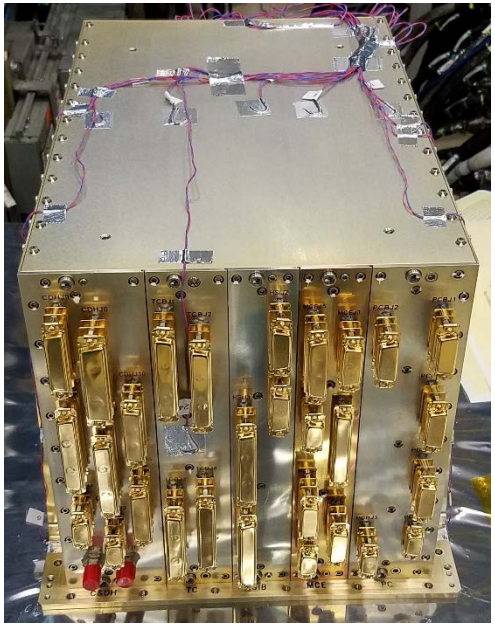


TIRS-2 Hardware

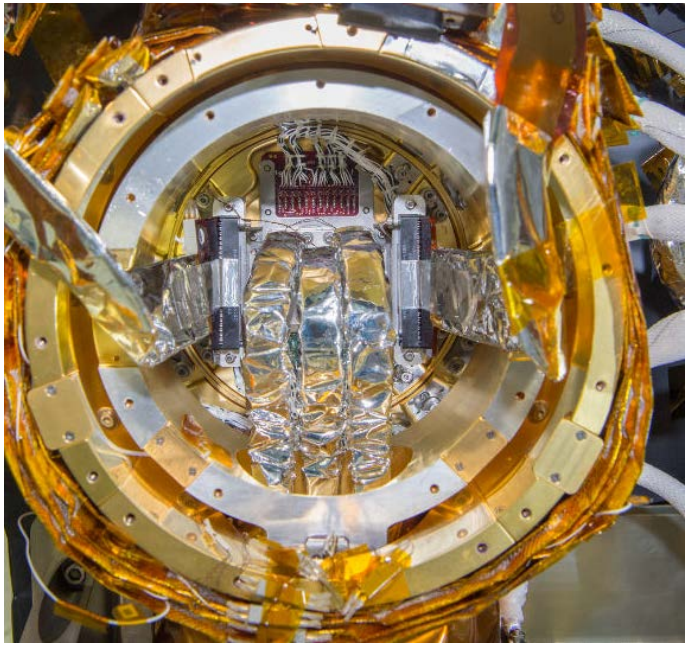


Front of Flight Detector with Filter segments installed, showing the 3 arrays with 2 channels each

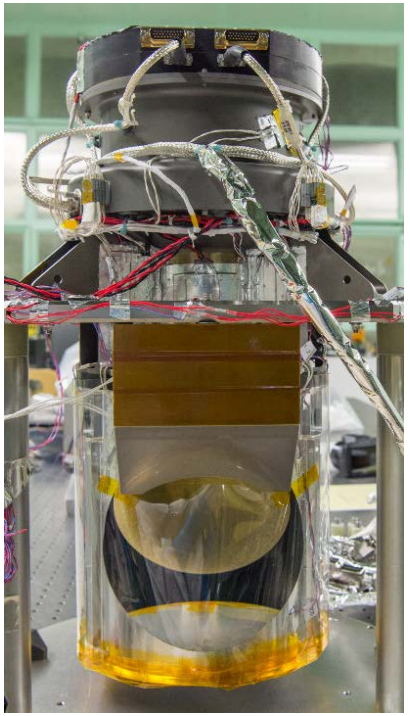
TIRS-2 Hardware



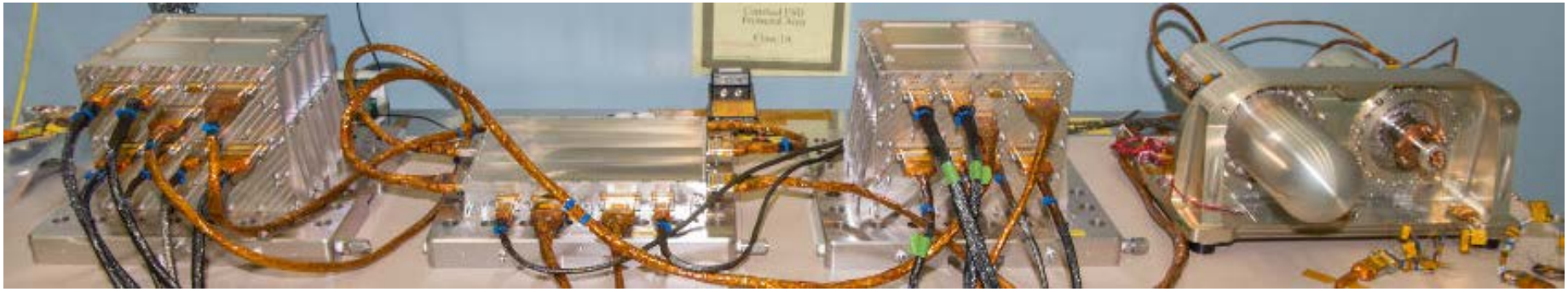
Flight MEB 1



Flight Detector Installed behind Telescope

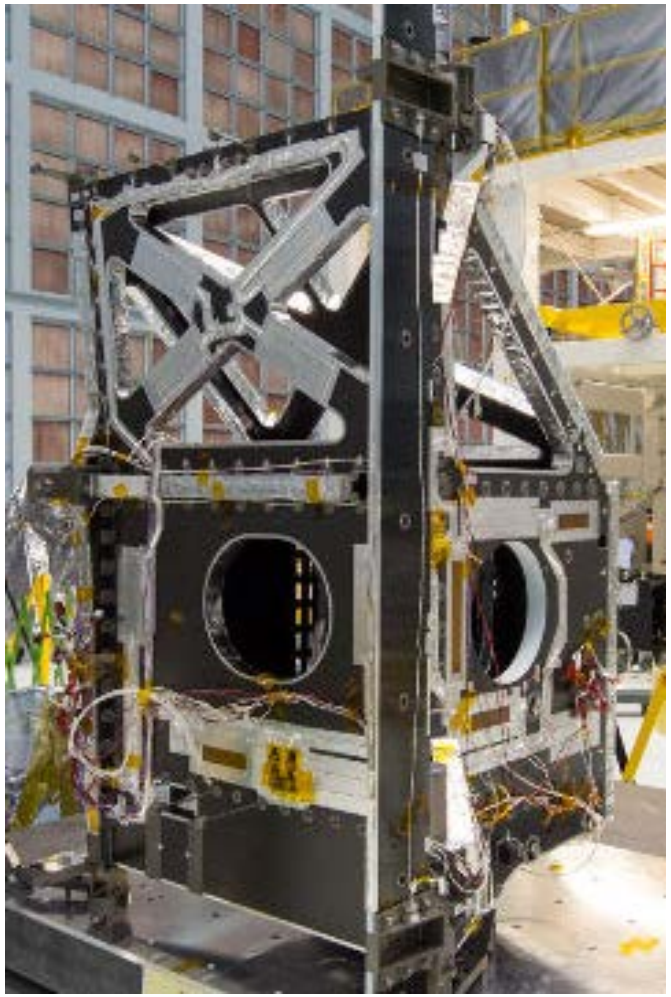


Flight Scene Select Mechanism

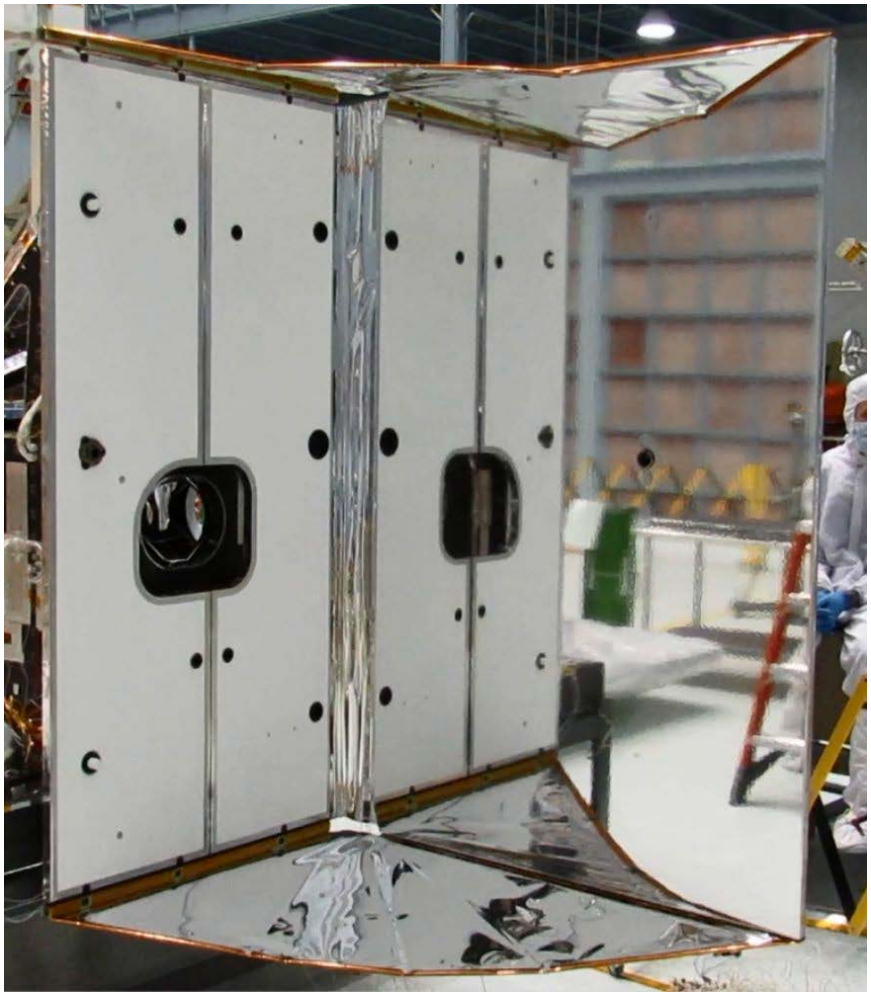


Flight Cyocooler Control Electronics, Redundancy Switch Electronics, and Thermal Mechanical Unit at GSFC

TIRS-2 Hardware



Flight Structure with Thermal Hardware Installed and Earth Shield Hinges and Strong Back

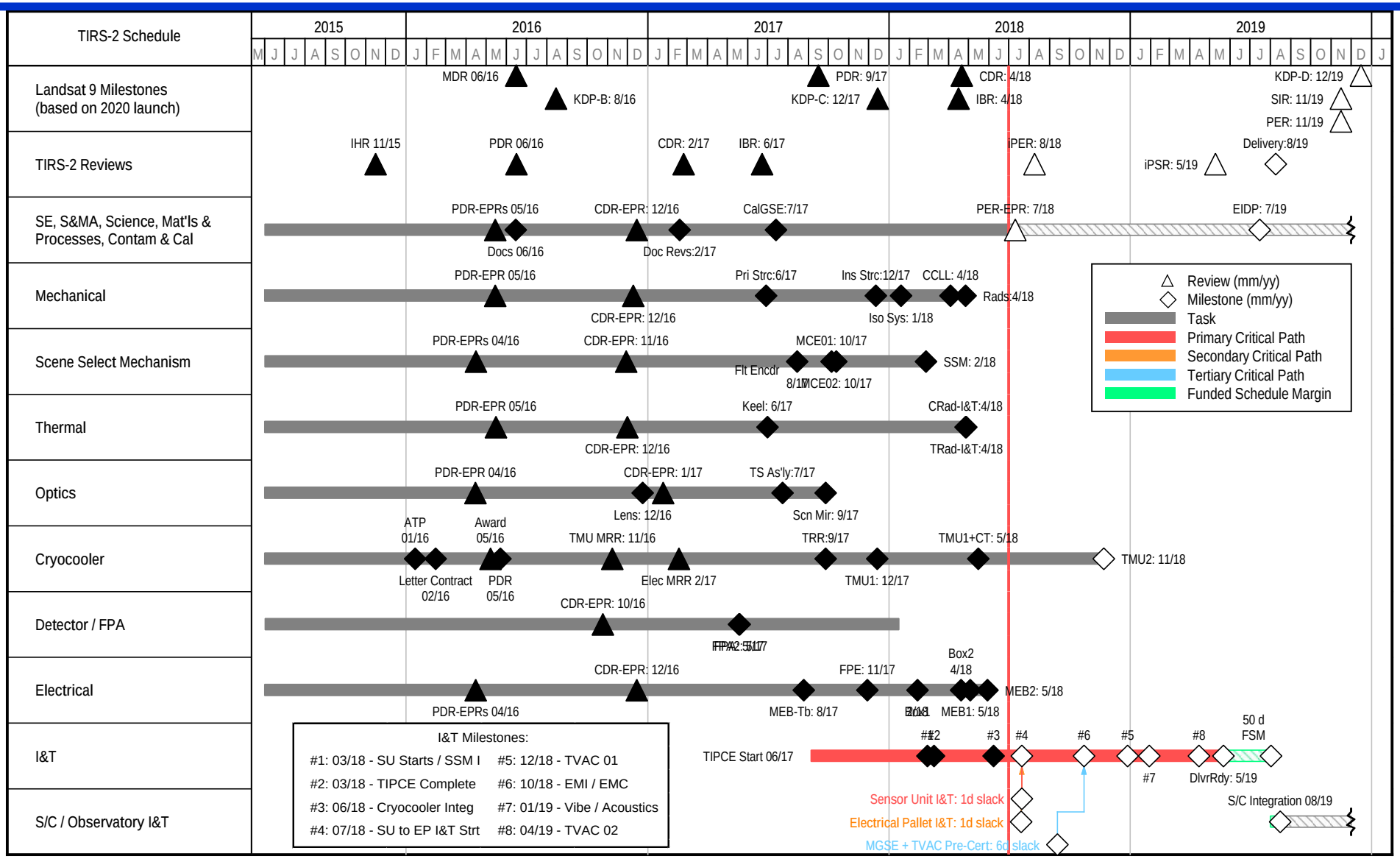


Flight Radiators on Structure with Earth Shield Deployed with Wing Blankets

TIRS-2 Stray Light Status

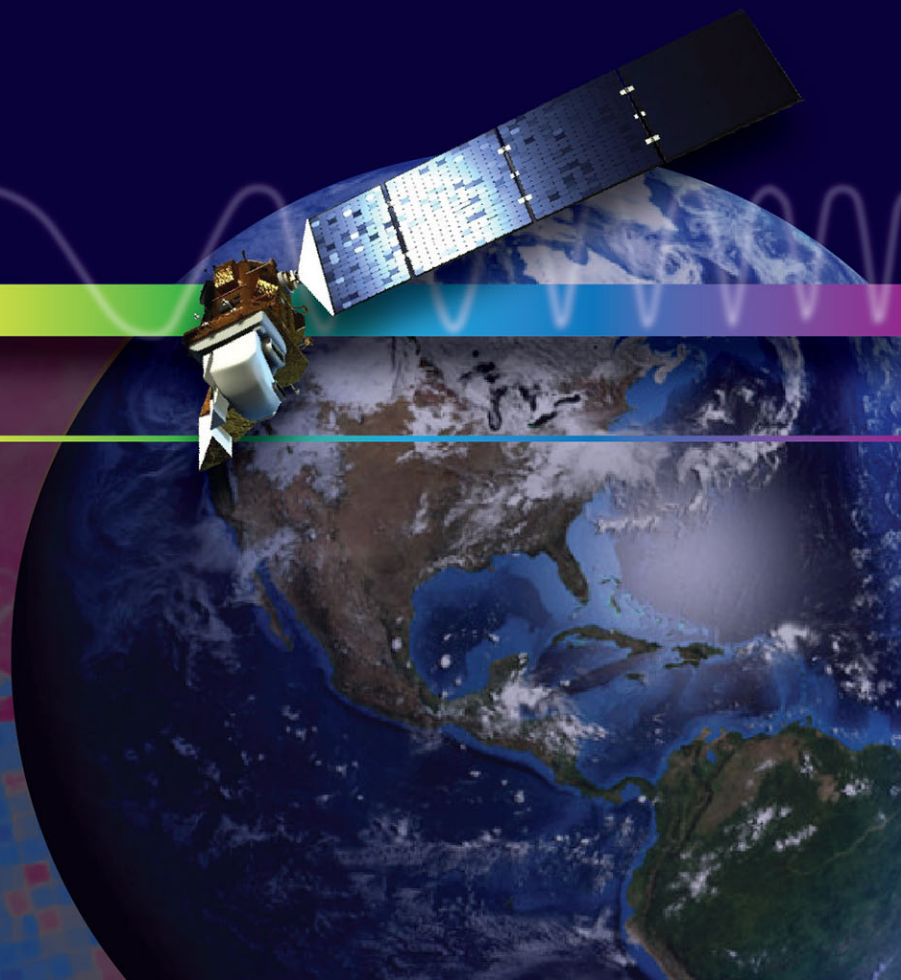
- The scattering from 13 degree annular feature seen on TIRS has been reduced by more than an order of magnitude on TIRS-2
  - A scene dependent correction for this effect was developed for TIRS which allows the observations to meet requirements
- The 22 degree annular feature observed in TIRS-2 TIPCE testing was not initially observed on TIRS and is not used in the correction
  - After the TIPCE results, the TIRS lunar data were analyzed again and the feature was seen in the extended approach scans at a much lower intensity than the 13 degree feature
  - TIPCE results indicate the 22 degree feature on TIRS-2 is lower than that on TIRS
- Effects of stray light have been reduced enough that TIRS-2 can meet absolute radiometric requirements without a scene-dependent correction like the one needed for TIRS
- Forward work
  - Continue to process the measured stray light results along with the optical model to determine the variance of the stray light effects from the 22 degree feature
  - Update assessments of performance relative to other requirements (e.g. NEdT) based on the higher fidelity results
- Final performance will be evaluated in flight and possible correction schemes using methodologies in place at USGS will be determined in conjunction with the Landsat cal/val and Science teams

TIRS-2 Overall Status



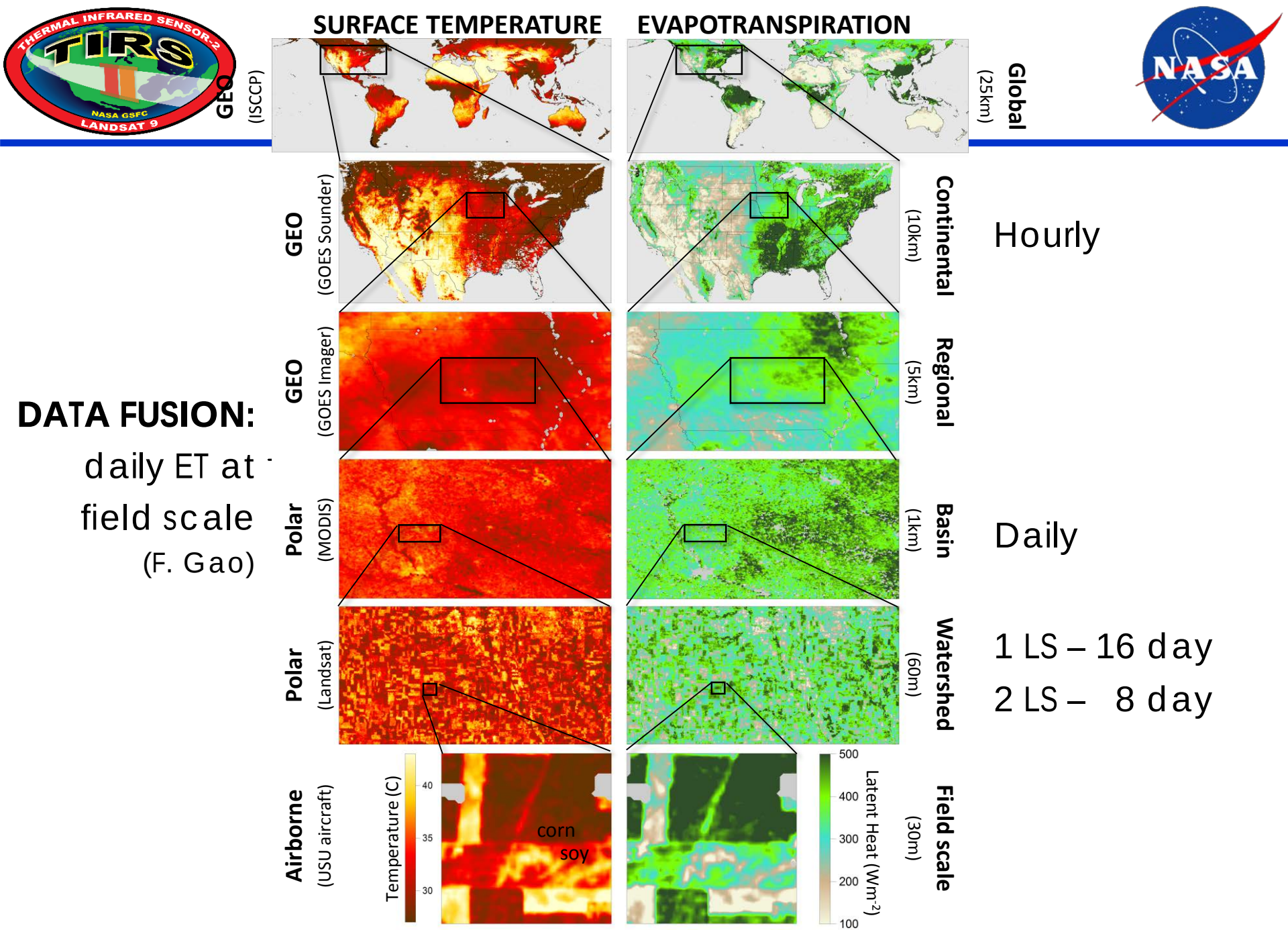
National Aeronautics and Space Administration

Thermal Infrared Sensor - 2 • Landsat 9



NASA Goddard Space Flight Center

Back Up



DATA FUSION:

daily ET at

field scale

(F. Gao)

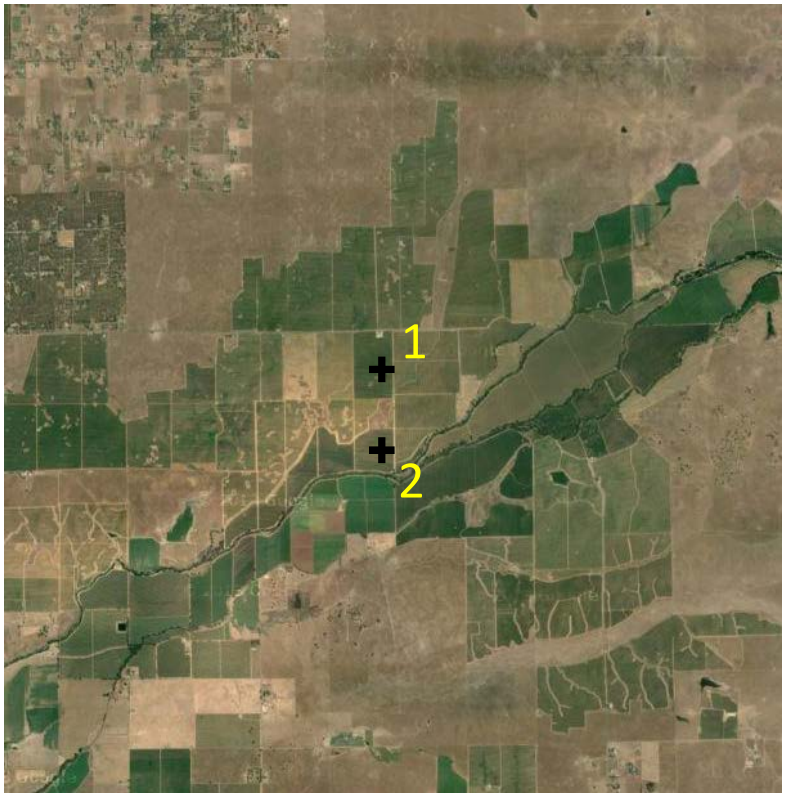
Hourly

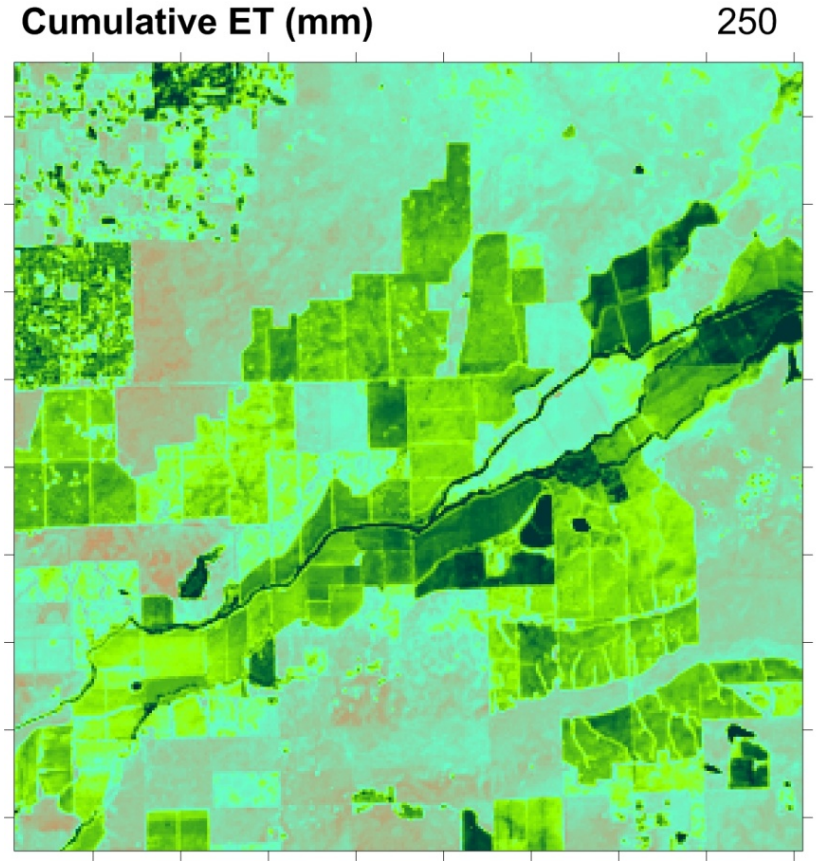
Daily

1 LS – 16 day

2 LS – 8 day

Gallo Vineyards, Lodi CA





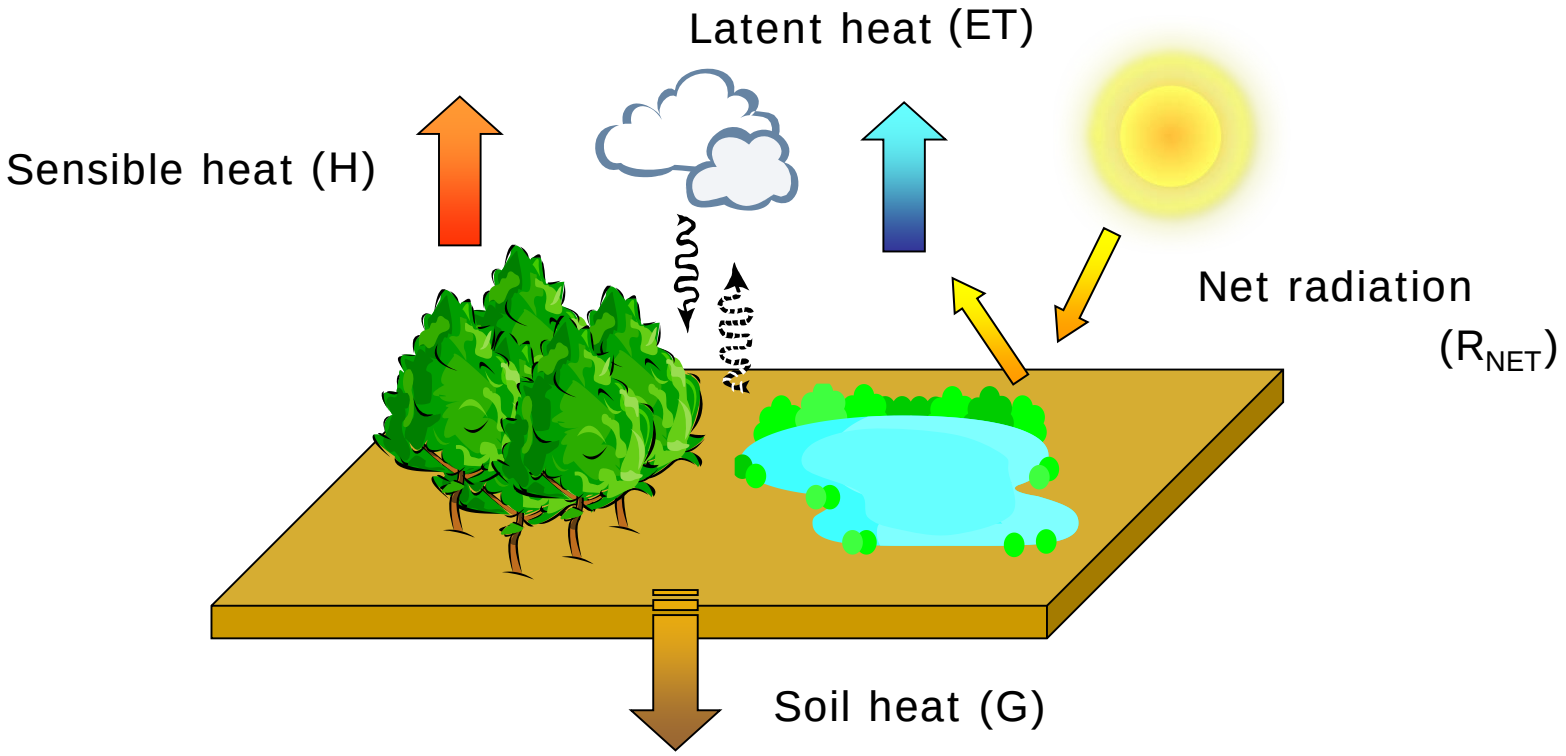
Landsat 8 - 2013

Semmens, K.A., et al.(2015). Monitoring daily evapotranspiration over two California vineyards using Landsat 8 in a multi-sensor data fusion approach. *Remote Sens. Environ., doi:10.1016/j.rse.2015.1010.1025*

Water Management Using Surface Energy Balance

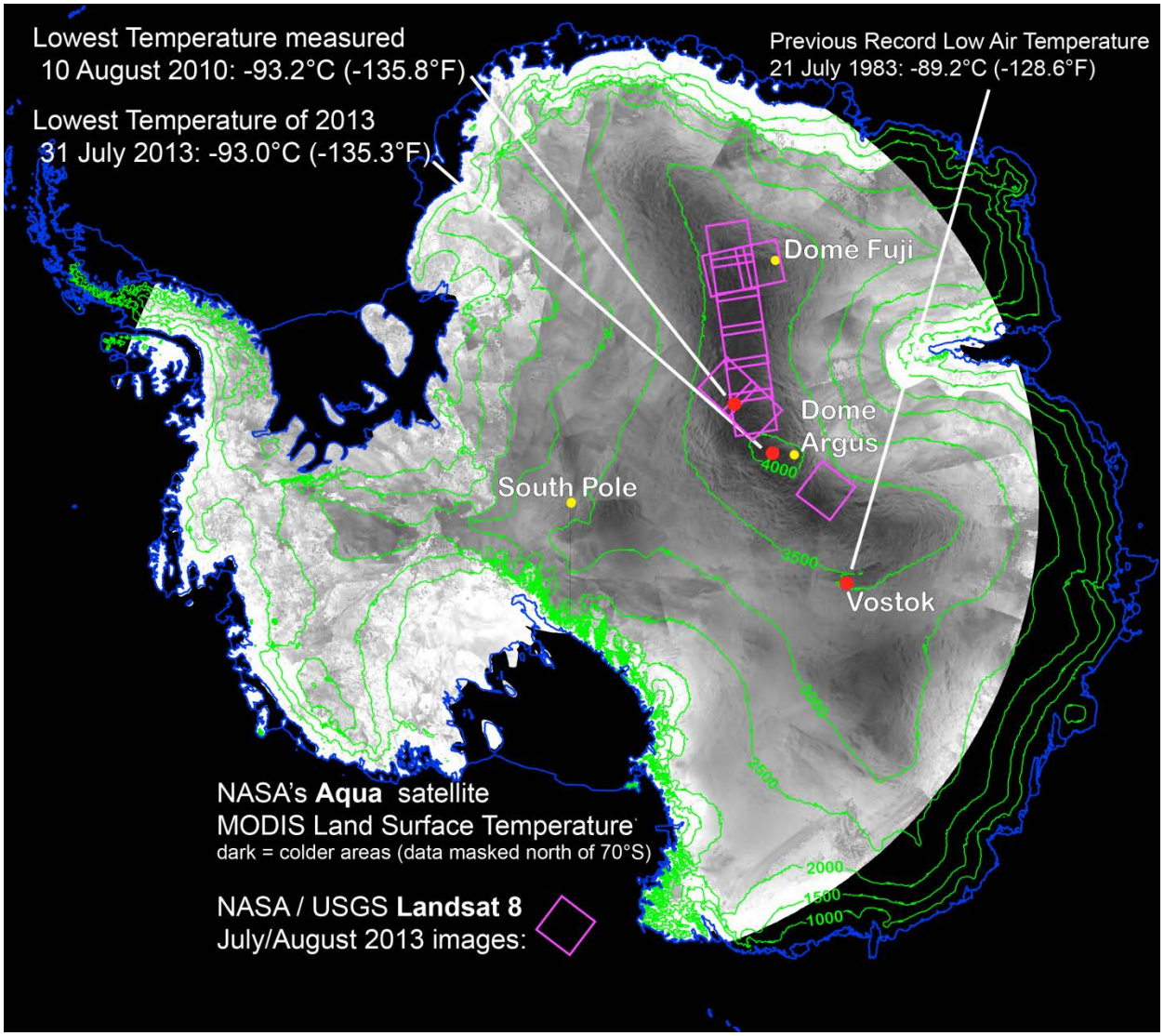
$$R_{NET} = G + ET + H$$

$$R_{NET} = (SW_{dn} - SW_{up}) + (LW_{dn} - LW_{up})$$



- Net Radiation is the balance between incoming minus outgoing radiation
  - OLI required to calculate the SWup (short wave albedo)
  - TIRS data required to calculate the LWup from surface temperature

At the Other End of the Spectrum (in More Ways Than 1) – The Coldest Spot on the Earth



Ted Scambos, Allen Pope, Garrett Campbell, Terry Haran

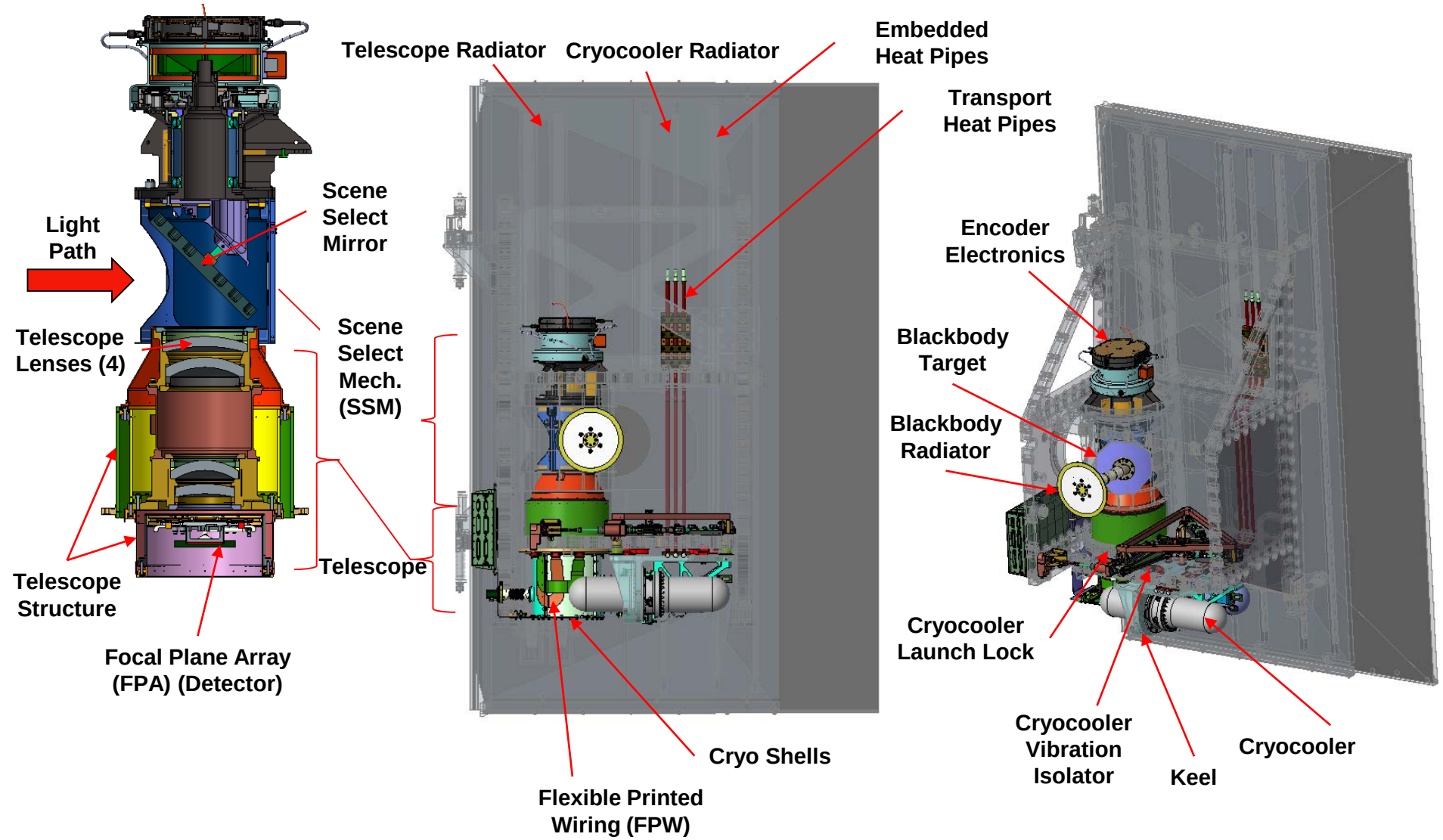
National Snow and Ice Data Center, University of Colorado, Boulder

Matt Lazzara

Antarctic Meteorology Research Center, University of Wisconsin, Madison

Ultra-low surface temperatures (90ºC and lower) occur in local topographic lows (pockets) just south of a long ice ridge. These areas routinely surpass the record temperature of the previous lowest temperature on record, at Vostok Station, Antarctica.

TIRS-2 Sensor Unit Design Overview



Overview of TIRS Sensor, con't