Linking JPSS-1 and SNPP CrIS through Inter-calibration Efforts

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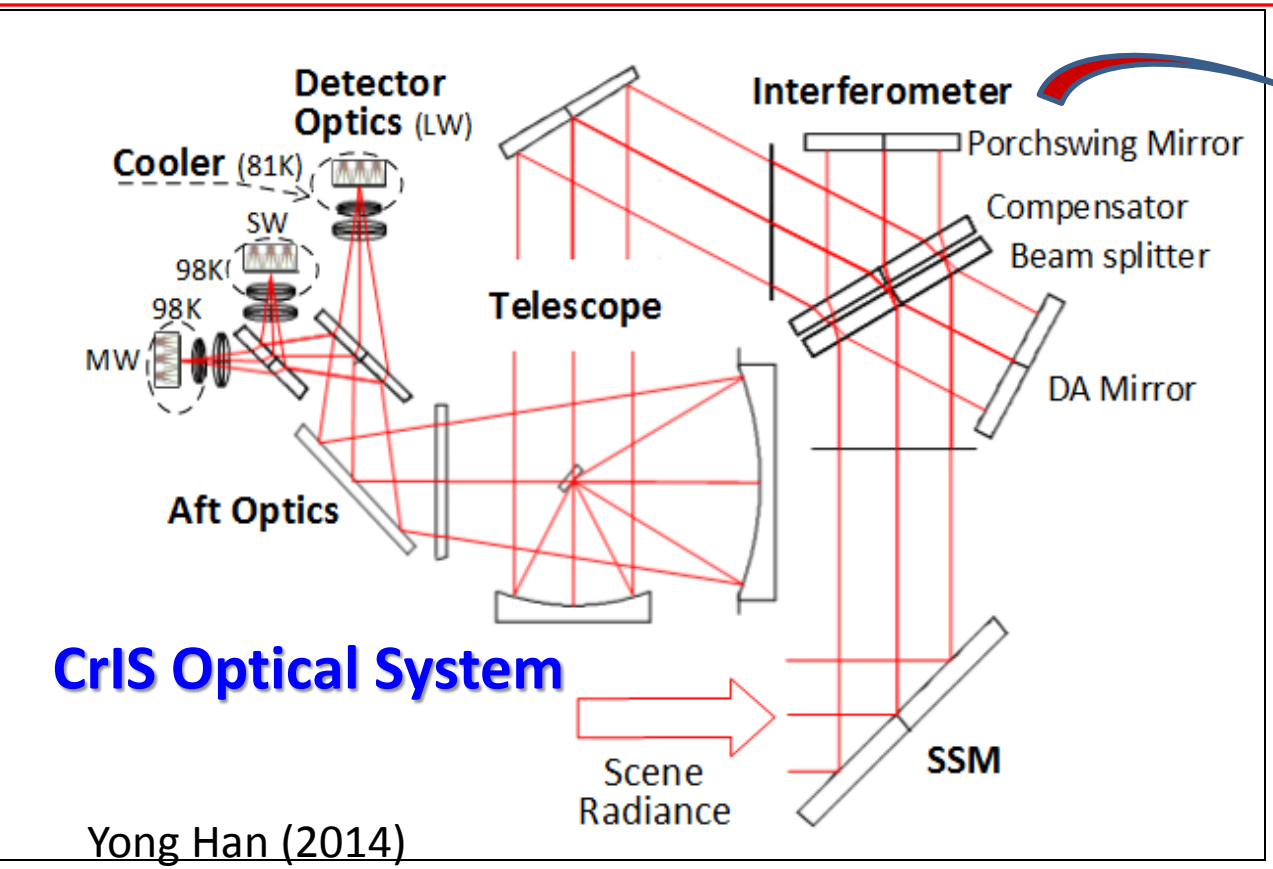
Outline

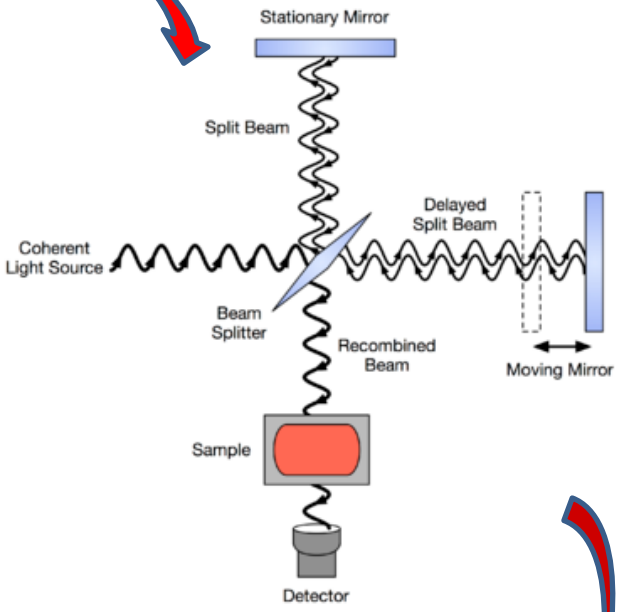
- JPSS and SNPP CrIS instrument characteristics
- Inter-comparison strategy
  - Direct comparison
  - In-direct comparison
- Conclusion Remarks

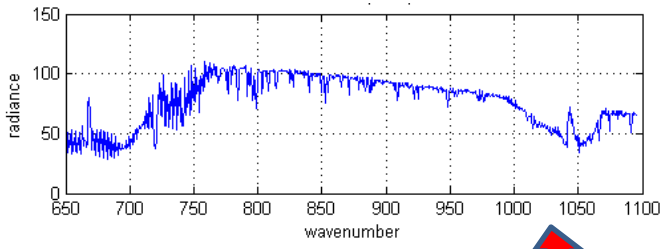
CrIS: Interferometer



CrIS Optical System

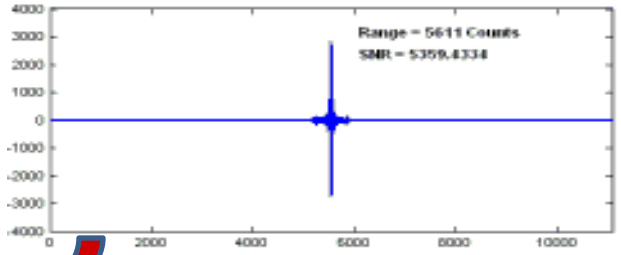
Yong Han (2014)





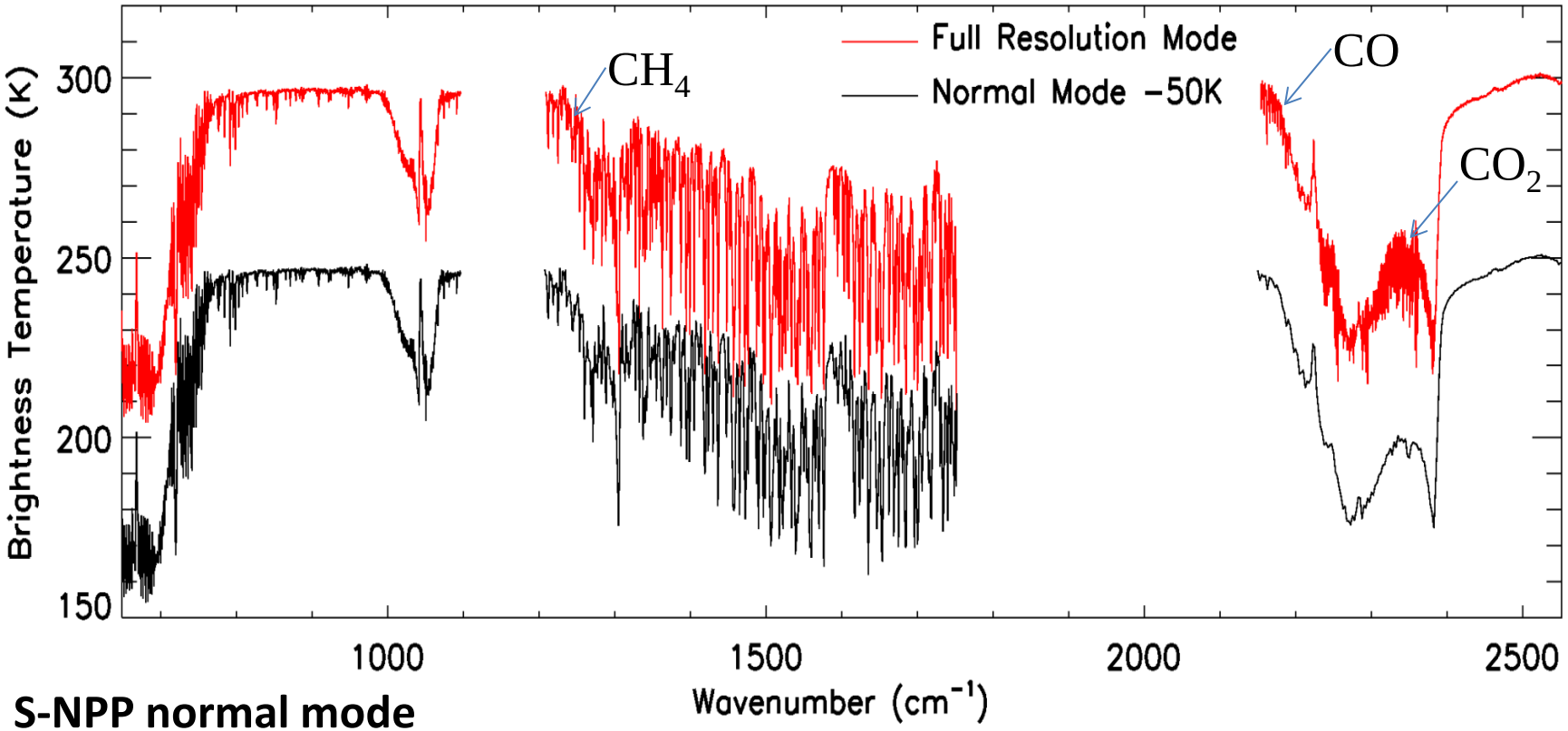
IR spectrum
(Sensor Data Records)

Fourier
Transform



Interferogram
(Raw Data Records)

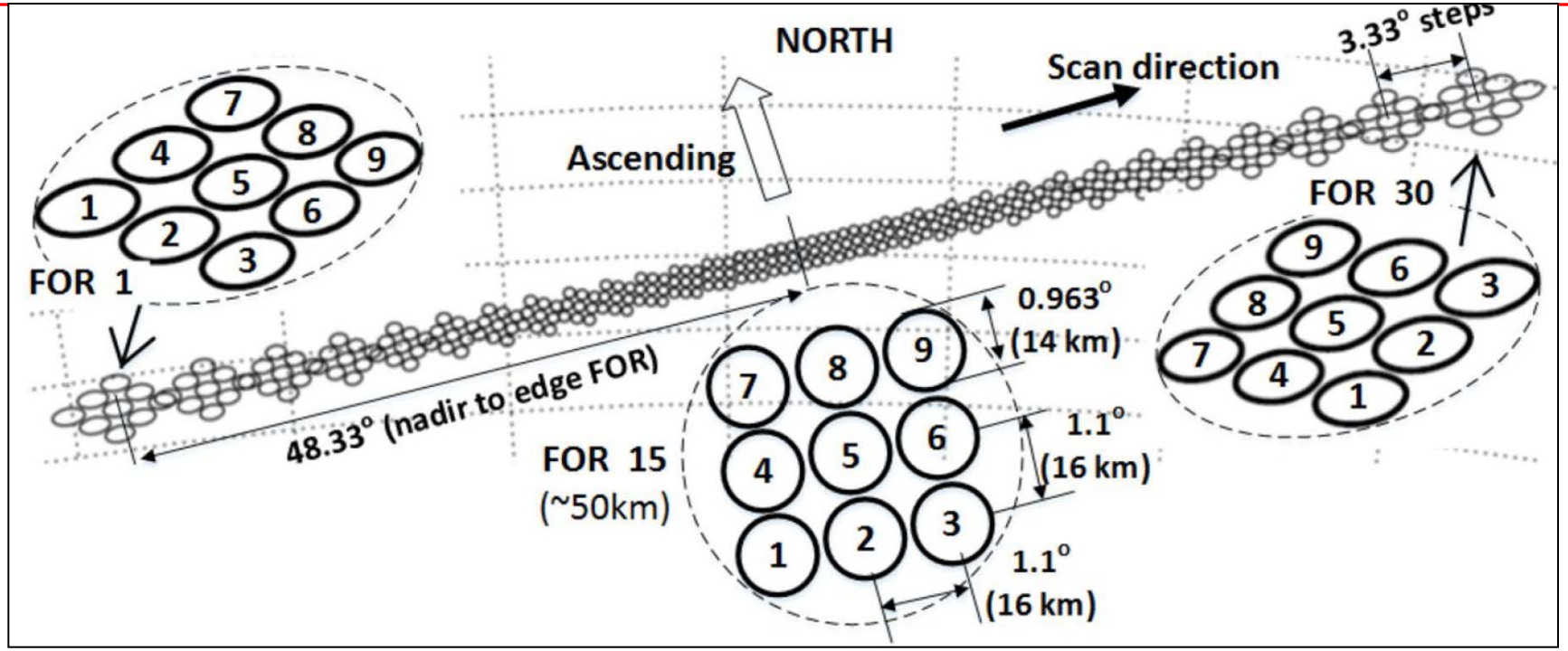
CrIS Spectral Bands



*** S-NPP normal mode**

Band	Laser Grid Range (cm^{-1})	User Grid Range (cm^{-1})	Spectral Resolution (cm^{-1})	Maximum Optical Path Difference (cm)
LWIR	603.2 – 1140.8	650-1095	0.625 (*0.625)	0.8
MWIR	1153.4 – 1806.6	1210 - 1750	0.625 (*1.25)	0.8
SWIR	2103.6 – 2601.3	2155-2550	0.625 (*2.5)	0.8

CrIS Scan Patterns

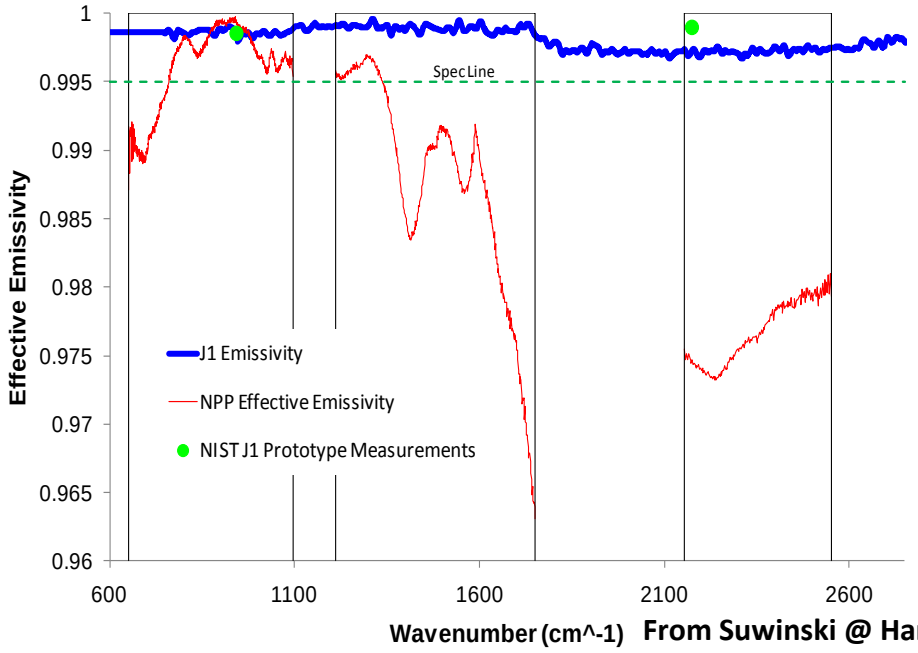


From Yong Han et al. (2014)

- For one mirror sweep, each focal planes illuminate 9 FOVs.
- The 9 FOVs form one FOR.
- Swath is 2200 Km (FOR1 to FOR 30).
- CrIS acquires 1 scan line every 8 seconds.
- CrIS measures 8.7 million spectra per day.

J1 CrIS ICT Performance Greatly Improved From SNPP

- Additional PRT (two for SNPP) for J1 provided more temperature and gradient knowledge.
- Cavity wedge design increase ICT blackbody emissivity, eliminating views to other optical parts within instrument
- Simplify the ICT model and more accurate calibration performance is expected.



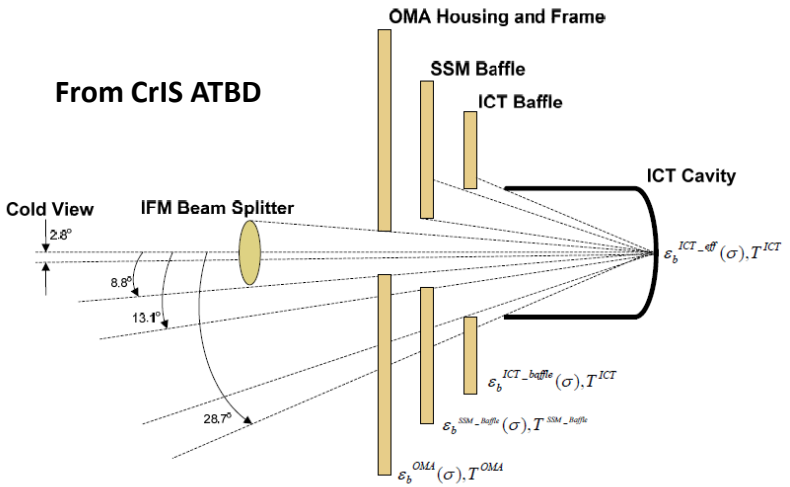
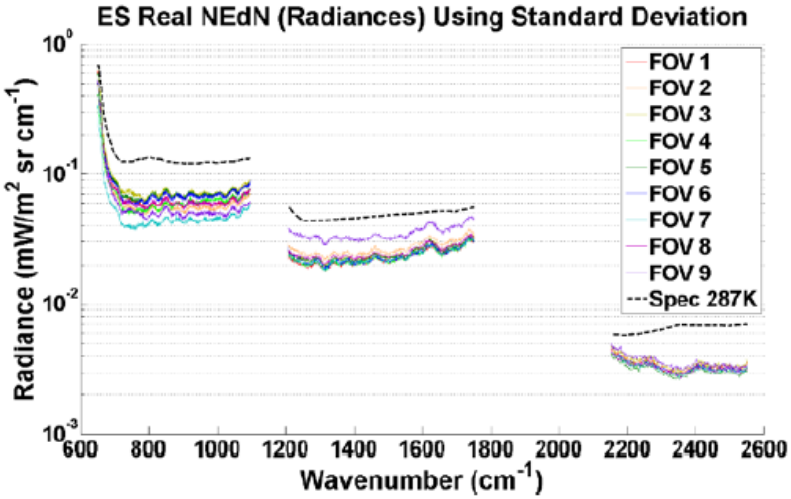


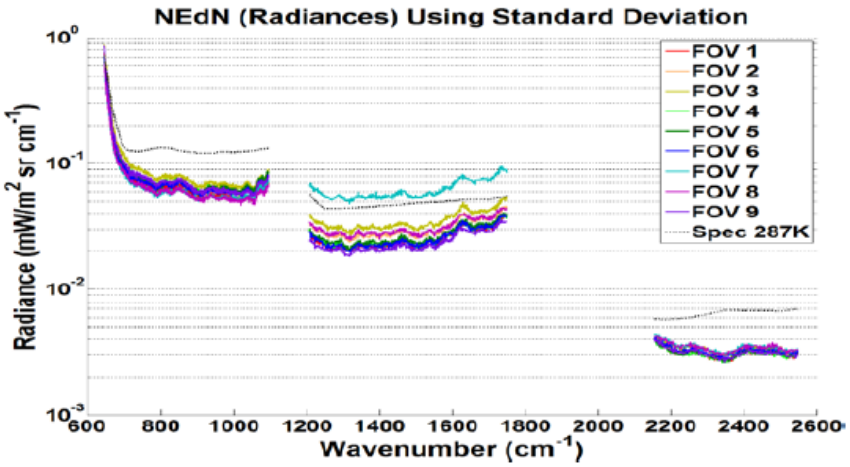
Figure 41: Radiometric model when the scene is the ICT

J1 NEdN Performance Equal to or Better Than SNPP

J1 RRTVAC: Total NEdN



NPP TVAC4 MN: Total NEdN

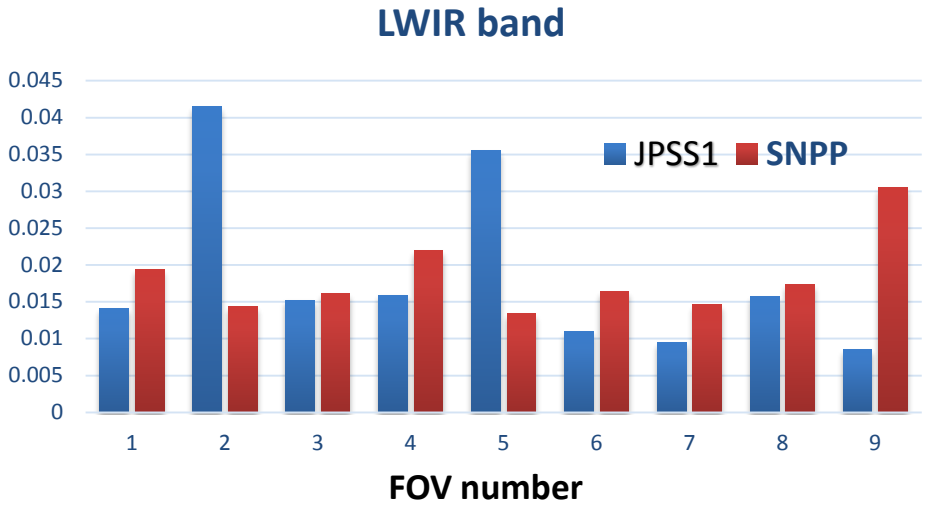


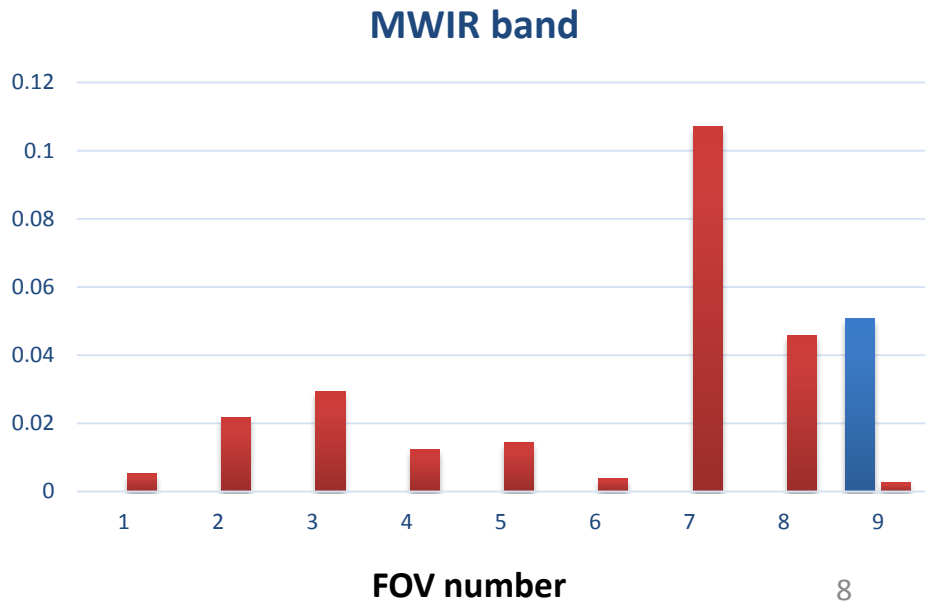
- J1 LWIR and SWIR noise performance is similar to SNPP
- J1 MWIR FOV 9 is out of family but within specification
- SNPP MWIR FOV 7 is out of family but larger than specification

From Mark Esplin @USU/SDL

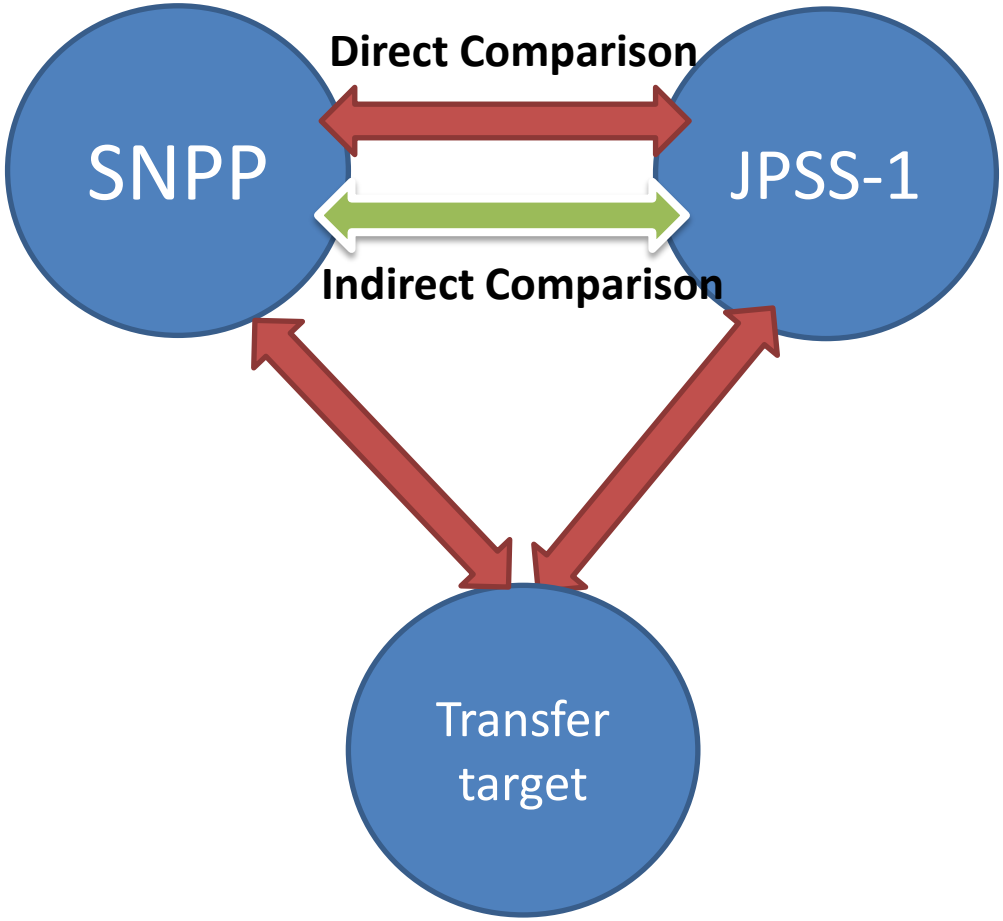
J1 Detector Nonlinearity Levels comparable or better than SNPP

- J1 FOV 2 and 5 have largest nonlinearity in LWIR, compared to FOV 9 in SNPP
- J1 nonlinearity is greatly improved in MWIR, only FOV 9 shows nonlinearity.
- The nonlinearity will be further tuned on-orbit.



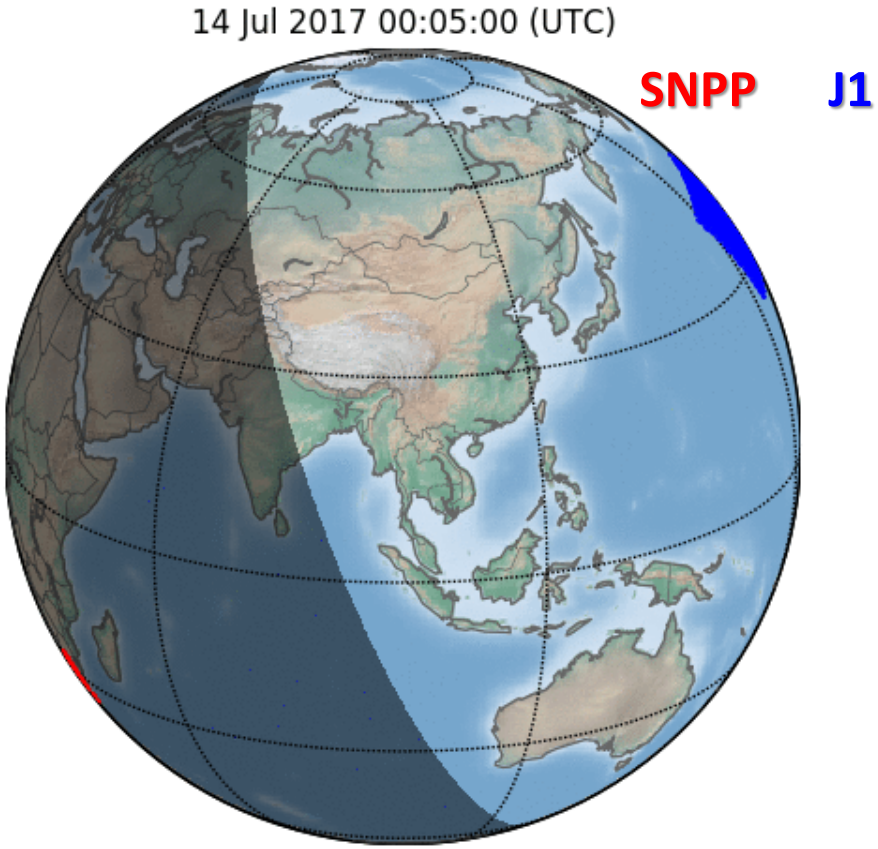


Strategy to compare J1 and SNPP CrIS

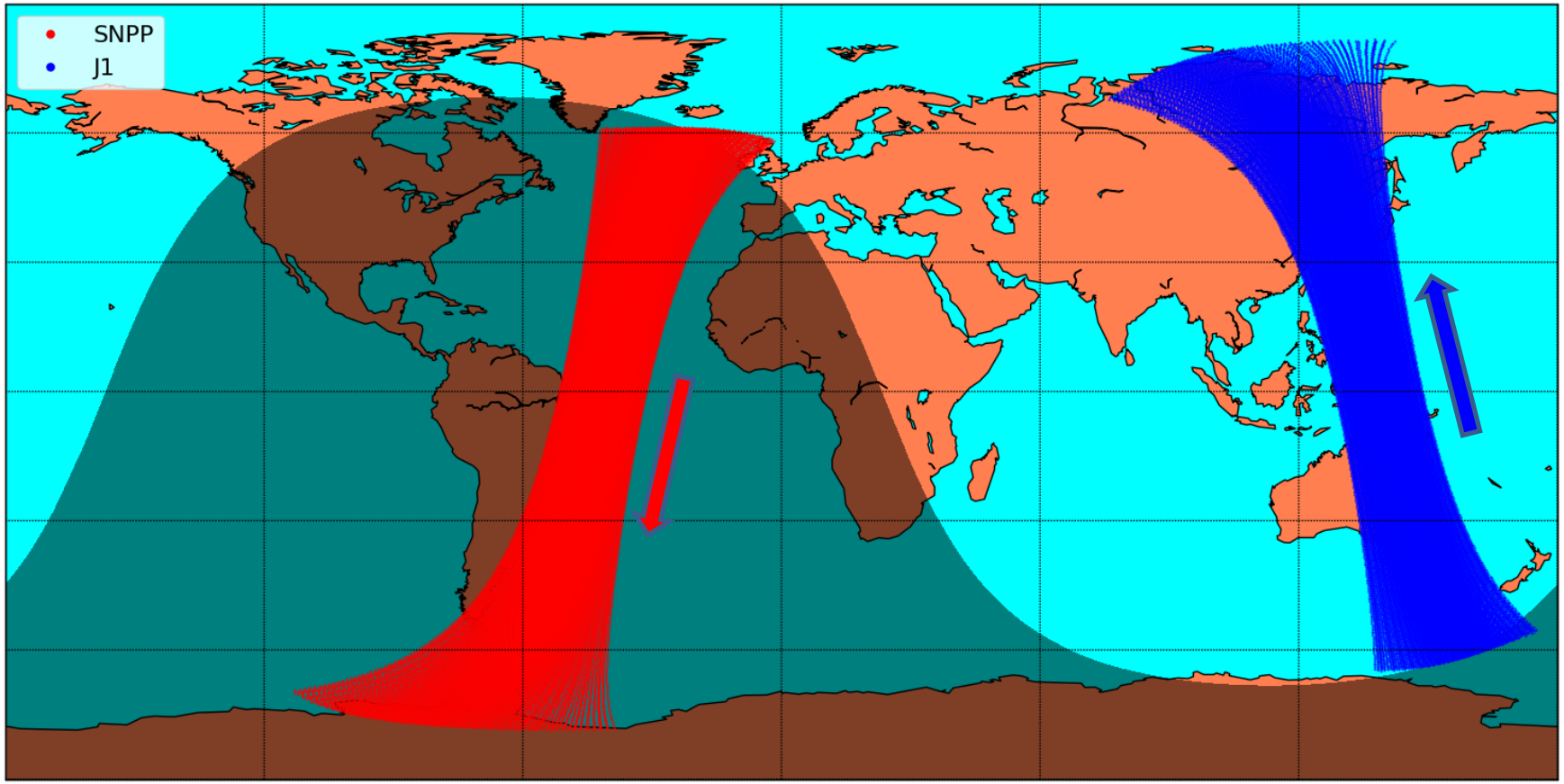


Inter-calibration of SNPP and J1 CrIS

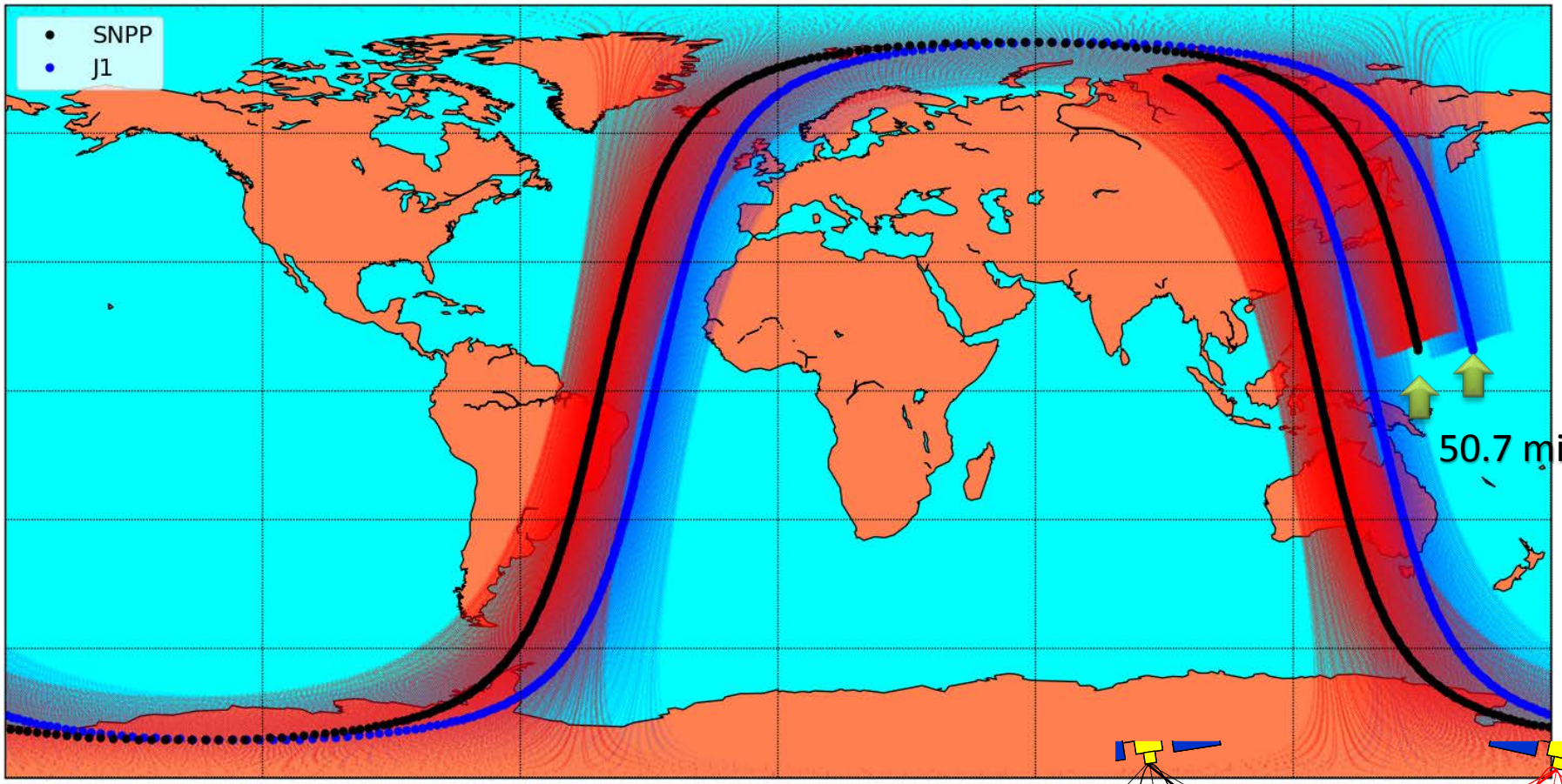
- Once J1 reaches in the final orbit, J1 will be the same orbit as SNPP except for the ½ orbit along track separation.
- SNO opportunities exist if instruments are turned on and collecting earth view data before orbit raising (Day 45).
- There will be **NO SNO**s between SNPP and J1 after it reaches final orbit.
- We need to explore the other ways to inter-calibrate J1 and SNPP CrIS.



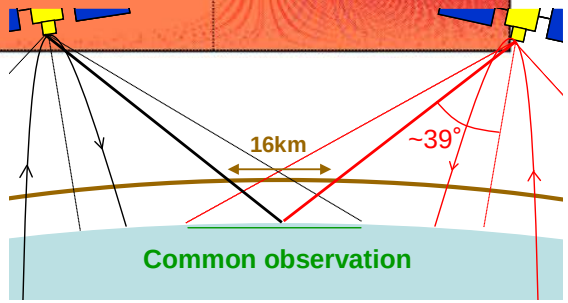
Same orbits with 180° shift



½ orbit along track separation

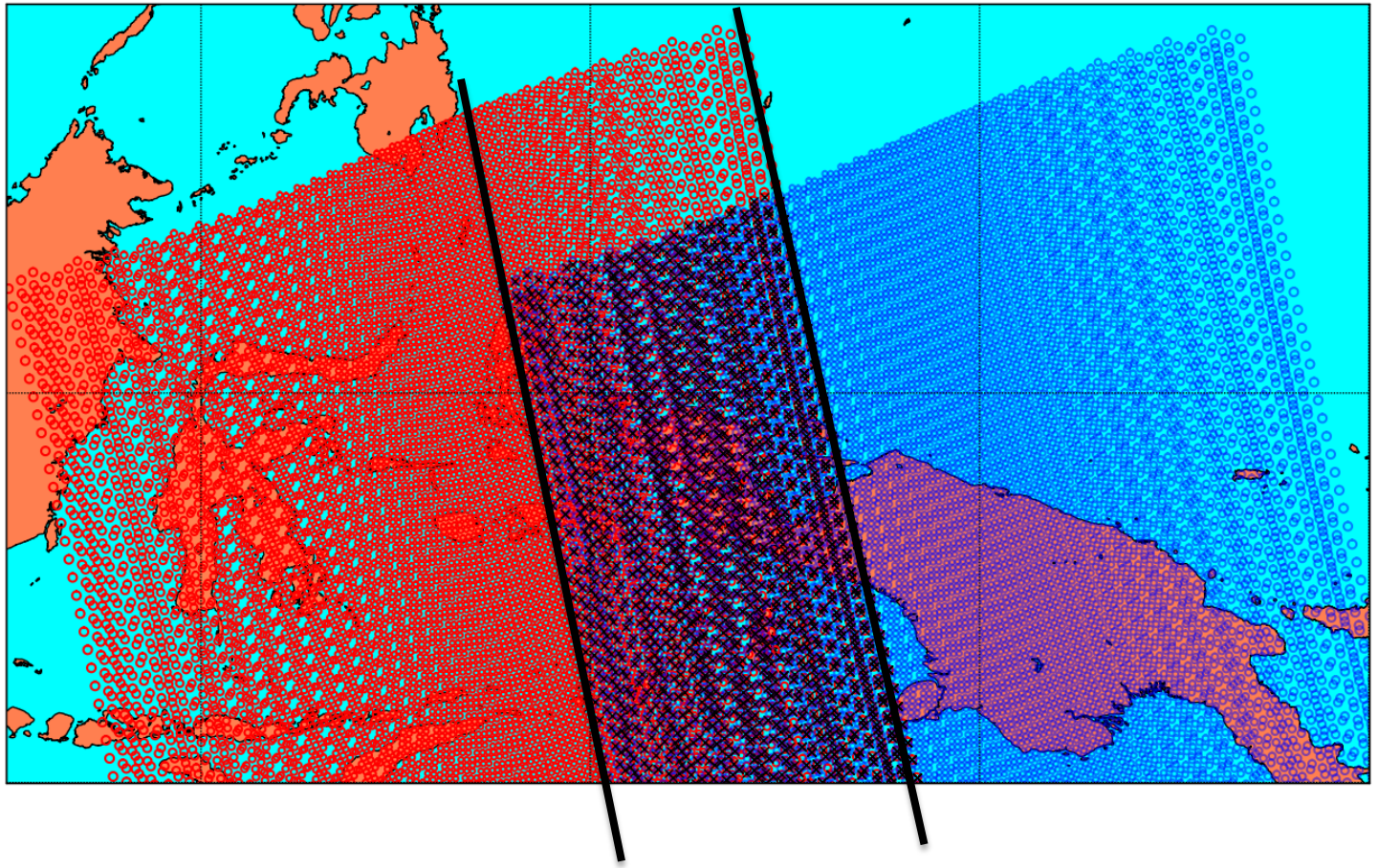


- For each SNPP orbit, with the J1 previous and following tracks
- Possible for all latitudes
- Off-nadir observations (nadir at the poles)
- 50.7 min time delay between J1 and SNPP



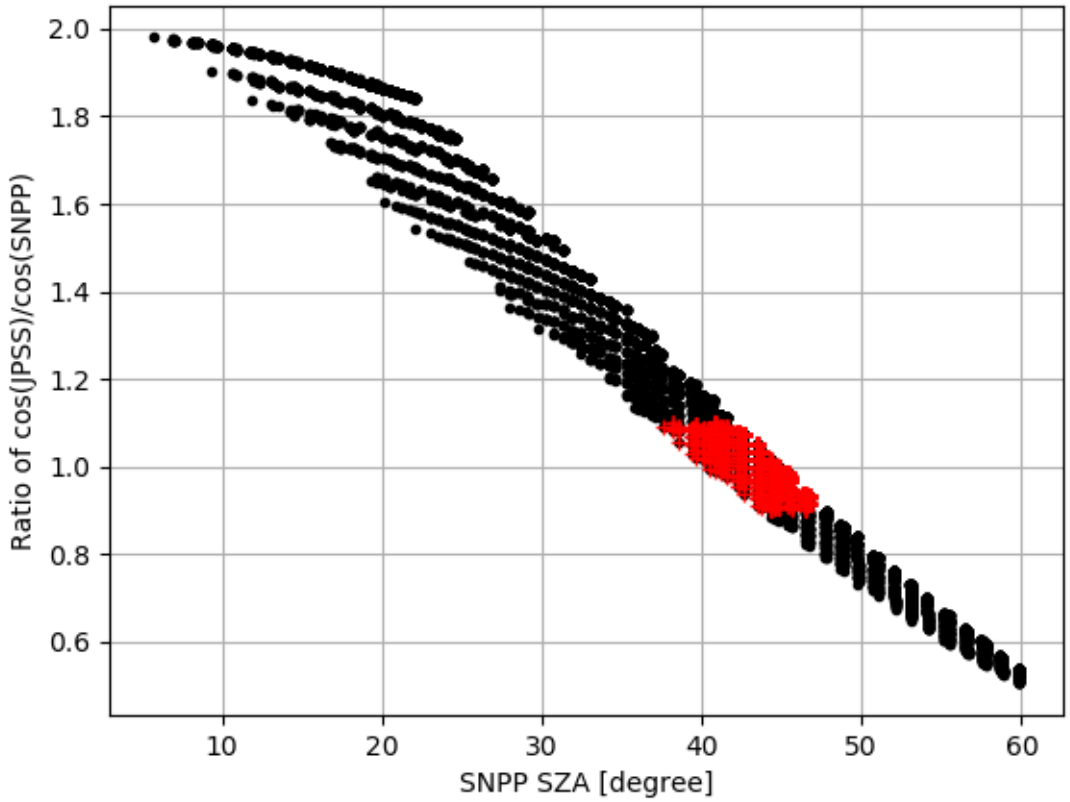
From Denis JOUGLET

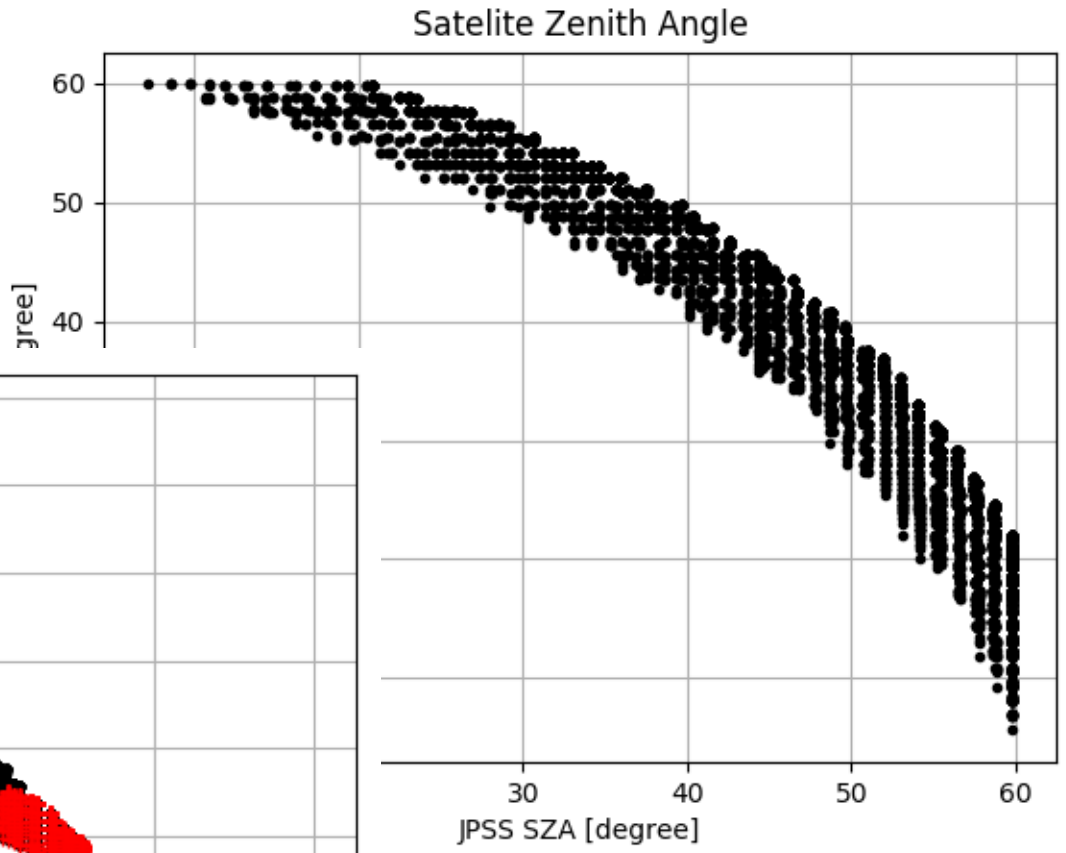
Overlapped regions with time delay



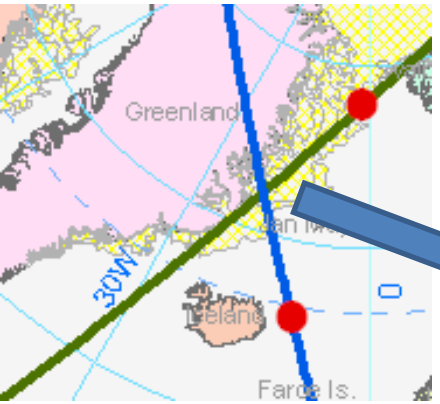
- Similar viewing absolute angles (same atmospheric thickness)
- Opposite scan positions
- homogeneous and stable scenes in 50.7 min
  - Collocated VIIRS

Satellite Zenith Angle for overlapped FOVs

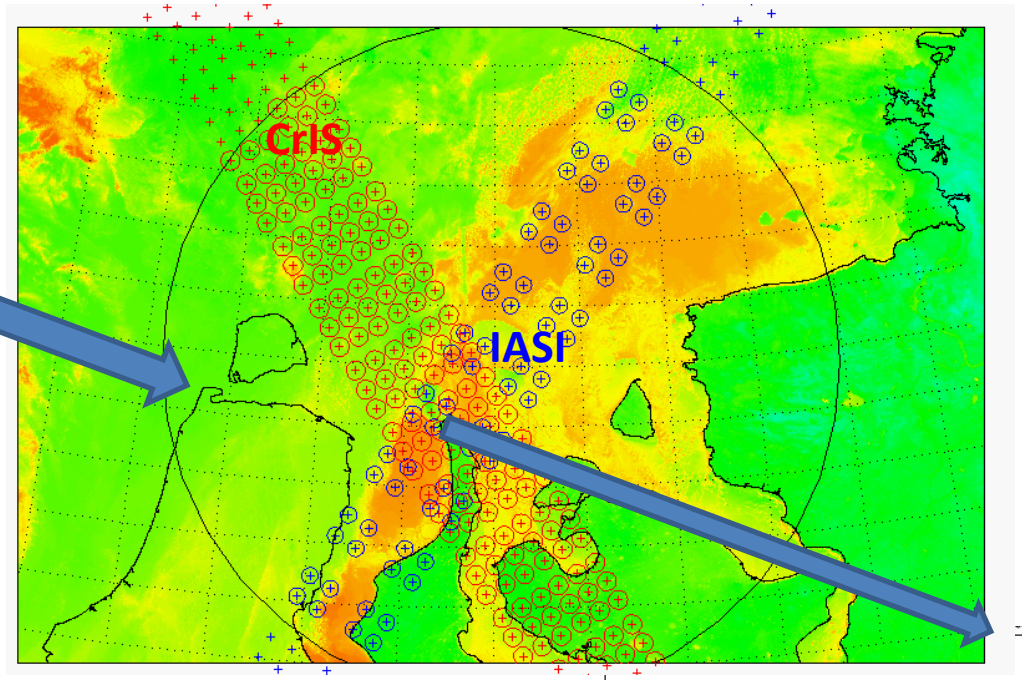




Using IASI as a transfer radiometer



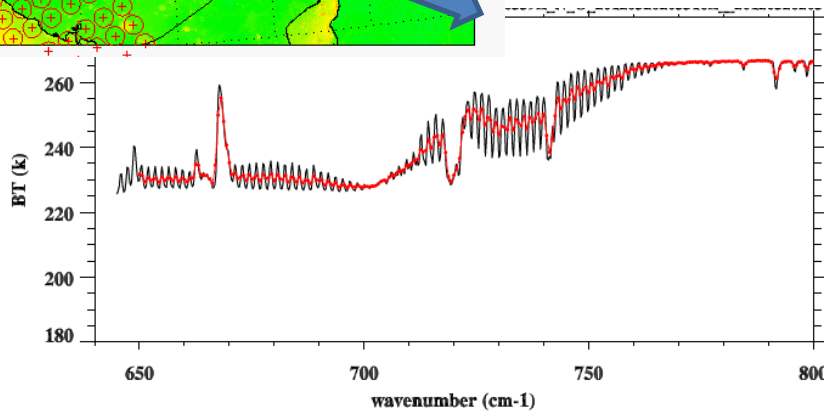
From Cao et al. 1999

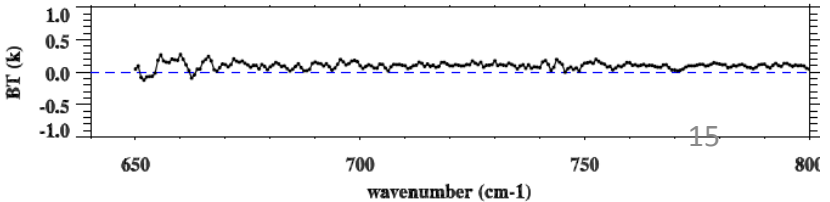


SNPP and J1 CrIS meet with IASI roughly every 50 days.

Using the same collocation algorithms to collocate CrIS/IASI with VIIRS.

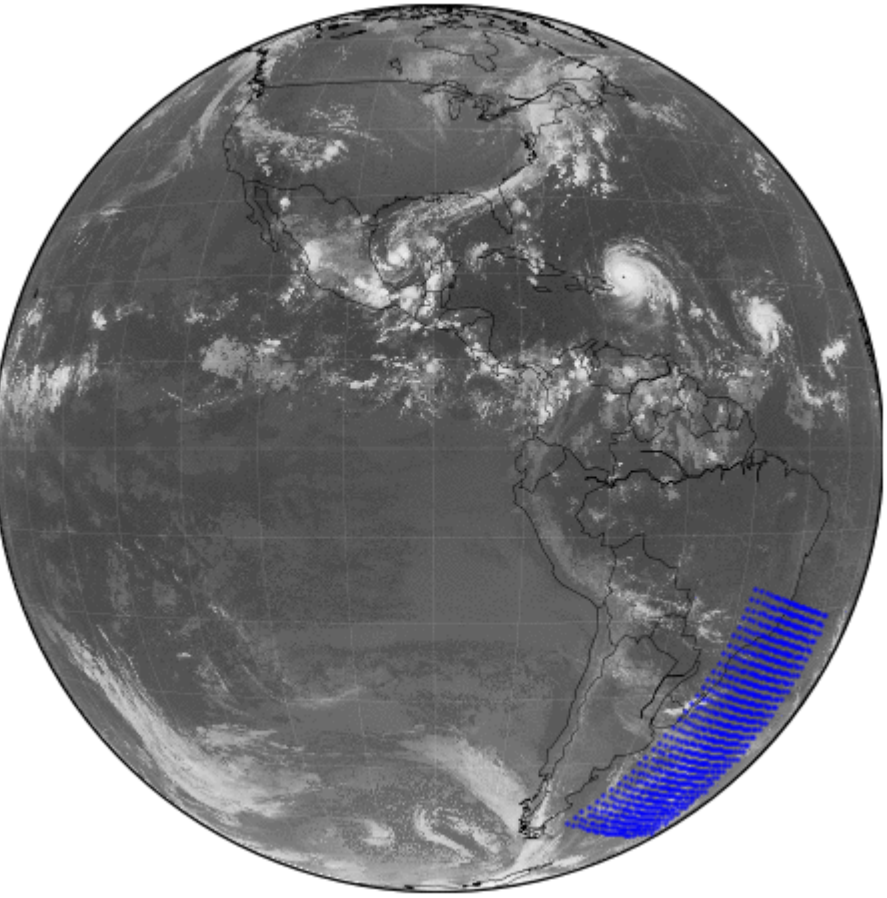
Easily to covert IASI to CrIS full or normal resolution spectra.

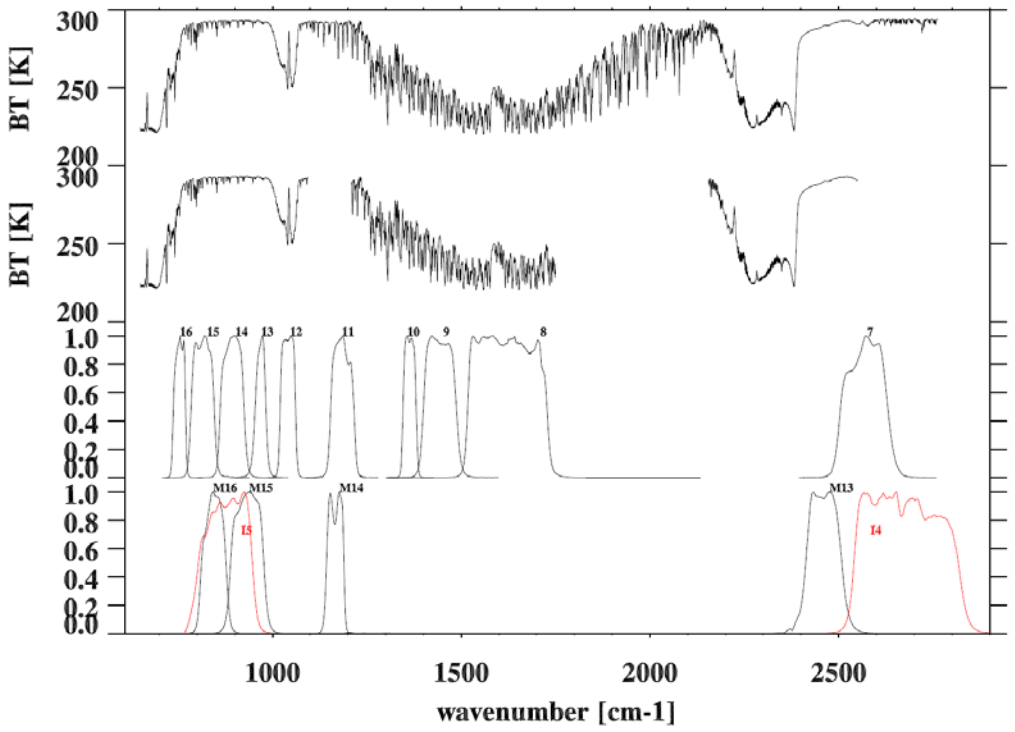




Using GOES16 ABI as a transfer radiometer

It is very straightforward to convert CrIS radiances to overlapped GOES16 ABI channels.



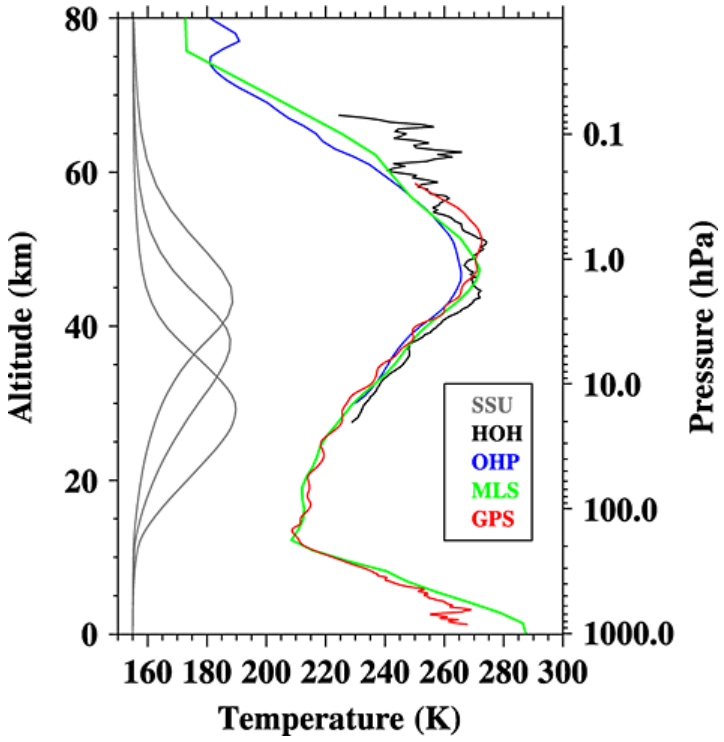


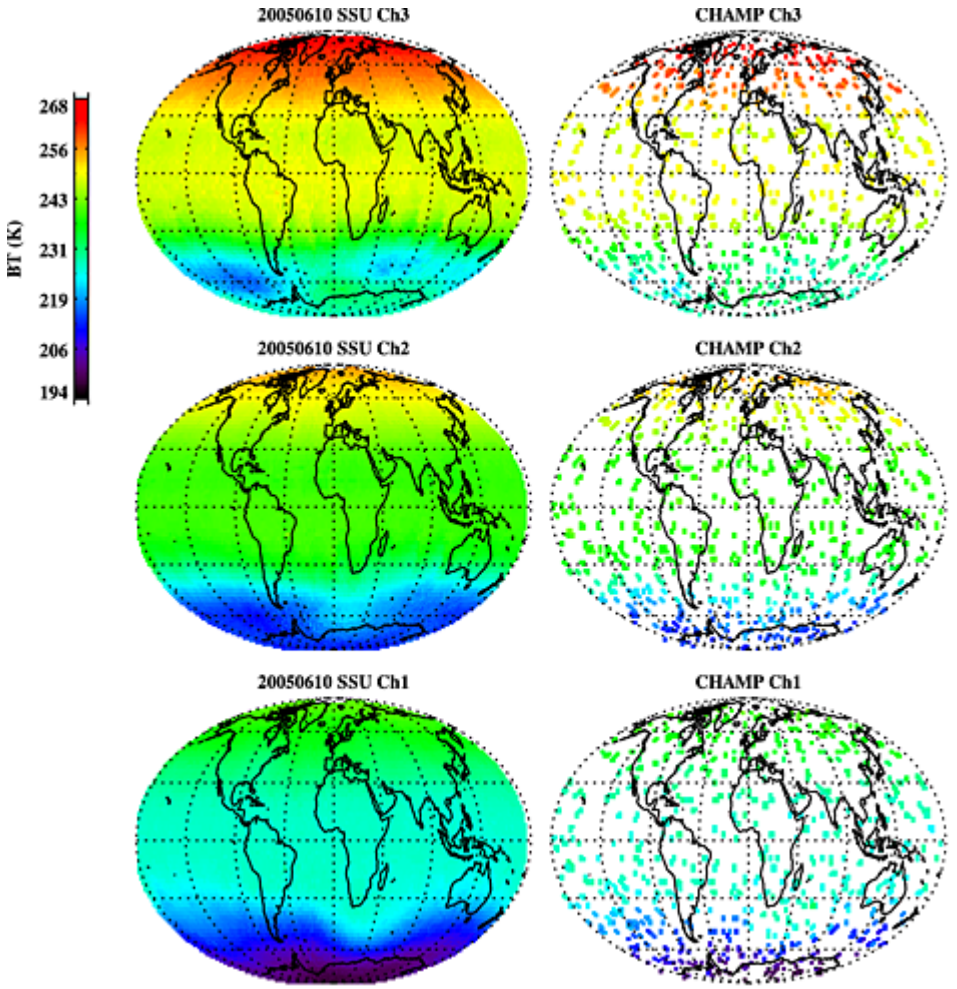
OES16 ABI should be very stable within 50 minutes and very suitable to serve as a transfer radiometer.

A lot of samples for CrIS (SNPP and J1) and GOES16 ABI.

Using GPS RO as a transfer target

the GPS RO retrieved profiles have shown potentials for use as a benchmark data set to validate other measurement at a range of 5–25 km





The previous study (Wang and Zou 2013) using GPS RO profiles to simulate SSU observations, showing very good agreement.

Conclusion Remarks

- Do we expect the BT difference along spectral domain between SNPP and J1 CrIS?
- If yes, are these BT differences trustable based on all direct and indirect comparison?
- If yes, do we understand the root causes of the BT differences?
- If yes, how can resolve these differences through re-processing efforts to link SNPP and J1 for a decade of CrIS dataset?

QUESTIONS?