20190424_PhilDabney_meeting

Attendees

@mention yourself and add others

Agenda

- Landsat-8 instrument specifications specifics
- Overview of instrument module and treatment of passive-imagers
- Discuss aggregation of metrics, what statistics are suitable to compare across different DSMs?
- Discussion of current phase-A instrument modelling for missions.
- SLI

Discussion

- ***Landsat-8***
  - ***(Phil's email)***
    There were four specific parameters they were looking for:
    - Along-track FOV (instantaneous view angle) for OLI and TIRS

    · Both OLI and TIRS are push broom instruments whose focal planes are arranged in a staggered array of detector arrays. To accommodate this the telescopes have to prove and un-vignetted near diffraction limited in-track FOV of ~3-4 degrees. The active pixel within a spectral band is much smaller than that.

    · The instantaneous IFOV of a single pixel in the pushbroom "linear" array are:

    o OLI Multi-spectral bands : 42.6 micro-radians (30/705E3)
    o TIRS: 142 micro-radians (100/705E3)
    o

    - The "lens specifications" for OLI. When I told him OLI was reflective, he asked if the "equivalent refractive" lens specs could be given.
      - OLI: f/6.4 (FMA – four mirror anastigmatic) Effl: 0.85 m (36E-6 * 705E3/30) 36 micron detector pitch

- TIRS: f/1.6 (refractive) Effl: 0.176 m
  (25E-6 * 705E3/100) 25 micron detector pitch

- Detector efficiencies for OLI and TIRS. He found a reference quoting 1% overall efficiency (aperture to read out?) for TIRS.
  - Do you mean including optical losses/efficiencies or only the detector QE or CE (conversion efficiency). If you want the effective conversion efficiency of the system we will need to convert it from the calibration coefficients and the knowledge of the focal plane electronics gain.
  - The number I can get you easily is the DN/L.lambda or digital counts per unit of spectral radiance at aperture.
  - The QWIP is somewhat of an electron amplification device so the QE (conversion to the initial photoelectron is very low) but then the photo-electron is multiplied in the detector gain. The conversion of the photon to electrons collecting in the ROIC is called the conversion efficiency by the ones who created it.
  - Array detectors only:

§ OLI: >90% VNIR and >85% SWIR
§ TIRS CE: ~2.5%

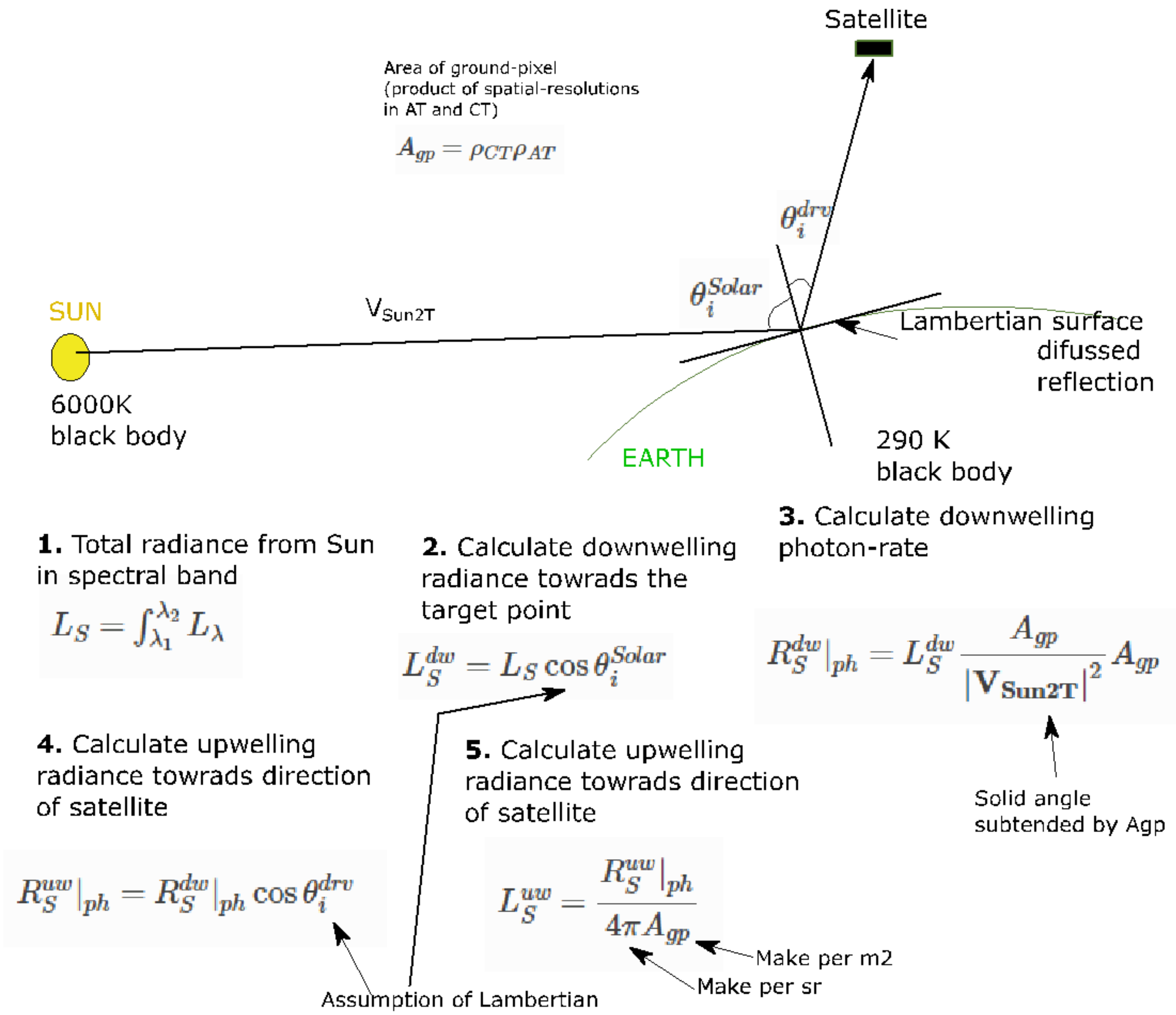
- Overall system losses

This is somewhat coupled to the Overall aperture photons to digital counts implied above.
Depends on where you want the loss calculated from and to. Photons leaving the ground to photons arriving at the associated detector element on the array?
If you are only talking about optical transmission and throughput in the middle of the passbands, then they are approximately:
§ OLI: 90%
§ TIRS: 60%

- 185 km swath width of TIRS, 1850 pixels are required for each row in each channel. At a ground speed of 7 km/sec, it requires approximately 0.014 seconds to move 100 meters and 70 effective rows of pixels are produced in each second for each channel. TIRS uses a 3.4 millisecond integration time and the resultant 25 meter image motion, when convolved with the instrument spatial function, does not excessively broaden the spatial resolution.

    - Not asked before: Number of read-out electrons specification for the OLI and TIRS

- ***Overview of instrument module and treatment of passive-imagers***
    - Outputs (Level0 Metrics) of all the SAR and imagers.
        - Any other suggestions for metrics to be included?
    - Model for optical imagers
        - Thermal imagers confident since is a direct reproduction of the framework in SMAD 3rd ed.
        - SAR confident since the Sandia Labs reference is pretty thorough.
        - Optical model built on own. Still need to verify.
            - Main issue is to calculate the reflected radiance of the Sun off the surface of Earth towards the instrument aperture



The units of radiance used is [photons s−1 m−2 sr−1]

- Inclusion of atmospheric losses.
- Which other instruments should be given priority for modelling? (‘sampling’ radiometers? LIDARs?)
  - Any references towards building an model of the instrument metrics evaluation like in SMAD for these instruments is appreciated.

- ***Discuss aggregation of metrics, what statistics are suitable to compare across different DSMs?***
  - Currently average and standard deviation of each of the metrics (Level0 metrics) are being calculated for (i) across all observations (Level 1 metrics) (ii) across all observations and across all grid-points (Level 2 metrics).
  - Example for passive-imagers.

- Currently in TATC only the Level 2 metrics are used in the end.
- Are there better statistics which could be used instead of these?

- ***Discussion of current phase-A instrument modelling for missions.***
  - In current initial phase of instrument system design, how are the end performance metrics determined from the subsystem specifications? Are there simple models used such as the one being built in the instrument module?

- ***Discussion on SLI***
  - Phil's email

SLI Architectural Studies Team ?AST) related analysis we need:

Another thing we need to look at, is something I had put on the table for capabilities in the new version of TAT-C ML. To be able to analyze vicarious calibration opportunities and frequencies, between satellites and over ground targets.

We are trying to optimize an architecture where we have a few dedicated reference spectroradiometers that underpin the constellation of NASA, ESA, other international observatories, and the commercial systems and provide a cross-calibration by looking at the same top-of-atmosphere radiance within a few minutes of each other.

We need to look at the frequency of near coincident (<10 (TDB) minutes) observation between instruments in different orbits at view angle differences of <3 (TBD) degrees. We would like to start with what we have now, Sentinal-2, Landsat-8, and the ISS instruments. These are all in a difference orbit plane so they do cross paths. I guess we could also put a satellite in a 45 degree inclination 500 km orbit and see how that performs also to tune our intuition. The initial combinations would be:

1. S2-L8
2. S2-ISS
3. L8-ISS

§ First we need to see how many times a day the 2 satellites cross paths.
§ Then we need to see how many of these crossings are within 10 minutes of each other.

§ Later we will have to consider what the FOV's and point-ability might add to that problem. But for now let's assume this only occurs looking at the nadir area under each track.

Action items

- [ ] Phil to send:
  - [ ] Landsat reference spectra (reflectivity for different land types)
  - [ ] OLI and TIRS documents. OLI associated person is Edward Knight of Ball Aerospace.
- [ ] To include:
  - [ ] Radiometric accuracy (different applciations have different needs)
  - [ ] Instrument stability
  - [ ] Change QE and Optical loss to [digitals counts/radiance] specification