

Discussion on White Paper  
Contributions:  
IR, Broadband and Microwave  
Observations

# IR

- Important to have control of all aspects of instrument design and build for achieving good accuracy and traceability chain [Dave Smith]
- Calibration characterisation often get cut at end of program
  - But less so if instrument end-users are also the instrument builders
- Spectral calibration often significant contribution to uncertainty
  - Benefit of hyperspectral inter-calibration reference instruments
- Black-body sources are primary means of SI traceability
  - Calibration uncertainties currently limited by BB thermometry/gradients
  - Uncertainties minimised by operating BB at ambient temperature
  - These black-bodies are now suitable for integration into flight instruments (breakthrough calibration improvement)
  - In fact, ARI now ready for space flight – *How can we encourage it?*
  - *Recommend use of phase-change cells transitions in commissioning + EOL?*

# Solar-Incoming and Solar-Reflected

- Outgoing measurements (CERES) still rely on continuity with 1 year of overlap (and SNOs)
  - Alternative approach: Regress zonal mean fluxes ( $1^\circ$ )
  - Retrieve SRF changes due to instrument degradation
- SSI measurements have moved toward end-to-end accuracy / calibrations and detector-based instrumentation
  - Accuracies improved from  $\sim 3-8\%$  (esp. in NIR) to  $0.2-0.3\%$
  - May not quite yet achieve stability over solar-cycle timescales desired for climate
- Possible detector-based improvements via parametric down-conversion to determine efficiencies ( $\sim 0.2\%$ )
  - Will have similar issues calibrating spectral-selection optics' throughput (thus are calibrated simultaneously with detectors)
  - Spectral selection done via separate paths and spectral bandpasses

# Microwave

- Current calibration accuracies
  - Sufficient for NWP – main users – need to push for SI-traceability
  - NIST prototype of black-body standard (18-220 GHz)
  - There is no requirement on national labs to support these measurements with standards
  - Need means for calibration transfer
  - [Bruce] Get NWP to push need for climate uses to NOAA (NOAA listens to them)
  - [Vince's talk] Instrument needs and ideas for improved climate-quality measurements
- Microwave Moon
  - Reference Model of Microwave Radiance:
    - emissivity & temperature profile
    - Reference Observations -Frequency Range, – range of phase angles + libration?
    - How to account for Antenna Pattern?
  - With existing observations, how well can we model Moon's Microwave Radiance?
  - What observations would be needed to model it to a useful level of uncertainty?
- Towards Climate Reference Microwave Satellite Instruments
  - Technology Developments needed?
  - Suitable platforms/orbits?
    - Overlaps
  - Possibility of on-orbit SI-traceability?
    - How to interface to GNSSRO? - Follow-on workshop? Specific – or general active-passive?

# Target Metrological Traceability?

- Are there different degrees of traceability?
  - e.g. Atmospheric correction of ground-based observations
  - What about *Unknown Unknowns*?
  - If so, how do we describe them?
- What do we aim for with SITSATs
  - Climate applications?
  - Inter-calibration?

# Uncertainty Communication

- Correlation of calibration errors between SITSAT channels could be important for some applications
  - *Can express as Structured error (FIDUCEO) to communicate to users?*

# Follow-on Workshops

- Need? (Feedback —> yes)
- Topics?
  - This same audience plus Active / GNSSRO? L2?
- Dates? ~5-years (2023 or 2024)
  - Prep for CLARREO, CRBS, and TRUTHS readiness
  - See feedback from agencies on white paper
- Hosts? (Wait until ~1 yr out)
- White Paper drafts at <http://tinyurl.com/sitscos>