Case study: Dome C - a potential CEOS radiometric reference site

Cao, Ungar, Xiong, Henry, Fox, Buck,
Mackin, Lecomte, and others

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Statement of the problem

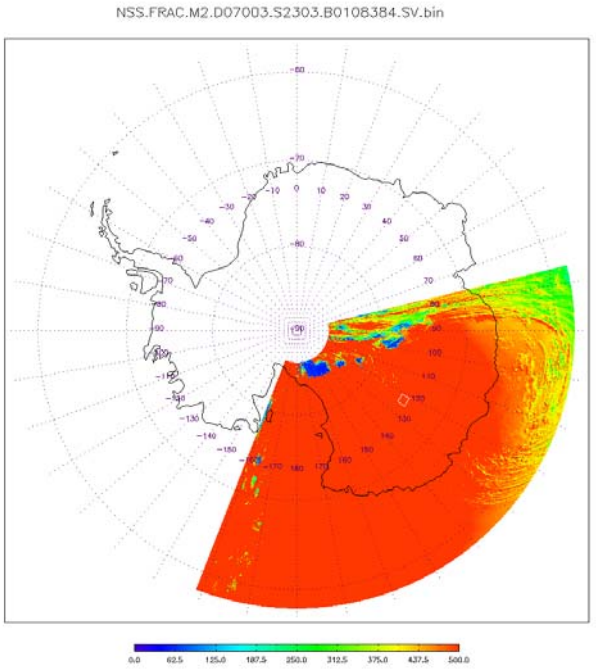
- To study motion, one needs stationary reference points.
- To study climate change, one needs stable calibration references.
- Key requirement in climate change detection: 1% stability per decade in albedo.
- Stability vs. variability: takes longer for larger variability to achieve the same stability

Goal

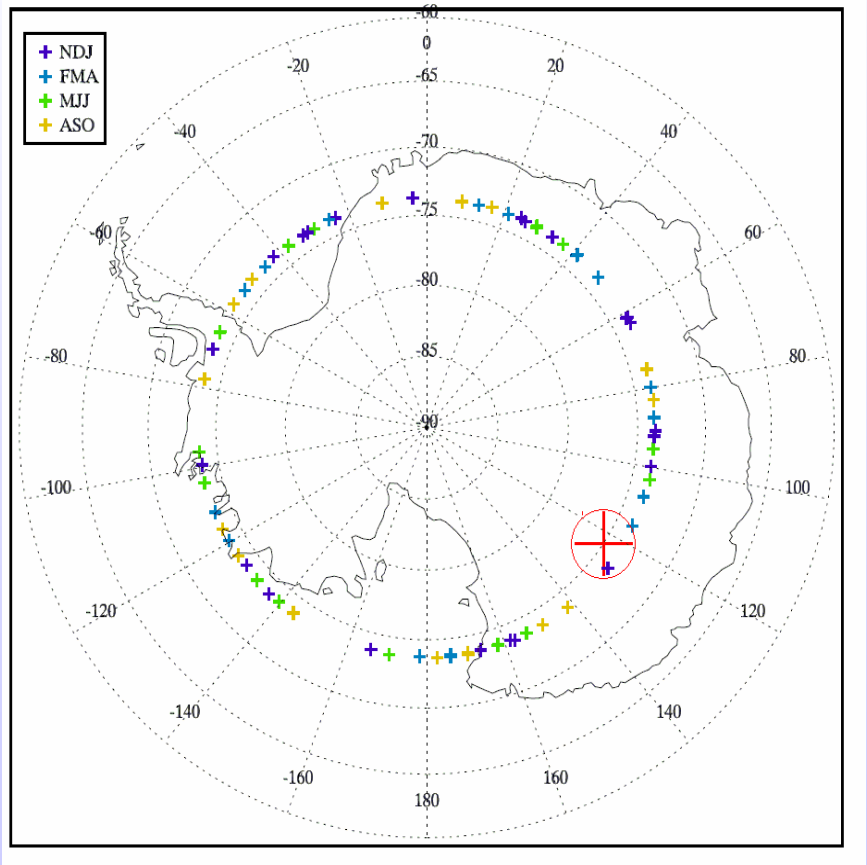
- Establish a common radiometric reference site:
  - Stable longterm,
  - Can be used by CEOS agencies for intercomparison at their own discretion
  - Simple to use, with limited radiative transfer calculations,
  - Complements other cal/val sites
  - Contributes to the cal/val portal

Why Dome C?

- Stable climate assures longterm use.
- Clear most of the time, and less affected by clouds due to high reflection (less contrast)
- Relatively uniform and flat snow surface, elevation > 3 kilometers
- Lower uncertainties from atmospheric variability and radiative transfer calculation dry atmosphere with low aerosol loading. Low wind speed.
- Politically more neutral
- Frequent satellite overpass (more opportunities for calibration)
- Simultaneous Nadir Overpass provides highly accurate calibration transfer between satellites
- Previous studies (Warren, Hudson, Masonis)



Simultaneous Nadir Overpass (SNO) at Dome C – MeTop vs. Aqua



Disadvantages

- Only available in the winter months (for solar bands), thus only good for infrequent intercomparison (not a substitute for your regular sites)
- BRDF effects
- Boundary layer (~30 meters)
- Limited ground measurements (Hudson)
- High solar zenith angles

Dome C calibration with a Simple Experimental Procedure

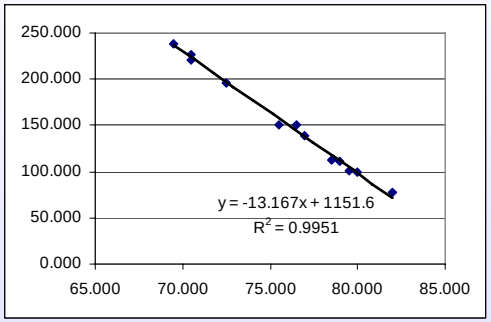
(Without using radiative transfer model)

- Extract near nadir observations (average reflectance/radiance, and solar zenith angle) from a small window for Dome C overpasses at similar times in the winter months.
- Compute the average and standard deviation for the samples in the window. Then import all data to MS Excel
- Remove data with solar zenith angle > 80
- Remove data with large standard deviations (simple cloud clearing)
- Plot the average reflectance/radiance vs. solar zenith angle, which appears to be linearly correlated (Why? Need radiative transfer studies)
- Derive the linear equation and compare with those from other instruments with similar spectral response functions

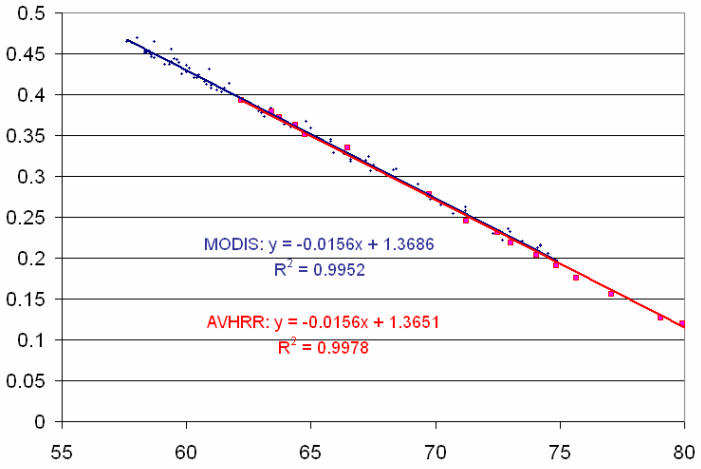
AVHRR and MODIS at Dome C for Band 1 at 0.64um

- Experimenting with AVHRR recalibration (since NOAA-6) over Dome C
- MetOP/AVHRR and Terra/MODIS Match relatively well using AVHRR prelaunch coefficients. However, not so well if consider: Sun-Earth distance factor not included for AVHRR, which has an effect of ~3% higher than average in the winter months.
- Postlaunch desert based calibration (at NOAA) will force it to adjust downward by another ~3%.

NOAA-6, 1980

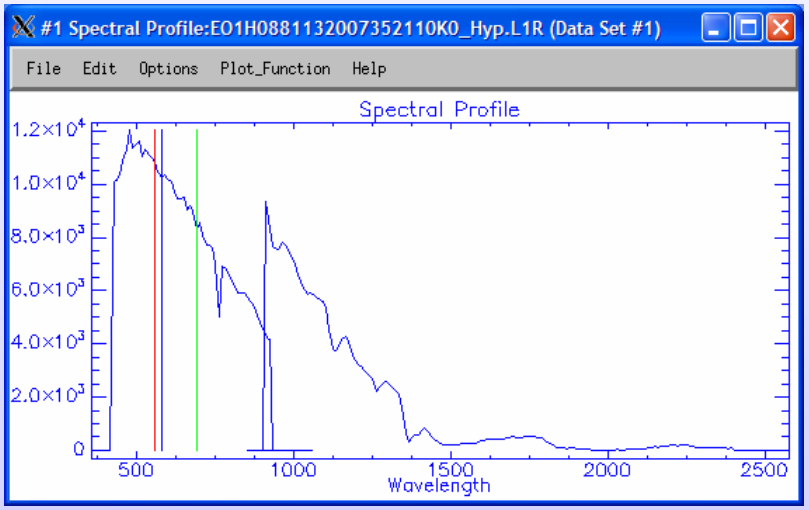


MODIS vs. MetOP/AVHRR



Hyperion Observations at Dome C

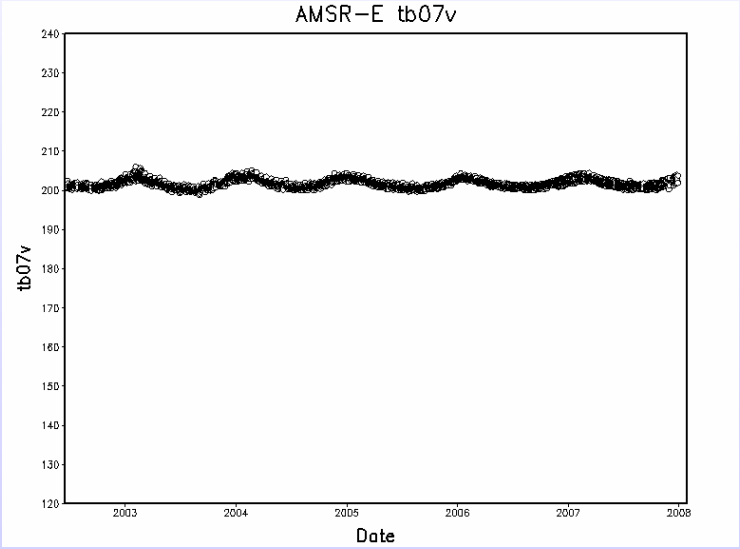
Dec 18, 2007 23:40:50 UTC

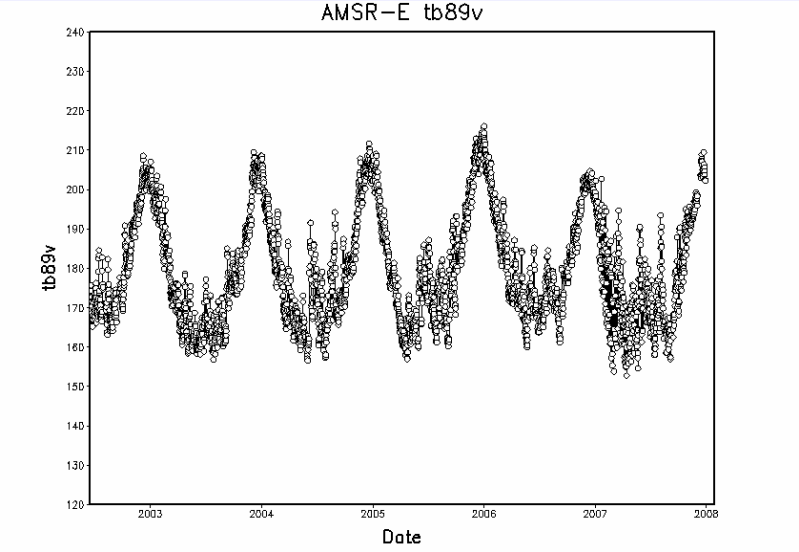


NASA contribution

Microwave Observations over Dome C

Low variability for the low frequency channels





After Drinkwater (ESA)

Summary

- Dome C is an excellent site due to its surface stability, and unique atmosphere.
- Preliminary results are promising
- Way forward:
  - Encourage joint experiments across agencies, missions, satellites, and instruments
  - Focused studies on the radiometric uncertainty
  - Spectral characterization.
  - Further investigate its potential use in the microwave and infrared.
  - Incorporate the results in the cal/val portal.
  - One of the deliverables to CEOS/SIT in 2008.
  - IVOS to develop best practices and procedures.

- Backup slides

Dry atmosphere at Dome C