**MSU channel 2 brightness temperature trend when calibrated using simultaneous nadir overpasses**

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1. Purpose

- To re-calibrate MSU observations at level 0 using simultaneous nadir overpasses
- To generate well-calibrated and well-merged multi-satellite MSU 1B data for use by the climate community
- To investigate the MSU trend derived from the well-merged 1B dataset
- To compare with previous trend studies and identify problems with previous use of the MSU data
- To provide a guidance on the future use of MSU data
- To provide the climate community an observed reference on the tropospheric temperature trend

2. SNO dataset

   ![Schematic diagram](image)

   - The local equation coming from (4.4.1) of the sounding orbit of NOAA satellites
   - Outgoing (Top) and incoming (Bottom) panels
   - Number of latitudinal differences between the blackbody target radiance
   - Number of longitudinal differences between the blackbody target radiance
   - Number of latitudinal differences between two satellites in the orbit
   - Number of longitudinal differences between two satellites in the orbit
   - Number of SNO data pairs for smaller distance due to sampling size problems
   - Number of SNO data pairs for larger distance

3. Calibration algorithm

   \[ R = R_0 + S(C_2 - C_1) \]  
   \[ R_0 = \text{Earth-view radiance by linear calibration} \]
   \[ S = \text{Cold Space Radiance, fixed value} \]
   \[ C_2 = \text{Cold space raw counts} \]
   \[ C_1 = \text{Earth-view raw counts} \]

   - Linear calibration equation:
     - Trend = 0.32 K Dec
     - Combined:
       - Trend = 0.16 K Dec

4. Calibration with SNO dataset

   \[ R(t_i, X_i) = R(t_j, X_j) + \varepsilon_i \]  
   \[ R(t_i, X_i) = R(t_j, X_j) + \varepsilon_j \]  

   - Taking differences
     - \[ \Delta R = R(t_i, X_i) - R(t_j, X_j) + \varepsilon_i - \varepsilon_j + \Delta R(M, AX) \]

   Using equation (4)

   \[ \Delta R = \text{error for any SNO data pair} \]

5. Results

   - Five-day averages of ascending and descending offsets for NOAA 10 for the period of October 3-5, 1993. Points 0, 6, and 7 are used in generating the trend data.

   - Table 4.1: To generate well-calibrated and well-merged multi-satellite MSU 1B data for use by the climate community.

   - Table 4.2: To investigate the MSU trend derived from the well-merged 1B dataset.

   - Table 4.3: To provide a guidance on the future use of MSU data.

6. Summary and Future work

- Use new nonlinear calibration equation to convert raw counts to radiance.
- Coefficients for reference satellite are determined by pre-launch calibration but non-reference satellites are determined by post-launch SNO data.
- Very well calibrated and merged MSU channel 2 data are generated. Biases for pentadal global ocean-averages are on the order of 0.05 to 0.1 K between satellite pairs, compared to 0.5 to 1 K with NESDIS operational algorithm.
- Global ocean trend with this merged dataset is 0.17±0.20 K/Decade, consistent with surface temperature trend.