NOAA's Stratospheric Sounding Units' (SSU) Climate Data Records Development

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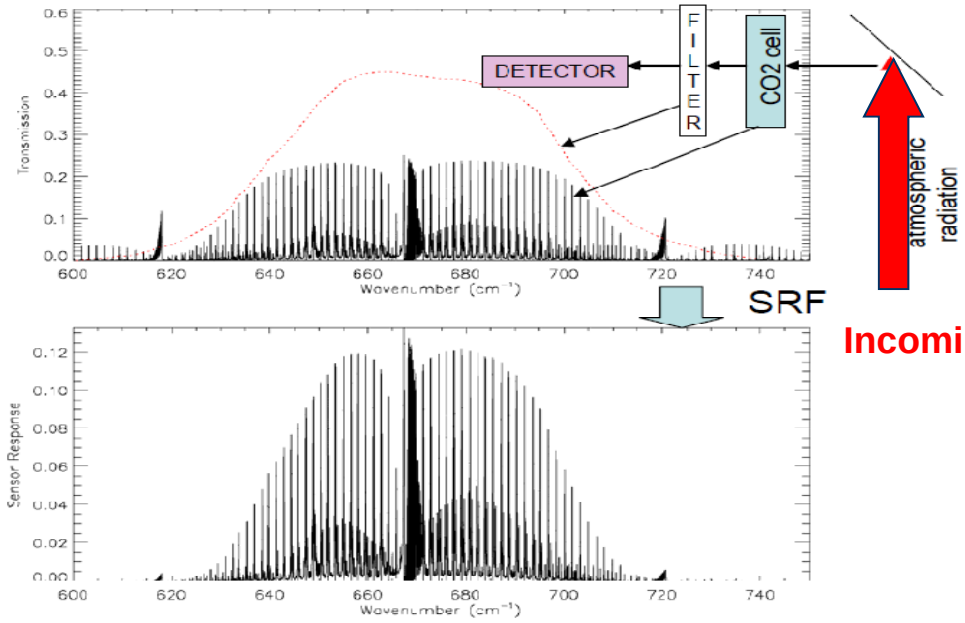
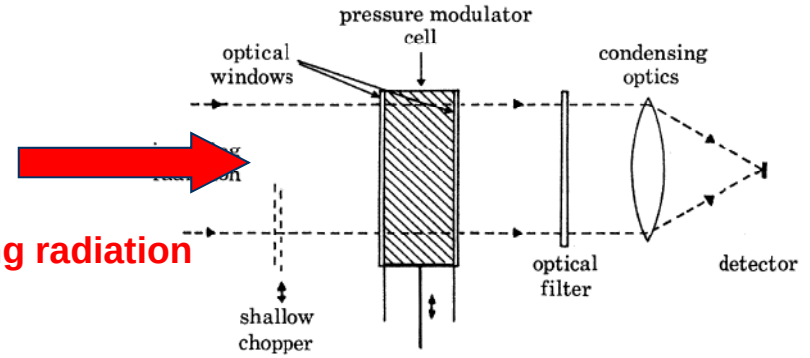
Contents

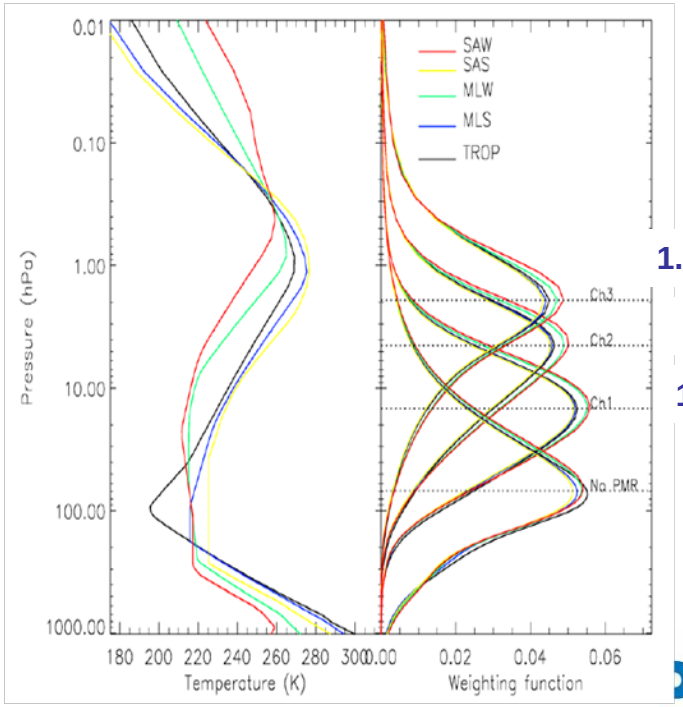
- **SSU instrument**
  - Time period: 1979 to 2006
  - Only instruments that made operational stratospheric temperature observations until AMSU-A
- **Challenges of SSU recalibrations**
- **NOAA's strategy for SSU recalibration**
- **Recent Progress**
- **Conclusion and future Work**

SSU instrument



Incoming radiation





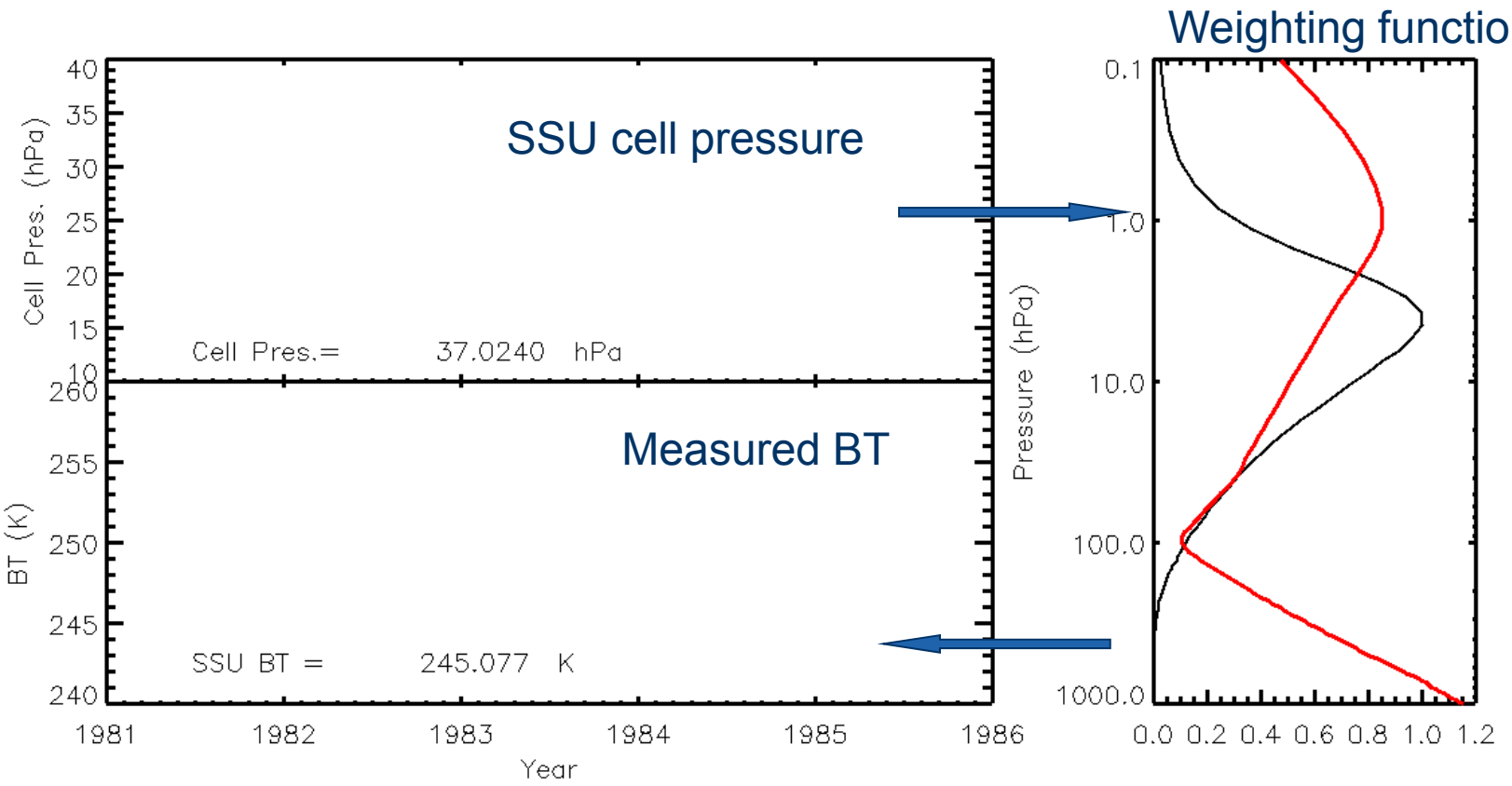
1.5 hPa

5 hPa

15 hPa

Spectral response is a product of traditional broadband SRF and the CO2 cell absorption line responses.

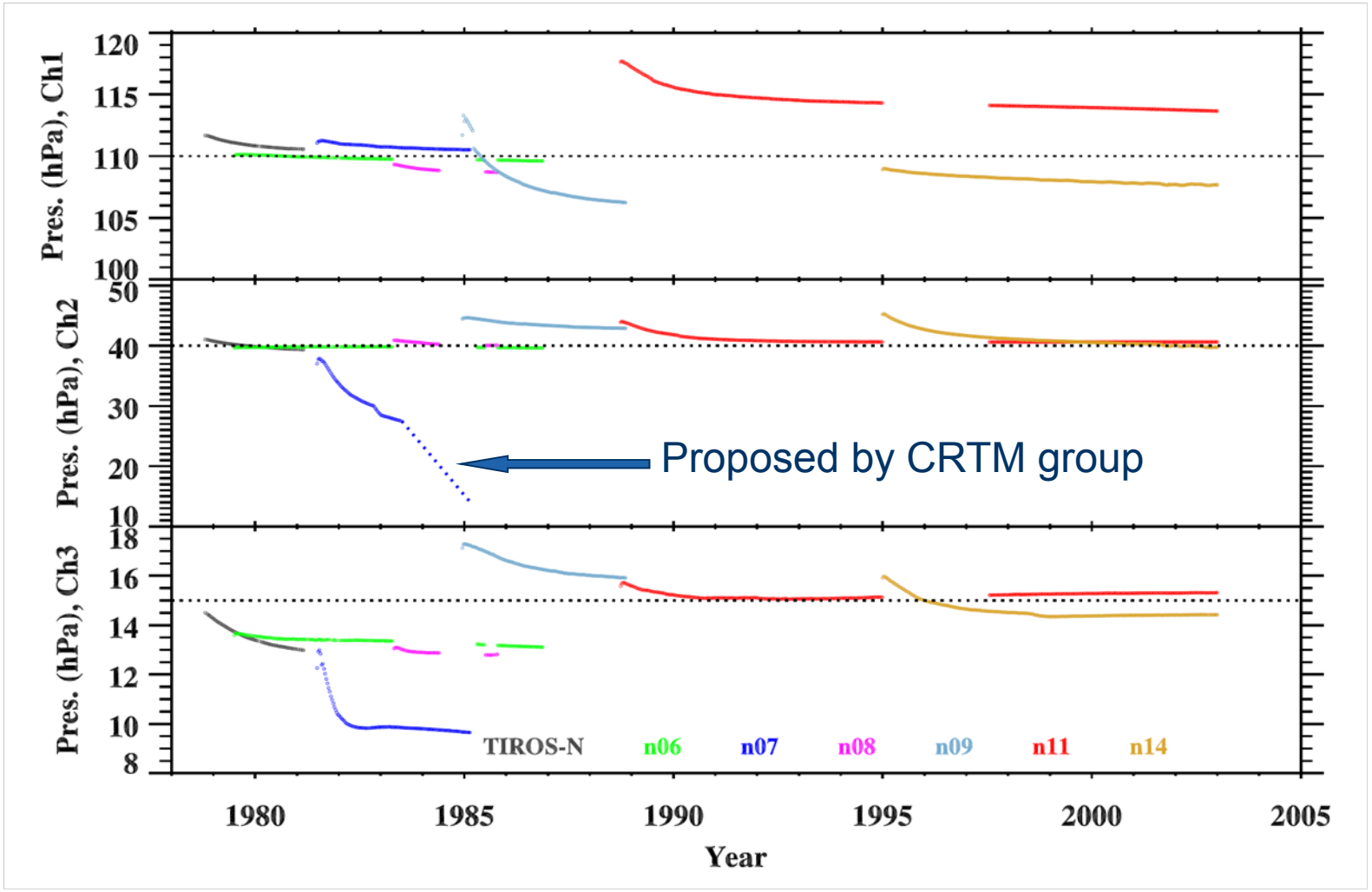
Cell pressure drift



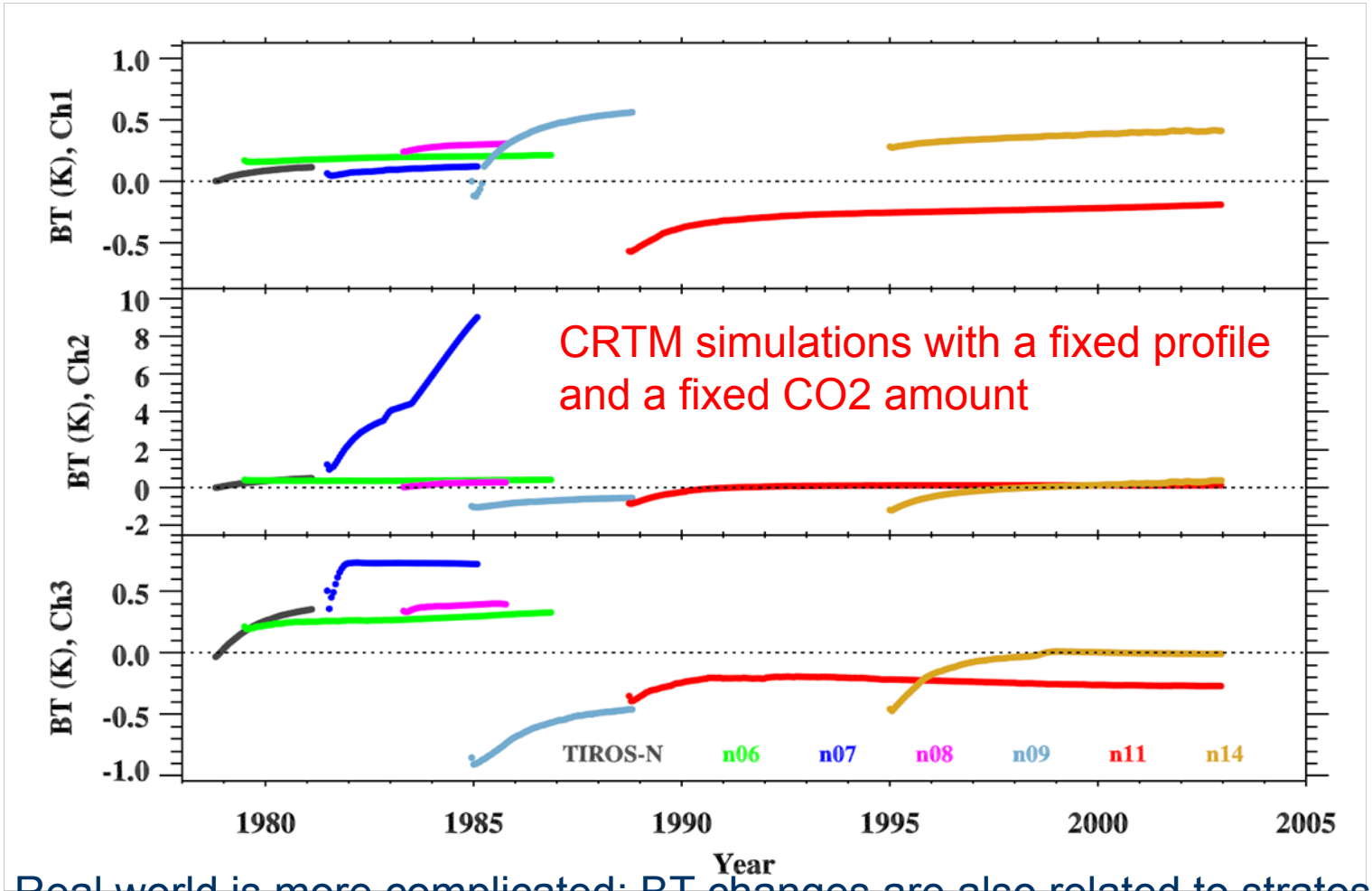
Cell pressure drift caused the change of weighing functions, resulting in the change of the measured BTs.

The change of the measured BTs is also related to the atmospheric profile.

SSU cell pressure changes in orbit



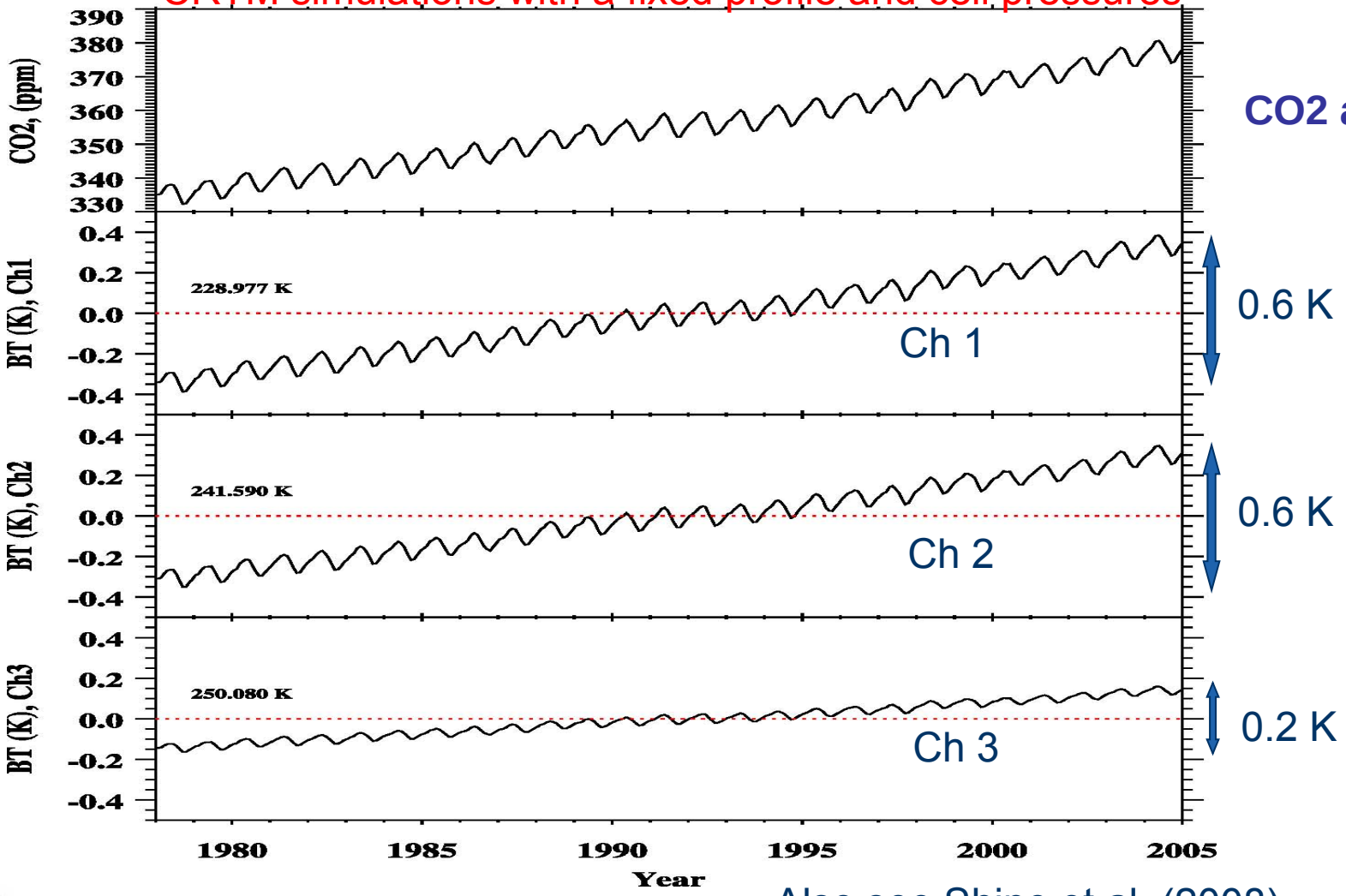
BT changes due to cell pressure drift



Real world is more complicated: BT changes are also related to stratosphere lapse rate.

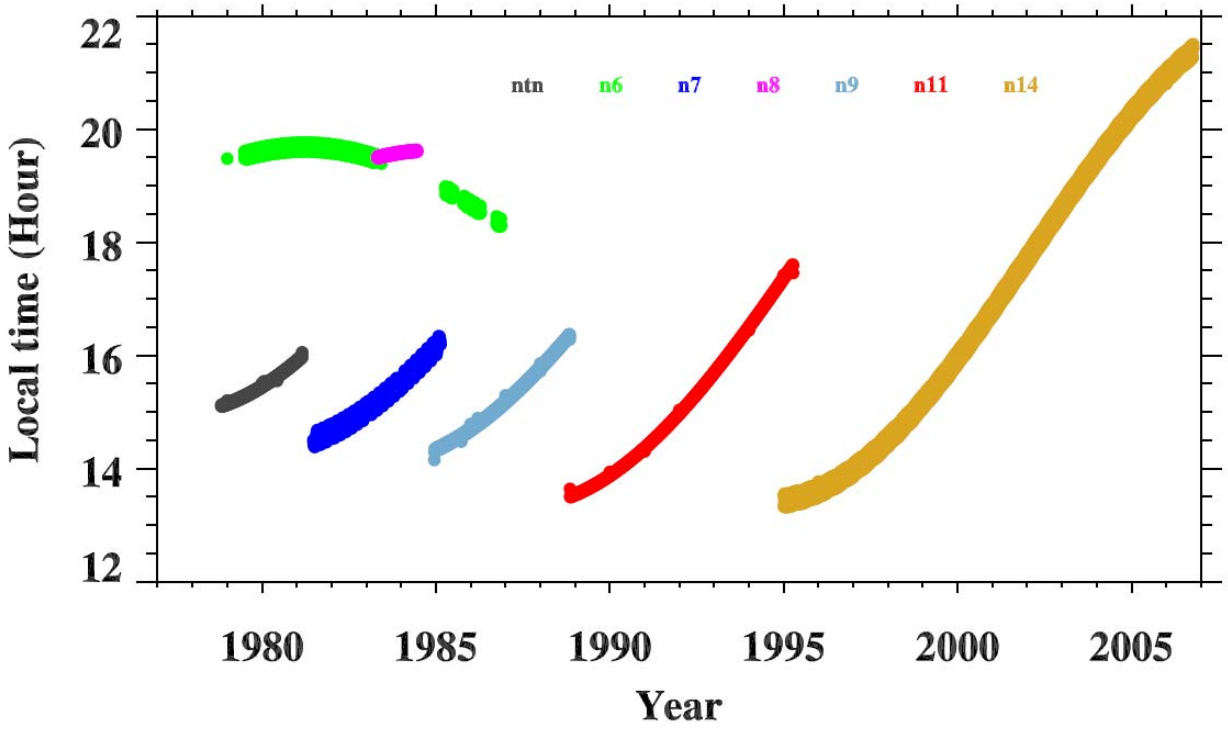
Effects of increasing CO2 amount

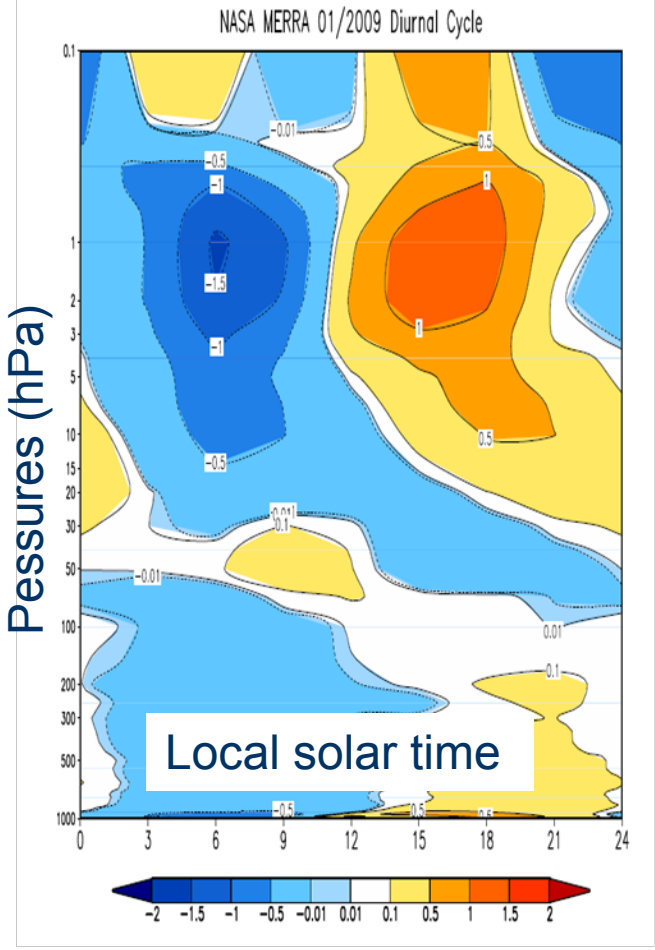
CRTM simulations with a fixed profile and cell pressures



Also see Shine et al. (2008)

Orbit drift





Stratosphere has a relatively strong diurnal cycle compared to the troposphere. Diurnal correction is important for SSU.

SSU Climate Data Records

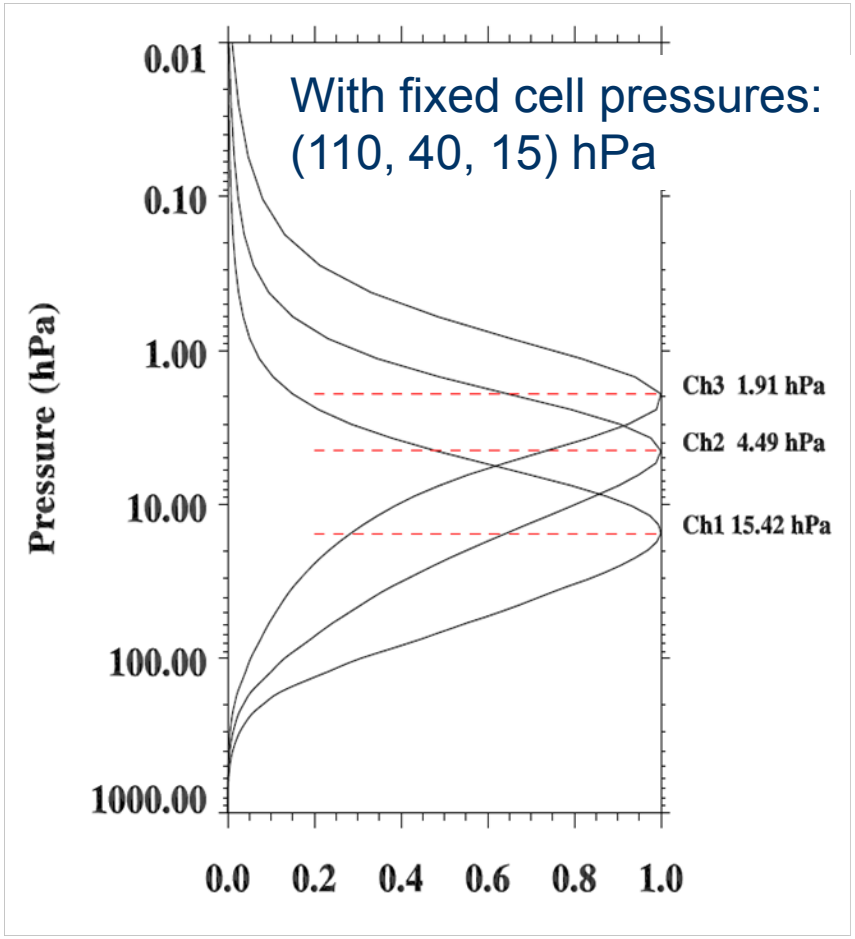
- **Final Goal: 2.5°×2.5° SSU climate data records that can be used for climate studies**

- **Procedures**
  - **Cell pressure correction**
    - See the Earth through a CO2 cell with constant pressures
  - **CO2 amount correction**
    - Correct CO2 increasing effects
  - **Diurnal cycle correction**
    - See the Earth at the same local time
  - **Limb correction**
    - See the Earth at the same view angle (like nadir)
  - **Other correction**
    - Instrument difference (plan to use the SNO observations)

Cell pressure correction

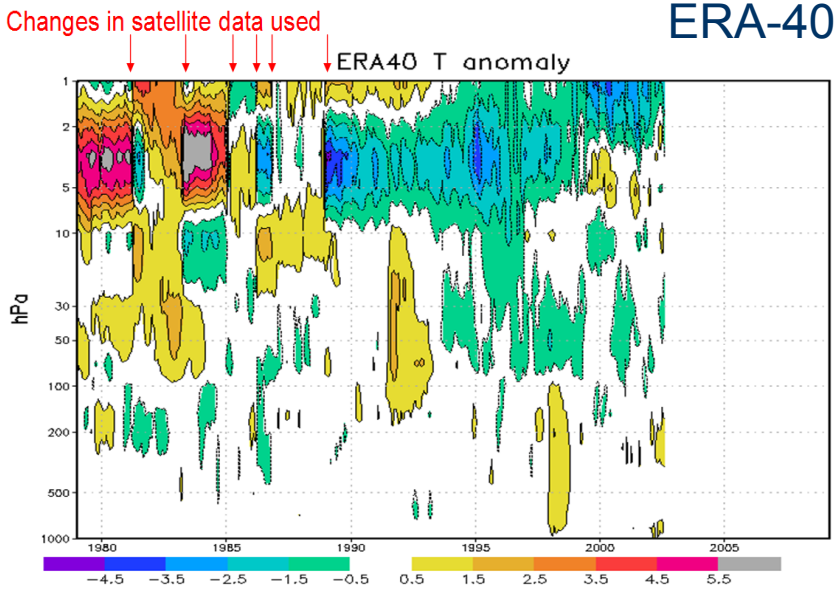
- **Step 1: Interpolate the reanalysis field at each SSU pixel to retrieve the atmospheric conditions for each SSU observations**
- **Step 2: Using CRTM to simulate the two radiances:**
  - R: SSU radiances with real cell pressures
  - R_0: SSU radiances with fixed cell pressures
- **Step 3: Pixel level corrections**
  - Correction term $\Delta R = R - R0$
  - Corrected SSU radiances

    $O_{new} = O_{real} - \Delta R$



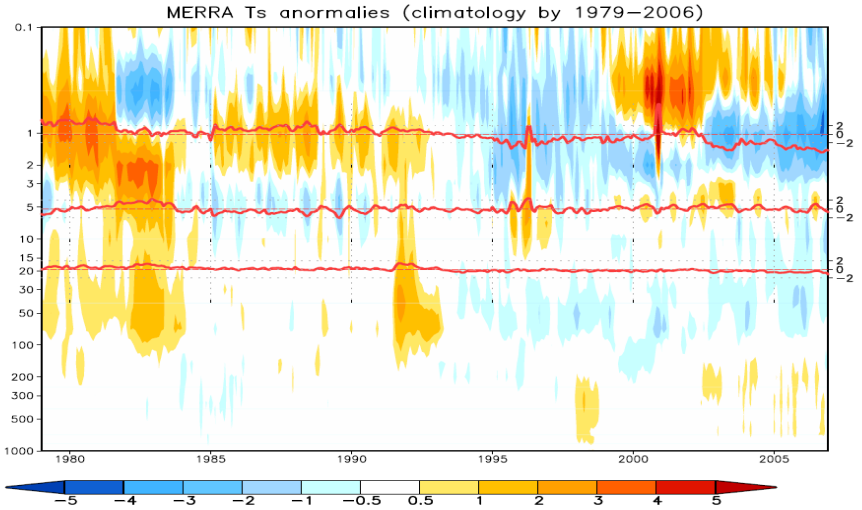
ERA40 / CFSR / MERRA

ERA-40

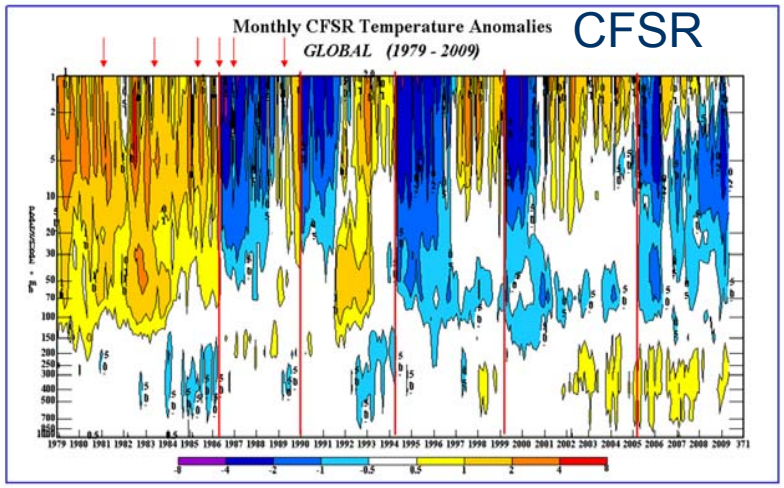


No apparent changes in satellite data used, BUT Big inter-stream jumps!

MERRA



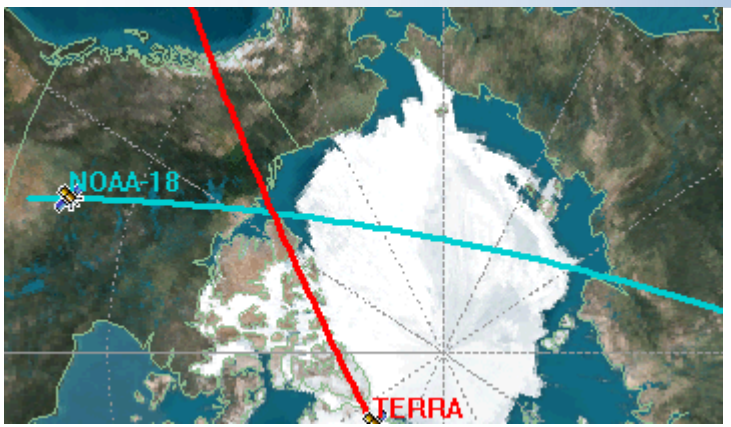
CFSR



NO big jumps between satellites and streams in MERRA

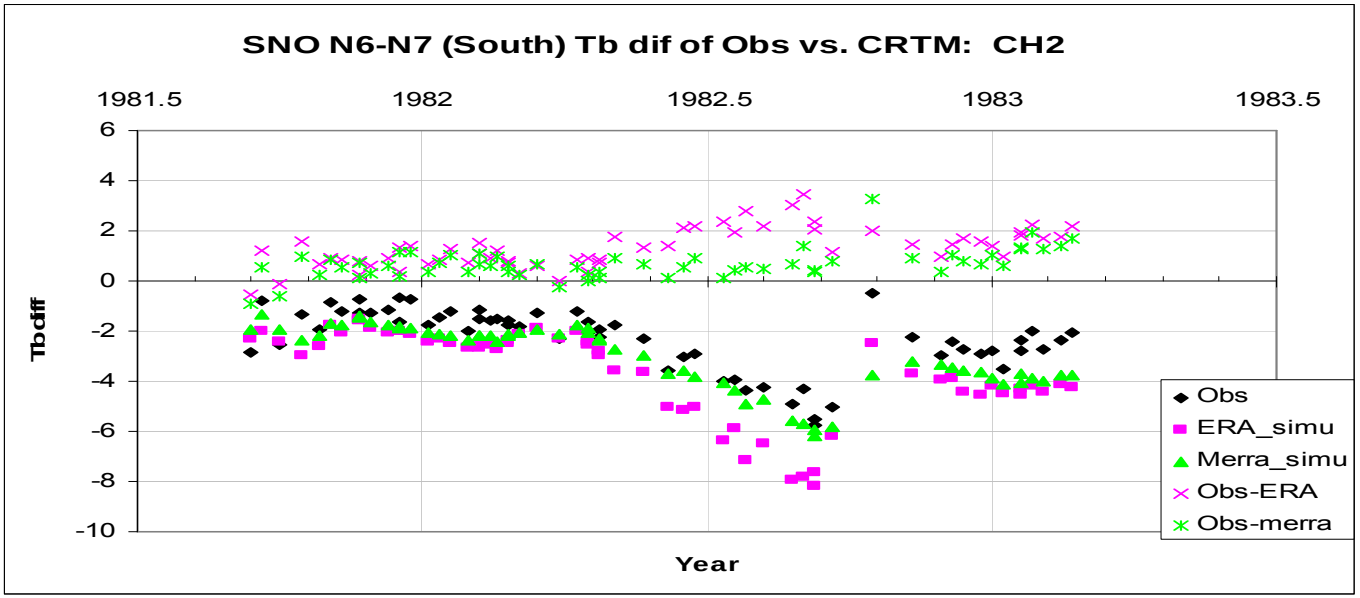
Courtesy of Craig Long

MERRA versus ERA-40 for SNO cases



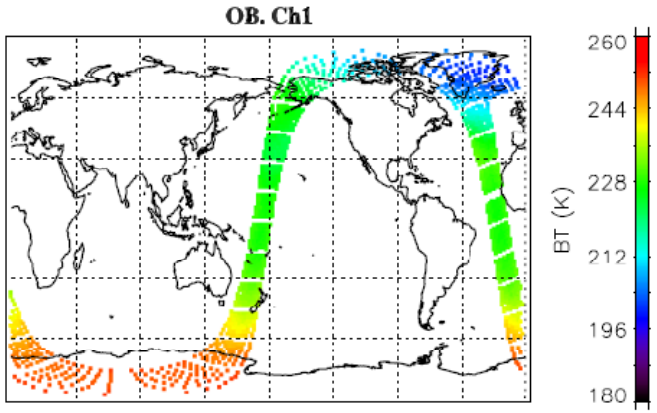
SNO – every pair of POES satellites with different altitudes pass their orbital intersections within a few seconds regularly in the polar regions.

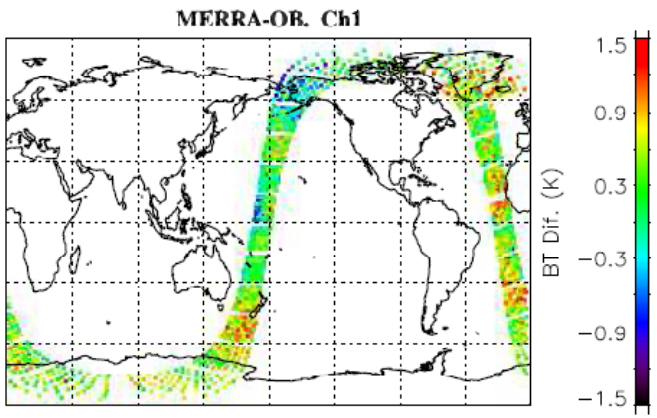
Using MERRA and ERA-40 as inputs to simulate the SNO bias between NOAA-6 and -7 channel 2



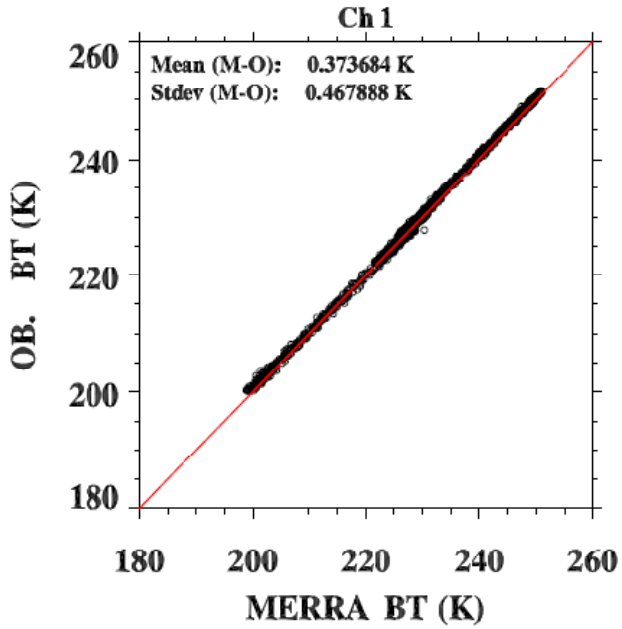
MERRA can well characterize the SNO inter-satellite bias.

CRTM for SSU

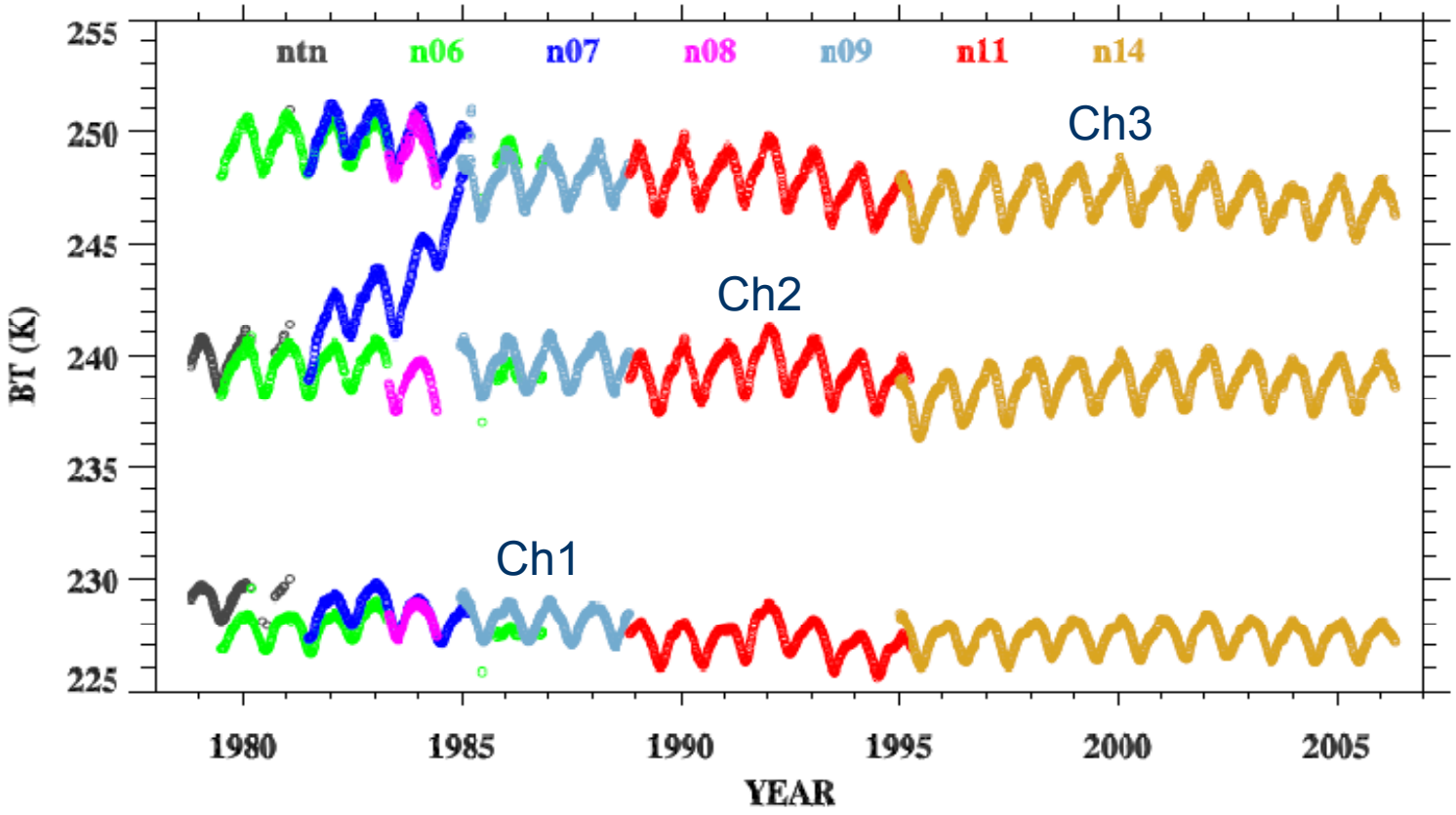




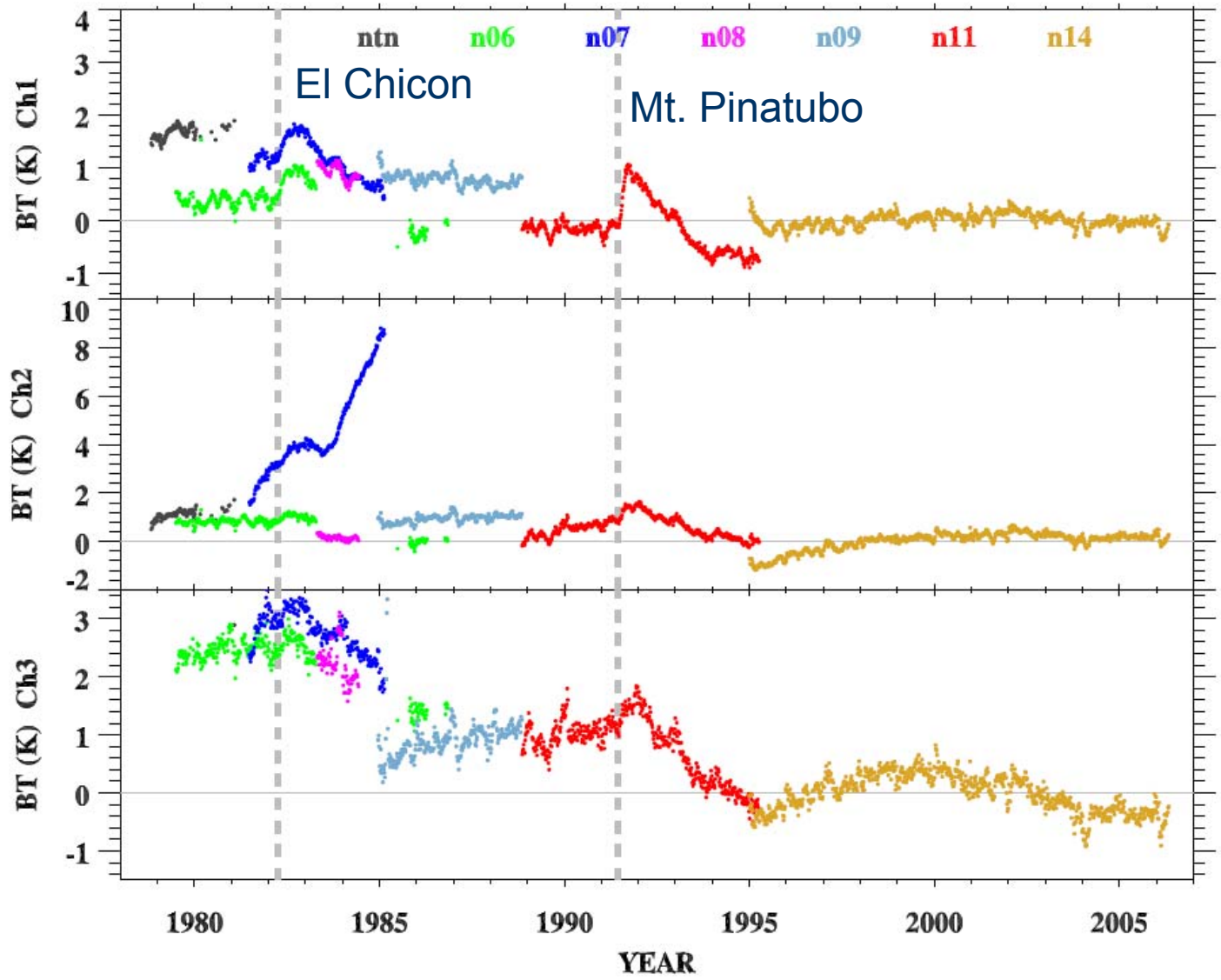
NOAA/NESDIS/STAR has developed a capability to simulate SSU that can account for the effects of variation of cell pressures.



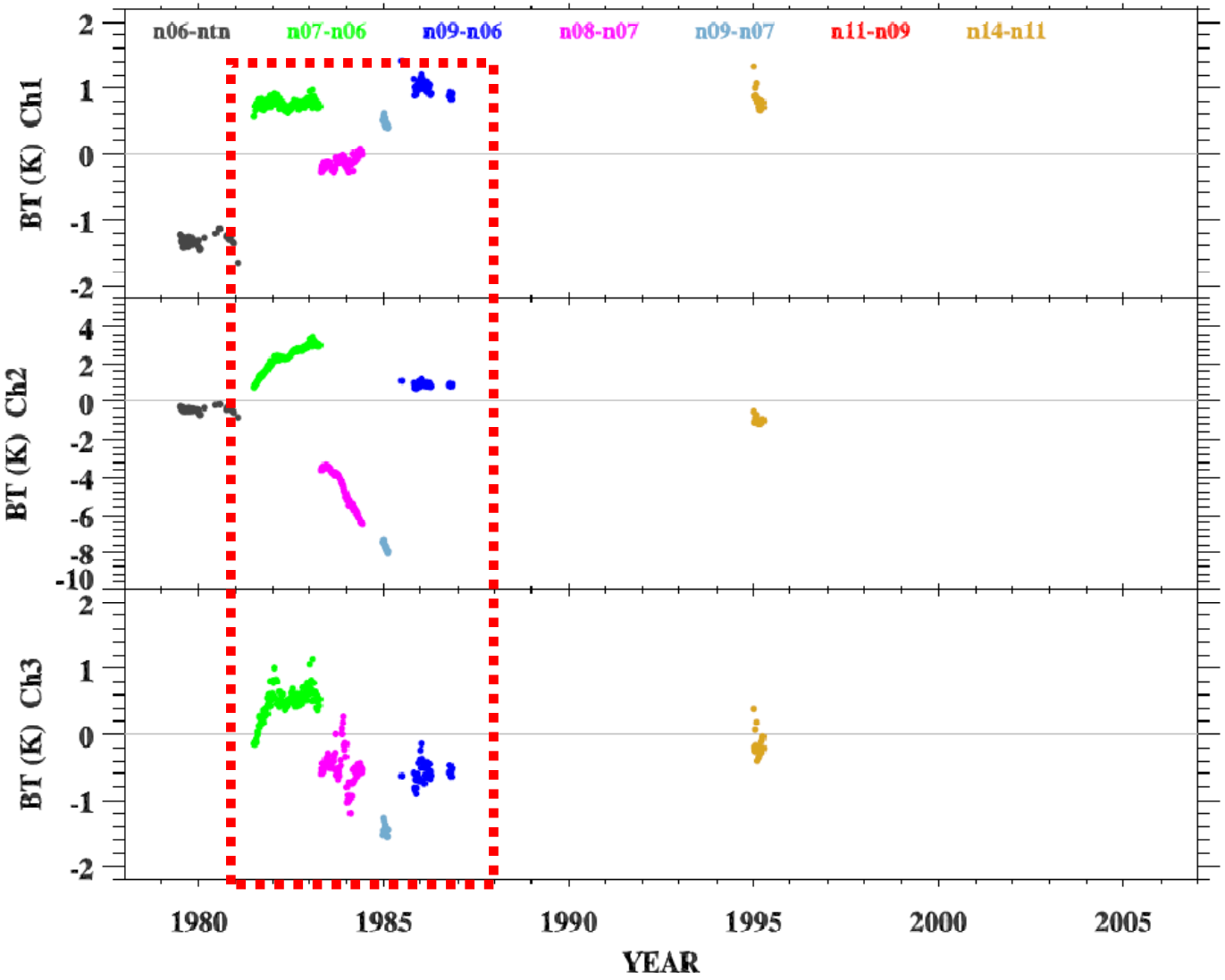
SSU Time series



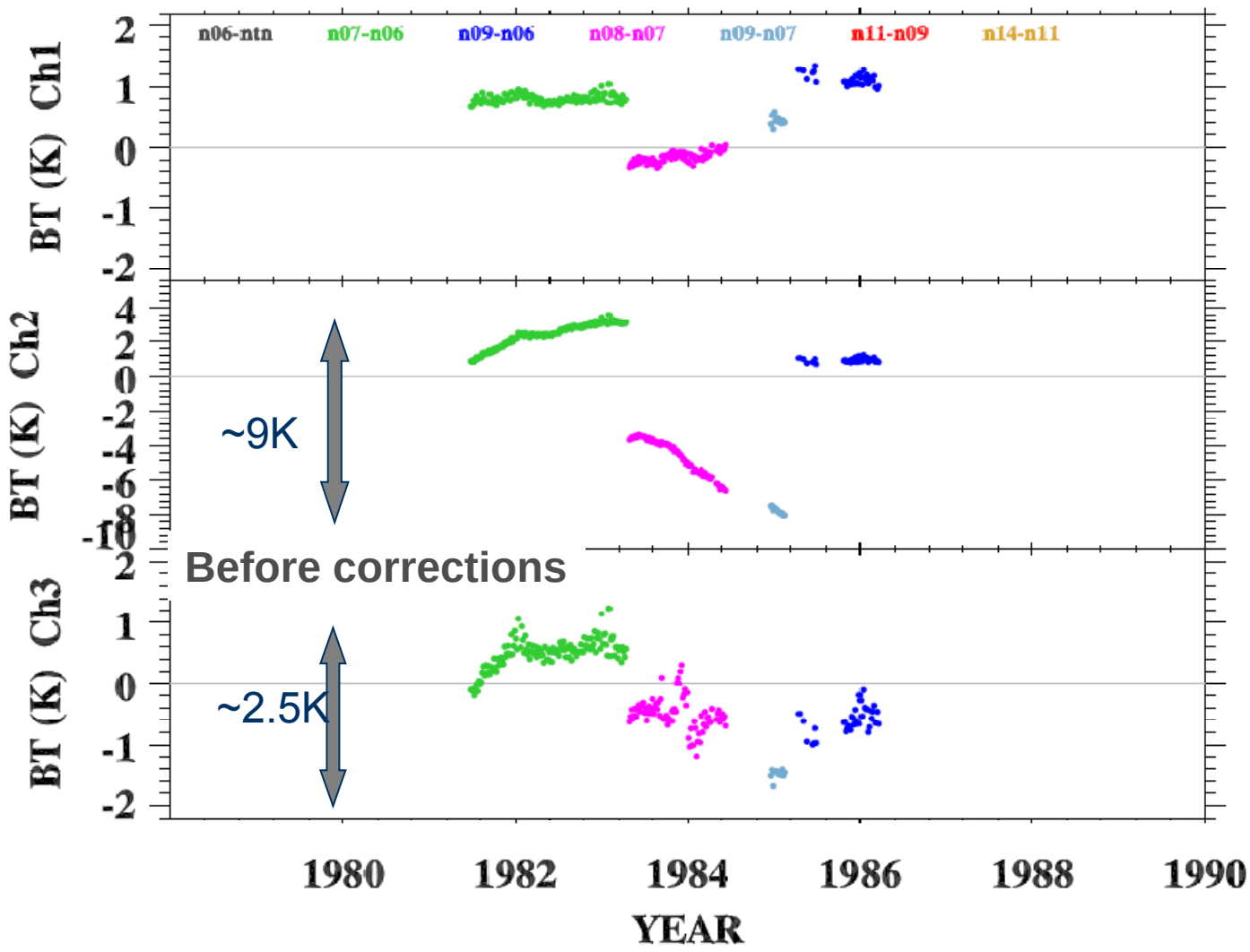
After removing seasonal signal



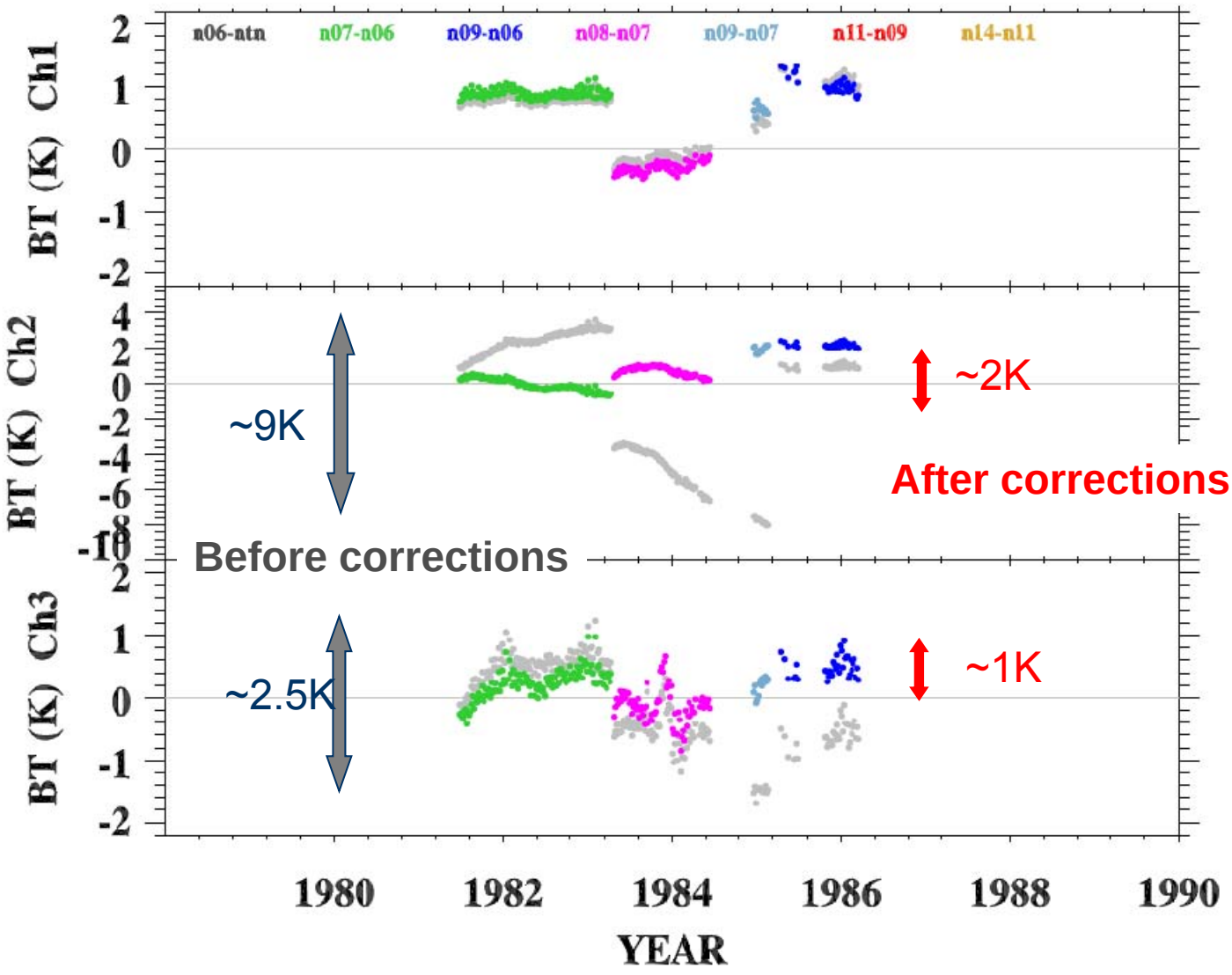
Inter-satellite bias



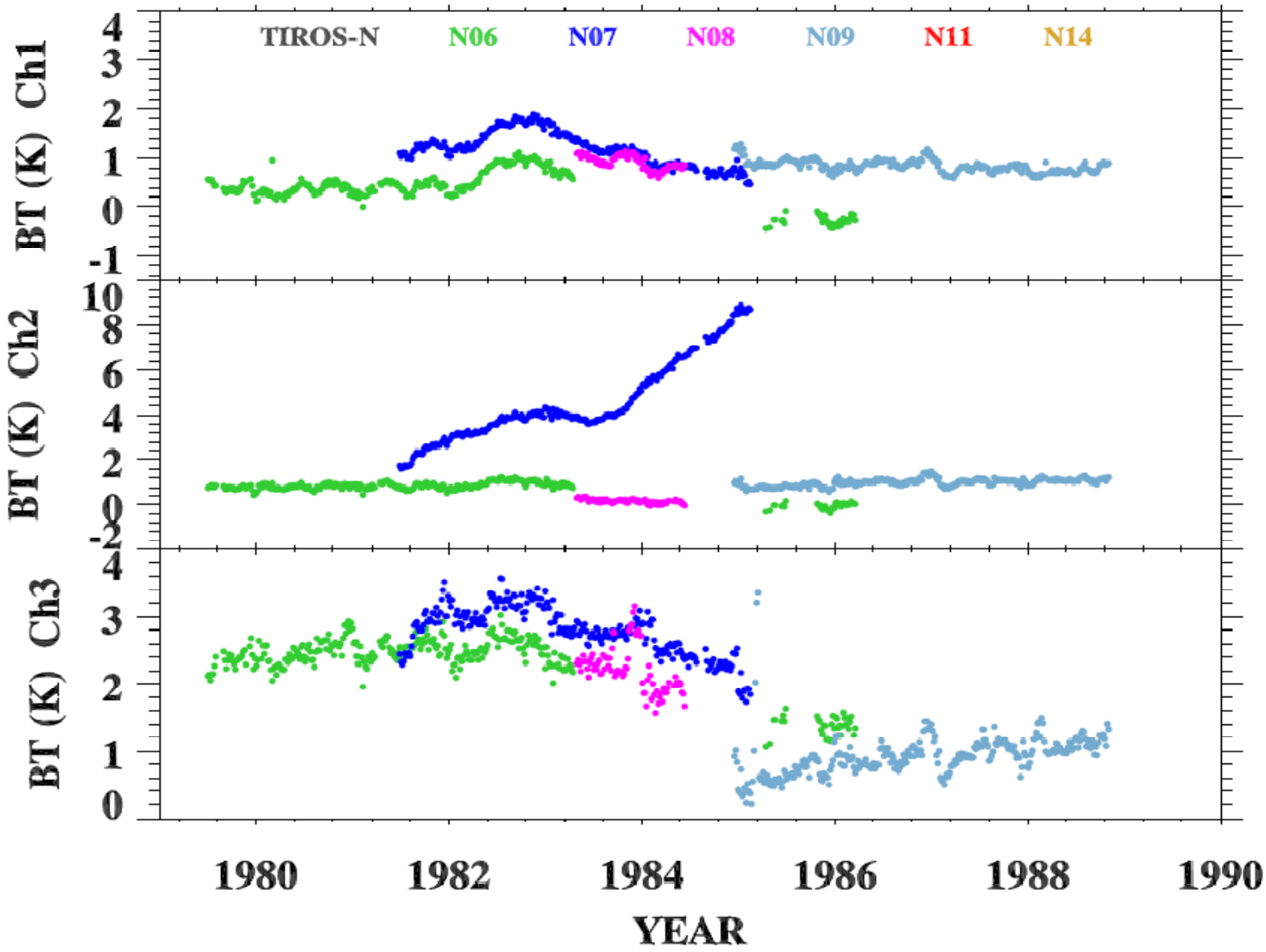
Inter-satellite bias before correction



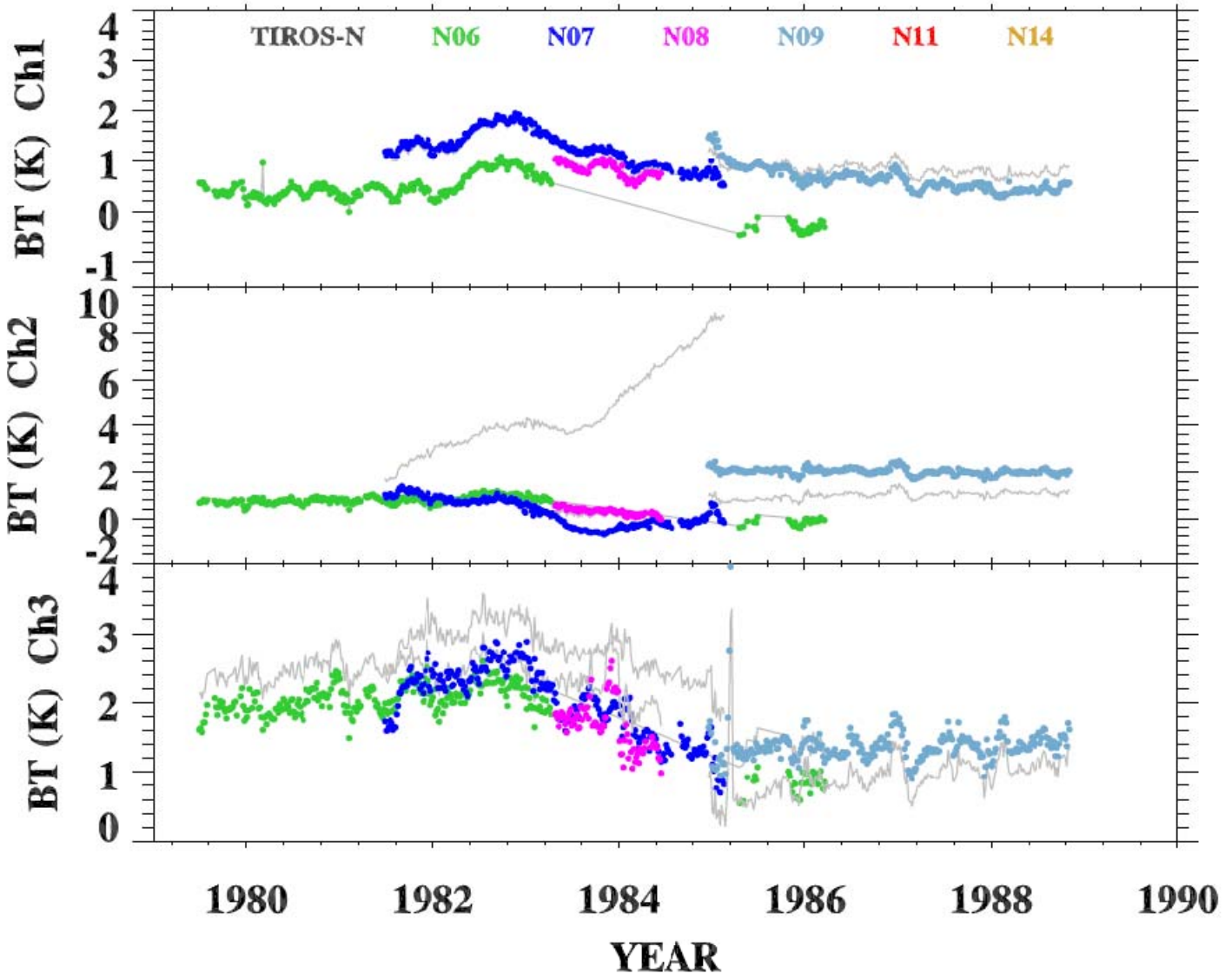
Inter-satellite bias after correction



Time series before correction



Time series after corrections



Conclusions

- The historic SSU dataset is important for climate studies.
- While it is challenging, we are making efforts to develop the SSU CDR.
- Progress has been made to successfully reduce the effects caused by the CO2 cell pressure leak.
- It is expected to release the first version of SSU CDR before December 2010.


Thank You !