Satellite Measurements of Atmospheric Temperature Change: New Results from Old Satellites

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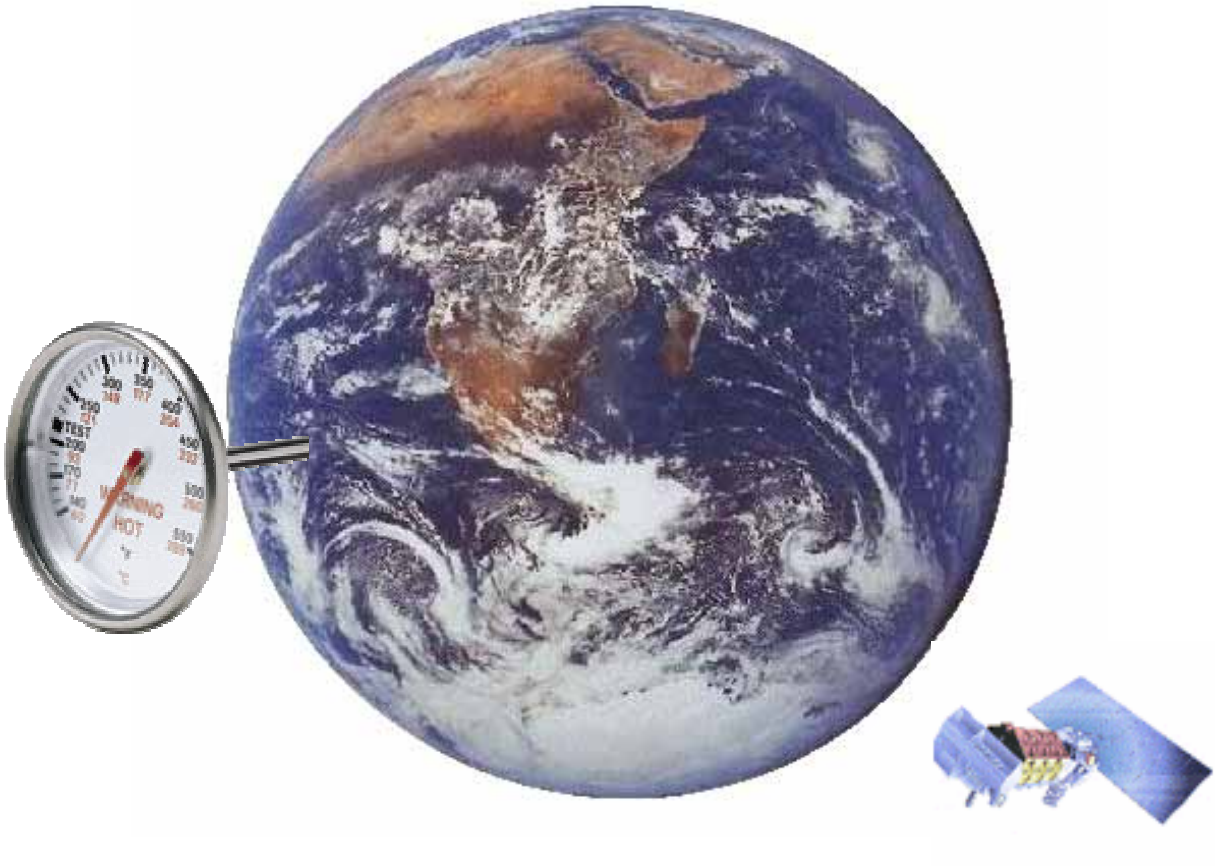


What do satellite measurements add to this debate?

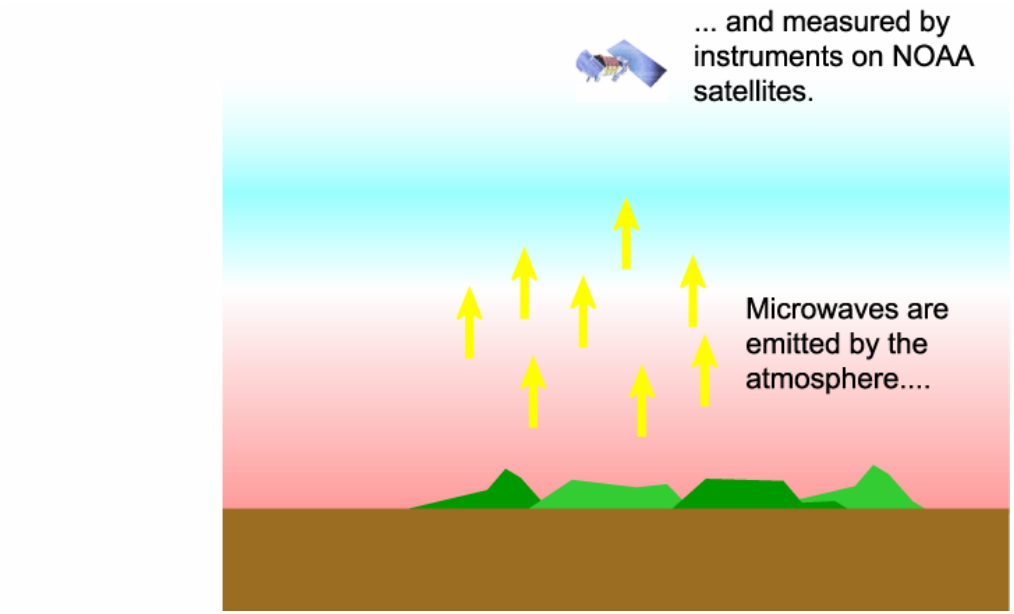
Global Coverage on a daily time scale

Each day, about 80% of the globe is measured.
Weather balloons only make measurements at specific locations, these are concentrated on land.

Fewer Instruments to Understand

The satellite data record since 1979 only involves 11 instruments – this limited number of instruments may make it possible to understand each instrument's characteristics in enough detail to correct for any errors that may be present.

What do microwave sounders measure?

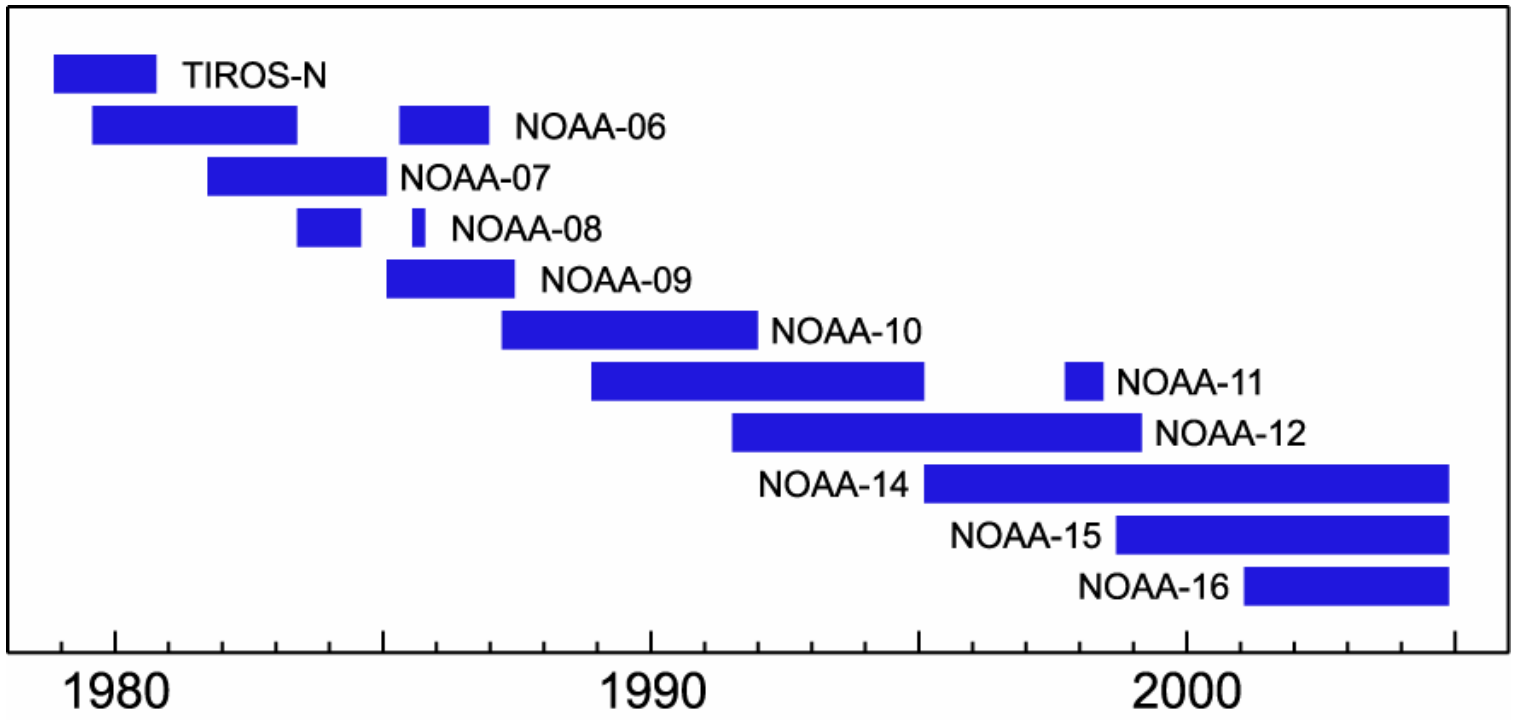


Higher temperatures >>> more microwave power.

By choosing different microwave frequencies, different layers in the atmosphere can be measured.

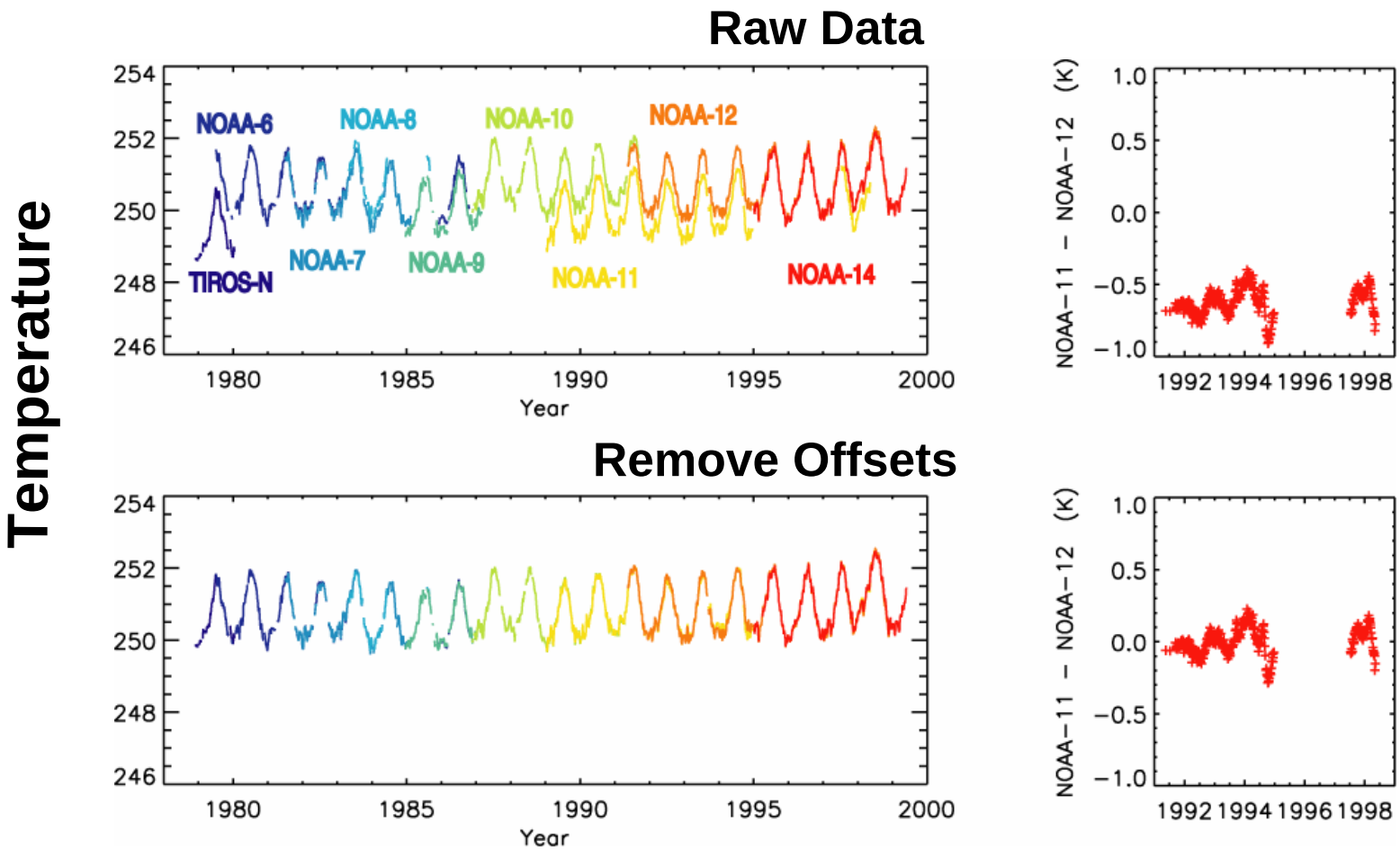
In this presentations, we will be discussing measurements of the temperature of the lowest 5 miles of the atmosphere.

11 different NOAA satellites since 1979

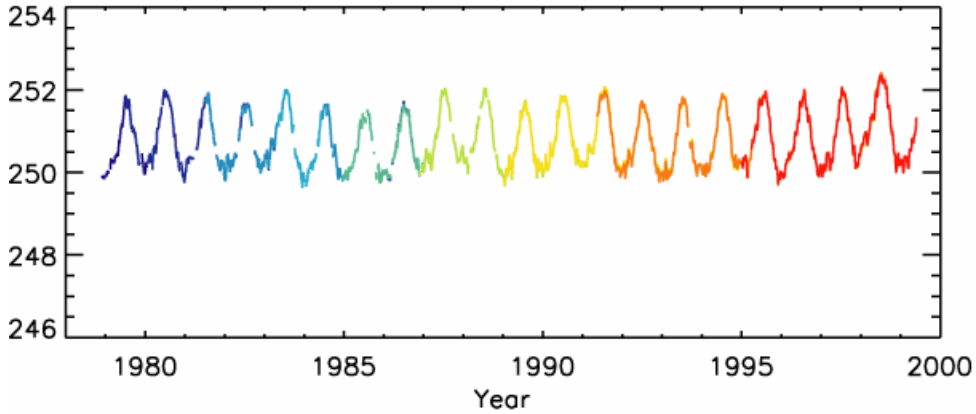


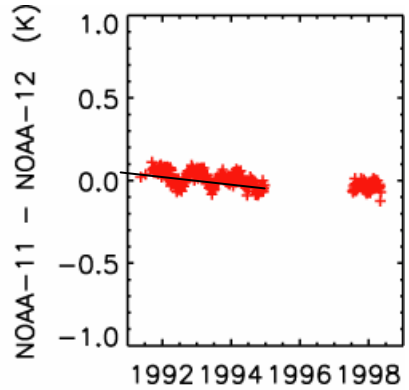
Different Satellites – Different Calibration
What to do? Focus on overlap periods

Cross-calibrate by comparing measurements of the globally averaged temperature

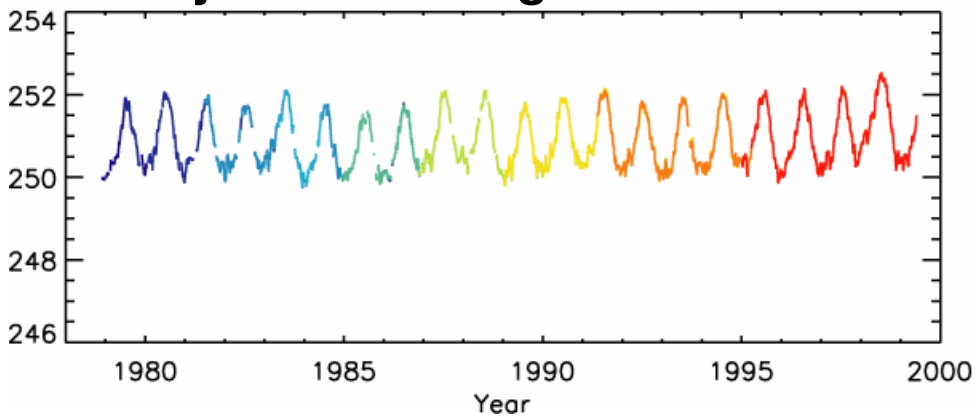


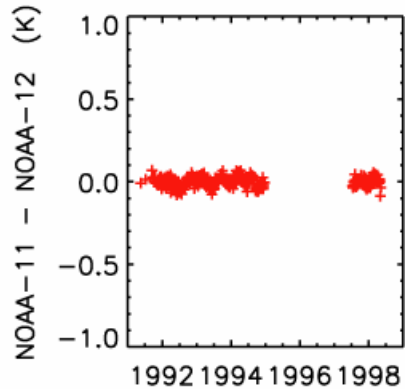
Adjust for drifts in satellite temperature





Adjust for changes in measurement time

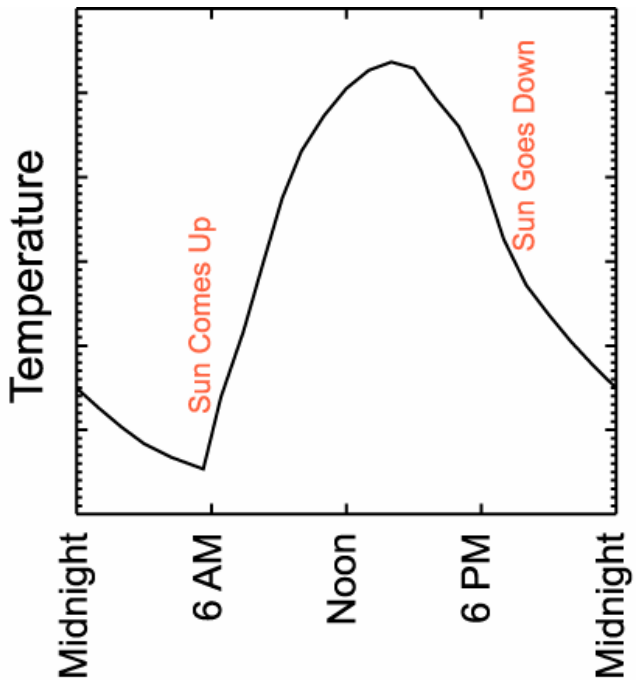




Adjustments for the changes in measurement time are the focus of the rest of my presentation

Changes in temperature with time of day "diurnal cycle"

Typical diurnal cycle
at ground level



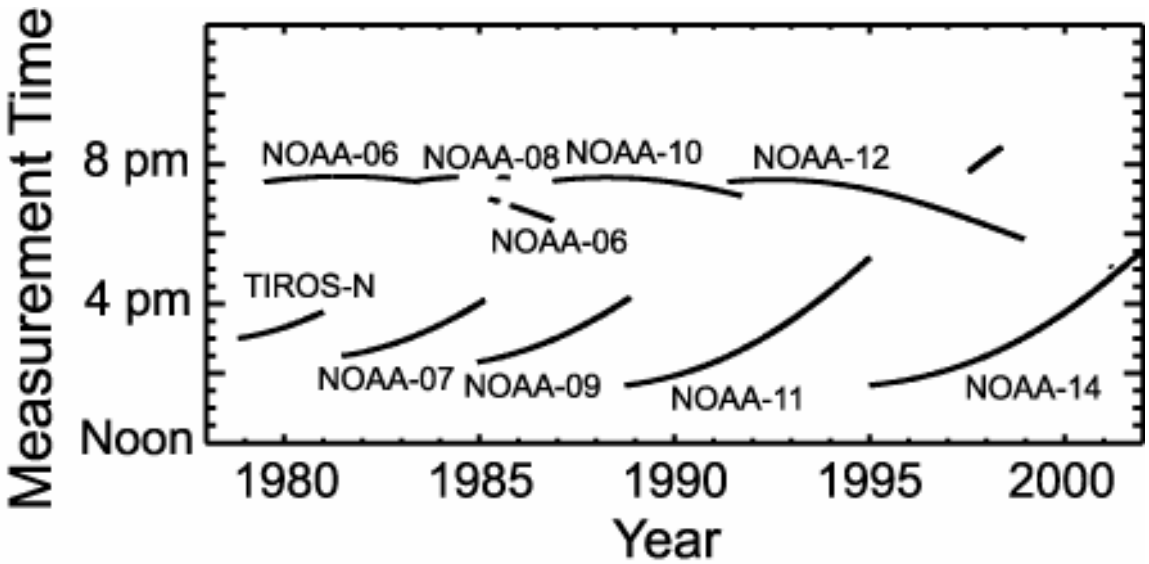
Diurnal cycle is similar, but smaller higher in the atmosphere.

Weather models, weather balloons, and satellite measurements are in rough agreement about the shape and size of the diurnal cycle in the troposphere.

Drifts in satellite measurement time

The time of day at which satellite observations were made slowly drifts.

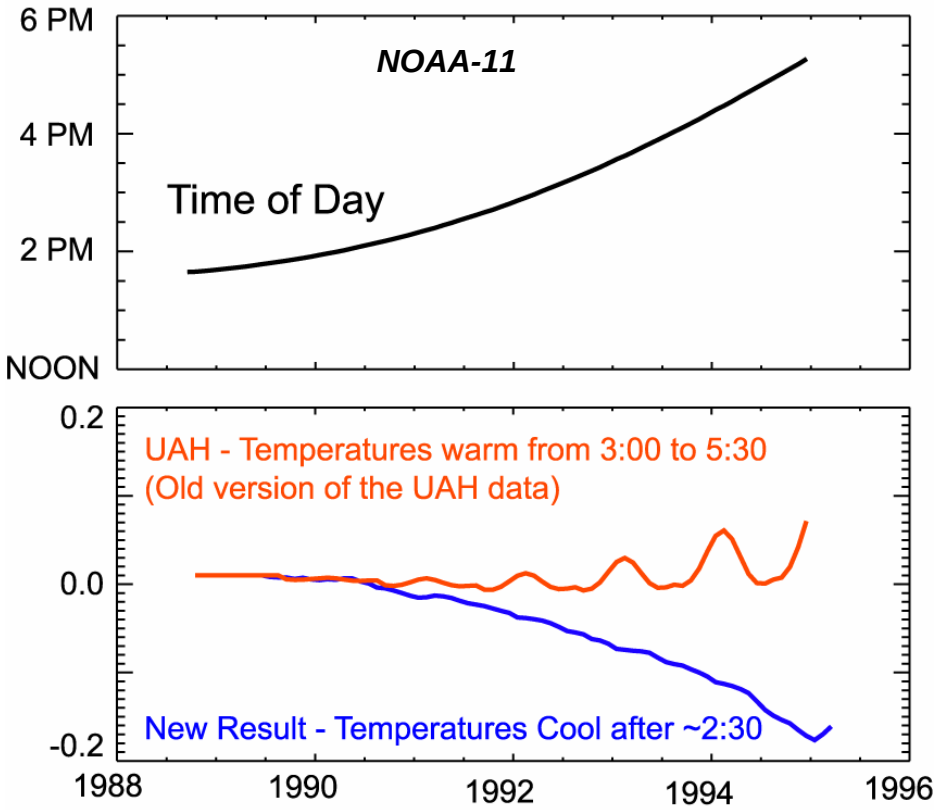
If an adjustment is not made for this, an artificial trend will be present in the data.



Earlier in the afternoon: warmer

Later in the afternoon: cooler

Diurnal adjustments



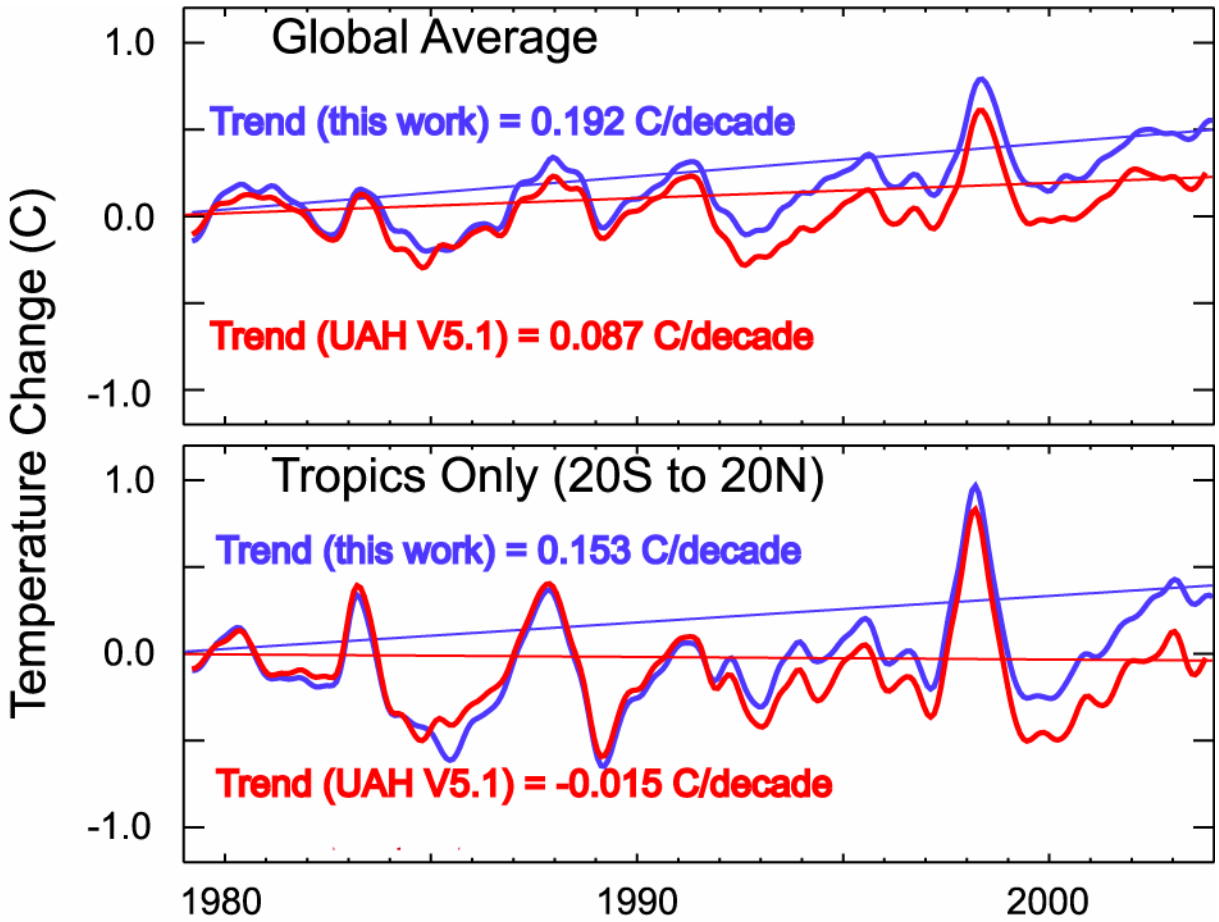
The UAH diurnal adjustment was deduced from the satellite measurements – their method contained a mathematical error, as well as being very sensitive to small changes in the attitude of the satellite.

Our new method is based on output from a numerical weather model, and is in agreement with weather balloon data.

Since this effect needs to be ***subtracted*** from the data, the new result will result in a warmer temperature trend when applied to all the satellites.

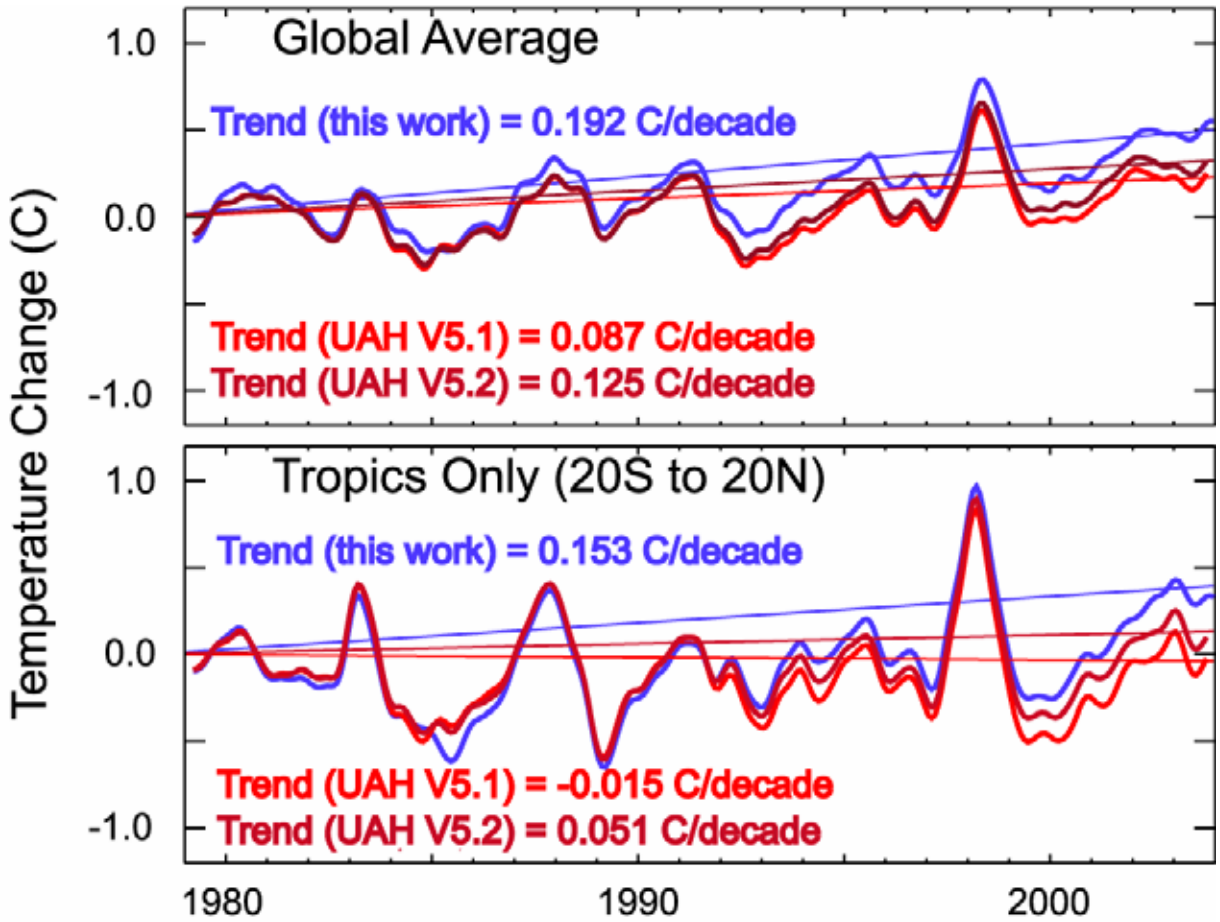
The UAH team agrees than this version of their diurnal adjustment is incorrect – they have now calculated a new diurnal adjustment using a completely different method.

Impact of the new diurnal adjustment

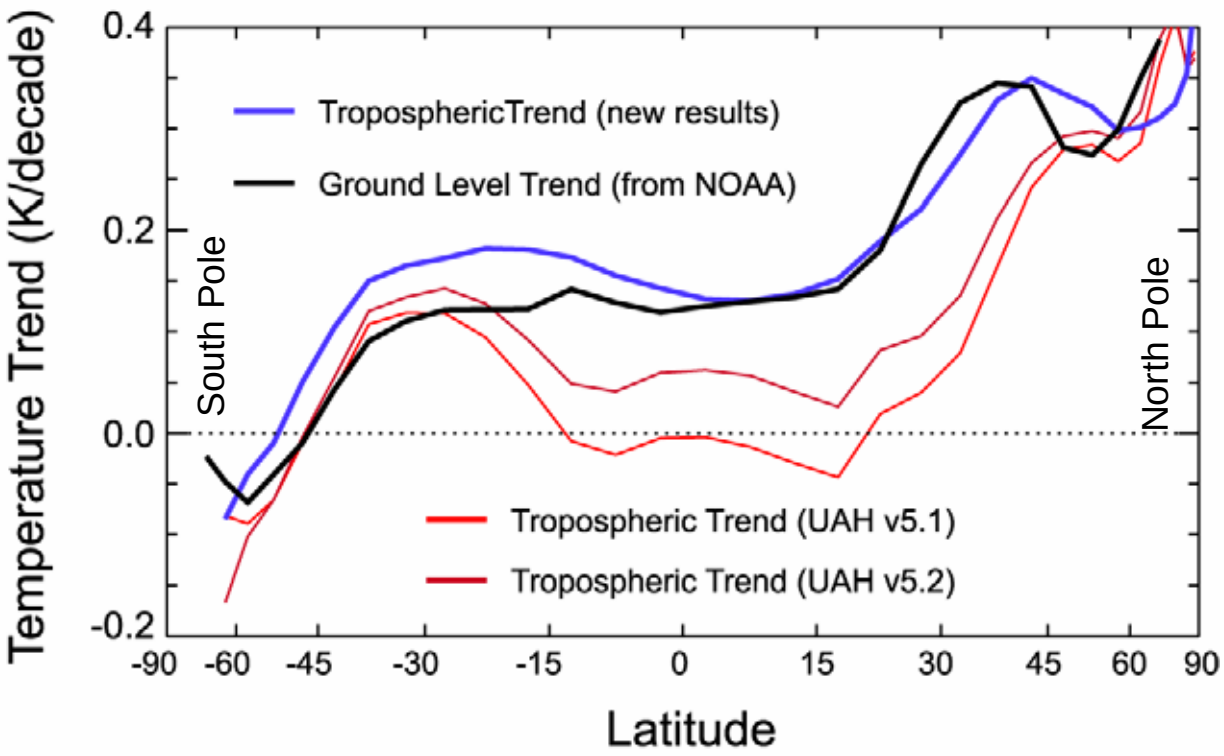


Impact of the new diurnal adjustment

(New UAH Results included)



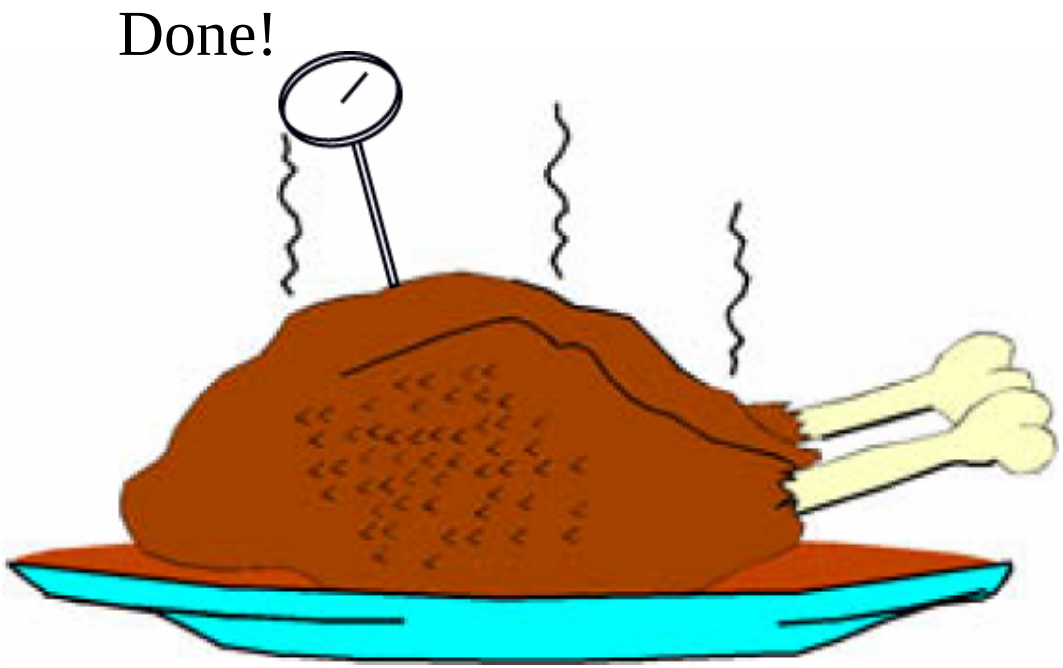
Dependence of Trends on Latitude (1979-2003)



New results are in better agreement with trends measured at the surface

In the tropics, trends in the troposphere are slightly larger than those at the surface, as expected

The tale of two thermometers



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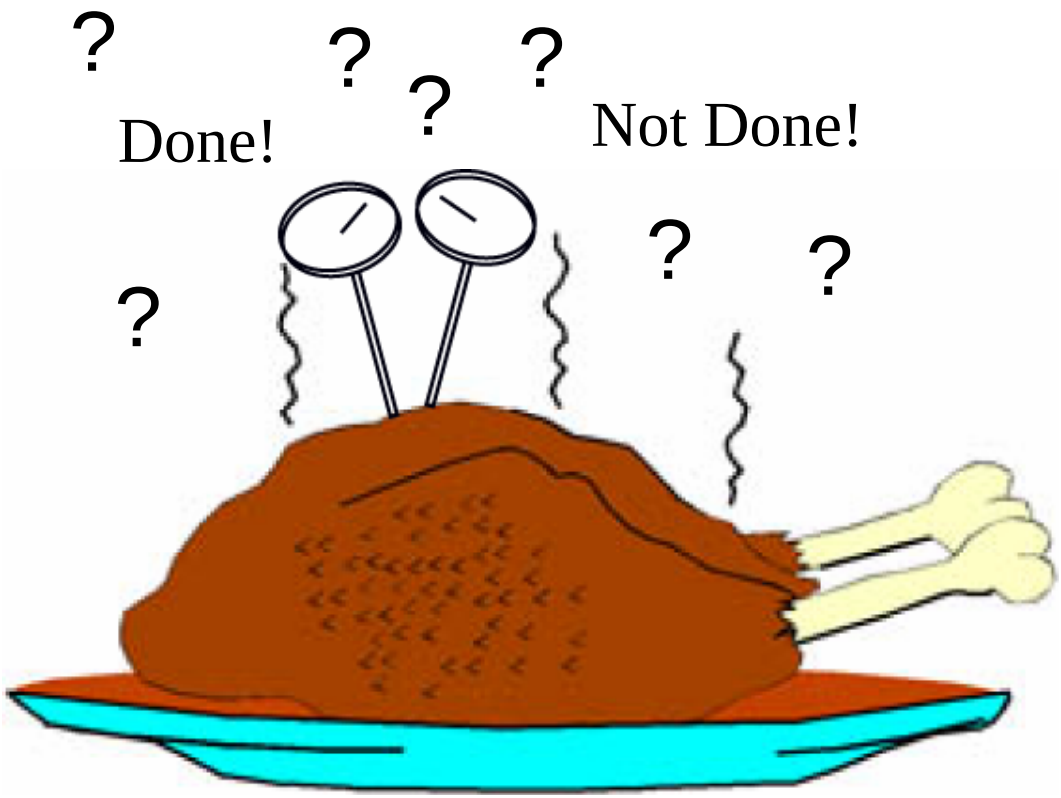

Conclusions

Trends in the satellite data are very sensitive to the details of the method used to “construct” the data set.

The size of this “construction” uncertainty only becomes apparent when two or more versions of the same dataset are available

Our new version is in better agreement with the observed warming of the surface, and physical arguments about warming of the troposphere.