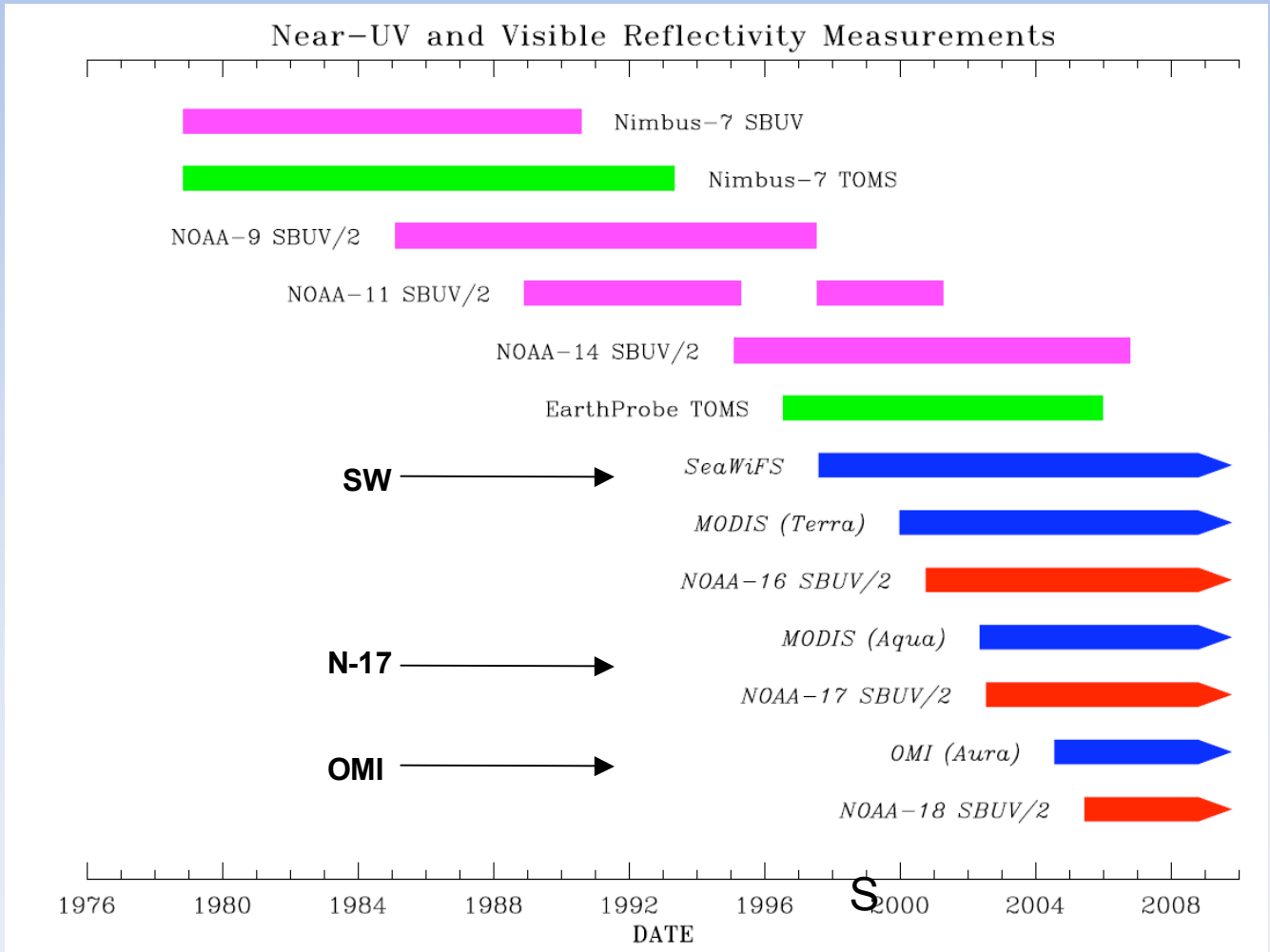
Earth Surface and Atmospheric Reflectivity ESDR Since 1979 from Multiple Satellites (TOMS, SBUV, SBUV-2, OMI, and SeaWiFS)

Jay Herman Gordon Labow Wenhan Qin
Jianping Mao Liang-Kang_Hhuang
David Larko Maria Tzortziou

Timeline for 13 UV and Visible Satellites for Reflectivity

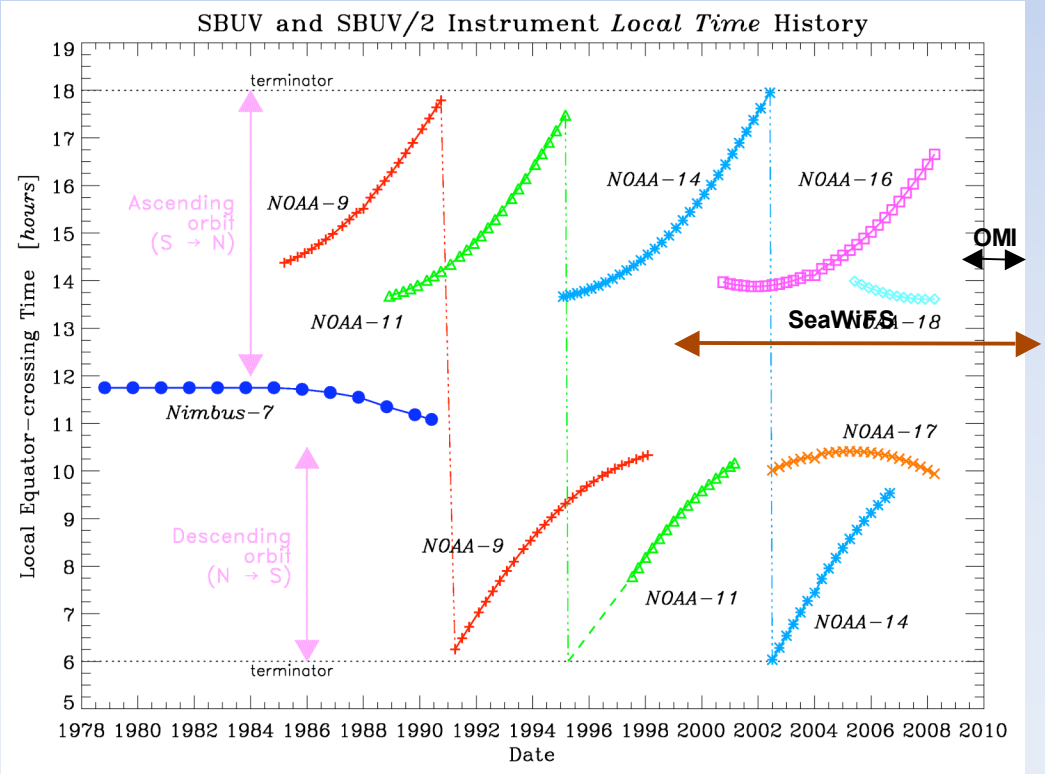
What are we doing? 1. Joining data sets



10 Satellites for Combined Reflectivity Data Set

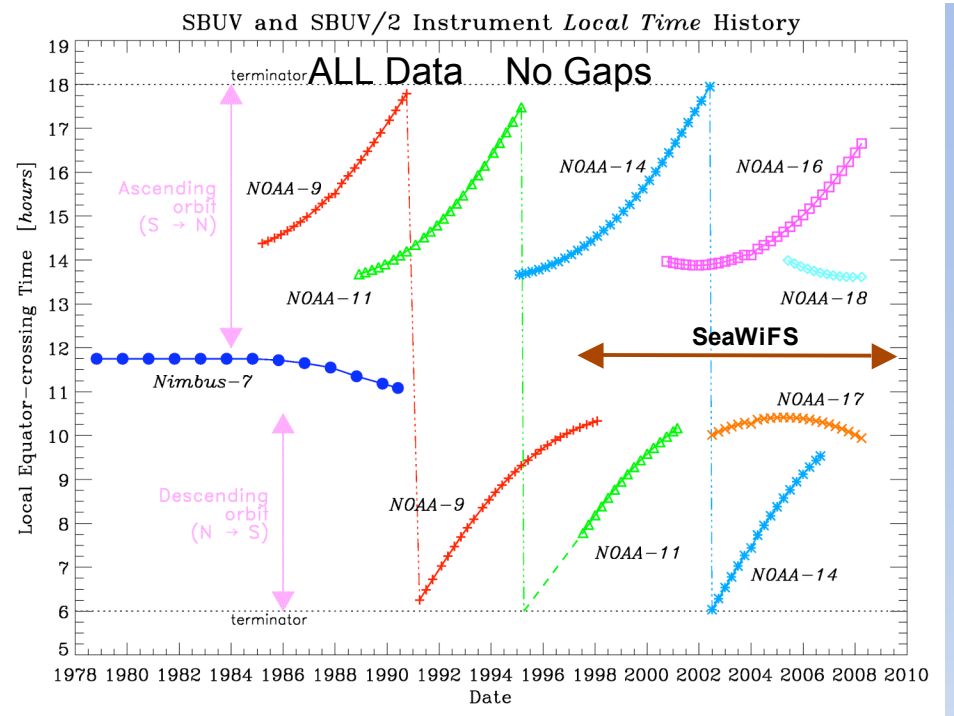
2. Finding a Common Calibration

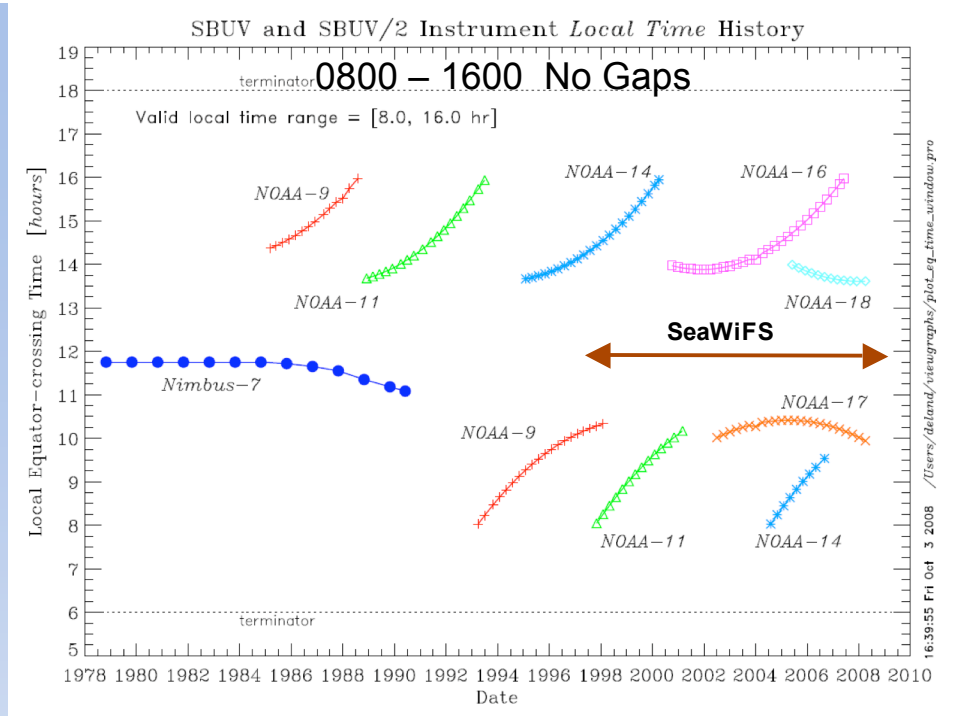
1	TOMS/SBUV 1979 – 1992	Two Instruments	340nm
2	SBUV-2 Series (see Chart)	Six Instruments	340 nm
3	SeaWifs 1997 to Present	One Instrument	412 nm
4	OMI 2006 to present	One Instrument	300 – 500 nm

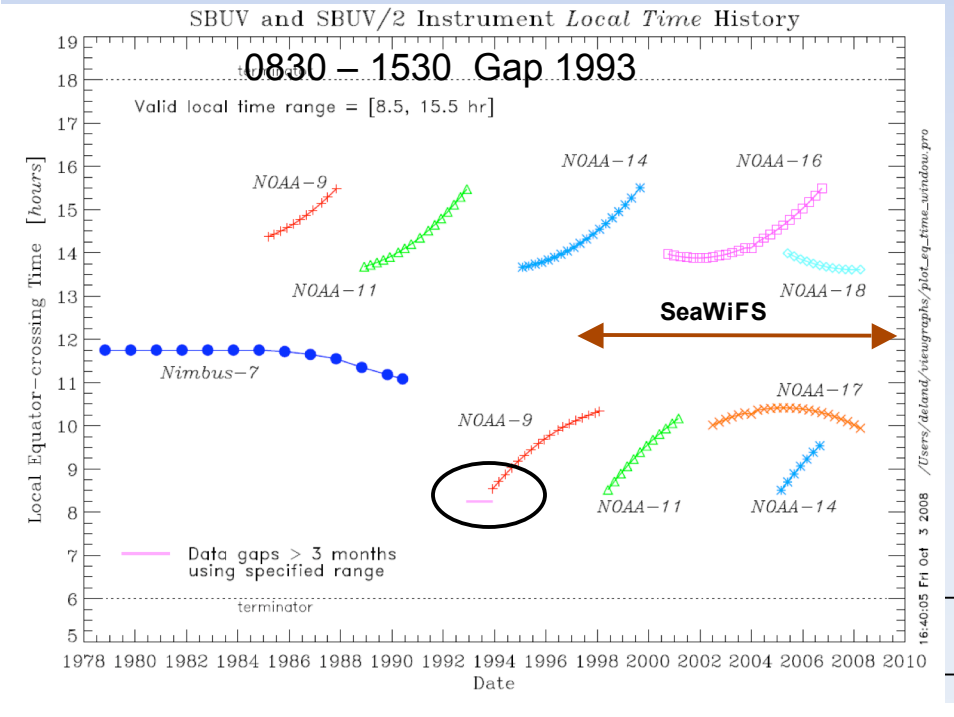


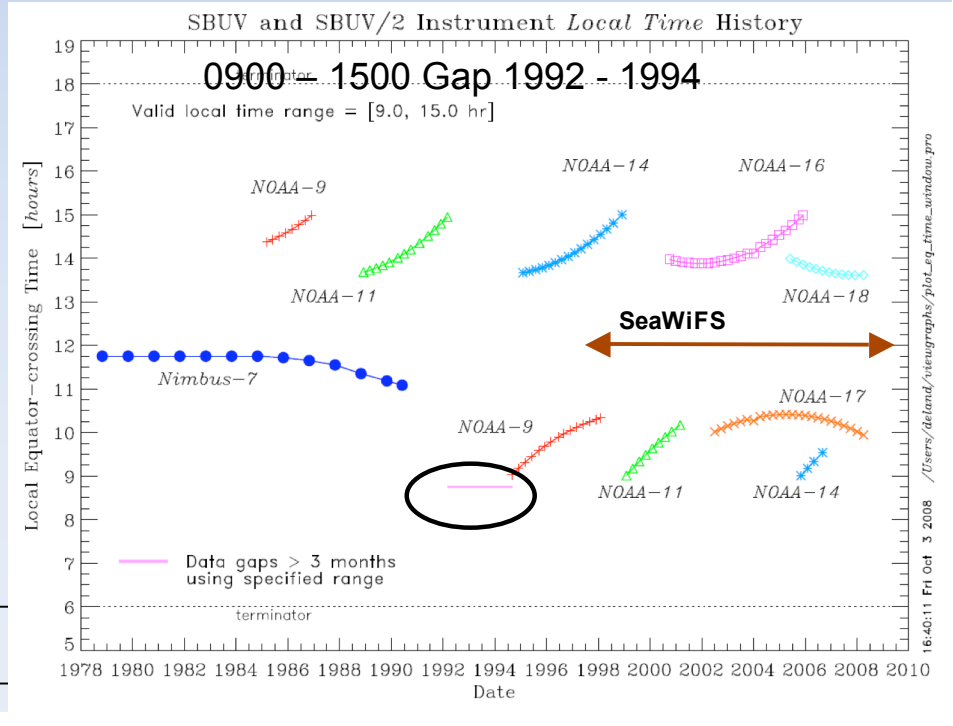
Problems:

- We need a common calibration as a function of latitude.
- SeaWiFs measures at 412 nm instead of 340 nm
- OMI is a spectrometer 300 – 500 nm, which can be used to relate 340 nm reflectivity to 412 nm reflectivity.


SBUV and SBUV/2 Instrument Local Time History
ALL Data No Gaps
terminator
Ascending orbit (S → N)
Descending orbit (N → S)
NOAA−9
NOAA−11
NOAA−14
NOAA−16
NOAA−18
NOAA−17
Nimbus−7
SeaWiFS
Local Equator−crossing Time [hours]
Date


SBUV and SBUV/2 Instrument Local Time History
0800 – 1600 No Gaps
Valid local time range = [8.0, 16.0 hr]
terminator
NOAA−9
NOAA−11
NOAA−14
NOAA−16
NOAA−18
NOAA−17
Nimbus−7
SeaWiFS
Local Equator−crossing Time [hours]
Date
16:39:55 Fri Oct 3 2008 /Users/deland/viewgraphs/plot_eq_time_window.pro

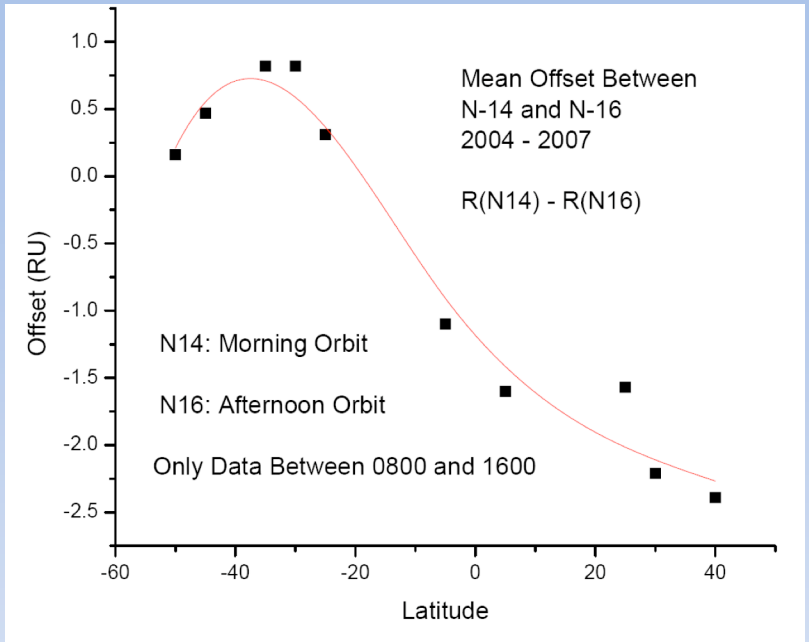

SBUV and SBUV/2 Instrument Local Time History
0830 – 1530 Gap 1993
Valid local time range = [8.5, 15.5 hr]
NOAA−9
NOAA−11
NOAA−14
NOAA−16
NOAA−18
NOAA−17
Nimbus−7
SeaWiFS
Data gaps > 3 months using specified range
terminator
Local Equator−crossing Time [hours]
Date
16:40:05 Fri Oct 3 2008 /Users/deland/viewgraphs/plot_eq_time_window.pro

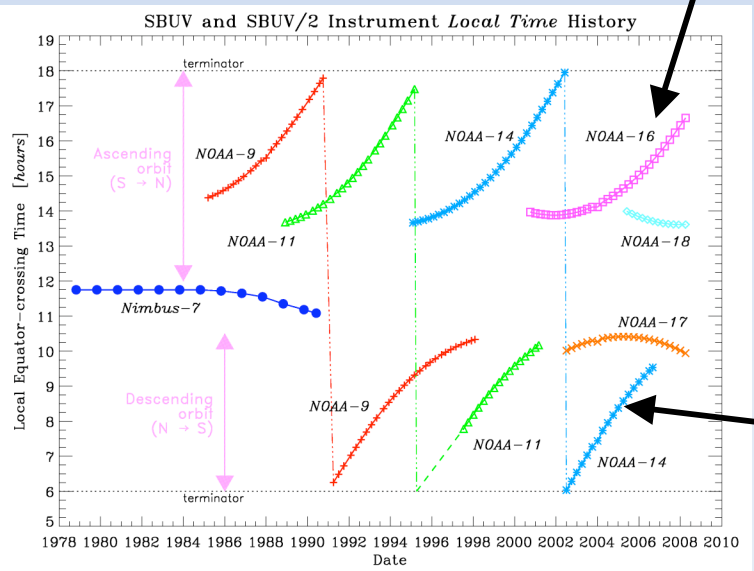

SBUV and SBUV/2 Instrument Local Time History
0900 – 1500 Gap 1992 - 1994
Valid local time range = [9.0, 15.0 hr]
NOAA−9
NOAA−11
NOAA−14
NOAA−16
NOAA−18
NOAA−17
Nimbus−7
SeaWiFS
Data gaps > 3 months using specified range
terminator
Local Equator−crossing Time [hours]
Date
16:40:11 Fri Oct 3 2008 /Users/deland/viewgraphs/plot_eq_time_window.pro

Progress on Joining Data Sets

1) Reprocessed SeaWiFS data with new calibration
2) Reprocessed NOAA SBUV series
3) Still working on finding differences as a function of latitude and year
4) Created a preliminary 30-year data set of reflectivity
5) The preliminary data set was used to estimate UV
6) Using the hyperspectral OMI data to understand the relationship between SeaWiFS 412 nm reflectivity and the standard UV 340 nm reflectivity

Mean Offset Between N-14 and N-16 (2004 – 2007)

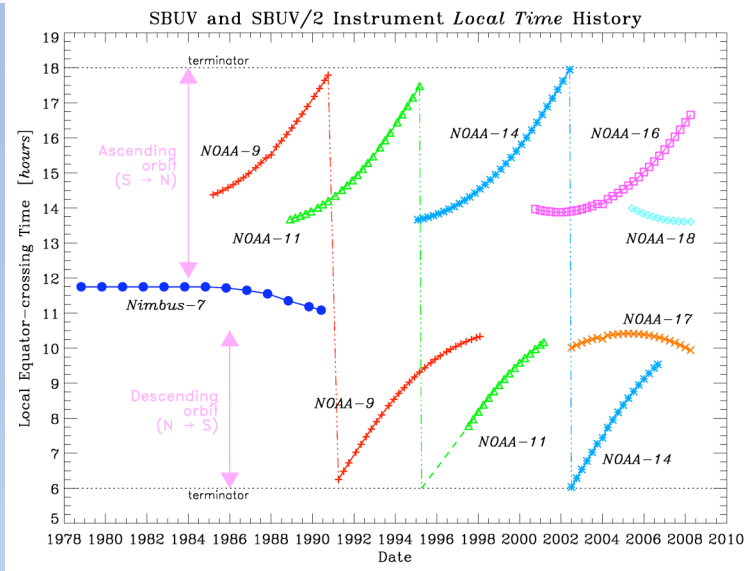




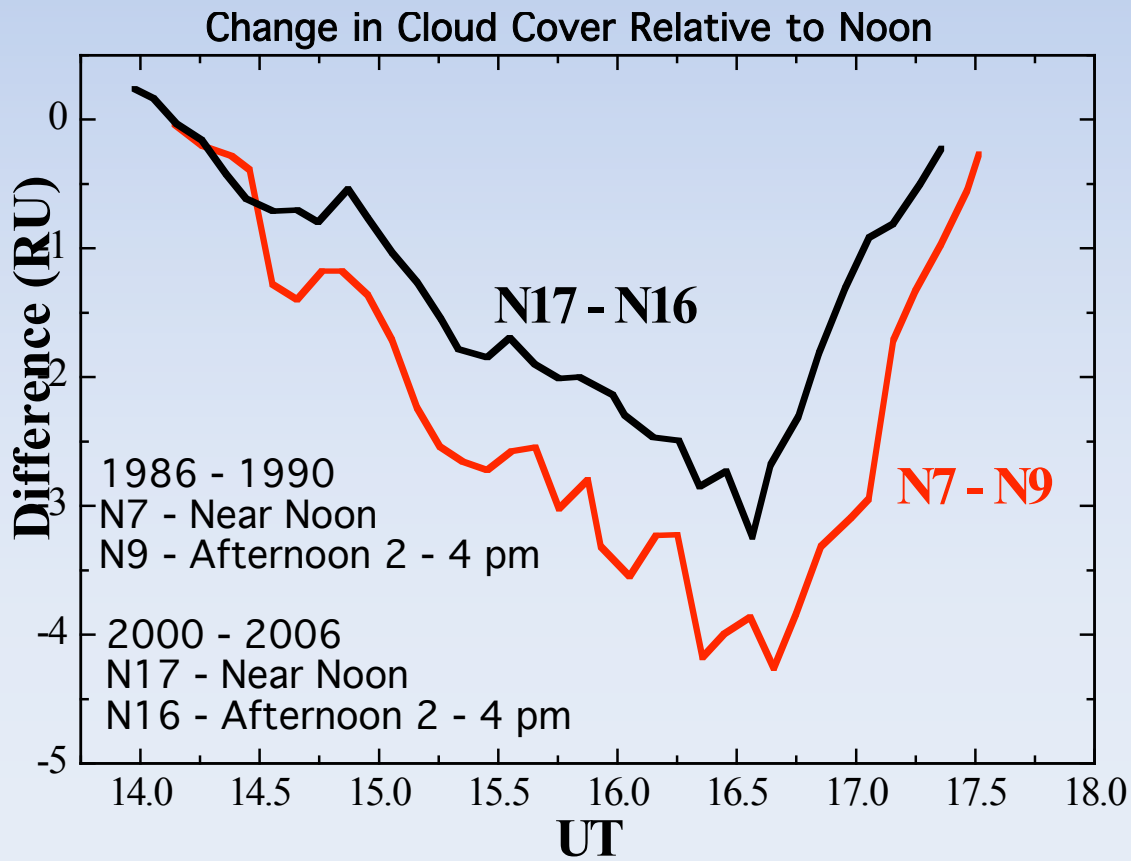
Afternoon

Morning

- **Zonal average data were compared as a function of latitude**
- **The mean quantity R(N14)-R(N16) is computed.**
- **The North-South offset asymmetry is likely due to the difference in cloud cover over land between morning and afternoon orbits, with more land in the NH than in the SH.**

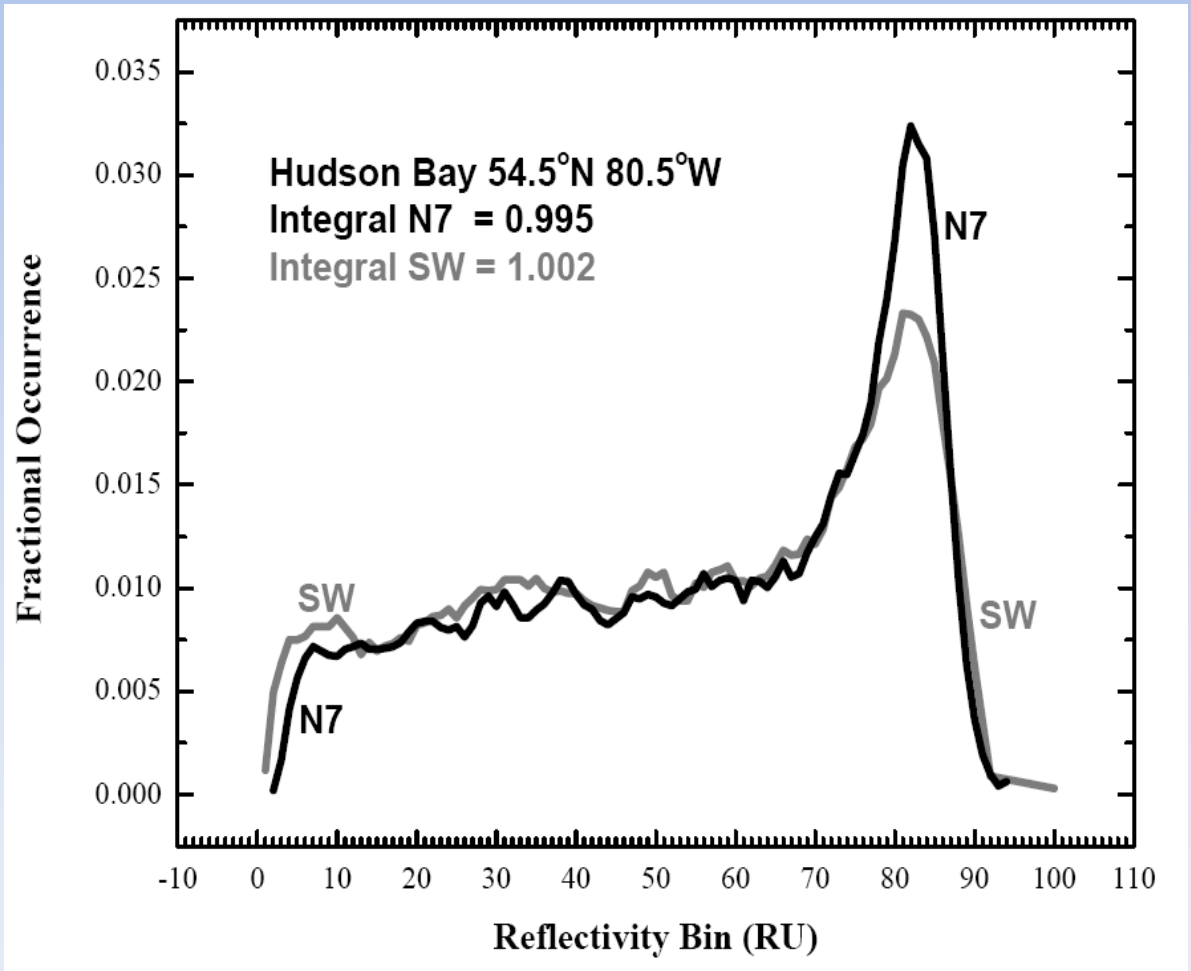


- Change in Cloud Cover vs Time of Day Relative to Noon
- These new results will permit us to normalize all cloud cover to local noon



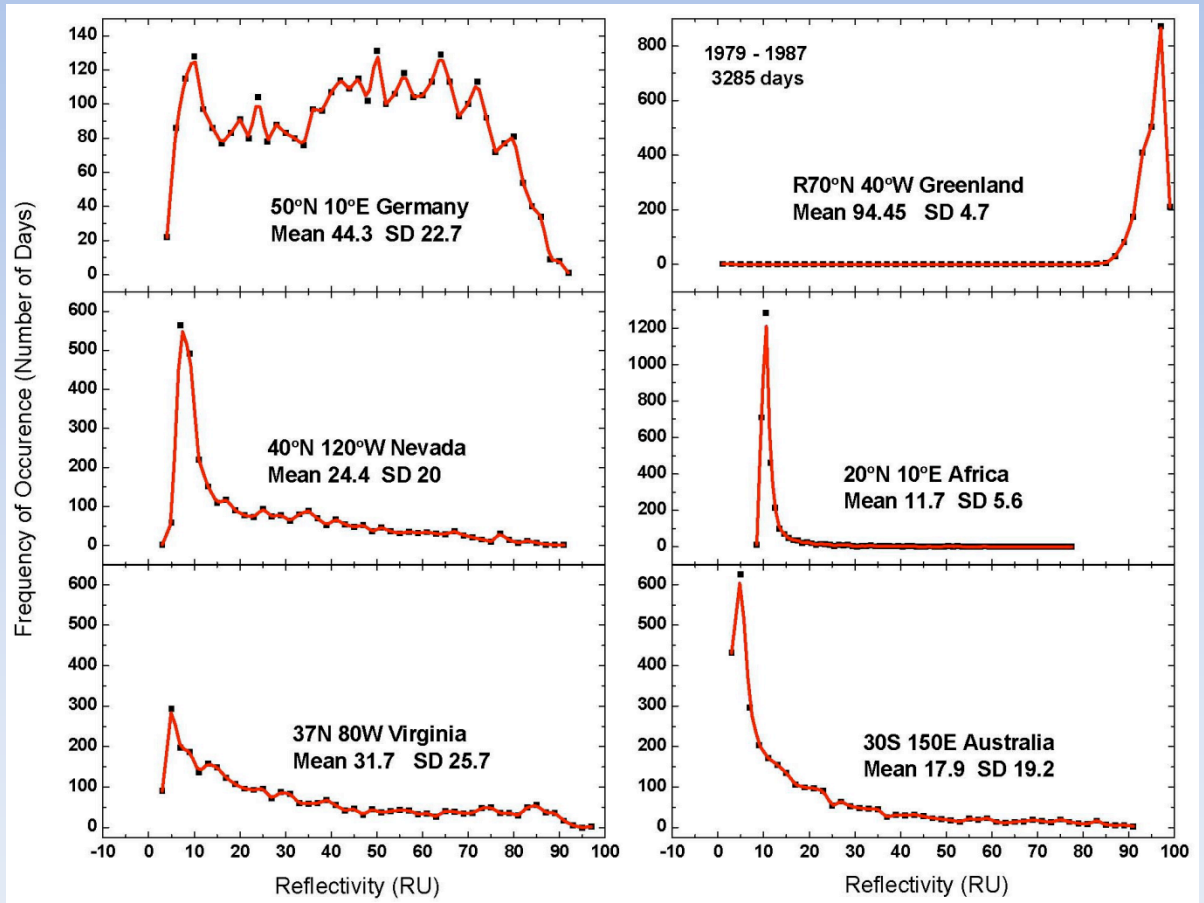
Detection of a Shorter Winter

Motivation for MEASURES CDR

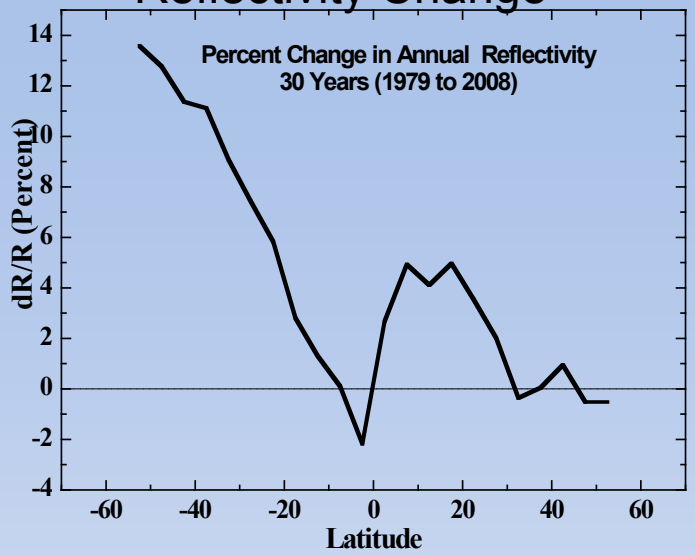


Motivation for MEASURES CDR

Different Cloud Behavior in Different Regions



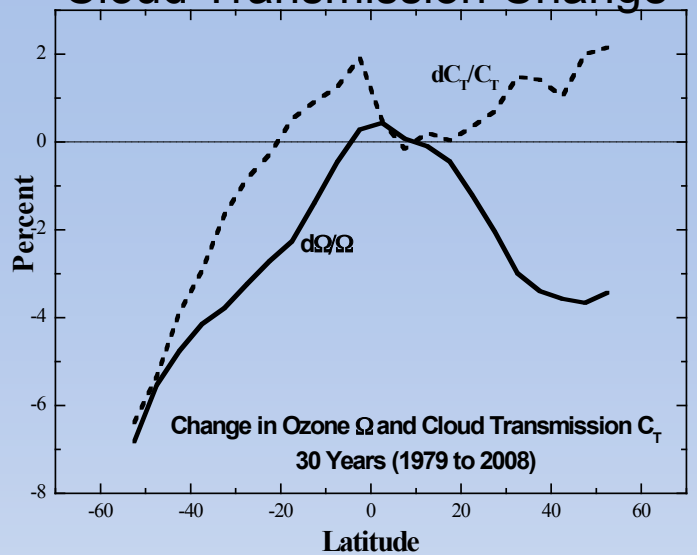
Reflectivity Change

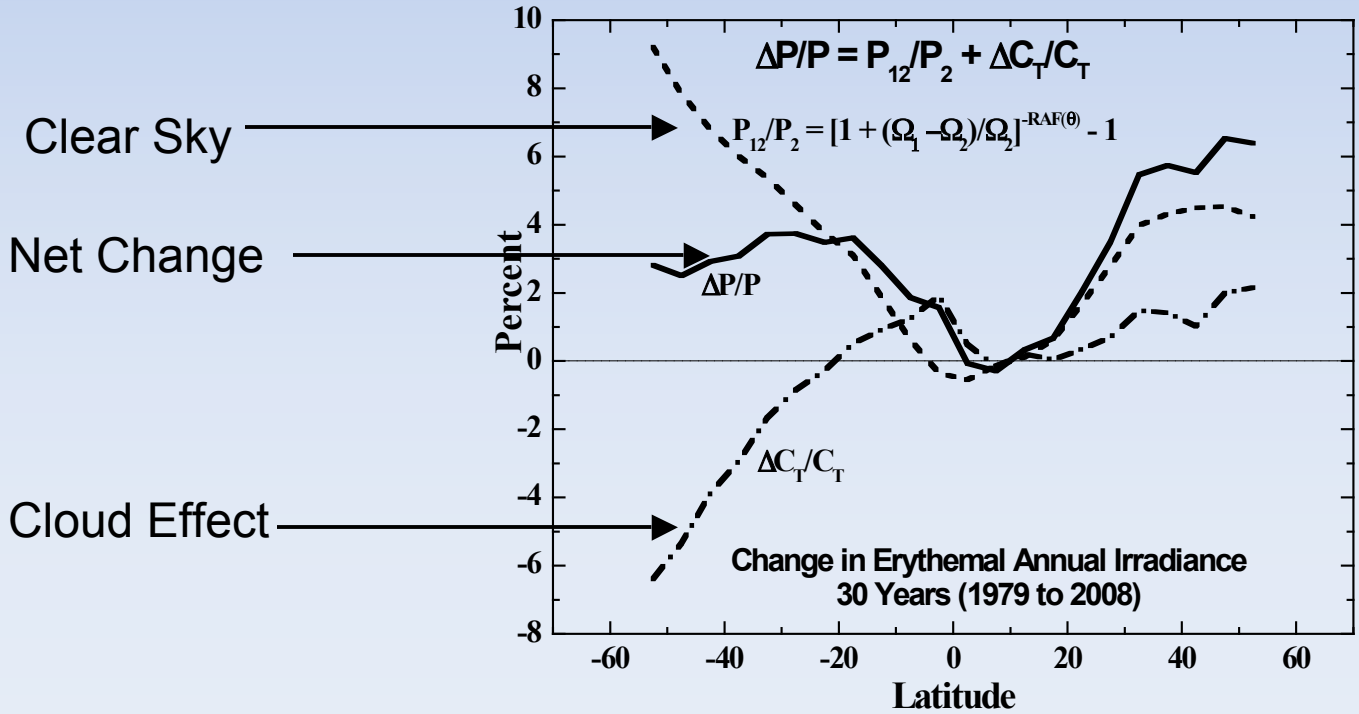


$R \rightarrow C_T$

$$C_T = \frac{1-R}{1-R_G}$$

Cloud Transmission Change





UV Reaching the Ground