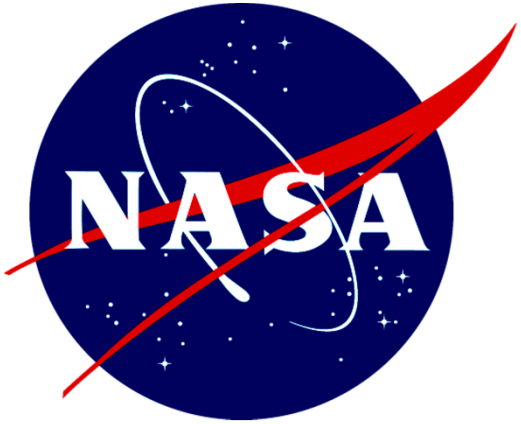
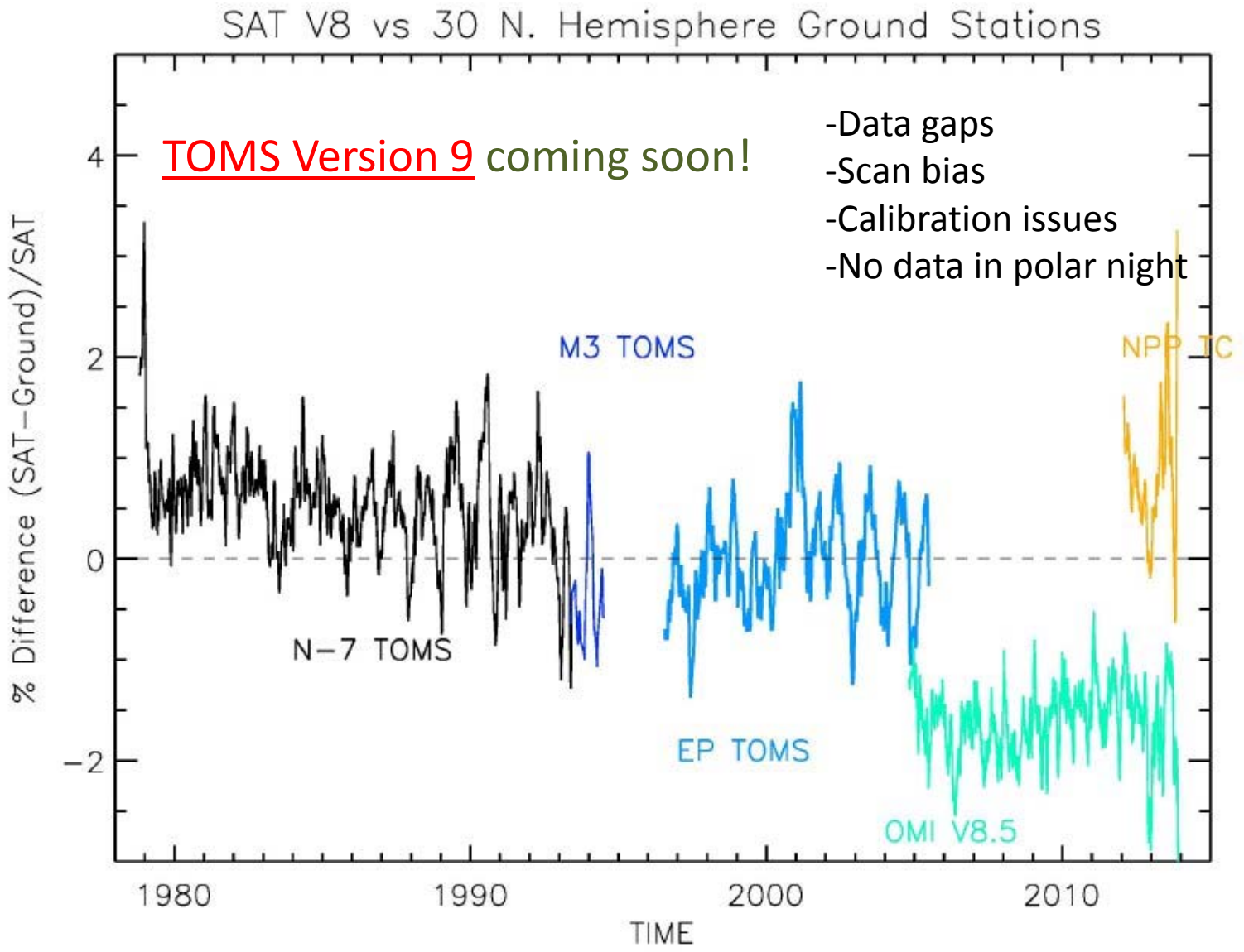


SCIENCE SYSTEMS AND APPLICATIONS, INC.

Creation of a 5 x 5 Degree Monthly Mean Total Column Ozone Data Set

Gordon Labow
Rich McPeters
P.K. Bhartia
Stacey Frith
Steven Pawson
April, 28, 2015

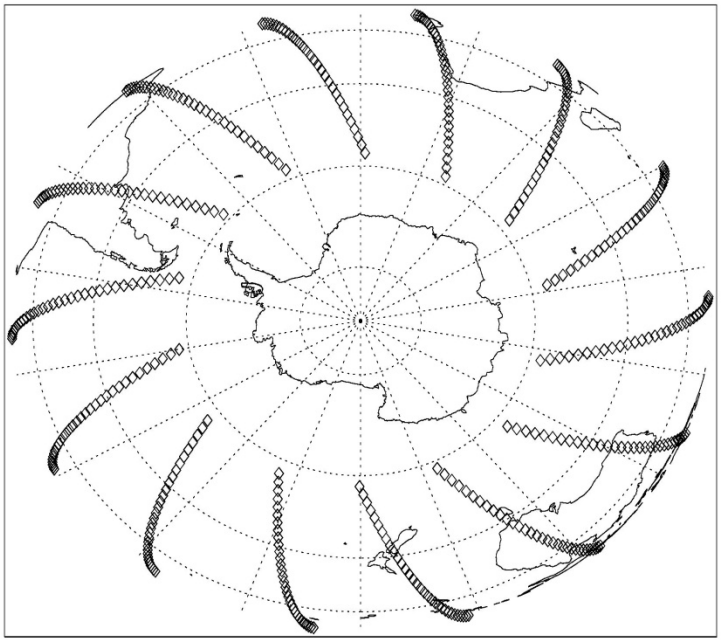

SAT V8 vs 30 N. Hemisphere Ground Stations
TOMS Version 9 coming soon!
-Data gaps
-Scan bias
-Calibration issues
-No data in polar night
M3 TOMS
NPP JC
N-7 TOMS
EP TOMS
OMI V8.5
% Difference (SAT-Ground)/SAT
4
2
0
-2
1980
1990
2000
2010
TIME

The issues with SBUV:

Nadir only (80N to 80S)

Drifting orbits

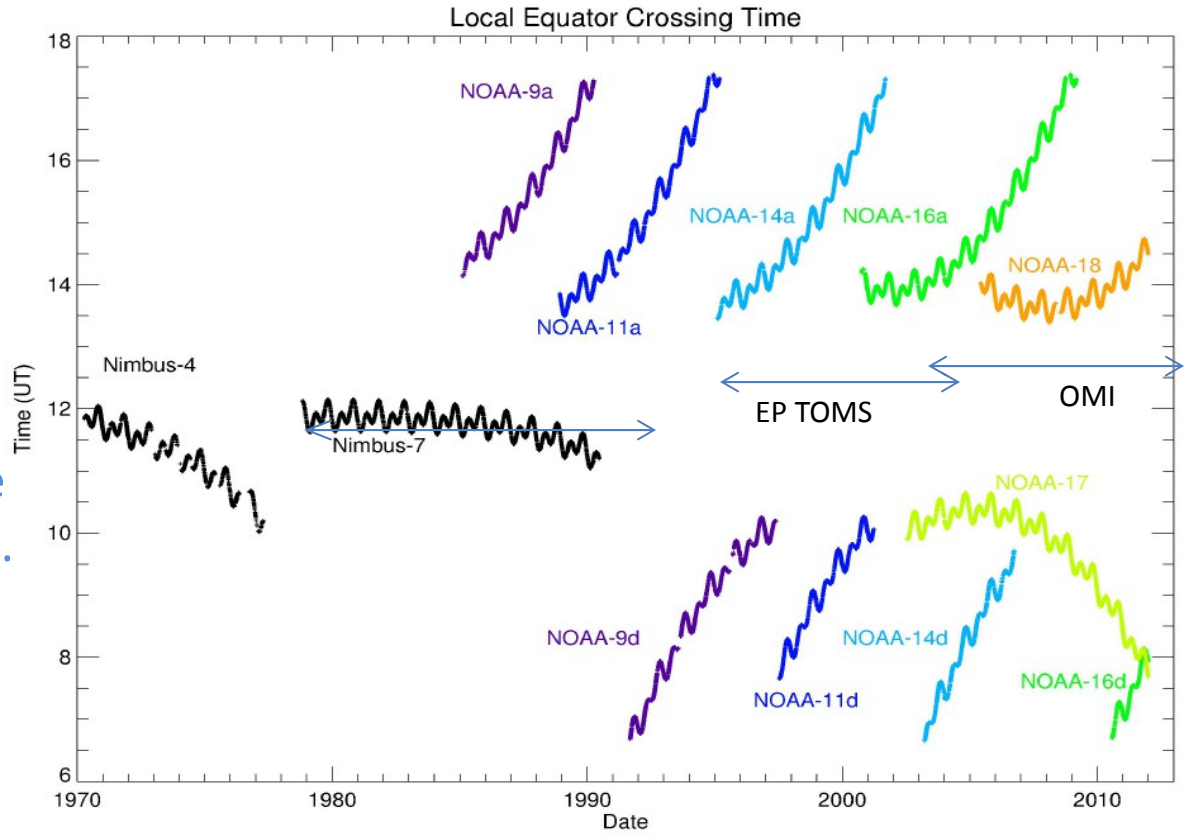
No data in Polar night

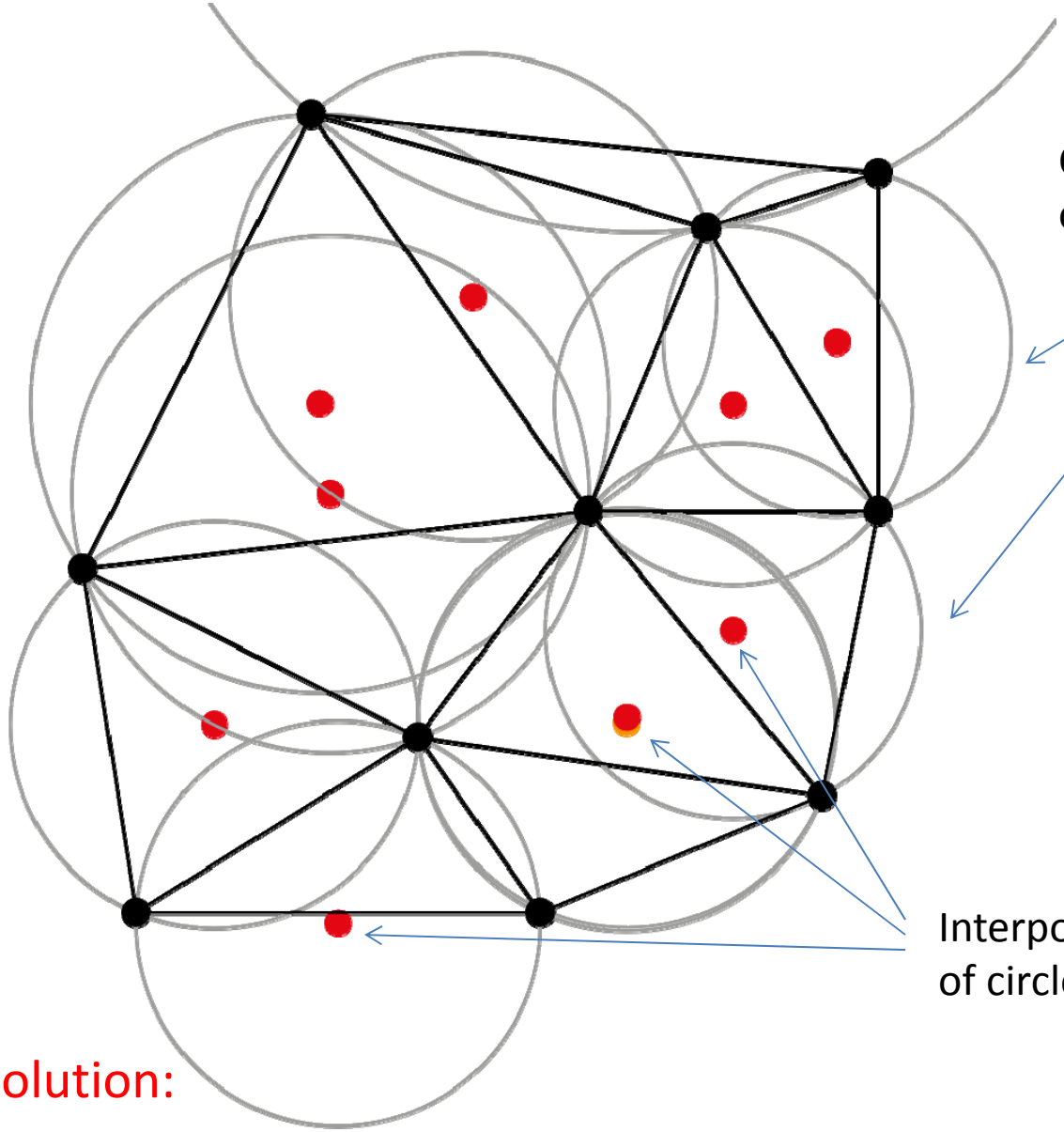


JULY 1st, 2013

We currently trust SBUV more than TOMS (better calibrated).

How can we fill in the missing coverage??

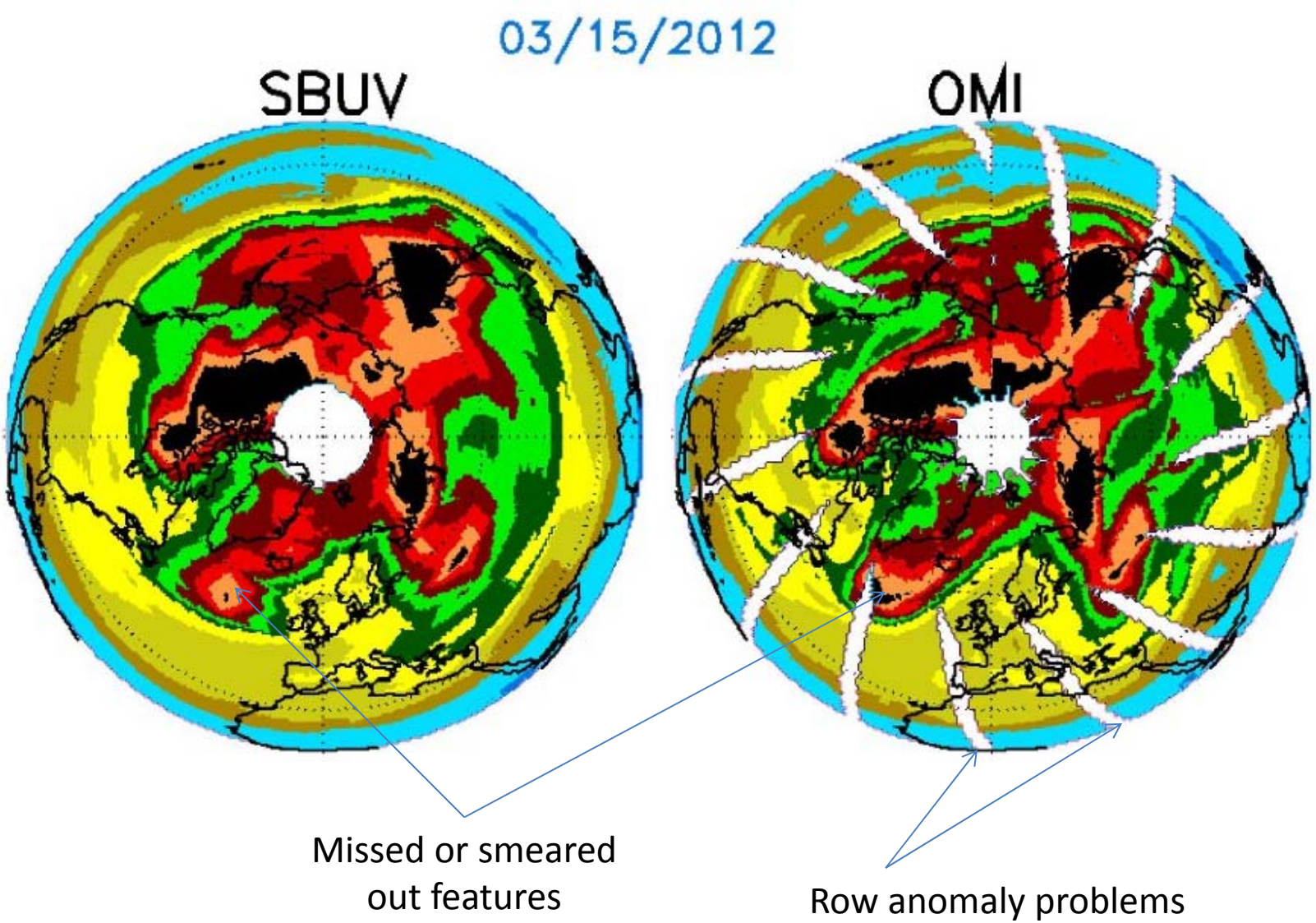


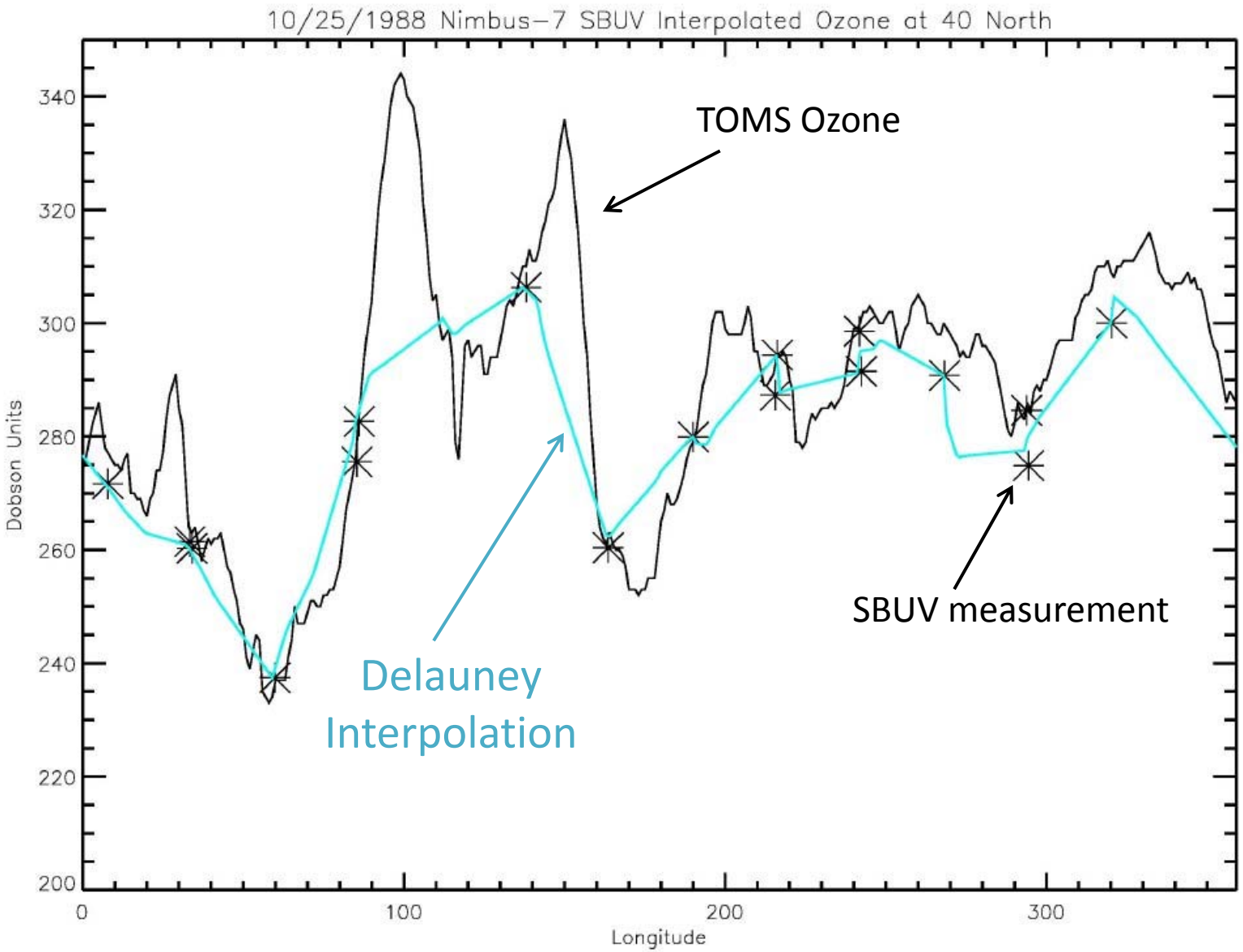


A possible solution:

A **Delaunay triangulation** for a set **P** of points in a plane is a triangulation DT(**P**) such that no point in **P** is inside the circumcircle of any triangle in DT(**P**). Delaunay triangulations maximize the minimum angle of all the angles of the triangles in the triangulation; they tend to avoid skinny triangles. Can be done in multiple dimensions.

Mathematically interpolate SBUV data to get global map




10/25/1988 Nimbus-7 SBUV Interpolated Ozone at 40 North
TOMS Ozone
SBUV measurement
Delauney
Interpolation
Dobson Units
Longitude
340
320
300
280
260
240
220
200
0
100
200
300

New Approach: Use MERRA-2 as a "Smart Interpolator"

What is MERRA?

MODERN-ERA RETROSPECTIVE ANALYSIS FOR RESEARCH AND APPLICATIONS

Based on the GEOS-5 assimilation system

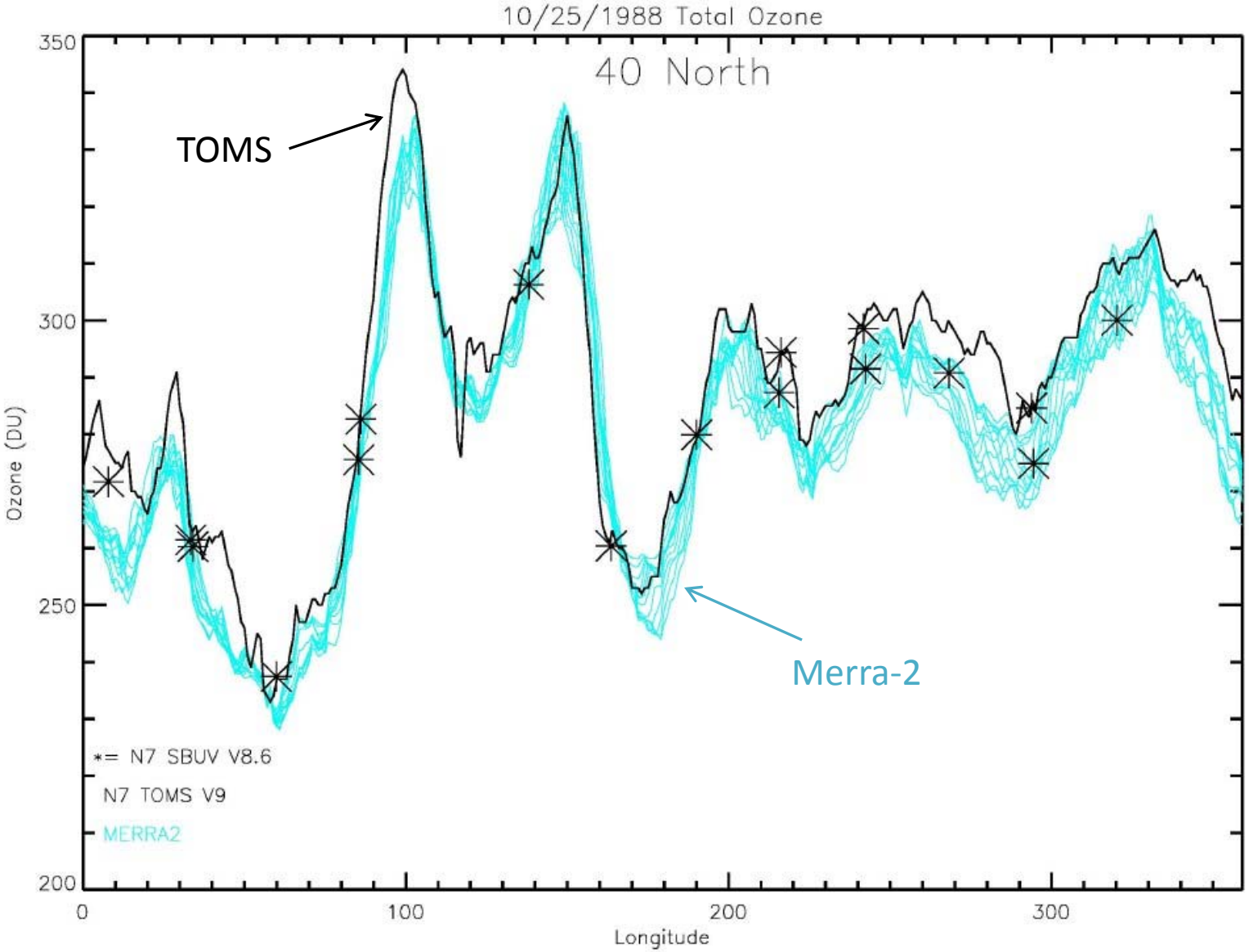
Input:

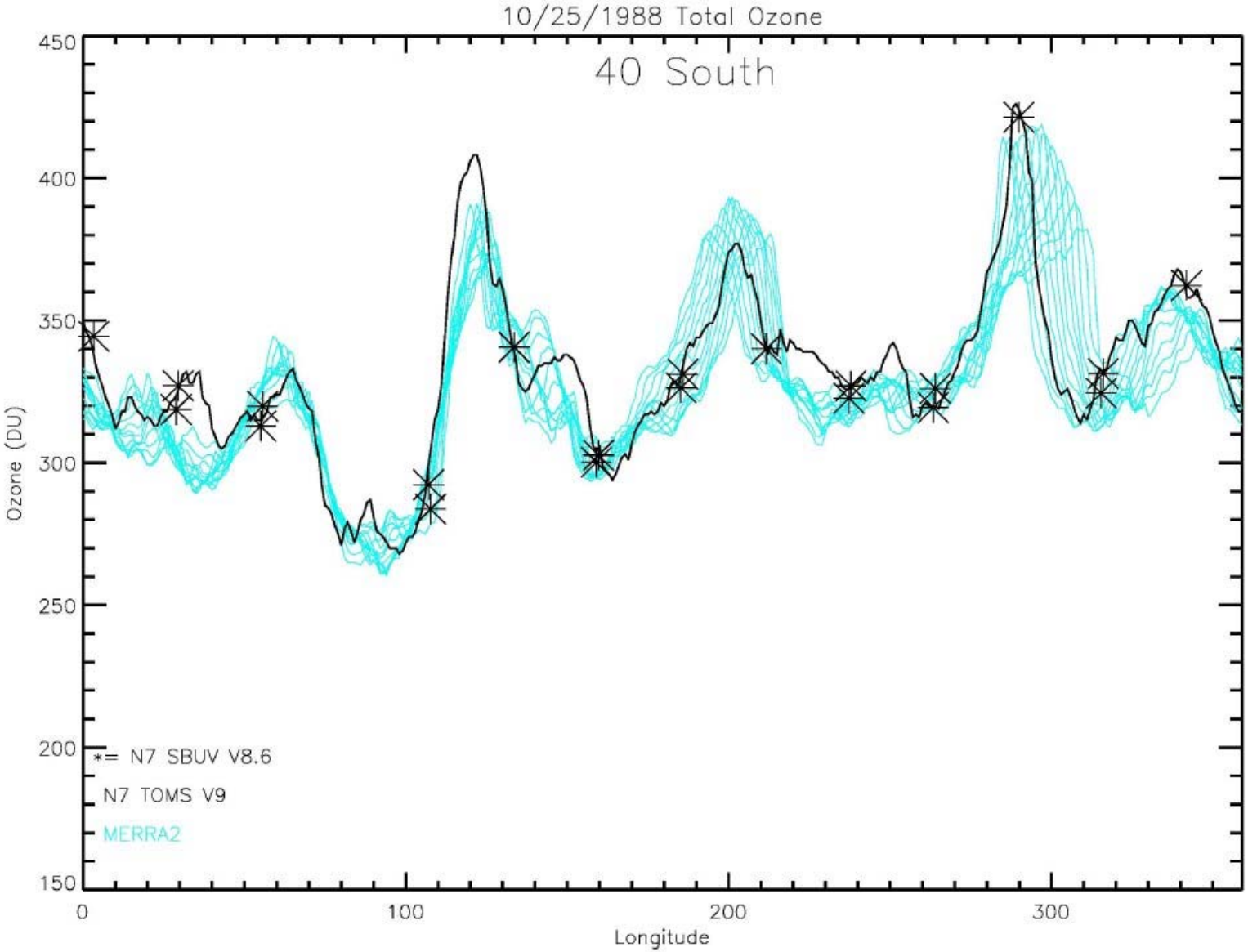
Ozone profiles & total column (SBUV, MLS/OMI), SST, winds, temperature, pressure (from radiosondes, aircraft, satellites)

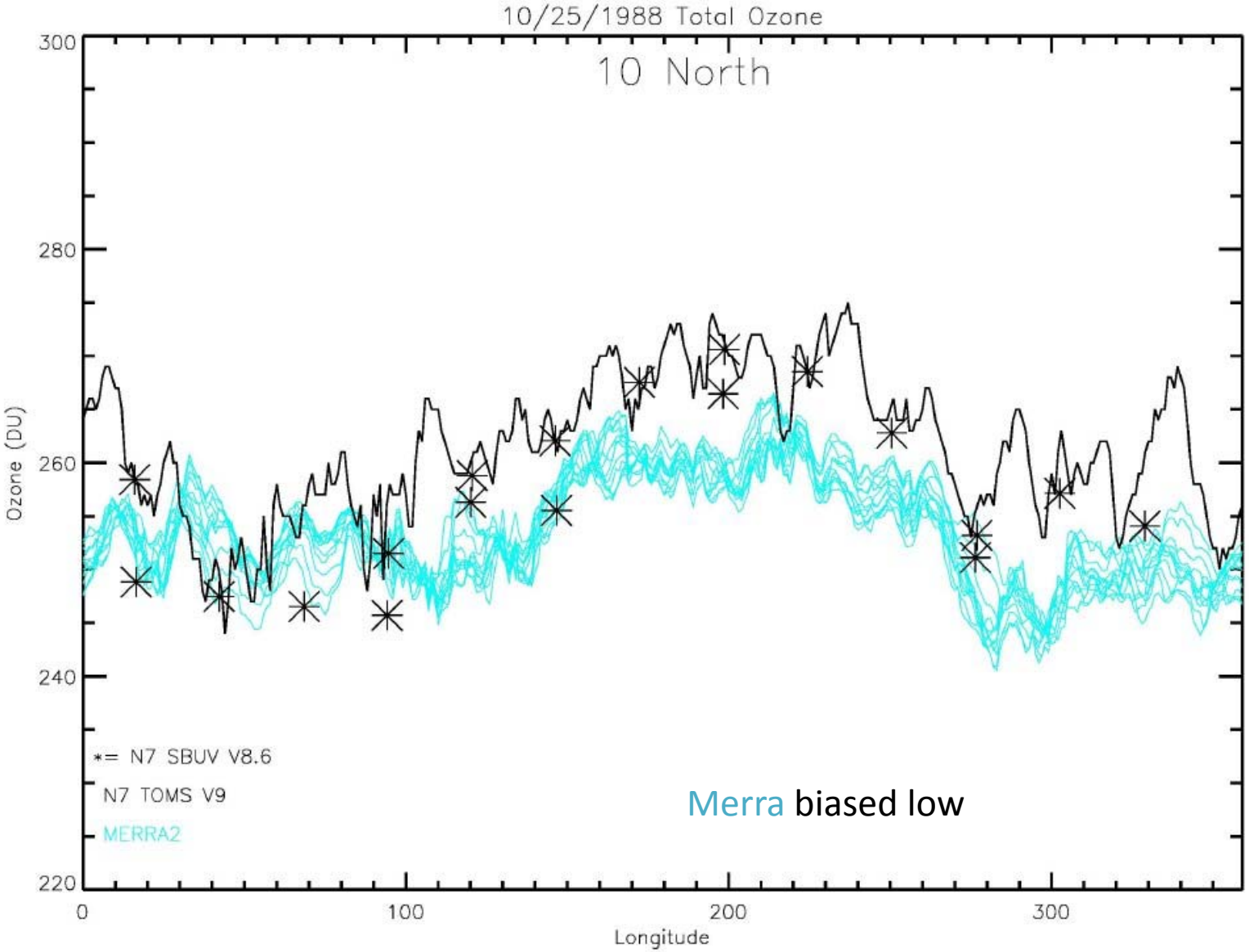
Output:

-72 vertical layers (about 1km)
-Summed ozone profile
-576 x 360 gridded data (0.625 x 1 degree)
-Every hour (total ozone)
-1979 to present
-Global daily maps (pole to pole)

(Available summer 2015)


10/25/1988 Total Ozone
40 North
TOMS
Merra-2
*= N7 SBUV V8.6
N7 TOMS V9
MERRA2
Ozone (DU)
Longitude
350
300
250
200
0
100
200
300

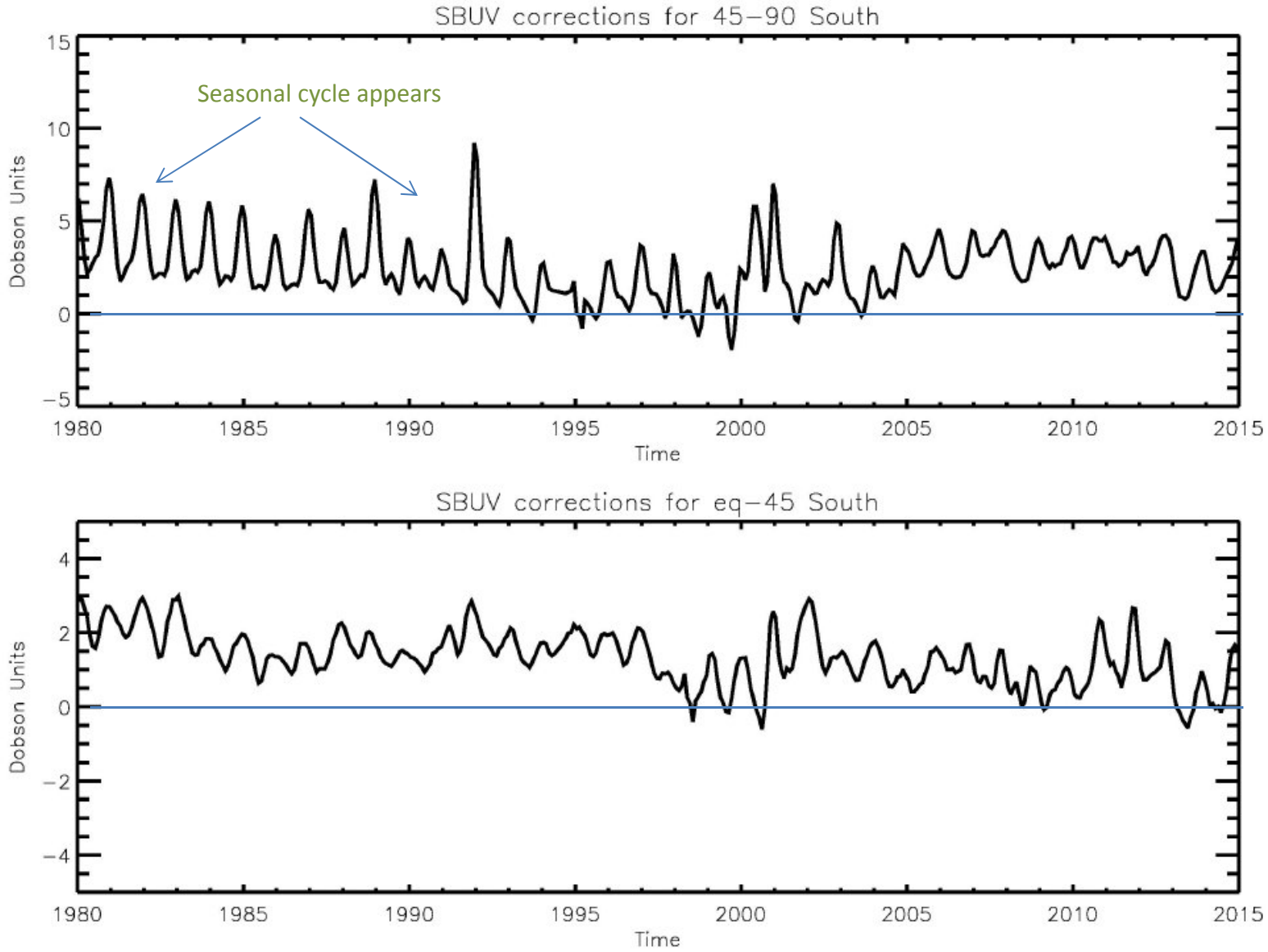

10/25/1988 Total Ozone
40 South
450
400
350
300
250
200
150
Ozone (DU)
0
100
200
300
Longitude
*= N7 SBUV V8.6
N7 TOMS V9
MERRA2

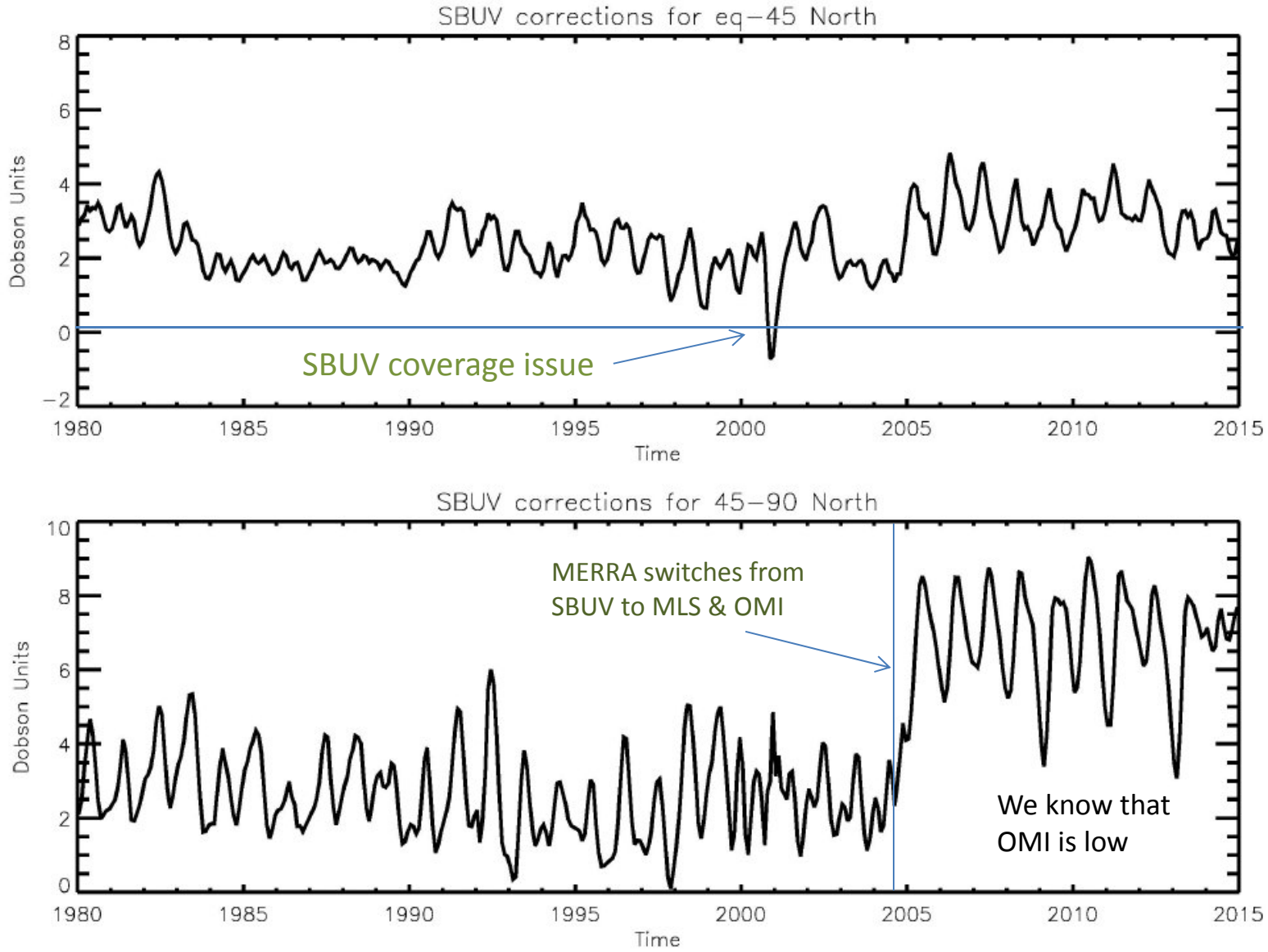

10/25/1988 Total Ozone
10 North
300
280
260
240
220
Ozone (DU)
0
100
200
300
Longitude
*= N7 SBUV V8.6
N7 TOMS V9
MERRA2
Merra biased low

Problem: we (some of us) don't completely trust the models….

Solution: Normalize to SBUV MOD to remove biases

5 degree zonal means


SBUV corrections for 45–90 South
Seasonal cycle appears
Dobson Units
15
10
5
0
−5
1980
1985
1990
1995
2000
2005
2010
2015
Time
SBUV corrections for eq–45 South
Dobson Units
4
2
0
−2
−4
1980
1985
1990
1995
2000
2005
2010
2015
Time


SBUV corrections for eq−45 North
Dobson Units
8
6
4
2
0
−2
1980
1985
1990
1995
2000
2005
2010
2015
Time
SBUV coverage issue
SBUV corrections for 45−90 North
Dobson Units
10
8
6
4
2
0
1980
1985
1990
1995
2000
2005
2010
2015
Time
MERRA switches from
SBUV to MLS & OMI
We know that
OMI is low

So, now what?

-Validate product using total ozone products from V9 TOMS, OMI, NPP, GOME, SCIA and a multitude of ground stations.

-What to do about Polar night??
-Validate using AIRS, IASI?