A joint retrieval of aerosol and sea surface temperature from AATSR

Haiyan Huang, Don Grainger,
Gareth Thomas, ***Adam Povey***

Atmospheric, Oceanic, and Planetary Physics, University of Oxford, Oxford

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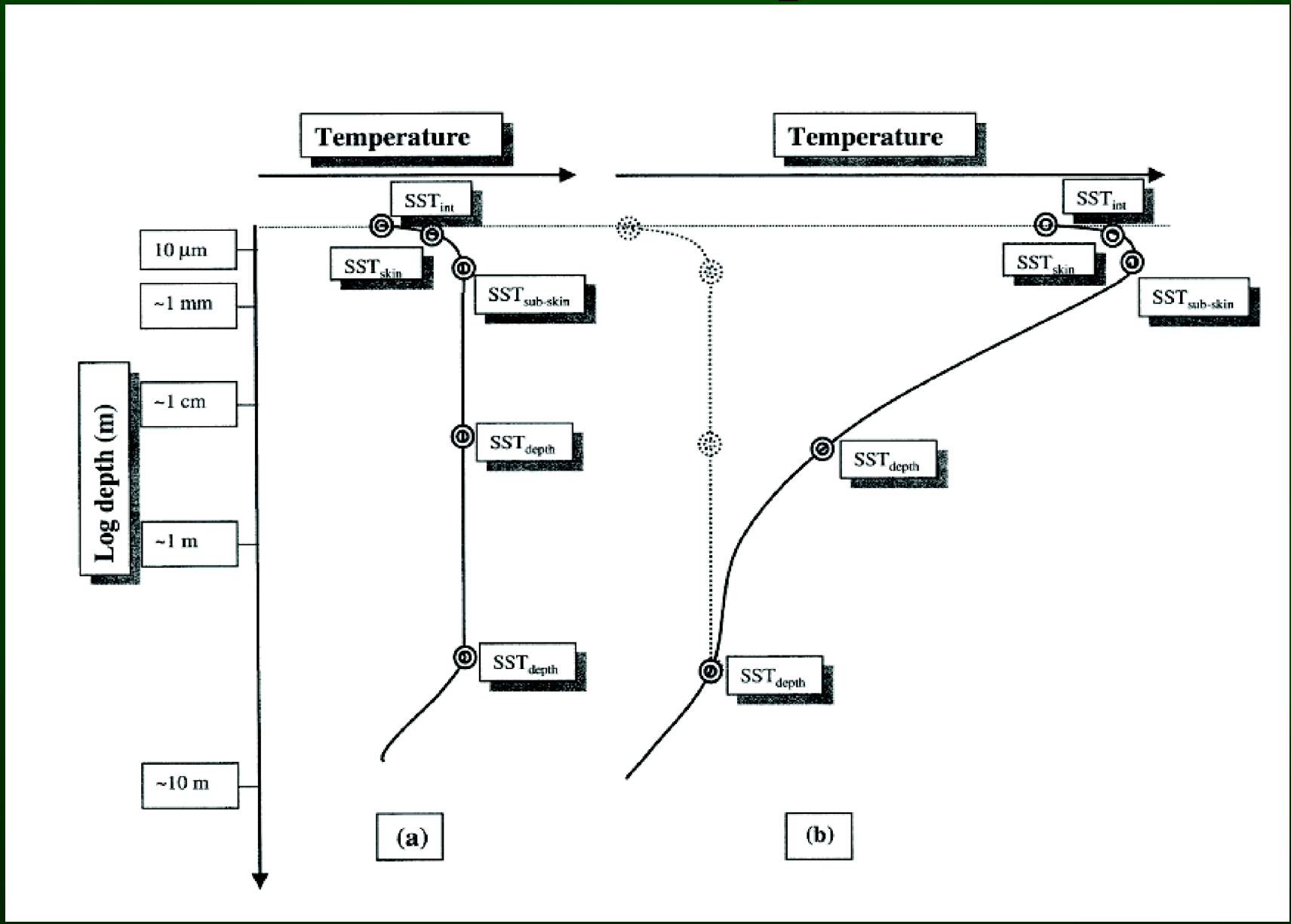
Remote sensing of atmospheric aerosol workshop

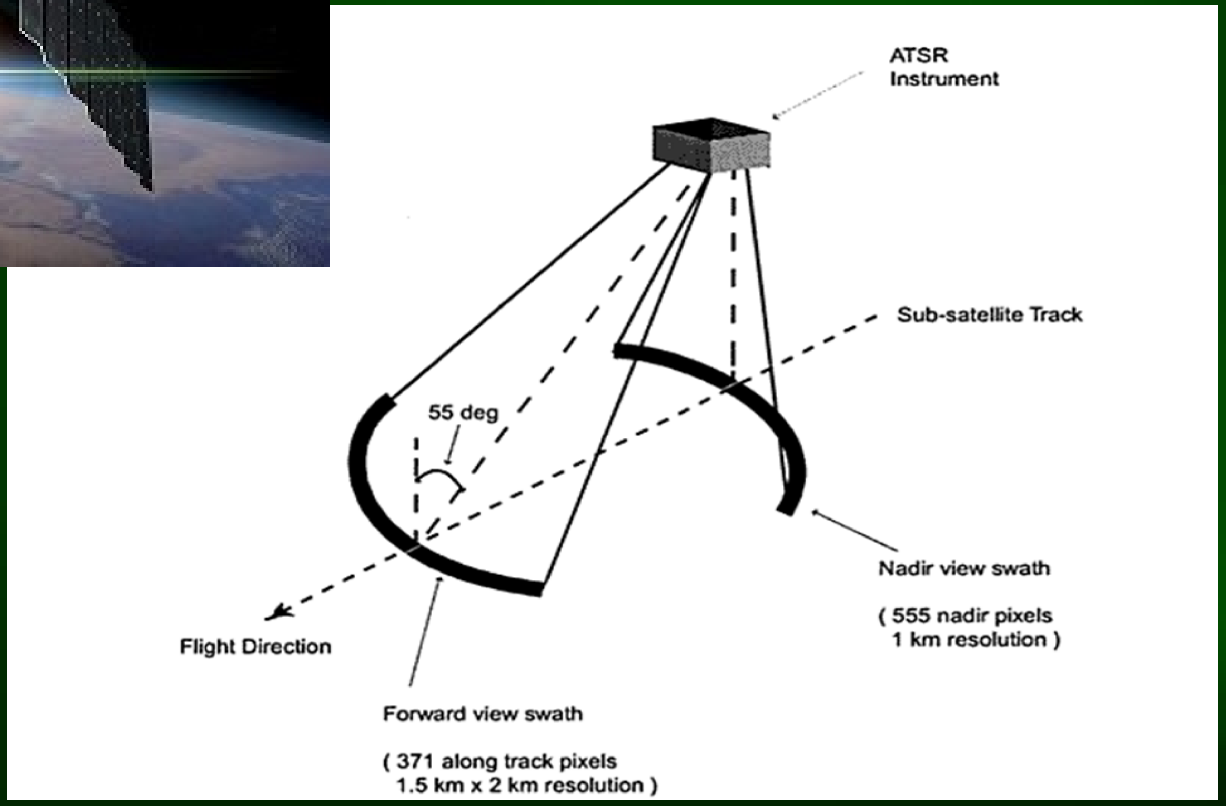
Sea surface temperature

- SST is closely related to the Earth's energy balance, atmospheric and oceanic circulation patterns and anomalies. It is widely used to describe ocean circulation and dynamics.
- The interactions between the ocean and atmosphere, which take place via the uppermost layer of ocean, include the exchanges of long wave radiation, momentum, heat associated with evaporation and condensation.

Sea surface temperature



AATSR


ATSR
Instrument
Sub-satellite Track
55 deg
Nadir view swath
(555 nadir pixels
1 km resolution)
Flight Direction
Forward view swath
(371 along track pixels
1.5 km x 2 km resolution)

Sea surface temperature

- Frequently estimated using a “coefficient” method,

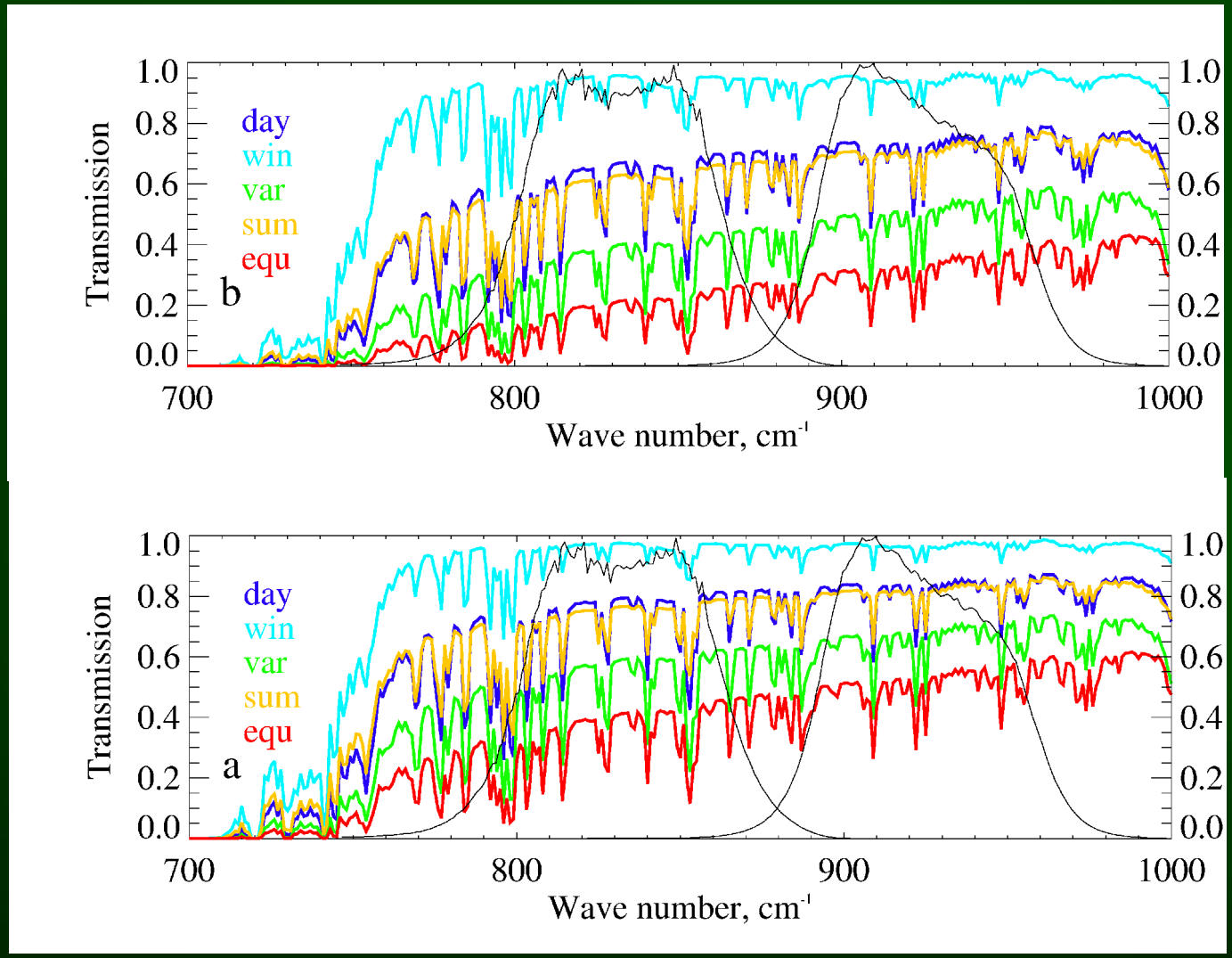
$$SST = a_0 + \sum a_i BT_i$$

- Coefficients derived empirically from a regression of in situ observations and satellite brightness temperatures.
  - The impact of the mean aerosol loading is considered within these coefficients.

Alteration of ORAC

- IR forward model added to the aerosol processor
  - Inputs are 0.55, 0.67, 0.87, 1.60, 11 and 12 μm from both views of ATSR
  - Retrieved quantities are AOD at 0.55, effective radius, layer height, surface albedo at 0.55, 0.67, 0.87, and 1.6, and surface temperature.

Impact of atmospheric gases



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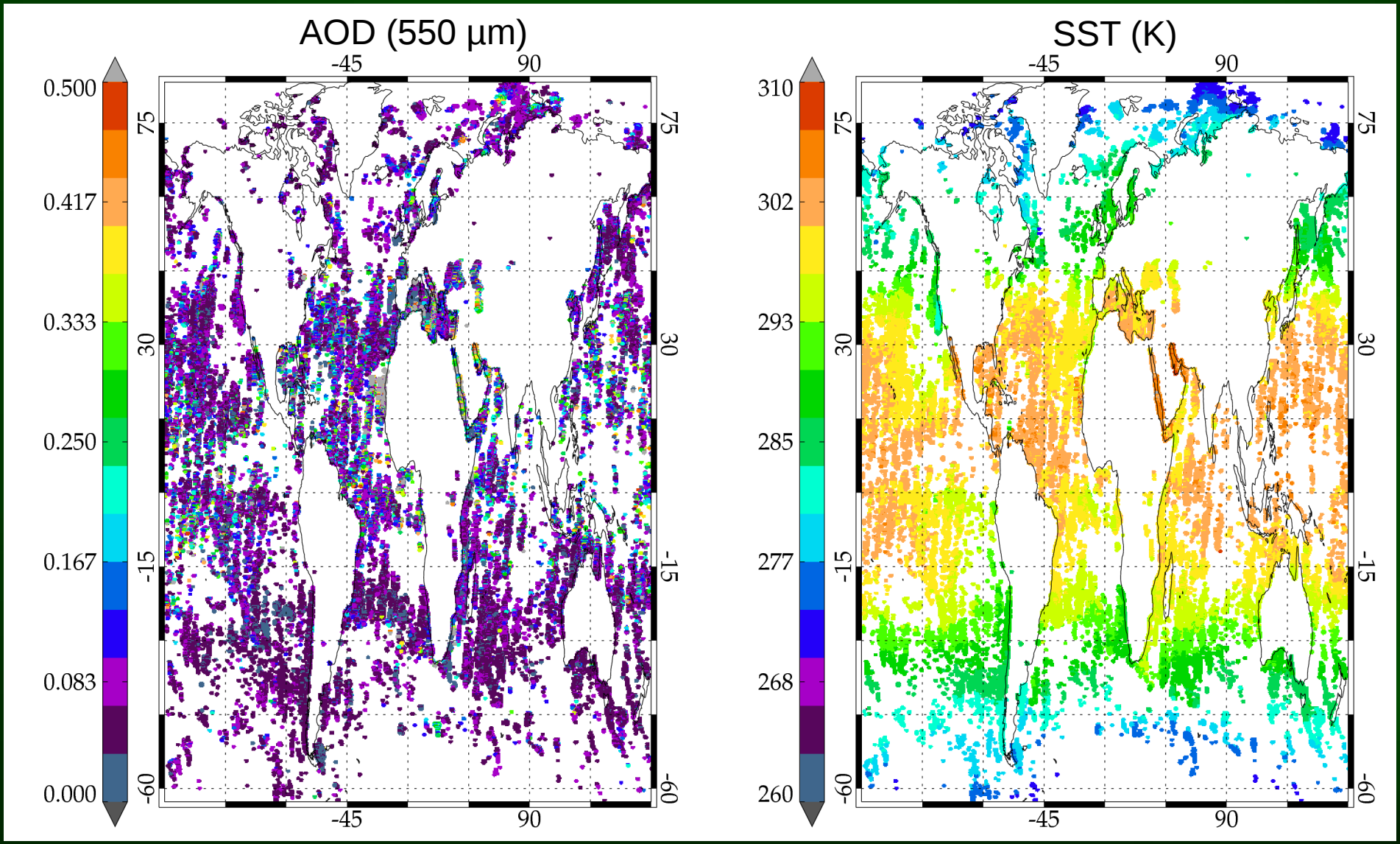
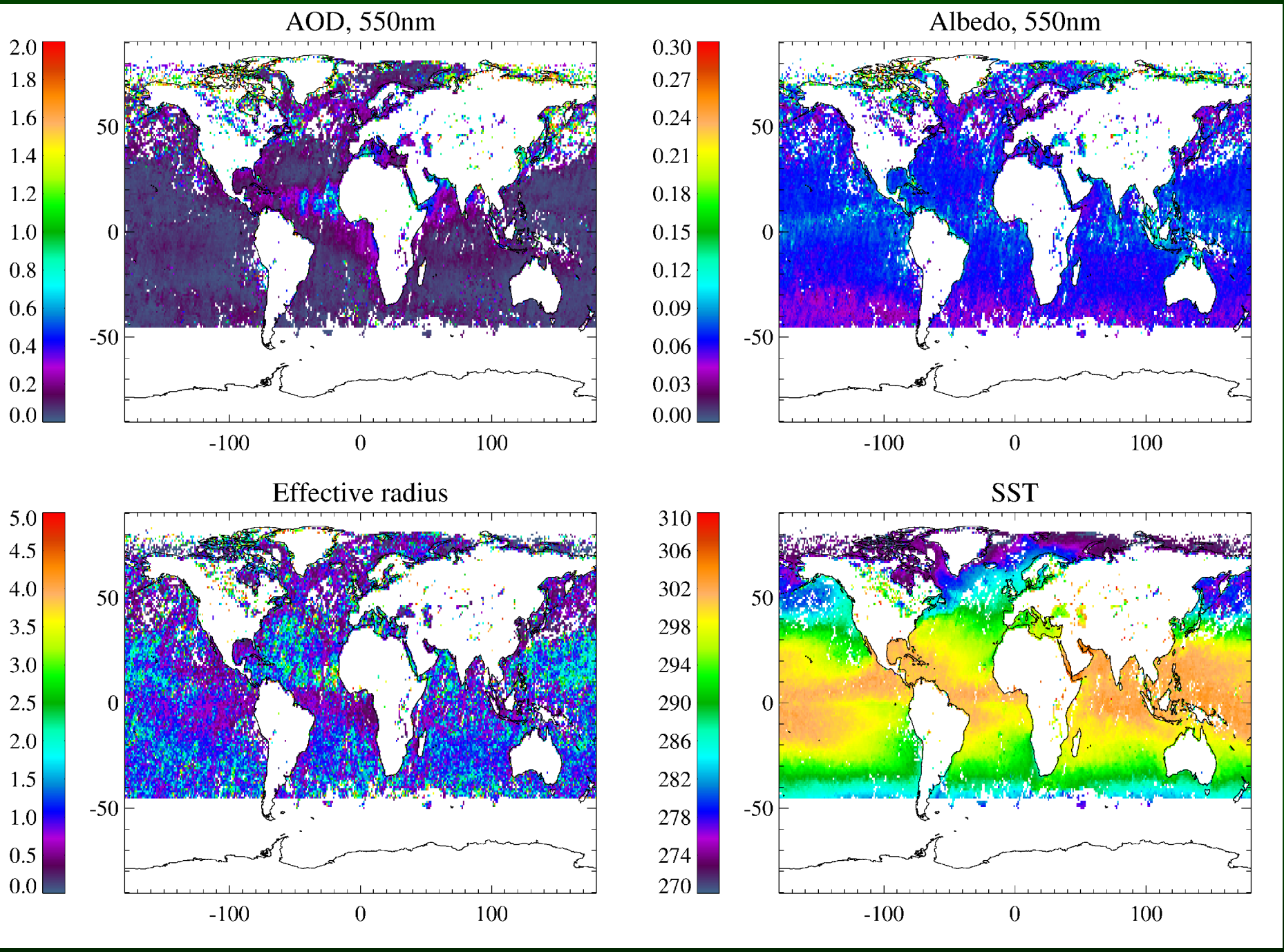
  - Retrieved quantities are AOD at 0.55, effective radius, layer height, surface albedo at 0.55, 0.67, 0.87, and 1.6, and surface temperature.
- Use of RTTOV to calculate impact of atmospheric gases on observations
  - H_2O, CO_2, HNO_3, and CFCs most important

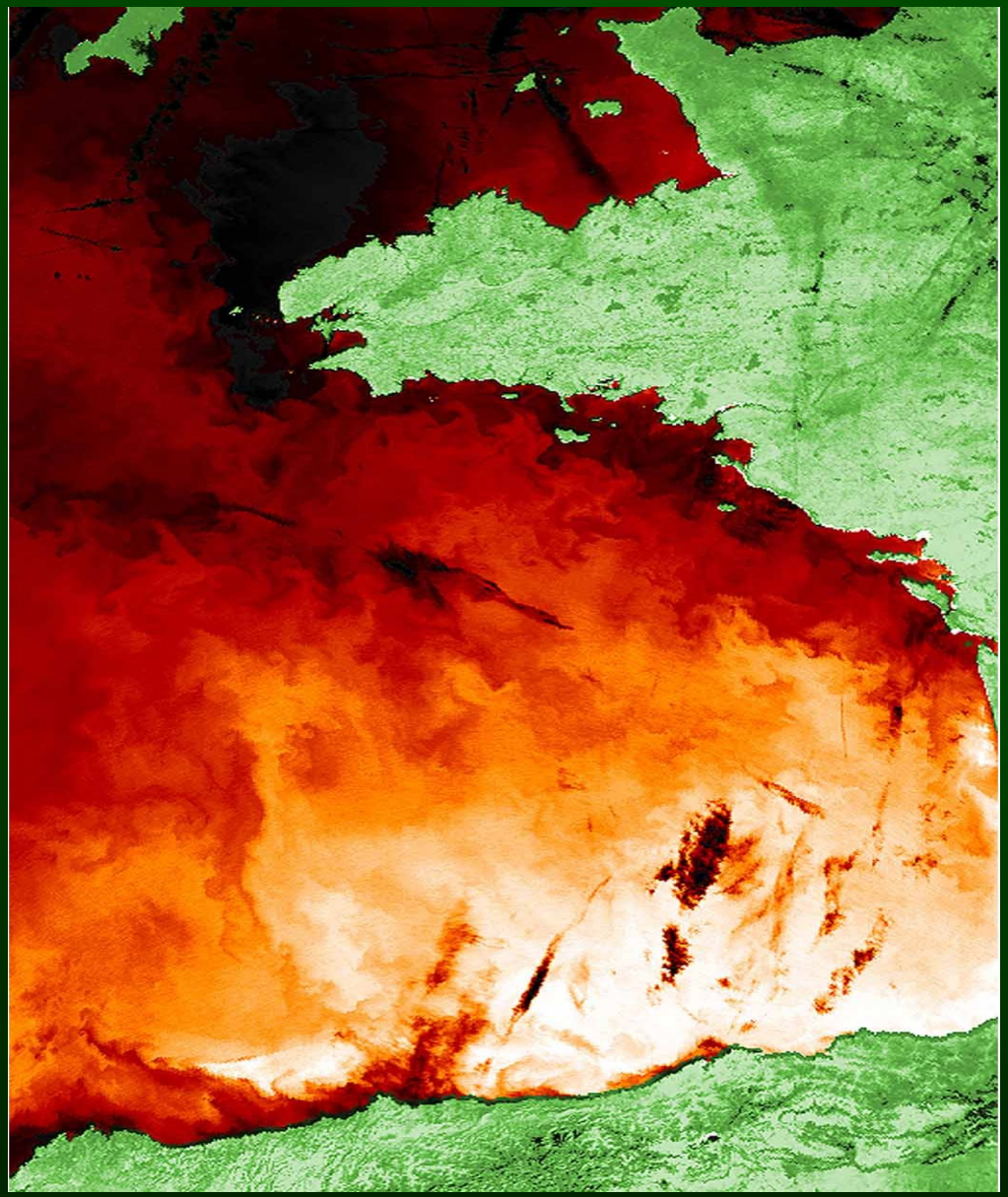
Example results



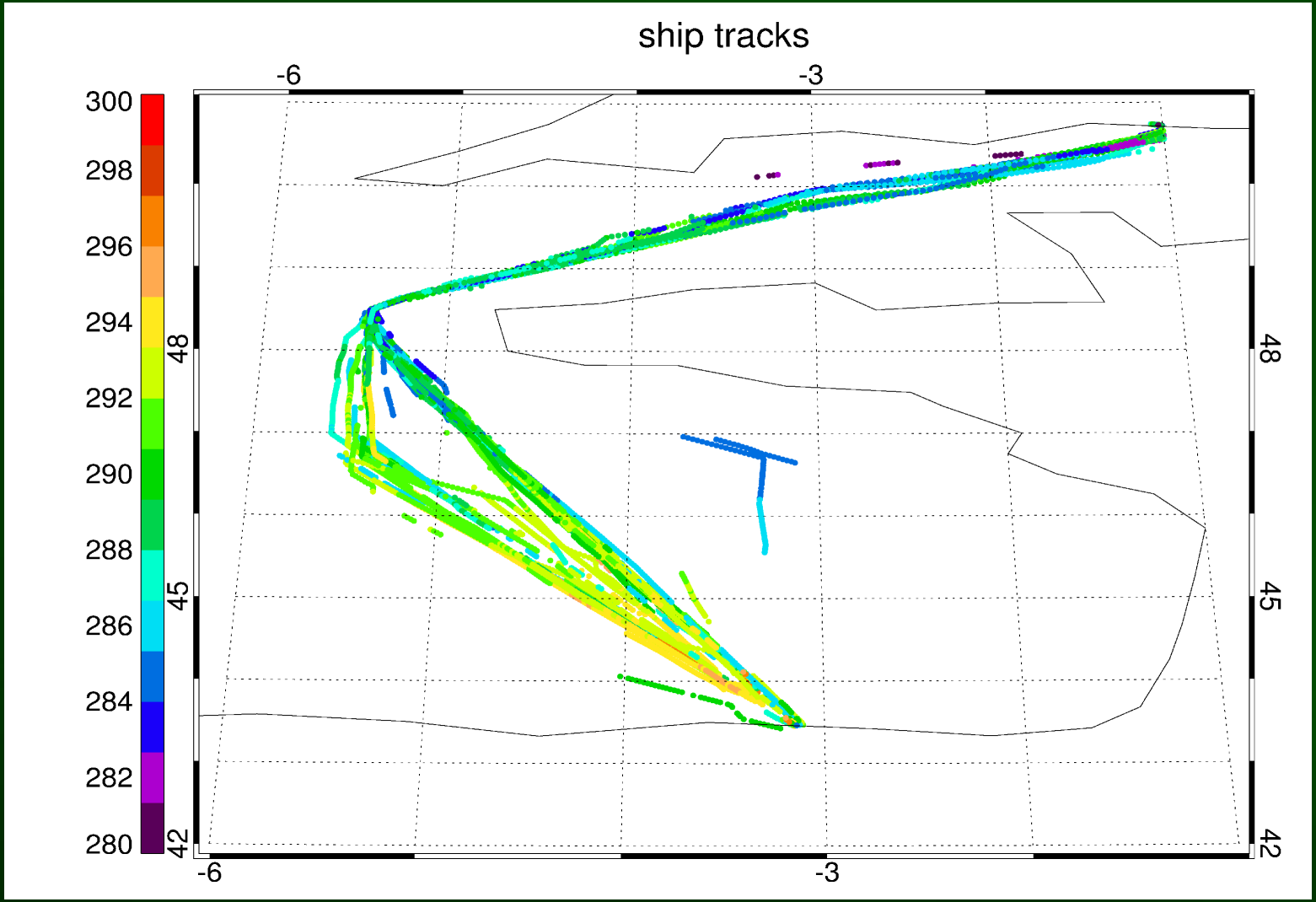
A few orbits from Sep 2008


AOD, 550nm
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
50
0
-50
-100
0
100
Albedo, 550nm
0.30
0.27
0.24
0.21
0.18
0.15
0.12
0.09
0.06
0.03
0.00
50
0
-50
-100
0
100
Effective radius
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
50
0
-50
-100
0
100
SST
310
306
302
298
294
290
286
282
278
274
270
50
0
-50
-100
0
100

SST validation against radiometer

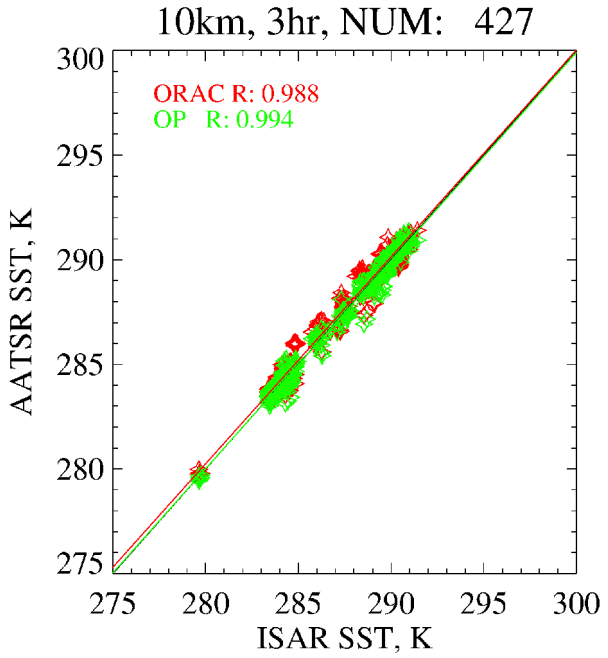


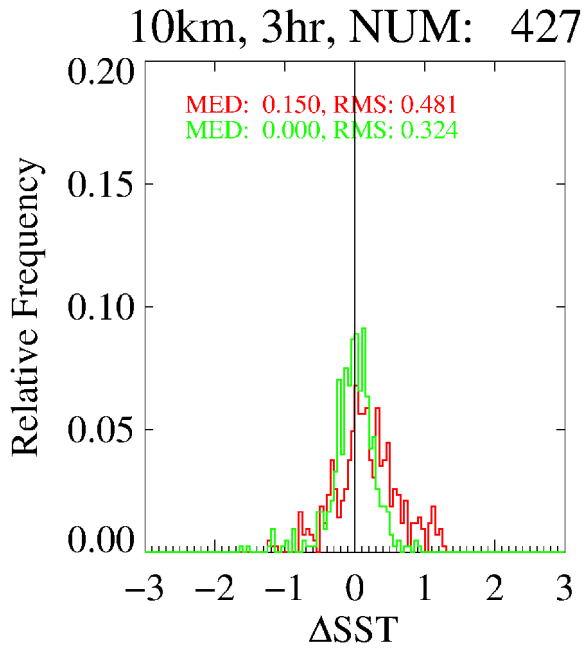
SST validation against radiometer

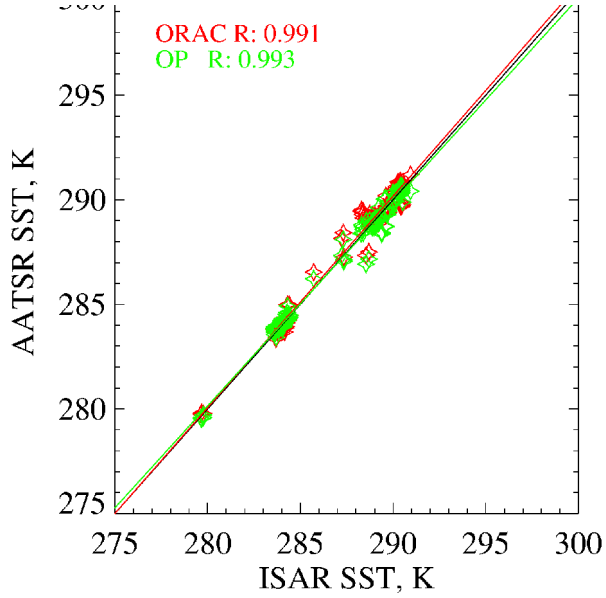


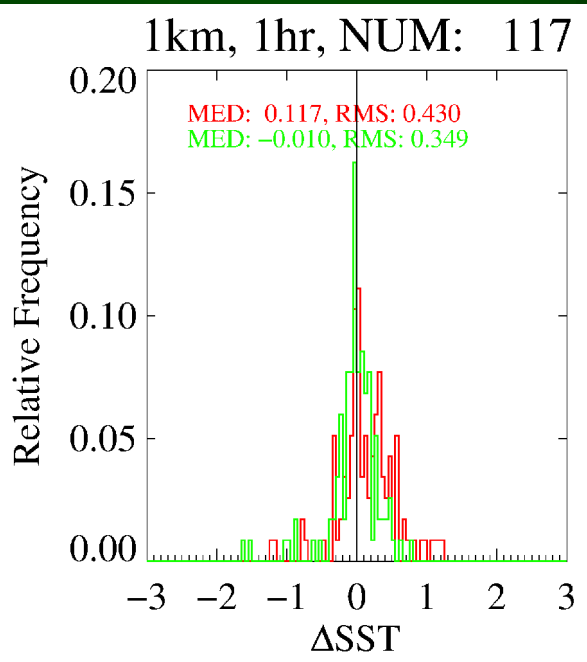
Ship tracks of the Pride of Bibao for Feb 2006 to Dec 2008.

SST validation against radiometer

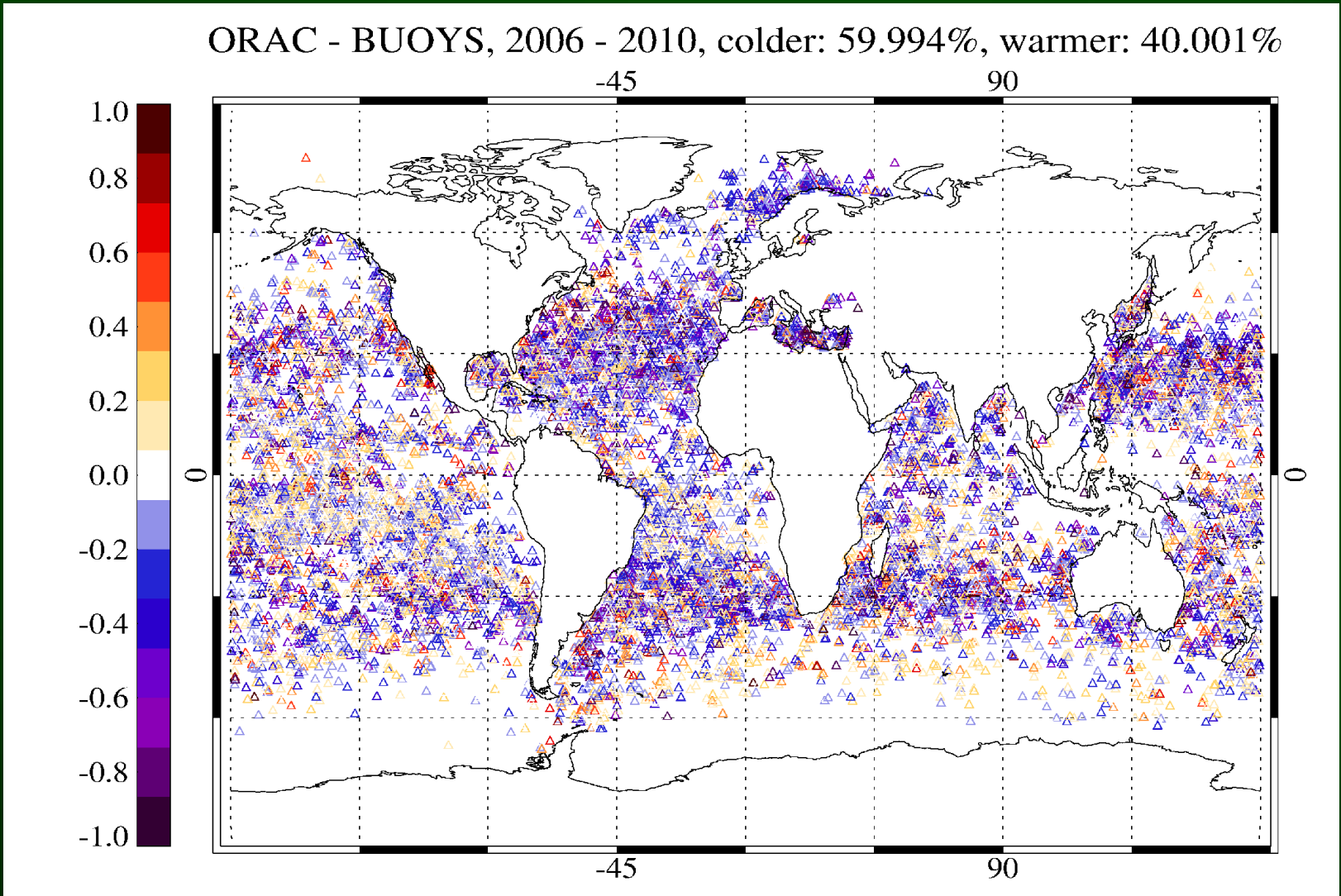






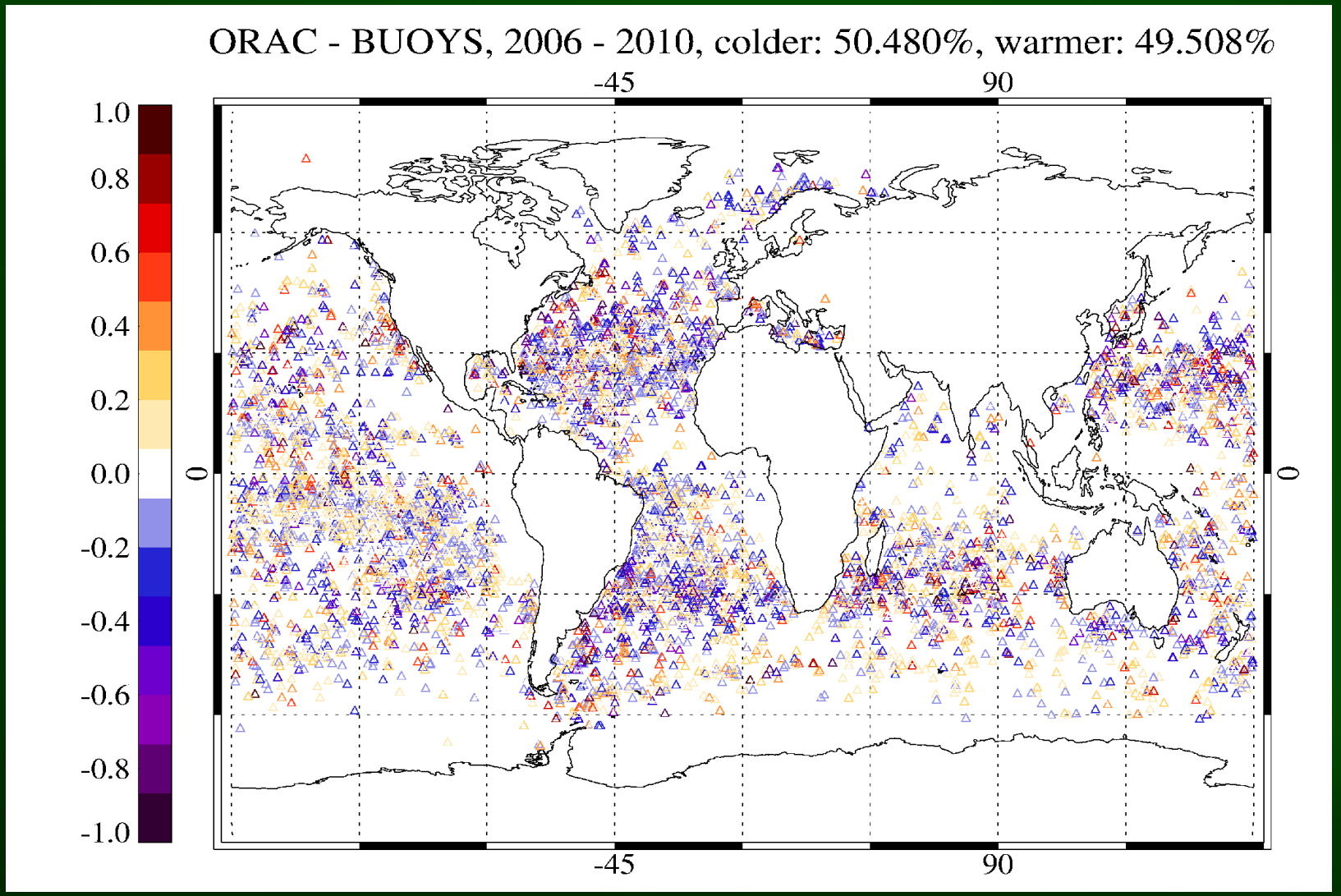


SST validation against buoys



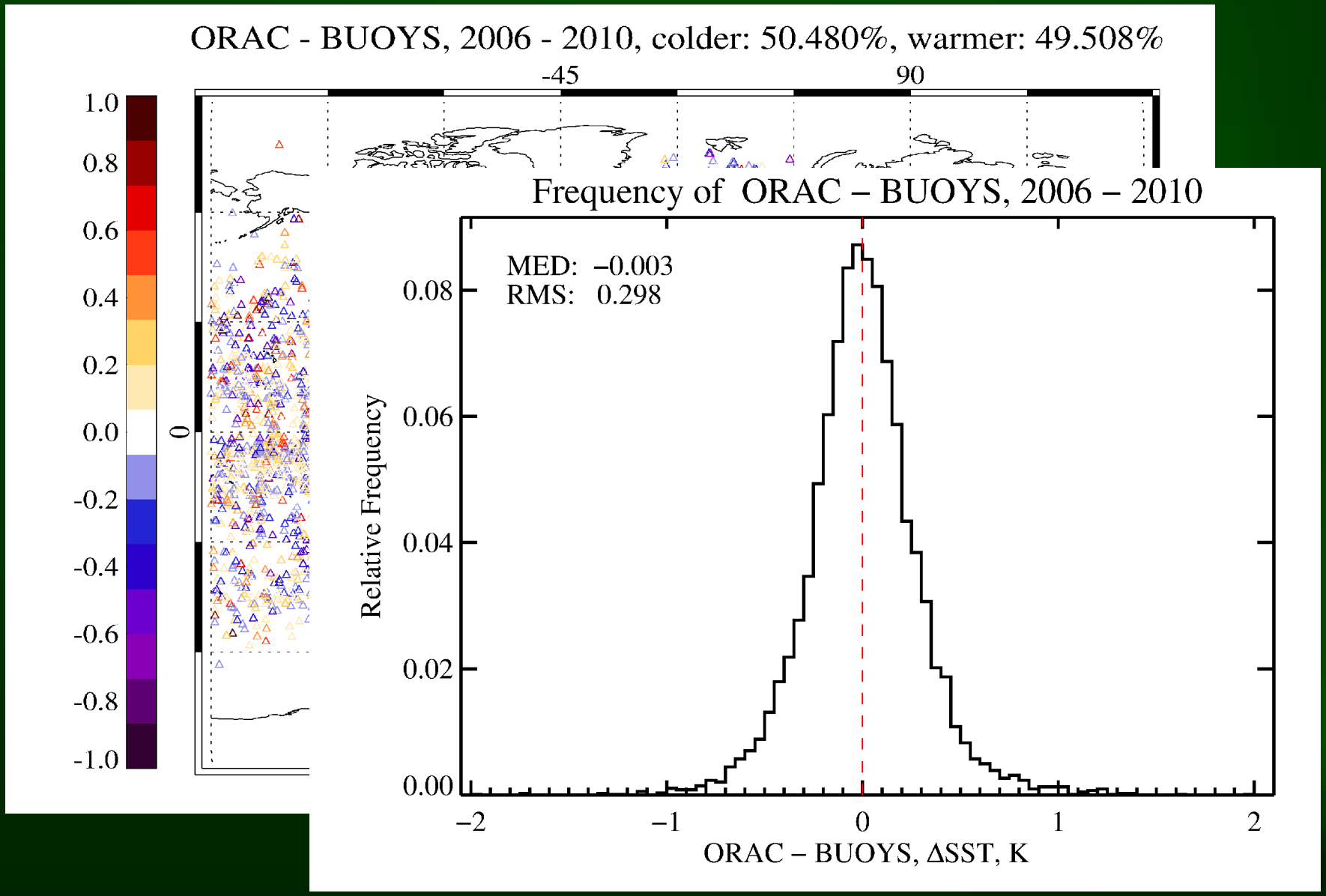
Global distribution of SST difference for 2006

SST validation against buoys



Global distribution of SST difference for 2006 for wind speed < 6ms^{-1}

SST validation against buoys



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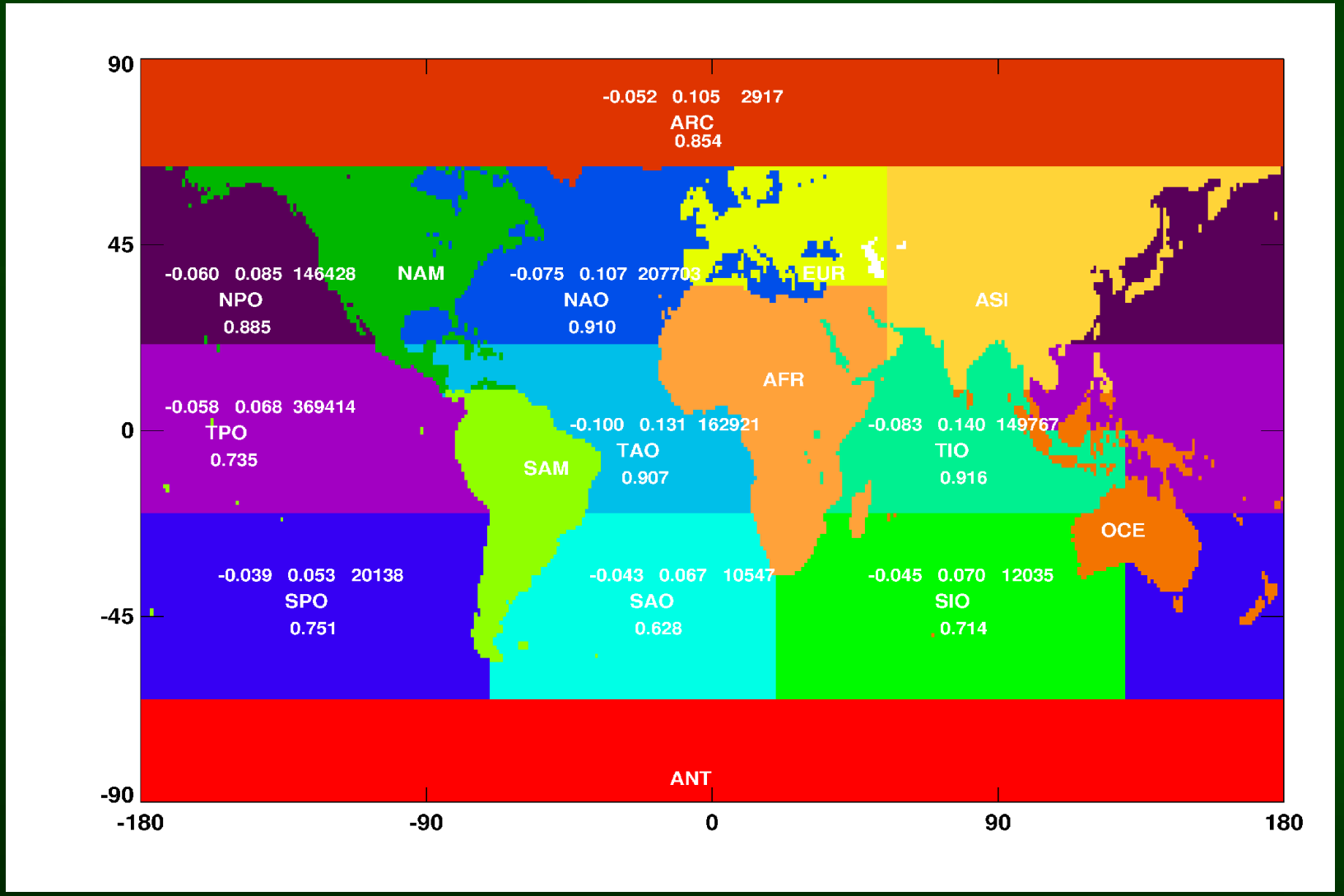
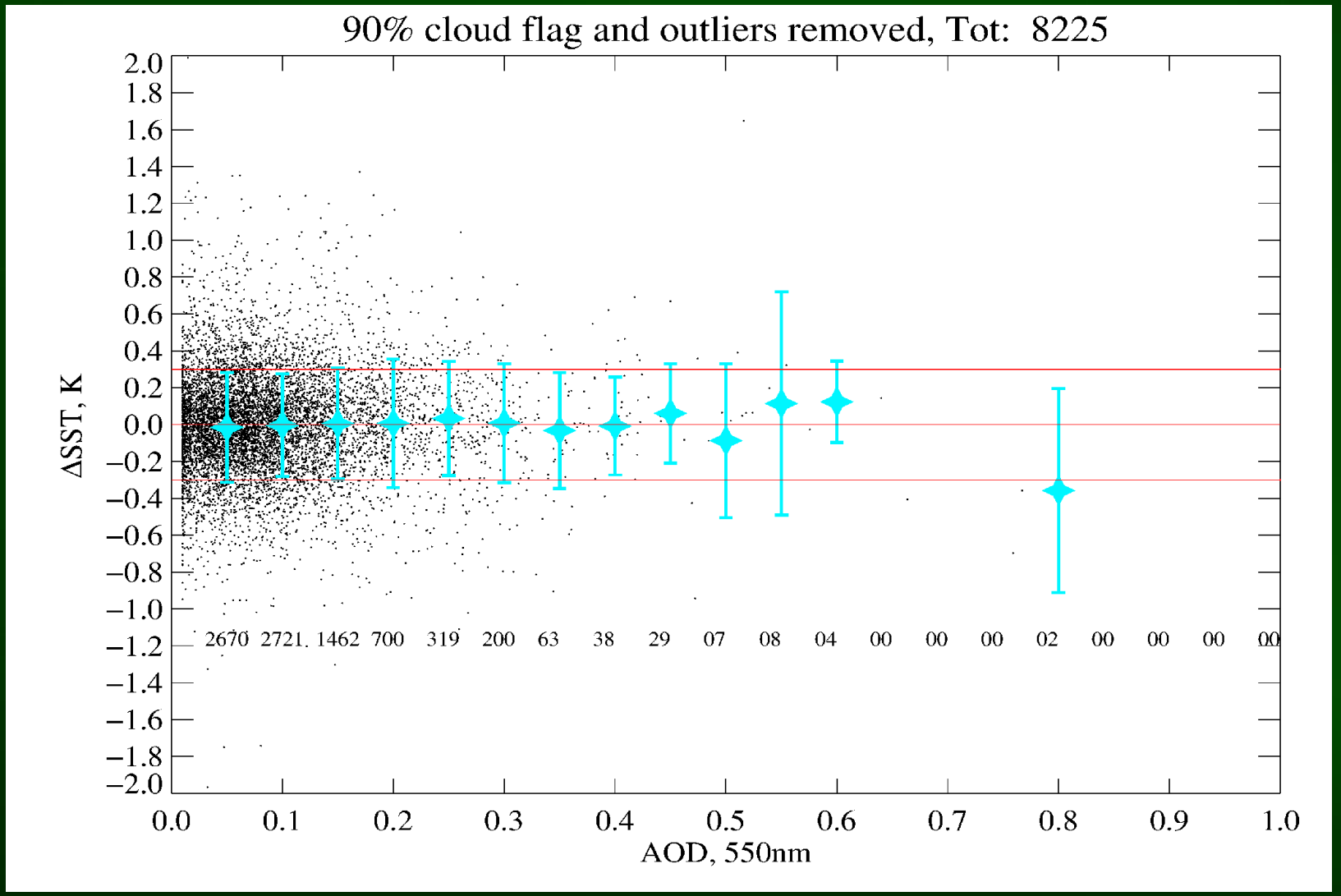


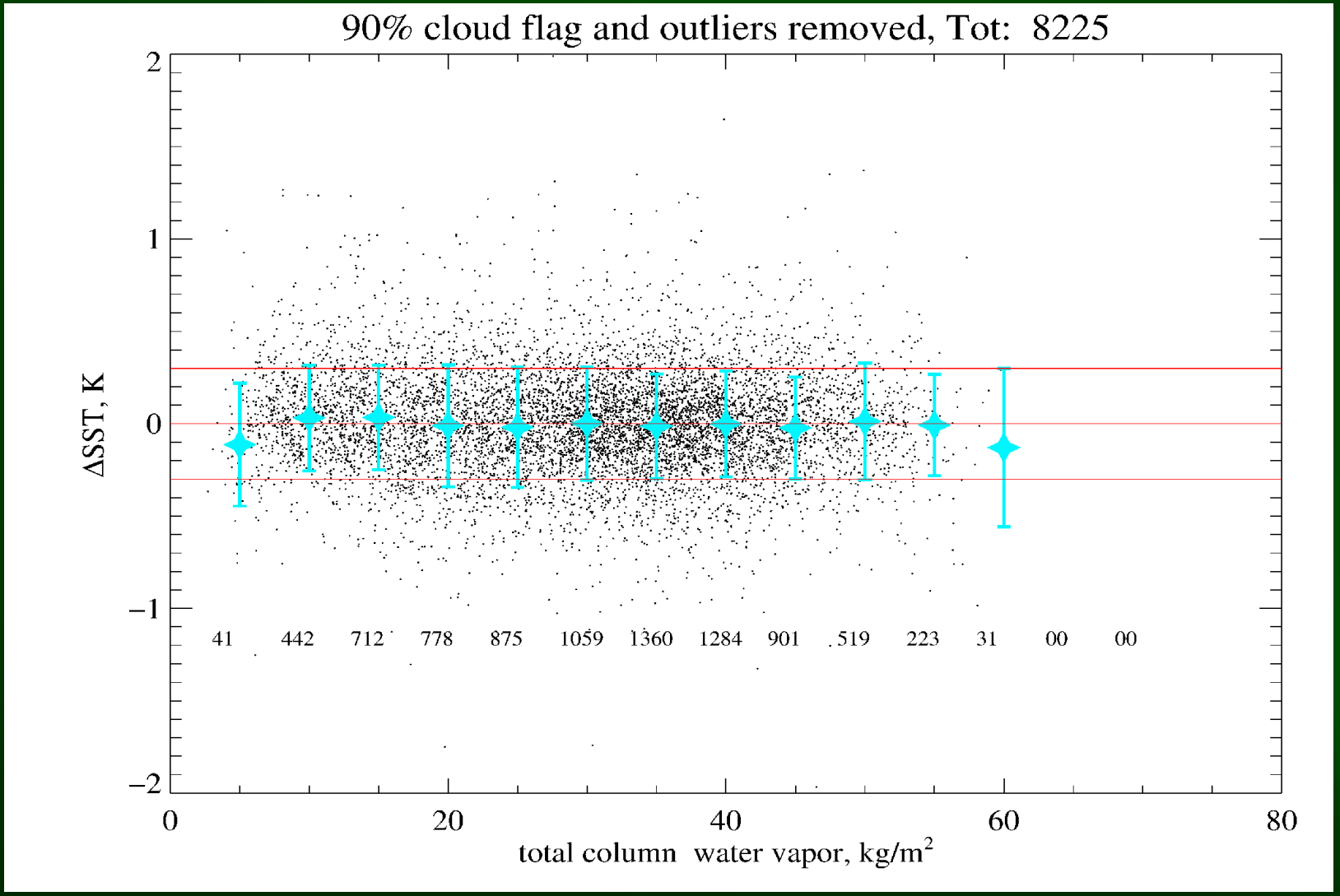
Median difference, RMS difference, number of points, and correlation coefficient by region.

SST validation against buoys



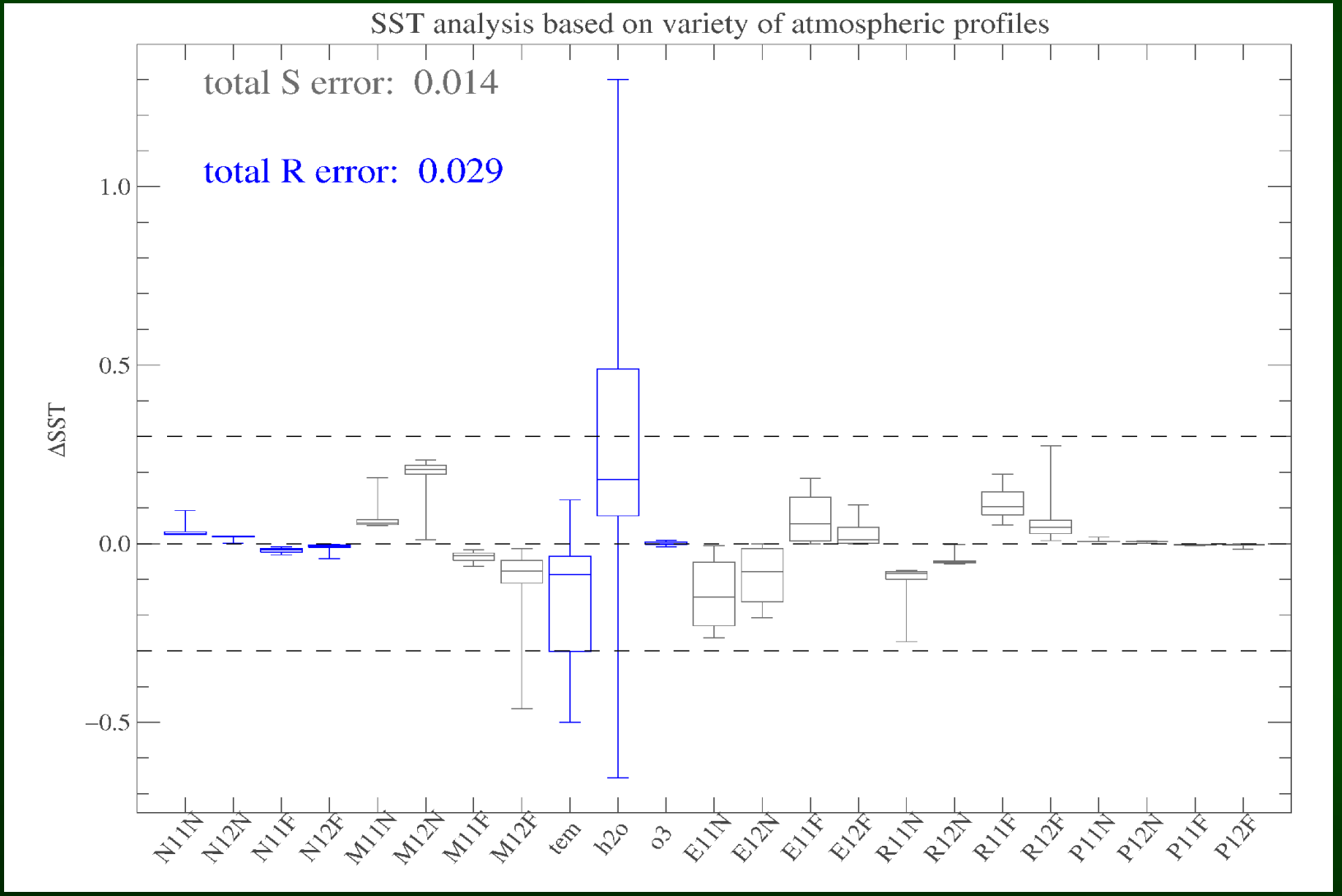
SST uncertainty as a function of retrieved AOD

SST validation against buoys



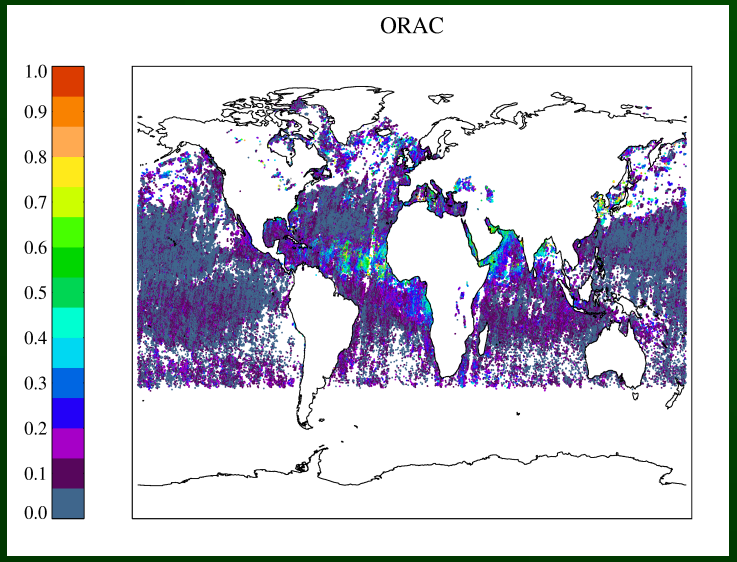
SST uncertainty as a function of column water vapour

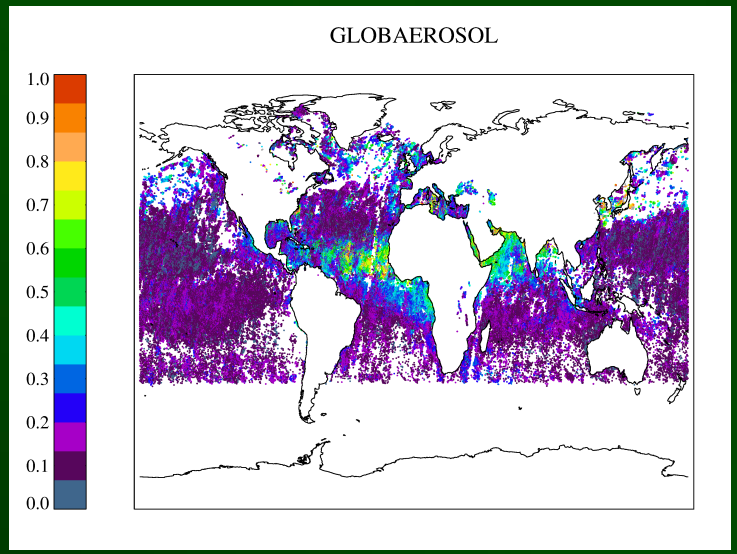
Error analysis

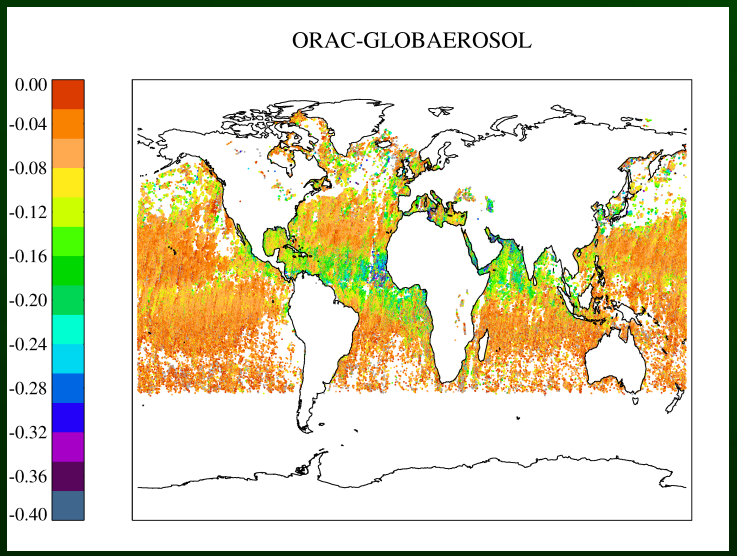


Contribution to SST uncertainty from calibration noise and bias, species profiles, emissivity, RTTOV errors, and the modified Planck function.

Comparison to GlobAEROSOL

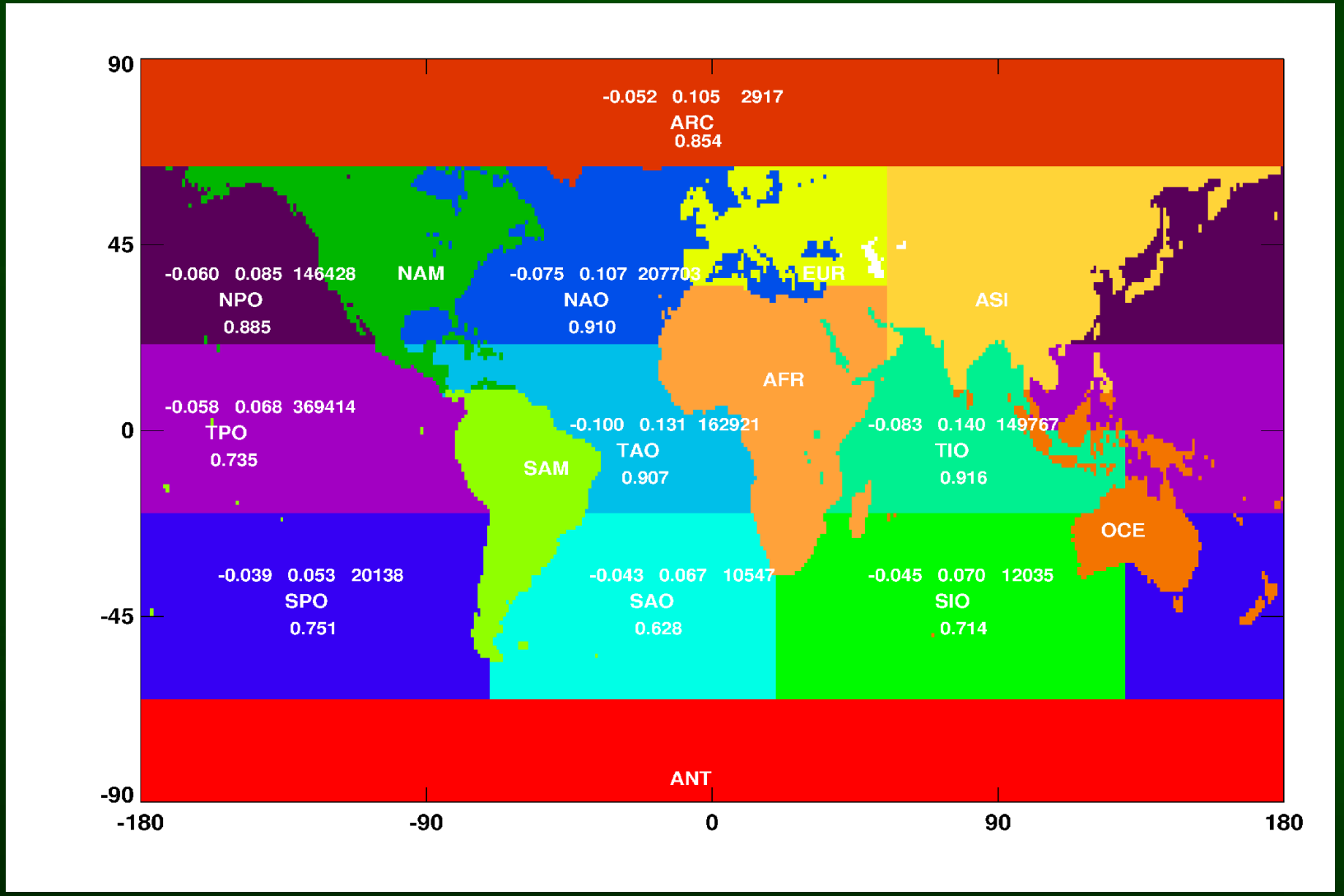






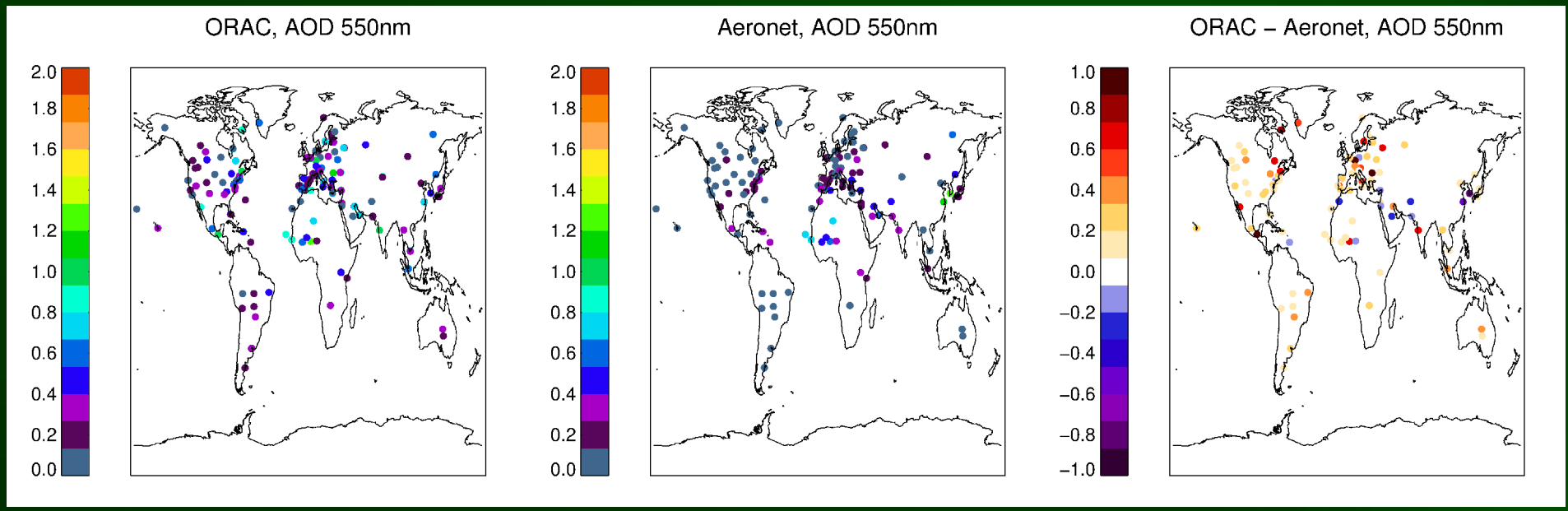
Monthly means from Sep 2008

Comparison to GlobAEROSOL

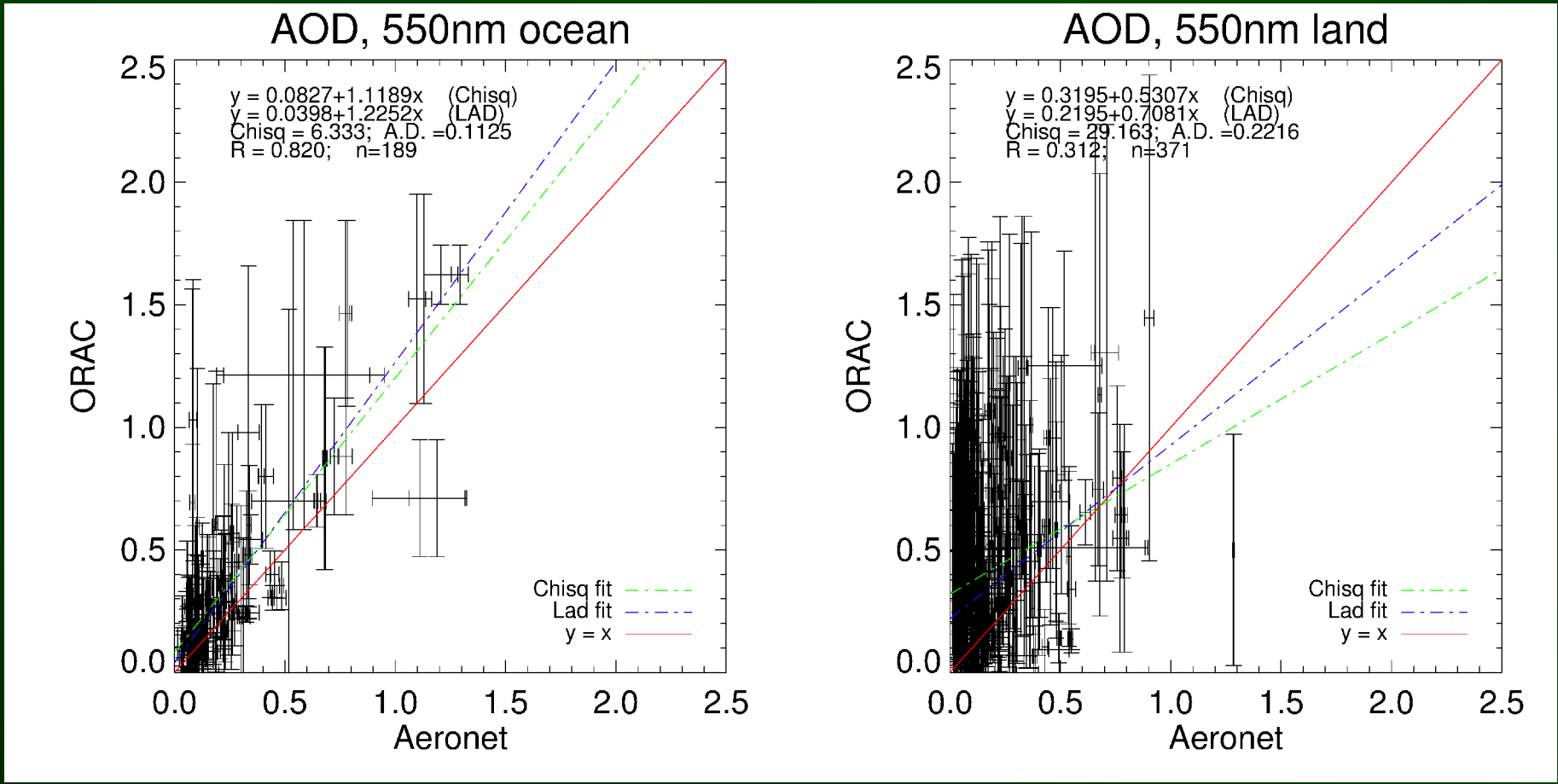


Median difference, RMS difference, number of points, and correlation coefficient by region.

Comparison to AERONET

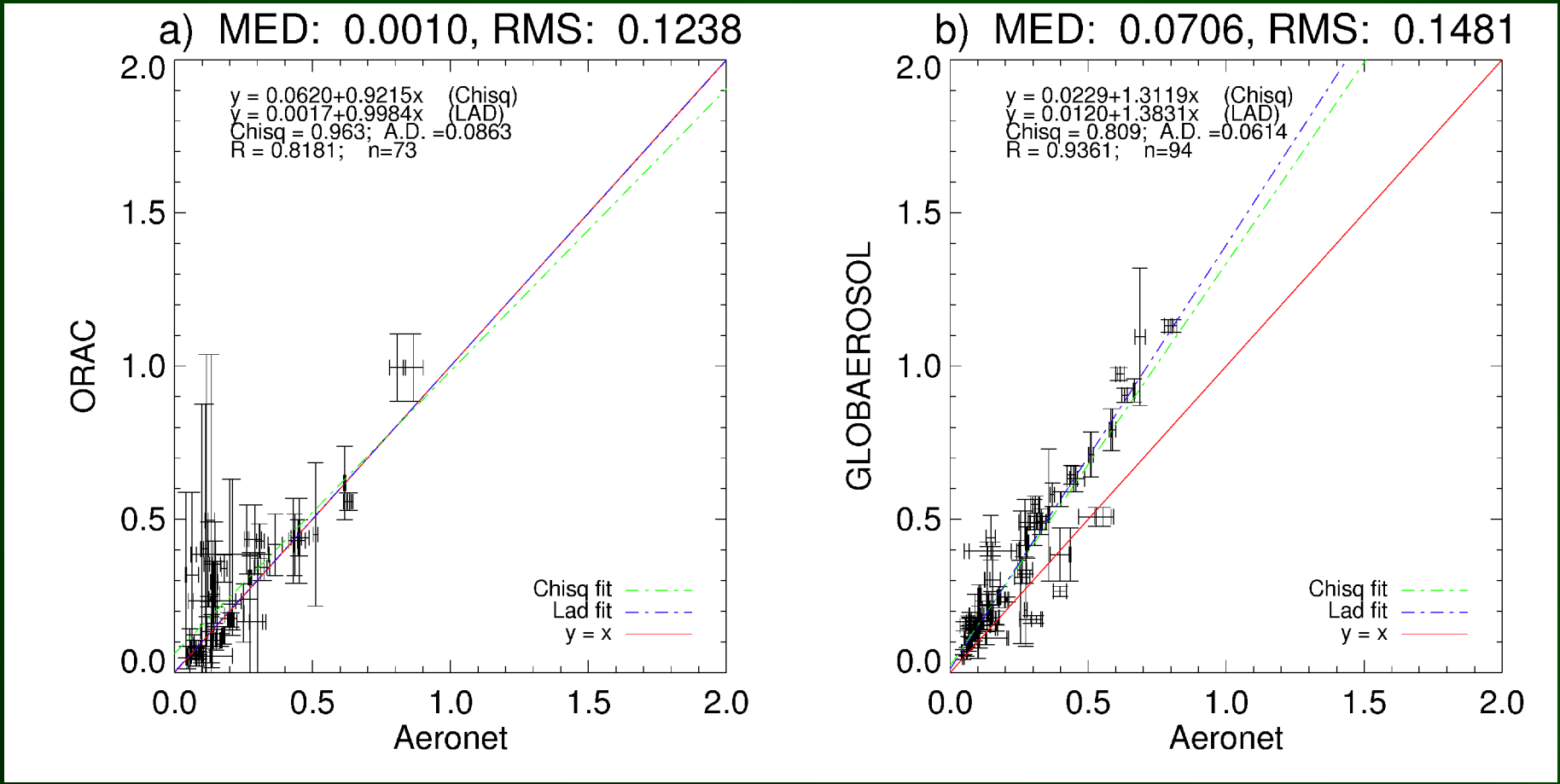


Comparison to AERONET



Retrievals averaged over 30 minutes and 30 km of an AERONET site during June 2008

Comparison to AERONET



The same, but for September 2008

Conclusions

- The ORAC algorithm has been adapted to simultaneously retrieve SST and AOD.
- SST uncertainties of ±0.3 K, in line with the design specification of AATSR.
- Aerosol retrievals requires further work, but are of a similar standard to previous results from ORAC.
- This system will be integrated with the Aerosol and Cloud CCI algorithms over the coming months.