SSES & L4

GHRSST-XVII

Overview of issues: Scope, objectives, metrics

Topic remit (proposed @GHRSST-XVI)

- Methods for SSES production
  - Are some methods better than others?
  - Is convergence necessary/desirable/possible?
- Methods for validation
  - How do we verify SSES methods?
  - Can this be standardized/improved?
- Use in L4
  - Do they help (How do we know)?
  - Are there issues?
  - How can their utility be improved?

- *N.B.* Primary scientific “value-added” of GHRSST L2P

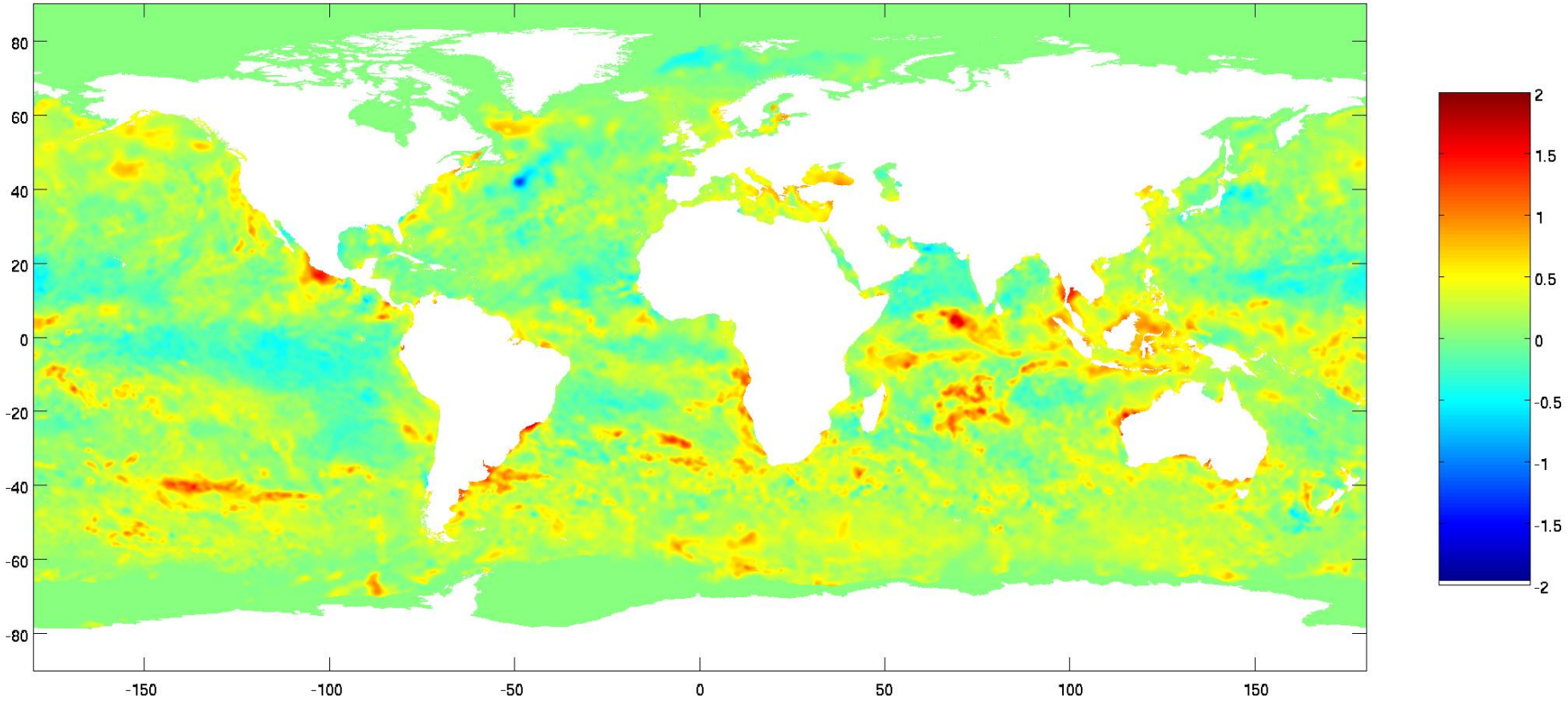
Overview of issues: Priorities

- **Use in L4**
  - Do they help (How do we know)?
  - Are there issues?
  - How can their utility be improved?
- Methods for validation
  - How do we verify SSES methods?
  - Can this be standardized/improved?
- Methods for SSES production
  - Are some methods better than others?
  - Is convergence necessary/desirable/possible?
  - Inconsistency, particularly SSTskin vs SSTdepth, after application of SSES bias

- *N.B.* Primary scientific "value-added" of GHRSST L2P

Compare ACSPO SST with/without SSES

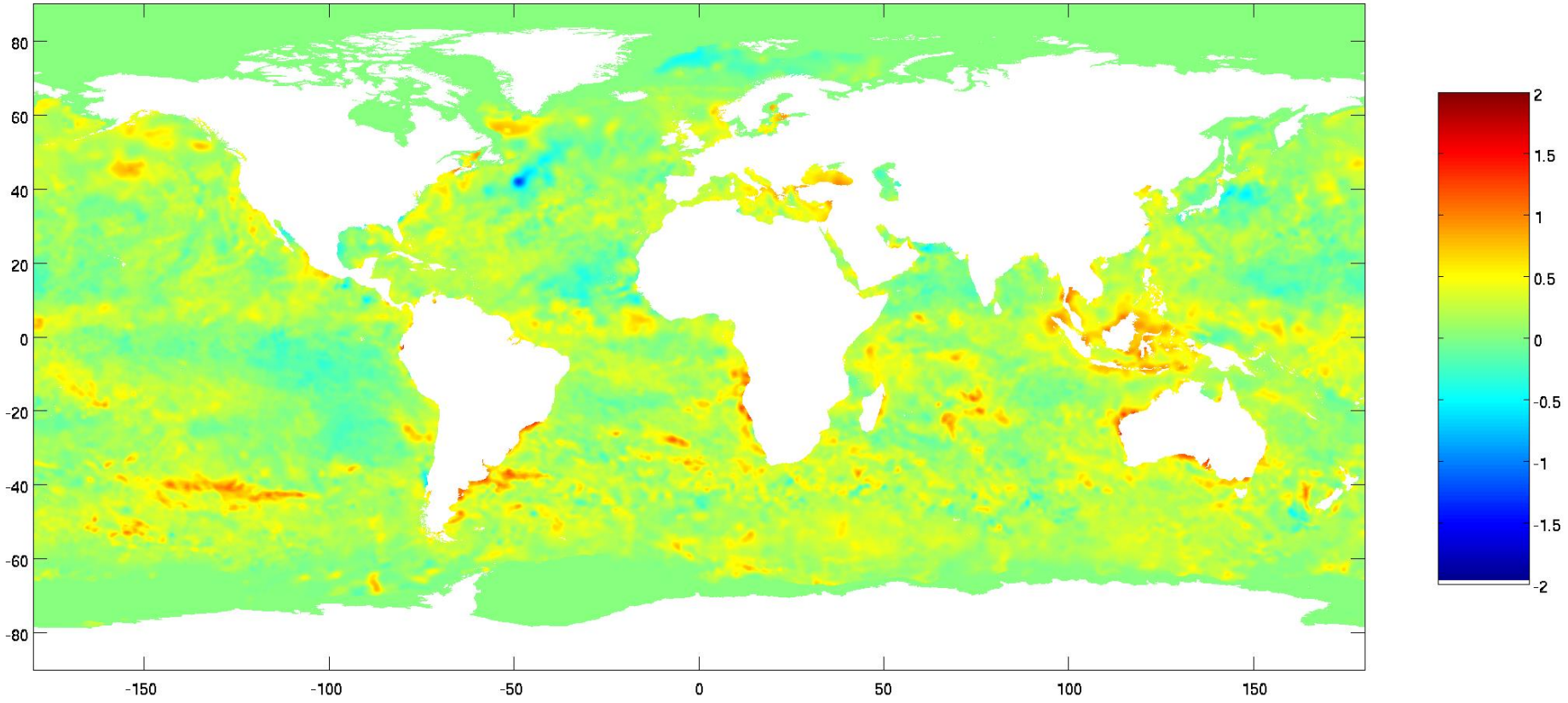
- Compare use of Bias & S.D., Bias-only, and no SSES



Bias for ACSPO VIIRS Day No SSES

Compare ACSPO SST with/without SSES

- Compare use of Bias & S.D., Bias-only, and no SSES



Bias for ACSPO VIIRS Day SSES Bias

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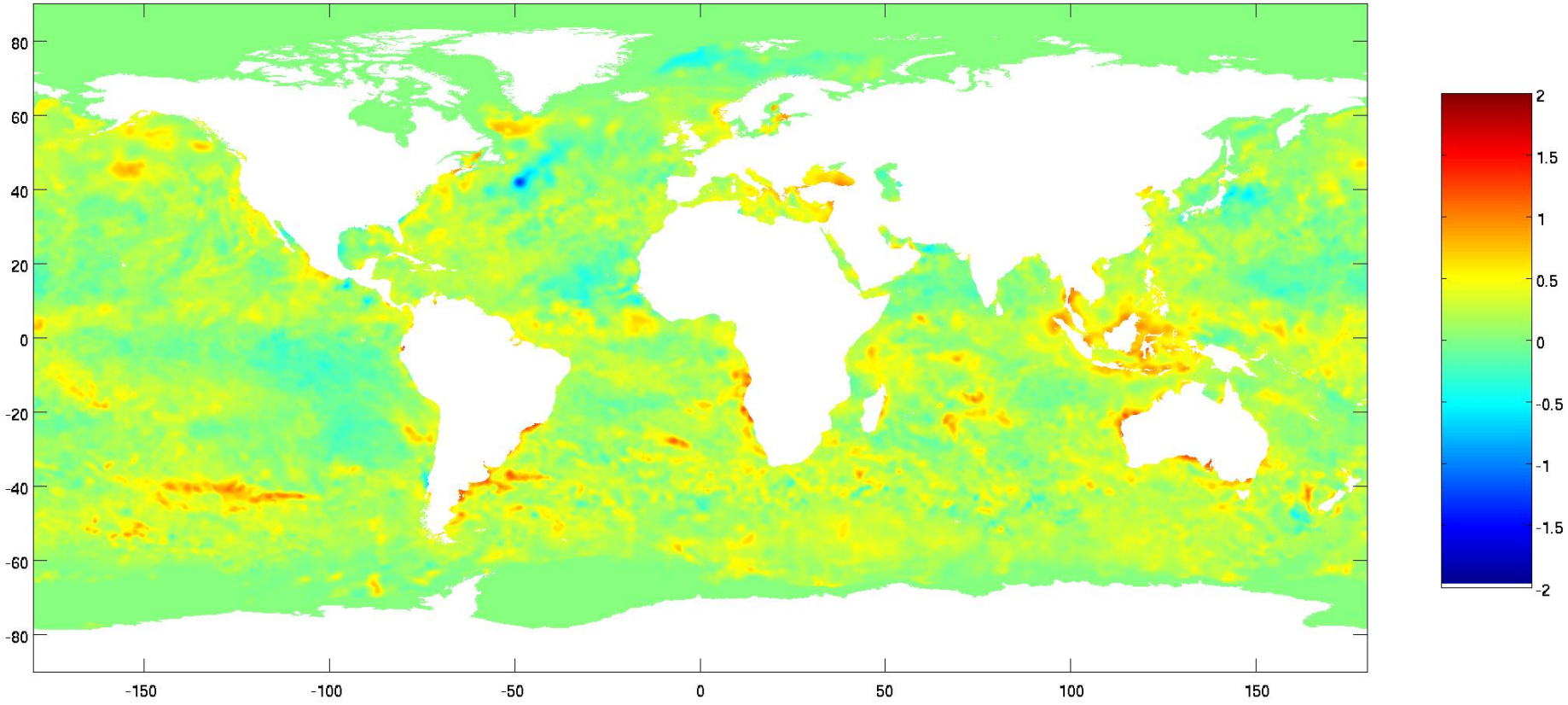

Bias for ACSPO VIIRS Day SSES Bias+SD

N.B. reversed sign *cf.* previous bias correction plots

Compare ACSPO SST with/without SSES

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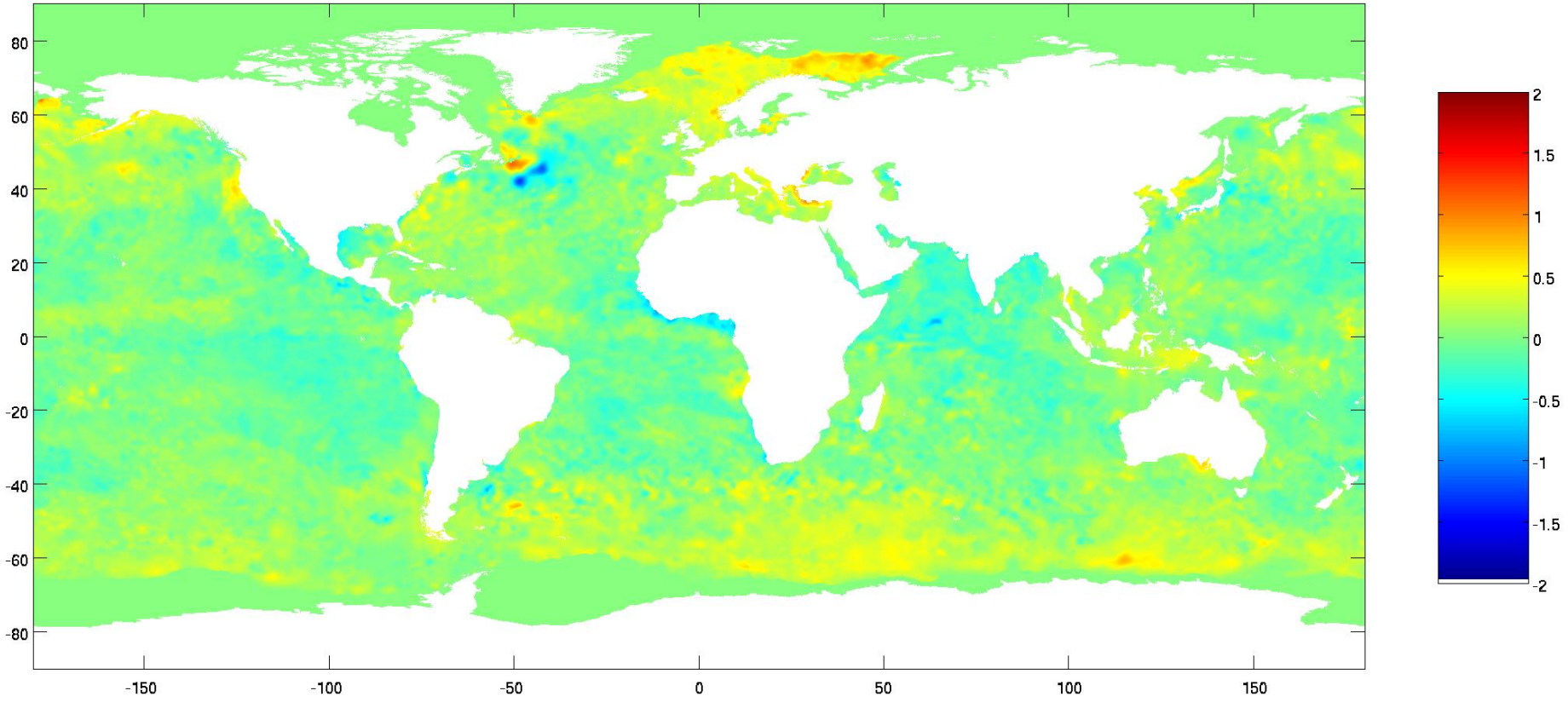

Bias for ACSPO VIIRS Night No SSES

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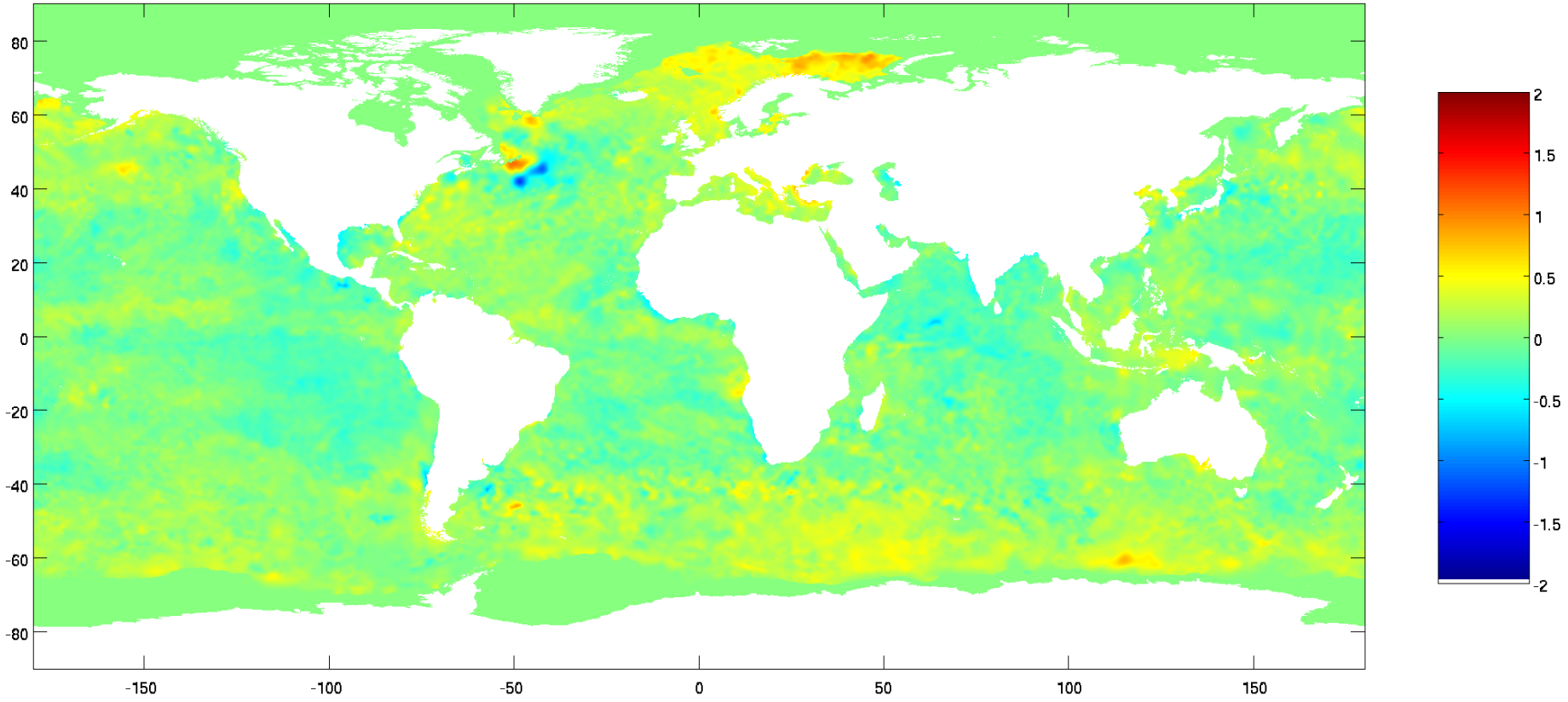

Bias for ACSPO VIIRS Night SSES Bias

Compare ACSPO SST with/without SSES

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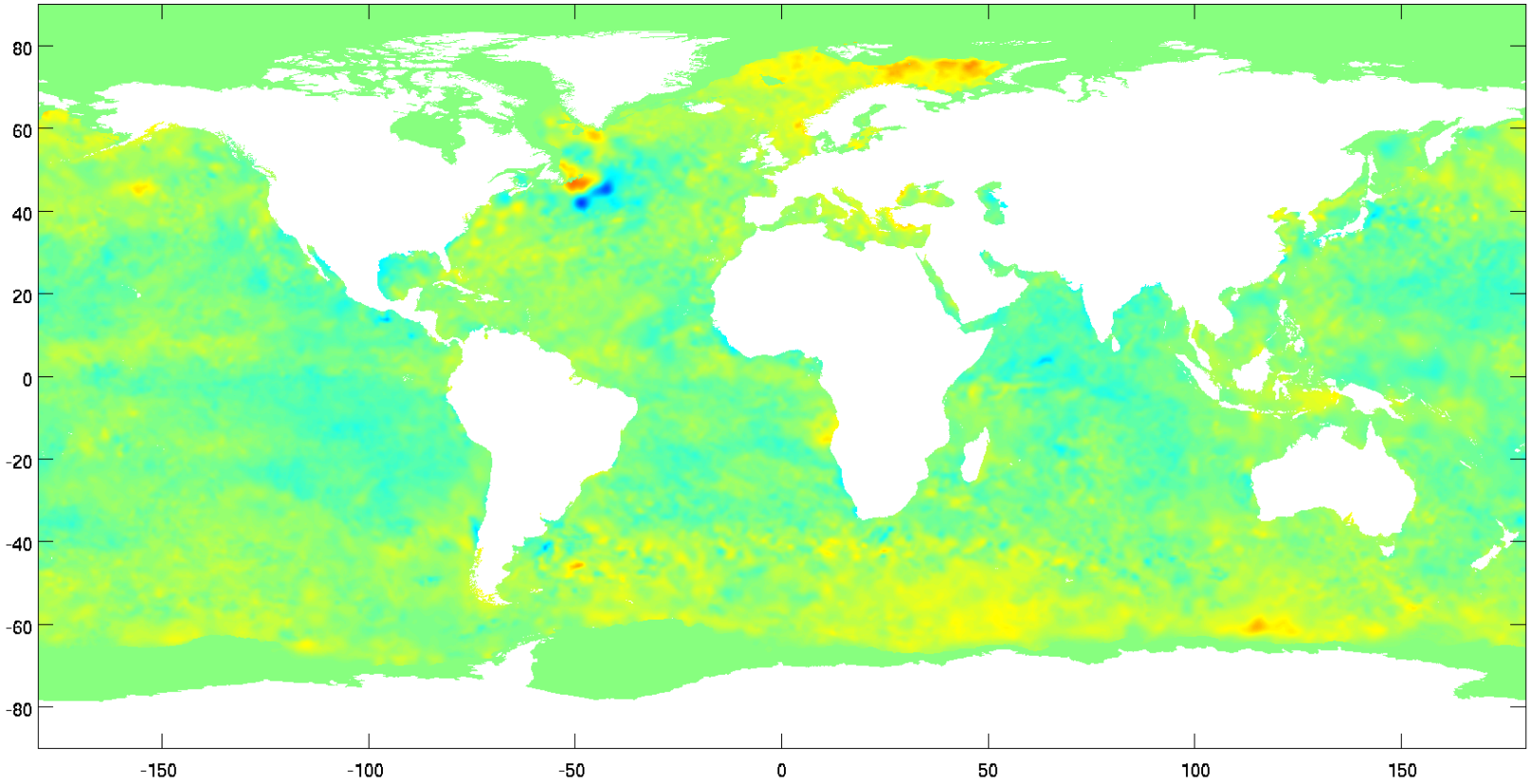

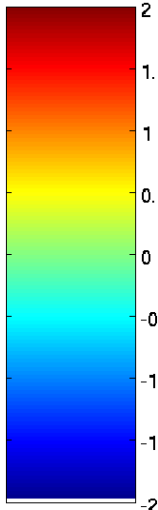

Bias for ACSPO VIIRS Night SSES Bias+SD

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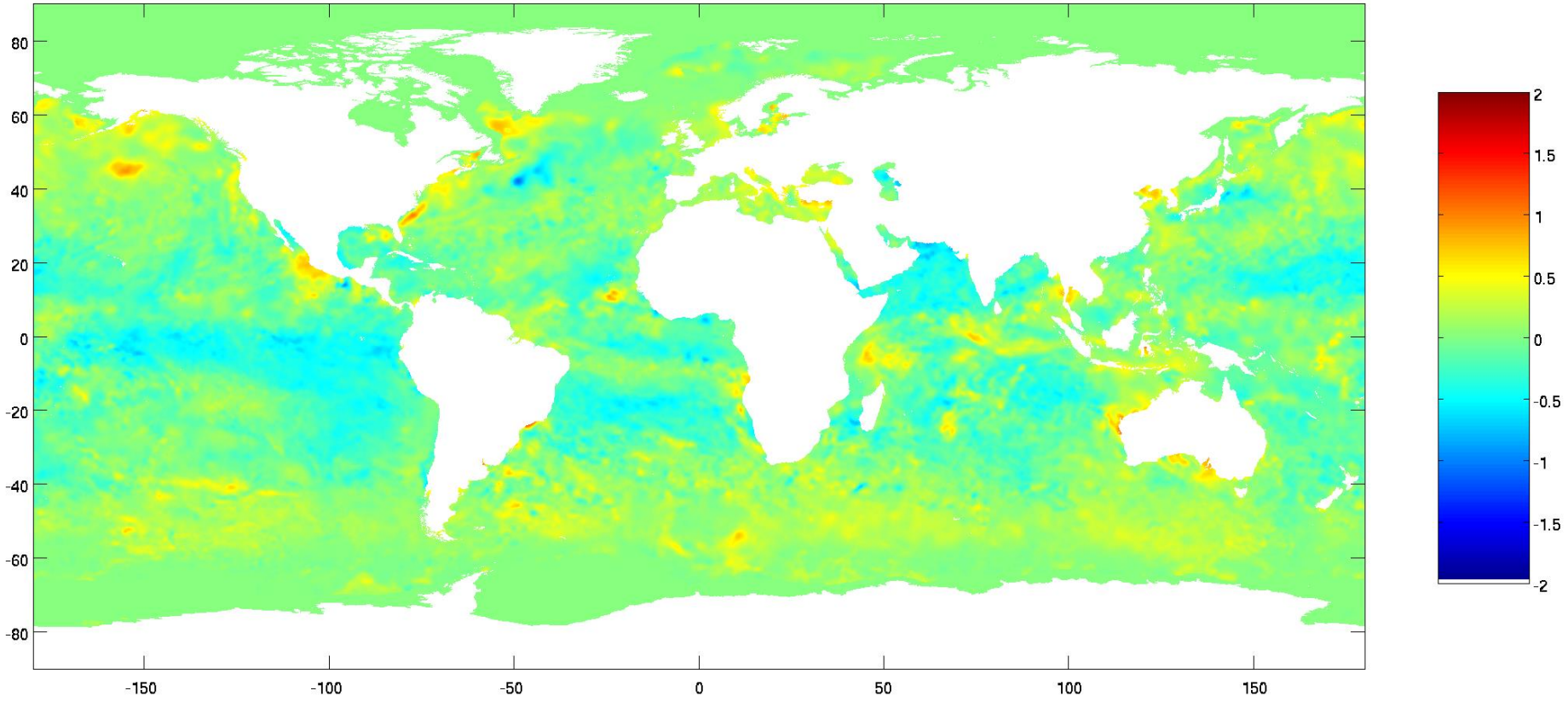
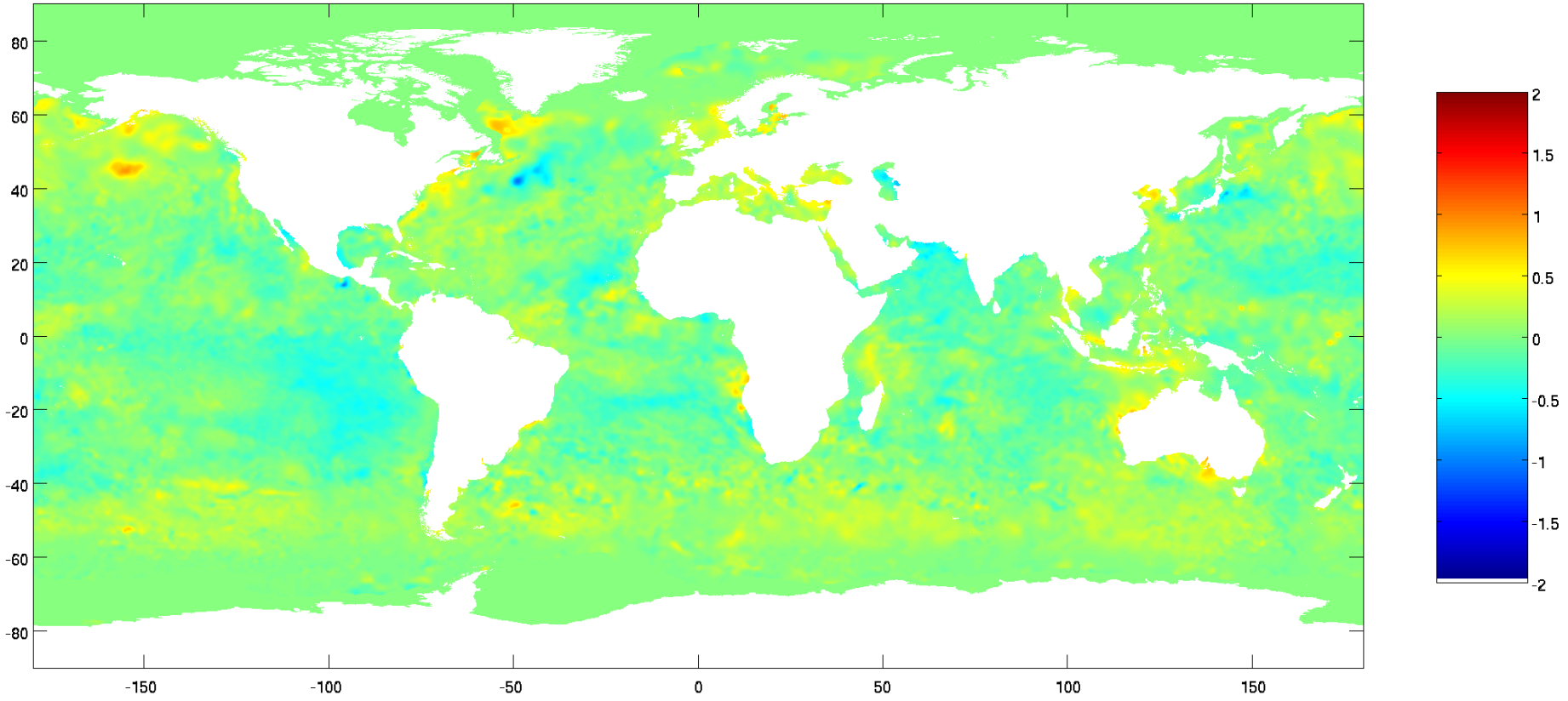


Bias for ACSPO METOP-B Day No SSES

Compare ACSPO SST with/without SSES

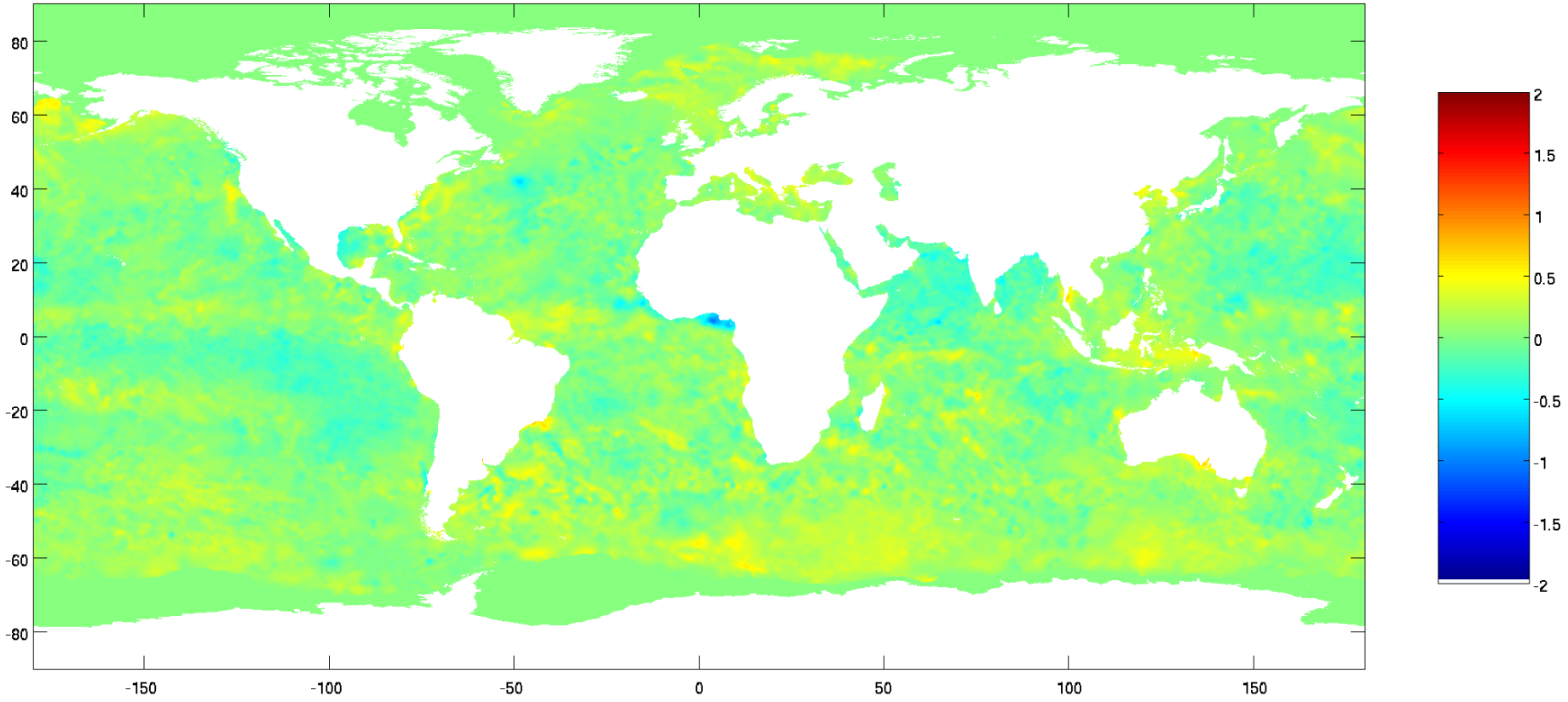
- Compare use of Bias & S.D., Bias-only, and no SSES



Bias for ACSPO METOP-B Day SSES Bias

Compare ACSPO SST with/without SSES

- Compare use of Bias & S.D., Bias-only, and no SSES



Bias for ACSPO METOP-B Night SSES Bias

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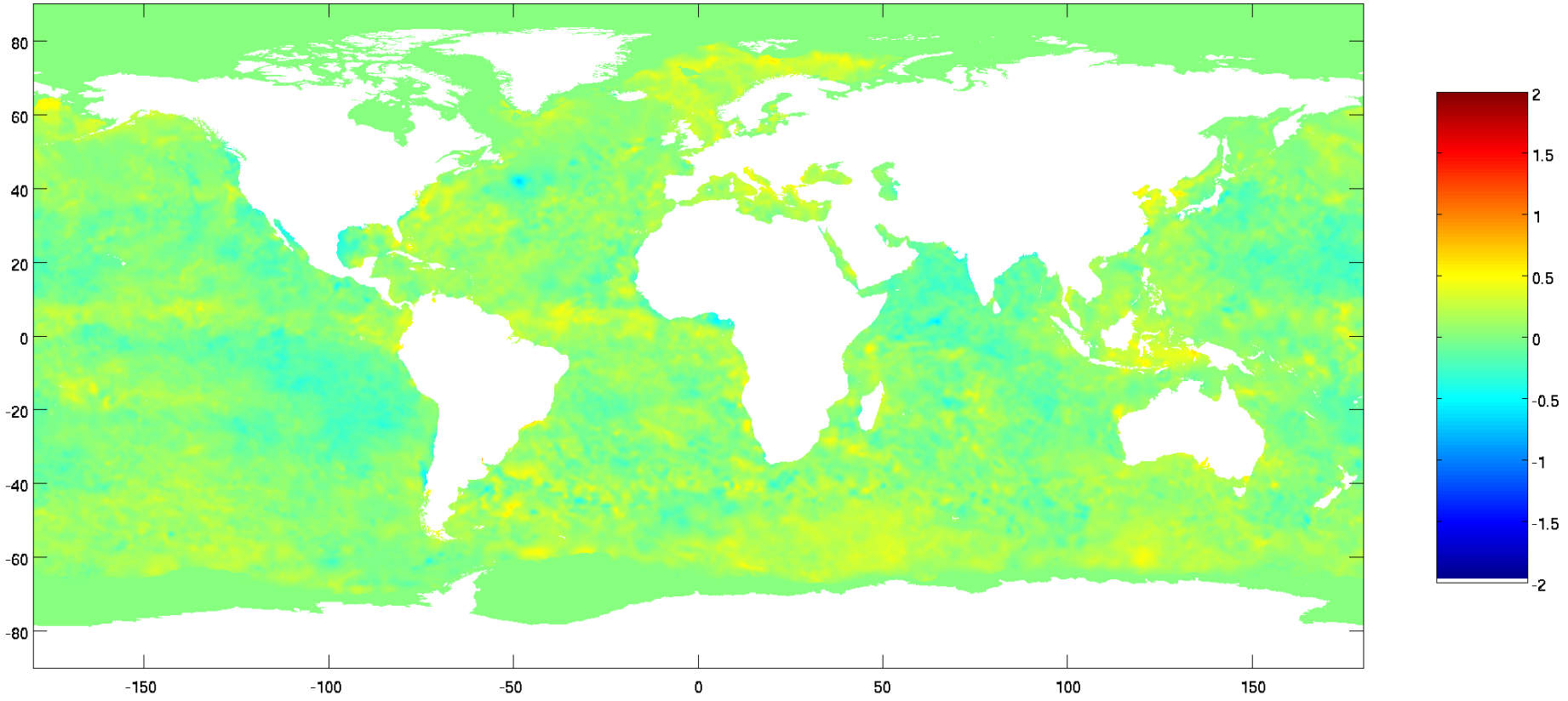

Bias for ACSPO METOP-B Night SSES Bias

Points to note

- Using S.D. makes very little difference to bias
  - Not too surprising
- Biases w.r.t. reference (OSTIA) may not reduce
  - OSTIA uses OSI-SAF METOP-A nighttime GHRSST QL5 restricted swath data and *in situ* as its bias-correction reference
  - Explain reduced biases for METOP-B night *cf.* VIIRS?
- ACSPO SSES bias is adjustment to PWR SST
  - Appears to suppresses diurnal warming
  - Makes correction for residual DW difficult
  - Since PWR does not make use of wind speed, implies there are signals (at least distinct statistical groupings) in BTs due to DW
    - Interesting physics
  - Investigate nighttime VIIRS PWR SST as reference?
  - Question – is SSES S.D. effectively that for PWR SST?

Experiments/collaborations

- **What is SSES trying to do?**
  - Originally for NRT L4 production – are they fit for purpose?
  - Bear in mind CDRs, other users
  - Revisit SSES common principles
  - Education of end-users (carefully – trust issue)
- **Use in L4**
  - Do they help (How do we know)?
  - Are there issues?
  - How can their utility be improved?
- Methods for validation
  - How do we verify SSES methods?
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- Methods for SSES production
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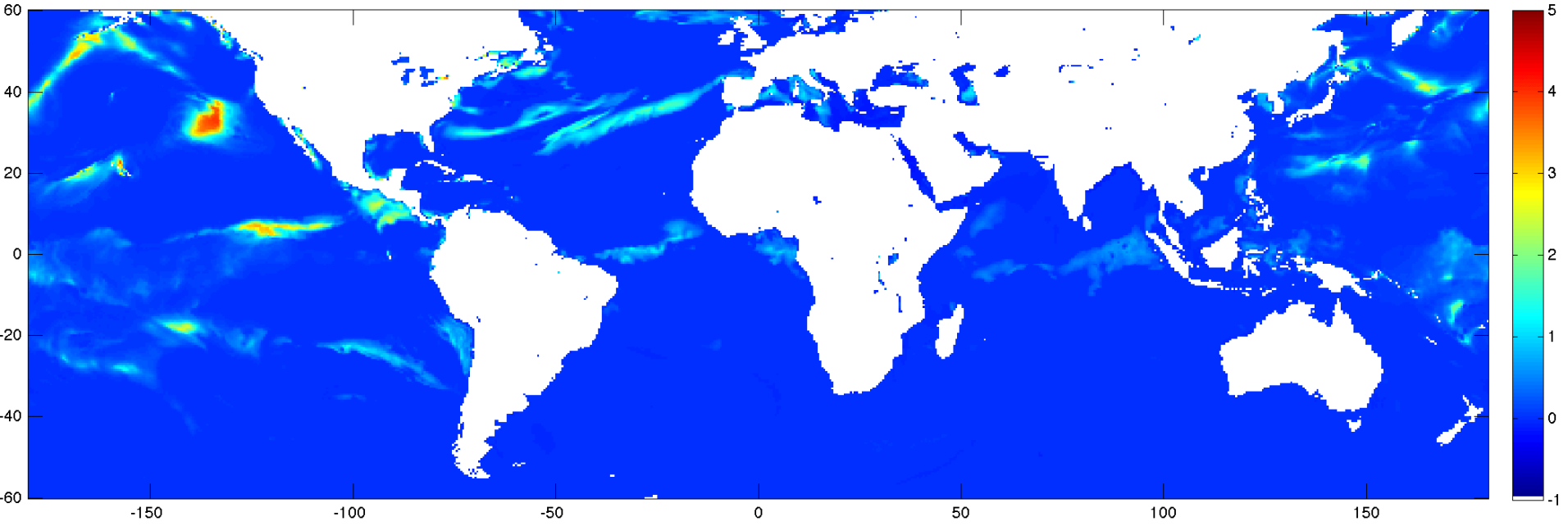
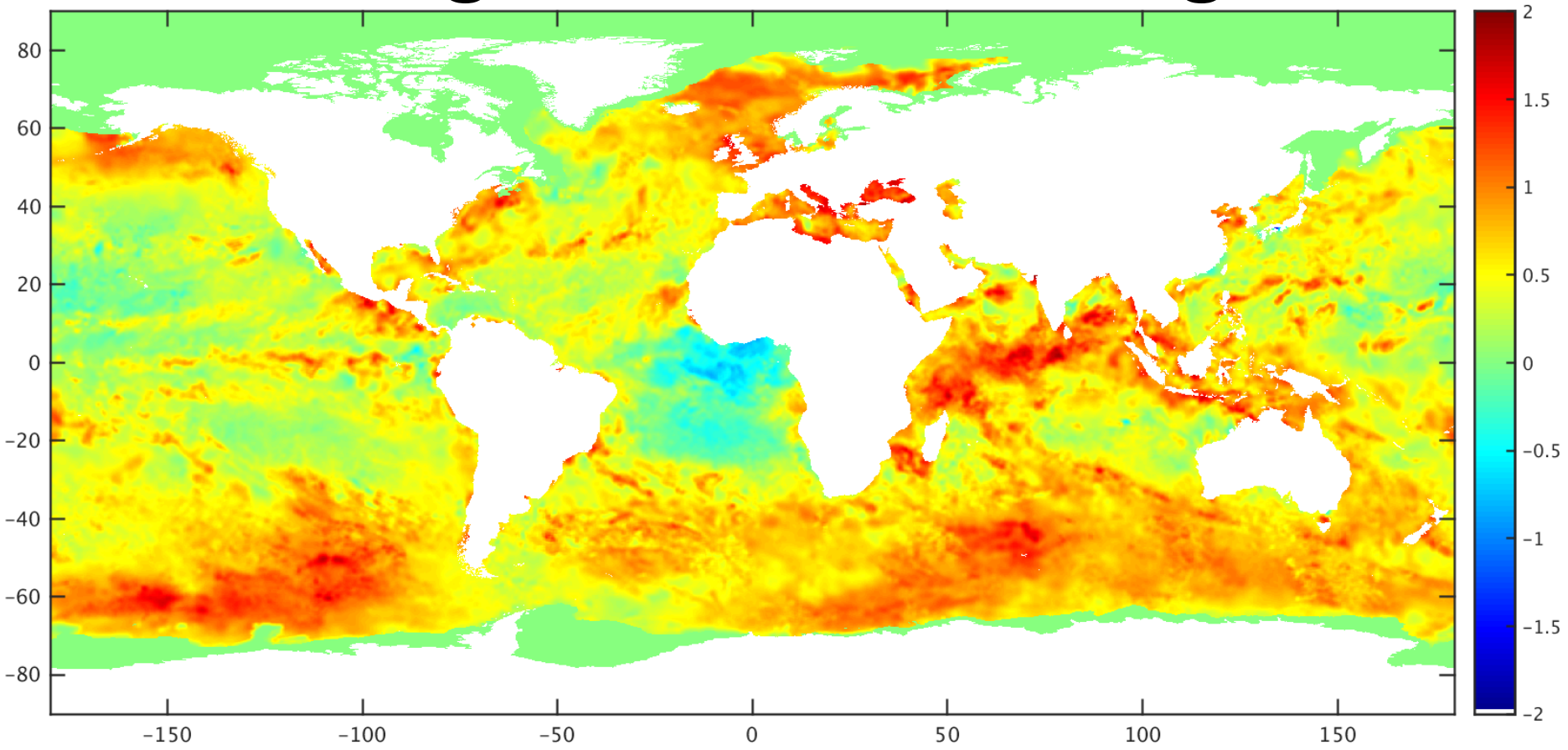
Diurnal adjustment example



- Regions of >5 K warming
- Note, warming events on edge of ±60° limit

Magnitude of warming



- Bias correction usually <2 K
- Model response damped by including gustiness parameterization
- Why might the observed diurnal excursion be damped?

How sensitive is retrieved SST to true SST?

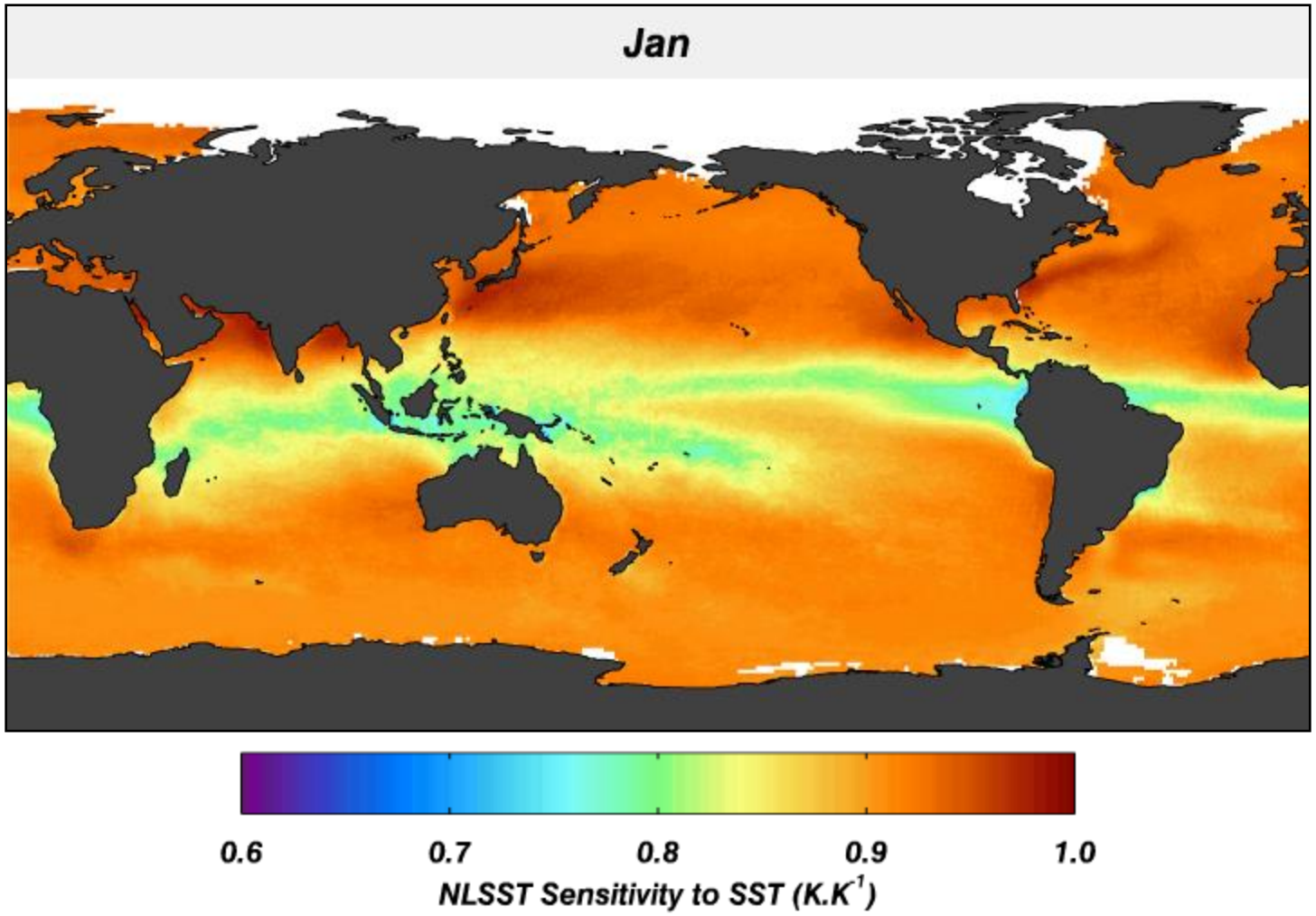
- If SST changes by 1 K, does retrieved SST change by 1 K?
- CRTM provides tangent-linear derivatives $\partial T_{11}/\partial SST_{\text{true}}$ $\partial T_{12}/\partial SST_{\text{true}}$

Response of **NLSST algorithm** to a change in **true SST** is…

$$\partial NLSST/\partial SST_{\text{true}} = \left(a_1 + a_2 \times SST_{bg} + a_3 \times \{\sec(ZA) - 1\}\right) \times \partial T_{11}/\partial SST_{\text{true}} - \left(a_2 \times SST_{bg} + a_3 \times \{\sec(ZA) - 1\}\right) \times \partial T_{12}/\partial SST_{\text{true}}$$

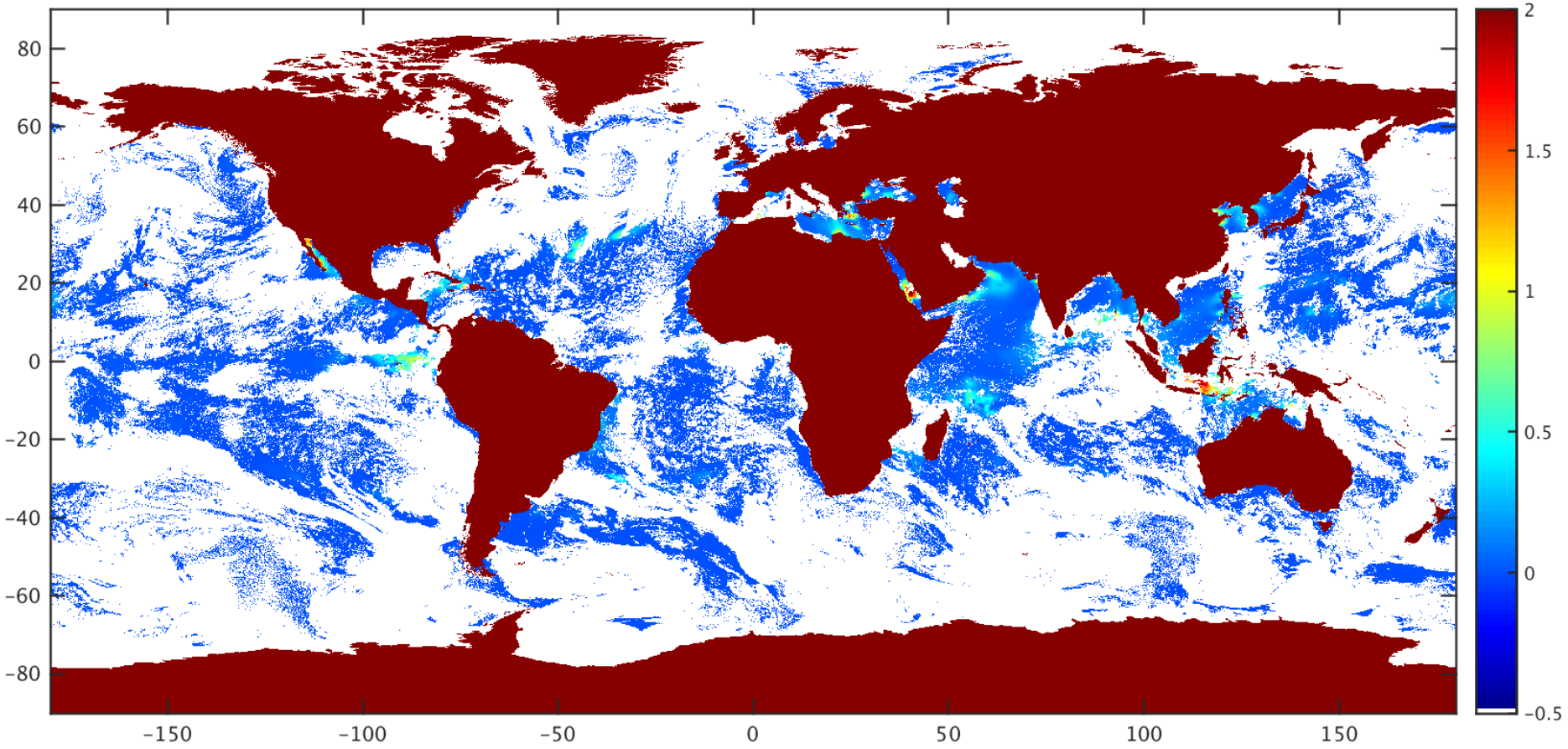
Merchant, C.J., A.R. Harris, H. Roquet and P. Le Borgne, Retrieval characteristics of non-linear sea surface temperature from the Advanced Very High Resolution Radiometer, Geophys. Res. Lett., **36**, L17604, 2009

Sensitivity to true SST



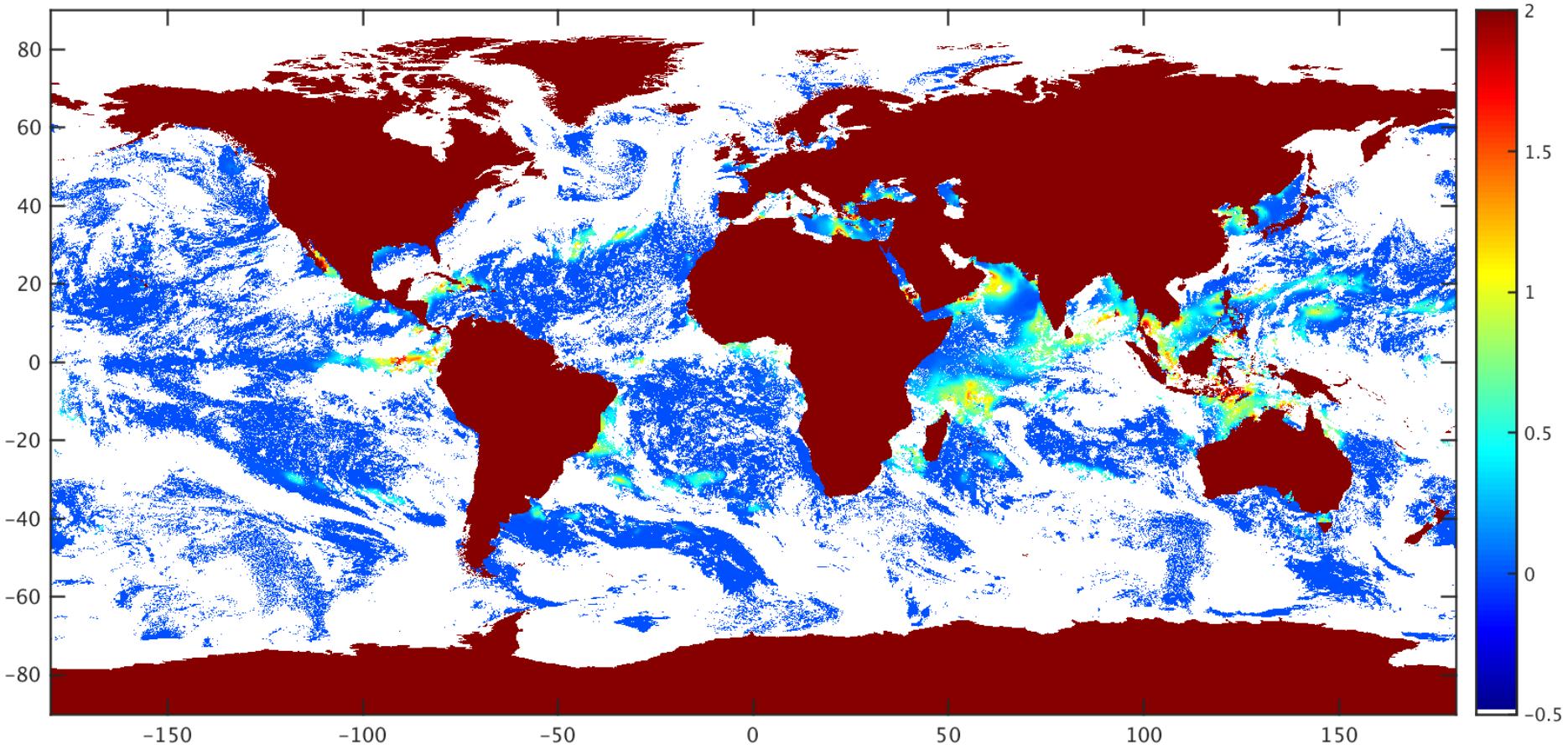
Sensitivity often <1 and changes with season

Effect of diurnal adjustment on input data



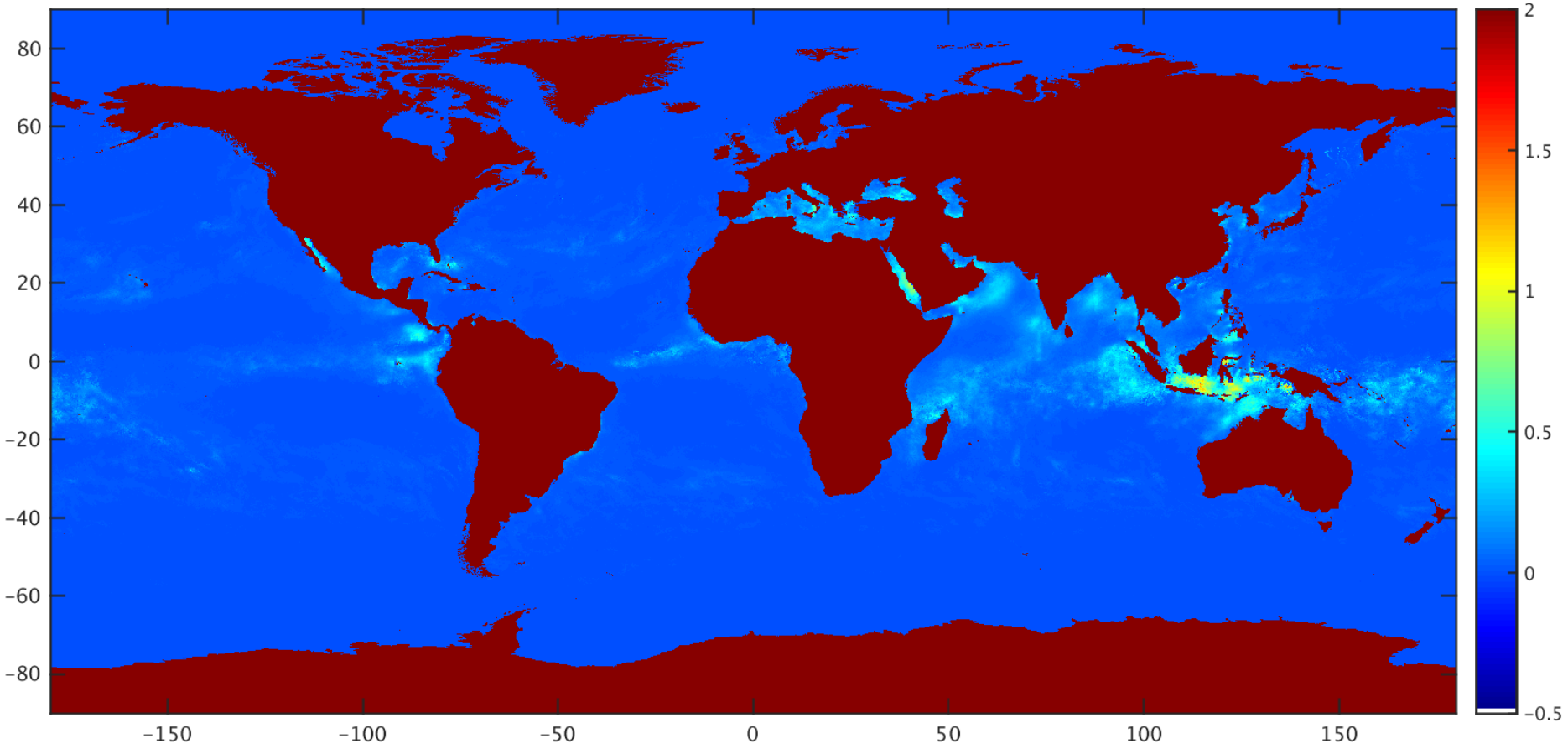
- METOP adjustments are fairly modest

Effect of diurnal adjustment on input data



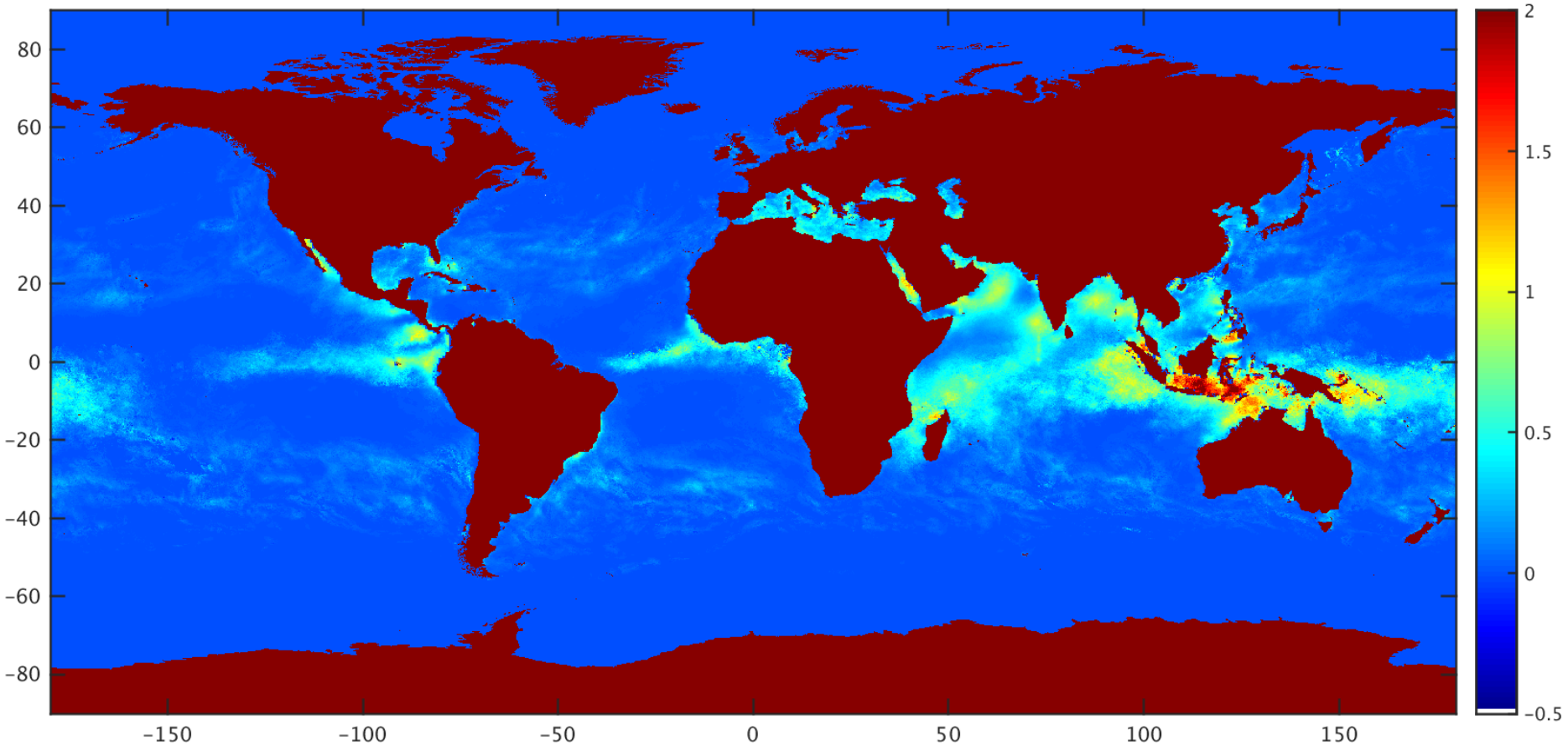
- VIIRS adjustments are more significant

Effect of diurnal adjustment on input data



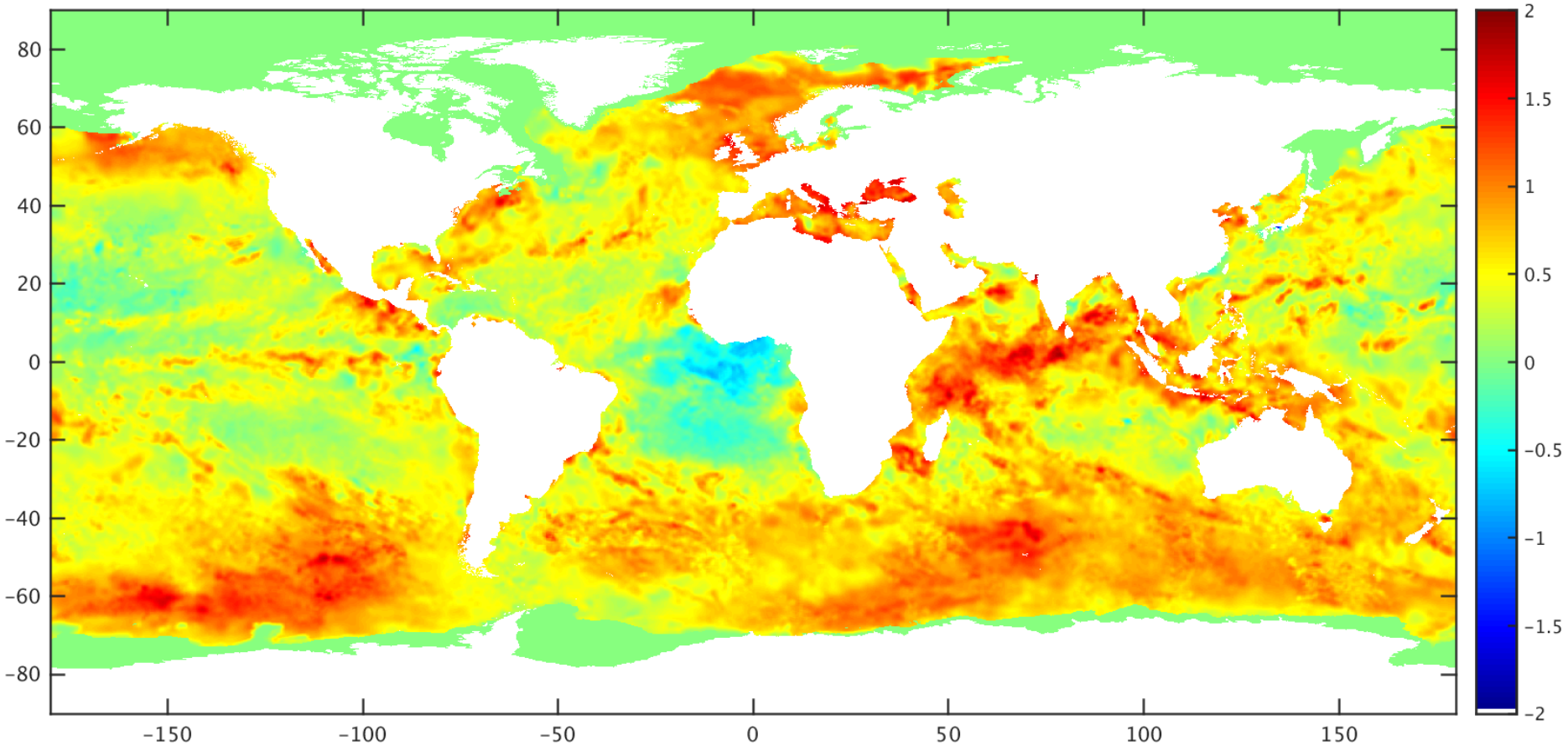
- METOP monthly average for March 2016

Effect of diurnal adjustment on input data



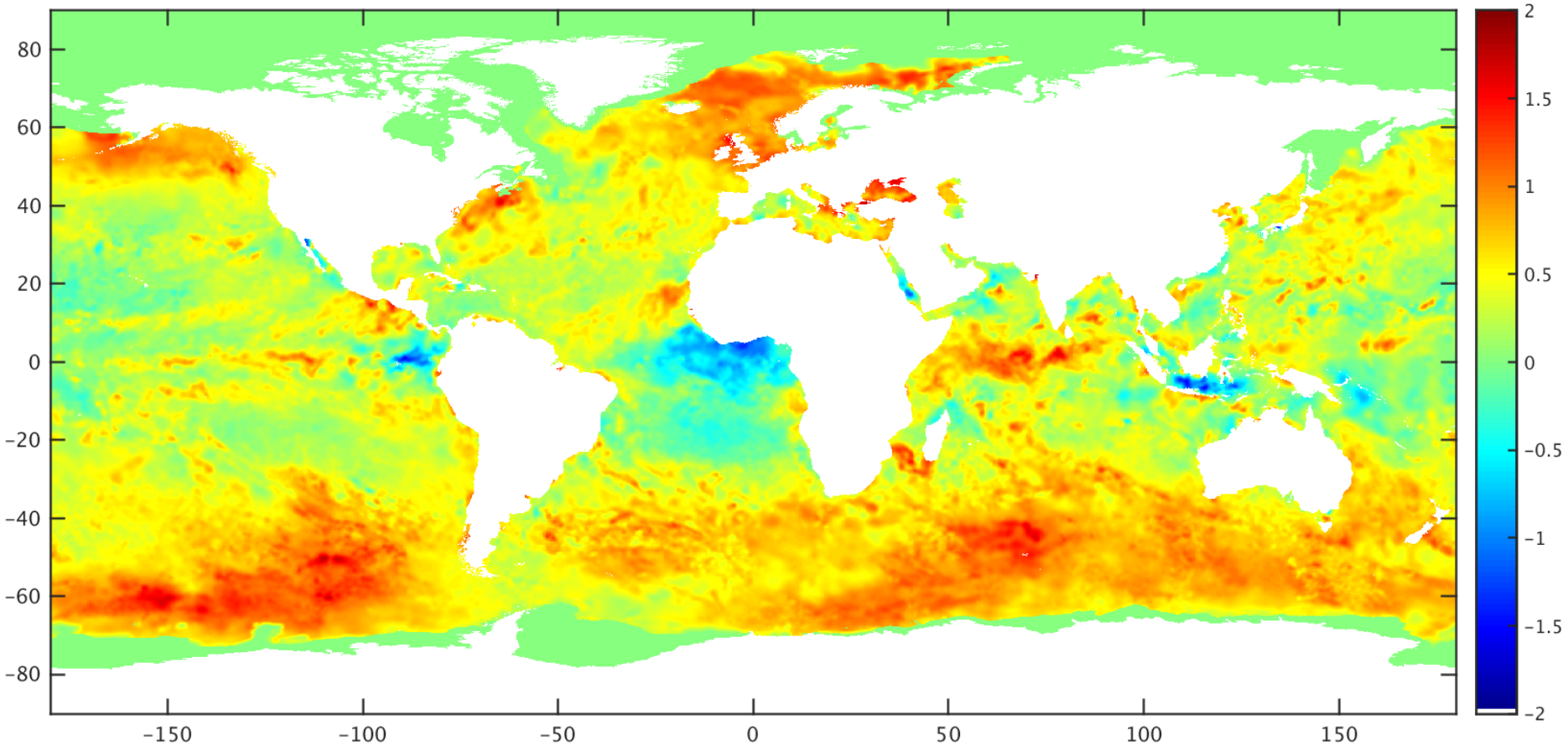
- **VIIRS monthly average for March 2016**

Effect of diurnal adjustment on bias correction



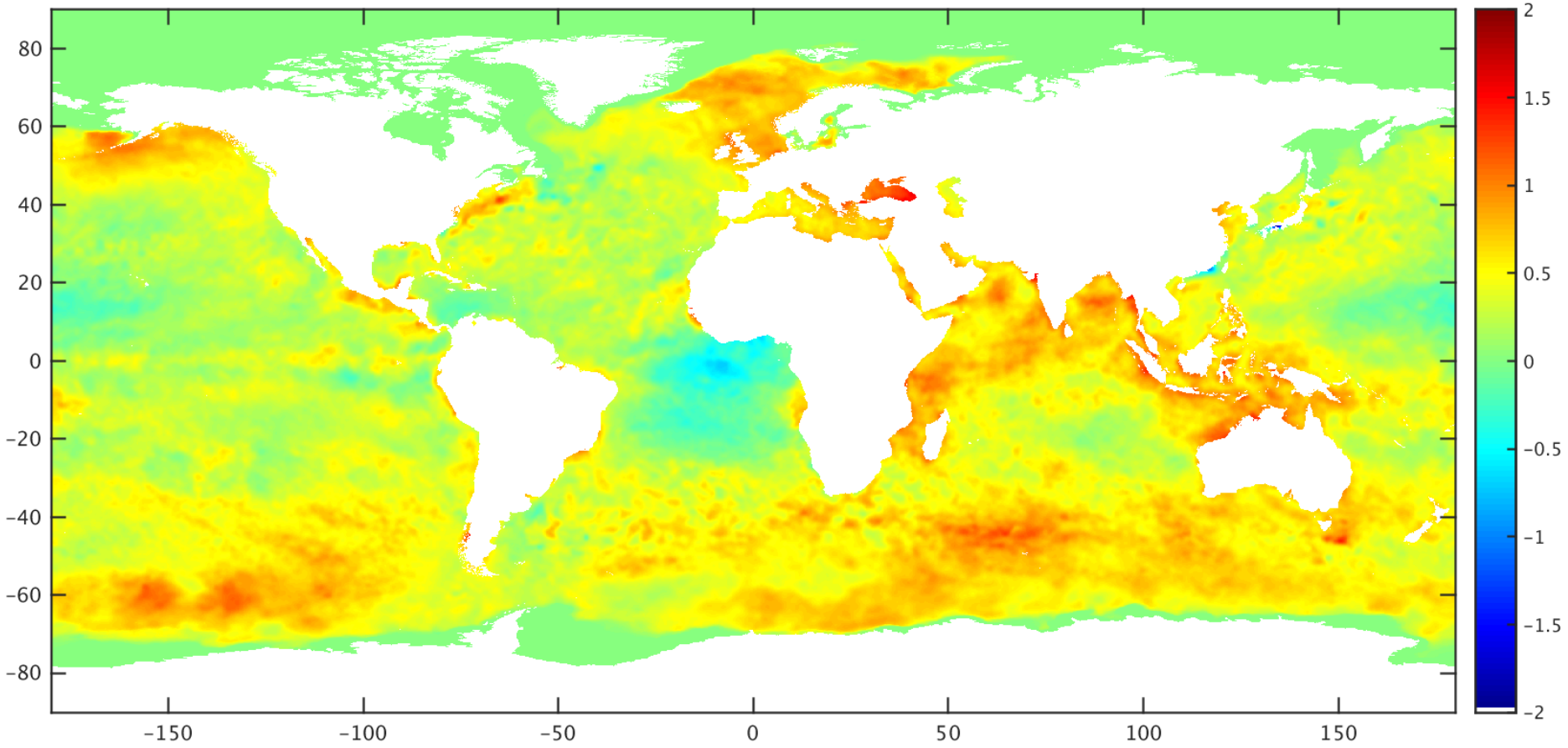
- **Unadjusted VIIRS**

Effect of diurnal adjustment on bias correction



- **Diurnally adjusted VIIRS**

Effect of diurnal adjustment on bias correction



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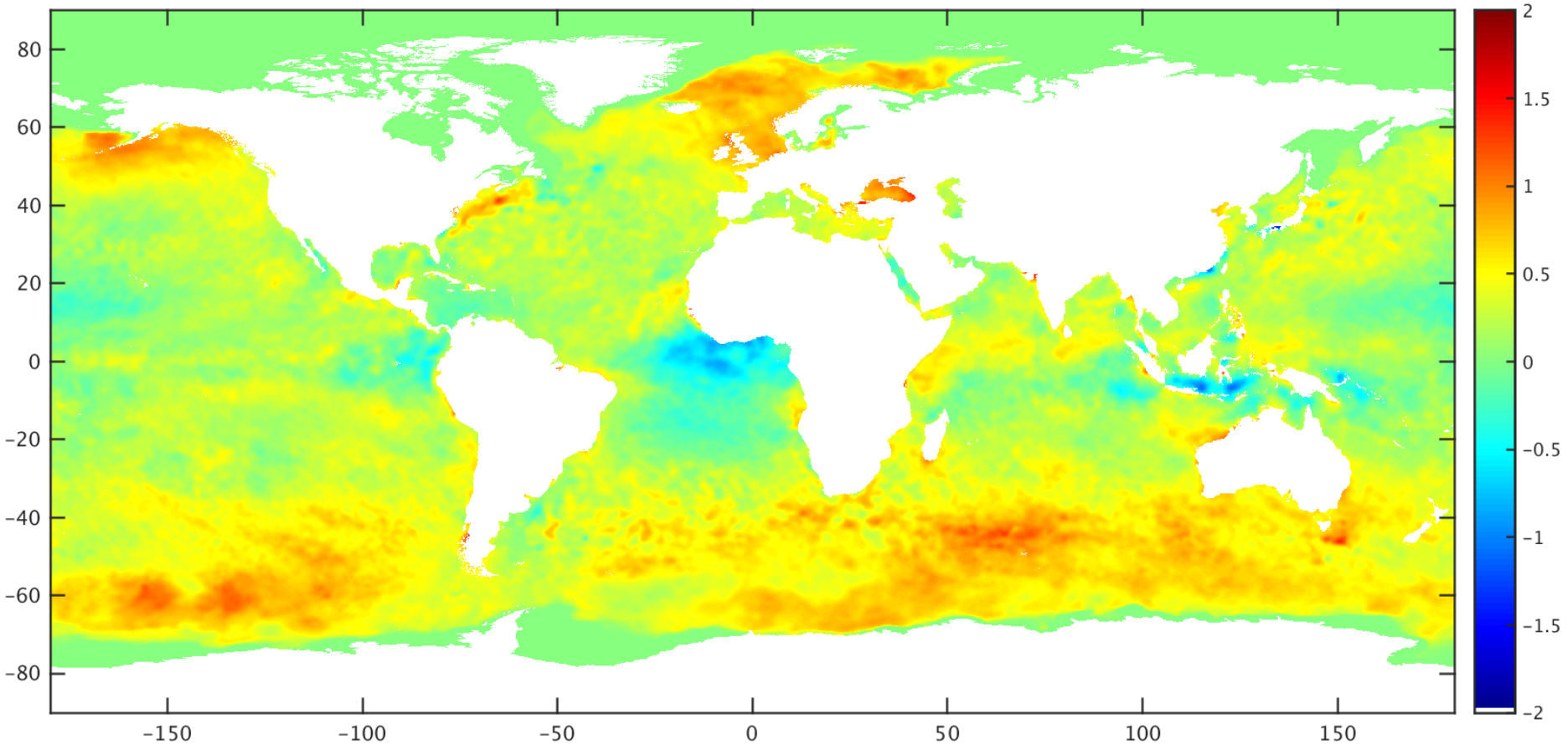
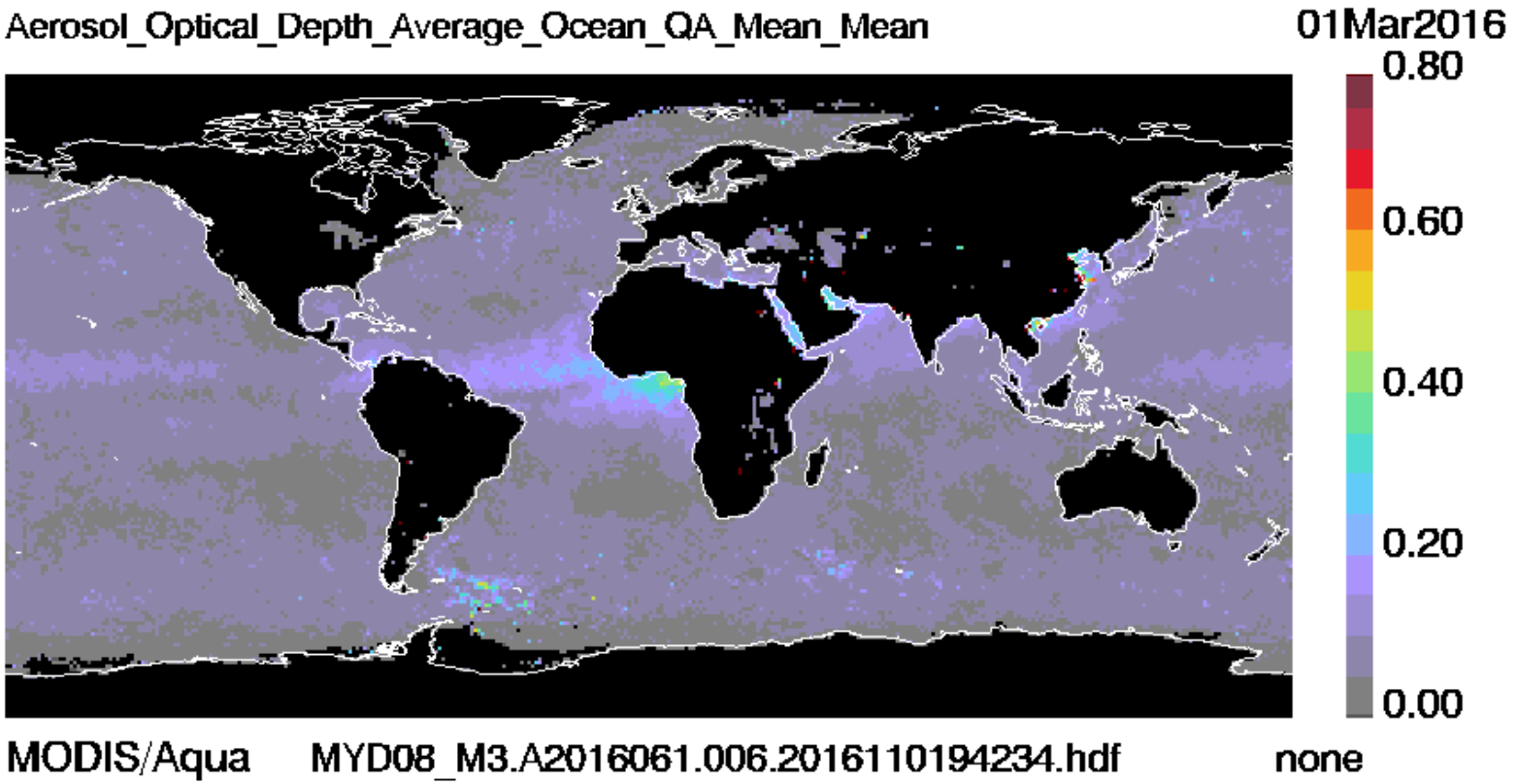


- **Diurnally adjusted monthly average VIIRS**

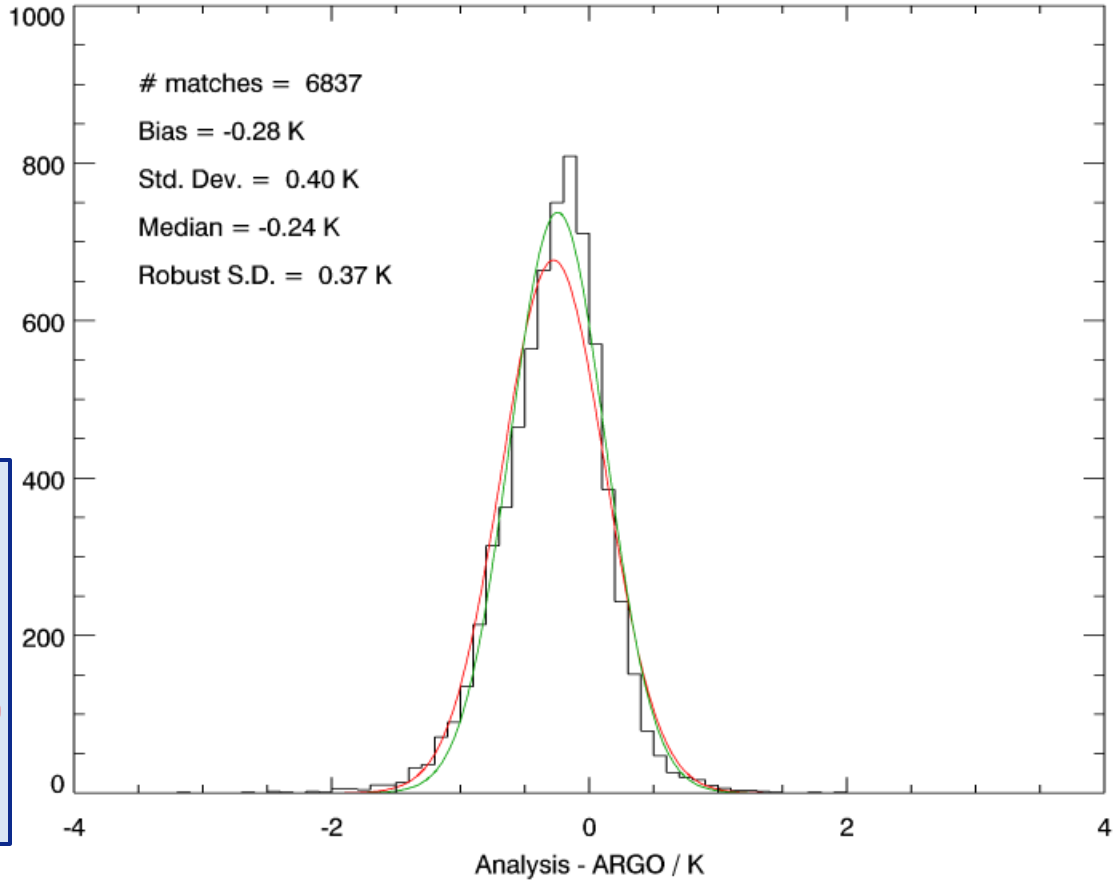
Retrieval biases – aerosol?



- **MODIS-A mean aerosol, Mar 2016**
- **Other atmospheric factors, *e.g.* water vapour loading**

Validation vs ARGO

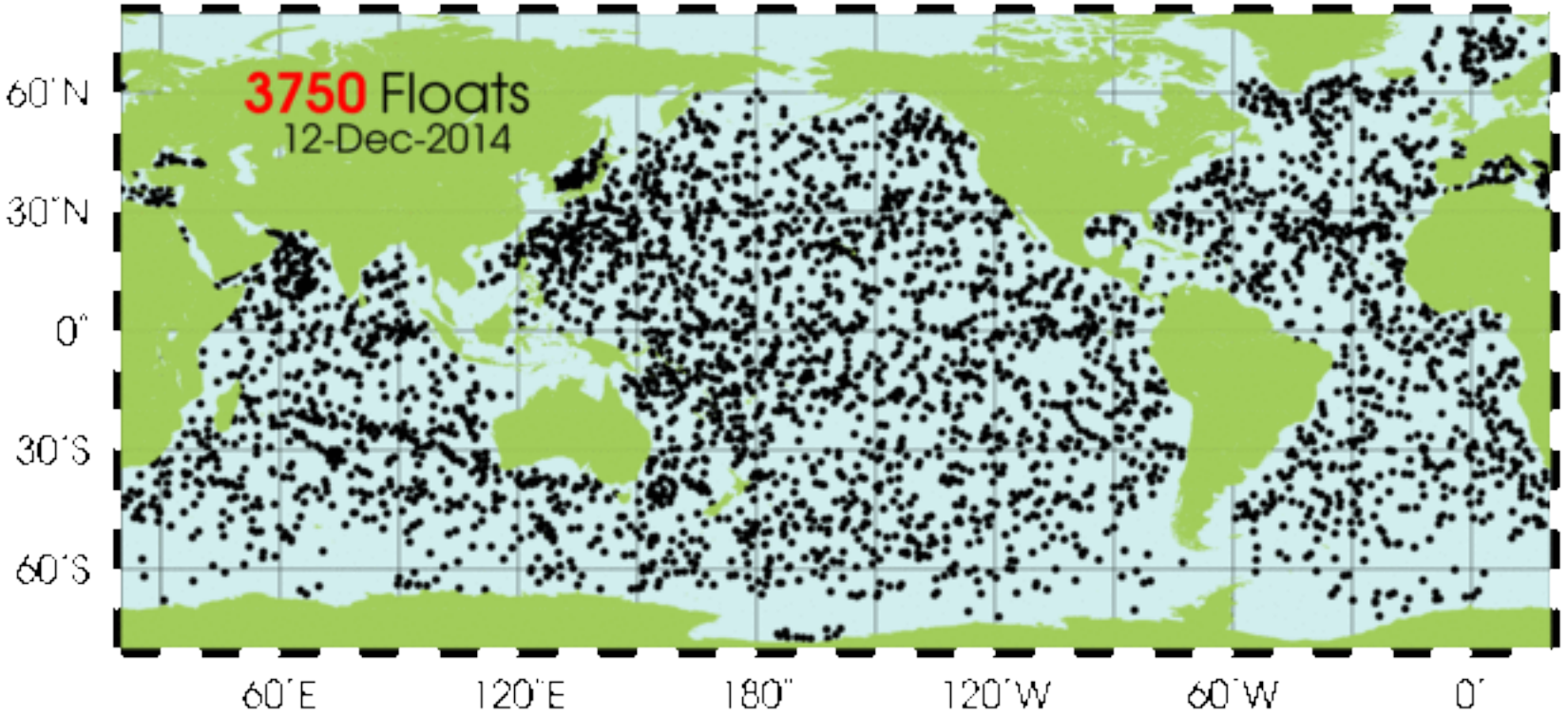
- March 2016
- iQuam QC
- 3 – 7 m depth



Global: -0.28±0.40 (0.37)
30+°N: -0.40±0.46 (0.36)
<|30°|: -0.18±0.36 (0.30)
30+°S: -0.40±0.41 (0.37)

N.B. Virtually identical statistics to uncorrected analysis!

Locations of currently active ARGO floats



Summary

- Diurnal correction with turbulence model & Stokes' Drift
  - Beneficial for applications that depend on SST at depth (*e.g.* CRW)
  - Daytime SST retrieval may not see full scope of DW, especially in tropics
    - Need pixel-based estimates of algorithm sensitivity
  - Gustiness parameter damps warming
    - Partly a work-around for above issue
  - Other regional algorithm biases
- Validation vs ARGO
  - Headline results are good…
  - …but diurnal adjustment has negligible impact
  - Analysis bias correction scheme due for update
    - Particularly using Sentinel-3 SLSTR

Backup slides