A general space-time gridding tool for analysis of MODIS radiances and retrieval products

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Smith et al. (under revision) JAMC

Why are data gridded?

Observation grid
- non-uniform -

→

Space-time grid
- uniform -

↓

- Data reduction
- Accessibility
- Multi-instrument comparisons
- Time series analysis
- Large scale geophysical analysis

Key questions:

Statistical characterization

Error traceability

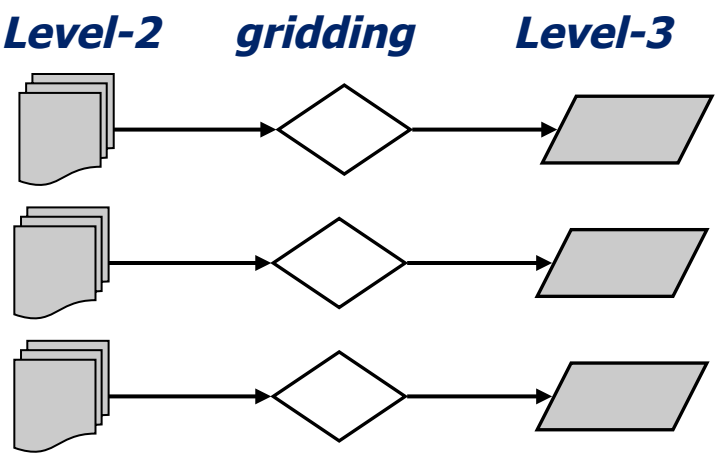
Statistical significance

Mapping complex phenomena

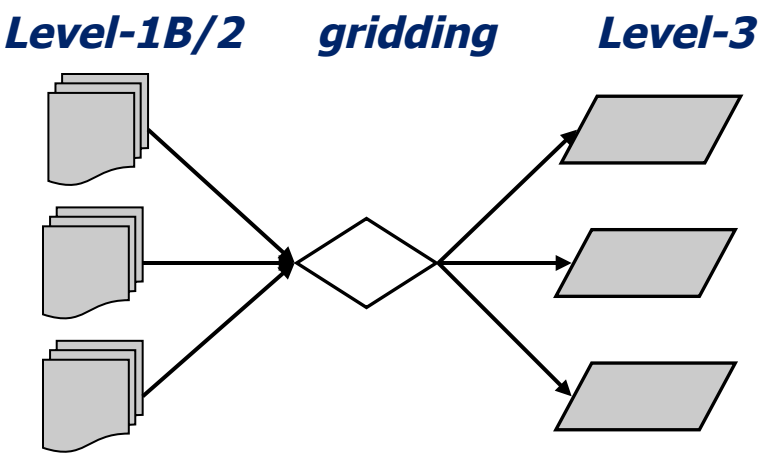
Probable vs. Possible

Correlation among parameters in grid space

Generation of Level-3



"Traditional" comparison



"Desired" comparison

Courtesy of Rob Roebeling, EUMETSAT

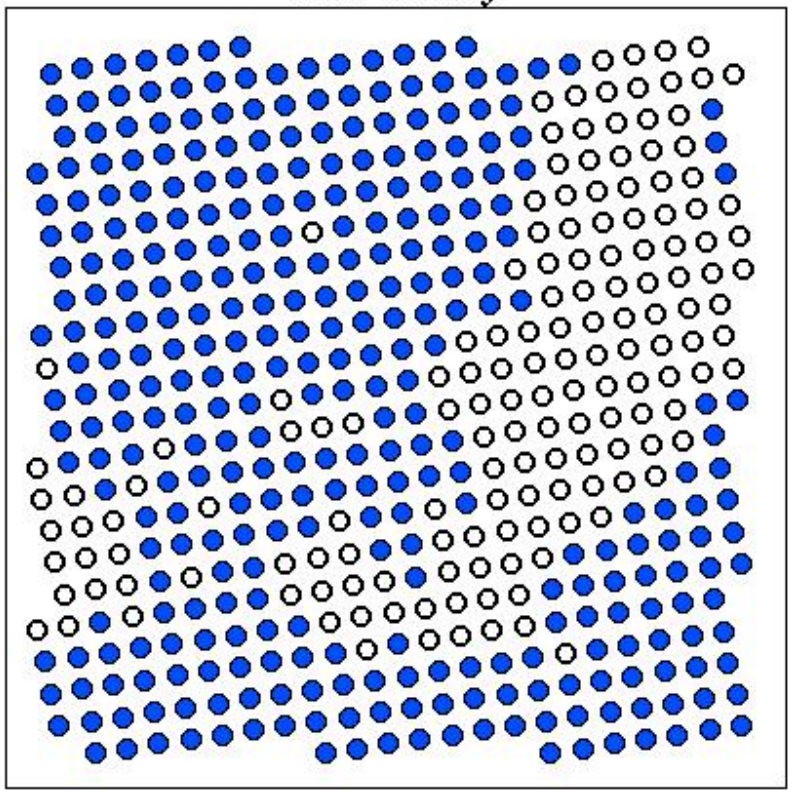
STEP 1: SPACE Gridding

1 x 1 degree grid cell

MODIS measurements = 487

CTP retrievals = 332

68% cloudy

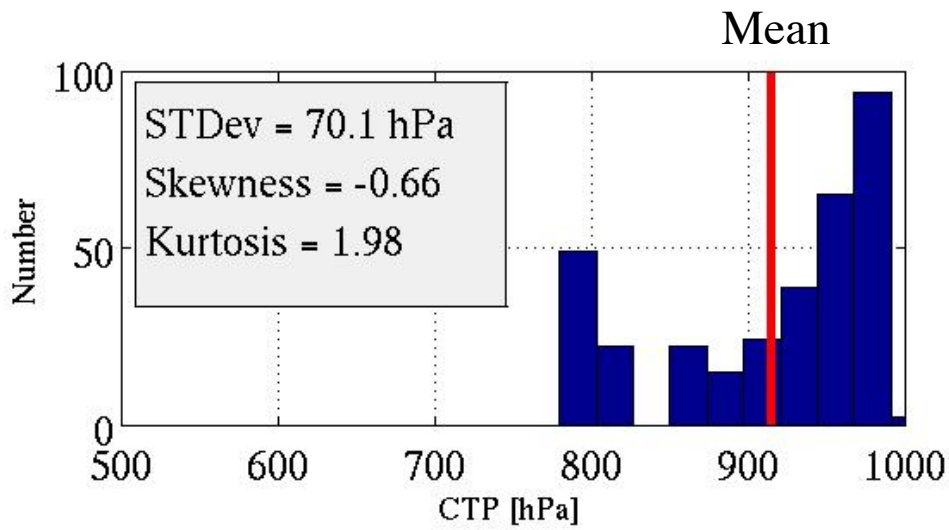


Physical data reduction

- Filtering criteria: day/night, nadir/off-nadir, lat/lon

- Snap to nearest neighbor grid cell

- Store only geophysical parameter value

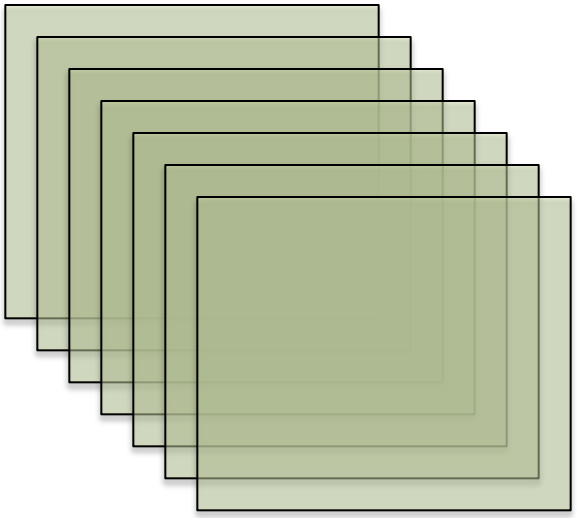


STEP 2: TIME Gridding

Statistical data reduction

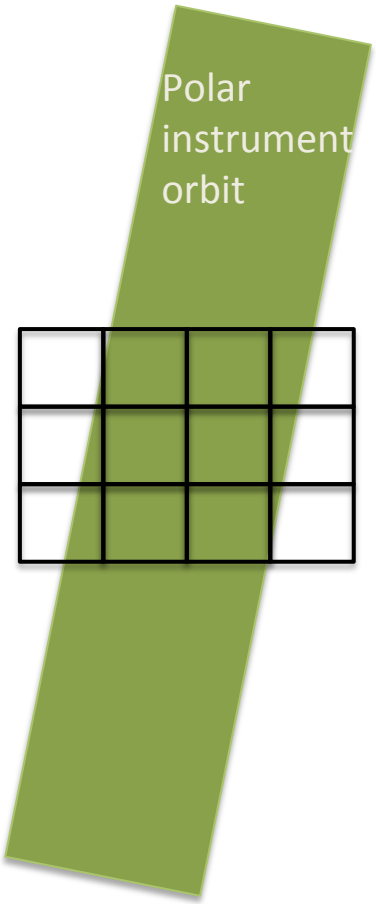
Daily statistic

Stack of daily statistics



Time aggregate statistic

Sensitivity to sample size



- How can statistical error be reduced?
- How to prevent misrepresentation of data?
- When is a day of observations not worth averaging?

Managing maximum sample size:

Calculation of daily statistics prevents accumulation of large sample sizes in polar grid cells

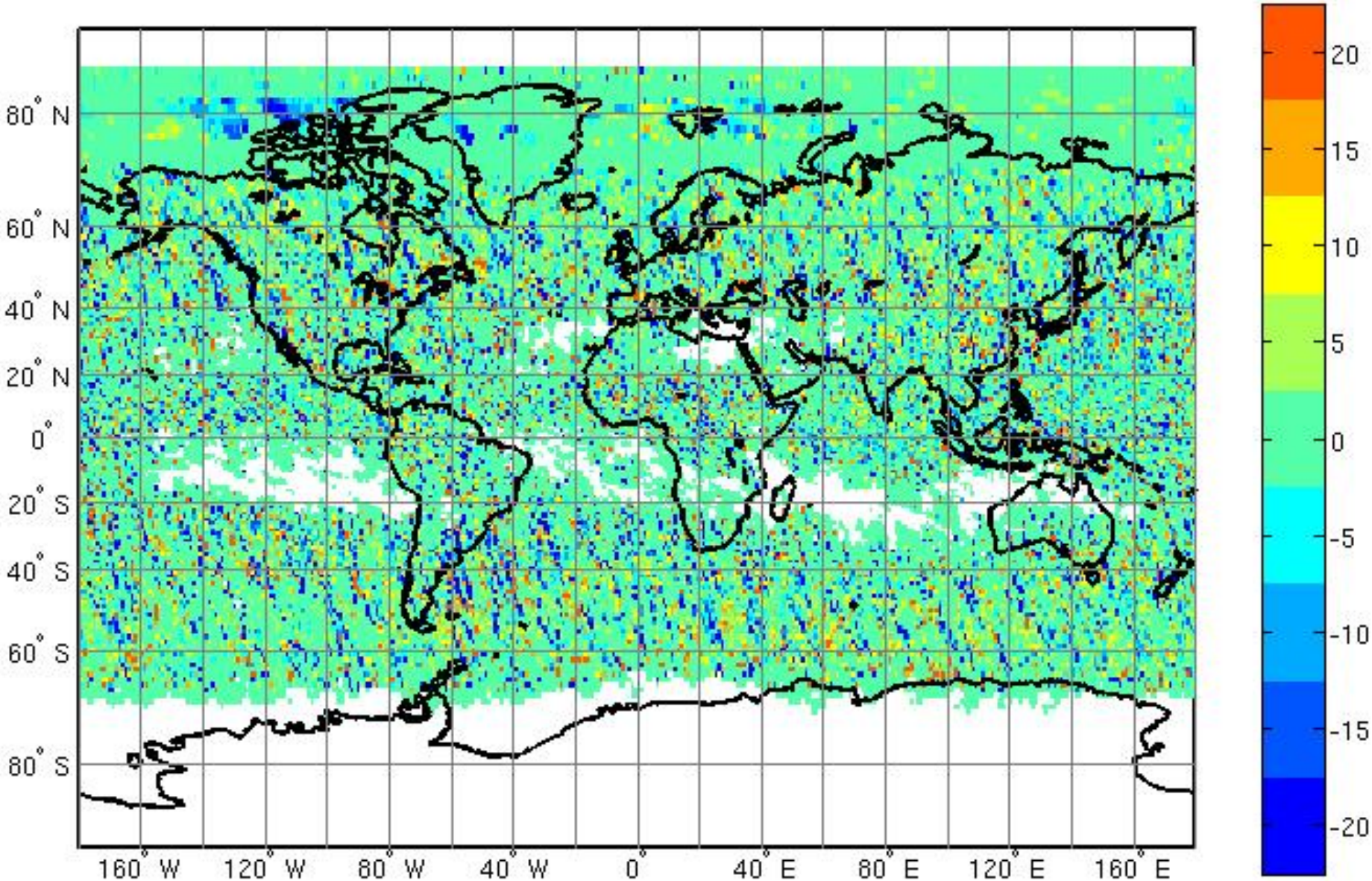
Managing minimum sample size:

$$\text{nobs} \geq \bar{m} - 1.5\sigma$$

(filter out cells with fewer than 3.5% of the average)

$$\bar{m} = \frac{\sum_{days} \text{obs}_T}{\sum days}$$

Monthly average difference: (All) minus (Filtered)



Sensitivity to viewing angle limits

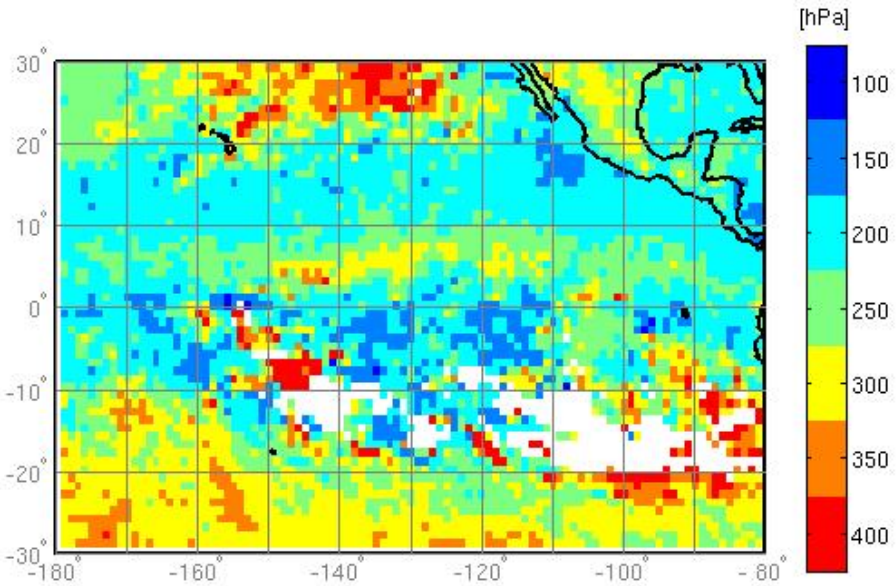


Fig. : *Gridding using all viewing angles*

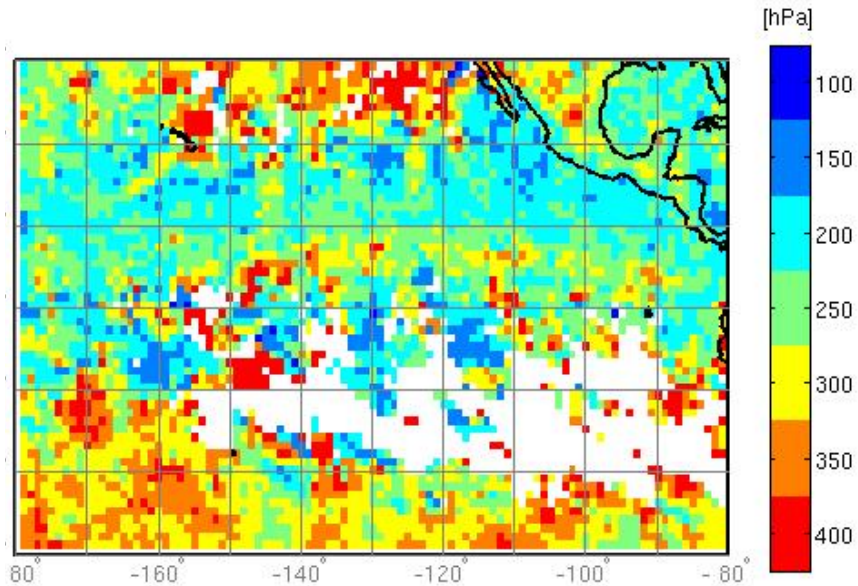


Fig. : *Gridding using viewing angles < 32 degrees*

Sensitivity to grid size

Fig. : *Gridding at 1 degree resolution*

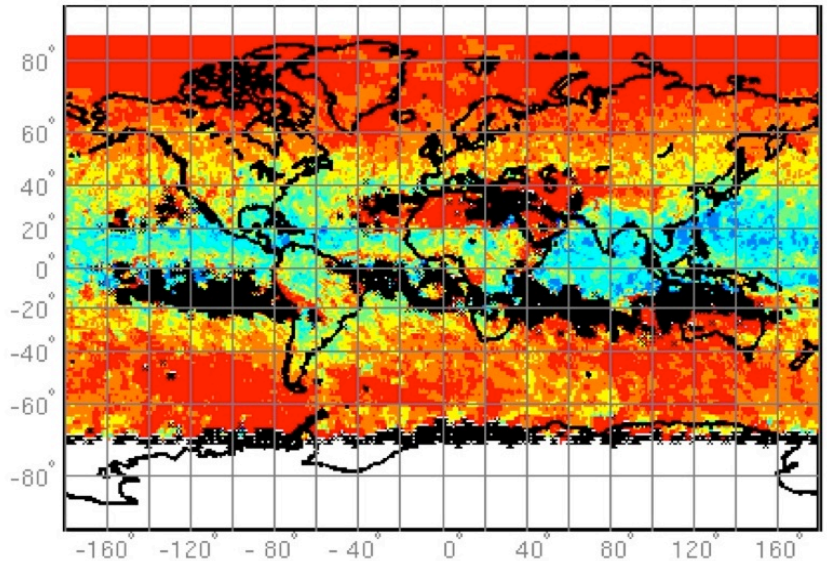
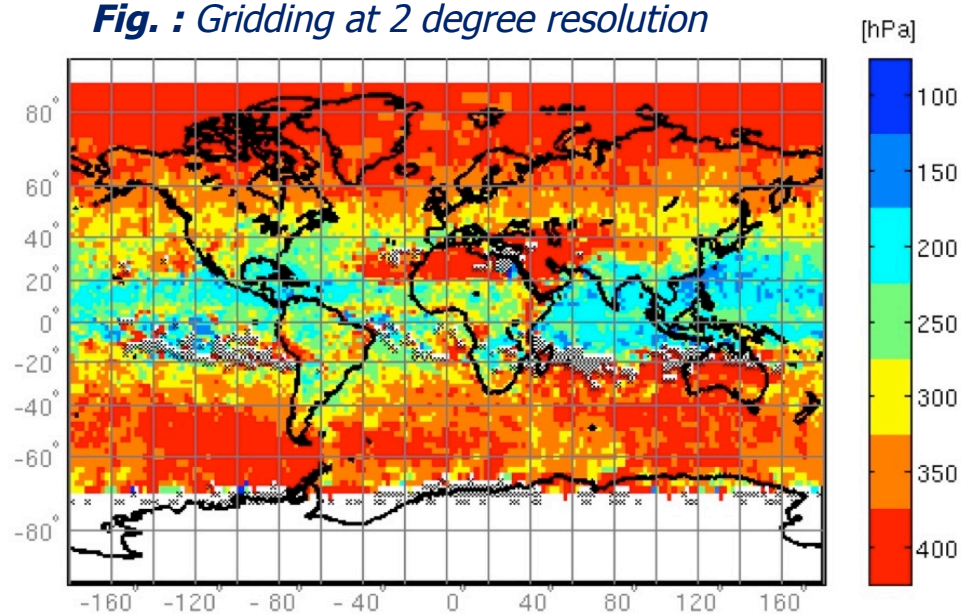
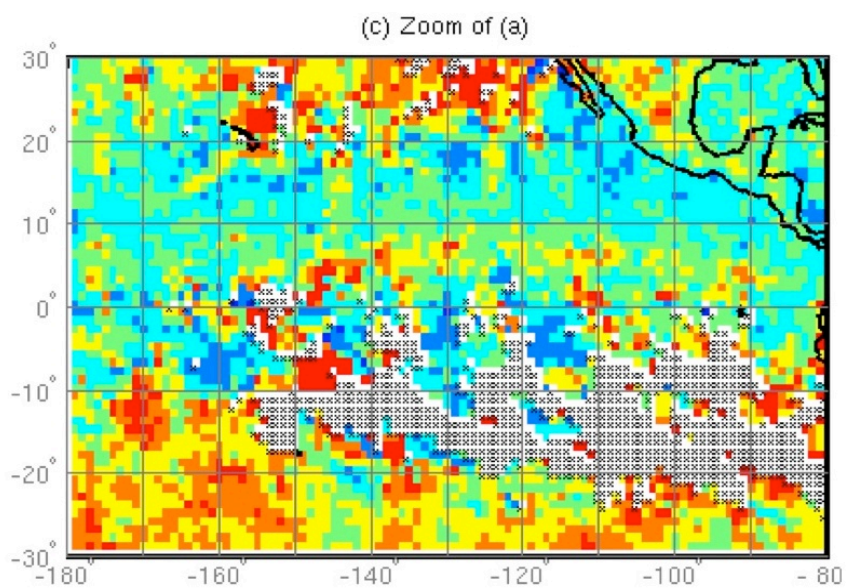
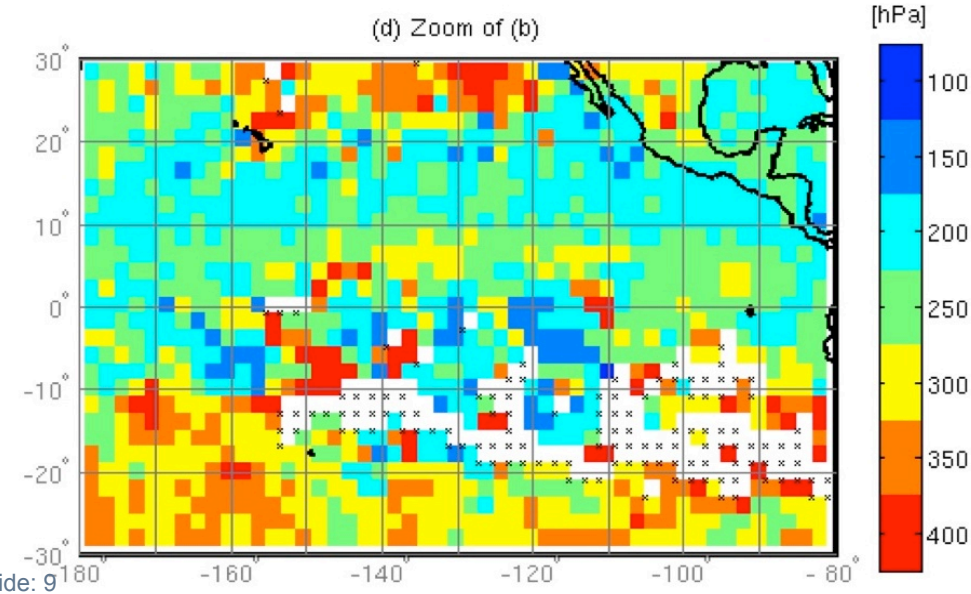


Fig. : *Gridding at 2 degree resolution*

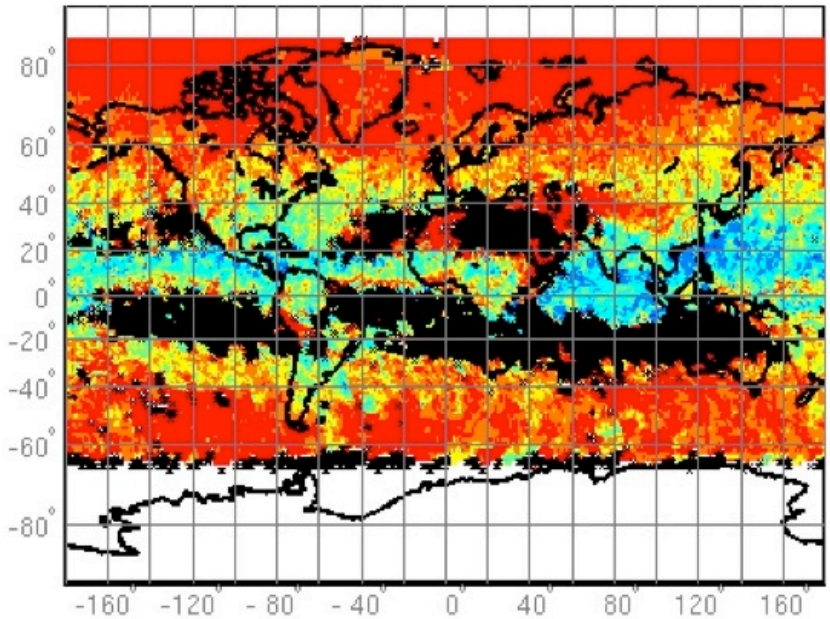






Sensitivity to time period

Fig. : *Gridding of 16 days*



(e) 1-16 August 2009

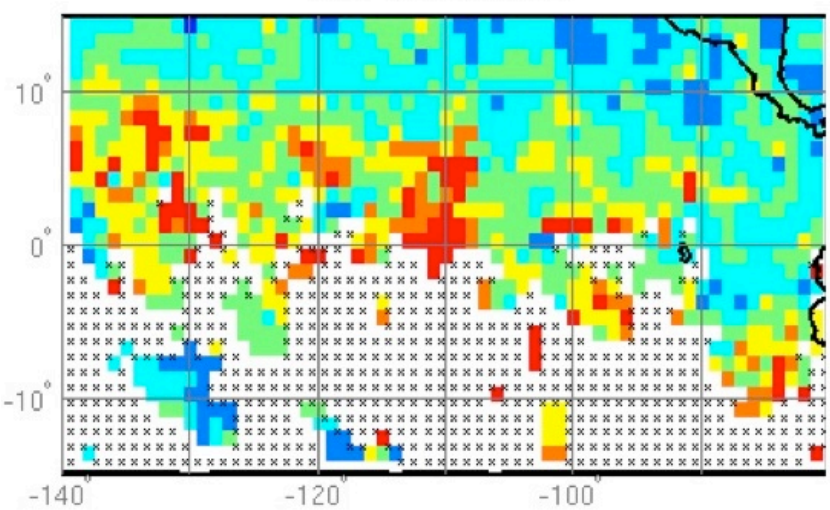
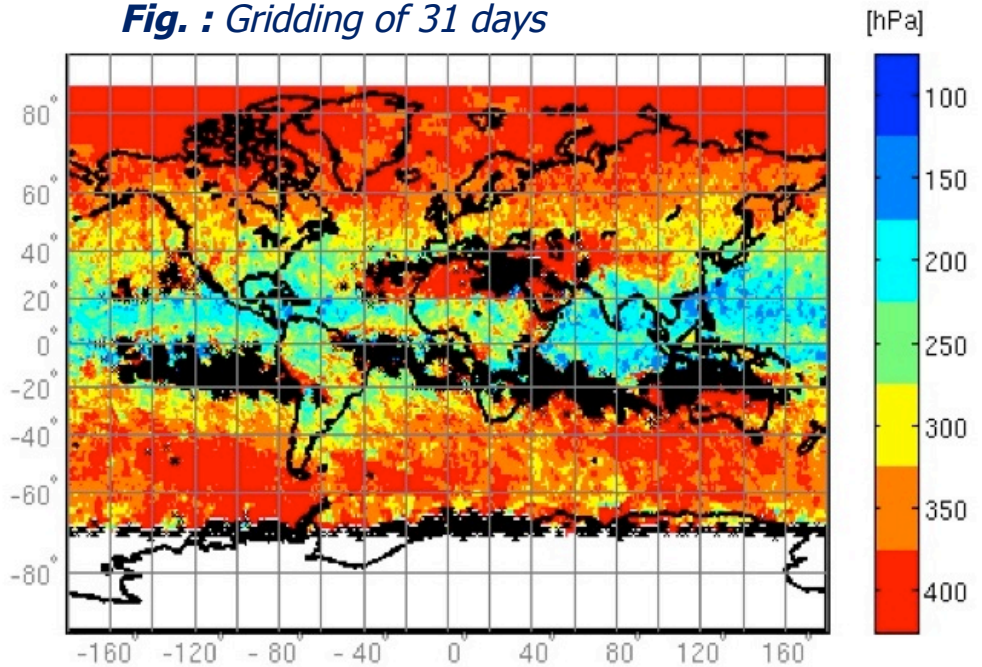
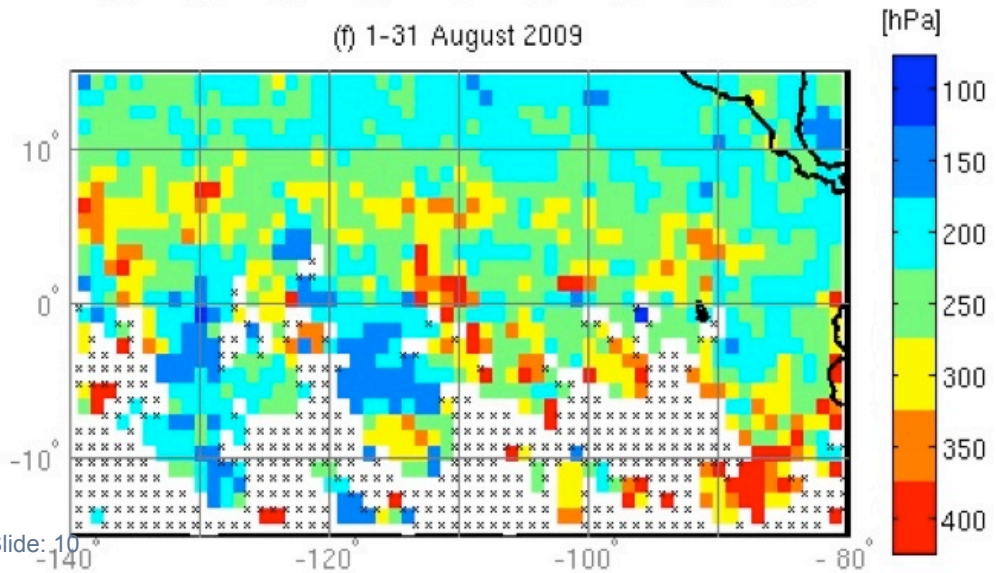


Fig. : *Gridding of 31 days*



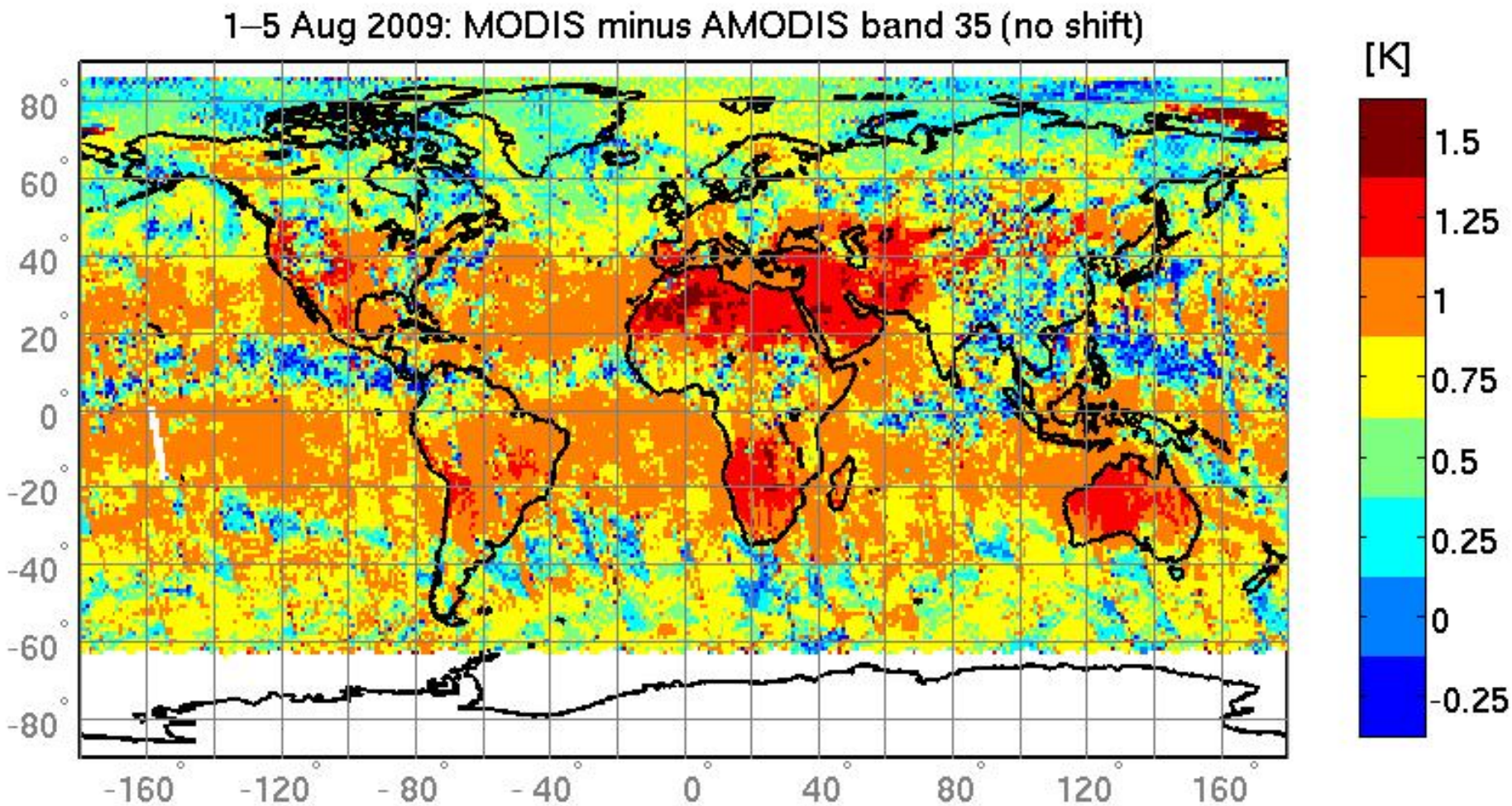
(f) 1-31 August 2009



MODIS and AMODIS band 35 BT comparisons: with and without shifts

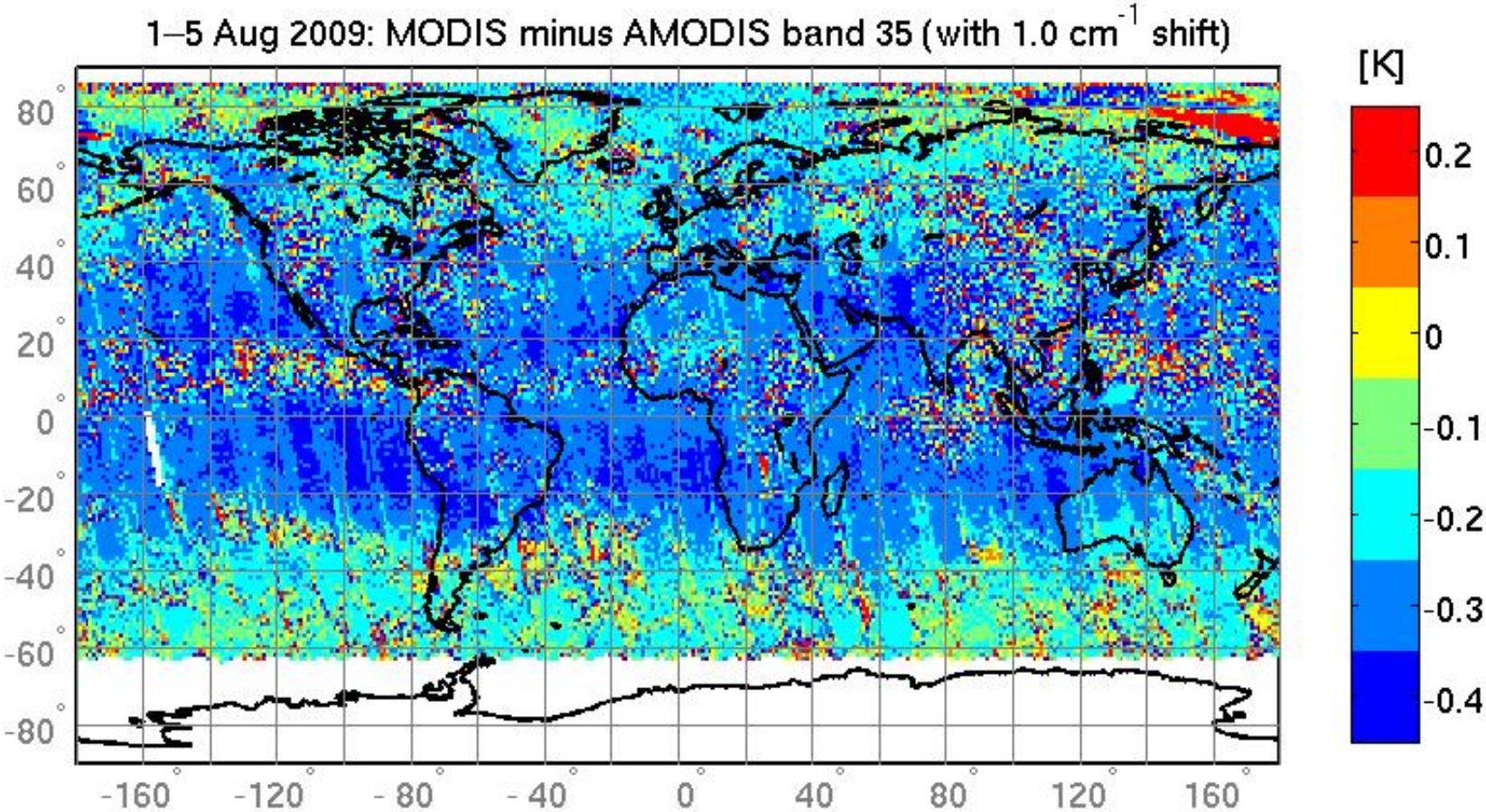
AMODIS = AIRS convolved to MODIS spectrum
Daytime near-nadir measurements
Aggregate of 5 daily statistical grids
1–5 Aug 2009

BT difference between MODIS and AMODIS (no shift)
AMODIS (no shift) has lower BT up to 1K in most areas

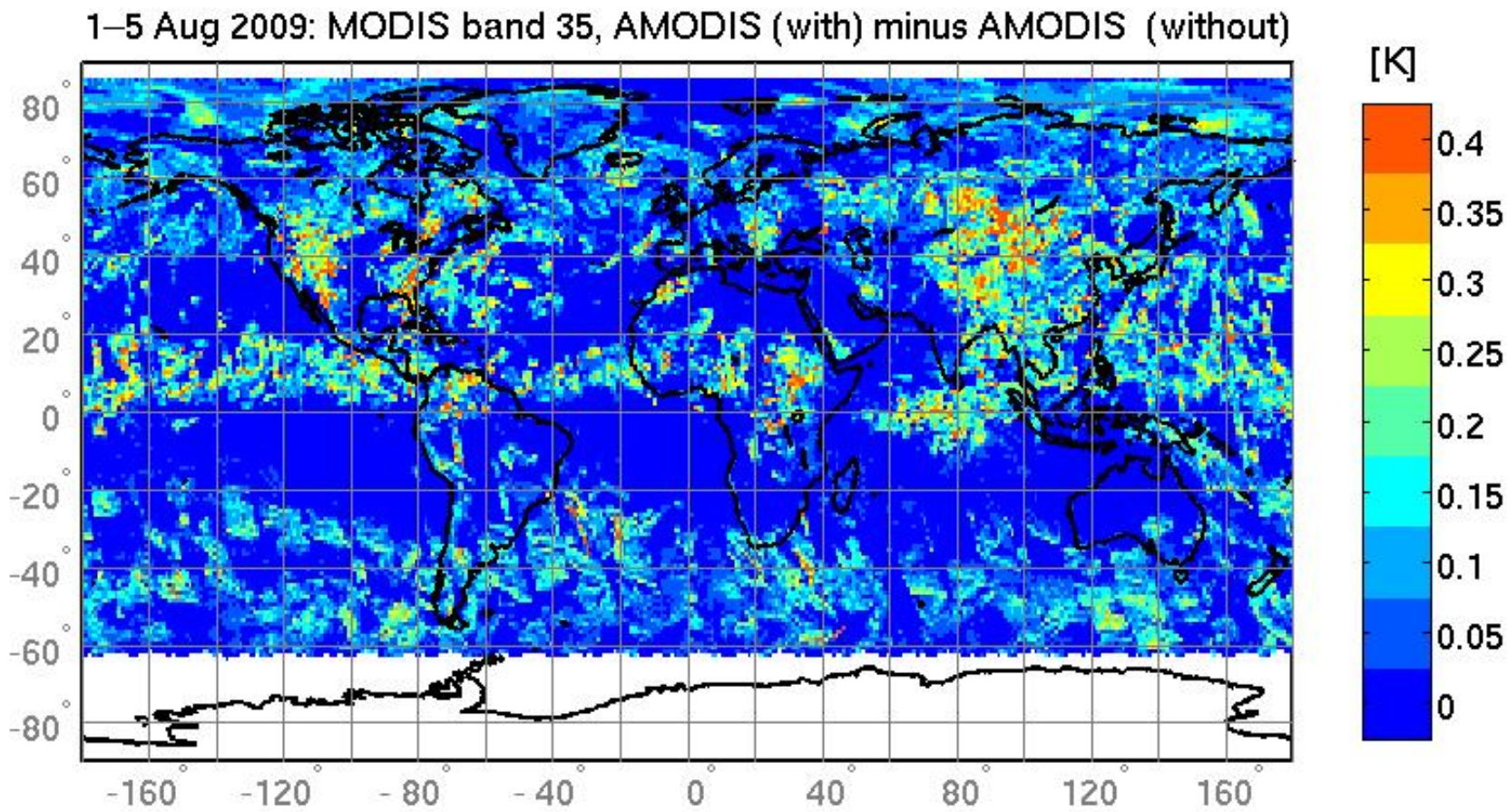


BT difference between MODIS and AMODIS (shift)

AMODIS (shift) is closer to the real MODIS, but in most areas slightly higher BT



Standard deviation difference between AMODIS (shift) and AMODIS (no shift)
With spectral shift, BT have higher spatial heterogeneity



Conclusions and future work

- We have developed an instrument-independent gridding approach that can be applied to any level space-based data
- Zonal statistics are parameter specific
- Gridding criteria are user-defined

Future work:

- Apply gridding to different sets of geophysical parameters
- Compare gridded geophysical parameters from many different instruments.