

Sun glint  
removal

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## Sun glint removal for GERB Edition-1

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Royal Meteorological Institute of Belgium

22 September 2011



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# Aim

- ▶ Estimate flux in sun glint-affected area
- ▶ To be applied to Edition-1
- ▶ To be applied to BARG (but currently only HR)

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# Problem

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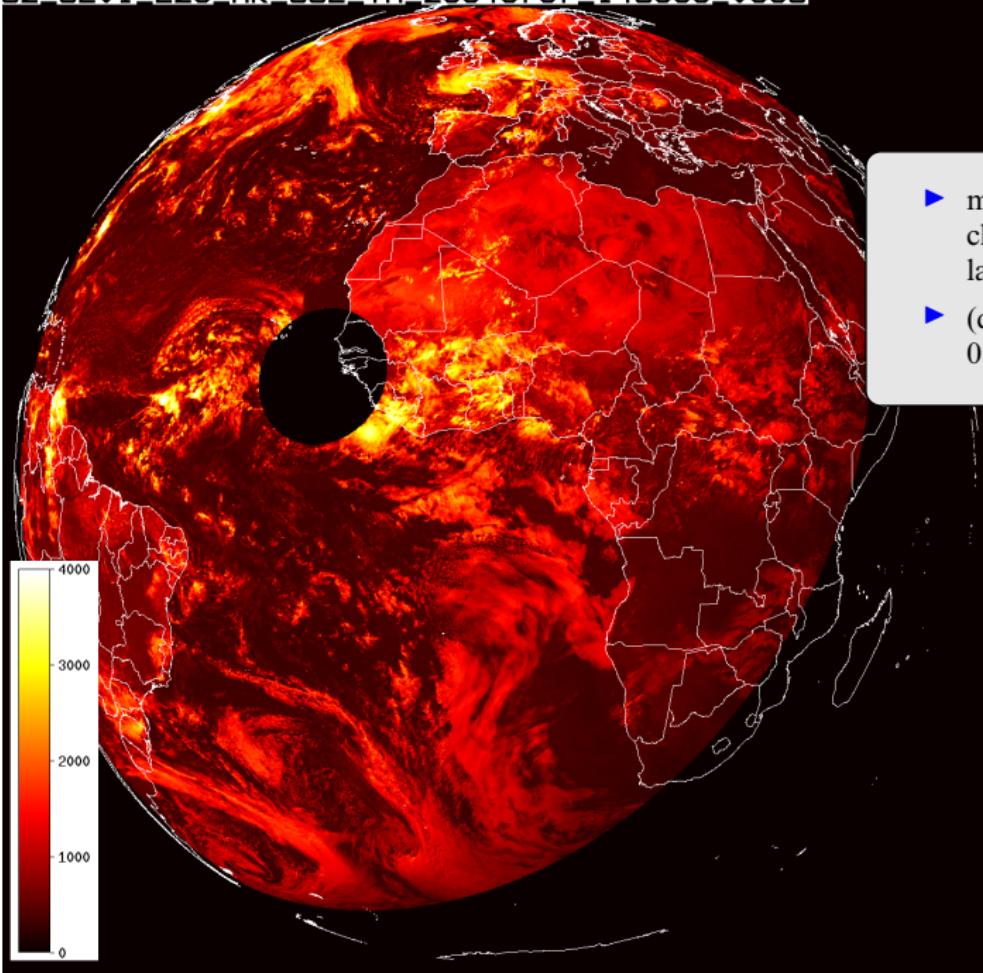
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- ▶ Under certain conditions, sun rays are reflected specularly towards the detector
- ▶ Scene identification is unreliable → radiance-to-flux conversion fails
- ▶ Currently there's a big black patch over the area defined by the geometric condition  $SGA < 15^\circ$

G2\_SEV1\_L20\_HR\_SOL\_TH\_20040707\_143000\_V003



- ▶ masked out over clear/cloudy ocean + over land
- ▶ (quantisation factor = 0.25)



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# Radiance-to-flux conversion

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- ▶ Scene identification is unreliable
- ▶ Solution: extrapolate scene ID just before sun glint to sun glint
- ▶ Not an interpolation between pre- and post-glint; it should work in near-real time

# Scene ID extrapolation

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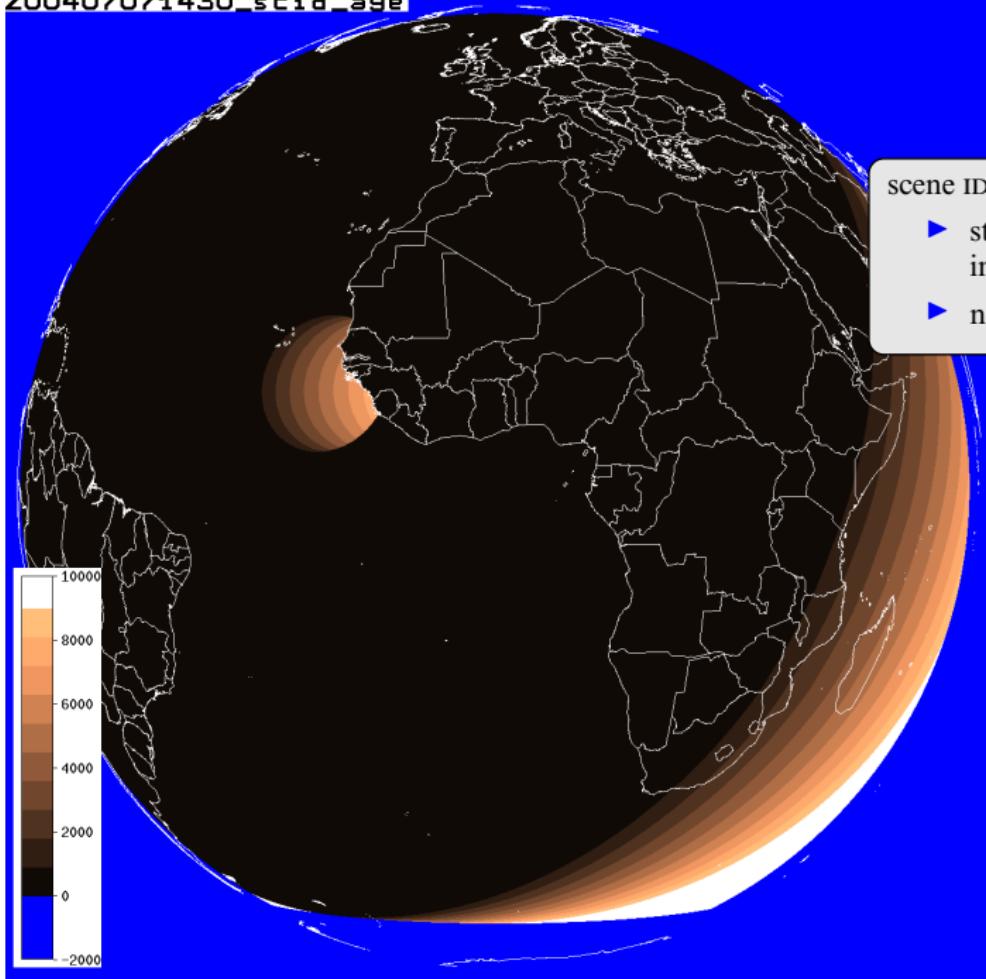
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- ▶ Last valid cloud cover, cloud phase & cloud optical depth are stored
- ▶ Do not keep scene ID longer than 2.5 hours
- ▶ Stored scene ID replaced with real scene ID as soon as available

200407071430\_scid\_age



scene ID extrapolation

- ▶ stored data > 2.5 hours invalid
- ▶ not required over land

# Correcting sun glint

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- ▶ SGA < 15°
  - ▶ Clear ocean: CERES TRMM climatology (albedo + incoming solar → flux)
  - ▶ Cloudy ocean: radiance-to-flux conversion using extrapolated scene ID
  - ▶ Land: radiance-to-flux conversion
- ▶ 15° < SGA < 25°
  - ▶ Clear ocean: CERES TRMM climatology

# Example: 7 July 2004, 14:30

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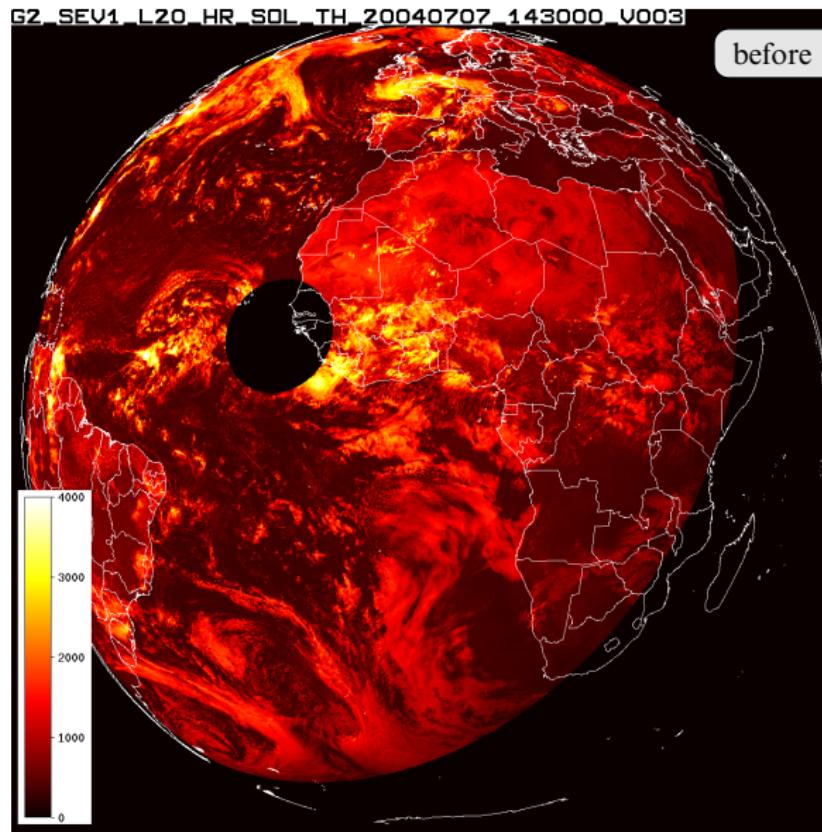
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# Example: 7 July 2004, 14:30

Sun glint  
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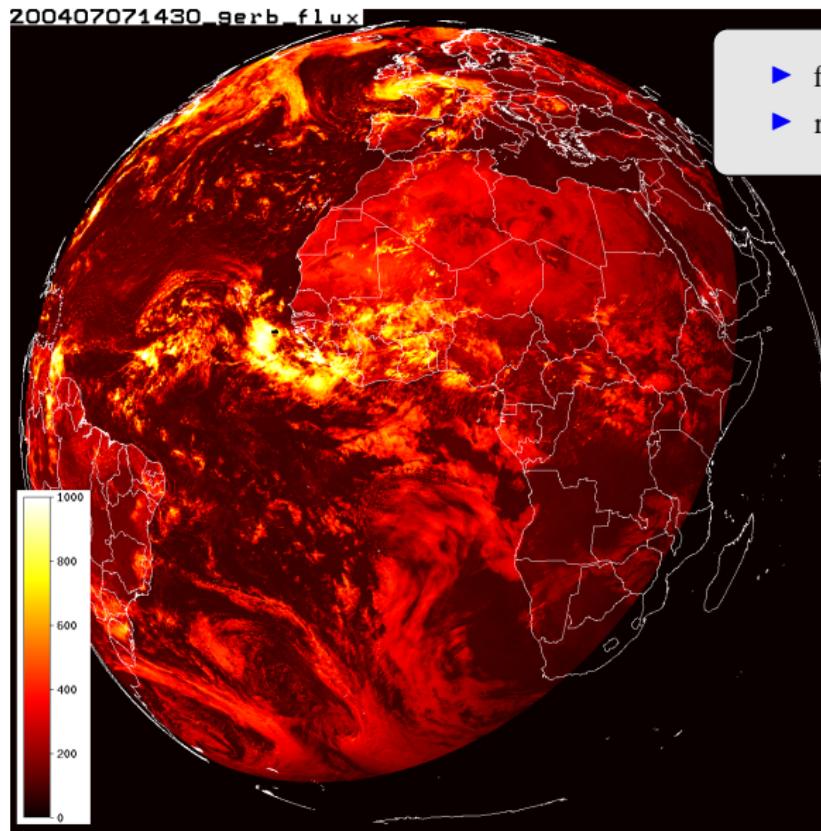
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- ▶ flux over land restored
- ▶ reasonable-looking fill-in

# Example: 7 July 2004, 14:30

Sun glint  
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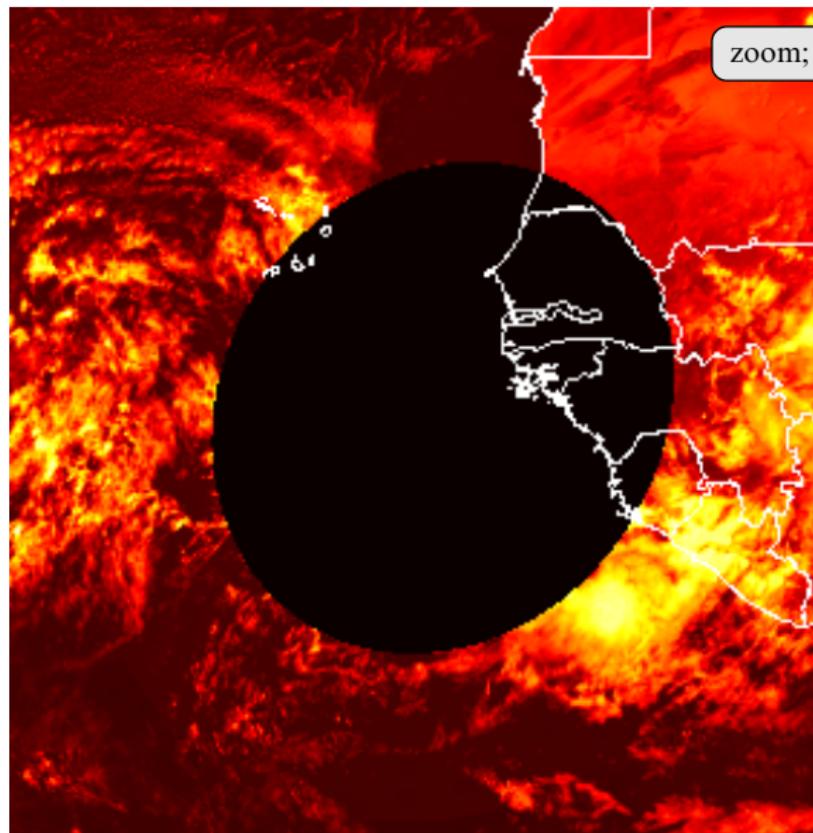
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# Example: 7 July 2004, 14:30

Sun glint  
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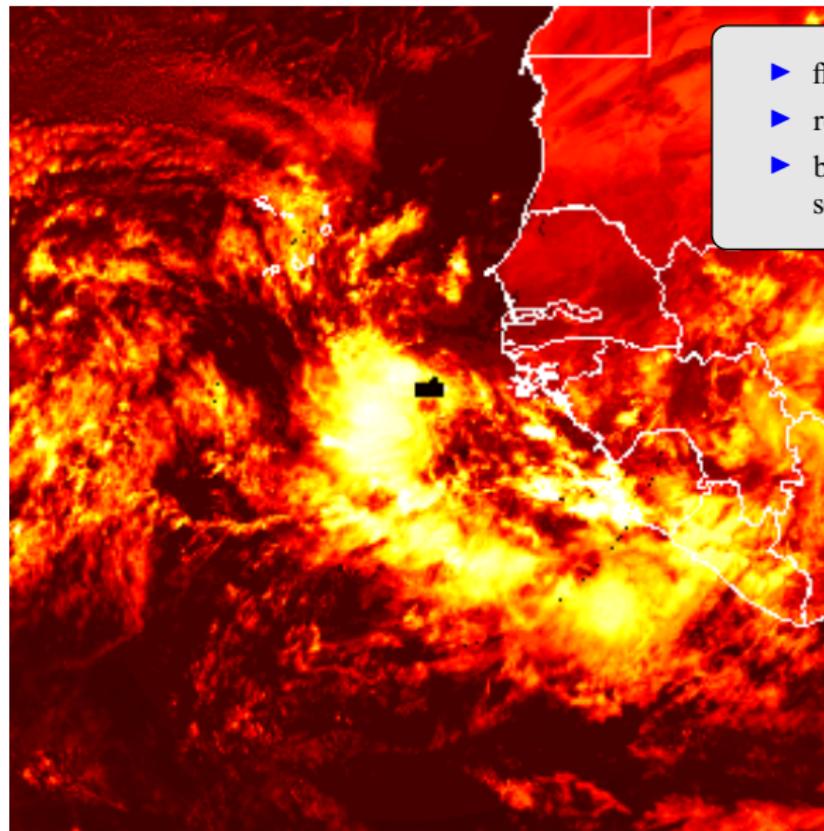
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- ▶ flux over land restored
- ▶ reasonable-looking fill-in
- ▶ black spot due to missing scene ID

# Example: 7 July 2004, 17:30

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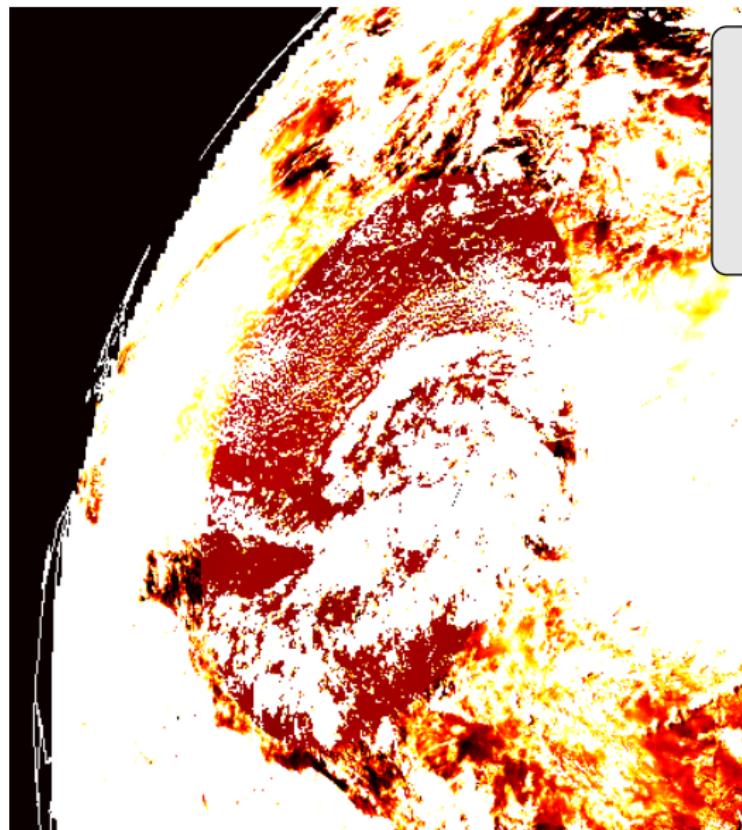
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- ▶ color scale intentionally clipped from 80 to 120  $\text{W m}^{-2}$  (clear ocean)
- ▶ step change in flux at SGA  $25^\circ$  transition

# Why the step change?

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GERB flux for clear ocean is calculated as follows:

$$F_{\text{GERB}} = a \frac{F_{\text{solar}} \cos \theta}{\tilde{r}^2} \Gamma$$

where  $a$  is CERES TRMM albedo, and  $\Gamma$  is (known) GERB–TRMM albedo ratio



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# How the following maps have been obtained

- ▶ Clear ocean points
- ▶ Outside of the sun glint area
- ▶ With a solar zenith angle  $< 70^\circ$
- ▶ With a viewing zenith angle  $< 70^\circ$
- ▶ With the dust detection flag off
- ▶ Surrounded by points meeting the same criteria

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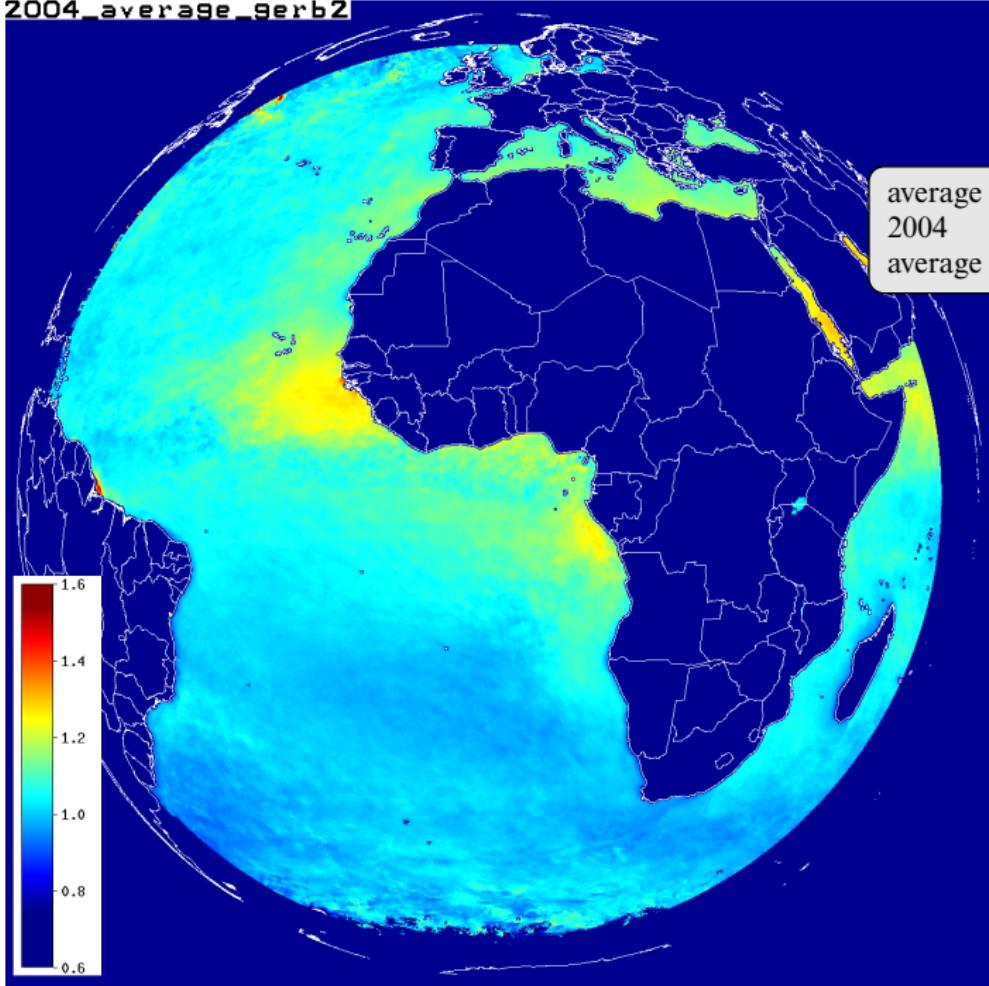
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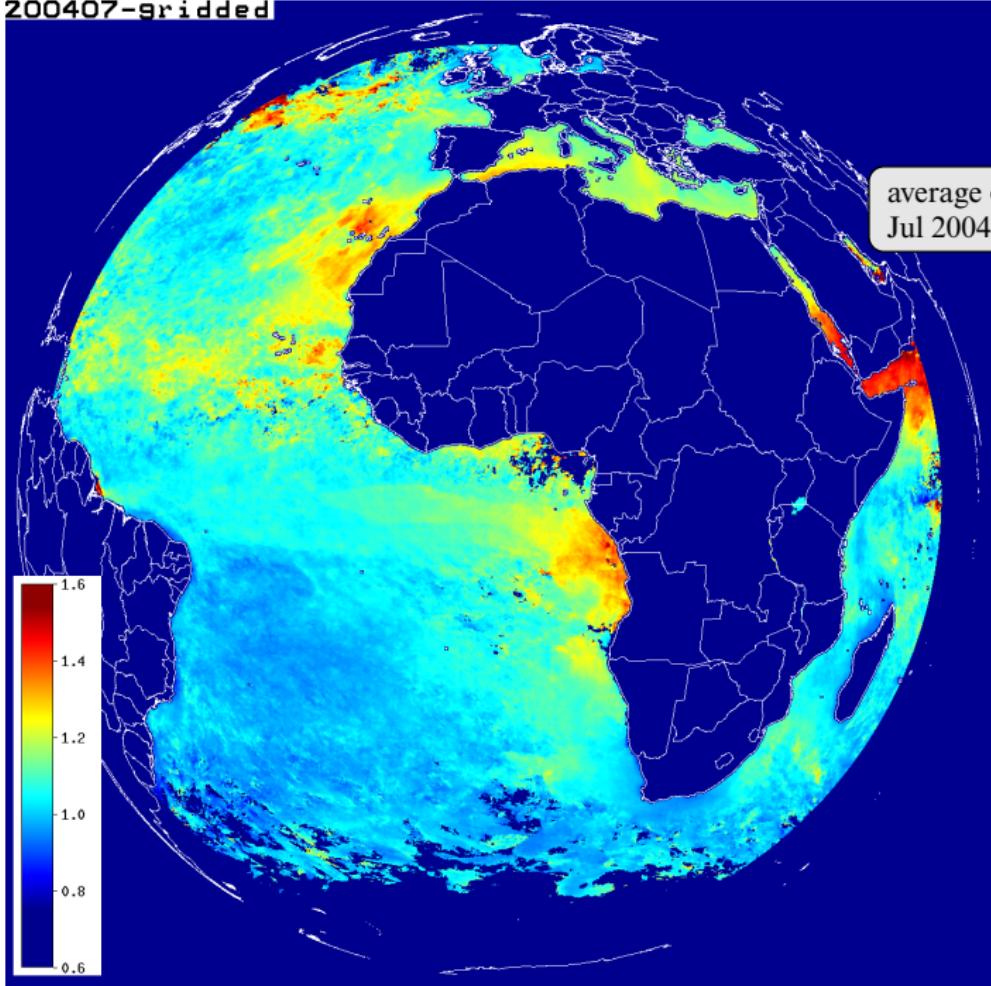
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2004\_average\_gerb2



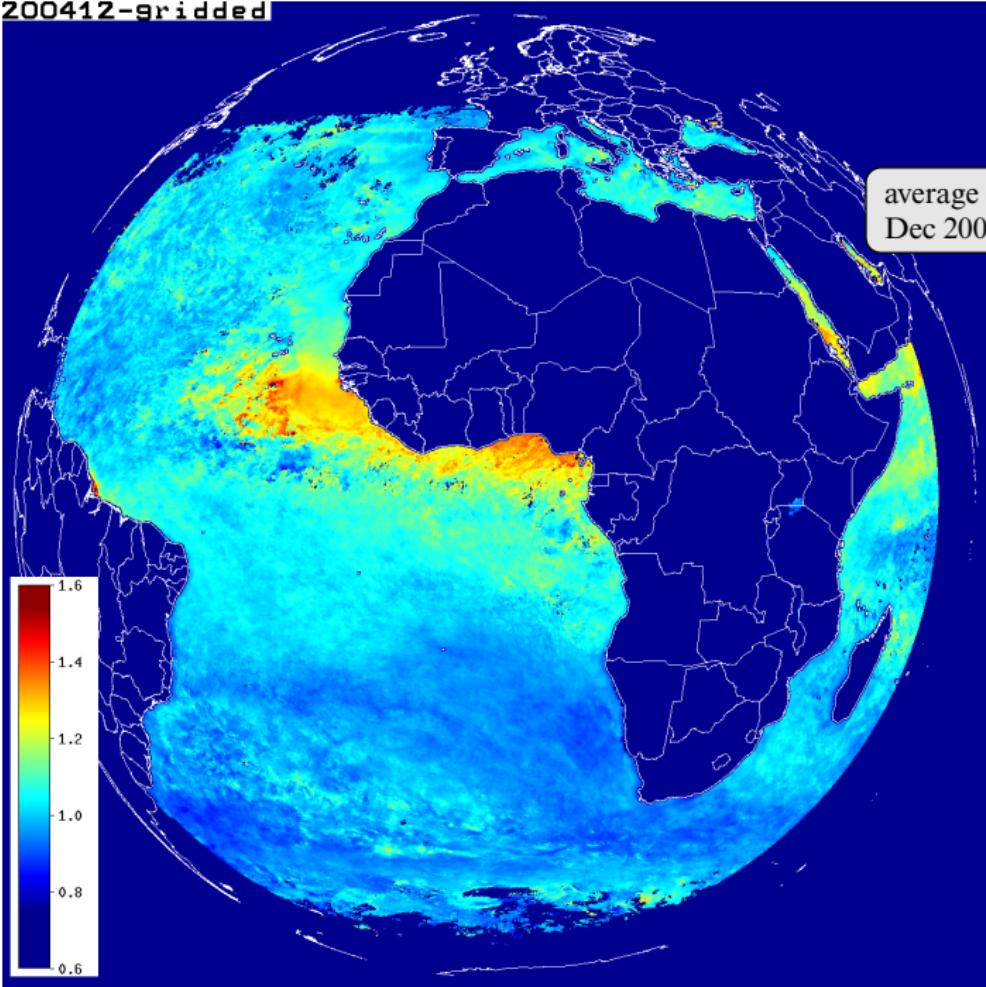
average GERB-TRMM albedo ratio  
2004  
average = 1.049

200407-gridded



average GERB-TRMM albedo ratio  
Jul 2004

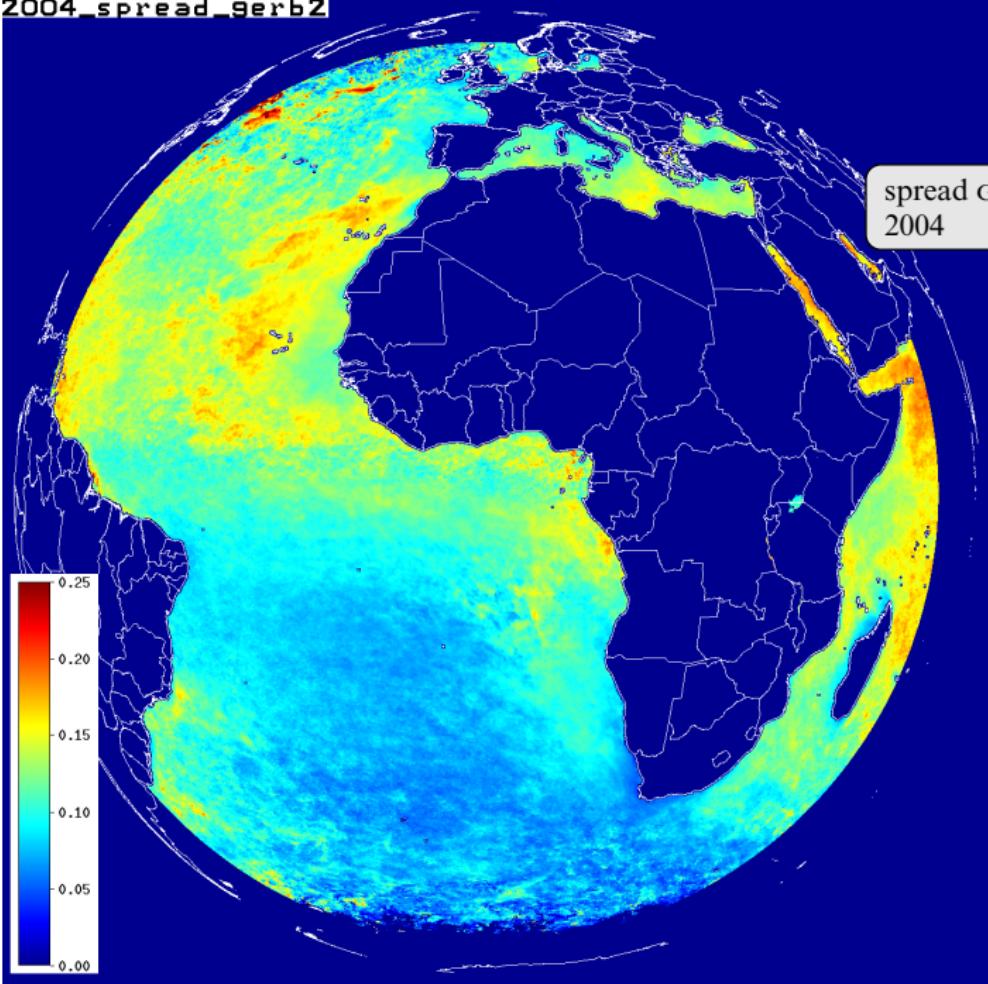
200412-gridded



average GERB-TRMM albedo ratio  
Dec 2004

2004\_spread\_gerb2

spread GERB-TRMM albedo ratio  
2004



# Average GERB–TRMM albedo ratio

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Month	GERB-2	GERB-1	Year	average
01	1.02525	0.93628	2004	1.0493
02	1.02731	0.94522	2005	1.0290
03	1.04082	0.88675	2006	1.0146
04	1.02421	0.94901	2007 (GERB-2)	1.0215
05	1.03255	0.95449	2007 (GERB-1)	0.9926
06	1.04433	0.95677	2008	0.9661
07	1.05262	0.97051	2009	0.9442
08	1.04833	0.98032	2010	0.9272
09	1.05289	0.98131	2011	0.9189
10	1.03025	0.95118		
11	1.01214	0.93965		
12	1.01207	0.92570		

# Standard deviation GERB–TRMM albedo ratio

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Month	GERB-2	GERB-1	Year	s.d.
01	0.09176	0.07837	2004	0.10722
02	0.09383	0.07692	2005	0.09803
03	0.09993	0.10734	2006	0.09879
04	0.09028	0.06970	2007 (GERB-2)	0.09583
05	0.09543	0.08529	2007 (GERB-1)	0.09028
06	0.09415	0.08504	2008	0.08727
07	0.09622	0.08734	2009	0.08440
08	0.08870	0.08561	2010	0.08419
09	0.09157	0.11885	2011	0.08074
10	0.08843	0.06032		
11	0.08641	0.07764		
12	0.08668	0.07306		



# Next

- ▶ Decide what to do with the GERB–TRMM ratio
- ▶ Produce BARG

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# Acknowledgements

- ▶ Dr. Jacqueline E. Russell, Imperial College
- ▶ GERB team at RMIB
- ▶ RMIB

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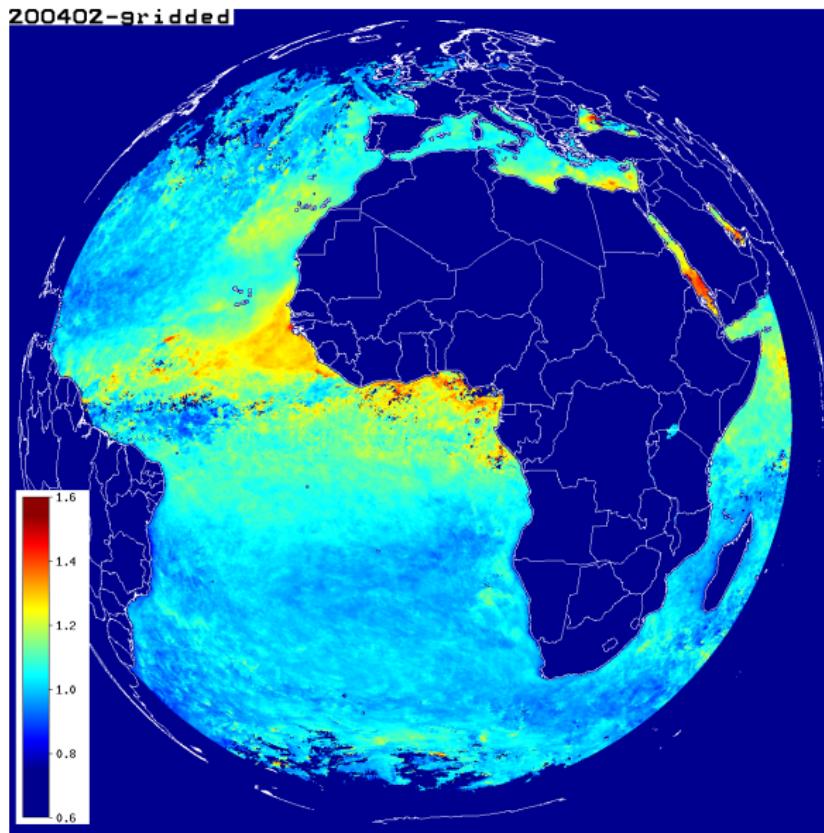
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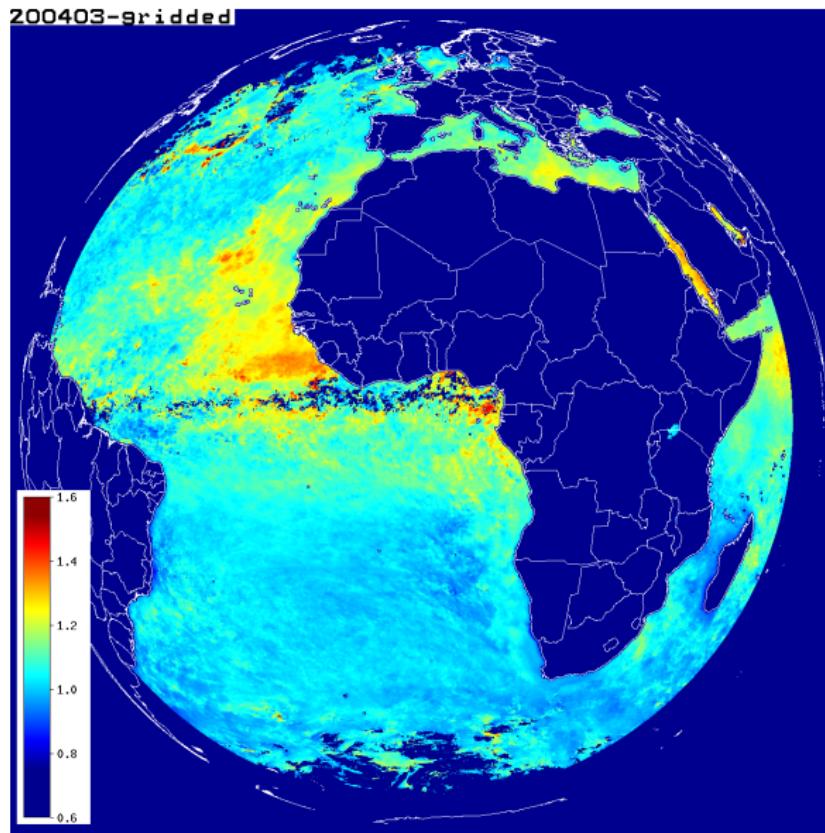
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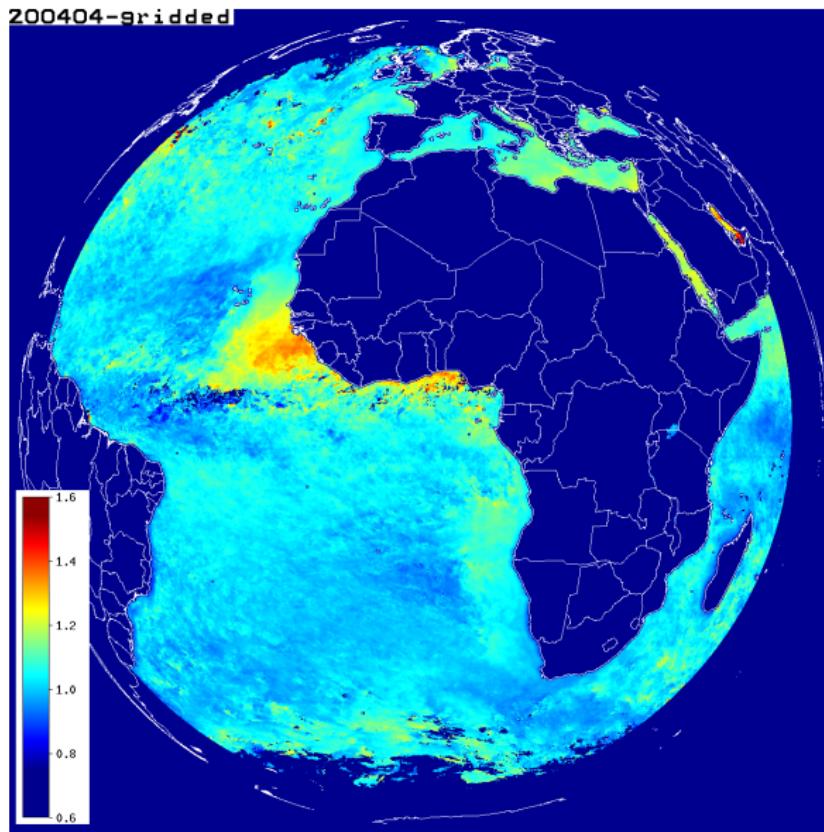
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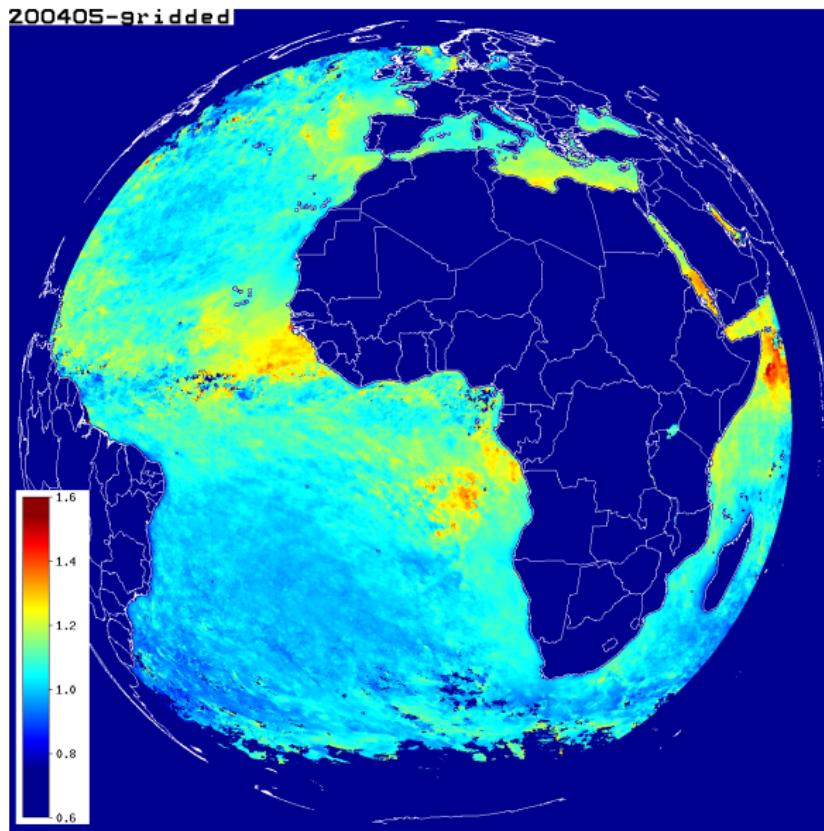
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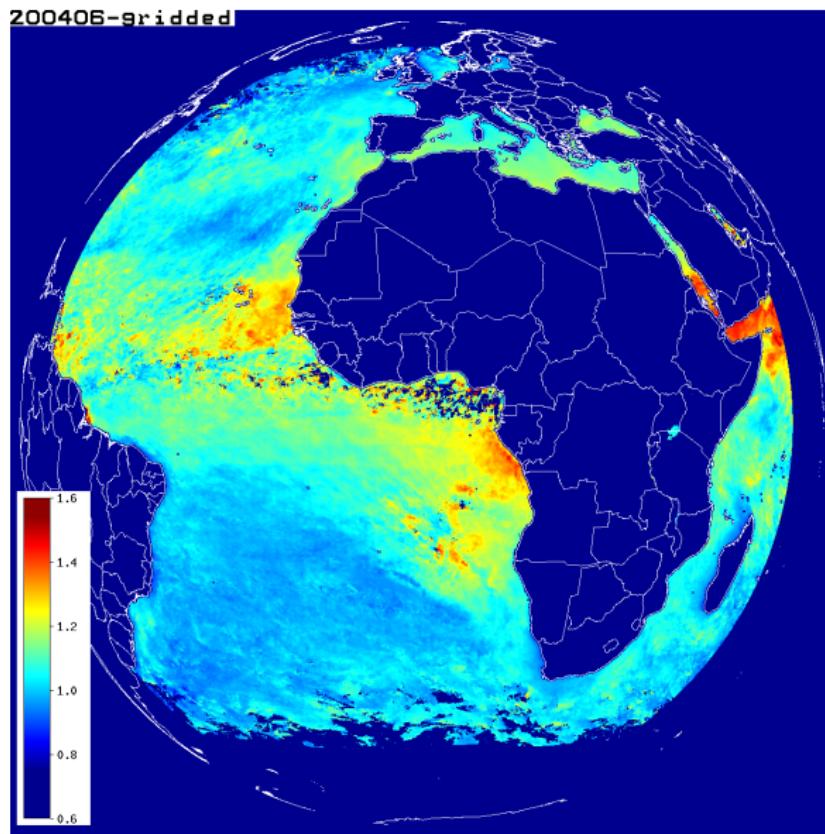
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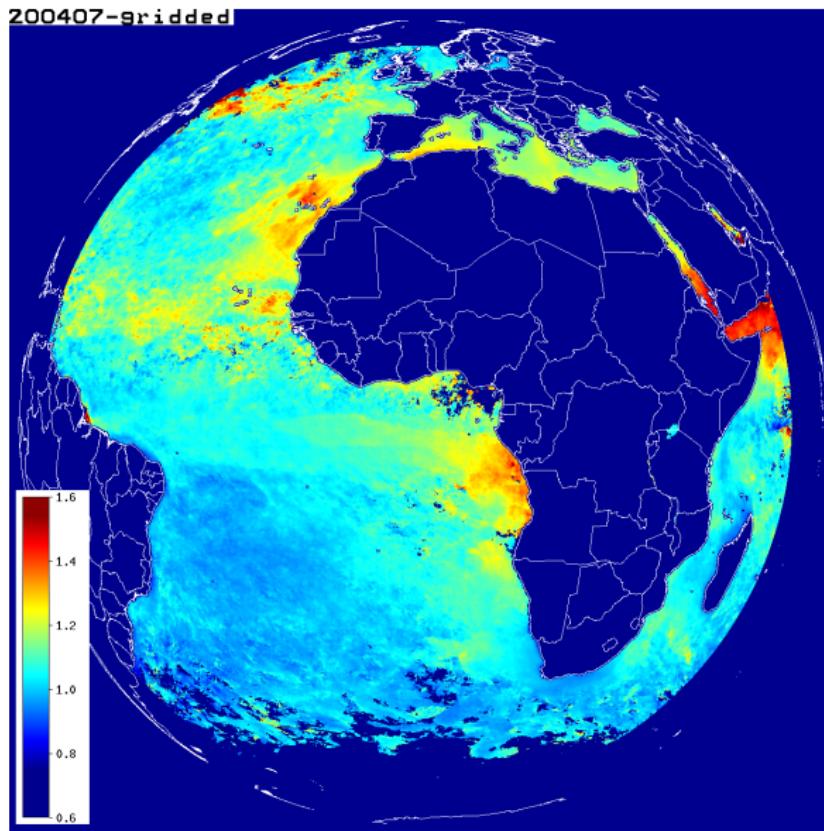
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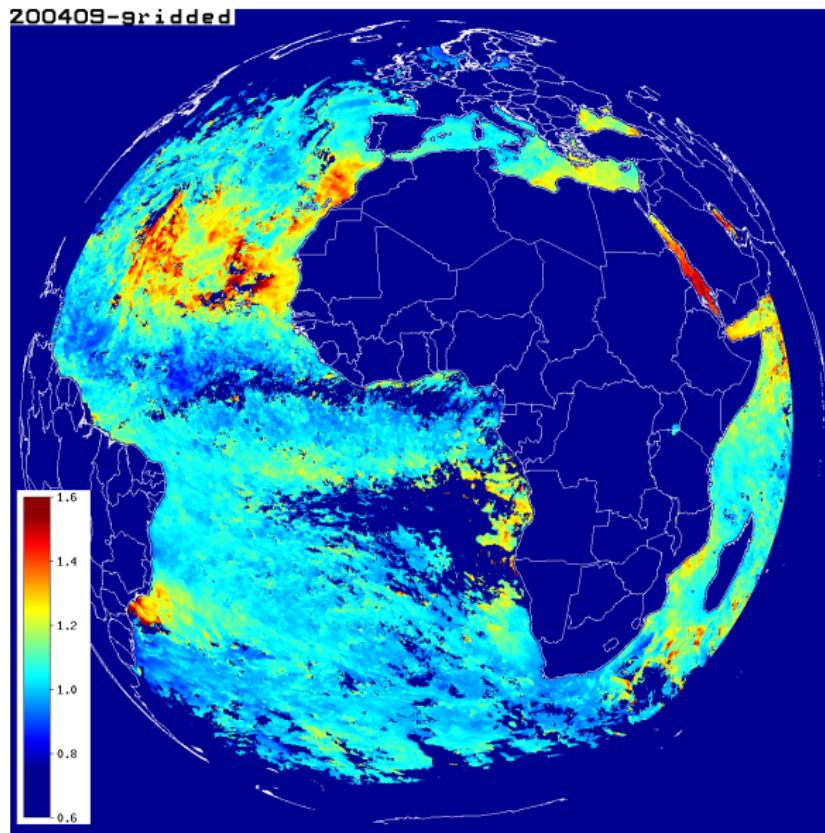
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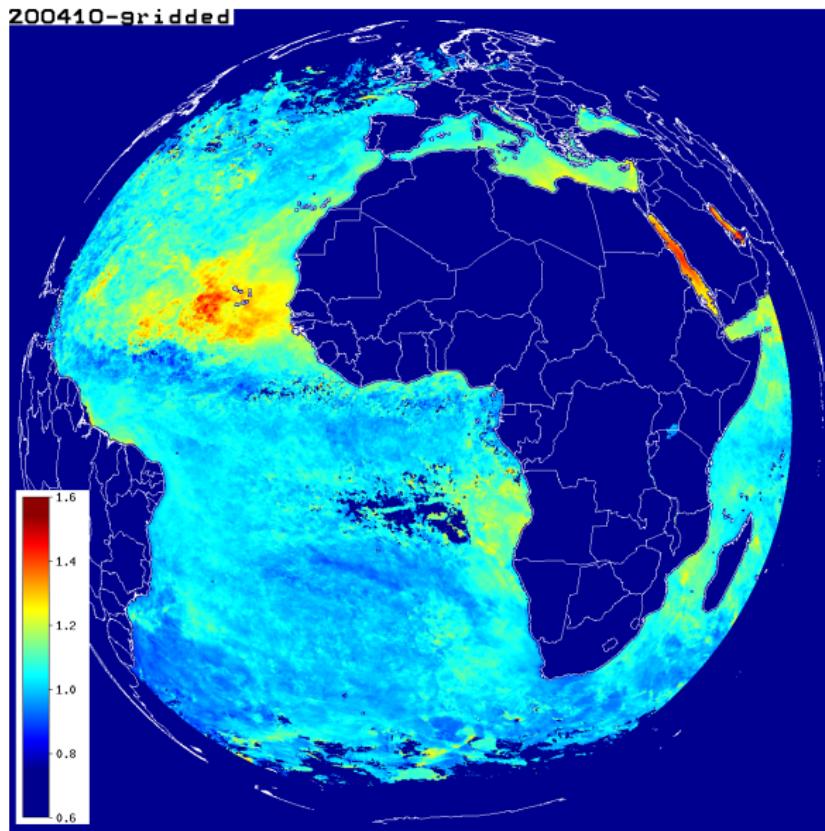
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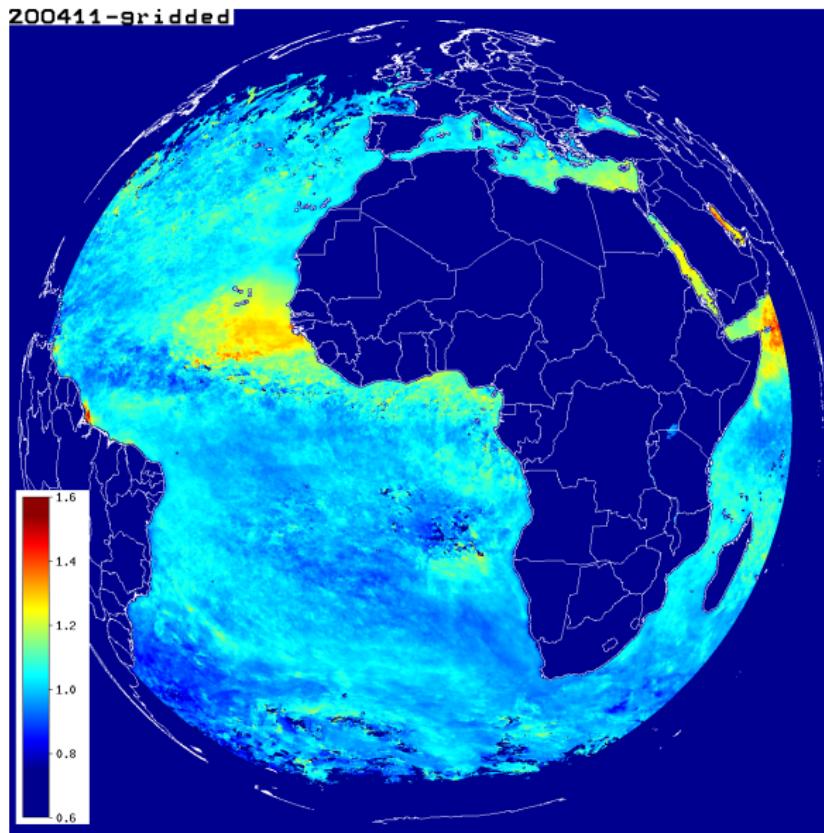
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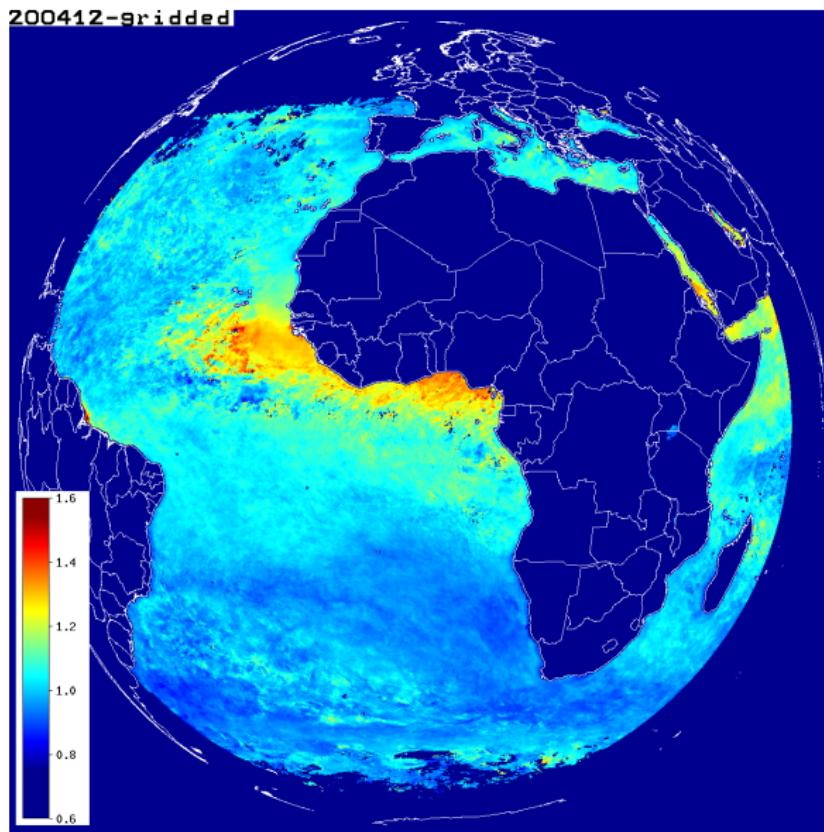
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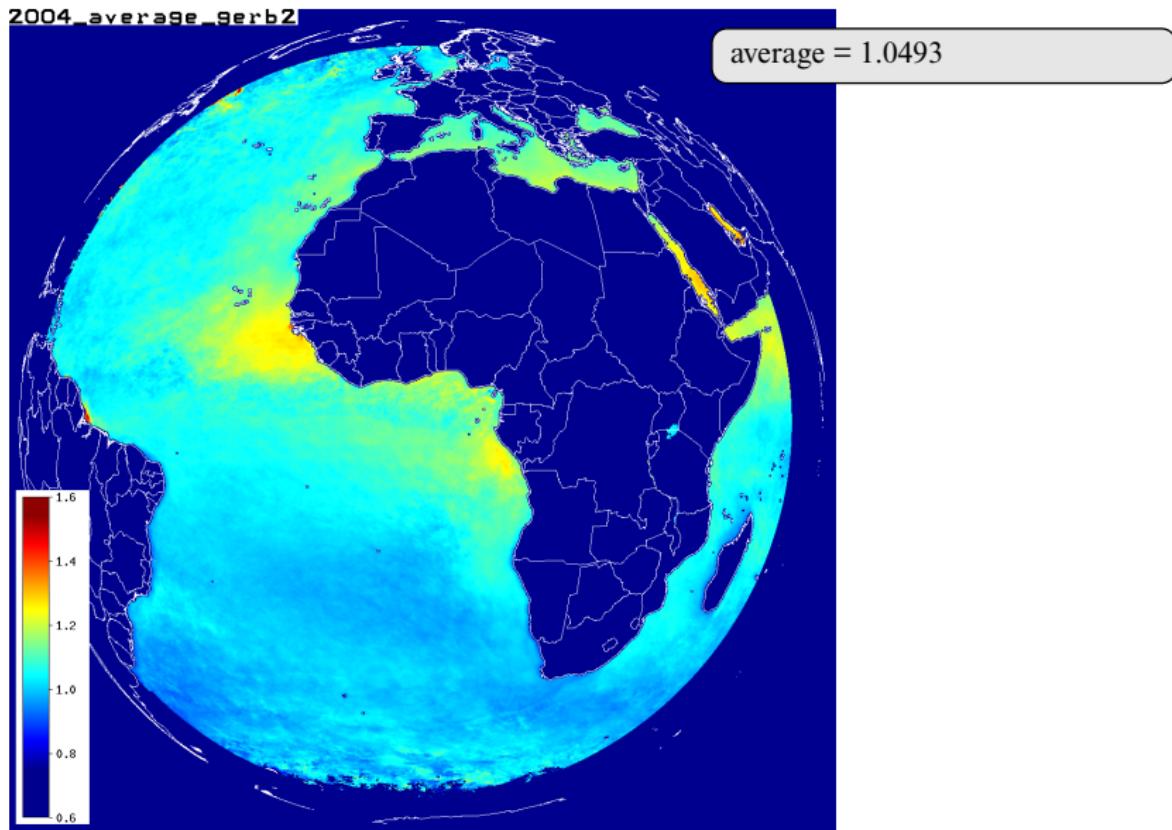
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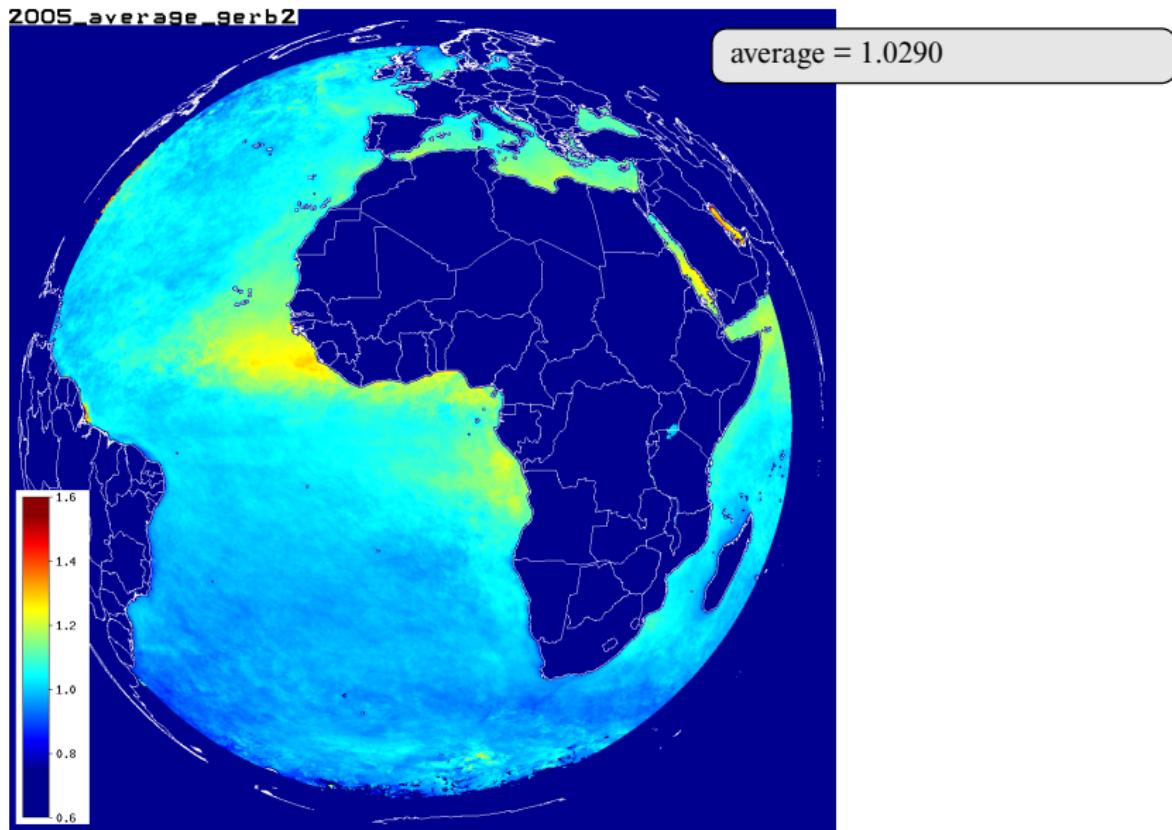
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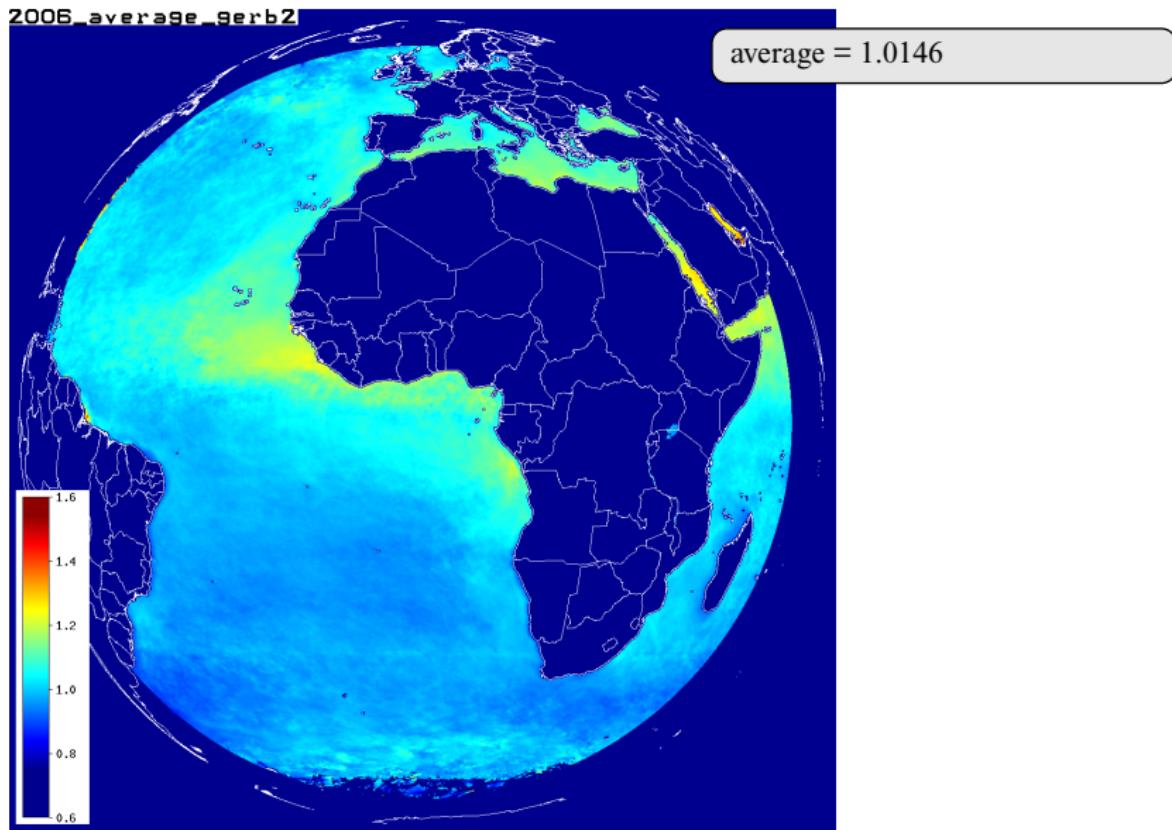
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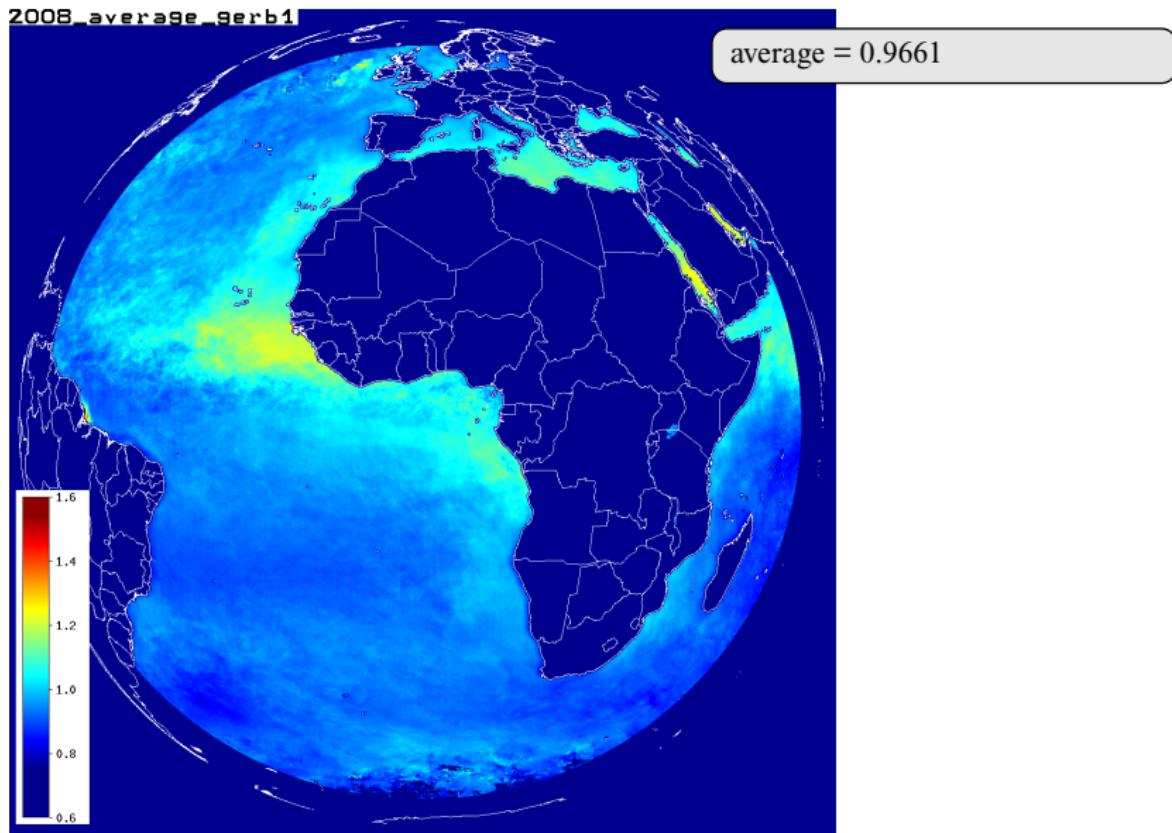
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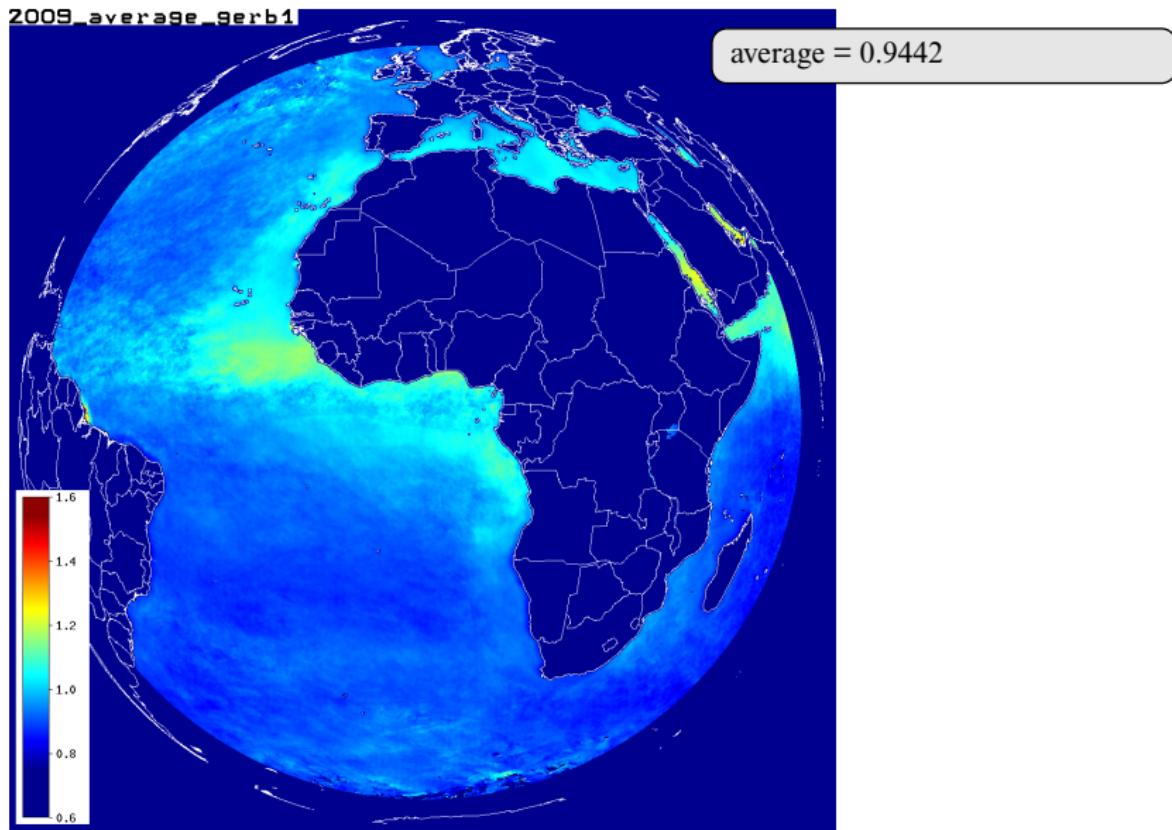
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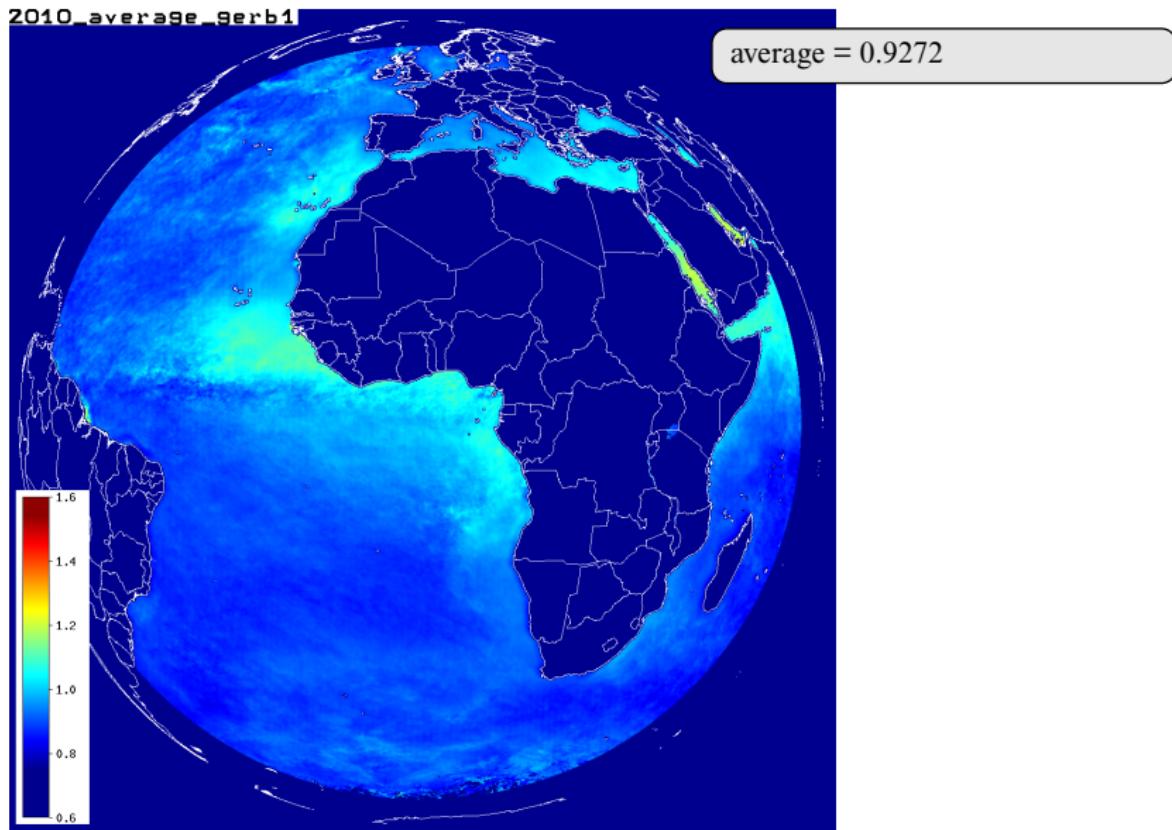
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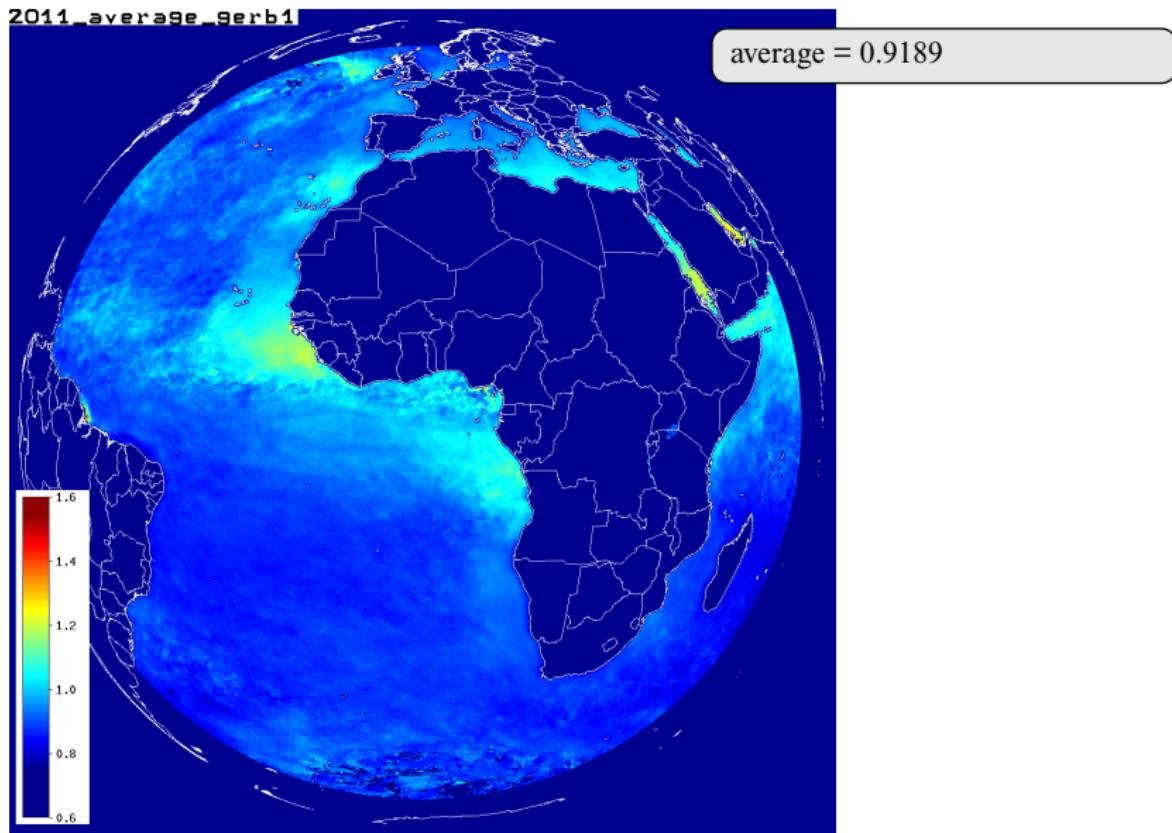
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# Spread GERB–TRMM albedo ratio, yearly

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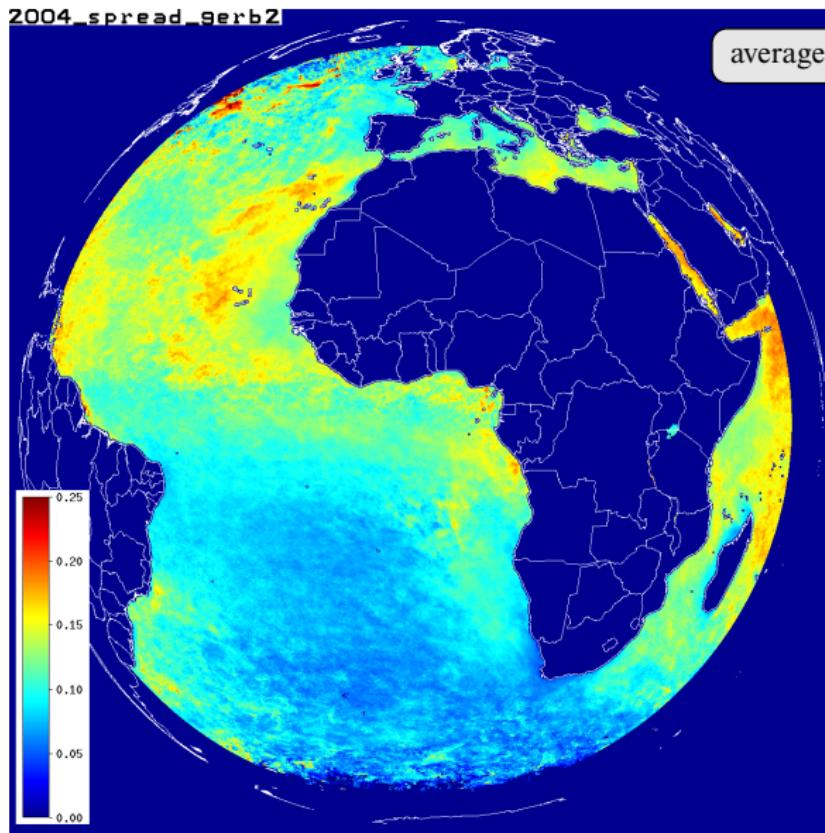
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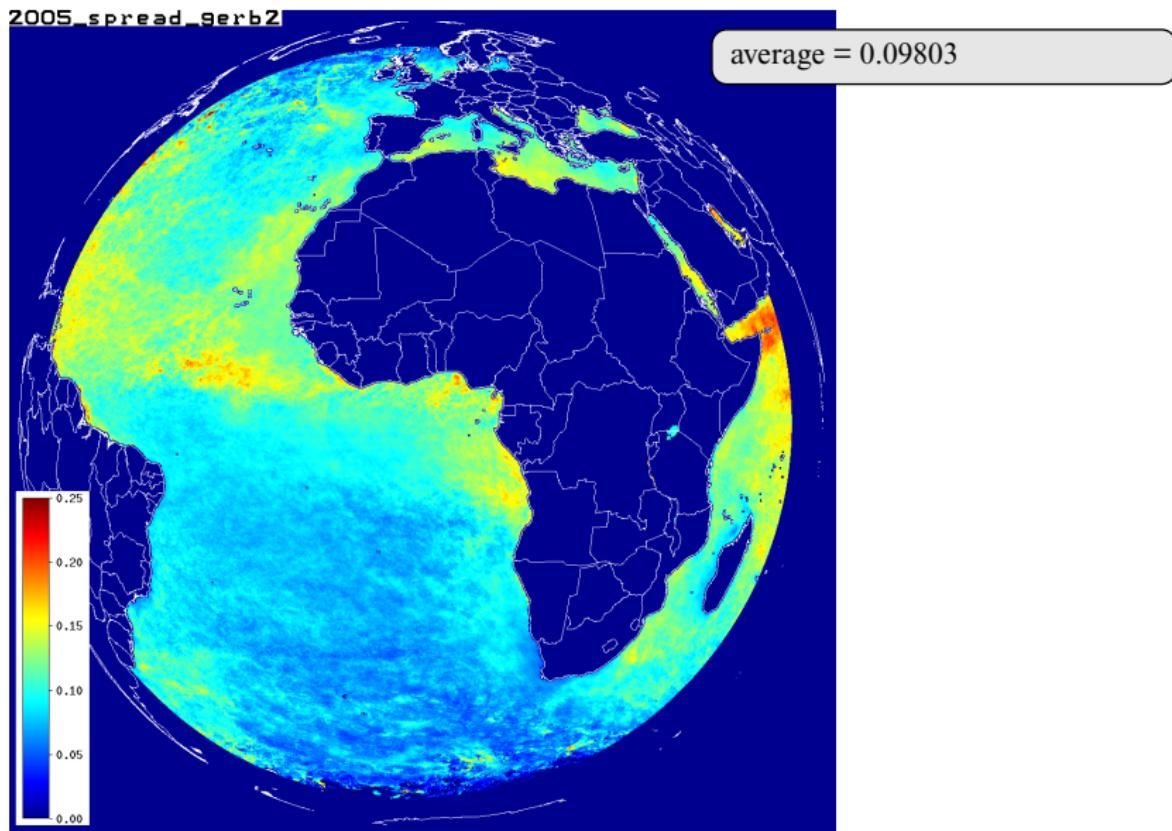
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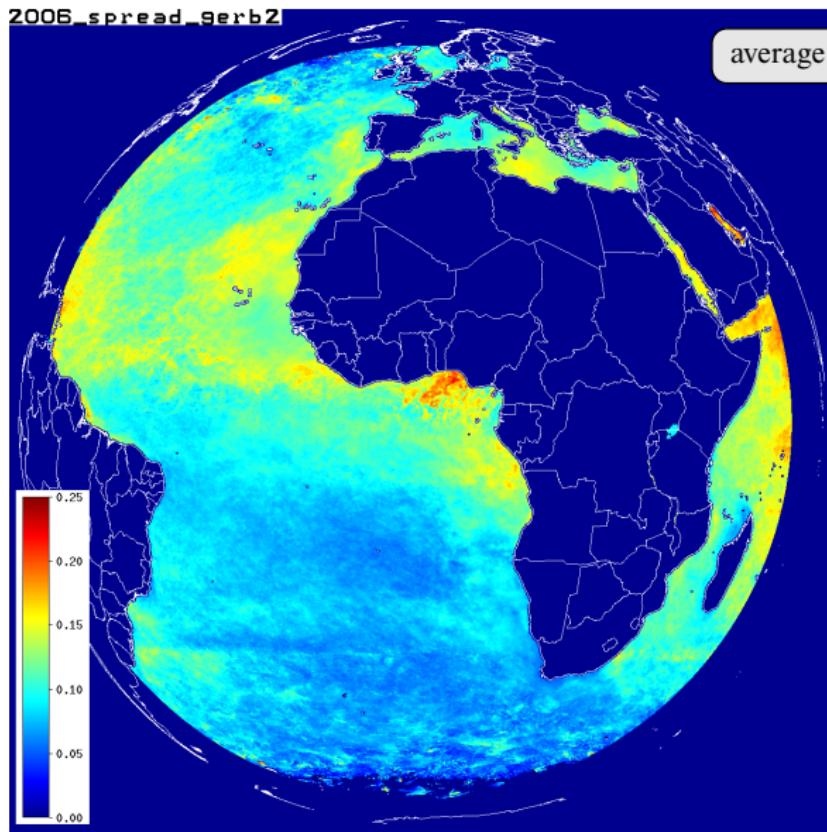
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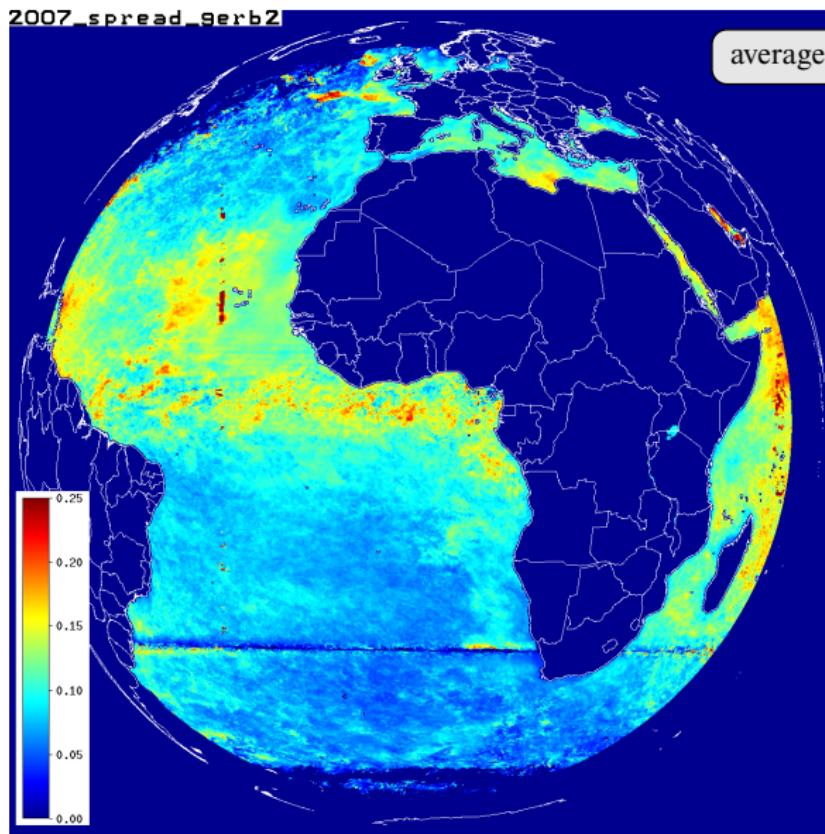
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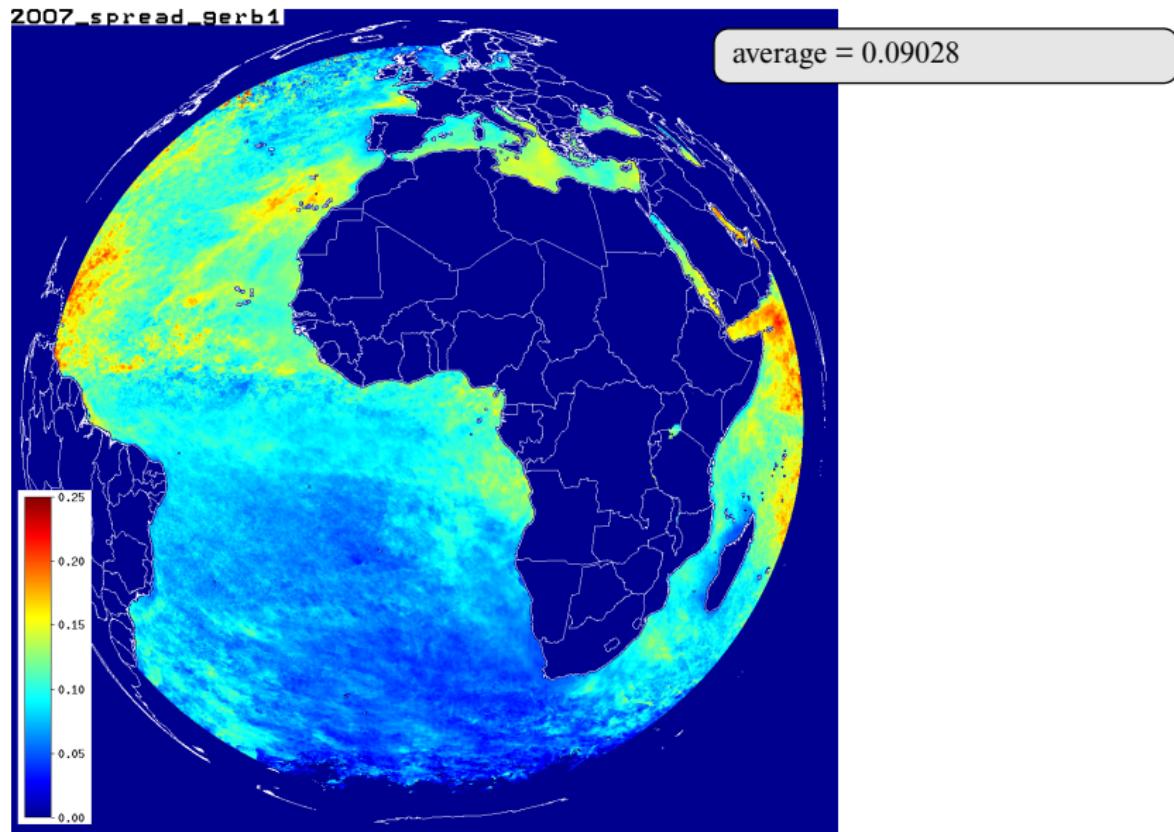
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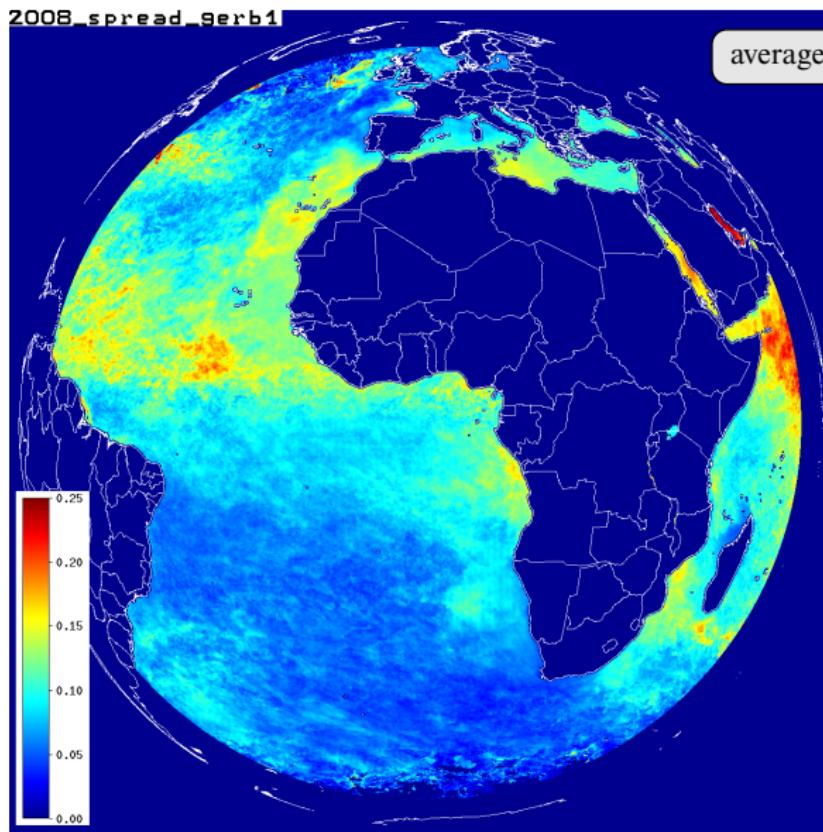
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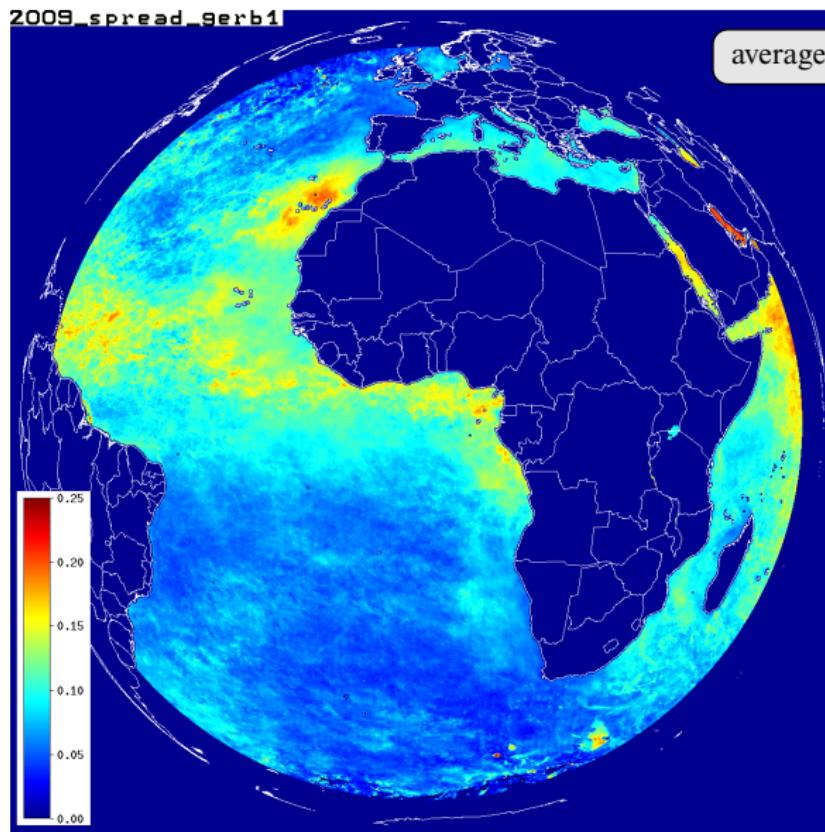
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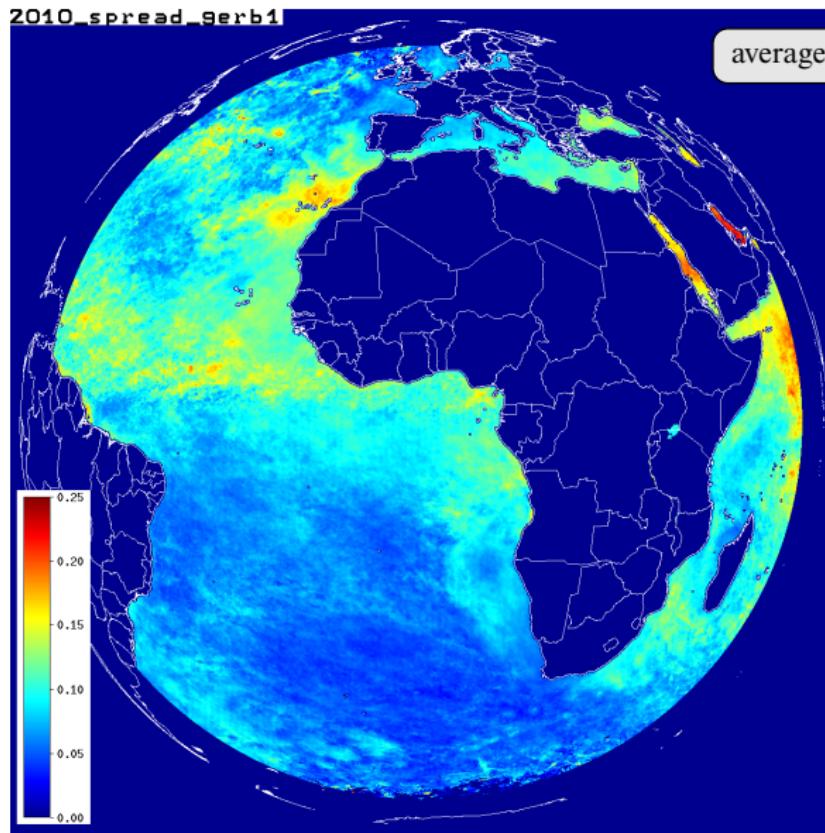
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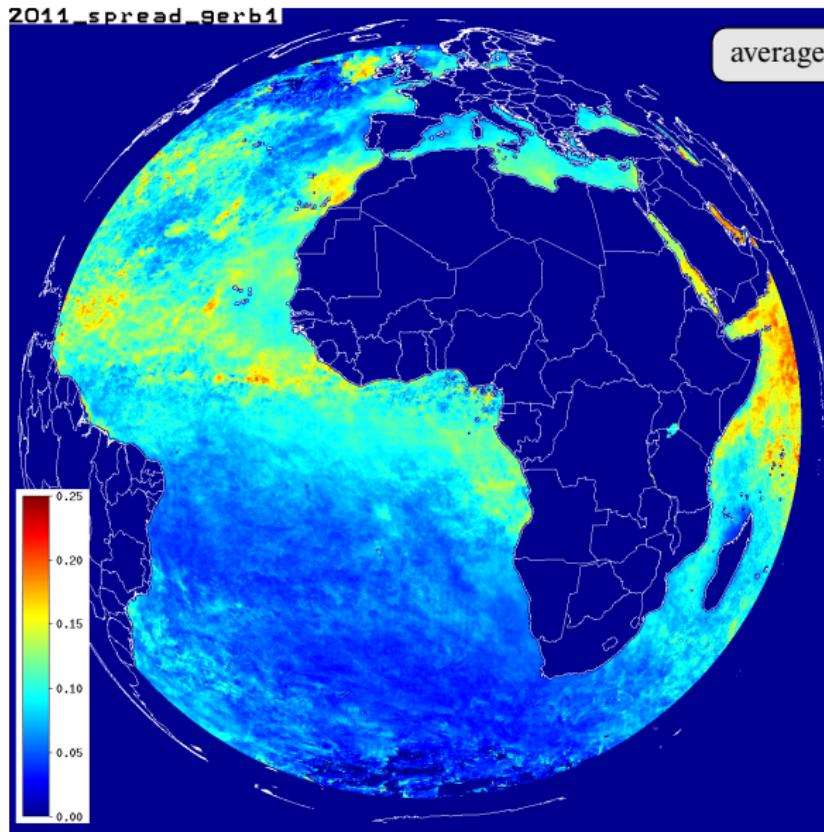
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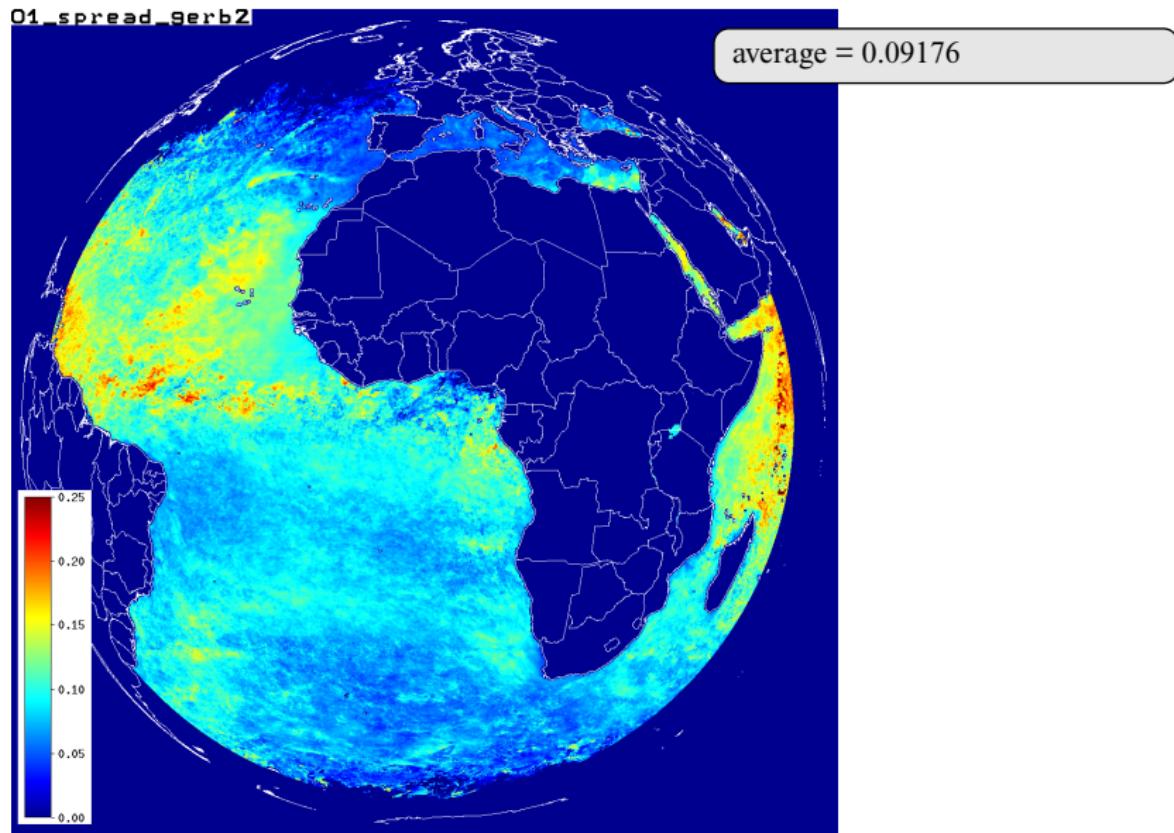
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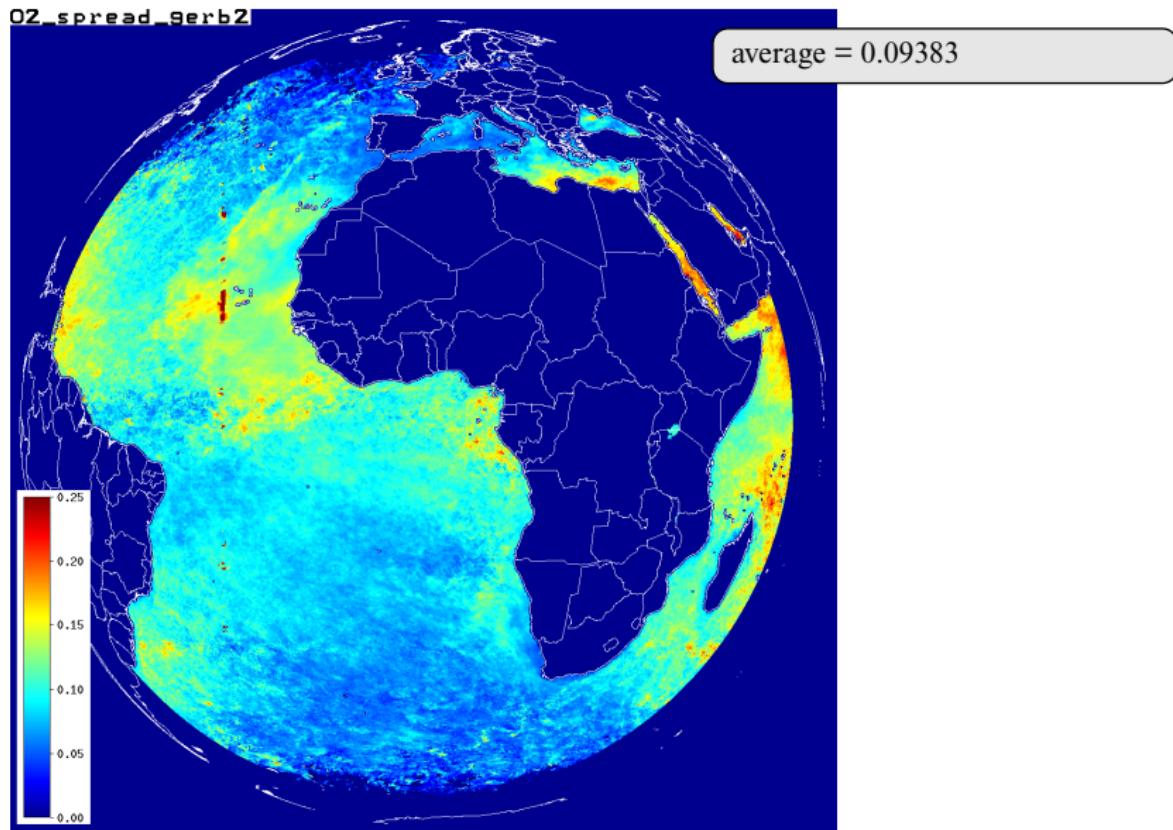
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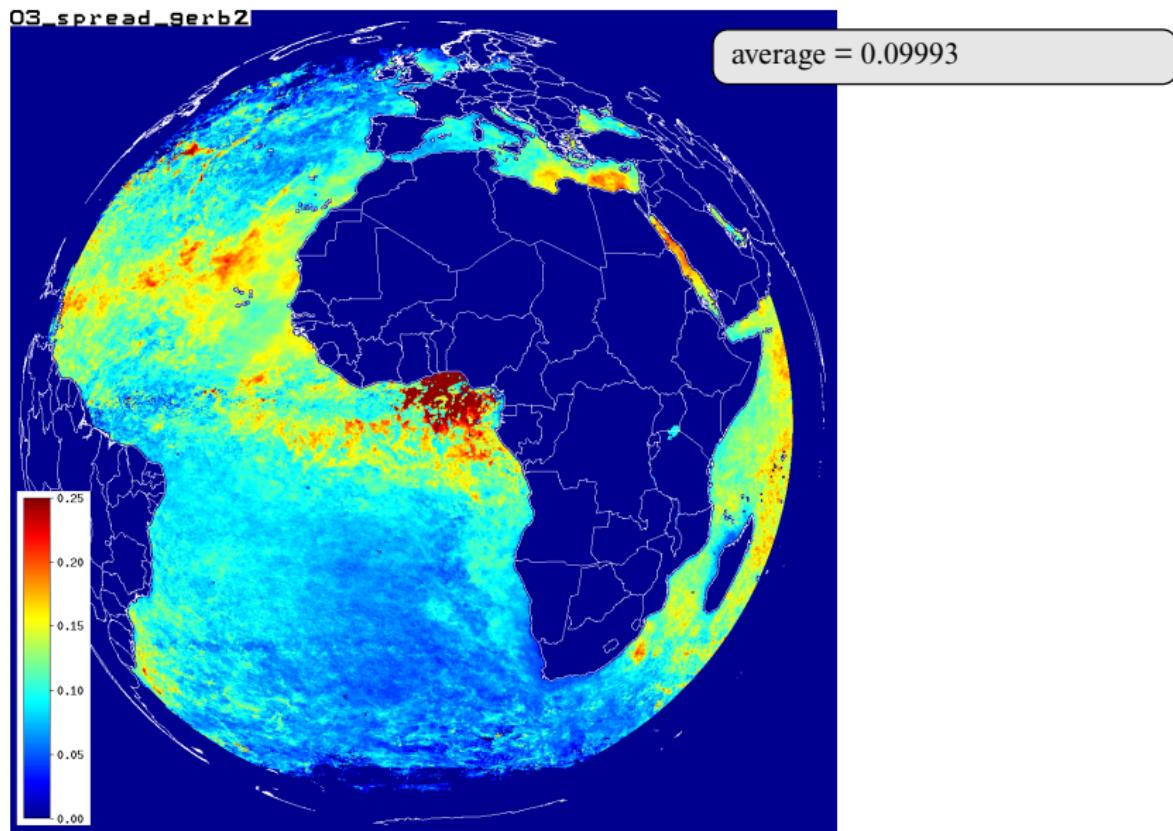
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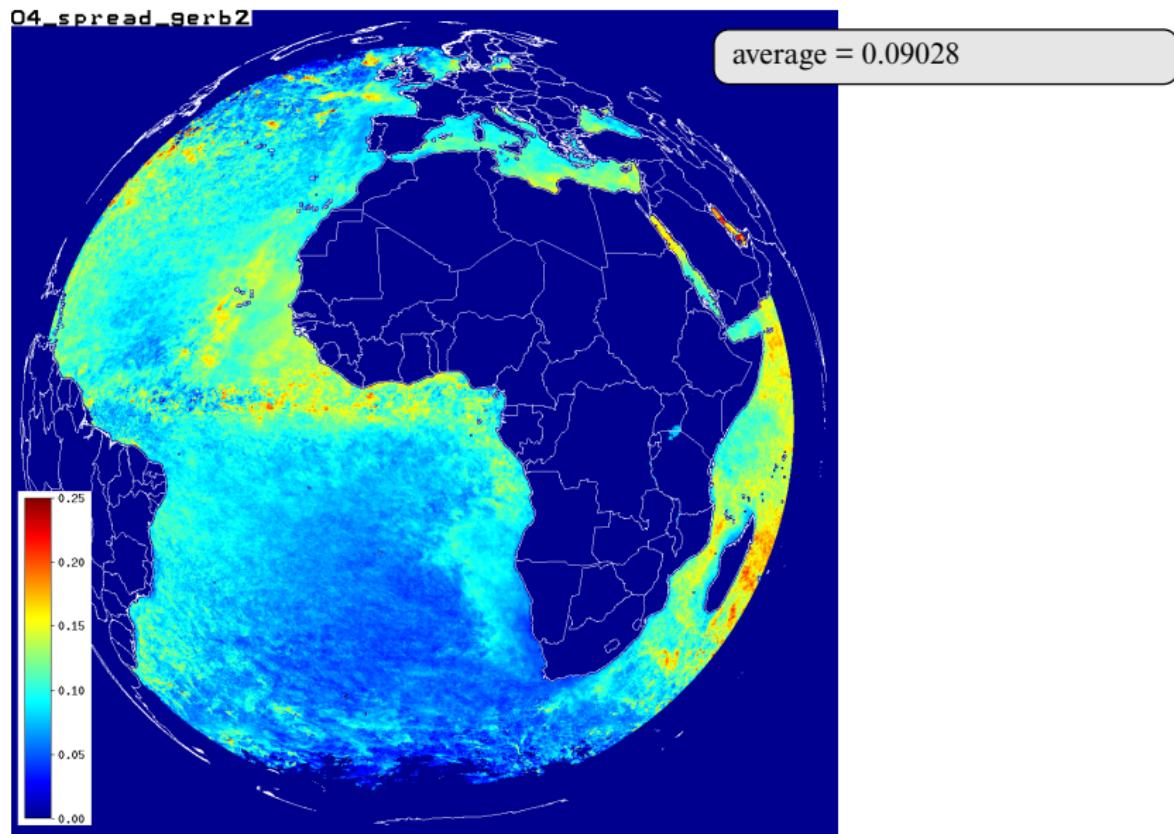
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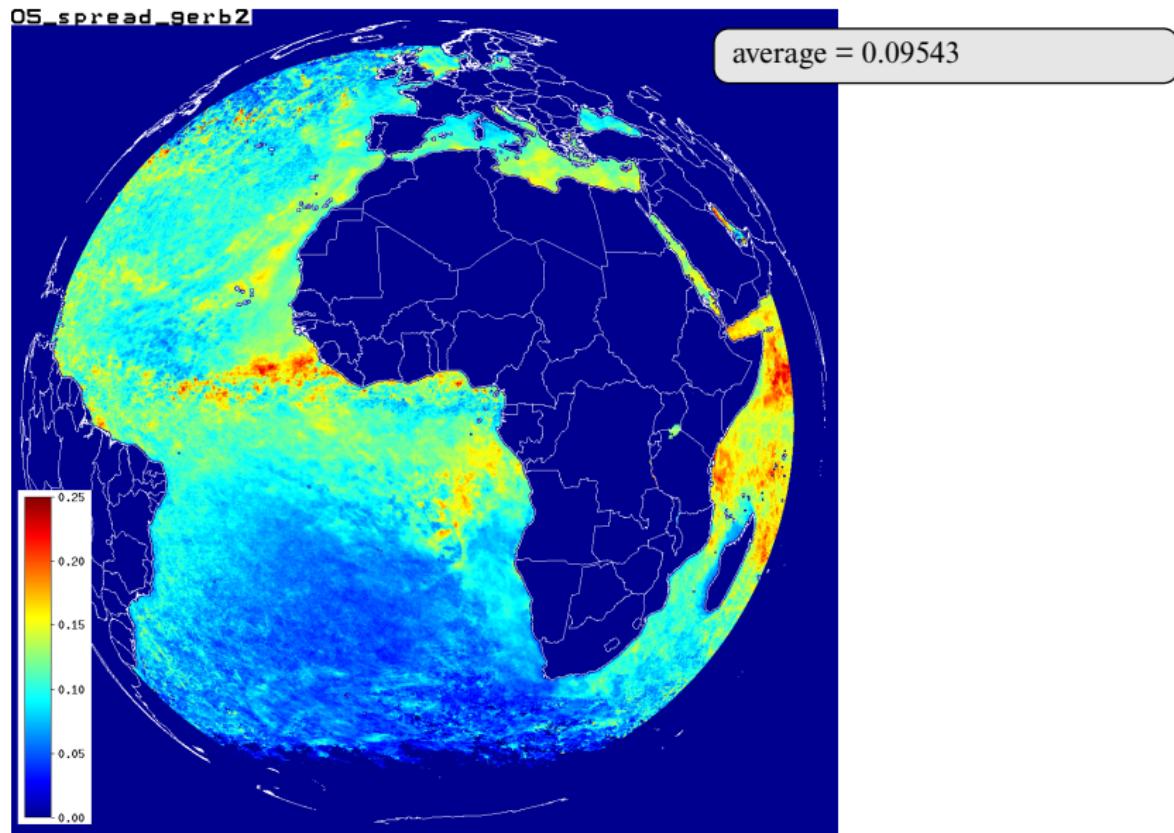
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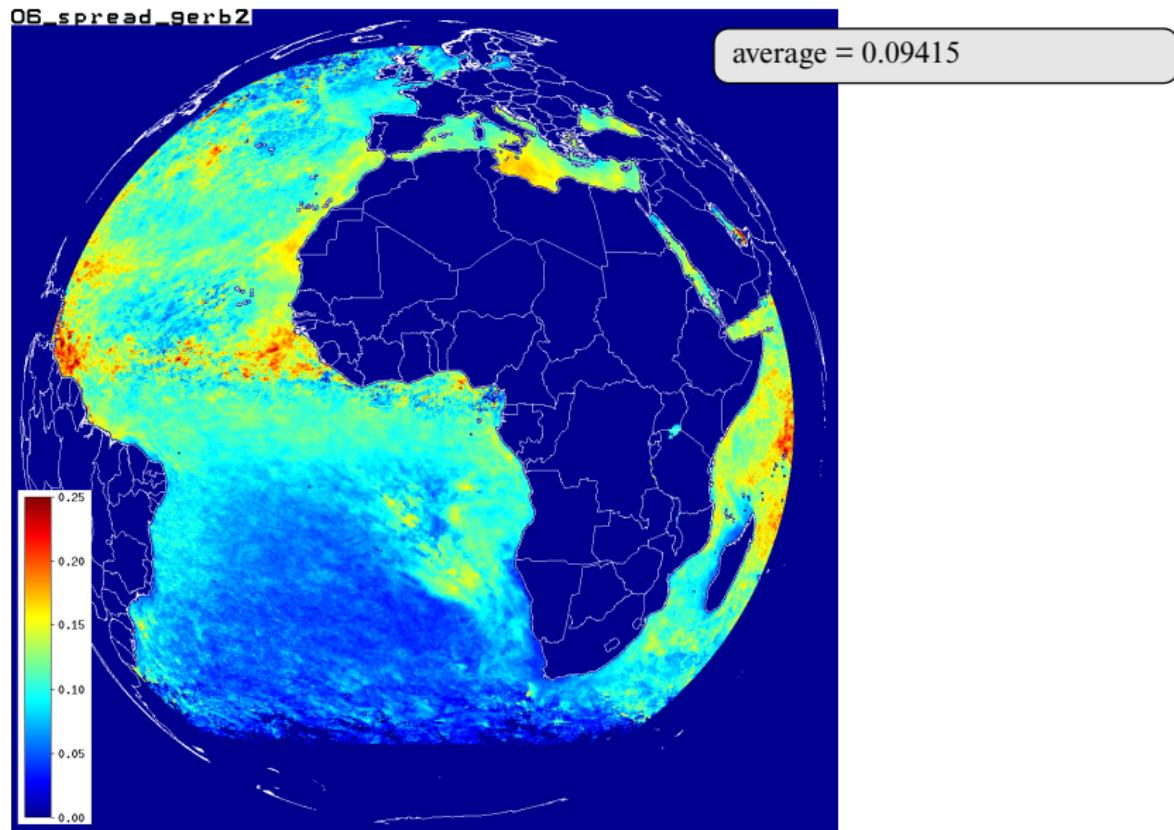
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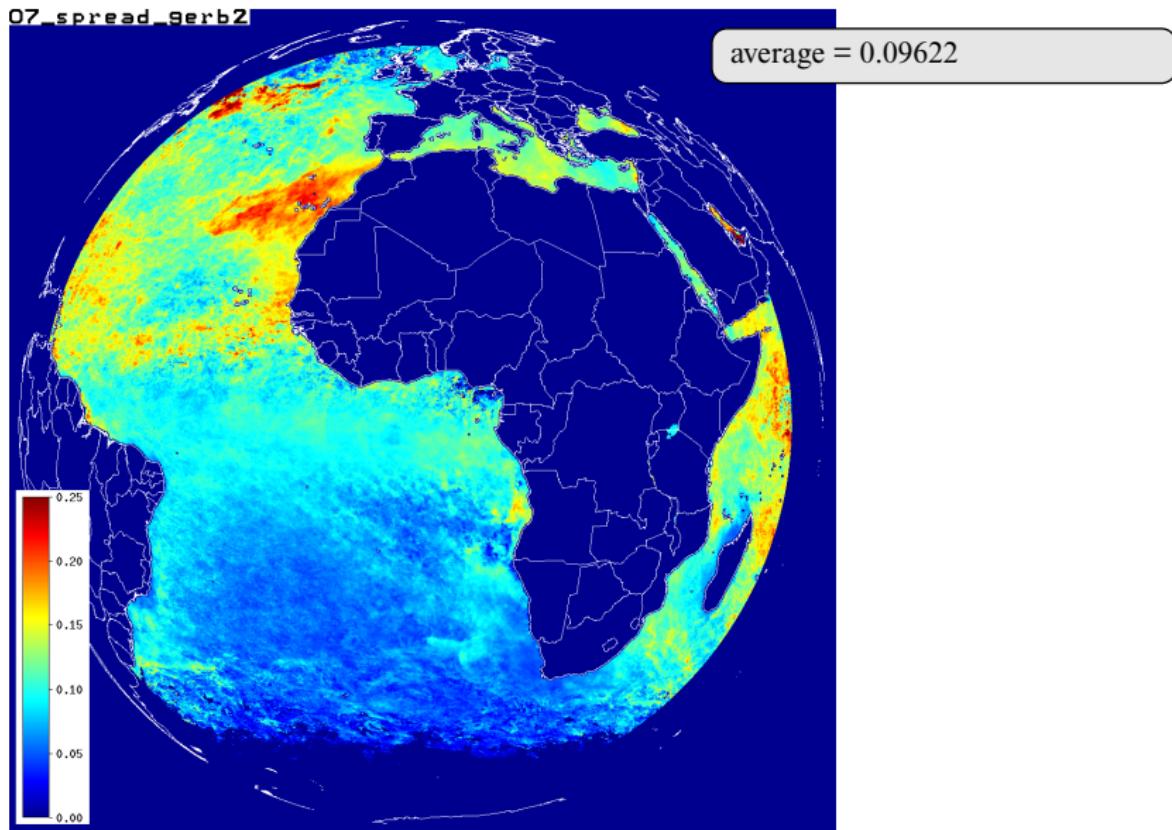
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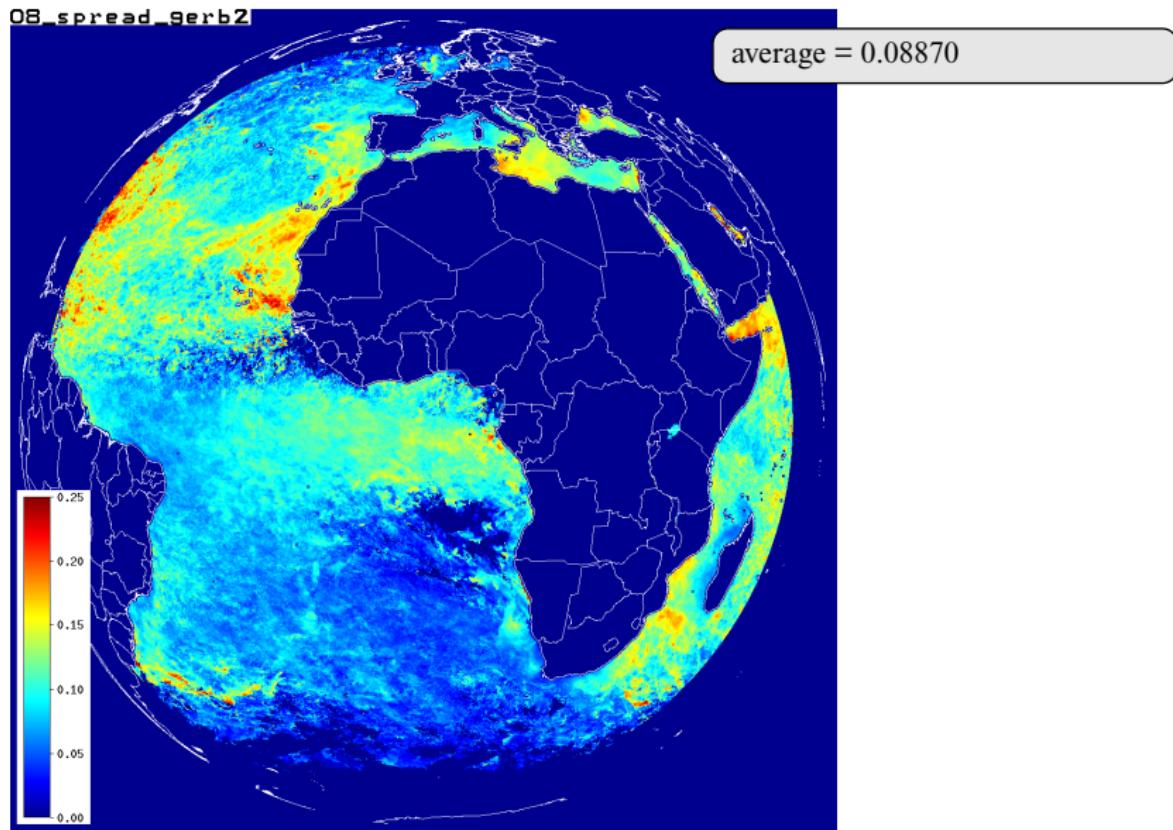
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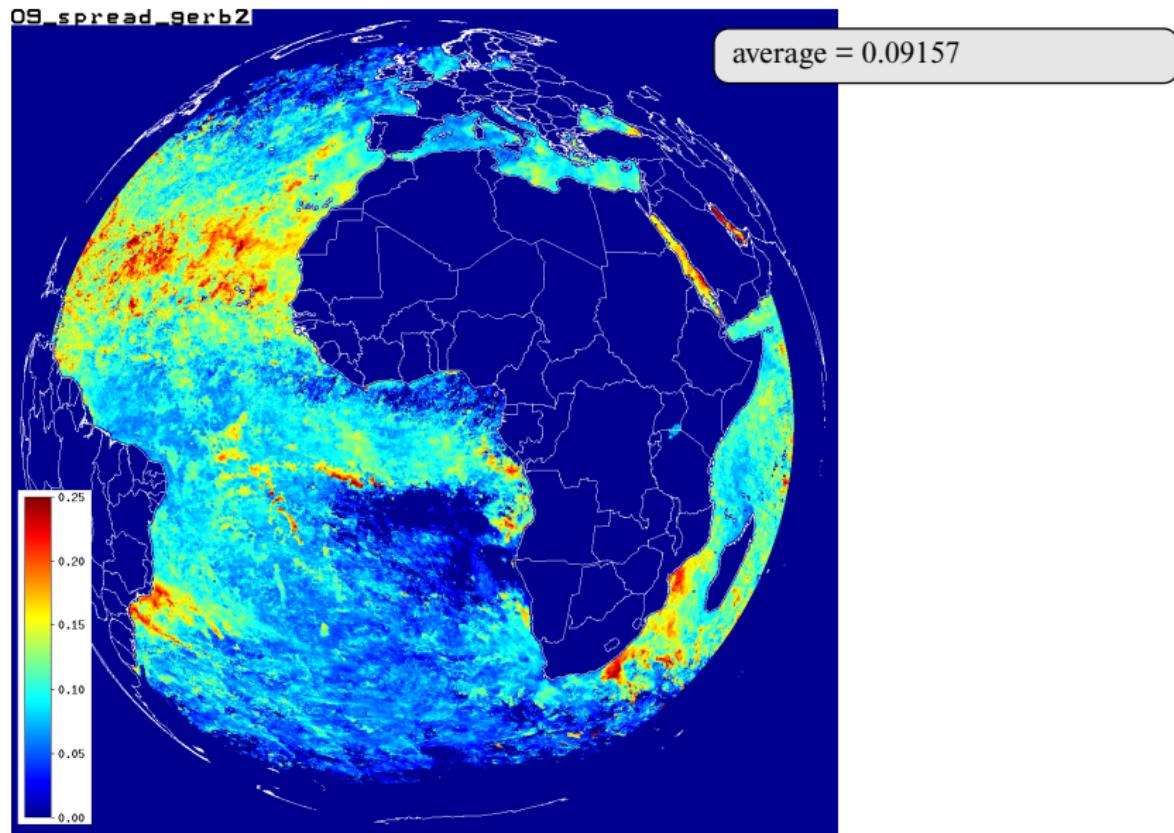
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# Spread GERB–TRMM albedo ratio, monthly

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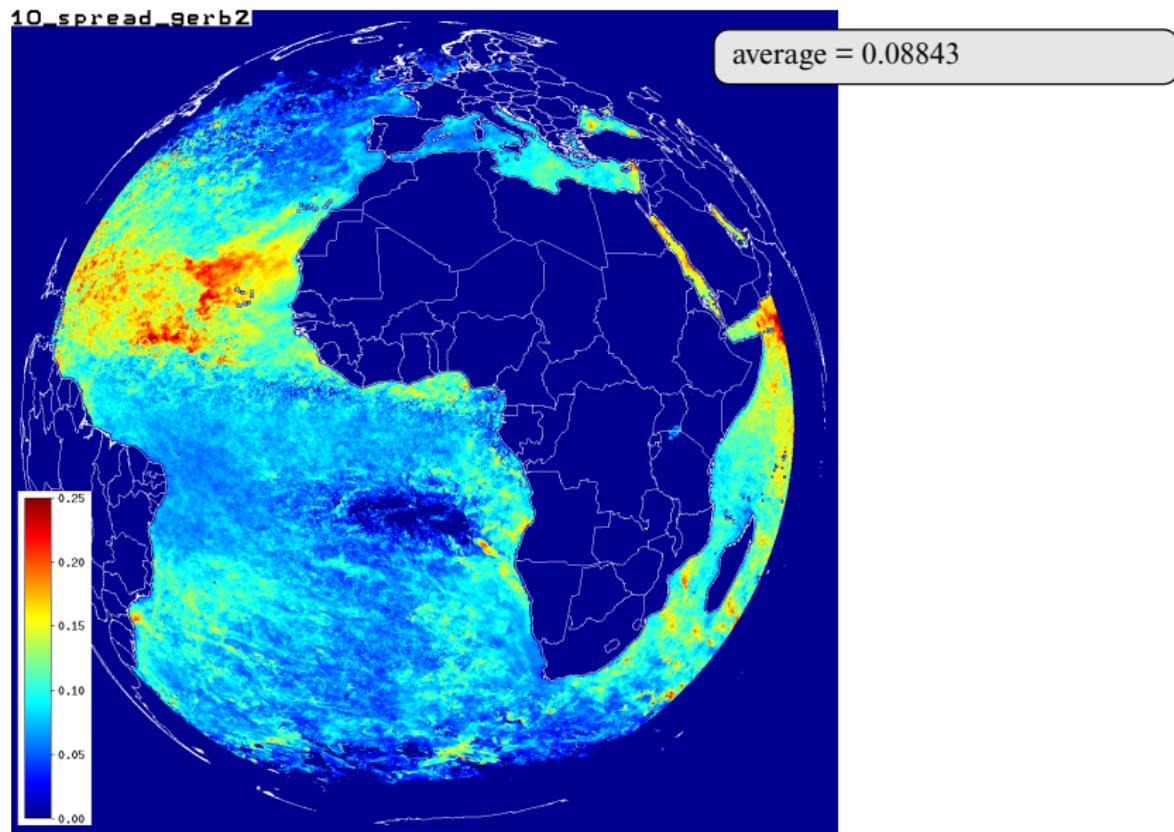
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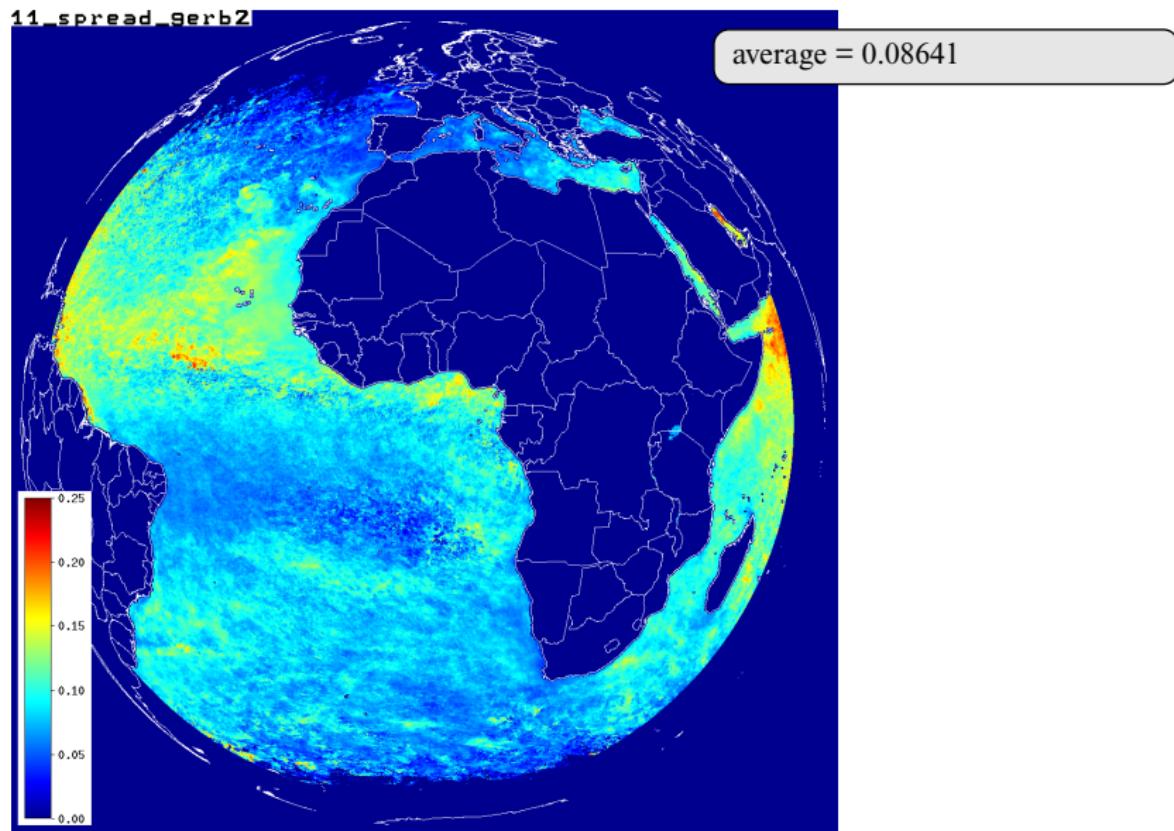
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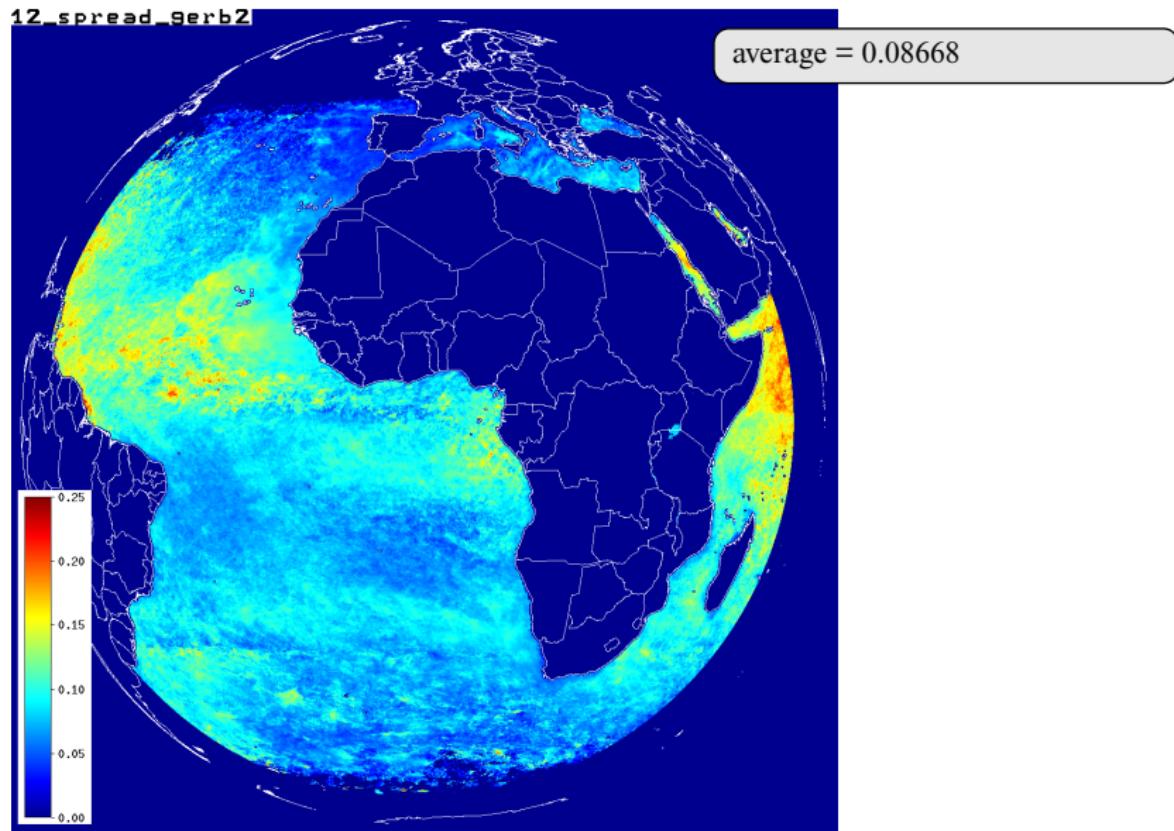
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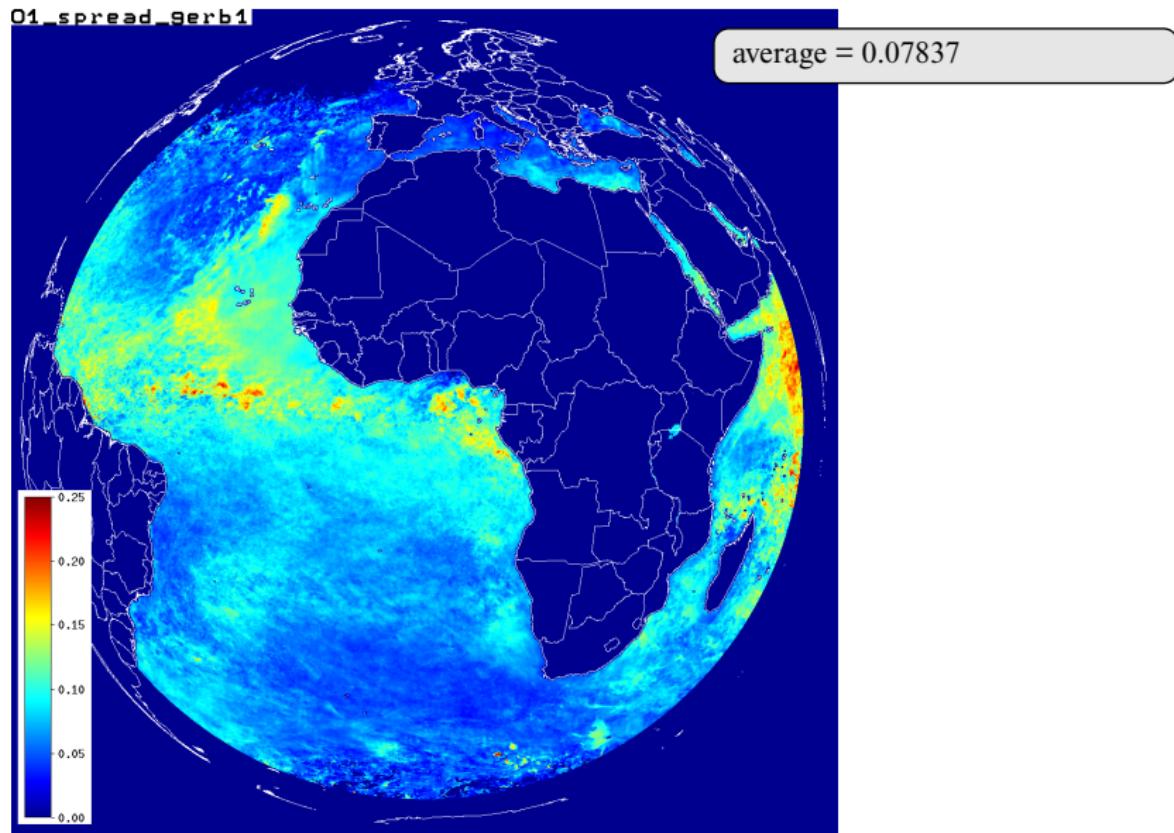
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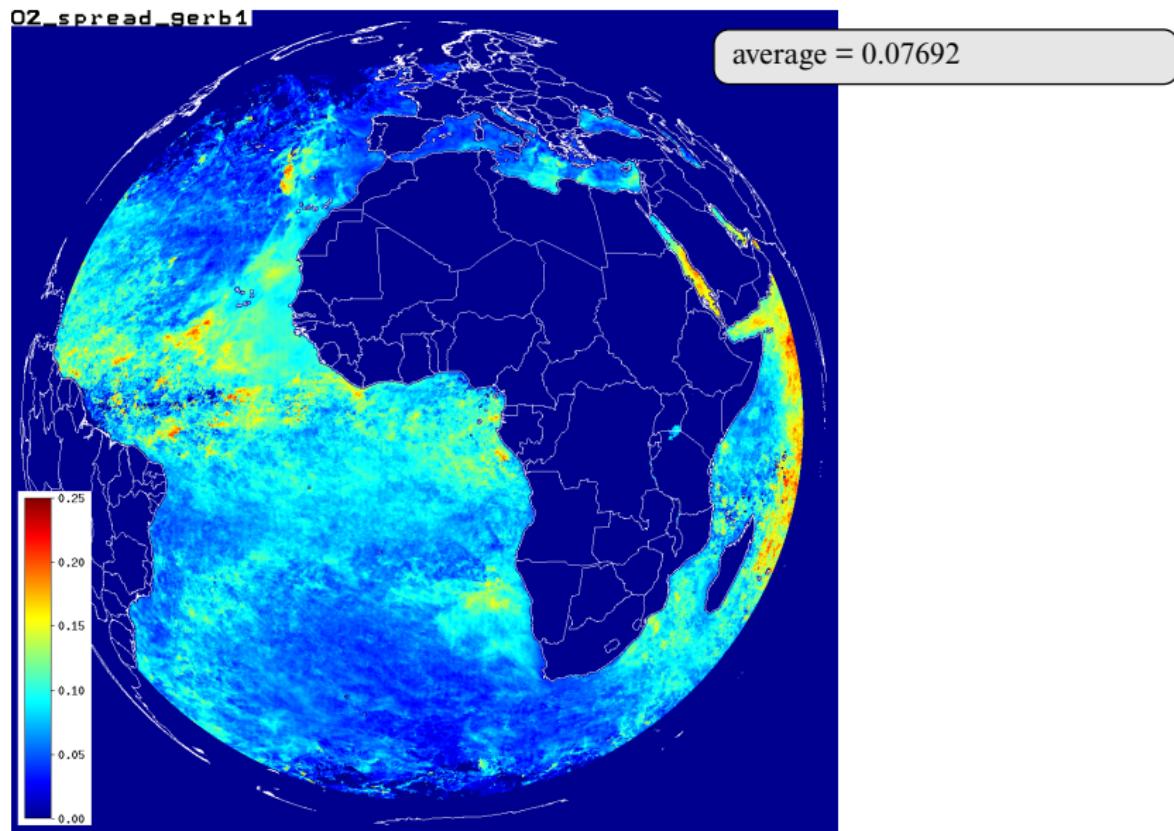
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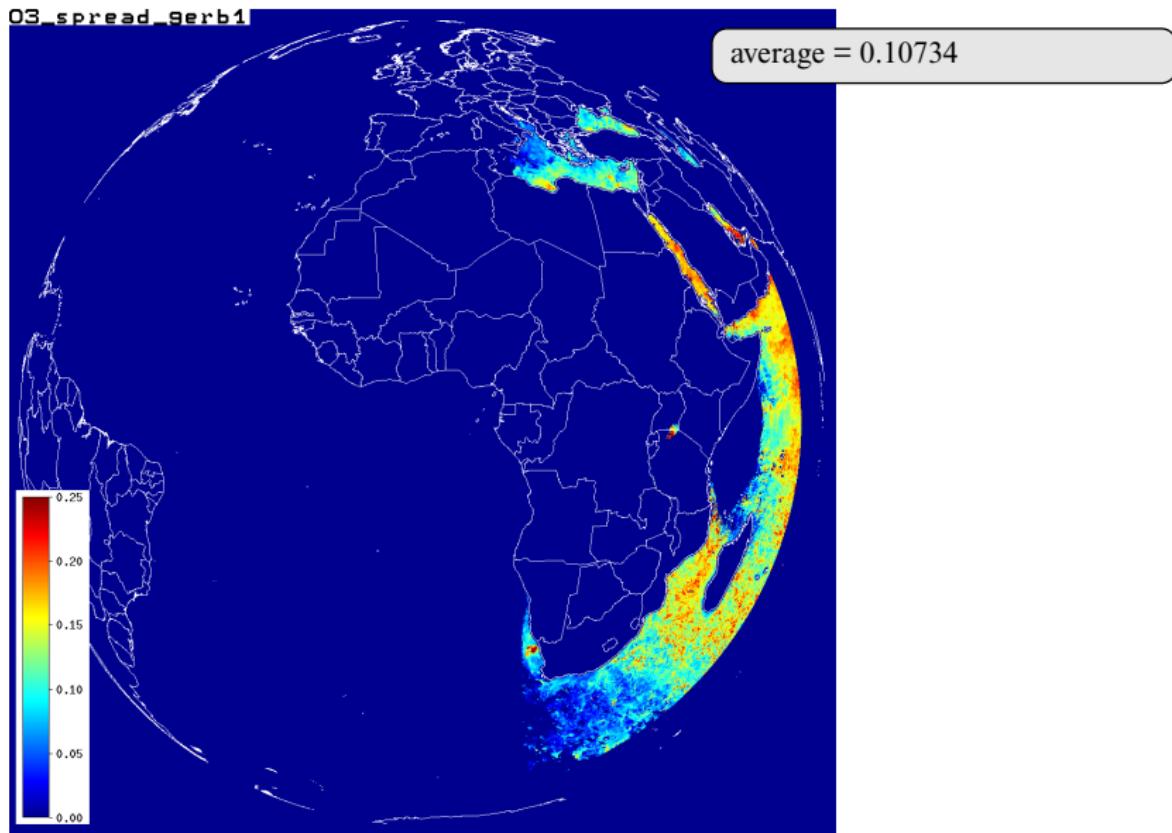
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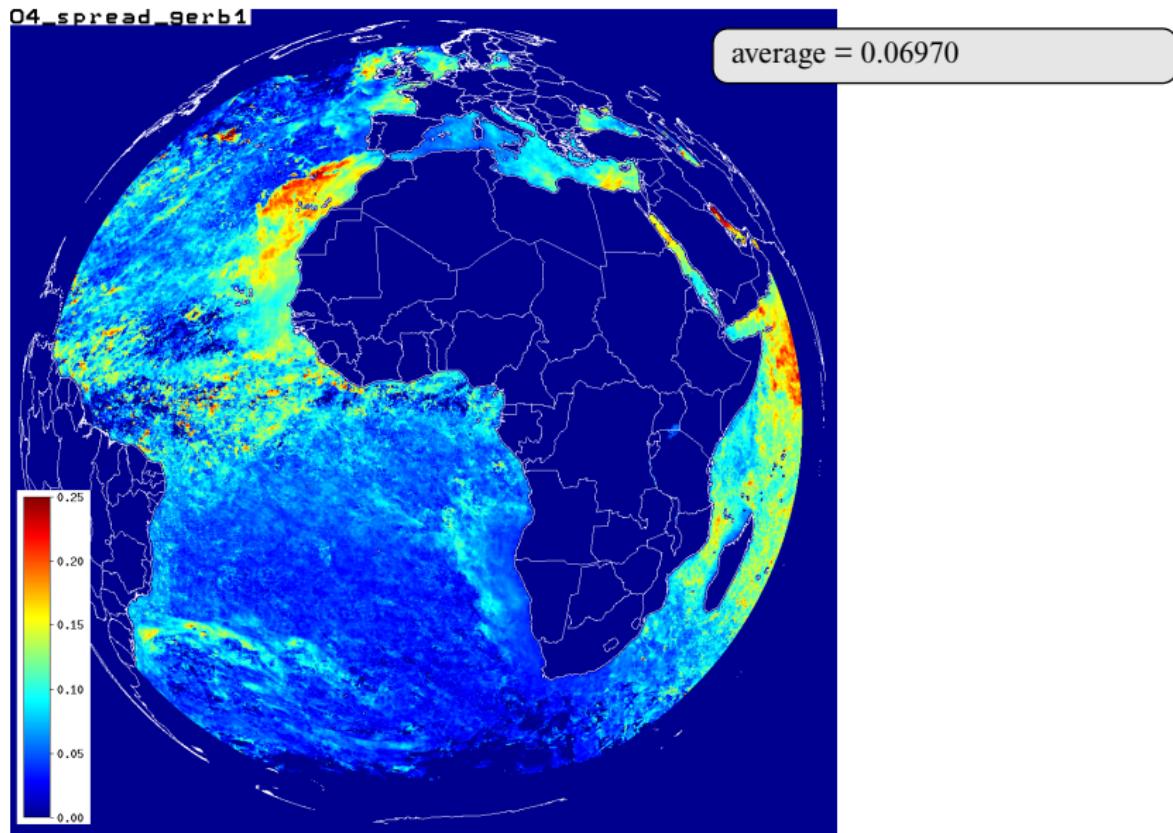
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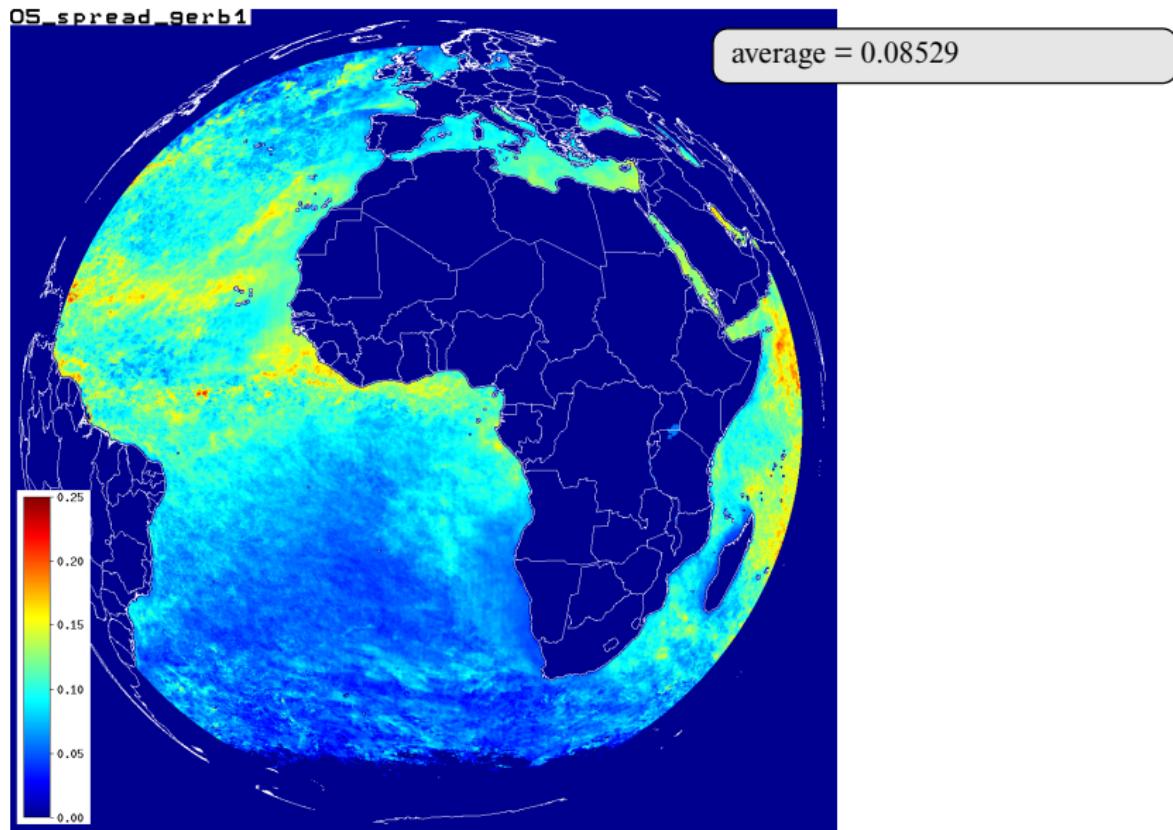
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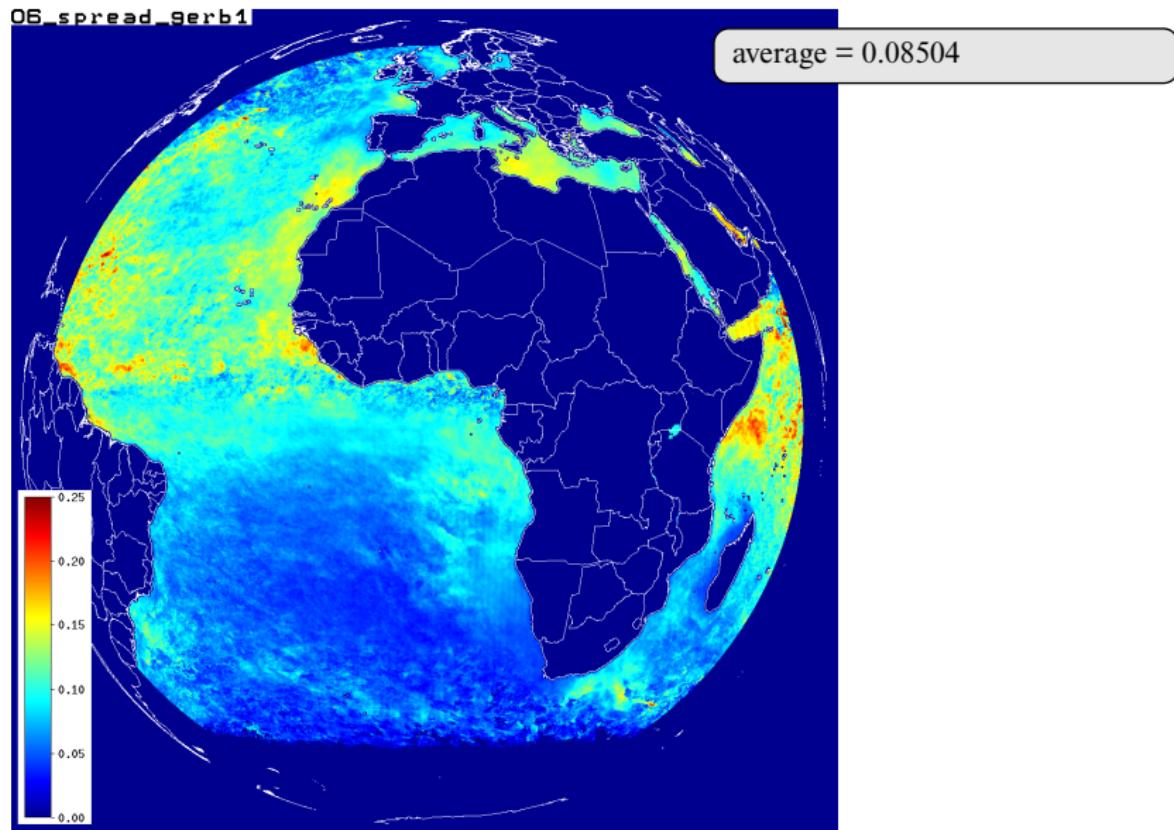
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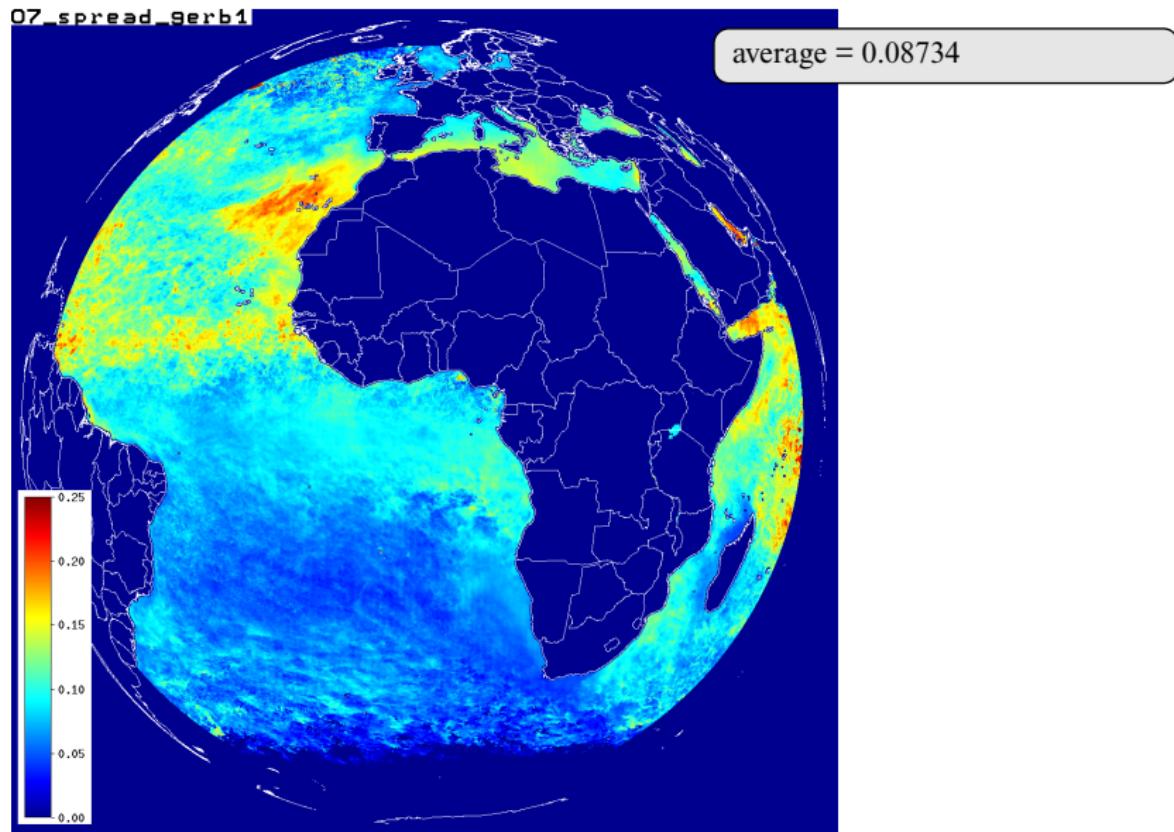
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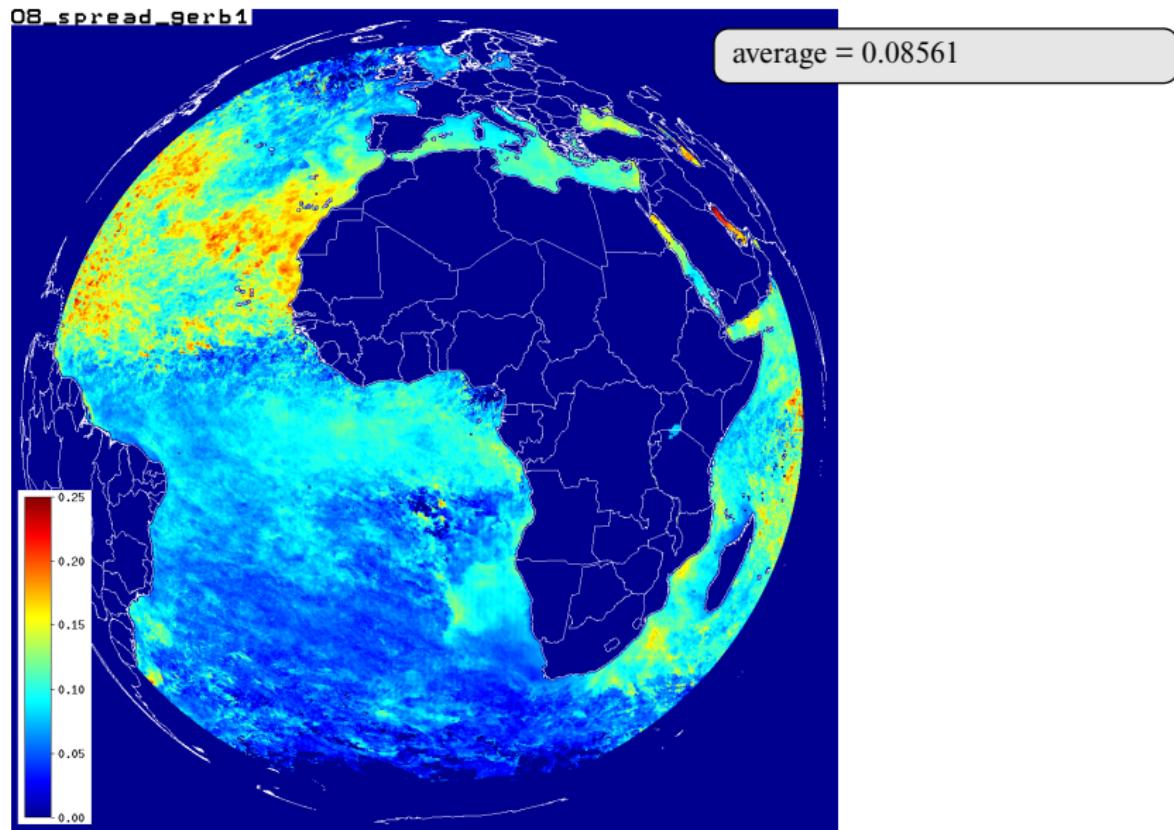
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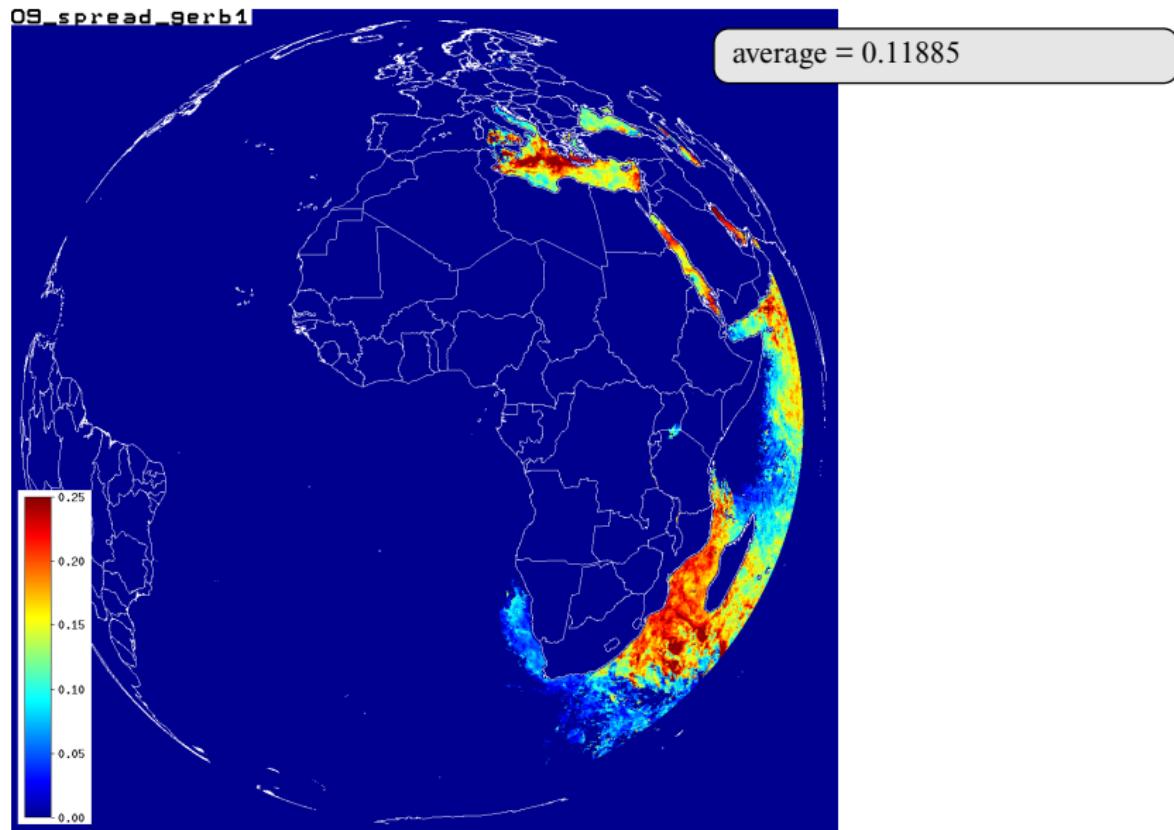
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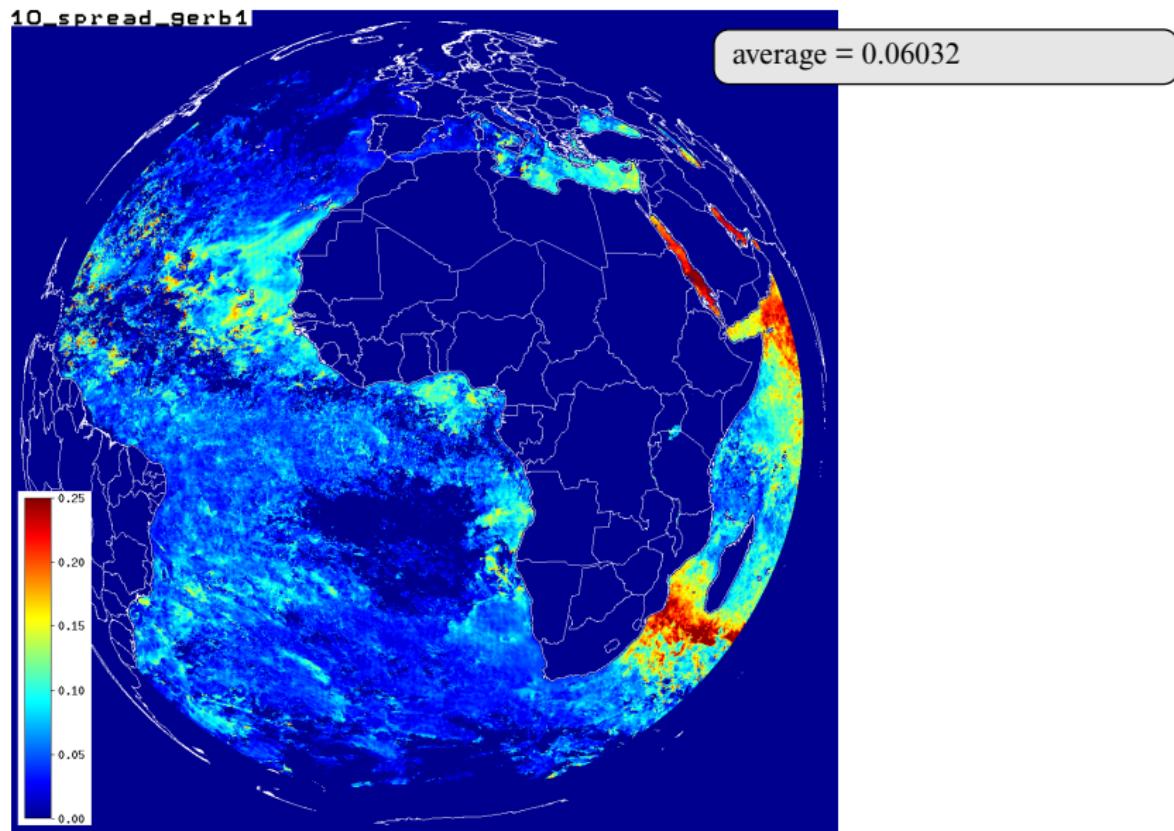
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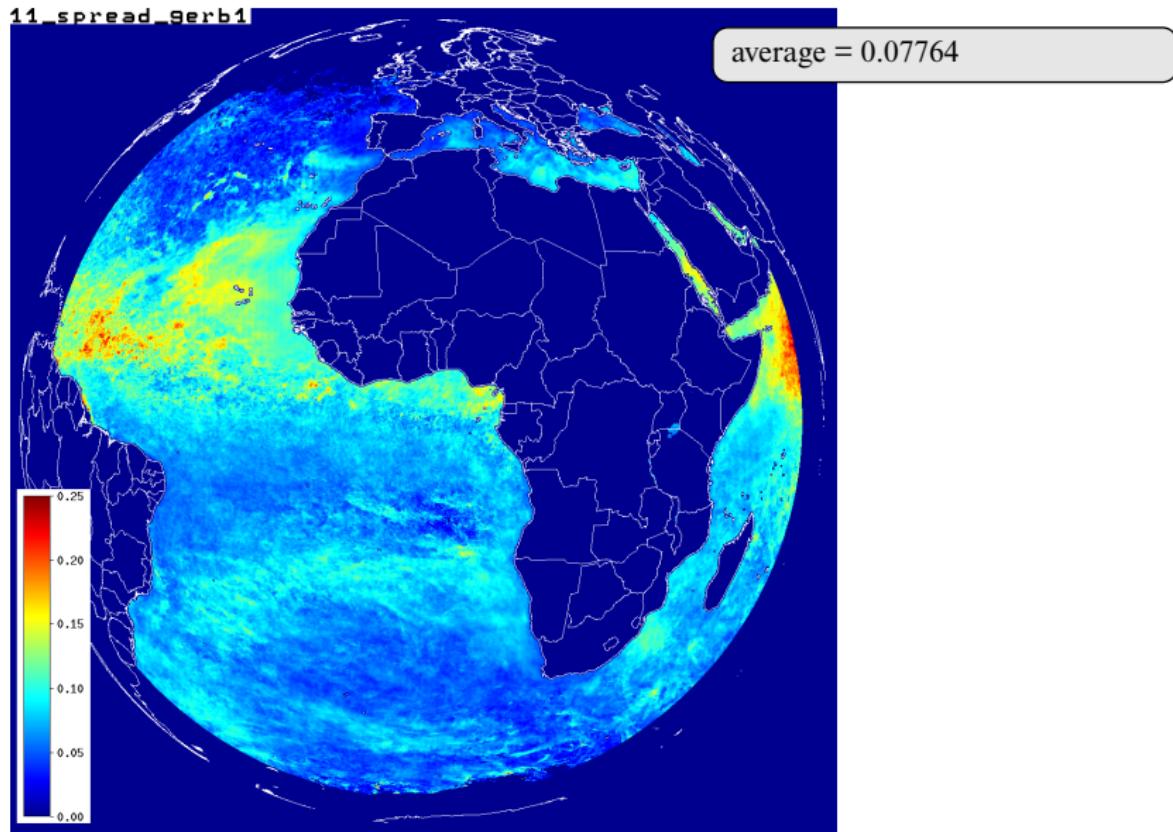
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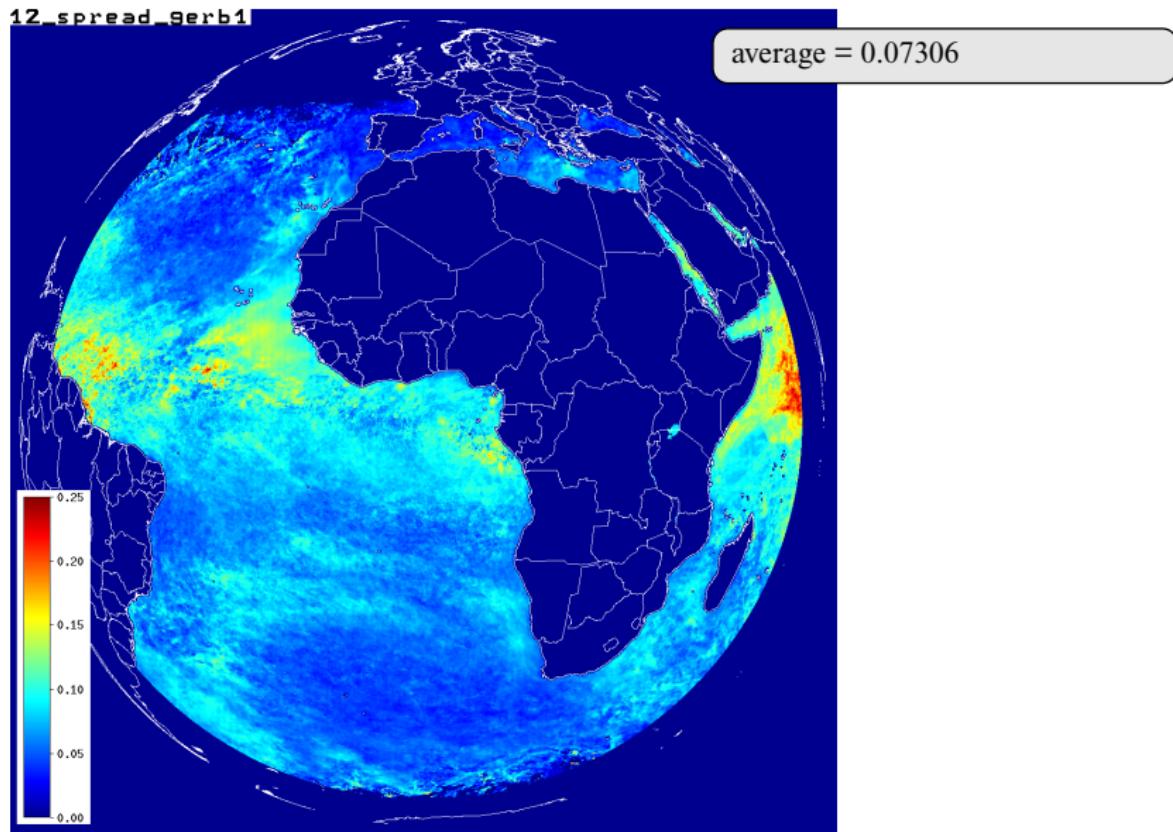
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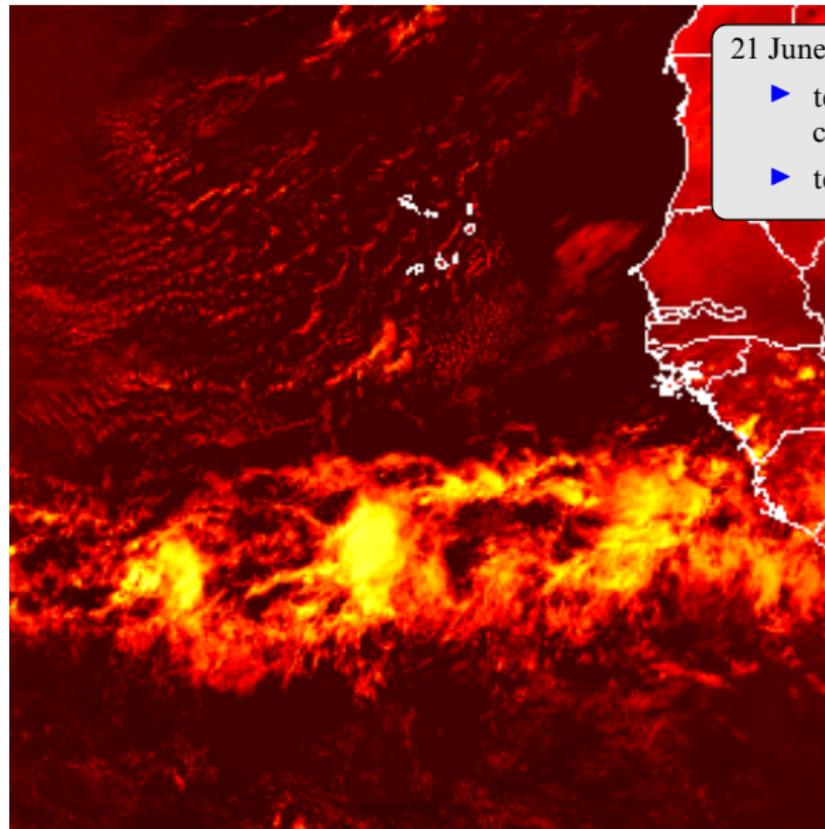
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21 June 2004: **before**

- ▶ tends to increase cloud cover
- ▶ tends to decrease crispness

# GERB-like

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removal

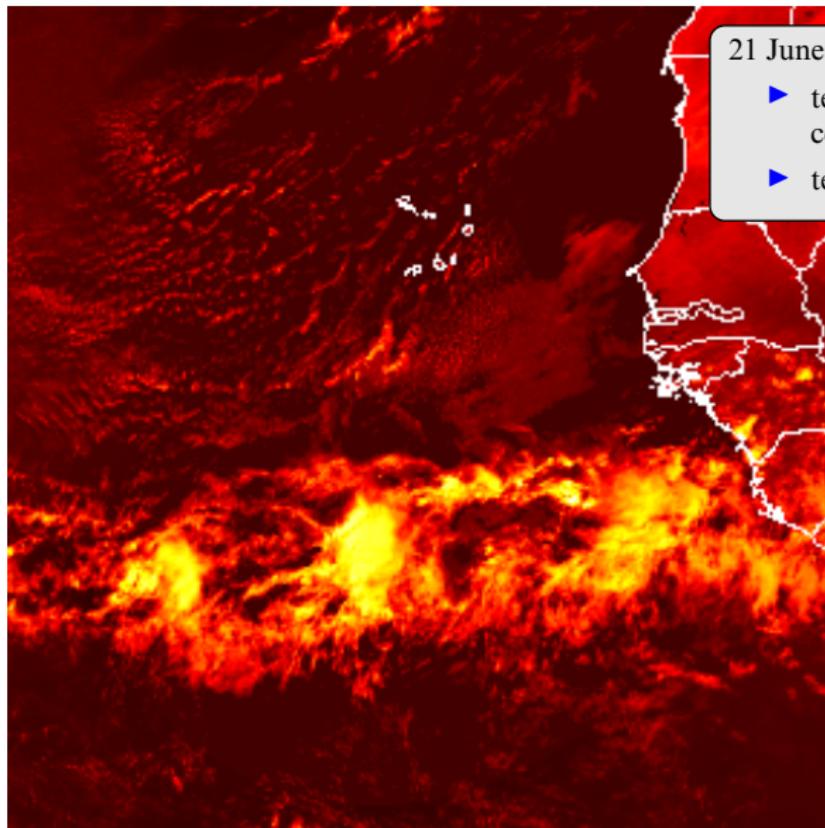
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21 June 2004: **after**

- ▶ tends to increase cloud cover
- ▶ tends to decrease crispness

# GERB-like

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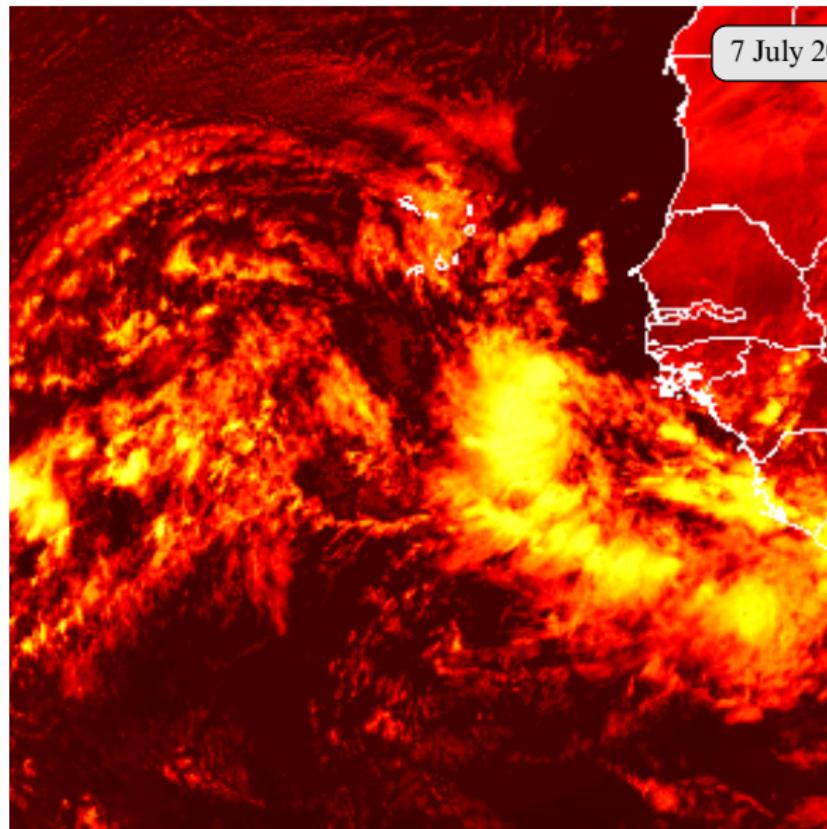
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