

# **Error in gridded sea surface height products**

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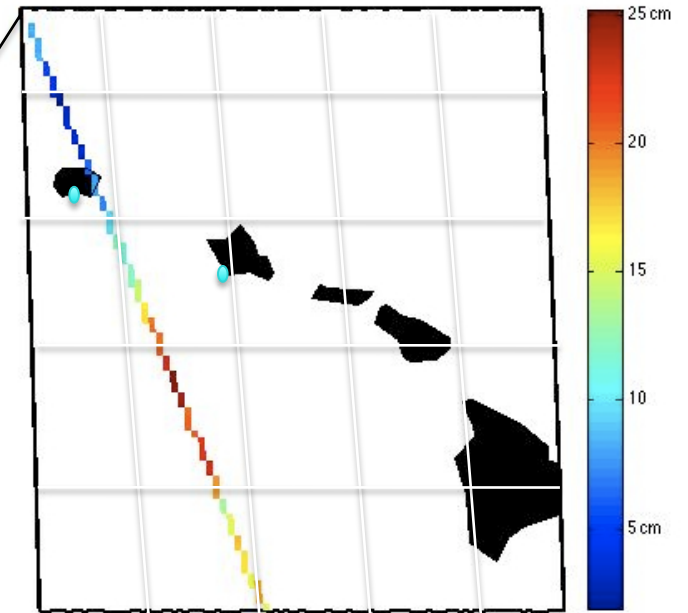
**A typical situation in global or basin-wide ocean modeling:**

**Model: typical grid resolution – 30km x 60km**

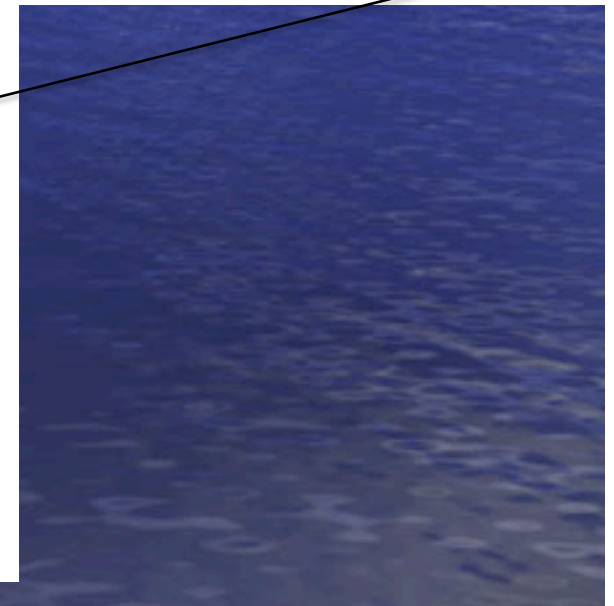
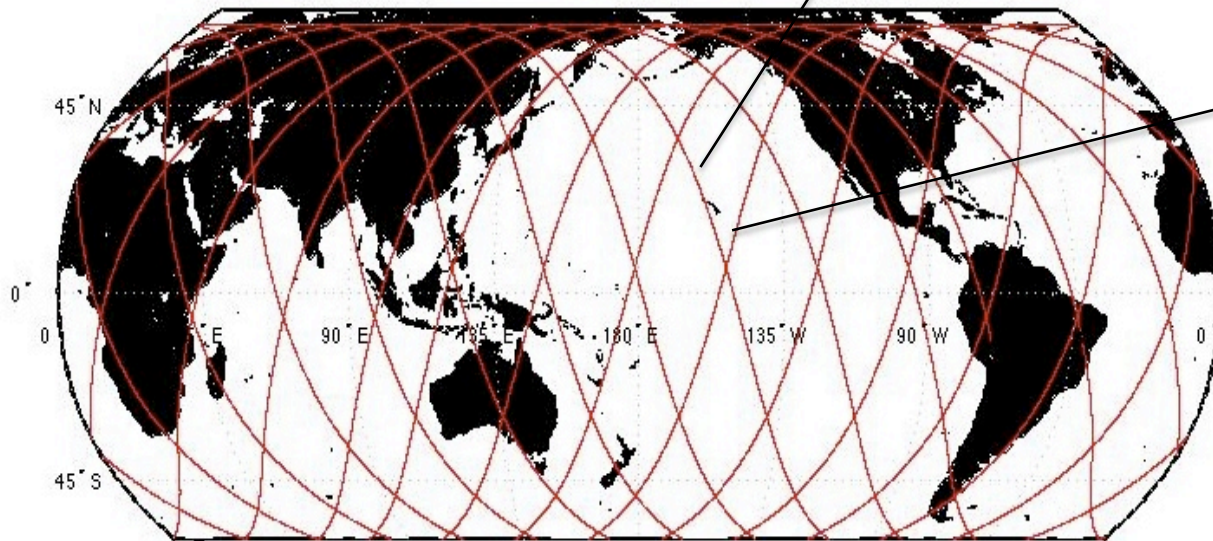
**Data:**

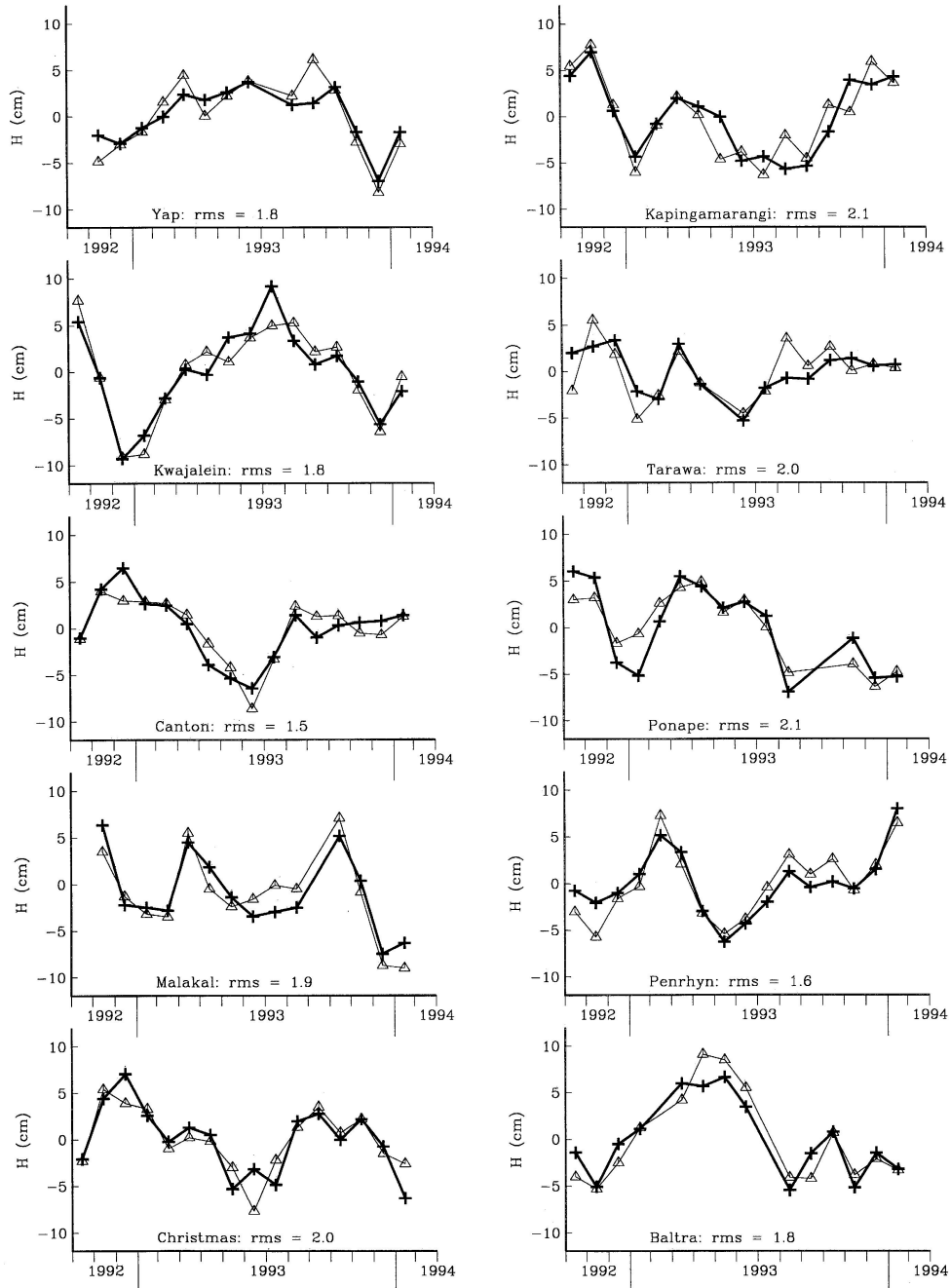
**Sea surface height altimetry – 6km footprint;  
SST – 1-4-25km averages, depending on the product;  
In situ observations – local.**

"Instantaneous" Jason-1 Sea Level Measurements



Single Day Jason-1 Ground Track





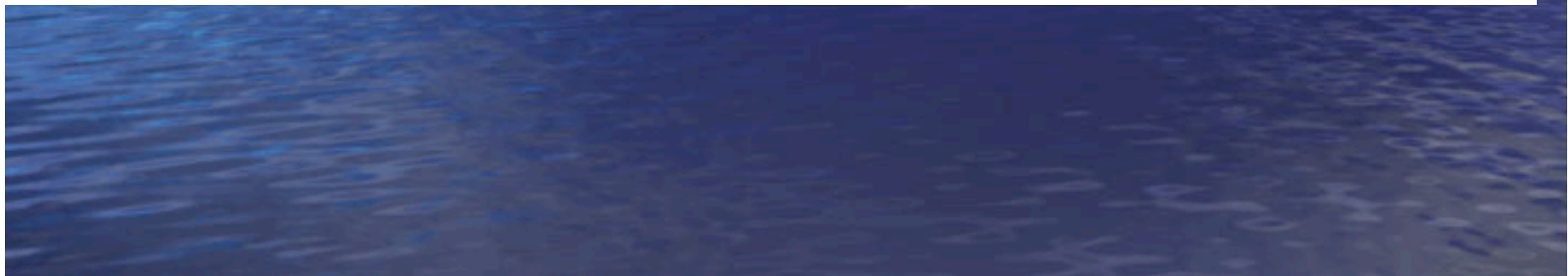
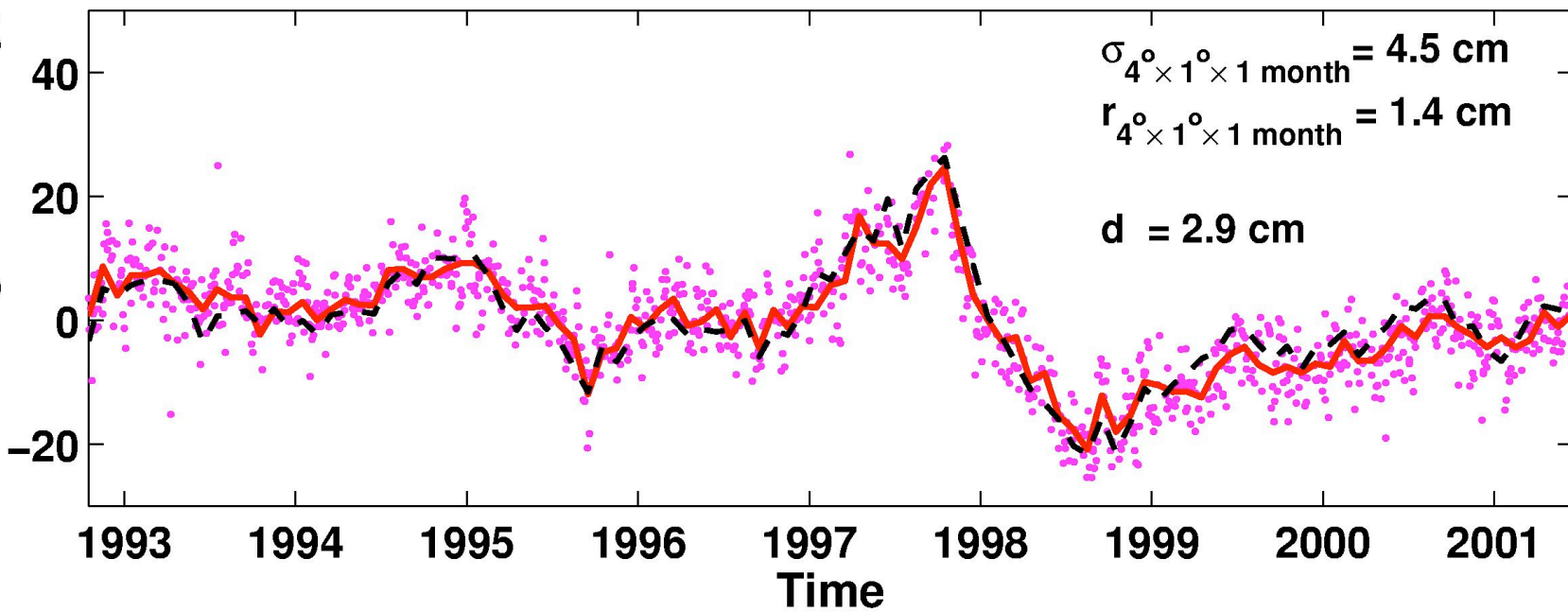
**Figure 5.** Time series from 10 island gauges (thin line) within  $10^\circ$  of the equator at which particularly good agreement was found with T/P data (heavy line). The existence of so many examples such as this argues that T/P is achieving accuracies at the 2-cm level for monthly mean heights in  $4 \times 1$  cells, without orbit adjustment.

**Comparison of  $4 \times 1$  degree T/P altimetry averages with tide gauge data (from Cheney et al 1994)**

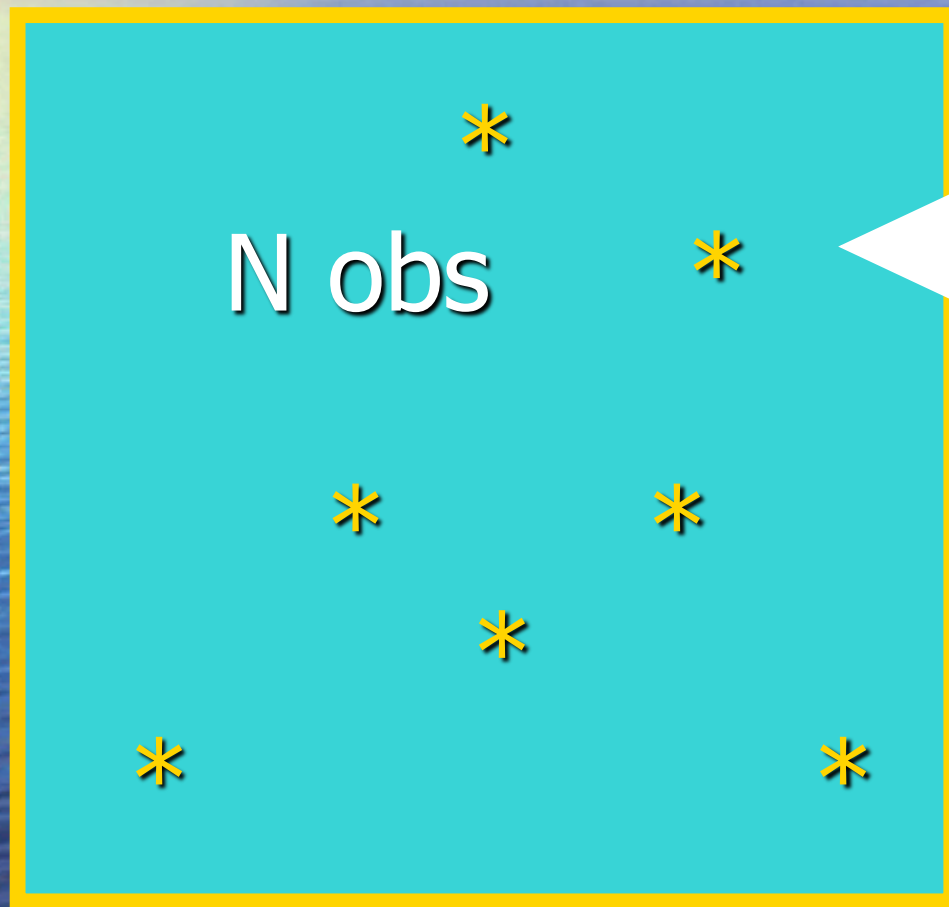


Sea level height anomaly, cm

### Christmas Island: 2° N, 157° W



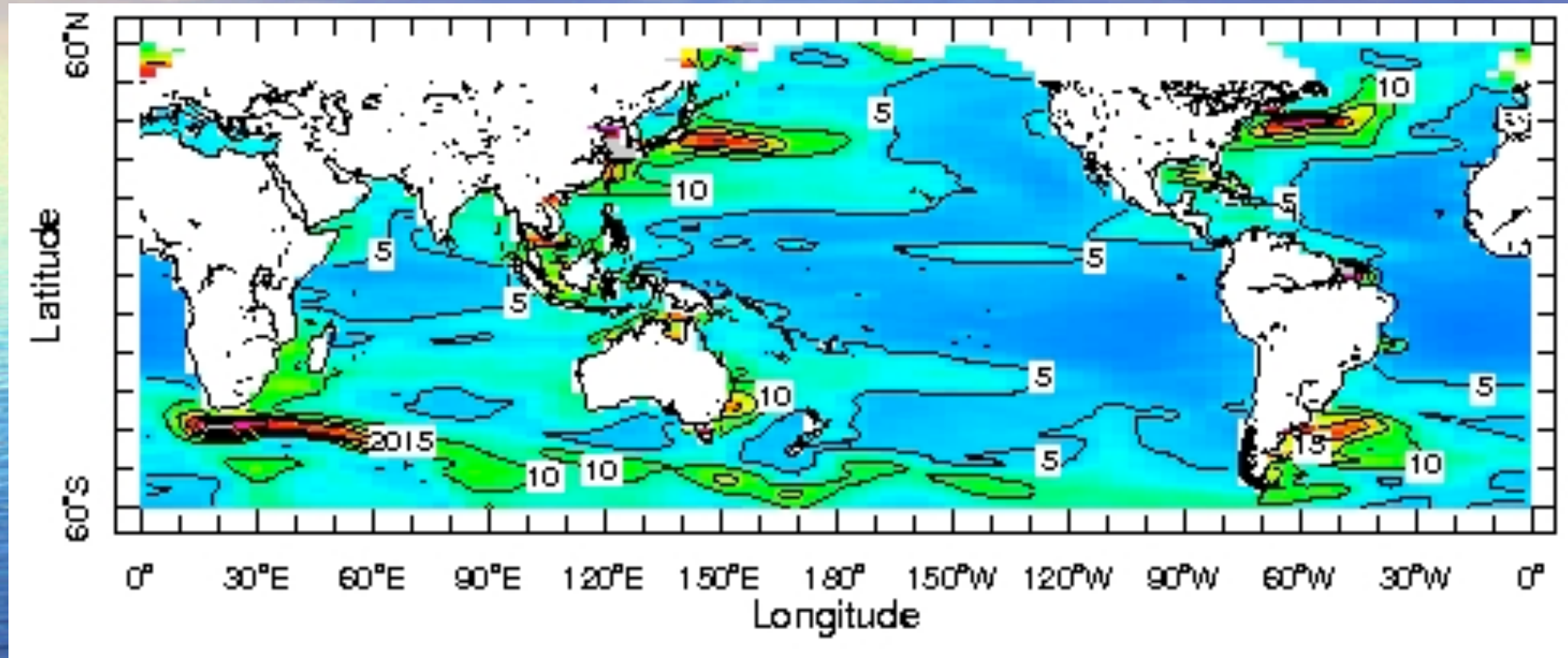
What is the error in the binned obs mean  
(as estimates of the "true" bin area average)?



$F(x,y)$  [or  $F(x,y,t)$ ]

Error variance  
for the mean  
of N observ is  
 $\sigma^2/N$

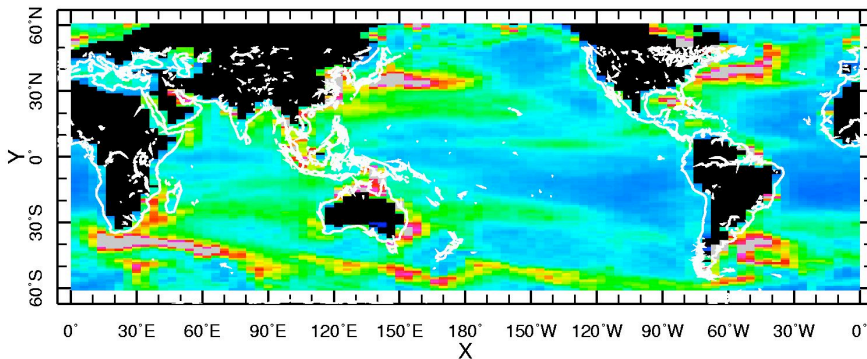
# Total SS and ST variability in T/P inside 4x1xmonth bins



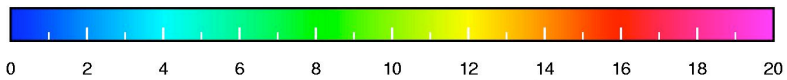
# TOPEX [*Ducet et al. 2000*]

## Time-space separation of small-scale sea level height variability

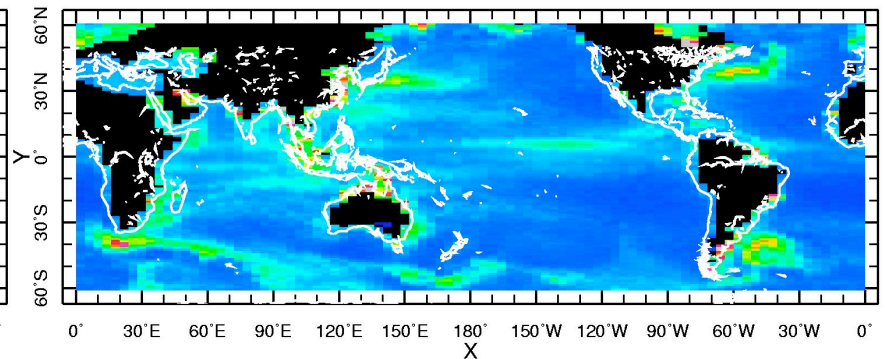
(a) Total SSV  $\sigma_{4^{\circ} \times 1^{\circ} \times 1 \text{ month}}(s)$



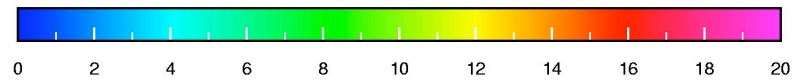
sqrt [ ( ssv + { stvg stv } ) squared ]  
point mean:  $6.1281 \pm 4.9101$  range [0.0228197 to 80.611]



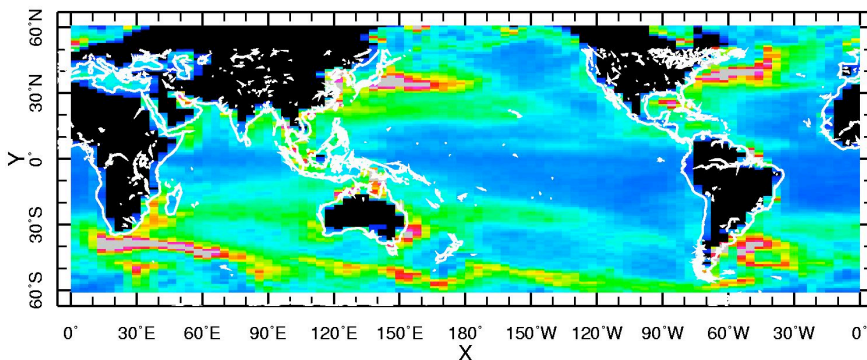
(b) Short-term temporal variability  $\sigma_{1 \text{ month}}([s]_{4^{\circ} \times 1^{\circ}})$



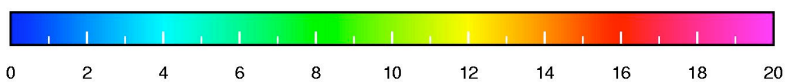
stvg stv  
point mean:  $2.9553 \pm 2.7528$  range [0.000756442 to 46.822]



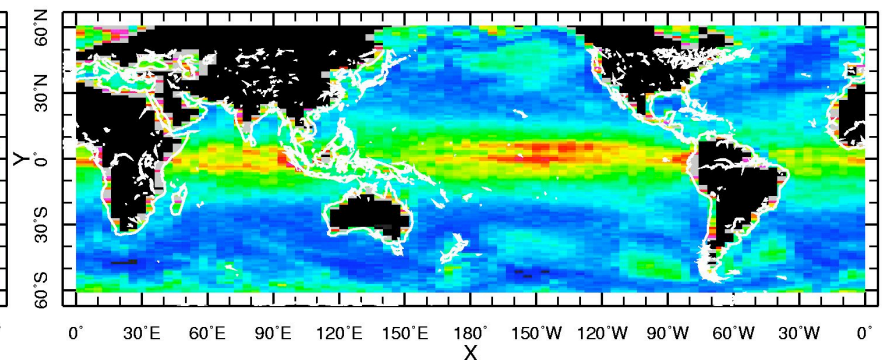
(c) Spatial variability inside bins  $\sqrt{[\sigma_{4^{\circ} \times 1^{\circ}}^2(s)]_{1 \text{ month}}}$



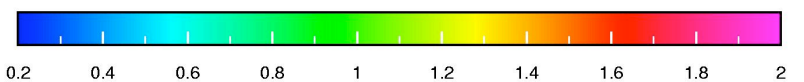
ssv  
point mean:  $5.1688 \pm 4.3149$  range [0.0 to 73.023]

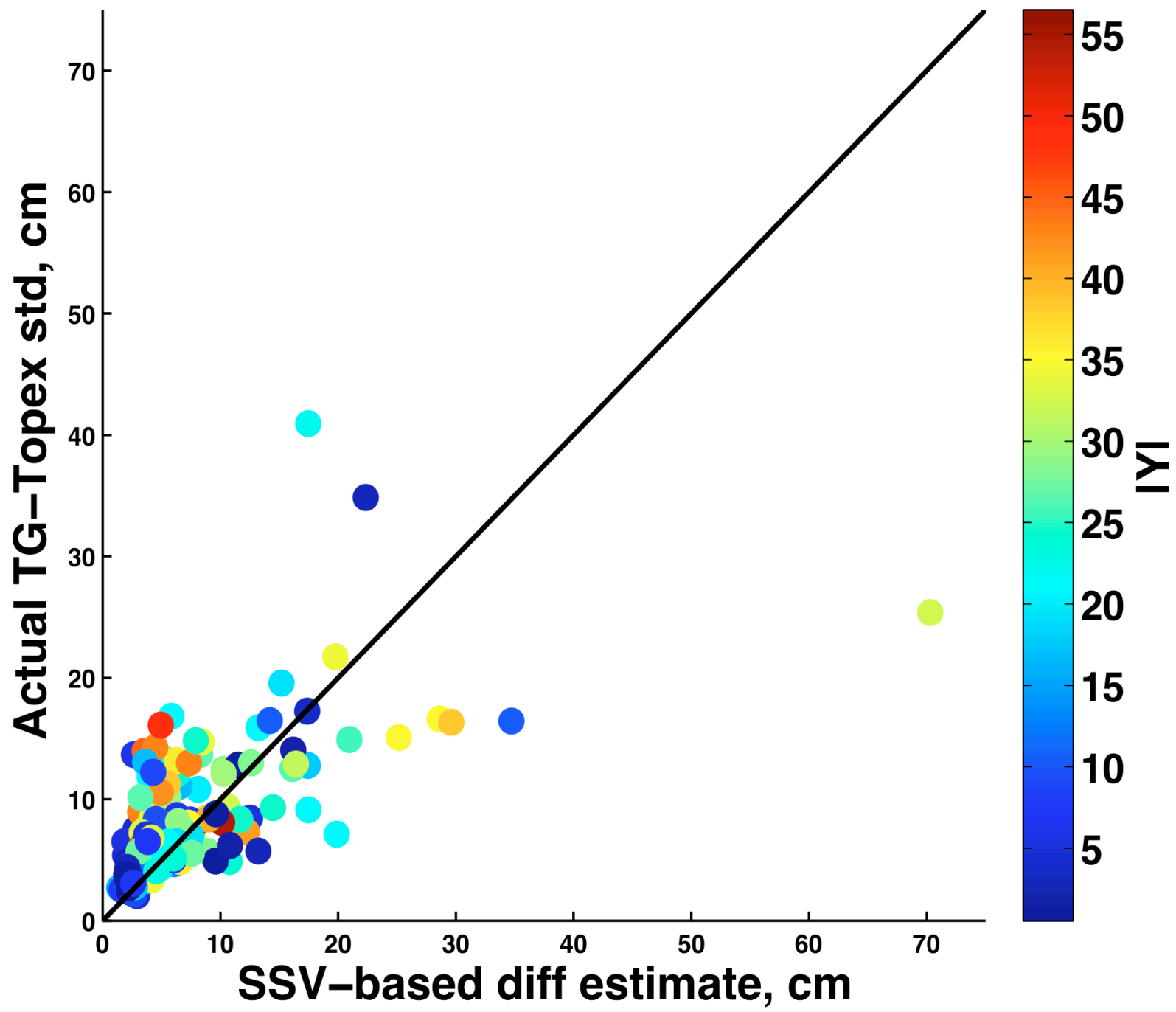


(d) Ratio  $\gamma$  of temporal to spatial variability

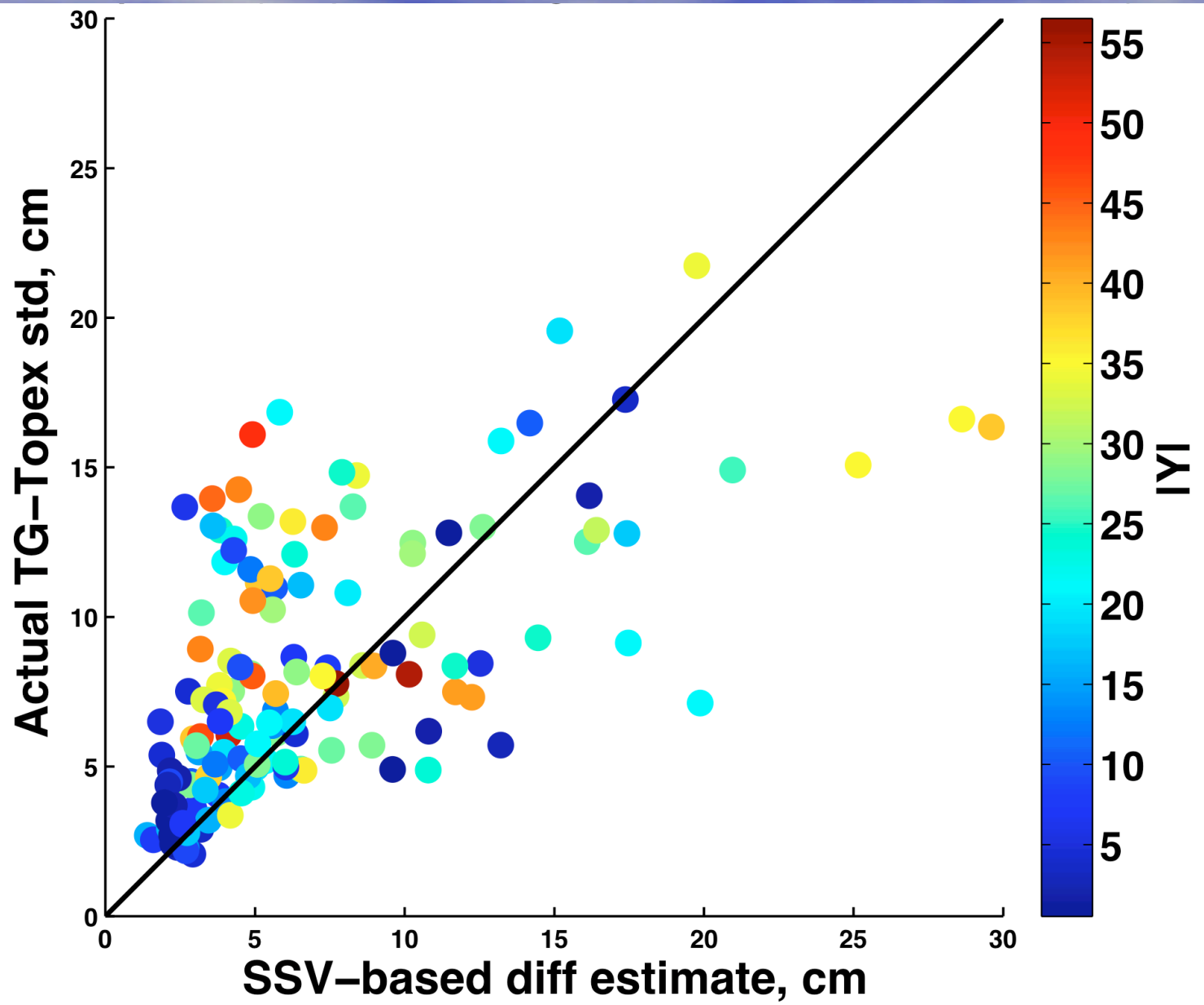


[ stvg stv ] / [ sqrt ( ssv - 1.00000E-07 ) squared ]  
point mean:  $0.94132 \pm 4.3132$  range [0.0260134 to 170.47]

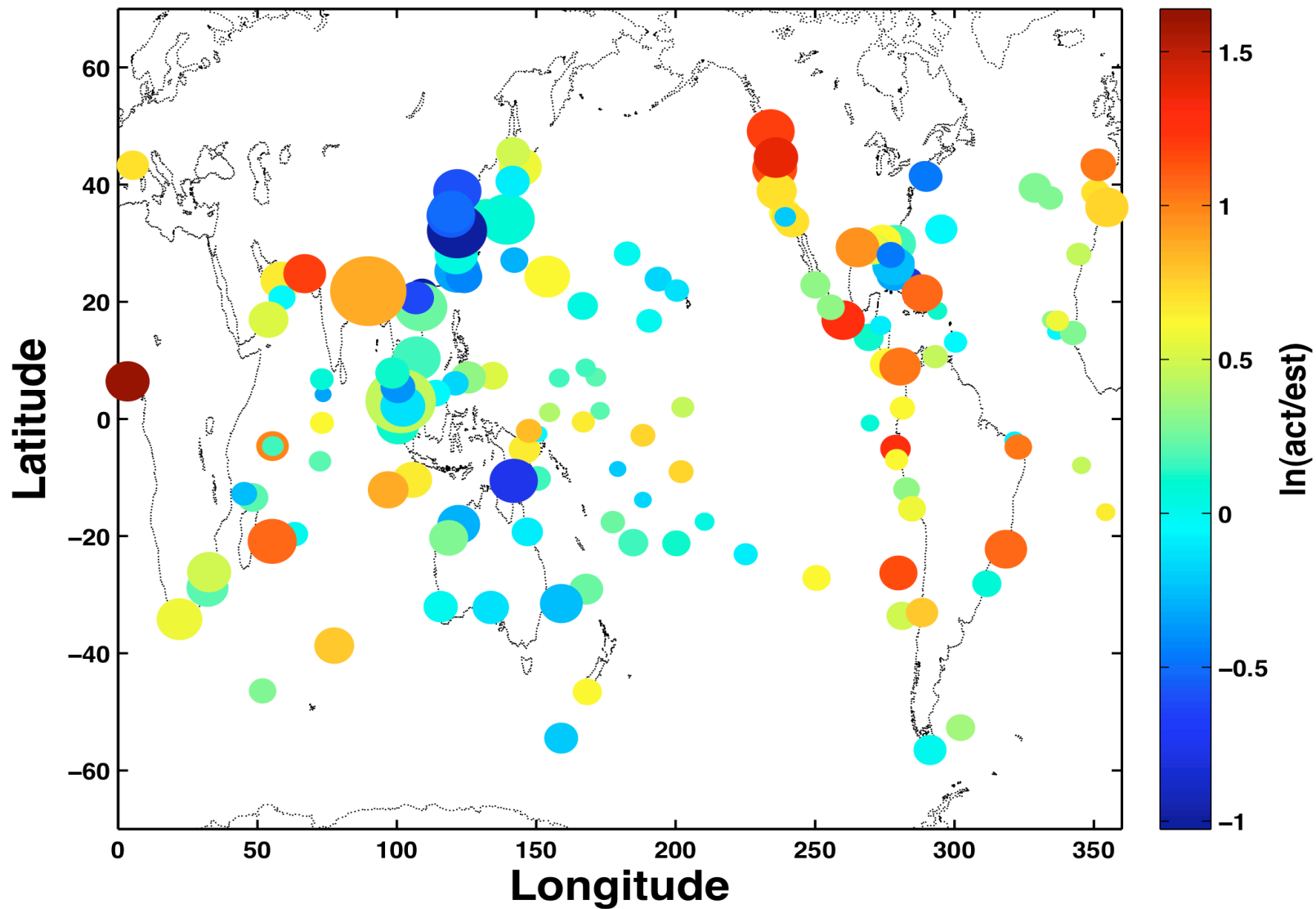




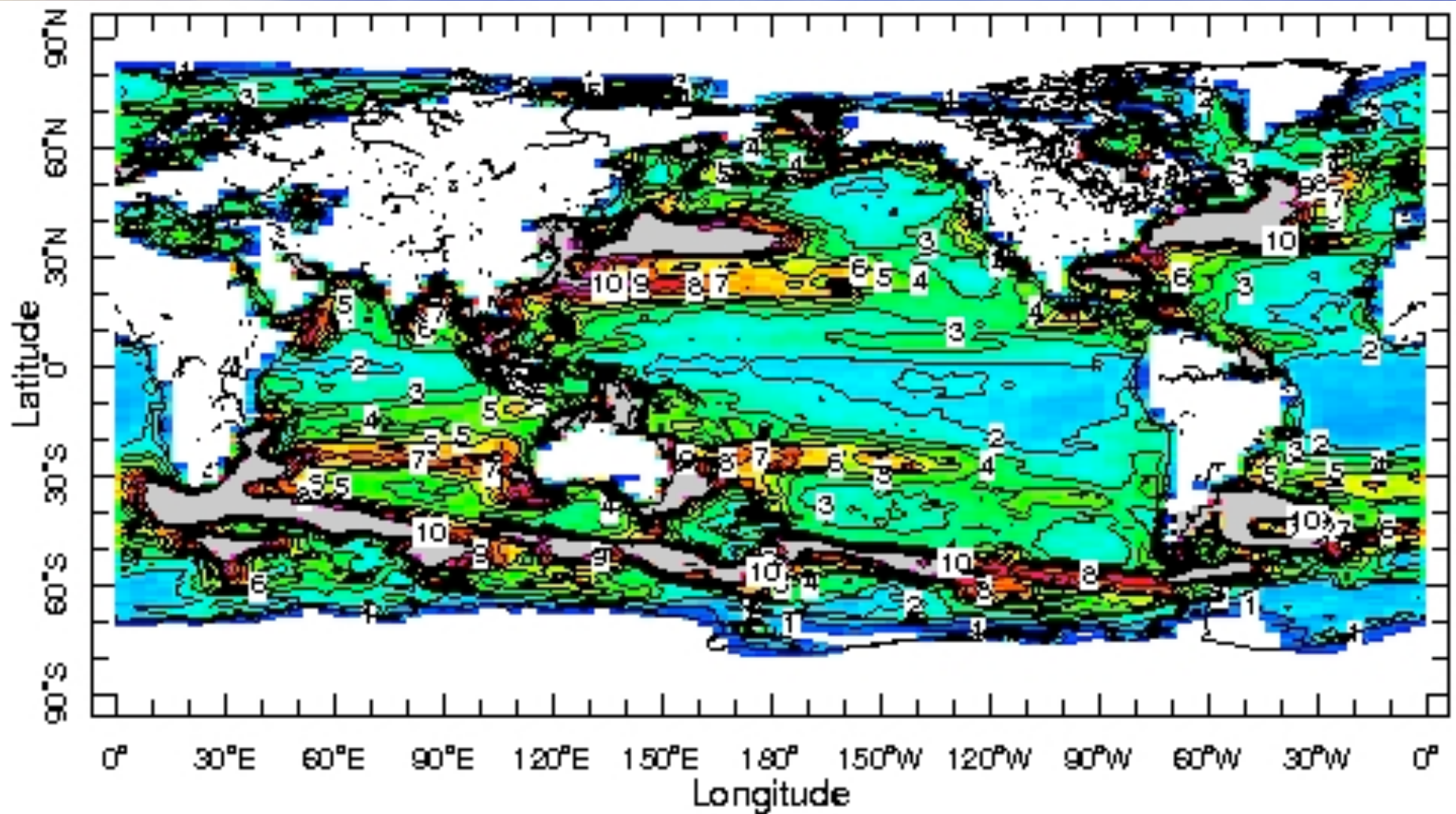




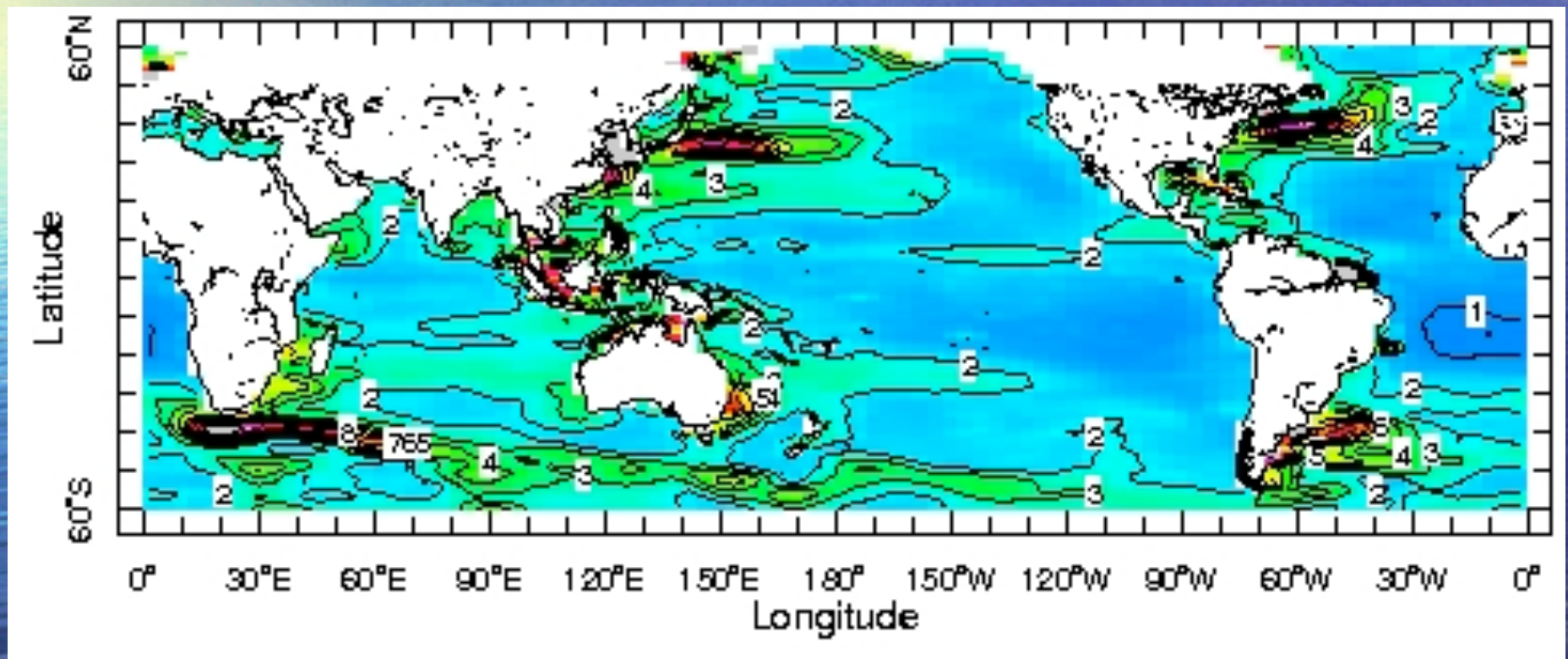
Actual TG–Topex std (size) and their log–ratios to SSV–based estimates (color)



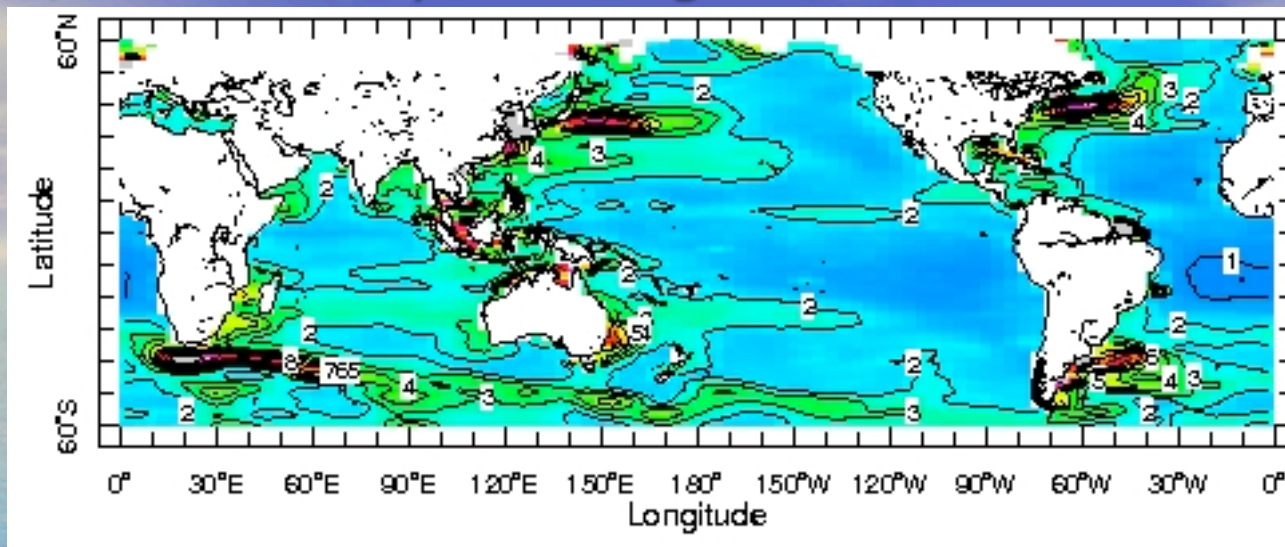
# Single TG error in representing 4x1x1mon mean



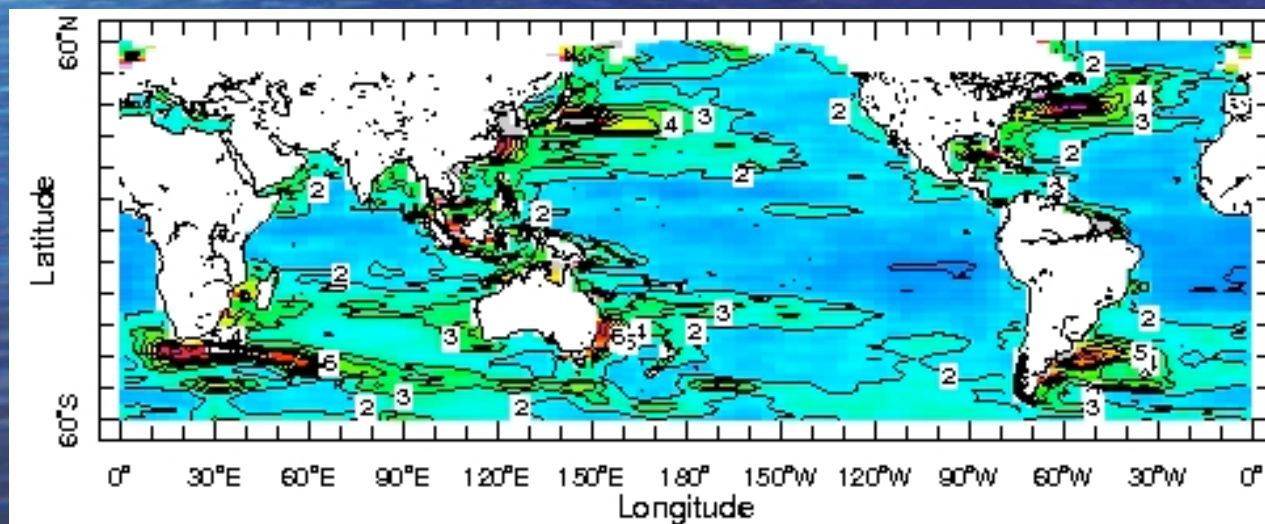
# T/P error in representing bin 4x1x1mon means



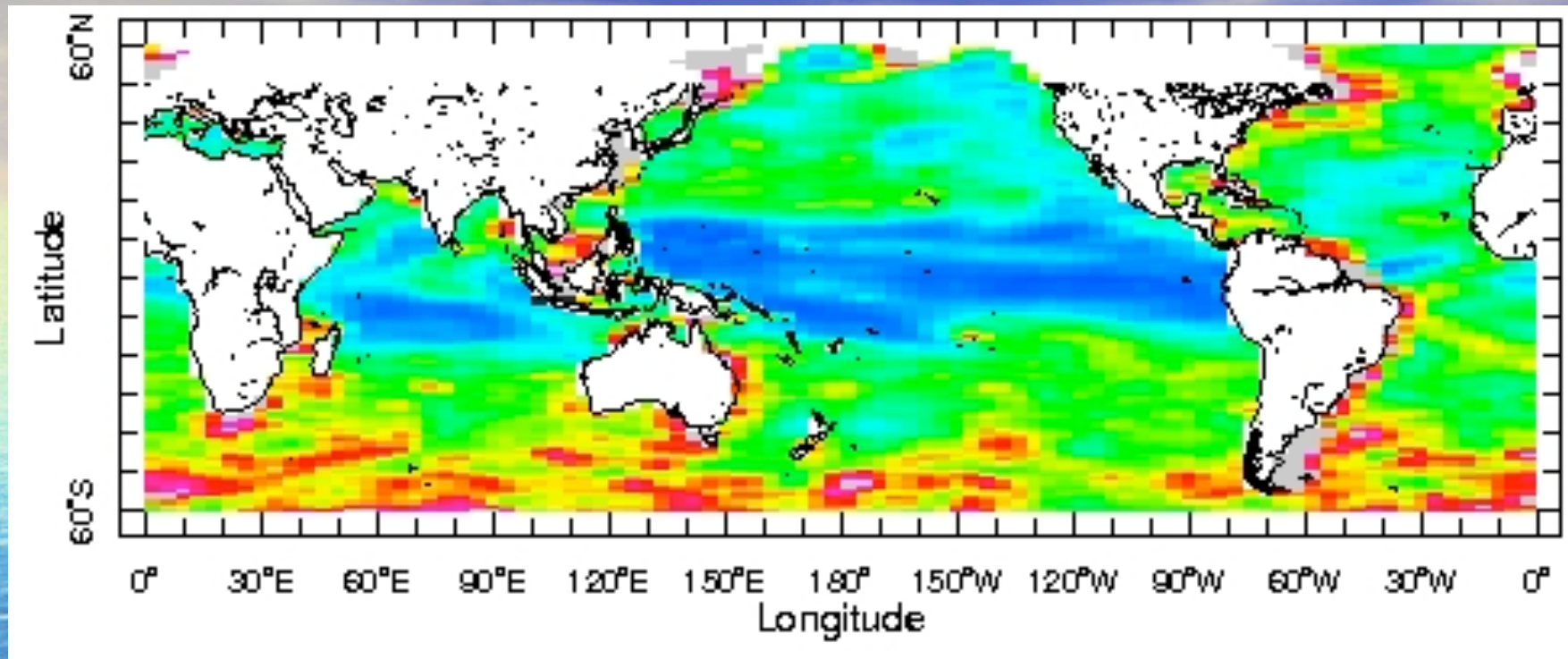
## T/P error in representing bin 4x1x1mon means



$T/P - (T/P + ERS1,2)$  [Ducet et al, 2000]

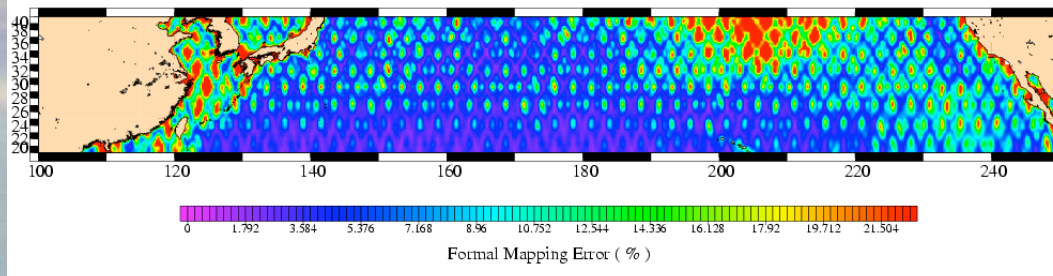


# Relative error in variance

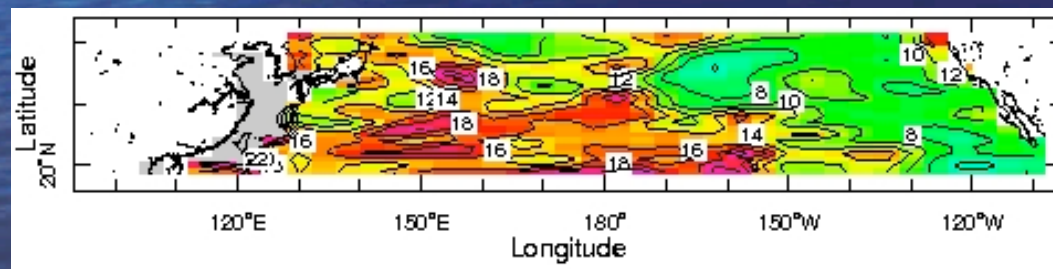
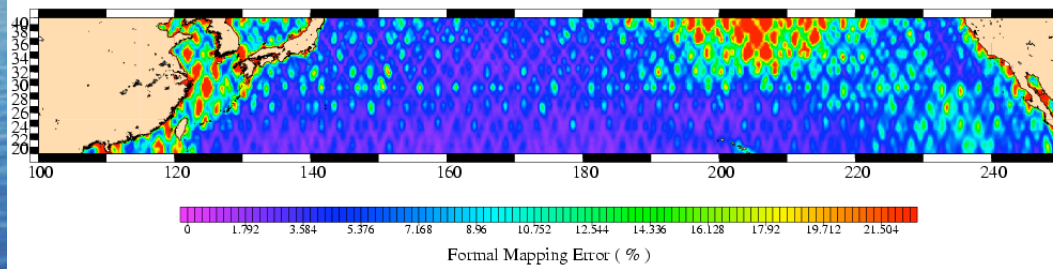


# Relative error in variance

SSALTO/DUACS – DT MSLA – Merged Product – Homogeneous Global Processing



SSALTO/DUACS – DT MSLA – Merged Product – Up-to-date Global Processing



# Altimetry error by Ponte et al [2007]

