

# Statistical characteristics of joint SST and SSH

## Spectral analysis from satellite data

*E. Autret\* , B. Chapron\* , S. Ba\*\* , R. Fablet\*\**

*\*IFREMER Laboratoire d'Océanographie Spatiale*

*\*\* Telecom Bretagne, LAB-STIC*

Objective :

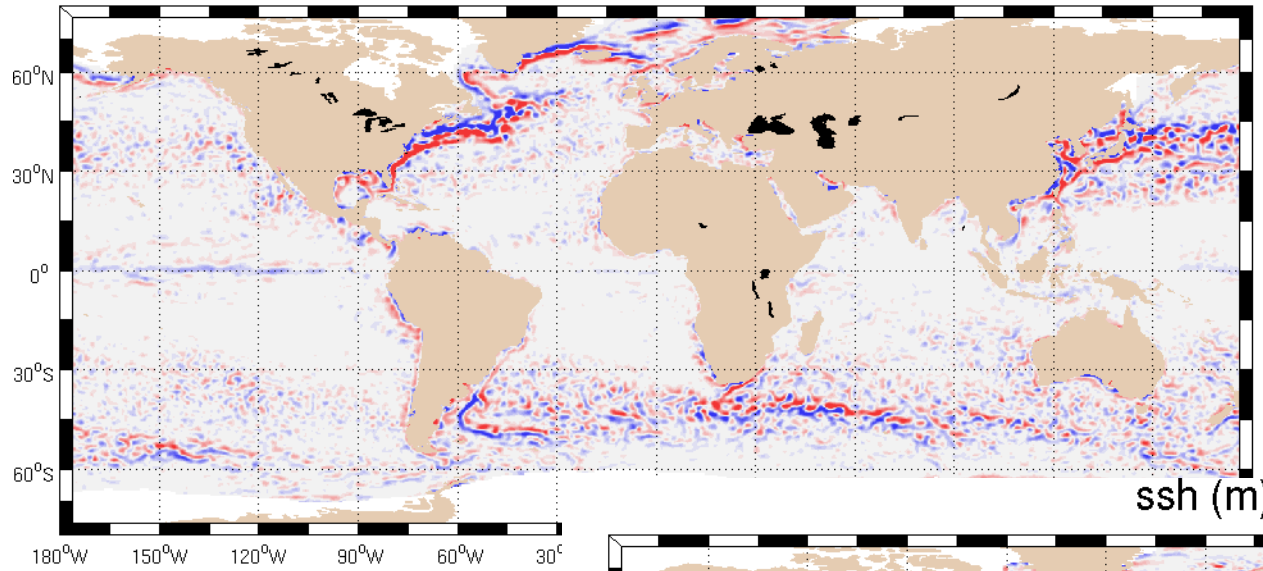
Joint Sea Surface Height / Sea Surface Temperature statistical characteristics to help refining the combined use of SST and SSH to study small scale ocean circulation

Dataset :

- 2003-2009 SST and SSH interpolated products (MADT/ SLA and AMSRE-TMI OI), 0.25° grid resolution
- Jason-1 Along-Track data
- 2003-2009 SST from AMSRE L3 products, 0.25° resolution
- 2006-2011 SST Modis data, spatial resolution : ~ 1 km
- 2008-2011 SST Metop data, spatial resolution : ~ 1 km

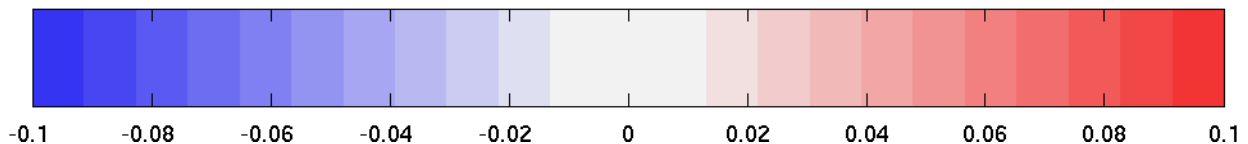
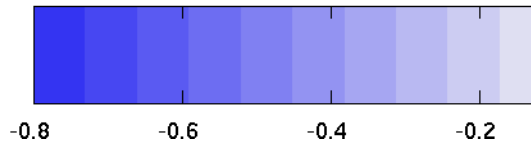
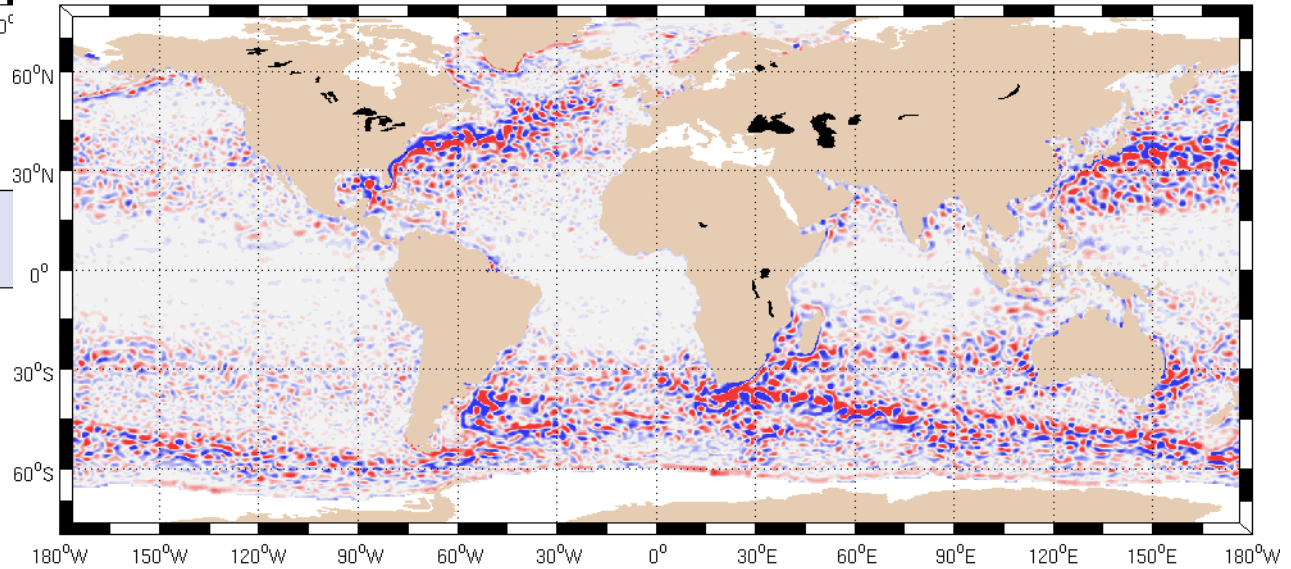
# SSH and SST in the 100-300 km band (monthly mean Feb. 2008)

sst (C)

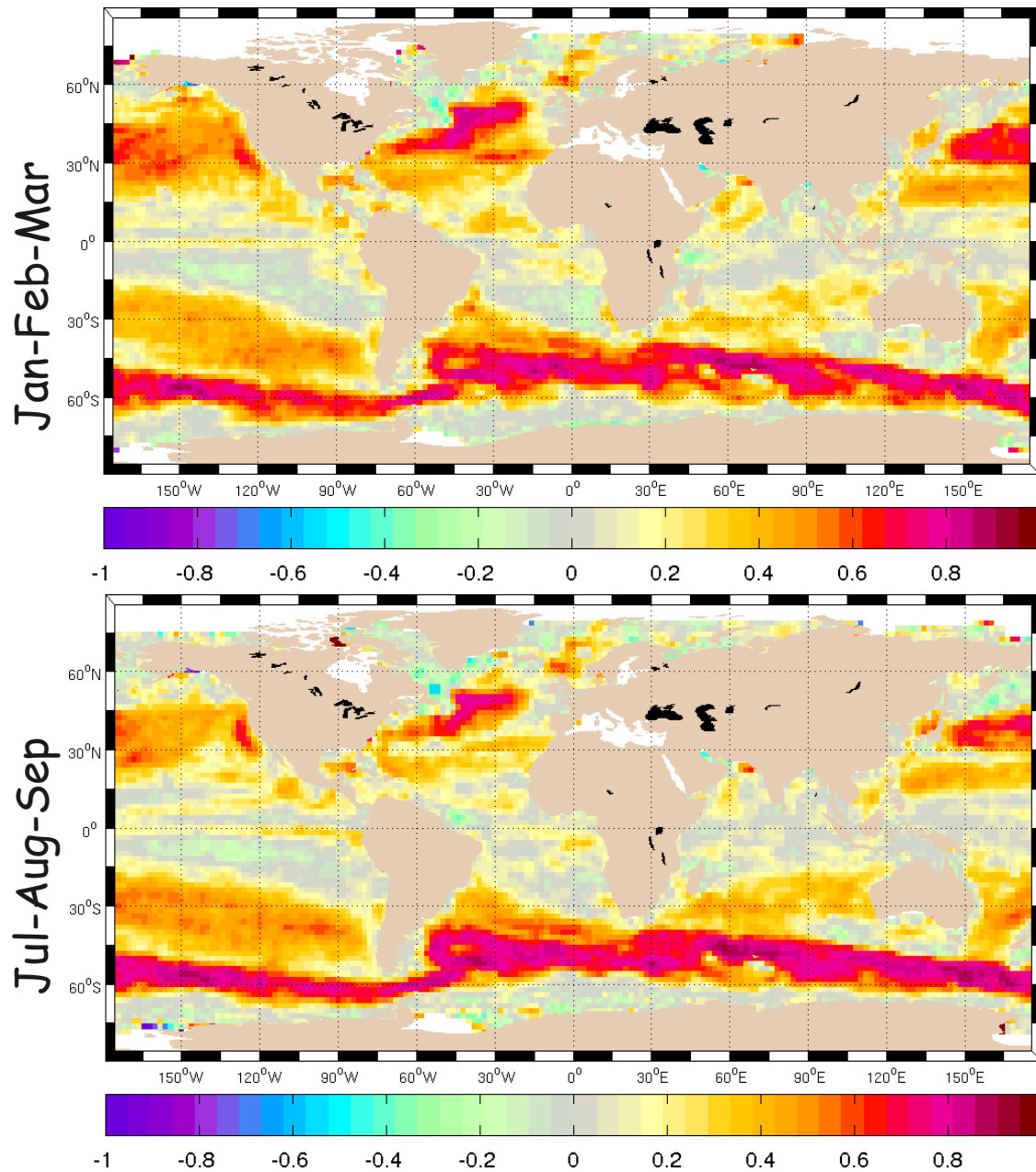


Monthly mean of SSH and SST, filtered in the 100-300 km band. Calculated with interpolated products

ssh (m)



# SSH/SST correlation in the 100-300 km band

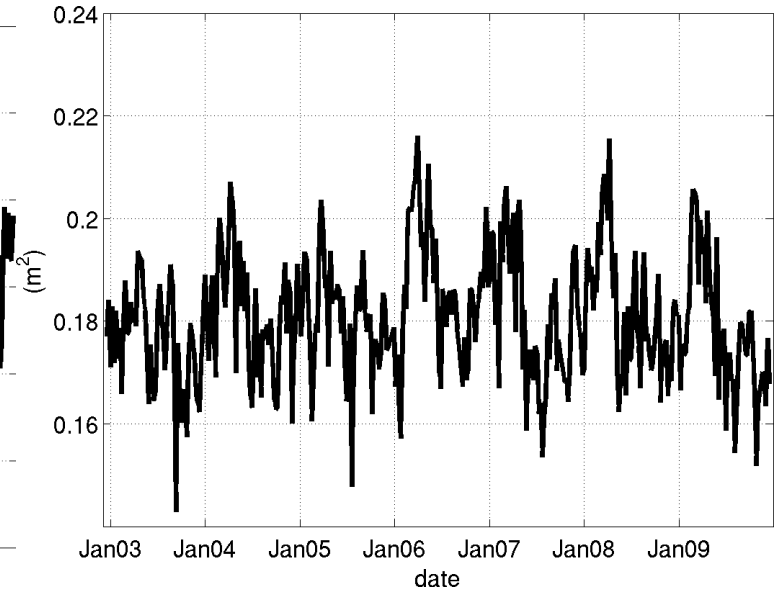
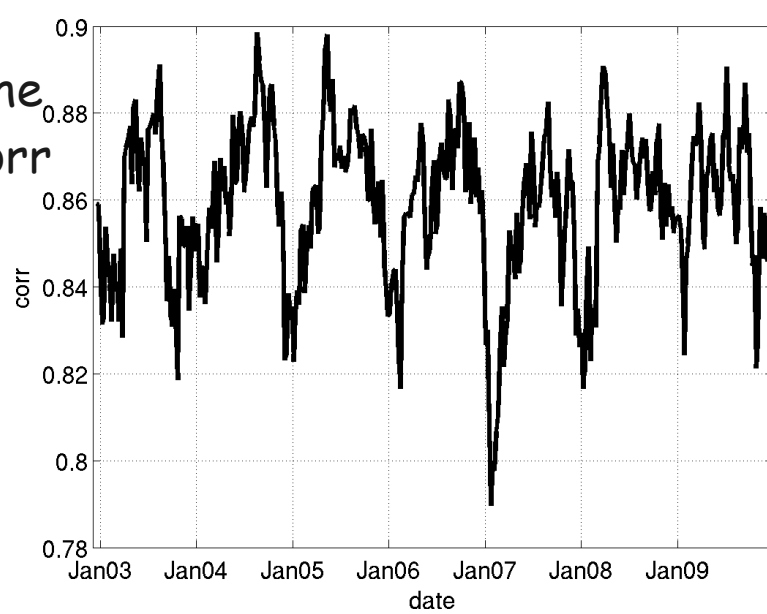


2003-2009 seasonal mean of correlation coefficients. Calculated from weekly 0.25° grid resolution OI products (MADT and AMSRE-TMI OI) within 8°x8° box at 2°x2° grid resolution

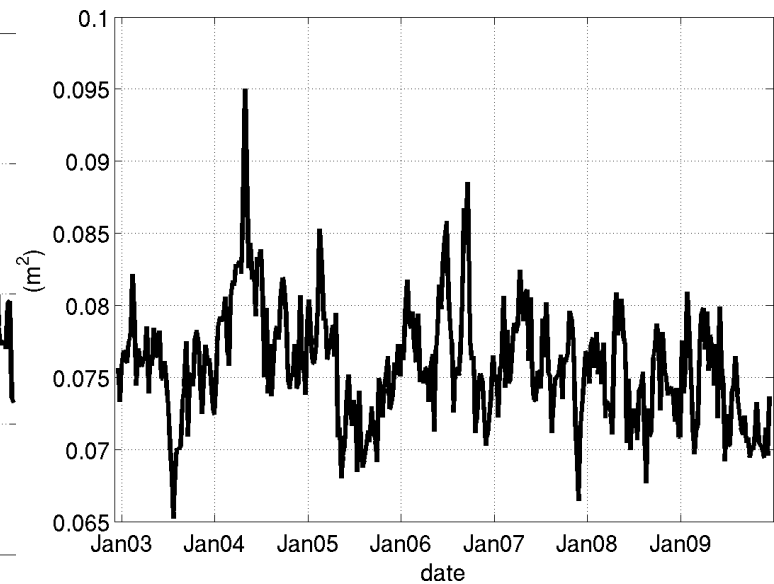
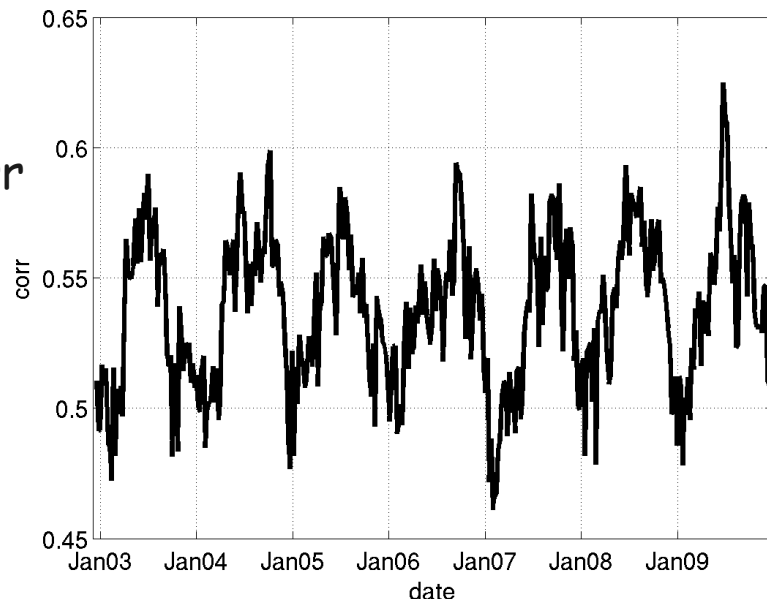
# SSH/SST correlation in the 100-300 km band

2003-2009 mean of correlation coefficients (within a  $20^{\circ} \times 60^{\circ}$  box :  $55^{\circ}S$   $35^{\circ}N$  -  $20^{\circ}E$   $80^{\circ}E$ )

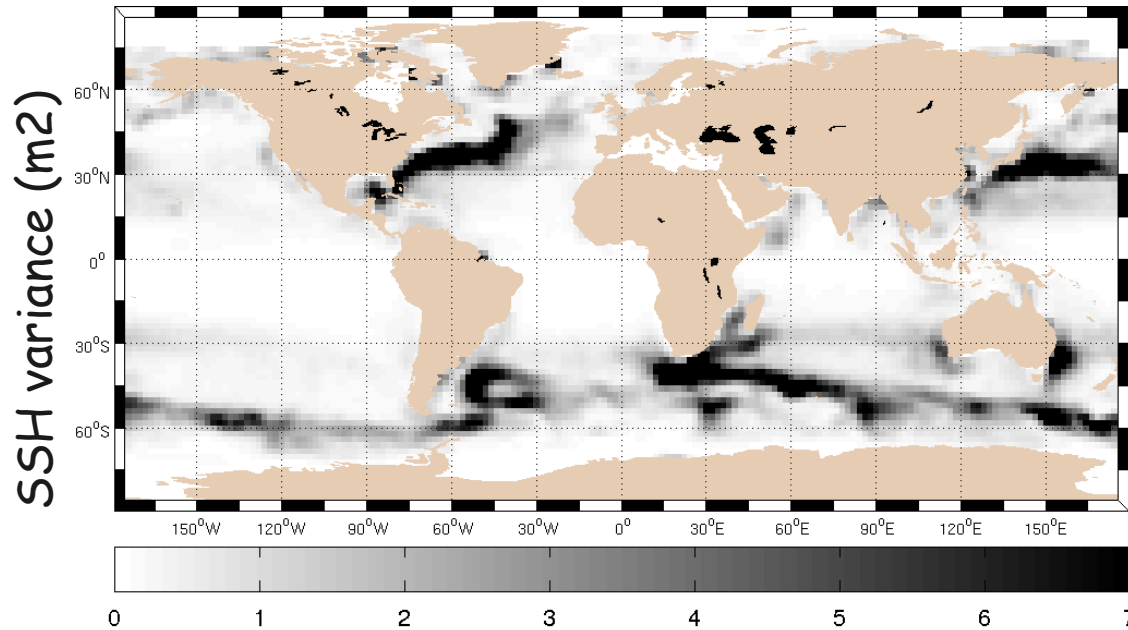
corr mean for the highest (20%) corr values and corresponding variance mean



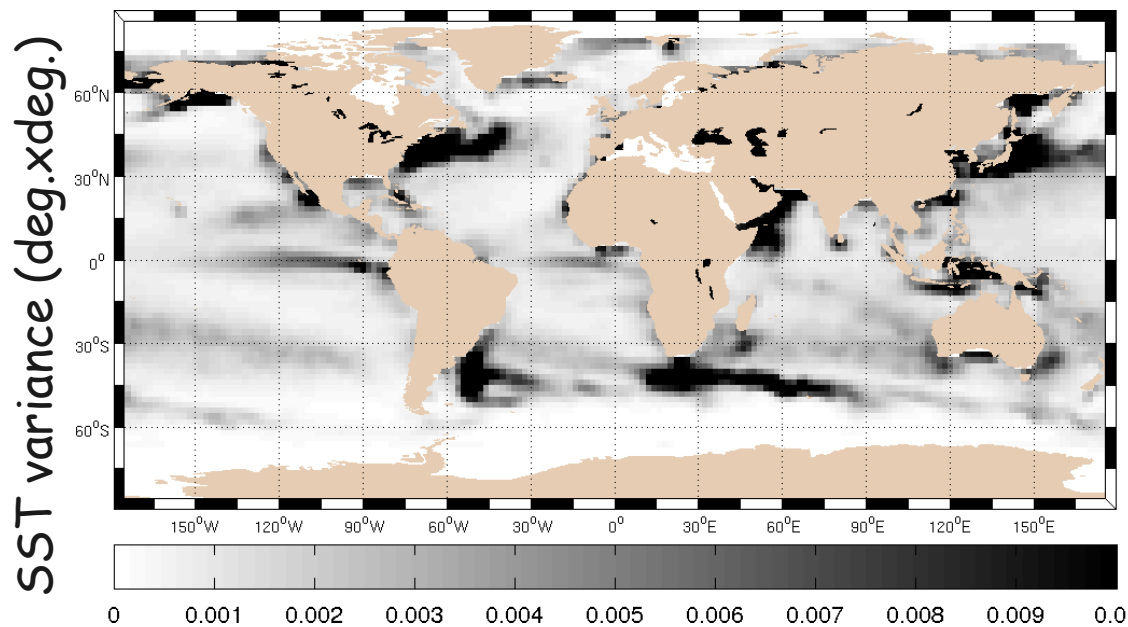
corr mean for other (80%) corr values and corresponding variance mean



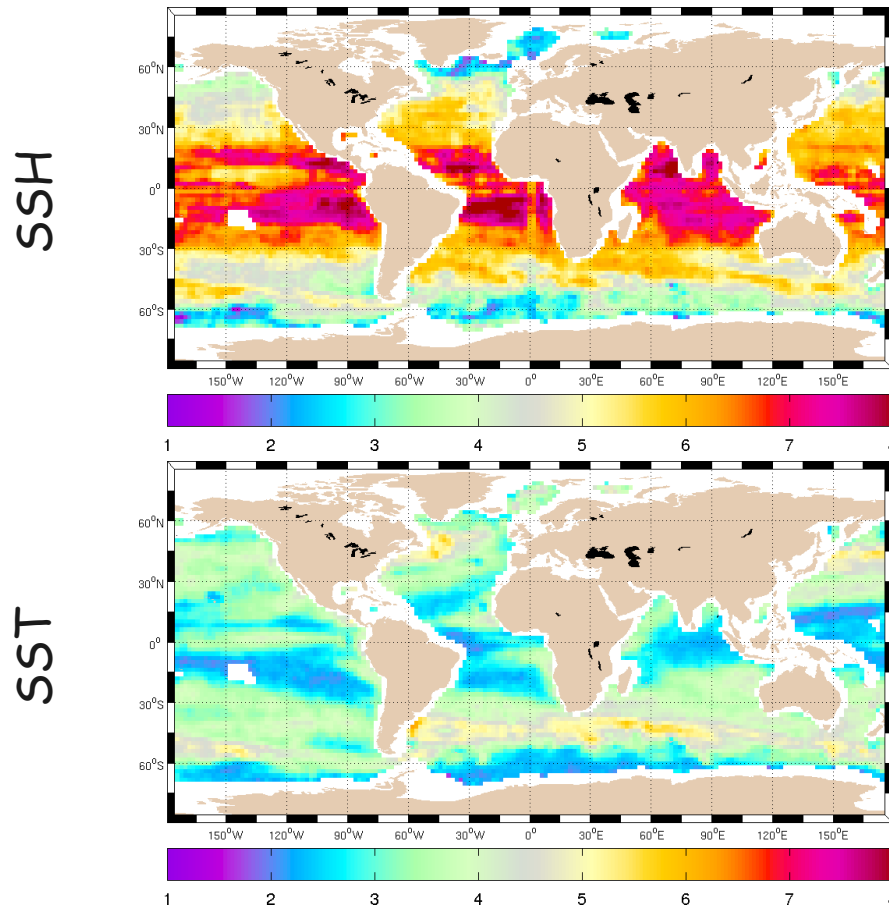
# SSH and SST variance in the 100-300 km band



2003-2009 seasonal mean (Jul-Aug-Sep) of variance at 2°x2° grid resolution calculated from interpolated data



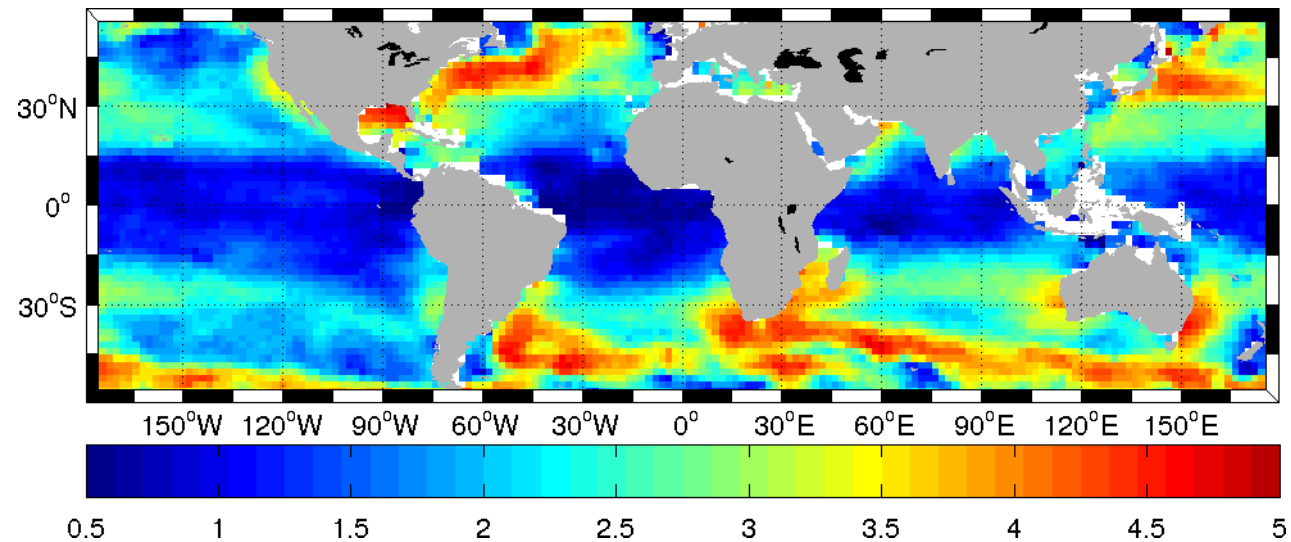
# SSH and SST wavenumber spectra in the 100-300 km band



2003-2009 seasonal mean (Jul-Aug-Sep) of spectral slopes (the sign of the slopes was reversed to make the value positive) at  $2^\circ \times 2^\circ$  grid resolution calculated from interpolated data

As expected spectra are imposed by structure functions

## SSH wavenumber spectral slopes in the 80-250 km band

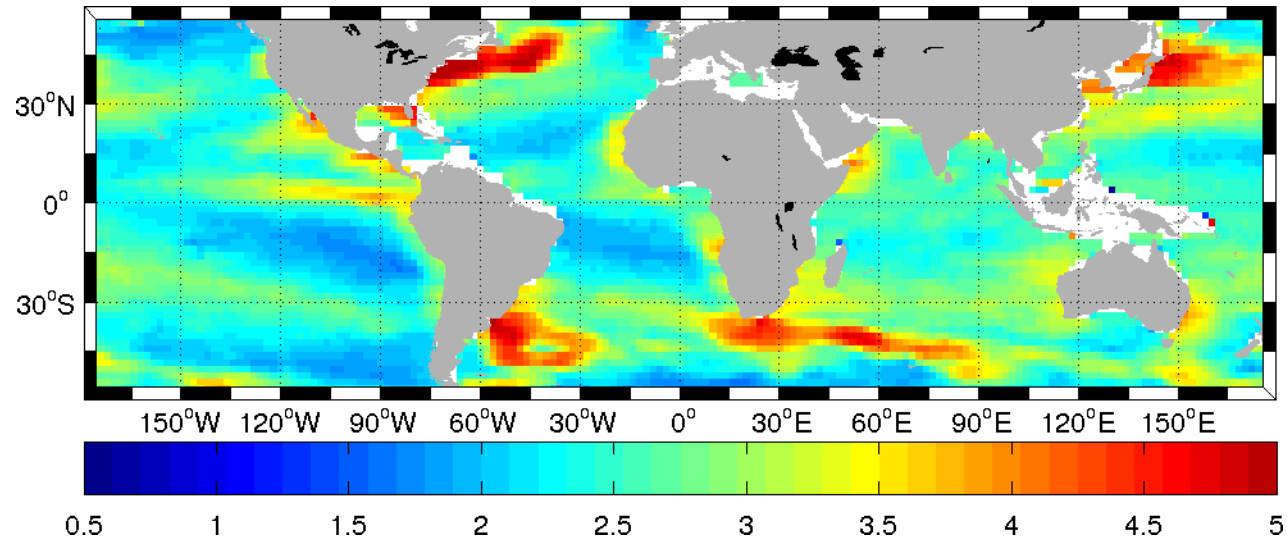


2003-2009 mean of the wavenumber spectral slope in the 80-250 km wavelength band calculated from Jason 1 Along-Track data (within 8°x8° box) at 2°x2° grid resolution

~global map proposed by Xu and Fu (JPO 2011)



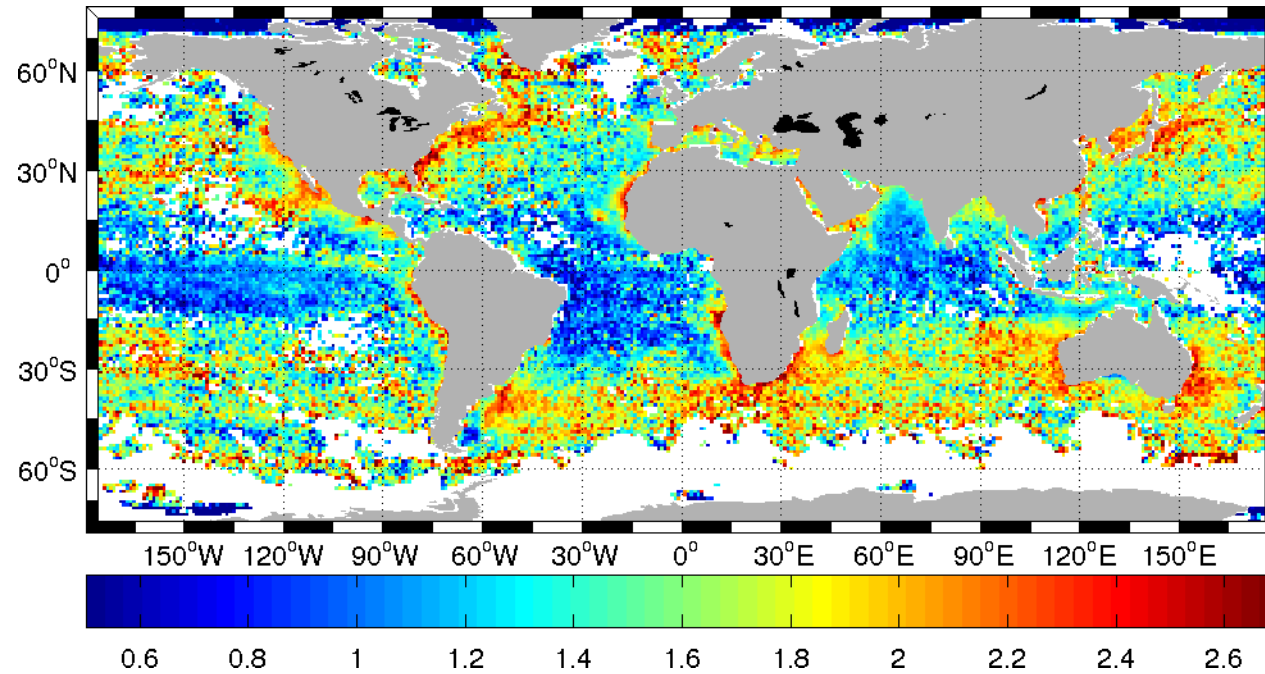
## SST wavenumber spectral slopes in the 80-250 km band



2003-2009 mean of the wavenumber spectral slope in the 80-250 km wavelength band calculated from AMSRE L3 data (within  $8^\circ \times 8^\circ$  box) at  $2^\circ \times 2^\circ$  grid resolution



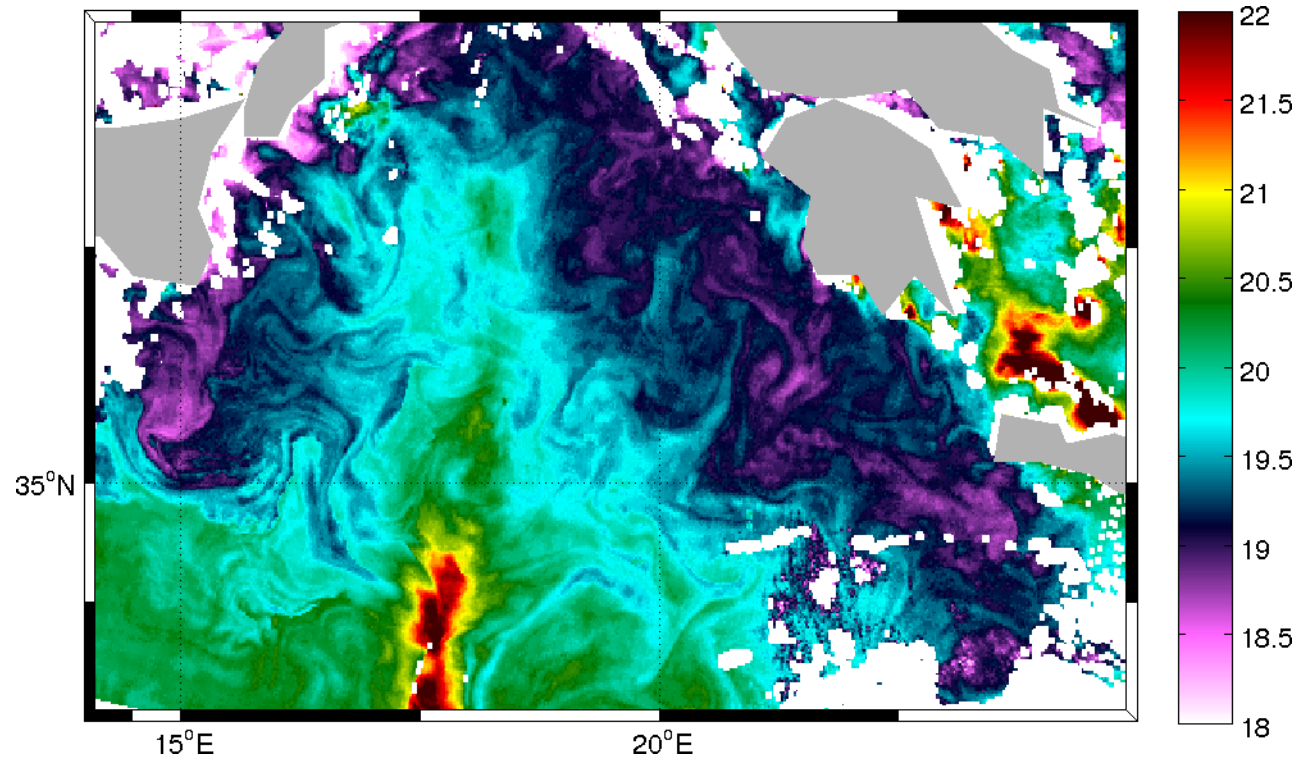
## SST wavenumber spectra in the 10-80 km band



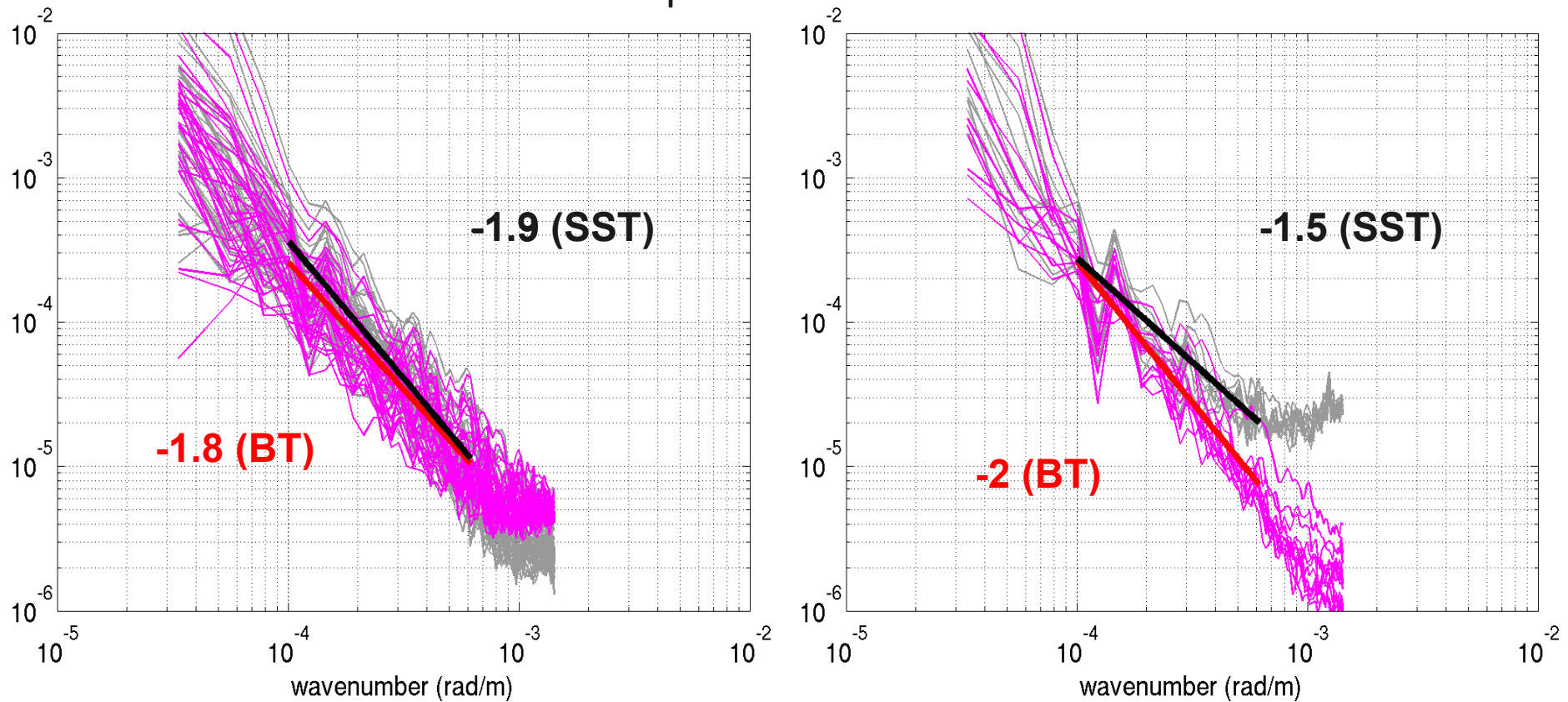
mid 2006-2007 wavenumber spectral slopes mean at  $1^\circ \times 1^\circ$  resolution in the 10-80 km wavelength band calculated from MODIS SST data ( $\sim 1$  km resolution). 2D-Spectra computed over  $1.28^\circ \times 1.28^\circ$  area with high coverage ( $>95\%$ )

## SST wavenumber spectra in the 10-80 km band

Example of wavenumber spectral slope estimation from MODIS and METOP SST data ( $\sim 1$  km)



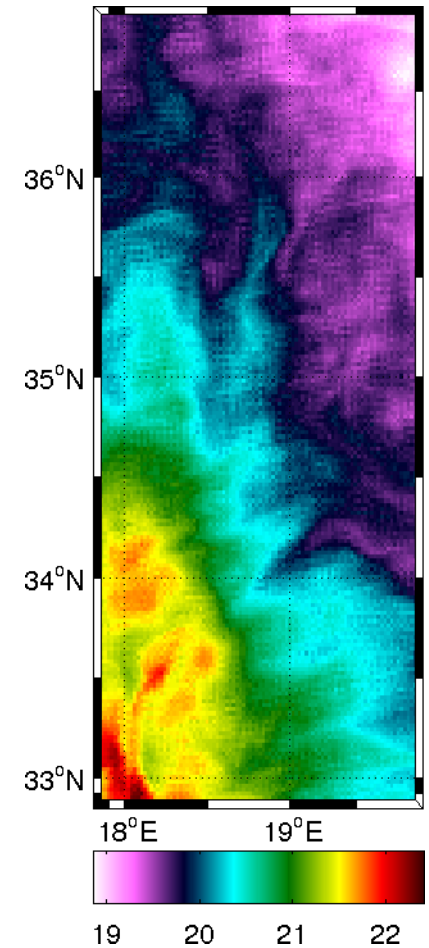
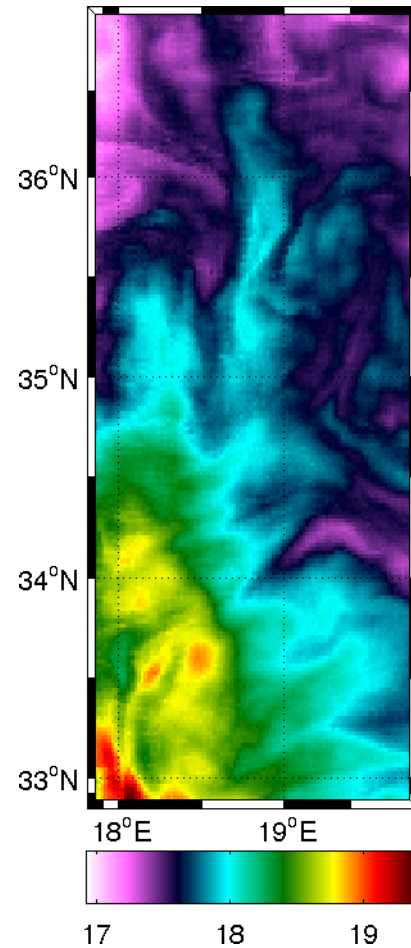
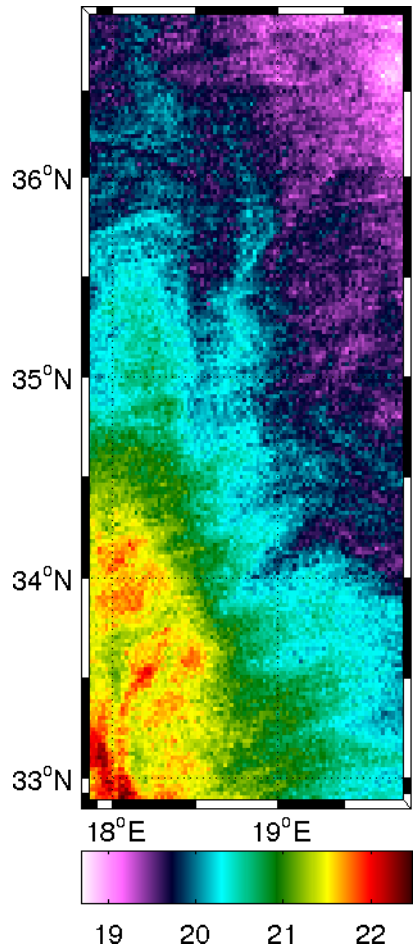
## SST wavenumber spectra in the 10-80 km band



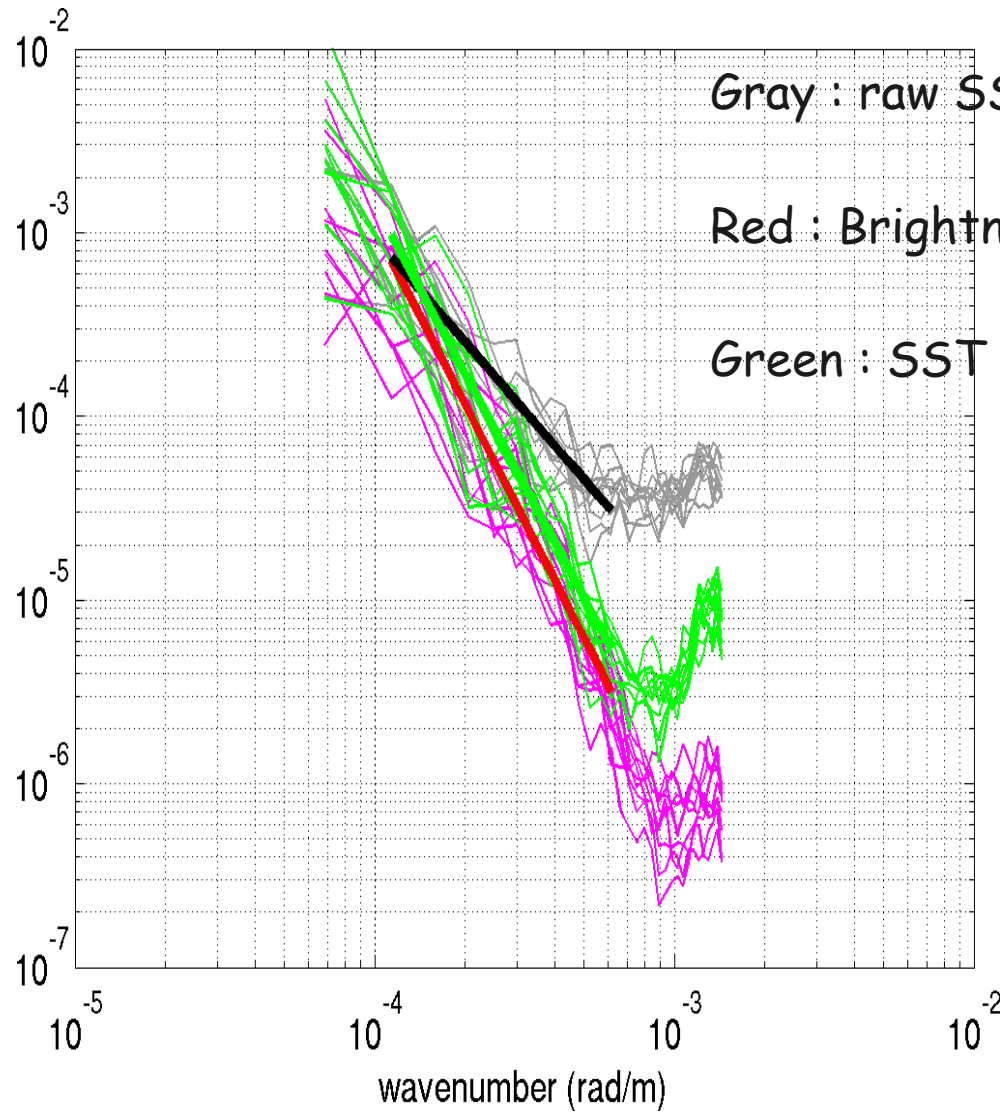
Wavenumber spectral slopes mean in the 10-80 km wavelength band calculated from METOP (left) MODIS (right) SST data ( $\sim 1$  km resolution). Spectra computed over  $1.28^\circ \times 1.28^\circ$  area with high coverage 95%

# SST wavenumber spectra in the 10-80 km band

## Noise correction



# SST wavenumber spectra in the 10-80 km band



Gray : raw SST. Slope = -1.9

Red : Brightness temperature. Slope = -3.2

Green : SST with noise correction. Slope = -3.1

## Conclusion

As somehow expected very high spatial correlation between SST and SSH in the mesoscale 80-300 km range.

=> Certainly a combined use of SST and SSH could improve the actual SSH fields in particular in terms of temporal sampling.

An improved spatial resolution would be less straightforward. From our data set : apparent spectral change in the 10-80 km range for SST with spectral slopes obviously weaker even after possible noise correction.

Geographical distribution of spectral slopes is still hampered by the total variance and the noise level