

Observational and numerical studies of SST variability at South Atlantic using the Regional CPTEC Oceanic Data Assimilation System (R-CODAS)

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Motivation

Understand the SST variability and the related mechanisms/processes

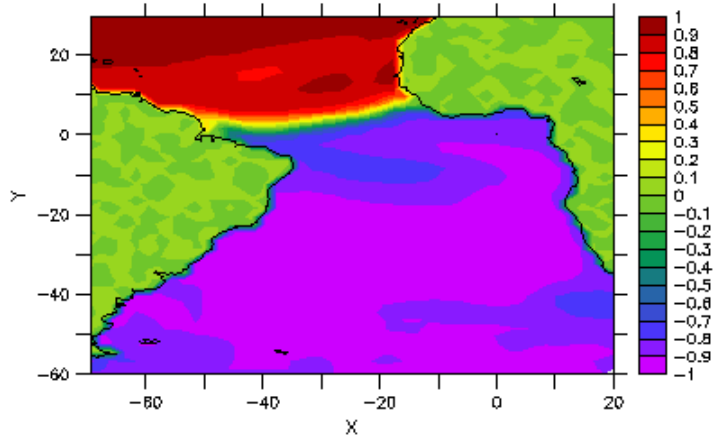
OISSTv2 as the base data set

ROMS as the modelling tool

LETKF as the scheme for data assimilation

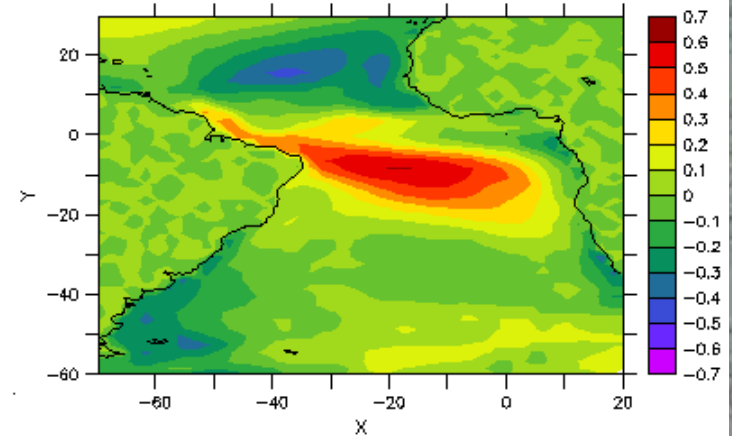
EOF results

T : 1 DATA SET: Nsst_atlantico_eof



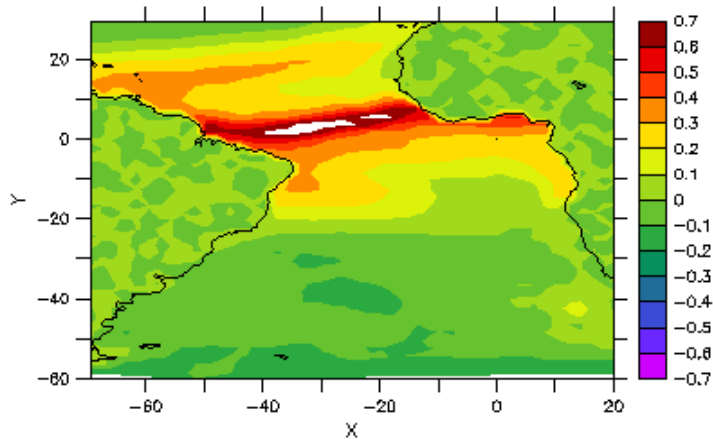
eof1 -> 80.4%

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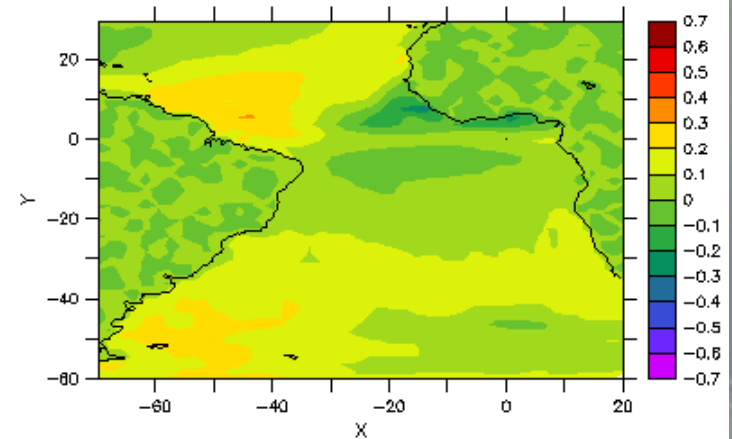
eof2 -> 3.5%

T : 3 DATA SET: Nsst_atlantico_eof



eof3 -> 3.2%

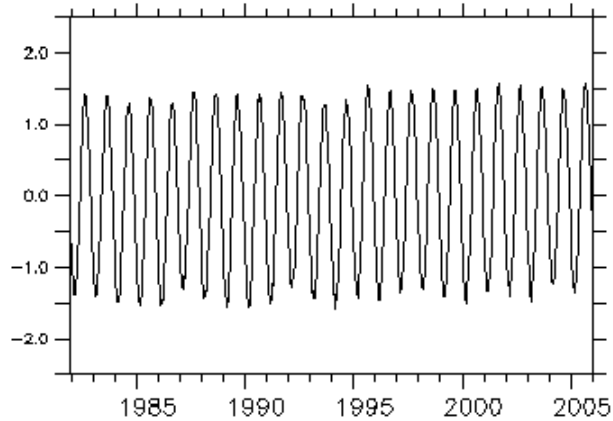
T : 4 DATA SET: Nsst_atlantico_eof



eof4 -> 1.9%

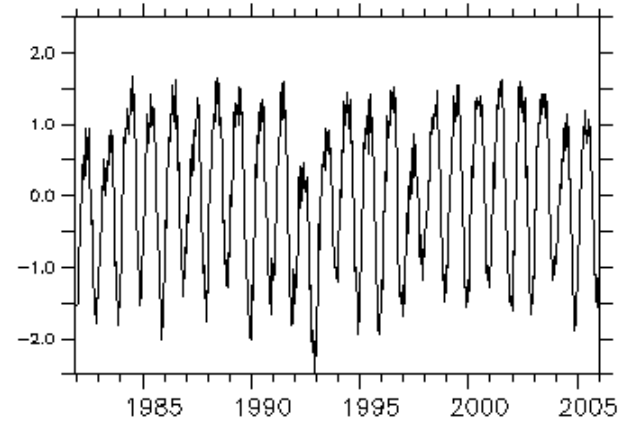
EOF results

X : 1 DATA SET: Nsst_atlantico_eof_tfunc



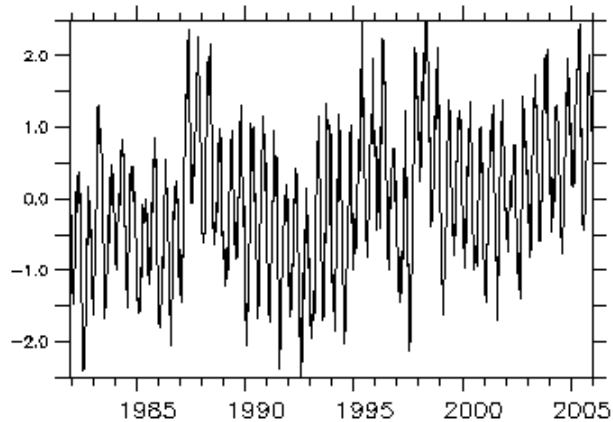
time function eof1

X : 2 DATA SET: Nsst_atlantico_eof_tfunc



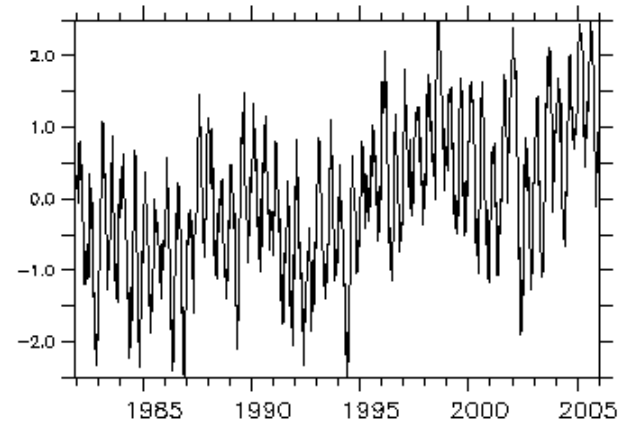
time function eof2

X : 3 DATA SET: Nsst_atlantico_eof_tfunc



time function eof3

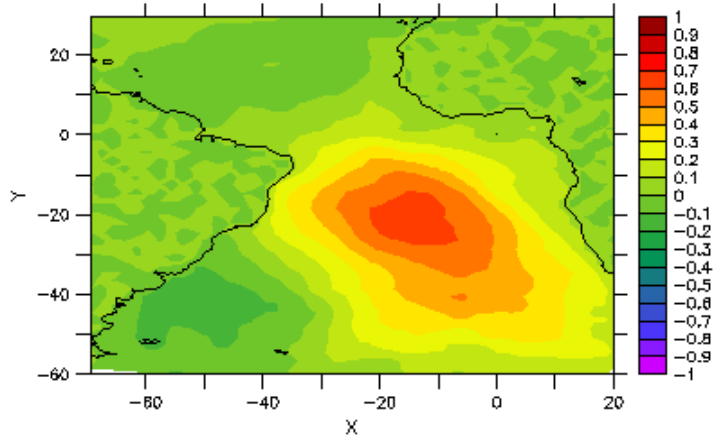
X : 4 DATA SET: Nsst_atlantico_eof_tfunc



time function eof4

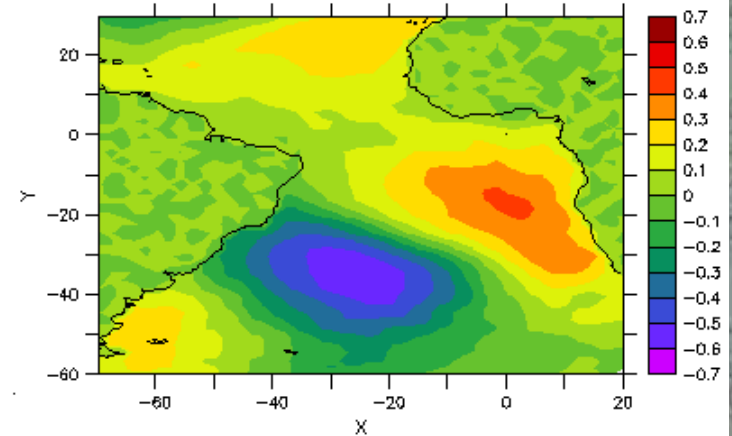
EOF results – 10-100 days

T : 1 DATA SET: Nsst_10-100_atlantico_eof



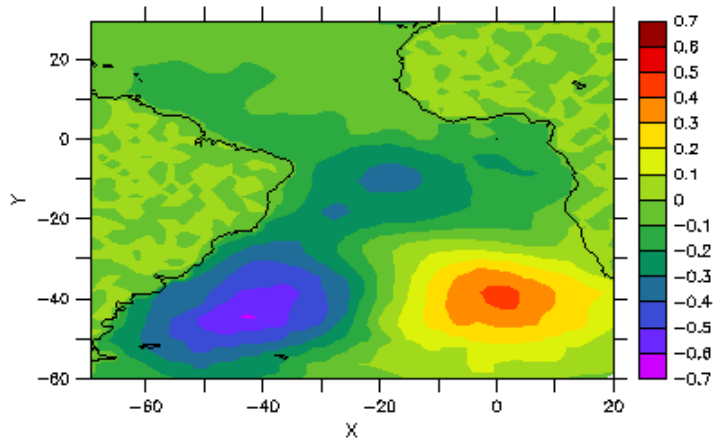
eof1 -> 5.1%

T : 2 DATA SET: Nsst_10-100_atlantico_eof



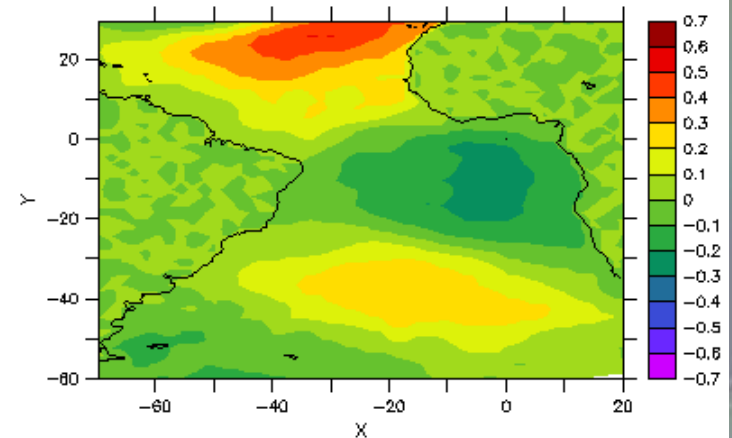
eof2 -> 4.3%

T : 3 DATA SET: Nsst_10-100_atlantico_eof



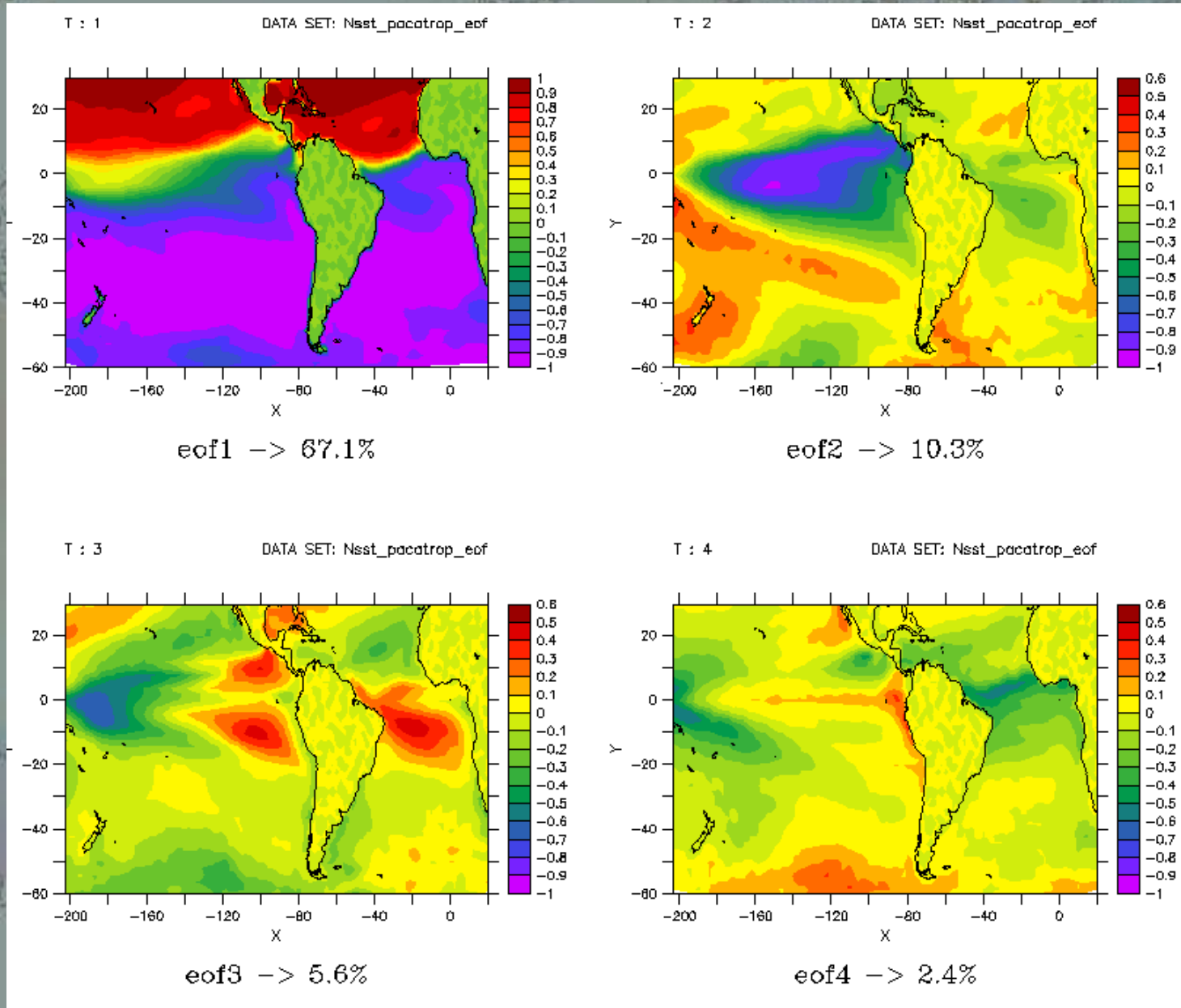
eof3 -> 3.8%

T : 4 DATA SET: Nsst_10-100_atlantico_eof



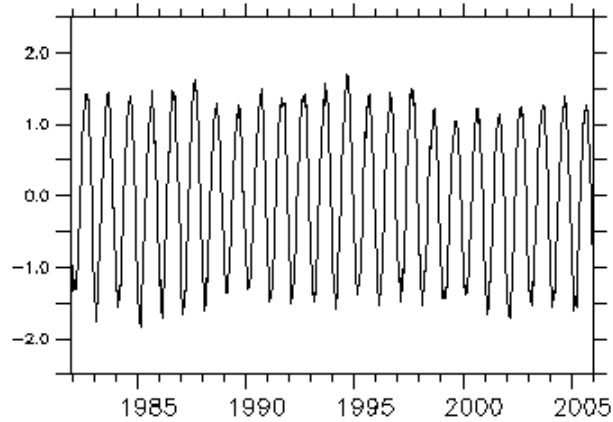
eof4 -> 3.6%

EOF results



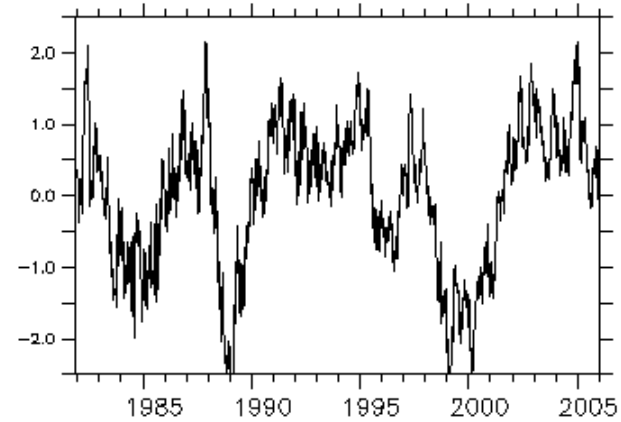
EOF results

X : 1 DATA SET: Nsst_pacatrop_eof_tfunc



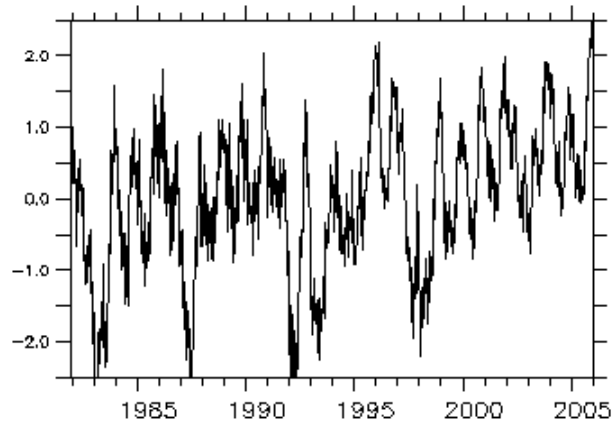
time function eof1

X : 2 DATA SET: Nsst_pacatrop_eof_tfunc



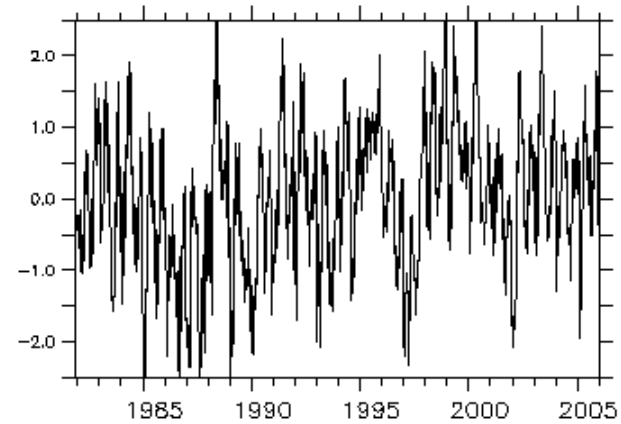
time function eof2

X : 3 DATA SET: Nsst_pacatrop_eof_tfunc



time function eof3

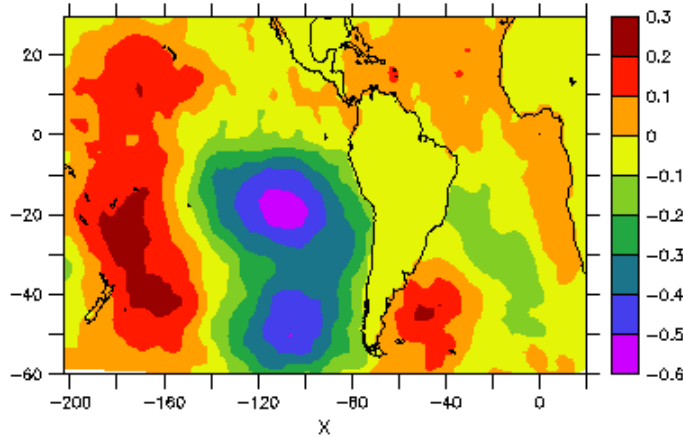
X : 4 DATA SET: Nsst_pacatrop_eof_tfunc



time function eof4

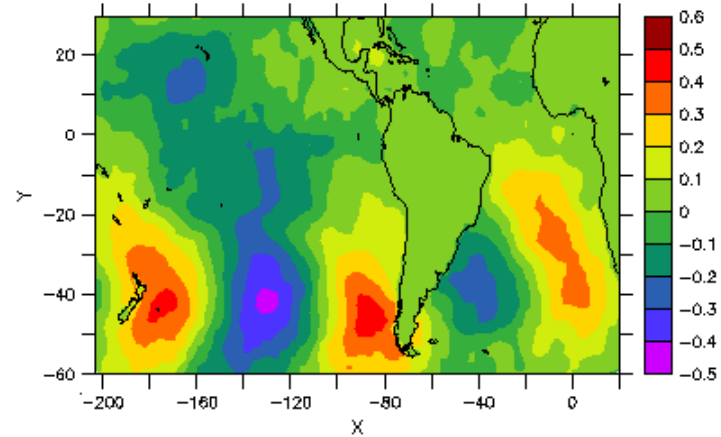
EOF results – 10-100 days

T : 1 DATA SET: Nsst_10-100_pacatrap_eof



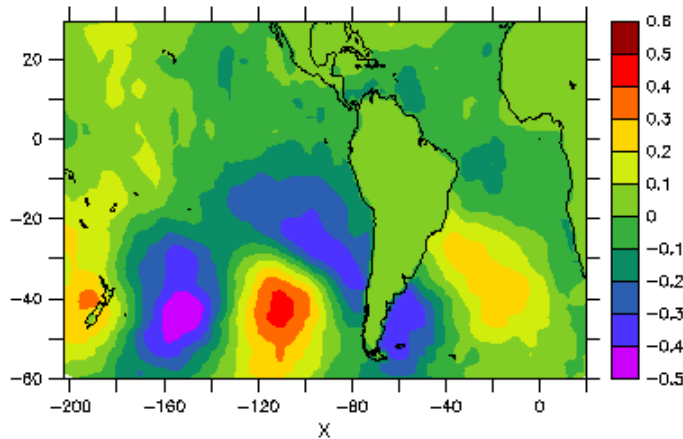
eof1 -> 8.2%

T : 2 DATA SET: Nsst_10-100_pacatrap_eof



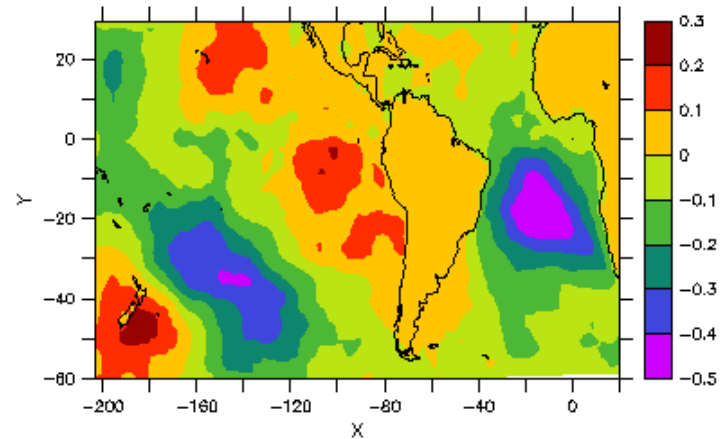
eof2 -> 7.9%

T : 3 DATA SET: Nsst_10-100_pacatrap_eof



eof3 -> 6.3%

T : 4 DATA SET: Nsst_10-100_pacatrap_eof

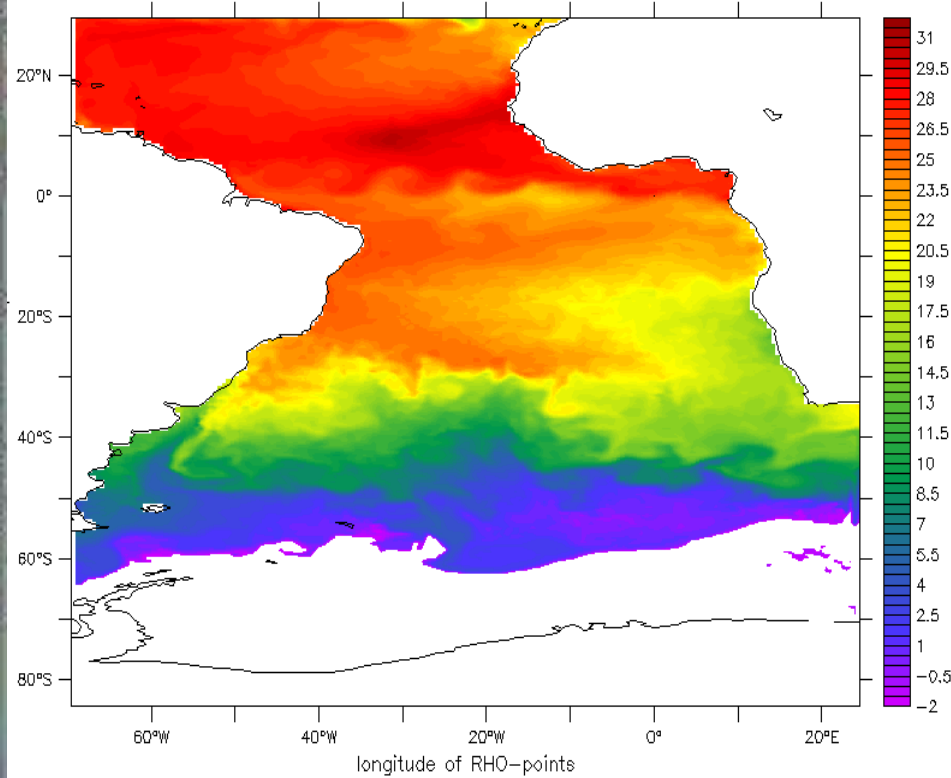


eof4 -> 5.7%

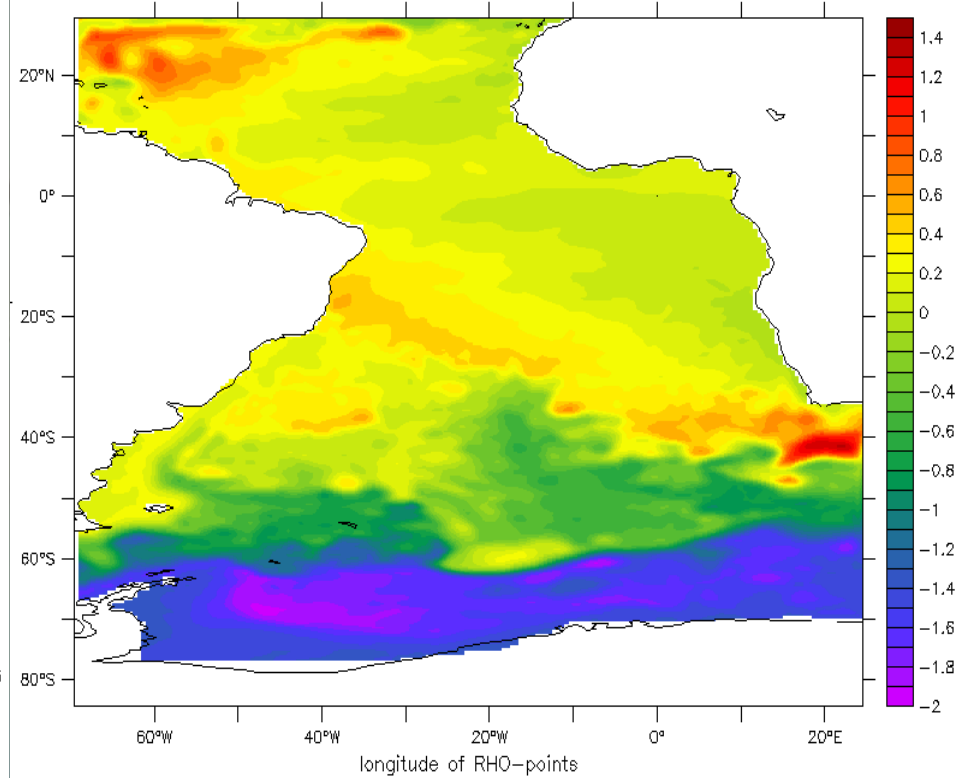
ROMS results - spinup

TIME : 16-SEP-0019 00:00 360_DAY DATA SET: tsa_avg_monltm-enrique2
Tropical and South Atlantic, 0.5 degree resolution

TIME : 16-SEP-0019 00:00 360_DAY DATA SET: tsa_avg_monltm-enrique2
Tropical and South Atlantic, 0.5 degree resolution



time-averaged potential temperature (Celsius)

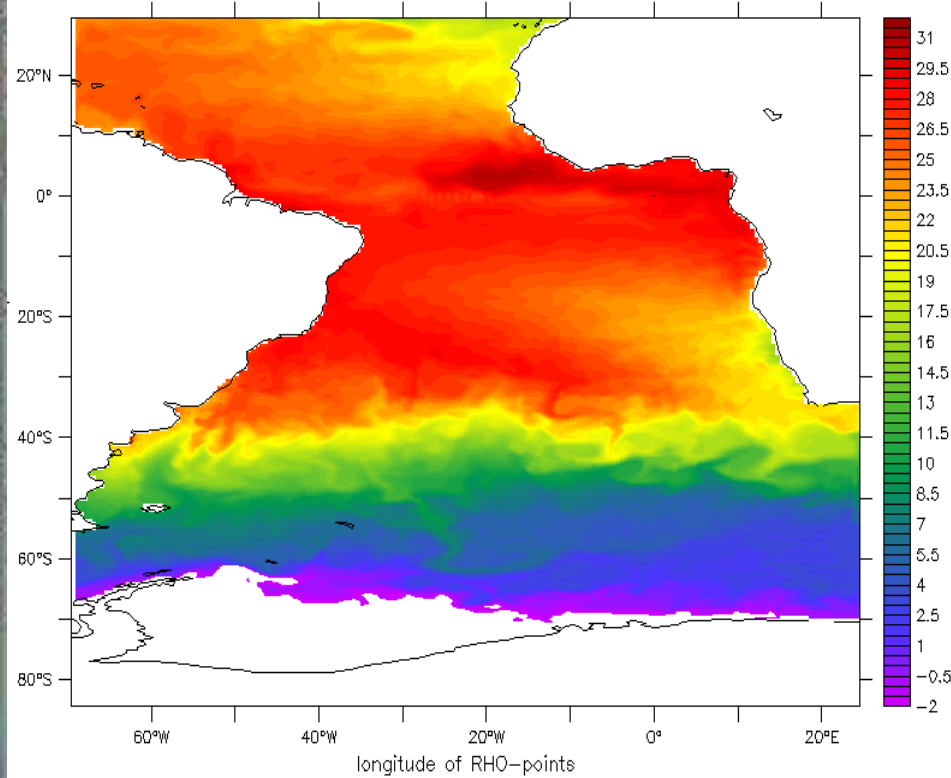


time-averaged free-surface (meter)

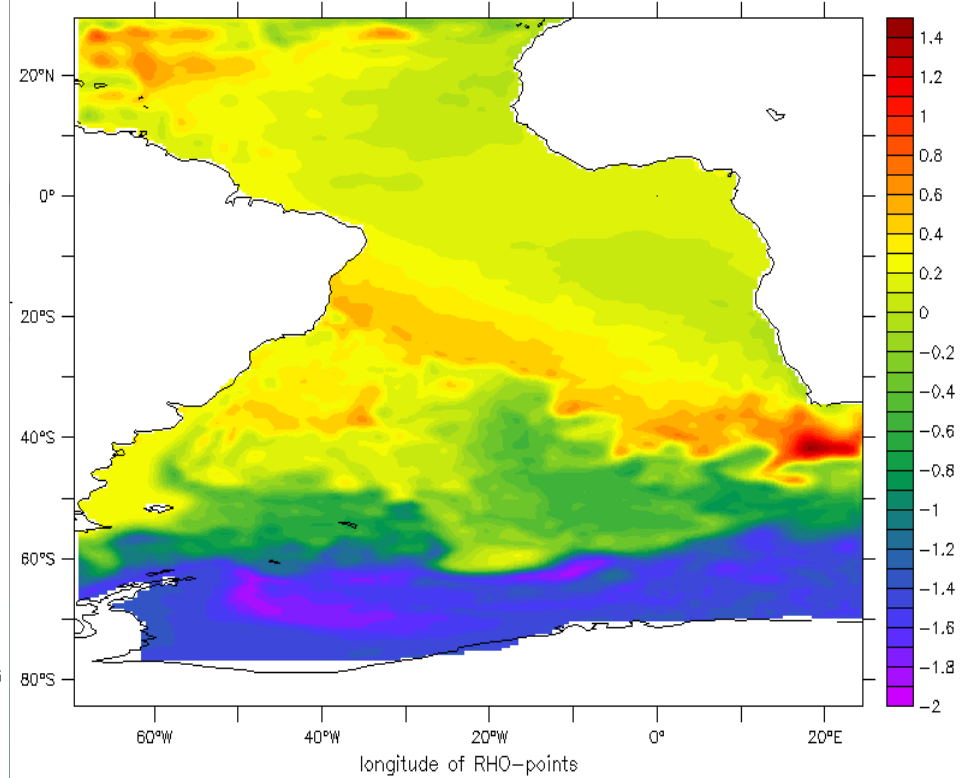
ROMS results - spinup

TIME : 16-MAR-0020 00:00 360_DAY DATA SET: tsa_avg_monltm-enrique2
Tropical and South Atlantic, 0.5 degree resolution

TIME : 16-MAR-0020 00:00 360_DAY DATA SET: tsa_avg_monltm-enrique2
Tropical and South Atlantic, 0.5 degree resolution



time-averaged potential temperature (Celsius)

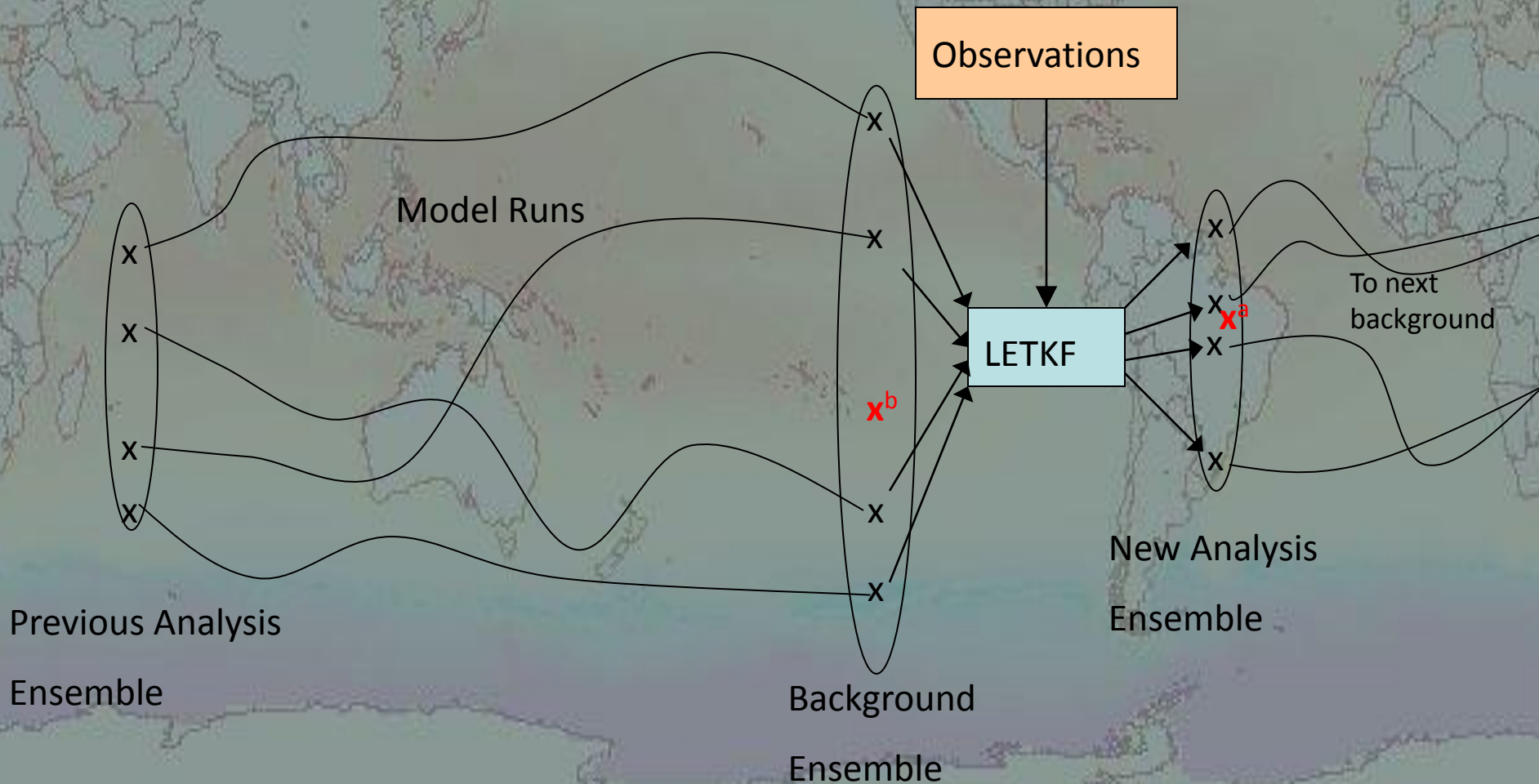


time-averaged free-surface (meter)

Data Assimilation at CPTEC

- LETKF is quicker and easier to develop and code than 3D-Var or 4D-Var since it does not require the adjoint model.
- LETKF gives the uncertainty along with the forecast.
- LETKF evolves covariance matrices, so it can correct "errors of the day."
- LETKF are already being developed and used for global atmospheric runs at CPTEC.
- LETKF is being implemented to MOM4 and ROMS

An assimilation cycle



How to create the analysis ensemble?

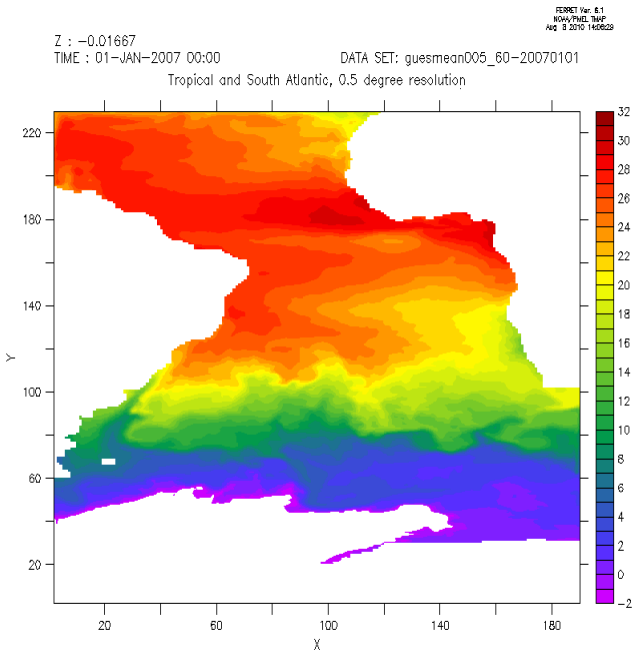
- There are many different types of EnKFs which differ in how they create the analysis ensemble.
- The LETKF uses a series of matrix operations to **transform** the background ensemble into the analysis ensemble. Hence the "T" in LETKF.
- This method comes from LTKF of Bishop et al. (2001).
- The version used (Miyoshi, 2010) uses adaptive inflation coefficient

LETKF results

- 2 months assimilation cycle at every 5 days
- SODA (pre-assimilated dataset) + OISSTv2
- 20, 40, 60 and 80 members for sensitivity tests

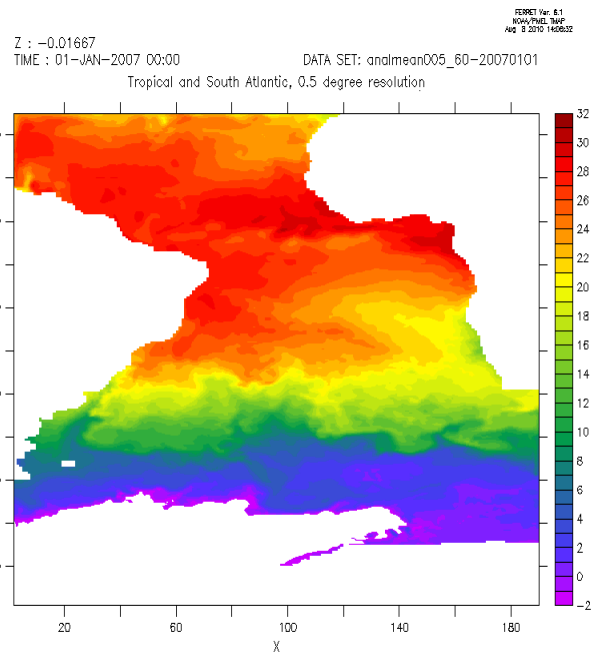
LETKF results – 60 members

01Jan2007



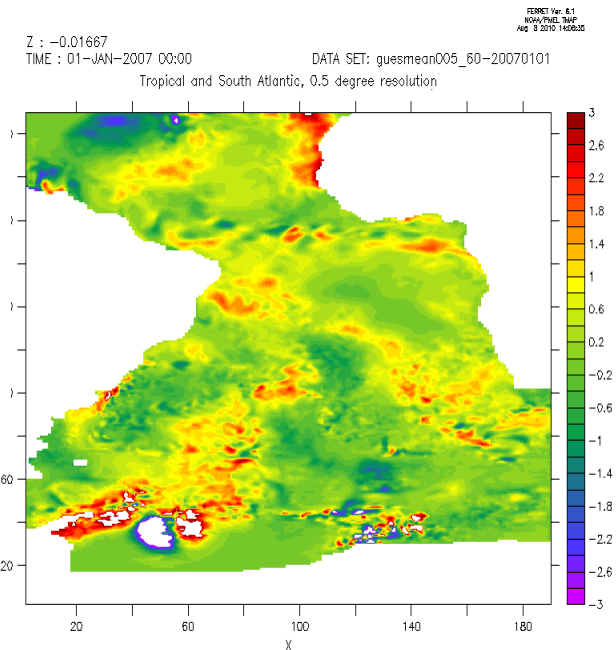
potential temperature (Celsius)

guess



potential temperature (Celsius)

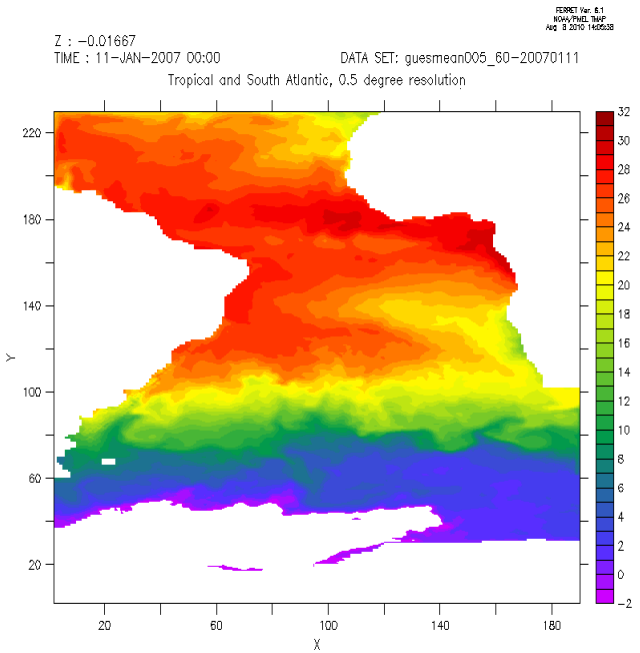
analysis



TEMP[D]=analmean005_60-20070101,I=2:190,J=2:230,K=30]-TEMP[I=2:190,J=2:230,K=30]

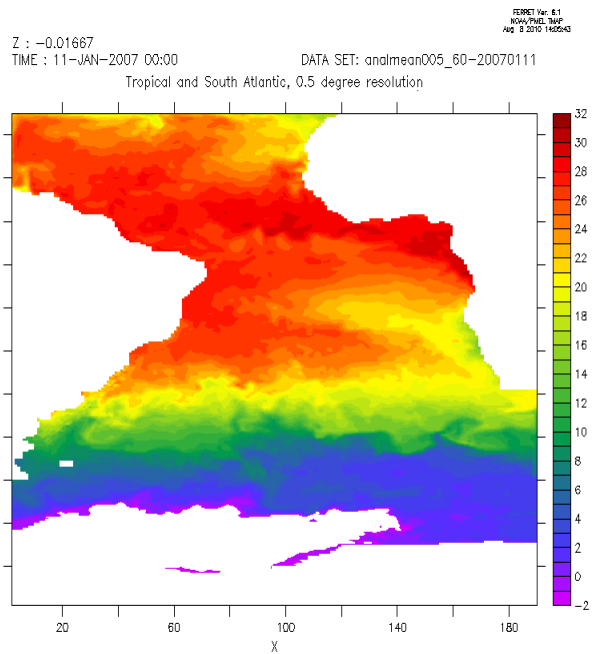
difference

11Jan2007



potential temperature (Celsius)

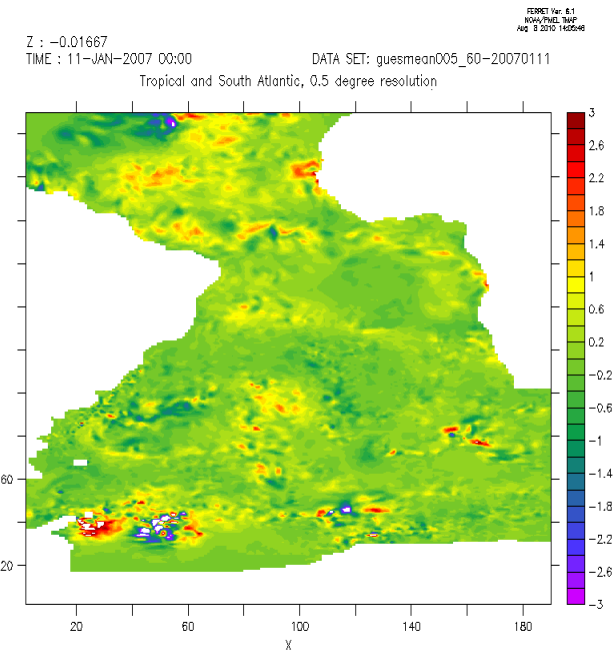
guess



potential temperature (Celsius)

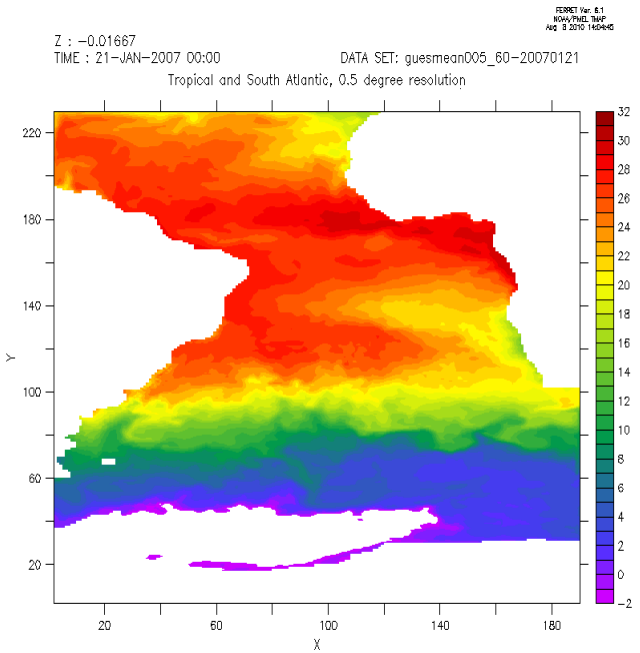
analysis

difference

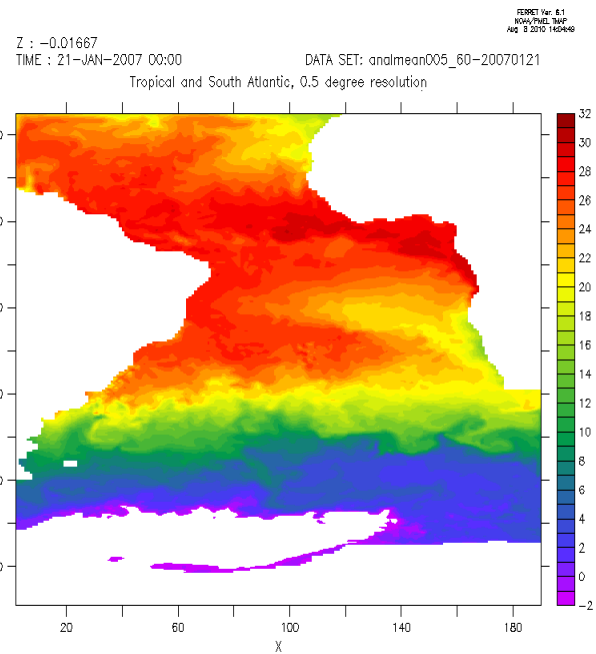


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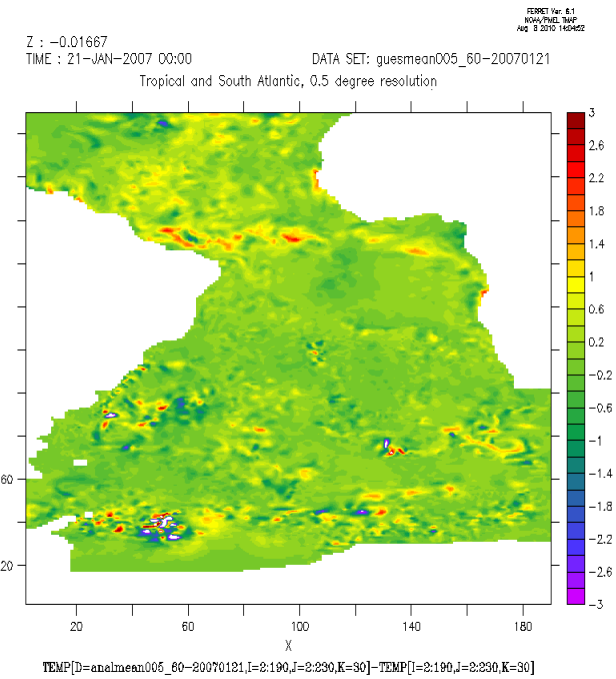
21Jan2007



guess

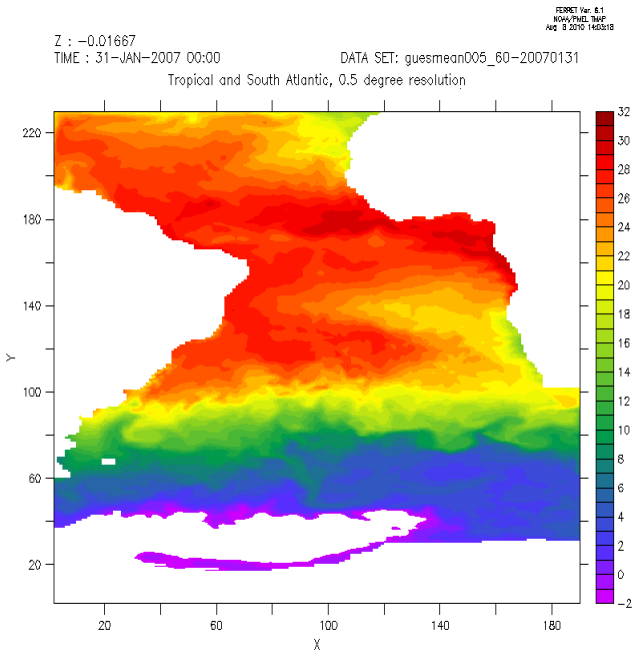


analysis



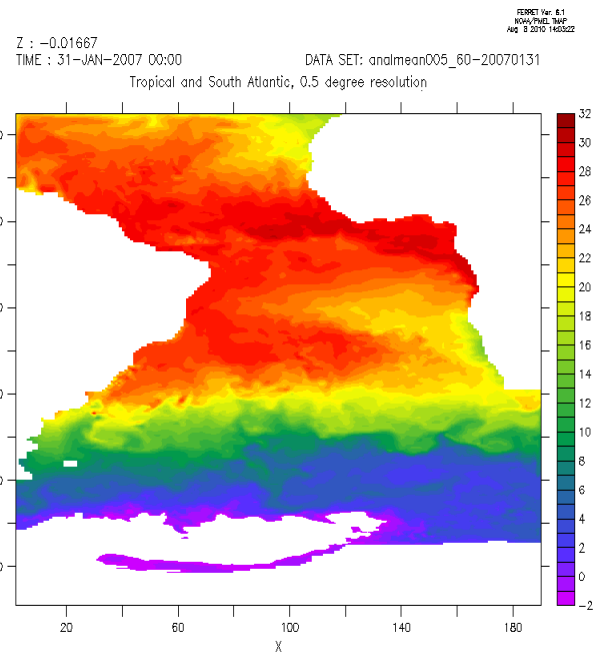
difference

31Jan2007



potential temperature (Celsius)

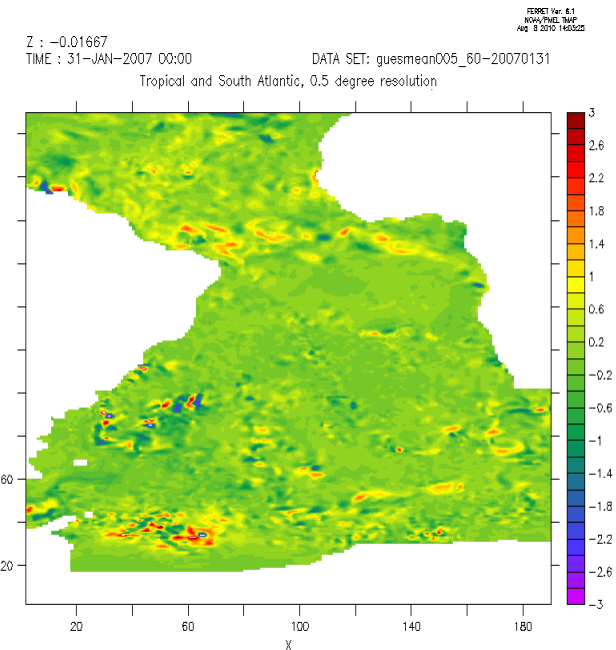
guess



potential temperature (Celsius)

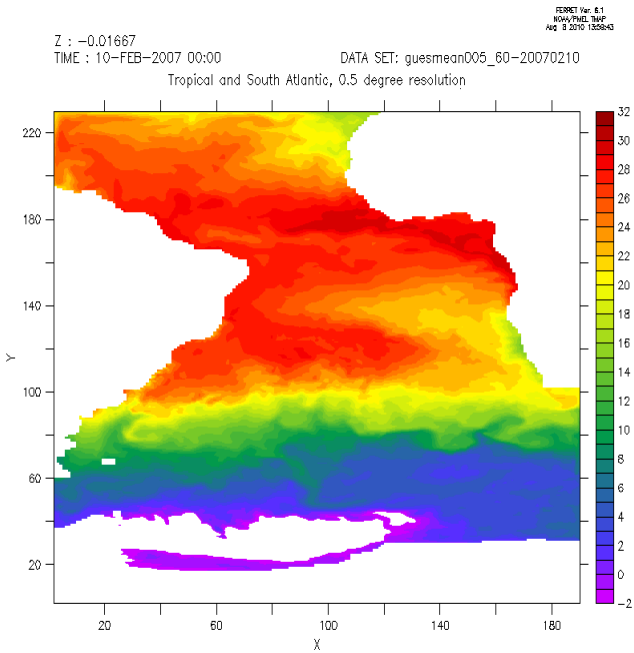
analysis

difference

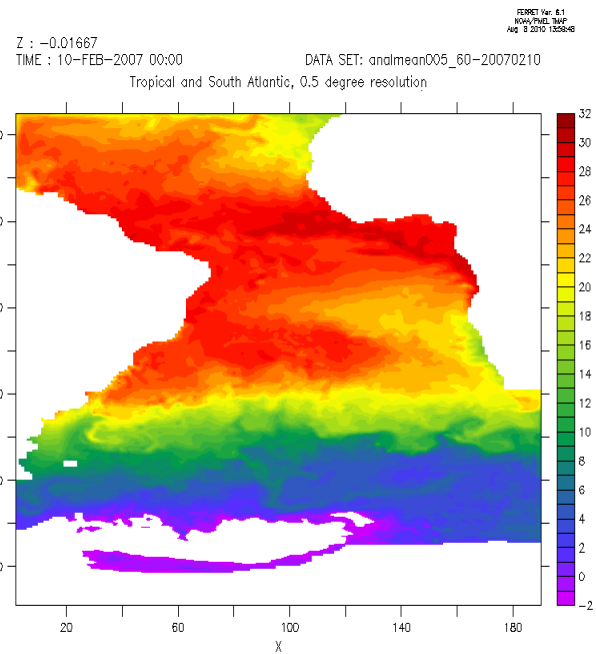


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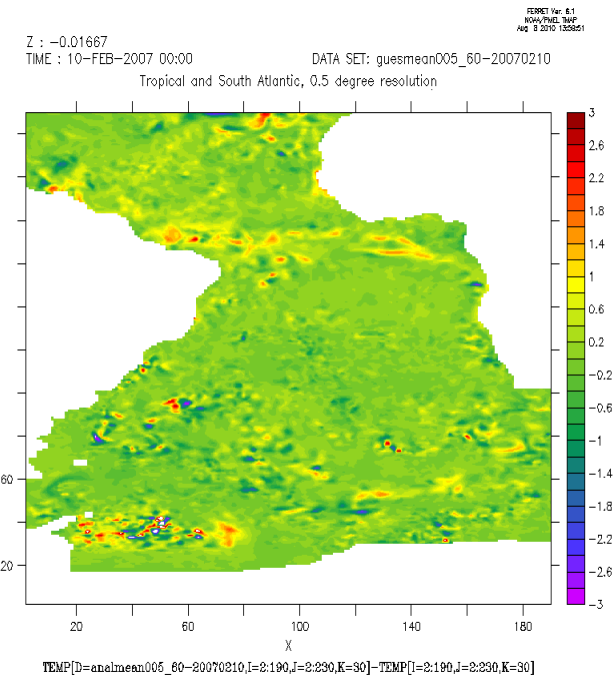
10Feb2007



guess

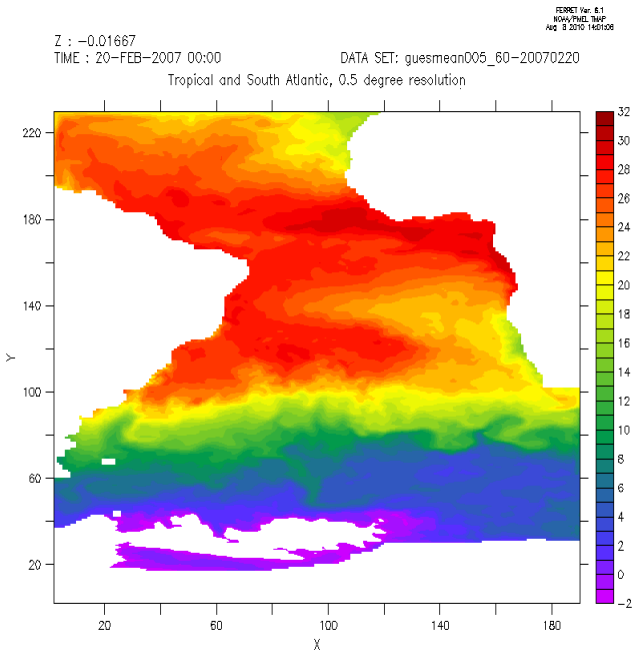


analysis



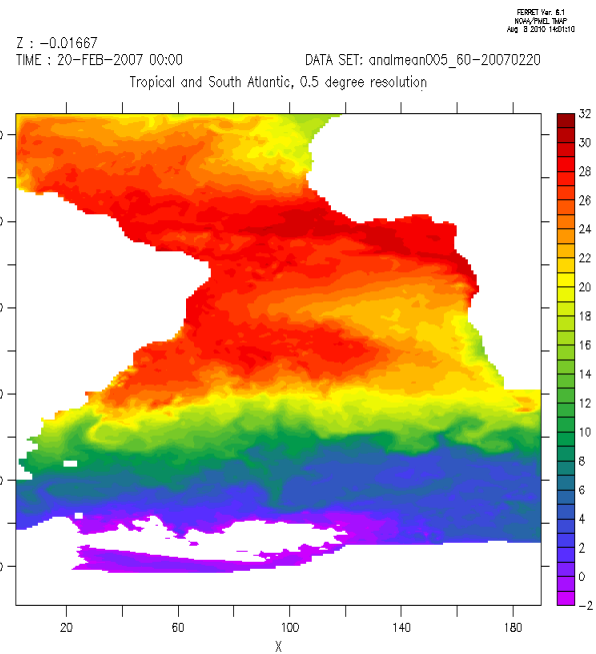
difference

20Feb2007



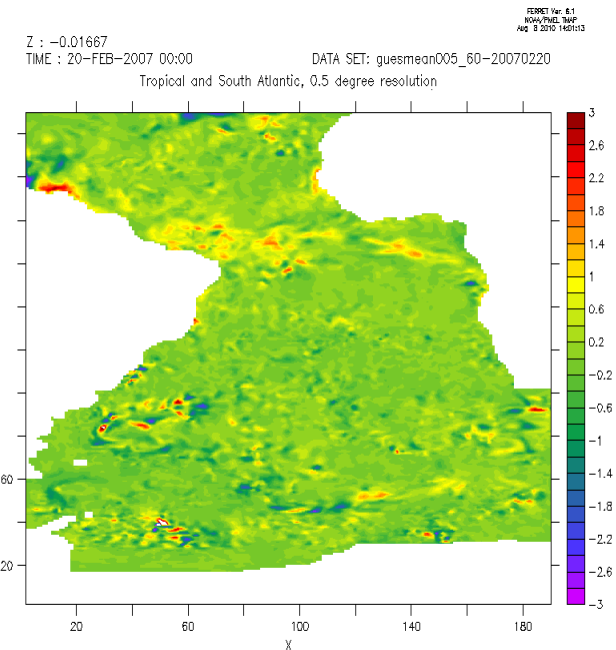
potential temperature (Celsius)

guess



potential temperature (Celsius)

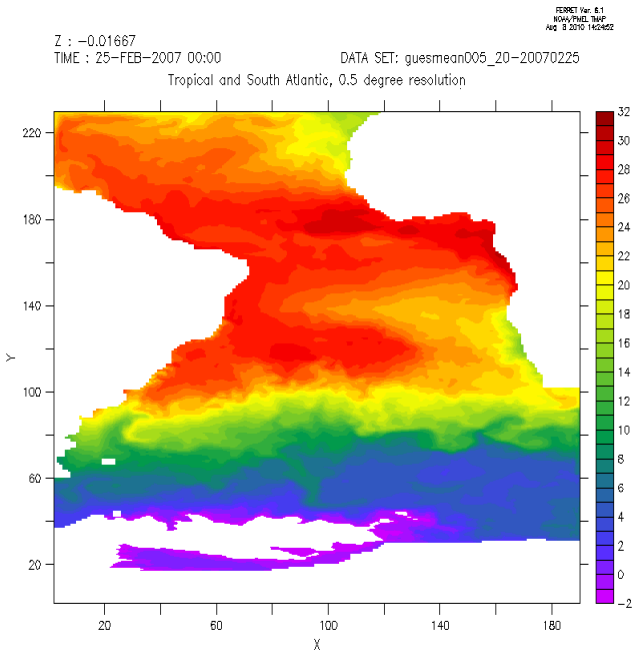
analysis



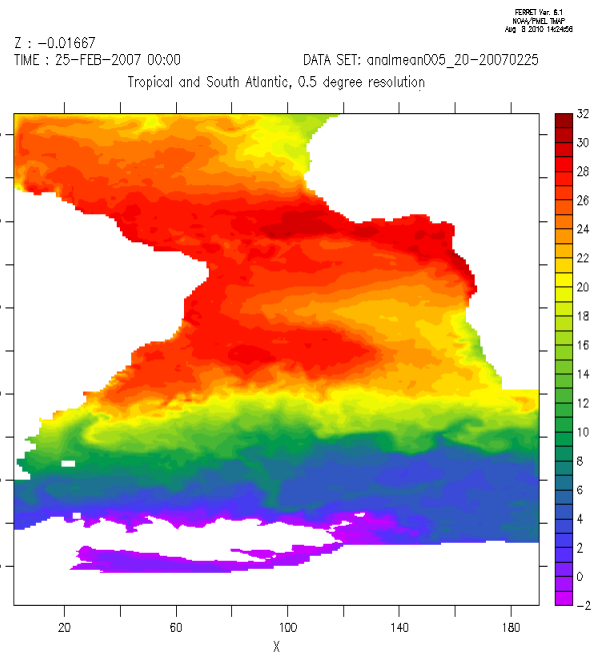
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difference

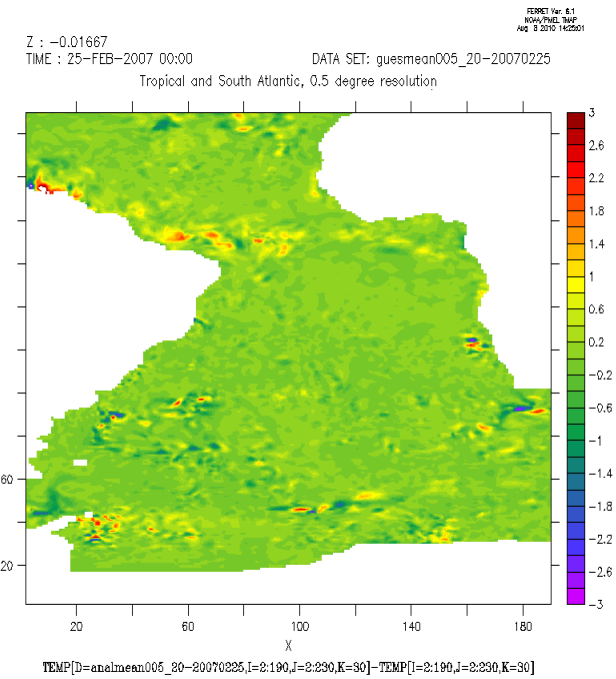
25Feb2007



guess

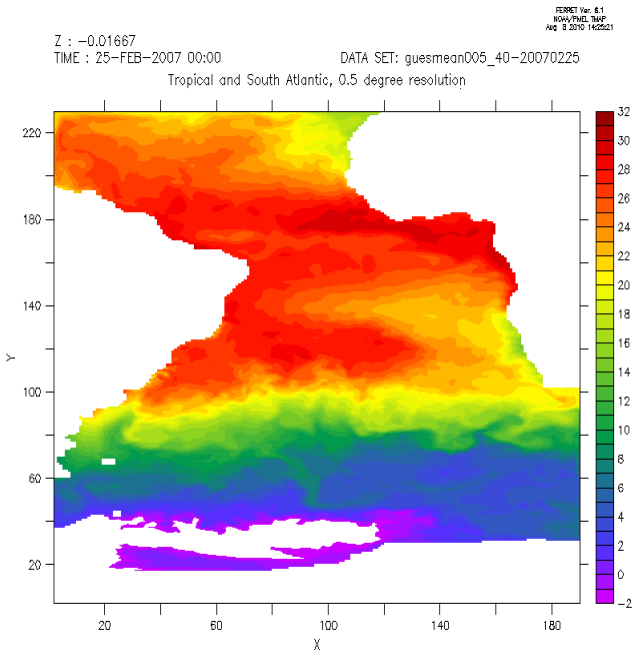


analysis



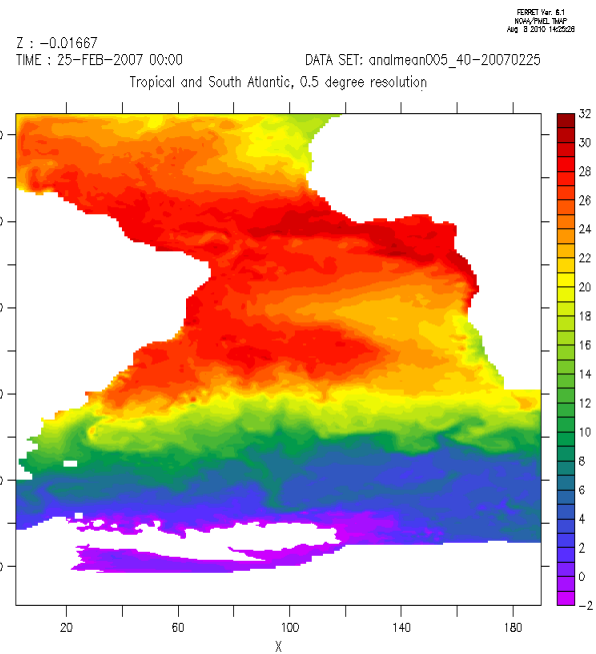
difference

25Feb2007



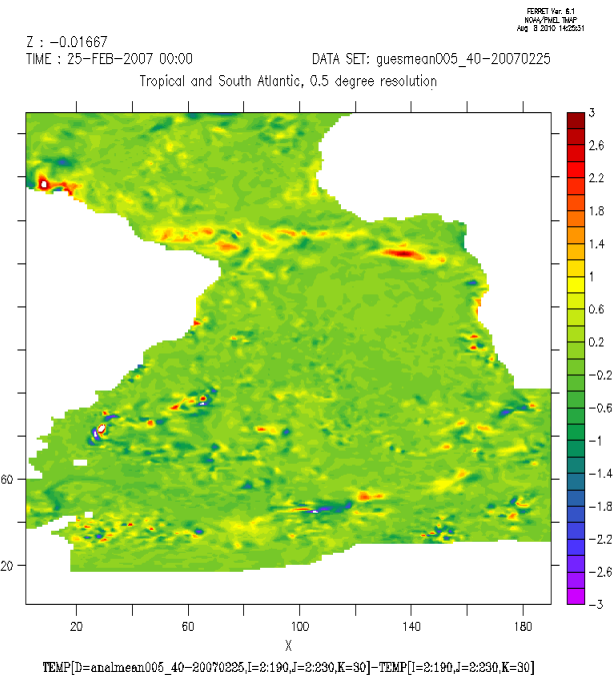
potential temperature (Celsius)

guess



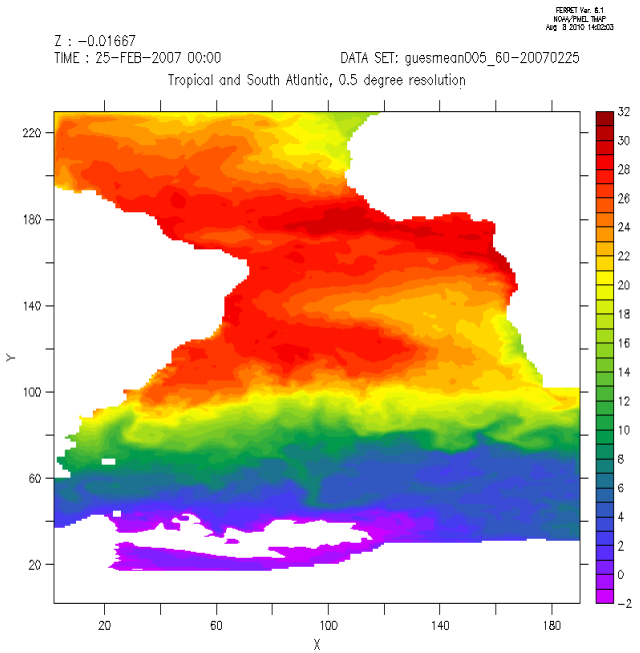
potential temperature (Celsius)

analysis

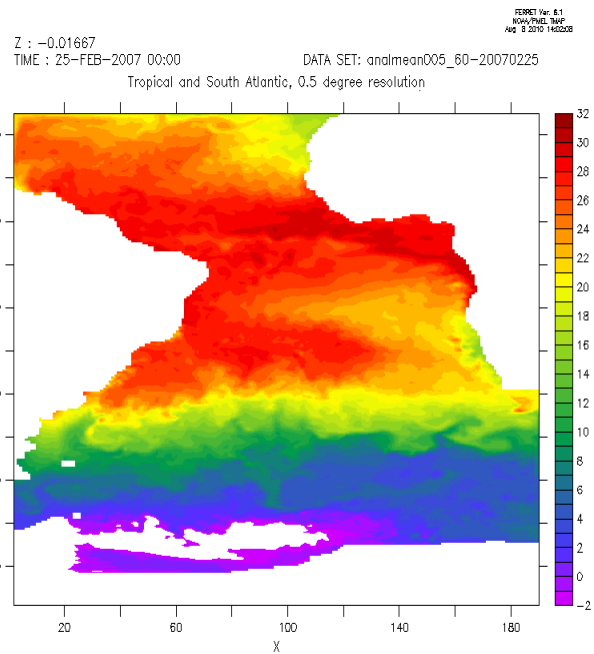


difference

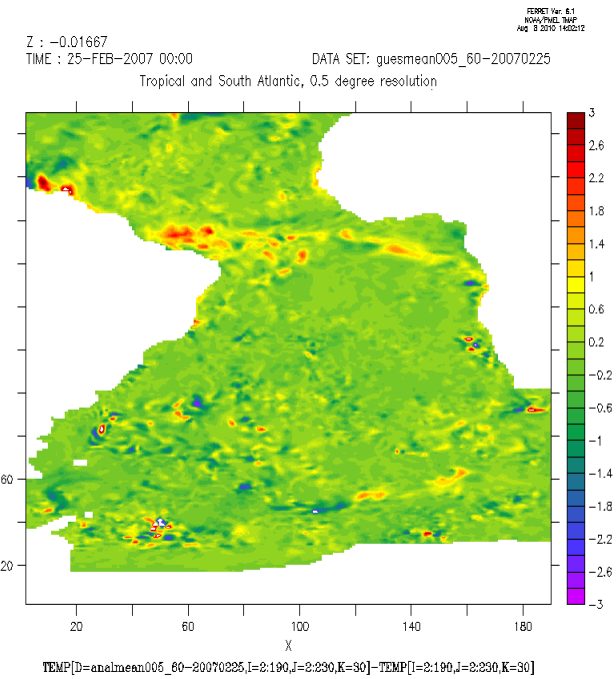
25Feb2007



guess

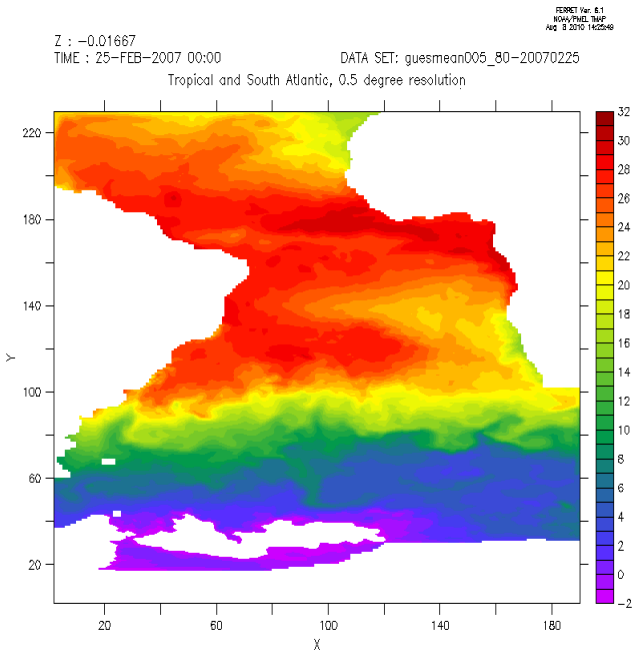


analysis

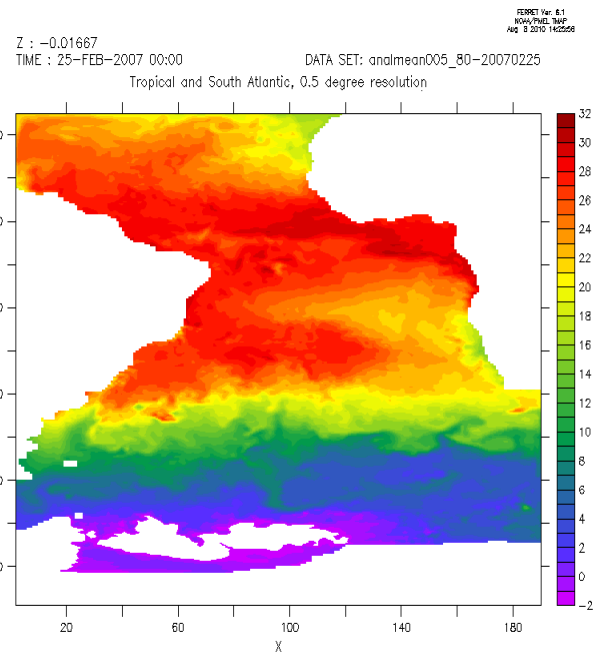


difference

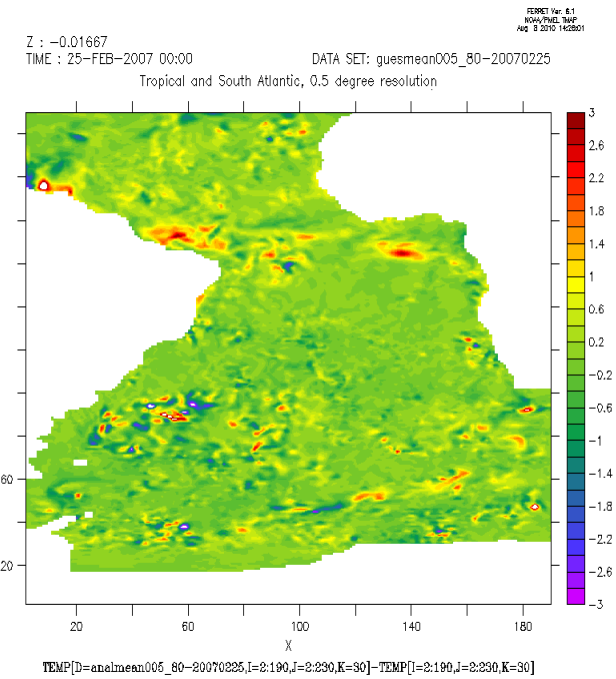
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guess

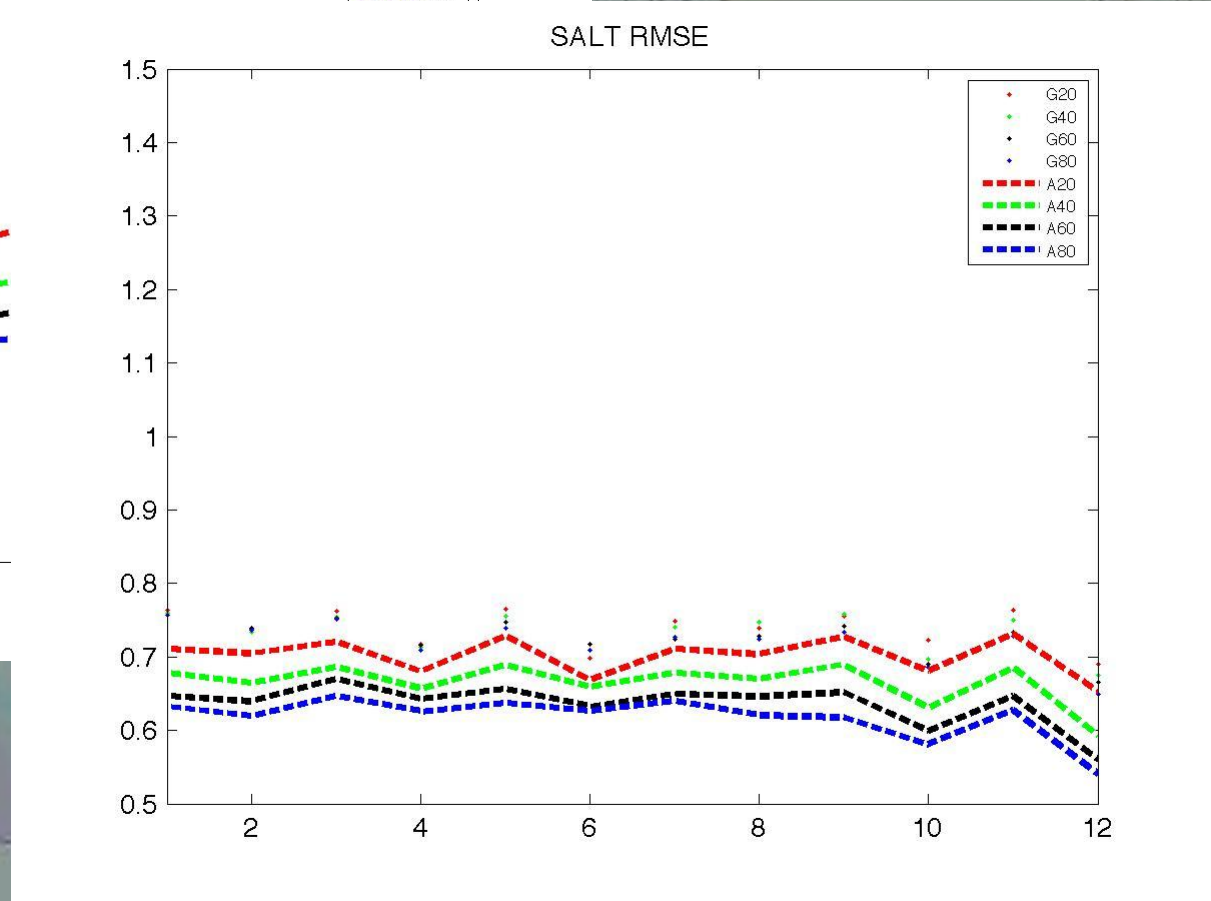
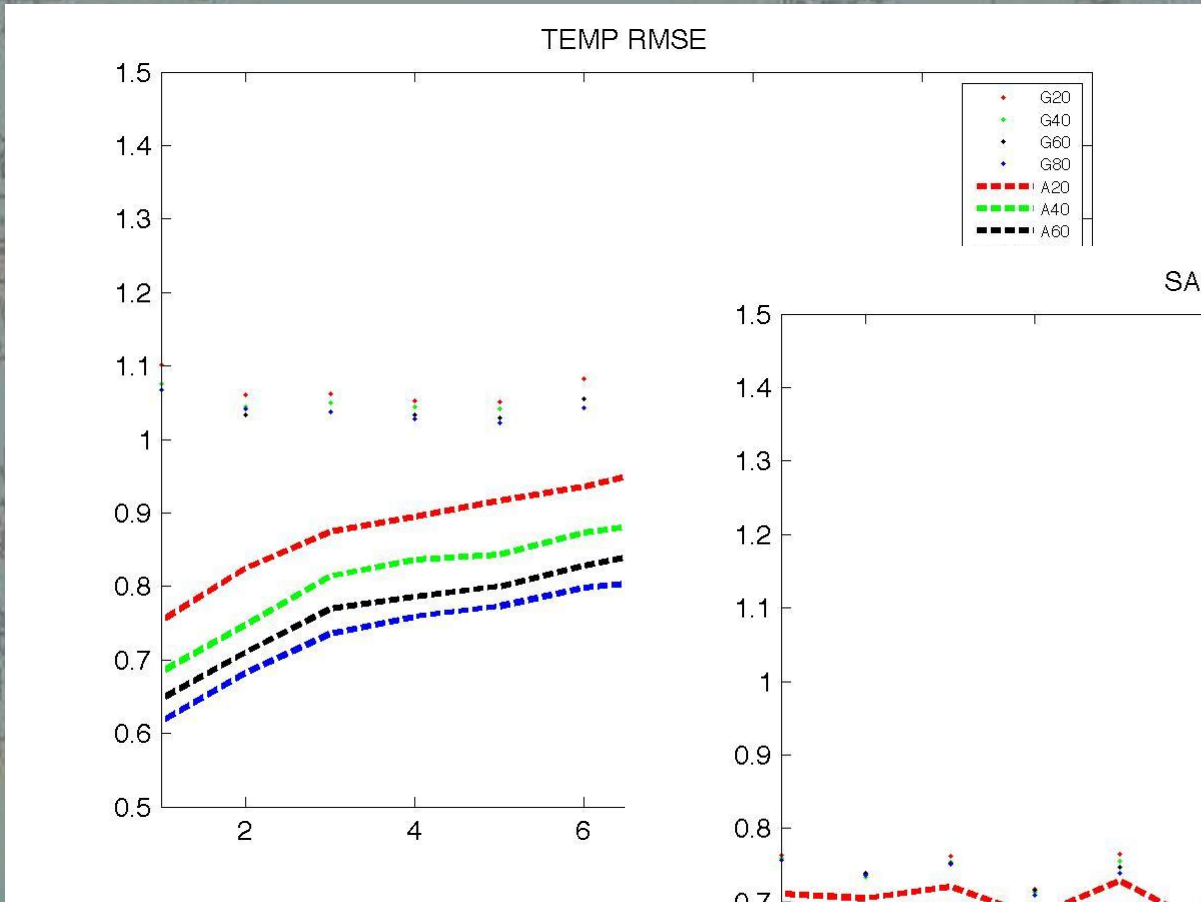


analysis



difference

LETKF results – # members



- Observational
 - Spatial patterns identified;
 - Needs further analysis (cross spectra, wavelet)
- ROMS
 - General features of superficial circulation well represented
 - Needs more efforts on boundary conditions and fresh water discharge
- LETKF
 - Initial corrections seem OK
 - Needs to test different subsets of assimilated data to verify the impact (surface and depth)
 - Inclusion of SSHA
 - Inclusion of Ice Model

Many thanks!