SEA SURFACE TEMPERATURE UNCERTAINTY ESTIMATES AND COUPLED FORECASTING

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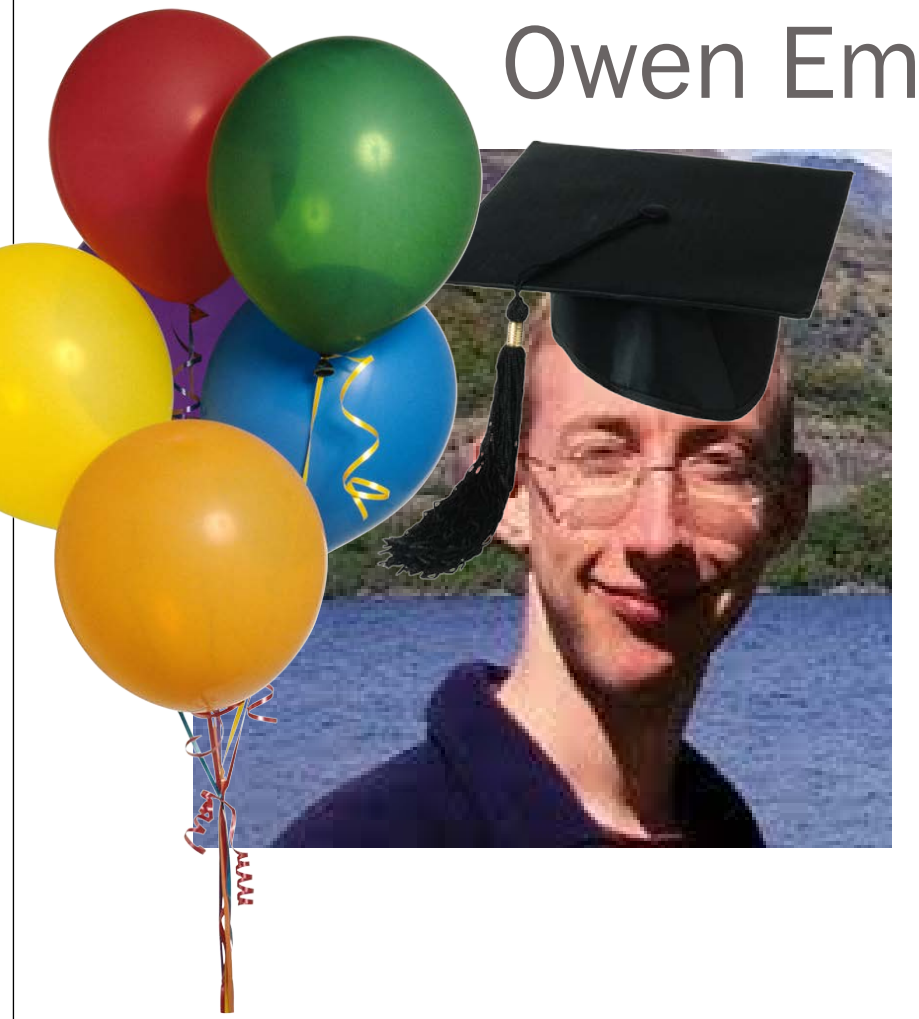
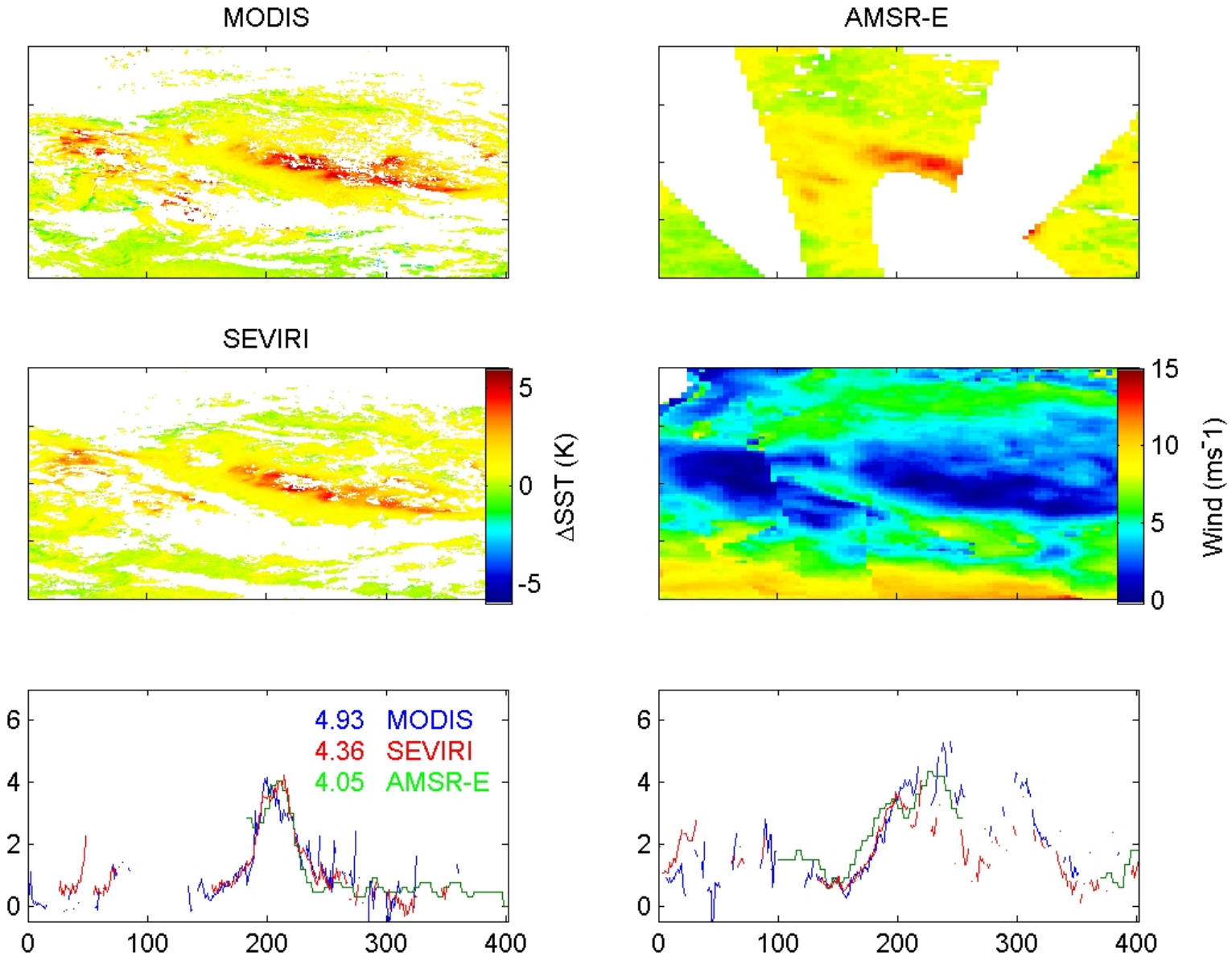
Owen Embury …

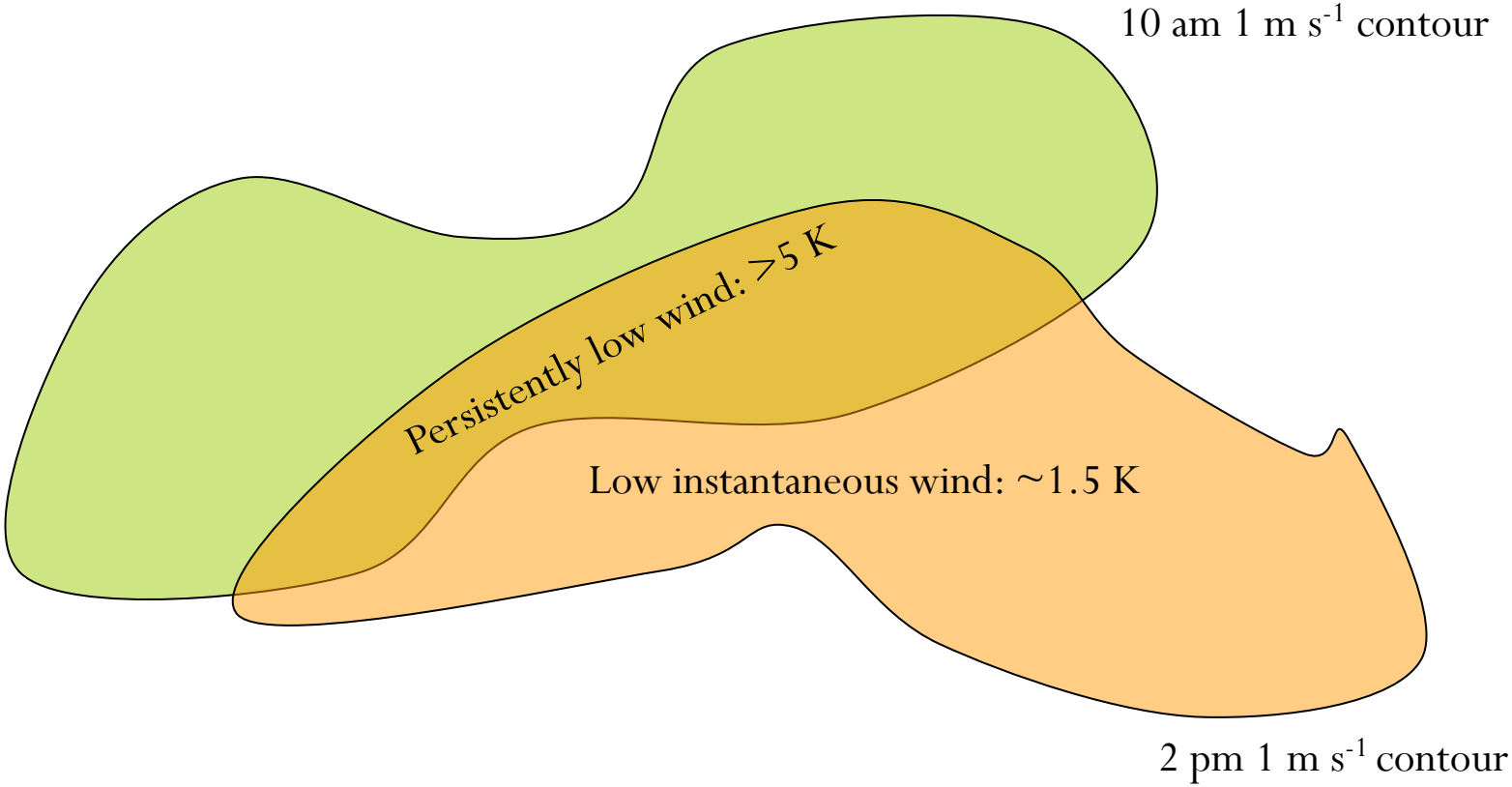


… submitted his PhD thesis 4 hours ago

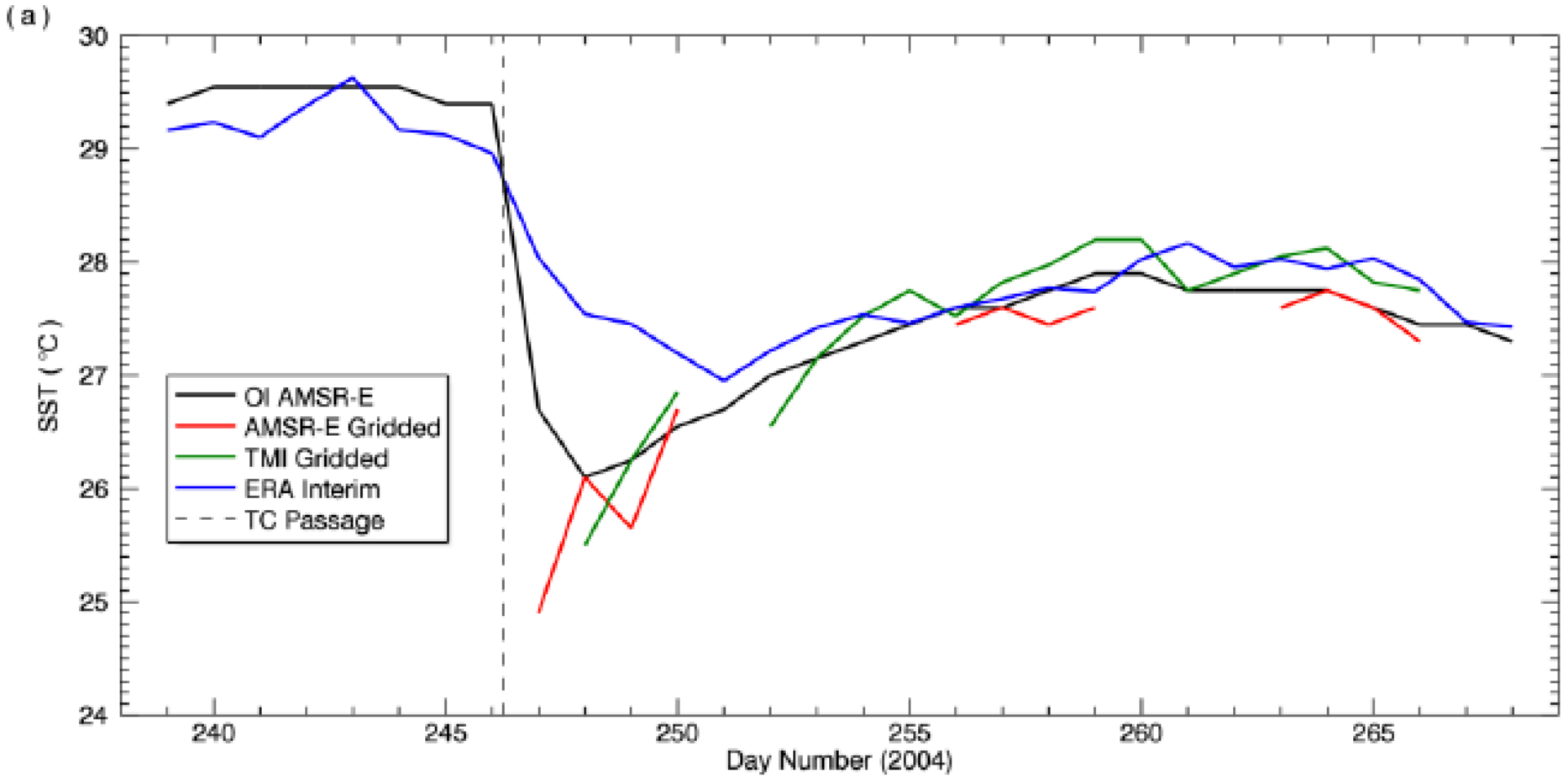
- Atmospheric conditions associated with rapid SST changes
- SST changes are informative of the atmospheric state


MODIS
AMSR-E
SEVIRI
5
0
-5
ΔSST (K)
15
10
5
0
Wind (ms-1)
4.93 MODIS
4.36 SEVIRI
4.05 AMSR-E
6
4
2
0
0
100
200
300
400

Persistent wind minima



Frances' –4.5 K wake



Coupled data assimilation / forecasting

- ECMWF and other NWP centres usually run their forecast systems with fixed SST from an L4 analysis …
- … even though they assimilate radiances sensitive to SST

- Coupled data assimilation is where variables are assimilated into a system representing the coupled dynamics of both atmosphere and ocean

- SST-sensitive radiances could be assimilated
- Or may choose to assimilate SST observations at L2 or L3

Why not L4?

- L4 analyses fill gaps in SST observations by interpolation
- Interpolation method probably incompatible with dynamics represented in the coupled model
- If L4 were assimilated this would unrealistically constrain the model
- E.g., L4s smooth over the diurnal warming and tropical cyclone signatures in the ocean

Assumptions of this talk

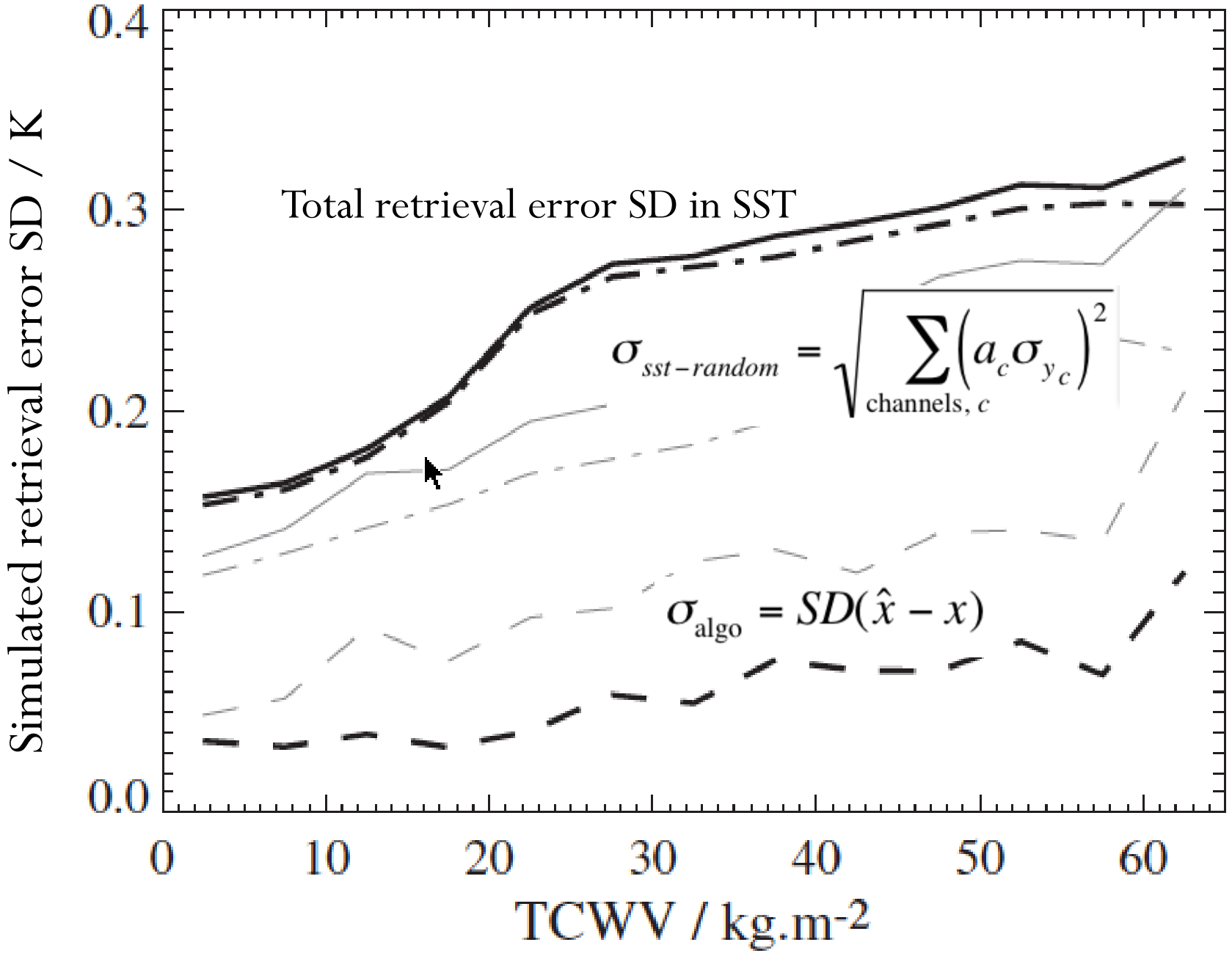
- To be weighted appropriately within the coupled assimilation system, satellite SSTs need realistic uncertainty information

- My view:

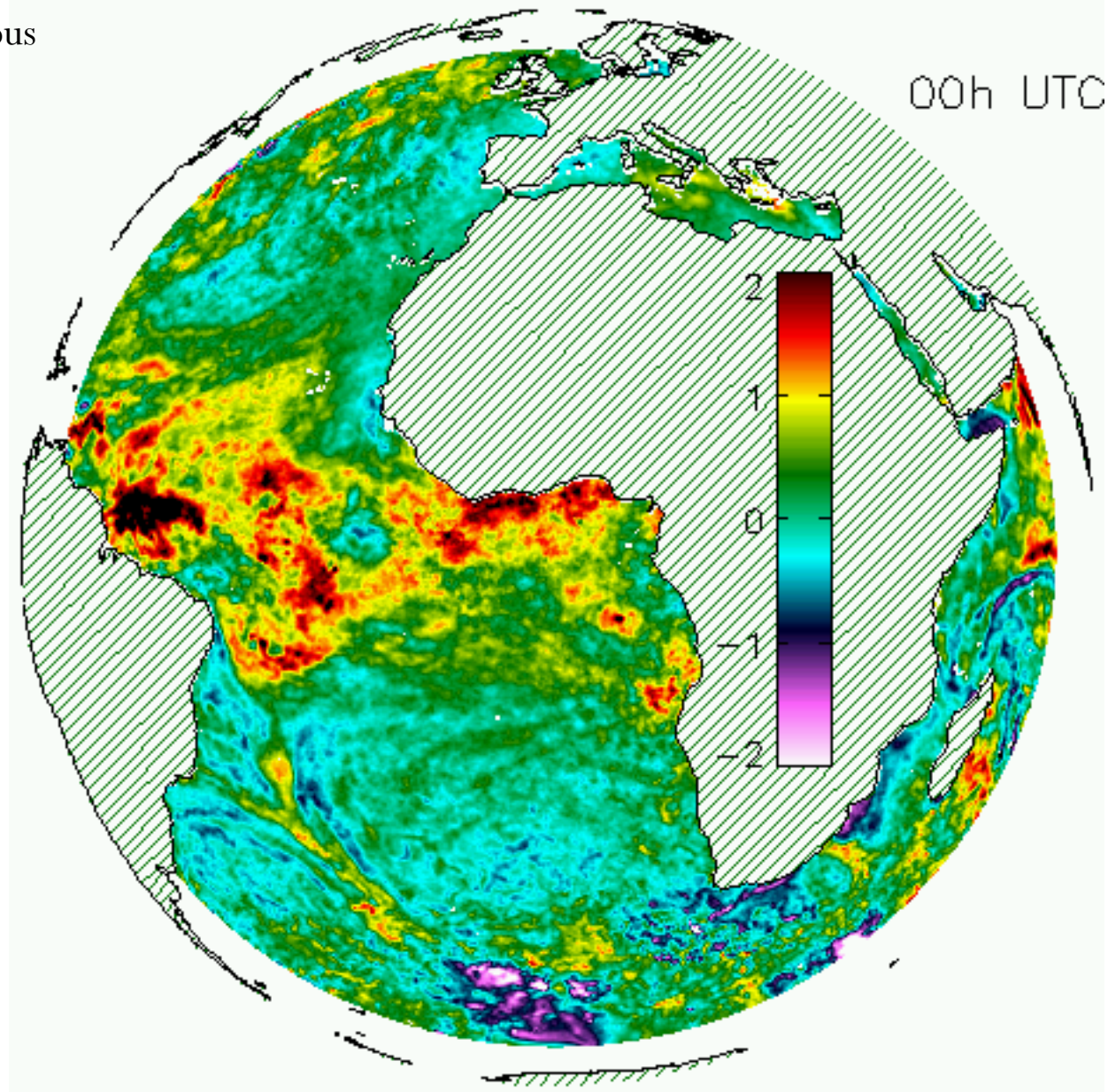
- SSES aren't adequate
- Need observation specific uncertainty
- Need to know about (auto) correlated effects

Components of SST uncertainty

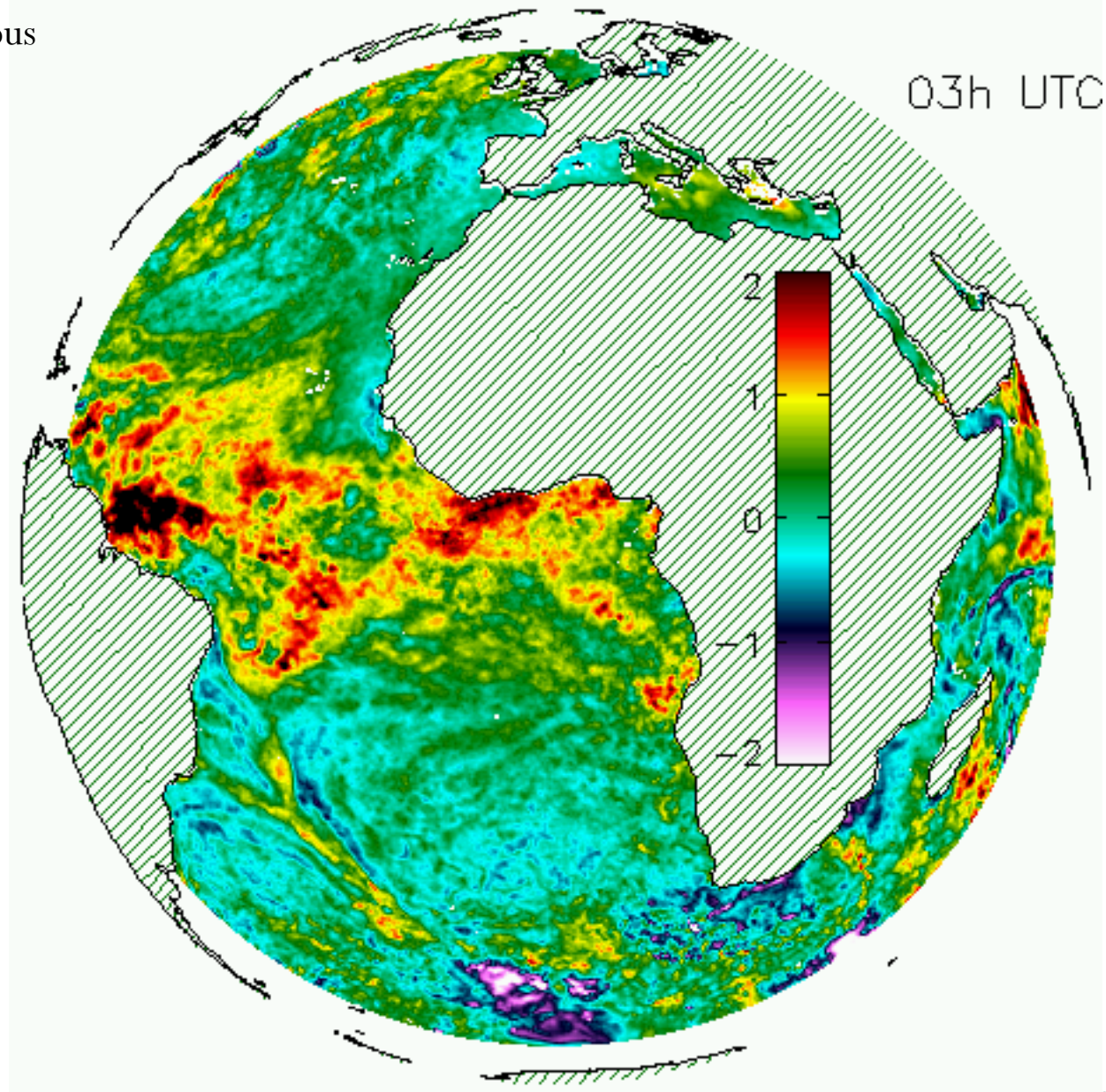
- Radiometric noise
  - Usually random (but variable)
  - $1/\sqrt{n}$ averaging over n pixels
- Algorithmic
  - Geographically systematic component
  - Variable component usually correlated on synoptic scales
  - This variable component averages differently $\neq 1/\sqrt{n}$
- Sampling (in L3)
  - Spatial sub-sampling (only clear sky) -- representativity
  - Time within diurnal cycle of SST
- Outliers (cloud, aerosol problems)


Total retrieval error SD in SST
$\sigma_{sst-random} = \sqrt{\sum_{\text{channels, } c} \left(a_c \sigma_{y_c}\right)^2}$
$\sigma_{\text{algo}} = SD(\hat{x} - x)$
Simulated retrieval error SD / K
0.0
0.1
0.2
0.3
0.4
0
10
20
30
40
50
60
TCWV / kg.m^{-2}

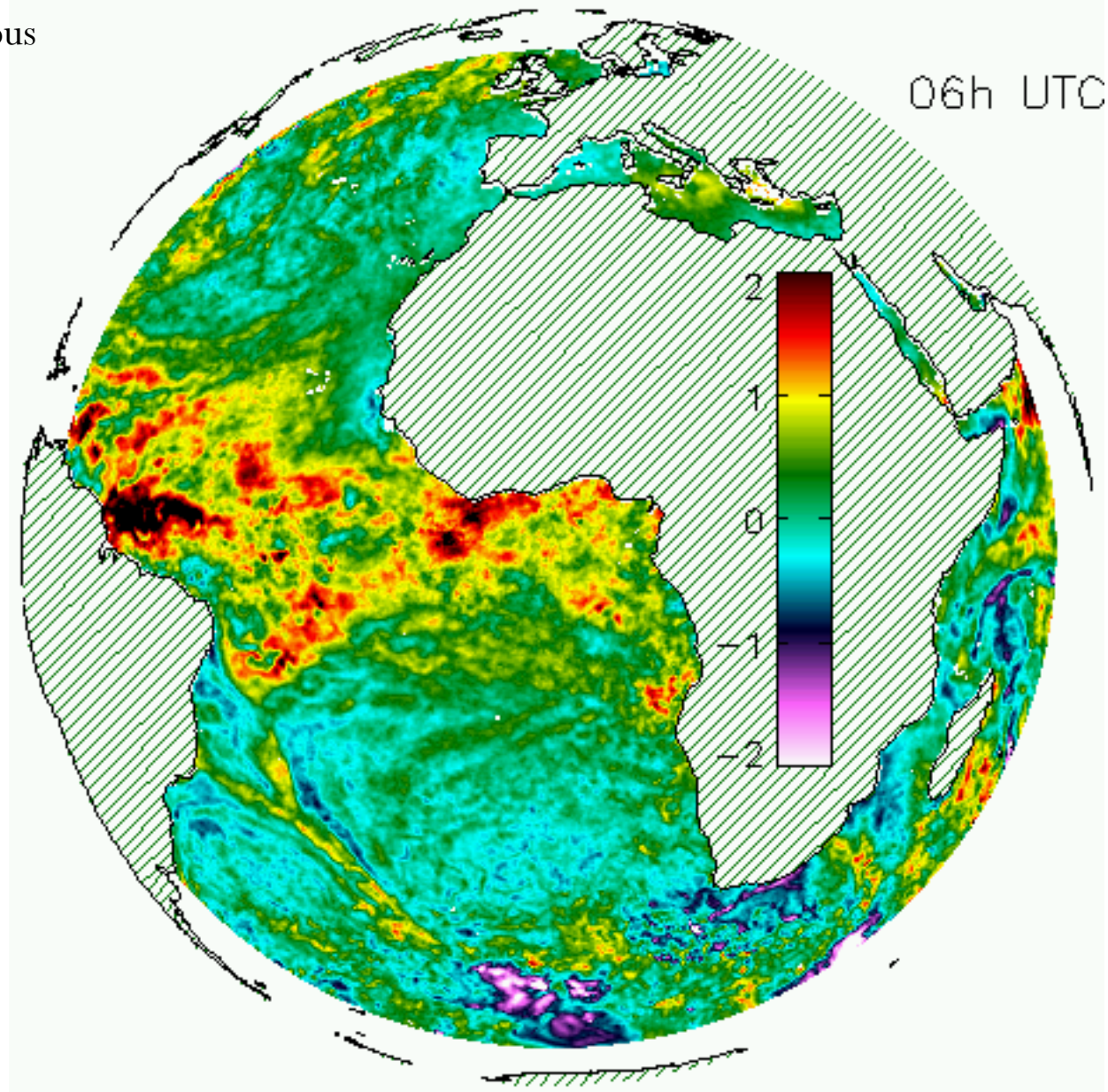
Instantaneous simulation of retrieval error



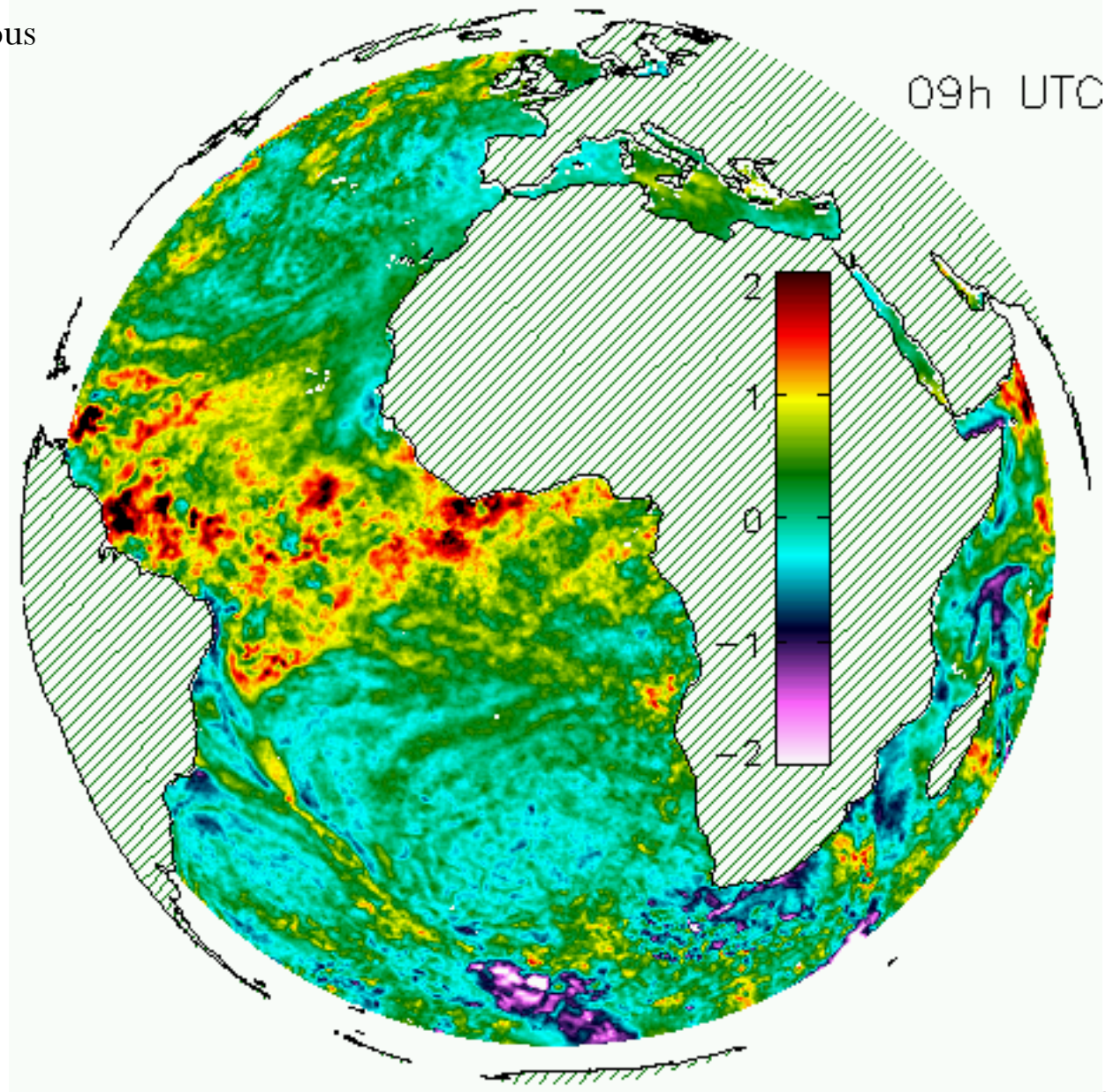
Instantaneous simulation of retrieval error



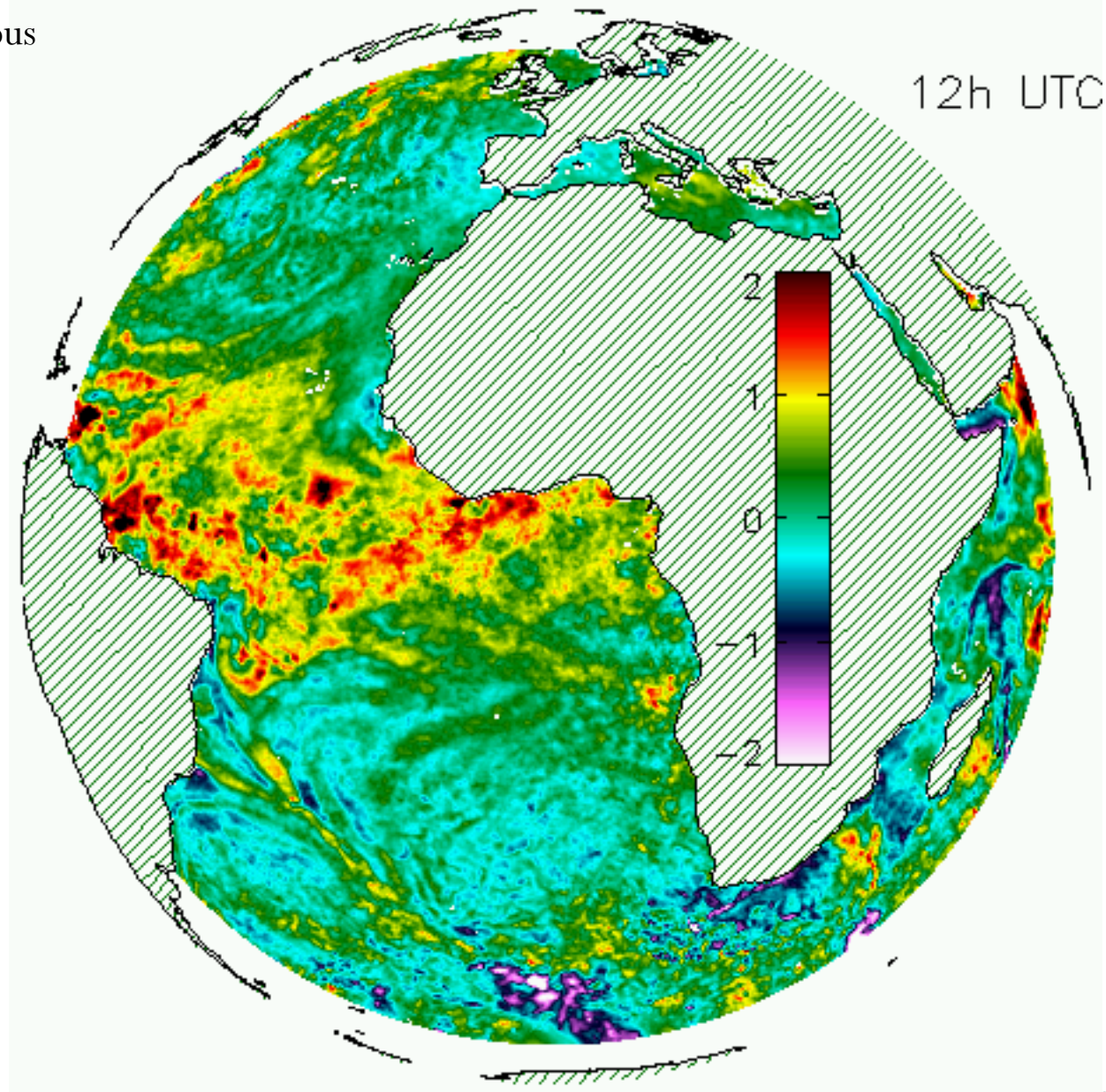
Instantaneous simulation of retrieval error



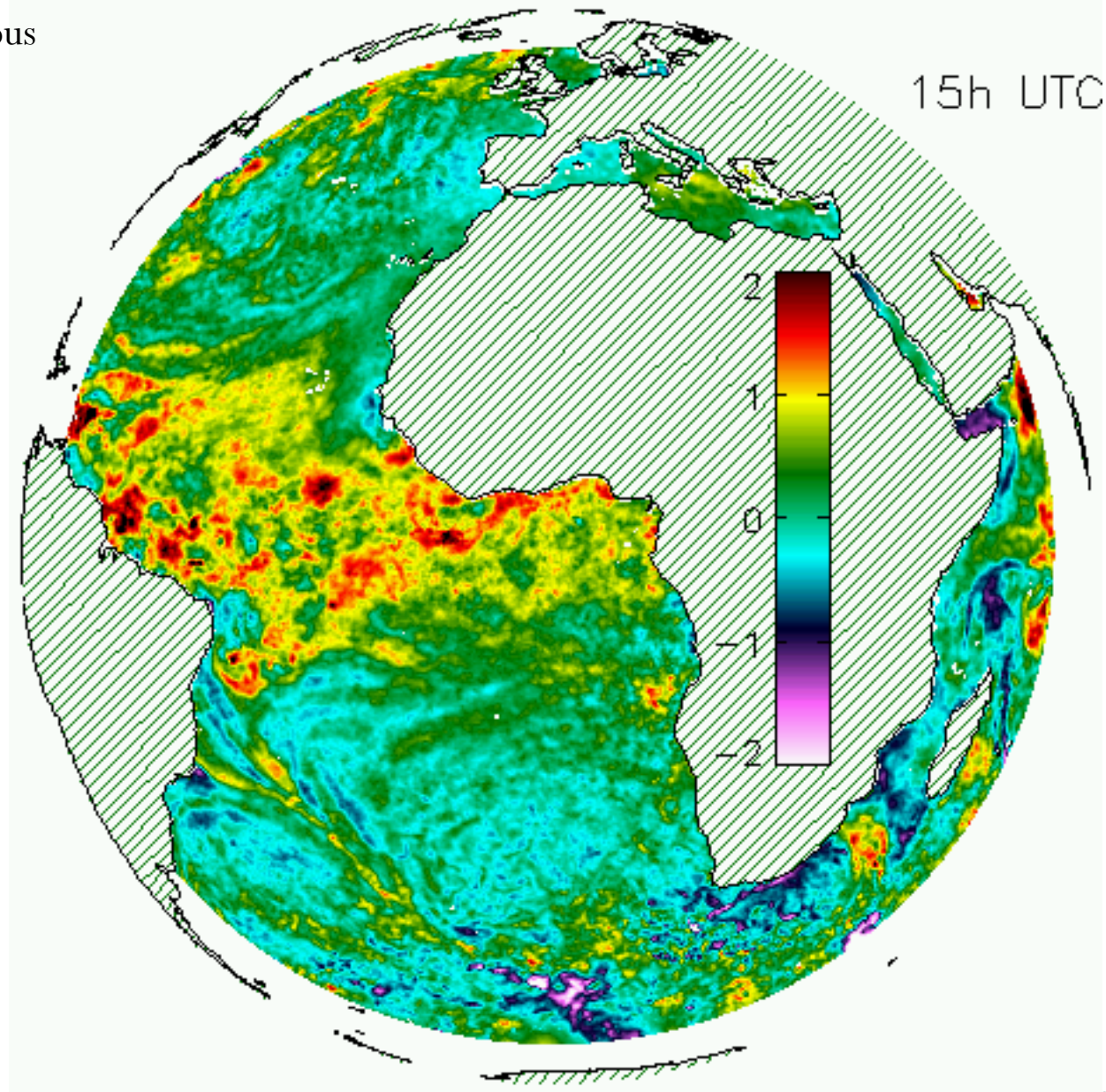
Instantaneous simulation of retrieval error



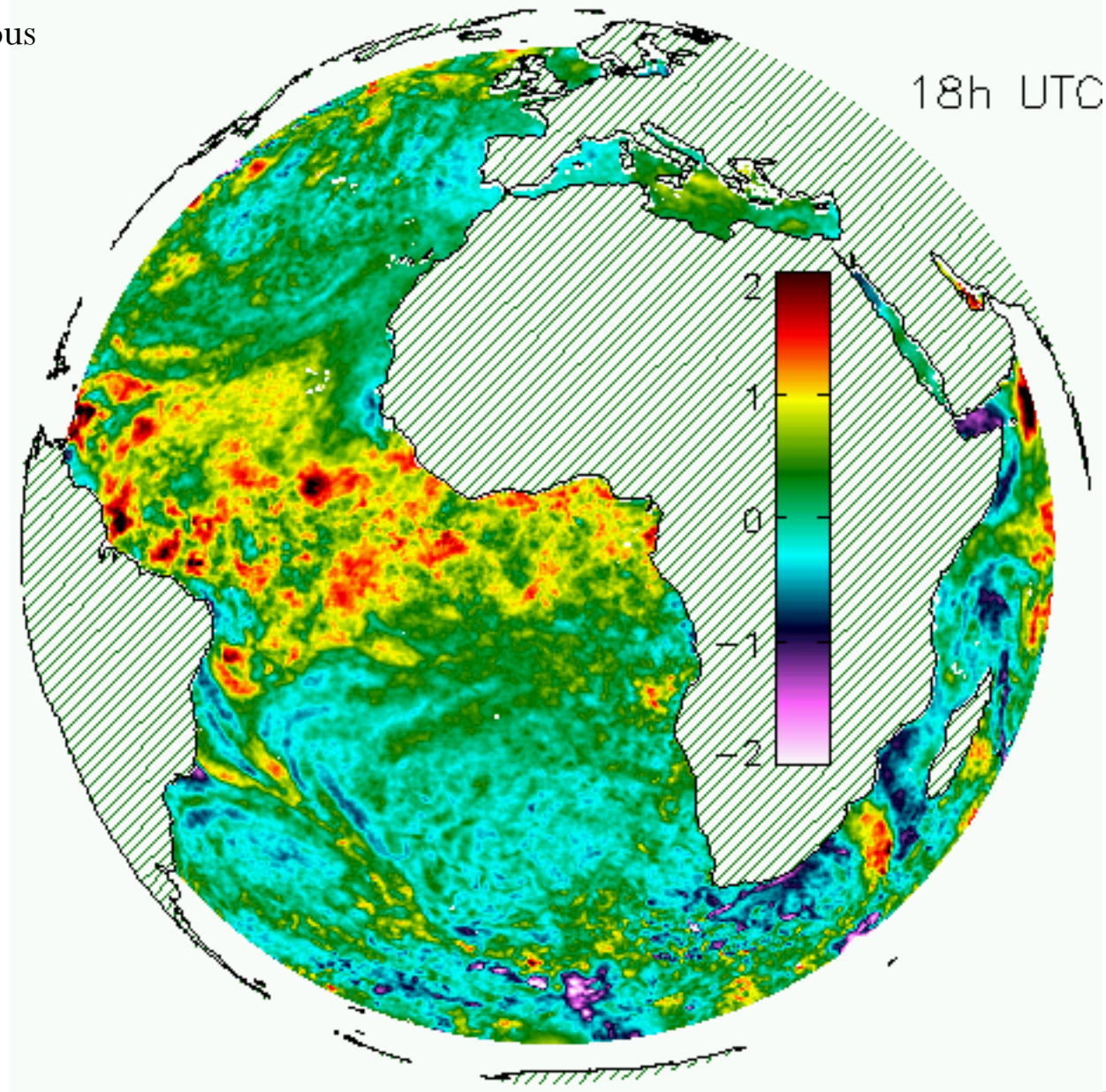
Instantaneous simulation of retrieval error

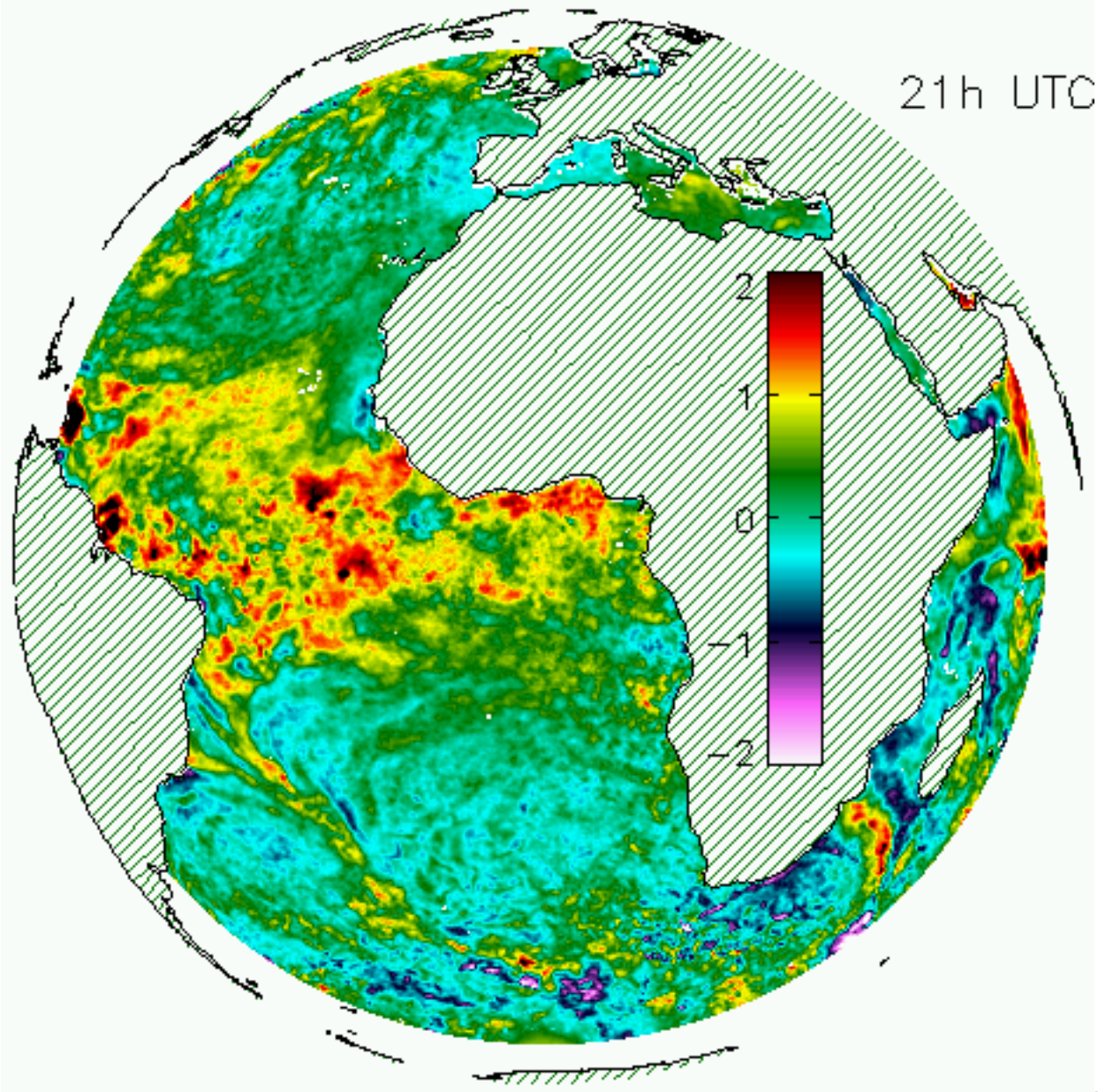


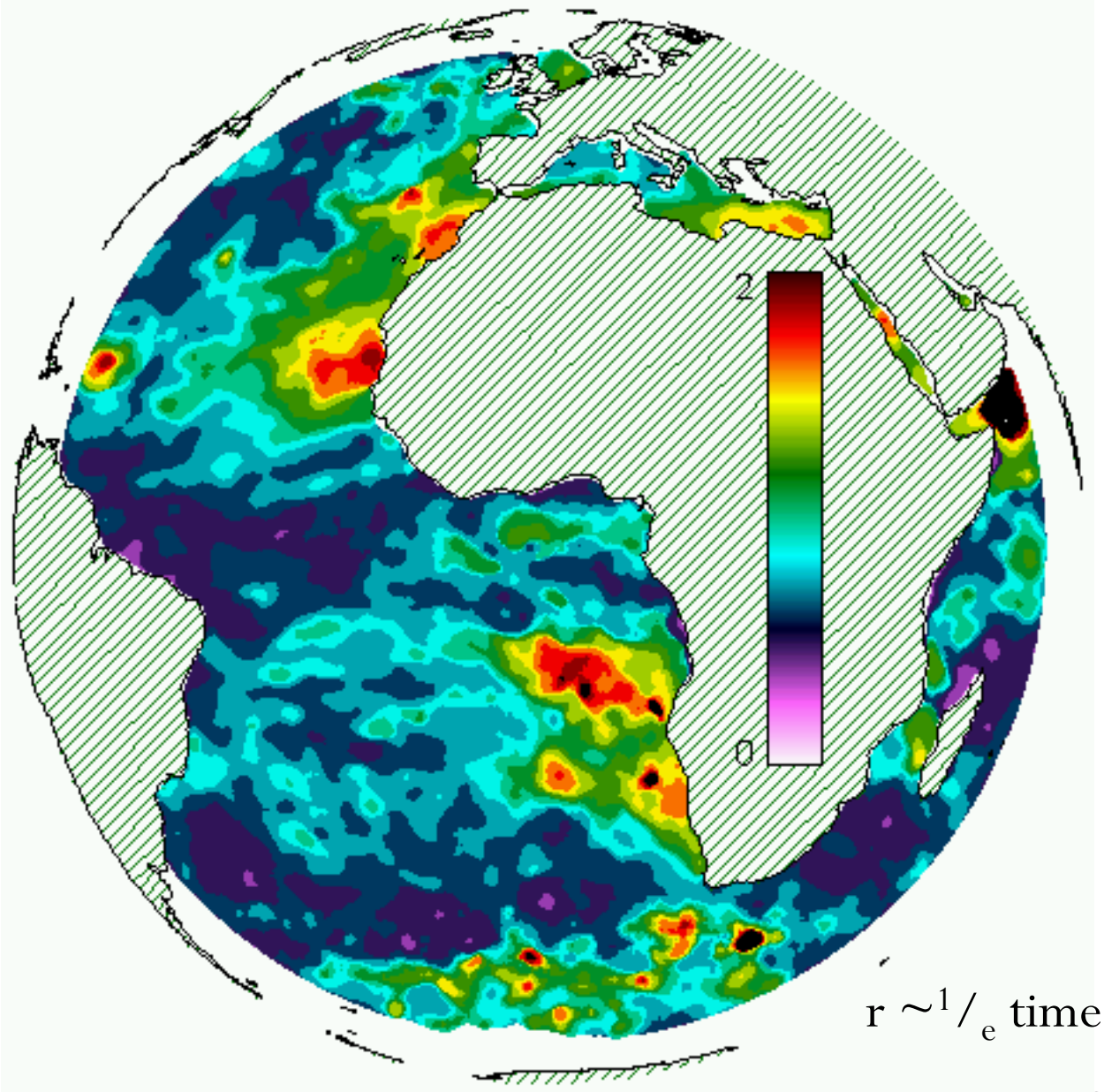
Instantaneous simulation of retrieval error



Instantaneous simulation of retrieval error




21h UTC
2
1
0
−1
−2



r ~ $^{1}/_{e}$ timescale / days

SST observation error correlations

- Very little work I am aware of on this
- Can simulate these for IR coefficient retrievals
- Not sure how to do this for incremental methods
- Anything done on MW SSTs?

Final points

- One approach to CDA is assimilation of L2 and L3 SSTs
- L4 analysis tends to smooth over SST signatures of coupled phenomena
- Context specific uncertainty in SST is needed to weight observations properly – **what form should it take? is the SST CCI approach useful?**
- (Auto)correlation information about SST observation errors – **what form should it take? would GHRSST customers actually use it? how are data producers going to characterise it?**