# Sea surface temperature UNCERTAINTY ESTIMATES AND coupled FORECASTING

Chris Merchant
Chris Old
Keith Haines
Gary Corlett

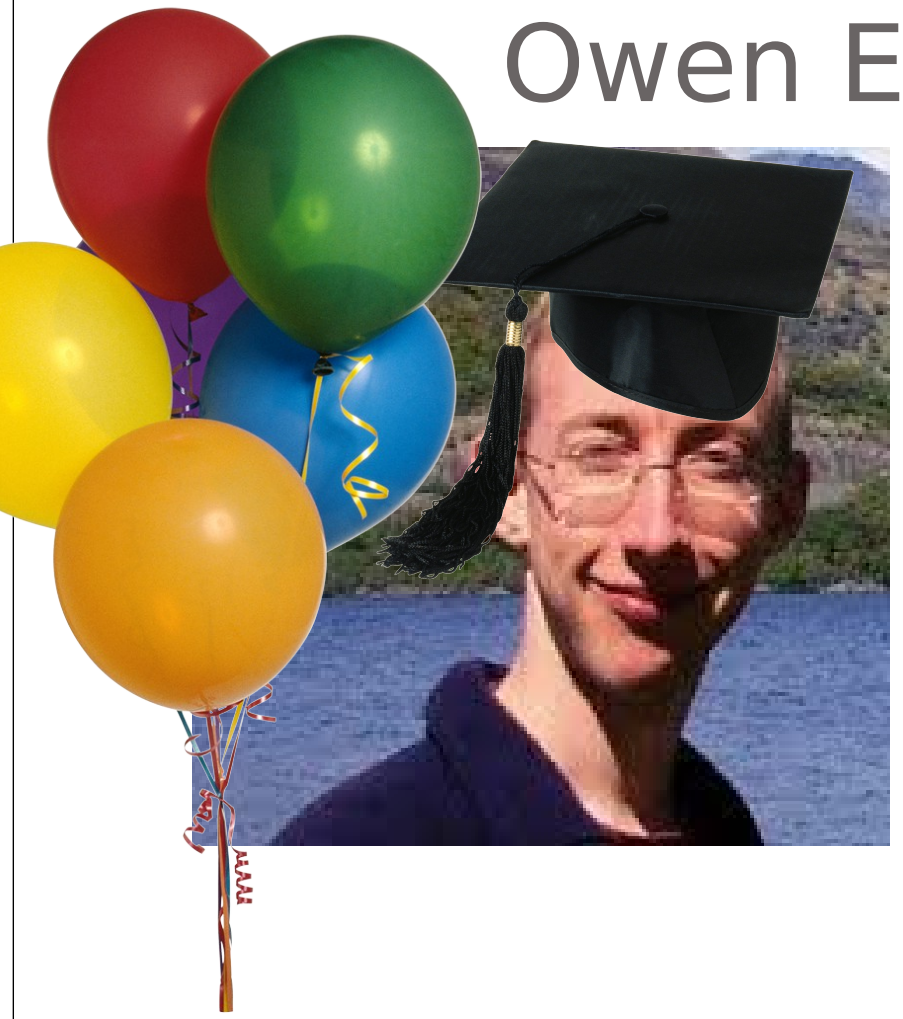
University of Reading

National Centre for Earth Observation
NATURAL ENVIRONMENT RESEARCH COUNCIL

sst cci

# Owen Embury

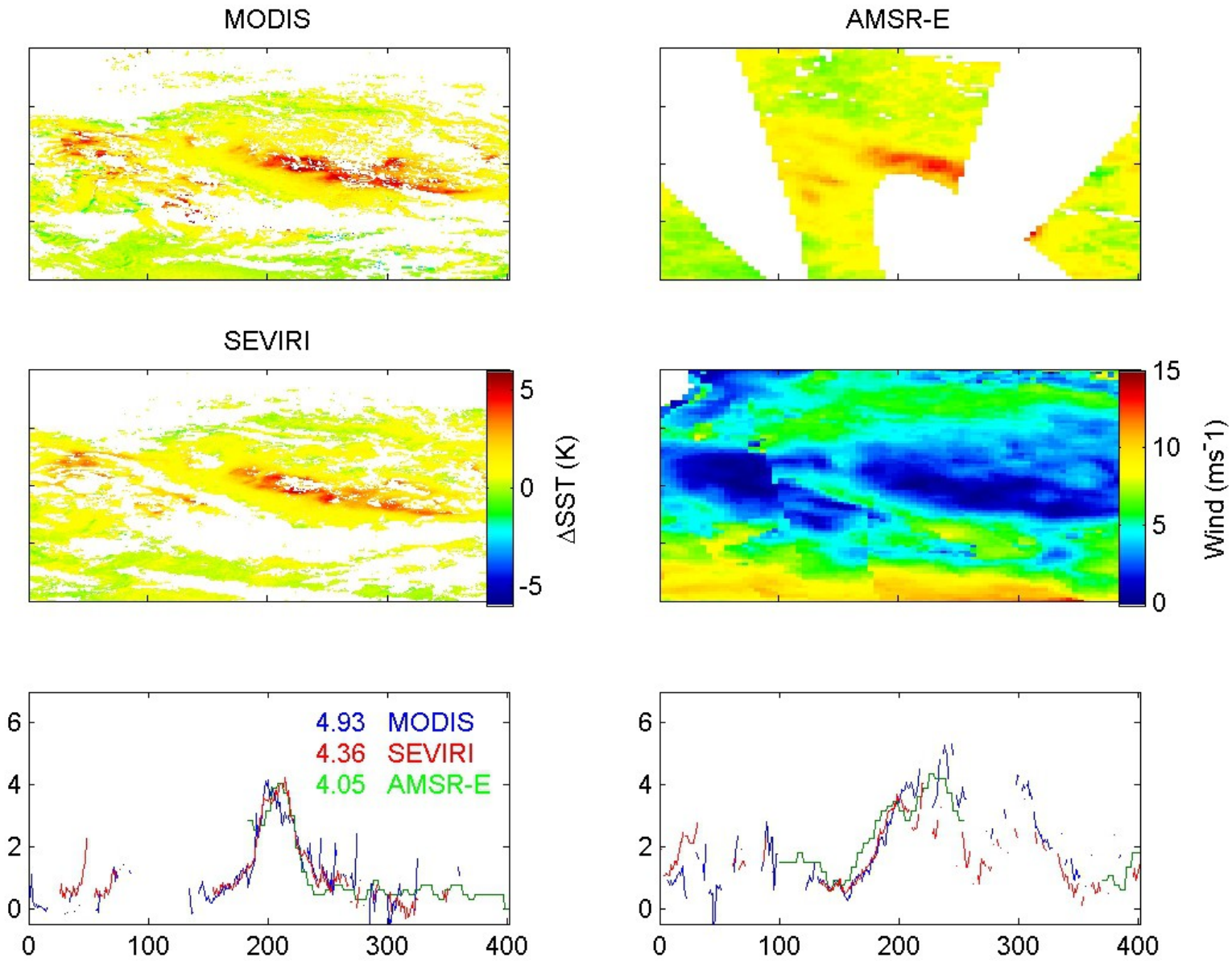
# Owen Embury ...



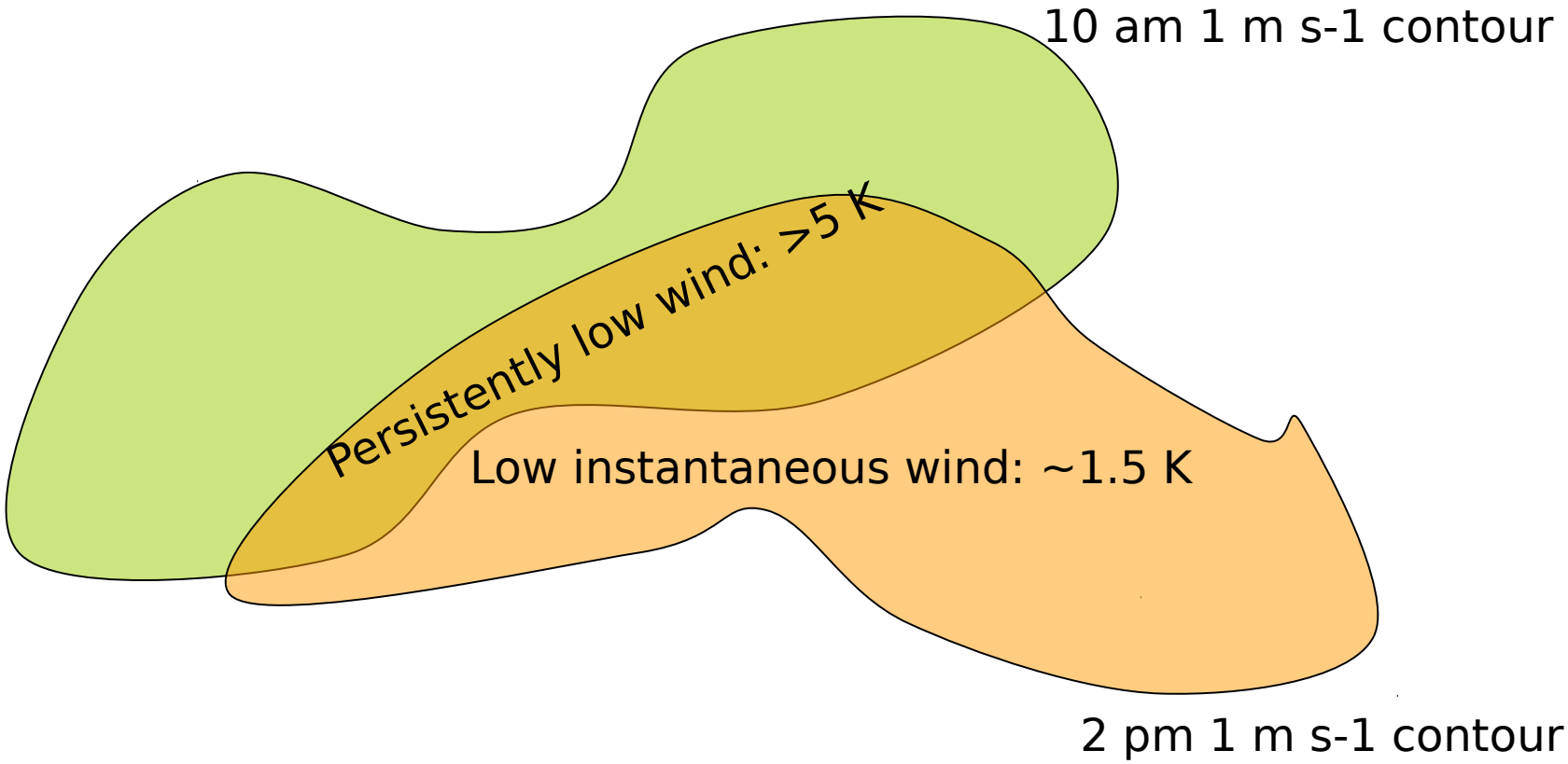
... submitted his PhD thesis 4 hours ago

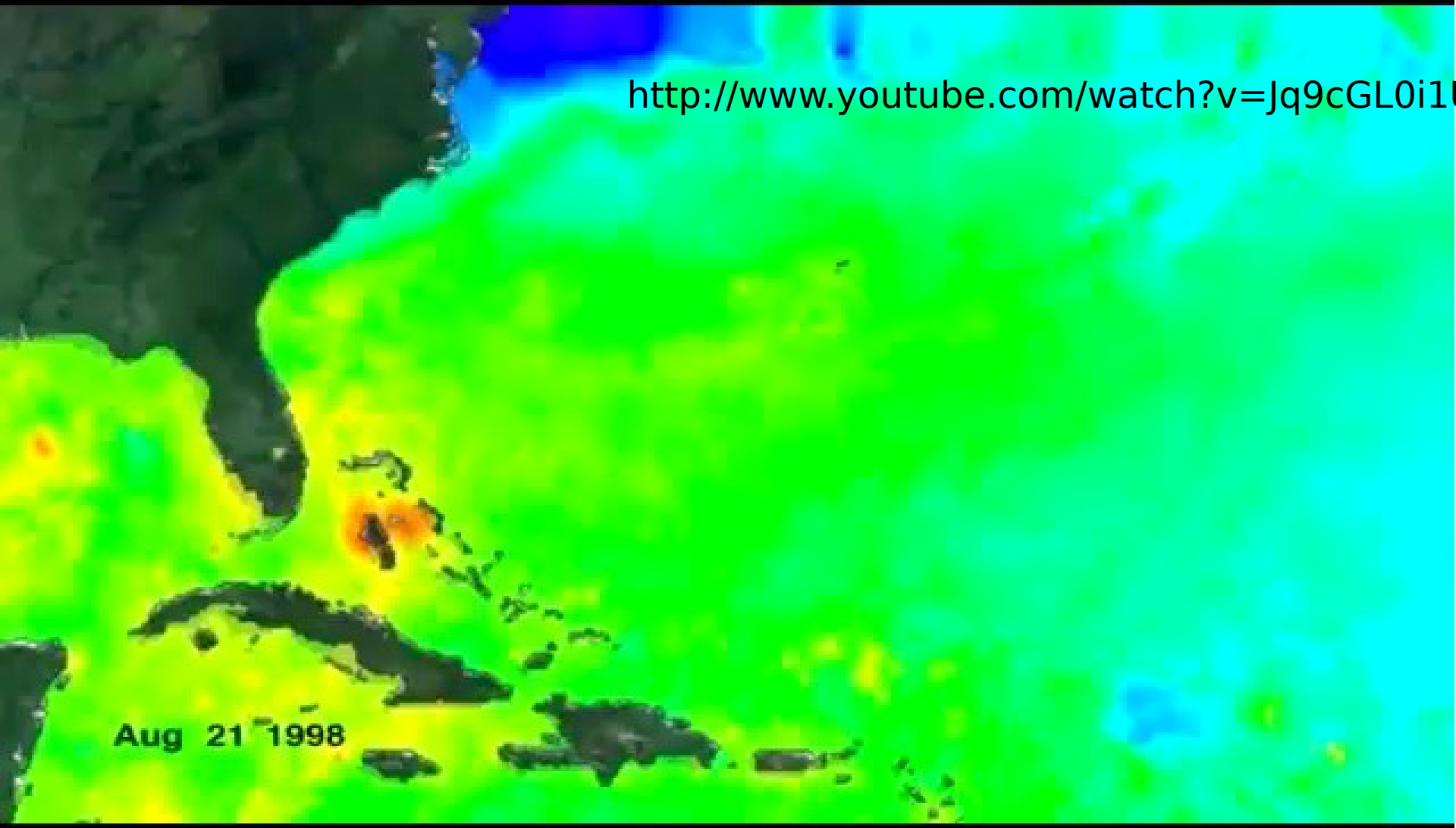
Atmospheric conditions associated with rapid SST changes

SST changes are informative of the atmospheric state

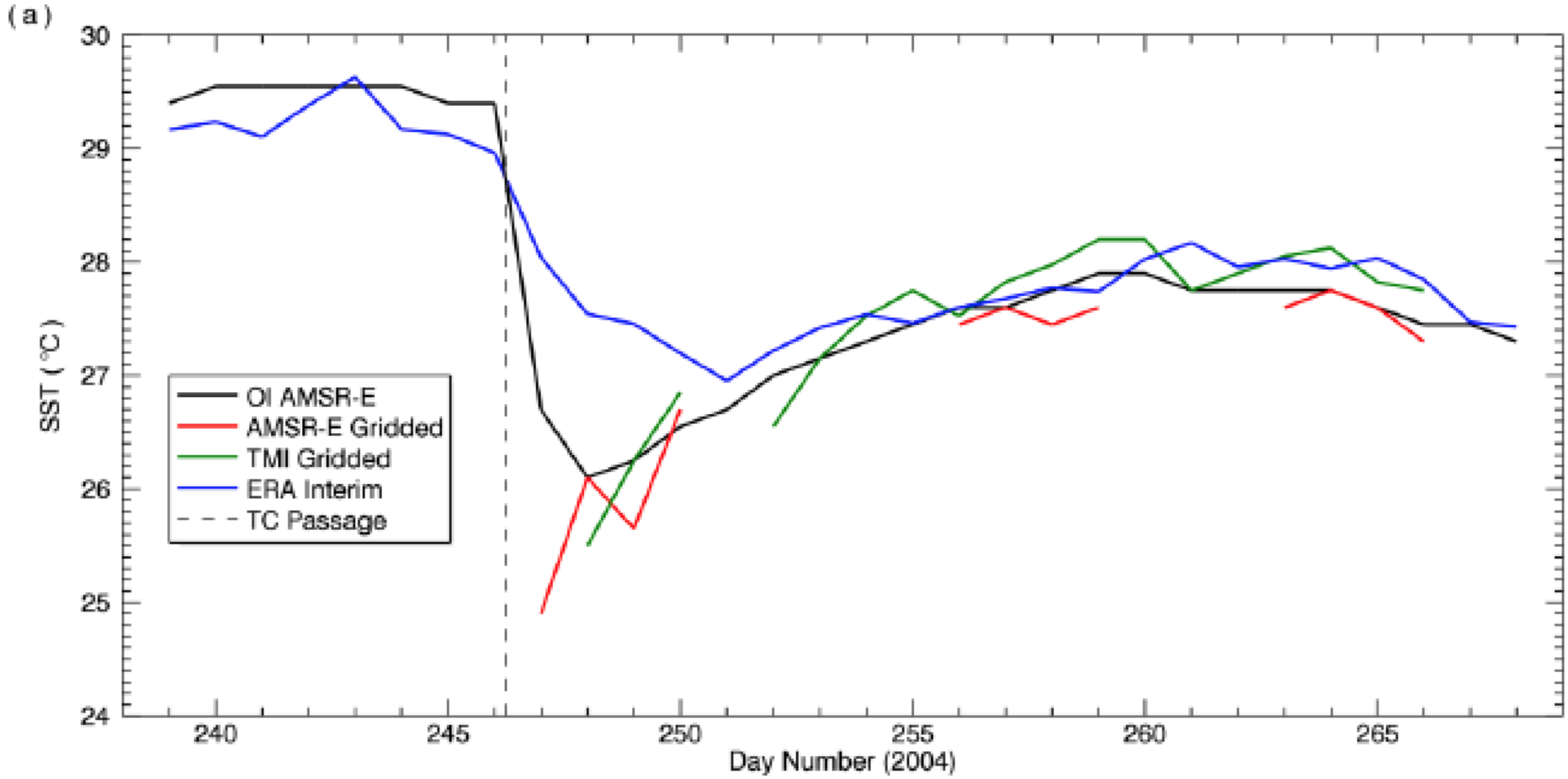

MODIS
AMSR-E
SEVIRI
5
0
-5
ΔSST (K)
15
10
5
0
Wind (ms-1)
4.93 MODIS
4.36 SEVIRI
4.05 AMSR-E
6
4
2
0
0
100
200
300
400

# Persistent wind minima




http://www.youtube.com/watch?v=Jq9cGL0i1U
Aug 21 1998

# 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

# 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:

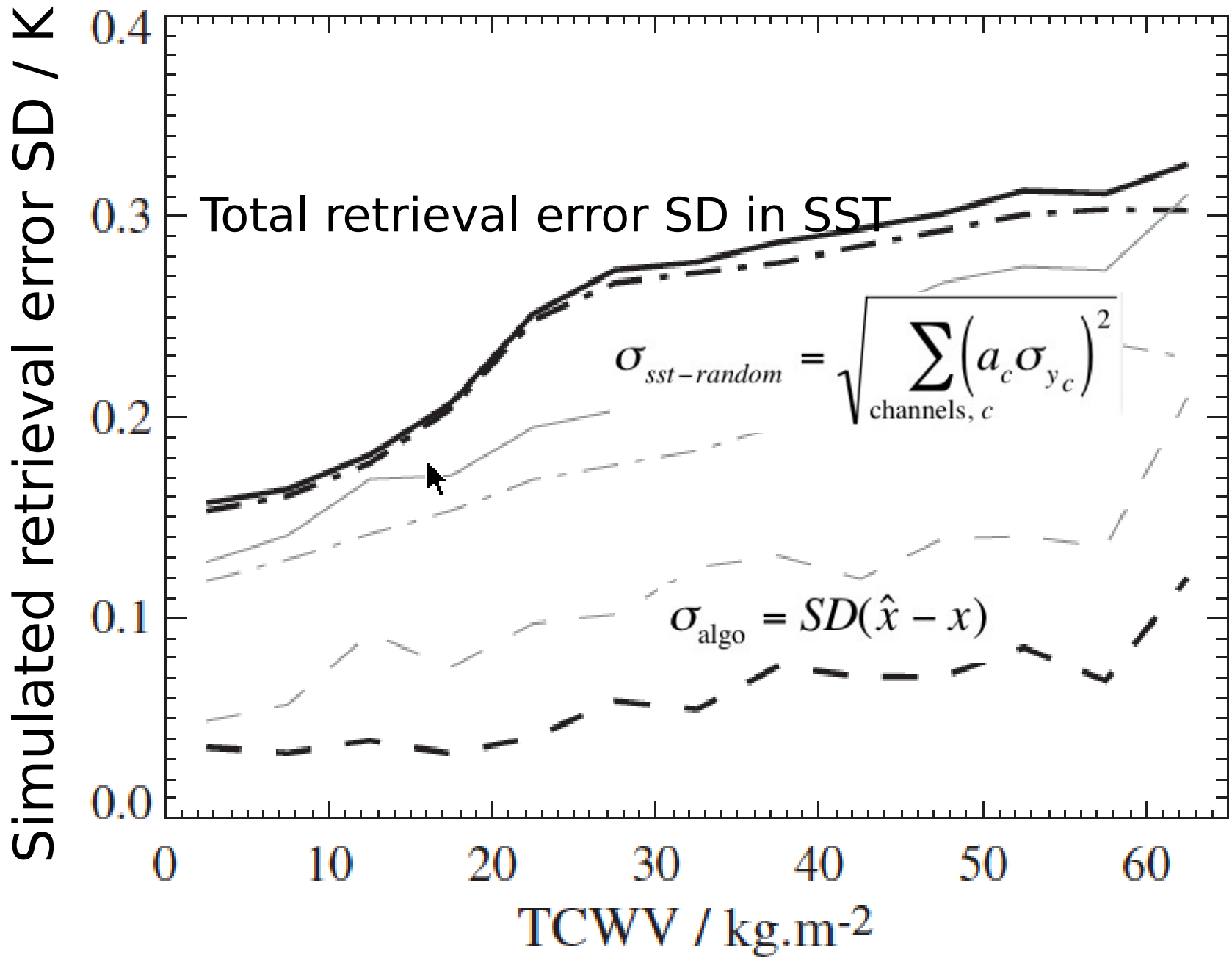
SSES aren’t adequate

Need observation specific uncertainty

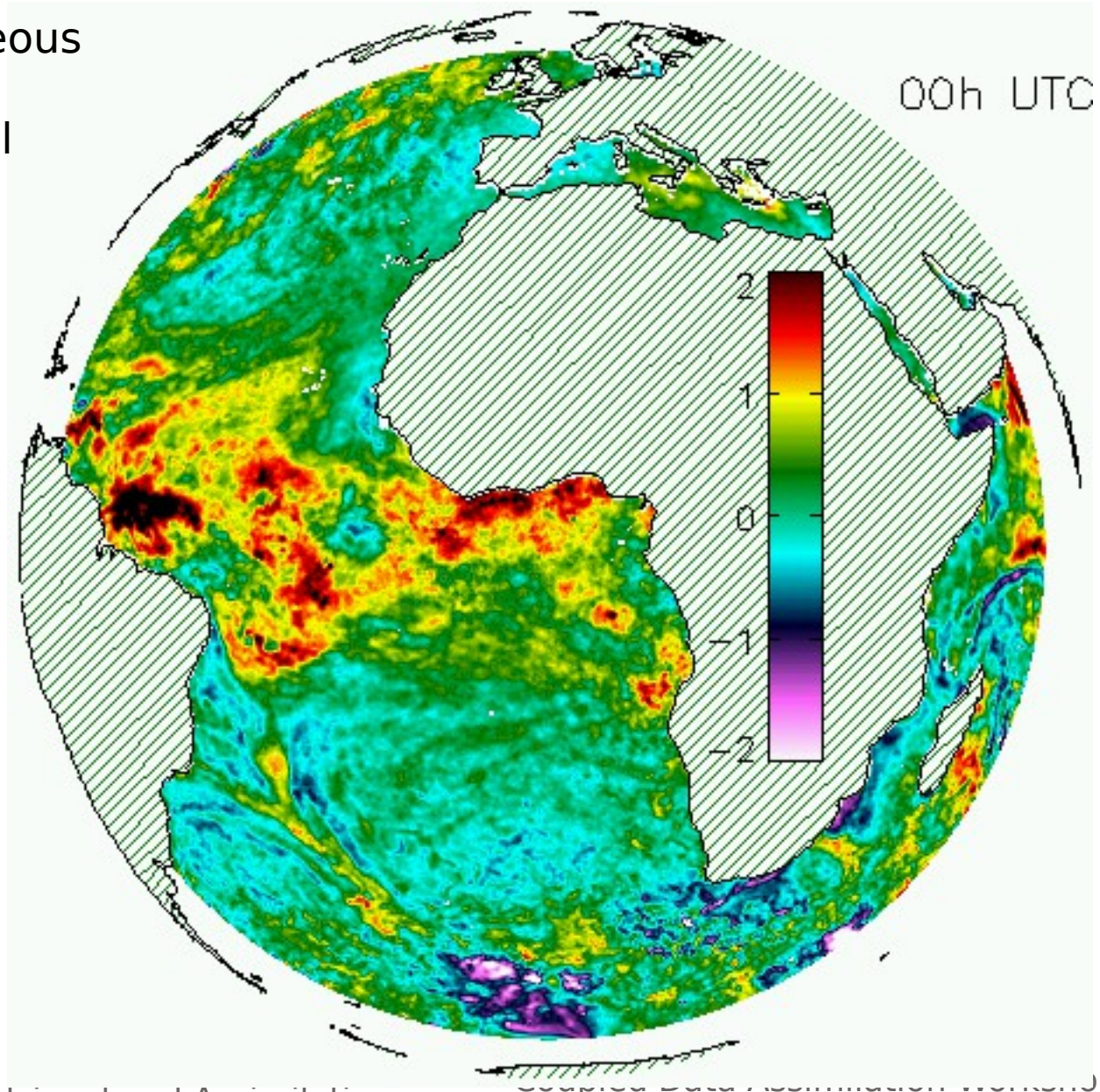
Need to know about (auto) correlated effects

## Components of SST uncertainty

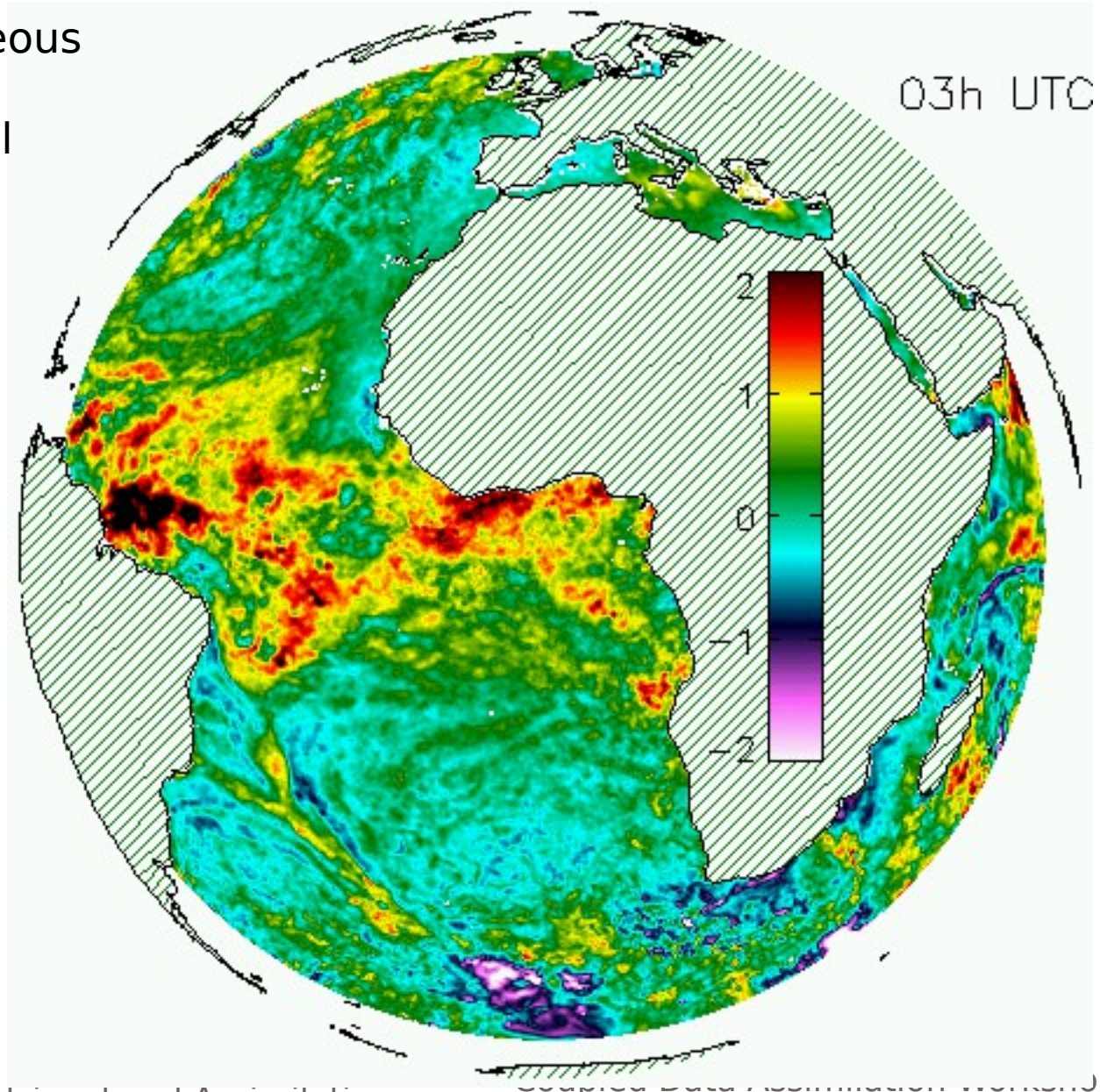
- Radiometric noise
  - Usually random (but variable)
  - $1/\sqrt{n}$ averaging over n pixels
- Algorithmic
  - Geographically systematic component
  - Variable component usually correlated on synoptic scales
  - This variable component averages differently $\neq 1/\sqrt{n}$
- Sampling (in L3)
  - Spatial 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

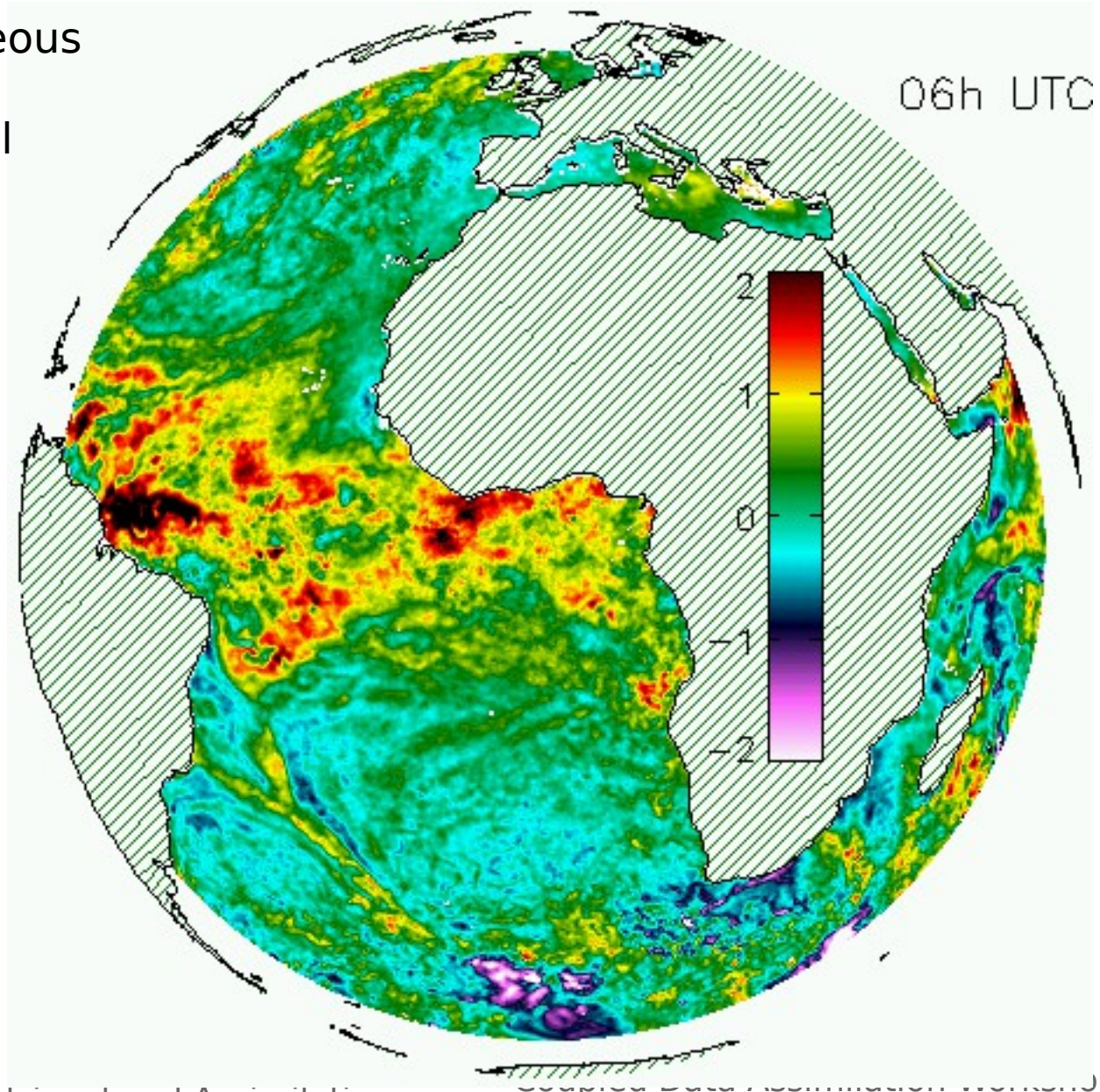
Instantaneous simulation of retrieval error



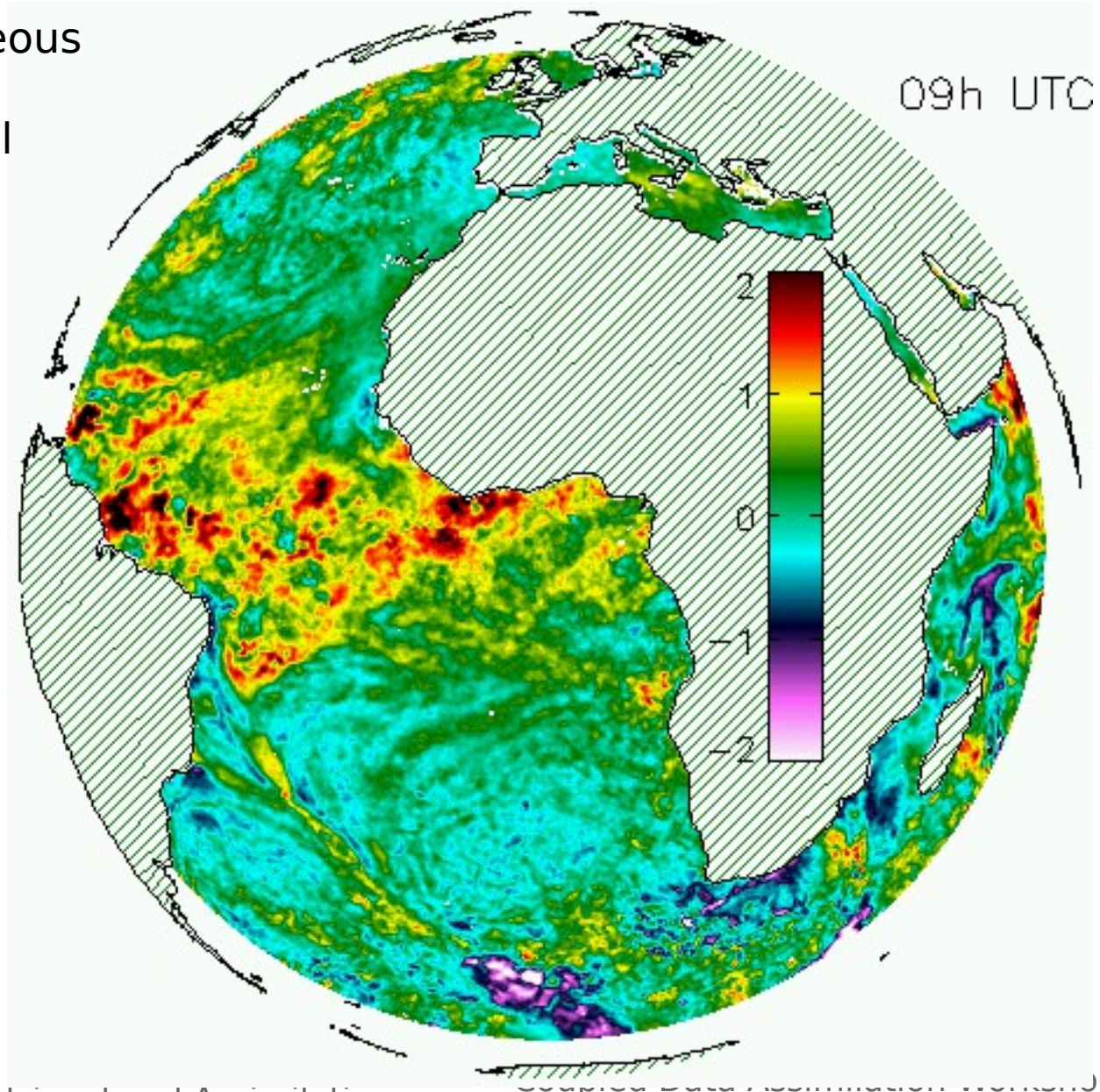
Instantaneous simulation of retrieval error



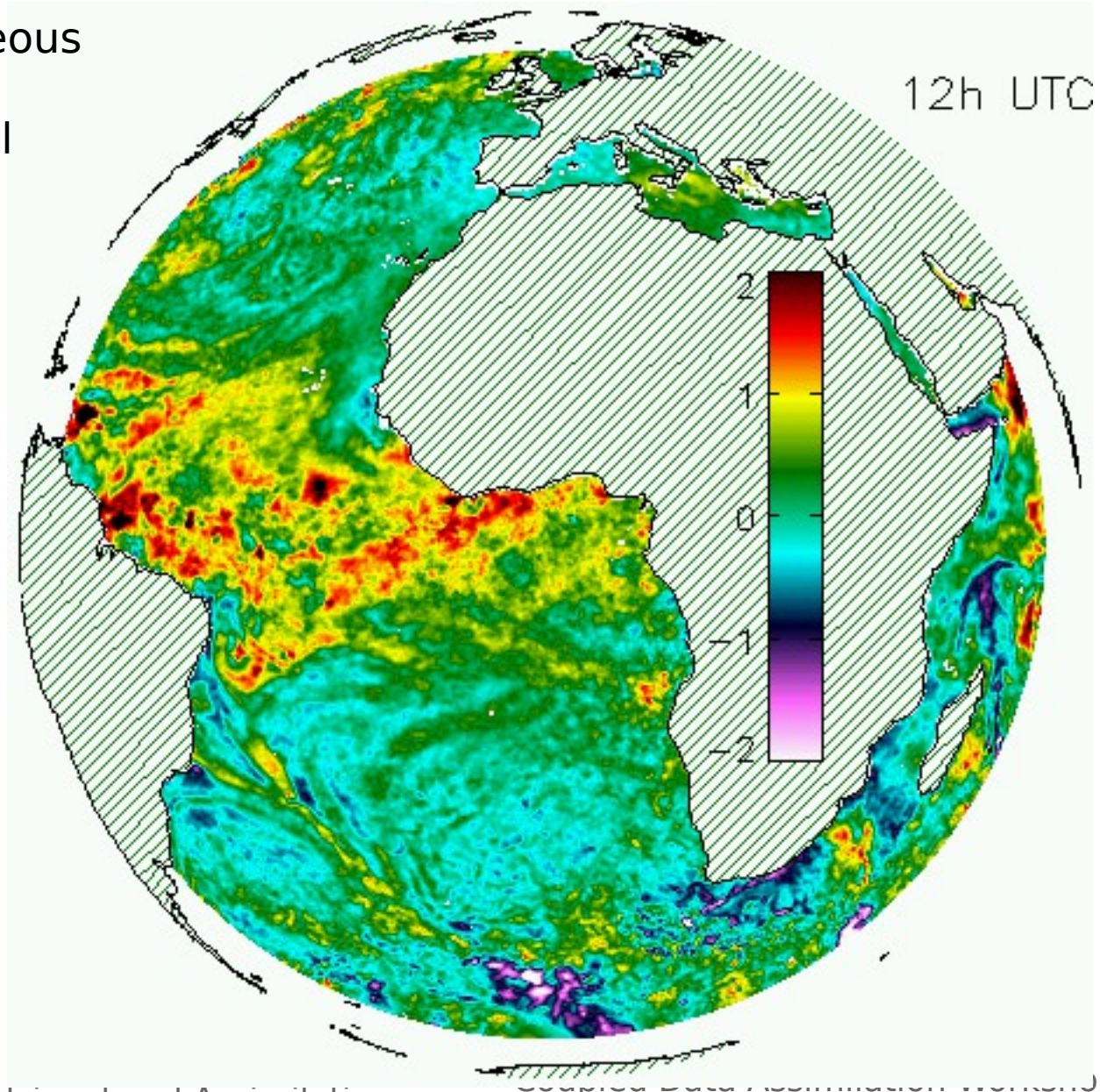
Instantaneous simulation of retrieval error



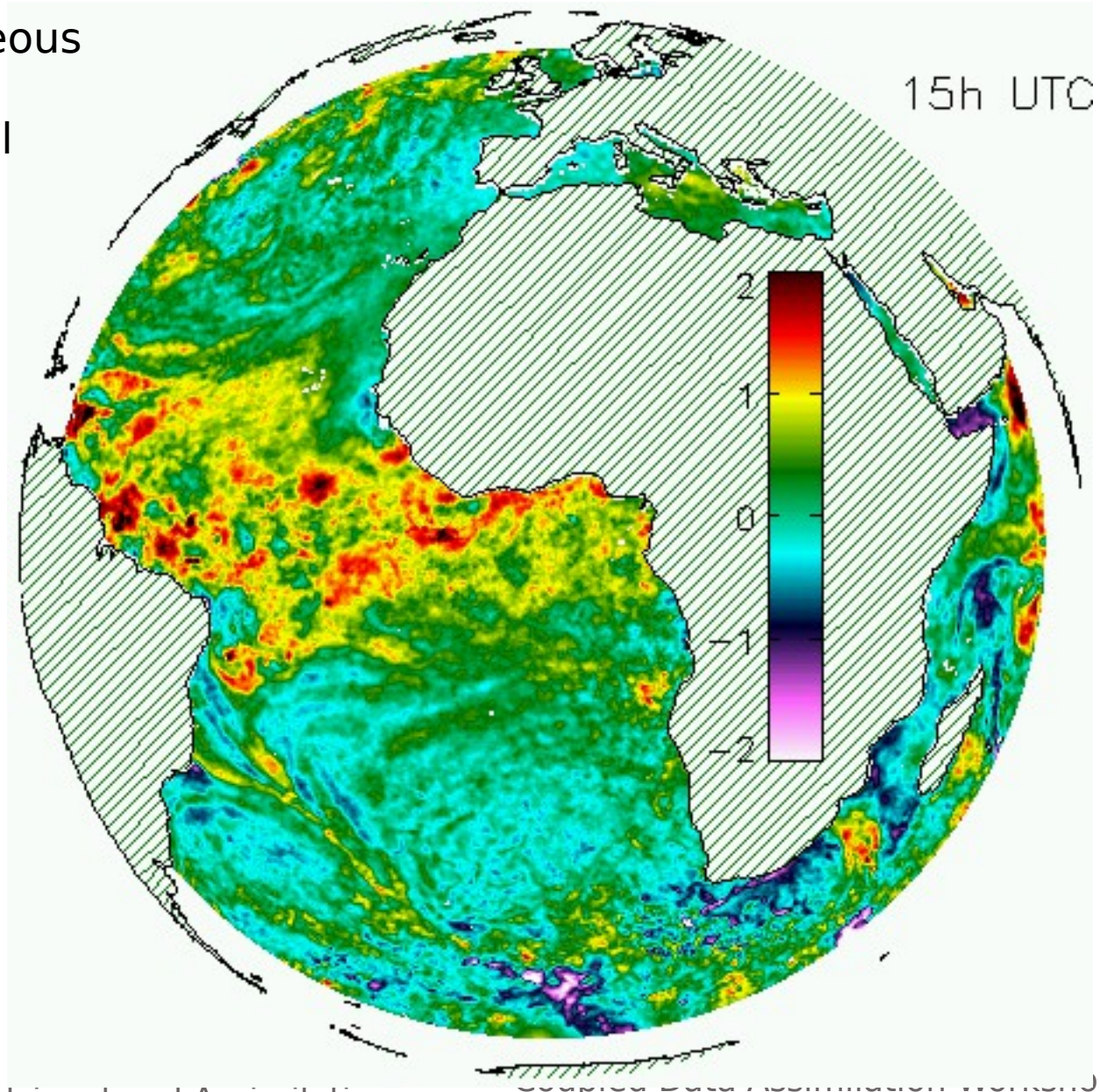
Instantaneous simulation of retrieval error



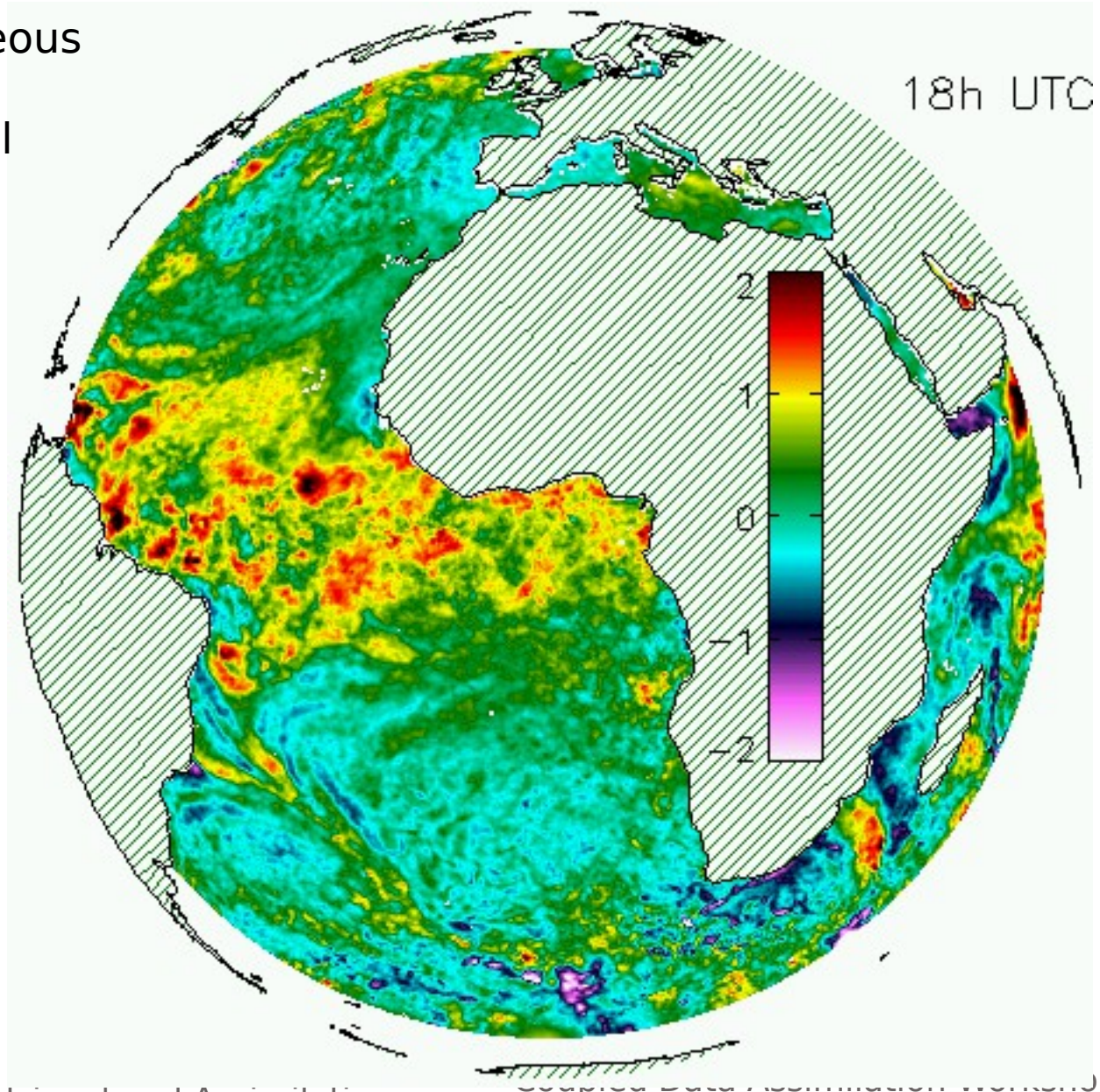
Instantaneous simulation of retrieval error

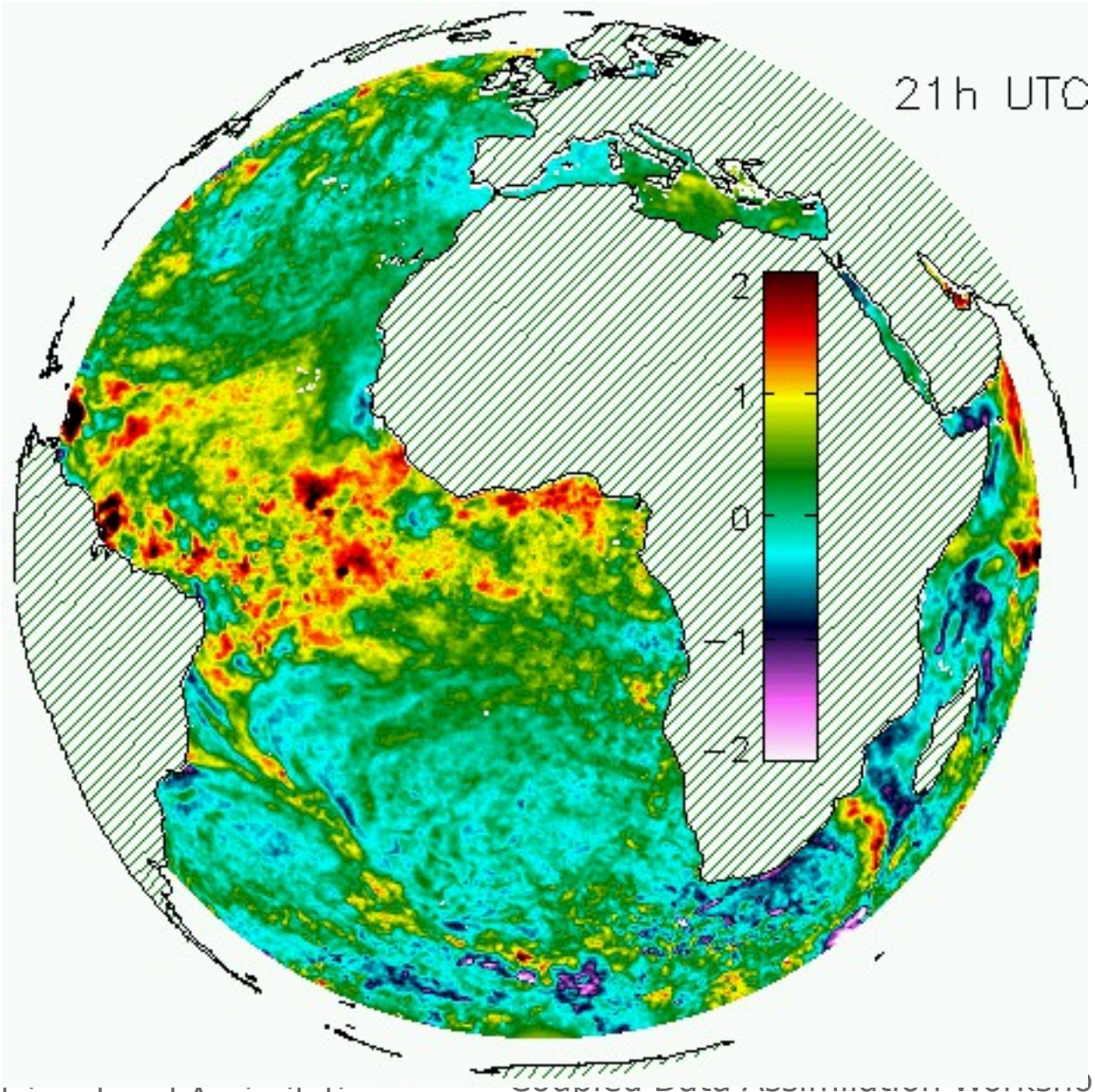


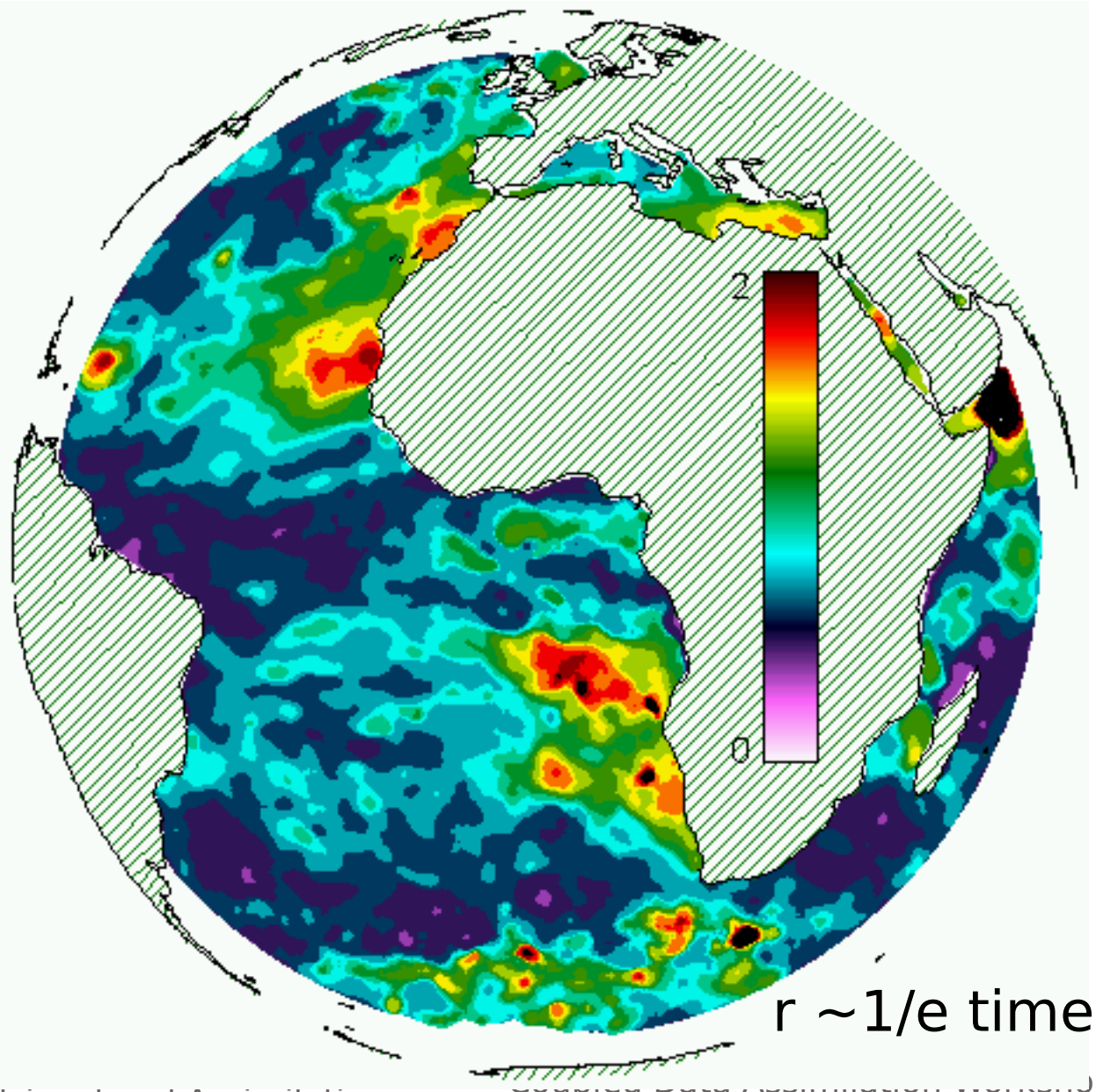
Instantaneous simulation of retrieval error



Instantaneous simulation of retrieval error




21h UTC
2
1
0
−1
−2




r ~1/e timescale / day

# 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?**