Preliminary Validation
TOPAZ - Gulf of Mexico

(Nuts and Bolts)

Dave Szabo

HYCOM NOPP GODAE Meeting

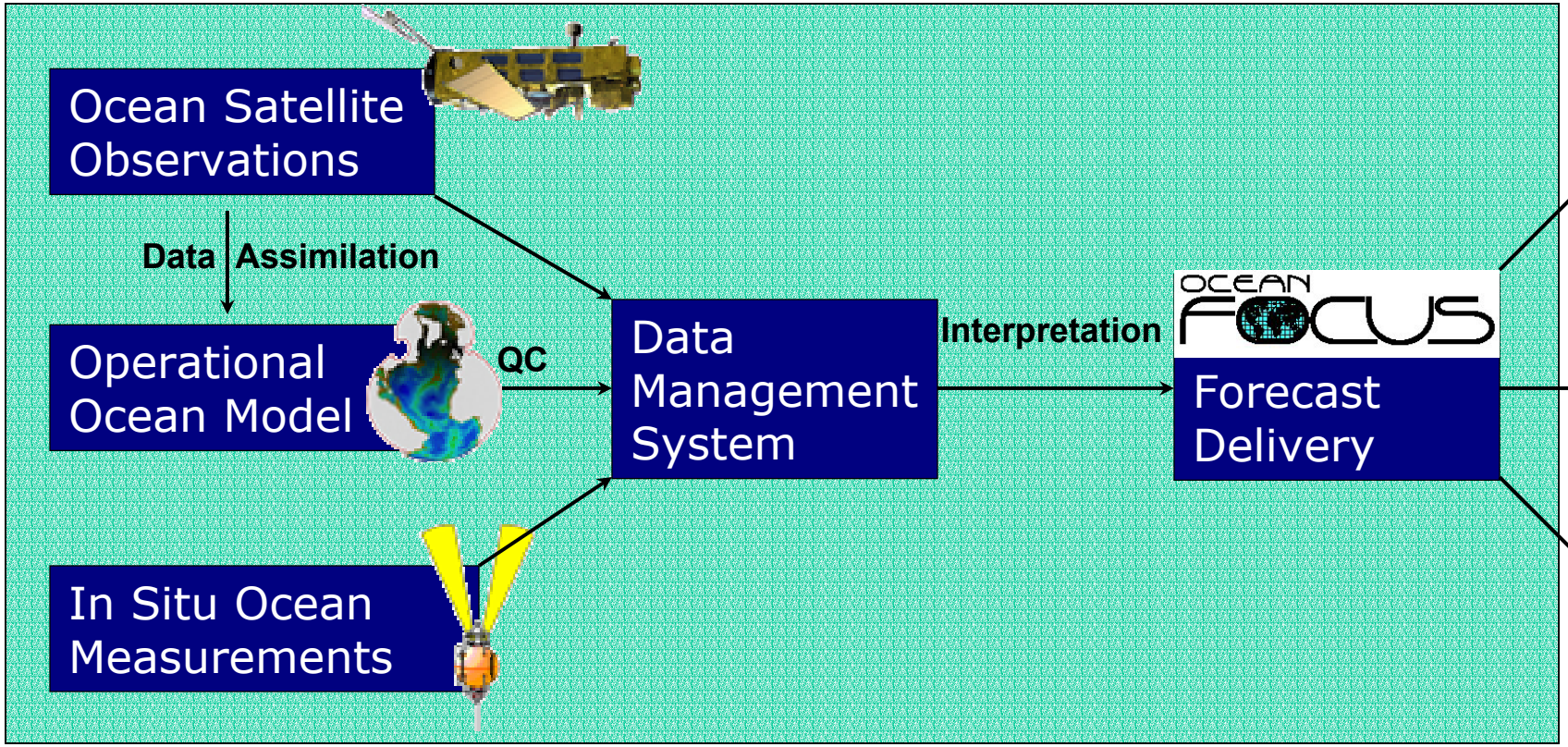
27-29 October 2004

Ocean FOCUS

Ocean FOCUS is a current advisory service using primarily satellite charts and the TOPAZ current forecast model

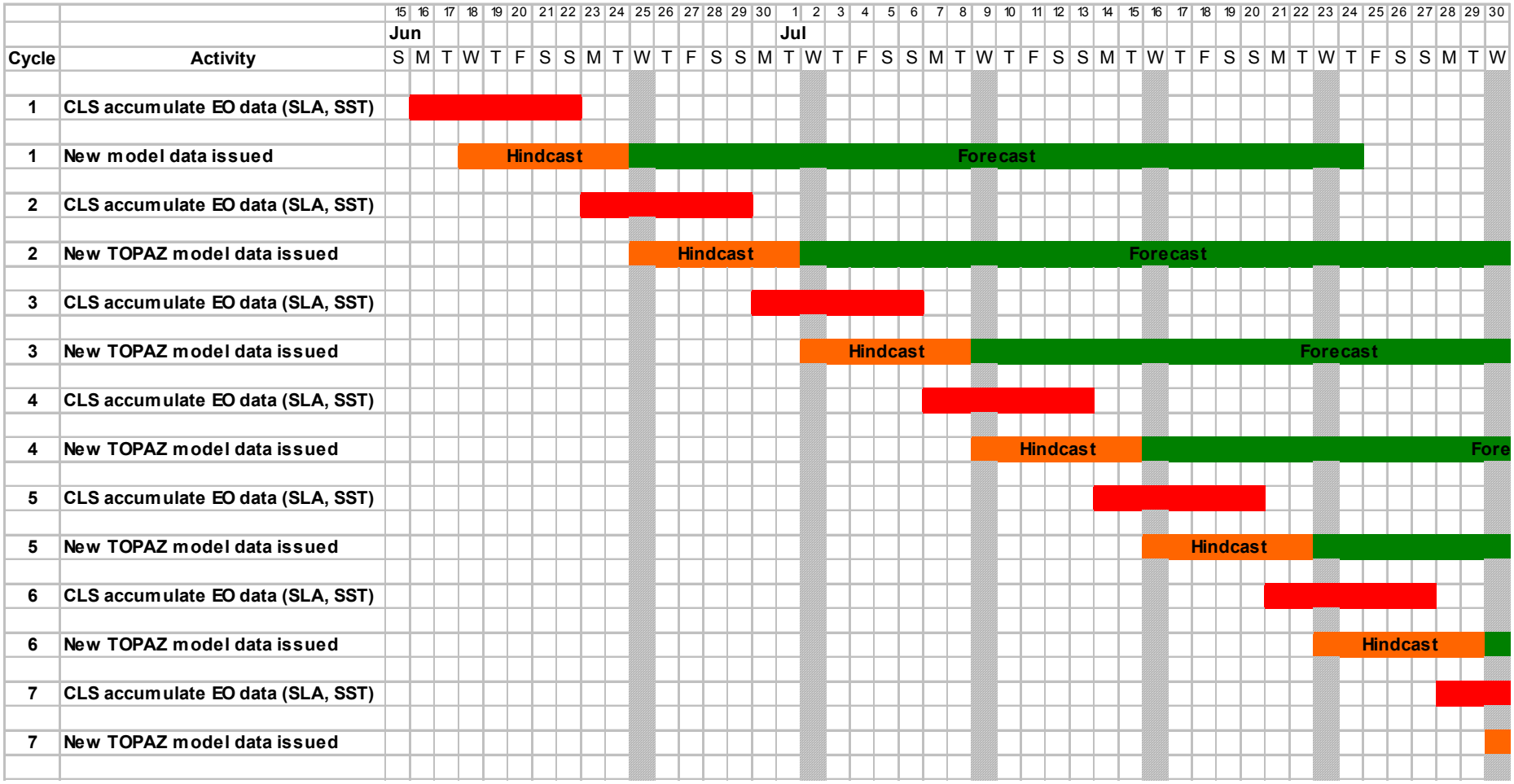
This is a service developed by the Ocean Numerics which is jointly owned by these three companies.

‘Operational Routine’

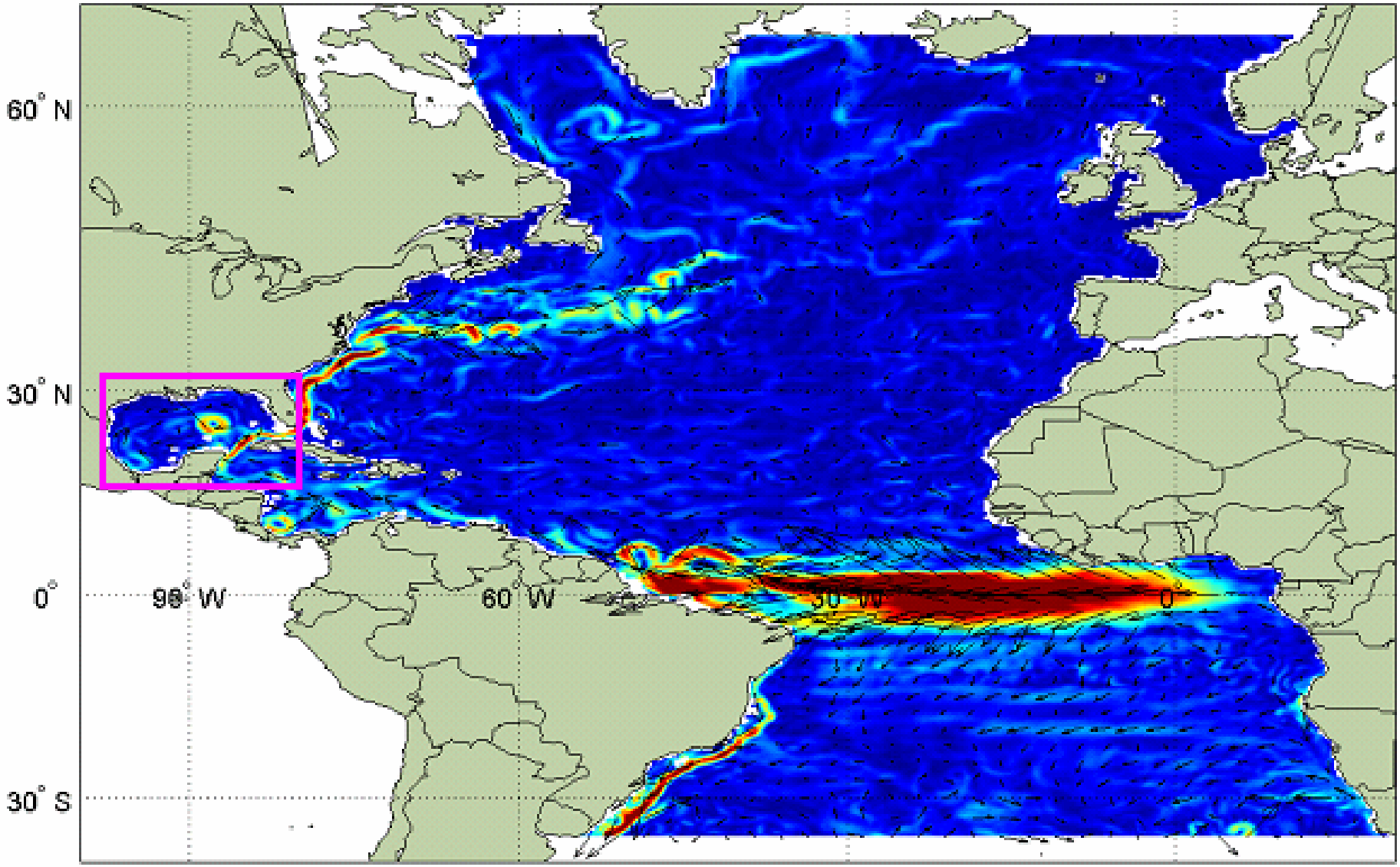


Ocean information to support operational decision-making by the oil and gas industry.

Operational Forecasting Cycle

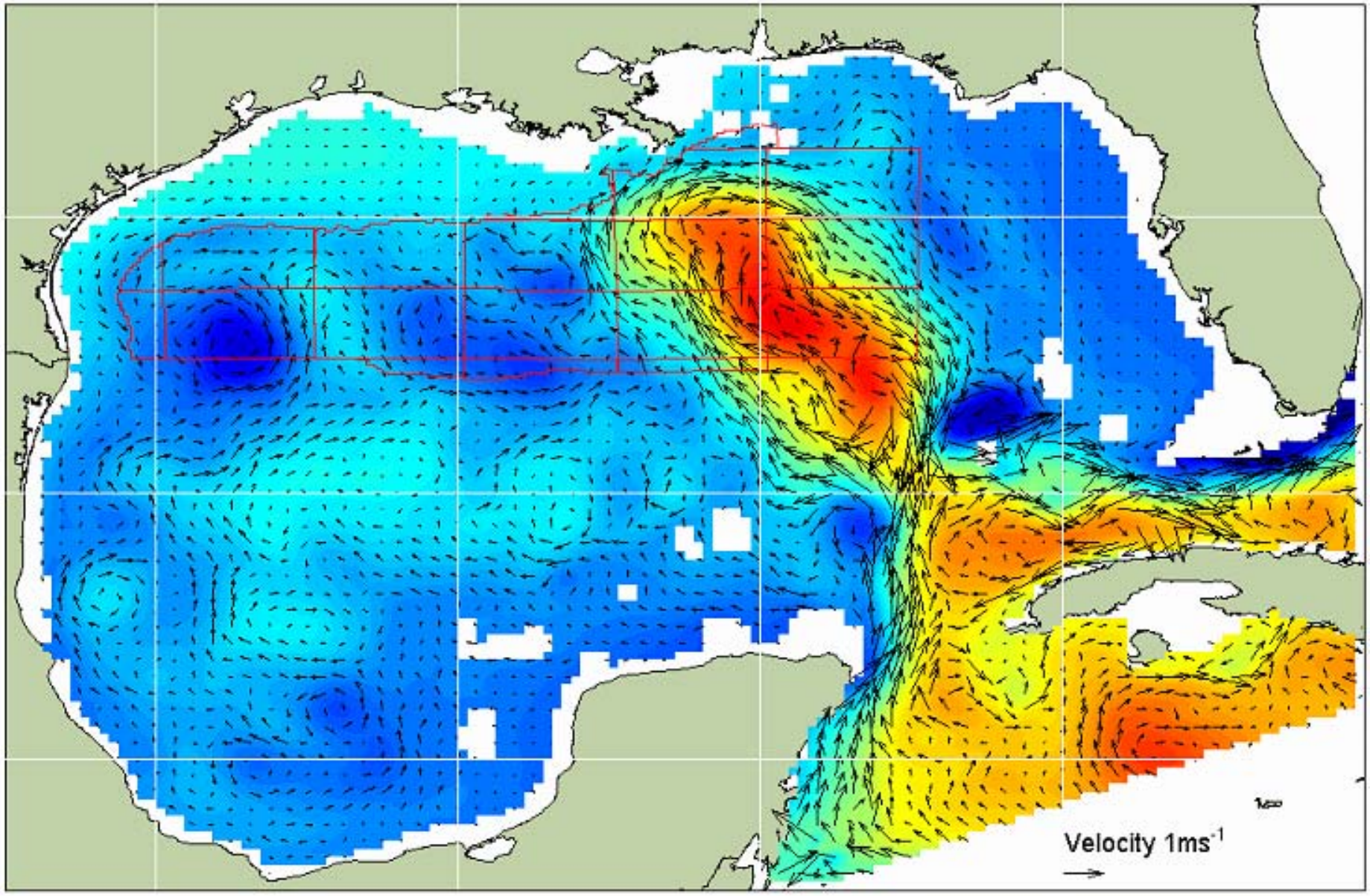


Nested Regional Model



Forecast Velocity Field

Ocean Numerics



How we would use model validation

- Demonstrate expected accuracy to client - what they can and can't expect

- Use as an aid in continued system development and improvement - continued validation.

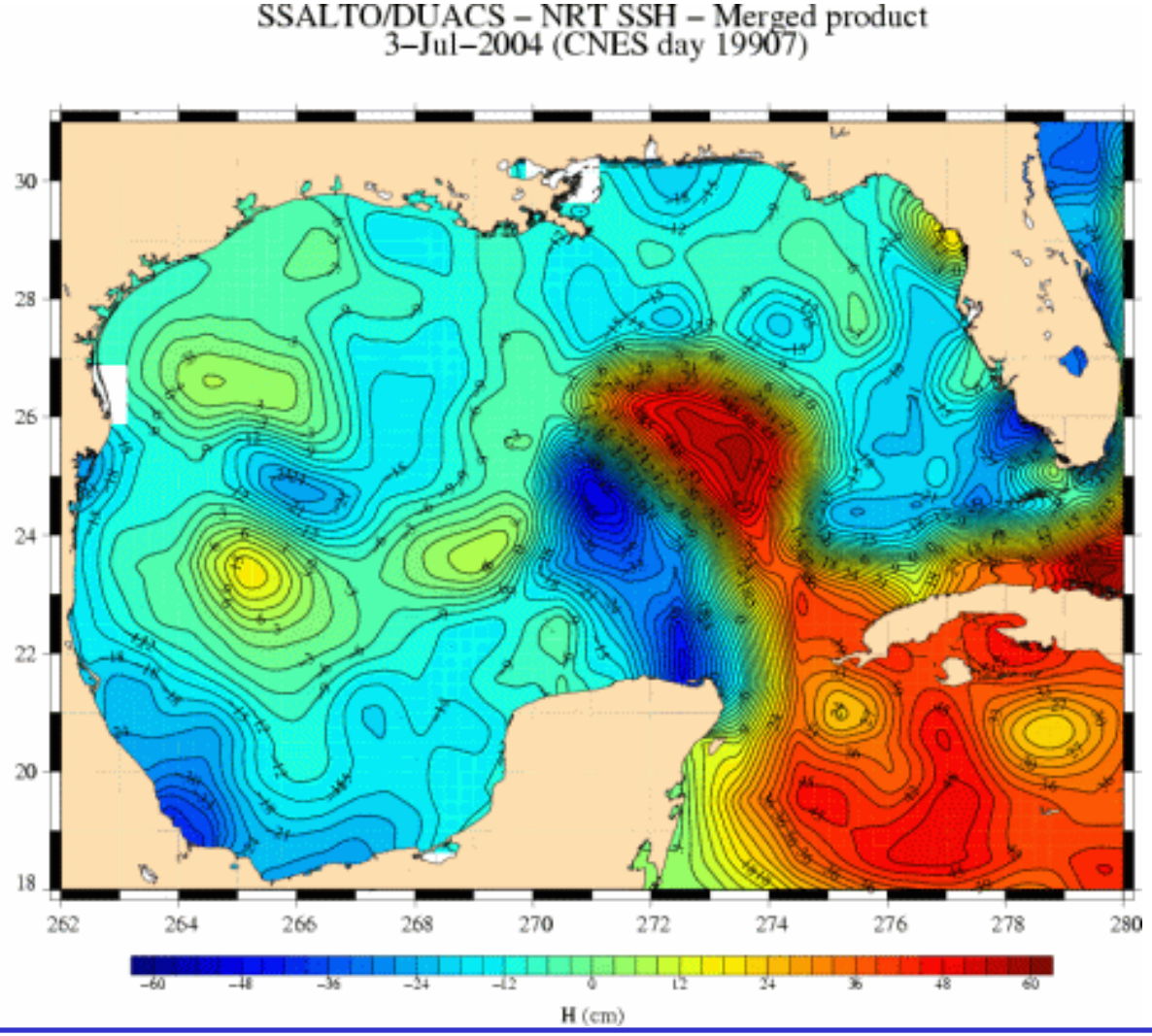
- To answer questions like: How soon will the ring break off the Loop Current? How long will it take the front to reach my location? How long will the strong currents last?

Validation - Demonstration of Skill

- This is the big story for us
- Industry clients need to be convinced that the model results can be useful
- Development by an international consortium and backing of the US Navy has merit but is secondary

Present Status

- We will complete a four month Free Service Trial this week
- Therefore we need to perform an initial validation as soon as possible
- We have started but have a long way to go


SSALTO/DUACS – NRT SSH – Merged product
3–Jul–2004 (CNES day 19907)
30
28
26
24
22
20
18
262
264
266
268
270
272
274
276
278
280
−60
−48
−36
−24
−12
0
12
24
36
48
60
H (cm)

Some Validation Methods

- Visual comparison of SSH fields from model and satellites
- RMS SSH differences through forecast
- Overlay SSH contours on ocean ‘color’
- Parametric fits to features - ellipse fit to Rings
- Tables of occurrence of Loop Current / Rings
- Time series of measured and modeled current

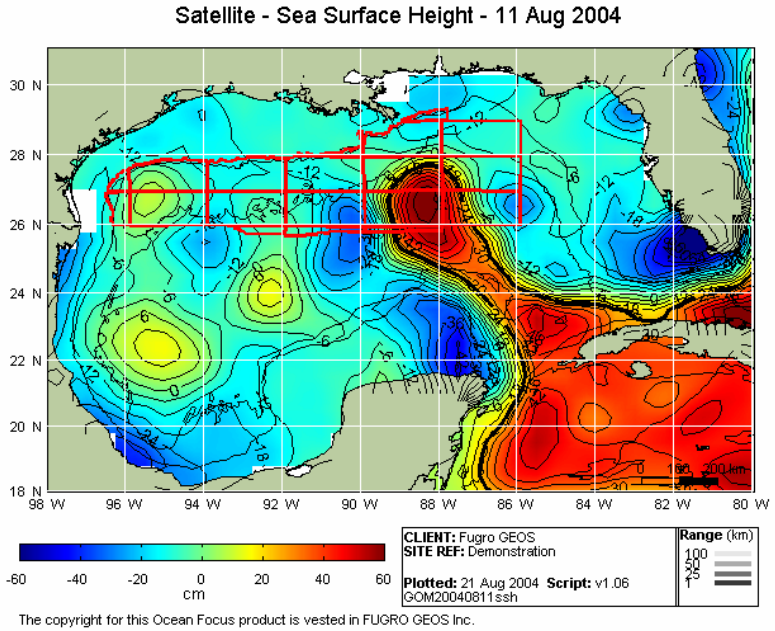
Visual comparison of SSH fields from model and satellites

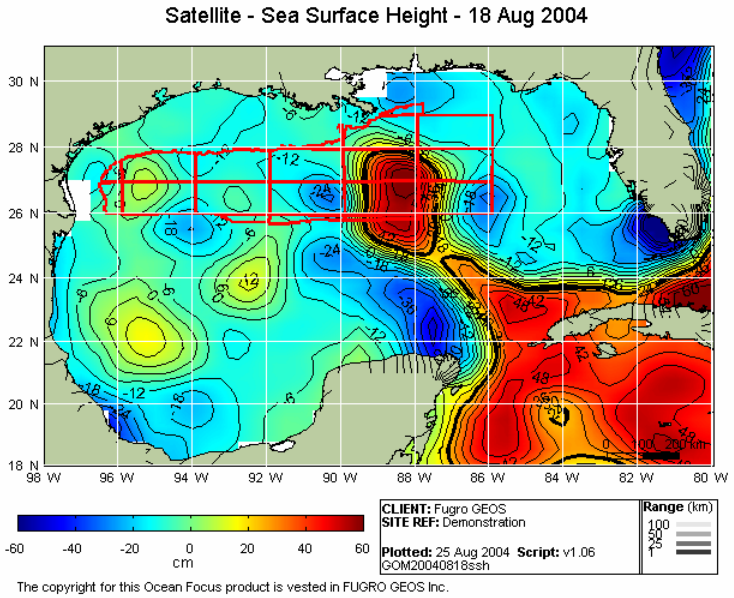
- Very qualitative

Satellite 11 Aug 04

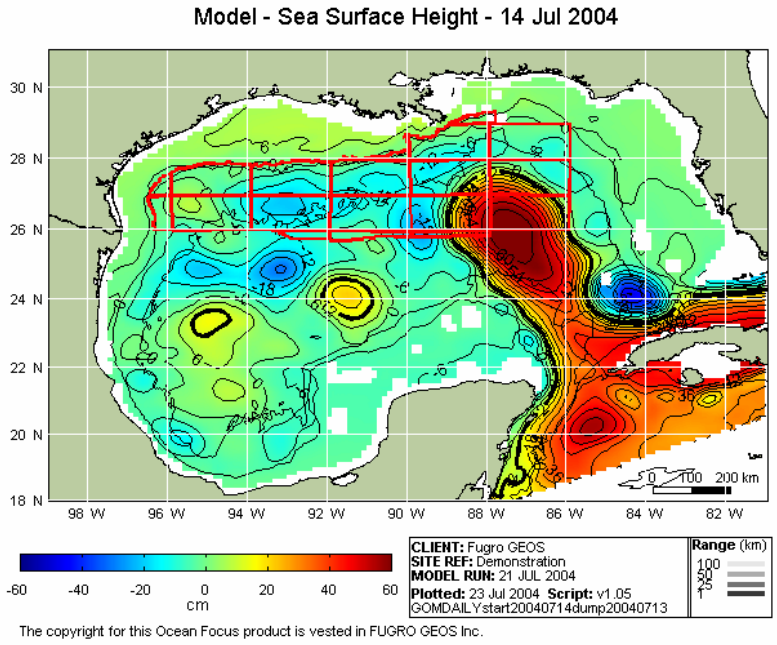
Satellite 18 Aug 04

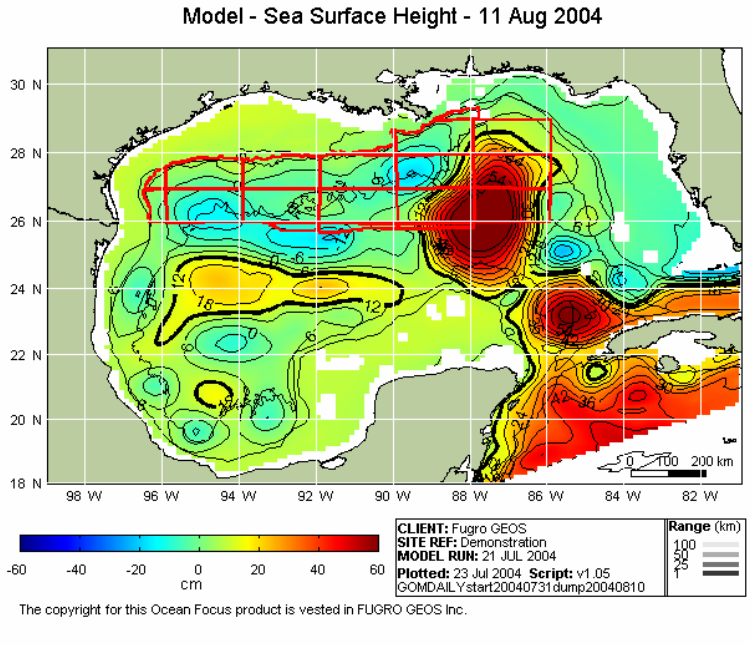
Ocean Numerics





Analysis 14 Jul 04 (4 week) Forecast 11 Aug 04

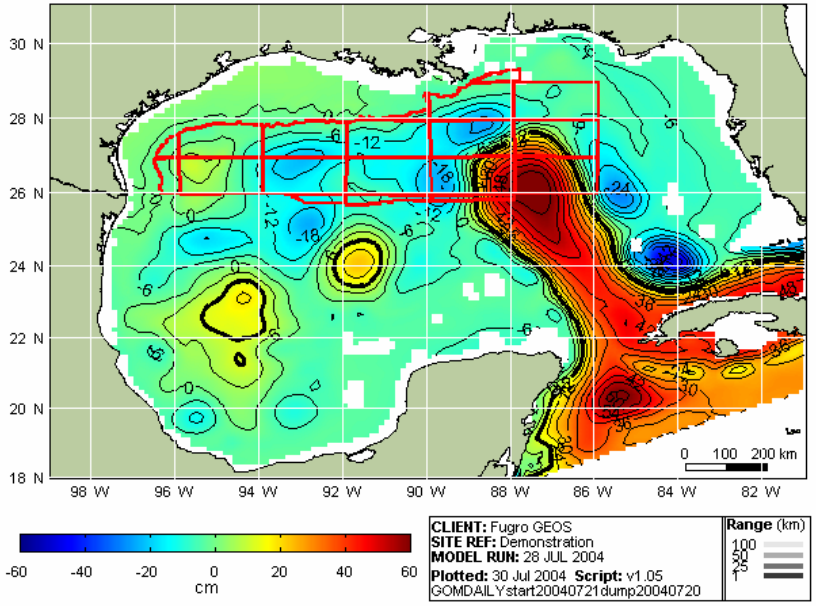




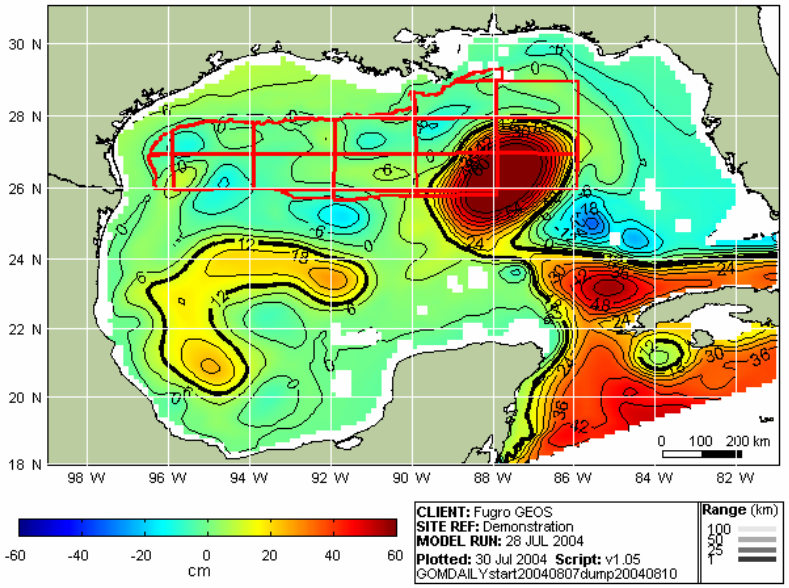
Analysis 21 Jul 04 (3 week) Forecast 11 Aug 04

Ocean Numerics

Model - Sea Surface Height - 21 Jul 2004



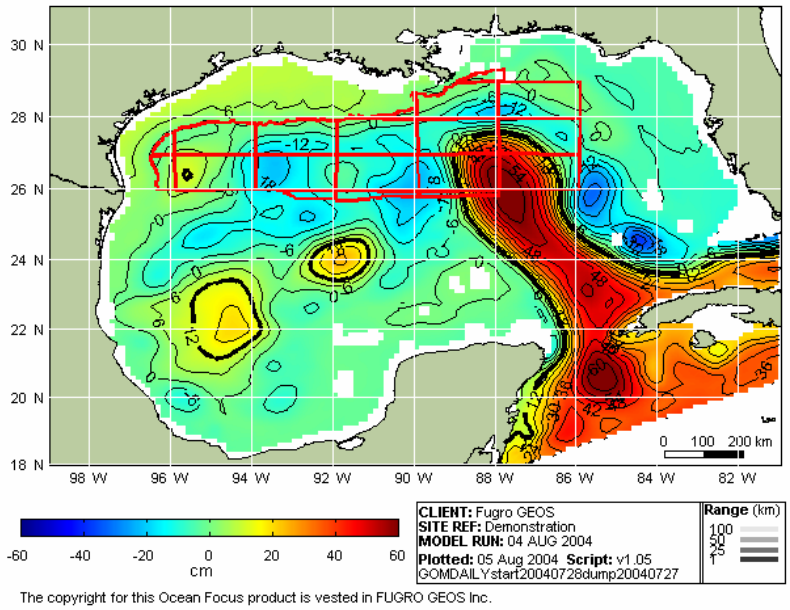
Model - Sea Surface Height - 11 Aug 2004



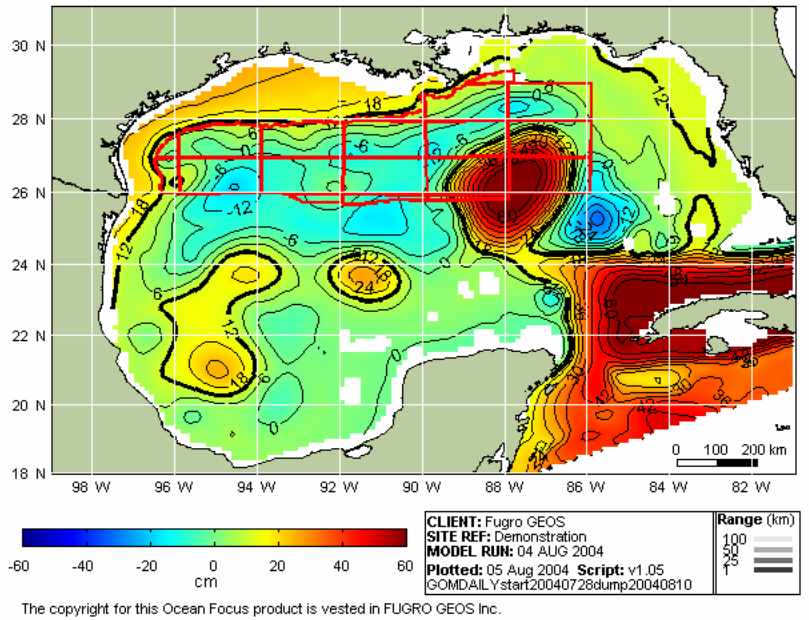
Analysis 28 Jul 04 (2 week) Forecast 11 Aug 04

Ocean Numerics

Model - Sea Surface Height - 28 Jul 2004



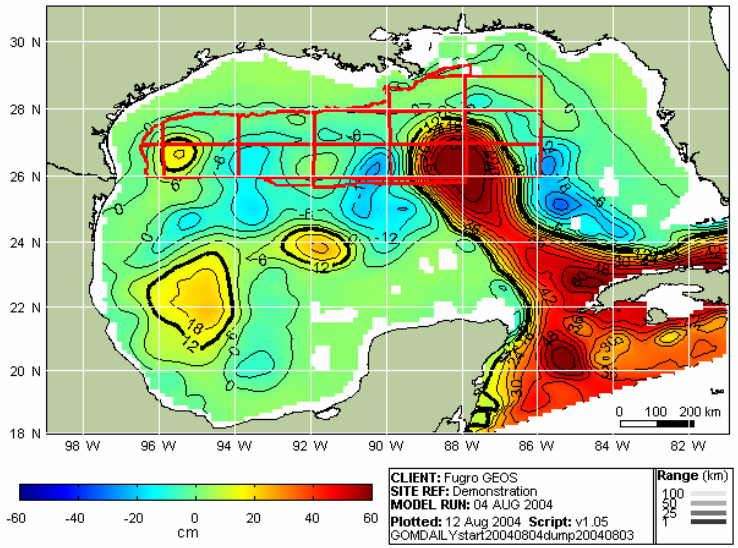
Model - Sea Surface Height - 11 Aug 2004



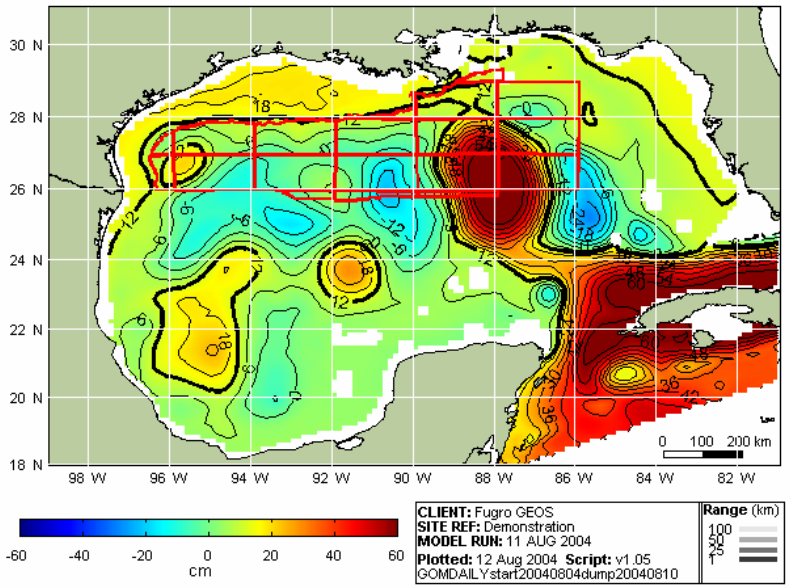
Analysis 04 Aug 04 (1 week) Forecast 11 Aug 04

Ocean Numerics

Model - Sea Surface Height - 04 Aug 2004



Model - Sea Surface Height - 11 Aug 2004

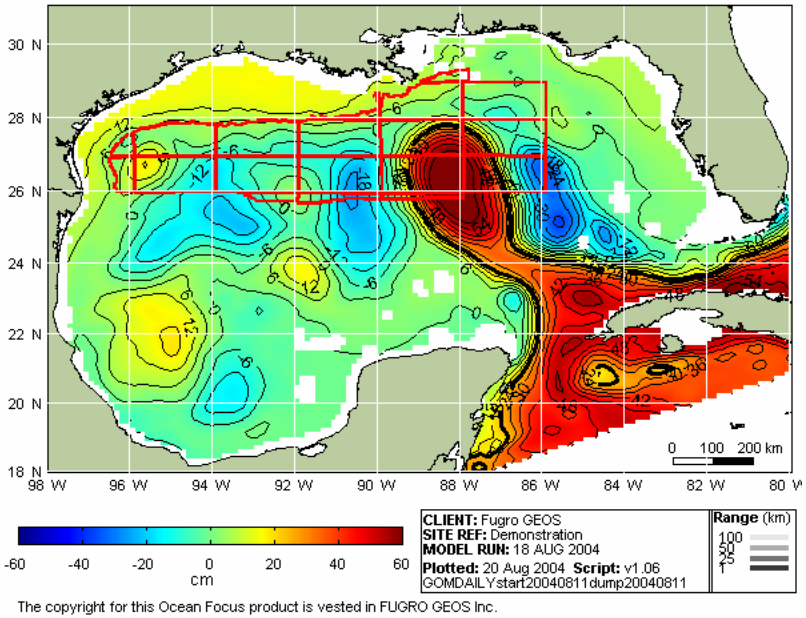


Analysis 11 Aug 04

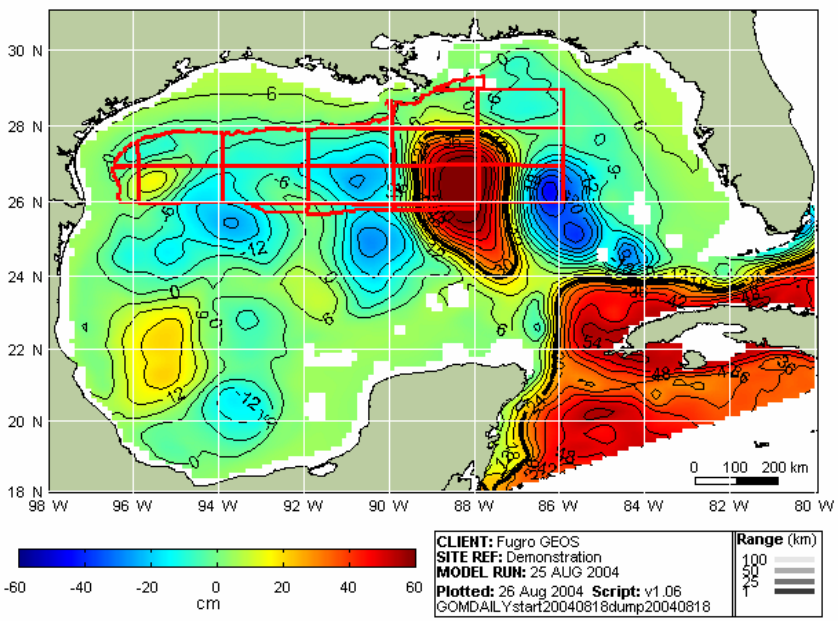
Analysis 18 Aug 04

Ocean Numerics

Model - Sea Surface Height - 11 Aug 2004



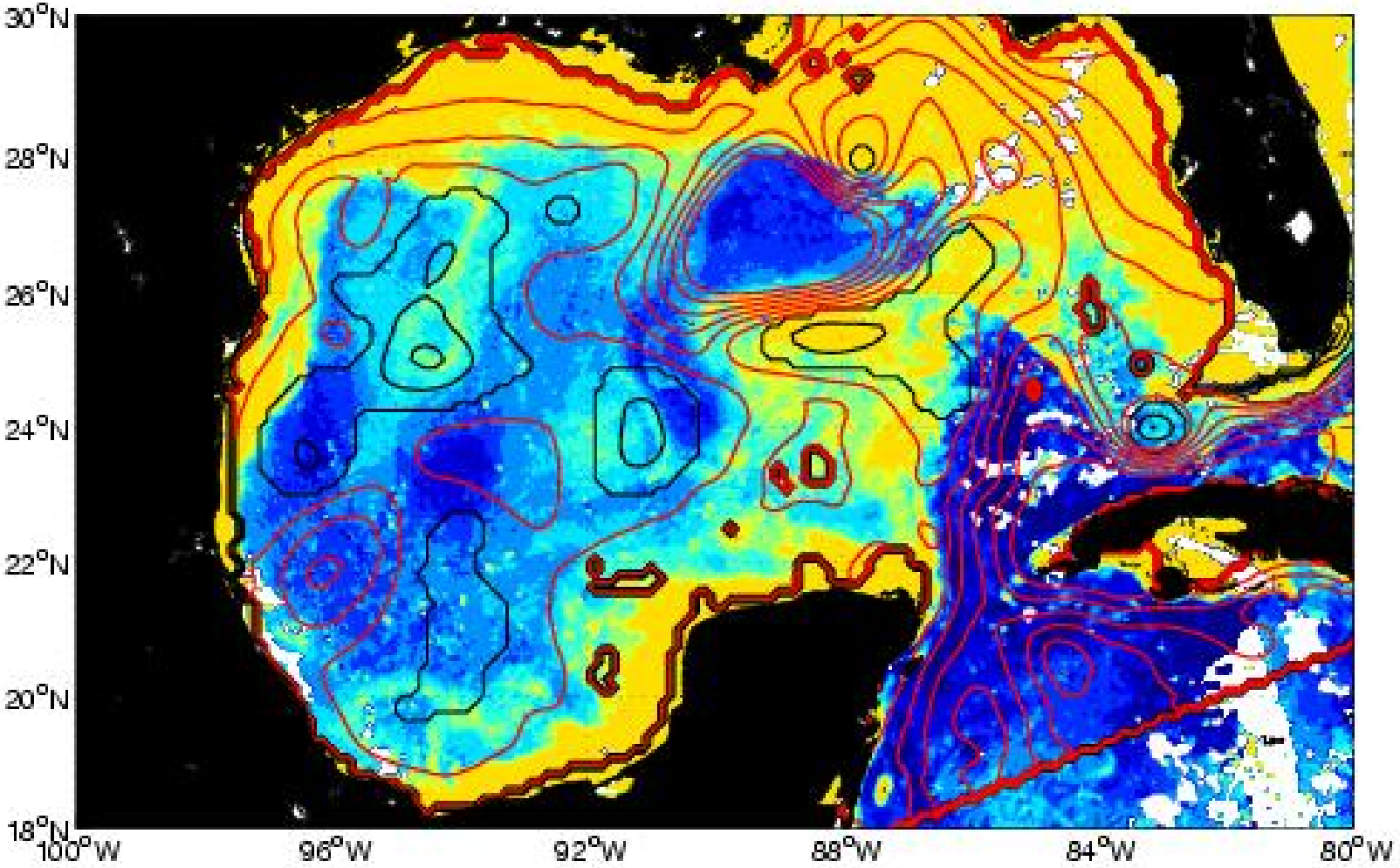
Model - Sea Surface Height - 18 Aug 2004



Overlay of SSH Contours on Ocean Color

- Phytoplankton acts as tracer
- High concentration in coastal water
- Low concentration in rings
- Qualitative

Overlay of SSH contours on ocean color



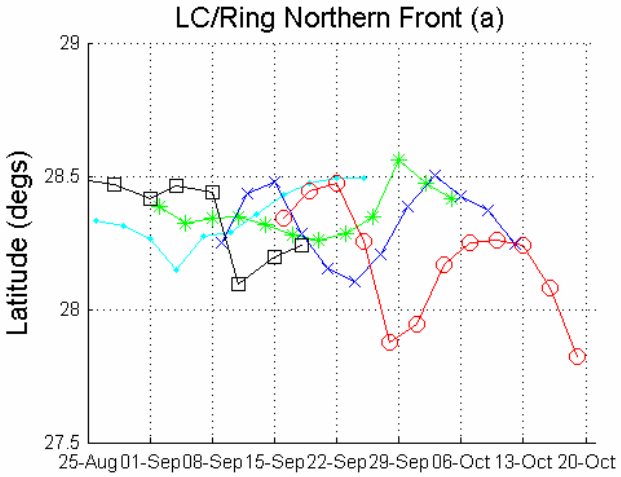
Parametric fits to features - ellipse fit to rings

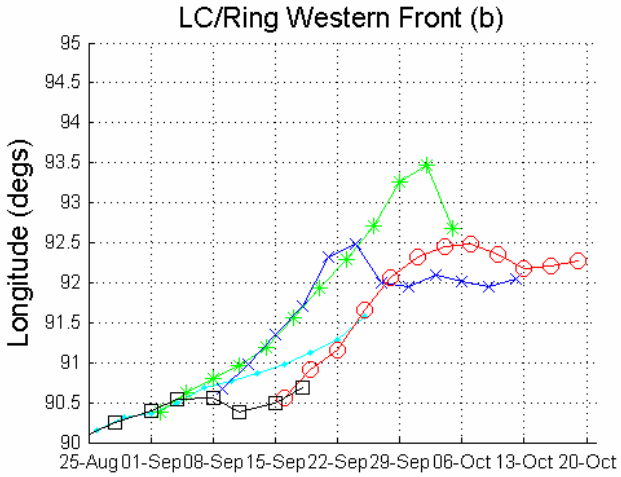
- Parameters:
  - edge location
  - lengths of principal axes
  - orientation of axes
  - ring area
  - speed of rotation
  - speed and direction of translation

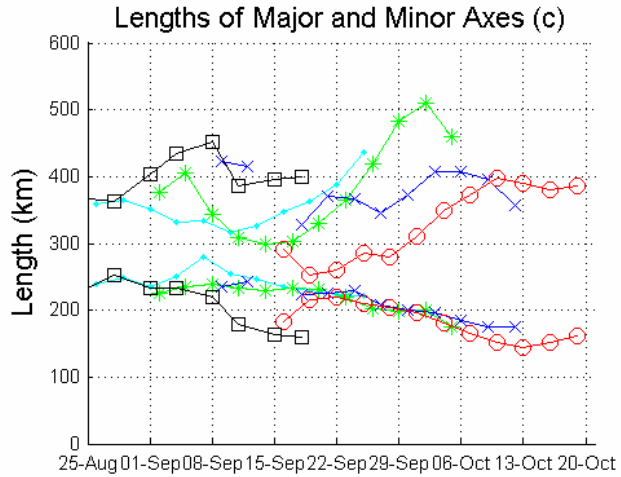
Parametric fits to features - ellipse fit to rings

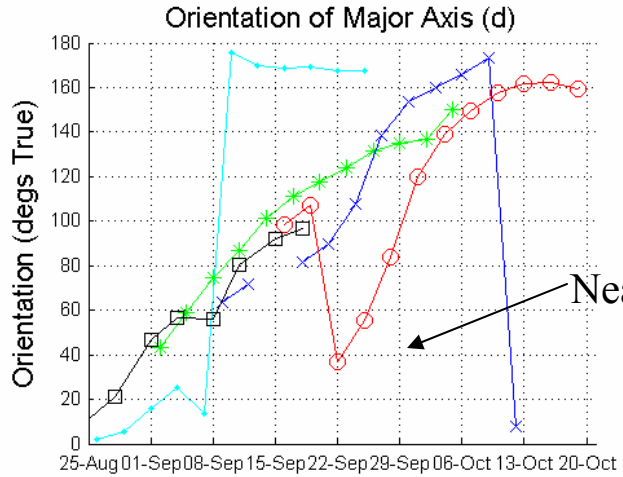
- Difficulties:
  - sensitive to choice of bounding contour
  - if contour too low may go outside of ring
  - if contour too high lose portions of ring
  - model and satellite charts have different mean sea levels (at present)
  - Hurricane Ivan created a large SSH signal
  - rings are not always well described as ellipses

Ellipse Parameters



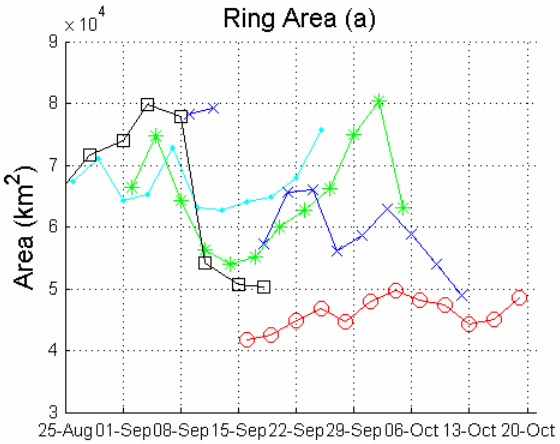


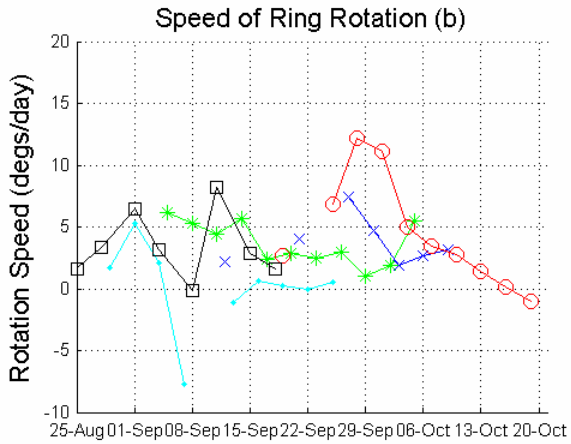


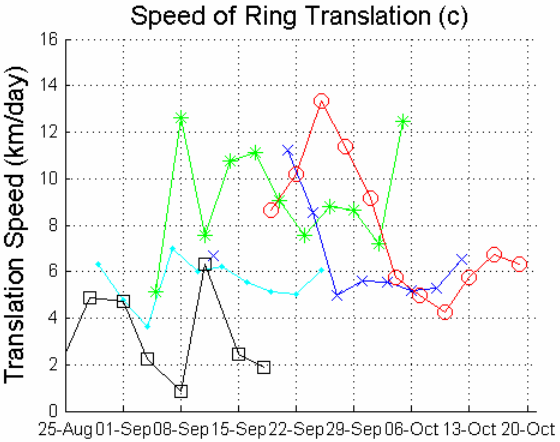


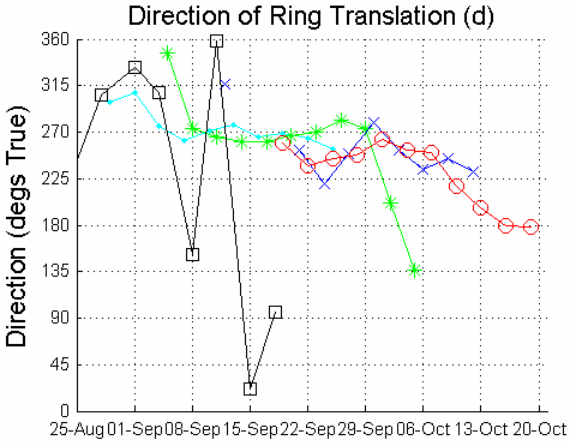
Near circular ring

Ellipse Parameters



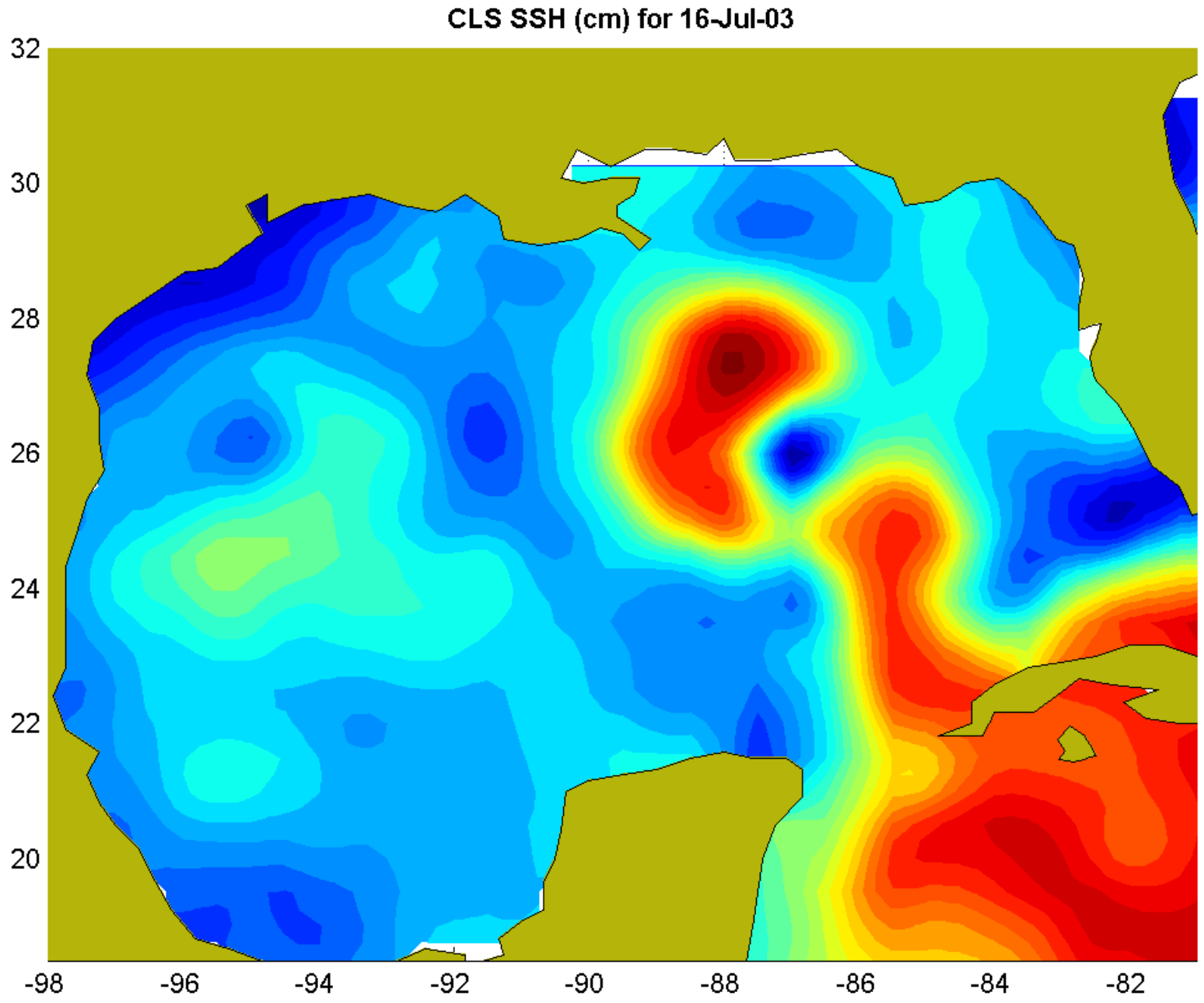


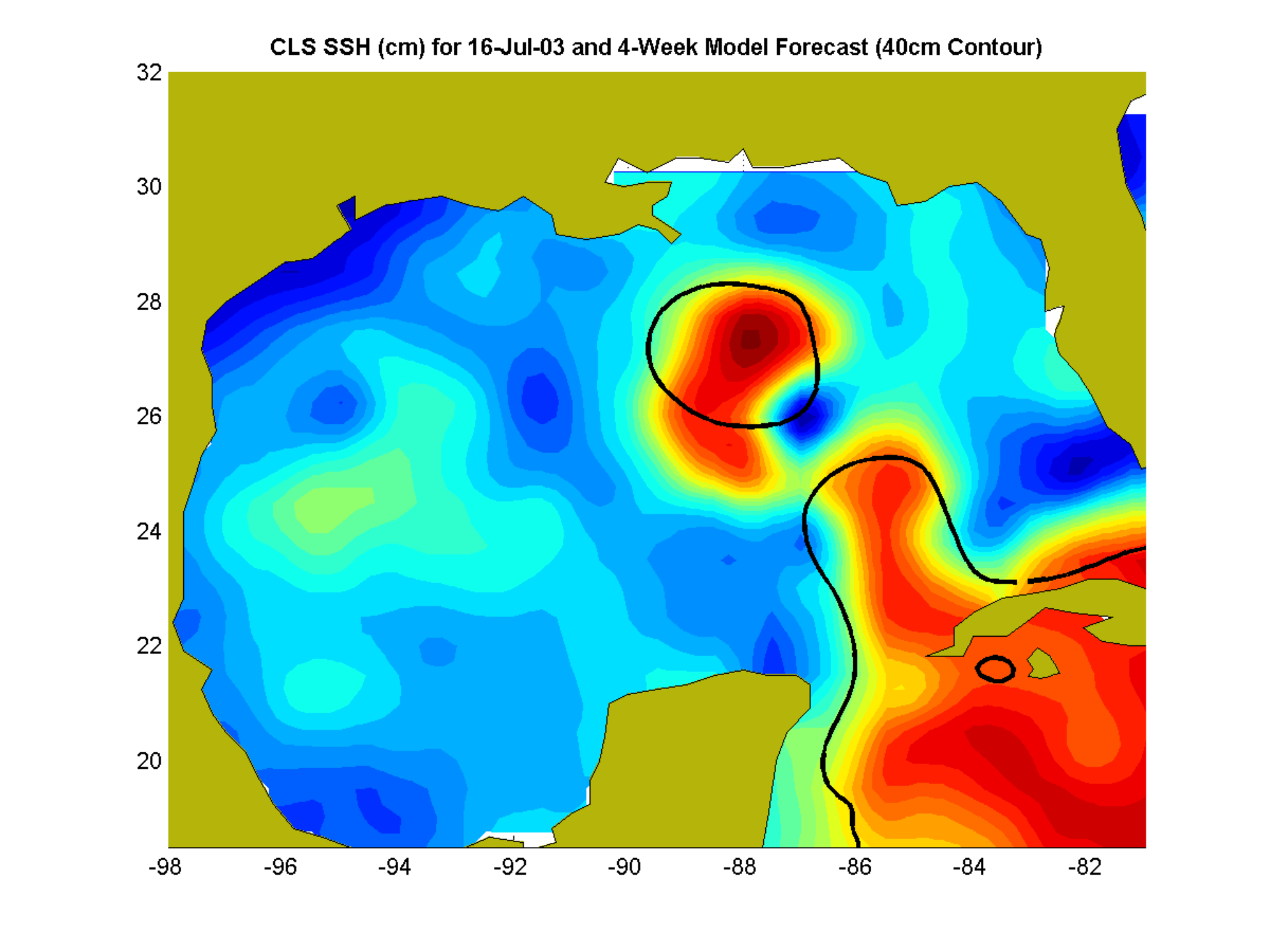


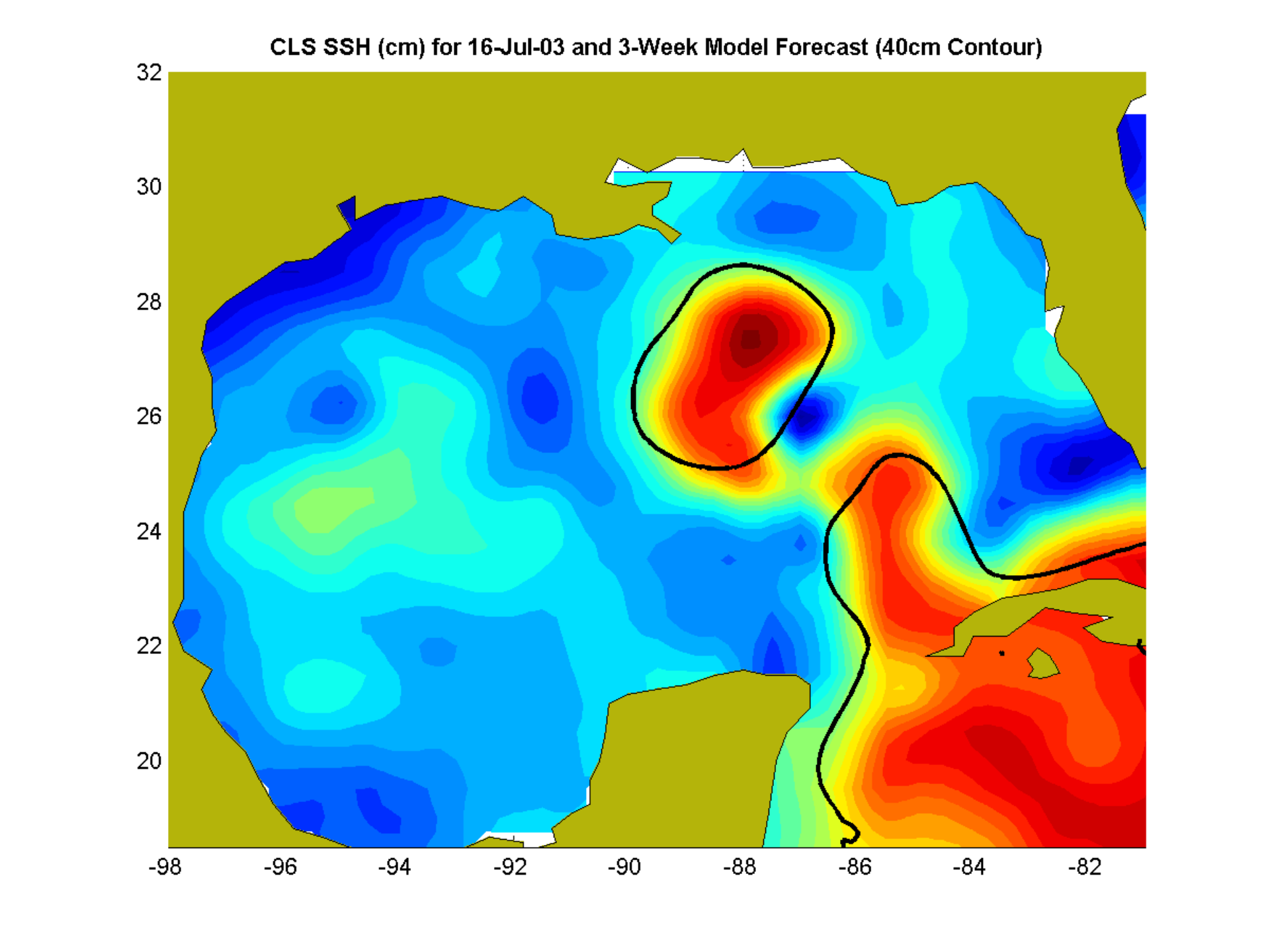


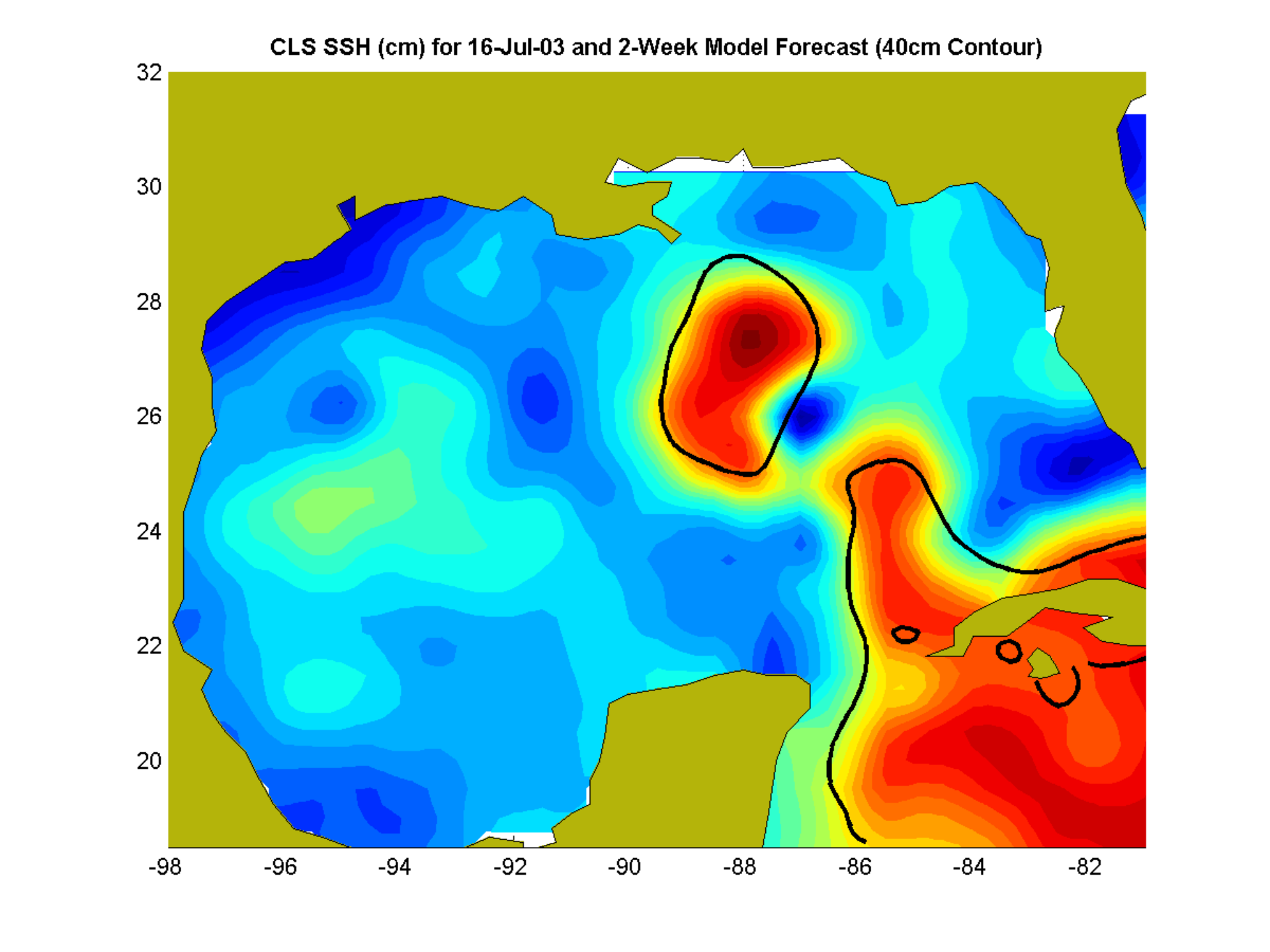
Following sequence

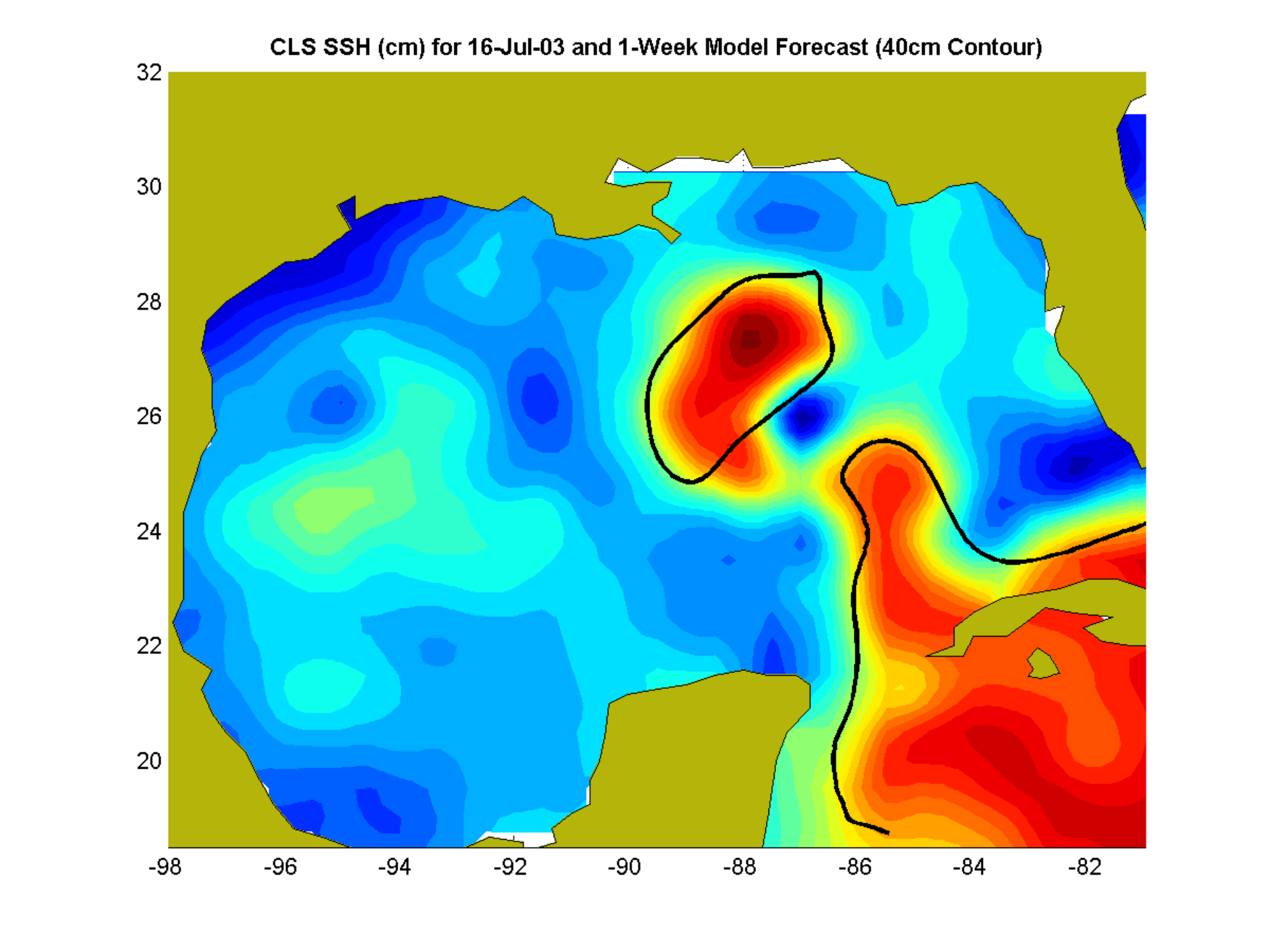
- Satellite SSH chart for 16 July 03
- Contour of 40cm from model at successive forecast times

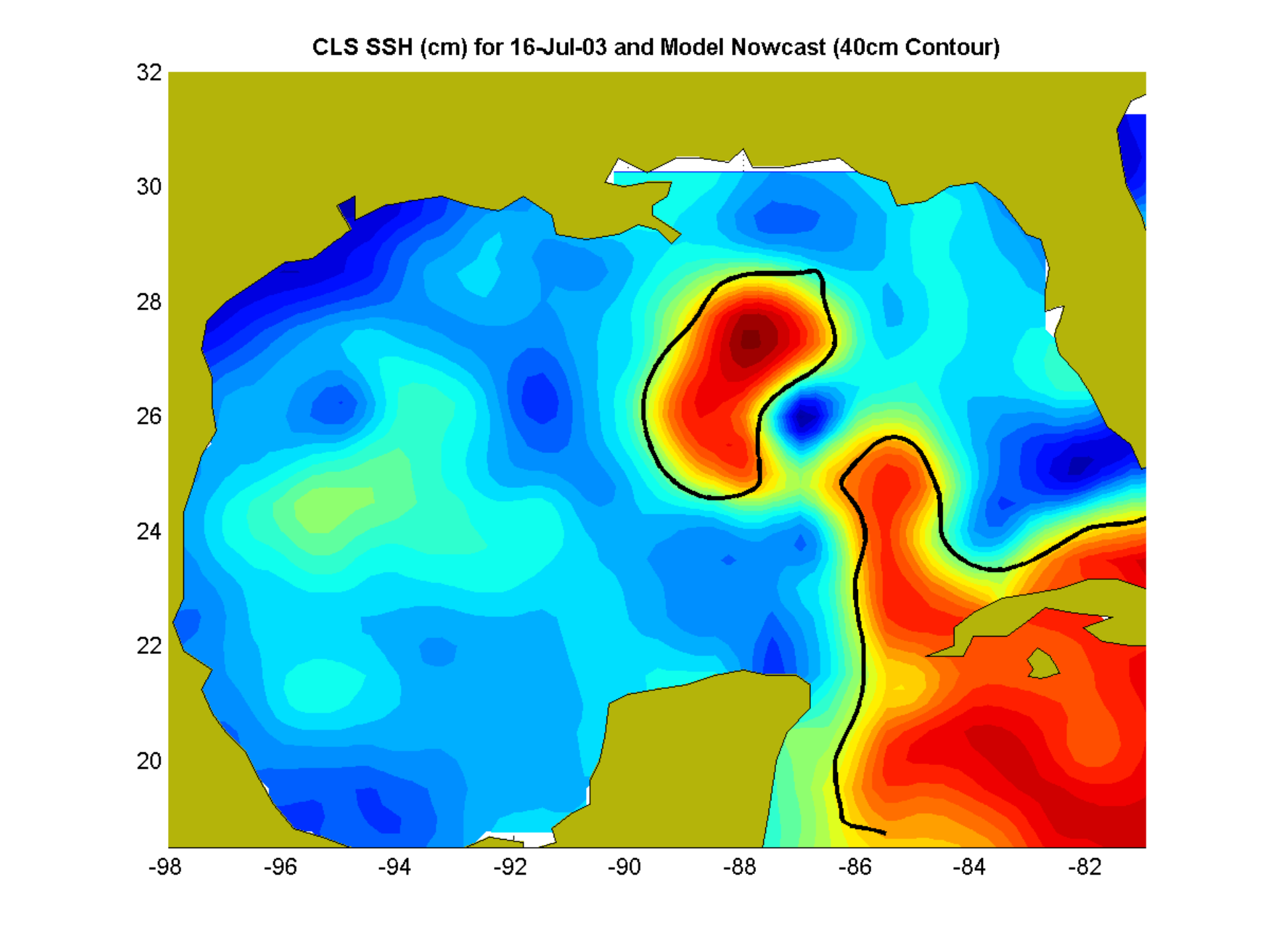

CLS SSH (cm) for 16-Jul-03
32
30
28
26
24
22
20
-98
-96
-94
-92
-90
-88
-86
-84
-82


CLS SSH (cm) for 16-Jul-03 and 4-Week Model Forecast (40cm Contour)
32
30
28
26
24
22
20
-98
-96
-94
-92
-90
-88
-86
-84
-82


CLS SSH (cm) for 16-Jul-03 and 3-Week Model Forecast (40cm Contour)
32
30
28
26
24
22
20
-98
-96
-94
-92
-90
-88
-86
-84
-82


CLS SSH (cm) for 16-Jul-03 and 2-Week Model Forecast (40cm Contour)
32
30
28
26
24
22
20
-98
-96
-94
-92
-90
-88
-86
-84
-82

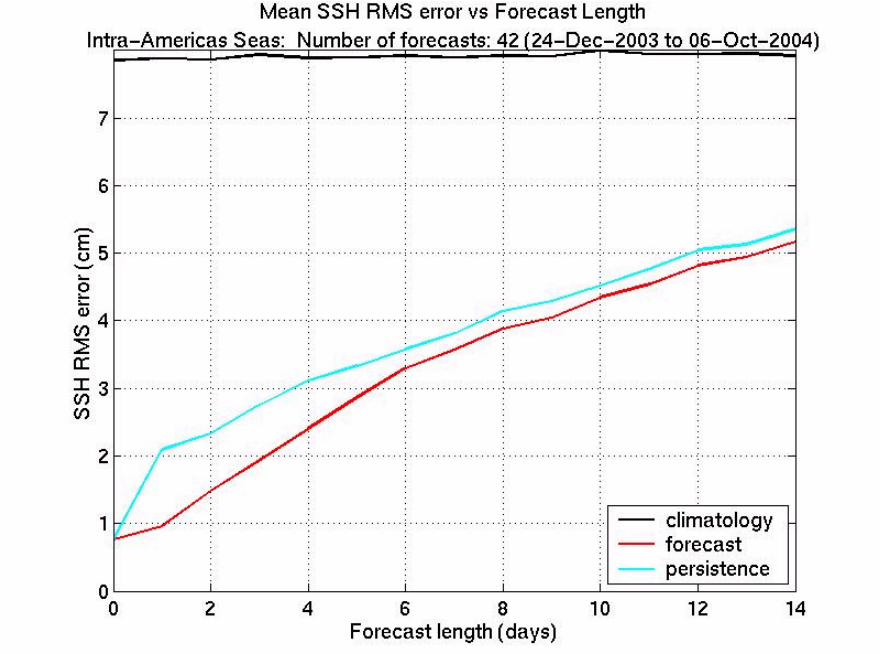

CLS SSH (cm) for 16-Jul-03 and 1-Week Model Forecast (40cm Contour)
32
30
28
26
24
22
20
-98
-96
-94
-92
-90
-88
-86
-84
-82

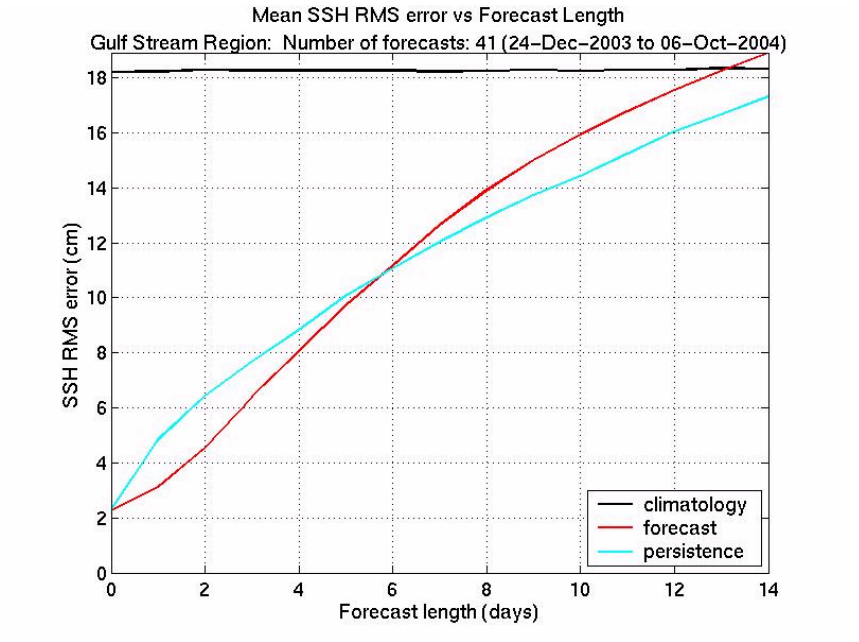

CLS SSH (cm) for 16-Jul-03 and Model Nowcast (40cm Contour)
32
30
28
26
24
22
20
-98
-96
-94
-92
-90
-88
-86
-84
-82

Tables of occurrence of Loop Current / Rings in specific areas by forecast

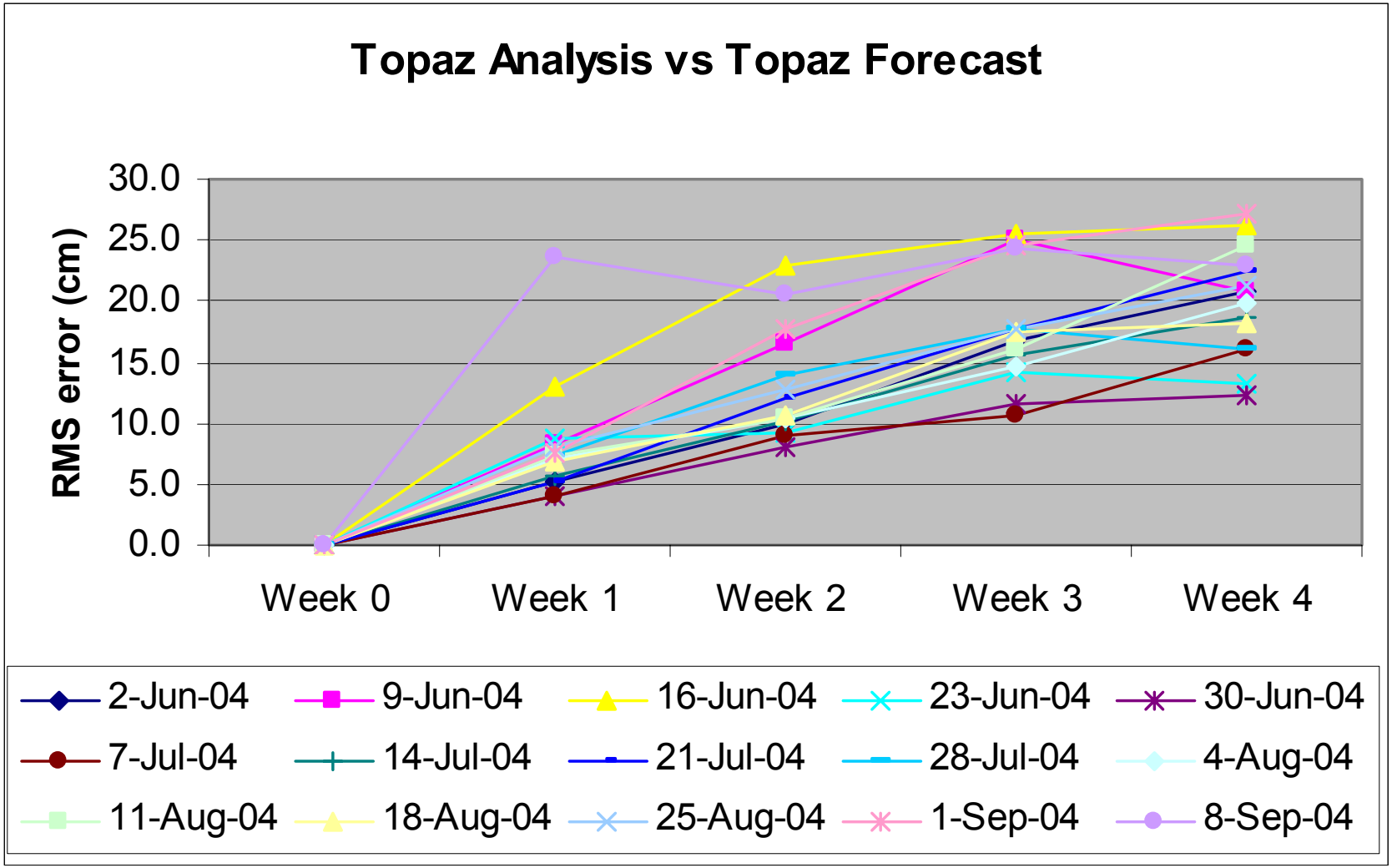
Area	DeSoto Canyon					
	Satellite		Nowcast (NC) + N days			
Date	(truth)	Analysis	NC	NC+7	NC+14	NC+21
7-Jul-04	N	N				
14-Jul-04	N	N	N			
21-Jul-04	N	N	N	N		
28-Jul-04	N	N	N	Y	Y	
4-Aug-04	N	N	N	N	Y	Y
11-Aug-04	N	N	SW	N	Y	Y
18-Aug-04	SW	SWC	N	SW	SW	N
25-Aug-04	SW	SWC	SWC	N	N	N
1-Sep-04	Y	Y	SWC	N	N	N
8-Sep-04	Y	SWC	SW	N	N	N
15-Sep-04	N	N	Y	N	N	N
22-Sep-04	N	N	N	N	N	N
29-Sep-04	N	N	N	N	N	N
6-Oct-04	N	N	N	N	N	N

Mean SSH RMS Error vs Forecast Length





Mean RMS SSH Error by Forecast



Mean SSH RMS Error vs Forecast Length

- What is used for truth - satellite or model?
- This is dependent on regional energy
- Is it dependent on grid resolution?