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BL5122 MamVisAD: Data display and hypothesis generation

"Looking Beneath The Waves: Visualizing Sub-surface Telemetry Data and Dynamic Oceanographic Parameters"

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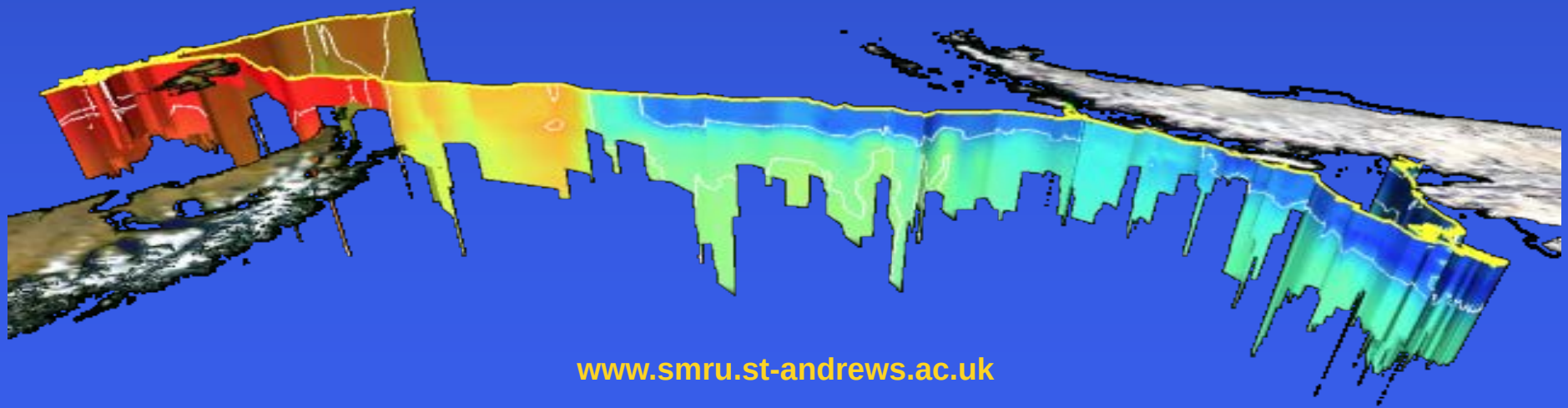
Aims

- Background to MamVisAD
- Discuss potential roles for such applications
- Visualization challenges posed by SRDL data
- Look at some southern elephant seal data



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MamVisAD on AppsAnywhere

- Special version of MamVisAD + datasets
- Works via AppsAnywhere in the PC classroom
- First launch can take a while. So start that now
- Might be worth patching with new files from this folder:
- L:\Biology\BL5122_MamVisAD_Practical\AppsAnywherePatch_2020\

The original MAMVIS
(Fedak, Lovell and McConnell,1996)

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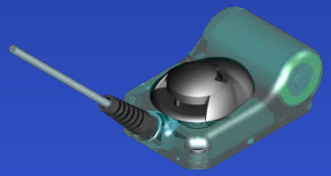
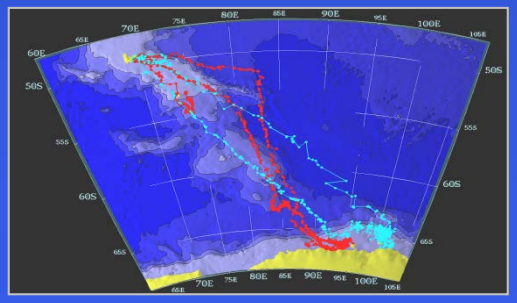
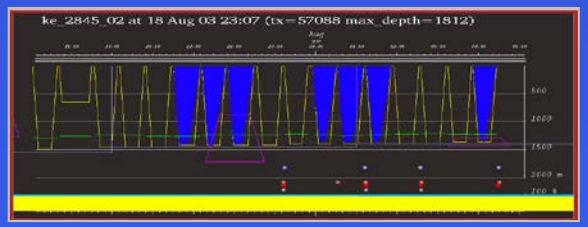
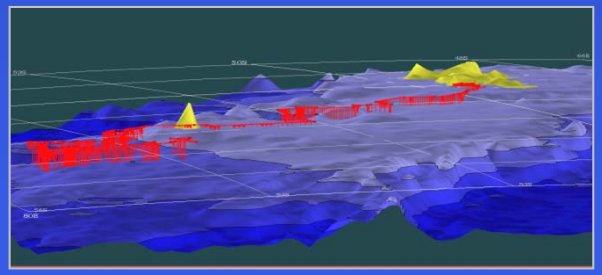
The "MAMmal VISualisation" system.

- Early 1990s SMRU starts deploying SRDLs.
- AVS + specialised graphics hardware.
- 3D "Virtual Globe" + Stripcharts
- Dives, bathymetry, SSTs, Sea Ice, diagnostics









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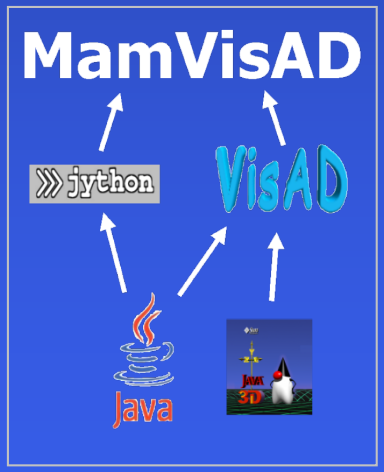
MamVisAD

The Census of Marine Life Project
Tagging Of Pacific Pelagics

- 1 year of Packard Foundation/TOPP funding
- Development started in 2003
- Targeting standard PC hardware
- Ideally also “free” to distribute
- Jython/Java/VisAD framework chosen

Led to the development of what is now the MamVisAD application.



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The main MamVisAD GUI

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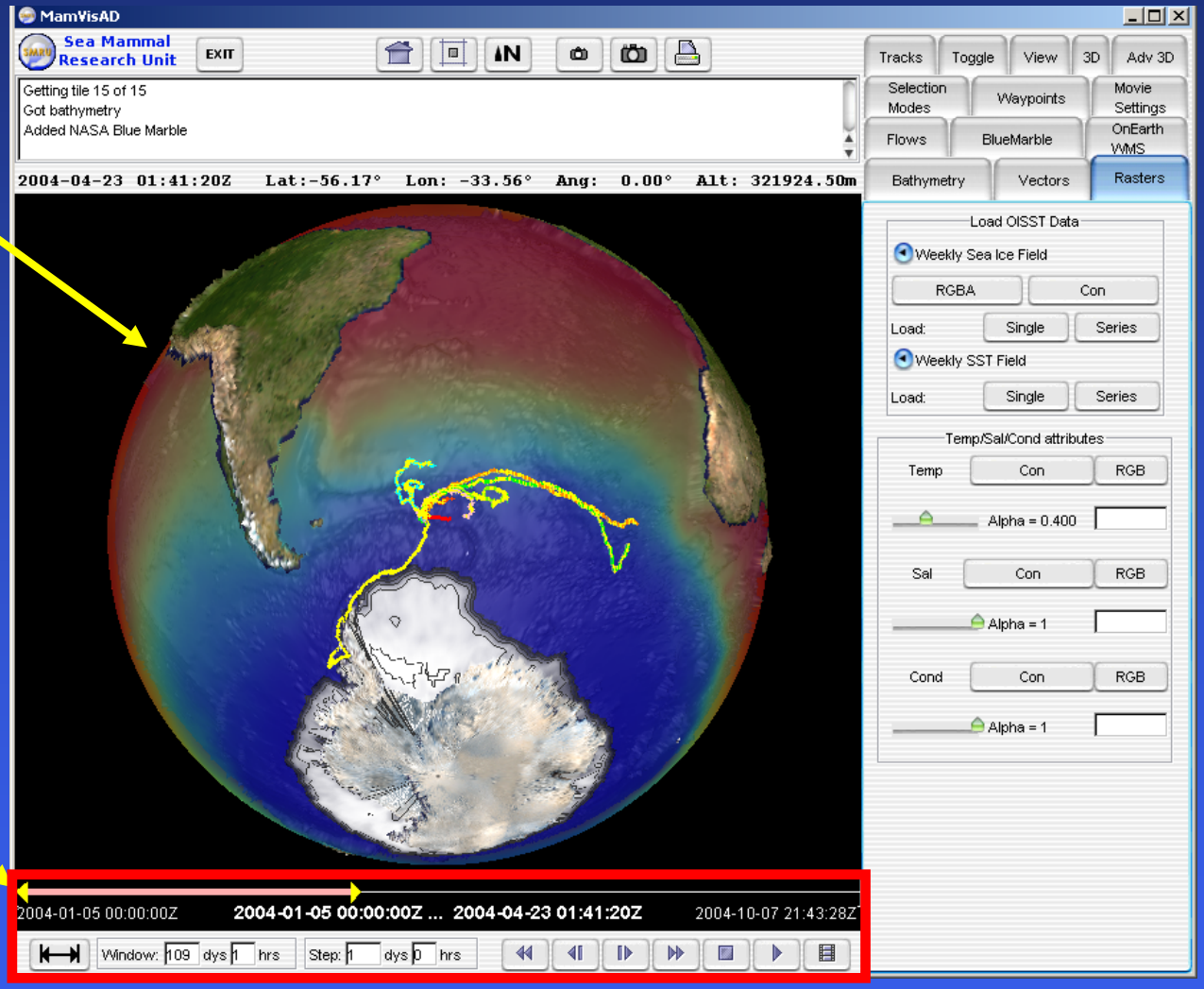
3D “Virtual Globe”

Time Slider



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The MamVisAD stripchart

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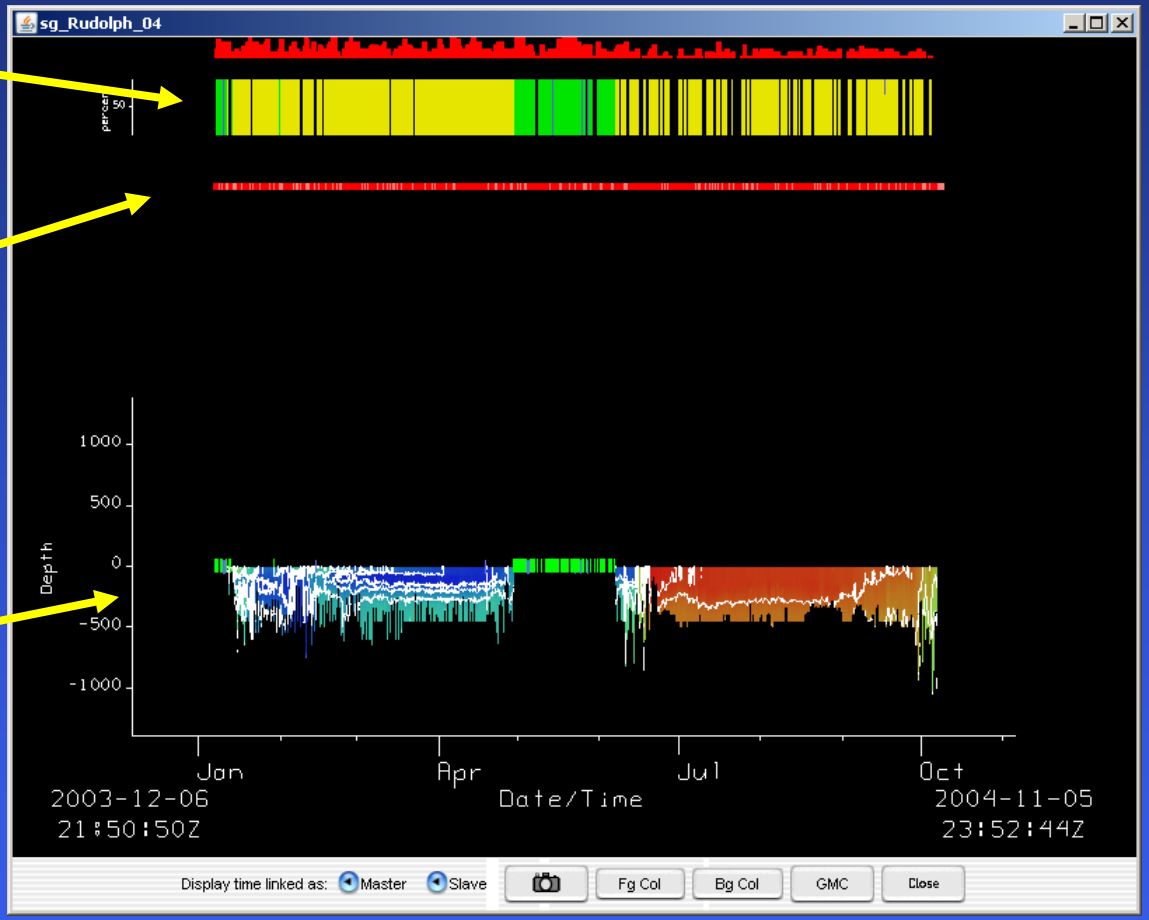
Summaries

Uplinks

Time Depth Plot



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Views “coupled” in various ways

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Time slider can limit what is shown in 3D window

Ranges of axes in strip charts adjust to match

Brushing/selection linked across the views

Same colour palettes used in both views

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Roles for Visualization

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Interactive use:

- Exploring data - “Hypothesis Generation”
- Quality control / sanity checks

Multimedia generation:

- Scientific Presentations
- Public Outreach

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Challenges of telemetry data

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- Wide range of spatial scales
  (from a few kilometres to whole oceans)
- Deployments can last years
- Individual dives may only be only minutes long
- Want to view the data in context with other datasets
- Ideally still want interactive visualizations.

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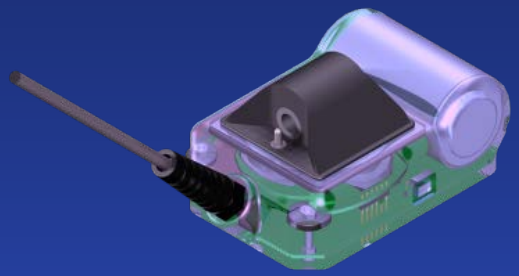
Temperature & CTD SRDL Data



- Deployments cover large spatial & temporal scales
- Interested animal behaviour & oceanography
- Want to see other data such as bathymetry, SSTs, Sea Ice Cover, etc.

As an example let's look at some data collected during the SEaOS project

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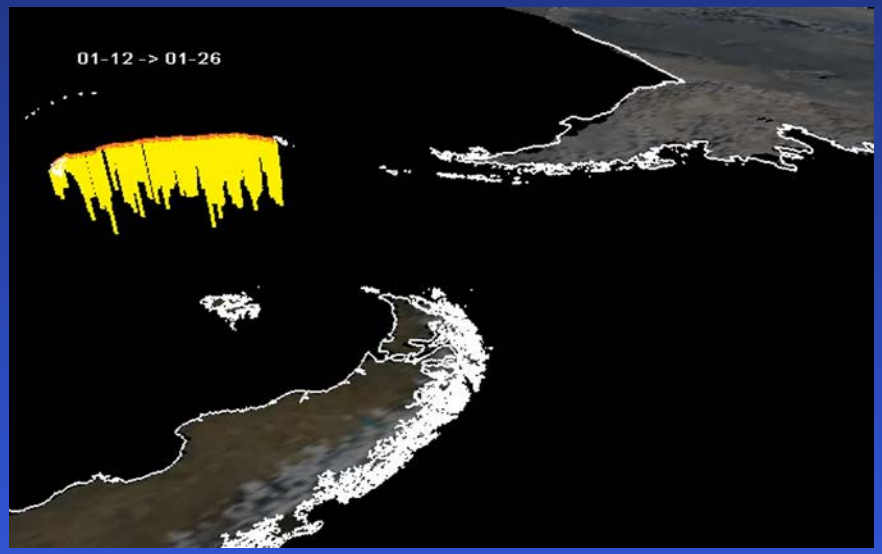
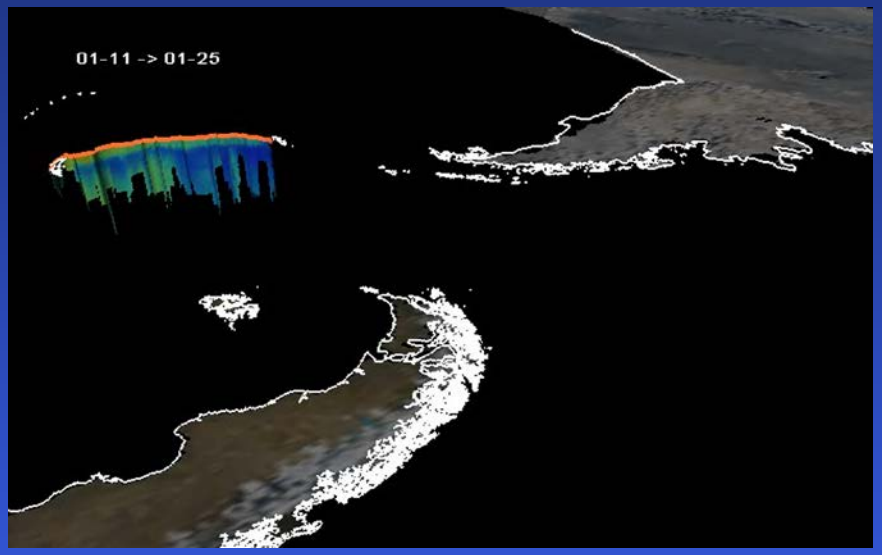
Rudolph – SRDL





The tag relayed data about diving & water temperatures

What vertical exaggeration was used for these movies?

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x 10

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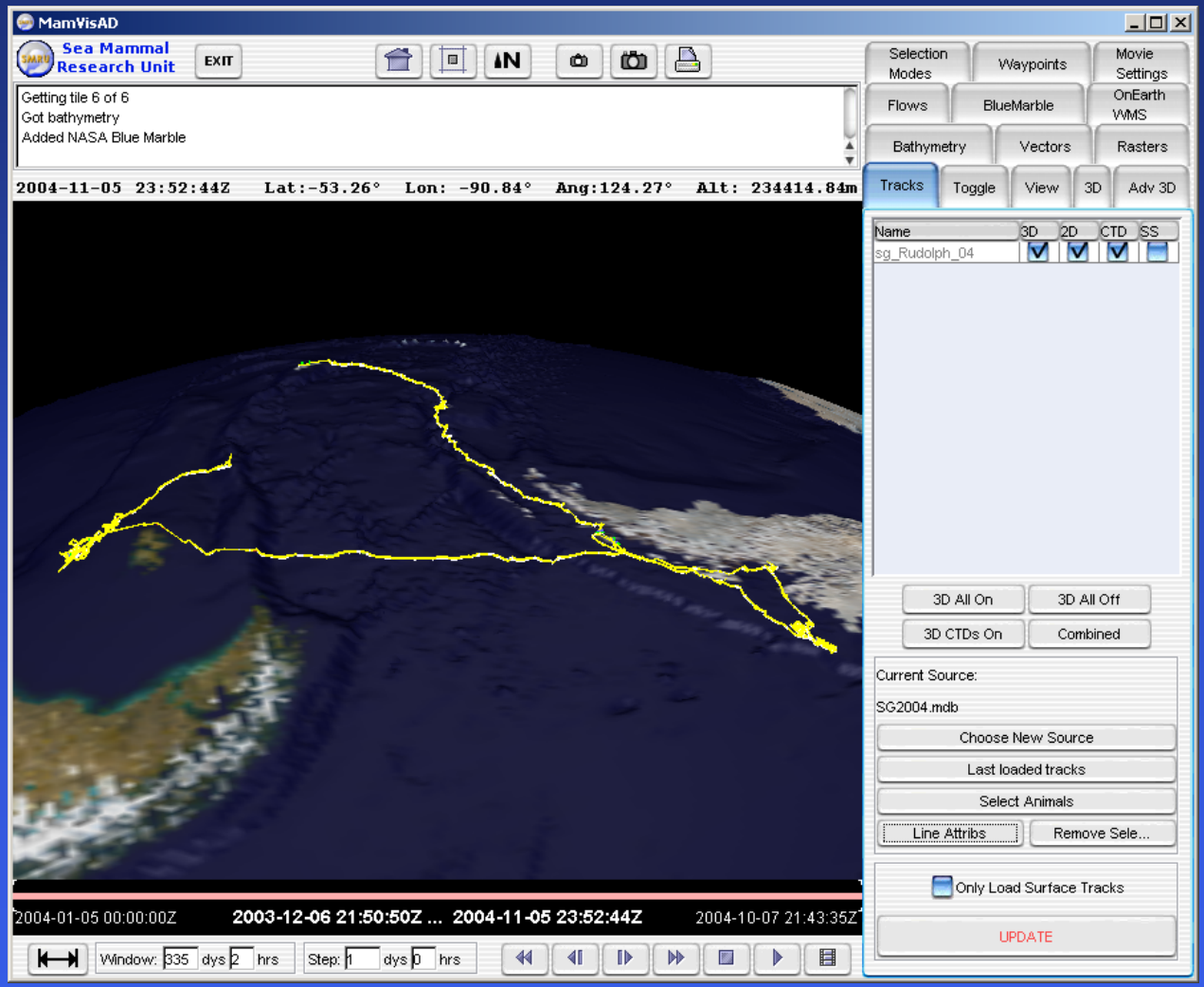

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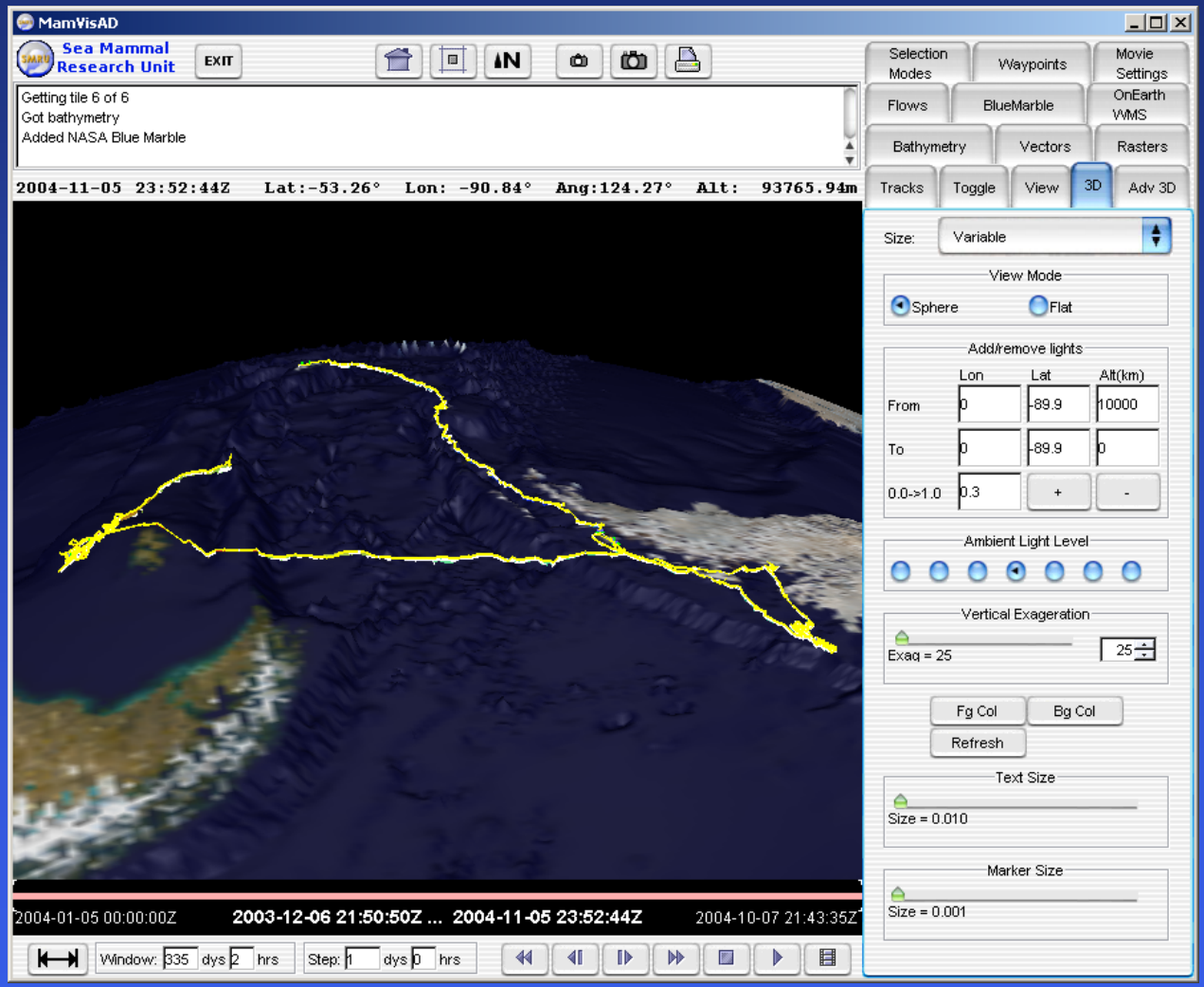
x 25



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x 50

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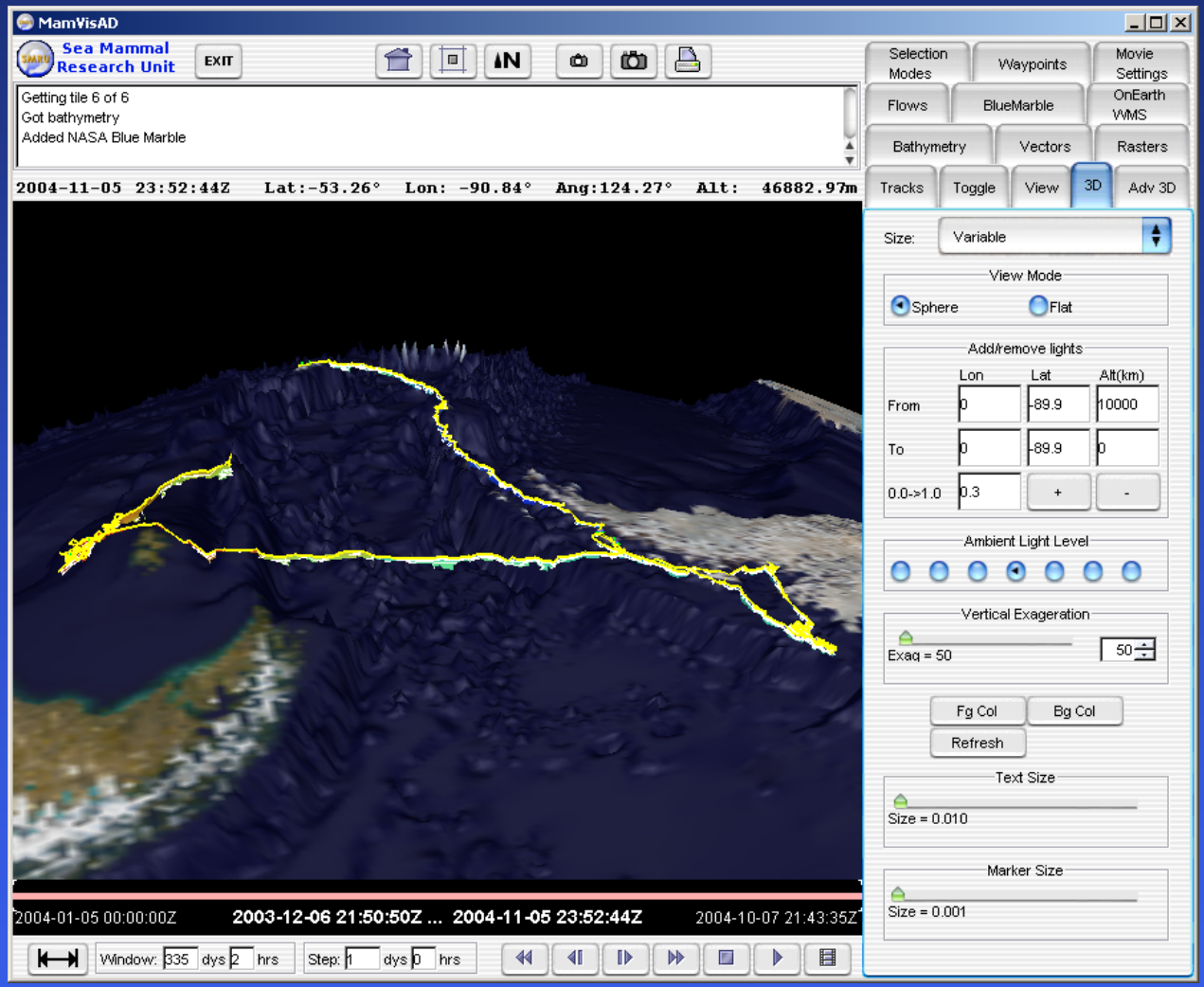

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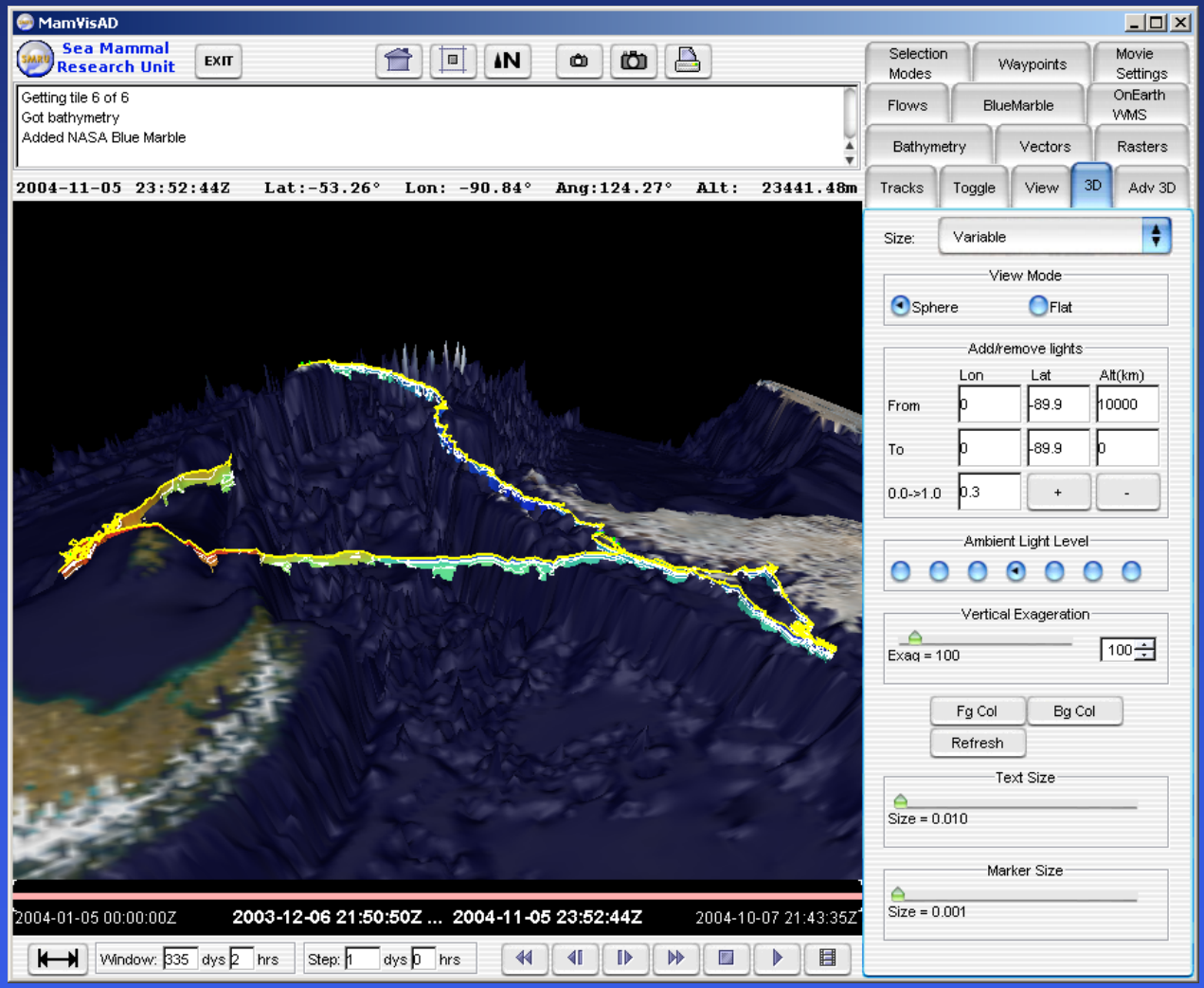
x 100



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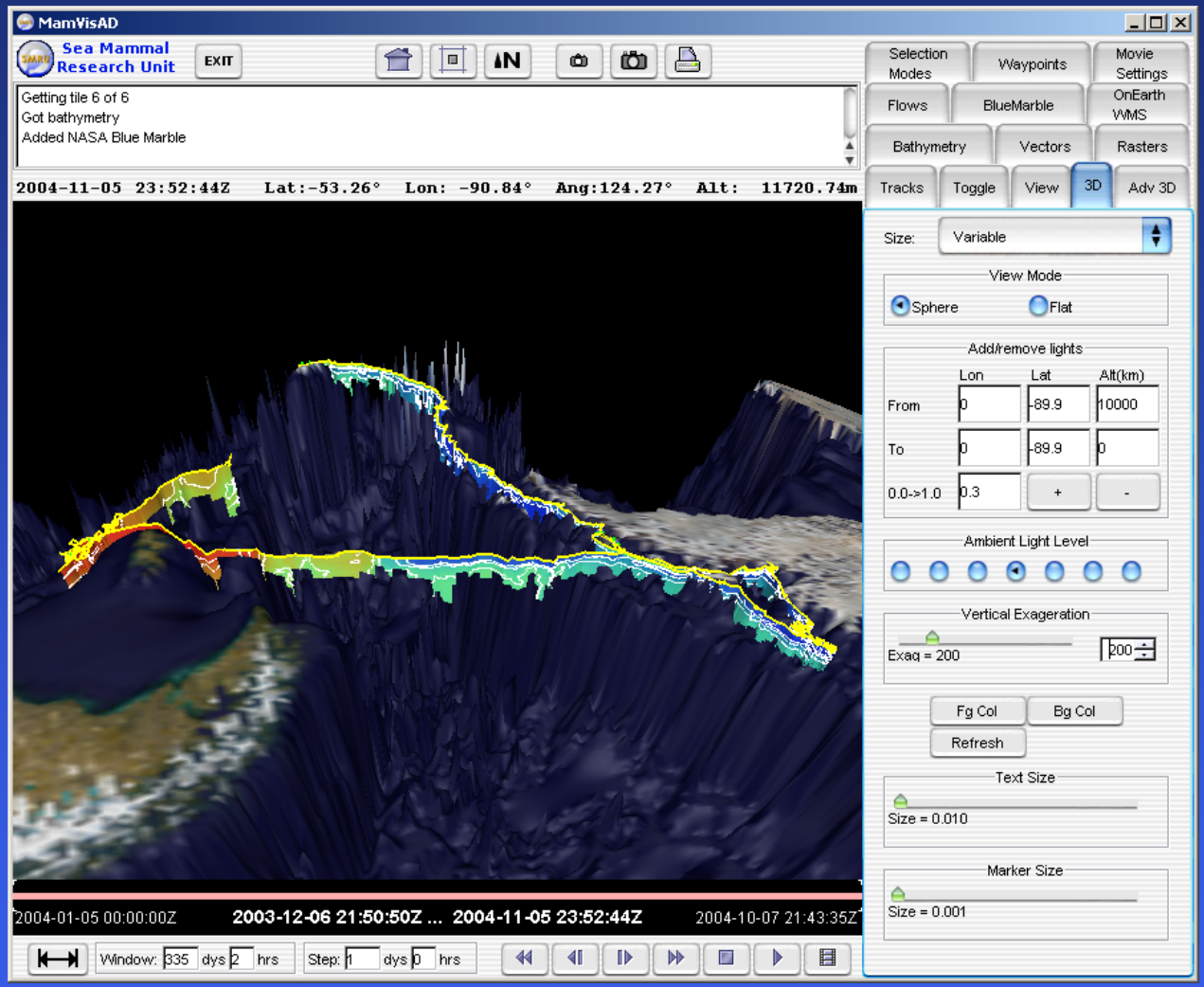
x 200



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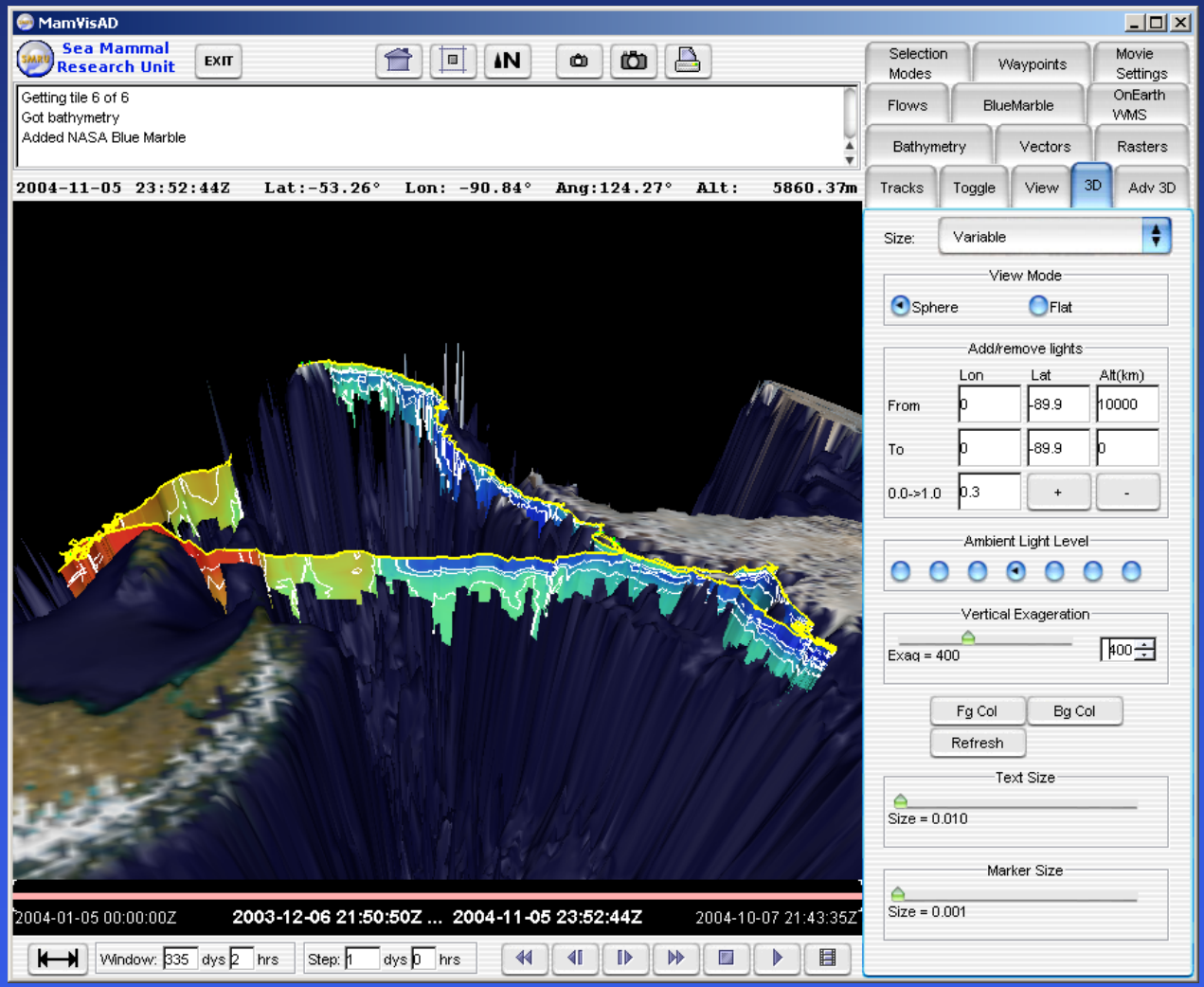
x 400



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An extremely high vertical exaggeration allowed us to see the recorded temperatures along the whole track

Another way to examine such data is by using the same 3D view but in conjunction with a linked 2D stripchart.

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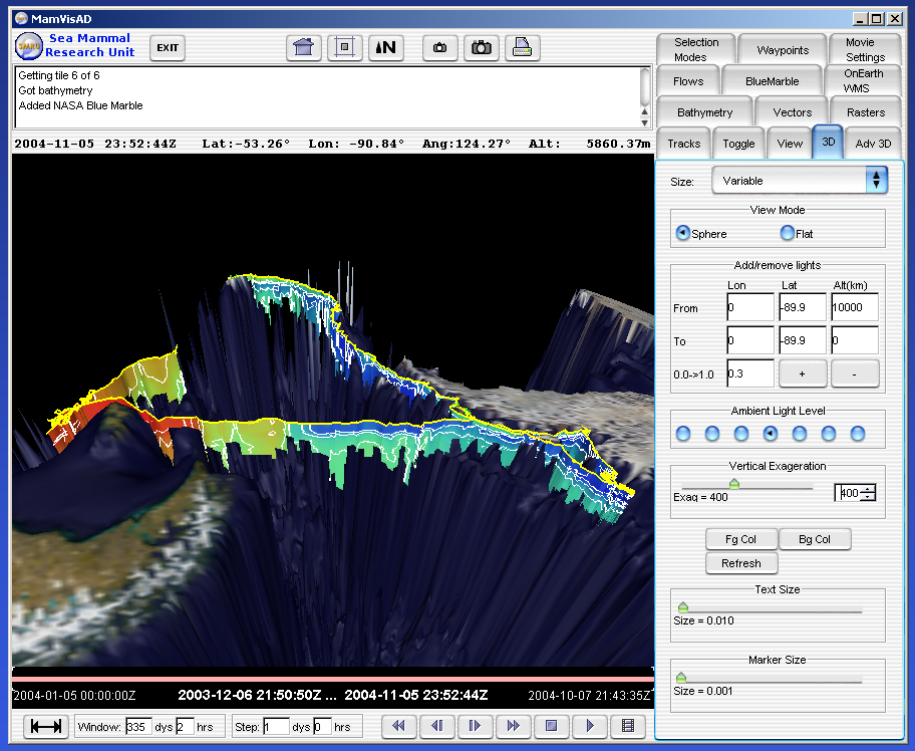

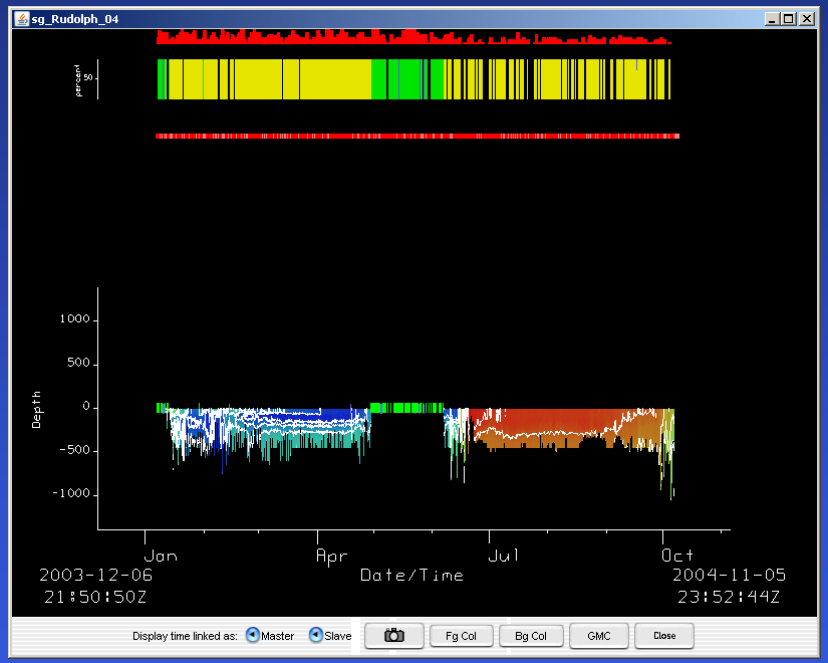

Now one can also see the temperatures as a time series

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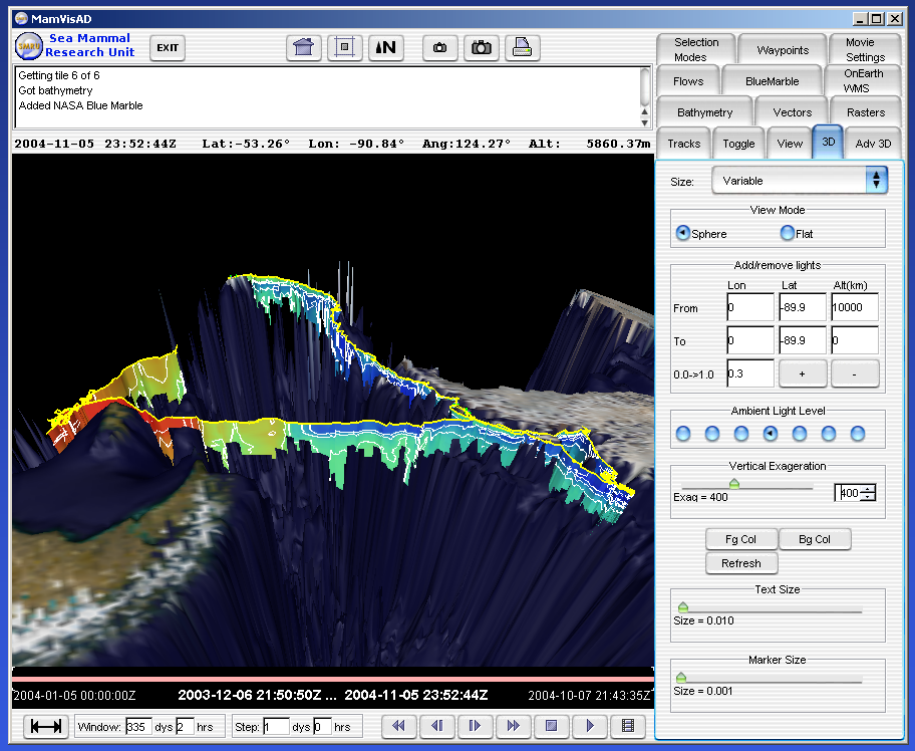

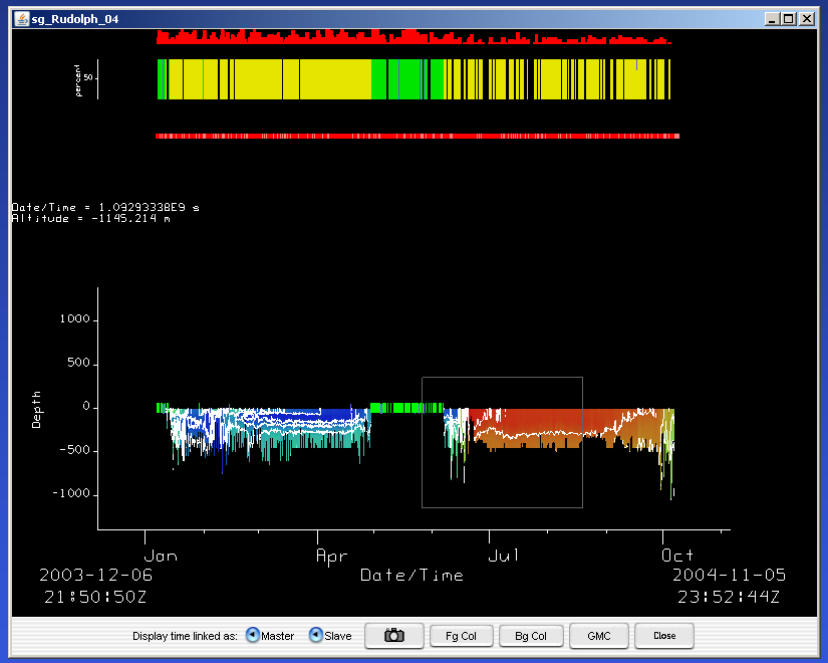

Can zoom in using the stripchart

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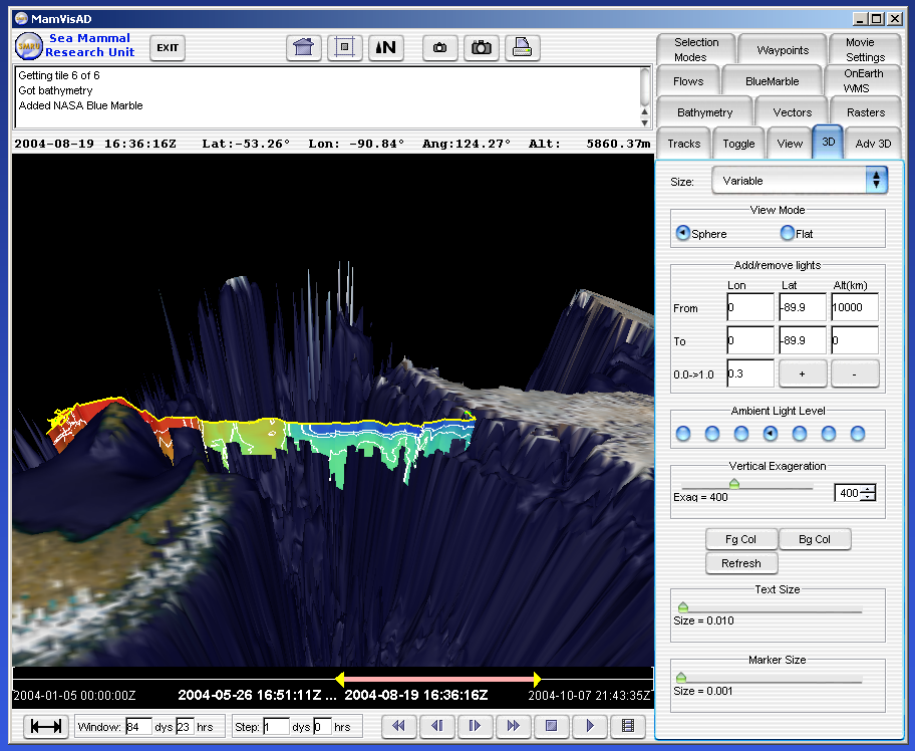

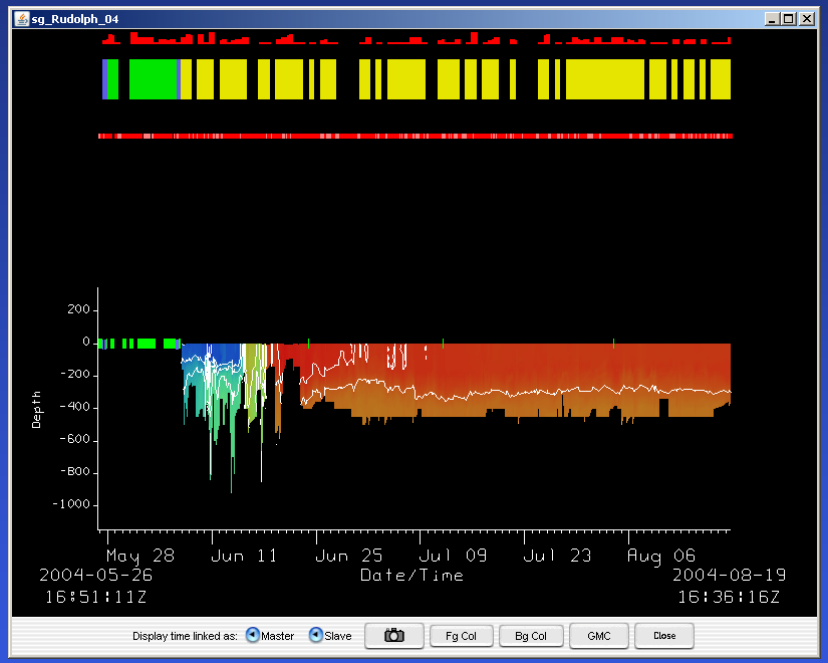

Time slider + 3D window automatically change

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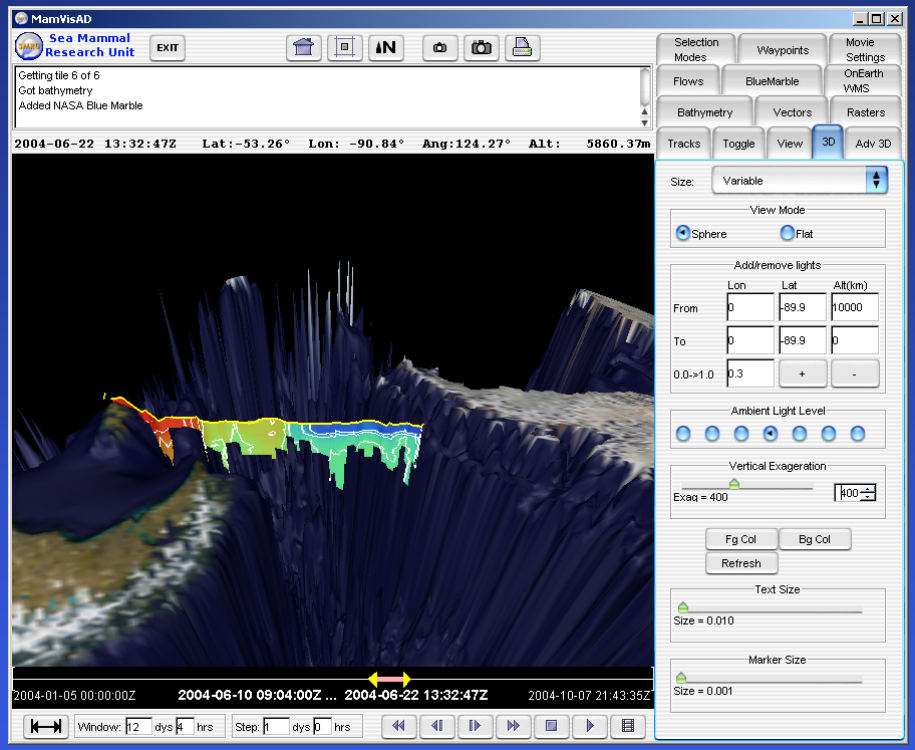

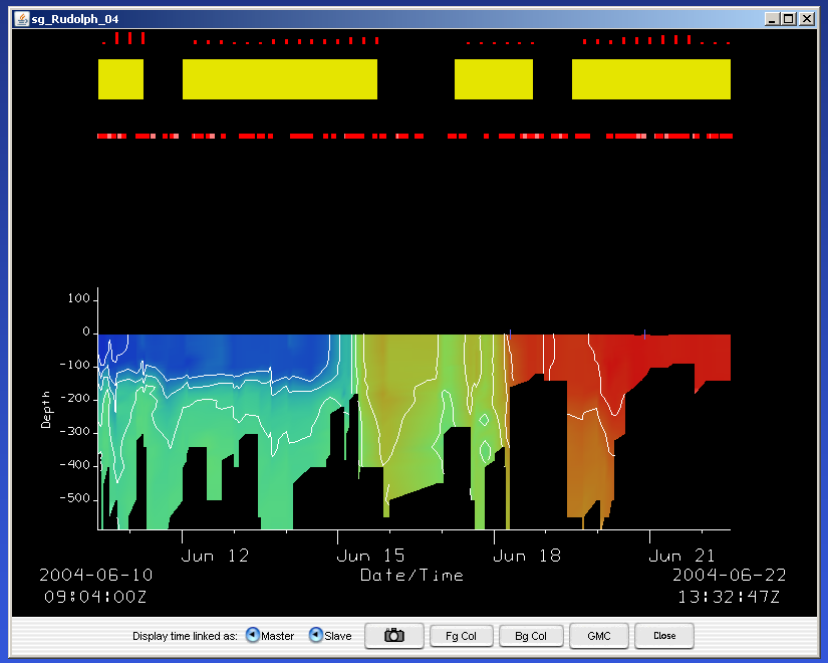

Zooming in time to where Rudolph meets warmer water

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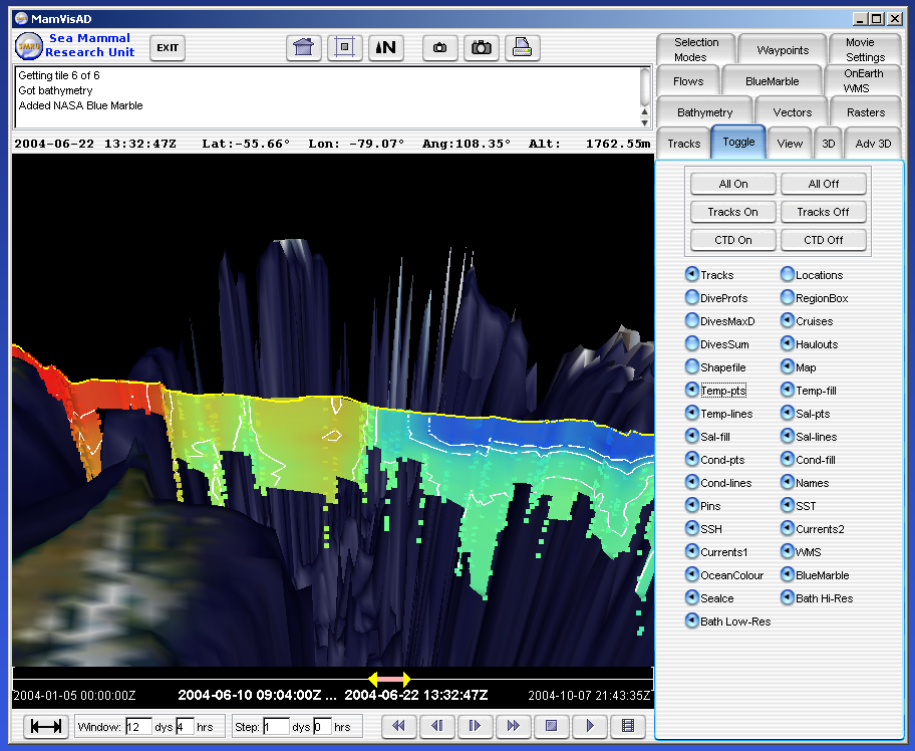

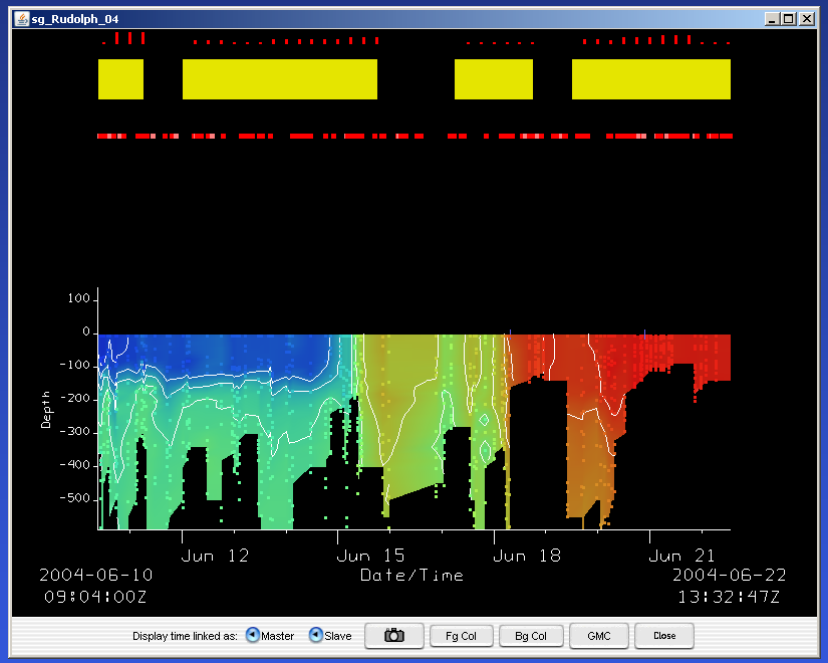

Zooming in 3D window and adding points

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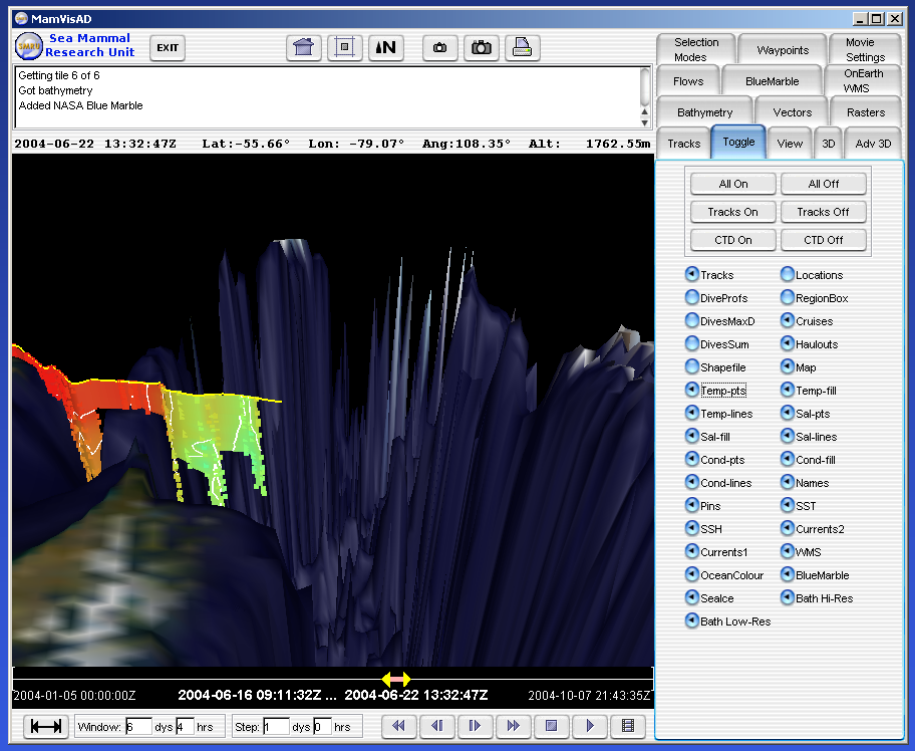

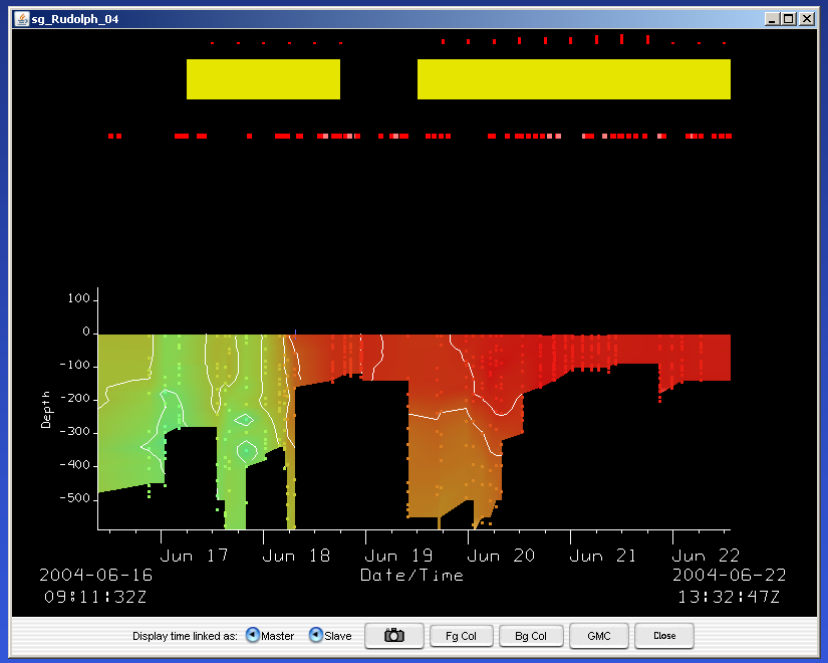

Zooming in time using the Time Slider

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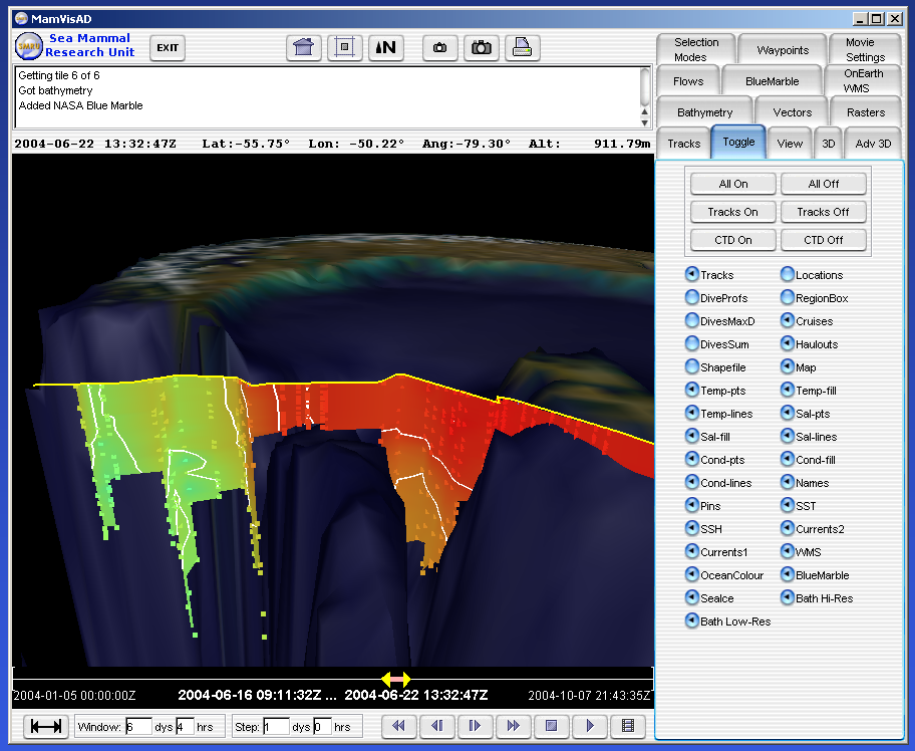

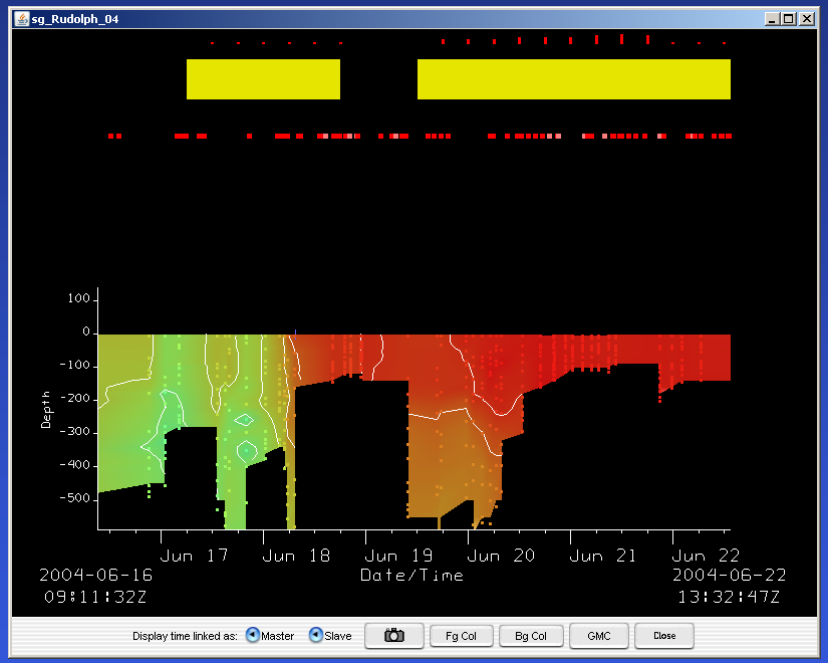

Moving the viewpoint in 3D window

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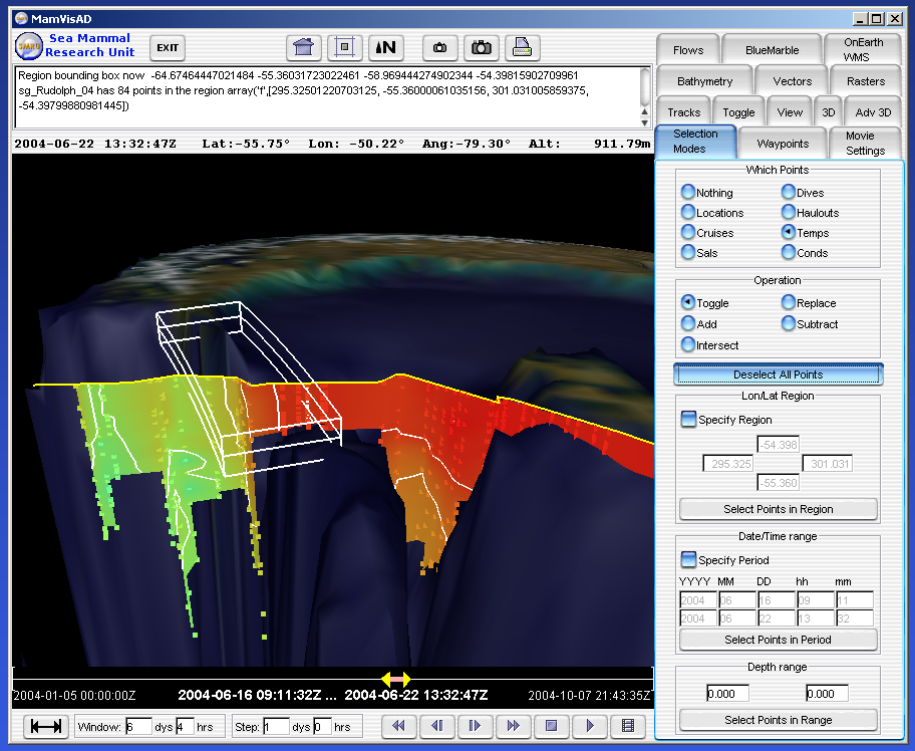

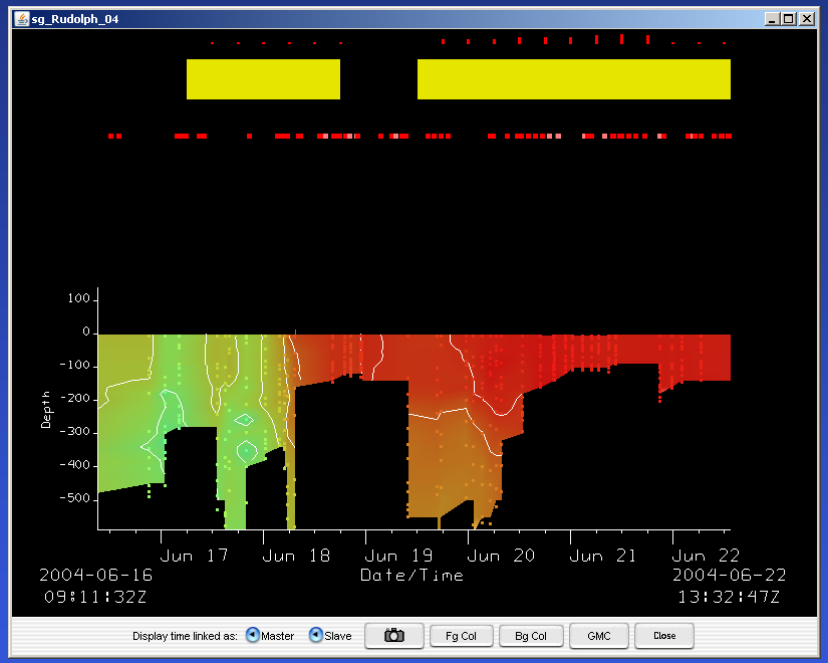

Choosing a spatial region

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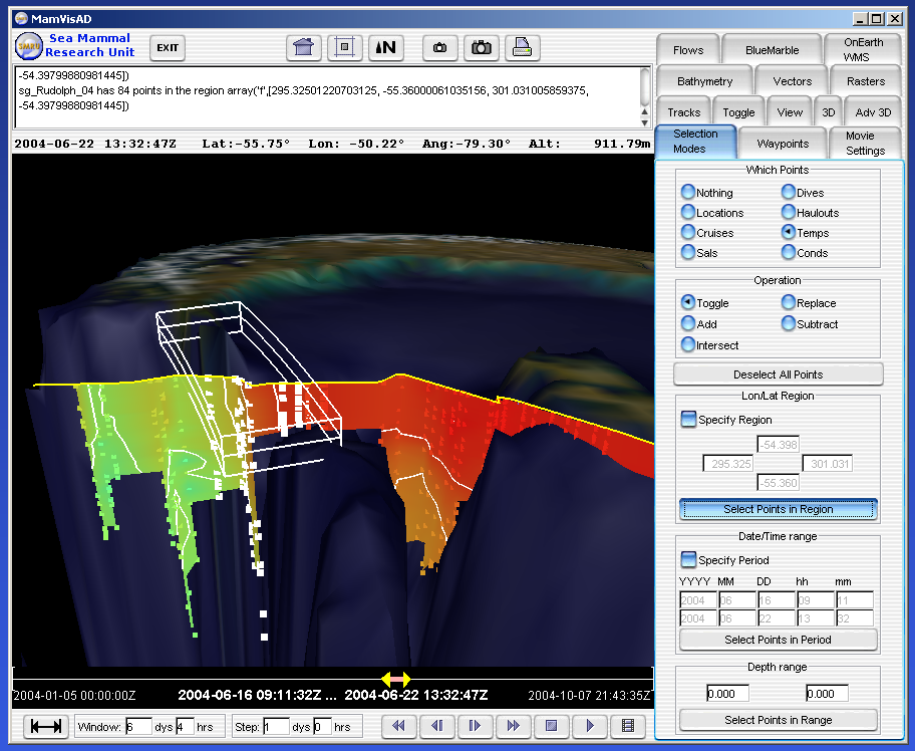

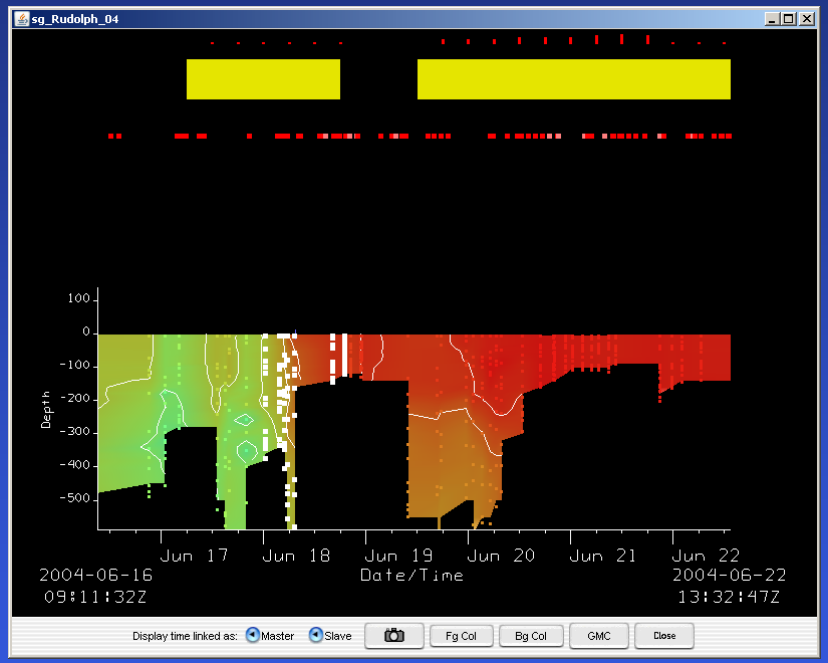

Selecting the temperature casts in that region

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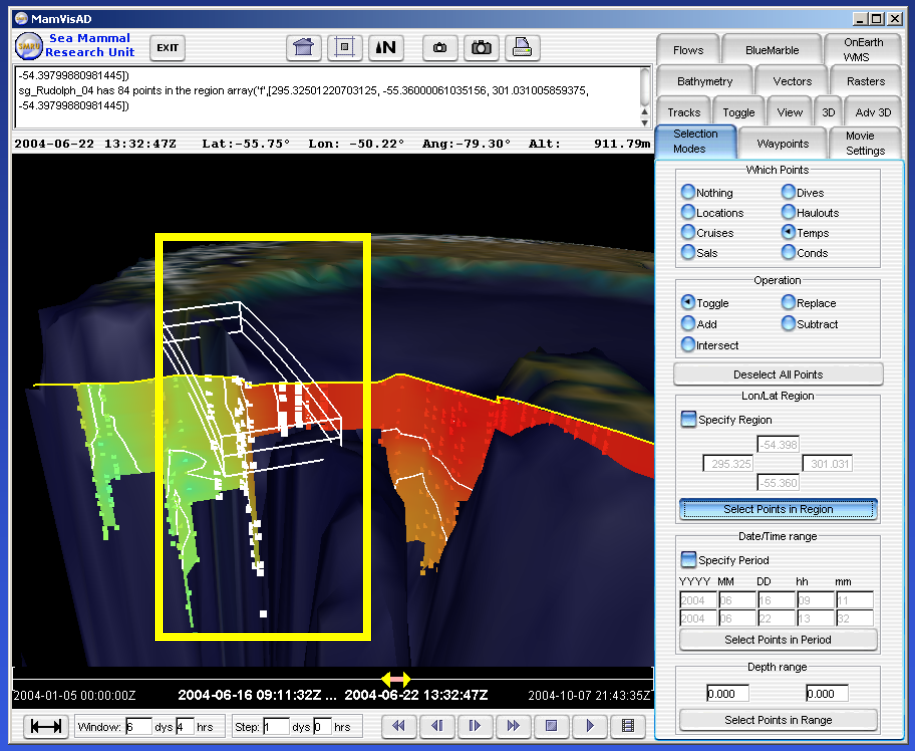

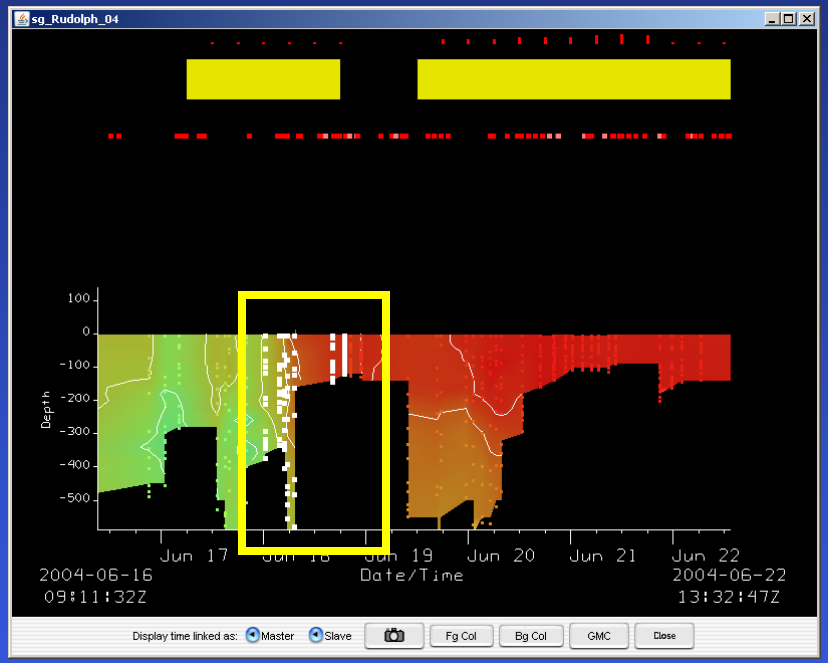

Same points highlighted in both views

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The linked views provide a powerful way of exploring the dataset

A similar approach can be taken when producing movies….

Southern Elephant Seals as Oceanographic Samplers

Rudolph June 2004: The Drake Passage

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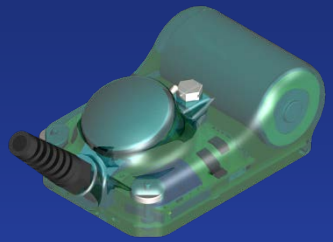
GSM-GPS SRDL Data



- Deployments tend to be smaller in spatial scale
- Can get more complete dive record than ARGOS.
  - Sometimes >50,000 dives per animal
- GSM allows more detailed dive profiles to be sent

In this case as an example let us look at some data from Strangford Lough in Northern Ireland

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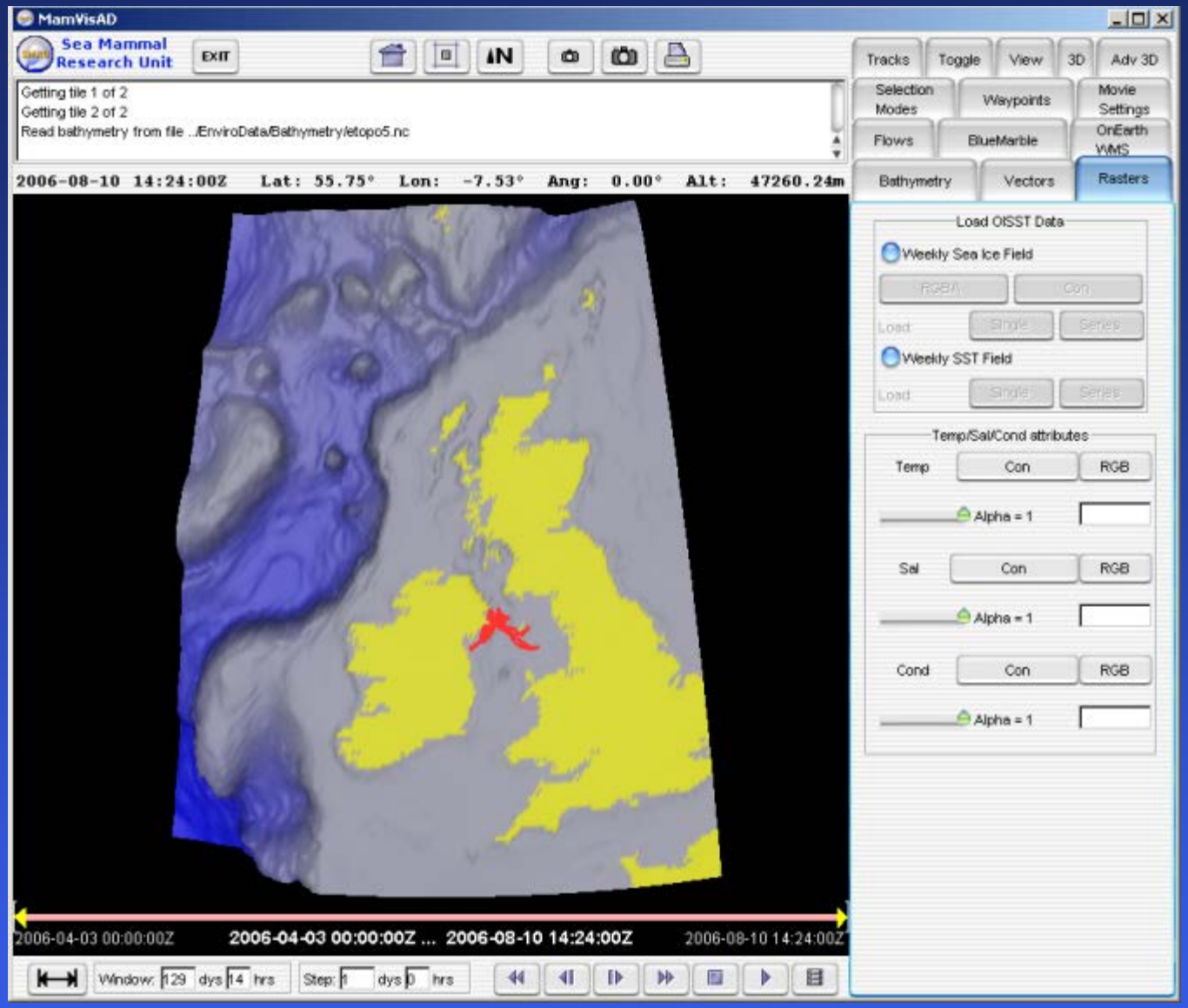

Strangford Lough

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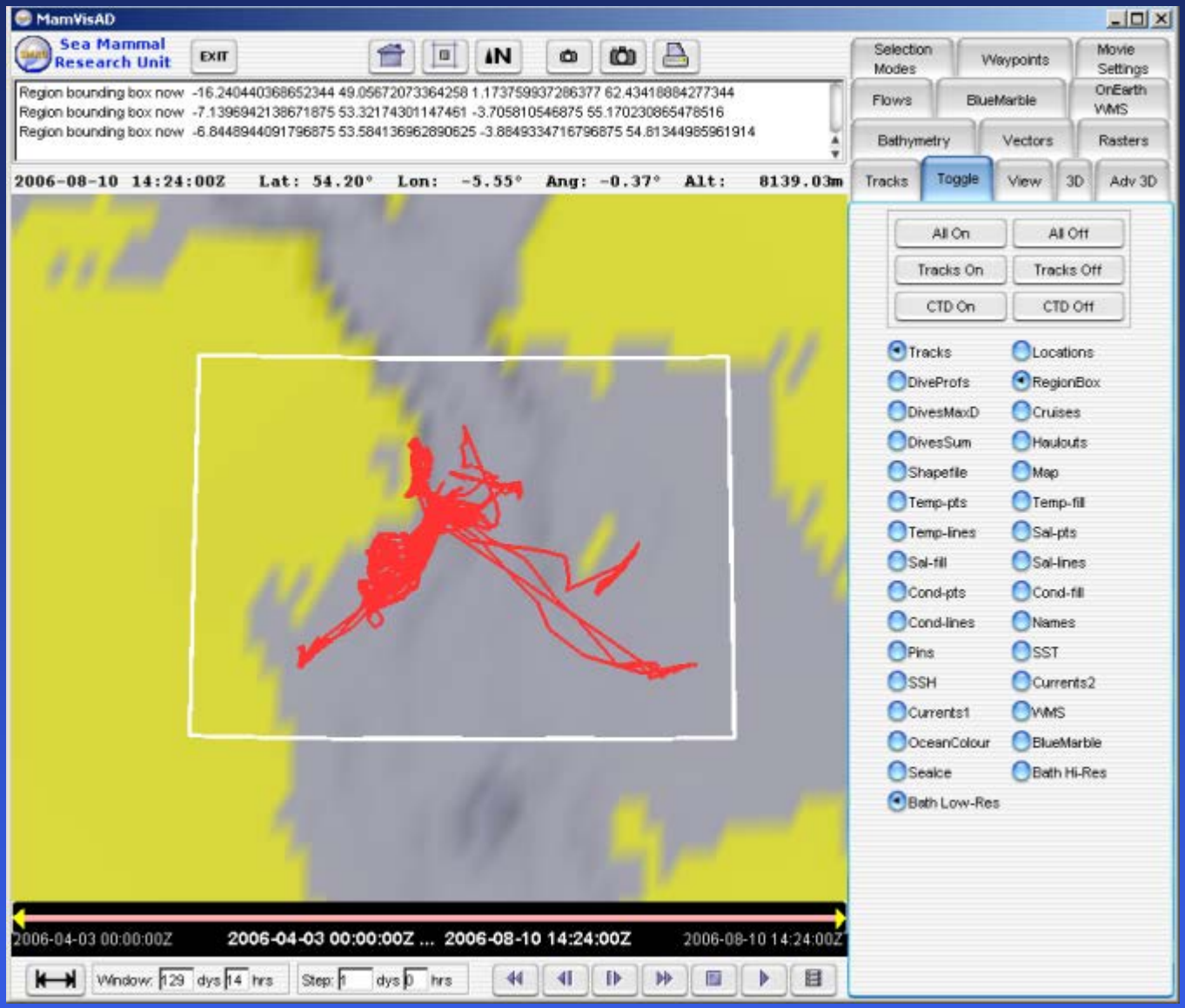

Zooming into the Lough

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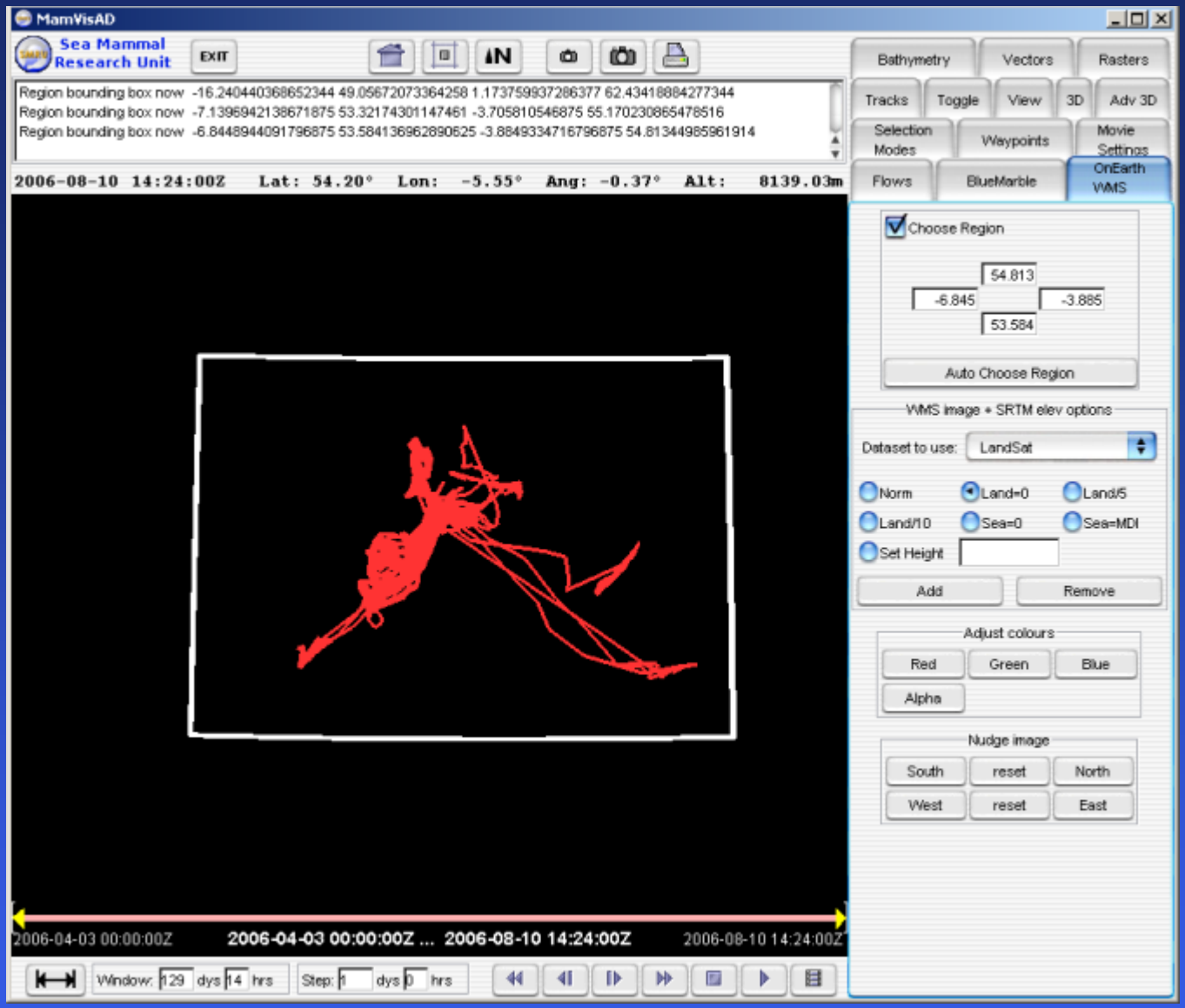

Selecting some online data – NASA OnEarth

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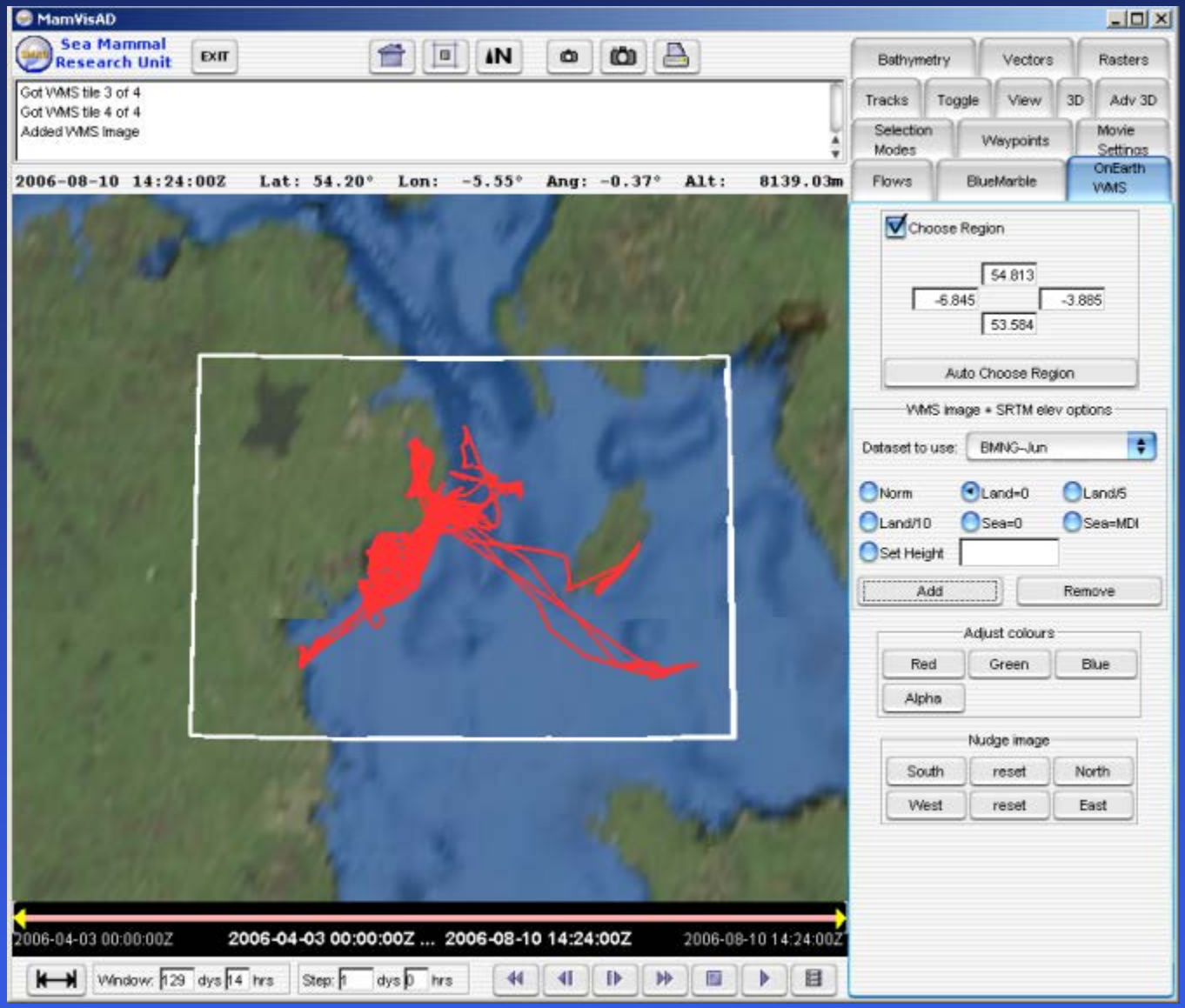

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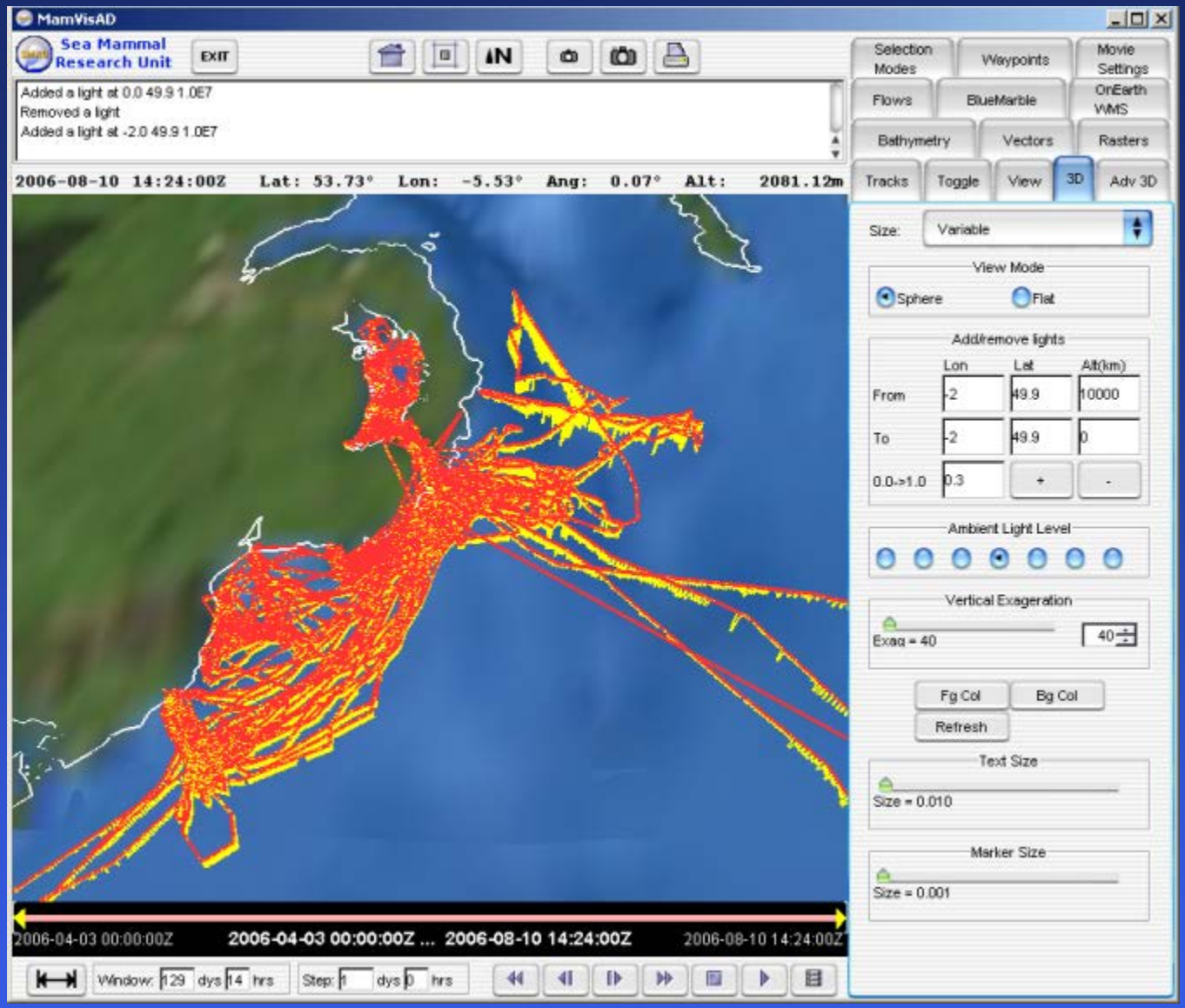

Turning on the dives and zooming in

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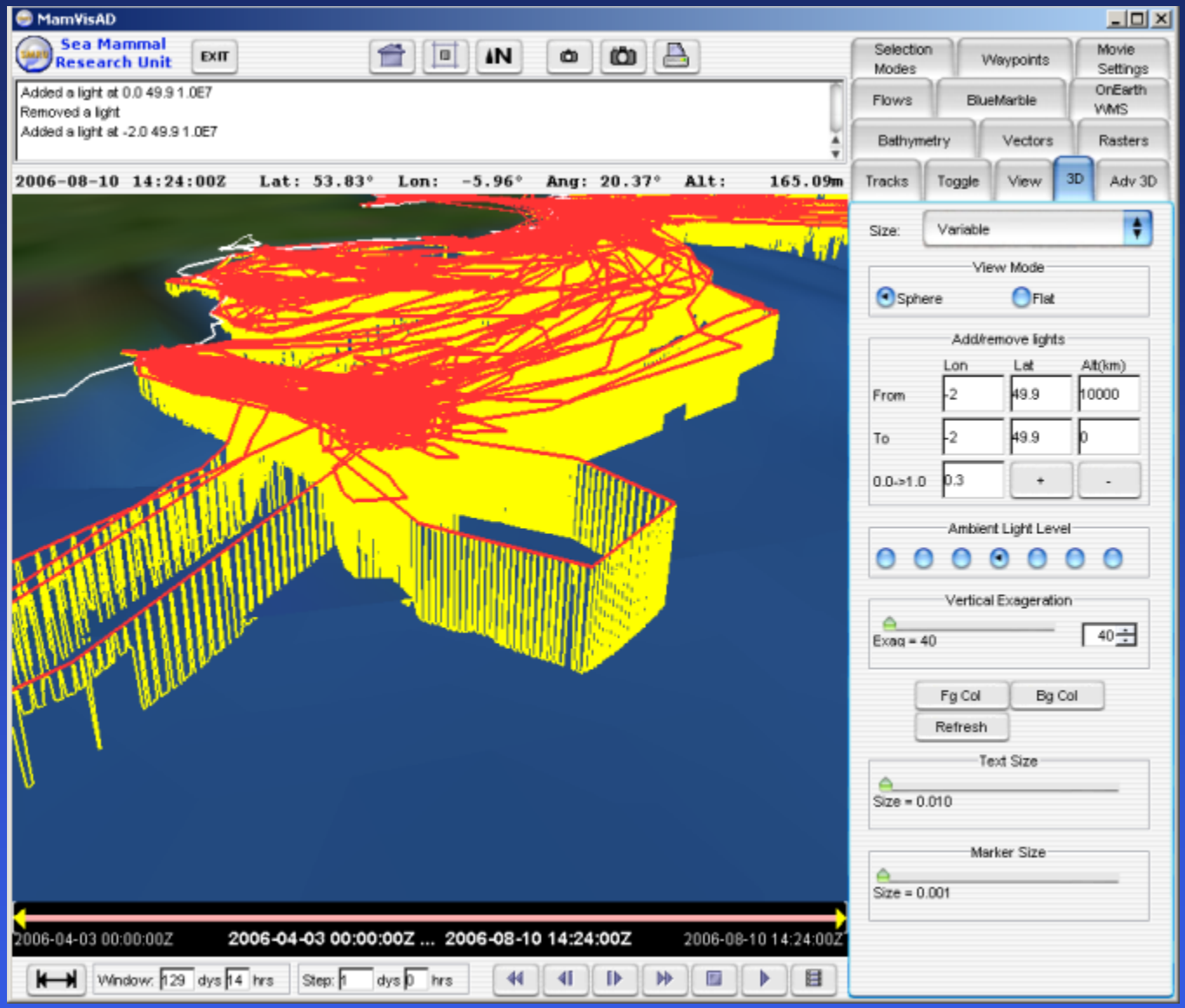

Moving to get a better view of the dives

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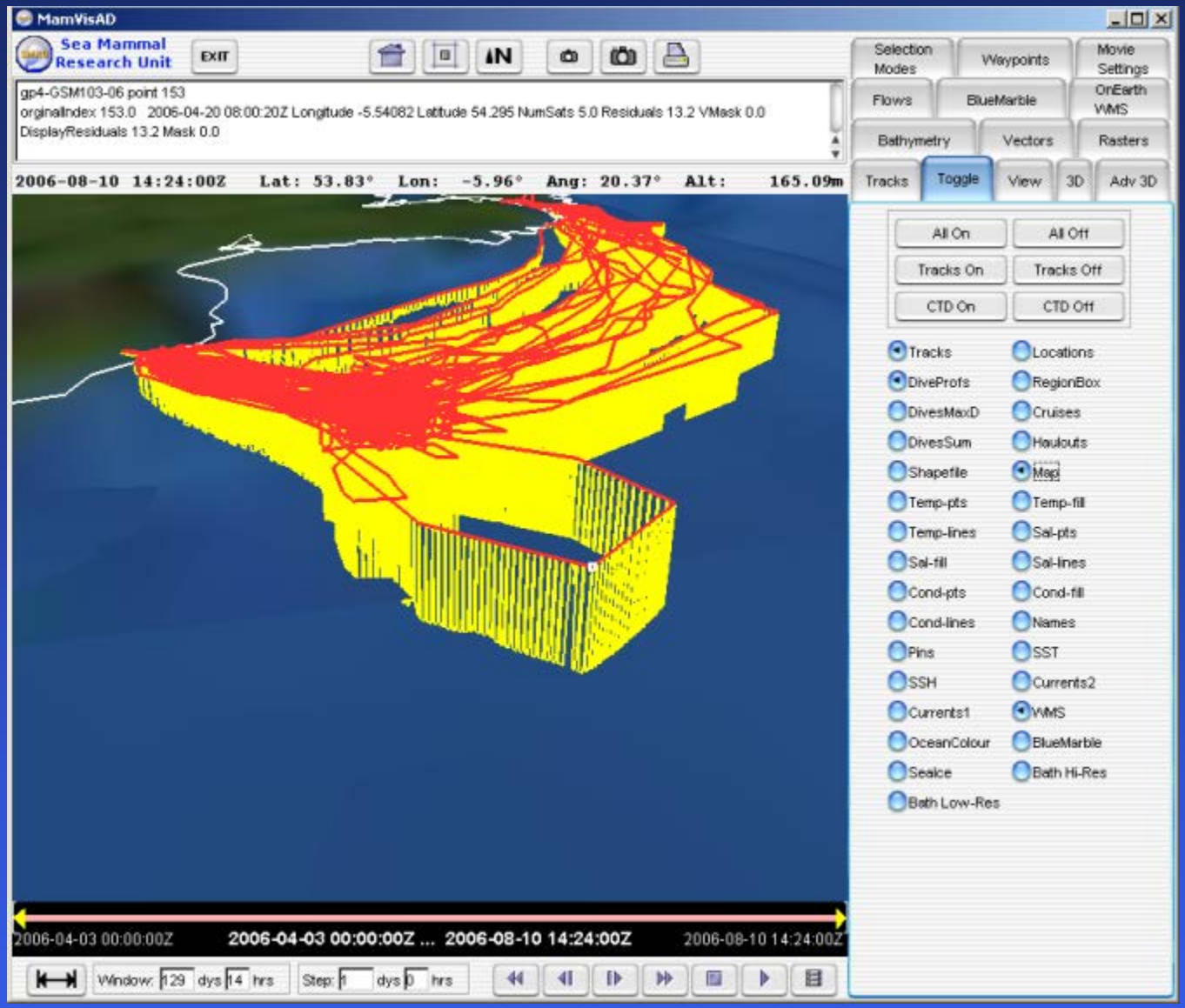

Toggling off the other seals

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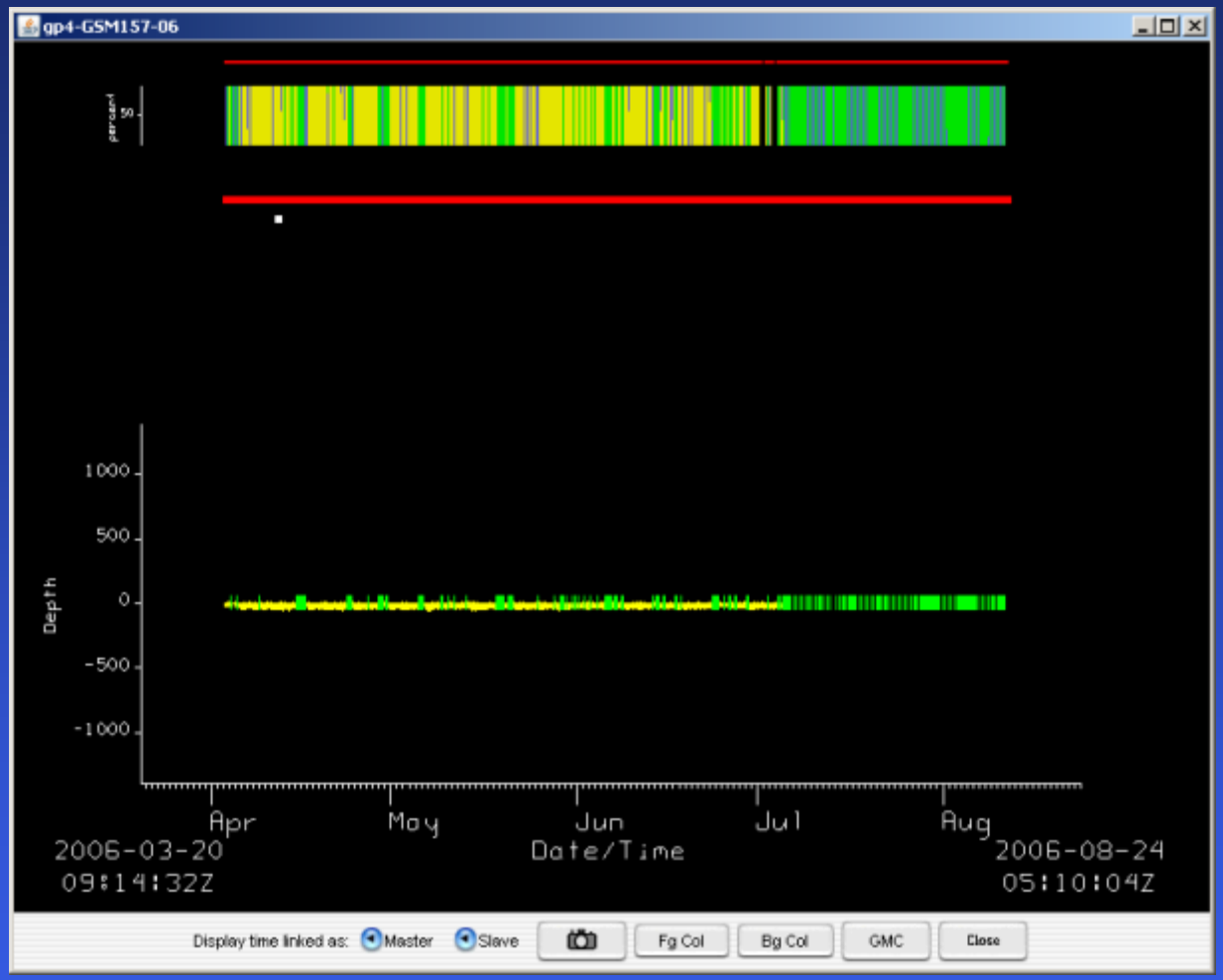

Opening the stripchart

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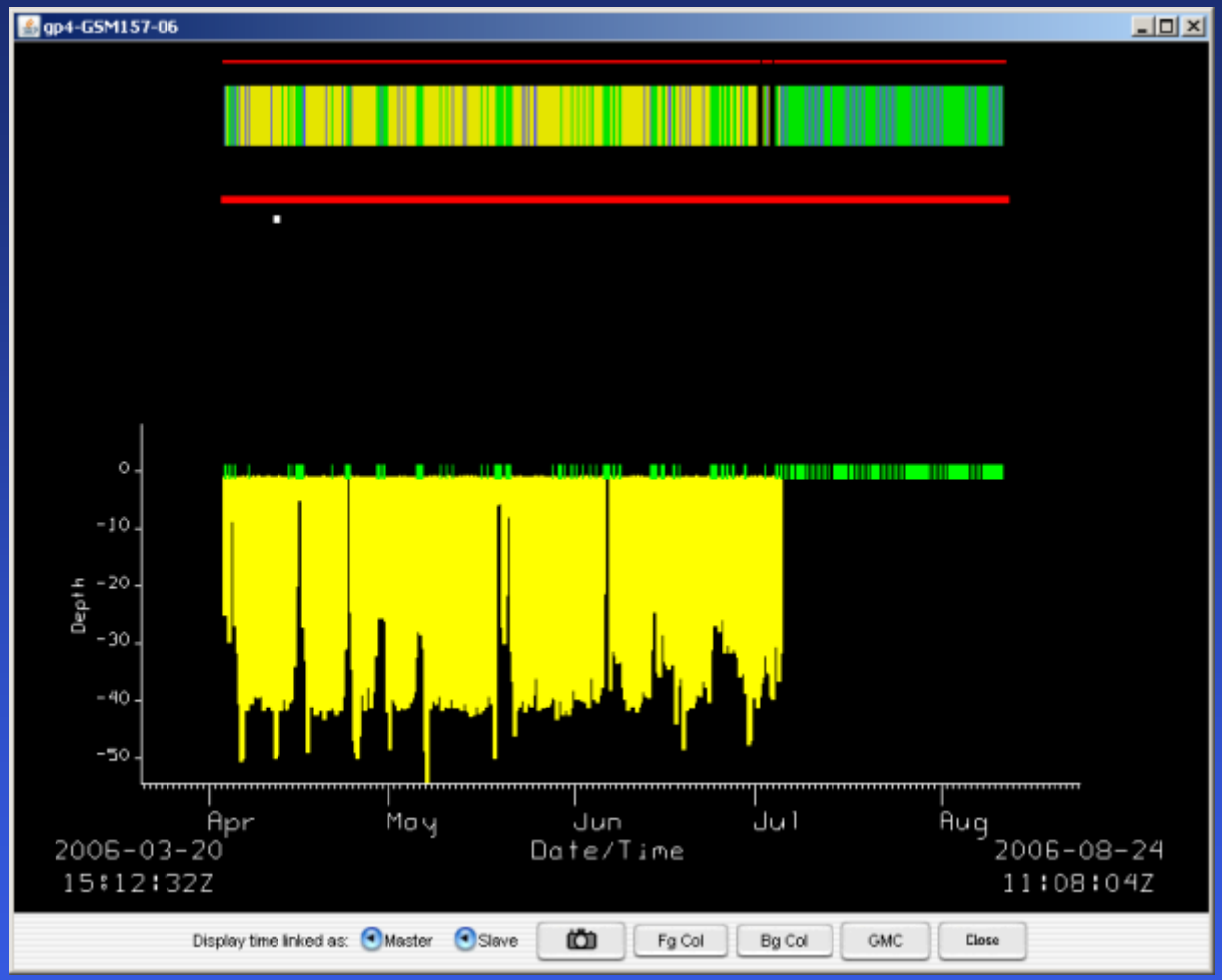

Stretching the vertical axis

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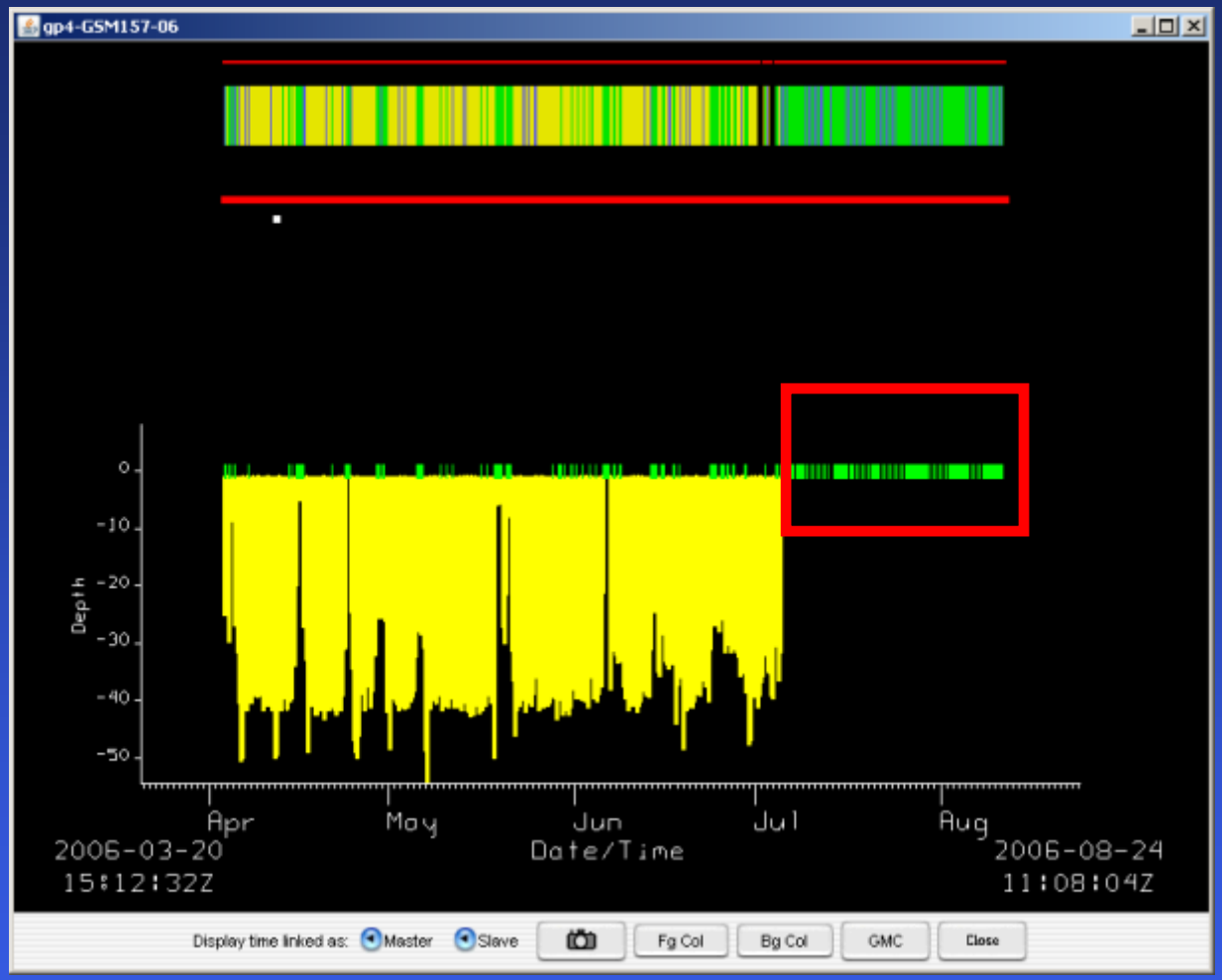

A sanity check. Has the tag fallen off?

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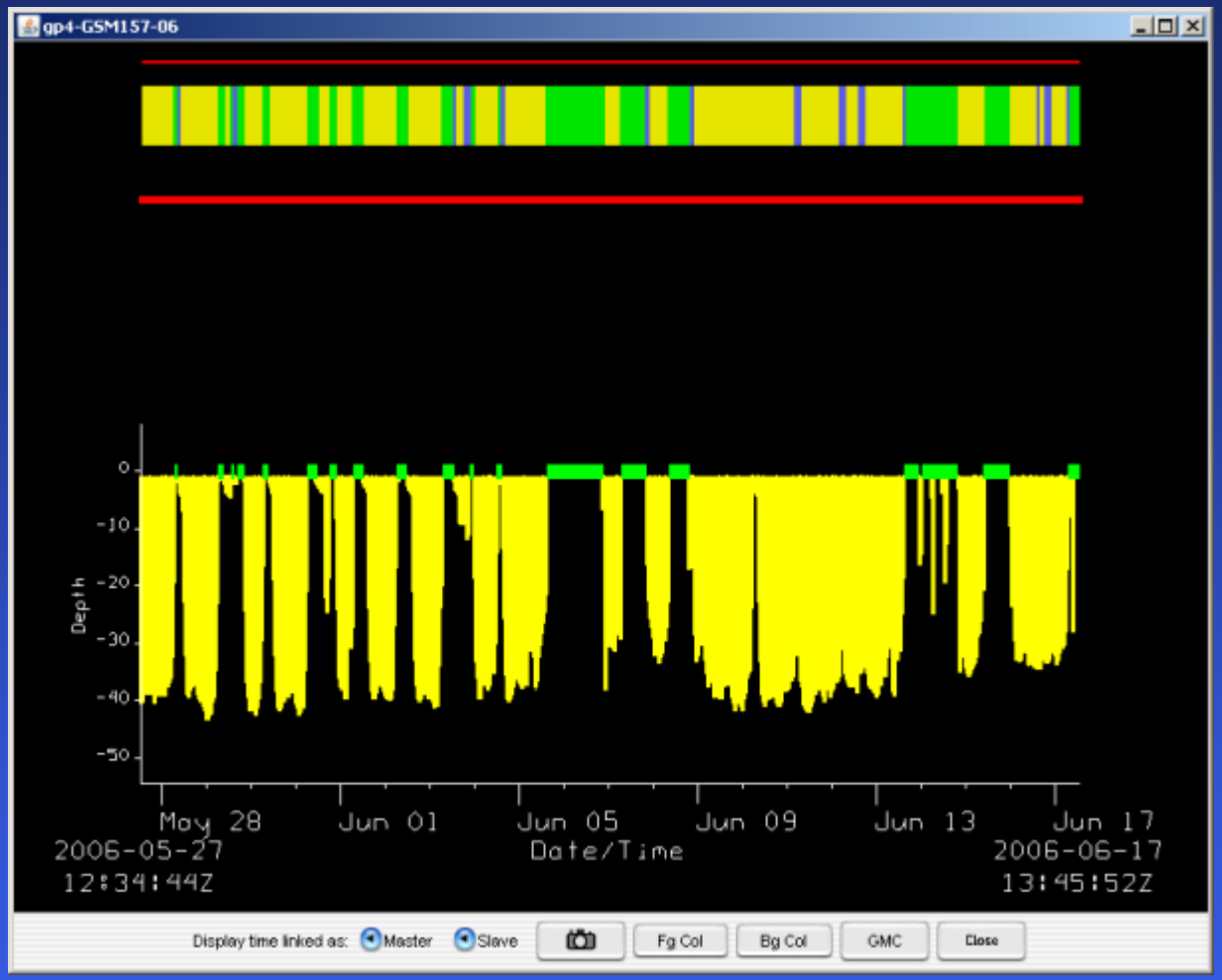

Stretching the time axis

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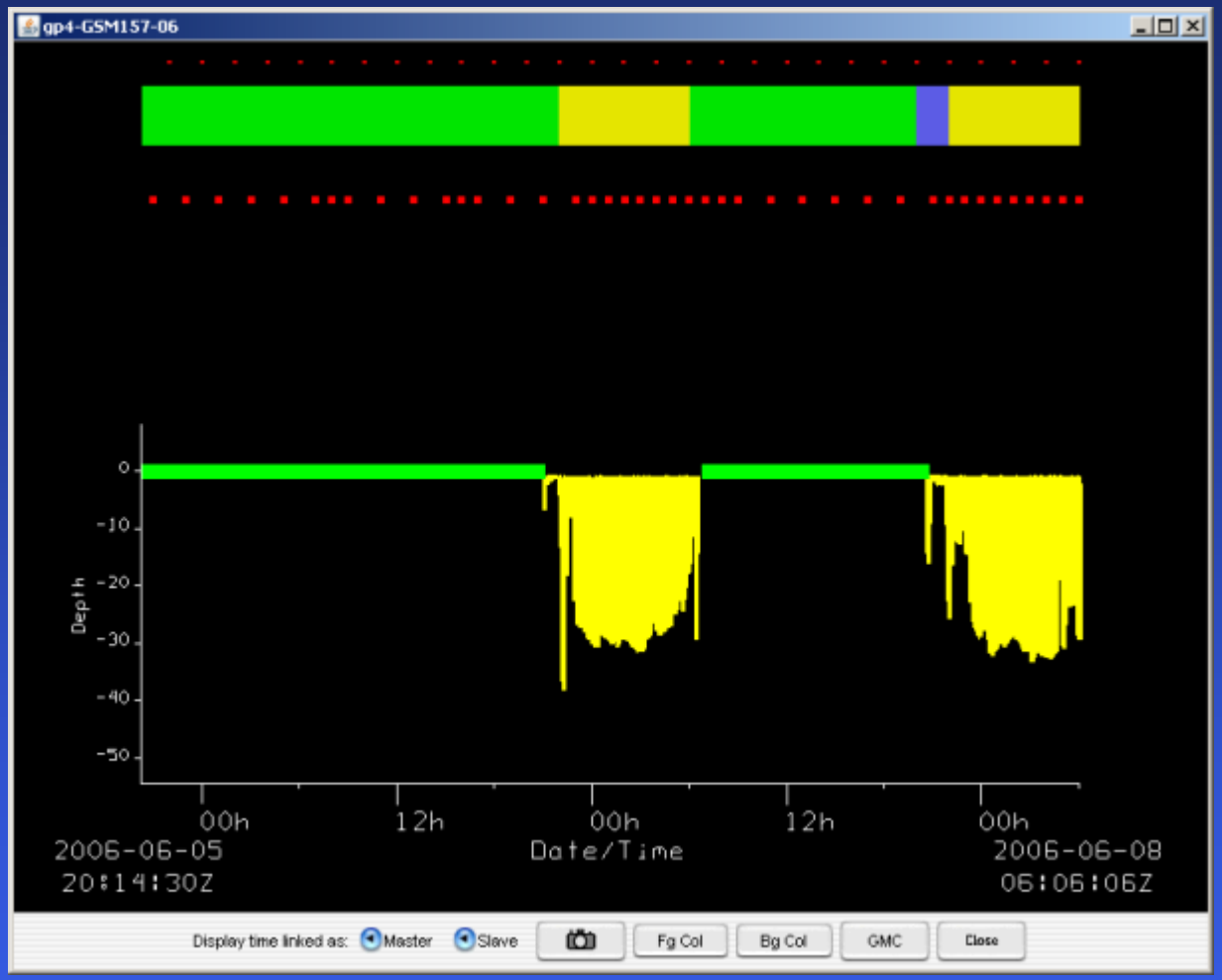

Zooming into to look at just one day

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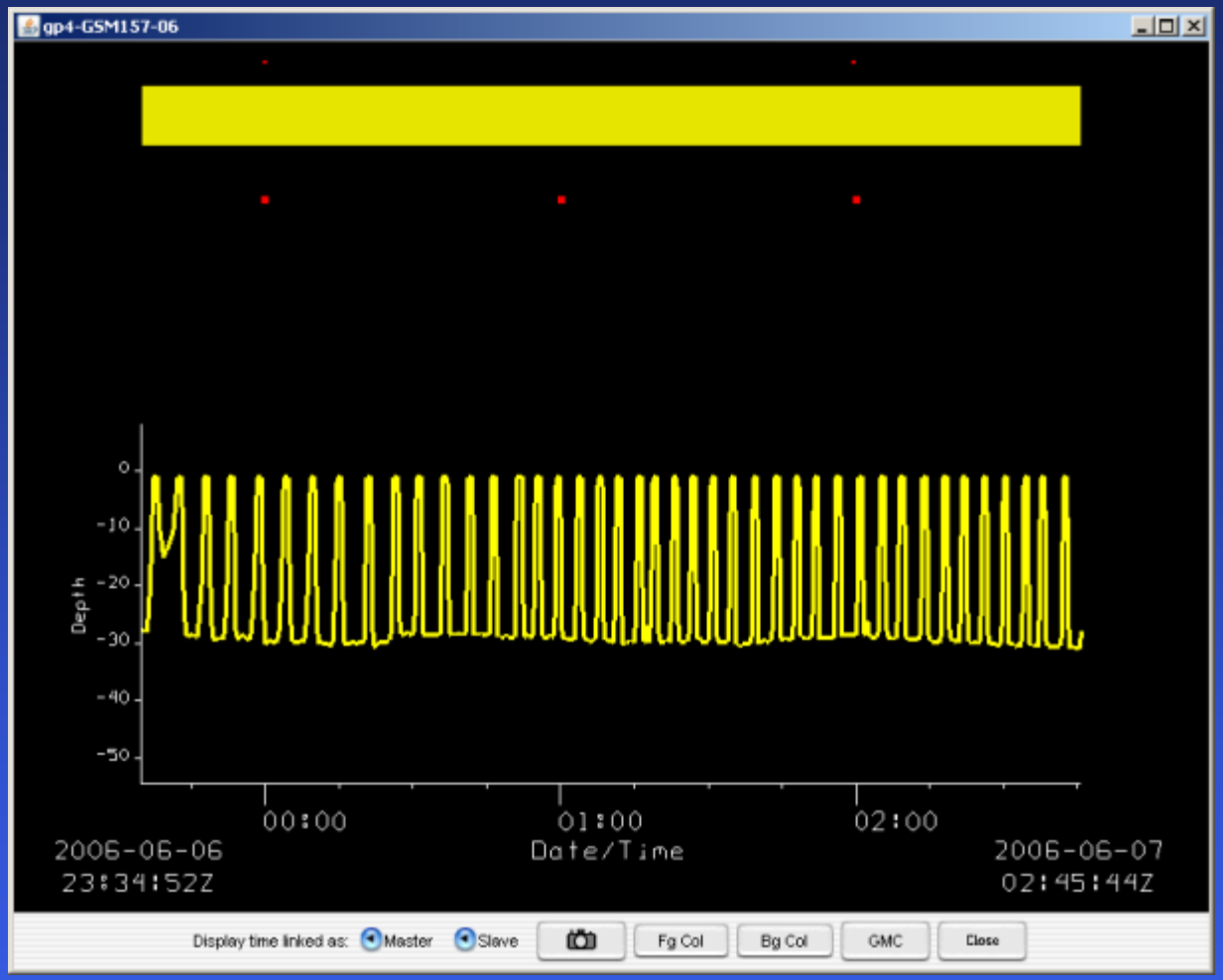

Now showing only three hours – starting to see individual dives

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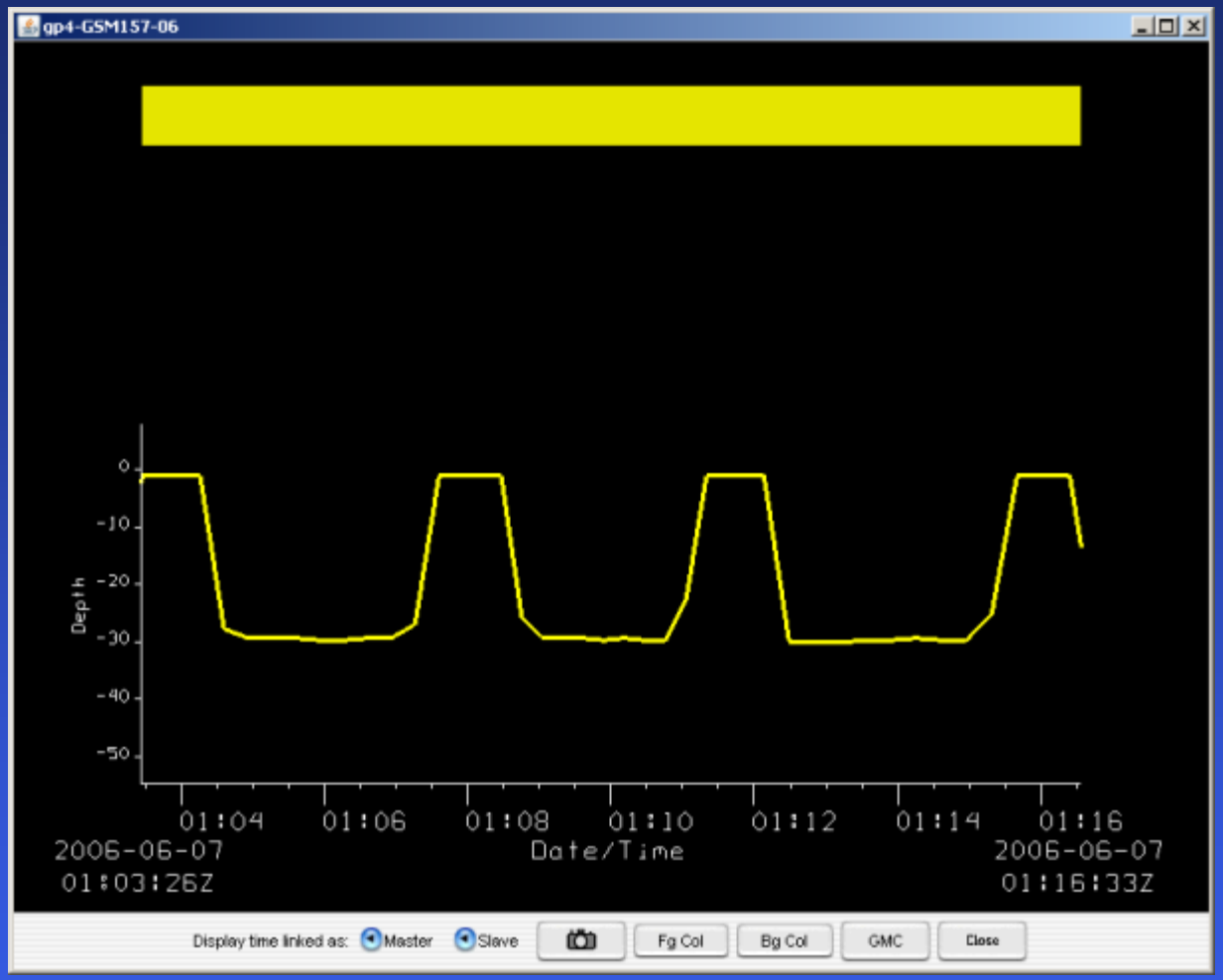

15 mins

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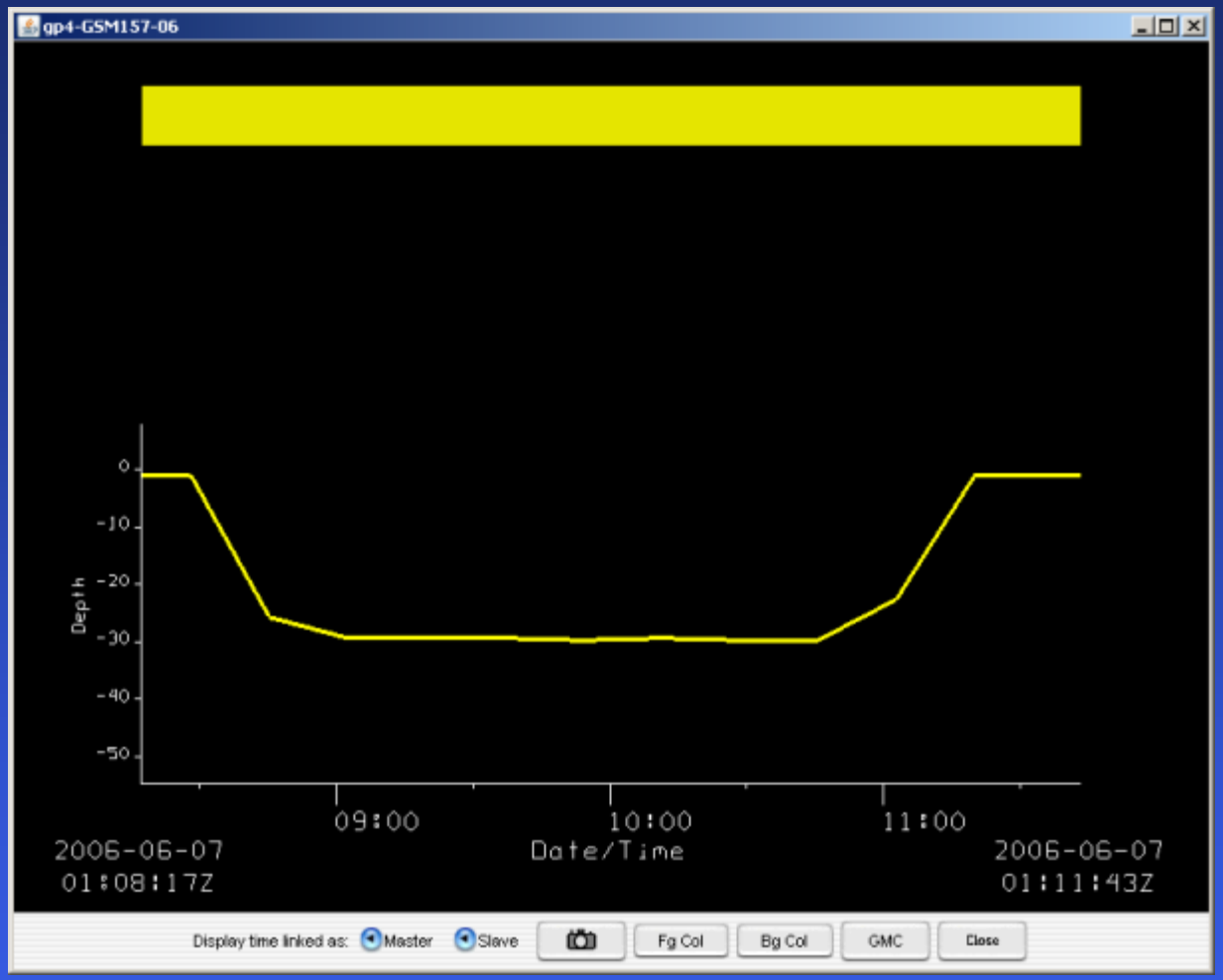

One dive which lasted < 5 mins

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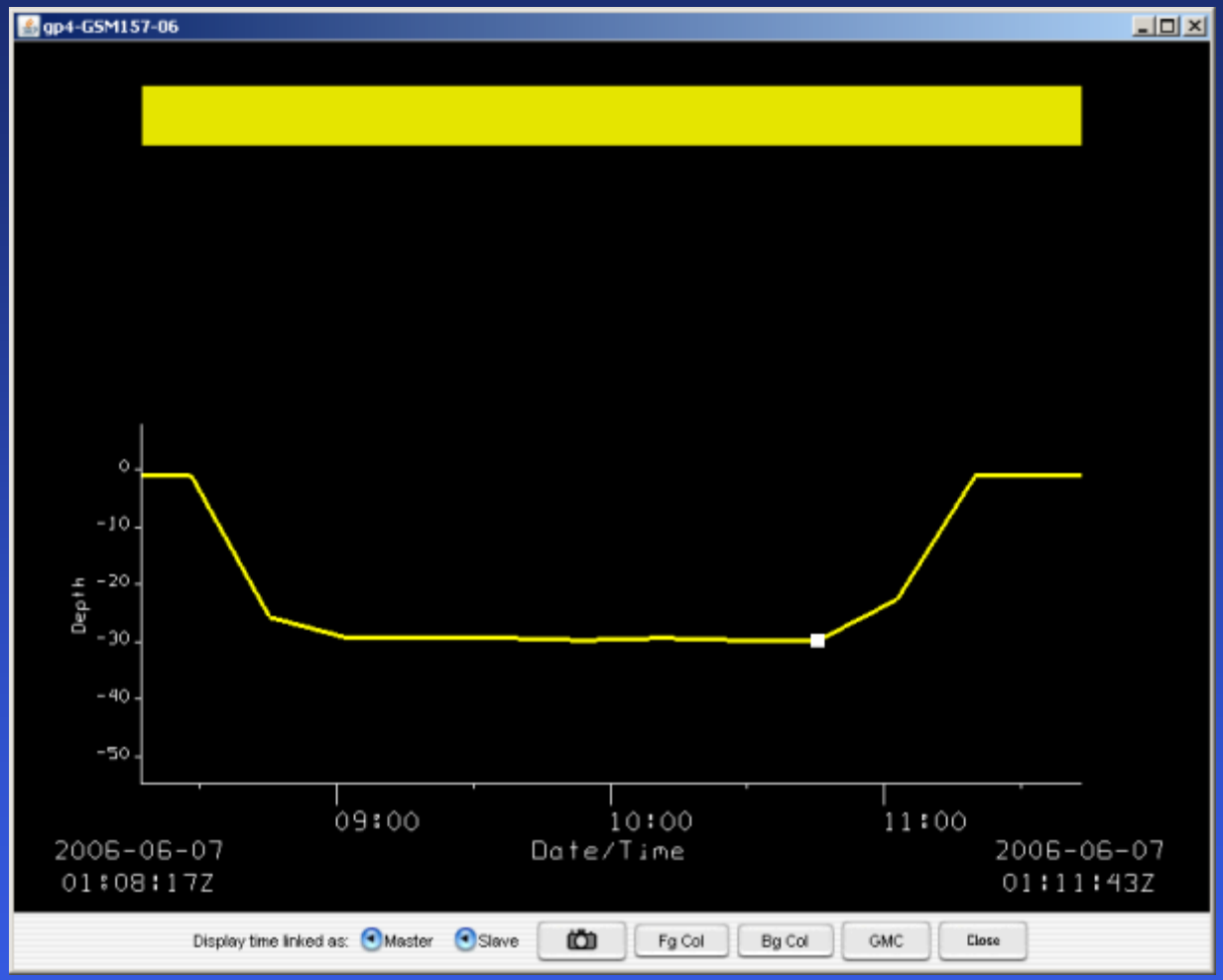

Selecting a point

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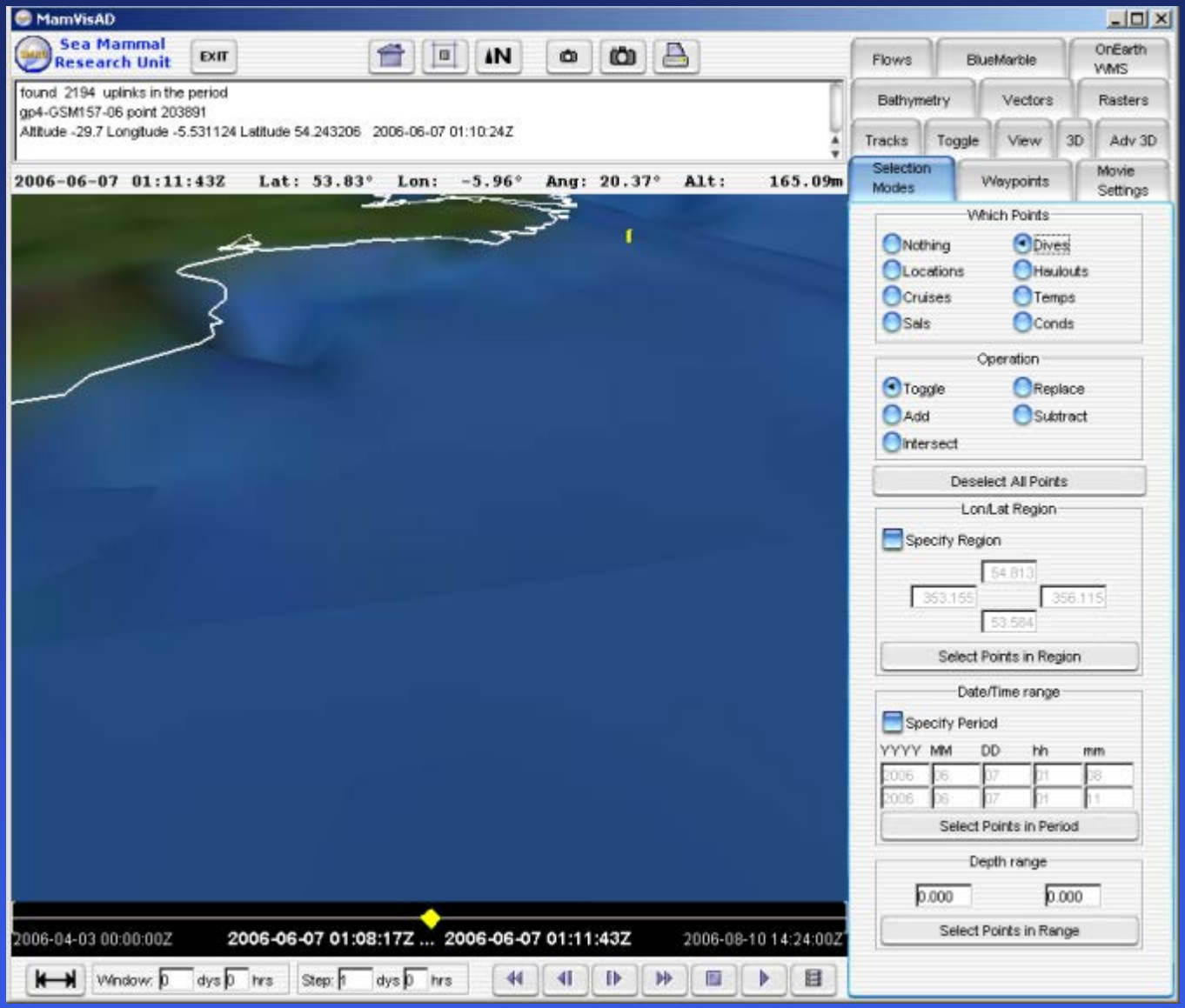

Moving back to the 3D view

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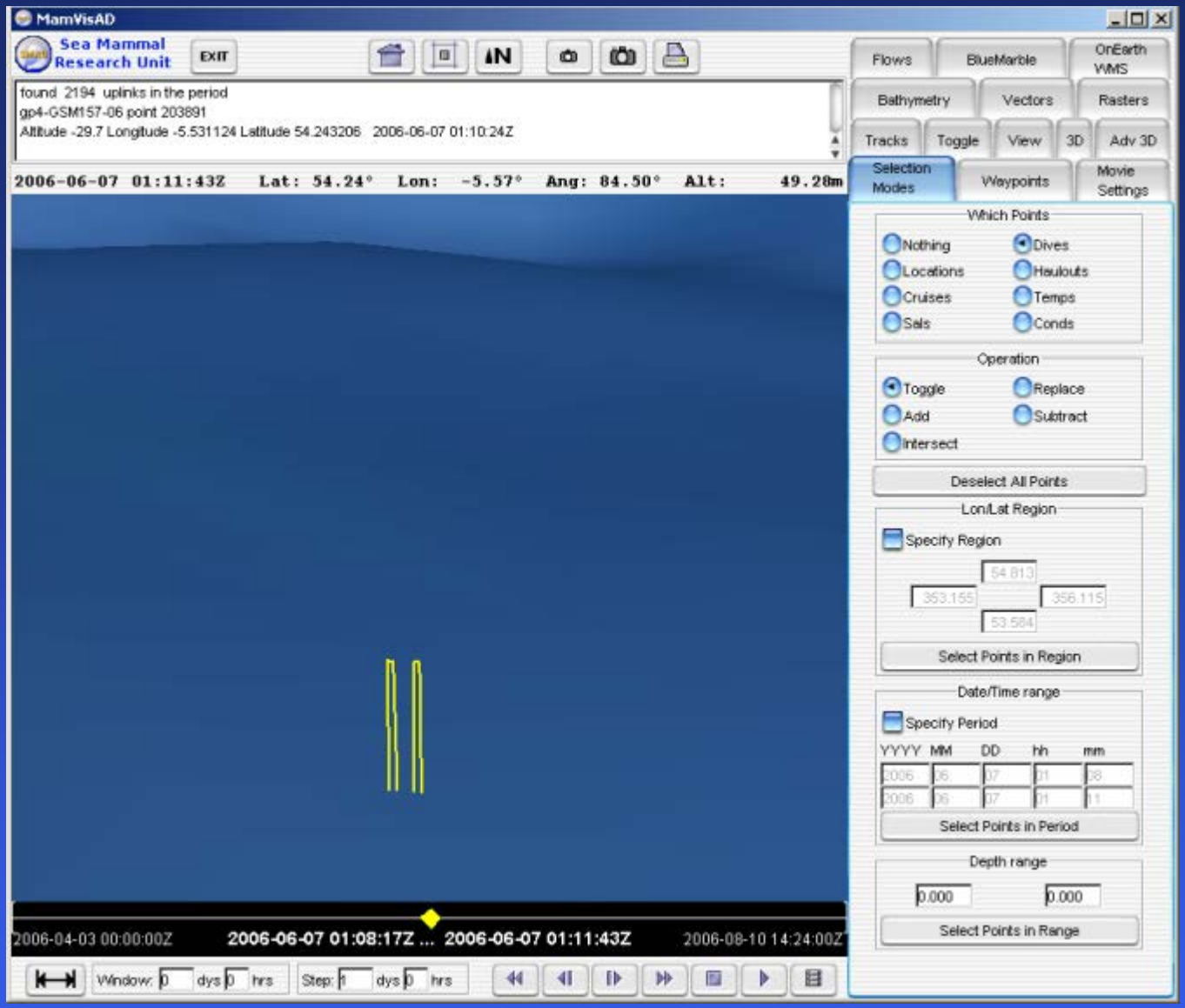

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The dive is showing through the bathymetry

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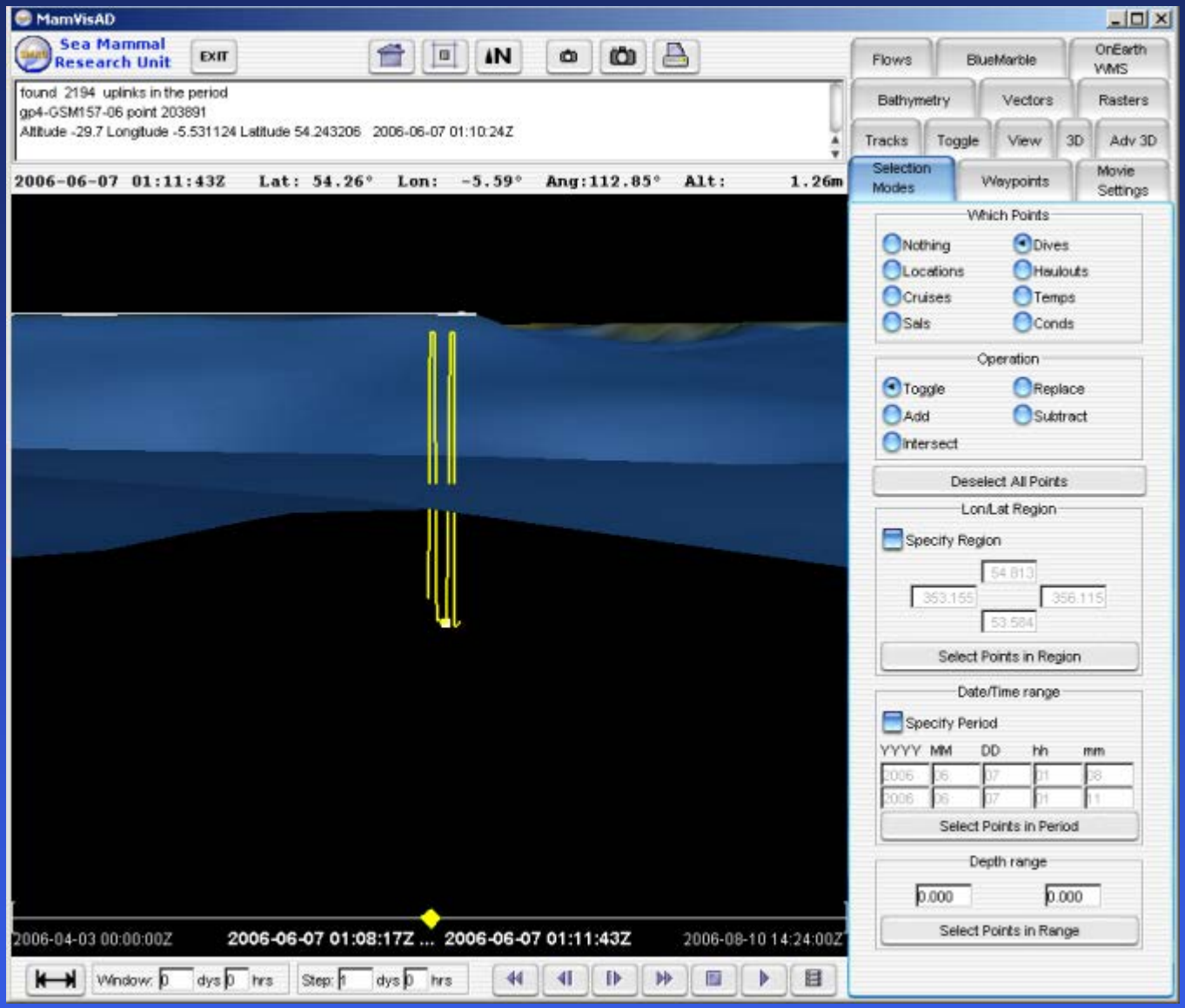

Looking underneath – can now see the selected point

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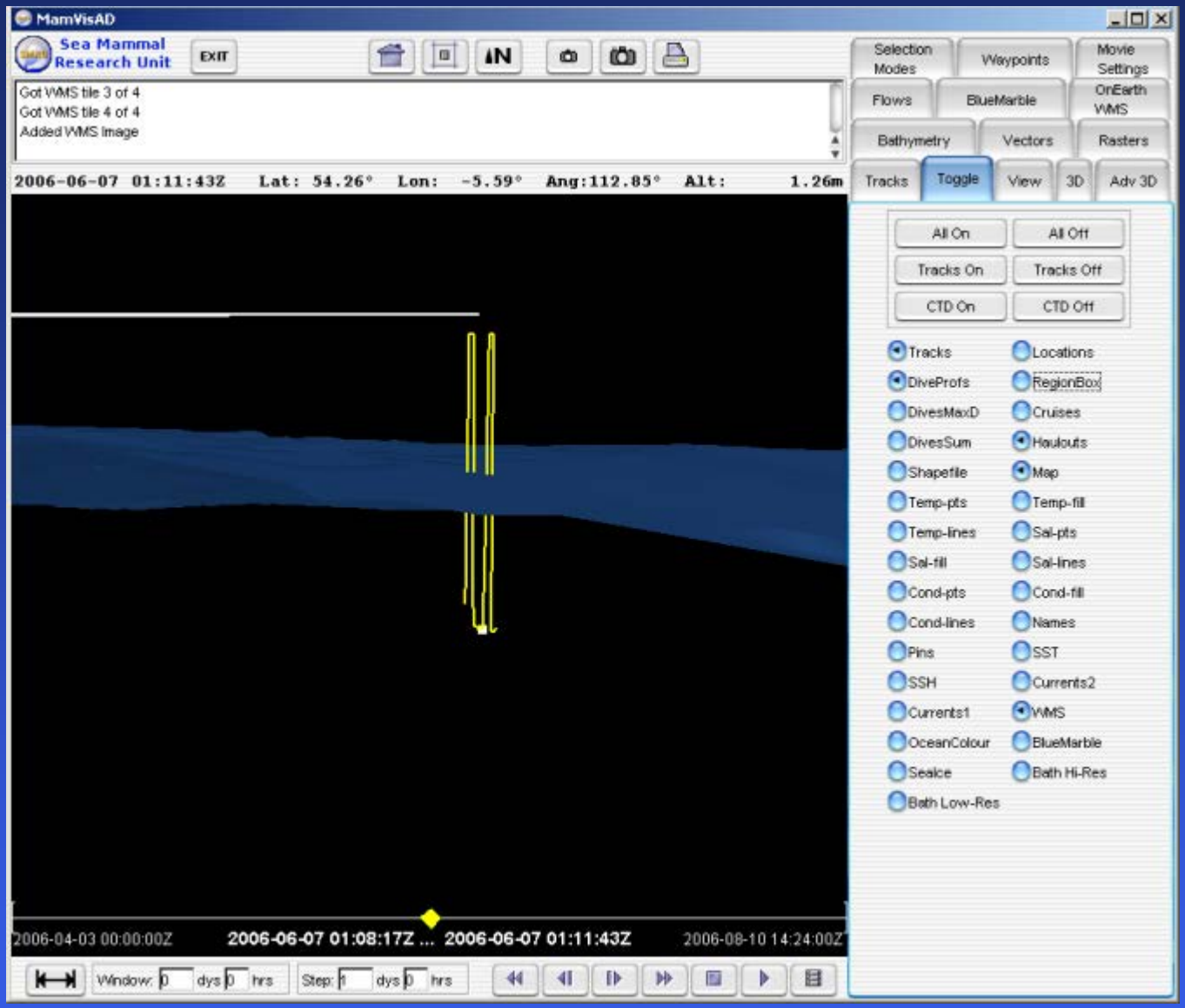

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Trying higher resolution bathymetry

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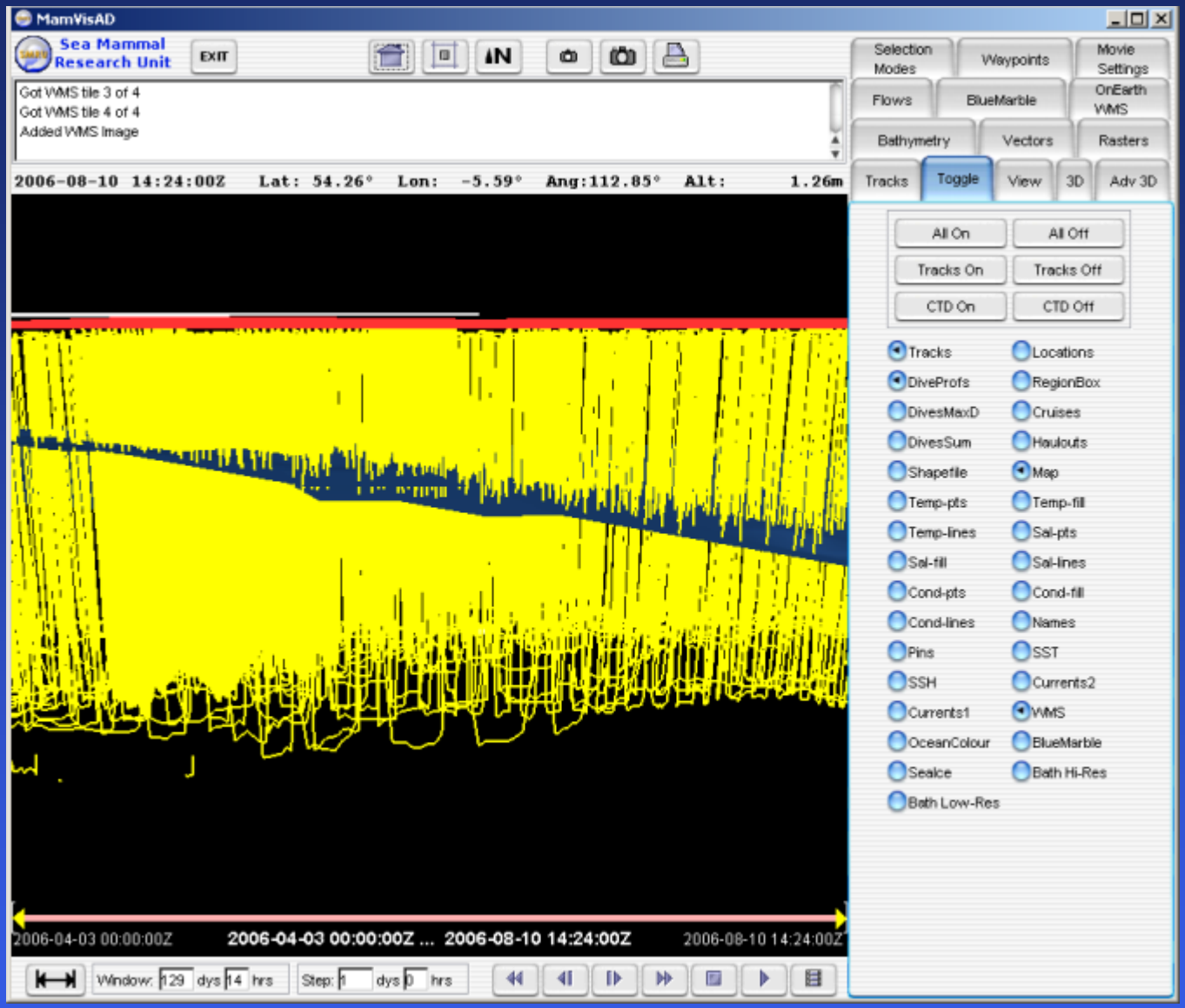

Looking at all the dives again

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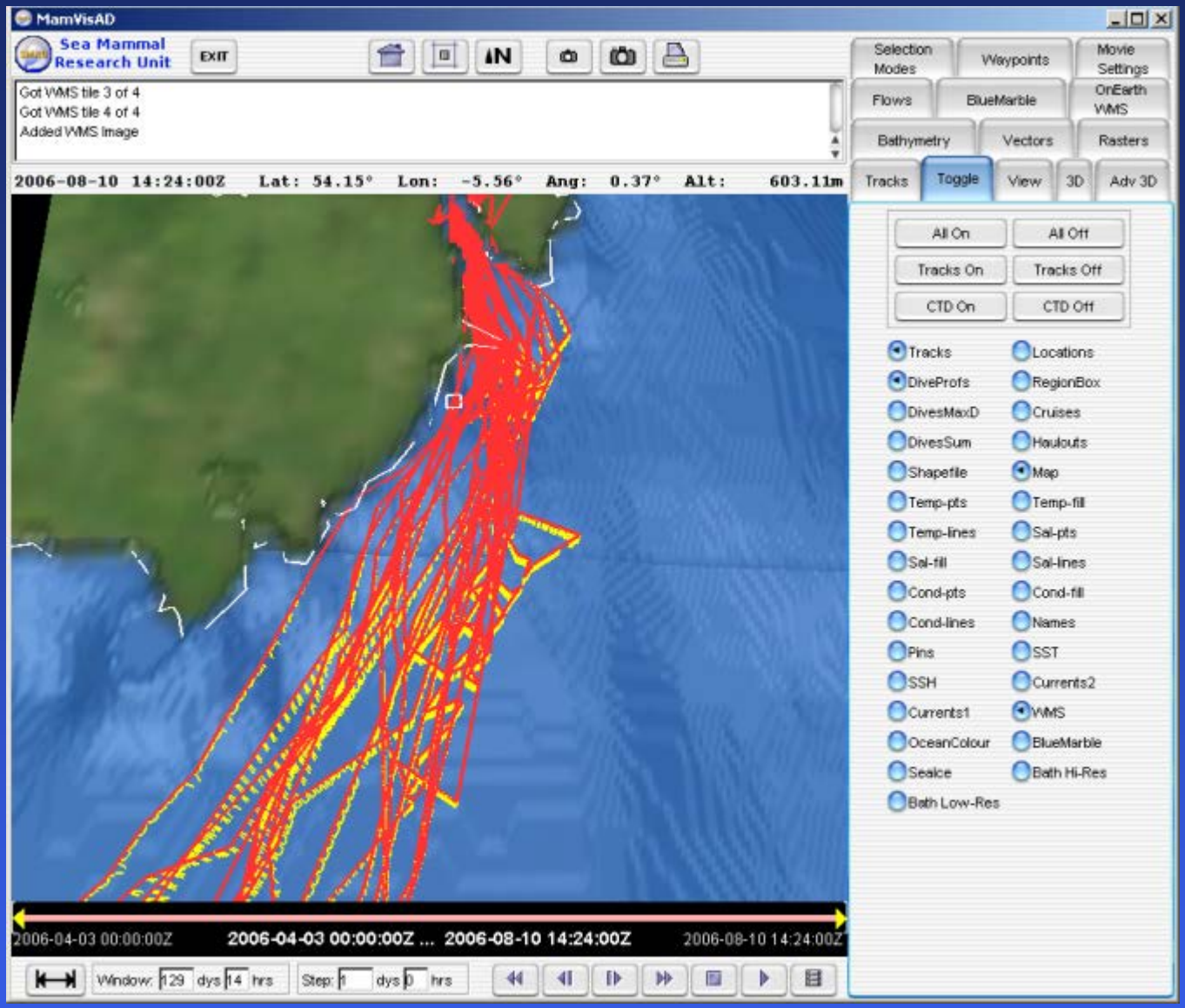

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Zooming back out to look at this one animal and the channel

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Making Movies

- One of the main uses for MamVisAD
- Sometimes for more scientific presentations
- Other times for public outreach

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Making Movies

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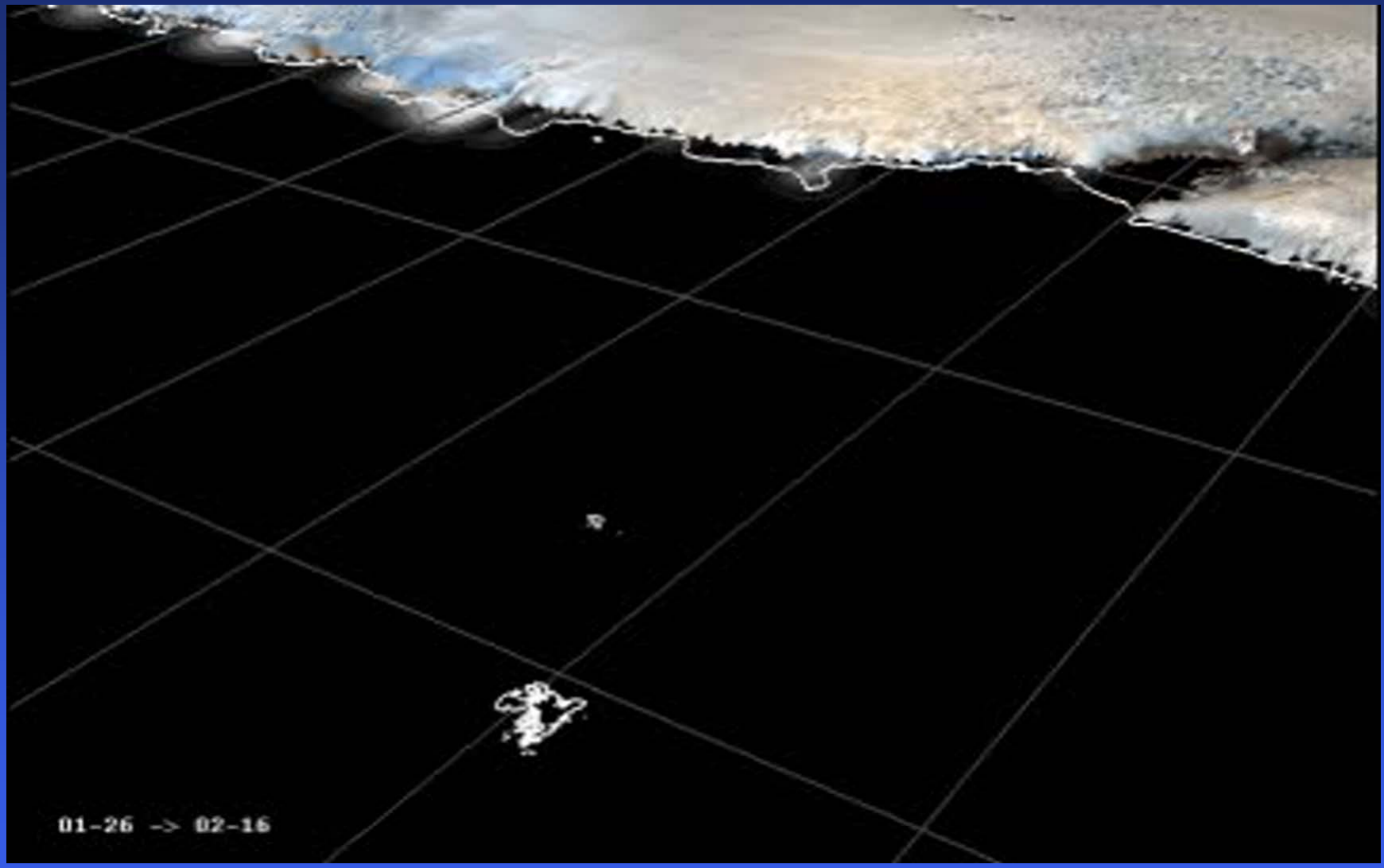
- Need lots of frames to get smooth movies.
- Think about viewpoints, logos, colours, credits, etc.
- Likely to be an iterative process
- Can take a very long time to make something nice!

Fixed camera movie



SEaOS data from seals tagged on Kerguelen by courtesy of Christophe Guinet, CNRS

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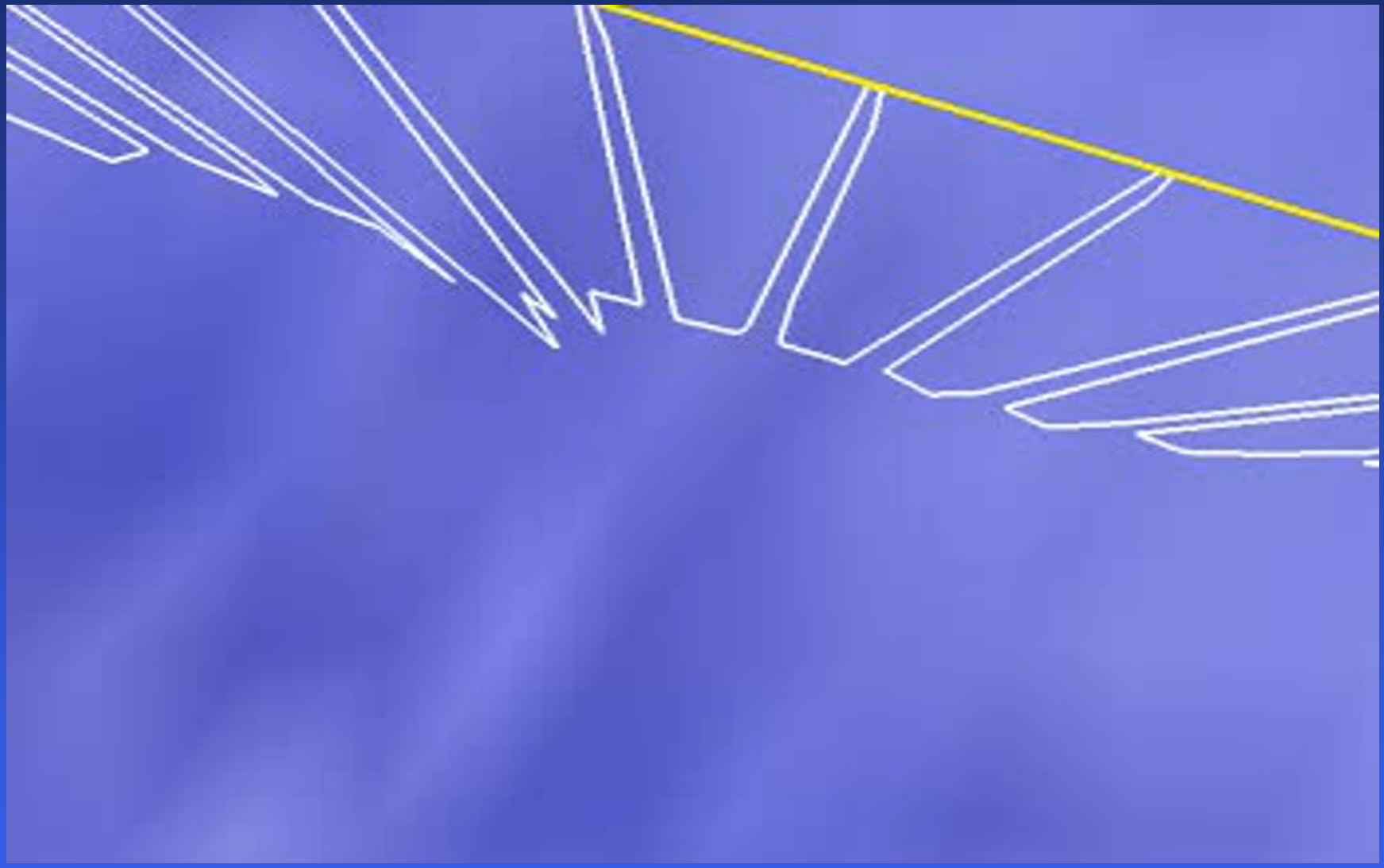
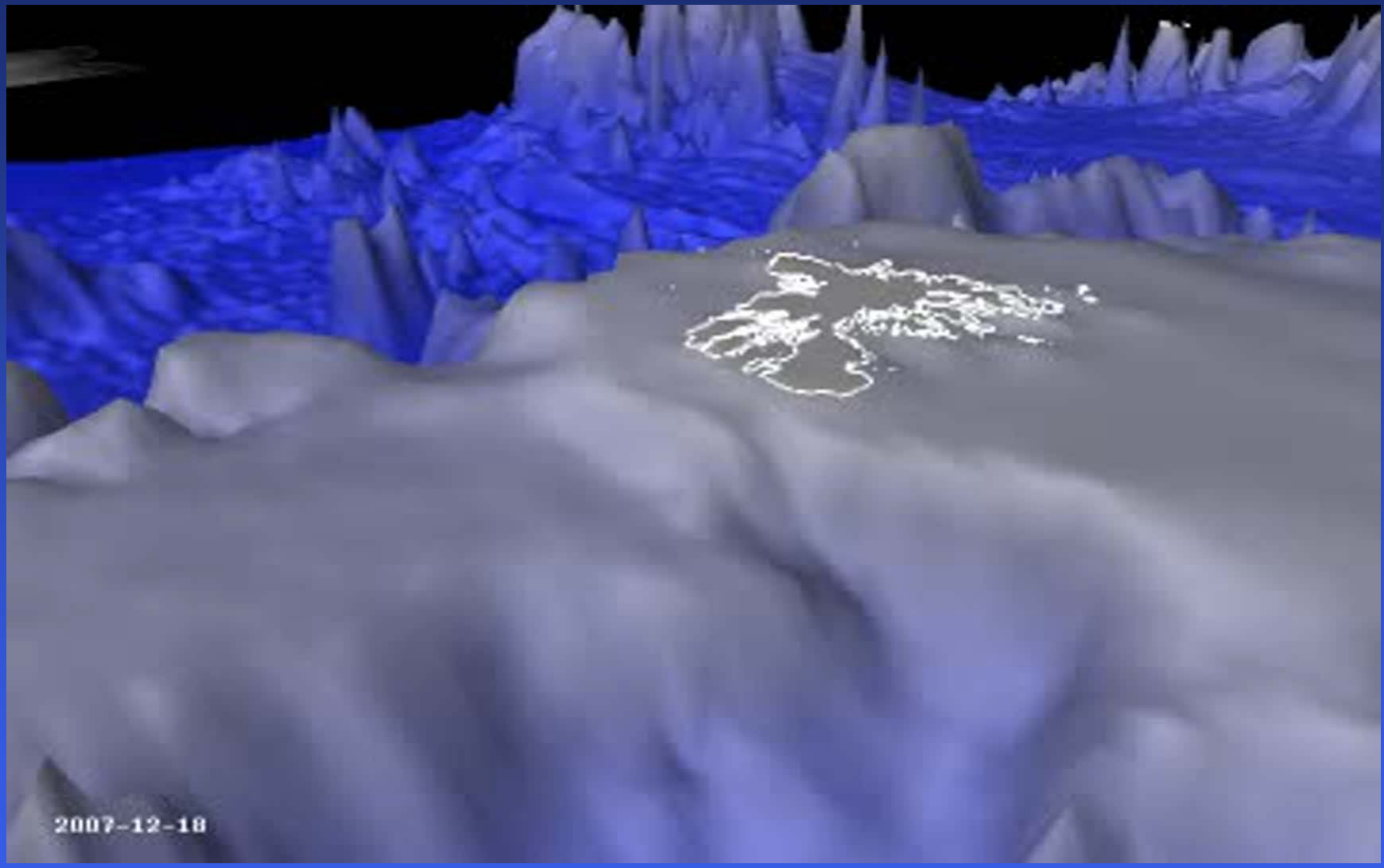
Zoom out movie



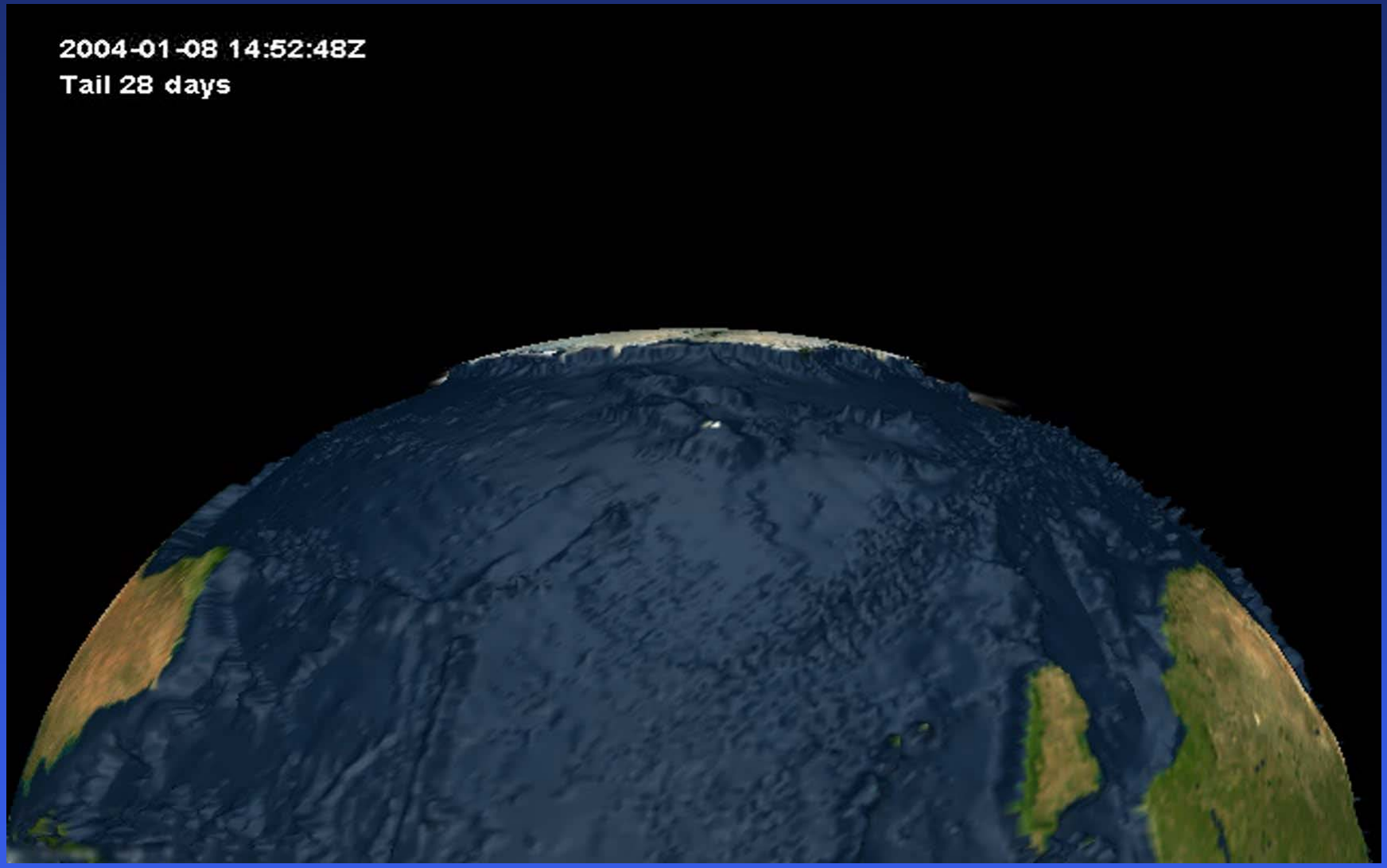
SEaOS data from seals tagged on Kerguelen by courtesy of Christophe Guinet, CNRS

Follow the animal movie



SEaOS data from seals tagged on Kerguelen by courtesy of Christophe Guinet, CNRS

Zoom then follow movie



SEaOS data from seals tagged on Kerguelen by courtesy of Christophe Guinet, CNRS

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SMRU tag data

- MamVisAD very much written as visualization tool for data from SMRU tags

- However some people have used it to display other tag data

Example Microsoft Access *.mdb databases in:

C:\MamVisAD\SMRUAccessDatabases

test_tracks_only.mdb

Template for surface only tracks

Data needed:

- latitudes, longitudes and times for each track

Only two tables actually required

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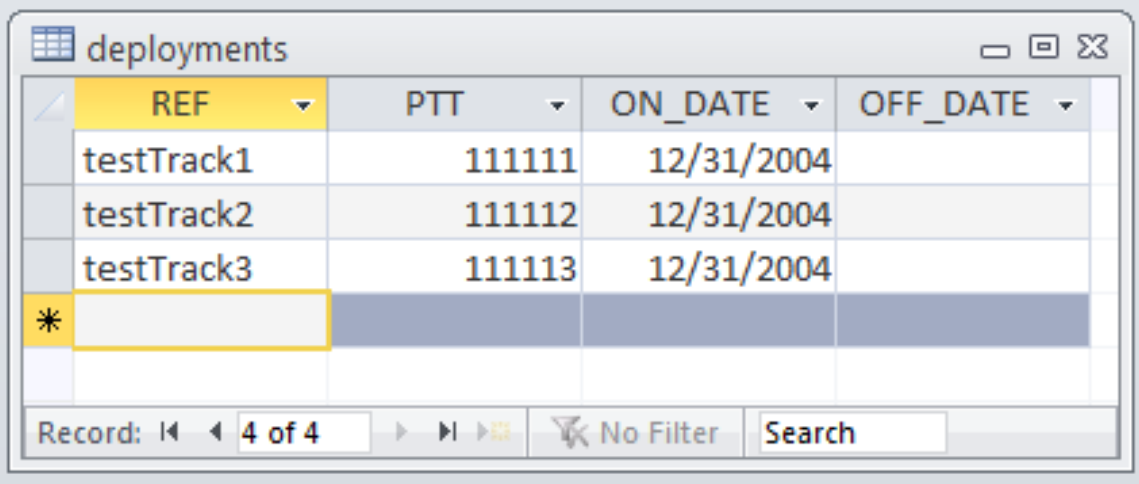
“deployments” table



deployments

REF	PTT	ON_DATE	OFF_DATE
testTrack1	111111	12/31/2004	
testTrack2	111112	12/31/2004	
testTrack3	111113	12/31/2004	
*			

Record: 4 of 4 | No Filter | Search

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“deployments” table

4 fields mimicking ARGOS data:

REF	unique name for each tracck
PTT	unique number for track
	(doesn’t need to be a valid PTT)
ON_DATE	some date before first location
OFF_DATE	some date after first location (can be blank)

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“diag” table

diag

ref	PTT	D_DATE	LQ	LAT	LON	V_MASK
testTrack1	11111	01/01/2005 03:14:33		30	-20	0
testTrack1	11111	01/02/2005 03:17:53		30	-25	0
testTrack1	11111	01/03/2005 04:17:53		40	-25	0
testTrack1	11111	01/04/2005 05:17:53		40	-35	0
testTrack1	11111	01/05/2005 05:17:53		33	-35	0
testTrack1	11111	01/06/2005 01:00:53		33	-45	0
testTrack1	11111	01/07/2005 05:01:11		38	-45	0
testTrack1	11111	01/08/2005 10:00:00		38	-50	-1
testTrack1	11111	01/15/2005 05:00:00		40	-50	-1
testTrack2	11112	01/02/2005 01:00:00		30	-20	0
testTrack2	11112	01/03/2005 02:00:00		32.59	-21	0
testTrack2	11112	01/04/2005 03:00:00		35	-22	0
testTrack2	11112	01/05/2005 04:00:00		37.07	-23	0
testTrack2	11112	01/06/2005 05:00:00		38.66	-24	0
testTrack2	11112	01/07/2005 06:00:00		39.66	-25	0
testTrack2	11112	01/08/2005 07:00:00		40	-26	0
testTrack2	11112	01/09/2005 08:00:00		39.66	-27	0
testTrack2	11112	01/10/2005 09:00:00		38.66	-28	0
testTrack2	11112	01/11/2005 10:00:00		37.07	-29	0
testTrack2	11112	01/12/2005 11:00:00		32.59	-30	0
testTrack2	11112	01/13/2005 12:00:00		30	-31	0
testTrack2	11112	01/14/2005 13:00:00		27.41	-32	0
testTrack2	11112	01/15/2005 14:00:00		25	-33	0
testTrack2	11112	01/16/2005 15:00:00		22.03	-34	0

Record: 1 of 50

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“diag” table

Actual location data for all the tracks.Each needs:

REF & “PTT”	matching an entry in “deployments”
D_DATE	the time associated with the location
LAT & LON	the location’s latitude and longitude
LQ	either an actual or dummy ARGOS location quality value (e.g. 3=“good”)
V_MASK	value for the “velocity mask” (if >0 then the location won’t be included in the visible track)

E.g. text / CSV file → MS Access

CSV (Comma Separated Values) Textfile often simple way of moving track data between software packages.

E.g R→ CSV → Access → MamVisAD

```
"ref","PTT","D_DATE","LQ","LAT","LON","V_MASK"
"testTrack2",11112.00,1/2/2005 01:00:00,3,30.00,-20.00,0
"testTrack2",11112.00,1/3/2005 02:00:00,3,32.59,-21.00,0
"testTrack2",11112.00,1/4/2005 03:00:00,3,35.00,-22.00,0
"testTrack2",11112.00,1/5/2005 04:00:00,3,37.07,-23.00,0
"testTrack2",11112.00,1/6/2005 05:00:00,3,38.66,-24.00,0
"testTrack2",11112.00,1/7/2005 06:00:00,3,39.66,-25.00,0
```

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or go straight from Excel → MS Access

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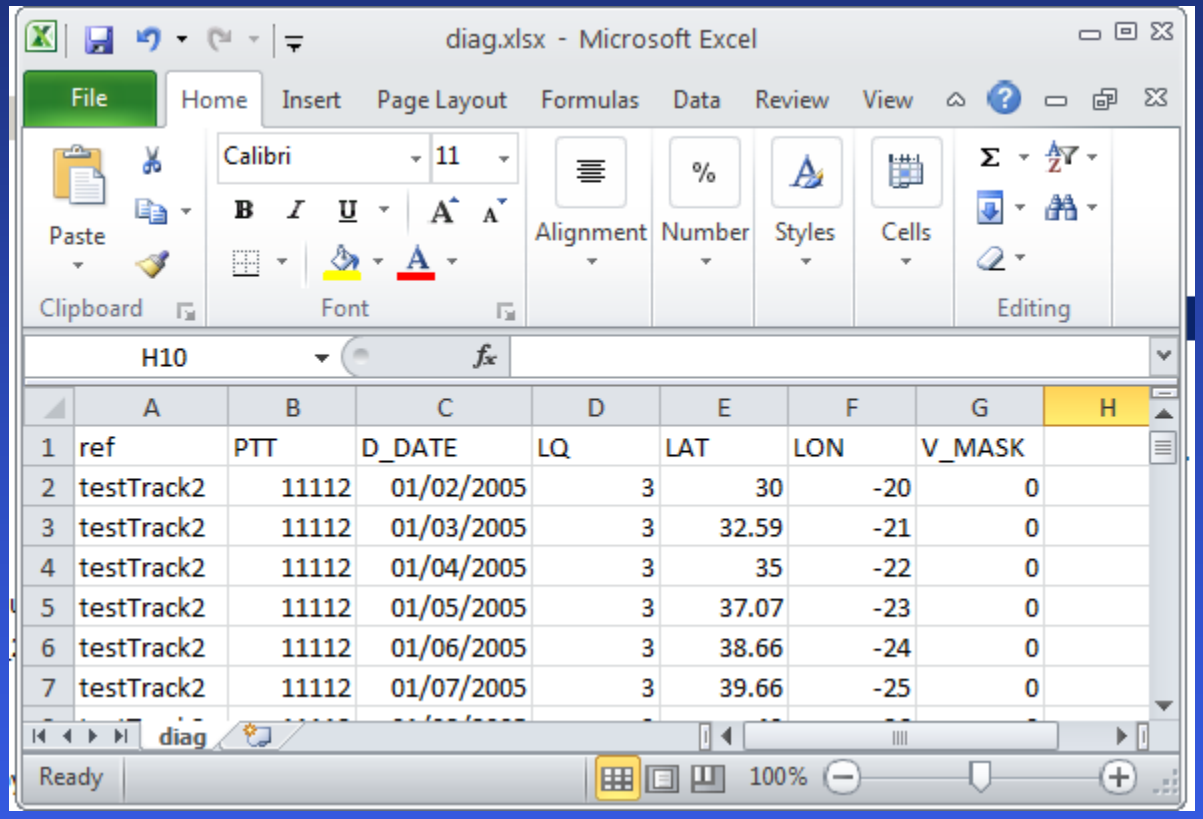

	A	B	C	D	E	F	G	H
1	ref	PTT	D_DATE	LQ	LAT	LON	V_MASK	
2	testTrack2	11112	01/02/2005	3	30	-20	0	
3	testTrack2	11112	01/03/2005	3	32.59	-21	0	
4	testTrack2	11112	01/04/2005	3	35	-22	0	
5	testTrack2	11112	01/05/2005	3	37.07	-23	0	
6	testTrack2	11112	01/06/2005	3	38.66	-24	0	
7	testTrack2	11112	01/07/2005	3	39.66	-25	0	

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The “Test Tracks”

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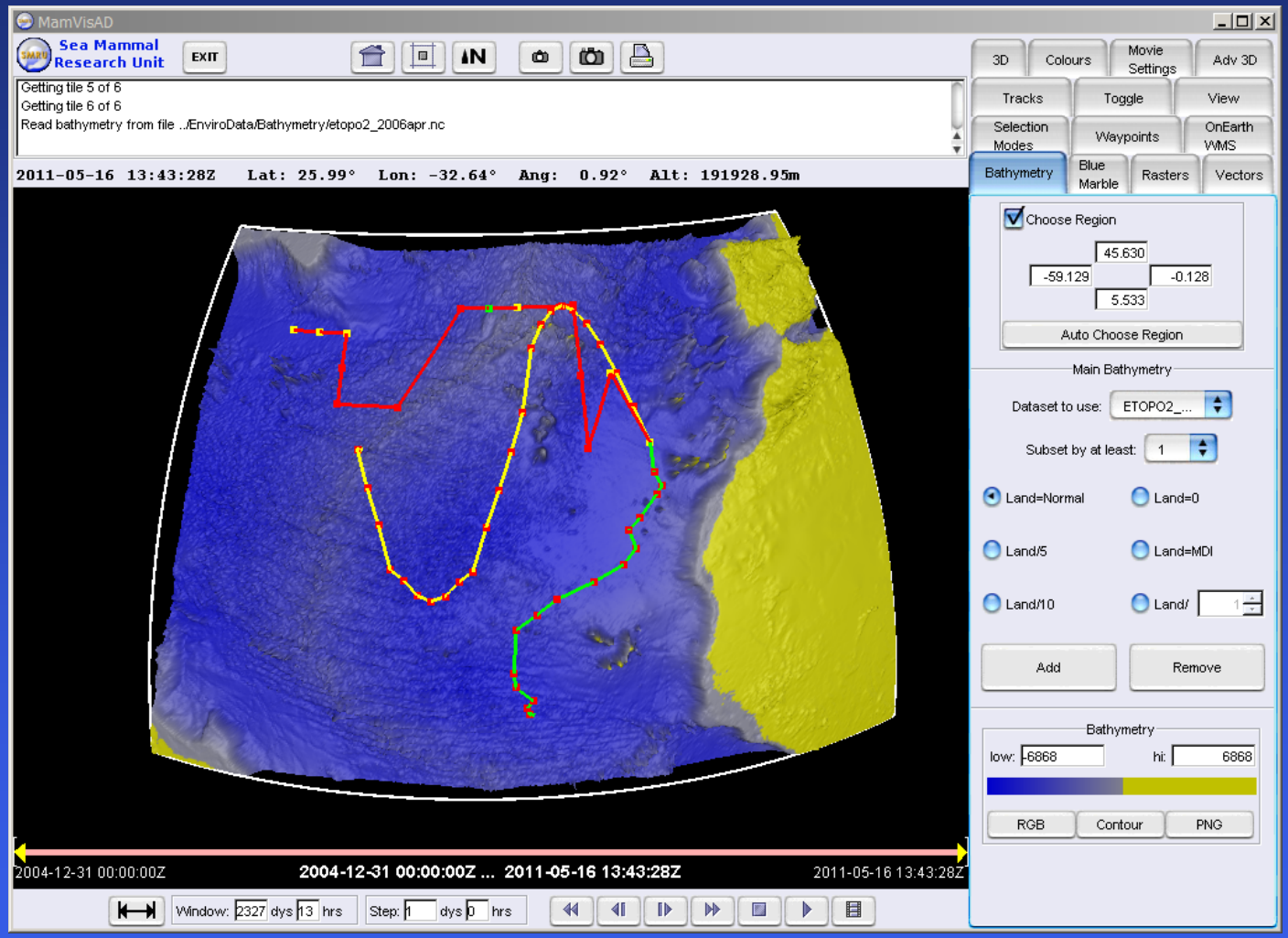

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Dive profiles

What about dives?

- Tags record pressure > depth every 4 secs
- Can’t send every point for every dive
- Tag generates compressed “profiles”
- These can be sent in 256 bit ARGOS messages
- Only some of those messages will be received.

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Dive message format

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PAGE CONTENTS (256 bits - 9 overhead):

PAGE 0:

PTT NUMBER OVERHEAD (28-bit code)
----------[8 bits: 0 - 7]

PAGE NUMBER
----------[2 bits: 8 - 9]

DIAGNOSTICS in format 0:

TX number: wraparound 11 bits in units of 32 (range: 0 to 65504)
Number of resets: wraparound 1 bits in units of 1 (range: 0 to 1)
----------[12 bits: 10 - 21]

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Dive message format

DIVE group in format 0:

Normal dives transmitted in groups of 3

Time of start of last dive: max 5 days 12 hours @ 30 secs= 15840
tx as raw 14 bits in units of 1 (range: 0 to 16383)
(recommended sell-by 5 days 11 hours)

Sell-by range: 5 days

Number of records: raw 2 bits in units of 1 (range: 0 to 3)

Reason for end: -- not transmitted --

Group number: wraparound 8 bits in units of 1 (range: 0 to 255)

Max depth: -- not transmitted --

Dive duration: odlog 1/6 in units of 30 s (range: 0 to 5715 s)

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Dive message format

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PAGE CONT Mean speed: -- not transmitted --
Profile data (4 depths/times, 0 speeds):
Depth profile: odlog 2/6 in units of 25 dm (range: 0 to 23887.5 dm)
Profile times: raw 5 bits in units of 32.2581 permille (range: 0 to 1000 permille)
Speed profile: -- not transmitted --
Residual: raw 2 bits in units of 60 (range: 0 to 180)
Calculation time: -- not transmitted --
Surface duration: odlog 2/4 in units of 2.5 s (range: 0 to 588.75 s)
cf. cruise starts after 9 mins (540 secs)
Dive area: -- not transmitted --
----------[225 bits: 22 - 246]

Available bits used exactly
=== End of page 0 ===

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Dive profiles

- Messages get decoded on SMRU's servers
- Converted into individual dive profiles
- Stored in a table called "dive"
- Different tags may have a different number of points in the profiles they generate.
- So needed a fairly flexible format

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“dive” table

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dive

ref	PTT	DE_DATE	DIVE_DUR	SURF_DUR	MAX_DEP	N_DEPTHS	DEPTH_STR	PROPN_STR
ct1-Donner-04	2442	29/01/2004 17:04:58	0	41	4	4	4.0, 4.0, 4.0, 4.0	19.3,38.7,58.0,58.0
ct1-Donner-04	2442	29/01/2004 17:05:39	0	111	4	4	4.0, 4.0, 4.0, 4.0	12.9,41.9,41.9,70.9
ct1-Donner-04	2442	29/01/2004 17:16:00	510	509	16	4	8.0, 8.0, 16.0, 16.0	6.4,48.3,70.9,87.0
ct1-Donner-04	2442	29/01/2004 17:26:50	90	46	12	4	8.0, 12.0, 8.0, 8.0	29.0,51.6,67.7,83.8
ct1-Donner-04	2442	29/01/2004 17:35:36	480	234	12	4	4.0, 12.0, 8.0, 8.0	6.4,12.9,19.3,90.3
ct1-Donner-04	2442	29/01/2004 17:44:00	270	61	12	4	12.0, 12.0, 8.0, 8.0	6.4,19.3,32.2,58.0
ct1-Donner-04	2442	29/01/2004 17:46:00	30	529	4	4	4.0, 4.0, 4.0, 4.0	16.1,35.4,45.1,70.9
ct1-Donner-04	2442	30/01/2004 23:55:01	60	8	8	4	4.0, 4.0, 4.0, 8.0	19.3,45.1,70.9,77.4
ct1-Donner-04	2442	31/01/2004 00:04:09	540	81	80	4	44.0, 44.0, 80.0, 48.0	19.3,29.0,61.2,87.0
ct1-Donner-04	2442	31/01/2004 00:15:30	600	101	44	4	40.0, 44.0, 36.0, 44.0	6.4,58.0,67.7,77.4
ct1-Donner-04	2442	31/01/2004 00:22:56	330	124	48	4	48.0, 44.0, 36.0, 16.0	6.4,29.0,64.5,80.6
ct1-Donner-04	2442	31/01/2004 00:27:30	150	529	12	4	12.0, 12.0, 12.0, 12.0	6.4,16.1,25.8,32.2
ct1-Donner-04	2442	05/02/2004 20:30:22	0	8	4	4	4.0, 4.0, 4.0, 4.0	12.9,12.9,41.9,70.9
ct1-Donner-04	2442	05/02/2004 20:31:00	30	529	8	4	8.0, 8.0, 4.0, 4.0	16.1,22.5,48.3,74.1
ct1-Donner-04	2442	05/02/2004 20:57:30	120	529	8	4	4.0, 8.0, 8.0, 8.0	3.2,48.3,58.0,67.7
ct1-Donner-04	2442	11/02/2004 06:19:00	90	529	16	4	4.0, 12.0, 16.0, 12.0	19.3,41.9,70.9,83.8
ct1-Donner-04	2442	15/02/2004 17:21:15	0	254	8	4	8.0, 8.0, 8.0, 8.0	16.1,48.3,48.3,64.5
ct1-Donner-04	2442	15/02/2004 17:35:59	630	91	60	4	16.0, 24.0, 52.0, 60.0	6.4,32.2,61.2,83.8
ct1-Donner-04	2442	15/02/2004 17:46:00	510	81	64	4	60.0, 64.0, 44.0, 52.0	6.4,19.3,58.0,87.0
ct1-Donner-04	2442	15/02/2004 17:59:38	690	91	108	4	64.0, 108.0, 96.0, 52.0	6.4,58.0,74.1,90.3

Record: 1 of 26909 No Filter Search

- Each row represents the profile for one dive
- Only the main fields are shown here

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“dive” table

The dive profiles data for all the animals

Each dive record needs:

REF & PTT	matching an entry in “deployments”
DE_DATE	time associated with end of the dive
DIVE_DUR	duration of the dive
SURF_DUR	duration of the associated surfacing

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“dive” table

The dive profiles data for all the animals

Each dive record needs:

NDEPTHS	number of points in profile
DEPTH_STR	the depth values
PROPN_STR	proportions of dive duration
MAX_DEP	maximum depth (“1 point” dive summary)

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Example of three dive profiles from one ARGOS message

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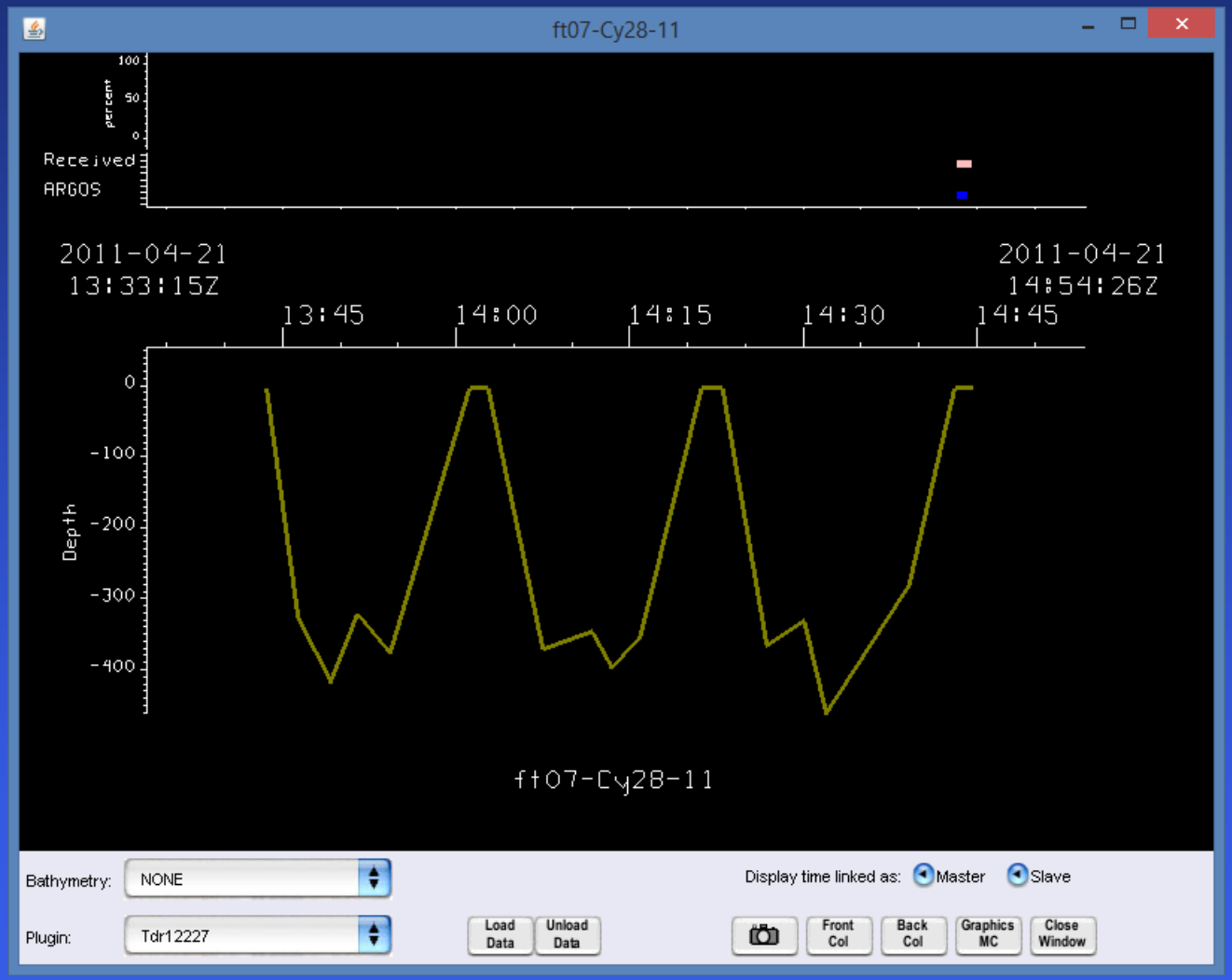

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Adding the original 4 second depth values stored in the tag

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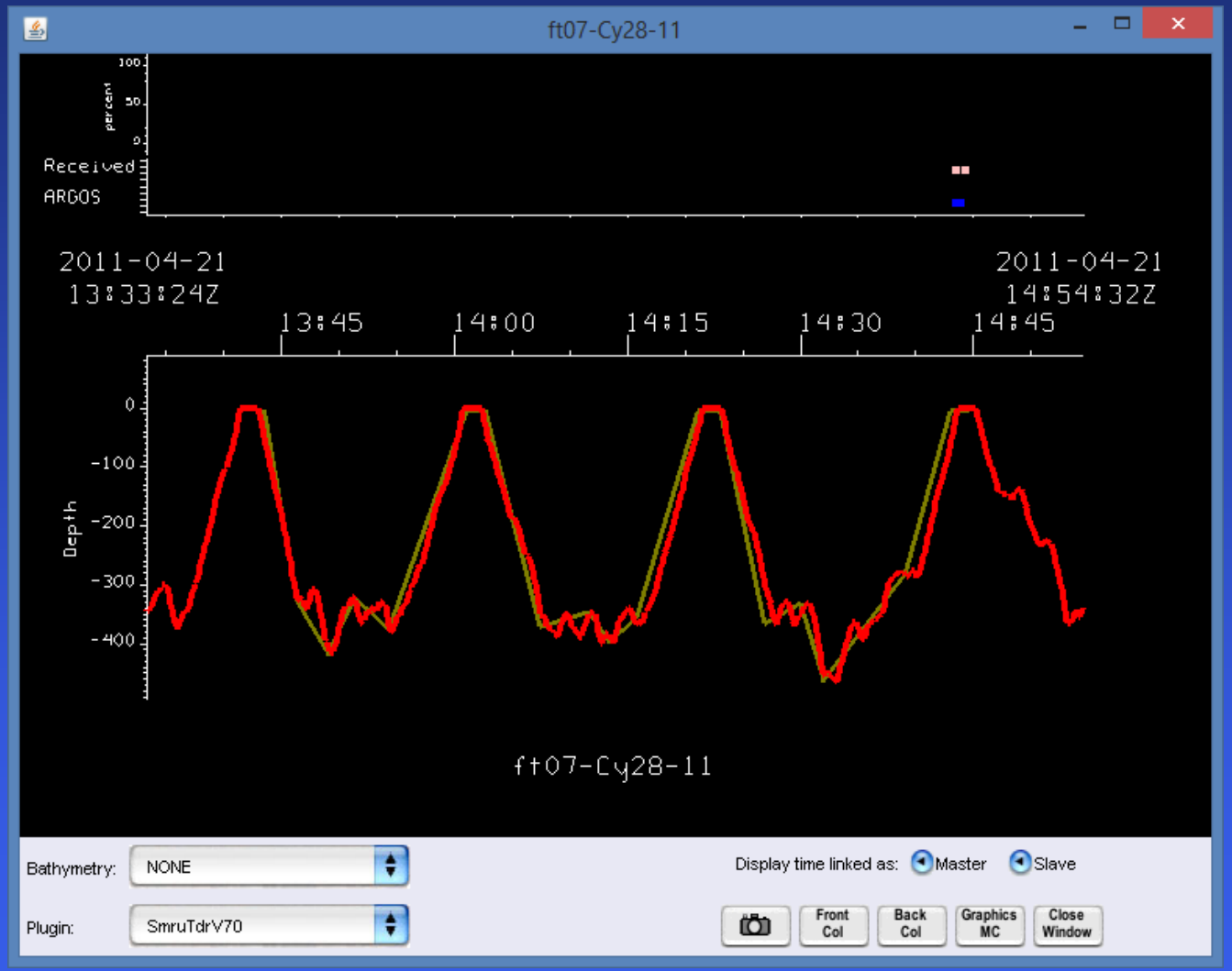

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So remember for ARGOS tags

- Tags record lots of data
- Some of that “compressed” into 256 bit messages
- Not all of the transmitted messages are received
- Those that are then need to be decoded at SMRU
- Dive profiles, CTD casts, summaries, etc. are then added to the appropriate tables in a database
- MamVisAD can then be used to visualise those records using linked 3D and times series views.

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Website

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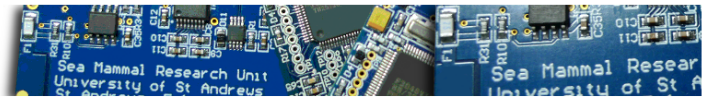
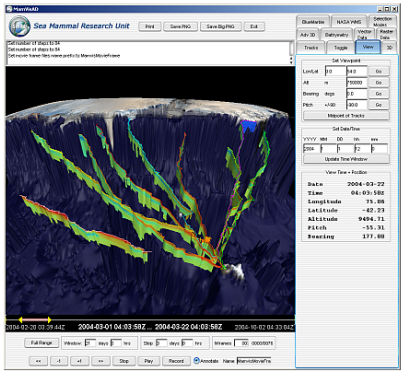
University of St Andrews | 600 YEARS | 1413 – 2013
Scotland's first university

MamVisAD

SMRU Instrumentation



- Home
- How Tos
- Downloads
- Docs
- Gallery



Features

- Interactive globe style 3D visualization of the ocean.
- Display of tracks alongside bathymetry, SSTs and sea-ice fields.
- Linked time series displays and spreadsheets.
- Built upon open source software; Jython, VisAD & Java.

Benefits

- Developed specifically to work with telemetry data from SMRU tags.
- Easy exploration of tracks, dives and CTD casts through time.
- Images and animations for presentations.

SMRU Instrumentation MamVisAD

http://www.smru.st-andrews.ac.uk/MamVisAD/

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Google Earth for telemetry data

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- Original MAMVIS was back in the early 1990s
- Development of a replacement started in 2003
- Couldn’t find any ready made “free” solution
- Now everyone knows how to use Google Earth but

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Google Earth Timeline

Google Earth 3.0 launched back in June 2005

- good for “static” surface tracks

“Time slider” added in 4.0 in September 2006

- allowed animated tracks

“Google Ocean” came with 5.0 in February 2009

- 3D ocean: bathymetry, objects below sea level

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Google Earth Timeline

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Google Earth 5.2 released July 2010

- new features included <gx:Track> etc.
- made animated tracks much simpler

Google Earth 7.0 – December 2012

Google Earth Pro free from the 30th January 2015

offers support for Shapefiles, GeoTIFFs, movie making, etc.

-features that can be useful when visualizing telemetry data

https://www.google.com/earth/

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KML just a fancy text file

KML = Keyhole Markup Language

- Form of XML so just a text based mark-up language
- KMZ files are a type of compressed KML file
- KMZ → KML can just “unzip” the file or open in Google Earth and “Save As” KML)
- Can generate / manipulate KML using text editors, wide range of utilities or by writing code

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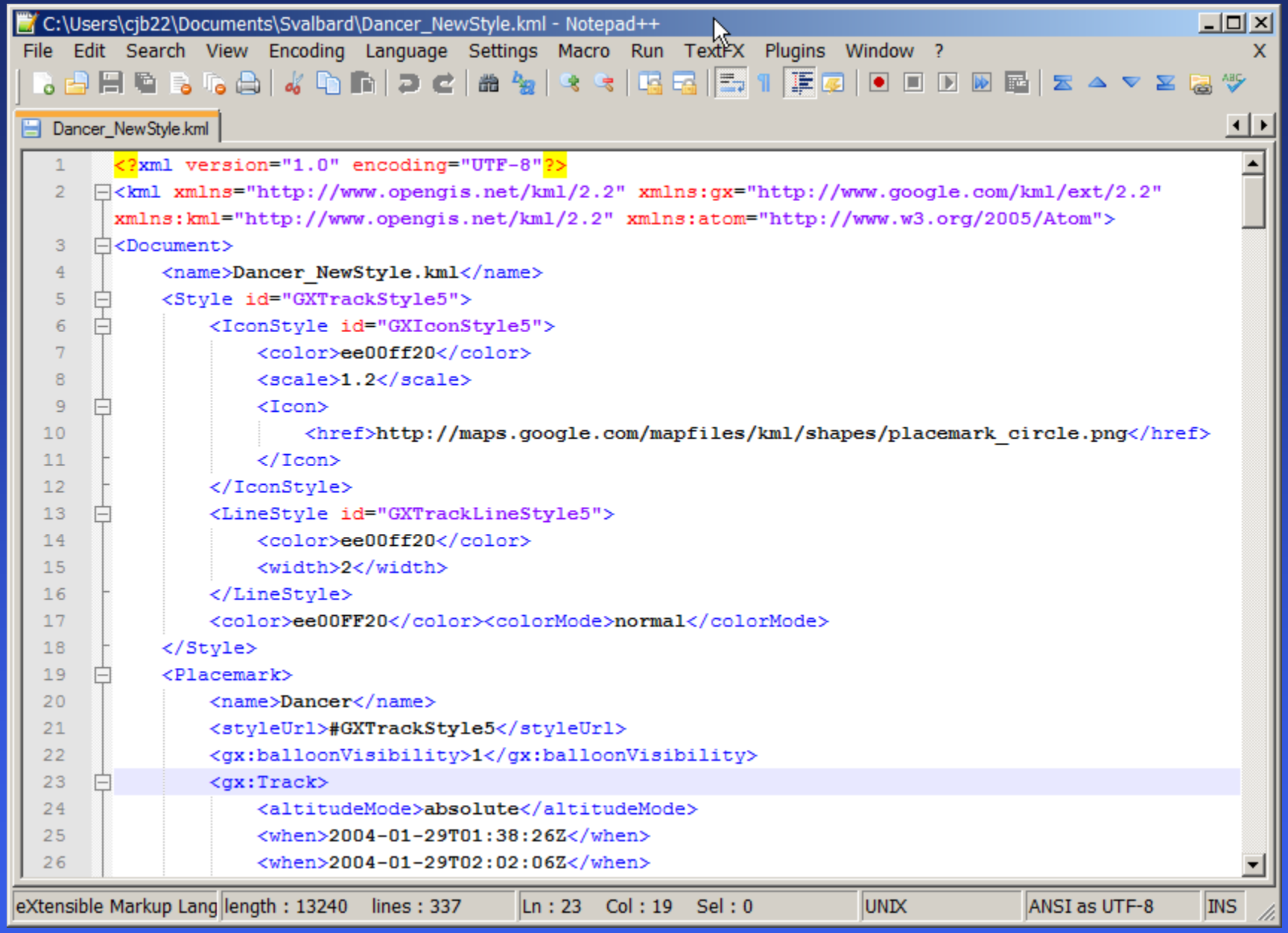
KML just a fancy text file

KML files are made up of:

- A “Header” section
- <Placemark> containing <gx:Track> element
- Time for each location as a set of <when>s
- Set of <gx:coords> with location Lon + Lats
- “Footer” section


C:\Users\cjb22\Documents\Svalbard\Dancer_NewStyle.kml - Notepad++
File Edit Search View Encoding Language Settings Macro Run TextFX Plugins Window ? X
Dancer_NewStyle.kml
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<kml xmlns="http://www.opengis.net/kml/2.2" xmlns:gx="http://www.google.com/kml/ext/2.2"
xmlns:kml="http://www.opengis.net/kml/2.2" xmlns:atom="http://www.w3.org/2005/Atom">
<Document>
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<color>ee00ff20</color>
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</Icon>
</IconStyle>
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<gx:Track>
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<when>2004-01-29T01:38:26Z</when>
<when>2004-01-29T02:02:06Z</when>
eXtensible Markup Lang length : 13240 lines : 337 Ln : 23 Col : 19 Sel : 0 UNIX ANSI as UTF-8 INS

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KML just a fancy text file

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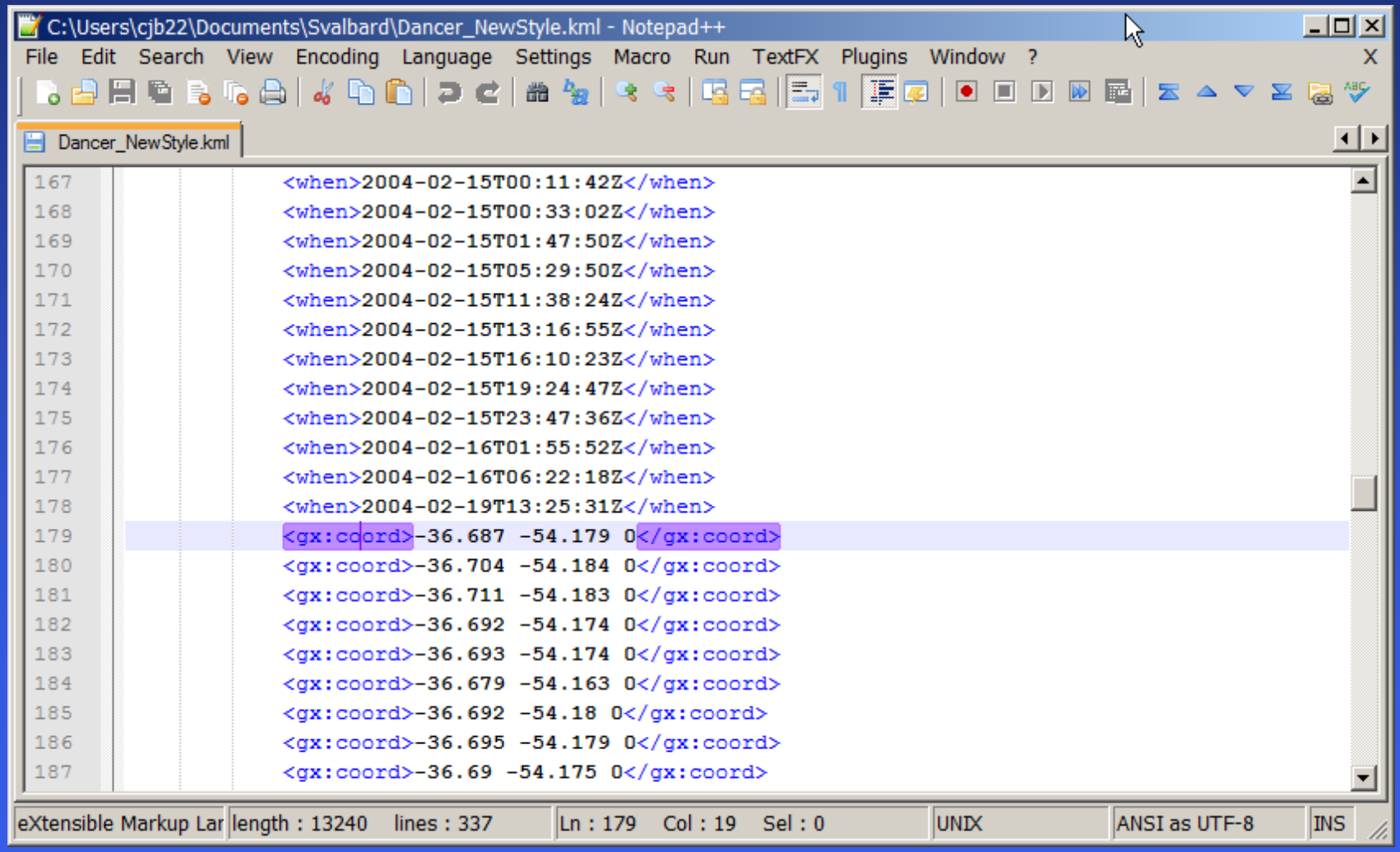

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KML just a fancy text file

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C:\Users\cjb22\Documents\Svalbard\Dancer_NewStyle.kml - Notepad++

File Edit Search View Encoding Language Settings Macro Run TextFX Plugins Window ? X

Dancer_NewStyle.kml

```
317                 <gx:coord>-32.151 -51.963 0</gx:coord>
318                 <gx:coord>-32.187 -51.988 0</gx:coord>
319                 <gx:coord>-32.3 -52.025 0</gx:coord>
320                 <gx:coord>-32.223 -51.949 0</gx:coord>
321                 <gx:coord>-32.255 -51.959 0</gx:coord>
322                 <gx:coord>-32.246 -51.96 0</gx:coord>
323                 <gx:coord>-32.198 -51.898 0</gx:coord>
324                 <gx:coord>-32.393 -51.964 0</gx:coord>
325                 <gx:coord>-32.452 -51.944 0</gx:coord>
326                 <gx:coord>-32.411 -51.854 0</gx:coord>
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328                 <gx:coord>-32.061 -51.855 0</gx:coord>
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330                 <gx:coord>-32.535 -51.839 0</gx:coord>
331                 <gx:coord>-32.643 -51.829 0</gx:coord>
332                 <gx:coord>-31.214 -51.618 0</gx:coord>
333             </gx:Track>
334         </Placemark>
335 </Document>
336 </kml>
337
```

eXtensible Markup Lar | length : 13240 lines : 337 | Ln : 23 Col : 19 Sel : 0 | UNIX | ANSI as UTF-8 | INS

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Useful tools

GPS Babel:

- good for manipulating tracks can output KML

  http://www.gpsbabel.org/

MapTiler:

- chops big “raster” images into “tiled” KMZ “SuperOverlay” files which Google Earth can then handle well

  http://www.maptiler.org/

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Useful tools

OSGeo4W / FWTools:

- bundled collections of many “GIS” tools
- include command line OGR/GDAL utilities.
- good for manipulating many common vector and raster formats

http://fwtools.maptools.org/

http://trac.osgeo.org/osgeo4w/

http://www.gdal.org/

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Useful tools

3D Game Recorders :

- record from Google Earth's 3D Window
- E.g. Open Broadcaster Software https://obsproject.com/

Google Earth Pro:

- became free in January 2015
- imports Shapefiles
- built-in movie recorder

https://www.google.com/intl/en_uk/earth/download/gep/agree.html

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SMRU Tag Data In Google Earth

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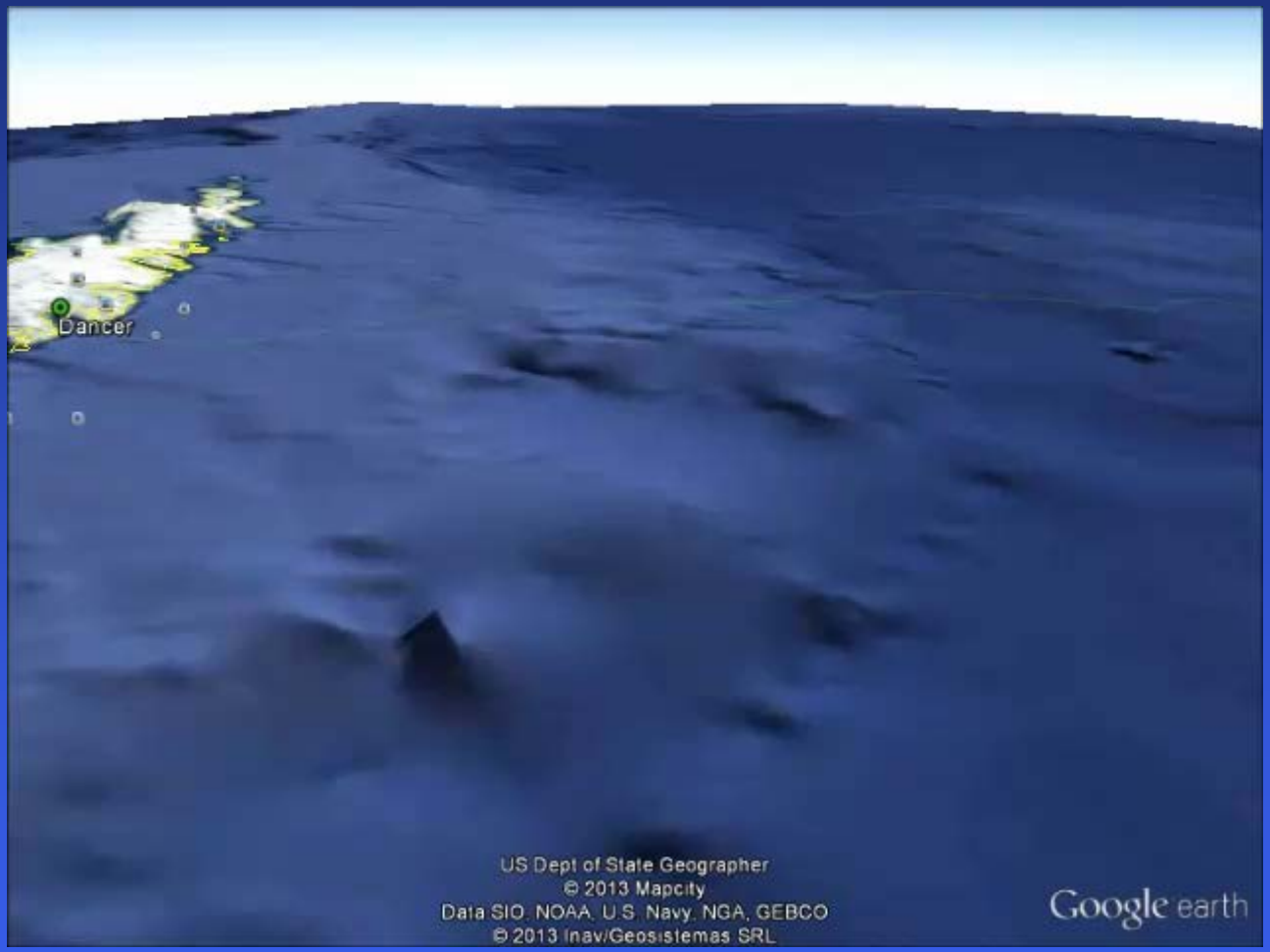

Google Earth Pro movie edited with Windows Movie Maker

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Google Earth for telemetry data

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- For many telemetry/tracking applications Google Earth alone may do everything required.
- Extra functionality can be obtained by combined it with an interactive website.
- Still has some limitations that are hard to overcome.
  - (E.g. basic time control, max vertical exaggeration x 3)
- Hence still a role for bespoke visualisation applications.

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Some other specialised software

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Trackplot

- From the University of New Hampshire's VisLab

  http://ccom.unh.edu/vislab/projects/trackplot.html

- Designed to visualise acoustic and accelerometer data from DTAGs

  http://soundtags.st-andrews.ac.uk/dtags/

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Trackplot

http://www.youtube.com/watch?v=40e3UvQAfIs

Telemetry Visualization

Need to be able to handle 3D space and time.

Many potential uses – exploration/analysis, quality control, public outreach, etc.

Can require flexible tools - more options becoming available all the time. (E.g. within QGIS and R/Matlab)

MamVisAD is the bespoke tool for data from SMRU Instrumentation tags.

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Intro to the practical

- Acts as the MamVisAD tutorial
- Practise “exploratory visualisation”
- Try some “hypothesis generation”
- SRDL Southern Elephant Seal data from SMRU

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MamVisAD: things to remember

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MamVisAD currently supports 3 views:

- A main 3D interactive scene
- Separate stripchart displays
- Spreadsheets of location data

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MamVisAD views are "coupled"

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These 3 types of display can be coupled in various ways:

- Brushing/selection linked across the views.
- Same colour palettes used for everything that represents a given parameter e.g. water temperature.
- "Time Window" can be set to limit what period is shown in the 3D window. Ranges of the axes in any strip charts adjust to match.

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The 3D Window

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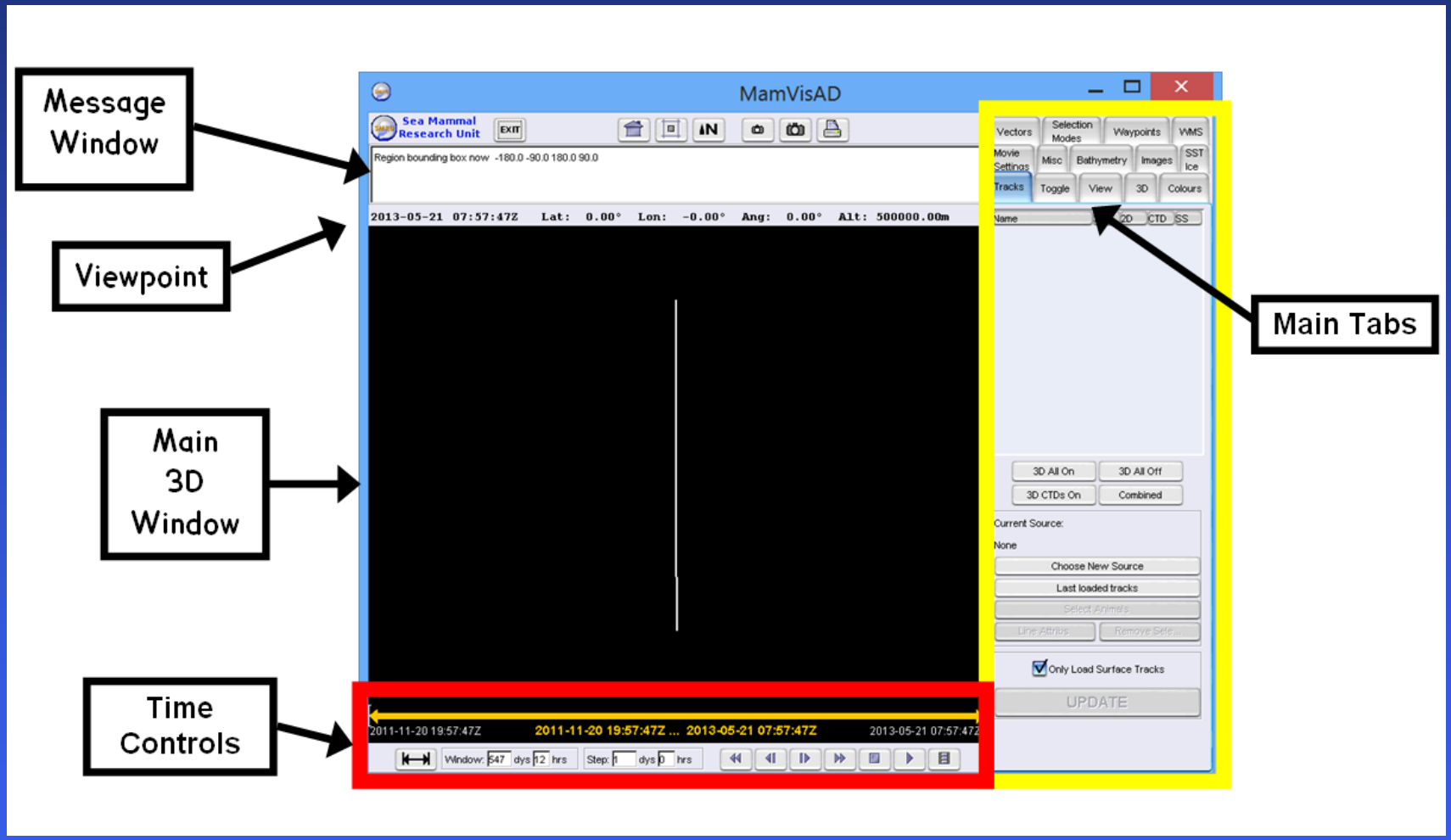

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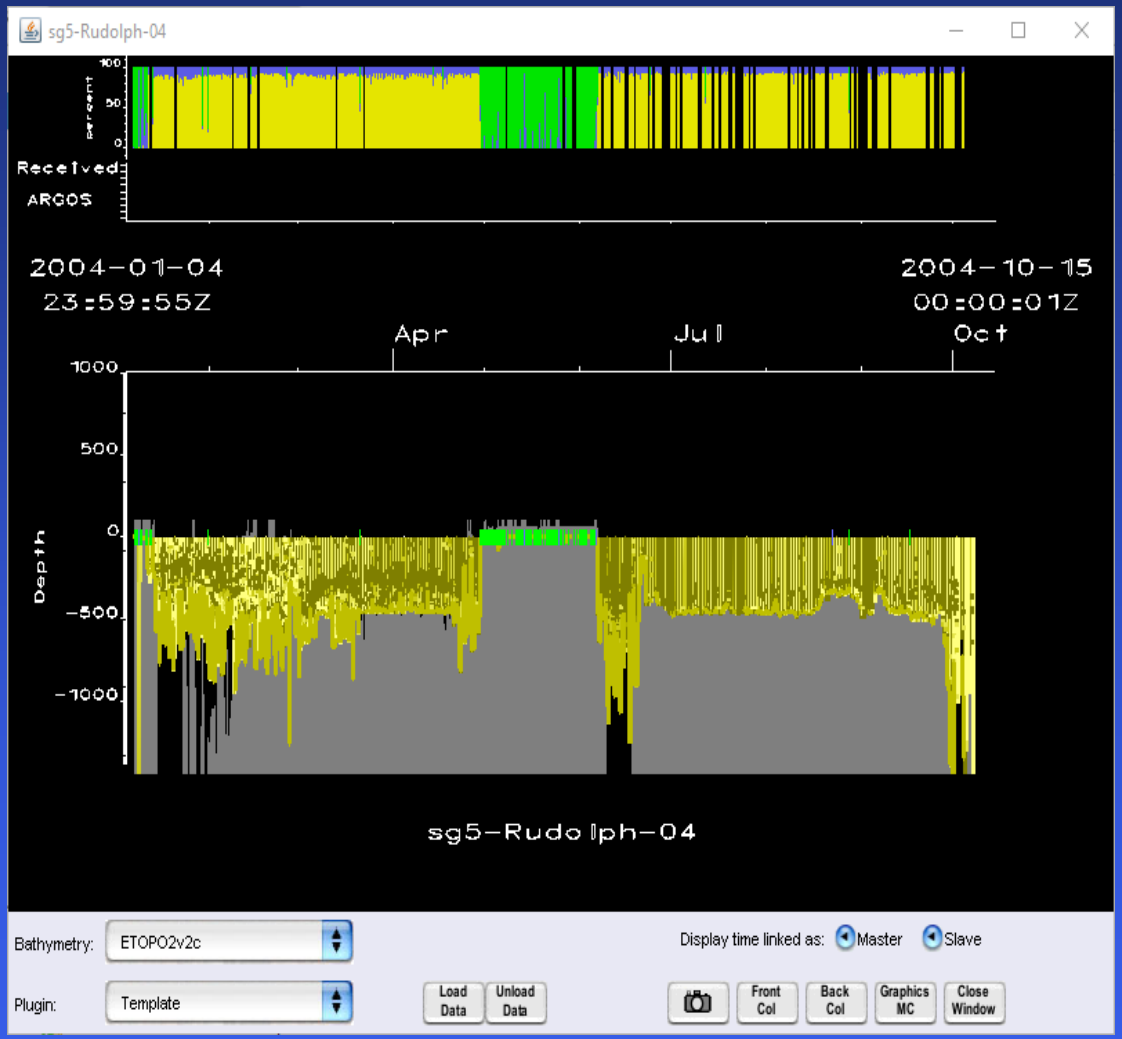
MamVisAD Stripchart



www.smru.st-andrews.ac.uk

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MamVisAD Spreadsheet

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Date/Time	Longitude	Latitude	LocationQual...	VMask	Altitude-Tracks
1.07541939...	-36.3819999...	-54.0979995...	0.0	-1.0	0.0
1.07542067...	-36.7169990...	-54.1870002...	-2.0	-1.0	0.0
1.0754208E9	-36.7190017...	-54.1839981...	3.0	0.0	0.0
1.07543142...	-36.8110008...	-54.2229995...	-2.0	20.0	0.0
1.0754336E9	-36.7109985...	-54.1819992...	3.0	0.0	0.0
1.07543449...	-36.6969985...	-54.1790008...	-2.0	0.0	0.0
1.07546035...	-36.7309989...	-54.1790008...	-1.0	0.0	0.0
1.0755104E9	-36.7050018...	-54.1699981...	1.0	0.0	0.0
1.07551308...	-37.3709983...	-53.8720016...	-2.0	20.0	0.0
1.07553497...	-37.2809982...	-54.0379981...	-2.0	0.0	0.0
1.07556339...	-36.7190017...	-54.1769981...	1.0	0.0	0.0
1.07558617...	-36.6940002...	-54.1809997...	-1.0	0.0	0.0
1.07561113...	-36.7120018...	-54.1809997...	3.0	0.0	0.0
1.07565529...	-36.7120018...	-54.1769981...	0.0	0.0	0.0
1.07566118...	-36.7000007...	-54.1769981...	3.0	0.0	0.0
1.07566976...	-36.7039985...	-54.1780014...	-1.0	0.0	0.0
1.07567155...	-36.6949996...	-54.1720008...	1.0	20.0	0.0
1.07567168...	-36.7010002...	-54.1749992...	-2.0	0.0	0.0
1.07567577...	-36.7019996...	-54.1800003...	2.0	0.0	0.0
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1.07570713...	-36.4249992...	-54.1780014...	-1.0	20.0	0.0
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1.07571110...	-36.7039985...	-54.1749992...	1.0	0.0	0.0
1.07572083...	-36.6879997...	-54.1739997...	3.0	0.0	0.0
1.07572185...	-36.6870002...	-54.1749992...	3.0	0.0	0.0
1.07574464...	-36.4749984...	-54.1720008...	-1.0	0.0	0.0
1.07574681...	-36.5019989...	-54.1790008...	-1.0	0.0	0.0
1.07575731...	-36.5009994...	-54.1800003...	2.0	0.0	0.0

Select All | Select Toggle Selection | Deselect All | Refilter | Close

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SEaOS Elephant Seal data

- Big international project 2004 →
- CTD SRDL's on Southern Elephant Seals.
- Lots of both animal behaviour and oceanographic data

  http://biology.st-andrews.ac.uk/seaos/
- Followed on in 2008 by the MEOP project

  http://www.meop.net/

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SEaOS data

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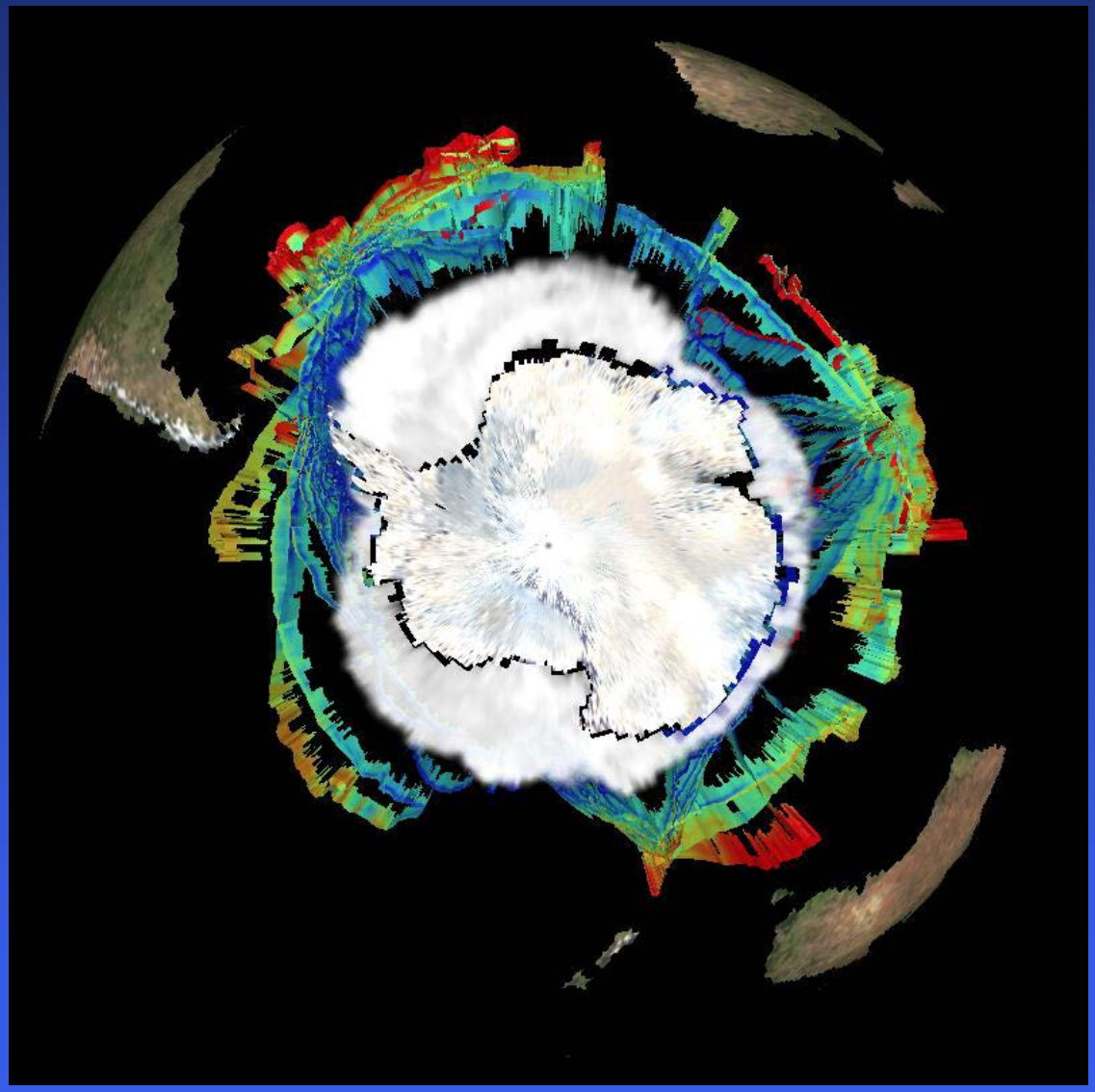

www.smru.st-andrews.ac.uk

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SEaOS Elephant Seal data

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- At the beginning of this practical you are going to use data from 6 animals from South Georgia.

- Start by looking at movement and dive shapes.

- Then move on to look at possible interactions with sea ice and water temperatures.

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Dive shapes?

A very simple model could suggest there are only six basic dive shapes.

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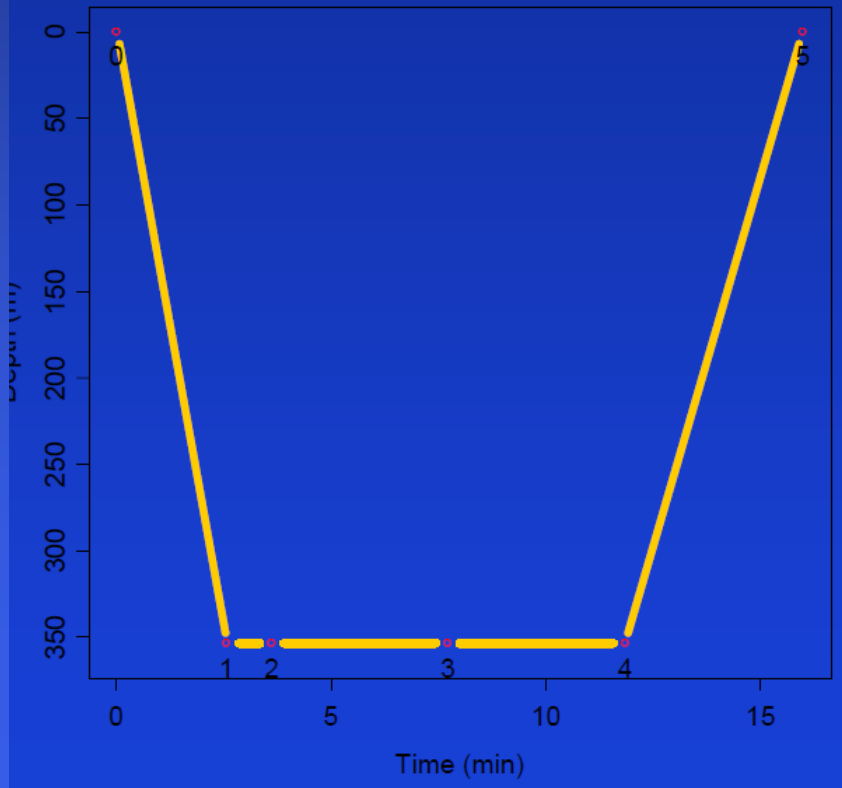
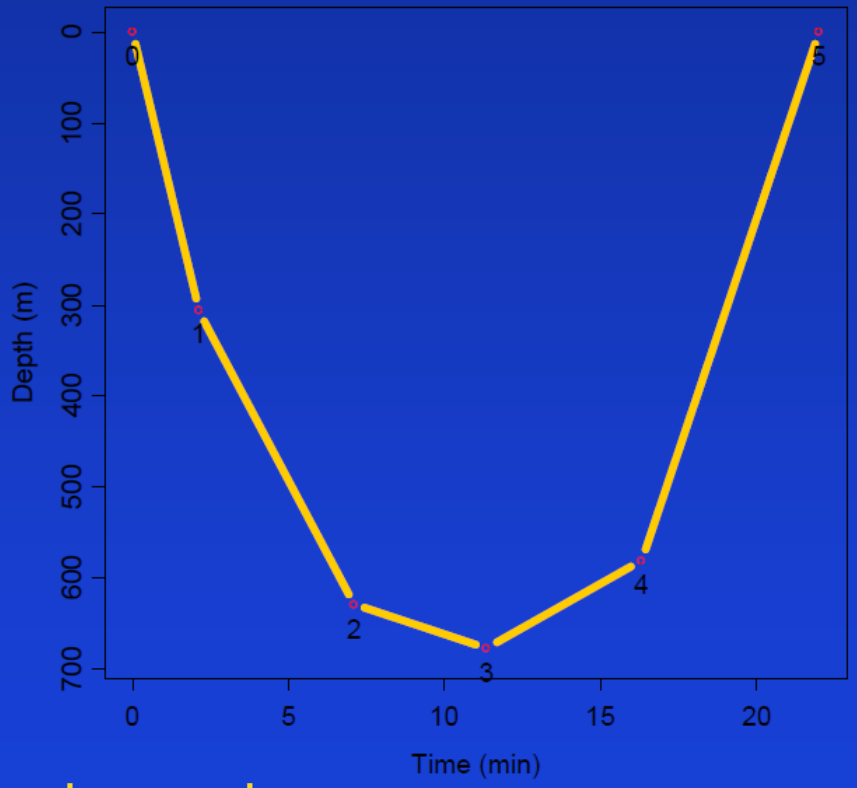
Dive shapes

Square dive



U-shaped dive



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Slide courtesy of T.Photopoulos

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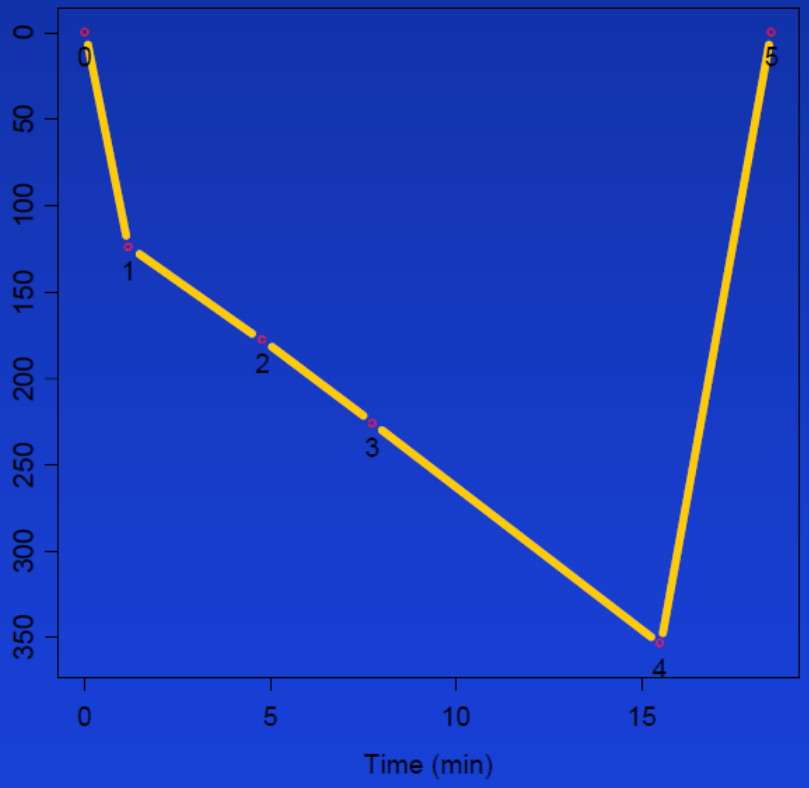
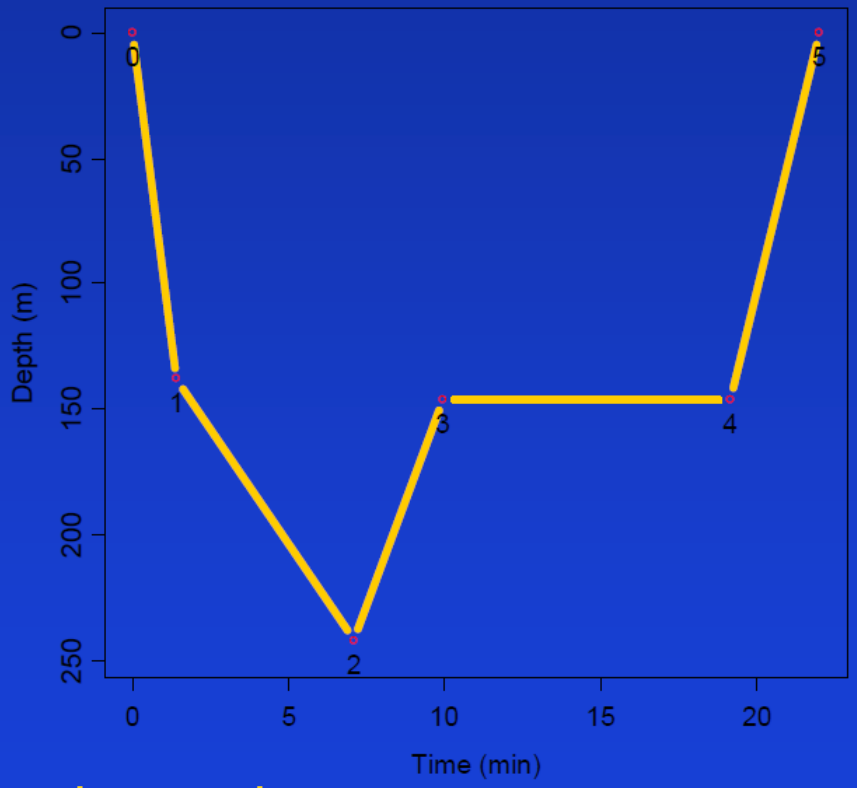
Dive shapes

Drift dive



Root-shaped dive



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Slide courtesy of T.Photopoulos

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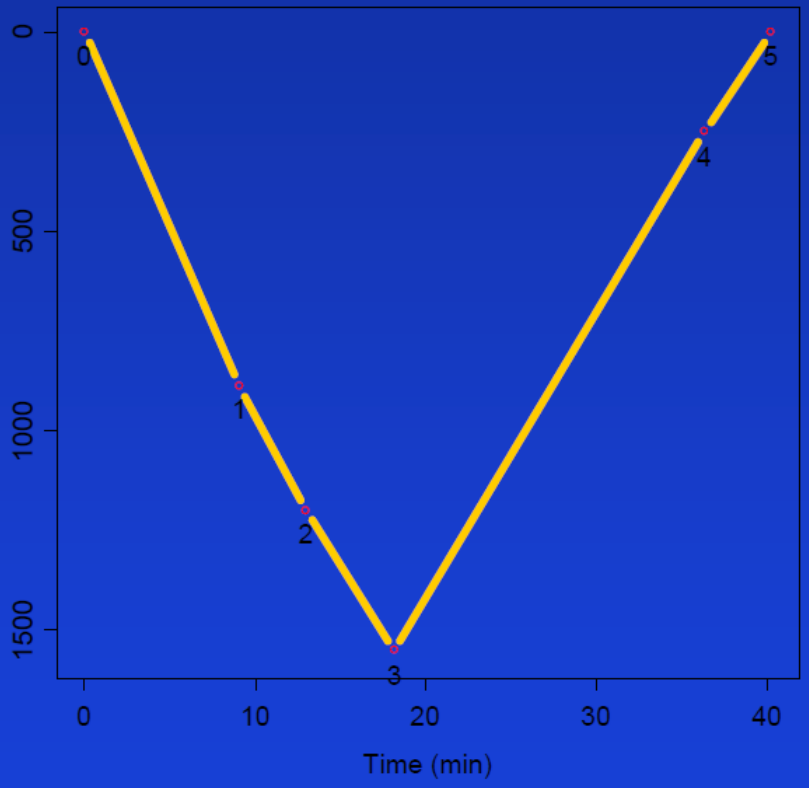
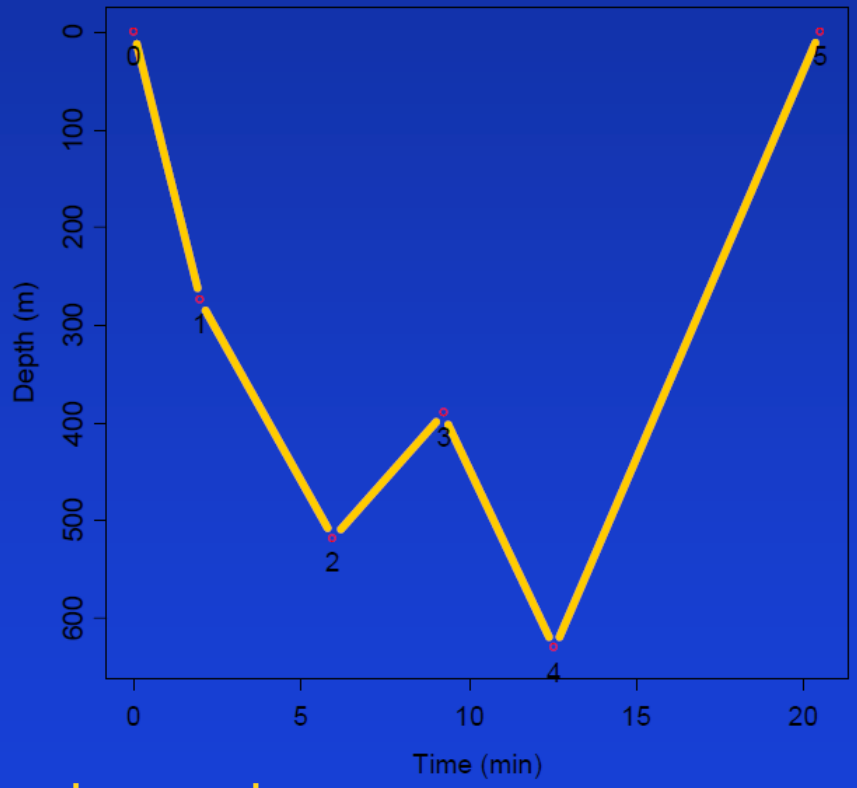
Dive shapes

V-shaped dive



Wiggle dive



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Slide courtesy of T.Photopoulos

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Starting the practical….

- Should all have files installed on the machines.
- Suggest you maybe work in groups of 2 or 3?
- Aim is to use MamVisAD to help think about biological “questions”.
- MamVisAD remains a bit of a “work in progress” research tool. So please be patient!

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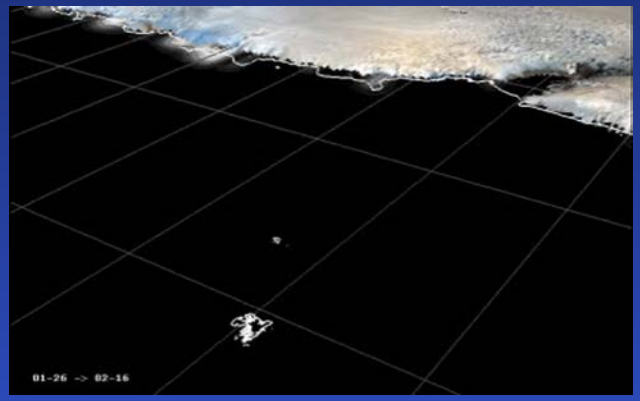
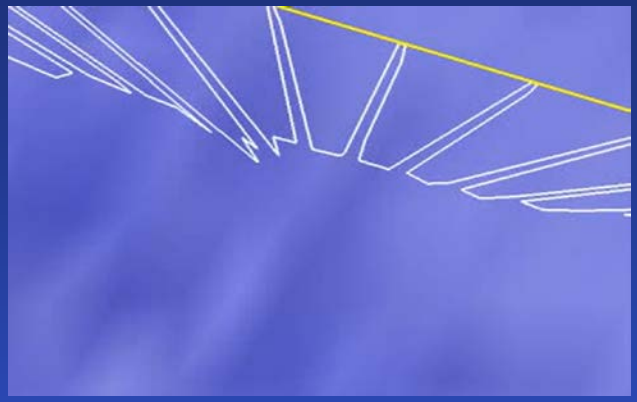
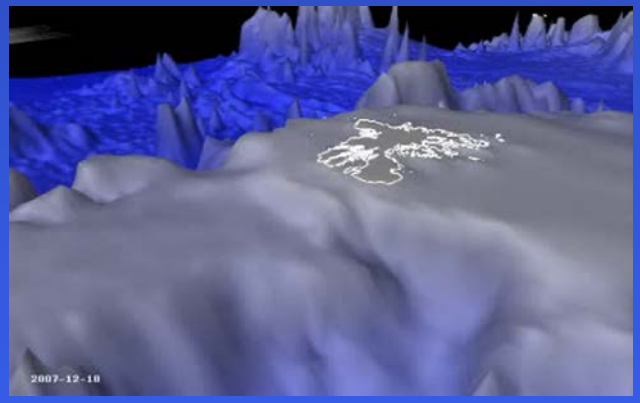
Thank you……..







Clint Blight

SMRU

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SEaOS data from seals tagged on Kerguelen
by courtesy of Christophe Guinet, CNRS