



# Track & Loc Service Fish Tag Processing

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On behalf of Philippe Gaspar, head of Marine  
Ecosystem Modeling & Monitoring by Satellite  
(MEMMS) at CLS

- About Fish tags
- Light based geo-location, principles, constraints
- Enhancing light based data
- Track & Loc service, how it works
- Products delivered
- Experience & References

# About Fish Tags

## How pop-up and archival tags work:

- All tags measure **pressure + temperature+ light level**
- **Pop-ups** detach from the animal and transmit **PART** of the recorded measurements through ARGOS
- Recovery of **archival tags** is possible only if the fish is recaptured...but then **ALL** measurements are recovered

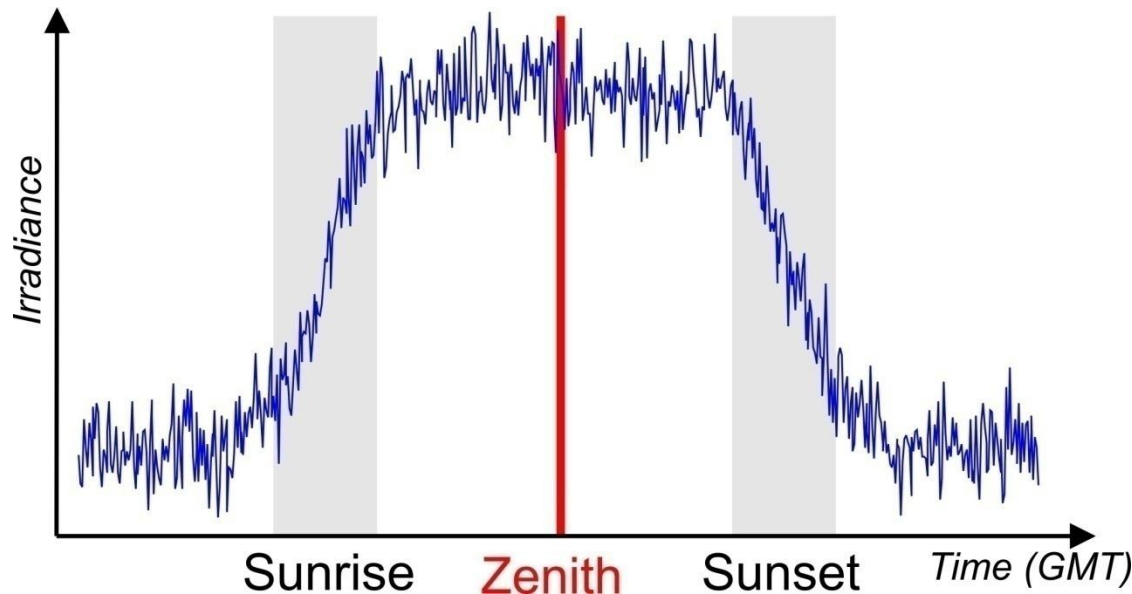


**Pop-up tag**



**Archival tag**

# How Fish Tags measure locations



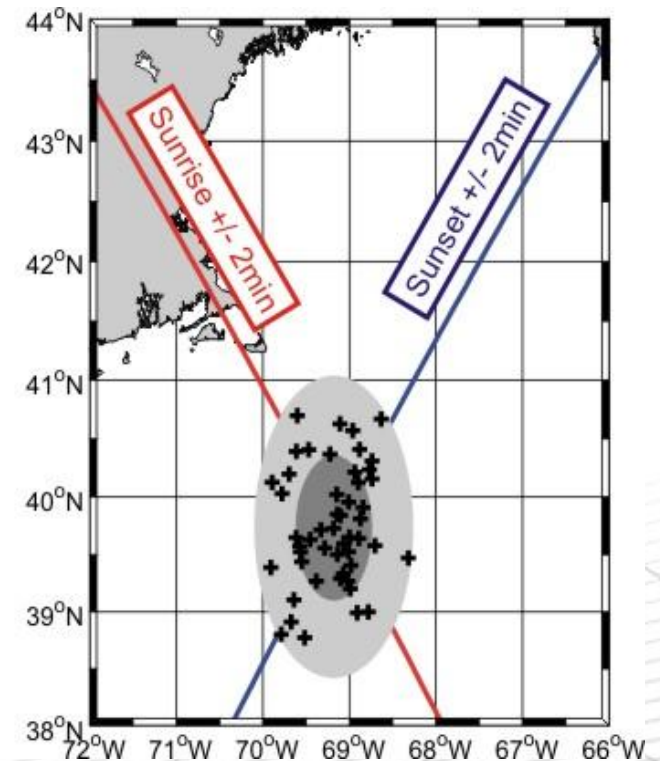
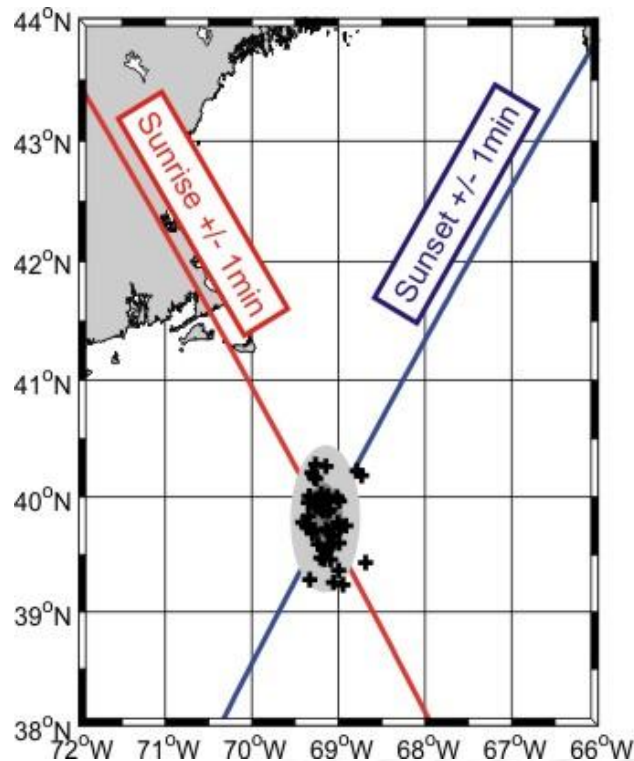
## Principles of light-based geolocation

- Estimates of **sunrise** and **sunset** times allows to geolocate the tag
- Precision in longitude almost **constant** over the year
- Precision in latitude **drops** at the **equinoxes**



# Light based geolocation

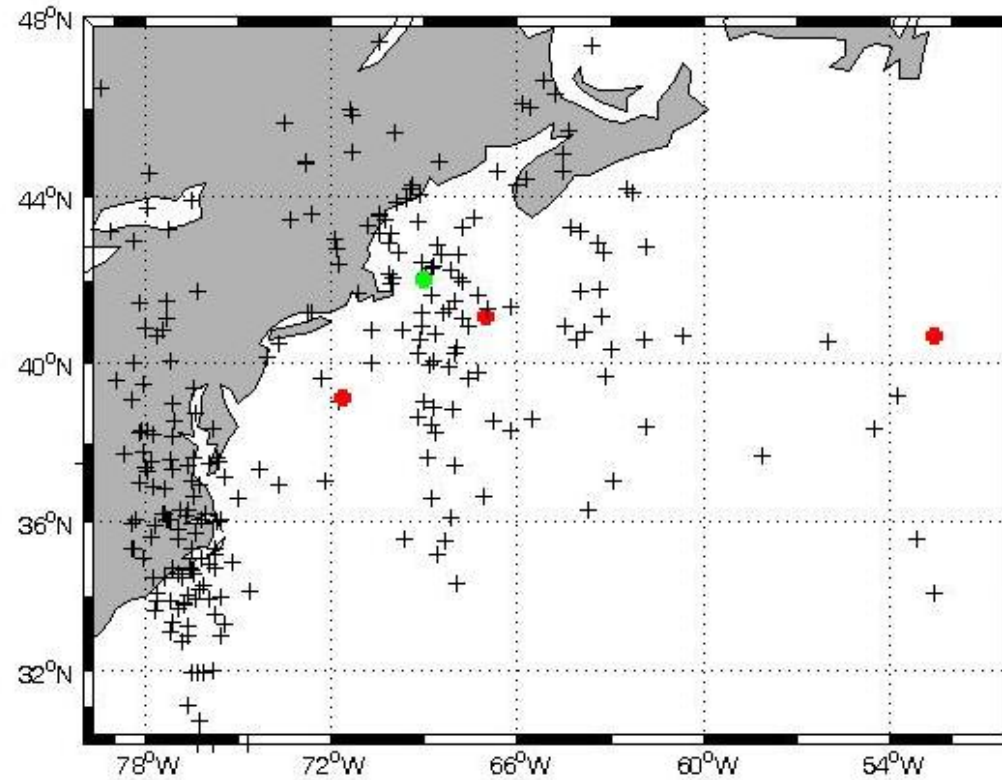
In theory...



- High sensitivity of geolocation accuracy to sunset/sunrise estimates
- In a perfect world, a 3min error for sunrise/sunset is the best we can expect...

# Theory vs. practice for light-based geolocation

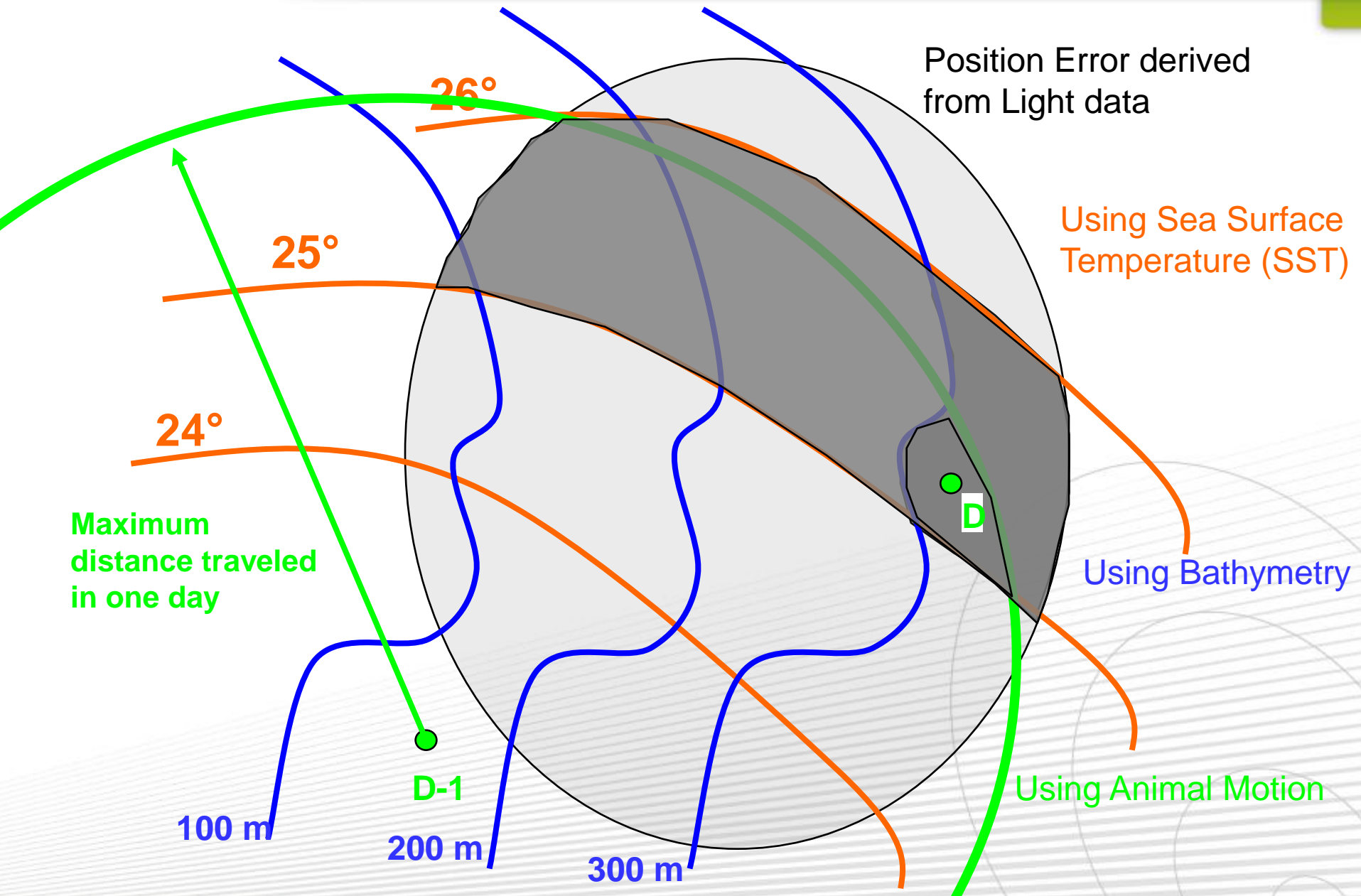
In practice...



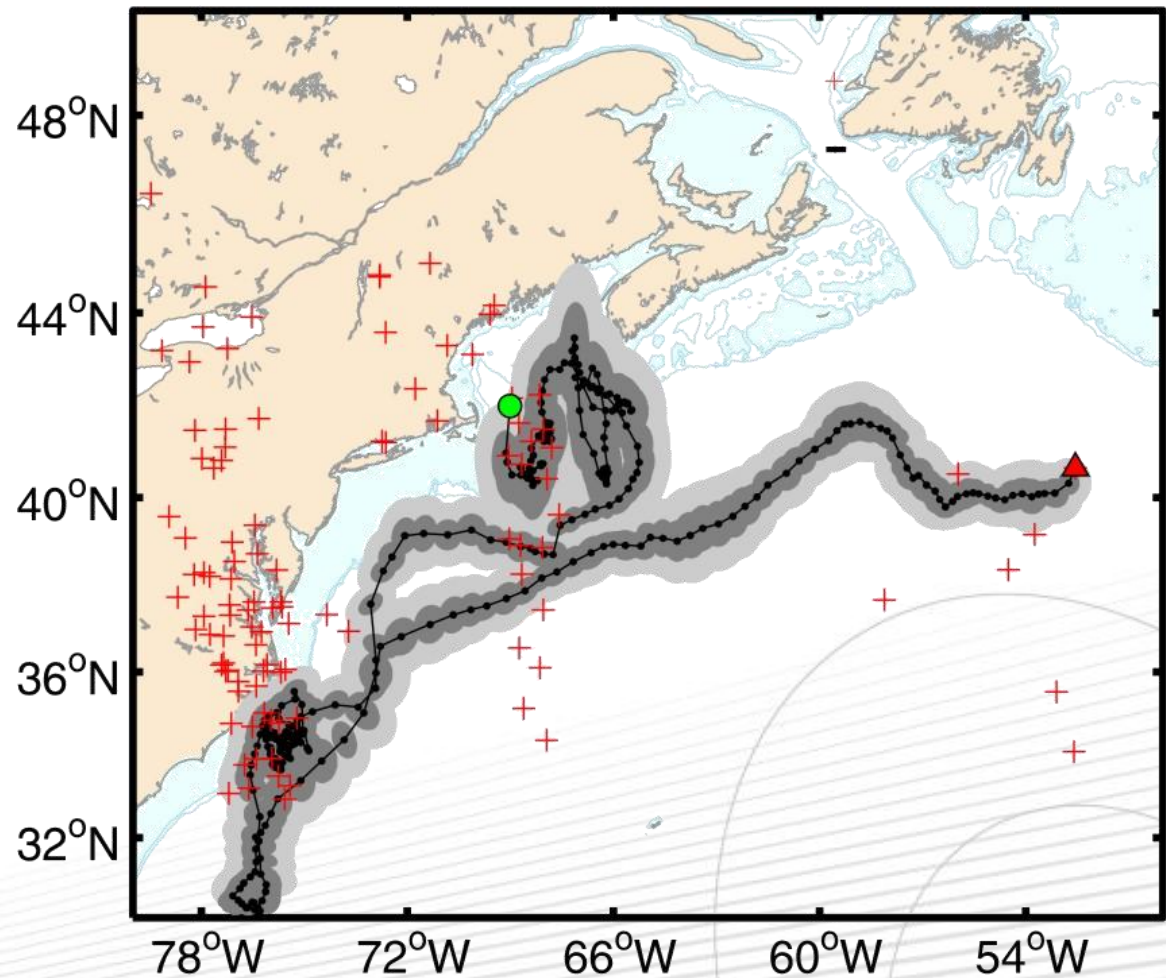
- Errors reach 1 degree in longitude and 3-5 degrees in latitude
- Many sources of error: water clarity, fish vertical behavior, gaps in ARGOS transmissions, equinoxes, coding issues...
- Need to **filter** the data to reduce geolocation error

- Objective : **improve light-level based positioning** by using additional constraints on the position
- Technique based on algorithms developed by F. Royer during his thesis at CLS/Ifremer and his Postdoc at University of New Hampshire.

# Fish tag processing at CLS: How it works



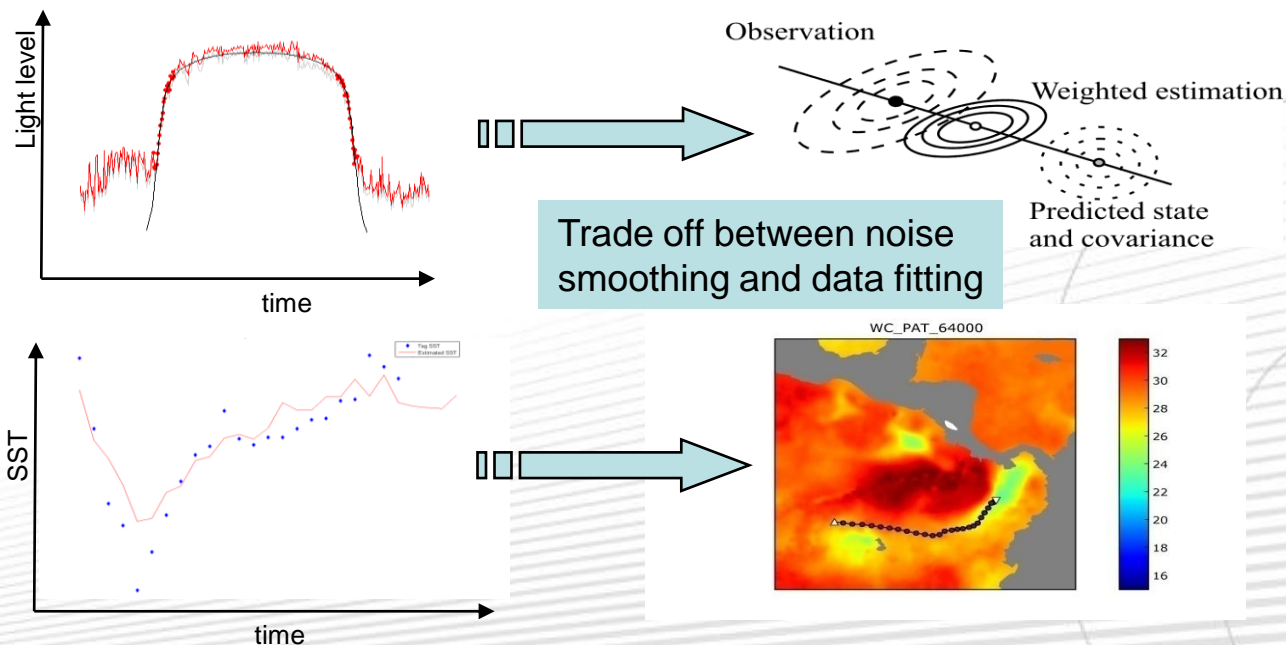




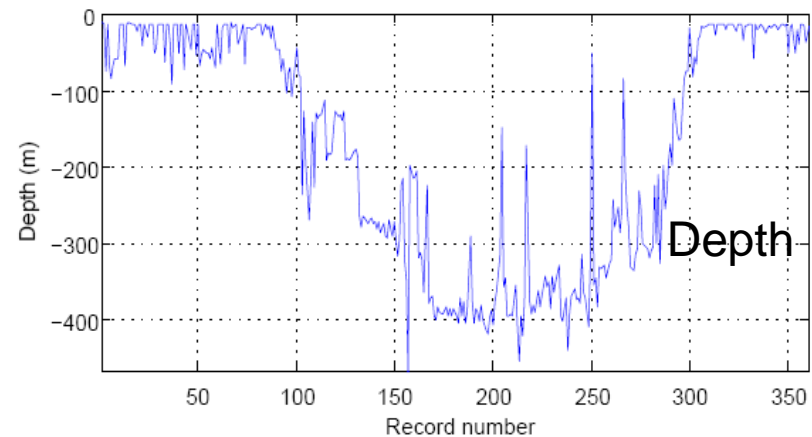
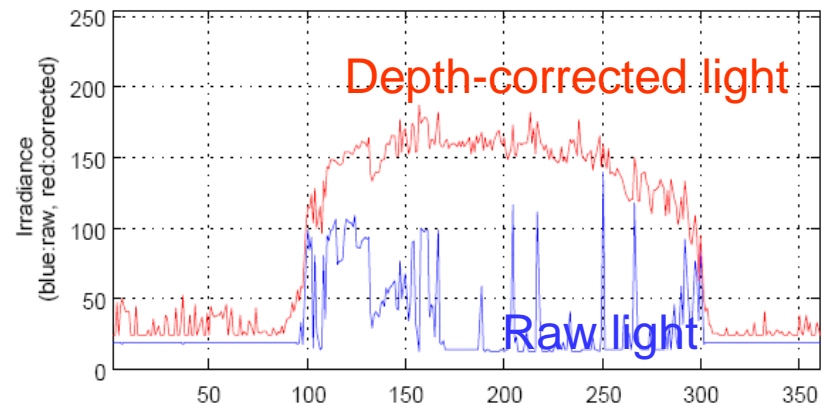
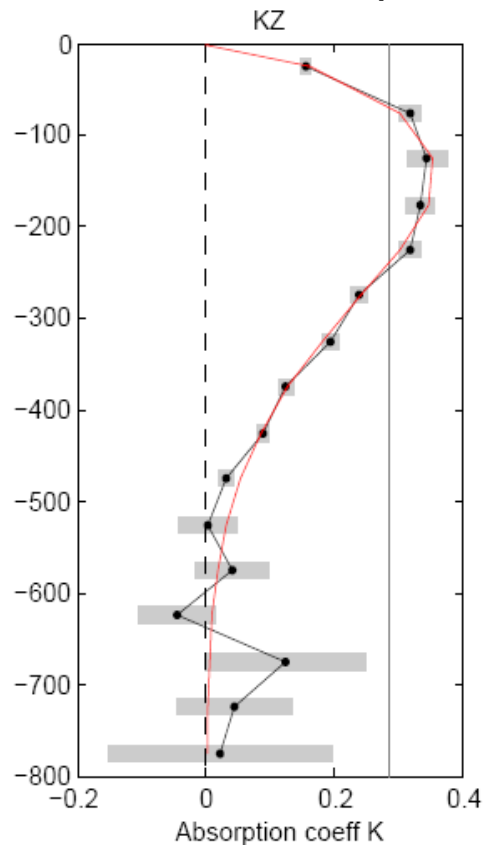
- + Microwave Telemetry geolocations
- Smoothed track (EnKF + SST + bathymetry)

More formally, the geolocation problem is formulated in a state space theory context and solved using a Kalman filtering /smoothing approach (Royer et al., 2004; Royer & Lutcavage, 2008) based on :

- a simple movement model
- observations including light-level, SST & bathymetry

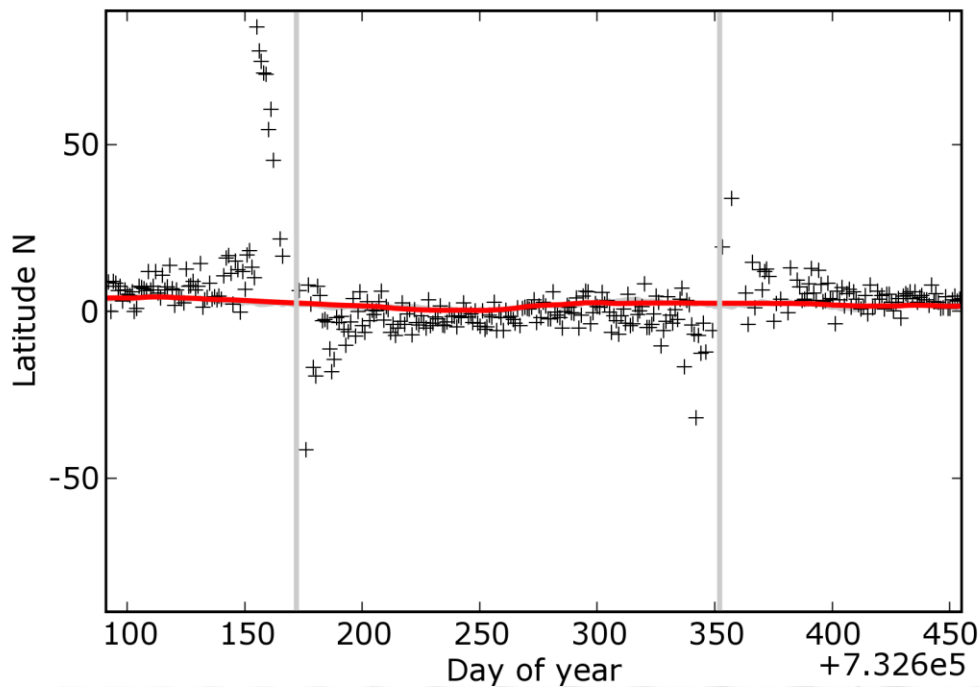


Correcting for light attenuation at depth...



# Theory vs. practice for light-based geolocation

Correcting for large errors at the equinoxes







# Main steps of a tracking study

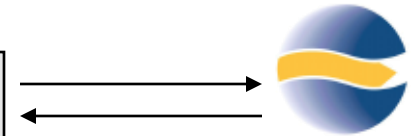
1. Get tags + Argos SUA

2. Tag fish!



3. Wait ... to retrieve tag data

4. Retrieve data from Argos



5. Process data

Send data to Microwave Telemetry

Through Wildlife Computers' software



6. Improve location accuracy

7. Publish!



User's responsibility



CLS's Track&Loc service

# Decoding Argos Raw data

- Satellite Transmitted Data – Not Usable Directly
- Decoding of Individual Datasets using Manufacturer's Software

Decoding

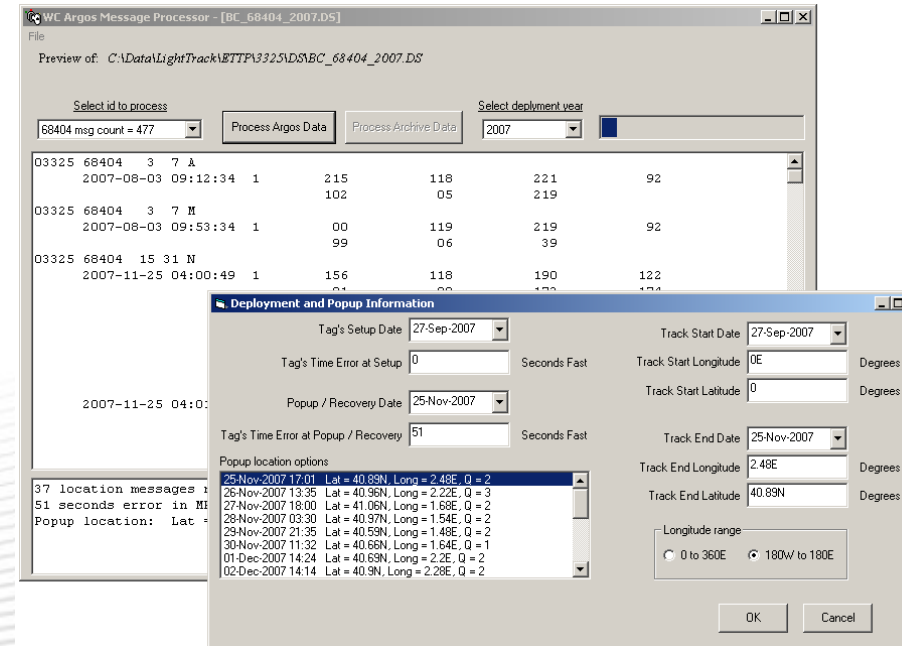
Geolocation

Filtering

Delivery

Example:

Wildlife Computers  
MK10



# Light-based geolocation

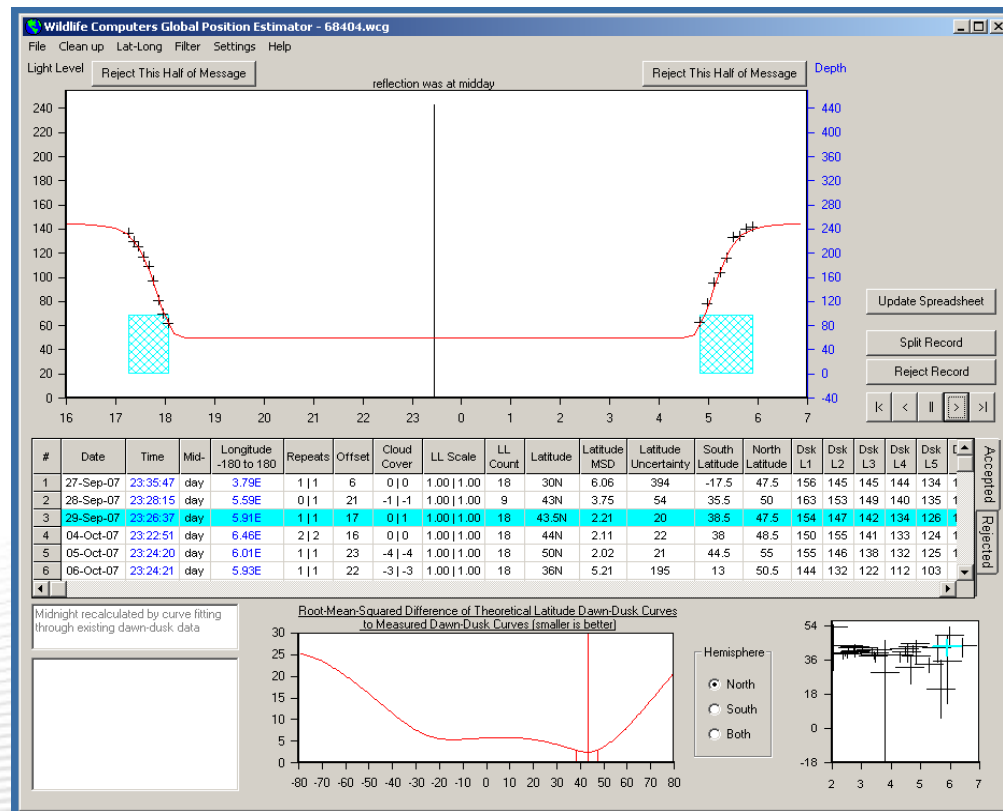
- Light-level data : first Location Estimation
- Using Manufacturer's Software, Record by Record
- Can be Subjective

Decoding

**Geolocation**

Filtering

Delivery



# Light-based geolocation

Decoding



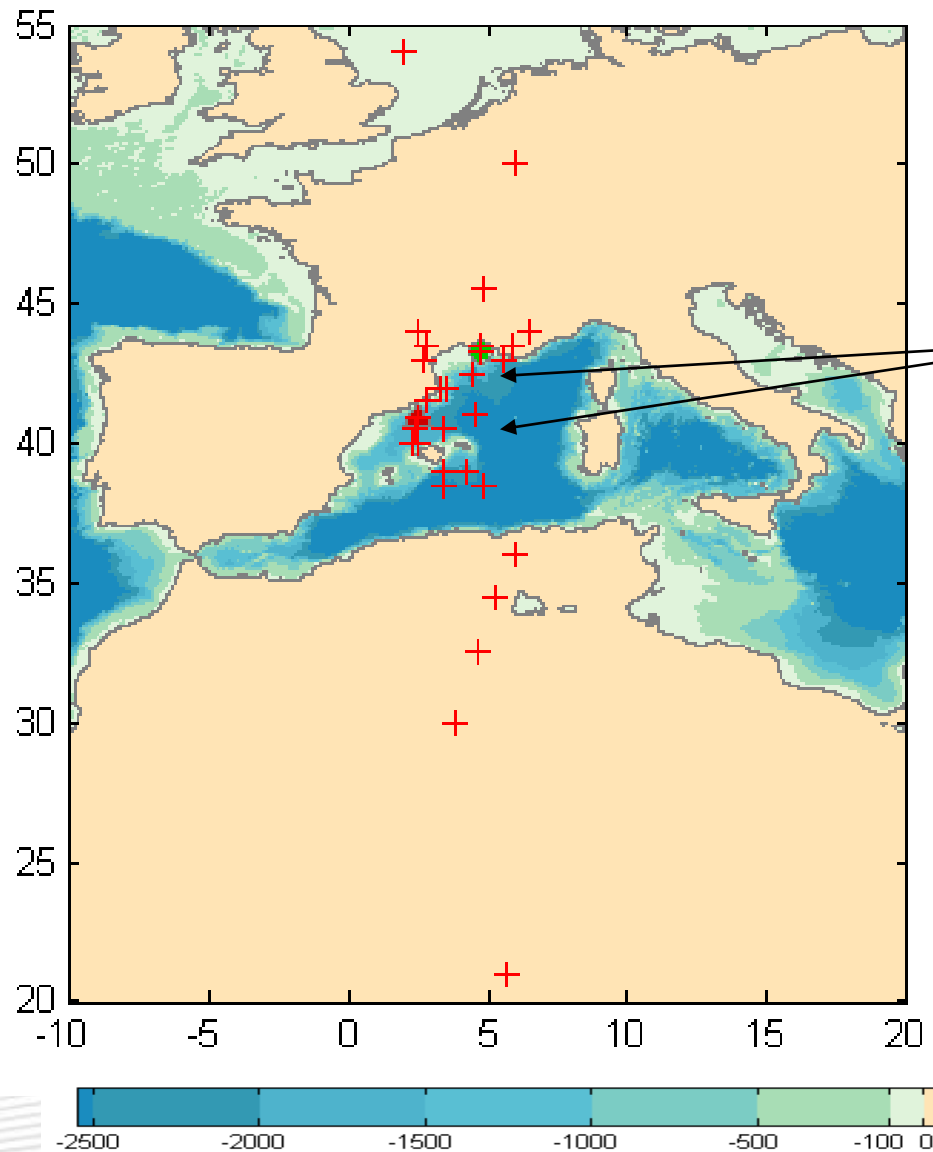
**Geolocation**



Filtering



Delivery



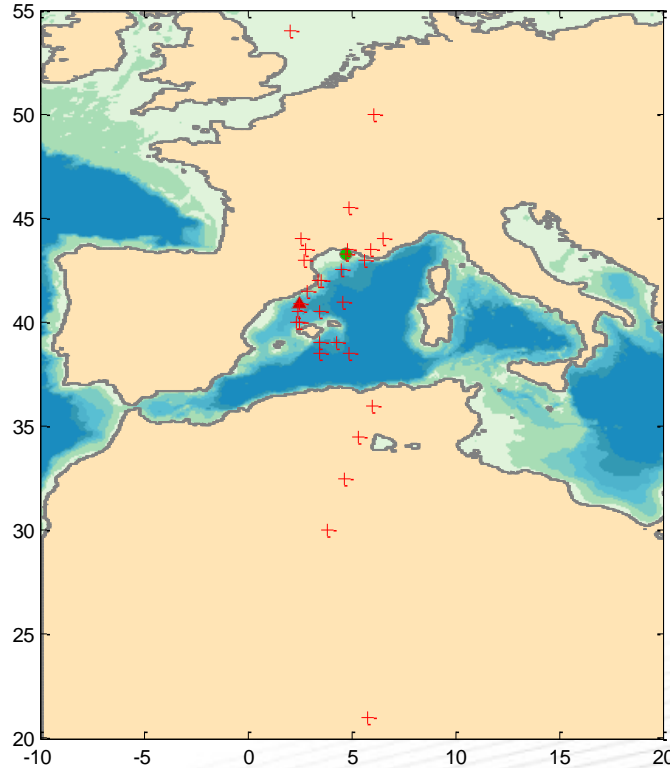
« Raw »,  
Unconstrained  
Light-based  
Geolocations



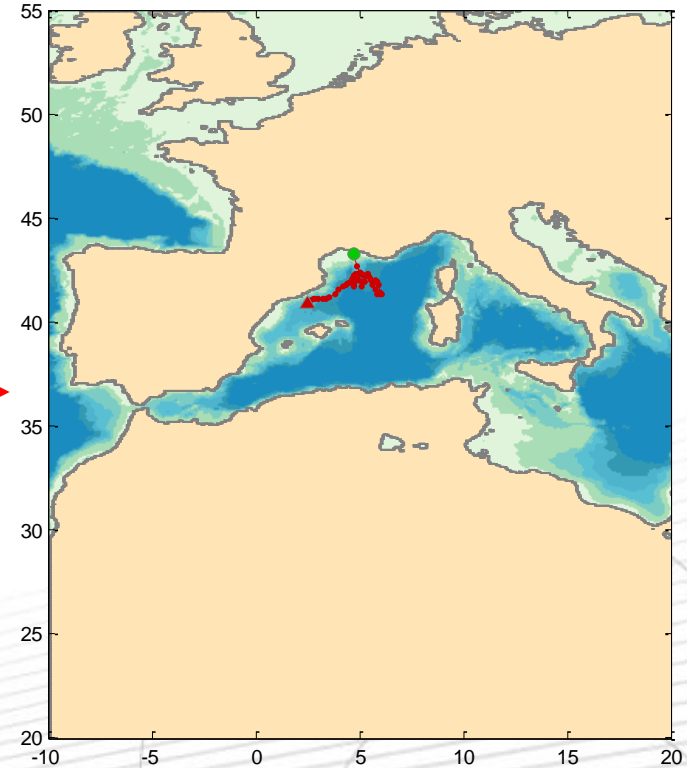
# Reduction of Location Error

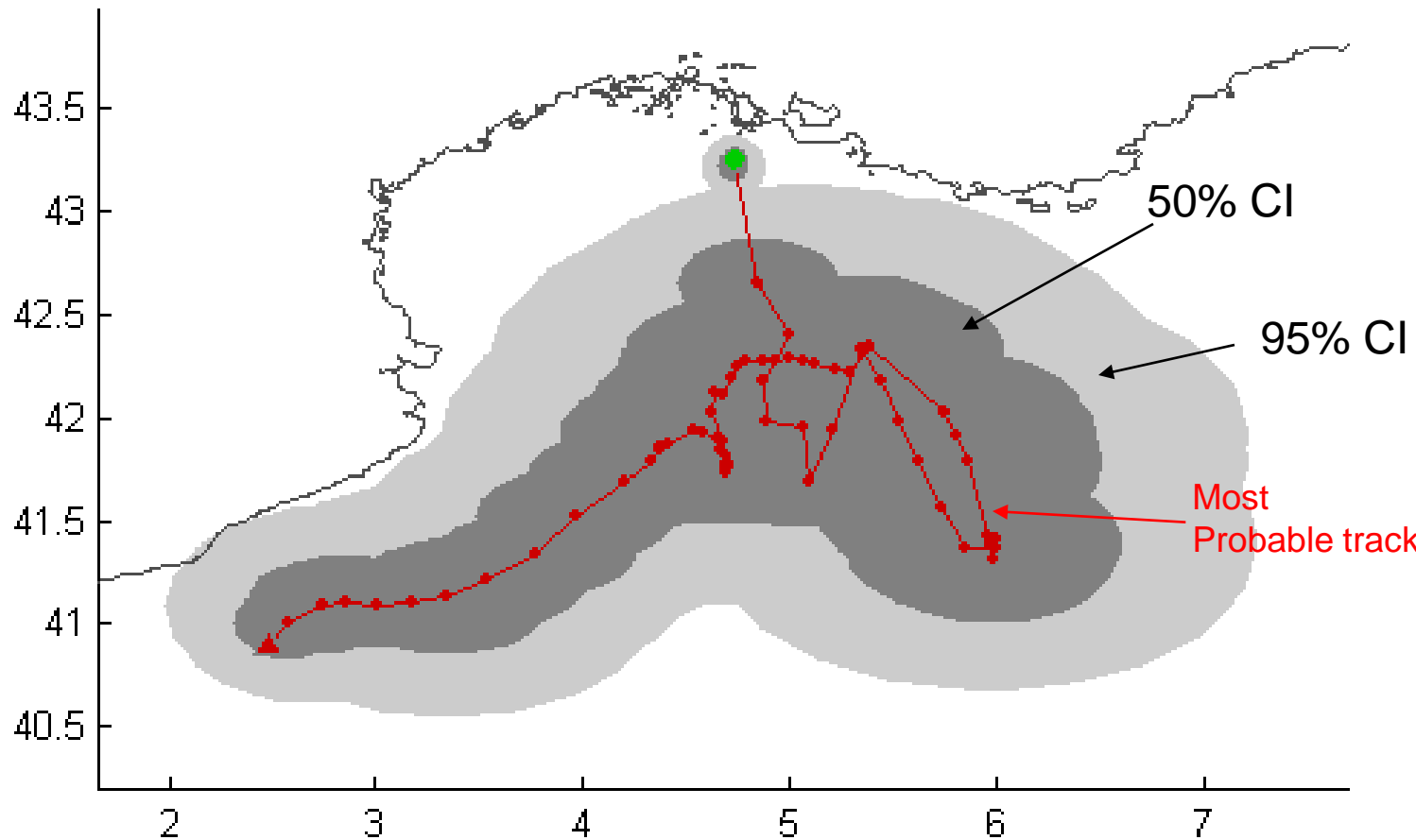
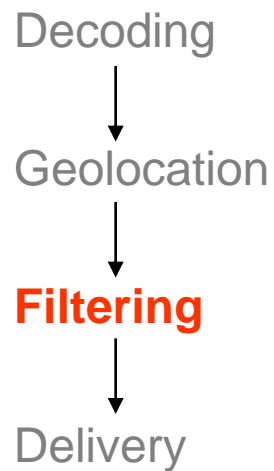
Decoding  
↓  
Geolocation  
↓  
**Filtering**  
↓  
Delivery

Before Filtering



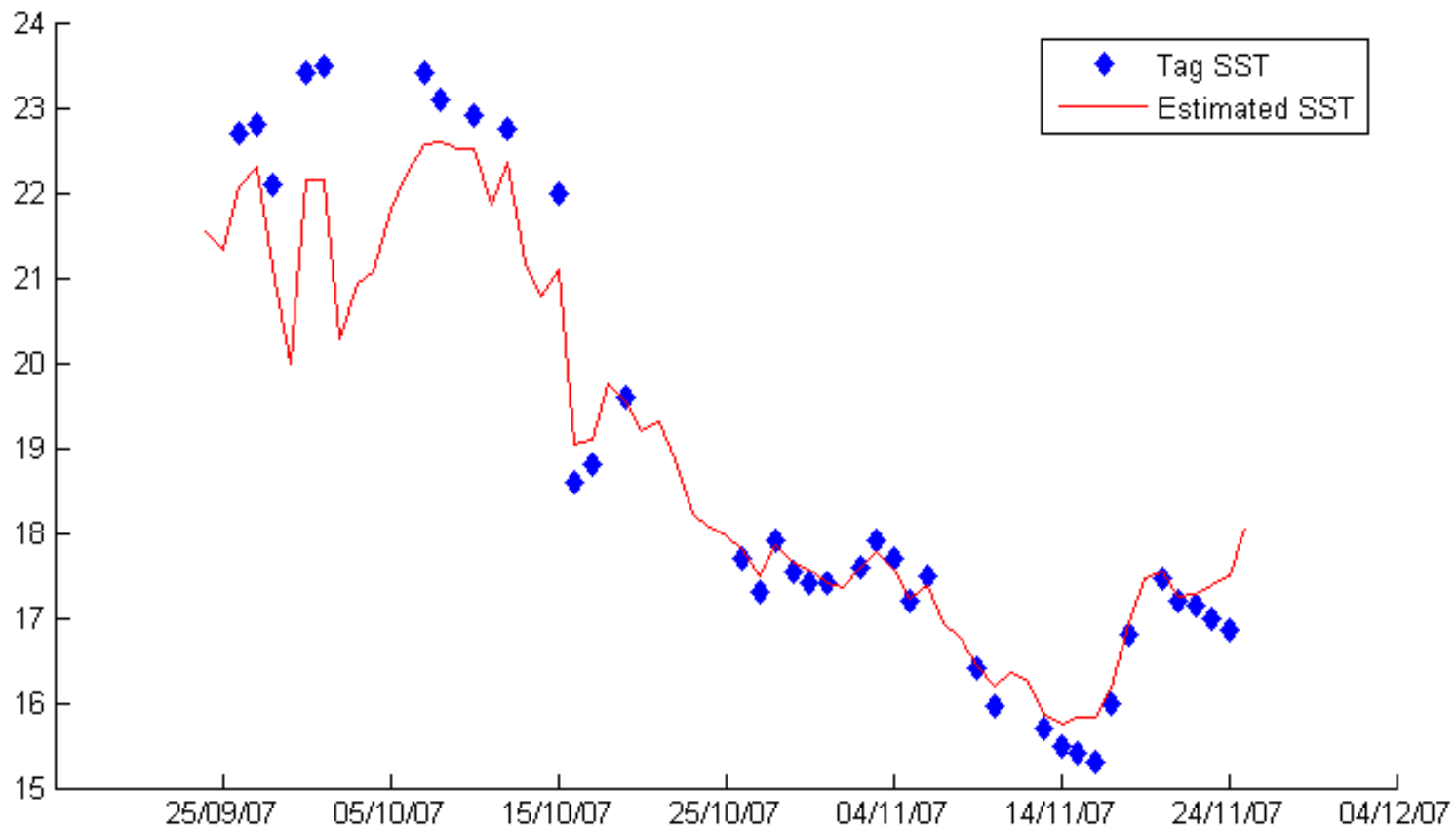
After Filtering





# Sea Surface Temperature

Decoding  
 ↓  
 Geolocation  
 ↓  
**Filtering**  
 ↓  
 Delivery



# Bathymetry

Decoding



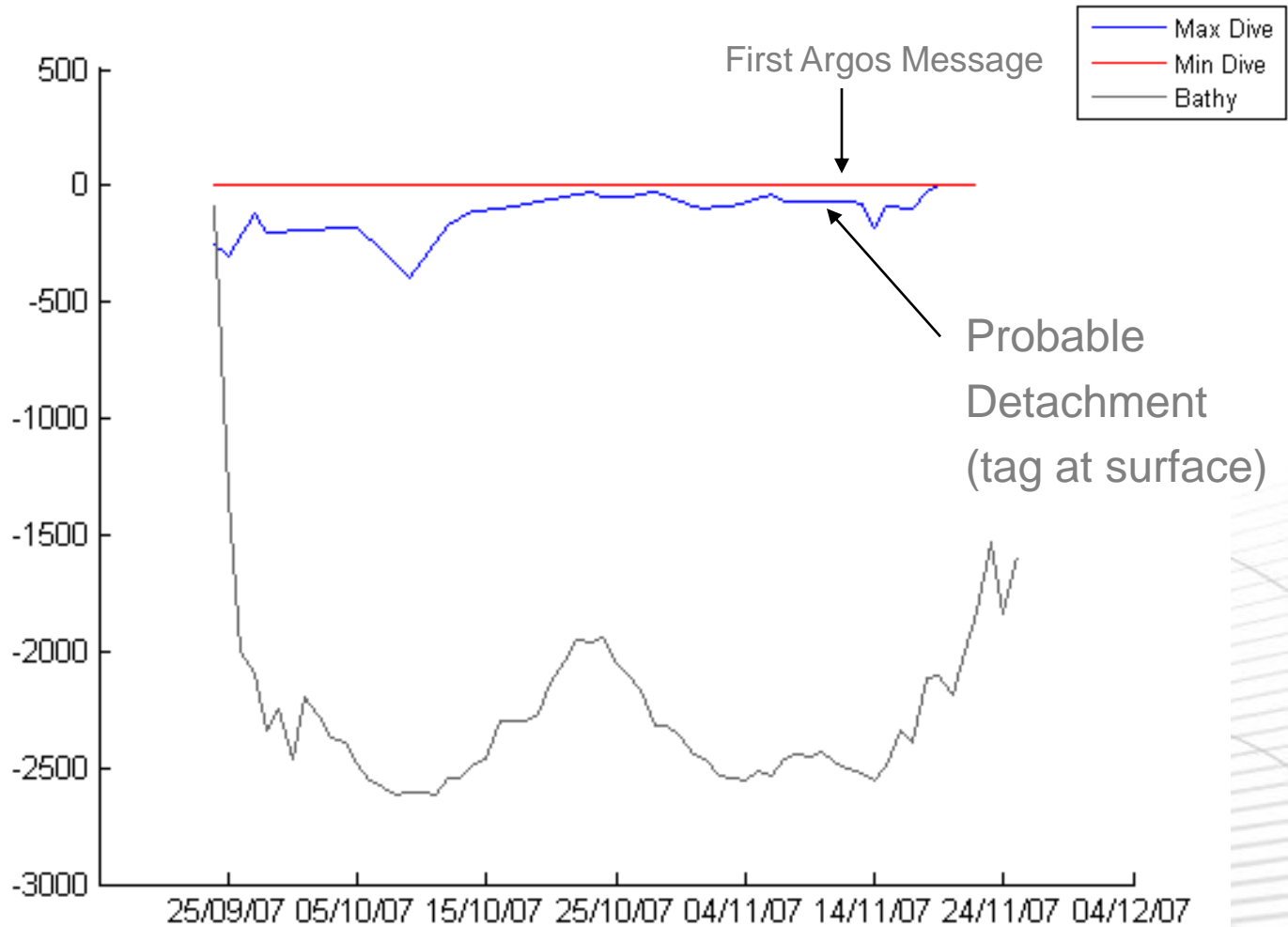
Geolocation



**Filtering**



Delivery





# Delivery : Raw Data

- Final Dataset: Raw + Preprocessed Data
- Binned (Temperature, Depth)

Decoding

Geolocation

Filtering

Delivery

Microsoft Excel - 68404.xls

Fichier Edition Affichage Insertion Format Outils Données Fenêtre ?

Tapez une question

100%

Arial 10

Y Répondre en incluant des modifications... Terminer la révision...

masquer

A2	1											
A	B	C	D	E	F	G	H	I	J	K	L	M
Record	Time & Date of Midnight or Midday	Longitude	Lon MSD	Latitude	Lat MSD	South Lat	North Lat	South Lat Range	North Lat Range	Lat Number	Lat Uncertainty	# of readings deleted
1	27-Sep-07 11:35:47	3.79	0.300	6.175	47.5	47.5	17.5	18	393.9	0	27-Sep-07	
2	28-Sep-07 11:26:15	5.89	0.430	4.355	60.0	7.5	7.0	9	54.4	0	28-Sep-07	
3	29-Sep-07 11:26:37	5.91	0.435	2.385	47.5	6.0	4.0	18	19.9	0	29-Sep-07	
4	04-Oct-07 11:22:51	6.46	0.440	2.380	48.5	6.0	4.5	18	22.2	0	04-Oct-07	
5	05-Oct-07 11:24:20	6.01	0.500	2.445	55.0	6.5	5.0	18	21.3	0	05-Oct-07	
6	06-Oct-07 11:24:21	5.93	0.360	5.130	50.5	23.0	14.5	18	195.3	0	06-Oct-07	
7	08-Oct-07 11:24:39	5.72	0.210	6.555	37.0	16.5	16.0	18	189.3	0	08-Oct-07	
9	09-Oct-07 23:29:02	4.55	0.410	3.355	45.5	6.5	4.5	18	26.4	0	09-Oct-07	
10	12-Oct-07 11:25:14	5.31	0.345	3.300	38.0	4.5	3.5	18	20.2	0	12-Oct-07	
11	16-Oct-07 11:26:54	4.66	0.325	5.235	40.0	9.0	7.5	18	86.6	0	16-Oct-07	
12	20-Oct-07 11:25:47	4.75	0.435	2.405	45.0	3.0	1.5	18	7.3	0	20-Oct-07	
13	22-Oct-07 11:25:06	4.84	0.455	3.420	47.5	3.5	2.0	18	16.7	0	22-Oct-07	
14	23-Oct-07 11:27:12	4.28	0.390	2.355	41.5	3.5	2.5	9	10.9	0	23-Oct-07	
15	25-Oct-07 23:36:03	2.00	0.540	5.310	58.0	23.0	2.0	18	128.4	0	25-Oct-07	
16	29-Oct-07 11:32:43	2.75	0.435	4.380	45.5	6.5	2.0	18	31.8	0	29-Oct-07	

A2

B

C

POT Number

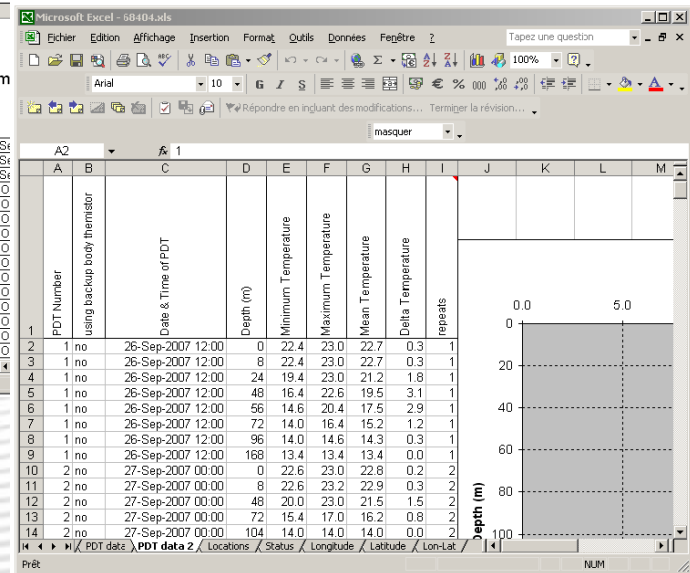
using backup body memstor

Date & Time of POT

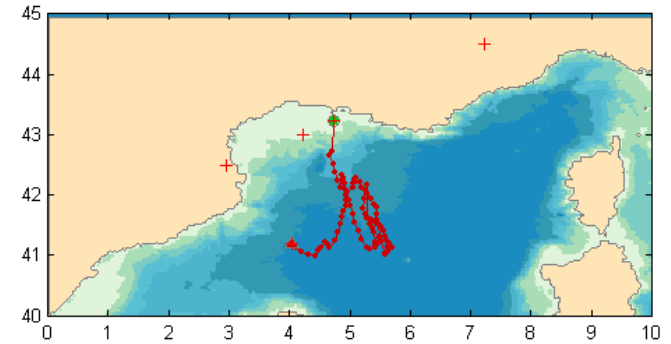
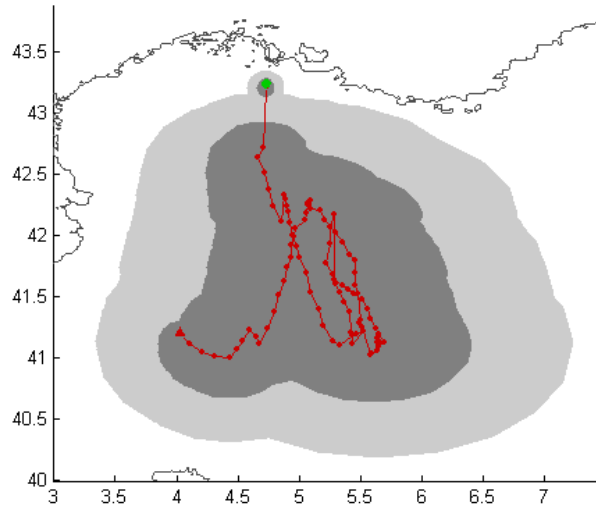
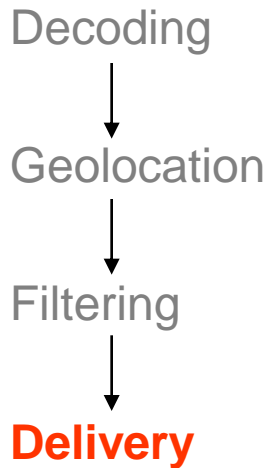
1	2	1 no	26-Sep-2007
3	1 no	26-Sep-2007	
4	1 no	26-Sep-2007	

POT data / POT data 2

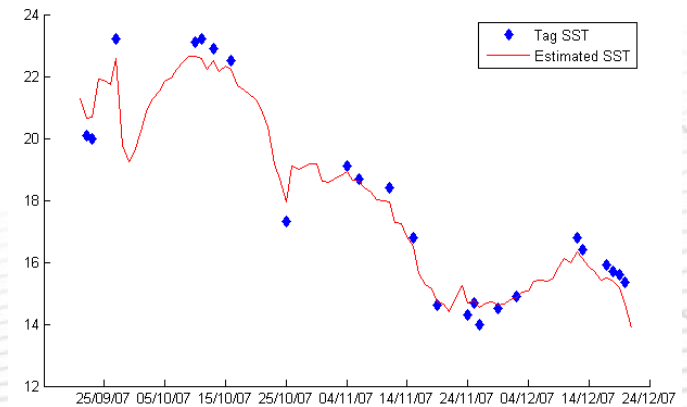
Locations / Status / Longitude / Latitude / Lon-Lat



# Delivery : Processed Data



- Excel File
- Interpolated Data
- Positions + Uncertainty
- Sea Surface Temperature
- Depth, Speed (min/max)



- Better results, without the effort
- Avoiding the technicalities of tag processing
- Time-saving
- Concentrating on interpreting the result & biology study

- European Tuna Tagging program (ETTP) (>100 pop-ups)
  - Indian Ocean Tuna Commision (40 pop-ups)
  - Secretariat of the Pacific Community (Oceanic Fisheries Programme) : 200 internal tags over 5 years
- + Ogasawara Fisheries Center, Irish Sea Fisheries Board, WWF, Univ. Of Cadiz.....

# THANKS FOR YOUR ATTENTION

