Track & Loc Service Fish Tag Processing

CLS, Christian Ortega

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

Overview

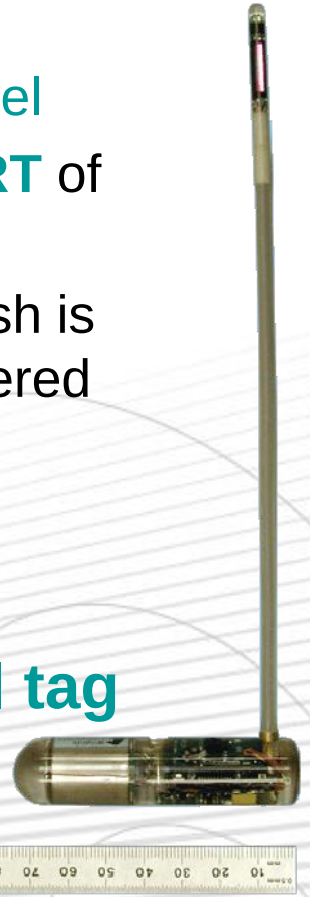
- About Fish tags
- Light based geo-location, principles, constraints
- Enhancing light based data
- Track & Loc service, how it works
- Products delivered
- Experience & References

About Fish Tags

How pop-up and archival tags work:

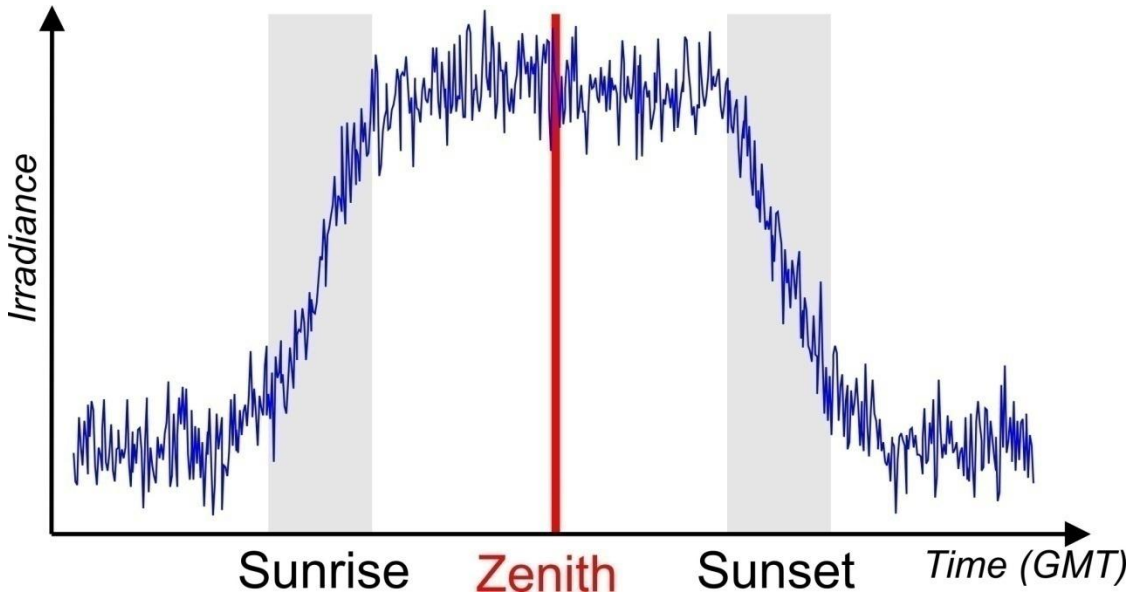
- All tags measure pressure + temperature+ light level
- **Pop-ups** detach from the animal and transmit **PART** of the recorded measurements through ARGOS
- Recovery of **archival tags** is possible only if the fish is recaptured…but then **ALL** measurements are recovered

Pop-up tag



Archival tag

How Fish Tags measure locations

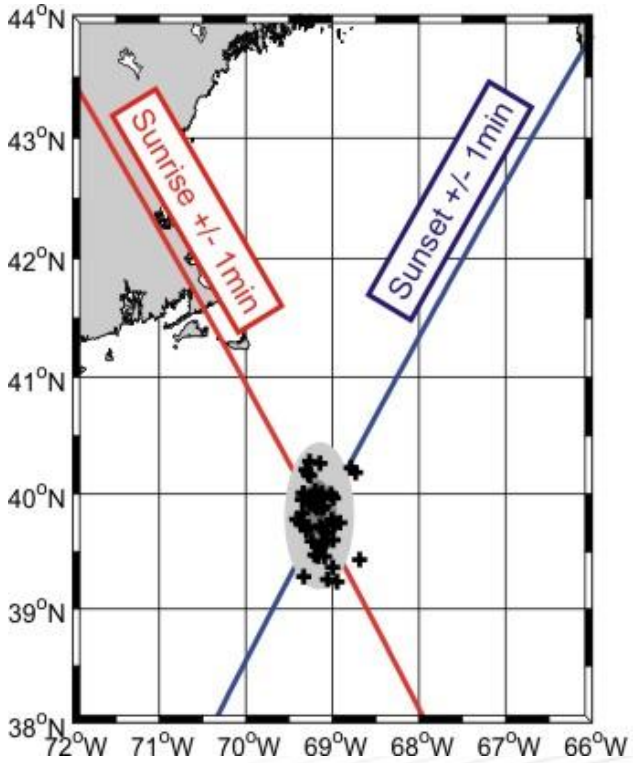


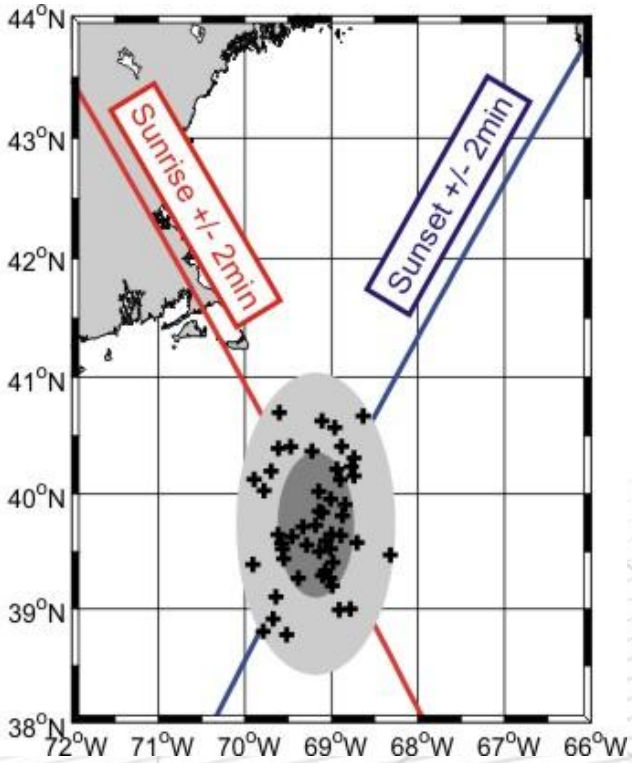
Principles of **light-based geolocation**

- 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…

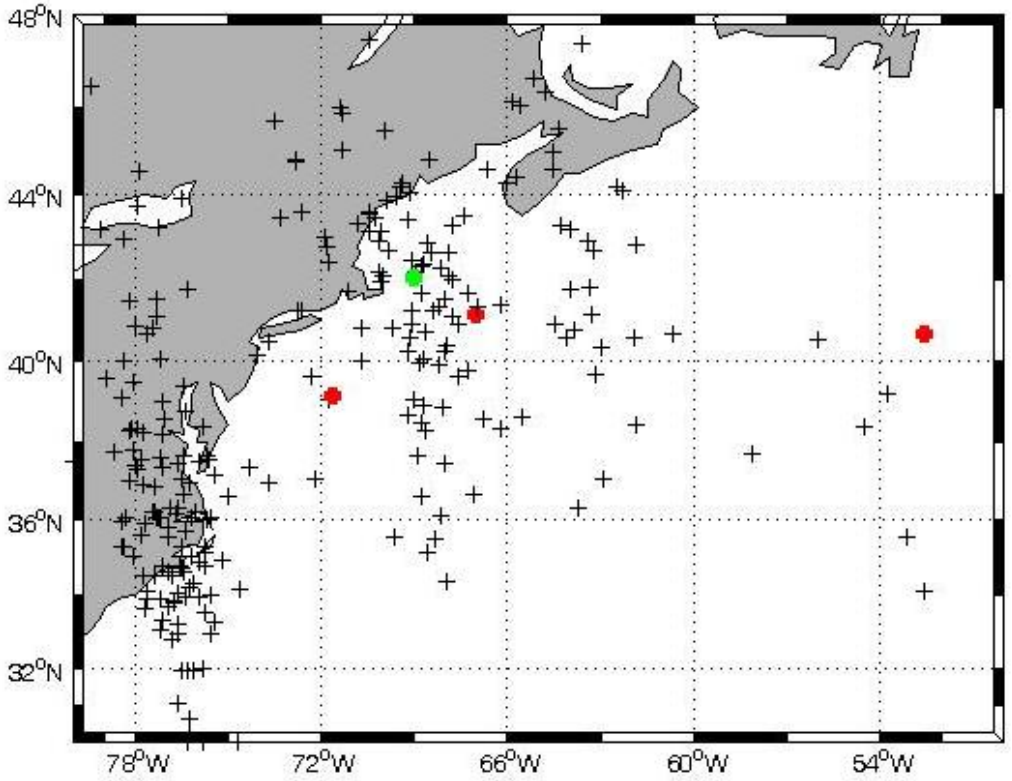




- High sensitivity of geolocation accuracy to sunset/sunrise estimates
- In a perfect world, a 3min error for sunrise/sunset is the best we can expect…

Theory vs. practice for light-based geolocation

In practice…

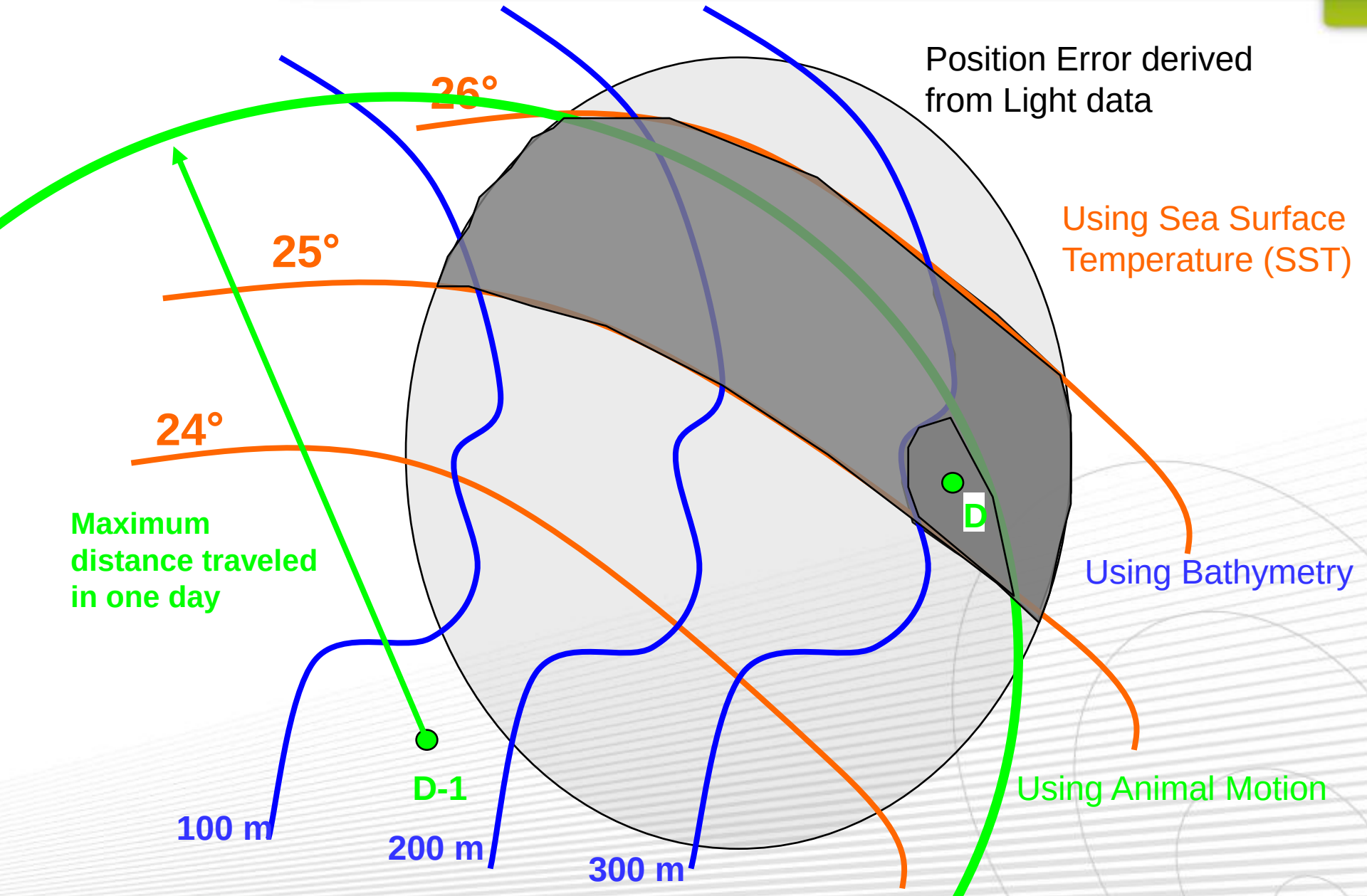


- Errors reach 1 degree in longitude and 3-5 degrees in latitude
- Many sources of error: water clarity, fish vertical behavior, gaps in ARGOS transmissions, equinoxes, coding issues…
- **Need to filter the data to reduce geolocation error**

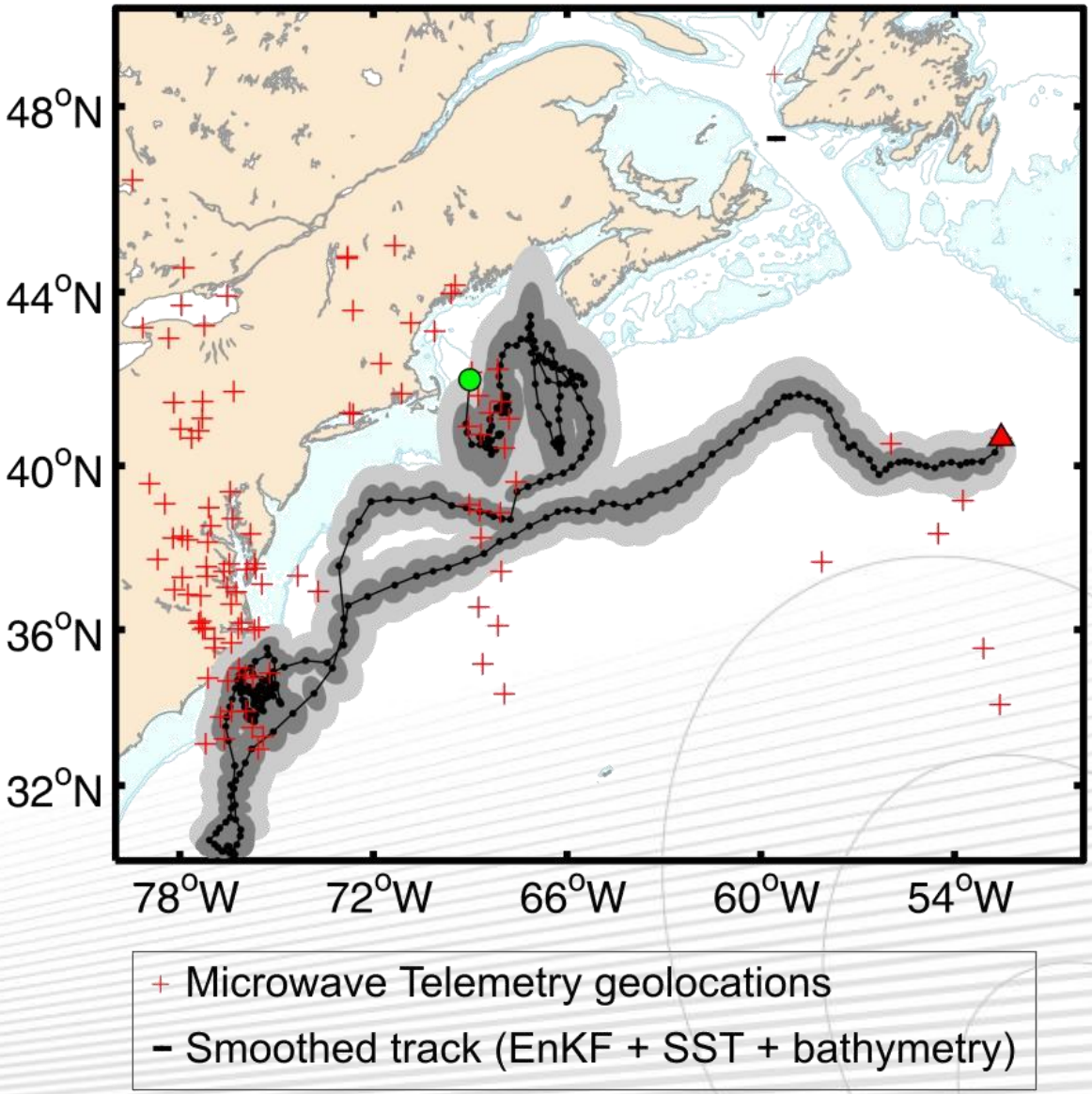
CLS Tag Processing Service

- 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



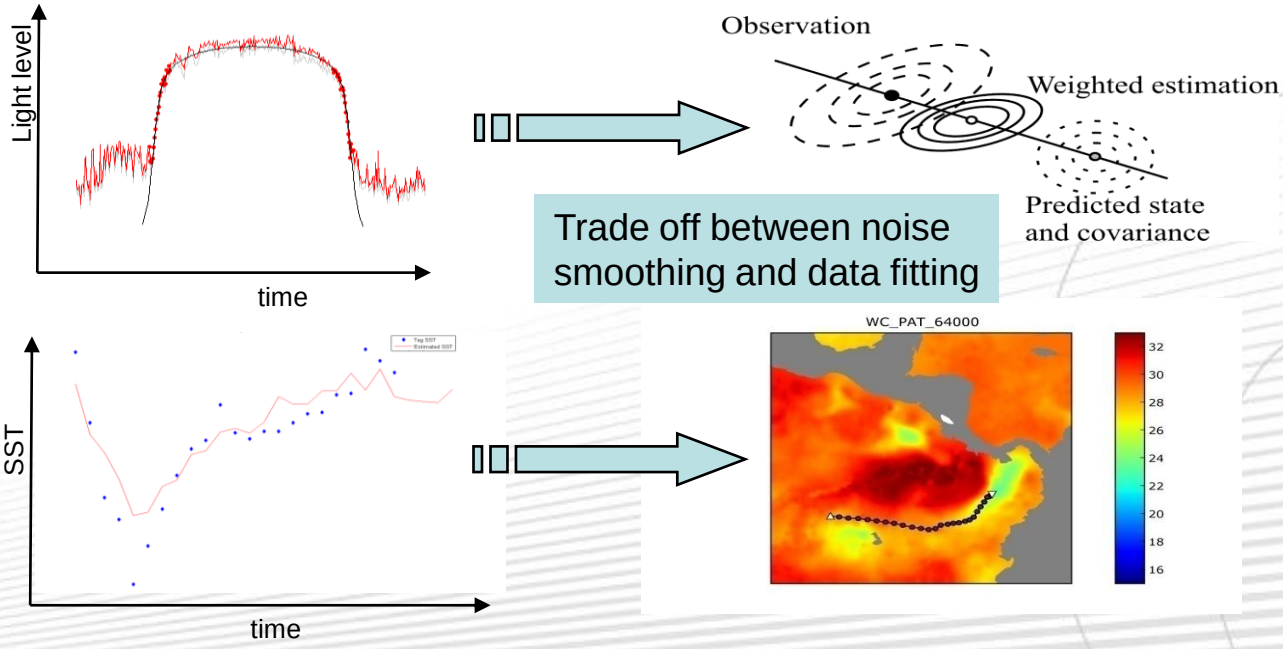
A realistic tracking of Bluefin tuna in the Atlantic



Theoretical Background

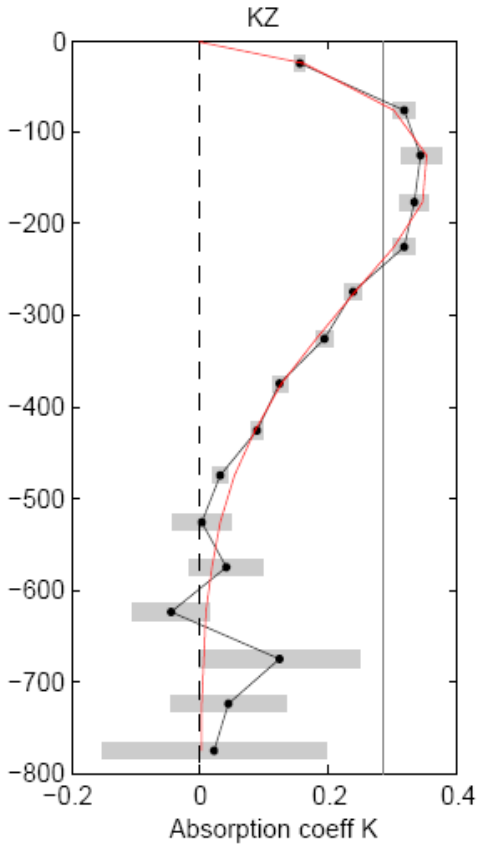
More formally, the geolocation problem is formulated in a state space theory context and solved using a Kalman filtering /smoothing approach (Royer et al., 2004; Royer & Lutcavage, 2008) based on :

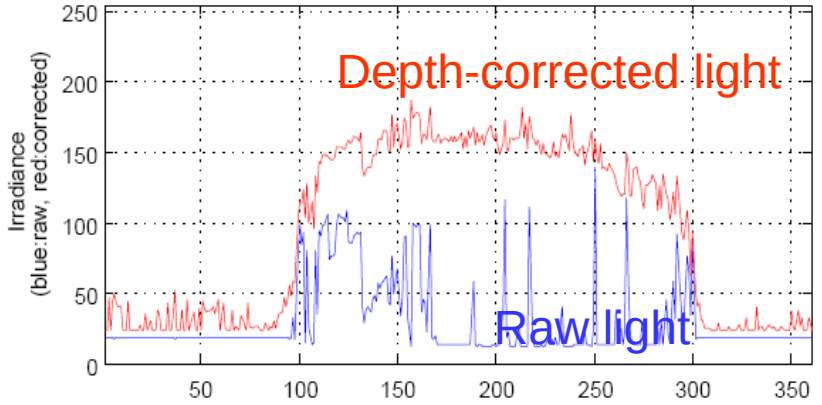
- a simple movement model
- observations including light-level, SST & bathymetry

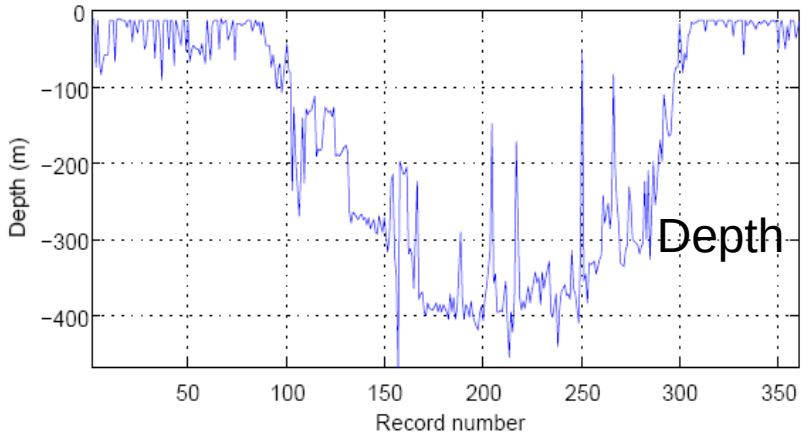


CLS Tag Processing Service

Correcting for light attenuation at depth…

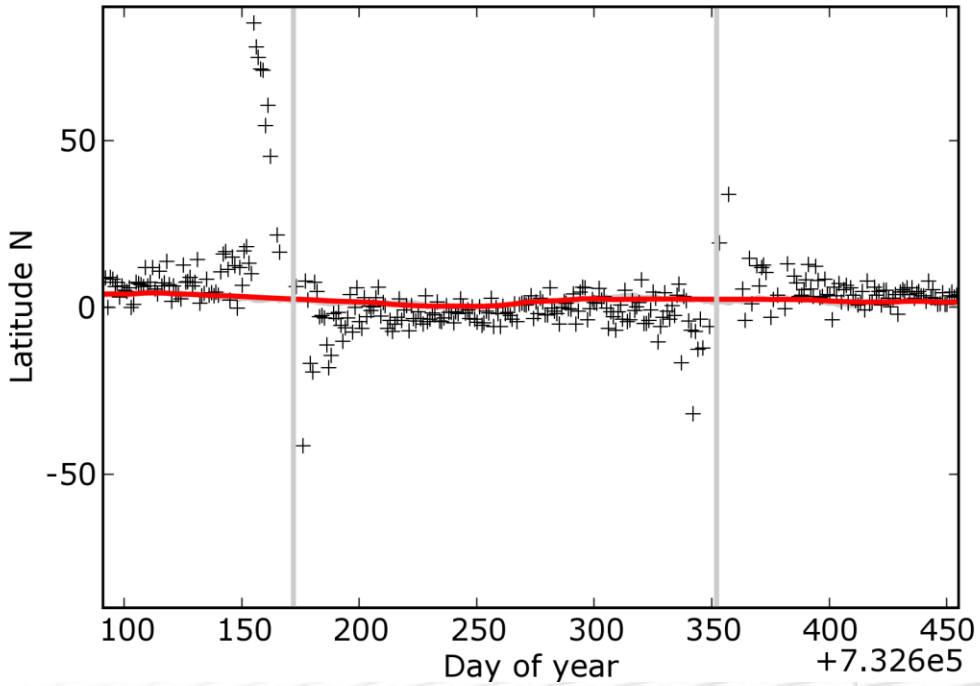






Theory vs. practice for light-based geolocation

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

Decoding

↓

Geolocation

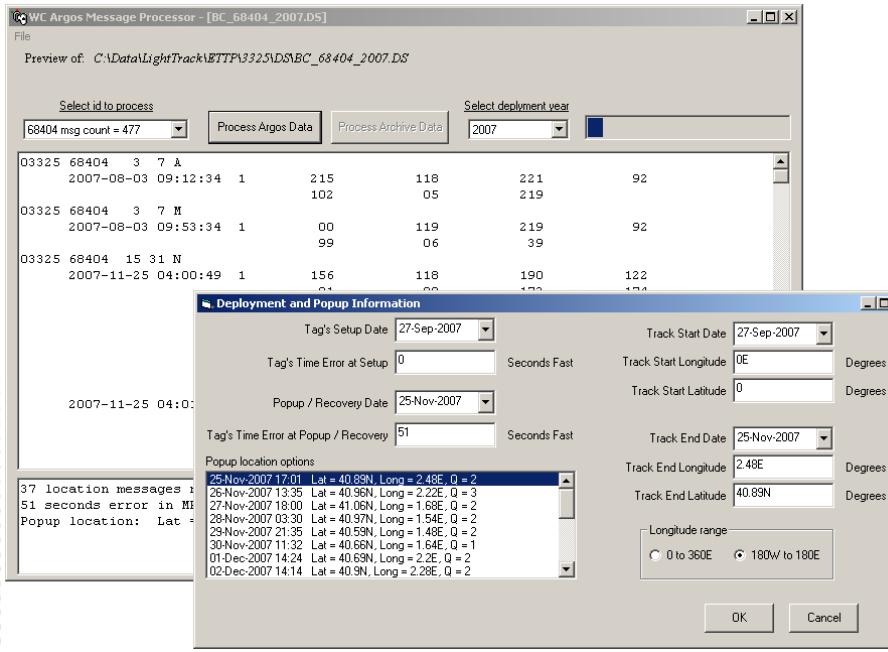
↓

Filtering

↓

Delivery

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



Example:

Wildlife Computers MK10

Light-based geolocation

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

Decoding

↓

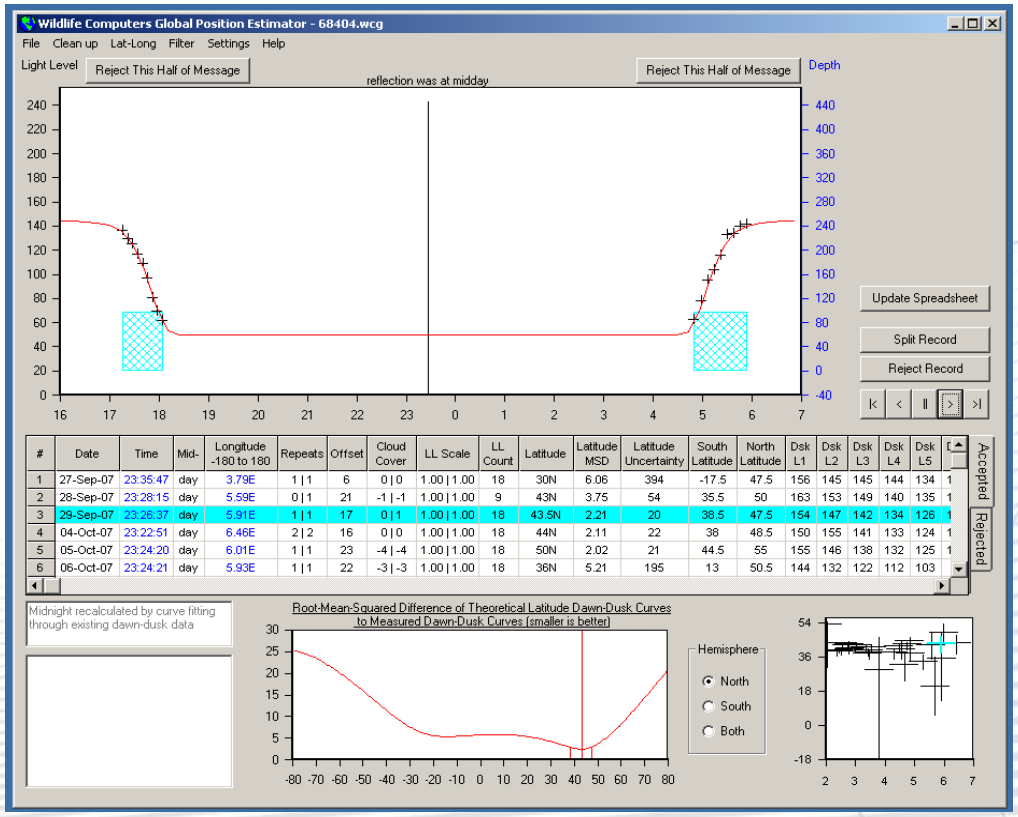
Geolocation

↓

Filtering

↓

Delivery



Light-based geolocation

Decoding

↓

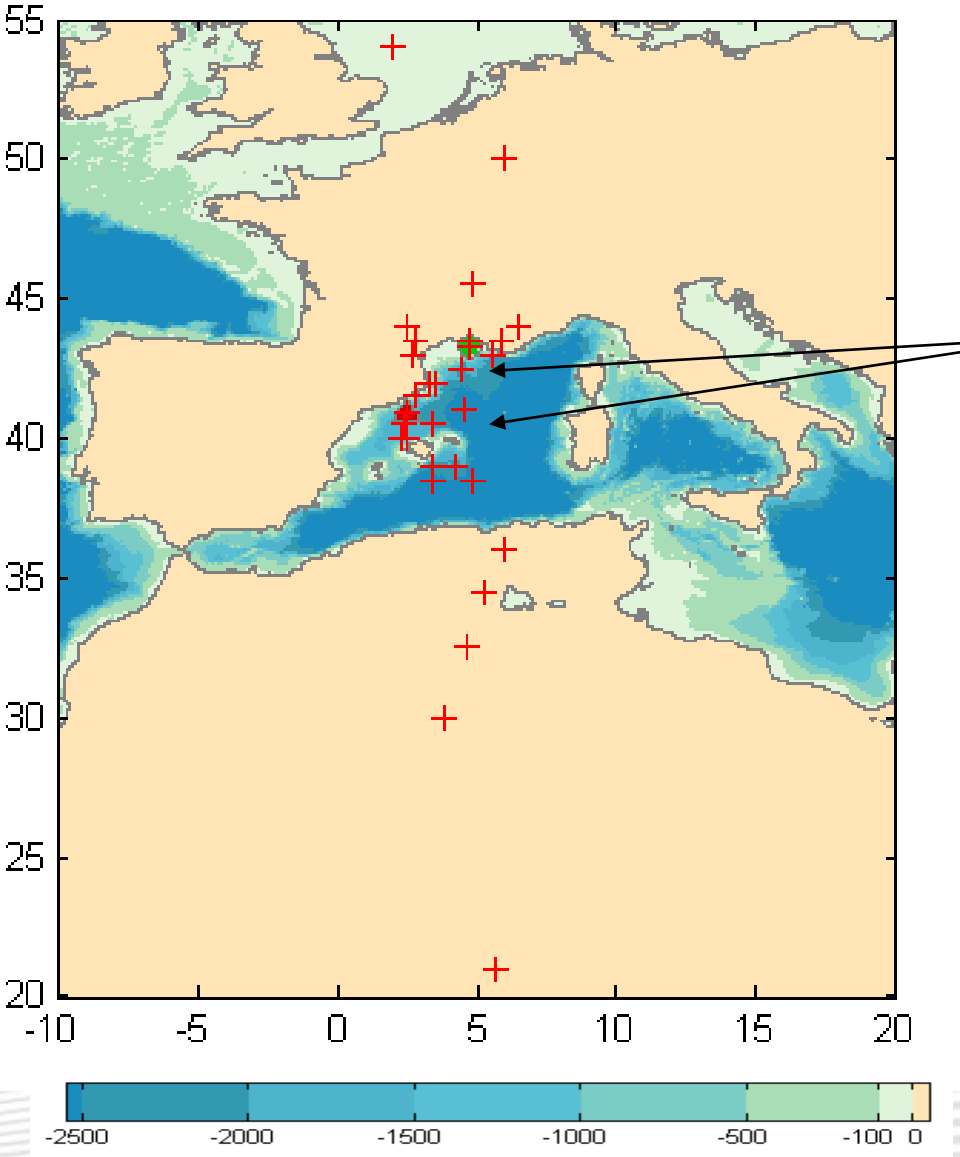
Geolocation

↓

Filtering

↓

Delivery



« Raw », Unconstrained Light-based Geolocations

Reduction of Location Error

Decoding

↓

Geolocation

↓

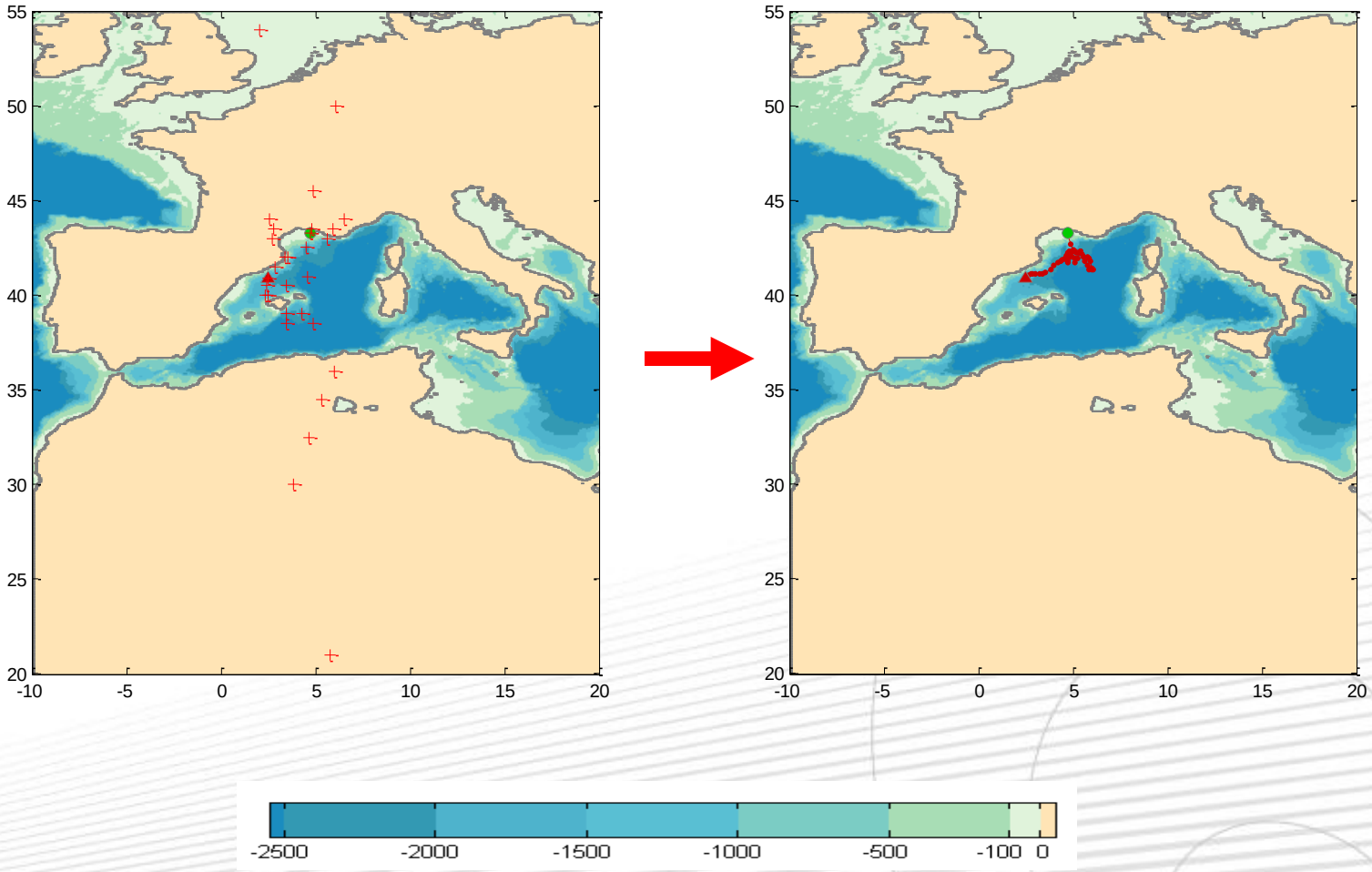
Filtering

↓

Delivery

Before Filtering

After Filtering



Location Uncertainty

Decoding

↓

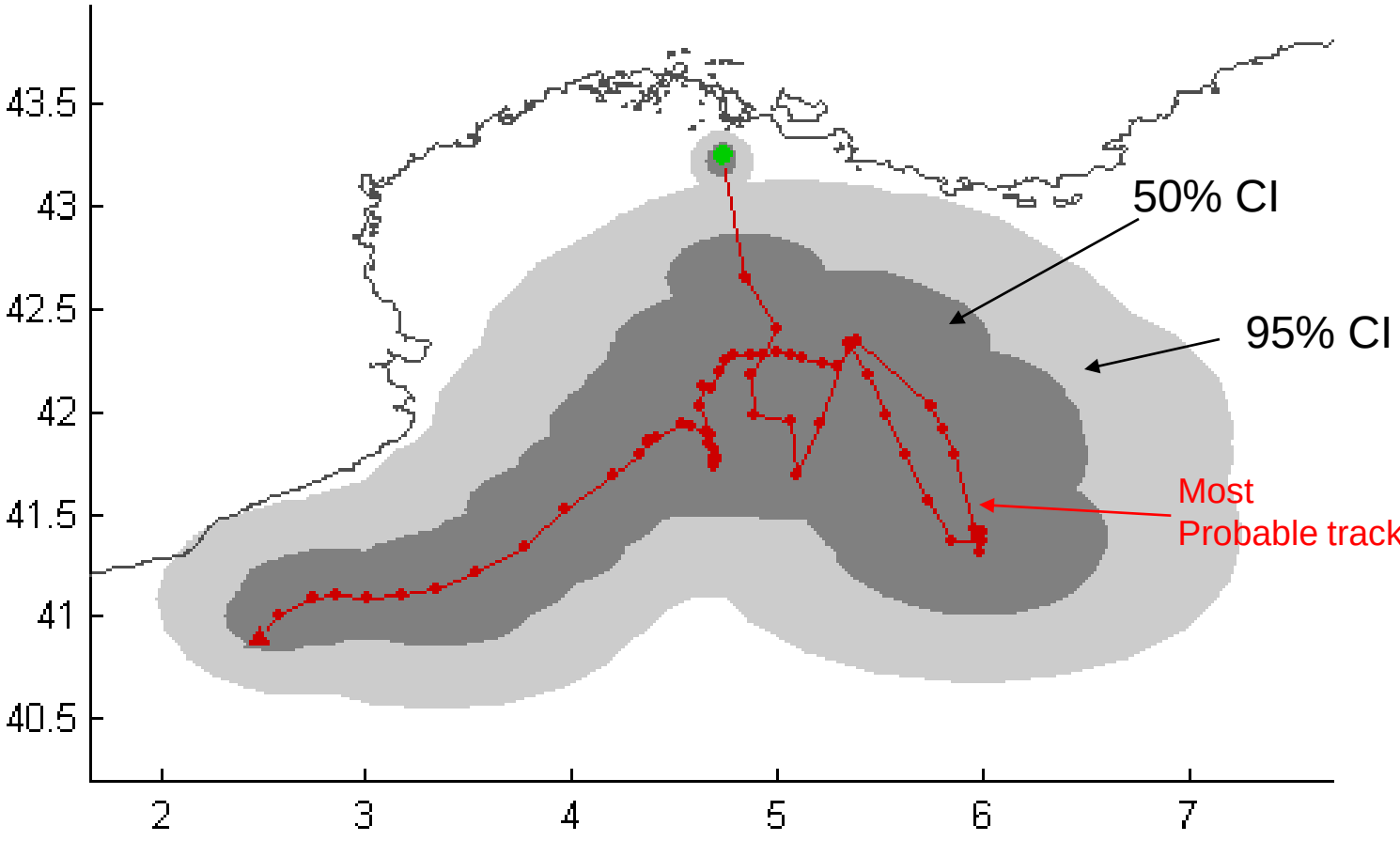
Geolocation

↓

Filtering

↓

Delivery



Sea Surface Temperature

Decoding

↓

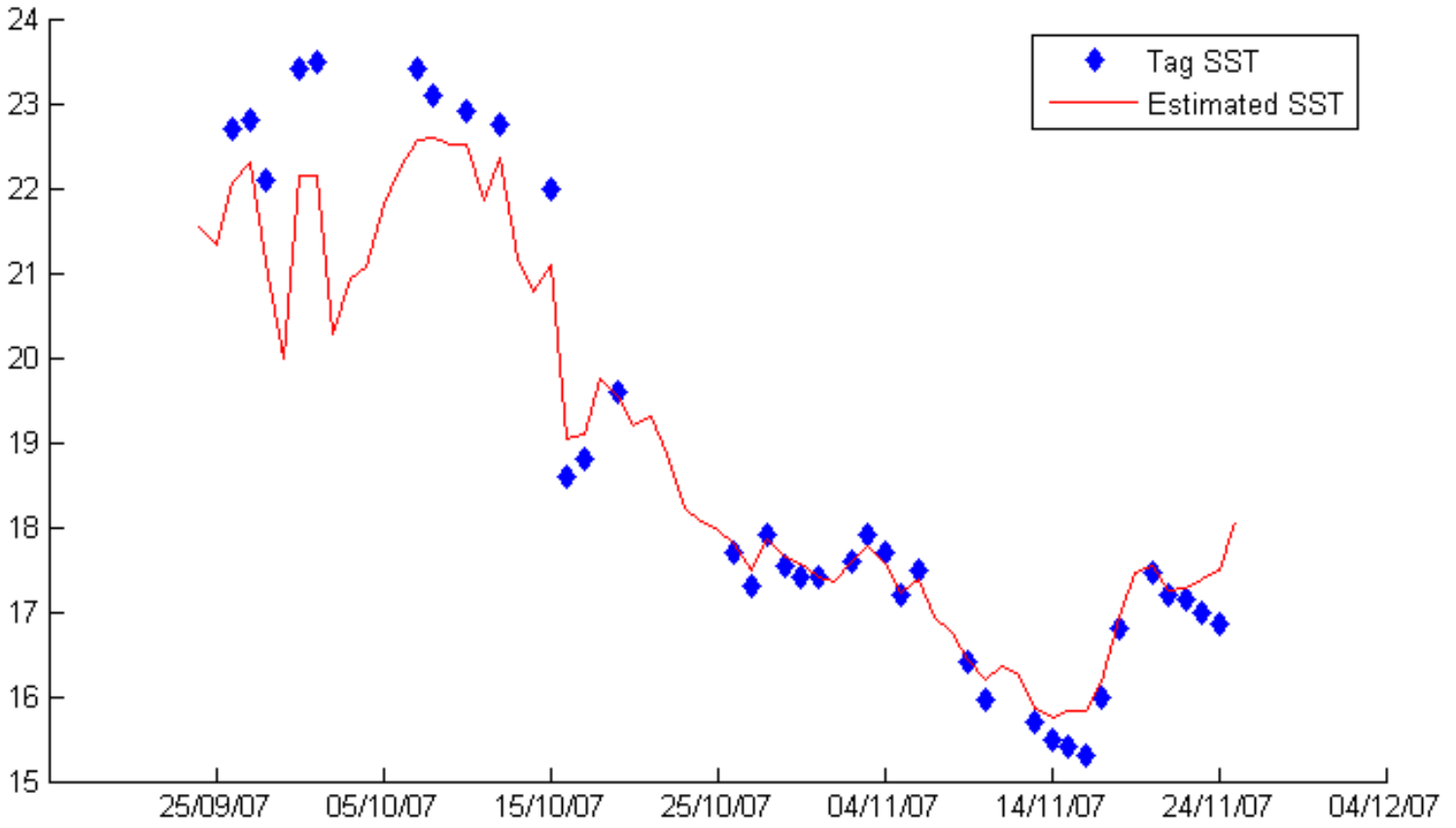
Geolocation

↓

Filtering

↓

Delivery



Bathymetry

Decoding

↓

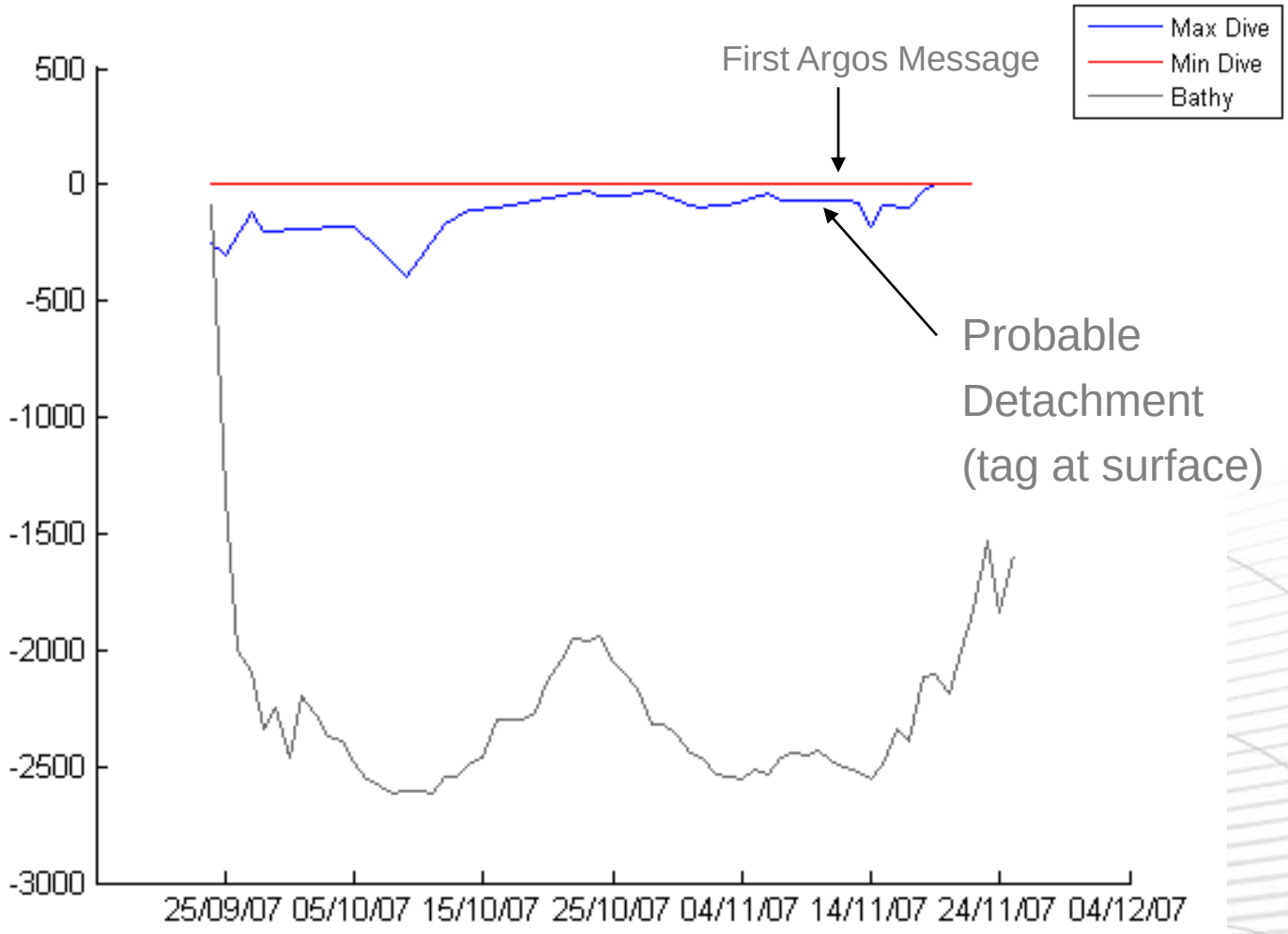
Geolocation

↓

Filtering

↓

Delivery



Delivery : Raw Data

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

Decoding

↓

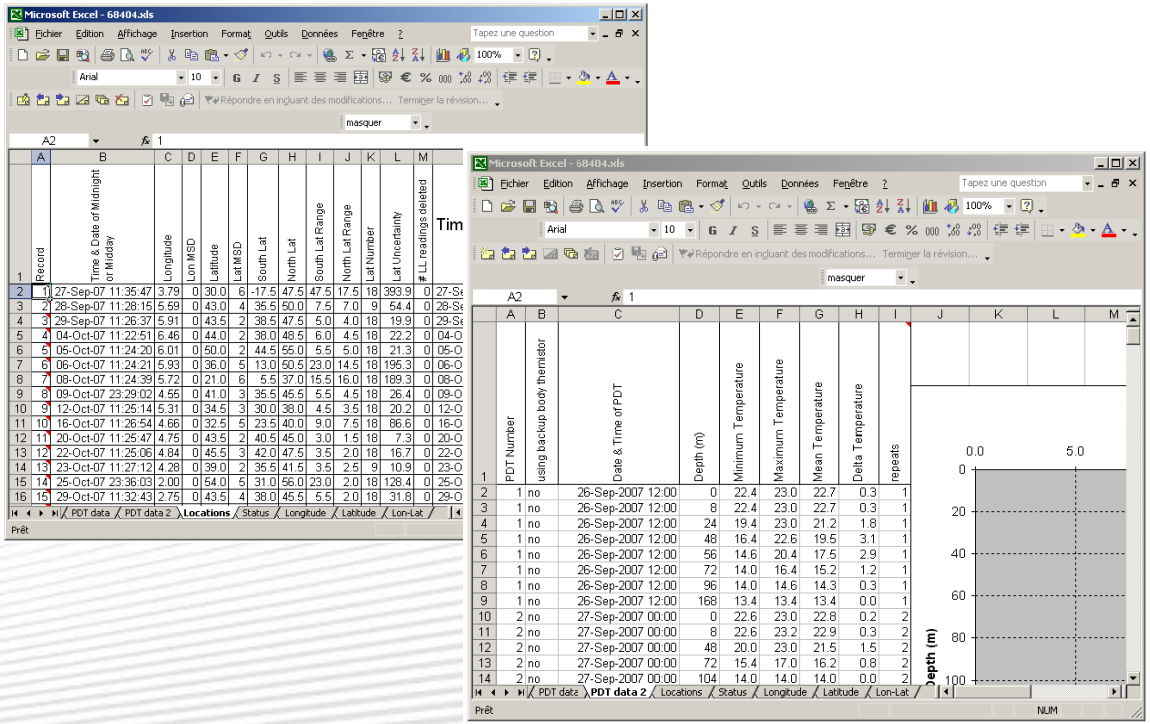
Geolocation

↓

Filtering

↓

Delivery



Delivery : Processed Data

Decoding

↓

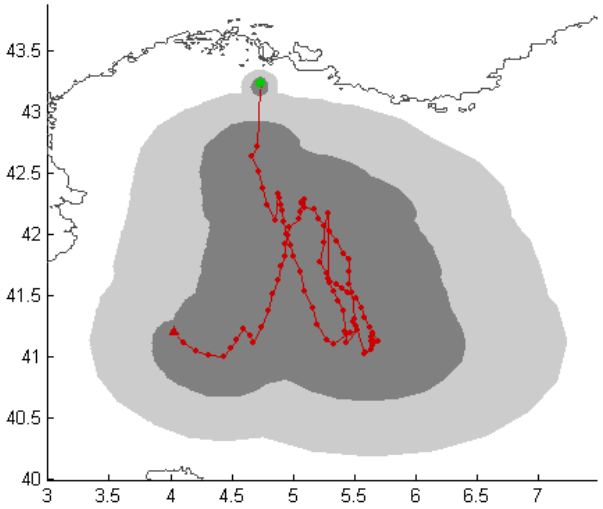
Geolocation

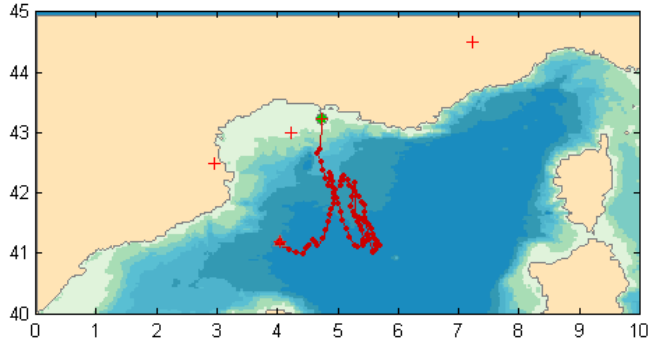
↓

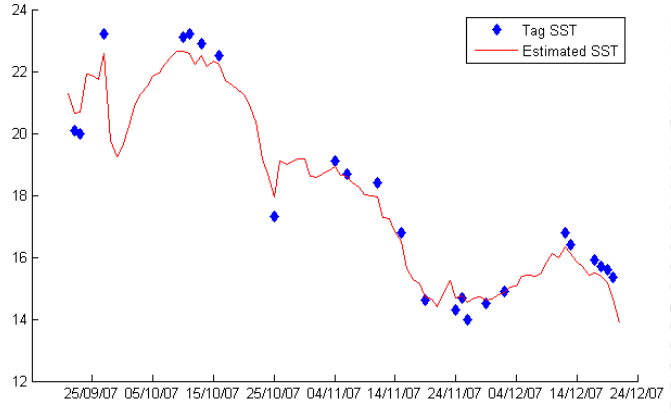
Filtering

↓

Delivery







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

Interest of Track & Loc for biologists

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

References

- 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…..

CLS
COLLECTE LOCALISATION SATELLITES

THANKS FOR YOUR ATTENTION