BIOLOGGING

The challenge of tracking animals in the wild

Workshop IPEE/CLS - 3-FEB-2010

Tracking and modeling

OBSERVE →UNDERSTAND→MODEL→FORECAST

Biologging data are indispensable to:

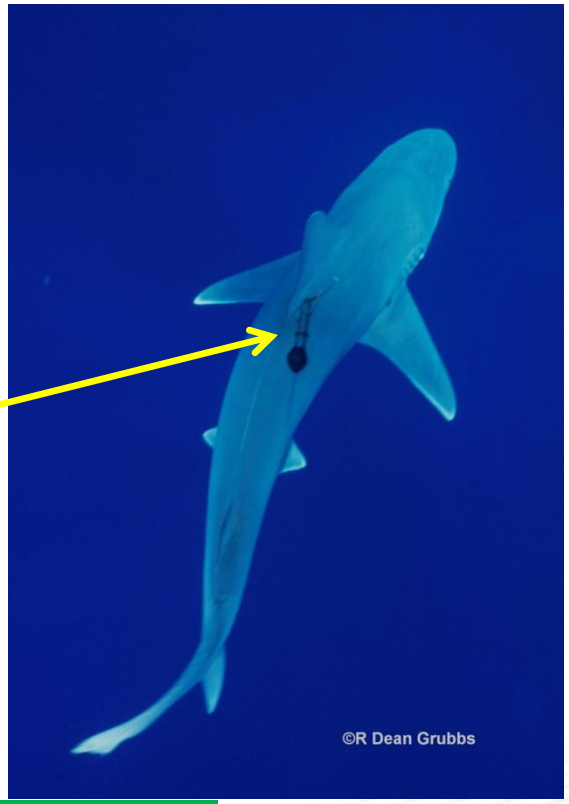
- **Observe movements : velocities, migration routes, orientation mechanisms, energy budgets….**
- **Identify habitats: foraging & breeding grounds, temperature-depth habitats…..**
- **Study how animals exploit or are constrained by their environment (requires simultaneous environmental observations)**

Tracking animals « above water »

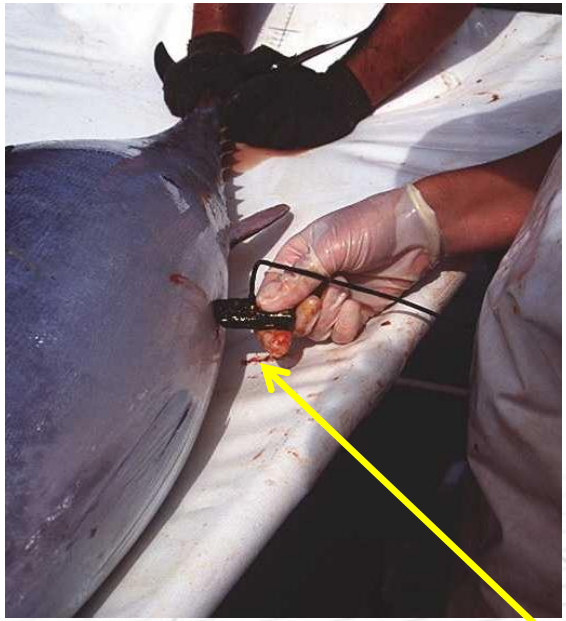
Satellite tracking (ARGOS) of animals is always a challenge :
Beacons with weak output power & in difficult environmental conditions

→ **Majority of low accuracy positions (class A or B) with no error estimation**

Tracking animals underwater



Pop-up tag



Internal tag

Light-based geolocation is presently the only operational solution for large scale long-term tracking

BUT obtaining accurate positions is extremely difficult

Improving « above water » tracking

Present ARGOS positioning algorithm:

- ≥ 4 msg : **Sequential** estimation (least-square) of position + error estimation (loc 0,1,2,3)
- 2 or 3 msg : geometric estimation of positions, error not estimated (loc A, B)

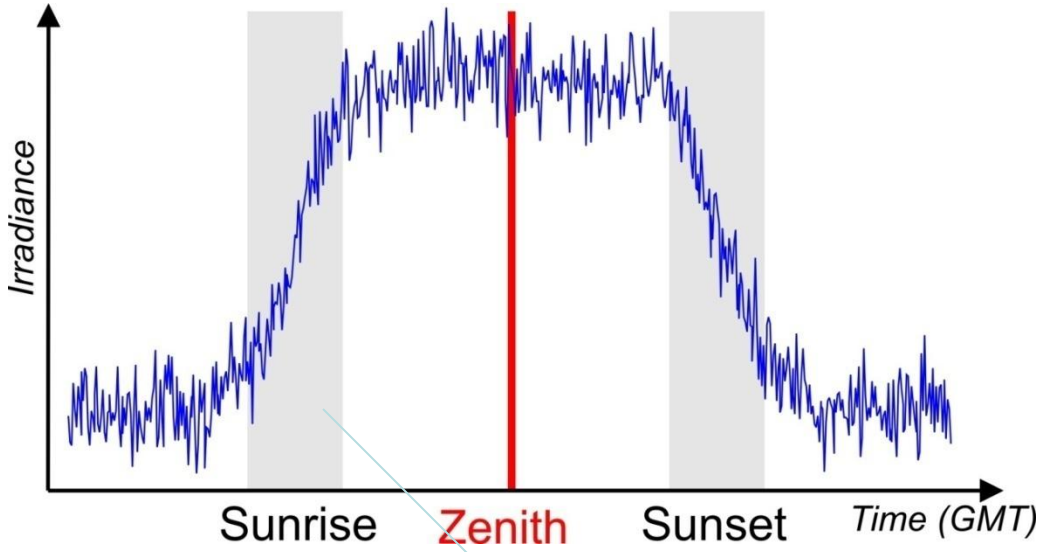
New algorithm (on-going PhD thesis)

- **U**nscented **K**alman **F**iltering of Argos (doppler shift) measurements assuming a random walk model for animals
- Slightly less « robust » (more subtle initialization)
- Position with error estimates obtained even with **1 msg** per pass
- General reduction in localization error
- No more « image positions »

An Example

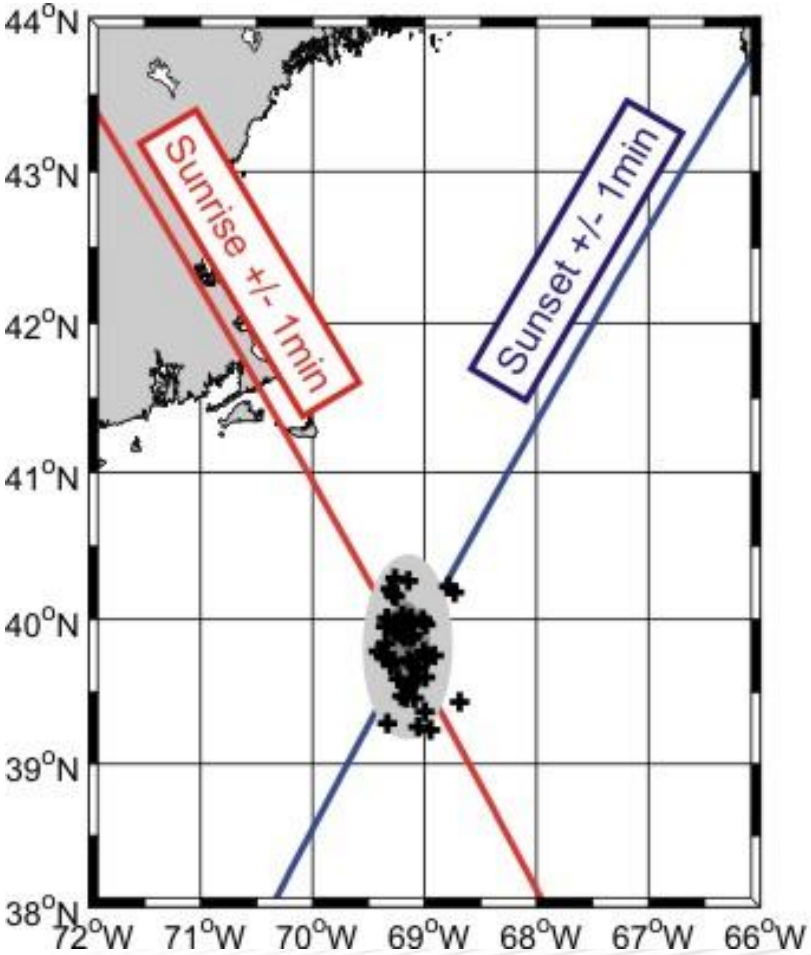
The case of Munaroh, a female olive ridley tagged May 20, 2009 on Prancak beach (Bali).

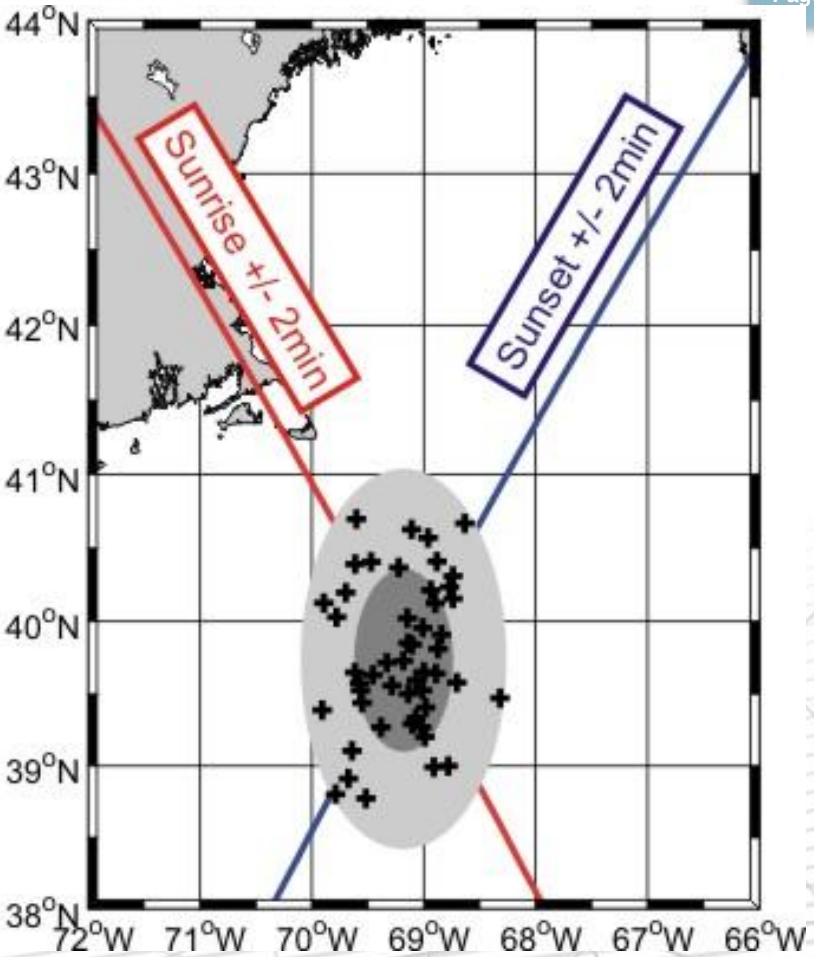
Light-based underwater geolocation



- Estimation of sunrise & sunset times allows geolocation of the tag
- Precision in longitude ~ constant ~
- Precision in latitude drops near the equinoxes

Error pattern

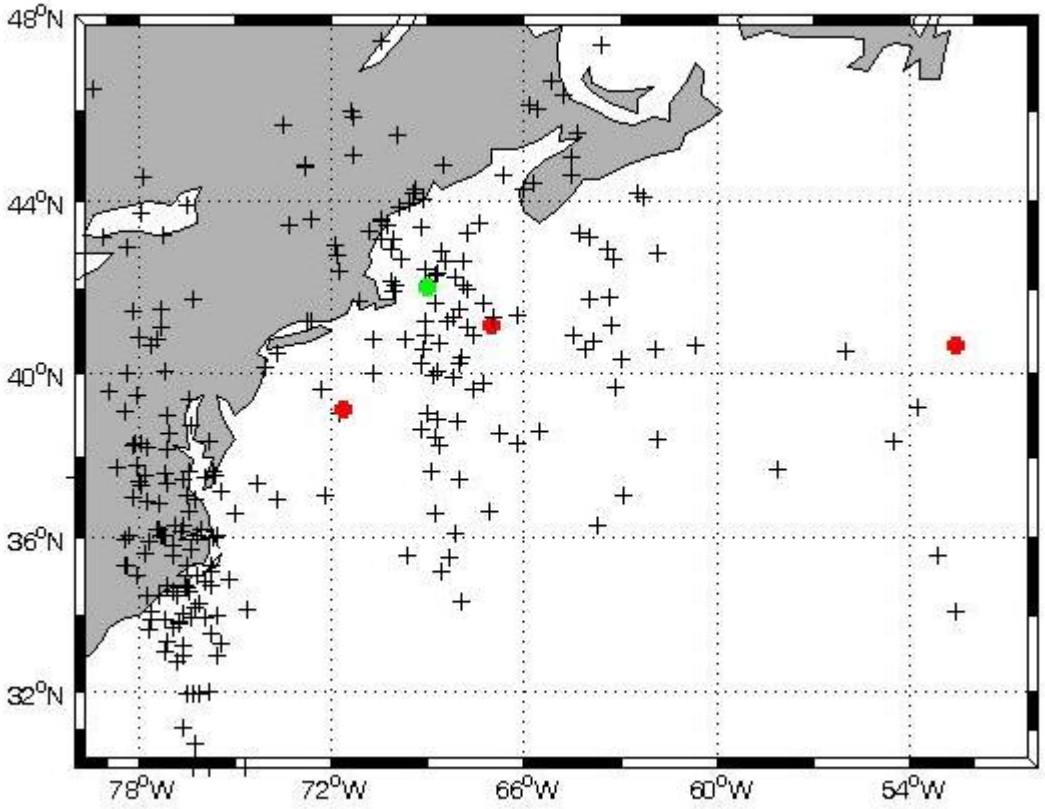




In practice, a 3 minutes error on sunrise/sunset time is very good !

Example : Atlantic bluefin tuna

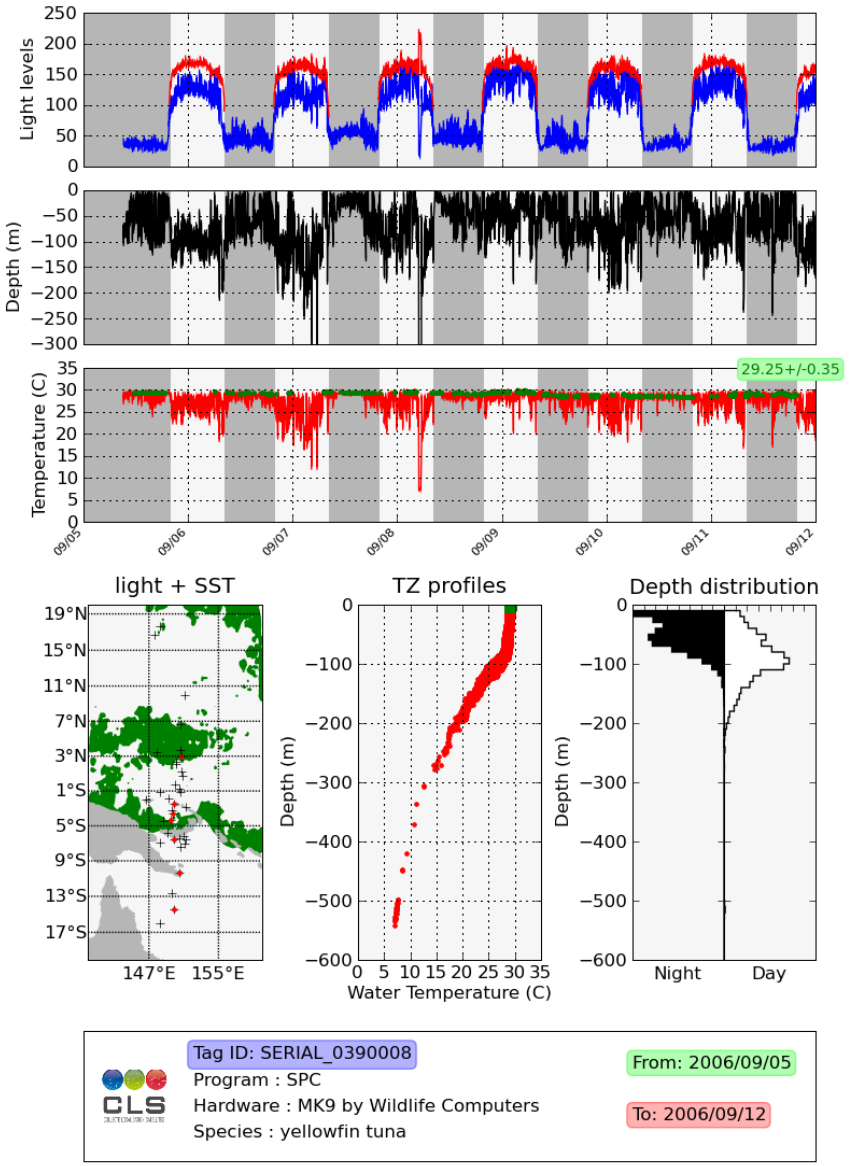
Large scatter in light-based position estimates

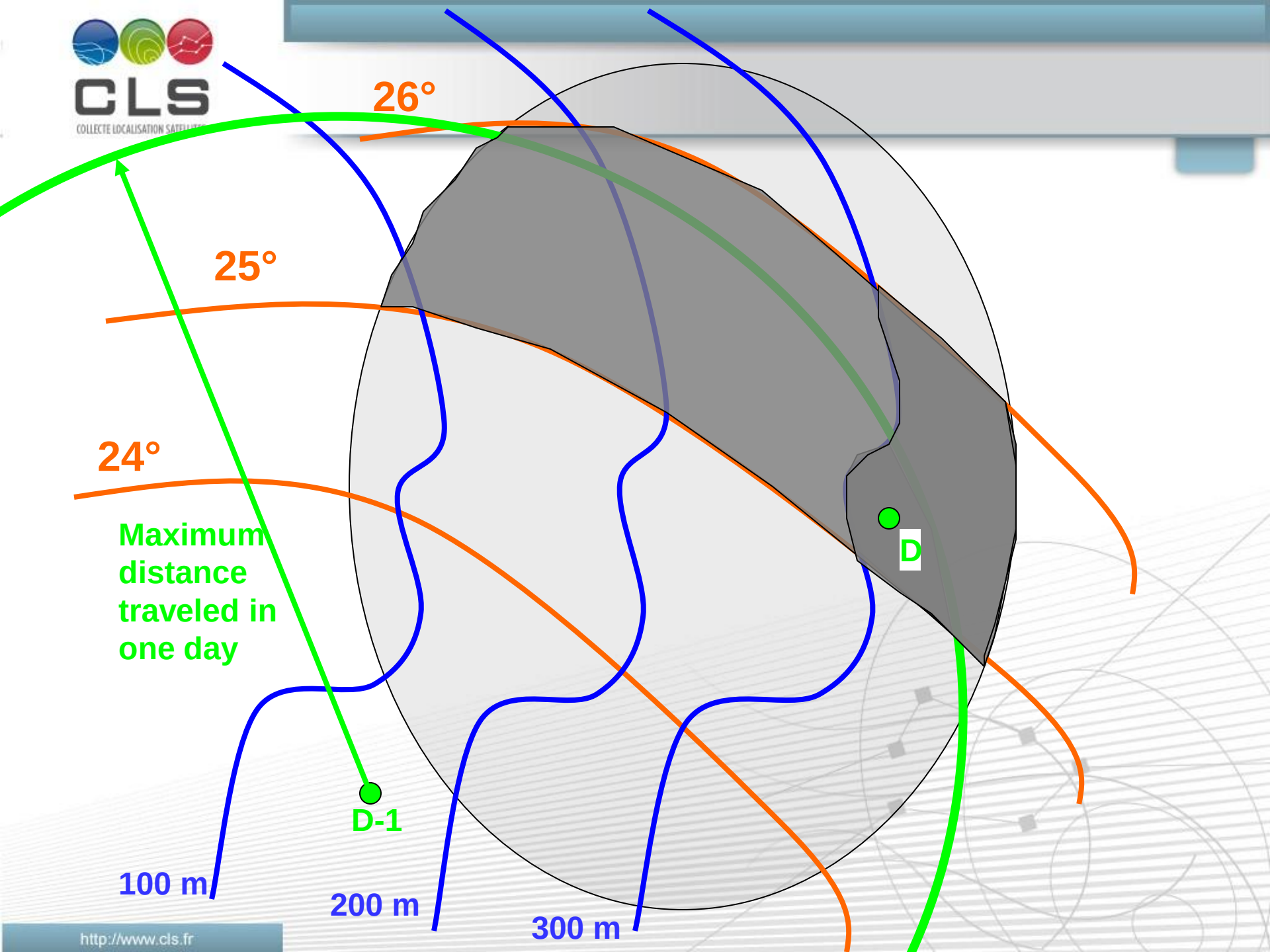


Combining information

Typical tag data include the following measurements:

- Light level
- Depth (pressure)
- Temperature

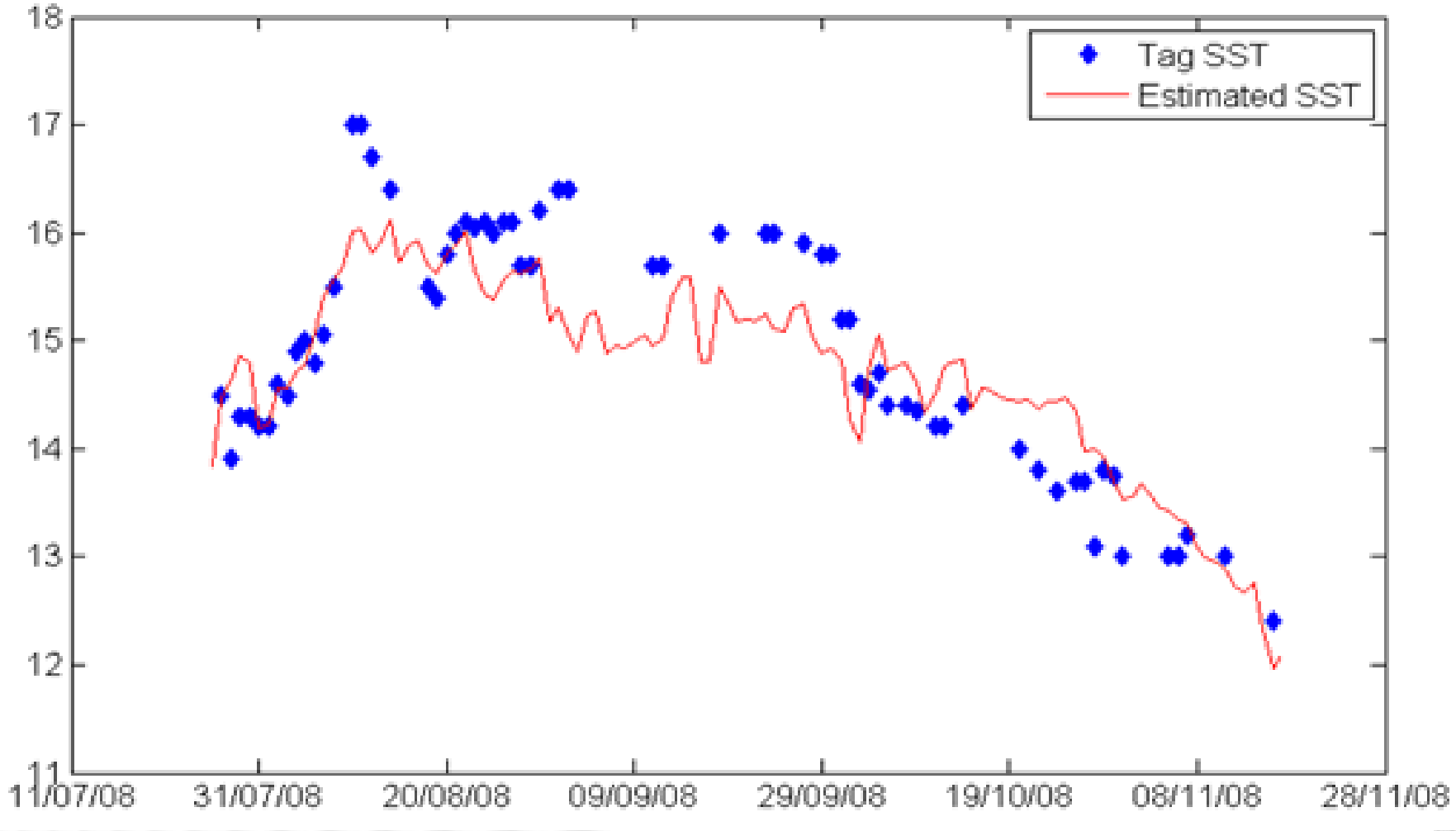


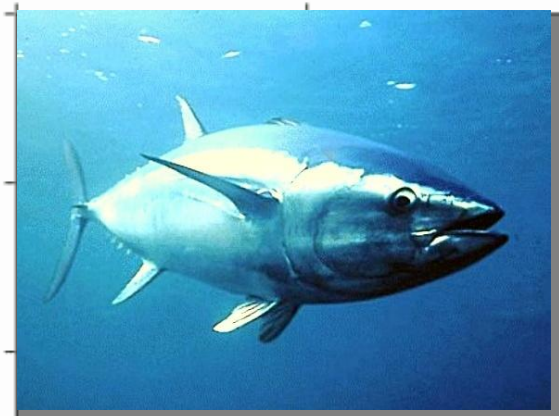

26°
25°
24°
Maximum distance traveled in one day
D
D-1
100 m
200 m
300 m

Bluefin tuna

Royer & Lutcavage, 2006

Basking shark





262 284.333 306.667 329 351.333 373.667 396

64.833 52.416 40 27.583 15.166 2.75 -9.834

0.0 0.375 0.75 1.125 1.5

lbt_Hf.dym

2002 July 27