CENTRE NATIONAL D'ÉTUDES SPATIALES

OSTM/Jason-2 and AltiKa new tracking modes

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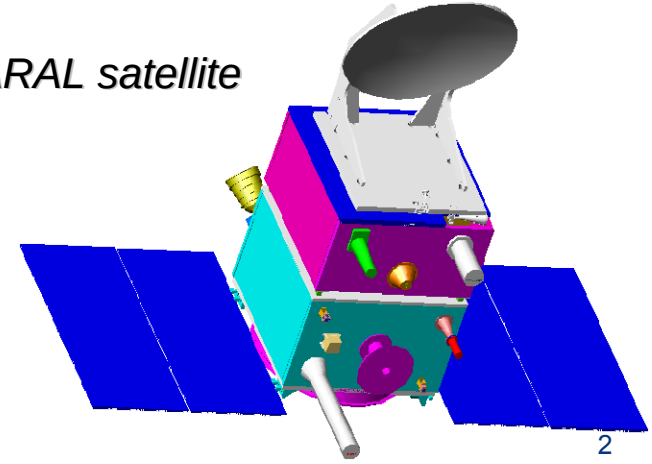
Upcoming CNES altimetry missions

- **OSTM/Jason-2: launch planned on June 15th, 2008**
  - **Poseidon-3 altimeter inherited from Poseidon-2 on Jason-1**
- **AltiKa/SARAL: planned for end 2009/early 2010**
  - **CNES-ISRO mission**
  - **Ka-band altimeter with embedded radiometer**
- **For those two missions, among the scientific objectives is the need to gather as much data as possible over coastal zone, inland water, ice.**
- **This led to develop new acquisition and tracking modes for Poseidon-3 and AltiKa**

Jason-2 during EMC test

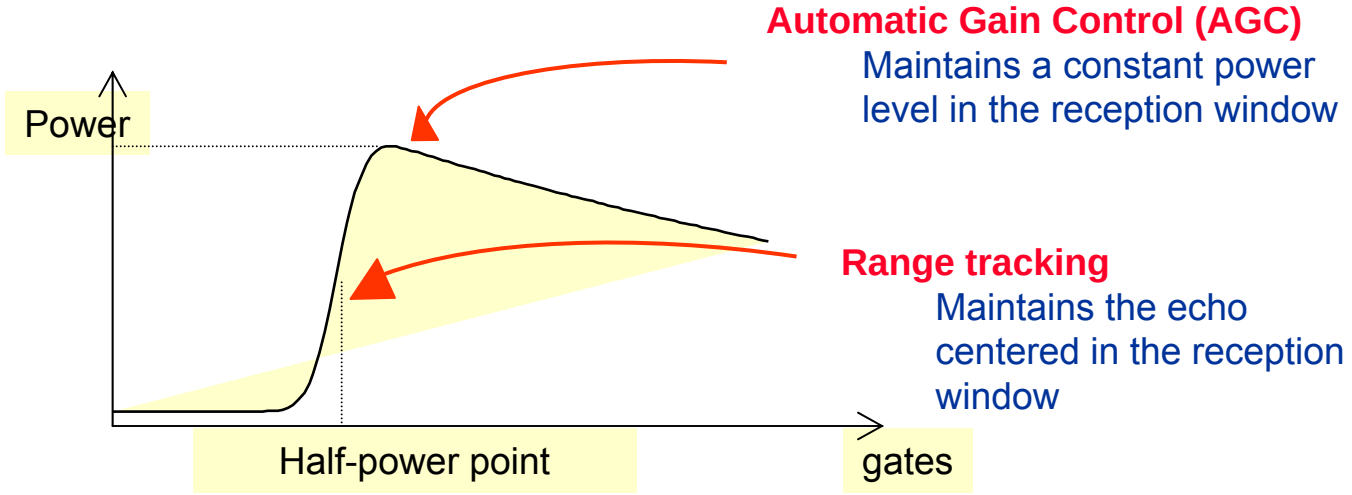
SARAL satellite



Why do we need acquisition and tracking loops?

- In order to ensure that the altimeter will **position its reception time window correctly**, two operations are necessary:
- The **acquisition mode** aims at detecting the useful signal and initializes the position of the analysis window whenever the instrument is powered up or loses track.
- The **tracking mode** aims at maintaining the analysis window in the correct position, as the range or the return power can change rapidly.

Conventional tracking loop:



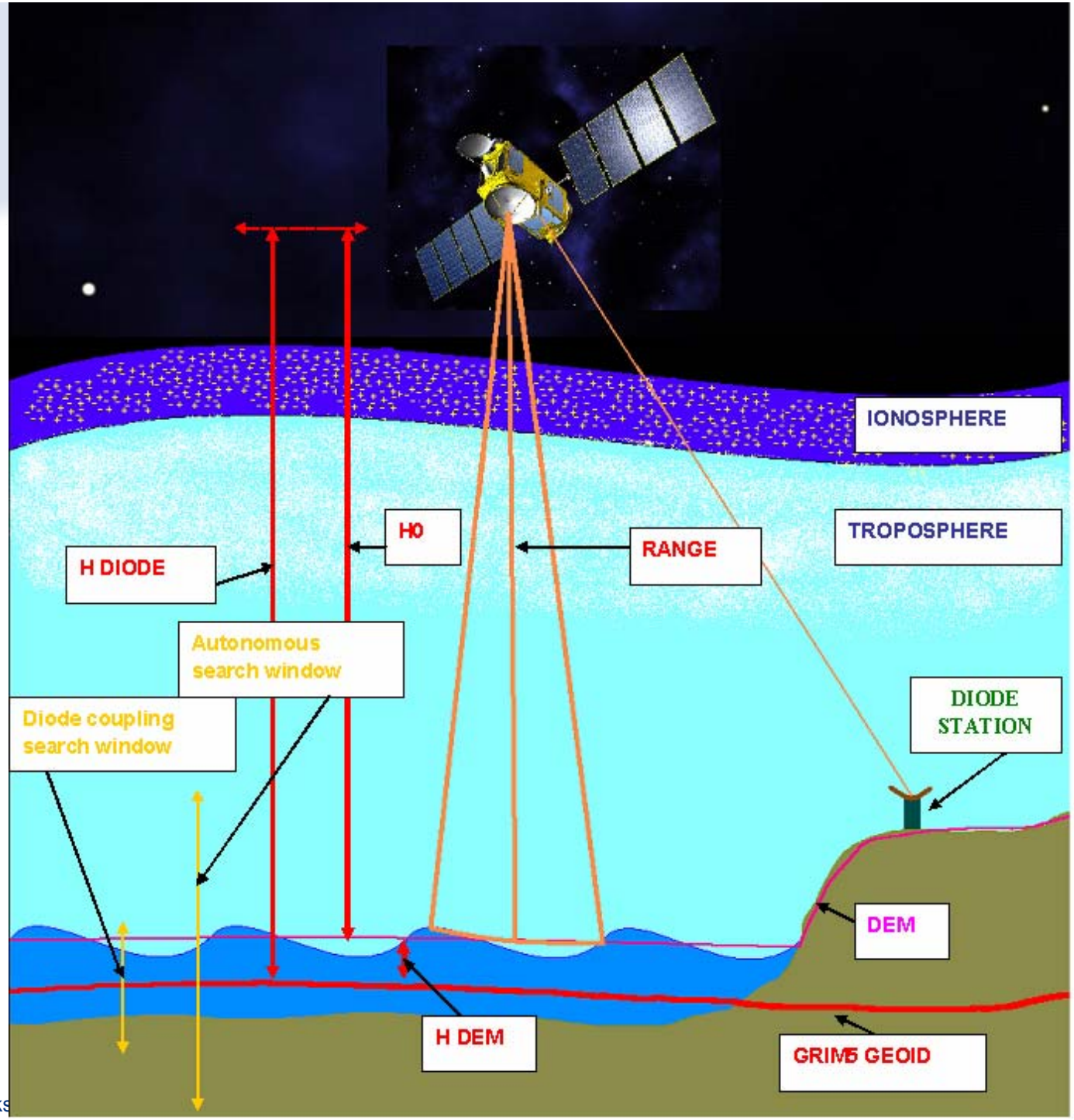
Evolutions

- Poseidon-2: range tracking based on a so-called split-gate algorithm
  - Tries to have the return power in the reception window fit a sort of Brown model
  - It performs poorly over other surfaces, in particular for specular echoes

- A first evolution: implement a median tracker as the nominal tracking mode
  - Center the return power in the reception window
  - On AltiKa: Earliest Detectable Part (EDP) tracker
  - More robust on non Brown echoes: less loss of track expected

- use of DORIS on-board navigator: “DIODE”
  - Gives the altitude of the satellite with respect to the geoid with an accuracy of 10 cm (30 on SARAL)
  - Used in acquisition mode to reduce the time of acquisition (by more than 1s => 6 km)
  - Used in combination with a DEM for an open-loop tracking mode

Principle

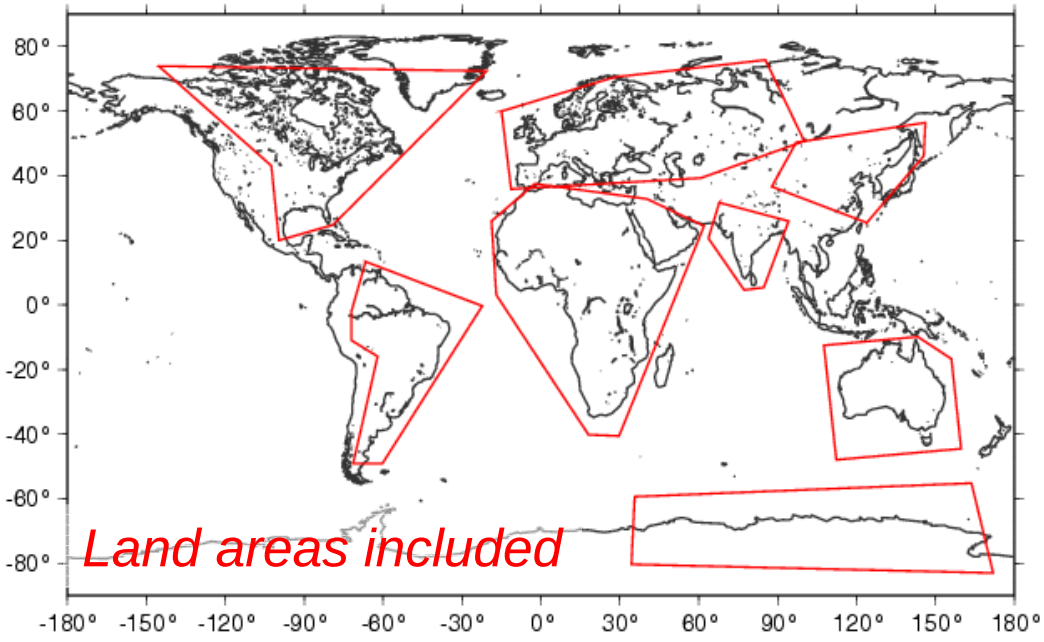

IONOSPHERE
TROPOSPHERE
H0
RANGE
H DIODE
Autonomous
search window
Diode coupling
search window
DIODE
STATION
DEM
H DEM
GRIM5 GEOID

Digital Elevation Model

- **Static DEM (Digital Elevation Model) data : stored in the altimeter memory (1Mbytes on Jason-2, 4Mb on AltiKa) and provides the local altitude with regards to the geoid.**

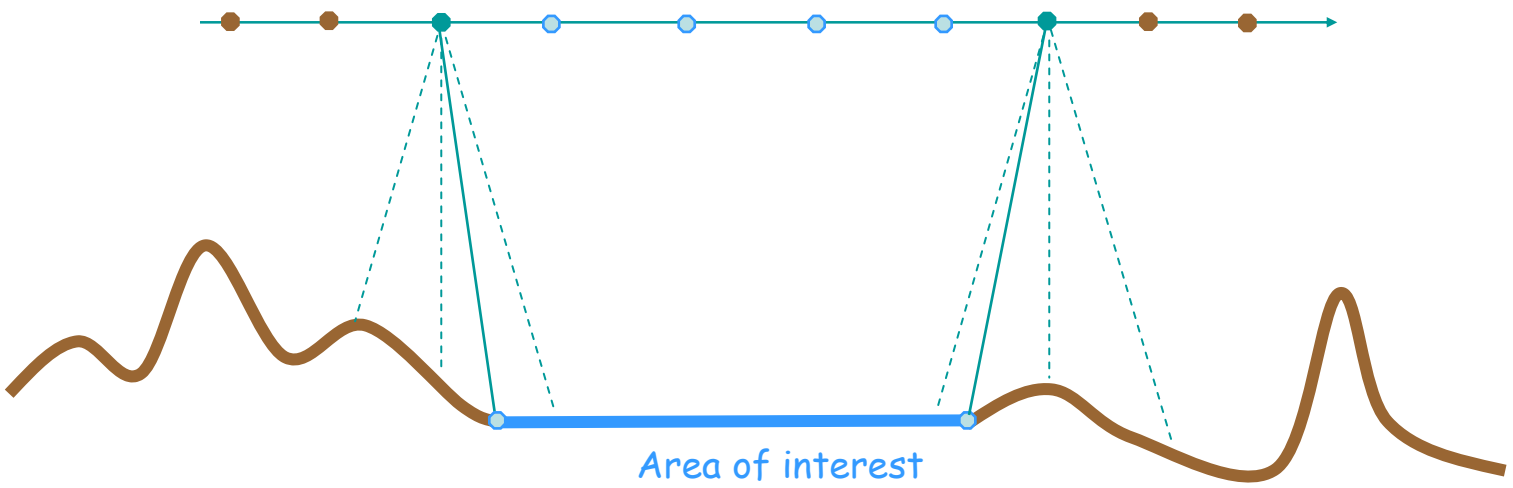
- **The DEM is calculated from different data sources:**
  - **ACE (University of Montfort, UK) for lands (excluding some areas where the topography is too rough, in order to optimize memory use)**
  - **Mean sea surface for oceans (CLS/CNES),**
  - **HYDROWEB database (LEGOS) for rivers and lakes.**

- **Note that the DEM can be updated using patch TC**



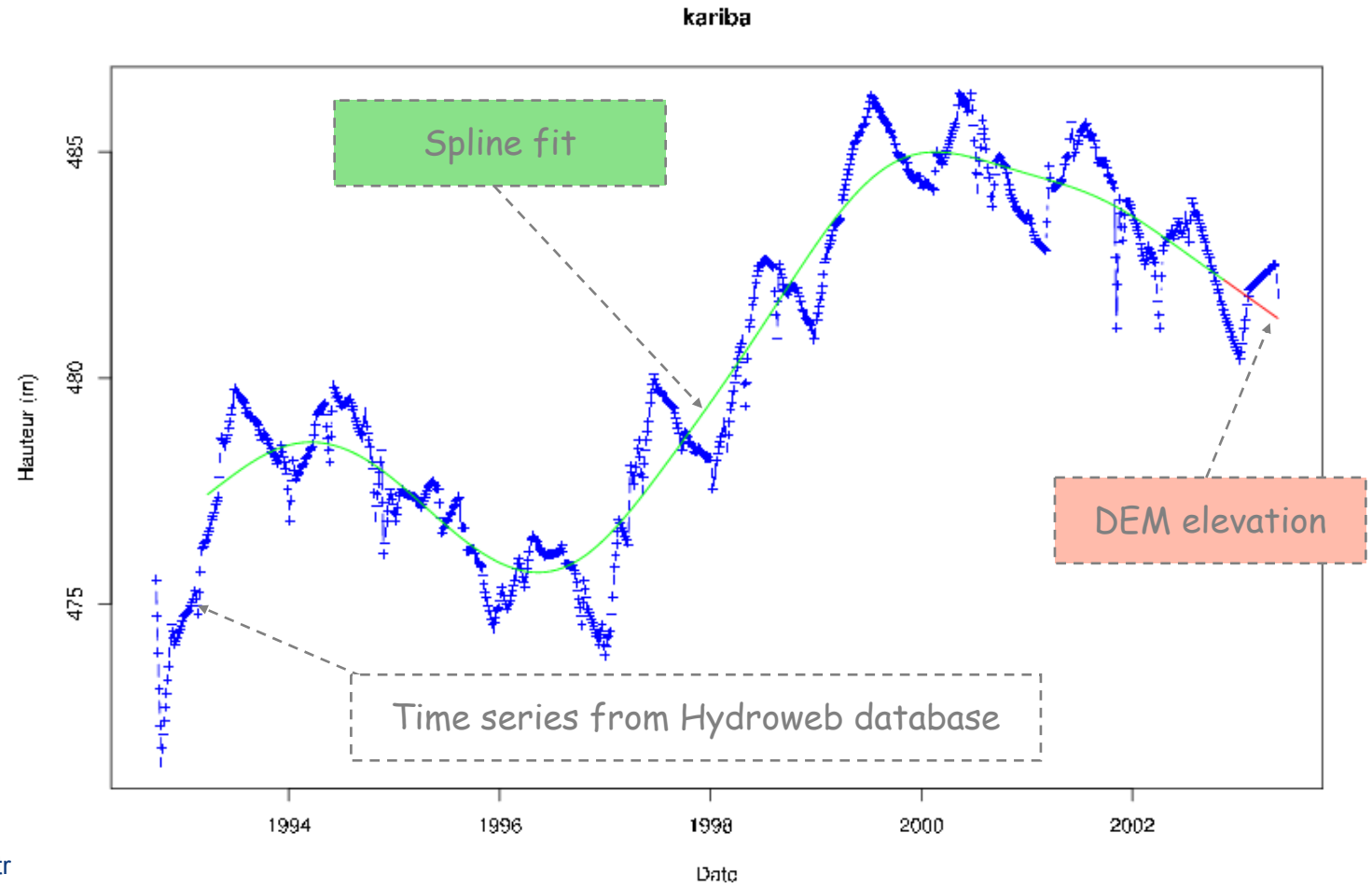
Off-nadir targets

- This open loop tracking mode also allow tracking of surfaces that are not strictly at nadir
  - Can **anticipate** an upcoming water surface of interest,
  - Can **observe lakes or rivers slightly off the nadir track** (but still in the altimeter footprint).
  - Hierarchy: oceans > lakes > rivers > land



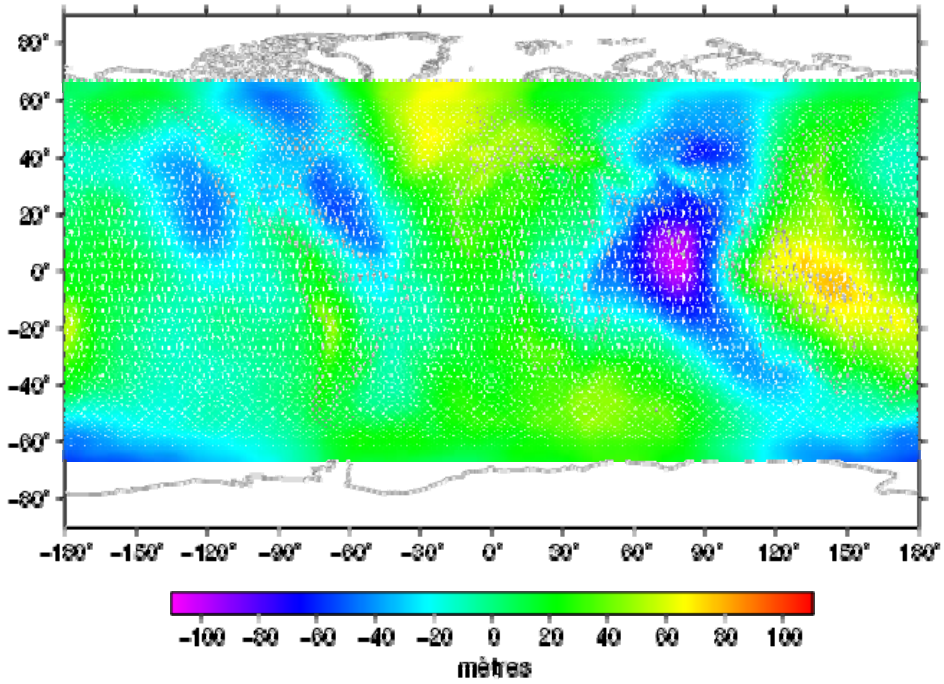
Seasonal variations on inland waters

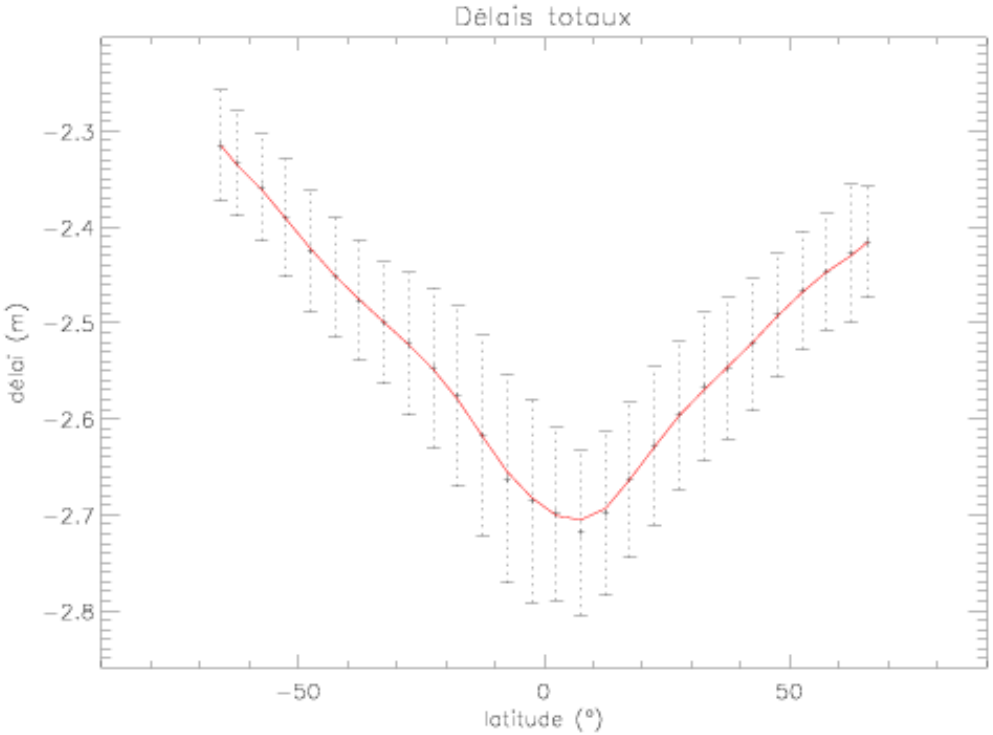
- Filtering of seasonal variations, extrapolation of the level expected by launch time
- Example on lake Kariba



Corrections

- **GEOID: DEM referenced to the same geoid as DIODE**





- **Ionosphere, troposphere: mean propagation delays estimated from Jason-1 GDRs**

Error budget?

- **Comprehensive error budget, based on:**
  - **Statistical DEM Global Budget, based on comparison between Poseidon2 Range Command (HO) and computed DIODE/DEM Range Command over 4 cycles of Jason1 data**
  - **Ionosphere, troposphere, tide… corrections not accounted for in the open-loop tracking mode**

DEM range RMS estimation (in meters)

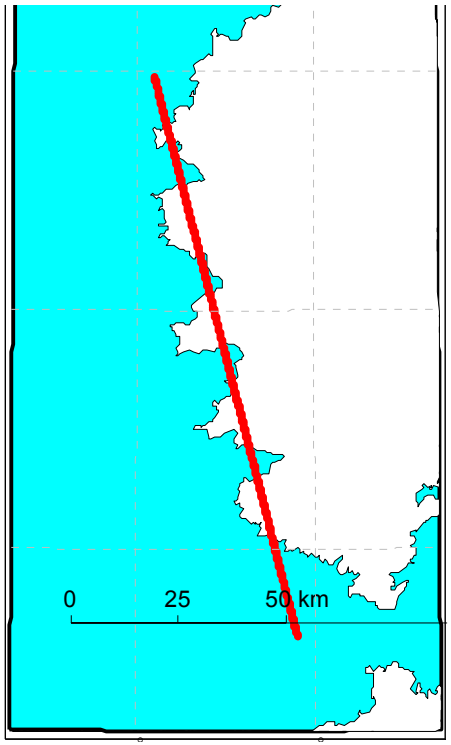
	Oceans	Lakes	Rivers	Lands (plains)	Lands (mountains)
Input data	0.530	1.210	1.370	5.000	100.000
Coding/Decoding	0.687	0.437	0.437	2.419	12.850
Delays	0.010	0.010	0.010	0.010	0.010
Tides	0.537	0.175	0.175	0.175	0.175
Doppler	0.025	0.025	0.025	0.025	0.025
Total error (m)	**1.021**	**1.299**	**1.449**	**5.557**	**100.822**

Compliant with the Poseidon3 performances allocation

The retracking algorithm is able to compensate for the mis-centering of the echo: no degradation of performances (except in mountains)

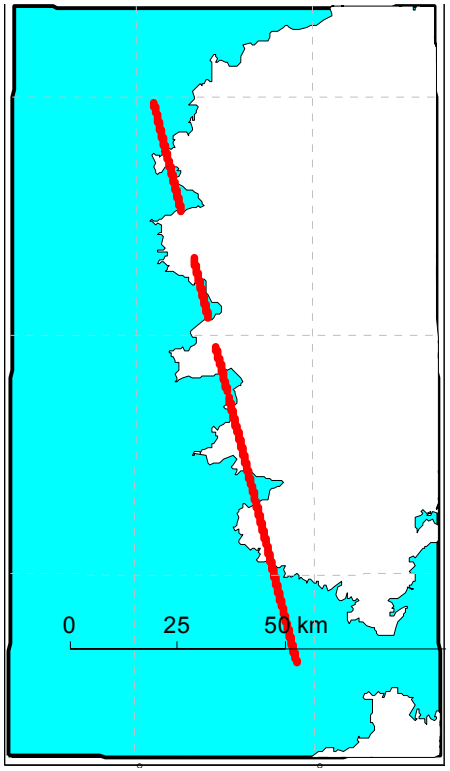
Comparison of tracked points between different tracking options

Coupling in acquisition and tracking



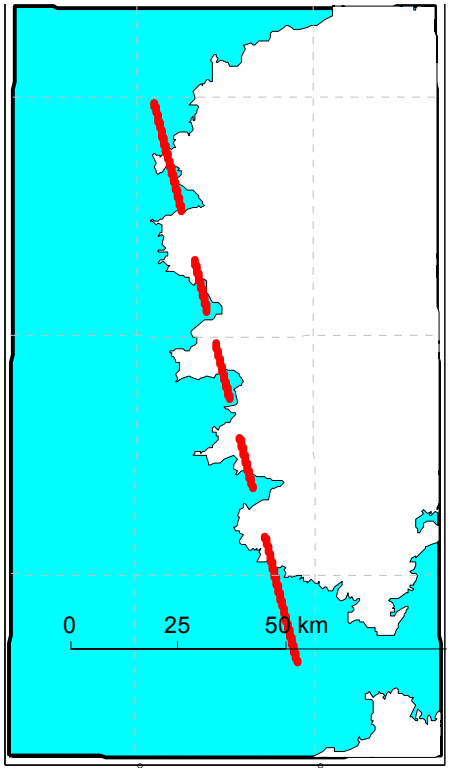
France (FRA)

Coupling in acquisition



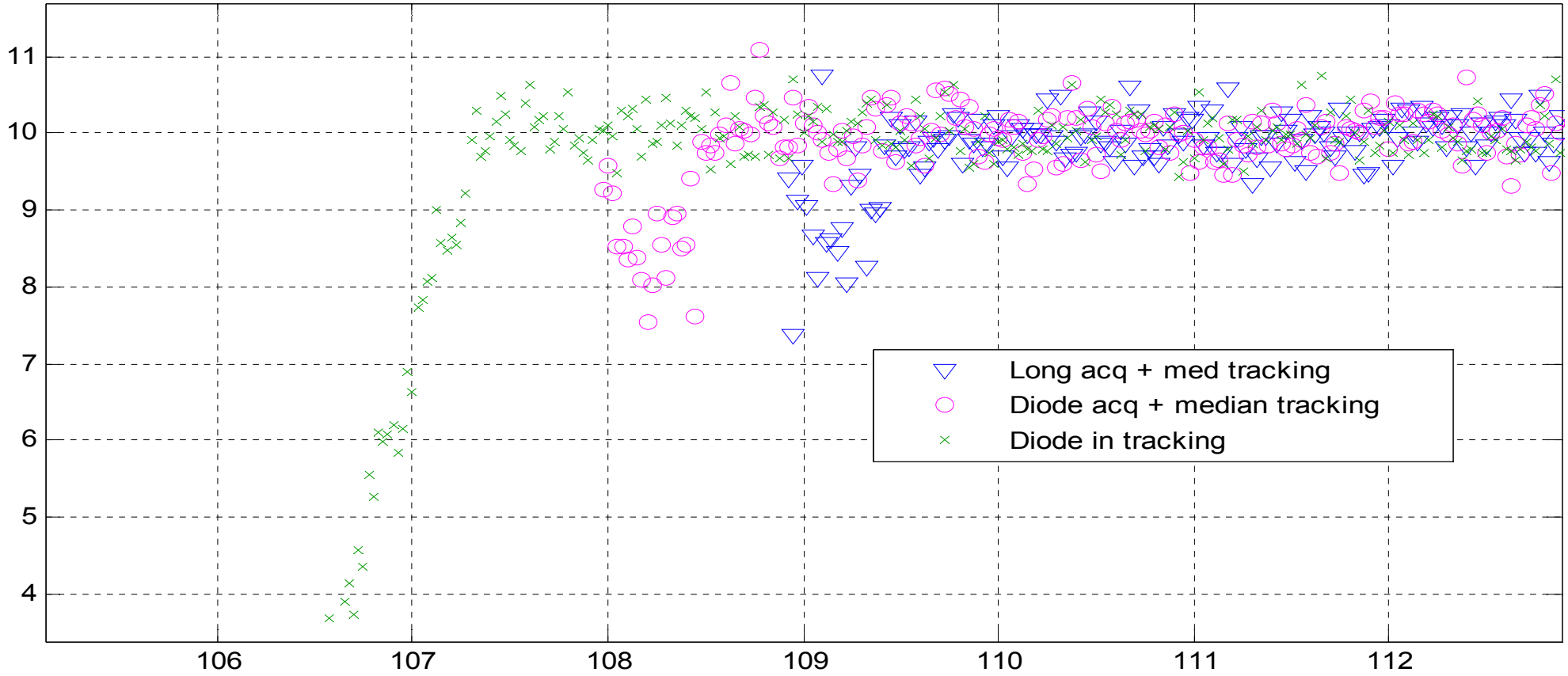
France (FRA)

No coupling

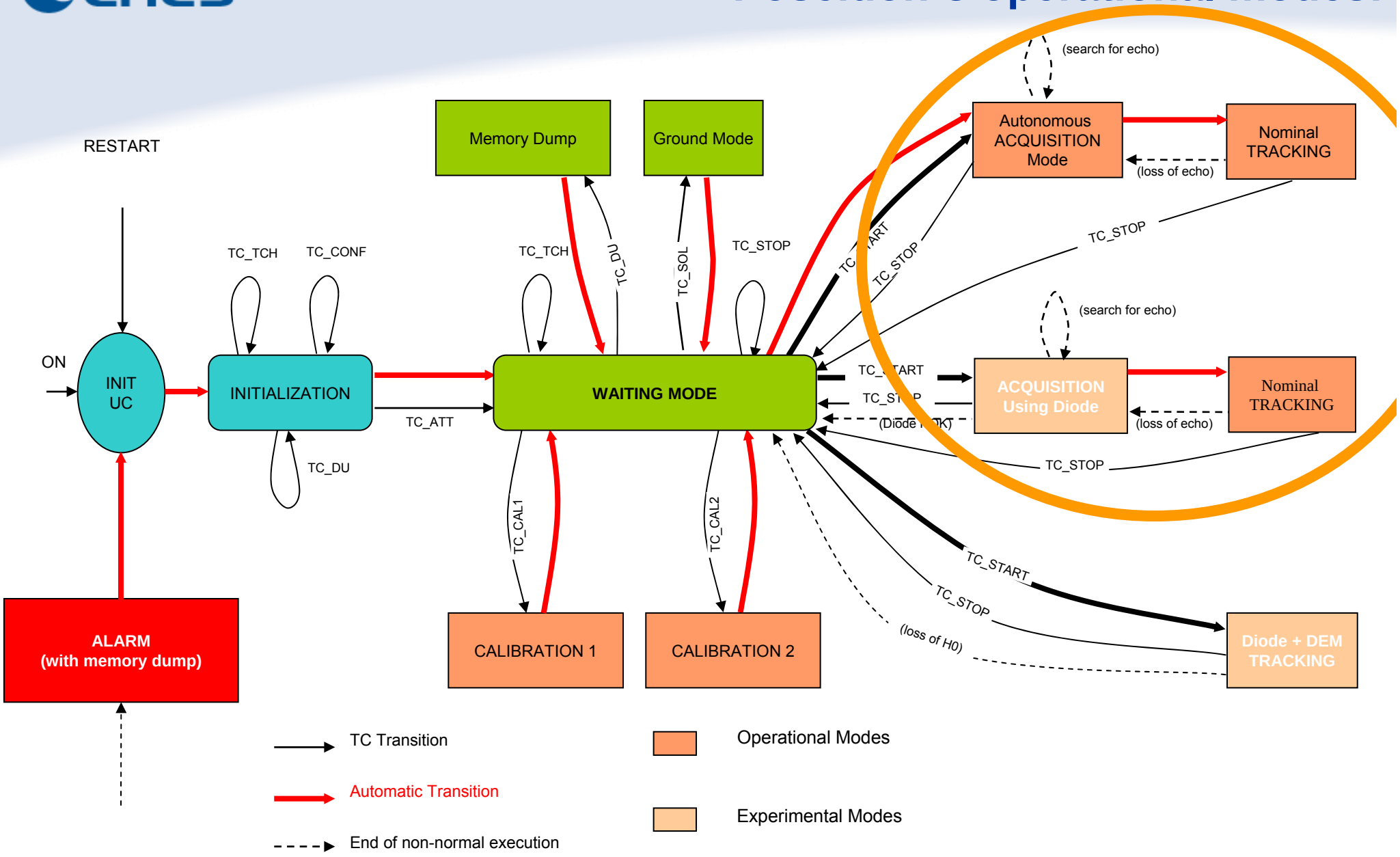


France (FRA)

Land to sea transition



Poseidon-3 operational modes:



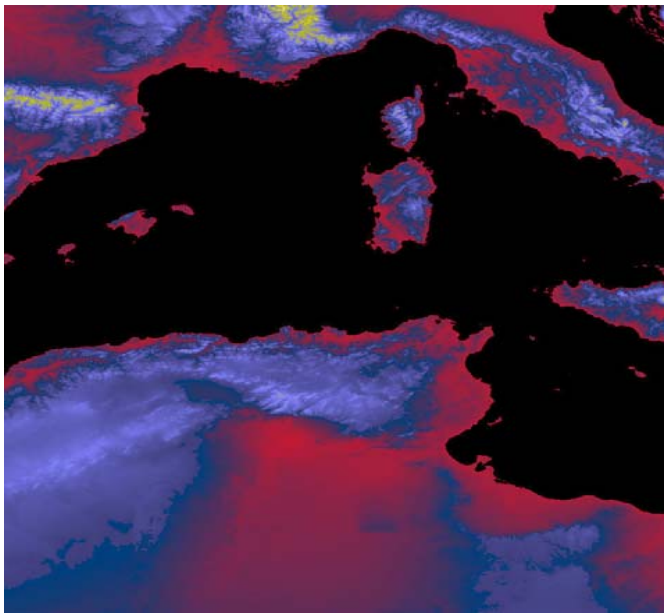
Summary of new acquisition/tracking modes

Acquisition mode	Tracking mode	Objectives
Median tracker	Median Tracker (or EDP on AltiKa)	**To increase data availability** on coastal zones (water/land transitions) and on continental waters (lakes)
DIODE	Median Tracker (or EDP on AltiKa)	**To increase data availability** on coastal zones (water/land transitions) and on continental waters (lakes) and **to reduce the delay** of the acquisition mode
DIODE + DEM		Open loop acquisition and tracking with DIODE and Digital Elevation Model algorithms **to increase data availability** on coastal, inland water areas, and possibly on selected land surfaces

Echantillonnage du MNT sous la trace du satellite

- **Utilisation du MNT ACE pour les terres émergées**
  - MNT global à 30” de résolution (GTOPO30 amélioré)
  - Résolution verticale de 1 m
  - Tuiles de 15° × 15°
  - 1800 × 1800 points par tuile
  - Université de Montfort (UK)

- **SMO CLS01 pour les océans**
  - Moyenne de données T/P, ERS
  - 2’ de résolution
  - Entre 80° S et 82° N
  - 10800 × 4861 points



Tuile ACE

Ajout de données actualisées pour les lacs et les fleuves

- **Bases de données du LEGOS: séries temporelles pour**
  - **71 lacs**
  - **168 points de mesure sur 15 fleuves différents**

    (www.legos.obs-mip.fr/soa/hydrologie/hydroweb/)