

news from Thierry Guinle, and CNES, NASA, EUMETSAT, NOAA –

« **11 years ago Jason-2 was successfully launched by a Delta-2 rocket.** Some hours later, payload instruments were switched ON (DORIS 1 at 18:45, POSEIDON3-1 at 11:12, AMR-H at 11:38, GPSPA around 11:40). Only 2 days after, the first Near Real Time product “OGDR” was

Today after more than 60k orbits around Earth Jason-2 is still on duty with excellent performances and we hope it will continue. »

WSOA was planned to fly on Jason-2, launched in 2008, but cancelled for financial reasons. We started the SWOT Science Preparation discussions also in 2008.

Excellent news on the robustness of altimetric missions in the past, and to continue with SWOT!

# Ocean summary

Thanks to all the session leads for organising/shaping the splinter sessions and the discussions

# Ocean Calval Workshop : Morning

## Toward designing the post-launch Californian CalVal site

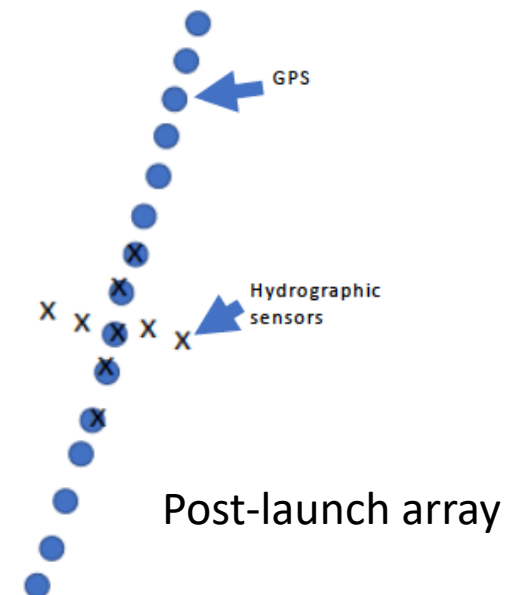
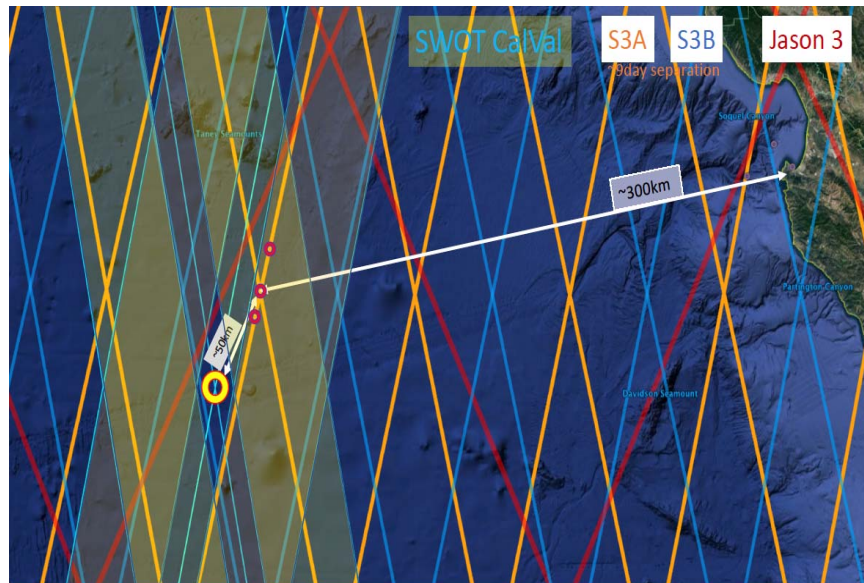
**Geodetic** SSH reconstruction needed to validate the ocean spectral requirements

**Oceanographic** validation of the vertical ocean processes contributing (balanced and IWs)

Pre-launch Testing of in-situ SSH observations using GPS buoy, CTD mooring, and BPR in early 2020.

Lidar preparation flights undertaken for 2D coverage of SSH & waves

Roadmap forward : design of pre-launch array to be finalised this summer  
Post-launch campaign design to be refined in 2020, based on pre-launch results



# Ocean Calval Workshop : Afternoon

## Science validation campaigns & Adopt a crossover sites

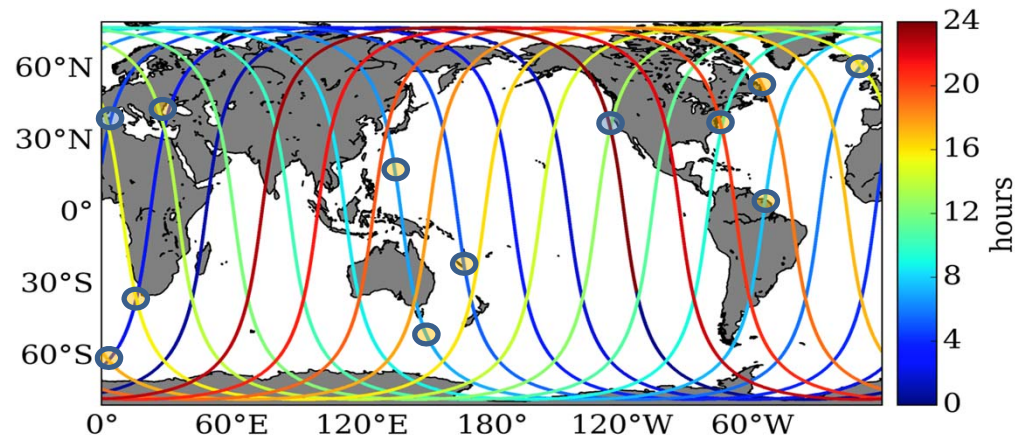
Overviews of SWOT Science validation workshop Nov 2018, CALYPSO Workshop, and pre-launch in-situ studies

### Recommendations

**(1) Support the Adopt-a-Crossover effort being organized as a PI-driven effort to collect measurements in crossovers of the SWOT fast-repeat orbit**

**(2) Organize additional measurements in the California Current region to leverage existence of SWOT cal/val array and fast-repeat orbit**

**(3) Have a separate, dedicated SWOT field campaign in one region 1-2 years after the SWOT launch.**



- 1) CLIVAR endorsement May 2019
- 1) & 2) Need rapid co-ordination to prepare campaigns – by Fall 2019
- 3) Planning for this campaign in 2019/2020

Discussion on risk of launch delay, and ocean science interest of having fast sampling phase extended for validation studies Mar-Jun & for spring blooms & NH subduction

## Oceanography Splinters

Splinters on state of the art for :

- High-resolution ocean modelling
- Fine-scale observations
- Tides, internal tides & waves
- Measurement errors & corrections
- 2D/3D reconstruction of SSH & currents
- Techniques for separating dynamics and noise in SWOT ocean images

# Ocean splinter 1 – High Resolution **Modelling**

## Key issues – handling internal tides & IGWs

### - Impact on horizontal & vertical velocities

- B. Arbic presented a **comparison of resolved internal tides and gravity waves in several global models versus observations**, highlighting the different skills of existing hi-res models depending on their detailed formulation.
- A. Nelson presented results showing **how increased model resolution affect the simulated internal wave spectrum**
- S. Gille discussed results from **regional modelling activities in the Californian current**, showing how **resolved internal wave field is sensitive to the boundary forcing** from the open ocean, and how this challenges regional modelling strategies.
- L. Brodeau / J. Le Sommer presented their **new North Atlantic model experiments** and discussed energy exchanges at scales <100km, **highlighting how internal waves affect energy cascades towards dissipation scales**
- S. Smith presented results on **vertical transport due to ocean fine scales** from two studies focusing respectively on tracer subduction and nutrient fluxes toward the surface, highlighting how solutions vary with model resolution
- P. Klein presented results from LLC4320 simulations showing **how balanced submesoscale motions are driving deeper vertical exchanges of heat and buoyancy** in the open ocean.

# High-resolution Observations of SSH, currents at small mesoscales in-situ & multi-satellite studies

Need of **integrated multi-platform experiments** (satellite, ship, gliders, drifters):

- with **eulerian & lagrangian strategy**, direct measurements of **vertical velocities**
- with **interdisciplinary approach** for understanding fine-scale processes, notably biochemistry: deep biological sampling (e.g. @ DCM !), knowledge of higher levels of the trophic web (e.g. grazers)
- Efforts in the **West Med** where contrasts of water masses give rise to interesting fine-scale activity for both physics and biology.
- could there be an international coordination in this region (2022)? funding to be sorted at national and/or european levels?

Several experimental studies focus on **internal gravity waves** in order to:

- estimate of the continuum internal gravity wavefield **directionality** from moorings
- estimate **transition length scales** from balanced to unbalanced data from shiptrack ADCP, leveraging a global database. A typical value around 70km emerges from ADCP data.

Promising **airborne surface velocity** measurements leading to maps of vorticity and divergence (Dopplerscat).

Elephant sea data and model analysis:

- Strong **submesoscale gradients** and **vertical velocities** are found below the mixed layer
- Strong correlation between gradients of buoyancy and FSLE are observed which opens doors in order to infer vertical velocities from satellite data

# Tides session

## Barotropic tides

- High-latitude barotropic tides are constantly improving due to Cryosat2 in particular; global tide correction models will soon reflect this
- Coastal tide modeling is in constant need of better bathymetric datasets.

## Internal tides

- Collecting as much in-situ validation data as possible for internal tides
  - Moorings, drifters, PIES, ADCP data, etc.
- Stationary internal tides:** Carrère et al. demonstrates substantial skill in several empirical tide models and even some skill in a hydrodynamical model
- **Nonstationary internal tides:** Suggest non-stationary internal tide prediction as a “grand challenge” for regional and global models—can it be done?



# Measurement Errors and Corrections

## Talks:

- Definition of error spectrum – noise variance at different grid resolution
- SWOT simulator implementations– noise dependence w/SWH, more realistic roll errors
- Geoid/MSS – consistent filtering and re-tracking improving small scales
- Waves and currents – better understanding/observations/simulations of wave-current interactions

## Discussion points:

- radiometer contamination by 5G near land – join with OSTST for a joint recommendation for altimetry – impacts, mitigation & new techniques?
- suggestion to add small-scale  $\sigma_0$  to simulator, to test exploitation of multivariate correlations
- test roll error corrections with more realistic models (internal tides included)

# Techniques for separating balanced motions and internal waves in SWOT SSH images

- A broad view of the separation problem, techniques developed in other communities including machine learning (ML), methods to foster developments and collaborations.
  - A Ponte : “On existing theoretical frameworks for separating waves and non-waves signals”
  - J-F Giovannelli: “Basic concepts of image separation” (invited)
  - R Fablet : “Interactions between ocean scientists and ML scientists : timeliness, instruments in the context of SWOT mission” (Invited)
  - M Durand : “A word on SWOT river discharge PEPSI challenge”
- Discussions
  - Machine Learning techniques can be improved with multiple data sets and constraining physics
  - Agreement on organizing ocean PEPSI challenges to work on common problems and teasing other communities. A first list of ST members interested in the design of PEPSI challenges

# 2D/3D Reconstruction session

## Potential recommendations

- Applaud diversity of 2dVar, 3dVar, and 4dVar methods
- Techniques to include HF tide / internal tide observations to be developed
- Common test problems/intercomparisons would be useful for next science team
  - Workshop or one-day add-on to SWOT meeting?
  - Types of benchmarks for comparing mapping?
  - Regions? Xover points? Data sets?
  - Someone (postdoc) funded to coordinate intercomparison?

Final remarks

# SWOT ST oral presentations & posters on the web

**Session leads** : please pass all presentations to myself or Nicolas Picot to be put on the AVISO website (If people used their own computer, request their slides!).

If you dont want your presentation on the web, let us know.

**Posters** give a complete overview of what was shown during this meeting

Please send them in pdf (less than 10 MB if possible) to [aviso@altimetry.fr](mailto:aviso@altimetry.fr)

Your presentations & posters will be available online at: 

<https://www.aviso.altimetry.fr/en/user-corner/science-teams/swot-science-team.html>

## **Last meeting with this current Science Team**

**Thanks to you all for your work in advancing our understanding of so many issues for SWOT observations and science/applications !**

The Science Leads will put together a **short meeting report**.

**Splinter session leads** : please provide a short (<1 page) report on the main outcomes and discussion points from your session

**Thanks to the organising committee** for their  
support for this meeting ...

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And a **big thanks to Eric Lindstrom** – for this his last SWOT Science Team meeting  
(but continuing to guide our ocean CalVal activities)

We wish you « Bon Vent » for your retirement!





