Cal/val during the 3-day fast phase, where are the required targets?

Ocean component

*R. Morrow, LEGOS*
Purpose of the 3-day fast-sampling mission

1. Cal/val, allows rapid accumulation of statistics to characterize the accuracy and precision of the measurement, which is key to the science analysis during the rest of the mission.

2. Selected in-situ sites for sampling of rapid oceanic and hydrological processes

Note: data collected during this phase (3 months) will be fully analysed later once the instrument is correctly calibrated – for dynamical studies, assimilation, …
1. Cal/Val of the instrument measurement

- Cal/val benefits: if we have a set of instrumented sites, better statistical sample from the 3-day mission, so that calibration would proceed 7 times faster.

- This holds for "static" calibration parameters (such as channel phase differences, range delays, phase screen).

- It does not apply to calibration of slowly varying parameters – drift calibration will be done over the entire mission.
Instrument calibration for Karin

- Instrument calibration for the primary products (1 km SSH) can be achieved solely using cross-overs with other altimeters and with the SWOT data itself.

- **Ka-band airborne observations** (and to a lesser extent, optical) will be also useful, but are not strictly required for calibration.

- The **nadir calibration** will require the usual calibration, so specific calibration sites (e.g., Harvest) or cross-calibration with other altimeters will be important for the nadir altimeter measurements and for the radiometer.

- **SWH and radar brightness** are not part of the required swath products. Unlike SSH, their calibration/validation using cross-overs is problematic, due to the time difference and their faster rate of change. They will have to be cal/val'ed using the traditional consistency of global histograms that has been used in the past for altimeters.
Needs

• Fixed calval sea level sites with high-precision, rapid temporal sampling – is this necessary for nadir?

• Inter-calibration with concurrent traditional altimetry for mesoscale - large-scale structure

• A number of sites with high-resolution spatio-temporal sampling of filaments (floats, gliders, drifter studies, Seasor, moorings, …)

Priority: coastal zones or pre-instrumented sites (easy access for delayed launch!)
Do we need absolute sea level calibrations sites?

Principal objective: use observations from tide gauges and other sensors directly on (or near) satellite ground tracks to calibrate the sea-surface height and ancillary measurements made by the satellite as it passes (nearly) overhead.

Several dedicated sites exist around the world.
What ocean in-situ measurements do we need of the sub-mesoscale and rapid processes?

- Gliders
- Ship-towed Sea-soars
- Current meter Moorings
- Tide gauges
- Profiling floats
- Dye experiments
- Others ???

We only have a 3-month (moveable) period for the 3-day fast-sampling phase, so the in-situ programme needs to be:

- in a region where infrastructure can be readily deployed (eg coasts)
- in a region where long-term instrumentation is in place
What science questions would we like to answer?

1- What is the **time scale of evolution** of SSH features for spatial scales between 5 km and 100 km? How universal is it? Is it consistent with Surface Quasi-Geostrophic theory? Is it consistent with high resolution model results? Can SWOT sample SSH appropriately?

2- How well can **vertical velocities be inverted** from SSH using SQG? How about fluxes?

3- How can **SSH and SST be combined** to get improved estimates of circulation at small scales? Can these sampling requirements be met from space?

4- Do the **SSH filaments always coincide with SST or ocean colour filaments**? At what scales? What is the impact of these exchanges on the ocean’s uptake of heat, carbon, nutrients?

5- How do these **sub-mesoscales interact with the meso-scale and large-scale circulation**?

6- Can **internal tide signals** be separated from submesoscale and mesoscale signals?

...
4) Selected in-situ sites for sub-mesoscale sampling

Ideally – regions with long term mesoscale-sub-mesoscale studies and possibility of rapid instrument deployment during the CalVal phase

**Example 1:**

**Coastal dynamics and upwelling**

« *Endurance Array* »: moorings and glider paths off Oregon and Washington

Or « *Monterey Bay* »

10 yr+ moorings, gliders, ship hydro, HF radar

Low tides, strong sub-mesoscale signature « squirts and jets »
Coastal site 2) : Bay of Biscay

Strong tides and internal tides, moderate sub-mesoscale signature

In-situ and modelling studies underway. Airborne obs possible
3-day sampling of storm surges

Not the main SWOT science

Need correctly positioned 3-day sampling tracks

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**Fig. 6** (a) Time-averaged and (b) time evolution of SLA ensemble variance (=model error) in two point of the domain (Lamouroux, 2006)

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**Jason-2 + SWOT 22j**

**Jason-2 + SWOT 3j**

Model error reduction gain
Example 3: Open ocean filament structures

High eddy energy or low eddy energy?

More flexible for groundtrack positioning?

3 day season sampling

One month of CTDs

Zonal Vel

Vertical Vel

P. Klein
Submesoscale-resolving, synoptic FSLE maps from AVISO NRT data have been used to identify an isolated eddy core where to perform a submesoscale iron fertilization experiment. The FSLE analysis has been also used to estimate the stretching of the fertilized patch during the experiment. During one cloud free day three weeks after the fertilization, the superposition of Chl image (MODIS, color) to the altimetry-derived FSLE (black lines) showed the excellent capability of this technique to locate tracer fronts. The compact distribution of the fertilized patch after three weeks (showed by an arrow) indicates the success in choosing a region with low stirring activity.
Tropical sites?

SW Pacific: SPICE
Solomon Sea surveys and moorings

Atlantic: Pirata? Accès plus difficile?

3-day sampling of Tropical instability waves...
High latitude regions?

High latitude zones – already have ~ 3d coverage with 22 day orbit

3-day fast-sampling phase … multiple daily passes at high-latitude?

Logistics more difficult
What independent measurements do we need for this instrument validation?

For Karin:
- Wind, wave in-situ observations?
- SAR Interferometric measurements?
- Overflight with HF radar for surface currents (or coastal HF radar currents?)
- Crossovers with other nadir altimeters
- Crossovers with optical instruments
- Airborne Ka interferometry observations?
- In-situ ocean observations (see later)

For nadir:
- Absolute sea level observations? (eg long-term sites, GPS buoy obs?)
- Standard nadir altimeter Cal/val
Personal opinion:

We will need to fix one major site for in-situ CalVal including airborne observations (e.g., US West coast).

We then circulate the proposed 3-day swath groundtrack to establish other in-situ CalVal sites.

Can re-assess the first groundtrack proposal if we miss important other sites.