Regional CALVAL of Jason-2 and SARAL/AltiKa at three calibration sites

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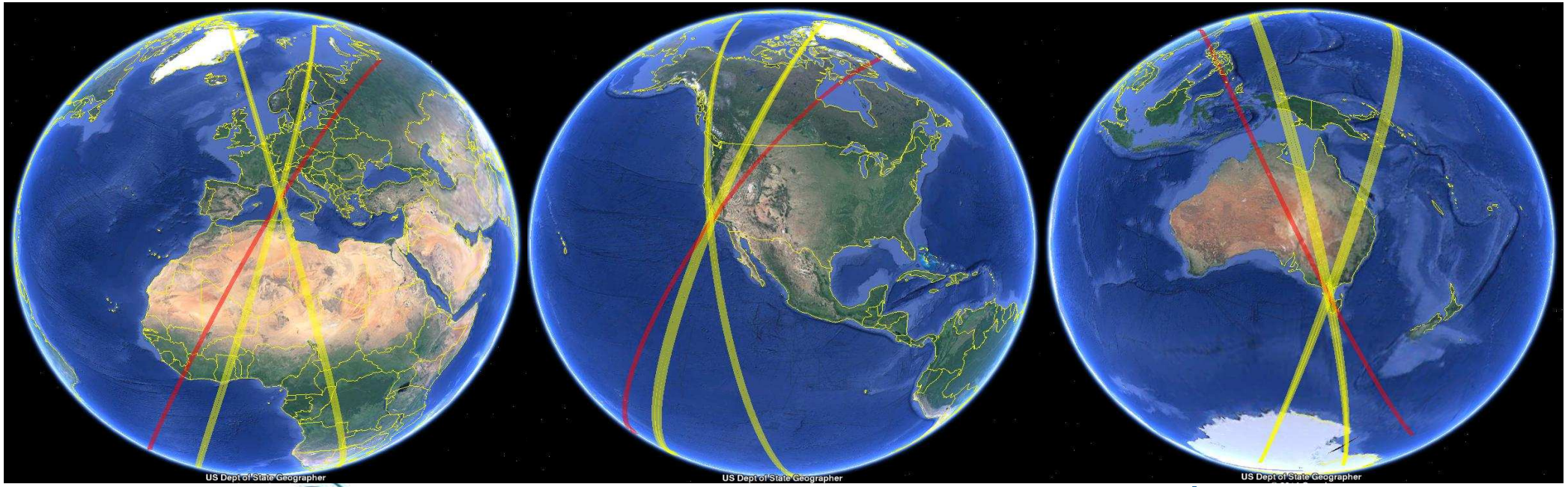


Regional CALVAL method

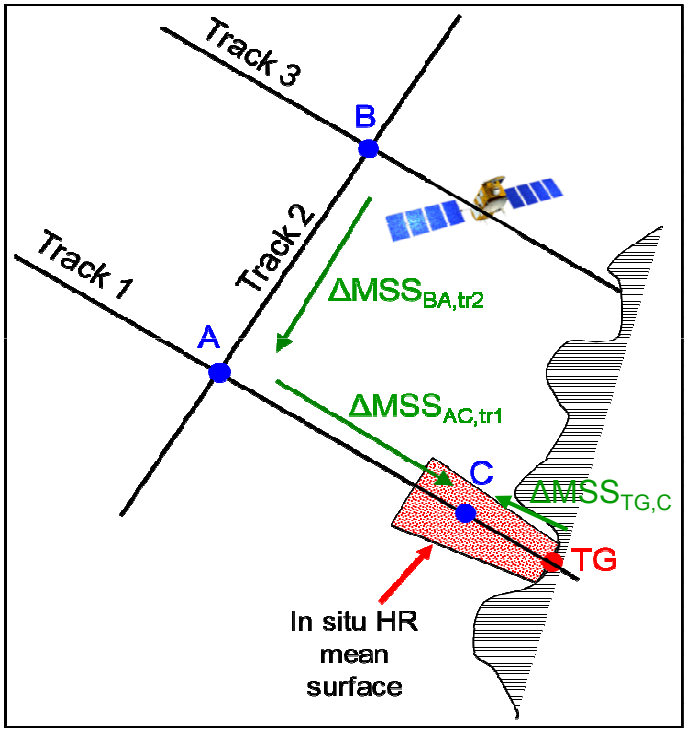
Combination of:

Absolute CALVAL: Direct comparison between altimeter and tide gauge SSH (point C).

- ✓ Only for satellite flying over the calibration sites.
- ✓ Directly comparable to the absolute bias estimates computed by the local in situ calval groups (Corsica, Harvest, Bass Strait, Gavdos…)
- ✓ BUT different selection of data and point of comparison

Offshore CALVAL: Computation of the bias on offshore passes (points A & B)

- ✓ Following a succession of accurate mean sea surface profiles, combining several missions
- ✓ Using a high resolution mean sea surface to link the *in situ* and altimetry SSH, when available (MSS otherwise)



Regional CALVAL method

Generic method:

➔ **Calibration of missions on new orbits**

✓ After an orbit change (ex: interleaved TP/Jason, Envisat after October 2010, Jason-1 end-of-life, Jason-2 end-of-life)

✓ For orbits without dedicated calibration sites

➔ **Calibration of non-repetitive orbits**

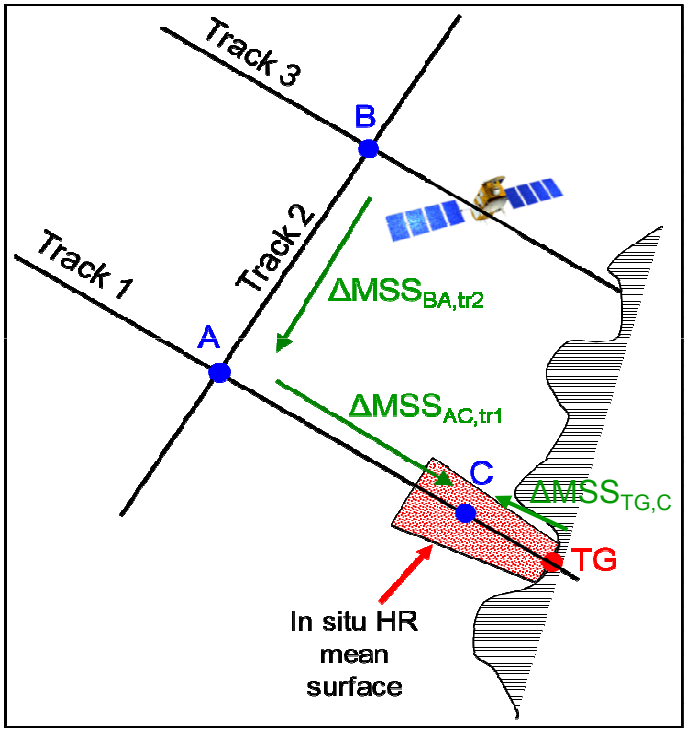
✓ Missions on non-repetitive or drifting orbits (ex: CryoSat-2).

Applicable to any calibration site:

➔ **in Corsica** (Senetosa & Ajaccio) for Topex, Jason-1, GFO, Jason-2, Envisat and SARAL/AltiKa

➔ **at Harvest** for Jason-2, Envisat and SARAL/AltiKa

➔ **at Bass Strait** for Jason-2, Envisat and SARAL/AltiKa



Altimetry data

	Jason-2	SARAL/AltiKa
Product version	GDR-D	GDR
Period	Cycles 1-259 07/2008 – 07/2015	Cycles 1-25 03/2013 – 08/2015
Ionosphere	GIM	GIM
Wet troposphere	• **Corsica:** ECMWF model (land contamination) • **Harvest:** Radiometer (S. Brown) • **Bass Strait:** Radiometer (S. Brown)	• **Corsica:** ECMWF model (land contamination) • **Harvest:** Radiometer • **Bass Strait:** Radiometer
Tides	• **Corsica:** COMAPI regional model (CNES) • **Harvest:** FES2004 • **Bass Strait:** FES2004	
DAC	High resolution global simulation (LEGOS)	

In situ data

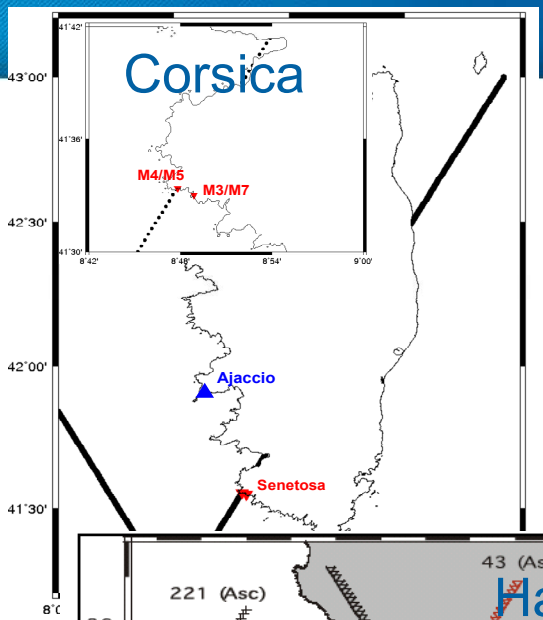
Corsica site

Ajaccio (SHOM):

✓ 1 tide gauge since 2002

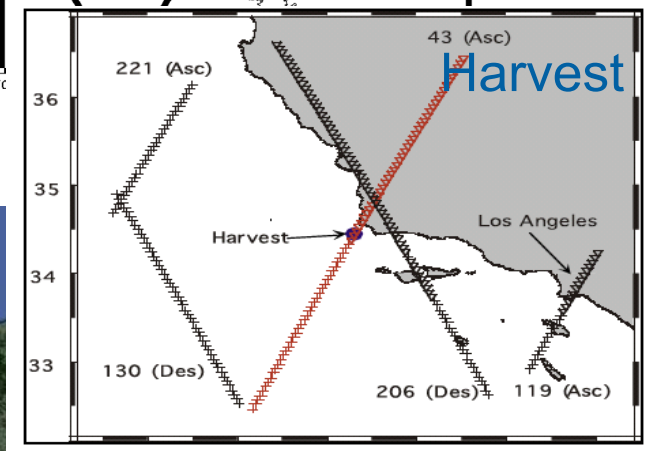
Senetosa (OCA/CNES):

✓ 4 tide gauges (2 couples of instruments) since 1998



Harvest site

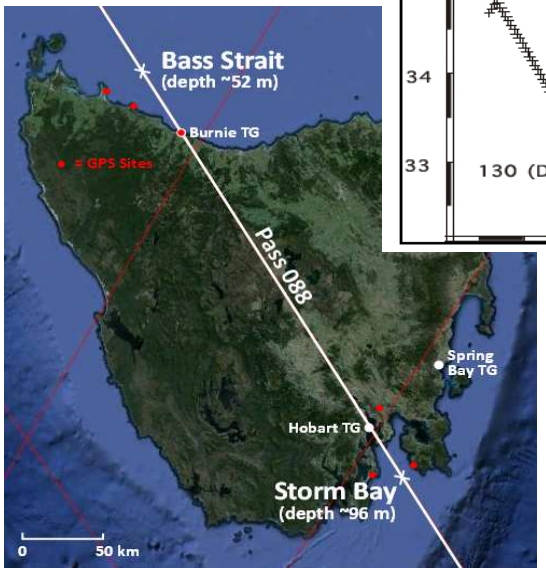
✓ Tide gauge SSH time series entirely reprocessed and checked between 2002 and 2015 (JPL)



(Haines et al, 2012)

Bass Strait site

✓ Quality controlled tide gauge SSH time series between 1992 and 2015 (UTAS)



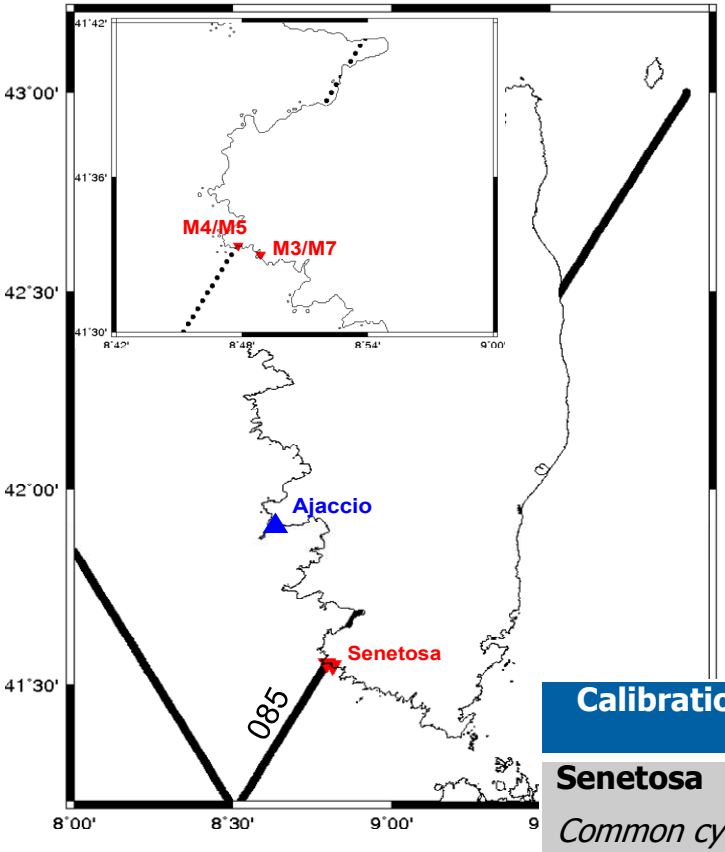
(Watson et al, 2013)

Jason-2 absolute CALVAL results

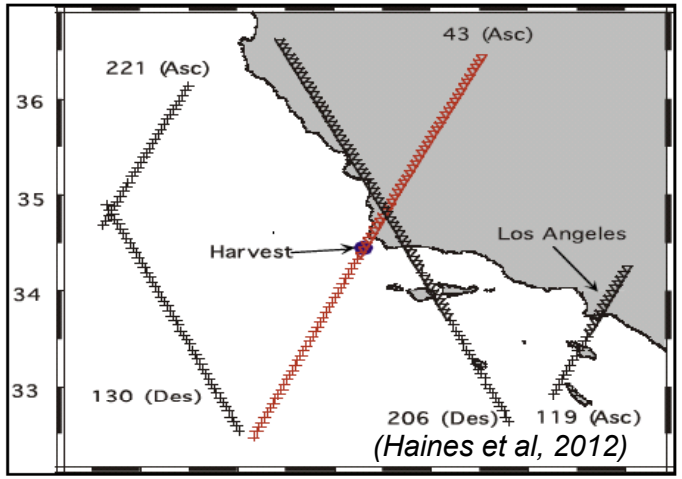
→ Evaluation of the regional method compared to the local groups' methods
→ Stability of the Jason-2 mission

Jason-2 CALVAL

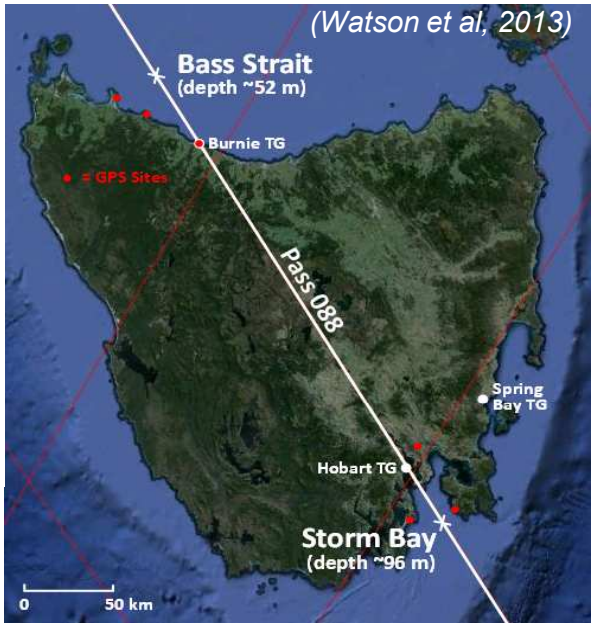
Corsica



Harvest



Bass Strait



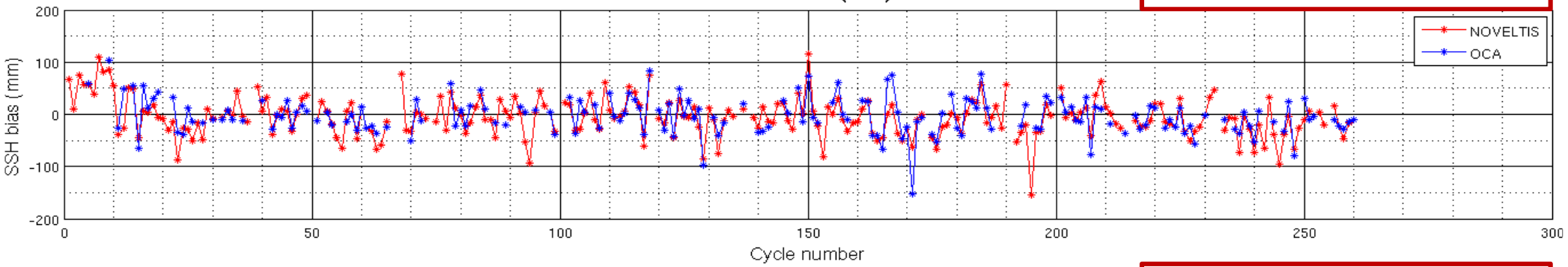
Calibration site – Jason-2	Method	Bias (mm)	Std (mm)	Nbre of cycles	Correlation
Senetosa *Common cycles (1 to 259)*	NOVELTIS	-8.8 ± 2.4	32.0	173	0.77
	OCA	-2.8 ± 2.7	34.8		
Harvest *Common cycles (1 to 259)*	NOVELTIS	22.2 ± 2.2	31.7	201	0.83
	JPL	19.1 ± 2.2	31.4		
Bass Strait *Common cycles (1 to 259)*	NOVELTIS	20.8 ± 2.4	36.0	226	0.78
	UTAS	18.1 ± 2.4	36.4		

→ Track overflying the calibration site

Jason-2 CALVAL

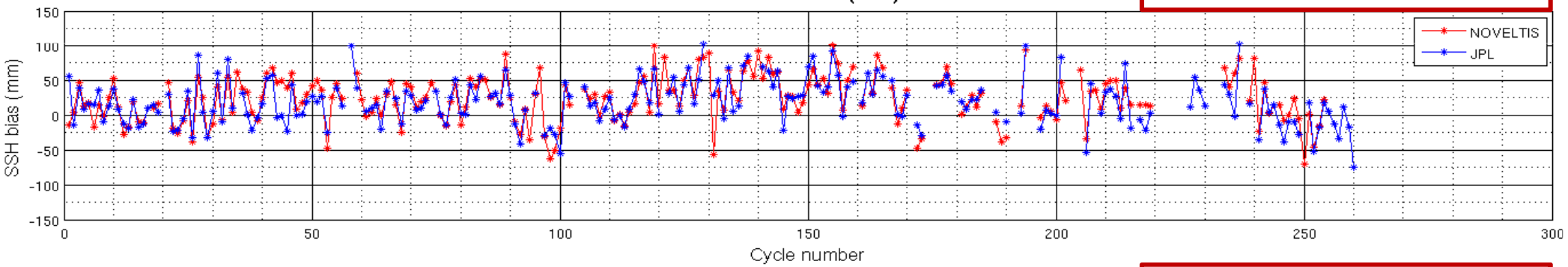
Jason-2 GDR-D SSH bias estimates (mm) at Senetosa - Track 085

Correlation NOV/OCA = 0.77



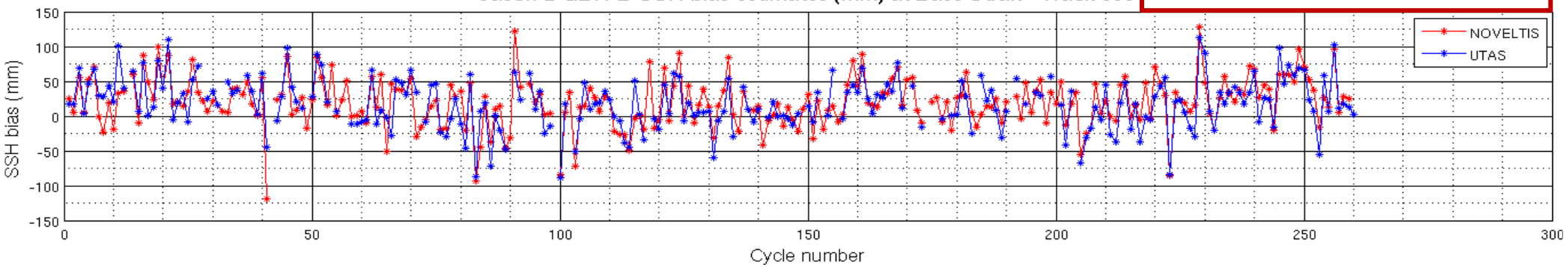
Jason-2 GDR-D SSH bias estimates (mm) at Harvest - Track 043

Correlation NOV/JPL = 0.83



Jason-2 GDR-D SSH bias estimates (mm) at Bass Strait - Track 088

Correlation NOV/UTAS = 0.78



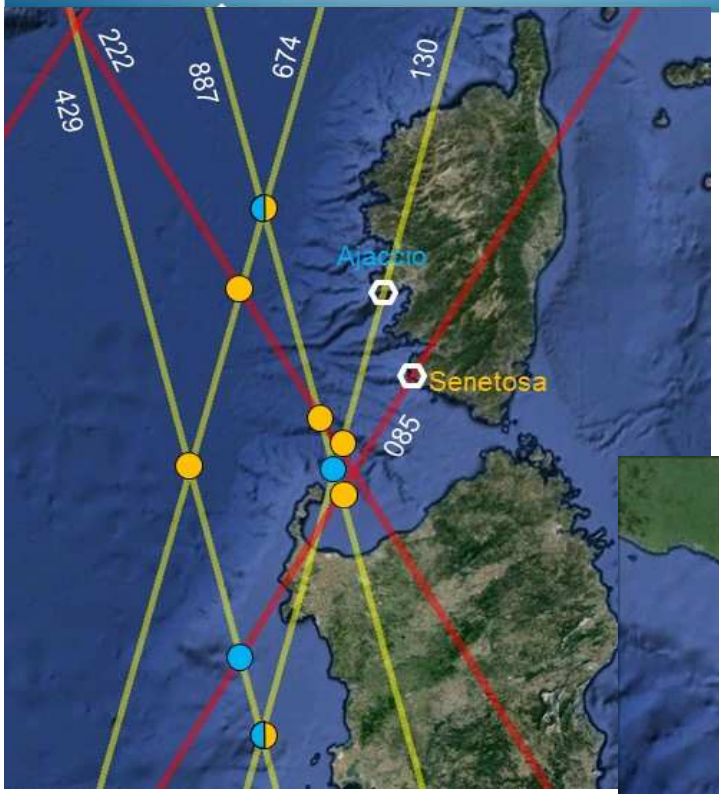
Jason-2 CALVAL in Corsica, at Harvest and at Bass Strait

- ✓ Jason-2 GDR-D absolute bias estimates
  - ✓ close to 0 at Senetosa
  - ✓ close to 2 cm at Harvest and Bass Stait
- ✓ Very good agreement between the local methods and the regional method (in the absolute configuration) at the 3 sites

SARAL/AltiKa regional CALVAL results

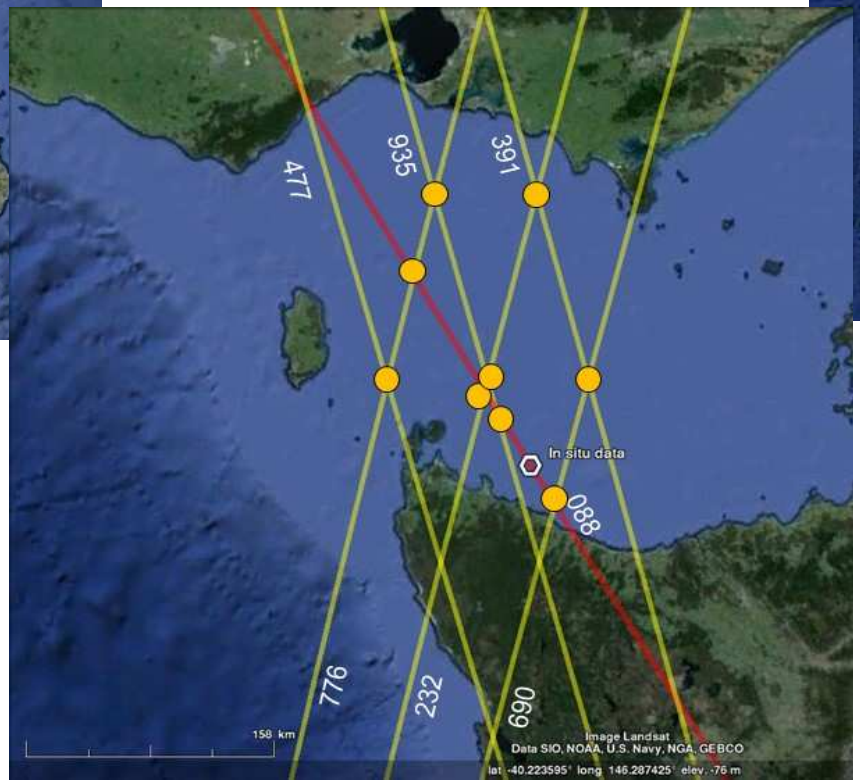
→ Legacy from Envisat regional calval activies (same ground-tracks configuration)
→ Comparison to the local groups' initiatives

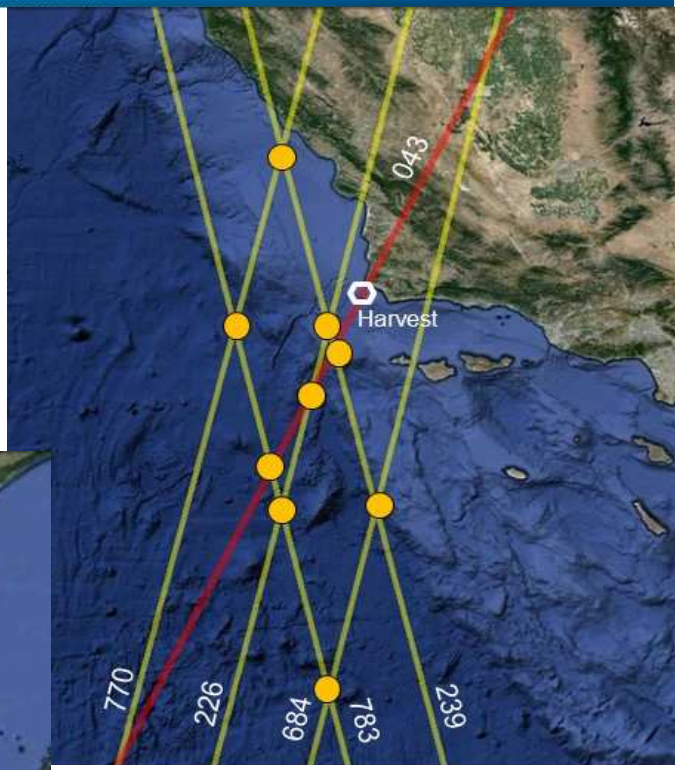
SARAL regional CALVAL



Corsica

Bass Strait

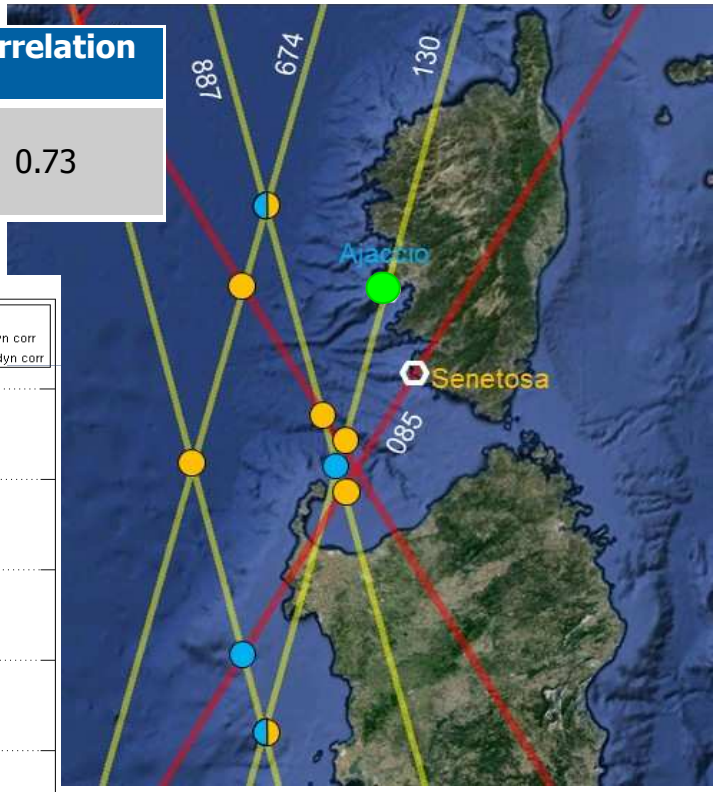


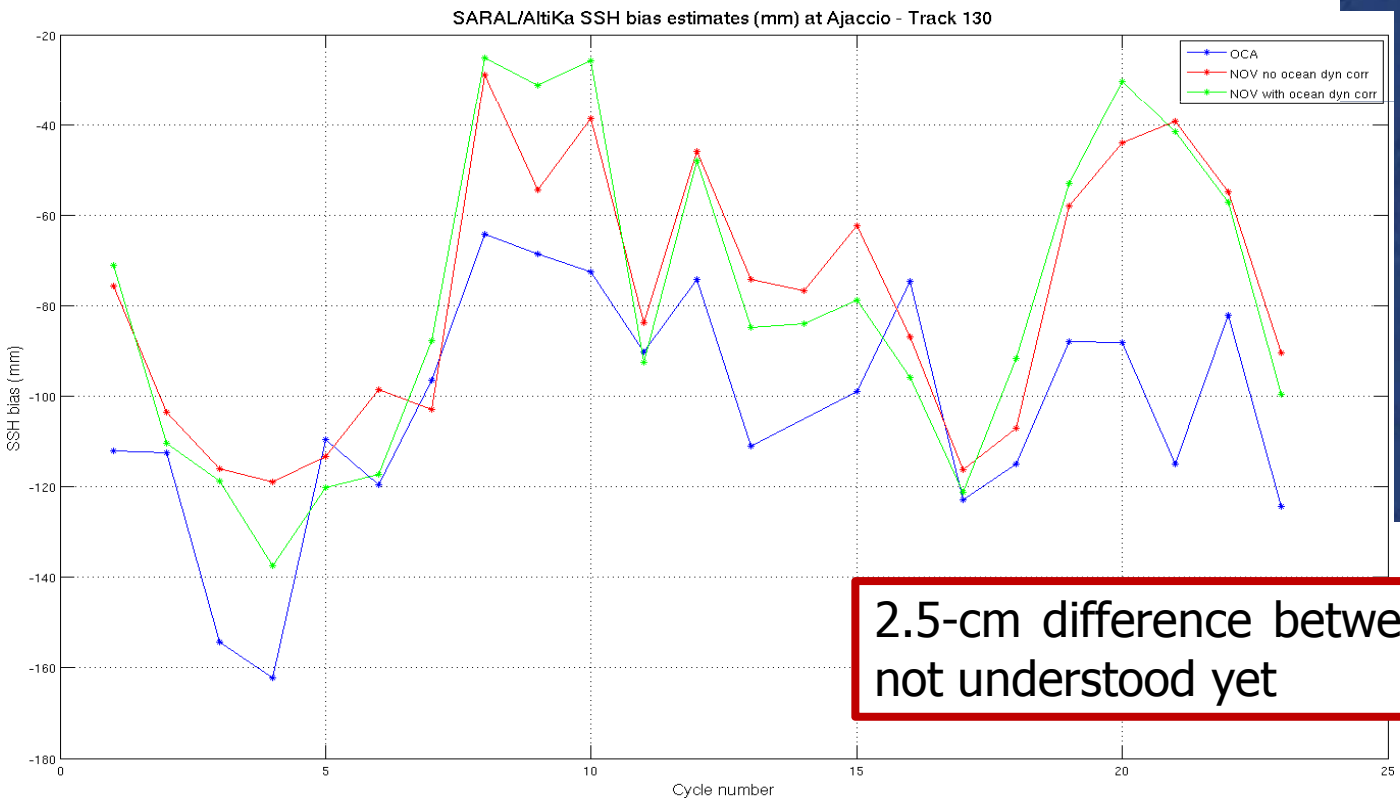


Harvest

SARAL/AltiKa absolute bias in Ajaccio

Calibration site – AltiKa	Method	Bias (mm)	Std (mm)	Nbre of cycles	Correlation
Ajaccio *Common cycles (1 to 25)*	NOVELTIS	-77.9 ± 6.3	29.3	22	0.73
	OCA	-102.6 ± 5.5	26.0		



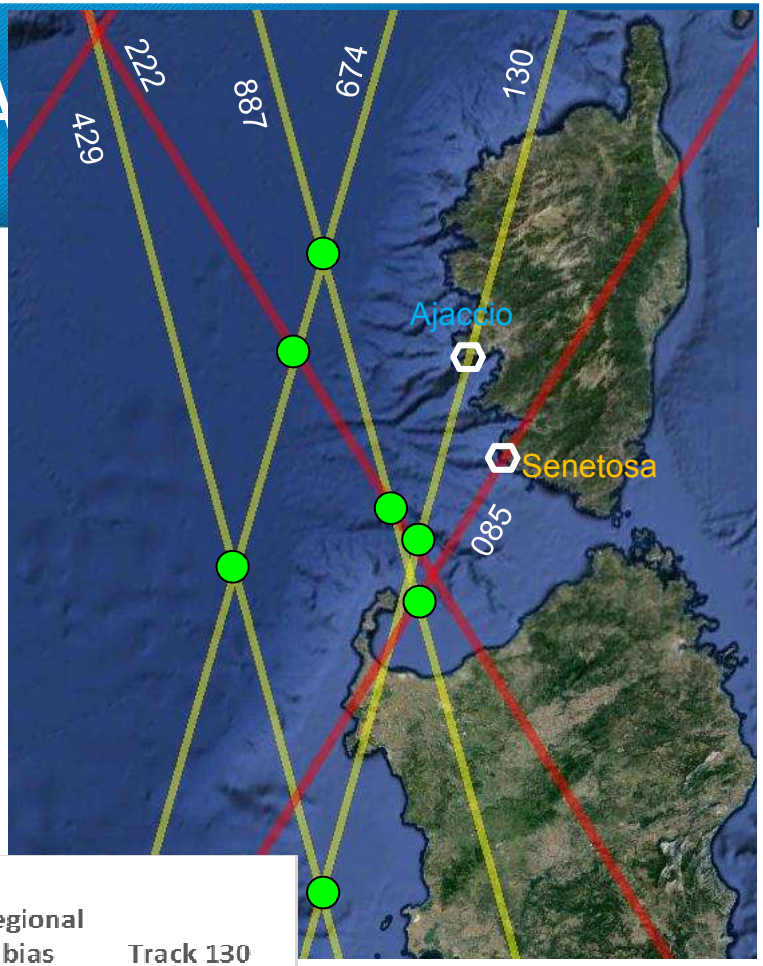


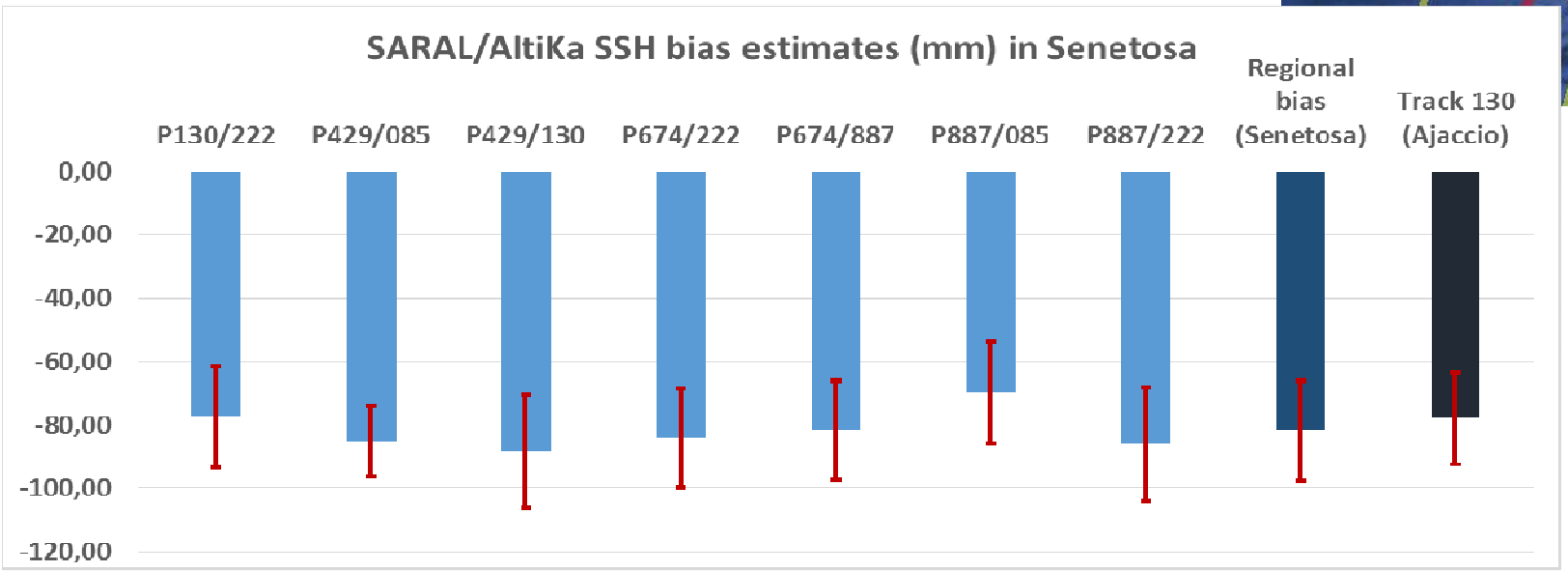
2.5-cm difference between the two estimates ➔ not understood yet

SARAL/AltiKa regional bias in Senetosa

Calibration site	Bias (mm)	Std (mm)	Nbre of cycles
Ajaccio (track 130)	-77.9 ± 6.3	29.3	22
Senetosa (regional)	-81.7 ± 6.3	31.4	25

Absolute bias estimate in Ajaccio and regional bias in Senetosa are consistent when using the same method (NOVELTIS).

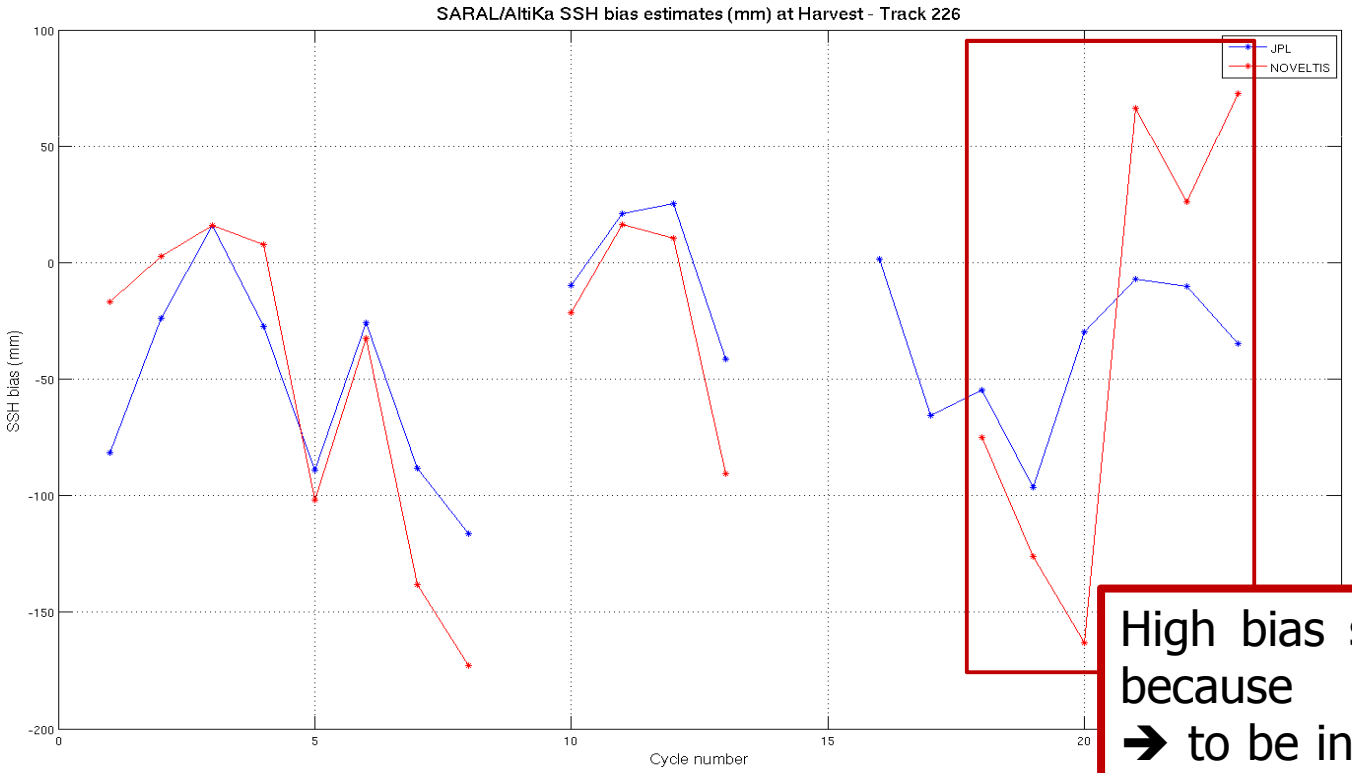


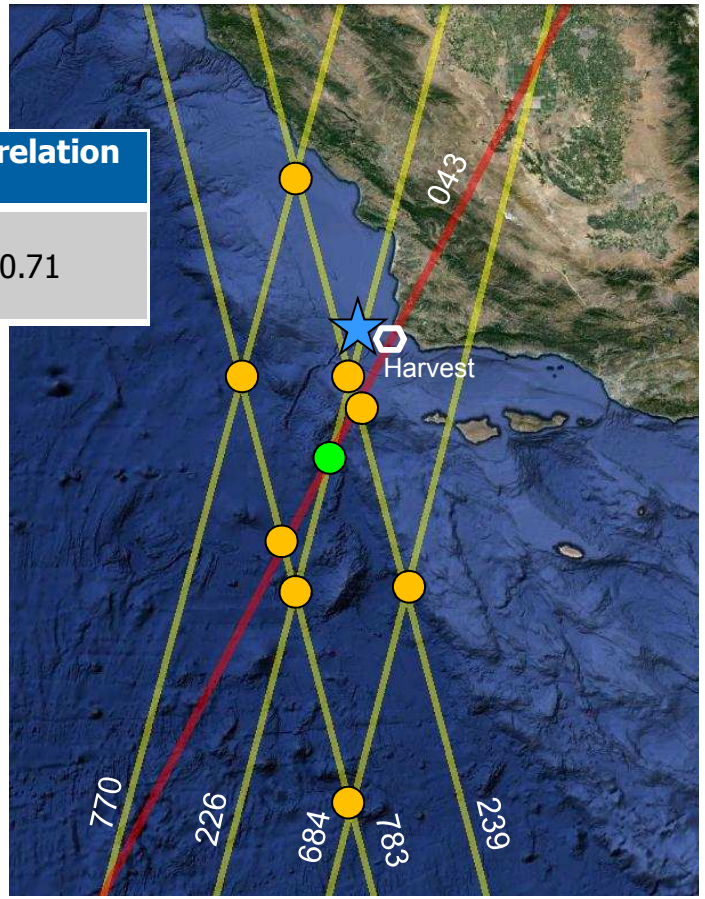


SARAL regional CALVAL

SARAL/AltiKa bias in Harvest

Calibration site – AltiKa	Method	Bias (mm)	Std (mm)	Nbre of cycles	Correlation
Harvest *Common cycles (1 to 25)*	NOVELTIS	-40.1 ± 18	76.6	18	0.71
	JPL	-37.5 ± 10	42.3		

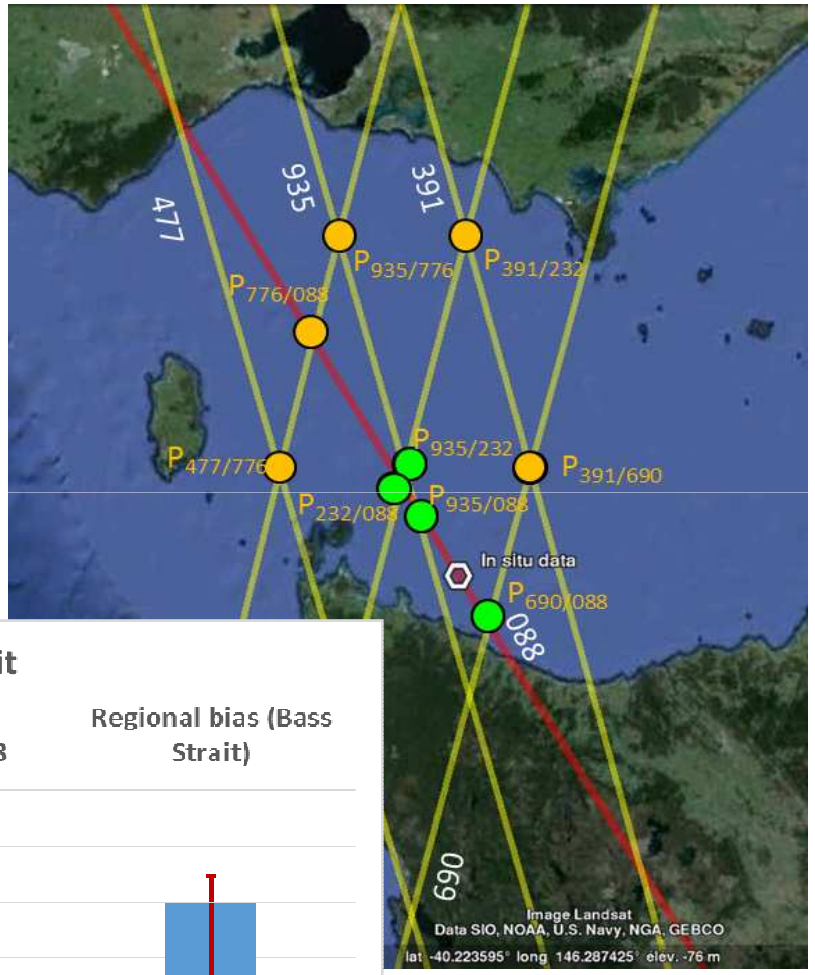


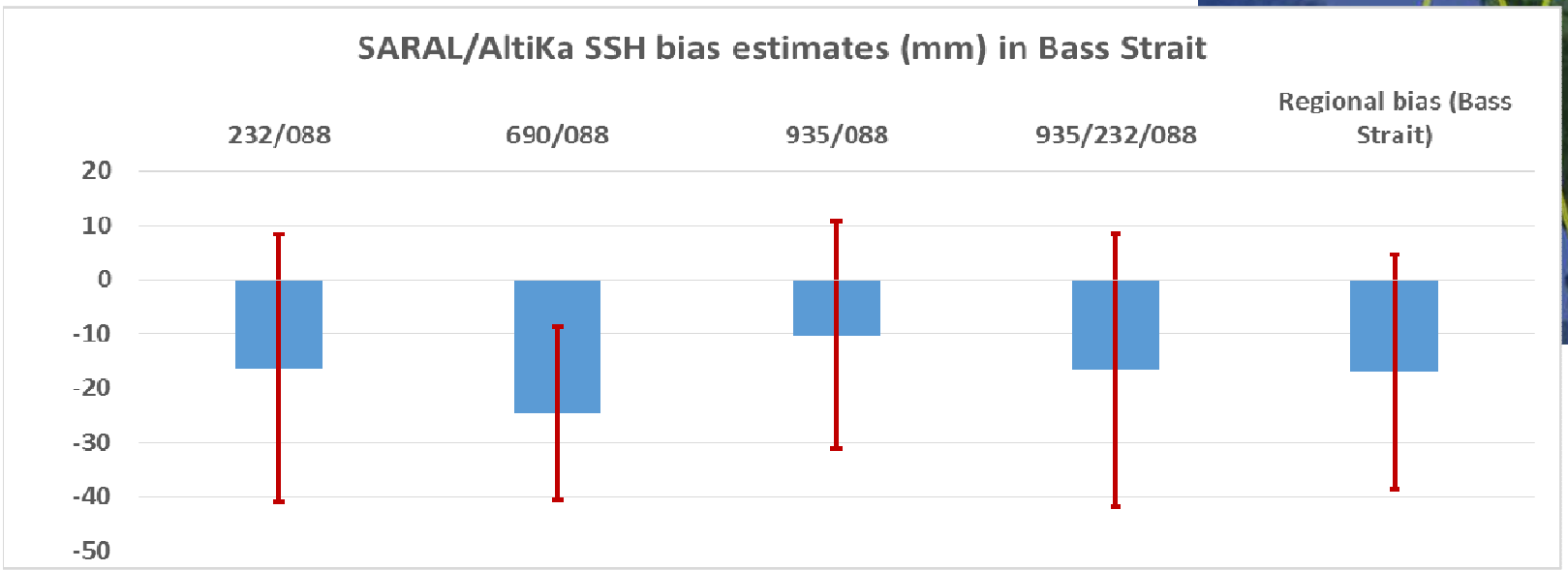


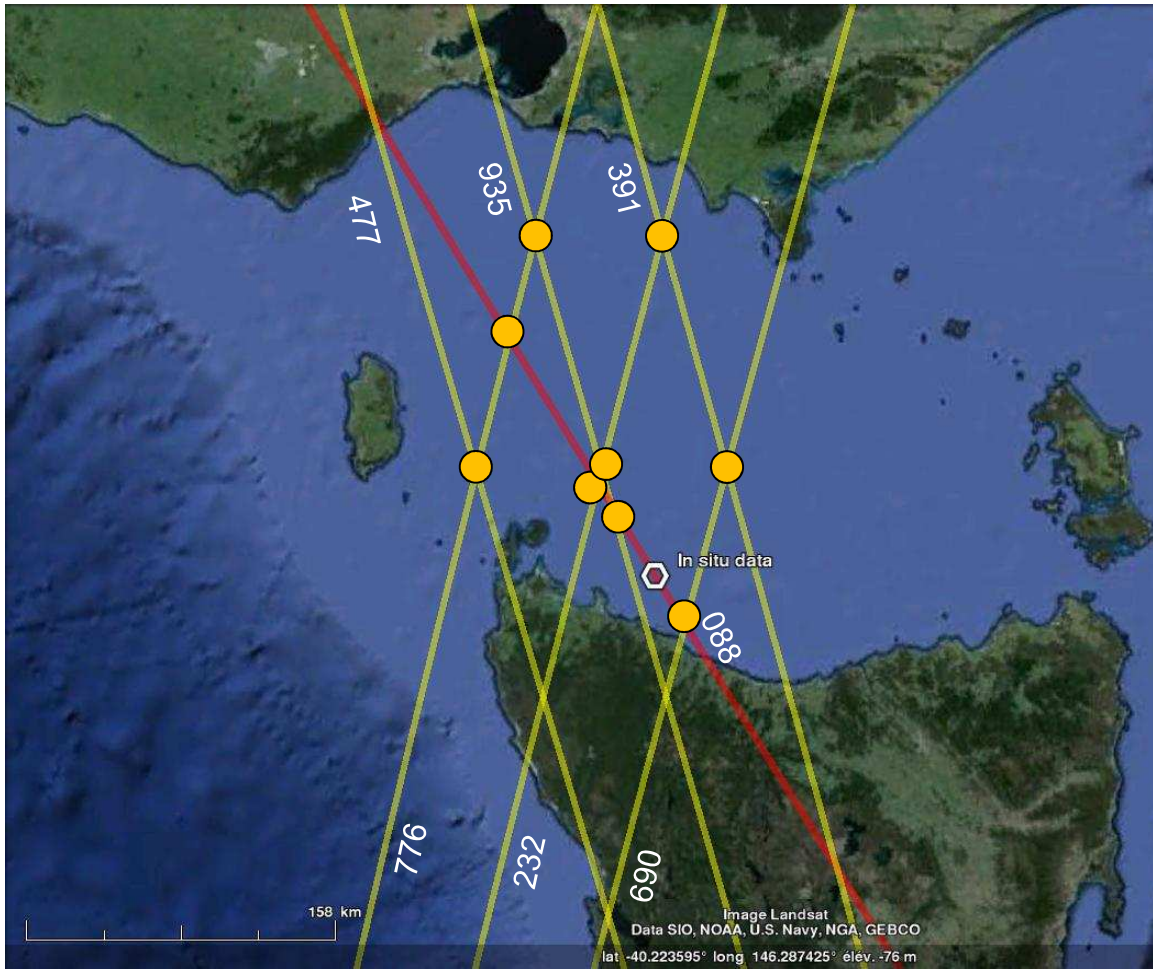
High bias std with regional calval method because of the last cycles ➔ to be investigated (data editing ? DAC ? Tide ?)

SARAL/AltiKa bias in Bass Strait

Much noise in the bias estimates ➔ Wet tropo (radiometer correction) ? Tide ? DAC ?





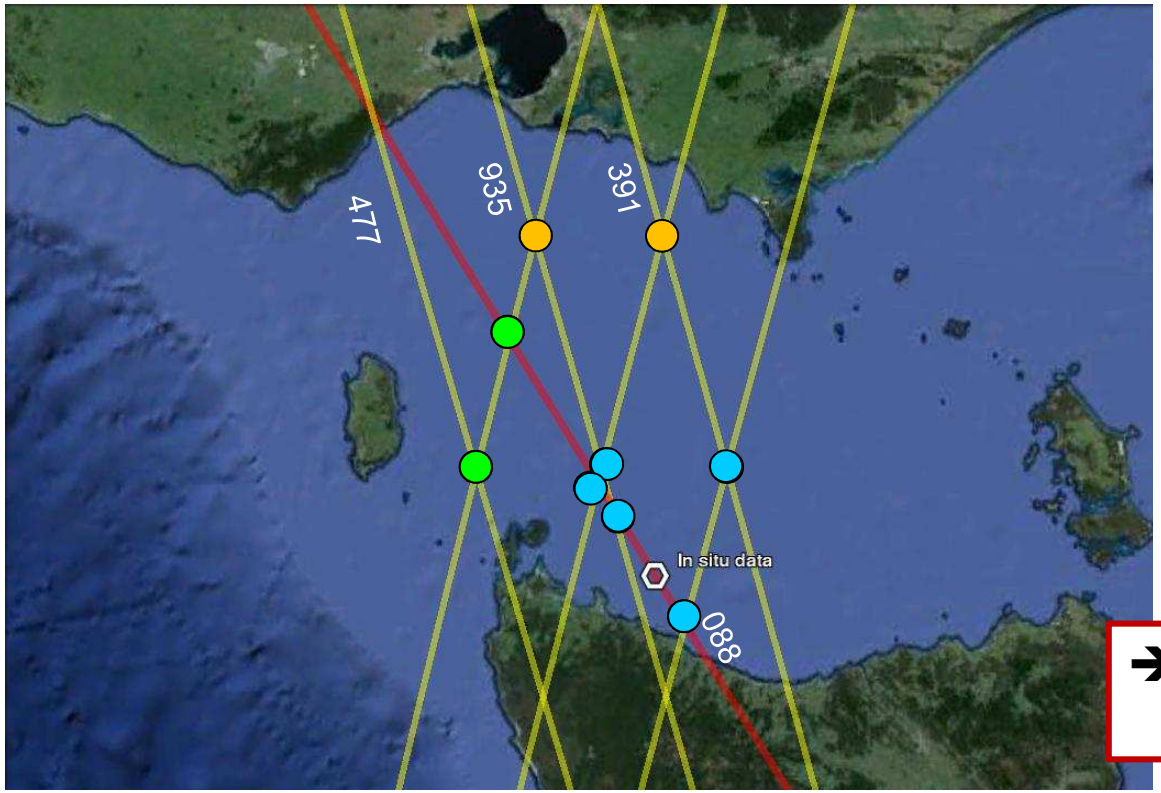


Impact of the tide model

- Initial selection of crossover points

Much variability in the bias estimates at the farthest offshore points, even with the tide/DAC corrections.

Envisat regional CALVAL



Impact of the tide model

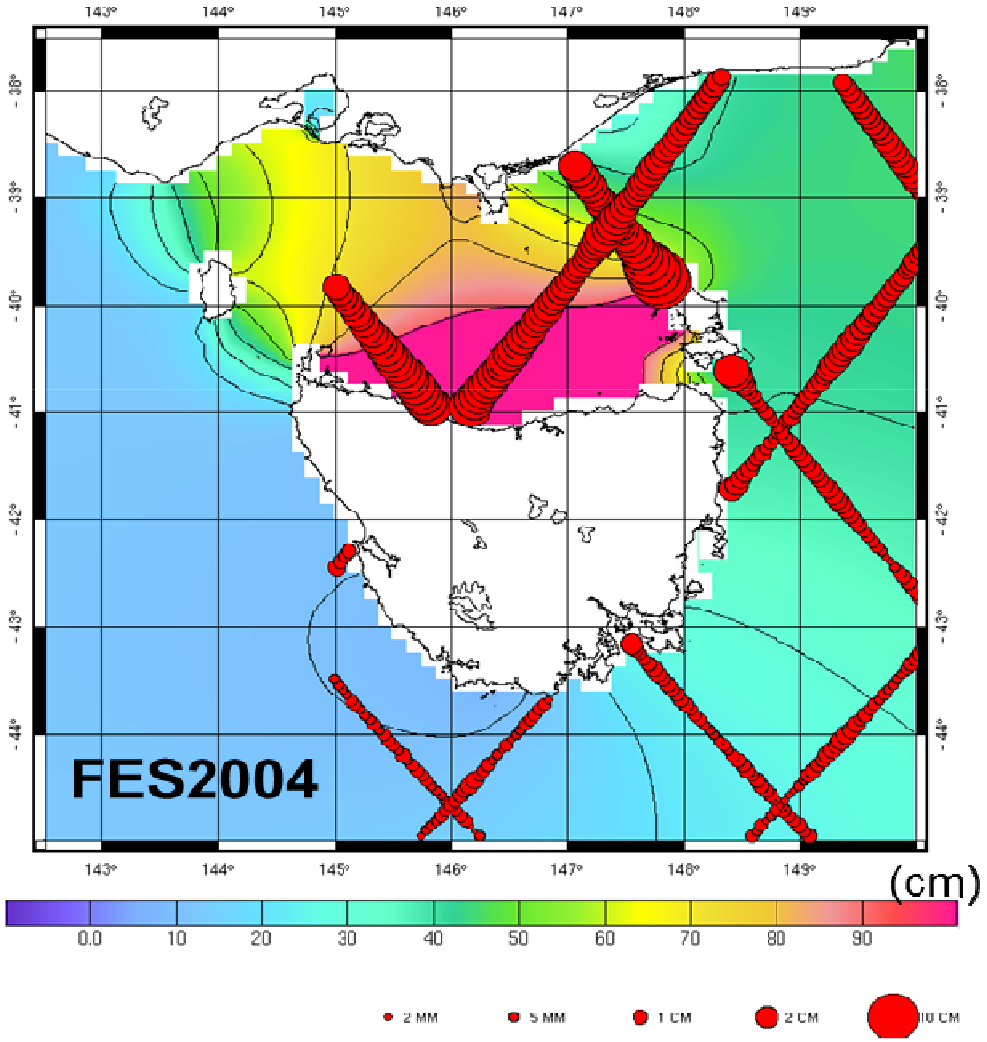
- Initial selection of crossover points
- Selection with FES2004 tidal model
- Additional selection (FES2014)

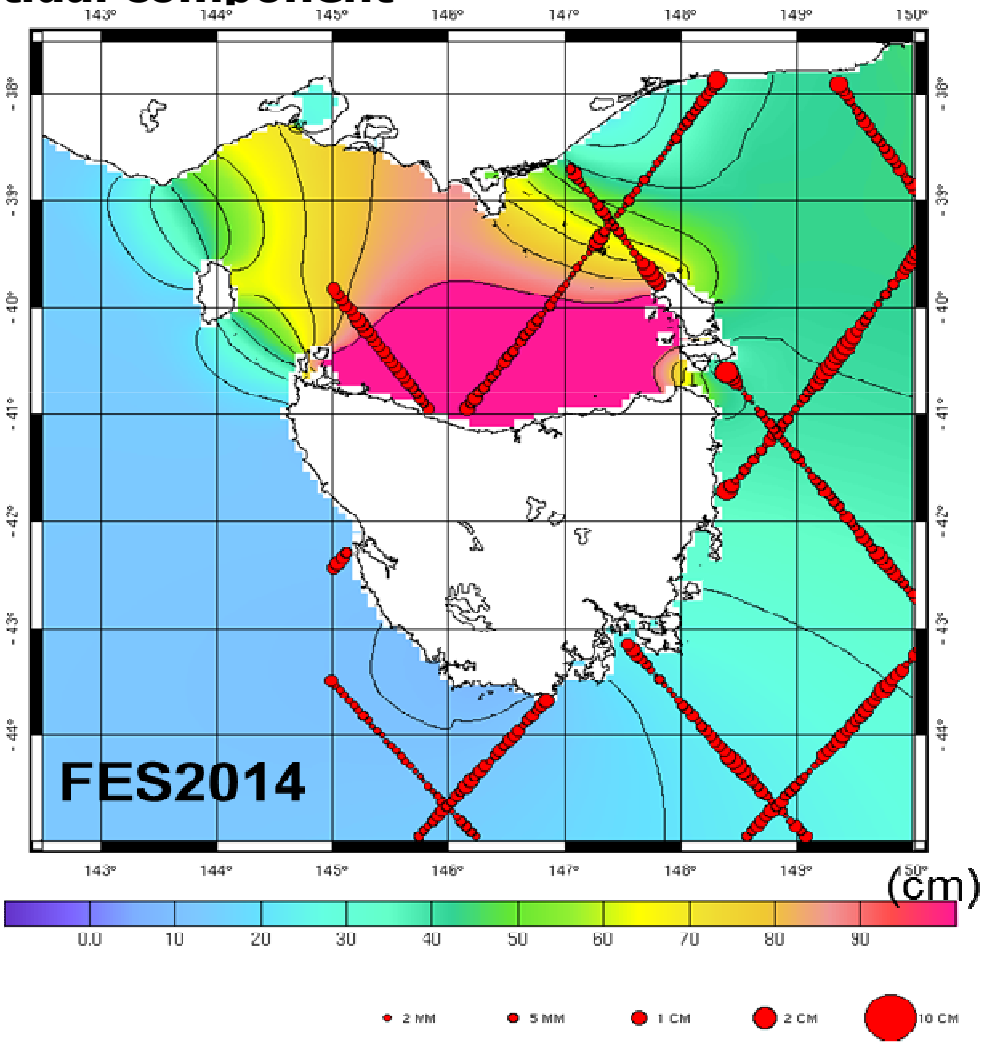
➔ **Major impact of the accuracy of the geophysical corrections.**

Envisat regional bias – GDR-D orbit	Bias (mm)	Std (mm)	Nbre of cycles
No ocean dynamics correction	499.0	128.7	84
With DAC + FES2004 tide	502.5	53.2	84
With DAC + FES2014 tide	489.7	45.8	84
+2 crossover points (green dots)	492.8	53.5	84

Envisat regional CALVAL

Vector differences between the models and the CTOH X-TRACK tidal harmonic constituents – M2 tidal component





The FES2014 tidal model will be officially released by the end of 2015.

Conclusions and perspectives

- ✓ Regional CALVAL = Link between the local and global CALVAL methods

  → Consistency with the other groups

  → Means to evaluate the accuracy of the corrections (wet tropo, iono, tides, DAC…)

- ✓ Still some work for SARAL/AltiKa, with benefit from the Envisat experiment
- ✓ The accuracy of the tide and DAC models has a direct impact on the regional bias estimate stability

  → with regional high resolution models at the calibration sites, this error in the bias estimates would be reduced

- ✓ Implementation of the method for Sentinel-3 in the coming months (ESA MPC S3)
- ✓ Sentinel-3, Jason-3, SWOT, Jason-CS/Sentinel-6 will benefit from all these activities

Thank you !