



# Potential of the Noumea Lagoon as a multi-mission Cal/Val site for past and future altimetry missions

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Venice - Italy

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# New Caledonia and the Lagoon

## Context

- World largest lagoon (24.000 km<sup>2</sup>)
- Near Noumea : Average depth ~20m  
Semi-diurnal tides  
Tidal range [0,6 - 1,4 m]

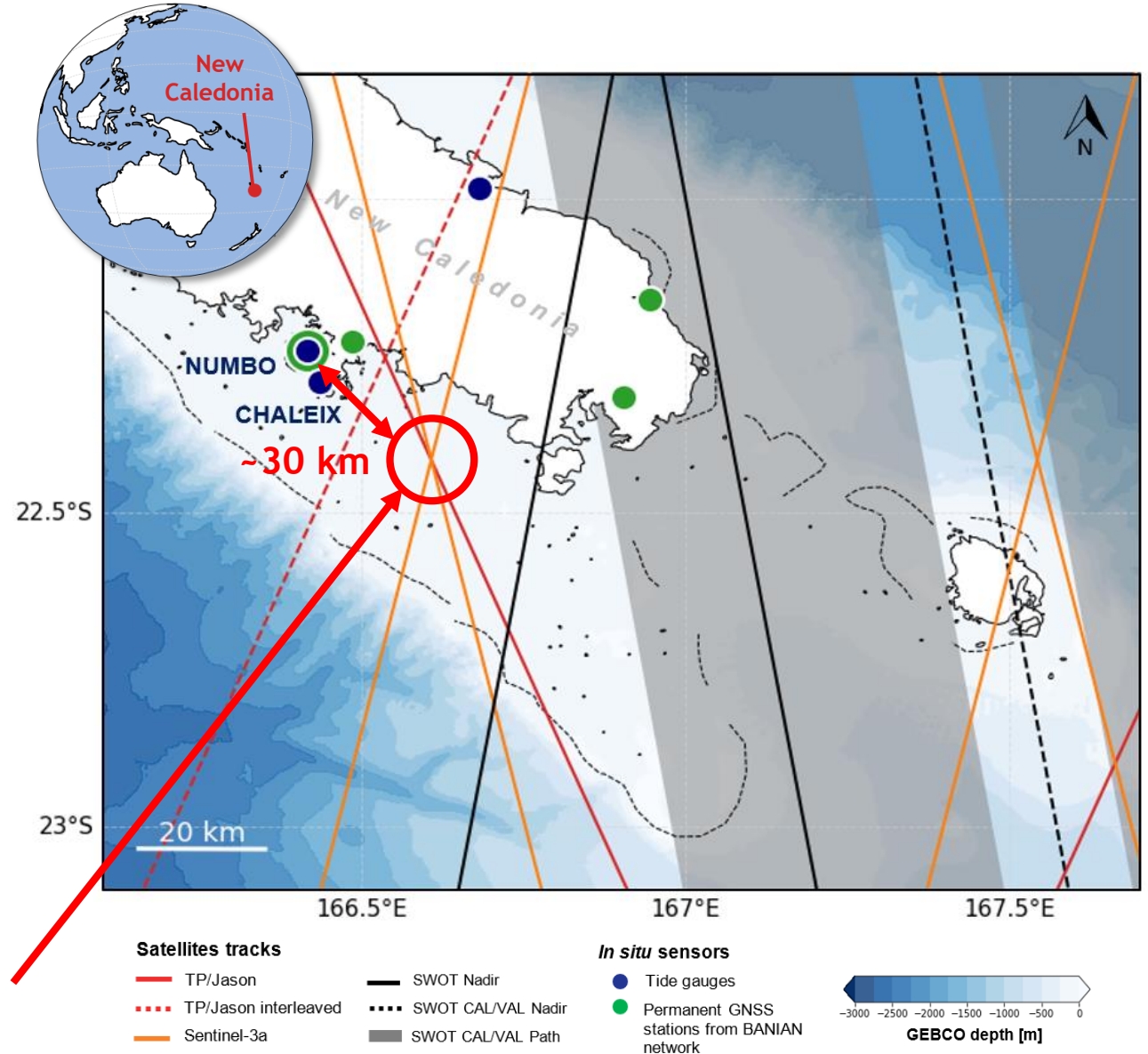
## In situ measurements

- BANIAN GNSS permanent stations
- Tide gauges ⇒ Long term time series from Chaleix/Numbo [Aucan et al., 2017]
- IRD ressources

## Satellite observations

- TP/Jason ⇒ Sentinel-6/Jason CS
- Sentinel-3
- SWOT ⇒ Included SWOT CAL/VAL path [Gourdeau et al., 2020]

**An interesting Jason/Sentinel-3a crossing point !**





# GEOCEAN-NC 2019 Campaign

Numbo tide gauge

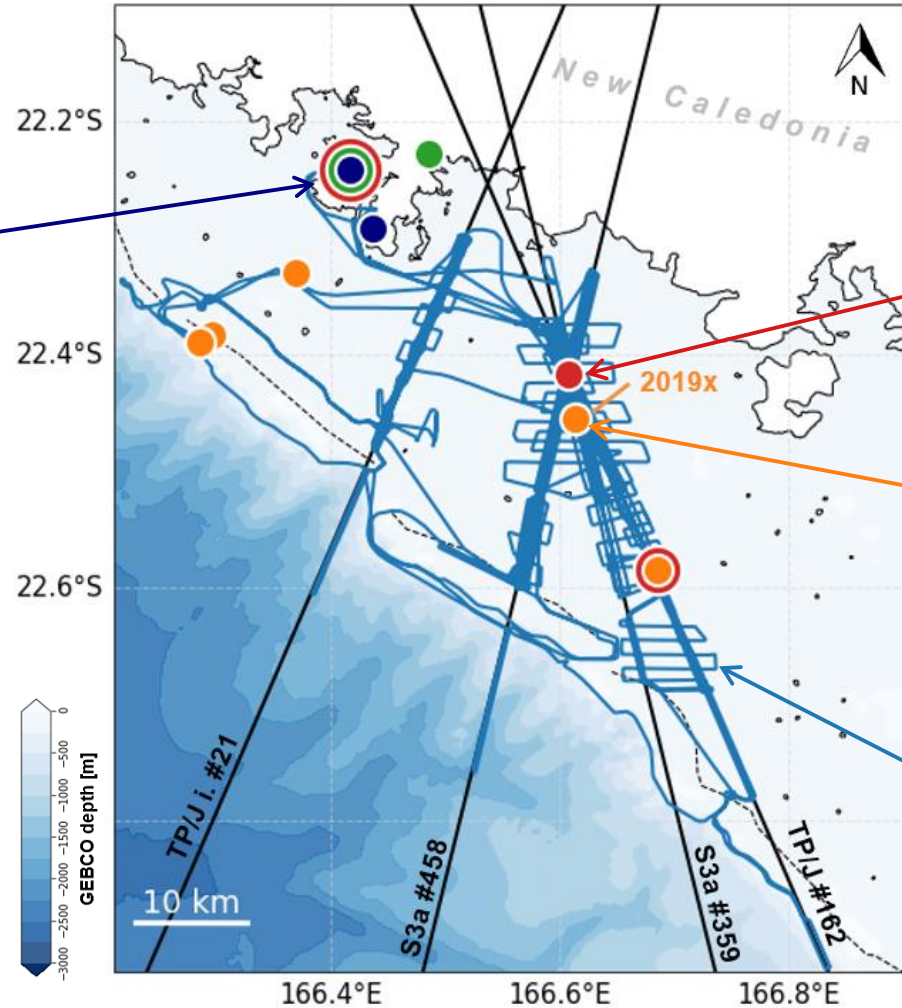


⇒ GNSS instruments calibration

N/O ALIS



⇒ 13 days navigation in the lagoon



Satellites tracks

— Satellites tracks

In situ sensors

- Tide gauge
- Permanent GNSS static

GEOCEAN-NC 2019

- Pressure gauge
- GNSS Buoy
- CalNaGeo track

GNSS Buoy



⇒ 3 days at the altimetry crossover

Pressure sensor



⇒ SBE 26plus

⇒ 1 year record

⇒ ~ 20m depth

CalNaGeo carpet



⇒ Towed by R/V ALIS

⇒ 260h of GNSS observations



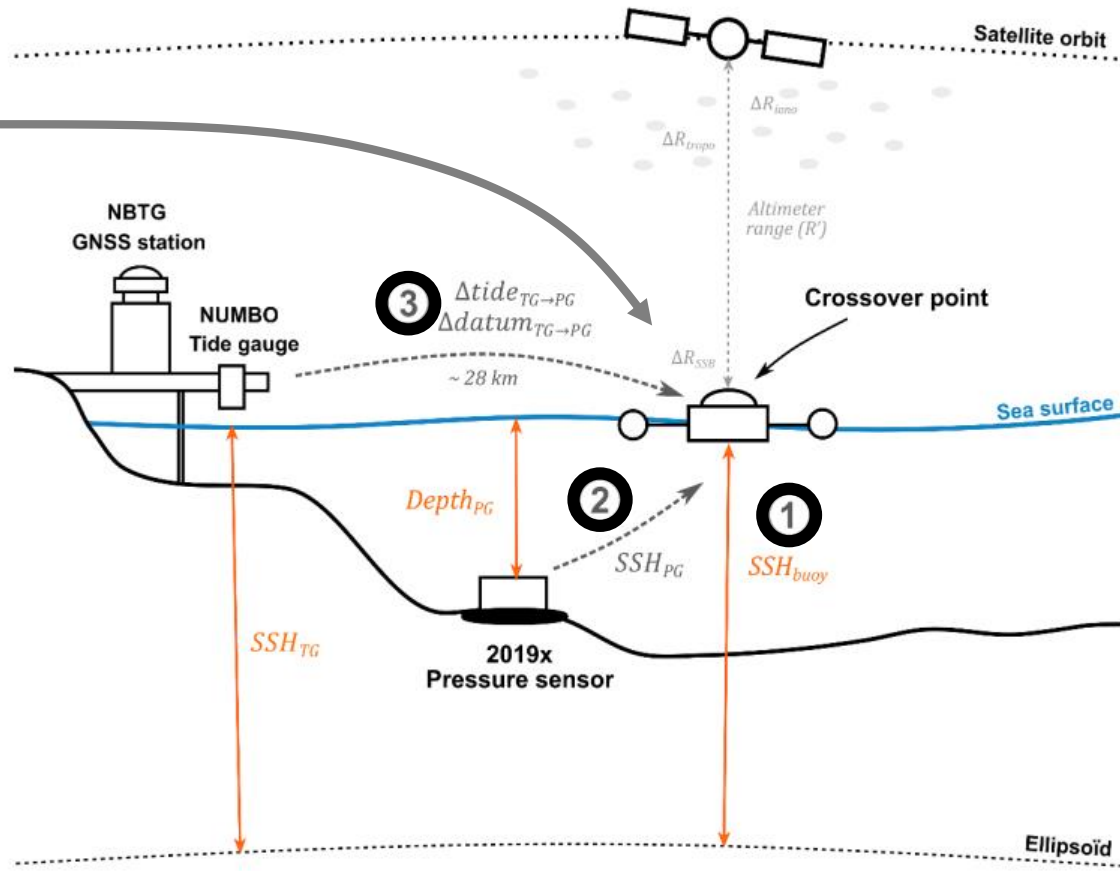
## Objective

Compare altimetry and *in situ* data following standards made for dedicated Cal/Val studies



Reconstruction of a long term virtual *in situ* sea level time series under altimetry tracks

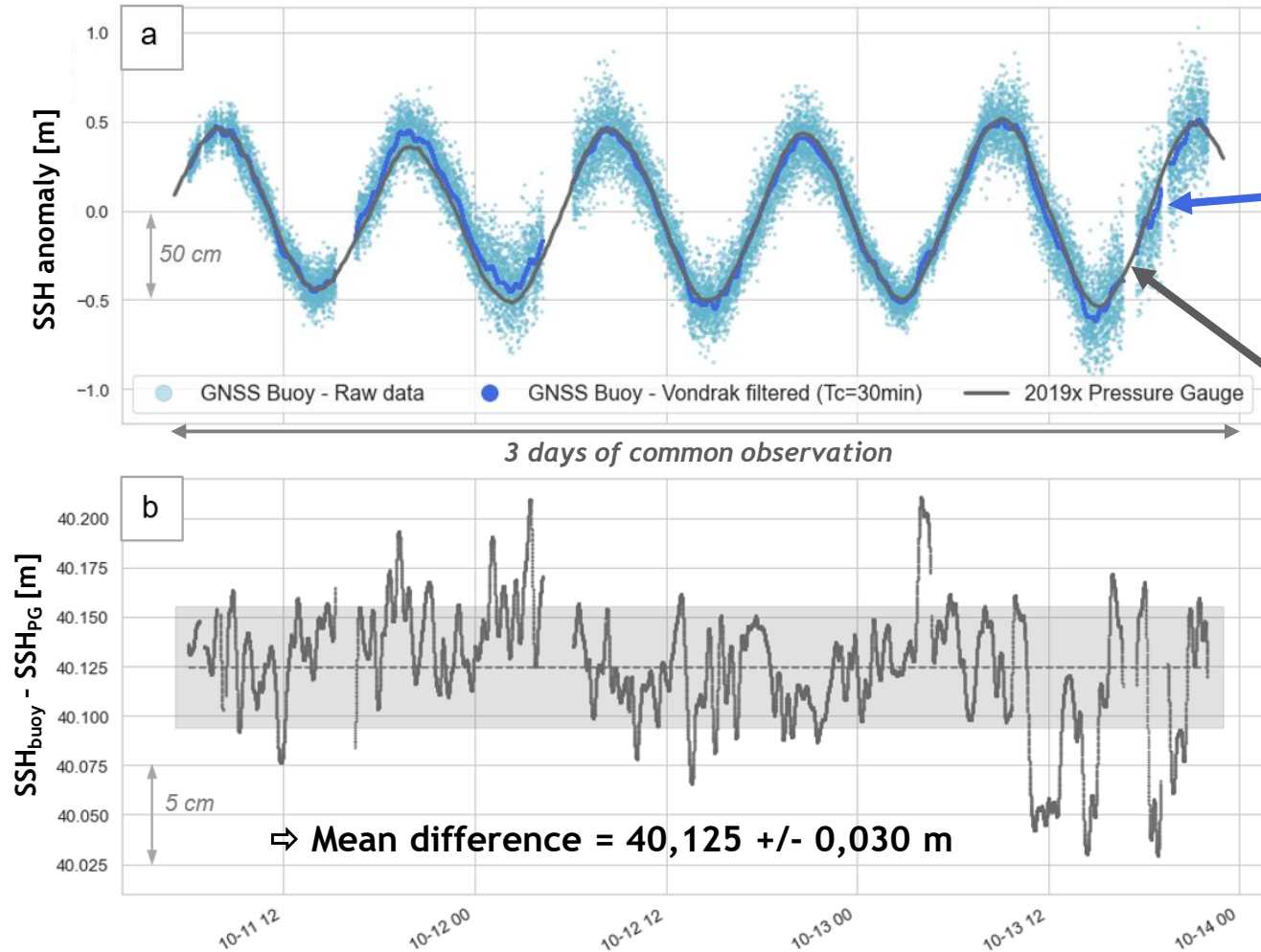
- ⇒ Direct SSH from the GNSS buoy at the crossover during 3 days
- ⇒ Referencing pressure sensor by comparing with GNSS buoy data over the common observation period
- ⇒ Transferred Noumea tide gauge observations by computing a tidal and datum correction using pressure gauge observations





STEP 1/2

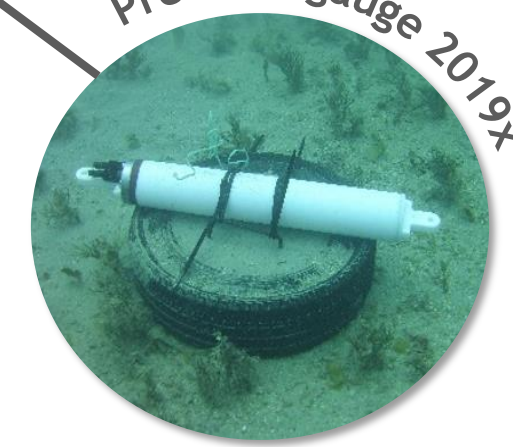
## Comparison between GNSS buoy and 2019x pressure gauge observations



GNSS Buoy



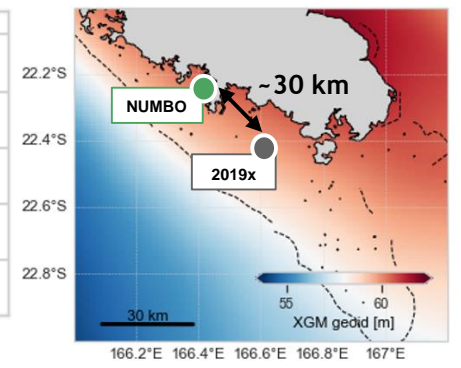
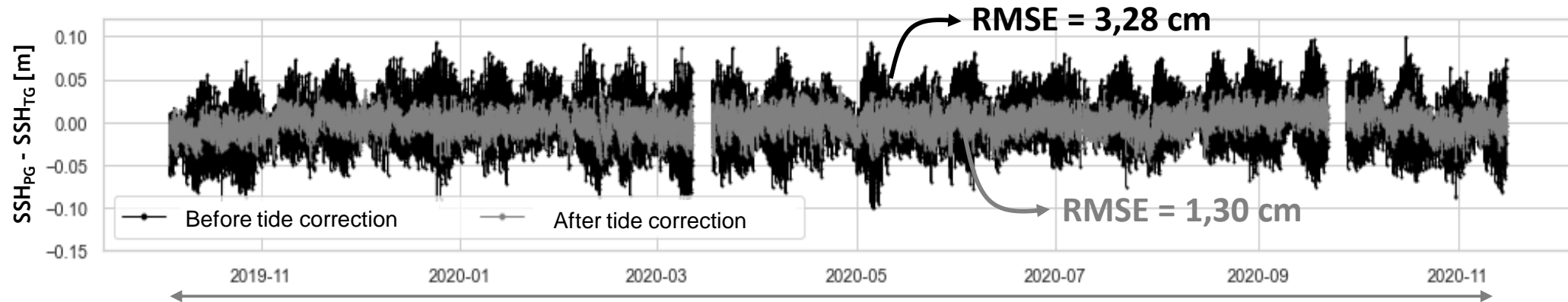
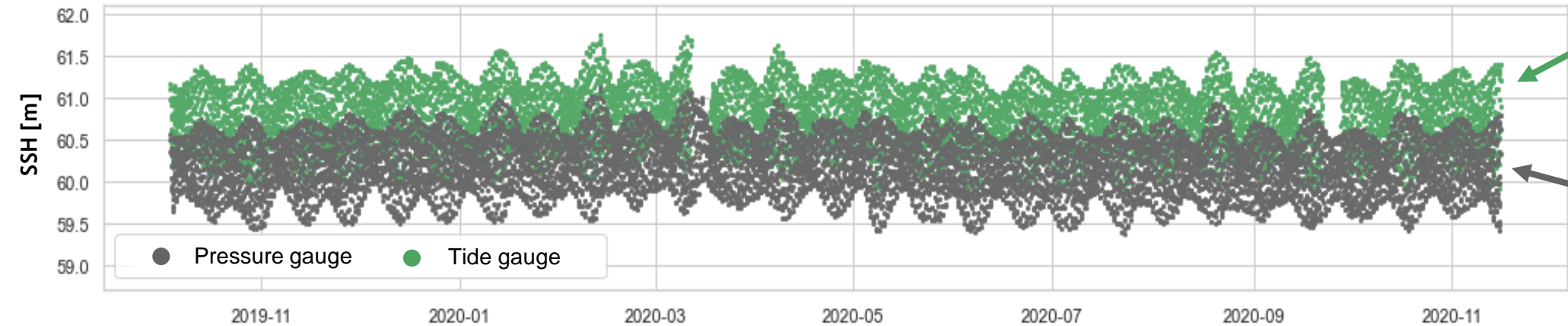
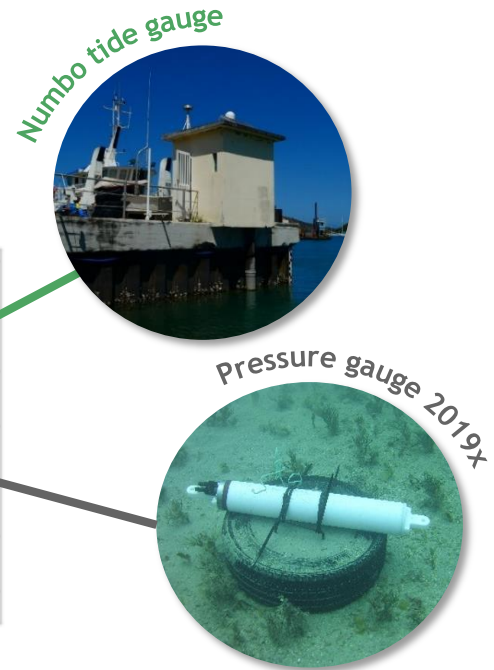
Pressure gauge 2019x





## STEP 3

### Transfer the Noumea tide gauge observations at the altimetry crossover





## Objective

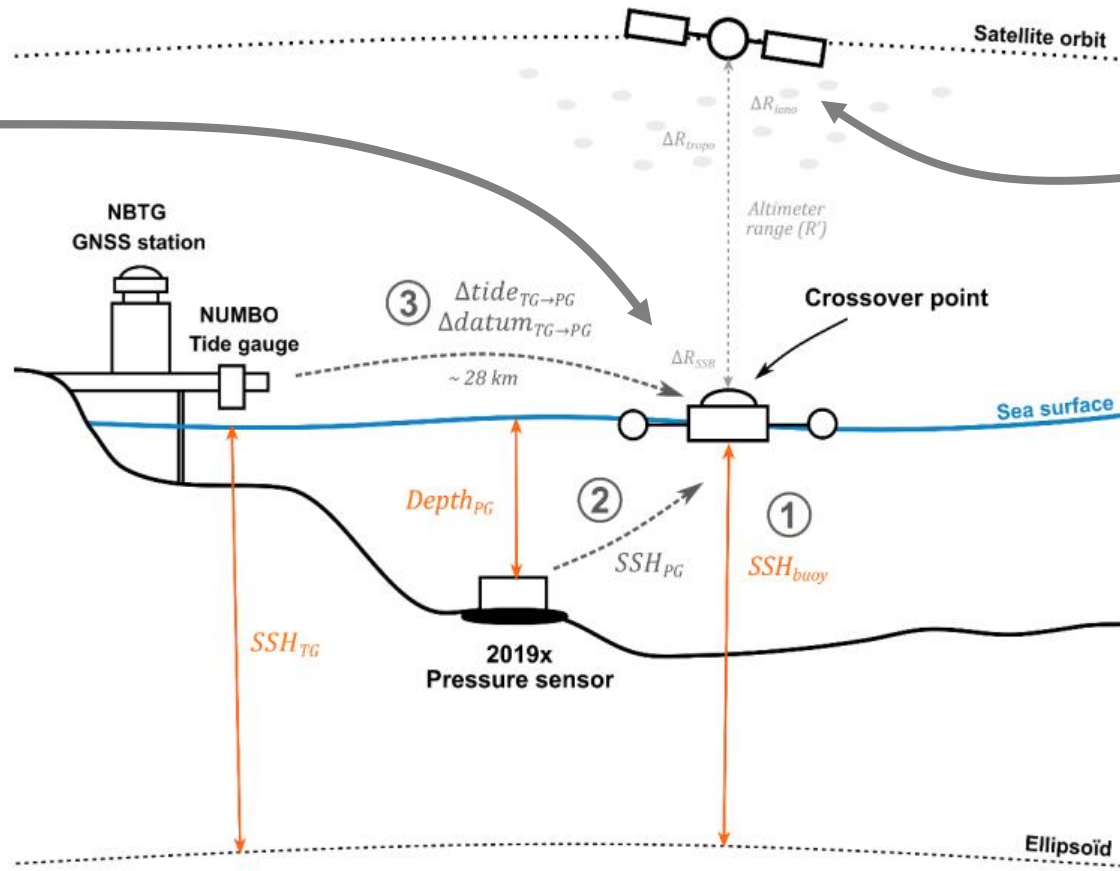
Compare altimetry and *in situ* data following standards made for dedicated Cal/Val studies



Reconstruction of a long term virtual *in situ* sea level time series under altimetry tracks



Dedicated processing of long-track altimetry data



- ⇒ Direct SSH from the GNSS buoy at the crossover during 3 days
- ⇒ Referencing pressure sensor by comparing with GNSS buoy data over the common observation period
- ⇒ Transferred Noumea tide gauge observations by computing a tidal and datum correction using pressure gauge observations

- ⇒ 20Hz along-track products
- ⇒ Cal/Val sites standards for altimetric corrections
- ⇒ Test of several wet tropospheric delays (radiometer, GNSS, ECMWF model)
- ⇒ Validation of XGM2019 gravity field model using CalNaGeo survey

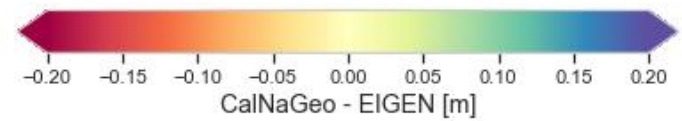
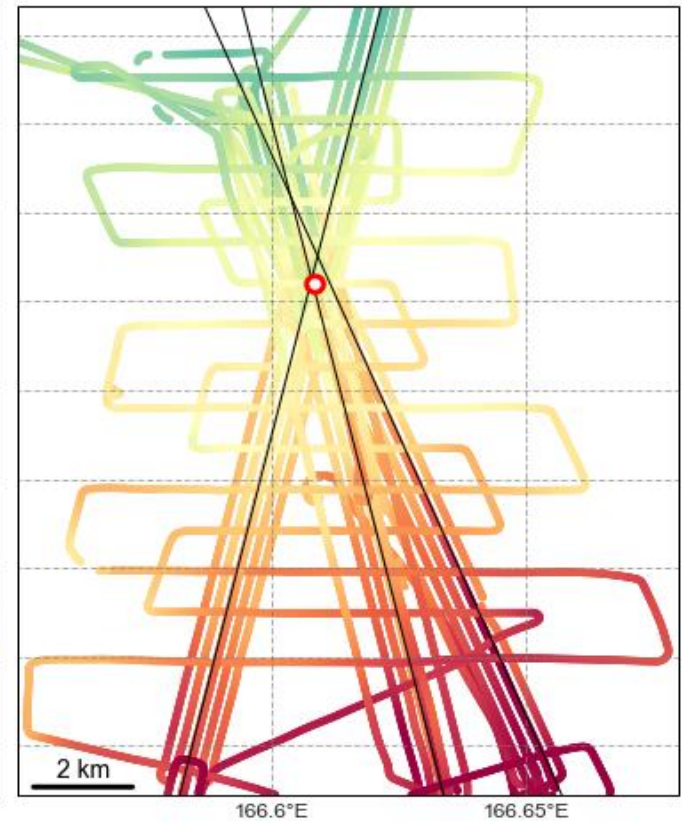
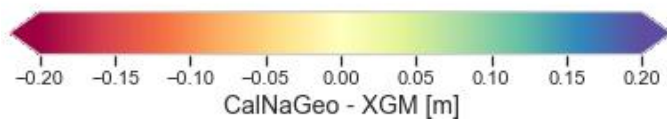
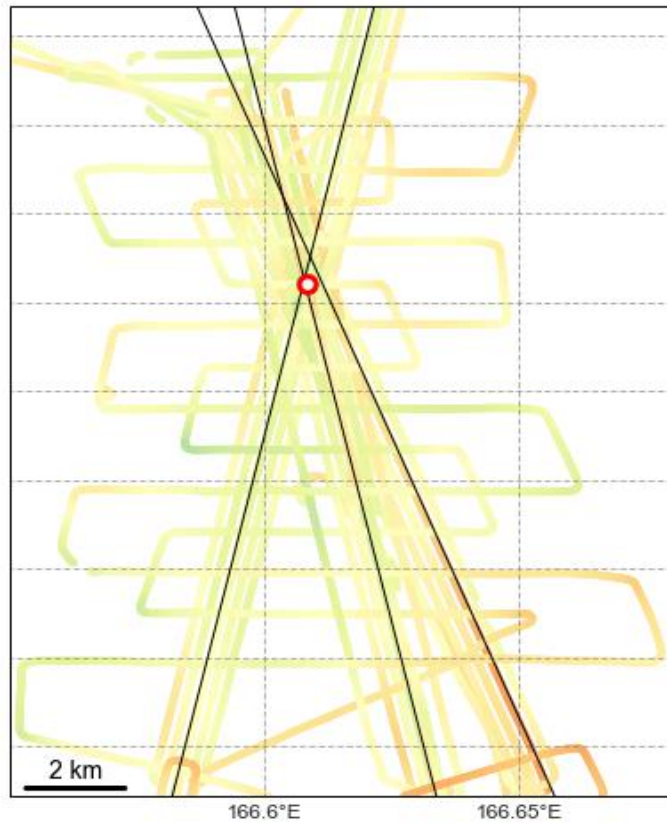
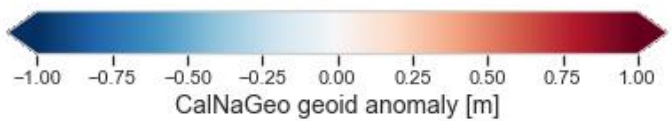
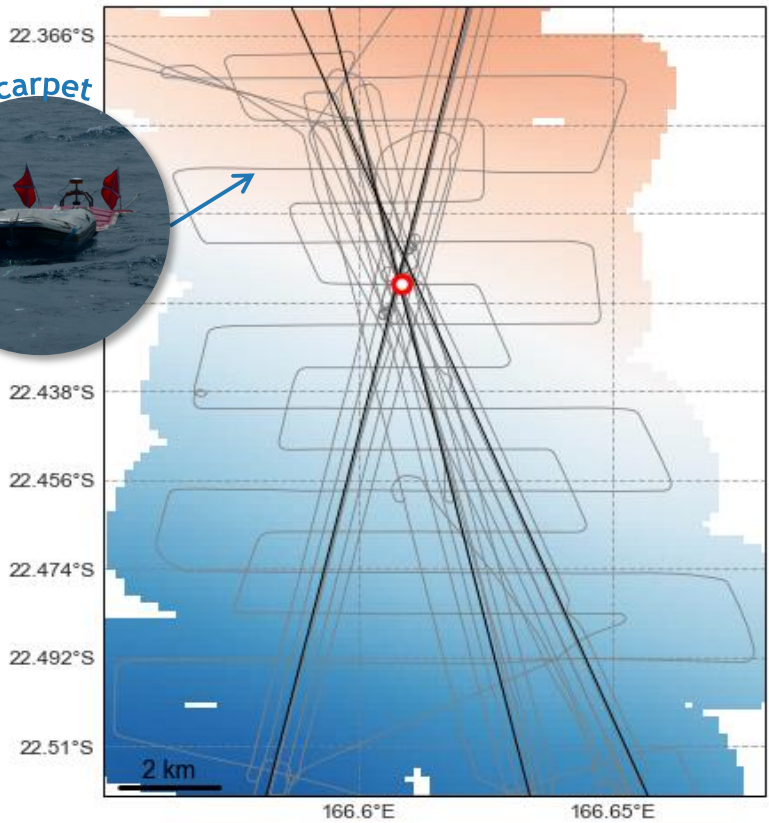


# Dedicated processing of along-track altimetry data

## Objective

Analyze the performance of different models to estimate geoid gradients

CalNaGeo carpet





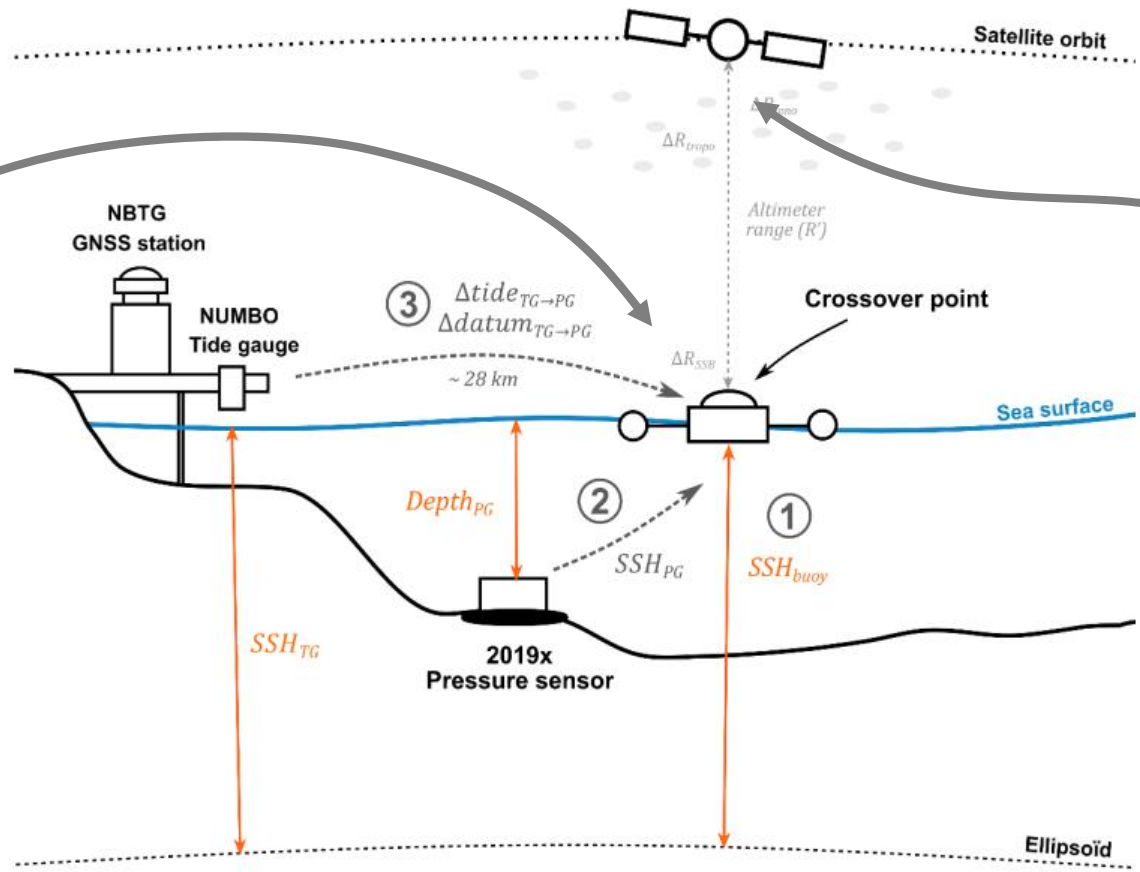


## Objective

Compare altimetry and *in situ* data following standards made for dedicated Cal/Val studies

Reconstruction of a long term virtual *in situ* sea level time series under altimetry tracks

Dedicated processing of along-track altimetry data



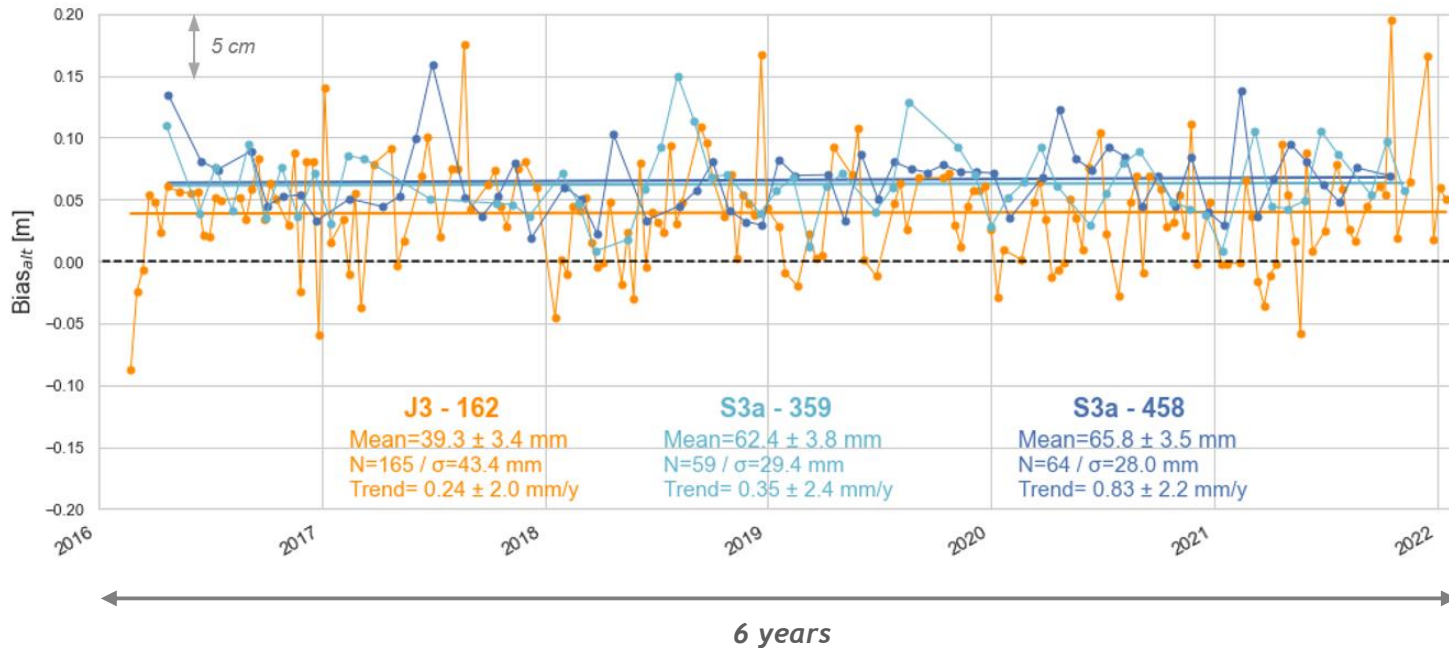


# Results - Altimetry bias in Noumea

## Objective

Compare altimetry and *in situ* data following standards made for dedicated Cal/Val studies

### Multi-mission comparison



Site	Sentinel 3a	Jason 3	Jason 2	Jason 1
<b>Nouméa</b>	+62.4 ± 3.8 mm (#359)	39.3 mm ± 3.4mm		
<i>Intermission</i>		-24.8 mm		
<b>Corsica*</b>	+17 ± 4 mm	-7 ± 3 mm		
<i>Intermission</i>		-24 mm		
<b>Bass Strait*</b>	+24.4 ± 2.0 mm	-6.7 ± 2.3 mm		
<i>Intermission</i>		-30 mm		
<b>Harvest*</b>	-	-12 mm ± 3 mm		
<i>Intermission</i>		-		

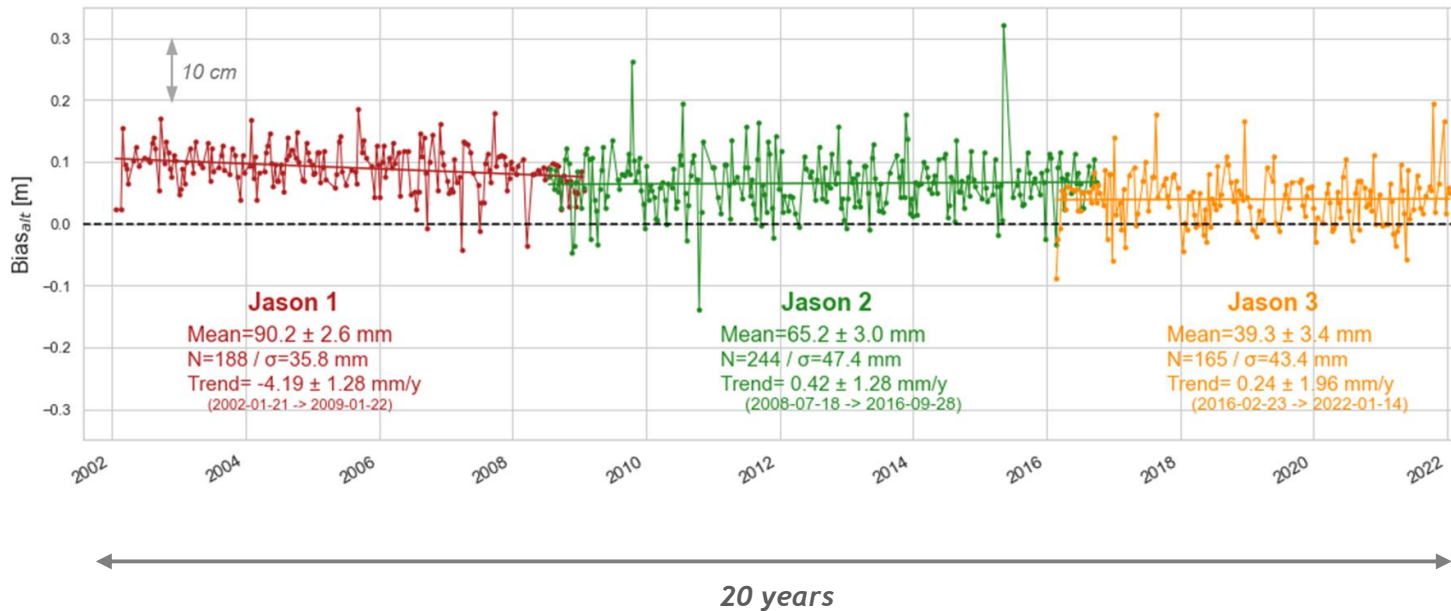
\* Altimetric mean biases from Harvest, Corsica and Bass Strait are extracted from the 2020 OSTST sessions and will be updated with the latest results



## Objective

Compare altimetry and *in situ* data following standards made for dedicated Cal/Val studies

### Long-term comparison



Site	Sentinel 3a	Jason 3	Jason 2	Jason 1
<b>Nouméa</b>	+62.4 ± 3.8 mm (#359) +65.8 ± 3.5 mm (#458)	39.3 mm ± 3.4 mm	65.2 mm ± 3.0 mm	90.2 mm ± 2.6 mm
<i>Intermission</i>		-24.8 mm	+25.9 mm	+25.0 mm
<b>Corsica*</b>	+17 ± 4 mm	-7 ± 3 mm	+16 ± 2 mm	+43 ± 3 mm
<i>Intermission</i>		-24 mm	+ 23 mm	+ 27 mm
<b>Bass Strait*</b>	+24.4 ± 2.0 mm	-6.7 ± 2.3 mm	+18.8 ± 2.1 mm	+45.6 ± 2.2 mm
<i>Intermission</i>		-30 mm	+ 25.5 mm	+ 26.8 mm
<b>Harvest*</b>	-	-12 mm ± 3 mm	+5 ± 3 mm	+6 ± 2 mm
<i>Intermission</i>		-	+ 17 mm	+ 1 mm

\* Altimetric mean biases from Harvest, Corsica and Bass Strait are extracted from the 2020 OSTST sessions and will be updated with the latest results



# Conclusion

## Objective

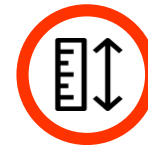
Compare altimetry and *in situ* data following standards made for dedicated Cal/Val studies

### Conclusion

- ⇒ Methodology to analyze 20 years of altimetry data in the Noumea Lagoon with a 3 weeks field campaign
- ⇒ Inter-mission biases consistent with historical Cal/Val sites

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### What's next ?



Consolidate the vertical datum and better constrain the absolute bias estimate

- ⇒ Improve GNSS processing (processing parameters, reference system changes, ...)



Extend the altimetric comparison with TOPEX/Poseidon and Sentinel 6 observations

- ⇒ Compare the long term trend with GNSS vertical movements and reconcile altimetry/tide gauge/GNSS observations



Transpose the methodology to other area



# Thanks for your attention !

For more details about our study :

Chupin, C., Ballu, V., Testut, L., Tranchant, Y-T., Aucan, J. : Potential of the Noumea Lagoon as a multi-mission Cal/Val site for past and future altimetry missions, Ocean Science, Preprint, <https://doi.org/10.5194/egusphere-2022-514> , 2022

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