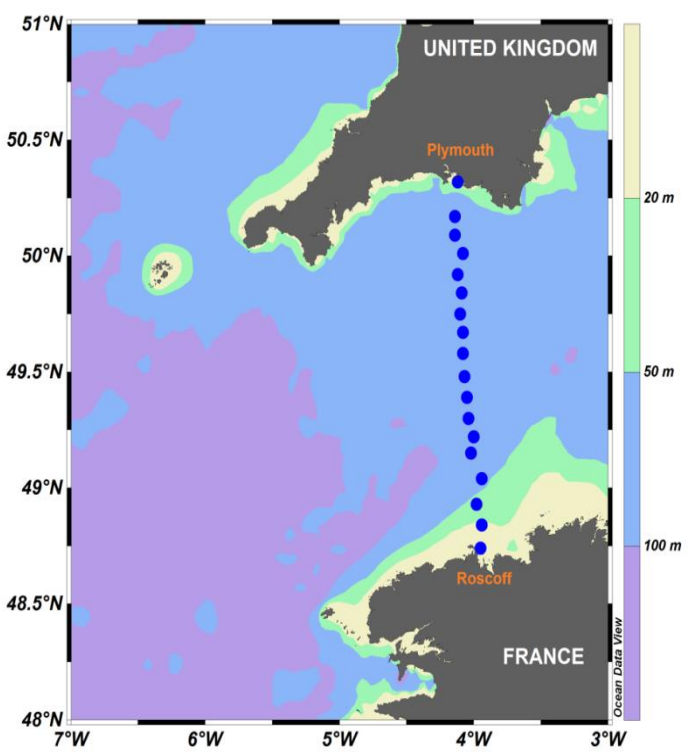
Contros HydroC CO_2/FT calibration using in-situ pCO_2 (DIC/TA) data from FB2014 (ROS-PLY) crossings

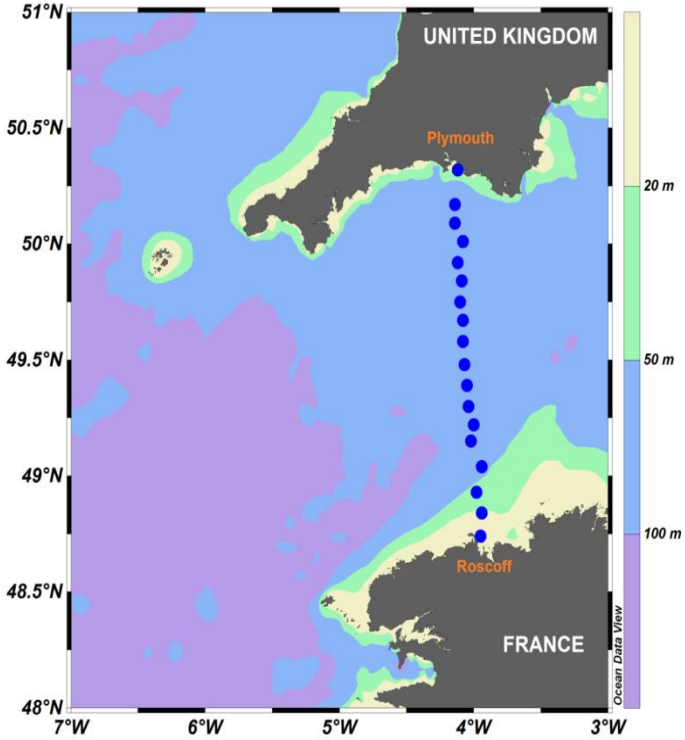
The Contros HydroC CO_2/FT deployment in 2014

- Sensor deployed from the 18/03/2014 to the 9/10/2014 on the Armorique FerryBox.
- 333 crossings with pCO_2 data acquisition.
- 2200 hours of data acquisition every minutes.
- Sensor calibrated by the Contros technical team in February 2014 (2000 €)



The Contros HydroC CO_2/FT deployment in 2014

- 8 monthly crossings between Roscoff and Plymouth.
- 18 DIC and TA samples during each crossings.
- pCO_2 calculated from DIC and TA measurements.
- The error associated to pCO_2 calculation from DIC and TA is around 5,8 µatm (Zeebe and Wolf-Gladrow, 2001).

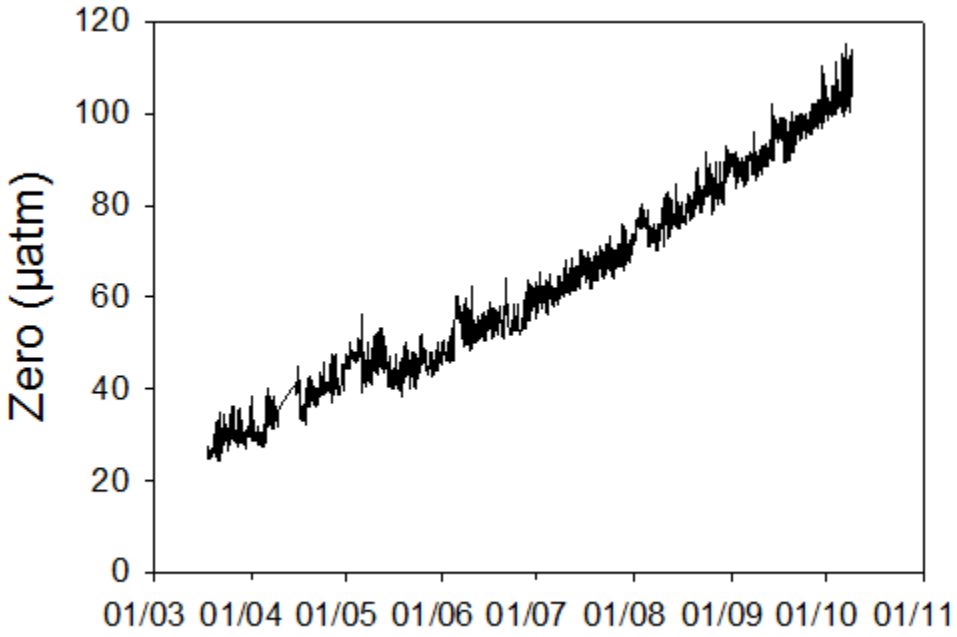


Zero

- During zero intervals, a zero CO_2 gas is created (through a soda lime cartridge) and the sensor provides the current zero reading used later for drift correction.

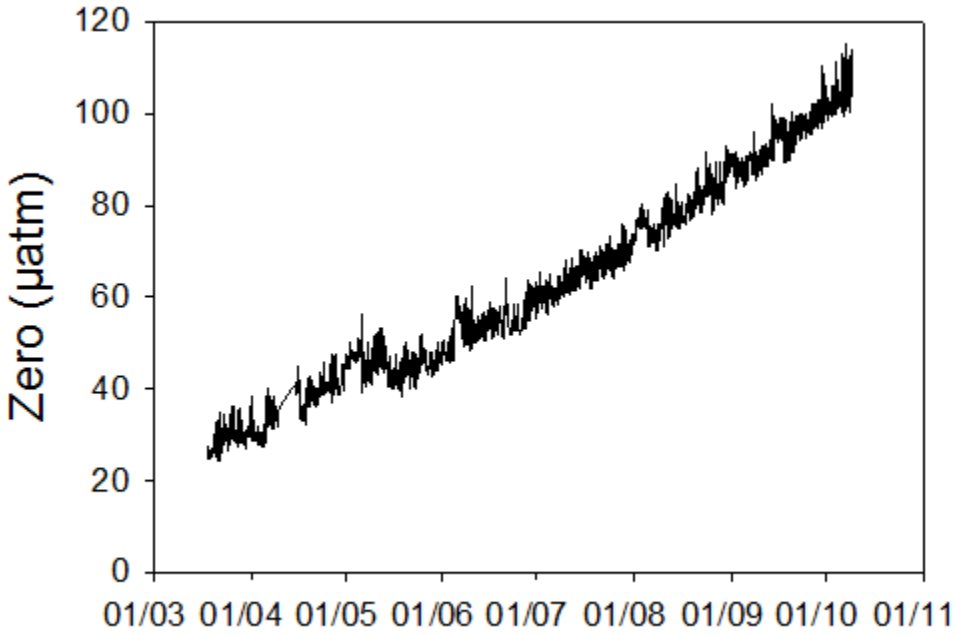
- On our FerryBox: 1 zero every 6h, during 2 min.

- Followed by flush intervals (during 2 min); used to flag data acquired during the signal recovery from the zero value to the ambient pCO_2 reading.
- But the signal recovery last at least 10-15 minutes.



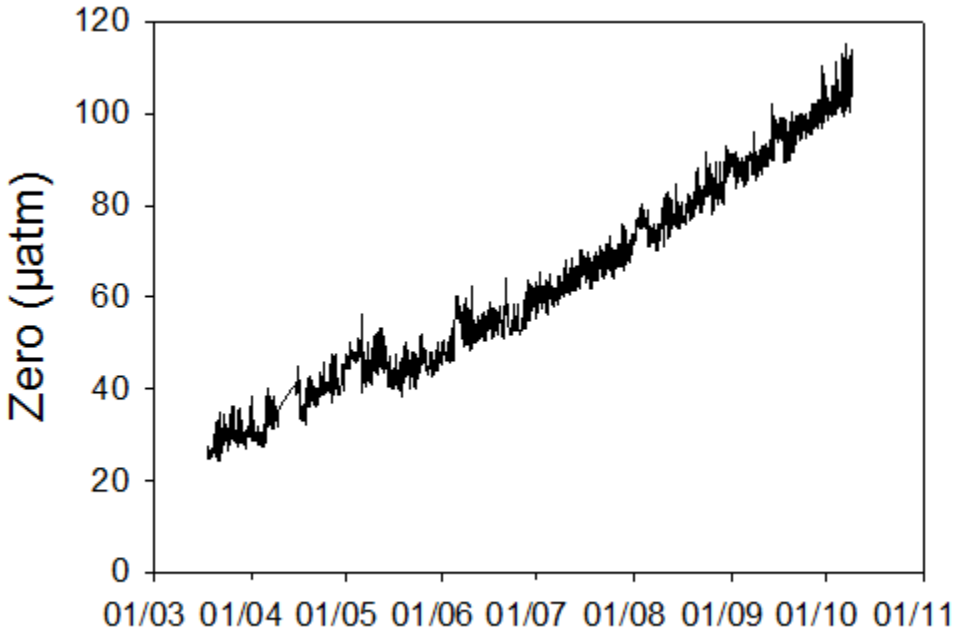
Zero

- Recommendations:
  - We now have the possibility to perform the zeroing when the ferry arrive in a harbour and when the FerryBox stop. Avoid loosing pCO_2 data during crossings.
  - A longer zero intervals (5 min).



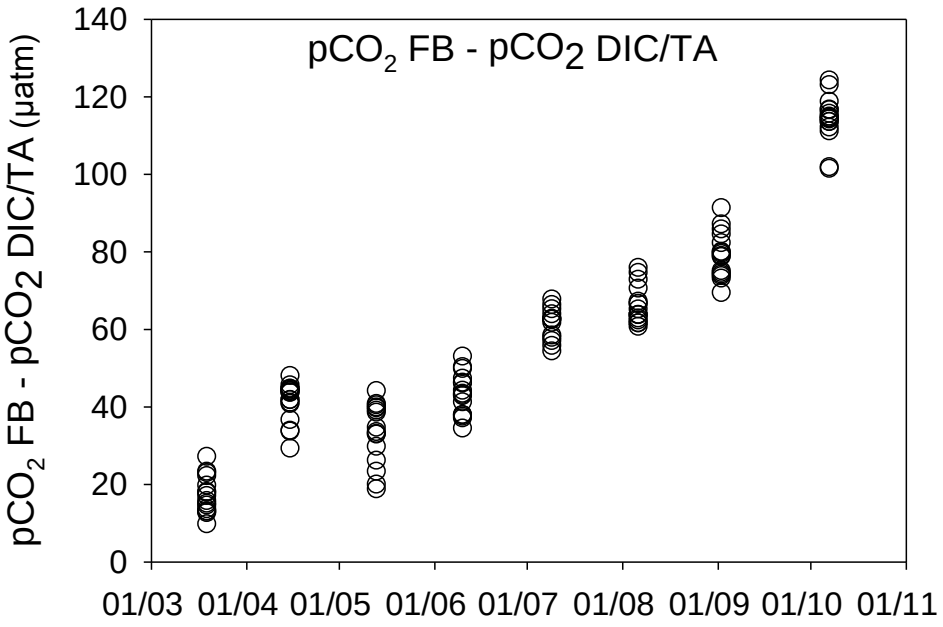
Zero

- Remarks:
  - When the ferry leaves the harbour and when the FerryBox starts, the signal recovery from the pCO_2 values during the washing cycle of the FB (acid cleaning and then high pCO_2 values (> 2000 µatm)) to the ambient pCO_2 readings is long (≈ 20 min).



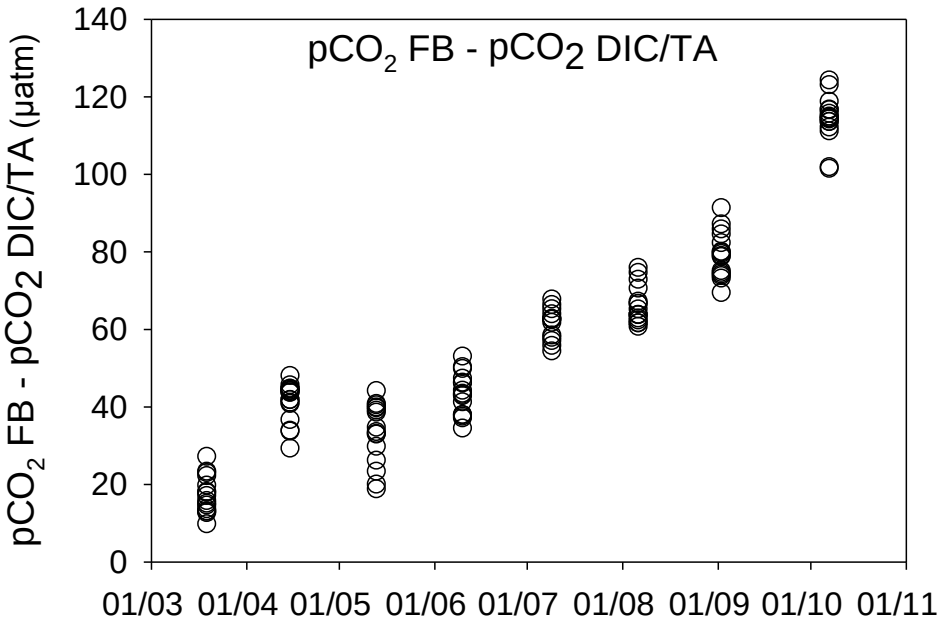
Comparison between pCO_2 FB & pCO_2 DIC/TA

- 18 DIC/TA sampling for each crossing
- But only 16 comparison between pCO_2 FB and pCO_2 DIC/TA due the signal recovery after the washing cycle in the harbour.
- Generally 1 pCO_2 DIC/TA wrong per crossing due to bad sampling or technical issue during the analysis.



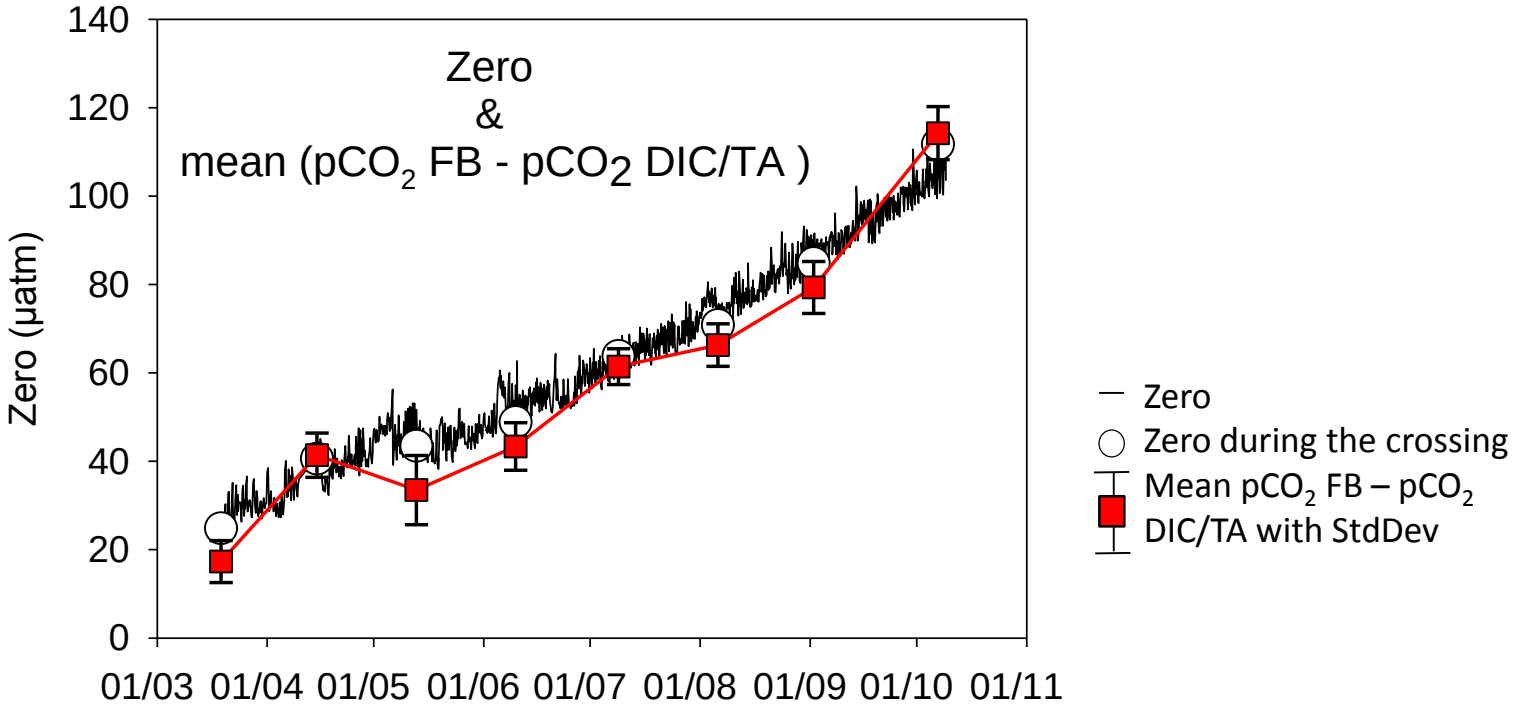
Comparison between pCO_2 FB & pCO_2 DIC/TA

- An important temporal drift between the rough pCO2 FB data and pCO2 DIC/TA.
- ≈ 100 µatm in 8 months
- Not linear



Comparison between pCO_2 FB, pCO_2 DIC/TA & zero

- Some similarities between the zero and the pCO_2 FB – pCO_2 DIC/TA temporal drifts.
- But the pCO_2 FB – pCO_2 DIC/TA and the zero signals don't follow exactelly the same trend.

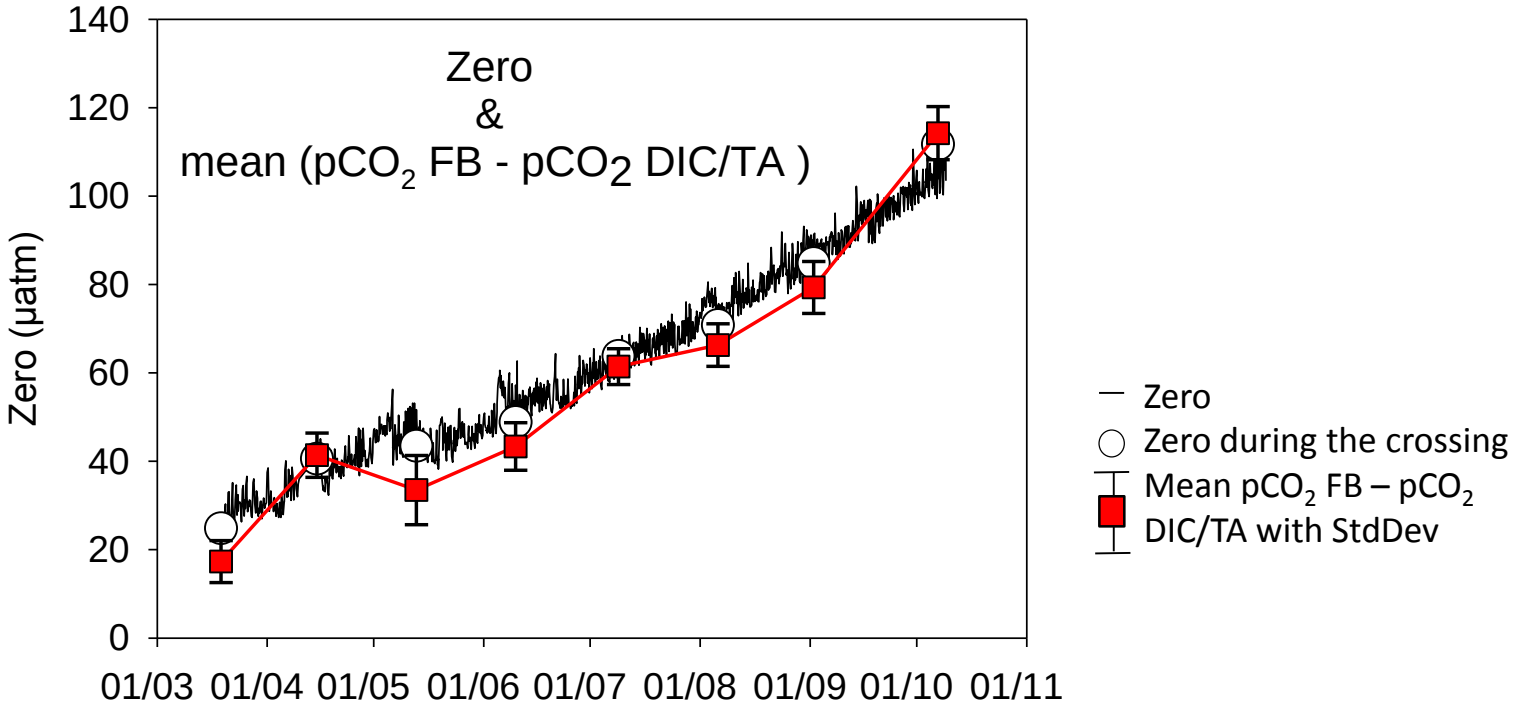


First corrections on the pCO_2 FB signal

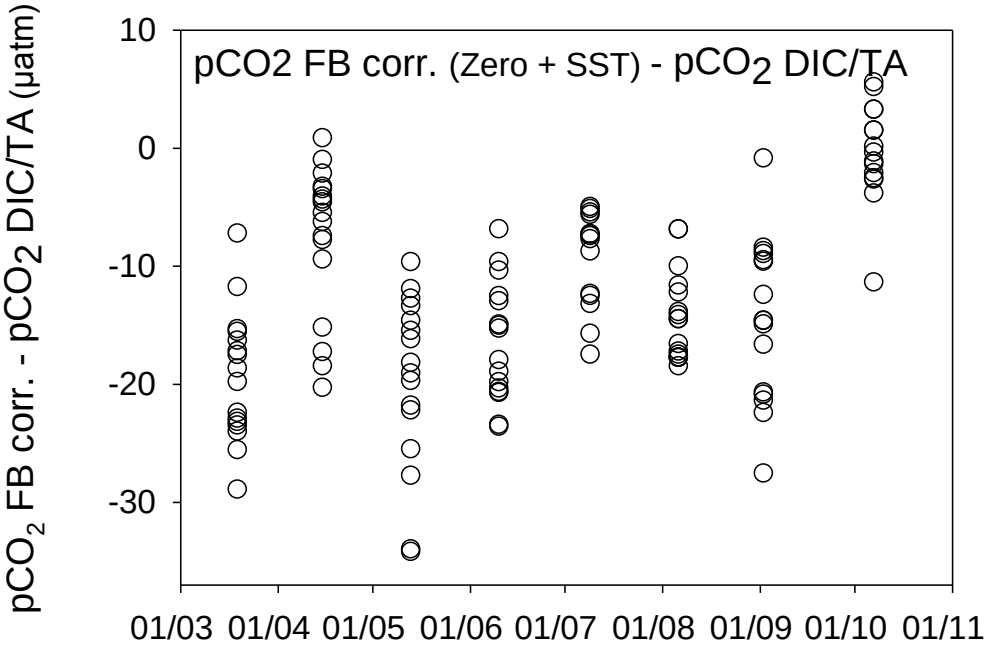
- In a first time, correction of the pCO_2 FB signal by the zero signal on all the high-frequency data.

- In the FB the temperature (tmpSBE45) is ≈ 0,5°C warmer than the real SST.
- pCO_2 DIC/TA calculated at the real SST (tmpSBE38).
- And correction of the pCO_2 signal at the in-situ SST (tmpSBE38 – tmpSBE45).

  → $pCO_{2,SBE38} = pCO_{2,SBE45}$ x exp (0,0423 x (tmpSBE38 – tmpSBE45))

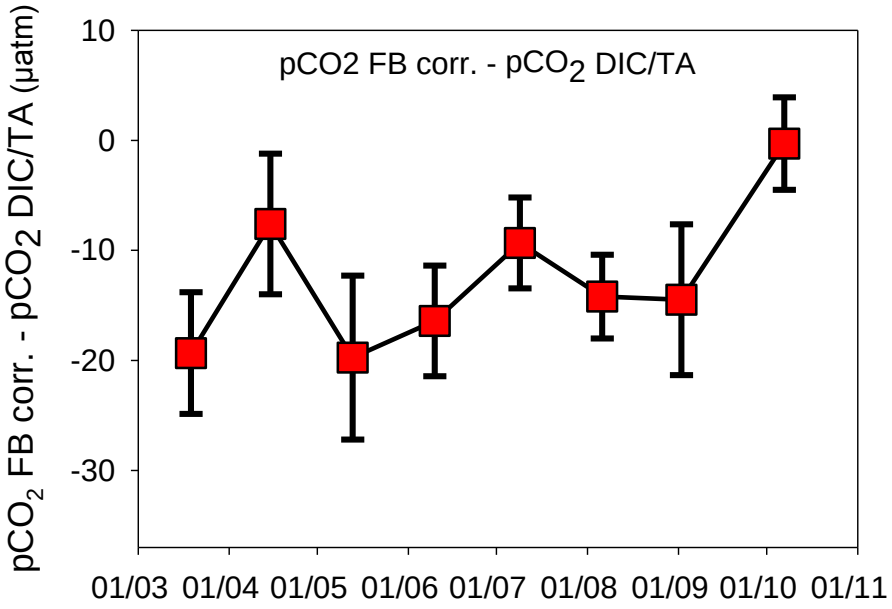


Comparison between pCO_2 FB corr. & pCO_2 DIC/TA



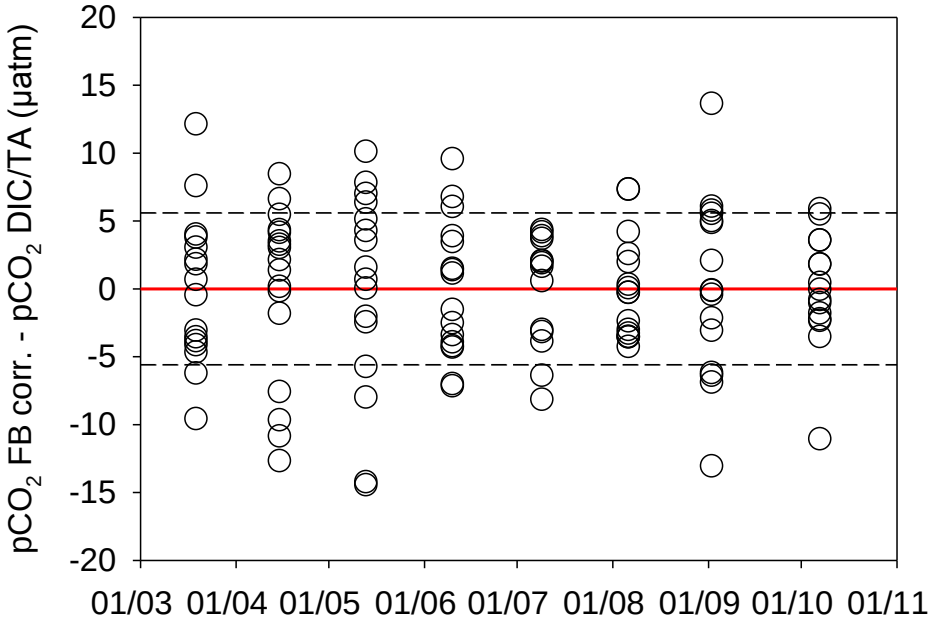
- pCO_2 FB corrected from the zero signal and with the temperature difference.

- Second correction on high-frequency pCO_2 FB data:
  - To take into account the difference between pCO_2 FB corr. nd pCO_2 DIC/TA with linear interpolation between each crossing.

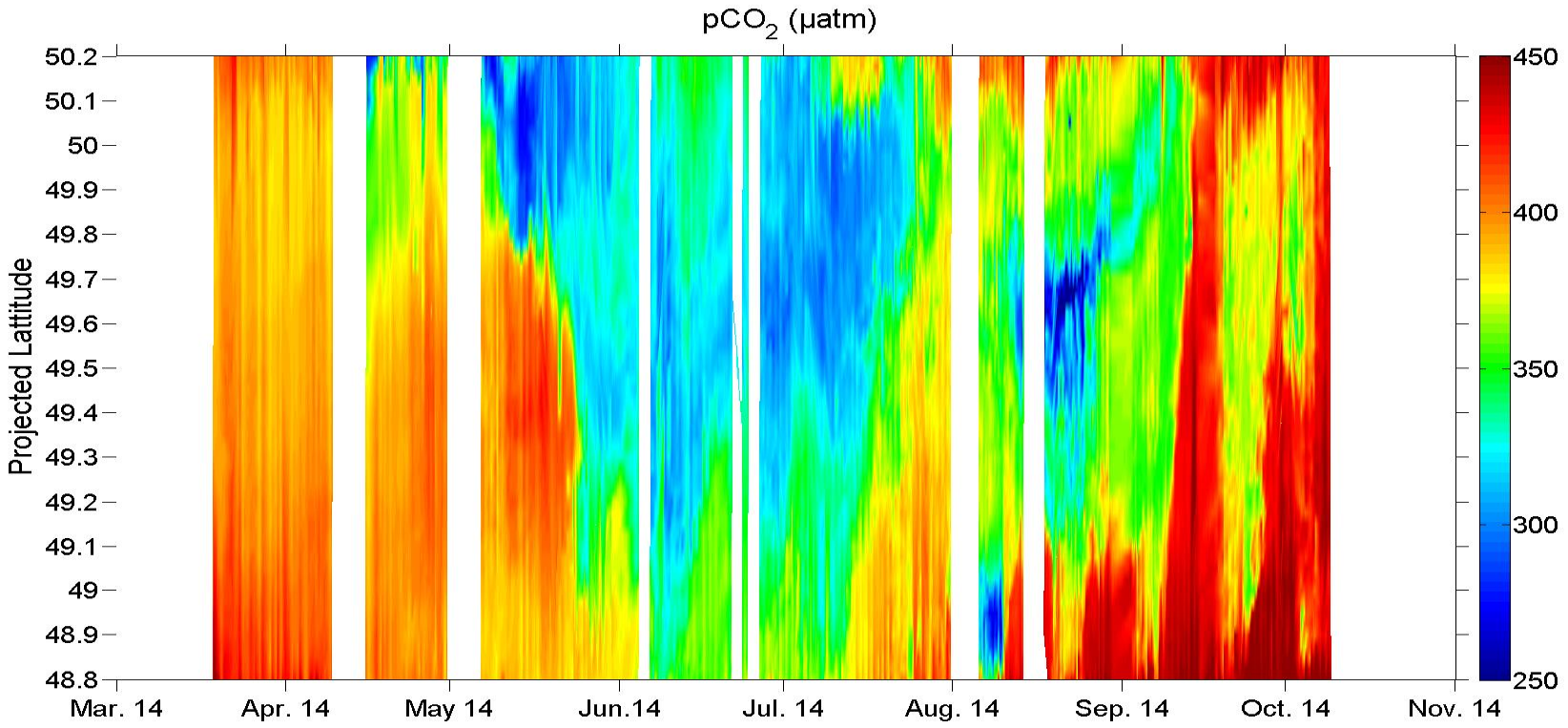


Results of the *in-situ* calibration

- The difference between pCO2 FB and pCO2 DIC/TA is considered and all the residuals are homogeneously distributed around 0.
- The error associated to pCO_2 calculation from DIC and TA is around 5,8 µatm (Zeebe and Wolf-Gladrow, 2001).
- StdDev on these residuals of 5,5 µatm.
- Coherent results, application of the in-situ calibration on all the HF-FB pCO_2 data.

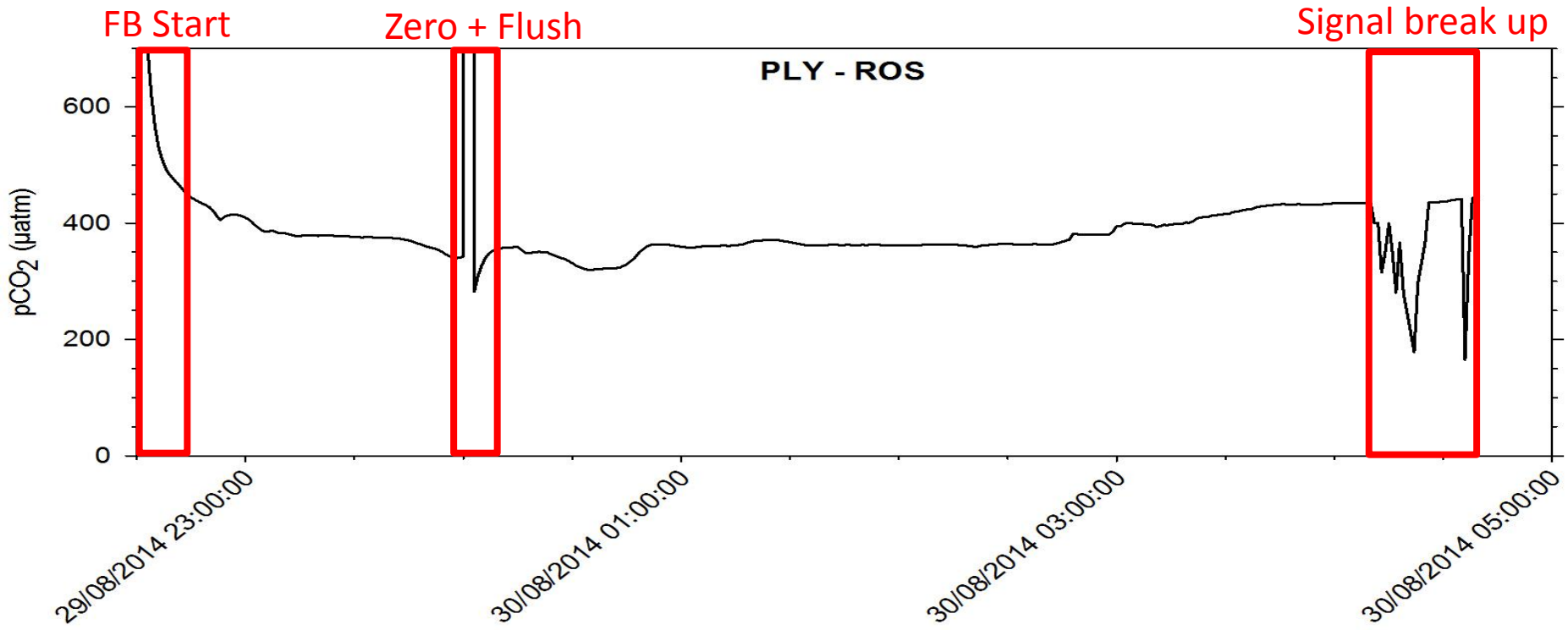


2014 Deployment



- Blanks = missing crossings due to technical issues on the FB.
- To obtain this quality, you must “clean” the dataset.

Post-processing



- "Cleaning" of the pCO_2 dataset (few days of post-processing, manually):
  - Remove all the zero and flush values
  - Remove the data when the pCO_2 signal break up
  - Remove the pCO_2 data at the start of the FB (first 20 min)