

Processing seafloor pressure data acquired during a large 2024 slow- slip-event offshore New Zealand

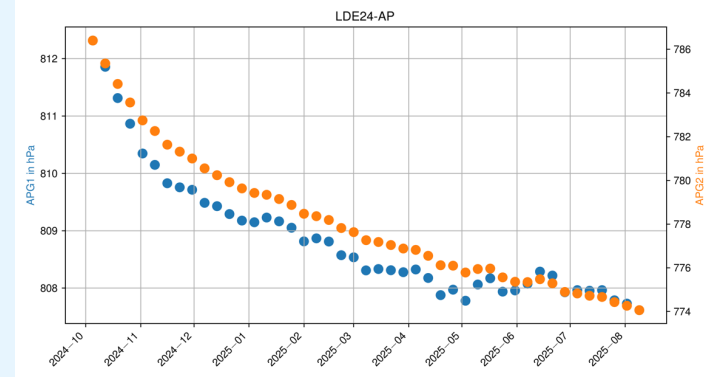
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1) GEOMAR 2) University of Rhode Island 3) University of Texas at Austin 4) Lamont-Doherty Earth
Observatory 5) Tohoku University 6) Kyoto University 7) Earth Sciences New Zealand

Pressure Processing

$$P = P_{\text{Tides}} + P_{\text{Non-tidal}} + P_{\text{Noise}} + P_{\text{Drift}} + P_{\text{Tectonic}}$$

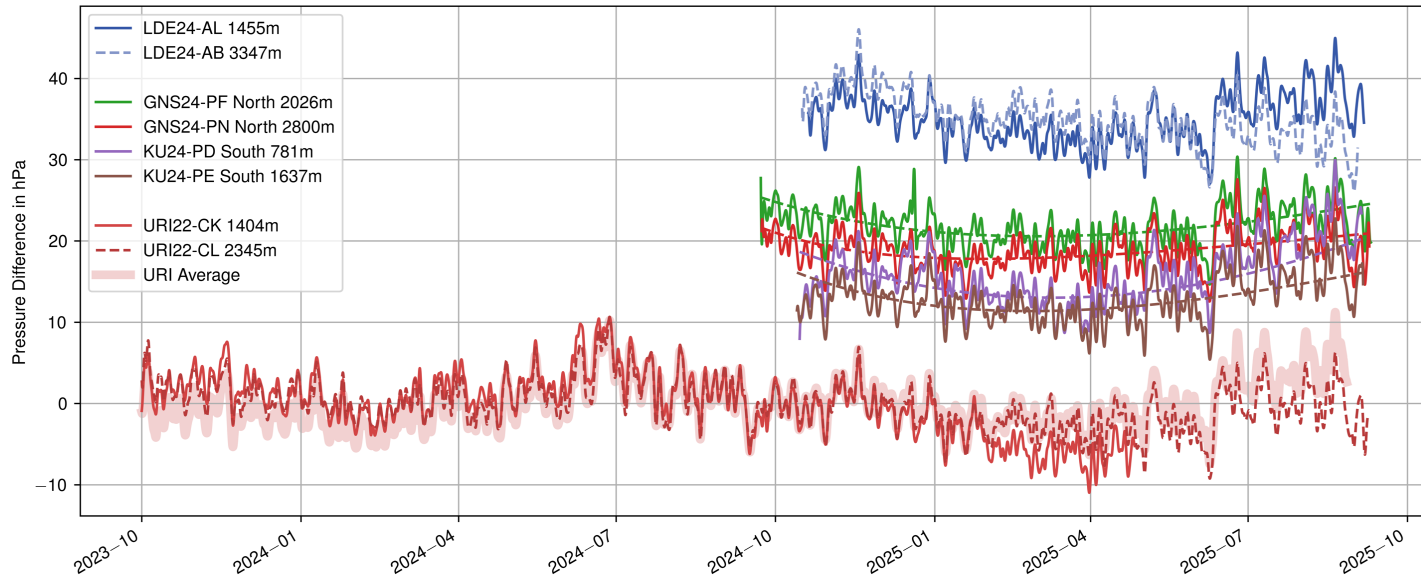
- 1) Detiding via a 48h LP filter
- 2) **Dedrifting the reference sites**
- 3) Depth-matched-differencing
- 4) Extract residual drift and slip



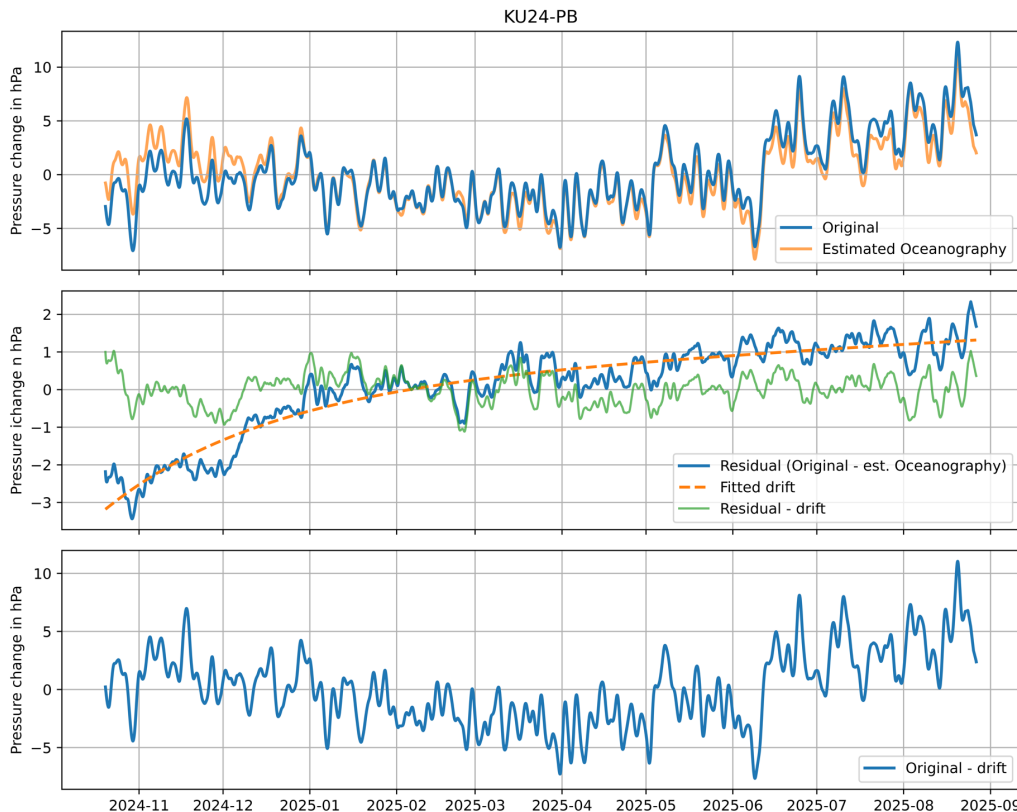
APG drift can be modelled by linear-exponential function

Dedrifting the reference sites – Motivation

Fitting a linear-exponential function to the raw data overfits to the oceanographic trend (traced by A-0-A and longer deployed C-PIES)

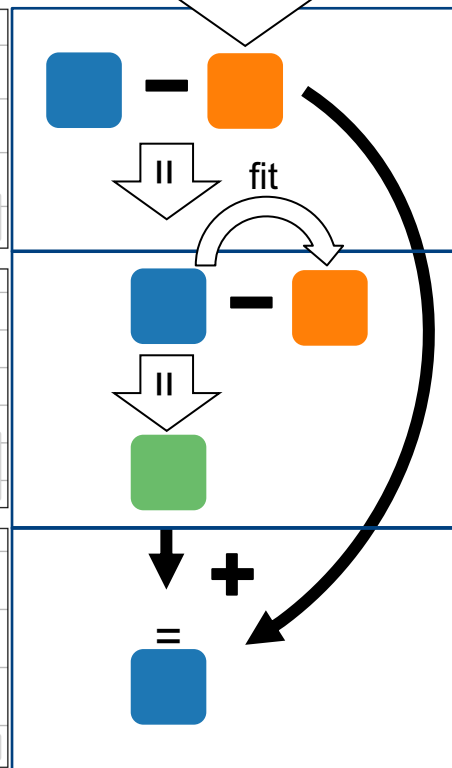


Dedrifting the reference sites



Non-drifting instruments

out-of-sample PCA



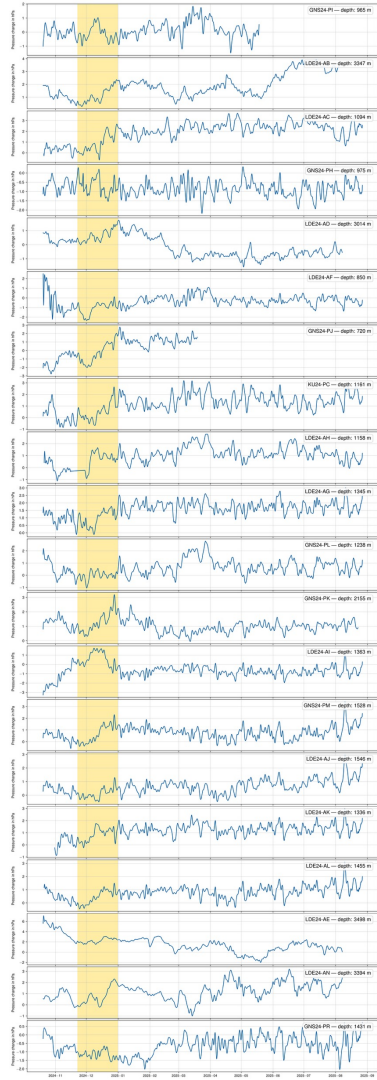
Removing the regional oceanography (from non-drifting instruments), fitting and removing the drift and restoring the oceanography

PCA on out-of-sample data

- $\Delta P_i(t) = o_i(t) + d_i(t) + s_i(t) + n_i(t)$
- Pressure at sensor i : local oceanography + instrument drift + slip + noise
- Assume local oceanography $o_i \approx O_i$ regional oceanography
- $O_i(t) = \sum_n C_n(t)$ Sum of first n principal components of “driftless” instruments
- $\hat{o}_i(t) = \sum_n \beta_{in} C_n(t)$ Transform drifting instruments into regional oceanography frame by estimating a factor $\beta_i = (O^T O)^{-1} O^T \Delta P_i(t)$ (minimizing $\|\Delta P_i(t) - \hat{o}_i(t)\|^2$)
- Subtract estimated local oceanography from ΔP_i and estimate slip

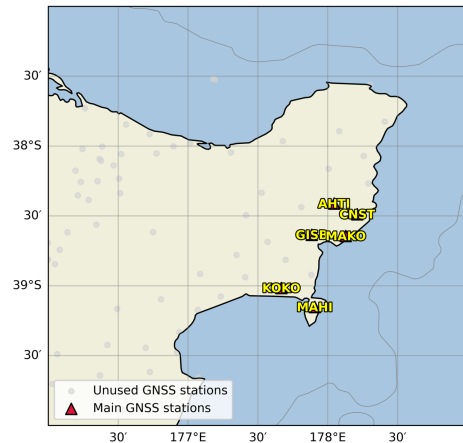
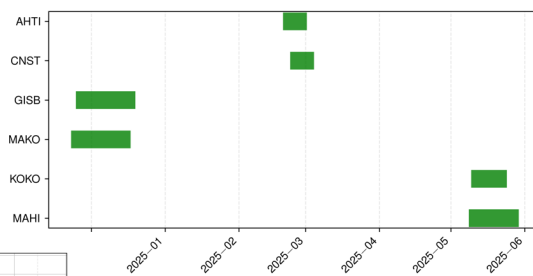
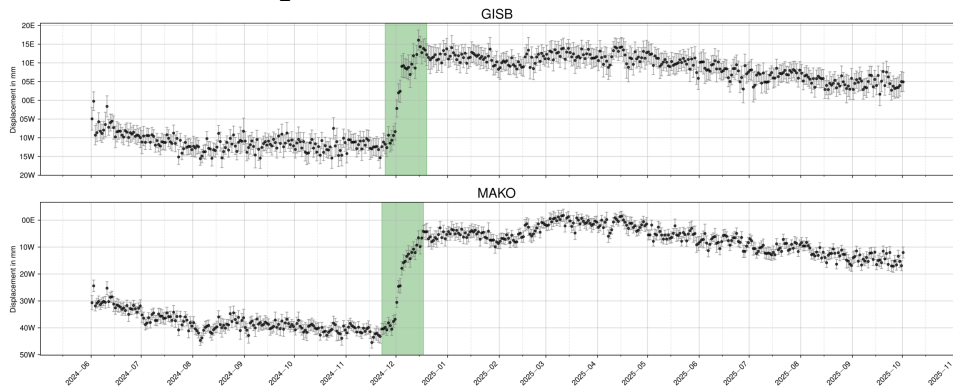
Dedrifting the reference sites



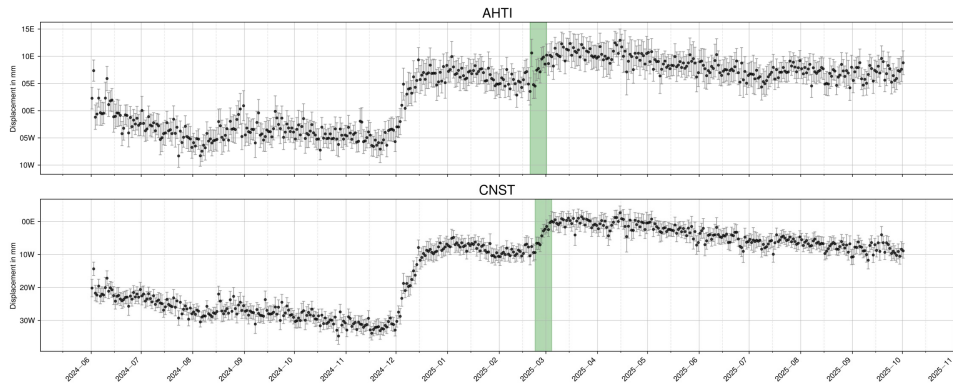


GNSS event timing

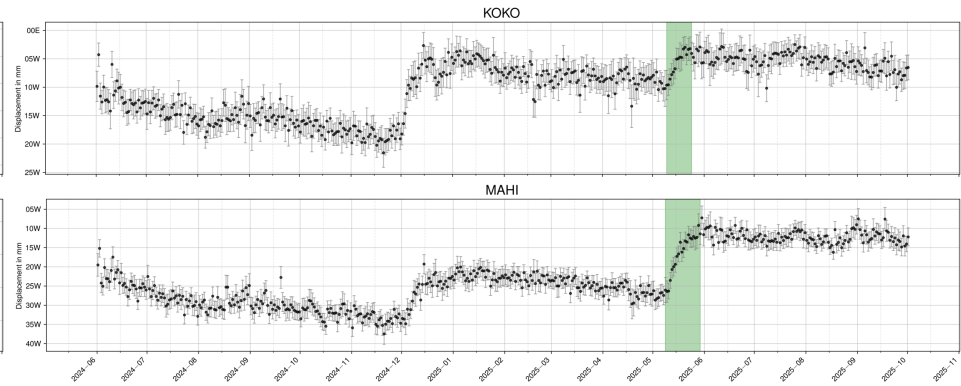
Main array



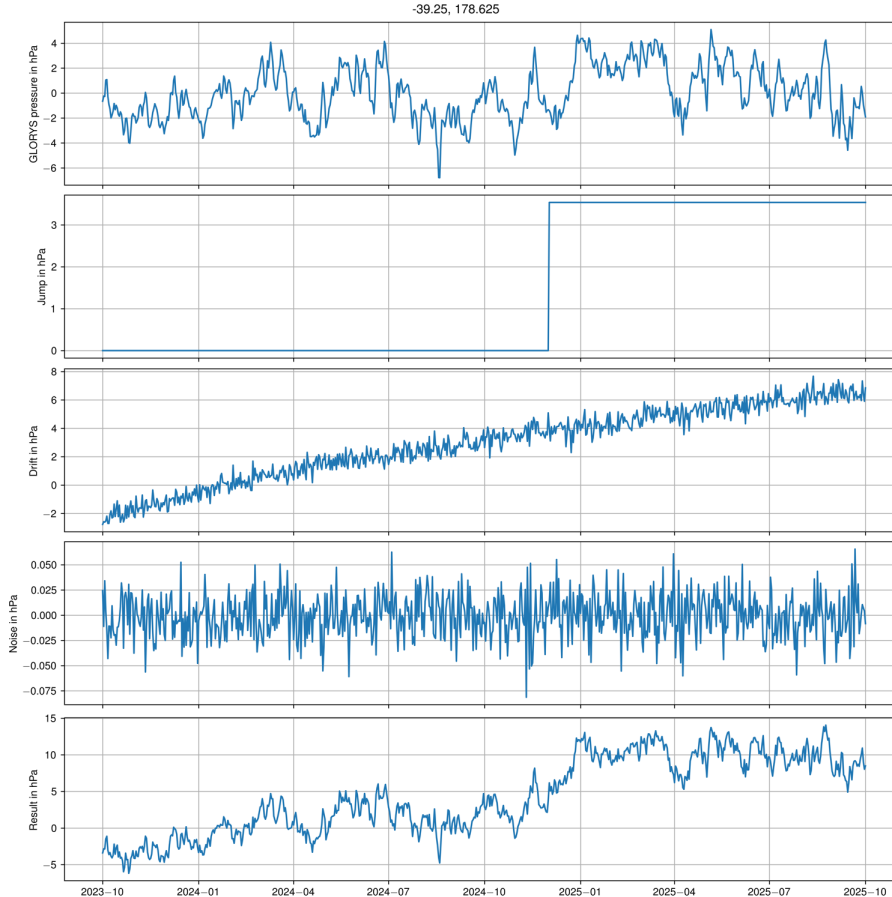
North event:



South event:



Building synthetic timeseries



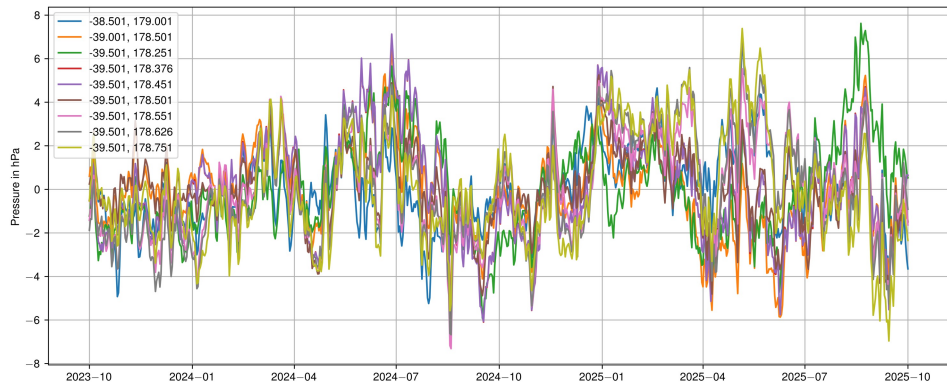
GLORYS (oceanographic model) derived bottom pressure
+ Vertical step (SSE)

+Drift (variable between stations)

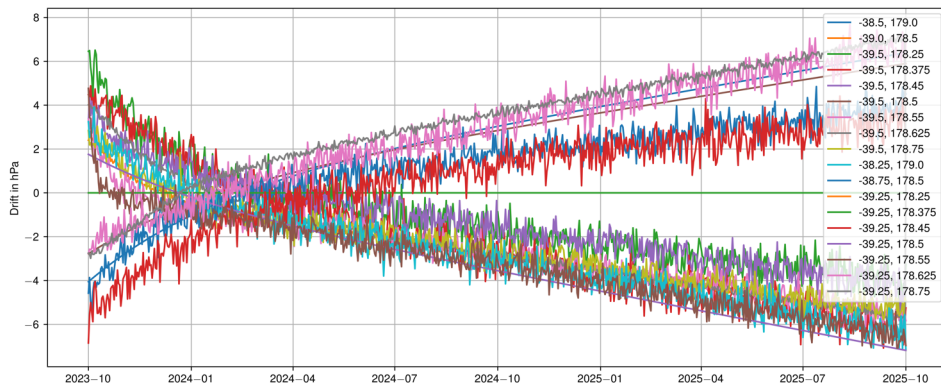
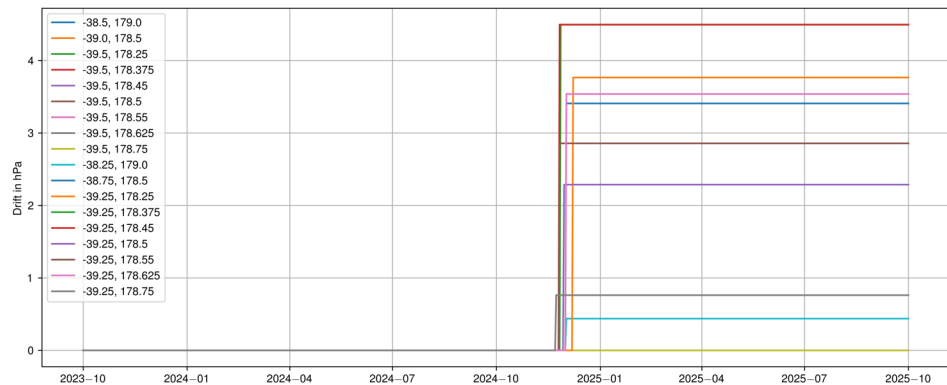
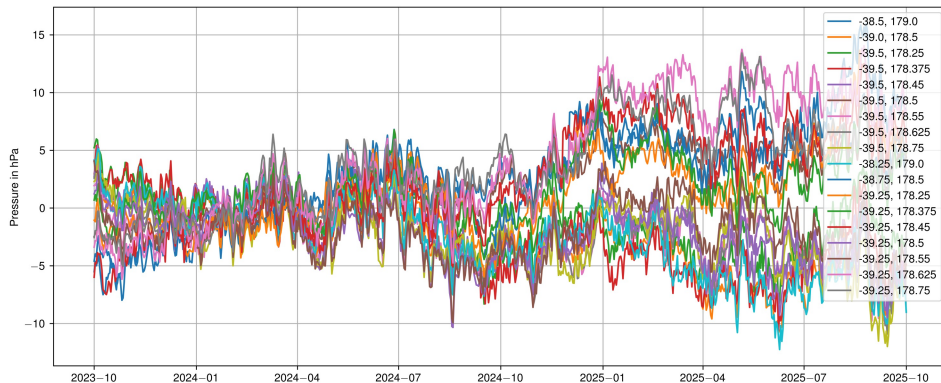
+Noise

= synthetic timeseries

No drift – simulating A-0-A



& Full timeseries



Synthetic data:

