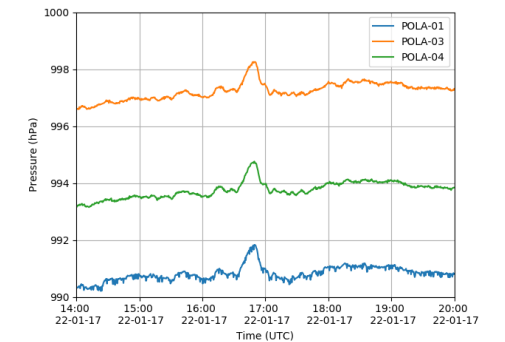
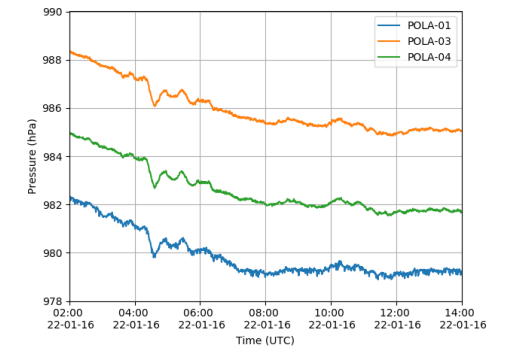
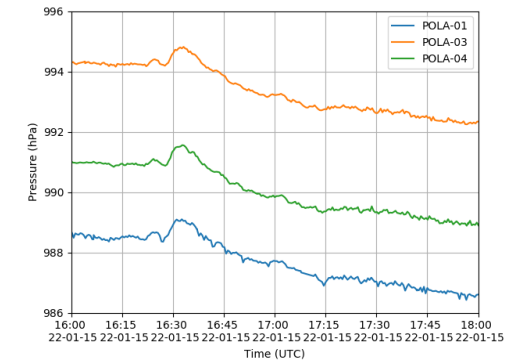
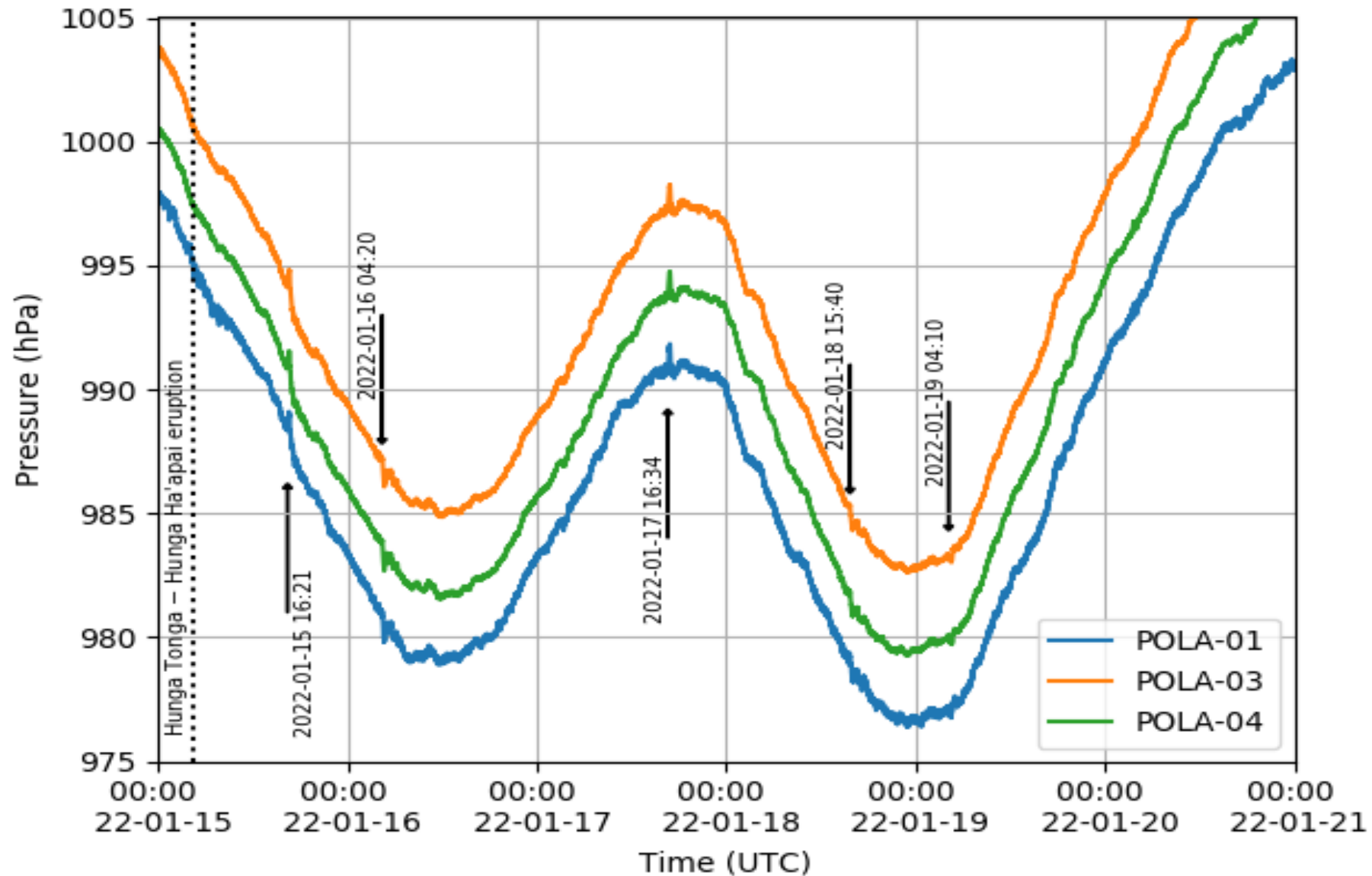


Detection of Rayleigh-Lamb waves generated by the 2022 Hunga-Tonga volcanic eruption with the POLA detectors at Ny-Alesund

Nicola Mazziotta and Marcello Abbrescia

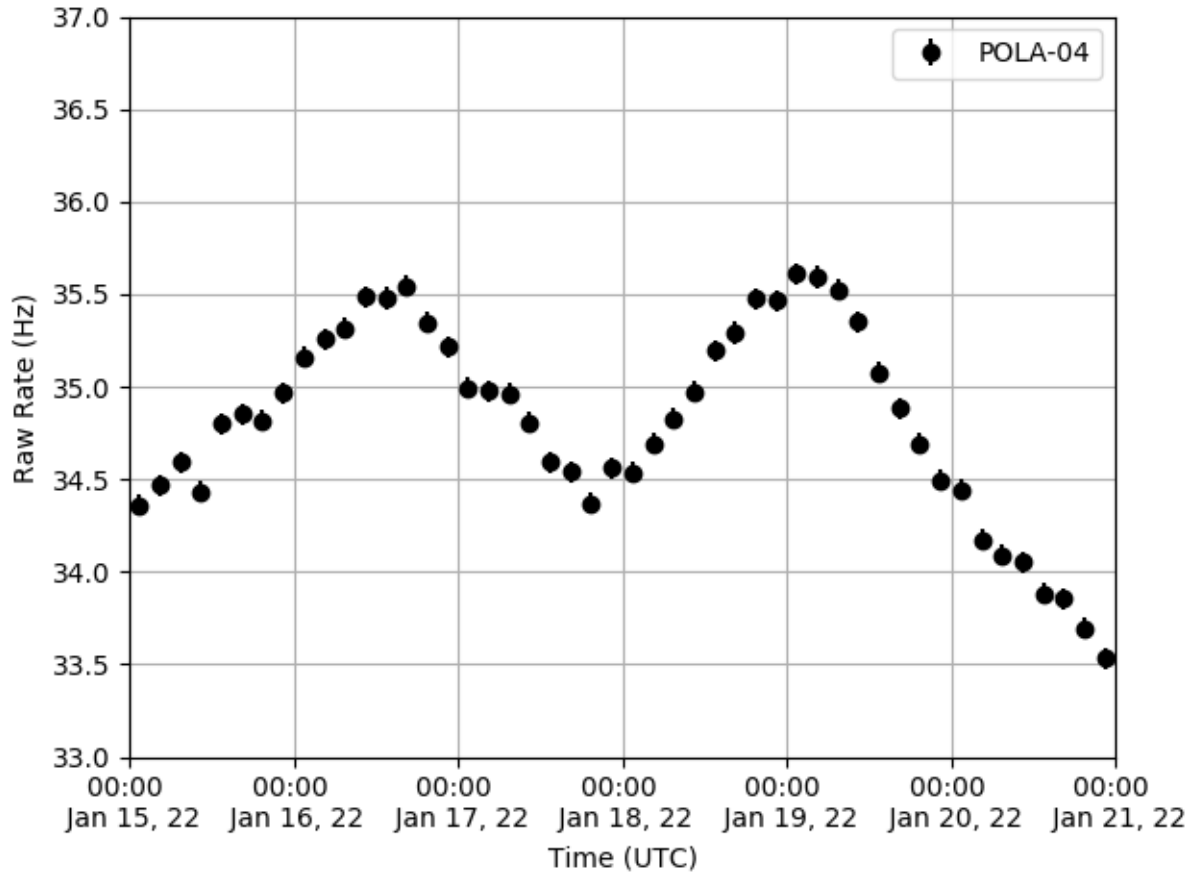
Apr 6, 2022

Real time pressure as a function of time

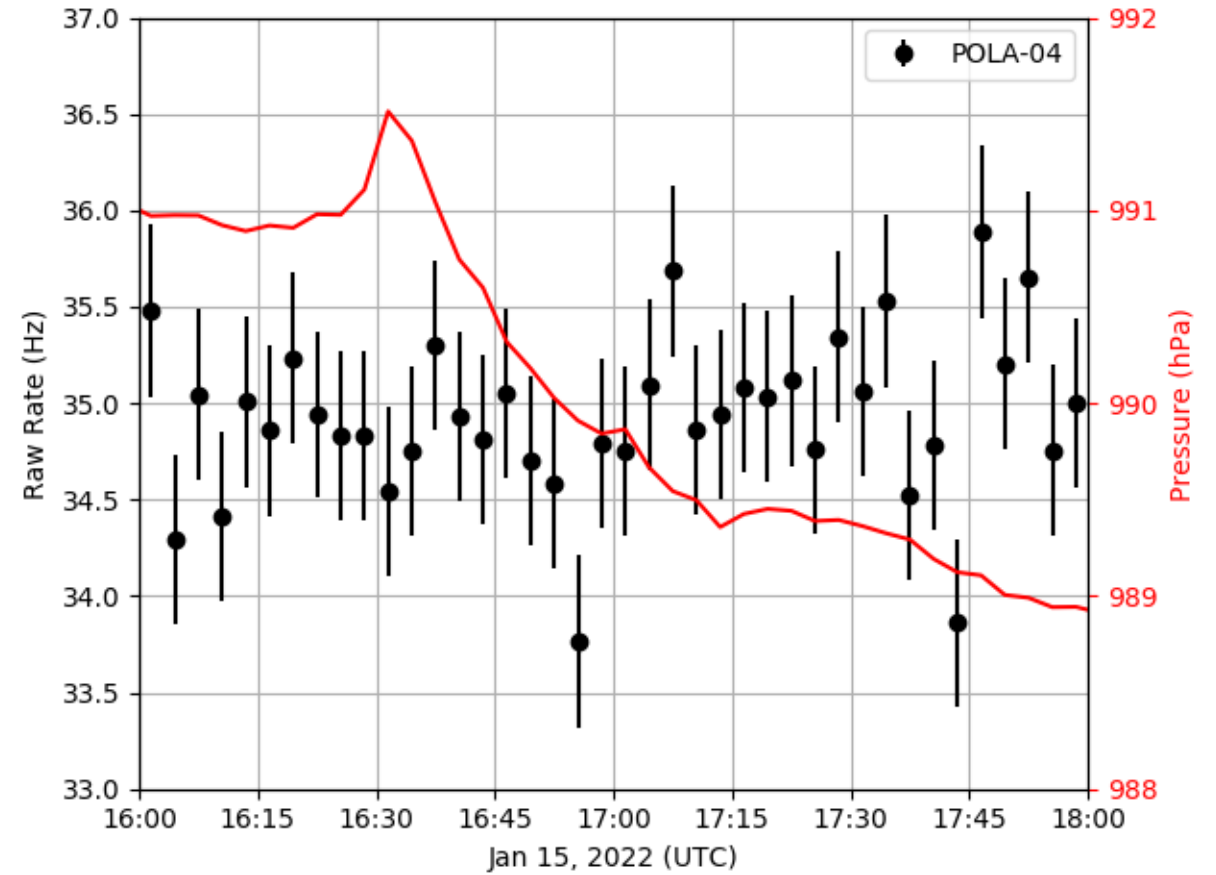


POLA-04 Rate

3-hour time bin



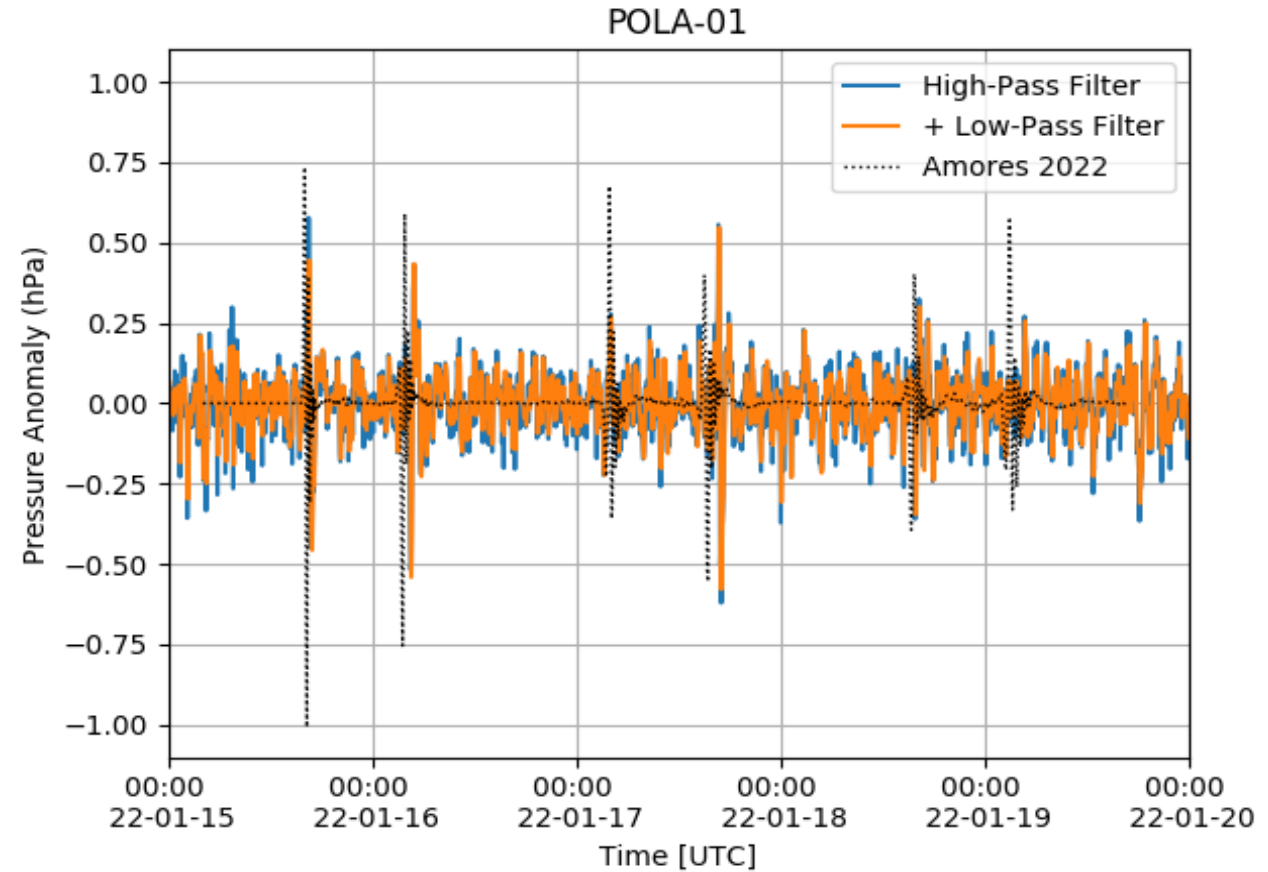
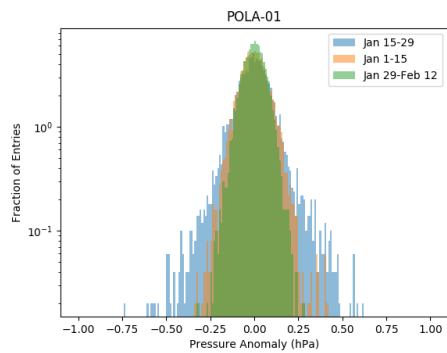
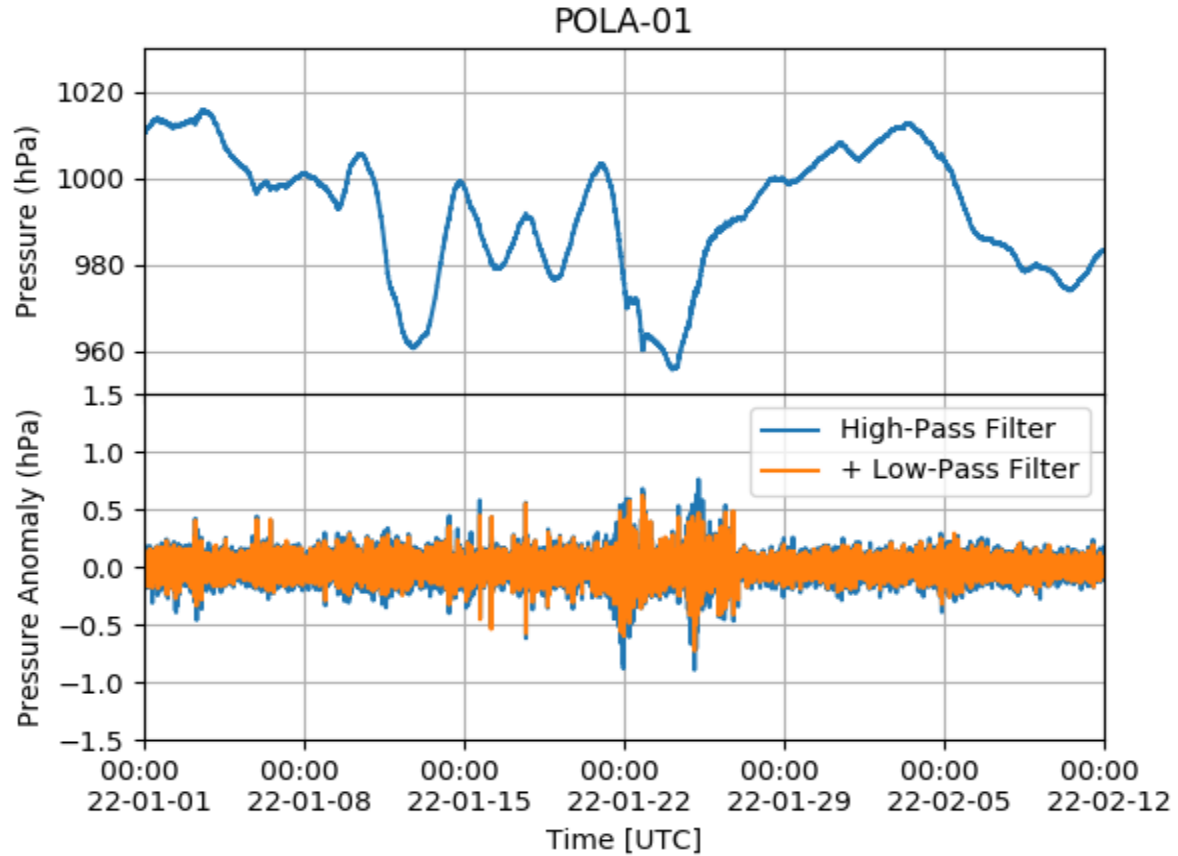
3-min time bin



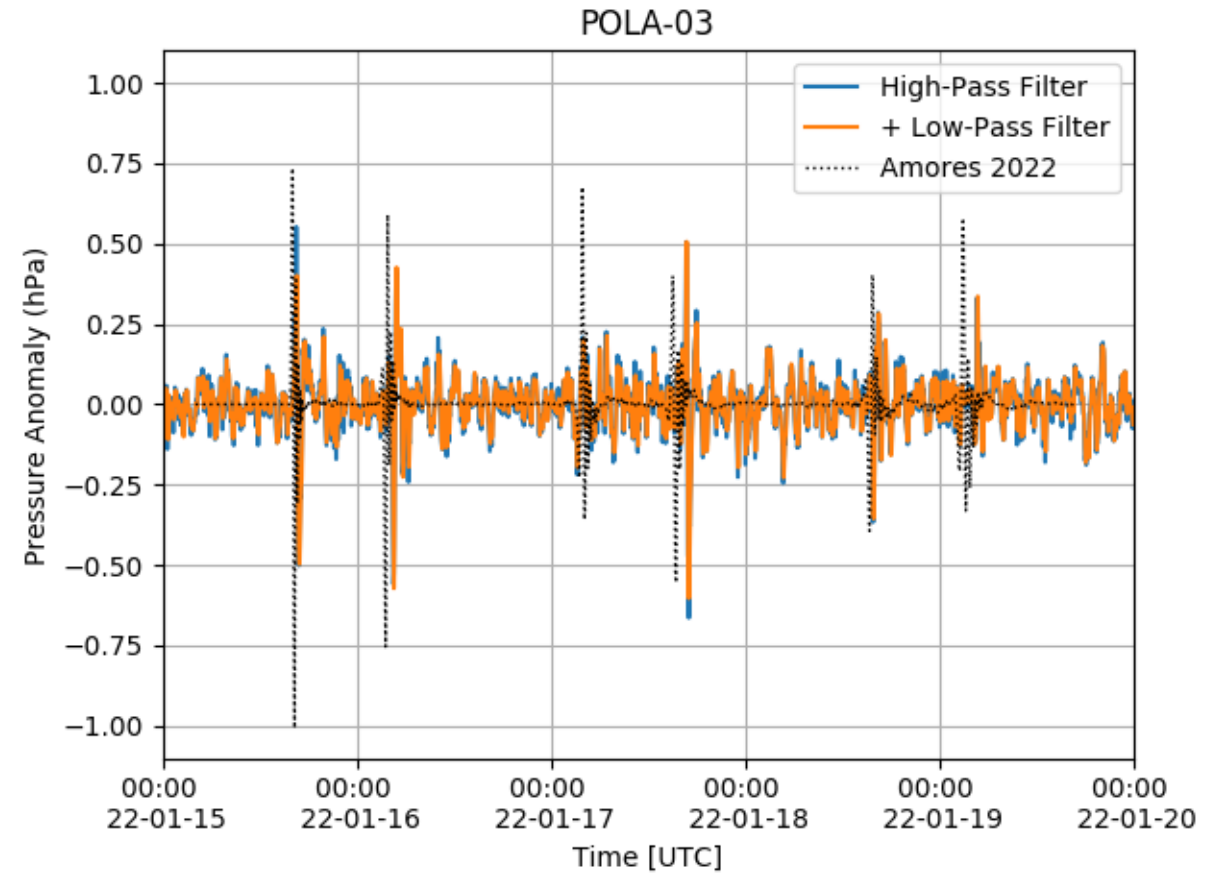
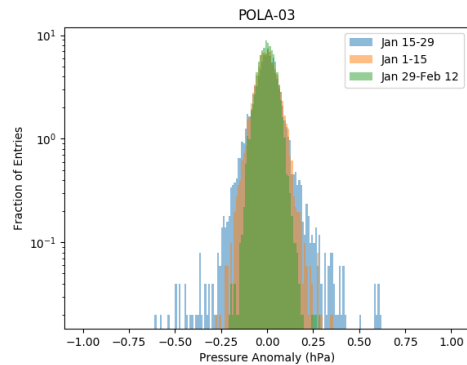
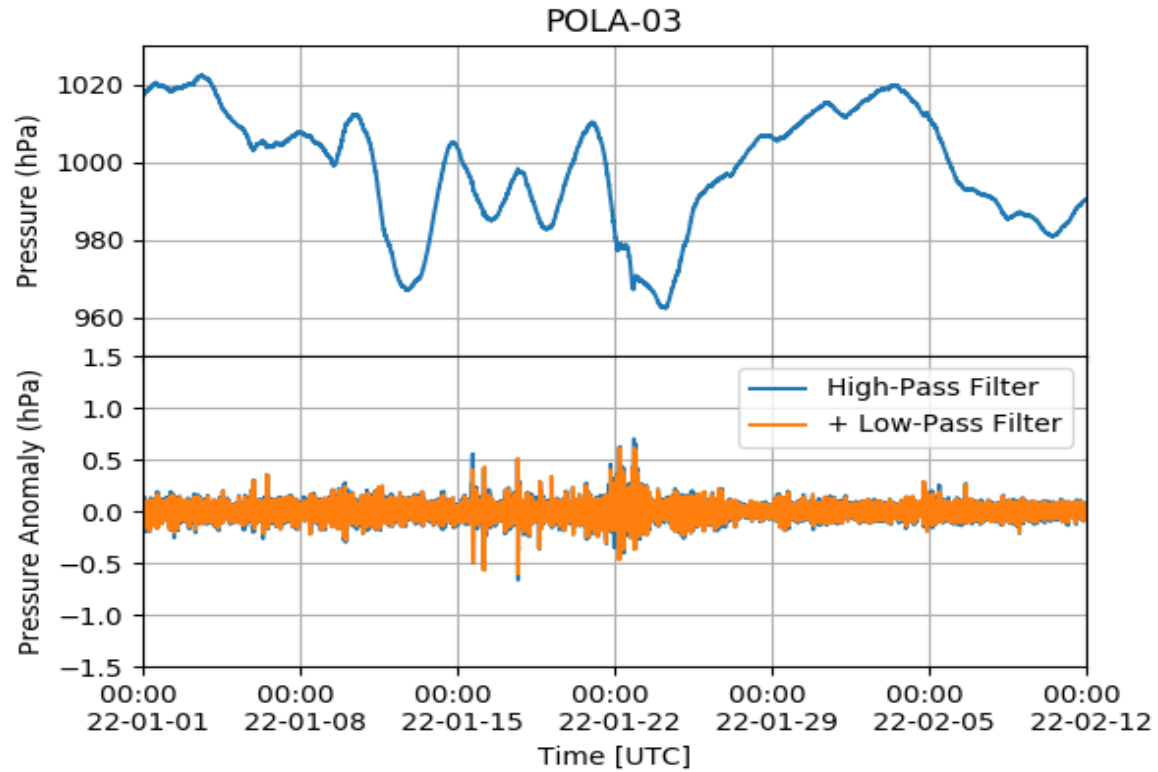
Data analysis methods

- Two methods to search for all possible pressure variations in a time range of several weeks
- Filter analysis:
 - High-pass filter with cutoff at 1/7200 Hz, then a low-pass filter with cutoff at 1/900 Hz
 - Filter: second order
- Best-fit procedure to search for local gaussian-like excesses on top of a smooth second-order polynomial function with a sliding window technique
 - Null hypothesis (H0):
 - $P(t) = a_0 + a_1 (t-t_w) + a_2 (t-t_w)^2$
 - Alternative hypothesis (H1):
 - $P(t) = a_0 + a_1 (t-t_w) + a_2 (t-t_w)^2 + \Delta P \exp(-(t-t_w)^2/2\sigma)$
 - Time window: $[t_w-w, t_w+w]$ with $w=1$ hour
 - σ fixed to 3, 5, 8, 10, 15 and 20 minutes
 - The significance of the features evaluated with 2-weeks data before Jan 15

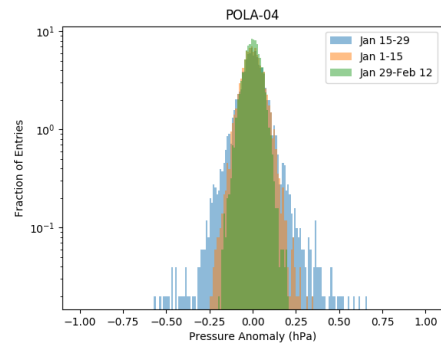
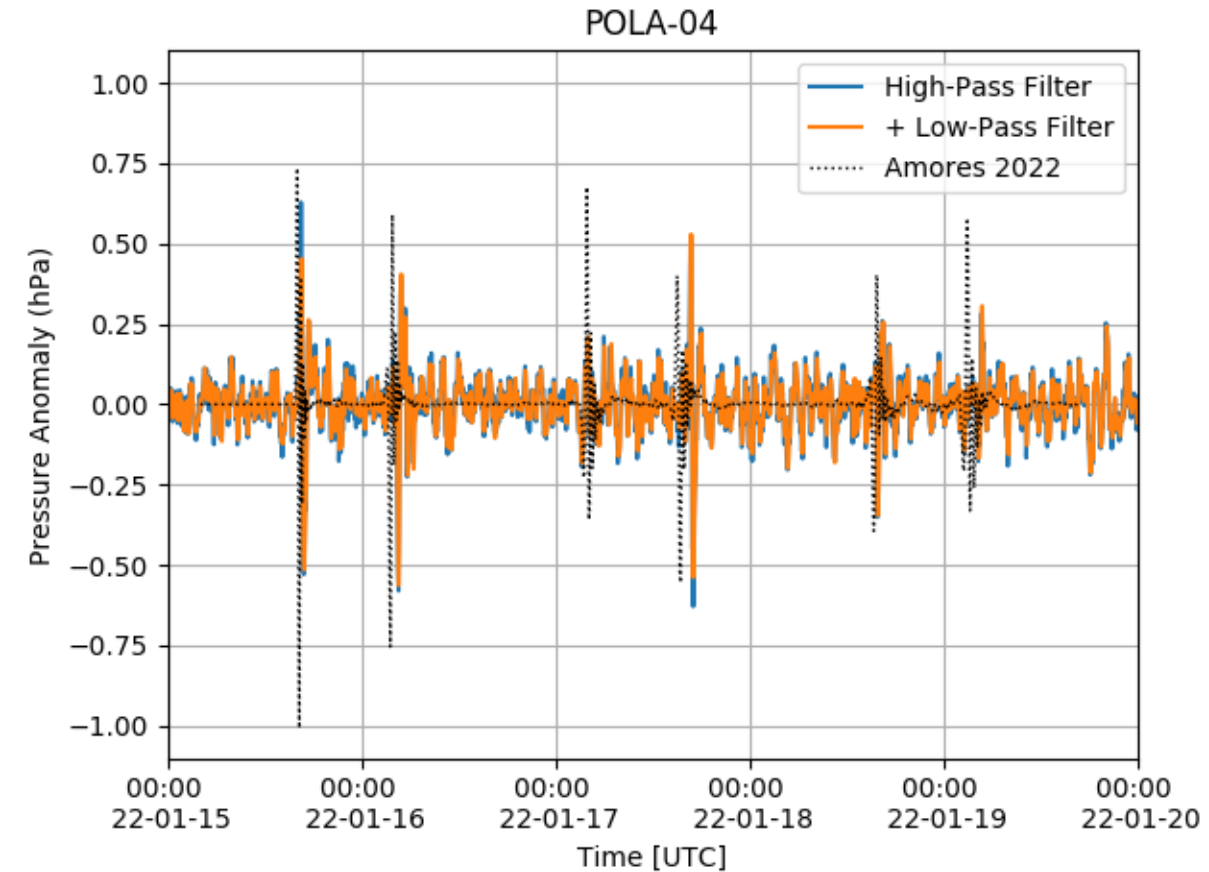
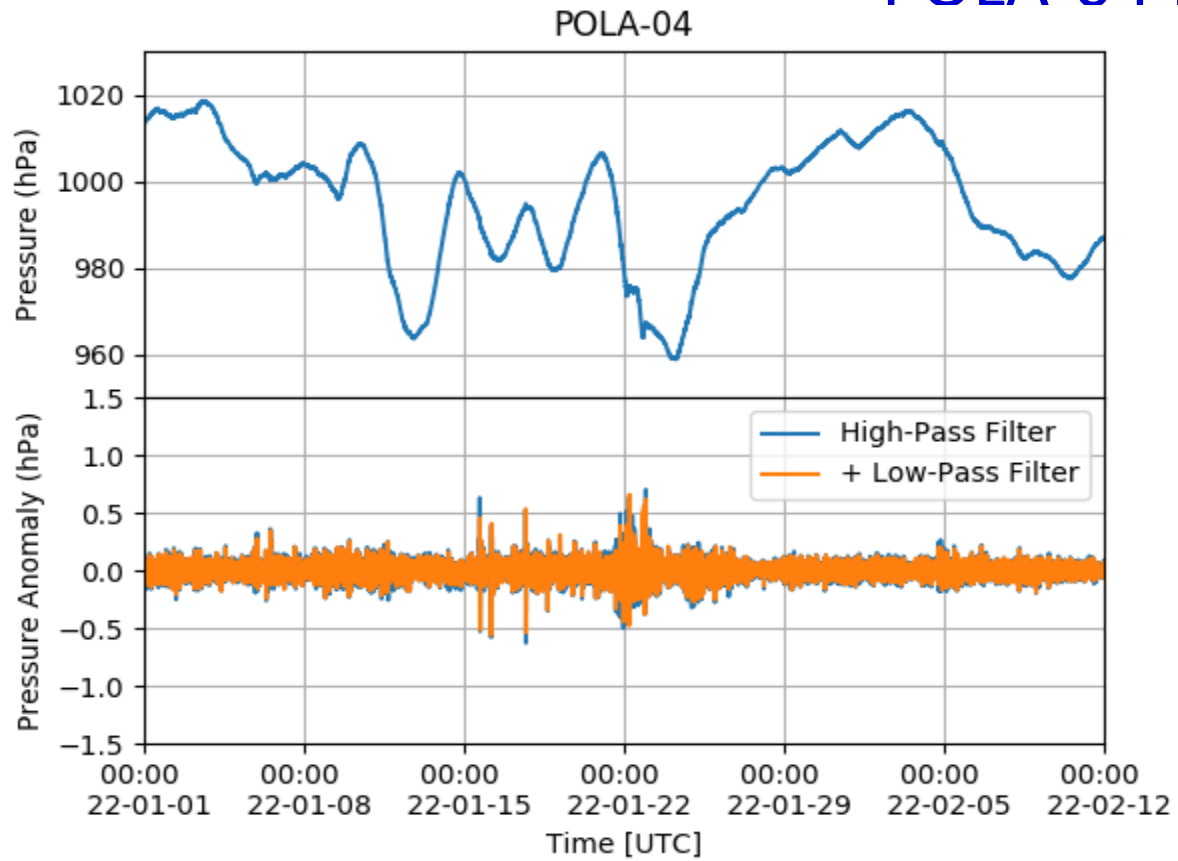
POLA-01 filter analysis



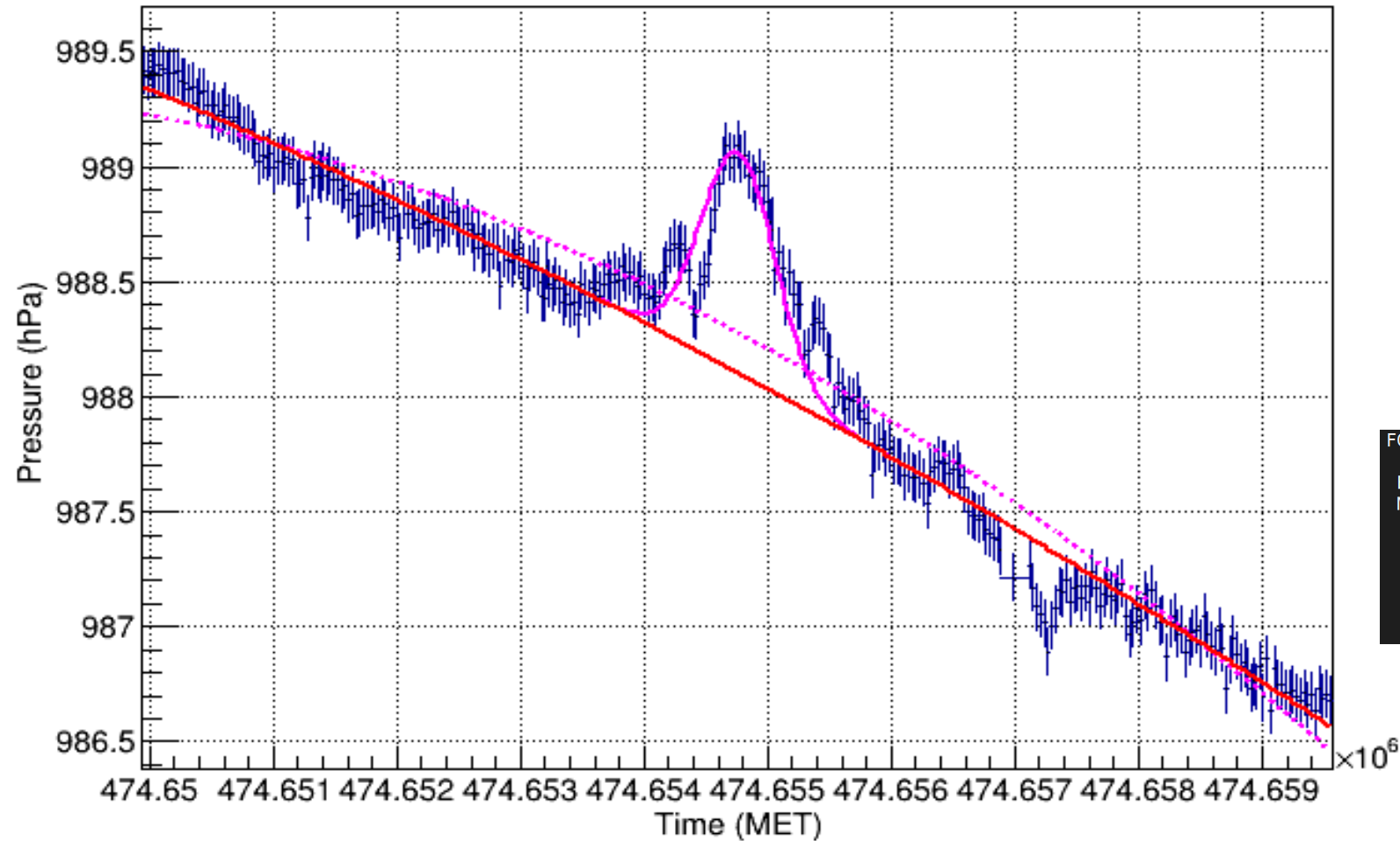
POLA-03 filter analysis



POLA-04 filter analysis



Fitting local anomalies

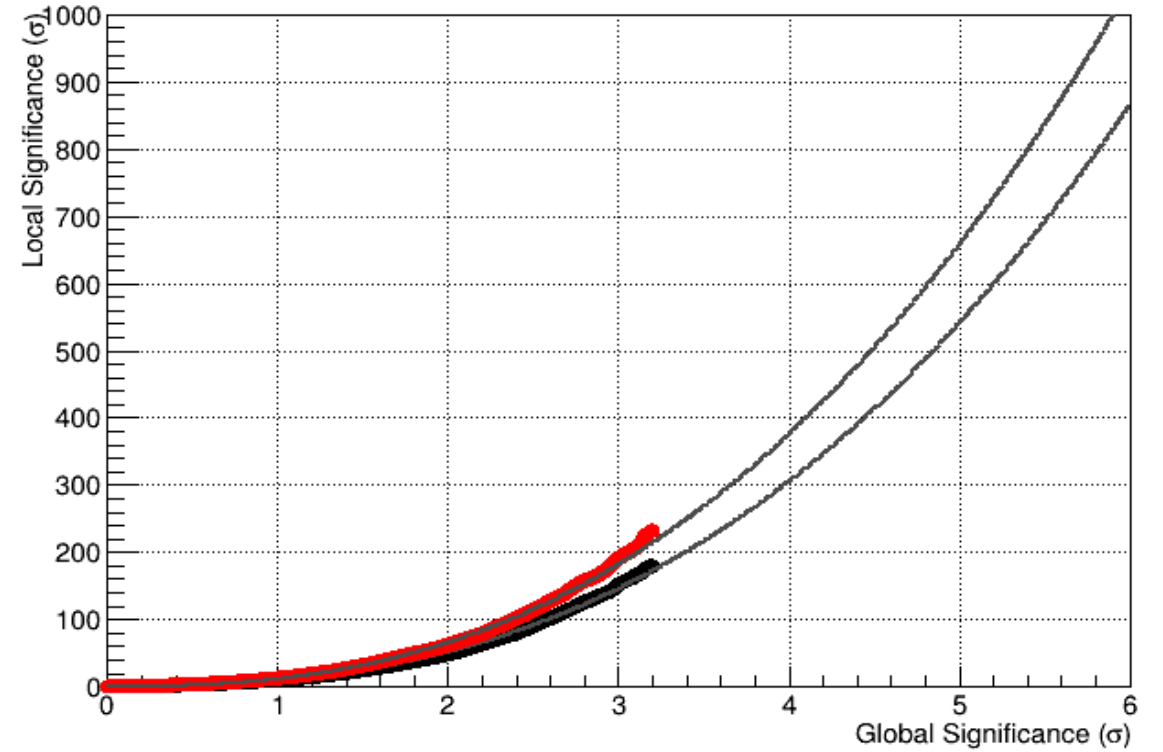
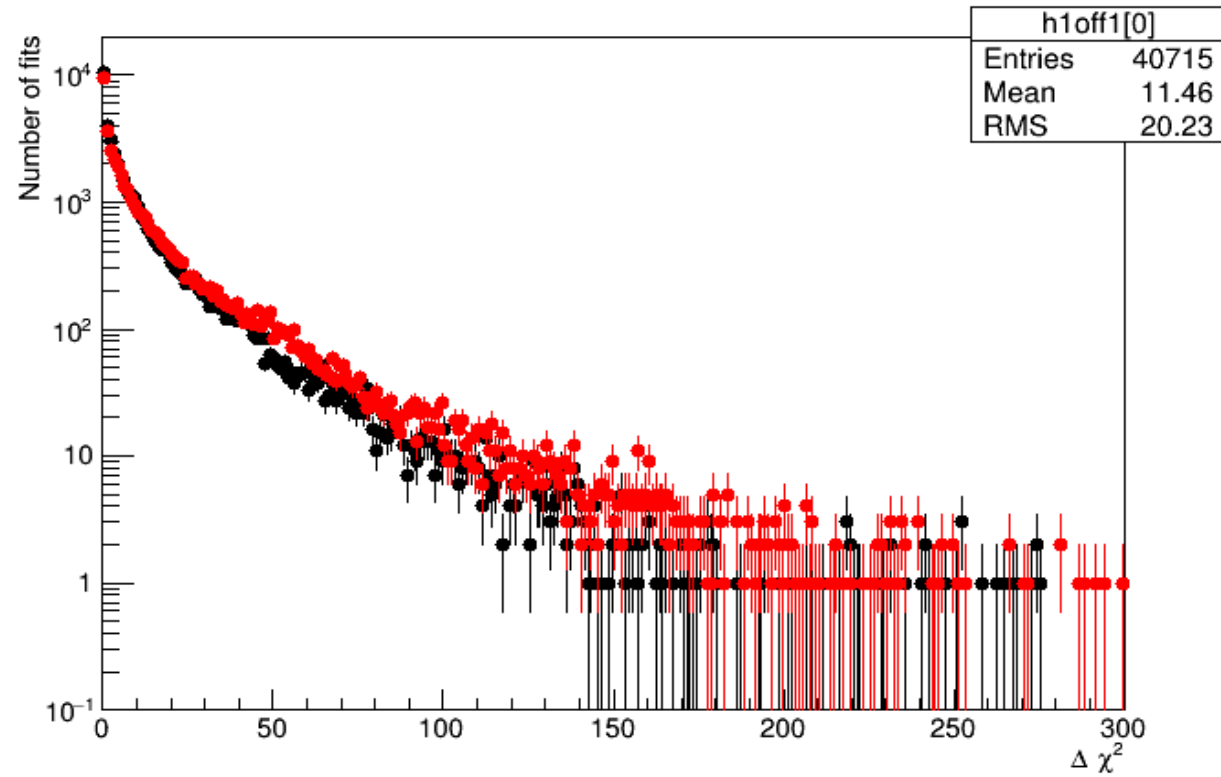


$$\chi^2 = \sum_{t_w - w < t_i < t_w + w} \frac{(P_i - P(t_i))^2}{\sigma_i^2}$$

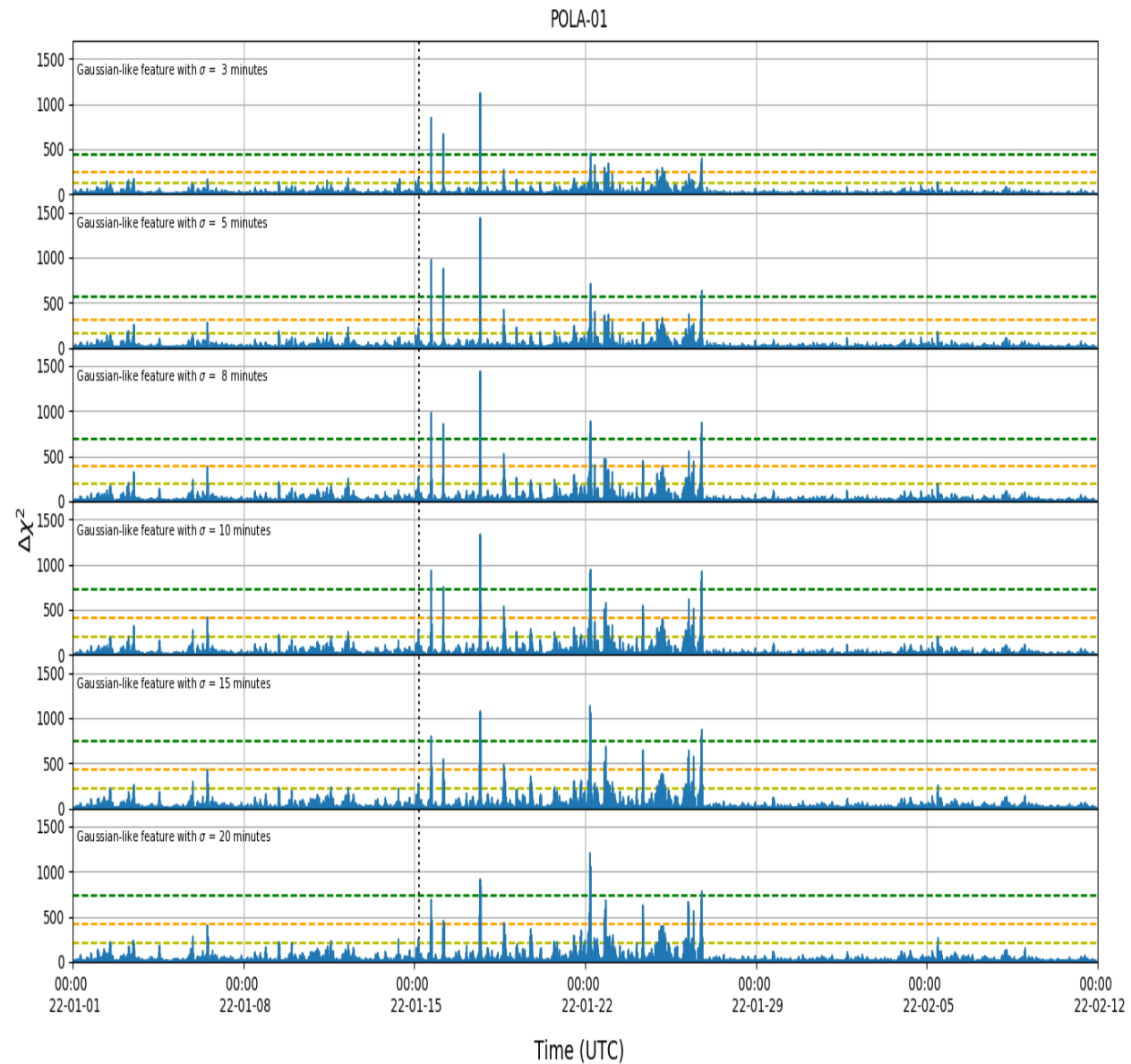
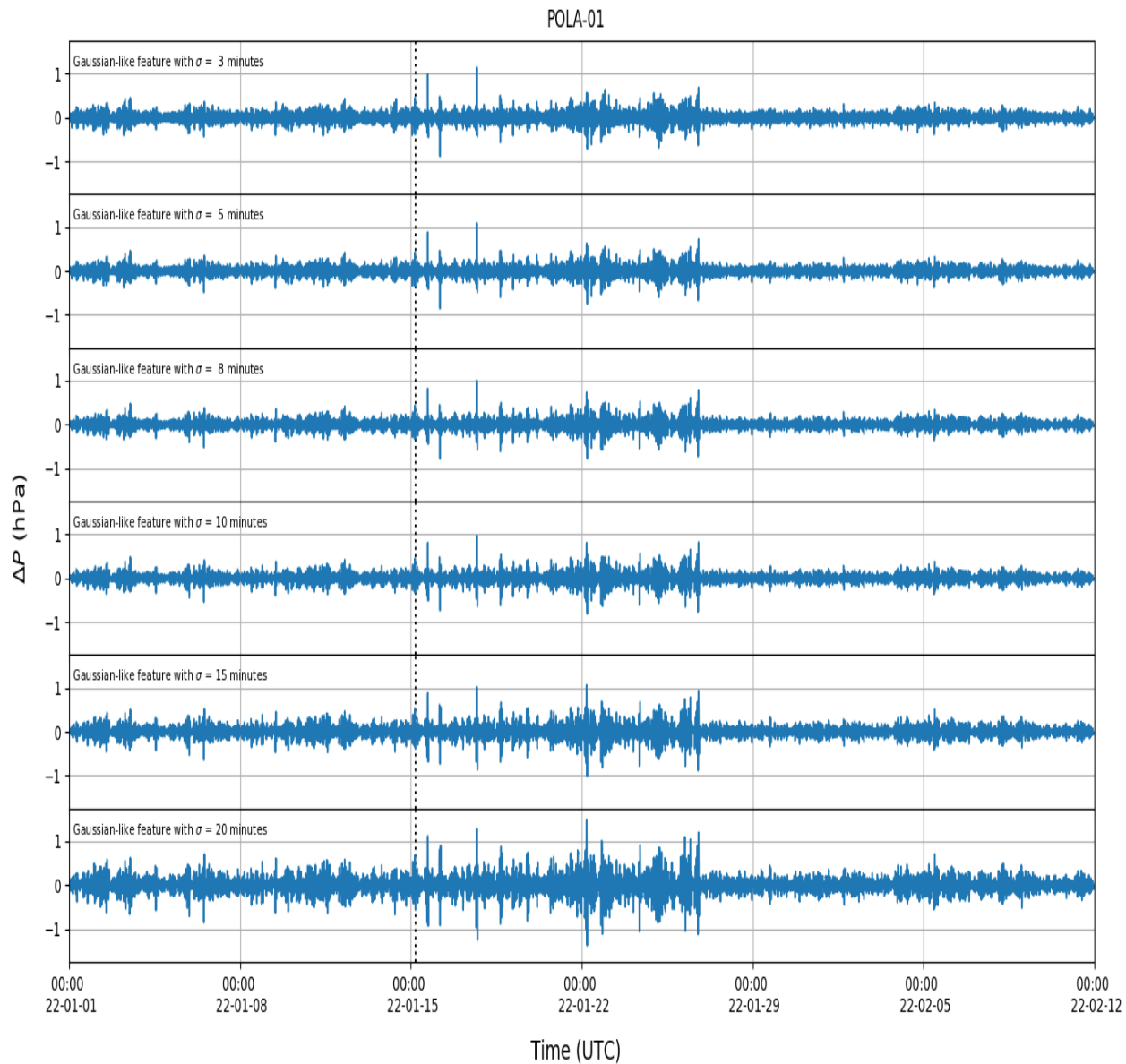
$\sigma_i = 0.1$ hPa
 $w = 1$ hour

FCN=377.953 FROM MIGRAD		STATUS=CONVERGED		73 CALLS	126 TOTAL
		EDM=2.01453e-06		STRATEGY= 1	ERROR MATRIX ACCURATE
EXT NO.	PARAMETER NAME	VALUE	ERROR	STEP SIZE	FIRST DERIVATIVE
1	p0	9.88107e+02	9.70504e-03	4.71166e-04	-5.59264e-02
2	p1	-1.73799e-02	1.20312e-04	1.14327e-07	-1.43856e+02
3	p2	-2.38506e-05	3.15451e-06	1.83452e-08	-2.32754e+01
4	p3	9.53440e-01	2.69892e-02	2.21066e-04	-4.36444e-02
5	p4	4.74655e+08	fixed		
6	p5	5.00000e+00	fixed		

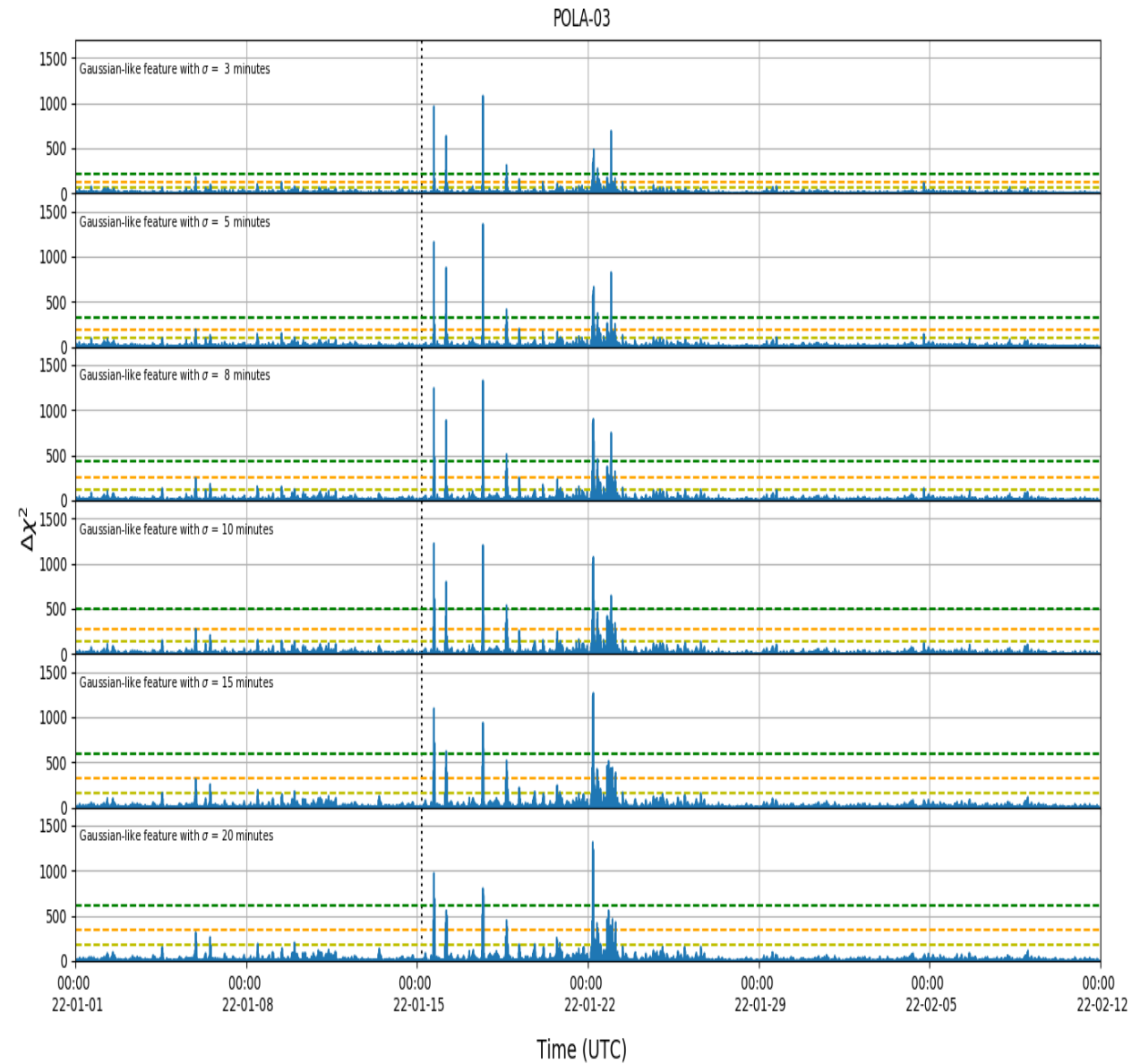
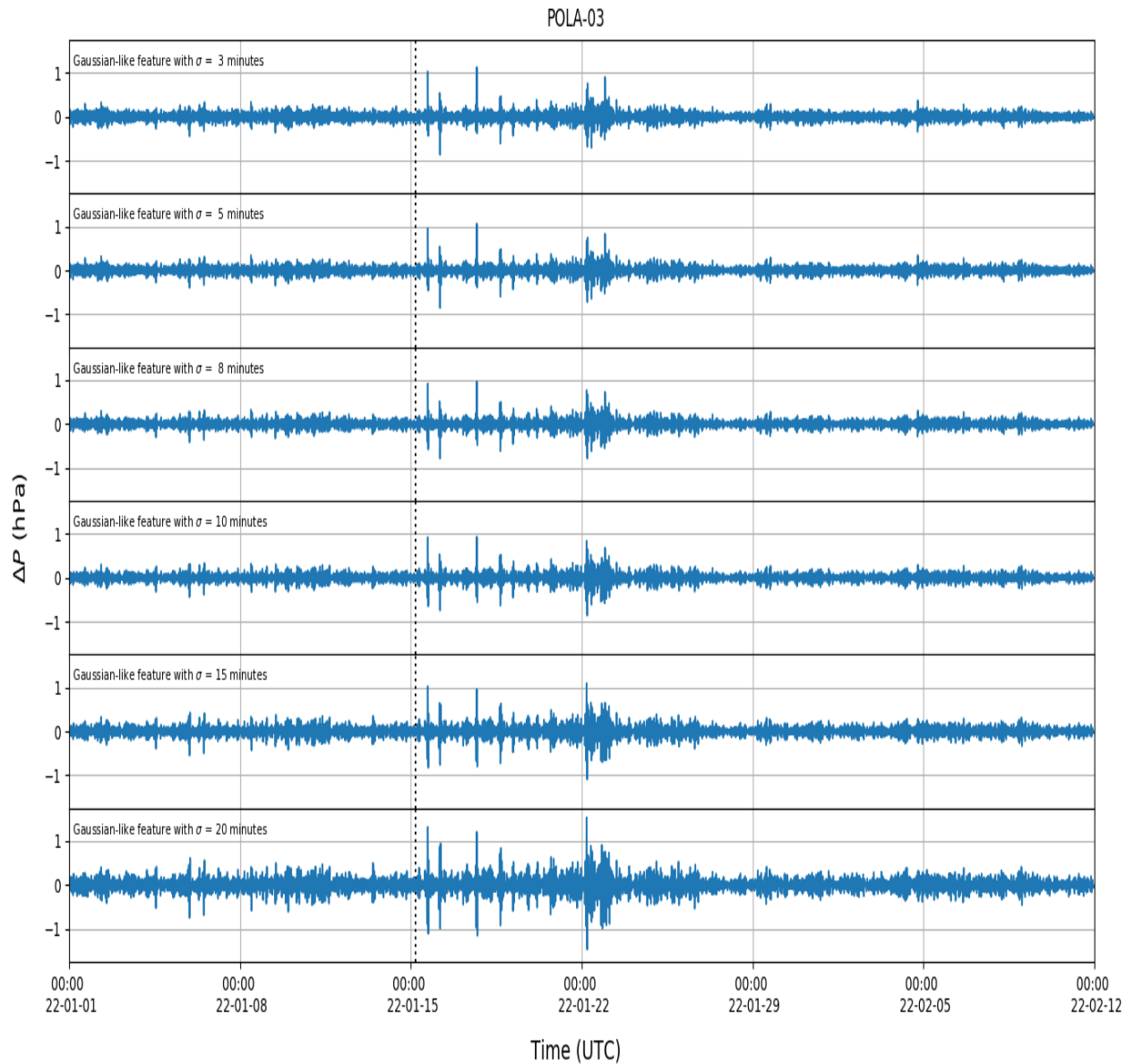
Jan 1-Jan 15 Significance (“off signal region”)



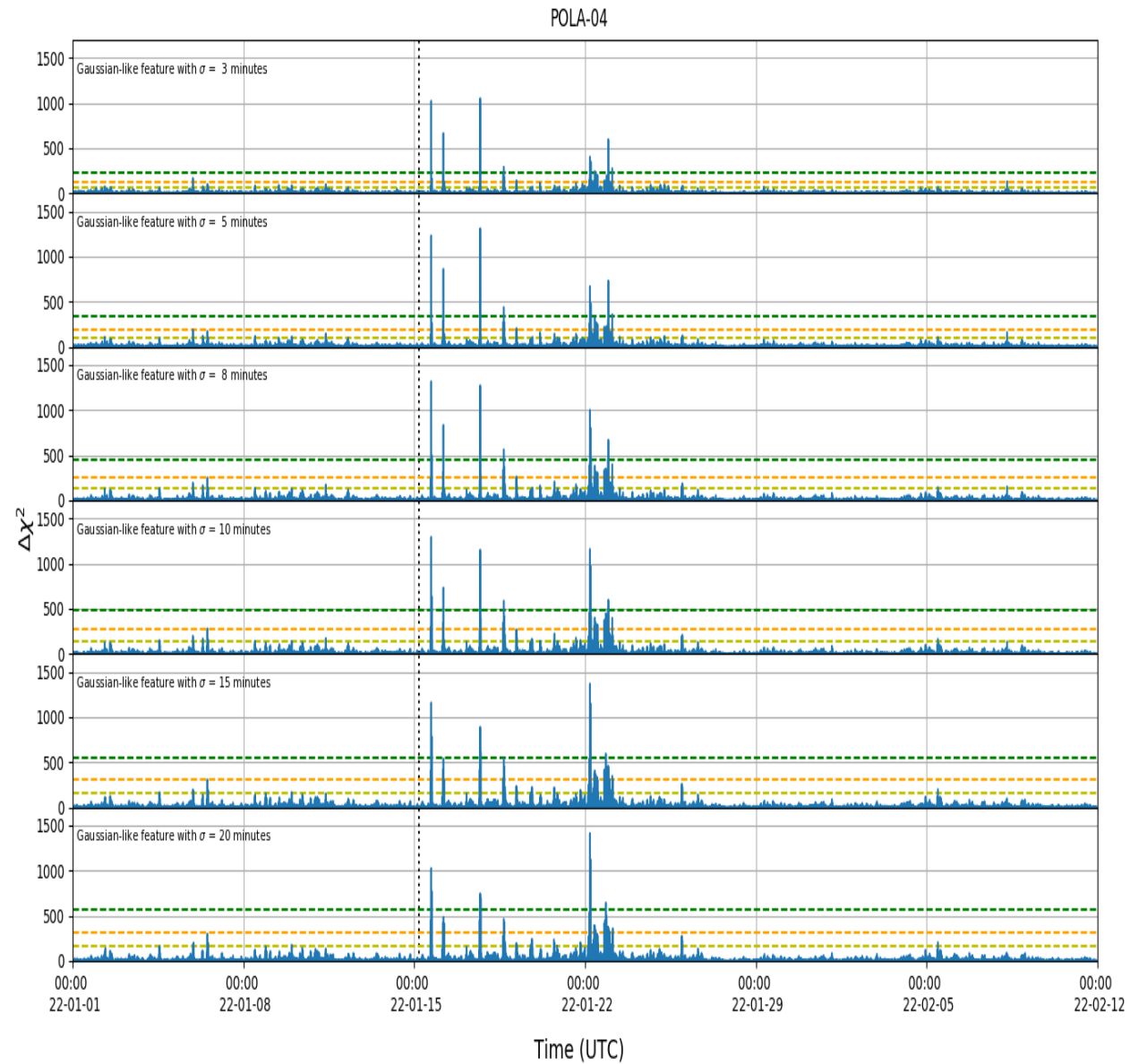
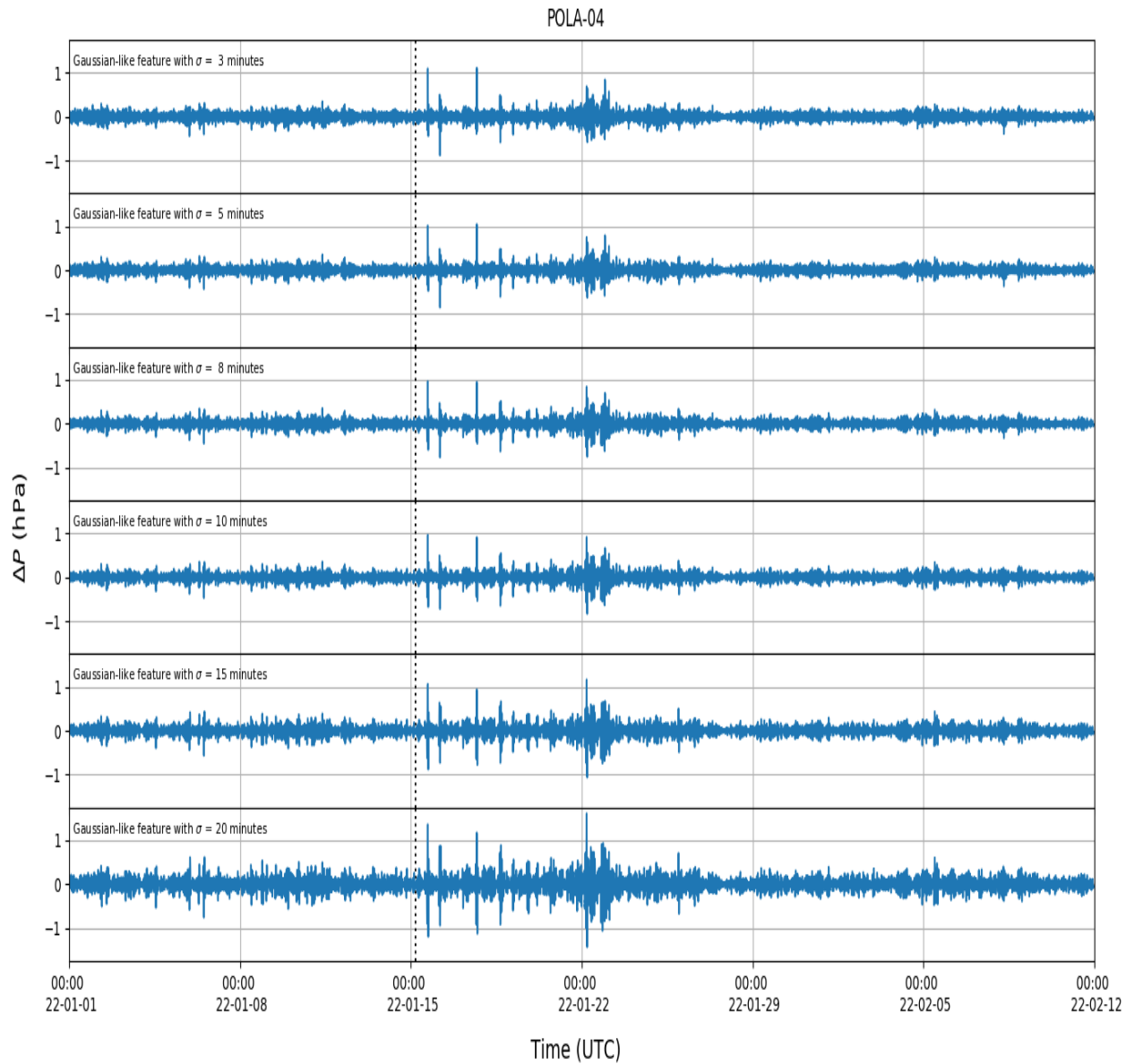
POLA-01 Gaussian-like features



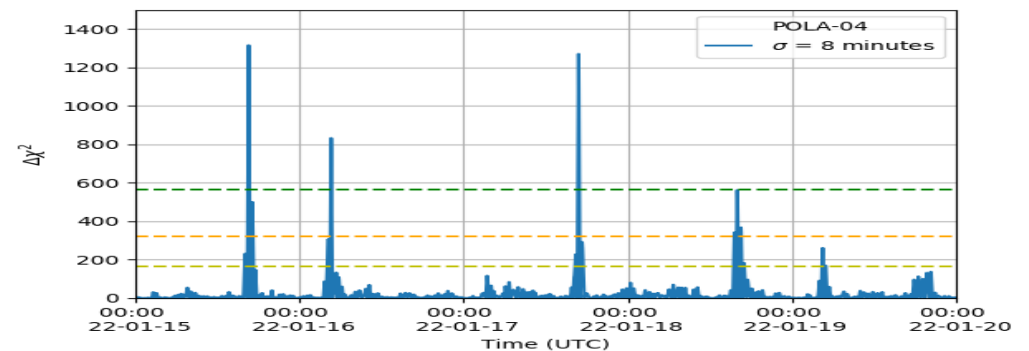
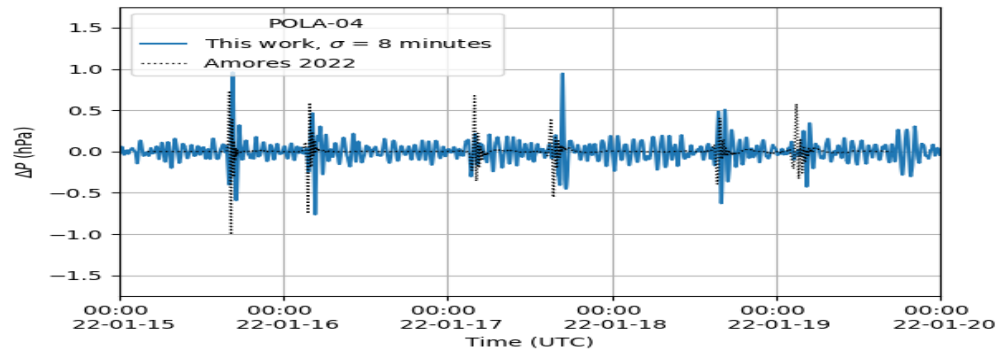
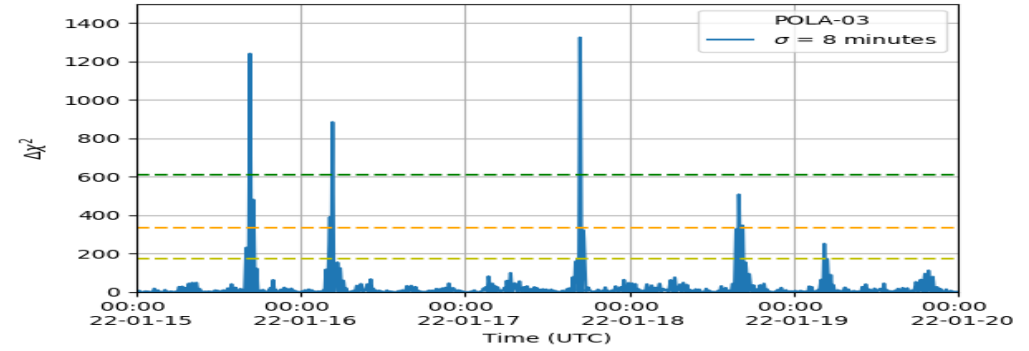
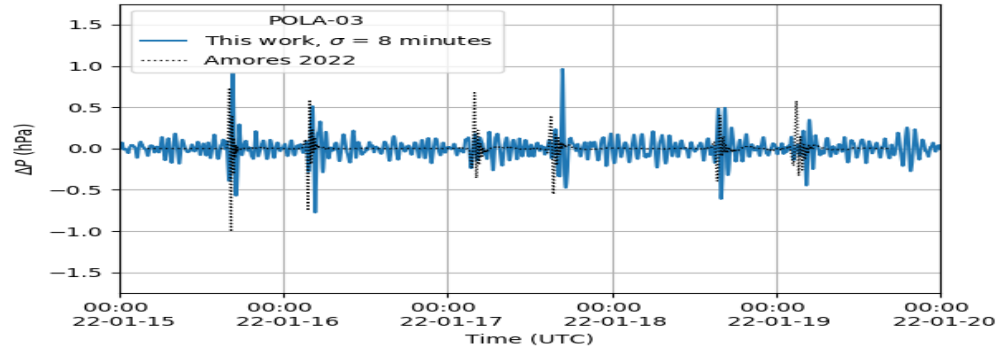
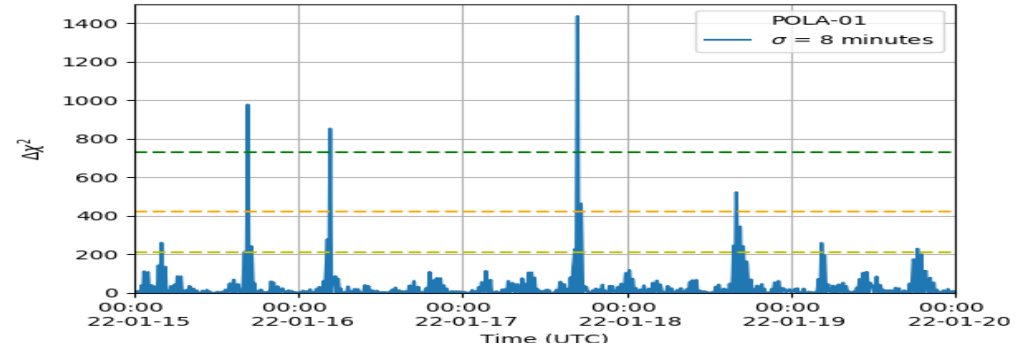
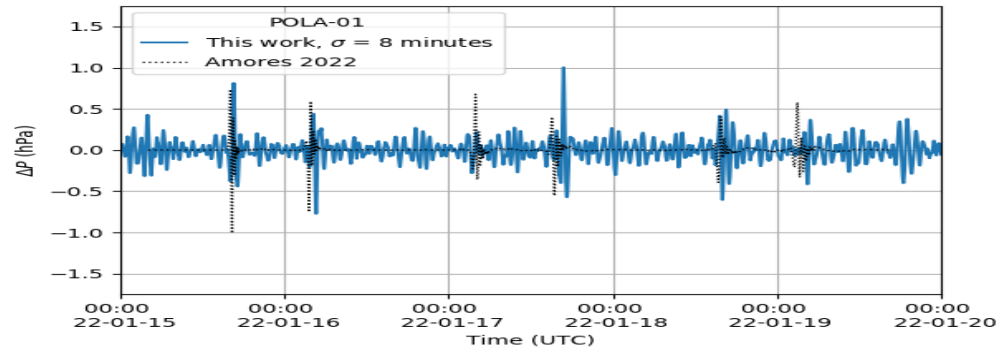
POLA-03 Gaussian-like features



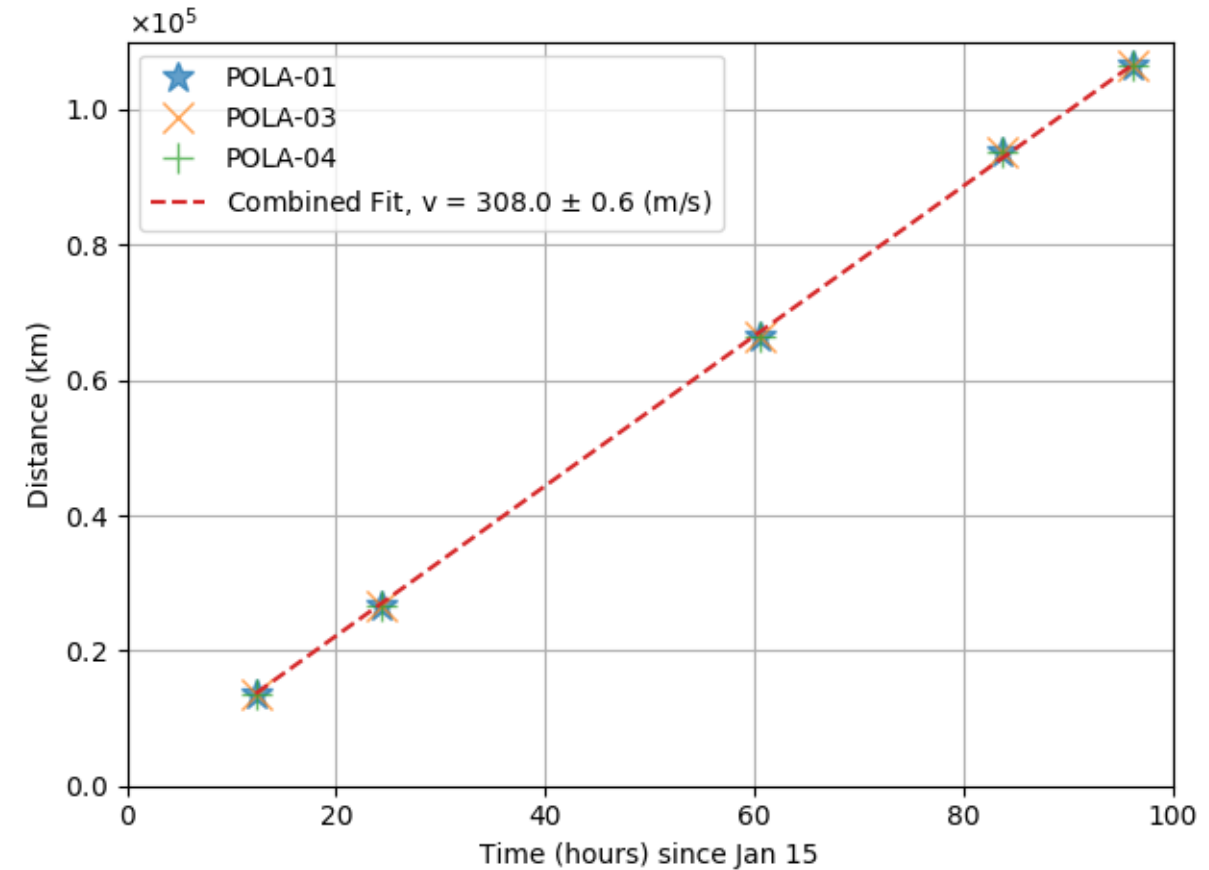
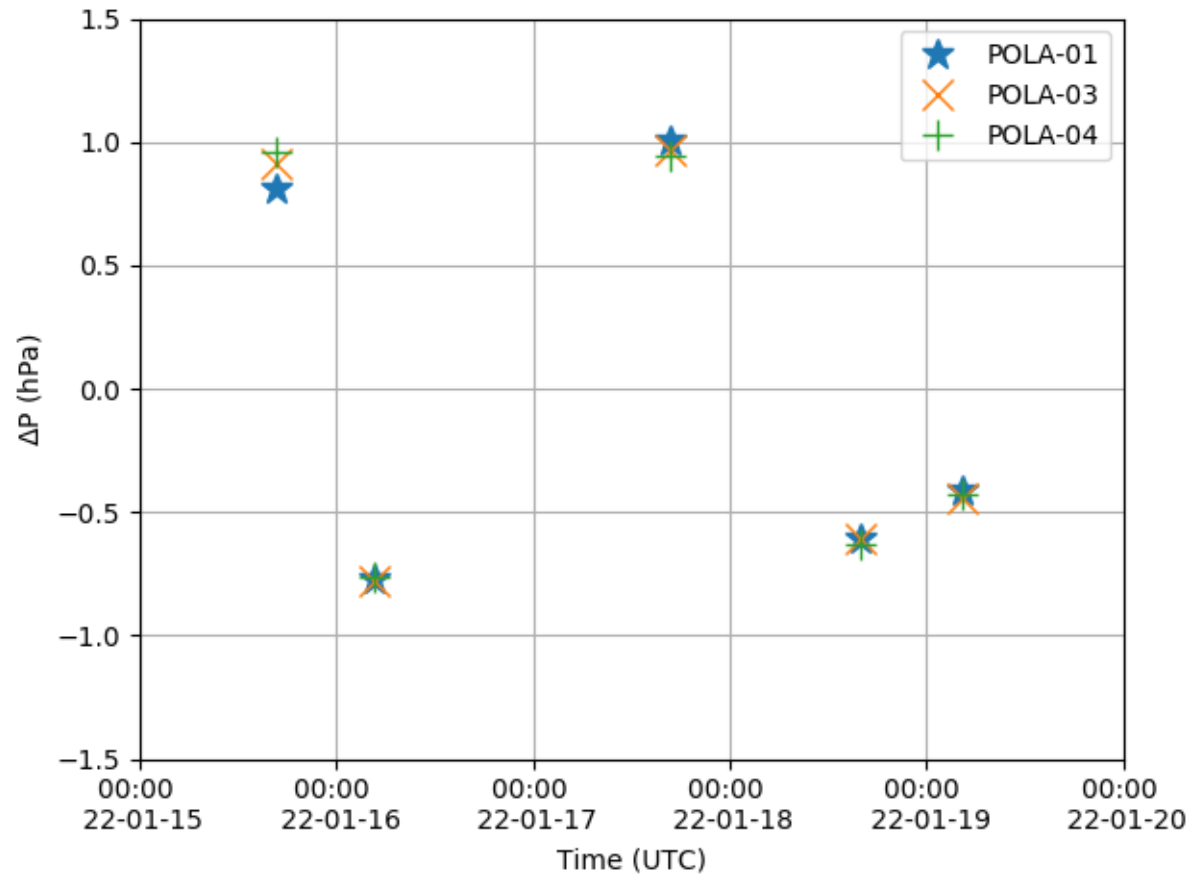
POLA-04 Gaussian-like features



Summary 8-min gaussian-like



Most significant gaussian-like pressure features with $\sigma=8$ minutes



Paper status

- First draft ready within a week
- Contents:
 - Introduction
 - POLA detectors
 - Almost-online data analysis
 - Dedicated offline data analysis
 - Filter analysis
 - Search for local excesses
 - Results
 - Conclusions

Backup