# Validation of conventional and retracked Sentinel-3 observations along the Norwegian coast

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**Nordic Geodetic Commission General Assembly | 5 - 8 September 2022 | Copenhagen, Denmark**

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## Abstract

Sentinel-3 is the first satellite altimetry mission to provide along-track resolution of 300 m while operating exclusively in SAR (Synthetic Aperture Radar) mode. However, the quality of reliable observations may be reduced close to the coast due to the inability to interpret complex waveforms or inaccurate geophysical corrections, which results in an "observational gap" between tide gauges and satellite altimetry. Several dedicated altimetry products have been developed to utilize altimetry data with better spatial resolution and as near to the coast as possible. One of these is the Adaptive Leading Edge Subwaveform (ALES) retracker, which aims to provide sea level data in coastal zones with increased precision. This study compares sea level anomalies (SLAs) from conventional and ALES-retracked Sentinel-3A/B observations with sea level anomalies from both permanent and temporary tide gauge observations along the complex Norwegian coast. We demonstrated that using ALES performs slightly better in comparison with tide gauges in terms of correlation and provides more observations closer to the coast.

## Data

**SA:** conventional and ALES retracked Sentinel-3A/B

**TG:** 23 permanent + 40 temporary tide gauges

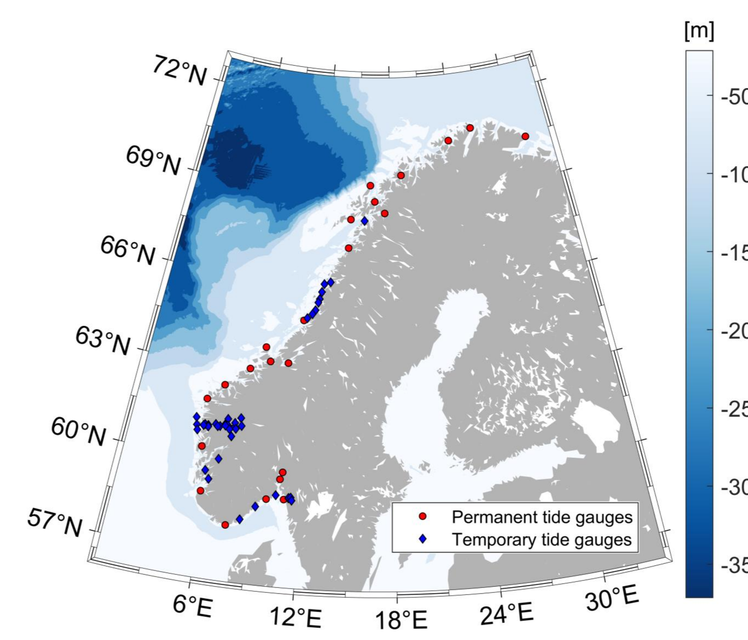
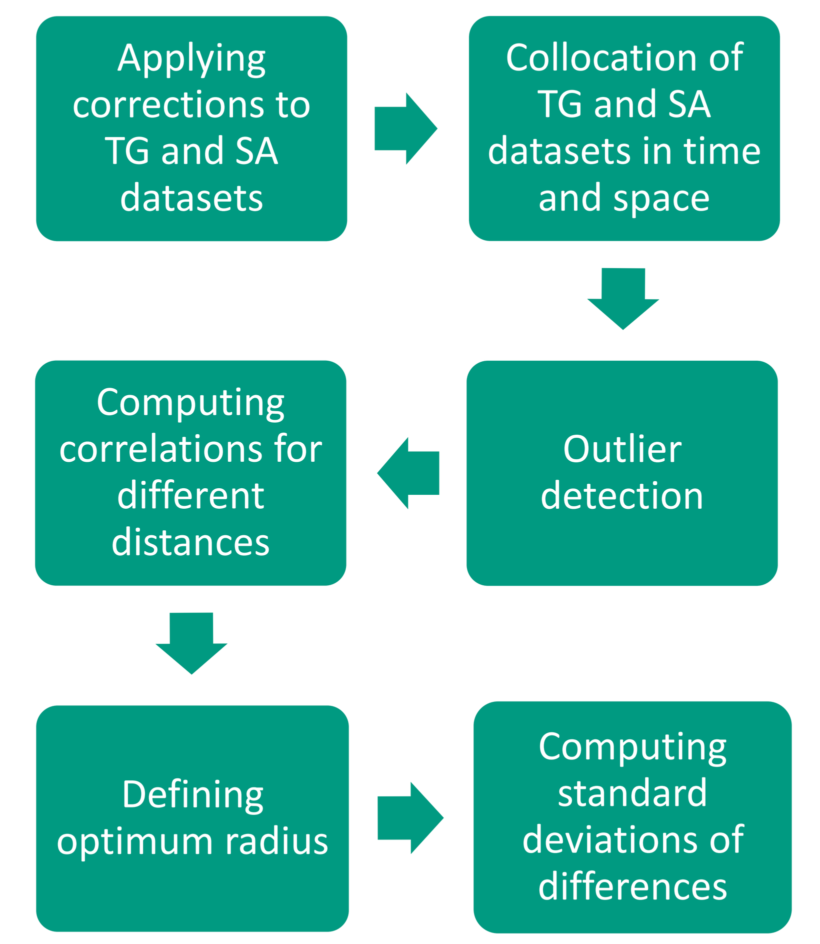



*Figure 1. Permanent and temporary tide gauges analyzed in present study*

## Methodology




## Results

In terms of correlation, ALES Sentinel-3A retracked data outperforms conventional Sentinel-3A dataset by 1.48 % and ALES Sentinel-3B outperforms conventional Sentinel-3B by 2.66 % at permanent tide gauges (Figure 2). In the case of temporary tide gauges, the conventional Sentinel-3A dataset outperforms retracked dataset by 0.27 % and ALES Sentinel-3B retracked dataset outperforms conventional Sentinel-3B by 3.86 % (Figure 3). ALES also provides more observations closer to the tide gauges than the conventional dataset, especially in complex areas like fjords (e.g. Oslo tide gauge located inside Oslofjord), where the conventional dataset does not provide enough observations to compute correlations or does not provide observations close to the tide gauge at all. Standard deviations of differences computed between altimetry and tide gauge observations are shown in Table 1 (permanent tide gauges) and Table 2 (temporary tide gauges).

| Product | STD [cm] |
|---|---|
| ALES S3A | 7.1 |
| S3A | 6.1 |
| ALES S3B | 7.5 |
| S3B | 6.3 |

*Table 1. Standard deviations of differences between SA and TG data – permanent TGs*

| Product | STD [cm] |
|---|---|
| ALES S3A | 12.4 |
| S3A | 12.8 |
| ALES S3B | 11.8 |
| S3B | 10.1 |

*Table 2. Standard deviations of differences between SA and TG data – temporary TGs*

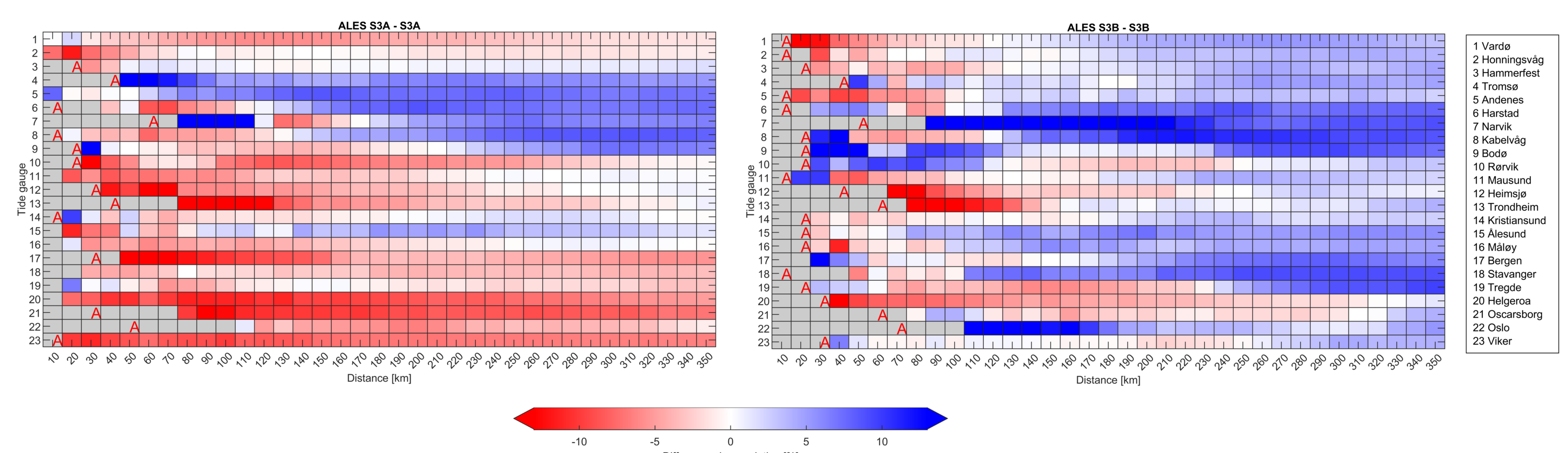



*Figure 2. Differences in correlations for increasing distances to permanent tide gauges, arranged from north to south. Letter A denotes regions where only ALES observations are available.*

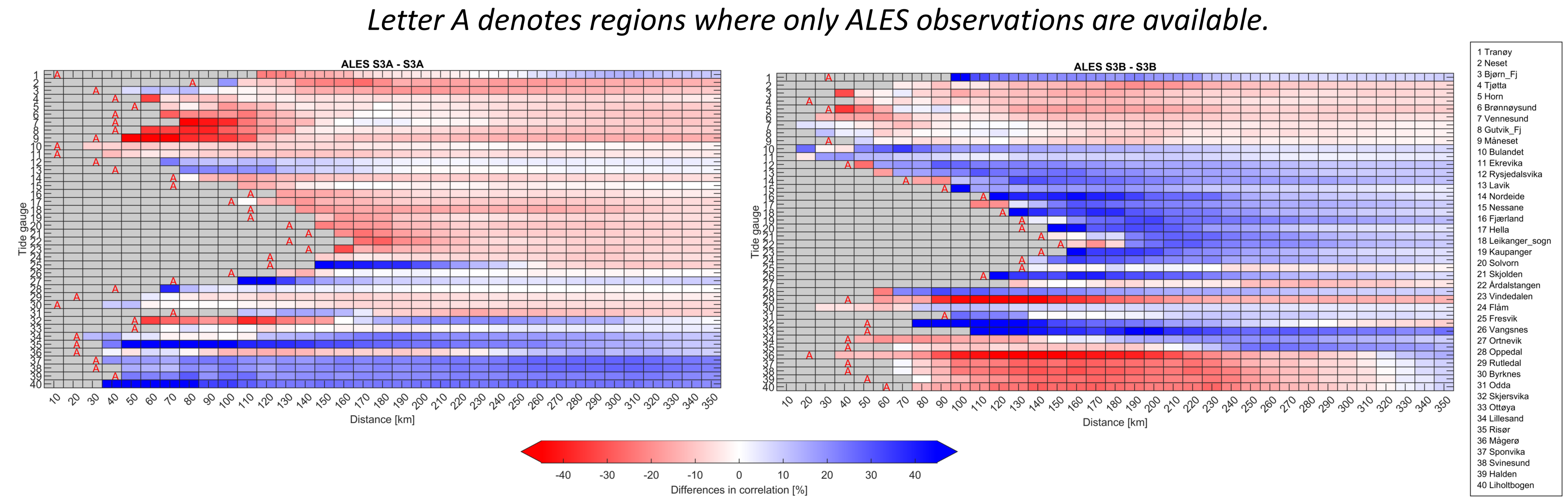



*Figure 3. Differences in correlations for increasing distances to temporary tide gauges, arranged from north to south. Letter A denotes regions where only ALES observations are available.*

## Conclusions and outlook

- Conventional and ALES retracked Sentinel-3 data was compared with observations obtained from permanent and temporary tide gauges along the Norwegian coast
- The complexity of the Norwegian coastline causes "observational gaps" between altimetry and tide gauges
- Comparison shows that using the ALES retracked dataset can contribute to a better agreement with tide gauges in terms of correlation
- The ALES dataset provides observations closer to tide gauges than the conventional dataset
- This study demonstrates the advantage of the ALES retracked dataset over the conventional dataset along the Norwegian coast

## References

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## Acknowledgments

We acknowledge the open policy of ESA and OpenADB. This work is part of the Norwegian University of Life Science's SEGREF project, supported by the Norwegian University of Life Sciences under project number 651040.

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