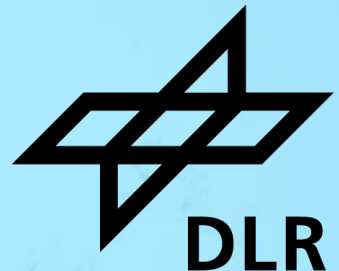


THE INFLUENCE OF SCENE SELECTION ON HEIGHT CHANGE RATES FROM TANDEM-X DEM DIFFERENCING

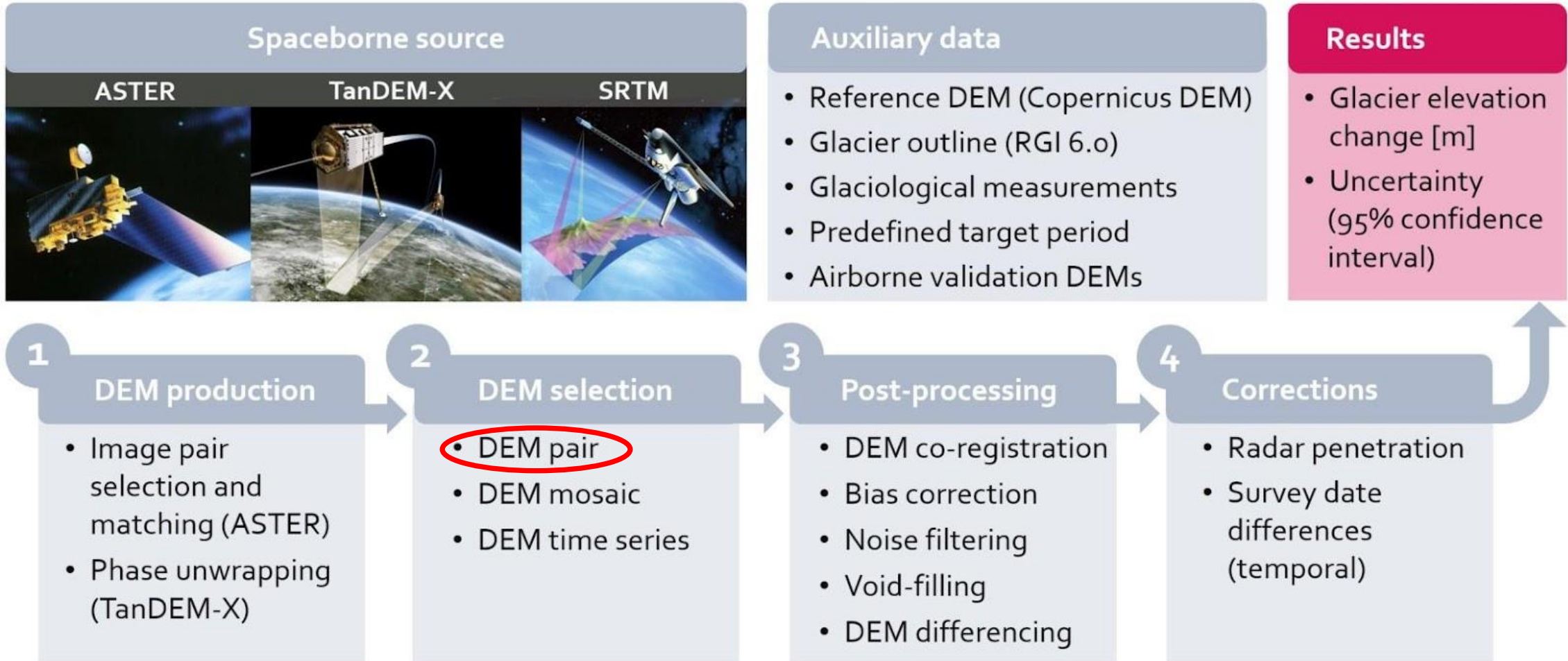
RESULTS OF THE RAGMAC INTERCOMPARISON EXERCISE

**Lukas Krieger, Dana Floricioiu
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2023-07-16 IUGG, Berlin

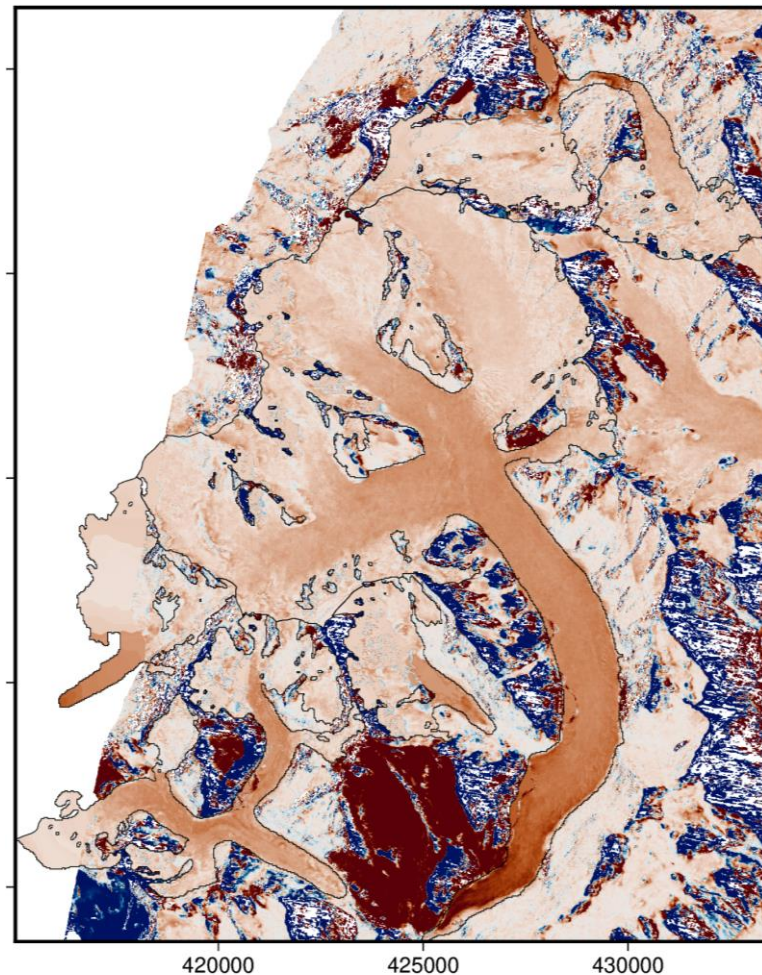


The RAGMAC intercomparison exercise

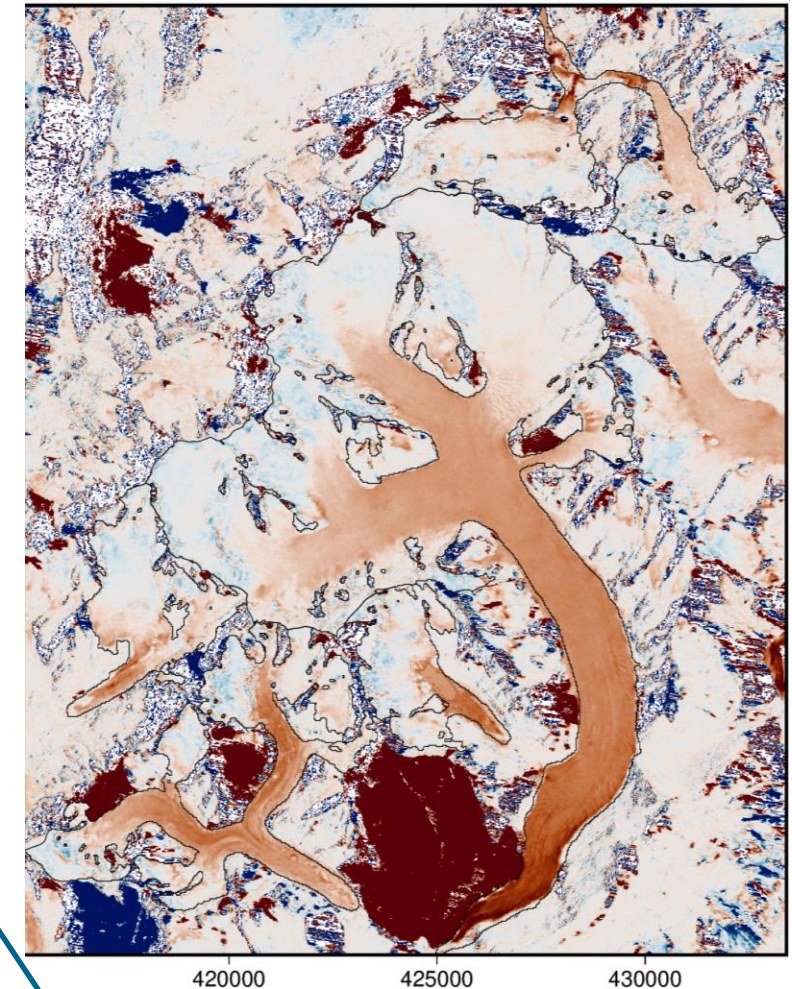
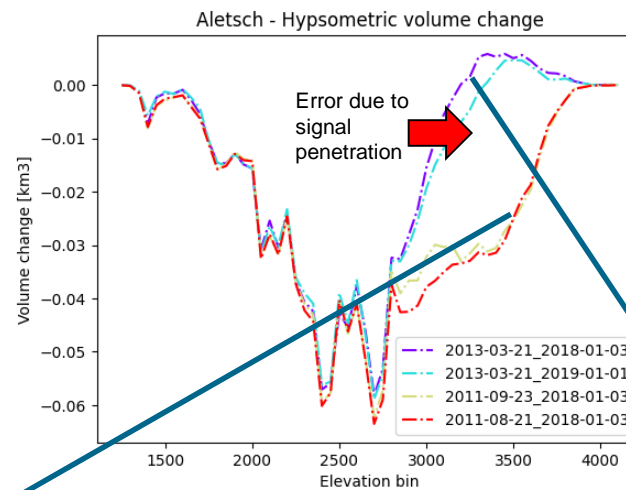
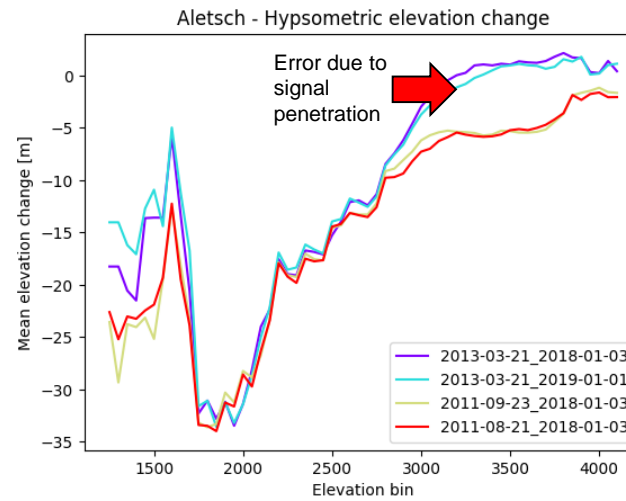


Piermattei et al. (in writing)

Exaples of scene mismatch - Penetration bias



Aug. 2011 – Jan. 2018



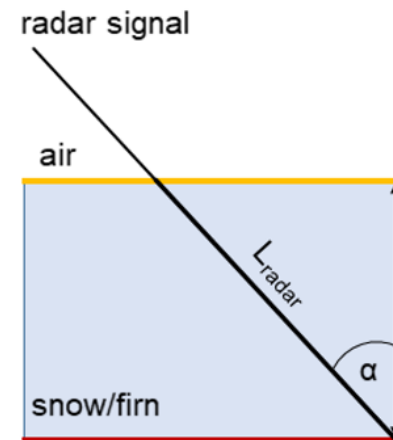
Mar. 2013 – Jan. 2018

- Within the RAGMAC setup some scene combinations performed better than others
- For large areas we want to decide on the used acquisitions before looking at the data
 - Coherence
 - Backscattering (sigma naught)
 - Remaining co-registration errors
- Considerations for TanDEM-X combinations
 - Glacier coverage
 - SAR geometries
 - Date of acquisition

Scene pair selection strategies

Target: Same SAR geometry in winter

- + Increased backscatter and reduced phase noise. Less noisy DEMs.
- + Signal penetration effects cancel out for similar firn/ice conditions with same geometry
- + Having the same areas of layover and shadow is beneficial for co-registration
- Scenes might still be affected by different signal penetration
- Adjustment needed to scale values to the end of glaciological year



Bannwart et al. (in review)

Target: End of ablation season

- + No signal penetration effects
- + Little adjustment needed to scale values to the end of glaciological year
- Different SAR geometries
- Water on the glacier surface decreases backscattering and increases phase noise on InSAR DEMs
- Scene availability of the TanDEM-X mission

Pair priority calculation



- When creating mosaics, which scene pairs should be prioritized?

Target: Same SAR geometry in winter

1. Temporal baseline (>5yr, >3yr, <3yr)
2. Seasonal separation (<30d, <60d, >60d)
3. Acquisition season (winter, summer, mixed)
4. Pass direction
5. Relative orbit

Target: End of ablation season

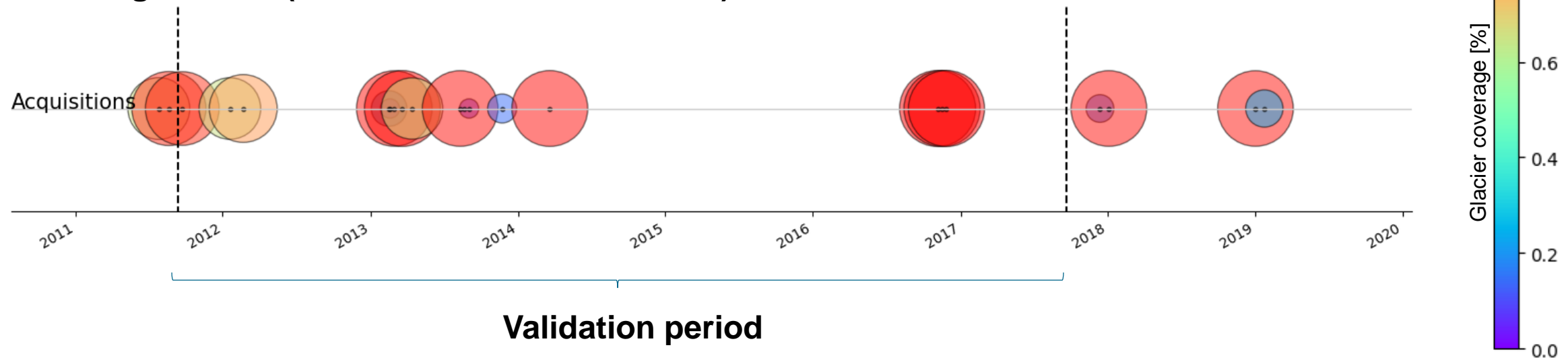
1. Seasonal separation (<30d, <60d, >60d)
2. Temporal baseline (>5yr, >3yr, <3yr)
3. Pass direction
4. Acquisition season (end of ablation, other, mixed)
5. Relative orbit

Experiment setup

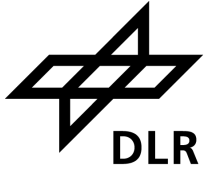
- Process all combinations of DEMs provided for the RAGMAC experiment
- Minimum temporal separation 1 year



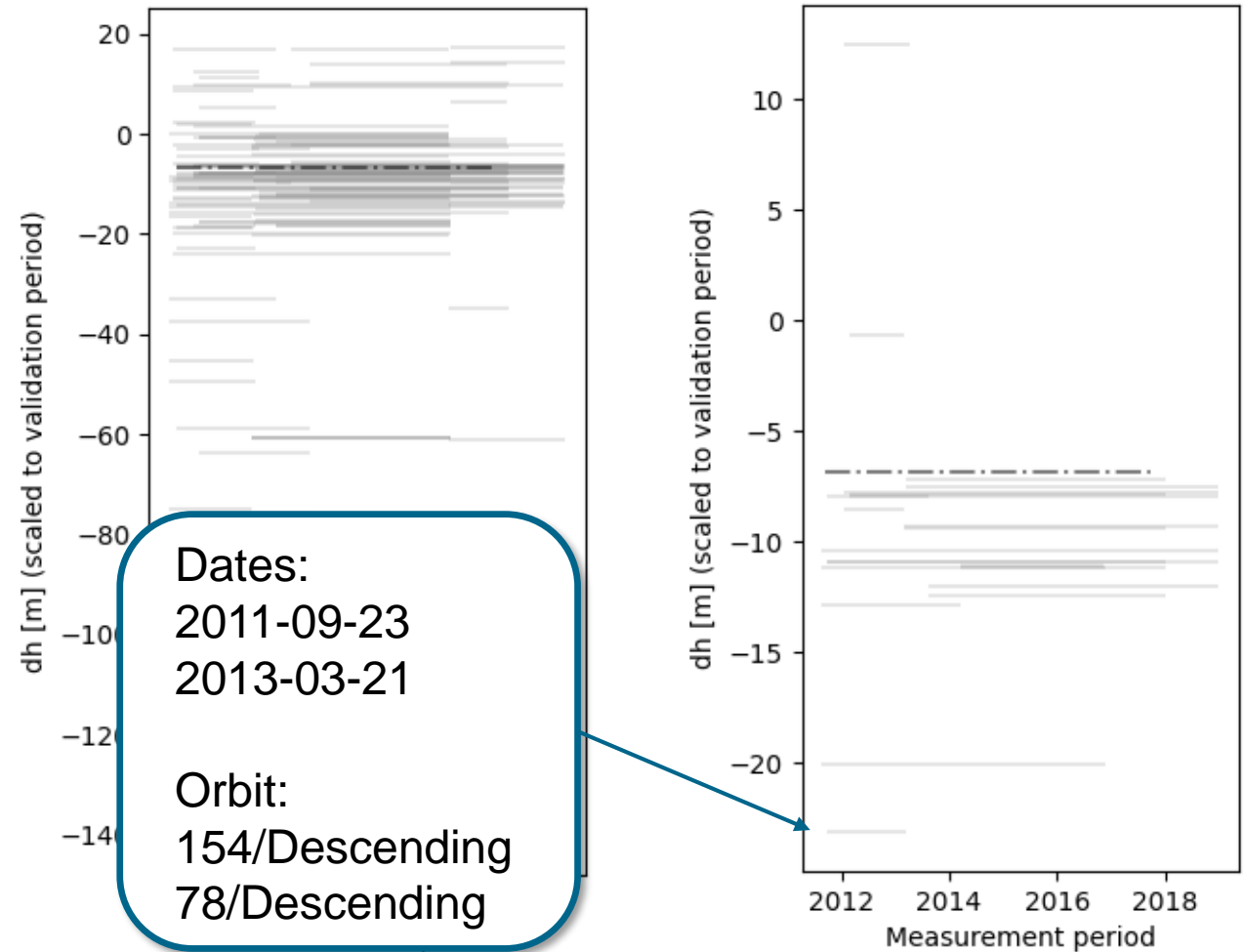
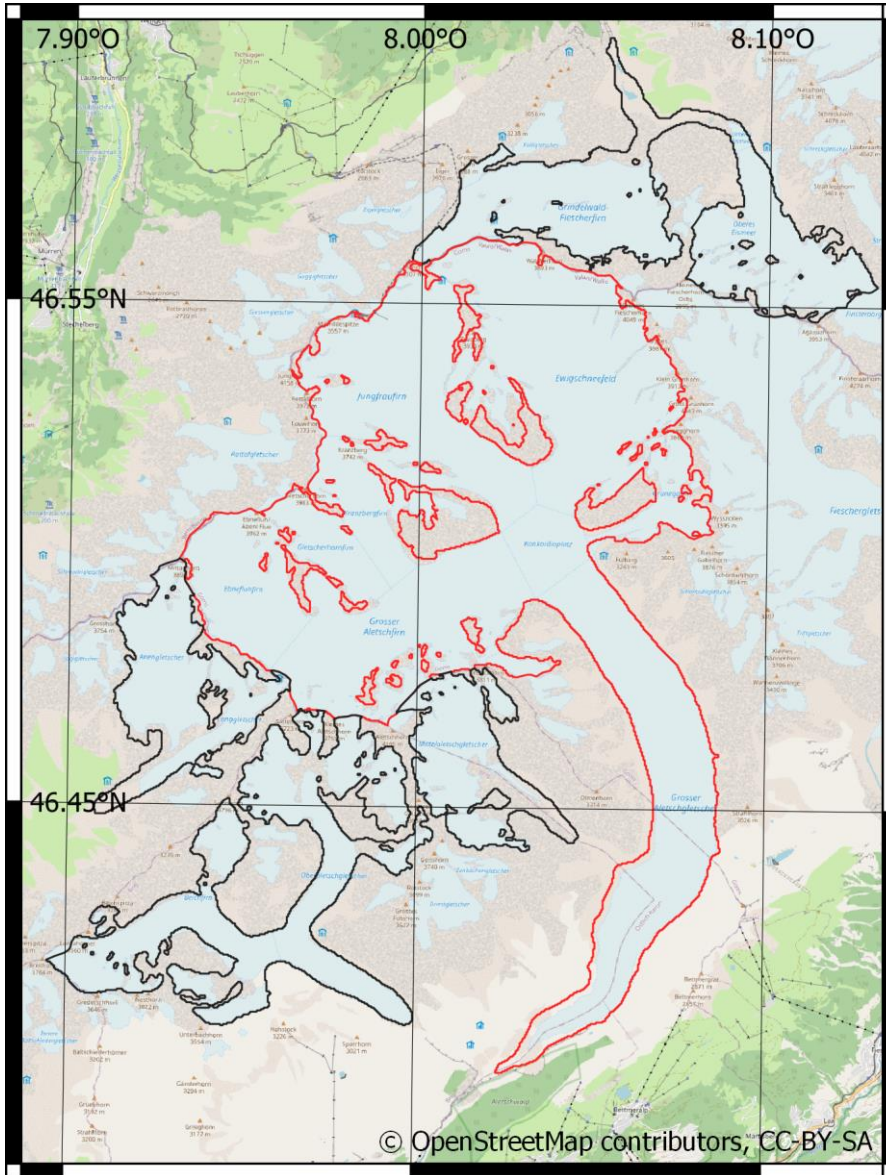
Aletschgletscher (22 DEMs, 130 combinations)



Results - Aletschgletscher



LIDAR Validation data: -6.88 m

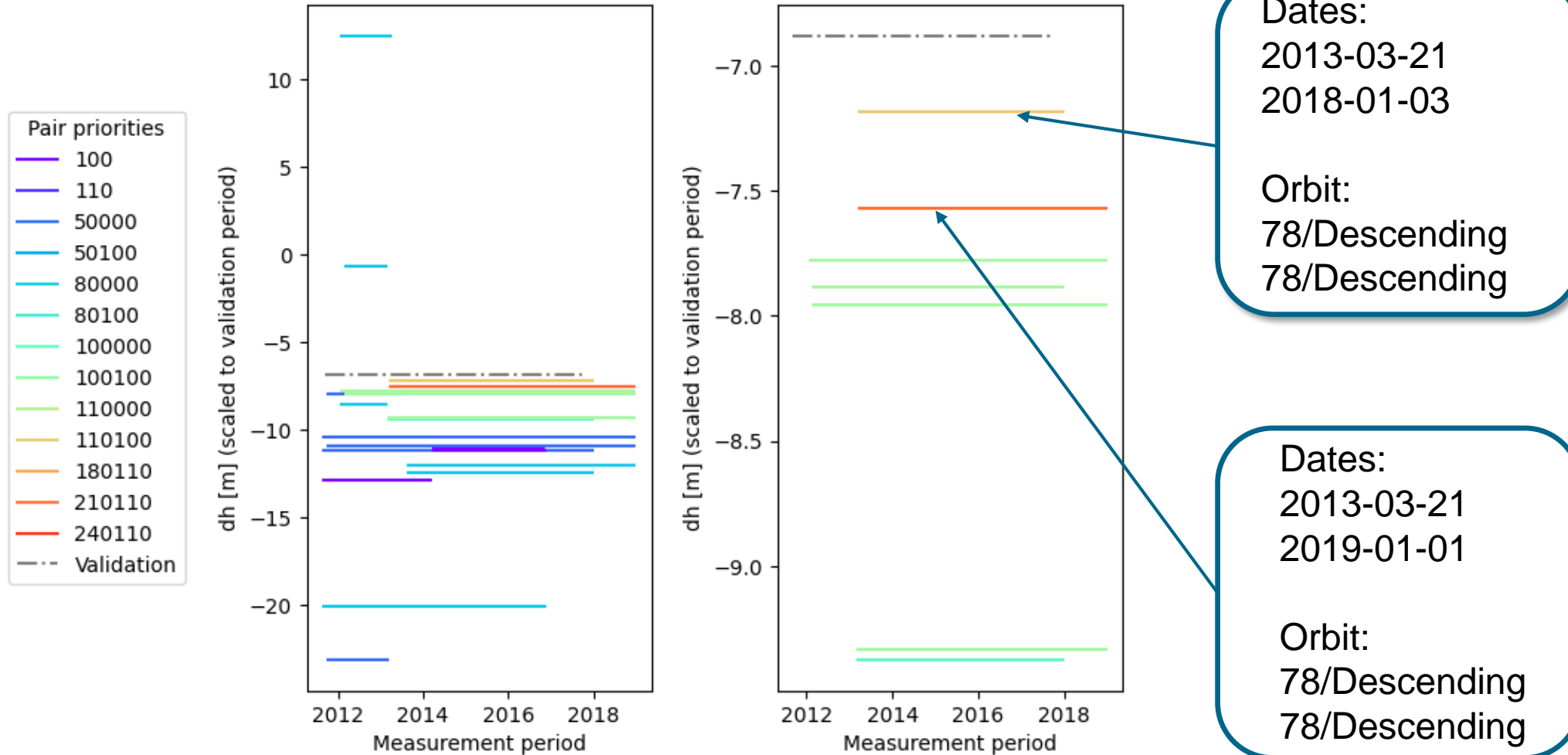


Results - Aletschgletscher

LIDAR Validation data: -6.88 m

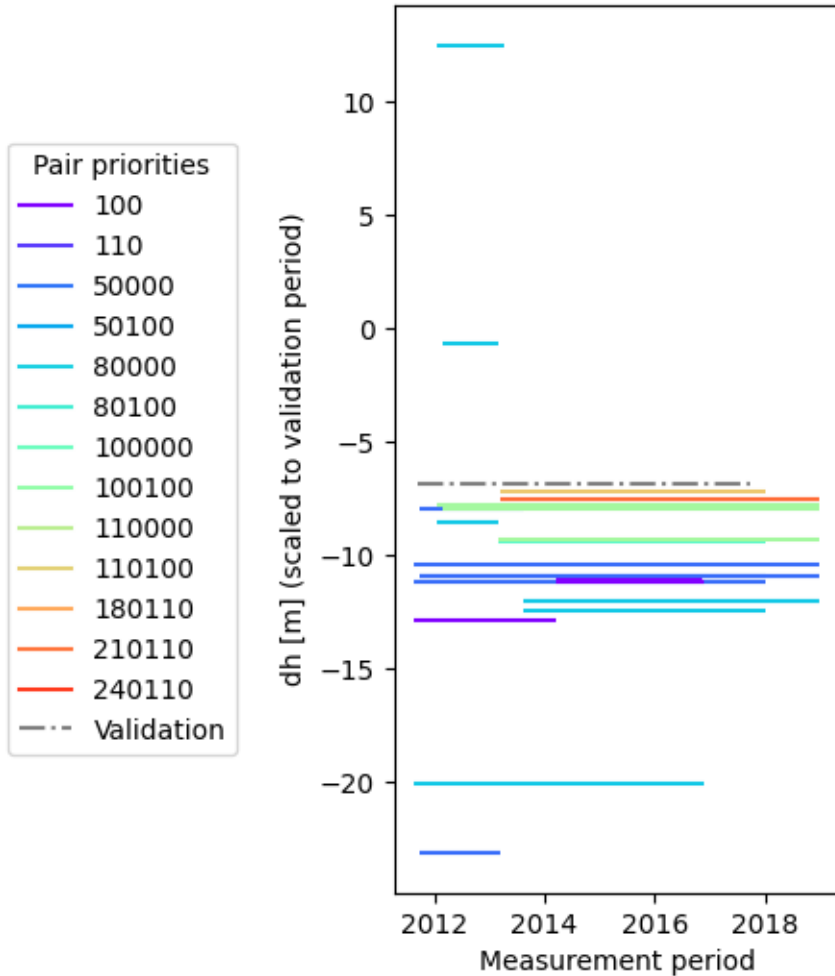


Target: Same SAR geometry in winter

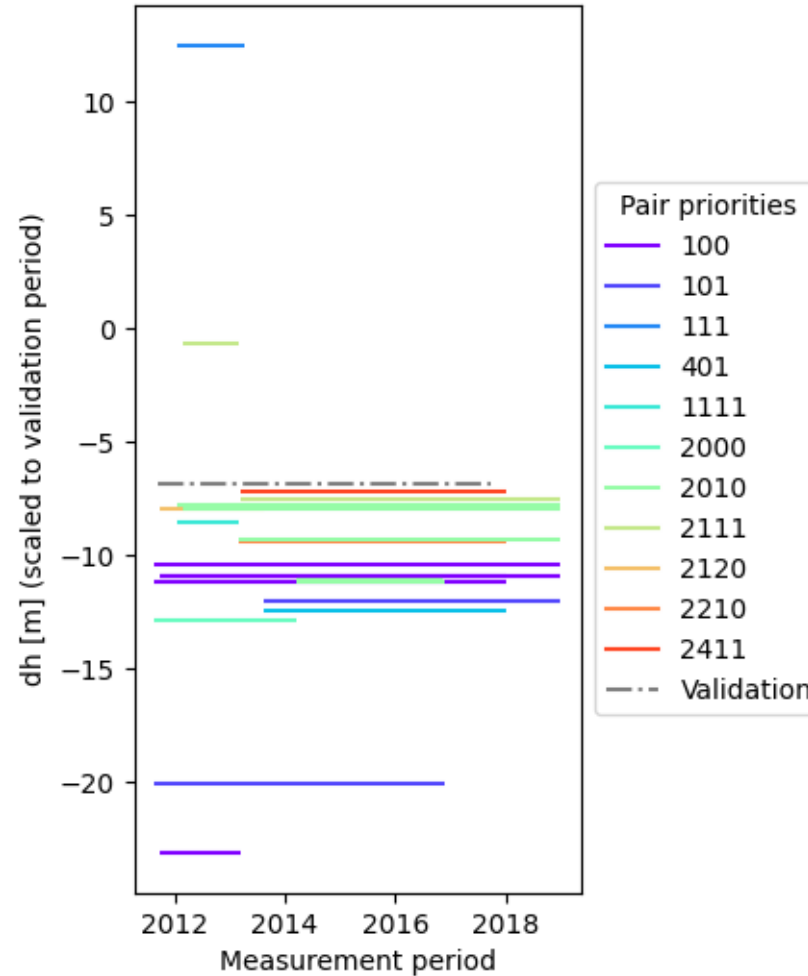


Results - Aletschgletscher

Target: Same SAR geometry in winter



Target: End of ablation season



- Both selection strategies order the scene pairs in a similar way
- In the dataset there are no good scene pairs combining summer pairs (ablation to ablation)

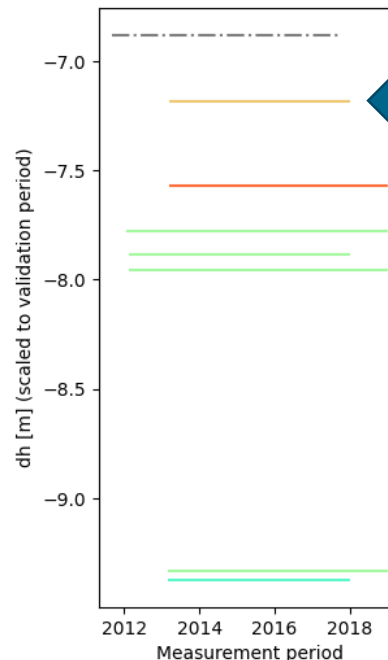
Conclusions



- We outlined two scene selection strategies
- If scenes are properly picked the bias to the validation data reduces to
 - Aletschgletscher: $30 \text{ cm} \pm 5 \text{ cm/yr}$, **11 cm/yr highest priority combination**
- Better results might be possible as the co-registration has not been fine-tuned to specific scene pairs
- Better scene combinations might be available in the TanDEM-X archive because the scenes were pre-selected for the RAGMAC intercomparison exercise
- To fill entire glacier regions with DEM difference mosaics
 - Is it better in some cases to chose extrapolation instead of covering additional area with a bad combination?
 - Can we relax the criteria if signal penetration correction is applied?

General recommendations

- Use the same SAR geometry (crossing orbits should be avoided)
 - This is especially true for small mountain glaciers
- Avoid signal penetration in ice and snow
 - Scene selection in ablation season
 - Scene selection in the same season with the same SAR geometry
 - Algorithmic correction for the penetration bias



Aletsch 2013-03-21 2018-01-03

