Mapping the grounding line of Antarctica in SAR interferograms with machine learning techniques

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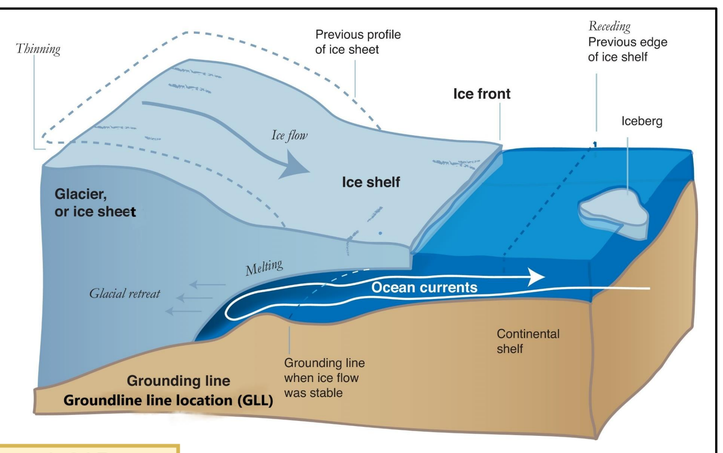
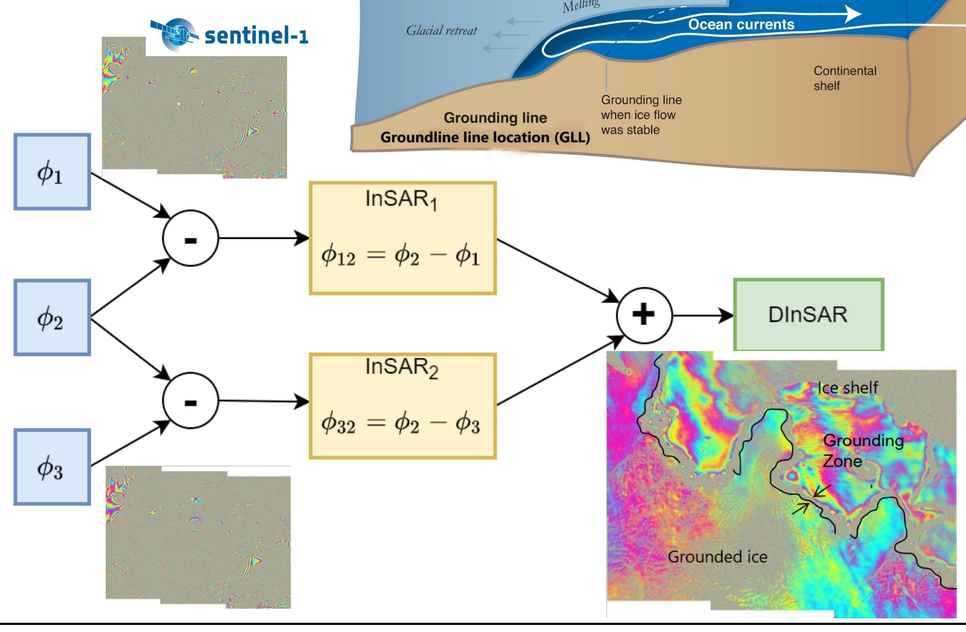
Background

The grounding line marks the transition between ice grounded at the bedrock and the floating ice shelf. Its location is required for estimating ice sheet mass balance, modelling of ice sheet dynamics and for evaluating ice shelf stability, which merits its close monitoring. The line migrates both due to short term influences such as ocean tides and atmospheric pressure, and long-term effects such as changes of ice thickness, slope of bedrock and variations in sea level.



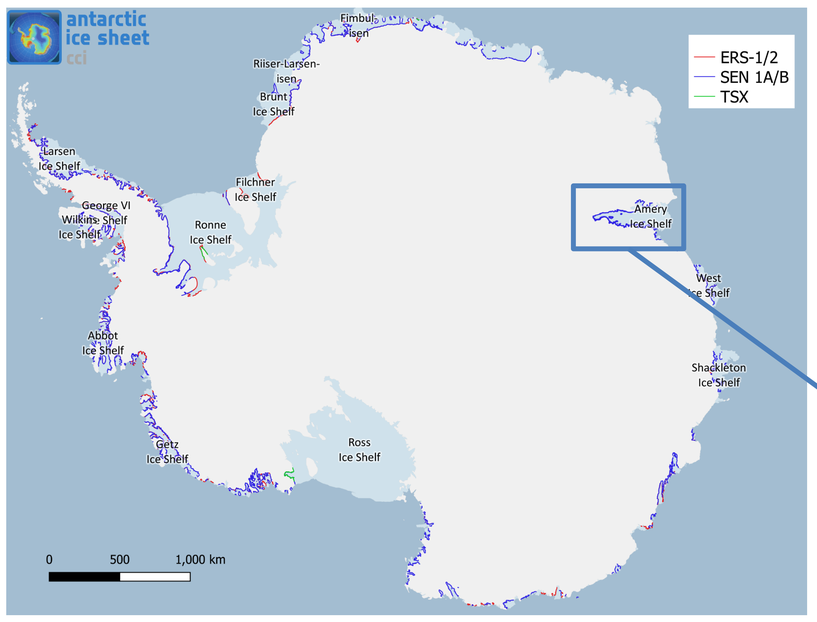
Differential Interferometric SAR (DInSAR) captures the vertical deformation that occurs at the grounding zone due to tidal forcing. The current approach of manually delineating the grounding line location (GLL) on DInSAR interferograms is unfeasible on a large scale and introduces inconsistencies due to the subjective interpretation of human operators.



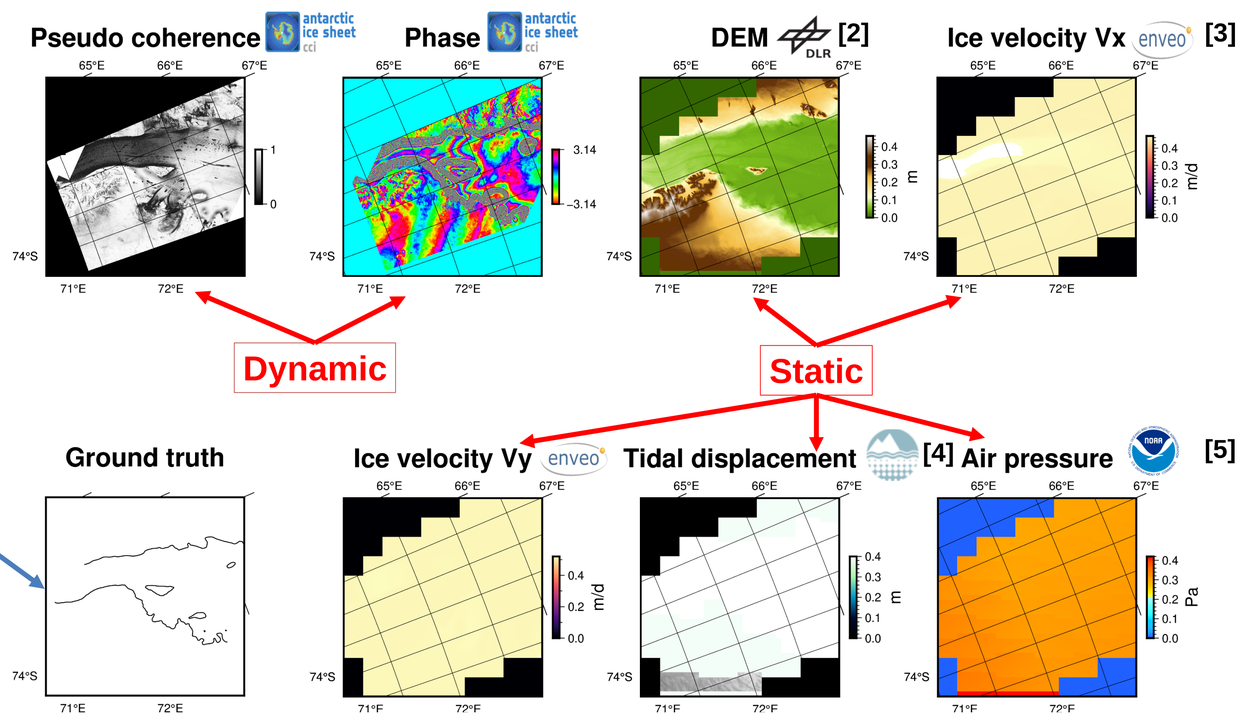
Aims of this study:

- Feasibility of automating grounding line delineation on DInSAR interferograms with deep neural networks (DNNs)
- Investigating the effects of complementary features – coherence, elevation information, ice velocity, tidal amplitudes and atmospheric pressure in addition to wrapped phases of DInSAR interferograms used for training the DNNs

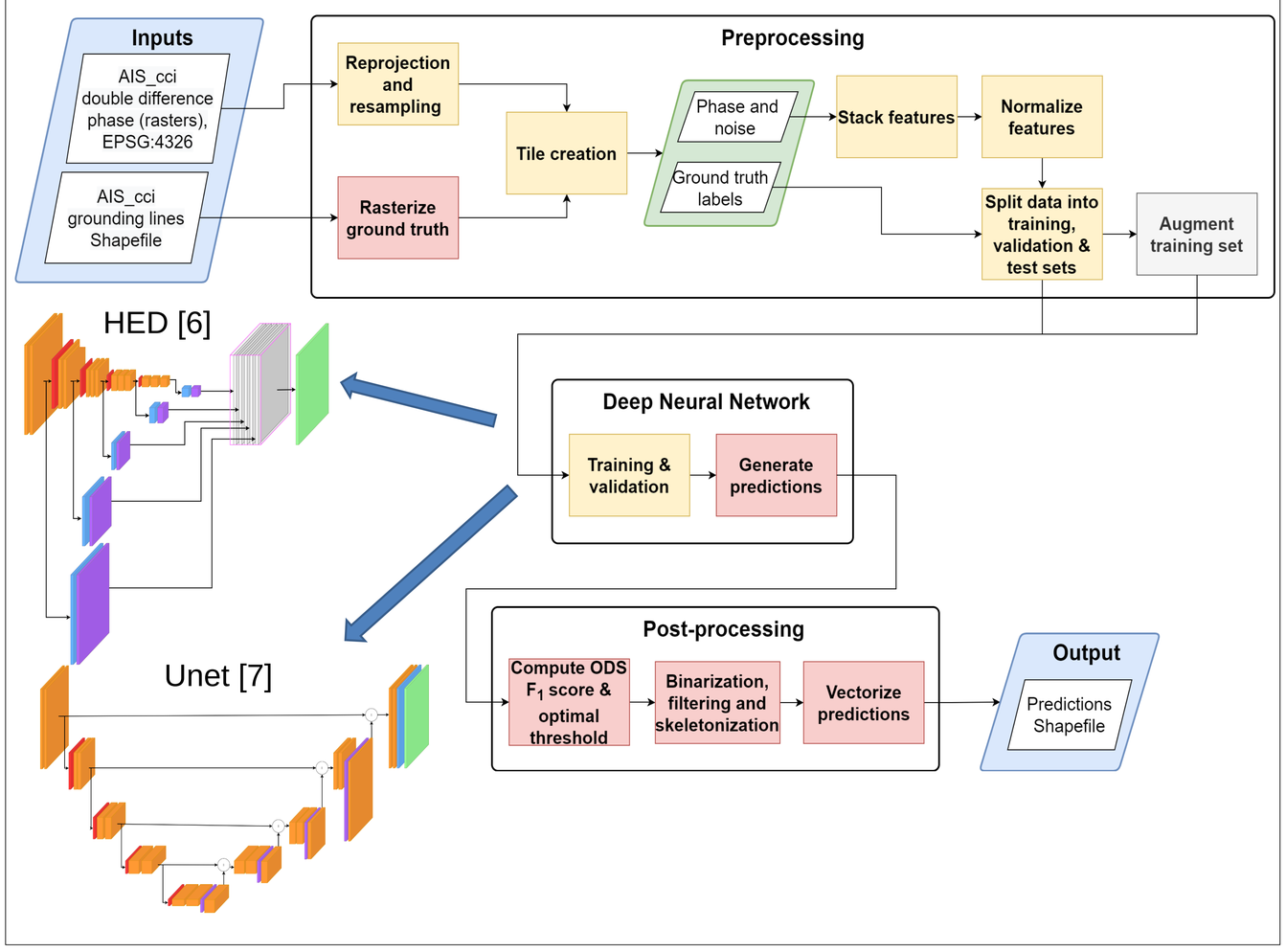
Dataset



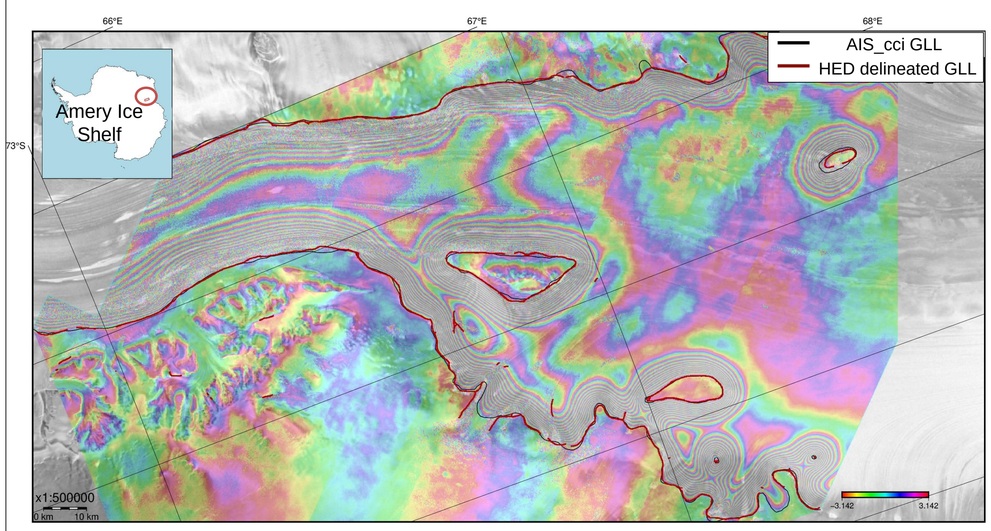
Manually delineated GLLs Antarctic Ice Sheet climate change initiative (AIS_cci) [1]



Processing chain



Results



- HED detects complex GLL geometries in a fraction of the time it takes for manual delineation
- The best performing model (trained on real and imaginary features only) achieves a median deviation of **209 m** from AIS_cci
- DEM, ice velocity, tidal displacement and air pressure do not significantly contribute to the predictions
- HED outperforms UNet

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