Antarctic Research Centre
Te Pūtahi Rangahau i te Kōpakatanga ki te Tonga

TE WHARE WĀNANGA O TE ŪPOKO O TE IKA A MĀUI
VICTORIA UNIVERSITY OF WELLINGTON

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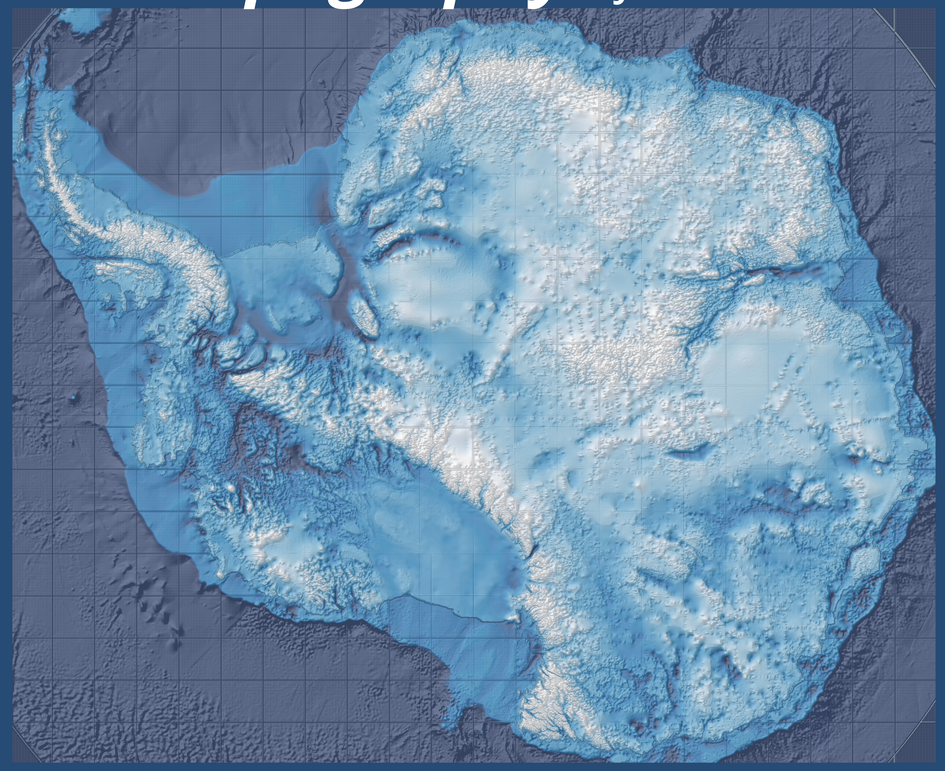
DeepBedMap

*Using **deep learning** to better resolve the **bed topography** of **Antarctica***



4x higher resolution (250m) DEM

than BEDMAP2 using a

Convolutional Neural Network

*trained on **remote sensing** data*

Photography encouraged

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This presentation participates in OSPP
Outstanding Student Poster & PICO Contest

1) Super-Resolution model

Not just a fancy BEDMAP2[1] interpolator. The neural neural network is **conditioned** with high resolution i**ce surface datasets**!

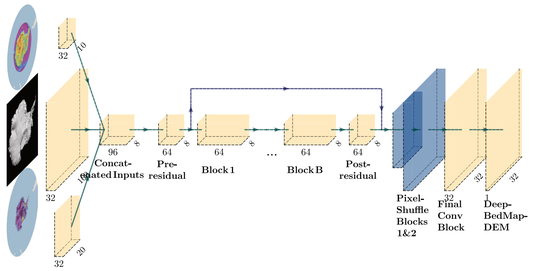

Fig 1: DeepBedMap **model architecture** adapted from the **Enhanced Super Resolution Generative Adversarial Network**[2]. The three inputs are: 1) **BEDMAP2**[1] (1000m); 2) **Reference Elevation Model of Antarctica**[3] (100m); 3) **MEaSUREs Ice Velocity**[4] (450m, resampled to 500m).

2) Results

Our model **matches** independent **groundtruth** observations **better than** simple **bicubic** interpolation.

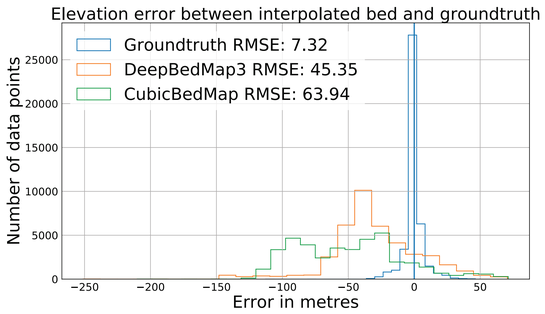

Figure 2: Histogram showing point-to-point elevation errors between grid products and actual raw groundtruth survey points from a test area at Pine Island Glacier independent from our training set. Our **DeepBedMap** model has a distribution closer to the groundtruth, with a Root Mean Squared Error (**RMSE)** about 18.6 metres lower than baseline bicubic interpolation.

References

1 Fretwell et al., 2013. doi:10.5194/tc-7-375-2013
2 Wang et al., 2018. arXiv:1809.00219
3 Howat et al., 2019. doi:10.5194/tc-13-665-2019
4 Rignot et al., 2011. doi:10.1126/science.1208336
5. Graham et al., 2017. doi:10.5194/essd-9-267-2017

3) Applications

- For i**ce sheet modellers** running **catchment-scale** simulations
- For **glaciologists** working on Antarctica's **subglacial hydrology** and **ice flow dynamics**

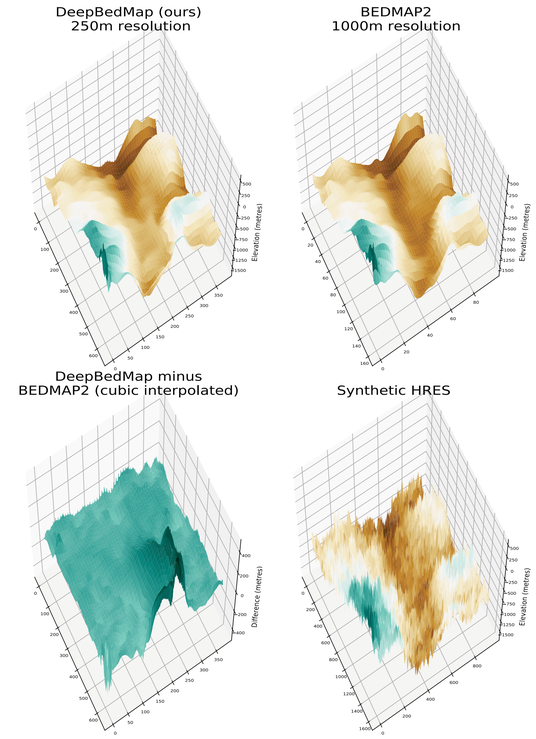

Fig 3: Closeup 3D perspective view of topography over Pine Island Glacier, West Antarctica. We compare our DeepBedMap generated DEM with BEDMAP2 (cubic interpolated to 250m resolution) and a 100m synthetic high resolution product[5]. Elevation is referenced to the WGS84 ellipsoid.

4) Next steps

Better data => Better model

- Add other glaciologically relevant datasets e.g. **surface accumulation** and **ice surface elevation change**
- Model performance will improve when trained with more **high-resolution groundtruth grids**.

Acknowledgements

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