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1) Super-Resolution Model

Not just a fancy BEDMAP2¹ interpolator.
The neural network is conditioned with
high resolution ice surface datasets!

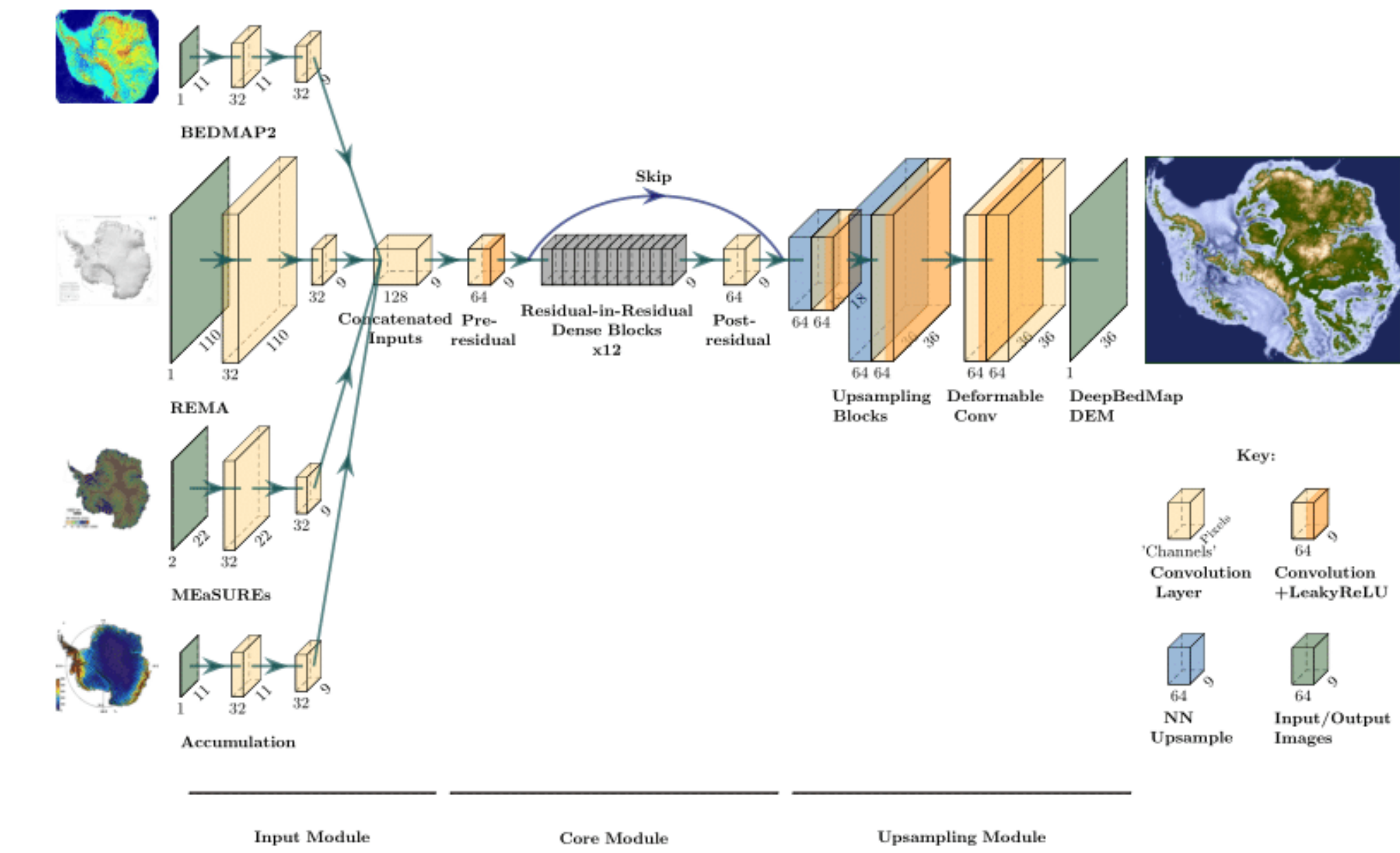


Fig 1: DeepBedMap model architecture adapted from the Enhanced Super Resolution Generative Adversarial Network². The four inputs are: 1) BEDMAP2¹ (1km); 2) Reference Elevation Model of Antarctica³ (100m); 3) MEaSUREs Phase-based Ice Velocity⁴ (500m resampled); 4) Snow Accumulation⁵ (1km).

2) Results

Our model can produce a **rougher** bed topography that **matches** groundtruth observations better.

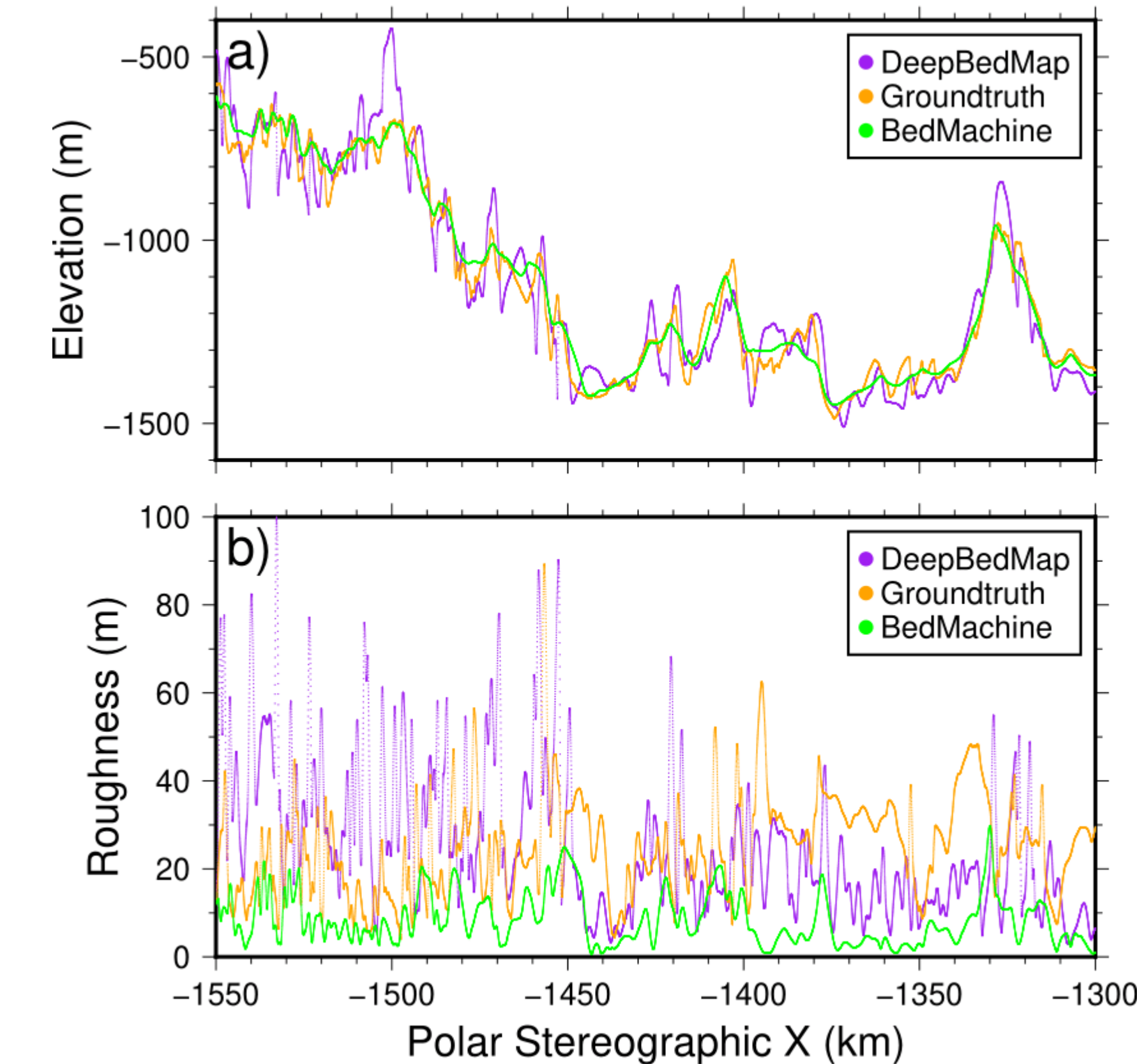


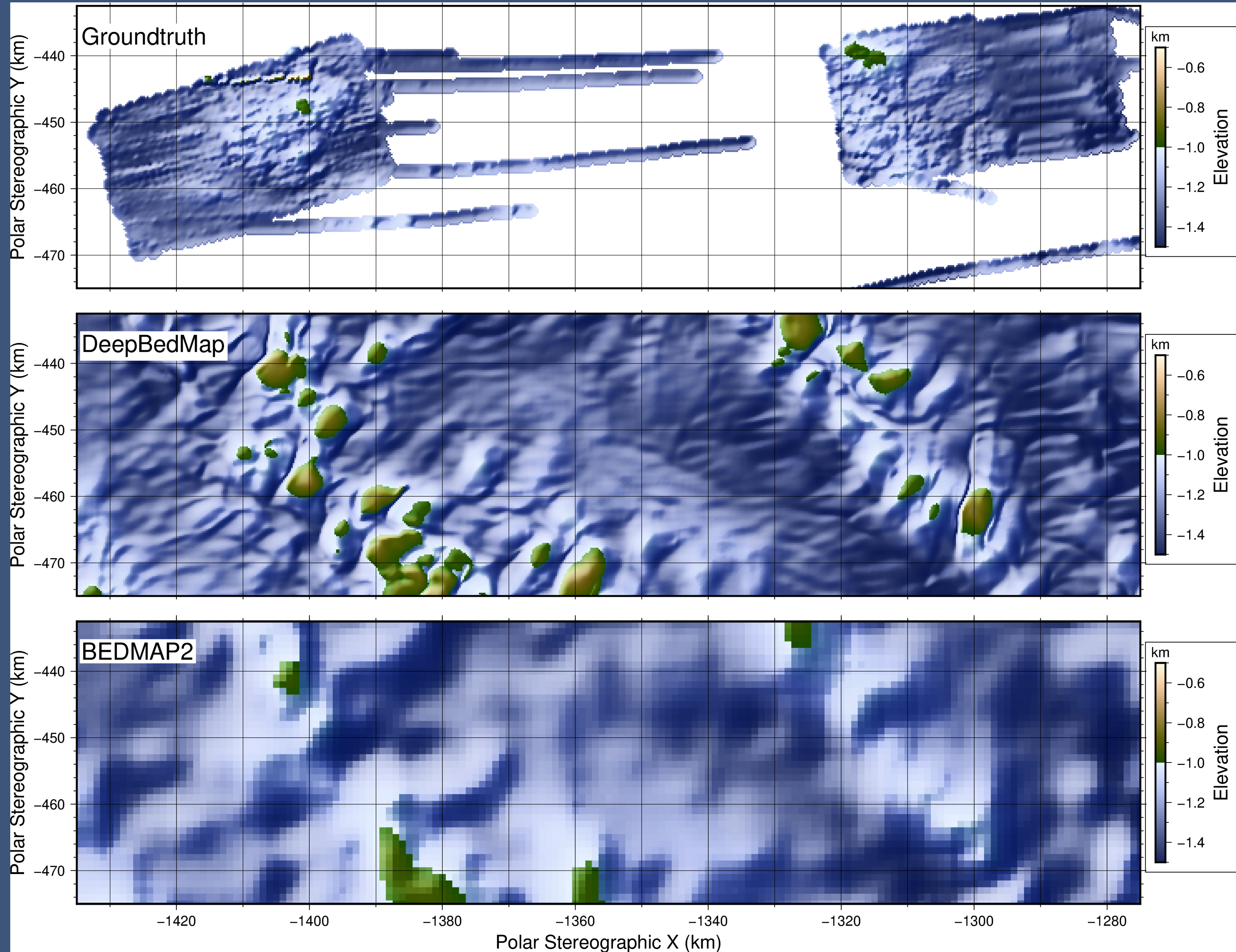
Fig. 2: Comparing **bed elevation** and **surface roughness** (standard deviation of elevation values) of each interpolated grid product (250 m resolution) over a transect. Purple values are from the super resolution DeepBedMap DEM; Orange values are from tension spline interpolated Operation IceBridge **groundtruth** points; Green values are from bicubic interpolated **BedMachine** Antarctica⁶.

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. Mouginot et al., 2019. doi:10.1029/2019GL083826
5. Arthern et al., 2006. doi:10.1029/2004JD005667
6. Morlighem et al., 2019 doi:10.1038/s41561-019-0510-8
7. Graham et al., 2017. doi:10.5194/essd-9-267-2017

DeepBedMap

Resolving the
*bed topography of Antarctica with
a deep neural network*



*4x higher resolution (250m) DEM
than BEDMAP2 using a
Convolution Neural Network
trained on remote sensing data*



Dataset (beta)
<https://osf.io/96apw>

Code (Open Source)
<https://github.com/weiji14/deepbedmap>

Preprint (in review)
<https://doi.org/10.5194/tc-2020-74>

3) Applications

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

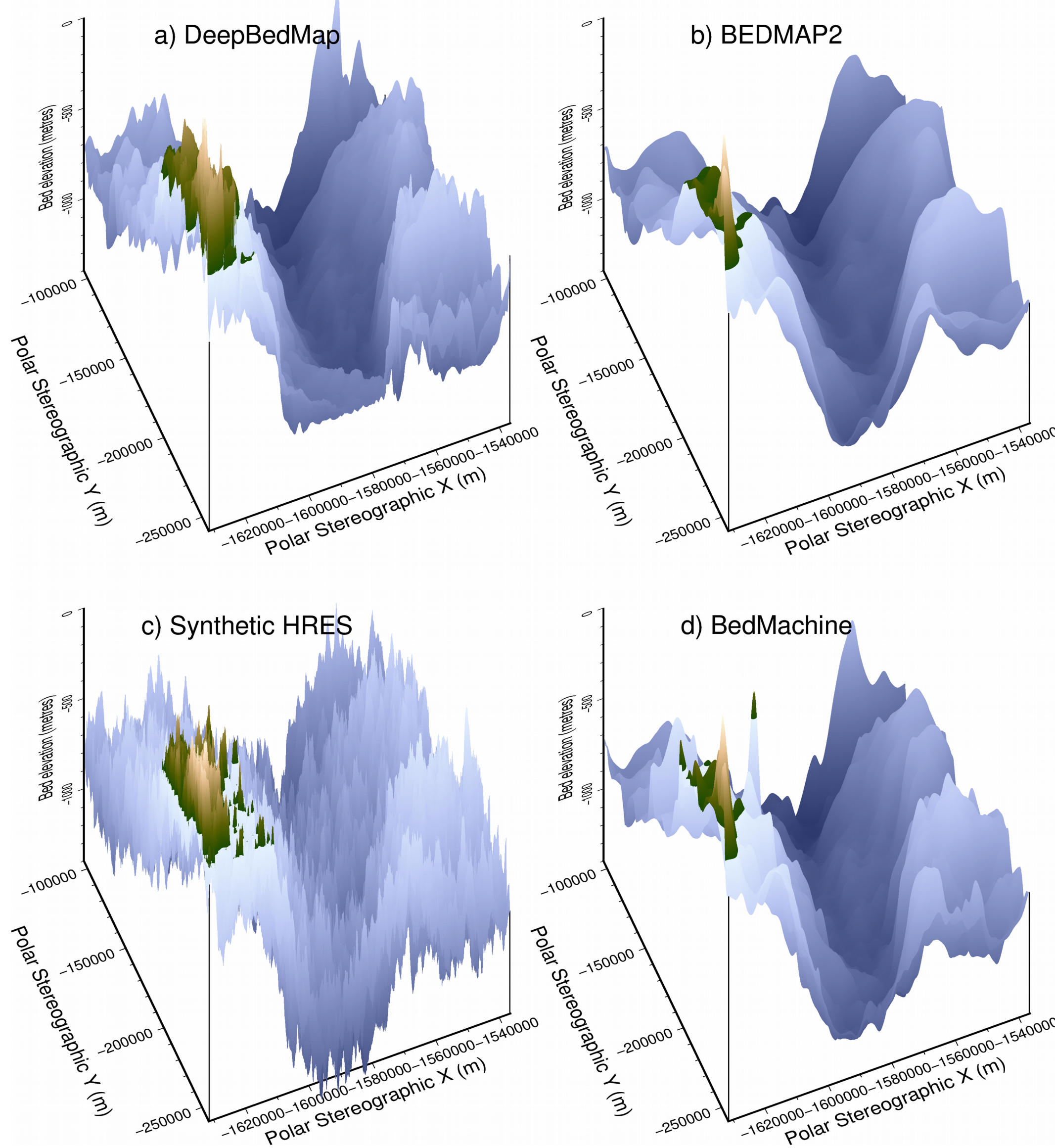


Fig 3: Closeup 3D perspective view of **bed topography** over Pine Island Glacier, West Antarctica. We compare the DeepBedMap DEM with BEDMAP2¹, a Synthetic high resolution grid⁷ and BedMachine Antarctica⁶.

4) Next steps

Better data => Better model

- Model performance will improve when trained with more **high-resolution grids** (e.g. from swath radar data)
 - Combine **super-resolution** with **mass conservation** techniques.
- DeepBedMap+BedMachine=>BEDMAP3?**

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