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Calibrating calving parameterizations using graph neural network emulators: application to Helheim Glacier, East Greenland

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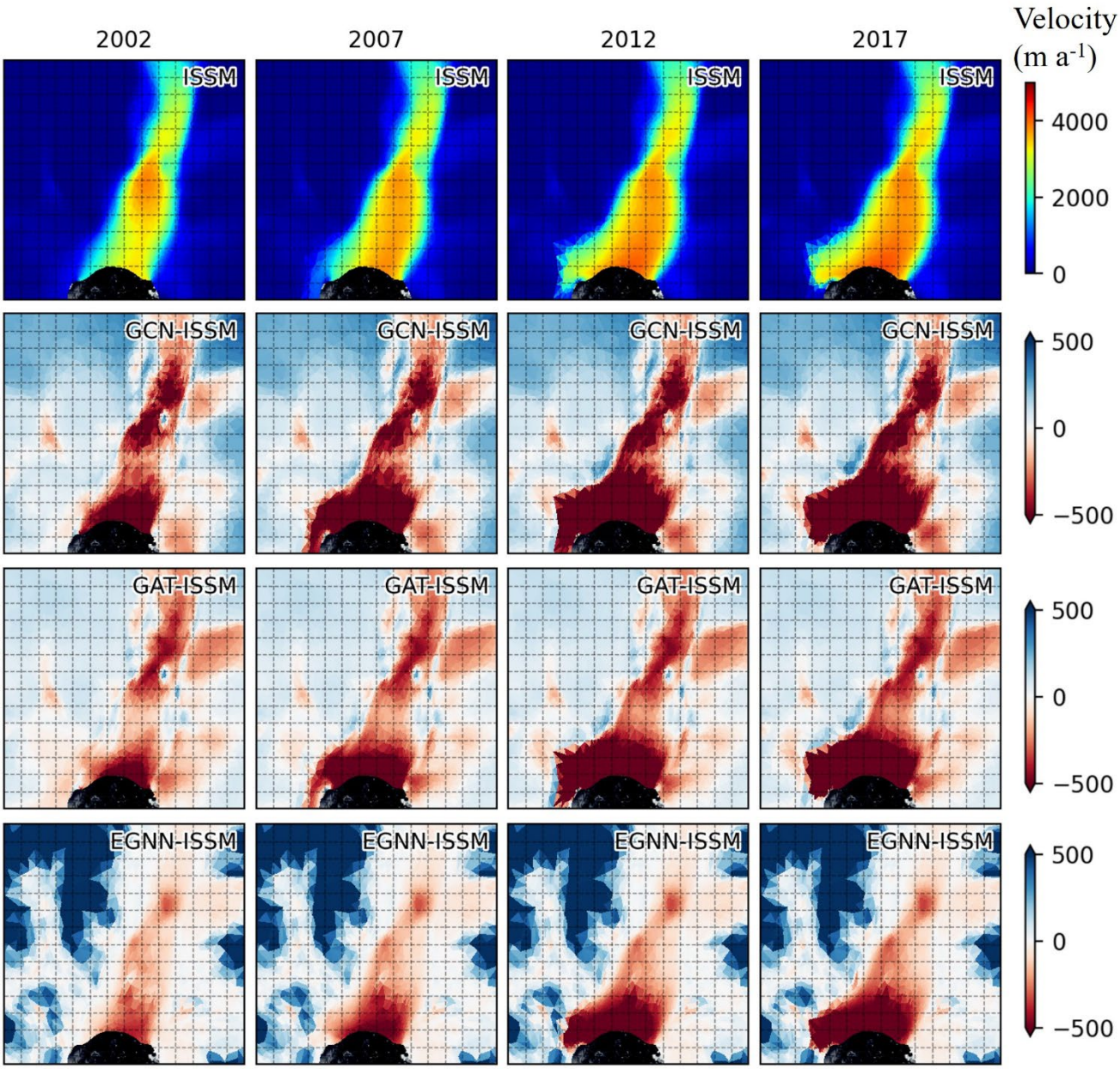

Figure S1. Maps of ISSM-simulated ice velocity in the Pine Island Glacier, Antarctica, and difference of ice velocity between GNN emulators (trained for Helheim glacier) and ISSM simulations (GCN, GAT, and EGCN from top to bottom). The grid size is 10 km. Detailed simulation settings can be found in Koo and Rahnemoonfar (2025).

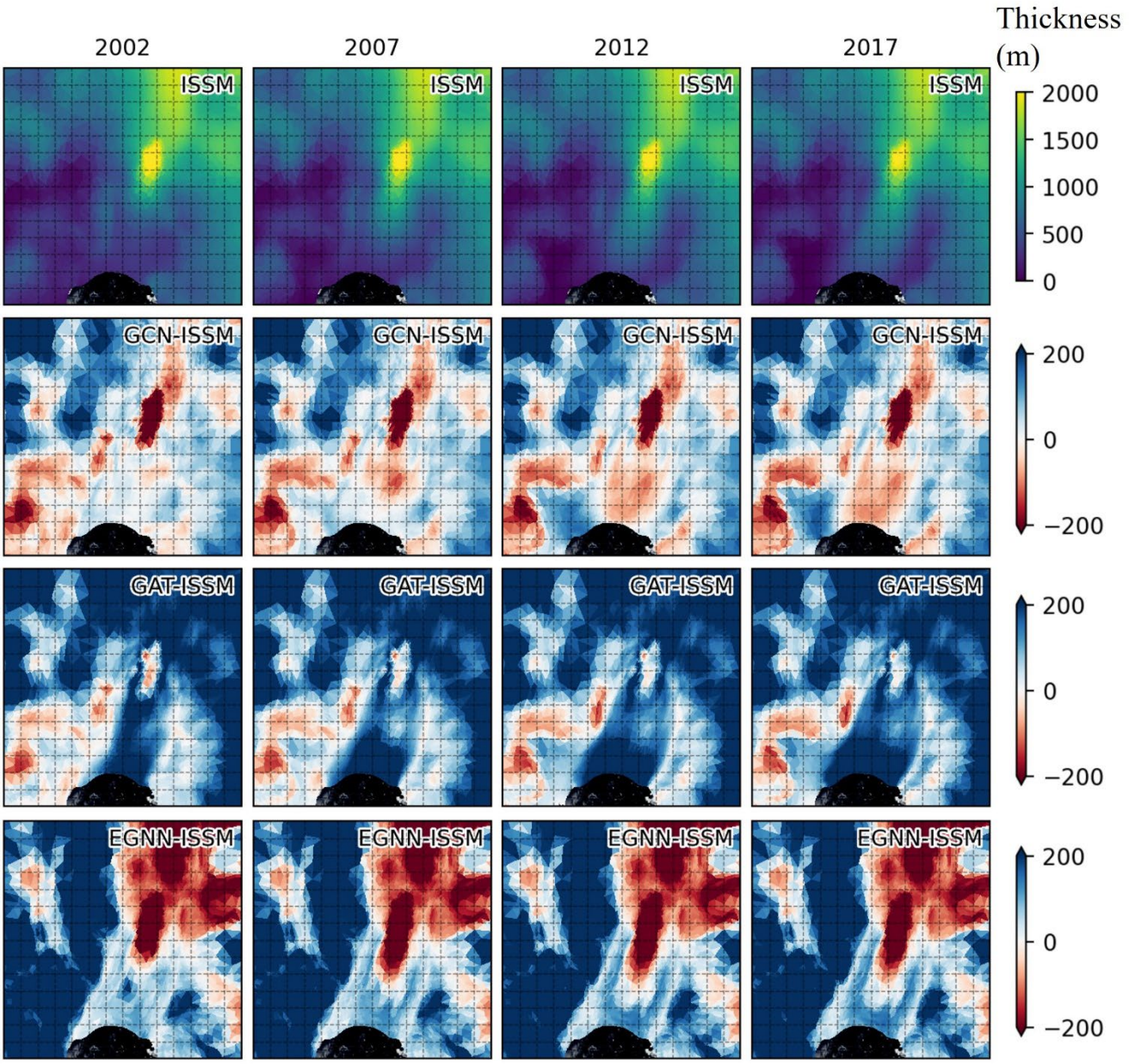

Figure S2. Maps of ISSM-simulated ice thickness in the Pine Island Glacier, Antarctica, and difference of ice thickness between GNN emulators (trained for Helheim glacier) and ISSM simulations (GCN, GAT, and EGCN from top to bottom). The grid size is 10 km. Detailed simulation settings can be found in Koo and Rahnemoonfar (2025).

Table S1. Ice velocity RMSE and ice thickness RMSE of GNN emulators (trained for Helheim glacier) for the Pine Island Glacier, Antarctica.

Model	Ice velocity RMSE	Ice thickness RMSE
GCN	372.1 m a^{-1}	127.0 m
GAT	266.8 m a^{-1}	190.8 m
EGCN	228.9 m a^{-1}	207.6 m

References

Koo, Y. and Rahnemoonfar, M.: Graph convolutional network as a fast statistical emulator for numerical ice sheet modeling, Journal of Glaciology, 71, e15, https://doi.org/10.1017/jog.2024.93, 2025.