EarthGAN: Can we visualize the Earth's mantle convection using a surrogate model?

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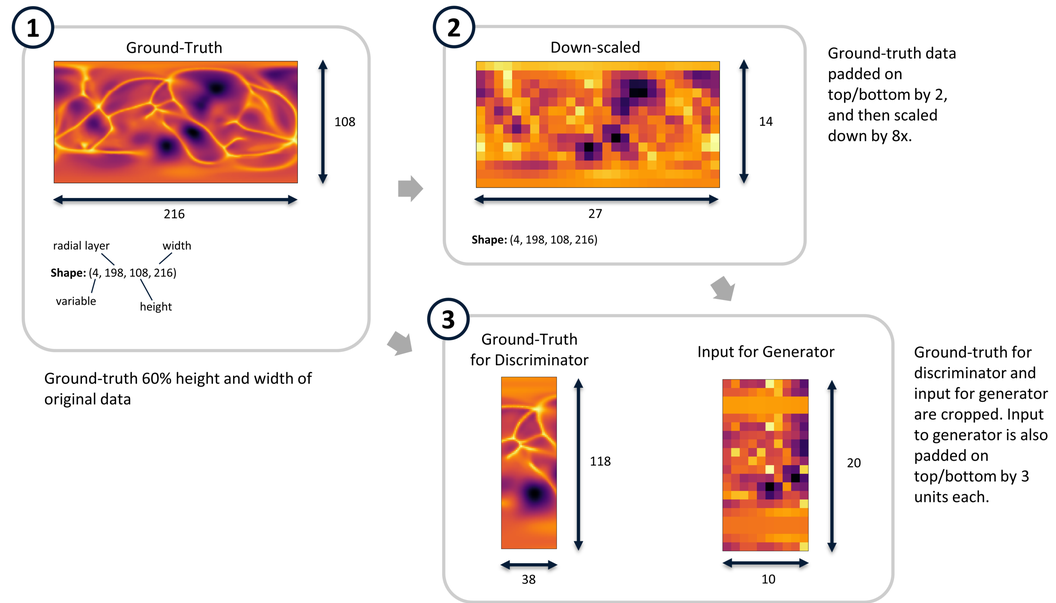
1. Challenge: Can we create a surrogate model of the Earth's mantle convection data set, using deep learning, and leverage it for real-time visualization? The final surrogate model must run locally (no off-premises computing), in a web browser, and be of similar visual fidelity to the original data set.

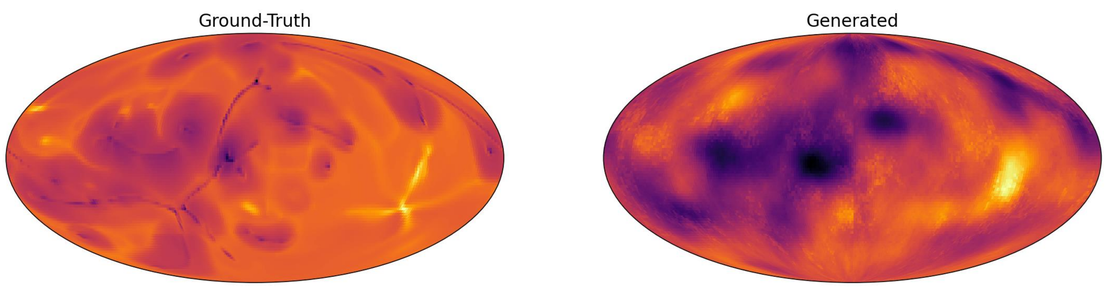
2. Why?: Expensive hardware is required to visualize the results of complex scientific simulations. With a surrogate model, the cost of visualizing the data is paid for once, upfront, during model training. Ideally, it is inexpensive to query the surrogate model, and readily accessible to the general public.

3. How: Utilize generator adversarial network (GAN), as implemented by Li et al. [1], to train surrogate model.

4. Data Prep: The process of preparing the data: 1) The ground-truth data is scaled to 60% of original size. 2) The data is down-scaled by 8-times. 3) The ground truth, used in the discriminator, is cropped. The input to the generator is also cropped.



5. Preliminary Results: Preliminary results are promising, and current work focuses on generating fine features. Next steps: multi-GPU training; use larger generator and discriminators; enhance input to discriminator with additional features.



All work is open-sourced and available at **earthgan.com** (redirects to GitHub).

Ideas, suggestions, and collaboration welcome! Reach out via email (18tcvh@queensu.ca), GitHub, or Twitter (@timothyvh).

[1] Y. Li, Y. Ni, R. A. Croft, T. Di Matteo, S. Bird, and Y. Feng, "AI-assisted superresolution cosmological simulations," *Proc. Natl. Acad. Sci.*, vol. 118, no. 19, 2021.