Lamont-Doherty Earth Observatory
## COLUMBIA UNIVERSITY | EARTH INSTITUTE

Making 3D printing Accessible for Science Education

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3D printing technology has been embraced by many technical fields, and is rapidly making its way into peoples' homes and schools. While there is a growing educational and hobbyist community engaged in the STEM focused technical and intellectual challenges associated with 3D printing, there is unrealized potential for the earth science community to use 3D printing to communicate scientific research to the public. Moreover, 3D printing offers scientists the opportunity to connect students and the public with novel visualizations of real data. As opposed to introducing terrestrial measurements through the use of colormaps and gradients, scientists can represent 3D concepts with 3D models, offering a more intuitive education tool. Furthermore, the tactile aspect of models make geophysical concepts accessible to a wide range of learning styles like kinesthetic or tactile, and learners including both visually impaired and color-blind students.
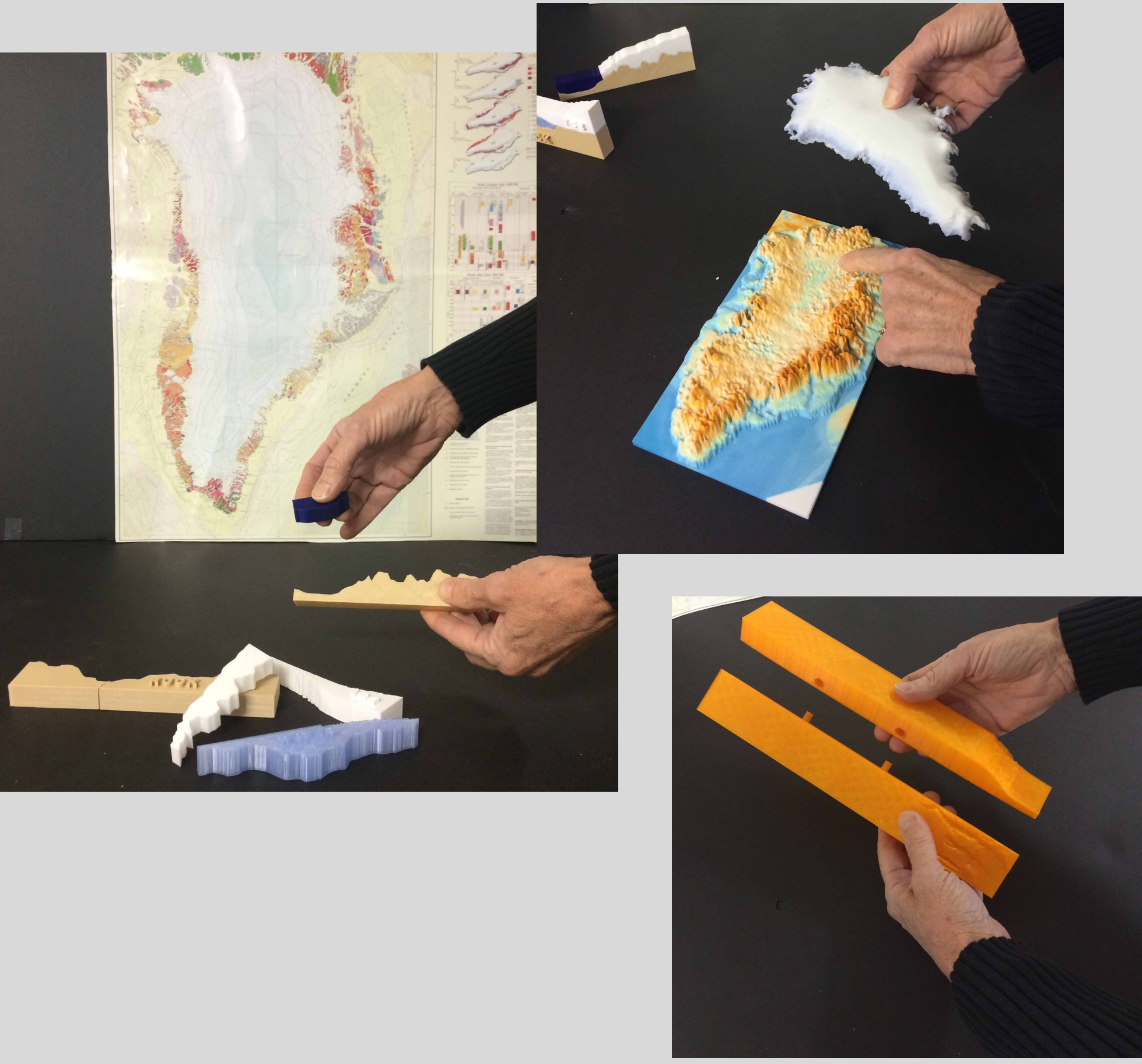
We present a workflow whereby scientists, students, and the general public will be able to 3D print their own versions of geophysical datasets, even adding time through layering to include a 4th dimension, for a "4D" print. This will enable scientists with unique and expert insights into the data to easily create the tools they need to communicate their research. It will allow educators to quickly produce teaching aids for their students. Most importantly, it will enable the students themselves to translate the 2D representation of geophysical data into a 3D representation of that same data, reinforcing spatial reasoning.

Import data

1D
profiles
line plots

InkScape
extrude
path to OpenSCAD

OpenSCAD
scale, export .stl

TinkerCad
create letters, export .stl

MakerWare
select infill, extrusion, rate,
temperature, raft

Print MakerBot

2D
topography grids
rasters
images

QGIS
scale, smooth
export black and white .png

hmstl
export to .stl

MakerWare
Select infill, extrusion
rate, temperature, raft

Print MakerBot

ArcMap   Clip
Export .vrml

Create colormap
Export 8 bit TIF

MATLAB
scale, export .stl

OpenSCAD
import .stil
create desired model
export .stl

MakerWare
Select infill, extrusion
rate, temperature, raft

Print MakerBot

3D
forams, brine chanels,
tomography, 3D scans

4D
stacked layers at different points in time

Meshlab
delete bad points

Rhinoceros
export .stl

MakerWare
Select infill, extrusion
rate, temperature, raft

Print MakerBot

Apply colormap to .stl

Print ZCorp Printer