High resolution land grids

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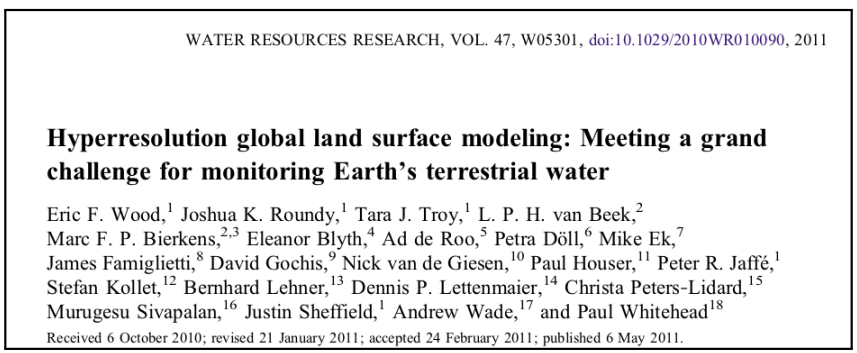
Motivation

- From Dave's plenary talk regarding E3SM's development strategy
  Resolution - *weather-scale to convective scale-atmosphere and eddy-resolving ocean for simulation of multi-scale phenomena*
- In my opinion, the land team has not identified the appropriate target resolution for the ELM
- Few recent publications have proposed spatial resolution for a next-generation global LSM


WATER RESOURCES RESEARCH, VOL. 47, W05301, doi:10.1029/2010WR010090, 2011

Hyperresolution global land surface modeling: Meeting a grand challenge for monitoring Earth's terrestrial water

Eric F. Wood,[1] Joshua K. Roundy,[1] Tara J. Troy,[1] L. P. H. van Beek,[2] Marc F. P. Bierkens,[2,3] Eleanor Blyth,[4] Ad de Roo,[5] Petra Döll,[6] Mike Ek,[7] James Famiglietti,[8] David Gochis,[9] Nick van de Giesen,[10] Paul Houser,[11] Peter R. Jaffé,[1] Stefan Kollet,[12] Bernhard Lehner,[13] Dennis P. Lettenmaier,[14] Christa Peters-Lidard,[15] Murugesu Sivapalan,[16] Justin Sheffield,[1] Andrew Wade,[17] and Paul Whitehead[18]

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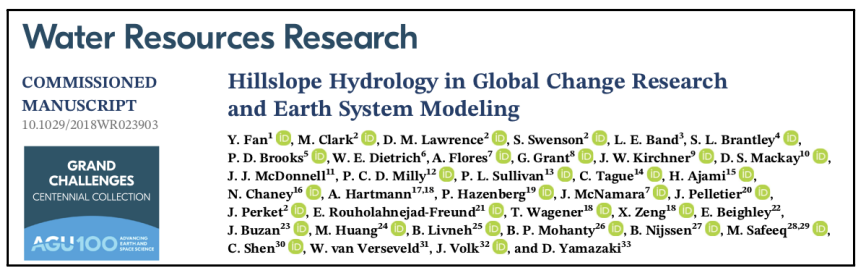
Target resolution 1 km


Water Resources Research

COMMISSIONED MANUSCRIPT
10.1029/2018WR023903

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Hillslope Hydrology in Global Change Research and Earth System Modeling

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Target resolution 20 km

- ELM is ≈3% of the total computational cost for A_WCYCL1950_HR at ne120 resolution[1]

[1] Data provided by Noel Keen

Size of land surface dataset netcdf

Resolution	# grid cells	Size of surface dataset
ne120 (25.0km)	777,602	6.5GB
ne240 (12.5km)	3,110,402	26.0GB
ne512[1] (6.50km)	14,155,778	118.0GB
ne1024[1] (3.25km)	56,623,112	473.0GB
ne2048 (1.60km)	226,492,448	1892.0GB

[1]Grids that will be used by the SCREAM project

Values in blue and red are estimated values based on size of currently supported dataset.

Current workflow for creating surface dataset

1. A grid file is generated for the new resolution. The grid could be structured or unstructured.
2. Generate 16 mapping files to remap "raw" surface datasets from their native resolution to the new grid.
3. Create the land surface dataset at the new resolution using mapping files and raw surface datasets.

Proposed high resolution grid for ELM

- Use a Delaunay triangular horizontal mesh to ensure planar grids
- Leverage the grid generation tool, JIGSAW, that is being used by MPAS

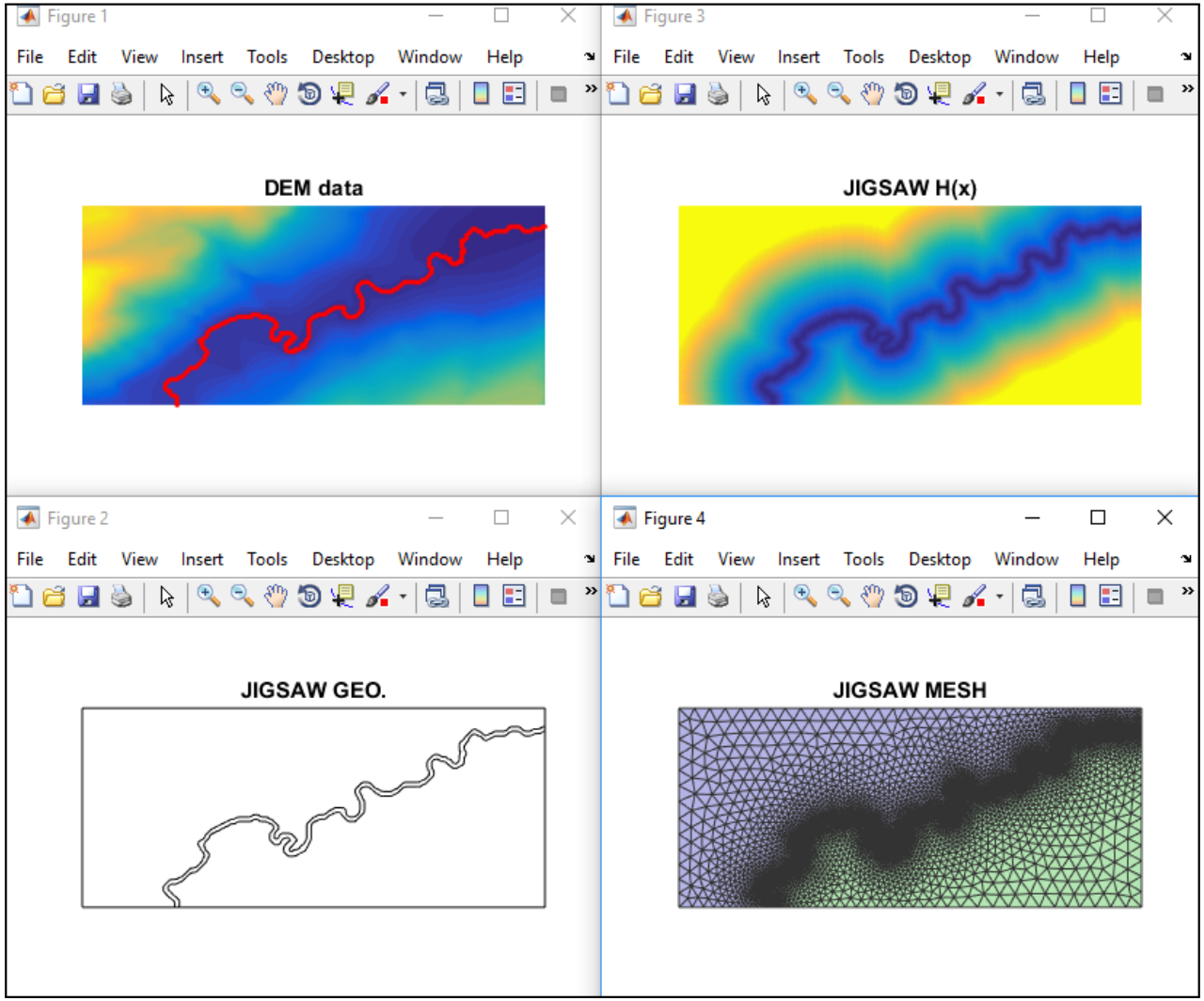

Image source: Darren Engwirda (Columbia Univ.) DEM source: Dipankar Dwivedi (LBNL)