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Collaborative Research: SI2-SSI: Landlab: A Flexible, Open-Source Modeling Framework for Earth-Surface Dynamics

PI: Greg Tucker, Co-Pis: Nicole Gasparini, Erkan Istanbuluoglu, Dan Hobley
Institutions: University of Colorado, Tulane University, University of Washington



Core Landlab Team:

G. Tucker¹, N. Gasparini², E. Istanbuluoglu³, D. Hobley⁴,
E. Huton¹, J. Adams², K. Barnhart¹, S. Nudurupati³,
C. Bandaragoda³, N. Lyons²,
a python toolkit for modeling earth surface processes

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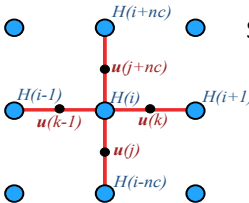
What is Landlab?

<http://landlab.github.io/#/>

An open-source, Python library that helps geoscientists efficiently develop 2D grid-based numerical models by providing:

- Building-block functionality for creating different terrain representations and surface/subsurface connectivity;
- A set of pre-built model **components**, each of which represents a particular landscape process;
- A framework for developing **drivers** that combine components into multi-process models.

Terrain representation

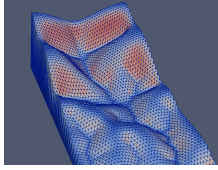
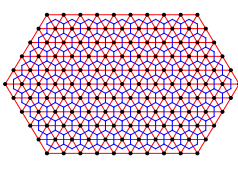
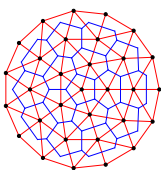


Scalars calculated at nodes (eg., H : water depth)
Vectors calculated at links (eg., u : flow velocity)

Structured or unstructured 2D grid can be created with a few lines of code:

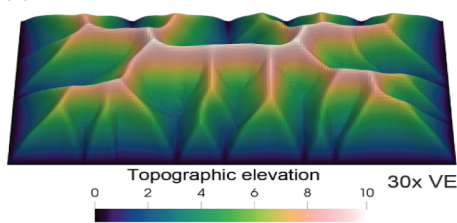
```
mg = RasterModelGrid(numrows, numcols, dx)  
z = mg.add_zeros('node', 'elevation') # node elevation
```

```
grid = RadialModelGrid((3, 5)) grid = HexModelGrid(11, 10)
```

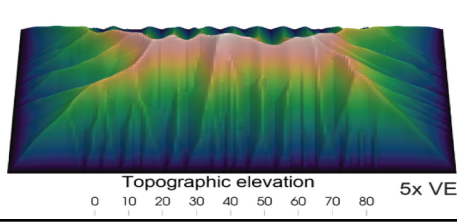


Landscape evolution (Barnhart et al., 2019)

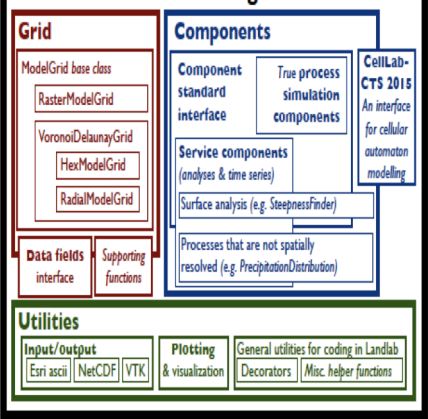
(a) Basic



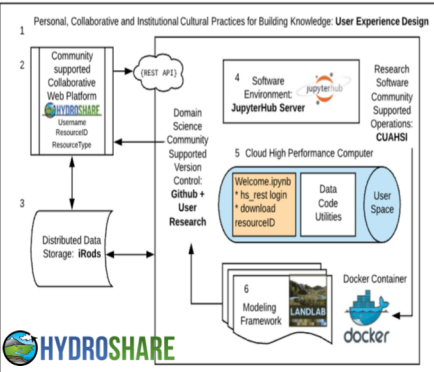
(b) Basic with $m = 0.25$



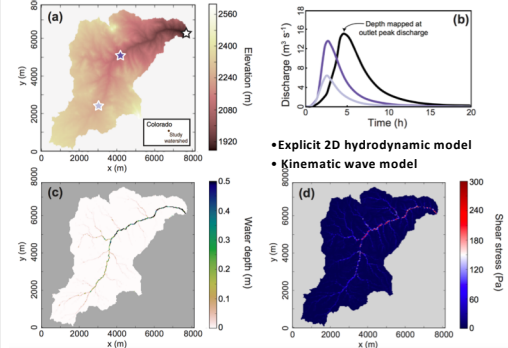
The LANDLAB modelling framework



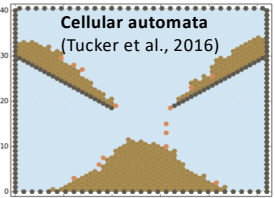
Cloud computing on Hydroshare (Bandaragoda et al., 2019)



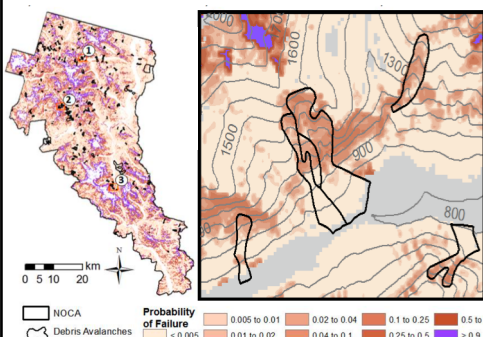
Flood routing (Adams et al., 2017)



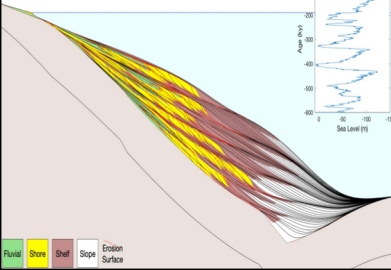
- Landlab flood routing components route 2D overland flow driven by runoff to calculate flow depth, discharge, velocity, and sediment transport across a watershed.
- 2-D continuous-time stochastic cellular automaton simulations can be developed with Landlab.



Landslide risk (Strauch et al., 2018)



Basin stratigraphy (Steckler et al., in prep)



Affiliations:

1. University of Colorado, Boulder, CO
2. Tulane University, New Orleans, LA
3. University of Washington, Seattle, WA
4. Cardiff University, UK

Vegetation modeling:

Landlab can be used to explore impacts of global change on vegetation, soil, and water resources resource.

