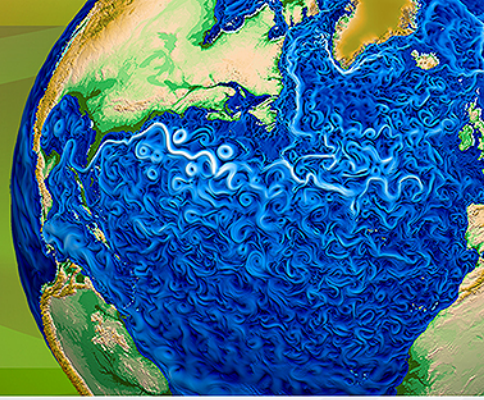
ACME
Accelerated Climate Modeling for Energy



A New Topography-based Subgrid Architecture for Land Surface Modeling

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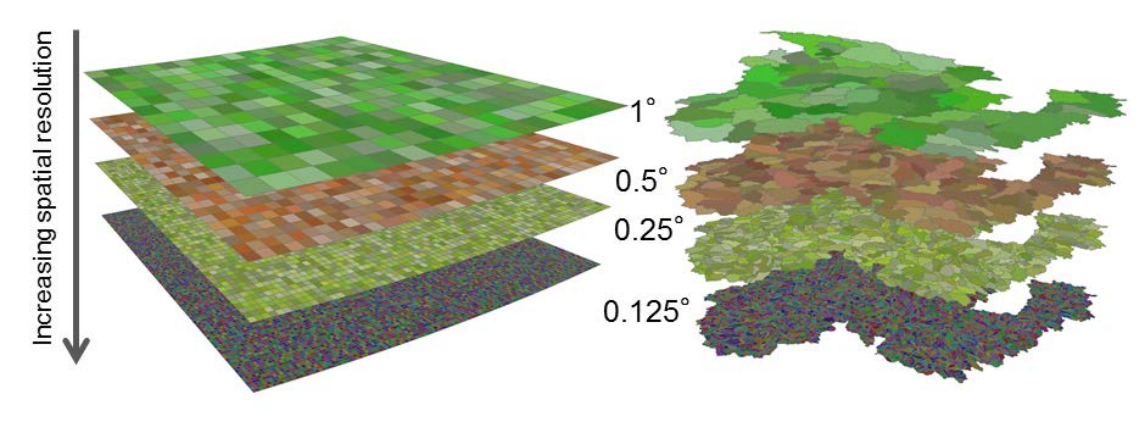
Outline

- Motivation
- Methods and Subgrid Structures Explored
- Results
- Summary and Conclusions

Motivation: Topography Matters

- Topography exerts major control on land surface processes.
- Spatial structures that capture topographic spatial heterogeneity may improve representation of land surface processes.
- Subbasin-based land surface modeling demonstrated better scalability (Tesfa et al., 2014 a&b).

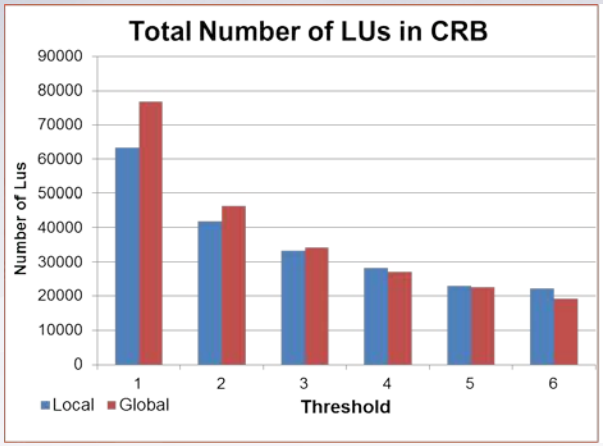


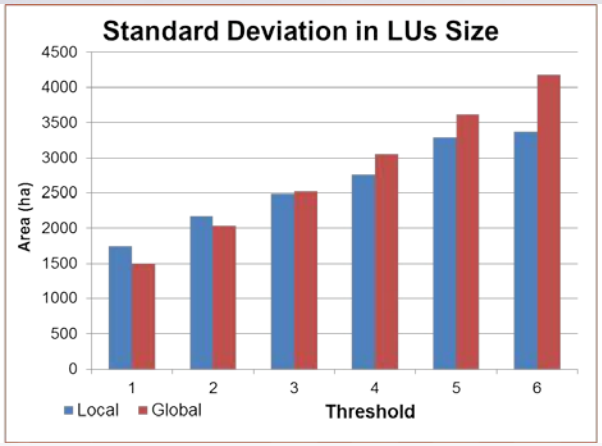
Methods and Subgrid Structures Explored

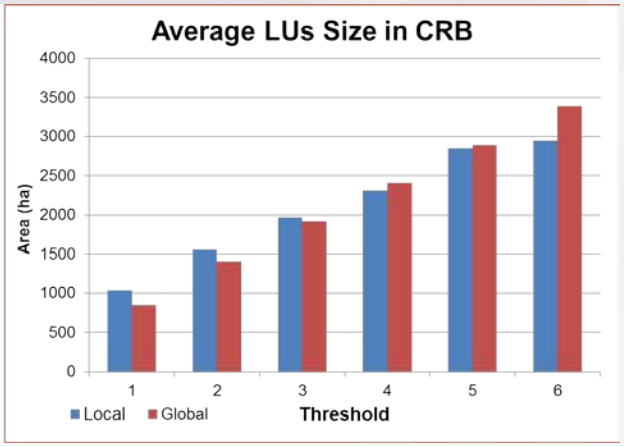
- **Two Methods:**
  - **Global Method:** Elevation classification of the whole domain following Leung and Ghan [1995 and 1998] is combined with slope and aspect, and area threshold to delineate each subbasin into subgrid land units (LUs).
  - **Local Method:** Elevation classification based on elevation-area profile of each subbasin is combined with aspect and area threshold to delineate each subbasin into subgrid land units.
- **Two Types of Subgrid Structures:**
  - **Geo-located** Subgrid structure: Subbasins are delineated into spatially contiguous land units.
  - **Non geo-located** Subgrid structure: Subbasins are delineated into spatially non-contiguous land units represented as fractional area.

Results

Local vs. Global Method in generating Non geo-located LUs for the Columbia River Basin



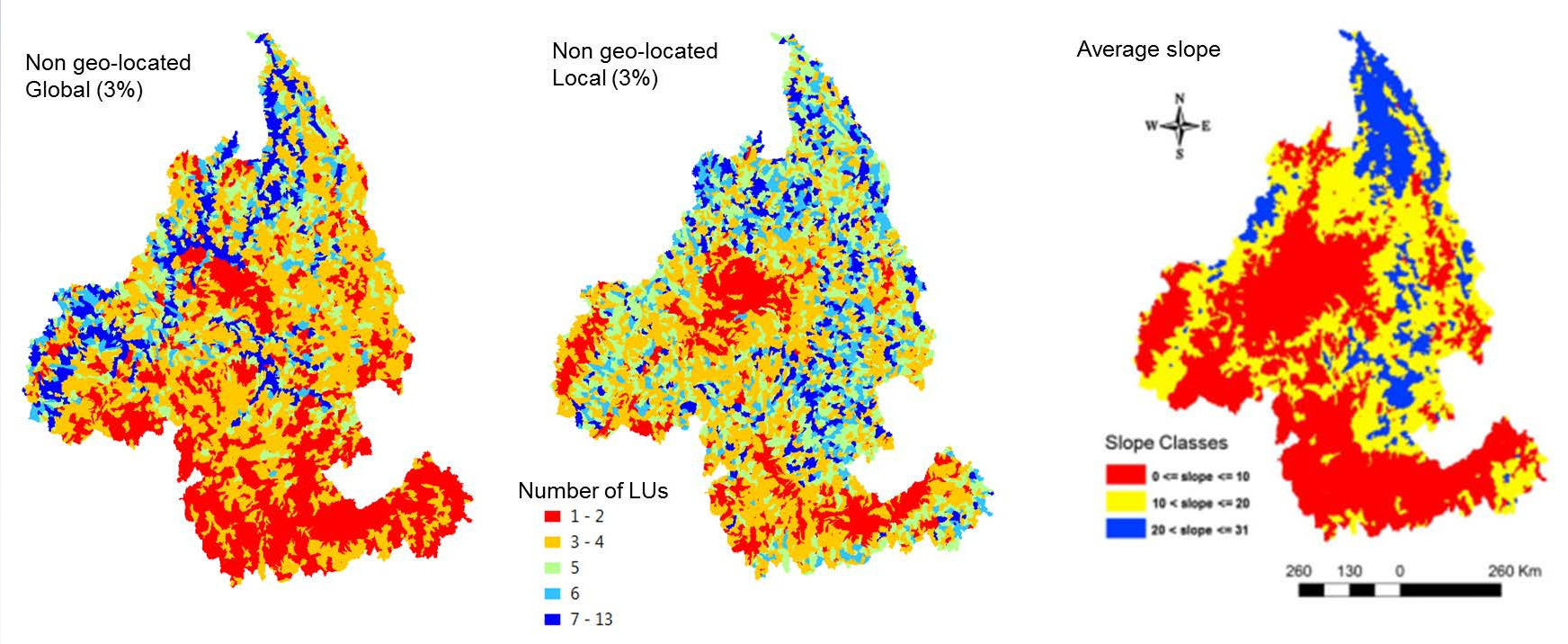




- Local method is generally less sensitive to threshold values than the global method

Results

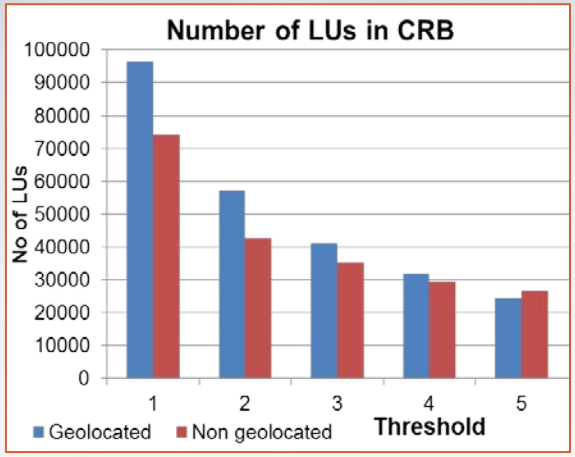
Local vs. Global Methods in capturing topographic patterns

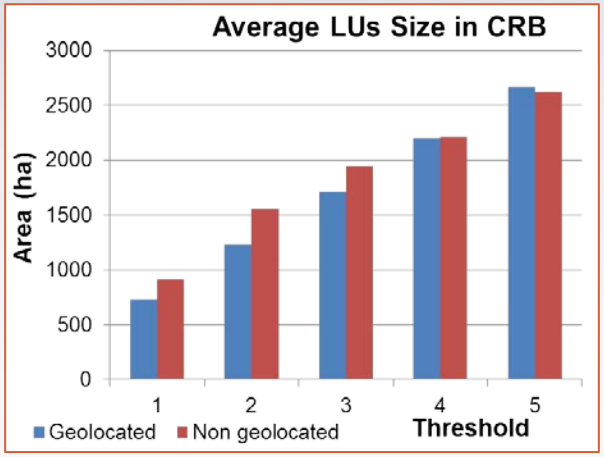


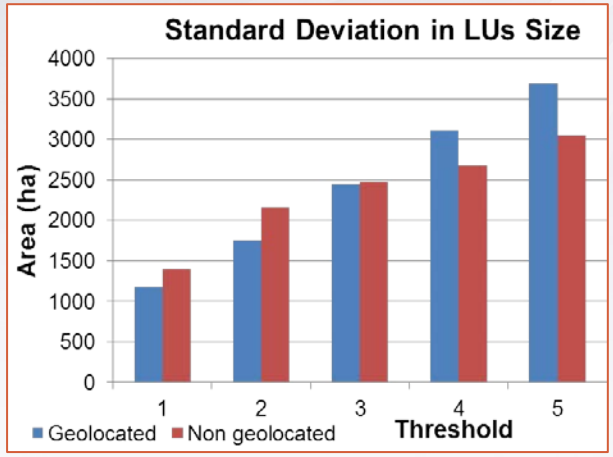
- Local method captures the topographic pattern better than the global method.

Results

Non geo-located vs. geo-located LUs using Local Method for the Columbia River Basin



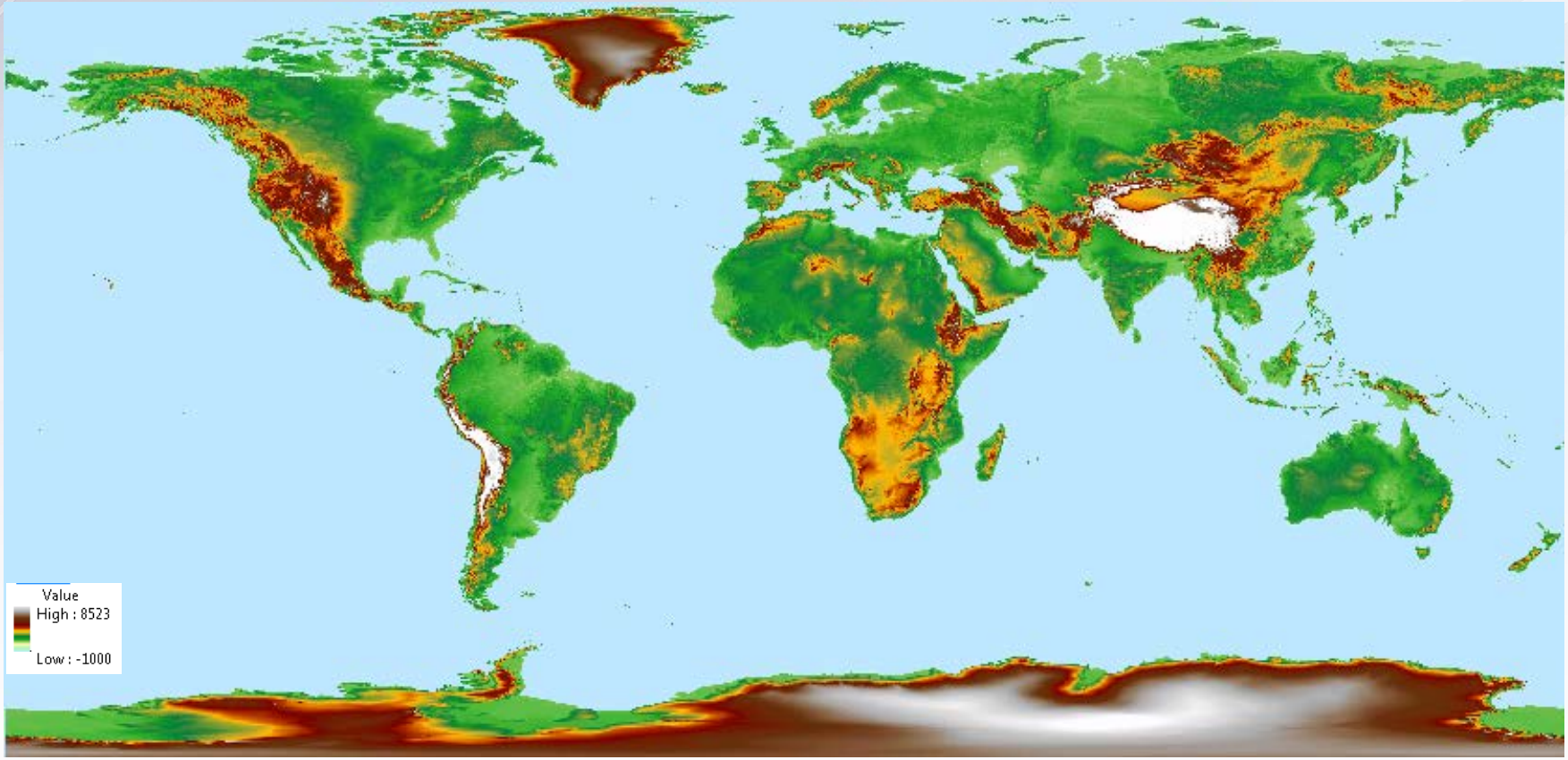




- The non geo-located LUs are less sensitive to threshold values than the geo-located LUs.

Results

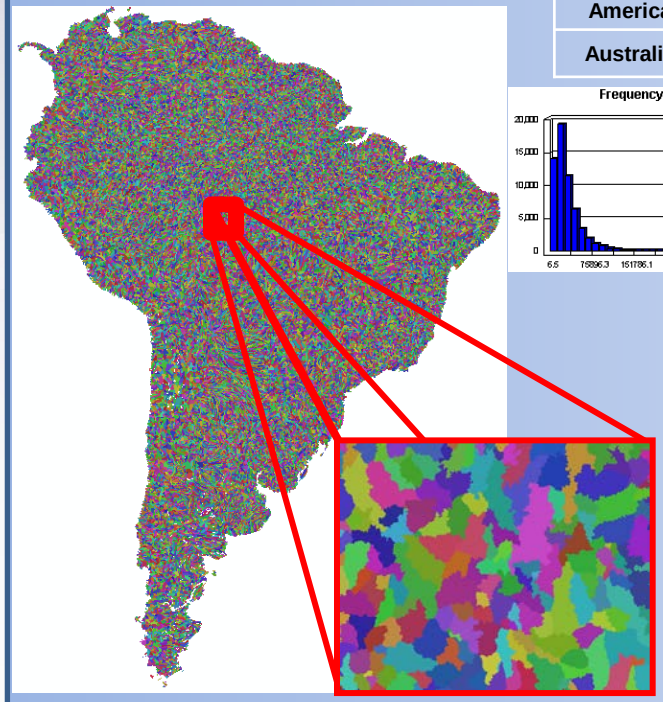
A globally consistent high resolution DEM

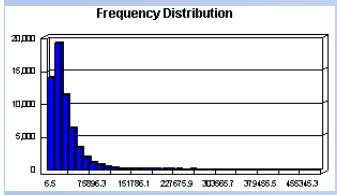


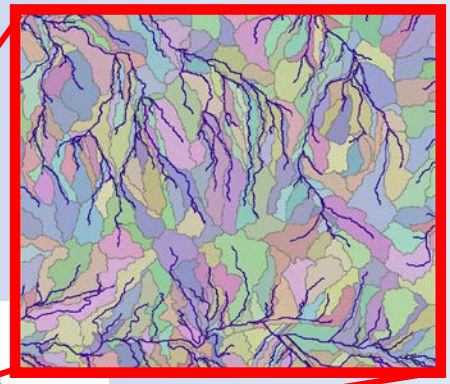
Results

New Subbasin Dataset for South America and Australia

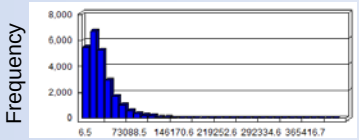
	No of Subbasins	Mean Size (ha)
South America	59,650	~260 km^2
Australia	24,621	~290 km^2







Frequency distribution of Subbasin size (ha)



Summary and Conclusions

- Global and Local Methods have been developed to derive a new topography-based land surface spatial structure for CLM.

- Both methods have been tested over the Columbia River Basin in deriving both geo-located and non geo-located LUs.

- The Local Method captures the topographic pattern better than the Global Method and is more consistent across threshold values in the number of LUs per subbasin.

- A new subbasin dataset for Australia and South America has been developed from the globally consistent high resolution DEM developed in this effort. The Local Method for Non geo-located LUs is being applied globally to generate a global topography-based land surface structure for CLM.