OntoSoft Demonstration:
Software Sharing in Critical Zone Observatories

EARTHCUBE
Building Block

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## Demonstration scenario: Cross-disciplinary modeling in the Critical Zone Observatories

1. To test that groundwater and forest life-cycle are important agents in the shaping of landforms over time scales of 10^3 to 10^7 years, a student wants to create an integrated model for landscape evolution
2. He looks for a hydrologic model and GIS tool in GeoSoft, decides to use PIHM and QGIS
3. He first builds a prototype in MATLAB, and gets advice from GeoSoft to share and describe the code.
4. He ports the code to C and integrates it with PIHM to develop a coupled landscape evolution-hydrologic model (LE-PIHM)
5. He shares results in GeoSoft including Computable Document Format files with data, workflow, visualizations online.
6. Others can then find the software and easily reuse it (especially scientists in other disciplines or who do not program!).
7. Other CZO scientists use LE-PIHM for new questions, e.g., how do evolving landscapes affect the water cycle and geochemical weathering for different geologic settings.

Hypothesis: Groundwater flow and the life-cycle of forests introduce Important new feedbacks on landscape co-evolution from tectonic uplift and hydroclimatic formation of soil, regolith and stream networks

Redistribution of soil moisture and groundwater (<1-10 yr) affects the life cycle of trees (~100 yrs). Tree-fall introduces bio-turbation that effects macropore formation and soil movement (creep) (~100 yrs). Tectonic uplift (10^3-10^6 yrs) exposes country rocks to decay from physical and chemical weathering. Together these processes lead to the formation of regolith/soil (100's yrs), stream networks and entire watersheds (>10^6 yrs).
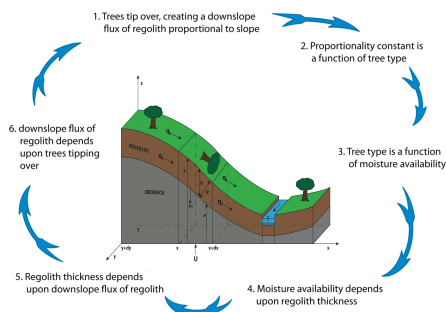
Simulated evolution of an initially uniform landscape to a complex terrain and river network over 10^8 years.

(a) time = 0
(b) time = 6,400,000 years
(c) time = 37,480,000 years
(d) time = 248,360,000 years
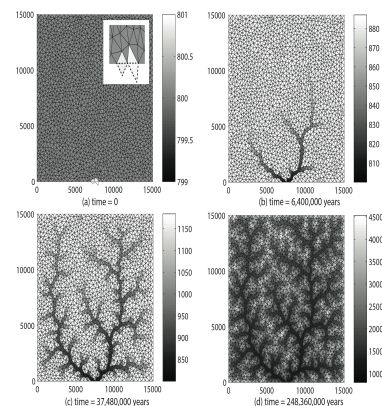
GeoSoft supports software sharing and reuse

Wrote a simplified version in MATLAB

Found a scalable hydrology model: PIHM

Found an efficient differential equation solver: SUNDIALS

Wrote data preparation scripts

Extended scalable model: LE-PIHM

Found an open source GIS software: QGIS

OntoSoft

Guidance to describe software with semantic metadata that will allow others to find it

Faceted search allows feature-based comparison of software, customized to science needs

Assistance to choose a license, to get a DOI so others can cite the software, etc

Social recommendations of software and visualizations used by similar users

Simplified model is reused by others for other sites

Extended model is reused by other researchers for new questions

Data preparation scripts are used by others with similar data

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