Investigating the impacts of urbanization on regional hydrometeorology by coupling an urban canopy model into a distributed hydrological model

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Motivation of coupling

1. Current hydrological model simplifies or lacks independent urban module.
2. Energy and water transport mechanisms for urban and natural surfaces are different.

Objective of coupling

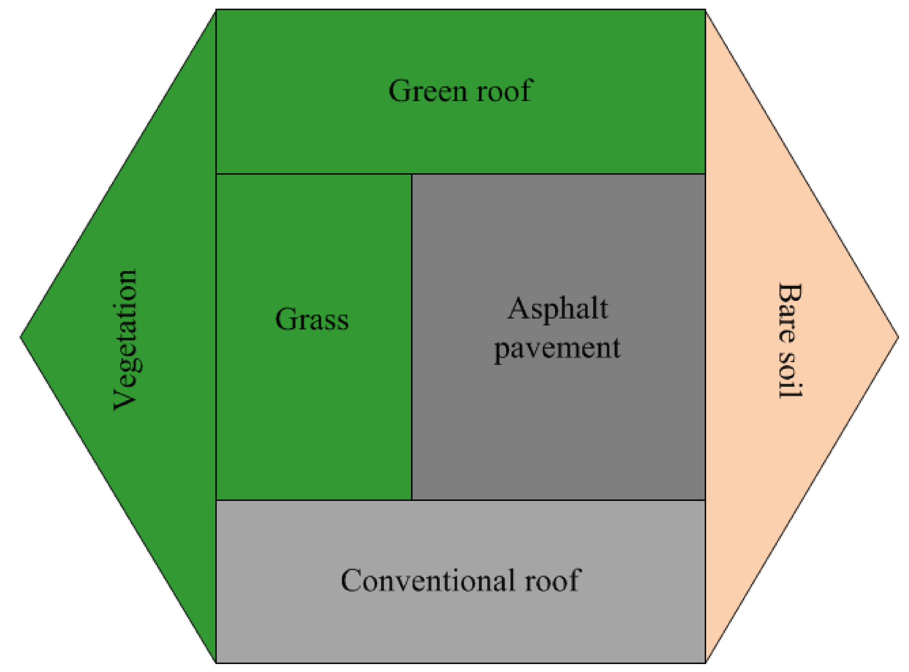
By coupling the UCM into the tRIBS, representation of hydrometeorological responses of urban land surface will be more realistic, and the impacts of urbanization on regional hydrometeorology (precipitation, runoff) can be better assessed.

The expected results will provide stakeholders more accurate hydrometeorological forecast and flood control, as well as better guidance on land management and ecohydrological services.

Methodology

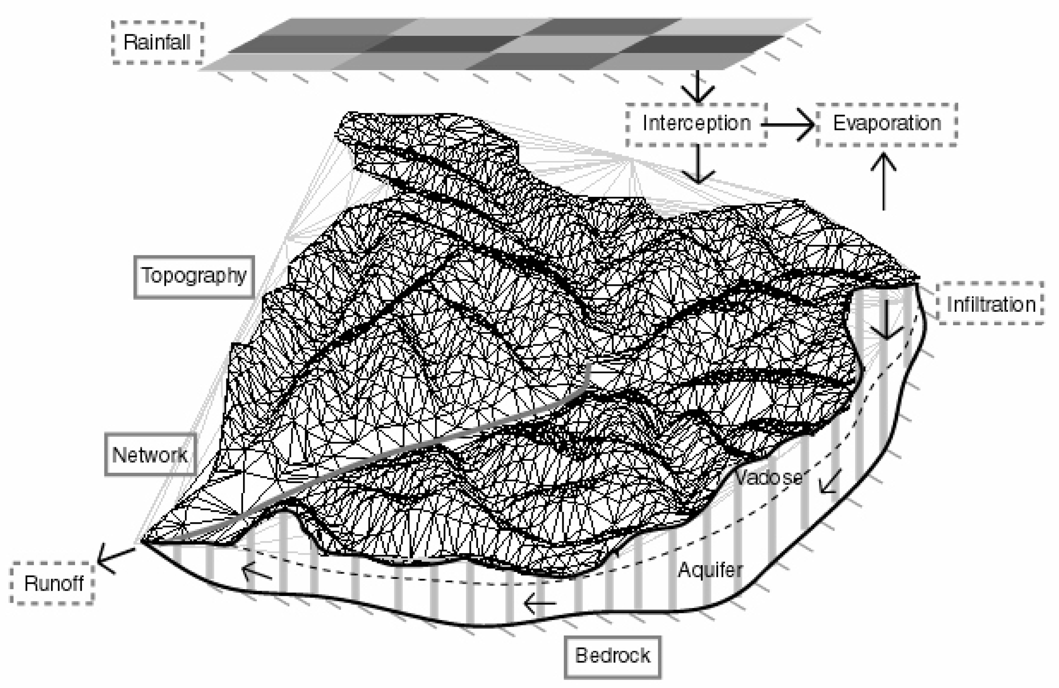
In the coupled tRIBS-UCM framework, a watershed is covered by a TIN network. Hydrologic computations made at each TIN node are assumed valid over a region consisting of the Voronoi cell associated with the node. Then the flow generated in each Voronoi cell will be routed from TIN node to TIN node, along a triangle edge, using a finite difference approach.

Each Voronoi cell has been divided into urban part and natural part. Urban part is parameterized by the UCM, while the natural ones are simulated by the tRIBS. The generated energy flux and runoff of each Voronoi cell will be integrated to total energy and water balance in a watershed scale through the tRIBS platform.



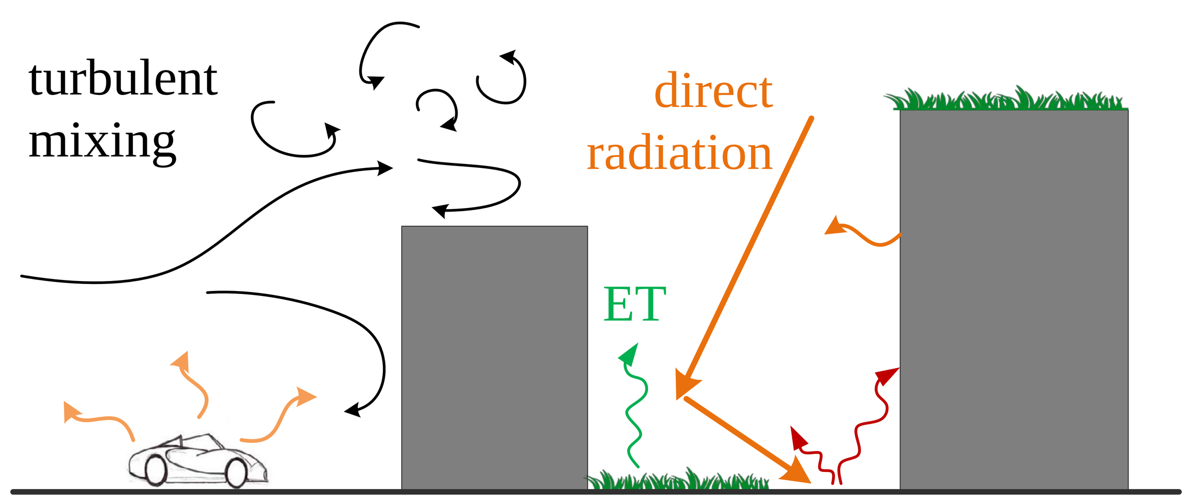
tRIBS

The tRIBS is a TIN-based distributed hydrological model, which is computationally efficient for simulating a large watershed by representing the watershed with multiple resolution meshes that conserve physiographic features (Vivoni et al., 2004).

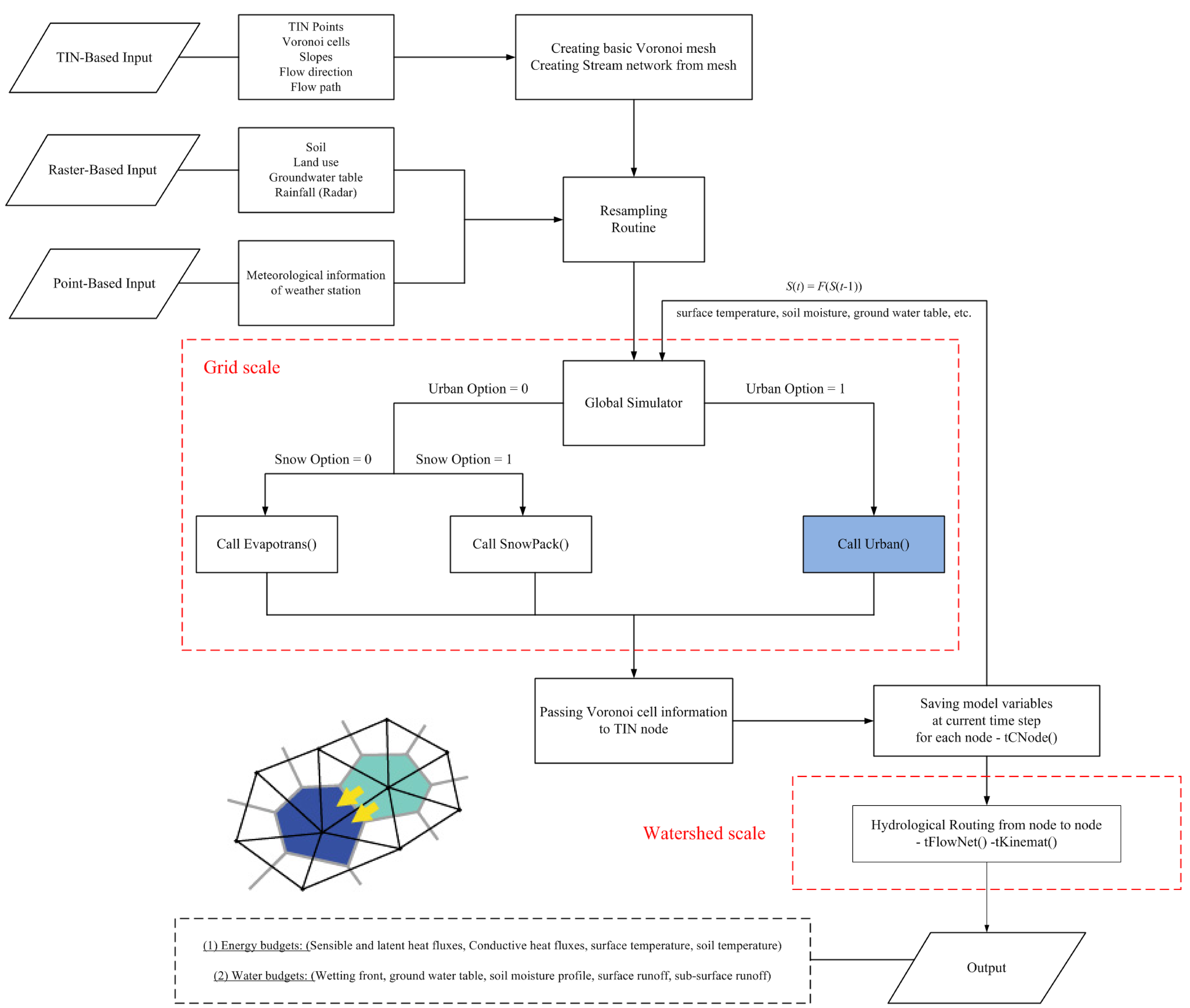


UCM

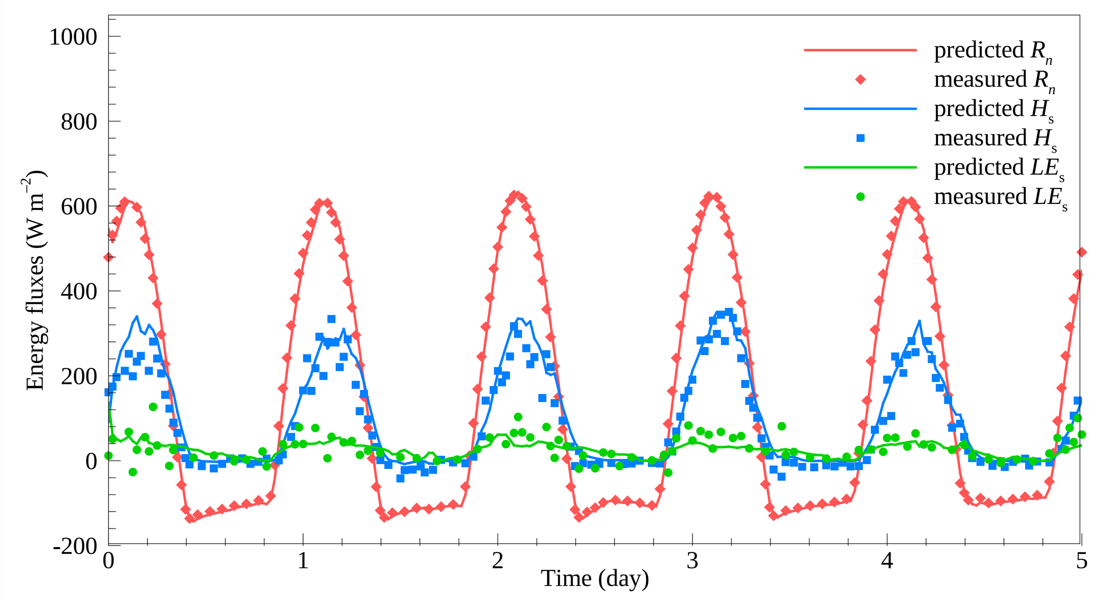
The "state-of-the-art" urban model we apply (UCM) can resolve both energy and water budgets on urban land surfaces (Wang et al., 2013).



Flow chart of coupled tRIBS-UCM



Grid scale test



Model validation with field measurements (June 12 – June 17, 2012) at Maryvale site, Phoenix,AZ

Future work

This coupled tRIBS-UCM framework will be tested in a watershed scale on not only energy budgets, but also water budgets.

The impacts of urbanization on regional hydrometeorology such as precipitation forecast, flood control can be better assessed.

Acknowledgement

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[2] Wang, Z.H., Bou-zeid, E., and Smith, J.A. 2013. A coupled energy transport and hydrological model for urban canopies evaluated using a wireless sensor network. *Quaterly Journal of the Royal Meteorological Society*. 139(675): 1643-1657.