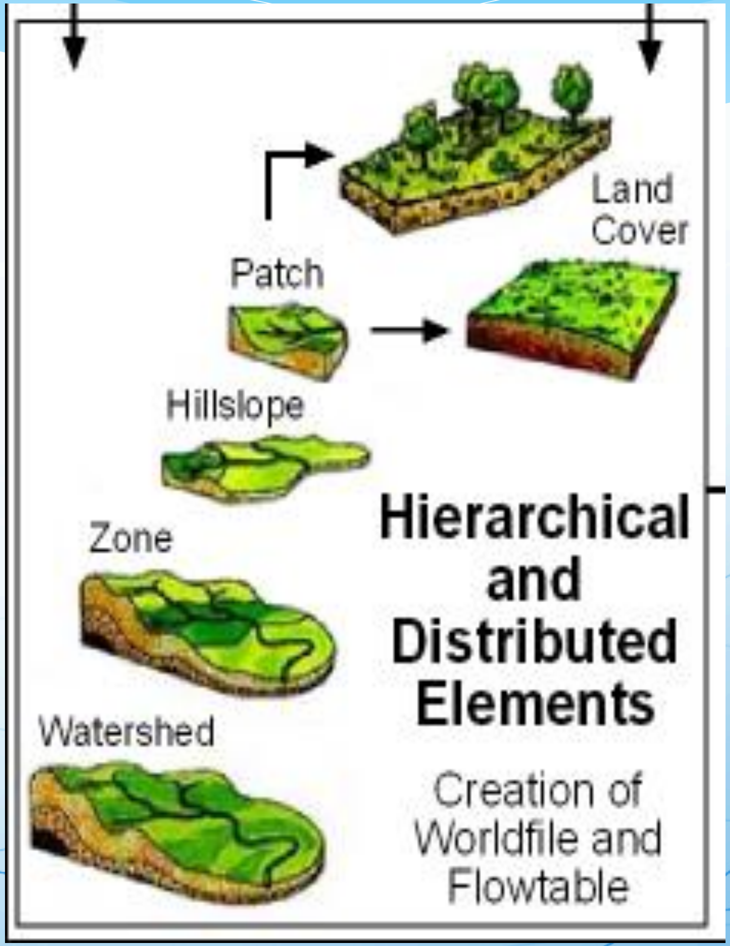
Regional Hydro-Ecologic Simulation System (RHESSys)

Hydro-ecological model that simulates water, carbon, and nutrient cycling.

Structured as a spatially nested hierarchical representation of the landscape.



* Implemented in the C programming language usingan object-based design approach
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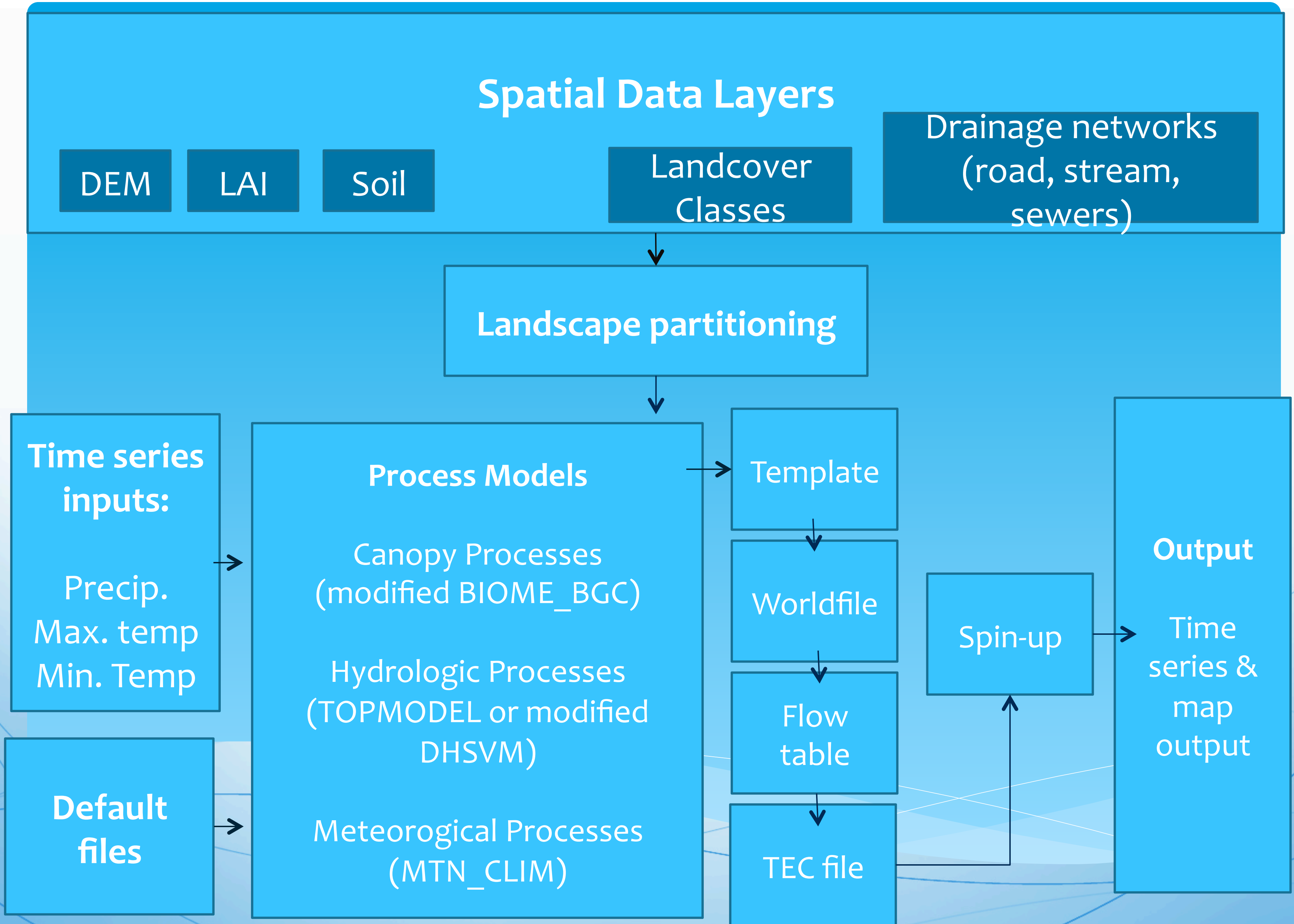
* Works with GRASS (Geographic Resources Analysis Support System) GIS
* Operates at a daily time step
* Has been implemented on 1st - 5th order streams.
* Has been applied to different ecosystems types in North America and Europe - Forested, grasslands and urban watersheds


Spatial Data Layers
DEM
LAI
Soil
Landcover Classes
Drainage networks (road, stream, sewers)
Landscape partitioning
Time series inputs:
Precip.
Max. temp
Min. Temp
Default files
Process Models
Canopy Processes (modified BIOME_BGC)
Hydrologic Processes (TOPMODEL or modified DHSVM)
Meteorogical Processes (MTN_CLIM)
Template
Worldfile
Flow table
TEC file
Spin-up
Output
Time series & map output

Advantages

* Models connectivity and lateral fluxes between landscape units
* Can model feedbacks between hydrology and carbon and nutrient cycling, including vegetation growth
* Appropriate for mountainous areas
* Can incorporate impacts from changes in roads, stormwater sewer networks, and rooftop connectivity

Climate change in the Pacific Northwest (PNW)

* During 1895–2011, the PNW warmed approximately 0.7 °C, while precipitation fluctuated with no consistent trend

Climate change projections estimate:

* little change in annual precipitation, with decreases during the summer and increases in the winter.
* increase in temperature year-round, especially in the summer

Impact on streams

Several studies have found that there has been a decrease of streamflow during the 20th century, especially during the summer months

Nutrient loads are also expected to increase under climate change and future urbanization

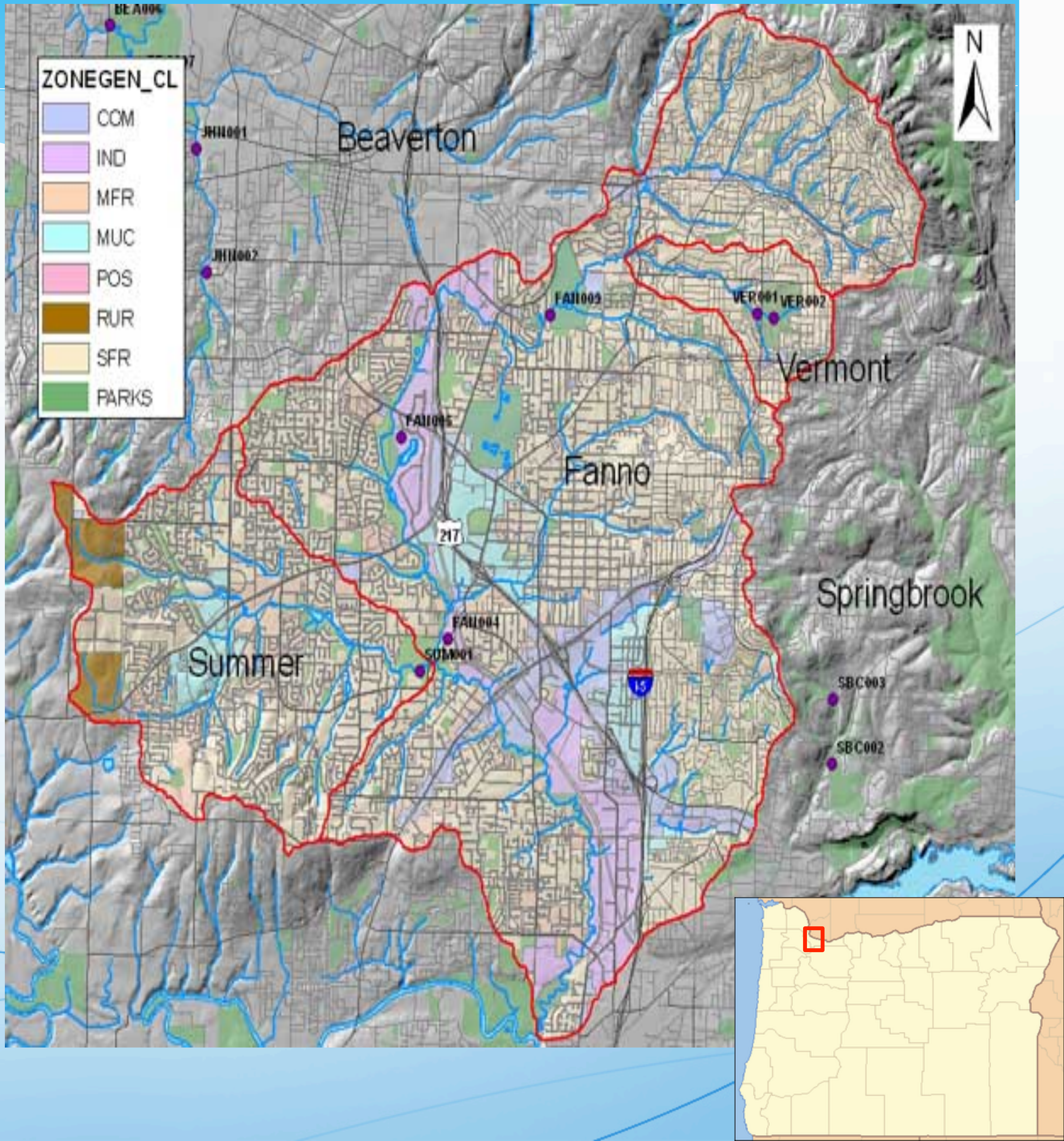
Objectives

* Evaluate the response of stream runoff to climate change and land cover change in urban watersheds of Oregon.
* Model the effect low impact development (LID) infrastructure on streamflows and nitrogen loads at a watershed level.
* Predict impacts of climate change on water temperatures is selected watersheds.

Pilot survey: Fanno Creek Watershed

Water quality is impaired by stormwater runoff from existing sources and development.

Ranks as poor on the Oregon Water Quality Index due to high levels of nutrients, total solids, and bacteria.



* Impervious surfaces total approximately 33% of the Fanno Creek Watershed. Impervious surface.

* This has contributed to increased stormwater runoff volumes and velocities that can cause stream bank instability, undercutting, erosion, in-stream sedimentation, and channel incision.

Modeling Green infrastructure

* Poff et al. (1997) suggested that implementation of green infrastructure at the watershed scale should restore the riverine ecosystem and address water quality issues.

* The hydrologic benefits of adding more green components to urban watersheds helps in restoration of pre-development flows (US EPA, 2009; Rai, 2013).