Studying Dissolved Organic Carbon flux from Penobscot Watershed into the Gulf of Maine

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Abstract:

The movement of Dissolved Organic Carbon (DOC) from terrestrial system into aquatic system plays an important role for carbon sequestration in ecosystems and affects the formation of soil organic matters. Carbon cycling, storage, and transport to marine systems have become critical issues in global-change science, especially with regard to northern latitudes (Freeman et al., 2001; Benner et al., 2004). DOC, as an important composition of the carbon cycling, leaches from the terrestrial watersheds is a large source of marine DOC.

The Penobscot River basin in north-central Maine is the second largest watershed in New England, which drains in to Gulf of Maine. Approximately 90% of the watershed is forested (Griffith and Alerich, 1996). Studying temporal and spatial changes in DOC export can help us to understand terrestrial carbon cycling and to detect any shifts from carbon sink to carbon source or visa versa in northern latitude forested ecosystems.

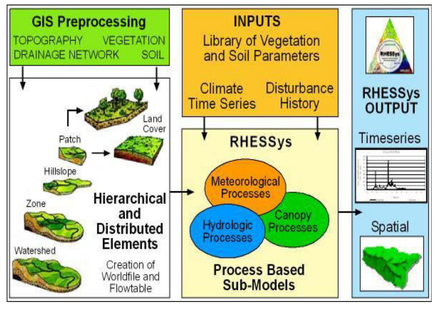
The focus of this study is on simulating the DOC flux from the land to the water using RHESSys (Regional Hydro-Ecological Simulation System) in the Penobscot watershed. The simulated results is compared with field measurement of DOC from the watershed and LOADEST model to explore the spatial and temporal DOC export pattern.

Research area:

- Second largest watershed in New England
- Almost 90% of watershed is forested
- 5% lakes and impoundments
- 5% agriculture

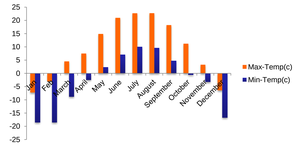
Study area – The Penobscot Watershed.

Methodology:

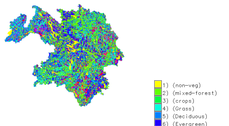


Input Data:

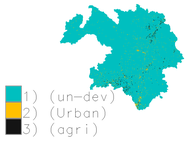
- Climate input: National Climatic Data Center (NCDC), Min and Max temperature, Precipitation (rain+snow)



Vegetation Map

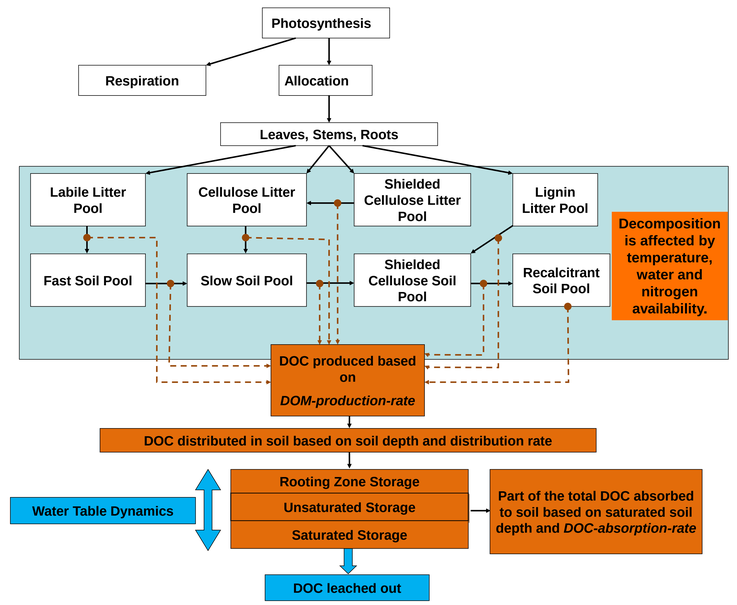


Landcover Map



Riparian area

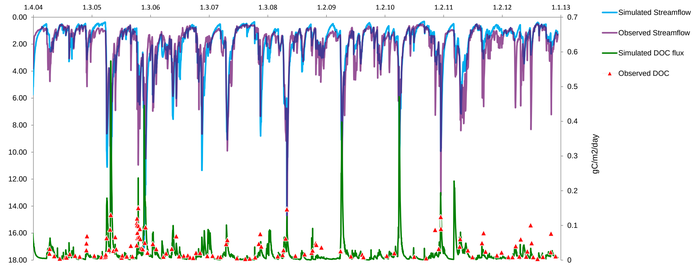
RHESSys DOC Simulation Processes:



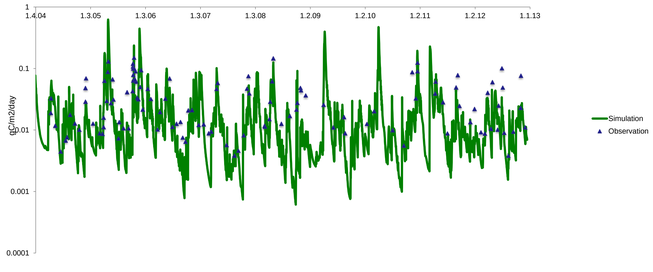
Yang, Yun, "Studying Soil Moisture and Land-to-Water Carbon Export in Urbanized Coastal Areas Using Remotely Sensed Data and a Regional Hydro-Ecological Model" (2013). Graduate Doctoral Dissertations. Paper 143.

Results:

Stream DOC flux Comparison



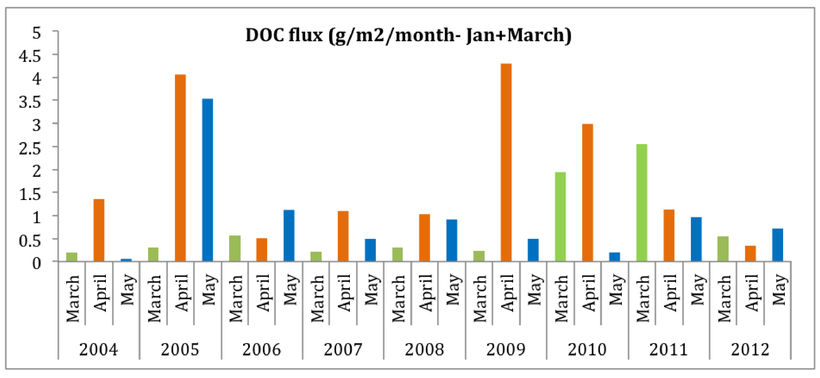
Stream DOC flux Comparison in log scale



Stream DOC flux Comparison between RHESSys and LOADEST

Gage Station	Model	Cumulative (2004-2005) DOC flux (Mt C)	DOC yield (Kg C/ha/year) 2004-2007
Penobscot at Eddington	RHESSys	387,600	77
	LOADEST	308,000	71
Other Tributaries in Penobscot watershed			DOC yield (Kg C/ha/year) 2004-2005
Kingsbury Stream near Abbot Village	RHESSys	3117.5	63
	LOADEST	3470	70
Seboeis *	RHESSys	4480	51
	LOADEST	5420	53
Piscataquis at Dover-Foxcroft*	RHESSys	8500	63
	LOADEST	10,600	71

Snowmelt timing and DOC flux



Conclusions:

- RHESSys DOC flux simulation results shows good correlation with observed data
- Rhessys DOC flux simulation result from Penobscot watershed and some of it's tributaries shows consistency with LOADEST DOC flux estimation
- Changes in timing of snowmelt might result in changes in timing of peak DOC release
- Warmer winter and changes in the form of precipitation (rain rather than snow) might decrease DOC concentrations in winter

Future work:

- Using RHESSys model to explore the possible impacts of climate change on streamflow, snowmelt timing and DOC flux in Penobscot Watershed
- Studding the possible impacts of landuse change scenario in Penobscot watershed on amount of stream DOC into the Gulf of Maine