Application of Dissolved Organic Carbon Runoff Model Considering Soil Infiltration and River Runoff Processes in Multiple Forested Watersheds

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30th Apr., 2021

Dissolved organic carbon (**DOC**) is an essential biogeochemical component of water quality in a forested watershed

The export of carbon from forest river is thus closely related to environmental issues at both **global** scale and **local** scale

How has the DOC load been estimated?

	Advantage	Disadvantage	
Empirical model	Easy to calculate	Spatiotemporal variation	Hinton et al. 1997)
Process-based model	High accuracy	Lots of Input data	(Futter et al. 2007)

Objectives

General objective

To develop a simple model for estimating the DOC runoff load at short-term(**event**) scale and long-term (**seasonal**) scale.

Specific objective

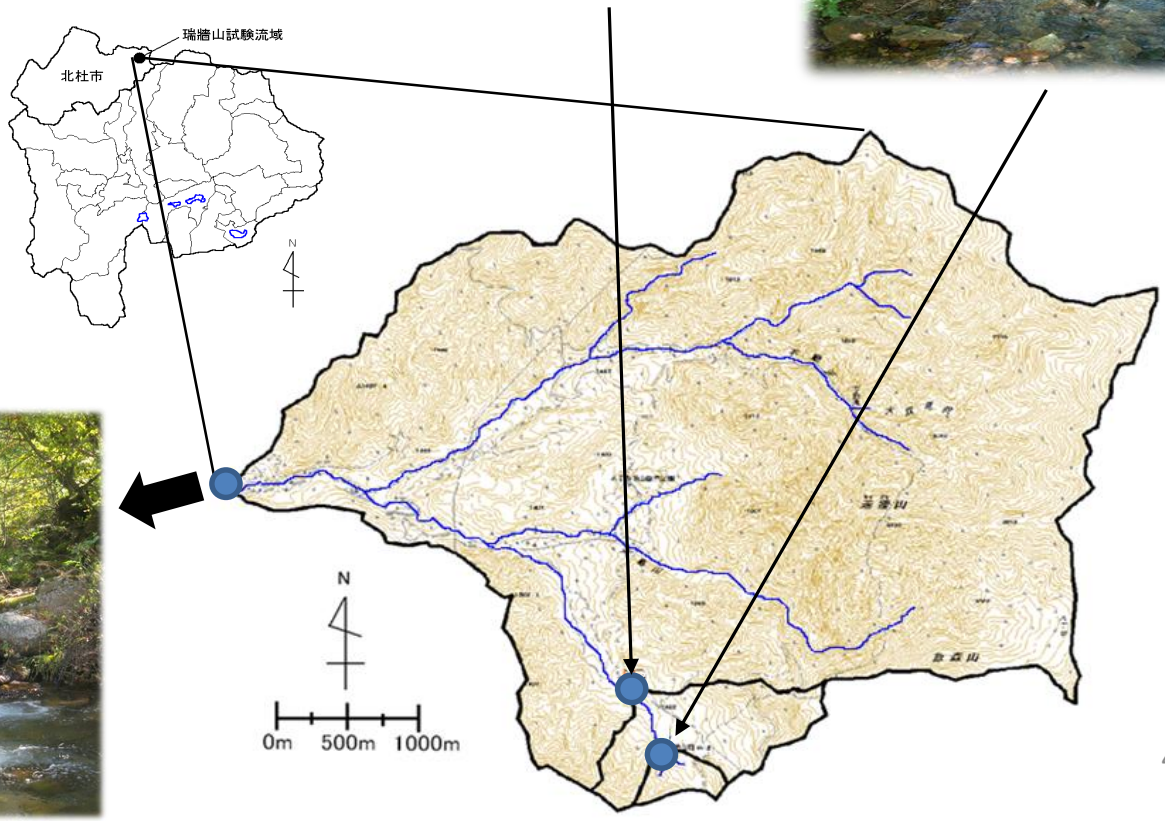
1. To characterize the DOC variation with long-term monitoring data
2. To establish a DOC runoff model considering soil and hydrologic processes
3. To validate the applicability of the DOC model to other area

Mizugaki Experimental Watershed

- Elevation: 1175 ~ 1555 m
- Vegetation: Japanese larch plantation forest
- Bedrock: Granitic rock
- Sampling period: MD(2004-2016), K2(2009-2016)

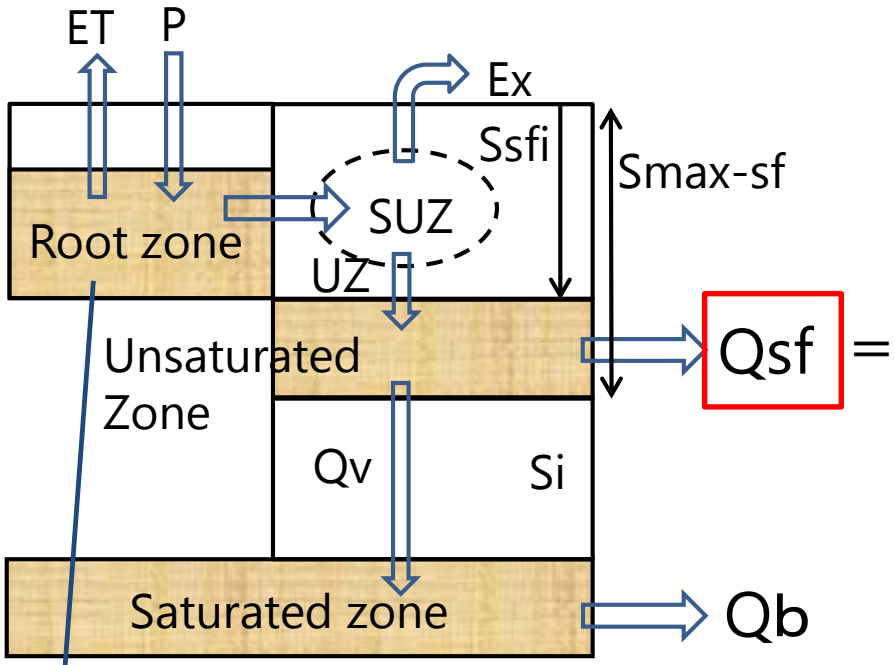
MD:98ha

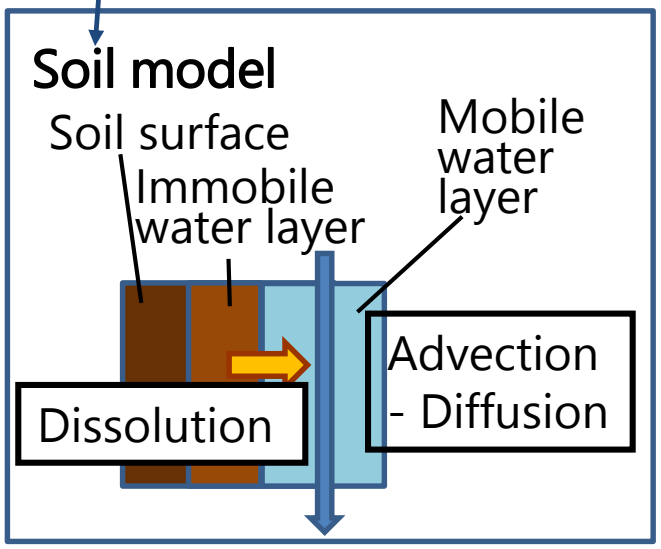
L3:15ha



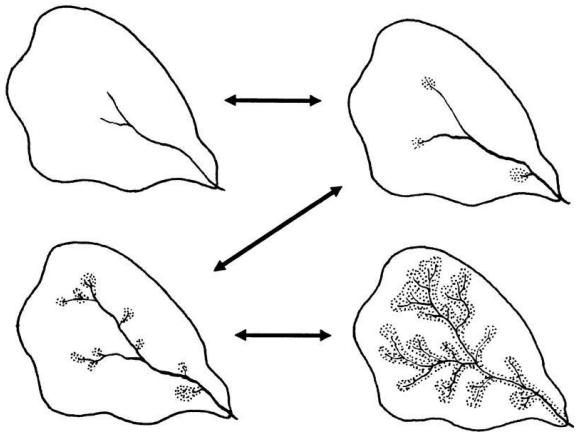
K2:1796ha

Hydrologic model(Modified-TOPMODEL)

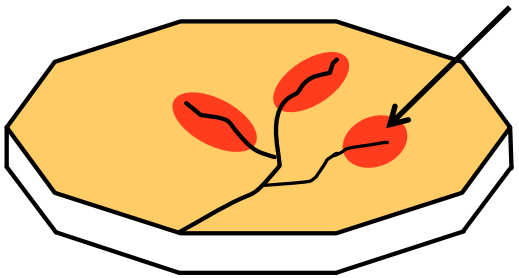




Variable Source Area concept(VSA) (Hewlett et al. 1970)

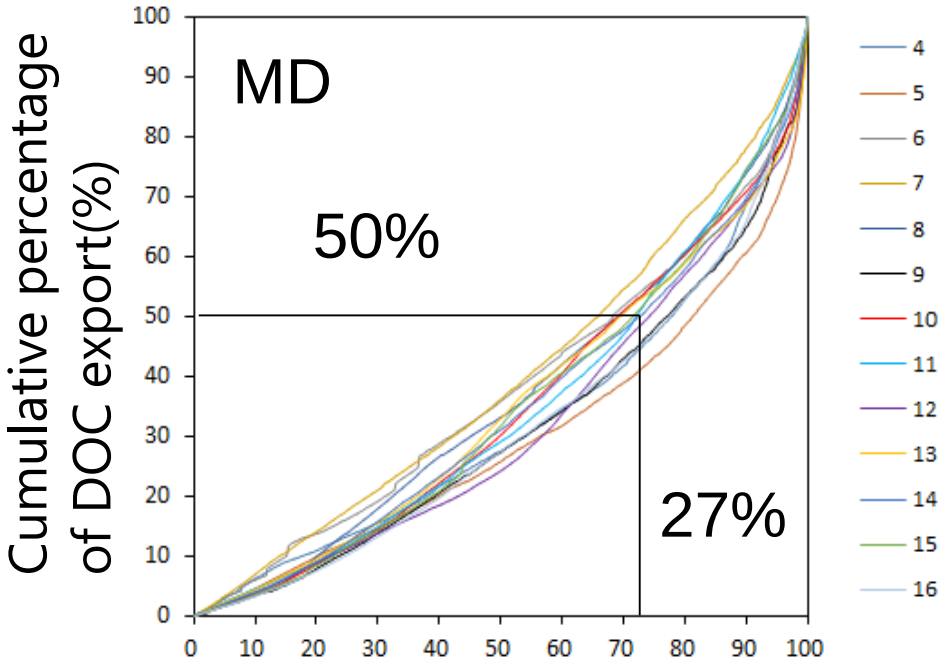


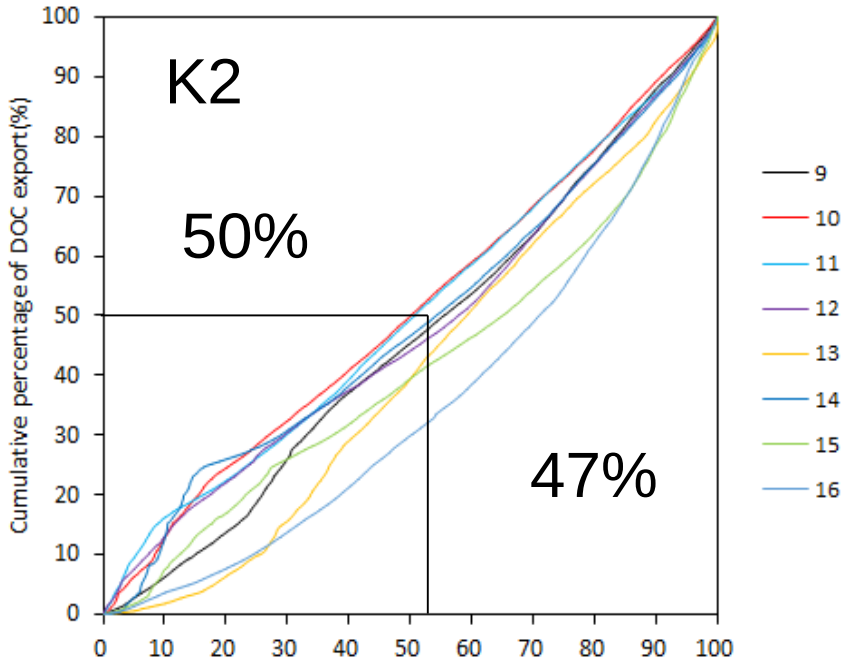
DOC Source Area



$$DOC\ load = DOC_{sf} \times Qsf + DOC_b \times Qb$$

DOC load: Storm flow impact (2004-2016)





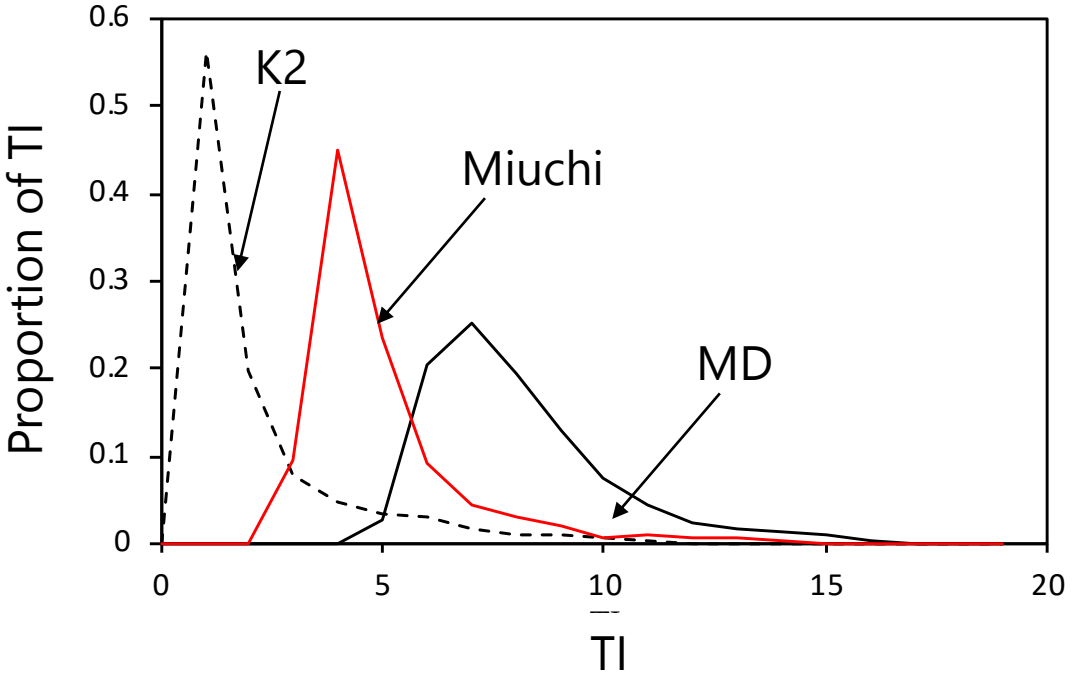
Upper 27% & 47% of high flows were responsible for 50% of the total DOC load at MD and K2, as respectively

Topographic characteristics (**TI** and **connectivity** b/w wetland & channel) distinctively controlled the storm flow contribution.

"DSA" is a useful for the interpretation of DOC runoff processes

Application to other watershed

	Mizugaki	Miuchi
Altitude(m)	1150 - 2142	657 - 1126
Area	15ha(L3), 98ha(MD), 1798ha(K2)	204ha
Vegetation	Quercus crispula, Betula platyphylla, larch, Abies firma	cedar, cypress
Rock type	granitic rock	metamorphic rock



- TI was varied from between MD and K2

DOC load at Miuchi watershed

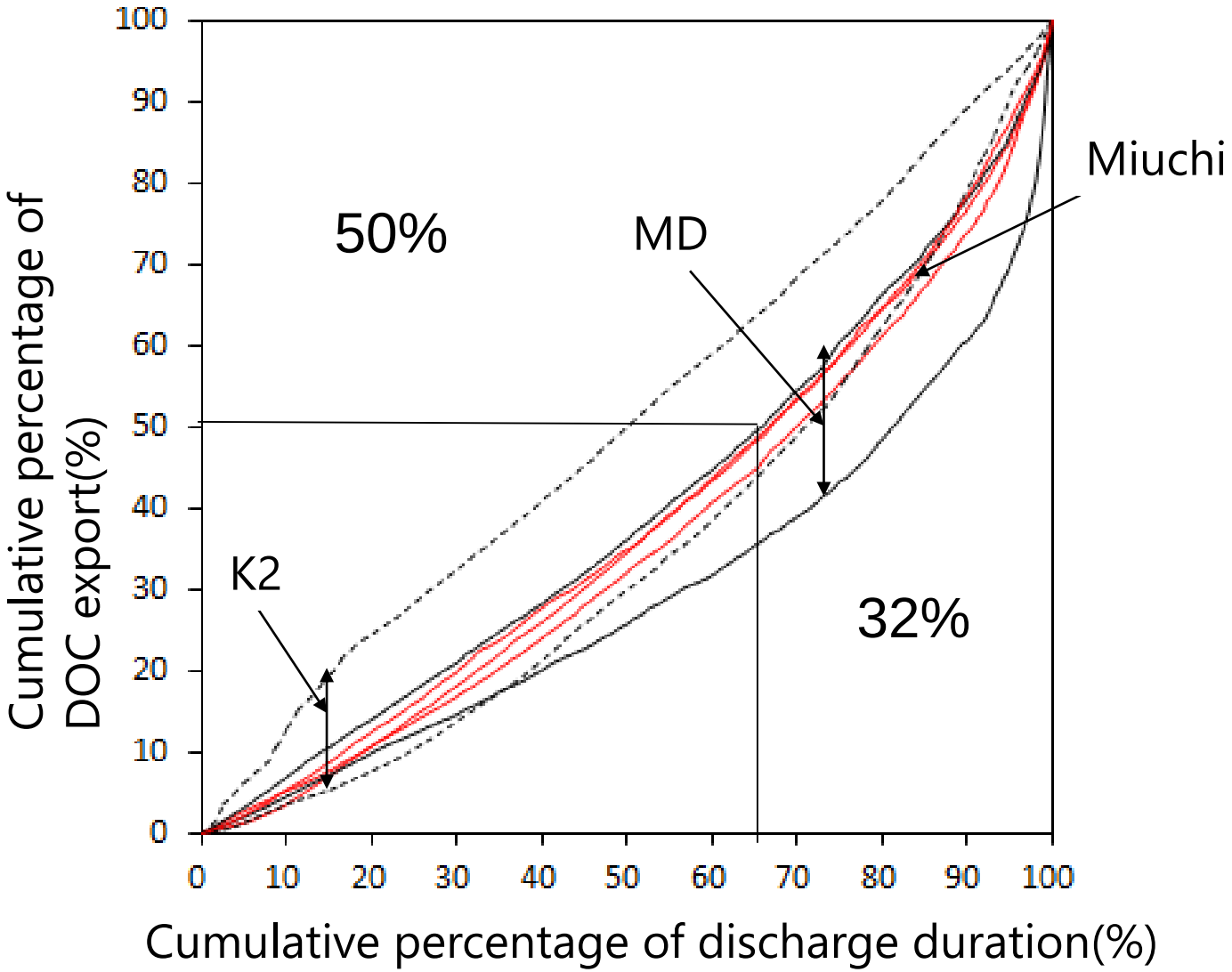
Base flow					Storm flow			
Year	Mean DOC load(kg/ha/yr)		PBIAS(%)	Duration (day)	Mean DOC load(kg/ha/yr)		PBIAS(%)	Duration (day)
	Obs.	Sim.			Obs.	Sim.		
2015	0.019	0.024	-22.4	212	0.069	0.061	11.4	153
2016	0.021	0.033	-60.3	231	0.069	0.072	-3.3	135
2017	0.017	0.034	-73,1	264	0.118	0.076	24.3	101

DOC loads were estimated with less than 100 % error

Year	Annual DOC load(kg/ha/yr)		PBIAS(%)
	Obs.	Sim.	
2015	14.7	14.5	1.5
2016	14.2	17.4	-22.7
2017	16.4	17.4	-5.8

Annual DOC loads were between MD and K2

DOC load impact at two watersheds



Assessment of the Storm flow contribution was applicable for different watershed(Mizugaki & Miuchi)

Contributions of study

- The originally developed numerical model, with combination of soil DOC concentration variations and the DOC source area variations controlled by rainfall, demonstrated the usefulness to improve the DOC load estimation

- The contribution of the high flow period to the overall DOC runoff from forest river was first demonstrated quantitatively through modelling methodology.