Variations of fluorescent DOC in temperate forest catchments

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Introduction

Forest catchments = Important source of terrestrial DOC

DOC properties can be controlled by Hydrology (Jaffe et al., 2008)

Rainfall-runoff characteristics in each catchment

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How affect on DOC properties??

Inamdar et al. (2012) clarified the distribution of DOM with different properties within forest catchments

How the distribution reflected in the streamwater DOC properties??

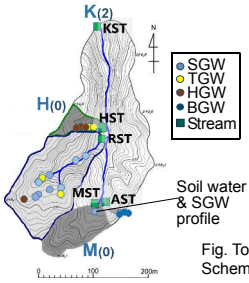
Objective:

We discuss the relationship between ranifall-runoff characteristics and DOC properties based on the observations in five well-organizedcatchments with homogeneous climate, geology, and vegetation.

Site Description

Kiryu Experimental Watershed (KEW), Japan (Katsuyama et al., 2010)

34°58' N, 136°00' E, MAP = 1628.7mm, MAP = 13.3°C
Geology = Granite, Vegetation = Japanese Cypress



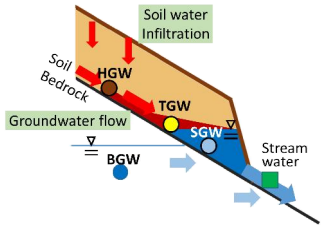


Fig. Topography of KEW and sampling point (Left)
Schematic about classification of sampled water (Top)

Main catchment :
K (2nd order, 5.99ha)

Subcatchments:
R (1st order, 1.75ha)
M (0th order, 0.68ha)
H (0th order, 0.40ha)
A (0th order, 0.086ha)

Sampling & Analysis

Classification of Sampled water

TF:
Throughfall

SW:
Unsaturated Soil water through the profile

HGW:
Groundwater occurred in hillslope during rainstorms

TGW:
Transiently or seasonally occurred groundwater

SGW & BGW:
Groundwater in soil layer (SGW) and bedrock layer (BGW) existed throughout the year

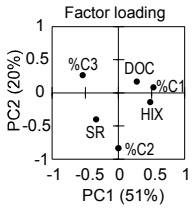
ST:
Streamwater in each catchment

Analysis - 6 parameters from Optical properties of DOC

Analysis	Index	Description	Reference
TOC Analyser	DOC conc.		
EEM+PARAFAC	3 components, and their abundance ratio		Stedmon et al. (2003)
	C1, %C1	humic-like, High molecular weight	
	C2, %C2	humic-like, Low molecular weight	
	C3, %C3	protein-like	
EEM	HIX	Index of humification. Larher value = More humified	Ohno (2002)
UV absorbance	SR	Index of Molecular weight. Larger SR = Lower weight	Helms et al. (2008)

Results

1. Relation between 6 parameters



PCA (principal component analysis) applied using 6 parameters

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71 of variance was explained by 2 components
PC1: Abundance of Humic- or Protein-like
PC2: Molecular weight

2. DOC distribution along hydrological processes

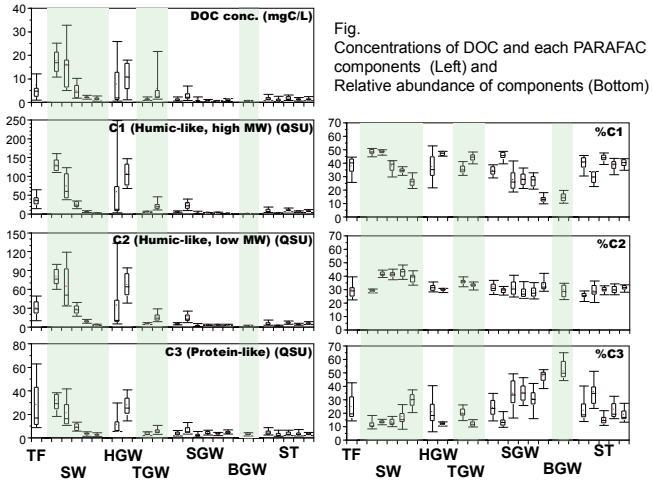


Fig.
Concentrations of DOC and each PARAFAC components (Left) and
Relative abundance of components (Bottom)

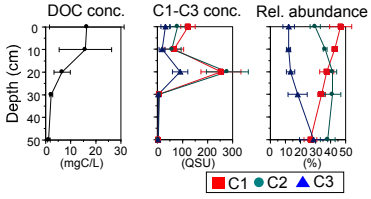
A) SW (Soil water):
Through infiltration processes,
DOC conc. and all Components decreased,
and Rerative abundance of C1 (%C1) decreased.

B) GW (Groundwater):
Through Groundwater movement (H => T => S => B),
DOC conc. and all Components decreased.
%C1 was smaller at deeper GW. Vise versa for %C3.

C) ST (Streamwater):
Rerative abundance is different between the catchment.

Discussions

A) DOM transformation along Soilwater infiltration profile



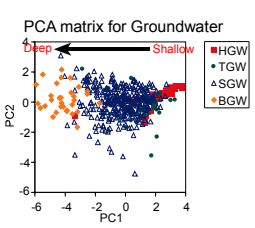
0-30cm: DOC conc. rapidly decrease
= Organic complex formed with Al or Fe (Kawasaki et al., 2005)

→ Mainly with C1

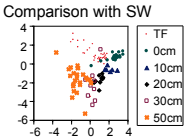
30-50cm: DOC conc. slowly decrease and %C3 increase

→ Microbial degradation

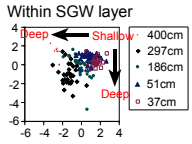
B) DOM transformation along Groundwater movement



Relative abundance of Humic-like substance decrease, and Protein-like substance increase



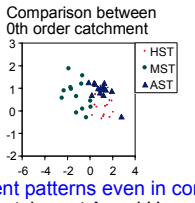
HGW is similar to SW at <10cm deep.
TGW is similar to SW at >20cm deep.
= Lateral flow movement of GW corresponds to Vertical infiltration of SW



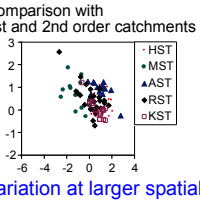
DOC composition is different between layers.
GW at 297cm is similar to SW at 50cm.

Saturated groundwater movement can affect DOC composition, but not so effective.
SW infiltration is more active for DOM transformation

C) Difference of streamwater DOM between the catchment



Spatial scaling →



Different patterns even in contiguous catchments
Subcatchment A and H
Larger contribution of shallower SW/GW

Subcatchment M
Larger contribution of deeper GW

Smaller variation at larger spatial scale
GW contributions from shallow - and deep layer are balanced

DOM variations are reflected in the difference of flow conditions

Conclusion

Water movement within the catchments	(Trans)formation of DOM - Source of Streamwater	Runoff generation process at each catchment
Vertical infiltration of Soil water Lateral movement of Groundwater	→ Rapidly transformed → Gradually transformed	→ Difference of dominant runoff component from shallower- or deeper layers

Hydrological processes make differnce of DOC properties between catchments even with similar background confitions.
For the linkage with the downstream ecosystems, Spatial scaling processes should be discussed.

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