H13D-1154 Large-Scale Field Experiments and Long-Term Observing Networks

Difference of Ecosystem and Hydrological control on Long-term water quality between adjacent subcatchments in a forested catchment in central Japan

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Introduction

Forest life is much longer than our lifetime.
Recent threat of climate change will affect forest dynamics, and cosequent change of hydrological / biogeochemical responses.

→ Long-term observation will basic to consider the ecosystem mechanisms (not only for parametarization)

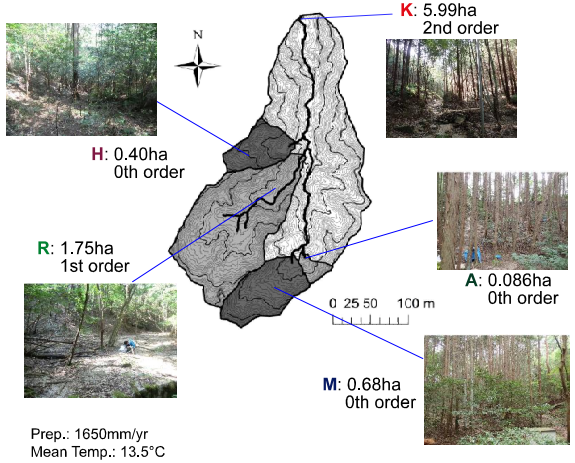
We have been monitoring the water quality in a forest site for more than 20 years.
Within this site, we have 4 adjacent subcatchments.
Under the context of the paired catchment approach, for example, these catchments 'should' respond uniformly.

→ We compare the difference of thestreamwater chemistry between the catchments, and discuss about their long-term response to forest dynamics

Site

Kiryu Experimental Watershed (KEW)

Whole catchment (K) and 4 subcatchments (R,M,H,A)
(Katsuyama et al., 2010; Iwasaki et al., inpress)



Prep.: 1650mm/yr
Mean Temp.: 13.5°C
Vegetation: Japanese cypress (*Chamaecyparis obtusa*) planted around 1960
Gentle slope (Main channel = 9.2°)
Bedrock: Weatherd Granite

Hydrochemical monitoring
K and M (most instrumented catchment) = since 1990
A = since 1999
R and H = since 2002.

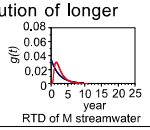
NO_3^- dynamics before 2005 in M catchment

(e.g., Ohte et al., 2003)

During early 90's, Japanese red pine trees attacked by insects, and fallen down few year after.

Streamwater NO_3^- concentration peaked around 1998, and then decreasing. The effects are still remaining.

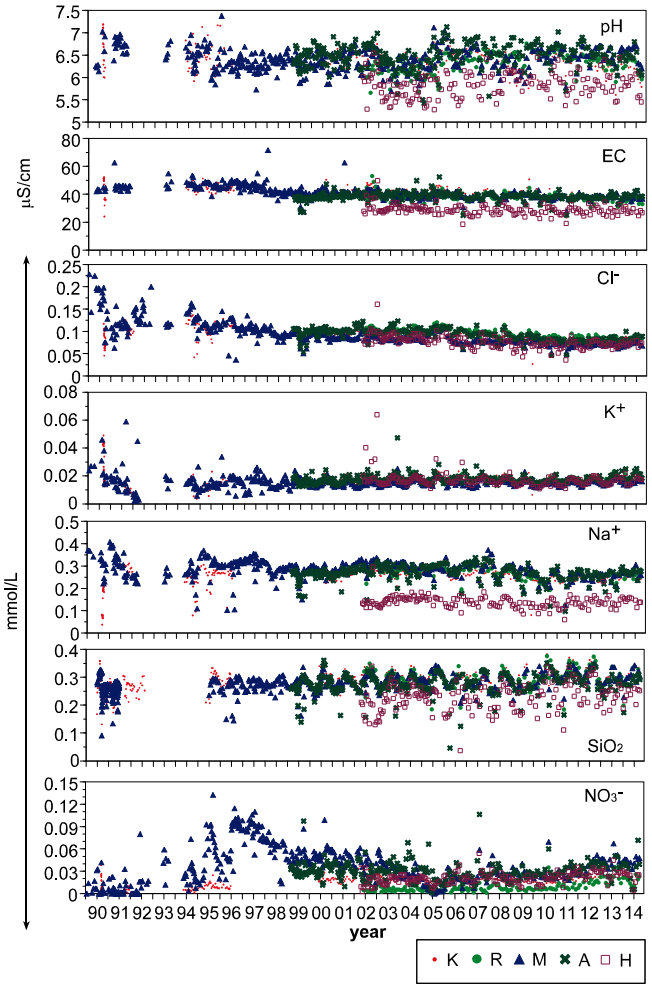
One reason of this prolonged effects is contribution of longer residence time pathways (Katsuyama, unpub.)



... In recent years, See Our Results

Results & Discussions

Long-term dynamics of Streamwater chemistry



EC, Na^+, Cl^-, and SO_4^{2-} (not shown) = Long-term decreasing

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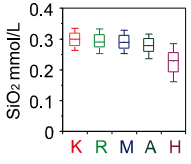
Some change of Hydro-Biogeochemical process Input/Output rerationship

H have different chemistry

Cl^- (Concentrated by ET in soil)
Same conc. in all catchments

K^+ (Cycle between Soil and Plant)
Clear seasonality
Same conc. in all catchments

Na^+, SiO_2 (Weartherring products)
Lower in H



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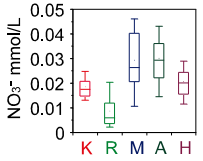
Processes in Soil layer are dominant in H catcment
(Bedrock layer contribution is small)

NO_3^- Lower conc in R and K catchment



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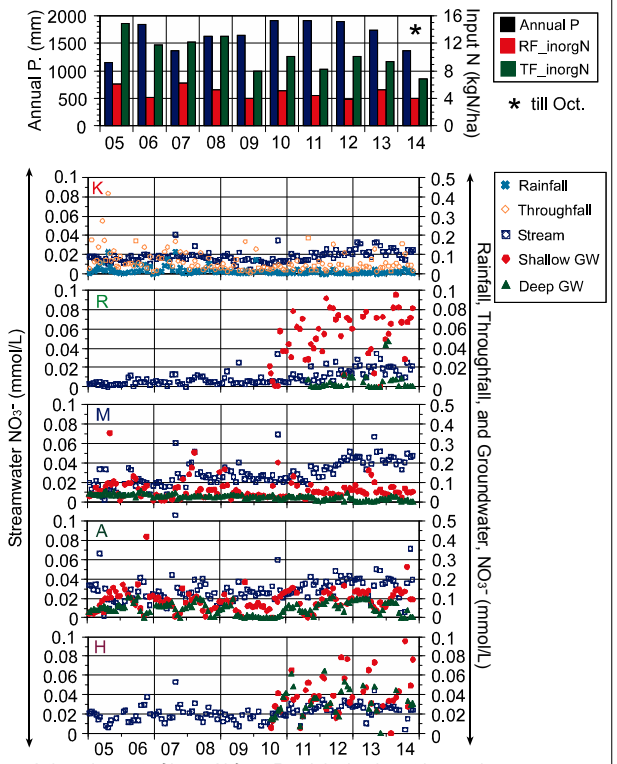
Riparian control at 1st order stream (Dentrification within wetland area)

Although the catchments are adjoin and under same geology, climate, and vegatation, the streamwater chemistry and the response is different each other.

NO_3^- dynamics in recent 10 years



Although Input of inorg-N from Precipitation is not increasing, Streamwater NO_3^- conc. are increasing in all catchments, especially in M and R, as well as of Shallow GW (in R and H).

Because of...

Recent disturbance caused by heavy storms, bank erosion (M and R)

And/or...

Prologue of degradation of Unmaneged artificial forest (>50-year-old) and change of biogeochemical cycles (e.g., reduce of N absorption), even in undisturbed catchments (A and H).

Conclusions

Long-term dynamics of streamwater chemistry is a good diagnosis tool of the ecosystem.
Climate change will cause heavy rainstorms, and consequent erosion.
On the other hand, Unmanaged artificial forsts is distributed widely throughout Japan.

Our site may be a typical example of response to these (future) disturbances

→ *Keep monitoring ! Consider mechanisms!*

References

Iwasaki, K., Katsuyama, M. and Tani, M.: Hydrol. Process., (in press)
Katsuyama, M., Tani, M. and Nishimoto, S.: Hydrol. Process., 24, pp. 2287-2299, 2010.
Ohte, N., Tokuchi, N., Katsuyama, M., Hobara, S., Asano, Y. and Koba, K.: Hydrol. Process., 17, pp. 237-249, 2003.

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