

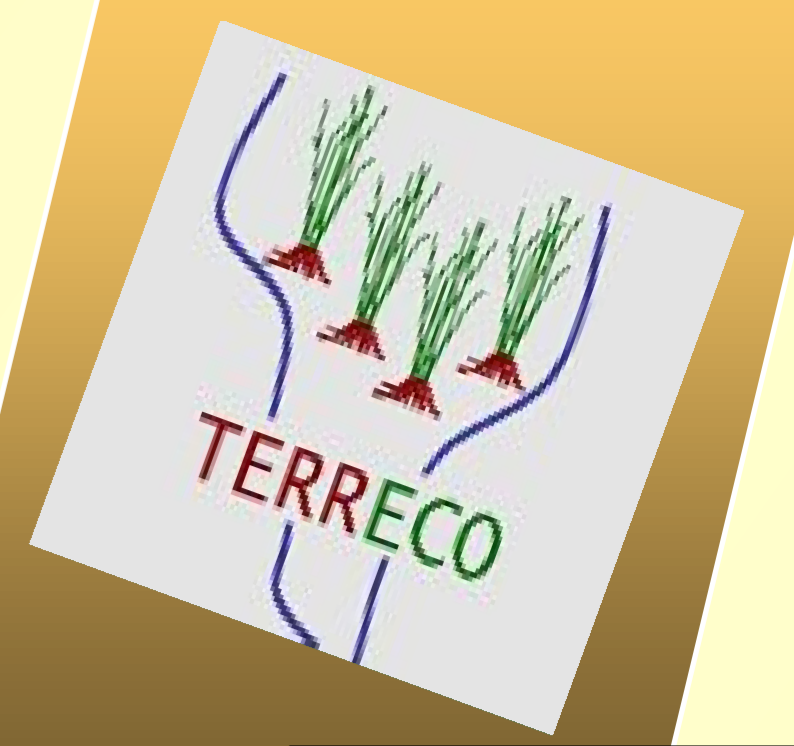
Isotope Signature to Trace the Origin and Fate of Nitrate in the Soyang Lake Watershed

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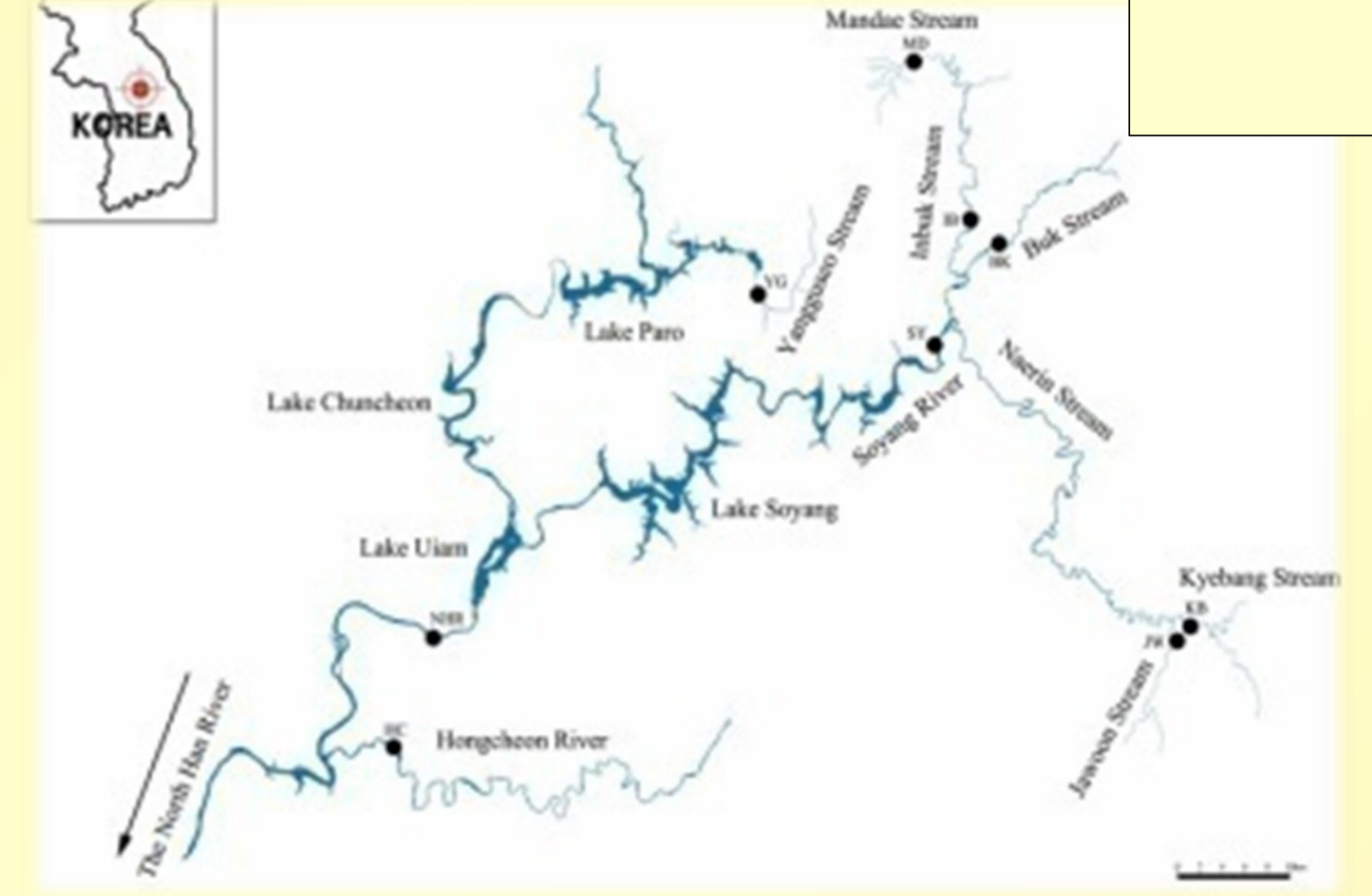
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Problem Statement:

The Soyang Lake watershed is composed of sub-catchments dominated by intensive agricultural management and by pristine (semi-)natural broadleaf and coniferous forests. Heavy nitrogen fertilization in the agriculture-dominated Haean basin is expected to be the major contributor to the nitrate output into the Mandae River and nitrate input into the Soyang Lake. Whether nitrate from atmospheric nitrogen deposition or from a surplus of microbial nitrification in the forest-dominated sub-catchments also contributes to nitrate output is an open question. Nitrate is a serious problem in surface and ground waters, because it causes eutrophication, affects drinking water quality and may even cause serious human health problems.



Overall Goals:

- Quantify the export of nitrate from sub-watersheds covered by different forest types and by agricultural land as influenced by the precipitation regime
- Quantify the import of nitrate into Lake Soyang and the export of nitrate from Lake Soyang as influenced by the precipitation regime
- Identify the proportional contribution of nitrate export and import originating from nitrification, atmospheric deposition and fertilizer application using the dual technique with stable isotopes
- Identify nitrate turnover processes within the Soyang Lake using the stable isotope approach

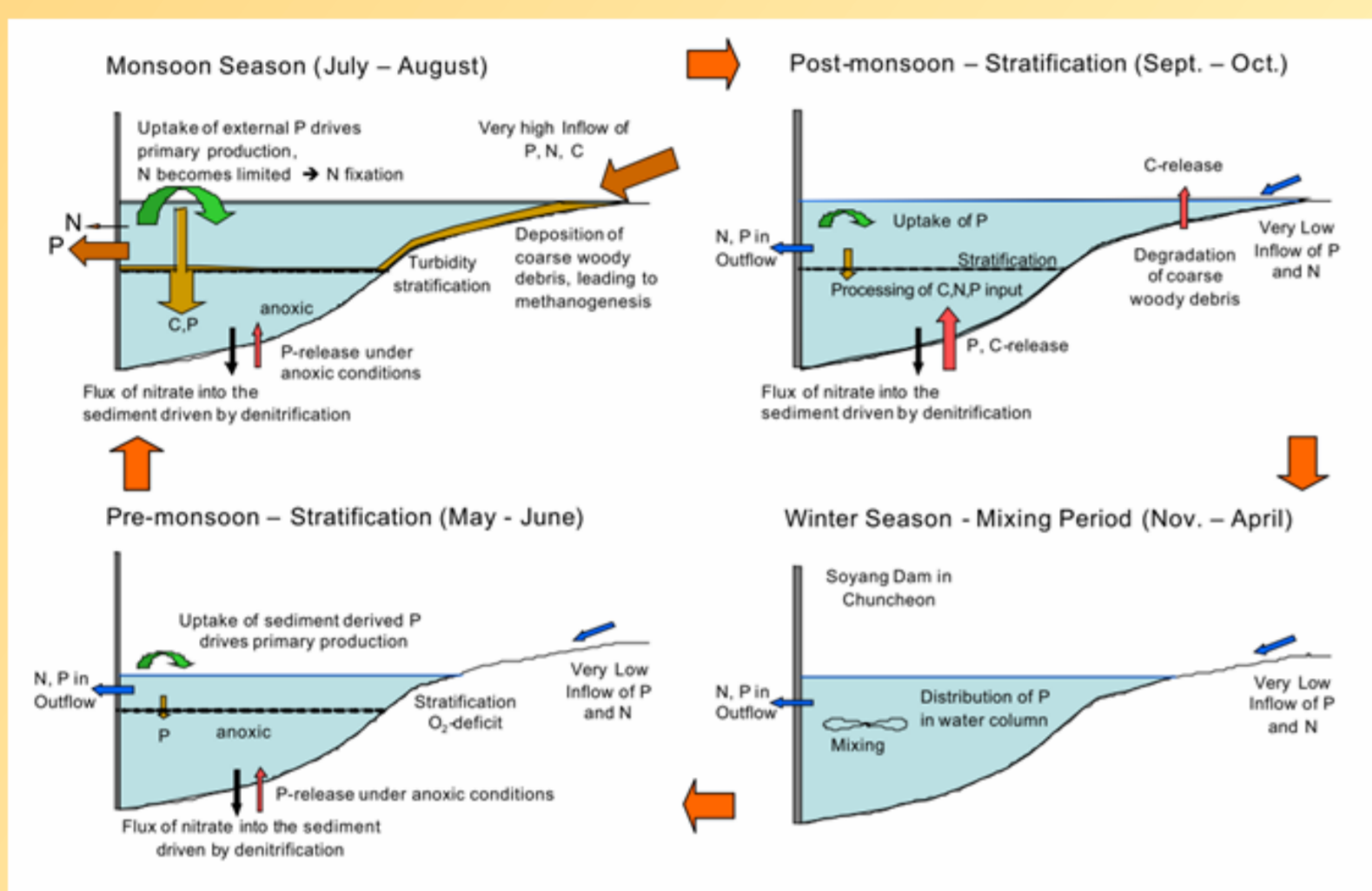


Figure 2. Hypothesized controls on the Soyang Lake water quality over an annual cycle.

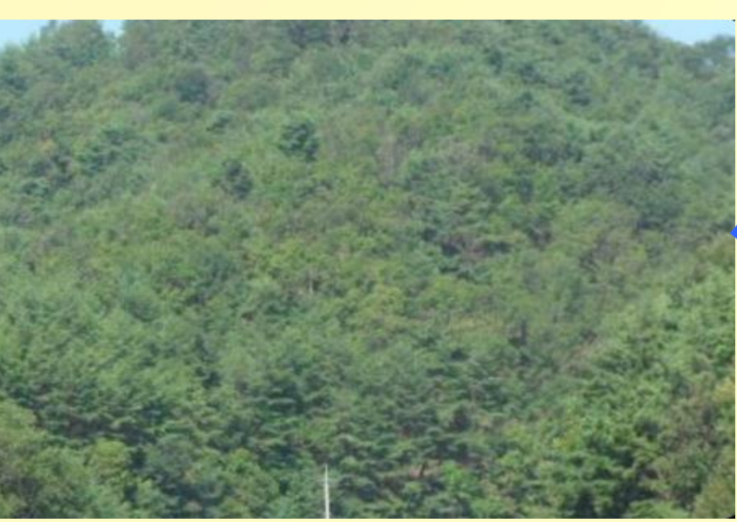
Methodology, Project Linkages and Research Organization:

Agricultural activities
Fertilization: + nitrate in groundwater, + nitrate in outlet to the river

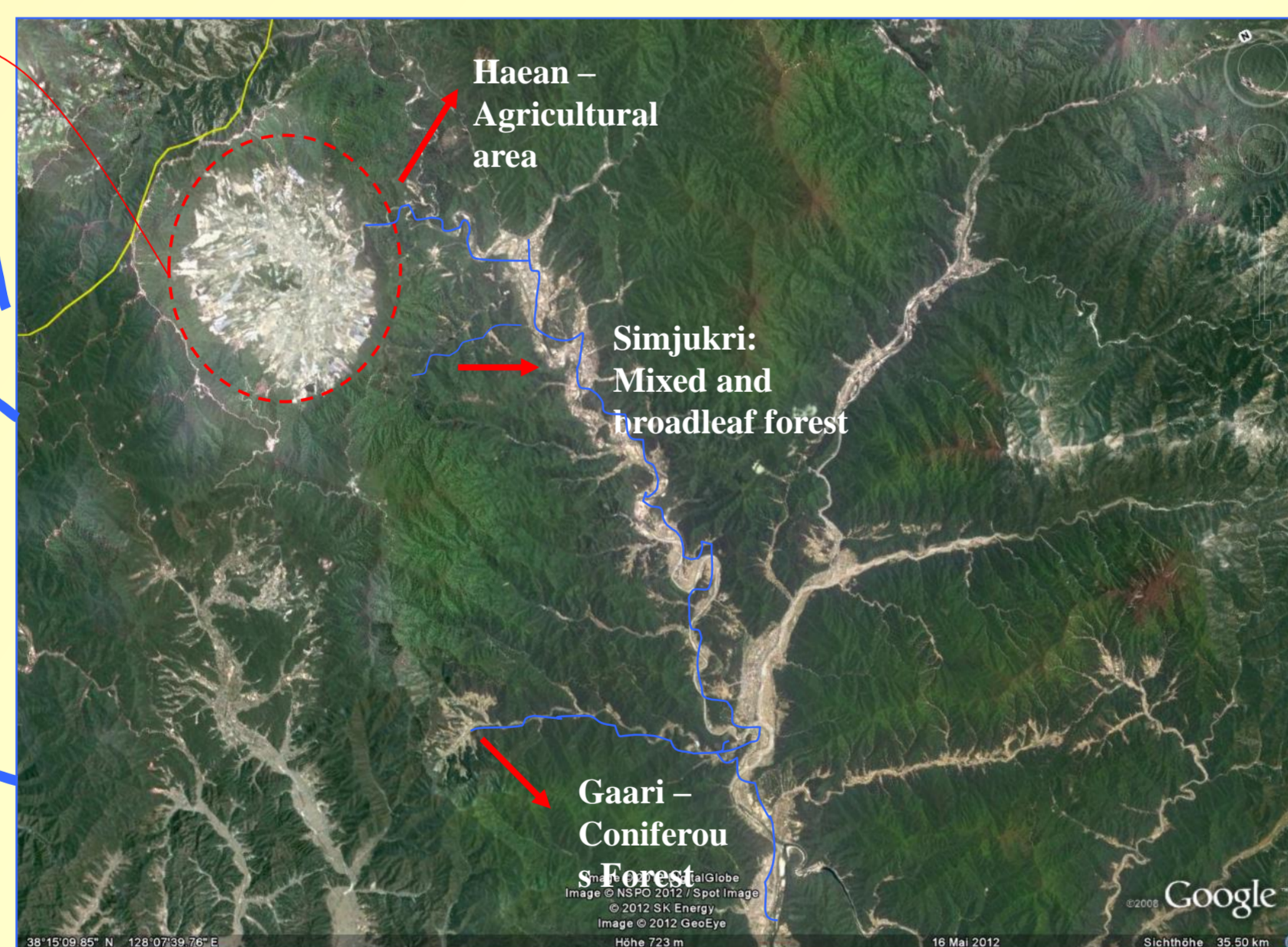
Nitrogen isotope ratios alone cannot readily differentiate between every nitrate sources.

Employing both $\delta^{15}\text{N-NO}_3^-$ and $\delta^{18}\text{O-NO}_3^-$ can provide useful source information owing to the large differences in oxygen isotope composition

Broadleaf forest + nitrate assimilation capacities



Coniferous Forest: Lower in nitrate assimilation capacities



Different nitrate isotopic composition

In principle stable isotopes signatures contain two categories of information:

Different and various processes

A source/sink tracer information that can be used to quantify the mixing of certain NO_3^- sources

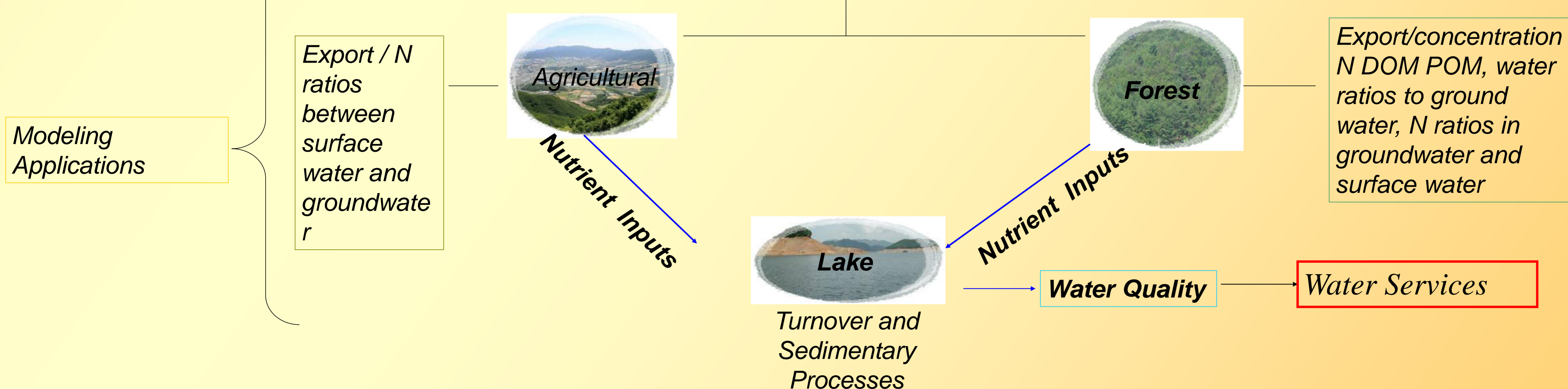
Different nitrate source

Process information: originated from isotopic fractionation

Soyang Lake: Nitrate inputs are extremely driven by seasonality, Intensive nitrogen turnover will occur based on several processes of N cycle

Cross-cutting Issues and Links to Other Project Groups:

Biogeochemical, hydrological processes and seasonality



References: Curtis J, Evans C, Goodale C, Heaton T, What Have stable Isotopes studies revealed about the nature and mechanisms of N saturation and Nitrate leaching from semi-natural catchments; *Ecosystems* (2011) 14: 1021-1037

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Deutsch B, Mewes M, Liskow I, Voss M, Quantification of diffuse nitrate inputs into a small river system using stable isotopes of oxygen and nitrogen in nitrate; *Organic Geochemistry* 37 (2006)1333-1342

Lee K, Bong Y, Lee D, Kim Y, Kim k, Tracing the sources of nitrate in the Han River watershed in Korea, using $\delta^{15}\text{N-NO}_3^-$ and $\delta^{18}\text{O-NO}_3^-$ values; *Science of the Total Environment*; 2008