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Influence of flow regime shift on the carbon-nitrogen coupling relationship of dissolved organic nitrogen export:

A case study of the Fushan Experimental Forest catchment

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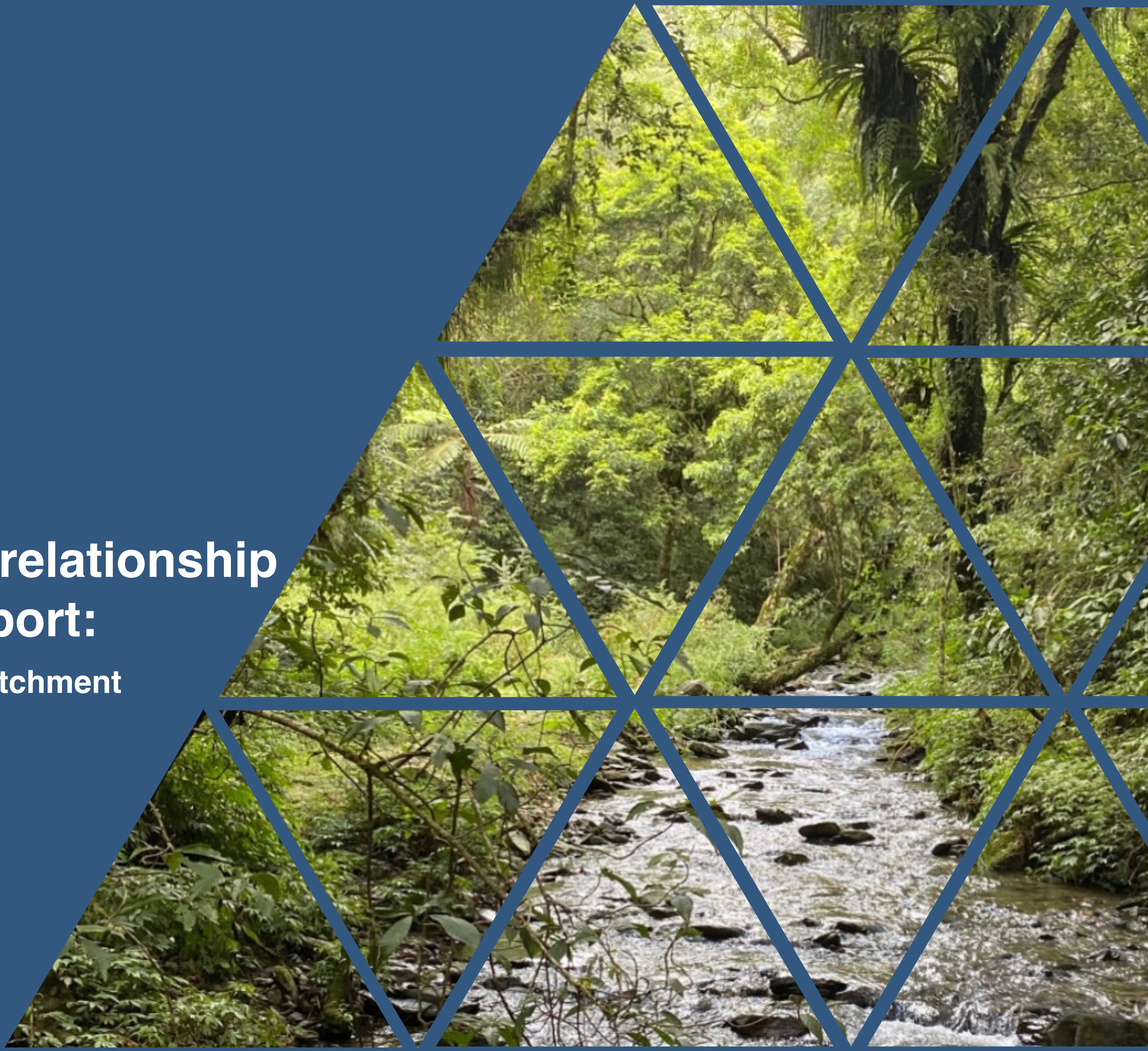


Research gap in the dissolved organic nitrogen

1. Reactive nitrogen and limiting nutrient.
2. Haber-Bosch N_2 fixation (~136 Tg N yr^{-1}).
3. Primary symptom of ecosystem N saturation: nitrate.

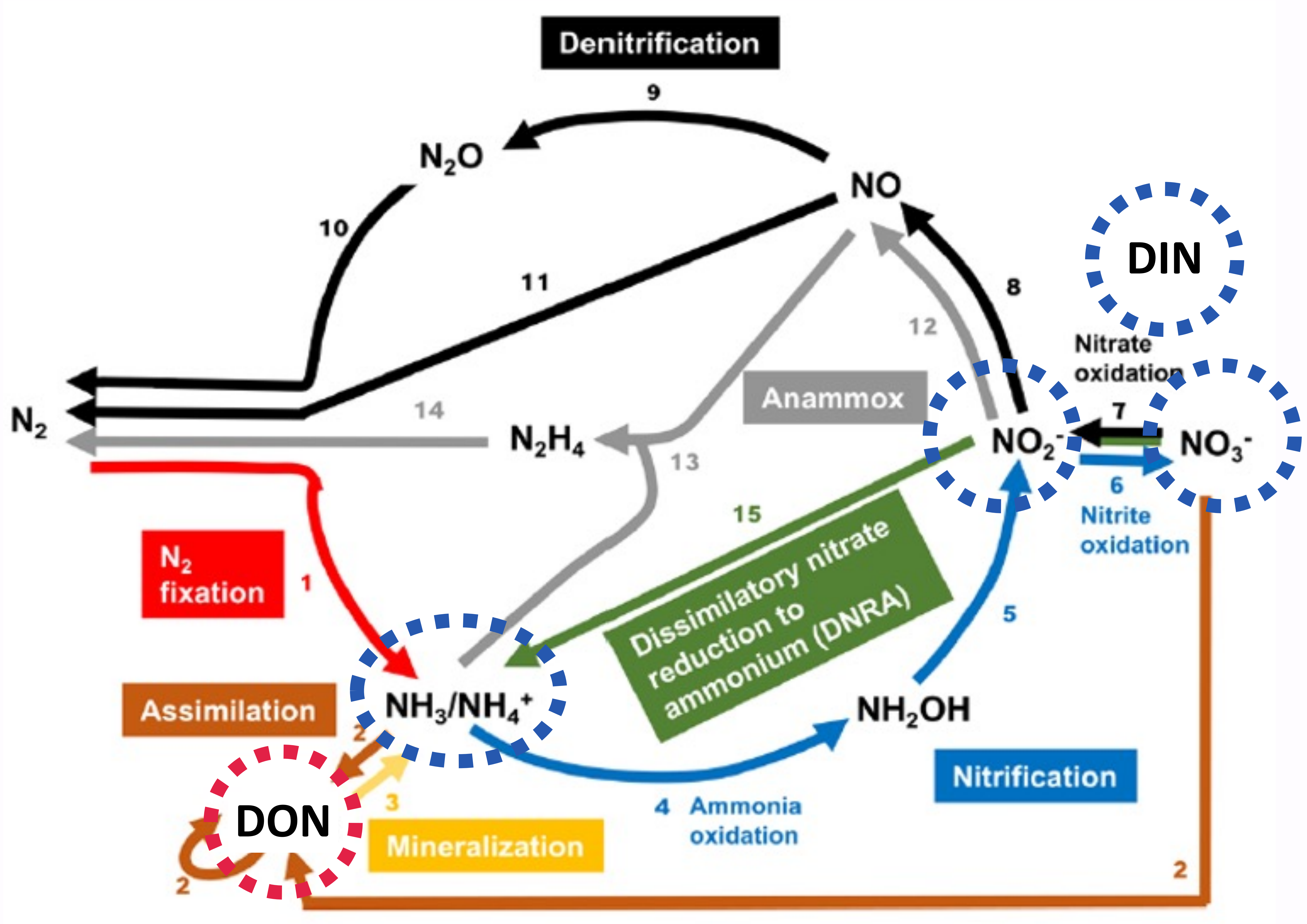


Figure 1. Nitrogen cycling (Zhang et al., 2020).

Research gap in the dissolved organic nitrogen

1. Nitrate (NO_3^-): Average 5%, range 0.1~18%. Ranging from 0.02 to 7.7 mg-N l^{-1} (average 1.9 mg-N l^{-1}).

2. DON: Average 80%, range 61~97%. Ranging from 8 to 135 mg-N l^{-1} .

3. DON is the primary source of nitrogen nutrient loss in the pristine ecosystem.

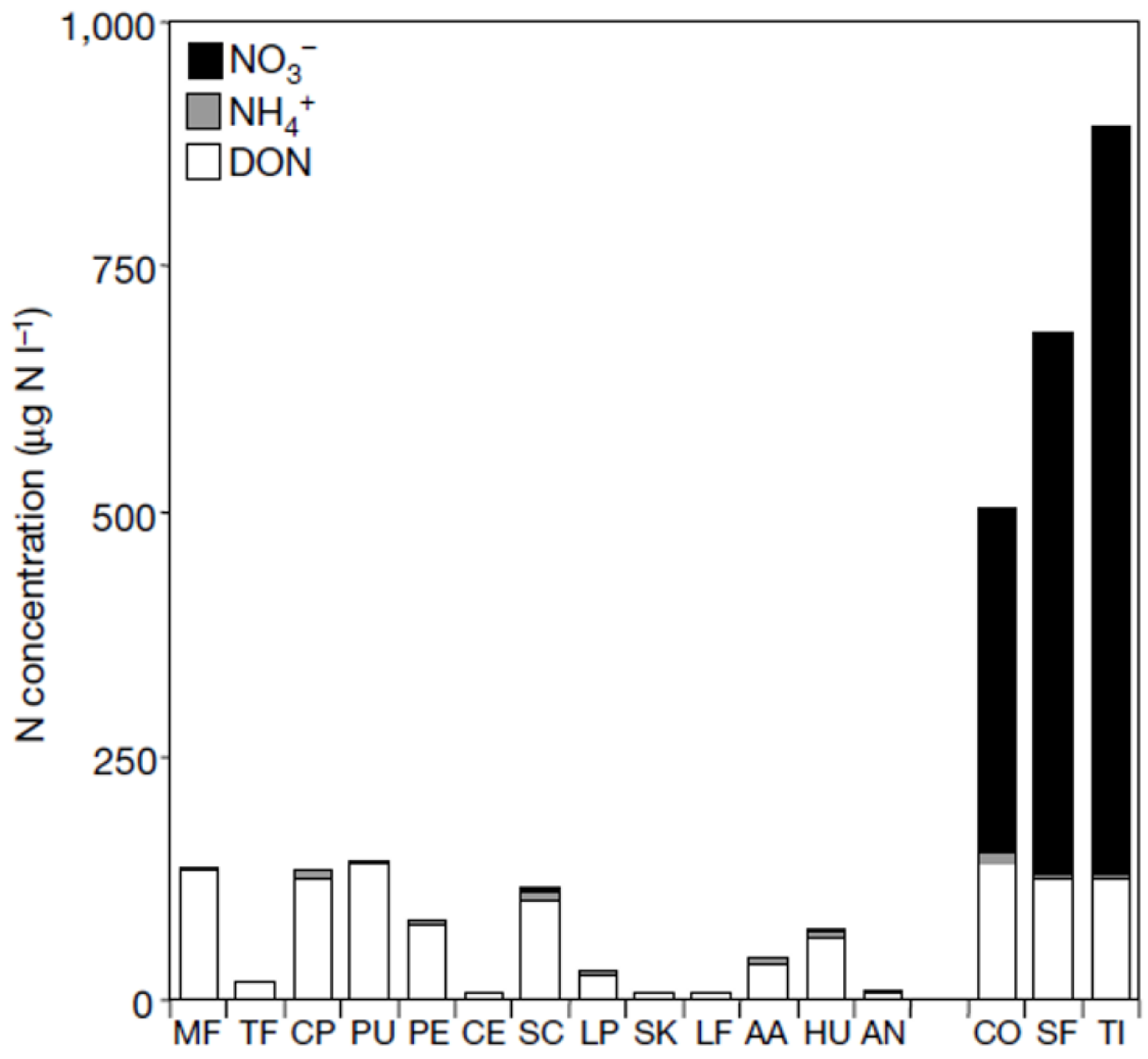


Figure 2. Hydrologic nitrogen losses (Perakis & Hedin, 2002).

The hypotheses of DON losses

1. **Passive carbon vehicle hypothesis**
   DON is largely biounavailable compounds leaching from slowly converted SOM by the strict stoichiometric with dissolved organic carbon.

2. **Stoichiometric enrichment hypothesis**
   DON and DIN concentrations are positively correlated that present the status of N saturation.

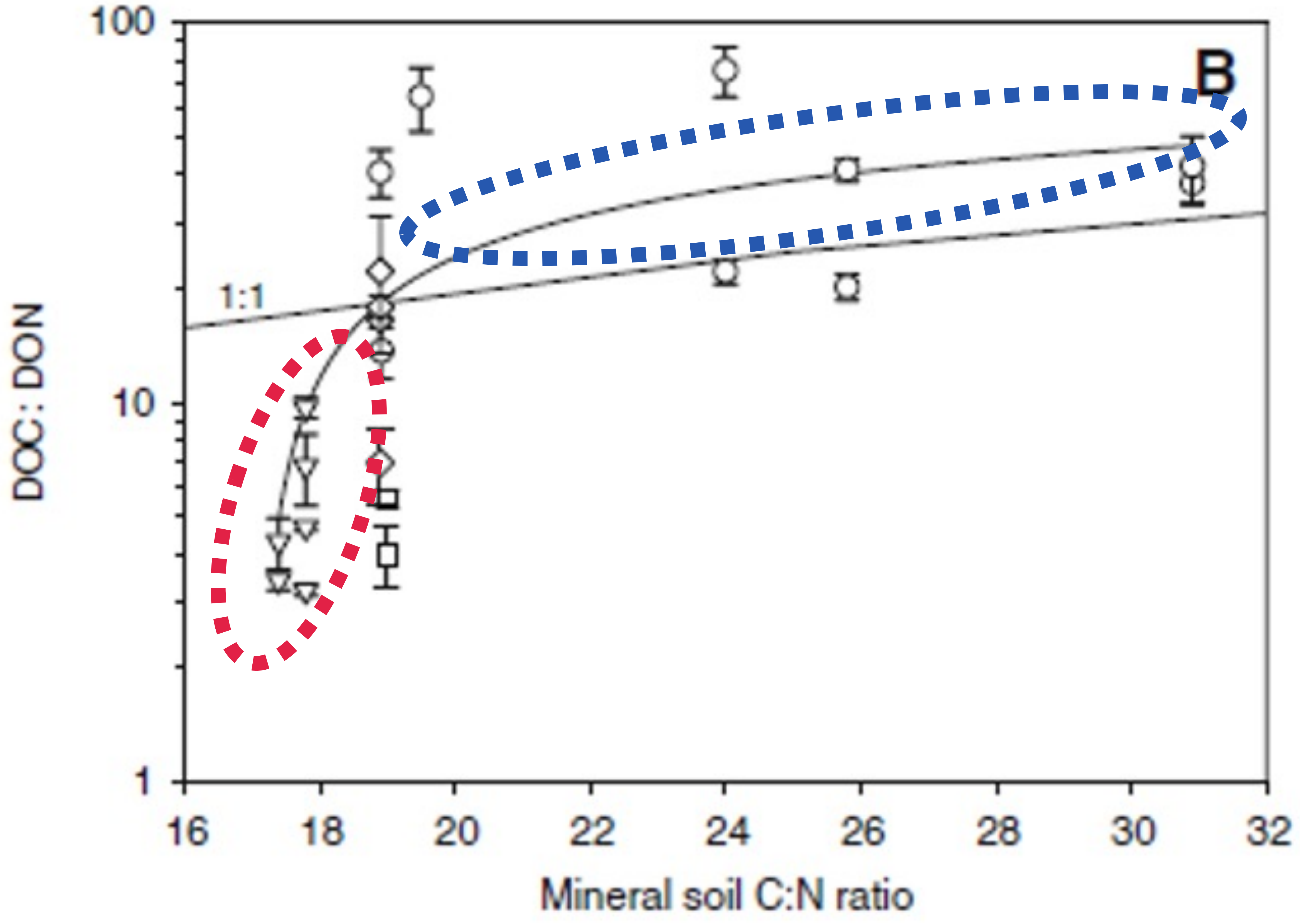


Figure 3. The relationship between soil and river water CN ratio (Brookshire et al., 2007).

The hypotheses of DON losses

3. Carbon indirect control hypothesis : Organisms tend to use DON instead of DOC.

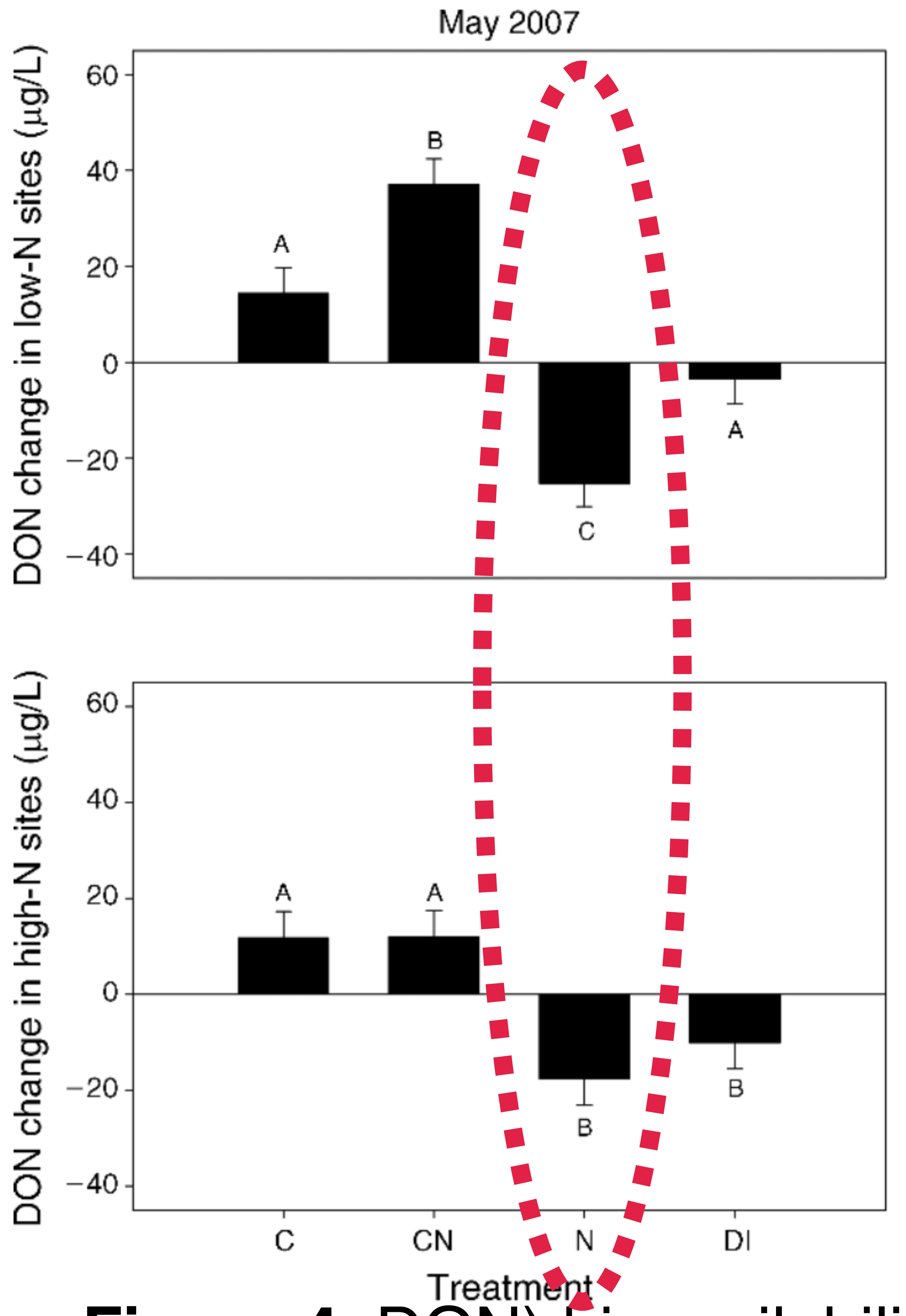


Figure 4. DON) bioavailability assays (Lutz et al., 2011).

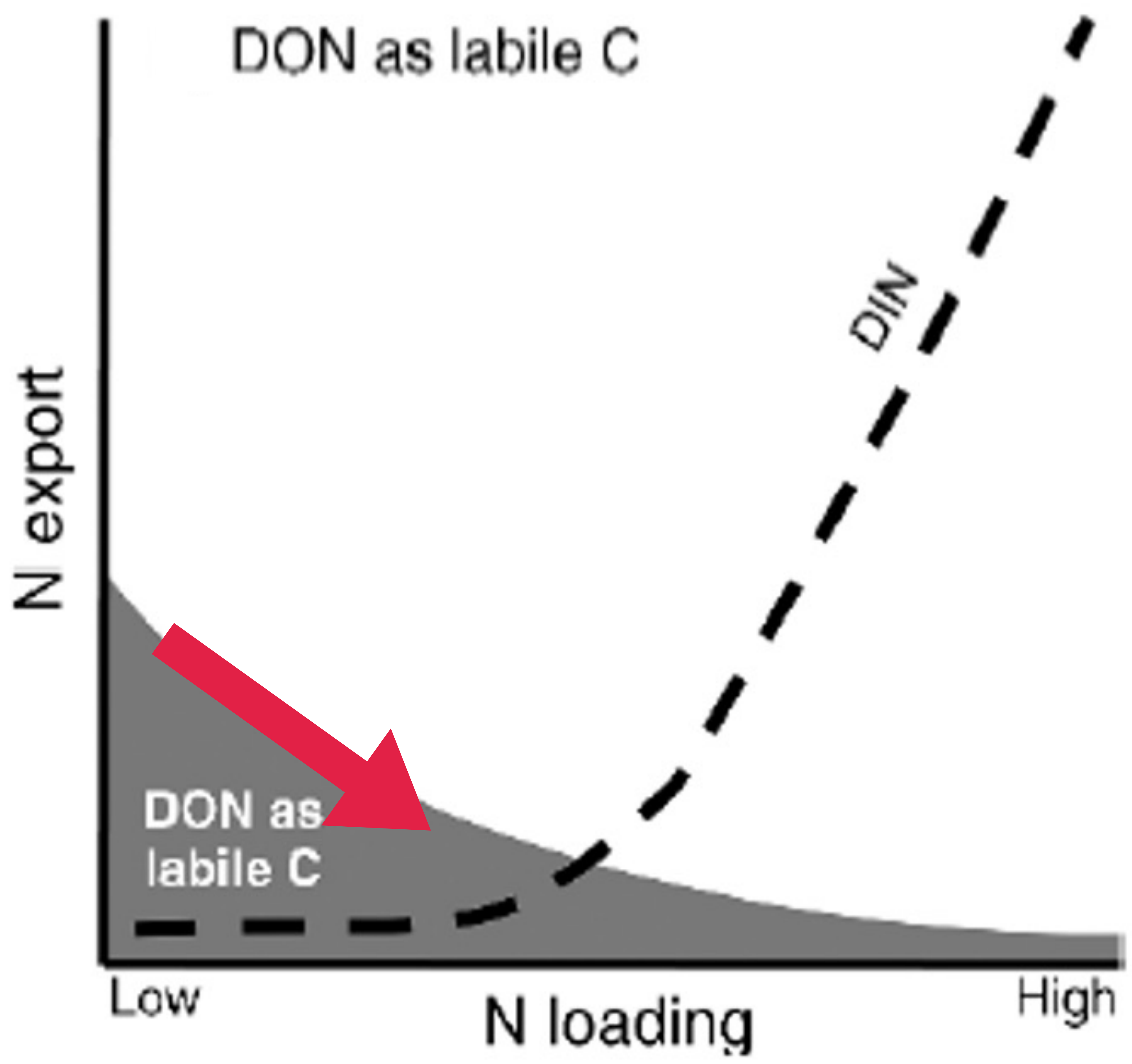


Figure 5. Carbon indirect control hypothesis (Lutz et al., 2011).

The patterns of DON losses

The carbon-nitrogen coupling and decoupling were different in each survey and experiment.

The pattern of DON losses

Carbon-nitrogen coupling

Carbon-nitrogen ratio

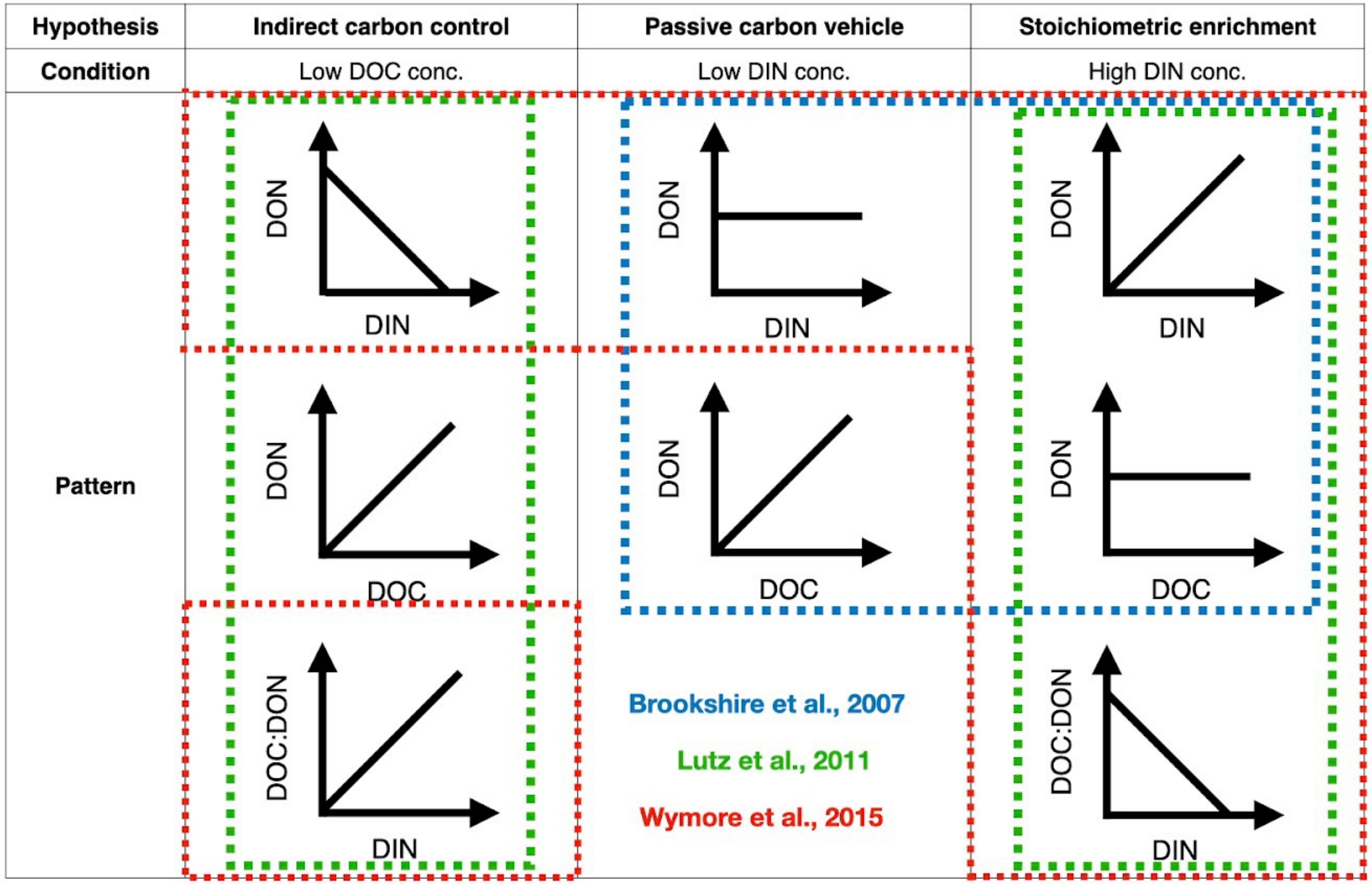


Figure 6. The patterns of DON losses

Objectives

1. To discuss the relationship between DON losses and the carbon-nitrogen coupling.
2. To sketch how the different flow regimes affect nutrient transport and the carbon-nitrogen coupling.

Objectives

1. High microbial activities (nitrification and mineralization,~4600 kg-N km^{-2} yr^{-1}) are most active in top soils and decrease with soil depth (Lu et al., 2017).

2. In advanced stages of N excess(high riverine DIN flux to atmospheric N deposition ratio, 0.45) (Lu et al., 2017).

3. Biomass at FEF (200-290 ton ha^{-1}) is low (Lin, 1994).

4. Litterfall ravaged by typhoons could account for 50% of total annual litterfall production (Lin et al., 2003).

5. Frequent rainfall (> 220 days annual) and high humidity (95 %), there is no observable dry season (Lin et al., 2011).

6. The forest experiences frequent typhoon disturbances (averages 0.49 major typhoons annually) (Lin et al., 2011).

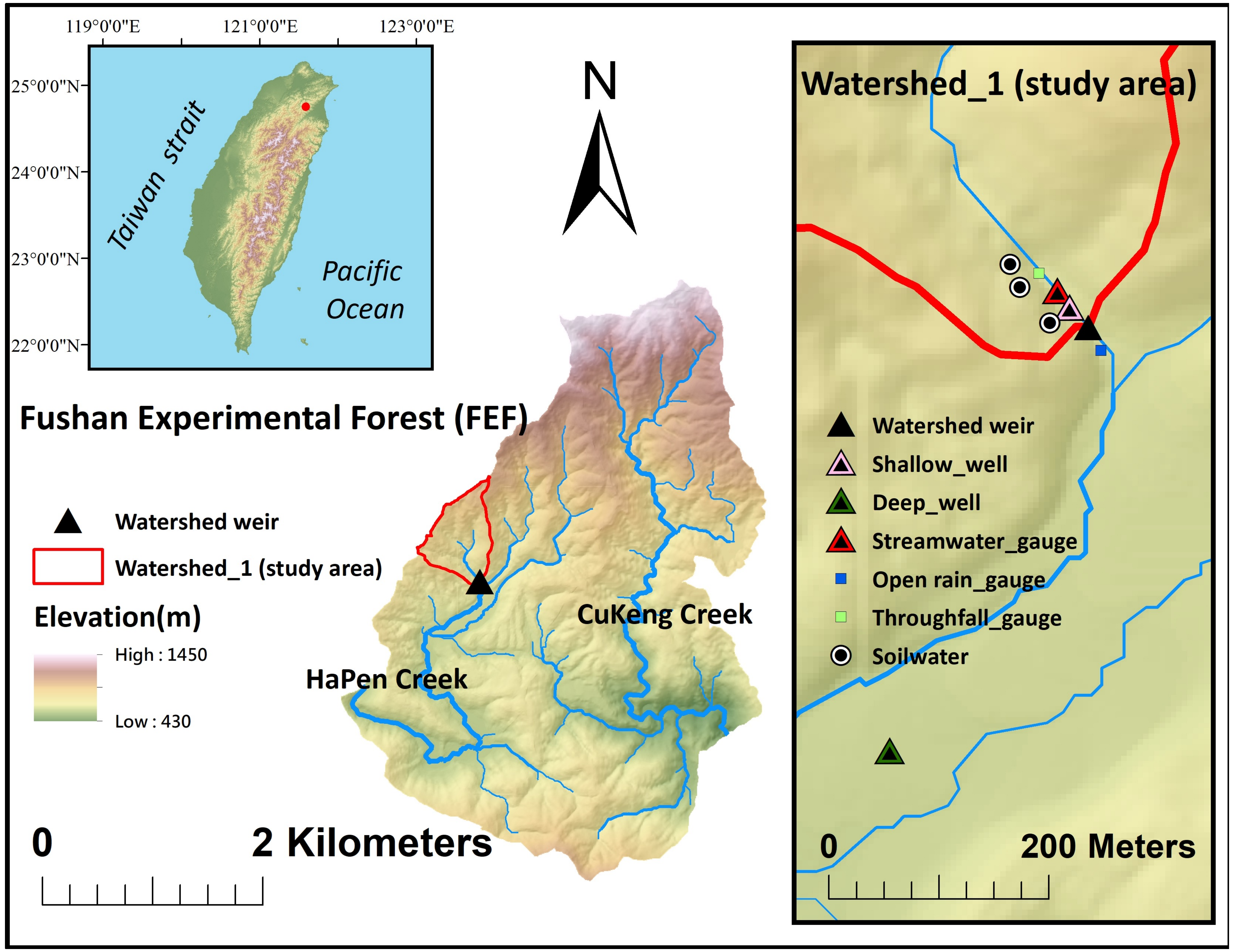
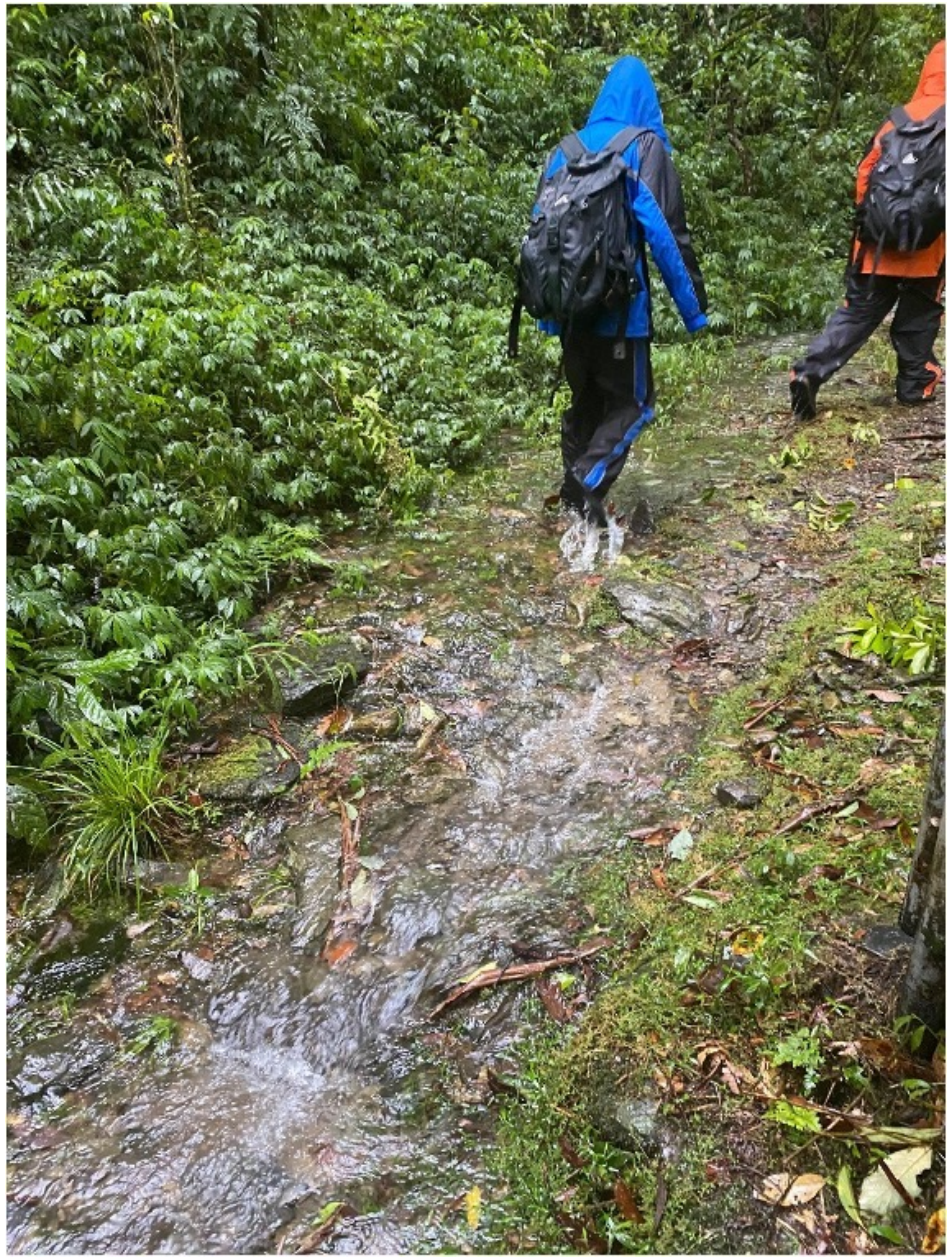


Figure 7. Location of Taiwan and Fushan experimental forest (FEF).

Water sampling in typhoon



Controlling endmembers of the DON losses in sMRs

1. Riverine nutrient was mainly controlled by groundwater.
2. The increasing DON in the stream was from the autochthonous source.

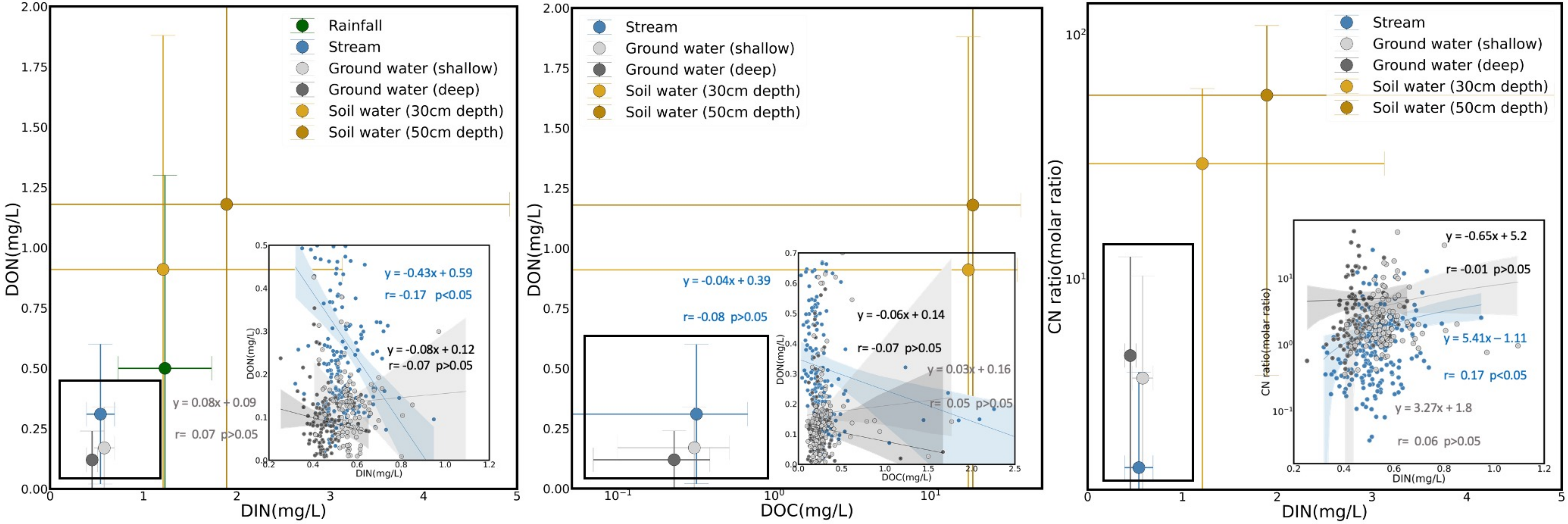


Figure 8. The pattern of dissolved organic nitrogen (DON) losses and the nutrient between each pool.

Controlling flow conditions of the carbon-nitrogen coupling

DOC in the soil can be continuously transported to the river, but DON has a significant consumption.

Typhoon Infa： 2021/7/23~ 2021/7/24, 114.5 mm/day maximum daily rainfall

Typhoon Merati： 2016/9/13~ 2016/9/14, 238.5 mm/day maximum daily rainfall

Typhoon Malakas： 2016/9/17~ 2021/9/18, 178.5 mm/day maximum daily rainfall

Typhoon Megi： 2016/9/27~ 2021/9/28, 352.5 mm/day maximum daily rainfall

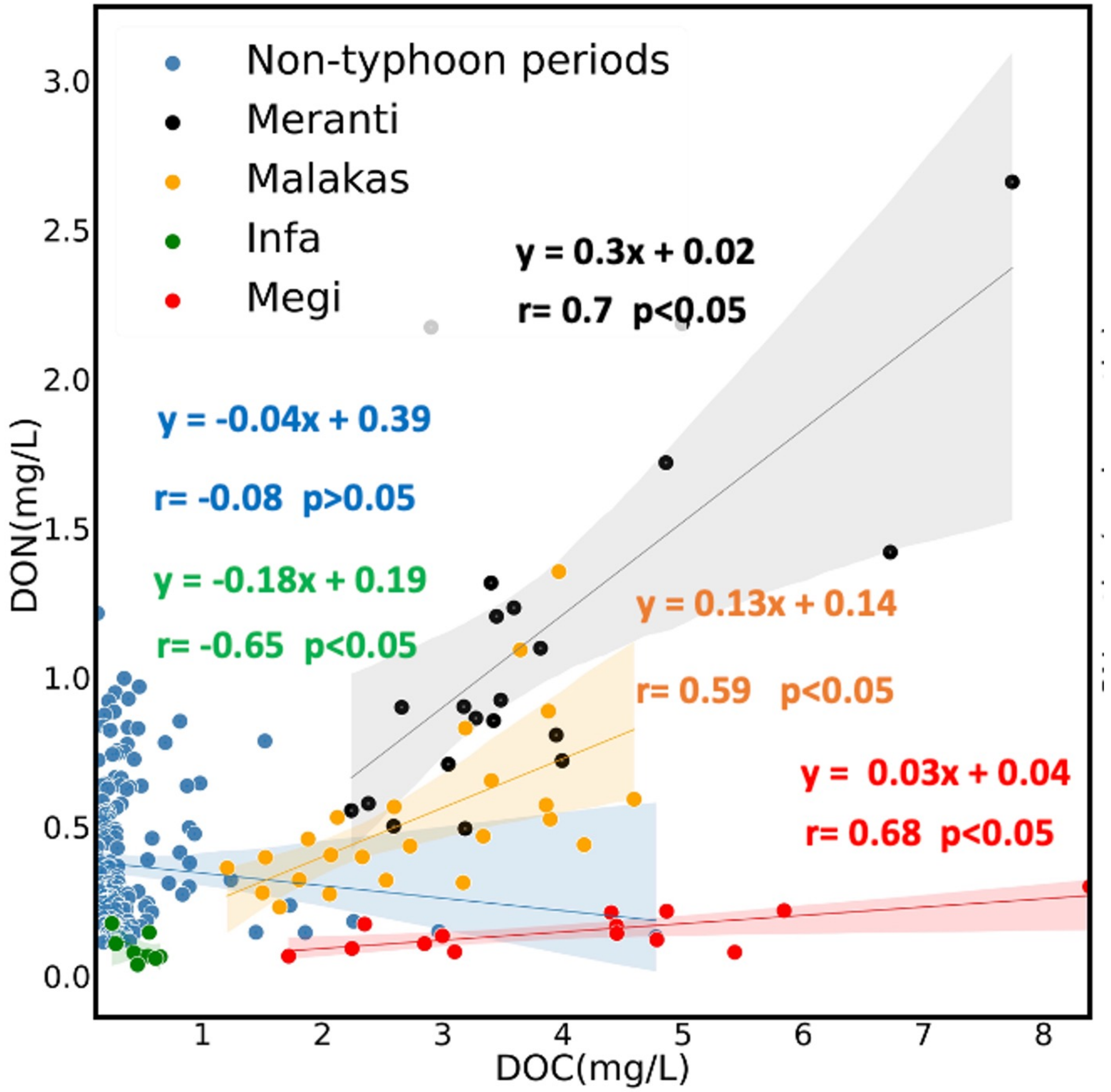


Figure 9. Relationships between DON DOC for non-typhoon periods and typhoon events.

Flow regime shifts the carbon-nitrogen coupling

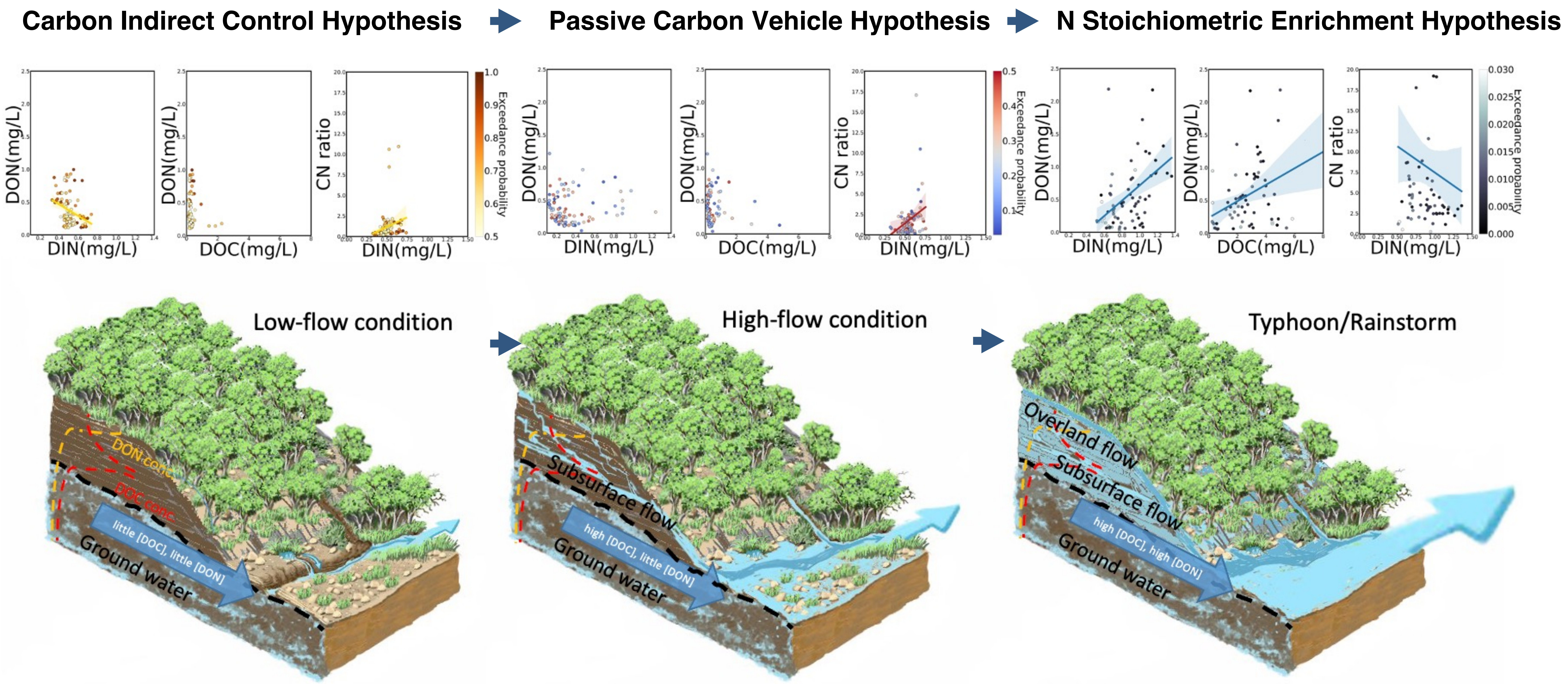


Figure 10. The conceptual model illustrates nutrient export.

The new hypotheses of DON losses at the FEF

The pattern of DON losses

Carbon-nitrogen coupling

Carbon-nitrogen ratio

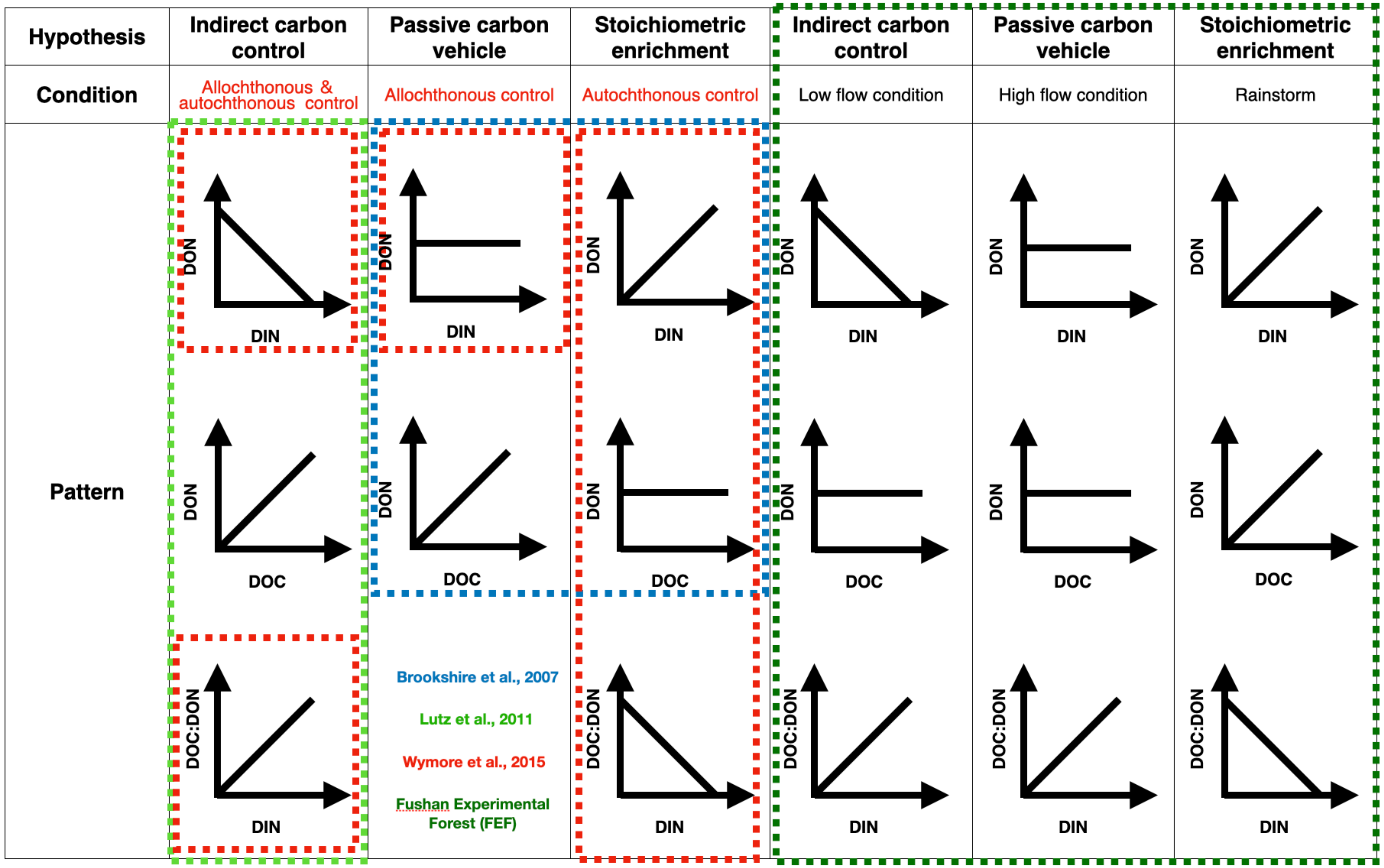


Figure 11. The conceptual model illustrates nutrient export.

Conclusions

1. The increasing **DON** in the stream was from the **autochthonous source** during **normal flow regimes**.

2. The mechanisms behind these complex carbon and nitrogen coupling changes are mainly affected by changes in **flow conditions** and **the distribution of carbon and nitrogen pools in the soil**.

3. These three hypotheses represent the **low flow condition**, the **high flow condition**, and **typhoon/rainstorm**, respectively, and they are the cycling of carbon-nitrogen coupling.

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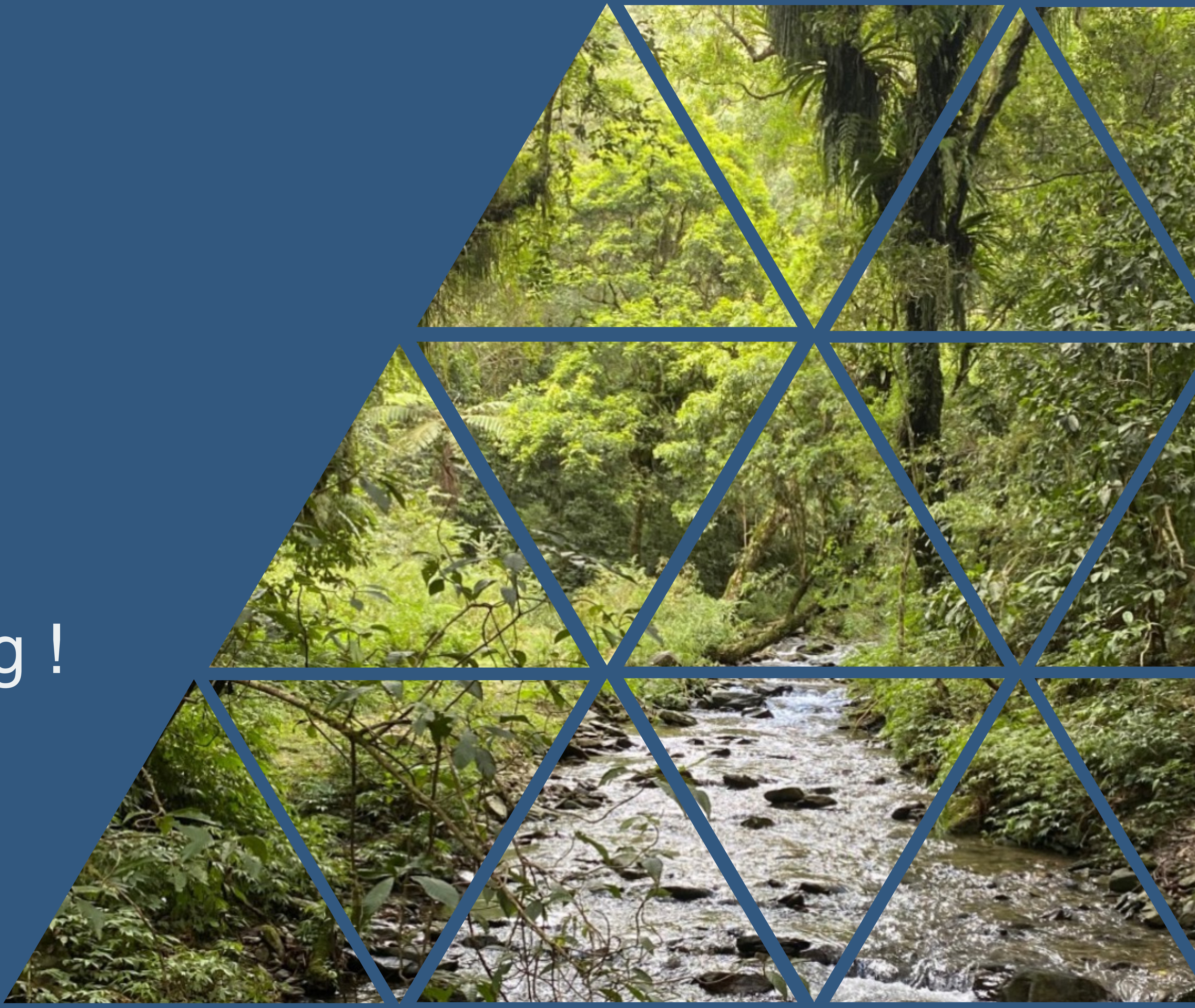

Thanks for listening !

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