

Putting a Whole System Approach for ecosystem, critical zone and socio-ecological research into praxis at the European scale: From triggering long-term N impact studies to interoperable standards and sustainable eLTER research services.

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We present recent site and cross-site evaluations of the drivers of long-term total (TIN) and dissolved inorganic N (DIN) concentrations and fluxes from catchments. In a global study, long-term, cross-site data shows that although N deposition is declining over time, atmospheric N inputs and precipitation remain important predictors for inorganic N exported from forested catchments. Despite decreased N deposition in Europe, TIN output fluxes and retention rates showed a mixed response with both decreasing and increasing trends. We put these trends in context using a karst catchment in the Austrian Alps (LTER Zöbelboden) from 27 years of records, where the study area was exposed to increasing N deposition during the 20th century, which are still at high levels of around 20-25 kg N ha⁻¹ y⁻¹. Albeit N deposition was close to or exceeded critical loads for several decades, 70–83 % of the inorganic N retained in the catchment. Exploring and interpreting the long-term dynamics of matter fluxes and stocks suggests cross-disciplinary collaborations, sharing, aligning and multiple usage of long-term operated Research Infrastructures. We will report on recent advancements in building a common theoretical base between major communities that is – inter alia - underlying the ongoing implementation of the Integrated European Ecosystem, critical zone and socio-ecological Research Infrastructure (eLTER RI). The “Whole System Approach for in-situ research on Life Supporting Systems in the Anthropocene” (WAILS) will be outlined. We will also expand on the potential of such unifying approach in theory-guided integration and division of tasks amongst related environmental RIs. Practical implications like Standard Observations will be addressed, which result from research teams driven (bottom-up) needs, but require centralistic RI design and operations for their implementation.