Project Database of ICP Forests
PROJECT DESCRIPTION

PROJECT INFORMATION

Project title: **Modeling global carbon flows in groundwater systems**
(Part of the project 'Modeling nutrient stoichiometry & carbon flows in freshwater systems')

Project ID: 126

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Introduction on the project

In global freshwater systems, roughly twice as much carbon enters aquatic systems from land as is exported from land to the sea. Freshwater systems therefore act as a carbon sink, though their size and specific role remains unquantified, involving a global 'missing carbon sink'.

Global groundwater systems may play an important role in the processing and retention of carbon along the aquatic continuum. We constructed a spatially explicit model to describe the carbon dynamics in groundwater systems at the global scale and give a first estimate of the role of groundwaters in the global carbon budget. Hydrology, lithology and the terrestrial carbon cycle in different biomes are used as conditions to describe dissolved organic carbon (DOC) and dissolved inorganic carbon (DIC) percolation from subsoils to aquifers and subsequently surface waters. The groundwater system consists of shallow and deep layers with a distribution of travel times. A first order decay rate depending on geohydrological and environmental conditions (i.e. residence time and temperature) is used to describe DOC processing and DIC production. Chemical weathering effecting DIC is also simulated. Both carbon species leave the groundwater system via riparian zones, hyporheic zones, by submarine groundwater discharge or groundwater withdrawal. Our model will

improve our understanding and allow to quantify the lateral transport of C in aquifers towards rivers and other surface waters in different biomes of the world.

Role of the ICP data in the project (aim)

In order to constrain the required input of our model (yearly average DIC&DOC concentration in deep layer soil solution), a database is being set up with measurement data on DIC and DOC concentrations in soil solutions. Also, potential drivers and data on related factors like soil properties, land cover and vegetation species are included (if available). The ICP Forests dataset will be an important part of the database, as for its spatial availability and consistency of the measurements quality. The results of the analysis of the database will be used to make an estimation of the global yearly average sub-surface (deep layer soil) DIC and DOC concentrations, which will serve as an input to our groundwater model.

Analysis and further data involved

We intend to include in the database on global DIC and DOC concentrations a wide spatial distribution of data. Naturally, most monitoring and sampling measurements are available for (Western) Europe. We will combine the ICP Forests dataset with measurements from literature studies and, if available, monitoring networks from other continents (for example USGS data). In addition, we also aim to include European data on DIC/DOC soil concentrations from other land use types (grasslands, croplands). Previously established global data-sets on soil characteristics (ISRIC) or terrestrial carbon cycle (LPJmL) are possibly used to fill in gaps in the database. LPJmL output is also used to study the relation between the terrestrial carbon cycle flows and the yearly carbon flows in soil solution.
First, a simple descriptive analysis will be conducted on the database (mean, median, standard deviation, error, percentage ranges etc.). Depending on data availability and comparability (regarding sampling method differences), this will be done for different groups

of parameters/drivers regarding vegetation (for example land cover type), soil characteristics (for example soil depth or C/N ratio), carbon budget (for example net ecosystem exchange) and meteorology (climate zones).

In a further detailed analysis, influences of possible drivers on the yearly carbon concentrations are studied. The extend of the further detailed analysis is mainly depending on the availability of the sub-groups of the data (yet unknown) and the results of the descriptive analysis. In principle it will involve a regression analysis in which the strength of predicting variables is analyzed, for example through a stepwise linear regression analysis. Naturally, necessary statistical values like the R2 and p-value will be included.

In general, Level II plots are used in order to enable comparing several variables from the same site. The database intends to include data on;

- Site characteristics
- Carbon in soil solution (DOC and/or DIC)
- Soil characteristics
- The present biome/vegetation
- Simple meteorological conditions