Effects of storage in field and in laboratory and influence of temperature and light on the chemistry of forest water samples


Fourteen different storage experiments:

- **Storage in the field - influence of the sampler design**: Experiment A, D, I - sample bottle hanging in a tube (A) versus sample bottle in a pit (B).
- **Storage in the laboratory simulating field conditions**: Experiment E, G, H - storage of unfiltered bulk open field (BOF), throughfall (TF), stemflow (SF), and soil solution (SS) samples 1 to 86 days at different temperatures (4, 8, 20, 30, 40 °C). Samples collected after 1 day, 1 or 2 weeks.
- **Long-term storage in the laboratory**: Experiment B, E, J, K, L, M, N, O - storage of filtered bulk BOF, TF, SF and SS samples at 2-4 or -20 °C. 1 day to 1 year.
- **Experiment L**: no changes for pH and conductivity during 1 month, no changes of DOC during 2 months, no changes of cations (acidified) during 4 months; slightly decrease of NO3, during 4 months at 2-4 °C.
- **Experiment M**: no changes in DOC after 2 weeks at 2°C and additional 3 months at -20°C; decrease in conductivity in samples with pH > 8; after 3 weeks at -20°C.
- **Experiment O**: no alteration of the samples in systematic way during long time storage at -20°C.
- **Experiment E**: Changes in DOC over time in different fresh samples from Solling, Germany (different storage temp.; filt. and unfilt.).

**Conclusions:**
- during the sampling period outside on the plot (2 weeks) the conditions are continuously changing; high temperature peaks up to 45°C are possible
- high temperature can promote changes in the (unfiltered) samples
- mostly changing parameters are DOC, pH, NH4, NO3
- the changes in unfiltered samples normally were higher than in filtered samples, but in filtered samples changes were also observed in most cases the changes were higher at higher temperatures
- in filtered samples stored at 2-4 °C or at -20 °C only the TC /DOC content sometimes decreased; the other parameters normally didn’t change
- the storage experiments with unfiltered samples stored up to 2 weeks at different temperatures show different changes for pH, DOC, NH4, and NO3. Many changes can happen in the field before sample collection for these parameters
- Overall, shorter sampling periods (weekly), early filtration and storage of the samples at 2-4 °C or -20 °C is the best to minimize changes. Changes can not be avoided totally.

**Results:**
1. **Storage in the field - influence of the sampler design:**
   - Experiment A, D, I (A): large daily variations in temperature, high temperature peaks (up to 45 °C), higher mean temperature; (B): better protected from light, lower variations in temperature, lower mean temperature (max. 20 °C).
   - Experiment I: lower pH in (B), higher conductivity and higher DOC in (B). No significant pattern for N.

2. **Storage in the laboratory simulating field conditions:**
   - Experiment E (fresh collected samples, 1 day after rainfall): evident changes in DOC, pH and NH4, and N: the changes were often higher and faster at higher temperatures and in unfiltered samples; DOC decreased and pH increased.
   - Experiment G (samples collected after 1 week): evident changes in DOC, pH and N compounds; but not clear how it is related to temperature.
   - Experiment H (samples collected after 2 weeks; 15 days storage of TF at room temperature sunny and hot places): high evaporation at the warm places after 15 days; no changes for pH, N compounds, small changes for Na+ and Ca2+.

3. **Long-term storage in the laboratory:**
   - Experiment B: no systematical changes of NO3, NH4, SO4, Cl, cations after storage at 20 °C for 1 year.
   - Experiment J: no changes for N compounds but decrease in DOC in SS at 2-4 °C and -20°C after 4 months; no or little difference when stored at 2-4 °C or 20°C.
   - Experiment L: no changes for pH and conductivity during 1 month, no changes of DOC during 2 months, no changes of cations (acidified) during 4 months; slightly decrease of NO3, during 4 months at 2-4 °C.

**Conclusions:**
- Experiment K (storage at 2 °C): no large differences for elements measured by ICP-OES between acidified and not-acidified storage.

**Methods:**
- 1 NW Swedish Environmental Research Institute, Sweden (Experiment D)
- 2 Department of Geosciences and Natural Resource Management, University of Copenhagen, Denmark (Experiment D)
- 3 WSL, Swiss Federal Institute for Forest, Snow and Landscape Research, Switzerland (Experiments U, K, L, M, O)
- 4 Northwest German Forest Research Station, Germany (Experiments E, F)
- 5 CNR-ISE, Institute of Ecosystem Study, Italy (Experiment G)
- 6 Forest & Nature Lab, Ghent University, Belgium (Experiment C)
- 7 Research Institute for Nature and Forest, Belgium (Experiments A, B)
- 8 Slovenian Forestry Institute, Slovenia (Experiment H)