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Impacts of rewetting on hydrological functioning and dissolved organic carbon flux in a degraded peatland (La Guette, France)

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► To cite this version:

Léonard Bernard-Jannin, Stéphane Binet, Sébastien Gogo, Franck Le Moing, Renata Zocatelli, et al.. Impacts of rewetting on hydrological functioning and dissolved organic carbon flux in a degraded peatland (La Guette, France). EGU General Assembly 2016, Apr 2016, Vienne, Austria. 18 (EGU2016-12698-1), 1 page, 2016. insu-01381432

HAL Id: insu-01381432

<https://insu.hal.science/insu-01381432v1>

Submitted on 14 Oct 2016

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1-INTRODUCTION:

Sphagnum-dominated peatlands contain about 30% of the world's soil C stock (Fig 1). This C-sink function is largely controlled by the low rate of organic matter (OM) decomposition due to hydrological conditions that favour soil waterlogging. Rewetting is a widespread method that has been used for restoration of degraded peatland ecosystems. The aim of this study is to assess the impact of rewetting on hydrology and dissolved organic carbon (DOC) dynamics that can affect carbon sink function of these environments

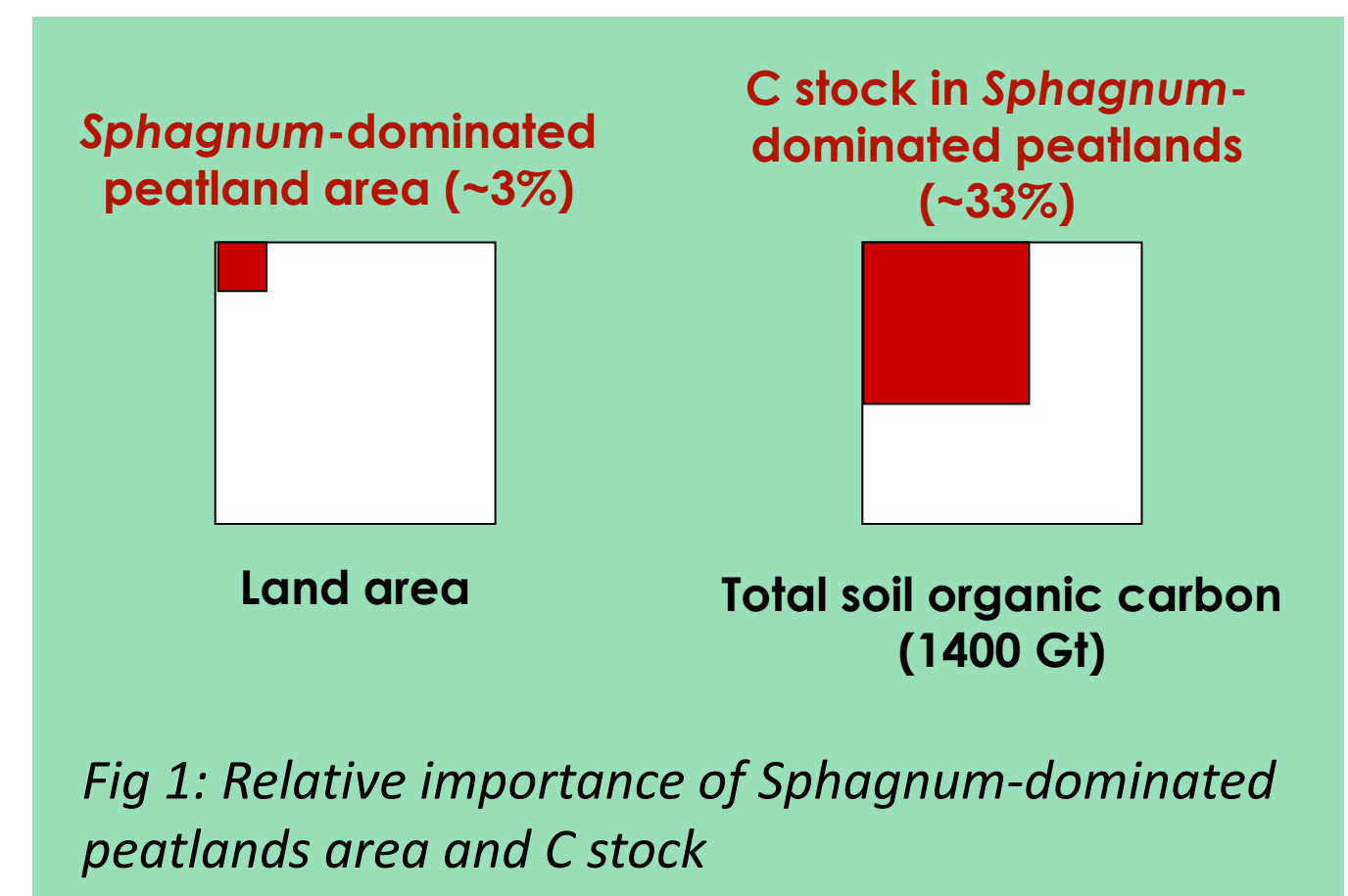


Fig 1: Relative importance of *Sphagnum*-dominated peatlands area and C stock

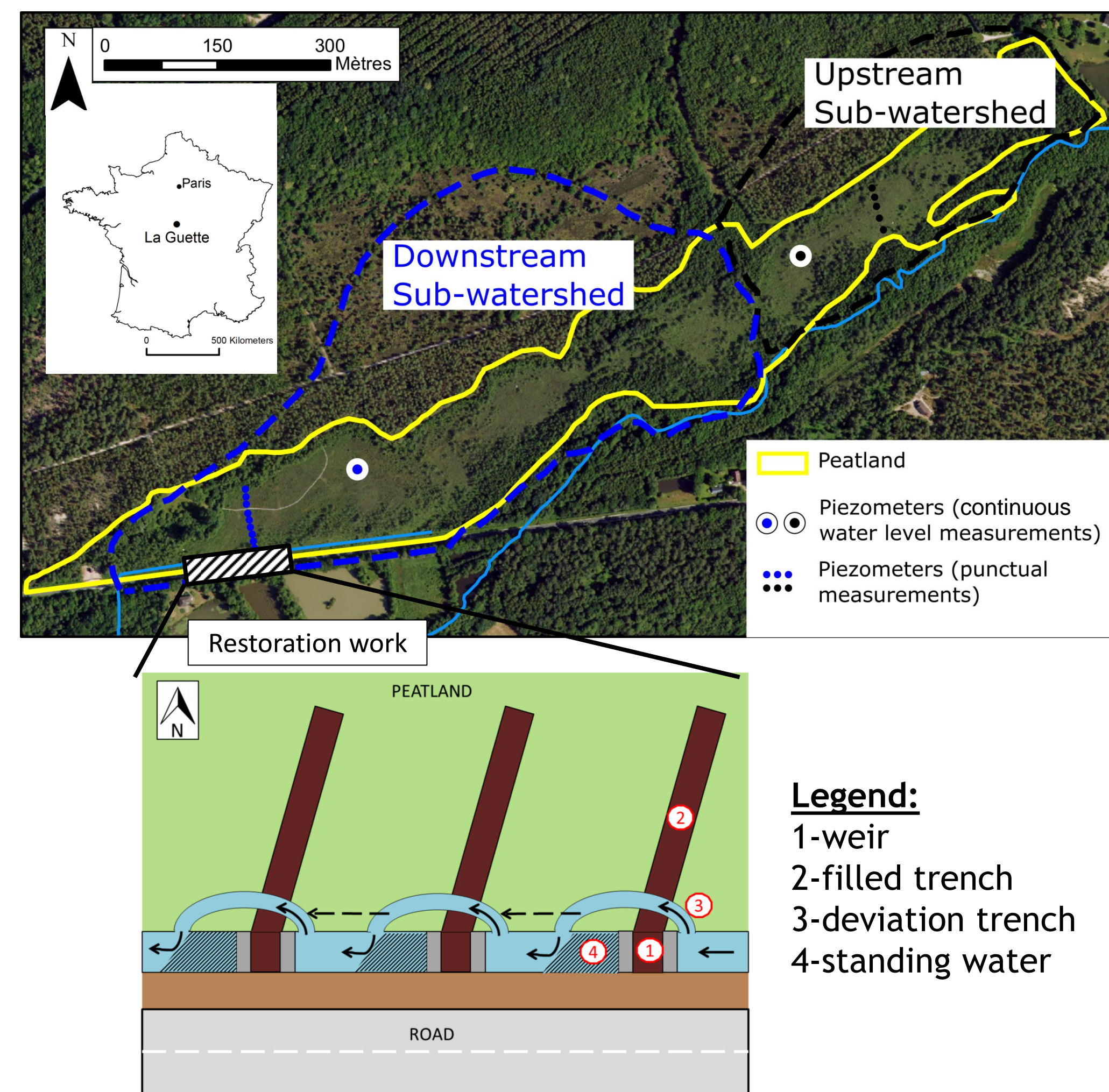


Fig 2: The La Guette peatland study area (top) and details of the restoration work (bottom)

2-STUDY SITE : La Guette Peatland (France)

Area: 20 ha
 Mean precipitation: 732 mm per year
 Mean evapotranspiration: 831 mm per year
 Vegetation: *Sphagnum* spp, *Calluna vulgaris*, *Erica tetralix*, *Molinia caerulea* and *Betula* spp

Two sub-watersheds (Fig 2):

- Upstream: natural conditions
- Downstream: drainage by a road ditch

Restoration work:

- Upstream: nothing (control)
- Downstream: rewetting started in February 2014 (installation of 8 weirs, Fig 2)

Data collection in monitoring piezometers:

- Continuous water level records in 2 points since 2010 (one in each catchment)
- Manual sampling since February 2014 (10 campaigns) in 2 transects: upstream (n=5) and downstream (n=10).
 - Physico chemical parameters (EC, pH, T° and water table depth)
 - ions (Cl⁻, Mg²⁺, Na⁺, K⁺, NO₃⁻)
 - DOC analysis (concentration and SUVA₂₅₄)

3-IMPACT OF REWETTING ON HYDROLOGY

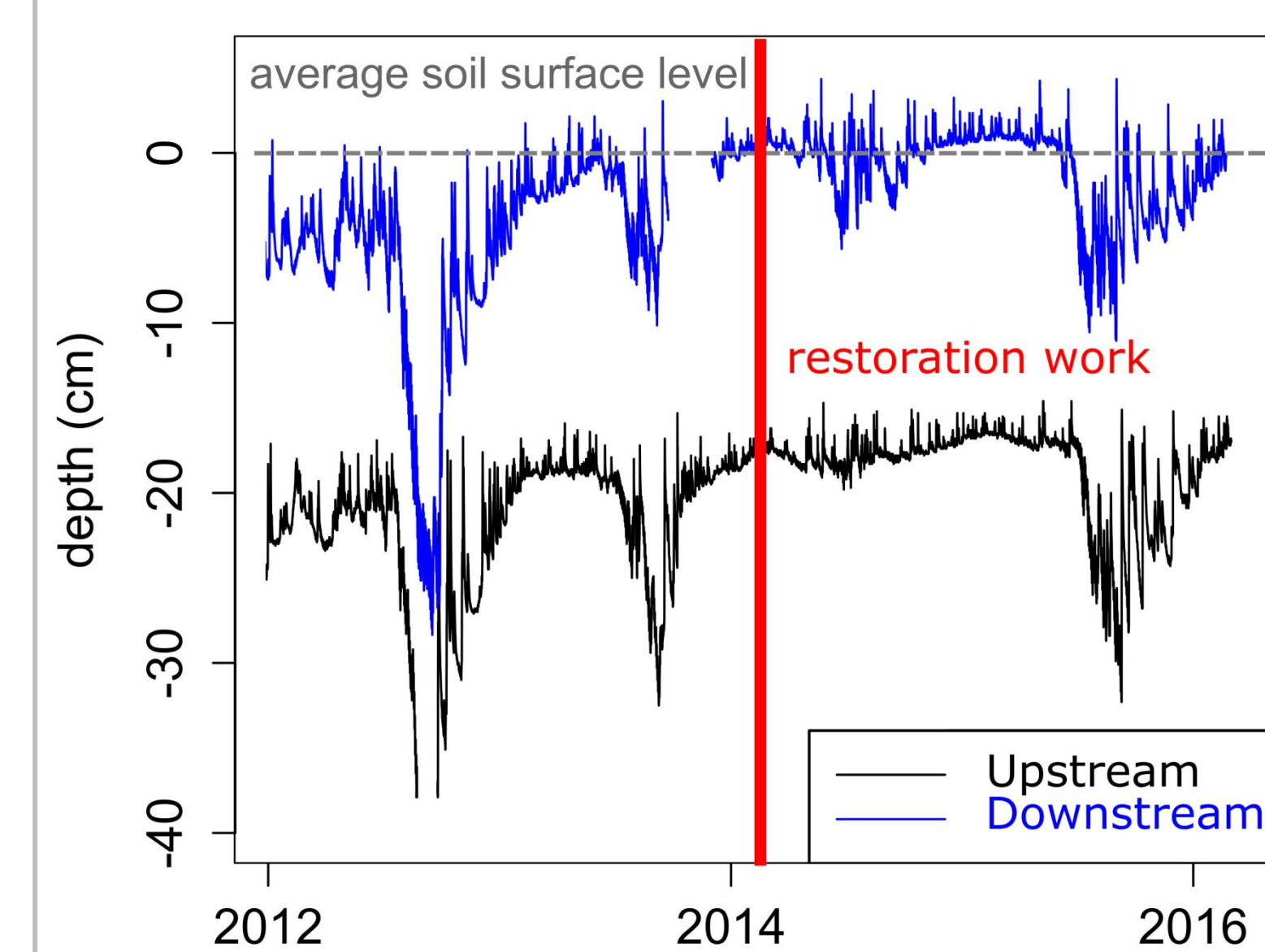


Fig 3: Water depth recorded in the two sub-watersheds since 2012

- Water level is higher in both catchments after the restoration (Fig 3)
- Precipitation might explain the changes: rainfall in summer 2014 = 268 mm; average rainfall in summer (2010-2015) = 193 mm.
- Relationship between water table depth in both catchments changed after the restoration (Fig 4)
- Possible impact of restoration work leading to higher water level downstream, after the work

- Water level is higher in both catchments after the restoration (Fig 3)
- Precipitation might explain the changes: rainfall in summer 2014 = 268 mm; average rainfall in summer (2010-2015) = 193 mm.

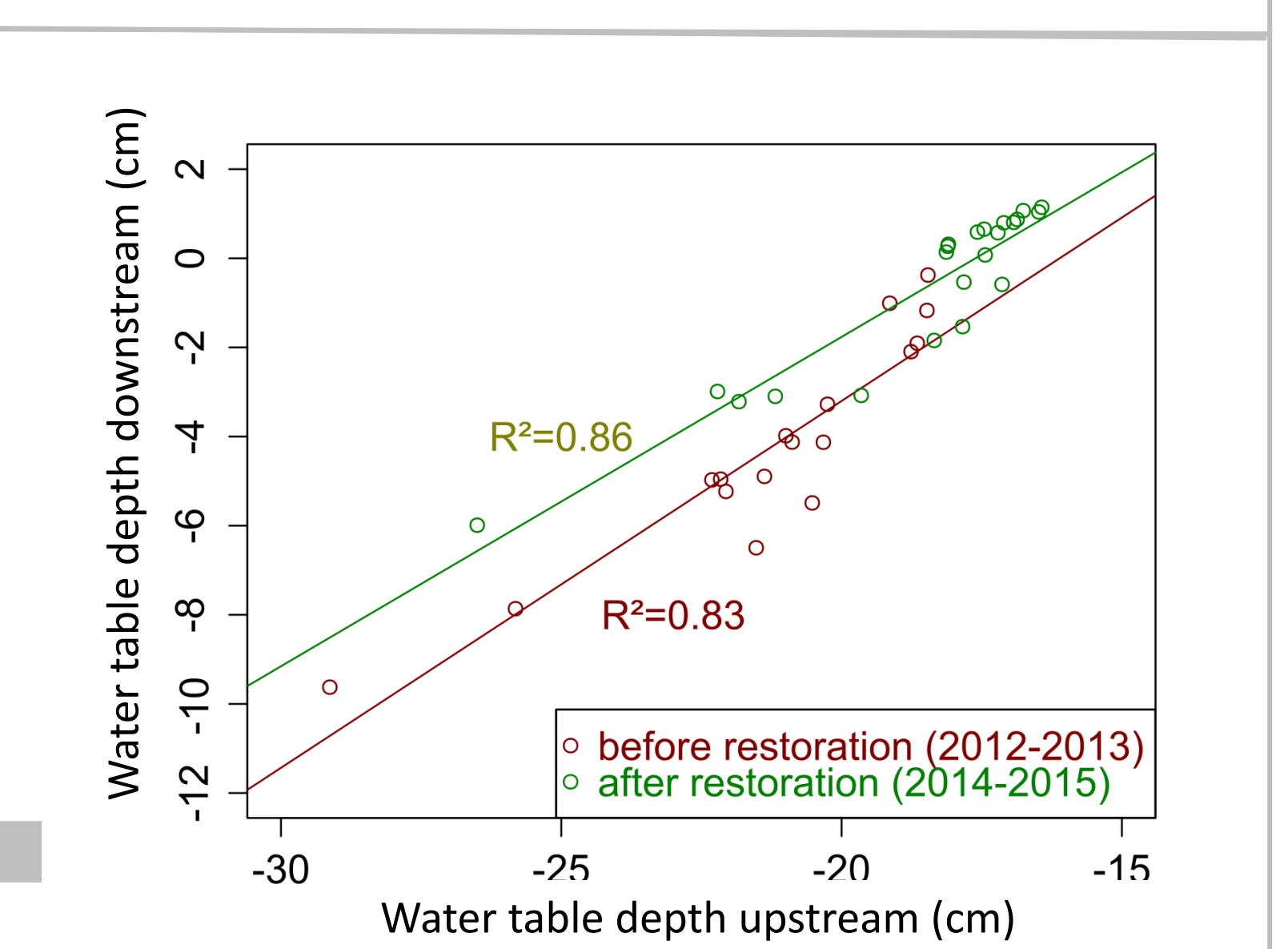


Fig 4: Relationship between monthly water table in both catchments for the 2 years preceding and the two years following the restoration

4- DOC CONCENTRATIONS DYNAMICS AFTER THE REWETTING

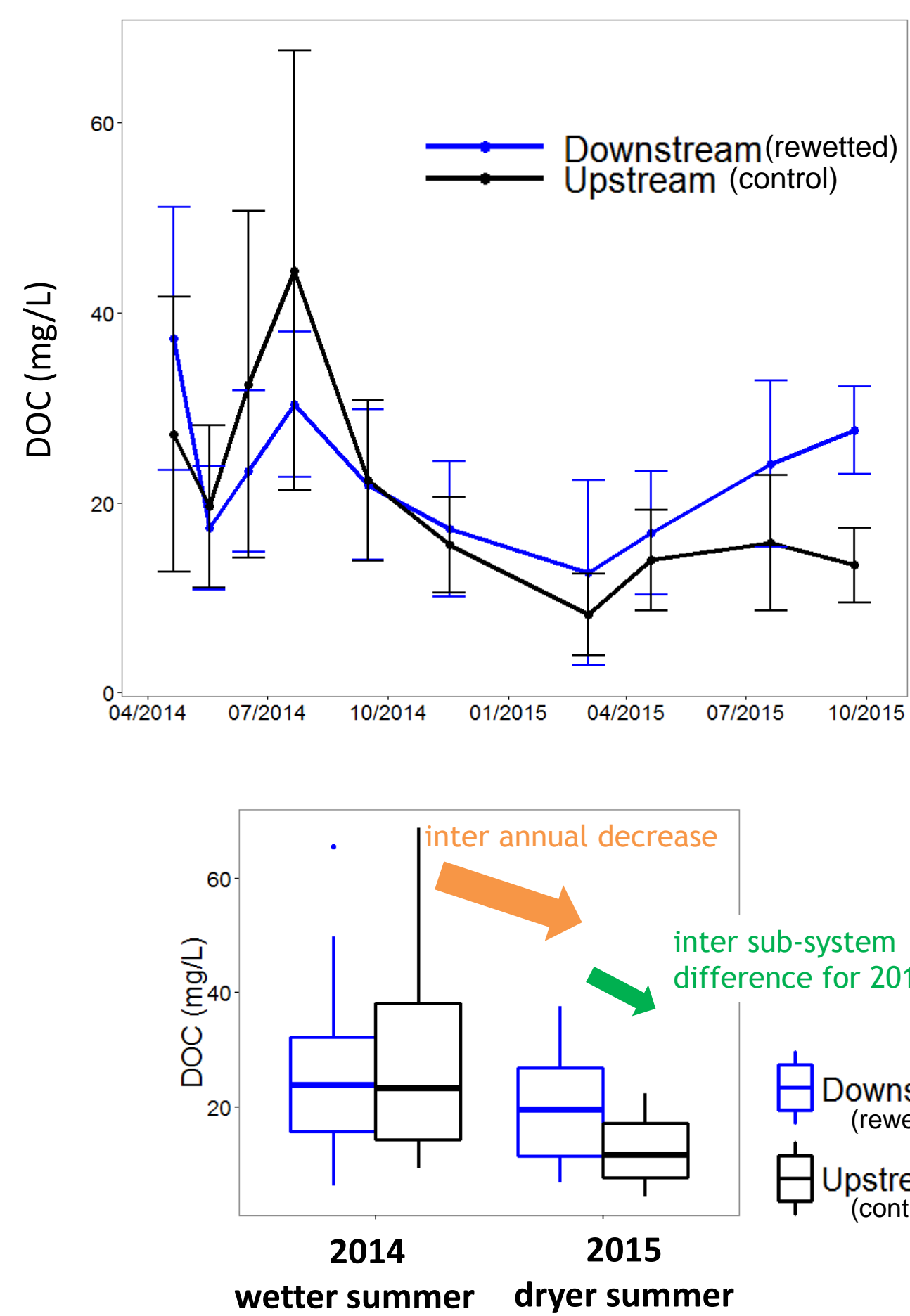


Fig 5: Time series of DOC concentration after the restoration

- DOC concentrations are lower in 2015 than in 2014 which has a particularly wet summer (Fig 5)
- In 2015, DOC concentrations were higher in the rewetted sub-watershed than in the control sub-watershed and could be related to a higher water table level in the former area than in the latter area (Fig 5)
- There are no significant spatio-temporal patterns for the recorded specific UV absorbance at 254 nm (SUVA₂₅₄, provides an estimate of DOC aromaticity, Fig 6)

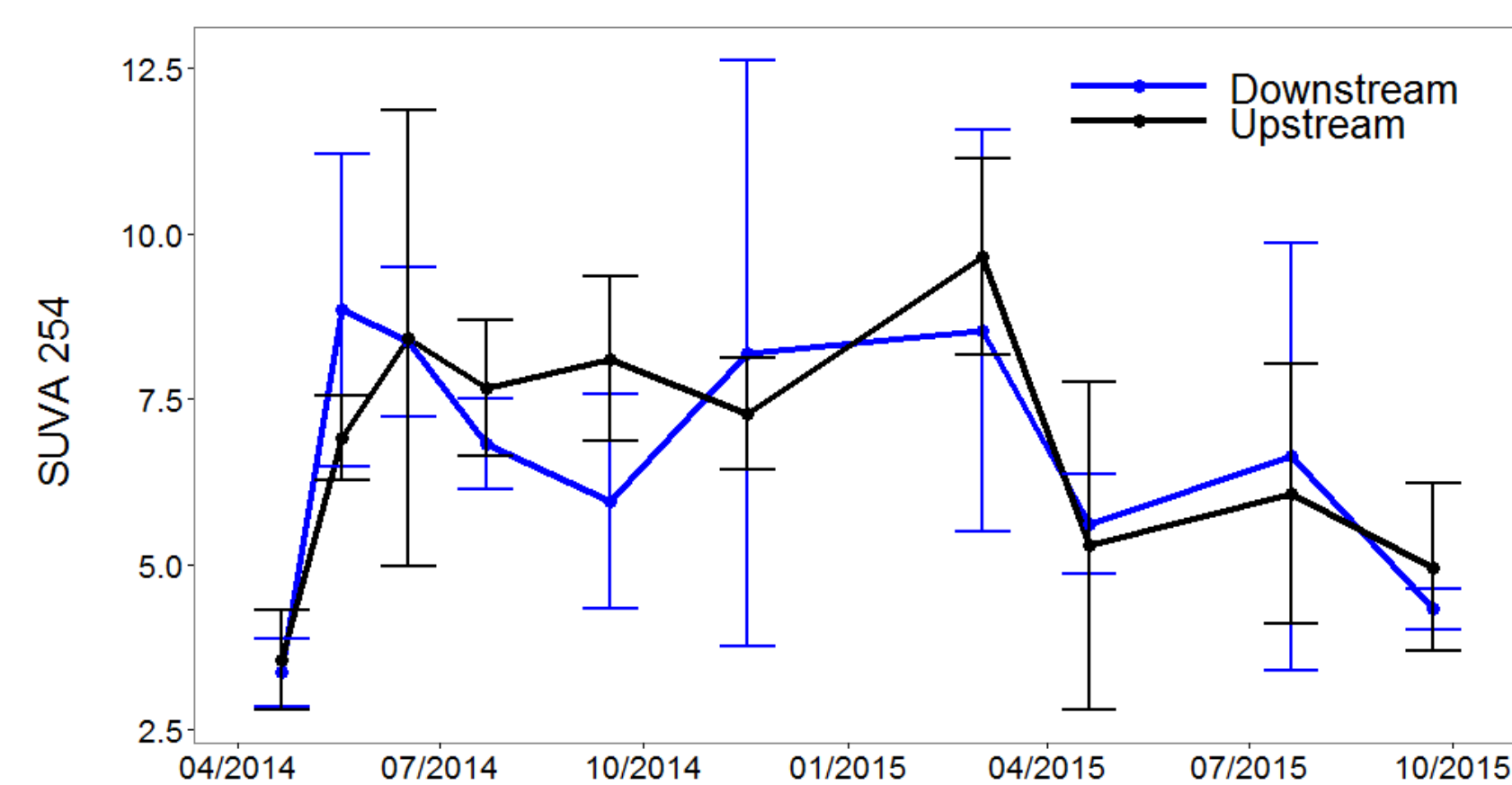


Fig 6: Evolution of SUVA₂₅₄ after the restoration

5- SPATIO-TEMPORAL VARIABILITY OF PORE WATER CHARACTERISTICS

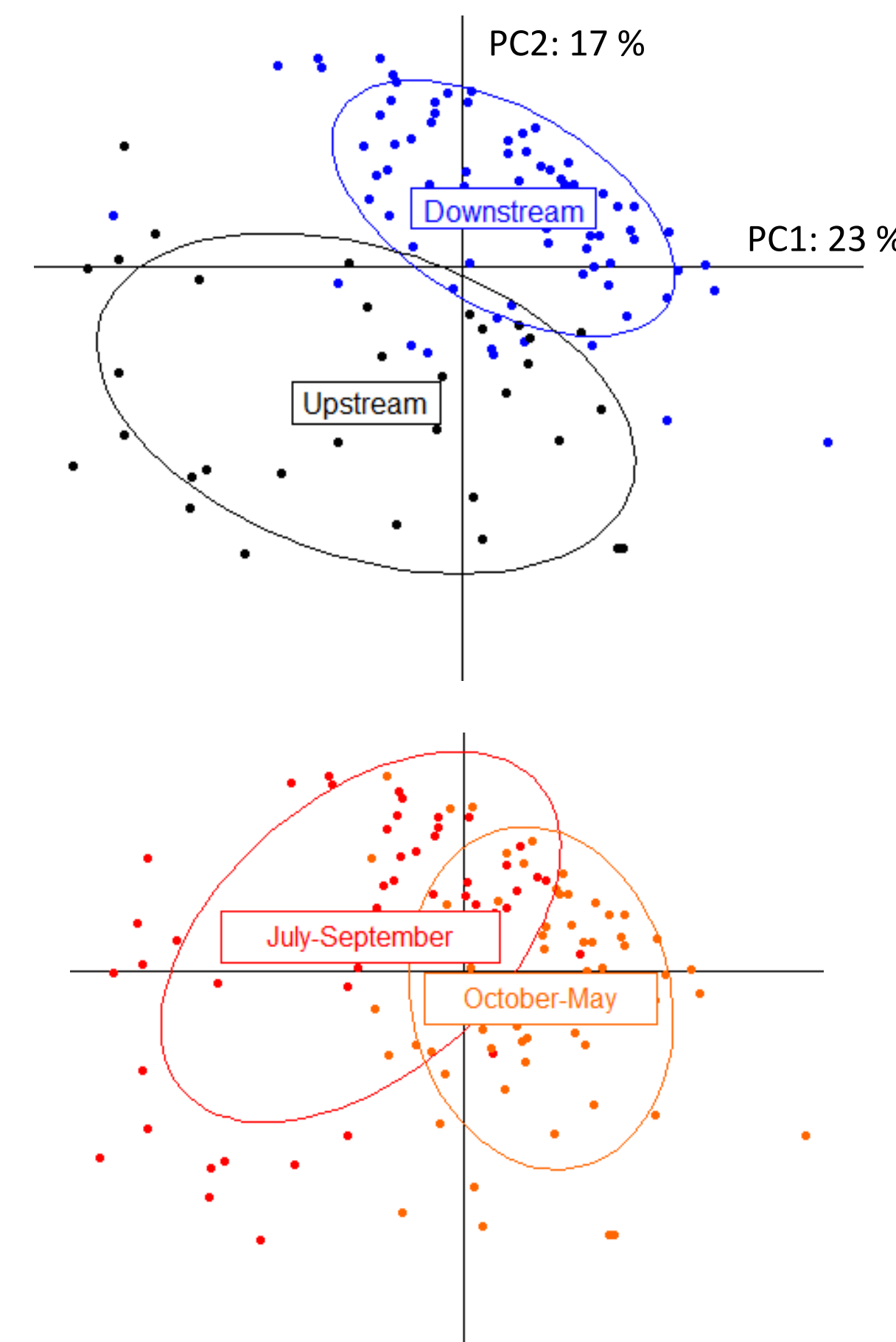
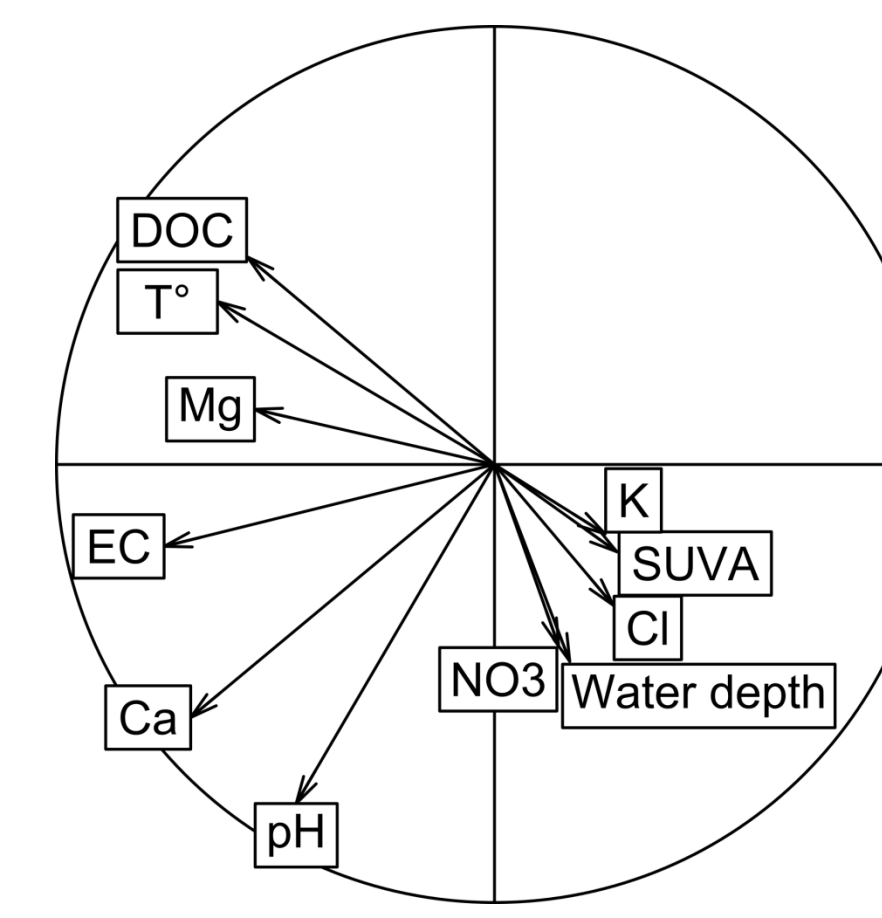


Fig 7: Results of the PCA analysis (2 first components); sampling points grouped by catchment (top left), season (bottom left) and variables (bottom right)

A principal component analysis (PCA) was performed on all samples based on 11 recorded variables (Fig 7):

- Differences between upstream and downstream catchments are mainly explained by a higher electrical conductivity, pH and Ca²⁺ in the upstream catchment
- Electrical conductivity and DOC concentrations are the highest in summer when the water level, Cl⁻ and SUVA are the lowest



6 - CONCLUSION

- The restoration work led to an increase of the water level in the downstream catchment
- DOC production by micro-organisms is the highest in summer. Newly produced DOC is then flushed when the water table rises, leading to high DOC concentrations in wetter summer.
- This process could also reflect the long-term drainage of the peatland in the downstream catchment. DOC has accumulated before the rewetting because of the low water table (high oxygen content stimulating microbial decomposition). It is now flushed due to the high water level caused by the rewetting. It could explain higher DOC concentrations in the rewetted than in the control catchment in summer 2015.
- Longer dataset is needed to better assess the role of restoration on peatland hydrochemistry
- Ongoing modelling studies would help to improve the understanding of the system and to identify key factors controlling hydrology and DOC dynamics