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

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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 environnements

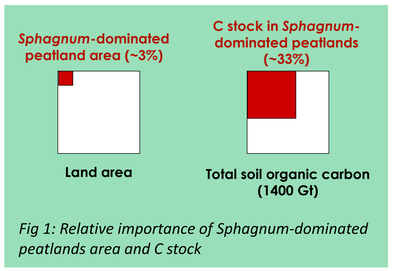
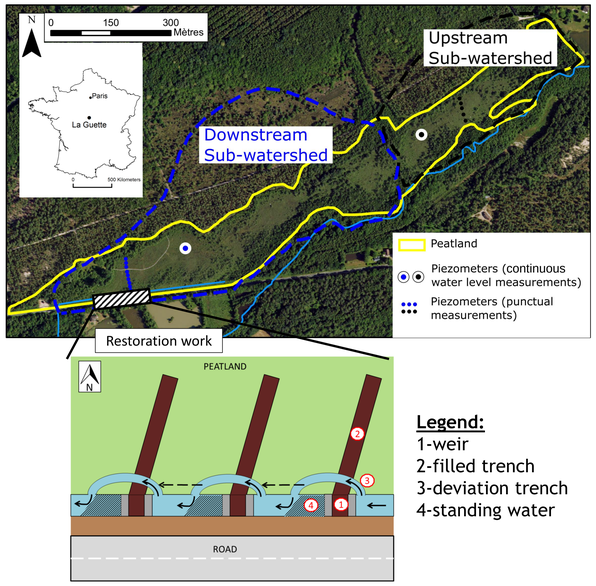


Fig 1: Relative importance of Sphagnum-dominated peatlands area and C stock



Legend:
1-weir
2-filled trench
3-deviation trench
4-standing water

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 caerula* and *Betula spp*

Two sub-watersheds (Fig 2):
- Upstream: natural conditons
- 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^-, Mg^{2+}, Na^+, K^+, $NO3^-$)
  - ➢ DOC analysis (concentration and $SUVA_{254}$)

3-IMPACT OF REWETTING ON HYDROLOGY

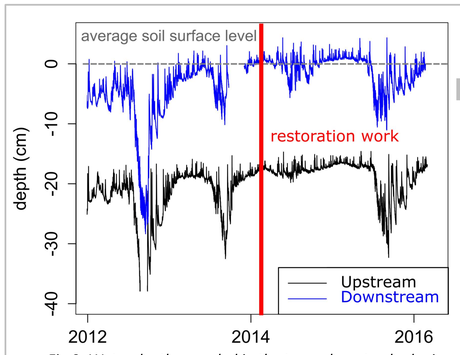


Fig 3: Water depth recorded in the two sub-watersheds since 2012

- 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**

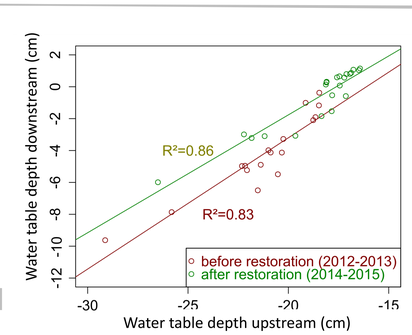
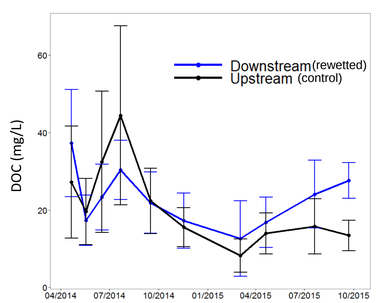


Fig 4: Relationship between monthly water table in both catchments for the 2 years preceding and the two years following the restoration

4- DOC CONCENTRATIONS DYNAMICS AFTER THE REWETTING



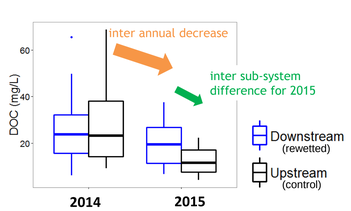


Fig 5: Time series of DOC concentration after the restoration

- 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 ($SUVA_{254}$, provides an estimate of DOC aromaticity, Fig 6)

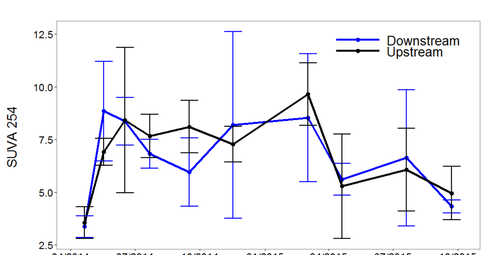


Fig 6: Evolution of $SUVA_{254}$ after the restoration

5- SPATIO-TEMPORAL VARIBILITY OF PORE WATER CHARACTERISTICS

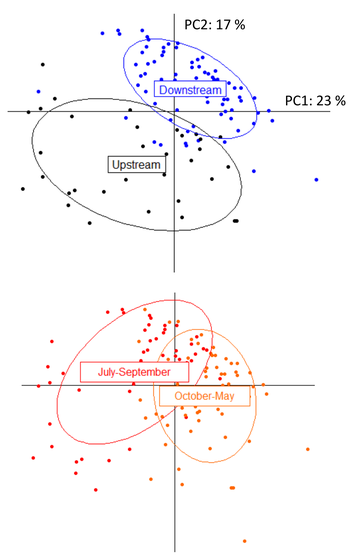


Fig 7: Results of the PCA analysis (2 first components); sampling points grouped by catchment (top left), season (bottom left) and variables (bottom right)

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 **Ca^{2+}** 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 **reflects 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

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