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Spatial and temporal variations of dissolved organic matter (DOM) dynamics in a disturbed *Sphagnum* peatland after hydrological restoration

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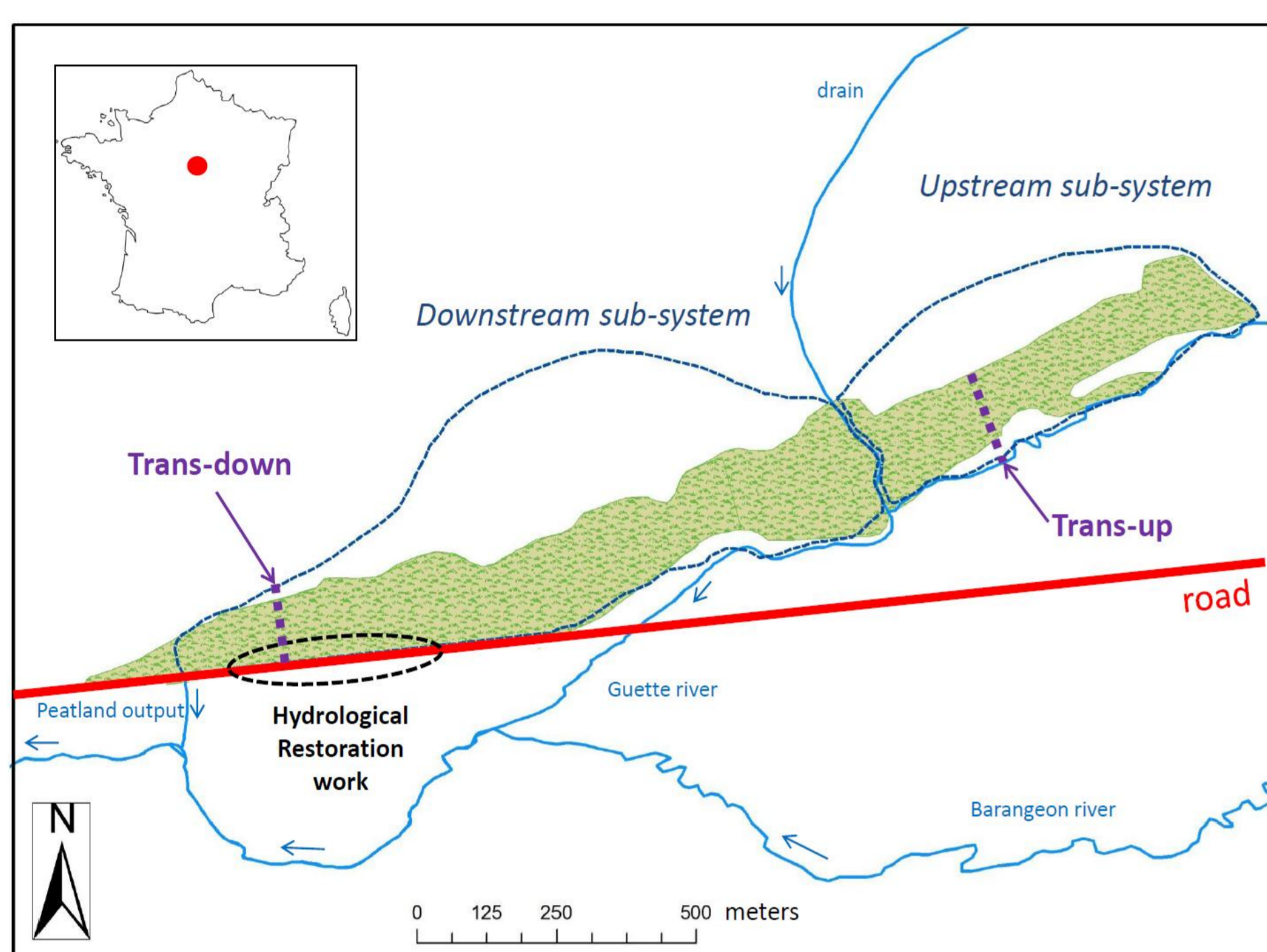
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Introduction:

Peatlands are strategic ecosystems involved into global carbon exchanges. These sinks of carbon can become sources due to global change and human activities. Monitoring and characterization of dissolved organic matter, particularly using its fluorescent properties, can be an relevant tool to understand operating dynamics (such as microbial activities) and assess human impact on these fragile ecosystems.

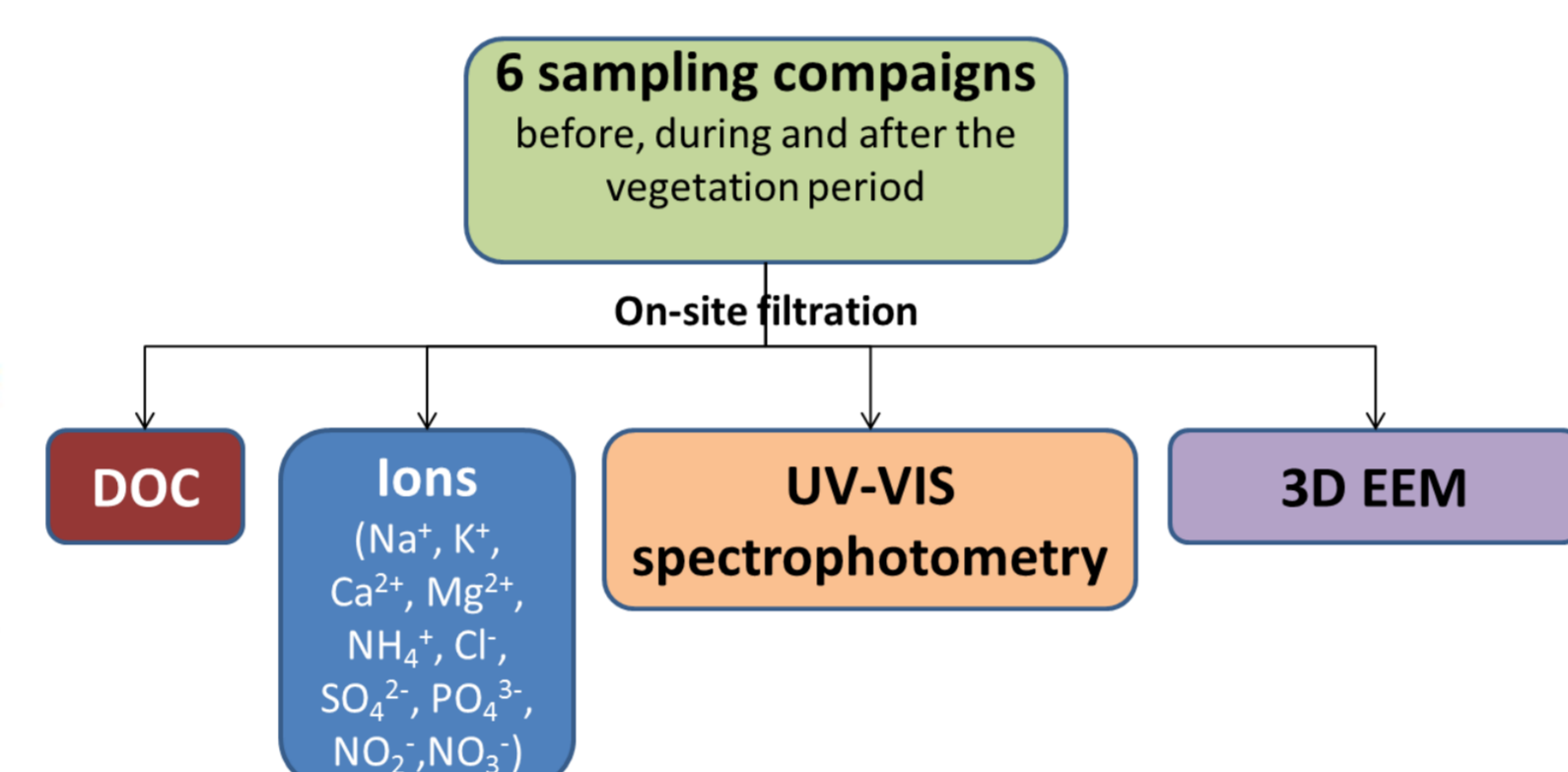
Material and method:

The investigated site was La Guette peatland (France, N 47°19'44", E 2°17'04", alt. 154m), whose hydrological conditions are influenced by a road passing through its former area. The road drain accelerates drying mechanisms, favouring thus vascular plants settlement to the detriment of specific flora of peatlands (i.e. *Sphagnum*).



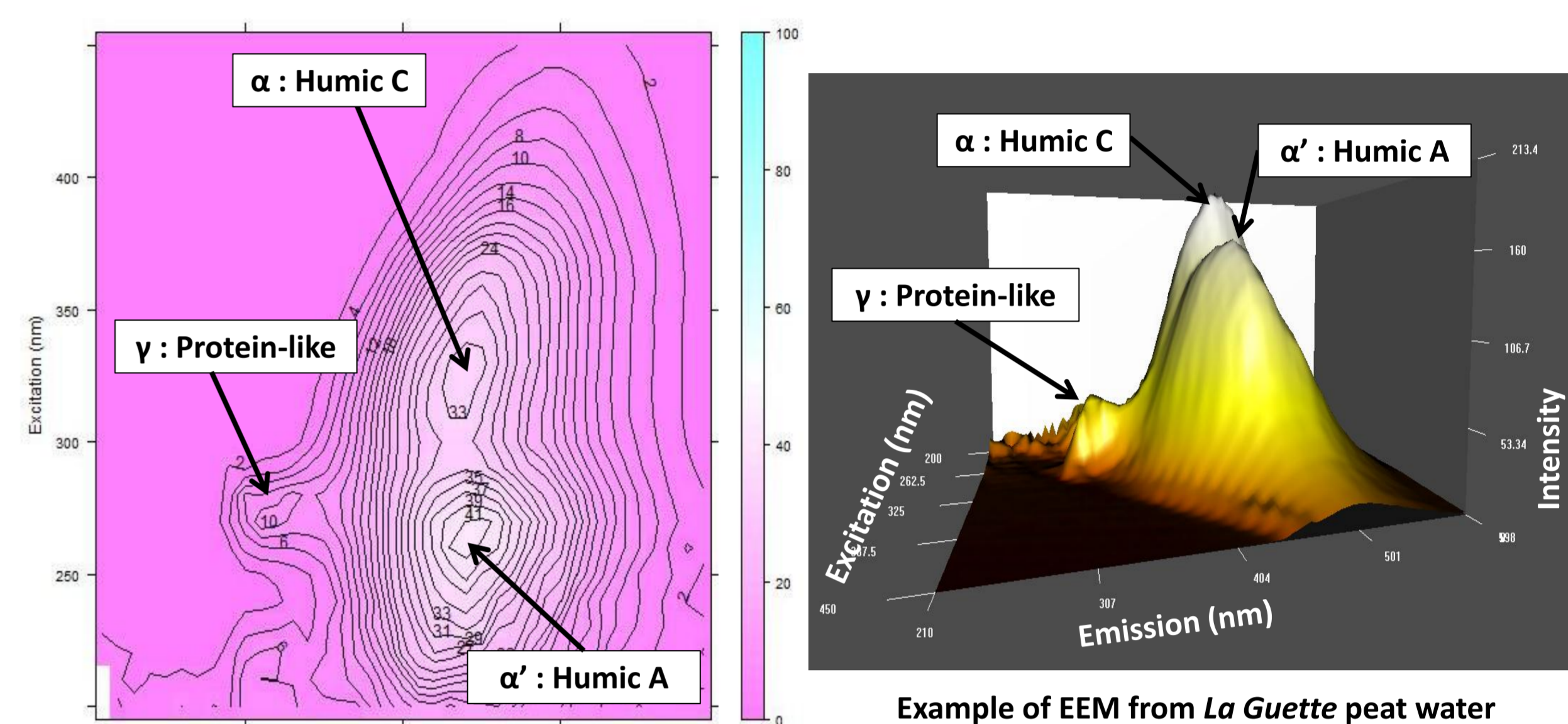
Hydrological restoration was undertaken in February 2014. It consisted in building thresholds to slow down drain runoff and to promote the soil rewetting. Two transects of piezometers were settled in independent two hydrological sub-systems: Trans-up and Trans-down. Trans-down is supposed to be influenced by the hydrological restoration, while Trans-up is not. These transects cross the peatland and follow water flow direction.

Water was sampled from these piezometers and analysed by following techniques:



Fluorescence of DOM:

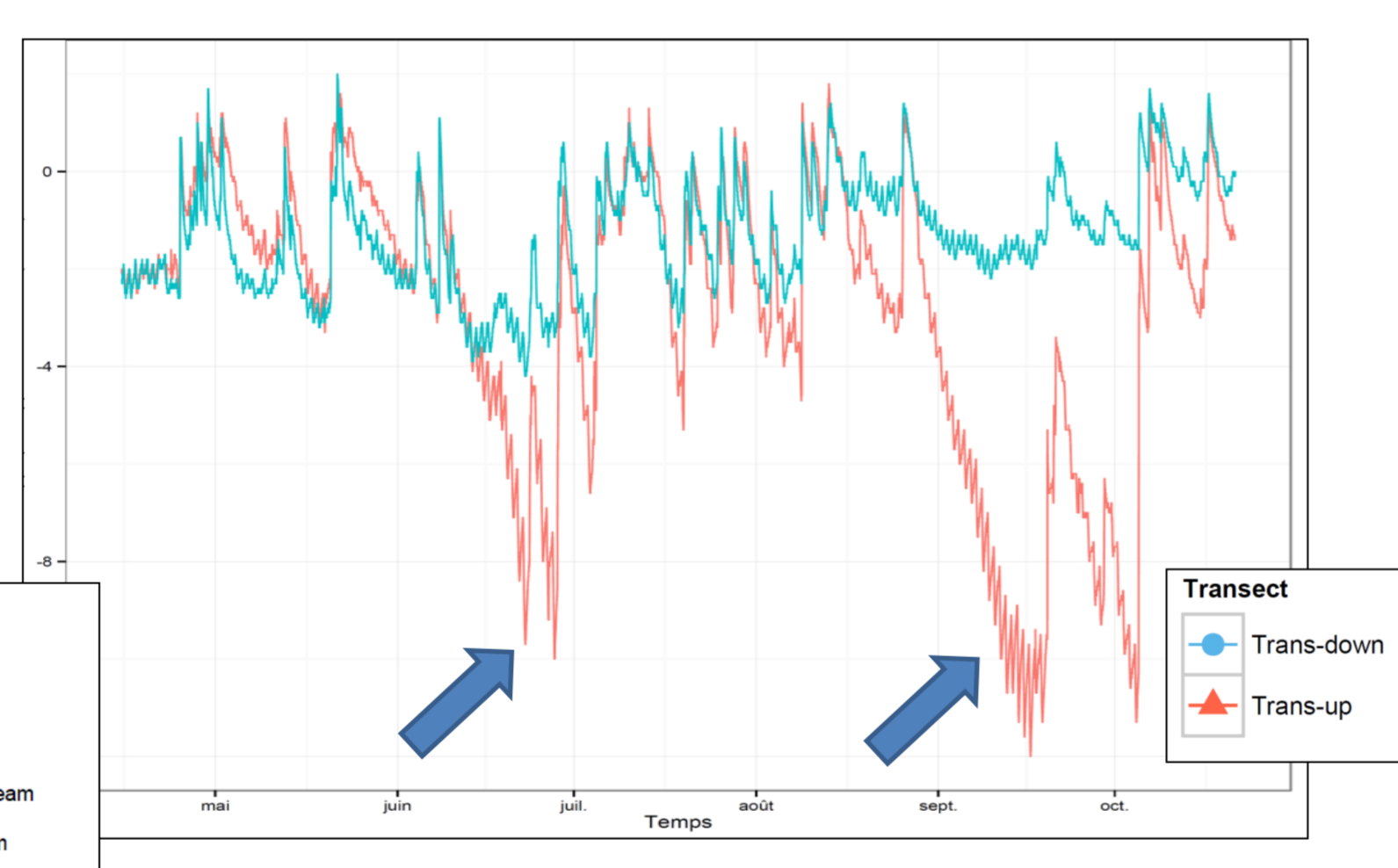
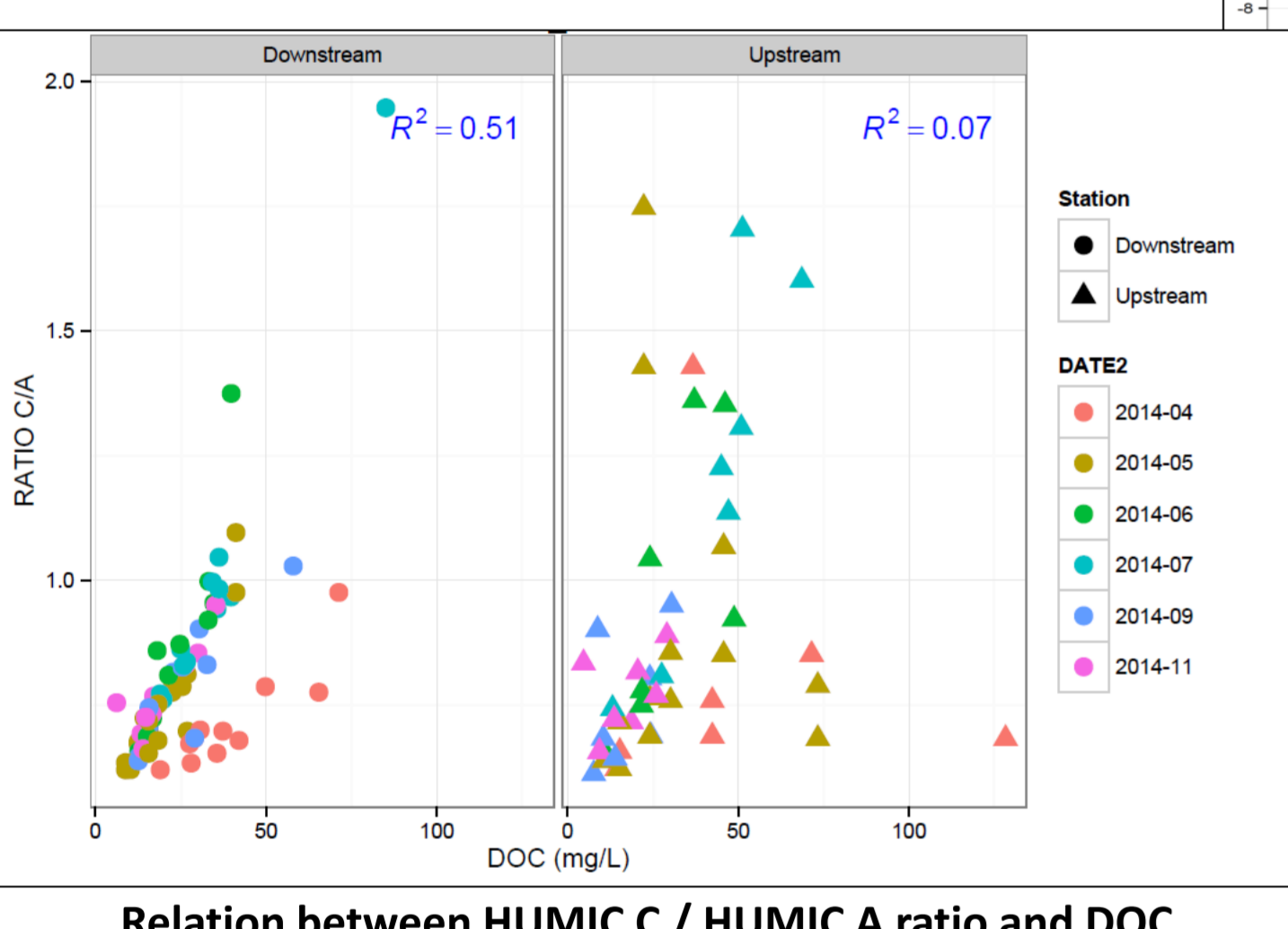
Absorbance was measured by UV-VIS spectrophotometer to assess Spectral Ratio (SR), E4/E6 ratio and aromaticity of DOM by SUVA. Three-dimensional excitation-emission matrices (EEM) were undertaken to characterise fluorescent DOM (FDOM). Humification (HIX) and biological (BIX) fluorescence indices were calculated.



Measured emission/excitation couples are similar to those found in peat standards and references (International Humic Substances Society). PARAFAC algorithm indicates that α (or HUMIC C), α' (or Humic A) (terrestrial sub-humic) and γ (protein-like) excitation/emission specific couples explain 97% of treated EEMs.

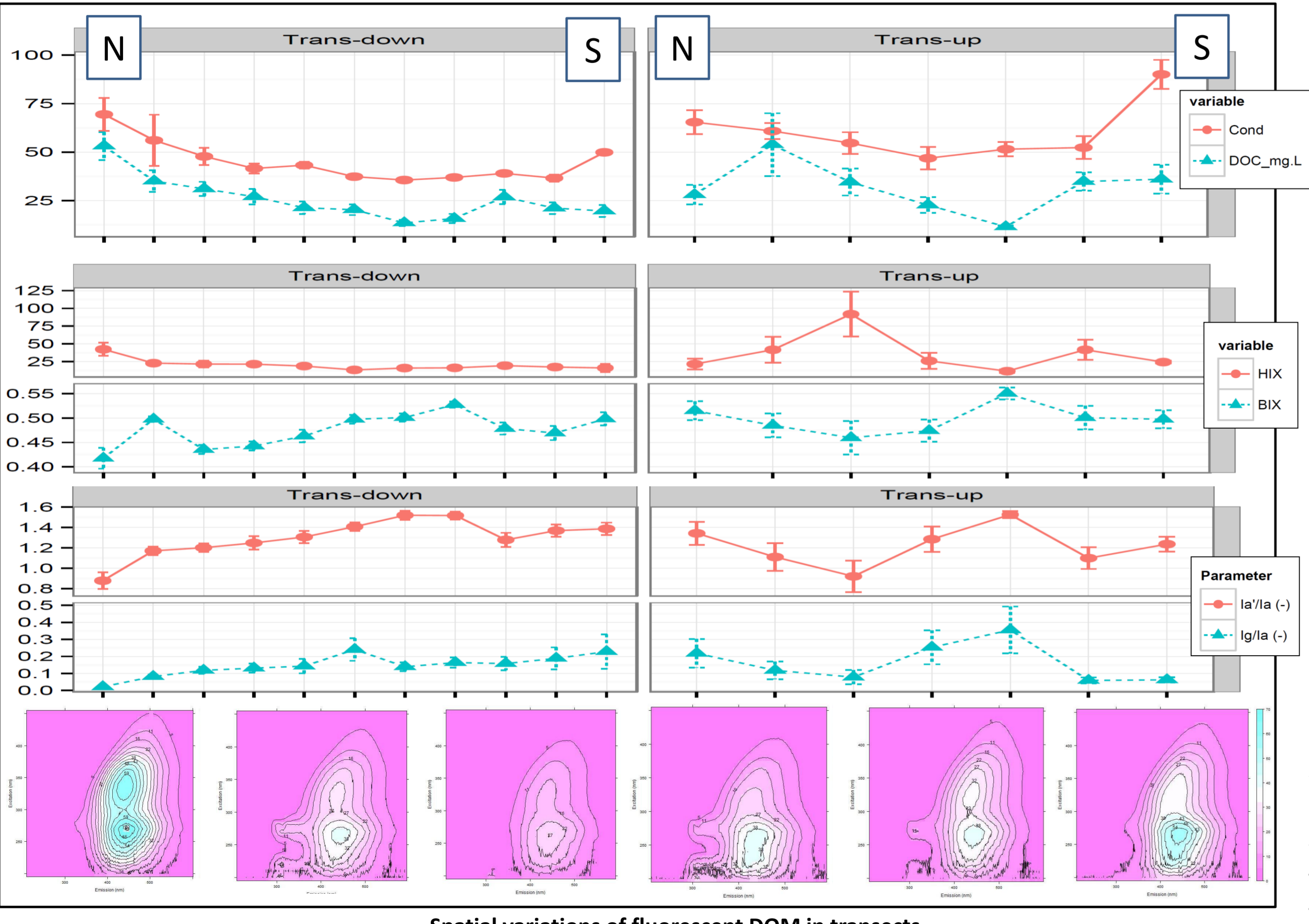
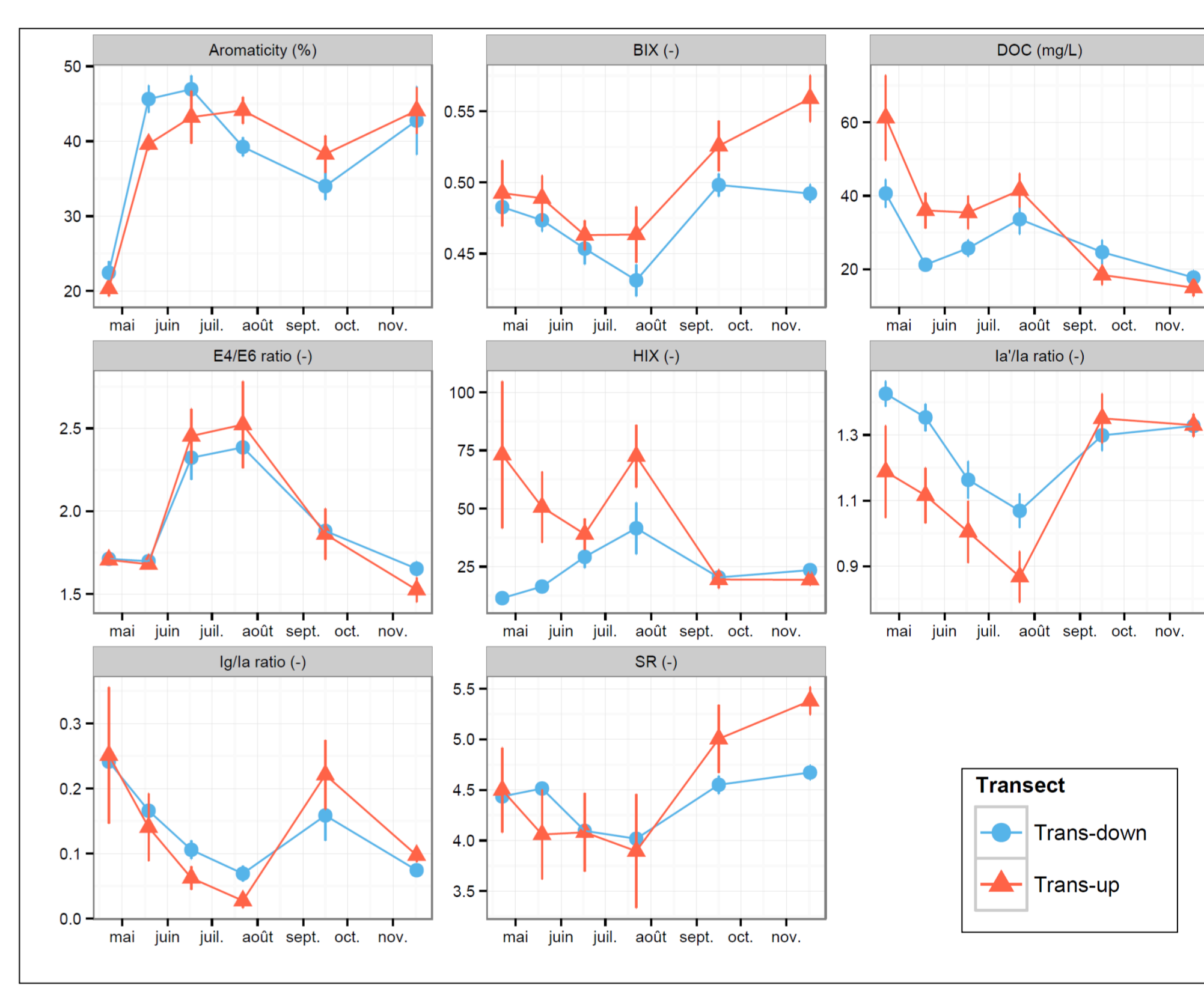
Results:

Since restoration work, most important water table drawdowns have been recorded on June and September 2014. Water table fluctuations are stronger in Trans-up than in Trans-down (6 cm vs 15 cm).

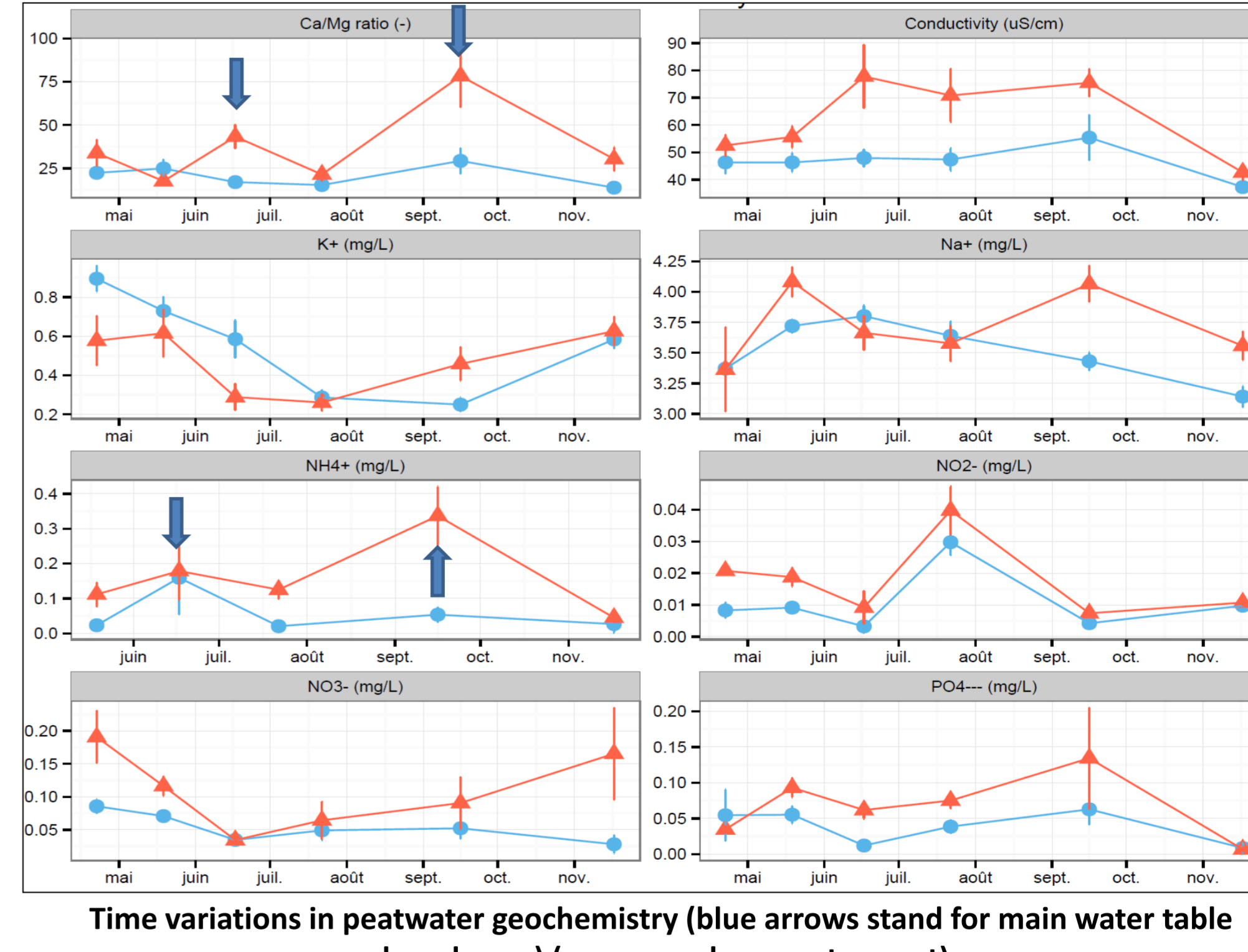


There is some correlation between DOC and HUMIC C/HUMIC A ratio only in Trans-Down but not in Trans-Up. DOM seems to be taken essentially from « old » organic material in Trans-down.

Concerning temporal variations, amplitude of DOC concentrations is more important in Trans-up than in Trans-down. HIX indicates that DOM is more humified in Trans-up than in Trans-down. For both systems, HIX and nitrites reaches their maximum value during July. BIX and intensity ratios (I_a/I_a and I_g/I_a) all increase in summer, indicating rise of microbial degradation processes. Intensity ratios increase stronger in Trans-up during main drawdown on September indicating that humified matter is taken from more « fresh » organic matter than in Trans-down. BIX index shows that DOM source is more « autochthonous » in Trans-up. SR shows that molecular weight of DOM is lighter in Trans-up after summer than Trans-down. Aromaticity shows seasonal variations for both systems and reaches its maximum. Aromaticity remains higher in Trans-up after summer than in Trans-down. However, E4/E6 ratio shows that molecular weight is lighter during June and July.



Conductivity and ionic concentrations generally show that Trans-down is more oligotrophic than Trans-up. Variations of Ca/Mg ratio are more important in Trans-up, showing a stronger impact of vegetation in this system, especially during main water table drawdowns. Concentrations of nitrogenous compounds (nitrates, nitrites and ammonium) and phosphates, necessary to vascular plants, are higher in peatwater in Trans-up after June. Potassium, necessary to plants growth, is more released in peat water in Trans-up during September, showing a more important decomposition of vegetal material than in Trans-down.



Concerning local spatial variations in both sub-systems, DOC and conductivity decrease while crossing the peatland following flow direction. HIX varies more in Trans-up than in Trans-down with a peak in the middle of the peatland. In Trans-down, HIX decreases while crossing the peatland following peat water flow direction. Minimum value is reached at the middle of the transect. In Trans-down, BIX increases while crossing the peatland showing an increasing of autochthonous part of DOM. In Trans-down, BIX, I_a/I_a and I_g/I_a increase while crossing the peatland following flow direction. Pattern is totally different in Trans-up.

Conclusions & perspectives:

Results from characterisation of DOM and peat water geochemistry show spatial and temporal variations in nature and origins of DOM. This study emphasizes contrasts between control and hydrologically reworked sub-systems. Downstream system, influenced by hydrological restoration work, is more stable seasonally and spatially in terms of geochemistry and DOM degradation than Upstream system. Finally, UV-VIS and fluorescent indices should be chosen carefully to assess peatland's « state of health ».

References:

Alberts J.J., Takacs M., 2003. Total luminescence spectra of IHSS standard and reference fulvic acids, humic acids and natural organic matter: comparison of aquatic and terrestrial source terms. *Organic Geochemistry* 35 (2004) 243–256
 Coble, P.G., 1996. Characterization of marine and terrestrial DOM in seawater using excitation-emission matrix spectroscopy. *Marine Chemistry* 51, 325–346.
 Parlanti, E., Wörz, K., Geoffroy, L., Lamotte, M., 2000. Dissolved organic matter fluorescence spectroscopy as a tool to estimate biological activity in a coastal zone submitted to anthropogenic inputs. *Org. Geochem.* 31, 1765–1781.
 Tedetti, M., Longhitano, R., Garcia, N., Guigue, C., Ferretto, N., Goutx, M., 2012. Fluorescence properties of dissolved organic matter in coastal Mediterranean waters influenced by a municipal sewage effluent (Bay of Marseilles, France). *Environ. Chem.* 9, 438–449.