Drought drives DOM reactivity at the terrestrial-aquatic interface

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Motivation

Natural dissolved organic matter (NDOM) in aquatic systems plays many environmental roles: **providing energy for aquatic biota and affect the ultimate fate of anthropogenic compounds.**

Such interactions are depend on the composition of NDOM. These are very complex molecules. This model structure (Fig. 1) is representative for thousands of different structures.

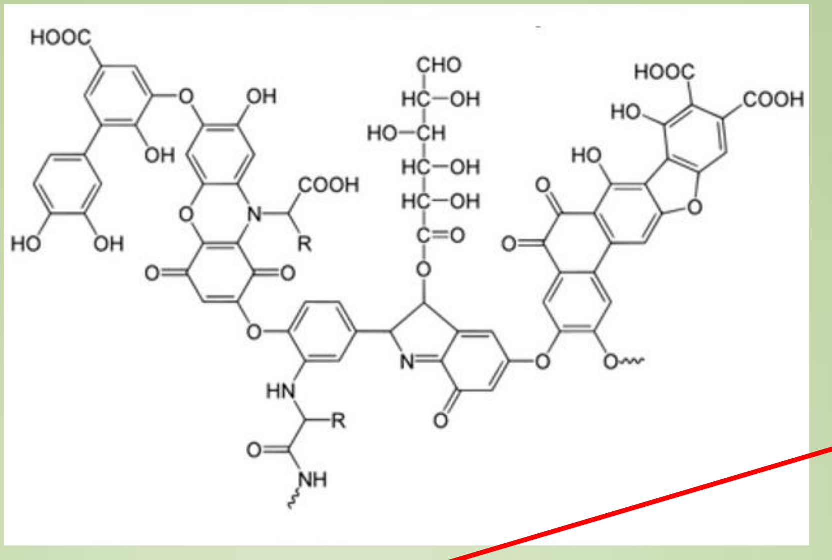

Fig 1: Model structure of NDOM (Source: Mensch, 2014)

What did we do?

13 sampling campaigns over 3 summer months (drought) of surface and pore waters from the hyporheic zone (the interface between surface water and groundwater).

The field site (Fig.2) is **an intermittent (temporarily dry) stream in Catalunya.**

The pore water was pumped from PVC tubes installed at a depth of 50cm in the stream bed (Fig.3).

The samples were analysed for Dissolved Organic Carbon (DOC) concentration and **its optical properties.**

Fig 2: Study zone: Fuirosos Stream (Montnegre)

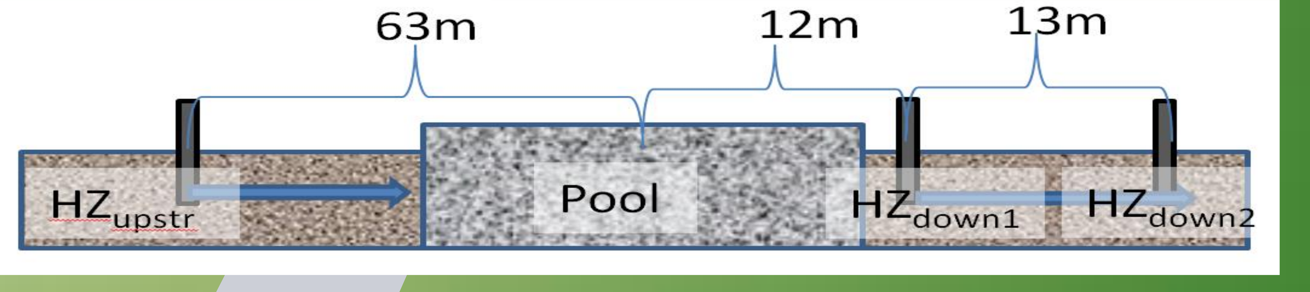

Fig 3: Scheme wells

What are the optical properties of NDOM?

NDOM includes fluorescending compunds. An excitation emission matrix (EEM) allows you to categorize compounds by their peaks. **These peaks are assigned to different molecular weights, biological availability and origin.**

In the hyporheic zone (Fig. 4) there are more bioavailable compounds and compounds of stream origin, as compared to the surface water (Fig. 5) .

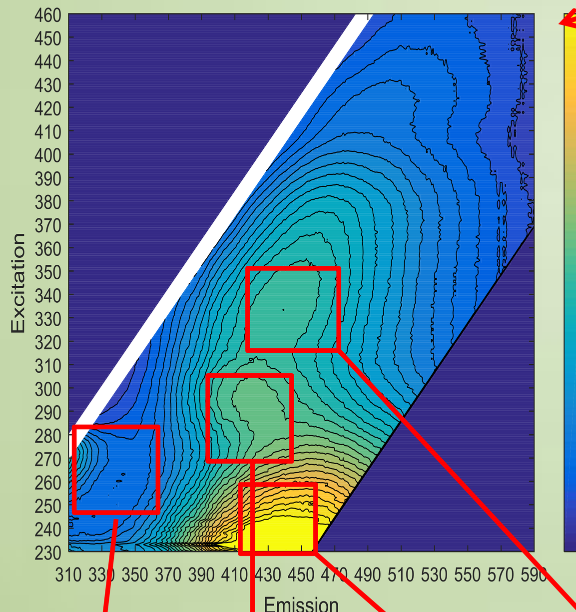

Fig 4: EEM Hyporheic Zone

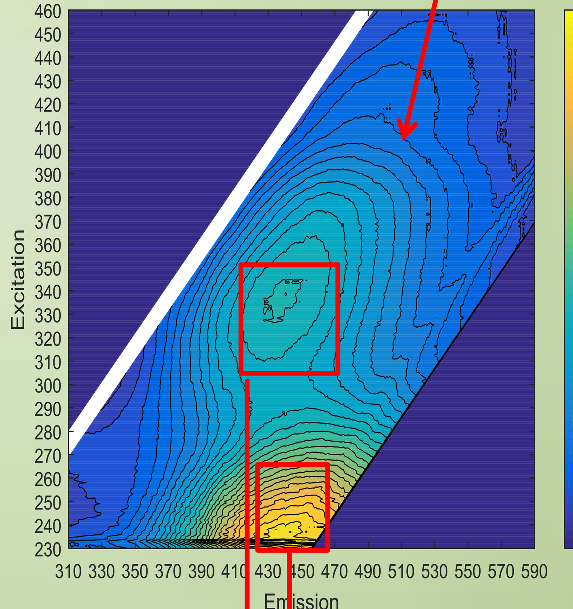

Fig 5: EEM Stream

Protein-like, very bioavailable

Reduced, low molecular weight, microbial origin

High molecular weight, recalcitrant

High molecular weight, aromatic, recalcitrant

What did we find?

EC offered a good discrimination between phases of connection and disconnection (Fig. 6). The **DOC concentration in the river bed decreases** with drought in contrast to the remaining surface water (Fig. 8).

The **disconnection of the pool** from and the river bed **resulted in a facilitation of DOM transformation (Fig. 4) and consumption(Fig. 8).** During the transition phase, **protein-like DOM was identified in the river bed (Fig. 4).**

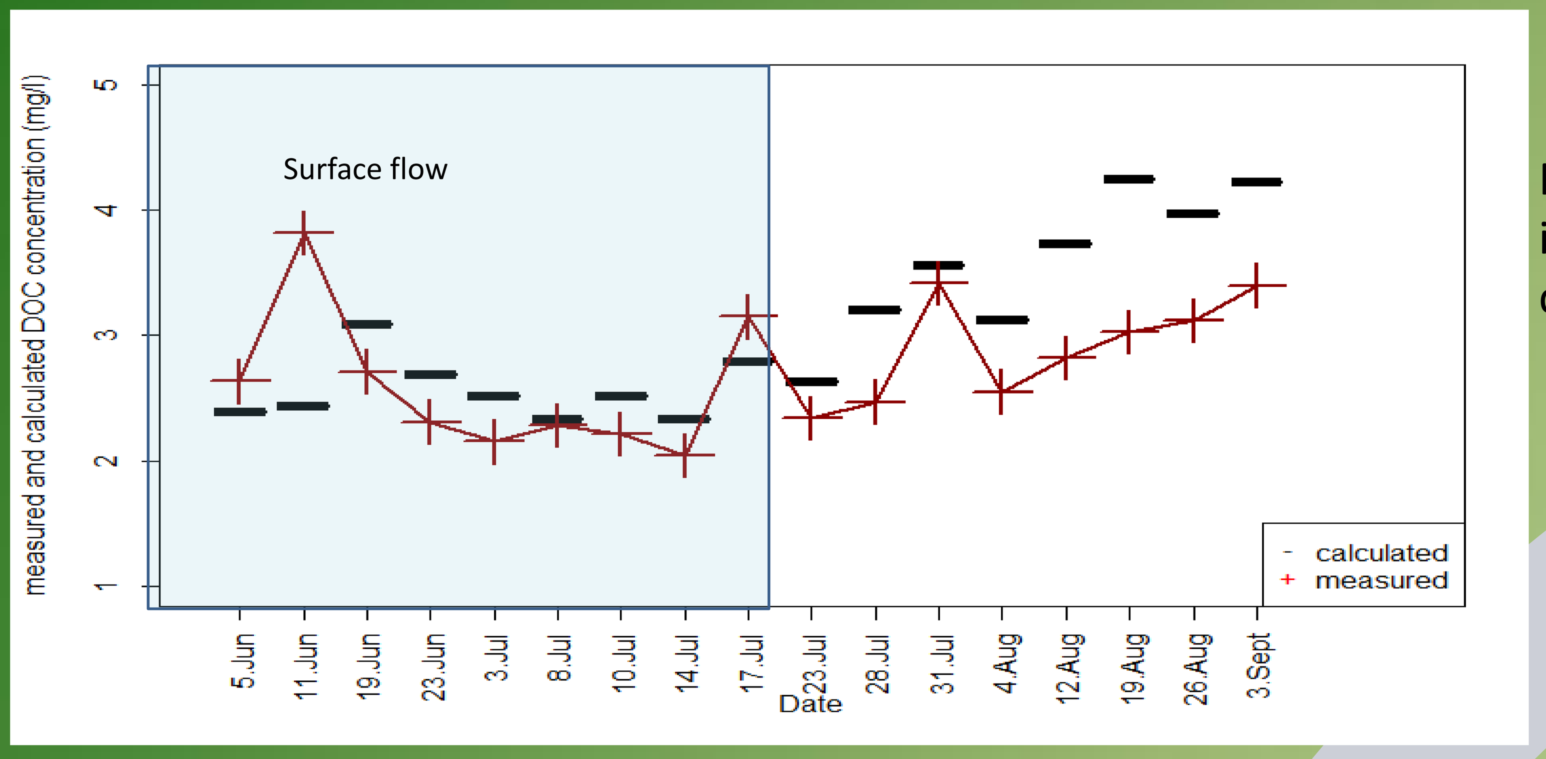

Fig 8: DOC depletion in the hyporheic zone during drought

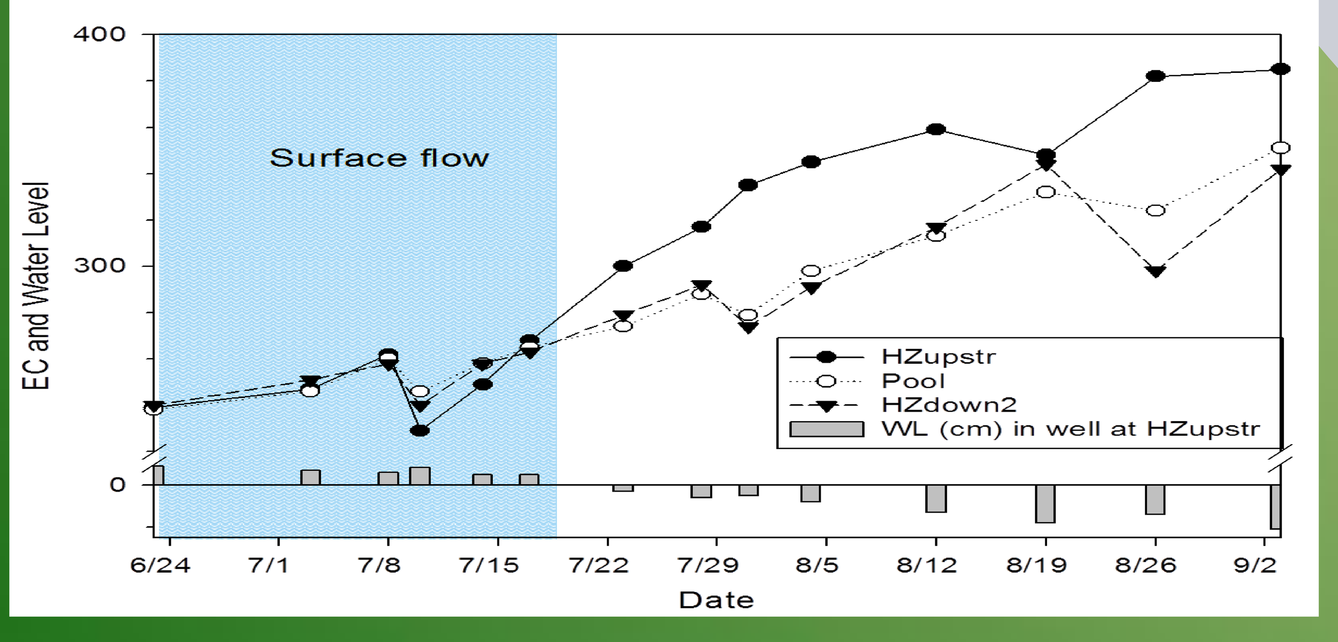

Fig 6: Electrical conductivity as a tracer and water level in the well upstream

Implications

During drought the hyporheic zone exhibits an important in stream production of DOM (Fig. 4). During normal flow conditions DOM quality in the stream bed, the pool and the stream water are similar.

The **most relevant changes in DOM quality** occurred at the **transition phase** from surface flow to no-surface flow. It is a small piece of a complex puzzle, but the better we understand these relationships, the better we can predict how changes, as for example is hydrology, will affect our aquatic systems.

Fig 7: Stream without Surface flow

Next steps

Changes of DOM quantities and qualities in the hyporheic zone during different hydrologic stages are related to **reducing and oxygen conditions in the stream bed and happen very fast.**

Therefore we want to look into these relationships, work with **sensors to get a higher temporal solution and relate the DOM composition to microbiological activities.**

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Sources:

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