Dear Reviewer,

First of all we would like to thank you for the time and effort you spent on reviewing our submitted MS. We very much appreciate your comments that clearly identify some parts of the submitted MS that need more effort, clarification and re-organization. We will try to address all the questions and comments you raised and we are convinced that the revised MS will be improved significantly.

Best regards,

Loris Deirmendjian & Co-authors

Comment#1: *"Major comments- The study address an important question and could be a significant contribution to the field of carbon biogeochemistry. Methods and sampling design are appropriate but the paper suffers from poor organization and presentation. Furthermore, there are several other critical issues that authors need to address before manuscript can be recommended for publication."*

Reply#1: We thank the Referee 1 for his/her constructive comment concerning the organization and presentation of our submitted MS. This general evaluation is very consistent with that expressed by the Referee 2. We clearly realized that the submitted MS suffered from poor organization and presentation and needed a complete re-organization and a more thorough review of similar studies in forested catchments. Consequently, we will put important effort in improving our revised MS to address the questions of presentation, description of the state of the art, and discussion in the light of previous works. We will modify the Introduction section and profoundly rework the text of the Results and Discussion sections of our revised MS that will include 2 new figures (Fig. 7 and 8 in the revised MS) and 5 revised figures (Fig. 1, 2, 4, 5, 6 in the revised MS) (see below). The figure 3 of the submitted MS did not change (see below). The figure 6 and 7 of the submitted MS were removed (see below).

Comment#2: *"Firstly, authors broadly discussed some knowledge gap in the Introduction section but no clarity on why this study was needed at the first place. What is necessary is a more thorough review of similar studies in forested catchments and clearly working out the current knowledge gap that authors attempted to address"*

Reply#2: As suggested by the Referee 1, we will rewrite the Introduction section, first mentioning the significant role played by forests in the global carbon cycle, acting as a net annual carbon sink. Second, we will introduce the significance of C hydrological export from terrestrial to aquatic system in the continental C budget. Then, we will highlight the fact that this export term is generally calculated as the sum of other fluxes occurring in river systems: CO_2 outgassing + OC burial in sediments + export downstream, and rarely from direct measurement at the land-water interface. We have performed a thorough review of similar study in forested and other type of catchments, which revealed that, the few available works that estimate lateral export of carbon are based on observations (1) in soil water (unsaturated zone) combined with soil water models (Öquist et al., 2009; Kindler et al., 2011; Leith et al., 2015), or (2) based on differences in the flux between upper and lower stream reaches (Shibata et al., 2001, 2005), or (3) based on observations in stream water combined with stream discharge (Dawson et al., 2002; Billett et al., 2004; Dinsmore et al., 2010; Olefeldt et al., 2013). We found few works that reported DIC/DOC concentrations and dynamics in groundwater (saturated zone). Kawasaki et al (2005) reported DIC/DOC dynamics in groundwater but this paper is out of the scope of our watershed with sandy podzols because it focused on a watershed with granite rocks overlied by cambisols. Venkiteswaran et al (2014) compared DIC concentrations in groundwater, streams and lakes, but this paper focused on degassing in streams based on isotopic model. Artinger et al (2000), Baker et al (2000) and Shen et al (2015) reported DOC dynamics and concentrations in groundwater but these works focus on the characterization and/or metabolism of DOC and not on carbon export to streams. Consequently, these studies do not allow a complete understanding of the link between C hydrological export and the physical and biological processes occurring in soils and groundwater. In addition, the approaches based with stream discharge may miss part of the DIC export flux that occurs as excess CO_2 that rapidly degas upstream of the sampling points in streams.

Changes in the revised MS#2: At the end of the Introduction section of the revised MS, we will define clearly the objectives of our study as: (i) to investigate (among the first time for DIC) the temporal dynamics of dissolved carbon species in groundwater in relation with hydrological processes in the soil (in particular migration of the water table, groundwater mass balance and apparent turnover time) and metabolic activity of the forest ecosystem (coupling dissolved carbon studies to ecosystem atmospheric carbon exchange is also original); (ii) to compare spatio-temporal variations of carbon concentrations in groundwater and first order streams in order to study the fate of dissolved C species at the groundwater-stream interface; (iii) to quantify directly the lateral drainage of DIC and DOC from groundwater to first order streams in the case of the sandy catchment of the Leyre River where no surface runoff occurs, based on concentrations in groundwater and discharge data; (iv) to compare this lateral drainage of terrestrial C with net CO_2 exchange of the forest ecosystem and degassing in first order streams.

The introduction of the revised MS will be clearer and more focused than that in the first version of the MS.

Comment#3*:* *"Secondly, the Result section is too detailed, unguided, and extremely difficult to follow. The reader has no idea what is coming up next and what are the take away messages from each paragraph."*

Reply#3: We agree with the need of better organizing the Results section, a comment also shared by Referee 2.

Changes in the revised MS#3: In the revised MS, we will split the Results section in five paragraphs: (i) water mass balance; (ii) carbon net ecosystem exchange; (iii) dissolved carbon in groundwater; (iv) dissolved carbon in first order streams; (v) hydrological carbon fluxes.

Firstly, in the 3.1 section, based on hydrological and eco-physiological criteria we will distinguish 4 different hydrological periods within the sampling period (Jan. 2014-Jul. 2015): HF, GS, LS and EW periods, respectively for high flow, growing season, late summer and early winter periods (see revised Fig. 2). Then, results will be described according to these 4 hydrological periods in the revised text as well as in the different revised figures, which we believe, will lead to greater clarity and understanding.

Secondly, we will modify Fig.4 (of the submitted MS) by separating the distribution of DIC and DOC concentrations in groundwater as a function of water table depth, from the time-course of concentrations (revised Fig. 4 and 5) (see below). The new figure 4 is central for the description of dissolved carbon mobilization from soil and transfer to groundwater. We will also add new Figures 7 and 8, which describe a conceptual model of carbon transfer at the groundwater-stream interface based on our observations. These two new figures allowed us to better discuss the seasonality of carbon fluxes in interaction with hydrological and biogeochemical processes without excessive interpretations.

Thirdly, as suggested by both referees, results of the Pearson's correlation will be much less emphasized in the revised version of the MS, as they appeared too simplistic to fully explain biogeochemical and hydrological processes controlling dissolved C concentrations and fluxes. We also removed the figure 7 of the submitted MS, which was based on Pearson's parameters.

Comment#4: *"Thirdly, the Discussion section is detailed, but somewhat unguided and does not show: a) how the study advances our general understanding of groundwater's role in mediating carbon exports from forested catchments, and b) how this study builds on the past work."*

Reply#4: We agree with the need of better organizing the Discussion section, a comment also shared by Referee 2. However, we would like to mention first that "past work" is quiet embryonic, so it is not easy to build on that. Indeed, very few studies compare groundwater and streams (Kawasaki et al., 2005; Venkiteswaran et al., 2014). We found few papers that report DOC dynamics in groundwater of forest ecosystem (Artinger et al., 2000; Baker et al., 2000; Shen et al., 2015) but those references are out of the scope of our study because they focused on the characterization and/or metabolism of groundwater DOC and not on carbon export to streams.

In addition, our study cannot exactly helps our "understanding of groundwater's role in mediating carbon export from forested catchments" because in our particular case, we have selected on purpose a watershed with sandy and permeable soils where no surface runoff occurs. As a consequence, at our study site, groundwater mediates all the C export to the watershed. However, our study helps understanding the dynamics of C export through groundwater drainage.

Changes in the revised MS#4: In the revised MS, we have split the Discussion section in three paragraphs: (i) water mass balance; (ii) soil carbon leaching to groundwater; (iii) carbon transfer at the groundwater-stream interface.

In addition, we will clarify the Discussion section in the revised MS and add more literature and discussion about DIC/DOC export from land to surface waters. However, we will also stress the lack of studies of carbon in groundwater, the knowledge gap at the soil-groundwater interface, and how our study helps in filling these gaps.

We will also modify significantly our figures by splitting the submitted Fig. 4 (panel a and panels b&c) into two separate figures (revised Fig.4 and 5), insisting in the description of the new figure 4 in the text. Indeed, the opposite evolution of DIC and DOC with water table is a first key result of our work that needs to be more highlighted. We will also show additional discharge data in first, second, and third order streams that will allow a much better description of the hydrological model used in the watershed.

Comment#5: *"Fourthly, massive overuse of the term "control". Control is a pretty strong word in the Catchment Science and I am not sure if the current sampling design (i.e., 3 wells, 1 rain gauge) is robust enough to reveal hydrological controls of carbon exports for a 2100 km2 catchment."*

Reply#5: Indeed, this term was overused in the submitted MS.

Changes in the revised MS#5: In the revised MS, we will change wording using also the terms "relation" or "impact", and using other arguments than the Pearson correlation coefficient.

Comment#6: *" Abstract: Iine20-21: When you say drainage here, did you mean to say- subsurface flow? Unclear?"*

Reply#6: In our study, drainage referred to shallow groundwater drainage.

Changes in the revised MS#6: In the revised MS, we will clarify the term drainage in the Materials and Methods section.

Comment#7: *"Line 21: Instrumented or implemented? Please revise this sentence."*

Reply#7: Instrumented.

Changes in the revised MS#7: We will rewrite the sentence as follows: "The studied watershed was also instrumented for continuous measurements of shallow groundwater table depth, precipitation, evapotranspiration, river discharge, and net ecosystem exchanges of sensible and latent heat fluxes as well as CO_2 fluxes.

Comment#8: *"Line 29-30: Grammatical issue, please revise the sentence"*.

Reply#8: We will rewrite the sentence L29-30.

Changes in the revised MS#8: "In contrast, DIC was in majority in the form of dissolved CO_2 in groundwater. Concentrations of DIC were apparently diluted during high flow periods and were maximum during late summer period, when the overlying ecosystem was overall in heterotrophic conditions (i.e., R_{eco}>GPP)".

Comment#9: *"Can you please add a sentence on the major implication of the study?"*

Changes in the revised MS#9: We will add in the Abstract section a sentence on the major implication of our study: "On an annual basis leaching of terrestrial carbon to streams occurs as DIC and DOC in similar proportion; however, DOC export occurs in majority during short period of highest water table, whereas DIC export was relatively constant throughout the year. C export to the watershed represents a small portion of the net land carbon sink (about 1.5%)."

Comment#10: *"Introduction Line 59-60: Please add references"*

Reply#10: We will change this sentence and added references that focused on the factors controlling C export from land to streams in temperate forested catchment.

Changes in the revised MS#10: "The carbon dynamics in forest stream ecosystems results from the interaction between biogeochemistry, *i.e.* biological activity and retention mechanisms in soils, and hydrology, *i.e.* water infiltration in soils and drainage (Shibata et al., 2001; Kawasaki et al., 2005)."

Comment#11: "*Line 62: How so, please explain? No references, is this the first study to address this question?"*

Reply#11: Most studies on DIC/DOC exports from land to streams are based on soils and/or streams observations and not on groundwater sampling, that is restricted submarine (e.g., Santos et al., 2012), estuarine (e.g., Sadat-Noori et al., 2016), coastal floodplain (e.g., Atkins et al., 2013) and boreal lakes (e.g., Einarsdottir et al., 2017) environments, but rarely streams. The few studies on the role of groundwater as a carbon source to streams using direct measurements in groundwater are: 1/ Venkiteswaran et al (2014) who showed that DIC concentration in groundwater was higher than in streams because of fast CO2 degassing close to in stream waters close to resurgence points ; 2/ Kawasaki et al (2005) who showed that DOC export from groundwater is a minor component of the land sink because of DOC-removal mechanisms during vertical infiltration.

Changes in the revised MS#11: The Introduction section will be rewritten, describing the available information on carbon leaching from soils, but stressing the lack of studies that report direct carbon concentration measurements in groundwater.

Comment#12: *"I can understand the overall aim of the study, but it would be helpful if you could clearly layout research questions or even hypotheses."*

Reply#12: As mentioned previously (Changes in the revised MS#2), the objectives of our study will be clearly stated at the end of the Introduction section in the revised MS.

Comment#13: *"Methods Line 76: Several places you have used "per mill" symbol."*

Reply#13: We have removed the per mill symbol and express the basin slope in percent (%) in the revised MS.

Comment#14: *"Line 92: You are focusing on shallow groundwater, may be worth mentioning once for clarity?"*

Reply#14: In the revised MS, we will mention clearly both in the Materials and Methods and Discussion sections that we focused on shallow groundwater.

Comment#15: *"Line 97: Some abbreviations are not in the table 1; SOC?"*

Reply#15: In the revised MS, we will define SOC as soil organic carbon in Table 1.

Comment#16: *"Line 110: Sampled for what?*

Reply#16: In the revised MS, we will mention that we sampled shallow groundwater and first order streams for pCO_2, TA and DOC.

Comment#17: *"Line 166: How did you interpolate groundwater stages between two dates?"*

Reply#17: In the revised MS, we will explain clearly that values of water table depth were linearly interpolated between two dates.

Comment#18: *"Line 196: How did you estimate D, please explain. I am extremely confused about how you took the catchment scale response from a stream gauge, and after multiplying it by a factor of 2 assumed it is as discharge for the Bilos site?"*

Reply#18: We would like to apology for the poor and confusing description of how stream discharge was obtained in the present study. In fact, the detailed description of the hydrological approach appears in a companion paper (Deirmendjian & Abril, submitted to Journal of Hydrology). When resubmitting the present paper, we will upload to the BG site the last version of this companion paper, in order to facilitate the reviewer's work. Because the two papers were written and submitted almost simultaneously, we did not realize that the description of hydrology was so poor in the present paper submitted to BGD. The companion paper describes the dynamics of DIC and its isotopic composition from groundwater to the outlet of the Leyre watershed (stream order 4) and contains a detailed analysis of river discharge data in streams orders 1 to 4. Our study took benefit from four calibrated gauging stations of the French water quality agency (with a daily temporal resolution), located on two second order streams, one third order stream and one fourth order stream (see revised Fig.1) (Deirmendjian, 2016). We also performed additional discharge measurements in first order streams. For each stream order, we calculated with a daily temporal resolution for a two years period the drainage factors (i.e., discharge divided by the corresponding catchment area, in $m^3\ km^{-2}\ d^{-1}$). We then determined the drainage enrichment factors α defined as the ratio between drainage factors of streams of successive orders. Because of the specific characteristics of the Leyre watershed with no surface runoff, we showed a regular increase in drainage factors (hence the drainage enrichment factors is > 1) between two streams of increasing orders, with enrichment factors relatively constant temporally. This allowed us a precise quantification of additional diffusive groundwater inputs in stream reach compare to that coming from the stream of inferior order. Our analysis leaded to the conclusion that monthly drainage values in first order stream was on average 2.3 times lower than that measured in fourth order stream. We will provide a copy of the submitted companion paper in order to help the review of the present paper.

Changes in the revised MS#18: In the revised MS, we will cite this companion paper and resume the hydrological method to make it fully understandable.

Comment#19: *"Line 214: With monthly sampling frequency, you will miss a lot of variation in DOC/DIC storage, especially during storms, no?"*

Reply#19: In fact, we believe that short storms would not have such crucial impact on the way we estimate carbon storage in groundwater based on monthly sampling frequency, because of the high permeability of the soil and the large storage capacity of water in the soil of the Leyre watershed.

In other types of environments (steeper and less permeable), DOC/DIC storage or export could be quickly affected by storms or pulsed hydrological events (e.g., Raymond and Saiers, 2010; Wilson et al., 2013). However, in the Leyre watershed, due to the combined effect of very low slope and high soil permeability, sudden hydrological events are buffered by temporary groundwater storage. Indeed, groundwater storage was strongly correlated with precipitation, whereas drainage was weakly correlated with precipitation (submitted Tab. 2). This buffer capacity of groundwater storage is illustrated in the revised figure 2: (i) river discharge increases in Feb. 2015, more than 2 months after the water table started to rise in Dec. 2014; (ii) river discharge remained constant between Sep. and Dec. 2015, although the water table was rising, but remaining at low stage; (iii) there was a lag time (about 3 months) between high precipitation and high river flow; (iv) with our monthly resolution we could appreciate the seasonal effect of DIC/DOC variations in shallow groundwater and streams (revised Fig. 5), suggesting that the main factors that impact DIC/DOC variations were taking into account.

Comment#20: *" Line 233, Equation 7 will be followed by the equation 6?"*

Reply#20: In the revised paper, equation 6 will be 7 and equation 7 will be 6.

Comment#21: *"Line 246 In equation 8, how did you estimate Qmean, unclear?"*

Reply#21: Q_{mean} is the mean river flow of first order streams in $m^3\ d^{-1}$ between two sampling dates determined from our hydrological model.

It was estimated from the mean discharge of the Leyre River between two sampling dates divided by our correction factor of about 2.3 as explained above in Reply#18.

Changes in the revised MS#21: In the revised MS, we will describe how we estimate Q_{mean} and we will mention the simple hydrological model citing our companion paper.

Comment#22: *"Results and Discussion- Too many ideas in a single paragraph and the main message is lost in the details. It is left to the reader to figure out the take home message. I would recommend re-writing results and discussion sections for better presentation of the key ideas"*

Reply#22: In the revised MS we will clarify both Results and Discussion sections, taking into account all comments made by both Referees.

See also reply#3 and #4

Comment#23: *"354: Given the study design, this sentence is a major overstatement"*

Reply#23: We agree with Referee 1 and rewrote the sentence.

Changes in the revised MS#23: "Our dataset –obtained during an 18 months long monitoring– enabled to understand how the water budget is impacted by the different hydrological parameters in the "Landes de Gascogne" area"

Comment#24: *"Line 460: Soil DOC in shallow layers cannot be mobilized by Precipitation? Lack of correlation between Soil DOC and P is not surprising as DOC exports from soil horizon is highly non-linear process"*

Reply#24: We are aware of this mistake and we are agree with Referee 1, that DOC exports from soil horizon are highly non-linear process and cannot be explain by Pearson's correlation that is a linear correlation. The non-linear character of DOC and DIC mobilization from soil to groundwater and export to stream will be emphasized based on the new figure (see revised Fig. 4 below) which gives the DIC and DOC concentration in groundwater as a function of water table depth.

Changes in the revised MS#24: In the revised MS, we will rewrite the sentence as follows: "In addition, we never observed an increase of groundwater DOC concentration during base flow periods (when groundwater table is low) (see revised Fig. 5c). Thus, it seems that soil DOC in upper horizons cannot be mobilized by rainwater percolation and that saturation of the soil horizon is necessary to generate high DOC concentration in groundwater. This conclusion in in agreement with other works on groundwater DOC, e.g., Kawasaki et al. (2005) who show that retention mechanisms in soils during vertical infiltration strongly impact DOC exports to streams.

Comment#25: *"Line 490: Sentence unclear"*

Reply#25: We rewrote the sentence.

Changes in the revised MS#25: "Water table depth impacts the watershed pressure hydraulic head driving the drainage, as well as the concentrations of DIC and DOC in the groundwater."

Comment#26: *"Tables and Figures. Table 5. It is good to provide conceptual table and later figure 7, but please remember you can only interpret so much from your limited study design."*

Reply#26: We took this comment into account.

Changes in the revised MS#26: The figure 7 and the conceptual table of the submitted MS will be replaced by another figure (see new Figure 7 below). The new figure 7 of the revised MS allows describe in a qualitative way processes and fluxes at the groundwater/stream interface without excessive interpretation.

Comment#27: *"Fig1. If possible, please show locations of the rain gauge and flux tower (or location of Eddy covariance measurements) on the map"*

Reply#27: In the revised MS, we will indicate on the legend that rain gauge and flux tower are located at the Bilos site.

Changes in the revised MS#27: "Legend revised Fig. 1: Map of the Leyre watershed with topography showing the location of the gauging stations (GL, PL, GAR and BR for the Grande Leyre, the Petite Leyre, the Grand Arriou and the Bourron, respectively), the Bilos site as well as the locations of the other sampled groundwater and first order streams. Rain gauge and Eddy tower are located at the Bilos plot."

Comment#28: *"Fig4: There is no gray side bar in the figure. Please revise caption or add the bar to the figure. How did you estimate error bars, _1 standard deviation?"*

Reply#28: The error bars were standard deviation of the 6 first order streams. In the revised MS, we will modify the legend. The side bars representing the different hydrological periods were added (see below).

Changes in the revised MS#28: Please see revised Fig. 5 below.

Comment#29: *"Fig7. The texts within the boxes are bit small, if possible please increase their font sizes."*

Reply#29: In the revised MS, this figure will be deleted and replaced by a new Fig. 7 (see below)

References cited

Artinger, R., Buckau, G., Geyer, S., Fritz, P., Wolf, M., Kim, J.I., 2000. Characterization of groundwater humic substances: influence of sedimentary organic carbon. Applied Geochemistry 15, 97–116.

Atkins, M.L., Santos, I.R., Ruiz-Halpern, S., Maher, D.T., 2013. Carbon dioxide dynamics driven by groundwater discharge in a coastal floodplain creek. Journal of hydrology 493, 30–42.

Baker, M.A., Valett, H.M., Dahm, C.N., 2000. Organic carbon supply and metabolism in a shallow groundwater ecosystem. Ecology 81, 3133–3148.

Billett, M.F., Palmer, S.M., Hope, D., Deacon, C., Storeton-West, R., Hargreaves, K.J., Flechard, C., Fowler, D., 2004. Linking land-atmosphere-stream carbon fluxes in a lowland peatland system. Global Biogeochemical Cycles 18.

Dawson, J.J.C., Billett, M.F., Neal, C., Hill, S., 2002. A comparison of particulate, dissolved and gaseous carbon in two contrasting upland streams in the UK. Journal of Hydrology 257, 226–246.

Deirmendjian, L., 2016. Transfert de carbone le long du continuum végétation-sol-nappe-rivière-atmosphère dans le bassin de la Leyre (Landes de gascogne, SO France). Université de Bordeaux.

Dinsmore, K.J., Billett, M.F., Skiba, U.M., Rees, R.M., Drewer, J., Helfter, C., 2010. Role of the aquatic pathway in the carbon and greenhouse gas budgets of a peatland catchment. Global Change Biology 16, 2750–2762.

Einarsdottir, K., Wallin, M.B., Sobek, S., 2017. High terrestrial carbon load via groundwater to a boreal lake dominated by surface water inflow. Journal of Geophysical Research: Biogeosciences 122, 15–29.

Kawasaki, M., Ohte, N., Katsuyama, M., 2005. Biogeochemical and hydrological controls on carbon export from a forested catchment in central Japan. Ecological Research 20, 347–358.

Kindler, R., Siemens, J.A.N., Kaiser, K., Walmsley, D.C., Bernhofer, C., Buchmann, N., Cellier, P., Eugster, W., Gleixner, G., GRŨNWALD, T., others, 2011. Dissolved carbon leaching from soil is a crucial component of the net ecosystem carbon balance. Global Change Biology 17, 1167–1185.

Leith, F.I., Dinsmore, K.J., Wallin, M.B., Billett, M.F., Heal, K.V., Laudon, H., Öquist, M.G., Bishop, K., 2015. Carbon dioxide transport across the hillslope–riparian–stream continuum in a boreal headwater catchment. Biogeosciences 12, 1881–1892. doi:10.5194/bg-12-1881-2015

Olefeldt, D., Roulet, N., Giesler, R., Persson, A., 2013. Total waterborne carbon export and DOC composition from ten nested subarctic peatland catchments—importance of peatland cover, groundwater influence, and inter-annual variability of precipitation patterns. Hydrological Processes 27, 2280–2294.

Öquist, M.G., Wallin, M., Seibert, J., Bishop, K., Laudon, H., 2009. Dissolved inorganic carbon export across the soil/stream interface and its fate in a boreal headwater stream. Environmental science & technology 43, 7364–7369.

Raymond, P.A., Saiers, J.E., 2010. Event controlled DOC export from forested watersheds. Biogeochemistry 100, 197–209.

Sadat-Noori, M., Maher, D.T., Santos, I.R., 2016. Groundwater discharge as a source of dissolved carbon and greenhouse gases in a subtropical estuary. Estuaries and Coasts 39, 639–656.

Santos, I.R., Maher, D.T., Eyre, B.D., 2012. Coupling automated radon and carbon dioxide measurements in coastal waters. Environmental science & technology 46, 7685–7691.

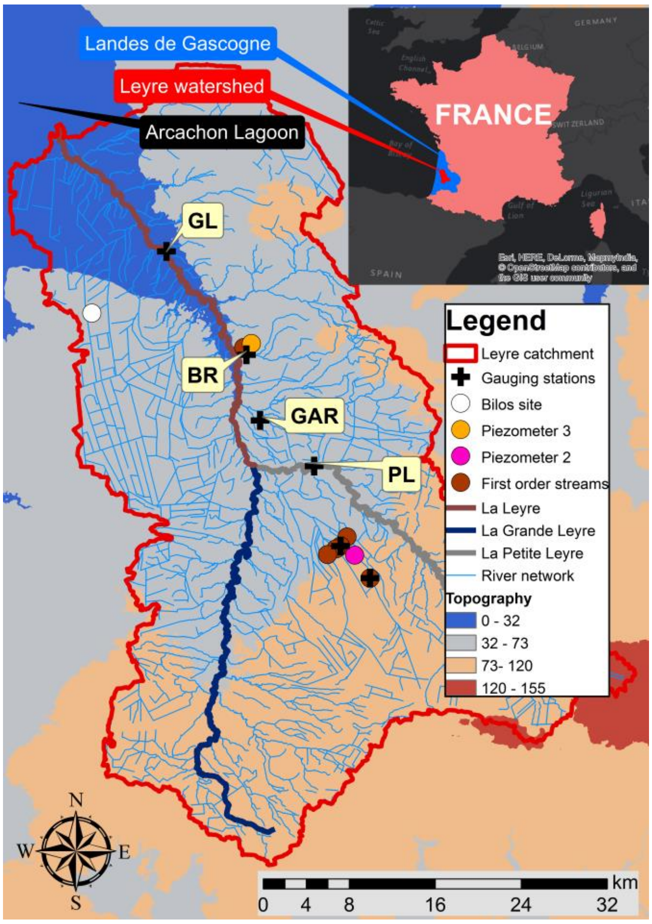
Shen, Y., Chapelle, F.H., Strom, E.W., Benner, R., 2015. Origins and bioavailability of dissolved organic matter in groundwater. Biogeochemistry 122, 61–78.

Shibata, H., Hiura, T., Tanaka, Y., Takagi, K., Koike, T., 2005. Carbon cycling and budget in a forested basin of southwestern Hokkaido, northern Japan. Ecological Research 20, 325–331.

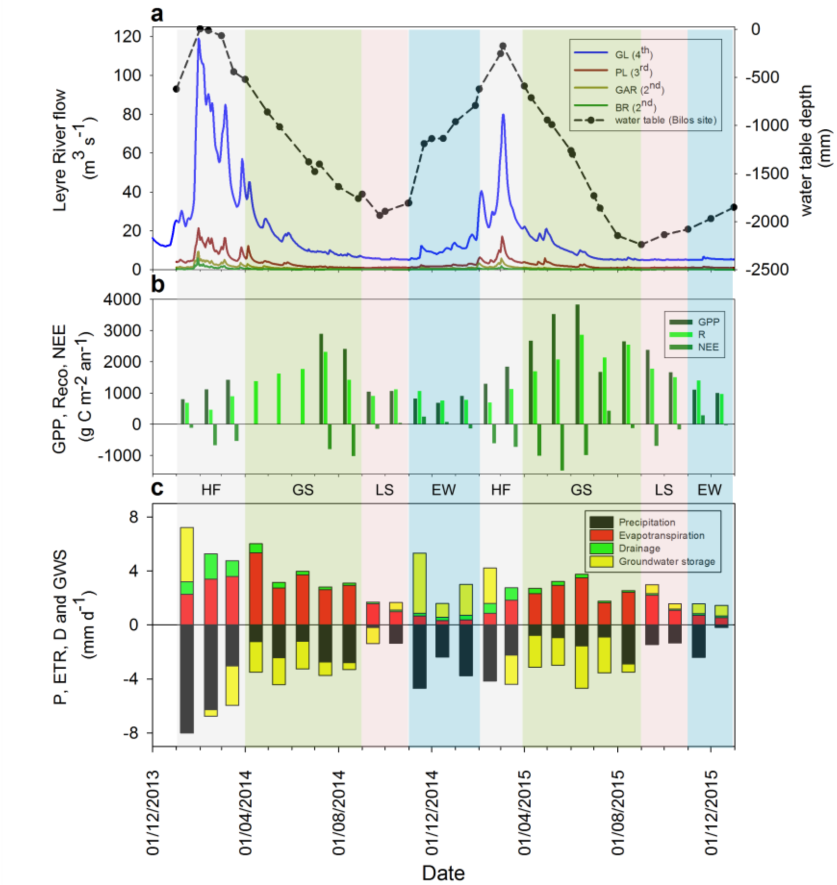
Shibata, H., Mitsuhashi, H., Miyake, Y., Nakano, S., 2001. Dissolved and particulate carbon dynamics in a cool-temperate forested basin in northern Japan. Hydrological Processes 15, 1817–1828.

Venkiteswaran, J.J., Schiff, S.L., Wallin, M.B., 2014. Large Carbon Dioxide Fluxes from Headwater Boreal and Sub-Boreal Streams. PLoS ONE 9, e101756. doi:10.1371/journal.pone.0101756

Wilson, H.F., Saiers, J.E., Raymond, P.A., Sobczak, W.V., 2013. Hydrologic drivers and seasonality of dissolved organic carbon concentration, nitrogen content, bioavailability, and export in a forested New England stream. Ecosystems 16, 604–616.



Revised Fig. 1: Map of the Leyre watershed with topography showing the location of the gauging stations (GL, PL, GAR and BR for the Grande Leyre, the Petite Leyre, the Grand Arriou and the Bourron, respectively), the Bilos site as well as the locations of the other sampled groundwater and first order streams. Rain gauge and Eddy tower are located at the Bilos plot.



Revised Fig. 2: Seasonal variations of hydrological parameters in the Leyre watershed. (a) Discharge of the Leyre River (GL), Petite Leyre river (PL), Grand Arriou (GAR) river and Bourron (BR) river associated with water table at the Bilos site; (b) Eco-physiological parameters (NEE, GPP, R_{eco}) estimated at the Bilos site; (c) Monthly precipitation (P), drainage (D), evapotranspiration (ETR) and groundwater storage (GWS) at the Bilos site. HF, GS, LS and EW represent respectively high flow, growing season, late summer, and early winter periods.

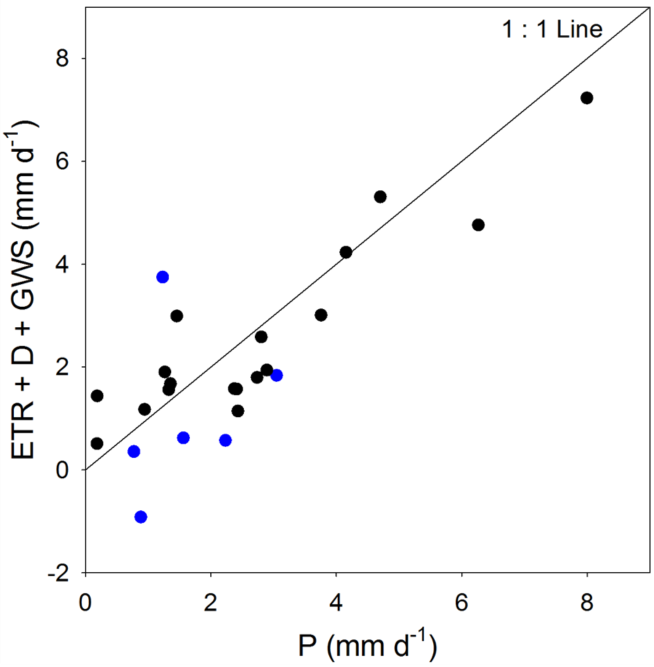
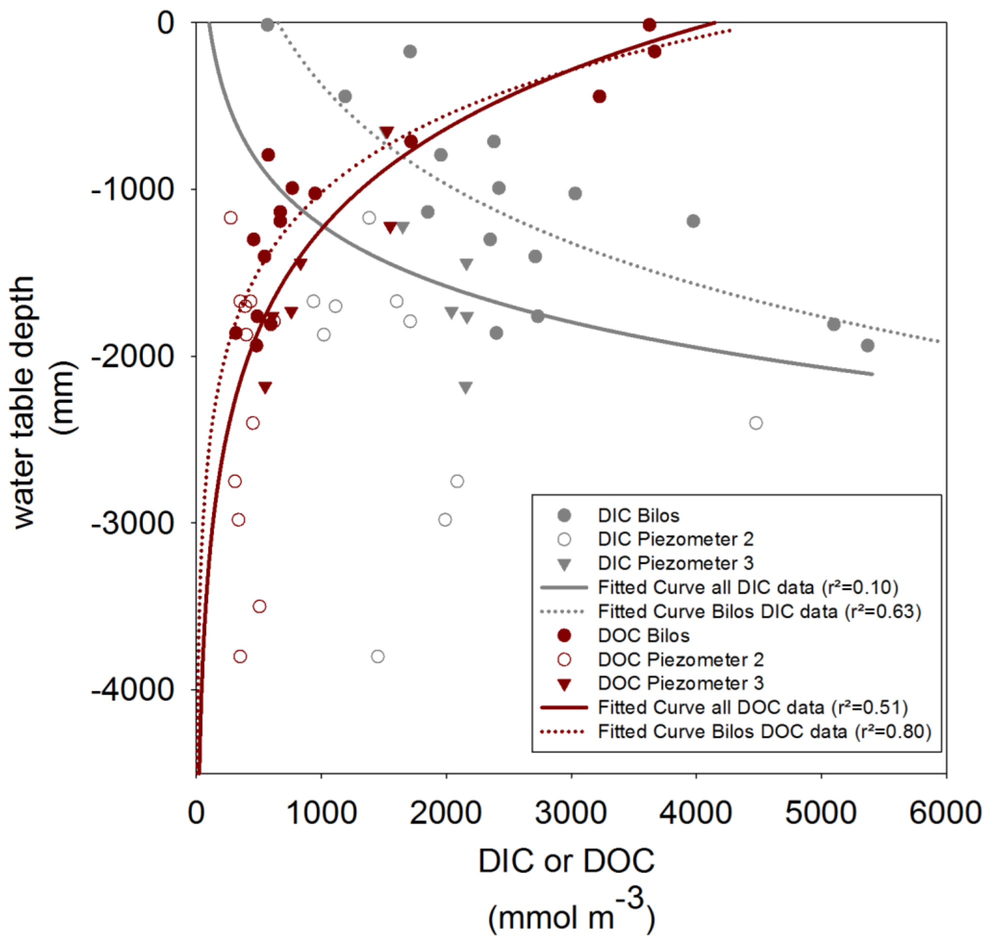
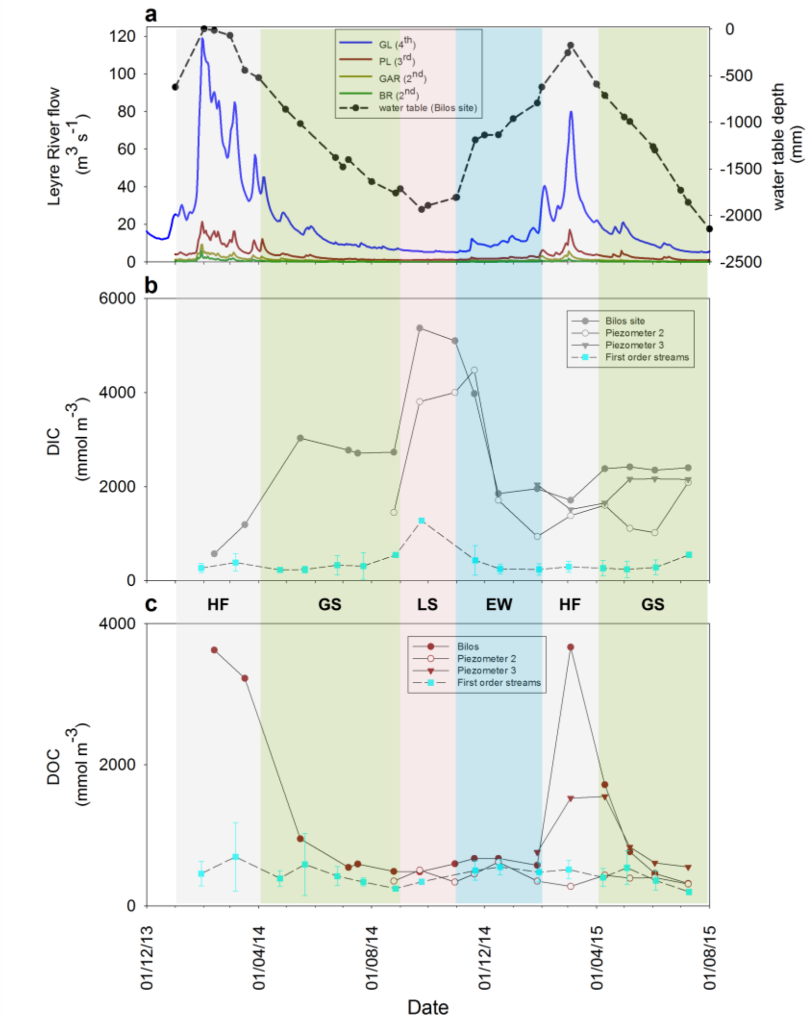


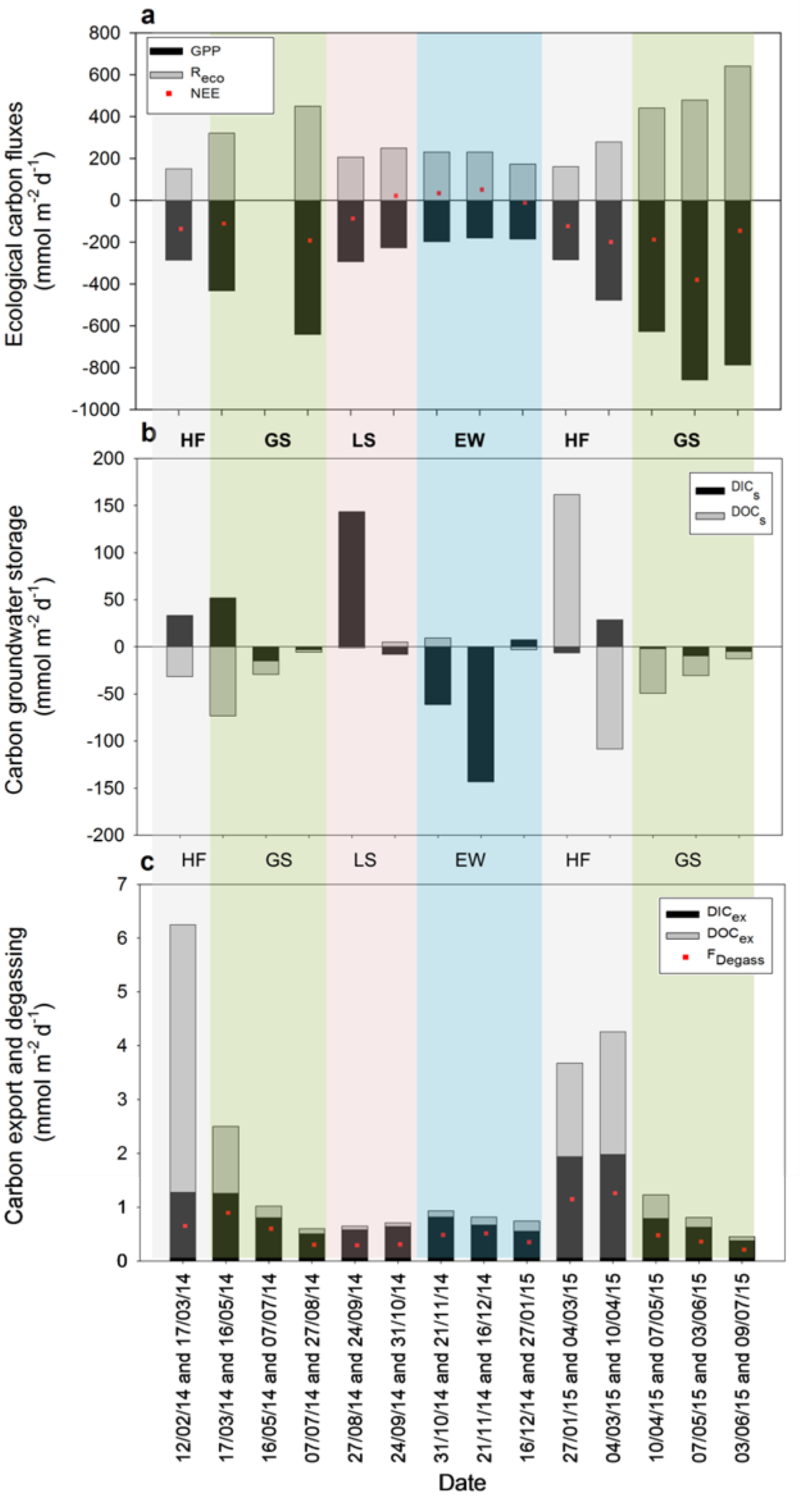
Figure 3: Monthly water mass balance (see section 2.5) at the Bilos site for 2014-2015. Pearson coefficient R = 0.85, p-value < 0.001. Blue points represent months where GWS (Mar. 2014, Apr. 2014, Mar. 2015, Apr. 2015, Jun. 2015, Jul. 2015) is extremely negative (see Fig. 2). These blue points are further away from the 1:1 Line than the other months (represented in black). The drainage of the Leyre River is delayed compared to the drainage of Bilos plot. Thus, when the loss of groundwater is extremely high (GWS negative), calculated D do not correspond to measured GWS. Hence, we expected more mistakes when GWS is extremely negative.



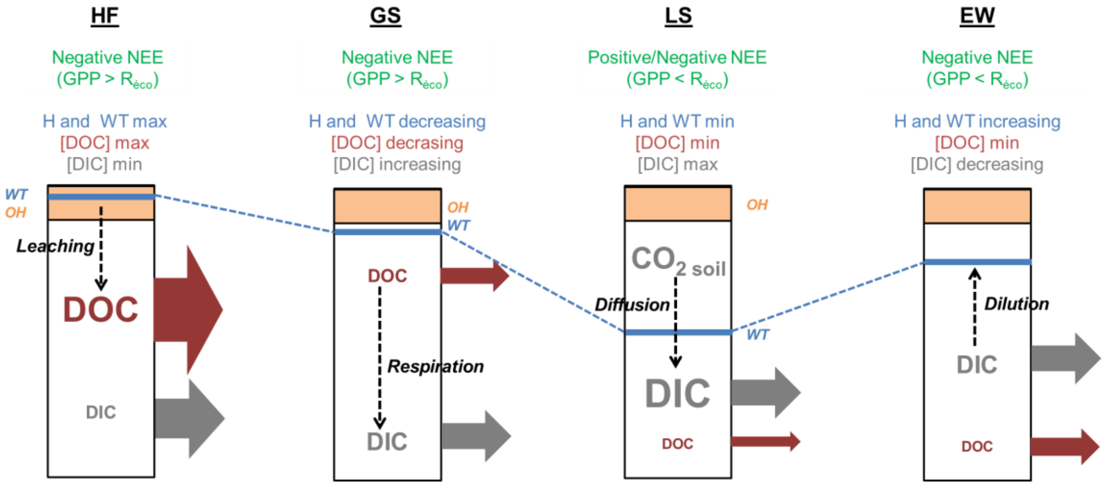
Revised Fig. 4: Concentration of DIC and DOC in groundwater as a function of water table depth



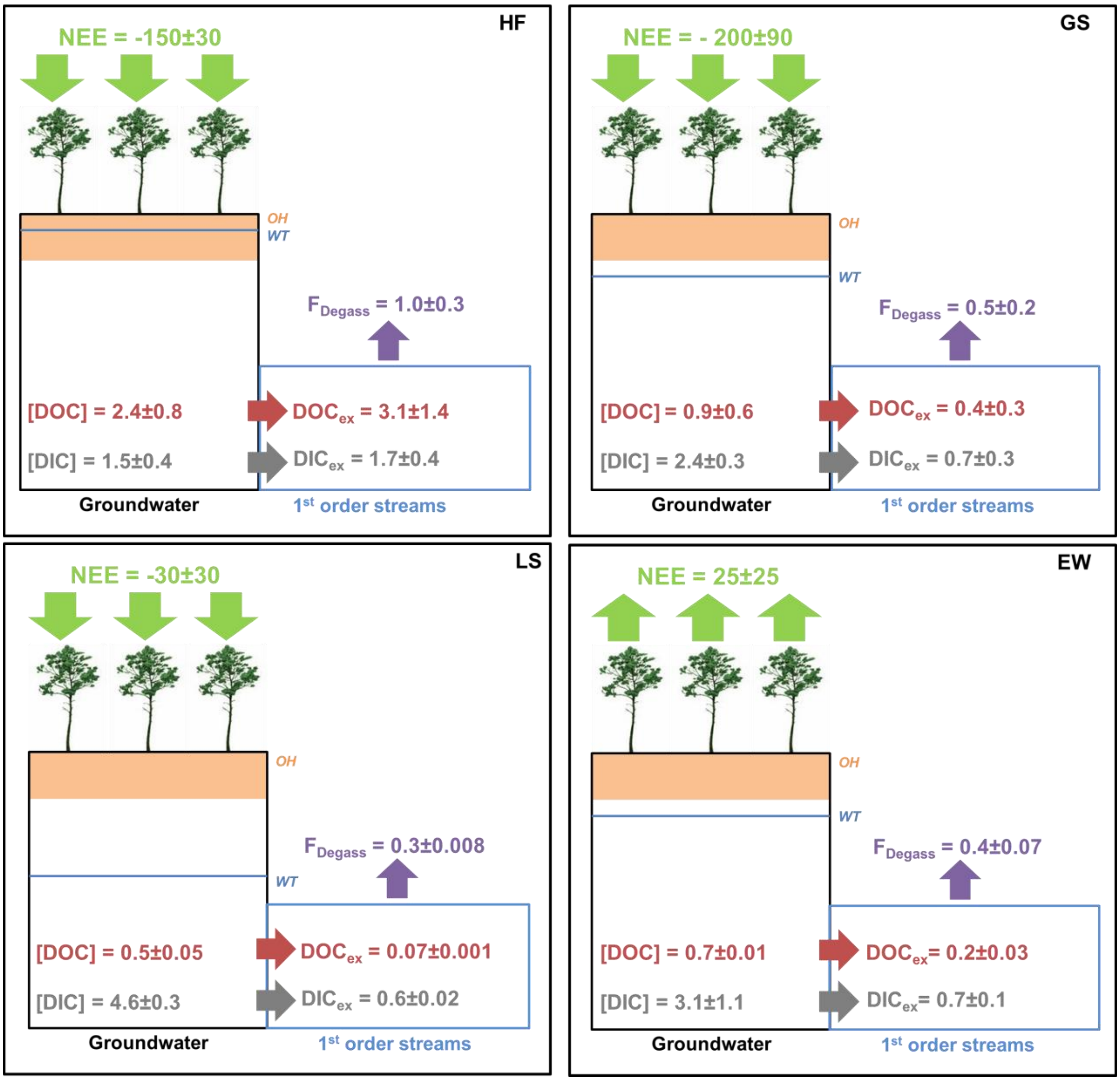
Revised Figure 5: (a) Discharge of the Leyre (GL), Petite Leyre (PL), Grand Arriou (GAR) and Bourron (BR) rivers associated with dwater table at the Bilos site Temporal variations throughout the sampling period of (b) DIC in groundwater (Bilos and the two other piezometers) and DIC in the 6 first order streams (medium dashed line; errors bars represent standard deviation of the 6 first order streams) and (c) DOC in groundwater (Bilos and the two other piezometers) and DOC in the 6 first order streams (medium dashed line; errors bars represent standard deviation of the 6 first order streams). HF, GS, LS and EW represent respectively high flow periods, growing season periods, late summer periods and early winter periods.



Revised Figure 6: Temporal variations throughout sampling period of (a) ecological parameters at the Bilos site (*GPP*, *R* and *NEE*), here *GPP* is represented negative (b) storage of DIC and DOC in groundwater at the Bilos site and (c) export of DIC and DOC throughout Bilos groundwater and degassing of CO_2 in first order streams. HF, GS, LS and EW represent respectively high flow periods, growing season periods, late summer periods and early winter periods.



New Fig. 7: Conceptual model at the vegetation-soil-groundwater-stream interface of the Leyre catchment. OH, WT, D are organic horizon of the soil, groundwater table and drainage, respectively. Hydrobiogeochemical processes are represented in medium dash black arrows. Carbon export are represented in full arrows, the thickness of the arrow provide qualitative information on the flux. . HF, GS, LS and EW represent respectively high flow periods, growing season periods, late summer periods and early winter periods.



New Figure 8: concentration of carbon in shallow groundwaters and fluxes of carbon at the vegetation-groundwater-stream-atmosphere over the 4 hydrological periods. Fluxes of carbon are in mmol m^{-2} d^{-1}. Concentrations of carbon ([DOC] and [DIC]) are in mol m^{-3}. Error bars represent the standard deviation of the different hydrological periods.