Project ECATA funded by FWF / NSC

Effects of extreme events on carbon cycling along a terrestrial – aquatic continuum at the catchment scale

ABSTRACT

The Intergovernmental Panel on Climate Change predicts a further global average surface warming - depending on future emission scenarios - in the range of 1.1 to 6.4°C until the end of the 21st century, which may entail dramatic consequences for biophysical and socio-economic systems. As a result of the above-mentioned temperature rise, extreme events, such as high-intensity rainfall events and resulting landslides and debris flows, are expected to increase in both frequency and magnitude. For example, the top 10% of precipitation intensity is predicted to increase by about 95% for each degree Kelvin increase in global mean temperature. These extreme events episodically export large amounts of terrestrial organic carbon (OC) into fluvial ecosystems. This resets vegetation succession and soil formation on land, and exposes terrestrial OC of varying sources, age and composition to physical and (bio)chemical reactions in aquatic ecosystems. Through the former (terrestrial) processes, C is fixed from the atmosphere and re-accumulated in biomass and soils; through the latter (aquatic) processes, the exported OC may partly be respired to the atmosphere, physically or (bio)chemically modified and hence stabilized or destabilized, buried for longer-term storage in deposited sediments, or transported to the ocean. These processes depend on the contribution of different terrestrial OC pools, such as litter and biomass, soil and rock OC, which in turn is controlled by the characteristics of the extreme events. The rates and extents of these processes and their driving forces are still poorly understood and scarcely quantified, but are recently understood to be of major significance at global scales. For an improved assessment of the effects of extreme events on carbon cycling, it is therefore crucial to better understand and quantify the associated terrestrial and aquatic processes.

In the ECATA project, we will focus on mountainous catchments in Taiwan, where landslides are frequent and export of terrestrial OC to aquatic ecosystems is high. We will quantify the re-accumulation and stabilization of OC in terrestrial ecosystems, and characterize the processing of exported biomass-, soil-, and rock-derived OC in freshwater ecosystems. The ECATA project will build on extensive experience in monitoring and modeling of landslides and sediment discharge by the Taiwanese partners and combine this with long-standing expertise and cutting-edge techniques to characterize OC in soils and sediments provided by the Austrian partners. Together, this shall yield fundamentally new insights into the fate of OC at the terrestrial – aquatic continuum impacted by extreme events, and provide needed inputs for improved modeling of the effects of extreme events on carbon cycling at regional scales and for better global estimations.

PI: Assoc. Prof. Dr. Franz Zehetner (BOKU Vienna)

Co-PI: Assoc. Prof. Dr. Thomas Hein (WCL & BOKU Vienna)