Geophysical Research Abstracts
Vol. 12, EGU2010-3730, 2010
EGU General Assembly 2010

Dynamics and Biodegradability of Chromophoric Dissolved Organic Matter in a Severely Polluted River

Mikhail Borisover (1), Yael Laor (2), Ibrahim Saadi (2), Marcos Lado (3), and Nadezhda Bukhanovsky (1)

(1) The Volcani Center, Agricultural Research Organization, Institute of Soil, Water and Environmental Sciences, Bet Dagan, Israel (vwmichel@volcani.agri.gov.il), (2) Newe Ya'ar Research Center, Agricultural Research Organization, Institute of Soil, Water and Environmental Sciences, Ramat Yishay, Israel (laor@volcani.agri.gov.il), (3) Area of Soil Science, Faculty of Sciences, University of A Coruña, A Coruña, Spain (mlado@udc.es)

The 70-kilometer long Kishon River is one of Israel's largest rivers. Its annual discharge may vary substantially, e.g. between 47 and 10 million m3. The lower section of the river has been severely polluted for dozens of years, by industrial effluents containing heavy metals, radionuclides, nutrients, and diverse organic contaminants. The total volume of effluents discharged from the plants into the river stream may contribute as much as 30% of the total water volume. Dissolved organic matter (DOM) and specifically its chromophoric components (CDOM) including humic-like and proteinous substances may form water-soluble complexes with multiple organic and inorganic pollutants and, thus, enhance their release from the sediments and their mobility. The volatility of pollutants, their bioavailability, toxicity and potential to undergo bio-, abiotic and photodegradation may be affected by interactions with CDOM. Therefore, the dynamics of CDOM is important for understanding the fate of pollutants in aquatic environments. In this study, we intended (i) to characterize the seasonal and spatial variability of CDOM at the most contaminated lower section of the Kishon River and (ii) to assess the impact of biodegradation, dilution by seawater and contribution of discharged effluents on the overall dynamics of DOM and CDOM.

For this purpose, water was sampled during 11 months at 8 locations distributed along Lower Kishon River. Samples were characterized for concentrations of dissolved organic carbon (DOC), UV- absorbance at 254 nm, electrical-conductivity, pH, concentration of dissolved oxygen and excitation emission matrices (EEM) of fluorescence. Parallel factor analysis of EEM enabled quantifying two major groups of riverine fluorescent CDOM: humic-like substances and components spectrally similar to those associated with phytoplankton productivity. CDOM (including fluorescent matter and components absorbing light at 254 nm) was found resistant to biodegradation by riverine microorganisms. The fraction of easily degradable riverine DOM that was not included in the CDOM was estimated to be between 8 and 26% of the overall DOC. The variability in DOM and CDOM composition was strongly affected by dilution with seawater. Approaching the estuary, the DOM in the Kishon River becomes depleted in CDOM. At the same time, the UV-active components become relatively enriched in fluorescent matter.

It was hypothesized that the concentration of humic-like substances may increase in the river due to DOM transformation. Effluent discharge from multiple industrial sites along the river did not result in a distinct increase in concentrations of CDOM components absorbing light at 254 nm or fluorescent humic-like substances. However, an increase in the fluorescent CDOM associated with phytoplankton productivity was observed in the central section of Lower Kishon River, probably linked to an increase of nutrients supply originating from discharged effluents, which enhanced biological activity. Thus, different processes appear to influence the concentrations of two major groups of fluorescent riverine CDOM.

The collected data showed significant correlations between concentration of dissolved oxygen, pH and UV- absorbance at 254 nm which may suggest that as the content of aromatic components increases, the oxygen demand for DOM biodegradation decreases, since DOM is enriched in biodegradation-resistant substances. The different dynamics of DOC and CDOM as observed in this study needs to be considered when modeling the impact of DOM on the fate of pollutants in riverine ecosystems.