Understanding the movement of elements like carbon, oxygen, and nitrogen between the biosphere and atmosphere is important for those studying pollution risk, agricultural production, and climate change. These processes are highly variable in space and time, making measuring, monitoring, and modeling difficult. The October issue of Vadose Zone Journal included a special section titled, “Soil Variability and Biogeochemical Fluxes,” which presents papers focused on the fluctuations of biogeochemical cycles in the vadose zone.

Guest editors of this special section included Gonzalo Martinez, University of Córdoba; Luca Brocca, Research Institute for Geo-Hydrological Protection of the Italian National Research Council; Horst Gerke, ZALF Institute of Soil Landscape Research; and Yakov Pachepsky, USDA-ARS. CSA News magazine recently spoke with Martinez about this special section.

CSA News: Can you describe some of the challenges and current approaches for measuring biogeochemical processes in the vadose zone?

Martinez: The main challenge is to be able to account for the large degree of variability in space and time that biogeochemical fluxes present. Analytical methods, sampling protocols, and the use of covariates and empirical or deterministic environmental models are important in characterizing and quantifying such flux variability.

CSA News: How did this special section come about?

Martinez: The origin of this special section was a session on "Spatial and Temporal Patterns in Soil Systems" that we first organized at the European Geosciences Union general assembly back in 2013. The term “biogeochemical fluxes” is really broad and refers to the dynamics of energy and matter that occur between the terrestrial biosphere and the atmosphere it can encompass from soil respiration processes to water and solute transport. We intended to open the scope of our special section as much as possible to enrich the readers with a multidisciplinary point of view that could be useful to all of them and help in their research.

CSA News: Did you have a specific goal or topics you intended to cover?

Martinez: Our main goal was to push farther the frontiers of knowledge in soil biogeochemical fluxes quantification, characterization, and modeling. We have covered very diverse topics, from spatio-temporal variability analysis of soil moisture and soil respiration, to temporal variations of soil hydraulic properties and pollutants transport. In this sense, methods that were previously developed for other disciplines have been applied to these studies. Moreover, this special section presents some works that suggest the need to update some types of water and solute flow models to account for highly dynamic factors such as vegetation.

CSA News: What do you think are the most important ideas presented in this special section? Are there any papers that strike you as particularly impactful?

Martinez: The main progress of this special section has been the identification of different controls on soil moisture and biodegradation rates depending on the scale of the study as well as the important dependence of the spatial and temporal variability of biogeochemical fluxes on dynamic properties such as vegetation and weather variables.

It is always hard to choose among works that have passed the high standards of the Vadose Zone Journal. However, due to its implications and relevance to evaluate the temporal variation of water flow and solute transport in soils, the work of Herbrich and Gerke (http://bit.ly/2A6PezT) is one. From a spatio-temporal variability point of view, the work of Eichert and co-authors (http://bit.ly/2AnD6xg), who conducted a multiscale study on evaluating distributed data for analyzing biodegradation patterns of hydrocarbon contamination in the vadose zone, might be of high relevance. This paper is a potential source of knowledge in setting the natural source zone depletion rates expectations in oil refineries.