Special Section: VZJ Anniversary Issue

Vadose Zone Journal: The First Ten Years

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Celebrating ten years of publication, the authors introduce a special section commemorating the anniversary of *Vadose Zone Journal* and reviewing the journal's role in an evolving understanding of vadose zone science.

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Vadose Zone J.
doi:10.2136/vzj2013.10.0186
Received 29 Oct. 2013.
Open access

We proudly present a special section inspired by the 10-year anniversary of *Vadose Zone Journal*. From the outset, the journal was intended to be different than traditional "soils" journals, with the goal of publishing contributions, reviews, and opinion papers across a broader range of disciplines concerned with the vadose zone, including scientific and societal issues related to the role of vadose zone processes in climate change, biofuels, sustainability, and nanotechnology. Since its inception, *Vadose Zone Journal* has grown tremendously as a scholarly publication with a strong reputation for high quality and diverse science. Accessible and timely reviews, in addition to technical notes and articles, have secured the journal's reputation as a definitive and valuable resource for soil scientists, hydrologists, ecologists, hydrogeophysicists, and other earth scientists. The growth of the journal is impressive and is partly reflected by the 2012 impact factor (IF) of 2.20 (5-yr IF of 2.67), ranking eighth in the soil science category, and 16th in the field of water resources. When the article influence score is used as the primary metric, then *Vadose Zone Journal* ranks fourth in soil science. The success of the journal is also reflected in the editorial board, which is composed of many leading vadose zone scientists from the United States and internationally. The high proportion of scholarly submissions from international scientists outside of the United States (approximately two-thirds of the manuscripts published) reflects on the status of the *Vadose Zone Journal* as a multi-disciplinary and multi-national scholarly outlet—an important goal from the outset.

The first issue of *Vadose Zone Journal* appeared in August 2002, and a total of 1275 papers have been published since. These papers cover a wide range of topics, including carbon sequestration, multicomponent (reactive) transport modeling, radionuclide transport, multiphase flow, recharge in arid and semiarid environments, multiscale vadose zone modeling, pedometrics, soil mapping, virus and bacteria transport, remote sensing of vadose zone properties, hillslope hydrology, gas diffusion, environmental observatories, flow in unsaturated fractured rock (and soils), thermodynamics of unsaturated flow, scaling issues in vadose zone hydrology, uncertainty analyses, inverse modeling, fractal mathematics, ecosystem services, and salinity and irrigation issues. Many of these papers have become "classical" contributions that have received widespread interest and heavily cited by a broad readership. To illustrate this aspect in some detail, please consider Fig. 1, which presents the number of published papers per year and the total number of citations these papers received per year. The number of papers published in *Vadose Zone Journal* rapidly increased during the first few years and has now stabilized to about 110 to 120 articles per year. The number of citations continues to increase linearly with each year, a demonstration of the continuous growth and impact of the journal.

To celebrate the tenth birthday of *Vadose Zone Journal*, we were tasked with organizing a special issue to commemorate the progress made in our understanding of the vadose zone. This effort has resulted in a total of 10 contributions that cover critical fields of vadose zone research. We will now briefly summarize these contributions.

This introduction to the anniversary begins with a perspective from the founding editor, Rien van Genuchten and his successor, Jan Hopmans, on the first ten year of *Vadose Zone Journal* (van Genuchten and Hopmans, 2013). This editorial describes the rationale that led to initiation of the journal in 2002 and briefly summarizes the growth the journal has experienced in the past 10 years. The authors particularly thank the current and past

Abbreviations: HCF, hydraulic conductivity function; WRC, water retention curve.

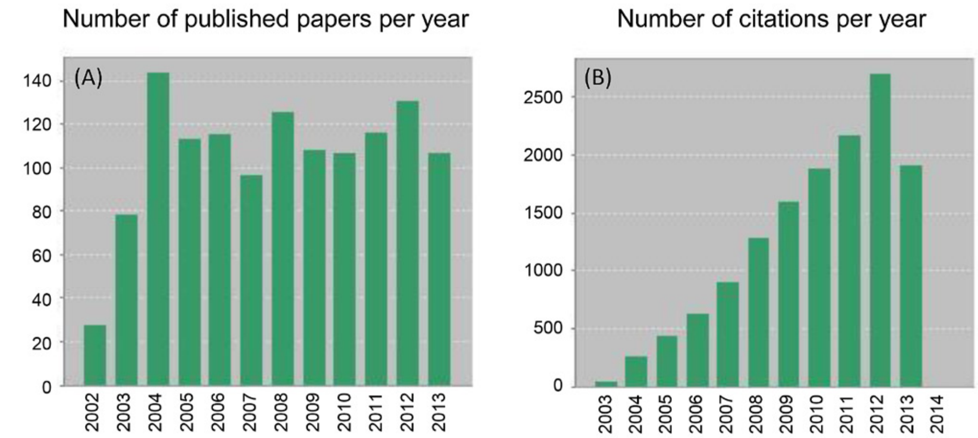

Fig. 1. The impact of papers published in *Vadose Zone Journal* from August 2002 to July 2013: (A) number of peer reviewed publications, and (B) total number of citations received (data from Thomson Reuters Web of Knowledge).

editors, associate editors, SSSA staff in Madison, and authors, readers, and reviewers that have made the journal to what it is today.

A challenging issue we all face is how to communicate our knowledge of the vadose zone to decision makers and stake holders to help protect the vadose zone and maintain soil and food security. Soil management can no longer be thought of in terms of single function management, but needs to be considered and managed in the context of the multiple functions it offers. Robinson et al. (2013) reviewed progress in the development of a coherent soil ecosystem services framework. They address some of the areas where the application of an ecosystems approach is gaining traction, including national and local decision making, as well as support for legal arguments in court. One of the main conclusions is the urgent need to develop decision support tools and data sets that inform policy and provide support in judicial hearings to protect ecological infrastructure.

Sposito (2013) explored strategies to secure food supplies sufficient to sustain the human population growth of the next forty years. New methodologies are warranted that transcend disciplinary boundaries and the contrasts that exist among the principal food crops and the soils across the planet in which they are grown. Sposito's main conclusion is that the grand scientific challenge offered by crop intensification cannot be met in the absence of a holistic understanding of soil properties.

The yield of crops is strongly dependent on the available soil moisture in the rooting zone. If the soil is too wet, plants will suffer from root loss due to insufficient availability of oxygen. On the contrary, if the soil is too dry, crop growth and yield are significantly reduced. Javaux et al. (2013) contemplates that macroscopic root water uptake models are often based on simplifying assumptions that no longer reflect, or even contradict, the current status of knowledge in plant biology. Javaux et al. (2013) therefore introduced a process-based approach to root water uptake modeling that much better reflects the actual three-dimensional architecture and properties of plant roots. They suggested the need for development of noninvasive measurement methods that provide better data about root resistance, soil resistance, root activity, and stress and compensation.

In recent years, significant progress has been made in the use of noninvasive imaging techniques to observe soil at micrometer resolution in three dimensions. Hallett et al. (2013) review recent research focused on an improved understanding of the impact of biologic processes on soil structure. Major challenges for future research are how to gain a quantitative understanding of how soil biology changes structure and then to incorporate this knowledge with studies of soil biodiversity, microbial functions, and root–soil interactions. An even greater challenge is how to upscale microbial processes at micrometer resolution to the whole plant, field, or catchment scale.

The water retention curve (WRC) and hydraulic conductivity function (HCF) are key ingredients in most analytical and numerical models for flow and transport in unsaturated porous media. Despite their formal derivation for a representative elementary volume of soil complex pore spaces, these two hydraulic functions are rooted in pore-scale capillarity and viscous flows that, in turn, are invoked to provide interpretation of measurements and processes such as linking WRC with the more difficult to measure HCF. Assouline and Or (2013) reviewed some of the primary soil hydraulic models and highlight their physical bases, assumptions, advantages, and limitations. Main conclusions are that the commonly assumed link between the WRC and HCF needs reevaluation, and that the modeling of flow and transport through structured and special porous media may require modification of the governing flow equations. Moreover, the impact of dynamic and transient processes at fluid interfaces on flow regimes and hydraulic properties necessitates the development of a new vadose zone modeling paradigm.

Although much progress has been made in the past decade to determine the WRC and HCF of soil samples, a major research challenge remains how to adequately characterize the hydraulic properties of the vadose zone at very large spatial scales. Mohanty (2013) reviewed the potential of remote sensing for characterizing large-scale vadose zone flow properties. While this indirect measurement method provides the initial breakthrough needed to estimate some of the most challenging properties of the soil needed for many hydrologic, land–atmosphere interaction, and environmental applications, much additional work is warranted to improve our understanding of the penetration depth, accuracy, and spatial and temporal resolution of remote sensing methods.

Globally, evaporation consumes about 25% of solar energy input and is a key hydrologic driver with 60% of terrestrial precipitation returning to the atmosphere via evapotranspiration. Quantifying evaporation is important for assessing changes in hydrologic reservoirs and surface energy balance, and for many industrial and engineering applications. Or et al. (2013) reviewed advances on resolving interactions between soil intrinsic properties and evaporation dynamics with emphasis on the roles of capillarity and wettability and how they affect liquid phase continuity and capillary driving forces that sustain early (Stage I) evaporation rates. The authors demonstrated that the soil water characteristics contain information for predicting the drying front depth and mass loss at the end of Stage I. This allows the use of soil textural maps to derive predictions for regional-scale evaporative water losses. Or et al. (2013) also discussed the formation of a secondary drying front at the onset of Stage II evaporation and subsequent diffusion-controlled dynamics.

Contamination of subsurface environments by chlorinated-solvent compounds remains a significant human-health issue in the United States and many other countries. Contaminant sources in the vadose zone pose specific potential risks through their impact on groundwater quality and vapor intrusion. Currently, these impacts constitute the primary risk drivers for decision making concerning remediation of contaminant sources in the vadose zone. Brusseau et al. (2013) discussed the performance of soil vapor extraction (SVE) to remedy contamination, and they summarized alternative actions such as flux control, air sparging and multiphase extraction, and the closing criteria used to determine when remediation efforts should end. Based on their experience at two sites overseen by the U.S. Department of Energy, the authors advocate an integrated approach to vadose zone sites contaminated by chlorinated solvents that incorporates analysis of SVE operations data, and that implements contaminant mass discharge tests and mathematical modeling.

Continued advances in direct and indirect measurement methods increase our ability to characterize the vadose zone at different spatial and temporal scales. The field of pedometrics, which has evolved significantly in the past decades, applies mathematical and statistical methods to study the distribution and genesis of soils. Minasny et al. (2013) highlighted some of the key common research areas for pedometrics in the vadose zone. In particular, they summarized elements of a Bayesian hierarchical modeling framework for dynamic spatiotemporal modeling.

In summary, these contributions highlight the diversity of topical scientific areas that have become the foundation of the *Vadose Zone Journal*. As Fig. 1 highlights, the scientific community continues to use the research contributions published in the journal. Looking forward, the *Vadose Zone Journal* will maintain its top scientific quality while striving to improve responsiveness to authors and readers of the journal. For example, *Vadose Zone Journal* will begin monthly publications in 2014. This will reduce turnaround time from publishing to indexing (e.g., Web of Knowledge), and it will lead to more rapid visibility of newly published manuscripts. We see improvements like this as illustrating *Vadose Zone Journal*'s commitment to the rapid dissemination of high-quality scientific contributions. We look forward to the next 10 years and beyond.

Acknowledgments

We are indebted to all the authors for their willingness to contribute to this anniversary issue and the reviewers for their time and effort in evaluating the different manuscripts.

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