

Is there a “Forest Filter Effect” for airborne organic pollutants?

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Almost a year ago, George Christakos, editor of the SERRA journal asked us individually as members of the editorial advisory board to organize for the journal a forum on a topic of current interest, involving some controversy, and of interest to the journal subscribers. In May 2002 both us found ourselves at conference in Vienna, Austria and in session with a rather lively discussion on the issue of whether forests can filter pollutants out of the atmosphere. Shortly after that we recognized that this would be a good topic for a SERRA forum and agreed to jointly organize this effort. Thus, we selected as topic for our forum the role of vegetation in controlling the transport, mobility, persistence, and partitioning of organic chemicals (not metals) in regional and global environments. In October 2002 we sent an e-mail to several of our colleagues posing two questions and asking for their participation. Here are the two questions we sent out.

Question 1

Based on your own research and the current literature, do you believe there is a forest filter effect (FFE) or vegetation filter effect for organic pollutants dispersed in a regional or the global environment? That is, does the presence of vegetation/forests in environmental systems significantly alter the mass-balance of organic chemicals released to air, water, or soil? And, if there is such an effect, what combination of chemical and environmental properties gives rise to this effect?

Question 2

What is the experimental and model evidence that you use to support your response to Question 1?

We received eight responses to these questions from a total of seventeen researchers who responded either individually or in teams. This group includes modelers and experimenters. It is of interest that there is rather universal agreement among this group that forests can indeed act at least as apparent if not true filters to remove pollutants from the atmosphere. But beyond this point the consensus is not clear. The authors have much different interpretations for what “filtering” means and how it works. Three of the responses use experimental

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evidence to support their interpretation while five rely primarily on theoretical evidence. The contributors cite a large number of mechanisms as contributing to the filter effect – for example simple partitioning, enhanced degradation in vegetation, increased deposition rates, variations of the physico-chemical properties of the plants themselves, sequestration in leaves and soil, and increased oxygen levels in soil with resulting increases in degradation. Moreover, several authors point out that several of these processes could be limited by either saturation or physical limits on the rate of transfer from air to plant so as to diminish the magnitude of the filter effect. Within the broad range of approaches used here to provide evidence for the FFE we see factors such as observations from measurements of depositional fluxes, mass-balance models run with and without vegetation, observations of the internal volatile compounds from plants, and literature reviews.

We encourage the reader to read on and form your own views on how and to what extent vegetation serves to remove pollutants from the atmosphere. We thank all of the contributing authors for their efforts to stimulate thinking on a timely but still unresolved issue. We hope that forum will serve as a starting point for more experiments and new theories.