E.A. Holland feedback on EPA report on Reactive Nitrogen. April 27, 2009

The basic premise of moving towards a comprehensive holistic view of the environmental consequences of the ongoing dramatic increase in the use of nitrogen and the atmospheric-land-water exchanges of reactive nitrogen is one that I support enthusiastically. However, the draft report falls well short of its intended mark. Future versions of the report need to build more strongly on the published literature and must include a clearly articulated plan for integration of the work with strong emphasis on both models and data.

The report does not adequately take into account its ambitious holistic scope. Instead it comes across as series of research recommendations that interest the people who wrote the report. The report does not adequately build on the underlying science. Much of the science cited is old parts of the literature and has not been updated to the modern literature. Because agriculture is at the center of the problem, I suggest that subsequent versions of the report build strongly on interactions with the agriculture community laying the groundwork for the strong interactions with USDA called for in the report.

A striking omission of the report is the connection between the climate system and the nitrogen cycle. The EU is currently funding Nitro-Euro, a multi-million dollar project that was motivated by this connection. A Science paper by Hungate et al in 2002, a series of ongoing studies by MIT (Sokolov et al. Journal of Climate 2008), Princeton (Levy, and others) and NCAR (Thornton et al 2008) underscore the importance of the links between the carbon and nitrogen cycle. The centrality of the carbon cycle to climate change and the impact of the N cycle on carbon uptake are the top of the list, followed by N_2O, NO and its role in tropospheric ozone production, and the increasing importance of N containing aerosols that play a role in global warming make a compelling case for addressing the connection between the changing nitrogen cycle and climate change in this report.

Recent work suggests that the ongoing declines in fertilizer use throughout the mid-west are not sufficient to decrease the ongoing recurrence of hypoxia in the Gulf of Mexico. See particularly work by Laurie Drinkwater and Mark Davids of Cornell and a paper by Vitousek et al. submitted to Science (The manuscript may be available directly from Peter Vitousek at Stanford). The body of work suggests that years of excess fertilizer use may have sufficiently bolster soil organic nitrogen content to compensate for reductions in fertilizer use and provide an ongoing source of reactive nitrogen N to downstream ecosystems.

The report requires a strong editorial hand to remove redundancy, increase the precision of the wording in the findings, recommendations and executive summary, and standardize the report throughout is needed. The current report is quite variable across the sections and needs considerable strengthening.

The executive summary must refer to the correct section of the science portion of the report so that it is obvious to the reader where to find the supporting science. As written, it is not substantiated by the science.

While I agree with the intent of the N cascade framework—to integrate the various system components into a whole—I am unconvinced that continuing use of the term ***N cascade*** is useful to convey the importance and usefulness of a holistic N budgeting to the community outside of the relatively small community of scientists who are doing N cycling work.

The atmosphere land section of the report is one of the better substantiated portion of the report, but the section is characterized by an overreliance on unpublished and unevaluated runs CEMAQ. The section also overlooks key papers like the US N budget done by Holland et al. 2005, published in Ecological Applications. The section also overlooks a series of important studies linking N deposition/fertilization to increased NO and N_2O emissions published by Butterbach-Bahl and Papen in the European literature.

The recommendations as currently constructed are likely to result in a series of independent studies that do not make substantial progress towards solving problems on larger spatial scale. Careful thought and substantial revision of the current plan is required to ensure that the studies and integration achieve the desired environmental and policy outcomes.