CORRESPONDENCE:

# Improved modelling of soil nitrogen losses

**To the Editor** — We thank Houlton *et al.*[1] for presenting a comparison between modelled (CLM4.5) and observationally inferred (using $\delta^{15}N$) estimates of the proportion of denitrification nitrogen loss ($f_{denit}$) versus total nitrogen emissions (denitrification plus hydrological losses) in natural terrestrial ecosystems. We agree that terrestrial models must represent these losses accurately if they are to credibly estimate emissions of nitrogen- and carbon-containing greenhouse gases important in climate change predictions.

They demonstrated that CLM4.5 predicted unrealistic frequency and spatial distributions of $f_{denit}$. Our recent work with CLM4.5 (and the identical land model ALM; ref. 2) indicates that the failure in this regard is due primarily to unrealistic assumptions regarding nitrogen competition and also to poor numerical representation of advective fluxes. These models assume a sequential competitive structure: first, plants and free-living decomposing and nitrifying microbes use available soil ammonium (scaled by their relative demands); second, denitrifiers use the available nitrate; and finally hydrological processes (that is, leaching and runoff) access the (often depleted) residual nitrate. In this approach, hydrological nitrogen losses are usually unrealistically small compared with denitrification losses.

To address this problem, we modified the nitrogen competition module with the equilibrium chemistry approximation (ECA) approach[3,4] and improved the representation of leaching fluxes. ECA represents the competition between multiple substrates ($NH_4^+$ and $NO_3^-$, for example) sharing one consumer and multiple consumers (plants, decomposing microbes, denitrifiers and so on) sharing one substrate (such as $NO_3^-$). These changes improved the model comparison with the probability, latitudinal, and longitudinal distributions of $\delta^{15}N$-inferred $f_{denit}$ (Fig. 1). However, the improved model has larger spatial heterogeneity. The $\delta^{15}N$-inferred $f_{denit}$ estimates are extrapolated from observed temperature and precipitation and are sensitive to isotope effects during denitrification[5]. In contrast, modelled denitrification and hydrological nitrogen losses are primarily controlled by hydrological dynamics, soil oxygen content, and soil nutrient competition, which tend to be more heterogeneous than air temperature and precipitation.

We believe the $\delta^{15}N$-inferred $f_{denit}$ estimates produced by Houlton *et al.* are valuable benchmarks for Earth system models, and look forward to a more thorough

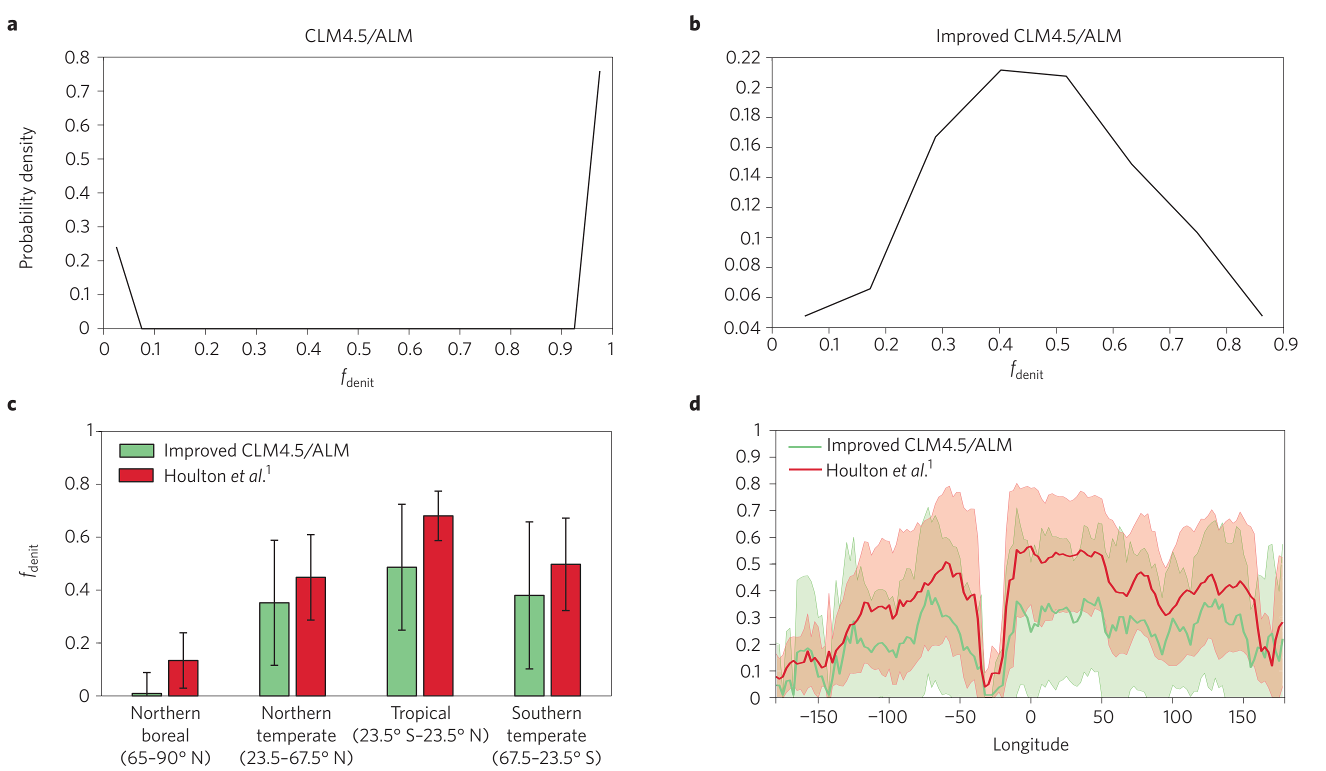


**Figure 1 |** Global pattern of $f_{denit}$. **a**,**b**, CLM4.5/ALM (**a**) and improved CLM4.5/ALM (**b**) $f_{denit}$ probability density. **c**, Latitudinal distributions of $f_{denit}$ from improved CLM4.5/ALM and the dataset used by Houlton and colleagues[1]. Error bars indicate the longitudinal variation of $f_{denit}$ within each latitudinal band. **d**, Longitudinal distribution of $f_{denit}$. Lines indicate the mean, shading represents the standard deviation.

comparison that uses the improved land models and considers uncertainty in the $\delta^{15}N$-inferred values.

References
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COMMENTARY:

# Expertise and policy-making in disaster risk reduction

Colin Walch

**The third UN World Conference on Disaster Risk Reduction ended with an agreement lacking ambition. The conference showed that better communication between the scientific community and decision-makers is needed to develop informed frameworks.**

Between March 14 and March 18, 2015, state delegates met in Sendai, Japan, and agreed on a new framework for disaster risk reduction for the years 2015–2030 (www.wcdrr.org). The Sendai Framework for Action 2015–2030 (SFA)[1] replaced the existing Hyogo Framework for Action 2004–2015. Adopted by consensus, this framework, which is not legally binding, aims to reduce the impact of natural disasters on society by providing guidance on how to better mitigate and manage natural disasters.

Given that climate change is likely to increase the frequency and intensity of a range of natural disasters[2], the conference was directly linked to the negotiations under the UN Framework Convention on Climate Change. Laurent Fabius, president of the upcoming Conference of the Parties (COP21), declared during the opening ceremony (of the World Conference on Disaster Risk Reduction) that the negotiations on disaster risk reduction and the upcoming climate change negotiations in Paris were "inseparably linked" and that "disaster risk reduction, and combating climate change should go hand in hand because the solutions are so often the very same" (http://go.nature.com/pAscBj).

The Conference, similar in form to the Rio Summit 2012, was attended by more than 6,500 accredited participants, including government representatives, UN agencies, international and local non-governmental organizations (NGOs), civil society groups, private sector representatives and scientists. Hundreds of events on disaster risk reduction were organized alongside the formal negotiations, and the United Nations International Strategy for Disaster Reduction (UNISDR) publically welcomed the participation and expertise from all of these actors.

Despite their presence, NGOs, civil society groups, and scientific experts were not allowed to participate in the formal negotiations. Diplomats would have benefited of the expertise from the scientific community and civil society groups as the delegates showed a very limited understanding of disaster risk reduction (DRR) and the broader concept of resilience during the negotiation.

Many delegates seemed most interested in promoting their national interests, suppressing wording that cemented commitments, rather than discussing the substance of the proposed framework. For example, the principle of common but differentiated responsibilities and the importance of addressing climate change in the framework created tensions between developed and developing countries. The inclusion of armed conflict and foreign occupation as underlying risk drivers to natural disasters further bogged down negotiations.

The deadlock was broken by delegates from Japan, who seemed eager to see an agreement forged in Sendai. These efforts made the text even more technical, however, suppressing mention of both conflict and foreign occupation as contributors to natural disaster risk. Previous research clearly documents links among armed conflict, displacement of people and vulnerability to natural disasters[3], although none of these findings seem to have informed decision-makers.

In general, much of the research done by the scientific community and NGOs — research that was centralized in the Global Assessment of Disaster Reduction 2015 (GAR)[4], and presented at the conference specifically to inform decision-makers — was widely neglected in the final agreement. As a result, the Sendai Framework lacks scientific substance, contains many loosely conceptualized targets, and poorly represents the amount of research presented during the conference.

These formal negotiations were closed to both the public and conference participants,