**Interactive comment on “Effects of global change during the 21st century on the nitrogen cycle” by D. Fowler et al.**

**Anonymous Referee #2**

Received and published: 4 April 2015

This paper is a comprehensive review of the nitrogen cycle, its future changes and policy implications. It is challenging to address some many topics in a single paper, but the authors manage to incorporate substantial amount of information in the manuscript. I am in favor of its publication. However, there are some important issues that need to be addressed as listed below.

**Major issues:**

1. **Structure.**
   
   This paper is not well structured and balanced which undermines its importance. The introduction is rather short and doesn’t give a clear overview of the whole nitrogen cycle. Then it immediate follows by sections describing individual processes, in which different structures have been adopted. For example, in the section of marine nitrogen fixation, its influencing factors have been intensive discussed (in several sub-sections) which is not the case in the terrestrial nitrogen fixation section. Overall, I found the figures are easier to understand than the texts. I agree with Referee #1 that substantial editorial work is needed to compile and synthesize work from individual contributors.

2. **Policy implications.**

   This paper is a contribution to the special issue "Atmospheric composition change: science for policy". If that’s the main purpose, this review can be to shortened to a large extent. Processes of less importance and larger uncertainties can be summarized into a single section without detailed discussions.

3. **Missing processes.**

   With regard to the exchange of molecular and reactive nitrogen between the atmosphere and terrestrial surfaces, the review should not miss to address recent findings indicating that cryptogamic covers on ground and plant surfaces may account for as much as half of the biological nitrogen fixation on land (Elbert et al. 2012; Porada et al., 2014) and that nitrous acid (HONO) can be reversibly deposited and emitted in large quantities comparable nitrogen oxide (NO) (Su et al. 2011; Kulmala and Petäjä 2011; Oswald et al. 2013; Maljanen et al. 2013; Donaldson et al. 2014; VandenBoer et al. 2015)."

**Other comments:**

Abstract: p1749 line 3, what is the meaning of “input of reactive nitrogen from human activities”, NOx emission or nitrogen fixation?

Introduction: p1750 line 13, I would suggest including an introduction to the nitrogen cycle and relevant processes in the beginning.

p1750 line 14, it is better to first explain what’s reactive nitrogen for policy makers.
The negative effects of human N... Biological nitrogen fixation (BNF) is currently estimated to provide a global annual input of approximately..., a reference is missing.

Q10 should be defined before use.

why not adopt the same structure for terrestrial N fixation

... providing a strong negative feedback to increases in atmospheric CO2, please explain what's the negative feedback

is combustion related emissions considered as fixation or emissions?

"kg", g should be a subscript

use either parentheses or brackets for NH3 and NHsw, the meaning of "sw" should be explained.

use either "exp" (Eq. 2) or "e" throughout the manuscript.

the global NH3 emission should be "that the global ocean NH3 emission"

why discuss denitrification in the nitrification section?

References:


Interactive comment on Atmos. Chem. Phys. Discuss., 15, 1747, 2015.