

## ***Interactive comment on “Site selective real-time measurements of atmospheric N<sub>2</sub>O isotopomers by laser spectroscopy” by J. Mohn et al.***

**Anonymous Referee #2**

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General comments:

This manuscript presents a novel and highly interesting technique to analyze with high precision in real-time and under field conditions the site-specific isotopic composition of the greenhouse gas N<sub>2</sub>O at ambient mixing ratios. Information about site-specific isotopic composition of N<sub>2</sub>O is a valuable tool to improve the mechanistic understanding of soil microbial processes underlying the N<sub>2</sub>O exchange between soil surface and atmosphere. The novel technique is based on a coupling of a mid-infrared quantum cascade laser with an automated and liquid nitrogen-free pre-concentration device. The authors, furthermore, present convincing results of a field application of this novel technique at a grassland site over three weeks of continuous measurement. From my point of view the analytical technique and the results as presented in the manuscript

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are of great interest to a broad readership of ATM and ready to be published. However, the discussion of the results in its current form is too simplistic and requires reconsideration in a couple of points (see specific comments).

Specific comments:

Page 824, lines 4-9: The authors assume for the inorganic soil nitrogen pool, which may serve as substrate for the microbial N<sub>2</sub>O formation, a  $\delta^{15}\text{N}$  value of 5‰ and refer to one reference from the literature (Makarov et al., 2010). However, from the literature there is ample evidence available that soil nitrate and ammonium  $\delta^{15}\text{N}$  values are highly variable in time and space and thus, cannot be simplified ascribed with one  $\delta^{15}\text{N}$  value of 5‰. E.g. Durka et al. (1994, Nature 373: 765-767) found for nitrate from forest soils a range of  $\delta^{15}\text{N}$  values from -6 to +6‰. Wrage et al. (2004, Rapid Commun. Mass Spectrom. 18: 1201-1207) found even a wider range for nitrate  $\delta^{15}\text{N}$  values from grassland soils spanning from about -20 to +5‰. Thus, I urgently recommend a more careful consideration of the potential variability of  $\delta^{15}\text{N}$  values in the soil inorganic nitrogen pool when calculating net isotope effects.

Page 824, lines 11-16: Microbial denitrification and nitrification are widely considered as processes involved in soil N<sub>2</sub>O emission, though nitrification has already been shown to be probably of very minor importance under natural conditions (see Tilsner et al. (2003) Biogeochemistry 63: 249-267 and Wrage et al. (2004) Rapid Commun. Mass Spectrom. 18: 1201-1207). Of probably much greater importance for soil N<sub>2</sub>O emissions than nitrification is a microbial process that came just since recently in a major focus, namely nitrifier denitrification (see e.g. Wrage et al. (2001) Soil Biol. Biochem. 33: 1723-1732 and Kool et al. (2011) Soil Biol. Biochem. 43: 174-178). I recommend considering the latter process in the manuscript.

Page 825, lines 9-13: Please note that N<sub>2</sub>O consumption in soils is not only driven by soil nitrate availability, but also by soil water content (Goldberg & Gebauer (2009) Global Change Biology 15: 850-860) and soil temperature regime (Goldberg et al.

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(2010) Biogeochemistry 97: 21-30). These aspects should be discussed.

Technical corrections:

I have no suggestions for any technical corrections. The manuscript is formally prepared in a perfect manner.

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