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Methane fluxes from a wet puna ecosystem in the Peruvian Andes

Sam Jones (1), Torsten Diem (2), Lidia Priscila Huaraca Quispe (3), Adan Julian Quispe Ccahuana (3), Patrick Meir (1,4), Yit Arn Teh (2,5)

(1) School of Geosciences, University of Edinburgh, Edinburgh, United Kingdom, (2) School of Geography and Geosciences, University of St Andrews, St Andrews, United Kingdom, (3) Universidad Nacional de San Antonio Abad del Cusco, Cusco, Peru, (4) Research School of Biology, Australian National University, Canberra, Australia, (5) Institute of Biological and Environmental Sciences, University of Aberdeen, United Kingdom

Discrepancies exist between top-down and bottom-up estimates of the tropical South American atmospheric methane budget. This suggests that current source-sink inventories fail to adequately characterise the landscapes of the region. This may be particularly true of Andean environments where very few field observations have been made. The high tropical Andes, between tree and permanent snow-lines, is home to diverse grass, shrub and giant rosette dominated ecosystems known variously from Venezuela to northern Chile and Argentina as paramo, jalca and puna. In humid regions these are characterised by wet, organic-rich mineral soils, peat-forming wetlands and shallow lakes. Such conditions are likely to promote methane production and potentially represent a regionally significant source to the atmosphere that should be considered.

We report on methane fluxes from a bunch-grass dominated puna habitat at 3500 m above sea level in south-eastern Peru. Mean annual temperature and precipitation are 11 °C and 2500 mm, respectively. Temperature is aseasonal but experiences considerable diurnal variations with overnight frosting common-place. In contrast, rainfall is intensely episodic and has a pronounced wet season between September and March. Sampling encompassed a range of topographic features, such as grassland on freely draining, gently inclined or steep slopes and depressions containing bogs, over a 3 ha ridge to basin transition. Monthly sampling was carried out between January 2011 and June 2013 to investigate seasonal variability in methane fluxes. Intensive sampling campaigns were conducted to investigate spatial and short-term variations on a daily basis in two nine-day campaigns during wet and dry season.

The site was a net source of methane to the atmosphere during the period of study. Methane fluxes were dominated by emissions from bogs, whereas, freely draining grassland exhibited weak source or marginal sink activity. Temporal variations were most notable at the seasonal scale with fluxes during the wet season almost an order of magnitude greater than those of the dry season. Mean emissions from bogs during wet and dry season were 85.0 (15.0) and 10.0 (2.0) mg C-CH_4 m^{-2} d^{-1}, respectively. Similarly, mean fluxes in the grassland were 0.4 (0.7) and -0.05 (0.6) mg C-CH_4 m^{-2} d^{-1}. These data highlight the importance of considering such Andean highlands in landscape scale source-sink inventories. In this respect, understanding the influence of differences in climatic regime found across the Andes and determining the areal extent of topographic hotspots driving methane emissions within these environments are key challenges.