MEASUREMENT AND SIMULATION OF N_2O EMISSIONS IN TWO TILLAGE MANAGEMENT SYSTEMS

ECOS2016_0969

Fidel Maureira[a], Claudio Stockle[a], Tina Karimi[a], Sarah Waldo[b], Kirrill Kostyanovsky[c], David Huggins[cd], Brian Lamb[b]

[a]Department of Biological Systems Engineering, Washington State University (WSU), Pullman, WA; [b]Laboratory for Atmospheric Research, Department of Civil and Environmental Engineering, WSU; [c]Department of Crop and Soil Sciences, WSU; [d]USDA Agricultural Research Service Land Management and Water Conservation Research Unit, Pullman, WA USA

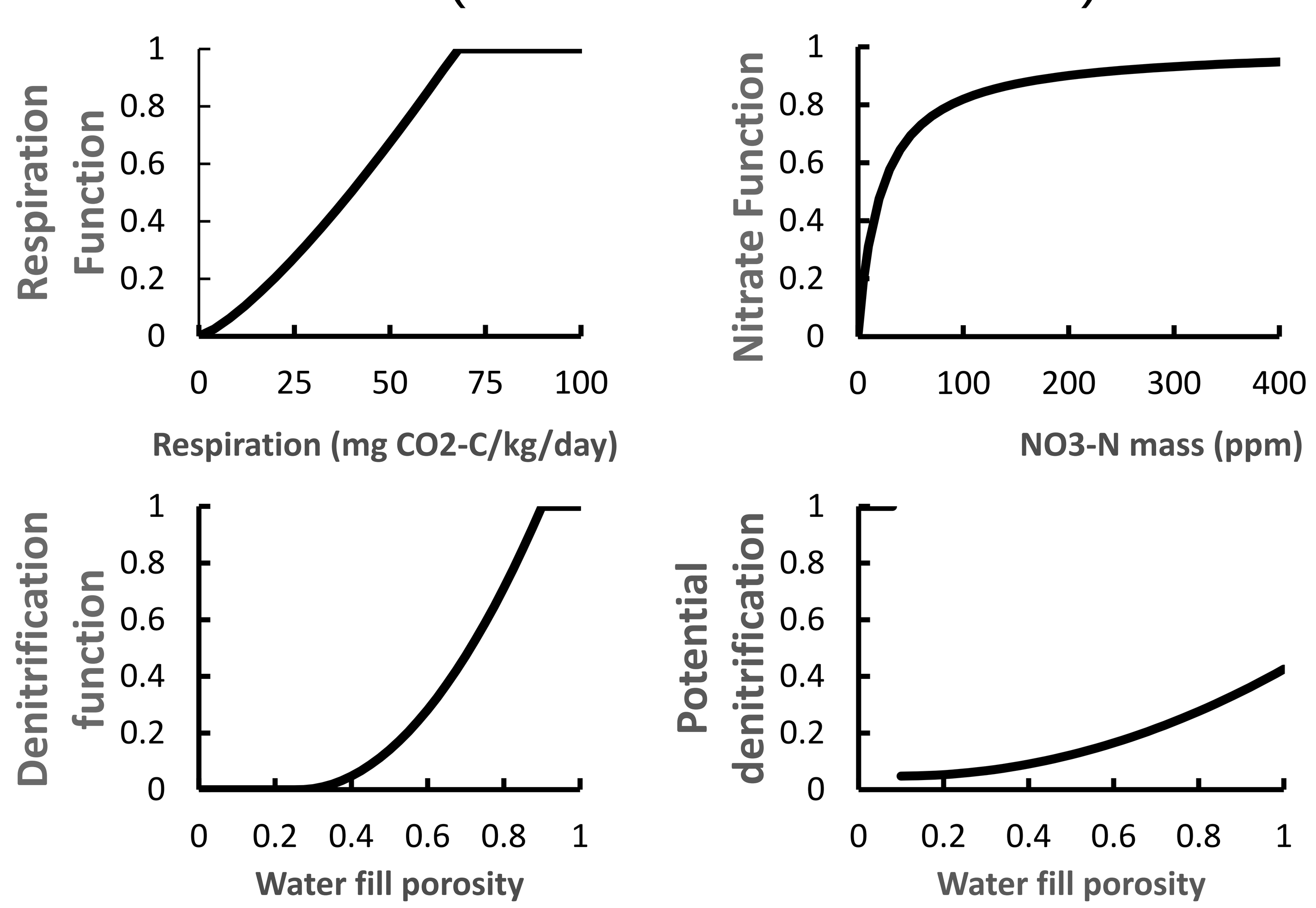
WASHINGTON STATE UNIVERSITY

INTRODUCTION

The atmospheric concentration of N_2O in 2011 was 1.5 times that of pre-industrial levels. In the US, N_2O accounts for 70% of greenhouse gas emissions from agricultural soil. N_2O is produced by soil microbial processes characterized by high spatial and temporal variability. The biggest challenge in characterizing and simulating emissions at the field scale are limited continuous N_2O instrumentation and limited knowledge of conditions that produce N_2O.

DRIVING FACTORS

Simulated N_2O is driven by soil carbon and nitrogen availability, temperature, and moisture. A sensitivity analysis was conducted considering 3 parameters affecting soil moisture response (alpha) and potential denitrification (scale and maximum rate).



ACKNOWLEDGEMENTS

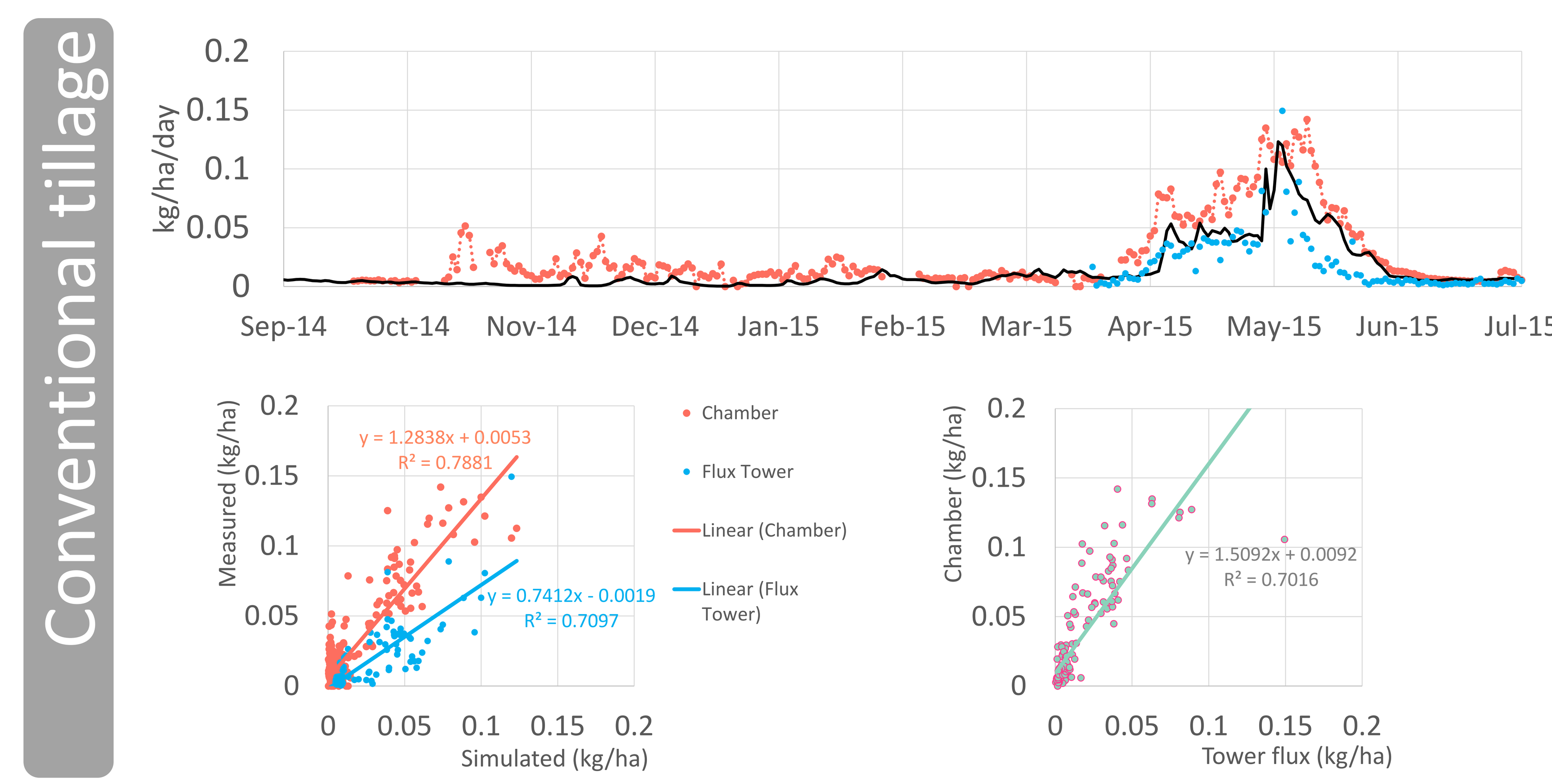
The REACCH portion of this work has been supported by the US Dept of Agriculture (grant no: BJKL03SB002. Approaches to climate change for inland Pacific Northwest Agriculture). The Cropsyst portion of this work s been supported by the US Dept of Agriculture (grant no: 20116700330341. Site-specific climate friendly farming). We would also like to acknowledge Erin Brook and Matt Yourek for the great help given.

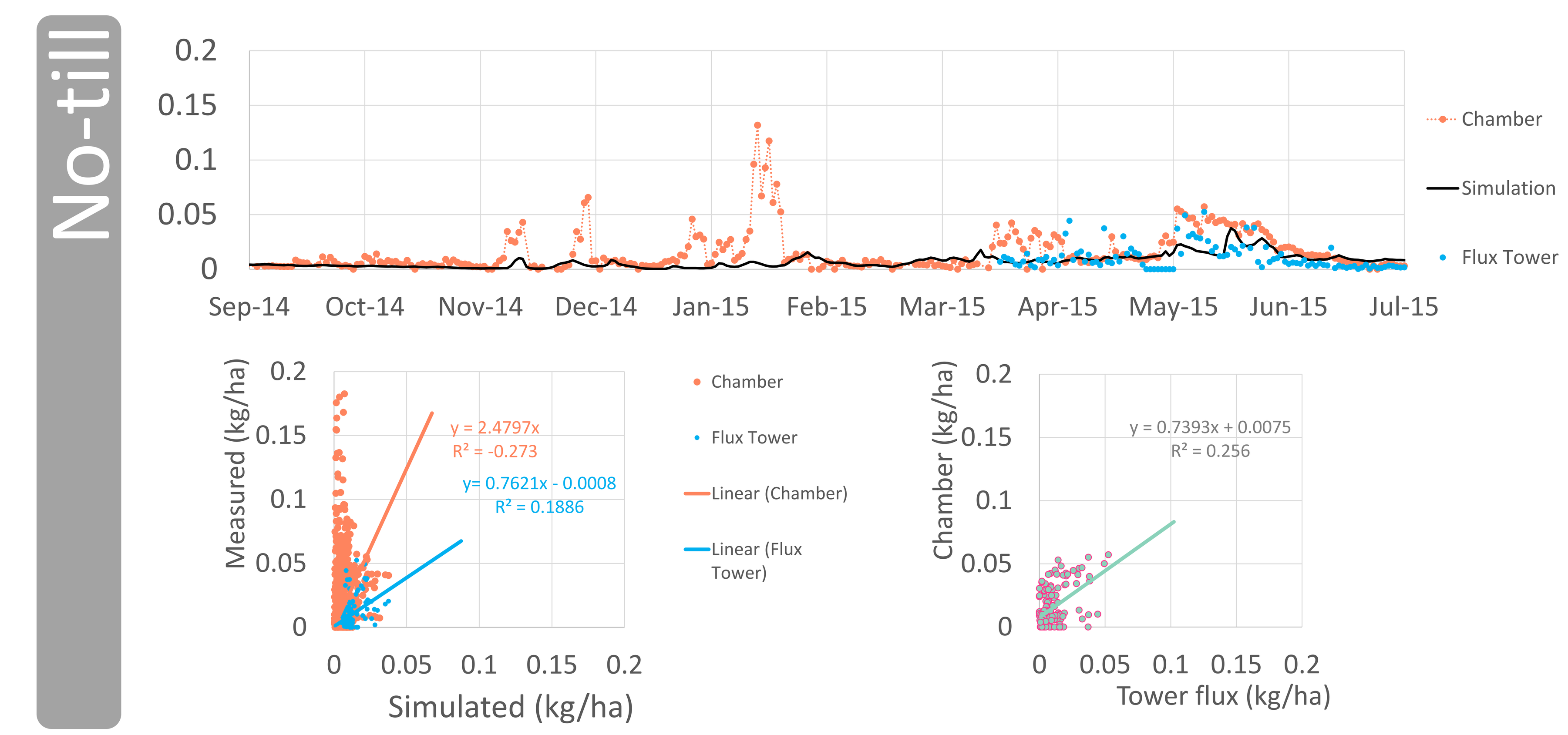
MODEL EVALUATION

Simulation was conducted with the CropSyst model, which is a crop growth model that has been used for a wide range of crops and weather conditions. N_2O emissions are simulated from two different processes, denitrification and nitrification.

We observed and simulated two sites located in a dryland production zone (annual 9°C mean temperature and precipitation of 550mm) of the US Pacific Northwest. The sites were managed under no-tillage (NT) and conventional tillage (CT) practices. Both sites had crop rotations of chickpea, winter wheat and spring canola. Spring canola was grown in both site during season of 2015. N_2O measurements were collected continually at each site with a set of 16 automatic chambers (CH; 2014-2015) and an eddy covariance tower flux (TF; began in April 2015).

RESULTS: Measured and simulated





The CT site simulation showed a mean annual emission of 3.54 kgN ha^{-1}. Over simulated and TF measurement, Nash-Sutcliffe efficiency (E) was 0.48 and RMSE=0.015 kgN ha^{-1} day^{-1}. On chamber measurement E=0.65 and RMSE=0.017 kgN ha^{-1} day^{-1}. The NT simulation had a mean annual emission of 2.01 kgN ha^{-1}. E=0.1 and RMSE= 0.01 kgN ha^{-1} day^{-1}. For TF E<0, RMSE=0.038 kgN ha^{-1} day^{-1} for chamber data. For the NT, chamber measurements were not correlated with TF. However, in CT site, chamber correlated strongly with TF and R^2=0.7. Cumulative simulation of CT showed consistently 1.5 kgN ha^{-1} $year^{-1}$ more emission over NT in the period 2011-2015.

Facts (kg/ha)

	Period	TF	Chamber	Sim
NT	spring 2015	1.21	2.23	1.47
CT	spring 2015	2.08	4.6	3.15

	NT		CT	
Year	Chamber	Sim	Chamber	Sim
2013	1.12	0.62	-	-
2014	11.96	1.34	1.14	0.22
2015	3.66	1.89	5.69	3.83

Cumulative emissions over days with data

CONCLUSIONS

CropSyst was able to capture N_2O dynamics and daily rates of emission for dryland production. However long-term simulations are needed to assess possible differences in tillage management systems.