Importance of dissolved greenhouse gases leached from soil:

insights from the lysimeter network TERENO SoilCan

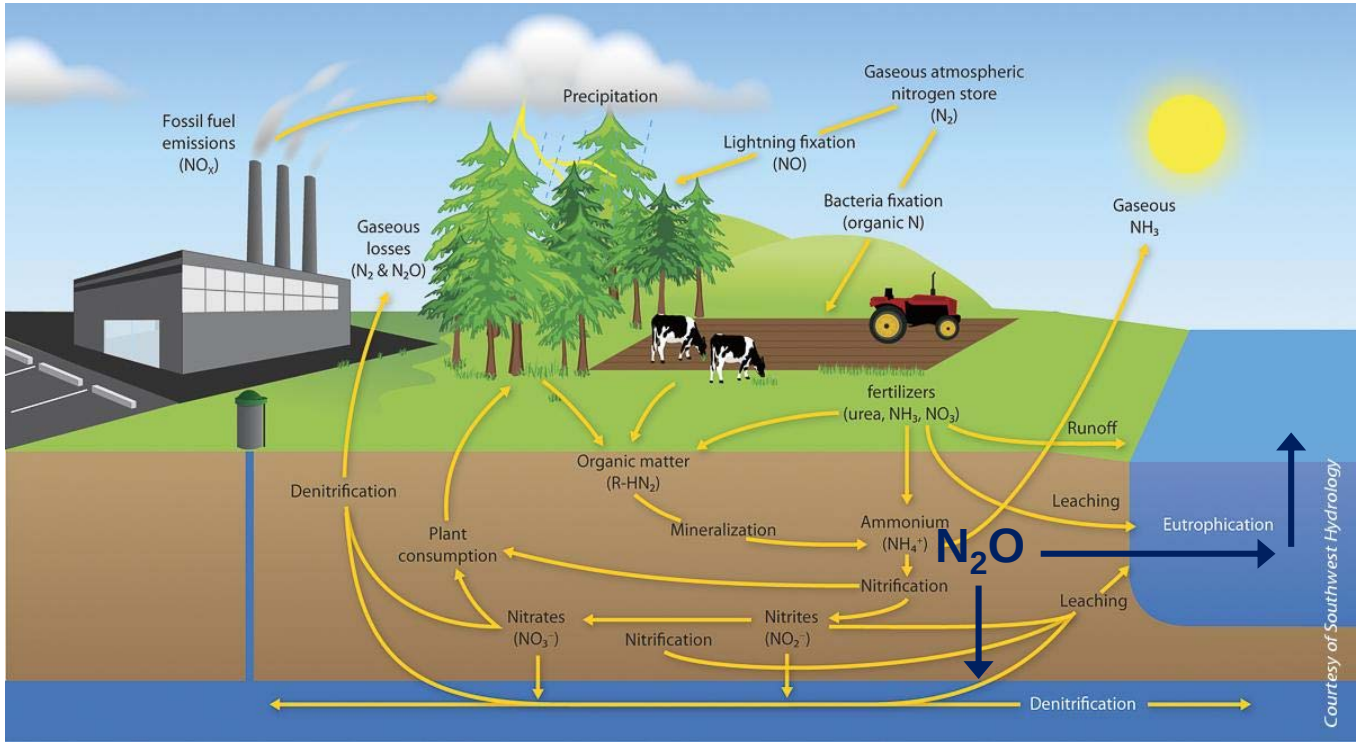
Daniel Weymann, Nicolas Brüggemann, Thomas Pütz, and Harry Vereecken
Agrosphere Institute (IBG-3) | Forschungszentrum Jülich

Background & Rationale

soil solution acts as…

- source and sink
- storage medium
- diffusion barrier
- transport medium

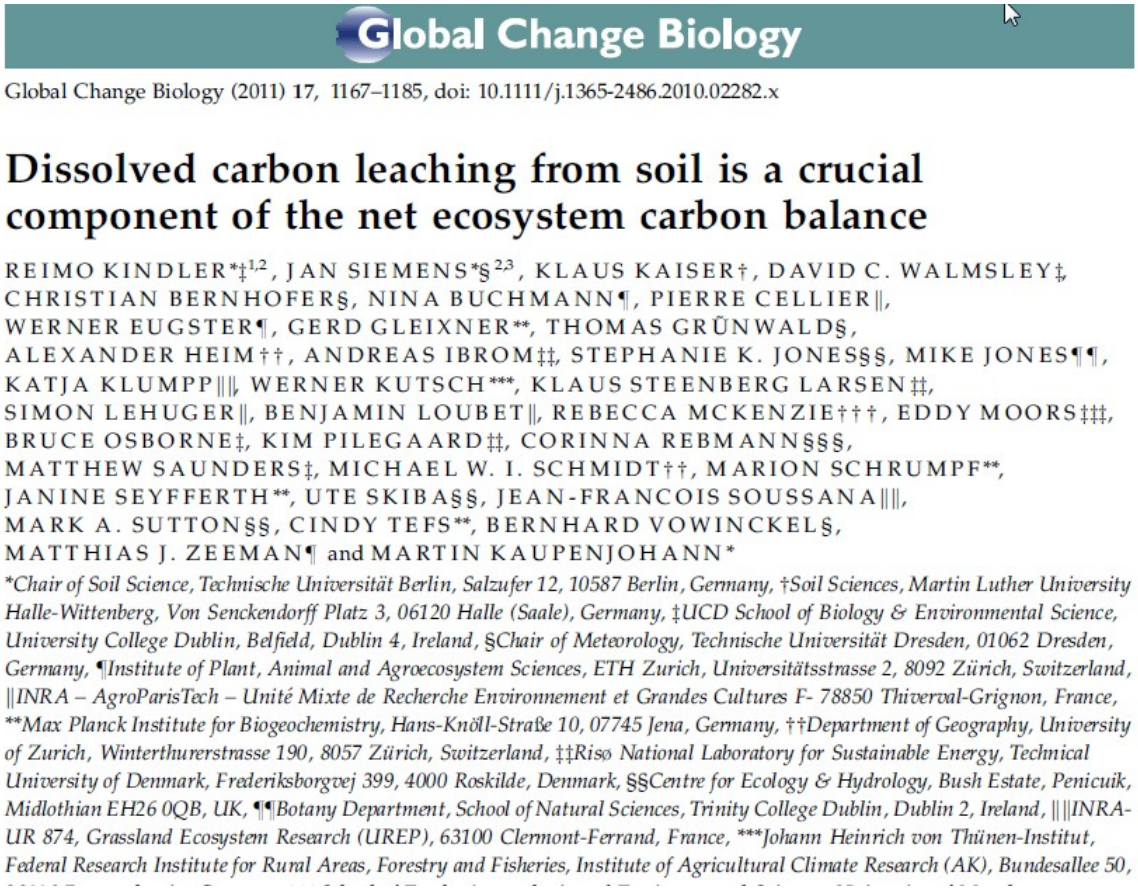
…for dissolved GHGs



Rosenstock et al. (2013)

Implications for GHG budgets?

- Janssens et al. (2003): systematic difference between „top down“ and „bottom up“ estimates of carbon sequestration
- Siemens (2003): leached DOC and DIC can well explain this gap



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Dissolved carbon leaching from soil is a crucial component of the net ecosystem carbon balance

REIMO KINDLER*‡[1,2], JAN SIEMENS*§[2,3], KLAUS KAISER†, DAVID C. WALMSLEY‡, CHRISTIAN BERNHOFER§, NINA BUCHMANN¶, PIERRE CELLIER‖, WERNER EUGSTER¶, GERD GLEIXNER**, THOMAS GRÜNWALD§, ALEXANDER HEIM††, ANDREAS IBROM‡‡, STEPHANIE K. JONES§§, MIKE JONES¶¶, KATJA KLUMPP‖‖, WERNER KUTSCH***, KLAUS STEENBERG LARSEN‡‡, SIMON LEHUGER‖, BENJAMIN LOUBET‖, REBECCA MCKENZIE†††, EDDY MOORS‡‡‡, BRUCE OSBORNE‡, KIM PILEGAARD‡‡, CORINNA REBMANN§§§, MATTHEW SAUNDERS‡, MICHAEL W. I. SCHMIDT††, MARION SCHRUMPF**, JANINE SEYFFERTH**, UTE SKIBA§§, JEAN-FRANCOIS SOUSSANA‖‖‖, MARK A. SUTTON§§, CINDY TEFS**, BERNHARD VOWINCKEL§, MATTHIAS J. ZEEMAN¶ and MARTIN KAUPENJOHANN*

*Chair of Soil Science, Technische Universität Berlin, Salzufer 12, 10587 Berlin, Germany, †Soil Sciences, Martin Luther University Halle-Wittenberg, Von Seckendorff Platz 3, 06120 Halle (Saale), Germany, ‡UCD School of Biology & Environmental Science, University College Dublin, Belfield, Dublin 4, Ireland, §Chair of Meteorology, Technische Universität Dresden, 01062 Dresden, Germany, ¶Institute of Plant, Animal and Agroecosystem Sciences, ETH Zurich, Universitätsstrasse 2, 8092 Zürich, Switzerland, ‖INRA – AgroParisTech – Unité Mixte de Recherche Environnement et Grandes Cultures F- 78850 Thiverval-Grignon, France, **Max Planck Institute for Biogeochemistry, Hans-Knöll-Straße 10, 07745 Jena, Germany, ††Department of Geography, University of Zurich, Winterthurerstrasse 190, 8057 Zürich, Switzerland, ‡‡Risø National Laboratory for Sustainable Energy, Technical University of Denmark, Frederiksborgvej 399, 4000 Roskilde, Denmark, §§Centre for Ecology & Hydrology, Bush Estate, Penicuik, Midlothian EH26 0QB, UK, ¶¶Botany Department, School of Natural Sciences, Trinity College Dublin, Dublin 2, Ireland, ‖‖‖INRA-UR 874, Grassland Ecosystem Research (UREP), 63100 Clermont-Ferrand, France, ***Johann Heinrich von Thünen-Institut, Federal Research Institute for Rural Areas, Forestry and Fisheries, Institute of Agricultural Climate Research (AK), Bundesallee 50,

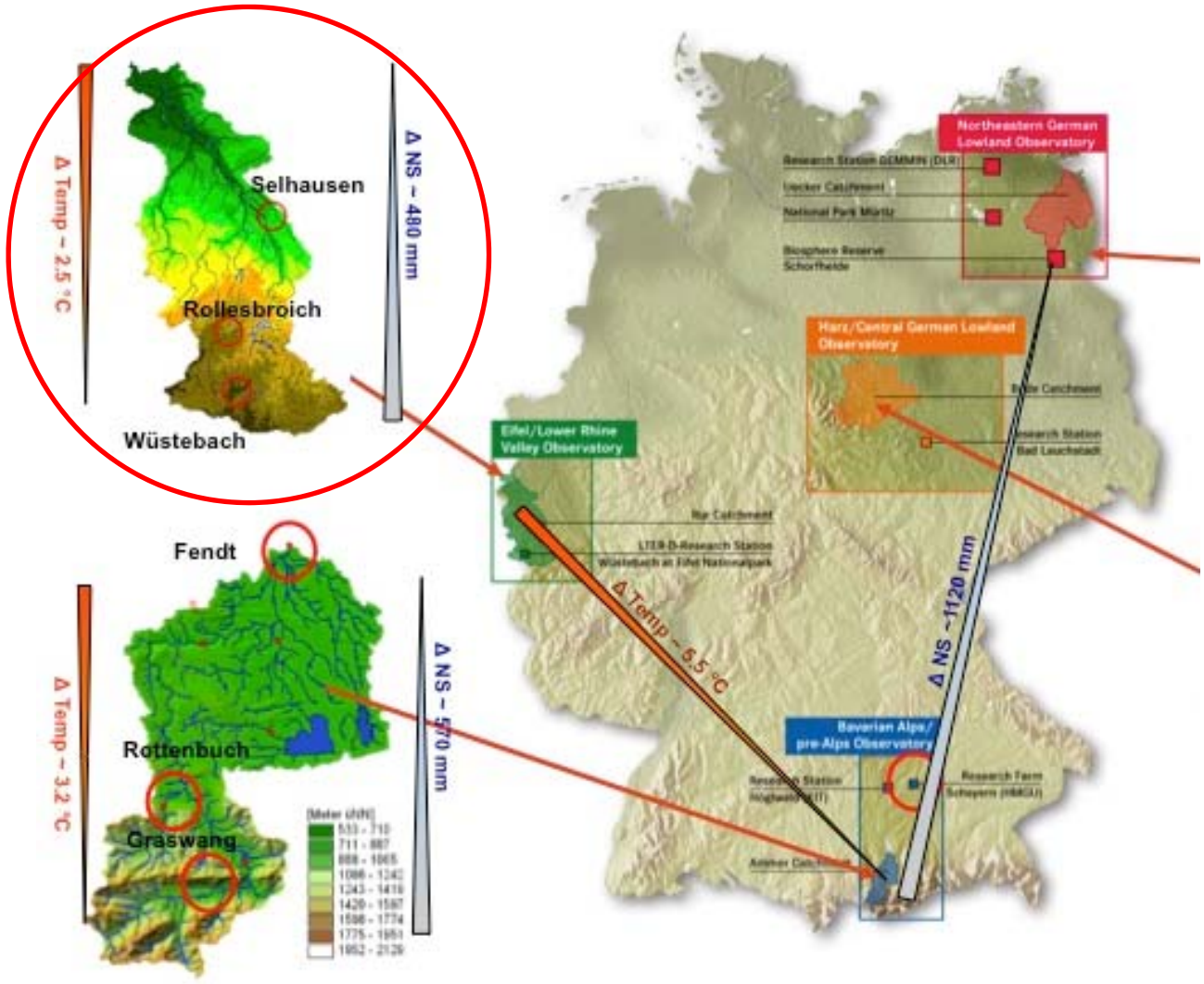
Kindler et al. (2011)

Objectives

- Implement a sampling method for GHGs dissolved in soil solution and seepage into an existing lysimeter network (TERENO-SoilCan)
- weekly monitoring of three major ecosystem types with respect to dissolved GHGs accompanied by measurements with closed chambers (gaseous GHG losses)
- Assess the importance of leaching losses in the light of gaseous GHG fluxes and finally for the GHG budget

Research Infrastructure:

TERENO-SoilCan Lysimeters of the Eifel/Lower Rhine Valley Observatory



Grassland

- ~ 500 m asl
- 1150 mm, 7.5 °C
- sandy loam
- Cambisols, Stagnosols

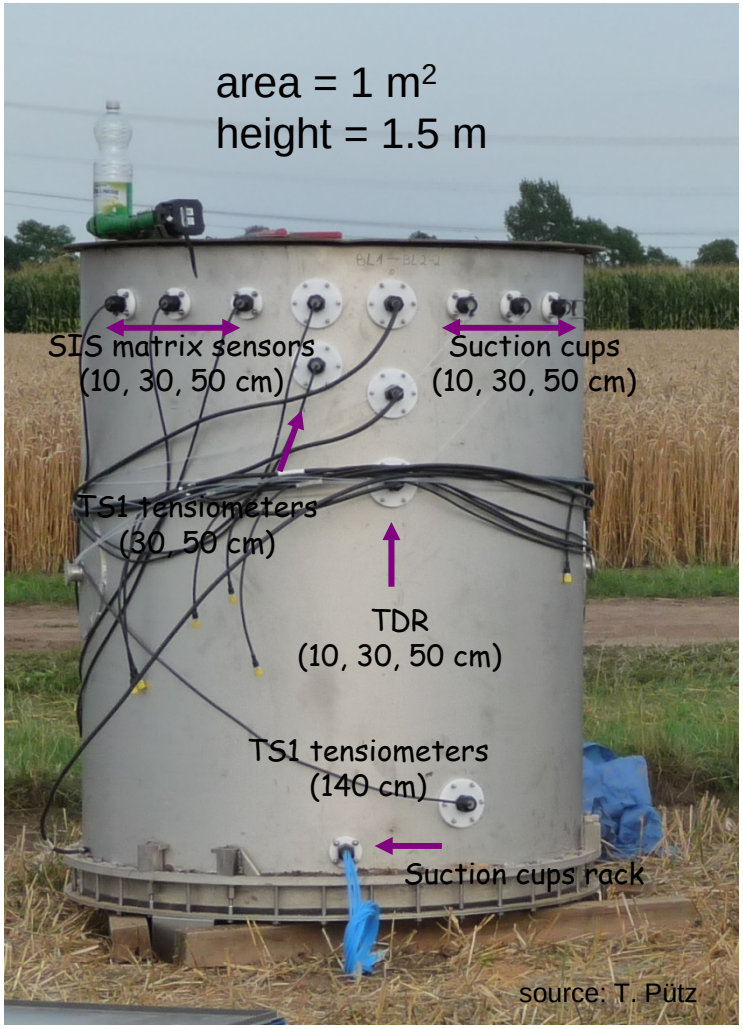
Forest

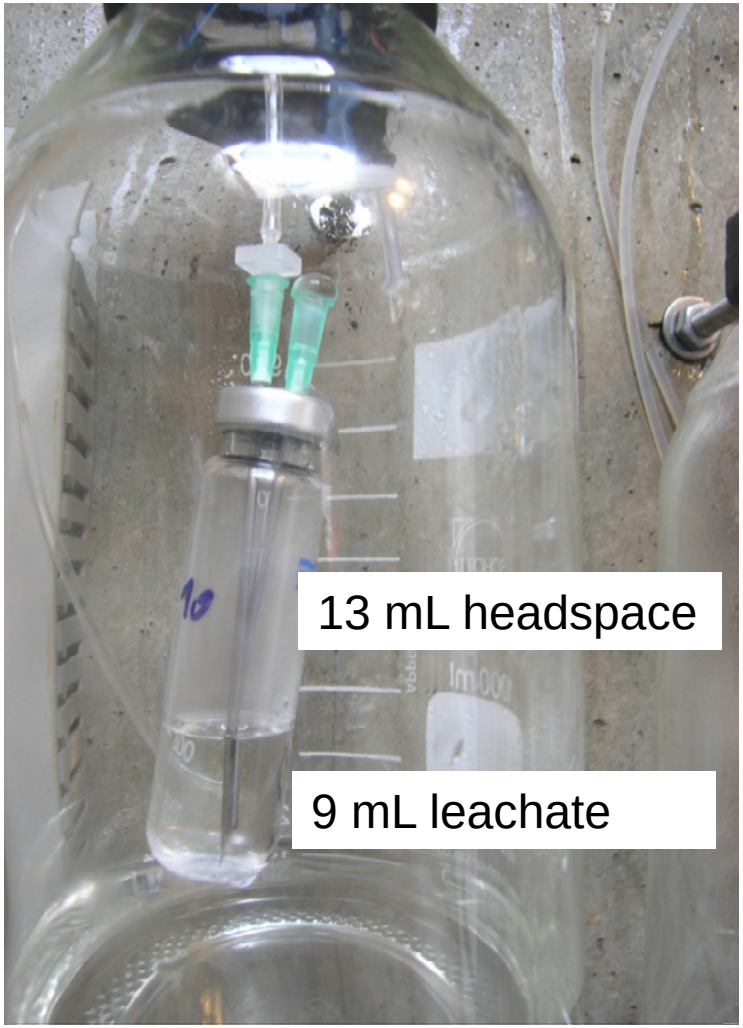
- ~ 600 m asl
- 1220 mm, 7.0°C
- loamy silt
- Cambisols

Arable land

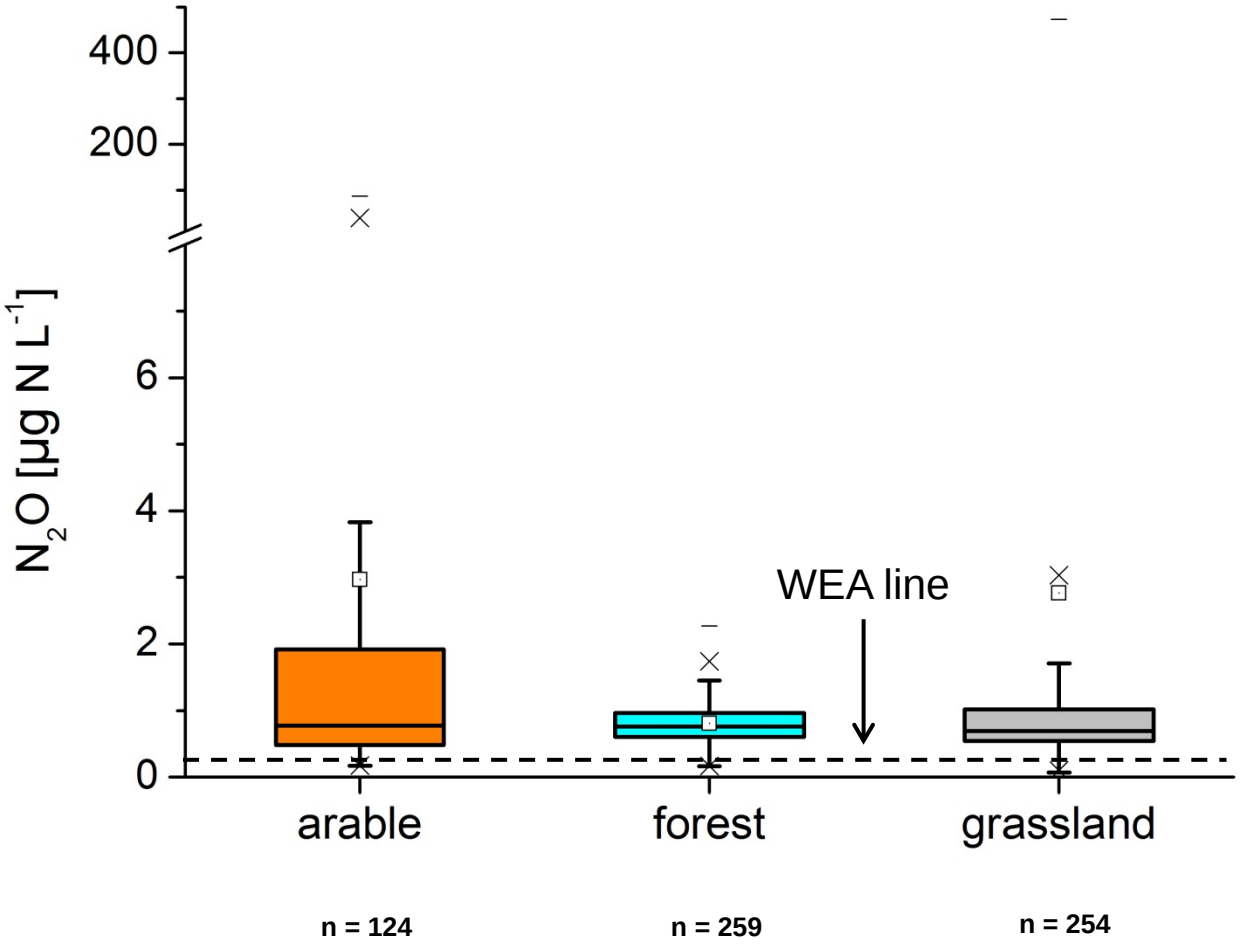
- ~ 100 m asl
- 700 mm, 10 °C
- silty clay loam
- gleyic Cambisols, Luvisols

Lysimeter Instrumentation

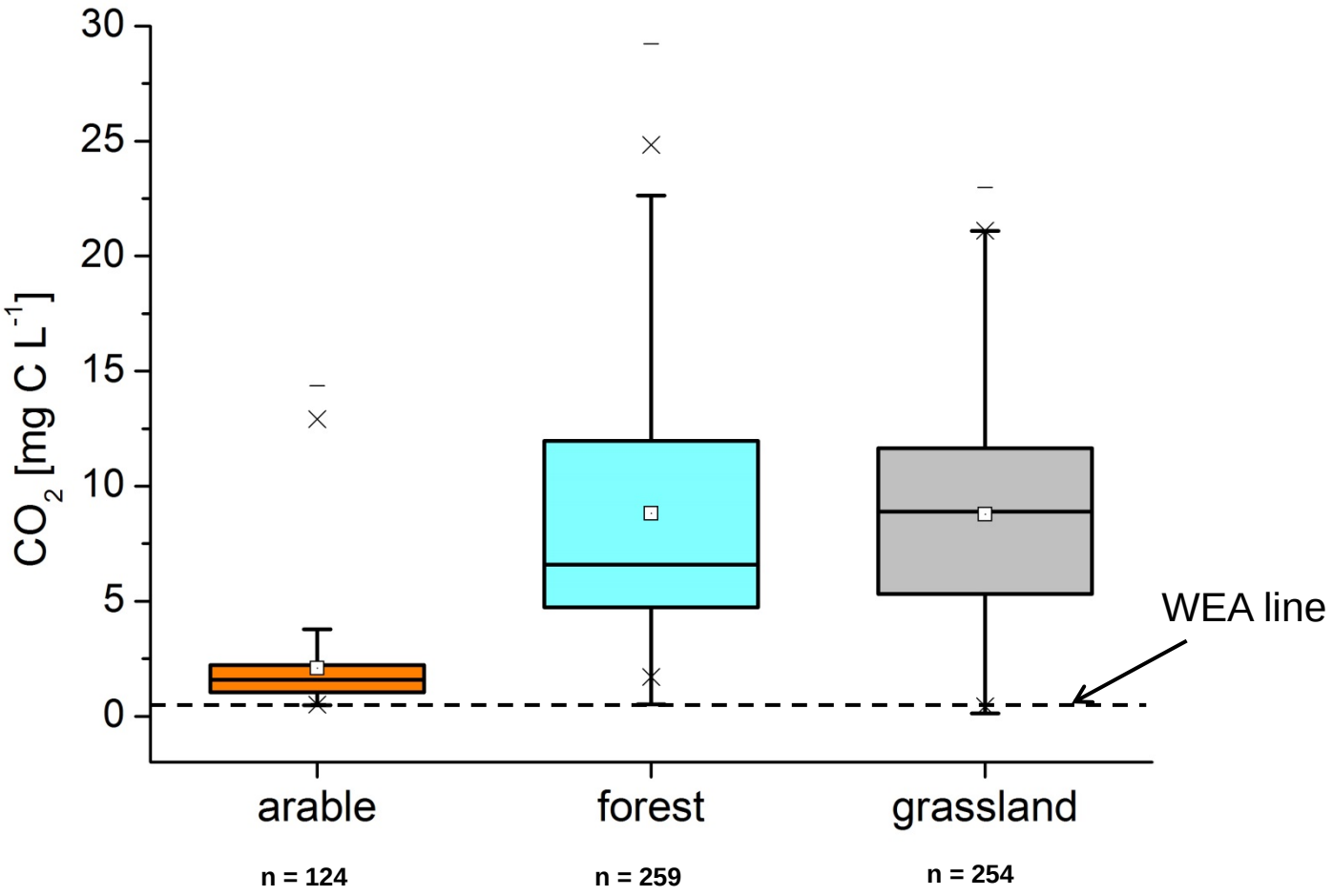




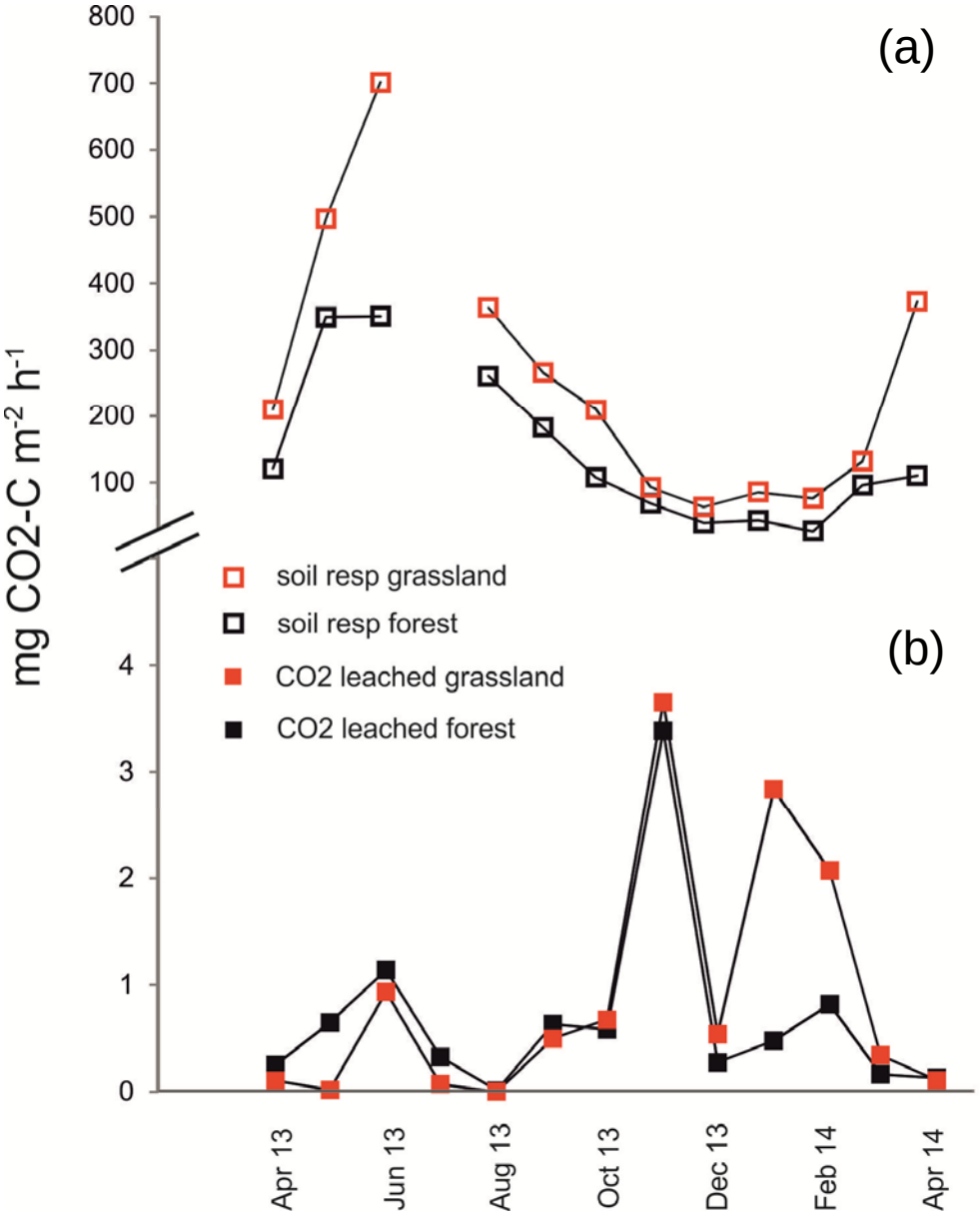
Dissolved N_2O concentrations



Dissolved CO_2 concentrations



Soil respiration (a) vs leached CO_2 (b) (monthly averaged)



- leaching losses are small compared to gaseous soil repiratory CO_2 flux
- soil respiration is determined by soil temperature, but leached CO_2 clearly by the drainage volume

Dissolved Inorganic Carbon leaching [g m^{-2} yr^{-1}]

	forest	grassland	cropland
CarboEurope sites (DIC) (Kindler et al. 2011)	8.3	24.1	14.6
this study (dissolved CO_2, CO_3-C analysis is in progress)	6.8	8.8	2.3

- Carbonate-C analysis has started and will have implications considering the leaching losses from the cropland soils
- dry weather conditions during the first measuring period → need to assess interannual variability

Conclusions & Outlook

- simple and reliable headspace method for dissolved gas measurements
- Leaching losses strongly depend on the drainage volume and become increasingly important under wet climatic conditions
- Importance of leaching losses is based upon the overall NEE/NECB/GHG budget
- Considering EC data of the grassland site will enable to compile a „really“ full GHG balance
- Measurements are in progress to investigate interannual and long-term variability

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TERENO
TERRESTRIAL ENVIRONMENTAL OBSERVATORIES

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W. Küpper
L. Fürst
F. Engels
R. Harms
C. Küppers
J. Groh

Contact:

d.weymann@fz-juelich.de

Dissolved CO_2 vs DOC (monthly averaged)