Project Number 282910

ÉCLAIRE

Effects of Climate Change on Air Pollution Impacts and Response Strategies for European Ecosystems

Seventh Framework Programme

Theme: Environment

D6.2 Improved terrestrial (semi)natural and agricultural emissions Type "other"

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Start Date of Project: **01/10/2011** Duration: **48 months**

Organisation name of lead contractor for this deliverable :
KIT

Project co-funded by the European Commission within the Seventh Framework Programme		
Dissemination Level		
PU	Public	☐
PP	Restricted to other programme participants (including the Commission Services)	☒
RE	Restricted to a group specified by the consortium (including the Commission Services)	☐
CO	Confidential, only for members of the consortium (including the Commission Services)	☐

1. Executive Summary

CNRS revised the biogenic emission module implemented in the global vegetation model ORCHIDEE. The biogenic VOC emission module was updated considering state of the art emission schemes and the most recent field and satellite measurements. In particular, CNRS focused on re-examining all the emission factors (EF), a significant source of uncertainty in the quantification of biogenic emissions, evaluated if and which other processes had to be included in the emissions calculation (i.e light dependency, leaf age activity factor) and added new BVOC chemical species that were not yet included in ORCHIDEE.
The impact of implemented changes was tested performing two simulations using the new and old version of the emission scheme and comparing the results to the MEGAN-MACC biogenic emission inventory. Significant changes were observed for methanol emissions, while differences for other chemicals emissions showed up mostly in their spatial distributions.

ULUND/KIT (Eclaire contribution to ULUND was moved to KIT, due to move of PI) improved the representation of vegetation dynamics in LPJ-GUESS by using European specific PFTs and adding new species. Emission capacities for the PFTs were updated to latest published data. All changes were also included in the latest version of the model that accounts for coupled C-N interactions. Simulations were performed for original global PFTs, new European PFTs, and the C-N version of the model. Significant differences arise when the European PFTs are used, both for Isoprene and Monoterpene emissions. Differences in spatial distributions of Monoterpene emissions are evident when the coupled C-N version is used.

AU/ALTERRA estimated ammonia emissions with a new improved version of the Danish Dynamical Ammonia Emission Model that can describe the emission of ammonia from agricultural sources as a function of e.g. temperature for an area covering Europe. The module can either be run off-line with the necessary input of meteorological data or it can be included directly in Chemistry Transport Models (CTM) and Chemistry Climate Models (CCM), whereby the emissions are calculated on-line in accordance with the meteorological parameters in the CTM/CCM models.
AU studied offline the sensitivity of ammonia emissions to climatic factors, handling necessary meteorological drivers and bias correction on combined MM5 and ENSEMBLES project climate data. The model application for ECLAIRE led to a spatial extension of the model domain and combining the required input data from various data sources. Results showed that climate and climate change cause considerable variations in ammonia emissions.

KIT developed a new biogeochemical process module within LandscapeDNDC including advanced process descriptions of the soil organic matter decomposition, nitrification, denitrification and chemodenitrification. The model was applied for the simulation of NO fluxes at ten different forest stands within a large latitudinal range representing boreal, temperate and Mediterranean climatic conditions across Europe. In addition but limited by observation data availability, several arable and two grasslands ecosystems under different management practices were evaluated. Daily climate data for model driving as well as NO flux observations were obtained from NORFRETETE and NITROEUROPE databases.

Details on the individual contributions can be found in the attached documents, which describe the model improvements and show example results. In case of partner ULUND (now KIT), description and simulations are part of Deliverable 3.4.

Objectives:

This deliverable relates specifically to the objective 1 of WP6

1. To quantify how trace gas emissions from natural, semi-natural, and agricultural ecosystems vary in response to interactions of weather and climate, atmospheric CO2 burden and N deposition, vegetation and soil carbon and nitrogen dynamics, and land use/land cover change.

2. Activities:

- Revision of the ORCHIDEE biogenic emission module focusing on emission factors, model application and provision of BVOC emission data, comparison of results with MAEGAN-MACC.
- Improvement of species representation, use of C-N interactions and updating of emission capacities in LPJ-GUESS, model application and provision of BVOC emission data, intercomparison of original and new versions.
- Sensitivity analysis of new Danish Dynamical Emission Model to climate data, including model-data coupling developments and model's geographical extension, model application and provision of ammonia emission data.
- Development of a new soil biogeochemical model for terrestrial ecosystems NO fluxes, integration to LandscaleDNDC mode and validation vs limited observation data.

3. Milestones achieved:

MS26 First improved emission estimates, based on model development
MS27 Improved emission estimates, evaluated against ÉCLAIRE results

4. Publications:

Skjøth, C. A. and Geels, C., The effect of climate and climate change on ammonia emissions Atmos. Chem. Phys, 13, 117-128, 2013.

Kraus et al., A new LandscapeDNDC biogeochemical module to predict CH4 and N2O emissions from lowland rice and upland cropping systems, subm. to Plant and Soil, 2014.

5. List of Documents/Annexes:

i. D6.2 contributions by partner