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NitroEurope IP

The nitrogen cycle and its influence on the European greenhouse gas balance.

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Global Change and Ecosystems

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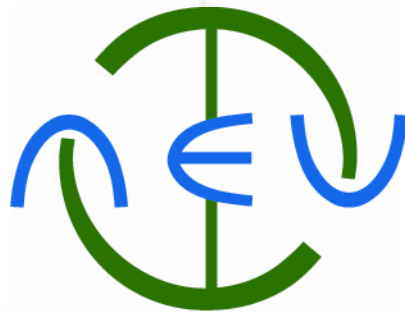
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NitroEurope IP

Open Science Conference

Reactive Nitrogen and the European Greenhouse Gas Balance

Scientific Report to ESF

Conference supported by



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Priority 6.3 Global Change and Ecosystems



Open Science Conference
Reactive Nitrogen and the European Greenhouse Gas Balance
Scientific Report to ESF

1. Summary

The Open Science Conference titled “Reactive Nitrogen and the European Greenhouse Gas Balance” has taken place in the *Het Pand* conference centre in the heard of Ghent/Belgium on February 20th and 21st 2008. The conference was preceded by a two day meeting of the Integrated Project “NitroEurope IP”, which is funded by the European Commission under the 6th Framework Programme and is running from 2006 – 2011.

A total number of 205 participants contributed 62 posters and 47 oral presentations, accompanied by 4 keynote presentations on selected topics (see *Section 4*).

The conference was organised in the following 6 topical sessions:

- **Session 1:** Flux measurements of reactive nitrogen, pools and processes
(*Chair: Mark Sutton*)
- **Session 2:** Impacts of changes in external drivers (global change, N deposition, management, land use change etc.) on fluxes and exchange of N, C and GHG in terrestrial ecosystems
(*Chair: Claus Beier*)
- **Session 3:** Plot scale modelling of processes controlling the biosphere-atmosphere exchange of trace gases to predict effects of changes in climate, land use and land management on gas exchange of C and N compounds (*Chair: Klaus Butterbach-Bahl*)
- **Session 4:** Up-scaling from plot to regional scales – analysing interactions on different spatial scales (*Chair: Pierre Cellier*)
- **Session 5:** Assessment of nitrogen and green house gas fluxes in response to human influence at large regional scales (*Chair: Wim de Vries*)
- **Session 6:** Verification and uncertainty assessment of N and GHG management across disciplines (*Chair: Jan Willem Erisman*)

The format for each of the session was a short introduction, selected oral presentations of 20 min duration (including questions) and a general discussion on the topics presented at the end of the session. A general wrap-up session at the end of the conference had rapporteurs reporting back from each session on the main items discussed and conclusions made.

On the Wednesday evening, a reception with an extended poster session gave all participants an excellent opportunity to inquire in more detail the topics of the posters with the authors and engage in an inspiring discussion.

Overall, the feedback received during and after the conference was very positive, participants felt that the presentations, posters and informal discussions during breaks fostered a very lively scientific discussion on all aspects of reactive Nitrogen and the GHG balance.

A majority of presentations has already been made available on the Conference website at <http://nitrogen.ceh.ac.uk/conference2008/>, where authors have released their contribution for publication. A special issue of the journal *Agriculture, Ecosystems and Environment* (Springer Publishers) is currently in preparation and will feature selected papers from the conference, with Klaus Butterbach-Bahl, Mark Sutton and Stefan Reis acting as guest editors.

2. Description of the scientific content of and discussion at the event

Day 1 started with two keynote talks by Peter Hogberg (Sweden) on *Nitrogen impacts on forest carbon* and Peter Adams (USA) on *Aerosol-Climate Interactions and the Nitrogen Cycle*. The conference then split into two parallel streams, one with a focus on flux measurements (Session 1), and the other on up-scaling from plot to regional scales (Session 4) and subsequently verification and uncertainty assessment (Session 6). On Day 2, keynotes by Sybil Seitzinger (USA) on *Watershed Nutrient Export to Coastal Systems: a Global Perspective* and Gilles Billen (France) on *Modelling the N cascade in regional watersheds* started the second conference day in plenary, before splitting into two parallel streams again, this time on impacts of changes in external drivers (global change, N deposition, management, land use change etc.) on fluxes and exchange of N, C and GHG in terrestrial ecosystems (Session 2), on plot scale modelling of processes controlling the biosphere-atmosphere exchange of trace gases to predict effects of changes in climate, land use and land management on gas exchange of C and N compounds (Session 3) and on the assessment of nitrogen and green house gas fluxes in response to human influence at large regional scales (Session 5). In the following sections, the content and discussion of the oral presentation is summarised. For an overview of the various posters presented, please refer to the post list in Section 4.

Session 1: Flux measurements of reactive nitrogen, pools and processes

In Session 1, talks focused on advanced new instruments and techniques for the measurement of N₂O, CH₄, CO₂ & NO as well as NH₃. Zheng et al. presented work on automatic chamber systems. Two gradient systems for NH₃ measurements were introduced by Spirig et al. (*Flairrmonia*) and Loubet et al. (*ROSAA*). In addition to that, a method for the Determination of ¹⁵N¹⁸O₃ was presented by Sebilo et al.

As a majority of the work presented in this session featured measurements conducted on NitroEurope IP Level 3 sites, the presentation by Skiba et al showed first comparisons of all level 3 sites. This talk elaborated on the comparison of NO, N₂O, CH₄ and CO₂ fluxes and this work is the basis for the next steps in the effort to determine comprehensive Greenhouse gas budgets and N-budgets for these sites. Besides this synthesis presentation, some examples of individual sites were given, for instance on peatlands and GWP (Philatie et al.), N-budget components at the Oensingen site (Neftel et al.), an averaged N-budget for the Soroe Beech forest 1998-2007 (Larsen et al.) and finally a talk on the N-budget of the Höglwald site (Brueggemann et al.).

The conclusions emerging from this session are that the community is very much on the way to understand N-budgets at a variety of sites, and that methods and instruments are available and operational. The next step and challenge will be to link the N-budget to carbon and other greenhouse gas budgets.

Session 2: Impacts of changes in external drivers (global change, N deposition, management, land use change etc.) on fluxes and exchange of N, C and GHG in terrestrial ecosystems

A first set of presentations in Session 2 focused on methods. Battipaglia et al. presented work on a multi isotope approach as a promising tool to investigate the impact of anthropogenic nitrogen pollutants released in the atmosphere. A presentation of Blagodotskaya et al. elaborated on the fungal to bacterial ratio and pulse N₂O emissions from soils, concluding that net N₂O production is governed by the fungal to bacterial ration in the soil. Augustin et al. presented modified helium incubation for fast measurements of actual N₂O and N₂ losses of soils and sediments. This method can give fast and reliable determination of N₂ and N₂O fluxes within 24 hours and preliminary results indicate that N₂ formation by denitrification is the main removal process (up to almost 1000 times higher than N₂O flux).

Furthermore, a set of presentations discussed site measurements for the different ecosystems for which manipulation experiments are conducted in NitroEurope: arable, forest, shrubland and wetlands:

On arable land, Olesen et al. presented nitrogen cycling and emissions in cropping systems under organic farming, where first results indicate that organic and conventional farming systems differ much more in change in soil N storage than in nitrate leaching and N₂O emissions. A presentation by

Alberti et al. discussed the influence of crop rotation and tillage on GHG fluxes in an intensive managed cropland in North Italy.

On forests, Schleppe et al. elaborated on the question, if increased CO₂ concentrations affect the availability of N in a mature temperate forest? Results show, that when CO₂ was fumigated in a mature mixed forest stand in Switzerland during a 7 year treatment, it increased the availability of nitrate in the soil. Brüggemann et al. presented work on the impact of clear-cutting and selective cutting on the soil-atmosphere greenhouse gas exchange of an N-saturated spruce forest in the course of its conversion to a mixed deciduous forest. They found a strong increase in NO₃ leaching and N₂O emissions as well as large decreases in CH₄ uptake in clearcut areas compared to control and selective cutting of the forest.

Work on shrublands was presented by Ambus et al., on the topic of denitrification and N₂O losses in a heath land under changing climate conditions. N₂O emission was found to be low and no significant differences between treatments could be observed, however, a trend of increased CO₂ and drought treatment would decrease N₂O emissions could be established.

Finally, on wetlands, Lund et al. discussed the effect of increased nutrient availability on the greenhouse gas exchange in nutrient poor peatlands. Observed short-term effects of increased nutrient availability in nutrient poor peatlands included increased CO₂ flux components and higher potential for N₂O emissions, while no treatment effect was detected for NEE and CH₄. Sheppard et al. presented work on the effects of different nitrogen forms, ammonia gas and wet deposited ammonium and nitrate, on methane and nitrous oxide emissions from an ombrotrophic bog, for Whim Moss, in the Scottish borders. They concluded, that the N form does affect the N₂O production (NH₃-N >>> NO₃-N = NH₄-N > CONTROL). CH₄ may be sensitive to oxidised N inputs, but the water table and soil temperature are the key drivers, while the effect of N may be ph mediated.

Session 2 was completed by a presentation of Massad et al. on modelling the ammonia stomatal compensation point in relation to the plant nitrogen and carbon metabolism and by Smith et al. discussing, if N₂O release from biofuel production can increase global warming. In the former, an improved model for NH₃ deposition was presented and preliminary results were satisfactory, but more studies are needed to determine model performance and reliability. A key result of the latter was that N₂O emissions from several biofuel crops that are currently produced can actually increase global warming rather than lead to a net reduction.

Session 3: Plot scale modelling of processes controlling the biosphere-atmosphere exchange of trace gases to predict effects of changes in climate, land use and land management on gas exchange of C and N compounds

Session 3 featured a number of presentations addressing specific issues of plot scale modelling. Lehuger et al. discussed the Bayesian calibration of the nitrous oxide module of an agro-ecosystem model (CERES-EGC). Lazzarott and Calanca presented work on simulating the effects of management and climate variability on grass/clover interactions and the N turnover in a temperate grassland ecosystem (using the PROGRASS model). Work presented by de Bruijn et al. on frost related N₂O emission bursts can be explained by microbial behaviour alone: a modelling approach features the DNDC2 model system. McGill et al. presented the new denitrification module in the bio-physical process model EPIC. Adapting the mechanistic model Volt'Air to model ammonia volatilisation from industrial fertilisers applied to bare soil as related to chemical and biological processes at the soil surface was the focus of the presentation by Le Cadre et al. and finally Blagodatsky et al. discussed processes and factors controlling N₂O emission from soil, using the MiCNiT model. Van den Broek et al. presented results calculated with the OPS model on modelled and measured ammonia concentrations over The Netherlands - The effect of dry deposition parameterization. While a general trend in improved communication between the various modelling groups was observed, a growing complexity included in the models emerged as well:

- PROGRASS: Competition of grass and clover (effects N₂ input)
- DNDC(2): „frost-thaw” events and substrate levels
- EPIC, MICNIT: New/ improved microbial N cycling approaches
- VOLT' AIR/ OPS: Improvements to volatilizations and dry deposition of Ammonia

A new focus of the work in this area will need to be on improved UA/UQ for the increasingly complex models. In addition to that, there is a clear demand for better measurements on field but also on process scale, since currently often a mismatch between data quality and process description exists, as well as a lack of comprehensive datasets describing all aspects of C/N cycling. However, it was stated that the number of mechanistic models and process descriptions is increasing which allows for model concept comparisons and overall improvement of process understanding.

Session 4: Up-scaling from plot to regional scales – analysing interactions on different spatial scales

In session 4, all spatial scales were represented, but more contributions to landscape than to regional scale had been received. In general, there was a good balance between experimental and modelling contributions, but more on physical and biological processes than on farm management.

A first presentation focused on biosphere-atmosphere fluxes of reactive nitrogen at the landscape scale (Dragosits et al.) was followed by a detailed study by Fang et al. on the soil-atmosphere exchange of N₂O, CO₂ and CH₄ along a slope of a monsoon evergreen broadleaved forest in southern China. Frumau et al. presented results of source-receptor coupling of atmospheric NH₃ using OPS-ST. The importance of indirect nitrous oxide emission at the field, farm and catchment scales was discussed by Reay et al. and Vache et al. presented work on the modelling of organic and inorganic nitrogen dynamics across ecosystem spheres.

The influence of spatial resolution of land cover data on N₂O emission inventories was discussed by Nol et al., while Dalgaard et al. elaborated on the issues when scaling up from farm to landscape – methods to model farm Nitrogen balances in European landscapes.

Many of the presentations highlighted the relevance of landscape scale: The landscape scale provides additional insights into the nitrogen problem and there is still much to learn about the interactions of the different elements (including farm management) in the landscape. There is substantial evidence on the spatial variation in processes, for instance in relation to:

- The importance of N₂O fluxes heterogeneity at slope/landscape scale (more than for CH₄/CO₂); linked to water availability
- Large uncertainties in indirect emissions
- Rapid degassing of N₂O having implications for estimating emissions from this process

With regard to the data representation and suitability, there is a need for detailed local data for modelling including spatial data on activities/environmental variables etc, importance of management data. The resolution in environment description may have strong implications for modelling and for emission estimates (errors in land cover data are systematic and do not average out in space: example of ditches → 24% error). Finally, there are still core questions to be addressed:

- Which is the relevant resolution for modelling?
- How to aggregate data in models at landscape scale?

Session 5: Assessment of nitrogen and green house gas fluxes in response to human influence at large regional scales

Within Session 5, the focus was on assessment, systems, human influence and large regional scales, with several contributions (presentations and posters) on each topic. Schmid and Schwab presented results from using an integrative modelling system to evaluate land use and management options in a multi-policy context. Aspects of nitrous oxide (N₂O) in the Seine River and factors controlling the emissions and budget were discussed by Garnier et al. while Britz and Leip presented work on the fast environmental impact assessment with the DNDC-EUROPE/CAPRI metamodel.

The topic of a presentation by Oenema et al. was the integral assessments of GHG and N emissions from livestock systems in EU-27. Finally, De Vries et al. discussed the results of an assessment of nitrogen and greenhouse gas fluxes at the European scale in response to land use and land management change.

Session 6: Verification and uncertainty assessment of N and GHG management across disciplines

In Session 6, Bergamaschi et al. presented work on the inverse modelling of European CH₄ and N₂O emissions, comprising a general explanation of the basic principle of inverse modeling and showing some comparisons between top down (inverse modelling) and bottom up (IPCC methodology) results for CH₄ and N₂O. They demonstrated, that it is feasible to provide top-down emission estimates on European/national scale; broad consistency between bottom-up and top-down estimates, however, overall uncertainties still large –especially ‘uncertain uncertainty estimates’. These are caused by limitations in the observational data sets as well as missing areas like e.g. Southern/Northern Europe. Li et al. showed results from modeling global N₂O emissions from agricultural land with DNDC. This presentation was marked by the challenge of applying a process-based model like DNDC on a global scale for calculating N₂O emissions and results indicated a large spatial and temporal variability in N₂O emissions, where the overall emission is highly determined by peak events. Although systematic differences between e.g. global and national DNDC input data are an important factor for the overall random variability, upscaling reduced this variability resulting in similar average results of the DNDC N₂O emission estimates for the two datasets. A point of discussion were the low estimates for N₂ compared to N₂O calculated for the US and China. Statistical upscaling of terrestrial greenhouse gas emissions was the topic of a presentation by Heuvelink et al. This showed that statistical upscaling is possible using different approaches: design-based and model-based, where design-based approaches have an advantage because no assumptions are needed for defining the relations in the overall process. However, measurements need to be selected by means of probability sampling, which is rare in GHG emission research. Hence, model-based upscaling is currently more suitable for GHG emission work, but so far this approach shows too much variability. This is mainly caused by the lack of measurements and the situation that measurements are focussing on process understanding and are not designed for upscaling purposes. Finally, Winiwarter et al. presented the work on nitrous oxide emissions, their uncertainty and a way to decrease the uncertainty in its implementation in the GAINS model. The overall uncertainty in the N₂O emission calculations is dominated by the emissions from agricultural soils and the scientific understanding of the N₂O release from soils is not (yet) satisfying for parameterisation of this process for use in models like GAINS. Different approaches are possible to calculate the emission: bottom-up (IPCC) or top-down (Crutzen). Top-down (based on formation of N_r) shows largest differences with bottom-up (based on application of N_r) for countries with high or low formation-application ratios (e.g. export of fertilizer, import of animal feed). The Implementation of these approaches in GAINS provides an additional validation check for the overall N₂O emission calculation

3. Assessment of the results and impact of the event on the future direction of the field

The work presented above is in many cases closely tied to the progress of the NitroEurope IP, where a lot of the groups are currently collaborating. However, a number of contributions from a wider community perfectly complemented the discussions and allowed for a wider view on the current state-of-the-art regarding research on reactive nitrogen and its implications for the European greenhouse gas balance.

The results discussed in Section 2 marks in most cases work in progress, with a significant amount of new and comprehensive measurement programmes delivering data across a variety of field sites. The conference took place at a crucial point of this work, at the watershed between building up the systems and establishing the measurement networks and the generation of large datasets that will drive the synthesis and integration efforts in the second phase of the project. And by bringing together both the NitroEurope IP community and further experts working on reactive N, the event served both to disseminate and communicate the findings and data availability from NitroEurope, and put methods and approaches applied within NitroEurope up for discussion across a diverse set of backgrounds and expertise.

However, the implications and potential impact of the conference go beyond the scope of the NitroEurope IP. A number of activities is currently in place addressing different aspects of the nitrogen cycle, for instance the ESF-NinE programme with the European Nitrogen Assessment (ENA) report (as well strongly supported by NitroEurope, but involving a larger community addressing aspects not only of terrestrial and biogeochemical N effects) emerging as a major effort to advance the state of knowledge on the N cycle in Europe. Next, the UNECE has recently established a new Task Force within the Convention on Long Range Transboundary Air Pollution (under the Working Group on Strategies and Review). This Task Force on Reactive Nitrogen (TFRN) has been explicitly set up with synthesis and integration of ongoing N related work in mind. These efforts are complemented by the COST Action 729 and the networking activities of the International Nitrogen Initiative (INI), with its European Centre hosted by CEH in Edinburgh.

All these activities, while having different foci and approaches, heavily depend on the communication and collaboration within the scientific communities and thus benefit greatly from events such as this conference. A series of workshops in relation to the ENA and the TFRN are scheduled for the next months and will continue many of the discussions that have been started at the conference in Ghent. Further milestones in this area of work are anticipated to be the publication of the ENA in a few years time, as well as the final conference presenting the results and conclusions of the NitroEurope IP, scheduled for spring 2011.

And besides the presentations and posters, different groups have been engaged in lively discussions on the future direction of the European research on nitrogen, mainly, but not limited to, the representation of nitrogen related research in the European Comissions 7th Framework Programme. In this context, it was a contribution of the conference as well to bring together not only scientists, but as well stakeholders from industry (e.g. the *International Fertiliser Industry Association* IFA or the *International Plant Nutrition Institute* IPNI) and policy makers from the European Commission.

4. Final programme of the meeting

Wednesday, Feb 20th, 2008

	08:15-08:45 Registration		
	08:45-09:00 Opening & Welcome		
	09:00-09:40 Keynote: Peter Hogberg		
	09:40-10:20 Keynote: Peter Adams		
11:00-13:00	Session 1 Flux measurements of reactive nitrogen, pools and processes (Chair: Mark Sutton)	Session 4 Upscaling from plot to regional scales – analysing interactions on different spatial scales (Chair: Pierre Cellier)	
	Introduction	Introduction	
	Biosphere atmosphere exchange of reactive N and greenhouse gases at the NitroEurope core measurement sites: A synthesis of the first annual data set.	Skiba U., Nemitz E., Vesala T., Ambus P., Brüggemann N., Hensen A., Duyzer J., Cellier P., Freibauer A., Magliulo A., Seufert G., Neftel A., Horvath L., Zechmeister-Boltenstern S., Cotrufo M.F., Tang Y.S., Sutton M.A.	Biosphere-atmosphere fluxes of reactive nitrogen at the landscape scale Dragosits U., Dalgaard T., Olesen J.E., Hertel O., Bleeker A., Kros H., Theobald M.R., Cellier P., Durand P., Loubet B., Sutton M.A.
	Chamber and eddy-covariance measurements of greenhouse gas fluxes on a sedge fen in northern Finland	Lohila A., Aurela M., Hatakka J., Minkinen K., Penttilä T., Laurila T.	Soil-atmosphere exchange of N ₂ O, CO ₂ and CH ₄ along a slope of a monsoon evergreen broadleaved forest in southern China Fang Y., Gundersen P., Zhang W., Christiansen J.R., Mo J.
	An automatic chamber system for simultaneously measuring fluxes of N ₂ O, NO and CH ₄ emissions/uptake and net ecosystem CO ₂ exchange (NEE)	Zheng X., Wang Y., Liu G., Liu C., Li M., Liang W., Wang Y.	Source-receptor coupling of atmospheric NH ₃ using OPS-ST Frumau K.F.A., Hensen A., Bleeker A., van Pul W.A.J., van den Broek M.
	A mini-wedd gradient system for measuring ammonia fluxes	Loubet B., Decuq C., Personne E., Ferrara R., Massad R.S. Fanucci O., Générmont S.	Importance of indirect nitrous oxide emission at the field, farm and catchment scales Reay D.S., Edwards A.C., Smith K.A.
	Bidirectional NH ₃ fluxes over intensively managed grassland - one year of measurements at Oensingen, Switzerland	Spirig C. and Flechard C.	Modelling of organic and inorganic nitrogen dynamics across ecosystem spheres Vaché K.B. and Breuer L.
Lunch			
14:30-16:00	Session 1 continued	Session 4 continued	
	Results on a flux measurement campaign at a drained peatland pine forest in Southern Finland	Pihlatie M., Vesala T., Mammarella I., Kieloaho A.-J., Laurila T., Aurela M., Minkinen K., Penttilä T., Zechmeister-Boltenstern S., Schoenborn J., Kiese R., Butterbach-Bahl K., Brüggemann N.	The influence of spatial resolution of land cover data on N ₂ O emission inventories Nol L., Verburg P.H., Heuvelink G.B.M.
	Role of the Soil Organic Matter pool in nitrate leaching	Sebilo M., Billen G., Nicolardot B., Mary B., Mayer B. & Mariotti A.	Scaling up from farm to landscape – methods to model farm Nitrogen balances in European landscapes Dalgaard T., Dragosits U., Happe K., Hutchings N., Olesen J.E., Cellier P., Drouet J.L., Bleeker A., Theobald M.
	Nitrogen Pollution Swapping in Grassland Buffer Strips: Nitrous oxide emissions from simulated buffer strip and control grassland plots, Northumberland, U.K	McAuley W., Reay D., Heal K.V., Smith K.	Session 6 Verification and uncertainty assessment of N and GHG management across disciplines (Chair: Jan Willem Erisman)
	Greenhouse Gas Emissions from Crop Production Systems and Fertilizer Management Effects	Snyder C.S., Bruulsema T.W., Jensen T.L., Fixen P.E.	Introduction Inverse modelling of European CH ₄ and N ₂ O emissions Bergamaschi P., Vermeulen A., Manning A., Bousquet P., Heimann M.
Coffee/Tea			
16:30-18:00	Session 1 continued	Session 6 continued	
	Application of reactive N measurements in a low-cost inferential network across Europe	Tang Y.S., van Dijk N., Simmons I., Daemngen U., Djuricic V., Vidic S., Zlatice G., Mitosinkova M., Uggerud T.H., Sanz M.J., Sanz P., Chorda J.V., Ferm M., Perrino C., Sutton M.A.	Modeling Global N ₂ O Emissions from Agricultural Land with DNDC Li C., Frolking S., Bouwman A.F., Zheng X., Butterbach Bahl K.
	Towards a generalised parametrisation of bi-directional ammonia exchange	Nemitz E., Flechard C., Famulari D., Sutton M.A.	Statistical upscaling of terrestrial greenhouse gas emissions Heuvelink G.B.M., Kros J., de Vries, W.
	Five years of C and N budgets in managed grassland systems	Ammann C. and Neftel A.	Nitrous oxide emissions, their uncertainty and a way to decrease the uncertainty in its implementation in the GAINS model Winiwarter W., Bertok I., Amann M.
Discussion		Discussion	

Thursday, Feb 21st, 2008

08:30-09:10 Keynote: Sybil Seitzinger			
09:10-09:50 Keynote: Gilles Billen			
Session 3 Plot scale modelling of processes controlling the biosphere-atmosphere exchange of trace gases to predict effects of changes in climate, land use and land management on gas exchange of C and N compounds (<i>Chair: Klaus Butterbach-Bahl</i>)		Session 2 Impacts of changes in external drivers (global change, N deposition, management, land use change etc.) on fluxes and exchange of N, C and GHG in terrestrial ecosystems (<i>Chair: Claus Beier</i>)	
Introduction		Introduction	
Bayesian calibration of the nitrous oxide module of an agro-ecosystem model	Lehuger S., Gabrielle B., van Oijen M.	Multi isotope approach as a promising tool to investigate the impact of anthropogenic nitrogen pollutants released in the atmosphere	Battipaglia G., Marzaioli F., Altieri S., Lubritto S., Strumia S., Cotrufo M.F.
Simulating the effects of management and climate variability on grass/clover interactions and the N turnover in a temperate grassland ecosystem	Lazzarotto P. and Calanca P.	Fungal to bacterial ratio and pulse N ₂ O emission from soils	Blagodatskaya E.V., Blagodatsky S.A., Dannenmann M., Butterbach-Bahl K.
Frost related N ₂ O emission bursts can be explained by microbial behaviour alone: a modelling approach	de Bruijn A., Butterbach-Bahl K., Grote R.	A modified helium incubation method for fast measurement of actual N ₂ O and N ₂ losses of soils and sediments	Augustin J., Steffens L., Brozyna M., Grossmann B.
The new denitrification module in the bio-physical process model EPIC	McGill W.B., Izaurralde R.C., Williams J.R., Schwab D.E.	Nitrogen cycling and emissions in cropping systems under organic farming	Olesen J.E., Rees R.M., Klemetsson L., Topp C.F.E., Chirinda N., Watson C.A., Ball B.C., Petersen S.O., Stenberg M., Norman J., Klemetsson Å A
Adapting the mechanistic model Volt'Air to model ammonia volatilisation from industrial fertilisers applied to bare soil as related to chemical and biological processes at the soil surface	Le Cadre E., Générmont S., Bedos C., Recous S., Cellier P.	Influence of crop rotation and tillage on GHGs fluxes in a intensive managed cropland in North Italy.	Alberti G., Delle Vedove G., Carfora A., Castaldi S., Zuliani M., Peressotti A.
Lunch			
Session 3 cont.		Session 2 cont.	
Processes and factors controlling N ₂ O emission from soil: the MiCNiT model	Blagodatsky S.A., Grote R., Kiese R., Butterbach-Bahl, K.	Do increased CO ₂ concentrations affect the availability of N in a mature temperate forest?	Schleppi P., Hagedorn F., Bucher I., Koerner C.
Modelled and measured ammonia concentrations over The Netherlands - The effect of dry deposition parameterization	van den Broek M.M.P., Sauter F., van Pul W.A.J., van Jaarsveld H.	Impact of clear-cutting and selective cutting on the soil-atmosphere greenhouse gas exchange of an N-saturated spruce forest in the course of its conversion to a mixed deciduous forest	Brueggemann N., Gasche R., Papen H., Thiel S., Willibald G., Butterbach-Bahl K.
Discussion		Denitrification and N ₂ O losses in a heath-land under changing climate conditions	Ambus P., Priemé A., Carter M.S., Albert K., Larsen K.S., Andersson M., Beier C.
Coffee/Tea			
Session 5 Assessment of nitrogen and greenhouse gas fluxes in response to human influence at large		Session 2 cont.	
Introduction		The effect of increased nutrient availability on the greenhouse gas exchange in nutrient poor peatlands	Lund, M., Stroem, L., Christensen, T.R., Lindroth, A.
Using an Integrative Modelling System to evaluate land use and management options in a multi-policy context	Schmid E. and Schwab D.E.	Effects of different nitrogen forms, ammonia gas and wet deposited ammonium and nitrate, on methane and nitrous oxide emissions from an ombrotrophic bog, whim moss, in the scottish borders.	Sheppard L.J., Leith I.D., Rung M., Van Dijk N., Field C., Skiba U.
Nitrous oxide (N ₂ O) in the Seine River: factors controlling the emissions and budget	Garnier J., Mounier E., Billen G., Sebilo M., Silvestre M., Laverman A., Martinez A.	Modelling the ammonia stomatal compensation point in relation to the plant nitrogen and carbon metabolism	Massad R.S., Tuzet A., Loubet B., Cellier P.
Fast environmental impact assessment with the DNDCEUROPE/CAPRI metamodel	Britz W. and Leip A.	N ₂ O release from biofuel production can increase global warming	Smith K. A., Crutzen P. J., Mosier A. R., Winiwarter W.
Integral assessments of GHG and N emissions from livestock systems in EU-27	Oenema O., Oudendag D., Velthof G.L.		
Assessment of nitrogen and greenhouse gas fluxes at the European scale in response to land use and land management change	de Vries W., Kros J., Reinds G.J., Wieggers H.J.J., Velthof G.L., Oudendag D.A., Perez Soba M., de Winter W.P., Bakker M., Eickhout B., Bouwman A.F.		
Discussion			
Wrap-up and conclusions (reporting back from sessions)			

List of posters presented

Session 1

Ammonia Emission Measurements on Manured Fields: Two Novel Measurement Techniques Compared to Calculated Emissions	Berkhout A.J.C., van der Hoff G.R., Bergwerff J.B., Swart D.P.J., Hensen A., Kraai A., Huijsmans J.F.M., Mosquera J., van Pul W.A.J.
Influence of land use change on nitrogen dynamics of a former fen peat-land	Brozyna M., Augustin J., Minke M.K., Halle E., Behrendt A., Juszczak R.
Effect of temperature on ammonia measurements by semi-permeable membrane coupled with conductivity	Decup C., Loubet B., Personne E., Ferrara R., Masson S., Flura D., Générmont S.
Evaluation of evaporation losses in a mini-wedd gradient system for measuring ammonia fluxes	Ferrara R.M., Decup C., Personne E., Massad R.S., Fanucci O., Loubet B.
The Effects of Nitrogen Addition on Carbon and Nitrogen cycling in Heathlands; Processes, Pools and Pathways.	Field C., Caporn S., Sheppard L.S.J., Dise N., Evans C., Carroll J.
Proposing a disposal and an associated protocole to objectively characterise the ability of a soil, a manure or a synthetic fertiliser to volatilise: the standard ammonia volatilisation	Générmont G.
Soil N processes responses to increased N inputs in three subtropical forests in South China	Gundersen P., Fang Y., Mo J., Zhu W.
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Long-term flux measurements of NO ₃ ⁻ , NH ₄ ⁺ , NO, NO ₂ , and N ₂ O in an old, Danish beech forest	Larsen K. S., Ibrom A., Ambus P., Carter M.S., Albert K., Pilegaard K., Beier C.
Methodological developments to quantify soil emissions of nitric oxide under field and laboratory conditions	Laville P., Flura D., Cellier P., Gabrielle B., Rolland M.-N., Fanucci O., Loubet B.
High-frequency loss corrections of eddy-covariance ozone fluxes over a crop rotation in sub-urban environment over 3 years.	Loubet B., Larmanou E., Cellier P.
Dynamics of NH ₃ plant-atmosphere exchange and the ammonia stomatal compensation point in relation to N fertilisation	Massad R.S., Loubet B., Tuzet A., Cellier P.
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A photoacoustic system for ammonia flux measurements with the aerodynamic gradient method	Pogány A., Mohácsi A., Bozóki Z., Horváth L., Szabó G.
Nitrogen dynamics in coniferous and deciduous forest soils determined using a N-15 tracing model	Staelens J., Huygens D., Boeckx P., Mueller C., Verheyen K.
Quantification and characterization of organic N pools in European soils under different land uses	Venturi A., Del Galdo I., Cotrufo M.F.
Uncertainties in the calculation of NO-NO _x -O ₃ fluxes by the gradient and the profile methods	Weidinger T., Horváth L., Machon A., Pintér K., Barcza Z., Gyöngyösi A., Nagy Z., Tuba Z.
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NitroEurope Component 4 – Dutch landscape	Frumau K.F.A., Hensen A., Bleeker A., Gies E., de Vries W., Kros J., Sonneveld M.P.W.
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.How the use of a mechanistic model of ammonia volatilisation in the field (Volt'Air) may improve national ammonia volatilisation inventories (NARSES)	Rosnoblet J., Theobald M., Générmont S., Gabrielle B., Cellier P.
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