



EUROPEAN COMMISSION
Research Executive Agency
Marie Curie Actions – Networks for Initial Training

Project No: 316472

Project Acronym: NORA

Project Full Name: NORA - Nitrous Oxide Research Alliance
Training Network

Marie Curie Actions

Periodic Report

Period covered: from 01/01/2013 to 31/12/2014

Period number: 1st

Project coordinator name:
Prof. Asa Frostegard

Version: 2

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Project coordinator organisation name:
NORGES MILJO-OG BIOVITENSKAPLIGE
UNIVERSITET

Periodic Report

PROJECT PERIODIC REPORT

Grant Agreement number:	316472
Project acronym:	NORA
Project title:	NORA - Nitrous Oxide Research Alliance Training Network
Funding Scheme:	FP7-MC-ITN
Periodic report:	1
Period covered - start date:	01/01/2013
Period covered - end date:	31/12/2014
Project co-ordinator:	
Organisation PIC:	999902967
Organisation legal name:	NORGES MILJO-OG BIOVITENSKAPLIGE UNIVERSITET
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DECLARATION BY THE PROJECT COORDINATOR

I, Prof. Asa Frostegard, as co-ordinator of the project (316472, NORA), hereby confirm that:

- The attached periodic report represents an accurate description of the work carried out in this project for this reporting period;
- The project has fully achieved its objectives and technical goals for the period;
- The project Website is up to date.
- To my best knowledge, the financial statements which are being submitted as part of this report are in line with the actual work carried out and are consistent with the report on the resources used for the project and if applicable with the certificate on financial statement.
- All beneficiaries, in particular non-profit public bodies, secondary and higher education establishments, research organisations and SMEs, have declared to have verified their legal status. Any changes have been reported under section 5 (Project Management) in accordance with Article II.3.f of the Grant Agreement.

PUBLISHABLE SUMMARY

Comments:

The pasted document did not come out right here. I therefore attach it; See Attachment #5 (Word document) and # 6 (pdf)

PROJECT OBJECTIVES FOR THE PERIOD

Comments:

The overarching scientific goal is to improve our understanding and predictive ability with regard to the regulatory biology and ecology of microbes involved in oxidation and reduction of mineral N species affecting atmospheric N₂O. Sub-goals are:

- Improved understanding and mathematical modelling of regulatory networks of denitrification in model strains (systems biology).
- Systematic characterization of regulatory responses of organisms isolated from habitats (key strains) and relationships between genotypes and phenotypes.
- Characterization and quantification of relationships between microbial community function and composition, and how these are affected by environmental factors.
- Translation of increased understanding to generate qualitative and quantitative predictive models to assess and predict the influence of environmental factors and land management strategies on N₂O emissions. (This requires results from now ongoing work and will be achieved during next project period)

S&T innovation lies within the individual projects and, crucially, in bringing together, for the first time, different approaches to analysis of an ecosystem process. Technical innovation is evident through use of cutting edge methodologies:

- Genome sequencing, functional genomics and systems biology to determine the influence of previously unstudied environmental factors on N₂O production by cultivated organisms.
- Genomic, biochemical, regulatory and kinetic analyses of environmentally relevant organisms.
- Detection and cultivation of key N₂O-producing strains using combined transcriptomics, metagenomics and bioinformatics methods.
- Incorporation of effects of environmental factors, newly characterised diversity and microbial interactions in predictive mathematical models. (Next project period)
- Co-ordinated testing of model predictions in a range of ecosystems. (Next project period)
- Automated biogeochemical analysis using robotic monitoring systems.

The training goal is to produce a new generation of nitrogen researchers, within both academic and private sectors, with inter- and cross-disciplinary skills (molecular biology, biochemistry, ecology, biogeochemistry, mathematics, engineering) and understanding and appreciation of both fundamental science and its direct application to environmental, industrial and societal issues. Sub-goals are:

- Cross-disciplinary education of experimentalists and modelers to provide seamless and unencumbered communication and integration of respective approaches in research
- Increased creative, innovative and imaginative research through exposure to, and appreciation of concepts and approaches of other disciplines
- Ability to direct fundamental research towards specific applied goals, through direct involvement (including secondments) with industrial and agronomic researchers
- Better informed applied research through training in cutting edge fundamental research and modeling allowing hypothesis-driven experimentation

The impact goal is to generate specific recommendations, strategies and solutions to reduce N₂O emissions. Specific goals are to:

- Invent novel approaches to reduce N₂O:N₂ product ratios in key ecosystems;
- Test the validity of such approaches at scales ranging from the cellular level to ecosystems;
- Increase the momentum and value of European industries in nitrogen issues generally, and N₂O-mitigations specifically;
- Provide strategies, guidelines and evidence-based recommendations for mitigation of N₂O emissions for policy makers, environmental agencies, industry and other stakeholders. (Next project period)

WORK PROGRESS AND ACHIEVEMENTS DURING THE PERIOD

Comments:

From Grant Agreement: “The overarching scientific goal is to improve our understanding and predictive ability with regard to the regulatory biology and ecology of microbes involved in oxidation and reduction of mineral N species affecting atmospheric N₂O”. Four main sub-goals were listed, and below is a short description of the progress towards each of those (bullet point). A more detailed report from the research conducted so far is found in Attachment #4.

The general progress of the entire NORA project follows the plans; the expected deliverables are in place (although some of these will be worked on further during the rest of the project).

Results obtained in relation to goals/sub-goals :

- Improved understanding and mathematical modelling of regulatory networks of denitrification in model strains (systems biology).
 - biochemical characterisations of how O₂, Cu and pH affect regulation of different steps in denitrification in *P. denitrificans*;
 - analyses of chaperone and regulating enzymes involved in NosZ maturation have been done although not yet finished;
 - a kinetic model of the denitrification pathway in *P. denitrificans* has been constructed but needs refinement; parametrization and optimization of models will continue in close connection with experimental work.
- Systematic characterization of regulatory responses of organisms isolated from habitats (key strains) and relationships between genotypes and phenotypes.
 - Over 70 denitrifying and DNRA bacterial strains (G⁺; G⁻) isolated from soils and wastewater; ca half of them characterized phenotypically so far (WP1 and 2). Work will continue to extend the collection to include an even wider range of organisms, especially nitrifiers; and whole genome sequencing of selected strains is currently underway.
- Characterization and quantification of relationships between microbial community function and composition, and how these are affected by environmental factors.
 - Laboratory and field-scale experiments have been performed on wastewater and soils. Methods for qPCR, metagenomics, transcriptomics and stable isotope labelling have been optimised, and a first version of a field robot for N₂O emission measurements has been developed and tested in field situations. Microbial community dynamics and functions in wastewaters has been examined in relation to C:N ratios and nitrite, and microbial community function (with focus on denitrification potential and N₂O emissions) and composition has been characterised in soils exposed to different fertiliser and management strategies. Other environmental factors that will be examined are effects of pH and Cu deficiency on N₂O emissions.

General progress:

The recruitment went well (9 ESRs and 3 ERs recruited, starting dates between 1 September and 1 February (Deliverable 2). Three project meetings and a mid-term review meeting have been held (Deliverables 1, 3, 5). All partners were represented at all meetings. All fellows participated in all meetings (except the Start-up when they were not hired). Three “summer schools” have been organised (Deliverables 4, 6 and 7). All fellows participated (except that ER3 did not attend School 1 since she was not yet hired).

The overall progress of the research work is fine and the progress reports submitted in October 2014 by each of the NORA fellows (revised by the NORA Technical Committee), as well as the fellows’ presentations of individual projects at our Meeting 3 and at the Mid-term review meeting (both held in Delft in November 2014), indicated generation of novel results that will lead to publication in scientific journals shortly; the first manuscripts will be submitted during the spring.

We are currently in the middle of a very intensive period of experimentation with intimate collaboration between partners through secondments. The fellows have been employed for between 12 and 15 months, and they are all working in a well focused way to reach the main goal and the subgoals listed above. The achievements so far are in line with the objectives of the different projects (specified in the Grant Agreement) and all deliverables expected for the first period are in place (Deliverables 8, 9, 10, 11, 12, 13 and 15), although some will be continued to further extend the results. There are no deviations from Annex I that have major impact on other tasks or on available resources and planning. ESR3 was on a 4 months maternity leave and her secondments have therefore been somewhat delayed, but this has not affected the progress of the other fellows and she has been catching up well with the research work after the leave. The planned workshop (Deliverable 14) is somewhat delayed since it is better to have it in spring season, and will be held in Gothenburg May 11-13. It is now open for registration and a webpage is open (<https://nora.nmbu.no/events/workshop>). It appears to attract substantial interest, and we expect between 50 and 100 participants. The workshop will be used to promote the field robot, to initiate production of several #-version of the robot for other research groups. Below is a concise summary of the main results achieved so far in the project. A more detailed description is uploaded as Attachment #4.

Main results so far:

WP1 (Partners 1, 2 and 3; and in parts 4, 5 and 13):

So far, we have mainly focused on denitrifying bacteria. A large number of bacterial strains have been isolated and characterized phenotypically (Deliverable 9); biochemical characterisations of how O₂, Cu and pH affect the regulation of different steps in denitrification have been obtained for *P. denitrificans* (Deliverable 10); more detailed chaperone and regulating enzymes involved in NosZ maturation have also been done although not yet finished (Deliverable 16); and a kinetic model of the denitrification pathway in *P. denitrificans* has been constructed (Deliverable 11). WP1 shows very good progress towards the general goals. The results obtained are in line with (and in fact ahead of) the plans for the deliverables listed in the GA.

Highlights:

- A biobank of isolated denitrifying and DNRA bacteria has been assembled; the strains have been characterized taxonomically and phenotypically and shown to cover a wide diversity of gram positive and gram negative bacteria with diverse denitrification phenotypes.
- The putative copper chaperone PCuC from *P. denitrificans* has been overexpressed and purified
- Results have been obtained that support the hypothesis that the nosZ regulator NosR is a Cu regulator.
- A first kinetics model has been developed as well as growth models for *P. denitrificans*.
- A fusion of NirS-mCherry has been constructed, aiming to elucidate the fate of denitrification proteins in oxically growing cells.

Other:

A need was identified to have a workshop on mathematical modelling to exchange ideas and make detailed plans for integration of laboratory experiments and modelling. The workshop (for WP1 mainly) was held in Brussels 19-20 May 2014 (see here). A total of 20 persons, connected not only to WP1, but also WP2 and WP 3 (NMBU, UEA, VUA, TUD), as well as two invited guest experts, attended the workshop. Nine oral presentations were given, followed by discussions. Topics included Dynamic models; metabolic control; Systems biology; Planning of collaborative projects and secondments for NORA fellows.

WP2 (Partners 4, 5, 6, 7, 8, 11, 13 and 14):

General progress in WP2 is very good and follows the plans according to the Grant Agreement with minor deviations with respect to the timing of planned secondments. Contrasting processes for wastewater treatments have been evaluated and conditions leading to accumulation of nitrite will be prioritized for further studies (Milestone 6; Deliverable 12) as described below. Key strain isolation schemes have been developed (Milestone 7) in collaboration with partners belonging to WP1 (see above). These will be further developed during the remaining project period, to make use of transcriptomics analyses to identify in situ active organisms. During the next period, nitrifying

bacteria and Archaea will be isolated. Metagenomics analyses have been performed to identify denitrification genes in soils (Deliverable 15) and optimization of metagenome/metatranscriptome analyses are currently ongoing also for wastewater treatments. Publishable results have already been obtained for nitrifiers, wastewater treatments and microbial communities in different soil fractions, and manuscripts will be submitted during spring 2015.

Highlights:

- COD:N ratio in wastewaters is not directly associated to emission of N₂O.
- The sudden presence of nitrite in wastewater treatments may lead to significant emissions of both NO and N₂O. Above a certain threshold nitrite addition, the resulting high NO emission leads to inhibition of microbial metabolism.
- 1-octyne can distinguish the relative contributions of AOA and AOB to NH₃ oxidation in soil, and can be used to distinguish N₂O production by AOB and AOA in soil, in which both are active.
- AOB dominate not only NH₃ oxidation but also N₂O production in NH₄⁺-amended soils. The relative contribution of AOA to N₂O emission is higher when NH₃ availability is limited, but the total amounts are low. Under conditions where archaeal ammonia oxidisers compete with bacterial ammonia oxidisers, N₂O yields are similar for AOB and AOA independently of NH₃ availability.
- Denitrifier gene abundance in fertilized soils varied across field sites but no general trends were found in relation to N-fertilization.
- Correlations were seen between soil pH and Ca content, and the structure of nosZI and nosZII communities, as well as between the nosZ diversity and the product ratio of N₂O:(N₂O+N₂).

Other:

The scientific community is currently debating which are the major mechanisms regulating N₂O emissions from soils: pH has been identified as a major factor affecting N₂O emissions (low pH interfering with the making of the N₂O reductase enzyme); Cu deficiency has been shown (in pure cultures with very low Cu levels) to lead to increased emissions of N₂O; and other investigations demonstrate negative correlations between the abundance of nosZ genes in soils (especially the nosZII gene) and N₂O emissions. Moreover, the role of ammonia oxidisers vs denitrifiers; as well as the role of DNRA organisms and fungi, with respect to N₂O emissions, are not well understood. One major interest in the NORA project consortium is to further investigate these parameters to try to disentangle which is/are most important under various conditions. The results so far are not clear-cut and the consortium will pinpoint one or two common questions addressing these issues, and set up well designed collaborative experiments to answer them. This will be executed during 2015.

WP3 (Partners 1, 9 and 10 and 12):

The progress is good, the development of the field robot is achieved (Milestone 5), and the documentation of the performance of the field robot is in good progress (Deliverable 13). Soils have been collected and emissions analyzed by tracer experiments, and these experiments are still running (Deliverable 8). Field experiments with N₂O emissions are ongoing (Deliverable 17). Promising mitigation options have been identified and implemented in a newly established field experiment (Milestone 7). New project applications are in preparation for new versions of the field robot to be constructed in collaboration with the German ICOS team (Milestone 13). Finally, the workshop (Deliverable 14) will take place in May 2015.

Highlights:

- An operating field robot for field measurements of N₂O emissions.
- Promotion of the robot through collaboration with ICOS and at the NORA workshop in Gothenburg.
- Several field experiments with measurements of N₂O emission and modelling
- Tracer experiments to identify the sources of N₂O

Training (WP5) All partners

Goals:

- Cross-disciplinary education of experimentalists and modellers to provide seamless and unencumbered communication and integration of respective approaches in research
- Increased creative, innovative and imaginative research through exposure to, and appreciation of concepts and approaches of other disciplines

- Ability to direct fundamental research towards specific applied goals, through direct involvement (including secondments) with industrial and agronomic researchers
- Better informed applied research through training in cutting edge fundamental research and modelling allowing hypothesis-driven experimentation

The training program follows the plans stated in the Grant Agreement. Progress of students is followed up in the local supervisory teams, and by the NORA Technical Committee and Supervisory Board through evaluation of submitted "Progress reports" (so far two) and constructive criticism of oral and poster presentations at project meetings and summer schools. Three planned Summer schools 1-3 have been arranged (Deliverables 4, 6 and 7) covering biochemistry, physiology and ecology of N-transforming microbes in soils and wastewater systems; experimental exercises; systems biology; mathematical exercises including kinetic modeling; IPR, management and entrepreneurship taught by leading fertilizer, waste treatment and robot industry; scientific writing. Secondments started during 2014 and follow a schedule (Attachment #3) in line with the Grant Agreement (with minor deviations; eg ESR3 has postponed secondments by a few months due to maternity leave). Partners have met ad hoc for planning of collaboration, and one workshop (not originally included in GA) has been arranged on Mathematical modeling in which fellows from all three research work packages (WP1, 2 and 3) participated.

Three Summer Schools have been arranged:

- 1) "Biology of N-transformations; N₂O emissions in the field" (4 credits (ECTS)) was held at UMB, Norway (15-19 October 2013) and included lectures on the biology and ecology of the nitrogen cycle; scientific writing; IPR and laboratory exercises.
- 2) "Systems biology and biochemistry of N₂O producing bacteria; Waste water treatment technologies" (3 credits (ECTS)) was held at TUD, The Netherlands, (15-17 November 2014) and included lectures and exercises on biochemistry, bioenergetics and kinetics of denitrification, as well as lectures and exercises on systems bioinformatics of metabolic networks.
- 3) "Entrepreneurial skills and IPR" (1 credit (ECTS)) was held at TUD, The Netherlands, (18-19 November 2014) and included lectures on entrepreneurship, patents and IP.

-School 1: program, lectures and literature in the NORA intranet:

https://nora.nmbu.no/project_intranet/intranet_frontpage/summerschool-1-2013 (login required: User nora; Password nitrox)

- Evaluation school 1 and plans for school 2 & 3 (attachment #1)

- School 2: program, lectures and literature in the NORA intranet:

<https://nora.nmbu.no/events/node/16774> (login required: User nora; Password nitrox)

- School 3: program, lectures and literature in the NORA intranet:

<https://nora.nmbu.no/events/node/16775> (login required: User nora; Password nitrox)

- Evaluation schools 2&3 (attachment #2)

Highlights:

- Frequent and constructive criticism of each individual fellow's research project. All fellows are showing satisfactory progress; the scientific results are promising and publishable data have already been obtained.
- During the summer schools and project meetings, fellows have been exposed to various research areas and trained in critical and creative thinking and in bridging between different disciplines.
- Fellows hired at academic institutions have already gained increased insight into issues specific to the private sector and, similarly, those hired at private companies have close contact and collaboration with academia. The students have thus already acquired abilities to link fundamental research to more applied goals and to seek mechanistic explanations often needed for innovation and development of new products.

Impact goals:

The impact goal is to generate specific recommendations, strategies and solutions to reduce N₂O emissions. Specific goals are to:

- Invent novel approaches to reduce N₂O:N₂ product ratios in key ecosystems;
- Test the validity of such approaches at scales ranging from the cellular level to ecosystems;

- Increase the momentum and value of European industries in nitrogen issues generally, and N₂O-mitigations specifically;
- Provide strategies, guidelines and evidence-based recommendations for mitigation of N₂O emissions for policy makers, environmental agencies, industry and other stakeholders.

The fellows have only been working on their projects for about a year, but some findings and results are already achieved that are very promising and can be expected to give societal impact.

- Parameters of major importance for N₂O emissions have been identified, including pH increasing treatments; crop rotations, tillage, soil copper content and nitrite peaks (wastewater specifically) and experiments are ongoing at different scales (cell cultures, microcosms, fields/wastewater plants) to test their effects in different conditions. We expect to be able to provide improved guidelines by the end of the project period, based on our findings.

- A field robot for emission measurements has been developed, in which the Norwegian SME NORA associate partner (12) has been heavily involved, and an agreement with the German ICOS team in Thünen (Mathias Hink) to join forces to develop a #-version based on our platform. The intention is to apply for ICOS funding of at least one #-version, and if successful it may become a standard for the ICOS sites of greenhouse gas monitoring across Europe.

- A biobank has been built consisting of nitrogen transforming bacteria isolated from soils and wastewaters, and after finalising phenotypic and genotypic characterisations a selection of these isolates will be deposited in the NCIMB commercial collection (NORA associate partner 13) thus making these ecologically relevant organisms available to the public.

DELIVERABLES AND MILESTONES TABLE

RECRUITMENT

Fellow First Name	Fellow Surname	Recruiting participant	Type of Contract	Category	Location of origin	Gender	Family charges	Start date of secondment/ recruitment	Duration of secondment / recruitment	End date of secondment/ recruitment	Working time commitment	Full-time equivalent person-months covered during the reporting period	Declaration of Conformity submitted
Pawel	Lycus	UMB	A	ESR	PL-Poland	Male	No	01/09/2013	36	31/08/2016	Full Time	16	Yes
Manuel	Soriano- Laguna	UEA	A	ESR	ES-Spain	Male	No	01/11/2013	36	31/10/2016	Full Time	14	Yes
Daria	Kaptsan	VUA	A	ESR	UA-Ukraine	Female	No	01/11/2013	36	31/10/2016	Part Time	10	Yes
Monica C onte	Calvo	TUD	A	ESR	ES-Spain	Female	No	01/11/2013	36	31/10/2016	Full Time	14	Yes
Linda	Hink	UNIABDN	A	ESR	DE-Germany	Female	No	01/01/2014	36	31/12/2016	Full Time	12	Yes
Martina	Putz	SLU	A	ESR	DE-Germany	Female	No	11/11/2013	36	10/11/2016	Full Time	13.75	Yes
Luiz Alb erto Domeignoz	Horta	INRA	A	ESR	BR-Brazil	Male	No	01/10/2013	36	30/09/2016	Full Time	15	Yes
Christop h	Keuschni g	ECL	A	ESR	AT-Austria	Male	No	01/10/2013	36	30/09/2016	Full Time	15	Yes
Philipp	Schleusn er	UGOT	A	ESR	DE-Germany	Male	No	01/09/2013	36	31/08/2016	Full Time	16	Yes
Jan Reen t	Köster	UMB	A	ER	DE-Germany	Male	No	01/12/2013	24	30/11/2015	Full Time	13	Yes
Carlo	Lammirat o	YARAG	A	ER	IT-Italy	Male	No	01/01/2014	24	31/12/2015	Full Time	12	Yes
Aline Ram os da	Silva	Bioclear	A	ER	BR-Brazil	Female	No	01/02/2014	24	31/01/2016	Full Time	11	Yes

No. of full-time equivalent months covered during this reporting period: 161.75

M - Months

RESR - Researcher

FAC B - Fixed amount contract B (%)

RECRUITMENT																																							
Participants	R.1	R.2	R.3	R.4	R.5	R.6	R.7	R.8	R.9	R.10	R.11	R.12	R.13	R.14	R.15	R.16	R.17	R.18	R.19	R.20	R.21	R.22	R.23	R.24	R.25	R.26	R.27	R.28	R.29	R.30	R.31	R.32	R.33	R.34	R.35	R.36			
UMB	36	1		16	1		20	0		24	1		13	1		11	0			0						0										0			
UEA	36	1		13	1		23	0			0						0				0					0										0			
VUA	36	1		10	1		26	0			0						0				0					0										0			
TUD	36	1		14	1		22	0			0						0				0					0										0			
UNIABDN	36	1		12	1		24	0			0						0				0					0										0			
SLU	36	1		13.5	1		22.5	0			0						0				0					0										0			
INRA	36	1		15	1		21	0			0						0				0					0										0			
ECL	36	1		15	1		21	0			0						0				0					0										0			
UGOT	36	1		16	1		20	0			0						0				0					0										0			
YARAG		0						0		24	1		12	1		12	0				0					0											0		
Bioclear		0						0		24	1		11	1		13	0				0					0											0		
UEA	36	1					36	1			0						0				0					0											0		
VUA	36	1					36	1			0						0				0					0											0		
TUD	36	1					36	1			0						0				0					0											0		
UNIABDN	36	1					36	1			0						0				0					0											0		
SLU	36	1					36	1			0						0				0					0											0		
INRA	36	1					36	1			0						0				0					0											0		
ECL	36	1					36	1			0						0				0					0											0		
UGOT	36	1					36	1			0						0				0					0											0		
YARAG		0						0		24	1					24	1				0					0												0	
Bioclear		0						0		24	1					24	1				0					0												0	
Total	612	17		124.5	9		487.5	8		120	5		36	3		84	2			0					0										0		0		

- R.1 : Foreseen months (ESR)
- R.2 : Foreseen researchers (ESR)
- R.3 : Foreseen Fixed amount contract B (%) (ESR)
- R.4 : Implemented months (ESR)
- R.5 : Implemented researchers (ESR)
- R.6 : Implemented Fixed amount contract B (%) (ESR)
- R.7 : Difference months (ESR)
- R.8 : Difference researchers (ESR)
- R.9 : Difference Fixed amount contract B (%) (ESR)
- R.10 : Foreseen months (ER)
- R.11 : Foreseen researchers (ER)

R.12 : *Foreseen Fixed amount contract B (%) (ER)*
R.13 : *Implemented months (ER)*
R.14 : *Implemented researchers (ER)*
R.15 : *Implemented Fixed amount contract B (%) (ER)*
R.16 : *Difference months (ER)*
R.17 : *Difference researchers (ER)*
R.18 : *Difference Fixed amount contract B (%) (ER)*
R.19 : *Foreseen months (VS <10)*
R.20 : *Foreseen researchers (VS <10)*
R.21 : *Foreseen Fixed amount contract B (%) (VS <10)*
R.22 : *Implemented months (VS <10)*
R.23 : *Implemented researchers (VS <10)*
R.24 : *Implemented Fixed amount contract B (%) (VS <10)*
R.25 : *Difference months (VS <10)*
R.26 : *Difference researchers (VS <10)*
R.27 : *Difference Fixed amount contract B (%) (VS <10)*
R.28 : *Foreseen months (VS >10)*
R.29 : *Foreseen researchers (VS >10)*
R.30 : *Foreseen Fixed amount contract B (%) (VS >10)*
R.31 : *Implemented months (VS >10)*
R.32 : *Implemented researchers (VS >10)*
R.33 : *Implemented Fixed amount contract B (%) (VS >10)*
R.34 : *Difference months (VS >10)*
R.35 : *Difference researchers (VS >10)*
R.36 : *Difference Fixed amount contract B (%) (VS >10)*

Comments:

Daria Kapsan (ESR3; VUA) was on maternity leave from 01.01.14 to 01.05.14. We have therefore registered "part time" on her.

The second table appears to be erroneous; the 10 bottom rows are to be removed. In the NORA project there are 9 ESRs and 3 ERs only.

INTERNATIONAL CONFERENCES / EVENTS OPEN TO EXTERNAL RESEARCHERS

Event Number	Participant hosting the event	Type of Event	Month when the event took place	Start date of the event	End date of the event	Total number of researchers outside the network attending the event	Total number of researcher days for researchers from outside the network attending the event	Website of the event
1	UMB	NORA Summer School 1 (Ås, Oslo)	10	13/10/2013	18/10/2013			https://nora.nmbu.no/events/node/5821
2	UMB	Modeling workshop (Brussels)	17	19/05/2014	20/05/2014			https://nora.nmbu.no/events
3	TUD	NORA Summer School 2 (Delft)	23	15/11/2014	17/11/2014			https://nora.nmbu.no/events/node/16774
4	TUD	NORA Summer School 3 (Delft)	23	18/11/2014	20/11/2014			https://nora.nmbu.no/events/node/16775

Total number of researchers outside the network attending the event	Total number of researcher days for researchers from outside the network attending the event
0	0

Planned number of researcher days for researchers from outside the network attending the event: 0

Remaining number of researcher days for researchers from outside the network attending the event: 0

I declare that the events in category F for which a contribution is claimed did not give rise to a profit: Yes

Comments:

In Summer School 1 (Oct 2013) eight non-NORA PhD students participated in, and passed, the school. In addition a number of PhD students from Campus Ås participated in the lectures given in the course. None of the external participants were paid for by NORA money.

A workshop on Mathematical modeling was arranged in Brussels (19-20 May 2014). There were 4 non-NORA researchers and several group members from the NORA partners, but none of these were paid for by NORA money

In Summer School 2&3 (Nov 2014) altogether four non-NORA PhD students participated in, and passed, the schools. None of the external participants were paid for by NORA money.

MILESTONES

Milestone no.	Milestone name	Due achievement date from Annex I	Achieved	Actual / Forecast achievement date
1	Recruitment	30/06/2013	Yes	01/02/2014
2	Consensus on project plans	31/08/2013	Yes	31/08/2014
3	Summer School 1	31/08/2013	Yes	18/10/2013
3	School evaluation	30/09/2013	Yes	31/01/2014
4	Model strategies	30/06/2014	Yes	30/06/2014
5	Field robot strategy	31/08/2014	Yes	31/08/2014
6	Wastewater processes	31/08/2014	Yes	15/11/2014
7	Mitigation options for soil emissions	31/08/2014	No	30/04/2015
8	Key strain isolation schemes	31/12/2014	Yes	30/11/2014

Comments:

Mitigation options tested so far were discussed during the Project meeting 3 in Delft; pH increasing management was agreed as one option but others were also discussed (management strategies regarding crop rotations, tillage, soil copper content) and are currently being evaluated.

ADDITIONAL INFORMATION

Fellows First name	Fellows Surname	Living allowance (€)	Mobility allowance (€)	Travel distance (km)	Travel allowance (€)	Career allowance (€)
Pawel	Lycus	49666.00	10978.80	1100		
Manuel	Soriel Laguna	58929.23	13026.46	2401		
Daria	Kapsan	39558.00	6119.63	1880		
Monica Conthe	Calvo	39558.00	8744.40	1483		
Linda	Hink	51072.00	11289.60	1971		
Martina	Putz	45068.00	9962.40	1937		
Luiz Alberto Domeignoz	Horta	41796.00	9744.00	8635		
Christoph	Keuschnig	44118.00	9752.40	1172		
Philipp	Schleusner	45068.04	9962.40	710		
Jan Reent	Köster	76459.50	10978.80	622		
Carlo	Lammirato	55458.00	7963.20	1240		
da Silva	Aline Ramos	60898.50	8744.40	10000		

Indicate any additional information, which may be considered useful to assess the work done during the reporting period. The socio-economic aspect of the project may be addressed in this section. If applicable, propose corrective actions related to discrepancies between planned and executed deliverables and milestones.

Living- and Mobility allowances: per year amounts, calculated from what was reported in Form C.

General comment to the table:

We note the discrepancies for ESR2 and ESR3:

- ESR2 report a somewhat higher salary than expected.
- ESR3 has had maternity leave for four months. Also, the university report's a lower salary in the beginning of the PhD period, promising to increase it during the employment period.

We did inform the beneficiaries about the following, expected allowances:

	Living Allowance	Mobility Allowance
ESR2	47143	12653
ESR3	39558	12,492.00 (with family: 1000 EUR/month x 12 months x 1.041(The Netherlands))

DISSEMINATION ACTIVITIES

Comments:

Executed, first 24 months:

- NORA has developed a website for the project with public access to all non-confidential information. It includes functionality to accept and facilitate discussion and comment from NORA members, disseminate topical publications, and provide a portal for the distance-learning program. The aim is to foster the interaction, communication and collaboration between researchers addressing N2O emissions with cutting edge science and the user community that impacted by emission, and who will benefit from new research developments and mitigation solutions.
- In the NORA web site all activities related to NORA so far have been registered by the partners (<https://nora.nmbu.no/nora-in-the-public>). This site is open to all readers, but can be edited only by NORA partners. There are currently 33 registrations. Activities include scientific publications as well as newspaper articles, radio interviews etc. All dissemination activity has to be uploaded on this site, and in addition reported to the WP6 leader (UEA).
- Three NORA newsletters have been distributed (in February, June and December 2014).
- A dissemination and use plan was drawn up for the midterm review meeting. This itemises all the proposed publications, conferences and exhibitions to be attended by the network participants for the following stage of the project.

Planned, next 24 months:

- Each ER and ESR will publish at least two first author scientific publications.
- NORA fellows will be encouraged to give oral or poster presentations at up to four relevant conferences (of which at least two are international) during their time on the network.
- Each NORA fellow has committed to the following dissemination activities in their career plans:
 - 1) write short communications once a year on the NORA webpage on his research results. Participate in the writing of two popular scientific articles; one for publication in a national web-based research journal (e. g. "Forskning.no" in Norway) and one in an international journal such as New Scientist.
 - 2) take part in the organization of a workshop/activity day aimed at raising scientific awareness, for school students and their parents and university undergraduates. This day will include a series of laboratory demonstrations, activities and scientific lectures.
 - 3) run a blog in collaboration with the other NORA fellows, targeting the general public, where environmental issues in general, and greenhouse gas emissions in particular, are debated, with special interest in the role of microorganisms in these matters.

PROJECT MANAGEMENT

Comments:

The links listed are password protected. To gain access please use
username: nora
password: nitrox

PROJECT MANAGEMENT

Consortium management tasks and achievements:

Fall 2012:

Grant Agreement Form A signed by all partners

01.01.2013:

An administrator employed to support the coordinator in the day-to-day financial and organizational management of the network. This person is also responsible for updating the NORA external webpage and the NORA intranet.

February 2013:

Deliverable 1. Project meeting 1 (“Start-up”) was held in Brussels (February 2013). All partners were represented with 1-3 researchers and thus the entire Supervisory Board. Important outcomes were the consolidation of the consortium; agreement on the recruitment process; agreement on the structure of the NORA website. Minutes from the meeting (NORA intranet):
https://nora.nmbu.no/project_intranet/intranet_frontpage/startup.

Spring 2013:

- Consortium Agreement signed by all partners, including the associated partners.
- Deliverable 2. Recruitment: All ESRs and two of the ERs were contracted for start between 1 September 2013 and 1 February 2014. The ESRs started 1 September or 1 October except ESR 5 who was selected due to very good qualifications, but had to finalize Master’s exam and started 1 January 2014. The ERs all started as planned. .

October 2013:

- Deliverable 3. Project meeting 2 (“Kick-off”) was held in Oslo. All partners represented by 1-3 senior researchers, and thus the entire Supervisory Board (SB) was present. All newly recruited NORA fellows participated except ER3 who was not yet hired at that point (now hired, start date February 1, 2014; as planned). Important outcomes were: Every partner presented their ongoing research relating to NORA themes and gave an overview of their planned research within NORA; Outreach was discussed and it was agreed that all NORA outreach will be posted on the NORA website; ideas for a more professional logo were agreed on; plans for collaboration and secondments were discussed in the individual WPs 1-3 groups and presented to the SB. Minutes from the meeting (NORA intranet): https://nora.nmbu.no/project_intranet/intranet_frontpage/kick-off_meeting
- Deliverable 4. First school (4 credits (ECTS) finished, according to plan. All fellows passed the school, diplomas have been sent out. The school was evaluated in a Quest back survey, a summary of which is attached to this report (attachment #1). School program (NORA intranet): https://nora.nmbu.no/project_intranet/intranet_frontpage/summerschool-1-2013

Fall 2013:

Declaration of Conformity (DoC) uploaded on the Participant Portal (PP) by the supervisors and submitted by the coordinator; one for each NORA fellow.

February 2014:

First Progress Report submitted via PP.

June 2014:

First Internal Progress Reports written by the fellows /supervisors and evaluated by the Technical Committee. Approved reports uploaded in the NORA intranet:

https://nora.nmbu.no/project_intranet/intranet_frontpage/progress-reports

October 2014:

- Updated Internal Progress Reports written by the fellows /supervisors and evaluated by the Technical Committee. Approved reports uploaded in the NORA intranet:
https://nora.nmbu.no/project_intranet/intranet_frontpage/progress-reports
- The Mid-term Report Submitted via PP.

November 2014:

- Deliverable 5. Project meeting 3 was held in Delft. All NORA fellows attended the meeting, and all full partners were represented by at least one senior researcher. Prof Jim Prosser represented the associated partner NCIMB. The Associate partners Adigo and Paque were represented by one person each, who attended the Mid-term review meeting and Supervisory Board Meeting held in connection with Meeting 3. Each of the NORA fellows gave a 25 minutes presentation about their research results so far, and their planned research tasks and secondments. The presentations can be downloaded from the NORA intranet:

https://nora.nmbu.no/project_intranet/intranet_frontpage/project-meeting-delft

After each presentation, the audience (supervisors and fellows) asked questions and commented on the research. This session lasted the first day and part of Day 2. After this, each of the “scientific WP” leaders (WP1-3) gave a summary of the state of the different projects, in relation to the plans outlined in the NORA Grant Agreement; and thoughts and ideas about future work. All three WP leaders concluded that overall progress is fine, and the progress reports submitted in October 2014 (revised by the Technical committee) as well as the presentations on individual projects indicated generation of data that are now likely to lead to publication.

- The Med-Term Review meeting held in connection with the project meeting in Delft. All partners and associated partners except NCIMB participated. Expert Reviewer Sara Parodi (REA) led the meeting, the agenda of which was
 - coordinator’s report
 - poster presentations (all fellows)
 - interview of fellows
 - oral, preliminary feedback from the expert reviewer.

The presentations given in this meeting can be downloaded from the NORA intranet:

https://nora.nmbu.no/project_intranet/intranet_frontpage/mid-term-review-meeting

- Deliverables 6 and 7. Summer School 2 (3 credits (ECTS)) and Summer School 3 (1 credit (ECTS)) finished, according to plan. They were arranged immediately after the mid-term review meeting by WP5 in Delft. All fellows passed the schools, and diplomas have been sent out.

The program for School 2: <https://nora.nmbu.no/events/node/16774>

The program for School 3: <https://nora.nmbu.no/events/node/16775>

An evaluation of the schools (QuestBack survey) is attached to this report (Attachment #2).

Project planning and status - from management point of view:

The NORA fellows

- The recruitment process was satisfying and according to plan.
- Personal Career Development Plans were written by each ESR and ER, in collaboration with their local supervisors. The plans have been quality checked by the leaders of the respective WPs 1, 2 and 3 and discussed in the Technical Committee (TC meeting). After revisions, all plans have been accepted (follow-up TC meeting) and made available to the Supervisory Board (SB) on the NORA intranet page: https://nora.nmbu.no/project_intranet/intranet_frontpage/personal-career-plans
The Personal Career plans are updated once a year.
- Detailed plans for the fellows’ secondments have been agreed on (in the Personal Career Plans as well as in the project meetings in 2013 and 2014), please see attached overview (Attachment #3). The plans are in agreement with the NORA Grant Agreement.

Problems which have occurred and how they were solved or envisaged solutions:

- None

Changes in the consortium, if any:

- None

Changes to the legal status of any of the beneficiaries, in particular, SME status:

- Amendment 1 - An amendment request letter sent December 20, 2013, concerning electronic signatures for the FormC. Approved by REA February 10, 2014.
- Amendment 2 - The Norwegian name of the coordinating university has changed, and so the acronym is now NMBU (not UMB). The English name is unchanged (The Norwegian University of Life Sciences). Amendment request letters concerning both acronym, address, and bank details were sent March 24, 2014. Approved by REA June 2, 2014.

List of project meetings, dates and venues:

- Start-up meeting (and Supervisory board meeting), February 7-8, 2013, Norwegian Liaison Office in Brussels, KoWi's meeting room, 8th floor, Rue de Trône 98, Brussels.
- Kick-off meeting (and Supervisory board meeting), October 9-10, 2013, The Rica Oslo Hotel, Oslo, Norway.
- Technical Committee (= Executive Board) meeting, January 14, 2014, via Skype.
- Technical Committee (= Executive Board) meeting, January 28, 2014, via Skype.
- Work-shop (sub-project meeting) on "Mathematical Modelling", May 19-20, 2014, Norwegian Liaison Office in Brussels, KoWi's meeting room, 8th floor, Rue de Trône 98, Brussels.
- Technical Committee (= Executive Board) meeting, June 19, 2014, via Skype.
- Technical Committee (= Executive Board) meeting, September 12, 2014, under the "N-cycle Meeting" in Ghent, Hotel NH Gent Belfort, Hoogpoort 63, 9000 Ghent, Belgium
- Technical Committee (= Executive Board) meeting, September 19, 2014, via Skype.
- Project Meeting (and Supervisory board meeting), November 12-13, 2014, Arts Centre Delft, Rotterdamseweg 205, Delft, Netherlands.
- Mid-Term Review Meeting, November 14, 2014, Arts Centre Delft, Rotterdamseweg 205, Delft, Netherlands.

Impact of possible deviations from the planned milestones and deliverables, if any:

- No deviations

Development of the project website (if applicable):

- NORA web site is active and running (inter- and intranet).

Gender issues:

- NORA hired nine ESRs (four women and five men) and three ERs (one woman and two men)

Ethical issues:

None

Justification of subcontracting:

- Not applicable

Justification of SME equipment:

- Not applicable

Justification of real costs (management costs):

The NORA project has used € 127.101.42 on management in the first 24 months, € 109,873.03 of which were used by the Coordinator.

For comparison, the management budget for the first 24 months was € 193,285.04.

FINANCIAL STATEMENTS – FORM C AND SUMMARY FINANCIAL REPORT

Comments:

Comments on the submitted Form Cs:

ESR2: Living and Mobility Allowances higher than expected.

ESR3: Living and Mobility Allowances lower than expected. A separate form about the maternity leave has been sent directly to REA from VUA.

In both cases the Coordinator advised the beneficiaries to report differently.

CERTIFICATES

List of Certificates which are due for this period, in accordance with Article II.4.4 of the Grant Agreement.

Beneficiary	Organisation short name	Certificate on the financial statements provided?	Any useful comment, in particular if a certificate is not provided
1	UMB	No	
2	UEA	No	
3	VUA	No	
4	TUD	No	
5	UNIABDN	No	
6	SLU	No	
7	INRA	No	
8	ECL	No	
9	UGOT	No	
10	YARAG	No	
11	Bioclear	No	

Attachments	PUBLISHABLE SUMMARY.pdf, PUBLISHABLE SUMMARY.docx, Periodic Report 1 attachment #2.pdf, Periodic Report 1 attachment #1.pdf, Secondments table.docx, Detailed description of research progress and achievements.docx
Name	
Date	

This declaration was visaed electronically by Asa FROSTEGARD (ECAS user name nfrosta) on 01/03/2015