OR 63/2010

CO_2nnect

CO_2 on the Way to School: Campaign Data Analysis Summary Report

Scott Randall

Norsk institutt for luftforskning
Norwegian Institute for Air Research
NILU

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Support

Education and Culture DG

Lifelong Learning Programme

This project has been funded with support from the European Commission.

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This campaign Summary Report is based on the full campaign report entitled: "CO2nnect, CO2 on the Way to School: Campaign Data Analysis" (Randall, 2010).

CO_2nnect Campaign Data Analysis

Summary Report

1 Introduction

As CO_2 emissions are being recognized as the pivotal contributor to global climate change, it is becoming important for students to learn about how these emissions are generated and solutions for emissions reduction in which students can relate to. The adaptive learning concept of Education for Sustainable Development (ESD) is an appropriate model to follow when developing tools to educate students in this issue. In addition, using Information and Communication Technologies (ICT) within the ESD platform yields a powerful learning tool that students can feel comfortable utilizing.

An ESD campaign with an ICT web-based platform was developed to increase awareness and understanding of the issue, and to affect attitudes and values towards the issue, at the global scale. To meet this goal the specific campaign exercise was developed in which student's measure their own individual CO_2 contribution during their daily travel to school, where the methods of this calculation were kept simple for greatest possible inclusion of students. The campaign (methods and platform) was inspired through a similar campaign performed in Norway in 2007 (Hansen & Randall, 2008).

1.1 Learning Outcomes

The campaign was developed according to specific learning outcomes associated with the principles of ESD. ESD attempts to improve and develop understanding, skills/abilities, awareness, and attitudes/values – and these outcomes were incorporated into the campaign through the theme of sustainability, climate change, and mobility. The specific learning outcomes and additional background information available on the campaign website at: http://www.co2nnect.org/help_sheets/?op_id=598&opt_id=98.

1.2 Goals/Objectives

The purpose of the campaign is to improve the understanding and practice of ESD in the context of a topic of global interest. The campaign meets this greater purpose through providing a web-based activity in which students from any nation can participate and engage with other students, researchers, and policy-maker within the topic of CO_2 emissions. The specific goals can be found on the campaign website at: http://www.co2nnect.org/?op_id=601&opt_id=100.

1.3 Background – 2007 Norwegian Campaign

The CO_2nnect campaign was based upon the 2007 Norwegian Research Campaign "CO_2 on the way to School". This campaign ran Fall of 2007 in Norway, and was carried out in cooperation between the Norwegian Directorate for Education and Training (*Utdanningsdirektoratet*), Science Days

(*Forskningsdagene*), the School Laboratory at the University of Bergen (*Skolelaboratoriet*), and the Norwegian Institute for Air Research (*NILU*). The campaign is a part of annual environmental research campaigns which have occurred every autumn in Norway since 2003. The report from the 2007 campaign is entitled "CO_2 on the way to school: English summary of final report assessing the 2007 Norwegian student-based web campaign" (Hansen & Randall, 2008).

2 Methods

The methods for the CO_2nnect campaign participation were based partially upon the 2007 Norwegian Campaign, and were specifically designed to be simple and straight-forward in order to encourage the greatest amount of involvement from all age classes. The campaign was also open to all schools throughout the world (the campaign website was available in 18 different languages), for students and teachers to participate. The campaign composed of the following main parts:

1. **Registration** of user and school information
2. Enter transportation **data** and answer **questionnaire**
3. **Analyze** individual/school results and compare to other's inputted data
4. **Additional activities** (working with local authorities, uploading climate ideas, projects, pictures, etc.).

More specific detail regarding the methods can be found on the campaign website at: http://co2nnect.org/what/. The precise calculation of emissions for each transportation category is available at the campaign website: http://www.co2nnect.org/help_sheets/?op_id=602&opt_id=98. Help sheets for the campaign were available on the campaign website at: http://www.co2nnect.org/help_sheets/. The campaign also stressed development of the school, and how the campaign could be incorporated into the school learning curriculum, where information on this was available on the campaign website at: http://co2nnect.org/help_sheets/?op_id=597&opt_id=98. Links to others valuable information sources were available on the campaign website at: http://www.co2nnect.org/links/. The campaign website also contained a valuable glossary of terms which is available at: http://co2nnect.org/help_sheets/?op_id=639&opt_id=98.

3 Results

The dataset used for this results analysis is from the time period February 15, 2009 to May 15, 2010. Note that the project is continually open for registration and participation, so the results are continually changing as well.

3.1 Participants

636 schools with 2252 classes from 44 different countries registered data for the project during the stated period, see Table 1 for the full list of registrants, which shows how Malaysia and Romania alone made up for almost 50% of the total number of schools and classes which registered for the campaign, followed by

Jordan, Greece and Finland. 31808 individuals from 401 schools from 30 different countries actually participated in the campaign.

Table 1: Campaign registration listed by different sortings – A) Alphabetically, B) By number of Schools, and C) By number of Classes.

A) Participation listed Alphabetically			B) Participation listed by # Schools			C) Participation listed by # Classes		
Country	# Schools	# Classes	Country	# Schools	# Classes	Country	# Schools	# Classes
Australia	1	2	Malaysia	158	472	Romania	114	536
Austria	7	18	Romania	114	536	Malaysia	158	472
Bahrain	2	5	Jordan	67	219	Jordan	67	219
Belgium	9	24	Greece	46	120	Finland	36	170
Bulgaria	2	2	Finland	36	170	Greece	46	120
Cyprus	4	8	Denmark	28	77	Germany	17	102
Denmark	28	77	Norway	25	45	Hungary	12	96
Estonia	5	16	Italy	19	45	Denmark	28	77
Finland	36	170	UK	18	61	UK	18	61
France	5	10	Germany	17	102	Spain	9	60
Germany	17	102	Hungary	12	96	Italy	19	45
Greece	46	120	Spain	9	60	Norway	25	45
Hungary	12	96	Belgium	9	24	Turkey	4	26
India	1	7	Slovenia	7	19	Belgium	9	24
Iraq	1	3	Austria	7	18	Slovenia	7	19
Ireland	2	10	Korea	5	15	Austria	7	18
Italy	19	45	Estonia	5	16	Estonia	5	16
Jordan	67	219	France	5	10	Korea	5	15
Korea	5	15	Russia	5	11	Russia	5	11
Malaysia	158	472	Cyprus	4	8	France	5	10
Moldova	1	1	Sweden	4	7	Thailand	2	10
Nepal	3	3	Turkey	4	26	Ireland	2	10
	3	8	Nepal	3	3		3	8
Nigeria	1	1		3	8	Zambia	1	8
Norway	25	45	Thailand	2	10	Cyprus	4	8
Pakistan	1	6	Bulgaria	2	2	Sweden	4	7
Poland	1	4	Portugal	2	5	India	1	7
Portugal	2	5	Bahrain	2	5	Slovakia	2	7
Romania	114	536	Slovakia	2	7	Pakistan	1	6
Russia	5	11	Ireland	2	10	Portugal	2	5
Saudi	1	5	Ukraine	1	1	Bahrain	2	5
Slovakia	2	7	Uganda	1	3	Saudi	1	5
Slovenia	7	19	Nigeria	1	1	Poland	1	4
Spain	9	60	UAE	1	1	Nepal	3	3
Sweden	4	7	Zambia	1	8	Iraq	1	3
Switzerland	1	1	Moldova	1	1	Uganda	1	3
Taiwan	1	2	Pakistan	1	6	Taiwan	1	2
Thailand	2	10	Taiwan	1	2	Bulgaria	2	2
Turkey	4	26	India	1	7	Australia	1	2
Uganda	1	3	Iraq	1	3	UAE	1	1
Ukraine	1	1	Poland	1	4	Switzerland	1	1
UAE	1	1	Saudi	1	5	Ukraine	1	1
UK	18	61	Switzerland	1	1	Moldova	1	1
Zambia	1	8	Australia	1	2	Nigeria	1	1

A map of the participating schools can be seen in Figure 1.

Figure 1: Map of the Participating Schools.

3.2 CO_2 Emissions

A summary of the overall CO_2 results can be seen in Table 2. The emission intensity for all participants is 80.4 g/km, where this value is dependent upon the school way distance and mode of transportation. The total CO_2 emitted during all 31808 participants travel to school (one-way) is 13513.7 kg (2.4 kg/participant average), where each participant averages 161 kg of CO_2 per year during their travels to school. To put these numbers into perspective, a one-way flight from London to Kuala Lumpur averages about 1231 kg of CO_2 per passenger (source: chooseclimate.org), where 10 passengers on one of these flights would almost equal all of the 31808 campaign participants CO_2 emitted during their one-way trip to school. It should also be noted that humans naturally respire approximately 1kg of CO_2 per day (depending on one's activity level)[1].

Table 2: Overall CO_2 results for CO_2nnect campaign.

Summary of results	All schools
Emission intensity (g/km)	80.4
No of reporters (students and teachers)	31808
Mean school way distance (km)	5.3
CO_2 emitted for pooled reported distances (kg)	13513.7
CO_2 per reporter per school year (190 days, kg)	161

[1] Human respiration values were not taken into consideration when calculating CO2 emissions for the campaign.

CO_2 emissions varied greatly between participant countries, where countries such as the UK, Bahrain, Spain, and Malaysia reported high CO_2 emission intensities over 100g/km; while countries such as Belgium, Finland, Romania, and Norway reported lower CO_2 emission intensities which were under 70 g/km (see Table 3).

Table 3: CO_2 emissions results per participant country[2].

Country	No. of schools	No. of reporters	School-way distance km (mean)	CO_2 (kg)	CO_2 kg/year/reporter	CO_2 g/km
Bulgaria	1	21	5.3	13.9	250.6	**124**
United Kingdom	5	508	2.6	149.8	112	**112**
Bahrain	2	136	7.5	105	293.4	**103**
Spain	6	690	2.5	174.9	96.3	**102**
Malaysia	138	13619	4.4	5658.6	157.9	**94**
Greece	12	486	5.5	245.5	192	**93**
Italy	8	203	6.6	115.7	216.6	**86**
Jordan	51	2588	5.6	1236.4	181.5	**86**
Slovenia	3	209	2.5	44.4	80.8	**86**
Estonia	2	64	6.9	35.6	211.5	**80**
Austria	3	102	19.7	155	577.4	**77**
Thailand	2	177	12.1	162.8	349.6	**76**
Korea (Republic of)	3	110	5.6	46.5	160.5	**76**
Germany	12	1376	10.6	1100.6	304	**75**
India	1	193	8.3	116.1	228.6	**73**
Denmark	9	179	8.9	114.5	243	**72**
Portugal	1	16	6	6.8	161.7	**71**
Norway	17	452	5.1	160.5	135	**69**
Hungary	8	1570	5.8	610.1	147.7	**67**
Romania	77	7110	5.5	2581.5	138	**66**
Turkey	2	42	12.8	35.1	318	**66**
Slovakia	1	29	3.2	6	78.9	**65**
Finland	25	1763	5.3	593.4	127.9	**64**
Sweden	2	15	10.3	9.4	237.2	**61**
Belgium	4	98	6.3	32.4	125.4	**52**
Cyprus	1	13	0.8	0.5	15.8	**52**
Poland	1	22	1.1	0.8	14.1	**34**
Netherlands	2	17	3.9	1.9	42.6	**29**
Russia	1	1	0.1	0	0	**0**
Iraq	1	1	1	0	0	**0**

3.3 Transport Modes and CO_2 emissions

In order to calculate the CO_2 emissions for each participant, the participants needed to record the length of their travel to school, and the transportation

[2] Countries which had less than 25 reporters, or only 1 school should be treated with caution as representing the whole country as this holds very low statistical power. Countries which fall into this category were not removed from the dataset, but were also not used in comparisons either.

method(s) used. Table 4 displays the 22 transportation methods recorded during the campaign, and the percent frequency of each mode (participants could choose more than one mode). 45% of participants use transportation modes which do not emit CO_2 (walking, biking, etc.), where 30% use mass transportation modes (busses, trains, etc.), and 36% use personal transportation modes (cars, motorcycles, etc.)[3].

Table 4 Transportation mode results for all participants.

Transport mode		
foot	35.4%	(11262)
bicycle	9.2%	(2918)
by animal transport	0.1%	(39)
rickshaw/trishaw	0.1%	(17)
moped	0.7%	(220)
motorcycle	8.6%	(2723)
auto rickshaw	0.2%	(52)
snowmobile	0.0%	(12)
car electric	0.1%	(34)
car small	7.4%	(2358)
car medium	14.9%	(4727)
car large	3.4%	(1078)
car hybrid	0.2%	(55)
taxi	1.4%	(460)
bus	22.6%	(7193)
minibus	3.5%	(1125)
diesel train	0.4%	(136)
electric train	0.9%	(297)
subway/metro	0.4%	(137)
electric tram/trolley bus	2.1%	(660)
ferry	0.1%	(18)
express boat	0.0%	(13)
other mode(s) (please specify)	1.1%	(359)

For each transportation mode, CO_2 totals were calculated for all participants (Table 5). Each of the transportation modes has different emission factors/multipliers which were used during the CO_2 calculation. These results show that busses contribute the greatest total CO_2 at nearly 4000 kg for all participants (one-way to school), and make up the greatest distance at more than 57000 km. But if you look at medium sized cars, this contribution is also almost 4000 kg, but the distance is approximately 29000 km – nearly half the bus distance. This result is due to the fact that the bus emission factor is exactly half that of medium-sized cars.

[3] These values are greater than 100% due to the fact that some participants use more than one mode of transport during their daily travel to school.

Table 5: Transportation modes, total distances and CO_2 results.

Modes of transport	Distance (km)	CO_2 (kg)
foot	15638.3	0
bicycle	6729.2	0
by animal transport	184.1	0
rickshaw/trishaw	113.2	0
moped	1135.4	82.9
motorcycle	11204.4	1053.2
auto rickshaw	223.7	13.7
snowmobile	88.6	8.3
car electric	274.3	11.8
car small	14089.4	1549.8
car medium	28458.8	3785
car large	6711.2	1228.1
car hybrid	419.8	35.3
taxi	3576.3	608
bus	57012.5	3933.9
minibus	8081.8	444.5
diesel train	2507.6	150.5
electric train	5251.2	341.3
subway/metro	1150.4	74.8
electric tram/trolley bus	3127.4	131.4
ferry	131.7	15.1
express boat	87	46.1
other mode(s) (please specify)	1988.5	0
Total	168185	13513

3.4 Questionnaire

The first part of the questionnaire presented four questions regarding campaign outcomes, in which participants would rank their agreement or disagreement with the statements (Table 6). All four of the statements were fairly equally agreed upon, showing that the participants are generally concerned with the greater campaign issue, feel they have transportation choices, feel safe on their way to school, and believe that their school can do more to offer "climate-friendly" transport.

Table 6: CO_2nnect Questionnaire results for all participants (Part I).

I am concerned about how transport contributes to climate change.

1 (strongly disagree)	5%	(1583)
2	6%	(2068)
3	21%	(6757)
4	25%	(8097)
5 (strongly agree)	36%	(11399)
N/A	6%	(1993)

I have a choice about how I travel to school.		
1 (strongly disagree)	13%	(4106)
2	12%	(3921)
3	19%	(6088)
4	18%	(5764)
5 (strongly agree)	33%	(10400)
N/A	5%	(1618)

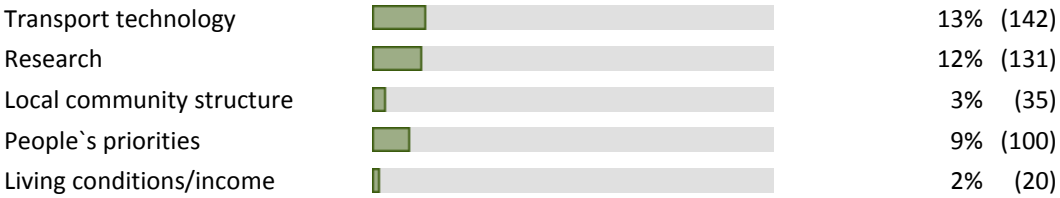
My school and local administration should do more to provide me with a more climate-friendly way to get to school.		
1 (strongly disagree)	9%	(2941)
2	9%	(2906)
3	20%	(6497)
4	20%	(6248)
5 (strongly agree)	32%	(10278)
N/A	9%	(3027)

I feel safe on the way to school.		
1 (strongly disagree)	8%	(2571)
2	10%	(3251)
3	22%	(7137)
4	24%	(7638)
5 (strongly agree)	31%	(9882)
N/A	4%	(1418)

The second part of the questionnaire challenged the participants to think where they believe solutions to CO_2 emission problems should come from (Table 7), each participant chose three topics from the available list. Results from this questionnaire are not dramatic, but it is interesting that the topics of "democratic processes", "public awareness", "economic regulations", "local community structure", and "living conditions" received very little consideration as valuable solutions, while "research", "technology", and "transportation plans/habits" were popular choices on average for all participants.

Table 7: CO_2nnect Questionnaire results for all participants (Part II).

What kinds of changes are needed to reduce CO_2 emission from transport?		
Laws and regulations	7%	(75)
National transportation plans	10%	(110)
Education	8%	(81)
Transport habits	11%	(116)
Transportation of goods	8%	(90)
Engagement by groups in society	8%	(82)
Democratic processes	2%	(18)
Information/public awareness	4%	(43)
Economic support/regulations	3%	(37)



4 Project Reports and Ideas

4.1 Participant Project Reports

Schools which participated in the campaign were encouraged to create a school project relating to the campaign outcomes, but within this framework the topics for the projects were very open. Guidance was given on the campaign website describing how to design and implement a campaign project: http://co2nnect.org/help_sheets/?op_id=594&opt_id=98. This guidance centered on defining the project, considering potential cooperative partners, designing a project plan, implementing the project, writing the project report, and presenting the project to interested parties.

The deadline to submit project reports was mid-October 2009, and by that time 40 had schools submitted reports (from 11 different countries).

4.2 Participant Climate Ideas

Learning outcomes of ESD includes the overall improvement in the understanding of the given issue, and attitudes towards the issue as well. Building upon this direction, the campaign encouraged individual students to suggest short ideas on how climate issues should be addressed and resolved (mostly in their local community). 266 climate ideas from 19 different countries were uploaded and posted to the campaign website. Many of the interesting ideas focused on the expected topics such as:

- Ways to encourage walking/bicycling and public transportation.
- Ways to discourage the strong reliance upon cars and single occupancy.
- Utilizing innovative technologies for lower emissions.
- Planting trees for the uptake of CO_2.

But, there were also many unique ideas which focused on education and societal change, suggesting that the ESD outcomes may have had large effects upon their knowledge and thinking regarding the issue. The full list of the climate ideas can be found on the campaign website at:
http://www.co2nnect.org/results/?vis=climate_ideas

5 Discussion and Conclusion

The campaign results show that overall, 45% of participants use transportation modes which do not emit CO_2 (walking, biking, etc.), where 30% use mass transportation modes (busses, trains, etc.), and 36% use personal transportation modes (cars, motorcycles, etc.)[4]. The fact that almost half of all participants do not emit CO_2 on their way to school is a good sign, showing that most participants have the necessary available transportation options to get to school without harming the climate – and it is excellent that a majority of students are actually utilizing these "climate friendly" options.

The total CO_2 emitted during all 31808 participants travel to school (one-way) is 13513.7 kg (2.4 kg/participant average), where each participant averages 161 kg of CO_2 per year during their travels to school. The values are relatively small when seen in perspective with how much CO_2 is emitted from single air travel journey's, or from industrial plants, etc. – so while students are doing a great job in minimizing their personal CO_2 emissions on the way to school, they must also be aware that other facets of society are contributing far greater amounts.

Modes of transportation to school greatly differ between countries, and this can be due to many regional factors including weather, cultural preferences, policy/planning, funding, and education. These factors affect the available transportation modes, which in turns affects the country-wide CO_2 emission rates. So it is possible that in many cases students have the desire to utilize low emission transportation modes, but the regional factors make this reality difficult – but not impossible!

The questionnaire was successful in identifying that a majority of participants feel safe on their way to school, feel they have adequate transportation choices, and have a genuine concern for how transport impact the climate – on the same hand most also agree that their schools should do more to provide "climate-friendly" transportation options to school. It is also interesting that students put the topics of research and technology as primary solutions to address climate/transport problems, and place economic incentives and societal change issues as lower priorities. But this result somewhat contradicts the "climate ideas" proposed by the participants, because very few of these proposed ideas mentioned research/technology, where mostly addressed behavioral and societal-based changes to address climate problems. This contradiction could be a factor of that when students are given the options for correct solutions, they will pick the mainstream answers (similar to picking the correct answers to a quiz), but when the question is left open ended, they tend to be more creative through finding more personal actions that they themselves can contribute to.

[4] These values are greater than 100% due to the fact that some participants use more than one mode of transport during their daily travel to school.

The CO_2nnect campaign can certainly be considered a great success. There was excellent participation at all levels, which in part can be due to the wonderful campaign website/tool and effective campaign organization. It is amazing that all of the results presented in this summary report were generated directly from the campaign website, where no additional tools or raw data-sets were needed to complete the analysis (most analysis in the full report was generated in the same manner). All of the participants should be commended for their contribution to the campaign, and extra recognition should be given to those schools which utilized the campaign to additional lengths such as writing reports, organizing community events and campaigns, and bringing issues up with local administrators and policy-makers. Based on this success, recommendations for the future are presented in the following section.

It is also encouraged to read the full campaign report (Randall, 2010) for additional data analysis, discussion, and conclusion.

6 Recommendations

Due to the success of the campaign, the following recommendations are presented to consider for future planning:

- Ensure distribution of this summary report and the full report to campaign participants.
- Bring the campaign and its results to a larger audience through international teacher training workshops.
- Repeat the campaign in the near future with the same participants to begin to notice any trends in behavioral change.
- Perform a simple follow-up web survey for the participants to determine any potential effects from campaign participation on their behavior.
- Use the success of the campaign model on different environmental and social issues.
- Publish the campaign results/methods in an international journal (focusing on ESD or similar).

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Norwegian Institute for Air Research
P.O. Box 100, N-2027 Kjeller, Norway
Associated with CIENS and the Environmental Research Alliance of Norway
ISO certified according to NS-EN ISO 9001

REPORT SERIES	REPORT NO. OR 63/2010	ISBN 978-82-425-2282-5 (printed) ISBN 978-82-425-2283-2 (electronic) ISSN 0807-7207	
SCIENTIFIC REPORT			
DATE	SIGN.	NO. OF PAGES	PRICE
13.08.2010		13	NOK 150.-

TITLE	PROJECT LEADER
CO2nnect Summary Report	Scott Randall
	NILU PROJECT NO. O-109147
AUTHOR(S) Scott Randall	CLASSIFICATION * A
	CONTRACT REF. Astrid Sandås

REPORT PREPARED FOR

Utdanningsdirektoratet (UDIR)

ABSTRACT

CO_2 and its relation to anthropogenic emission has been primary issue in researching and providing solutions to the current global climate change issue. The CO_2nnect project tackled this issue by crafting a campaign for schools to determine their CO_2 emissions generated during their daily travels to school. The campaign was based on ESD-ICT premises, with an excellent campaign webpage for registration, data entry, data analysis, and questionnaires. The CO_2nnect campaign is also primarily influenced and based on the 2007 Norwegian campaign which containing similar goals and methods. The main goal of the CO_2nnect campaign was to engage a large number of schools to understand more about the field of climate and transport.

Overall participation in the campaign was excellent (over 30000 participants, from 44 countries), which gives strong power for analysis and comparison of the data. The campaign data was analyzed by focusing on the CO_2 emission intensities, the transportation mode results, and the questionnaire results. Comparisons were also made to the Norwegian 2007/2008 campaigns, as well as cross-analysis of CO_2 data and questionnaire data was performed.

NORWEGIAN TITLE

KEYWORDS		
CO_2	ESD-ICT	Student Campaign

ABSTRACT (in Norwegian)

** Classification*
- *A Unclassified (can be ordered from NILU)*
- *B Restricted distribution*
- *C Classified (not to be distributed)*

REFERENCE: O-109147
DATE: AUGUST 2010
ISBN: ISBN 978-82-425-2282-5 (printed)
ISBN 978-82-425-2283-2 (electronic)

NILU is an independent, nonprofit institution established in 1969. Through its research NILU increases the understanding of climate change, of the composition of the atmosphere, of air quality and of hazardous substances. Based on its research, NILU markets integrated services and products within analyzing, monitoring and consulting. NILU is concerned with increasing public awareness about climate change and environmental pollution.

NILU Norsk institutt for luftforskning
Norwegian Institute for Air Research