



EUROPEAN COMMISSION
RESEARCH & INNOVATION DG

Periodic Report

Project No: 242446

Project Acronym: MONARCH-A

Project Full Name: Monitoring and Assessing Regional Climate
change in High latitudes and the Arctic

Periodic Report

Period covered: from 01/03/2010 to 28/02/2011

Date of preparation: 21/06/2011

Start date of project: 01/03/2010

Date of submission (SESAM):
21/06/2011

Project coordinator name:

Prof. Johnny A. Johannessen

Project coordinator organisation name:

STIFTELSEN NANSEN SENTER FOR
FJERNMAALING

Version: 2

Periodic Report

PROJECT PERIODIC REPORT

Grant Agreement number:	242446
Project acronym:	MONARCH-A
Project title:	Monitoring and Assessing Regional Climate change in High latitudes and the Arctic
Funding Scheme:	FP7-CP
Date of latest version of Annex I against which the assessment will be made:	23/02/2010
Period number:	1st
Period covered - start date:	01/03/2010
Period covered - end date:	28/02/2011
Name of the scientific representative of the project's coordinator and organisation:	Prof. Johnny A. Johannessen STIFTELSEN NANSEN SENTER FOR FJERNMAALING
Tel:	+47-55-205800
Fax:	+47-55-205801
E-mail:	johnny.johannessen@nersc.no
Project website address:	http://monarch-a.nersc.no

Declaration by the scientific representative of the project coordinator (1)

I, Prof. Johnny A. Johannessen STIFTELSEN NANSEN SENTER FOR FJERNMAALING , as scientific representative of the coordinator of the project MONARCH-A and in line with the obligations as stated in Article II.2.3 of the Grant Agreement declare that:

The project has fully achieved its objectives and technical goals for the period.

The attached periodic report represents an accurate description of the work carried out in this project for this reporting period.

The public 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 (section 6) 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.

Name	Prof. Johnny A. Johannessen STIFTELSEN NANSEN SENTER FOR FJERNMAALING
Date	21/06/2011

This declaration was visaed electronically by Johnny A JOHANNESSEN (ECAS user name njohanja) on 21/06/2011

1. Publishable summary

Summary description of project context and objectives

Quantifying and reducing the uncertainty in climate predictions is a critical element in IPCC considerations, in order that society can use the predictions to take informed decisions on mitigation and adaptation strategies. This presents a major challenge in climate modeling and prediction. Quality control of the model fields through regular and consistent validation and inter-comparison against independent observations is therefore mandatory, as is implementation of realistic initial conditions. Recently Cox and Stephenson (2007) have shown that the major element of uncertainty in predictions up to 30 years is the lack of adequate information on initial conditions - i.e. lack of quality observations. In order to reduce the uncertainty in climate predictions over such a multi-decadal period, improved knowledge of the coupling between the dynamic processes in the atmosphere, the solid Earth, the hydrosphere, the cryosphere, the biosphere and the anthroposphere are needed. These components are interlinked by forcing and feedback mechanisms at a broad range of temporal and spatial scales, and usually with distinct regional characteristics. The Arctic and northern hemisphere high latitude regions, in particular, are susceptible to climatic and environmental change. Rapid decreases in Arctic Sea ice concentration and decreases in sea surface carbonate saturation caused by human-produced CO₂ are two striking examples. Quantitative uncertainties in changes in high latitude and Arctic sea level, permafrost and surface albedo are other examples. The European citizen has a right to know the consequences of such changes for Europe. However, this cannot adequately be provided today. The scientific rationale, uniqueness and timeliness of the MONARCH-A project must be seen in this perspective.

The ultimate goal of MONARCH-A is consequently to generate a dedicated information package tailored to a subset of multidisciplinary Essential Climate Variables (ECVs) and their mutual forcing and feedback mechanisms associated with changes in terrestrial carbon and water fluxes, sea level and ocean circulation and the marine carbon cycle in the high latitude and Arctic regions. Adopting an Earth system approach MONARCH-A will execute systematic provision of tailored information and products to assist climate change research and generate and make available reliable, up-to-date scientific input for the elaboration and implementation of European and international policies and strategies on climate change and society. The information package will be based on generation of time series of observation datasets and reanalyses of past observational data enabling adequate descriptions of the status and evolution of the high latitude and Arctic region Earth system components.

The MONARCH-A approach will be organized around four main activities, notably: (i) changes in carbon-water interaction; (ii) changes in sea level and ocean circulation; (iii) changes in marine carbon cycle; and (iv) synthesis and interaction with the scientific community on climate change research. 11 multidisciplinary Essential Climate Variables (ECVs) relevant for high latitude and Arctic regions will be generated and made available in the information package. Arranged according to the GCOS ECVs domain they include:

- Terrestrial: river discharge, snow cover, ice sheet mass balance and permafrost;
- Oceanic: sea ice drift and sea ice volume, sea level, current, ocean color and CO₂ partial pressure;
- Atmospheric: near surface wind field

Description of work performed and main results

The activity of MONARCH-A during the first year involves assembling of data sets and model runs for further analysis of the Essential Climate Variables that will lead to a synthesis of mutual forcing and feedback mechanisms associated with changes in terrestrial carbon and water fluxes, sea level and ocean circulation and the marine carbon cycle in the high latitude and Arctic regions.

For the terrestrial systems time series snow extent and start/end dates of snow cover have been completed, as well as altimetry based water level variations of some large Arctic rivers and lakes. A large set of historical Russian permafrost maps have been assembled and digitized. Available land cover and fire products, runoff, their trends and uncertainties from a range of sources have been analyzed and comparison with models.

For sea level and ocean circulation data sets on spatial-temporal variability and changes of Greenland

ice sheet elevation from 1992 to 2008 from satellite radar altimetry are available. Several numerical models of the Arctic circulation and sea ice cover and have been compared and assessed together with recommendations of further model improvements. For ice thickness a geoid model has been applied to recover freeboard data.

For the ocean carbon cycle a comprehensive data base of inorganic marine carbon cycle data is made available together with derived quantities and meta-information on data quality and statistics for the Atlantic through the Arctic. Primary productivity time series based on remotely sensed ocean color are provided as gridded data sets for the Arctic Ocean. For projecting trends in ocean carbon uptake, a model simulation spanning 1850-2099 of the ocean carbon cycle is performed highlighting anthropogenic CO₂ uptake and horizontal transport for the Arctic and other major oceanic basins.

A preliminary synthesis report of the work progress and achievements for the first year has been provided.

Expected final results and potential impacts

As the length of existing Essential Climate Variables (ECV) data records increases (in some cases now to around 20-30 years) and they gradually become of better quality and accuracy, adequate validation and adaptation to better initialization of models are becoming feasible. In this context, the expected advanced achievements from the Earth system approach undertaken in MONARCH-A, with its focus on high latitude and Arctic regions, will lead to progress beyond the state-of-the-art. In particular the generation of refined and consistent multidisciplinary time series of:

- Terrestrial: river discharge, snow cover, ice sheet mass balance and permafrost;
- Oceanic: sea ice drift and sea ice volume, sea level, current, ocean color and CO₂ partial pressure;
- Atmospheric: near surface wind field

integrated with existing complementary information on land cover, fire, sea ice extent and concentration, sea ice thickness, sea surface temperature and sea level will provide tailored information and products to assist climate change research to incorporate the refined and consistent ECVs. For the ocean carbon cycle, satellite observations constrain primary production - through ocean color and chlorophyll related transfer functions (with the possibility to quantify air-sea gas exchange and detect blooms of specific species), through surface wind-speeds and their variability, sea state/white capping, sea surface temperature and ice cover which influences biological production and gas exchange. There is some hope to obtain new reliable atmospheric CO₂ column measurements from space (GOSAT), but not for the surface ocean where one still has to rely on in-situ measurements. For the carbon budget, moreover, the export production rather than the primary production is critical. Though export production can be roughly estimated from primary production, models need to be employed in order to fully account for a correct quantification of the biological carbon pump.

Through re-analyses adequate and consistent description of the status and evolution of the high latitude and Arctic region will be provided in the context of terrestrial carbon and water fluxes, sea level and ocean circulation and marine carbon cycle. It will focus on changes during the last 30 - 50 years. This will ensure new scientific input for the elaboration and implementation of European and international policies and strategies on the environment and society, including climate adaptation strategies addressing European, national, regional and local levels. All in all the outcome of MONARCH-A is therefore anticipated to provide important new quantitative scientific knowledge and information consistent with GCOS -107 (2006) to:

- characterize the state of a subset of dominant multidisciplinary ECVs and their variability in high latitude and Arctic areas;
- monitor the forcing of the high latitude climate system, including natural and anthropogenic contributions, at regional and local scales;
- support the attribution of the causes of high latitude climate change;
- support prediction of high latitude climate change
- enable advanced understanding of the two-way connections between global and regional climate change.

Project public website address:

<http://monarch-a.nersc.no>

2. Core of the report

Project objectives, Work progress and achievements, and project management during the period

The Project Summary Pdf document contains the core of the report.

3. Deliverables and milestones tables

Deliverables (excluding the periodic and final reports)										
Del. no.	Deliverable name	Version	WP no.	Lead beneficiary	Nature	Dissemination level	Delivery date from Annex I (proj month)	Actual / Forecast delivery date	Status	Comments
2	D1.2.2/D1.2.3 Water level variations over the large Arctic rivers from satellite altimeters	1.0	1	CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE	Report		12	11/04/2011	Submitted	
3	Del 1.1.1 and 1.1.3: Monthly and 5-day fields of snow extent Start and end dates of snow cover	1.0	1	CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE	Report	PU	9	11/04/2011	Submitted	
10	D1.4.1 Analysis of available land cover and fire products and recommendations for use in climate models	2.0	1	THE UNIVERSITY OF SHEFFIELD	Report	PU	12	15/04/2011	Submitted	
12	D1.4.2: Land	1.0	1	THE UNIVERSITY	Report	PU	15	20/06/2011	Submitted	

	cover maps transformed into forms suitable for carbon, water and climate modeling			OF SHEFFIELD						
4	D2.4.1 Assessment existing descriptions of the Arctic Ocean Circulation and its transport properties	1.0	2	UNIVERSITAET HAMBURG	Report	PU	12	11/04/2011	Submitted	
5	D.2.4.2 Assessment shortcomings and needs for new improved Arctic Reanalyses	1.0	2	UNIVERSITAET HAMBURG	Report	PU	12	11/04/2011	Submitted	
6	D3.1.1 Consistent databases of inorganic marine carbon cycle data	2.0	3	UNIVERSITETET I BERGEN	Report	PU	12	11/04/2011	Submitted	
1	D5.1.4 Report on service level agreement	1.0	4	STIFTELSEN NANSEN SENTER FOR FJERNMAALING	Report	PU	12	04/04/2011	Submitted	

	with the GMES core services and ESA CCI projects									
7	D4.4 Design, implementation and maintenance of web portal Web site	1.0	4	STIFTELSEN NANSEN SENTER FOR FJERNMAALING	Demonstrator	PU	12	12/04/2011	Submitted	
8	D4.2 Interaction and feedback report from contacts with external scientific communities	1.0	4	STIFTELSEN NANSEN SENTER FOR FJERNMAALING	Report	CO	13	12/04/2011	Submitted	
9	D4.1 Synthesis report of the state and variability of changes in high latitude and Arctic regions including dedicated feedbacks to the GMES core services	2.0	4	STIFTELSEN NANSEN SENTER FOR FJERNMAALING	Report	PU	12	13/04/2011	Submitted	
11	D5.1.1 Periodic Management Reporting	1.0	5	STIFTELSEN NANSEN SENTER FOR FJERNMAALING	Report	PU	12	20/04/2011	Submitted	

Milestones							
Milestone no.	Milestone name	Work package no	Lead beneficiary	Delivery date from Annex I	Achieved Yes/No	Actual / Forecast achievement date	Comments
1	M1.1 Snow database	1	CNRS	31/08/2011	No	31/08/2011	
2	M1.2 Surface water and runoff database	1	CNRS	31/08/2011	No	31/08/2011	
3	M1.3 Permafrost database	1	NIERSC	30/06/2012	No	30/06/2012	
4	M1.4 Permafrost model interface	1	USFD	31/08/2012	No	31/08/2012	
5	M1.5 Land cover database	1	USFD	31/05/2011	No	31/05/2011	
6	M1.6 Fire database	1	USFD	31/08/2012	No	31/08/2012	
7	M2.1 Arctic climate database	2	UHAM	29/02/2012	No	29/02/2012	
8	M2.2 Arctic mean sea level	2	DTU	29/02/2012	No	29/02/2012	
9	M2.3 Arctic climate Greenland Ice sheet mass database	2	CNRS	29/02/2012	No	29/02/2012	
10	M2.4 Arctic ocean and Ice synthesis	2	UHAM	28/02/2013	No	28/02/2013	
11	M2.5 Sea Ice motion database	2	NERSC	28/02/2013	No	28/02/2013	
12	M2.6 Maps of sea ice thickness, volume and improved SSH measurements	2	DTU	31/08/2012	No	31/08/2012	
13	M2.7 Freshwater runoff trend	2	CNRS	31/08/2012	No	31/08/2012	
14	M3.1 Marine carbon cycle database	3	UiB	29/02/2012	No	29/02/2012	
15	M3.2 Marine carbon cycle hindcast	3	UiB	28/02/2013	No	28/02/2013	
16	M3.3 Reanalyses of	3	UiB	28/02/2013	No	28/02/2013	

	anthropogenic carbon uptake and transport in the Arctic for the last 50 years						
17	M4.1a Preliminary synthesis report	4	NERSC	29/02/2012	No	29/02/2012	
18	M4.2b Final synthesis report	4	NERSC	28/02/2013	No	28/02/2013	
19	M4.2 Support to design and implementation of Arctic monitoring and prediction system	4	UiB	28/02/2013	No	28/02/2013	
20	M5.1 Minutes of Kick-off meeting	5	NERSC	30/04/2010	Yes	30/04/2010	Available at http://monarch-a.nersc.no
21	M5.2 Annual review meeting	5	NERSC	20/05/2011	No	20/05/2011	
22	M5.3 Final meeting	5	NERSC	12/02/2013	No	12/02/2013	

4. Explanation of the use of the resources

STIFTELSEN NANSEN SENTER FOR FJERNMAALING			
Work Package	Item description	Amount	Explanations
2 Changes in sea level and ocean circulation	Labor	35373.53	This is 2.3 person months salary for scientist/expert, 1 person-month for senior scientist/expert and 0.8 person-month for junior expert.
2 Changes in sea level and ocean circulation	Overhead	45055.50	Corresponding overhead costs
2 Changes in sea level and ocean circulation	Travels	1605.52	Travel for Kjetil Lygre to the 1st project meeting in Hamburg, 6-7 September 2010.
3. Changes in marine carbon cycle	Labor	27030.87	This is 4.5 person-months for junior scientist/expert, and 1 person-month for senior scientist/expert.
3. Changes in marine carbon cycle	Overhead	36706.53	Corresponding overhead costs.
4 Synthesis and Interaction with the scientific community	Labor cost	23919.70	This is 1.2 person months for senior expert/scientist and 0.8 person-months for junior scientist/expert.
4 Synthesis and Interaction with the scientific community	Overhead	28630.83	Corresponding overhead costs.
4 Synthesis and Interaction with the scientific community	Consumables	800.01	481.75 for the Kick-off meeting at NERSC in Bergen on 18-19 March 2010 The remaining are running consumable expenses.
5. Management	Labor	17409.87	The is 1.6 person months for senior scientist.
5. Management	Overhead	15360.80	Corresponding overhead costs.
5. Management	Travels	1356.56	Travel for the coordinator Johnny A. Johannessen to the 1st project meeting in Hamburg, 6-7 September 2010.
	Total:	233249.7200000003	

THE UNIVERSITY OF SHEFFIELD			
Work Package	Item description	Amount	Explanations
1	Labor	24307.25	The labor costs are connected with WP 1 and include the 1.3 person-months salary for one senior expert and 5 person-months for junior expert.
1	Overhead	15853.10	Corresponding overhead costs.
1	Travels	2114.59	Expenses for S. Quegan to attend the kick-off meeting at

			NERSC in Bergen, Norway on 18-19 March 2010 and the 1st PM at UHAM in Hamburg, Germany on 6-7 September 2010 where also Euripides Kantzas participated.
	Total:	42274.94	

UNIVERSITAET HAMBURG

Work Package	Item description	Amount	Explanations
2	Labor	60764.62	The labor costs are connected with WP 2 and include the salary of one senior expert for 2 person-months and one junior expert for 11 person-months.
2	Overhead	38698.59	Corresponding overhead costs.
2	Travels	3733.03	Expenses for D. Stammer to attend the kick-off meeting at NERSC in Bergen on 18-19 March 2010.
	Total:	103196.23999999999	

CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE

Work Package	Item description	Amount	Explanations
1	Labor	0.00	No labor costs have been charged to the project
1	Overhead	0.00	No overhead costs have been charged to the project
1	Travels	3608.09	Travel expenses for one person to attend the kick-off meeting at NERSC in Bergen, Norway on 18-19 March 2010 and one person to the 1st PM at UHAM in Hamburg, Germany on 6-7 September 2010. In addition travel expenses are for presenting MONARCH-A results at the ESA Living Planet symposium in Bergen Norway, 28 June-2 July.
2	Labor	20844.39	Total person months are 7. This has been spent by one junior scientist.
2	Overhead	16893.67	Corresponding overhead costs
2	Travel	3703.64	Expenses for three persons to attend the 1st progress meeting in Hamburg.
	Total:	45049.78999999999	

Third Party UNIVERSITE PAUL SABATIER TOULOUSE III

Work Package	Item description	Amount	Explanations
1	Labor	31986.08	Total person months are 6. This is labor costs for one senior scientist.
1	Overhead	19191.65	Corresponding overhead costs.
	Total:	51177.73	

Scientific foundation Nansen International Environmental and Remote Sensing Centre

Work Package	Item description	Amount	Explanations
1	Labor	14522.88	This corresponds to a total of 6.36 person months of which 4.81 person months are senior scientist and 1.55 person months are scientist/technical support
1	Overhead	10571.85	Corresponding overhead costs.
1	Consumables	325.86	Office expenses. Printing paper and software for the Laptop
1	Travels	2771.01	Travel for L. Bobylev to the kick-off meeting at NERSC in Bergen, Norway from 18-19 March 2010 and the 1st progress meeting at UHAM in Hamburg, Germany from 6-7 September.
3	Labor	13581.21	This corresponds to 5.65 person months of which 5.29 person months are senior scientist and 0.66 person months are scientist
3	Overhad	13526.80	Corresponding overhead costs.
3	Consumables	1309.86	Purchase of Laptop. The purchase of the new Laptop was really necessary to fulfill the work. The computer was purchased for the calculation of suspended inorganic carbon release into the Arctic Ocean due to coccolithophore blooming. The calculations needed large memory and speed resources, ensured by the new computer.
3	Travels	7653.59	Expenses for D. Pozdnyakov participation to the kick-off meeting at NERSC in Bergen, Norway from 18-19 March 2010 and the 1st progress meeting at UHAM in Hamburg, Germany from 6-7 September. D. Pozdnyakov has also made two visits to NERSC, Bergen to work on the bio-optical retrieval algorithm (WP3.2) with NERSC staff.

	Total:	64263.06	
--	--------	----------	--

UNIVERSITETET I BERGEN

Work Package	Item description	Amount	Explanations
3	Consumables	2541.10	Purchase cost for 1 desktop and 1 laptop. The computer equipment was necessary as front-ends to supercomputers, for carrying out test runs, for model development (adjustments, tuning) as well as for verification of results and graphics.
3	Travels	1524.66	Participation of C. Heinze in MONARCH-A progress meeting at UHAM on 6-7 September 2010 in Hamburg, Germany.
	Total:	4065.76	

DANMARKS TEKNISKE UNIVERSITET

Work Package	Item description	Amount	Explanations
2	Labor	12658.18	Labor costs are salary for 2.1 person-months for one junior expert
2	Overhead	9775.71	Corresponding overhead costs.
2	Travels	3634.67	Expenses for the participation of three persons to the Kick-off meeting at NERSC, Bergen, Norway from 18-19 March 2010 and the 1st PM at UHAM in Hamburg, Germany on 6-7 September 2010.
	Total:	26068.559999999998	

INSTITUT FRANCAIS DE RECHERCHE POUR L'EXPLOITATION DE LA MER

Work Package	Item description	Amount	Explanations
2	Labor	11641.35	Labor costs for contribution to WP 2 in total 1.3 person months, of which 1.15 is for senior scientist/expert and 0.15 junior scientist/expert.
2	Overhead	7334.05	Corresponding overhead costs.
	Total:	18975.4	

Attachments	MONARCHa_periodic report_year 1.pdf
Grant Agreement number:	242446
Project acronym:	MONARCH-A
Project title:	Monitoring and Assessing Regional Climate change in High latitudes and the Arctic
Funding Scheme:	FP7-CP
Project starting date:	01/03/2010
Project end date:	
Name of the scientific representative of the project's coordinator and organisation:	Prof. Johnny A. Johannessen STIFTELSEN NANSEN SENTER FOR FJERNMAALING
Period covered - start date:	01/03/2010
Period covered - end date:	28/02/2011
Name	
Date	21/06/2011

This declaration was visaed electronically by Johnny A JOHANNESSEN (ECAS user name njohanja) on 21/06/2011