



EUROPEAN COMMISSION  
Research Executive Agency  
Marie Curie Actions – International Fellowships

**Project No:** 624680

**Project Acronym:** MANU

**Project Full Name:** Marine Aerosol NUcleations

## **Marie Curie Actions**

# **Periodic Report**

**Period covered:** from 17/03/2014 to 01/03/2016

**Period number:** 1st

**Start date of project:** 17/03/2014

**Project coordinator name:**  
Prof. colin o dowd

**Version:** 1

**Date of preparation:** 28/04/2016

**Date of submission (SESAM):** 28/04/2016

**Project coordinator organisation name:**  
NATIONAL UNIVERSITY OF IRELAND,  
GALWAY

# Periodic Report

## PROJECT PERIODIC REPORT

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|--|---|
| <b>Grant Agreement number:</b>   | 624680  |
| <b>Project acronym:</b>  | MANU  |
| <b>Project title:</b>  | Marine Aerosol NUcleations                                |
| <b>Funding Scheme:</b>   | FP7-MC-IOF  |
| <b>Period report:</b>  | 1st   |
| <b>Period covered - start date:</b>  | 17/03/2014  |
| <b>Period covered - end date:</b>  | 01/03/2016  |
| <b>Name, title and organisation of the scientist in charge of the project's coordinator:</b> | Prof. colin o dowd NATIONAL UNIVERSITY OF IRELAND, GALWAY |
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## **DECLARATION BY THE SCIENTIST IN CHARGE**

I, Prof. Colin O'Dowd, as scientist in charge of the project (624680, MANU), 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:
  - (o) has fully achieved its objectives and technical goals for the period;
  - ( ) has achieved most of its objectives and technical goals for the period with relatively minor deviations;
  - ( ) has failed to achieve critical objectives and/or is not at all on schedule.
- The project Website (if applicable) 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.
- The beneficiary, 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 6 (Project Management) in accordance with Article II.2.f of the Grant Agreement.

## 1. PUBLISHABLE SUMMARY

This section normally should not exceed 2 pages.

It shall be of suitable quality to enable direct publication by the REA or the Commission. You may extract this wholly or partially from the website of the project, if suitable, but please ensure that this is set out and formatted so that it can be printed as a stand-alone paper document.

Please include:

- a summary description of the project objectives,
- a description of the work performed since the beginning of the project,
- a description of the main results achieved so far,
- the expected final results and their potential impact and use (including the socio-economic impact and the wider societal implications of the project so far).

You should update this publishable summary at the end of each reporting period.

Please include also, as appropriate, diagrams or photographs illustrating and promoting the work of the project, the project logo and relevant contact details.

Please ensure that all publishable reports submitted to the REA for publication are of a suitable quality to permit direct publication without any additional editing. By submitting the publishable reports to the REA, you are also certifying that they include no confidential material.

The address of the project public website should also be indicated, if applicable.

The internet address should be active.

### **Publishable summary:**

The topic of this proposal is the natural marine aerosol, which is of paramount importance at the global scale and influences the Earth's radiative budget and the biogeochemical cycles. New particle formation dominates the atmospheric aerosol number budgets and most of these particles are formed by nucleation of marine biogenic vapours. MANU (Marine Aerosol Nucleations) aims to directly identify the spontaneous creation of new nanometer-sized particles in the open ocean marine atmosphere and to understand the physical and chemical transformations occurring in them once formed. MANU will (1) obtain the spatial variability of new particle formation (NPF) events in different open ocean areas, (2) elucidate the chemical composition of NPF events, (3) associate NPF events with biological processes and (4) interpret how NPF events affect the existing aerosol and its overall Cloud Condensation Nuclei (CCN) population. The approach involves state-of-the-art mass spectrometry measurements including ATOFMS, HR-ToF-MS and Api-ToF/MS during a Southern Ocean research cruise (Hesperides, 2014) and at the Mace Head research station (Ireland, 2015).

We have successfully collected aerosol size resolved information in open ocean conditions, taking the opportunity to deploy SMPS and AMS, as well as ATOFMS and CCN-OTDMA-HTDMA instrumentation between 20-10-14 and 15-02-15 on board of the research vessel Hesperides. We covered a large time coverage (4 months) as well as spatial one (Mediterranean sea, tropical Atlantic and southern Ocean).

## 2. PROJECT OBJECTIVES FOR THE PERIOD

Please provide an overview of the project objectives for the reporting period in question, as included in Annex I of the Grant Agreement. These objectives are required so that this report is a stand-alone document.

Please include a summary of the recommendations from the previous reviews (if any) and indicate how these have been taken into account.

### **Project objectives for the period:**

MANU (Marine Aerosol Nucleation)

Researcher: Manuel Dall'Osto

Scientist in charge: Colin O'Dowd

17-03-2014 till 01-03-2016

## WORK PROGRESS AND ACHIEVEMENTS DURING THE PERIOD

Summary of progress towards objectives and details for each task;

Objective 1: Obtain the spatial variability of new particle formation (NPF) events in different open ocean areas, including the Southern Ocean and the North Atlantic.

We have collected large datasets including tropical ocean and southern ocean, for a total of about 100 days of measurements. Objective 1 was achieved.

Objective 2: Elucidate the chemical composition of NPF events in the open ocean atmosphere by state-of-the-art on-line particle mass spectrometry.

We have deployed on line mass spectrometry - both AMS and ATOFMS - to the same oceanic transits of objective 1. Instruments were working well, objective 2 well achieved.

Objective 3: Associate NPF events with biological processes occurring in the open ocean environment.

We are associating new particle formation events with processes occurring in the tropical ocean (around Equator, case study 31-10-2014) and around the Weddell sea (case study, January 2015). Objective 3 achieved and manuscripts currently being written.

Objective 4: Interpret how NPF events affect the existing aerosol and its overall CCN population.

We are working on this objective 4, we do not see any problems achieving it on the second year of MANU.

Summary of progress of the researcher training activities/transfer of knowledge activities/integration activities

The researcher have gained excellent training at Aerodyne Inc (outgoing institution), working in close contact with world leading researcher like Dr Tim Onash, Dr. Manjula Canagaratna, Dr. Doug Wornsop and Dr. John Jayne. Training included both deployment of state of the art instruments, data analysis and data interpretations of HR-AMS data. We are constantly integrating and continue to transfer knowledge between Aerodyne (USA) and Europe (ICM-CSIC Spain and NUI Galway Ireland).

Highlight clearly significant results

1. We were able to link an important case study of an open ocean nucleation event of biogenic origin in the tropical Atlantic ocean, and link it with clear marine air masses in biogenic rich waters. We found that amines and methansulphonic acid are key chemical components in the growth of new particle formation events.
2. We were able to link enhancement of new particle formation in the Weddell sea region, suggesting the sea ice marginal zone is a source of new particle formation.

Reasons for deviations from Annex I and their impact on other tasks as well as on available resources and planning;

I applied to the Marie Skłodowska-Curie IOF fellowship in August 2013, and I was very excited when on the 29-11-2013 I was awarded the fellowship Marie Curie IOF 624680 MANU (Marine Aerosol Nucleations) with a total score of 92.7%. I was particularly pleased of the facts that the

reviewers rated as very good the quality of the proposed research, as well as the good training research objectives in the outgoing host American (Boston) institution. We all agreed the match between the project and the applicant's profile is excellent.

After negotiation, I started my MANU project on 17-03-2014. I spent about 9 months at Aerodyne (outgoing host) and I achieved most of the challenging training provided. Specifically, as described in section B2.1 of part B, I achieved specific training on pToF-HR-ToF-AMS where we were able to first detect the direct chemical composition of open ocean tropical nucleation events, a clear objective of MANU (currently in preparation for submission to Nature Geoscience).

A second main objective of MANU was to obtain the spatial variability of new particle formation events in different open ocean areas, including the Southern Ocean and North Atlantic. In order to do so, we took the great opportunity to a long (6 weeks) oceanographic cruise on board of the Hespérides to the regions of South Georgia Island (subantarctic) and the Weddell Sea (Antarctica). The intended dates (PEGASO - already founded by the Spanish ministry of innovation, but lacking in atmospheric measurements - now greatly provided by this Marie Curie project MANU) were late 18-11-2014/30-12-2014, as shown in page 22 of the Part B proposal. However, the six weeks long research cruise vessel PEGASO (Plankton-derived Emissions of trace Gases in the Southern Ocean), a founded ICM-CSIC project which aims at investigating the biological factors driving plankton-derived production and emission of aerosol forming substances in the Southern Ocean was greatly expanded. This was because of the great synergy of multidisciplinary areas provided by different projects, including the current project MANU. This was a unique opportunity not to be missed, so I stayed on board of the research vessel in order to acquire valuable data. For this reason, I asked to Mr. Andreas Obermaier (Project Officer Research Executive Agency) to interrupt my Marie Curie for 6 months (from 15 December 2014 to 15 June 2015). The requested was accepted on 16-12-2014 due to duly and well-founded professional reasons.

Additionally, during the research cruise (made possible thankfully to the old return host, Dr. Rafel Simo) we were able to collect some key physical measurements - not originally planned - including:

- Cloud Condensation Nuclei (CCN). A CCN counter instrument is a key instrument in addressing climate change - aerosol properties relationship. Indeed, as indicated in the part B of the proposal (pg. 4 second para), MANU is strongly related to one of the central topics of the international project Surface Ocean Lower Atmosphere Study or Surface Ocean Lower Atmosphere Study (SOLAS-IGBP): Quantify the nucleation and growth of aerosols in the marine environment and their relative contribution to the marine CCN population.

- Moreover, two additional physical instruments were deployed on board of the research vessel: Hygroscopic Tandem Differential Mobility Analyser (HTDMA) and UFO-TDMA (ultrafine organic tandem differential mobility analyser, called OTDMA). The scattering strongly depends on the aerosol's ability to absorb water (hygroscopicity), which in turn, determines the particle's ambient size under a given humidity regime. Additionally, hygroscopicity can determine the particle's ability to act as a cloud condensation nucleus – CCN.

The Hygroscopic Tandem Differential Mobility Analyser (HTDMA) is designed to measure size resolved aerosol hygroscopic properties. Hygroscopic properties refer to how an aerosol population responds to a change in relative humidity. The working principle of the UFO-TDMA (ultrafine organic tandem differential mobility analyser, called OTDMA) is similar to the HTDMA, except that ethanol is the working fluid rather than water and the particles are brought to a selected sub-saturated ethanol vapour environment where they can grow to a new size in accordance to their composition and size.

It is important to note that the candidate (as shown in part B.3 of Part B) has not expertise in CCN, HTDMA, OTDMA data analysis. Also, as indicate in Pg 7 section B1.4 of the part B, this project is very timely and a major benefit of MANU include the fact that marine aerosol needs to consider nucleation processes to accurately evaluate the CCN number. This is a unique opportunity for the applicant to gain knowledge and experience in the field of emerging aspects of new particle formation events, including detecting and understanding how amines and other organo-nitrogen compounds influence the formation of new particle events and their overall influence on the CCN

population.

For this reason, I would like to change the host in the Department of Physics of NUI Galway (Ireland), probably the best centre in Europe where to implement physics chemistry and biology of marine new particle formations. This will give me the possibility to integrate and analyse all the data collected, and produce some great science.

In a nutshell, taking the four main objective of MANU (Page 5 of Part B):

- Obtain the spatial variability of new particle formation (NPF) events in different open ocean areas, including the Southern Ocean and the North Atlantic.

Achieved thankfully the old European Host contact and the possibility to take part to an Antarctica expedition.

- Elucidate the chemical composition of NPF events in the open ocean atmosphere by state-of-the-art on-line particle mass spectrometry.

Achieved thankfully the great research training conducted at the outgoing research host.

- Associate NPF events with biological processes occurring in the open ocean environment.

Achieved thankfully the great possibility to join a research vessel with 15 biologists on board.

- Interpret how NPF events affect the existing aerosol and its overall CCN population.

Missing and possible due to the new measurements taken (CCN, HTDMA, OTDMA) and the change of host at NUIG with the experienced scientist in charge Prof Colin O'Dowd.

If applicable, explain the reasons for failing to achieve critical objectives and/or not being on schedule and explain the impact on other tasks as well as on available resources and planning

The impact of MANU is even better than previously thought.

A statement on the use of resources, in particular highlighting and explaining deviations between actual and planned researcher-months in Annex 1 (Description of Work)

The impact of MANU is even better than previously thought, we have collected even more data than we hoped, and analysed them jointly with the return and host institution.

### **3. WORK PROGRESS AND ACHIEVEMENTS DURING THE PERIOD**

Please provide a concise overview of the progress of the work in line with the structure of Annex I of the Grant Agreement - except project management, which will be reported in section 6.

- A summary of progress towards objectives and details for each task;
- A summary of the progress of the researcher training activities/transfer of knowledge activities/integration activities (as it applies for the MC action);
- Highlight clearly significant results;
- If applicable, explain the reasons for deviations from Annex I and their impact on other tasks as well as on available resources and planning;
- If applicable, explain the reasons for failing to achieve critical objectives and/or not being on schedule and explain the impact on other tasks as well as on available resources and planning (the explanations should be coherent with the declaration by the scientist in charge) ;
- A statement on the use of resources, in particular highlighting and explaining deviations between actual and planned researcher-months in Annex 1 (Description of Work)

- If applicable, propose corrective actions.

#### **Work progress and achievements during the period:**

see above

### **4. ADDITIONAL INFORMATION**

#### **Comments:**

### **5. DISSEMINATION ACTIVITIES**

Use this section to summarise all dissemination activities executed during the reporting period as well as activities planned for next period.

#### **Dissemination activities:**

- Conference overview: PEGASO and MANU project, SOLAS conference September 2015, Germany.
- Divulga at ICM-CSIC gave internet coverage. Through the web portal ICM DIVULGA ([www.icmdivulga.icm.csic.es](http://www.icmdivulga.icm.csic.es)), MANU was helped by the main field study (PEGASO) and we created and maintained an outreach and education blog with texts and images. Before the start of the cruise, the blog presented the objectives and strategy of the project, and a brief description of the participants. Once a week during the cruise, the scientists and technicians posted information on the research activities, the life on board, educational contents about Antarctica and the poles, and personal experience expressed by poetry. Scholars were invited to send their comments and questions around the contents provided or other issues of their interest, and all of them were answered from the ship.
- The field study was broadcast in local TV (TV3 Barcelona Spain) and in several national newspapers, including "el mundo".
- Outreach was also carried out at local administrations in the port of Punta Arena (Chile) and Ushuaia (Argentina).

### **6. PROJECT MANAGEMENT**

Please use this section to summarise management activities during the period:

- Project planning and status - from management point of view;
- Problems which have occurred and how they were solved or envisaged solutions;
- Changes to the legal status of any of the beneficiaries, in particular, SME status;
- Impact of possible deviations from the planned milestones and deliverables, if any;
- Development of the project website (if applicable);
- Gender issues; Ethical issues;
- Justification of subcontracting (if applicable);
- Justification of real costs (management costs);
- Other

For 2007 and 2008 calls a detailed description of costs related to management and overhead is requested

#### **Project management:**

Project management

The MANU project is running well according to its objectives planned.



## Attachments

The content of this report has been approved by the researcher and the scientist in charge assigned to this project. The electronic submission of this report shall replace their signatures.

This declaration was visaed (signed) electronically by Colin O'DOWD (ECAS user name nodowdcn) on 28/04/2016