Version 2015-03-10

COST Action 13013
(22/10/2013– 21/10/2017)

Towards operational ground based profiling with ceilometers, Doppler lidars and microwave radiometers for improving weather forecasts (TOPROF).

PROGRESS REPORT 1/2
(Action start: 22/10/2013 – Report date: May 2015)

This report is submitted by the MC Chair on behalf of the Management Committee and is validated by the Scientific Committee of the COST Association.

Confidentiality: the document will be made available to the public via the Action page on the COST website except for Section II.D.

Executive summary of the Progress Report:
(max.500 words) (to be completed by Action Chair describing the Action's progress with achieving the Action MoU objectives and generating outputs and impacts)

TOPROF is concerned with observations from three currently under-exploited instruments: Automatic Lidar Ceilometers (ALC), Doppler wind lidars (DWL) and microwave radiometers (MWR), so they can provide observations suitable for Data Assimilation (DA) into the new generation of high resolution numerical weather prediction (NWP) models developed by European National Weather Services (NWSs). The goal being to improve forecasts of impending hazardous weather such as flash floods, storm events, fog conditions, and pollution episodes. The deployment, networking, and near-real time data exchange of the hundreds of ALCs in Europe is the responsibility of the NWSs via the EUMETNET 'E-PROFILE' activity, whereas the Doppler lidars and MWRs are also distributed among national research institutions and universities. The four working groups of TOPROF are responsible for standardized calibration, data quality and algorithms to transform observations into variables held in the NWP models.

WG1: ALCs measure aerosol and cloud backscatter profiles, providing valuable information on aerosol loading, volcanic ash, fog, cloud phase, depth and density. Following calibration field campaigns, work on harmonising data formats and defining instrument errors, an inter-comparison campaign with 12 ALCs will take place June-Aug 2015. E-PROFILE is setting up a pilot network to test data flow from the ALCs.

WG2; Doppler Wind Lidars (DWL) sense the movement of aerosol particles and so measure wind and turbulence. Toprof has established the first DWL network with calibrated and quality assure wind and turbulence data. A data hub has been set up, so winds can be received by 'E-PROFILE' with a view to incorporating the boundary layer winds from DWLs into the operational wind profiler network.

WG3: Microwave radiometers provide temperature and humidity profiles together with column integrated water vapour and liquid cloud water. A calibration campaign has been completed, and data flow organised from 10 instruments to a common server, so that the observations ('O') can be compared with NWP model background ('B'), and the first 'O-B' statistics can be gathered.

WG4: Data assimilation. After a year's harmonising data formats and characterising errors for the instruments in WG1, 2 and 3, and developing 'forward models' to predict the instrument observations from the model variables, the first 'O-B' statistics for the DWD forecast model will be carried out in autumn 2015; data can only be assimilated observations if they are close to the values held in the model.

After the kick-off meeting, three joint MC/WG meetings have been held: MC2: 18-20 March 2014 (Payerne, CH), MC3: 18-20 Nov 2015 (Roskilde, DK) and MC4: 5-7 May 2015 (Granada, ES) with attendances of 55,

60 and 80, respectively. At the Granada meeting 20 out of the 22 countries participating in TOPROF were present; and 15 out of a possible 16 participating National Weather services were in attendance as were six manufacturers: 4 for ALCs, 1 Doppler lidar, and 1 for MWR. Thus far, we have had 4 STSMs and 5 SWGs (Special Working Group meetings), with a further 6 and 4, respectively, to take place before the end of this year. All documents and papers from these activities are on the TOPROF web site.

Summary assessment of Progress Review by Action Rapporteur:	
(max.500 words) (to be transferred by SO from Action Rapporteur report) SO enters Action Rapporteur 500 word summary here. SO enters Action Rapporteur 500 word . SO enters Action Rapporteur 500 word summary here. SO enters Action Rapporteur 500	
Action Rapporteur	Name Institution Country

Validation by Scientific Committee
This report was validated by the Scientific Committee on: <insert date of SC validation>

COST is supported by the EU Framework Programme Horizon 2020

COST Association
Avenue Louise 149 I 1050 Brussels, Belgium
t: +32 (0)2 533 3800 I f: +32 (0)2 533 3890
office@cost.eu I www.cost.eu

I. Progress Report

I.A. COST Action Profile

Objective/ Aim

Copy here Action main objective from eCOST/ the Action MoU

Details

MoU:	03/07/2013	Start of Action:	22/10/2013
CSO approval date:	16/05/2013	End of Action:	21/10/2017

COST Member Countries and Cooperating State having accepted the MoU

22: Austria, Belgium, Bulgaria, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Netherlands, Norway, Poland, Portugal, Romania, Spain, Switzerland, Turkey, United Kingdom.

0

Other participants:

Institution Name	Country
0	

Contacts

Chair/ Vice Chair

Position	Name	Contact details	Country	Date of PhD:	Gender
Chair:	Anthony Illingworth	University of Reading Earley Gate, RG6 6BB Reading United Kingdom **A.J.Illingworth@reading.ac.uk**	UK	1970	M
Vice Chair:	Dominique Ruffieux	MeteoSwiss, Les Invuardes, 1530 Payerne, Switzerland **dominique.ruffieux@meteoswiss.ch**	CH	1985	M

Working Group Leaders

WG#	WG Title	WG Leader	Country	Date of PhD:	Gender	Number of participants
1	Automatic Lidars and Ceilometers (ALCs)	Martial Haeffelin	F	1996	M	30
2	Doppler Wind Lidars	Ewan O'Connor	FI	2003	M	25
3	Microwave Radiometers (MWR)	Ulrich Loehnert	D	2002	M	25
4	Data Assimilation	Roland Potthast	D	1994	M	25

Other positions if applicable (STSM Coordinator, WG Vice Leader, Task Force Leader…)

Position	Name	Country	Date of PhD:	Gender
WG 3 co-chair	Domenico Cimini	IT	2002	M

Action website:	**http://www.toprof.eu**

I.B. Progress with MoU objectives and deliverables and additional outputs

MoU objectives

MoU objective	Achieved Yes/ Partially/ No	Evidence of (partial) achievement including hyperlink to enable assessment of the achievement[1]. Justification if full achievement is not foreseen
1 To implement a harmonized ceilometer network reporting quality-controlled calibrated attenuated backscatter profiles of aerosols and clouds in near real time across Europe	Partially	Four Tasks are carried out within Work Group 1 to reach these objectives: 1. ALC calibration methods (Rayleigh and Cloud) have been tested on multiple ALCs (several ALC models, several sites). We plan to deliver a recommendation on calibration methods to E-PROFILE by end-2015. STSM report available at: http://www.toprof.imaa.cnr.it/index.php/short-term-scientific-mission/8-1-short-term-scientific-mission 2. A new version of the RAW2L1 converting tool to put all ALC data in a common data format has been developed (available autumn 2015). Former version available at http://www.lmd.polytechnique.fr/~strat/download.php 3. ALC measurement uncertainties have been assessed. Instrument issues have been raised and partially solved through discussions with manufacturers. Four manufacturers participated in the MC4 meeting. 4. An ALC intercomparison campaign is organized by Working Group 1 for 3 months (June-Aug 2015) at the DWD Lindenberg observatory, where 12 instruments will be compared. See WG1 report from MC4 and WG1 work plan: http://www.toprof.imaa.cnr.it/images/toprof/working_group/TOPROF_WG1_2015_UpdatedWorkPlan.pdf Finally, an ALC pilot network has been setup by E-PROFILE to test data flow, calibration procedures, data harmonization and provision of calibrated attenuated backscatter profiles. http://e-profile.org/alc.html
2. To evaluate the backscatter profiles predicted by the prognostic aerosol schemes within the next generation of European forecast models for forecasting air quality as exemplified by the EU-FP7 MACC model at European Centre for Medium-Range Weather Forecasts	Partially	Two Tasks to support this objective: 1. Coordinated developments based on the 4 Tasks described above will lead to the provision of datasets containing Calibrated attenuated backscatter profiles from the ALC pilot network. A first dataset will be provided in October 2015. 2. WG1 supports the development of ALC forward operators by WG4. A special working group meeting dedicated to this issue is planned for 27-28 July in Reading. O-B comparisons will be able to start in fall 2015.
3 To set up a system to monitor the spatial distribution, height and density of aerosol plumes (e.g. volcanic ash, mineral dust, biomass burning, or industrial accidents) over Europe, which are key information	Partially	Three tasks are dedicated to these objectives: 1. fog prediction using ALC profiles to trace aerosol activation processes. See STSM report: http://www.toprof.imaa.cnr.it/index.php/short-term-scientific-mission/18-use-of-alc-measurements-to-detect-and-predict-fog 2. mixing height retrieval using ALC profiles. A specific

[1] The links to the outputs and deliverables will be used by the Action Rapporteur in assessing the progress.

for air traffic safety, and to monitor the depth through which surface emitted species are mixed or trapped over Europe, a key factor for pollutant concentration predictions.		session was dedicated to this issue at the MC3. A recommendation on mixing height retrieving technique will be delivered to ICOS. See http://www.toprof.imaa.cnr.it/index.php/management-committee/21-2014-11-18-mc3-and-wg 3. A method to infer aerosol extinction surface and volume from elastic backscatter lidars is under development.
4. To establish the operational procedures for the new Doppler lidars by defining suitable scan strategies that combine zenith viewing operation to sense vertical wind structure and turbulence with azimuth scanning operation to provide accurate and representative high resolution profiles of horizontal winds.	Partially	WG2 has assessed instrument performance, and is establishing operational procedures for generating quality-controlled wind and turbulence profiles at high spatial and temporal resolution from Doppler lidar across Europe. A Special Working Group meeting (11-12 Sep, 2014, Fuerstenwalde) was devoted to defining operational procedures for retrieving profiles of horizontal wind from different instruments, and instrument configurations. The SWG Scientific report on wind retrievals is available at: http://www.toprof.imaa.cnr.it/index.php/test-3?jsmallfib=1&dir=JSROOT/sub_working_group&download_file=JSROOT/sub_working_group/Scientific_Report_WG2_DL-winds-SWG_20140912.pdf. An update on uncertainties in wind retrievals was discussed at the MC4 meeting; the report will be available shortly. A Special Working Group meeting (2-3 Mar, 2015, Helsinki) was dedicated to methods for retrieving turbulent properties from different instruments and instrument configurations. The SWG Scientific report on turbulent retrievals is available at: http://www.toprof.imaa.cnr.it/index.php/test-3?jsmallfib=1&dir=JSROOT/sub_working_group&download_file=JSROOT/sub_working_group/Report_WG2_DL-Turbulence-SWG_20150302.pdf Instrument measurement uncertainties are being assessed, with issues reported to and discussed with manufacturers.
5 To investigate the ability of the Doppler lidars to identify the various boundary layer states, such as, stable, unstable, coupled and decoupled, so that boundary layer classification and parameterization schemes implicit in NWP models can be evaluated.	Partially	New turbulent retrievals allow the diagnosis of various aspects of the dynamical boundary layer, including type and height, and identifying the presence and source of mixing. The potential is outlined in the Scientific report for the 1st Special Working Group meeting on turbulent properties (2-3 Mar, 2015, Helsinki), available at: http://www.toprof.imaa.cnr.it/index.php/test-3?jsmallfib=1&dir=JSROOT/sub_working_group&download_file=JSROOT/sub_working_group/Report_WG2_DL-Turbulence-SWG_20150302.pdf Potential improvements/updates to the standard classical picture of the boundary layer, prompted by the new Doppler lidar observations, continued at the MC4 meeting; the report will be available shortly.
6 To establish the operational procedures for the microwave radiometers by defining protocols for calibration procedures, scanning	Partiallly	A Special Working Group meeting, including a 3-day field campaign (Joint microwave calibration experiment, J-CAL, August 25-28, 2014) was organized to derive recommendations for microwave

COST is supported by the EU Framework Programme Horizon 2020

COST Association
Avenue Louise 149 I 1050 Brussels, Belgium
t: +32 (0)2 533 3800 I f: +32 (0)2 533 3890
office@cost.eu I www.cost.eu

strategies, and maintenance.		radiometer absolute calibration procedures using liquid nitrogen; this was carried out for instruments from the two common, commercial manufacturers. Additionally, a common set-up of measurements was used to provide a better characterization on the absolute accuracy as well as on the uncertainty of such calibrations. The SWG scientific report of J-CAL is available at: http://www.toprof.imaa.cnr.it/index.php/test-3?jsmallfib=1&dir=JSROOT/sub_working_group&download_file=JSROOT/sub_working_group/Scientific_Report_20140825_Lindenberg.pdf A document containing a guideline for users during the calibration and operation procedure is still in preparation
7 To foster the utilization of disparate microwave radiometer observations by implementing a harmonized microwave radiometer data processing chain to provide quality-controlled calibrated multiple frequency radiances (for direct data assimilation into forecast models) and accurate profiles of temperature and humidity as well as cloud liquid water path in a near real time monitoring network.	Partiallly	A Special Working Group meeting (May 4-5, 2015) was held to organize a continuous and harmonized data-flow from 10 selected instruments to a central data server. The data flow will consist of level 1 (brightness temperature) and level2 (temperature and humidity profiles) data. Both will be used to create so-called O-B (Observation minus model background) statistics to monitor observational data quality and to prepare for data assimilation. The report will be available soon.
8 To investigate optimized means of using down-welling radiance observed with the microwave radiometer network to derive profiles of temperature with highest accuracy in the boundary layer, lower resolution humidity profiles and the integrated water vapour and cloud liquid water path in the observed column.	Partiallly	A Special Working Group meeting was held to develop the forward model and Jacobian codes to integrate in a 1-dimentional Variational (1DVAR) procedure exploiting microwave radiometer observation for the retrieval of water vapour and cloud liquid water path. The SWG scientific report is available at: http://www.toprof.imaa.cnr.it/index.php/test-3?jsmallfib=1&dir=JSROOT/sub_working_group&download_file=JSROOT/sub_working_group/Scientific_Report_SWG3.2_V4.pdf
9 To collaborate with researchers running NWP models in NMHSs to ensure that the quality controlled data from the remote sensing networks of ceilometers, Doppler lidars and microwave radiometers meets their requirements.	Partiallly	Preparation of common formats for the ALCS, DWLs and MWRs to enable comparison with NWP models. Special working group meeting on forward operators for ALCs end of July 2015. First comparisons of observations from the three instruments with the variables held in the DWD (German Weather Service) NWP model planned for September/October 2015. Microwave radiometer brightness temperatures to be compared with forward modelled temperatures from the MeteoFrance model.

MoU deliverable	Level of progress[1]	Evidence of (partial) delivery achievement including hyperlink to enable assessment of the delivery[1]. Justification if full achievement is not foreseen
1Standardised techniques for calibrating, maintaining and operating ceilometers, Doppler lidars, microwave radiometers so that the products derived from them are quality controlled and accompanied by quantified errors.	Partial	A document providing recommendation for ALC configuration, operation, and calibration is under development. An operational procedures document describing instrument siting, calibrating and scan selection, together with uncertainty quantification is in progress. A document summarizing the best practises to calibrate and operate microwave radiometers is the output of SWG3.1. The document will soon be available through the action website,
2.Standardised formats and data protocols, so that observations can be exchanged in near real time between the various NMHSs across Europe.	Partial	A new version of the RAW2L1 data format harmonization tool has been developed, compliant with NetCDF climate and forecast convention. This software will be tested in the ALC pilot network and the ALC intercomparison campaign. A common format has been agreed for Doppler lidar wind profile data, conforming to netCDF CF (Climate and Forecast) convention. A common format has been agreed for microwave radiometers, compliant with netCDF CF convention. Example data files have already been exchanged and application to the microwave radiometers network MWRnet has been planned for 2015.
Standardised retrieval algorithms for ceilometers, Doppler lidars and MWRs so that key atmospheric properties (clouds, humidity, temperature, aerosol, and winds) can be derived together with their errors.	Partial	Algorithms to derive attenuated backscatter profiles from ALC together with their errors have been developed by the MetOffice. Recommended scan configurations and wind retrieval methods for different Doppler lidar instruments and locations have been developed, together with quality control and uncertainty estimates. Two standardized retrieval methods, each serving a specific objective, are being developed. One is based on multivariate regression (mwr_pro) and is currently used for deriving O-B (Observation-Background) statistics throughout the network; the other one on a variational approach (1DVAR), which is used for the preparation of the direct assimilation of MWR observations into models.
Forward models and metrics for model evaluation.	Partial	Improved ALC forward models are under development, to include both aerosol and cloud backscatter. Wind profiles are ready to be assimilated, but will first undergo O-B testing; utility of high resolution Doppler lidar radial velocities is under discussion. First steps on how to evaluate model boundary layer type and dynamics made at Granada MC/WG meeting. A fast forward model for ground-based microwave radiometer observations (RTTOVgb) has been developed and implemented by adapting existing RTTOV code developed for satellite observations. The code is currently under testing at Meteo France. First approach for metrics for model evaluation have been agreed upon at the Granada MC/WG meeting.

COST is supported by the EU Framework Programme Horizon 2020

COST Association
Avenue Louise 149 I 1050 Brussels, Belgium
t: +32 (0)2 533 3800 I f: +32 (0)2 533 3890
office@cost.eu I www.cost.eu

Co-authored publications and FP7/ H2020 proposals
The co-authored publications and FP7/ H2020 proposals/ projects resulting from the Action are listed on the page following the “Additional outputs and achievements” section

Additional outputs and achievements

Please describe any other outputs and achievements that have resulted or are in progress, focusing in particular on those that contribute to the COST mission of “COST enables break-through scientific developments leading to new concepts and products and thereby contributes to strengthen Europe’s research and innovation capacities.”
1. The four European manufacturers of ALCs are member of the action, as are the two manufacturers of Doppler Wind Lidars, and the only European Manufacturer of Microwave Radiometers. This is a field where European manufacturers are currently dominating the marked. 2. TOPROF activities have led to a modification of ALC firmware by European manufacturer to enable qualitative exploitation of attenuated backscatter profiles provided by the instruments. 3. TOPROF activities have led to a modification of microwave radiometer firmware and software by the European manufacturer. Please describe any additional outputs and achievements from the Action

COST is supported by
the EU Framework Programme
Horizon 2020

COST Association
Avenue Louise 149 I 1050 Brussels, Belgium
t: +32 (0)2 533 3800 I f: +32 (0)2 533 3890
office@cost.eu I www.cost.eu

Version 2015-03-10

Co-authored publications and FP7/ H2020 proposals

Co-authored publications

Enter in the table below only publications on the topic of the Action, co-authored by at least two Action participants from two different countries participating in the Action and for which the Action networking added value. A maximum of ten publications may be entered. If the Action has more than ten such publications the Core Group should select the ten most significant ones to include in the table below.

The complete publication list is available at: http://www.toprof.imaa.cnr.it/index.php/publication

NO.	Bibliographic data (including: Title, Authors, Title of the periodical or the series, Issue number or volume, Publisher, Year of publication, Relevant pages)	Main author	Number of authors	Action participants listed among the authors (Name, country and role[2])	WGs involved in publication	Date of submission (must be after Action start date)	Expected date of publication (if not already published)	Persistent link to publicly available version of the paper (if available) or the abstract	Is/Will open access[3] provided to this publication?	Is/ will COST be cited/ acknowledged in the publication?	Are/ will COST funds (be) implicated in this publication	Relevance to H2020 Societal Challenges[4]?	Is it peer-reviewed?	Was the added value of the Action Networking necessary for the publication	Impact Factor (if applicable)
1	Illingworth, A. J., D. Cimini, C. Gaffard, M. Haeffelin, V. Lehmann, U. Loehnert, E. J. O'Connor, D. Ruffieux, Exploiting Existing Ground-Based Remote Sensing Networks To Improve High Resolution Weather Forecasts, Bull. Amer. Meteor. Soc. doi: 10.1175/BAMS-D-13-00283.1, February, 2015	*Illingworth*	*8*	*7*	*All*	*???*	*Published in early online release*	*http://journals.ametsoc.org/doi/abs/10.1175/BAMS-D-13-00283.1*	*yes/no*	*yes*	*yes*	*yes*	*yes*	*yes*	*11.57*
2	Cimini, D., Nelson, M., Güldner, J., and Ware, R.: Forecast indices from a ground-based microwave radiometer for operational meteorology, Atmos. Meas. Tech., 8, 315-333, doi:10.5194/amt-8-315-2015, 2015.	*Cimini*	*4*	*2*	*WG3*	20 June 2014	*Published*	*http://www.atmos-meas-tech.net/8/315/2015/amt-8-315-2015.html*	*yes*	*yes*	*no*	*yes*	*yes*	*yes*	*3.2*
3	Schween, J. H., Hirsikko, A., Löhnert, U., and Crewell, S., 2014: Mixing layer height retrieval with ceilometer and Doppler lidar: from case studies to long-term assessment, Atmos. Meas. Tech., 7, 3685-3704, http://dx.doi.org/10.5194/amt-7-3685-2014	*Schween*	*4*	*2*	*WG1, WG2*	*14 Feb 2014*	*Published*	*http://www.atmos-meas-tech.net/7/3685/2014/amt-7-3685-2014.html*	*yes*	*no*	*no*	*yes*	*yes*	*yes*	*3.2*
4	Vakkari, V., O'Connor, E. J., Nisantzi, A., Mamouri, R. E., and Hadjimitsis, D. G.: Low-level mixing height detection in coastal locations with a scanning Doppler lidar, Atmos. Meas. Tech., 8, 1875-1885, doi:10.5194/amt-8-1875-2015, 2015.	*Vakkari*	*5*	*2*	*WG2*	*13 Oct 2014*	*Published*	*http://www.atmos-meas-tech.net/8/1875/2015/amt-8-1875-2015.html*	*yes*	*no*	*no*	*yes*	*yes*	*yes*	*3.2*
5															
6															
7															
8															

[2] MC Member/ MC Substitute/ MC Observer/ WG Member/ Training School Trainee/ STSM Recipient/ Other Action Participant

[3] Open Access is defined as free of charge access for anyone via Internet. Please answer "yes" if the open access to the publication is already established and also if the embargo period for open access is not yet over but you intend to establish open access afterwards.

[4] H2020 Societal Challenges are “Health, demographic change and wellbeing”; “Food security, sustainable agriculture and forestry, marine and maritime and inland water research, and the Bioeconomy”; “Secure, clean and efficient energy”; “Smart, green and integrated transport”; “Climate action, environment, resource efficiency and raw materials”; “Europe in a changing world - inclusive, innovative and reflective societies”; “Secure societies - protecting freedom and security of Europe and its citizens”

9									
10									

FP7/ H2020 Proposals and projects

This table contains FP7/ H2020 proposals/ projects spinning off from Action activities and including in the proposing consortium at least three Action participants from at least t

NO.	Title	Name and country of main proposer	Number of proposers	Action participants listed among the proposers (Name, country, role[3] in the Action)	Funding agency submitted to	Date submitte
Projects						
1	GAIA-CLIM (http://www.gaia-clim.eu/) The leader of WG3 on Microwave Radiometers (MWR) is responsible for the MWR component of this recently started action.	Peter Thorne, Ireland	20 parties in total: 17 parties from 9 EU countries, 3 international parties and 2 from USA	Cimini, IT, WG3 co-chair Haeffelin, FR, WG1 chair Gueldner, DE, WG3 member	EU	March
2	ACTRIS-2: starting in May 2015: http://www.actris.net TOPROF via the leader of WG2 on Doppler Lidars has contributed to the Doppler Lidar component of this action.	Gelsomina, Pappalardo, Italy	31 parties, from 21 EU countries and 7 outside the EU	Alabados, Spain, ALCs, Baars, Germany, ALCs Bortoli, Pt, ALCs Cimini, I, MWRs Haeffelin, F, ALCs Illingworth,UK, cloudradar Msaddon, I, ALCs Nicolae, Ro, O'Connor, FI, DLRs	EU	Sept 20
Proposals						
	List FP7/ H2020 proposals submitted as a result of the Action in this section of the table					

I.C. Networking

Added value of the Networking
1.E-PROFILE: Strong interaction with this Eumetnet activity (organised by National Weather Services, NWSs) and the establishment of the European ceilometer network. E-PROFILE is responsible for the instrument installation and the near-real time exchange of data. TOPROF is responsible for calibration and algorithm development. Defining common data formats is a joint activity. 2.National Meteorological Hydrological Services. The MC has representatives from 16 NWSs NMHSs Please describe here the added value of the networking, highlighting in particular anything that would not have happened without the Action networking.
Extent of the networking
1.E-PROFILE. Chair of E-Profile attended MC/WG meetings 2 and 3; MS/WG meeting in Oct 2015 will be hosted by MeteoFrance and will have a joint E-PROFILE-TOPROF session. 2.NHMSs – 16 National Weather Services are taking part of the action and attending the six monthly MC meetings. Every one of the STSMs and Special Working Group Meetings so far has involved National Weather Services as either visitors or hosts. 3.ITCs: Representatives from Bulgaria, Hungary, Poland, Portugal, Romania, and Turkey were present at recent MC meetings. Six of the 22 (27%) participating countries are ITCs. 4. At the most recent combined MC/WG meeting in Granada, of the 70 participants, 17 were ECIs and 18 were women

I.D. Impacts

The impacts that have resulted, or might result from the Action are described in the following table.

Description of the impact	Type of impact[5]	Timing of impact[6]
TOPROF has been involved with defining the ISO standard for Doppler wind lidars.	Economic	Acceptance of ISO is Imminent.
TOPROF scientists from NMHSs are leading the installation of the European ceilometer network	Economic	End of Action
Fog forecasting at airports – large economic implications.	Economic	End of Action
Volcanic ash monitoring/forecasting – large economic implications	Economic	End of Action
ICOS – Integrated Carbon Observation System- part of ERIC https://www.icos-ri.eu - for calculating fluxes requires boundary layer mixing height observations provided by TOPROF instruments	Scientific	End of Action
WG3 is responsible for the microwave radiometer guidelines of the Global Climate Observing System Reference Upper Air Network (GRUAN)	Scientific/ technological	First draft is due June 2015
FIRST O-B comparisons with DWD (German Weather Service) operational model planned for September/October 2015	Scientific/ technological	Early 2016
Doppler lidars to provide the missing winds in the boundary layer to complement the existing operational wind profilers in e-profile.	Scientific/improved forecasts	End of action

[5] Scientific/ technological, Economic, Societal
[6] Achieved/ Foreseen within 2 years/ Foreseen 2-5 years/ Foreseen 5-10 years/ Foreseen 10+ years

COST is supported by the EU Framework Programme Horizon 2020

COST Association
Avenue Louise 149 I 1050 Brussels, Belgium
t: +32 (0)2 533 3800 I f: +32 (0)2 533 3890
office@cost.eu I www.cost.eu

I.E Dissemination and exploitation of Action results

Describe the Action's dissemination and exploitation approach as well as all activities undertaken to ensure dissemination and exploitation of Action results and the effectiveness of these activities.			
Add description here			
Item/ activity	Target audience	Result	Hyperlink
Participation to the World Weather Conference 16-20 Aug 2014 Montreal, Canada	Members of Nat Met Services & Universities. Media	Presentations by chairs/v-chairs of WG2, WG4 & WG3 representative	http://wwosc2014.org/pdf/20140825-WWOSC-FinalBookofAbstracts.pdf
Doppler lidar network: Presentation at EMS Sept 2015, Bulgaria	Members of National Met Services & Universities.	Will take place September 2015.	http://www.emetsoc.org/meetings-events/ems-annual-meetings
Representation at ITARS summer school 2014 (EU-Marie-Curie ITN)	ITARS PhD students and their universities	Three PhD students from NL, D and I made presentation to MC3 meeting Roskilde, DK, Nov, 2014.	http://tinyurl.com/ITARS-talk-TOPROF-Roskilde-pdf
Special session at ISARS Bulgaria 6-9 June 2016	Members of National Met Services & Universities	Chair of conference is on TOPROF MC	Programme and special TOPROF sessions are yet to be announced

I.F. Implementation of COST policies

Policy implementation through specific initiatives and management of Action funds and participation (data from 22/10/2013 to 31/05/2015 see Annex 2)	
Action expenditure on ITCs is considered Excellent if >45%, Very Good if 40-45%, Fair if 30-35%, Poor if 20-30% and Fail if <20%. The Action spent 22.9 % (see below) of budget on ITCs (data at point I.1 of Annex 2).	
Please comment here on the % of Action funds spent on ITCs with respect to the expectation that half of COST funds are spent on ITCs. The majority of our expenditure is the cost of holding our four joint MC/WG meetings attended by participants from all 22 participating countries. Six of these countries (27%) are ITCs, and their travel claims constitute 22.9% of the total. It is difficult to conceive of an arrangement whereby we can fulfil our contractual deliverables as listed in the MOU if 45% of the expenditure were devoted to just 6 participating countries.	
Extent of implementation	Description of the implementation (achievement/ effort)[7] / comment
Inclusiveness Target Countries (ITC)	
☐ High ☐ **Medium** ☐ Low ☐ None	Representatives from Bulgaria, Hungary, Poland, Portugal, Romania, and Turkey were present at recent MC meetings. Six of the 22 (27%) participating countries are ITCs. In June 2016 an MC meeting will be held in Bulgaria. TOPROF will be organising sessions at the ISARS conference in Bulgaria, June 2016. Figures from the MC4 meeting in Granada 5-7 May 2015 are not yet available, but for all meetings previous to that data the expenditure of participants from ITC countries was 19,144.75 Euro, or 22.91% of the total expenditure.
Early Career Investigator (ECI)	
☐ High ☐ **Medium** ☐ Low ☐ None	At the last MC meeting in Granada with 70 participants 17 (24%) were ECIs
Gender balance	
☐ High ☐ **Medium** ☐ Low ☐ None	At the last MC meeting in Granada with 70 participants, 18 (25%) were female. Two of the four WGs have female vice chairs.
Contribution to the Innovation Union goals (industrial, SME cooperation)[8]	
☐ **High** ☐ Medium ☐ Low ☐ None ☐ N/A	The four European manufacturers of ALCs are member of the action, as are the two manufacturers of Doppler Wind Lidars, and the only European Manufacturer of Microwave Radiometers This is a field where European manufacturers are currently dominating the market. At a special plenary session during the recent MC4 meeting the four ALC manufacturers gave presentation as to how they were modifying their instruments in response to TOPROF requirements. If the ALCs fulfil their potential in improving weather forecasts then a large marked will open for these companies.
International Cooperation	
☐ **High** ☐ Medium ☐ Low ☐ None	Participation to the World Weather Conference 16-20 Aug 2014, Montreal, Canada, with invited presentation by three chairs of the working groups. http://wwosc2014.org

[7] Achievement is the extent to which the policy is actually implemented in the Action, effort is the effort expended trying to implement the policy (regardless of the results)

[8] "Contribution to the Innovation Union goals" includes all participation of/ engagement with organisations from industry (services as well as products) that is aimed at enhancing their ability to use the outputs of the Action. Sponsorship of meetings by industrial organisations with the objective of selling products/ services to Action participants is not included.

COST is supported by the EU Framework Programme Horizon 2020

COST Association
Avenue Louise 149 I 1050 Brussels, Belgium
t: +32 (0)2 533 3800 I f: +32 (0)2 533 3890
office@cost.eu I www.cost.eu

I.G Action success(es)

COST regularly communicates the successes of Actions. At this point in time what aspect(s) (outcomes and/ or impacts, rather than activities) of this Action is/ are the most suitable for communication?

Description of the success story.	Dimension of the success
The first MC meeting after the KO meeting was March 2014 so after just 14 months it is too early for communicating successes	■ Breakthrough: scientific, technological or socioeconomic ■ Policy implementation (specify which policy) ■ Capacity building

COST is supported by the EU Framework Programme Horizon 2020

COST Association
Avenue Louise 149 I 1050 Brussels, Belgium
t: +32 (0)2 533 3800 I f: +32 (0)2 533 3890
office@cost.eu I www.cost.eu