

EUROPEAN COMMISSION

DIRECTORATE-GENERAL
HUMANITARIAN AID AND CIVIL PROTECTION - ECHO

Directorate A - Strategy, Policy and International Co-operation
Unit A.5 – Civil Protection Policy, Prevention, Preparedness and Disaster Risk Reduction

PROFORCE



Bridging of Probabilistic Forecasts and Civil Protection

Project Nr: S12 661053



Period: 12/2013 to 11/2015

Final Technical Report



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2. Project objectives, partnership and expected deliverables

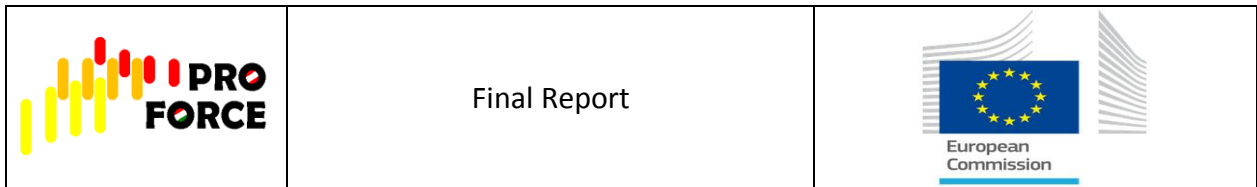
The PROFORCE project is a cooperation between the national weather services of Austria and Hungary and civil protection partners from both countries. The coordinator of the project is the Central Institute for Meteorology and Geodynamics (ZAMG), and the associated beneficiaries are the Provincial Government of Lower Austria - Section for Fire Brigade and Civil Protection (NOEL-CP), the Hungarian Meteorological Service (OMSZ) and the Disaster Management Directorate of Somogy County (DMDSC). The main goal of this project is a seamless probabilistic forecasting system including nowcasting, short range and medium range forecasting up to several days ahead which is especially tailored to the needs of civil protection applications. The main characteristic of the seamless system is its probabilistic feature containing information about the uncertainty and predictability of severe weather events. This information should support civil protection agencies to optimize their decision making procedure in terms of preparedness and awareness and therefore better protect the society and environment from impacts of severe weather. The activities to be carried out within the project have been split into the following tasks: Task A – Management and reporting to the European Commission, Task B – Publicity, Task C – Requirements, Task D – Integration and adaptation of a seamless forecasting system, Task E – Pilot implementations, Task F – Evaluation and feedback, Task G – Training and transnational cooperation. The project is implemented through a dedicated feedback cycle between meteorologists and civil protection authorities guaranteeing continuous adjustments and improvements in a strong multidisciplinary and transnational cooperation. The expected deliverables of the project besides the seamless probabilistic weather forecasting system (Deliverable D.1-3) are a number of technical documents describing and evaluating the methodologies (Deliverables C.1, E.1, G.1), a report about the application of the system during real-time cases (Deliverables E.2, F.1), the reports to the EC (Deliverables A.2-3) as well as publicity deliverables including the project website (Deliverable B.1), a project flyer and a Layman’s report (Deliverable B.3), a video (Deliverable B.4) and several contributions to international conferences and workshops (Deliverable B.2). These deliverables are described in section 6 of this report, and are available on the project web page.

3. General summary of project implementation process

The project partners and the SAB (scientific advisory board) members met at the kick-off meeting in Vienna (20 January 2014), the mid-term meeting in Budapest (27-28 January 2015) and the final meeting in Vienna (28-29 October 2015) (Task A) to discuss the progress and achievements of the project. Evaluation sheets were filled out for mid-term and final meeting by all participants.

In general terms, the project has been carried out following the working plan of the proposal, with only small delays in some of the tasks (see Table 1 at the end of this document).

A project web page (www.echo-proforce.eu) was created and continuously updated with respective material like presentations, minutes, etc. (Task B). To spread project information



to the scientific community several presentations in oral and poster form were made at international conferences (e.g. EGU 2015, Vienna; Aladin workshop 2015, Copenhagen; EMS 2015, Sofia; EWGLAM/SRNWP meeting 2015, Belgrade; etc.). A flyer with general information about PROFORCE was prepared, printed in 200 copies and distributed during major events. Furthermore, an article about the PROFORCE project was published in the Hungarian civil protection journal "Katasztrófavédelmi szemle" (2015/2), another one is in preparation for the Austrian civil protection journal "Brandaus" (Task B). A scientific paper about forecast skills of a convection permitting ensemble with contributions from the PROFORCE project has been submitted to the AMS journal "Weather and Forecasting". A video presenting the project was produced and uploaded on YouTube in the three languages English, German and Hungarian (<http://tiny.cc/7fih6x>).

The technical implementation of the project focused on the preparation of the Austrian and Hungarian web-portals (Task E) upon requirements and feedback from civil protection partners summarized in a document of Task C (finished in June 2014). The web-portals can be accessed via the private section of the PROFORCE webpage (see Fig. 1). After some test runs and feedback from forecasters and civil protection partners the Austrian web-portal went online in the final version in December 2014. Archived images and warnings can be retrieved from January 2015 onwards. The Hungarian web-portal was delayed due to technical problems but the short and medium range forecasts were available since January 2015 and the entire application was finalized in August 2015 (and linked to the Austrian portal). The web-portals integrate probabilistic information from the nowcasting up to the medium range (10 days ahead) period in a seamless way (Task D). The system is based mainly on output of the En-INCA, ALADIN-LAEF, ECMWF-EPS probabilistic forecasting systems. The most innovative part of it was the operational implementation of probabilistic forecasts in the nowcasting range (INCA-EPS). Another state-of-the-art high-resolution ensemble prediction system, AROME-EPS, was also established but its operational use was limited due to high computational expenses. It can be switched on in case of severe weather situations.

The whole system together with the information exchange between meteorologists and civil protection authorities has been tested on several real-time cases of severe weather during the project (Task E). The EPS materials were also distributed to partners in disaster management during the protection of main cultural and sport events, e.g. at the Lake Balaton (concerts, sport competitions involving several ten-thousands of participants). The full use of the Austrian web-portal has been trained together with the end-users in an extensive test case in March 2015 (heavy storm event, Task F). A lot of feedback and supporting documents (concerning the weather events in Task E) were collected by the disaster management. All the test cases (storm events, heavy precipitation events, thunderstorms, etc.) and experiences were documented in a joint report for Tasks E and F. Originally it was written in the application form that two separate reports for Task E and F should be provided, but due to the strong overlap of these two tasks we decided to merge them into one comprehensive report. DG ECHO was informed via email.

Two special trainings for the civil protection agencies were organized by the Hungarian and Austrian civil protection partner on 18 June 2014 (Balatonföldvár) and on 11-12 May 2015 in Tulln (Task G). Besides, smaller exercises and presentations of the web-portal for the end-

users in civil protection were also organized (e.g. by OMSZ in Siófok on 26 March 2014 and by DMDSC in Kaposvár, 28 May 2015).

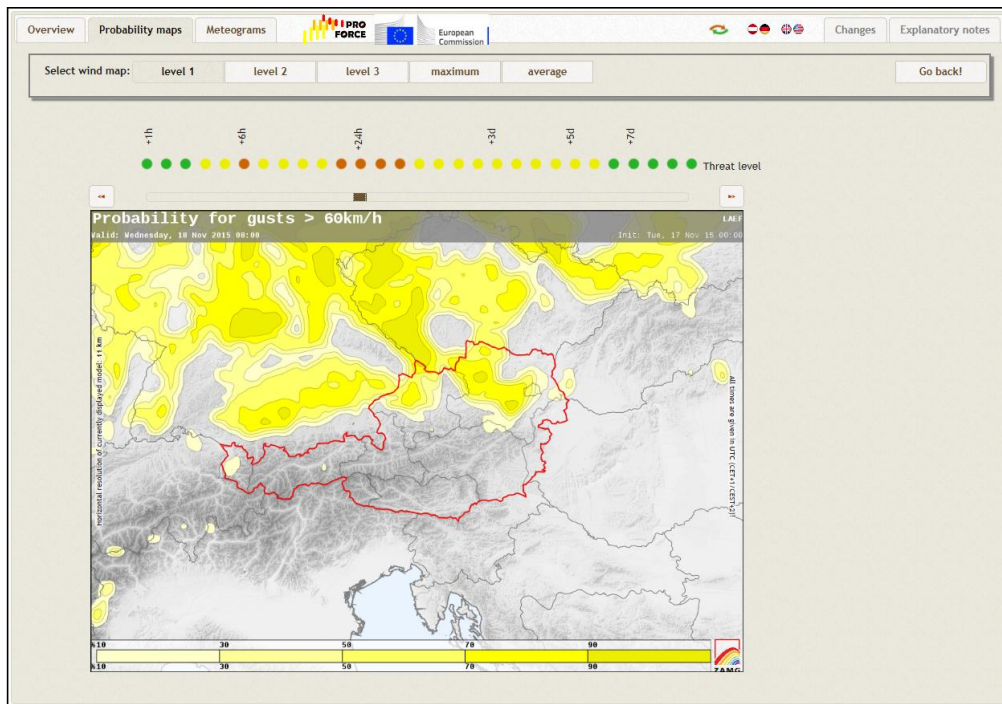


Fig. 1a: The Austrian PROFORCE web-portal (example on wind forecast selection).

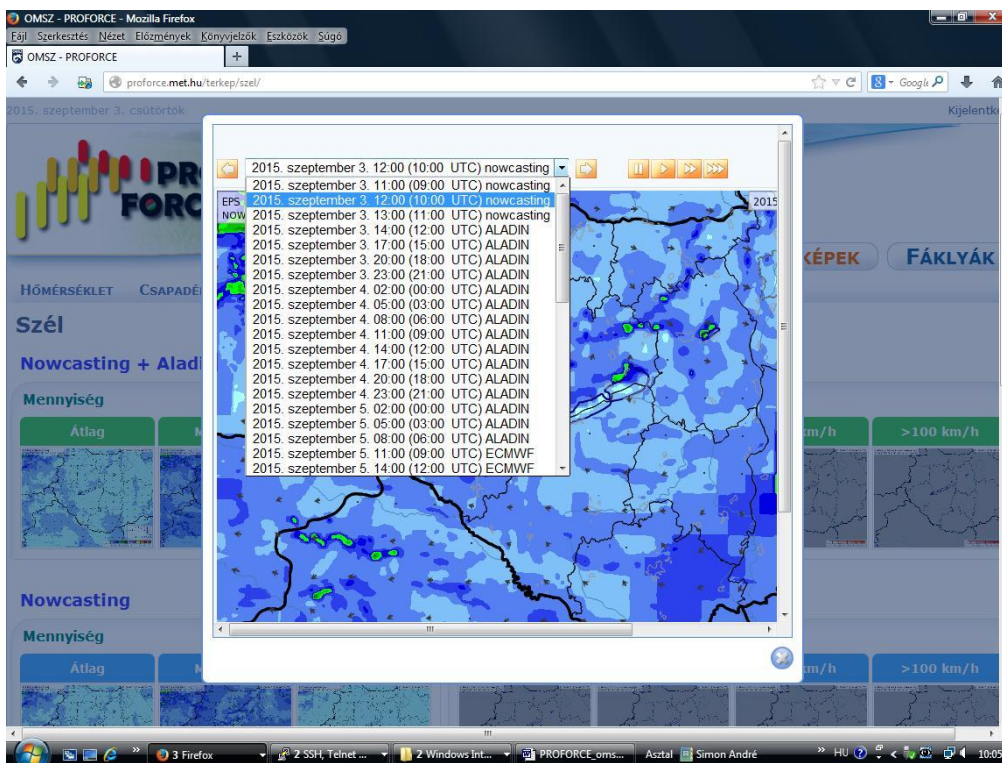




Fig. 1b: The Hungarian PROFORCE web-portal (example on wind forecast selection).

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4. Evaluation of project management/implementation process

The project partners were in constant contact via phone and e-mail. Generally, the transnational collaboration between the Austrian and Hungarian colleagues was very good and strong. Necessary materials and documents were usually sent in time and deadlines have been kept. From the management point of view the project was very easy to handle for the project coordinator. Also the cooperation between meteorologists and civil protection partners was very tight and we got a lot of feedback and material, which helped to evaluate the meteorological outputs. Also the suggestions of the operational forecasters in the weather services were very helpful. The exchange of experiences during meetings and trainings was very important and we got a lot of feedback and advice from the SAB members, who participated at all major meetings. This helped us significantly during the implementation of the project.

The organization and preparation of the main project meetings was quite successful as it was also reflected by the results of the written evaluation forms.

The cooperation with the European Commission was also very good and smooth. Requests and questions, mainly regarding administrative and financial issues, were answered promptly and in a competent way.


During the development of the project no major difficulties were found. The Austrian seamless forecasting system was finalized a bit earlier than expected. It is constructed in a way that it can be easily transferred to other European countries as well (one of the planned continuations after the project ends). The current domain is spanning from Europe as a whole (medium range) over Central Europe (short range) to Austria in the nowcasting. The results of test cases of severe weather events are encouraging. EPS material is processed in a very user friendly manner and the end-users have reported that the additional probability information can help significantly during decision making. The operational implementation of the nowcasting EPS in Hungary was slower than expected. This was mainly due to large computer problems at OMSZ in November and December 2014. However, test products could be generated and these were also distributed to disaster management already in the first year of the project. The final version of the web-portal (including all forecast ranges) was available in August 2015 and it was operationally tested (numerous cases with heavy thunderstorms and intense rainfall appeared also in summer and autumn of 2015 when the web-portal was fully operational).

The resources that have been used were mainly due to personnel costs. Overall, there have been minor departures from the expected use of resources, which are essentially related to a higher cost in personnel. This has been compensated by reducing the costs initially foreseen in other budget categories like subcontracting or equipment). Travel and subsistence were associated with project meetings, trainings and conferences (e.g. EGU 2015, EMS 2015, ALADIN workshop 2015, etc.). The financing of the travel costs of the SAB members (2 overseas flights) were covered by money transfer from the budget category subcontracting. All budget shifts were communicated to DG-Echo and are documented in the excel-document "F-form with budget shifts". The delayed (usually planned in reporting period 1) purchase of the equipment at OMSZ was finally achieved and installed at the end of January 2015. The video has been produced by an external company and delivered as planned. In connection with the usage and added value of probabilistic weather forecast in

day to day disaster management DMDSC instructed a sub-contractor for collecting and evaluating all statistics, reports, data etc.



Fig. 2: Meetings and trainings of the PROFORCE participants. From top left to bottom right: Kick-off meeting in Vienna, 20 January 2014; EPS training of CP people in Siofok, 26 March 2014; Training at Balatonföldvár, 18 June 2014; Mid-term meeting in Budapest, 27-28 January 2015; Training in Tulln, 11-12 May 2015; Final meeting in Vienna, 28-29 October 2015.

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5. Activities

The activities carried out during the entire project are presented for the different tasks in the project plan.

Task A - Management and Reporting to the EC: The lead partner ZAMG was responsible for the submission of the 1st and 2nd progress report. These were delivered in time and accepted by the EC. Also the preparation of the present final progress report lies mainly in the responsibility of ZAMG. Three main meetings (kick-off, mid-term, final) were organized by ZAMG and OMSZ, where all project-partners and SAB members participated (the EC representative was also invited for the mid-term and final meeting). Minutes and evaluation sheets of the meetings are available on the project website. Furthermore, the lead partner participated at the kick-off meeting of the “Preparedness and Prevention Call 2013” in Brussels in January 2014.

Task B – Publicity: The project website (www.echo-proforce.eu) with a public and a private section has been continuously updated with new content. A flyer providing the main information about the project was prepared at the beginning of the project; a Layman’s report describing the relevant output for the public has been finished and distributed end of 2015. Several oral and poster presentations were presented at international conferences (e.g. EGU 2015, Vienna; Aladin workshop 2015, Copenhagen; EMS 2015, Sofia; EWGLAM/SRNWP meeting 2015, Belgrade; ECSSS, Wiener Neustadt; ÖGM meeting, Vienna). An article about the project has been published in the Hungarian civil protection journal “Katasztrófavédelmi szemle” (2015/2), another one has been submitted to the Austrian civil protection journal “Brandaus”. A scientific paper about forecast skills of a convection permitting ensemble with contributions from the PROFORCE project has been submitted to “Weather and Forecasting”. A video promoting the project was produced in several languages (EN, DE, HUN) and uploaded on publicly available websites (i.e., YouTube: <http://tiny.cc/7fih6x>).

Task C – Requirements: The requirements of the civil protection concerning thresholds, warning parameters, the design of the web-portals and its outputs have been collected and processed in a “Requirements” document in June 2014. It was the basis for all further steps in the project. This document contains also some general information about probabilistic forecasts, especially for civil protection staff.

Task D - Integration and adaptation of a seamless forecasting system: The development of a seamless forecasting system has been finalized at the Austrian meteorological service ZAMG by combining a medium range weather forecast system, a short-range weather forecast system and a nowcasting tool to one common probabilistic system. The system has been tailored to the needs of civil protection applications and has been successfully tested in pilot implementations. The user friendly and comprehensible probability maps and meteograms are automatically uploaded to the web-portal together with an overall threat level indicating the highest warning in the area. The web-portal in Hungary has been finished as well, including all its elements (nowcasting, short-range, medium-range). Similarly to the Austrian portal, it enables to choose between map presentation and meteograms for most important

locations in the pilot area (Lower Austria, Somogy County). The output of the EPS system was adapted according the requirements of the disaster management defined in task C. A report describing the Austrian and Hungarian seamless system together with a manual for the web-portals has been produced.

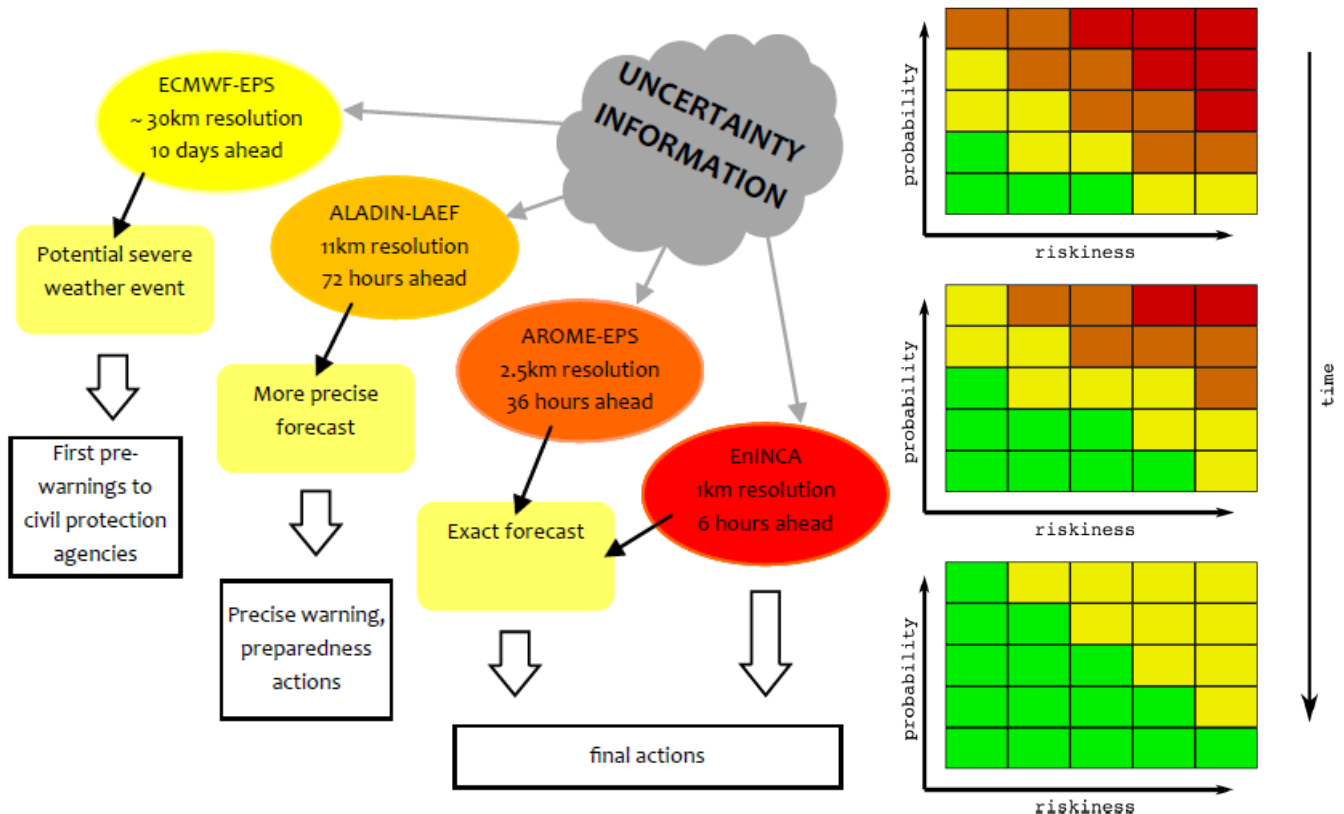


Fig. 3: Left: Combination of different EPS models to one seamless system. Right: Warning level matrix depending on probability, riskiness and lead time.

Task E – Pilot implementation: The main focus in this task was on the development of the web-portals for the civil protection partners. The Austrian web-portal is online since December 2014, archived images can be accessed since mid of January 2015. The prototype of the Hungarian web-portal became available at the end of January 2015 (providing short- and medium-range EPS forecasts) and the final version was ready by August 2015 (nowcasting EPS added). The web-portals containing EPS output were tested and distributed to disaster management on numerous occasions during severe weather and during the protection of large cultural and sport events (Blue Ribbon yacht race, Balaton cross-swimming, 20 August national holiday cultural events etc.). According to the feedback of disaster management, the EPS materials were helpful making decisions about possible postponement or cancellation of events (e.g. the Balaton cross-swimming in 2014 had to be postponed twice due to bad weather). The most important cases (e.g. the 14-16 May 2014 storm “Yvette”, the 30 March – 2 April 2015 storm “Niklas” and 5-6 May 2015

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thunderstorms affecting both Austria and Hungary) were described in a comprehensive report which contains also important information from civil protection.

Task F – Evaluation and Feedback: First feedback to Task D was possible for a case study of storm Yvette in 2014. Another storm case in January 2015 brought the opportunity to give a forecaster’s feedback to the pilot implementation of the seamless probabilistic forecasting system. The usability of this seamless forecasting system especially for the operational forecast shift was analysed and a first verification of the new system was done and presented at the mid-term meeting in Budapest. Storm “Niklas” in March/April 2015 was the first opportunity to test the full functionality of the web-portals. Broad feedback of the users in civil protection helped to improve the system significantly. A report summarizing these results and showing the added value of the use of probabilistic forecasts was provided, together with a description of all major cases collected in Task E.

Task G – Training and transnational cooperation: Two special trainings for the civil protection agencies were organized by the Hungarian and Austrian civil protection partners on 18 June 2014 (Balatonföldvár, Hungary) and on 11-12 May 2015 in Tulln (Austria), respectively. At the second training in Tulln also responsible civil protection persons of surrounding Austrian districts participated. Besides, smaller exercises and presentation of the web-portal for the end-users in civil protection were also organized (e.g. by OMSZ in Siófok on 26 March 2014 and by DMDSC in Kaposvár, 28 May 2015). Last but not least, the meteorological services were in continuous contact with the civil protection agencies and provided explanations and help in the interpretation of the EPS materials.

6. Presentation of the technical results and deliverables

All deliverables are linked and accessible for everyone on the project website (<http://www.echo-proforce.eu>, menu item “deliverables”). A direct link to the deliverables is also given in Table 1 at the end of this document.


Deliverable A1 - Minutes of project meetings: For the major meetings (kick-off, mid-term, final) the main output and key issues have been summarized in a proceedings documents.

Deliverable A2 – Progress report 1 and 2: The first and second progress report have been delivered and accepted by the EC.

Deliverable A3 – Final report: The final report is the present document.

Deliverable A4 – Project handbook: The project handbook including important information (deliverables, deadlines, etc.) for the partners has been created and updated continuously. Initially, it was not planned in the application form.

Deliverable B1 – Project Website: The project website (www.echo-proforce.eu) with a private and a public section has been continuously updated with new content. Here you can find all kind of information about the project (documents, photos, deliverables, etc.). Since

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December 2014 the Austrian web-portal is also accessible via a link on the project webpage. The link to the Hungarian web-portal has been added in August 2015.

Deliverable B2 – Papers/articles/presentations: Several oral and poster presentations were made at international conferences (e.g. EGU 2015, Vienna; Aladin workshop 2015, Copenhagen; EMS 2015, Sofia; EWGLAM/SRNWP meeting 2015, Belgrade; ECSSS, Wiener Neustadt; ÖGM meeting, Vienna, etc.). An article about the project has been published in the Hungarian civil protection journal “Katasztrófavédelmi szemle” (2015/2), another one has been submitted to the Austrian civil protection journal “Brandaus”. A scientific paper about forecast skills of a convection permitting ensemble with contributions from the PROFORCE project has been submitted to “Weather and Forecasting”.

Deliverable B3 – Layman’s report: A Layman’s report containing information about the project implementation together with outputs of the project has been finished in December 2015. It is published in English, German and Hungarian, is produced on paper and electronic format and will be distributed to interested people from the meteorological and civil protection side.

Deliverable B4 – Project video: A project-promoting video has been produced and made publicly available in three languages (English, German, Hungarian). The video is available on the YouTube and has been linked to from the project website: <http://tiny.cc/7fih6x>



Deliverable B5 – Project flyer: At the beginning of the project also a flyer was produced containing some general information about PROFORCE. It has been disseminated at all the conferences/meetings listed in Deliverable B2. This deliverable was not planned in the original application form.

Deliverable C1 – Requirements document: A report containing the present possibilities of numerical weather prediction and requirements of civil protection concerning the seamless forecasting probabilistic system has been completed in June 2014. It was the basis for all the following activities in the project.

Deliverable D1/D2/D3 – Report about seamless system: The three deliverables D1, D2 and D3 which should document the different parts of the seamless forecasting system have been merged to one comprehensive document. This document describes the technical background of probabilistic weather forecasts as well as the use of the PROFORCE web-portals.

Deliverable E1 – Documented process chain: A report documenting the process chain from forecasting up to the decision making was prepared upon the transnational (both Austria and Hungary concerned) severe weather case storm “Yvette” (14-16 May 2014).

Deliverable E2/F1 – Case study report: A comprehensive report presenting 10 major cases collected during the pilot implementation of the web-portal and the feedback of the civil protection has been prepared (final version in October 2015). For that purpose the two originally planned deliverables E2 and F1 have been merged.

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Deliverable G1 – Training session 1: A training session on probabilistic weather forecasting has been organized in Balatonföldvár (18 June 2014).

Deliverable G2 – Training session 2: A training session on new products for end-users has been organized in Tulln (11-12 May 2015). At this training also civil protection people from surrounding Austrian districts participated. Presentations and documents of this training session are available on the website. An exercise on the Hungarian web-portal has also been organized for the DMDSC dispatchers in Kaposvár (28 April 2015).

7. Evaluation of the technical results and deliverables

This project gave us the opportunity to strengthen the transnational cooperation between the project partners in Austria and Hungary. The main ideas and methods have been discussed and elaborated together at the kick-off meeting and also the development and implementation of the system was done in strong collaboration. Even though the final output comprises two separate web-portals for Austria and Hungary, the basic contents and settings are the same (choices of maps and meteogram visualisation, main parameters, thresholds, etc.). The main reason for creating two separate web-portals lies in the different operational visualisation software packages at the meteorological centres of Austria and Hungary. To guarantee a continuation of the portals after the project end we decided to go that way.

The project meetings and training sessions were essential for reaching the main goals of the project in time. Another important issue was the feedback of the civil protection agencies as end-users during the pilot implementation of the system. Their helpful and constructive comments helped a lot to improve the seamless system. Also new ideas and products (e.g. overall warning level, additional thresholds, parameters) which were initially not planned in the project are resulting from a strong cooperation between all partners and institutions. The invitation of international experts of the SAB to the major meetings was also very successful. Their critical comments were very fruitful and significantly improved the main output.

Much experiences was gained by elaborating test cases, especially during the convective season. In general no major difficulties have been found or envisioned for the actions and tasks. The delay in the Hungarian web-portal was due to technical reasons and concerned only a part of the web-portal (nowcasting), which was completed and successfully tested with all its segments before the project ended. From a technical point of view, merging several, qualitatively different forecasting systems was demanding. Its operational, everyday use required a sophisticated control of updates. However, it has been proven that such a system can work and that it can help in the decision making process of the civil protection, bringing added value (probabilistic information) compared to existing deterministic forecasts.

The interpretation of certain products by non-meteorologists is not always easy. It requires assistance of forecasters, and more training would be necessary in the future to impart both theoretical knowledge and practical experience. Considering a sustainable and optimal use of the seamless system the project life time of two years was too short. The probabilistic information proved to be very important in the short and medium range, because it can

eventually extend the lead time for certain decisions and measures in civil protection. For local extreme events (such as thunderstorms), high-resolution parts of the seamless system brought some promising results but further development and increase in computational power will be needed in future to improve their reliability.

8. Follow-up

The newly implemented probabilistic system will be sustained after the project ends. E.g. the developed EPS maps and meteograms are already in operational use at the meteorological services. The intense collaboration between meteorologists and civil protection people will be continued after the project and eventually may lead to a follow-up project in the future. Furthermore, the system is constructed in a way that it can be easily adapted to other European countries. We received consistently positive feedback when presenting and promoting the project idea. Also the WMO (World Meteorological Organization) showed interest in the idea of a seamless probabilistic forecasting system.

Table 1: Summary of expected and real duration of the tasks and deliverables.

Task ID	Deliverable Nr.	Task/Deliverable title	Expected month	Actual month
A		Reporting to the European Commission	1 - 24	1 - 24
	A.1	Minutes of project meetings: Kick-off , Mid-term , Final	2, 13, 24	2, 13, 24
	A.2	Progress reports: First , Second	8, 16	8, 16
	A.3	Final report	24	24
	A.4	Project handbook	not planned	3
B		Publicity	1 - 24	1 - 24
	B.1	Project website	1 - 24	1 - 24
	B.2	Dissemination of project information <i>Papers:</i> Katasztrófavédelmi szemle Brandaus (submitted) 24 Weather and Forecasting (submitted) 22 <i>Presentations:</i> EGU 2015, Vienna 17 Aladin workshop 2015, Copenhagen 17 EMS 2015, Sofia 22 EWGLAM/SRNWP meeting 2015, Belgrade 22	20 - 24	17 - 23

		ECSS meeting 2015, Wr. Neustadt		22
		ÖGM-Meteorologentag, Vienna		23
	B.3	Layman's Report	24	24
	B.4	Project video	24	20
	B.5	Project flyer	not planned	6
C		Requirements	1 - 6	1 - 6
	C.1	Requirements document	6	6
D		Integration and adaptation of a seamless forecasting system	4 - 18	4 - 21
	D.1	D.1-3 Merged to 1 comprehensive report: Report about seamless system	18	21
	D.2			
	D.3			
E		Pilot implementations	7 - 24	6 - 24
	E.1	Report about pilot implementations	16	18
	E.2	Report about case studies (merged with F.1)	24	22
F		Evaluation and Feedback	13 - 24	13 - 24
	F.1	Report about case studies (merged with F.1)	24	22
G		Training and transnational cooperation	7 - 18	7 - 18
	G.1	Training session in Hungary	7	7
	G.2	Training session in Austria	18	18