

"The Project is co-funded by the European Regional Development Fund (ERDF) and by national funds of the countries participating in the Interreg V-A "Greece-Bulgaria 2014-2020" Cooperation Programme under grant agreement PREVEN-T – CN2 – SO2.4 – SC049

# Interreg - IPA CBC



Greece - Republic of North Macedonia

## Preven-T

### PREVEN-T DELIVERABLE Del.4.1

<b>Authors:</b>	International Hellenic University [IHU]
<b>Status:</b>	Final report
<b>Due Date:</b>	31/10/2023
<b>Version:</b>	1.0
<b>Dissemination Level:</b>	PU

#### Disclaimer:

The contents of this document are sole responsibility of the PREVEN-T Project Consortium and can in no way be taken to reflect the views of the European Union, the participating countries the Managing Authority and the Joint Secretariat. The project has received funding from the Interreg IPA Cross-border Cooperation Programme: PREVEN-T – CN2 – SO2.4 – SC049. This document and its content are the property of the PREVEN-T Consortium. All rights relevant to this document are determined by the applicable laws. Access to this document does not grant any right or license on the document or its contents. This document or its contents are not to be used or treated in any manner inconsistent with the rights or interests of the PREVEN-T Consortium or the Partners detriment and are not to be disclosed externally without prior written consent from the PREVEN-T Partners. Each PREVEN-T Partner may use this document in conformity with the PREVEN-T Consortium Grant Agreement provisions.

(\*) Dissemination level. -PU: Public, fully open, e.g. web; CO: Confidential, restricted under conditions set out in Model Grant Agreement; CI: Classified, Int = Internal Working Document, information as referred to in Commission Decision 2001/844/EC.

# Interreg - IPA CBC






CCI 2014 TC 16 I5CB 009

## PREVEN-T Project Profile

**Grant Agreement No.:** PREVEN-T – CN2 – SO2.4 – SC049

<b>Acronym:</b>	PREVEN-T
<b>Title:</b>	PREVEN-T – Modern Tools for wildfires’ and Floods’ Risk punctual forecast and monitoring and innovative techniques for citizens’ safeguard awareness and preparedness
<b>URL:</b>	<a href="http://www.preven-t.eu/">http://www.preven-t.eu/</a> - <a href="http://prevent.the.ihu.gr/">http://prevent.the.ihu.gr/</a> (NOT OFFICIAL - temporal)
<b>Start Date:</b>	03/03/2022
<b>Duration:</b>	18 months

### Partners

 INTERNATIONAL HELLENIC UNIVERSITY	International Hellenic University (IHU)	Greece
	Military Academy "General Mihailo Apostolski" (MAGMA)	RNM
	National Park Pelister	RNM

## Document History

Version	Date	Author (Partner)	Remarks/Changes
0.1	20/07/2022	Kalliopi Kravari (IHU)	Table of Contents
0.2	20/10/2023	Panagiotis T. Nastos	1 <sup>st</sup> Draft ready for internal review
0.3			2 <sup>nd</sup> Draft ready for quality control
1.0			FINAL VERSION TO BE SUBMITTED

**Abbreviations and acronyms**

Deliverable	D
Expected Outcomes	EO
International Hellenic University	IHU
Non-governmental organization	NGO

---

---

## Table of Contents

<b>1</b>	<b>WP 4.1 “High resolution weather forecast model”</b>	<b>7</b>
1.1	Validation of the WRF-CHEM modeling system .....	7
1.2	Operational forecasts and continuous feed of observations over the target area of Greece and Northern Macedonia. ....	8
<b>References</b>	<b>11</b>	

### List of Figures & Tables

Figure 1 WRF domain configuration. D01: 13.5×13.5 km, D02: 4.5×4.5 km, D03:1.5×1.5 km..... 7

Figure 2 Left: Accumulated 6-h precipitation (mm) and mean sea level pressure (hPa) at the external WRF domain. Right: Temperature (°C) and geopotential height (m) at 500 hPa..... 8

Figure 3 Left: Accumulated 6-h precipitation (mm) and mean sea level pressure (hPa) and Right: wind speed at 10m (m/s) at the intermediate WRF domain ..... 9

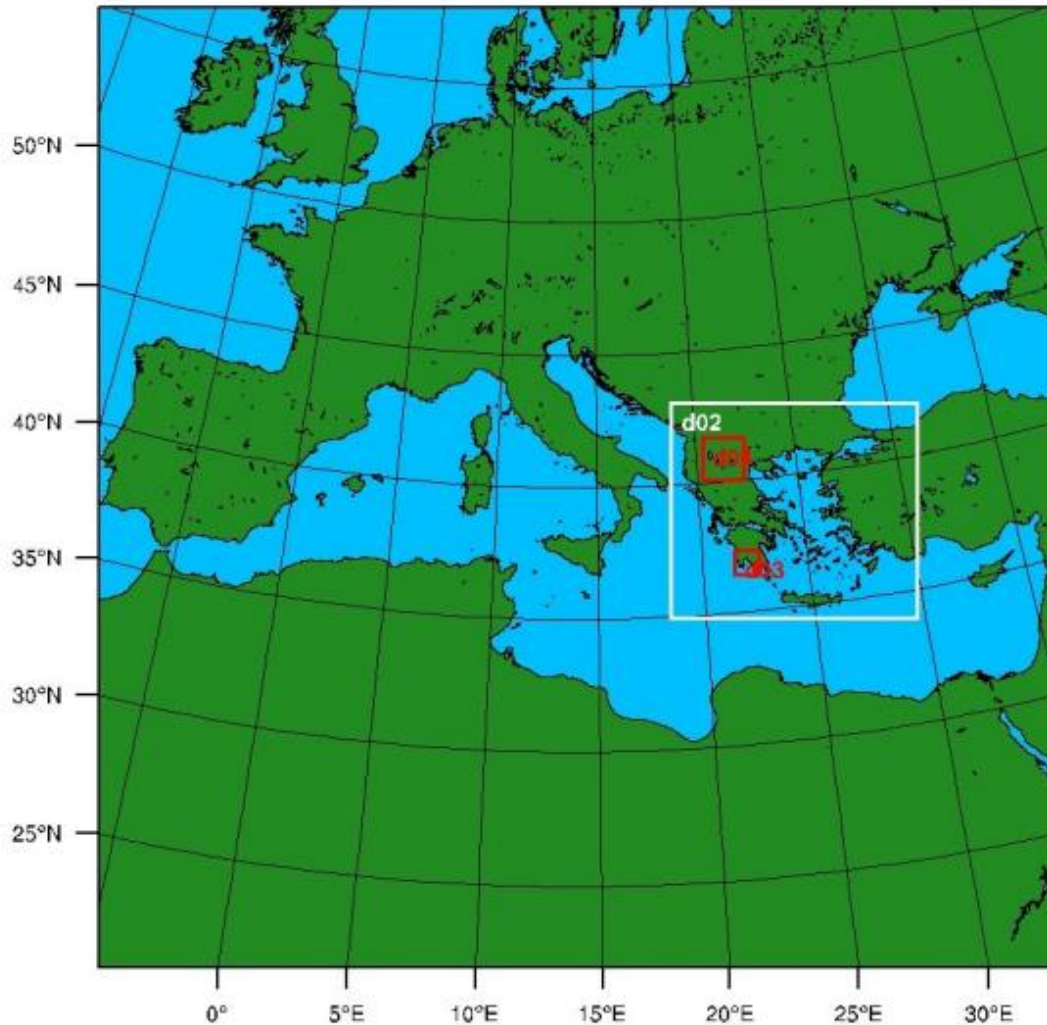
Figure 4 Left: Accumulated 6-h precipitation (mm) and topography (m) and Right: Temperature at 2m (°C) and topography (m) at finest WRF domain over the area of interest. .... 9

Figure 5 Forecast (accumulated 6-h precipitation (mm) and mean sea level pressure (hPa) for 2-6/7/2020. .... 10

# 1 WP 4.1 “High resolution weather forecast model”

## 1.1 Validation of the WRF-CHEM modeling system

Atmospheric modeling simulations for the area of interest are performed on an operational daily basis with the WRF\_v4.1 modeling system. The model is configured in a 3:1 nesting domain structure allowing higher resolution up to  $1.5 \times 1.5$  km over the area of interest as shown in Figure 6.

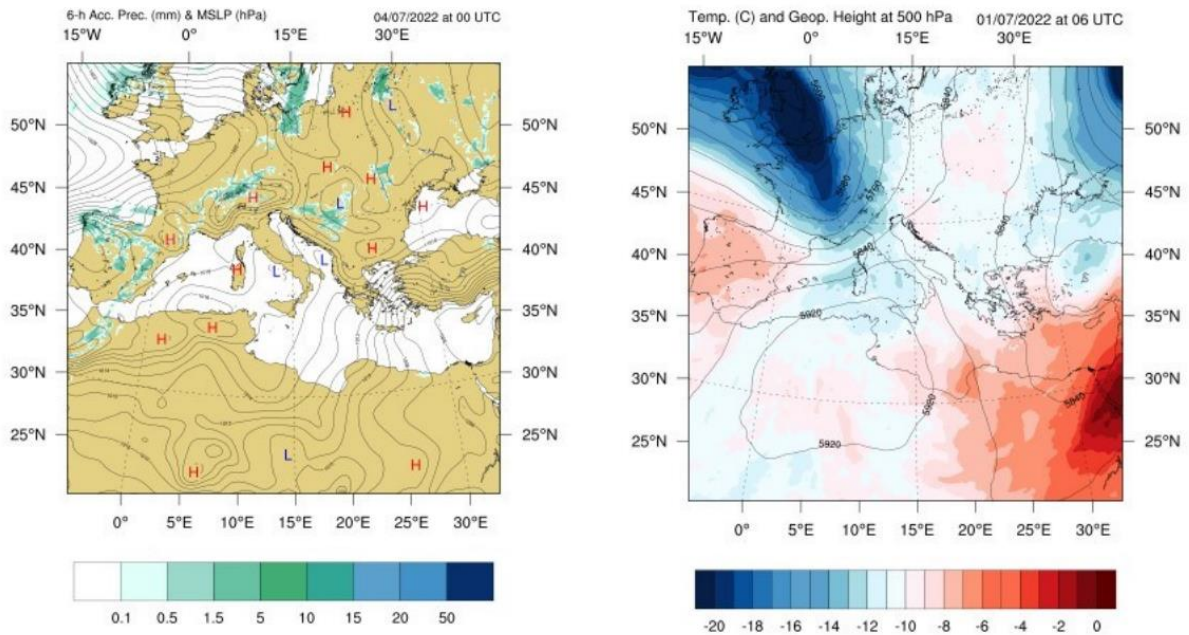


**Figure 1 WRF domain configuration. D01:  $13.5 \times 13.5$  km, D02:  $4.5 \times 4.5$  km, D03:  $1.5 \times 1.5$  km**

The high-resolution nesting structure provides advantages for the description of atmospheric flows over complex terrains (e.g. mountainous surfaces, terrain slopes, and coastal areas where the proper resolving of local flows becomes crucial). Under such circumstances the increased mechanical mixing and the elevated sensible heat sources during daytime result in an accordingly complex spatial distribution of PBL heights, a feature that cannot be easily reproduced in mesoscale model resolutions. The inner finest grid allows the detailed resolving of convective scale motions and cloud-precipitation processes by the explicit scheme of the model. The vertical structure of the model is configured with 41 terrain-following levels. Initial and boundary conditions are from the NCEP GFS at  $0.5^\circ \times 0.5^\circ$  resolution and daily updated SST is taken from the NCEP analysis.

## 1.2 Operational forecasts and continuous feed of observations over the target area of Greece and Northern Macedonia.

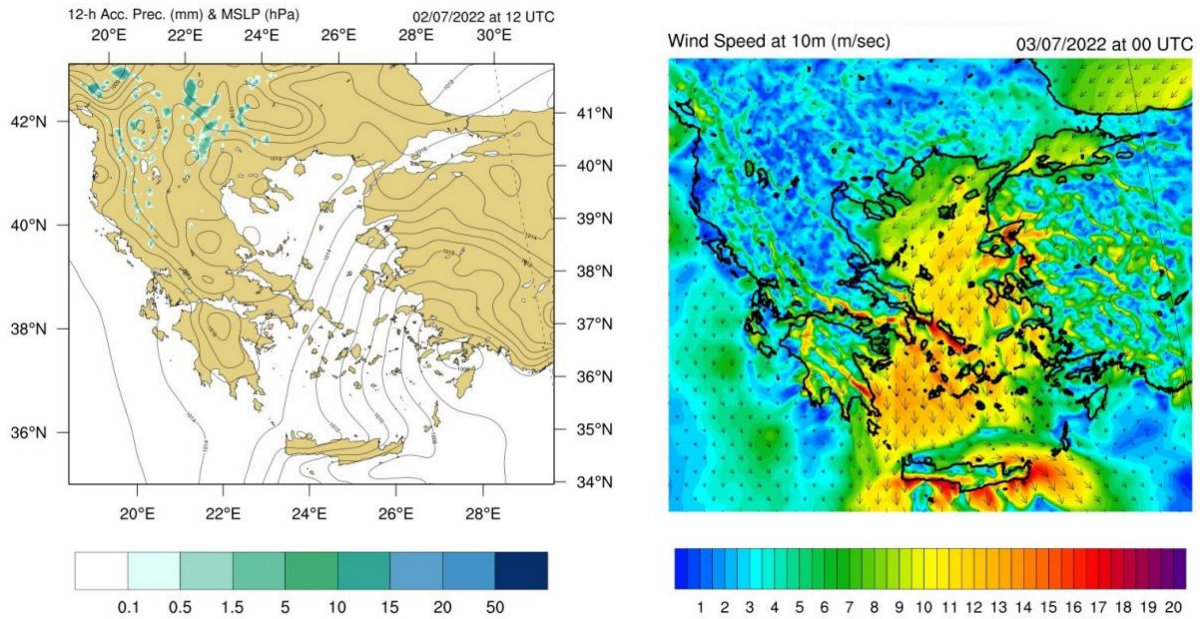
The atmospheric modeling system for PREVEN-T is running on a daily operational mode. The daily model output exceeds 200 Gb and is analyzed by in-house developed suite of tools (bash scripting, FORTRAN, Python, NCL) to compute the forecasting meteorological maps and surface fields to support the needs of the project. Examples from the operational modeling system are presented in the following figures.



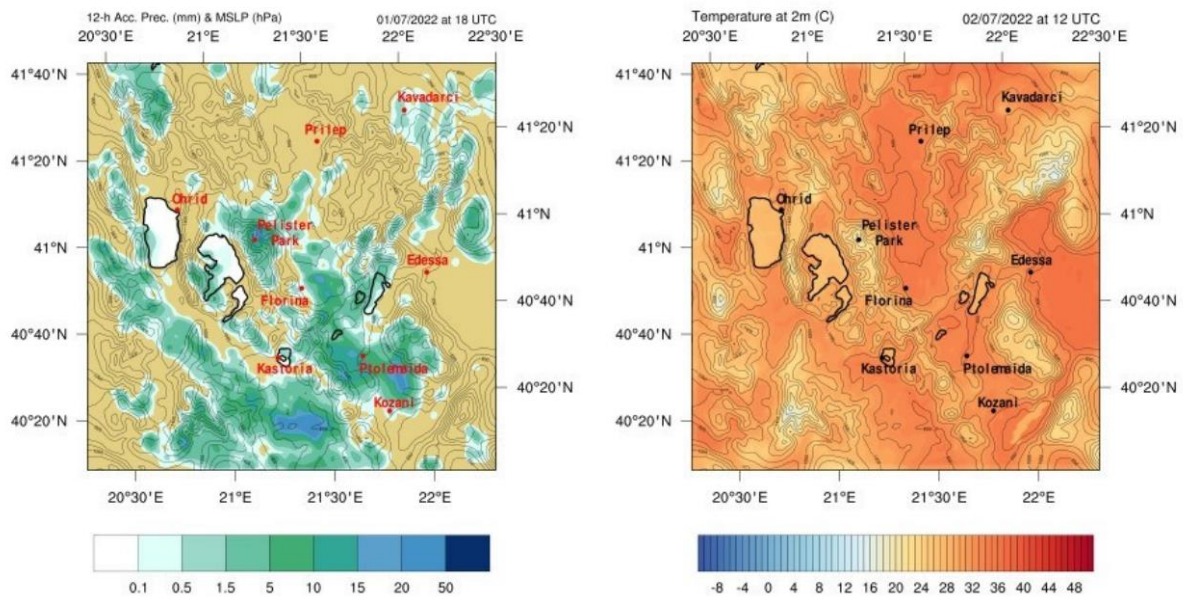
**Figure 2 Left: Accumulated 6-h precipitation (mm) and mean sea level pressure (hPa) at the external WRF domain. Right: Temperature (°C) and geopotential height (m) at 500 hPa.**

The forecasted variables include : Accumulated precipitation (mm), Incoming Shortwave Radiation ( $W/m^2$ ), Sea Level Pressure (hPa), Wind Speed at 10m ( m/s), Air Temperature at 2m (in °C), Air Temperature (in °C) at 500hPa and 850 hPa, Geopotential Height (in m) at 500hPa and 850 hPa, Total Cloud Cover (%), Wind Speed (m/s) at 200 hPa, 500 hPa and 850 hPa.





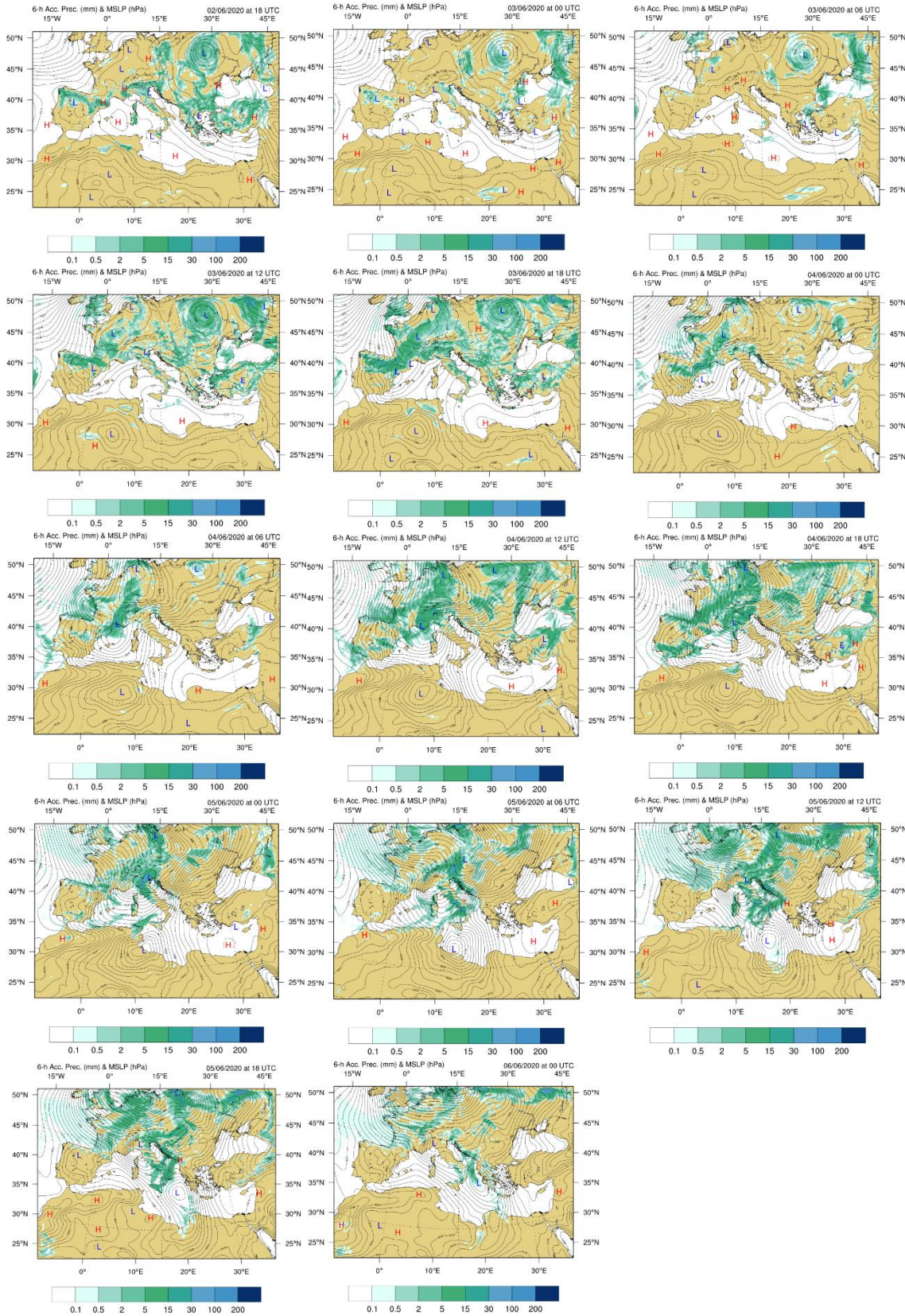
**Figure 3 Left: Accumulated 6-h precipitation (mm) and mean sea level pressure (hPa) and Right: wind speed at 10m (m/s) at the intermediate WRF domain**



**Figure 4 Left: Accumulated 6-h precipitation (mm) and topography (m) and Right: Temperature at 2m (°C) and topography (m) at finest WRF domain over the area of interest.**

Finally, in Figure 5, one can see an indicative forecast for the wider area during June, 2-6, 2020, when a flash flood event occurred in Bitola city on June 4<sup>th</sup>, due to torrential rain contributing to urban flooding in the surrounding area<sup>1</sup>.

<sup>1</sup> <https://english.republika.mk/news/macedonia/streets-flooded-in-bitola-after-a-torrential-rain/>



**Figure 5 Forecast (accumulated 6-h precipitation (mm) and mean sea level pressure (hPa) for 2-6/7/2020.**

## References

---

Draxler, R. R., & Hess, G. D. (1997). Description of the HYSPLIT4 modeling system.

Rolph, G.; Stein, A.; Sunder, B. Real-time Environmental Applications and Display sYstem: READY. Environ. Modell. Softw. 2017,95, 210–228.

Stein, A.F.; Draxler, R.R.; Rolph, G.D.; Stunder, B.J.B.; Cohen, M.D.; Ngan, F. NOAA's HYSPLIT Atmospheric Transport and Dispersion Modeling System. Bull. Amer. Meteor. Soc. 2015, 96, 2059–2077.

Stohl, A.; Forster, C.; Frank, A.; Seibert, P.; Wotawa, G. Technical note: The Lagrangian particle dispersion model FLEXPART version 6.2. Atmos. Chem. Phys. 2005, 5, 2461–2474.