

*Follow-Up Operations Workshop  
South East Europe Flash Flood Guidance  
(SEEFFG) System*

*Status of Operational flash flood  
forecasting and early warnings  
capabilities at the NHFC - Romania*

*National Institute of Hydrology and Water Management, Romania*

*Zagreb, Croatia, 9-13 May 2016*

# Introduction

- In the last decades and especially in the last years a **general increase of the frequency of extreme flash flood events** have been reported, floods that generated significant damages and frequently also loss of lives.
- In particular in Romania, such extreme events occurred in different regions of the country, most of the time having catastrophic effects.
- Taking into account the perspectives of further increase of the frequency of such extremes events as results of the climate changes, the needs for analysing and simulating the hydrological processes associated with flash floods events become more and more a priority for the scientific hydrological community.

# Introduction

- The Romanian National Hydrological Forecasts Centre is part of the National Institute of Hydrology and Water Management (NIHWM), and is in charge with the operational hydrological short-range, medium and long-range forecasts and flood warnings in Romania.
- At the basin-level (the main 11 River Basins) the short-range forecasts are downscaled by the River Basin Hydrological Forecasts Centres of the eleven branches of the Romanian Water National Administration.
- The methods and procedures used for the hydrological forecasts elaboration are specific to each hydrological forecast category and vary from empirical relations to complex models.

# Introduction

- Operational procedures for elaborating flash flood warnings are based on Information from the following main sources:
  - Radar products (rain intensities, different period rainfall accumulation products, 5 minutes updates)
  - Manual and automated hydrometric and meteorological stations.
  - Operational numerical meteorological forecasts – different resolutions / sources.
  - Operational hydrological forecasts from the National Hydrological Forecasting System (distributed model NOAH, RFS)
  - Romanian Flash Flood Guidance System
  - South East Europe Flash-Flood Guidance System
  - European Flood Awareness System (EFAS)
  - Other informations/indices related with flash-flood potential / susceptibility.

# National hydrometric and meteorologic station networks

- Includes a number of around 1000 manual and automated hydrometric stations.
- The measured and estimated amounts of precipitation are also used in the operational activity for real time validation of radar precipitation.

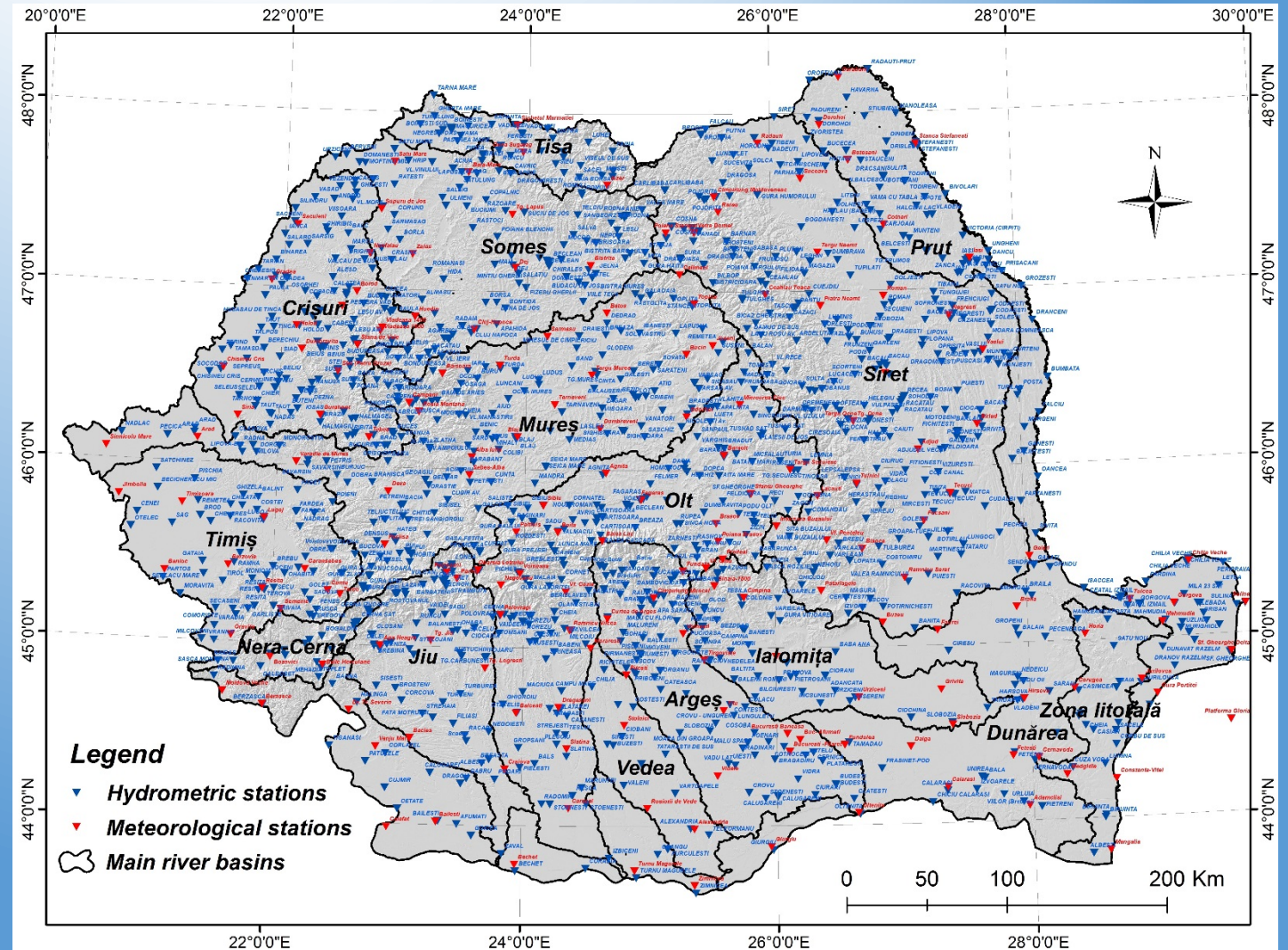


Fig. 1 The location of hydrometric and meteorologic stations in Romania

# **ROFFG – ROMANIA FLASH FLOOD GUIDANCE SYSTEM**

**(implemented by Hydrologic Research Center, San Diego, USA, within DESWAT national modernization project)**

- **Provides products which contain indicative information in real time (with hourly updates) that can help to identify the watersheds where the flash-floods could occur. The watersheds included in ROFFG system have an average area around 30 km<sup>2</sup>. In Romania, for ROFFG system were delineated a number of 8851 watersheds.**
- **the input data for ROFFG system includes:**
  - **hourly precipitations estimated from radar products;**
  - **amount of precipitations recorded at meteorological and hydrometric stations;**
  - **values of air temperatures recorded at at meteorological and hydrometric stations;**
  - **additional meteorological informations (snow depth and snow water equivalent).**




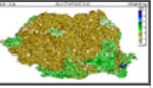
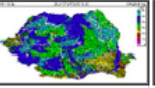
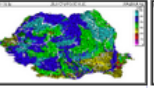


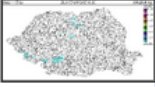
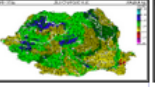
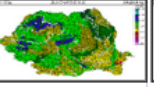


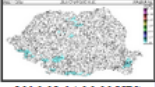
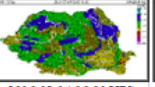
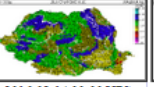

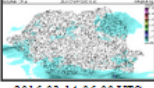
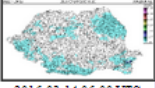
# ROFFG - Romania Flash Flood Guidance System

Current Date: 2016-03-14 06:50 UTC

Product Date: 2016-03-14 06:00 UTC

Year: 
 Month: 
 Day: 
 Hour:

REGION:

DT	RADAR	MERGED MAP	GAUGE MAP	ASM	FFG	PREV FFG	FFT
01-hr	 2016-03-14 06:00 UTC	 2016-03-14 06:00 UTC <a href="#">view text</a>	 2016-03-14 06:00 UTC <a href="#">view text</a>	 2016-03-14 06:00 UTC <a href="#">view text</a>	 2016-03-14 06:00 UTC <a href="#">view text</a>	 2016-03-14 05:00 UTC <a href="#">view text</a>	 2016-03-14 06:00 UTC <a href="#">view text</a>
03-hr	 2016-03-14 06:00 UTC	 2016-03-14 06:00 UTC <a href="#">view text</a>			 2016-03-14 06:00 UTC <a href="#">view text</a>	 2016-03-14 03:00 UTC <a href="#">view text</a>	 2016-03-14 06:00 UTC <a href="#">view text</a>
06-hr	 2016-03-14 06:00 UTC	 2016-03-14 06:00 UTC <a href="#">view text</a>			 2016-03-14 06:00 UTC <a href="#">view text</a>	 2016-03-14 00:00 UTC <a href="#">view text</a>	 2016-03-14 06:00 UTC <a href="#">view text</a>
24-hr	 2016-03-14 06:00 UTC	 2016-03-14 06:00 UTC <a href="#">view text</a>					

[Composite Product Text Export: view text](#)
[SFTP data transfer \(requires WinSCP\): EXPORTS.NATIONAL.2016.03.14](#)




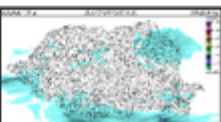
ROFFG Realtime Surfmet Observations for 2016-03-14 06:00 UTC																	
CODE	NAME	LOX	LAT	ELEV	UD	UR	TA	NR	FA	FP1	FP3	FP6	FP12	FP24	SD	SW24	IntSt
<a href="#">AARCLDQ</a>	<a href="#">CLUNG MUSCEL</a>	25.0333	45.2833	681	+	+	0.60	1.00	940.30	+	+	+	+	+	+	+	T
<a href="#">AARCNDQ</a>	<a href="#">Candesti Deal</a>	25.1801	45.0543	583	+	+	+	+	+	0.00	0.00	0.00	+	+	+	+	T
<a href="#">AARCURQ</a>	<a href="#">CURTEA DE ARGES</a>	24.6667	45.1667	448	+	+	-0.50	0.00	967.50	+	+	+	+	+	+	+	F
<a href="#">AARGHUQ</a>	<a href="#">GIURGIU</a>	25.9500	43.8833	24	+	+	2.70	6.00	1019.40	+	+	+	+	+	+	+	T
<a href="#">AAROLTQ</a>	<a href="#">OLTENITA</a>	26.6333	44.0667	15	+	+	2.80	7.00	1020.80	+	+	+	+	+	+	+	F
<a href="#">AARTHDQ</a>	<a href="#">TITU</a>	25.5833	44.6500	159	+	+	1.50	4.00	1004.10	+	+	+	+	+	+	+	T
<a href="#">AARVIDQ</a>	<a href="#">VIDELE</a>	25.5333	44.2833	106	+	+	2.10	7.00	1009.70	+	+	+	+	+	+	+	F
<a href="#">ADBAFUQ</a>	<a href="#">BUC-AFUMATI</a>	26.1833	44.4833	90	+	+	3.00	6.00	1013.10	+	+	+	+	+	+	+	T
<a href="#">ADBBANQ</a>	<a href="#">BUC-BANEASA</a>	26.1333	44.5000	90	+	+	2.50	4.00	1011.90	+	+	+	+	+	+	+	T

[HOME](#) |
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 [Processing Logs](#) |
 [Server Monitor Logs](#) |
 [Static Resources](#)

ROFFG v1.2  
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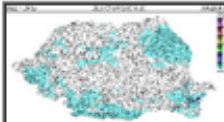
Fig. 2 The web interface of ROFFG system

# ROFFG PRODUCTS

DT	RADAR
01-hr	 2016-03-14 06:00 UTC
03-hr	 2016-03-14 06:00 UTC
06-hr	 2016-03-14 06:00 UTC
24-hr	 2016-03-14 06:00 UTC

## RADAR PRODUCTS

- Are represented as maps with unadjusted precipitation amounts accumulated in 1, 3, 6 and 24 hours, which are estimated based on radar products in Romania.
- The maps are in grid format with spatial resolution of 1 km size.
- This product is unavailable in tabular format.

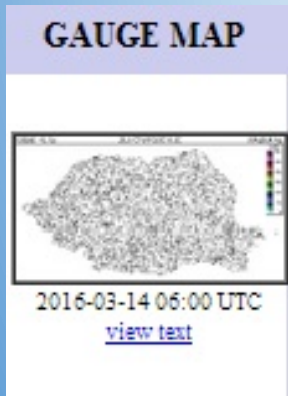
MERGED MAP
 2016-03-14 06:00 UTC <a href="#">view text</a>
 2016-03-14 06:00 UTC <a href="#">view text</a>
 2016-03-14 06:00 UTC <a href="#">view text</a>
 2016-03-14 06:00 UTC <a href="#">view text</a>

## MERGED MAP

(Mean Areal Precipitation)

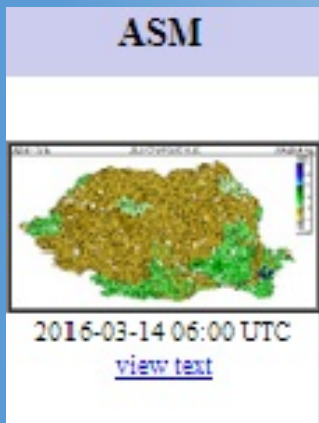
- Represent the average precipitation on the ROFFG catchments, accumulated in 1, 3, 6 and 24 hours.
- This product is derived based on radar estimations adjusted with the recorded amounts of precipitation from gauge station.
- This product is also available in tabular format.





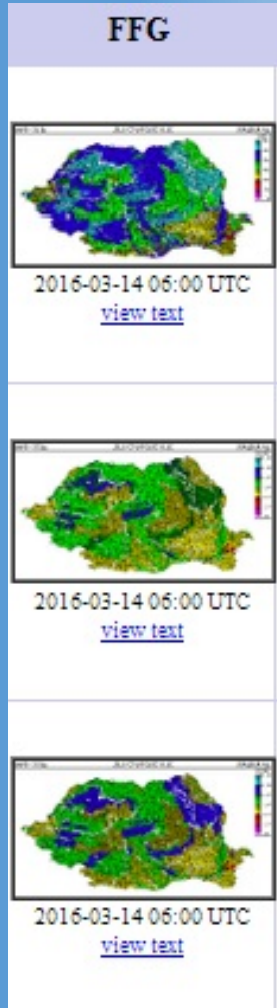
## GAUGE MAP

- Provide accumulations of mean areal precipitation (mm) estimates for each sub-basin produced from interpolation of precipitation gauge data.
- The Gauge Map data products are updated hourly;
- The product is available in both graphic and tabular formats.



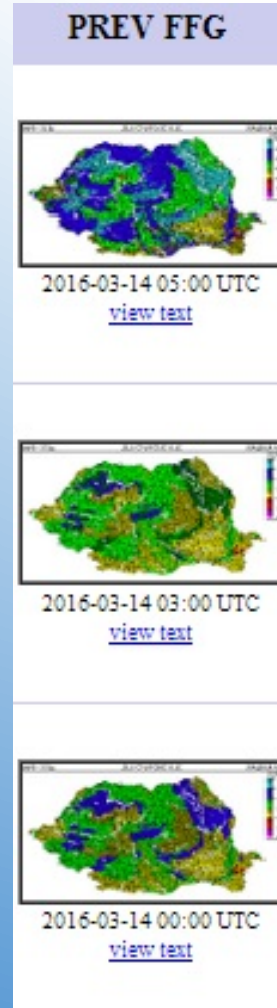
## ASM (Average soil moisture)

- soil moisture(%);
- represents the simulated soil water saturation fraction (dimensionless ratio of contents over capacity) for the upper zone (approximately 20 cm depth) of the Sacramento Soil Moisture Accounting Model for each of the sub-basins.
- the products are updated hourly;
- the product is available in both graphic and tabular formats.



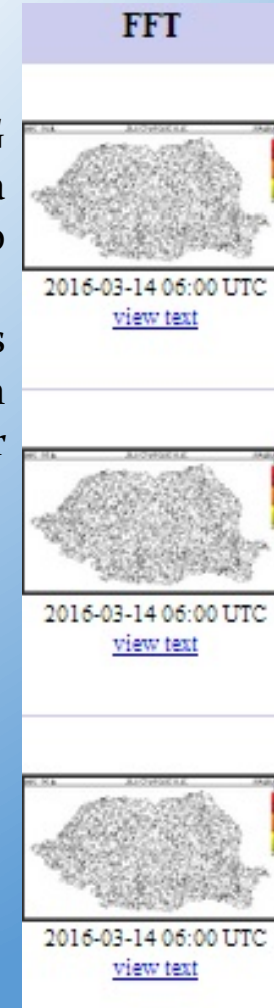
### FFG (Flash Flood Guidance)

- For a given sub-basin and duration (1-hour, 3-hour or 6-hour), the FFG value indicates the total volume of rainfall over the given duration which is just enough to cause bankfull flow at the outlet of the draining stream.
- the product is available in both graphic and tabular formats.



### PREV FFG

- Represent the FFG values calculated at a previous time step (previous hour).
- The product is available in both graphic and tabular formats.



### FFT

- FFT products include text, tables and images of hourly, 3-hourly and 6-hourly flash-flood threat (mm) for each ROFFG catchment.
- The values indicate the difference of observed mean areal rainfall of the given duration and the corresponding past FFG of the same duration for a given ROFFG subbasin.

# SEEFFG – South East Europe Flash-Flood Guidance System

(implemented by Hydrologic Research Center under International Program coordinated by WMO)

- Provides in great measure the same informations as ROFFG system.

## Differences between SEEFFG and ROFFG:

- The larger area for catchements: SEEFFG – around 100-150 km<sup>2</sup> vs. ROFFG – around 30 km<sup>2</sup>.
- The estimated rainfall using satellite products.
- Include rainfall forecast component based on ALADIN model.
- Use 6 hours rainfall accumulation and air temperature from stations;
- Products regarding the snow layer:
  - Fraction of basin snow cover area;
  - Snow water equivalent (mm);
  - Snow melt (mm).

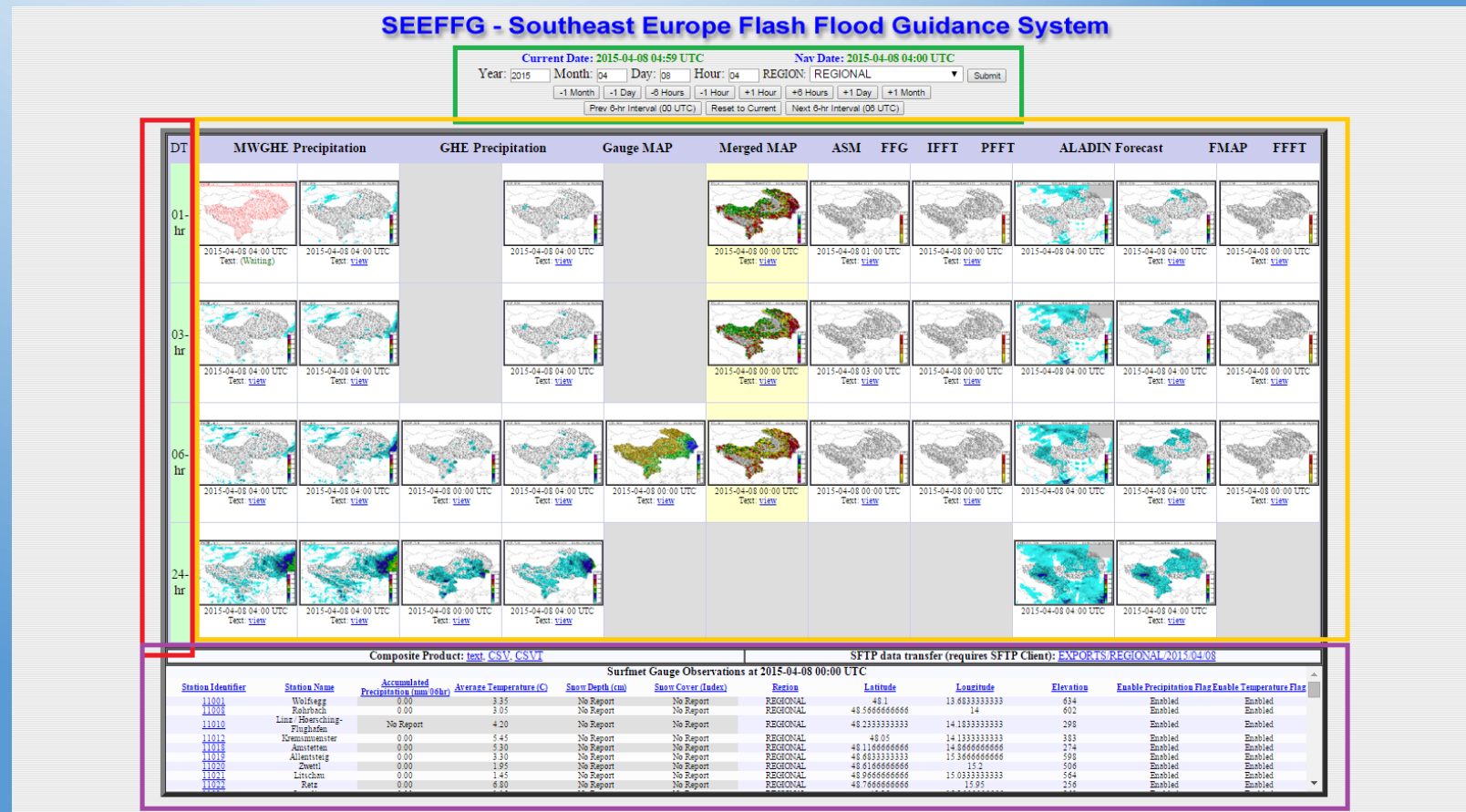


Fig. 3 The web interface of SEEFFG system

# European Flood Awareness System (JRC together with partners from EU countries)

- Is the first monitoring and forecast operational system for floods at european level.
- EFAS was designed in the first instance for medium and large size river basins and lead time up to ten days.
- The dedicated flash-floods component from EFAS includes 2 products: *Reporting points and Affected Drainage Area*.

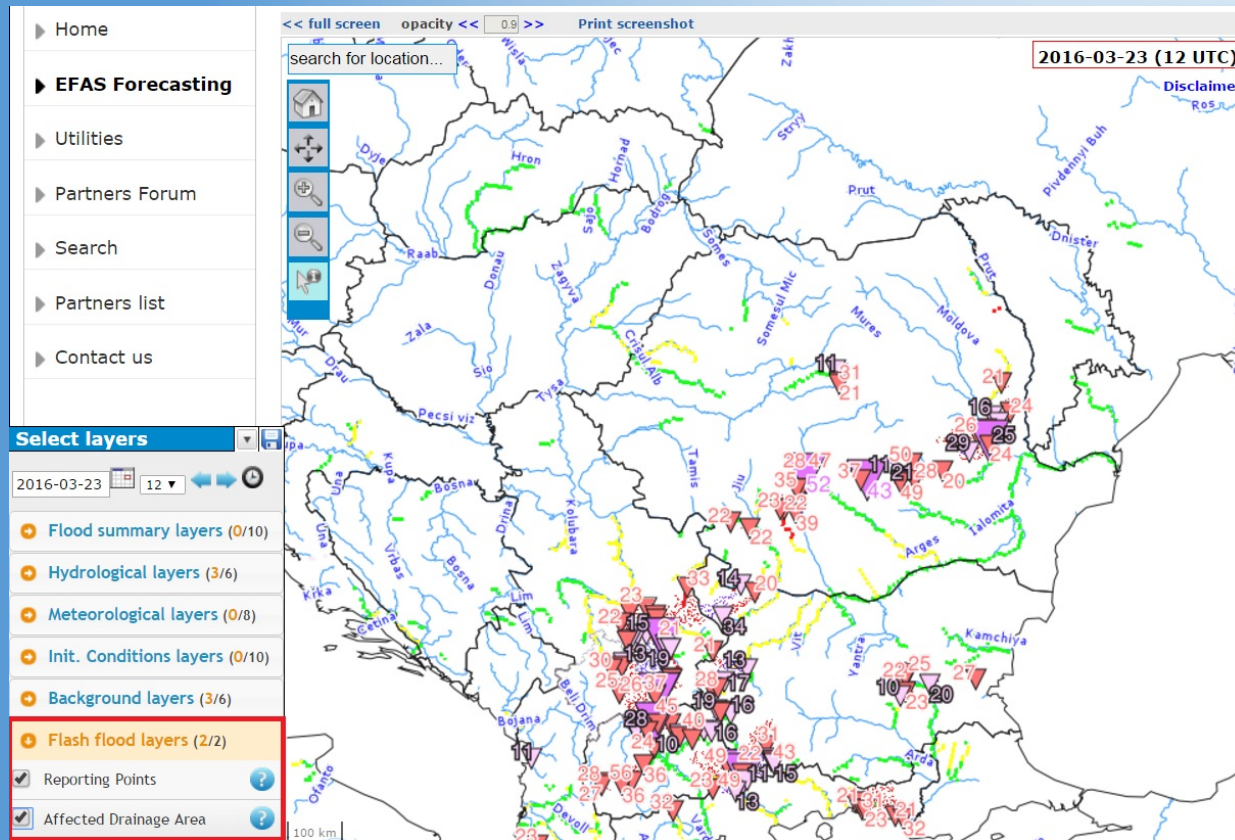


Fig. 4 The web interface of EFAS with flash-floods component highlighted

- Reporting points showing the forecasted probability [%] of surface runoff index to exceed a 5 or 20 year return period magnitude.
- A red warning point is generated when the probability of an event to exceed the 5-year return period is greater than 20%.
- A purple reporting point is generated when the probability of an event to exceed a 20-year return period is greater than 10%.
- These warning points are displayed on the web interface as colored triangles. By selecting one of these points a graph showing the corresponding probabilistic ERIC (Raynaud et al., 2014, A dynamic runoff co-efficient to improve flash flood early warning in Europe: evaluation on the 2013 central European floods in Germany) return period forecast will appear. It displays the forecasted ERIC values for the following 5 days.

# European Flood Awareness System

- A separate layer entitled 'Affected Drainage Area' highlights the upstream river network which contributes to each reporting point, i.e. the areas of the network which may be at risk from flash flooding. These river pixels are colored in the same scheme as their corresponding warning points (red = high and purple = severe).
- EFAS flash flood informations are useful mainly when the probability of exceeding a 20 year return period magnitude of the surface runoff index is greater than 35% and the forecasted start of the event is < 72 hours.

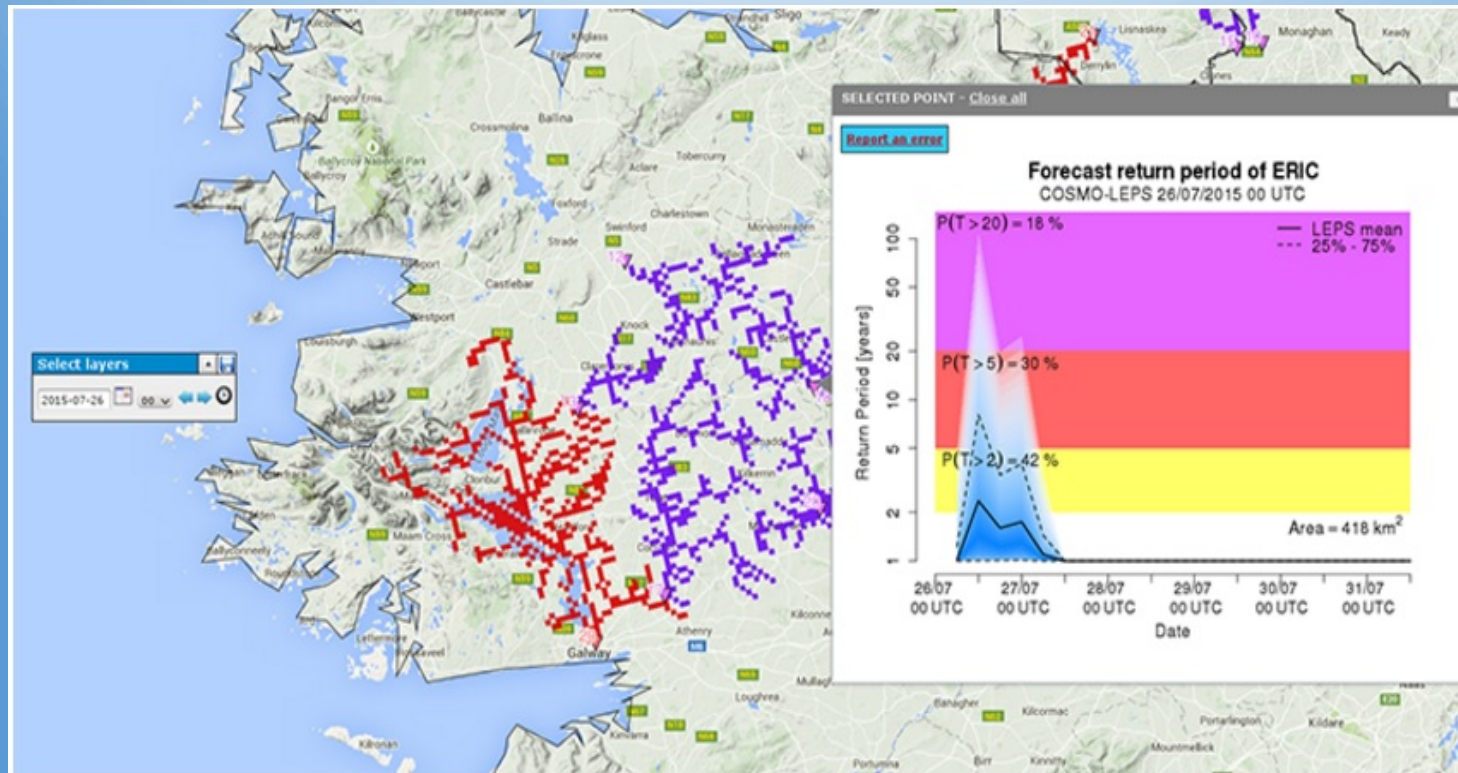
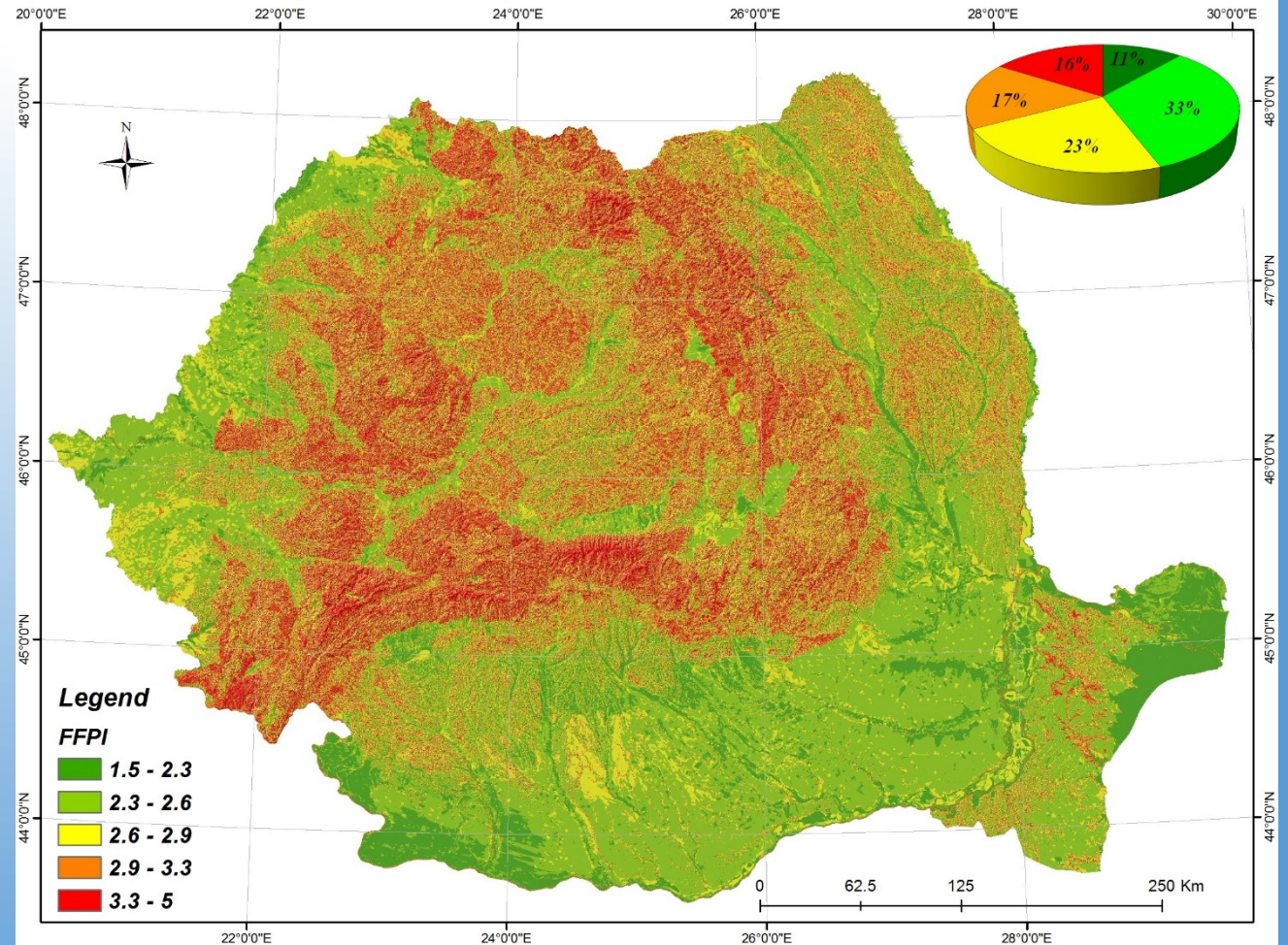


Fig. 5 The web interface of EFAS with the graph of Forecast return period of ERIC

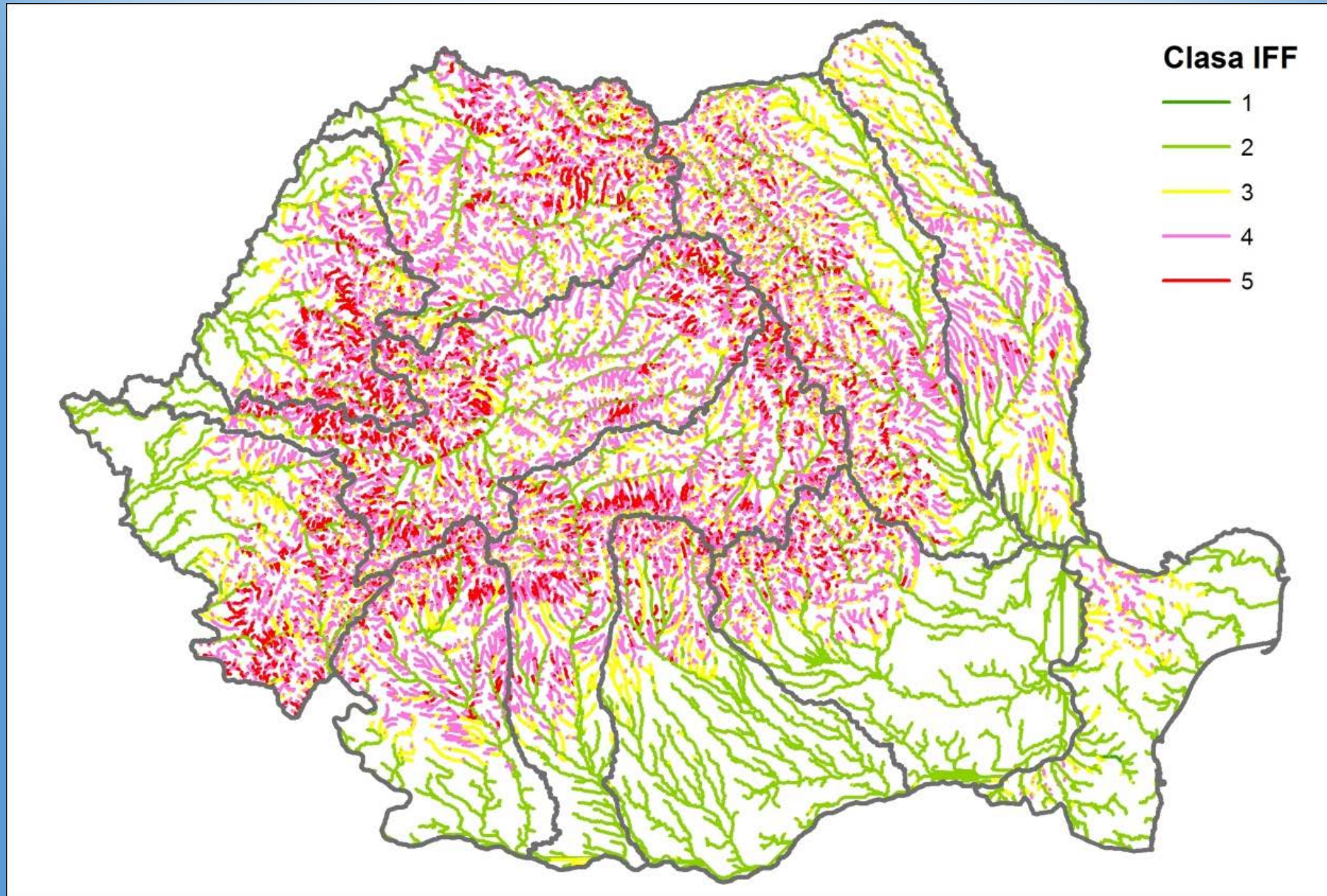
# Flash-Flood Potential Index

- Is a dimensionless index which was obtained by overlapping multiple layers (lythology, slope, land cover, profile curvature and hydrological soil groups) in the GIS environment.
- The FFPI values shows the potential of different terrain surfaces to generate the rapid surface runoff and further to trigger the flash-flood. At the same amounts of rainfall, according to their characteristics, the terrain surfaces, can trigger or not flash-floods.
- Spatially modelling of the values of FFPI at national scale is very useful for the decision to issue or not a flash-flood warning .

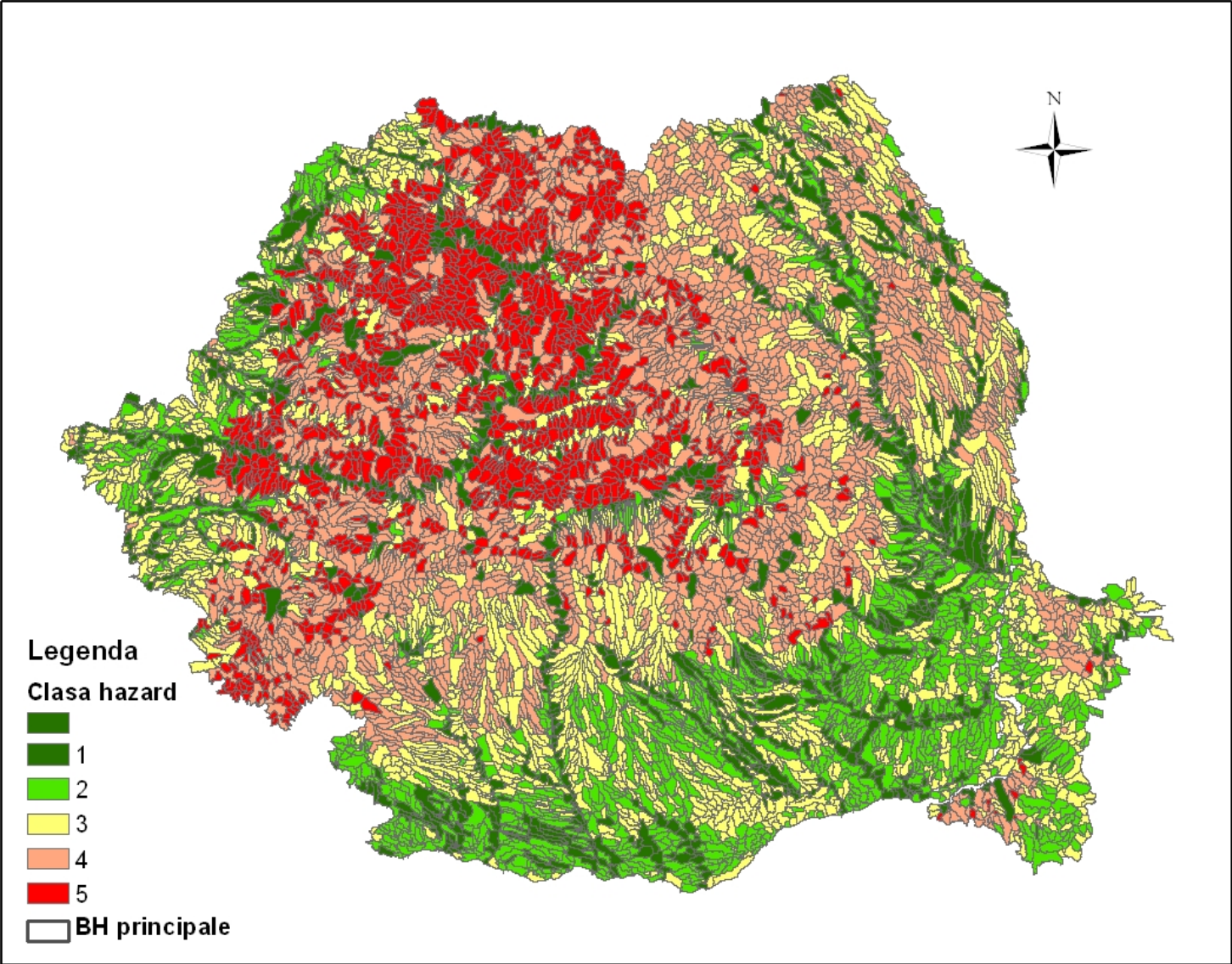


*FFPI values in Romania*

# Flash Floods susceptibility index - preliminary version




# Flash Floods hazard classes – preliminary version





# Example of Flash-Flood Warning issued in Romania

ADMINISTRAȚIA NAȚIONALĂ "APELE ROMÂNE"		
INSTITUTUL NAȚIONAL DE HIDROLOGIE ȘI GOSPODĂRIRE A APELOR		
		
Șos. București - Ploiești 97, București, cod 013686, ROMÂNIA		
Tel.: +40-21 - 3181115 Fax: +40-21-3181116 E-mail:relatii@hidro.ro		
-INH/A		
<b>ATENȚIONARE HIDROLOGICĂ PENTRU FENOMENE IMEDIATE</b> <b>NR. 4 DIN 09.04.2016</b>		
<b>Sursa:</b> INSTITUTUL NAȚIONAL DE HIDROLOGIE ȘI GOSPODĂRIRE A APELOR, BUCUREȘTI		
<b>Ziua/luna/anul:</b> 09.04.2016	<b>Ora:</b> 19:55	<b>Numărul mesajului:</b> 4
<b>Către:</b>		
Ministerul Mediului, Apelor și Pădurilor, Inspectoratul General pentru Situații de Urgență, Administrația Națională Apele Române, Ministerul Administrației și Internelor, S.C. Hidroelectrică S.A., Administrațiile Bazinale de Apă: Crișuri		
<b>FENOMENELE VIZATE:</b>		
Scurgeri importante pe versanți, torenți, pâraie cu posibile efecte de inundații locale și creșteri de debite și niveluri cu posibile depășiri ale COTELOR DE ATENȚIE		
<b>Bazine afectate:</b>		
Râurile mici din bazinul superior al râului Cigher (afluent al Crișului Alb) – județul Arad		
<b>ATENȚIONARE HIDROLOGICĂ PENTRU FENOMENE IMEDIATE</b> <b>COD GALBEN</b>		
<b>MOMENTUL PRODUCERII FENOMENELOR VIZATE:</b>		
<b>Data:</b> 09.04.2016 ora 20:10 – 09.04.2016 ora 24:00		
Ca urmare a precipitațiilor lichide înregistrate în ultimele ore, a celor prognozate, și propagării, se pot produce scurgeri importante pe versanți, torenți, pâraie cu posibile efecte de inundații locale și creșteri de debite și niveluri cu posibile depășiri ale COTELOR DE ATENȚIE pe râurile mici din bazinul superior al râului Cigher (afluent al Crișului Alb) – județul Arad.		
Fenomenele menționate se pot produce cu probabilitate mai mare în bazinele Timercea, Nadăș și Pustaciu.		
În funcție de evoluția fenomenelor hidrometeorologice vom reveni cu actualizarea prognozei hidrologice.		
Se impune urmărirea evoluției situației hidrometeorologice în conformitate cu „Regulamentul privind gestionarea situațiilor de urgență generate de inundații, fenomene meteorologice periculoase, accidente la construcții hidrotehnice, poluări accidentale pe cursurile de apă și poluări marine în zona costieră”.		
Romulus-Dumitru COSTACHE		Aprobat, Director C.N.P.H. Dr. ing. Marius MATREATA

Thank you very much for  
your attention!