

ADMINISTRAȚIA NAȚIONALĂ “APELE ROMÂNE”
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EAST AVERT Project



TECHNICAL REPORT

SIMULATION EXERCISES REPORT

2017

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SIMULATION EXERCISES REPORT

Coordinated by

Partner 4 - National Institute of Hydrology and Water Management, Romania

With the contribution of:

Lead Partner: Ministry of Environment, Romania

Partner 2: Prut-Barlad Water Basin Administration, Romania

Partner 3: Siret Water Basin Administration, Romania

Partner 5: "Apele Moldovei" Agency, Republic of Moldova

Partner 6: Dnister-Prut Basin Department of water resources, Ukraine

Partner 7: Chernivtsi Regional Centre on Hydrometeorology, Ukraine

*Ref: The trilateral project "The prevention and protection against floods in the upper Siret and Prut River Basins, through the implementation of a modern monitoring system with automatic stations EAST AVERT",
cod 966, funded by the Joint Operational Programme Romania - Ukraine - Republic of Moldova,
European Neighbourhood and Partnership Instrument (ENPI)*

1. INTRODUCTION

In general Operational Hydrological Forecasting Systems have (or could have) the following main components:

- Monitoring networks and Data acquisition systems: Is the basic component for an operational system, and the data type and availability have major implications on the modeling part of the system.
- Rainfall forecasts models: Is the most important part for the forecast lead-time increase. Unfortunately the present results of the numerical meteorological models are not enough accurate for the hydrological forecasts applications.
- Rainfall-runoff forecasts models: The possible approach extend from the simple forecast relations, event type model, through conceptual semi-distributed models, which are still the most used models in operational, to complex physically based models.
- Flood routing and flood plain models: The hydrological routing methods are still extensively used, but the general direction is to use appropriate hydraulic models, which take into account the river geometry, and allow reasonable estimations of flood maps.
- Flood impact analysis component: If flood maps are available, flood impact analysis could be finally obtained by superimposing flood maps with GIS georeferenced spatial data on constructions, traffic, agriculture, etc.

Considering the previous experience of project partners, the design and implementation of the system of observation, communication and processing of information, forecasting of hydrological processes and notification in upper part of river basins of Prut and Siret was created on multi-level basis:

- the first level (meteorological and hydrological stations) – gathering and transferring of real-time information at the basin of Prut and Siret river;
- the second level (regional center of information processing and forecasting) – processing of primary information, development of forecasts and recommendations at the basin of Prut and Siret river;
- the third level (basin center of information processing and forecasting) – processing of information, development of forecasts and recommendations at the basin of main river taking in consideration data on river basins, tributaries in conjunction with the data of neighbouring countries.

In order to check the dataflow and general message communication between partners, taken into account the new implemented informational and forecasting system components, during the project implementation were organized several simulation exercises, for the Prut and Siret transboundary river basins.

2. SIMULATION EXERCISES

During the simulation exercises preparation phase, the project partners have done the following tasks:

- Selection of institutions that will participate in the simulation exercise.
- Definition of simulation exercise scenario, for both Siret and Prut river basins.
- Definition of communication type that will be used during the exercise.
- Definition of the format for the messages / files containing observational data, forecasts, warning messages, etc.

Based on the status of the project implementation, two set of simulation exercise were done, respectively:

- A general simulation exercise, concentrating on the communication, and following a detailed predefined scenario, that was done in November 2016.
- A supplemental simulation exercise for testing the new technical solution implemented for exchange of the data from the new automatic stations, based on web services, simulation that was done at the end of the project implementation, after all the automatic stations were installed.

The main communication channel used during the simulation exercise were the following:

- E-mail communication, between the selected dispatch and forecast centers, from Romania, Ukraine and Moldova.
- FTP communication was used as a backup communication for the standard file messages, but also for exchanging other non-standard files and information, considered to be useful for the real-time operation, and in general for flood warning and flood forecasting activities.

The scenario for the simulation exercises, for Prut and Siret river basins are presented further on at sub-chapters 2.1. and 2.2..

The first meteorological and hydrological warning message, issued and transmitted at the start of the exercise by PP7 is presented in Annex 1.

All the exercises were successfully completed by the project partners, according to the predefined scenarios.

All the messages and data were transmitted in real time, with no delay, according to their availability, as in a real time situation.

2.1. Upper Prut River Basin – Simulation exercise scenario

SCENARIO	INVOLVED ORGANISATIONS	GENERAL DESCRIPTION – EVENTS/ACTIONS
R.B. Upper Prut – 19-23 November 2016		
<ul style="list-style-type: none"> ▪ River Basin PRUT ▪ Hypothesis: Exceedance of danger level at OROFTIANA H = 800 cm (+150 cm CP) - CA = 370 cm - CI = 470 cm - CP = 650 cm ▪ RADAUTI - PRUT: <ul style="list-style-type: none"> - H = 685 cm (+85 cm CP) - Q = 2020 mc/s 	<ul style="list-style-type: none"> • ABA Prut-Barlad • EC Stanca Costesti • PP7 – Chernivtsi Regional Centre on Hydrometeorology • PP6 – Dnister-Prut Basin Department of Water Resources • PP5 – „Apele Moldovei” Agency • SGA BT • INHGA, • MMAP-COSU 	<p><u>Day 0</u> <u>19.11.2016</u></p> <ul style="list-style-type: none"> ▪ <u>Hour 10:00</u> ▪ Meteorological Warning “Red Code” from PP7 - HYDROMET Center, for the period Day 20.11.2016 Hour 12:00 - Day 21.11.2016 Hour 24:00 for the upper part of the Siret and Prut River Basins. ▪ SGA BT – Hydrologic Station BT – send throw the data flow the observations from HS: <ul style="list-style-type: none"> Oroftiana H = 38 cm ; Radauti Prut H = 31 cm ; Q = 42,7 mc/s Stanca aval H= -3cm ; Q = 26,3mc/s ▪ <u>Hour 14:00</u> ▪ Hydrological Warning “Red Code” from PP7 - HYDROMET Center, increase of water levels in Upper Prut River Basin, for the period 20.11.2016 Hour 18:00 – 22.11.2016 Hour 06:00. ▪ Hydrological Warning “Red Code” from INHGA, increase of water levels in Upper Prut River Basin, for the period 20.11.2016 Hour 24:00 – 22.11.2016 Hour 18:00 ▪ <u>Hour 18:00</u> ▪ PP7 - HYDROMET Center send throw the data flow the observations from the upper Prut River Basin.

SCENARIO	INVOLVED ORGANISATIONS	GENERAL DESCRIPTION – EVENTS/ACTIONS
<p>- CA = 290 cm</p> <p>- Q = 434 mc/s</p> <p>- CI = 410 cm</p> <p>- Q = 773 mc/s</p> <p>- CP = 600 cm</p> <p>- Q = 1590 mc/s</p>		<ul style="list-style-type: none"> ▪ SGA BT – Hydrologic Station BT – send throw the data flow the observations from the HS. : Oroftiana H = 196 cm ; Radauti Prut H = 186 cm ; Q = 240 mc/s Stanca aval H= -3cm ; Q = 26,3mc/s <p><u>Day 1</u> <u>20.11.2016</u></p> <ul style="list-style-type: none"> ▪ Hour 08:00 ▪ PP7 - HYDROMET Center – send throw the data flow the observations from the upper Prut River Basin. ▪ SGA BT – Hydrologic Station – send throw the data flow the observations from the HS Oroftiana H = 220 cm ; Radauti Prut H = 189 cm ; Q =244 mc/s Stanca aval H= -3cm ; Q = 26,3mc/s ▪ Hour 12:00 ▪ EC Stanca Costesti send the information about the operations for increase the outflow from ac. Stanca S.H. Stanca aval H = 150 cm Q= 216 mc/s ▪ ABA Prut - Barlad – Dispatch - send the information about the operations for increase the outflow from ac. Stanca to S.G.A. Botosani , Iasi , Vaslui , Galati ▪ PBHH –ABA Prut-Barlad elaborate the hydrological forecasts for the hydrometrical stations upstream Stanca reservoir, and send the forecasts for validation at INHGA ▪ ABA Prut - Barlad – Dispatch - send the hydrological forecasts to SGA.

SCENARIO	INVOLVED ORGANISATIONS	GENERAL DESCRIPTION – EVENTS/ACTIONS
		<p><u>Day 2</u> <u>21.11.2016</u></p> <ul style="list-style-type: none"> ▪ Hour 08:00 ▪ Water level reach the Flood Level at hydrometric station Oroftiana ▪ PP7 - HYDROMET Center – send throw the data flow the observations from the upper Prut River Basin. ▪ SGA BT – Hydrologic Station BT – send throw the data flow the observations from the HS Oroftiana H = 470 cm Radauti Prut H = 248 cm ; Q =349 mc/s ▪ Hour 12:00 ▪ Water level reach exceed the Danger Level at hydrometric station Oroftiana - raul Prut H = 655 cm ▪ Water level reach the Attention Level at hydrometric station Radauti H=290 cm ▪ SGA BT – Hydrologic Station BT – send throw the data flow the observations from the HS Oroftiana H = 655 cm ; Radauti Prut H = 290 cm ; Q =434 mc/s ▪ EC Stanca Costesti send the information about the outflow increase from ac. Stanca S.H. Stanca aval H = 225 cm Q= 333 mc/s ▪ ABA Prut - Barlad – Dispatch - send the information about the outflow increase from ac. Stanca to S.G.A. – Botosani, Iasi , Vaslui, Galati

SCENARIO	INVOLVED ORGANISATIONS	GENERAL DESCRIPTION – EVENTS/ACTIONS
		<ul style="list-style-type: none"> ▪ Hour 18:00 ▪ SGA BT – Hydrologic Station BT – send throw the data flow the observations from the HS ▪ Water Level Reach the Danger Level Oroftiana H = 800 cm ; Radauti Prut H = 600 cm ; Q = 1590 mc/s ▪ Hour 22:00 ▪ PP7 - HYDROMET Center – send throw the data flow the observations from the upper Prut River Basin. ▪ SGA BT – Hydrologic Station BT – send throw the data flow the observations from the HS ▪ Water level decrease at Oroftiana H = 425 cm Radauti Prut H = 685 cm ; Q = 2020 mc/s <u>Day 3</u> <u>22.11.2016</u> ▪ Hour 08:00 ▪ PP7 - HYDROMET Center – send throw the data flow the observations from the upper Prut River Basin. ▪ SGA BT – Hydrologic Station BT – send throw the data flow the observations from the HS Oroftiana H = 263 cm ; Water level decrease below the Danger Level at Radauti Prut H = 440 cm ; Q = 885 mc/s

SCENARIO	INVOLVED ORGANISATIONS	GENERAL DESCRIPTION – EVENTS/ACTIONS
		<ul style="list-style-type: none"> ▪ Hour 18:00 ▪ Water level decrease below the Flood Level at Radauti Prut ▪ PP7 - HYDROMET Center – send throw the data flow the observations from the upper Prut River Basin. ▪ SGA BT – Hydrologic Station BT – send throw the data flow the observations from the Oroftiana H = 218 cm ; Radauti Prut H = 402 cm ; Q = 743 mc/s <u>Day 4</u> <u>23.11.2016</u> ▪ Hour 08:00 ▪ Water level decrease below the Attention Level at Radauti Prut ▪ PP7 - HYDROMET Center – send throw the data flow the observations from the upper Prut River Basin. ▪ SGA BT – Hydrologic Station BT – send throw the data flow the observations from the Oroftiana H = 183 cm ; Radauti Prut H = 249 cm ; Q =351 mc/s ▪ EC Stanca Costesti send the information about the outflow decrease from ac. Stanca S.H. Stanca downstream H = 85 cm Q= 113 mc/s ▪ ABA Prut - Barlad – Dispatch - send the information about the outflow decrease from ac. Stanca to S.G.A. – Botosani, Iasi , Vaslui, Galati

2.2. Upper Siret River Basin – Simulation exercise scenario

SCENARIO	INVOLVED ORGANISATIONS	GENERAL DESCRIPTION – EVENTS/ACTIONS
R.B. Upper Siret - 19-23 November 2016		
<p><u>River Basin SIRET</u></p> <ul style="list-style-type: none"> ▪ Hypothesis: Exceedance of danger level at SIRET : - H =440 cm (+40cm CP) - Q =920mc/s - CA = 300 cm - Q = 476 mc/s - CI = 350 cm - Q = 617 mc/s 	<ul style="list-style-type: none"> • ABA Siret, • PP7 – HYDROMET CernautiChernivtsi Regional Centre on Hydrometeorology • PP6 – Dnister-Prut Basin Department of Water Resources • SGA BT • SGA SV • SHI Siret • INHGA, • MMAP-COSU 	<p><u>Day 0</u> <u>19.11.2016</u></p> <ul style="list-style-type: none"> ▪ <u>Hour 10:00</u> ▪ Meteorological Warning “Red Code” from PP7 - HYDROMET Center, for the period Day 20.11.2016 Hour 12:00 - Day 21.11.2016 Hour 24:00 for the upper part of the Siret and Prut River Basins. ▪ SGA SV – Hydrological Station SV – send throw the data flow the observations from a HS Siret H = -30 cm ; Q = 20,6 mc/s • <u>Hour 14:00</u> • Hydrological Warning “Red Code” from PP7 - HYDROMET Center - increase of water levels and discharges for the Upper Siret, for the period 20.11.2016 Hour 18:00 – 22.11.2016 Hour 06:00. • Hydrological Warning “Red Code” from INHGA - increase of water levels and discharges for the Upper Siret, for the period 20.11.2016 Hour 24:00 – 22.11.2016 Hour 06:00 • <u>Hour 18:00</u> • PP7 - HYDROMET Center – send throw the data flow the observations from the upper River Basin Siret.

SCENARIO	INVOLVED ORGANISATIONS	GENERAL DESCRIPTION – EVENTS/ACTIONS
<p>- CP = 400 cm</p> <p>- Q = 773 mc/s</p>		<ul style="list-style-type: none"> • SGA SV – Hydrological Station SV – send throw the data flow the observations from HS Siret H = 95 cm ; Q = 119,5 mc/s • SHI Siret request to increase the outflow from ac. Rogojesti and ac. Bucecea • ABA Siret – Dispatch - approve the request • SHI Siret start to increase the outflow from ac. Rogojesti and ac. Bucecea (100 – 300 mc/s) • SHI Siret send information to SGA SV and SGA BT regarding the increase of outflows from ac. Rogojesti and ac. Bucecea. <p><u>Day 1</u> <u>20.11.2016</u></p> <ul style="list-style-type: none"> • <u>Hour 08:00</u> • PP7 – HYDROMET Center - send throw the data flow the observations from the upper Siret River Basin • SGA SV – Hydrological Station SV – send throw the data flow the observations from HS Siret H = 200 cm ; Q = 263 mc/s • SHI Siret - request approval of reservoir operation for flood transition for the ac. Rogojesti and ac. Bucecea • ABA Siret – Dispatch - approve the requested reservoirs operations • SHI Siret - execute the approved reservoir operation for flood transition ac. Rogojesti and ac. Bucecea (300-500 mc/s) • SHI Siret - send warning information to SGA SV and SGA BT for the reservoir operations

SCENARIO	INVOLVED ORGANISATIONS	GENERAL DESCRIPTION – EVENTS/ACTIONS
		<p><u>Day 2</u> <u>21.11.2016</u></p> <ul style="list-style-type: none"> • Hour 8.00 Water Level reach Flood Level – at Siret station, Siret river • PP7 - HYDROMET Center send throw the data flow the observations from the upper Siret River Basin, with 2 hours frequency • SGA SV – Hydrological station SV – send throw the data flow the observations from HS Siret H = 350 cm ; Q = 617 mc/s • SHI Siret - request approval of updated reservoir operation for flood transition from ac. Rogojesti and ac. Bucecea • ABA Siret – Dispatch - approve the requested reservoirs operations • SHI Siret - execute the approved reservoir operation for flood transition from ac. Rogojesti and ac. Bucecea (500-600 mc/s) • SHI Siret - send warning information to SGA SV and SGA BT for the reservoir operations • Hour 17.00 Water Level Exceed Danger Level at Siret station, river Siret • PP7 - HYDROMET Center - send throw the data flow the observations from the upper Siret River Basin with 2 hours frequency • SGA SV – Hydrological Station SV – send throw the data flow the observations from HS Siret H = 440 cm ; Q = 920 mc/s

SCENARIO	INVOLVED ORGANISATIONS	GENERAL DESCRIPTION – EVENTS/ACTIONS
		<ul style="list-style-type: none"> • SHI Siret - request approval of updated reservoir operation for flood transition at ac. Rogojesti and ac. Bucecea • ABA Siret – Dispatch - approve the requested reservoirs operations • SHI Siret - execute the approved reservoir operation for flood transition from ac. Rogojesti and ac. Bucecea (600-780 mc/s) • SHI Siret - send warning information to SGA SV and SGA BT for the reservoir operations <p><u>Day 3</u> <u>22.11.2016</u></p> <ul style="list-style-type: none"> ▪ Hour 01.00 ▪ PP7 – HYDROMET Center - send throw the data flow the observations from the upper Siret River Basin, with 2 hours frequency Water Levels decrease below Danger Level at Siret station - river Siret ▪ SGA SV –Hydrological Station SV – send throw the data flow the observations from StHm Siret H = 390 cm ; Q = 740 mc/s ▪ Hour 06.00 Water Levels decrease below Flood Level at Siret station - river Siret ▪ PP7 - HYDROMET Center - send throw the data flow the observations from the upper Siret River Basin, with 4 hours frequency ▪ SGA SV – Hidrological Station SV – send throw the data flow the observations from StHm Siret H = 340 cm ; Q = 588 mc/s

SCENARIO	INVOLVED ORGANISATIONS	GENERAL DESCRIPTION – EVENTS/ACTIONS
		<ul style="list-style-type: none"> ▪ SHI Siret - request approval of updated reservoir operation for flood transition at ac. Rogojesti and ac. Bucecea ▪ ABA Siret – Dispatch - approve the requested reservoirs operations ▪ SHI Siret - execute the approved reservoir operation for flood transition at ac. Rogojesti and ac. Bucecea (500-600 mc/s) ▪ SHI Siret - send warning information to SGA SV and SGA BT for the reservoir operations <p><u>Day 4</u> <u>23.11.2016</u></p> <ul style="list-style-type: none"> ▪ Hour 08.00 Water Levels decrease below Attention Level at Siret station - river Siret ▪ PP7 - HYDROMET Center - send through the data flow the observations from the upper Siret River Basin with normal transmission frequency ▪ SGA SV – Hidrological Station SV – send through the data flow the observations from HS Siret H = 340 cm ; Q = 412,5 mc/s ▪ SHI Siret - request approval of updated reservoir operation for flood transition at ac. Rogojesti and ac. Bucecea ▪ ABA Siret – Dispatch - approve the requested reservoirs operations ▪ SHI Siret - execute the approved reservoir operation for flood transition at ac. Rogojesti and ac. Bucecea (400 mc/s) ▪ SHI Siret - send warning information to SGA SV and SGA BT for the reservoir operations

2.3. Simulation exercise for data communication from automatic stations

After the installation of all the automatic stations a second simulation exercise was done in order to test and validate the technical solution adopted and implemented by project partners, in order to exchange in real time the data provided by the automatic stations, in an automatic way.

This data is very important both for the monitoring in real time of the evolution of the meteorological and hydrological situation, but also for providing better input data for the hydrological forecasting model and for the hydraulic routing model.

A specific software program interface was implemented by PP4, that successfully demonstrated the capability of the wbe service solution implemented by PP6, at the level of the data collection server in Ukraine.

The new data exchange solution proved to be stable, secured and with good response time, being adequate for real-time operation.

2.4. Other information exchange during the simulation exercise

Taking into account the capabilities of the new common flood forecasting system implemented during the project, the project partners exchange also other simulation results from the hydrological and hydraulic models.

This supplemental information was sent using the FTP site, dedicated to the real time data exchange between the project partners.

The main supplemental information exchanged for demonstration purposes, was an example of the simulation via the model chain WRF- RR (Topkapi) - 2D Modeling of inundation areas, with a 2D simulation of the Prut transboundary site Vamchykybsty – Mamlyga (Figures 1 – 2).

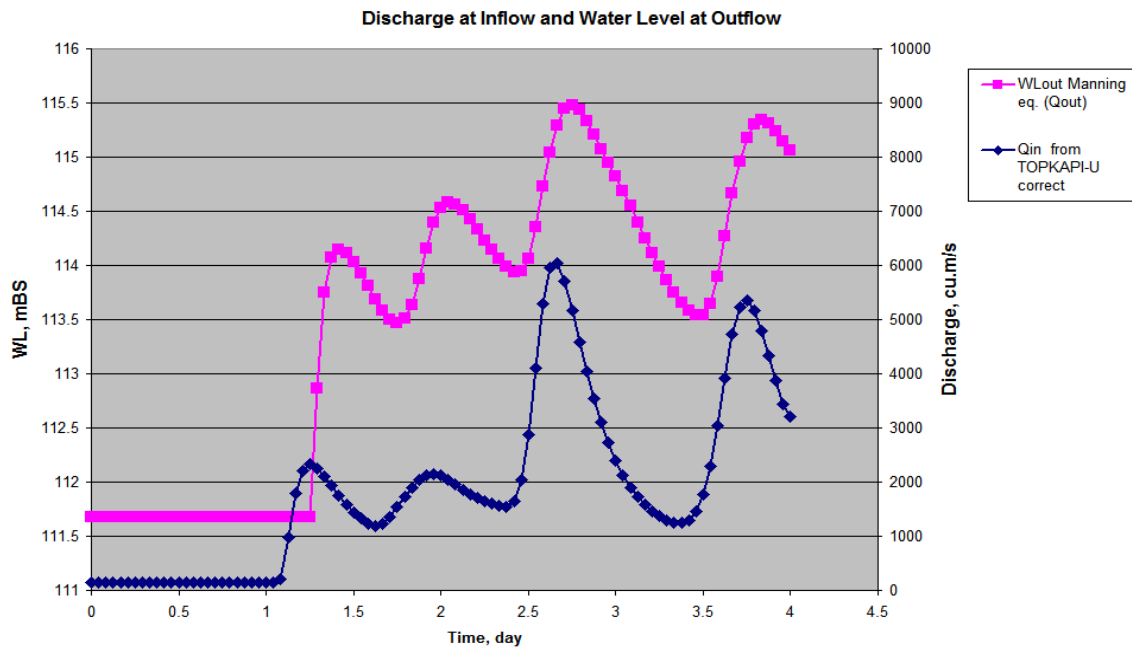


Figure 1: Discharge at Inflow and Water Level at Outflow for Modeling “WRF-2008” scenario of Simulation Exercise 19.11.2016

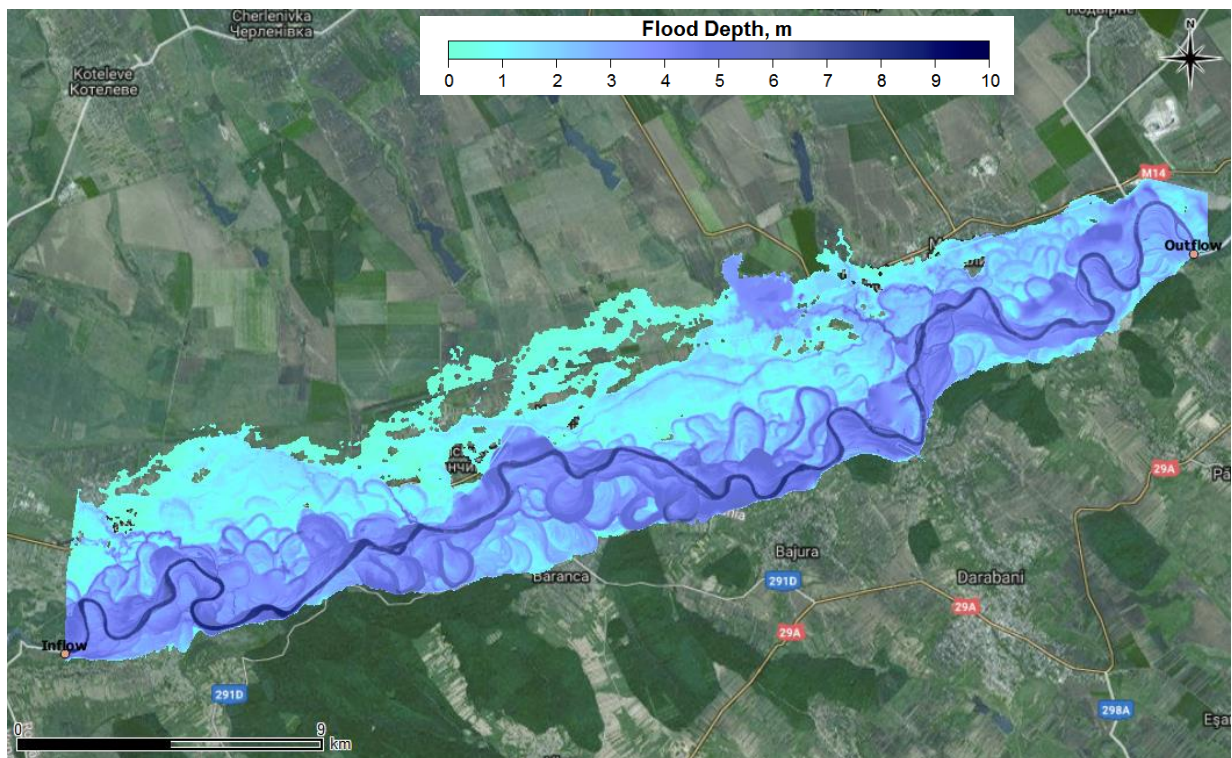


Figure 2: Flood depth map for site Vanchykvitsi-Kostychany-Dranytsya-Mamalyha for scenario “WRF-2008” of Simulation Exercise 19.11.2016

Annex 1

PRUT

1. Meteorological Forecast as of 19.11.2016 at 10:00 AM.

During 19-20 of November, in the Chernivtsi region, the heavy rains which will reach the criteria of dangerous hydrometeorological phenomena are expected.

THIS IS AN EXERCISE!!! THE INFORMATION ARE NOT REAL!!!

2. Hydrological flood warning as of 19.11. 2016 at 14:00.

Due to very heavy precipitation, during 20 - 21 of November in the mountainous part of the river Prut basin, raisings of water levels up to 2.00 - 2.50 meters, in some areas up to 3.00 meters, are expected. On the lower part of the river Prut (section city Kolomyia - state border) raisings of water levels up to 3.00 - 4.00 meters are expected above today's water levels at 8:00 o'clock. There is a possibility of dangerous consequences, significant flooding of riverine areas.

THIS IS AN EXERCISE!!! THE INFORMATION ARE NOT REAL!!!

3. The hydrological forecast of maximum water level / water flow discharge.

Passing the maximum water level of the rainfall flood on the river Prut through the section line of the gauging station Chernivtsi is expected at night on 21 of November with the height of 850 - 900 cm above zero water level of the gauging station, the maximum water flow discharge will be 3500-4000 m³/second. The water level at 8:00 pm on 19 of November at river Prut - Chernivtsi is 186 cm above zero water level of the gauging station.

THIS IS AN EXERCISE!!! THE INFORMATION ARE NOT REAL!!!