FLASH FLOOD FORECASTING AND EARLY WARNING IN SLOVENIA

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SLOVENIAN ENVIRONMENT AGENCY (ARSO)

Body of the Ministry for the Environment and Spatial Planning
100% governmental institution, 5 Offices

The principle tasks of the Meteorological and Hydrological Offices:

Continuous monitoring, analyzing and forecasting of weather and hydrological conditions of rivers and the sea in Slovenia

Issuing warnings on extreme/dangerous weather, weather related and hydrological phenomena
SOME FACTS ABOUT SLOVENIA

FOUR MAJOR EUROPEAN GEOGRAPHIC REGIONS MEET IN SLOVENIA – SIGNIFICANT IMPACT ON WEATHER AND CLIMATE.

The Alps (N and NW)

The Pannonian plain (E and NE)

The Mediterranean (SW)

The Dinaric Karst (S and SW)

Area and Altitude:
20,273 km²
0 to 2,864 m a.s.l., average of 557 m

Major river catchments:
Sava, Drava, Mura, Kolpa – Black Sea RB
Soča, Adriatic rivers – Adriatic Sea RB
THE RIVER NETWORK OF SLOVENIA

1.4 km/km²
average drainage density
Average annual values in the 1971–2000 period

PRECEPITATION MAP OF SLOVENIA
ELEMENTS OF THE WATER BALANCE

PRECIPITATION (mm):
- 2386
- 1594
- 1619
- 1534
- 897

EVAPOTRANSPIRATION (mm):
- 726
- 716
- 748
- 757
- 697

RUNOFF (mm):
- 1660
- 878
- 871
- 777
- 748
- 757
- 693

ADRIATIC RIVERS
- SOČA
- MURA
- DRAVA
- KOLPA

WMO RAVI Hydrological Forum, 20–23 Sept 2016, Oslo, Norway, Workshop on hydrological modelling, forecasting and warnings
FLASH FLOODS IN 2014

Polhov Gradec, Aug & Sep 2014

Poljanska dolina, Oct 2014

Planina, Feb & Nov 2014

Bač, Nov 2014
FLOODS IN SLOVENIA

Savinja, Celje, 1990
Sora, Železniki, 2007
Drava, Duplek, 2012
Savinja, Laško, 1998
Better Observations for Better Environment Response (BOBER)

Upgrading the system for monitoring and analysing the state of the water environment in Slovenia:

- 281 upgraded / new **measuring stations** throughout Slovenia
- additional **weather radar**
- upgraded **computer infrastructure** in the Computer Centre
- **forecasting systems** developed for the state of the Slovenian rivers, the sea dynamics, the underground water in alluvial aquifers and drought monitoring
HYDROLOGICAL OBSERVATIONS IN REAL-TIME

Current status – Sept 2016: 177 stations (incl. 145 of 150 BOBER stations)
PREcipitation Observations in Real-Time

Current status – Sept 2016: 123 stations and 2 weather radars (incl. 87/91 BOBER stations and 1/1 radar)

ftp data exchange:
- additional 39 stations in Italy
- 18 stations in Austria
- 14 stations in Croatia
INCA AND NWP MODELS

INCA-CE (up to +12h)

INCA/SI PT
19.09.2016 06:00 UTC

Aladin ECDA (up to +72h) + LAEF Ensemble

ECMWF (up to +240h)

Aladin AR (up to +72h)

NCEP Ens (up to +384h)
THE HYDROLOGICAL FORECASTING SYSTEM (HFS) OF ARSO

 Boundary conditions on the transboundary rivers:

- Drava – EFAS forecast
- Mura – Mura model forecast
HFS WARNING PRODUCTS

Statistically derived thresholds:

1h cumulative rainfall [mm]
3h cumulative rainfall [mm]
6h cumulative rainfall [mm]

Catchment specific runoff [m$^3$/s/km$^2$]
EFAS Flash Flood information

EFAS Flash Flood Notification for Slovenia - Podravska Region

Written by Michalca Mikuleckova
Monday, 02 May 2016 06:34

EFAS Flash Flood Notification*

Country: Slovenia
Region: Podravska Region
Earliest predicted peak: Monday 2nd of May 2016 12:00
Percent of affected area susceptible to landslides: very high 21%, high 25%, moderate 46%
Forecast data: 2016-05-01 12 UTC
Comment: -

This is the only notification you will receive for this event! Please follow the evolution of the event on EFAS.

EFAS forecaster on duty
Michalca Mikuleckova
Tel: +421-2-94415106; 9445244
E-mail: michalca.mikuleckova@bsmu.sk
Slovenian Hydrometeorological Institute (SHMI)
* indicating a high probability of extreme precipitation and potential flash flooding
### southeast Europe Flash Flood Guidance System

**Current Date:** 2016-09-01 12:00 UTC  
**Nav Date:** 2016-05-01 12:00 UTC

<table>
<thead>
<tr>
<th>DT</th>
<th>MWGHE</th>
<th>GHE</th>
<th>Gauge MAP</th>
<th>Merged MAP</th>
<th>ASM</th>
<th>FFG</th>
<th>IFFF</th>
<th>PFFT</th>
<th>ALADIN Forecast</th>
<th>FMAP</th>
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**Composite Product:** see SEEGG, SEEGG

**Surface Gauge Observations at 2016-05-01 12:00 UTC**

<table>
<thead>
<tr>
<th>Station Name</th>
<th>Station Code</th>
<th>Location</th>
<th>Temperature</th>
<th>Soil Moisture</th>
<th>Rainfall</th>
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<tbody>
<tr>
<td>Station 1</td>
<td>SC1</td>
<td>Location 1</td>
<td>25°C</td>
<td>0.20</td>
<td>5 mm</td>
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<tr>
<td>Station 2</td>
<td>SC2</td>
<td>Location 2</td>
<td>30°C</td>
<td>0.15</td>
<td>10 mm</td>
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<tr>
<td>Station 3</td>
<td>SC3</td>
<td>Location 3</td>
<td>28°C</td>
<td>0.18</td>
<td>7 mm</td>
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**SFTP data transfer (requires SFTP Client):** `export:SVN/2016-05-01`
Integrated hydro-meteorological activities:

- 24/7 meteorological, daily hydrological service (on call)
- Daily consultations at specified hours (9:00 and 13:00)
- Common operation and communication strategies in emergency situations
- Harmonized warning thresholds for intensive rainfall and flood hazard – coloured warnings
- Meteorological data and forecasts available for hydrological forecasting through common database and local network
Assess if the event is:
• unusual
• dangerous
• likely - less or more
• locally limited or may affect wider area

Assess the possible **impact**, consider **vulnerability** and respond

**Weather Impact Matrix**

Present, report, share i.e. colours

- Be aware
- Be prepared
- Take action
OPOZORILO

Zaradi močnih naplav bodo danes dopolnilo hitreje naraščali hudoimki in reke v Vipavske dolini, na Goriki, na območju Istrijsko-Goriljskega hribovja ter v jugovzhodni Sloveniji. Pri tem lahko pride do različenj na izpostavljenih mestih ob vodotokih.

Danes tekom dneva bodo reke po državi močneje naraščale, zvečer in v noči na četrtek lahko pride do različenj manjših vodotokov v jugovzhodni, osrednji in jugovzhodni Sloveniji. V četrtek bodo reke še naraščale, do različenj v nekaj večjih obsegu lahko pride zredi na poročilu Krke.


Lep pozdrav,
Hidrološka protnoza

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<td>issued warnings</td>
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<td>32</td>
<td>125</td>
<td>118</td>
<td>234</td>
<td>74</td>
<td>72</td>
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</tbody>
</table>
WARNING, DATA AND FORECAST DISSEMINATION

Authorities (national EWS):
  Ministry of Defence,
  Administration for Civil Protection and Disaster Relief

Media and general public:
  Radio and TV stations, teletext, newspapers

Neighbouring countries (bilateral agreements):
  Authorities in Croatia, Italy and Hungary (and Austria)

ARSO website, meteo.si, MeteoAlarm,
  ftp, e-mail, fax, telephone communication
Flash flood event on Sora and Gradaščica, 22 Oct 2014

Yellow warning for small river flooding 21 oct 2014 09:00

Red warning 22 oct 2014 08:00
Flash flood event on Sora and Gradaščica, 22 Oct 2014
CONCLUSION

(Flash) Flood forecasting and warning issues in Slovenia:

• establishing full 24/7 hidrometeorological service
• communicating event uncertainties with the end users, media and general public
• general flood and flood warning awareness
• EWS warning products update
• Modern media and community presence (tweeter, YT, FB)
Thank you for your attention!