Coastal flooding in Slovenia

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Covers:

• Rivers
  – forecasting river discharges, using model MIKE for Sava, Soča (Isonzo) and Mura river basins
  – river floods occur several times a year in Slovenia, mainly in spring and autumn

• Sea
  – forecasting high sea levels – based on tide tables, meteorological forecast and forecaster experience, no sea level height model
  – forecasting high waves
Hydrological forecast office

– follow river and sea states – river discharges, sea levels, water temperatures
– releasing warnings and cooperation with Civil Protection and local authorities in case of expected river and/or sea floods and high sea waves which could cause damage on the coast
Warnings

Meteoalarm

Hidroalarm
Coastal problems

• Slovenian coast is exposed to high waves during bora, scirocco events (autumn, winter) and storms from the north-west (summer)
• coastal floodings during storm surge events and also seiches afterwards combined with high astronomical tides
Case: Scirocco Floods
Case: Strong Bora
Case: summer storms
Measurements
Marine measuring stations

Mareographic station Koper
- sea level height
- sea surface temperature

Oceanographic buoy Vida
- sea surface and bottom temperature
- sea currents profile
- sea waves (height, direction, period)
- salinity
- dissolved oxygen
- wind speed, air temperature and humidity

2 new oceanographic buoys (mooring in December 2013)
- sea surface temperature
- sea currents profile
- sea waves (height, direction, period)

http://www.arso.gov.si/vode/podatki/
Figure: Measuring stations
Warning system:
Yellow: 1st stage warning h>300 cm
(MSL + 80 cm)
Orange: 2nd stage warning h>320 cm
(MSL + 100 cm)
Red: 3rd stage warning h>340 cm
(MSL + 120 cm)

Figure: Yearly maximal sea levels in Koper, coastal flooding is present when sea
level is above 300 cm at mareographic
station Koper
Forecasting
Prognostic approach for high sea levels forecasting – using meteorological model ALADIN/SI products in combination with tide tables and observed residuals:

- low pressure over the northern Adriatic (inverse barometer effect)
- strong scirocco wind forecasted over the middle Adriatic
- high astronomical tides
- seiches after the main high sea level event
Forecasting challenges

• River floods and coastal flooding are usually synchronized during strong scirocco events
BOBER hydrological forecast system

- prognostic system for Soča (Isonzo) river basin based on model MIKE (DHI)
- common monitoring between Slovenia and Italy, Friuli-Venezia Giulia
- Soča river discharge forecast → input for oceanographic model
BOBER wave forecasting model

Figure: Wave height and direction in the northern Adriatic Sea
BOBER oceanographic forecasting model

sea surface currents

sea surface salinity
BOBER tidal model

Figure: Tidal elevation in the Adriatic Sea
Conclusion

- Sea level forecasts should be precise since level of consequences can vary a lot within few cm
- Future – ocean-atmosphere 2 way coupled models