Real-time prognoses of peak flows: a case study from the upper Nysa Kłodzka basin (SW Poland)

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Outline



- HydroProg
 - Formal issues
 - Idea and infrastructure
- Experimental use of the HydroProg system in SW Poland
 - Study area and methods
 - Experimental results

System supporting a comparison of hydrologic predictions

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(UNIQUE RESEARCH FACILITY) Setting up a new system for hydrological forecasting, designed to work in real time and based on prognoses computed independently by dissimilar models, utilizing a concept of multimodelling.

- **(HydroProg)** System for early warning against selected hydrological hazards based on external prediction signals computed by external hydrological models and on the multimodel ensemble generator (patent application no. P.407067).
- (Modelling) Several empirical and physically-based hydrological models
- (Web map service) Publication of water level predictions in the interactive on-line fashion

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System supporting a comparison of hydrologic predictions



(FUNDAMENTAL RESEARCH) Understanding processes which control performance of hydrologic predictions

- (Comparison) Objectively-performed comparison of prediction methods, working operationally in real time
- (Classification) Prediction methods will classified according to their performance expresses as a function of physical-geographical conditions (e.g. synoptic situations, topography, geology)
- (Recommendation) Elaborating recommendation on usage of individual methods in specific environmental situations

Actors of HydroProg



- Executive institution University of Wrocław, Poland
- Computational centre networking and supercomputing infrastructure of the Laboratory for Geographic Information Systems (Department of Geoinformatics and Cartography, University of Wrocław)
- **Project partner** institution providing hydrometeorological data on the basis of a separate agreement (as a feedback, the executive institution provides the partner with a set of forecasts, a multimodel ensemble forecast, a link to the web map service, and access to e-mail alerting service)
- **Project Participant** institute/team/researcher preparing hydrological forecasts that participates in the project following the project regulations and the rules established by the participation contract

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Formal issues Idea and infrastructure

Computational centre



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HydroProg

Experimental use of the HydroProg system in SW Poland

Formal issues Idea and infrastructure

How do actors act?





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Formal issues Idea and infrastructure

Partner \rightarrow computational centre (every 15 min)





Real-time prognoses of peak flows

Computational centre \rightarrow participants (every 15 min)



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Real-time prognoses of peak flows

Participants \rightarrow computational centre (every 15 min)





HydroProg

Experimental use of the HydroProg system in SW Poland

Formal issues Idea and infrastructure

computational centre \rightarrow users (every 15 min)



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+ ISSUING ALERTS ON HYDROLOGICAL HAZARDS BY E-MAIL

Real-time prognoses of peak flows

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Study area and methods Experimental results

Partner – LSOP

Local System for Flood Monitoring, Kłodzko County, Poland (Lokalny System Osłony Przeciwpowodziowej, LSOP)



Hydrometeorological data are available in real time, with 15-minute sampling



Real-time prognoses of peak flows

Study area and methods Experimental results

Partner – LSOP 🌌





Real-time prognoses of peak flows

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Description of experiment – hydrograph prediction



- Implementation of the HydroProg system for the upper Nysa Kłodzka basin (SW Poland)
- 11 gauges at which river stages are being predicted in real time, with 15-minute recalibration and update
 - Międzylesie
 - Bystrzyca Kłodzka
 - Krosnowice
 - Kłodzko-most
 - Bardo
 - Lądek-Zdrój
 - Żelazno
 - Szalejów Dolny
 - Szczytna
 - Ścinawka Górna
 - Gorzuchów
- Lead time of 3 hours, with 15-minute time step
- Lead time of 2 days, with 6-hour time step

Prediction methods

Executive institution acts as participants

- VARhvdro vector autoregressive model: water stages at numerous gauges
- ARhydro autoregressive model: water stages at one gauge
- ACVhydro autocovariance model; water stages at one gauge
- ANNARhydro artificial neural-network autoregressive model; water stages at one gauge
- TOPMODELhydrometeo Topmodel; discharges at gauges, precipitation and evapotranspiration from Weather Research and Forecasting (WRF)

ENSmultimodel – multimodel ensemble prognosis; weights are based on Root Mean Squared Error (RMSE) of predictions updated every 15 minutes and limited to the monthly moving time span

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Call for participation

- We kindly invite experts who have their hydrological predictive models and would like to act as participants
- We offer co-authorship of papers

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Study area and methods Experimental results

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Flood wave dynamics



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Study area and methods Experimental results

Prediction of peak flow on 09 December 2013



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Study area and methods Experimental results

Prediction of peak flow on 16–18 May 2014



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Study area and methods Experimental results

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Example hydrograph, Bystrzyca Kłodzka



Warning water level = 110 cm, emergency water level = 180 cm

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Study area and methods Experimental results

Prediction at 06:15 UTC 14/09/2013, Bystrzyca Kłodzka





Study area and methods Experimental results

Prediction at 06:45 UTC 14/09/2013, Bystrzyca Kłodzka





Study area and methods Experimental results

Prediction at 07:30 UTC 14/09/2013, Bystrzyca Kłodzka







Study area and methods Experimental results

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Example hydrograph, Bystrzyca Kłodzka



Warning water level = 110 cm, emergency water level = 180 cm

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Study area and methods Experimental results

Prediction at 11:00 UTC 16/03/2014, Bystrzyca Kłodzka





Study area and methods Experimental results

Web map service for HydroProg



www.klodzko.hydroprog.uni.wroc.pl

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Intellectual rights



- PATENT APPLICATION
 - System for early warning against selected hydrological hazards based on external prediction signals computed by external hydrological models and on the multimodel ensemble generator (no. P.407067 [WIPO ST 10/C PL407067], 03/02/2014)
- TRADE MARKS
 - HYDROPROG (word, no. Z.422237, 02/12/2013)
 - HYDROPROG (word and graphics, no. Z.422238, 02/12/2013)



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Thank you for your attention & I kindly invite you for participation

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