COMBINING AN ATMOSPHERIC WEATHER MODEL AND A HYDROLOGICAL RUNOFF MODEL TO CORRECT FLOOD RECORDS AND PREDICT PROBABLE MAXIMUM FLOODS IN THE ÞJÓRSÁ-TUNGNAÁ RIVER BASIN IN ICELAND

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A flood analysis system has been set up for the Þjórsá-Tungnaá river basin in South Iceland. An atmospheric model (MM5) is used to simulate the weather over the model area. The MM5 output variables used as input into the flood analysis system are precipitation, temperature, wind speed, short wave radiation, water vapor mixing ratio and air pressure. Evolution of the snow pack is modeled by a one–dimensional energy and mass balanced model predicting surface water originating from both precipitation and snowmelt. Surface water is then routed through the river basin using the U.S. Army Corps of Engineers Hydrologic Modeling System HEC-HMS.

Two flood events of very different character were selected for calibration of the flood analysis system, a rapid winter flood which occurred in January 2002 and a spring-melt flood event in 1992. The modeled discharge in the January 2002 flood reflects very well the measured discharge. The model over-predicts on the other hand the discharge somewhat throughout much of the 1992 spring melt event. This is caused by overprediction of precipiation in the weather model, which in turn causes over-prediction of flood discharge.

Due to influence of the many reservoirs, diversions schemes, power stations and other hydraulic structures built within the river basin since 1970, discharge records over a large part of the basin are disturbed from that time on. To obtain undisturbed and thus homogeneous discharge records, the flood analysis system was used to "correct" the measured floods for the influence of the structures so as to obtain a homogeneous "natural" discharge record over the entire measurement period, i.e. an estimate of what the recorded floods would have been if structures had not been built within the river basin. From the corrected discharge record the 150 year flood discharge at the Urriðafoss gauging station is estimated to be 2300 m^3/s , the 500 year flood 2600 m^3/s and the 1000

year flood 2800 m^3/s.

Due to the size of the Þjórsá–Tungná river basin and the general meteorological conditions in Iceland, extreme precipitation over the basin is expected to be due to orographic effects, i.e. due to moist air being lifted up by topographic features, resulting in condensation due to cooling. This together with scarcity of records on short duration precipiation intensity in the area makes prediction of extreme precipitation using conventional probable maximum preciptation (PMP) methods quite difficult. The methodology applied here to predict extreme precipitation over the river basin is to use the MM5 weather model to compute "worst case" conditions with respect to precipitation in the area. Two historical storms from the period 1966-2003 that caused heavy precipitation within the basin were identified for this purpose. To maximize precipitation in these events, the boundary conditions in the MM5 model are frozen at the time of maximum precipitation and kept unchanged for 48 hours. This represents meteorological conditions that are known to occur in the area, although they did not occur in these particular storms, nor have they occurred for such a long period in other historical storms. Additionally, the mixing ratio is increased in the model and the threshold value for droplet size decreased. Both result in increased precipitation. With these modifications to the meteorological conditions in these historical storms, precipitation within the area is believed to be brought close to its physically realizable maximum.

These extreme precipitation events combined with extreme snow-melt conditions were used in the flood analysis system to estimate extreme flood conditions. For each location within the river basin the event that gave the largest flood in that particular location was taken as PMF. This results in PMF peak discharge of 20000 m^3/s at the Urriðafoss gauging station, which is larger then earlier PMF estimates for the area. The flood estimates obtained with the flood analysis system are believed to be more accurate and reliable than earlier estimates based on uncorrected discharge records and conventional methods for estimation of probable maximum precipitation and probable maximum floods.

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