ON THE ROAD TO A NEW NATIONAL HYDROLOGICAL DATABASE OF ICELAND

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ABSTRACT

The Hydrological Service in Iceland is working on a set of digital spatial data that contains information about surface water features. The objective will be a nationwide coverage of a direction-based hydrological data in the scale of ca. 1:50,000 with greater accuracy and detail than existing database. The database will be used for future work on the adaptation of the European Water Framework Directive. This paper lists the origin of the data provided and describes problems with processing a very high-resolution hydrographical database.

INTRODUCTION

In 2007, the Icelandic parliment voted for adaptation of the Water Framework Directive (WFD) of EU (http://www.euwfd.com) with the objective to fulfill its requirements before 2017. The initial work to comply with its adaptation is to define watersheds and the so-called water bodies, which will subsequently be characterized for pressures, impacts and economic analysis.

The existing hydrology database in Iceland is comprised of two parts:1) a digital image of rivers and lakes in a vectorised and georeferenced ArcInfo coverage in 1:250,000 scale from the Iceland Geodetic Survey (IGS) with classification of lines and polygons according to standards at IGS and the National Energy Authority/Hydrological Service (NEA/HS); and 2) an Oracle database edited at the HS, which includes separate tables of river and lake id‘s as well as other attributes, such as inter-relationships between rivers/lakes, (Jóhannsson and Einarsson, 1998). This combined database is a spaghetti vector data model with no flow directions, or river center-lines.

A study was made on a subset of the 1:250,000 hydrology database to estimate the time and cost needed to adjust it to the 1:50,000 IS50V water database of IGS and to add data such as flow directions and center-lines required for further work for the WFD adaptation. The main results of this

study were that the cost for this modification exceeded available funds and that the IS50V water database was inadequate in many instances.

Hence, to continue work for the WFD adaptation, the NEA has leased a high-resolution (<1:5000) digital database of surface water features from Loftmyndir ehf., including lakes, ponds, streams, and rivers. This database includes attributes such as center-lines and flow directions required for watershed establishment and future work for the WFD. For the last year, the HS has worked on this digital database in order to correct and modify it for future use. The final product will be a nationwide coverage of hydrological data in the scale of 1:50,000; replacing the 1:250,000 data base. The advances to the available database will be a topologically correct dataset and tabular data storing directions, names (river and lake id‘s) and connections to water bodies making it possible to build a river network in the future. A river network database enables one to trace water movement through the landscape.

ORIGIN AND STRUCTURE OF THE HYDROLOGICAL DATABASE

The database from Loftmyndir ehf. is comprised of digitized polygons and lines representing various hydrographic features such as rivers, lakes, shorelines etc. shown in Table 1. The lines were traced from aerial photographs covering the entire country with up to 1 m accuracy. A Digital Elevation Model (DEM) is needed before watersheds can be delineated therefore, a DEM with a 25-m-pixel size and 10-50 m accuracy was obtained from Iceland GeoSurvey (ÍSOR) in 2007. The DEM was constructed combining from different sources the most accurate elevation data available. As a result the quality of the DEM varies with location for instance the area around glaciers and their vicinity has the poorest quality due to lack of data.

The structure of the national hydrological database will be based on the ArcHydro data model schema (Maidment, 2002), storing the existing 1:250,000 hydrological river-id from the older database (Jóhannsson and Einarsson, 1998). The ArcHydro data model was chosen because it has become one of the most tried and tested GIS data models for water resources. It provides a simple way of linking time series data to geospatial data within a single information system making it possible to trace water movement throughout the stream and river network.

Table 1. Main polygons and lines in the Loftmyndir database.

Polygons	**Lines**
Glaciers	Glaciers
Hot springs area, fumaroles	Hot springs
Intermitted lakes	Hot springs area, fumaroles
Foreshore flat	Intermitted lakes
Bare rocks and islands in rivers and lakes	Coastline (low tide)
Bare rocks and islands in sea	Bare rocks and islands in rivers and lakes
Lake	Bare rocks and islands in sea
River (<7 m)	Coastline (high tide)
Mud area and intermitted creek area	Wharf
	Pier
	Ditches
	Intermitted rivers
	Lake
	Riverbank
	River, centerline
	Mud area (unvegetated)/intermitted creek area
	Rapids
	Waterfalls
	River, centerline rivers <7 m
	Connecting line btw. rivers/ditches etc. and centerlines
	Dams
	Culvert

WORK PHASES AND PROCEDURES

The objective is to create a layer consisting of direction-based hydrological data in the scale of 1:50,000. In order to do this the data has to be processed to meet the requirements of the project. Figure 1 pictures the main phases of the project.

Data preparation

Various errors were encountered in the initial error-check of the digital data set from Loftmyndir and the DEM from ÍSOR.

1) The traced lines used in the Loftmyndir dataset were produced using a CAD Microstation system which has produced problems in converting the data to ArcGIS. Therefore, time-consuming correction of topology has been carried out in the pre-processing phase. Basic topology rules were defined so that lines were for example not allowed to self overlap or intersect (Figure 1).

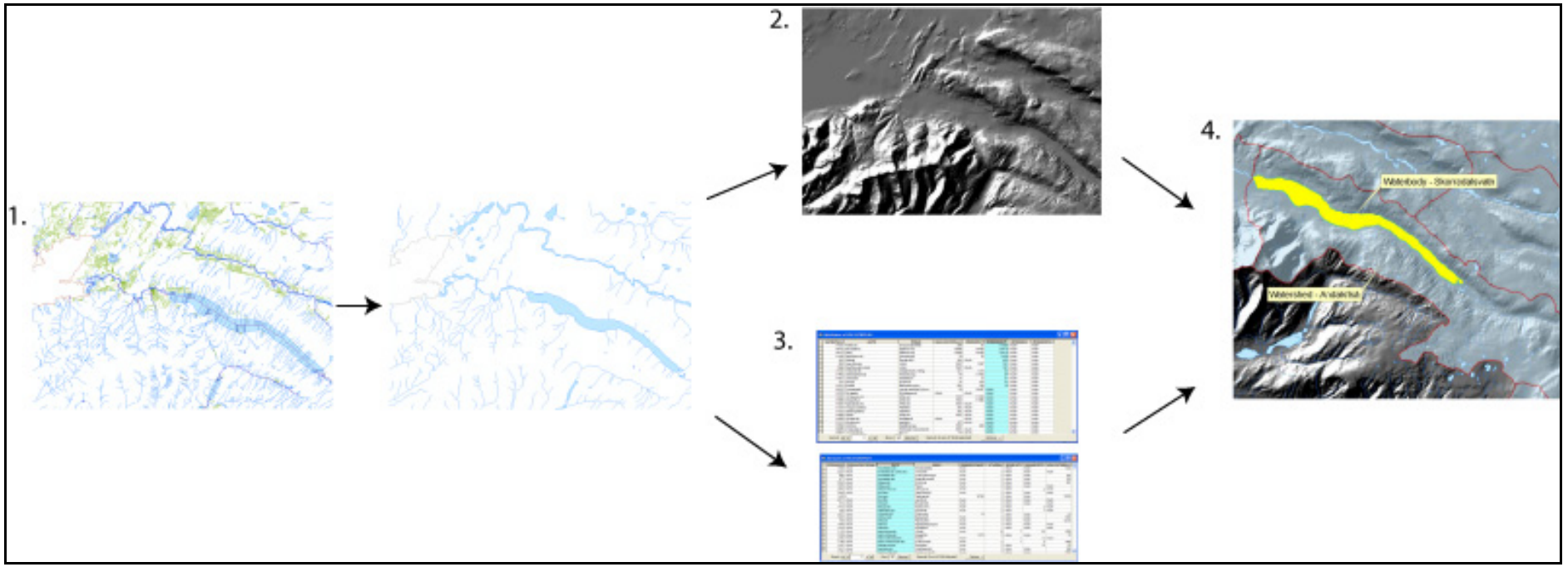

Figure 1. The main phases of the project: 1. Generalization of the Loftmyndir database. 2. DEM perperation. 3. Attribute transfer. 4. New hydrological database with waterbodies for WDF.

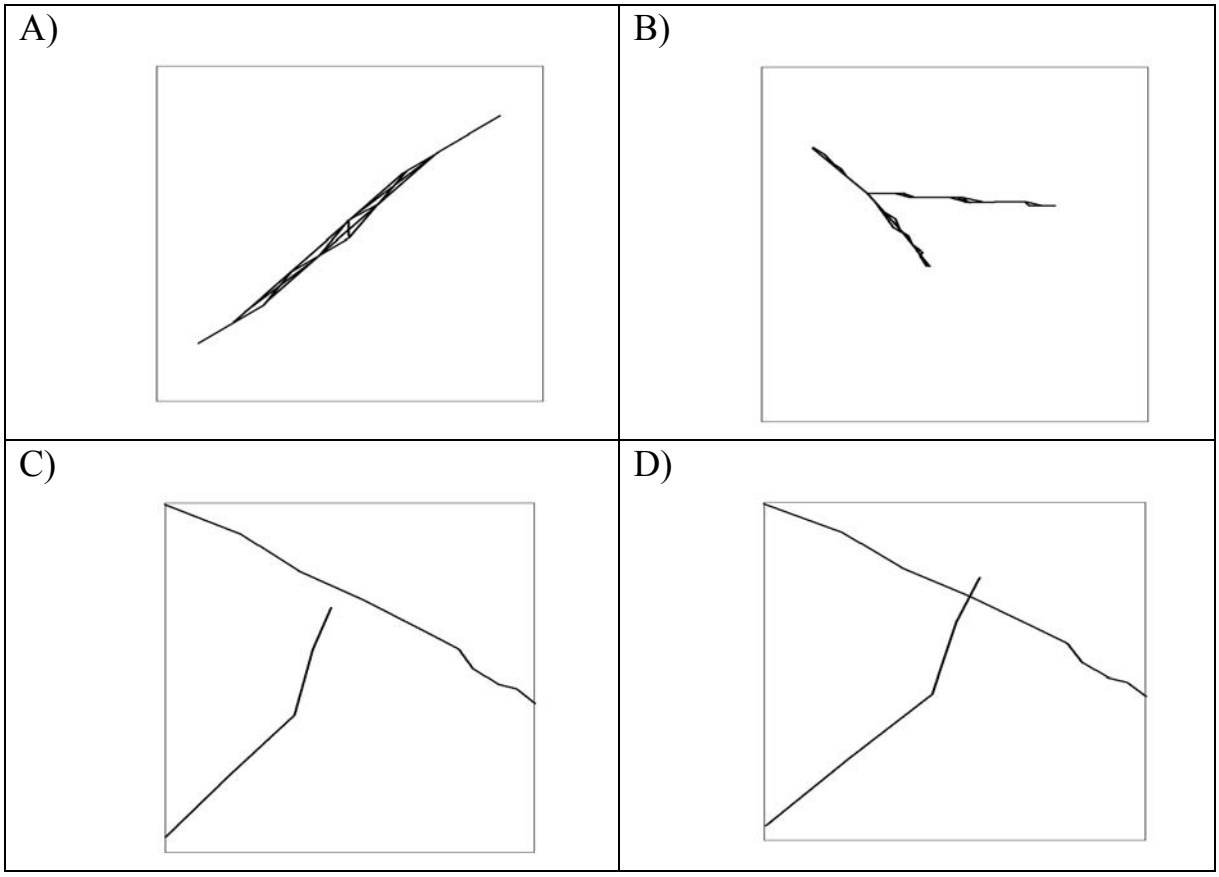

Figure 2. Different types of errors found in the Loftmyndir data set which have to be correcting within the pre-processing phase. A) Intersect; B) Overlap; C) Undershoot; and D) Overshoot.

2) The resolution of the traced lines is too high for subsequent work in the dataset, e.g. at present every line in the dataset, such as a ditch or a river, has equal importance. Thus, a simplification is needed before it is possible to work with the data set at the intended scale of 1:50,000. A Strahler classification will be attempted on the database and subsequently used to simplify it. For the Strahler classification the RivEx tool (see www.rivex.co.uk), an add on program that works with ArcGIS, will be used.
3) The DEM is only approximate representation of land surface terrain. In order to create an accurate representation of flow direction a depressionless DEM is needed. Sinkholes need to be filled and streams need to be burned in to allow for correct flow direction calculations.

Delineation of watersheds

Combining the classified/simplified data set from Loftmyndir and the DEM data set has been tested for individual areas with promising results. For the

results to be meaningful careful preparation of both the hydrographic database and the DEM needs to be completed.

Connection to the older database of rivers and lakes

Moving the old river and lake id‘s from the existing 1:250,000 database has to be done manually due to the much higher resolution of the Loftmyndir dataset and inaccuracy in the older database. The old database consists of more than 5000 rivers-id’s and more than 2000 lakes with names that have to be transferred (Jóhannsson and Einarsson, 1998).

CONCLUDING REMARKS

The final deliverables of this work will be a national direction-based hydrological database in the scale of ca. 1:50,000, which will be the basis for watershed definition and other prerequisites for the adaptation of the European Water Framework Directive. The hydrological database will have a national coverage and a greater accuracy and detail than the database of rivers and lakes already existing at the Hydrological Service. This work is still ongoing with the initial phase being finished in 2008.

REFERENCES

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