Technical Report No. 4

DATABASE WITH HYDROMETEOROLOGICAL VARIABLES FOR SELECTED RIVER BASINS: METADATA CATALOGUE

Henny A.J. van Lanen, Lena M. Tallaksen, Miguel Candel, Jesus Carrera, Sue Crooks, Kolbjørn Engeland, Miriam Fendeková, Ingjerd Haddeland, Hege Hisdal, Stanislav Horacek, Jorge Jódar Bermúdez, Anne F. van Loon, Andrej Machlica, Vicente Navarro, Oldřich Novický & Christel Prudhomme

August 2008

WATCH is an Integrated Project Funded by the European Commission under the Sixth Framework Programme, Global Change and Ecosystems Thematic Priority Area (contract number: 036946).
The WACH project started 01/02/2007 and will continue for 4 years.

Title:	Database with hydrometeorological variables for selected river basins: Metadata Catalogue
Authors:	Henny A.J. van Lanen, Lena M. Tallaksen, Miguel Candel, Jesus Carrera, Sue Crooks, Kolbjørn Engeland, Miriam Fendeková, Ingjerd Haddeland, Hege Hisdal, Stanislav Horacek, Jorge Jódar Bermúdez, Anne F. van Loon, Andrej Machlica, Vicente Navarro, Oldřich Novický & Christel Prudhomme
Organisations:	- Wageningen University - Hydrology and Quantitative Water Management Group (WUR) - University of Oslo – Department of Geosciences (UiO) - University of Castilla-La Mancha, Ciuad Real (UCLM) - Consejo Superior de Investigaciones Científicas, Barcelona (CSIC) - Comenius University, Bratislava (UC) - Norwegian Water Resources and Energy Directorate, Oslo (NVE) - T.G. Masaryk Water Research Institute, Prague (TGM-WRI) - Centre for Ecology and Hydrology (CEH Wallingford)
Submission date:	May 2008
Function:	This metadata catalogue is an output from Work Block 4 Extremes: frequency, severity and scale, and will contribute to Task 4.1.1 Investigate processes controlling the propagation of drought, Task 4.1.2 Spatial and temporal scales and severity of droughts in 20th century, Task 4.1.3 Investigate processes and phenomena of major floods in 20th century, Task 4.1.4 Spatial and temporal scales and severity of floods in 20th century, Task 4.1.5 Detection and attribution, Task 4.3.1 Frequency, severity and extent of droughts in 21st century, Task 4.3.2 Frequency, severity and extent of floods in 21st century.
Deliverable	WATCH deliverable D 4.1.1

photos on the cover: H.A.J. van Lanen
- headwaters of the River Metuje, Upper-Elbe (Czech Republic)(upper right)
- Rio Cigüela, Upper-Guadiana (Spain)(lower left)

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1. Introduction

The prediction of potential impacts of climate change on the hydrological cycle relies on projections from global, and nested, regional climate models. The land surface modules in these large scale models only crudely represent hydrological processes. The current generation of climate models is still unable to reliably reproduce historical hydrological extremes, with considerable variability in the prediction of rainfall patterns, between climate models and between different ensemble members of the same climate model (Cubasch *et al.*, 2001; Huntingford *et al.*, 2003).

In the WATCH project, selected river basins in Europe and the second region (Ganges basin, Sub-Indian Continent) play a key role in the validation of large-scale models, such as Land Surface Hydrological Models (LSHMs) and Global Hydrological Models (GHMs). Observed hydro-meteorological variables in selected river basins will be used to evaluate the ability of LSHMs and GHMs to: (1) to satisfactory represent hydrological processes that control the propagation of drought (from meteorological droughts to hydrological droughts) and the generation of large-scale floods, and (2) understand sub-grid (10-50 km) variability. Time series of observed variables in the selected river basins will be complemented with simulation results from River Basin Hydrological Models (RBHMs). RBHMs, such as ECOMAG (Gottschalk *et al*., 2001), WatBal (Petrovic, 2004), and G2G (Bell *et al*., 2007) are physical based models with a daily time step and atypical spatial scale of 1 km. Moreover, the increased process knowledge gained at the river basin scale will help to understand the driving mechanisms and the spatial and temporal variability of droughts and large-scale floods (space-time development) at the regional scale. This knowledge will support the identification of possible inadequacies in LSHMs and GHMs for improved simulation of extreme hydrological events.

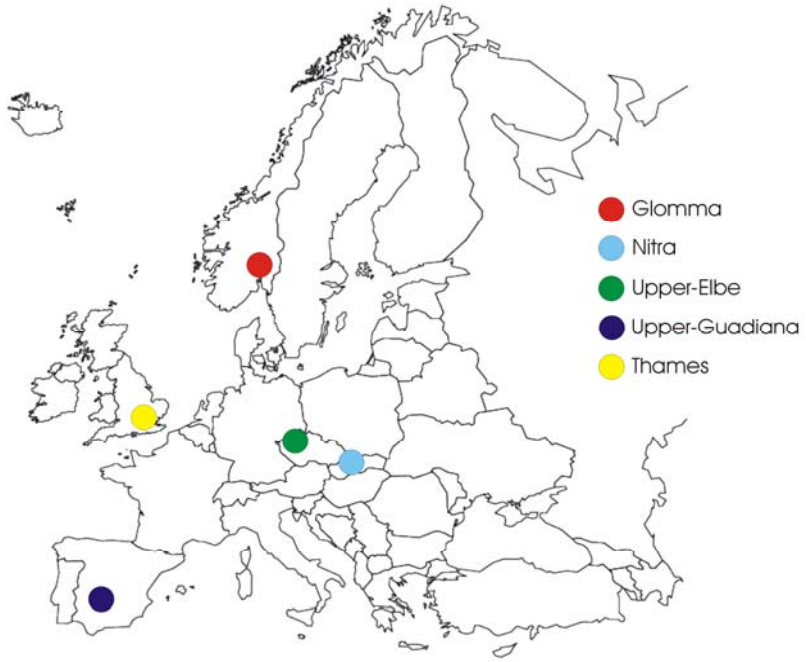


Figure 1 Location of the selected river basins for the study on hydrological extremes.

The selected river basins and associated RBHMs will further be applied to identify possible trends in historical droughts and large-scale floods. Knowledge on trends generated at the river basin scale will be linked to the outcome from analysis at the regional and the global scales using the gridded time series data from the LSHMs and the GHMs. The trend detection analysis will also explicitly address the

attribution of climate and human influences to possible trends in the hydrological extremes. This is a key activity and involves comparing trends in observed time series with simulations obtained from RBHMs, LSHMs and GHMs.

In addition to the study of the 20th century climate, the river basins will contribute to the analysis of changes in the physical characteristics of drought and large-scale floods in the 21st century. RBHMs simulations using downscaled climate forcing data from a future climate will be compared with the gridded, modelled output from LSHMs and GHMs covering the same area and period. The extremes will be analysed using model simulations both with and without anthropogenic changes (to compare the sensitivity in hydrological extremes to the impact of climate change alone).

For the study of hydrological extremes in Europe, five river basins were selected on the basis of differences in climate, including a cold climate (Nordic), temperate (continental) and temperate, dry summer (Mediterranean), physical catchment characteristics (geology, lakes, soils, topography), human influence (irrigation, hydropower) and predicted climate change. The selected basins include (Fig. 1):

- Glomma (Norway);
- Nitra (Slovakia)
- Upper-Elbe (Czech Republic)
- Upper-Guadiana (Spain)
- Thames (United Kingdom).

Focal areas (i.e. sub-basins) were identified within the larger basins to carry out more detailed studies on hydrological processes controlling the development of extremes (except the Thames basin). Table 1 provides some characteristics.

Table 1 Selected basins, sub-basins and their area

country	basin	area (km^2)	sub-basins	area (km^2)
Norway	Glomma	40 470	Upper-Glomma	2 411
Slovakia	Nitra	4 501	Upper-Nitra	601
Czech Republic	Upper-Elbe	51 394	Metuje	74
			Sázava	131
Spain	Upper-Guadiana	16 000	La Mancha Occidental	4 569
United Kingdom	Thames	9 948		

A metadata catalogue has been compiled for each of the basins and sub-basins based on a prototype developed for the Glomma basin. The example had an open structure, which offered the opportunity to add basin-specific information. The metadata catalogue has the following structure for each of the basins and sub-basins:

- General information
- Time series
  - Meteorological time series
  - Hydrological time series
- Spatial data
- Model (output)
  - Climate model output
  - Hydrological model (output)
- Abbreviations
- References
- Maps

The following chapters contain the metadata catalogue for the Glomma, Nitra, Upper-Elbe, Upper-Guadiana and the Thames, respectively.

2. Glomma basin (Norway)

This chapter provides the metadata catalogue for the Glomma (whole basin) and the Upper-Glomma as focal area.

2.1 Glomma basin (whole basin)

GENERAL INFORMATION	
BASIN NAME	Glomma and Laagen (at Solbergfoss)
AREA *(km²)*	40470
LOCATION *(Country/ies)*	Norway, Sweden (Sweden: 422 km²)
LATITUDE	59⁰00'-63⁰00' N (SW and NE corner, respectively)
LONGITUDE	7⁰25'-12⁰75' E (SW and NE corner, respectively)
BRIEF DESCRIPTION *(textual description of up to 40 words of the basin's main features and physical characteristics)*	• Drains both mountainous and lowland areas; 91 – 2469 masl. • 49 % forest, 27 % barren, 8 % bogs, 5 % agricultural, 4 % lake, less than 1 % urban • Mean annual precipitation: ranges from 260 to 1060 mm • Mean annual streamflow: 700 m^3s^{-1} • Reservoir capacity: 3.5 km^3 (16 % of mean annual runoff) See Annex 1
CONTACT PERSON(S)	Ingjerd Haddeland, NVE (iha@nve.no) Lena Tallaksen, UiO (lena.tallaksen@geo.uio.no)
AREAS OF INTEREST	
FLOOD ASPECTS (make a difference between operational and research questions, if possible)	• Economically important region • Well-documented measurements of streamflow available free of charge (Solbergfoss) • Snow and hydropower • Lakes (Mjøsa, Øyeren)
DROUGHT ASPECTS (make a difference between operational and research questions, if possible)	• Affected by drought: Hydropower, water supply, forestry (diseases and forest fires), agriculture (irrigation), ecology • Drought research: Effects of climate change on drought characteristics (duration, severity, area affected), focus on effects on the hydropower sector (e.g. will the probability of two dry years in a row change in a changing climate)
WATER RESOURCES ASPECTS (make a difference between operational and research questions, if possible)	• Annual hydropower production: ≈ 10 TWh (about 9 percent of total hydropower production in Norway)
REGIONAL CLASSIFICATION *(Flow Regime type)*	Scandinavian (continental: winter low flow – snow, spring flood, summer low flow)
IS THIS A "PRB" BASIN OF THE WFD COMMON IMPLEMENTATION STRATEGY?	No
IS THIS A TRANSBOUNDARY RIVER?	Yes, minor area in Sweden.
HAS THE BASIN BEEN USED IN OTHER EU STUDIES? *(Please list if yes)*	No

INFORMATION ON HISTORICAL DEVELOPMENT (e.g. river regulation, reservoirs, abstractions, large-scale drainage) *(Please list if yes)*	See www.glb.no (The home page of the Glommen's and Laagen's Water Management Association)

TIME-SERIES				
METEOROLOGICAL TIME-SERIES	No. of Records	Resolution H/D/M	Period of record (Start Yr – End Yr)	Avg. length (Yrs)
PRECIPITATION • HISTORIC • REAL-TIME	See Annex 1	See Annex 1	See eklima.no	See eklima.no
TEMPERATURE • HISTORIC • REAL-TIME	See Annex 1	See Annex 1	See eklima.no	See eklima.no
REFERENCE EVAPORATION • HISTORIC • REAL-TIME				
DATA OWNER(S) *Name(s) of organization(s)*	Norwegian Meteorological Institute			
ARE THE DATA OWNERS INTERSTED TO INTERACT WITH THE PROJECT?	Yes			
ARE THE DATA AVAILABLE FREE-OF-CHARGE?	Yes, stored at: eklima.no – but webpage only in Norwegian			
WHAT RESTRICTIONS APPLY TO THE USE AND DISTRIBUTION OF THE DATA? *(Please specify)*	Not for commercial purposes			

TIME SERIES				
HYDROLOGICAL TIME-SERIES	No. of Records	Resolution H/D/M	Period of record (Earliest – Latest)	Avg. length (Yrs)
RIVER FLOW • HISTORIC • NATURALIZED	See att 2 Solbergfoss	D D	Various 1903 - 2006	≈ 50 yrs
LAKE/RESERVOIR LEVEL • HISTORIC	See Annex 3	D		
LAKE/RESERVOIR OUTFLOW • OBSERVED • LICENSED/CONSENTED	See Annex 3	D D		
SNOW PILLOWS (SWE)	See Annex 4	D		
SNOW DEPTH	See Annex 1	D		
DATA OWNER(S) *(Name(s) of organization(s))*	• Norwegian Water Resources and Energy Directorate • GLB – Glommen and Laagen's Water Management Association • Meteorological Institute			
ARE THE DATA OWNERS INTERSTED TO INTERACT WITH THE PROJECT?	Yes			

ARE THE DATA AVAILABLE FREE-OF-CHARGE?	Yes (see contact persons, pg. 4)
WHAT RESTRICTIONS APPLY TO THE USE AND DISTRIBUTION OF THE DATA? *(Please specify)*	Not for commercial purposes

SPATIAL DATA				
DATASET NAME *(Please specify; expand boxes for multiple datasets)*	Owner or Source	Scale or Resolution	Temporal resolution/ Date published	Format (ASCII, shape files, ArcGIS coverages, GIF, etc.)
PRECIPITATION	Norwegian Meteorological Institute	1 * 1 km within Norway (1961 and onwards)	Daily updates	Binary file
TEMPERATURE	Norwegian Meteorological Institute	1 * 1 km within Norway (1961 and onwards)	Daily updates	Binary file
REFERENCE EVAPORATION				
DIGITAL ELEVATION DATA	Norwegian Mapping Authority	1 km	2002	
FRESHWATER BODIES (RIVERS, LAKES)	NVE	Lines, polygons		ArcGis
LAND-USE/LAND-COVER	Norwegian Forest and Landscape Institute			
URBANISATION/POPULATION				
SOILS	Geological Survey of Norway			
GEOLOGY	Geological Survey of Norway			
HYDROGEOLOGY				
SNOW/ICE				
OTHER SPATIAL:	senorge.no (spatial data based on observations and simulations of meteorological and hydrological components)	1*1 km (1971 and onwards)	Daily	WMS

WHAT RESTRICTIONS APPLY TO THE USE AND DISTRIBUTION OF THE DATA?	The data are available to NVE. WATCH partners can use the DEM within the WATCH project. The gridded precipitation and temperature data are not available to the WATCH partners. We have contacted the other owners and asked them if these data can be made available to the WATCH partners.			

CLIMATE MODEL OUTPUT					
DATASET NAME *(Please specify; expand boxes for multiple datasets)*	Owner or Source	Scale or Resolution	Temporal resolution/	Scenarios/date published	Format (ASCII, shape files, ArcGIS coverages, GIF, etc.)
CURRENT AND FUTURE CLIMATE (GCM, RCM and further downscaling)	Meteorological Institute	Meteorological climate data exist for 900 cells (precipitation: 600, temperature: 300) within Norway. We have asked how many of these are within the Glomma Basin, and are waiting for the answer.			
WHAT RESTRICTIONS APPLY TO THE USE AND DISTRIBUTION OF THE DATA?	Freely available				

HYDROLOGICAL MODEL (OUTPUT)					
MODEL NAME AND TYPE: *(Please specify; expand boxes for multiple models)*	Owner or Source	Scale or Resolution	Temporal scale	Datasets (*specify output*)	
				Output	Contact
HBV	NVE	1x1 km			
VIC	NVE	4x4 km - 20x20 km			
MIKE11	NVE	River			

ABBREVIATIONS

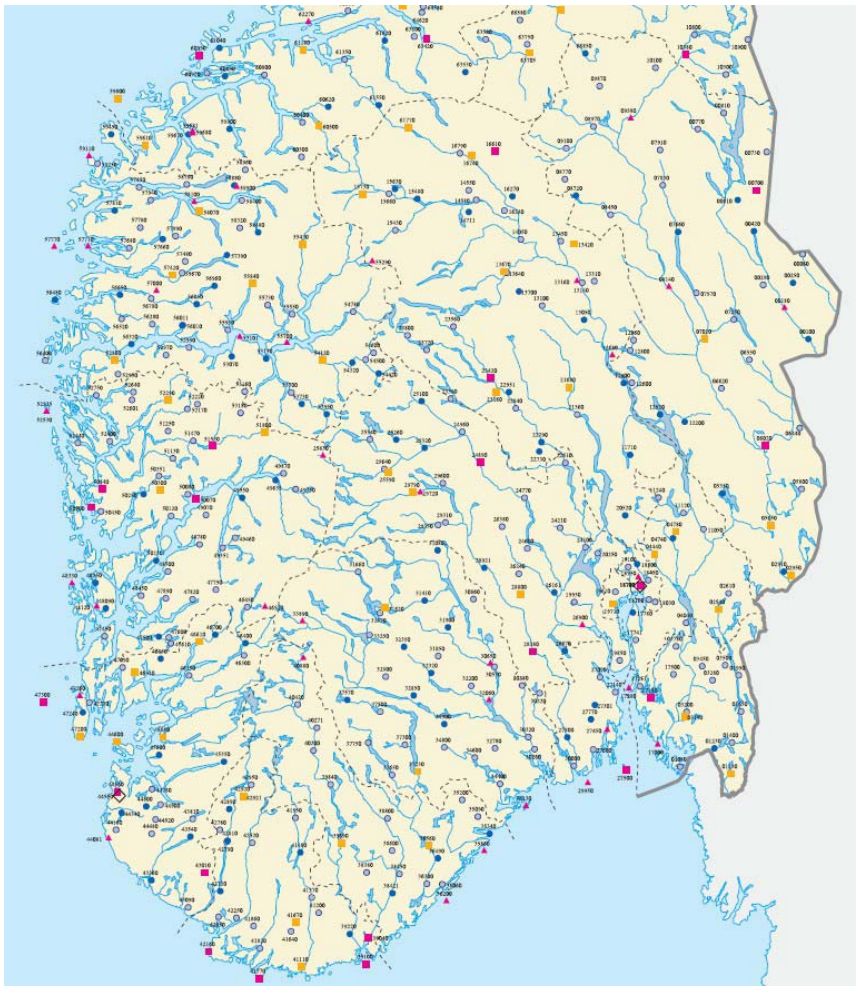
SWE: Snow water equivalent

REFERENCES

Norwegian Institute for Nature Research and Eastern Norway Research Institute (2000) The Glomma and Laagen Basin, Norway, case study prepared as an input to the World Commission on Dams, Cape Town, www.dams.orgnone (http://www.adb.org/Water/Topics/Dams/pdf/csnomain.pdf)

Skaugen, T. & Væringstad, T. (2005) A methodology for regional flood frequency estimation based on scaling properties. Hydrol. Process. 19, 1481–1495.

Annex 2.1.1 Meteorological stations (from: www.met.no)



Weather station – partly atomatic (VH)
Instrumental obervations sent met.no every hour. Visual observations 3 – 8 times a day. Attended by an officer.

Weather station – synoptic (VS)
Instrumental obervations of air pressure, temperature, humidity, wind, precipitation, and snow depth sent met.no 3-8 times a day. Attended by an officer.

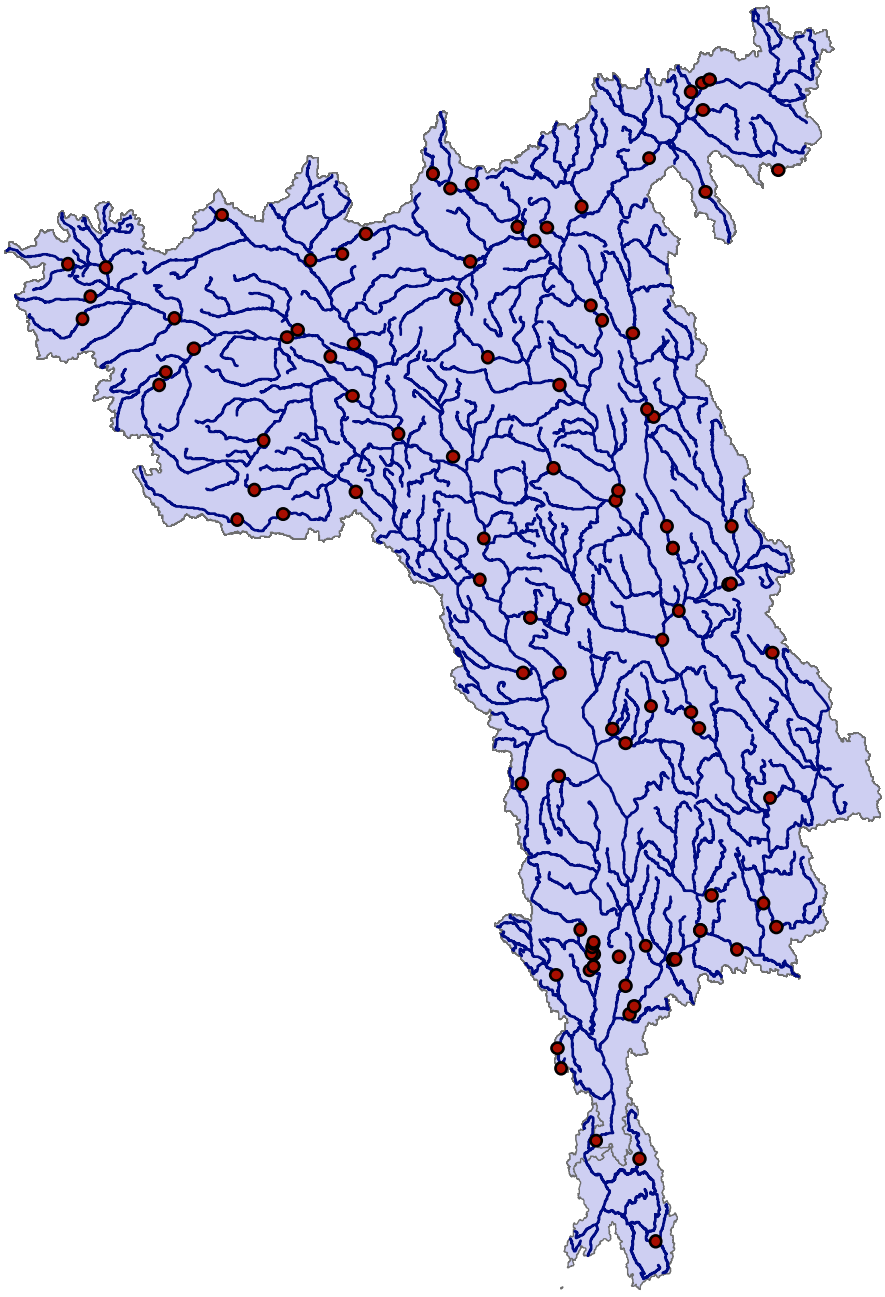
Automatic station (A)
Instrumental obervations of air pressure, temperature, humidity, wind, and precipitation sent met.no every hour.

Precipitation – real time (IN)
Precipitation and snowdepth are measured every morning. In addition, precipitation type and snowcover are evaluated. Observations are sent met.no every day.

Precipitation (N)
Precipitation and snowdepth are measured every morning. In addition, precipitation type and snowcover are evaluated. Observations are sent met.no every week.

Annex 2.1.2 Discharge stations

Map showing current lake/stream level gages in the Glomma basin where discharge is available (calculated based on stage-discharge curves):



Annex 2.1.3 Reservoir levels and hydropower plants in the Glomma basin:

Annex 2.1.4 Snow pillows

Snow pillows within the Glomma river basin:

Snow pillow	masl	Time period
Fokstua	960	1997 - 2007
Kvarstadseter	665	1997 - 2007
Lybekkbråten	195	1982 - 2007
Sognefjellhytta	1435	1998 - 2007
Vauldalen	840	1984 - 2007

2.2. Upper-Glomma sub-basin

GENERAL INFORMATION	
BASIN NAME	Upper Glomma (at Hummelvoll) (Annex 2.2.1)
AREA *(km²)*	2411 km²
LOCATION *(Country/ies)*	Norway (Sweden; less than 1%)
LATITUDE	62⁰00'-63⁰00' N (SW and NE corner, respectively)
LONGITUDE	10⁰50'-12⁰75' E (SW and NE corner, respectively)
BRIEF DESCRIPTION *(textual description of up to 40 words of the basin's main features and physical characteristics)*	• Wide, open mountain landscape with gentle contours, 586 – 1595 masl. • Headwater basin of the largest river in Norway • Lake Aursunden is a hydropower reservoir, almost the only anthropogenic activity in the basin. Cold winters, relatively warm summers (mean annual temperature 0.3 ⁰C, mean annual precipitation 450 - 890 mm). Winter and summer low flow, spring snowmelt flood. • Hydrological important deposits, soil and groundwater data available.
CONTACT PERSON(S)	• Lena Tallaksen (UiO) (lena.tallaksen@geo.uio.no) • Hege Hisdal (NVE) (hhi@nve.no)
AREAS OF INTEREST	
FLOOD ASPECTS (make a difference between operational and research questions, if possible)	• Economically important region • Ecologically sensitive basin • Measurements of various hydrological variables, well documented (good quality, long term and spatial, readily available data – free of charge) • Has been used in various international and national projects • Hydrological models (lumped and distributed) have been calibrated • Snow and hydropower - relevant for short and long term flood forecasting and reservoir management.
DROUGHT ASPECTS (make a difference between operational and research questions, if possible)	See also the list above for flood; • Short and long term drought forecasting for reservoir management • Propagation of drought through the hydrological cycle • Relevant for both flood and drought forecasting (combined GIS-based system for flood and drought forecasting aimed at assisting water managers towards integrating early warning systems into water resources planning and development).
WATER RESOURCES ASPECTS (make a difference between operational and research questions, if possible)	Focus: Hydropower
REGIONAL CLASSIFICATION *(Flow Regime type)*	• Scandinavian (Continental: Winter low flow – snow, spring flood, summer low flow). Lake Aursunden is ice-covered approx. from mid-November to mid-May.
IS THIS A "PRB" BASIN OF THE WFD COMMON IMPLEMENTATION STRATEGY?	No
IS THIS A TRANSBOUNDARY RIVER?	Yes, minor area in Sweden.

HAS THE BASIN BEEN USED IN OTHER EU STUDIES? *(Please list if yes)*	Yes, EnviSnow
DOES THE BASIN COMPRISE ONE OR MORE SUB-BASINS *(Please specify the different subbasins)*	Aursunden (835 km^2) and Narsjø (119 km^2) are sub-basins of Upper Glomma at Hummelvoll. Aursunden is affected by a regulation, Narsjø has natural flow. Long (> 30 yr) streamflow records (daily) exist for all three basins. In addition there are 6 sub-basins with shorter records (of which 2 are still in operation).
ARE THERE SITES WITHIN THE BASIN THAT ARE ECOLOGICALLY SENSITIVE (e.g. RAMSAR SITES, SSSIs) *(Please specify)*	Special landscape area, including wetlands with many birds and rare plants, and traditional cultivated landscape. Part of the Forollhogna National Park lies within the basin (north-western part). In the region nine endangered or vulnerable plants are listed, some of which may be threatened by climate change. Early snow melting may damages ideal growth conditions for some species whereas changes in the utilization of the area, such as cultivation and water-course development, are the main threat to others.
INFORMATION ON HISTORICAL DEVELOPMENT (e.g. river regulation, reservoirs, abstractions, large-scale drainage) *(Please list if yes)*	Lake Aursunden was regulated for power production in 1923.

TIME-SERIES				
METEOROLOGICAL TIME-SERIES	No. of Records	Resolution H/D/M	Period of record (Start Yr – End Yr)	Avg. length (Yrs)
PRECIPITATION • HISTORIC • REAL-TIME	12	H - D	1871 – date	> 50
TEMPERATURE • HISTORIC • REAL-TIME	1	H - D	1871-date	135
POTENTIAL EVAPORATION	0			
SOLAR RADIATION	1		1998-2000, UiO	3
CLOUDINESS	1		1998-2000, UiO	3
RELATIVE HUMIDITY	1		1998-2000, UiO	3
WIND SPEED	1		1998-2000, UiO	3
WIND DIRECTION	1		1998-2000, UiO	3
DATA OWNER(S) *Name(s) of organization(s)*	met.no (Norwegian Meteorological Institute)			
ARE THE DATA OWNERS INTERSTED TO INTERACT WITH THE PROJECT?	Yes			

ARE THE DATA AVAILABLE FREE-OF-CHARGE?	Yes, stored at: eklima.no – but webpage only in Norwegian
WHAT RESTRICTIONS APPLY TO THE USE AND DISTRIBUTION OF THE DATA? *(Please specify)*	Not for commercial purposes

TIME SERIES				
HYDROLOGICAL TIME-SERIES	No. of Records	Resolution H/D/M	Period of record (Earliest – Latest)	Avg. length (Yrs)
RIVER FLOW				
• HISTORIC	4	H -D	1930-96	~ 20
• REAL-TIME	5	H -D	1902-date	~ 30
RIVER LEVEL				
• REAL-TIME	3	H -D	1923-date	~ 30
GROUNDWATER LEVEL				
• HISTORIC	8	W	1969-94	~ 20
• REAL-TIME	2	H - W	1954-date	~ 30
SOIL MOISTURE (4 depths)				
• HISTORIC				
• REAL-TIME	1	H	1999 - date	~ 5
LAKE/RESERVOIR LEVEL				
• HISTORIC	1	D	1923-date	80
• REAL-TIME			(also lake temp at the outlet)	
LAKE/RESERVOIR OUTFLOW				
• OBESRVED	1	D	1923-date	80
• LICENCED/CONSENTED				
SURFACE WATER ABSTRACTIONS	0			
• OBESRVED				
• LICENCED/CONSENTED				
GROUNDWATER ABSTRACTIONS	0			
• OBESRVED				
• LICENCED/CONSENTED				
IRRIGATION GIFTS				
DATA OWNER(S) *(Name(s) of organization(s))*	• NVE • GLB – Glommen's and Laagen's Water Management Association			
ARE THE DATA OWNERS INTERSTED TO INTERACT WITH THE PROJECT?	Yes			
ARE THE DATA AVAILABLE FREE-OF-CHARGE?	Yes (see contact persons, pg. 13)			
WHAT RESTRICTIONS APPLY TO THE USE AND DISTRIBUTION OF THE DATA? *(Please specify)*	Not for commercial purposes			

SPATIAL DATA				
DATASET NAME *(Please specify; expand boxes for multiple datasets)*	Owner or Source	Scale or Resolution	Date published	Format (ASCII, shape files, ArcGIS coverages, GIF, etc.)
PRECIPITATION Throughfall	UiO	Plot	2000	Files
TEMPERATURE Lake temperature (spatial)	UiO	Irregular	1999 2000	Files
POTENTIAL EVAPORATION				
OTHER METEOROLOGICAL Climate stations (3 sites, 1998-2000) - SOLAR RADIATION - CLOUDINESS - RELATIVE HUMIDITY - WIND SPEED - WIND DIRECTION	UiO	H-D		Files
DIGITAL ELEVATION DATA	Norwegian Mapping Authority	100 m		ArcGIS
TOPOGRAPHICAL (RELIEF, SLOPE, ASPECT, ETC.)		Gridded: 1 km^2		ArcGIS
FRESHWATER BODIES (RIVERS, LAKES, WETLANDS)	NVE	1:50 000		ArcGIS
LAND-USE/LAND-COVER	Norwegian Forest and Landscape Institute	1: 50 000		ArcGIS
URBANISATION/POPULATION				
SOILS Quaternary geological map	Geological Survey of Norway	1:250 000		ArcGIS
GEOLOGY	Geological Survey of Norway	1:250 000		ArcGIS
HYDROGEOLOGY				
SNOW/ICE Automatic point measurements of snow water-equivalent 1962-dd (snow pillow) Satellite images of snow cover Snow courses (manual measurements)	UiO/NVE GLB	includes time series		ArcGIS Files
ADMINISTRATIVE BOUNDARIES	Norwegian Mapping Authorities			
LOCATION PREPICIATION STATIONS	Annex 2.2.2			
LOCATION TEMPERATURE STATIONS				
LOCATION METEOROLOGICAL STATIONS				
LOCATION SOIL MOISTURE STATIONS	[1]			

[1] Engeland (2006)

LOCATION GROUNDWATER OBSERVATION WELLS				
LOCATION STREAMFLOW GAUGING STATIONS	Annex 2.2.3			
LOCATION SURFACE WATER ABSTRACTIONS				
LOCATION GROUNDWATER ABSTRACTIONS				
LOCATION IRRIGATED FIELDS				
OTHER SPATIAL Synoptic measurements of streamflow (63 sites, 2 measurements) Synoptic measurements of soil moisture – TDR (16 squares, 1998-99) Synoptic measurements of groundwater level (12 stations, 1998-2000) Synoptic measurements of snow depth (snow courses, 2000-2003)	UiO			Files
WHAT RESTRICTIONS APPLY TO THE USE AND DISTRIBUTION OF THE DATA?	The data owned by UiO, NVE, met.no, and the Norwegian Mapping Authority can be used free of charge within the WATCH project.			

CLIMATE MODEL OUTPUT					
DATASET NAME *(Please specify; expand boxes for multiple datasets)*	Owner or Source	Scale or Resolution	Temporal resoultion	Scenarios/ Date published	Format (ASCII, shape files, ArcGIS coverages, GIF, etc.)
CURRENT AND FUTURE CLIMATE (GCM, RCM and further downscaling)	met.no	Downscaling – point	Daily	See reports published at http://www.nve.no/modules/module_109/publisher_view_product.asp?iEntityId=10713	
WHAT RESTRICTIONS APPLY TO THE USE AND DISTRIBUTION OF THE DATA?					

HYDROLOGICAL MODEL (OUTPUT)					
MODEL NAME AND TYPE: *(Please specify; expand boxes for multiple models)*	Owner or Source	Scale or Resolution	Temporal scale	Datasets (*specify output*)	
				Output	Contact
HBV	NVE	1x1 km			
ECOMAG	UiO	1x1 km -			
COUP	NVE	Point along the river			

ABBREVIATIONS

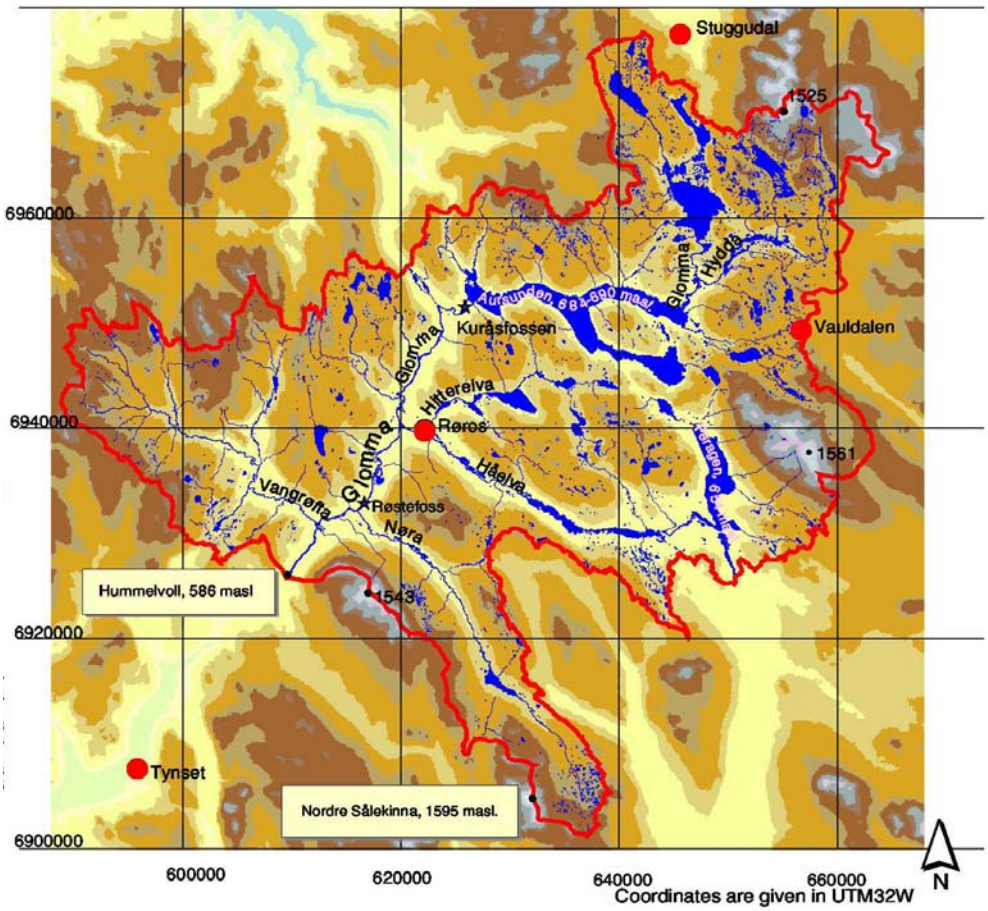
HBV: Hydrologiska Byråns Vattenbalansavdelning
ECOMAG: Regional model of hydrological cycle
SWE: Snow water equivalent

REFERENCES

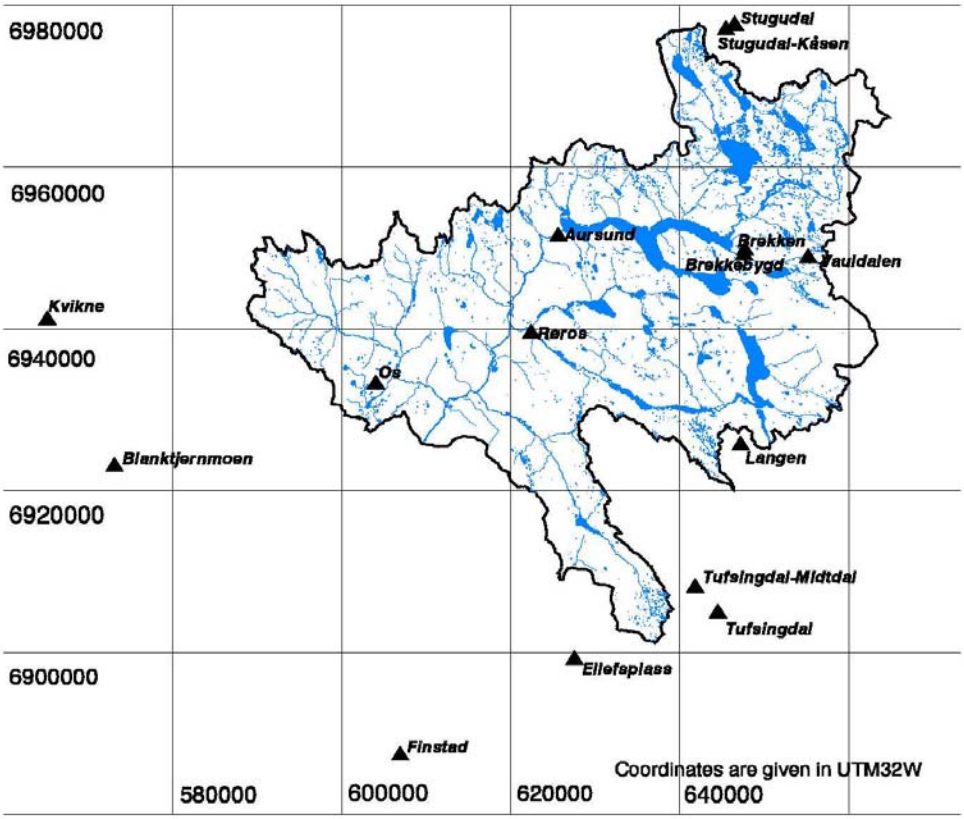
Engeland, K., Gottschalk, L. & Tallaksen, L.M. (2001) Estimation of regional parameters in a mesoscale hydrological model. Nordic Hydrol. 32(3), 161-180.

Engeland, K., (2006) ECOMAG - Application to the Upper Glomma catchment (four separate reports). Department of Geosciences, University of Oslo, Norway.

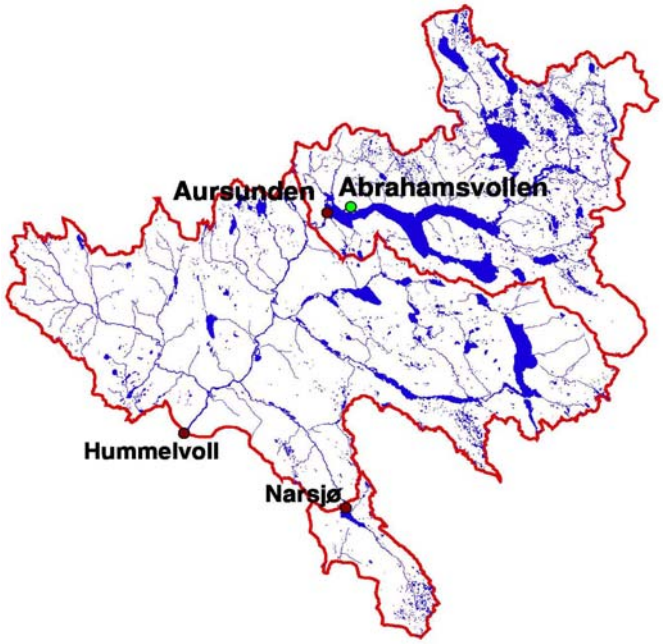
Annex 2.2.1 Location of the Upper-Glomma catchment (indicated in the lower map are precipitation stations with long records) (Engeland, 2006)



Annex 2.2.2 Precipitation stations, including one climate station (Røros) (Engeland, 2006)



Annex 2.2.3 Discharge stations (red) and soil moisture station (green) (Engeland, 2006)



3. Nitra basin (Slovakia)

This chapter provides the metadata catalogue for the Nitra (whole basin) and the Upper-Nitra as focal area.

3.1 Nitra basin (whole basin)

GENERAL INFORMATION	
BASIN NAME	Nitra
AREA *(km²)*	4501.1 km²
LOCATION *(Country/ies)*	Slovakia
Latitude	47°30'-49°00'N
Longitude	17°30'-19°00'W
BRIEF DESCRIPTION *(textual description of up to 40 words of the basin's main features and physical characteristics)*	• Catchment ranged in the upper part by mountains, in the lower part typical lowland characteristic • 108 – 1346 m amsl.
CONTACT PERSON(S)	Miriam Fendekova, fendekova@fns.uniba.sk
AREAS OF INTEREST	
FLOOD ASPECTS (make a difference between operational and research questions, if possible)	• Economically important region • Ecologically sensitive basin • Measurements of various meteorological and hydrological variables, well documented (good quality, long time series) • Hydrological models calibrated for some streams in the upper part of the catchment (study flood aspects). • Upper part of the catchment is nationally protected landscape area called Ponitrie.
DROUGHT ASPECTS (make a difference between operational and research questions, if possible)	• Economically important region • Ecologically sensitive basin • Measurements of various meteorological and hydrological variables, well documented (good quality, long time series) • Hydrological models calibrated for some streams in the upper part of the catchment (study drought aspects). • Upper part of the catchment is nationally protected landscape area called Ponitrie.
WATER RESOURCES ASPECTS (make a difference between operational and research questions, if possible)	• Water transfer from the neighboring catchment of Turiec river • Different aspects of water use – industrial, agricultural including irrigation, mining areas dewatering, drinking water sources, healing purposes.
REGIONAL CLASSIFICATION *(Flow Regime type)*	Rainy-snowy type Rainy-snowy runoff regime (maxima in February-April, minima in August-October
IS THIS A "PRB" BASIN OF THE WFD COMMON IMPLEMENTATION STRATEGY?	
IS THIS A TRANSBOUNDARY RIVER?	No
HAS THE BASIN BEEN USED IN OTHER EU STUDIES? *(Please list if yes)*	No

INFORMATION ON HISTORICAL DEVELOPMENT (e.g. river regulation, reservoirs, abstractions, large-scale drainage) *(Please list if yes)*	

TIME-SERIES				
METEOROLOGICAL TIME-SERIES	No. of Records	Resolution H/D/M	Period of record (Start Yr – End Yr)	Avg. length (Yrs)
PRECIPITATION • HISTORIC • REAL-TIME	59 stations	D	1981*-date	25
TEMPERATURE • HISTORIC • REAL-TIME	7 stations 2 stations	D H	1961-date 1983-date	45 to 20
REFERENCE EVAPORATION • HISTORIC • REAL-TIME	7 stations	D	1961-date 1983-date	45 to 20
OTHER REMARK *			Longer time series on precipitation are available as original sheets in the SHMI archive, hardcopy accessible	
OTHER Relative humidity, wind speed, cloudiness data • HISTORIC	7 stations	D	1961-date 1983-date	45 to 20
DATA OWNER(S) *Name(s) of organization(s)*	Slovak Hydrometeorological Institute (SHMI)			
ARE THE DATA OWNERS INTERSTED TO INTERACT WITH THE PROJECT?	No response			
ARE THE DATA AVAILABLE FREE-OF-CHARGE?	Yes, daily data for scientific research purposes			
WHAT RESTRICTIONS APPLY TO THE USE AND DISTRIBUTION OF THE DATA? *(Please specify)*	Use by Slovak scientists. The possibility to share the data with scientists abroad within a scientific project.			

TIME SERIES				
HYDROLOGICAL TIME-SERIES	No. of Records	Resolution H/D/M	Period of record (Earliest – Latest)	Avg. length (Yrs)
RIVER FLOW • HISTORIC • NATURALIZED	26 stations	D	1931-date 1992-date	14-75
LAKE/RESERVOIR LEVEL • HISTORIC	not relevant			
LAKE/RESERVOIR OUTFLOW • OBSERVED • LICENSED/CONSENTED	not relevant			

SNOW PILLOWS (SWE)	no			
SNOW DEPTH	historic 7 stations	D	1973-date	33
IRRIGATION	No data on irrigation gifts are available.			
OTHER	Data on ground-water abstractions available			
DATA OWNER(S) *(Name(s) of organization(s))*	Slovak Hydrometeorological Institute			
ARE THE DATA OWNERS INTERESTED TO INTERACT WITH THE PROJECT?	Yes			
ARE THE DATA AVAILABLE FREE-OF-CHARGE?	Yes, daily data for scientific research purposes			
WHAT RESTRICTIONS APPLY TO THE USE AND DISTRIBUTION OF THE DATA? *(Please specify)*	The possibility to share the data within a scientific project			

SPATIAL DATA				
DATASET NAME *(Please specify; expand boxes for multiple datasets)*	Owner or Source	Scale or Resolution	Temporal resolution/ Date published	Format (ASCII, shape files, ArcGIS coverages, GIF, etc.)
PRECIPITATION	SHMI	Different scales	2000	Shape file
TEMPERATURE	SHMI	1:500 000 for whole Slovakia		Shape file
REFERENCE EVAPORATION	SHMI	1:500 000 for whole Slovakia		Shape file
DIGITAL ELEVATION DATA	GKI	1:10 000 to 1:200 000 10 m Grid		TIFF,CIT,RLERLC ASCII
FRESHWATER BODIES (RIVERS, LAKES)	GKI	1:10 000 to 1:200 000		TIFF,CIT,RLERLC
LAND-USE/LAND-COVER	Slovak environmental agency	1:50 000 1:100 000 1:200 000		Only vector data
URBANISATION/POPULATION	PRIF UK/Statistical office	1:750 000 1:4 000 000	2006	TIFF
SOILS	Soil Research Institute	1:1000 to 1:500 000		TIFF

GEOLOGY	Geological survey	1:50 000		Shape file
HYDROGEOLOGY	Geological survey	1:200 000		-
SNOW/ICE	no			
OTHER SPATIAL:				
OTHER SPATIAL:				
OTHER SPATIAL:				
WHAT RESTRICTIONS APPLY TO THE USE AND DISTRIBUTION OF THE DATA?	Most of the data not available free of charge			

CLIMATE MODEL OUTPUT					
DATASET NAME *(Please specify; expand boxes for multiple datasets)*	Owner or Source	Scale or Resolution	Temporal resolution/	Scenarios/date published	Format (ASCII, shape files, ArcGIS coverages, GIF, etc.)
CURRENT AND FUTURE CLIMATE (GCM, RCM and further downscaling)	Prof. Milan Lapin, Comenius University	Upon request	Upon request	2005	
WHAT RESTRICTIONS APPLY TO THE USE AND DISTRIBUTION OF THE DATA?	No				

HYDROLOGICAL MODEL (OUTPUT)					
MODEL NAME AND TYPE: *(Please specify; expand boxes for multiple models)*	Owner or Source	Scale or Resolution	Temporal scale	Datasets (*specify output*)	
				Output	Contact
BILAN	UC Hydrogeology Dept.	whole basin, and for 3 sub-basins	D, M		Miriam Fendekova
FRIER	UC Hydrogeology Dept	5 km grid	D, M		Oliver Horvat

ABBREVIATIONS

SWE: Snow water equivalent
SHMI: Slovak Hydrometeorological Institute
GKI: Geographical-cartographical Institute
UC: Comenius University
VUVH: Water Research Institute

REFERENCES

Anon.: Hydroecological plan of the Nitra River catchment, VUVH, Bratislava, 1981

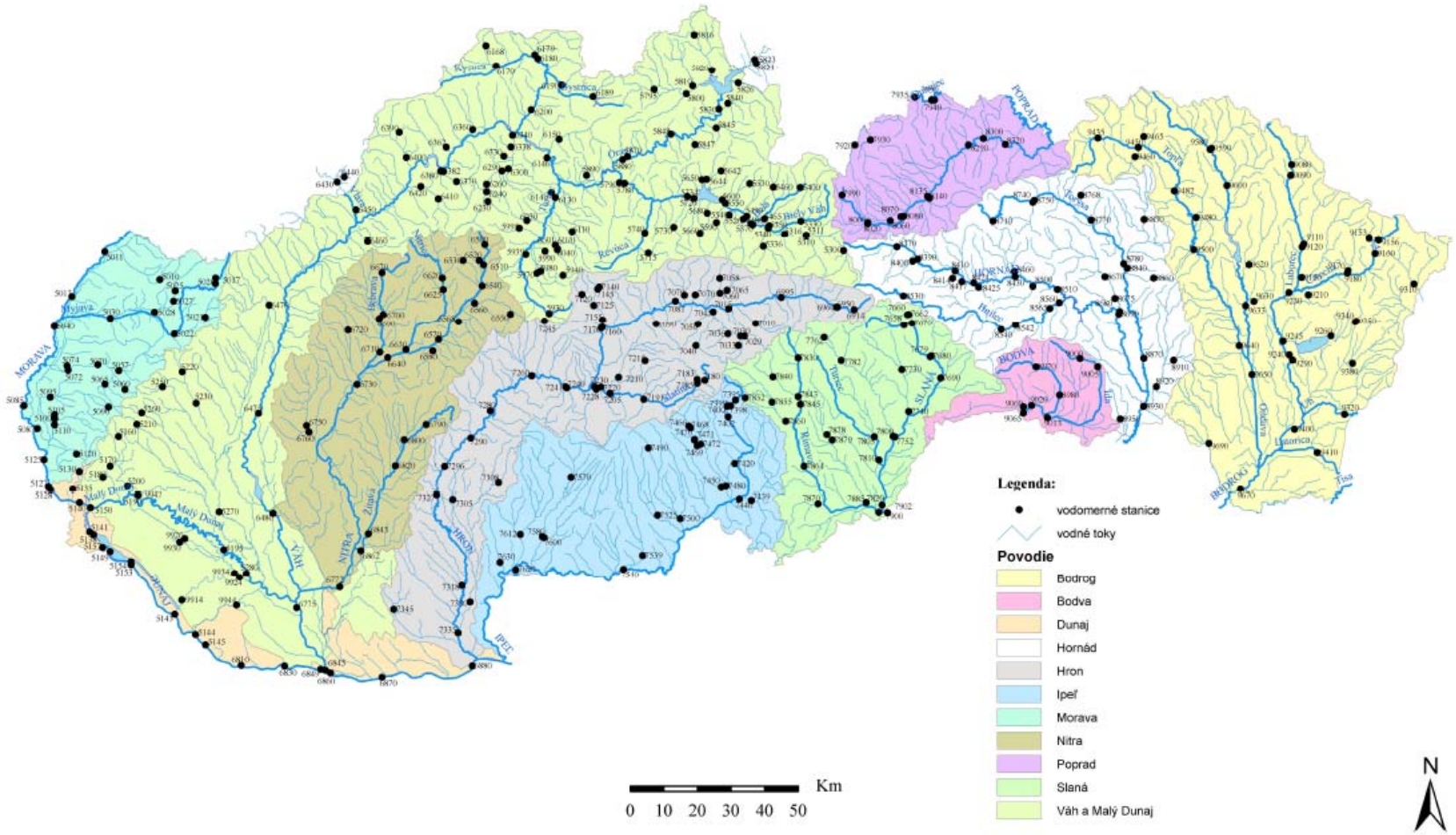
Anon.: Hydrological yearbooks, part surface waters, SHMI Bratislava, 1993-2005

Anon.: Hydrological yearbooks, part ground waters, SHMI Bratislava, 1995-2005

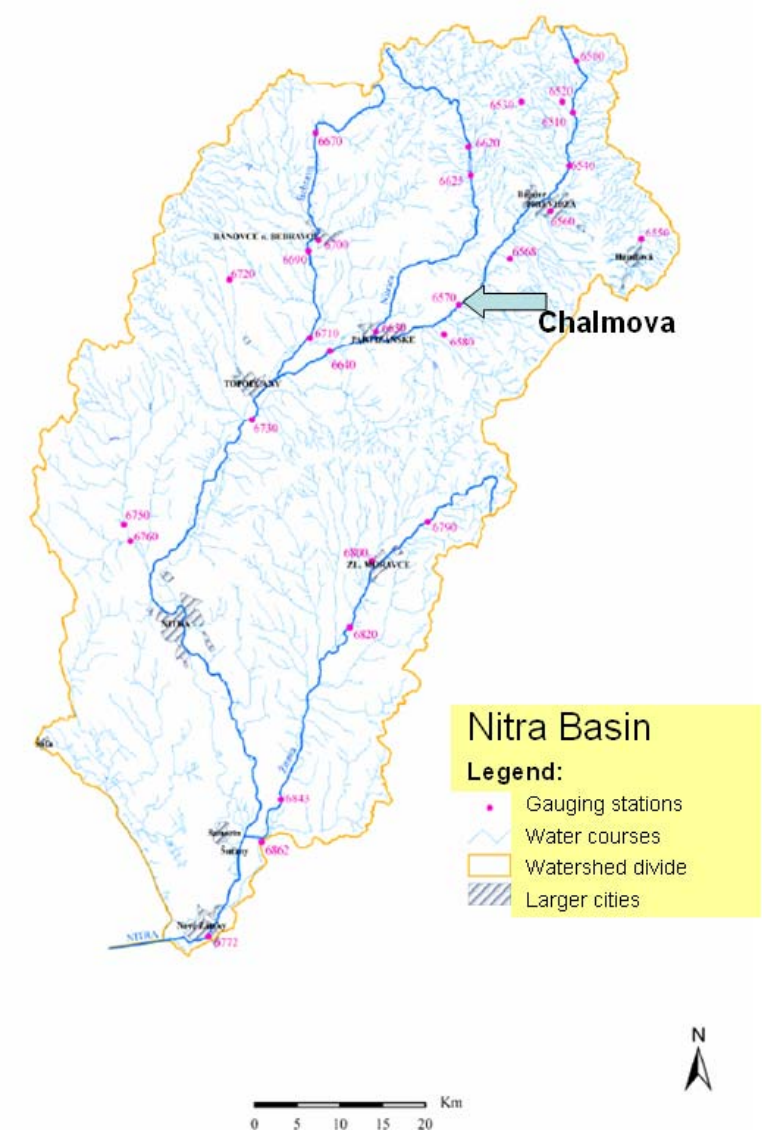
Pekarová, P. and Szolgay, J., Ed.: Scenarios of changes of selected elements of hydrosphere and biosphere in Hron and Vah catchments resulting from climate change. VEDA Publishers, Bratislava, 2005, 494 p. (in Slovak).

Petrovic, P.: The Danube Basin Water Balance – Case Study: The Nitra River Basin. In: Proceedings of the 21st Conference of the Danubian Countries on the Hydrological Forecasting and Hydrological Bases of Water Management – Bucharest, 2-6 September 2002.

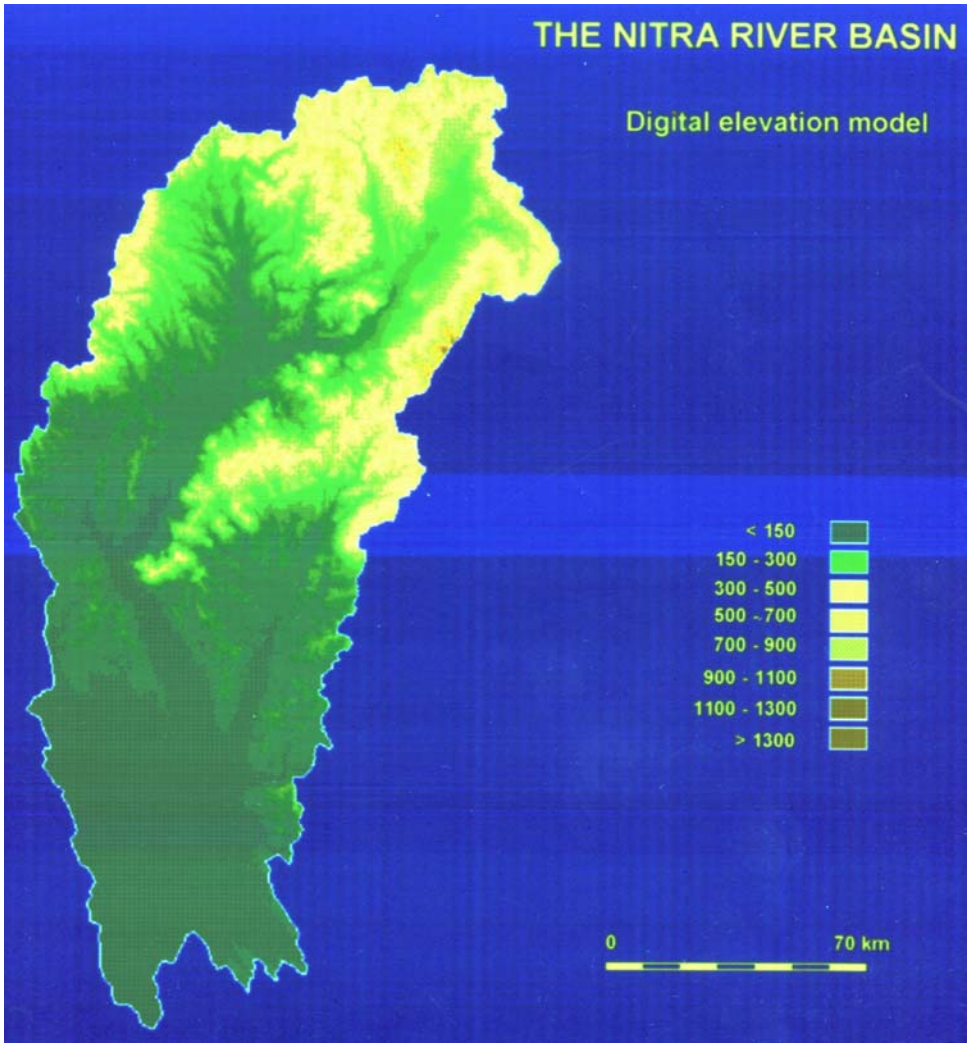
Annex 3.1.1 Stream flow gauging stations in Slovakia with main river basins in 2005 (source: www.shmu.sk)



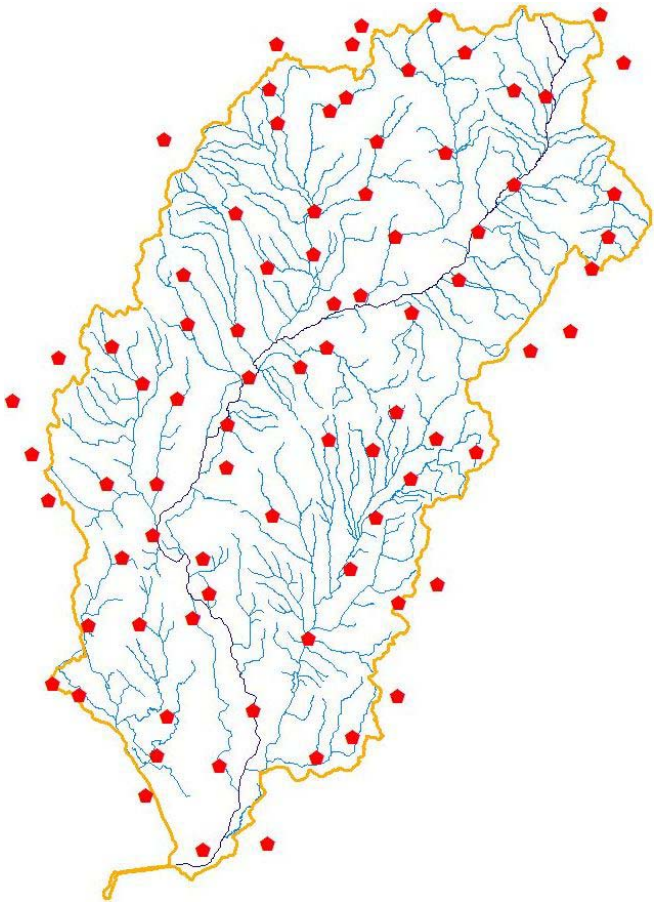
Annex 3.1.2 Nitra basin with streamflow gauging stations (source: www.shmu.sk)



Annex 3.1.3 Nitra basin – elevation (Petrovic, 2002)



Annex 3.1.4 Drainage system and precipitation gauging stations in the Nitra basin and in neighbouring catchments



3.2. Upper-Nitra sub-basin

GENERAL INFORMATION	
BASIN NAME	Nitra at Chalmova
AREA *(km²)*	601.11 km²
LOCATION *(Country/ies)*	Slovakia
Latitude	47°30'-49°00'N
Longitude	17°30'-19°00'W
BRIEF DESCRIPTION *(textual description of up to 40 words of the basin's main features and physical characteristics)*	• Catchment ranged by mountains in the upper part, more flat in the lower part • 210.71 – 1346 m amsl. • Mountainous part forested, river plain agriculturally used • Different geology of surrounding mountain ranges
CONTACT PERSON(S)	Miriam Fendekova, fendekova@fns.uniba.sk
AREAS OF INTEREST	
FLOOD ASPECTS (make a difference between operational and research questions, if possible)	• Economically important region • Ecologically sensitive basin • Measurements of various meteorological and hydrological variables, well documented (good quality, long time series) • Hydrological models calibrated for three tributaries and for the main stream at Chalmova (BILAN)
DROUGHT ASPECTS (make a difference between operational and research questions, if possible)	• Economically important region • Ecologically sensitive basin • Measurements of various meteorological and hydrological variables, well documented (good quality, long time series) • Hydrological models calibrated for three tributaries and for the main stream at Chalmova (BILAN)
WATER RESOURCES ASPECTS (make a difference between operational and research questions, if possible)	a. water transfer from the Turiec River Basin mainly for industrial use b. groundwater usable amounts estimated
REGIONAL CLASSIFICATION *(Flow Regime type)*	Rainy-snowy runoff regime type (maxima in February - April, minima in August-October)
IS THIS A "PRB" BASIN OF THE WFD COMMON IMPLEMENTATION STRATEGY?	No
IS THIS A TRANSBOUNDARY RIVER?	No
HAS THE BASIN BEEN USED IN OTHER EU STUDIES? *(Please list if yes)*	No
DOES THE BASIN COMPRISE ONE OR MORE SUB-BASINS *(Please specify the different subbasins)*	Yes – Nitra up to Chalmova profile has 3 measured tributaries Tuzina (35.6 km²), Chvojnica (17.18 km²), Handlovka (132.68 km²)
ARE THERE SITES WITHIN THE BASIN THAT ARE ECOLOGICALLY SENSITIVE (e.g. RAMSAR SITES, SSSIs) *(Please specify)*	The area belongs to the nationally protected landscape area Ponitrie

INFORMATION ON HISTORICAL DEVELOPMENT (e.g. river regulation, reservoirs, abstractions, large-scale drainage) *(Please list if yes)*	• Rare data on water abstractions from brown coal mining area Novaky-Handlova • Data on groundwater abstractions available • Groundwater transfer data from the neighboring Turiec River basin available

TIME-SERIES				
METEOROLOGICAL TIME-SERIES	No. of Records	Resolution H/D/M	Period of record (Start Yr – End Yr)	Avg. length (Yrs)
PRECIPITATION • HISTORIC • REAL-TIME	6 stations	D	1981- date	25
TEMPERATURE • HISTORIC • REAL-TIME	1 station 1 station	Mean daily	1973- date	33
POTENTIAL EVAPORATION	no			
SOLAR RADIATION	no			
CLOUDINESS • HISTORIC	1 station	Mean daily	1973- date	33
RELATIVE HUMIDITY • HISTORIC	1 station	Mean daily	1973- date	33
WIND SPEED • HISTORIC • REAL-TIME	1 station 1 station	Mean daily	1973- date	33
WIND DIRECTION • HISTORIC	1 station	Mean daily	1973- date	33
OTHER Length of the sunshine	1 station	Mean daily	1973- date	33
OTHER				
DATA OWNER(S) *Name(s) of organization(s)*	Slovak Hydrometeorological Institute (SHMI)			
ARE THE DATA OWNERS INTERSTED TO INTERACT WITH THE PROJECT?	No			
ARE THE DATA AVAILABLE FREE-OF-CHARGE?	Yes, daily data for scientific research purposes			
WHAT RESTRICTIONS APPLY TO THE USE AND DISTRIBUTION OF THE DATA? *(Please specify)*	The possibility to share the data within a scientific project.			
Remark	Longer time series on precipitation are available as original sheets in the SHMI archive, hardcopy accessible			

TIME SERIES				
HYDROLOGICAL TIME-SERIES	No. of Records	Resolution H/D/M	Period of record (Earliest – Latest)	Avg. length (Yrs)
RIVER FLOW • HISTORIC • REAL-TIME	6 stations	Mean D	1931-date 1976- date	40 to 75
RIVER LEVEL • HISTORIC • REAL-TIME	6 stations 5 stations	Mean D	1921- date 1976- date	40 to 85
GROUNDWATER LEVEL • HISTORIC • REAL-TIME	8 wells	W,D	1961- date 1970- date	36 to 45
SOIL MOISTURE (4 depths) • HISTORIC • REAL-TIME	No			
LAKE/RESERVOIR LEVEL • HISTORIC • REAL-TIME	not relevant			
LAKE/RESERVOIR OUTFLOW • OBSERVED • LICENCED/CONSENTED	not relevant			
SURFACE WATER ABSTRACTIONS • OBSERVED • LICENCED/CONSENTED	yes			
GROUNDWATER ABSTRACTIONS • OBSERVED • LICENCED/CONSENTED	yes	M	1980-date	App. 25
IRRIGATION GIFTS	Data not available			
OTHER				
OTHER				
DATA OWNER(S) *(Name(s) of organization(s))*	Slovak Hydrometeorological Institute			
ARE THE DATA OWNERS INTERESTED TO INTERACT WITH THE PROJECT?	Yes			
ARE THE DATA AVAILABLE FREE-OF-CHARGE?	Yes, daily data for scientific research purposes			
WHAT RESTRICTIONS APPLY TO THE USE AND DISTRIBUTION OF THE DATA? *(Please specify)*	Possibility of data sharing within the Watch project.			
REMARK	Soil moisture data available in app. 20 km downstream observation station.			

SPATIAL DATA				
DATASET NAME *(Please specify; expand boxes for multiple datasets)*	Owner or Source	Scale or Resolution	Date published	Format (ASCII, shape files, ArcGIS coverages, GIF, etc.)
PRECIPITATION	SHMI	Different scales	2000	Shape file
TEMPERATURE Lake temperature (spatial)	SHMI	1:500 000 for whole Slovakia		Shape file
POTENTIAL EVAPORATION	SHMI	1:500 000 for whole Slovakia		Shape file
OTHER METEOROLOGICAL - SOLAR RADIATION - CLOUDINESS - RELATIVE HUMIDITY - WIND SPEED - WIND DIRECTION*	SHMI			Shape file
DIGITAL ELEVATION DATA	GKI	1:10 000 to 1:200 000 10 m Grid		TIFF,CIT,RLERLC ASCII
TOPOGRAPHICAL (RELIEF, SLOPE, ASPECT, ETC.)	GKI	1:10 000 to 1:200 000		TIFF,CIT,RLERLC
FRESHWATER BODIES (RIVERS, LAKES, WETLANDS)	GKI	1:10 000 to 1:200 000		TIFF,CIT,RLERLC
LAND-USE/LAND-COVER	Slovak Environmental Agency	1:50 000 1:100 000 1:200 000		Only vector data
URBANISATION/POPULATION	PRIF UK/State Statistical office	1:750 000 1:4 000 000	2006	TIFF
SOILS Quaternary geological map	Soil Research Institute	1:1000 to 1:500 000		TIFF
GEOLOGY	Geological survey	1:50 000		Shape file
HYDROGEOLOGY	Geological survey	1:200 000		-
SNOW/ICE	no[2]			
ADMINISTRATIVE BOUNDARIES	GKI	1:50 000	2002	Shape file
LOCATION PREPICIATION STATIONS	SHMI		2005	ASCII
LOCATION TEMPERATURE STATIONS	SHMI[3]		2005	ASCII
LOCATION METEOROLOGICAL STATIONS	SHMI		2005	ASCII
LOCATION SOIL MOISTURE STATIONS	SHMI		2005	ASCII
LOCATION GROUNDWATER OBSERVATION WELLS	SHMI		2005	ASCII

[2] Automatic point measurements of snow water-equivalent 1962-dd (snow pillow) Satellite images of snow cover.
[3] In ordinates of JTKS.

LOCATION STREAMFLOW GAUGING STATIONS	SHMI**			ASCII
LOCATION SURFACE WATER ABSTRACTIONS	SHMI		2005	ASCII
LOCATION GROUNDWATER ABSTRACTIONS	SHMI**		2005	ASCII
LOCATION IRRIGATED FIELDS				
OTHER SPATIAL				
OTHER SPATIAL				
OTHER SPATIAL				
OTHER SPATIAL				
WHAT RESTRICTIONS APPLY TO THE USE AND DISTRIBUTION OF THE DATA?	Most of the data are not free of charge			
REMARK				

CLIMATE MODEL OUTPUT					
DATASET NAME *(Please specify; expand boxes for multiple datasets)*	Owner or Source	Scale or Resolution	Temporal resolution	Scenarios/ Date published	Format (ASCII, shape files, ArcGIS coverages, GIF, etc.)
CURRENT AND FUTURE CLIMATE (GCM, RCM and further downscaling)	Prof. Milan Lapin, Comenius University	point data	Upon request	2005	
WHAT RESTRICTIONS APPLY TO THE USE AND DISTRIBUTION OF THE DATA?	No				

HYDROLOGICAL MODEL (OUTPUT)					
MODEL NAME AND TYPE: *(Please specify; expand boxes for multiple models)*	Owner or Source	Scale or Resolution	Temporal scale	Datasets (*specify output*)	
				Output	Contact
BILAN	UC Hydrogeo-logy Dept.	whole focal area, and for 3 subbasins	D, M		Miriam Fendekova
FRIER	UC Hydrogeo-logy Dept	5 km grid	D, M		Oliver Horvat

ABBREVIATIONS

SWE: Snow water equivalent
SHMI: Slovak Hydrometeorological Institute
GKI: Geographical-Cartographical Institute
UC: Comenius University
VUVH: Water Research Institute
JTKS: unified trigonometric cadastral network coordinates system

REFERENCES

Anon.: Hydroecological plan of the Nitra River catchment, VUVH, Bratislava, 1981

Anon.: Hydrological yearbooks, part surface waters, SHMI Bratislava, 1993-2005

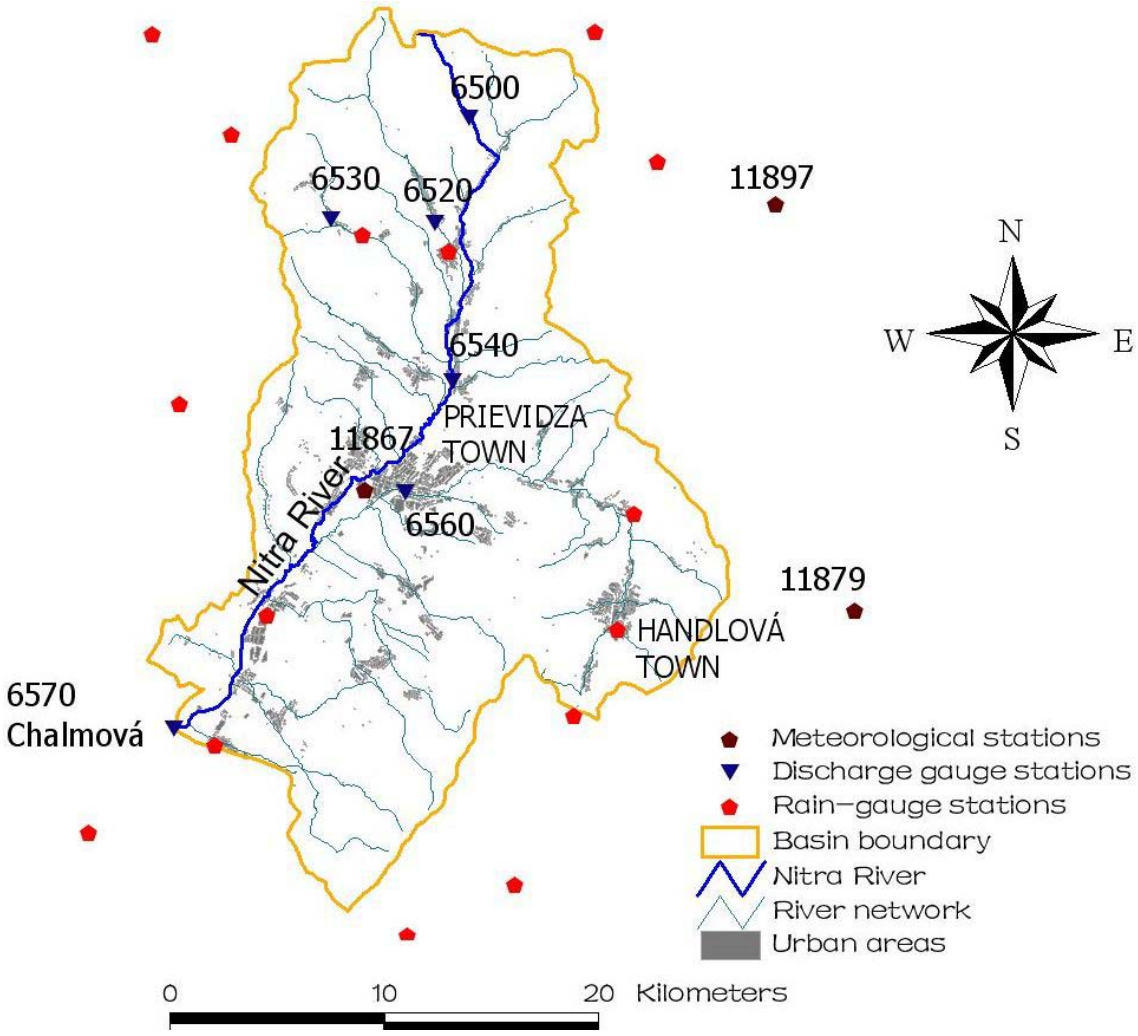
Anon.: Hydrological yearbooks, part ground waters, SHMI Bratislava, 1995-2005

Pekarova, P. and Szolgay, J., Ed.: Scenarios of changes of selected elements of hydrosphere and biosphere in Hron and Vah catchments resulting from climate change. VEDA Publishers, Bratislava, 2005, 494 p. (in Slovak).

Petrovic, P.: The Danube Basin Water Balance – Case Study: The Nitra River Basin. In: Proceedings of the 21st Conference of the Danubian Countries on the Hydrological Forecasting and Hydrological Bases of Water Management – Bucharest, 2-6 September 2002.

Annex 3.2.1 General map of whole Nitra basin (source: www.shmu.sk)

Annex 3.2.2 Upper Nitra sub-basin



4. Upper-Elbe basin (Czech Republic)

This chapter provides the metadata catalogue for the Upper Elbe (whole basin) and the two focal areas: the Metuje sub-basin and the Sázava sub-basin. Two focal areas have been selected because their different response to precipitation. The Metuje sub-basin responds slowly, whereas the Sázava sub-basin has an opposite behaviour.

4.1 Upper-Elbe basin (whole basin)

GENERAL INFORMATION	
BASIN NAME	Upper Elbe
AREA *(km²)*	51 394 Upper Elbe (upstream from Decin)
LOCATION *(Country/ies)*	- Czech Republic 49 933 km² - Germany 1125 km² (122 km² Vltava basin, 1003 km² Ohre basin) - Austria 920.7 km² (Vltava basin) - Poland 239.3 km² (Upper Elbe basin)
Latitude	- 48°06'- 51°06'N
Longitude	- 12°02'- 18°80'W
BRIEF DESCRIPTION *(textual description of up to 40 words of the basin's main features and physical characteristics)*	- Discharges into the North Sea - Mean annual streamflow 311 $m^3.s^{-1}$ - Mild climate, influence of continental climate - Mean annual temperature in lowlands 8-9 °C, in uplands 1-3 °C - Mean annual precipitation 666 mm, from 450 mm in Zatec area to 1700 mm on the top of the Krkonose and Jizerske Mountains - Potential evapotranspiration 477 mm per year on average for the whole basin, ranging from 400 mm in mountains to 700 mm in lowlands - Relief: 3.5% of lowlands (<200 m a.m.s.l.), 79.2% of uplands (200-600 m), 17.3% of mountainous area (>600 m a.m.s.l.), mean altitude 464 m.a.m.s.l. - Narrow valleys with steep platforms in the upper areas of the Elbe and its tributaries, downstream areas are formed by wide lowlands of the Czech Cretaceous basin, outflow area is shaped by narrow valleys of Ceske Stredohori and Labske piskovce - Basin area is composed of 38.3% of cropland, 15.4% of grass fields, 33.4% of forest and 12.9% of urban and other areas.
CONTACT PERSON(S)	Oldrich Novicky (oldrich_novicky@vuv.cz)
AREAS OF INTEREST	
FLOOD ASPECTS (make a difference between operational and research questions, if possible)	- Inundation area 368 km² (Q100) - Density of stream network 660 m/km² - Reservoir operational capacity 2 556.9 mil m^3 - Reservoir storage capacity 248.2 mil m^3 - Occurrence of floods more probable during the spring season caused by combination of snowmelt and rainfall or during the summer caused by an extreme precipitation. - Changes in seasonal distribution of floods and droughts consequently to climate change should be studied for predictions of future changes in possible use of the Elbe River (e.g. for navigation) and for preparation of necessary measures.

DROUGHT ASPECTS (make a difference between operational and research questions, if possible)	- $Q_{354\ d}$ at Decin 44.0 $m^3.s^{-1}$, flow extreme 37 $m^3.s^{-1}$ in 1934 - Research is needed to be carried out in the areas of determination of minimum ecological flows, possible impacts of climate change on the low flows and possible mitigation effects of the reservoirs in the basin.
WATER RESOURCES ASPECTS (make a difference between operational and research questions, if possible)	- With the exception of the Ohre River, there is no significant transboundary river, bringing water into the Elbe basin, the water resources are fed by precipitation only. - Surface runoff 26.4% of annual precipitation, the remaining 73.6% is evaporation, soil moisture and ground water storage - Annual hydropower production approximately 1.5 TWh
REGIONAL CLASSIFICATION *(Flow Regime type)*	- Pluvial type of flow regime having its maximum in March, April or May, during the spring 40-45% of total annual runoff, minimum flows occurring in mountain areas during the winter season, in lowland areas during the autumn - The precipitation regime dominates the runoff processes
IS THIS A "PRB" BASIN OF THE WFD COMMON IMPLEMENTATION STRATEGY?	NO
IS THIS A TRANSBOUNDARY RIVER?	Yes, minor areas in Germany, Austria and Poland
HAS THE BASIN BEEN USED IN OTHER EU STUDIES? *(Please list if yes)*	NO
INFORMATION ON HISTORICAL DEVELOPMENT (e.g. river regulation, reservoirs, abstractions, large-scale drainage) *(Please list if yes)*	- Regulation of the river channel since the 16th century for navigation - The most important reduction of the river length during 1848-1992 from 422.9 km to 370.7 km by river canalisation, difference of 52.2km (12.3% of the length) - Since 1962 construction of dikes in the river section between Hradec Kralove to the mouth of Jizera in the total length 23.4 km - Dikes against backwater on the banks of the Orlice, the Vltava, the Ohre in the total length 27.4 km - Construction of the dams since the end of the 19th century, total amount of dams with capacity higher than 0.3 mil m^3: 118 (to the year 2003) - The Elbe upstream the mouth of the Vltava: 19 dams, total operational capacity 167.4 mil m^3, storage capacity 45.2 mil m^3 - The Elbe downstream the mouth of Vltava: 16 dams, total operational capacity 27.2 mil m^3, storage capacity 7.1 mil m^3 - The Vltava: 72 dams, total operational capacity 1895.7 mil m^3, storage capacity 125 mil m^3 - The Ohre: 11 dams, total operational capacity 397.6 mil m^3, storage capacity 69.6 mil m^3 - During the 20th century construction of 28 weirs and locks
SUB-BASINS	- Vltava basin: basin area 28 090 km^2, 99.5% of area higher altitude than 200 above sea level, mean annual precipitation 656 mm, mean annual streamflow 154 $m^3.s^{-1}$ - Ohre basin: basin area 5 614 km^2, 96% of area higher altitude than 200 above sea level, mean annual precipitation 667 mm, mean annual streamflow 38 $m^3.s^{-1}$

SLOPE CHARACTERISTICS ALONG LONGITUDINAL PROFILE	- From the spring to the water reservoir Labska: 11.6 km, slope 59.5‰ - From the water reservoir Labska to Vrchlabi: 15.9 km, 16.2‰ - From Vrchlabi to the water reservoir Les Kralovstvi: 26.4 km, 4.6‰ - From Les Kralovstvi to Jaromer: 25.6 km, 26‰ - From Jaromer to Hradec Kralove: 22.8 km, 1.1‰ - From Hradec Kralove to Prelouc: 43.8 km, 0.46‰ - From Prelouc to Podebrady: 47.4 km, 0.48‰ - From Podebrady to the mouth of Vltava: 67.2, 0.44‰ - From the mouth of Vltava to Usti nad Labem: 69.6 km, 0.29‰ - From Usti nad Labem to Decin: 26.4 km, 0.45‰ - Median of slope for the Upper Elbe 0.47‰
OTHER	- 5.95 mil inhabitants in the basin area - Navigability of the Elbe over a length of 212 km

TIME-SERIES				
METEOROLOGICAL TIME-SERIES	No. of Records	Resolution H/D/M	Period of record (Start Yr – End Yr)	Avg. length (Yrs)
PRECIPITATION • HISTORIC	1	M	January 1931 – October 2001	71
TEMPERATURE • HISTORIC	1	M	January 1931 – October 2001	71
REFERENCE EVAPORATION • HISTORIC • REAL-TIME	none			
RELATIVE HUMIDITY	1	M	January 1931 – October 2001	71
DATA OWNER(S) *Name(s) of organization(s)*	- T.G.M. Water Research Institute, public research institution - Czech Hydrometeorological Institute			
ARE THE DATA OWNERS INTERSTED TO INTERACT WITH THE PROJECT?	- T.G.M. Water Research Institute Yes - Czech Hydrometeorological Institute No			
ARE THE DATA AVAILABLE FREE-OF-CHARGE?	- T.G.M. Water Research Institute Yes - Czech Hydrometeorological Institute No			
WHAT RESTRICTIONS APPLY TO THE USE AND DISTRIBUTION OF THE DATA? *(Please specify)*	- Data can be used for WATCH Project only			

TIME SERIES				
HYDROLOGICAL TIME-SERIES	No. of Records	Resolution H/D/M	Period of record (Earliest – Latest)	Avg. length (Yrs)
RIVER FLOW • HISTORIC	1	M	January 1931 – October 2001	71
LAKE/RESERVOIR LEVEL • HISTORIC	Not available			
LAKE/RESERVOIR OUTFLOW • OBSERVED • LICENSED/CONSENTED				

DATA OWNER(S) *(Name(s) of organization(s))*	- T.G.M. Water Research Institute, public research institution - Czech Hydrometeorological Institute
ARE THE DATA OWNERS INTERSTED TO INTERACT WITH THE PROJECT?	- T.G.M. Water Research Institute Yes - Czech Hydrometeorological Institute No
ARE THE DATA AVAILABLE FREE-OF-CHARGE?	- T.G.M. Water Research Institute Yes - Czech Hydrometeorological Institute No
WHAT RESTRICTIONS APPLY TO THE USE AND DISTRIBUTION OF THE DATA? *(Please specify)*	- Data can be used for WATCH Project only

SPATIAL DATA				
DATASET NAME *(Please specify; expand boxes for multiple datasets)*	Owner or Source	Scale or Resolution	Temporal resolution/ Date published	Format (ASCII, shape files, ArcGIS coverages, GIF, etc.)
PRECIPITATION	CHMI, T.G.M. WRI	Basin time series data available		
TEMPERATURE	CHMI, T.G.M. WRI			
RELATIVE HUMIDITY	CHMI, T.G.M. WRI			
REFERENCE EVAPORATION	none			
DIGITAL ELEVATION DATA	T.G.M. WRI	10x10m 1:10 000		.tiff
FRESHWATER BODIES (RIVERS, LAKES)	T.G.M. WRI		See Annex 4.1.1	.gif .shp
LAND-USE/LAND-COVER	T.G.M. WRI			.shp
URBANISATION/POPULATION				
SOILS	VUMOP			
GEOLOGY	SGS			
HYDROGEOLOGY	SGS			
SNOW/ICE	No data			
WHAT RESTRICTIONS APPLY TO THE USE AND DISTRIBUTION OF THE DATA?	Some of the data (VUMOP, SGS) are not available free of charge.			

CLIMATE MODEL OUTPUT					
DATASET NAME *(Please specify; expand boxes for multiple datasets)*	Owner or Source	Scale or Resolution	Temporal resolution/	Scenarios/date published	Format (ASCII, shape files, ArcGIS coverages, GIF, etc.)
CURRENT AND FUTURE CLIMATE (GCM, RCM and further downscaling)	T.G.M. WRI	50 x 50 km	Daily	RCM – HIRHAM, RCAO SRES 2000	*.dat
WHAT RESTRICTIONS APPLY TO THE USE AND DISTRIBUTION OF THE DATA?	Data can be used only for WATCH Project				

HYDROLOGICAL MODEL (OUTPUT)					
MODEL NAME AND TYPE: *(Please specify; expand boxes for multiple models)*	Owner or Source	Scale or Resolution	Temporal scale	Datasets (*specify output*)	
				Output	Contact
BILAN	T.G.M. WRI	River basin data (for whole basin)	M		Oldrich Novicky

ABBREVIATIONS

T.G.M. WRI T.G. Masaryk Water Research Institute, public research institution
CHMI: Czech Hydrometeorological Institute
VUMOP: Research Institute for Land Reclamation and Protection
SGS: State Geological Service

REFERENCES

Blazkova, S., Nesmerak, I. Novicky, O. (Editors) 1998. Elbe Project II, T. G. Masaryk Water Research Institute, Prague.

Hladný, J., Krátká, M., Kašpárek, L. (editors) 2004. August 2002 Catastrophic Flood in the Czech Republic. Ministry of Environment of the Czech Republic, Prague, ISBN 80-7212-343-2.

Novický, O., Kašpárek, L. 2006. Grouping of extreme runoff events in Central Europe. In: Climate change, consequences for water resources management. Wasser Berlin 2006 – International DWA symposium on water resources management. Berlin, 2006.

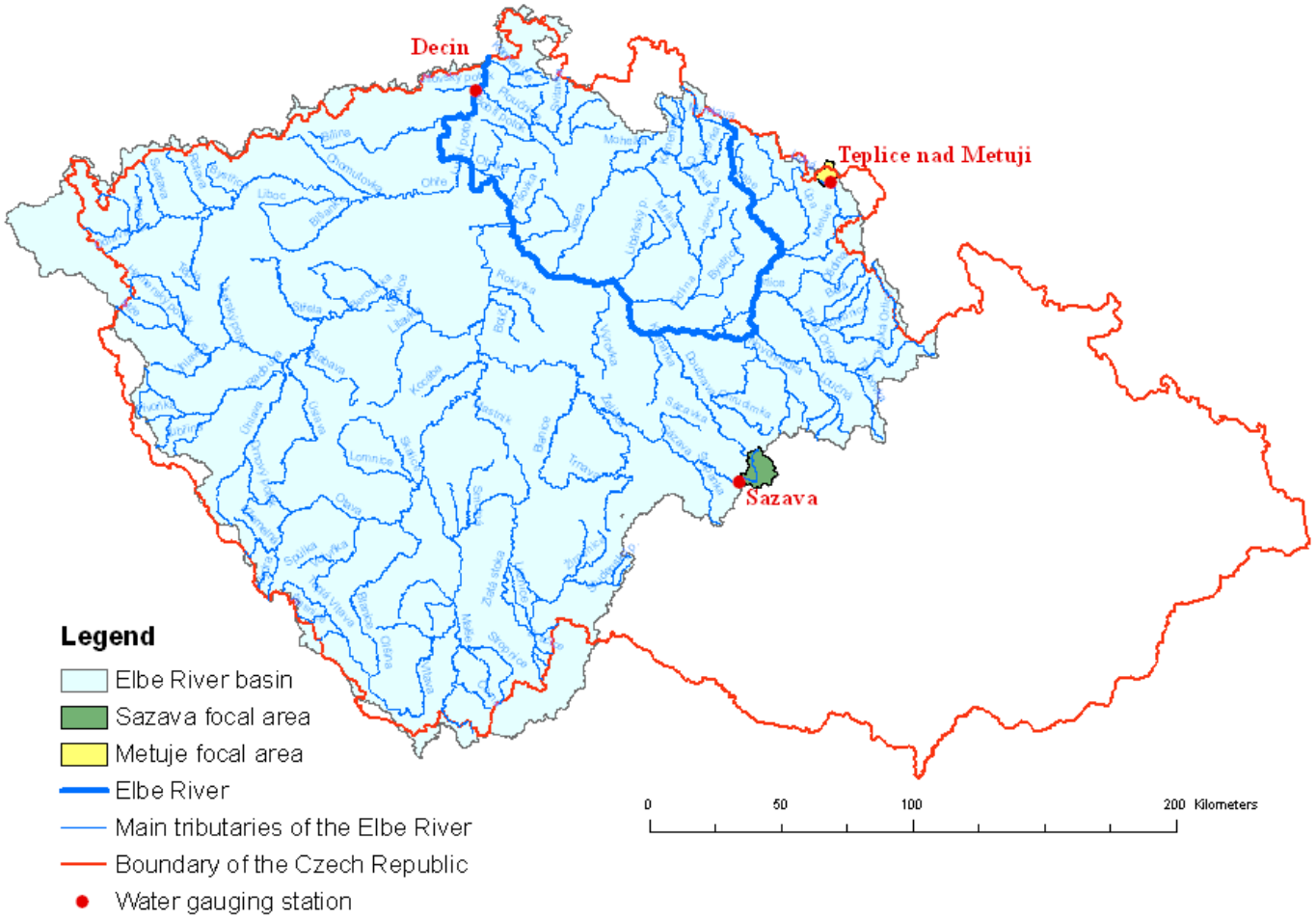
Novický O., Kašpárek L., Peláková M. 2006. Climate change impacts and responses in the Czech Republic and Europe. In proceedings from 5th World FRIEND Conference, La Havana, Cuba.

Kašpárek, L., Novický, O., Jeníček, M., Buchtala, Š. 2006. Influence of large reservoirs in the Elbe River basin on reduction of flood flows. T.G. Masaryk Water Research Institute, Prague, ISBN 80-85900-60-2.

Kašpárek, L., Novický, O., Peláková M. 2006. Climate change and water regime in the Czech Republic. Collection of papers no.1, T.G. Masaryk Water Research Institute, Prague, ISBN 80-85900-60-2.

Kašpárek, L., Novický, O., Hanel, M. Horáček, S. (editors) 2006. 2006 spring flood in the Czech Republic. T.G. Masaryk Water Research Institute and Ministry of Environment of the Czech Republic, Prague, ISBN 80-85900-71-8

Annex 4.1.1 Map of Upper Elbe River basin



4.2 Metuje sub-basin

GENERAL INFORMATION	
BASIN NAME	Upper Metuje
AREA *(km²)*	73.63
LOCATION *(Country/ies)*	Czech Republic, Poland
Latitude	- 50°61'- 50°66'N
Longitude	- 16°06'- 16 °18'W
BRIEF DESCRIPTION *(textual description of up to 40 words of the basin's main features and physical characteristics)*	- Upper part of the Metuje River basin (total area of whole Metuje basin is 511.37 km²) - Transboundary river located in Northern Bohemia, part of its basin belongs to Poland - Northern part of Upper-Elbe basin - Discharges into the Elbe River (the North Sea) - Mean annul streamflow (1970-2000 at M XII station) 0.862 $m^3.s^{-1}$ - Q_{10d} = 0.68 $m^3.s^{-1}$ - Q_{300d}= 0.46 $m^3.s^{-1}$ - Q_{min}= 0.33 $m^3.s^{-1}$ (December 1970) - Q_{max} ~ 50 $m^3.s^{-1}$ (estimated value for the flood in June 1979) - Mild warm and very humid climate zone, changing into the cold zone - Mean annual temperature 5.5 °C (1970-2000, meteorological data from the Bucnice station), the warmest month is July with mean temperature 14.5 °C, the coldest month is January with –3.8 °C - Mean annual precipitation 743 mm, most of the total amount during July (100 mm) and less during March (45 mm) - Relief formed by Teplicke steny upland, mean altitude between 490-684 m a.m.s.l., altitude of the climatologic station 490 m a.m.s.l. - High diversity of deep valleys, gentle and steep slopes and uplands are characteristic for the landscape of the basin. - Metuje River Basin area is composed of cropland and grass fields in 54% of the area, forest in 35%, urban areas in 4% and others in 7% - Hydrogeology: it is a Cretaceous basin which is located on Permian-Carboniferous formations of relatively impermeable rocks. Groundwater in the Metuje is characterised by deep circulation of groundwater and high storage.
CONTACT PERSON(S)	Oldrich Novicky (oldrich_novicky@vuv.cz)
AREAS OF INTEREST	
FLOOD ASPECTS (make a difference between operational and research questions, if possible)	- Occurrence of floods more probable during the spring season caused by combination of snowmelt and rainfall. Floods in the summer are caused by an extreme precipitation. - Possible impacts of climate change on frequency, severity and seasonal distribution of floods are unknown.

DROUGHT ASPECTS (make a difference between operational and research questions, if possible)	- A decrease of groundwater level is likely due to the climate change. Consequently, the base flow could drop to levels of the existing groundwater abstractions in the basin (about 100 l .s^{-1}); the Metuje River may be dry in the periods when it used to be fed from the groundwater storage. - A research is needed to be carried out for reducing uncertainty in estimating possible impacts of climate change and other anthropogenic impacts (groundwater abstractions) on groundwater resources, particularly in deep aquifers. The research should combine knowledge from an analysis of observed time series on groundwater levels and results of the simulation by using hydrological and hydraulic modes for climate conditions projected by climate change scenarios.
WATER RESOURCES ASPECTS (make a difference between operational and research questions, if possible)	- No significant withdrawals of surface water neither discharges of waste water into surface water bodies - Groundwater abstractions for drinking water supply in the lower parts of the basin. The long-term mean of the abstracted quantity is close to 100 l/s.
REGIONAL CLASSIFICATION *(Flow Regime type)*	- Pluvial type of flow regime having its maximum in March, April or May, during the spring 40-45% of total annual runoff, minimum flows occurring in mountain areas during the winter season, in lowland areas during the autumn - The precipitation regime dominates runoff processes.
IS THIS A "PRB" BASIN OF THE WFD COMMON IMPLEMENTATION STRATEGY?	No
IS THIS A TRANSBOUNDARY RIVER?	Yes, minor area is in Poland
HAS THE BASIN BEEN USED IN OTHER EU STUDIES? *(Please list if yes)*	- Yes - ASThyDA (Analysis, Synthesis and Transfer of Knowledge and Tools on Hydrological Drought through a European Network)
DOES THE BASIN COMPRISE ONE OR MORE SUB-BASINS *(Please specify the different subbasins)*	No
ARE THERE SITES WITHIN THE BASIN THAT ARE ECOLOGICALLY SENSITIVE (e.g. RAMSAR SITES, SSSIs) *(Please specify)*	Nature reserve of Adrspassko-teplicke skaly
INFORMATION ON HISTORICAL DEVELOPMENT (e.g. river regulation, reservoirs, abstractions, large-scale drainage)	The groundwater resources are affected by groundwater abstractions. Data on the groundwater abstractions are available.

TIME-SERIES				
METEOROLOGICAL TIME-SERIES	No. of Records	Resolution H/D/M	Period of record (Start Yr – End Yr)	Avg. length (Yrs)
PRECIPITATION • HISTORIC	1	D	1.11.1980 – 31.10 2006	26
SNOW COVER	Data on snow cover are not available in electronic form but snow does not play important role meteorological conditions of the basin			
TEMPERATURE • HISTORIC	1	D	1.11.1980 – 31.10 2006	26
POTENTIAL EVAPORATION				

SOLAR RADIATION	1	D	1999 - 2004	6
CLOUDINESS				
RELATIVE HUMIDITY	1	D	1.11.1980 – 31.10 2006	26
WIND SPEED	1	D	1999 - 2007	9
WIND DIRECTION	1	D	1999 - 2007	9
DATA OWNER(S) *Name(s) of organization(s)*	T.G.M. Water Research Institute, public research institution			
ARE THE DATA OWNERS INTERSTED TO INTERACT WITH THE PROJECT?	Yes			
ARE THE DATA AVAILABLE FREE-OF-CHARGE?	Yes			
WHAT RESTRICTIONS APPLY TO THE USE AND DISTRIBUTION OF THE DATA? *(Please specify)*	Data can be used for WATCH Project only			

TIME SERIES				
HYDROLOGICAL TIME-SERIES	No. of Records	Resolution H/D/M	Period of record (Earliest – Latest)	Avg. length (Yrs)
RIVER FLOW • HISTORIC	1	D	1.11.1980 – 31.10 2006	26
RIVER LEVEL • REAL-TIME				
GROUNDWATER LEVEL • HISTORIC • REAL-TIME	1	D	1.11.1980 – 31.10 2006	26
SOIL MOISTURE (4 depths) • HISTORIC • REAL-TIME				
LAKE/RESERVOIR LEVEL • HISTORIC • REAL-TIME				
LAKE/RESERVOIR OUTFLOW • OBESRVED • LICENCED/CONSENTED				
SURFACE WATER ABSTRACTIONS • OBESRVED • LICENCED/CONSENTED				
GROUNDWATER ABSTRACTIONS • OBESRVED • LICENCED/CONSENTED	1	M	1980 - 2006	26
IRRIGATION GIFTS				

DATA OWNER(S) *(Name(s) of organization(s))*	T.G.M. Water Research Institute, public research institution
ARE THE DATA OWNERS INTERSTED TO INTERACT WITH THE PROJECT?	Yes
ARE THE DATA AVAILABLE FREE-OF-CHARGE?	Yes
WHAT RESTRICTIONS APPLY TO THE USE AND DISTRIBUTION OF THE DATA? *(Please specify)*	Data can be used for WATCH Project only

SPATIAL DATA				
DATASET NAME *(Please specify; expand boxes for multiple datasets)*	Owner or Source	Scale or Resolution	Date published	Format (ASCII, shape files, ArcGIS coverages, GIF, etc.)
PRECIPITATION Throughfall	time series from one station available (representative for the small basin area)			
TEMPERATURE				
RELATIVE HUMIDITY				
POTENTIAL EVAPORATION				
OTHER METEOROLOGICAL - SOLAR RADIATION - CLOUDINESS - RELATIVE HUMIDITY - WIND SPEED - WIND DIRECTION				
DIGITAL ELEVATION DATA	T.G.M. WRI	10x10m 1:10 000		.tiff
TOPOGRAPHICAL (RELIEF, SLOPE, ASPECT, ETC.)	T.G.M. WRI	10x10m 1:10 000		.tiff
FRESHWATER BODIES (RIVERS, LAKES, WETLANDS)	T.G.M. WRI		See Annex 4.2.2	.gif .shp
LAND-USE/LAND-COVER	T.G.M. WRI			.shp
URBANISATION/POPULATION				
SOILS Quaternary geological map	VUMOP			

GEOLOGY	SGS		See Annex 3	
HYDROGEOLOGY	SGS			
SNOW/ICE	Data in form of notices from several measurements			
ADMINISTRATIVE BOUNDARIES	T.G.M. WRI			.shp
LOCATION PREPICIATION STATIONS				
LOCATION TEMPERATURE STATIONS	Map with locations is available		See Annex 4.2.4	
LOCATION METEOROLOGICAL STATIONS				
LOCATION SOIL MOISTURE STATIONS				
LOCATION GROUNDWATER OBSERVATION WELLS	Map with locations is available		See Annex 4.2.4	
LOCATION STREAMFLOW GAUGING STATIONS			See Annex 4.2.1 and 4.2.4	
LOCATION SURFACE WATER ABSTRACTIONS				
LOCATION GROUNDWATER ABSTRACTIONS				
LOCATION IRRIGATED FIELDS				
WHAT RESTRICTIONS APPLY TO THE USE AND DISTRIBUTION OF THE DATA?	Some of the data (VUMOP, SGS) are not available free of charge.			

CLIMATE MODEL OUTPUT					
DATASET NAME *(Please specify; expand boxes for multiple datasets)*	Owner or Source	Scale or Resolution	Temporal resolution	Scenarios/ Date published	Format (ASCII, shape files, ArcGIS coverages, GIF, etc.)
CURRENT AND FUTURE CLIMATE (GCM, RCM and further downscaling)	T.G.M. WRI	50 x 50 km	Daily	RCM – HIRHAM, RCAO / SRES 2000	*.dat
WHAT RESTRICTIONS APPLY TO THE USE AND DISTRIBUTION OF THE DATA?	Data can be used for WATCH Project only				

HYDROLOGICAL MODEL (OUTPUT)					
MODEL NAME AND TYPE: *(Please specify; expand boxes for multiple models)*	Owner or Source	Scale or Resolution	Temporal scale	Datasets (*specify output*)	
				Output	Contact
BILAN	T.G.M. WRI	River basin data	D		Oldrich Novicky

ABBREVIATIONS

CHMI:	Czech Hydrometeorological Institute
SWE:	Snow water equivalent
T.G.M-WRI:	T.G. Masaryk Water Research Institute, public research institution
VUMOP:	Research Institute for Land Reclamation and Protection
SGS:	State Geological Service

REFERENCES

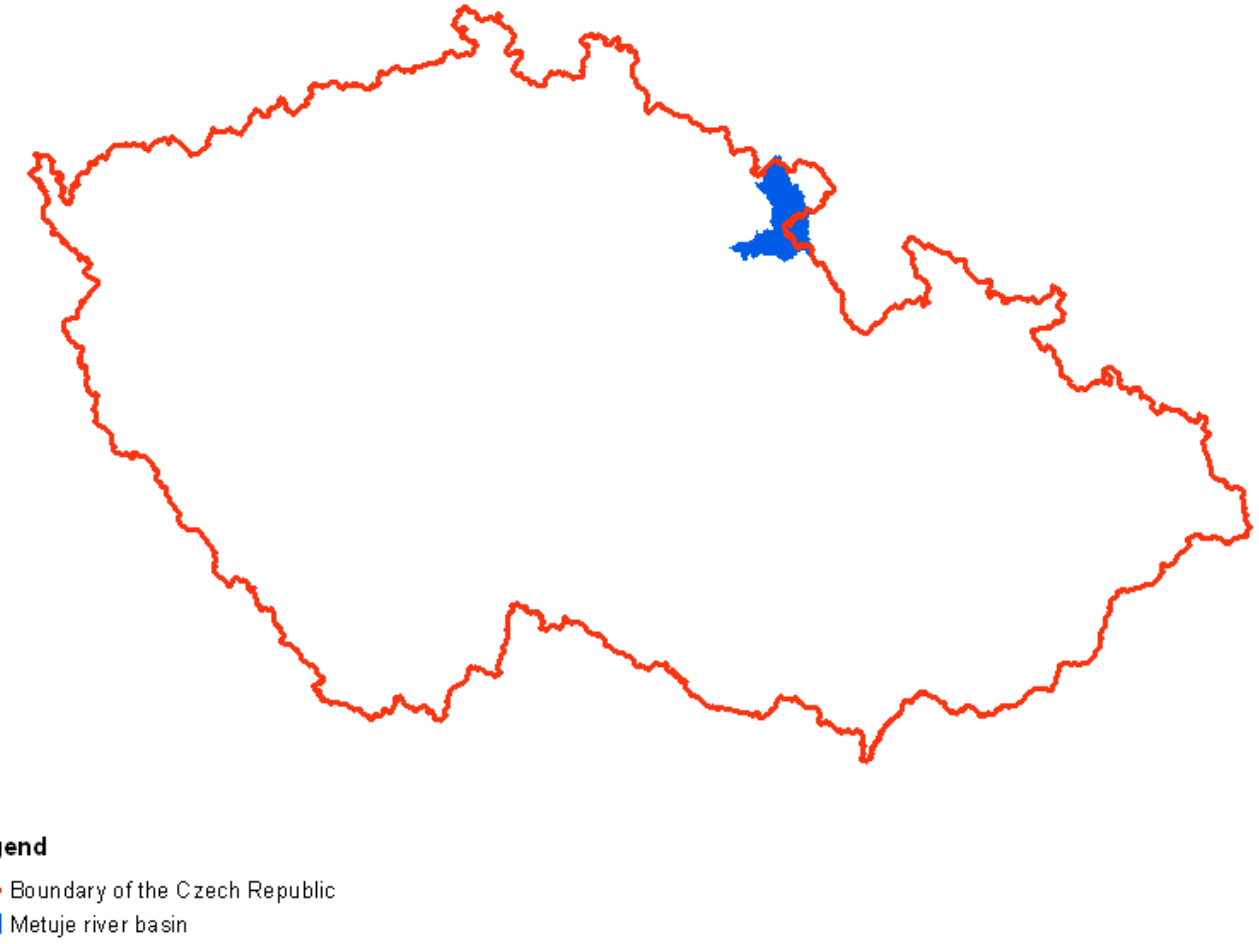
Tallaksen, L.M. & Lanen, H.A.J. van (editors) 2004. Hydrological drought - processes and estimation methods for streamflow and groundwater. Developments in water science, 48, Elsevier B.V., Amsterdam.

Kasparek, L. (Ed.), 2006. Water resources in Intra-Sudeten basin. Result of Czech-Polish co-operation in monitoring and modelling (1975-2004). T.G.M. WRI, Ministry of the Environment of the Czech Republic, ISBN 80-7212-393-0, Prague.

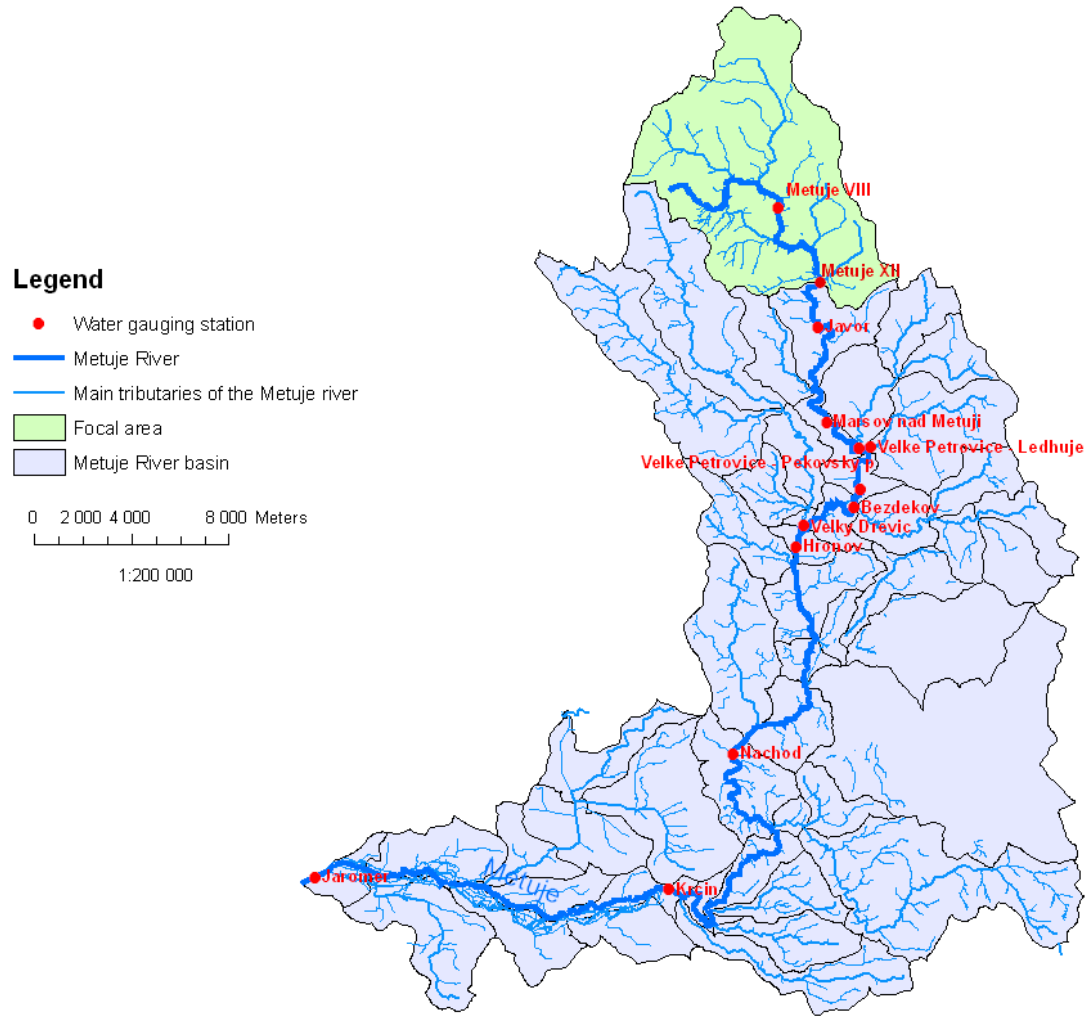
Kašpárek L., Novický O. (2005): Analysis of casual factors of extreme flow decrease in the Metuje River in 2004. In: Northern European Friend Low Flow meeting. University of Natural Resources and Applied Life Sciences, Vienna.

Novický, O., Kašpárek, L., Uhlík, J. 2007. Possible impacts of climate change on groundwater resources and groundwater flow in well developed water bearing aquifers. In: Proceedings from the Third international conference on climate and water, Helsinki, Finland, September 2007, ISBN 978-952-11-2790-8.

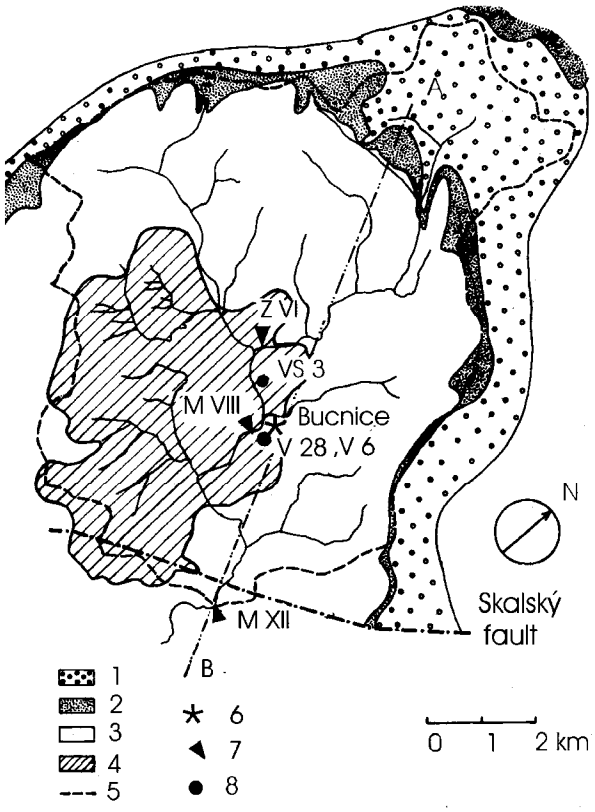
Annex 4.2.1 Location of the Metuje sub-basin in the Czech Republic



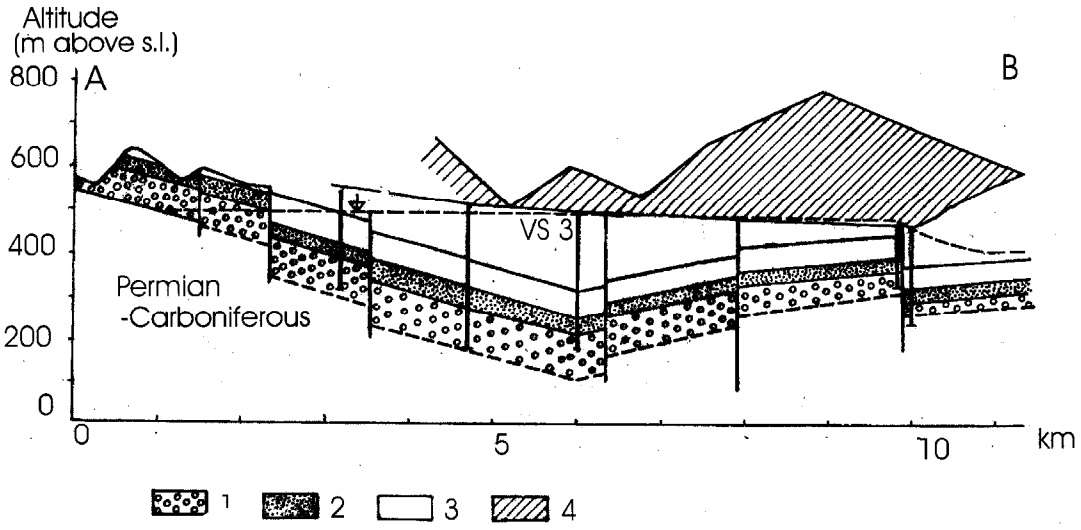
Annex 4.2.2 Map of Metuje sub-basin



Annex 4.2.3 Map of geology (upper graph) and cross-section (lower graph) of Metuje sub-basin

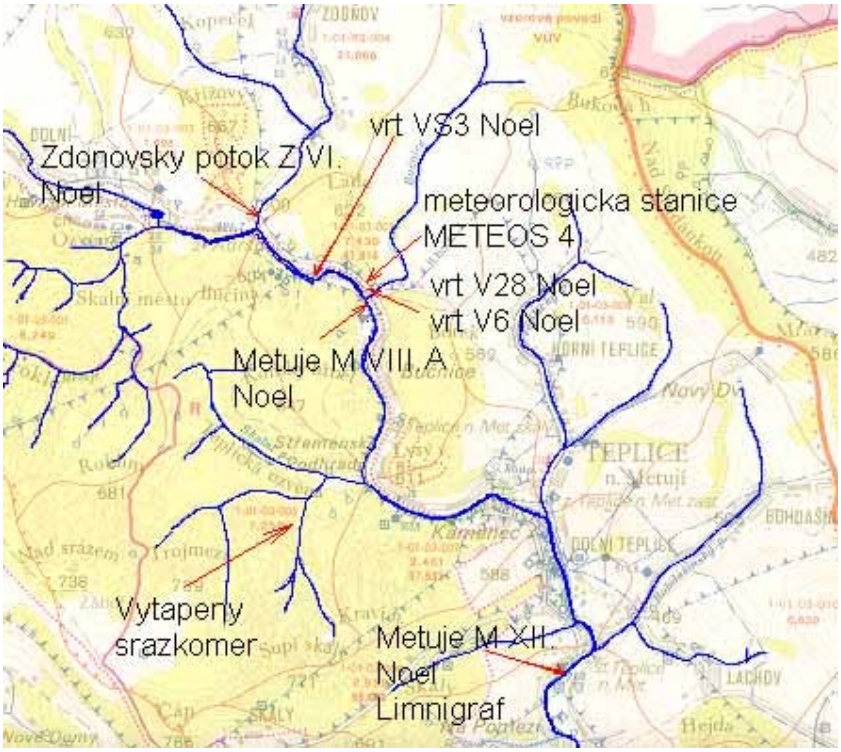


1 Kaolin sandstone and conglomerations (Lower Triassic)
2 Glauconite and clay sandstone (Upper Cretaceous - Cenomanian)
3 Sandy marlstone with fillers of sandstone and siltstone (Upper Cretaceous - Middle Turonian)
4 hick-bedded sandstone (Upper Cretaceous - Middle Turonian)
5 Water divide
6 Precipitation and meteorological station
7 Water gauging station
8 Observed borehole



1 Kaolin sandstone and conglomerations (Lower Triassic)
2 Glauconite and clay sandstone (Upper Cretaceous - Cenomanian)
3 Sandy marlstone with fillers of sandstone and siltstone (Upper Cretaceous - Middle Turonian)
4 Thick-bedded sandstone (Upper Cretaceous - Middle Turonian)

Annex 4.2.4 Map of water gaugin stations (Zdonovsky potok ZVI Noel, Metuje MVIII A Noel, Metuje MXII Noel), groundwater observation boreholes (vrt VS3 Noel, vrt V28 Noel, vrt V6 Noel), and meteorogical station (METEOS 4)



4.3 Sázava sub-basin

GENERAL INFORMATION	
BASIN NAME	*Sázava upstream from Zdar nad Sazavou*
AREA *(km²)*	131.26
LOCATION *(Country/ies)*	Czech Republic
Latitude	49°54'- 49°67'N
Longitude	15°85'- 16°49'W
BRIEF DESCRIPTION *(textual description of up to 40 words of the basin's main features and physical characteristics)*	- Upper part of the Sázava River basin (total area of the whole Sázava basin is 4 349.75 km²) - Eastern part of Upper Elbe basin - The Sázava is a tributary of the Vltava River (North sea drainage area), springs in the borderland between Moravia and Bohemia in the central part of the Czech Republic. - Mean annual streamflow 1.443 $m^3.s^{-1}$ - Mean annual maximum streamlow 20.6 $m^3.s^{-1}$ - Rather cold climate, wet and windy. - Mean annual temperature from 6.8 °C in lower parts to 5 °C in uplands. - Mean annual precipitation 729 mm, in altitudes higher than 800 m a.m.s.l. - 1100 mm per year, - Mean annual runoff 347 mm. - Relief formed by the Ceskomoravska upland, mean altitude between 400-800 m a.m.s.l., altitude of the climatologic station 625 m a.m.s.l. - Hilly landscape with flat and wide valleys, mild slopes and curved hilltops. - Basin area is composed of 50% of forests, 40% of cropland and grass fields, 2% of water bodies, 1% of urban area and 7% of other land use - Hydrogeology: bedrock consists of metamorphic rocks, different kinds of gneiss, migmatites and mica schist with some areas of serpentine and crystalline limestone.
CONTACT PERSON(S)	Oldrich Novicky (oldrich_novicky@vuv.cz)
AREAS OF INTEREST	
FLOOD ASPECTS (make a difference between operational and research questions, if possible)	- Occurrence of floods more probable during the spring season caused by combination of snowmelt and rainfall. Floods in the summer are caused by an extreme precipitation. - Possible impacts of climate change on frequency, severity and seasonality of floods are unknown.
DROUGHT ASPECTS (make a difference between operational and research questions, if possible)	- Research should be carried out in order to investigate possible impacts of climate change on frequency, severity and magnitude of drought in hydrogeological conditions represented by this basin.
WATER RESOURCES ASPECTS (make a difference between operational and research questions, if possible)	- Area of positive hydrological balance (resources are larger than demand because water supply requirements are relatively small), relatively high density of stream network, spring area of many brooks and small streams.

REGIONAL CLASSIFICATION *(Flow Regime type)*	- Pluvial type of flow regime having its maximum in March, April or May, during the spring 40-45% of total annual runoff, minimum flows occurring in mountain areas during the winter season, in lowland areas during the autumn - The precipitation regime dominates runoff processes
IS THIS A "PRB" BASIN OF THE WFD COMMON IMPLEMENTATION STRATEGY?	No
IS THIS A TRANSBOUNDARY RIVER?	No
HAS THE BASIN BEEN USED IN OTHER EU STUDIES? *(Please list if yes)*	No
DOES THE BASIN COMPRISE ONE OR MORE SUB-BASINS *(Please specify the different subbasins)*	No
ARE THERE SITES WITHIN THE BASIN THAT ARE ECOLOGICALLY SENSITIVE (e.g. RAMSAR SITES, SSSIs) *(Please specify)*	- Basin is part of the Zdarske vrchy protected landscape area, which is a protected area of natural water accumulation.
INFORMATION ON HISTORICAL DEVELOPMENT (e.g. river regulation, reservoirs, abstractions, large-scale drainage) *(Please list if yes)*	- Maintained to be a balanced and well-preserved cultivated landscape - Peat-bog areas were transformed in several pound systems, the largest one Velke Darko with a total area of 205 ha.

TIME-SERIES				
METEOROLOGICAL TIME-SERIES	No. of Records	Resolution H/D/M	Period of record (Start Yr – End Yr)	Avg. length (Yrs)
PRECIPITATION • HISTORIC	1	D	1.11.1961-31.10.2006	45
SNOW COVER	1	D	1961-2007	46
TEMPERATURE • HISTORIC	1	D	1.11.1961-31.10.2006	45
POTENTIAL EVAPORATION				
SOLAR RADIATION				
CLOUDINESS				
RELATIVE HUMIDITY	1	D	1.11.1961-31.10.2006	45
WIND SPEED				
WIND DIRECTION				
DATA OWNER(S) *Name(s) of organization(s)*	- Czech Hydrometeorological Institute			
ARE THE DATA OWNERS INTERSTED TO INTERACT WITH THE PROJECT?	- No			

ARE THE DATA AVAILABLE FREE-OF-CHARGE?	- No
WHAT RESTRICTIONS APPLY TO THE USE AND DISTRIBUTION OF THE DATA? *(Please specify)*	Data can be used only for WATCH Project

TIME SERIES				
HYDROLOGICAL TIME-SERIES	No. of Records	Resolution H/D/M	Period of record (Earliest – Latest)	Avg. length (Yrs)
RIVER FLOW • HISTORIC • REAL-TIME	1	D	1.11.1961-31.10.2006	45
RIVER LEVEL • REAL-TIME				
GROUNDWATER LEVEL • HISTORIC • REAL-TIME				
SOIL MOISTURE (4 depths) • HISTORIC • REAL-TIME				
LAKE/RESERVOIR LEVEL • HISTORIC • REAL-TIME				
LAKE/RESERVOIR OUTFLOW • OBESRVED • LICENCED/CONSENTED				
SURFACE WATER ABSTRACTIONS • OBESRVED • LICENCED/CONSENTED				
GROUNDWATER ABSTRACTIONS • OBESRVED • LICENCED/CONSENTED				
IRRIGATION GIFTS				
DATA OWNER(S) *(Name(s) of organization(s))*	- Czech Hydrometeorological Institute			
ARE THE DATA OWNERS INTERSTED TO INTERACT WITH THE PROJECT?	- No			
ARE THE DATA AVAILABLE FREE-OF-CHARGE?	- No			
WHAT RESTRICTIONS APPLY TO THE USE AND DISTRIBUTION OF THE DATA? *(Please specify)*	Data can be used only for WATCH Project			

SPATIAL DATA				
DATASET NAME *(Please specify; expand boxes for multiple datasets)*	Owner or Source	Scale or Resolution	Date published	Format (ASCII, shape files, ArcGIS coverages, GIF, etc.)
PRECIPITATION Throughfall				
TEMPERATURE	Time series from one station available (representative for the small basin area)			
RELATIVE HUMIDITY				
POTENTIAL EVAPORATION				
OTHER METEOROLOGICAL - SOLAR RADIATION - CLOUDINESS - RELATIVE HUMIDITY - WIND SPEED - WIND DIRECTION				
DIGITAL ELEVATION DATA	T.G.M. WRI	10x10m 1:10 000		.tiff
TOPOGRAPHICAL (RELIEF, SLOPE, ASPECT, ETC.)	T.G.M. WRI	10x10m 1:10 000		.tiff
FRESHWATER BODIES (RIVERS, LAKES, WETLANDS)	T.G.M. WRI			.gif .shp
LAND-USE/LAND-COVER	T.G.M. WRI			.shp
URBANISATION/POPULATION				
SOILS Quaternary geological map	VUMOP			
GEOLOGY	SGS			
HYDROGEOLOGY	SGS			
SNOW/ICE	No data			
ADMINISTRATIVE BOUNDARIES	T.G.M. WRI			.shp
LOCATION PREPICIATION STATIONS				
LOCATION TEMPERATURE STATIONS	Map with location is available			
LOCATION METEOROLOGICAL STATIONS				
LOCATION SOIL MOISTURE STATIONS				
LOCATION GROUNDWATER OBSERVATION WELLS				
LOCATION STREAMFLOW GAUGING STATIONS				

LOCATION SURFACE WATER ABSTRACTIONS				
LOCATION GROUNDWATER ABSTRACTIONS				
LOCATION IRRIGATED FIELDS				
WHAT RESTRICTIONS APPLY TO THE USE AND DISTRIBUTION OF THE DATA?	Some of the data (VUMOP, SGS) are not available free of charge			

CLIMATE MODEL OUTPUT					
DATASET NAME *(Please specify; expand boxes for multiple datasets)*	Owner or Source	Scale or Resolution	Temporal resolution	Scenarios/ Date published	Format (ASCII, shape files, ArcGIS coverages, GIF, etc.)
CURRENT AND FUTURE CLIMATE (GCM, RCM and further downscaling)	T.G.M. WRI	50 x 50 km	Daily	RCM – HIRHAM, RCAO / SRES 2000	*.dat
WHAT RESTRICTIONS APPLY TO THE USE AND DISTRIBUTION OF THE DATA?	Data can be used only for WATCH Project				

HYDROLOGICAL MODEL (OUTPUT)					
MODEL NAME AND TYPE: *(Please specify; expand boxes for multiple models)*	Owner or Source	Scale or Resolution	Temporal scale	Datasets (*specify output*)	
				Output	Contact
BILAN	T.G.M. WRI	River basin data	D		Oldrich Novicky

ABBREVIATIONS

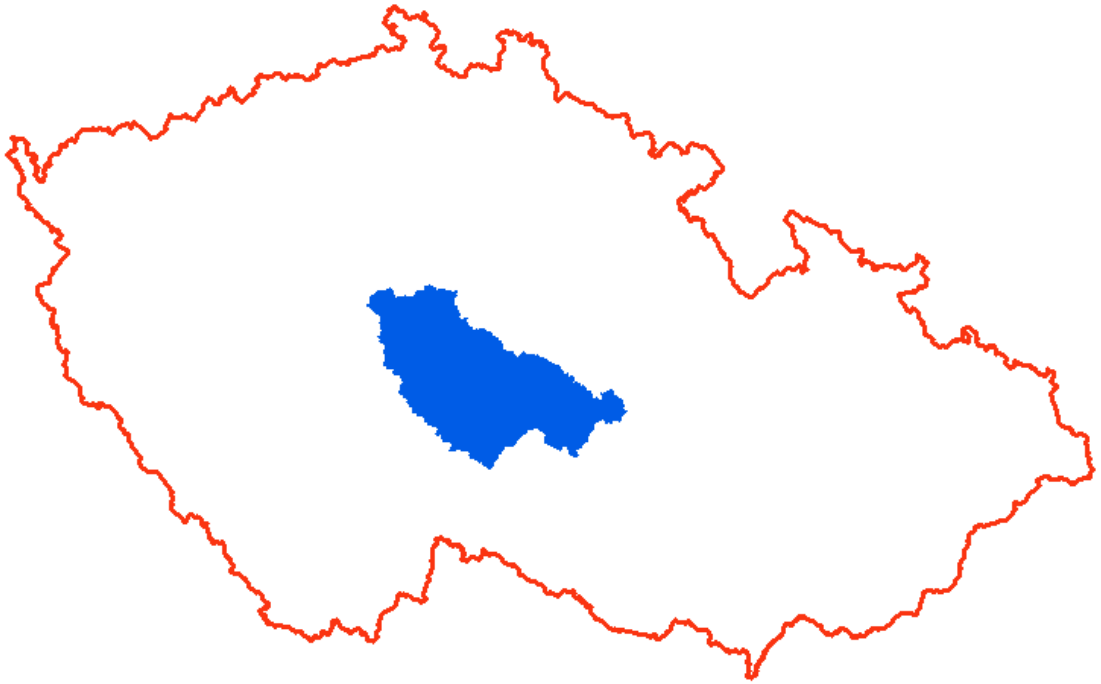
SWE: Snow water equivalent
T.G.M-WRI T.G. Masaryk Water Research Institute, public research institution
CHMI: Czech Hydrometeorological Institute
VUMOP: Research Institute for Land Reclamation and Protection
SGS: State Geological Service

REFERENCES

Hladný, J., Krátká, M., Kašpárek, L. (editors) 2004. August 2002 Catastrophic Flood in the Czech Republic. Ministry of Environment of the Czech Republic, Prague, ISBN 80-7212-343-2.

Kašpárek, L., Novický, O., Hanel, M. Horáček, S. (editors) 2006. 2006 spring flood in the Czech Republic. T.G. Masaryk Water Research Institute and Ministry of Environment of the Czech Republic, Prague, ISBN 80-85900-71-8.

Annex 4.3.1 Location of the Sázava sub-basin in the Czech Republic

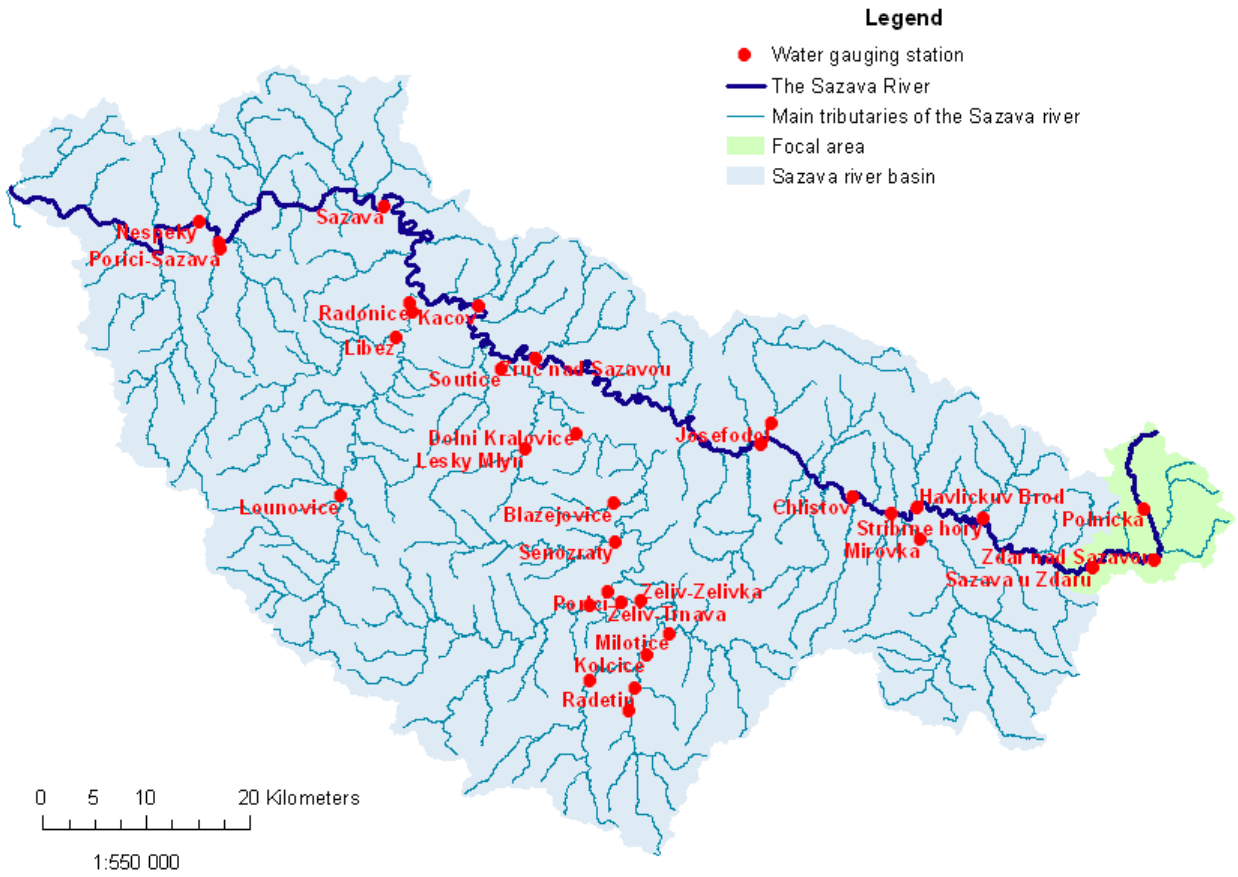


Legend

Boundary of the Czech Republic

Sazava river basin

Annex 4.3.2 Map of Sázava sub-basin and the focal area (headwater)



5. Upper-Guadiana basin (Spain)

This chapter provides the metadata catalogue for the Upper Guadiana (whole basin) and the focal area: the La Mancha Occidental sub-basin. The latter is not a surface water basin as the previous ones, but one of the major aquifer systems (groundwater basin) in the Upper-Guadiana.

5.1 Upper-Guadiana (whole basin)

GENERAL INFORMATION	
BASIN NAME	Upper Guadiana
AREA *(km²)*	16 000
LOCATION *(Country/ies)*	Spain
LATITUDE	38º00'-40º30'N
LONGITUDE	1º30'-5º00'W
BRIEF DESCRIPTION *(textual description of up to 40 words of the basin's main features and physical characteristics)*	The basin is part of the Central Spanish Plateau. It has a typical continental, semi-arid, Mediterranean climate. The precipitation shows a marked temporal and spatial variability. Potential evaporation clearly exceeds rainfall, resulting in a relatively low streamflow. Most of the surface of the Guadiana basin is rather flat. Some 66% of the basin is underlain by porous aquifers. These are connected with the rivers and wetlands in a complex way. Seven major aquifer systems can be distinguished in the Upper Guadiana basin. The most important is La Mancha Occidental aquifer, located in the centre of the basin.
CONTACT PERSON(S)	Jesus Carrera (jcarrera@ija.csic.es) Jorge Jódar Bermúdez (jjodar@ija.csic.es) Vicente Navarro (vicente.navarro@uclm.es) Miguel Candel (miguel.candel@uclm.es)
AREAS OF INTEREST	
FLOOD ASPECTS (make a difference between operational and research questions, if possible)	To date, no major flood events have been reported. Some local flooding occurs (e.g. in 2004 near Alcazar de San Juan).
DROUGHT ASPECTS (make a difference between operational and research questions, if possible)	• Assessment of droughts and relate these to water scarcity; • Assessment of impact of climate change on drought, irrigated agriculture and the ecosystem.
WATER RESOURCES ASPECTS (make a difference between operational and research questions, if possible)	Until the 1960s, the basin was a typical rural one and the economy was based mainly on dryland farming of cereal and vineyards and traditional small scale irrigation. From then on wards irrigated cropping systems were implemented. Abstractions were sixfold larger than in the past. As a result, the groundwater levels significantly dropped and most of the wetlands in the La Mancha Occidental region were affected and some disappeared completely (e.g. the Tablas de Daimiel National Park (UNESCO, Biosphere Reserve). In response, the Spanish administration took action, involving decreasing abstractions and the promotion of crops that consume less water. In order to preserve Las Tablas de Daimiel, water was imported (water transfer) from another catchment (Tagus Basin) to the Guadiana.

	The wetter period after 1995 and the reduced abstractions induced some recovery of groundwater levels. There is a pressing need to reduce abstraction of groundwater in the Upper Guadiana. Investment has been made in efficient irrigation systems, but demand needs to be reduced further. Adequate regulations have not been developed and even where they exist, they are not easily enforced. • to find a proper balance between economy (irrigated agricultural) and ecology (conservation and restoration of wetlands and springs), which considers climate change; • to enhance further stakeholder participation: from "confrontation" to "collaboration" to achieve sustainable development.
REGIONAL CLASSIFICATION *(Flow Regime type)*	In the Upper Guadiana basin there are basically three tributaries to the Guadiana river; the Cigüela River, the Záncara river and finally the Upper Guadiana river. Both Cigüela and Záncara rivers flow through low permeability materials, presenting a very low base flow rate. That is the reason why these rivers show a quick flow rate response as a function of rainfall, becoming almost dry up to the next precipitation event. On the contrary, the Upper Guadiana born as a result of a karstic surge, flowing through this karstic limestone landscape ("Campos de Montiel"). Limestone continuously feeds the river up to the point that ir reaches the plain of "La Mancha". That makes the base flow rate to grow up to 50 hm^3/yr. Once the river reaches the plain it disappears. This water percolates through the soil to reach the water level of the aquifer of "La Mancha Occidental", appearing as groundwater surge again in the "Ojos del Guadiana". Summarizing, since this basin has a continental, semi-arid, Mediterranean climate, the flow regime basically follows the precipitation cycle, that is, water flows following an intermittent pattern, being summer flow generally very low or zero, depending on the river base flow component.
IS THIS A "PRB" BASIN OF THE WFD COMMON IMPLEMENTATION STRATEGY?	
IS THIS A TRANSBOUNDARY RIVER?	No, the Upper Guadiana is at Spanish territory. The Lower Guadiana river basin is in the Spanish-Portuguese border region.
HAS THE BASIN BEEN USED IN OTHER EU STUDIES? *(Please list if yes)*	Yes, the Upper Guadiana basin has been investigated in a number of EC projects, e.g. EFADA, GRAPES, ARIDE, ASTHyDA, and recently NEWATER.
INFORMATION ON HISTORICAL DEVELOPMENT (e.g. river regulation, reservoirs, abstractions, large-scale drainage) *(Please list if yes)*	Large-scale groundwater abstraction for irrigation and conversion from traditional dryland farming to irrigated vineyards and olives. General estimates for the abstracted groundwater are provided by the previous EU projects.
STAKEHOLDERS	• Guadiana Water Authority, which is legally the lead organization in management of the catchment. This is supported by the Spanish Ministry of the Environment;

	• National Park of Las Tablas de Daimiel, which also belongs to the Spanish Ministry of the Environment; • Department of Agriculture of the Regional Government(agricultural planning and distributes all the farming subsidies coming from the European Union); • Communities of Groundwater Users; • farmers (in general, not only irrigators); • local and national Conservation Groups.
OTHER	

TIME-SERIES				
METEOROLOGICAL TIME-SERIES	No. of Records	Resolution H/D/M	Period of record (Start Yr – End Yr)	Avg. length (Yrs)
PRECIPITATION • HISTORIC (• REAL-TIME	 159 167	 M D	 1959-1999 1959-2007	 29 29
TEMPERATURE • HISTORIC • REAL-TIME	 159 167	 M D	 1959-1999 1959-2007	 29 29
REFERENCE EVAPORATION • HISTORIC • REAL-TIME	 	 D	 1999-2007	 8
OTHER				
OTHER				
DATA OWNER(S) *Name(s) of organization(s)*	AEMET UCLM			
ARE THE DATA OWNERS INTERSTED TO INTERACT WITH THE PROJECT?	No			
ARE THE DATA AVAILABLE FREE-OF-CHARGE?	AEMET: Yes UCLM: Yes			
WHAT RESTRICTIONS APPLY TO THE USE AND DISTRIBUTION OF THE DATA? *(Please specify)*	In both cases, the data cannot be used in personal bussines to obtain a personal capital gain. It is necessary to acknowledge the source of data in all the documents where these data are used. AEMET: "Resultados obtenidos a partir de la información cedida por el Instituto Nacional de Meteorología. Ministerio de Medio Ambiente. Web site: http://www.aemet.es" UCLM: " Servicio Integral de Asesoramiento al Regante (SIAR) de Castilla-La Mancha. Web site: http://crea.uclm.es/siar"			

TIME SERIES				
HYDROLOGICAL TIME-SERIES	No. of Records	Resolution H/D/M	Period of record (Earliest – Latest)	Avg. length (Yrs)
RIVER FLOW • HISTORIC • NATURALIZED	65	monthly	Feb 1974 – Oct 2006	8 years
LAKE/RESERVOIR LEVEL • HISTORIC	2	daily and weekly	Oct 1958 – Feb 2002	10 years
LAKE/RESERVOIR OUTFLOW • OBSERVED • LICENSED/CONSENTED	1	daily	Oct 1959 – May 2000	40 years
SNOW PILLOWS (SWE)	Not relevant			
SNOW DEPTH	Not relevant			
GROUNDWATER ABSTRACTIONS				
IRRIGATION GIFTS				
GROUNDWATER LEVELS	170	monthly	Oct 1959 – Sep 2007	15 years
OTHER				
DATA OWNER(S) *(Name(s) of organization(s))*	• Confederación Hidrográfica del Guadiana (CHG) • Centro de Estudios y Experimentación de Obras Públicas (CEDEX) • Instituto Geo-Minero de España (IGME)			
ARE THE DATA OWNERS INTERSTED TO INTERACT WITH THE PROJECT?	No			
ARE THE DATA AVAILABLE FREE-OF-CHARGE?	IGME have information in their website. Data consists of piezometric head evolution measured in piezometres owing to IGME. Data is not free of charge. The hydrological time series from CHG and CEDEX can be used in the framework of the WATCH-Project. They are free of charge			
WHAT RESTRICTIONS APPLY TO THE USE AND DISTRIBUTION OF THE DATA? *(Please specify)*	Data cannot be used in personal bussines to obtain a personal capital gain. It is necessary to acknowledge the source of data in all the documents where these data are used. CHG: "Confederación Hidrográfica del Guadiana, Web site: http://www.chguadiana.es" CEDEX: "Centro de Estudios y Experimentación de Obras Públicas. Centro de Estudios Hidrográficos. Web site: http://www.cedex.es/castellano/hidrograficos/presentacion.html" IGME: "Instituto Geológico y Minero de España. Ministerio de Educación y Ciencia. Web site: http://www.igme.es"			

SPATIAL DATA				
DATASET NAME *(Please specify; expand boxes for multiple datasets)*	Owner or Source	Scale or Resolution	Temporal resolution/ Date published	Format (ASCII, shape files, ArcGIS coverages, GIF, etc.)
PRECIPITATION	CEDEX	2.5 km grid	Monthly (Oct 1940-Dec 2007)	ASCII
TEMPERATURE	AEMET	1:50,000		TIFF
REFERENCE EVAPORATION (Thornthwaite)	CEDEX	2.5 km grid	Monthly (Oct 1940-Dec 2007)	ASCII
DIGITAL ELEVATION DATA	IGN	1:25,000		
FRESHWATER BODIES (RIVERS, LAKES)	IGN	1:25,000		
LAND-USE/LAND-COVER	IGN	1:200,000		
URBANISATION/POPULATION	CHG	1:200,000		
SOILS	IGME/CIEMAT	1:50,000		
GEOLOGY	IGME	1:50,000		
HYDROGEOLOGY	IGME	1:200,000		
SNOW/ICE	Not relevant			
OTHER SPATIAL: Irrigation	CHG	1:200,000	2005	JPG
OTHER SPATIAL:				
OTHER SPATIAL:				
WHAT RESTRICTIONS APPLY TO THE USE AND DISTRIBUTION OF THE DATA?				

CLIMATE MODEL OUTPUT					
DATASET NAME *(Please specify; expand boxes for multiple datasets)*	Owner or Source	Scale or Resolution	Temporal resolution/	Scenarios/date published	Format (ASCII, shape files, ArcGIS coverages, GIF, etc.)
CURRENT AND FUTURE CLIMATE (GCM, RCM and further downscaling)	No specific national products are available yet				
WHAT RESTRICTIONS APPLY TO THE USE AND DISTRIBUTION OF THE DATA?					

HYDROLOGICAL MODEL (OUTPUT)					
MODEL NAME AND TYPE: *(Please specify; expand boxes for multiple models)*	Owner or Source	Scale or Resolution	Temporal scale	Datasets (*specify output*)	
				Output	Contact
SIMPA	CEDEX	2.5 km	monthly	Recharge Discharge	Juan Manuel Ruiz García (Head in charge of the centre for hydrographic studies-CEDEX)
MODFLOW	WU	2.5 km	monthly	Heads, discharge	Henny van Lanen
MODFLOW	UCLM	2.5 km	monthly	Heads, discharge	Vicente Navarro and Miguel Candel form UCLM, and Jesús Carrera and Jorge Jódar from CSIC

ABBREVIATIONS

CEDEX: Centro de estudios y experimentación de obras públicas
CIEMAT: Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas
CHG: Confederación Hidrográfica del Guadiana
IGME: Instituto Geo-Minero de España
IGN: Instituto Geográfico Nacional
AEMET: Agencia Estatal de Meteorología (formely INM or Instituto Nacional de Meteorología)
MMA: Ministerio de Medio Ambiente
SIMPA: Sistema Integrado de Modelizatión Precipitación-Aportación
MODFLOW: Modular Three-Dimensional Finite-Difference Groundwater Flow Model
UCLM : Universidad Castilla la Mancha

REFERENCES

Acreman, M. (Ed.), 2000. Guidelines for the sustainable management of groundwater-fed catchments in Europe. GRAPES: Groundwater and River Resources Action Programme on a European scale. Institute of Hydrology, Wallingford, UK, 82 pg.

Conan C, de Marsily G, Bouraoui F, et al., 2003. A long-term hydrological modelling of the Upper Guadiana river basin (Spain). Physics and chemistry of the earth 28 (4-5): 193-200 2003

Cruces, J., 1996. In: Bromley, J. (Ed.) EFEDA-2, Hydrology Group. Institute of Hydrology, Wallingford, UK, 82 pg.

Hernandez-Mora N, Martinez Cortina L, Fornes J (2003) Intensive groundwater use in Spain. In: Llamas R, Custodio E (eds) Intensive use of groundwater: challenges and opportunities. 478 pg, I.S.B.N. 90-5809-390-5. Balkema, The Netherlands.

Horst, M.M.S ter, 2001. Groundwater Flow in the Mancha Occidental aquifer unit (Upper-Guadiana catchment, Spain) under near natural conditions. Exploration with a GMS MODFLOW model. MSc thesis Wageningen University/ARIDE Technical Report No. 14.

Martínez Cortina, L., 2001. Estimación de la recarga en grandes cuencas sedimentarias mediante modelos numéricos de flujo subterráneo. Aplicación a la cuenca alta del Guadiana. PhD thesis, Universidad de Cantabria.

Peters, E., 2003. Propagation of drought through groundwater systems – illustrated in the Pang (UK) and Upper-Guadiana (ES) catchments. PhD thesis Wageningen University.

Peters, E. & van Lanen, H.A.J., 2001. Groundwater Droughts. In: Demuth, S. & Stahl, K. (Eds.) Assessment of the Regional Impact of Droughts in Europe (ARIDE), University of Freiburg, pg. 27-46.

Estrela, T. & L. Quintas, 1996. A distributed model for water resources assessment in large basins. Proc. of 1st Int. Conf. On Rivertech 96. IWRA. Chicago, USA, September 1996, Vol. 2, pp. 861-868

Ruiz García, J.M., 1998. Dessarrollo de un modelo hidrológico conceptual distribuido de simulación continua integrado con un SIG. Thesis doctoral. Universidad Politécnica de Valencia, 245 pg.

Ruiz García, J.M., 1999. Modelo distribuído para la evaluación de recursos hídricos. 245 pg., I.S.B.N. 84-498-0417-5. CEDEX, Ministerio de Fomento.

Annex 5.1 Upper-Guadiana basin with the major aquifer Systems (below)

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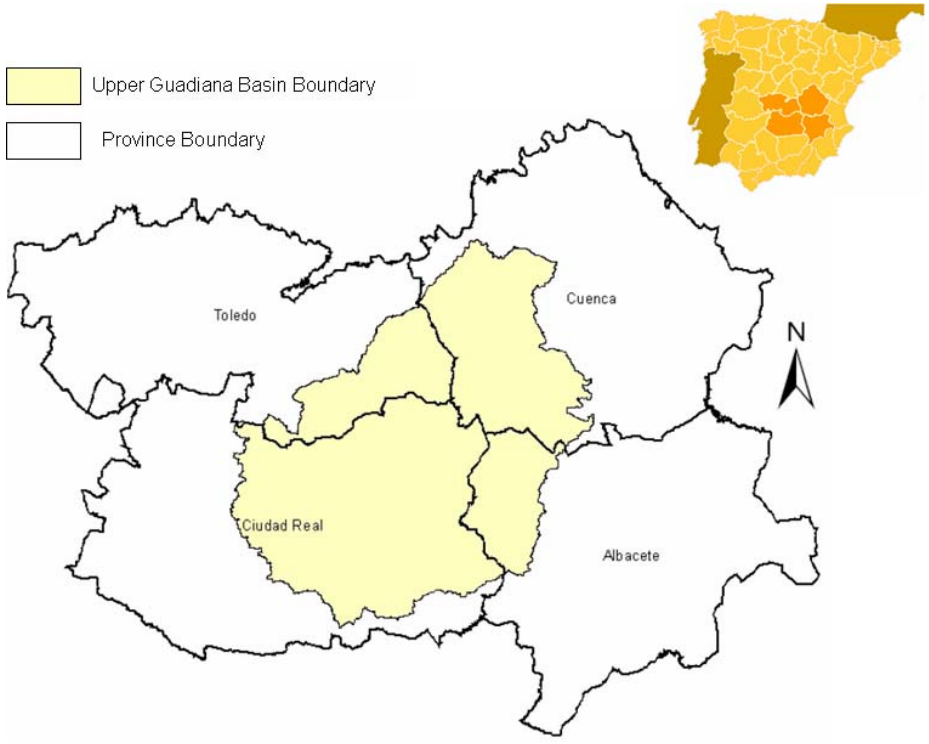
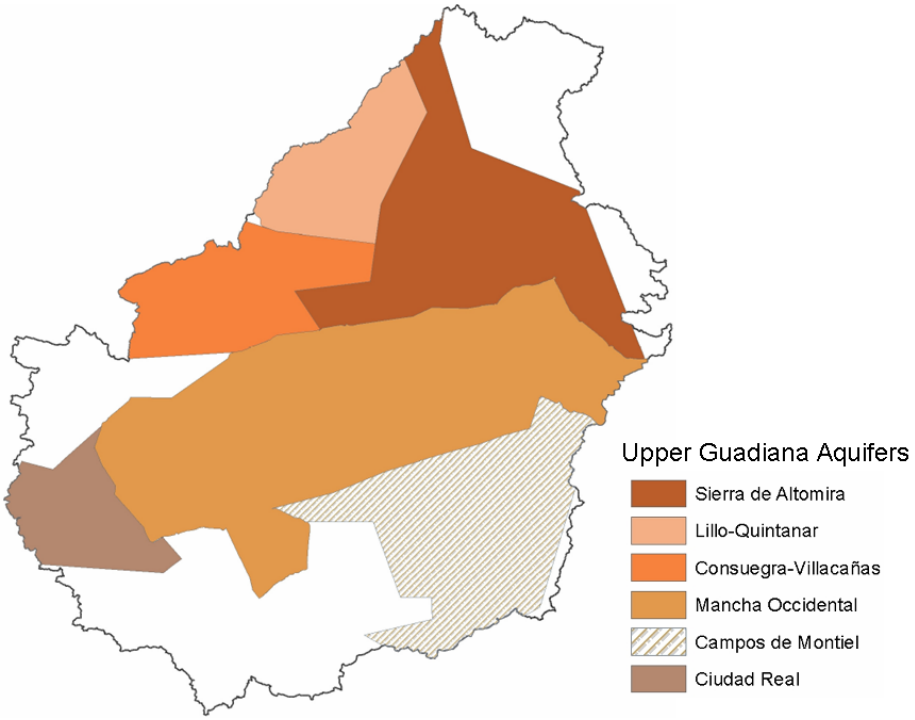
Geographic location of the Upper Guadiana Basin



Aquifers in the Upper Guadiana Basin



5.2 La Mancha Occidental sub-basin

GENERAL INFORMATION	
BASIN NAME	La Mancha Occidental (Upper Guadiana)
AREA *(km²)*	4569
LOCATION *(Country/ies)*	Spain
LATITUDE	38º54'-39º31'N
LONGITUDE	2º16'-3º49'W
BRIEF DESCRIPTION *(textual description of up to 40 words of the basin's main features and physical characteristics)*	La Mancha Occidental is the most important aquifer in the Upper-Guadiana river basin. The aquifer has a Paleozoic basement (shale and quartzites) which underlies Mesozoic sediments (Cretacic and Jurassic limestones). It consists of Quaternary and Tertiary (Miocene limestones and Miocene detritic). In the east of the aquifer system, different limestone formations ageing from Jurassic to Cretaceous are distinguished. Layers with different permeability and thickness divide the limestone formations. They form a geological continuation of the Campo de Montiel aquifer unit and the Sierra Altomira aquifer unit underneath the younger deposits from the Quarternary and Tertiary.
CONTACT PERSON(S)	Jesus Carrera (jcarrera@ija.csic.es) Jorge Jódar Bermúdez (jjodar@ija.csic.es) Vicente Navarro (vicente.navarro@uclm.es) Miguel Candel (miguel.candel@uclm.es)
AREAS OF INTEREST	
FLOOD ASPECTS (make a difference between operational and research questions, if possible)	To date, no flood events have been reported.
DROUGHT ASPECTS (make a difference between operational and research questions, if possible)	• Assessment of droughts (groundwater and streamflow) and relate these to water scarcity; • Assessment of impact of climate change on drought, irrigated agriculture and the ecosystem (e.g. Tablas Damiel) •
WATER RESOURCES ASPECTS (make a difference between operational and research questions, if possible)	See description: Upper-Guadiana (whole basin). There is a pressing need to reduce abstraction from the La Mancha Occidental aquifer. Challenges are: • to find a proper balance between economy (irrigated agricultural) and ecology (conservation and restoration of wetlands and springs), which considers climate change; • to enhance further stakeholder participation: from "confrontation" to "collaboration" (social learning approach) to achieve sustainable development.
REGIONAL CLASSIFICATION *(Flow Regime type)*	The study area is characterized by a high density and diversity of wetlands. The most famous are "Las Tablas de Daimiel" and the "Ojos del Guadiana". The latter is the natural source of the Guadiana river. In the focal area there is a continental, semi-arid, Mediterranean climate. In the Guadiana River the runoff from direct rainfall is fairly intermittent and scarce, and it can be considered the driest in Spain, with an average lower than 30 mm/yr. This small value is not sufficient to explain the permanence of the water, being the groundwater flow the main driver of the flow regime in the Guadiana River.

	The flow regime in the Guadiana river is quite stable as can be expected from a groundwater source. Regardless the hydrologic relevance of this area, there are not very long as well as reliable hydrologic data series from any gauging station close to the location of Ojos del Guadiana.
IS THIS A "PRB" BASIN OF THE WFD COMMON IMPLEMENTATION STRATEGY?	
IS THIS A TRANSBOUNDARY RIVER?	No.
HAS THE BASIN BEEN USED IN OTHER EU STUDIES? *(Please list if yes)*	Yes, the La Mancha Occidental aquifer has been investigated as part of the Upper Guadiana basin in a number of EC projects, e.g. EFADA, GRAPES, ARIDE, ASTHyDA, and recently NEWATER.
INFORMATION ON HISTORICAL DEVELOPMENT (e.g. river regulation, reservoirs, abstractions, large-scale drainage) *(Please list if yes)*	Large-scale groundwater abstraction for irrigation and conversion from traditional dryland farming to irrigated vineyards and olives. General estimates for the abstracted groundwater are provided by the previous EU projects.
STAKEHOLDERS	• Guadiana Water Authority, which is legally the lead organisation in management of the catchment. This is supported by the Spanish Ministry of the Environment; • National Park of Las Tablas de Daimiel, which also belongs to the Spanish Ministry of the Environment; • Department of Agriculture of the Regional Government(agricultural planning and distributes all the farming subsidies coming from the European Union); • Communities of Groundwater Users; • farmers (in general, not only irrigators); • Local and national Conservation Groups.
OTHER	

TIME-SERIES				
METEOROLOGICAL TIME-SERIES	No. of Records	Resolution H/D/M	Period of record (Start Yr – End Yr)	Avg. length (Yrs)
PRECIPITATION				
• HISTORIC (	35	M	1959-1999	29
• REAL-TIME	38	D	1999-2007	29
TEMPERATURE				
• HISTORIC	35	M	1959-1999	29
• REAL-TIME	38	D	1999-2007	29
REFERENCE EVAPORATION				
• HISTORIC				
• REAL-TIME	3	D	1999-2007	8
OTHER				
OTHER				

DATA OWNER(S) *Name(s) of organization(s)*	AEMET UCLM
ARE THE DATA OWNERS INTERSTED TO INTERACT WITH THE PROJECT?	No
ARE THE DATA AVAILABLE FREE-OF-CHARGE?	AEMET: Yes UCLM: Yes
WHAT RESTRICTIONS APPLY TO THE USE AND DISTRIBUTION OF THE DATA? *(Please specify)*	In both cases, the data can not be used in personal bussines to obtain a personal capital gain. It is necessary to acknowledge the source of data in all the documents where these data are used. AEMET: "Resultados obtenidos a partir de la información cedida por el Instituto Nacional de Meteorología. Ministerio de Medio Ambiente. Web site: http://www.aemet.es" UCLM: " Servicio Integral de Asesoramiento al Regante (SIAR) de Castilla-La Mancha. Web site: http://crea.uclm.es/siar"

TIME SERIES				
HYDROLOGICAL TIME-SERIES	No. of Records	Resolution H/D/M	Period of record (Earliest – Latest)	Avg. length (Yrs)
RIVER FLOW • HISTORIC • NATURALIZED	18	monthly	Jan 1996 – Oct 2006	10 years
LAKE/RESERVOIR LEVEL • HISTORIC	2	daily and weekly	Oct 1958 – Feb 2002	10 years
LAKE/RESERVOIR OUTFLOW • OBSERVED • LICENSED/CONSENTED	1	daily	Oct 1959 – May 2000	40 years
SNOW PILLOWS (SWE)	Not relevant			
SNOW DEPTH	Not relevant			
GROUNDWATER ABSTRACTIONS				
IRRIGATION GIFTS				
GROUNDWATER LEVELS	70	monthly	Oct 1959 – Sep 2007	15 years
OTHER				
DATA OWNER(S) *(Name(s) of organization(s))*	• Confederación Hidrográfica del Guadiana (CHG) • Centro de Estudios y Experimentación de Obras Públicas (CEDEX) • Instituto Geo-Minero de España (IGME)			

ARE THE DATA OWNERS INTERSTED TO INTERACT WITH THE PROJECT?	No
ARE THE DATA AVAILABLE FREE-OF-CHARGE?	IGME have information in their website. Data consists of piezometric head evolution measured in piezometres owing to IGME. Data is not free of charge. The hydrological time series from CHG and CEDEX can be used in the framework of the WATCH-Project. They are free of charge
WHAT RESTRICTIONS APPLY TO THE USE AND DISTRIBUTION OF THE DATA? *(Please specify)*	Data can not be used in personal bussines to obtain a personal capital gain. It is necessary to acknowledge the source of data in all the documents where theese data are used. CHG: "Confederación Hidrográfica del Guadiana, Web site: http://www.chguadiana.es" CEDEX: "Centro de Estudios y Experimentación de Obras Públicas. Centro de Estudios Hidrográficos. Web site: http://www.cedex.es/castellano/hidrograficos/presentacion.html" IGME: "Instituto Geológico y Minero de España. Ministerio de Educación y Ciencia. Web site: http://www.igme.es"

SPATIAL DATA				
DATASET NAME *(Please specify; expand boxes for multiple datasets)*	Owner or Source	Scale or Resolution	Temporal resolution/ Date published	Format (ASCII, shape files, ArcGIS coverages, GIF, etc.)
PRECIPITATION	CEDEX	2.5 km grid	Monthly (Oct 1940-Dec 2007)	ASCII
TEMPERATURE	INM	1:50,000		TIFF
REFERENCE EVAPORATION (Thornthwaite)	CEDEX	2.5 km grid	Monthly (Oct 1940-Dec 2007)	ASCII
DIGITAL ELEVATION DATA	IGN	1:25,000		
FRESHWATER BODIES (RIVERS, LAKES)	IGN	1:25,000		
LAND-USE/LAND-COVER	IGN	1:200,000		
URBANISATION/POPULATION	CHG	1:200,000		
SOILS	IGME/CIEMAT	1:50,000		
GEOLOGY	IGME	1:50,000		
HYDROGEOLOGY	IGME	1:200,000		
SNOW/ICE	Not relevant			

OTHER SPATIAL: Irrigation	CHG	1:200,000	2005	JPG
OTHER SPATIAL:				
OTHER SPATIAL:				
WHAT RESTRICTIONS APPLY TO THE USE AND DISTRIBUTION OF THE DATA?				

CLIMATE MODEL OUTPUT					
DATASET NAME *(Please specify; expand boxes for multiple datasets)*	Owner or Source	Scale or Resolution	Temporal resolution/	Scenarios/date published	Format (ASCII, shape files, ArcGIS coverages, GIF, etc.)
CURRENT AND FUTURE CLIMATE (GCM, RCM and further downscaling)	No specific national products are available yet				
WHAT RESTRICTIONS APPLY TO THE USE AND DISTRIBUTION OF THE DATA?					

HYDROLOGICAL MODEL (OUTPUT)					
MODEL NAME AND TYPE: *(Please specify; expand boxes for multiple models)*	Owner or Source	Scale or Resolution	Temporal scale	Datasets (*specify output*)	
				Output	Contact
SIMPA	CEDEX	2.5 km	monthly	Recharge Discharge	Juan Manuel Ruiz García (Head in charge of the centre for hydrographic studies-CEDEX)
MODFLOW	WU	2.5 km	monthly	Heads, discharge	Henny van Lanen
MODFLOW	UCLM	2.5 km	monthly	Heads, discharge	Vicente Navarro and Miguel Candel form UCLM, and Jesús Carrera and Jorge Jódar from CSIC

ABBREVIATIONS

CEDEX:	Centro de estudios y experimentación de obras públicas
CIEMAT:	Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas
CHG:	Confederación Hidrográfica del Guadiana
IGME:	Instituto Geo-Minero de España
IGN:	Instituto Geográfico Nacional
AEMET:	Agencia Estatal de Meteorología (formely INM or Instituto Nacional de Meteorología)
MMA:	Ministerio de Medio Ambiente
SIMPA:	Sistema Integrado de Modelizatión Precipitación-Aportación
MODFLOW:	Modular Three-Dimensional Finite-Difference Groundwater Flow Model
UCLM:	Universidad Castilla la Mancha

REFERENCES

Acreman, M. (Ed.), 2000. Guidelines for the sustainable management of groundwater-fed catchments in Europe. GRAPES: Groundwater and River Resources Action Programme on a European scale. Institute of Hydrology, Wallingford, UK, 82 pg.

Conan C, de Marsily G, Bouraoui F, et al., 2003. A long-term hydrological modelling of the Upper Guadiana river basin (Spain). Physics and chemistry of the earth 28 (4-5): 193-200 2003

Cruces, J., 1996. In: Bromley, J. (Ed.) EFEDA-2, Hydrology Group. Institute of Hydrology, Wallingford, UK, 82 pg.

Hernandez-Mora N, Martinez Cortina L, Fornes J (2003) Intensive groundwater use in Spain. In: Llamas R, Custodio E (eds) Intensive use of groundwater: challenges and opportunities. 478 pg, I.S.B.N. 90-5809-390-5. Balkema, The Netherlands.

Horst, M.M.S ter, 2001. Groundwater Flow in the Mancha Occidental aquifer unit (Upper-Guadiana catchment, Spain) under near natural conditions. Exploration with a GMS MODFLOW model. MSc thesis Wageningen University/ARIDE Technical Report No. 14.

Martínez Cortina, L., 2001. Estimación de la recarga en grandes cuencas sedimentarias mediante modelos numéricos de flujo subterráneo. Aplicación a la cuenca alta del Guadiana. PhD thesis, Universidad de Cantabria.

Peters, E., 2003. Propagation of drought through groundwater systems – illustrated in the Pang (UK) and Upper-Guadiana (ES) catchments. PhD thesis Wageningen University.

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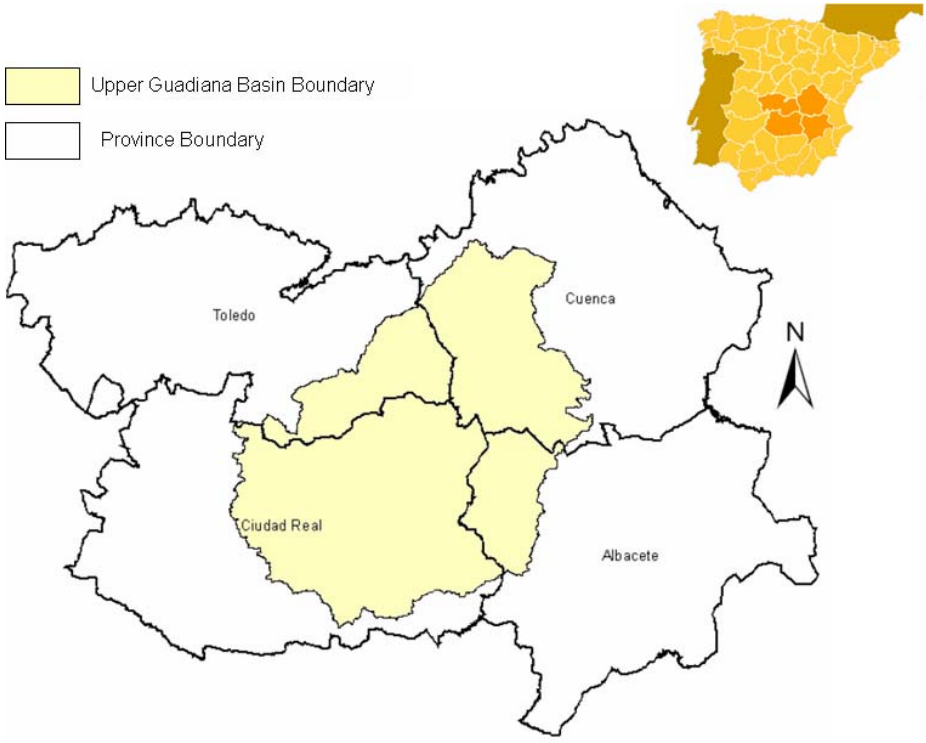
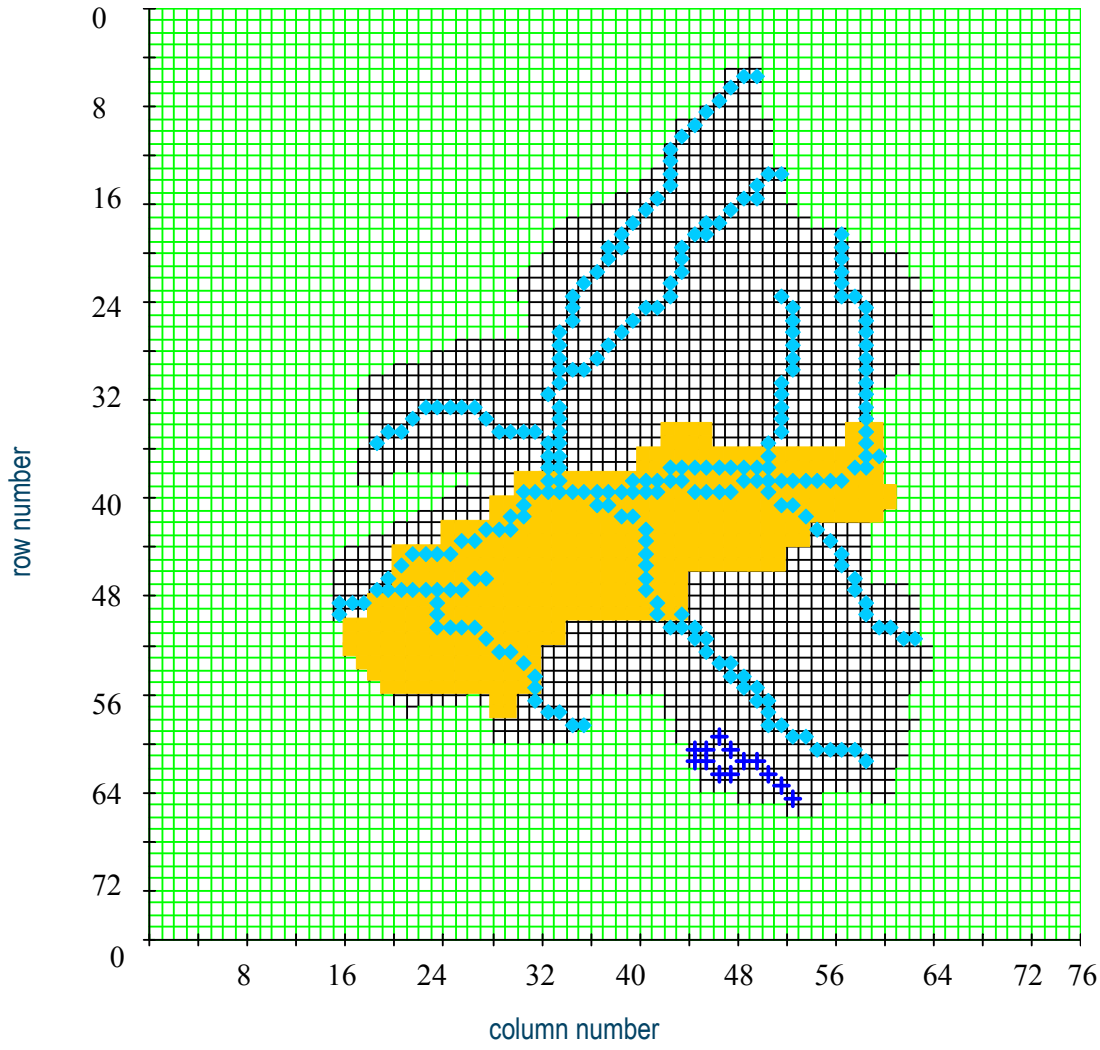
Annex 5.2.1 Location of the La Mancha Occidental aquifer system (Upper-Guadiana basin)

Geographic location of the Upper Guadiana Basin



Location of La Mancha Occidental Aquifer

Annex 5.2.2 Grid of Modflow model for Upper-Guadiana (ter Horst, 2001)



6. Thames basin (United Kingdom)

This chapter provides the metadata catalogue for the Thames basin. This applies to the whole basin. No focal area has been distinguished.

1. GENERAL INFORMATION	
BASIN NAME	Thames at Kingston-on-Thames
AREA *(km²)*	9948
LOCATION *(Country/ies)* Latitude Longitude	England 50°48' – 51°42' N 0°33' – 3°24' W
BRIEF DESCRIPTION *(textual description of up to 40 words of the basin's main features and physical characteristics)*	Altitude range; 4.7 – 330 maod Annual average rainfall: 710mm (600 – 900 mm), 1971-2000 Annual average flow: 78.2 m^3s^{-1} Land use: 36% agricultural, 32% grassland, 16% woodland, 14% urban, 1% heathland, 1% inland water 43% underlain by permeable geologies (chalk & limestone)
CONTACT PERSON(S)	Christel Prudhomme chrp@ceh.ac.uk Sue Crooks smcr@ceh.ac.uk
AREAS OF INTEREST	
FLOOD ASPECTS (make a difference between operational and research questions, if possible)	Several major urban areas in flood plain (Oxford, Reading, Maidenhead, Staines to Kingston)
DROUGHT ASPECTS (make a difference between operational and research questions, if possible)	Relevant with respect to water resources, water quality
WATER RESOURCES ASPECTS (make a difference between operational and research questions, if possible)	Groundwater and surface water abstraction for public water supply and agriculture
REGIONAL CLASSIFICATION *(Flow Regime type)*	Rainfall regime
IS THIS A "PRB" BASIN OF THE WFD COMMON IMPLEMENTATION STRATEGY?	No
IS THIS A TRANSBOUNDARY RIVER?	No
HAS THE BASIN BEEN USED IN OTHER EU STUDIES? *(Please list if yes)*	Yes EUROTAS (European River Flood Occurrence & Total Risk Assessment System) ENV4-CT97-0535 IT Frameworks (HarmonIT) EVK1-CT-2001-00090 FLOOD-1 Interreg

INFORMATION ON HISTORICAL DEVELOPMENT (e.g. river regulation, reservoirs, abstractions, large-scale drainage) *(Please list if yes)*	Off-line reservoirs, regulation, surface water abstraction, groundwater abstraction, effluent returns. Levels are regulated by 44 locks/weirs with water level data from late 19th century. Metadata (station and catchment description) available for every gauging station. Metadata available for observation wells in the national network.
ECOLOGICALLY SENSITIVE AREAS	Many SSSIs within catchment
RESEARCH CATCHMENTS	The Pang and Lambourn (subcatchments in Thames basin) were part of the NERC LOCAR programme to improve the science required to support current and future management needs for permeable lowland catchments through an integrated and multi-disciplinary experimental and modelling programme. http://catchments.nerc.ac.uk/
OTHER	

TIME-SERIES				
METEOROLOGICAL TIME-SERIES	No. of Records	Resolution H/D/M	Period of record (Start Yr – End Yr)	Avg. length (Yrs)
PRECIPITATION • HISTORIC • REAL-TIME	100s	D	various	
TEMPERATURE • HISTORIC • REAL-TIME	10s	D Max, min	various	
REFERENCE EVAPORATION • HISTORIC • REAL-TIME	2 (near catchment)	D	CEH has data 1985-1992	
OTHER Full meteorological data (humidity, pressure, sun, wind etc) Radcliffe Met station, Oxford		D & 15 min	Daily rainfall & temp from 1815, full record from 1881	
OTHER				
DATA OWNER(S) *Name(s) of organization(s)*	MO BADC Oxford University			
ARE THE DATA OWNERS INTERSTED TO INTERACT WITH THE PROJECT?				
ARE THE DATA AVAILABLE FREE-OF-CHARGE?	Some			

WHAT RESTRICTIONS APPLY TO THE USE AND DISTRIBUTION OF THE DATA? *(Please specify)*	Data licence or charge for MO data www.metoffice.gov.uk All BADC data free of charge but strictly for academic use only. badc.nerc.ac.uk Oxford University www.geog.ox.ac.uk./climate/rms

TIME SERIES				
HYDROLOGICAL TIME-SERIES	No. of Records	Resolution H/D/M	Period of record (Earliest – Latest)	Avg. length (Yrs)
RIVER FLOW • HISTORIC • NATURALIZED	185 stations, see Annex 1 3 stations	 D D	 Various Longest 1883-	30
LAKE/RESERVOIR LEVEL • HISTORIC				
LAKE/RESERVOIR OUTFLOW • OBSERVED • LICENSED/CONSENTED				
SNOW PILLOWS (SWE)				
SNOW DEPTH				
SURFACE/GROUNDWATER ABSTRACTION LICENCES/CONSENTS	100s			
GROUNDWATER LEVELS	7 <5000	D/M	Longest 1933- Short-term historic data series	45
DATA OWNER(S) *(Name(s) of organization(s))*	CEH National River Flow Archive, nrfa@ceh.ac.uk Abstractions – Environment Agency, Thames BGS National Groundwater Level Archive, www.bgs.ac.uk or hydroenq@bgs.ac.uk			
ARE THE DATA OWNERS INTERESTED TO INTERACT WITH THE PROJECT?	Yes			
ARE THE DATA AVAILABLE FREE-OF-CHARGE?	Yes			
WHAT RESTRICTIONS APPLY TO THE USE AND DISTRIBUTION OF THE DATA? *(Please specify)*	Not for commercial use			

SPATIAL DATA				
DATASET NAME *(Please specify; expand boxes for multiple datasets)*	Owner or Source	Scale or Resolution	Temporal resolution/ Date published	Format (ASCII, shape files, ArcGIS coverages, GIF, etc.)
PRECIPITATION	CEH	1 * 1 km 185 catchments	D 1961-2004 M longest 1883 - 2007	

TEMPERATURE				
REFERENCE EVAPORATION	Morecs (PE) UK MO	40 * 40 km	M 1961-	
DIGITAL ELEVATION DATA	CEH	50m	1990 with updates	
FRESHWATER BODIES (RIVERS, LAKES)				
LAND-USE/LAND-COVER	CEH	25 m	1990 2000	
URBANISATION/POPULATION				
SOILS	CEH (HOST)	1 km	1994	
GEOLOGY/ HYDROGEOLOGY	BGS www.bgs.ac.uk	1:625 000 1:50 000		On-line
SNOW/ICE				
OTHER SPATIAL:				
OTHER SPATIAL:				
OTHER SPATIAL:				
WHAT RESTRICTIONS APPLY TO THE USE AND DISTRIBUTION OF THE DATA?	Data available to CEH within WATCH but fee-paying licence may be required for other partners to use data Catchment monthly rainfall freely available			

CLIMATE MODEL OUTPUT					
DATASET NAME *(Please specify; expand boxes for multiple datasets)*	Owner or Source	Scale or Resolution	Temporal resolution/	Scenarios/date published	Format (ASCII, shape files, ArcGIS coverages, GIF, etc.)
CURRENT AND FUTURE CLIMATE (GCM, RCM and further downscaling)	MO	RCM 25 km			
WHAT RESTRICTIONS APPLY TO THE USE AND DISTRIBUTION OF THE DATA?	Not outside CEH				

HYDROLOGICAL MODEL (OUTPUT)					
MODEL NAME AND TYPE: *(Please specify; expand boxes for multiple models)*	Owner or Source	Scale or Resolution	Temporal scale	Datasets (*specify output*)	
				Output	Contact
PDM	CEH	catchment	H & D	Flow	
CLASSIC	CEH	Grid (variable)	D	Flow	
G2G	CEH	1 km	D	Flow	

ABBREVIATIONS

NERC: Natural Environment Research Council
LOCAR: Lowland Catchment Research Programme
SSSI: Site of Special Scientific Interest
BADC: British Atmospheric Data Centre
MO: UK Met Office
HOST: Hydrology of Soil Types
BGS: British Geological Society

REFERENCES

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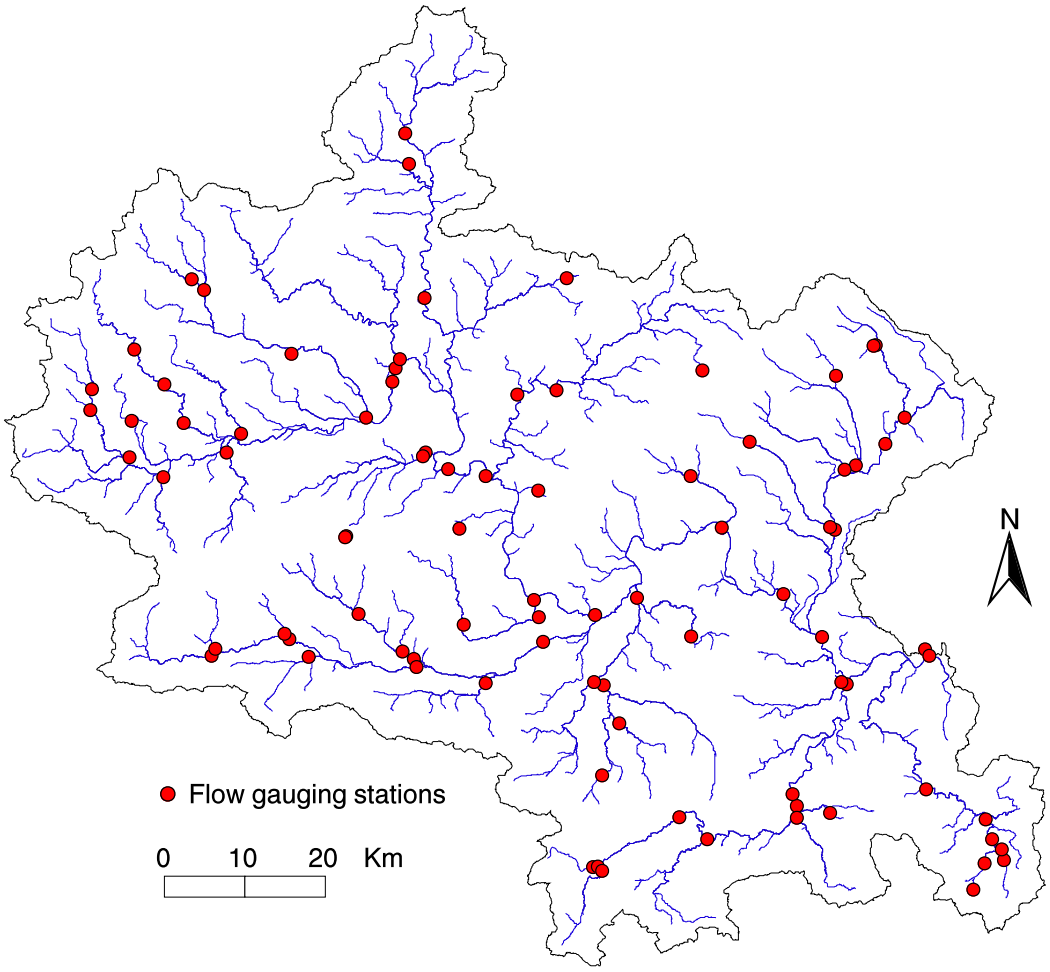
LOCAR www.nwl.ac.uk/locar

Annex 6.1 Location of gauging stations in the Thames basin above the tidal limit



References

References specifically referring to a basin or sub-basin can be found in the specific chapter.

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