BONUS RETURN
Reducing Emissions by Turning Nutrients and Carbon into Benefits
www.bonusprojects.org/bonusprojects/the_projects/blue_baltic_projects/return
www.bonusreturn.eu

Deliverable No: D.4.3 – Free access to functioning SWAT application of the three river basins
Ref: WP4 Task 1
Lead participant: SYKE
Date: 29 Feb. 2020

BONUS RETURN has received funding from BONUS (Art 185), funded jointly by the EU and Formas, A Swedish Research Council for Sustainable Development; Sweden's innovation agency, Vinnova; Academy of Finland; and the National Centre for Research and Development in Poland.

Deliverable Title	**D.4.3 – Free access to functioning SWAT application of the three river basins**
Filename	BONUSRETURN_D.4.3.DOCX
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Date	29/2/2020

Start of the project: 01/05/2017
End of the project: 01/05/2020
Project coordinator: Stockholm Environment Institute (SEI)

Dissemination level

x	PU	Public.
	PP	Restricted to other project partners.
	RE	Restricted to a group specified by the consortium.
	CO	Confidential, only for members of the consortium.

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EXECUTIVE SUMMARY

The Bonus Return project produced 3 baseline (no scenarios with e.g. mitigation measures or BMPs) SWAT applications with different parameter combinations for the project's case study catchments in Finland (Vantaanjoki), Sweden (Fyrisån) and Poland (Slupia). So, the user can not only utilize the parameterization of the case study applications in his/her similar target area, but also start making his/her own scenarios for these areas on top of the baseline applications of these Bonus Return case study areas.

As a new contribution to the SYKE's open data (https://ckan.ymparisto.fi/dataset), the three SWAT applications of Bonus Return project were compressed into zip-files and stored in the open data repository of the Finnish Environment Institute (SYKE), from where anyone with knowledge on SWAT can download the files and start making his/her own runs, simulations and scenarios. To find a SWAT application in the public SYKE Research Data Service, the user can either scroll or type e.g. "SWAT" into the search box, or use the direct link (https://ckan.ymparisto.fi/dataset/free-access-to-functioning-swat-application-of-the-three-river-basins).

1 INTRODUCTION

The degradation of the Baltic Sea is an ongoing problem, despite investments in measures to reduce external inputs of pollutants and nutrients from both diffuse and point sources. Available technological and management measures to curb eutrophication and pollution flows to the sea have not been adapted adequately to the contexts in which they are being applied. Furthermore, measures are often designed based on single objectives, thereby limiting opportunities for multiple benefits.

In addition, there is a general sense that measures to address the deterioration of the Baltic ecosystem are primarily technologically-driven and lacking broader stakeholder acceptance, and the "experts" who define these measures have little engagement with industry, investors, civil society and authorities. This problem is exacerbated by governance and management taking place in sectoral silos with poor coordination across sectors.

As a result, research shows that regional institutional diversity is presently a barrier to transboundary cooperation in the Baltic Sea Region (BSR) and that actions to achieve national environmental targets can compromise environmental goals in the BSR (Powell et al. 2013). The regional dimension of environmental degradation in the BSR has historically received weaker recognition in policy development and implementation locally. However, developments in recent years suggest a new trend with growing investments in environmental protection supporting social, economic, and territorial cohesion.

The BSR is an environmentally, politically and economically significant region and like other regions globally, its rapid growth needs to be reconciled with the challenges of sustainable development in a global setting that demands unprecedented reductions in GHG emissions. This poses a truly wicked problem exacerbated by the fact many of the challenges in BSR will also magnify in a changing climate. In order to navigate the uncertainties and controversies associated with a transformation towards a good marine environment, BONUS RETURN will enact an innovative trans-disciplinary approach for identifying and piloting systemic eco-technologies.

Focus will be on eco-technologies that generate co-benefits within other interlinked sectors and which can be adapted according to geophysical and institutional contexts. More specifically, emphasis will be given to eco-technologies that reconcile the reduction of present and future eutrophication in marine environments with the regional challenges of policy coherence, food security, energy security, and the provision of ecosystem services.

1.1 Project Objectives

The **overall** aim of RETURN is to improve the adaptation and adoption of eco-technologies in the BSR for maximum efficiency and increased co-benefits.

The **specific objectives** of the project can be divided into 6 categories presented below. These categories are interlinked but for the purpose of providing a step-wise description, the following overview of each category proves useful. RETURN will:

1) **Support innovation and market uptake of eco-technologies:**

- Contribute to the application and adaptation of eco-technologies in the BSR through an evidence-based review (systematic map) of the developments within this field.
- Contribute to the development of emerging eco-technologies that have the capacity to turn nutrients and carbon into benefits (e.g. bio-energy, fertilizers), by providing an encompassing framework and platform for rigorous testing and analysis.
- Development of decision support systems for sustainable eco-technologies in the BSR.
- Contribute to better assessment of eco-technology efficiency via integrated and participatory modelling in three catchments areas in Finland, Sweden and Poland.
- Contribute to methodological innovation on application and adaptation of eco-technologies

2) **Reduce knowledge gaps on policy performance, enabling/constraining factors, and costs and benefits of eco-technologies**

- Assess the broader socio-cultural drivers linked to eco-technologies from a historical perspective
- Identify the main gaps in the policy environment constraining the implementation of emerging eco-technologies in the catchments around the Baltic Sea
- Inform policy through science on what works where and under which conditions through an evidence-based review (systematic map and systematic reviews) of eco-technologies and the regional economic and institutional structures in which these technologies evolve.

3) **Provide a framework for improved systematic stakeholder involvement:**

- Develop methods for improved stakeholder engagement in water management through participatory approaches in the case study areas in Sweden, Finland and Poland.
- Enact a co-enquiry process with stakeholders into opportunities for innovations in eco-technologies capable of transforming nutrients and pollutants into benefits for multiple sectors at different scales.
- Bring stakeholder values into eco-technology choices to demonstrate needs for adaptation to local contexts and ways for eco-technologies to efficiently contribute to local and regional developments.
- Disseminate results and facilitate the exchange of learning experiences, first within the three catchment areas, and secondly across a larger network of municipalities in the BSR.
- Establish new cooperative networks at case study sites and empower existing regional networks by providing information, co-organize events and engage in dialogues.

4) **Support commercialization of eco-technologies:**

- Identify market and institutional opportunities for eco-technologies that (may) contribute to resource recovery and reuse of nutrients, micro-pollutants and micro-plastics (e.g. renewable energy).

- Identify potential constraints and opportunities for integration and implementation of eco-technologies using economical models.
- Facilitate the transfer of eco-technologies contributing to win-win solutions to multiple and interlinked challenges in the BSR.
- Link producers of eco-technologies (small and medium enterprises – SMEs), to users (municipalities) by providing interactive platforms of knowledge exchange where both producers and users have access to RETURN's envisaged outputs, existing networks, and established methodologies and services.

5) Establish a user-driven knowledge platform and improve technology-user interface

- Develop an open-access database that maps out existing research and implementation of eco-technologies in the BSR. This database will be intuitive, also mapped out in an interactive geographical information system (GIS) platform, and easily managed so that practitioners, scientists and policy-makers can incorporate it in their practices
- Develop methodologies that enact the scaling of a systemic mix of eco-technological interventions within the highly diverse contexts that make up the BSR and allows for a deeply interactive media of knowledge.

1.2 Project Structure

BONUS RETURN is structured around 6 Work Packages that will be implemented in three river basins: The Vantaanjoki river basin in Finland, the Słupia river basin in Poland, and Fyrisån river basin in Sweden. Hereafter in this report, these river basins are referred to as study catchments.

Work Package 1: Coordination, management, communication and dissemination.
Work Package 2: Integrated Evidence-based review of eco-technologies.
Work Package 3: Sustainability Analyses.
Work Package 4: Environmental Modelling.
Work Package 5: Implementation Support for Eco-technologies.
Work Package 6: Innovative Methods in Stakeholder Engagement.

1.3 Deliverable context and objective

The current deliverable (Del. 4.3) is part of WP4. The objectives of WP4 are to contextualize the most promising eco-technologies through three case study sites in Finland, Poland and Sweden. The objective of this deliverable is to present background and instructions of use of the openly available, free-access SWAT model applications stored in the data repository of Finnish Environment Institute (SYKE).

1.4 Outline of the report

This report describes the background of the free-access models and the links where they are found. There are presentation of SYKE's repository and instructions how to navigate there and how to find and download the SWAT-model applications of the three case study catchments.

2 SYKE'S DATA REPOSITORY AND INSTRUCTIONS HOW TO USE THE FREE-ACCESS MODEL APPLICATIONS

2.1 SYKE's open data

SYKE produces open data and information (https://www.syke.fi/en-US/Open_information) for an ecologically, economically and socially sustainable society. SYKE's open data includes versatile information on water resources, surface and ground waters, the Baltic Sea, environmental load and distractions, the valuable natural environment, land cover and the built environment. Environmental data is accessible by utilizing web services, spatial datasets and satellite observations, as well as data stored in environmental information systems. Environmental data can also be viewed in various web map applications.

2.2 SWAT model

SWAT (Soil and Water Assessment Tool, https://swat.tamu.edu) was developed to predict the impacts of land management practices on hydrological regimes and the loading of surface waters in complex watersheds over long periods of time. Building a SWAT application is a laborious process. It is of great help to other modelers (researchers and practitioners) if ready applications, in which all the numerous parameters have already been determined for similar areas than that of the user's own target area.

Basic info about ArcSWAT can be found in the following www-pages

- https://swat.tamu.edu/software/arcswat
- https://swat.tamu.edu/software/swat-editor

The document with general descriptions of SWAT input/output files can be downloaded from here:

- https://swat.tamu.edu/media/69296/swat-io-documentation-2012.pdf

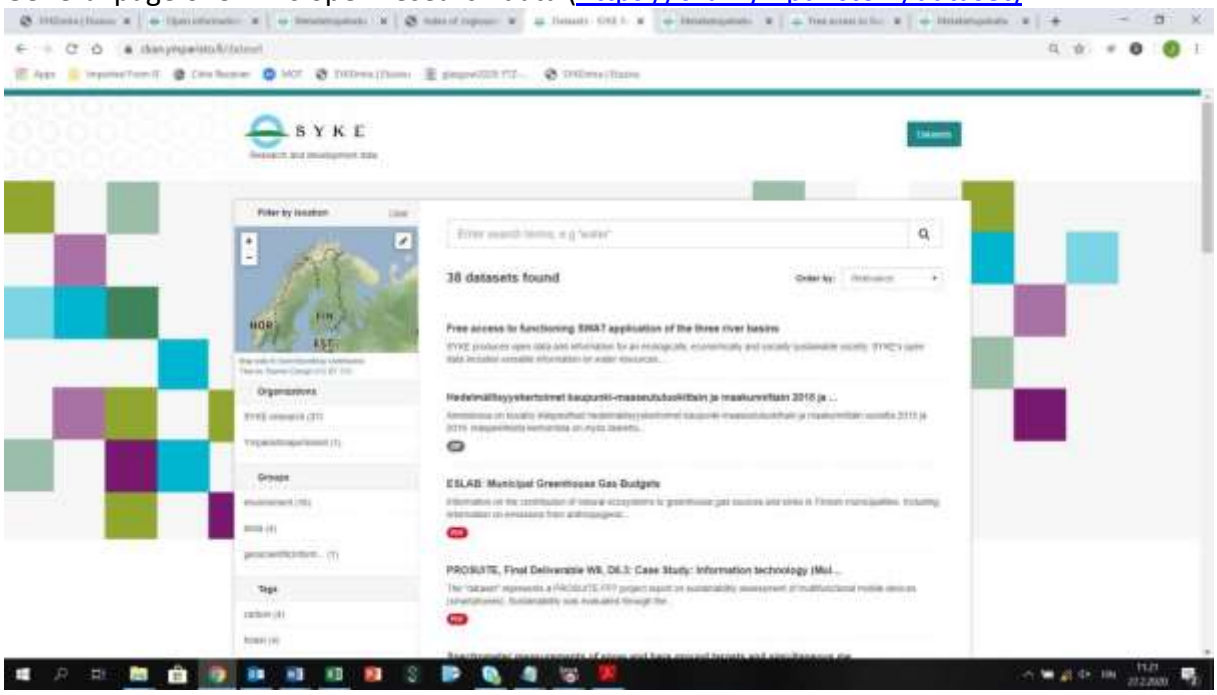
2.3 Free-access SWAT applications of the Bonus Return project

The Bonus Return project produced 3 baseline (no scenarios with e.g. mitigation measures or BMPs) SWAT applications with different parameter combinations for the project's case study catchments in Finland (Vantaanjoki), Sweden (Fyrisån) and Poland (Slupia) with vigorous calibration/validation processes (see Bonus Return Deliverable D4.1). So, the user can not only utilize the parameterization of the case study applications in his/her similar target area, but also start making his/her own scenarios for these areas on top of the baseline applications of these Bonus Return case study areas. The basic input information for the model applications are listed at the end of this document.

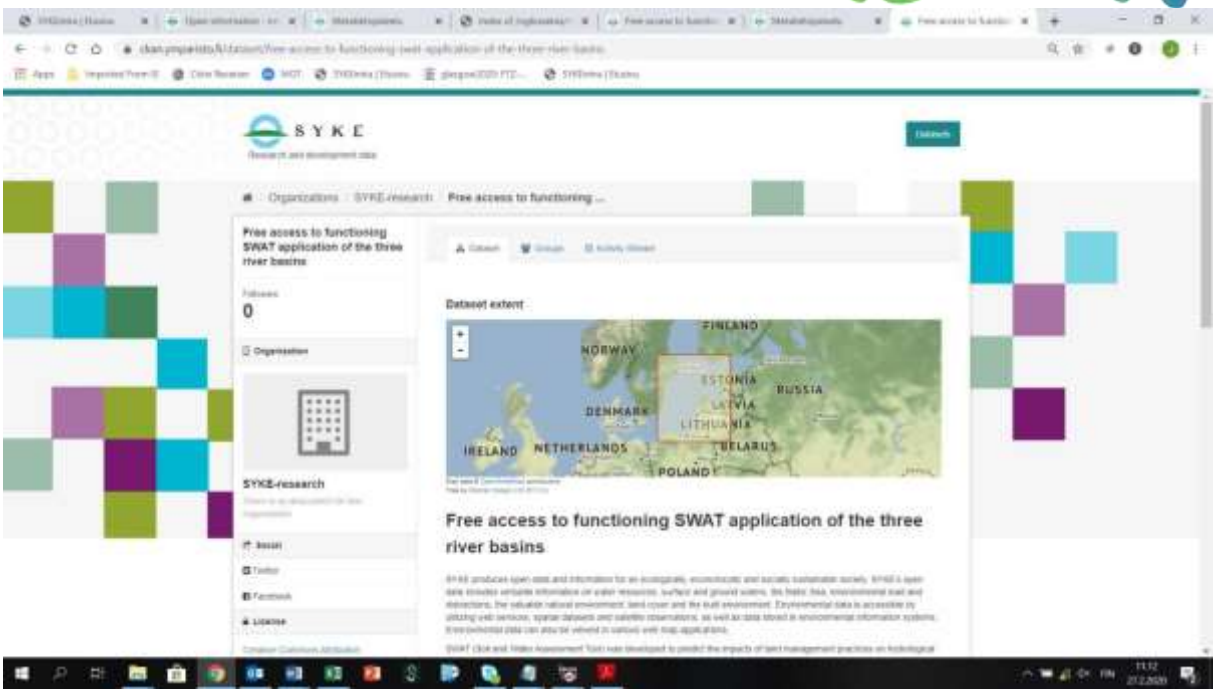
As a new contribution to the SYKE's open research data (https://ckan.ymparisto.fi/dataset), the three SWAT applications of Bonus Return project were compressed into zip-files and stored in the open data repository of the Finnish Environment Institute (SYKE), from where

anyone with knowledge on SWAT can download the files and start making his/her own runs, simulations and scenarios. To find a SWAT application in the public SYKE Research Data Service, the user can either scroll or type e.g. “SWAT” into the search box, or use the direct link (https://ckan.ymparisto.fi/dataset/free-access-to-functioning-swat-application-of-the-three-river-basins). Below are images describing how the data repository pages looks like and how to navigate there.

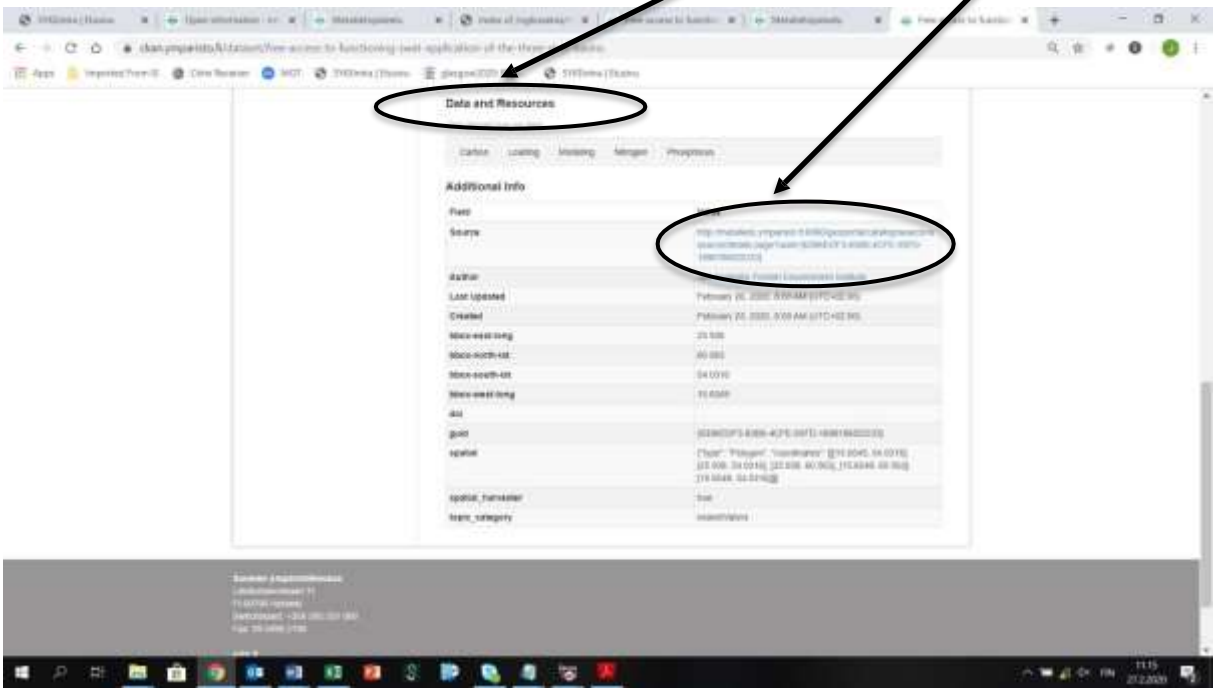
General page of SYKE’s open research data (https://ckan.ymparisto.fi/dataset):



The page where SWAT applications can be found here: https://ckan.ymparisto.fi/dataset/free-access-to-functioning-swat-application-of-the-three-river-basins



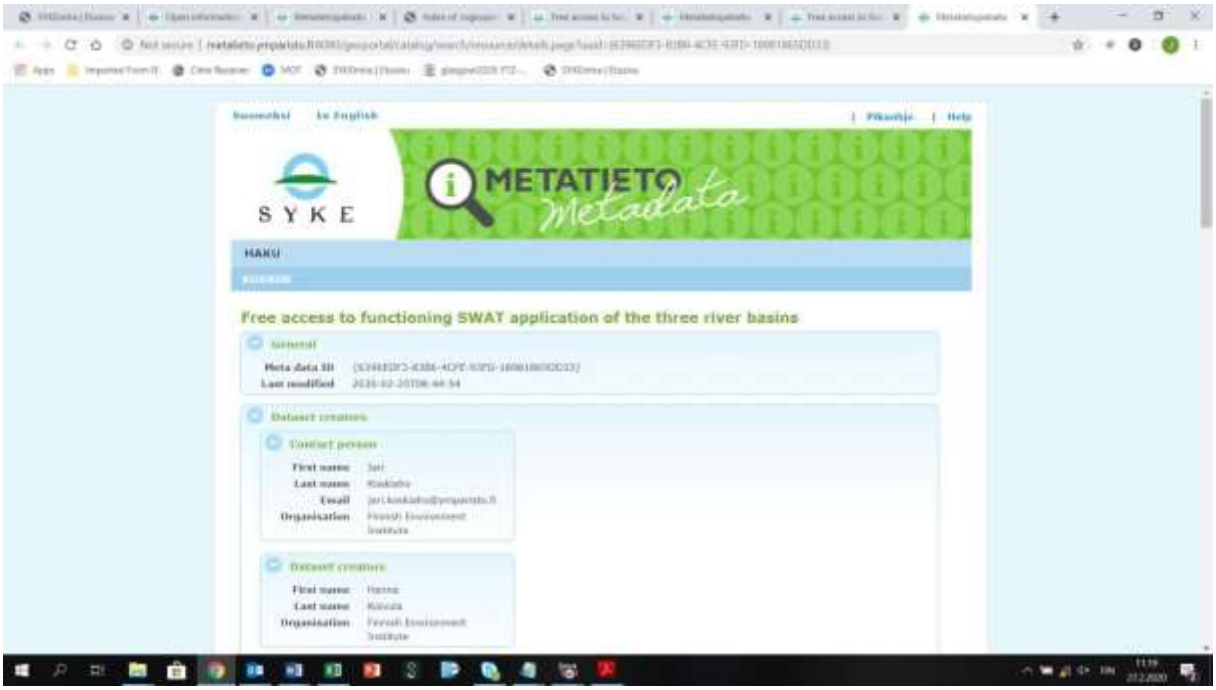
In the page, scroll the window down to find the zipped files and their metadata:



The zipped files can be opened with commonly available software such as:

- IZArc (https://www.izarc.org/)
- WinZip (https://www.winzip.com/)
- 7-Zip (https://www.7-zip.org/)

In the metadata there is basic information how the SWAT applications were made, what SWAT version was used in their creation etc.



In case of problems with the datasets and their deployment, the users are advised to contact:

- Mikolaj Piniewski (M.Piniewski@levis.sggw.pl)
- Pawel Marcinkowski (P.Marcinkowski@levis.sggw.pl)
- Jari Koskiaho (jari.koskiaho@ymparisto.fi)

APPENDIX SOURCES OF BASIC INPUT INFORMATION FOR THE MODEL APPLICATIONS

General	Catchment	Vantaanjoki		
	Coordinator	SYKE (Jari Koskiaho and Sirkka Tattari)		
	Modeller	Jari Koskiaho		
	Catchment size [km2]	1688 km2		
	Item	**Source**	**Resolution / scale**	**Description**
Watershed delineation	DEM	MML (National Land Survey of Finland) SYKE (Finnish Environment Institute)	Grid size 10m x 10m, the accuracy of the elevation 1.4 m	Based on contour lines of MML:s terrain database.
	River network	SYKE	1:250 000	Required for "burning in" streams
	Water use and transfer locations		1 hydropower plant with weir (Vanhankaupunginkoski) and a weir at the outlet of the regulated lake Tuusulanjärvi, maybe some minor fish ponds in the upper reaches	Required in order to modify placement of inlets and outlets in watershed delineation
	Lake/reservoir map	SYKE	1:250 000	Required in order to modify placement of inlets and outlets in watershed delineation
	Gauge stations locations	SYKE/Hertta	9 points	Required in order to modify placement of inlets and outlets in watershed delineation
	Point source locations	SYKE/Vahti	21 municipal, 11 industrial	Required in order to modify placement of inlets and outlets in watershed delineation
HRU delineation	Land cover map	CORINE Land Cover 2012	20m x 20m	Principal input data for land cover map. Needs reclassification to SWAT classes
	Soil map	GTK (Finnish Geological Survey) and SYKE	1:200 000	Principal input data for soil map. Needs reclassification to SWAT classes
Weather data definiti	Precipitation data	FMI (Finnish Meteorological Institute)	3 stations	Recommended to interpolate precipitation from points to subbasins (stations outside are useful)
	Temperature data		3 stations	
	Wind speed data		1 station	
	Relative humidity data		3 stations	
	Solar radiation data		1 station	
Land management	Crop structure	TiKe (Information Centre of the Ministry of Agriculture and Forestry) and MAVI (Agency for Rural Affairs)	Field-block level data	Data from several years needed in order to define crop rotations
	Mineral fertilisers	MMM (Ministry of Agriculture & Forestry)	Nation-wide limit values of fertlization	Required to define fertiliser rates in management schedules
	Livestock / manure	TiKe and MAVI	Farm-level data	Required to define manure rates in management schedules
	Other practices (tillage)	TiKe and MAVI	Field-block level data	Required for definition of management schedules
	BMPs	MAVI	Nation-wide database, from which the BMPs located on the Vantaanjoki area can be extracted.	Useful to include in the model setup, otherwise there might be problems in calibration
Water management	Reservoirs	SYKE	Data for each object	Morphometric parameters, outflow release rules
	Fish ponds		Data for each object	Water uptake, water discharge
	Irrigation	LUKE (Natural Resources Institute Finland)	ELY-centre (province) -level statistics	Irrigated area, timing and rates
	Water withdrawals	Waterworks of the municipalities using	Data for each object	Amount (monthly), source
	Wastewater treatment plants	Municipalities discharging their wastewaters into the river Vantaanjoki.	Data for each object	Effluent parameters (monthly, if not available annual)
Ground water	Hydrogeology maps			Ground water elevation conturs (5 m interval) - not required but can be useful
Channel	Channel cross-sections			Useful to update default SWAT channel dimensions
Soil properties	Soil physical parameters	Literature	Data for each soil class in SWAT	One of the most critical parts of the model setup
	Soil chemical parameters			Measurements bi-annual (spring, autumn); samples from 3 depths (30,60,90cm); determination NO3&NH4 in soil and ground water
Atmospheric deposition	N and P deposition data	SYKE	? stations inside and ? stations outside catchment	Concentrations/loads of N and P (dry and wet deposition). P data cannot be used as SWAT input
Calibration & validation	Discharge	SYKE	9 flow gauges	Daily data (some not in operation any more)
	Crop yields	LUKE	Province-level data	Not required, but worth ensuring that mean crop yields match with observations
	Sediment concentrations	SYKE	32 (river) water quality monitoring stations	Measurements between 2000-2016 with varying frequency, on average 22 samples per year
		SYKE	1 location (16 km upstream from the outlet) with	Daily turbidity (=> sediment) data since 2011 from automatic station
	N & P concentrations	SYKE	32 (river) water quality monitoring stations	Measurements between 2000-2016 with varying frequency, on average 22 samples per year
		SYKE	1 location (16 km upstream from the outlet) with hourly intervals	Daily turbidity (=> total P) and NO3-N data since 2011 from automatic station (still operating)
	TOC (Total organic carbon)	SYKE	30 water quality monitoring stations;	Much more infrequent data than for TSS and nutrients: on average 2 analyses per year, for COD on average 7 analyses per year
		SYKE	1 location (16 km upstream from the outlet) with hourly intervals	Daily TOC (and DOC) data since 2011 from automatic station (still operating)
	BOD5	SYKE	19 water quality monitoring stations;	Much more infrequent data than for TSS and nutrients: on average < 1 analysis per year, for COD on average 7 analyses per year
	Other observational data (soil moisture, groundwater levels, ET measured)			Optional (hard to use them directly for calibration in SWAT)

General	Catchment	Fyrisån		
	Coordinator			
	Modeller			
	Catchment size [km2]	2005 km2		
Item		**Source**	Resolution / scale	**Description**
Watershed delineation	DEM	Lantmäteriet	2 m	Lidar-based
	River network	Lantmäteriet Property map HL		https://www.lantmateriet.se/globalassets/kartor-och-geografisk-
	Water use and transfer locations	SMHI?		Required in order to modify placement of inlets and outlets in watershed delineation
	Lake/reservoir map	Lantmäteriet Property map MV		https://www.lantmateriet.se/globalassets/kartor-och-geografisk-
	Gauge stations locations	SLU (water quality) SMHI (water discharge)		http://miljodata.slu.se/mvm/ https://www.smhi.se/klimatdata/hydrologi/vatt
	Point source locations	SMED		http://tbv20.smhi.se/tbv/granska/
HRU delineation	Land cover map	SMED		http://tbv20.smhi.se/tbv/granska/
				Potential data source for improvement of land cover map in urban areas
				Potential data source for improvement of land cover map in urban areas
		Swedish Bord of Agriculture (SBoA)	Block data	Potential data source for improvement of land cover map in agricultural areas
	Soil map	Digital soil map	50 x 50 m	http://markdata.se/
Weather data definition	Precipitation data	SMHI		https://www.smhi.se/klimatdata/meteorologi/temperatur
	Temperature data			https://www.smhi.se/klimatdata/meteorologi/nederbord
	Wind speed data			https://www.smhi.se/klimatdata/meteorologi/vind
	Relative humidity data			
	Solar radiation data			https://www.smhi.se/klimatdata/meteorologi/stralning
Land management	Crop structure	Swedish Bord of Agriculture	Block data	Data from several years needed in order to define crop rotations
	Mineral fertilisers	SCB, SMED	Production areas level, production area 6 for Fyrisån	Required to define fertiliser rates in management schedules
	Livestock / manure	SCB, SMED	Production areas level, production area 6 for Fyrisån	Required to define manure rates in management schedules
	Other practices (tillage)	SCB, SMED	Production areas level, production area 6 for Fyrisån	Required for definition of management schedules
	BMPs	VISS?		http://viss.lansstyrelsen.se/
Water management	Reservoirs	SMHI?	Data for each object	Morphometric parameters, outflow release rules
	Fish ponds	SMED? SBoA?	Data for each object	Water uptake, water discharge
	Irrigation	SCB, SBoA?	Data for each object	Irrigated area, timing and rates
	Water withdrawals	?	Data for each object	Amount (monthly), source
	Wastewater treatment plants	Plant specific data, SMED	Data for each object	Effluent parameters (monthly, if not available annual)
Ground	Hydrogeology maps	SGU	https://www.sgu.se/en/groundwater/	Ground water elevation conturs (5 m interval) - not required but can be useful
Channel	Channel cross-sections	SMHI?		Useful to update default SWAT channel dimensions
Soil properties	Soil physical parameters	Literature	Data for each soil class in SWAT	One of the most critical parts of the model setup
	Soil chemical parameters	SMED, SLU, SBoA		Measurements bi-annual (spring, autumn); samples from 3 depths (30,60,90cm); determination NO3&NH4 in soil and ground water
Atmospheric	N and P deposition data	SMHI?		Concentrations/loads of N and P (dry and wet deposition). P data cannot be used as SWAT input
Calibration & validation	Discharge	SMHI		https://www.smhi.se/klimatdata/hydrologi/vatten foring https://vattenwebb.smhi.se/station/
	Crop yields	SCB, SMED		Not required, but worth ensuring that mean crop yields match with observations
	Sediment concentrations	SLU	http://miljodata.slu.se/mvm/	
		SLU		
	N & P concentrations	SLU		
		SLU		
	TOC (Total organic carbon)	SLU		
	BOD5	SLU		
	Other observational data (soil moisture, groundwater levels, ET measured)	SMHI?		Optional (hard to use them directly for calibration in SWAT)
				Optional (hard to use them directly for calibration in SWAT)

General	Catchment	Słupia		
	Coordinator	WULS (Ignazy Kardel, Mikolaj Piniewski)		
	Modeller			
	Catchment size [km2]	1621 km2		
	Item	**Source**	Resolution / scale	**Description**
Watershed delineation	DEM	CODGIK (Centre for Geodetic and Cartographic Data)	10 m	Lidar-based
	River network	MPHP (Map of Hydrographic Division of Poland)	1:10 000	Required for "burning in" streams
	Water use and transfer locations	RZGW (Regional Water Management Authority) / WZMiUW (Land Reclammation Board)	5 small hydropower plants, 13 weirs, 11 objects drained areas, 17 fish ponds	Required in order to modify placement of inlets and outlets in watershed delineation
	Lake/reservoir map	MPHP (Map of Hydrographic Division of Poland)	1:10 000	Required in order to modify placement of inlets and outlets in watershed delineation
	Gauge stations locations	IMGW (Institute of Meteorology and Water Management)	8 points	Required in order to modify placement of inlets and outlets in watershed delineation
	Point source locations	RZGW (Regional Water Management Authority) / WIOŚ (Voivodship Institute of Environmental	9 municipal, 6 industrial	Required in order to modify placement of inlets and outlets in watershed delineation
HRU delineation	Land cover map	CORINE Land Cover 2012	The smallest polygon ~100 ha	Principal input data for land cover map. Needs reclasification to SWAT classes
		BDOT (Database of Topographic Objects)	?	Potential data source for improvement of land cover map in urban areas
		Copernicus Land Monitoring Service (Imperviousness 2012)	20 m	Potential data source for improvement of land cover map in urban areas
		ODR (Agricultural Advisory Centres)	Commune level statistics on crop structure	Potential data source for improvement of land cover map in agricultural areas
	Soil map	WODGIK (Voivodship Centre for Geodetic and Cartographic Data), Forest department	1:2 000 -1:5 000	Too detailed map, needs reclassification
Weather data definition	Precipitation data	IMGW (Institute of Meteorology and Water Management)	11 stations (+36 stations outside of catchment)	Recommended to interpolate precipitation from points to subbasins (stations outside are useful)
	Temperature data		10 stations (some outside)	
	Wind speed data		2 stations	
	Relative humidity data		2 stations	
	Solar radiation data		1 station	To be acquired
Land management	Crop structure	ODR (Agricultural Advisory Centres)	Commune-level data	Data from several years needed in order to define crop rotations
	Mineral fertilisers	ODR (Agricultural Advisory Centres)	Commune-level data	Required to define fertiliser rates in management schedules
	Livestock / manure	ODR (Agricultural Advisory Centres)	Commune-level data	Required to define manure rates in management schedules
	Other practices (tillage)	ODR (Agricultural Advisory Centres)	Commune-level data	Required for definition of management schedules
	BMPs	ODR (Agricultural Advisory Centres)	Commune-level data	Useful to include in the model setup, otherwise there might be problems in calibration
Water management	Reservoirs	RZGW (Regional Water Management Authority)	Data for each object	Morphometric parameters, outflow release rules
	Fish ponds	RZGW (Regional Water Management Authority)	Data for each object	Water uptake, water discharge
	Irrigation	WZMiUW (Land Reclammation Board)	Data for each object	Irrigated area, timing and rates
	Water withdrawals	RZGW (Regional Water Management Authority)	Data for each object	Amount (monthly), source
	Wastewater treatment plants	WIOŚ (Voivodship Institute of Environmental Protection) + own survey	Data for each object	Effluent parameters (monthly, if not available annual)
Ground	Hydrogeology maps	PIG (Polish Hydrogeological Institute)	1:50 000	Ground water elevation conturs (5 m interval) - not required but can be useful
Channel	Channel cross-sections	KZGW (National Water Management Authority)	One cross-section per 500 m on main rivers	Useful to update default SWAT channel dimensions
Soil properties	Soil physical parameters	Literature	Data for each soil class in SWAT	One of the most critical parts of the model setup
	Soil chemical parameters	OSChR (Chemical-Agricultural Stations)	21 locations	Measurements bi-annual (spring, autumn); samples from 3 depths (30,60,90cm); determination NO3&NH4 in soil and ground water
Atmospheric deposition	N and P deposition data	GIOŚ (Chief Inspectorate of Environemntal Protection)	3 stations outside catchment	Concentrations/loads of N and P (dry and wet deposition). P data cannot be used as SWAT input
Calibration & validation	Discharge	IMGW (Institute of Meteorology and Water	8 flow gauges	Daily data (some not in operation any more)
	Crop yields	ODR (Agricultural Advisory Centres)	Commune-level data	Not required, but worth ensuring that mean crop yields match with observations
	Sediment concentrations	WIOŚ (Voivodship Inspectorate of Environemntal Protection)	19 water quality monitoring stations;	Monthly measurements, only 5 stations with long term observation (>10 years)
		IMGW (Institute of Meteorology and Water Management)	1 location (close to outlet); daily intervals	Daily data since 2014 from automatic station (still operating)
	N & P concentrations	WIOŚ (Voivodship Inspectorate of Environemntal Protection)	19 water quality monitoring stations;	Monthly measurements, only 5 stations with long term observation (>10 years)
		IMGW (Institute of Meteorology and Water Management)	1 location (close to outlet); daily intervals	Daily data since 2014 from automatic station (still operating)
	TOC (Total organic carbon)	WIOŚ (Voivodship Inspectorate of Environemntal Protection)	19 water quality monitoring stations;	Monthly measurements, only 5 stations with long term observation (>10 years)
		IMGW (Institute of Meteorology and Water Management)	1 location (close to outlet); daily intervals	Daily data since 2014 from automatic station (still operating)
	BOD5	WIOŚ (Voivodship Inspectorate of Environemntal Protection)	19 water quality monitoring stations;	Monthly measurements, only 5 stations with long term observation (>10 years)
		IMGW (Institute of Meteorology and Water Management)	1 location (close to outlet); daily intervals	Weekly data since 2014 from automatic station (still operating)
	Other observational data (soil moisture, groundwater levels, ET measured)	PIG (Polish Hydrogeological Institute)	Groundwater levels from 6 locations; daily/monthly interval	Optional (hard to use them directly for calibration in SWAT)
		PIG (Polish Hydrogeological Institute)	Groundwater quality from 5 locations; bi-annual interval	Optional (hard to use them directly for calibration in SWAT)