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European Environment Agency
European Topic Centre on Inland, Coastal and Marine Waters

Background supporting document on the EEA water accounts

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Acronyms

ECRINS	European Catchment and Rivers Network System
SoE	State of Environment
UN	United Nations
UN SEEA	United Nations System of Environmental-Economic Accounting
UN SEEA-W	United Nations System of Environmental-Economic Accounting for Water
UWWTD	Urban Waste Water Treatment Directive
UWWTP	Urban Wastewater Treatment Plant
WAPD	Water Accounts Production Database
WFD	Water Framework Directive
WISE	Water Information System for Europe

1 Purpose of this document

During the 2018 Eionet consultation regarding the update of the CSI 018 (WEI+) indicator assessment on the Use of freshwater resources in Europe ([1]), there was a growing interest by NRCs water quantity in the methodology for evaluating seasonal water scarcity at the river basin level in Europe, as well as for the underlying data supporting the CSI 018 computation. The underlying data for the CSI 018 computation is part of the so-called "EEA Water Accounts Production Database (WAPD)". This is an achievement of multi-annual efforts at EEA, which focus on a consistent data structure for hydrological and economic information, in line with the conceptual principles of the System of Environmental-Economic Accounting for Water-SEEA – W (United Nations, 2012a). The current WAPD is supporting with data the development of the physical water asset accounts (i.e. freshwater resources and water availability) and flow accounts tables (i.e. water exchange between environment and economy). Although the WAPD is intensively used by EEA, the database itself remains not publicly available yet. The interest of NRCs water quantity have prompted to consider the possibility of publication of the WAPD and to further explore future improvements.

With this short document, we aim to provide further information and clarifications on components of EEA water accounts, water accounts production database, its underlying data and the methodology behind, encountered uncertainties and finally take stock of key outputs from the workshop for the future improvements. This actively requires the wider participation of interested experts from EEA member countries to ensure support to future developments in the water accounts of Europe.

[1] Use of freshwater resources – EEA Web version of the CSI 018 (WEI+)

2 Overall structure and concept of the EEA Water accounts for Europe

The SEEA-Water provides the conceptual framework integrating hydrological and economic information in a standardized and coherent way, to feed knowledge into the decision-making process. It helps in organizing the data in a coherent way to address water flows within the inland water resource system and between economy and environment. EEA water accounts follows the SEEA–Water conceptual framework. It presents **asset accounts** (water resource availability in the environment) and **flow accounts** (flow of water between environment and the economy) i.e. water use and water supply. The fundamental spatial unit (territory of reference) of the EEA water accounts is the functional elementary catchment (FEC) as defined in the spatial reference data of European Catchment and River Network System-ECRINS (EEA, 2012) while the accounting unit is river basin (EEA, 2013). The computation of the water accounts at several spatial scales (ETC/ICM, 2016, Zal et. al, 2017) is conducted via a particular application called "Nopolu" (European Commission - DG ENV, 2012a, 2012b).

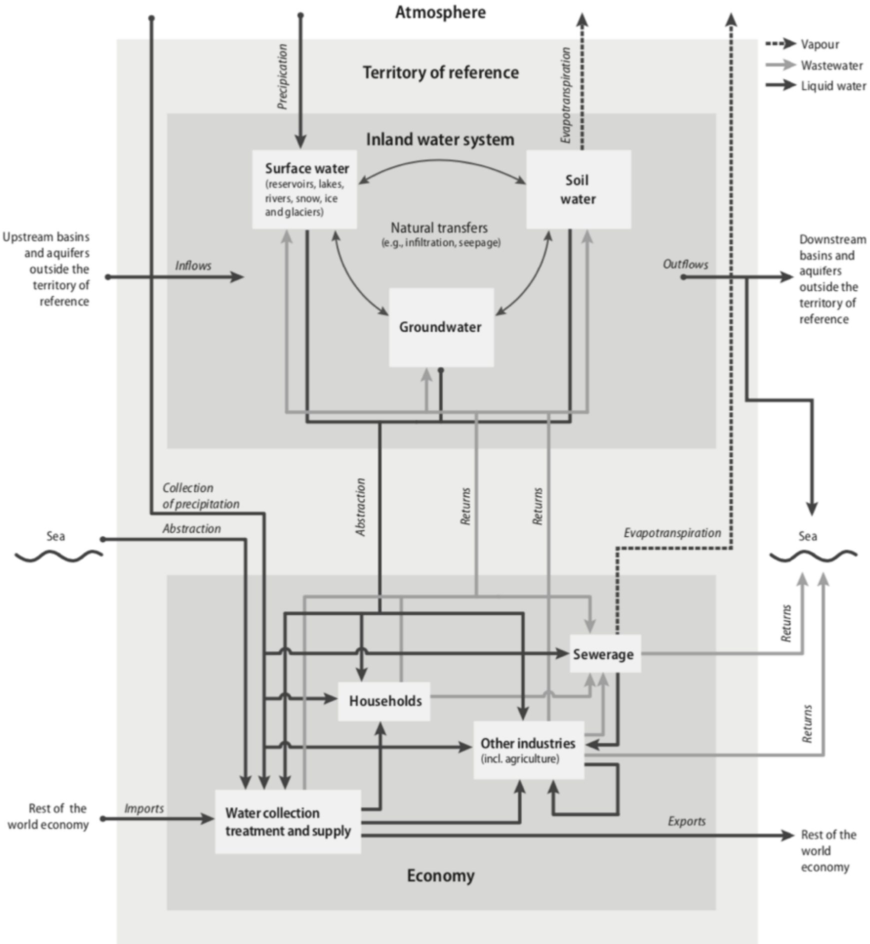

Figure 1 - Main flows within the inland water system and the economy (Source: UN SEEA-Water, 2012)

The inland water system based on SEEA-Water, which is also adopted in EEA water accounts, consists of natural and man-made water bodies/assets which are organized as follows:

- **EA.131: Surface water**
    - EA.1311: Artificial reservoirs
    - EA.1312: Lakes
    - EA.1313: Rivers
    - EA.1314: Glaciers, snow and ice
- **EA.132: Groundwater**
- **EA.133: Soil water**

Asset accounts table (Figure 2) is describing the stocks (reserves) of water resources and their variations during the respective accounting period. Water asset accounts can be calculated with the following balance formula:

[Opening Stocks] + **[Increases in Stock]** – **[Decreasing in Stocks]** = **[Closing Stocks]**

	EA.131. Surface water						
	EA.1311 Artificial reservoirs	EA.1312 Lakes	EA.1313 Rivers	EA.1314 Snow, ice and glaciers	EA.132 Groundwater	EA.133 Soil water	Total
1. Opening stocks	**1 500**	**2 700**	**5 000**	**0**	**100 000**	**500**	**109 700**
Increases in stocks							
2. Returns	300	0	53		315	0	**669**
3. Precipitation	124	246	50			23 015	**23 435**
4. Inflows	1 054	339	20 137		437	0	**21 967**
4.a. From upstream territories			17 650				**17 650**
4.b. From other resources in the territory	1 054	339	2 487	0	437	0	**4 317**
Decreases in stocks							
5. Abstraction	280	20	141		476	50	**967**
6. Evaporation/actual evapotranspiration	80	215	54			21 125	**21 474**
7. Outflows	1 000	100	20 773	0	87	1 787	**23 747**
7.a. To downstream territories			9 430				**9 430**
7.b. To the sea			10 000				**10 000**
7.c. To other resources in the territory	1 000	100	1 343	0	87	1 787	**4 317**
8. Other changes in volume							**0**
9. Closing stocks	**1 618**	**2 950**	**4 272**		**100 189**	**553**	**109 583**

Figure 2 - Asset accounts table (Source: UN SEEA-Water, 2012)

It combines hydrological and water resource management concepts to achieve hydrologically consistent asset accounts particularly to better address water flows within the inland water system and, between environment and economy (water abstractions and returns). The EEA water accounts include only freshwater, as recommended by the United Nations International Recommendations for Water Statistics-IRWS (United Nations, 2012b), and they exclude brackish and saline waters or water reuse. Furthermore, it does not take into account the "exploitable water resources", after the consideration of environmental flows (e-flows). However, the EEA WAPD contain data - where seawater abstraction information is accessible, especially for cooling purposes (e.g. in industrial or energy production sectors). This information at European level is not sufficient to lead in solid conclusions, therefore is not included in our assessments.

The economic activities are organized in accordance with the International standard industrial classification of all economic activities – ISIC Rev.4 (United Nations, 2008) which is also aligned with the Statistical classification of economic activities in the European Community – NACE (EUROSTAT, 2008). The following six aggregated economic divisions are included into the EEA water accounts for organizing the data on water abstractions from environment and return water from economic activities back to the water bodies:

a) ISIC divisions **1-3: agriculture, forestry and fishing**;
b) ISIC divisions **5-33 and 41-43: mining and quarrying, manufacturing and construction**;
c) ISIC division **35: electricity, gas, steam and air-conditioning supply**;
d) ISIC division **36: water collection, treatment and supply**;
e) ISIC division **37: sewerage**;
f) ISIC divisions **38, 39 and 45-99**, which correspond to the **service industries**.

The current EEA water accounts production database stores the data on hydrological components of the assets accounts e.g. climatic parameters, hydrological flows and exchange of water between environment and economy. While the underlying data for the hydrological components are hybrid of observed data (i.e. reporting to WISE SoE water quantity) and modelled data (e.g. Distributed Water Balance and Flood Simulation Model-LISFLOOD (JRC, 2013), data for water abstraction and water use contain mainly interpolation and extrapolation in the database due to presenting large gaps in the reported data.

The final production of the EEA water accounts contains coherent and harmonized data, capable of delivering monthly water asset and flow accounts at the river basin level.

3 Data foundations and processing – European data availability

The EEA water accounts are integrating a wide range of water statistics and socioeconomic information of different context into database systems: point measurements; water abstraction data reported at various spatial scales e.g. sub-unit, river basin, NUTS; socio-economic data; etc. Organization of all this information according to the conceptual framework of the UN SEEA-Water provides standardized outputs on the utilization of water by economic sector and exploitation of water resources by type of water source. However, there is no seamless data available at the European level to fully populate the tables of asset and flow accounts. On the other hand, parameters describing the interactions of water with environment and economy are remarkably diverse collected by different agencies, institutes and organizations across Europe. This requires temporal and spatial interpretation with various datasets collected under different data flows by different organizations e.g. EEA, Eurostat, OECD as well as modelled data such as LISFLOOD of JRC and using surrogate data for filling the gaps. Under these conditions, significant efforts have to been put to harmonize the essential data in spatial and temporal context before running the accounting. Among others, water accounts results are intensively used in developing and updating EEA indicators, such as the seasonal water stress indicator - CSI 018 (WEI+) at the river basin level and the annual water intensity of crop production at national level.

The EEA water accounting system consists of a set of sections, which aggregate thoroughly three major sections of the environment-economy interactions. These sections include **renewable water resources** (climate, surface and groundwater flows, water exchanges, watershed inflows/outflows), **water utilization** (abstractions / returns by economic sectors based on ISIC Rev. 4) and **water stocks balance** (opening/closing stocks). All these three sections integrate the necessary information for producing coherent and standard water accounting tables (Figure 3).

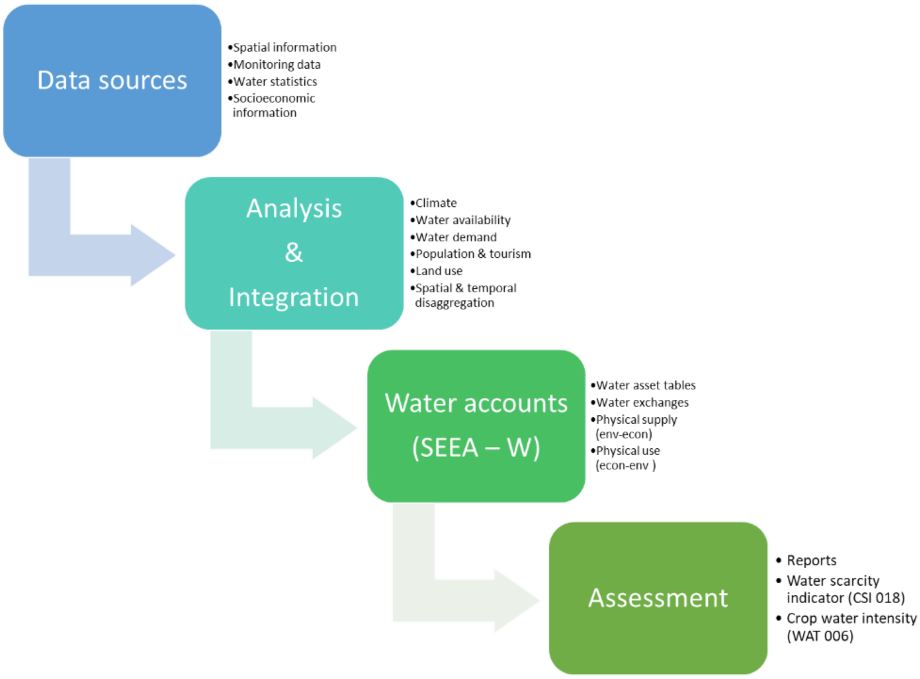

Figure 3 – EEA water accounts processes are based in 4 main pillars

The following chapters provide detailed information on the structure of various data sets, which are used during the development of the water accounts, as well as on the relevant uncertainties.

3.1 Spatial reference data – ECRINS

Spatial data is the information of reference entities and station coordinates. European Catchment and River Networks – ECRINS is a spatial reference system used in the EEA water accounts work that allows carrying out spatial operations in data integration and assimilation, as well as, displaying the results at the different scales (e.g. catchment, sub-basin, river basin district and country level). The delineations of hydrological units in Ecrins (i.e. catchment, sub-basin, river basin district) are quite different from those reported under the WFD Article 5. ECRINS spatial units are purely hydrological; without considering the national boundaries.

Figure 4 - ECRINS drainage network extent (Strahler level above 5)

Despite ECRINS provides fully fledged spatial data for the consistent hydrological elements across Europe, it is quite far from being completed spatial reference dataset. It hosts some topological errors, having a wrong connection in some river segments. Despite it doesn't induce significant impacts on the general results, further improvements are required. Currently EEA is developing another spatial dataset, EU Hydro, which aims to eliminate those type of inconsistencies from the spatial reference data. ECRINS update is planned for 2020.

3.2 Climatic data

Climate datasets contain data for precipitation and actual evapotranspiration. Precipitation data is obtained from the European Climate Assessment & Dataset project-ENSEMBLES observation data, E-OBS (Haylock et al., 2008). It is available at 25 km^2 raster on daily resolution (Figure 5).

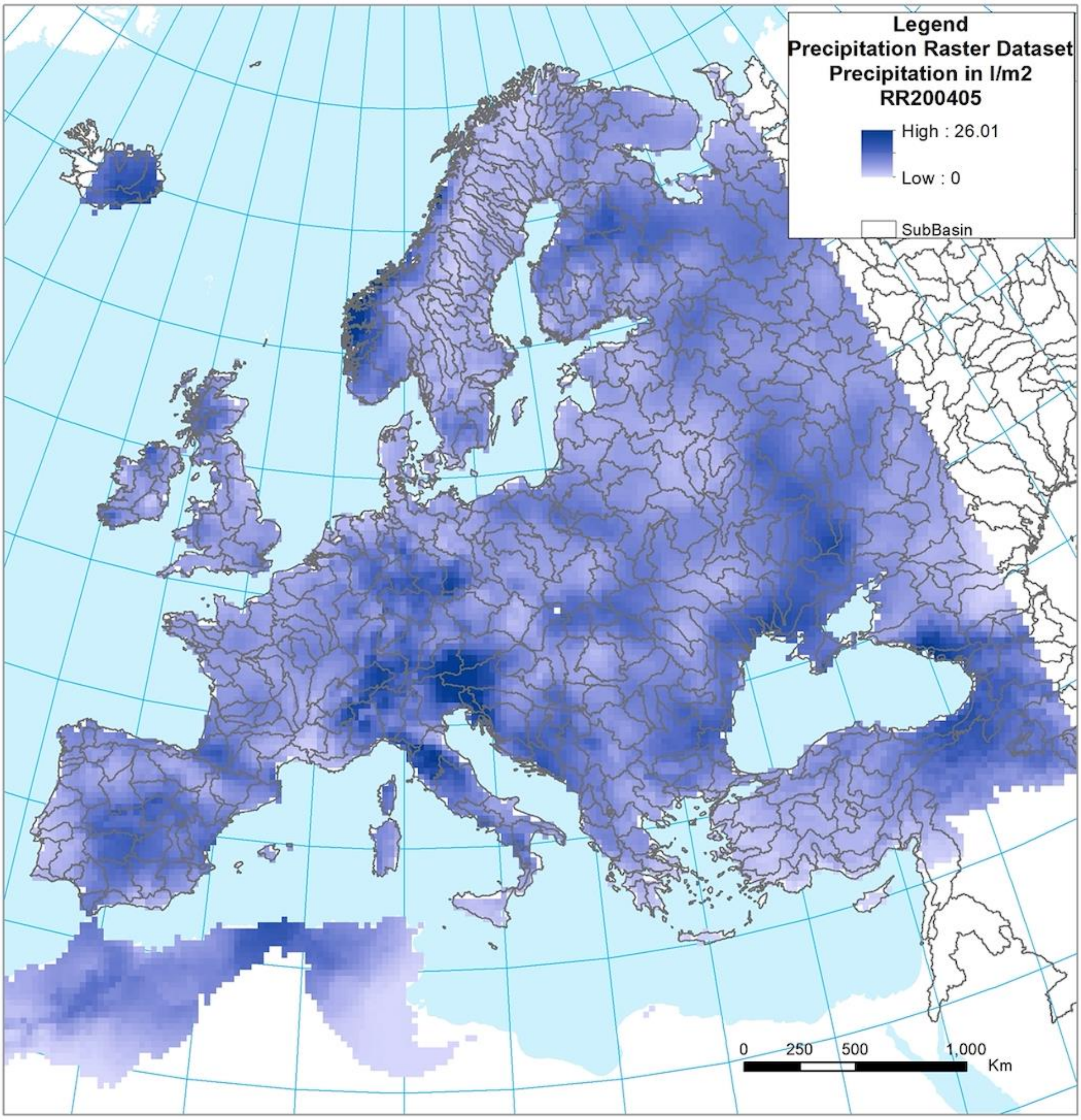

Figure 5 – E-OBS precipitation data (L / m^2) (Example: May 2004)

The integration procedure is the intersection of the 25 km^2 raster with the ECRINS Catchment (EcrFEC) and calculate average precipitation and actual evapotranspiration in litres/m^2 per catchment (Kurnik, et.al. 2014) . In the second step, the averaged value of precipitation and evapotranspiration are converted into million m^3 per catchment and aggregated to the any other upper scale subject to the water accounts calculation e.g. sub-basin, river basin district, country.

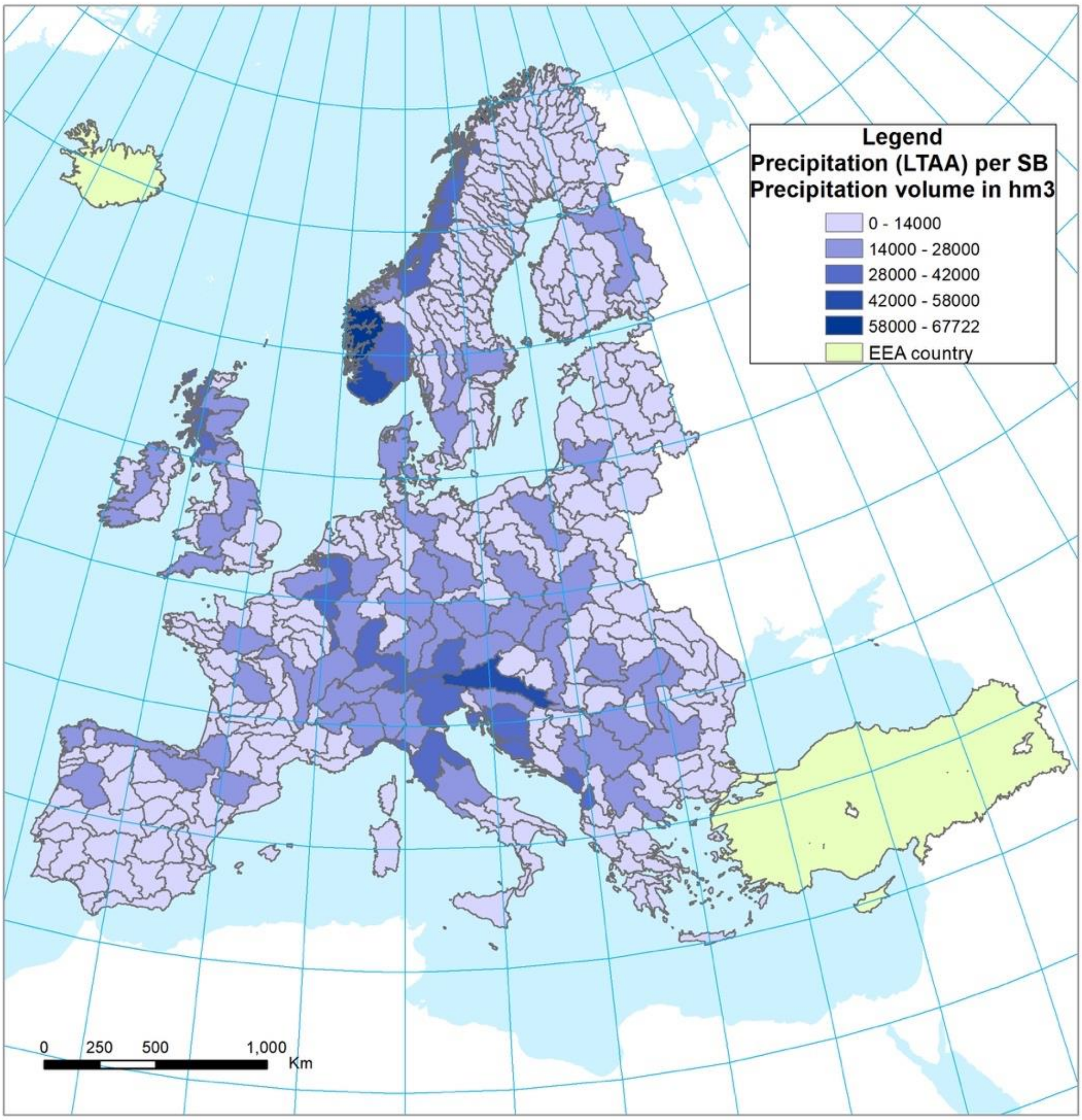

Figure 6 – Precipitation volume (LTAA 1990-2015 in hm^3) per sub basin

Intersecting 25 km^2 raster with the catchment area (the average catchment area is 62 km^2) creates bias result for those areas located in transition between high precipitation and low precipitation values. By means of newly reported data under the WISE SoE 3, further validation will be possible at higher scales e.g. sub-unit, river basin or country. Actual evapotranspiration is modelled data based on soil water balance model (Kurnik, et.al. 2014). It is also available at 25 km raster and integration procedure with the ECRINS catchment is similar to the precipitation.

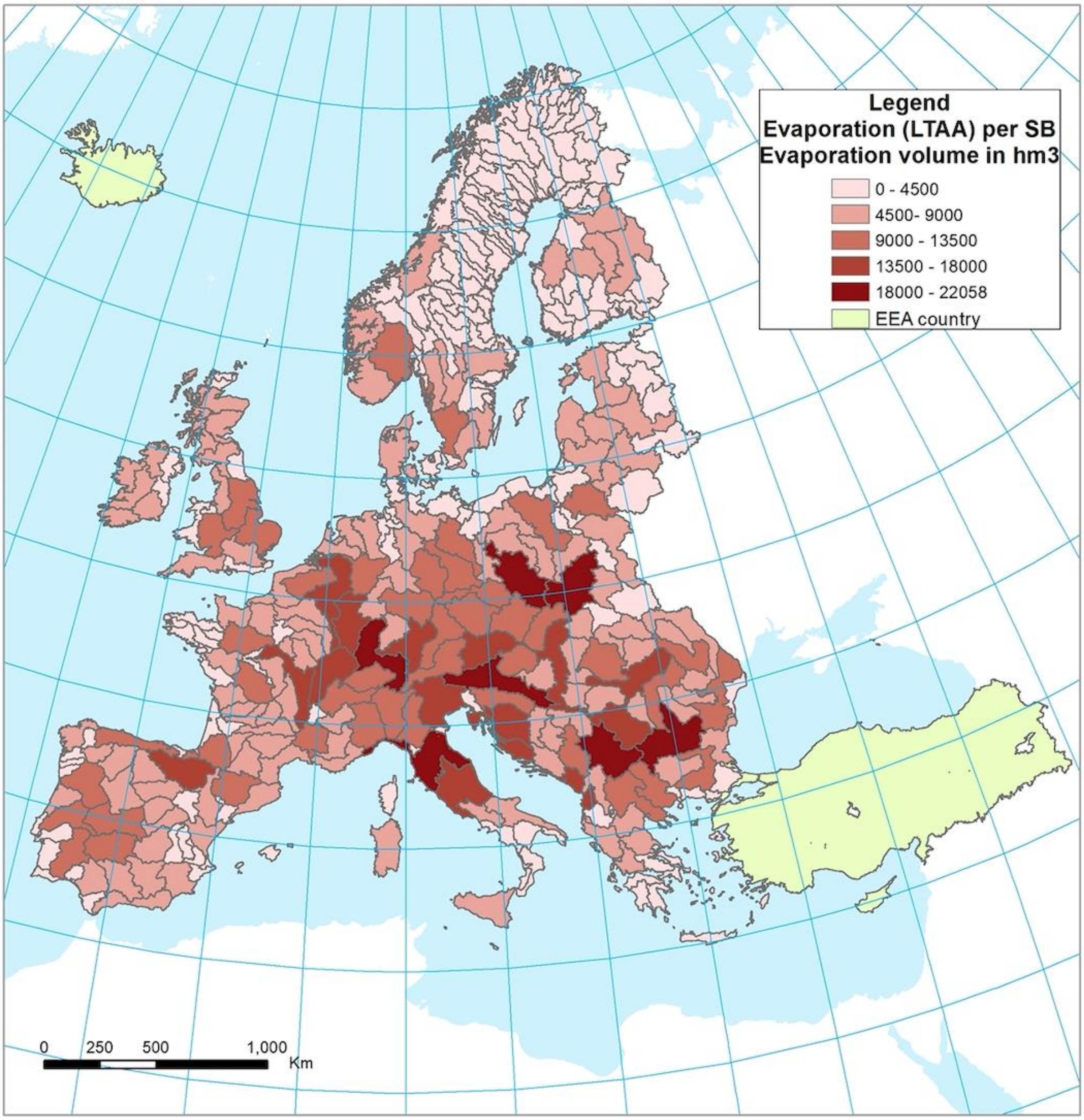

Figure 7 - Evapotranspiration volume (LTAA 1990-2015 in hm^3) per sub basin

The model calibration provides actual evapotranspiration (ETA) higher than 0 in December and January in some Nordic locations. An external calibration is performed only for those areas by assigning 0 as ETA value to avoid from inconsistencies in the soil-water balance.

3.3 Streamflow data and LISFLOOD data integration

Streamflow data present extended gaps in records, both in space and time, before data reporting period in 2016. Water accounts production database was not holding sufficient streamflow data to perform flow estimation for all Europe to populate inflow and outflow components of the water accounts. Hence, it was inevitable to substitute the data with the modelled, such as LISFLOOD model from the DG Joint Research Centre (DG JRC). Figure 8 below is illustrating proportional contribution of reported data versus LISFLOOD data for the streamflow component of the current EEA water accounts production database. However, it should be noted that streamflow data is being improved since the 2018 WISE-3 data call which has not been embedded into the current results of the water accounts subject for the water accounts workshop.

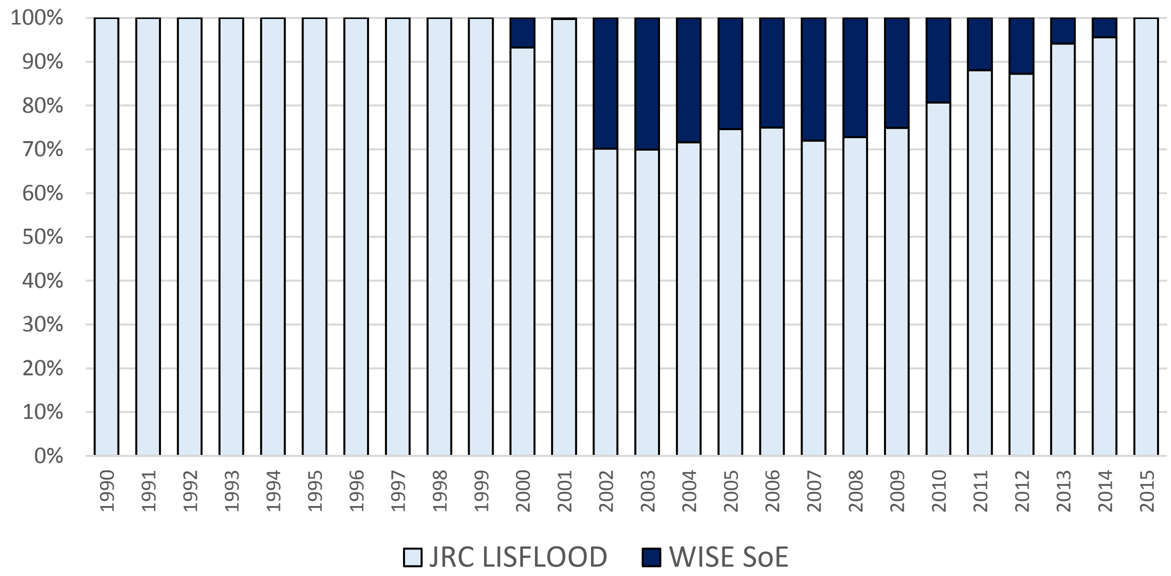

Figure 8 - Streamflow data availability in EEA WAPD (latest update 31/12/2017)

3.4 Reservoirs and lakes

The EEA water accounts production database covers approximately 388,333 lake entities. In the SoE water quantity database only 105 reservoirs are presented with information on the reference volume of water. The WaterBase-Lakes database has also around 1,860 lake water bodies presented with the information on either area together with mean, max and min. depth or total volume of water which can be used as a proxy in estimating the reference volume of water stored in lakes and reservoirs. But, still available information for a number of lakes is far from being sufficient to support reference volume of water in estimation of water storage and stock calculation in the Asset Accounts. Hence, the current results of the water accounts present only the estimates of “inflow from other resources in the territory”.

Figure 9 - Reservoirs and Lakes presented in the ECRINS

3.4 Water abstraction, water use and returns

Economy exerts pressure on freshwater resources by using water for human needs, food production, manufacturing products and electricity generation. The level of pressure of the economy on freshwater resources is measured by water exploitation index and expressed as level of water stress. In this context, addressing different types of water flow between environment and economy is crucially important to appropriately measure the actual level of water stress. Water quantity (WISE-3) data dictionary was revised in 2015 in accordance with the overall concept of the implementation of the regional water exploitation index (WEI+) and defines flow of water from environment to economy as water abstractions, water use and returns (Figure 10).

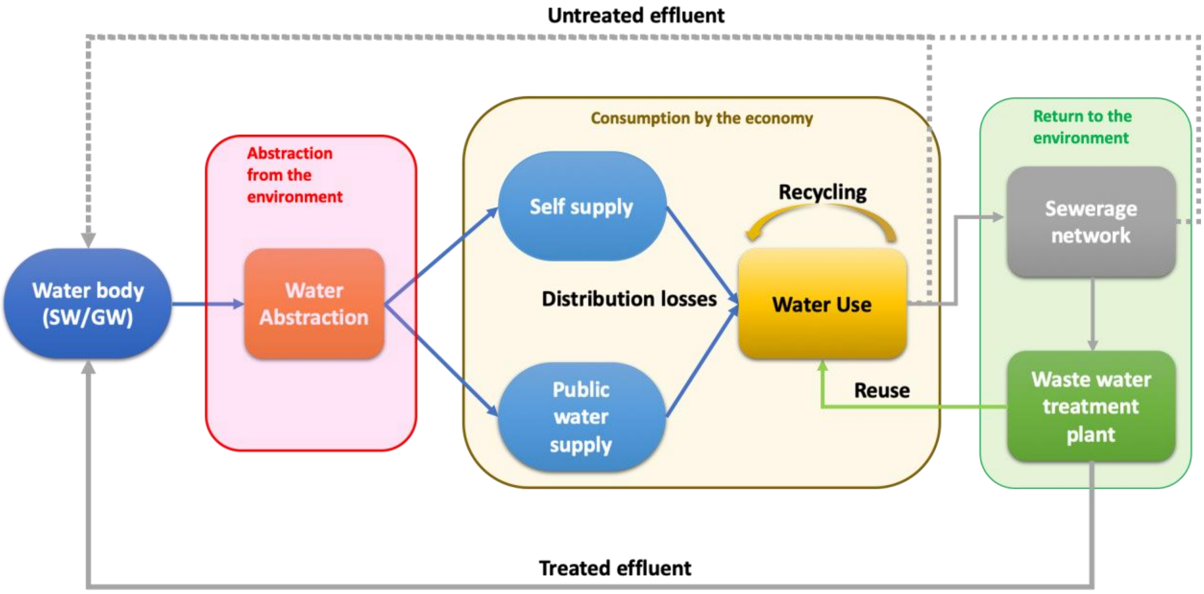

Figure 10 – Basic water flows from the environment to the economy and return to the environment (Source: George Bariamis)

Water abstraction refers to volume of abstracted water at a certain time on the spatial unit (SU, RBD or country) from freshwater resources (surface and groundwater) for different economic activities, whereas water use defines net water supply (self-supply or public supply) to economic activities after the losses in water conveyance system (WISE SoE water quantity data dictionary). Returns is the volume of water which flows from economy back to environment e.g. inland water resources, land or sea at a certain time on the spatial unit (United Nations, 2012b).

This concept presents some conceptual implications in terms of data collection and processing. The current EEA water accounts production database holds quite substantial reported data on water abstraction whereas returns had to be populated either by implementing proxies or purely based on modelling.

Availability of the reported data on water abstraction (Figure 11) present quite better spatial and temporal coverage (at national scale) compared to other components of water flow between environment and economy (returns and sewage volumes). A short statistical analysis with the reported data versus surrogate data shows that on average around 70% of water abstraction data has been reported by the countries whereas the remained had to be populated with the surrogate data.

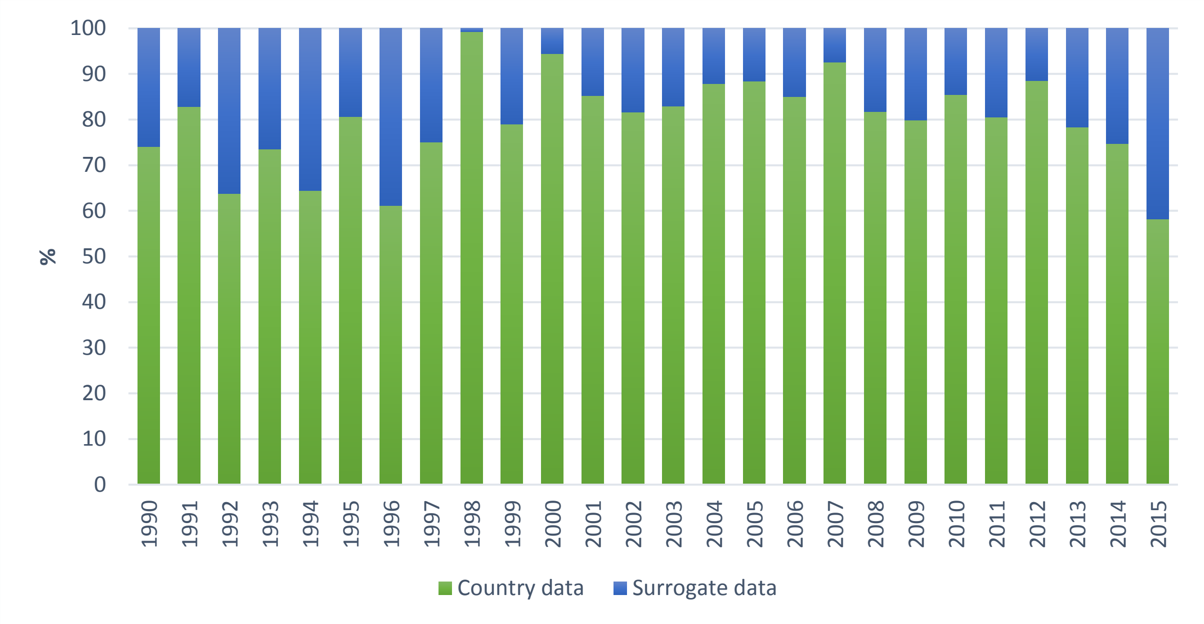

Figure 11 – Data availability on freshwater abstractions in EEA WAPD (latest update 31/12/2017)

Level of spatial and temporal data coverage is substantially varying among different economic activities. Large gaps are subject in irrigation whereas water abstraction for agriculture is the main pressure on water resources in southern part of Europe.

Data on water abstraction for various economic activities have been collected from the WISE SoE 3 (data reported before 2015) and Joint questionnaire of Eurostat and OECD. Data on cooling water has been provided by DG ENV under the pilot project on “Availability, use and sustainability of water production of nuclear and fossil energy” (ENV.D1/SER/2013/0004) which enables to use the production level (e.g. electricity) as proxy to extrapolate the data on cooling water.

The overall source of data on water abstraction and proxies used for populating the water use data is illustrated in the Table 1 below.

Table 1 – Data sources and implemented proxies for surrogate data

Cooling water		Irrigation		Manufacturing industries		Water collection treatment supply	
Method for gap filling	**Input data**	**Method for gap filling**	**Input data**	**Method for gap filling**	**Input data**	**Method for gap filling**	**Input data**
Mean factor water intake, discharge, consumption of cooling instalation x electricity generation		**Step 1-Mean factor of share of Irrigated area in UUA**	**Eurostat, apro_acs_a**	*Step1 - Mean factor water intake, discharge, consumption of manufacturing industry (NACE digit 2)*	*BREF specifications (JRC)*	Step- 1 Share of households in public water supply	WISE SoE, env_wat_abs, OECD
	Eurostat,[nrg_110a]		*Eurostat, ef_poirrig*			Step-2 Water abstraction per capita for households	Water abstr/Eurostat, [demo_gind]+Eurostat, [tour_occ_nin2]
	Eurostat, [nrg_113a]		*OECD.stat_irrigated_area*	*Step 2- Location of industrial installations*	E-PRTR (EEA, 2015)	Step-3 Proportional population distribution over water abstraction for households	UWWTP database (EEA, 2017)
	DG ENV, 2014, Coolin water database		Eurostat, [aei_ef_ir]			Step-4 Share of water abst. Between households and connected services	WISE SoE, env_wat_abs
			CLC-212, 2012	*Step 3 Water intake, water consumption and discharge/Industrial production*	Eurostat, sts_inpr_a	Step-5 Water supply to households and connected services	WISE SoE, env_wat_cat
		Step 2-Mean factor of water density (m3/ha)	*Wise SoE 3, env_wat_abs, OECD stat*				
		Wise SoE, env_wat_abs, OECD stat/Irrgated area					
		Step- 3 water irrigation					
		Water density x Irrigated area					
		Step 4 Monthly disaggregation					
		Phenology	Ivits, at al., 2012				
		Crop water needs	FAO http://www.fao.org/docrep/s2022e/s2022e05.htm#TopOfPage				

Manufacturing industries

Spatial disaggregation of the industrial water abstractions has been conducted based on the location of the industrial installations reported under the E-PRTR dataflow requirements. Water returns from the manufacturing industry is based on estimations in accordance with the technical specifications of the establishments provided in the BREF and BAT documents by DG JRC (EC, 2001, 2003, 2006, 2007; JRC, 2014, 2015b, 2015a, 2015c) for a set of industrial sectors which represent more than 90% of total industrial water abstraction.

Because the reporting of industrial freshwater abstraction volumes and the location of production facilities is not complete, the total volume may not be disaggregated accurately to the respective accounting unit (e.g. FEC, SB, RBD).

Water collection, treatment and supply

Water collection, treatment and supply data is illustrating the volume of water abstracted for public water supply for all sectors. The data has been collected from WISE SoE Water quantity (data reported before 2016) including data water abstraction for public water supply [env_wat_abs and env_wat_cat] reported to Eurostat & OECD Joint questionnaire. Almost 80% of data for these variables was obtained from the reported data whereas gap filling was performed for some countries.

The gap filling was based on the calculation of the water abstraction per capita for households and modulation coefficient has been performed to estimate proportional share of water abstraction between households and connected services based on the Eurostat [env_wat_abs and env_wat_cat] data. Spatial disaggregation has been conducted in accordance with the UWWTP database. This database has been used also to estimate water returns from households and connected services. The number of tourists was also included over the permanent resident to disaggregate the water abstraction on monthly resolution. However, as the origin of tourist is not taken into account, this approach causes double counting in terms of water use by tourist at the origin of tourist.

Cooling water for energy production

Data on cooling water has been obtained from DG Energy and DG ENV; a Cooling water database compiled under a pilot project. The gaps have been completed energy production data from Eurostat and water abstraction for electricity production. Further gaps have been populated via the estimation of water intake and discharge coefficient per kWh provided in the DG ENV cooling database.

3.5 Validation of the final dataset

Currently, WAPD contains a lot of information from different data providers across Europe. The context of the dataset is ranging from hydrologic, meteorological data, to population and socioeconomic context. Runoff and climatic data are mainly based on model outputs as already explained (LISFLOOD and E-OBS data respectively). Water abstractions by economic sectors is a synthesis of annual reported data (mainly from Eurostat) and gap filled data based on statistical analysis of already available time series. Spatial uncertainty arises when water abstraction data reported at the country level are disaggregated to sub-basin (SB) and river basin district (RBD) scales. The validation steps are mainly dictated by the current structure of the databases and it is planned to take advantage of the new structure of the WISE-3 database for validation purposes where applicable. The validation is primarily affecting the outputs of the water accounts algorithm rather than the input itself which is now an intricate task for the data to be replaced extensively.

The current structure of the WISE-3 reporting enables direct integration of WISE-3 data into the water asset and PSU tables. Once the WISE SoE 3 contain sufficient data from all EEA Member and Cooperating countries, the output dataset will contain significantly declined data uncertainties. Time demanding processes on EEA side would be reduced even more. On the other hand, starting from 2019, the WISE SoE data reported during the data call in 2018 and 2019 are progressively being integrated into the new version of the water accounts database.

4 Accounting tables and indicators

4.1 Computation process

EEA uses the Nopolu application to run the computation of the water accounts. The computation process includes all the necessary preparatory and operational steps required to successfully complete the scheduled update of the water accounts databases. The computation can be performed based on the selected spatial and temporal scales (e.g. sub-basin, river basin district or national and annual, monthly). Production steps of water accounts are organized in three major sections: data analysis and integration; running the accounting modules in the Nopolu; and validation of the outputs. The overall workflow of the annual updates of the WAPD is explained schematically in Figure 12.

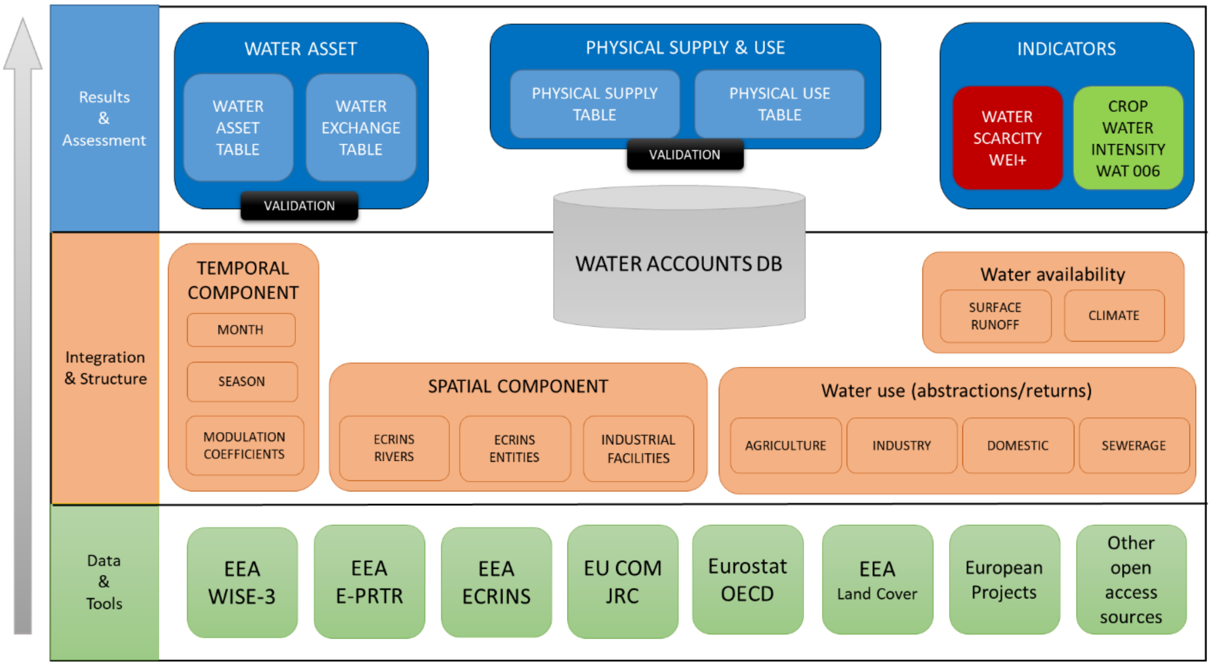

Figure 12 – Schematic workflow of annual updates of the EEA WAPD (Source: George Bariamis)

Data Analysis & Integration

Once the data collection phase is being completed, a set of stepwise processes are required in order the data to be properly integrated in the water accounts databases. Currently, the water accounts databases are included in the Nopolu System, developed by Naldeo and updated, modified and operated by EEA and ETC/ICM. The data collected are transformed into structured information, spatially linked with the hydrographic and watersheds' boundary system of ECRINS. The temporal resolution of the integrated input is monthly, and it is supported by a set of disaggregation coefficients based on extensive data analysis. Tools and database management systems of Nopolu are employed to support the administration of a such complex system with numerous subcomponents.

Water accounts modules

The EEA water accounting system consists of distinct modules; set of sections aggregating systematically 3 major sections of the system. These sections include renewable water resources (climate, surface and groundwater flows, water exchanges, watershed inflows/outflows), water utilization (abstraction / returns by economic sectors based on ISIC) and water stocks balance (opening/closing). All these three sections are functioning cooperatively to harvest the necessary information and produce coherent and standard water accounting tables.

Use of the water accounts results in the EEA products.

EEA uses the outputs of the water accounts primarily to update indicators such as use of freshwater resources (CSI 018) and water intensity of crop production (WAT 006). In addition, the results are an integral part of the EEA Natural Capital Accounting and also used in climate adapt urban adaptation map viewer. EEA provides inputs to Eurostat for the EU reporting on SDG 6.4.2 (water use efficiency) based on the outputs of the water accounts.

4.2 Asset accounts and Flow accounts tables

Based on the principles of water accounting already explained in Chapter 2, Tables 2 and 3 below present water assets and flow (environment ↔ economy) accounts respectively at EEA level for the latest year available – 2015. Based on these results the latest version of CSI 018 has been published.

Table 2 – European asset accounts for 2015

Annual water asset accounts of Europe 2015 (million m^3)	**Type of water resource**						
	EA. 131. Surface water						
	EA.1311. Artifical reservoirs	EA.1312. Lakes	EA.1313. River and streams	EA:1314. Glaciers, snow and ice	EA.132. Groundwater	EA. 133.Soil water	Total
1. Opening stock of water resources	0	0	0	0	0	0	**0**
Increases in stocks							
2. Returns		1,096	114,272			29,250	**144,618**
3. Precipitation	72,543	2,234	7,591	266,359		2,953,827	**3,302,554**
4a. Inflows from upstream territories							
4b. Inflows from other resources in the teritory	4,206,681	2,491,634	5,388,693		339,822		**12,426,830**
Total increase in stocks	4,279,224	2,494,964	5,510,556	266,359	339,822	2,983,077	**15,874,002**
Decreases in stock							
5. Abstraction	23,911	3,444	150,069		54,918		**232,341**
6. Actual evapotranspiration	37,736	1,560	5,315			2,009,172	**2,053,783**
7a. Outflows to downstream territories							
7b. Outflows to the sea			1,800,414				**1,800,414**
7c. Outflows to other resources in the territory	4,552,299	2,442,901	4,710,137			721,494	**12,426,831**
Total decrease in stock	4,613,946	2,447,905	6,665,935		54,918	2,730,666	**16,513,369**
Changes	**-334,722**	**47,059**	**-1,155,379**	**266,359**	**284,904**	**252,411**	**-639,367**
8. Closing stcok of water resources	0	0	0	0	0	0	0

Note: Dark grey cells are null by definition

Despite the fact that a certain level of knowledge on reservoirs and lakes geography is known, as well as some of their structural/natural characteristics, not consistent and extended time series are available to be harmonized under SEEA – W principles. Water assets accounts table is based on the primary water balance equation with opening and closing stocks playing a key role. During the last years of development of WAPD, it was not possible to find a dataset which adequately describes the inflows/outflow of reservoirs and lakes; important parameters which define the water balance. Therefore, we continue to rely on the initial assumptions of the applications' developer, on freshwater abstractions/returns from these water assets and we algebraically solve the equation with focus on the change of stocks rather than the separate components of opening and closing stocks. It has to be mentioned that WISE-3 data dictionary under the latest 2015 update, includes the necessary parameters to support water asset accounts.

Table 3 – European flow accounts (physical supply and use tables)

Annual physical water use table (million of cubic meters) Europe -2015		**Industries (by ISIC category)**									
		Agriculture, forestry and fishing	Mining and quarrying, manufacturing and construction	Electricty, gas, steam and air conditioning supply	Water collection, treatment and supply	Sewerage	Service industries	Total	Households	Rest of the World	Total
From the environment	1. Sources of abstracted water										
	1311: Reservoirs	15,035			7,078			22,112			22,112
	1312: Lakes	365	49	1,584	1,170			3,167			3,167
	1313: Rivers	12,308	28,135	105,743	10,365		1,902	158,454			158,454
	132: Groundwater	29,285			18,416			47,701	907		48,608
	21: Sea water										
	Total abstracted water	56,993	28,184	107,326	37,029	0	1,902	231,435	907		232,341
Within the economy	2. Water received from other economic units										
	E.36 Water collection treatment and supply	0	0	0	0	0	9,244	9,244	27,785		37,029

Annual physical water use table (million of cubic meters) Europe -2015		**Industries (by ISIC category)**									
		Agriculture, forestry and fishing	Mining and quarrying, manufacturing and construction	Electricty, gas, steam and air conditioning supply	Water collection, treatment and supply	Sewerage	Service industries	Total	Households	Rest of the World	Total
Within the economy	Households				23,304			23,304			23,304
	Service industries (38, 39, 45-99)						7,678	7,678			7,678
	Sewerage (37)		2,946				4,991	7,937	15,752		23,689
	Total		2,946		23,304		12,669	38,919	15,752		54,671
Into the environment (Returns)	1312: Lakes		27	1,099							1,126
	1313: Rivers		9,127	79,952	816	23,689	129				113,713
	133: Soil	18,704					2,682		8,394		29,780
	Total water supply	18,704	9,154	81,051	816	23,689	2,811		8,394		**144,619**

When Table 3 is compared with the standard physical supply and use tables under SEEA – Water (Table III.1) it is apparent that especially some rows are missing. Some examples are the, self-supplied water, rain harvested water and reused water on both sides of economy (as effluent and/or supply). The main causes of non-matching are; data availability as well as the structure of the database which is planned to be improved in the coming versions of the WAPD.

4.2 Using the EEA water accounts for the calculation of the CSI 018 (water exploitation index plus - WEI+) indicator

The European Environment Agency had been developing the WEI indicator for many years, initially as annual WEI at the country level, later at the basin level on seasonal resolution following the methodological recommendation of the Technical Working Group (TWG) developed under the WG Water Scarcity and Droughts from CIS 2010-2012 (Faergemann, 2012). The TWG introduced "water return" as additional variable into the assessment of socio-economic pressures on water resources. Formerly, the volume of water abstraction was taken as variable representing the economic demand. With the introduction of return into the WEI calculation, the objective is to assess the net water consumption. It is obvious that implementation of the WEI+ is high data demanding. It requires a number of iterative data integration and assimilation process to obtain a harmonized dataset at basin scale on monthly resolution covering all Europe. There is no such European seamless data available. Hence, a strong need exists in using a conceptual/structural framework to build hydrologically and economically consistent database. The United Nations System of Environmental-Economic Accounting for Water is offering sufficient conceptual approach as such with the implementation of the asset and flow accounts. The both accounting tables help to organize heterogenic datasets, which are capable to address environmental and economic aspects of water availability and water exchange between environment and economy.

Choice of WEI+ formula

The WEI+ provides a measure of the total water use as a percentage of the renewable freshwater resources for a given territory and time scale. It is an advanced and geo-referenced implementation of the WEI. It quantifies (as percentage) how much water is monthly or seasonally used (abstracted and returned to the environment). The difference between water abstraction and return is regarded as water use. It is estimated by the formulas;

$$\boldsymbol{WEI+} = \frac{\boldsymbol{Abstractions - Returns}}{\boldsymbol{Renewable\ Water\ Resources}}$$

$\boldsymbol{RWR_1 = ExIn + P - ET_a \pm \Delta S}$ for natural and semi-natural areas

$\boldsymbol{RWR_2 = Outflows + (Abstractions - Returns) \pm \Delta S}$ for densely populated areas

Where:

- ExIn = external inflow
- P = precipitation
- ETa = actual evapotranspiration

- ΔS = change in storage (lakes and reservoirs)
- Outflow = outflow to downstream/sea

Water exploitation index is being regularly updated every year. Indicator values are provided as percentages of water use over renewable freshwater resources of each of the spatial units across EEA Member and Cooperating countries. The available spatial units are available at sub-basin and river basin districts on seasonal resolution.

4.3 Updating the indicator on water intensity of crop production (WAT 006)

Water is generally abundant is Europe, although long-term climate and hydrological assessments — including on population dynamics — indicate an acceleration in water scarcity across Europe. The agricultural sector is still one of the major users of water resources in Europe, accounting for approximately 40 % of total annual water abstraction. In southern Europe, this figure reaches more than 80 % in the summer months (EEA, 2017).

The water intensity of crop production is defined as the volume of water input (irrigation plus soil moisture in cubic meters; m3) for one unit of GVA (in euros or PPS) generated from the production of all crop types, adjusted for subsidies. The lower the value of the indicator, the better the water intensity. It is a relative measure of the pressure of the economy (NACE activities A1.1 and A1.2) on water resources[2].

$$\boldsymbol{WAT\ 006 = \frac{Water\ Input_{crop}}{Gross\ Value\ Added}}$$

Units

Two different units can be used for the economic variable:

m^3 per EUR (€) for exploring trends across time within the same country m^3 per PPS for comparing different countries from the same geographical region within the same year[3].

Thus, WAT 006 is a composite indicator, which combines environmental information with the economic information for the purpose of undertaking a water resource efficiency assessment.

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[2] Further information can be found on EEA web version of indicator page

[3] The purchasing power standard (PPS) unit is used by Eurostat as a common currency for the European region that accounts for differences in the purchasing power in the EU-28 European countries included in the assessments. Theoretically, one PPS can buy the same amount of goods and services in each country. The adjustment for price level differences is implemented using the purchasing power parities (PPPs). Thus, PPPs can be interpreted as the exchange rate of the PPS against the euro.

5 Roadmap for future and improvements with data foundation

EEA Water accounts production database enables linking water quantity data and information on water resources with socio-economic data and information. It provides the primary data inputs into the updating the WEI+ and Crop water intensity, it is also used to support the overall development of the European Ecosystem Accounting under the KIP INCA process. Furthermore, the data potentially will be used in various water-related assessments; e.g. providing support to the updating water abstraction indicator of the Eurostat environmental indicator, WEI agriculture which is one of the potential pressure indicators in the overall CAP assessment, as well as support to the global assessment of the SDG 6. In addition, the EU water scarcity policy, resource efficiency roadmap, water reuse for agriculture, European assessment on water services under the article 5 of the WFD are just some of those potentially will benefit from the outputs of the EEA water accounts. Data provisions under the WISE SoE water quantity play key role in improving the quality of the water accounts outputs. It is expected that in the coming data call periods the Eionet member countries will provide sufficient data to run more comprehensive water accounts addressing various aspects of the water scarcity and resource efficiency issues.

Taking into account the needs of addressing pressure of economy on the freshwater resources in Europe, EEA has been expanding the water accounts work over other components such as freshwater ecosystem condition accounts and emission accounts. In the coming years, the seamless water accounts will support to undertake even more integrated assessment around quantity and quality of water resources.

The following activities are envisaged to be implemented within the activities of developing the water accounts in the near future;

2020

- Fine-tune the Nopolu in line with the data model of the WISE - 3
- Replace Ecrins v1.1 with the Ecrins v1.5, or replace ECRINS with EU Hydro in the case EU Hydro is available
- Complete integration of the WISE - 3 data reported after 2016 into the EEA production database
- First completion of the freshwater ecosystem condition accounts
- Continuation with the test case of the emission accounts
- Continuation with supporting the EU reporting to SDG 6.4.2

2021

- Develop fully fledged asset and flow accounts for the years 1990-2020 at the sub basin scale
- Combine asset and flow accounts with the ecosystem condition accounts
- Finalise testing stage of the emission accounts
- Use the outputs of the water accounts as inputs to various water resources related assessments
- Support the reporting to SDG 6.4.2

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