CONCEPT FOR TOOLS INTEGRATION

WORK PACKAGE T1 - EXPLOITATION: CONCEPT OF CE TOOLS INTEGRATION

ACTIVITY T1.2 EXPLOITING OF TOOLS AND MEASURES WITH INTEGRATION CONCEPT

DELIVERABLE D.T1.2.1

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Table of Contents

List of abbreviations

AHP	Analytic hierarchy process
BMP	Best Management Practices
BWT	Bathing Water Directive
CC-ARP-CE	Integrated toolbox for Climate Change Adaptation and Risk Prevention in Central Europe
CC	Climate change
CE	Central Europe
C3S	Copernicus Climate Change Service
DSS	Decision Support System
DST	Decision Support Tool
DTP	Danube Transnational Programme
DWD	Drink Water Directive
FD	Floods Directive
GIS	Geographic Information System
GWD	Groundwater Directive
IED, ex. IPPC	Industrial Emissions Directive
NSWRM	Natural Small Water Retention Measures
ND	Nitrate Directive
PSD	Priority Substances Directive
SDG	Sustainable Development Goals
UWWTD	Urban Waste-water Treatment Directive
WISE	Water information system for Europe
WFD	Water Framework Directive

1. Introduction

The main objective of the TEACHER-CE project is to develop an integrated TEACHER-CE Toolbox - CC-ARP-CE - focusing on the adaptation (and where possible mitigation) of the water management sector to CC to prevent the risk of floods/heavy rain/drought risks far as possible, for example by small water retention measures and protection of water resources through sustainable land-use management.

The TEACHER-CE toolbox is the central component of the project, also having a specific role as a central platform for the integration of different objectives and WP T1 deliverables of the project in a real environment on an operational level, enabling multi-institutional application. The project is namely integrating and harmonizing results of previously funded projects recognizing their links to topic V - Climate change (CC) adaptation and risk prevention. The tools delivered by the CE projects being integrated within the TEACHER-CE project are valuable to:

- manage the effects of heavy rainfall and floods (CE project RAINMAN);
- exploit small water retention measures (CE project FRAMWAT);
- protect drinking water through sustainable land use (CE project PROLINE-CE);
- and properly manage forests under CC (CE project SUSTREE).

The toolbox is based on the integration of tools of the four selected projects by CE: RAINMAN, FRAMWAT, PROLINE-CE, SUSTREE, and other projects (CE: LUMAT; H2020: FAiRWAY, LifeLocalAdapt; DTP: DRIDANUBE and DAREFFORT, Copernicus Climate Change Service (C3S): Sectoral Information System Disaster Risk Reduction and Demo Case “Soil Erosion”). Moreover, synergies with additional selected projects will be built. Therefore, the conceptualization of the toolbox must be performed in a way that it meets the defined aim, but at the same time it needs to be user-friendly and operational.

User Experience Design is especially important. In addition to the selected projects named above, the project partners have identified that a plethora of tools supporting water management on national level as well as EU level already exists. These tools must be put into perspective as the potential users of the toolbox should not be confused even more with one more tool having similar features as comparable, already existing tools. Some of the tools which exist on the national level are official tools providing information on water bodies and especially their status (according to EU WFD), information on flood hazards and program for the implementation of flood risk reduction measures (EU Floods Directive). Collection of maps for the Water Information System for Europe (WISE) is in the Floods Directive section[1].

The toolbox is defined in the TEACHER-CE application form as a specific objective with the programmed development and validation of a framework for tools (Toolbox) for integrated and cross-beneficial strategies and measures for climate change adaptation and prevention/reduction of related risks. Already at that stage we have recognized the necessity and positioning of the toolbox in the area where it could contribute to the integration of cross-beneficial strategies on specific catchment (i.e. size of the TEACHER-CE pilot action catchment) where interests of different user groups meet and confront the challenges related to the climate change adaptation process in the water management sector.

Building on the tools from the existing projects, TEACHER-CE aims to develop a decision support tool to support Climate Change Adaptation and Risk Prevention in the water management sector. All these aspects are included into the CC-ARP-CE toolbox logo (Figure 1): vertical blue lines are presenting rainfall, inclined yellow lines are presenting sun, rising temperature and climate change, blue curls are presenting runoff and floods and brown horizontal lines soil and drought.

To link multiple sectors and scales engaged in the decision-making process on the level of sub-basins and catchments which are close to the municipalities in longer-term strategic vision, capitalization of these tools will include:

[1] https://www.eea.europa.eu/themes/water/interactive/by-category/floods-directive

(a) making them "climate proof" and applicable under likely future scenarios and

(b) Integrating them in a comprehensive Toolbox to tackle interacting water-related issues affecting CE.

Figure 1: Logo oft he CC-ARP-CE (TEACHER-CE) Toolbox: Integrated toolbox for Climate Change Adaptation and Risk Prevention in Central Europe

The aim of the TEACHER-CE Toolbox is also to stimulate the exchange of different views and visions on the development of water in specific catchment with different stakeholders therefore supporting learning process along with the participatory process which is already envisaged by the WFD CIS Guidance Document No 8 - Public Participation in Relation to the Water Framework Directive[2].

TEACHER-CE is therefore having a holistic approach taking water issues in focus. It will contribute to the improvement and implementation of the EU WFD, FD, GWD, DWD and SDG6 by:

(i) developing the TEACHER-CE Toolbox and recommendations considering climate change (CC);

(ii) promotion of policy recommendations to stakeholders that have not been approached before;

(iii) interrelation of the Toolbox for CC adaptation and risk prevention, CC adaptation with other tools from the broad field of action in integrative and participatory water and land use management.

It is therefore well embedded in the context of existing WFD and FD processes, but at the same time attempting to avoid the confusion and multiplication of the existing tools.

A specific challenge regarding the conceptualization of the toolbox is integration of the Climate Change indicators in the toolbox. Climate change indicators are namely numerous (temperature, precipitation, days, solar radiation) with several scenarios, and time frames (D.T1.1.2). They are also localized to specific location in different ways depending on the resolution applied. Their usage is to certain extent subject to sensitive interpretation and should be applied with necessary interpretations and explanations.

In the development of the TEACHER-CE toolbox following main steps will be applied:

- Identification and integration of the outcomes of the capitalizing projects: mainly from the four selected CE projects (FRAMWAT, PROLINE-CE, RAINMAN, SUSTREE), building a core of the toolbox, and from other projects following the results of D.T1.1.1 and D.T1.1.5.
- Link to different existing tools supporting the governance process in the field of water management (national and EU legislation).
- Integration of the climate change adaptation process with the integration of the key CC indicators (D.T1.1.2).
- Identification of the main gaps relative to the existing tools and positioning of the TEACHER-CE toolbox in the identified (bottom-up) decision making context.

[2] European Communities (2003), COMMON IMPLEMENTATION STRATEGY FOR THE WATER FRAMEWORK DIRECTIVE (2000/60/EC) Guidance Document No 8 Public Participation in Relation to the Water Framework Directive Produced by Working Group 2.9 – Public Participation - Office for Official Publications of the European Communities

2. Overview of the tools of capitalising projects

Toolbox focuses on the integration of the results and tools developed in the selected Interreg Central Europe (CE) projects and other EU projects, reviewed in D.T1.1.1.

2.1. The main capitalised projects – four selected CE projects

The focus of the four selected CE projects (FRAMWAT, PROLINE-CE, RAINMAN and SUSTREE) is set on the climate-proof management of water related issues, recognizing common achievements of four transnational cooperation projects in the programme area of Central Europe. They are sharing several focus points:

- floods/heavy rain/drought risk prevention (FRAMWAT, PROLINE-CE, RAINMAN),
- small water retention measures (FRAMWAT, PROLINE-CE, RAINMAN),
- protection of (drinking) water sources through sustainable land-use management (PROLINE-CE),
- forest adaptation process (SUSTREE).

The catalogues of measures were specific outcomes of three projects (PROLINE-CE, RAINMAN, FRAMWAT) and are recognized to be the core of the harmonization process. The catalogue of measures and its use will be one of the cornerstones of the TEACHER-CE toolbox we are conceptualizing in this report.

Recognizing several shared focus points of the four projects subject to capitalization there are also some individual characteristics and developed tools related to each one of them which could be capitalized in the framework of TEACHER-CE project.

Overview of the key features addressed by the four selected CE projects integrated in the TEACHER-CE project is presented in Figure 2 and Table 1.

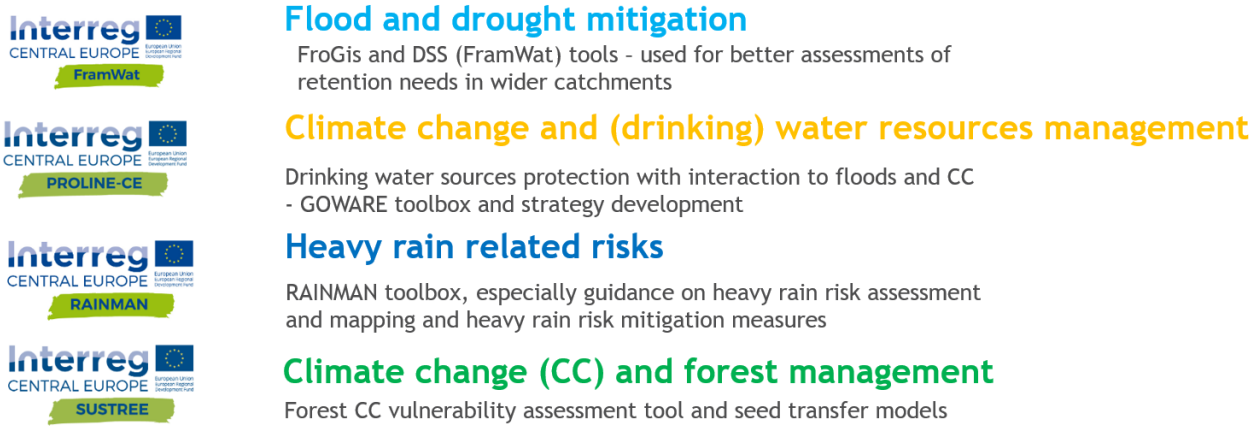


Figure 2: Overview of the key features addressed by the Central Europe projects integrated in the TEACHER- CE project.

Table 1: Overview of the key features of the tools integrated in the TEACHER- CE project

FRAMWAT:	Development of the two-stage system of sub-basin status identification, static tool assessment (simplified modelling), dynamic tool assessment (modelling), development of concept plan and action plan for the implementation of mitigation measures based upon the non-structural small water retention measures. Use of the GIS DSS tools on different level of this process. Focus on floods, droughts and water quality. Climate change impact and adaptation process in not addressed.
PROLINE-CE:	Focused on the groundwater protection zones for drinking water supply, interaction with floods and forest management. Development of complex catalogue of measures related to drinking water protection, including CC and nonstructural flood measures, which are related to the pilot actions. AHP decision support tool uses this catalogue of measures as a core DSS component of the project.
RAINMAN:	Catalogue of measures to mitigate heavy rain risks. The RAINMAN toolbox informs about risk mitigation measures and does not depend on climate related changes (whereas the implementation of some of the measures by the user would depend on it). The RAINMAN-Toolbox guidance the adaptation process of municipalities and regions related to heavy rain risks with the assumption that heavy rains events will increase in the future.
SUSTREE:	SUSTREE: Identification of vulnerability of forest species/structure to climate change. Climate change indicators addressed; specific application developed.

2.1.1. FRAMWAT

FRAMWAT DSS (Figure 3) application was created for people involved in planning water retention measures to mitigate the effects of drought, floods and surface contamination by biogenes.

The goal of the application is to familiarize the user with the catalog of Natural Small Water Retention Measures (NSWRM) and the planning process as well as to survey his preferences for his area of interest. An additional function is to help the user in making a decision about the location and type of measure and to develop a report, based on which the user will be able to develop the concept and prepare the necessary permits for their implementation. An available set of data, tools, guideline and procedures (methods) enables the assessment of cost and efficiency of different combinations of NSWRM at the catchment scale.

The application is designed for users such as: governmental units dealing with the coordination of measures in the catchment, province or country; management boards of catchment areas, protected areas, communes, forest districts; non-governmental organizations and individual users.

The application is open source and was funded by INTERREG Central Europe project name FramWat "Framework for improving water balance and nutrient mitigation by applying small water retention measures".

The tool is available at: https://planning.waterretention.sggw.pl.

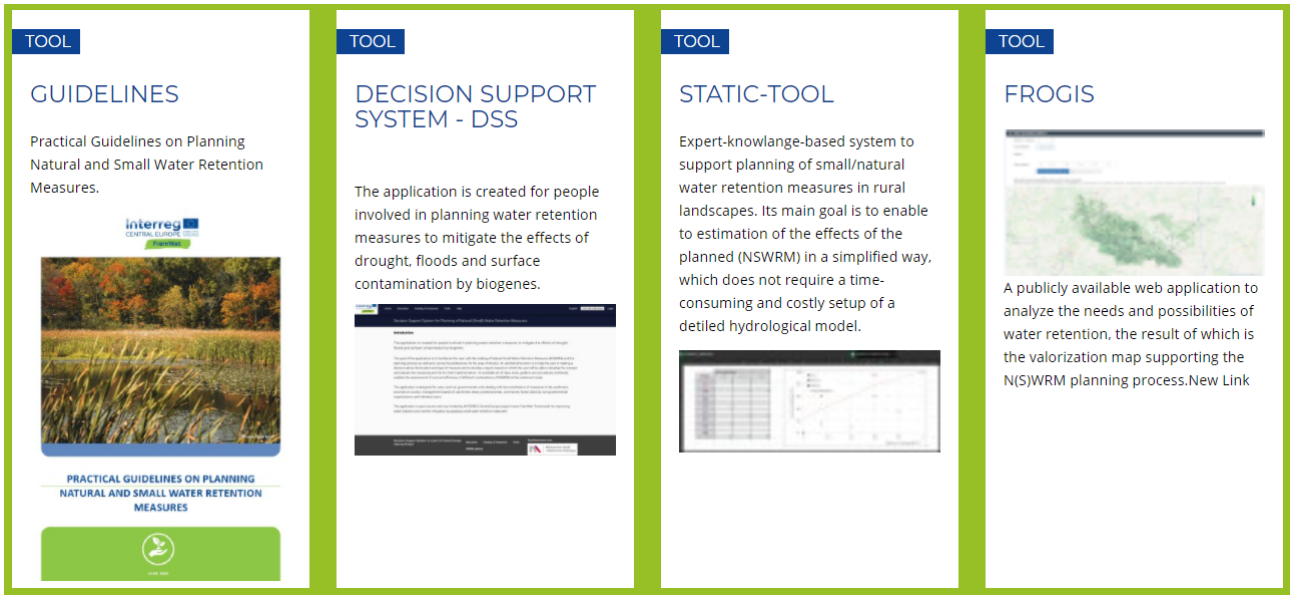


Figure 3: FRAMWAT Toolbox of containing key components of the FRAMWAT project: FROGIS, STATIC-TOOL, DECISION SUPPPORT SYSTEM – DSS.

2.1.2. PROLINE-CE

The Transnational Guide towards Optimal WAter REgime (GOWARE) has been developed as a Decision Support Tool (DST) in the framework of the PROLINE-CE project. Its main objective is to support interested Users and stakeholders in the decision-making process for the selection of the most suitable Best Management Practices (BMPs) for sustainable land use, drinking water management and flood risk protection. GOWARE design includes two main stages of analysis:

Stage 1 – Analysis scoping: this phase consists in defining the context that appropriately represents the issues that the User is facing in the decision-making process. It permits reducing the list of the suitable options among the full catalogue included in the tool.

Stage 2 – Criteria ranking: this phase consists in assigning a "relative importance" to a number of characterizing criteria by means of pairwise comparisons, i.e. considering the defined criteria two-by-two. It permits ranking the alternatives according to the preferences of the different Users.

Two different versions of GOWARE have been released:

(1) GOWARE toolkit (Figure 4) works as off-line tool (Excel-based) and it is aimed at supporting the decision-making processes carried out by both single User (in off-line mode) and groups of Users.

(2) GOWARE web-tool (Figure 4) is designed for supporting online decision processes carried out by a single User (in online mode; http://proline-ce.fgg.uni-lj.si/goware/).

Main feature of the GOWARE PROLINE-CE toolbox is the adoption of the Analytical Hierarchical Process permitting to rank more and less suitable BMPs according to the perspective of the single User able to weight the relative relevance of the criteria characterizing the BMPs.

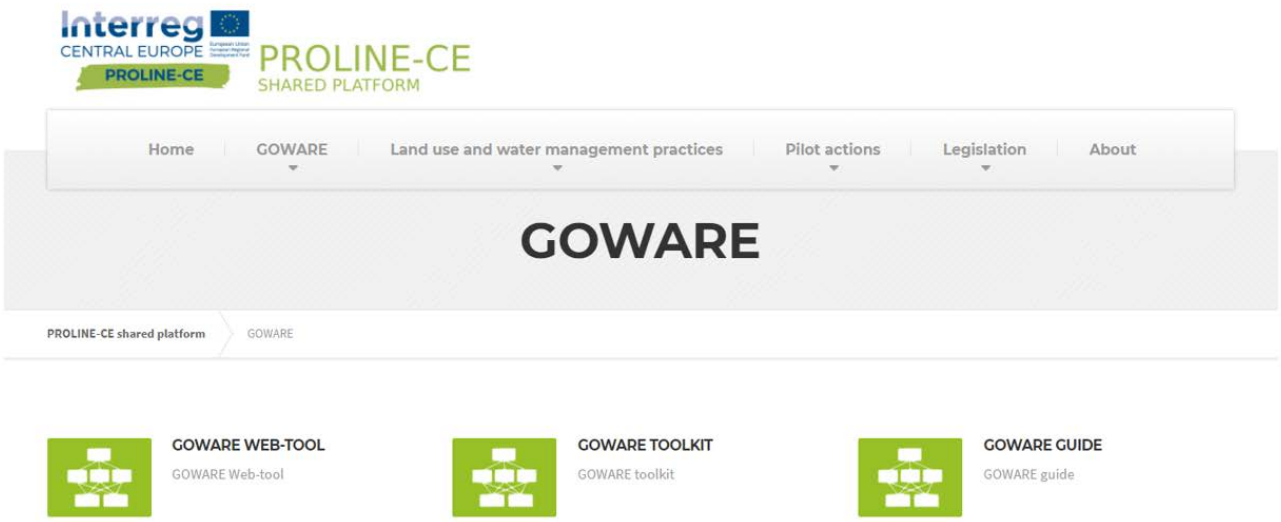


Figure 4: PROLINE-CE Toolkit – GOWARE

2.1.3. RAINMAN

The RAINMAN-Toolbox (Figure 5) aims at reducing the risks of heavy rain events by capacity-building for local public administration on integrated heavy rain risk management. Therefore, the toolbox includes innovative methods and tools for the integrated management of heavy rain risks by public authorities.

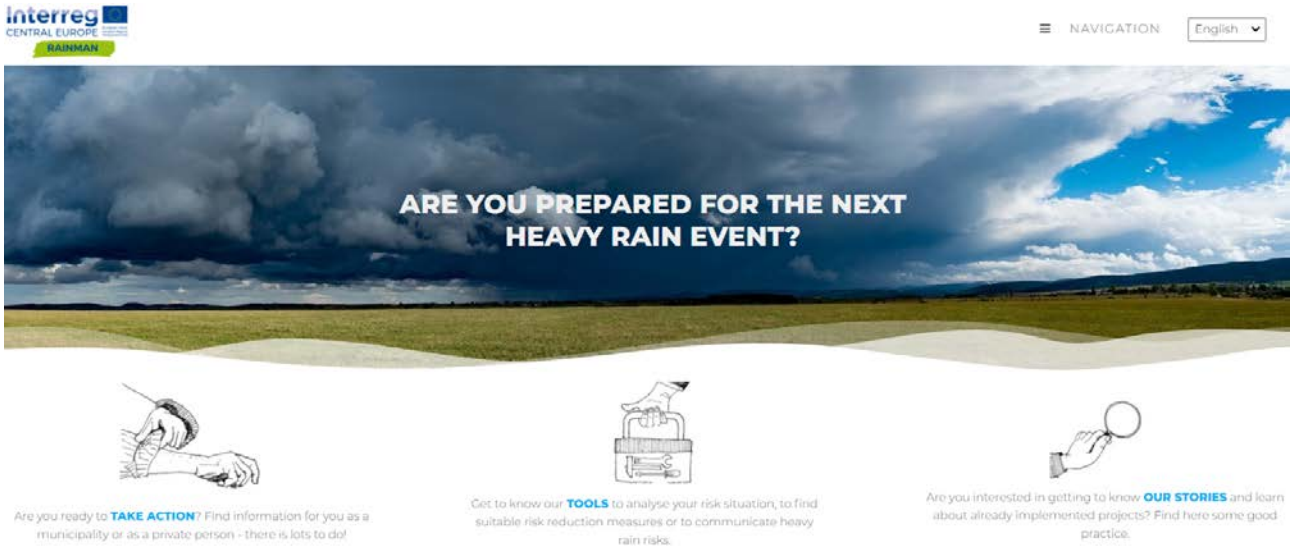


Figure 5: RAINMAN Toolbox

An online knowledge platform (Figure 5) offers good practice examples and guidance on:

(1) assessment and mapping,

(2) a catalogue of risk reduction measures with additional detailed information on retention, prevention, spatial planning, early warning and emergency response and

(3) risk communication.

The RAINMAN-Toolbox is available on http://rainman-toolbox.eu/

2.1.4. SUSTREE

The SUSTREE toolbox is a delineation model for forest seed transfer and genetic conservation, based on species distribution models and available intra-specific climate–response functions with updated species distribution and seed transfer models, harmonization of national databases for national registers of FRM and awareness raising for an adaption of international legislature framework.

The tool **SusSelect** (Figure 6) is aimed at assessing the vulnerability of forests to climate change and identifying adapted seed sources. It has been developed as an application for smartphone that displays the vulnerability of seven European tree species under current and future climate conditions. The toolbox was updated into an online decision support tool after the project.

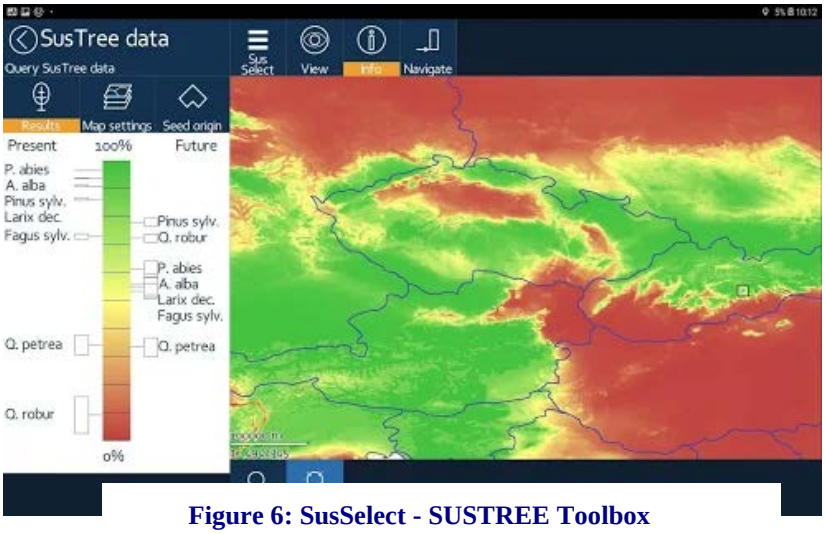


Figure 6: SusSelect - SUSTREE Toolbox

Key features of the SusSelect tool:

- DSS – Climate change impact
- Forest species – impact and adaptation process
- DSS for the adaptation

The tool is available at: https://play.google.com/store/apps/details?id=com.topolynx.susselect&hl=en

2.2. Integration of other directly exploited projects

Besides four selected main projects, the CC-ARP-CE tool and its catalogue of measures will eventually also integrate catalogue of measures and/or tools form the other EU projects analysed in D.T1.1.1, as listed below:

- LUMAT (CE): DSS (LumaTo) tool and action plan for sustainable development on threatened sites by integrated stakeholder management emphasizing CC adaption processes.

  https://www.interreg-central.eu/Content.Node/LUMAT/LUMATO-tool-manual.pdf

- Life Local Adapt (LIFE): tool supporting CC adaptation of communities - rollout of CC adaptation strategies.

  https://www.life-local-adapt.eu/en;https://rekisviewer.hydro.tu-dresden.de/fdm/ReKISExpert.jsp. The beta version is available at the following webpage: https://rekis.hydro.tu-dresden.de/

- Fairway (H2020): Farm water management to mitigate diffuse pollution of vulnerable drinking water resources; measures for groundwater.

  https://www.wur.nl/en/article/Annual-Nutrient-Cycling-Assessment.htm

- DRIDANUBE (DTP): DroughtWatch tool, Drought Risk mapping method, drought management measures. https://droughtwatch.eu/

- Copernicus Climate Change Service (C3S) Sectoral Information System “Disaster Risk Reduction” downscaling at very high resolution (about 2 km) of the fifth generation of ECMWF reanalysis (ERA5) for reconstructing urban flooding past events dynamics.

https://climate.copernicus.eu/pluvial-flood-risk-assessment-urban-areas

- Demo Case "Soil Erosion" (C3S): it developed datasets and applications for quantification of potential soil loss due to rainwater erosion for both recent decades and future time over Italy. https://climate.copernicus.eu/soil-erosion
- KAMPINOS (LIFE): Verification of the effectiveness of natural small water retention measures, toolbox validation. http://www.kampinoskiebagna.pl/opis-projektu,en
- JOINTISZA (DTP): Flood measures, governance (cooperation River Basin Management Plan - flood risk prevention). http://www.interreg-danube.eu/approved-projects/jointisza

2.3. Synergies with other not directly exploited projects

Synergies with twelve projects which will not be directly exploited in the TEACHER-CE project were identified in the D.T1.1.5 report. These projects are: CE: boDEREC-CE; DTP: CAMARO-D, Danube Floodplain, DAREFFORT, REFOCuS; H2020: Shui & OPERANDUM, LIFE+: ReQpro; CEF Telecom HIGHLANDER; CBC DE-CZ: STRIMA II – cross-border flood risk management, CBC DE-PL: NEYMO-NW, TRANSGEA. The following overview of the projects gives a description of the respective tools and their objectives:

- boDEREC-CE (CE): the decision support system modePROCON will provide information about potential model applications for different substances in different kinds of environments.
- CAMARO-D (DTP): Best Practice Catalogues (BPC), GUIDR (guidance for sustainable land-use planning) for improving of transnational water management and flood risk prevention. Adaptation of spatial planning can mitigate flood risks and protect drinking water.
- Danube Floodplain (DTP): many tools supporting a prioritization of existing and former floodplains with regard to the FD and WFD as well as with regard to the requirements of the Birds and Habitats Directive and Biodiversity Strategy; determination of priority areas with potential preservation, restoration areas and associated measures in terms of flood risk reduction and ecological improvement.
- DAREFFORT (DTP): Evaluation report of flood and ice forecasting systems and methodologies in the Danube countries): the tool aims to optimize flood and ice forecasting collaborations in the Danube River Basin.
- REFOCuS (DTP): many tools supporting the adaptation of forests to climate change. Tool 1 focuses on species distribution models (SDMs) and their application in changing environments for 7 Riparian forest species. Tool 2 looks at the transnational seed transfer zones for key riparian tree species.
- CEF Telecom HIGHLANDER: DApOS - Downstream Application and preOperational Services for demonstrating the potential and further need of High-Performance Computing (HPC) to support robust climatesmart land management.
- SHui (H2020): Best Practice Examples – case studies for transnational water management for a sustainable hydropower use and to support the cooperation between Europe and China.
- ReQpro (LIFE +): the tool for tracing the use of treated wastewater for irrigational purposes and optimizing its management in the general frame of water resources management and distribution for associated farmers.
- STRIMA II (CBP DE-CZ): –CB flood risk management (Catalogue of funding measures); tool (DSS) provides funding options for suitable flood risk prevention measures for municipalities, entrepreneurs, farmers and private persons.

- NEYMO-NW (CBP DE-PL): TWCIW - Transboundary Virtual Water Resources Information Center - good practice examples and guidance on the assessment of drought hazards in present climate conditions and under future conditions based on climate change scenario as well as on risk communication.
- TRANSGEA (CBP DE-PL): Map of sensitivity of selected sectors (health, tourism, forestry, transport, agriculture, biodiversity) and areas in particular Polish-Saxon and support for local administrations and other stakeholders in selecting appropriate adaptation measures to climate change.
- OPERANDUM (H2020): project focuses mainly on hazards caused by landslides or storm, while the TEACHER-CE project focuses on hazards caused by heavy rainfall, floods and drought.

The results of these projects, above all tools and catalogues of measures, which could be integrated into the toolbox, will be further analysed in T2 during the Toolbox development (D.T2.1.5).

3. Integration Approach for the CC-ARP-CE toolbox

Integration of different tools and processes from different projects in one single toolbox is always a difficult task. Different projects have different background, focus, supporting different decision processes, and above all different target users. Developing a toolbox which would integrate selected tools of all projects that are subject to capitalization (FRAMWAT, PROLINE-CE, RAINMAN, SUSTREE) as well as other projects and developments with similar thematic area can basically follow three approaches (Figure 7):

APPROACH 1: Development of a **toolbox** that is in its core enabling supported switching among the tools developed by previous projects. Development of such intelligent switching is by itself not a straightforward process, having in mind the differences among the projects. Main challenge and drawback would be the user experience – event with the well-developed switching mechanism there is a significant risk that the user would be confused when observing the gaps and potential inconsistencies among different project specific tools.

APPROACH 2: Development of completely new integrated toolbox that would encompass all the results and tools from previous projects. Ta advantage would certainly be in eliminated risks from the "approach 1", but new development of the tools encompassing all previous endeavours would be beyond the scope of the TEACHER-CE project and available resources for that.

APPROACH 3: Approach 3 is integrated, combined approach – which takes the best from the "Approach 1" and "Approach 2". The integrated approach is providing links to the tools developed within the past projects, while at the same time upgrading them with selected new integrated features recognized as important by the TEACHER consortium of partners and future users, which were communicated during the 1st national workshops.

The discussion among the partners was focused on the integrated (e.g. an "umbrella Tool") approach, which would to large extent integrate the advantages of both basic approaches (1 and 2) and reduce their identified shortcomings. An "umbrella Tool" (a "landing page") will provide a readable structure and a good navigation through the tool and a feasible development.

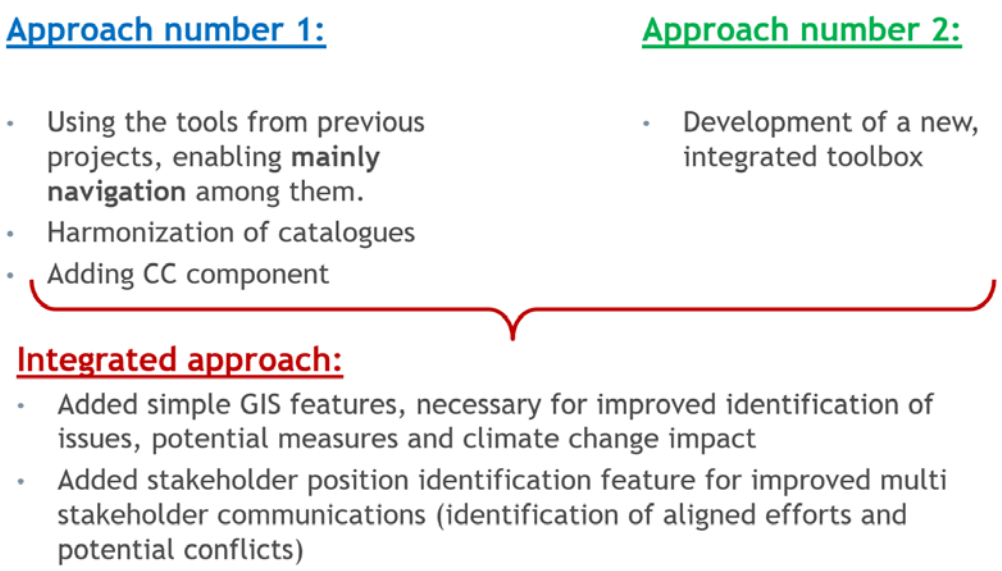


Figure 7: Overview of the potential approaches

4. Concept of the CC-ARP-CE toolbox

The TEACHER-CE CC-ARP-CE ‘’Umbrella’’ Tool integrates catalogue of measures, GIS features, link to EU legislation and climate change maps and climate indicators (Figure 8). Integration of many components (or their parts; listed in Figure 8) into a single toolbox is a challenging task, nevertheless such toolbox is filling an important gap, while at the same time keeping the position of other tools quite intact from the point of view of their process role, legal status, maintenance framework and other aspects.

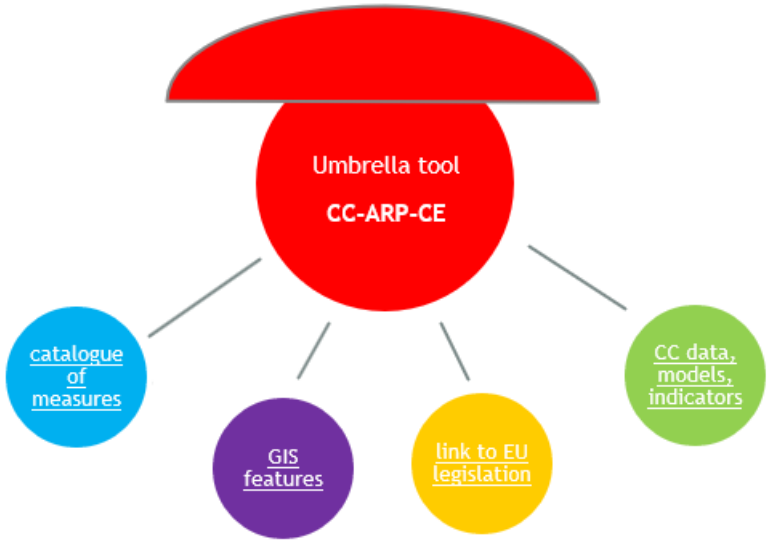


Figure 8: Components of the CC-ARP-CE toolbox

The CC-ARP-CE aims at the integration of different views. The users provide their ideas/issues/problems within a specific sub-river basin (Figure 9) and communicate via this tool also with the national tools which are already established for the implementation of the WFD. The tool has a simplified GIS function, which provides spatial orientation and provides information on the climate change models and results of climate change for specific sub-river basins analysed. Climate change data and models will provide a climate proof tool, valid for different extreme events (mitigation measures that are relevant for floods but do not negatively influence risk management strategies for droughts) and still valid in case of changing climate conditions.

A specific task is the development of the harmonised catalogue of measures (Figure 9). If the issues are net of specific river basins linked to national water management and to potential infrastructure measures identified in the previous projects, this information goes back to the group of stakeholders, where they can see the issues of other stakeholders (aggregated/integrated issues) and can also see the proposed measures and deposition of other stakeholders' views on how other stakeholders view the proposed measure. This provides an improved platform for communication between stakeholders on the proposed measures.

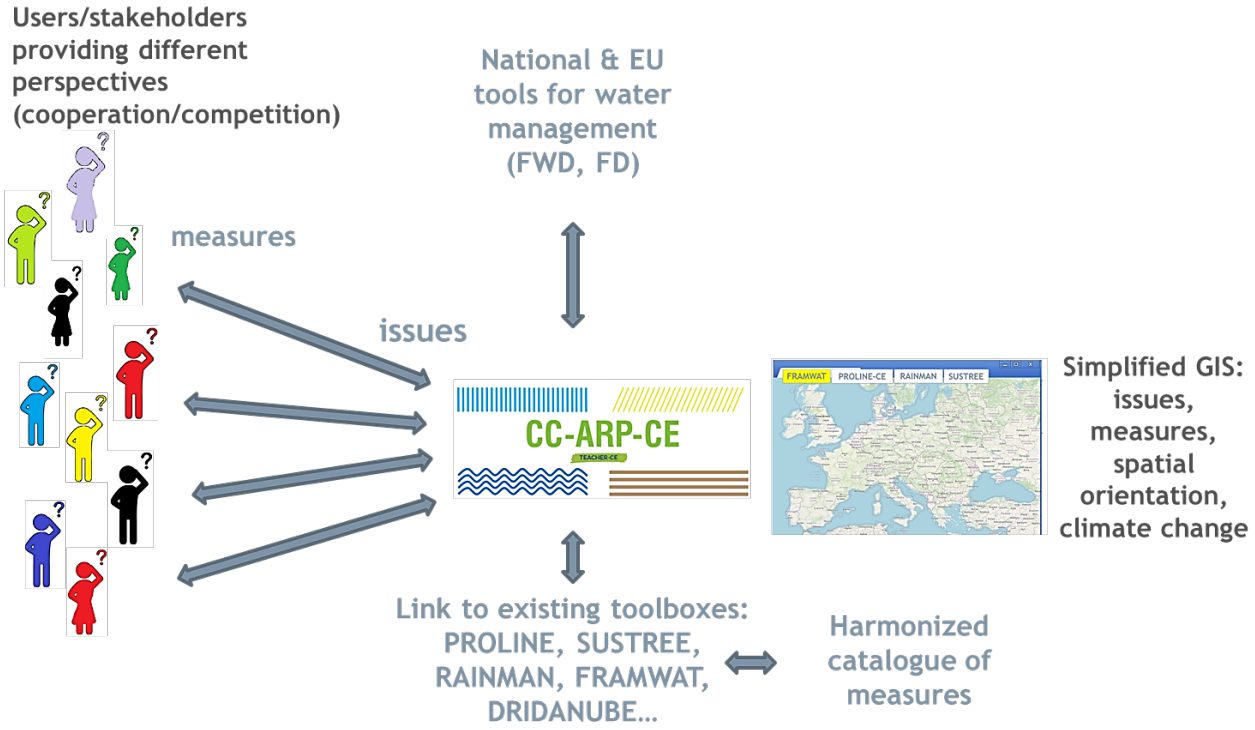


Figure 9: Conceptual scheme of the Toolbox

4.1. Toolbox workflow

Each specific user can identify own issues (Figure 10) and enter selected topics in the toolbox and see how this topics relate to the evaluation tools developed in other projects, understands the issues and the proposed measure form the other users, see these issues on the map and also allow them to identify the CC models for their area (what are the trends and how are these trends related to his issues and measures) and what is the information related to the national tools for water management (WFD & FD).

The result of using this tool would be the issues of all stakeholders identified on a platform with a ranking of the measures from the catalogue, including the assessment of the impact of CC and the reference to the national water management tools. This will support the development of river management plans and the integration of green infrastructure in specific river basins.

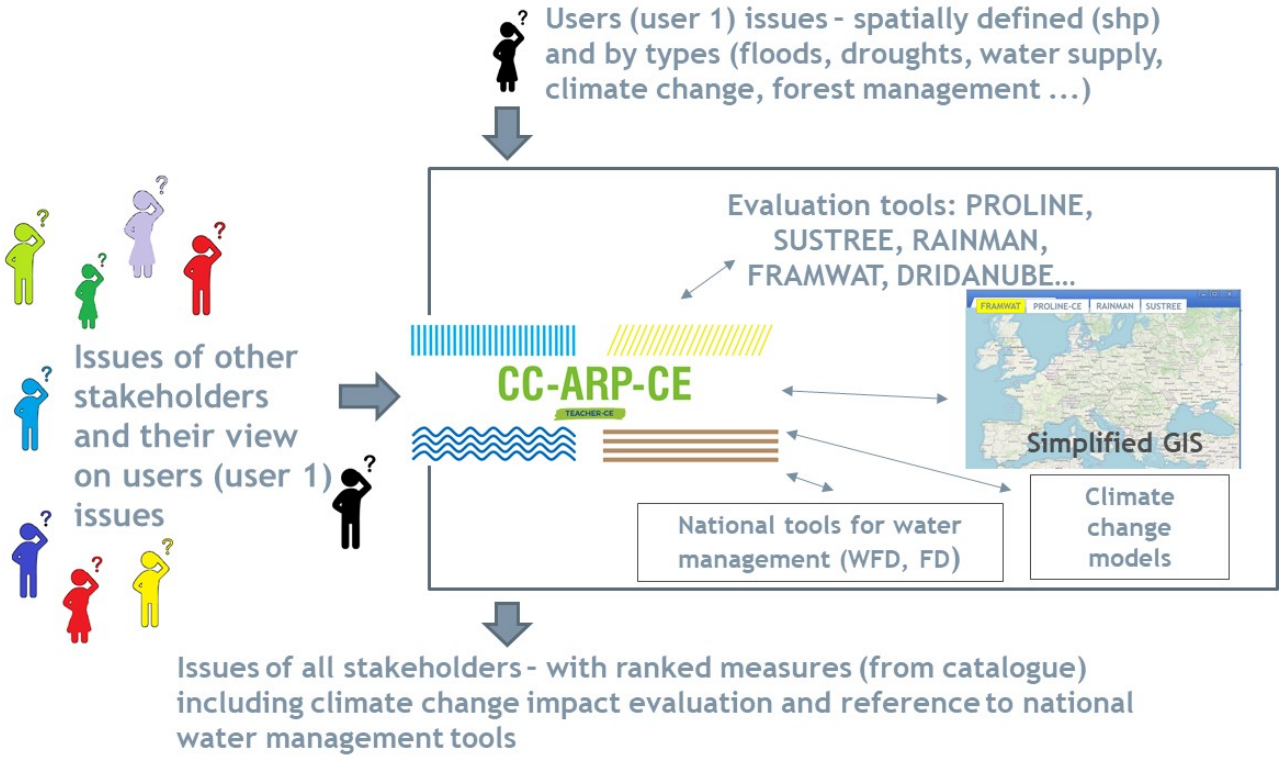


Figure 10: Toolbox workflow

4.2. Cross-sectoral aspects on water resources and identification of climate change impact

The concept of competition for limited resources (water resources in the case of the TEACHER-CE project) and competition among the water management and land use / spatial planning is a well-known challenge (Figure 11), which is historically part of the water resources management and allocation. Potential climate impacts on water availability and water quality could affect surface water, groundwater and coastal water. In D.T1.1.3, several fields of actions of the water management sector were identified that are affected by climate change. For the purpose of wide use of the TEACHER-CE toolbox, the terminology used in D.T1.1.3 was updated with expressions used in EU legislation and strategies and from other strategies (WMO, GWP, WHO, etc.); see Appendix 1. Seven fields of actions of the water management sector were identified that are relevant for the TEACHER-CE:

- Fluvial flood risk management
- Pluvial flood risk management
- Groundwater management
- Drinking water supply management
- Irrigation water management
- Water scarcity and drought management
- Management of water-dependent ecosystems
- Urban wastewater collection and treatment (management)

Potential conflicts caused or intensified by climate change between different sectors arise from increased competition for land use. Adaptation needs in the water sector often require restrictions on land use for other sectors. Adaptation options cover a wide range of possible structural (e.g. construction of flood protection walls) and non-structural measures (e.g. adapted land use planning, awareness raising or adaptation of management). Whereas the tools (toolboxes) used for the status identification of impacts on water resources (water bodies, flood hazards, emissions, treatment and similar concepts) are relatively common. There is still a question if identification of cooperation and competition has to be part of the toolbox.

The TEACHER-CE toolbox has an ambitious goal to address this challenging domain as well. The approach is probably part of the WFD planning and decision-making processes (WFD CIS Guidance document No. 9 – Public Participation in relation to the Water Framework Directive), the overall conflict identification and resolution process is still recognized as a challenging issue, which is part of the water governance process.

Aim of the TEACHER-CE toolbox is to identify the position of the users of the toolbox and along with that identify synergies and conflicts among different professionals/sectors/views which are also mirrored in the selection process of measures (which are part of a catalogue).

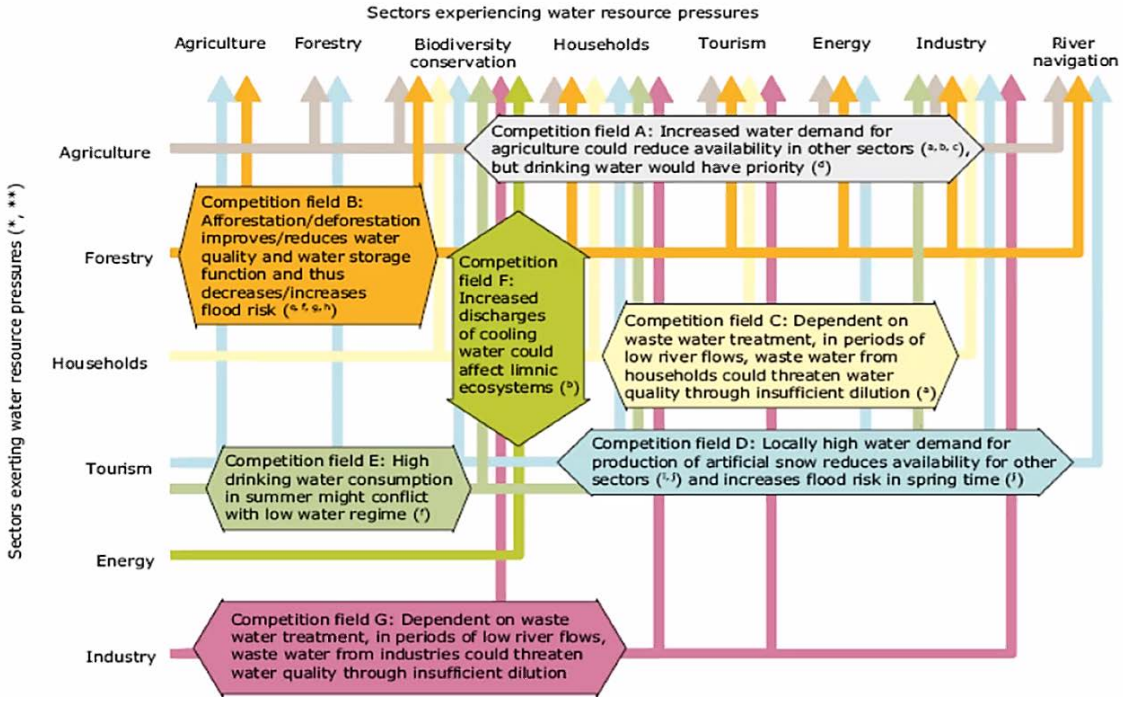


Figure 11: Fields of potential cross-sectoral water competition relevant for climate adaptation (EEA, 2009)

4.2.1. Climate change data and climate proofing

According to D.T1.1.2 and D.T1.1.3, climate change indicators are aimed at providing information about the occurrence and severity of weather-related events. The anomalies between future time spans and the current period permit evaluating the potential impacts of climate changes. Of course, it is well to recall that they could have a limited information content compared to the results of physically based approaches (more time- and resource-consuming). Nevertheless, the indicators represent a consolidated, reliable, and prompt approach to give insights about several dynamics. In this regard, more than 40 indicators have been selected by considering Users and Project Partners requirements, starting from several variables (temperature, precipitation, snow). They consider several greenhouse gases scenarios, and time frames. They are also localized to specific location in different ways depending on the resolution applied. Their

usage is to certain extent subject to sensitive interpretation and should be applied with necessary interpretations and explanations.

4.3. National & EU tools for water management

Nowadays development of any toolbox in the field of water management must be fully aware of already existing, often also legally binding toolboxes, which are closely related to the implementation of EU legislation:

- Water Framework Directive (WFD),
- Floods Directive (FD),
- Urban Waste-water Treatment Directive (UWWTD),
- Nitrate Directive (ND),
- Drinking Water Directive (DWD),
- Bathing Water Directive (BWT),
- Industrial Emissions Directive (IED, ex. IPPC),
- Priority Substances Directive (PSD)

While some country level toolboxes are quite target oriented towards the mechanisms addressing specific directive, some are more horizontal, encompassing more complex view on water management.

Navigation among the universe of these tools is already a challenge, sometimes even for the national experts, which are continuously following these tools, their status, concepts, and often continuous upgrading and modifications. This issue was also raised on several national consultations performed in order to verify and position the anticipated toolbox adequately.

Therefore, the existing National links to different tools (data portals, reports, legislation, etc.) have to be considered. PPs presented their national tools supporting WFD (RBMP 2015-2021) and Floods directive in the country and focus on the preparation of the 3rd generation of RBMP (2022-2027), at the second TEACHER-CE project meeting PW2 on July 16, 2020. PPs will also provide the links to their national tools for the overview of the existing national tools and to enable the access through CC-ARP-CE. The links will be further categorized by its content and structured into Fields of actions (categories described in D.T1.1.3) with subcategories. This Water navigation node will provide a transparent overview of the existing national tools accessible through the CC-ARP-CE.

In addition to the national toolboxes, which are usually disclosing status of specific sub-component of water management, there are also EU tools, usually managed by the European Environment Agency (EEA):

- **EIONET**

The European environment information and observation network (Eionet) is a partnership network of the EEA and its member and cooperating countries.

The EEA is responsible for developing Eionet and coordinating its activities. To do so, the EEA works closely with national focal points (NFPs), which are typically based in national environment agencies or environment ministries. NFPs are responsible for coordinating national networks, involving many institutions.

NFPs are responsible for coordinating networks of national reference centres (NRCs), bringing together experts from national institutions and other bodies involved in environmental information.

Taking up its work in 1994, Eionet has become a well-known and trusted provider of high-quality data, information and assessments for Europe.

The concept of Eionet encompasses the following defining elements:

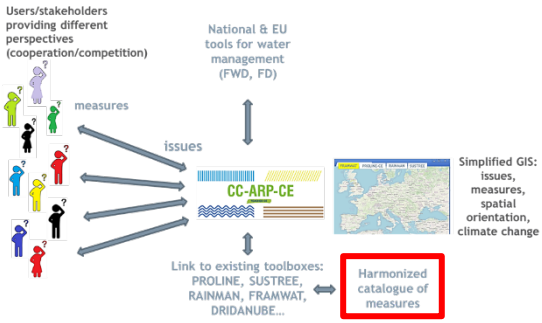
- Strong institutional cooperation across several levels (national, regional, European, international) as well as partnerships with civil society, facilitated by a coordinating entity.
- Agreed common content — data, information, indicators, analysis.
- Shared infrastructure, standards and tools.

- **CIRCA**

CIRCA (Communication & Information Resource Centre Administrator) enables to maintain a private shared workspace for the exchange of data and documents and participation in discussion forums to individual communities (committees, working and project groups, etc.), which may be geographically dispersed across Europe. Circa applications are installed on the servers of many EU institutions and bodies, including European Environment Agency (EEA) and in all member countries. Most national experts participating in the EIONET network in each country use Circa in their own country, but there are usually also CIRCA - EEA users, some also CIRCA - EC (DG-EN) or CIRCA - Eurostat on European Commission.

4.4. Harmonised catalogue of measures

Some existing tools are based on identification and filtering of priorities related to the catalogue of measures. The catalogues of measures from directly exploited projects (see chapter 2.1 & 2.2) will be harmonized and measures will be classified into domains (land use type, water management issue) by the assigned expert group. When catalogue of measures will be harmonised, the next step will follow, which is assigning relative importance according to the ranking of selected criteria.



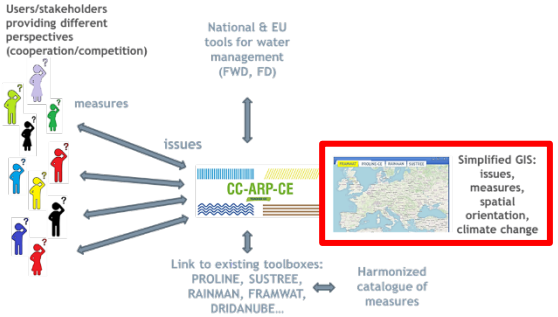
Not all projects from the list of exploited projects produced catalogues, some of them produced modelling tools instead. These projects could be integrated into our toolbox in two different ways: i) as links to the tools and ii) within the catologue as a measure, which will introduce this modelling tool. Catalogues will be integrated into one big catalogue of measures.

4.5. Links to existing toolboxes of the direct exploited projects

In the toolbox there will be also direct links to the existing toolboxes of the direct exploited projects, which are described in chapters 2.1 and 2.2.

4.6. GIS features of the tool

Some existing DSS tools are GIS based. Existing projects with active GIS tools are FRAMWAT and SUSTREE with integration of issues and priorities (e.g. floods in FRAMWAT and species composition in SUSTREE) and enable guiding towards the selection of measures from the catalogues (DSS) (FRAMWAT).



The use of the CC-ARP-CE toolbox should be easy but at the same time at higher level since the necessary data and information usually contain sophisticated features and it is

necessary to set up a well working tool. Geographic Information System (GIS) displays geographic data on digital maps and allows user to browse quickly and simply through the tool, whereas downloading and using large grid data of climate etc. is only for advanced users.

For the development of the TEACHER-CE toolbox with the integrated climate change adaptation process, the computed anomalies in indicators will be provided as maps using the native grid resolution and at aggregated level (Country, NUTS1, NUTS2, NUTS3). Furthermore, a focus for each Pilot Action is provided where information about recent decades (from E-OBS) and future time spans (from EURO-CORDEX). Based on the climate projections obtained by means of the ensemble of the EURO-CORDEX simulations, the selected climate indicators have been evaluated in D.T1.1.3 for two future time periods: 2021-2050 for the short-term analysis and 2071-2100 for the long-term analysis. The indicators selected for further evaluation are: seasonal temperature and cumulative precipitation values, consecutive dry and wet days and maximum daily precipitations (related to the precipitation pattern) and the number of summer and frost days (related to the temperature pattern). The full set of all the statistical values will be available online on the web-platform in form of table and maps to be downloaded by interested advanced end-users.

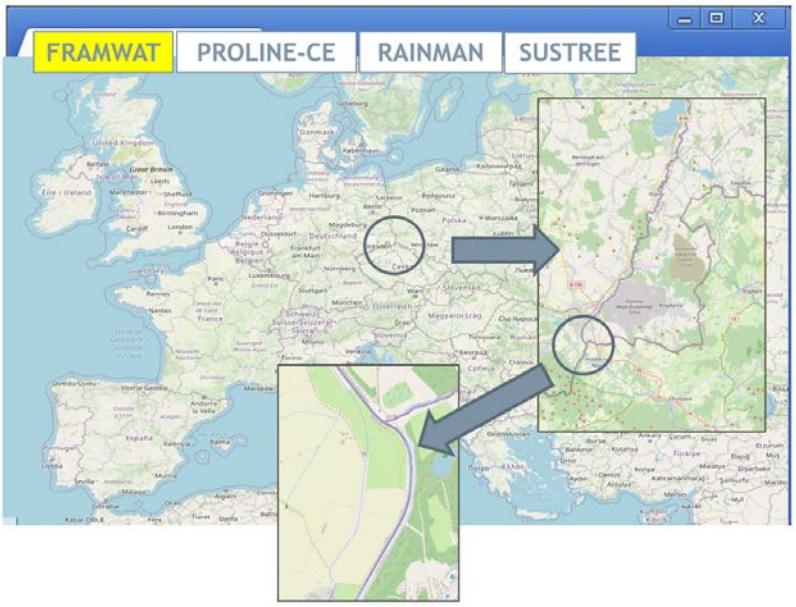


Figure 12: Example of a GIS based tool

5. National consultations and the TEACHER-CE Toolbox

The concept of the toolbox was presented at the 1st start-up stakeholder workshops (D.T1.2.4), which took place in the TEACHER-CE partner countries in the autumn of 2020. Having in mind the integrative concept, the aims of the toolbox and the final users, it was extremely important for the partners to obtain the feedback from the experts and institutions to identify which features of the toolbox they would deem as utmost necessary. The main stakeholder feedbacks regarding the toolbox recommendations are gathered in the Table 2.

The involvement of Associated Partners in a very early stage of the Toolbox development and later by its validation will ensure sustainability of the project outputs. Project partners test TEACHER-CE Toolbox in pilot actions and have tasks addressed by the different partner institutions' roles, which will continue in the future.

The involvement of ASPs in a very early stage of the Toolbox development and later by its validation will ensure sustainability of the project outputs. PPs test TEACHER-CE Toolbox in pilot actions and have tasks addressed by the different partner institutions' roles, aiming at the successful use and development of the toolbox in the future:

- governmental institutions: guidelines implementation;
- water suppliers: implementation of measures for drinking water protection;
- municipalities: sustainable land use management for water protection and risk prevention;
- research institutions: assessing and applying research results and dissemination.

The same objective verification of the requirements of the final users, we are also following the set objective of the defined target users, institutions applying new/improved tools and services (18 of them). Specific types of institutions were envisaged by the AF: municipalities, associations of municipalities, water suppliers, water and forest authorities. With the identified institutions as the end users (primarily municipalities) we are aiming at the bottom-up focus of the toolbox, recognizing that top-down approaches usually apply to the central government level institutions, which do not necessary meet the views and expectations of the end-users – people and their first level of the government – municipalities[3].

[3] European Charter of Local Self-Government; Treaty No.122 (1985)

Table 2: Analysis of stakeholder feedback on the Toolbox concept (needs, requirements, suggestions) from the 1st national consultations in partner countries

AT	The stakeholders want to have insight into the whole catalogues of Best Practices for the respective thematic areas; prior interest for water protection issues; the selection procedure should be transparent.
HU	One of the components of the toolbox should be a guidance on developing these water usages for multi-purposes (irrigation, ecology, fishing, etc. This guidance should contain: • an estimation of the volume of usable sources, • recommendations for storages and other possible solutions of usages, • an example CBA analysis to understand the importance and seriousness of these measures.
PL	The key issue of toolbox should be functionality. On the one hand, the toolbox should be general enough to allow everyone to use it in a way that does not require much training. On the other hand, it is also important that it should be expanded enough to allow trained people to use it in a more professional way. Furthermore, it is important that the toolbox contains basic knowledge, a directory of good practices and dedicated climate change and risk/threat indicators for each administrative unit.
SI	Desired features and contents of the tool according to stakeholders: cross-sectoral view into the future (projections of objectives and measures), potential flood areas, climate change scenarios, data set (water, environment, nature protection), systematic monitoring of plans and measures on the resolution of watercourses or subbasins, up-to-date digital cadastre of ownership and plots, cadastre of realized connections to the sewerage system, data from detailed municipal plans, records of watercourse maintenance, links to groundwater and surface water monitoring data, water cadastre and water infrastructure, landslide areas, data on natural disasters and damages.
CZ	Generally, the proposed climatic indicators have been found sufficient, though it was proposed that variation in soil water content could also be included. Stakeholders would prefer a simplified user interface (ideally web-based) with detailed instructions and links to pilot actions to learn about the functionality of the combined solution and how the different sectors are connected on a landscape level. Also, a good description of the input data was requested.
IT	Use of clear (and eventually already known) indicators to communicate impacts/effects of technical actions and measures, in order to realize them. Consider even economic indicators. Modularity to ensure clear impact of the different management choices and to “translate” difficult actions/concepts into clear and simple indicators Necessity for a strong integration between measures linked to different water sectors (multi-resource/multi-issues system) To be built in order to sustain steering committee and other discussion tables – one above all the Observatories on water uses.
PL2	Needs: simple, intuitive interface, necessity for including climate projections (so the final user knows what can be faced in the aspect of projected climate changes); Requirements: function of searching for various aspects of a given problem, searching using GIS tools; Suggestions: tasks related to increasing awareness about the issues that are considered in TEACHER and methods to transfer the information to the final users (including simple way of communication).
SK	UTILITY: 1. Comprehensive and harmonized catalogue of measures (58%); 2. GIS feature identifying issues relative to climate change and water management of different stakeholders (53%); 3. Links to existing tools supporting water management processes in your country (47%); 4. Feature on integration of different views on the identified issues/measures (21%). Toolbox must be legally binding for the institutions. Otherwise (personal and financial) resources will not be allocated. Toolbox need be in national language, include national and regional data. - Best practice examples are required for region and / or similar environmental issues and conditions.
DE	Heavy rain, flood risk and drought management are the most important aspects the stakeholders in the pilot area are dealing with. Information should be bundled to make better use of existing planning instruments. Synergies should be identified. This supports the idea to develop an “umbrella tool” that guides through the already developed tools of the exploited projects. It is important that tools are easy to understand. Complex interlinkages of different impacts of climate change may not even need to be communicated in detail, but the possible solutions must be shown. Nevertheless, information on conflicts and synergies needs to be available as basis for planning decisions. The process supporting the implementation of EU legislation in the field of water management (water framework directive and floods directive) is well established. Further support is not needed.

6. Sustainability and transferability of the toolbox

The TEACHER-CE toolbox and strategy is transnational and integrates various viewpoints regarding the water issues of partner countries, therefore several linkages exist for taking up the strategy and adapting it for other regions and/or countries.

The proposed TEACHER-CE project toolbox concept is providing an innovative solution to the integration of different topics, which were not addressed until now. The need for this was identified within the partnership and national stakeholder workshops. The sustainability issue was addressed as a conceptual issue but will be further addressed as the TEACHER-CE project develops. At the final stage any stable organization (i.e. EU EPA, CIRCA, EIONET) or national agencies might use the developed toolbox and adopt it for its own use and include it in a family of national toolboxes. For this purpose, also the family of national and EU toolboxes is part of the TEACHER-CE toolbox.

The Sustainability and transferability will be further discussed in WP T4 (Joint strategy: defining potential commitments in improvement of planning process considering climate change) after the implementation of toolbox in Pilot Actions and stakeholder evaluation of the toolbox.

7. Conclusions

Building on the tools from the existing projects, TEACHER-CE toolbox CC-ARP-CE aims to develop a decision support tool to guide water management stakeholders and local communities to Climate Change Adaptation and Risk Prevention (risk of flooding/heavy rain/drought). The results and tools developed in the selected Interreg Central Europe (CE) projects will be integrated with the "umbrella'' approach as a complex toolbox. This toolbox structure provides links to the tools developed in the past projects, while upgrading them with selected new integrated functions: harmonized catalogue of measures, GIS functions, linkage with EU legislation and CC integration with key indicators.

The CC-ARP-CE tool aims to identify the aspect of the users of the toolbox and to support the user with his ideas/issues/problems within a specific sub-river basin or area with identification and filtering of priorities related to the harmonized catalogue of measures and at the same time to communicate through this tool also with the national tools already established for the implementation of the WFD. The identified synergies and conflicts among different experts/sectors/views, which are also reflected in the selection process of measures (which are part of a catalogue). The tool has a simplified GIS function that provides a spatial orientation and provides information on the climate change issues and models and results from the climate change for specific sub-river basins or areas analysed.

The CC-ARP-CE tool is designed to support climate change adaptation measures and should have a cross-sectoral overview of the future projections of goals and measures and it should be developed to support the practical side of adaptation tasks as efficiently as possible. In order to support the needs of the users, the use of the tool should be simple, but at the same time at a higher level, as the necessary data and information usually contain sophisticated features and are necessary to set up a well-functioning tool.

APPENDIX 1

Development of the terminology for the Fields of Action

D.T1.1.3 terminology	TOOLBOX terminology	
Fields of Action	**Fields of Action in Water Management**	**Sources (relevant strategis and legislation)**
Inland river flood management and protection	**Fluvial flood risk** (management)	**EU Flood Directive**: management of flood risks (prevention, protection, prepardness), aiming at the reduction of the adverse consequences for human health, the environment, cultural heritage and economic activity associated with floods **Fluvial (river) floods** occurr when a natural or artificial drainage system, such as a river, stream or drainage channel, exceeds its capacity (**European Court of Auditors: Special Report Floods Directive, 2018**).
Low water management	**Water Scarcity and Drought risk** (management)	**EU Action on Water Scarcity and Drought** - Policy Review 2012: **Water scarcity**: insufficient water resources to satisfy long-term average requirements; It refers to long-term water imbalances, combining low water availability with a level of water demand exceeding the supply capacity of the natural system (Water Exploitation Index). **Drought** (hydrological, agricultural, meteorological); a temporary decrease of the average water availability due to e.g. rainfall deficiency; imbalances between water demands and the supply capacity of the natural system. see also: **IDMP - Integrated Drought Management programme (WMO & GWP)**
Groundwater protection and groundwater use	**Groundwater management**	**EU WFD** measures for the achievement of good quantitative and chemical status of groundwater & **EU Groundwater Directive** specific measures to prevent and control groundwater pollution **GW management**: both GW quality management (pollution prevention & GW protection) and GW quantity managment (recharge and water use/demand); also risk - unceartainty
Drinking water supply	**Drinking water supply** (management)	**EU WFD**: establishing safeguard zones for bodies of water used for the abstraction of water intended for human consumption (**drinking water sources protection**) **EU Drinking Water Directive**: quality of water intended for human consumption, acess to water intended for human consumption **WHO Guidelines and Water Safety Plan Manual** & **standard EN 15975-2** concerning security of drinking water supply **REMARK**: in TEACHER-CE we are adressing only protection and management of drinking water sources (recharge area) and we are not addressing the entire drinking water supply elements (raw water treatment and drinking water distribution system)
Urban drainage and wastewater treatment	**Urban wastewater collection and treatment** (management)	**EU Urban Wastewater Treatment Directive**: collection, treatment and discharge of urban waste water and the treatment and discharge of waste water from certain industrial sectors; protection of the environment from the adverse effects of the waste water discharges.
Conservation of aquatic ecosystems	**Management of water-dependent ecosystems**	**EU WFD**: the chemical composition of the groundwater body is such that the concentrations of pollutants would not result in any significant damage to terrestrial ecosystems which depend directly on the groundwater body (GDE - groundwater-dependent-ecosystems). **EU DWD**: groundwater should be protected from deterioration and chemical pollution, which is particularly important for groundwater-dependent ecosystems. **Water dependent ecosystems** are parts of the environment in which the composition of species and natural ecological processes are determined by the permanent or temporary presence of flowing or standing surface water or groundwater. The in-stream areas of rivers, riparian vegetation, springs, wetlands, floodplains, estuaries, karst systems and groundwater-dependent terrestrial vegetation are all WDEs. (**Gov. Western Australia, Guidance note 7: Managing the hydrology and hydrogeology of water dependent ecosystems**)
Heavy rainfall and flash floods (management and protection)	**Pluvial flood risk** (management)	**Pluvial flooding** is direct runoff over land causing local flooding in areas not previously associated with natural or manmade water courses (**RAINMAN Policy Breaf, June 2020**). It is caused by heavy rainfall that overwhelms saturated natural or urban drainage systems. The excess water cannot be absorbed and flows out over streets or runs off hillsides (**European Court of Auditors: Special Report Floods Directive, 2018**). **Flash flood** is a flood that rises and falls quite rapidly with little or no advance warning, usually as the result of intense rainfall over a relatively small area (**Glossary of the American Meteorological Society, 2017**). Flash floods occur when heavy rainfall (and/or rapid snowmelt) exceeds the ability of the ground to absorb water and/or the ability to drain the water and the water level rises and falls quite rapidly. Flash Floods can occur also due to Dam or Levee Breaks, and/or Mudslides (Debris Flow). Sustainable Drainage Systems (SuDS) measures are a part of pluvial flood risk management.
Water for irrigation in agriculture	**Irrigation water** (management)	1) Irrigation is mostly meant for irrigation in agriculture: irrigation is the provision of water to help crops grow when rainfall is not sufficient. 2) There are also irrigated parks, sport fields, golf courses and other green spaces. Broader definition: irrigation is management of water for the plants.