



World Meteorological Organization

Regional Association VI

Working Group on Climate and Hydrology

Task Team on Water Scarcity and Drought

WORK PLAN 2014-2017

Silvano Pecora and Sandor Szalai

ISSUES on Water Scarcity and Drought

Water Resources Availability

Drought Monitoring Systems

Prolonged Droughts

Low flows

WMO - RA VI - WG CH
TT Water Scarcity and Drought
Work Plan 2014-2017

Hydrological Predictions

CC Impacts

Hydrological Data Availability

Water Scarcity and Drought Characterization

Integrated Drought
Management Programme



WORKPLAN on Water Scarcity and Drought

Task Team on Water Scarcity and Drought

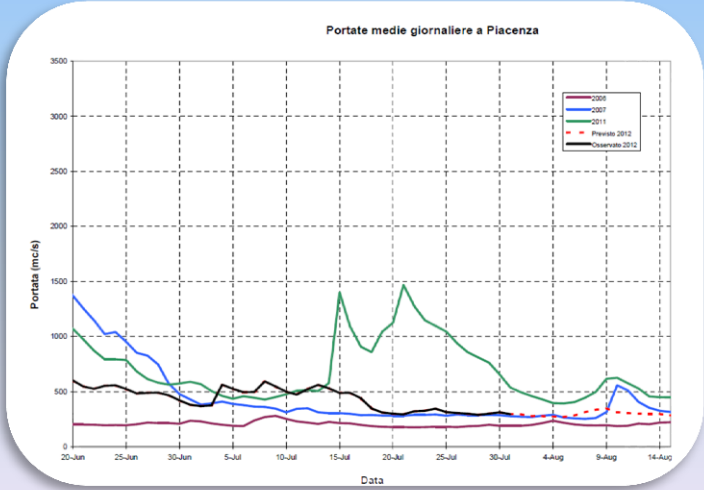
ST	Issues /Themes	Task#	Task	Deliv#	Activity/Deliverable
C+H	Socio-Economic Benefits	12	Develop regional guidance on methodologies for assessing socio-economic benefits of weather, climate and water services	12.1	Review and strengthen drought monitoring systems, especially development and implementation on methodologies as well as application of related information by users, in RA VI countries, considering existing mechanisms as well as deficits in drought information services;
				12.2	Guidance on water scarcity and drought characterization, including different analysis of drought episodes, providing algorithms and tools to monitor the temporal evolution of a drought event and to perform an appropriate assessment of a drought.
				12.3	Review analysis of climate change impacts on water scarcity and droughts by regional climate simulations downscaling global climate projections, coupled with hydrological and water balance modeling chains, simulating the available water distribution in river basin and considering water demand.
				12.4	Improve knowledge on water resources available in European basins and their use, assessing potential impacts of management, technological and economical measures to reduce the vulnerability of the territory against desertification, water scarcity and drought.

ACTIVITIES on Water Scarcity and Drought



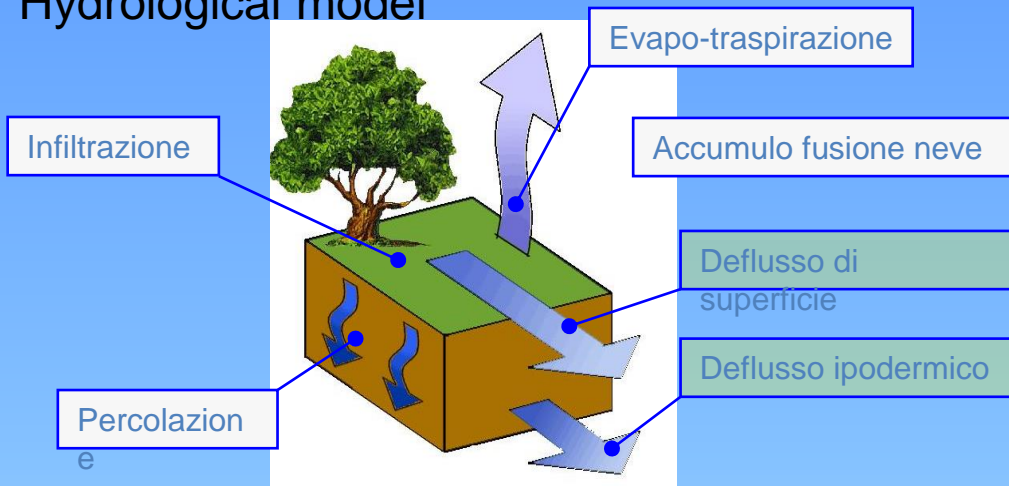
Drought Monitoring Systems

Review and strengthen drought monitoring systems, especially development and implementation on methodologies as well as application of related information by users, in RA VI countries, considering existing mechanisms as well as deficits in drought information services.



Modeling chain for drought forecasting and mitigation

Hydrological model



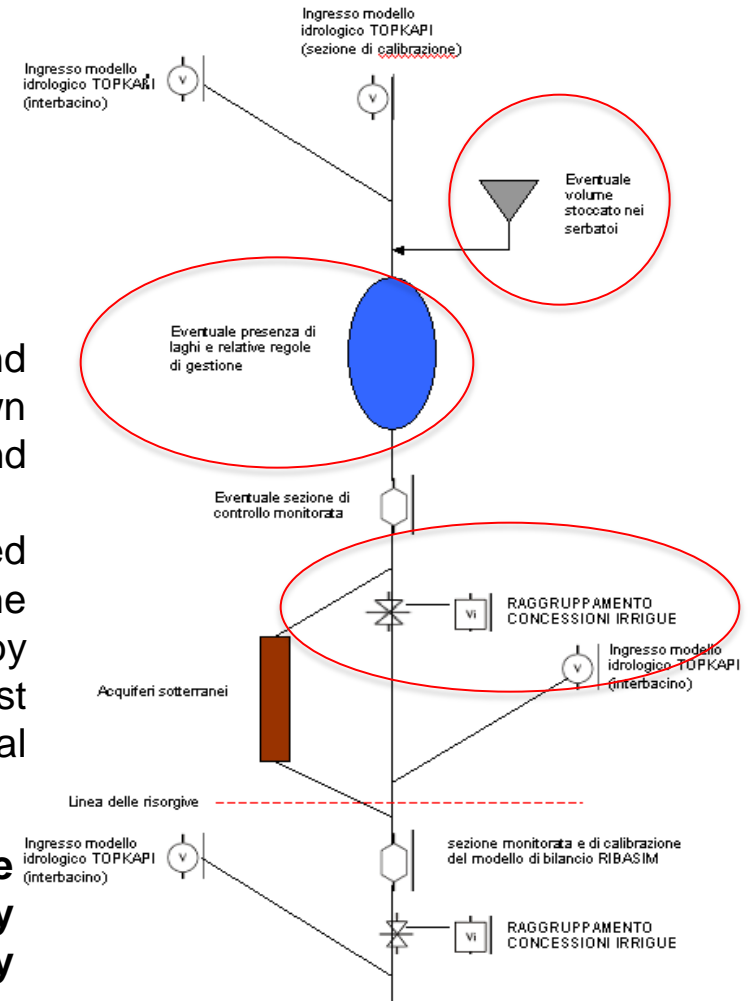
The hydrological model (TOPKAPI) is a distributed and physically based model. The flow hydrographs are shown from the input meteorological and physical and morphological characteristics of the river basin.

The water balance model (RIBASIM) allows integrated management and optimization of water resources of the basin by computing the distribution of the flow, simulated by the hydrological model Topkapi distribution networks consist of rivers, open canals, reservoirs or artificial control/hydropower production and aqueducts.

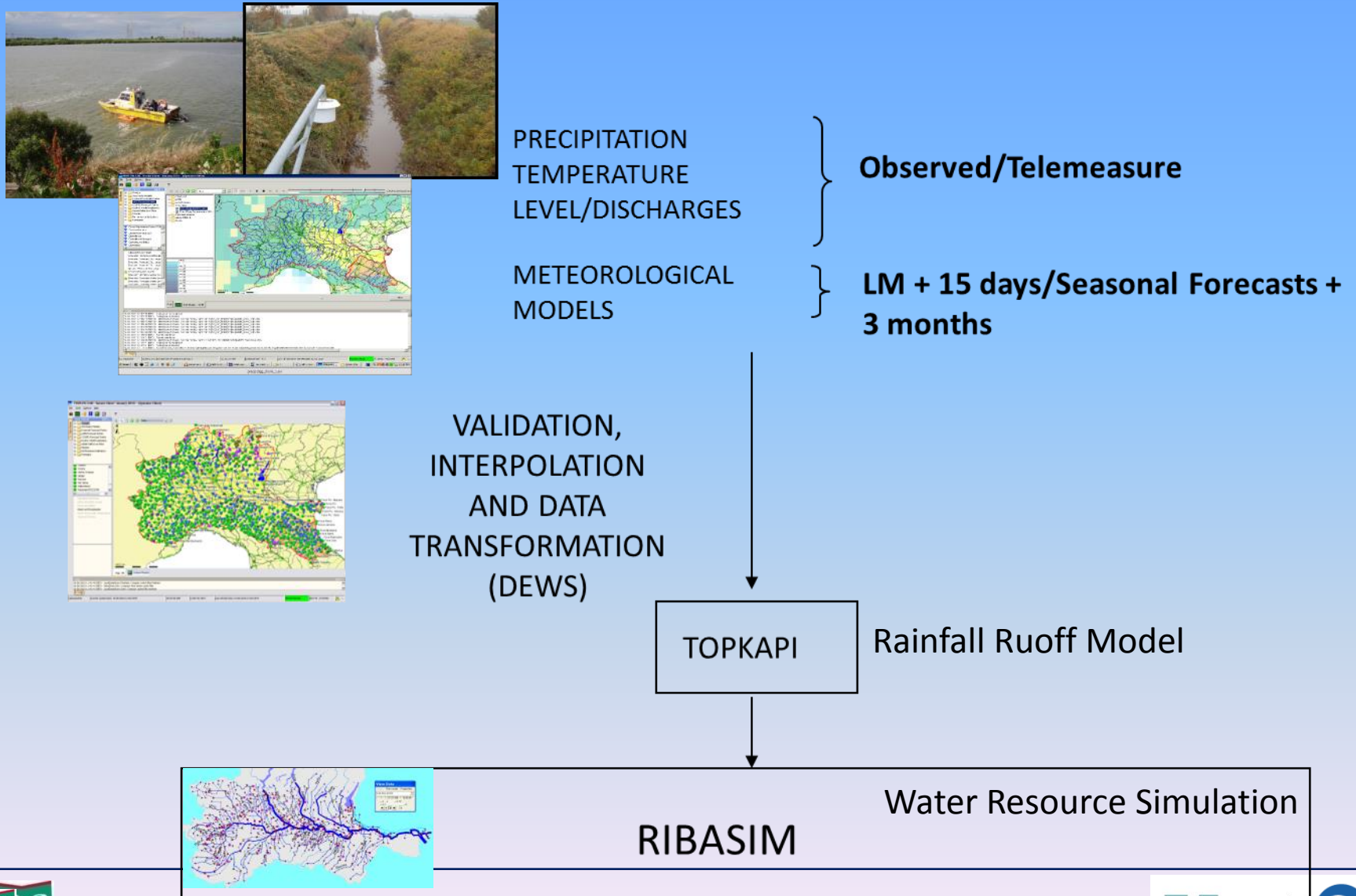
The simulation of the flow rate distribution is therefore an assessment of how the availability of water quantity and effectiveness of the distribution system are, or may be able to meet the demand of individual users.

Water balance model

RAPPRESENTAZIONE SCHEMATICA DI UN AFFLUENTE DI PO NEL MODELLO DI BILANCIO RIBASIM

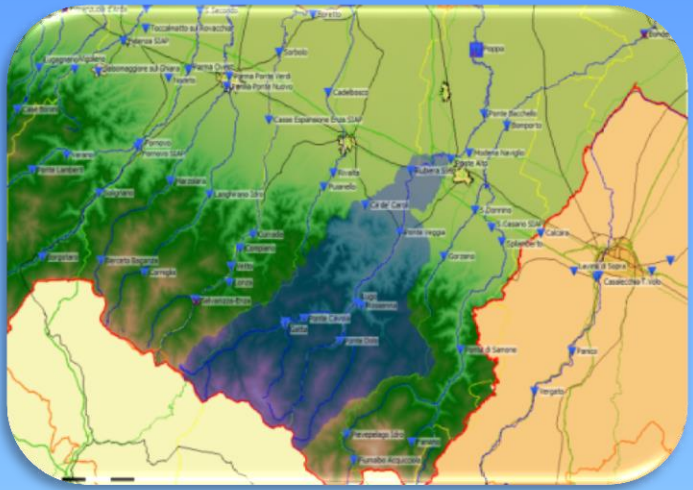


Drought Early Warning Systems in Europe

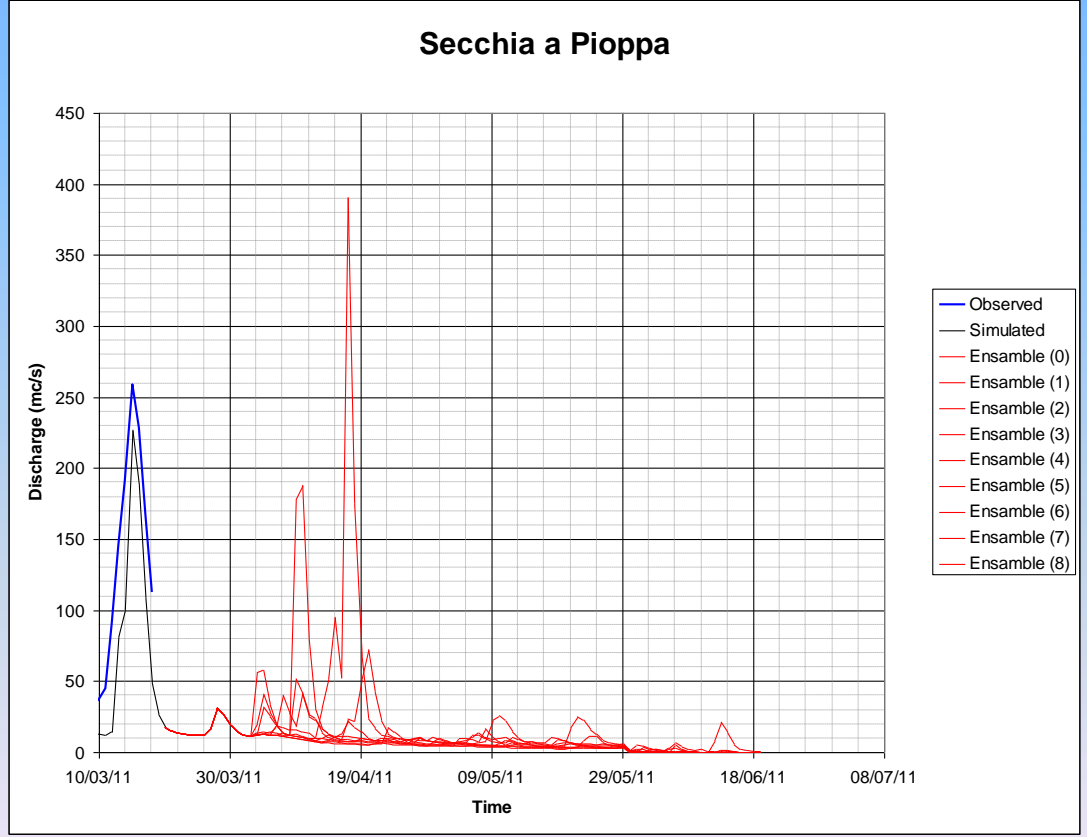


Hydrological Predictions

Hydrological Drought Prediction (HDP) is possible by implementing a monitoring and forecast system, based on a strong historical knowledge, a data network, long term and seasonal meteorological forecast and basin simulation models



During dry weather periods HDP will be crucial for the implementation of measures planned in advance, in order to reduce social and economical damages



Low flows

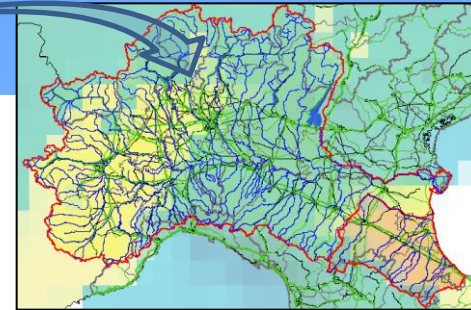
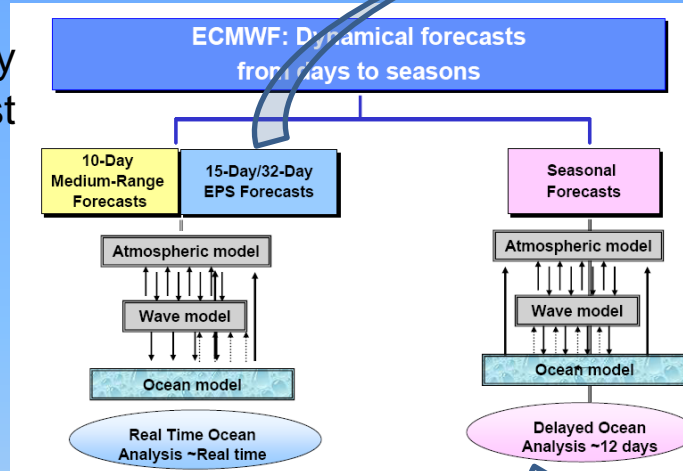


Review and strengthen low flow information is required from a number of Stakeholders. Measurements and estimates of low flows is strategic for water resources planning, development and management. However, reliable and long-term information is generally not available as most basins are ungauged. In addition, low flow measurements are often associated with errors as cross-sections change during the flood season and re-surveying of the sections is needed. This is often not done and sometimes changes between big flood events are not evaluated. Additionally, Hydrological Programmes on field collection of low flows should take into account river basin features, such as the rainfall and discharge regimes, the permeability of the soils, the geomorphology of the river network and channel.

Seasonal and long term meteorological products

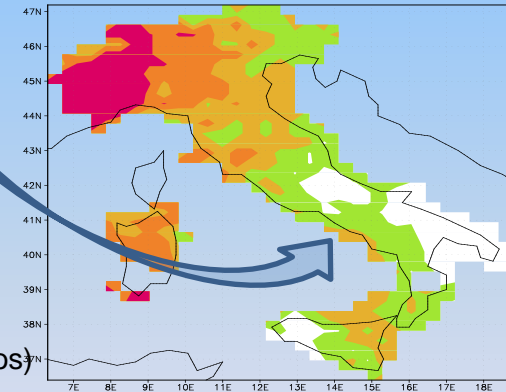
Meteorological centre of ARPA EMR gives an elaboration of ECMWF forecasts feeding the hydrological chain:

1. Are composed of precipitation and temperature fields, given by seasonal and long term forecast products
2. The spatial domain is northern Italy with a grid step from 16 (deterministic) to 35 (seasonal) km, daily precipitation and 6 hours for temperature.
3. The daily detail of seasonal forecasts is given by a statistical post processing, that is a weather generator.



The process contains an harmonization of computational grids, data assimilation and a downscaling of the seasonal forecast.

- deterministic forecast ECMWF (0-6 days) – daily updated
- ensemble forecast ECMWF EPS (7-14 days) – daily updated (median or scenarios)
- monthly ens forecast (15-30 days) – weekly updated (median or scenarios)
- seasonal ens forecast (1-3 months) – monthly updated (median or scenarios)



Integrated drought management programme

A global IDMP exists with a headquarter in WMO, and a nice homepage. A subregional IDMP for the CEE region exists also. GWP (global water partnership) is the supervisor and responsible for the project. Suggested actions:

- a. To contact with Rob Stefanski (global IDMP) and set up an RAVI-Global co-operation
- b. Clarify the IDMP connecting past, present and future at the RAVI countries (questionnaire, if it does not exist, yet)
- c. Organize an RAVI IDMP meeting (conference) may be in 2015 (the CEE IDMP will still run) (of course, I suggest Hungary as a venue. If there is a better offer, we can change, but do not afraid not to have any offer)

Drought monitoring

Some suggestions: Swiss Drought Platform, the CARPATCLIM database (<http://www.carpatclim-eu.org/>), together with Drought Early Warning Systems implemented in many European countries as pilot sites to develop a drought monitoring system; co-operation with Josef (Eitzinger), who has similar task at the agriculture TT.

Federation of Hydrological Information Systems

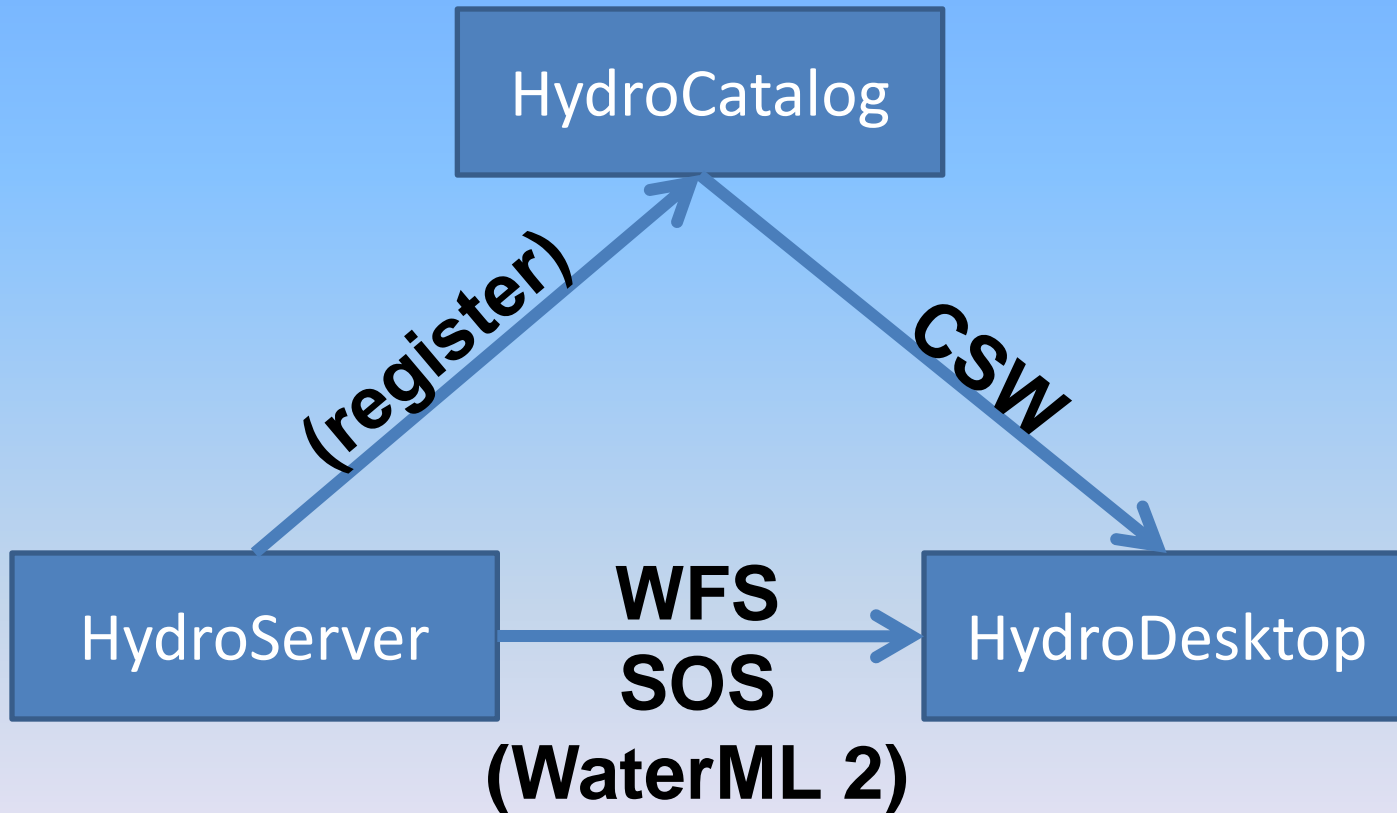
Support of access to and exchange of hydrological data provided by the National Hydrological Services in Europe, this activity is intended to provide additional operational capability, in particular for in situ water observations, as a federated resource for National Hydrological Services. The scope of the proposal is defined as an European registry of water data and map services catalogued using the standards and procedures of the Open Geospatial Consortium and the World Meteorological Organization.



This registry will be open to all users and institutions from any country or level of government, and applies to any type of water information. It is anticipated that this activity will be undertaken in collaboration with Theme 2: “Data Operations and Management” of the WMO Commission for Hydrology, which is active from 2012 to 2016.

The Road Further Ahead

Using OGC Standards





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Istituto Superiore per la Protezione
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WMO

ISPRA Hydrologic Information System Central Web Service Registry

The Italian hydrologic monitoring is a federated network composed by 19 Administrative Regions and 2 Autonomous Provinces, together with [ISPRA](#), the governmental technical body established by the Italian Ministry of Environment.

The portal provides access to the hydrological observations in Italy, commonly published as Hydrological Yearbooks. In particular, it provides additional operational capability, for in situ water observations, as a national registry of water data services catalogued using the standards and procedures of the Open Geospatial Consortium and the World Meteorological Organization.

The published interfaces of the portal retrieve data from distributed regional water data providers. enabling plots and



Internet | Modalità protetta: disattivata



100%

Catalog interfaces

Published interfaces

The following catalog interfaces are available:

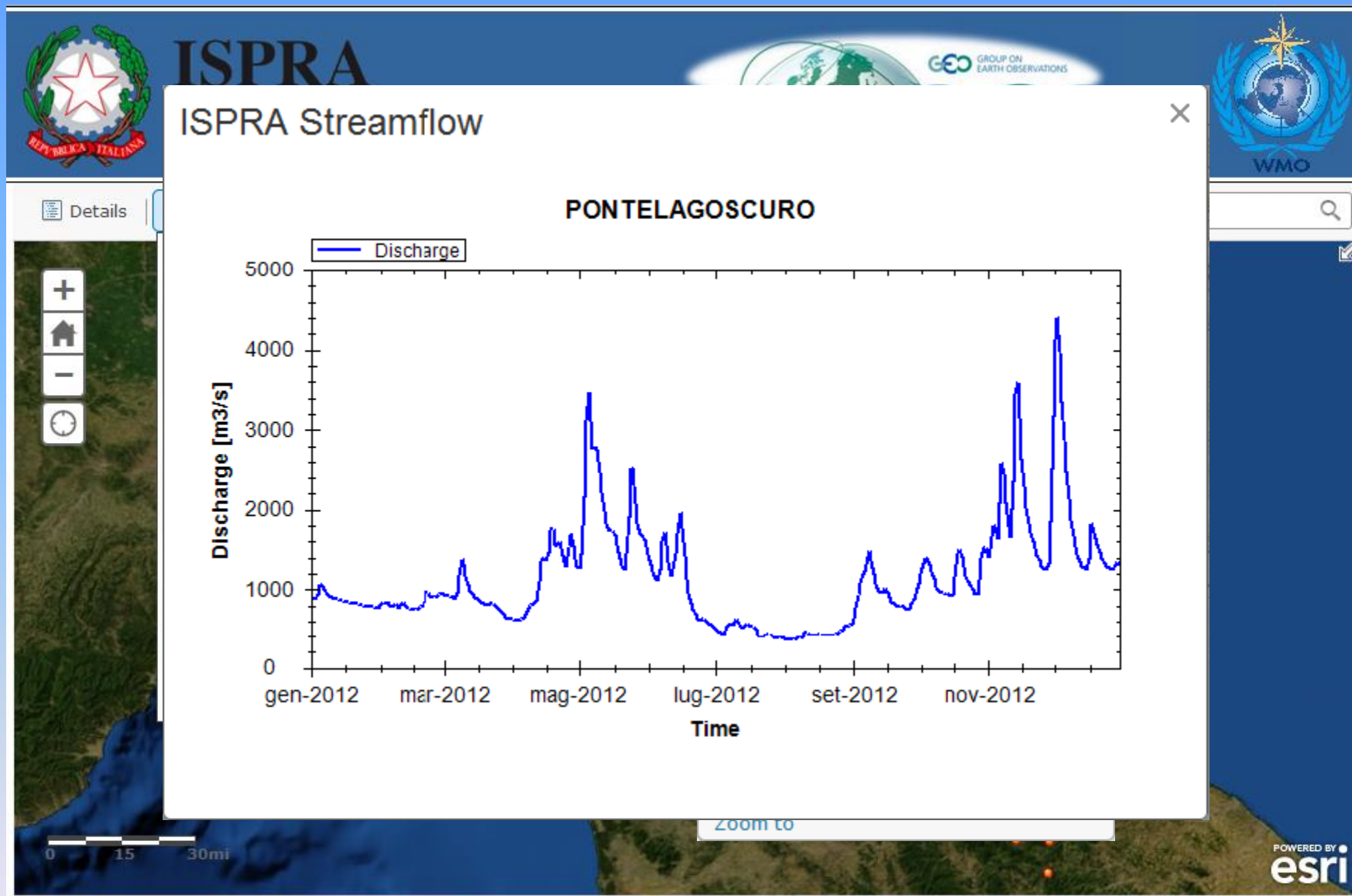
- **CUAHSI API** interface
Endpoint: <http://www.smr.arpa.emr.it/wdlpr/hiscentral/webservices/hiscentral.asmx>
Target namespace: <http://hiscentral.cuahsi.org/20100205/>
[Capabilities document](#)
- **CSW/ISO 2.0.2** interface
Endpoint: <http://www.smr.arpa.emr.it/wdlpr/gi-cat/services/cswiso?>
Target namespace: <http://jaxws.ogc.essi.imaa.cnr.it/>
[Capabilities document](#)
- **CSW/ISO-GEO 2.0.2** interface
Endpoint: <http://www.smr.arpa.emr.it/wdlpr/gi-cat/services/cswisogeo?>
Target namespace: <http://jaxws.ogc.essi.imaa.cnr.it/>
[Capabilities document](#)
- **GI-CAT** interface
Endpoint: <http://www.smr.arpa.emr.it/wdlpr/gi-cat/services/catalog?>
Target namespace: <http://floraresearch.eu/sdi/services/8.0/messages/schema>
[Capabilities document](#)
- **OPENSEARCH** interface
Endpoint: <http://www.smr.arpa.emr.it/wdlpr/gi-cat/services/opensearch?getDescriptionDocument>
Target namespace: http://_2_0_2.csw.sdi.floraresearch.eu/
[OpenSearch description](#)
- **OPENSEARCH-GEO** interface
Endpoint: <http://www.smr.arpa.emr.it/wdlpr/gi-cat/services/opensearchgeo?getDescriptionDocument>
Target namespace: http://_2_0_2.csw.sdi.floraresearch.eu/
[OpenSearch description](#)
- **OAI-PMH 2.0** interface
Endpoint: <http://www.smr.arpa.emr.it/wdlpr/gi-cat/services/oaipmh?>
Target namespace: http://oai_pmh.sdi.floraresearch.eu/
[Identify response](#)

Fine

Intranet locale | Modalità protetta: disattivata

100%

GIS client for using web services



Registered regional data provider



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Regione Emilia Romagna



ARPA Emilia Romagna

Regione Emilia Romagna

WaterML Service

WFS Service

Contact: Silvano Pecora
specora@arpa.emr.it

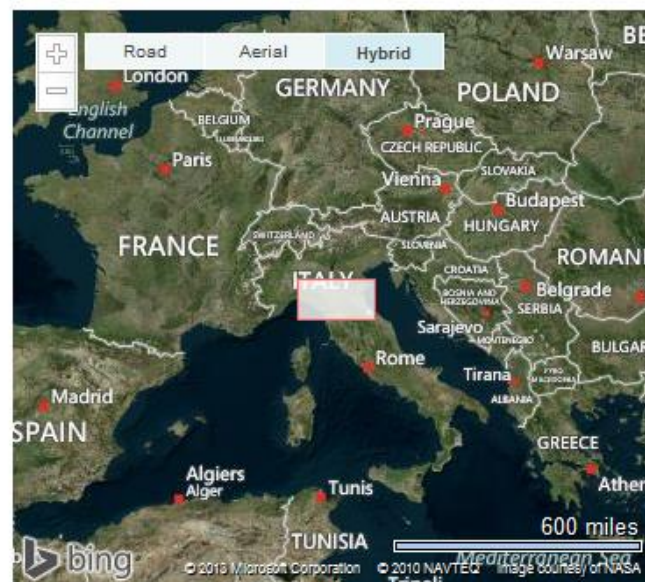
Service Statistics:

Sites:	699	Geographic Extent:	45.1443	
Variables:	5		8.8493	12.7349
Values:	6004488		43.6956	

Last Harvested on 12/18/2013 12:25:38 PM
(updated weekly, assumed static)

Abstract

ARPA SIMC, Servizio Idro-Meteo-Clima dell'Agenzia Regionale Prevenzione e Ambiente Emilia-Romagna, svolge attività osservative e previsionali operative e di ricerca e sviluppo, in meteorologia, climatologia, idrologia, agrometeorologia, radarmeteorologia e meteorologia ambientale.



Data provider web services

Service Description.

There are five Water Web services,

- The WaterML 1.0 version service is found at:http://192.168.139.37/ODMEmiliaRomagna/waterml_1_0.asmx
- The WaterML 1.1 version service is found at: http://192.168.139.37/ODMEmiliaRomagna/waterml_1_1.asmx
- The WaterML 2.0 version service is found at:http://192.168.139.37/ODMEmiliaRomagna/waterml_2_0.asmx
- The GML version service is found at:<http://192.168.139.37/ODMEmiliaRomagna/qml.asmx>
- The O&M version service is found at:<http://192.168.139.37/ODMEmiliaRomagna/oem.asmx>
- The SensorML version service is found at:<http://192.168.139.37/ODMEmiliaRomagna/sensorml.asmx>
- The WFS version service is found at:<http://192.168.139.37/ODMEmiliaRomagna/webservices/wfs.asmx>
- The SOS version service is found at:<http://192.168.139.37/ODMEmiliaRomagna/webservices/sos.asmx>
- a prototype capabilities document is found here: [Capabilities.xml](#)

Catalog Interfaces

There are seven catalog services,

- [CUAHSI API](#)
- [CSW/ISO 2.0.2](#)
- [CSW/ISO-GEO 2.0.2](#)
- [GI-CAT](#)
- [OPENSEARCH](#)
- [OPENSEARCH-GEO](#)
- [OAI-PMH 2.0](#)

Web Service Description:

Status Level: Developmental

Network Name: OD

Vocabulary Name: ODM

AuthenticationSettings:(TB Redone)

HIS in the SAVA River Basin



SAVA Hydrologic Information System Central Web Service Registry

The Sava hydrologic monitoring is a federated network composed by 5 States (Bosnia and Herzegovina, Croatia, Montenegro, Serbia and Slovenia), including 2 Entities (Federation of Bosnia and Herzegovina - Bosnia and Herzegovina, Republika Srpska), together with the [International Sava River Basin Commission](#), an international organization established by the Framework Agreement on the Sava River Basin (FASRB), which is the unique international agreement integrating all aspects of the water resources management.

The portal provides access to the hydrological observations in the International Sava River Basin, commonly published as Hydrological Yearbooks. In particular, it provides additional operational capability, for in situ water observations, as a national registry of water data services catalogued using the standards and procedures of the Open Geospatial Consortium and the World Meteorological Organization.

The published interfaces of the portal retrieve data from distributed national water data providers, enabling plots and download.



WEB SERVICE REGISTRATION SYSTEM

- Brokered services: 6
- Brokered sites: 110
- Brokered variables: 5
- Brokered values: 58724
- Geographic extent: [14.1653, 20.4547, 42.8622, 46.34]

Environmental Agency of the Republic of Slovenia



Environmental Agency of the Republic of Slovenia

SI

WaterML Service

WFS Service

Contact: Slovenian Environment Agency
gp.arso@gov.si

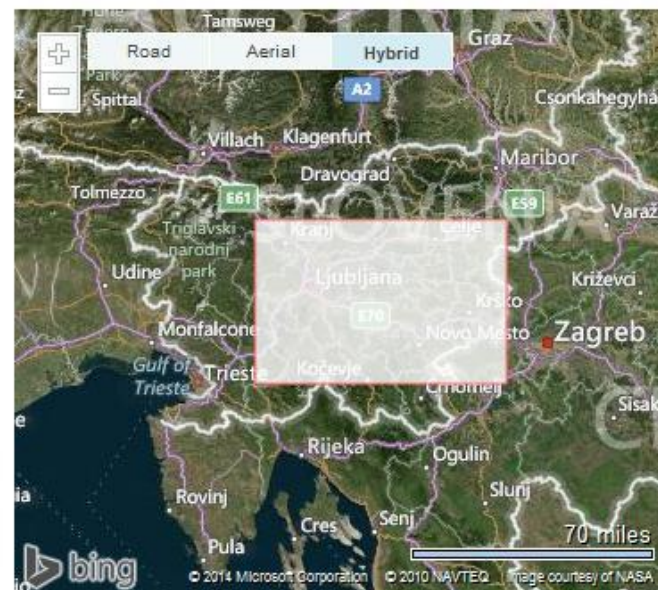
Service Statistics:

Sites:	11	Geographic Extent:	46.34
Variables:	4		14.1653
Values:	12045		15.7053
			45.6344

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(assumed static)

Abstract

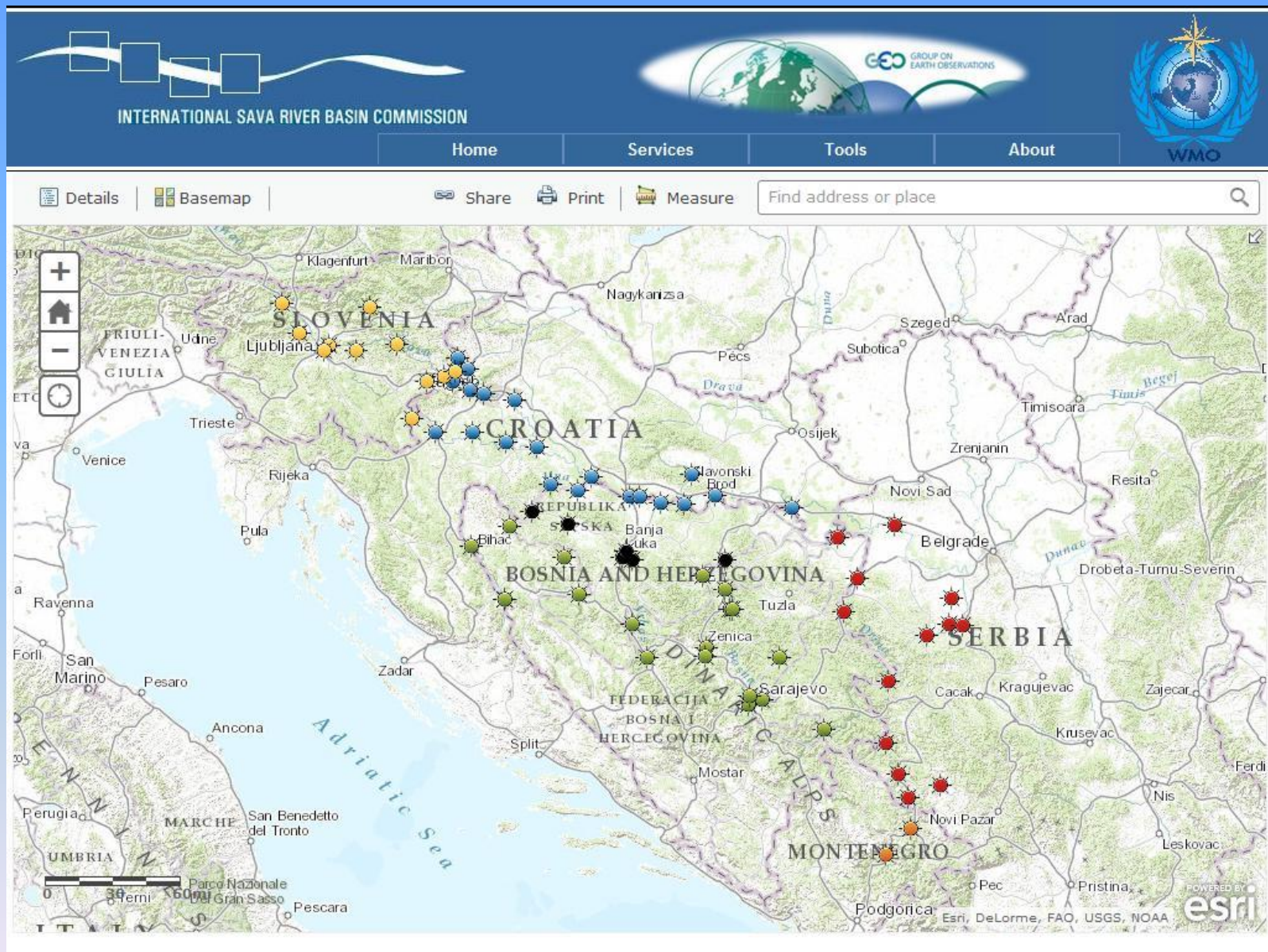
As in other European countries, overall water resource management is being introduced in Slovenia in accordance with the Water Framework Directive. The priority is eliminating adverse effects on waters, providing an appropriate quality of water for humans and natural ecosystems, and maintaining biodiversity. In the field of water, the Environmental Agency of the Republic of Slovenia performs the following activities: prepares programmes for monitoring the quality of waters (rivers, lakes, groundwater and sea); determines water pollution on the basis of physicochemical and biological analyses; monitors and measures individual elements of the water cycle at hydrologic monitoring stations for surface water (watercourses, lakes, sea) and for groundwater and springs, measures levels and temperature of groundwater, springs, rivers, lakes and sea, and determines changes; determines and monitors river discharge regimes, and notes changes on the basis of water level and hydrometric measurements; issues warnings of an increased risk of flooding from rivers and sea, and of declining water levels of surface and groundwater; manages waters in a manner



Citation

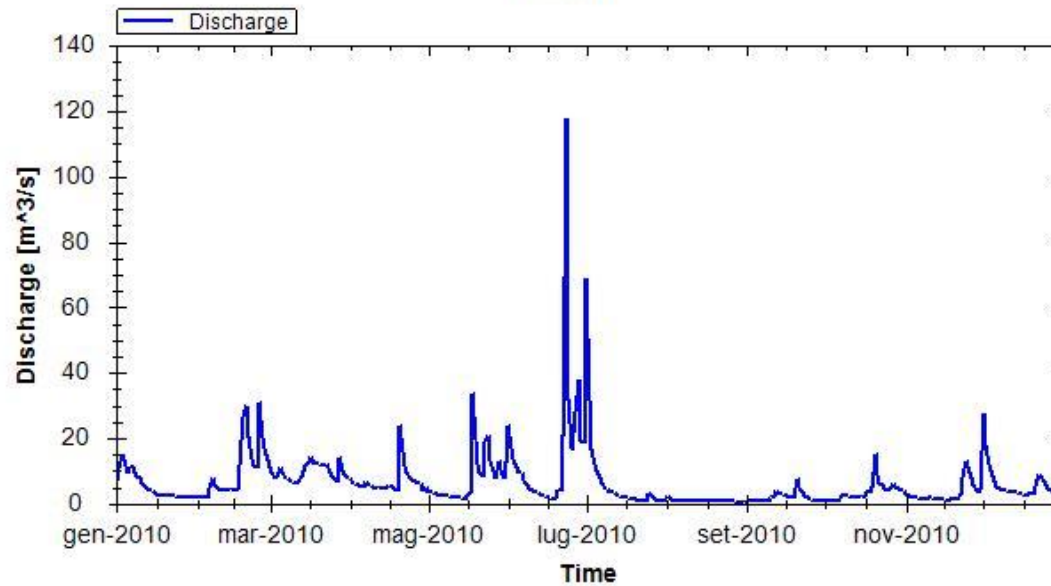
Data are collected from selected hydrological and meteorological stations for the publication of the Hydrological Yearbooks of the Sava River Basin

HIS in the SAVA River Basin



SAVA Streamflow

Valjevo



DataType	Average
StartDate	January 1, 2010
EndDate	December 31, 2010
Latitude	44.27
Longitude	19.89
WaterML_1.0	More info
WaterML_1.1	More info
WaterML_2.0	More info
SensorML	More info
GML	More info
O&M	More info
GraphURI	More info
Graph	Show Graph
Zoom to	



HIS in the Arctic Region

WHYCOS
WORLD HYDROLOGICAL CYCLE OBSERVING SYSTEM



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ARCTIC Hydrologic Information System Central Web Service Registry

The Arctic-HYCOS program is being promoted through the World Hydrological Cycle Observing System (WHYCOS). The main goal of the Arctic-HYCOS program is to improve monitoring, data accuracy, availability and dissemination of information in the pan-arctic drainage basin. This project is science-driven and is aimed at monitoring freshwater fluxes and pollutants into the Arctic Ocean with the objective of improving climate predictions in the Northern Hemisphere and assessing the pollution of the Arctic coastal areas and the open Arctic Ocean.

The portal provides access to the hydrological observations in the Arctic monitoring network, composed of stations located in Canada, Denmark, Finland, Iceland, Kazakhstan, Mongolia, Norway, Russian Federation and United States of America. In particular, the portal provides additional operational capability, for in situ water observations, as an international registry of water data services catalogued using the standards and procedures of the Open Geospatial Consortium and the World Meteorological Organization.

The published interfaces of the portal retrieve data from distributed national water data providers, enabling plots and download.



WEB SERVICE REGISTRATION SYSTEM

- Brokered services: 12
- Brokered sites: 5329
- Brokered variables: 1
- Brokered values: 3082174
- Geographic extent: [-178.67, 179.24, 45.82, 80.6]



WMO Hydrological Observing System (WHOS)

are already freely and openly available online. As HYCOS projects mature and are able to provide data, they would be included within WHOS.



Figure 1 - WHOS interactive map showing National Hydrological Services in the World

Information on hydrological data access available in WHOS are provided by WMO Members belonging to each Regions. CHy meets once every four years, with the participation of Member countries, to review the ongoing activities and determine the course of WHOS development.

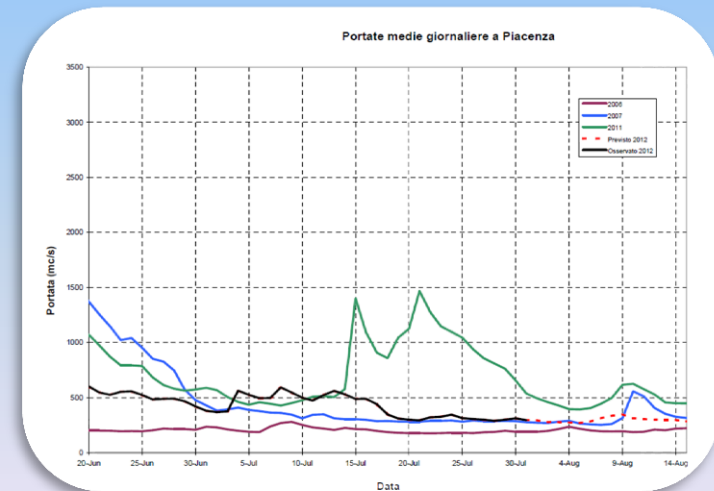
For more details on the plans for the implementation of WHOS see sessions of WHYCOS International Advisory Group (WIAG).

ACTIVITIES on Water Scarcity and Drought



Water Scarcity and Drought Characterization

Guidance on water scarcity and drought characterization, including different analysis of drought episodes, providing algorithms and tools to monitor the temporal evolution of a drought event and to perform an appropriate assessment of a drought.

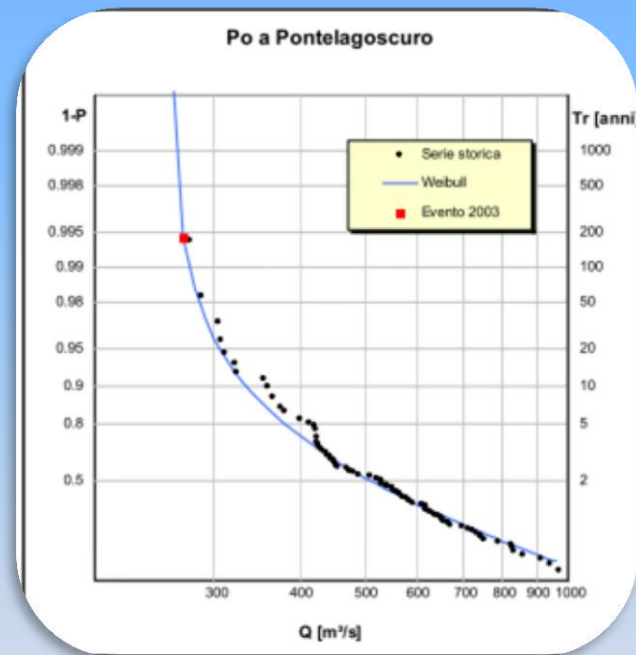


Methodologies for Drought Characterization

Provide correct methodologies for drought characterization, providing decision makers with a measurement of abnormal variability, so that protection from possible impacts may be implemented.

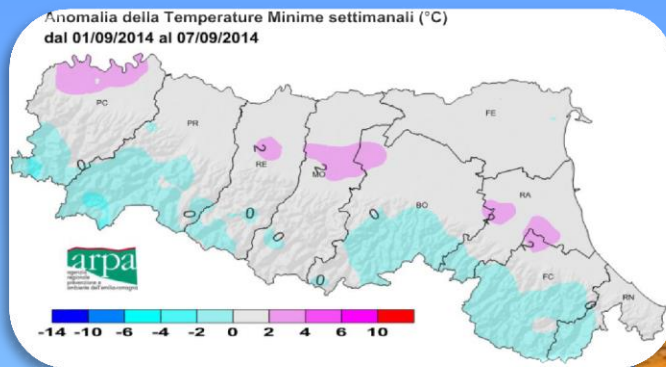
Droughts can be classified into: hydrological, if they involve periods of below normal flow and depleted reservoir storage; meteorological, relatively, to below normal precipitation; agricultural, if the soil moisture is not sufficient to support crop growth; and socio-economical, when the low water supply affects society's productive and consumptive activities. Operational definitions are based on the main features of a drought, like extension, onset, termination, duration, severity, and intensity.

This activity will introduce different analysis to characterize drought episodes, providing algorithms and tools to monitor the temporal evolution of a drought event and to perform an appropriate assessment of a drought.



Harmonize the SPI softwares

Users think that one and common SPI exists. Unfortunately, this is not the case, and therefore, it would be very necessary and useful to discuss the generally suggested form of the SPI. A couple of people could provide substantial matter on this topic, only. Juergen Vogt (JRC) led a work about the differences of the approximation of the distribution of precipitation (Gamma, Beta, Pearson) in the frame of the WG on water scarcity and drought at EU Water Directors. Peter Bissoli with co-author (DWD) prepared a paper on the modified SPI, and according Stefan Roesner, it is used in GCOS. Started from climatological features, Tamas Szentimrey (Hungarian Meteorological Service) improved the original (McKee's) algorithm using vector form and probably somebody from Mike Haynes group (Lincoln), because they distribute one of these form of SPI around the world. About 5-8 people should agree on the common SPI algorithm and software. Unfortunately, small differences in precipitation could cause large differences in SPI according to the local climate.



Prolonged Droughts

'Prolonged' droughts should be clearly distinguished from non-prolonged droughts. The conditions of a prolonged drought, i.e. the circumstances that are exceptional or that could not reasonably have been foreseen, should be demonstrated, as normal dry hydrological conditions should be addressed in the reference conditions. Relevant indicators are necessary to facilitate the common understanding of a 'prolonged drought'. This activity will support the implementation of the Water Framework Directive and, in particular, it will provide technical identifications of certain conditions which are exemptions for temporary deterioration of the status of bodies of water in certain circumstances, which are exceptional or could not reasonably have been foreseen.

Frequency analysis of droughts - Run method

Run method (Yevjevich, 1967)

This method is based on daily discharge Q
 Given a threshold level q_D , for example $q_{95\%}$, $q_{90\%}$
 A drought is identified by 3 components:

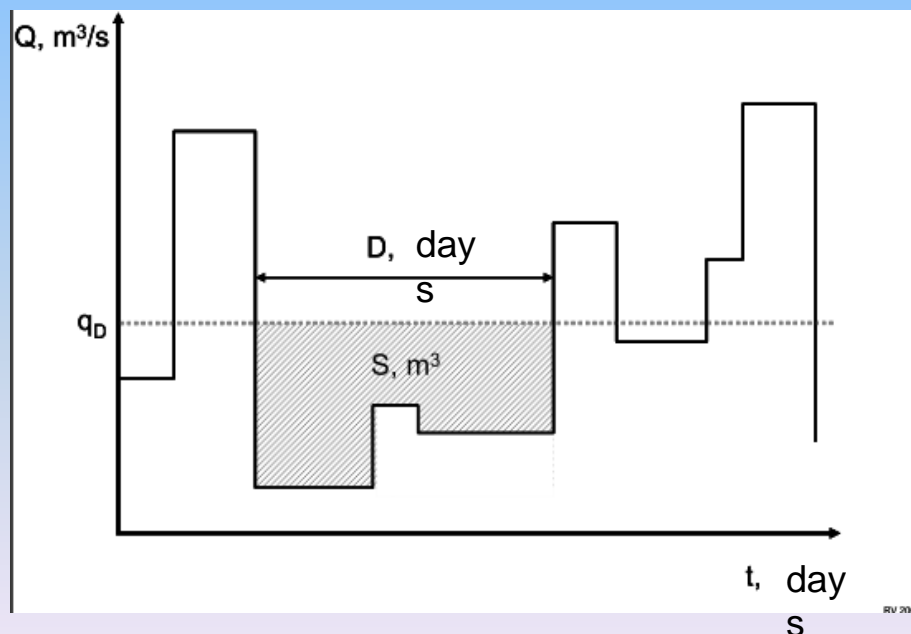
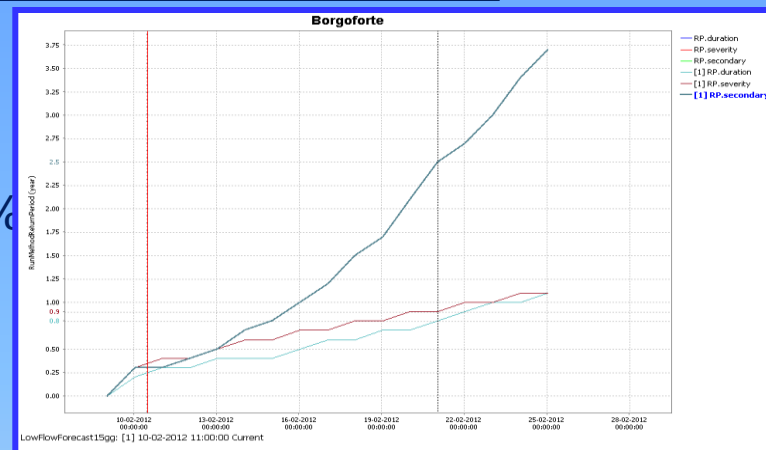
D = drought duration : $q \leq q_D$

S = drought severity

$$S = \int_0^D (q(t) - q_D) dt$$

I = drought intensity

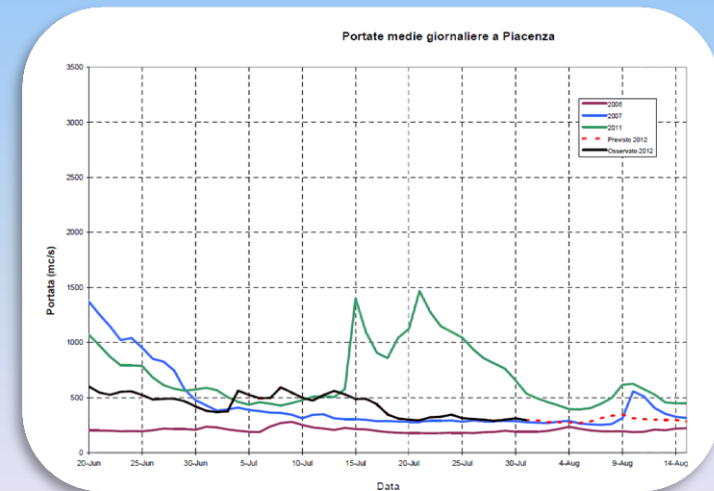
$$I = \frac{1}{D} \int_0^D (q(t) - q_D) dt$$





Climate Change Impacts

Review analysis of climate change impacts on water scarcity and droughts by regional climate simulations downscaling global climate projections, coupled with hydrological and water balance modeling chains, simulating the available water distribution in river basin and considering water demand.



An example from the Alps

Pizzo Bernina, 1978



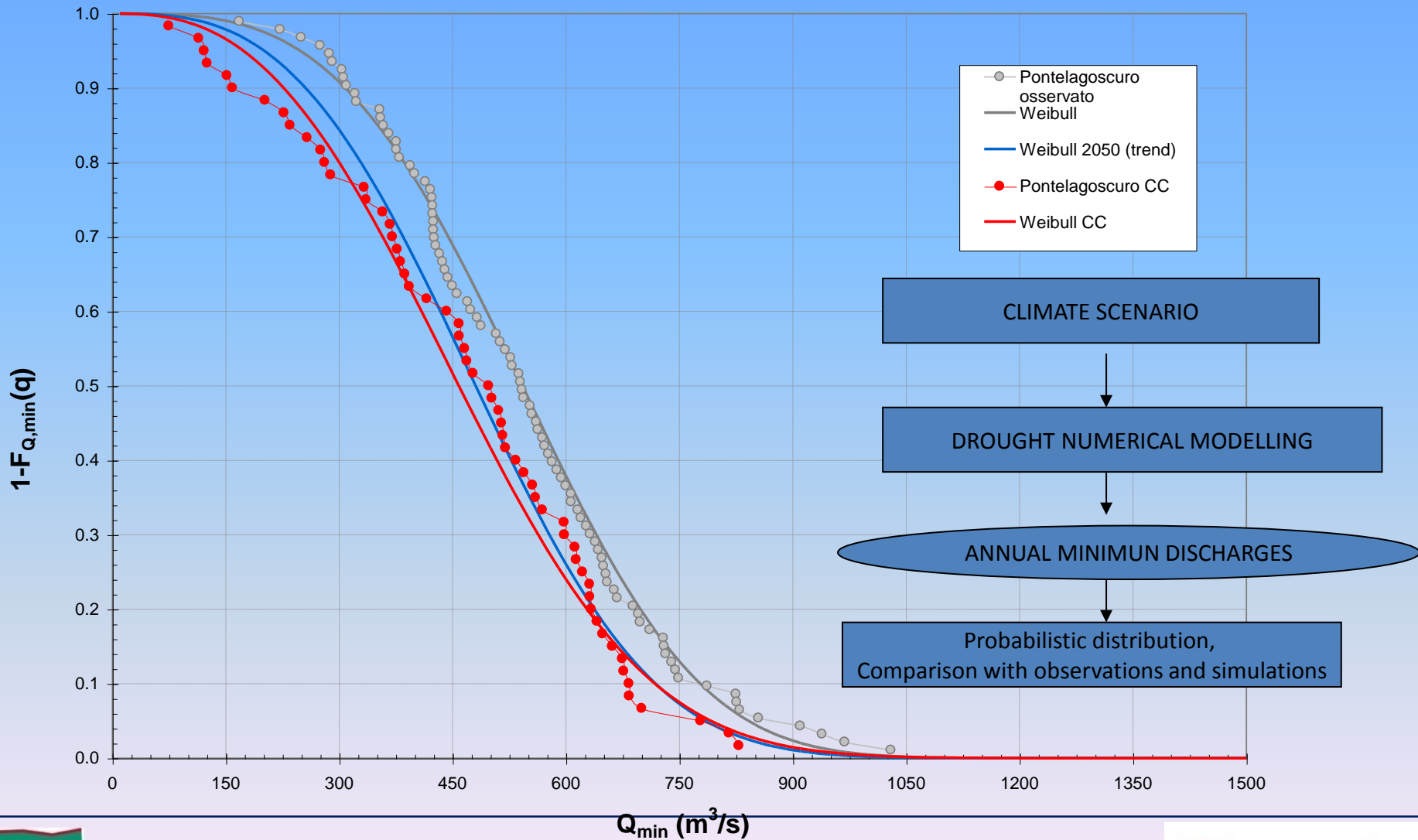
Pizzo Bernina, 2003



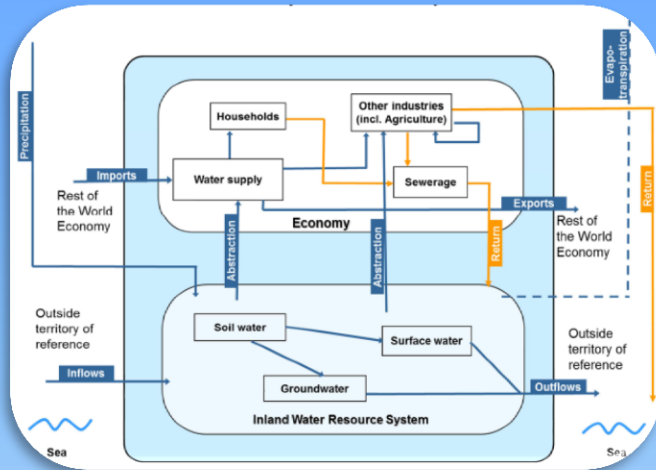
Climate Change Impacts on water scarcity and droughts

Climate change impacts on water scarcity and droughts is an additional pressure on ecosystems, leading to northward and uphill shifts of many plant and animal species. It negatively impacts agriculture, forestry, energy production, tourism, and infrastructure in general. Here, the question “what should we expect for future European river discharges?” could be addressed through numerical climate/hydrological/water balance modeling. EU initiatives aim to cut greenhouse gas emissions can be simulated by regional climate simulations downscaling global climate projections, coupled with a hydrological and water balance modeling chain, simulating the available water distribution in the river basin and considering water demand (i.e. withdrawals related to agriculture, urban, industrial uses), reservoirs, groundwater and other hydraulic features

Distribution of the annual minimum observed (1970-2000) and simulated (2000-2050)

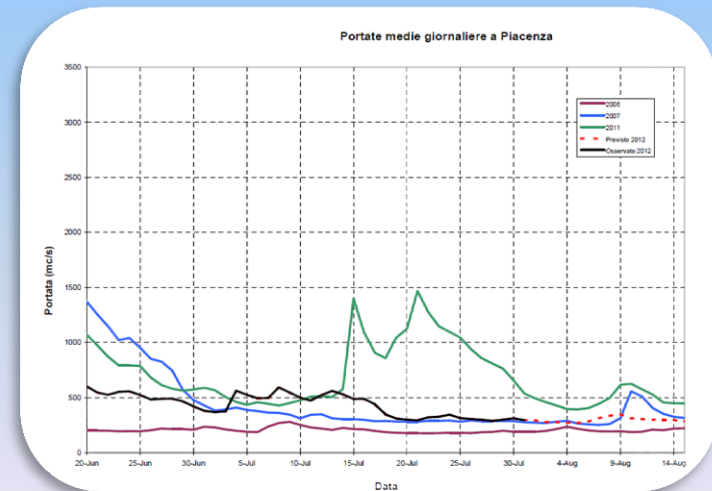


ACTIVITIES on Water Scarcity and Drought



Water Resources Availability in Europe

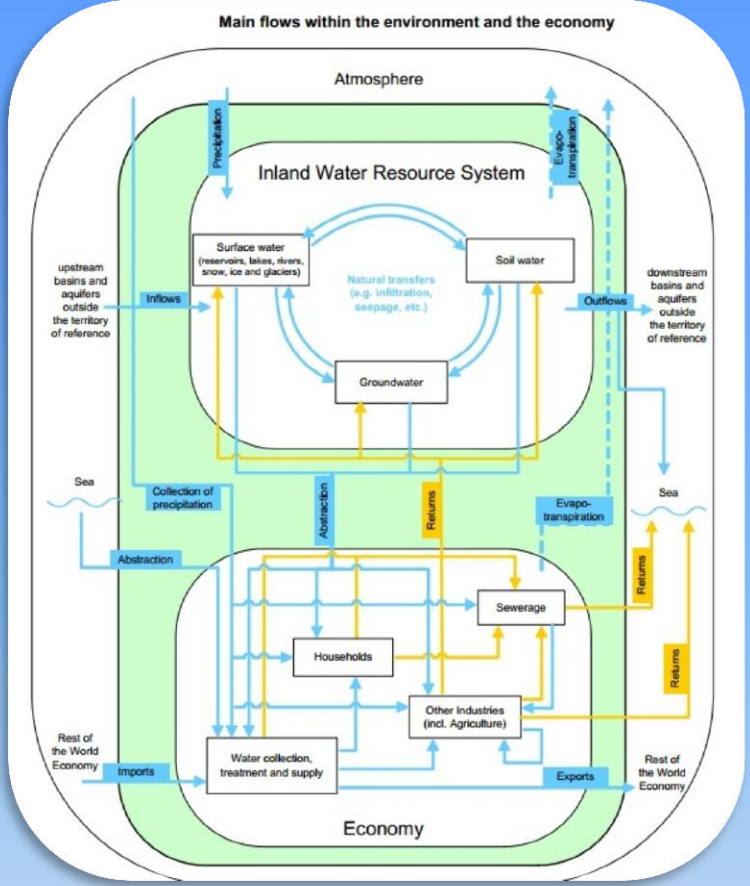
Improve knowledge on water resources available in European basins and their use, assessing potential impacts of management, technological and economical measures to reduce the vulnerability of the territory against desertification, water scarcity and drought.



Water Scarcity and Drought - Activities

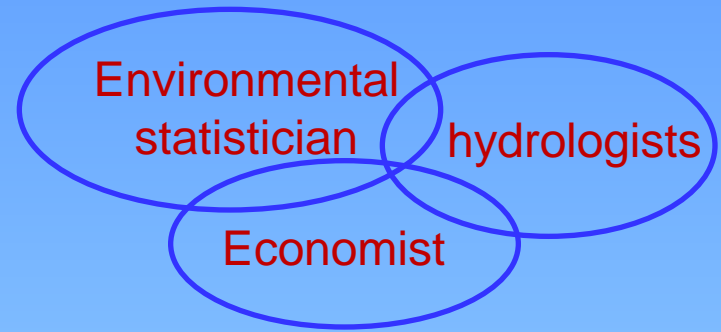


SEEA - Water



The activity will foster knowledge exchange on the application of the System of Environmental-Economic Accounting for Water (SEEA-Water), which provides a conceptual framework for organizing hydrological and economic information in a coherent and consistent manner, describing the interaction between the economy and the environment and covering the whole spectrum of natural resources and the environment.

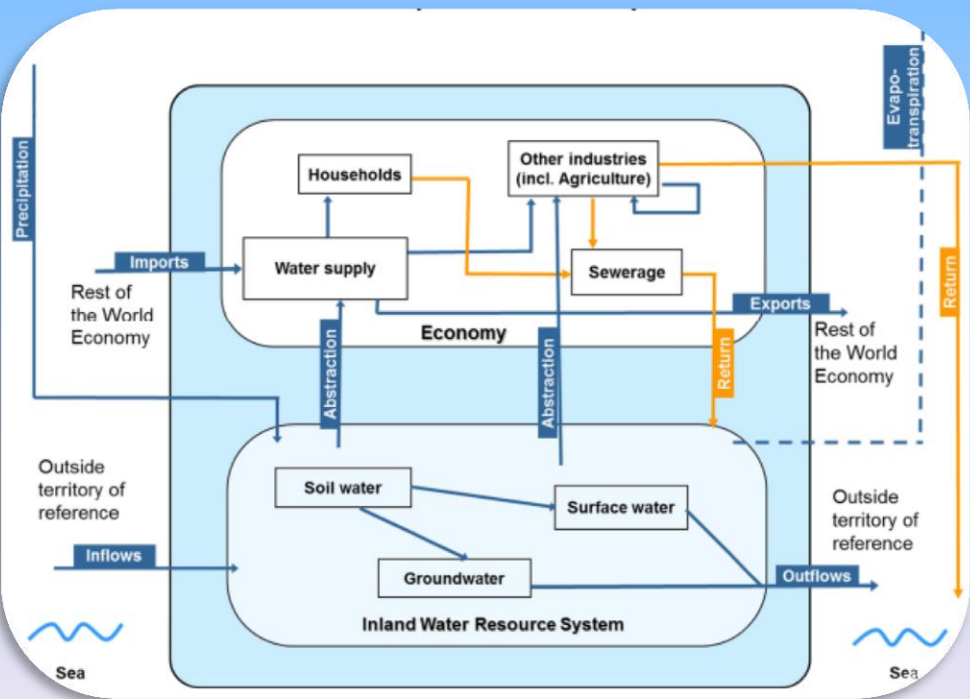
Organizing hydrological data in economic terms enables communication among different Actors on water resource; thus all the components and interrelationship of the subsystem of the water cycle can be compared.



SEEA–Water is a tool supporting IWRM.

Supplies useful information in decision making, with the targets of:

- Resource allocation
- Water efficiency improvement
- Maximizing investments on hydraulic structures
- Policy decisions impact on users
- Link uses and availability
- a better acceptance of decision by the stakeholders



CAPACITY BUILDING on Water Scarcity and Drought



**THANKS FOR YOUR
ATTENTION**