REPUBLIKA SLOVENIJA
MINISTRSTVO ZA OKOLJE IN PROSTOR

AGENCIJA REPUBLIKE SLOVENIJE ZA OKOLJE

BOBER
BOLJŠE OPAZOVANJE ZA BOLJŠE EKOLOŠKE REŠITVE
BETTER OBSERVATION FOR BETTER ENVIRONMENTAL RESPONSE

Naložba v vašo prihodnost
OPERACIJO DELNO FINANCIRA EVROPSKA UNIJA
Kohezijski sklad

Dosežki projekta »Nadgradnja sistema za spremljanje in analiziranje stanja vodnega okolja v Sloveniji«

Project achievements »Upgrade of the system for monitoring and analyzing the water environment in Slovenia«

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Največji projekt za spremljanje stanja okolja v Sloveniji: »
Nadgradnja sistema za spremljanje in analiziranje stanja vodnega okolja v Sloveniji«, poimenovan s kratico:

The most extensive project for monitoring the state of environment in Slovenia:
» Upgrading the system for monitoring and analysing the state of the water environment in Slovenia«:

BOBER

Boljše Opazovanje za Boljše Ekološke Rešitve
Better Observation for Better Environmental Response

BOBER
BOLJŠE OPAZOVANJE ZA BOLJŠE EKOLOŠKE REŠITVE
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Uvod

Agencija RS za okolje upravlja enega največjih merilnih sistemov v Sloveniji. Državne meteorološke, hidrološke in ekološke mreže postaj nam zagotavljajo podatke, s katerimi spremljamo in analiziramo stanje okolja. Zavedamo se pomena kakovosti naših podatkov in storitev, saj se neposredno uporabljajo na različnih področjih družbe.

Zaradi omejenih finančnih virov smo v preteklosti državno mrežo postaj nadgrajevali prepočasi, da bi lahko zagotovili potrebne podatke za učinkovito prostorsko načrtovanje, gospodarjenje z vodami in pravočasno opozarjanje na izredne razmere. Agencija RS za okolje je zato s pomočjo sredstev Evropske unije med letoma 2009 in 2015 izvajala obsežen projekt nadgradnje sistema za spremljanje in analiziranje stanja vodnega okolja v Sloveniji. Poimenovali smo ga Bober, kar je kratica za geslo »**B**oljše **o**pazovanje za **b**oljše **e**kološke **r**ešitve«, ki povzema temeljni cilj projekta.

S projektom želimo zagotoviti zanesljive, kakovostne in prostorsko reprezentativne meteorološke in hidrološke podatke, ki omogočajo celovito spremljanje in analiziranje stanja vodnega okolja v Sloveniji ter natančnejše napovedovanje hidroloških razmer, še posebej poplav. Celoten projekt je naravnan k zmanjšanju škodljivega delovanja voda in vzpostavljanju trajnostnega razvoja vodnega okolja na ravni celotne države.

Največji del projekta smo namenili gradnji merilne infrastrukture na 281 merilnih mestih, ki bo omogočala sproten dostop do številnih okoljskih podatkov. Bogatejši smo za novo opremo za umerjanje merilnih naprav, sodobne laboratorijske instrumente za analize kemijskega stanja voda, modelsko orodje za napovedovanje pretokov slovenskih rek, morskih tokov in valovanja morja, količinskega stanja podzemnih vod ter za spremljanje kmetijske suše. Posodobili smo računalniško infrastrukturo in kupili visoko zmogljiv računanik za poganjanje omenjenih modelov, postavili nov meteorološki radar na Pasji ravni in obnovili starega na Lisci. Pridobili smo prostore za delovanje Službe za morsko meteorologijo in oceanografijo v Izoli. V novem laboratorijskem prizidku so ustrezne prostore za svoje delovanje dobili kemijsko-analitski, biološki in umerjevalni laboratorij ter meteorološka in hidrološka prognoza.

Vodni krog je samo eden in ga je treba obravnavati celostno. To s projektom Bober na območju Slovenije tudi zagotavljamo, saj so vse potrebne službe zbrane na enem mestu. Tako smo lahko vzor mnogim tujim službam, nakazali pa smo tudi nadaljnji razvoj na tem področju. Z dosežki projekta se po sodobnosti opreme, orodju in znanju postavljamo ob bok sorodnim evropskim službam, konceptualno pa smo celo korak pred njimi.

Vsa naša prizadevanja za kakovostnejše okoljske podatke, analize in napovedi, k čemur bodo prispevali tudi dosežki projekta Bober, pa so namenjena izboljšanju naših storitev. Z njimi se odzivamo na potrebe naše družbe ter prispevamo k večji varnosti in blaginji ljudi, zaščiti okolja, narave in premoženja, trajnostni oskrbi z naravnimi viri in učinkovitejšemu gospodarstvu.

Joško Knez
generalni direktor Agencije RS za okolje

Introduction

The Slovenian Environment Agency manages one of the largest measurement systems in Slovenia. Networks of national meteorological, hydrological and ecological stations provide us with the data required to monitor and analyse the state of the environment. We provide information and services which are used directly in various spheres of society, and we are well aware of the importance of data quality.

Previous limited funding resources made the pace of upgrading the national network too slow and hindered us from ensuring the data required for efficient spatial planning, water management and timely issuing of emergency situation warnings. Supported by EU funds, the Slovenian Environment Agency carried out a major project of upgrading the system for monitoring and analysing the state of the water environment in Slovenia in the period from 2009 to 2015. The project was titled BOBER, an acronym for **B**etter **O**bservation for **B**etter **E**nvironmental **R**esponse, which summarised the project's basic objective.

We aim to ensure reliable, high quality and spatially representative meteorological and hydrological information facilitating comprehensive monitoring and analysis of the state of the water environment in Slovenia, as well as more accurate forecasting of extreme hydrological phenomena, particularly floods. The entire project is dedicated to reducing the harmful effects of water and ensuring sustainable development of the water environment across the country.

The major part of the project involved the construction of measuring infrastructure at 281 measuring sites, which now enable real-time access to a large amount of environmental data. We have acquired new equipment for instruments calibration, modern laboratory instruments for chemical analysis of water, model tools for forecasting of rivers discharge in Slovenia, sea currents and waves, the quantitative status of groundwater bodies and monitoring agricultural drought. We have modernised computer infrastructure and bought a supercomputer to run the aforementioned models, installed a new meteorological radar on Pasja Raven and reconstructed an old one on Lisca Hill. The Maritime Meteorological and Oceanographic Service has acquired new premises for its operations. A new extension to the laboratory houses the chemical and analytical, biological and calibration laboratories and the meteorological and hydrological forecasting services.

There is only one water cycle and we have to consider it comprehensively, and the BOBER project provided for all required services to be housed under one roof. In addition to setting an example to many foreign services, we have also set a trend for future development in this field. The modern equipment, tools and knowledge acquired through the project put us side by side with similar European services and, in terms of concept, even one step ahead of them.

The BOBER project has helped to enhance the quality of environmental data, analyses and forecasts and thus supports the efforts aimed at improving our services, which respond to the needs of society and contribute towards the safety and wellbeing of people, protection of the environment, nature and property, sustainable supply of natural resources and an efficient economy.

Joško Knez
Director General of the Slovenian Environment Agency

Laboratorijski prizidek Agencije RS za okolje
Extension to the laboratory of the Slovenian Environment Agency

Dosežki projekta:

- nova in posodobljena meteorološka merilna mesta;
- dodaten vremenski radar na Pasji ravni in obnovljen radar na Lisci;
- nova in posodobljena hidrološka merilna mesta;
- izpolnjeni pogoji za delovanje Službe za morsko meteorologijo in oceanografijo;
- laboratorijski prizidek za dodatne meritve in analize kemičnih in bioloških parametrov ter umerjanje merilnih instrumentov;
- posodobljena računalniška infrastruktura;
- novo operativno prognostično orodje: hidrološki in morski prognostični sistemi;
- sistem za podporo odločanju na aluvialnih telesih podzemnih voda Slovenije;
- novo orodje za sledenje kmetijske suše.

Project achievements:

- New and renovated infrastructure at meteorological measuring sites;
- Additional weather radar station located on Pasja Ravan and reconstructed weather radar station on Lisca Hill;
- New and upgraded hydrological measuring stations;
- New infrastructure for the operation of the Service for Marine Meteorology and Oceanography;
- New building for the laboratories for analyses of chemical and biological parameters and the calibration of measuring instruments;
- Modernised computer infrastructure for high perfomance computing;
- New operational forecasting tools: hydrological and marine forecasting systems;
- System supporting decisions related to groundwater in alluvial aquifers in Slovenia;
- New tools to monitor agricultural drought.

Meteorološka prognostična služba
Meteorological forecasting service

Samodejno meteorološko merilno mesto
Automated meteorological measuring site

Meteorološka merilna mesta

V okviru projekta BOBER smo državni mreži meteoroloških postaj poleg novega meteorološkega radarja na Pasji ravni dodali tudi 90 novih samodejnih meteoroloških postaj po vsej Sloveniji. Z nadgradnjo in razširitvijo meteorološke merilne mreže smo pridobili sodoben sistem za spremljanje vremena v podnebno raznovrstni Sloveniji. Nismo povečali le števila merilnih mest, temveč smo razširili tudi nabor meteoroloških veličin in pogostost meritev. Podatki o vremenu na območju Slovenije, ki jih z novimi samodejnimi meteorološkimi postajami pridobivamo vsakih 10 minut, bodo sproti prosto dostopni javnosti. Poleg vpogleda v trenutno vremensko dogajanje na območju Slovenije so podatki samodejnih meteoroloških postaj še posebej pomembni zaradi vključevanja v sisteme za zelo kratkoročno napovedovanje vremena ter s tem za spremljanje nevarnih vremenskih razmer in opozarjanje nanje. Hkrati pa bodo novopridobljeni podatki v prihodnje tudi pomemben vir za proučevanje podnebja Slovenije in njegove spremenljivosti.

Meteorological measuring sites

Within the framework of the BOBER project, the existing network of meteorological stations has been extended with a new meteorological radar installed on Pasja Ravan and 90 new automated meteorological stations set up throughout Slovenia. The upgraded and extended meteorological measuring network provides a modern system for monitoring the weather in Slovenia's diverse climate conditions. In addition to the increased number of measuring sites, we have also expanded the range of the observed meteorological quantities and the frequency of measurements. Information about the weather in Slovenia, obtained through new automated meteorological stations every 10 minutes, will be immediately and freely accessible to the public. The automated meteorological stations provide information about current weather conditions throughout Slovenia; in addition, this information is integrated into the system of very short-term forecasting, which enables the monitoring and issuing of weather warnings. Furthermore, this new data will be an important source for studies of the climate, and indeed climate change, in Slovenia.

Vremenski radar na Pasji ravni
Pasja Raven weather radar

Vremenski radar na Pasji ravni

Novi vremenski radar na Pasji ravni je pomembna pridobitev, saj je omogočeno sprotno in celostno spremljanje padavinskega dogajanja nad Slovenijo. Je drugi vremenski radar v Sloveniji, ki bo dopolnil radarsko sliko padavin z obstoječega radarja na Lisci. Nameščen je na tromeji občin Dobrova - Polhov Gradec, Gorenja vas - Poljane in Škofja Loka. Pridobljeni podatki so ključnega pomena pri zelo kratkoročnem in natančnem napovedovanju izjemnih vremenskih dogodkov, ki jih spremlja velika količina padavin v zelo kratkem času, kar običajno privede do izrednih vremenskih in hidroloških dogodkov. Poleg novega radarja na Pasji ravni smo nadgradili in posodobili tudi vse ključne dele obstoječega radarja na Lisci. Oba radarja sestavljata usklajen, sočasno delujoč par z enakimi merilnimi lastnostmi, kar je zelo pomembno z vidika zagotavljanja neprekinjenih meritev. Slovensko omrežje vremenskih radarjev ne živi samo zase. Vključeno je v evropsko omrežje, sestavljeno iz več kot 150 vremenskih radarjev, ki jih upravljajo državne meteorološke službe.

Pasja Raven weather radar

The new weather radar on Pasja Ravan is an important acquisition as it enables continuous and comprehensive monitoring of precipitation events above Slovenia. It is the second weather radar in Slovenia and is to complement the radar image of precipitation currently provided by the existing weather radar on Lisca Hill. The radar is located on the triple border of the Dobrova–Polhov Gradec, Gorenja Vas–Poljane and Škofja Loka municipalities. Data provided by this radar are of key importance for very short-term and accurate forecasts of extreme weather events that are accompanied by large quantities of precipitation over a very short time period, which normally result in dangerous weather and hydrological events. In addition to installing a new radar on Pasja Raven, all key components of the existing radar located on Lisca Hill were upgraded and modernised. The two radars form a coherent pair operating simultaneously and having equal measurement characteristics, which is very important in terms of providing continuous dataflow. Of course, the Slovenian weather radar network is not isolated: it is part of the European network, which consists of more than 150 weather radars managed by the various national meteorological services.

Merilno mesto Otiški Vrh na Meži
Discharge surface of the water measurement Otiški Vrh on the Meža River

Samodejno merilno mesto za podzemno vodo v Vogljah
Automated groundwater measuring site

Hidrološka merilna mesta

Gradnja novih in posodobitev že obstoječih hidroloških merilnih mest na površinskih in podzemnih vodah pomenita kakovostnejše doseganje ciljev, povezanih z ugotavljanjem vodnih količin in vodnih zalog ter stanj, pretočnih režimov voda, temperature vode, transporta suspendiranega materiala, dinamike in valovanja morja ter z ocenjevanjem hidroloških elementov ekološkega stanja rek, jezer in morja. Podatki hidrološkega monitoringa so podlaga za spremljanje, napovedovanje in obveščanje v izrednih hidroloških razmerah ter ob drugih naravnih nesrečah in nesrečah, ki jih povzroči človek. Uvedba sodobnih merilnih metod in sistemov, samodejni prenos podatkov in avtomatska predhodna kontrola podatkov zagotavljajo številne sprotne podatke in informacije ne samo strokovni, ampak tudi širši javnosti, predvsem z vidika učinkovitega izvajanja ukrepov zaradi povečane stopnje ogroženosti škodljivega delovanja voda. Vključevanje vseh teh podatkov v prognostične sisteme pa zagotavlja zanesljivejše modelske produkte ter pravočasno in natančnejše opozarjanje na visoke vode. Podatki merilnih mest in informacije so dosegljivi na spletni strani Agencije RS za okolje.

Hydrological measuring sites

Construction of new and modernisation of the existing hydrological measuring sites for surface and groundwater has provided a basis to improve the attainment of objectives related to the assessment of water resources and reserves, the state of the water environment, river discharge regimes, water temperature, transport of suspended material, sea dynamics and waves, and hydrological elements of the ecological status of rivers, lakes and the sea. The hydrological observation data provide a platform for the monitoring of the hydrological situation, forecasting, and providing information on extraordinary hydrological conditions, natural disasters and accidents caused by human factors. The introduction of modern measurement methods and systems, automated data transfer and automated data pre-control ensure that both the expert and the general public can access current data and information, which is of vital importance for efficient implementation of measures related to increased risks of harmful effects of waters. The assimilation of these data into prognostic systems ensures reliable model-based products and timely and accurate warnings against high waters. Data from the measurement sites and relevant information are available on the website of the Slovenian Environment Agency.

Postavitev dveh oceanografskih boj
Oceanographic buoys deployment

Lokacija Službe za morsko meteorologijo in oceanografijo v Izoli
Service for Marine Meteorology and Oceanography in Izola

Služba za morsko meteorologijo in oceanografijo

Slovensko morsko okolje je izpostavljeno številnim družbenim pritiskom – obala je gosto poseljena, pomorski promet in turizem se povečujeta. S tem se povečujejo varnostna in okoljska tveganja, še zlasti ob izrednih vremenskih in oceanografskih razmerah na morju. S projektom Bober smo razširili opazovalno mrežo tudi na morje, kjer smo januarja 2014 zasidrali novi oceanografski boji. Boji merita višino in smer valovanja morja, smeri in hitrosti morskih tokov po celotnem vodnem stolpcu ter temperaturo morja na površini. Podatki se prenašajo v podatkovno zbirko Agencije RS za okolje in prikazujejo na spletni strani agencije v realnem času ter tako omogočajo spremljanje trenutnih razmer.

Produkti morskih prognostičnih modelov so napovedi morskih valov, tokov, temperature in slanosti morja za 72 ur vnaprej. Za vhodne podatke se pri morskih modelih uporabljajo meteorološke napovedi modelov ALADIN in ECMWF (veter, vlažnost in temperatura zraka, padavine, zračni tlak, sončno in dolgovalovno sevanje), napovedi hidrološkega prognostičnega sistema (pretok reke Soče na izlivu v morje) in napovedi sredozemskega morskega modela MFS (temperatura morja, morski tokovi).

Service for Marine Meteorology and Oceanography

Society puts a substantial load on the marine environment in Slovenia – the coast is densely populated and sea transport and tourism have been increasing. These circumstances give rise to increased safety and environmental risks, particularly in cases of extreme weather and oceanographic conditions. Within the BOBER project, two new oceanographic buoys were deployed in January 2014, thus expanding the marine monitoring network. The buoys measure wave height and direction, sea currents throughout the water column, and sea surface temperature. The data are transmitted to the database of Slovenian Environmental Agency via mobile network and are publically available on Agency's website in real time, thus providing information about current sea state and conditions.

The operational marine forecasting model products are wave, current, temperature and salinity forecasts for 72 hours. As its input data, the marine models use ALADIN and ECMWF meteorological forecasts (wind, air humidity and temperature, precipitation, atmospheric pressure, and solar and long wave radiation), the hydrological forecasting system data (the River Soča discharge into the sea), and the MFS Mediterranean Sea model (sea temperature and currents).

Umerjevalni laboratorij
Calibration laboratory

Biološki laboratorij
Biological laboratory

Kemijsko-analitski laboratorij
Chemical analytical laboratory

Laboratorijski prizidek

Z zgraditvijo laboratorijskega prizidka sta omogočena prostorsko povečanje ter vsebinska nadgradnja kemijsko-analitskega, biološkega in umerjevalnega laboratorija. Tako je kemijsko-analitski laboratorij bogatejši za vrsto visokotehnoloških in naprednih laboratorijskih instrumentov, ki ustrezajo najnovejšim analitskim standardom. Z njimi bo mogoče kakovostneje opravljati obstoječe in dodatne meritve ter analize kemičnih in bioloških parametrov voda in zraka. Na podlagi verodostojnih in natančnih podatkov se lahko sprejemajo ukrepi, ki vodijo k čistejšemu okolju, v katerem živimo.

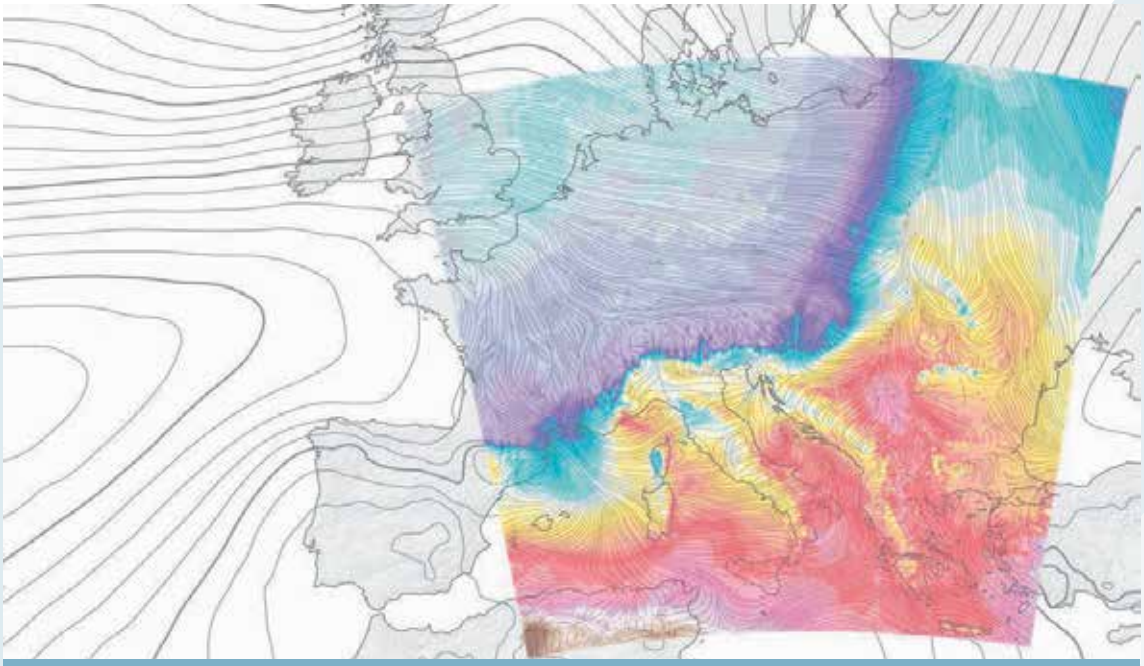
Temeljni namen dejavnosti umerjevalnega laboratorija je zagotavljanje kakovosti merilnih podatkov, ki se uporabljajo za obveščanje javnosti, v meteoroloških modelih, klimatoloških in ekoloških analizah, v prometu, kmetijstvu ... Za to je potrebno redno umerjanje merilnih instrumentov v meteorološki, hidrološki in ekološki merilni mreži Agencije RS za okolje ter na slovenskih mednarodnih letališčih. Svetovna meteorološka organizacija je leta 2005 umerjevalni laboratorij prepoznala in imenovala za regionalni instrumentacijski center, ki je pristojen za območje jugovzhodne Evrope.

Laboratory extension

The extension to the laboratory increased its floor space and enabled content-related upgrading of chemical-analytical, biological and calibration laboratories. The chemical- analytical laboratory has been provided with a number of state-of-the-art laboratory instruments complying with the latest analytical standards. These will allow for improved quality in carrying out the existing measurements and analyses of the chemical and biological parameters of air and waters and indeed enable additional ones. On the basis of credible and precise data, measures leading to a cleaner living environment can be adopted.

The primary purpose of the calibration laboratory is to provide quality of measured data, which are then used in informing the public, in meteorological models, in climatological and ecological analyses, and in transport, agriculture, etc. This requires regular calibration of measuring instruments within the meteorological, hydrological and ecological measurement network of the Slovenian Environment Agency and at the international airports in Slovenia. In 2005, the World Meteorological Organization identified and designated the calibration laboratory a regional instrumentation centre competent for the area of south-eastern Europe.

Visoko zmogljiv računanik
High performance computer



Izračun modela ALADIN-SI dne 18. septembra 2007 ob izrazitih hudourniških poplavah v severozahodni Sloveniji.
ALADIN-SI model calculation for 18 September 2007 when torrential flooding hit north-west Slovenia

Računalniška infrastruktura – visoko zmogljiv računanik

Informacijski sistem je hrbtenica vseh dejavnosti, ki se opravljajo na Agenciji RS za okolje. Visoko zmogljiv računanik je eden najzmogljivejših računalnikov v Sloveniji za analiziranje zbranih podatkov ter poganjanje zahtevnih modelov za napovedovanje vremena in opozarjanje na nevarne vremenske dogodke ter z njimi povezana hidrološka stanja.

Računalniški modeli za opis in simulacijo razmer v okolju seveda niso novost, saj je že dolgo znano, da so v svetu prav meteorološke službe med naročniki najzmogljivejših računalnikov. Kakovost modelskih napovedi je sorazmerna s količino vhodnih podatkov – meritev, z gostoto računske mreže in kompleksnostjo opisov naravnih procesov znotraj modelov. Ker želimo rezultate računskih simulacij za napovedovanje naravnih procesov v realnem času, so za to nalogo potrebni izredno zmogljivi računalniki.

Sodobni računalniki nam omogočajo, da lahko z veliko gotovostjo predvidevamo, kaj se bo z vremenom dogajalo v prihodnje, da s pomočjo računskih simulacij ocenjujemo, kakšne bodo posledice posegov v okolje za razmere v okolju, v katerem živimo, saj so vsa področja človekove dejavnosti in gospodarstva odvisna od razmer v naravi.

Computer infrastructure – high performance computer

The information system is the backbone of all activities performed in the Slovenian Environment Agency. Its high performance computing is one of the most powerful computers in Slovenia used for data analysis; it runs the complex models for weather forecasting and warning against dangerous weather events and related hydrological conditions.

Of course, using computer models to describe and simulate environmental conditions is by no means a new development, and most people are aware that meteorological services around the globe rank among the users of the world's most powerful computers. This is because the quality of model forecasts correlates with the quantity of input data, i.e. measurements, the computation network density, and the complexity of natural process descriptions within the models. Extremely powerful computers enable the computational simulation results required to predict the natural processes in real time.

Modern computers provide for great confidence in forecasting future weather developments and enable computational simulations to assess how the situation in our living environment might be affected by environmental interventions, given that natural conditions affect all areas of human activity, including the economy.

Služba za hidrološko prognozo
Hydrological forecast service

Hidrogram napovedanega odtoka Krke v Soteski
Hydrograph of forecasted runoff of the Krka River at Soteska

Hidrološki prognostični sistem

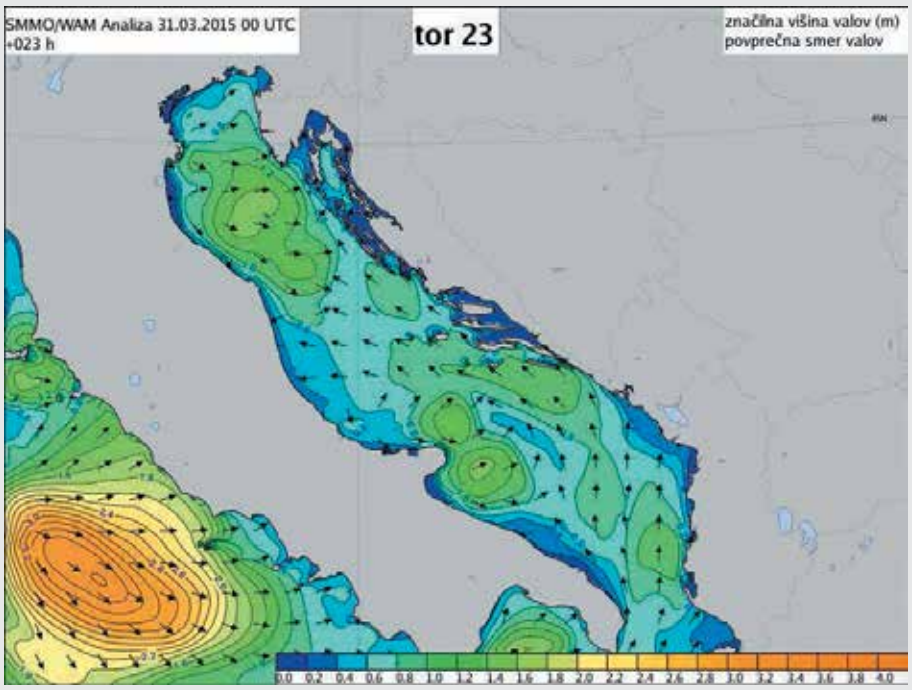
Z vzpostavitvijo hidrološkega prognostičnega sistema je hidrološka prognostična služba dobila ključno operativno orodje za spremljanje in napovedovanje stanja slovenskih rek. Prognostični sistem obsega hidrološke in hidrodinamične modele vseh slovenskih porečij – tj. porečja Soče, Save, Drave in Mure. Modelske točke, v katerih se računajo pretoki in vodostaji rek, so usklajene z opazovalno mrežo vodomernih postaj – tako z obstoječimi kot tudi z novimi samodejnimi postajami. Vhodni podatki hidrološkega prognostičnega sistema so meritve in napovedi meteoroloških spremenljivk, med robne pogoje pa so dodani že izmerjeni pretoki rek. Rezultati sistema se obnavljajo vsako uro in omogočajo napoved stanja slovenskih rek za šest dni vnaprej.

Pravočasne in natančnejše napovedi vodnatosti rek so podlaga za zmanjšanje posledic škodljivega delovanja voda, saj so pomemben člen v sistemu zgodnjega opozarjanja na poplave in zaščite pred njimi. Napovedi pretokov so uporabne tudi v gospodarskih panogah, na primer v elektrogospodarstvu, kmetijstvu, turizmu in drugih družbenih dejavnostih.

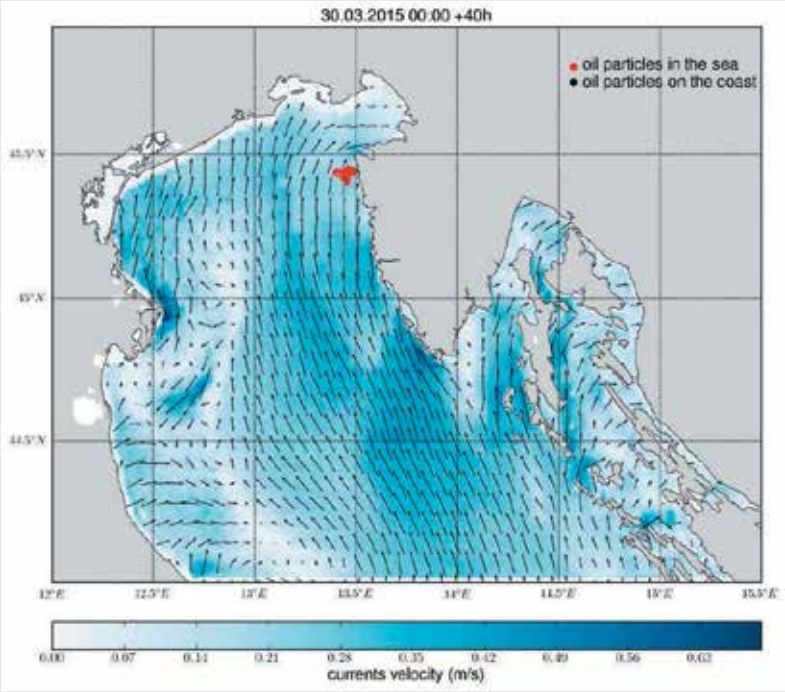
Hydrological forecasting system

The development of the hydrological forecasting system provided the hydrological forecasting service with a vital operational tool for monitoring and forecasting the state of Slovenian rivers. The forecasting system covers hydrological and hydrodynamic models for all major river basins in Slovenia, i.e. those of the Soča, Sava, Drava and Mura rivers. The model forecasting points, where discharges and water levels are calculated, have been synchronized with the gauging network – including old as well as new automated stations. The data entered into the hydrological forecasting system consist of the measurements and meteorological variable forecasts; boundary conditions and also include river discharge measurements. The results produced by the system are updated hourly and provide for 6-day water level and discharge forecasts for the Slovenian rivers.

Timely and accurate river flow forecasts are vital for reducing the harmful impacts of water and are an important element of the system of early flood warning and protection. Sectors such as the hydropower industry, agriculture and tourism find such forecasts particularly useful.



Napoved valovanja na območju Jadranskega morja
Wave forecast for the Adriatic Sea



Napoved gibanja morskih tokov na površini in simulacija razširjanja oljnega madeža
Sea surface current forecast and oil spill simulation

Morski prognostični sistem

Napovedovanje stanja morja v Sloveniji pomeni nov mejnik pri zagotavljanju varnosti na morju in ob obali. Operativni morski prognostični sistem za področje celotnega Jadranskega morja je temeljno orodje Službe za morsko meteorologijo in oceanografijo. Sestavljajo ga modeli za napovedi valovanja morja, gibanja morskih tokov, astronomsko plimovanje morja in model za simulacijo širjenja oljnega madeža.

Sistem omogoča napovedi višine gladine morja, gibanja morskih tokov, višine in smeri valovanja morja, temperature in slanosti morja. Vhodni podatki sistema so napovedi meteoroloških prognostičnih modelov, napovedi hidrološkega prognostičnega sistema (pretok reke Soče na izlivu v morje) in napovedi sredozemskega morskega modela.

Napovedi tokov na površini morja so podlaga za simulacije razširjanja oljnih madežev ob morebitnem razlitju na odprtem morju. Simulacije pomagajo pri določanju ocene tveganja za posamezna območja na obali in pri načrtovanju ukrepov za zmanjšanje negativnih posledic onesnaženja. Za simulacijo širjenja oljnega madeža je potrebna informacija o kraju in času razlitja ter o količini in vrsti razlite nafte.

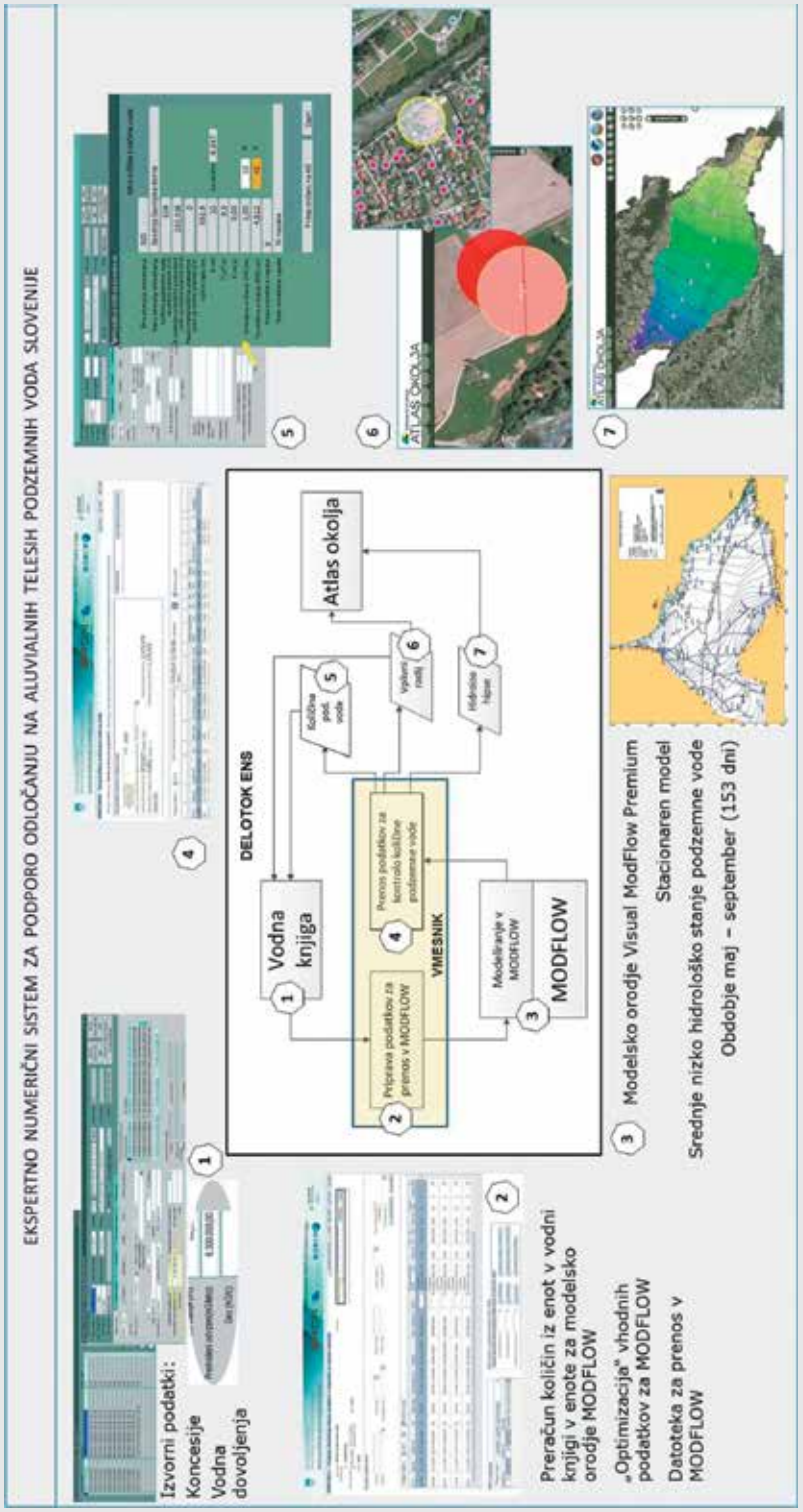
Napovedi stanja morja bodo dostopne širši javnosti, simulacije širjenja oljnih madežev pa so namenjene predvsem v podporo pristojnim strokovnim službam za zaščito in reševanje.

Marine forecasting system

Forecasting the sea state in Slovenia has reached a new level in ensuring safety at sea and by the coast. The Service for Marine Meteorology and Oceanography set up the operational marine forecasting system covering the entire Adriatic Sea. The system consists of oil spill model and models for forecasting waves, currents and astronomical tides.

The system’s output are forecasts of sea level, currents, wave heights and directions, temperature and salinity. Meteorological forecast models, the hydrological forecast system (the RiverSoča discharge into the sea) and the Mediterranean Sea model provide boundary conditions for oceanographic models.

Sea surface current forecasts are the basis for oil spill simulations in case of an accident in the open sea. The model needs additional information about oil type, location and volume of spilled oil. Information about movement of the oil spill is crucial for civil protection service in order to minimize potential hazards for marine ecosystem and coast.The sea state forecasts will be available to the general public, while the oil spill simulations areprimarily intended to support the operations of the responsible civil protection and disaster relief services.



Shema delovanja ekspertno numeričnega sistema ENS za podporo odločanju pri upravljanju podzemnih voda
Workflow of the expert decision support system (ENS) for groundwater management

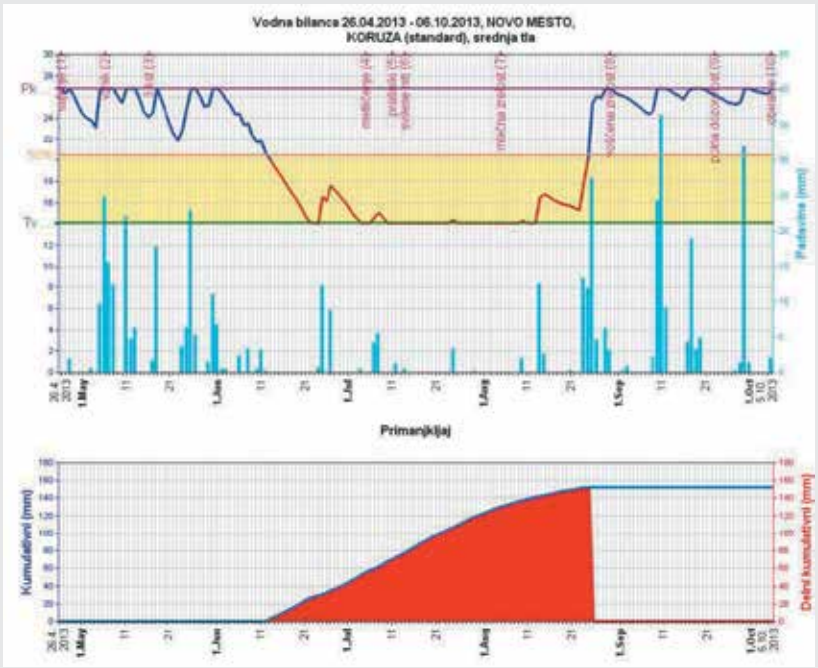
Sistem za podporo odločanju na aluvialnih telesih podzemnih voda Slovenije

Ekspertno numerični sistem (ENS) za podporo odločanju pri upravljanju podzemnih voda na aluvialnih vodonosnikih povezuje modele toka podzemne vode z zbirko vodnih dovoljenj in koncesij, kar omogoča ocenjevanje količin in zagotavljanje trajnostne rabe podzemne vode. Glavni cilj naloge je tako bil zagotoviti nadzorne mehanizme, s katerimi se preverja podeljevanje vodnih pravic. V postopku pridobitve informacije o količini vode na določenem kraju ENS uporablja podatke iz aplikacij Vodna dovoljenja in Koncesije (Vodna knjiga) ter zagotavlja mehanizem za nadzor nad znižanjem gladine podzemne vode na želenem izbranem kraju in mehanizem za nadzor nad poseganjem v vplivno območje črpanja. Podlaga za ENS so regionalni hidrogeološki matematični modeli toka podzemne vode, vzpostavljeni na šestih območjih količinsko najbolj obremenjenih vodnih teles podzemnih voda: na Murskem in Dolinsko-Ravenskem polju, Dravsko-Ptujskem polju, Spodnjesavinjskem polju, Krškem polju, Kranjsko-Sorškem polju in Ljubljanskem polju. Z njimi pridobimo izhodiščno informacijo o modelski količini podzemne vode za podeljevanje vodnih pravic za trajnostno rabo podzemnih vodnih virov.

A system as a support to the decision making process in the field of groundwater management for alluvial groundwater bodies in Slovenia

The numerical expert decision support system (ENS) for groundwater management in alluvial aquifers links the groundwater flow models with the water permits and concessions databases in order to help quantify groundwater reserves for a given groundwater body. Within the framework of this task, the main objective is to provide control mechanisms to verify the granting of water rights for the sustainable use of groundwater resources. To obtain the information about quantity of groundwater for a given body, the ENS, in conjunction with the models, uses the data from the Water Permits and Concessions Database (Water Book) and ensures a control mechanism on groundwater level decline at a given location due to pumping, as well as a mechanism to control co-impact of groundwater pumping. The basis for the ENS are six regional groundwater flow models which were set up for the aquifers within groundwater bodies under large abstraction stress: Mursko and Dolinsko Ravensko Polje, Dravsko-Ptujsko Polje, Spodnje Savinjsko Polje, Krško Polje, Kranjsko-Sorško Polje and Ljubljansko Polje. The models provide basic information about the estimated quantities of groundwater for the granting of water rights with a view to ensuring the sustainable use of groundwater resources.

Kmetijska suša na koruznih poljih v severovzhodni Sloveniji poleti 2012
Maize fields in the north-eastern Slovenia affected due to summer drought 2012



Primanjkljaj vode pri koruzi na tleh s srednje dobro vodnozadrževalno sposobnostjo v Novem mestu leta 2013
Maize water deficit on the soils with medium water holding capacity, Novo mesto, 2013

Orodje za sledenje kmetijske suše

Programsko orodje omogoča obdelavo podatkov meteorološkega monitoringa Agencije RS za okolje in zunanjih podatkovnih virov. Glavni elementi sistema so štirje moduli za izračun vodnih bilanc, upravljanje podatkov, analizo podatkov in administracijo sistema. Modul za izračun vodne bilance je jedro novega orodja, ki temelji na vodnobilančnem modelu IRRFIB, ki je plod lastnega znanja. Omogoča vnos in urejanje podatkov za simulacijo vodne bilance nenamakanih kmetijskih rastlin, za namakane rastline pa možnost izbire različnih tipov namakanja ter vključevanje napovedi namakanja za naslednjih pet dni. Modul omogoča sledenje sušnega stresa in primanjkljaja vode ter porabe namakalne vode pri kmetijskih rastlinah. Modul za analizo podatkov omogoča časovno in prostorsko obdelavo ter prikaz osnovnih in izvedenih agrometeoroloških podatkov. Sestavljata ga podatkovno skladišče, ki je njegova osrednji del, in orodje za analizo podatkov, Oracle Bussines Intelligence (OBI). V vegetacijski sezoni s pomočjo orodja izdelujemo Dekadni bilten stanja vodne bilance kmetijskih tal v Sloveniji, ki je vsako dekado v vegetacijski sezoni objavljen na spletni strani agencije in poslan številnim uporabnikom. Z namenom ozaveščanja in spodbujanja k prilagajanju sušnim razmeram ter zaradi zmanjševanja škodljivih vplivov suše je informacijski sistem prek uporabniškega profila na voljo tudi zunanjim uporabnikom.

Agricultural drought monitoring tool

Software facilitates the processing of data from meteorological monitoring performed by the Slovenian Environment Agency of and from external data sources. The system has four main modules: for the calculation of the water balance, data management, data analysis and system administration. The module for calculating the water balance is at the core of this new tool and is based on the IRRFIB water balance model, which has been developed using the Agency's own expertise. It allows the data entry and editing to simulate the water balance for non-irrigated crops, a selection of different types of irrigation regime for crops under irrigation and the inclusion of irrigation forecasts for five days. The module makes it possible to monitor drought stress, water shortages and the use of the irrigation water by agricultural crops. The data analysis module enables temporal and spatial data processing and display of basic and derivative agro-meteorological data. It comprises data storage, which is the module's core component, and Oracle Business Intelligence (OBI), which is a tool for data analysis. During the vegetation period, a Ten-day Agricultural Soil Water Balance Bulletin for Slovenia is issued; it is published every ten days on the Agency's website and disseminated to numerous users. With a view to raising awareness, facilitating adaptation to drought conditions and reducing the adverse impact of droughts, the information system is also accessible to external users through a user interface.

Dosežki projekta
»Nadgradnja sistema za spremljanje in analiziranje stanja vodnega okolja v Sloveniji«

Project achievements
»Upgrade of the system for monitoring and analyzing the water environment in Slovenia«

REPUBLIKA SLOVENIJA
MINISTRSTVO ZA OKOLJE IN PROSTOR

AGENCIJA REPUBLIKE SLOVENIJE ZA OKOLJE

Ljubljana, junij 2015