eleaf HydroLogic WATER TECHNOLOGY HIDROMOD THE UNIVERSITY OF SYDNEY hydro & meteo HCP international

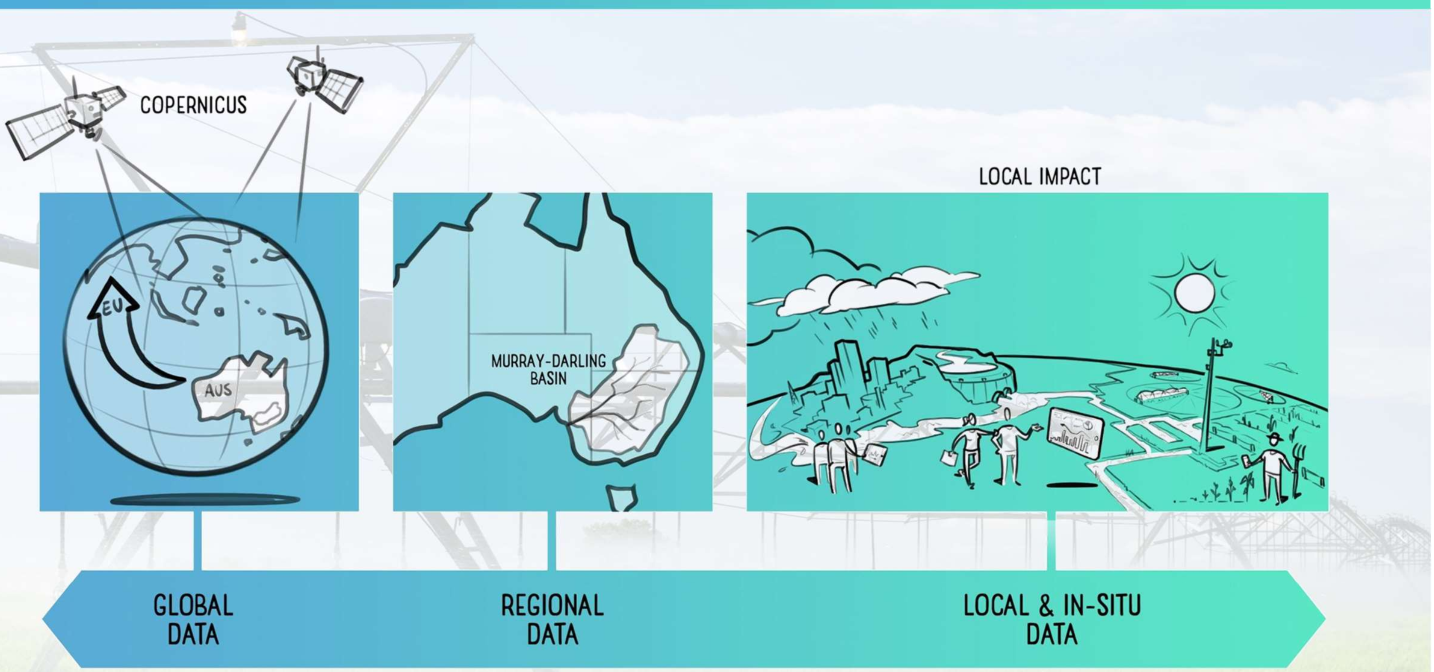
WaterSENSE

Making SENSE of the water value chain in Australia

www.watersense.eu | www.watersense.com.au

#MakingWaterSENSE

Newsletter 2- February 2021



LinkedIn: Project WaterSENSE **Twitter:** @MakeWaterSENSE

This project has received funding from the Horizon 2020 research and innovation programme grant agreement No 870344

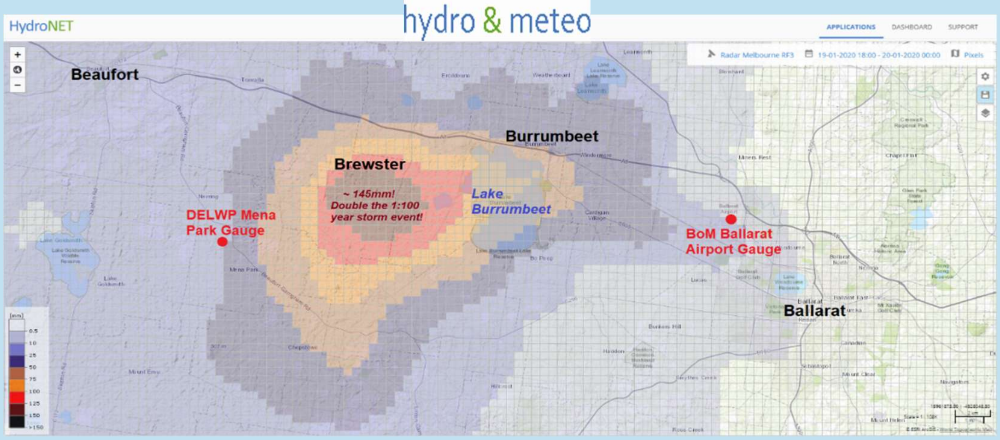
WaterSENSE

For an overview of the WaterSENSE Research in Action Project, please refer to Newlsetter 1.

WaterSENSE consortium members

The WaterSENSE consortium consists of 7 partners: eLEAF (Netherlands), Hydrologic Research (Netherlands), Water Technology (Australia), Hidromod (Portugal), hydro & meteo (Germany), the University of Sydney (Australia) and HCP International (Netherlands).

Partner Spotlight– Hydro & Meteo



Specialists in Hydrometeorology

The main focus of hydro & meteo is on innovative solutions for the interface between hydrology and meteorology, addressing specifically the water industry and other weather-related economic sectors. Hydro & meteo GmbH offers hydrological and meteorological services and consulting in the following areas:

- The analysis and processing of precipitation data (weather radar and stations).
- Creation of precipitation forecasts and warnings.
- Operation of warning systems.
- Analysis and evaluation of climate records.
- Evaluation and downscaling of climate projections.
- Software development.
- Training of specialists and software training.

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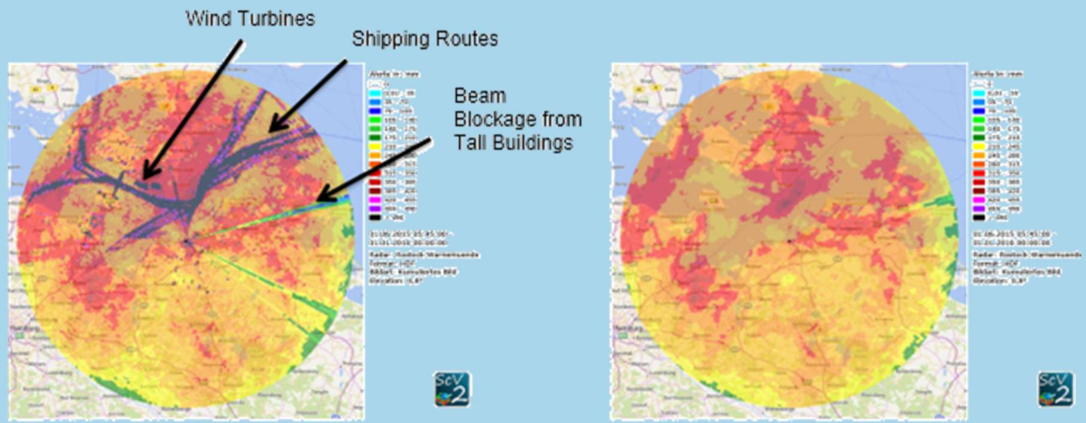
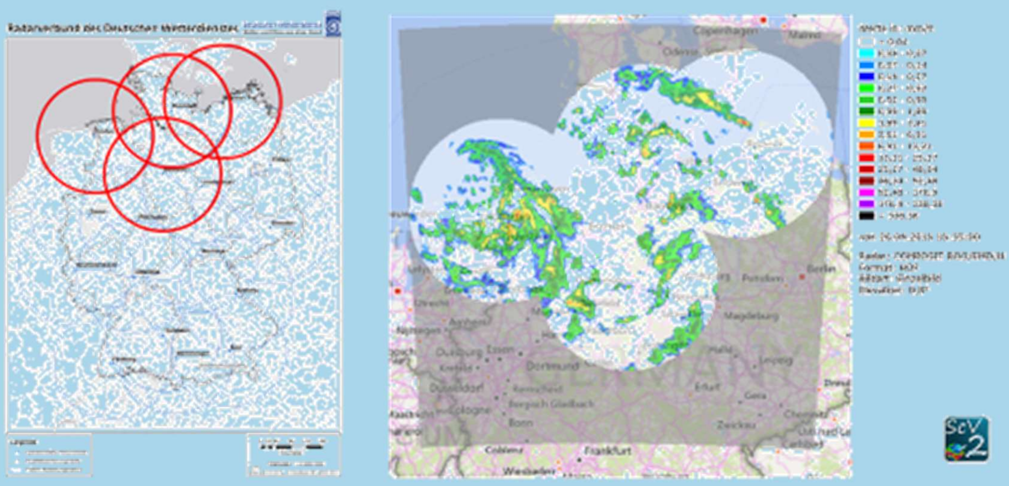
HydroNET-SCOUT Software

SCOUT is software to process radar rainfall measurements. **HydroNET** is a web based portal providing tailored information to support decision making. **HydroNET-SCOUT** is an excellent connection between two supplementary software products. Important functions are:

- Numerous correction possibilities to correct frequent errors in radar measurements, like Clutter, beam blockage, attenuation and Bright Band. The filters can be specially adjusted for different kinds of radars.



- Compositing of data from several radar stations to one combined gridded radar map.



- Conversion of the radar reflectivity factor into rainfall intensities based on configurable ZR-relationships.
- Combination of radar data with rain gauge measurements to estimate reliable quantitative data for the estimated amount of rainfall (adjustment).
- Calculation of nowcasts over a period of 1-3 hour based on current radar measurements. The nowcasts can also be calculated and produced as ensemble forecasts.
- Supplement of nowcasts through numerical weather forecasts (NWP).
- Creation of warnings.
- Display of processed data in different formats, such as images or data matrices, animations, aggregated rainfall for different areas, e.g. sub catchment areas, and for different time periods.

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Spotlight on hydro & meteo staff

The founder and Managing Director, Dr. Thomas Einfalt:

Thomas Einfalt graduated in 1985 in Mathematics and Computer Science at Hannover University. In Paris, France he went to the Ecole Nationale des Ponts et Chaussées for his Ph.D. thesis on radar rainfall forecasting for real-time applications of the Paris sewer control system until 1988. He joined RHEA S.A. in Versailles in 1989 where he was responsible for the improvement of the installed forecasting system and the knowledge transfer to the operational personnel of the sewer system. From 1991 to 1999 he was responsible for specialised software development and the quality control of measurement data with Hydrotec GmbH in Aachen. In April 1999 he founded his own company which is now ***hydro & meteo GmbH***. Furthermore, he acts as an adviser for several water authorities and municipalities for rainfall related questions. He is secretary of the IWA/IAHR working group on Urban Rainfall (IGUR), chairman of ISO/TC 146/SC 5/WG 7 (Weather radar) and has been invited expert of COST 717 and COST 731 at several occasions.

Thomas has developed the SCOUT radar software system for analysis, display and online forecasting of radar measured rainfall. He has experience with different hydrological software packages.

Dr. Alexander Strehz:

Alexander Strehz is a meteorologist (Dipl.-Met., Christian-Albrechts-University, Kiel, Germany, 2009) with a Ph.D. in Physics. His professional interest is the application of meteorological remote sensing data in industry and research with more than 10 years of experience. After his degree in meteorology, he started to work as a research assistant at the Christian-Albrechts-University in Kiel, Germany on collocating in-situ and satellite precipitation data (Projeject Kollsat of the German Weather Service), which sparked his

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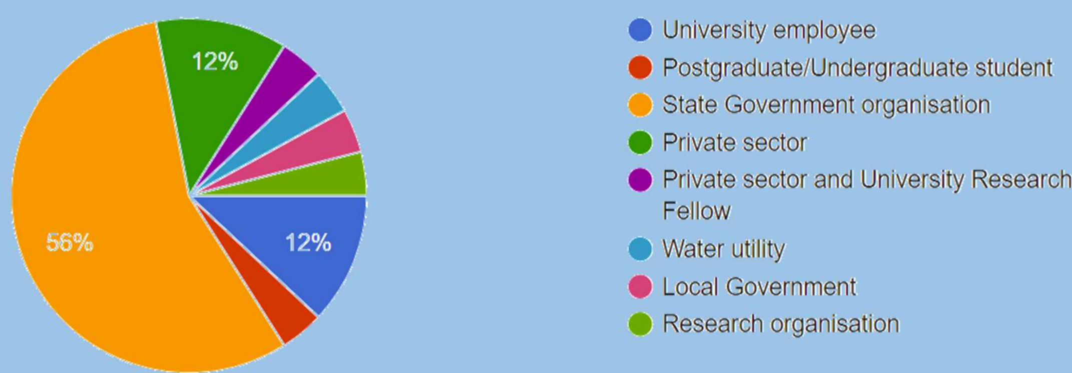
interest in remote sensing data. Afterwards he went on to develop a remote sensing instrument for wind for wind energy applications during his Ph.D. at the University of Auckland, New Zealand (Title: A Scanning Bi-static SODAR). Since 2015 he is working for hydro & meteo where his focus is on the development and administration of automated radar data analysis and visualisations systems including warning systems for the city of Hamburg (www.wabiha.de) and other international clients

WaterSENSE Summer School

We will be holding our first WaterSENSE summer school event from 23 – 25 February 2021. Due to COVID restrictions, we will be running this both on-line and in person at the University of Sydney. However, this has not stopped more than 20 enthusiastic people enrolling from all different sectors in the water resource area.



The main delivery of the Summer school will be through project members at the University of Sydney and WaterTechnology, but we will also bring in (via on-line links) other consortium members (eLEAF and Hydrologic Systems) to deliver parts of the program. We are also teaming up with colleagues from Australian National University and Geoscience Australia, as some of the work they do is complementary to the work in WaterSENSE.

During the Summer school, the participants will be introduced into the WaterSENSE project, followed by hands-on experience with some of the tools and algorithms that the consortium has developed and is using for the project. In addition, there will be a brainstorming session in which we will work with the participants to develop different potential applications of the WaterSENSE toolbox.

In this course you will:

- Work with an application platform that can be used for climate smart water management: a) Introduction into the Hydronet platform for data management; b) Remote sensing information via different platforms, such as Digital Earth Australia, Google Earth Engine (GEE) and the Hydronet API; c) scripting and associated tools for version control and collaboration.
- Develop scripting in python to access the different highlighted interfaces.
- Collaborate with fellow summer school participants to address real world challenges in three water management case studies in the Namoi basin.

If you would like more information or register, please follow this link.

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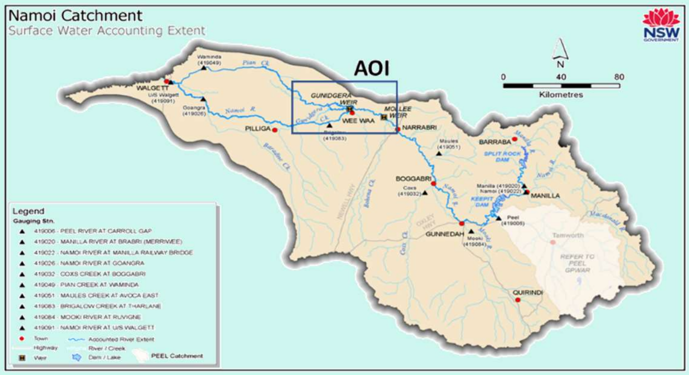
Research Update

The Namoi Catchment is our Area of Interest

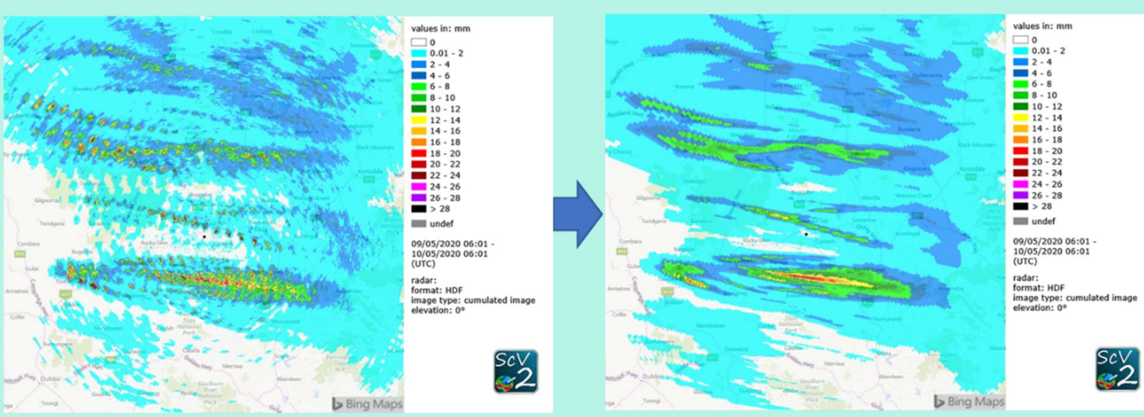
All WaterSENSE research to date has been focused on the Namoi Cacthment in New South Wales, Australia. The team has also selected a smaller area of interest between Gunnedah and Wee Wah within the Namoi for more detailed work. The research updates in this newsletter are thus all within the Namoi Catchment.



Adjusted Radar Rainfall Data for the Namoi

Hydro & meteo have finalised the corrections to the Radar Rainfall data in the Naomi Catchment. The polar volume data from the Australian Bureau of meteorology was used as the base data on which a number of corrections were applied through the **SCOUT** software of hydro & meteo. The corrections applied are listed below.

- Speckle.
- Clutter map.
- Texture.
- Reverse speckle.
- Beam block.
- Time interpolation to correct fishbone pattern. Time interpolation between consecutive images, effectively converting the snapshots to cumulated precipitation.



Fishbone Pattern Correction.

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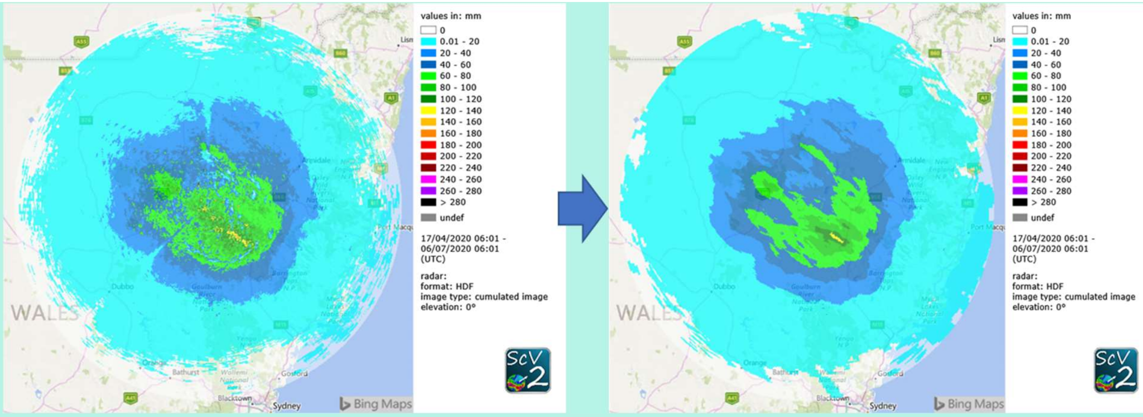
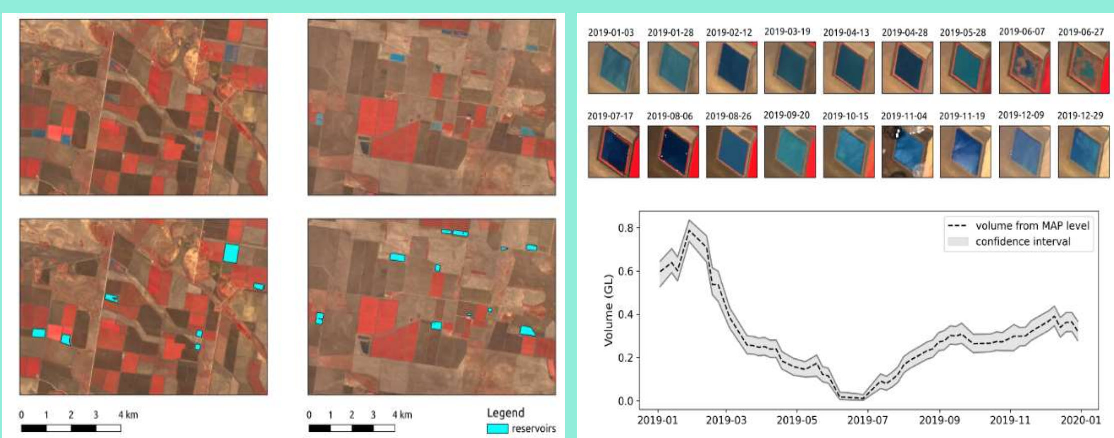


Final Results after all corrections applied.

On-farm reservoir detection and monitoring from remote sensing data sources

WaterSENSE members Dr. Ignacio Fuentes and A/Prof Willem Vervoort from the University of Sydney,have teamed up with Dr Richard Scalzo, a data scientist from the ARC IIT centre Data Analytics for Resources and the Environment to develop a methodology to quantify uncertainties related to deriving water levels in farm dams using Copernicus Sentinel 2 data images. A paper has just been submitted to the journal of Environmental Modelling and Software.

Time series of the water index derived from Sentinel 2 were used to estimate how often water occurs at different locations in a catchment and a threshold of water occurring 20% of the time was used to detect reservoirs (farm dams). Morphometric relationships (such as that farm dams can be square or round but are generally not very elongated such as rivers) were used to filter out water bodies. Elevation LiDAR data can then be used to calculate 0.1 m water elevation intervals to estimate water volumes and identify flooded pixel areas for each water elevation. Using novel Bayesian statistics and assuming a relationship between flooded pixels and the water index we can then estimate the water level and the uncertainty. We accurately estimated water elevations and volumes in reservoirs, with a systematic error of about 2.5% and 10% of the maximum capacity observed during the study period based on example data from Keepit dam and Pamamaroo lake.



Identification of on-farm reservoirs and estimation of volume.

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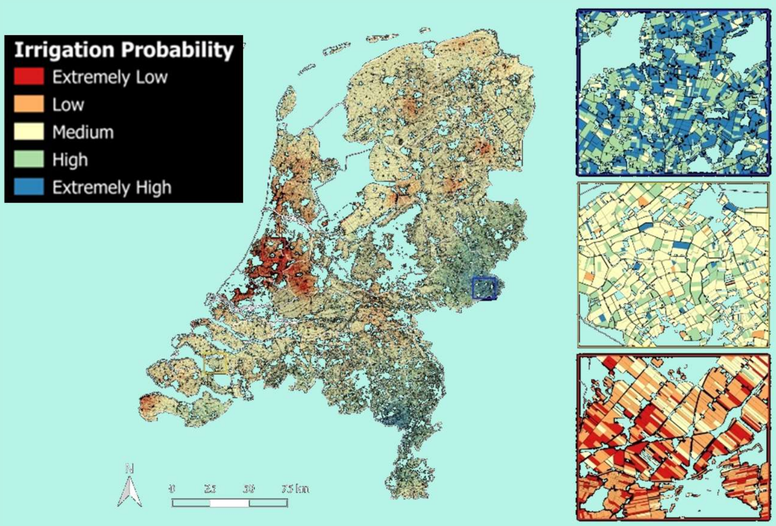
Estimation of Irrigated Lands

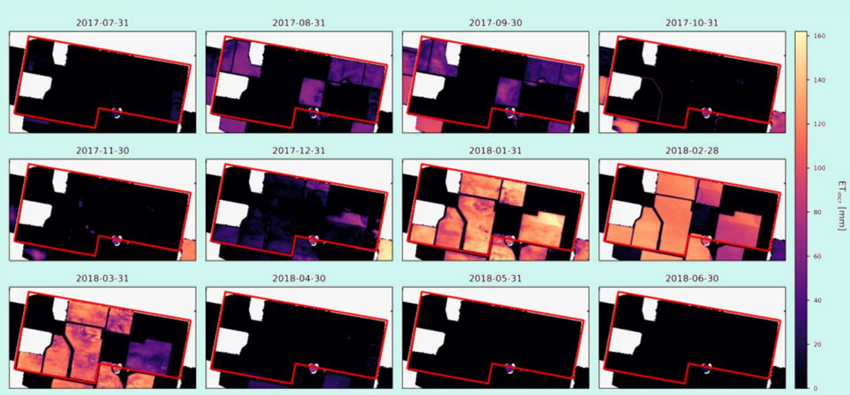
One of the limitations of the application is that it relies on previously identified land use classification data. This can be issue when estimating irrigated water use at the current time, as the irrigated lands may not match those of the previously identified areas. Any new lands under irrigation would not be visible either. WaterSENSE is thus investigating a process to automatically estimate irrigated lands. The process currently being researched is:

- Calculate reference evapotranspiration (ET0) based on ERA5 meteorological data and the FAO-56 standardized Penman-Monteith equation.
- Calculate crop coefficient (Kc) per field based on NDVI-Kc relation derived per crop type.
- Calculate actual evapotranspiration (AET) per field using derived Kc.
- Calculate precipitation deficit based on AET and precipitation data.
- Create irrigated area map based on precipitation deficit, croptype, and soilproperties.



From Polygon based to Raster based ET_{incr}

The application currently calculates water use on averaged ETincr and area of field polygons. However, not every pixel within the polygon is irrigated agriculture, so water use might be overestimated. In future, the area of the pixels that are classified as irrigated agriculture and lie within the field polygon will be summed and used to calculate the water use only for irrigated agriculture. This will also improve the calculation of application rates per polygon in Ml/ha.



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Water Allocation Monitoring and Auditing Service (WAMAS App) Update

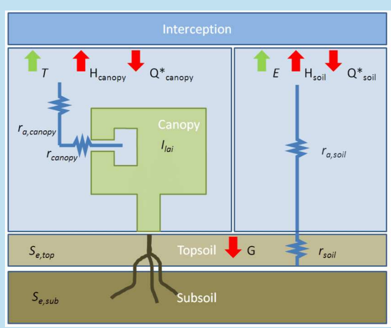
This WaterSENSE Toolbox Application is the furtherst developed. It is a satellite based compliance check that uses the existing eLEAF ETLook® and HSP Algorithms at its core.

- Calculates the actual crop evaporation (due to irrigation) across an entire catchment.
- Per field or larger unit.
- Compares with the allowed water.
- Easy identification of big water users.

The ETLook® and HSP Models are summarised below.

Models: ETLook

- Remote sensing based evapotranspiration model.
- Energy balance and Penman-Monteith.
- Raster based satellite imagery and weather data.
- Scalable from fields (10 m) to continents (250 m).
- References: Bastiaanssen et al. (2012), Pelgrum et al. (2012), FAO & IHE Delft (2019), and Blatchford et al. (2020).

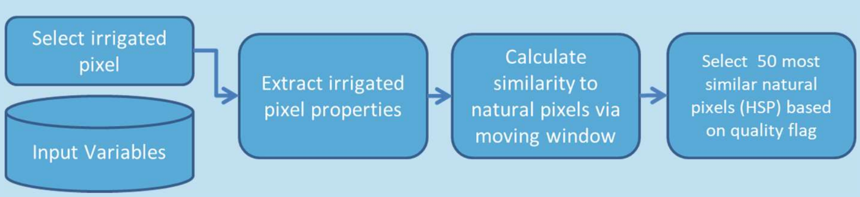


ETLook® Energy Balance Modelling.

Models: Hydrologically Similar Pixels (HSP)

Identifier of hydrological similar pixels based on a variety of static inputs.

- Subsets number of natural pixels that are similar to irrigated pixel and calculates the (weighted) average ETact (ETnat).
- Compares ETnat to ETact of irrigated pixel to calculate incremental evapotranspiration (ETincr), which is a measure of the water use due to irrigation.



HSP Process.

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Conferences and Presentations

EO for Water Cycle Science 2020

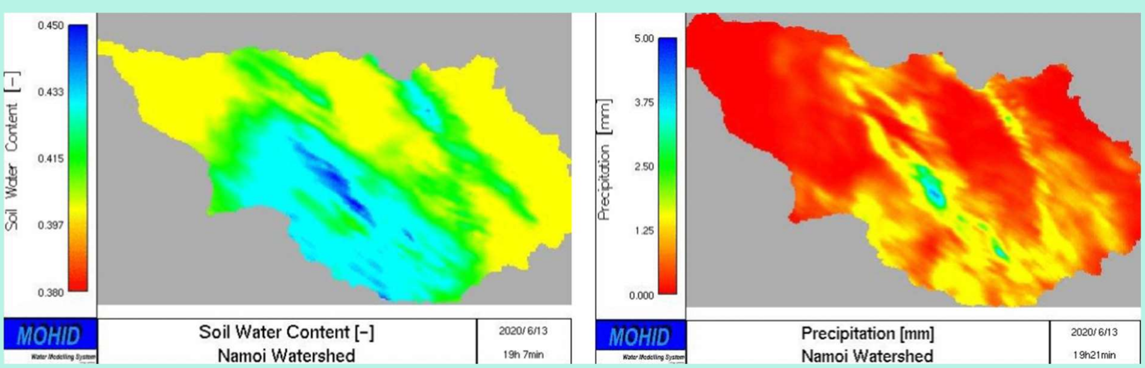
Pedro Chambel-Leitão from WaterSENSE consortium member Hidromod presented to the 2020 EO for Water Cycle Science online conference.

The title of the presentation was "Creating A Modular Water-Monitoring System Capable Of Dealing With A Large Variety Of Datasets At Different Space And Time Scales" and a summary of the abstract is provided below.

The WaterSENSE project will provide water-availability and mapping services for any place in the world at different time and spatial resolutions, based on integrating Copernicus data, hydrological models and local data, starting in Australia. For that ***WaterSENSE uses various levels of models, each with different levels of data requirements and modelling accuracy.*** *These represent a balance between local data and knowledge and the use of globally applicable approaches using generic datasets available from EO data.*

Three levels of modelling *are applied in WaterSENSE: 1) Soil-water availability modelling; 2) Catchment hydrological modelling; 3) Detailed spatial modelling. Each level of modelling is characterised by the detail of data used for input, the processes modelled and the outputs produced, ranging from generic outputs to details such as water fluxes and water volumes.*

While the ***first level of modelling focuses on the soil*** *(porous media), and the main water fluxes in a water column are precipitation and evapotranspiration (ET), at the* ***second level it is the entire catchment*** *and its geographical and physical components that determine water volumes in time and space. The* ***final, most detailed level of modelling*** *encapsulates all the details of a water system and its water infrastructure and control strategies. It* ***can be embedded within the other types of models****, and its accuracy is highly dependent on in-situ data availability, including time series of water levels, flows and specific local needs.* ***Each of these three levels can satisfy different user requirements****.*



Detailed soil mosture modelling within the Namoi Catchment, based on our high resolution and corrected Radar Rainfall data.

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Connect with us!

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