GEO WEEK & MINISTERIAL SUMMIT 2023

Workshop on EO data-driven agricultural and water use monitoring, prediction, and smart decision making

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GEO WEEK 2023 MINISTERIAL SUMMIT

GEO GROUP ON EARTH OBSERVATIONS

EO data-driven agricultural and water use monitoring, prediction, and smart decision making

Making sense of the Water value chain in Australia

S. Wonink, B. Jackson, J. Brombacher, R.W. Vervoort, T. Einfalt, M. Alderlieste, P. Chambel Leitão, AR Safi

Mark Noort

06/11/2023 @ 16:00 hrs

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Partners and Affiliations

- eLEAF, Netherlands, SME, coordinator, technical partner
- Hydrologic Research, Netherlands, SME, technical partner
- Water Technology, Australia, SME, value chain development partner
- University of Sydney, institute, research partner
- Hydro&meteo, Germany, SME, technical partner
- Hidromod, Portugal, SME, technical partner
- HCP International, Netherlands, SME, communication partner

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The WaterSENSE Challenge

Deliver a modular approach to water accounting across the landscape

- Observe water balance components using remote sensing (RS)
- At all scales (from “within field” scales to landscape/catchment scales)
- Crop water use, water storage, water application in a closed farm water balance
- Vegetation condition, wetland flooding, quantifying environmental flow delivery.



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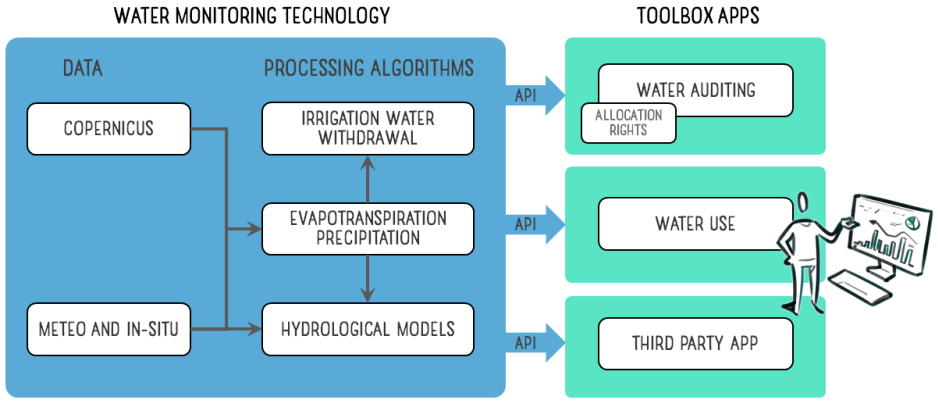
The WaterSENSE Concept

Collaborative solution connecting platforms through service buses using open standards

- Water Monitoring System Toolkit:
  Modular, operational, water monitoring system:
  Integrates Copernicus EO data, ground radar, models, in-situ data;
- Water Management Toolbox:
  Makes data, algorithms and services available to users.
  Various apps provide reliable, actionable Information.
- Flexible Service Subscription models
- Flexible Front Ends



Examples

- Farm Water Balance
- Environmental Flow Management
- Regional Agronomy Decision Support
- Water Resource Mapping
- Water Availability Forecasting,
- Calamity Monitoring

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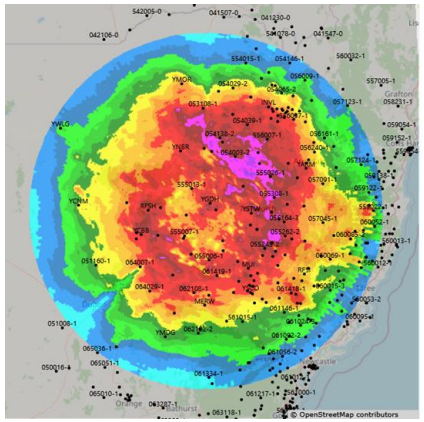
Rainfall and RS

- Rainfall (near real time): Integration of radar and IMERG can provide a spatial product at 1 km scale
- Satellite derived soil moisture (using TOTRAM), regrettably not a feasible downscaling tool for rainfall.



geomatics
MDPI

Technical Note

Precipitation Data Retrieval and Quality Assurance from Different Data Sources for the Namoi Catchment in Australia

Alexander Strehz * and Thomas Einfalt

Hydro & Meteo GmbH, Breite Straße 6-8, 23552 Lübeck, Germany; einfalt@hydrometeo.de
* Correspondence: a.strehz@hydrometeo.de

atmosphere
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Article

Feasibility of Downscaling Satellite-Based Precipitation Estimates Using Soil Moisture Derived from Land Surface Temperature

Alexander Strehz [1,*], Joost Brombacher [2], Jelle Degen [2] and Thomas Einfalt [1,*]

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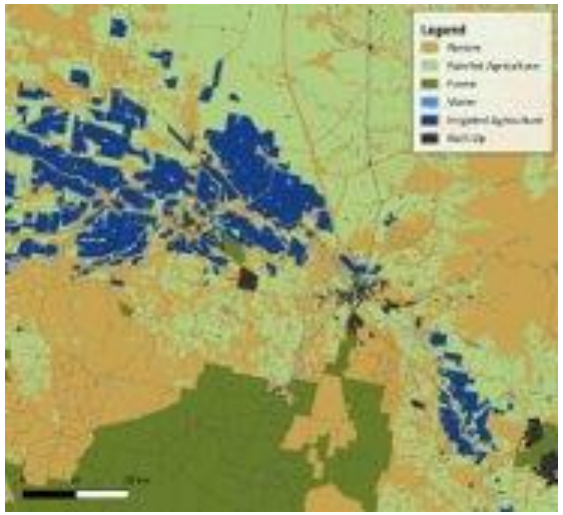
Evapotranspiration product verification

- Compared ETLook with CMRSET
  for single Sentinel 2 image tile (55JGG) (Narrabri)
- Highlights different assumptions
  in soil moisture model used (GVMI versus TOTRAM)
- ETLook more sensitive
  to dry conditions
- Products similar
  in wet conditions and irrigation



Study area

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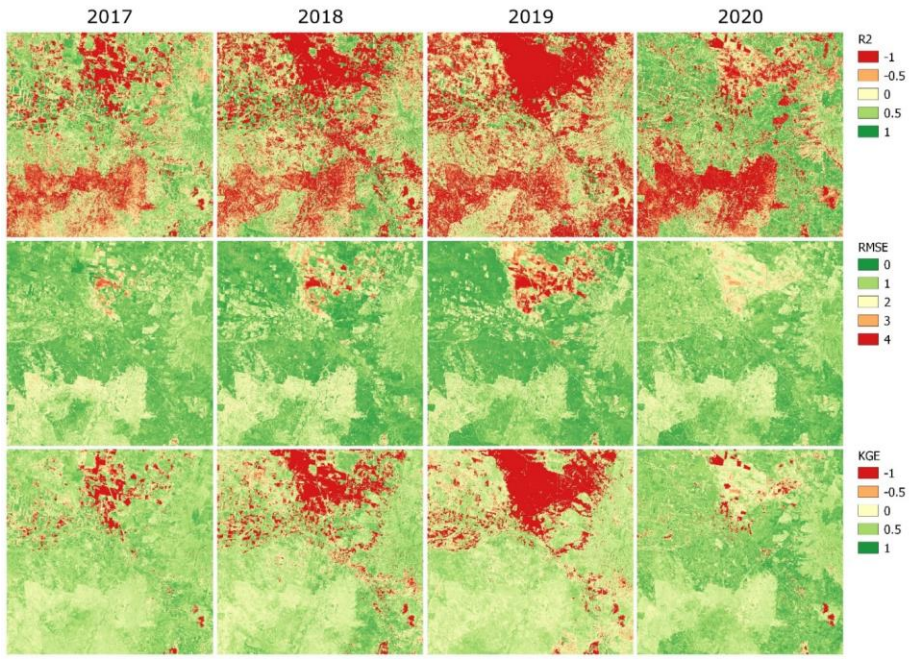
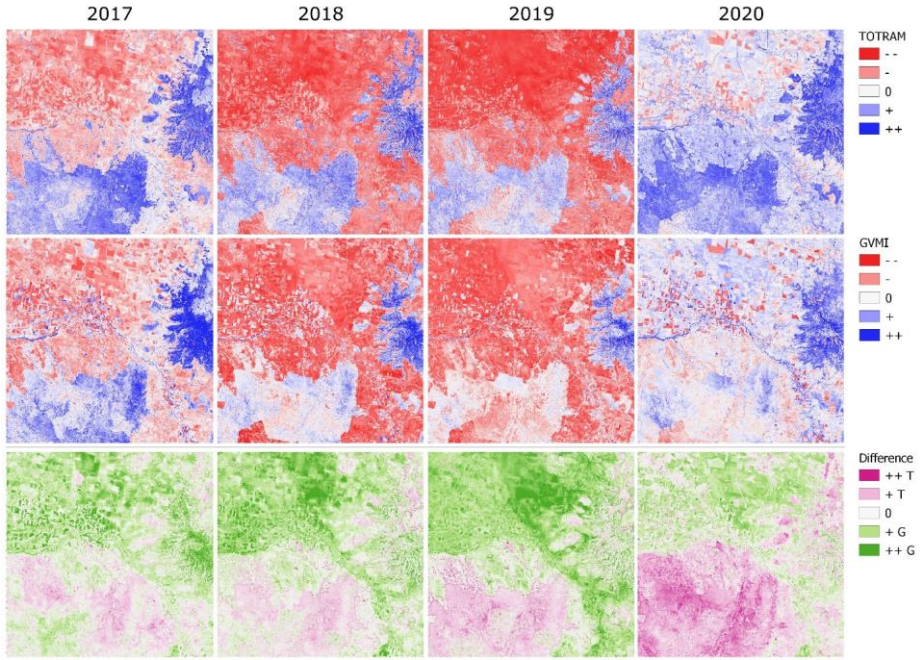
Evapotranspiration product verification 2



R2, RMSE, and KGE calculated for the comparison between ETa data from ETLook and CMRSET for each year separately during the 2017-2020 study period.



Comparison between ETLook's soil moisture model (TOTRAM) and CMRSET's soil moisture index (GVMI) per year for the 2017-2020 study period.

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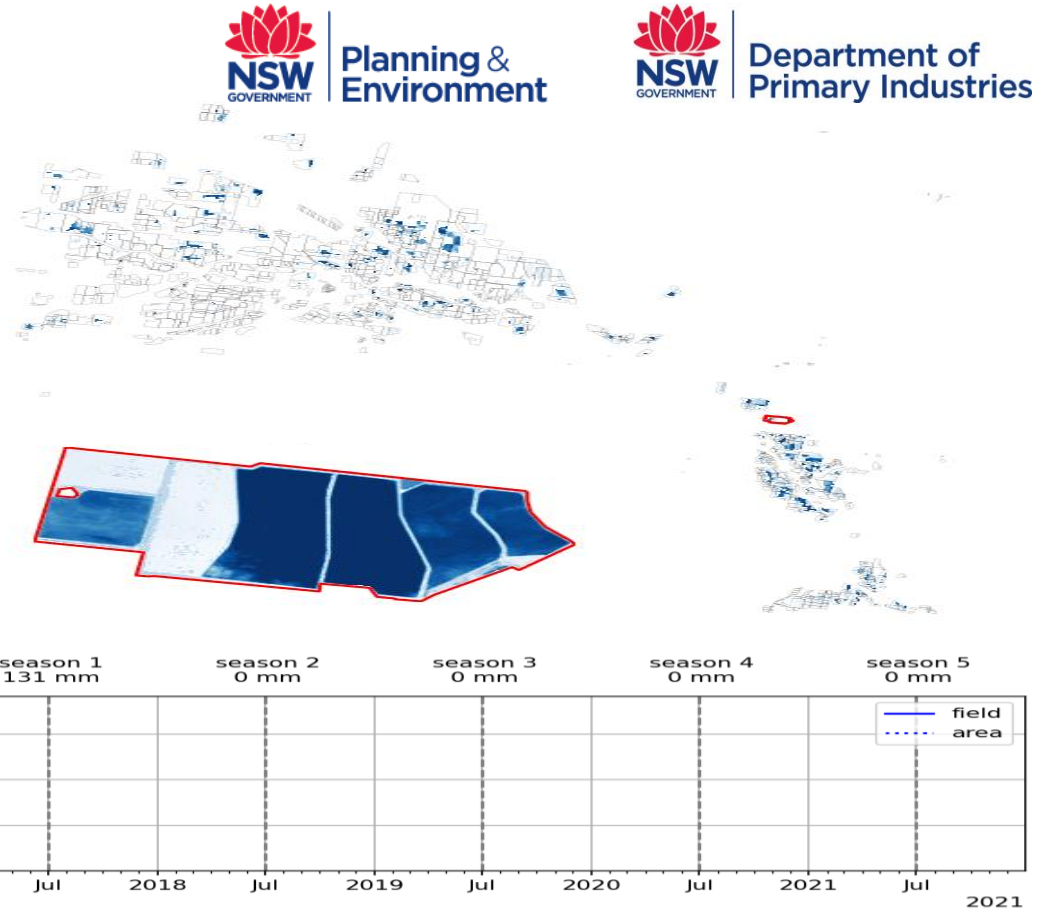
Irrigated water consumption

Irrigated water consumption per field can be calculated, based on incremental ET calculations using the updated Hydrologically Similar Pixels (HSP) method. Available at 250 m (NSW) and 10 m resolution (Namoi)

Working with the DPE (Water) and DPI as demonstration partners:

- Water Use Monitoring and Auditing Service (WUMAS)
- Farm Water Balance Service Pilot
- Regional Agronomy Decision Support



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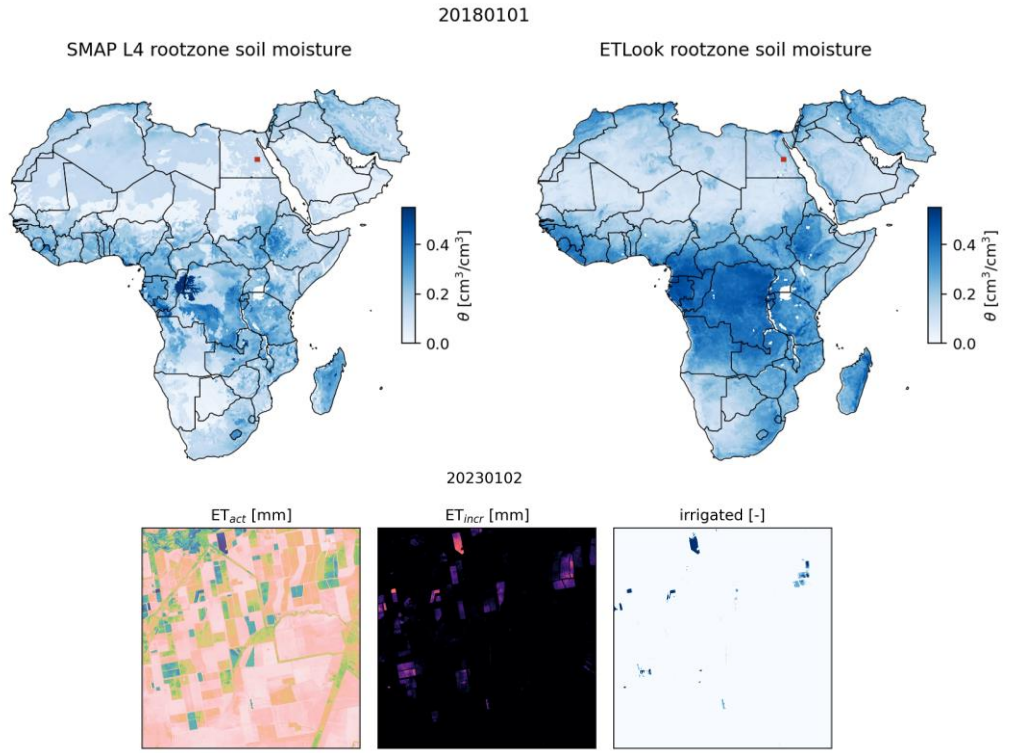
Updates to ETLook and HSP

ETLook:

- eLEAF has been focusing on creating a new cloud-based (AWS) data factory for global ET modelling at various resolutions (10m, 100m, 300 m)
- Initial soil moisture validation study for Africa and the Middle East using SMAP L4 data

HSP algorithm:

- Implemented an irrigation detection module in the HSP algorithm to apply a loss factor to the irrigation water use estimates
- Now able to deliver a weekly update on irrigated areas, which is beneficial for hydrological modelling efforts



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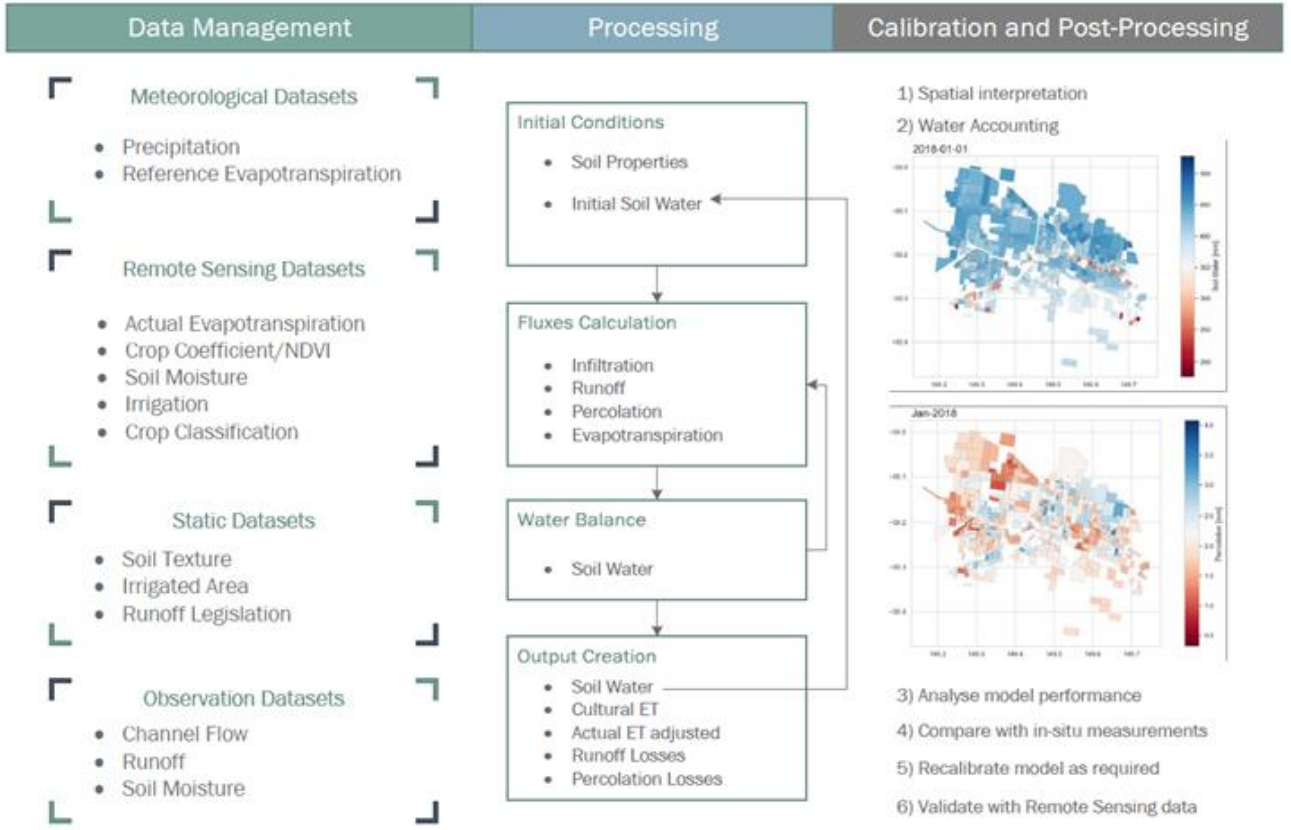
Field scale modelling

- Using ETLook and rainfall inputs: detailed model of farm water balance
  - Numerical modelling
- Soil data from SLGA (CSIRO)
- New HydroAquaFarm model hosted as a cloud service
  - Soil water content, runoff and percolation, aggregated per property.
  - Fast, enabling use over large regions



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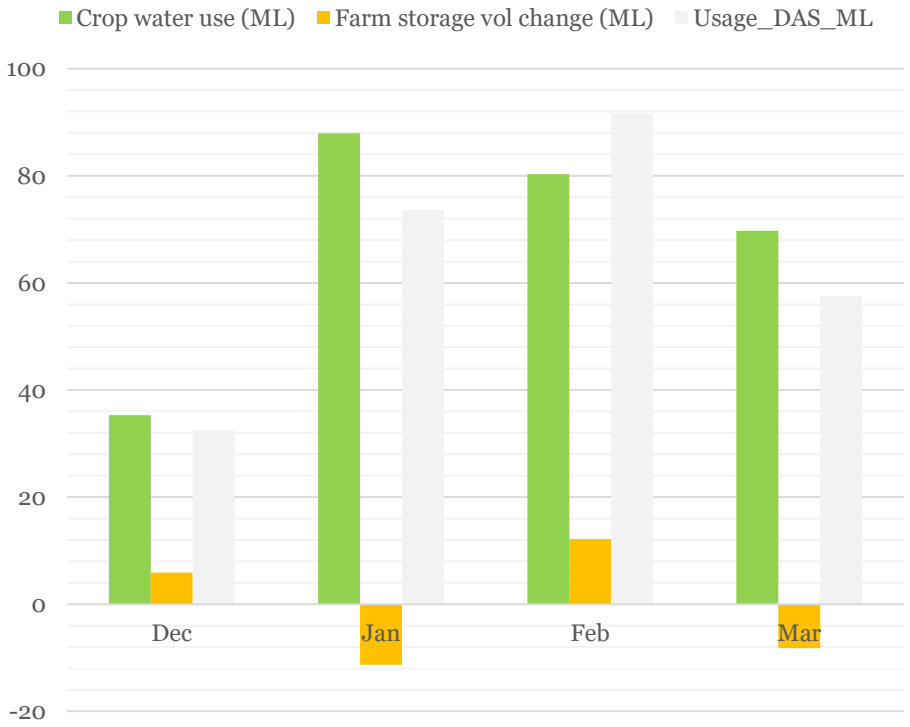
Farm water balance validation by telemetered farm storage



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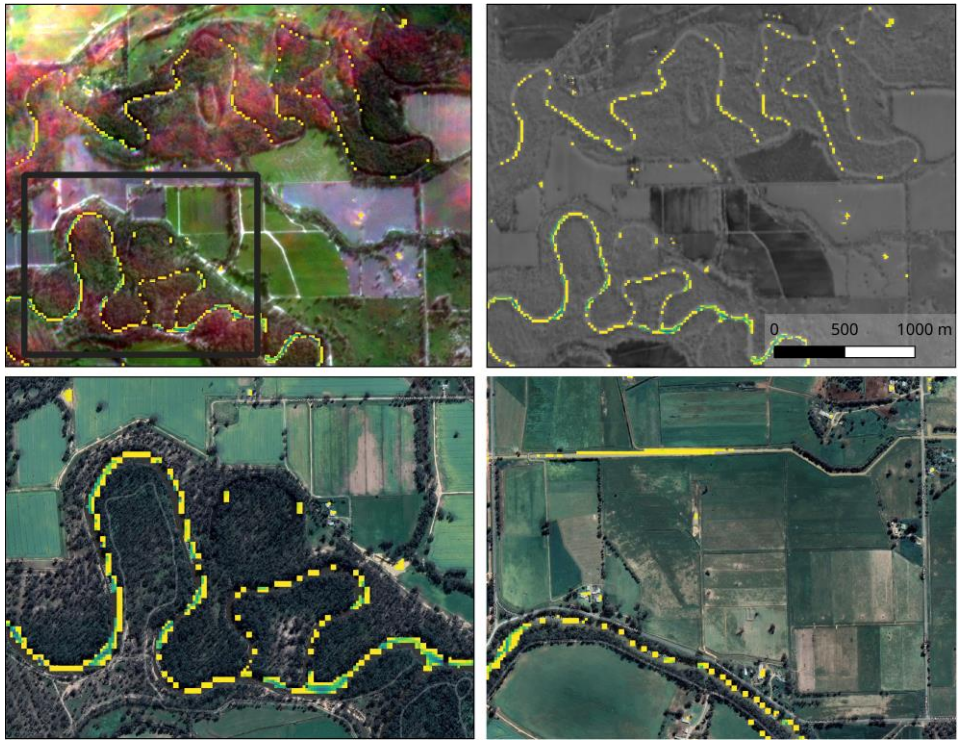
GOULBURN BROKEN CATCHMENT MANAGEMENT AUTHORITY
Working with GBCMA in Victoria as a demonstration partner

Environmental water

- Two components:
  observing surface water and vegetation condition.
- Challenges to using remote sensing to quantify surface water for environmental watering
  - Cloud coverage
  - Shadows
  - Vegetation canopy above the water
  - Small water bodies with long perimeters compared to their area
- Investigate merits of a surface water growing algorithm.
- Rossi, J et al. presented surface water growing algorithm at iEMSS 2022.



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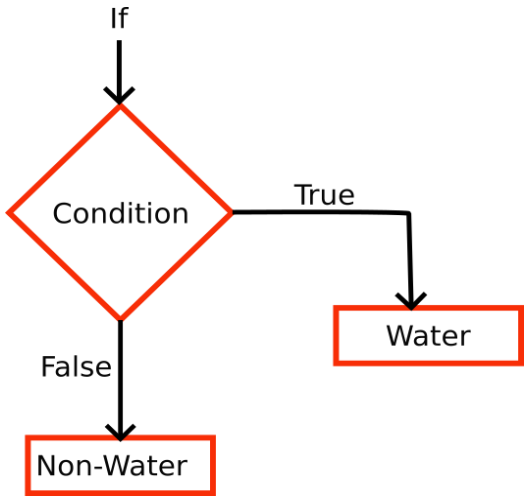
Surface water growing algorithm

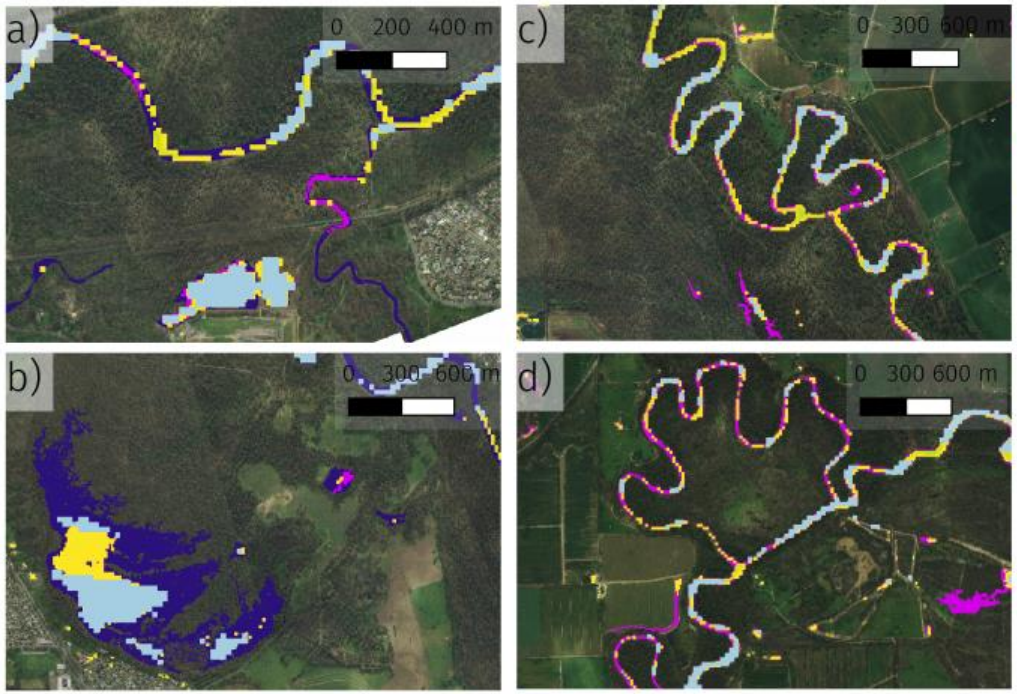
The SRG algorithm checks the adjacent pixels of the pdep map against threshold condition. If yes, pixel is added to the region of the seed pixel.

Fill in gaps with SRG algorithm:

How does this work?

Pdep of pixel **>** Percentile 50 pdep inside the seed





Rossi et al. in prep.

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Biomass Production Score (BS)

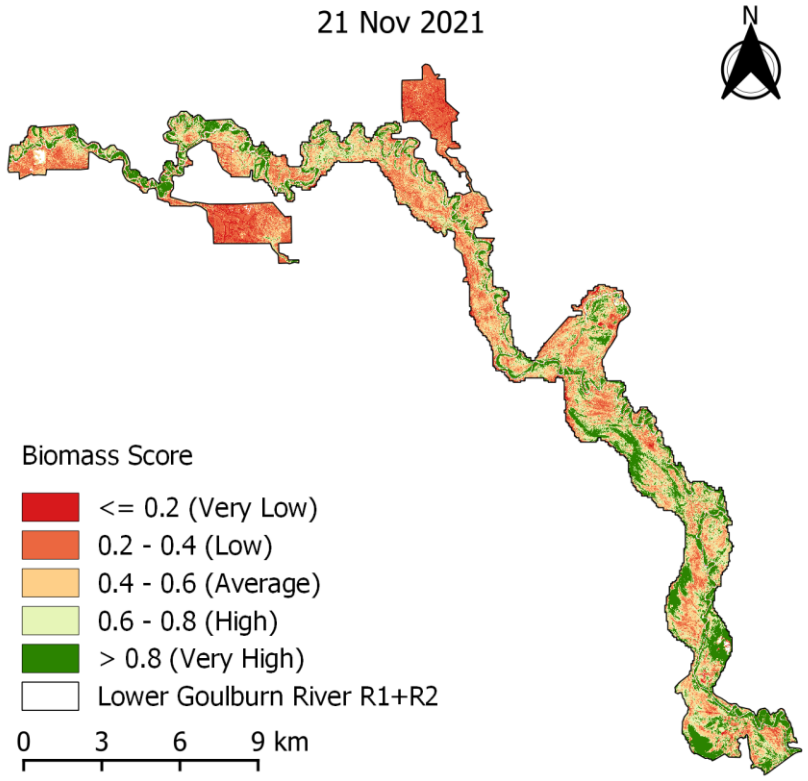
BPS scores biomass production of a pixel against a set benchmark (potential biomass production). BPS tells how a biomass production of a pixel performs in relation to other pixels in the area of interest.

$$BPS = \frac{B-B5}{B99-B5}$$

BPS	: biomass production score (-)
B	: actual biomass production (g C m^{-2} day^{-1})
B5	: 5th percentile of biomass in the area of interest (g C m^{-2} day^{-1})
B99	: 99th percentile of biomass in the area of interest (g C m^{-2} day^{-1})

Vegetation score help understanding:

- What is the performance of vegetation production of each pixel relative to other pixels (same vegetation type) in the area of interest (AOI).
- What are the spatial trends of biomass score (proximity to river or lake, upstream or downstream reach)
- How the average performance of an AOI is changing with the flow release?



Biomass Production Score, Goulburn river (Reach-1+2), 21 Nov, 2021

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Vegetation condition

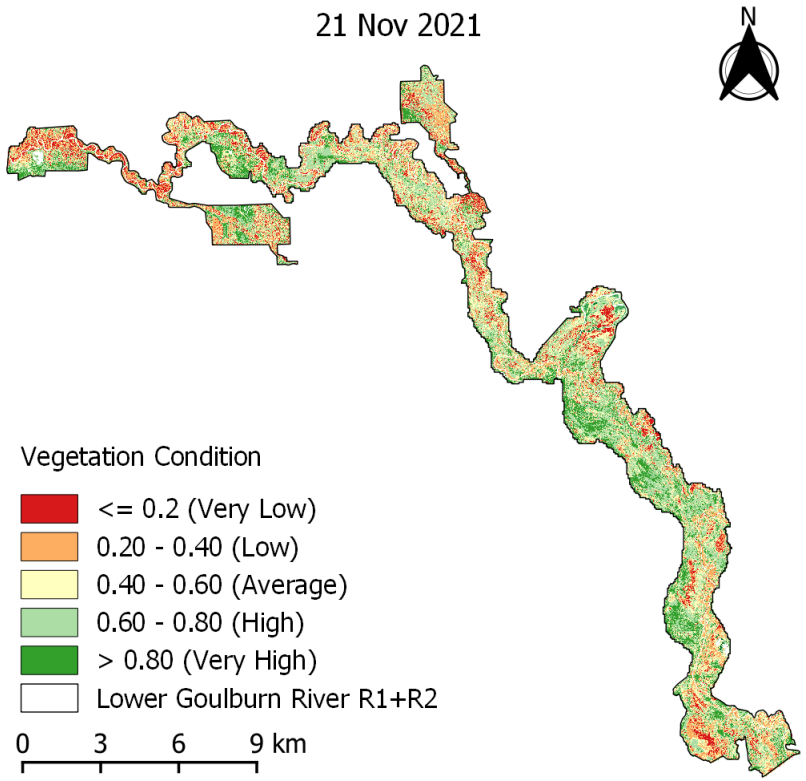
VC assesses the vegetation condition by comparing the observed biomass to a cumulative probability plot of the long-term statistics for the same week period. VC tells how a biomass production of an individual pixel change over time.

$$P = \frac{m}{n+1}$$

P : the probability of biomass value occurrence of a pixel
m : the rank of the biomass value for a pixel
n : the number of years involved in the analysis

Vegetation condition parameters help understanding:

- What is the relative vegetation condition change over time, independent of neighbouring pixels
- What are the most affected areas by droughts, flow reduction or other human activities, over a longer period



Biomass Production Condition, Goulburn river (Reach-1+2), 21 Nov, 2021

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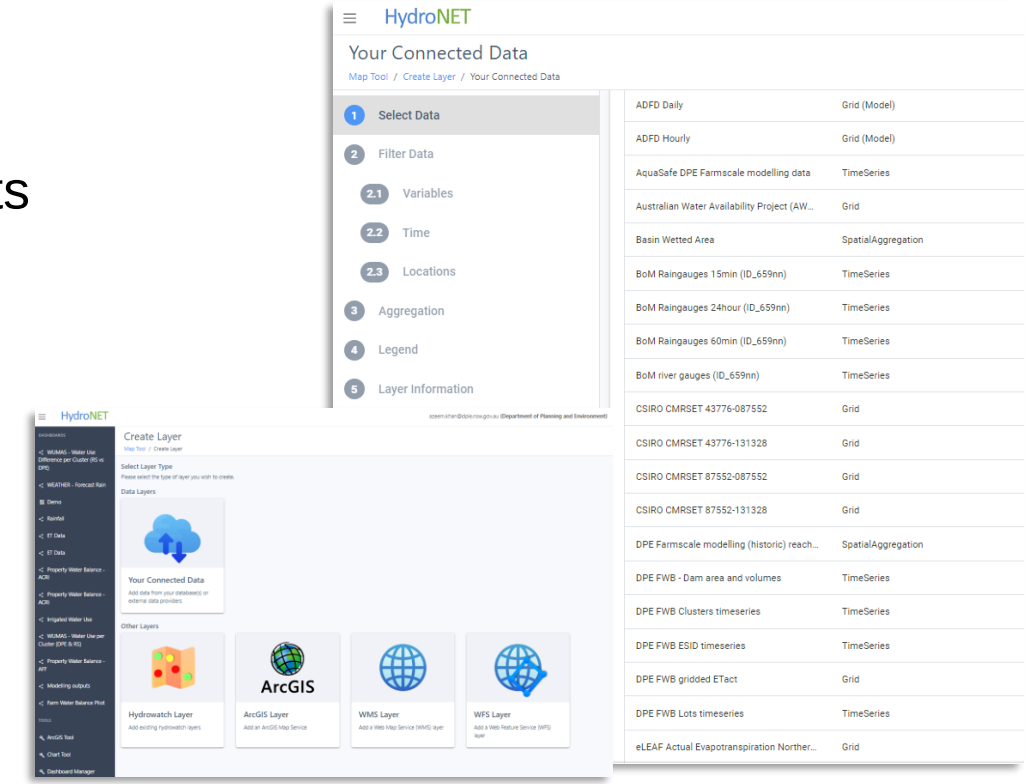
Operational implementation in HydroNET

- Live connections to 3rd party data sources
  - (Copernicus, BoM, DPE, SILO, WaterNSW, …)
- Live connections to WaterSENSE partner environments and model outputs
  - eLEAF: ETLook for ETact; HSP for ETinc
  - Hidromod: HydroAquaFarm for Farm Water Balance data;
  - Hydro & Meteo: SCOUT for gauge adjusted radar rainfall data.
- HydroNET dashboards for demonstrations:
  - Farm Water Balance
  - eFlows



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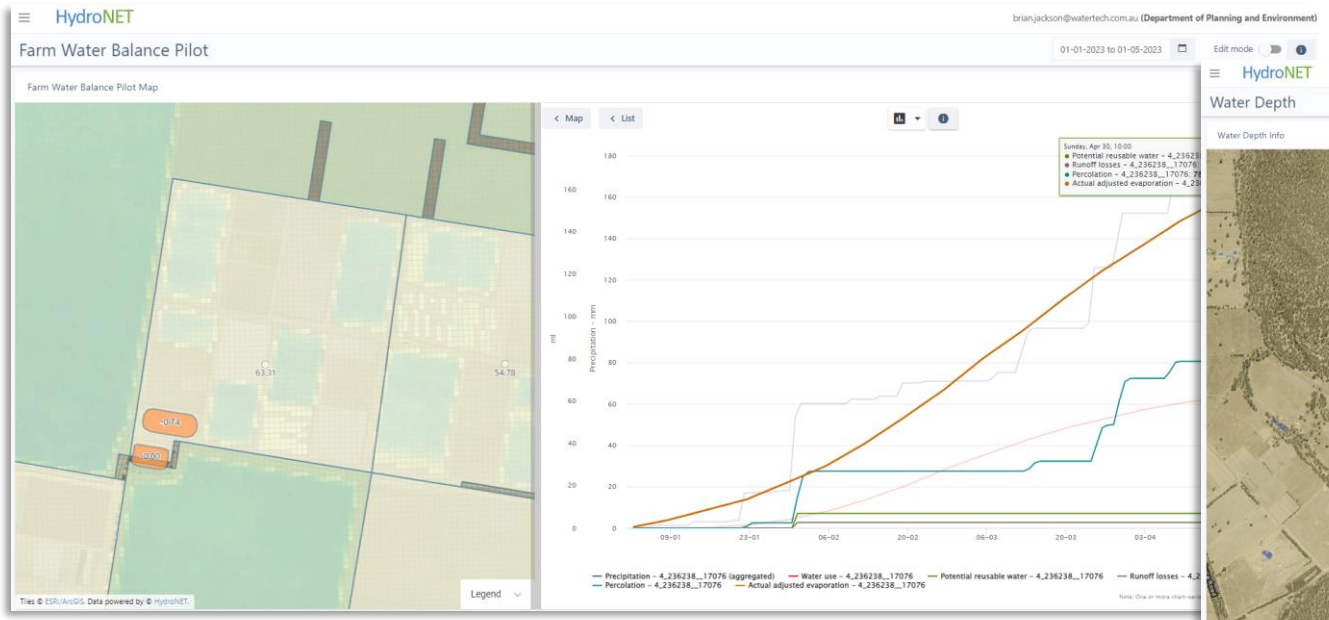
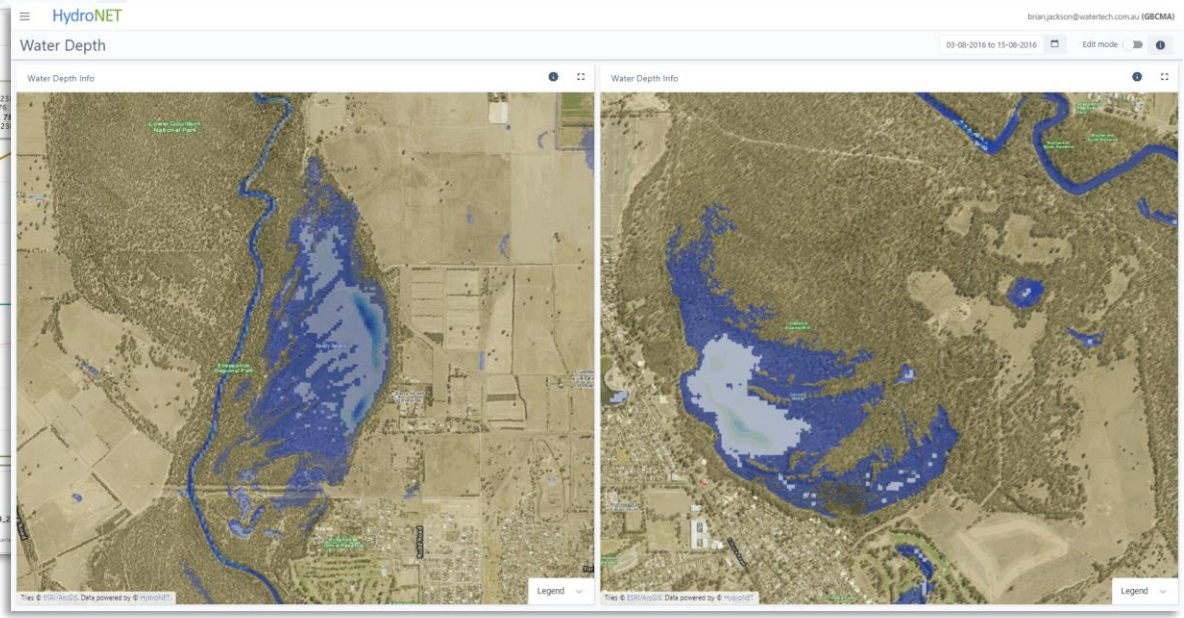
Dashboards in HydroNET

Multiple layers, maps and charts can be created for access and visualisation of the multiple data sources.



Farm Water Balance dashboard, showing ETinc and Farm Dam Volume Change.

Water Growing Algorithm Dashboard



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Summary

- WaterSENSE has developed a range of new approaches to using remote sensing for water balance observations
- Focus on water accounting and environmental water delivery
- Research has been implemented in an operational dashboard as a service and is tested by partners
- Final six months will further verify and fine-tune operational delivery and finalise research
- Demonstration partners interested in paying for services

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WaterSENSE

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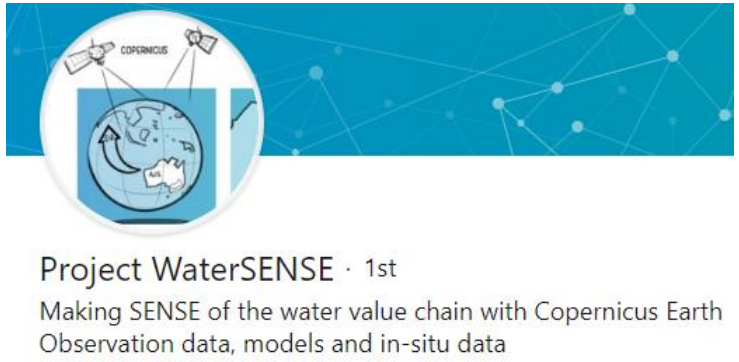

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