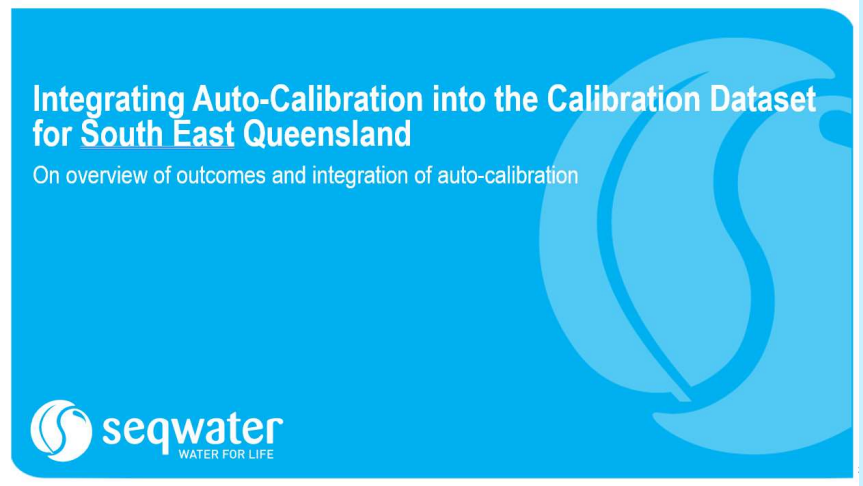
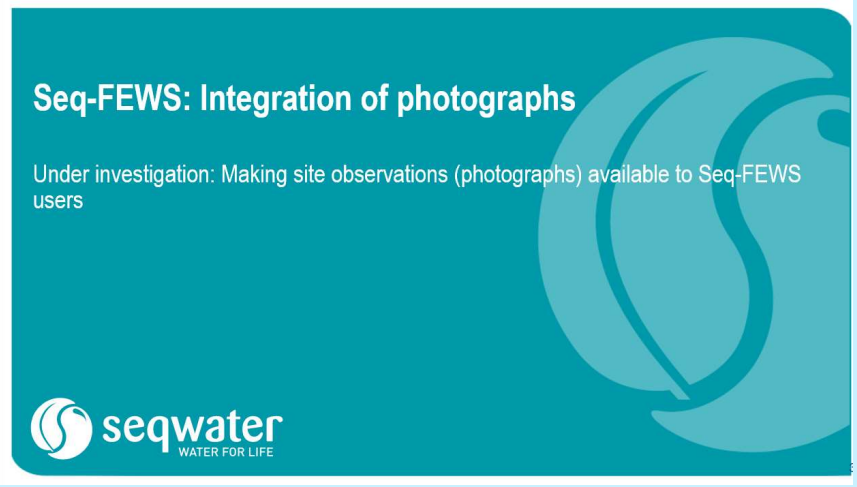
Australian Delft-FEWS User Days 2022

Seq-FEWS Continuous Improvement Projects:
An overview of key projects

Dave Pokarier

Seq-FEWS: Continuous Improvement Projects





Integrating Auto-Calibration into the Calibration Dataset for South East Queensland

On overview of outcomes and integration of auto-calibration

seqwater
WATER FOR LIFE

Integrating Auto-Calibration into the Calibration Dataset for South East Queensland

Calibration Dataset for South East Queensland

Project team acknowledgements

Project lead: David Pokarier

Development: Steve Wang, Storm Stickland, Elizabeth Jackson

Initial Implementation (calibrations): Surali Pinto

Integrating Auto-Calibration

Project team acknowledgements

Development: Steve Wang, Dave Pokarier

Deltares Support: Simone De Kleermaeker & Erik Pelgrim

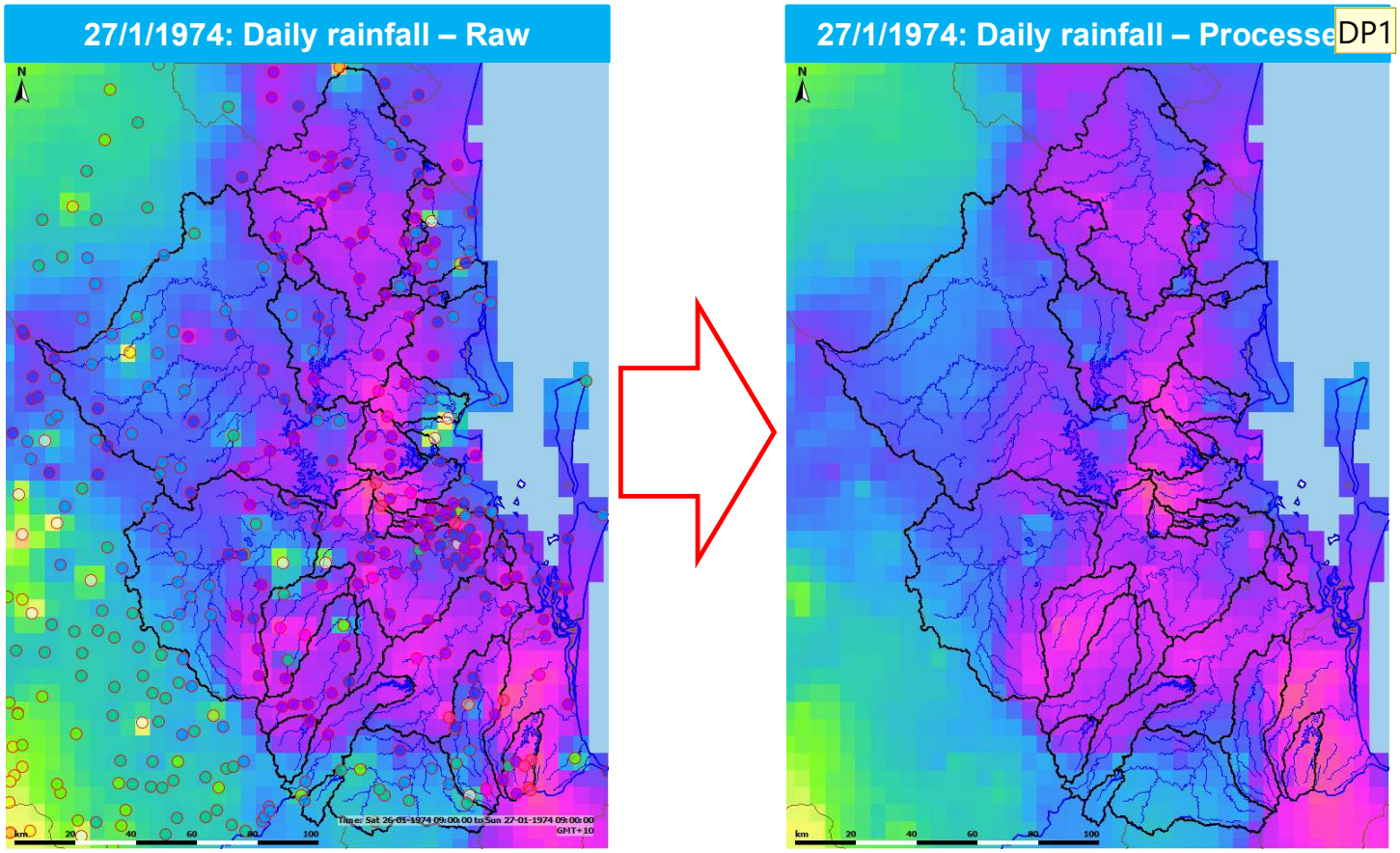
Calibration Dataset for South East Queensland: Overview

Data cleansing & processing

A range of techniques applied to remove errors in data

Point rainfall data

- **Spatial homogeneity:**
  - Validates rainfall based on neighbouring stations
  - Tuned to suit southeast Queensland
  - Scalable (time and space)



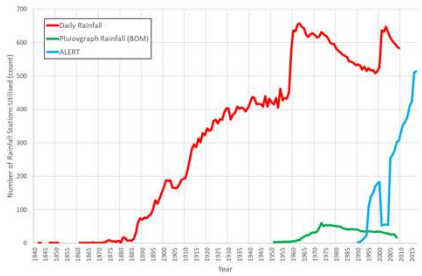
Calibration Dataset for South East Queensland: Overview

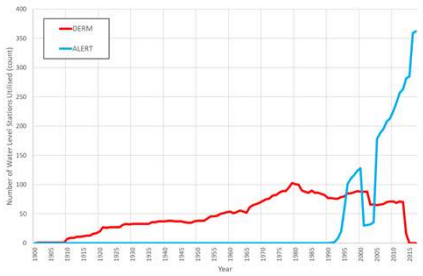
Data collection

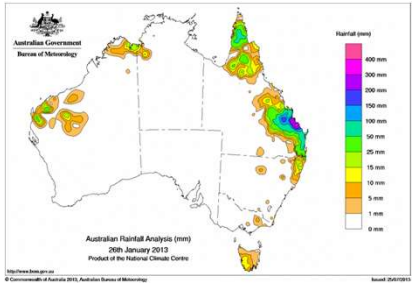
Collate all available data for southeast Queensland relevant for URBS model calibration

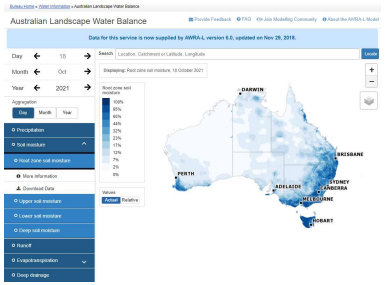
- **Point rainfall data**
- **Water level data**
- **AWAP gridded rainfall (daily)**
- **AWRA-L Model (soil moisture)**
- **SILO gridded rainfall data (daily)**

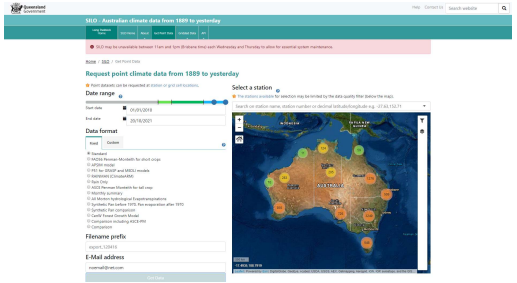
Database statistics	
Size	~10GB
Non-equidistance scalars	293 x 10^6
Equidistance scalars	14 x 10^9
Number of grid cells	120 x 10^9











Externally sourced images:
QLD Government website: https://www.longpaddock.qld.gov.au/silo/point-data/, accessed 19 October 2021
Bureau of Meteorology website: http://www.bom.gov.au/water/landscape/#/sm/Actual/day/-28.4/130.4/3/Point////2021/10/18/, accessed 19 October 2021
Bureau of Meteorology website: http://www.bom.gov.au/climate/maps/, accessed 19 October 2021

Calibration Dataset for South East Queensland: Overview

DP1

Overview of benefits and outcomes

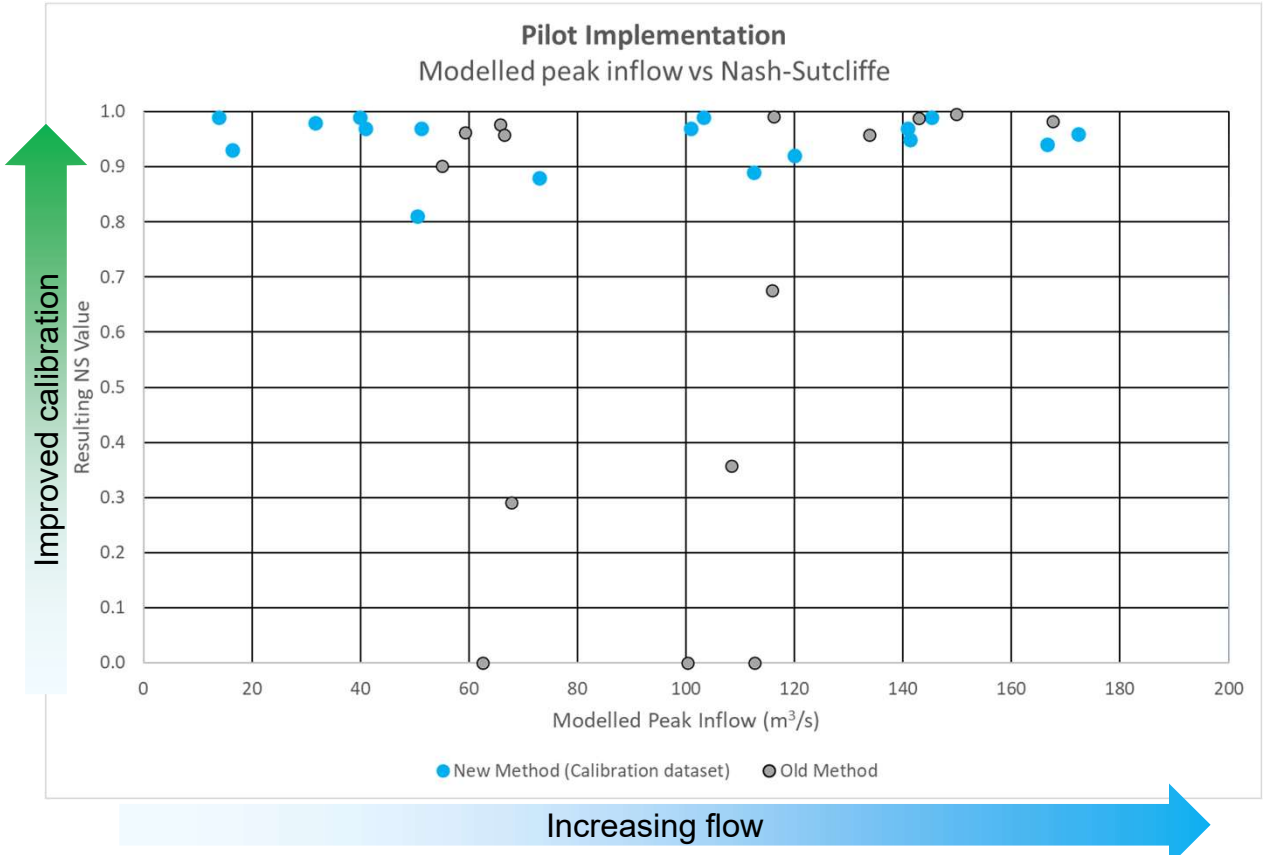
(caution: a sample size of two projects)

Case Study 1: Pilot implementation:

Aim: To test the practicalities of using the system and develop a process for future calibrations

Case Study 2: Initial implementation:

Aim: Apply the calibration procedures to catchment



Calibration Dataset for South East Queensland: Overview

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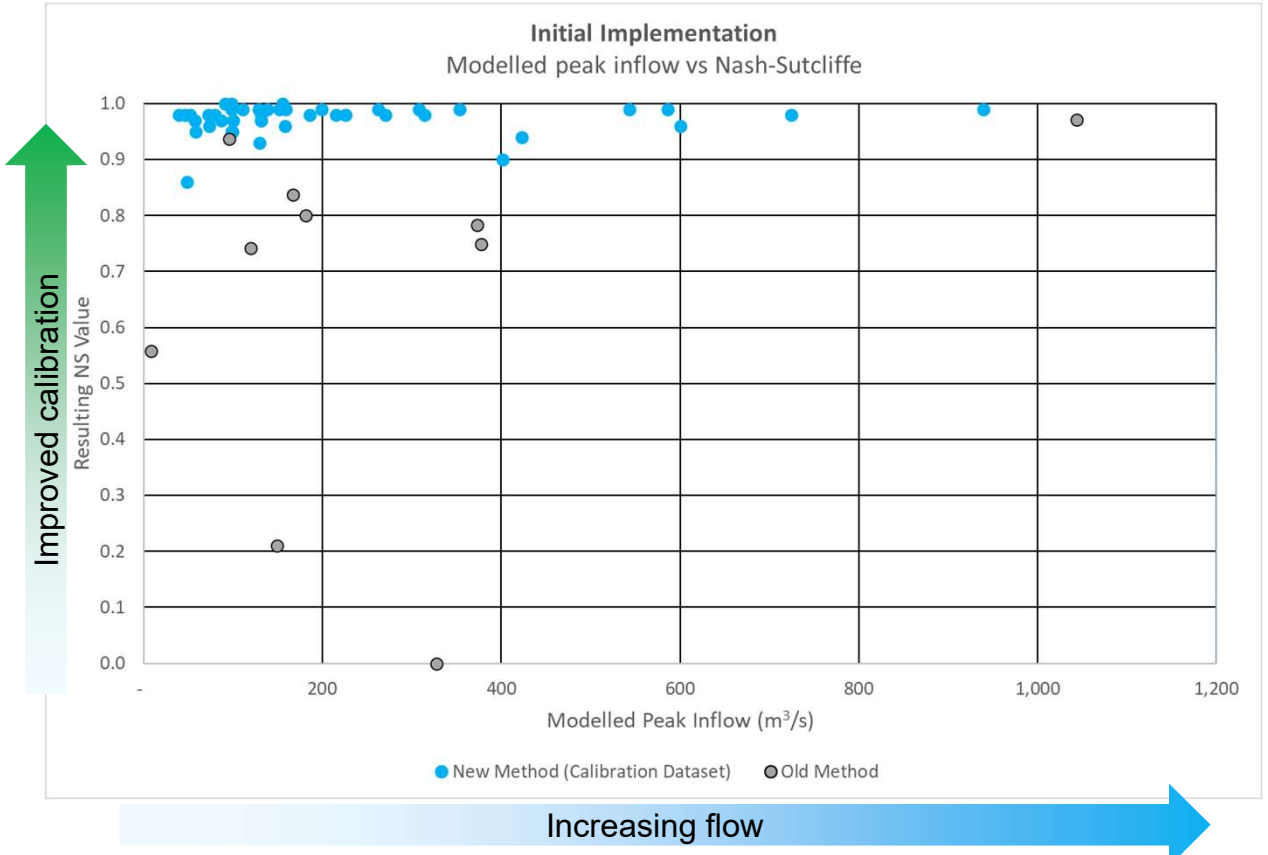
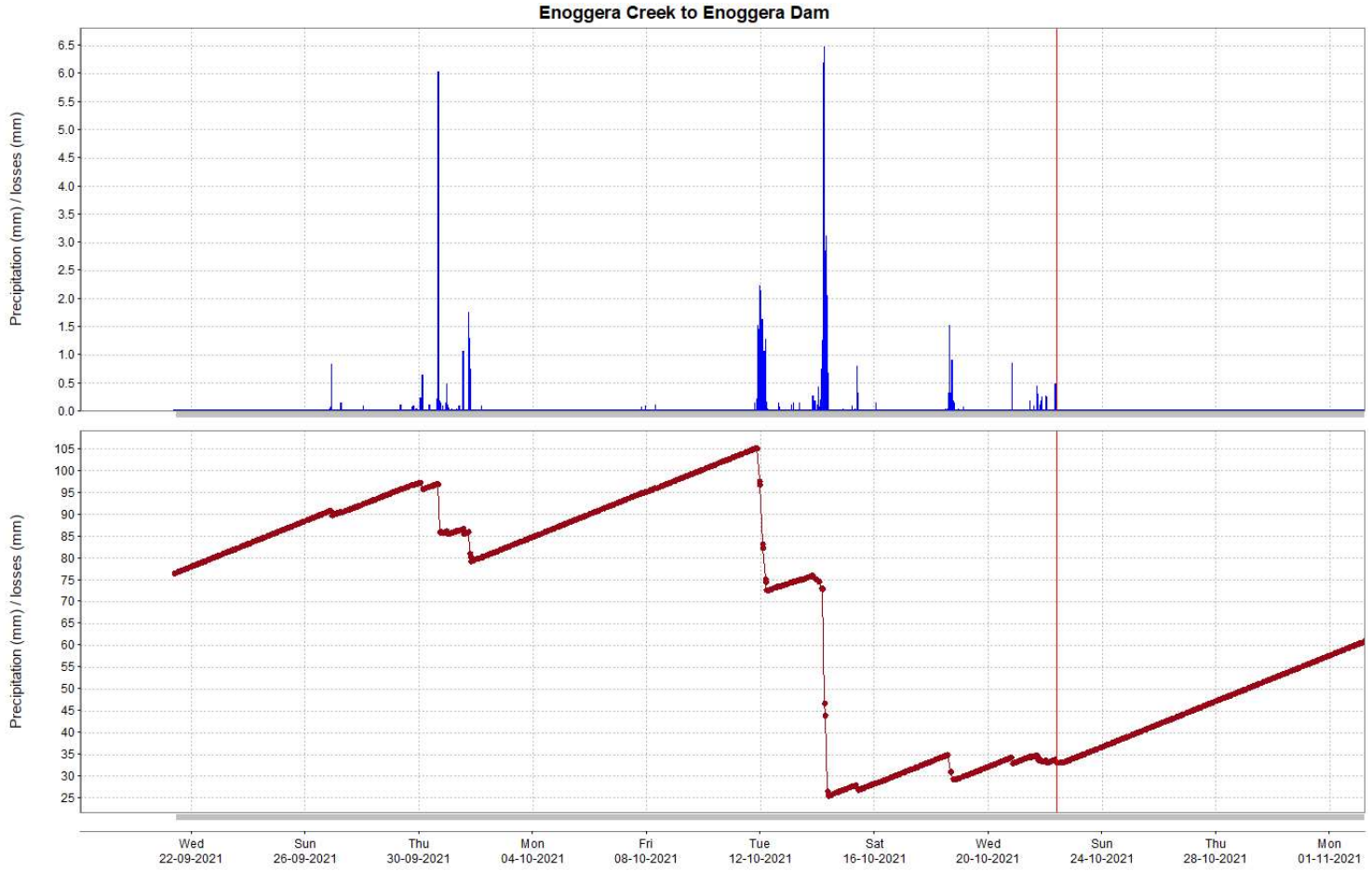


Calibration Dataset for South East Queensland: Benefits and outcomes

URBS parameter: Recovering initial loss

"Essentially the RILM is a simple initial loss single bucket model – once rainfall is less than potential loss, the deficit is made up in part from the initial loss store. The capacity of the Initial loss store (ILmax) is specified by the user. If it is not specified, it is assumed to be the initial loss specified for the first event. This means that that the first event should commence after a significantly dry period"

(A Rainfall Runoff Routing Model for Flood Forecasting & Design, version 6.00, Don Carroll, December 2016)

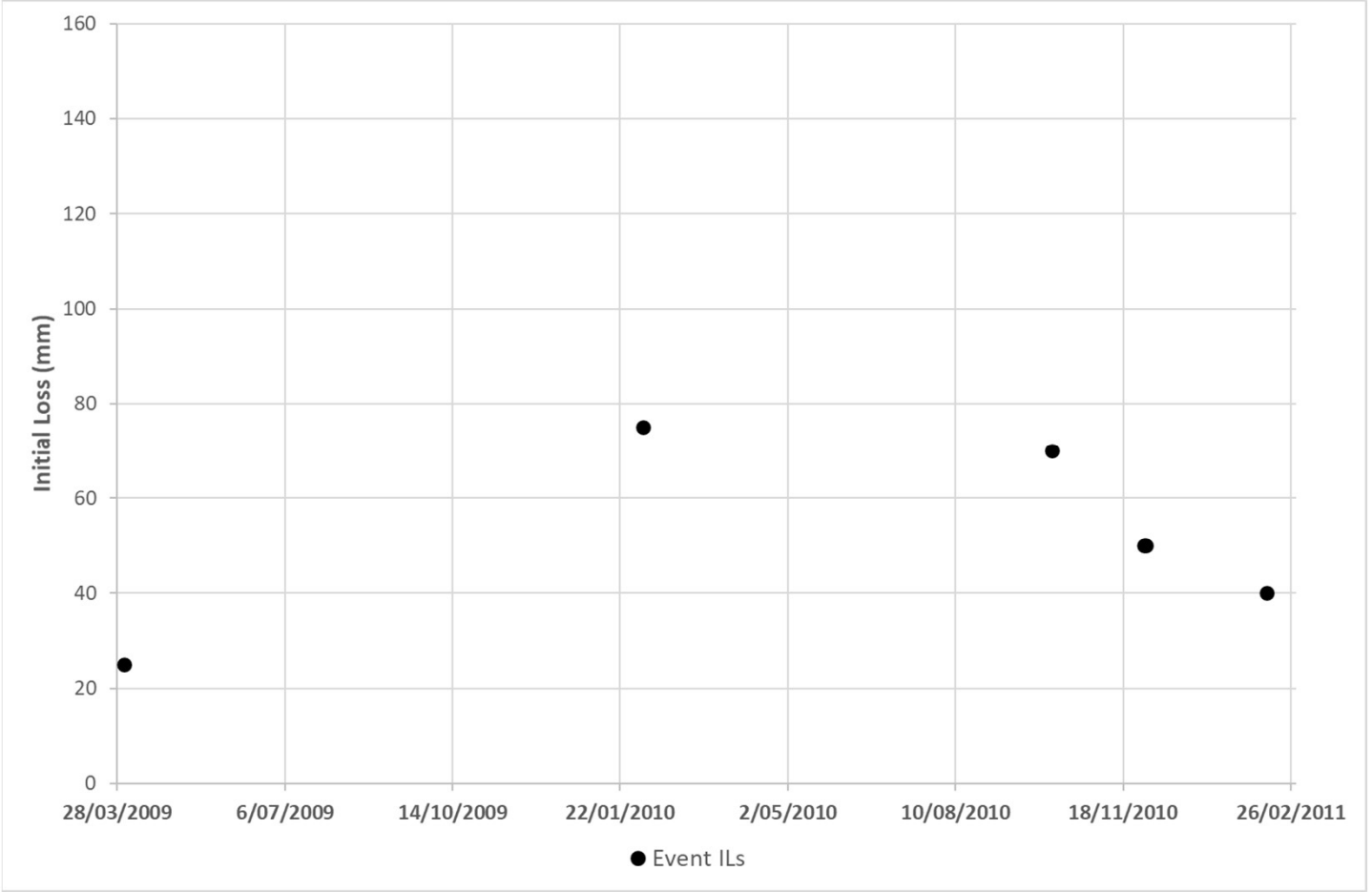


Calibration Dataset for South East Queensland: Benefits and outcomes

URBS parameter: Recovering initial loss

An approach to estimating URBS initial loss recovery parameter:

1. **Create a time series of initial losses (from event calibrations)**

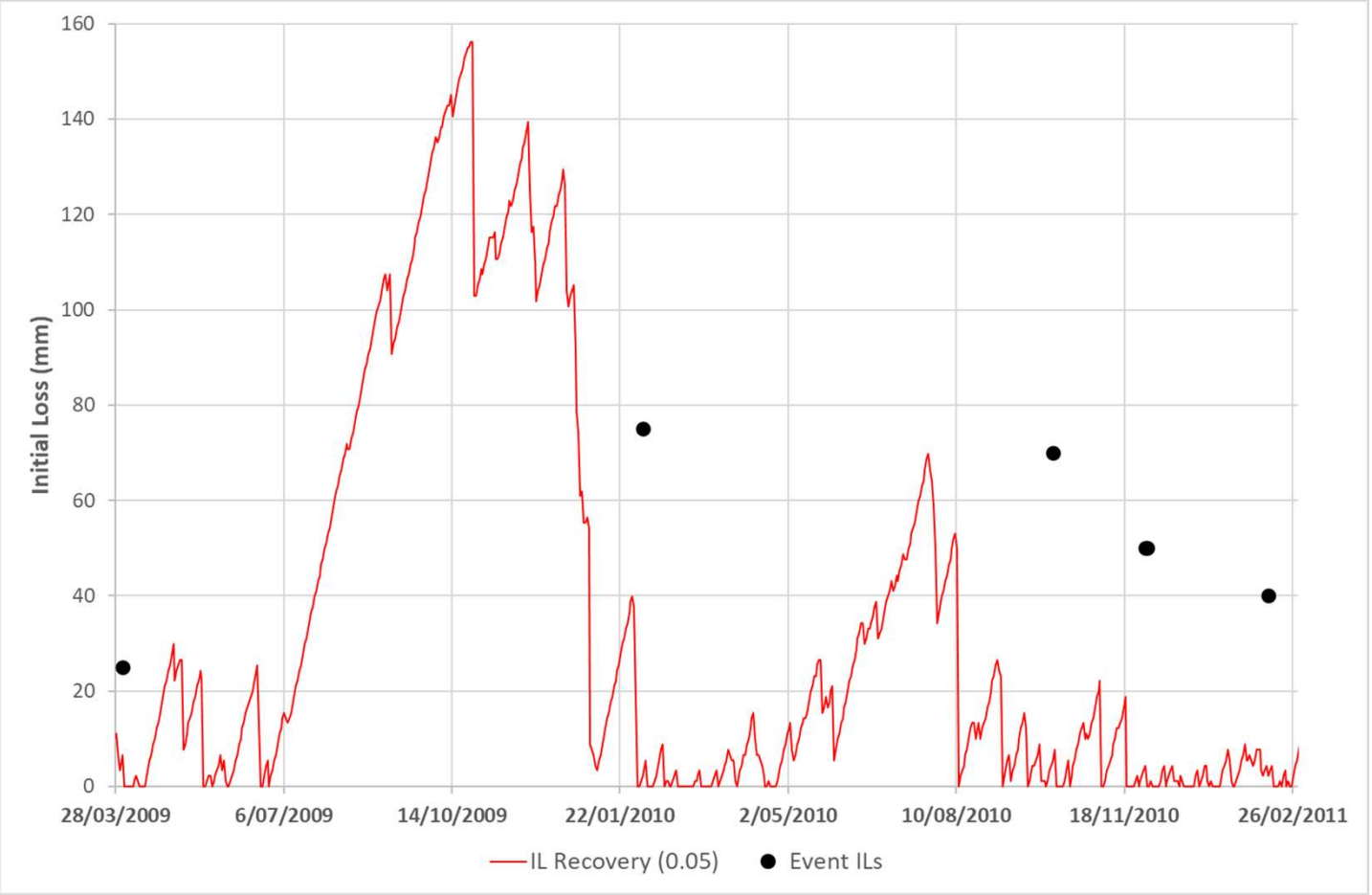


Calibration Dataset for South East Queensland: Benefits and outcomes

URBS parameter: Recovering initial loss

An approach to estimating URBS initial loss recovery parameter:

1. Create a time series of initial losses (from event calibrations);
2. **Generate initial loss time series using URBS, vary IL recovery**



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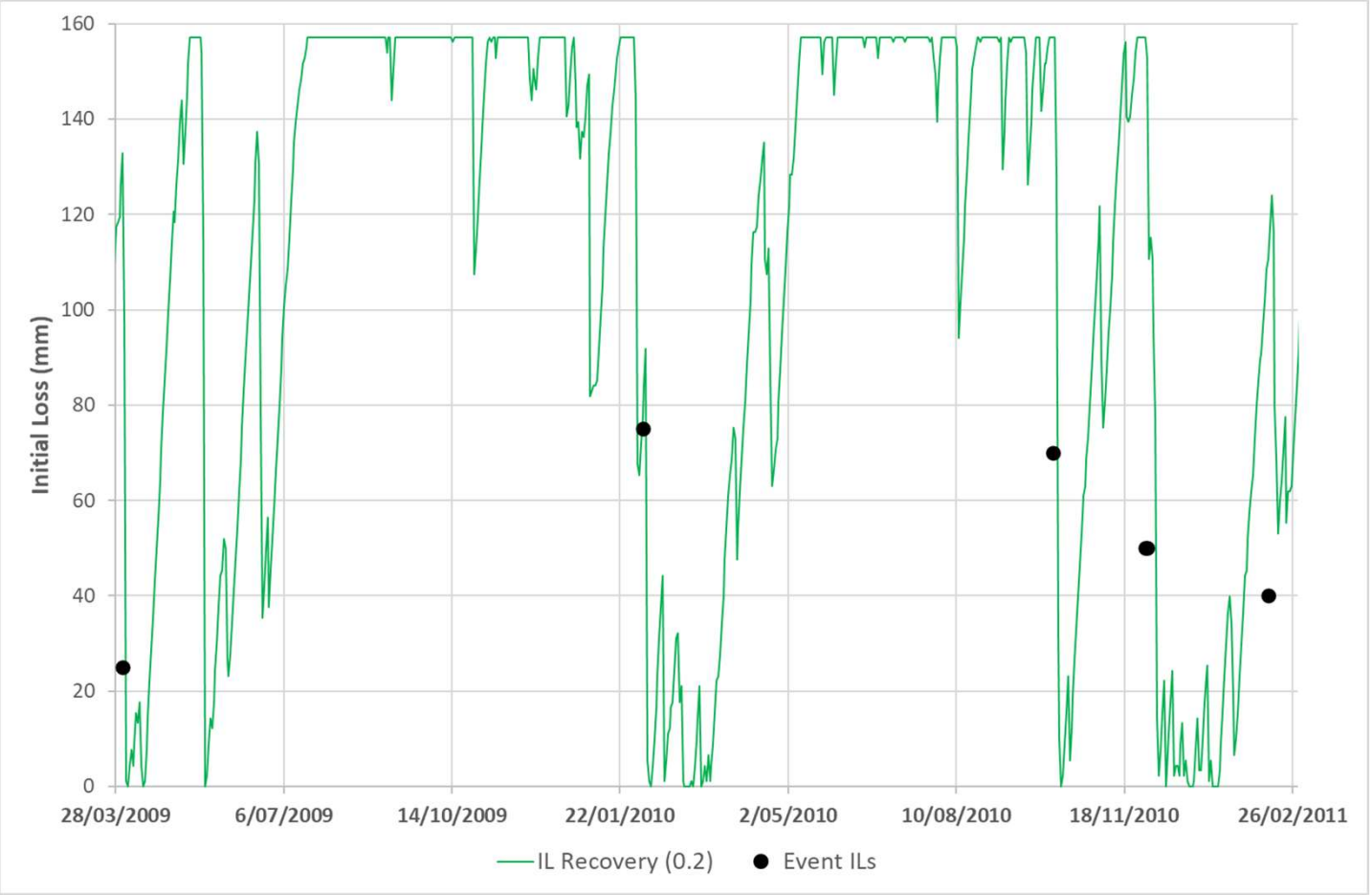

Calibration Dataset for South East Queensland: Benefits and outcomes

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An approach to estimating URBS initial loss recovery parameter:

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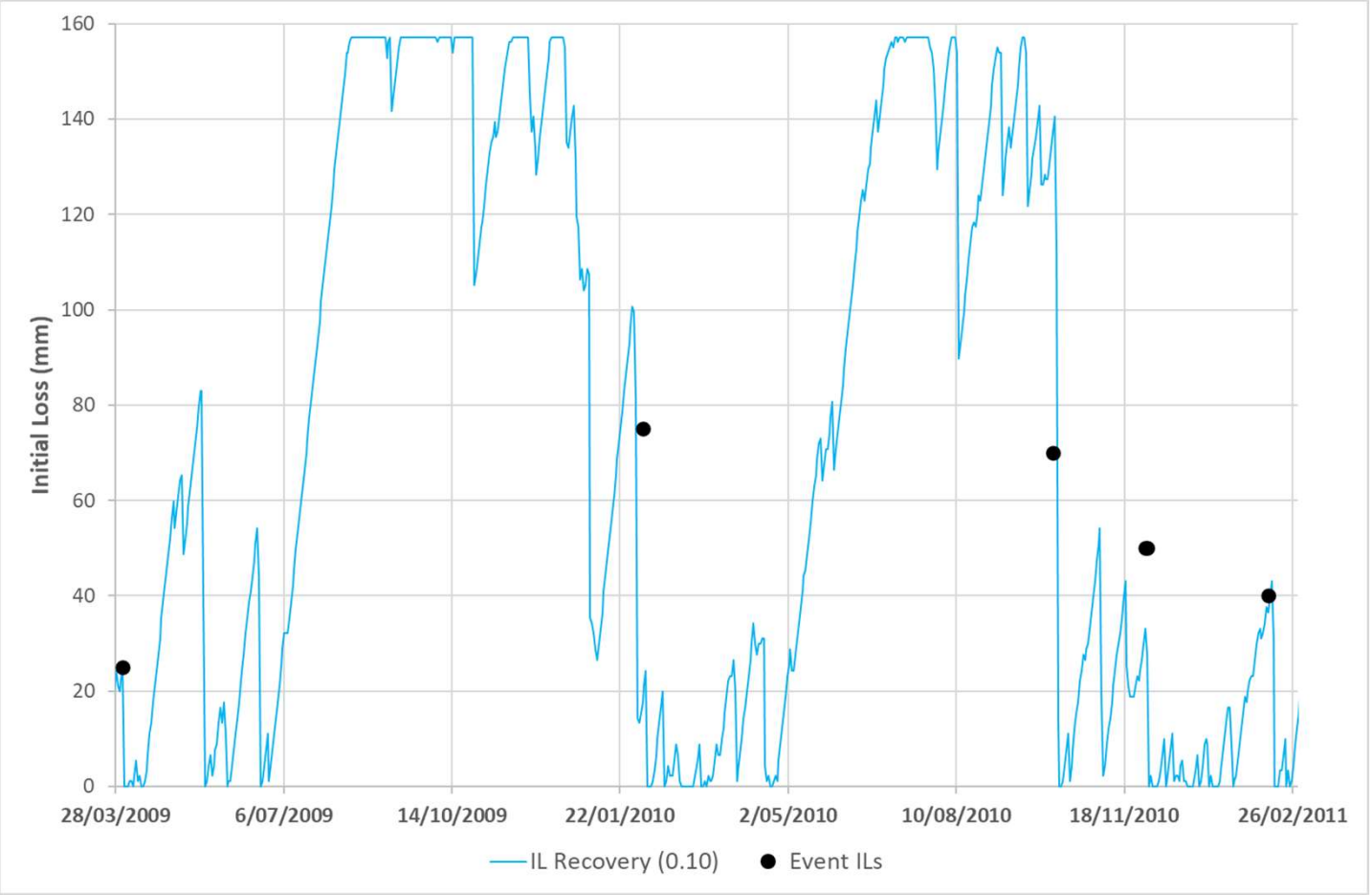
3. **Adopt best fit, recalibrate and repeat to verify**



Calibration Dataset for South East Queensland: Benefits and outcomes

URBS parameter: Recovering initial loss

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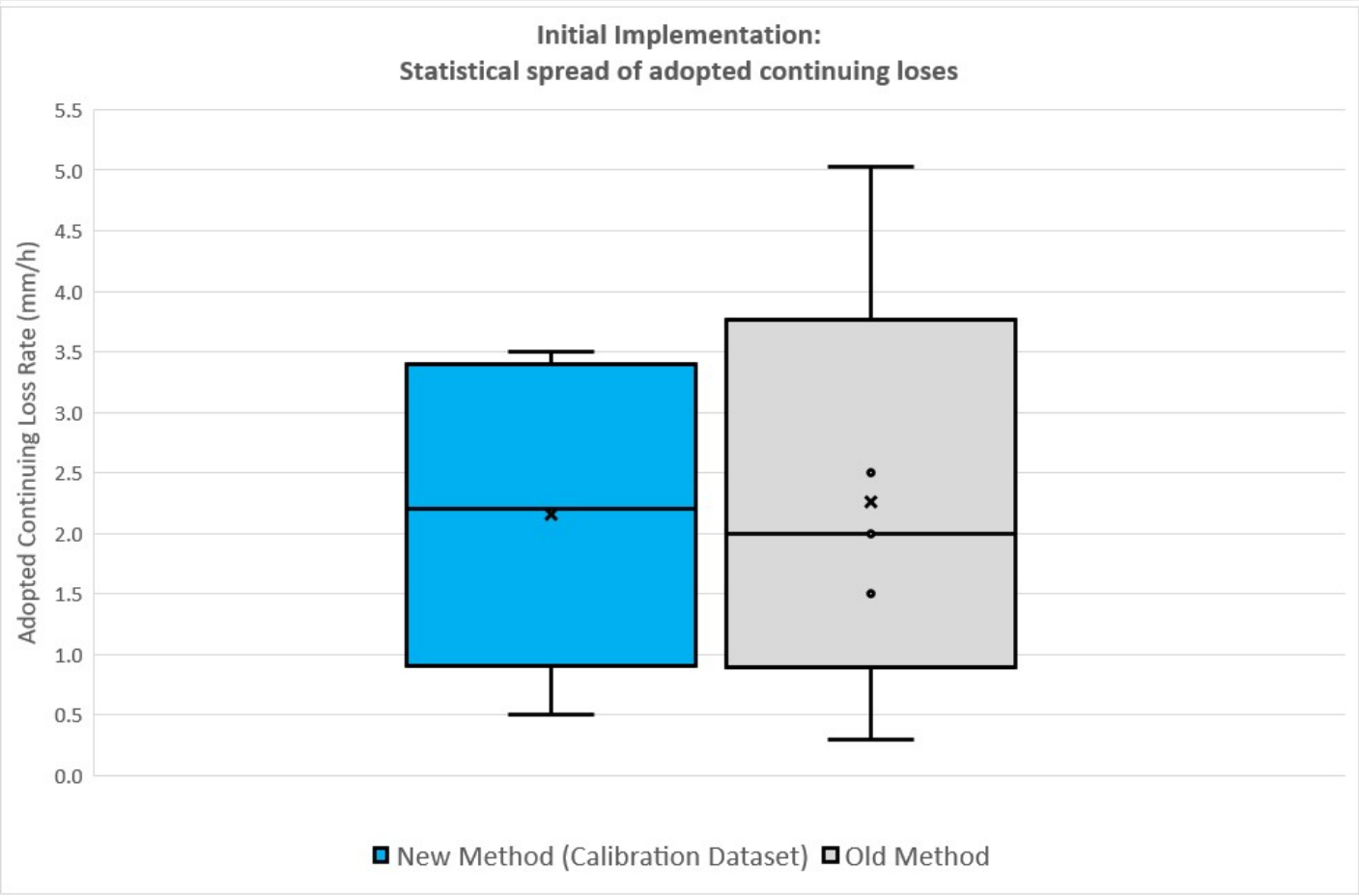
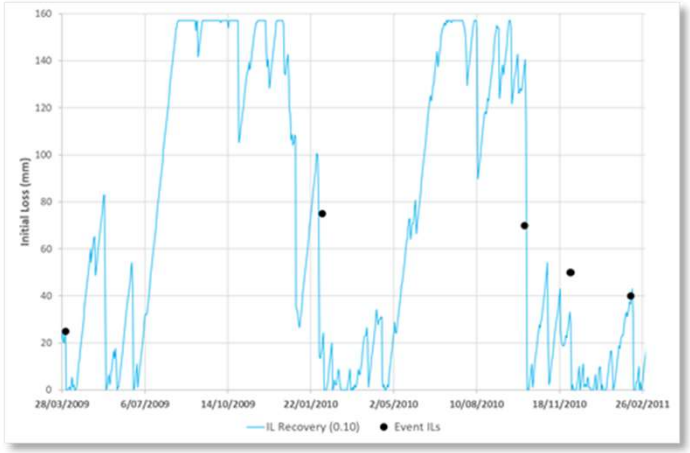
1. Create a time series of initial losses (from event calibrations)
2. Generate initial loss time series using URBS, vary IL recovery
3. Adopt best fit, recalibrate and repeat to verify
4. **Outcome:** Reduced spread of continuing loss across all events

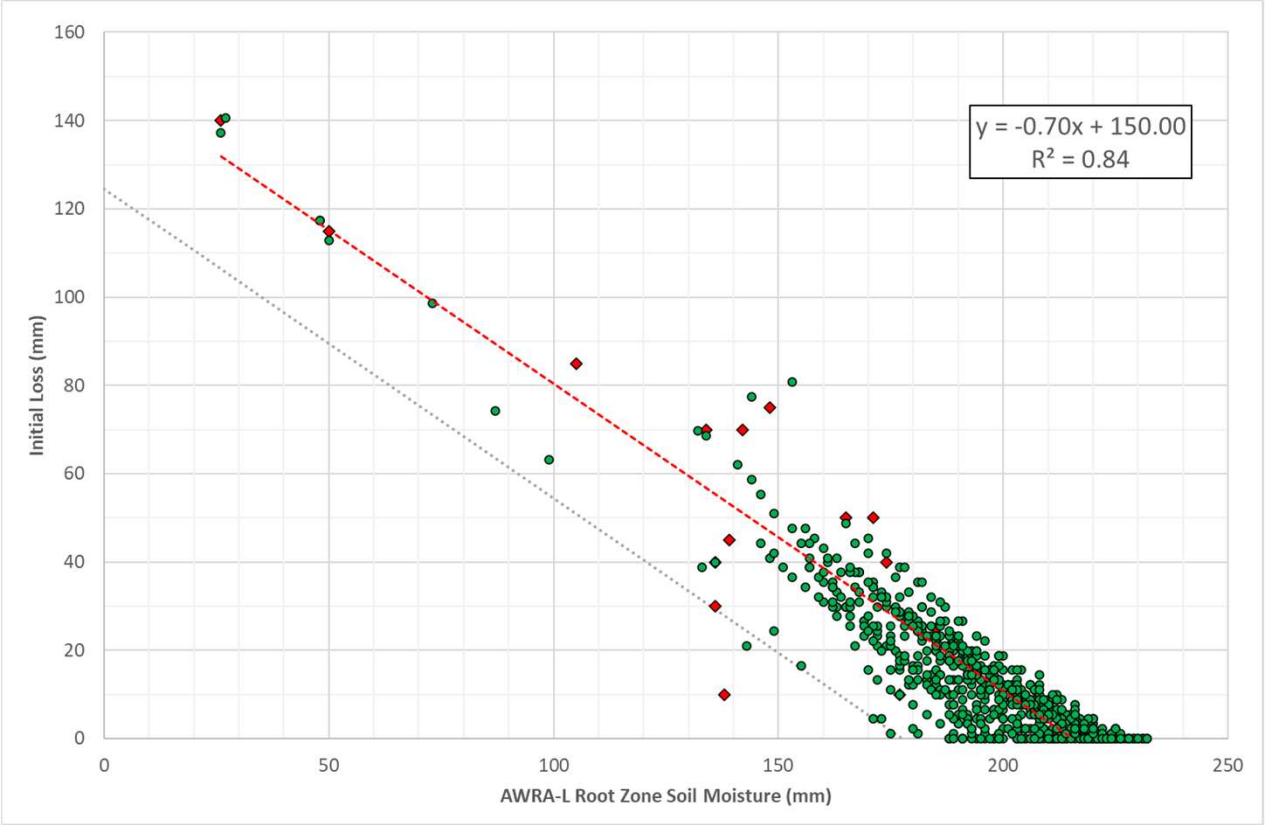


Calibration Dataset for South East Queensland: Benefits and outcomes

Improved correlations between initial loss and AWRA-L data

- Able to extract event initial loss time series to assist the correlation
- Improved coefficient of determination (R^2)
- Improved standard error (less uncertainty)

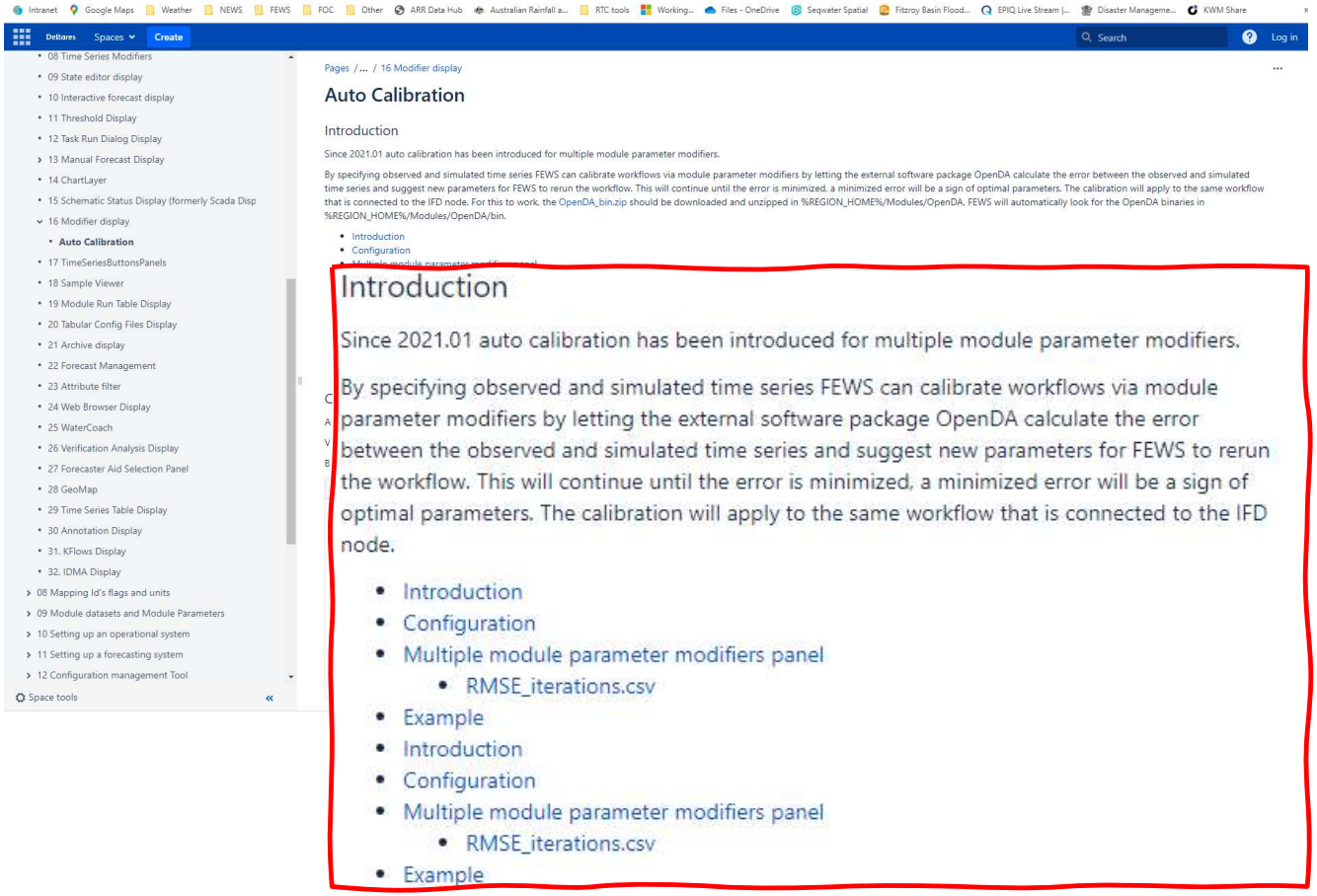




Calibration dataset for south-east QLD

Auto-Calibration

- Introduced in 2021.01
- Allows user to select which parameters and set upper and lower bounds
- Various other parameters
- Let it run!



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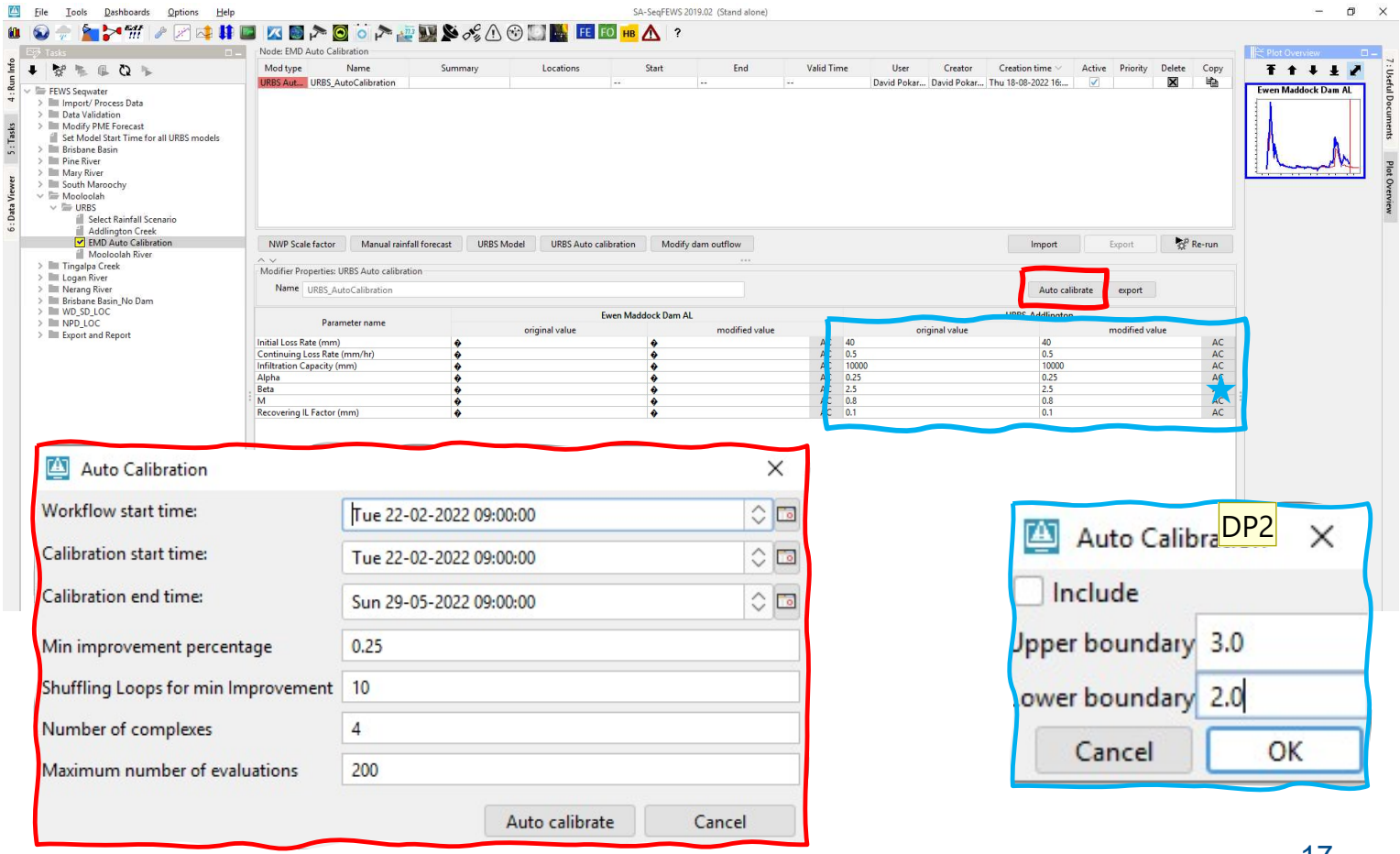

Auto-Calibration Trial

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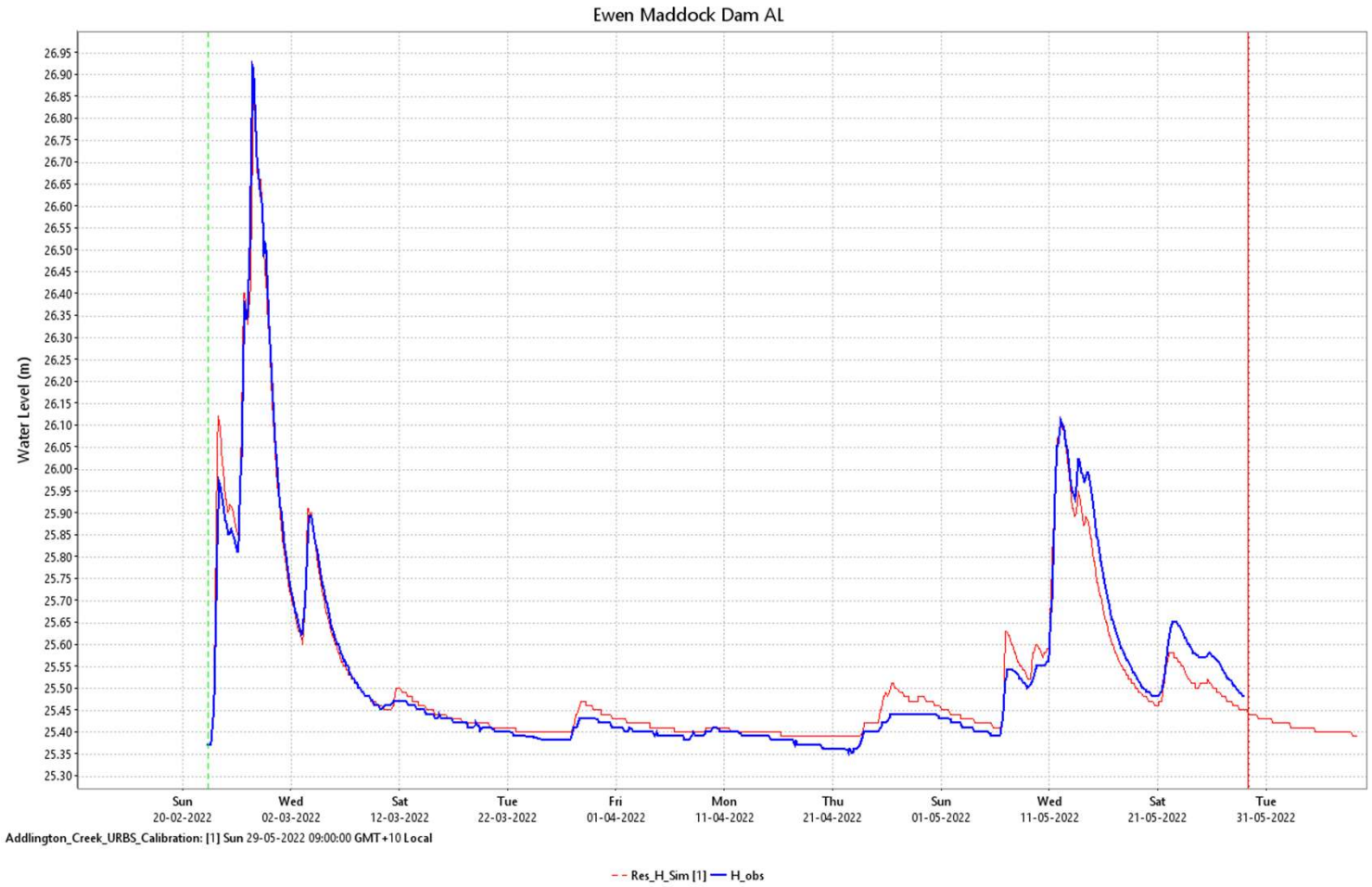
Iteration: 001



Auto-Calibration Trial

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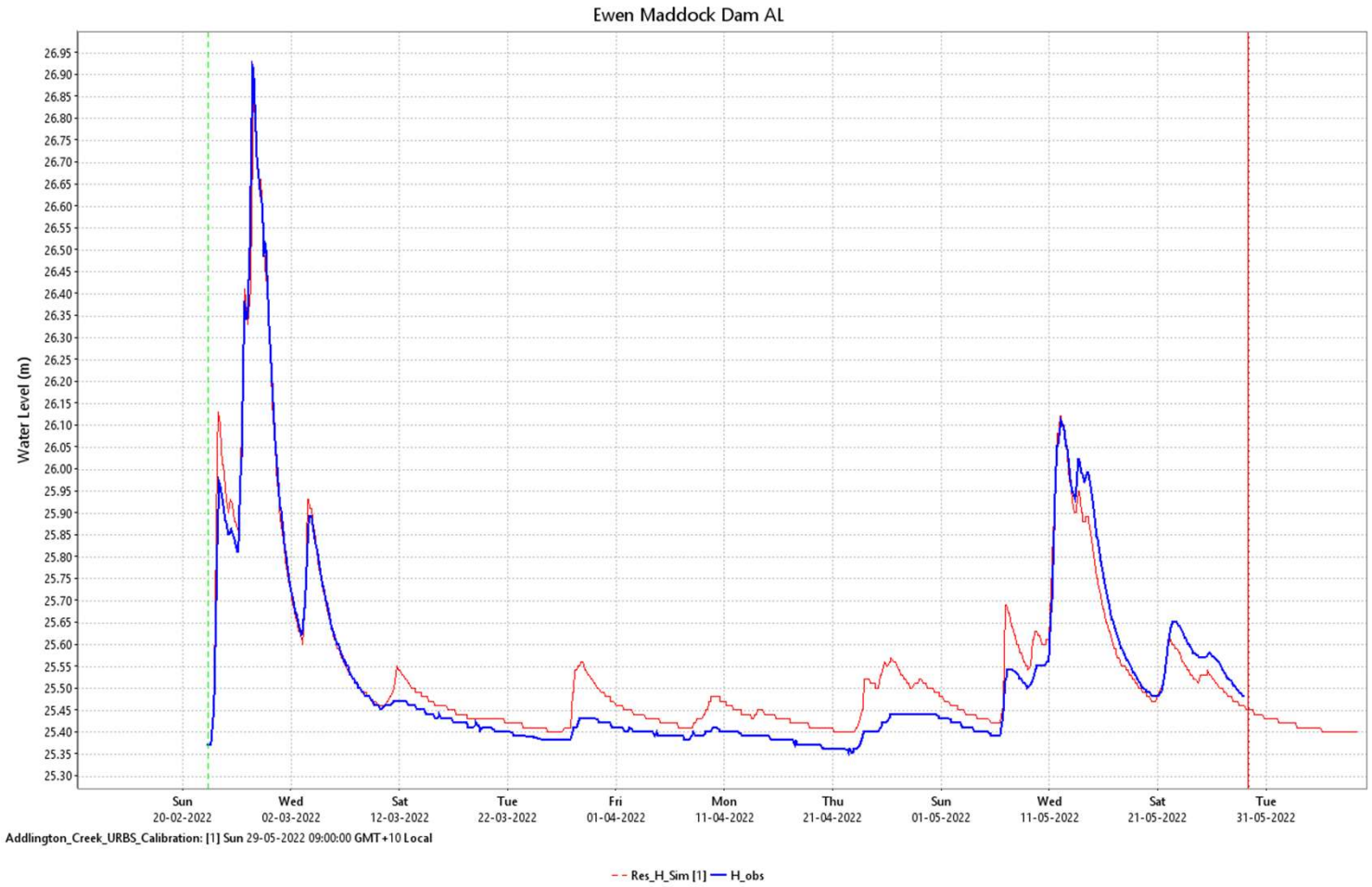
Iteration: 008



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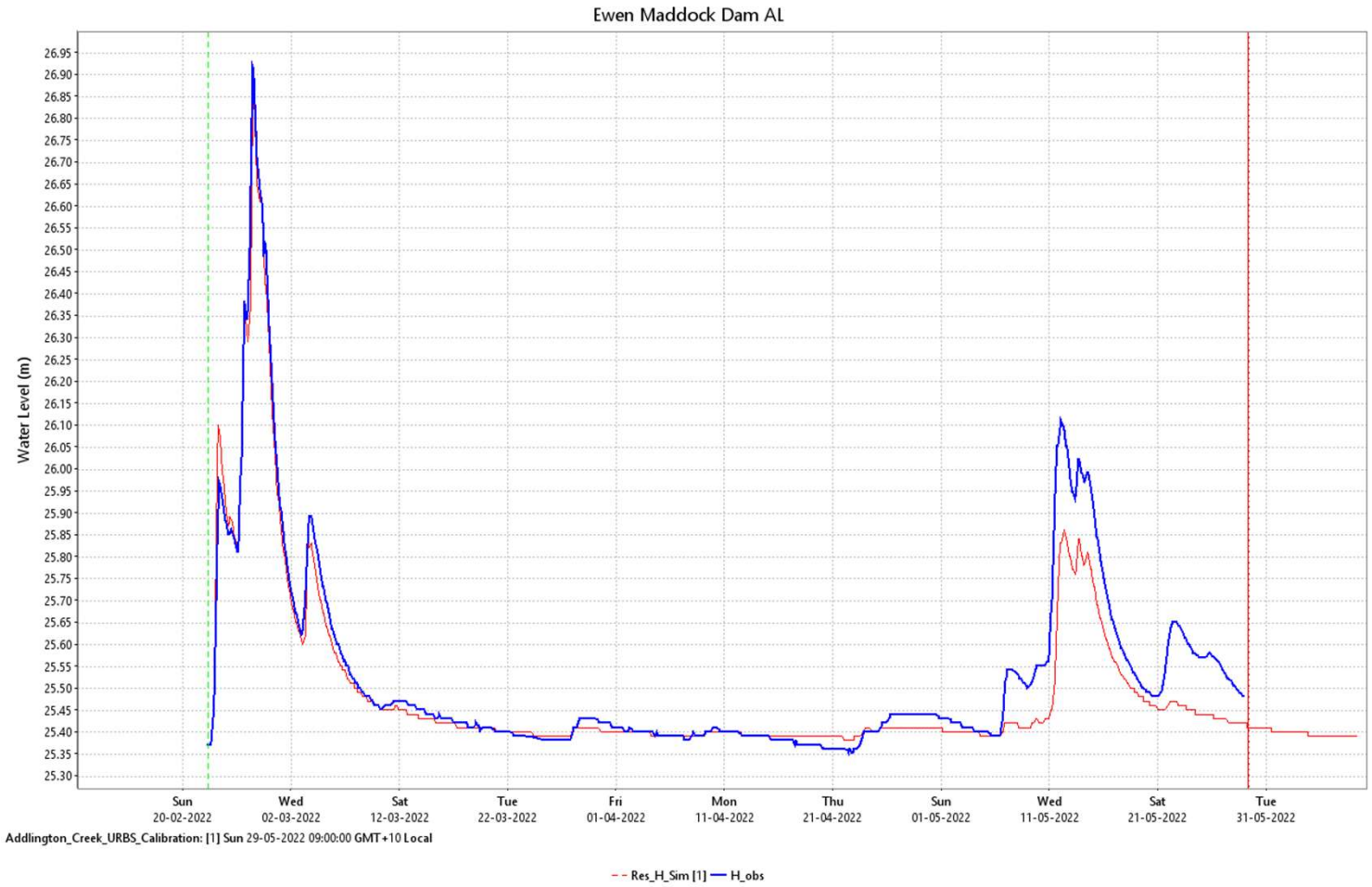
Iteration: 084



Auto-Calibration Trial

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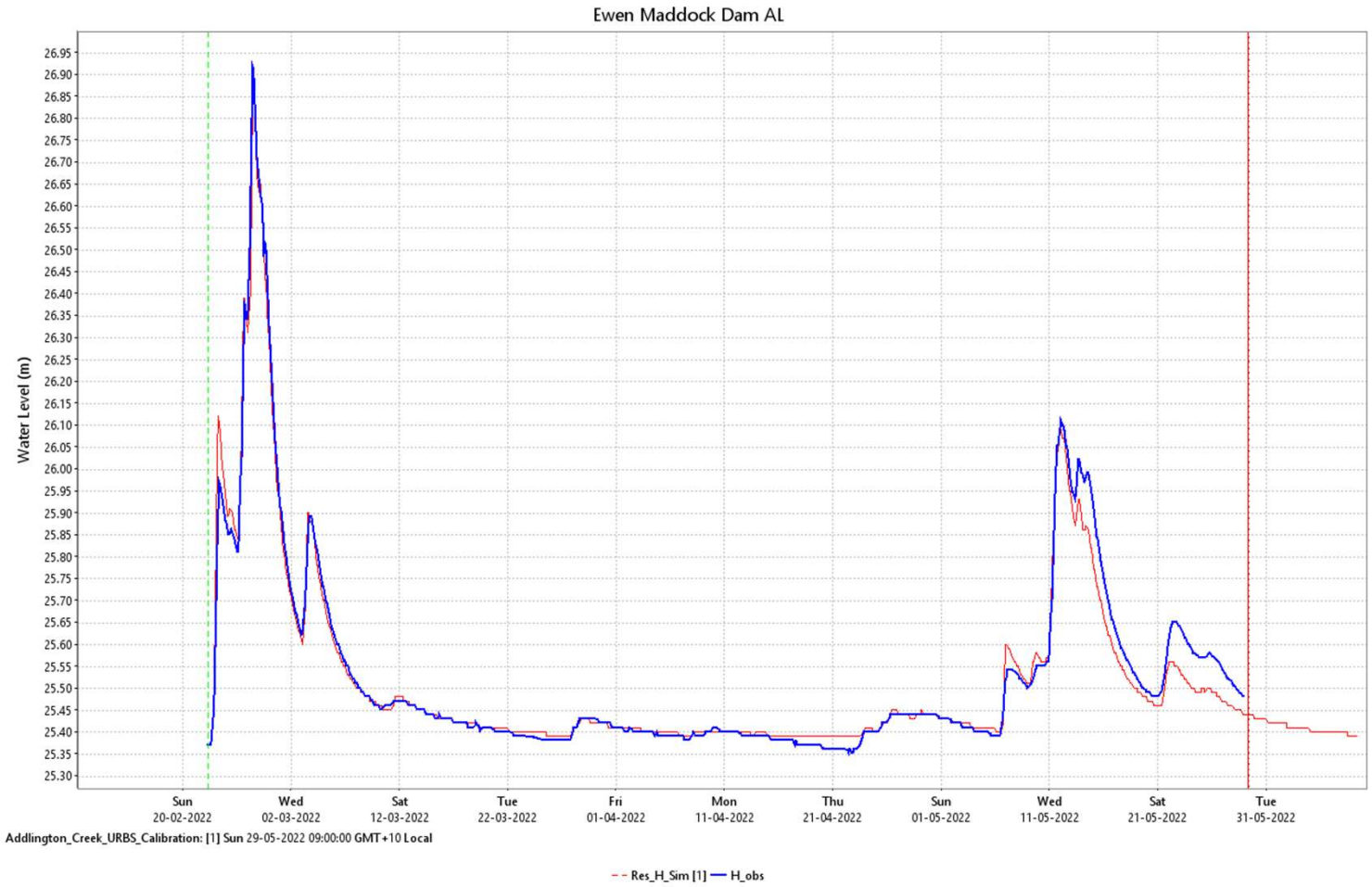
Iteration: 102



Auto-Calibration Trial

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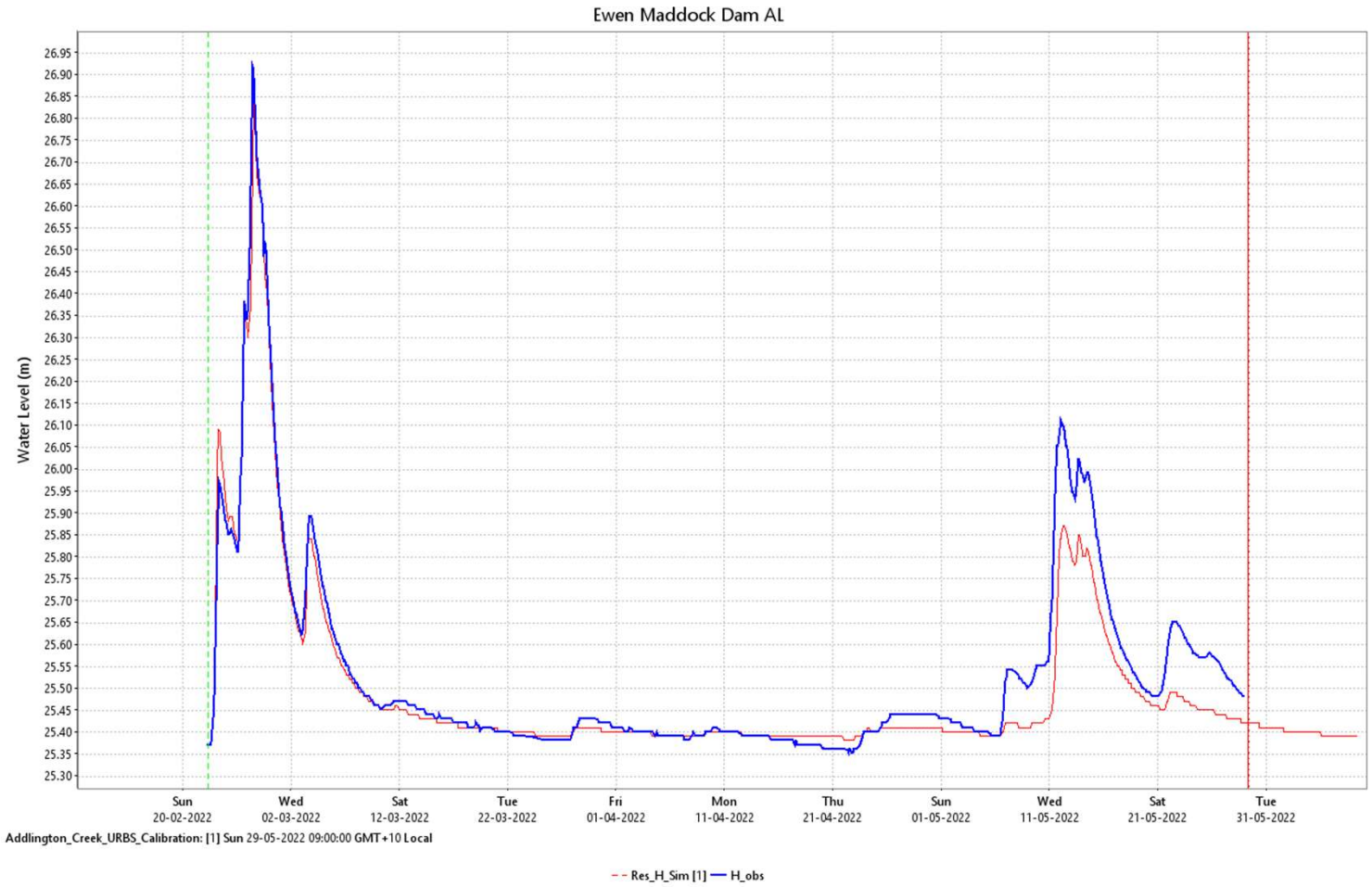
Iteration: 168



Auto-Calibration Trial

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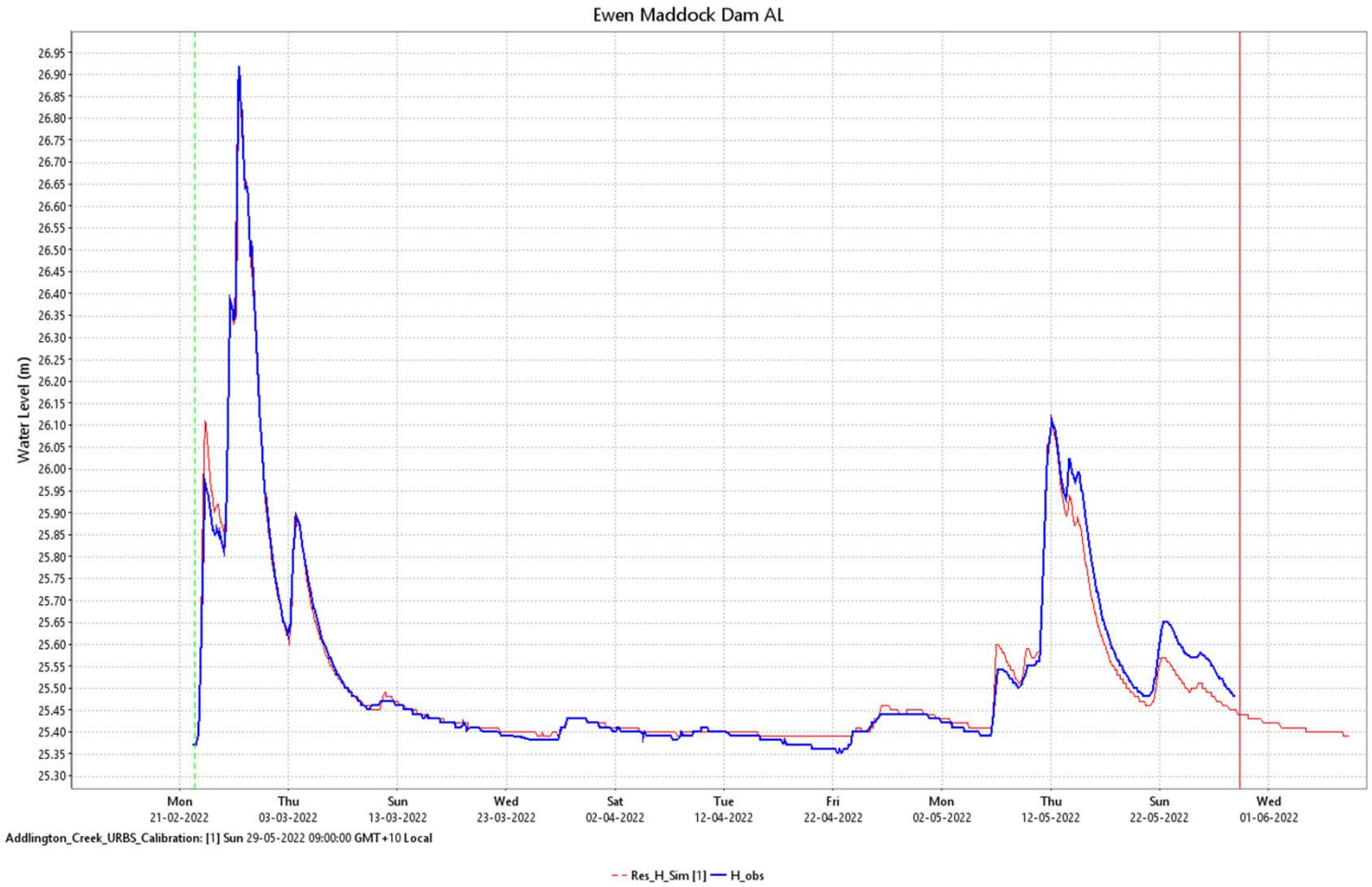
- Let it run!

Iteration: 200



Auto-Calibration Trial

Auto-Calibration: Outputs

- RMSE output via csv file
- Finalised parameters

Iteration	Cost	value[0]	value[1]	value[2]	value[3]	value[4]
1	0.037748860988344461	55.0	0.3	0.2	2.0	0.4
2	0.039966890460110977	37.380755726778844	0.47729690047258 79	0.28554016714670416	2.189790765019446	0.38419960267834 08
3	0.067112467361606 98	68.524483384357 75	0.69123811583051 66	0.24623922965280892	2.190491838833 66	0.43763907540866254
4	0.046499027853082 37	46.114682424982 79	0.48522215048003 19	0.17897786934581075	1.749707497872 5091	0.16403790156474 415
5	0.054350055090039 15	72.660506279489 45	0.28936034929732 2	0.28784518053379 78	1.842222328338 8932	0.13421269067244454
6	0.042824749291767 94	68.231330167564 24	0.58562850026717 9	0.23818034371058 1	2.125912539634 4674	0.15988443786595 84
7	0.053108426111112 17	42.134643196114496	0.26114312350038 84	0.22163935569683704	1.724425555294 6253	0.18639493690497144
8	0.071555632634959 45	73050755052728	0.73728573810840 332	0.28783722377004317	1.798677818638 61177	0.49569789602496617
9	0.039896399335939337	63.629243555143 63	0.51186723077991 49	0.21991006412714392	2.717096534320515	0.35736619576655915
10	0.057410955509232296	65.757411459485898	0.19800211021276057	0.20350946415 19825	2.267725216942602 0	0.14120939050446 9
11	0.037166974736586 67	61.910400873079 31	0.49656051300512183	0.19787102999365622	1.927321140342477 7	0.29528341176048106
12	0.050114753461352 72	31.090651170464 71	0.23953359713655065	0.23738220361468082	2.678158887098138	0.22934038678787988
13	0.047231877490160935	51.644278349587 37	0.18653315333804021	0.15857633161870174	2.677298702454549	0.38033025228436614
14	0.067085901749676 1	56.340968830495 23	0.63577053524984 88	0.22559311885375092	2.667267626843691 83	0.48708366752731014
15	0.044595090950532 2	52.389218791757 93	0.23894832071010 48	0.28750885870640175	2.932080125082188	0.32006310766642415
16	0.041945039778408084	57.750641188339258	0.25130289290309 37	0.26924144761 8665	2.853040183307811	0.36130091211559915
17	0.037787753196128 71	45.920399728380 37	0.47604465369269755	0.17404639262221225	1.906823225853825 4	0.33522401327613 88
18	0.058819997196243395	65.794811408418 81	0.14238460370207904	0.21860195153425016	1.780674419692733 8	0.20160489069865975
19	0.057687390782717 69	37.732749962061725	0.39965617930203 15	0.15473004366654386	2.847463440274342 6	0.03156317661211876 4
20	0.056210263140655414	57.143936232156506	0.21277336405945 59	0.27074931321013 14	2.097869408133248 3	0.15090797716232393
21	0.048570929915379426	67.004363060364 23	0.43455161755145597	0.25037674463282433	2.648546088104572	0.49219830346109533
22	0.040927873432643 94	50.795843026304 94	0.07504752953355 55	0.26475790747387096	1.951077855903850 9	0.15010501567686285
23	0.037360410760559	53.249498372841 94	0.46159730999076 03	0.18464352947973017	2.285951145534633	0.36386460998646165
24	0.044933397114325254	56.318343919022674	0.18123377421332654	0.22392396825902673	2.099486642110329	0.46102622251673 33
25	0.069466705316939 12	52.375779162367 05	0.97850847763890 57	0.21643801641106486	2.181880599221406 8	0.30408771352329 58
26	0.048900357820 63	34.533859606686781	0.65267487973822 57	0.28585053253845 37	1.873132913522762 3	0.09258118577516067
27	0.047808363138889 88	52.428239252123745	0.50425994960215 49	0.23256694644361275	2.500616341247974 3	0.12313274312568914
28	0.052464813075353924	43.658809532761694	0.15109610879132622 6	0.2667919057076 0936	1.731504860880468	0.35978799455439 33
29	0.049634443524351 75	37.263111670532766	0.62317420478821 82	0.15693188789675733	2.357459342920194 4	0.08861852849347573
30	0.056811415280734 05	65.772546485600315	0.15412110021816303	0.27468103100212066	2.736621801020424 6	0.18704252031533103
31	0.050756633081127024	33.071824804641466	0.17920374855052393	0.18934402476587326	2.053849243272138	0.33429224801307786
32	0.046069733066608325	37.610495566963 24	0.38795956077773 95	0.27530929563741025	2.504523298991847	0.18296288489277576
33	0.067017207007835 7	63.661393639755 2	0.67069931205589 46	0.25330473864237 41	2.824579263891149 8	0.45076119272052 14
34	0.070453962859571594	49.475132952848 29	0.80604304367158337	0.26541761499485212	2.658103959376195 5	0.41890699411 05578
35	0.049162430157368826	39.797758626935 68	0.53453862944787 28	0.26966077141 98941	1.582857845510662 6	0.39141786320630306
36	0.049965225459403 12	31.631653843111586	0.91039043833239 96	0.20552770935033895	1.604268026459108 3	0.07079992622582397
37	0.052450791318435 06	74.603647456989 776	0.32723195960313 35	0.28071608404460635	2.160369319563467	0.13352245880340 39
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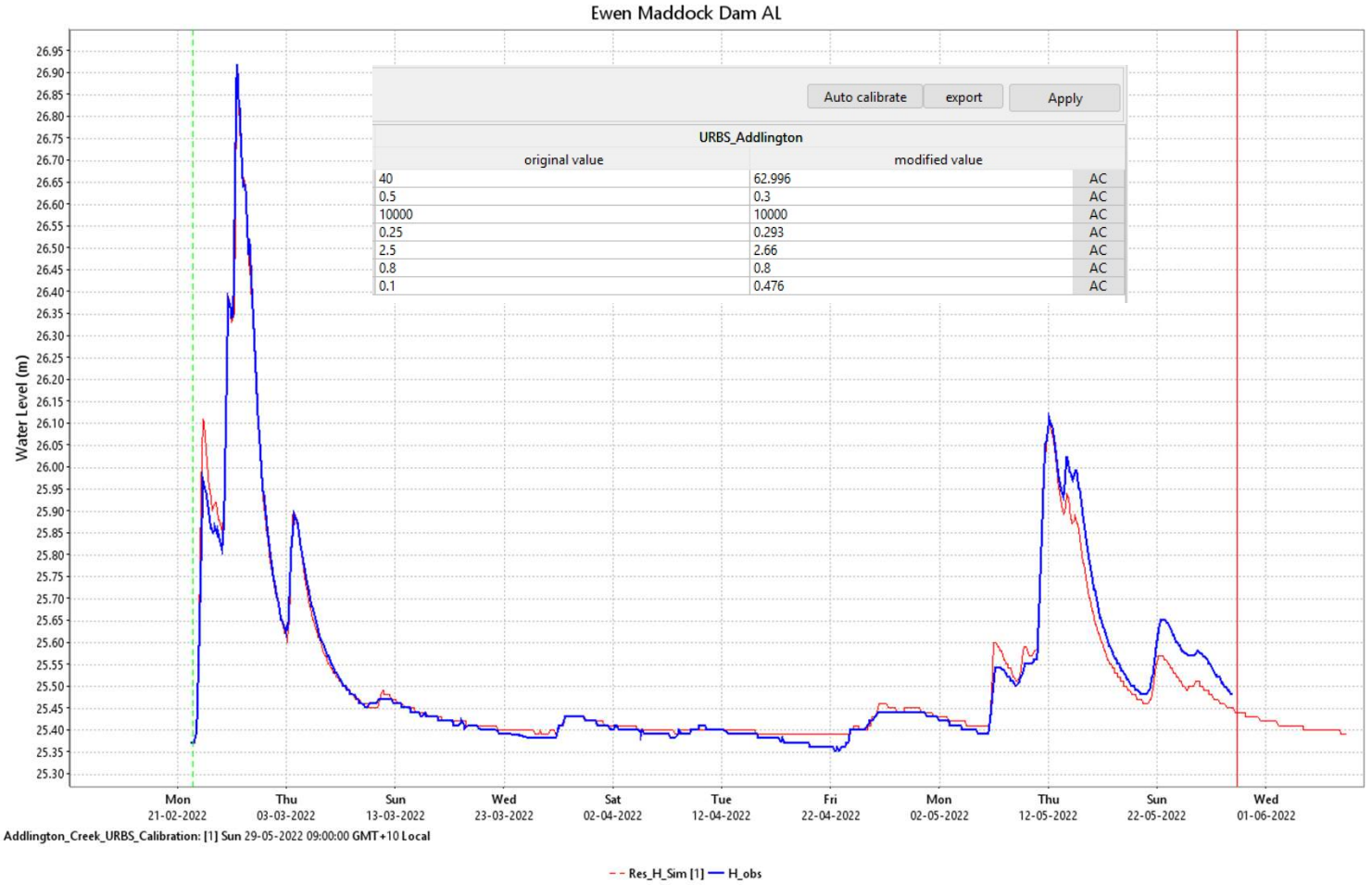


Auto-Calibration: Further work & initial observations

- **Integration with Calibration Dataset for southeast QLD**
  - Will this improve calibrations?
  - Should we expand/change our standard parameters (e.g., recovering infiltration capacity)?
  - Do more parameters = better quality calibration
    - Can we better define catchment parameterization? (tighter band of parameters)

- **Beyond typical flood data:**
  - Longer runtimes = more reliant on good quality data (extractions, evaporation…)

- **Objective function:**
  - Are additional metrics required?

More information: https://publicwiki.deltares.nl/display/FEWSDOC/Auto+Calibration

Seq-FEWS: Flood Warning Display

Adding the ability to track and display Flood Warnings in Seq-FEWS

seqwater
WATER FOR LIFE

Seq-FEWS: Flood warning display

Project team acknowledgements

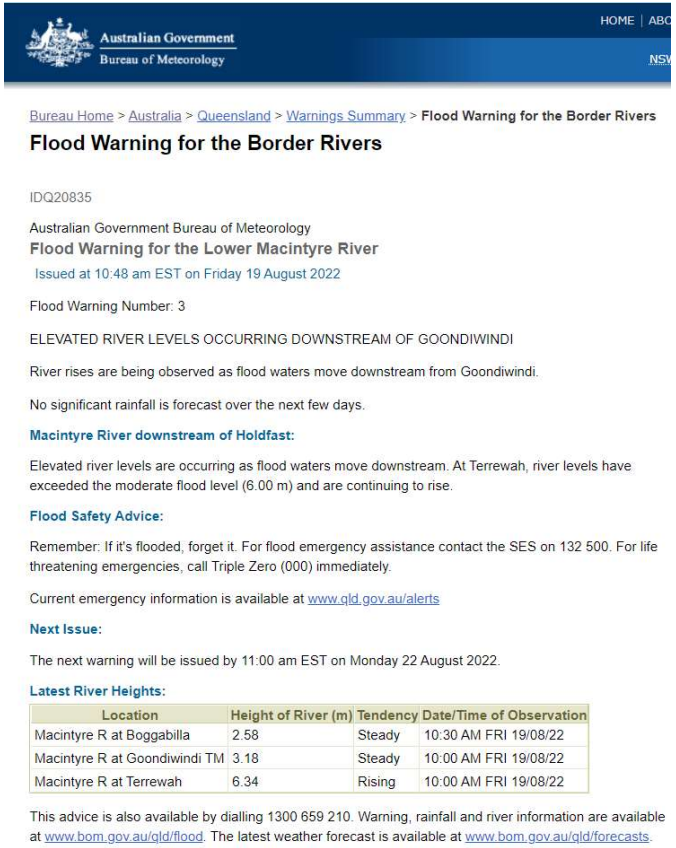
Project lead: Leanne Salter

Assistance: Bureau of Meteorology (Wen Wang & Idske Galema) and Deltares (Simone)

Aim: To provide an up-to-date status of flood warnings and flood watches across Australia

Impact:

- **Situational awareness:** Confidence all users are aware of the current flood warnings and flood watches
- **Record keeping:** A record of flood warnings and flood watches for reporting
- **Data to support processes:** Change to Seqwater's messaging based on Flood Warning status



Australian Government
Bureau of Meteorology

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Flood Warning for the Border Rivers

IDQ20835

Australian Government Bureau of Meteorology

Flood Warning for the Lower Macintyre River

Issued at 10:48 am EST on Friday 19 August 2022

Flood Warning Number: 3

ELEVATED RIVER LEVELS OCCURRING DOWNSTREAM OF GOONDIWINDI

River rises are being observed as flood waters move downstream from Goondiwindi.

No significant rainfall is forecast over the next few days.

Macintyre River downstream of Holdfast:

Elevated river levels are occurring as flood waters move downstream. At Terrewah, river levels have exceeded the moderate flood level (6.00 m) and are continuing to rise.

Flood Safety Advice:

Remember: If it's flooded, forget it. For flood emergency assistance contact the SES on 132 500. For life threatening emergencies, call Triple Zero (000) immediately.

Current emergency information is available at www.qld.gov.au/alerts

Next Issue:

The next warning will be issued by 11:00 am EST on Monday 22 August 2022.

Latest River Heights:

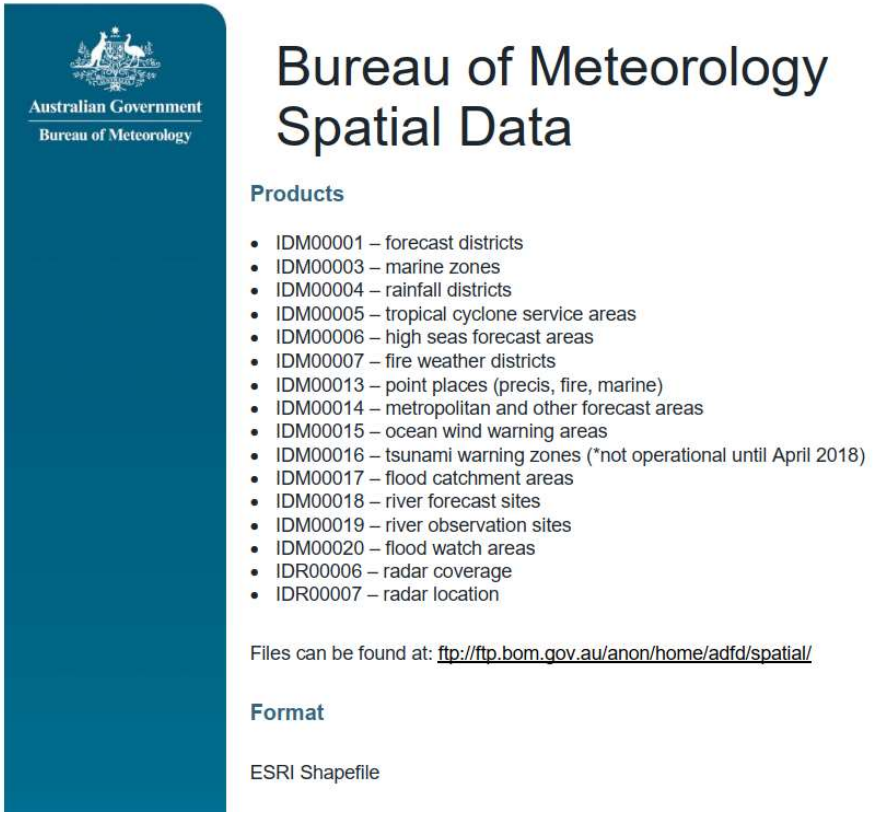
Location	Height of River (m)	Tendency	Date/Time of Observation
Macintyre R at Boggabilla	2.58	Steady	10:30 AM FRI 19/08/22
Macintyre R at Goondiwindi TM	3.18	Steady	10:00 AM FRI 19/08/22
Macintyre R at Terrewah	6.34	Rising	10:00 AM FRI 19/08/22

This advice is also available by dialling 1300 659 210. Warning, rainfall and river information are available at www.bom.gov.au/qld/flood. The latest weather forecast is available at www.bom.gov.au/qld/forecasts.

Seq-FEWS: Flood warning display

- BOM flood warnings available in AIFS format
  - Public FTP: ftp://ftp.bom.gov.au/anon/gen/
  - Publicly available shapefiles (locationSets)

- Delft-FEWS supports importing AIFS files
  - AifsXMLHazard
  - AifsXML



Seq-FEWS: Flood warning display

Import

- Direct from BOM public FTP
- Direct into Seq-FEWS using AifsHazard import type

Processing

- Non-equidistant to equidistant
- Enumerations (1 = BLWMIN, 2 = MIN…)

AifsMLHazard

Overview

The AifsMLHazard import function (<importType>AifsMLHazard</importType>) imports forecast time series with comments from specific XML files. The AifsMLHazard format is a very specific XML format developed at the Bureau of Meteorology in Australia. Files with this format are produced in the home made Content Reviewer (WET) software that is used to generate official flow forecasts.

The new AifsMLHazard import type has functionality to import the warning (type=river-basin) and watch (type=flood-watch-area) information. The enumerated warning severity (BLWMIN, MIN, MOD, MAJ and CAN) need to be converted to numerical values in the FEWS database. When the warning and watch information is imported FEWS knows for each catchment/area the status. These status values are stored as non-equidistant values in the database for the catchment/area locationsets

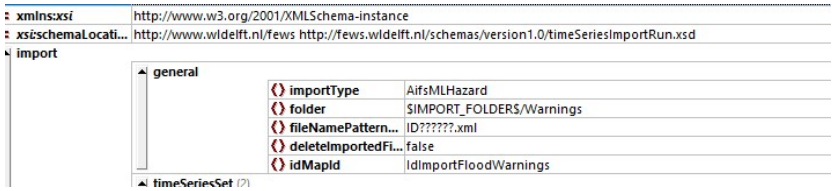
There is an XML schema available on the Bureau web site: http://www.bom.gov.au/weather/schema/v1.5/product.xsd

The time series parser looks for the following elements in the AifIML file.

8 WarningLevel

value (4)

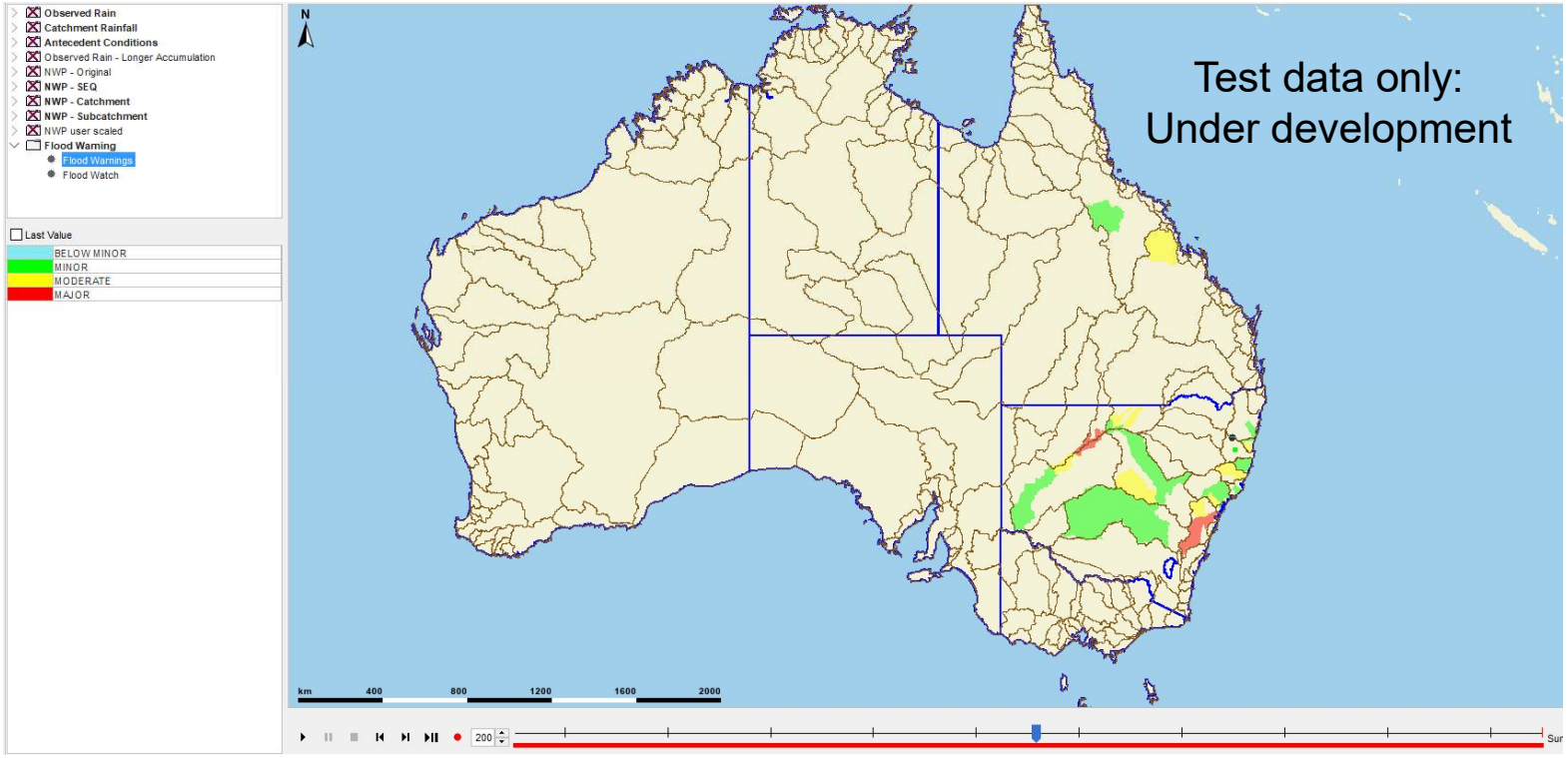
	= label	= code
1	Below Minor	1
2	Minor Flood Warning	2
3	Moderate Flood Warning	3
4	Major Flood Warning	4



Seq-FEWS: Flood warning display

Display Configuration

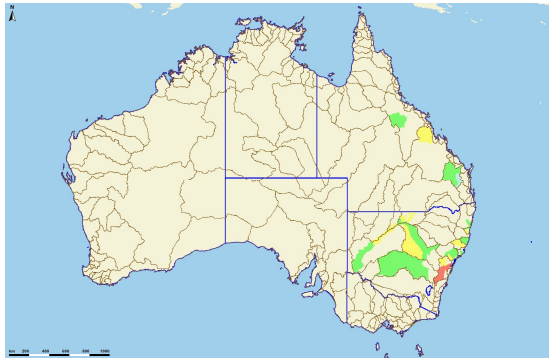
- Spatial display
- Flood warning colours
- Benefit of time sliders for reporting



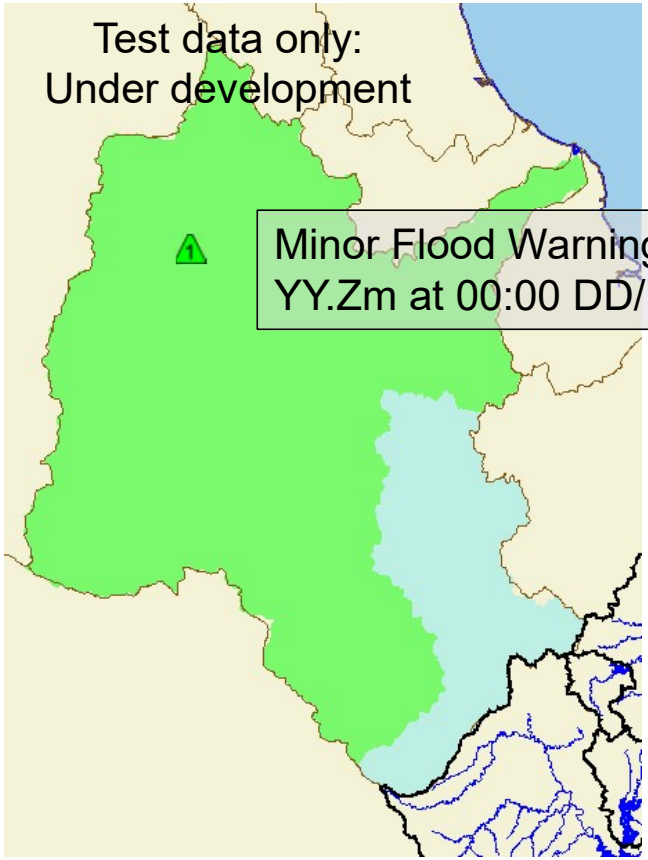
Seq-FEWS: Flood warning display

Still to come:

- Flood Warnings and Flood Watches
- Include locations and associated forecasts in display
- Consideration with Situation reports
- Include in automated exports for reporting



Contact Leanne, Steve or myself if you want to know more



Seq-FEWS: Integration of photographs

Under investigation: Making site observations (photographs) available to Seq-FEWS users

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Seq-FEWS: Integration of photographs

The problem:

- During Floods, many photographs are captured to assist operations:
  - Replace failed\faulty gauges
  - May provide more context than water level plot
  - Provides additional flood intelligence

- Photographs often filed with flood event (difficult to quicky access)

Project aim:

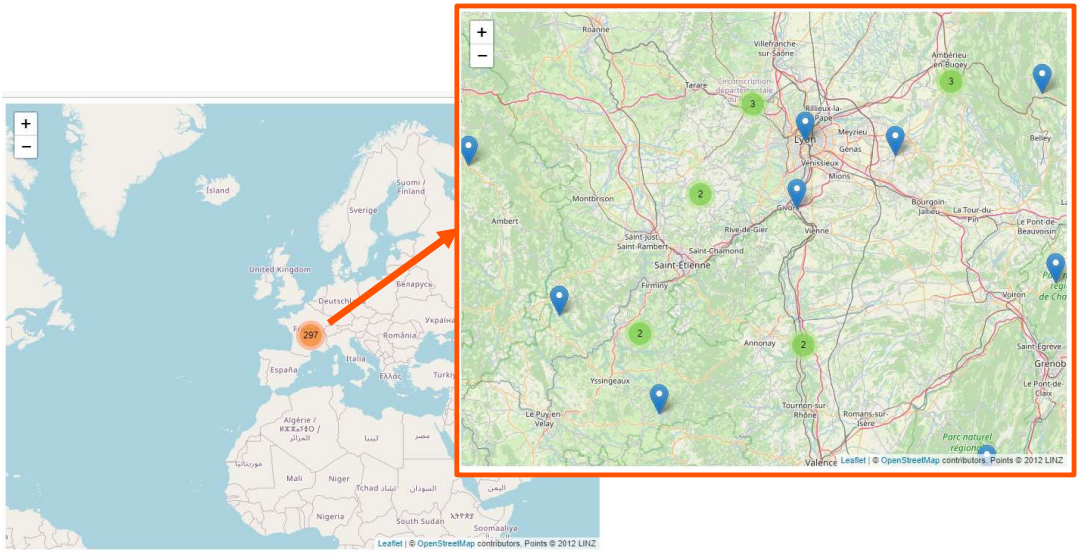
Investigate the integration of photographs in Seq-FEWS:

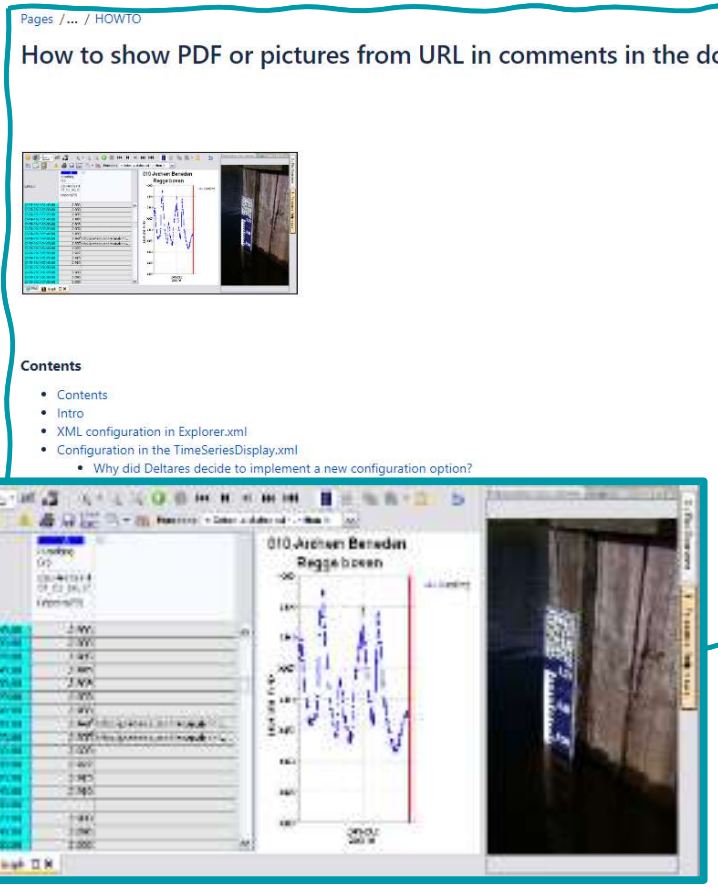
- Assist accessing these photographs
- Connect time series with photographs

Seq-FEWS: Integration of photographs

Under investigation

- Easy to access location to make historical photographs available to Seq-FEWS users
- Operator Client vs WebAPI?
- Other options?





Seq-FEWS: Continuous Improvement Projects

Integrating Auto-Calibration into the Calibration Dataset for South East Queensland

On overview of outcomes and integration of auto-calibration

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Seq-FEWS: Flood Warning Display

Adding the ability to track and display Flood Warnings in Seq-FEWS

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Seq-FEWS: Integration of photographs

Under investigation: Making site observations (photographs) available to Seq-FEWS users

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Thank you.
Questions?