

VORTECH

Deltares



Rijkswaterstaat
Ministry of Infrastructure
and Water Management

Delft-FEWS, Open Archive and WaterCoach - *connecting the dots* -

***Delft-FEWS User Days Australia
25.08.2022***

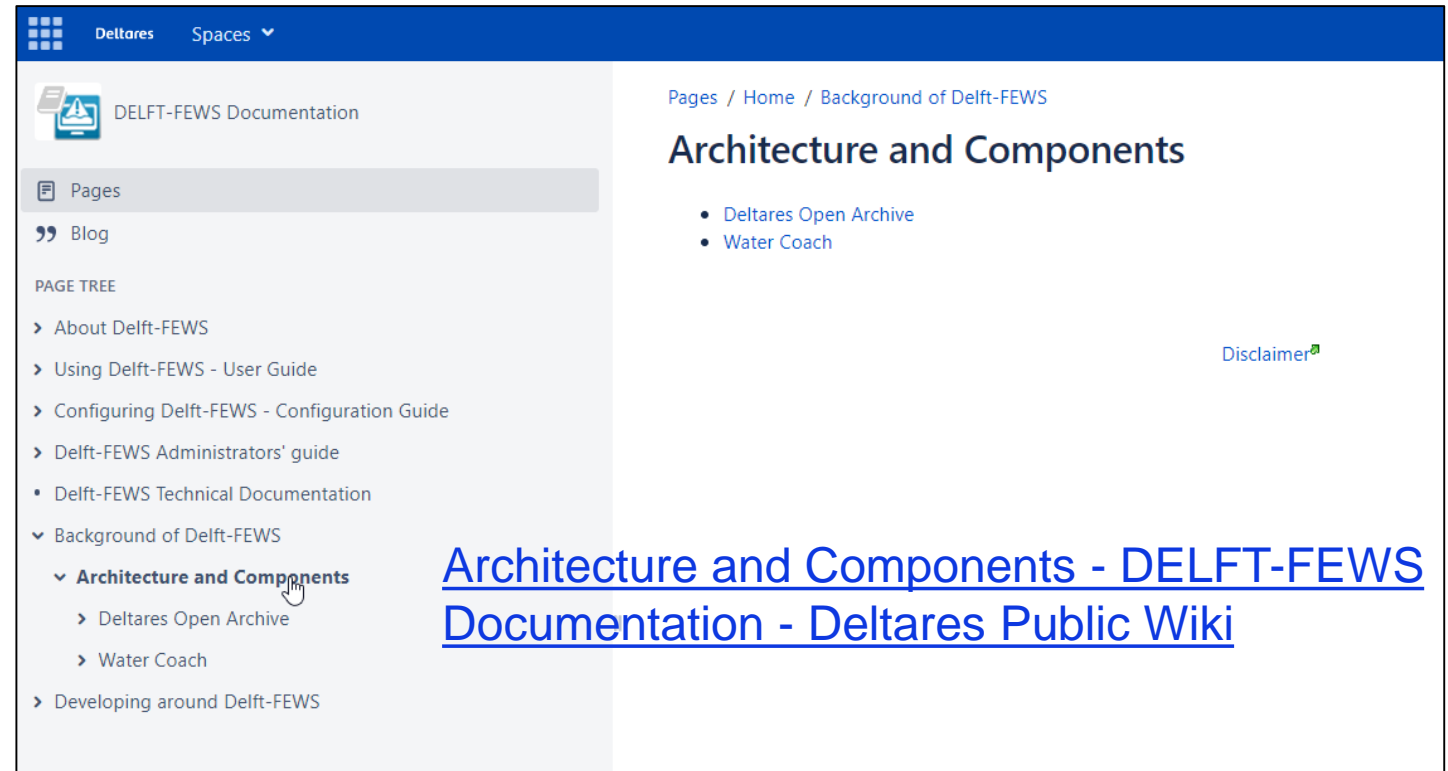
Maarten Smoorenburg, Andre Grijze, Tom Bogaard, Simone de Kleermaeker

August 2022

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- Introduction – links to FEWS road map 2025
- FEWS Open Archive
 - What's in a name?
 - Why?
 - How? (incl. new developments)
 - Highlights
 - Desired developments
- WaterCoach
 - What is it?
 - Relation with Open Archive
 - Desired developments

As usual: [Links for more info](#)

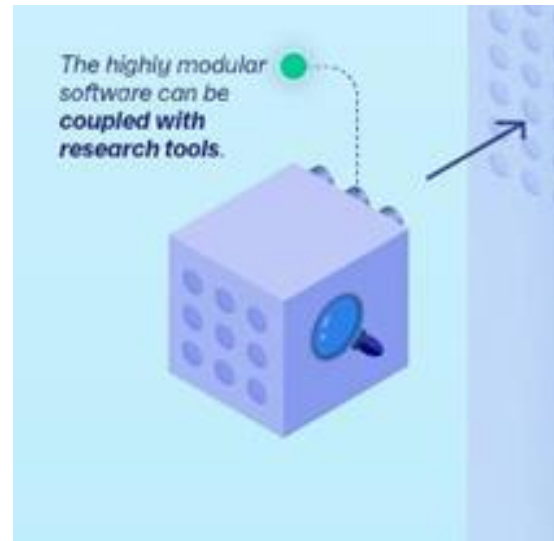


[Architecture and Components - DELFT-FEWS Documentation - Deltares Public Wiki](#)

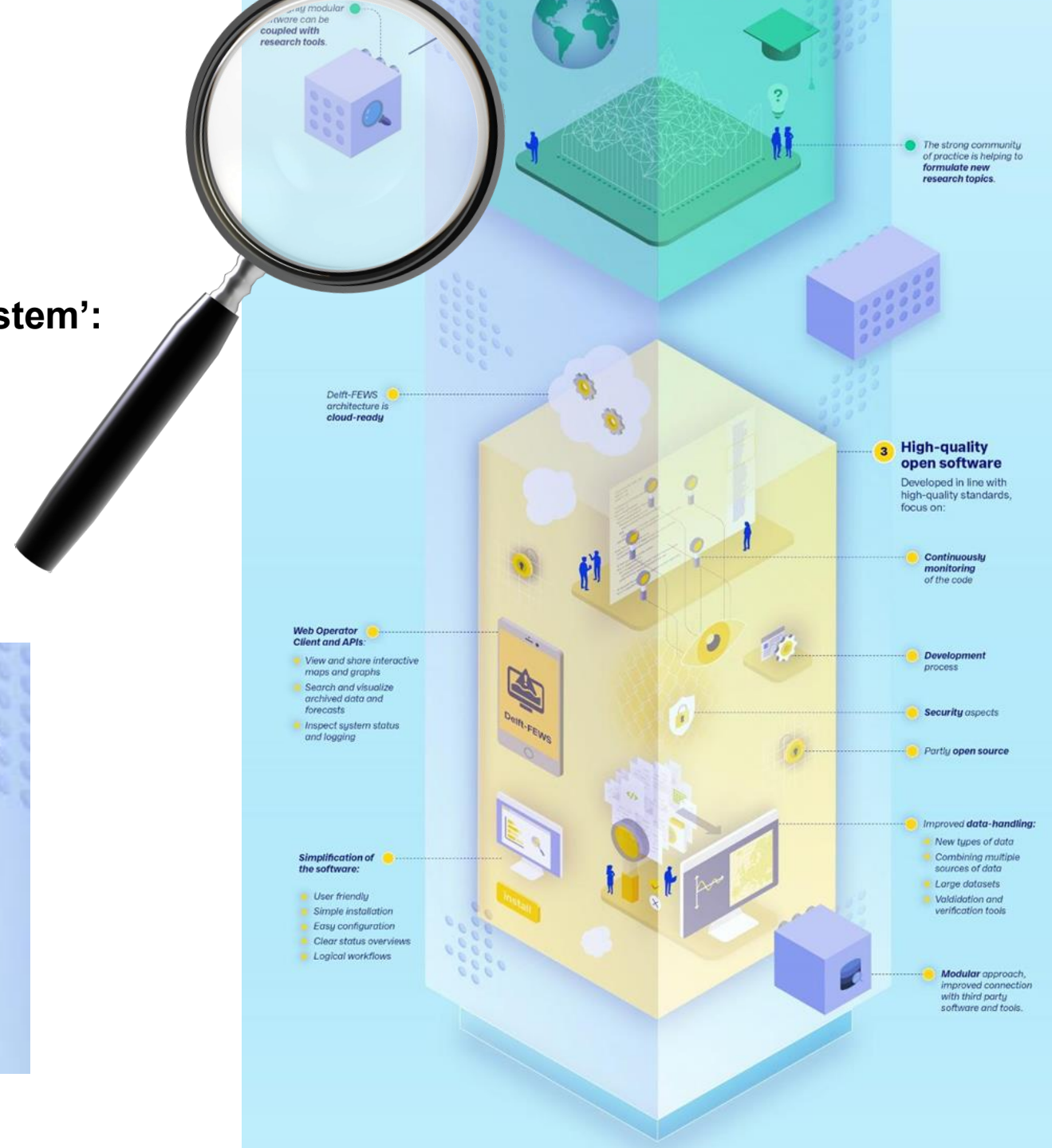
Introduction

Important components of the FEWS 'ecosystem':

Open Archive & WaterCoach



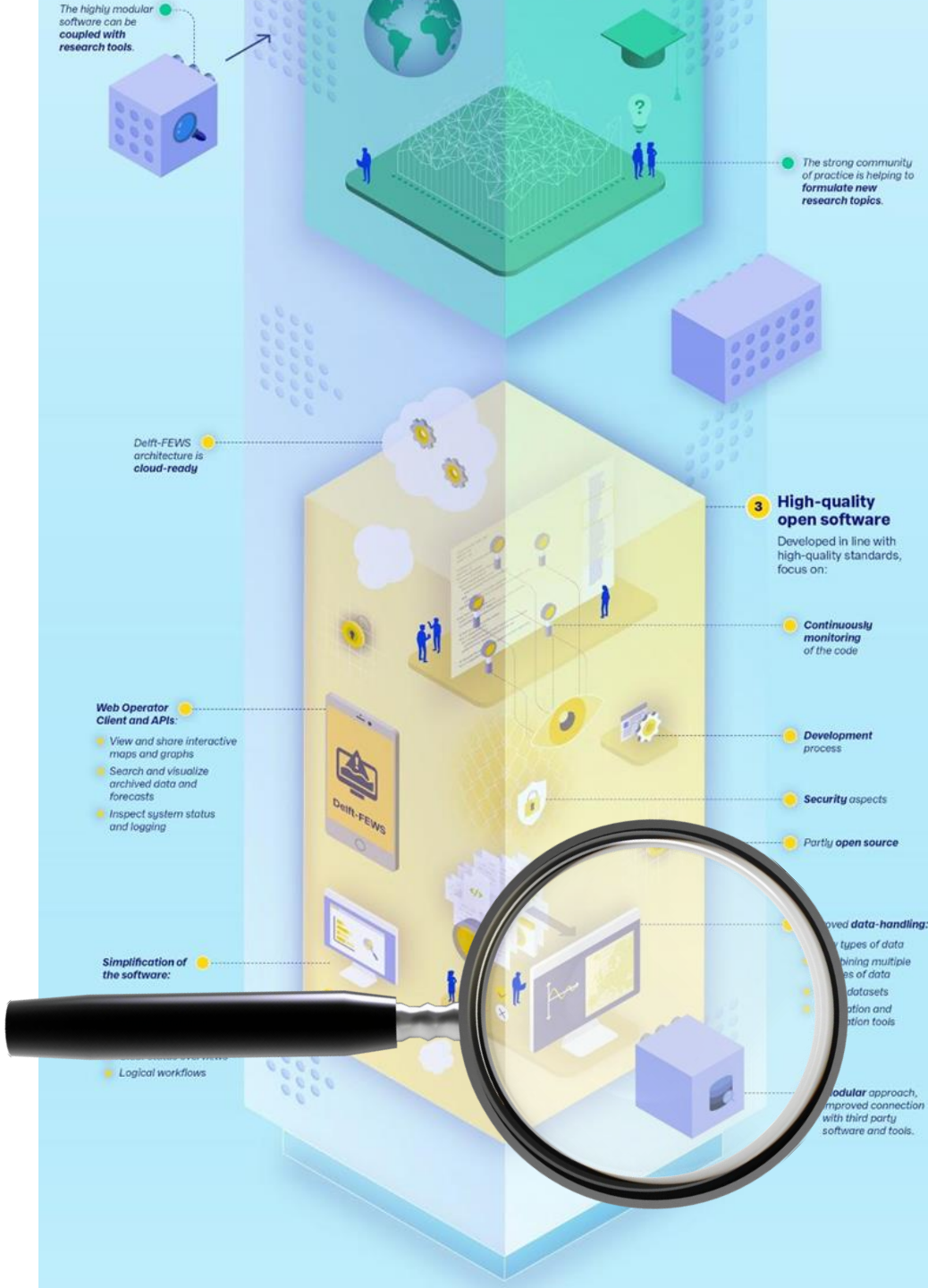
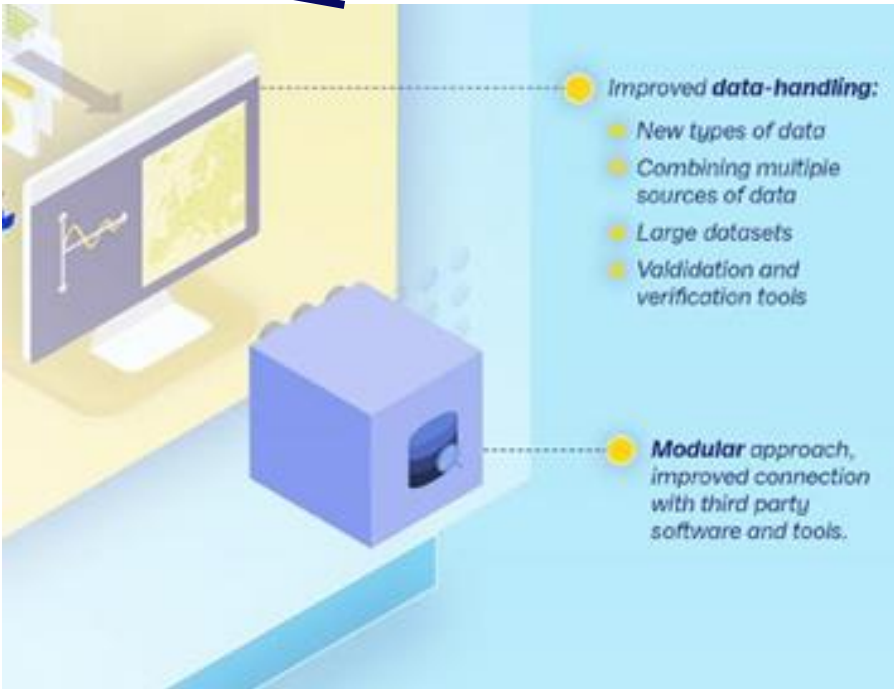
Deltares



Introduction

Important components of the FEWS 'ecosystem':

Open Archive & WaterCoach

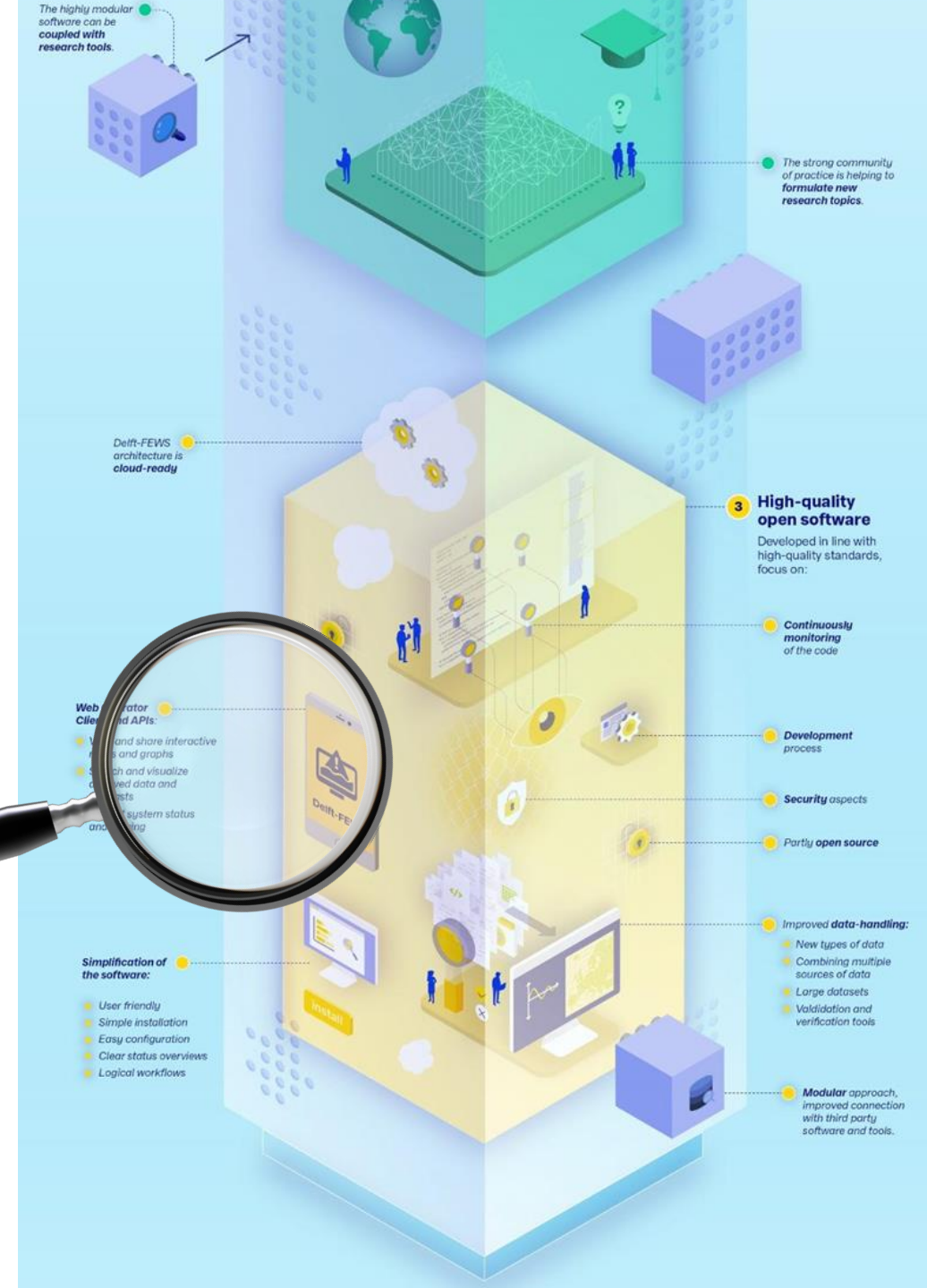


Introduction

Important components of the FEWS 'ecosystem':

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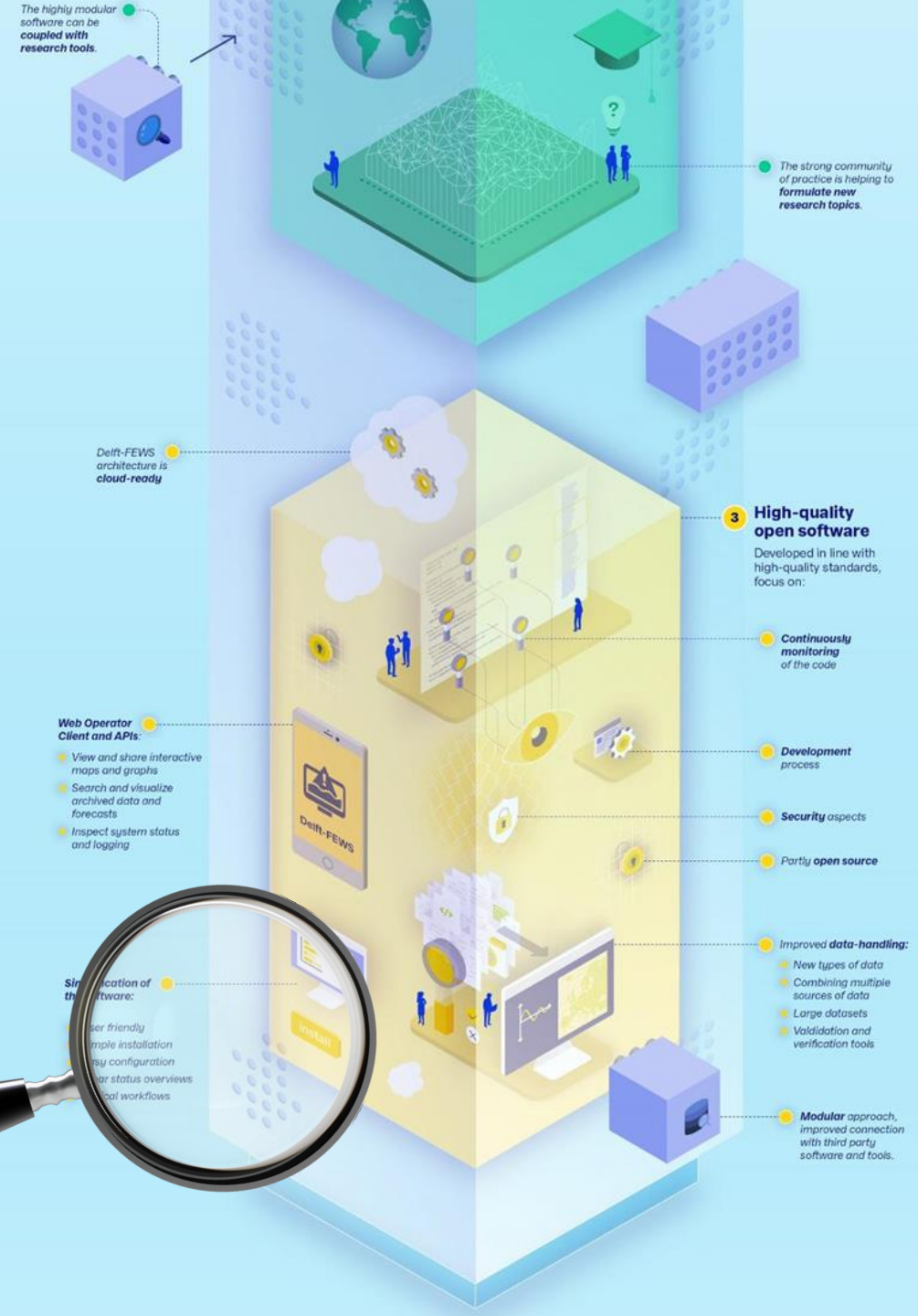
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Introduction

Important components of the FEWS 'ecosystem':

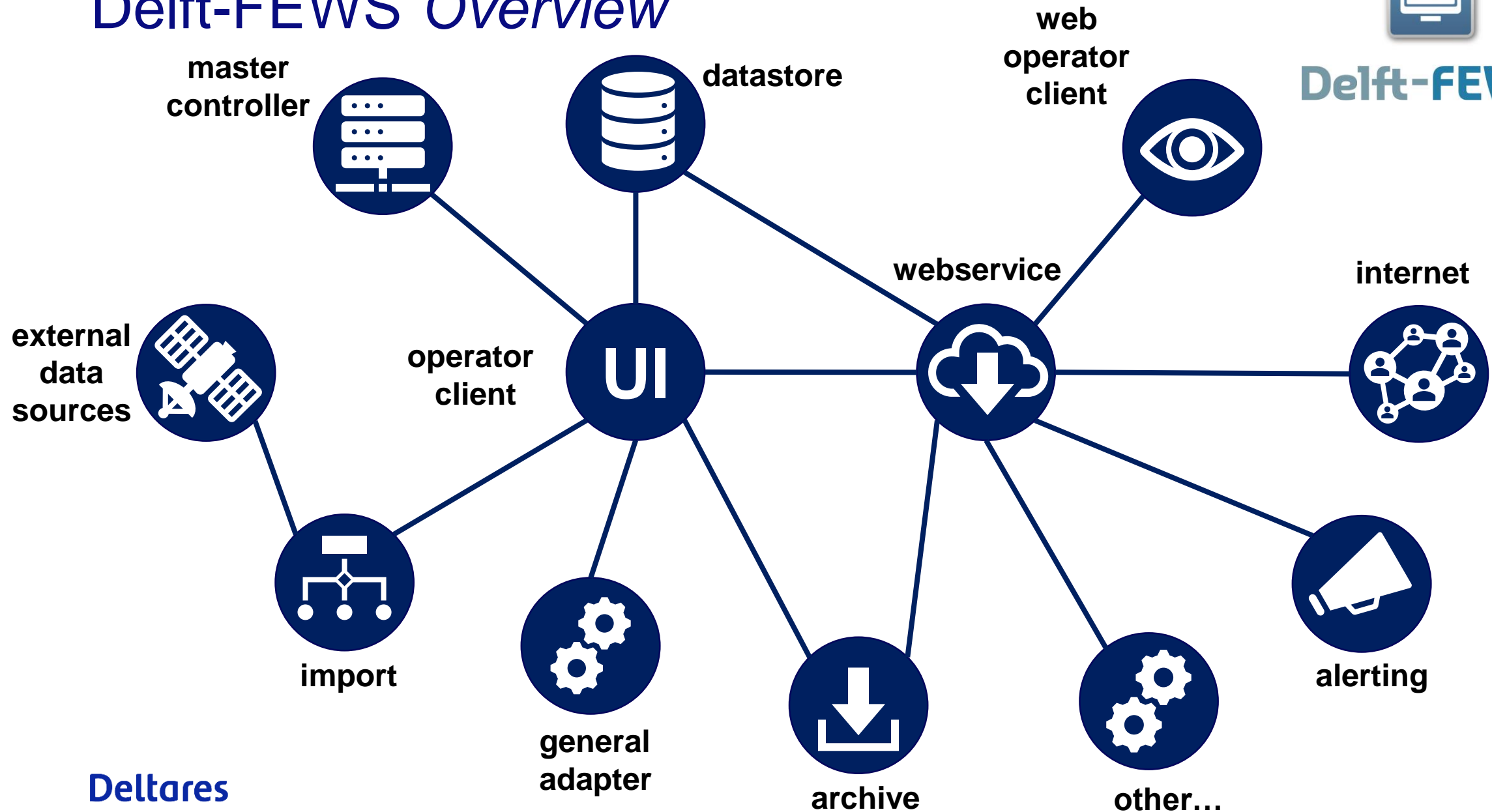
Open Archive & WaterCoach



Delft-FEWS Overview



Delft-FEWS



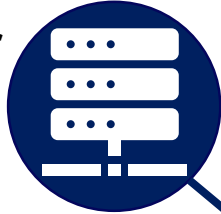
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Delft-FEWS Overview



Delft-FEWS

master
controller



datastore



web
operator
client



webservice



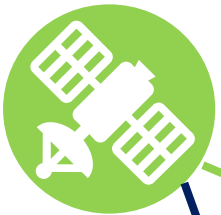
internet



operator
client



external
data
sources



import



general
adapter



archive



alerting



other...



e.g.: WaterCoach

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FEWS Open Archive

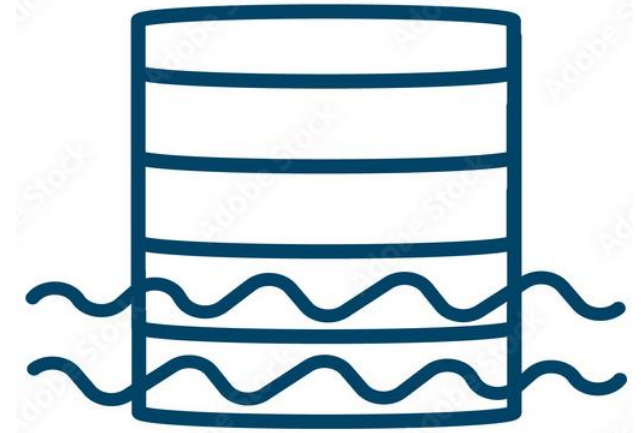
- Introduction – links to FEWS road maps 2025
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Open Archive: What's in a name?

Archive (dusty)



**(Big) data lake
(or graveyard?)**



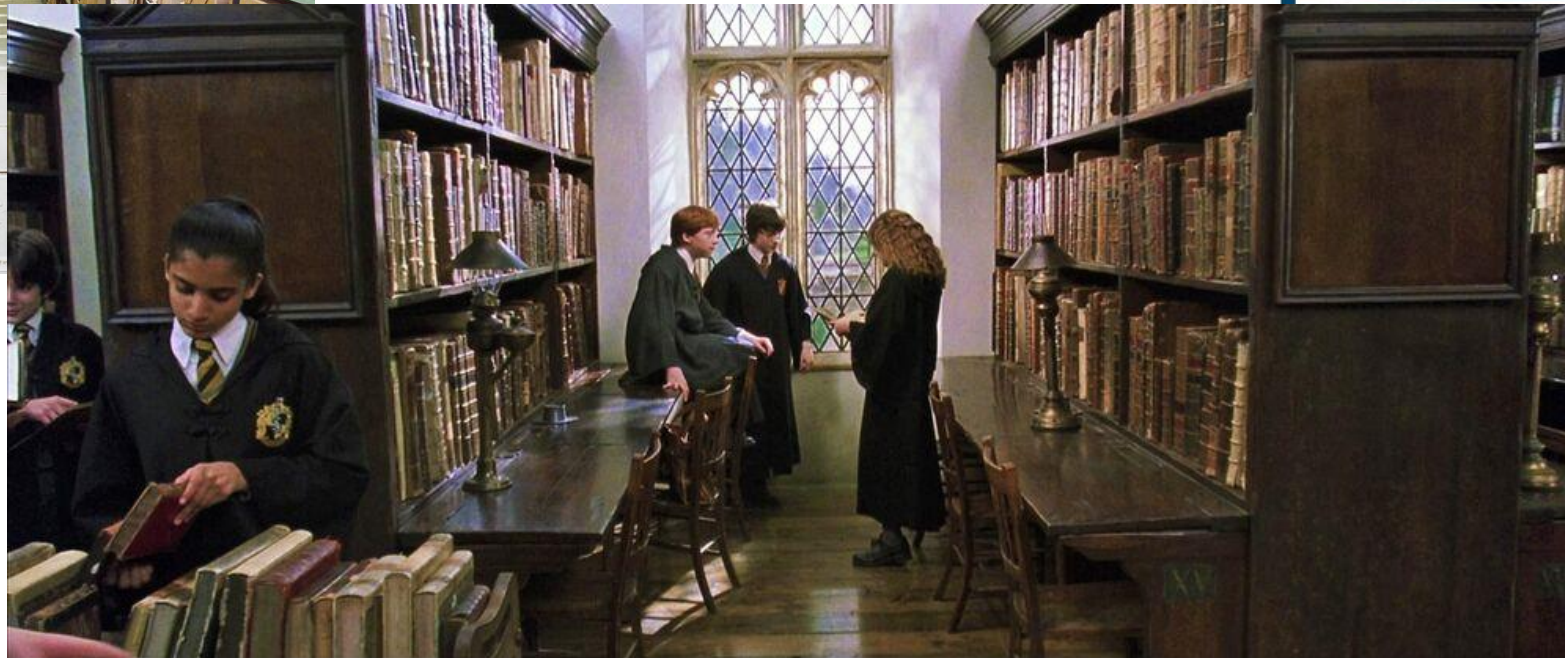
Open Archive: What's in a name?

- Archive (dusty)



- (Big) data lake (or graveyard?)

Library with magic



Open Archive: What's in a name?

Why is it called **Open** Archive?

- Started as FEWS's archive solution, filled by FEWS' exported files and **openly accessible** with FEWS' webservices (*if desired*)
- Then already possible to **store different data types** (*timeseries, states, reports, configuration, forecaster notes, database snapshots, rating curves*)
- Now **opened up** more:
 - catalogue can deal with NetCDF files produced by other systems
 - connects also to external archives via OpenDAP
 - data can be archived using a the webservice 'post' call
 - extended with archive database(s) like MongoDB

The FEWS Open Archive – Why?

- Accountability: (raw) timeseries data, forecaster notes, database snapshots, etc.
- Dissemination to outside world → via FEWS webservice
- Event analysis
 - In OC by displaying historical floods alongside current forecasts
 - Post-event analysis: FEWS Stand Alone or WaterCoach
- Training software and forecasting → FEWS WaterCoach
- Model development and scenario analysis → FEWS Comp. Framework
- Evaluation of models, forecasts and services
- Forecast calibration (statistical pre- and postprocessing, machine learning)

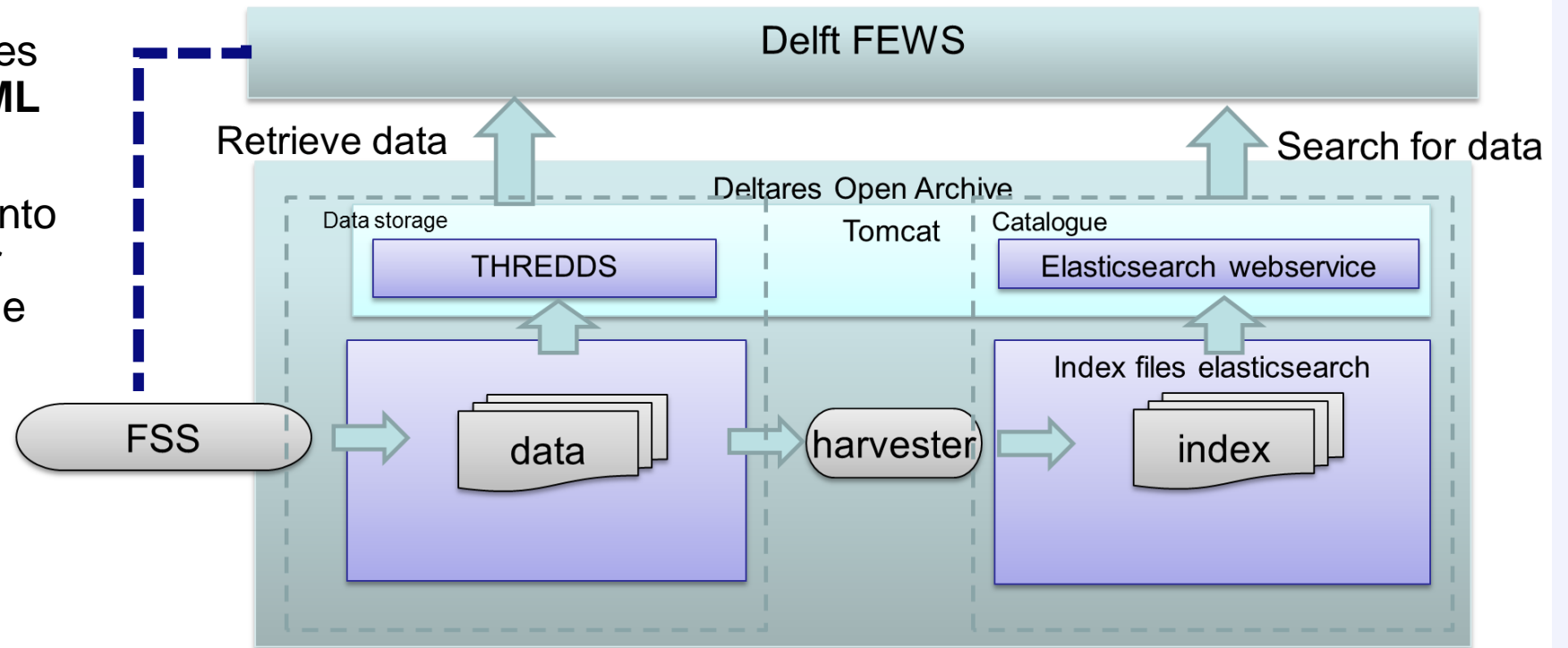


**Learning
from the
past**

The FEWS Open Archive – How?

For starters:

- **FEWS' FSS's export** files with **accompanying XML for metadata**
- Data can be **imported** into a FEWS Stand Alone or Operator Client using the [Archive Catalogue Display](#)



- Source: [FEWS public wiki](#)

Deltares

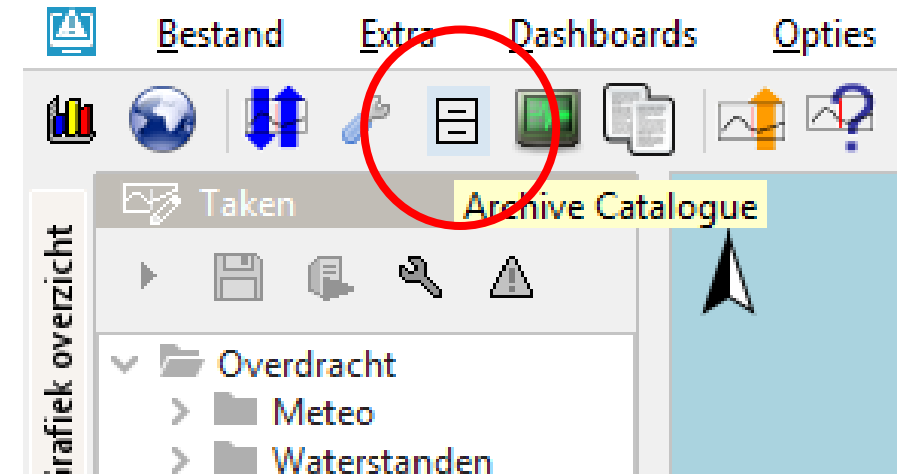
powered by open source:



The FEWS Open Archive – How?

For starters:

- **FEWS' FSS's export files with accompanying XML for metadata**
- Data can be **imported** into a FEWS Stand Alone or Operator Client using the [Archive Catalogue Display](#)



search and download datasets create a new event search and download events Archive database Upload to Archive

5 Select data sets to download

area 1 time zero is between 2 2 data set 3 Select... source 4

data set	area	source	WhatIf template name	WhatIf scenario name	prope
202202180000_WDNZ_series_delft3dfm_dcsn-fm_05nm...	rwsos 6	rwsos.noordzee	--	--	--
202202180000_WDNZ_series_delft3dfm_dcsn-fm_05nm...	rwsos	rwsos.noordzee	--	--	--
simulatedforecasting_QINE_MLR_6hourly.nc;simulatedf...	WBrSusquehanna	MARFC_MMM_Forec...	--	--	--
simulatedforecasting_QINE_MLR_6hourly.nc;simulatedf...	UpperPotomac	MARFC_MMM_Forec...	--	--	--
simulatedforecasting_QINE_MLR_6hourly.nc;simulatedf...	UpperMainStemSusq	MARFC_MMM_Forec...	--	--	--
simulatedforecasting_QINE_MLR_6hourly.nc;simulatedf...	UpperDelaware	MARFC_MMM_Forec...	--	--	--

The FEWS Open Archive – How?

For starters:

- FEWS' FSS exports files with accompanying XML for metadata
- Data can be imported into a FEWS Stand Alone or Operator Client using the Archive Catalogue Display
- Same display for tagging event data for historic events and later use (e.g. WaterCoach)

The screenshot shows the HyFS-DEV (Operator Client) interface. The top menu bar includes File, Tools, Options, and Help. Below the menu is a toolbar with various icons. The main window is divided into two panes. The left pane, titled 'Forecast Tree', contains a list of items numbered 1 through 6. The right pane, titled 'event properties', contains a form for creating or editing an event. The form includes a dropdown menu for 'area' (set to 'NSW Bellinger and Nambucca'), input fields for 'start time' (25-03-2015 15:45:00) and 'end time' (30-03-2015 15:45:00), a dropdown for 'event type' (set to 'Flood Event'), and text boxes for 'name' (minor Surge flood) and 'description' (minor event). Below the form is a table with the following data:

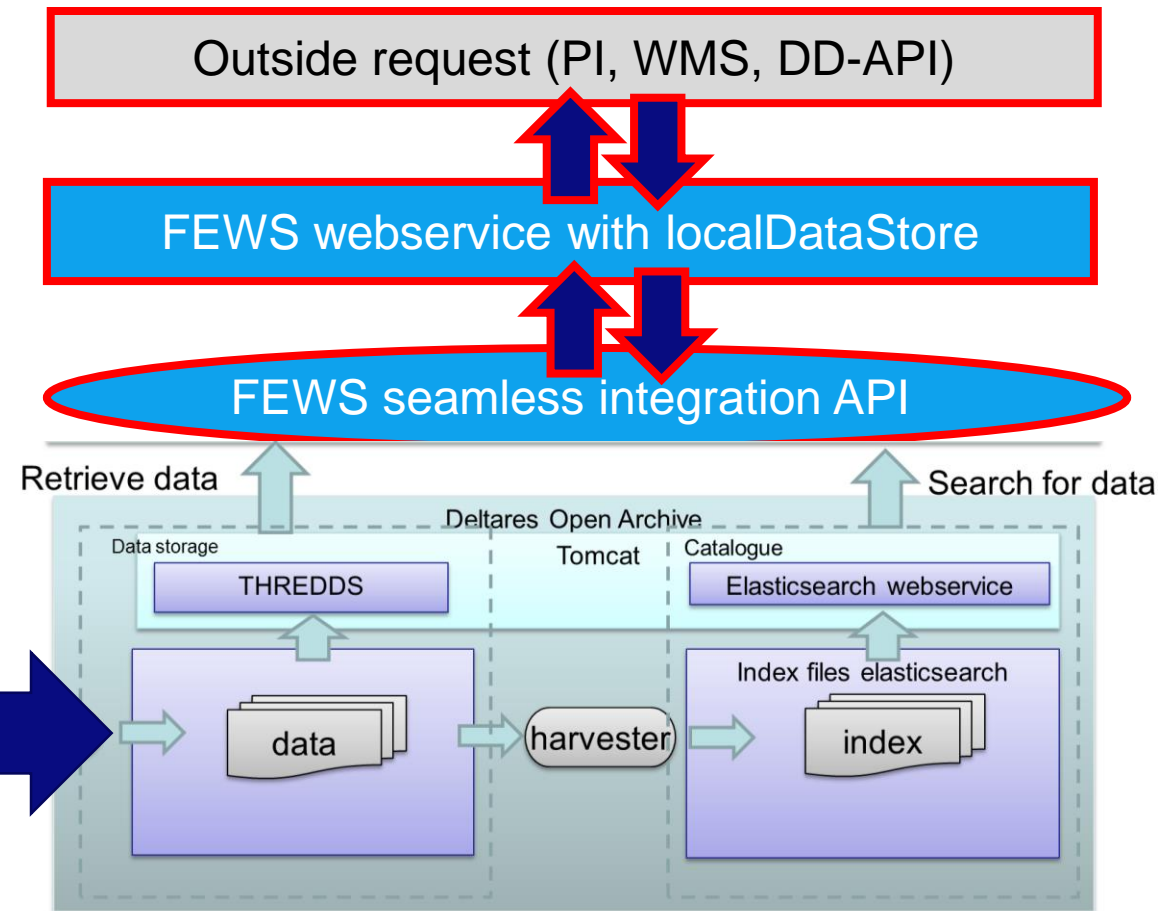
name	description	creation time	start time	e
minor Surge flood	minor event	30-03-2015 16:25:37	25-03-2015 15:45:00	30
Test Water Coach	Test Water Coach	24-03-2015 10:03:12	18-02-2015 12:00:00	28
test Historic Event	test Historic Event	23-03-2015 17:57:29	17-02-2015 17:45:00	27
test	test	23-03-2015 16:43:32	01-03-2015 13:00:00	23

The FEWS Open Archive – How?

Dissemination with **webservices** coupled **directly** to Open Archive

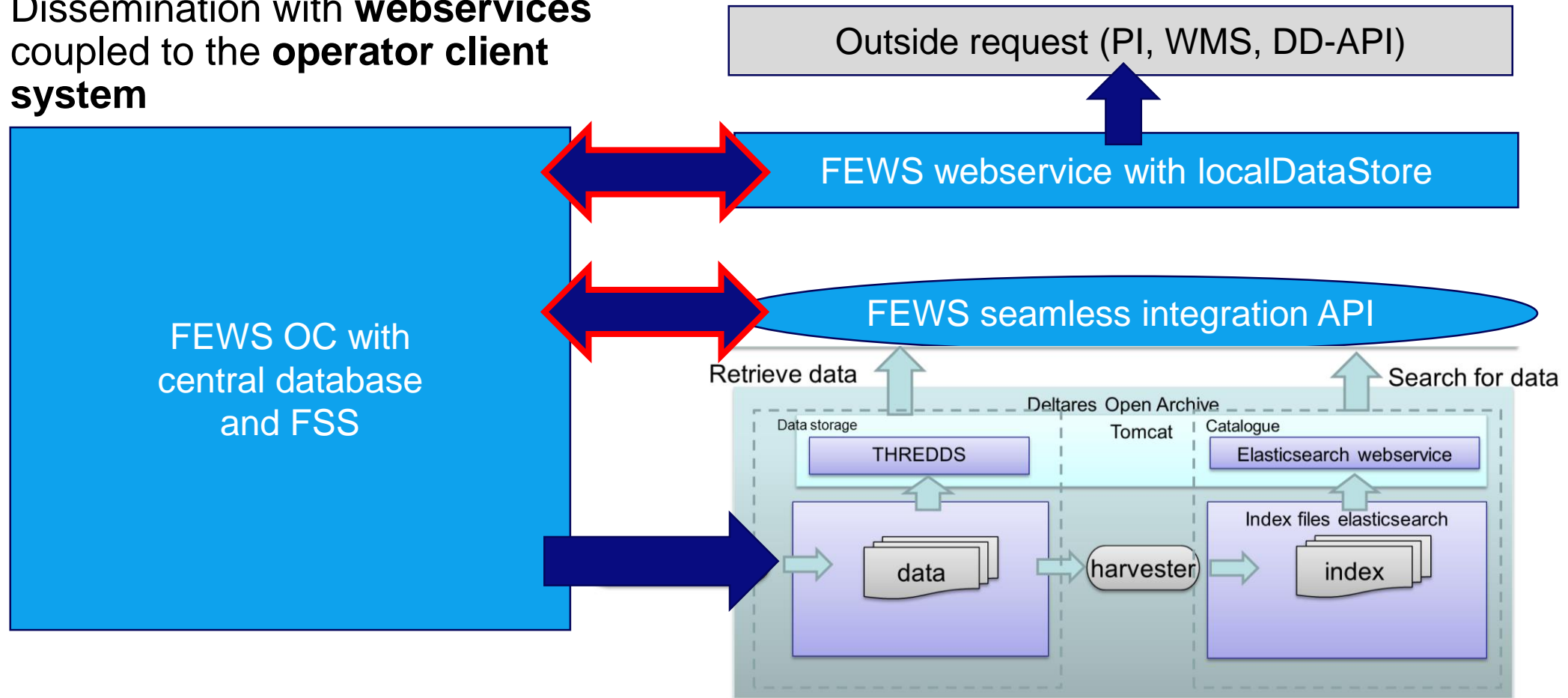
Not only **read**, but also **write** to the archive

FEWS OC with central database and FSS



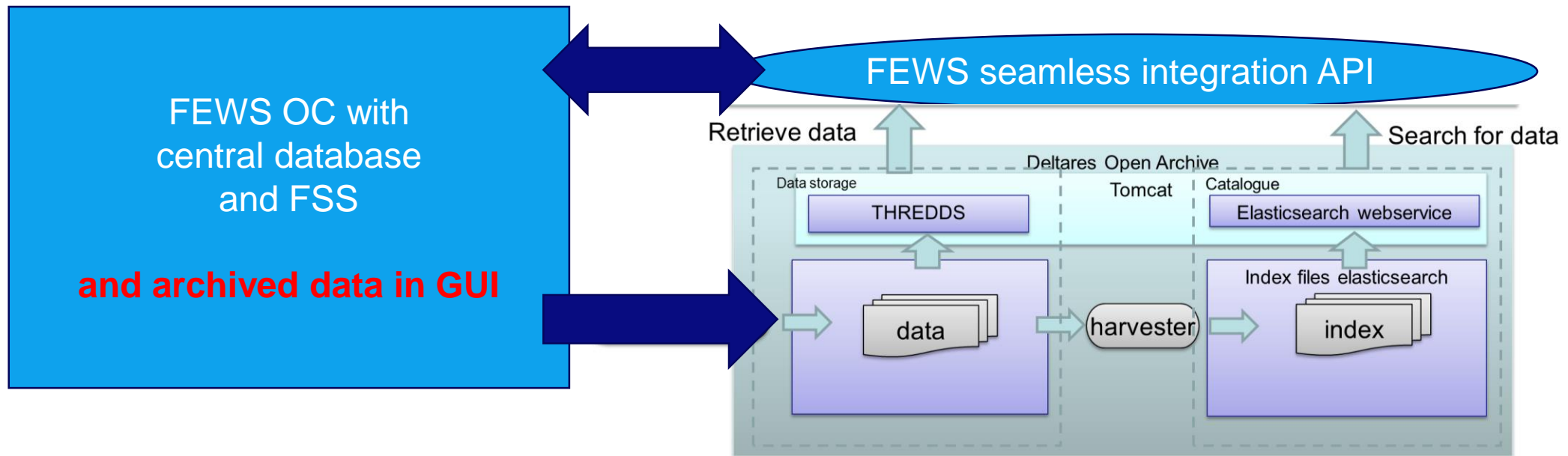
The FEWS Open Archive – How?

Dissemination with **webservices** coupled to the **operator client system**



The FEWS Open Archive – How?

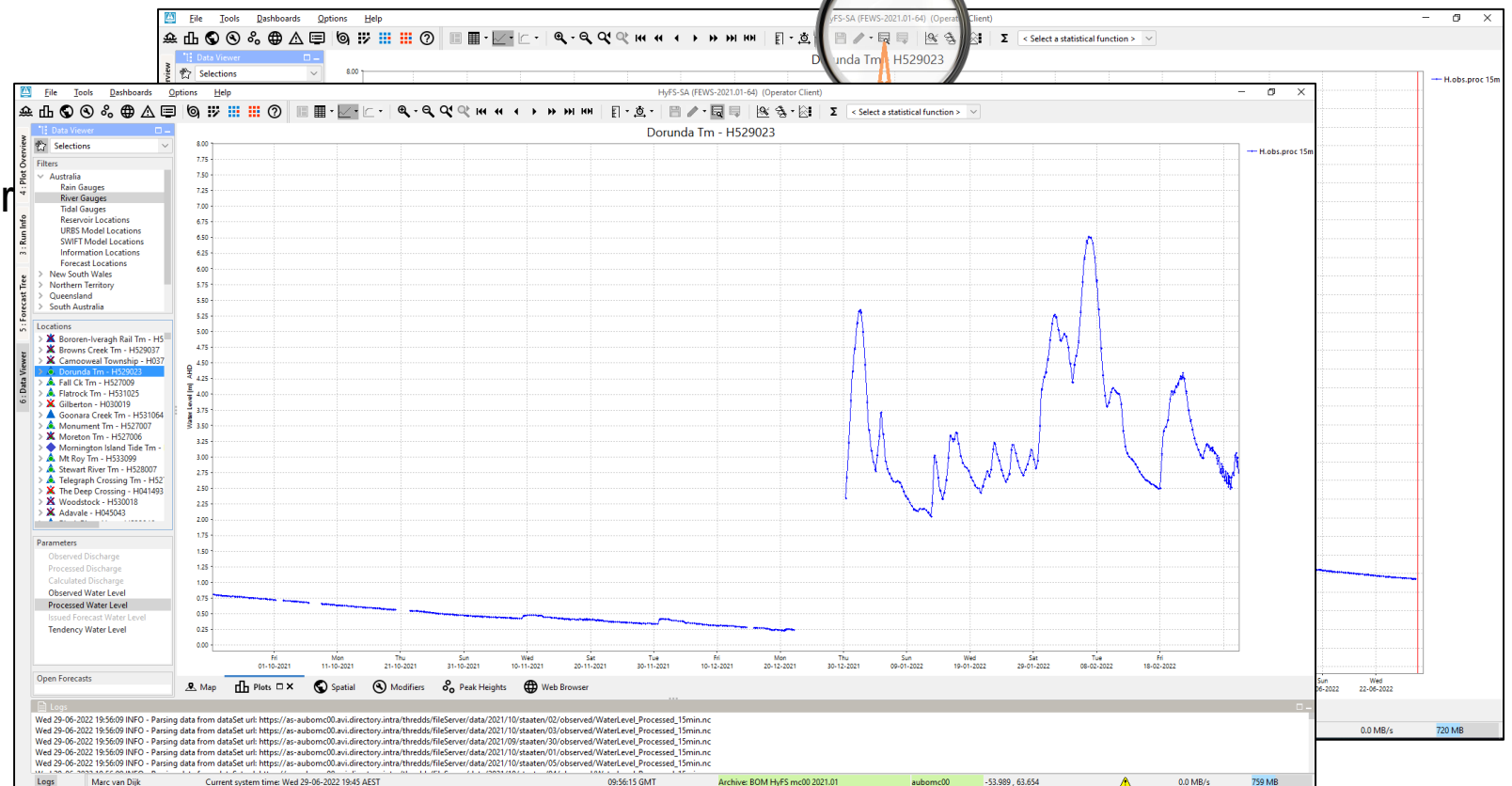
Seamless integration of
historical data usable in the OC



The FEWS Open Archive – How?

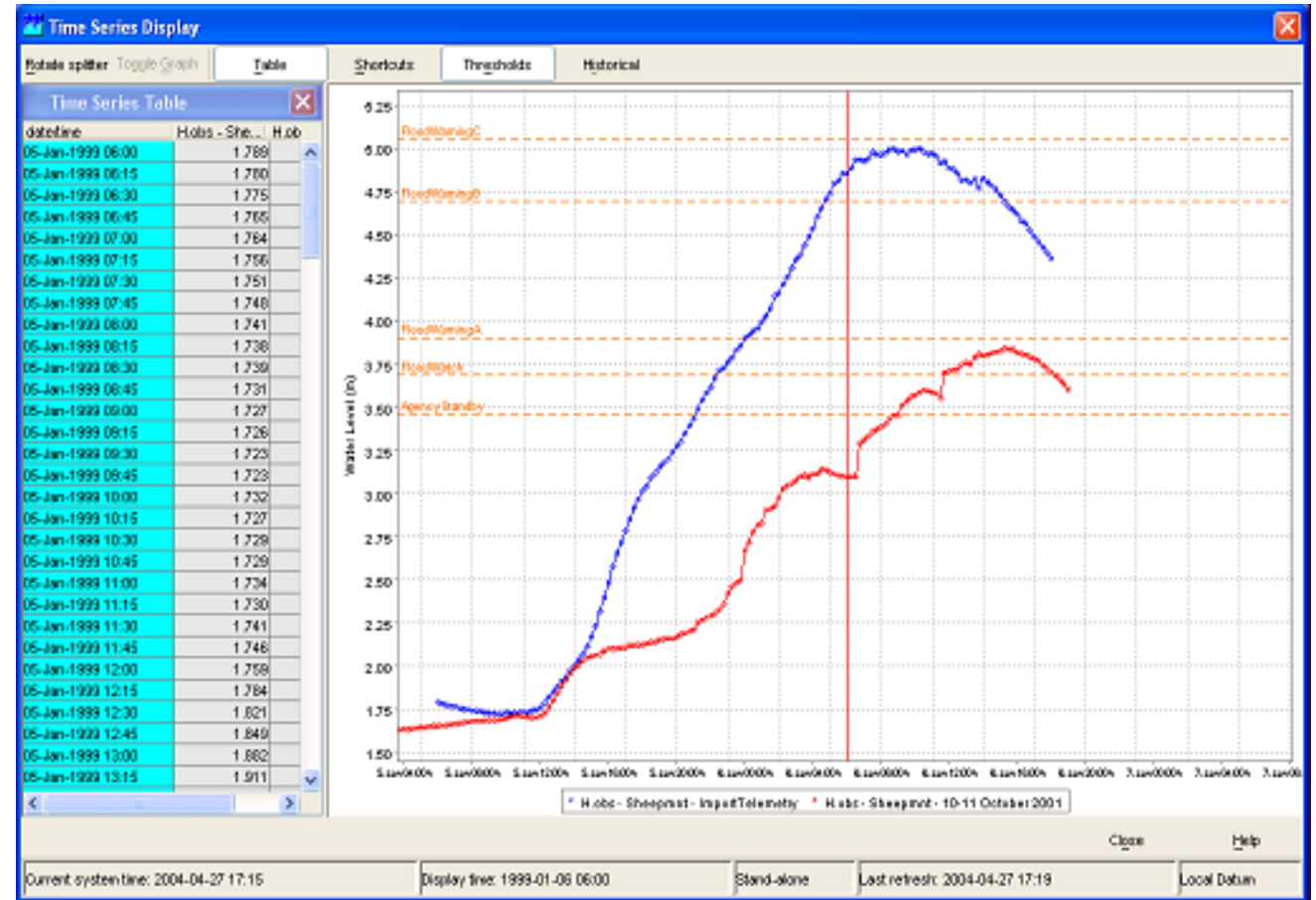
Seamless integration with the FEWS GUI

- [Time series display](#)
- [Grid Display](#)
- [Workflows](#)
(downloadMissingDataFromArchive)



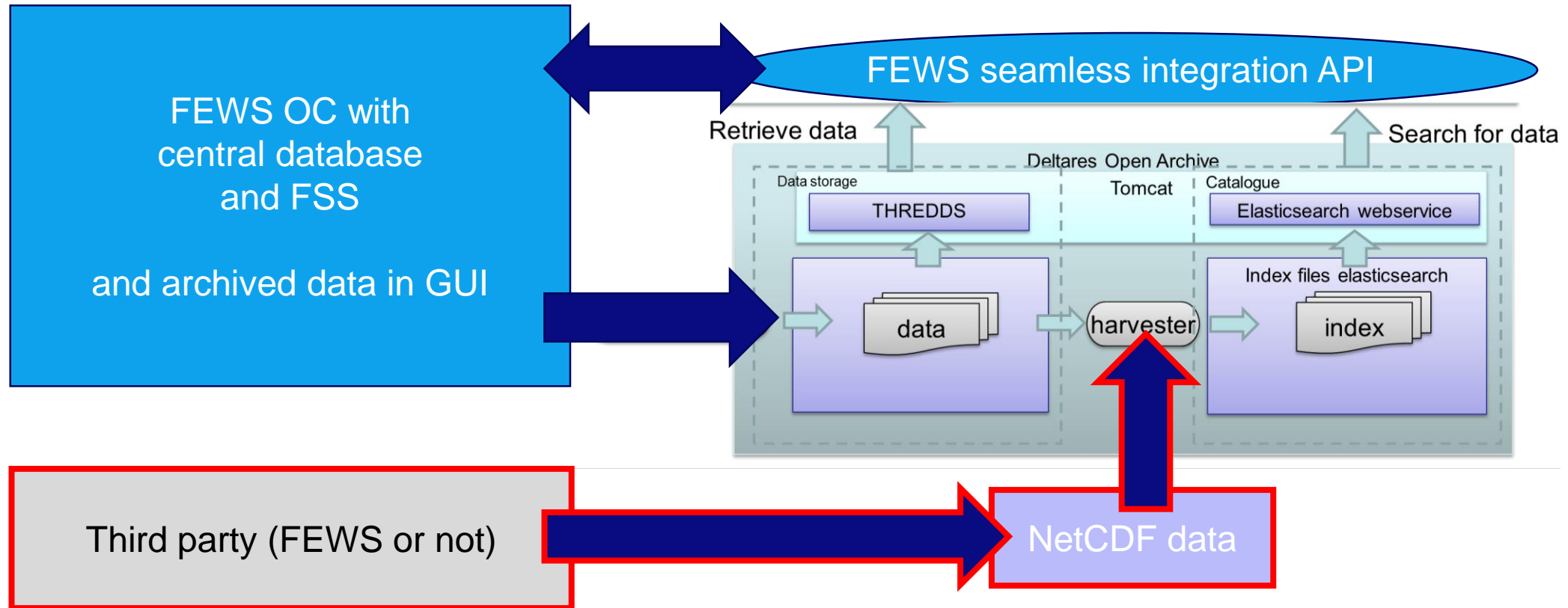
The FEWS Open Archive – How?

Display **historic events** in the **FEWS GUI**



The FEWS Open Archive – How?

Recent developments: **external NetCDF storage**



The FEWS Open Archive – How?

Recent developments: **external NetCDF storage**

- NetCDF files must be **CF 1.6 compliant**
- Files are **stored 'locally'** on disk with read access for archive server (harvester+catalogue)
- **Metadata** from files can be **put into the catalogue**
- Dissemination of data following **same protocols** as existing archive
- No need to also have a FEWS archive
- **Seamless integration works the same** as for the FEWS archive
- **Archive Catalogue Display works the same** as for the FEWS archive

Third party (FEWS or not)

FEWS se

Retrieve data

Data storage

THREDDS

data

NetCDF data

Background of Delft-FEWS

Architecture and Components

Deltares Open Archive

- Deltares Open Archive: Technical background
- Deltares Open Archive and Delft-FEWS
- › Deltares Open Archive and third party application
- › Deltares Open Archive - Admin Console User Guide
- › Deltares Open Archive management

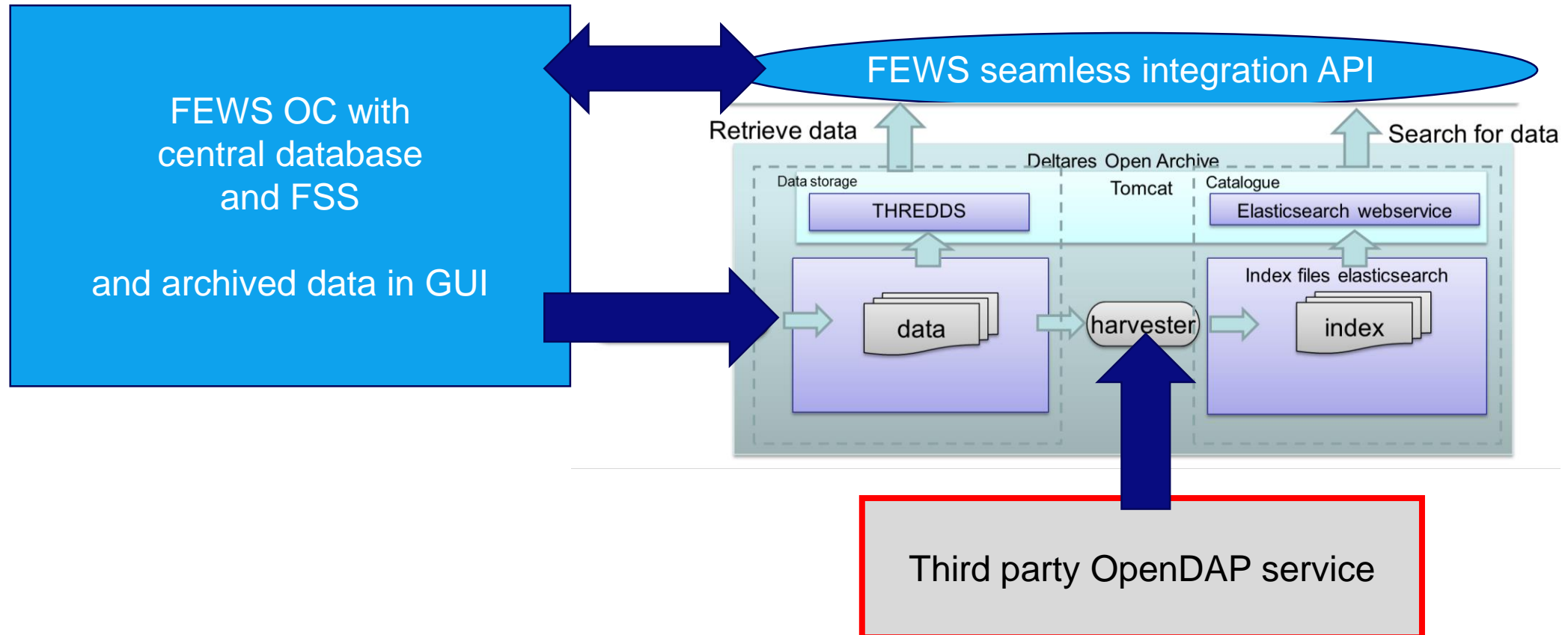
Extensions for the Deltares Open Archive

- Alternative to file-based storage - Archive data
- **External netcdf storage**

Water Coach

The FEWS Open Archive – How?

Recent developments: **leverage OpenDAP**



The FEWS Open Archive – How?

Recent developments: **leverage OpenDAP**

- **OpenDAP** was implemented to **improve download and import performance**
- By-product: possibility to **harvest external OpenDAP services**

FEWS seamless integration API

Retrieve data

Search for data

Deltares Open Archive

Tomcat

Catalogue

THREDDS

Elasticsearch webservice

data

harvester

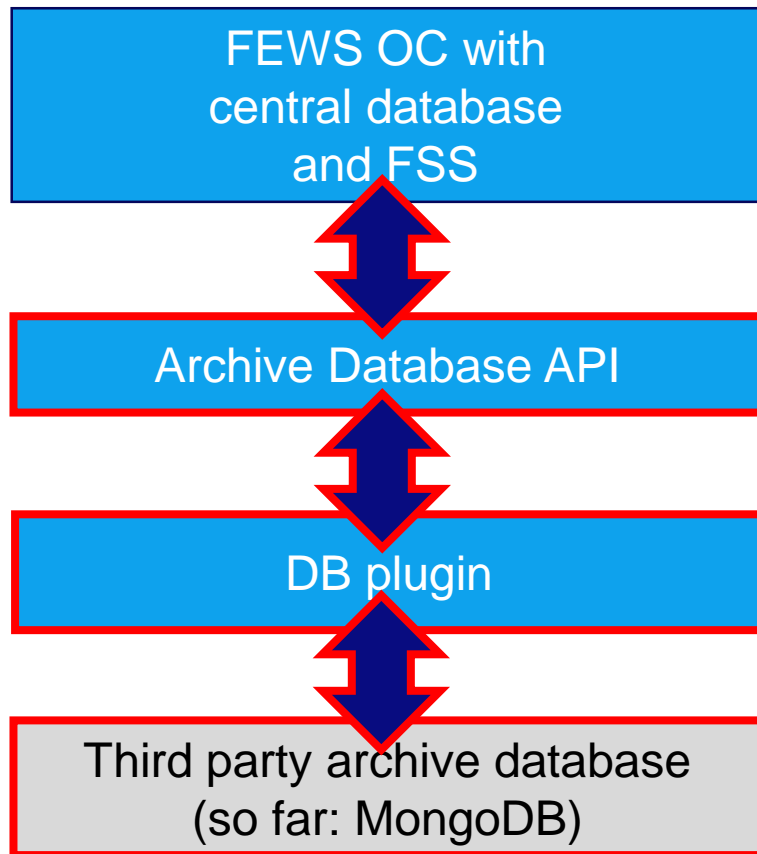
index

Index files elasticsearch

Third party OpenDAP service

The FEWS Open Archive – How?

Recent developments: **connecting an archive database**



- **Adapter approach:** first flavor is **MongoDB**, but adapters can be made for other databases like WISKI, Aquarius, Hadoop, any SQL type
- **MongoDB:** very powerful for **scalar timeseries** and can be coupled to analysis software like Tableau, SRRS, or PowerBI
- **Importing** and **exporting** possible; other software **can edit the database too.**
- **Dedicated data panel**
- **Seamless integration with GUI**

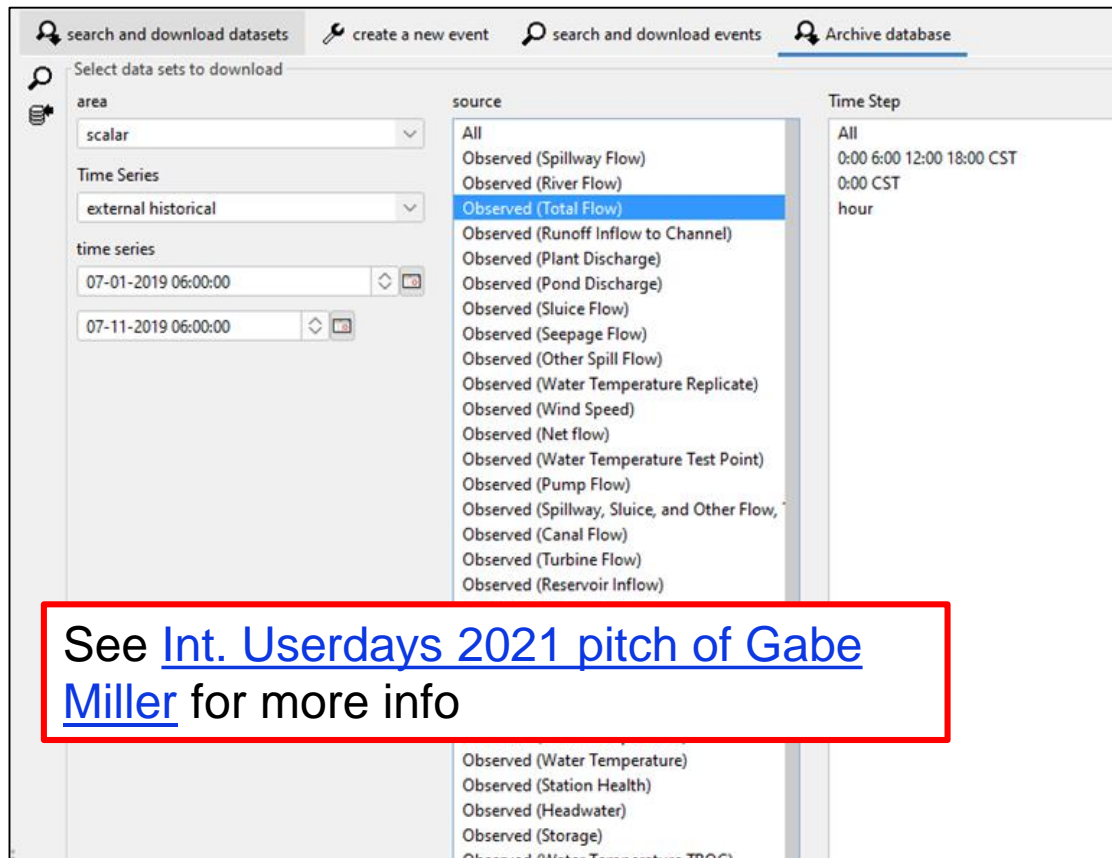
The FEWS Open Archive – How?

Recent developments: **connecting an archive database**

▼ Extensions for the Deltares Open Archive

- Alternative to file-based storage - Archive data
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► Water Coach



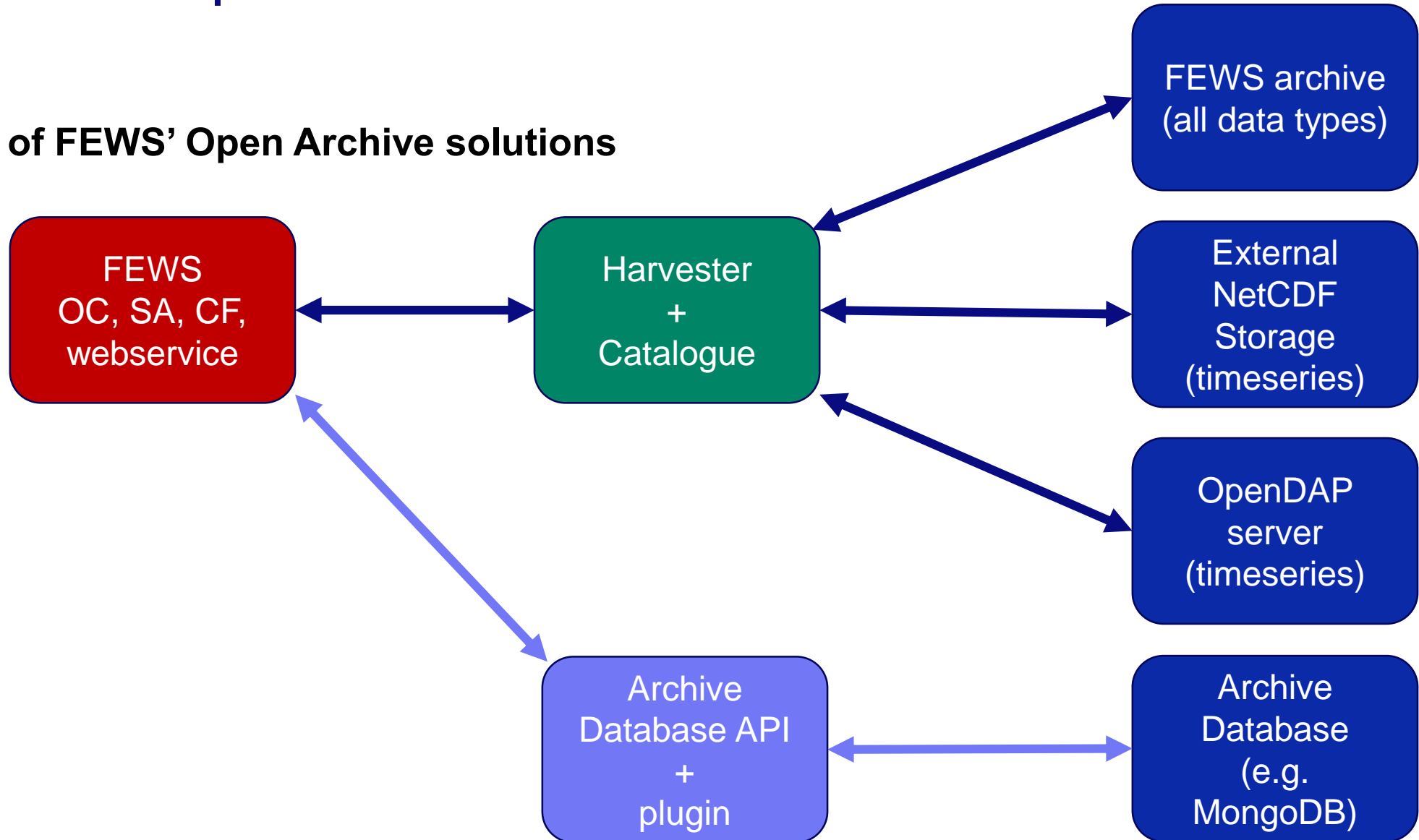
See [Int. Userdays 2021 pitch of Gabe Miller](#) for more info

Benefits

1. no harvester (for scalar data)
2. data integrity checks
3. fast analysis

The FEWS Open Archive – How?

Summary of FEWS' Open Archive solutions



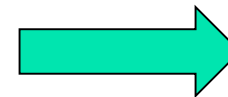
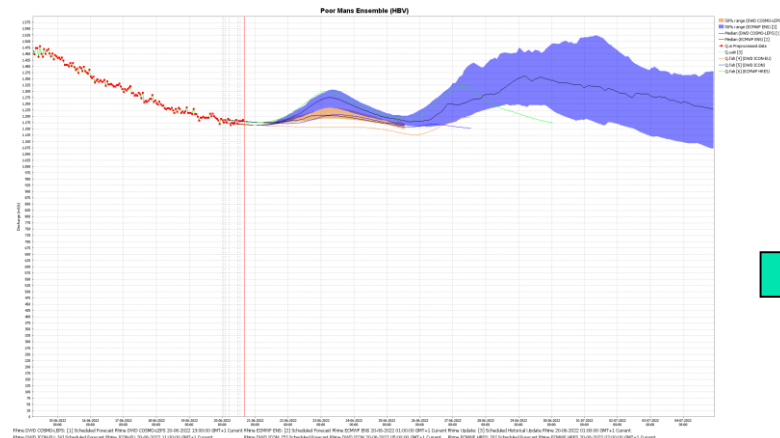
The FEWS Open Archive – Highlight 1

Automatic and collaborative reporting at Rijkswaterstaat

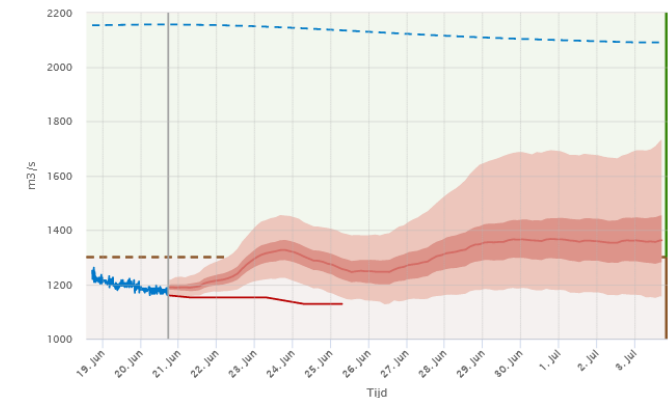
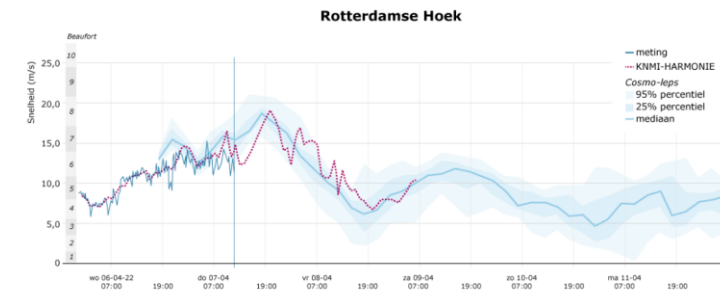
Problem

- Collaboration on reports during events is
 - Too cumbersome
 - Error prone (data selection from FEWS by hand)
 - FEWS' graphs not readable enough
 - Little possibility to change format if desirable
 - Not traceable

*Collaboration of
Deltares (Tom Bogaard)
and Vortech*



Vanuit het westen (beginnend naar WZW, ruimend naar West) wordt een windveld verwacht dat rond 14.00u op het IJsselmeer zijn piek bereikt en ongeveer 2 uur zal aanhouden. Dit windveld heeft een kracht van 8 Bft (17-19 m/s). In de loop van de middag neemt de windkracht af tot rond 6 Bft.

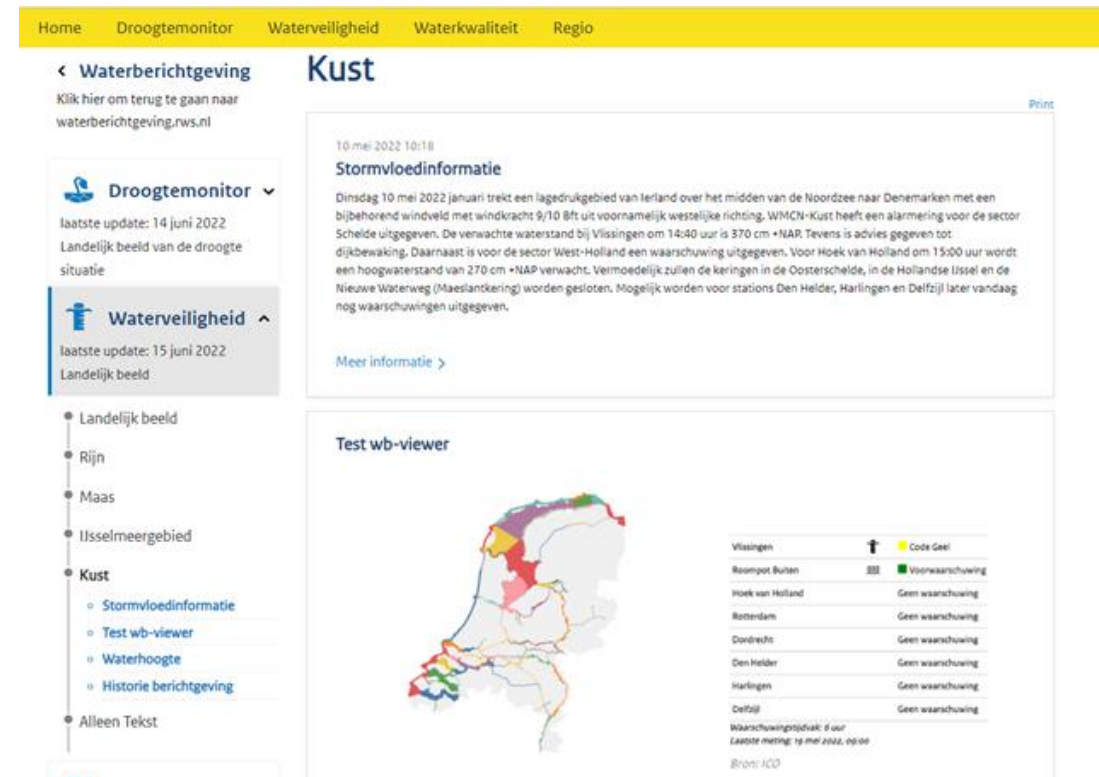


The FEWS Open Archive – Highlight 1

Automatic and collaborative reporting at Rijkswaterstaat

Goals

- **Harmonize way of working** and **report look&feel** for the **different forecasting groups**
- **Prevent copy+paste** as much as possible
- Data and reporting are **traceable**
- Align style with new info and data website



The FEWS Open Archive – Highlight 1

Automatic and collaborative reporting at Rijkswaterstaat

FEWS Product Service



/archive/products

file:



parameters:

key	value
timeZero	2021-06-21T08:00:00Z
attribute(product_id)	Hoogwaterbericht Maas
attribute(source_id)	RWS
attribute(status)	draft
...	

Product



Metadata



- onderdeel van Fews Archief
- centrale plaats voor aanlevering
- gearhiveerd / traceerbaar



/archive/products

- timeZero (tijd van uitgifte)
- Laatste actuele bericht
- Specifieke versie van een eerder bericht



/archive/productsmetadata

- Lijst met beschikbare producten
- Binnen een bepaalde tijdperiode
- Filteren op metadata

The FEWS Open Archive – Highlight 1

Automatic and collaborative reporting at Rijkswaterstaat

Steps

1. FEWS exports inputs as much as possible (data, graphs, tables)
2. Operators iterate in web interface:
 1. Add text
 2. Add additional graphs
 3. Set status (draft / final)
3. Store new version in Open Archive
→ Full report as well as separate components get separate Id's

B
I
U

lsector-flevopolder-status

@dinsdag 21 jun. 08:48

#1

Sector Flevopolder

Kleurcode groen

Dijkvak: kleurcode groen

Buitendijkse gebieden: kleurcode groen

Kunstwerken: kleurcode geel

Meteoverwachting

lsector-flevopolder-meteobeeld

@dinsdag 21 jun. 08:48

#1

Vanuit het westen (beginnend **WZW**, ruimend naar **West**) wordt een windveld verwacht dat rond **14.00u** op het IJsselmeer zijn piek bereikt en ongeveer 2 uur zal aanhouden. Dit windveld heeft een kracht van **8 Bft** (17-19 m/s). In de loop van de middag neemt de windkracht af tot rond **6 Bft**.

$$F_x = \frac{1}{\rho} \frac{\partial \tau_x}{\partial z}$$

$$F_y = \frac{1}{\rho} \frac{\partial \tau_y}{\partial z}$$

Algemeen waterbeeld

lsector-flevopolder-waterbeeld

@dinsdag 21 jun. 08:48

#1

De westenwind in combinatie met het licht verhoogde **IJsselmeerpeil** (rond -0.1 m NAP) zorgt voor **verhoogde waterstanden in het oostelijke deel van het IJsselmeer**. Dit leidt voor onderstaande kunstwerken tot het bereiken van waarschuwniveaus.

lsector-flevopolder-status-tabel

@dinsdag 21 jun. 08:48

#1

Beheerder	Code	Locatie	Overschrijding eerste criterium		Criterium	Drempelwaarde	Max waarde
			Tijdstip	Duur			
WSZZL	Geel	Ketelsluis	2022-04-08 00:00	4	WS	0,23	0,32

The FEWS Open Archive – Highlight 1

Automatic and collaborative reporting at Rijkswaterstaat

Data editing can be very flexible!

Example: probability of exceedance table per lead time

Kanstabel debiet

LOBITH ST. PIETER

HANDLEIDING

Trend

HERSTEL STANDAARDINSTELLINGEN

Cox-Stuart test

Significantie

✓ 95

%

Minimale trend

Limietwaarde

↗ ± 5

m³/s / dag

Overschrijdings-/onderschrijdingskansen

Limietcategorieën

⚠ Langjarig maandgemiddelde ✕

☒ Overschrijdingskansen

☐ Onderschrijdingskansen

KOPIEER NAAR KLIPBORD

AANPASSEN

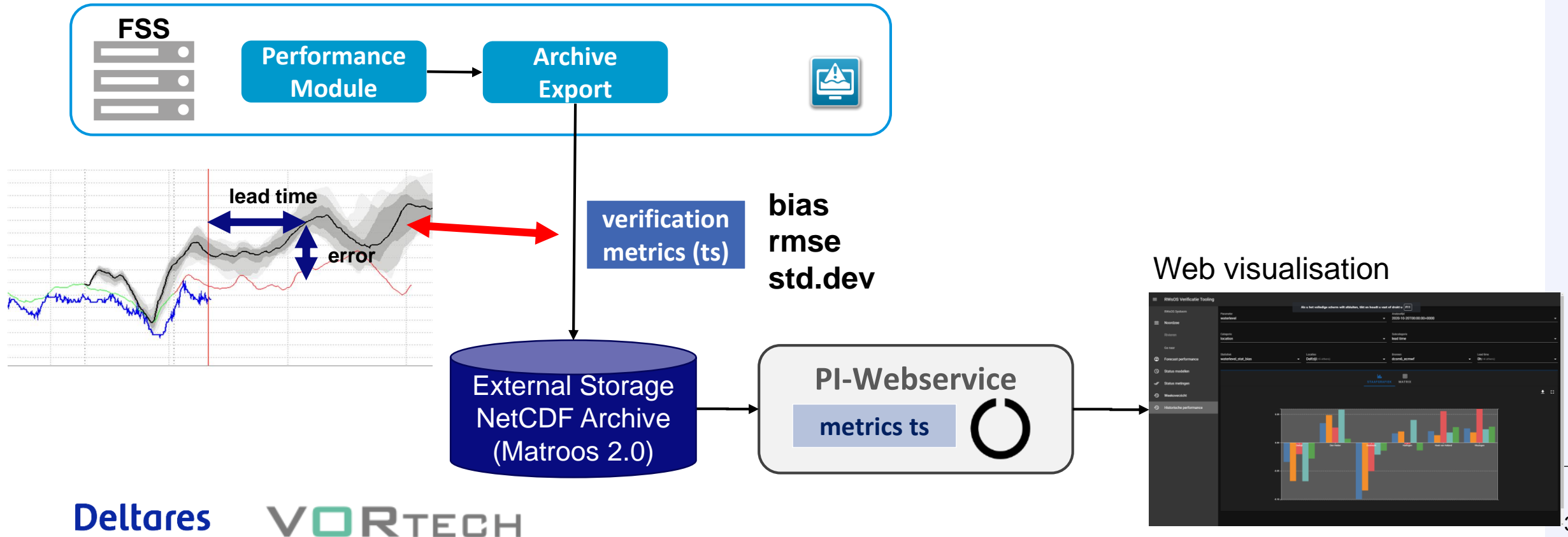
☒ TOON EXTRA LIMIETEN

Komende...	5 dagen					6 tot 10 dagen			11 tot 15 dagen		
	do 16 jun.	vr 17 jun.	za 18 jun.	zo 19 jun.	ma 20 jun.	di 21 jun.	t/m	za 25 jun.	zo 26 jun.	t/m	do 30 jun.
Verwachte afvoer [m³/s]	1335	1315	1270	1245	1220	↑	1225 – 1550			1290 – 1585	
Overschrijdingskans [%]:											
Q > 1800 m³/s	0		0		0		10			10	
Q > 1700 m³/s	0		0		0		15			15	
Q > 1600 m³/s	0		0		0		20			25	
Q > 1500 m³/s	0		0		0		30			35	

The FEWS Open Archive – Highlight 2

Model and forecast verification at Rijkswaterstaat

1. Statistics are computed in OC, and exported to an External NetCDF Storage
2. Lightweight website queries FEWS webservice for metadata and data



The FEWS Open Archive – Highlight 1

Model and forecast verification at Rijkswaterstaat

- Example diagrams



The FEWS Open Archive – Highlight 1

Model and forecast verification at Rijkswaterstaat

Planned next steps

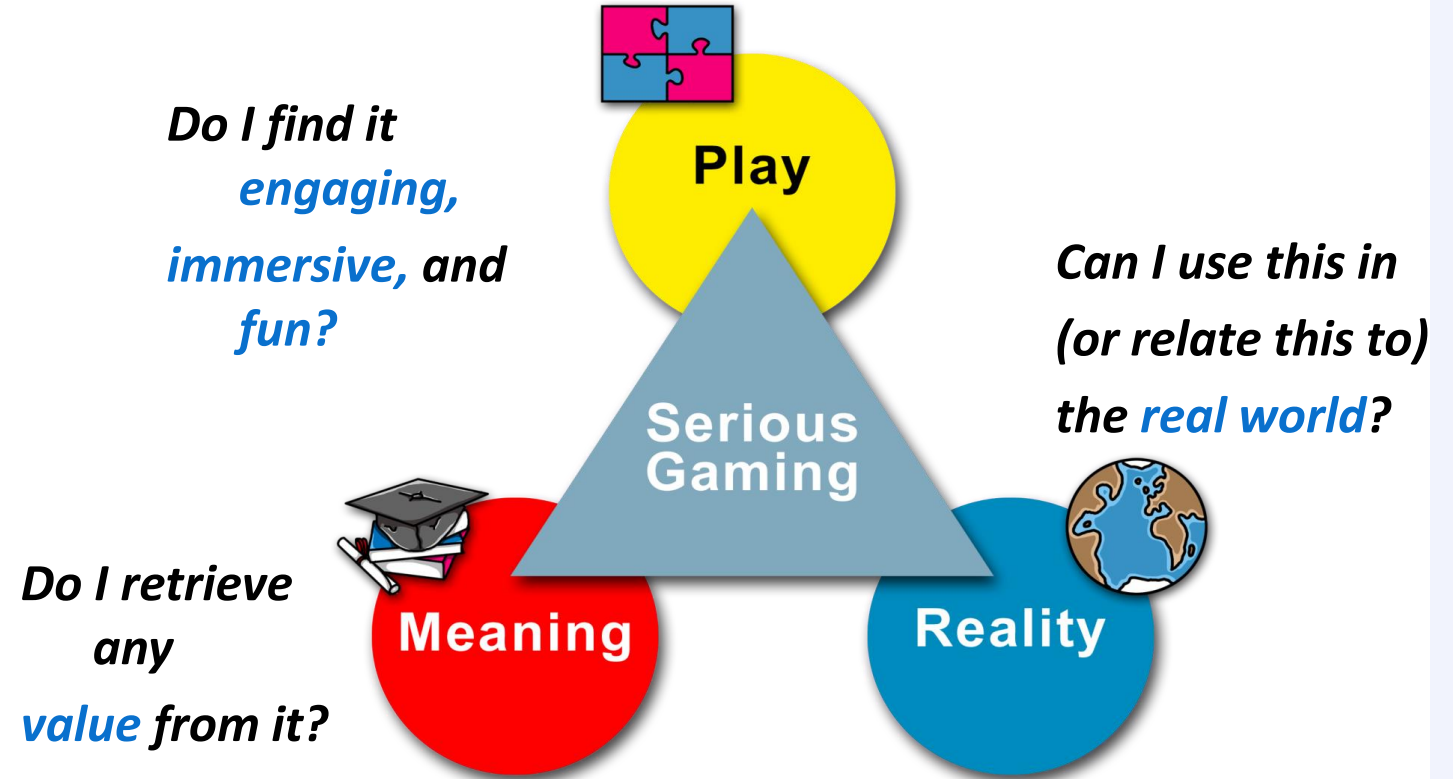
- GOAL: Verify ensemble forecasts stored in the archived
- Use FEWS' General Adapter + Python + [EVS](#) software for the analysis
- Scheduled regularly to produce raw metrics and diagrams
- Dissemination using the automatic and collaborative reporting web interface

The FEWS Open Archive – Desired developments

- Align with Web-OC developments:
 - Web-interface for searching, selecting (and tagging)
 - Leverage same visualization code on archived data
- Improve archive maintenance tooling

WaterCoach, a FEWS serious game

- Introduction
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Detailed info and course material: <https://publicwiki.deltares.nl/display/FEWSDOC/Water+Coach>

WaterCoach – what is it?

Delft-FEWS and WaterCoach arranged side by side

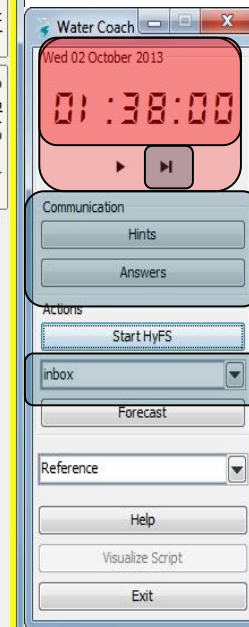
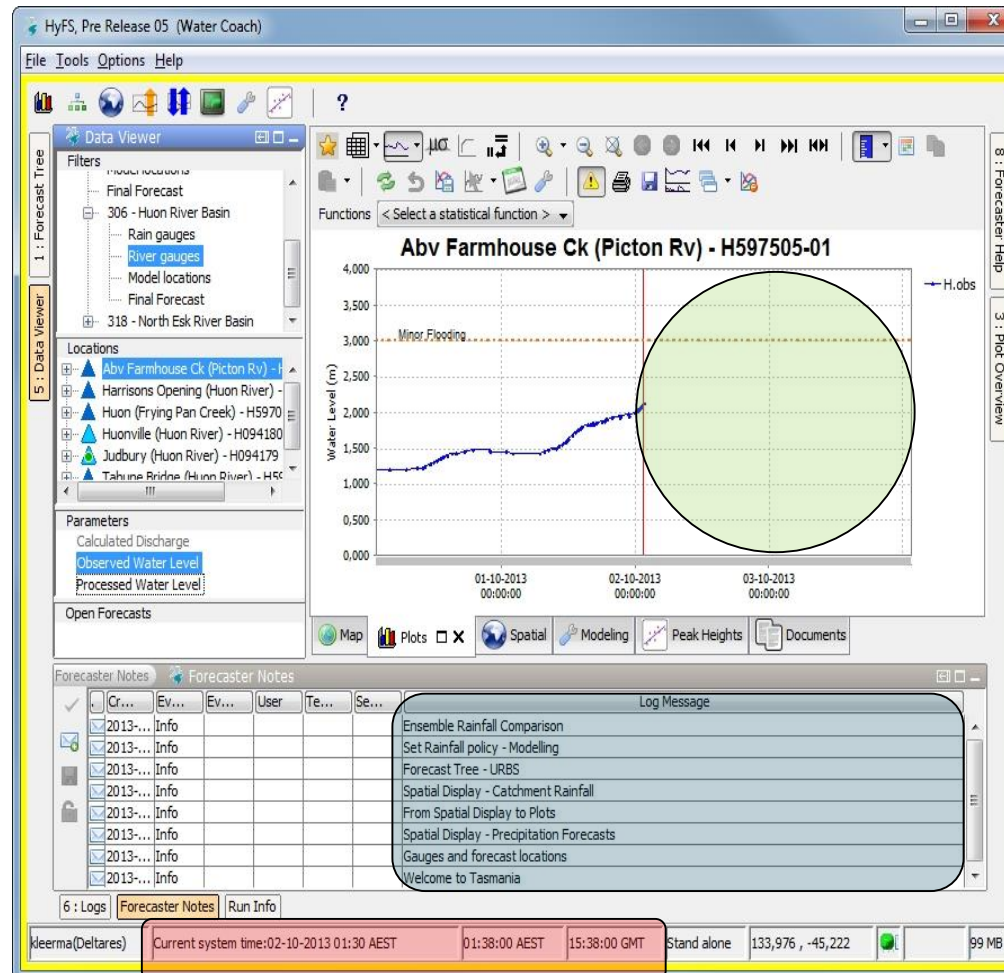
Yellow border = Training Mode

System Time is dictated by WaterCoach

Observations in “the future” are hidden

WaterCoach sends messages to Forecaster Notes

Water Coach (clock) always on top



WaterCoach – what is it?

WaterCoach can be used in a

- Exercise (team)
 - Script not required (or at least not the focus)
 - Focus on team interaction, communication with externals
- Training (individual)
 - Both scenario and script need to be developed
 - Focus on training skills, content, procedures



WaterCoach – relation with Open Archive

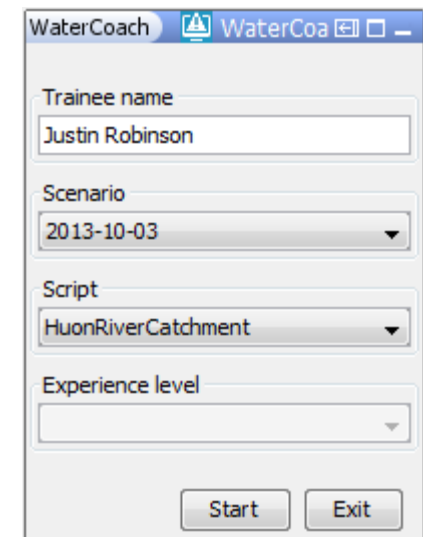
A **scenario** consists of data, preferably **realistic** data

The FEWS Archive Catalogue Displays can be helpful here; steps:

1. **Tag an event** in the OC; relevant data is marked in the catalogue
2. Open an **SA with empty localDataStore**
3. **Select the event** and **import the data**

Next steps:

4. Make a **script** (XML); can be just exercise title, start and end time
5. **Store** script with configuration and localDataStore in dedicated **folder structure**
6. Open WaterCoach panel and select the script of interest



WaterCoach – new developments

Finished:

- Data in external NetCDF storage can be tagged together with FEWS archive data

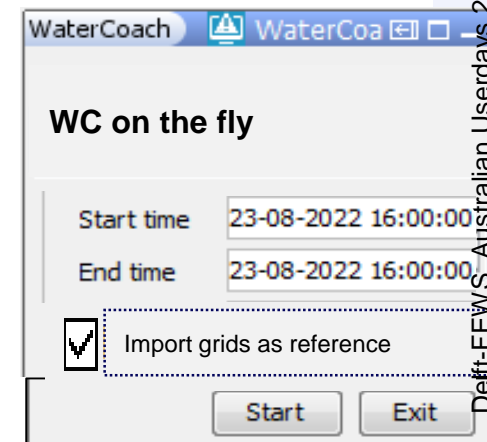
Planned:

- 1) WaterCoach-on-the-Fly (enter start+stop times and let FEWS do steps 1-6)

User Story: quickly load WC with empty script for training or event analysis

- 2) Add option to import grids as reference only

User Stories: fast starting of WC-on-the-Fly, and use for large (offline) analyses (computational framework)



Summary

FEWS' Open Archive opens up many ways to **learn from the past, e.g.**

- Training (WaterCoach)
- Verification
- Event analysis
- Etc.

FEWS' Open Archive with **webservices** can facilitate **lightweight, interactive web front-ends** for **dissemination, analysis and collaboration**

Contact

-  www.delft-fews.com
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Thank you for your attention

Looking forward to your questions and feedback

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