Incident Management Forecasting System: JBA-led elements

Delft-FEWS User Days Nov 2022

www.jbaconsulting.com

Email

Date

Two key parts:

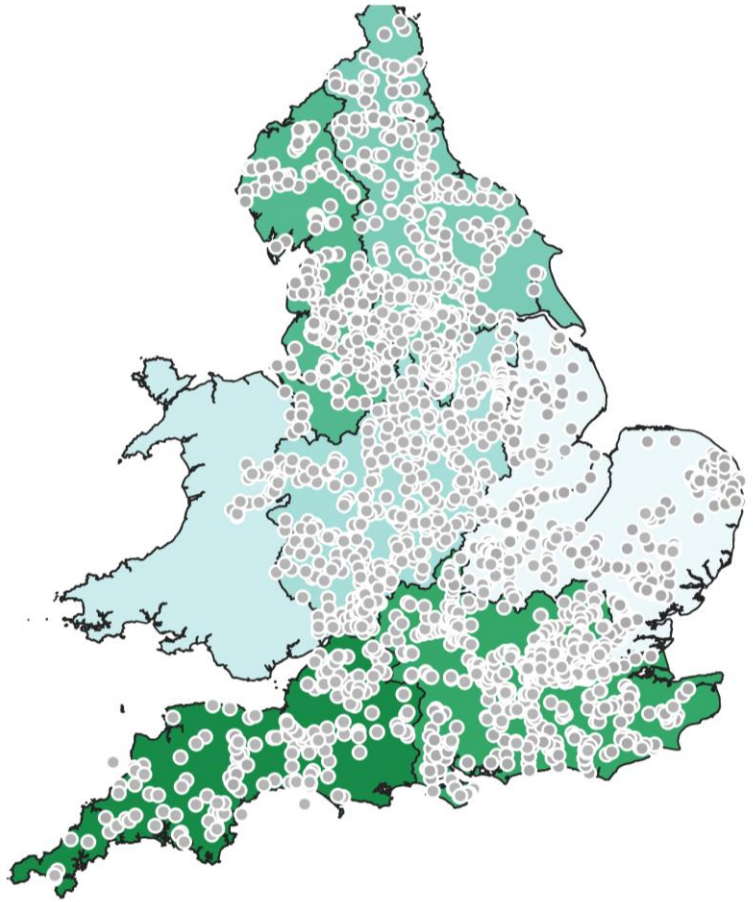
- Incident Management Reference Database (IMRD)
- Performance testing module

Environment Agency's Vision

A nationally consistent *service* delivering:

- Probabilistic forecasts
- Flood extents
- Greater coverage
- Model as *assets* (condition/performance)

What's holding things back?



- 7 FEWS systems, configured differently
- Old hardware
- 4 River & 5 RR model types
- Different ways of working

Solution: Massive change!

Incident
Management
Forecasting
System

England

PDM

Microsoft Azure

FMP

Consistent working practices

System configuration

ISIS_UpperCherwell_GA_Historical_1 1.01 default.xml

```
<?xml version="1.0" encoding="UTF-8"?>
<!-- edited with XMLSpy v2009 sp1 (http://www.altova.com) by Environment Agency (Capgemini UK plc) -->
<!--NFFS Thames-->
<!-- added by JBA Consulting (May 2014) for the Cherwell Improvements project (JBA Ref: 2013s7532) -->
<generalAdapterRun xmlns="http://www.wldelft.nl/fews" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://www.wldelft.nl/fews http://fews.wldelft.nl/schemas/version1.0/generalAdapterRun.xsd">
    <general>
        <description>ISIS Model run for the Upper Cherwell to Banbury Historical</description>
        <rootDir>%REGION_HOME%/Modules/ISIS/UpperCherwell</rootDir>
        <workDir>%ROOT_DIR%/_working_folder_</workDir>
        <exportDir>%ROOT_DIR%/UpperCherwell_Input</exportDir>
        <exportIdMap>IdISIS_UpperCherwell_Export</exportIdMap>
        <importDir>%ROOT_DIR%/UpperCherwell_Output</importDir>
        <importIdMap>IdISIS_UpperCherwell_Import_Historical</importIdMap>
        <dumpFileDir>$GA_DUMPFILEDIR$</dumpFileDir>
        <dumpDir>%ROOT_DIR%</dumpDir>
        <diagnosticFile>%ROOT_DIR%/UpperCherwell_Diagnostics/diagnostics.xml</diagnosticFile>
        <convertDatum>true</convertDatum>
    </general>
    <burnInProfile>
        <length unit="hour" multiplier="12"/>
        <timeSeries>
            <parameterId>Q.merged</parameterId>
            <locationId>14_UCher_Ung1TH</locationId>
            <locationId>14_UCher_Ung2TH</locationId>
            <locationId>14_UCher_Ung3TH</locationId>
            <initialValue>0.100</initialValue>
        </timeSeries>
    </burnInProfile>
    <activities>
        <startUpActivities>
            <purgeActivity>
                <filter>%ROOT_DIR%/UpperCherwell_Input/*.*</filter>
            </purgeActivity>
            <purgeActivity>
                <filter>%ROOT_DIR%/UpperCherwell_Output/*.*</filter>
            </purgeActivity>
            <purgeActivity>
                <filter>%ROOT_DIR%/UpperCherwell_States/*.*</filter>
            </purgeActivity>
        </startUpActivities>
        <!-- Export activities -->
        <exportActivities>
            <!-- Export state (warm state)-->
            <exportStateActivity>
                <moduleInstanceId>ISIS_UpperCherwell_GA_Historical_2</moduleInstanceId>
                <stateExportDir>%ROOT_DIR%/UpperCherwell_States</stateExportDir>
                <stateConfigFile>%ROOT_DIR%/UpperCherwell_States/input.xml</stateConfigFile>
                <stateLocations type="file">
                    <stateLocation>
                        <readLocation>input.zzs</readLocation>
                        <writeLocation>output.zzs</writeLocation>
                    </stateLocation>
                </stateLocations>
                <stateSelection>
                    <warmState>
                        <stateSearchPeriod unit="hour" start="-72" end="-6"/>
                    </warmState>
                </stateSelection>
            </exportStateActivity>
            <!-- Export time series -->
```

FEWS Core Engine

- ✓ Familiar, mature, well proven
- ✓ Powerful
- ✓ Cloud compatible
- ✓ Very flexible

FEWS Core Engine

- ✓ Mature, well proven
- ✓ Powerful
- ✓ Cloud compatible
- × Very flexible

- × Scope for inconsistency
- × File based configuration
- × Skills gap
- × Maintenance time consuming

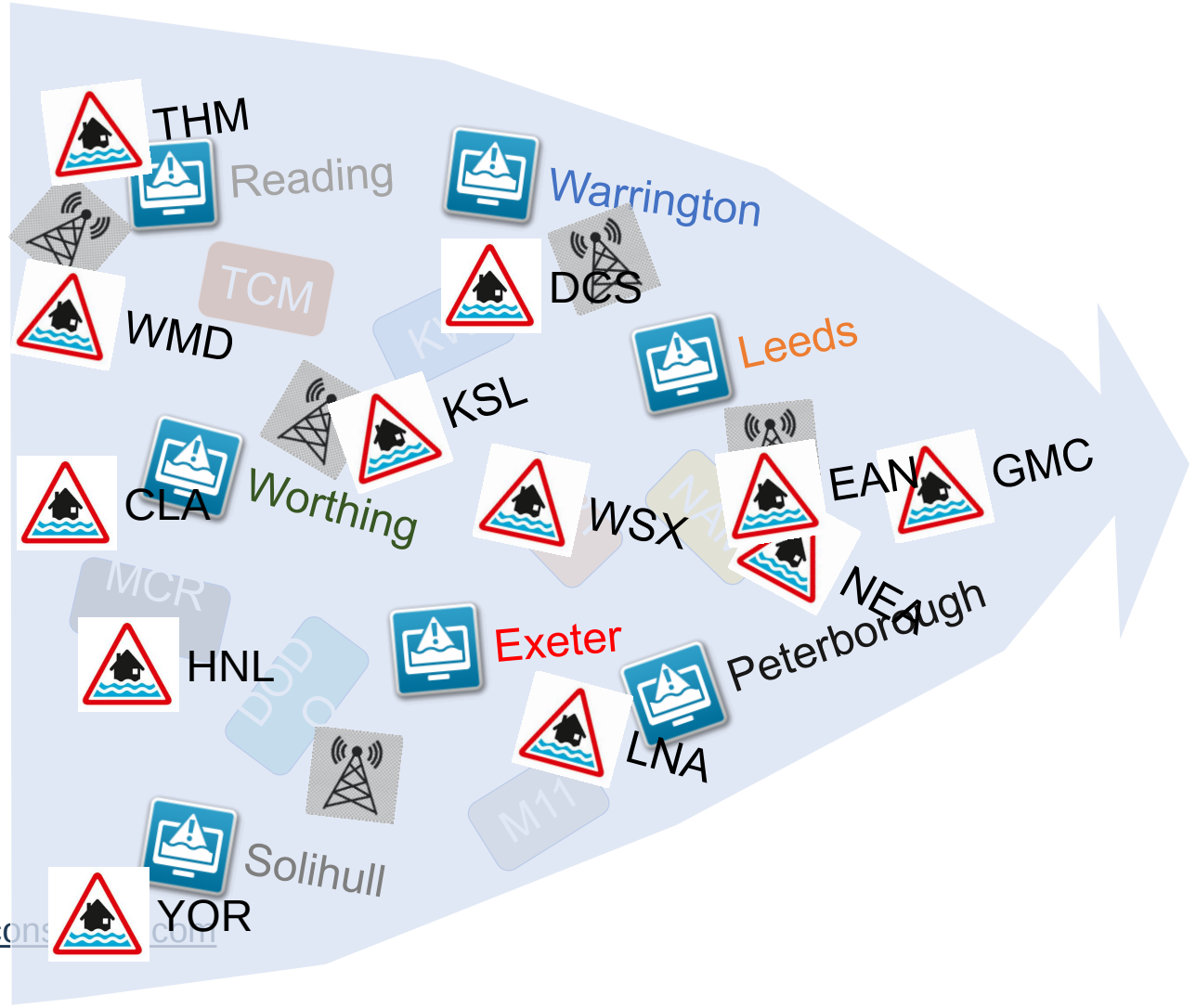
UN_CN_3	As a system administrator I need a system that is intuitively configurable with assistance/system tips in configuration being provided by the system (and contained in administrator documentation) so that we can develop and control our own modelling and forecasting capabilities efficiently.
UN_CN_4	As a system administrator I need to configure the system using an intuitive visual interface based on hydrology so that the risk of introducing errors into the system is minimised.
UN_CN_5	As a system administrator I need to complete routine configuration work that is defined by the Authority (such as threshold value changes) quickly and with minimal effort so that I don't have to take on testing or implementation activities that are too cumbersome for the change being made.
	As a system administrator I need to be able to configure both the content ...w
UN_CN_8	communicate to different audiences.
	As a system administrator I need to be able to configure an overview of high
UN_	...d...
	As a system administrator I need to be able to easily add new sources of input to the system (e.g. open data) so that data from these sources can be imported and viewed in the system, and used in models (where appropriate) ...nal involvement of the supplier.
UN_CN_11	...em administrator I need to be able to configure report templates that can be automatically populated with observed and forecast information from the system so that forecasters can be released to add value in other ways.

"Intuitive visual interface based on hydrology…"

"Configure quickly and with minimal effort"

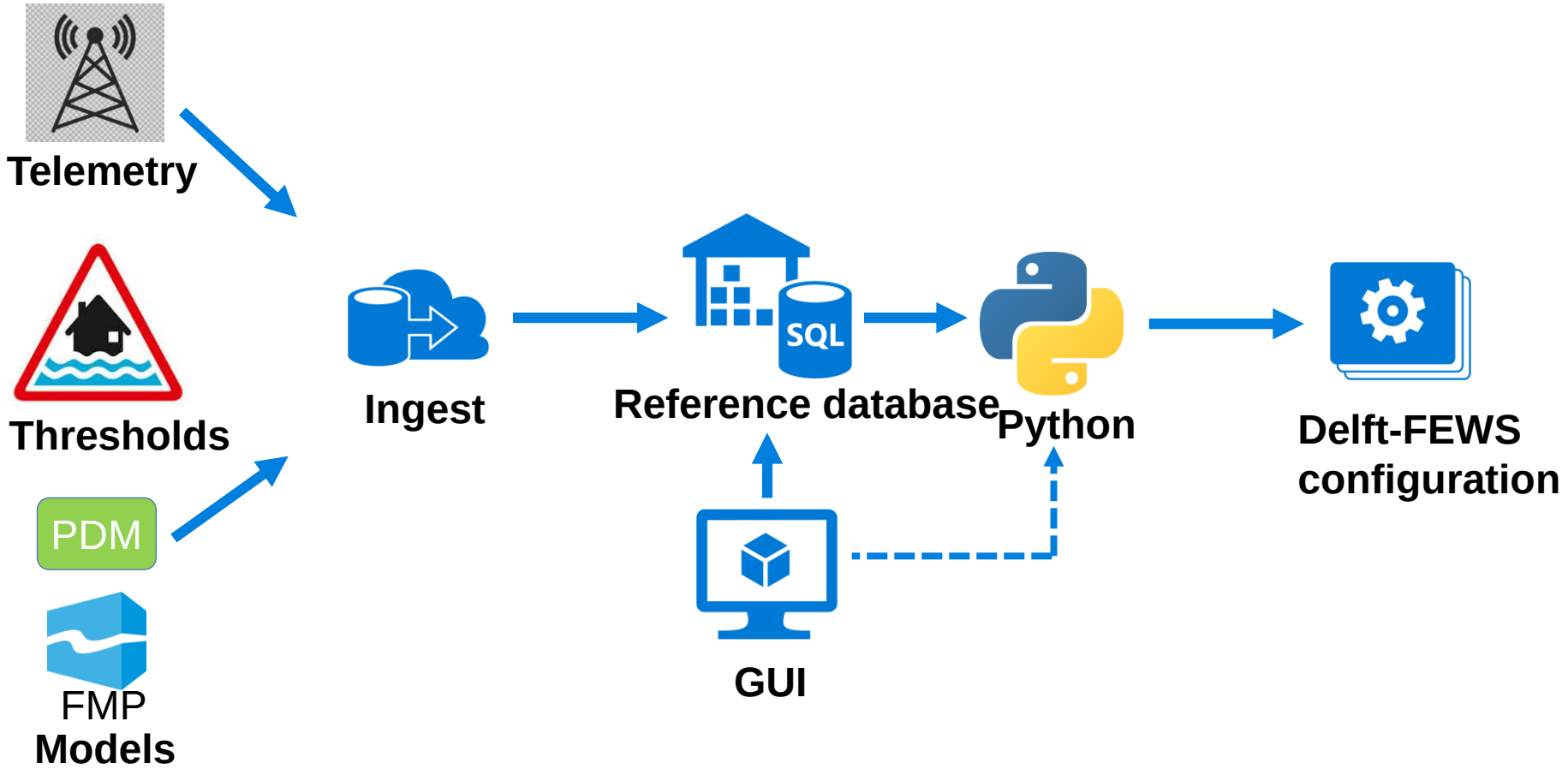
"Self documenting"

Starting with a complete reference dataset



Reference database

The alternative solution



IMRD demo

IMRD - Welcome

imfs-pre1-reference-frontend.azurewebsites.net

GOV.UK Incident Management Reference Database

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ALPHA This is a new service – your feedback will help us to improve it.

Dashboard | Locations | Geolocations | Monitoring assets | Models | Network | Rating curves | Astrosums | Thresholds | Pending Edits | MFDO Info | Admin

Home

Welcome

Welcome to IMRD. Please use the links at the top of the page to navigate around the site.

Built by the Environment Agency

Locations

10 entries | RLOI only | Scenario only | Clear filters | Search: north musk

IMFS ID	Name	River	Centre	Area	Category description	Type	Group	Nav tree catchment	
cINFLW02_UG_SL_C02...	Trent to Colwick Scaled...	Causeway Dyke	Birmingham	DBNTLS	Ungauged	FMP Model Node	Fluvial	Lower Trent	Details - Edit
bINFLW02_UG_SL_C02...	Trent to Kelham Scaled ...	Causeway Dyke	Birmingham	DBNTLS	Ungauged	FMP Model Node	Fluvial	Lower Trent	Details - Edit
LTRENTLAT_UG_C028064	Lower Trent Lat UG Tren...	Causeway Dyke	Birmingham	DBNTLS	Ungauged	Forecast Site	Fluvial	Lower Trent	Details - Edit
4022	North Muskham	River Trent	Birmingham	DBNTLS	Gauge	Flow	Fluvial	Lower Trent	Details - Edit

Showing 1 to 4 of 4 entries

Previous 1 Next

More actions

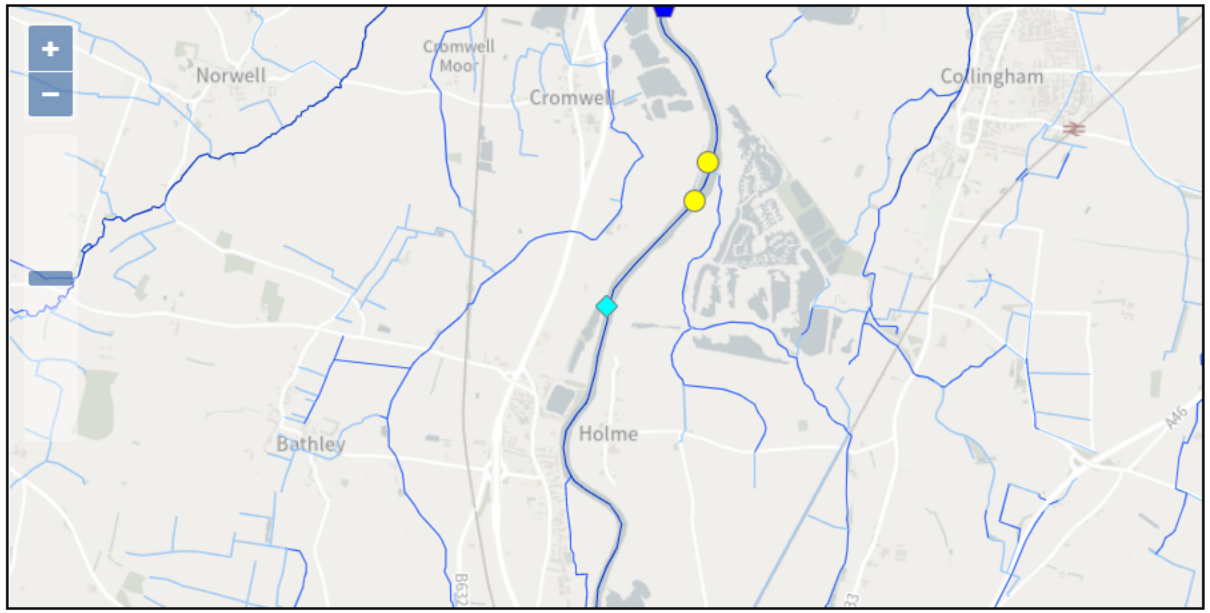
Create new location

Bulk create new locations (upload)

North Muskham

Hydrological Gauge

IMFS ID	4022
Category	Fluvial - Flow - Gauge
Description	Hydrological Gauge
Admin comment	SIGNED OFF 25/05/2017 EM
River	River Trent
Easting/Northing	480140, 360080
Lat/Long	53.1318664511249, -0.803660401292193
G2G	480500, 361500
Gauge zero	5
Centre	Birmingham
Additional centres	CIM, FFC, RLOI
WISKI ID	4022
Telemetry ID	4022
RLOI ID	2109



Recentre map

Show / hide map legend

Time Series

UDO ID	External ID	Parameter	Qualifier	WISKI ID	WISKI parameter	Unit	Internal parameter	
b1dacf99-5d73-4772-bed2-af858875983c	4022	Flow		4022	FL	m3/s	Q.obs	View monitoring asset
c9573d0e-cb51-4f43-8c33-489d44c12178	4022	Water Level	Stage	4022	SG2	mALD	H.obs	View monitoring asset

Models

Name	Type	Sub basin	
North Muskham FMP	FMP	Lower Trent	Details
River Trent FMP	FMP	Trent HD FMP	Details
Tidal Trent FMP	FMP	Tidal Trent HD FMP	Details

Processes

Module ID	Type	Sub basin	
4022_FMP_Q	ARMA	Lower Trent	Details
Telemetry_4022_H_obs	Import		Details
Telemetry_4022_Q_obs	Import		Details

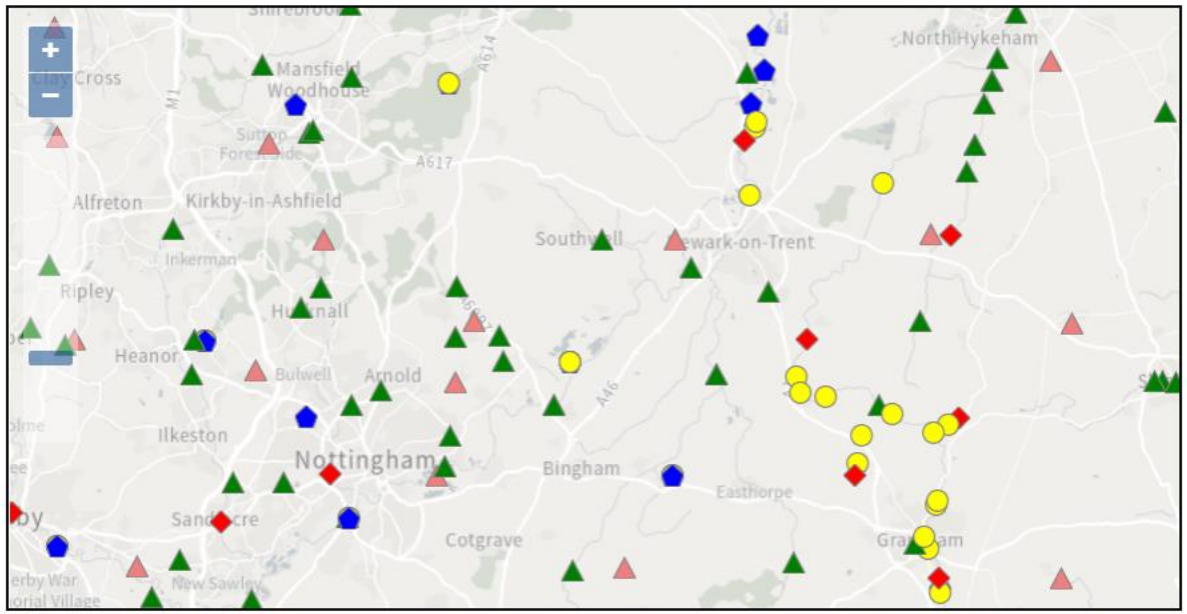
Rating curves

Qualifier	Rating type	Season	
Power	Power	All	View/edit values

North Muskham FMP

4022_north_muskham

Model type	FMP
Sub basin	Lower Trent
Basin	Trent
Comments	Added with Converged Models
Estimated run time (seconds)	1
Source	Solihull converged models
Last modified by	import
Model Documentation	Add file



Recentre map

Show / hide map legend

Alternative Configurations

Add Alternate Configuration

Model Files

Model Files

Ini file	4022_north_muskham.ini	Replace
Dat file	RS.dat	Replace
Zzs file	input.zzs	Replace
Ief file	hot.ief	Replace

Additional files

RS.gxy	RS.gxy	Remove Replace

Upload additional files
Download all files

Input

Location	Parameter	External ID	Initial value	Scale	Lag (minutes)	Offset	Minimum	Connection		
Colwick	Q.fcast.upd	cINFLW01	0	1	0	0	0.046	ARMA(4009_FMP_Q)	Edit Boundary	Edit Connection Remove Connection
Devon Lat UG Smite	Q.fcast.sim	cINFLW04	0	0.32	0	0	0	Devon Lat UG PDM	Edit Boundary	Edit Connection Remove Connection
Trent to Colwick Scaled Lower Trent Lat UG	Q.fcast.sim	cINFLW02	0	0.9	0	0	0	Lower Trent Lat UG PDM	Edit Boundary	Edit Connection Remove Connection

Trent to Colwick Scaled Lower Trent Lat UG	Q.fcast.sim	cINFLW02	0	0.9	0	0	0	Lower Trent Lat UG PDM	Edit Boundary	Edit Connection Remove Connection
Trent to Kelham Scaled Lower Trent Lat UG	Q.fcast.sim	bINFLW02	0	0.1	0	0	0	Lower Trent Lat UG PDM	Edit Boundary	Edit Connection Remove Connection
Wensor Bridge	Q.fcast.upd	cINFLW03	0	1	0	0	0.046	ARMA(4191_FMP_Q)	Edit Boundary	Edit Connection Remove Connection

Output

Location	Parameter	External ID	Initial value	Calculate Rated Level	Export	Connection	
Gunthorpe	Q.fcast.sim	cRCH_08	0.02	View curve	FFOI Telemetry Map		Edit Boundary
North Muskham	Q.fcast.sim	bRCH_09e	0.046	View curve	FFOI Telemetry Map	ARMA(4022_FMP_Q)	Edit Boundary

More actions

Edit FMP
Remove FMP

IMRD - Network

imfs-pre1-reference-frontend.azurewebsites.net/Network/Trent/Lower_Trent

GOV.UK Incident Management Reference Database

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Dashboard | Locations | Geolocations | Monitoring assets | Models | Network | Rating curves | Astrosums | Thresholds | Pending Edits | MFDO Info | Admin

Basins

Open all

Birmingham

+ Add basin

Severn

Trent

+ Add sub-basin

Tame

Dove

Upper Derwent and Ashford HD FMP

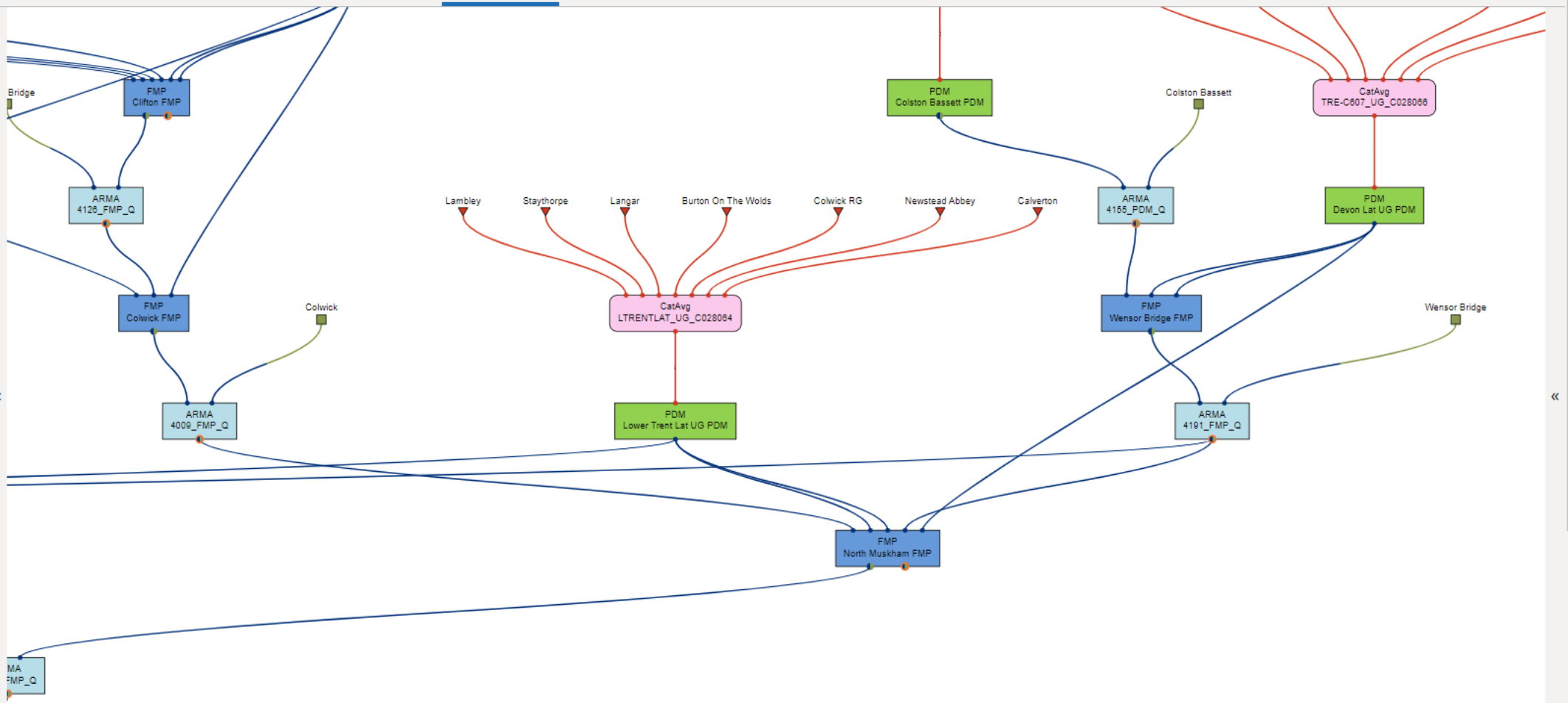
Upper Derwent and Wye

Derwent

Derwent HD FMP

Soar HD FMP

Erewash and Leen



IMRD - Network

imfs-pre1-reference-frontend.azurewebsites.net/Network/Trent/Lower_Trent

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Basins

Open all

Birmingham

+ Add basin

Severn

Trent

+ Add sub-basin

Tame

Dove

Upper Derwent and Ashford HD FMP

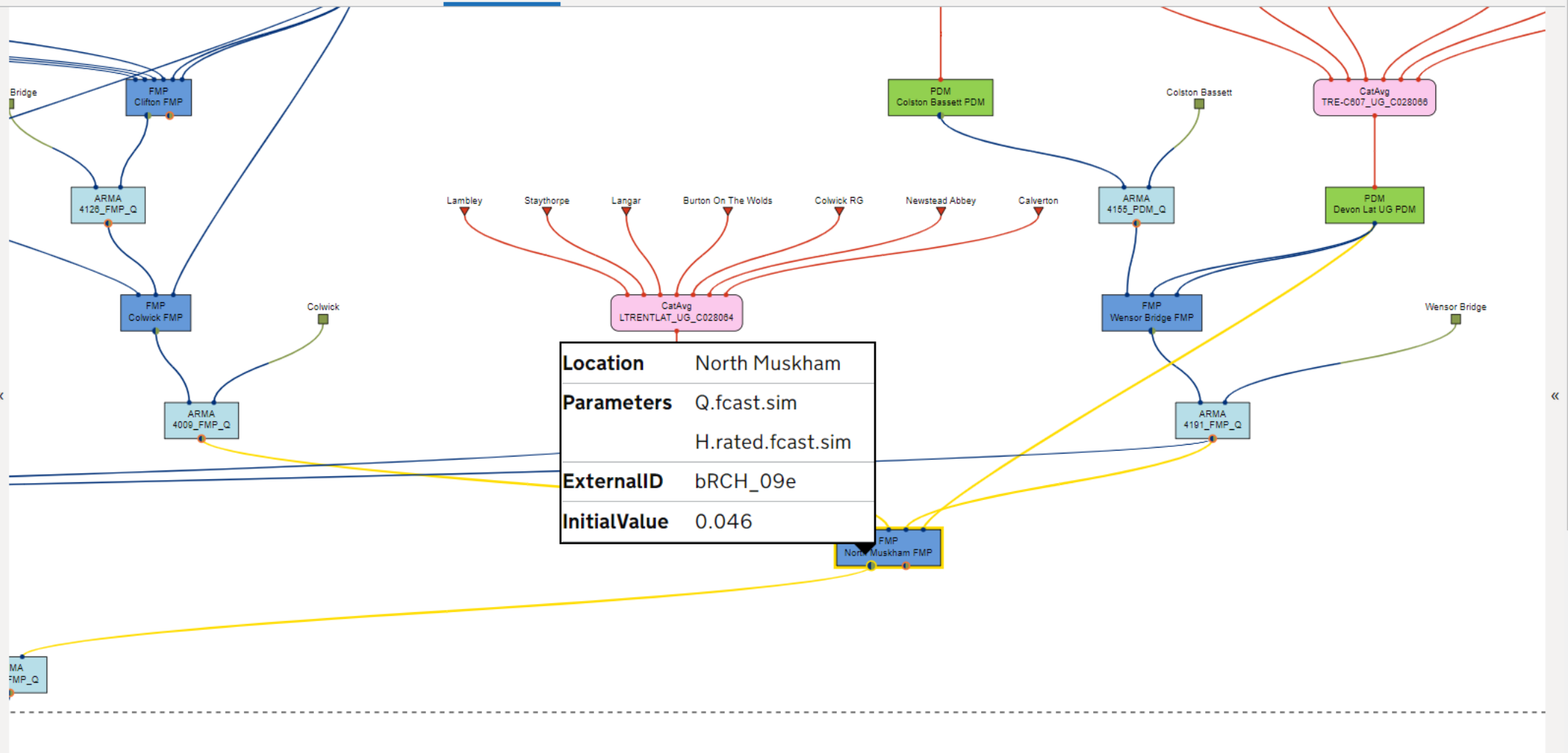
Upper Derwent and Wye

Derwent

Derwent HD FMP

Soar HD FMP

Erewash and Leen



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North Muskham

Choose a section to edit:

View

Select...

North Muskham

Datum: 5m

Quick Site Summary

- Model performance is excellent. Above 2.95m, models tends to slightly underestiamte peak levels (by 5-10cm), whilst below 2.70m model tends to overestimate by 5-10cm. Timing of forecast peak is also excellent (particularly above 1.55m), forecast peak tends to be very slightly earlier than observed peak.
- No observed events between 2.70m - 2.95m to compare to modelled data, so hard to know for definite how model perfoms at these levels, but fair to assume the model transistion from underestimating to overestimating from 2.95m - 2.70m, so model probably performs very well between these values.
- Levels are **simulated accurately**.
- There is a large, active **floodplain** and multiple **small lakes and ponds**.
- Last gauge on the fluvial Trent before the tidally influenced section begins just downstream at Cromwell Weir.

Tidal Trent FMP (Stage)

Rating curve: N
ARMA corrected: No
View sub basin schematics

River Trent FMP (Stage)

Rating curve: N
ARMA corrected: No
View sub basin schematics

North Muskham FMP (Flow)

View full historical report (stage)

North Muskham FMP (Flow)

Rating curve: Y
ARMA corrected: Yes
View sub basin schematics

View full historical report (stage)
View full historical report (flow)

Model Description

- Forecast at this site is from an **FMP routing model with storage component**.
- The FMP routing model is used to route flows from Colwick, Wensor Bridge and ungauged portions of the catchment.
- **Levels are back-calculated** from a rating curve.

Model Description

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- The FMP routing model is used to route flows from Colwick, Wensor Bridge and ungauged portions of the catchment.
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Model Performance Description

- Levels are **simulated accurately**.
- **Reasons for poor performance:**
  - Observed flows are missing from Wensor Bridge in the November 2000 event affecting performance of the model for that event.
  - Operationally, errors will be cascaded from upstream.

River Trent FMP (Flow)

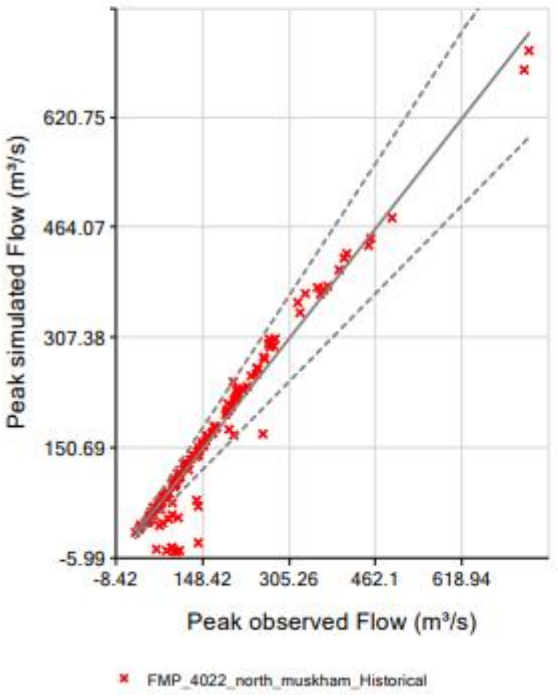
River River Trent@North Muskham (Flow)
Trent\Lower Trent\North Muskham FMP\4022

Historical Report for 01 Oct 2011 to 01 Jan 2020 using:
LevelToFlow\4022\Q.rated
FMP_4022_north_muskham_Historical\4022\Q.hist.sim

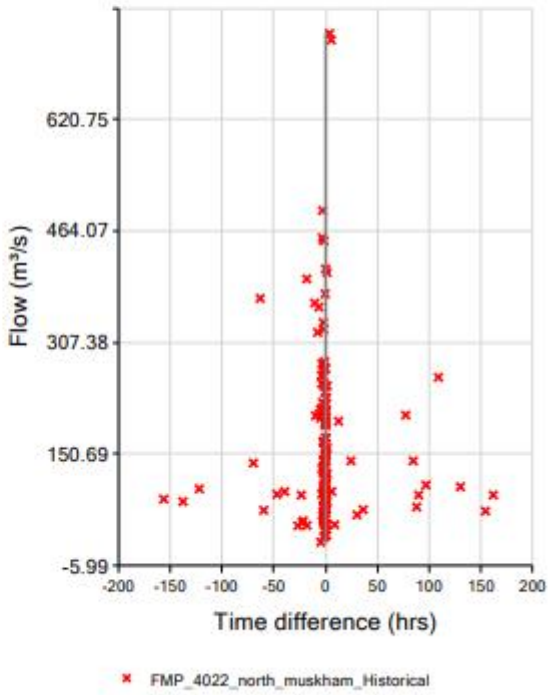
	Date	Obs (m^3/s)	Date	Sim (m^3/s)	% Peak Diff	% Vol Diff	NSE	r^2
1	28 Nov 2012 08:00	740.13	28 Nov 2012 11:45	715.34	-3.4%	-1.6%	0.969	0.970
2	25 Dec 2012 09:45	731.28	25 Dec 2012 15:15	688.18	-5.9%	-3.2%	0.970	0.982
3	05 Apr 2018 03:30	492.11	05 Apr 2018 00:30	477.57	-3.0%	-2.5%	0.985	0.986

River River Trent@North Muskham (Flow)
Trent\Lower Trent\North Muskham FMP\4022

Peak differences (r^2 0.95)

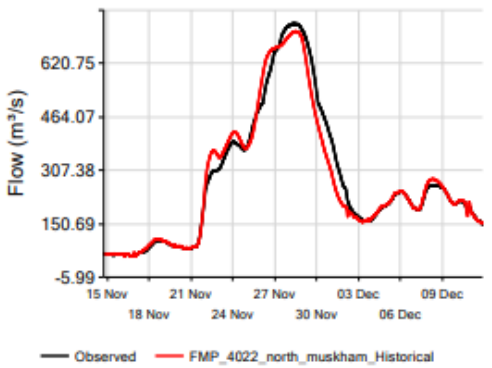


Peak timing differences

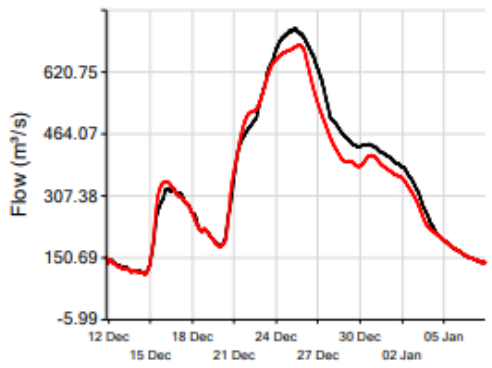


River River Trent@North Muskham (Flow)
Trent\Lower Trent\North Muskham FMP\4022

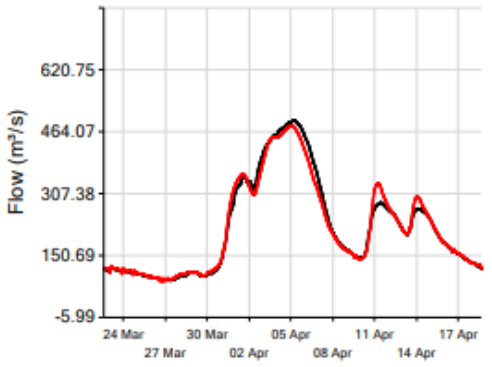
1. 28 Nov 2012 08:00



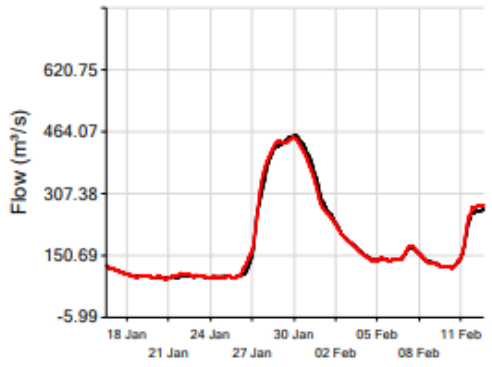
2. 25 Dec 2012 09:45



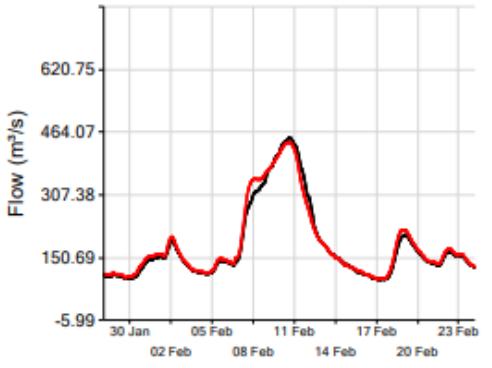
3. 05 Apr 2018 03:30



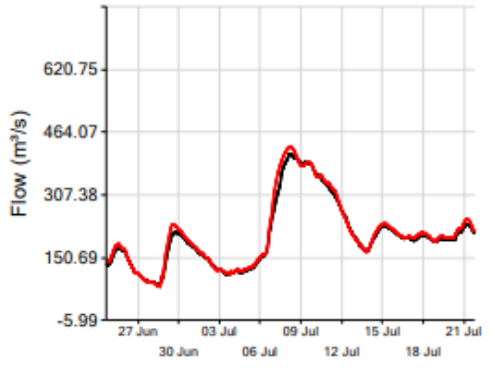
4. 30 Jan 2013 02:15



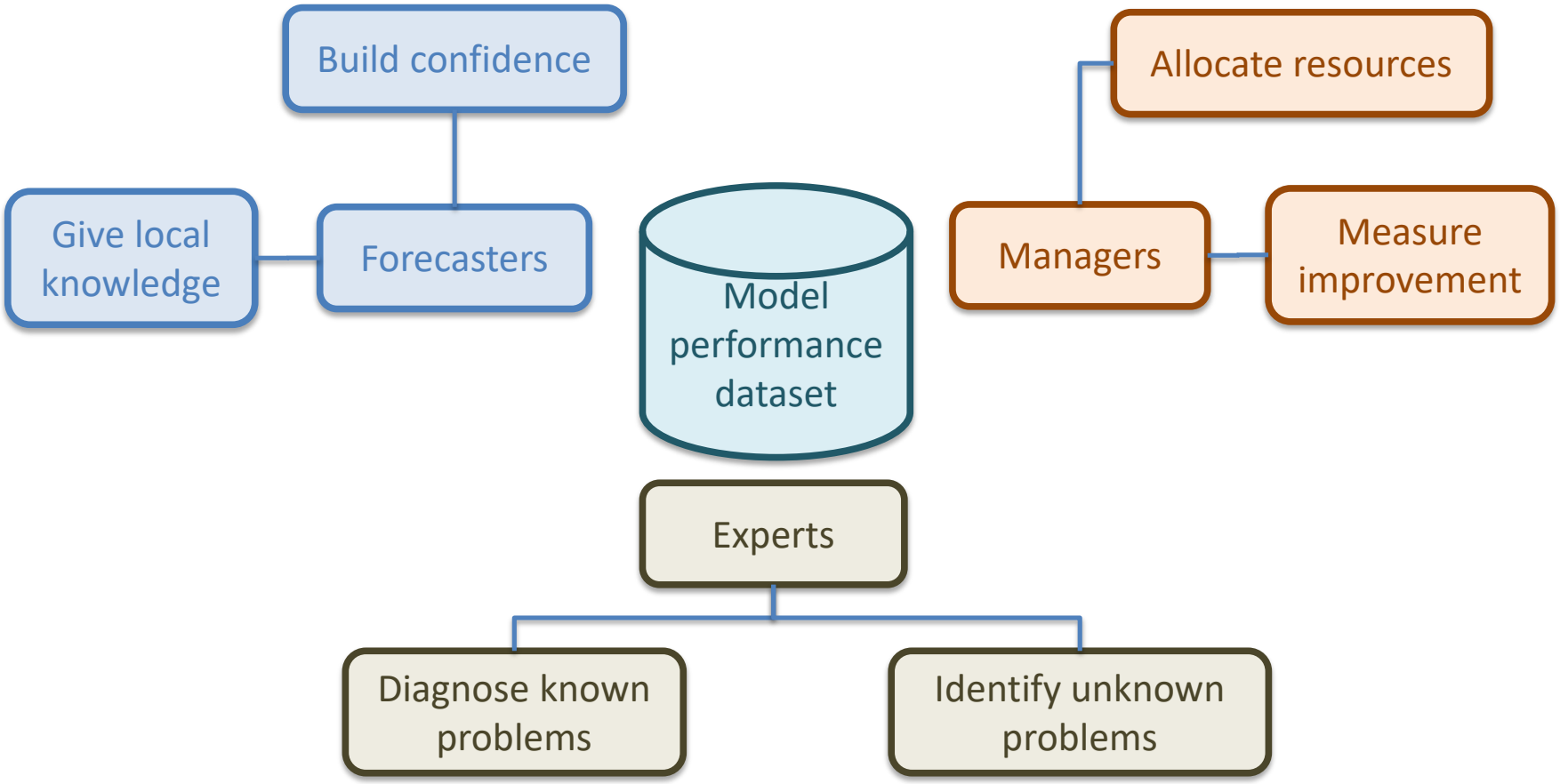
5. 10 Feb 2016 15:30



6. 08 Jul 2012 05:30



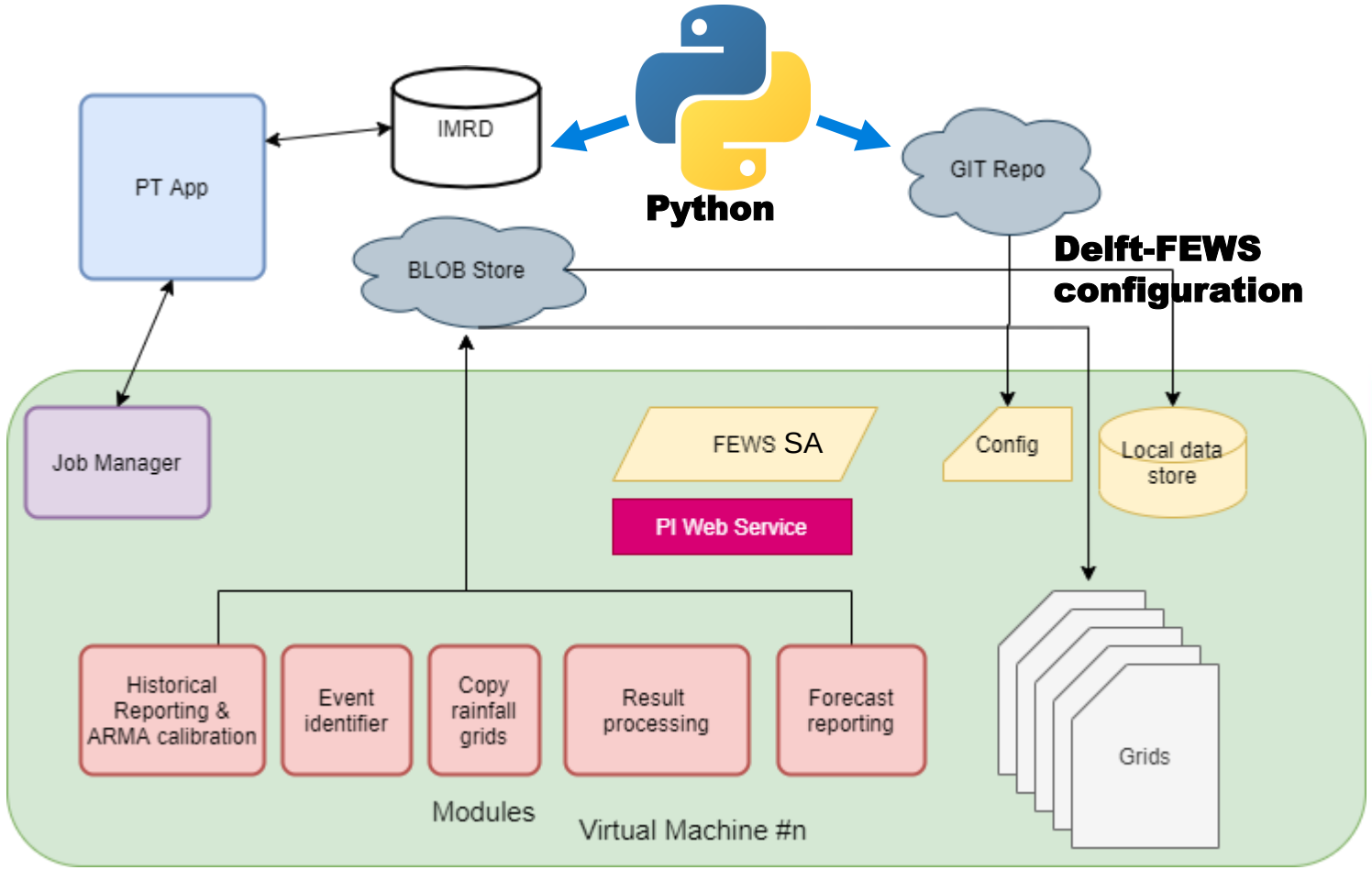
Model performance data



Basic requirement

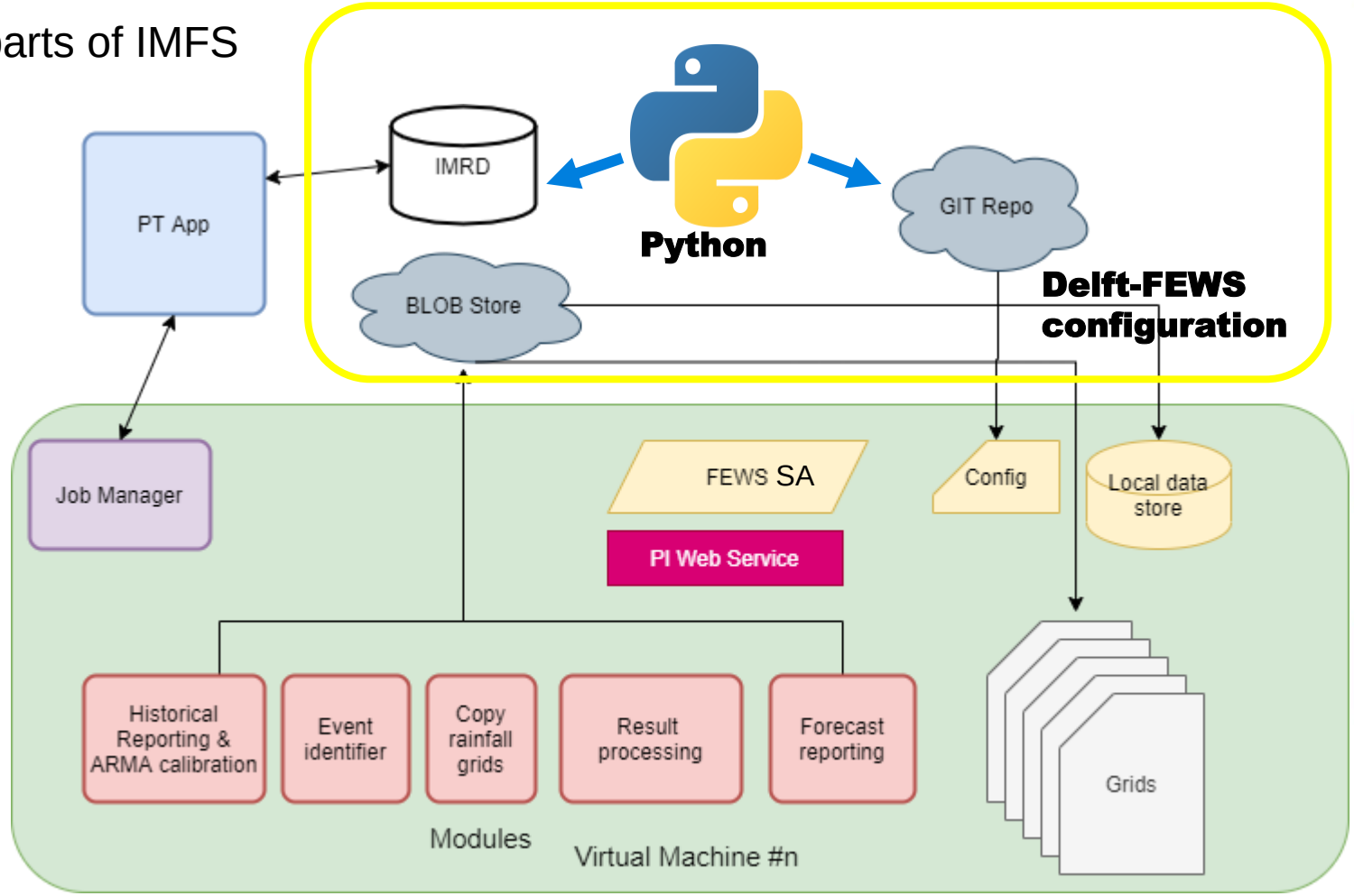
- Run a long historical & visualise results
- Run MANY pseudo real-time forecasts with different rainfall scenarios
- Analyse then visualise results

How the App does it



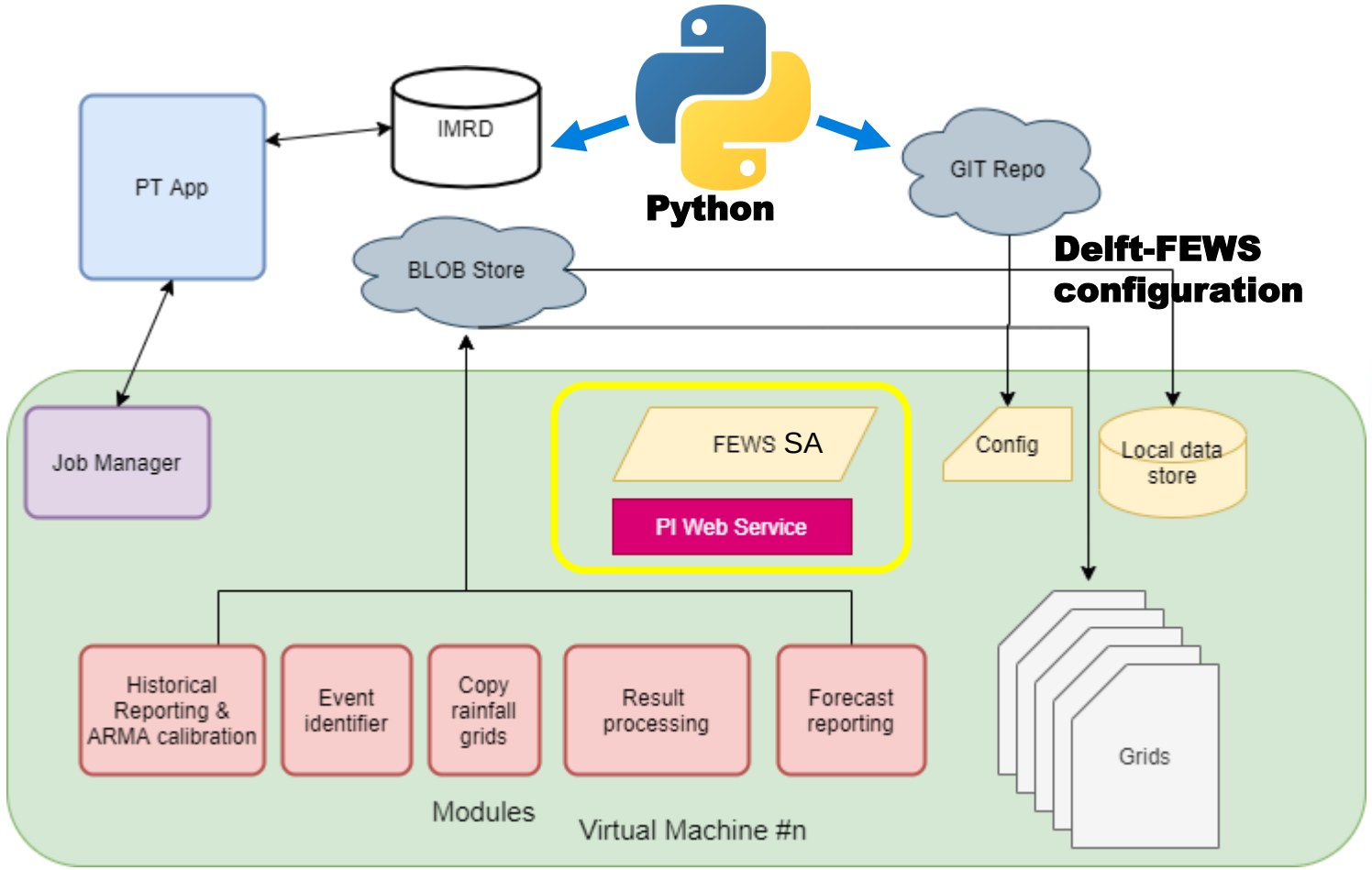
How the App does it

Key parts of IMFS



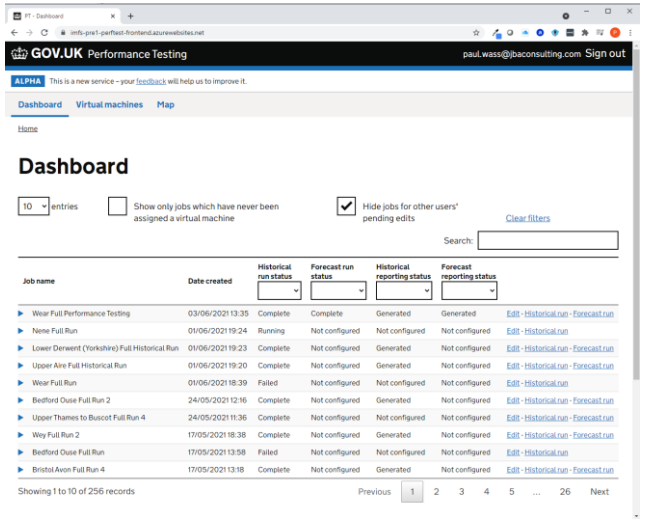
How the App does it

Performance testing uses a FEWS standalone and the PI web service

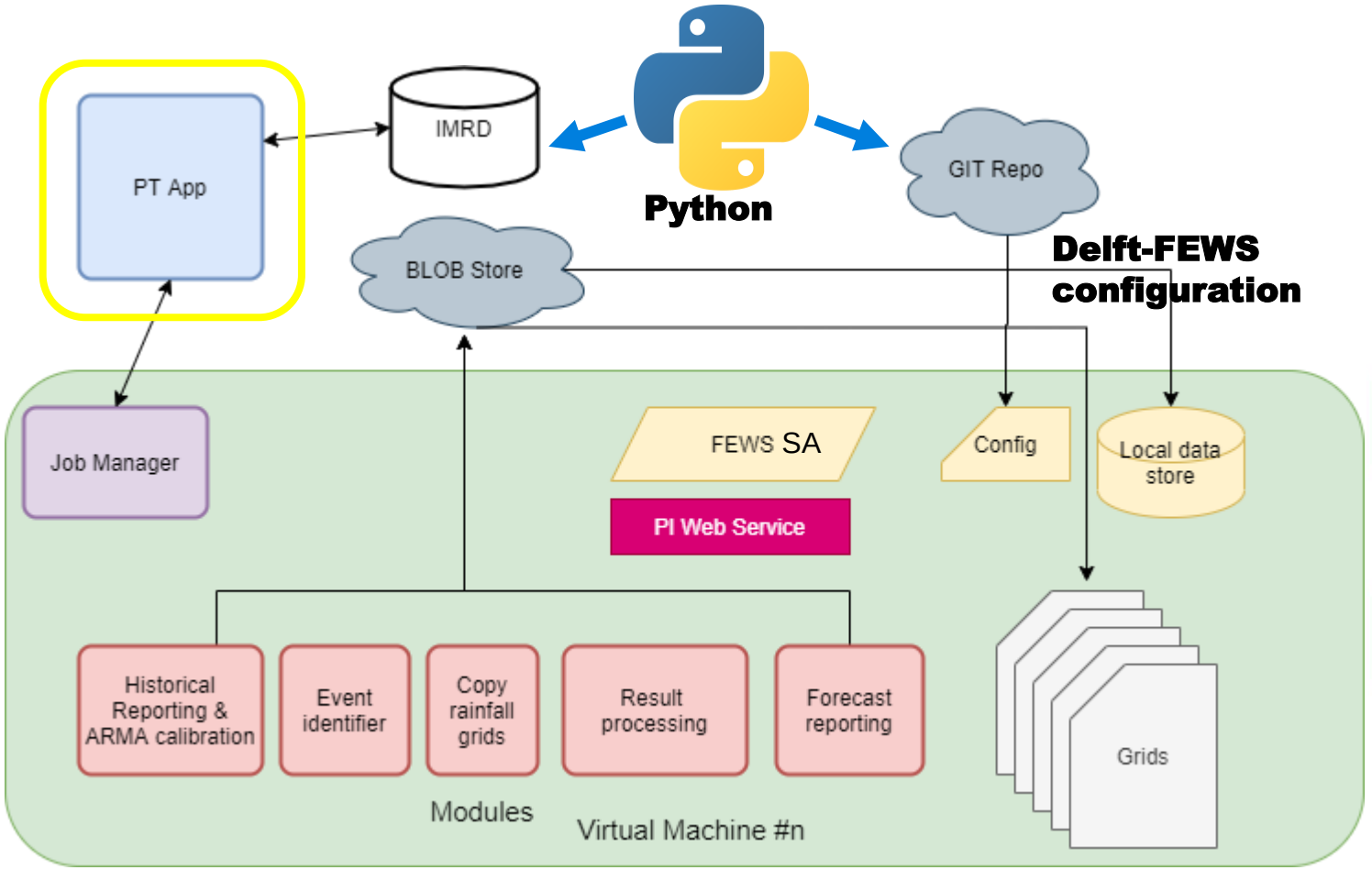


How the App does it

Azure ‘Web App’



- User interface
- Links to IMRD
- Controls job flow



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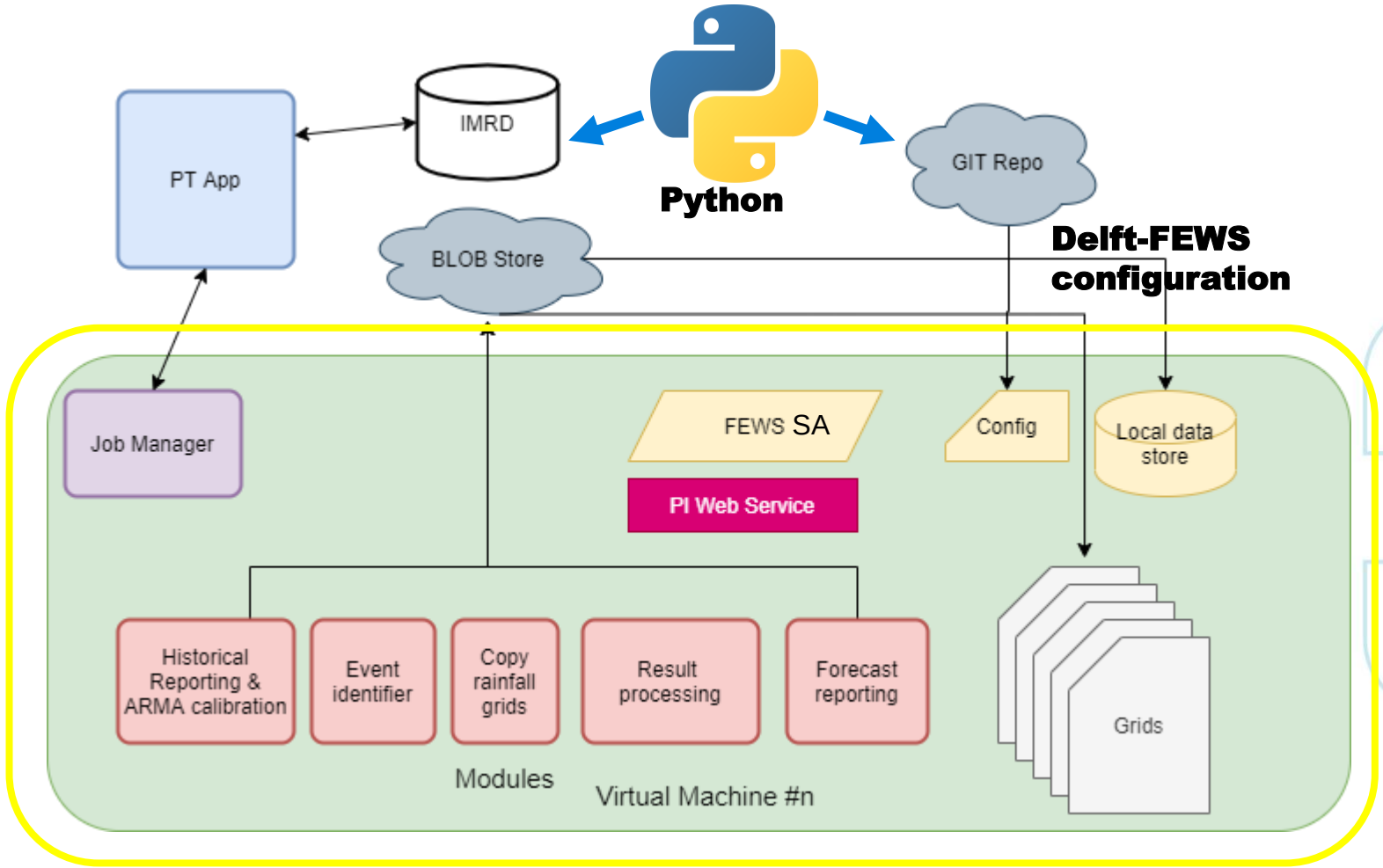
How the App does it



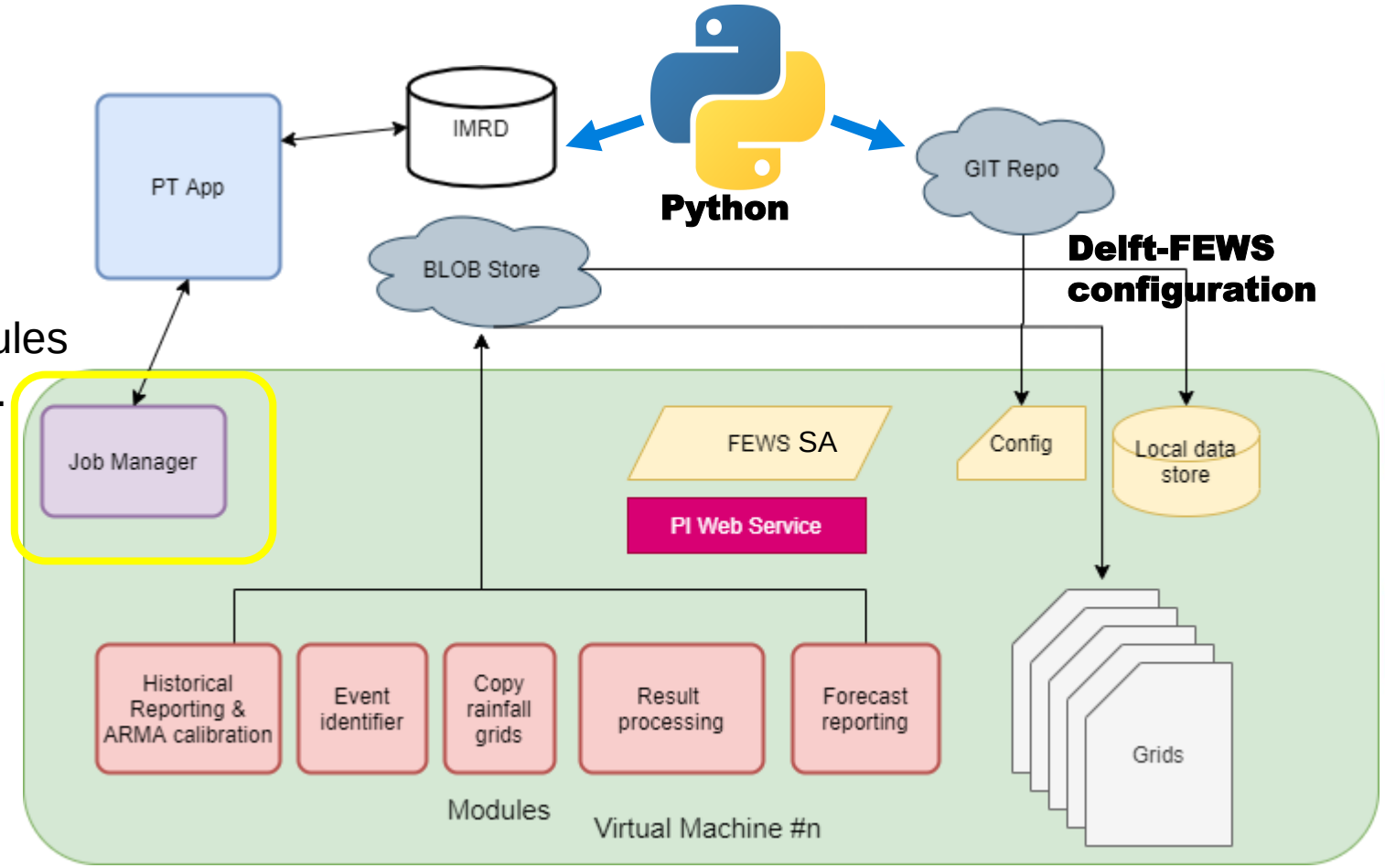
Virtual machine(s)

- 20+ Identical machines
- 1 is the 'lead' for a job
- Others added when running forecasts
- Allocated/deallocated through the Web App

How the App does it

Console application

- Instructed by Web App
- Orchestrates individual modules
- Pulls data, runs modules etc.



River River Tyne@Bywell (Flow)
Tyne\Tyne\Lower South Tyne FMP\023001

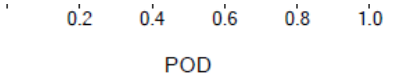
Environment Agency

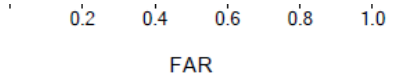
JBA consulting

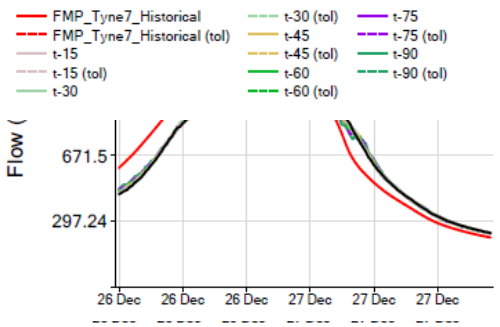
Re

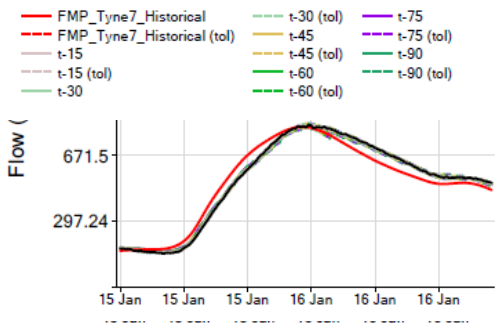
NSE for error corrected time series of different lead times (minutes)

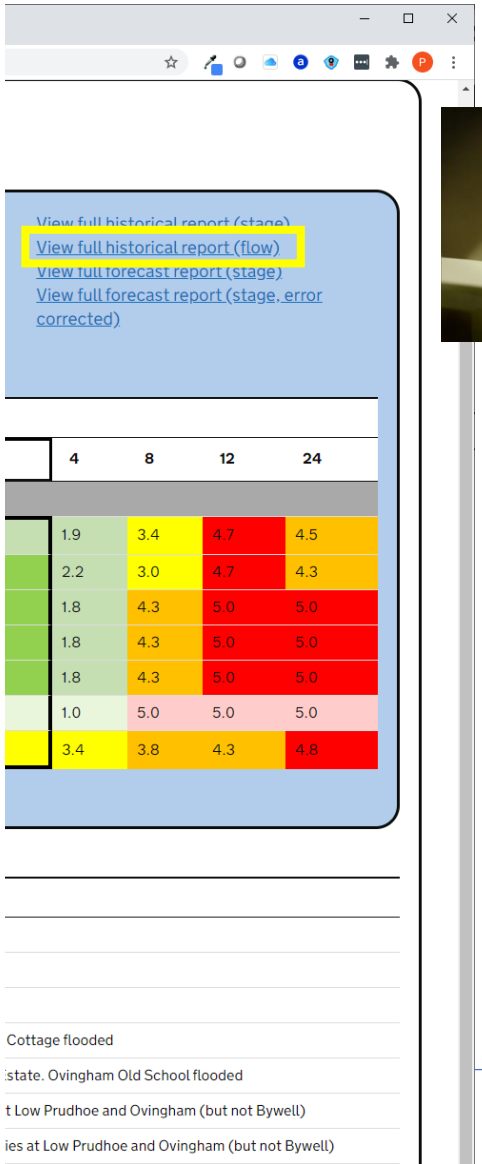
Event	Simulated	t-15	t-30	t-45	t-60	t-75	t-90
1. 06 Dec 2015 00:15	0.7632	0.9982	0.9971	0.9956	0.9932	0.9899	0.9870
2. 09 Feb 2020 15:30	0.9723	0.9992	0.9981	0.9967	0.9954	0.9940	0.9929
3. 06 Sep 2008 18:45	0.9068	0.9995	0.9990	0.9981	0.9967	0.9947	0.9919
4. 15 Nov 2015 12:00	0.8924	0.9995	0.9989	0.9981	0.9966	0.9945	0.9922
5. 26 Dec 2015 23:45	0.8652	0.9996	0.9992	0.9986	0.9975	0.9959	0.9941
6. 15 Jan 2011 23:45	0.9575	0.9995	0.9992	0.9988	0.9984	0.9977	0.9968
7. 18 Nov 2009 11:45	0.8902	0.9997	0.9993	0.9981	0.9963	0.9937	0.9904
8. 16 Mar 2019 18:45	0.9407	0.9996	0.9992	0.9988	0.9978	0.9966	0.9951
9. 16 Feb 2020 00:30	0.9504	0.9995	0.9988	0.9978	0.9962	0.9941	0.9915
10. 10 Aug 2019 21:30	0.9299	0.9989	0.9982	0.9967	0.9946	0.9920	0.9886
11. 18 May 2013 17:15	0.8523	0.9997	0.9988	0.9971	0.9946	0.9915	0.9879
12. 28 Jun 2012 21:45	0.9289	0.9995	0.9982	0.9956	0.9920	0.9879	0.9834
13. 25 Nov 2009 04:15	0.9551	0.9998	0.9996	0.9991	0.9982	0.9969	0.9953
14. 04 Dec 2015 03:30	0.9296	0.9996	0.9990	0.9979	0.9964	0.9941	0.9913
15. 05 Feb 2011 08:30	0.9412	0.9994	0.9990	0.9986	0.9979	0.9968	0.9957
16. 01 Nov 2009 19:45	0.9117	0.9997	0.9990	0.9973	0.9944	0.9903	0.9850
17. 22 Dec 2015 15:30	0.9415	0.9996	0.9993	0.9985	0.9971	0.9951	0.9924
18. 25 Sep 2012 11:00	0.9429	0.9991	0.9983	0.9970	0.9953	0.9921	0.9883
19. 05 Jan 2016 16:00	0.8798	0.9994	0.9988	0.9982	0.9971	0.9954	0.9932
20. 18 Jul 2009 05:15	0.7519	0.9997	0.9992	0.9982	0.9964	0.9937	0.9903
21. 12 Jan 2009 10:45	0.9800	0.9996	0.9993	0.9990	0.9984	0.9975	0.9965
22. 08 Dec 2011 17:45	0.9338	0.9996	0.9988	0.9977	0.9961	0.9940	0.9914
23. 11 Jan 2020 23:00	0.9577	0.9995	0.9987	0.9979	0.9963	0.9939	0.9908
24. 10 Dec 2015 06:15	0.8312	0.9995	0.9987	0.9974	0.9950	0.9915	0.9869











3am test

Current status

- Simulation results for everywhere by January -> inform model improvements programme
- Then, ‘real time’ results after that…

Thank you