ConocoPhillips

Using forecast and smoothing techniques together

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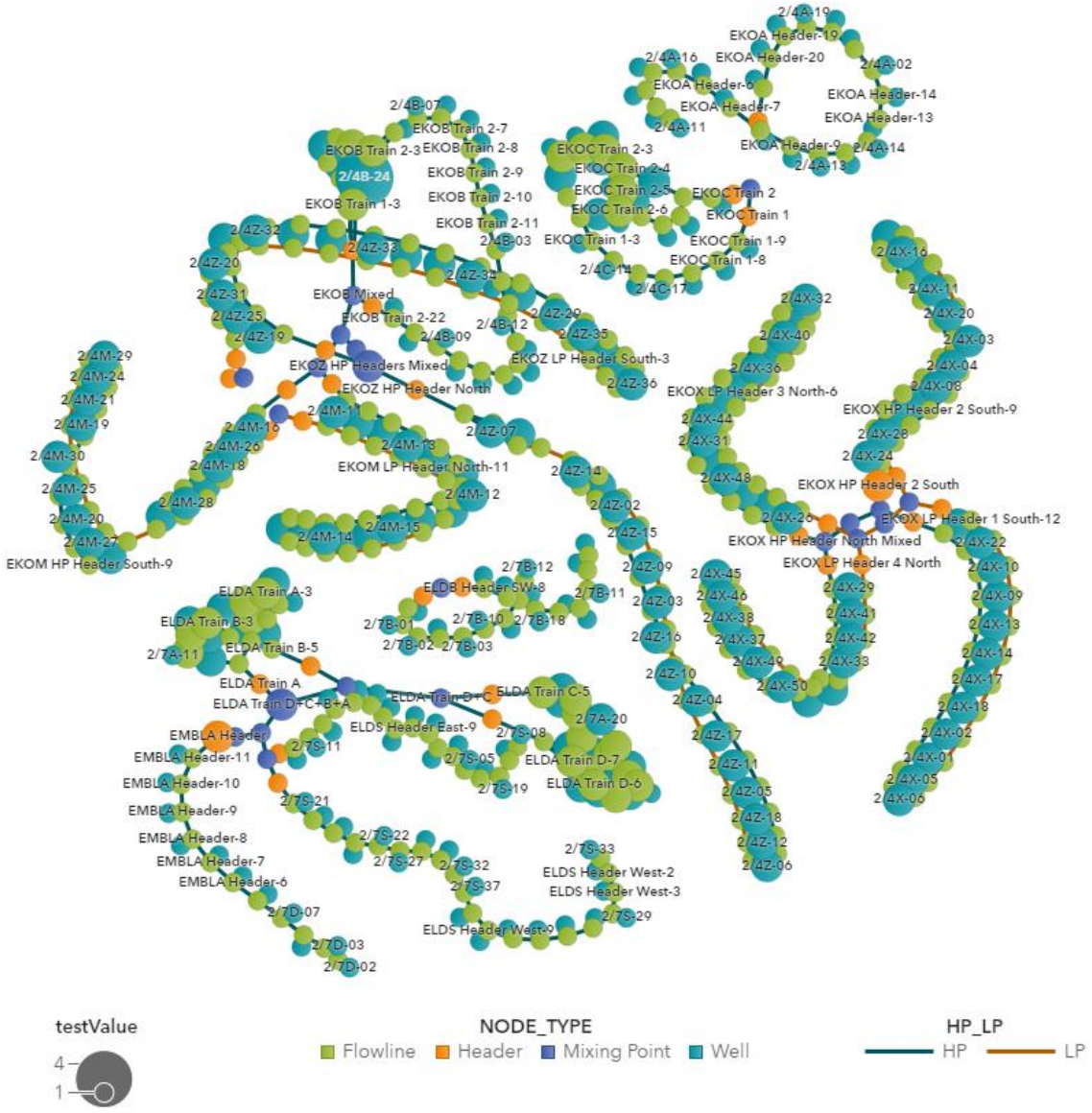
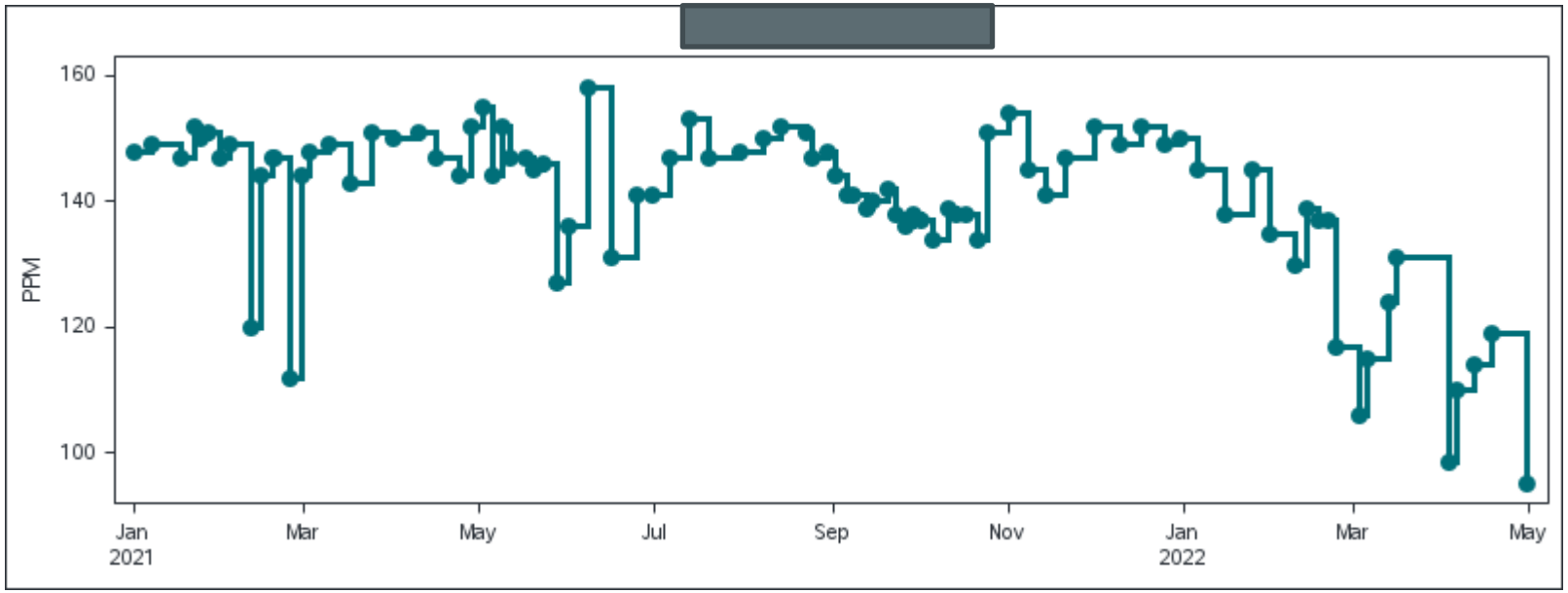
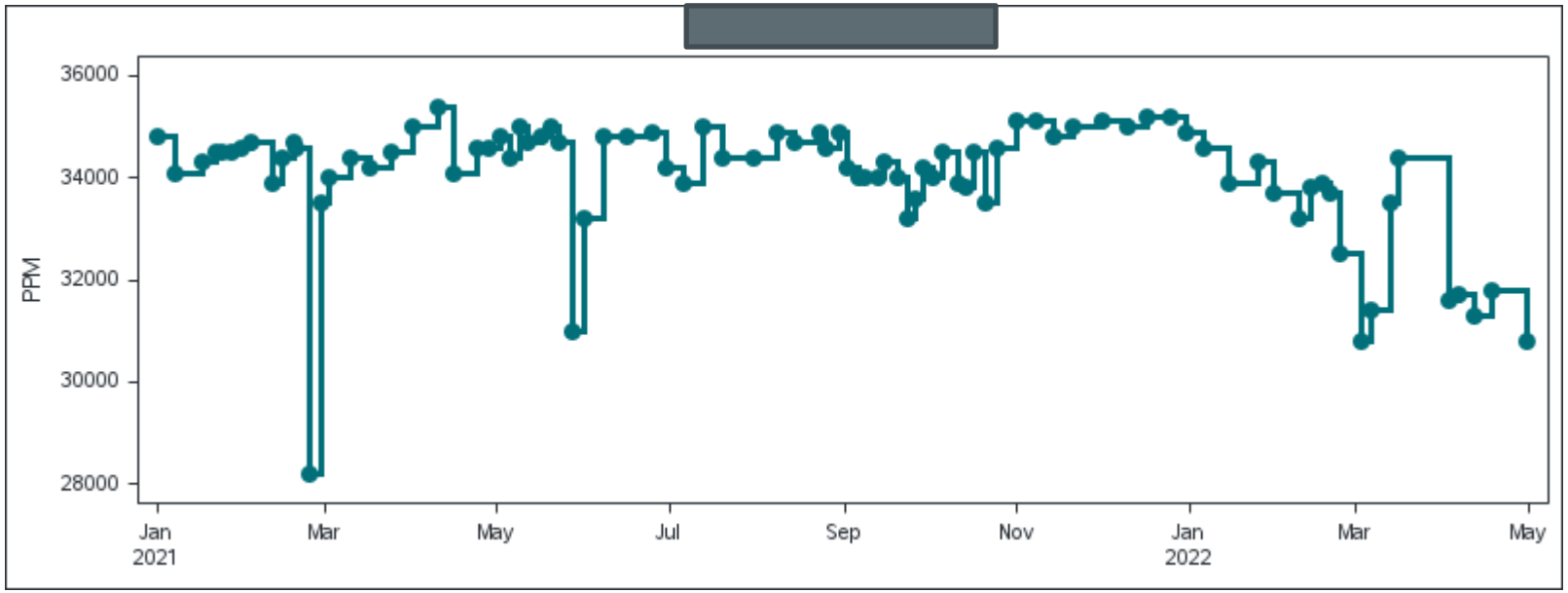
From well to topside, how to manage

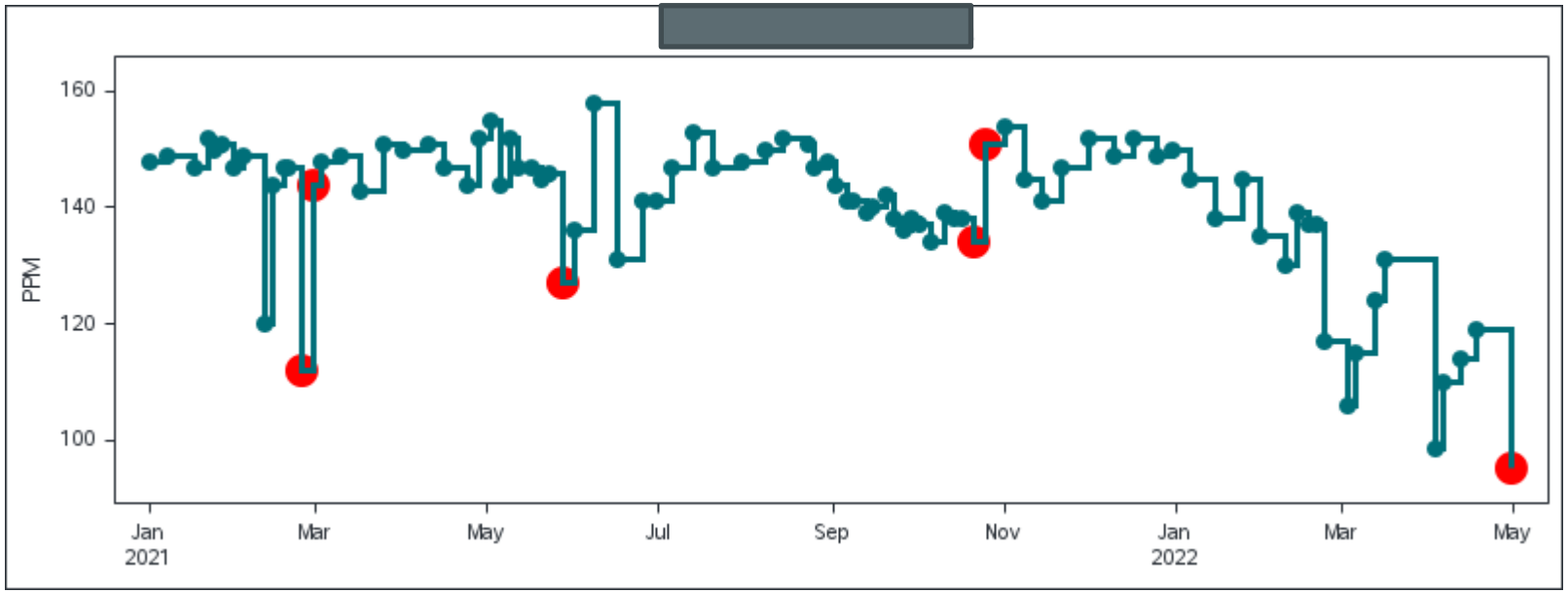


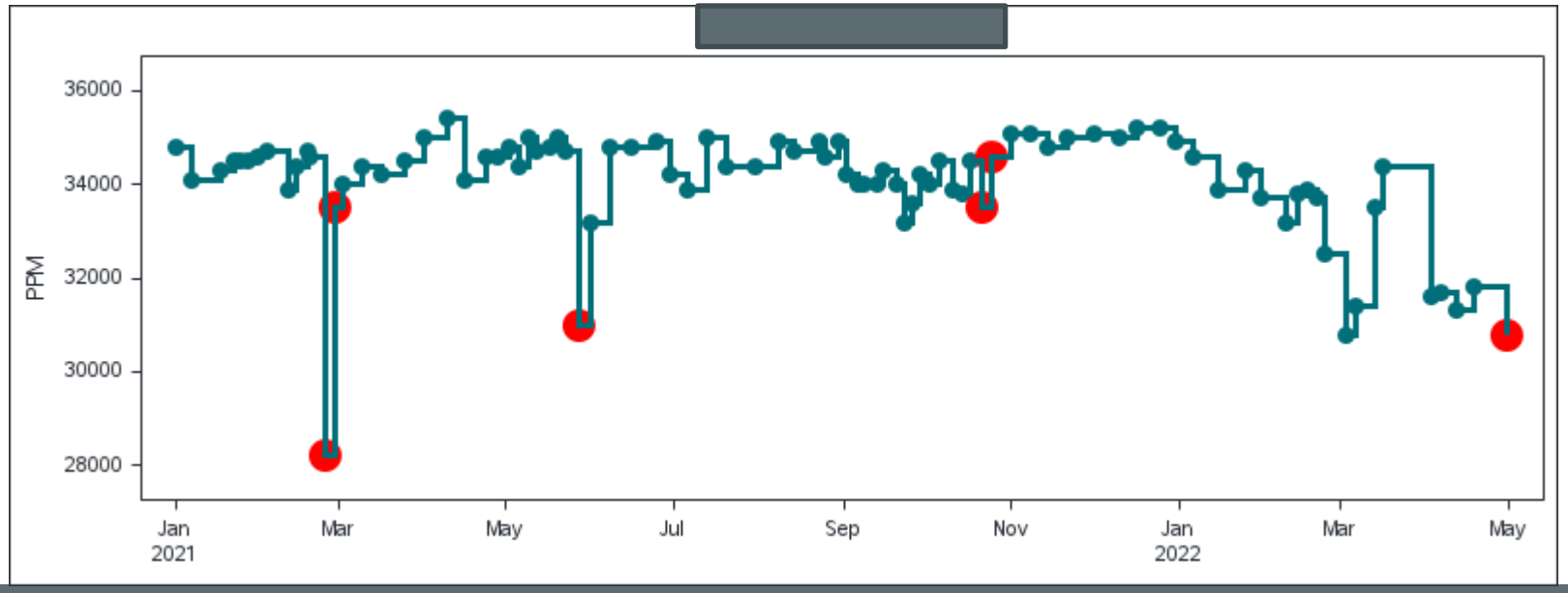
Data from one well/sample-point



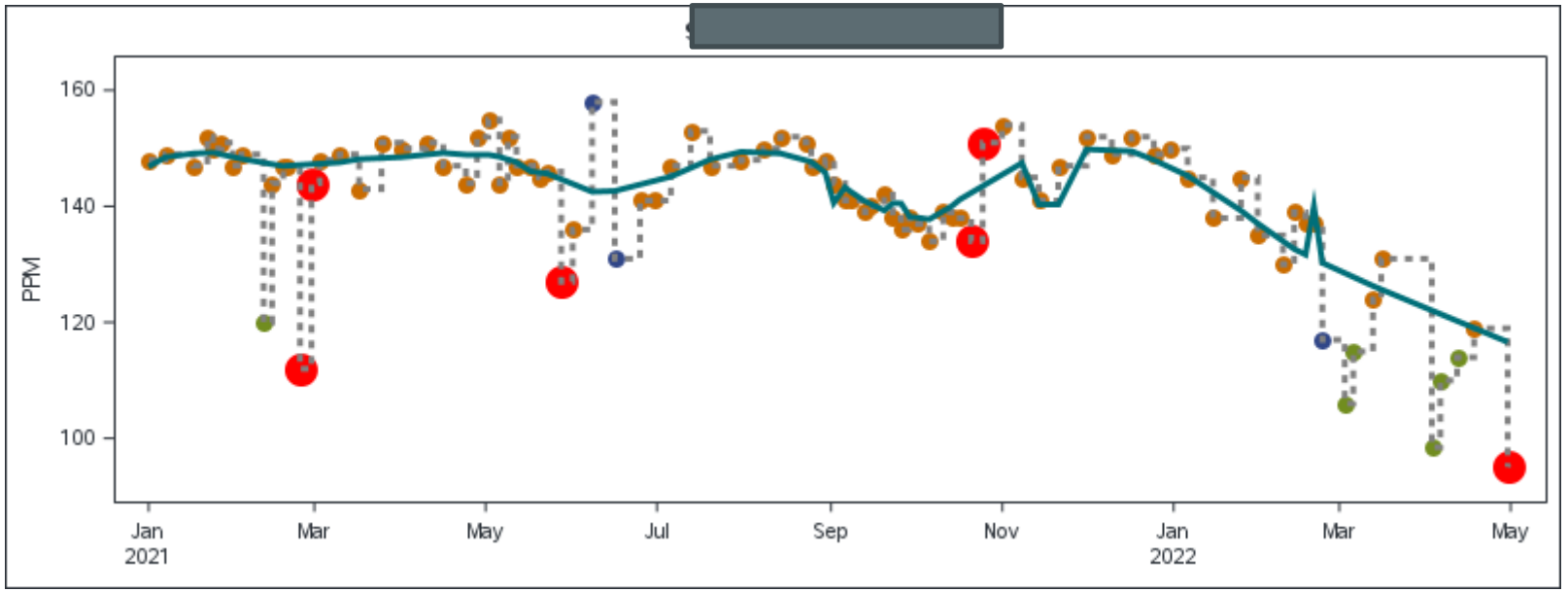


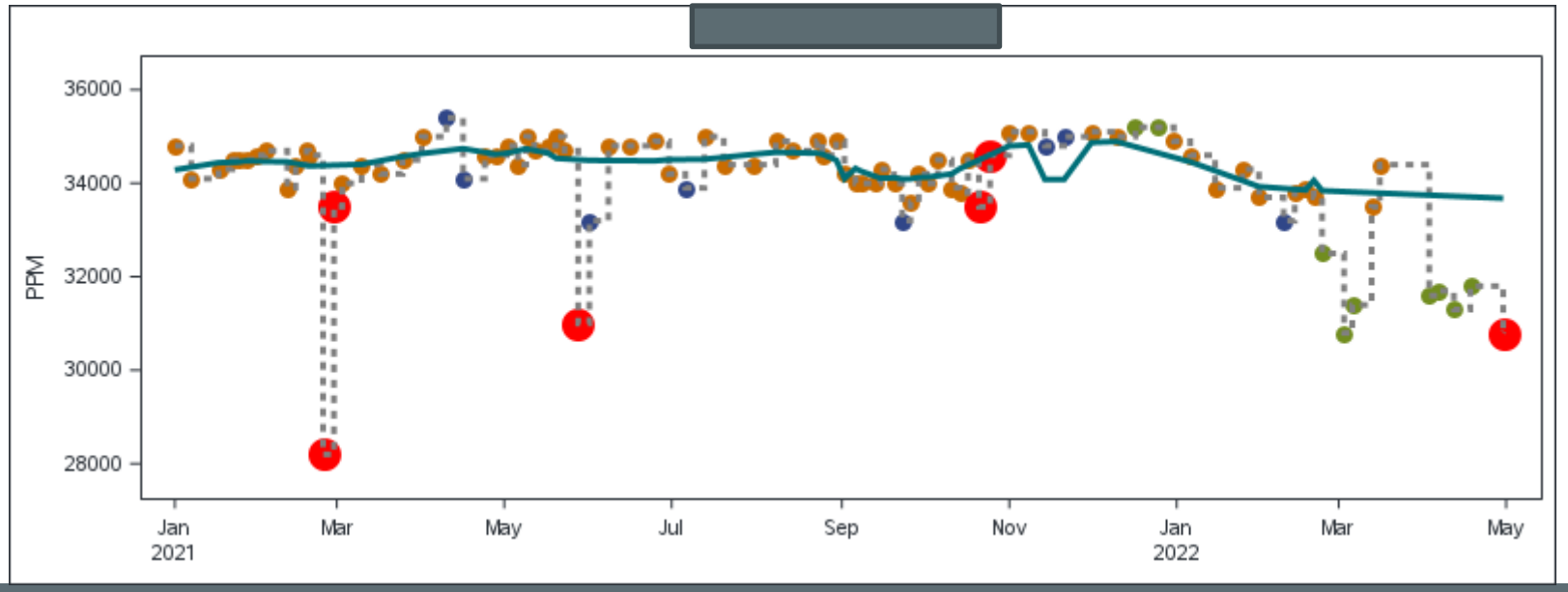
Same well, events marked



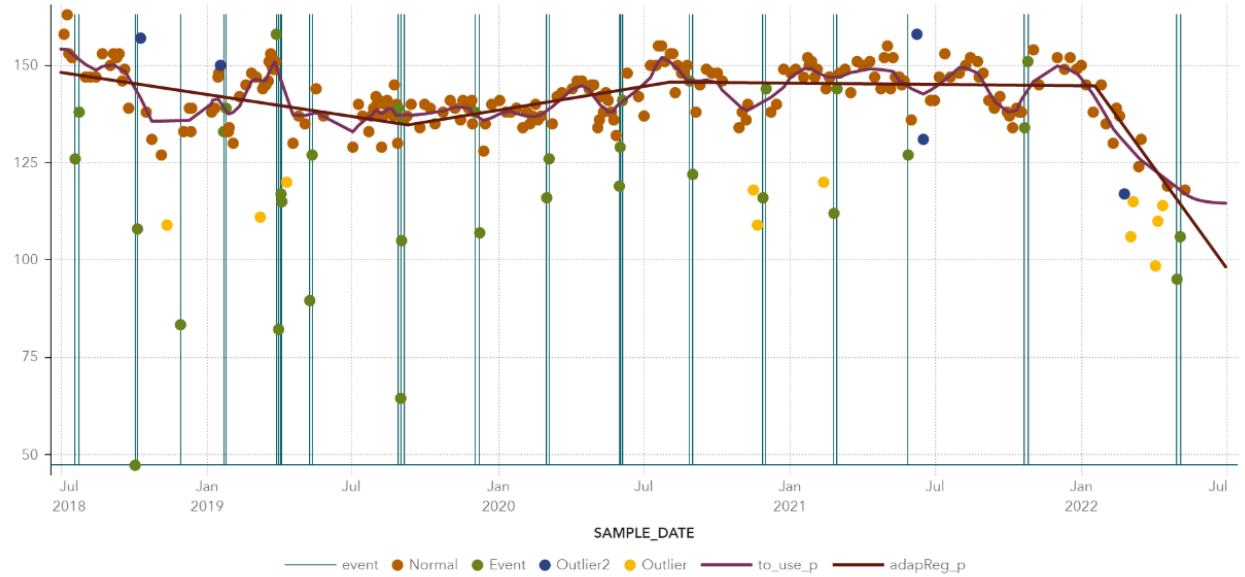


Same well events, outliers and smoothed line

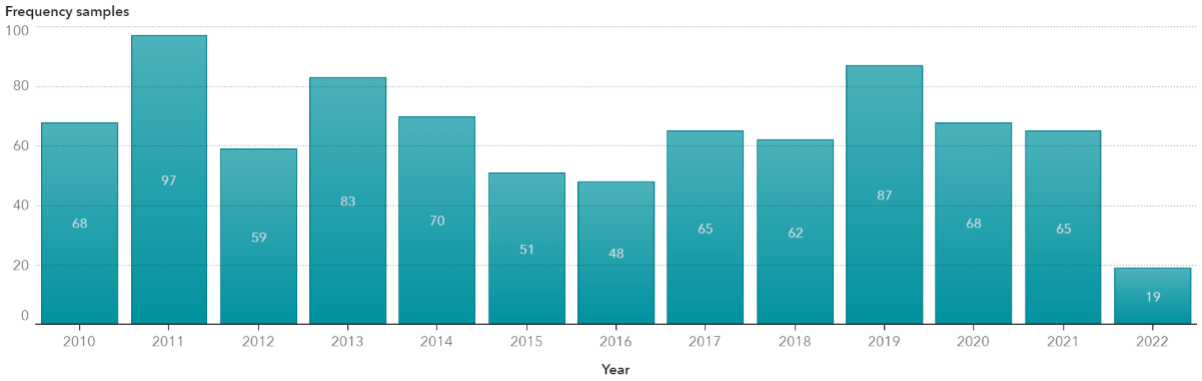


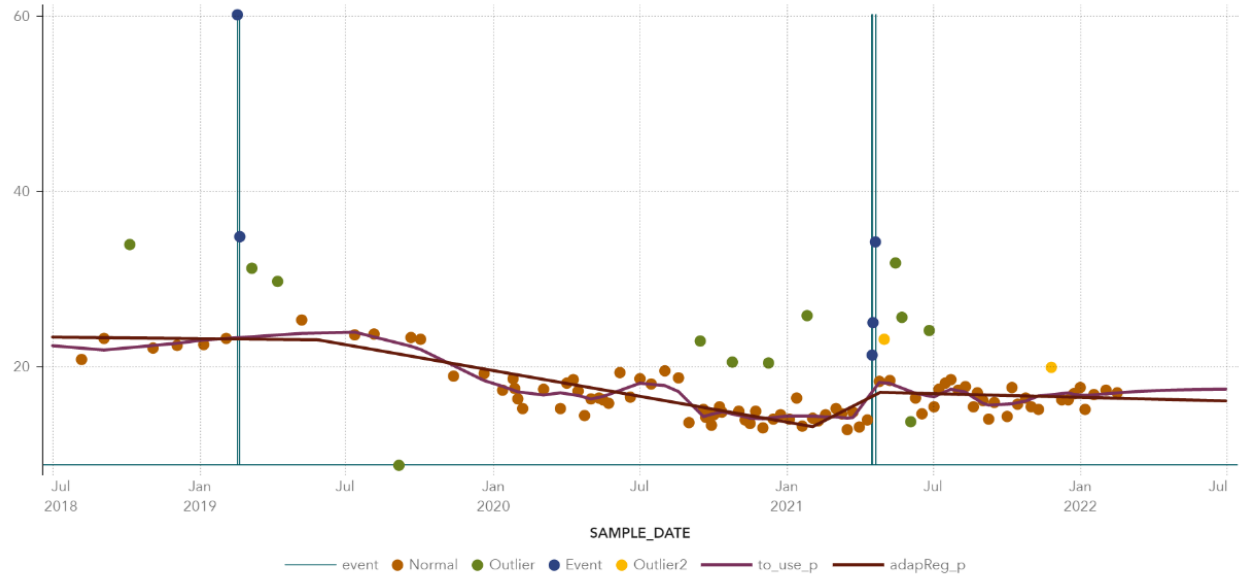


Expanded to day, can easily see trends

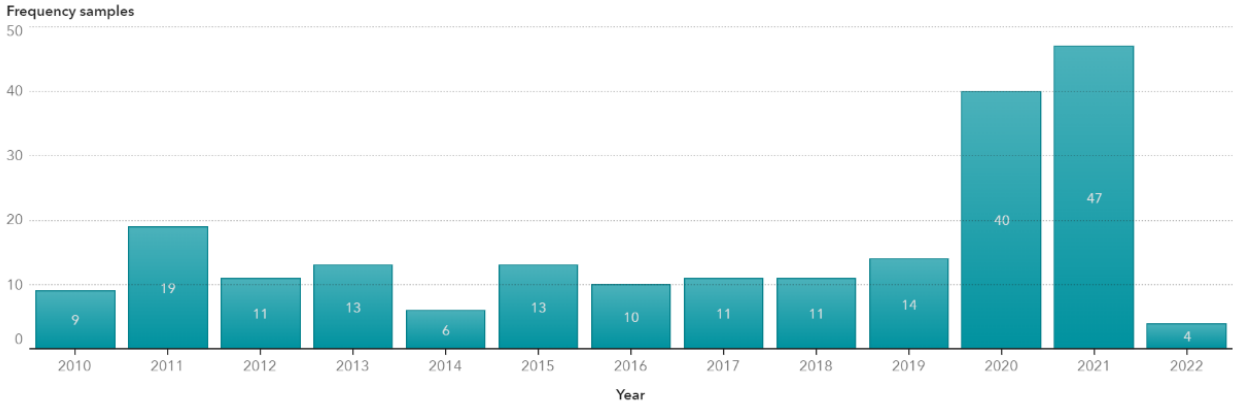


Same well



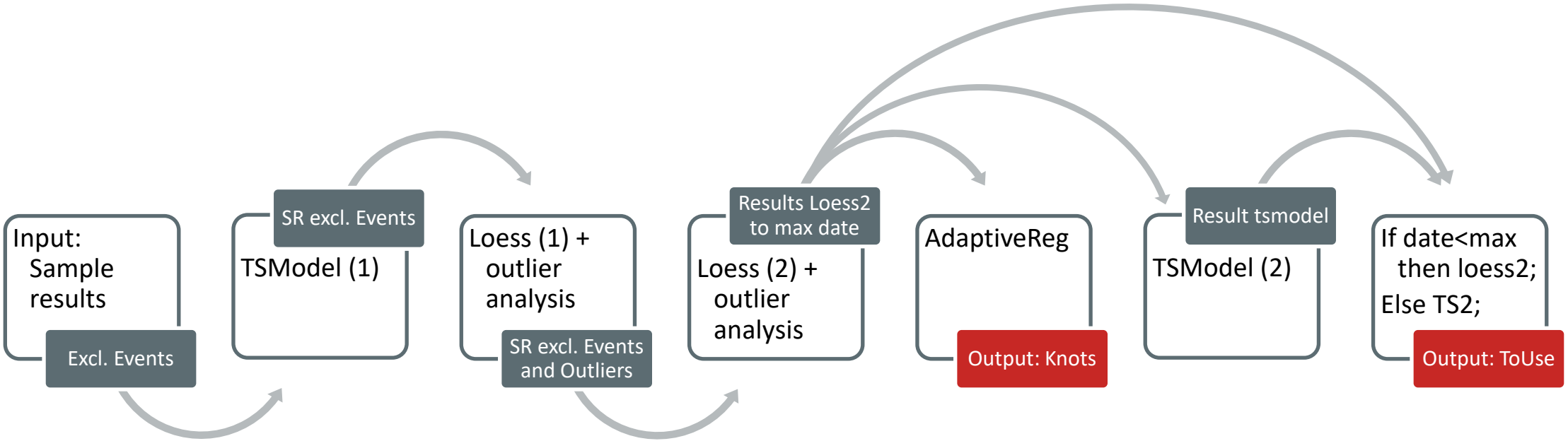


Different well



The method

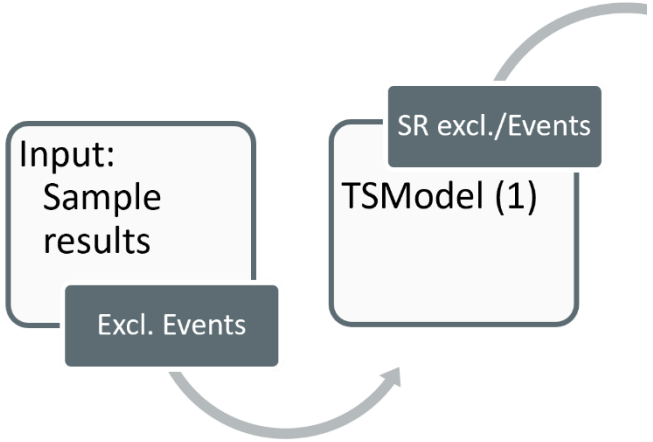
- Tsmodel, with forecast
  - Mainly to get all days imputed
- Smoothing with Loess, to find large outliers
- Remove outliers and smooth again
- Adaptivereg to find breaks in data and get linear trends
- TSModel forecast to get data at all days and calculate risk



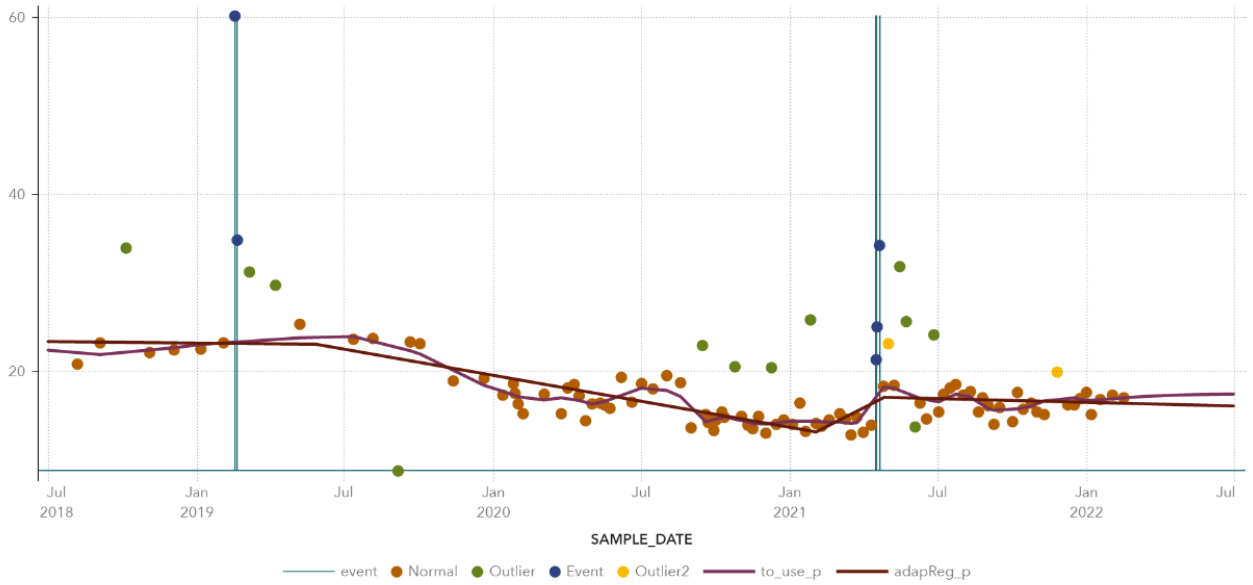
The code - TSModel

```
proc cas;
    session mysession;
    loadactionset "timedata";
    action runTimeCode /
                table={caslib=…, name="preProcessedData", groupBy={{name='SAMPLE_PARAMETER'}, etc.} }
                objOut={{table={caslib=…., name="result_tsmodel", replace="true"}, objRef='outFcast'} }
                seasonality=7
                timeId={name='SAMPLE_DATE', FORMAT="_DATA_"}
                interval="Day"
                series={'SAMPLING_RESULT_excl_event'}
                require={{pkg='TSM'}}
    code='
                declare object myModel(TSM);
                declare object mySpec(ESMSpec);
                rc = mySpec.open( );
                rc = mySpec.SetOption(''method'', ''best'');
                rc = mySpec.close( );

                /* Setup and run the TSM model object */
                rc = myModel.Initialize(mySpec);
                rc = myModel.SetY(SAMPLING_RESULT_excl_event);
                                rc = myModel.SetOption(''horizon'', intnx( "year", today(), 1, "end")) ;
                                rc = myModel.SetOption(''back'',0);
                                rc = myModel.SetOption(''alpha'',0.05);
                rc = myModel.Run( );

                                /* Output model forecasts and estimates */
                declare object outFcast(TSMFor);
                rc = outFcast.Collect(myModel);
        ';
        run;
```

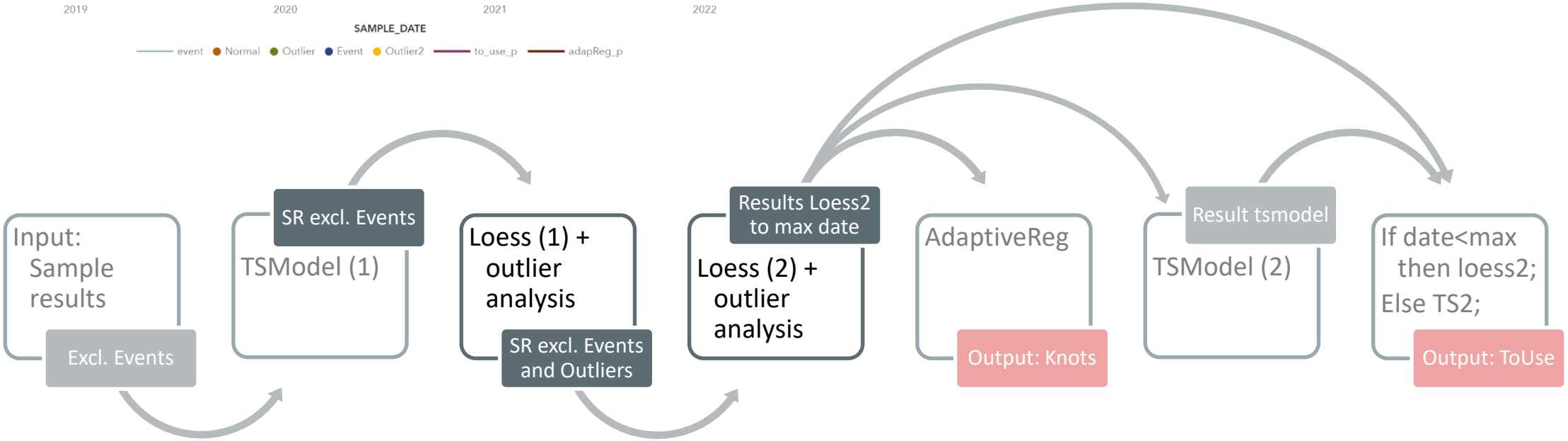
- Actionset: timedata
- Action: runTimeCode
- Pkg: TSM
- Declare object **TSM**
- mySpec SetOption **method**
- MyModel SetOption **horizon**



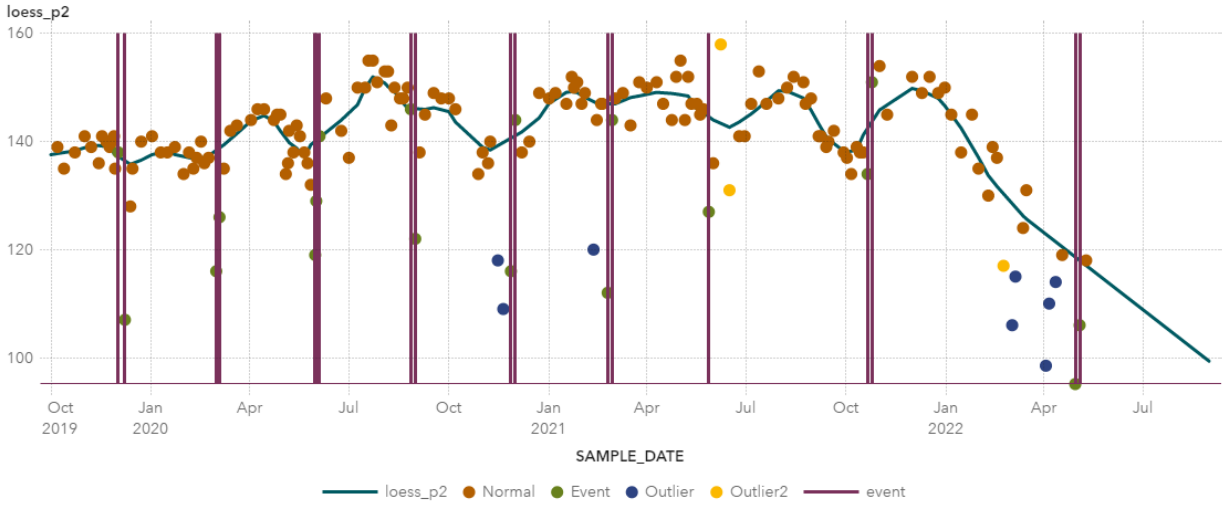
The code – loess and outlier analysis

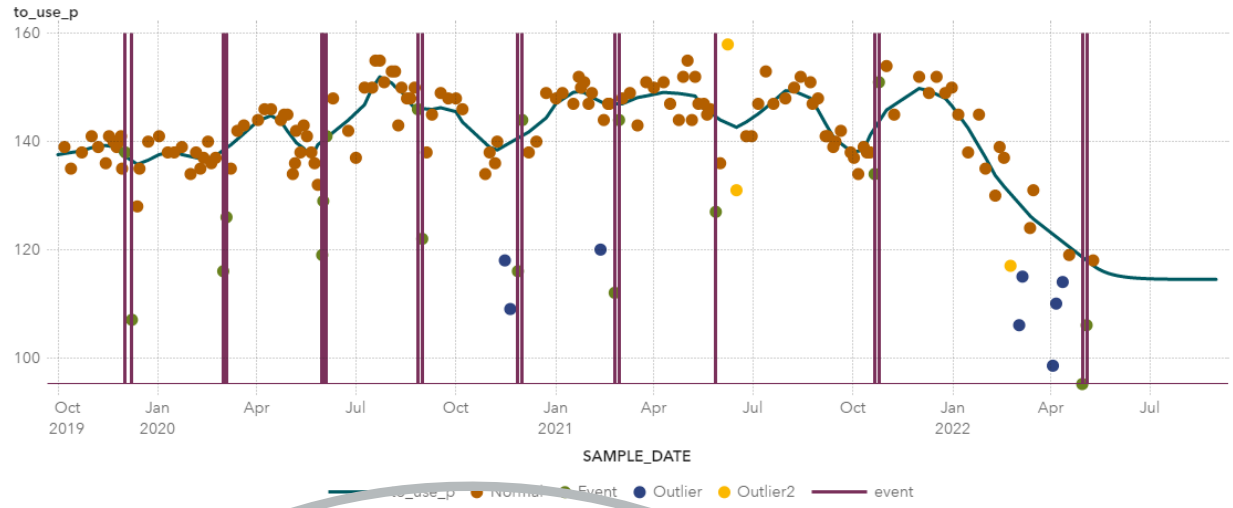


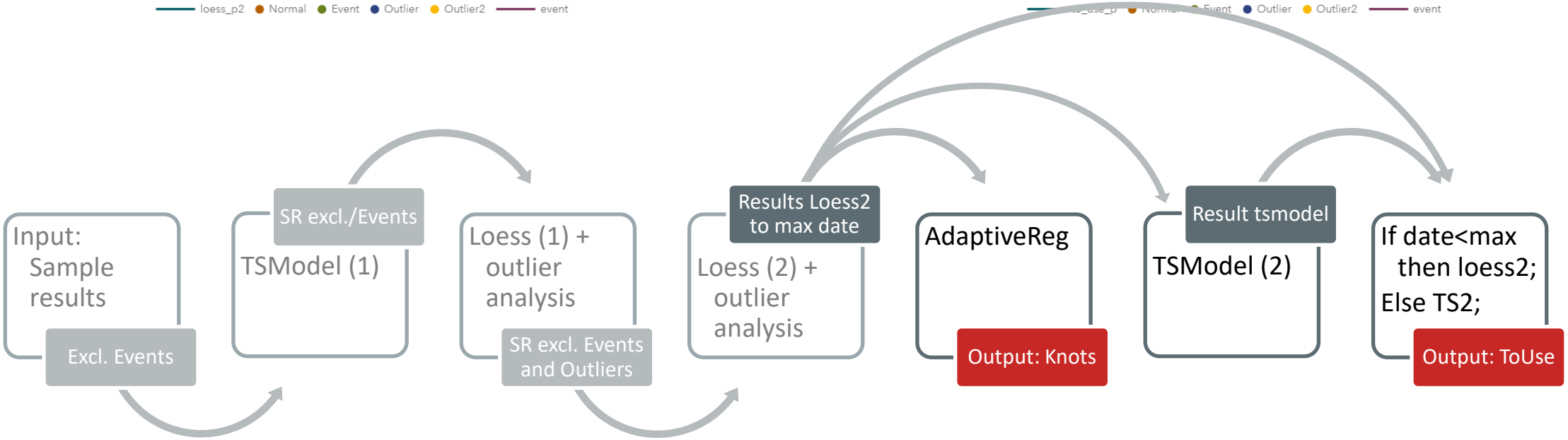
- PROC LOESS
  - Input: sample result excluding events
  - Output: predicted and residual
  - 9.4 procedure
- DATAPREPROCESS.OUTLIER
  - Input: residual
  - Method: IQR
  - scaleMultiplier=1.5



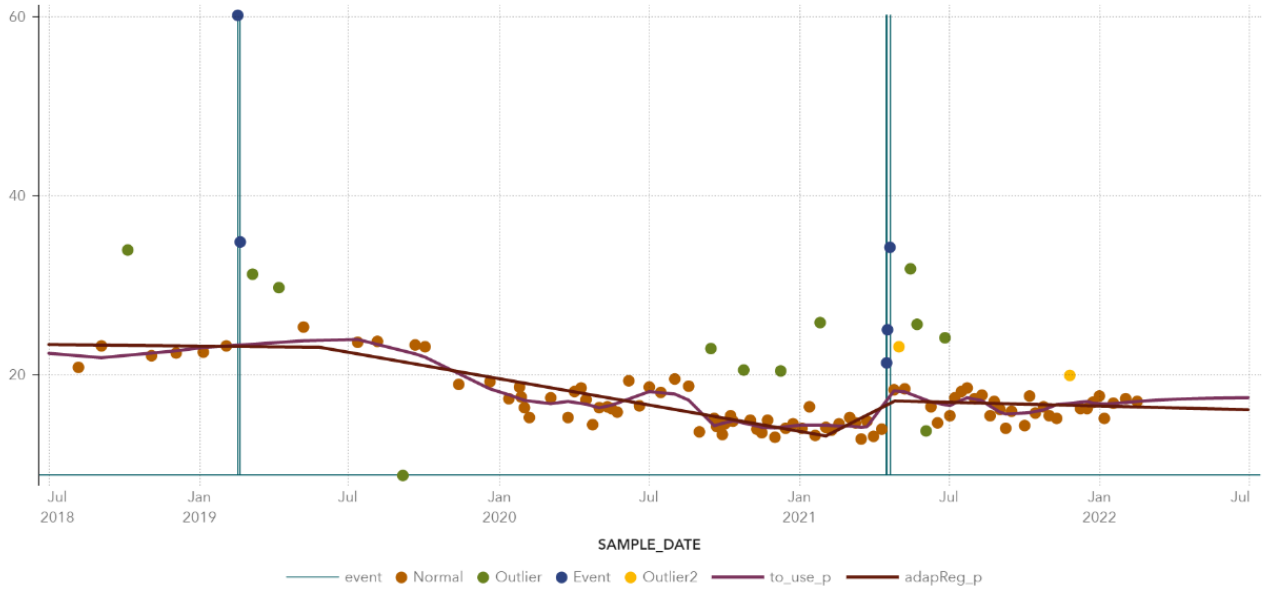
The code – ToUse and Knots



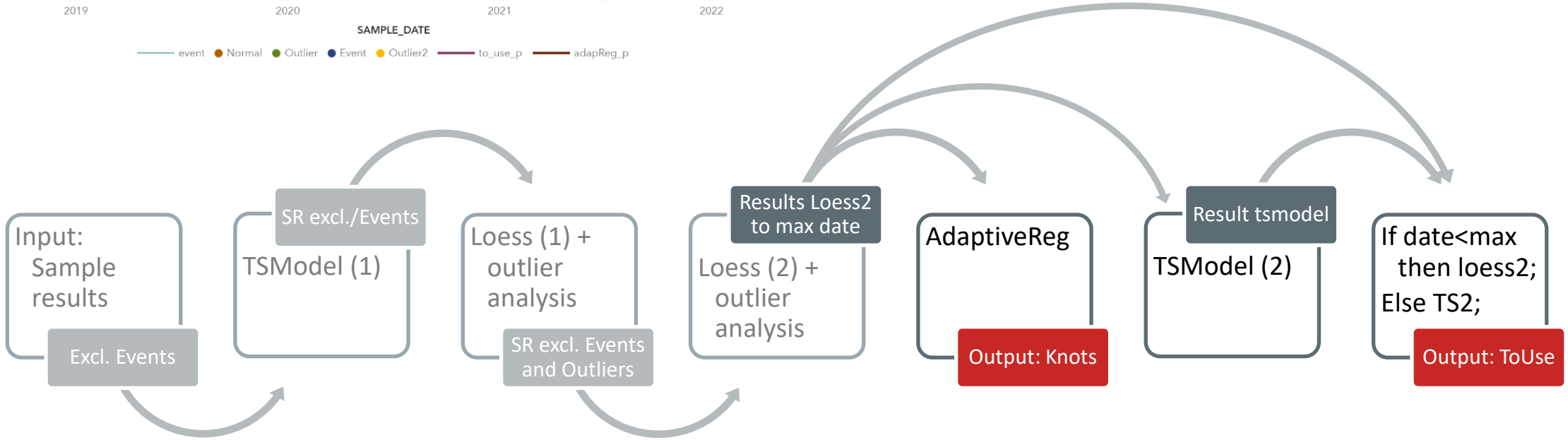




The code – ToUse and Knots

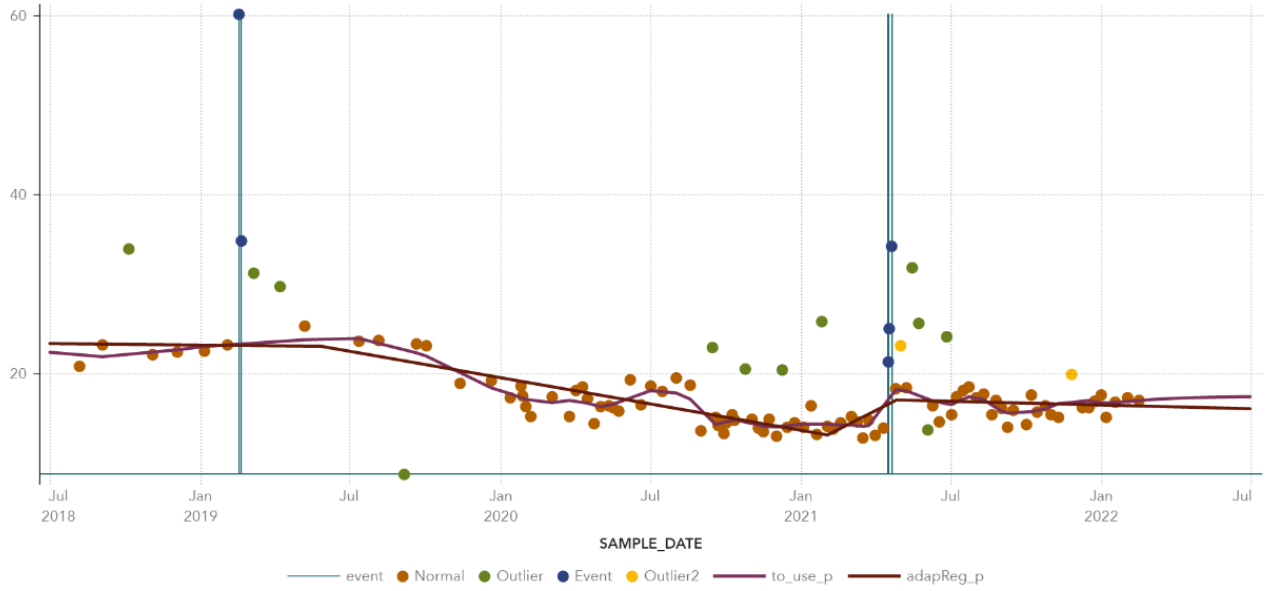


- TSModel
  - Input: loess2 to max date
- PROC ADAPTIVEREG
  - Analyse knots
  - 9.4 procedure



The code – outer structure

- Need to run complete sample history
  - Around 1300 unique keys
  - 1.5M rows -> 66.8M rows
- WhereTable
  - To control selected keys to analyse and to delete and append to final table
- Delete/Append to promoted table
  - CAS action table.deleteRows

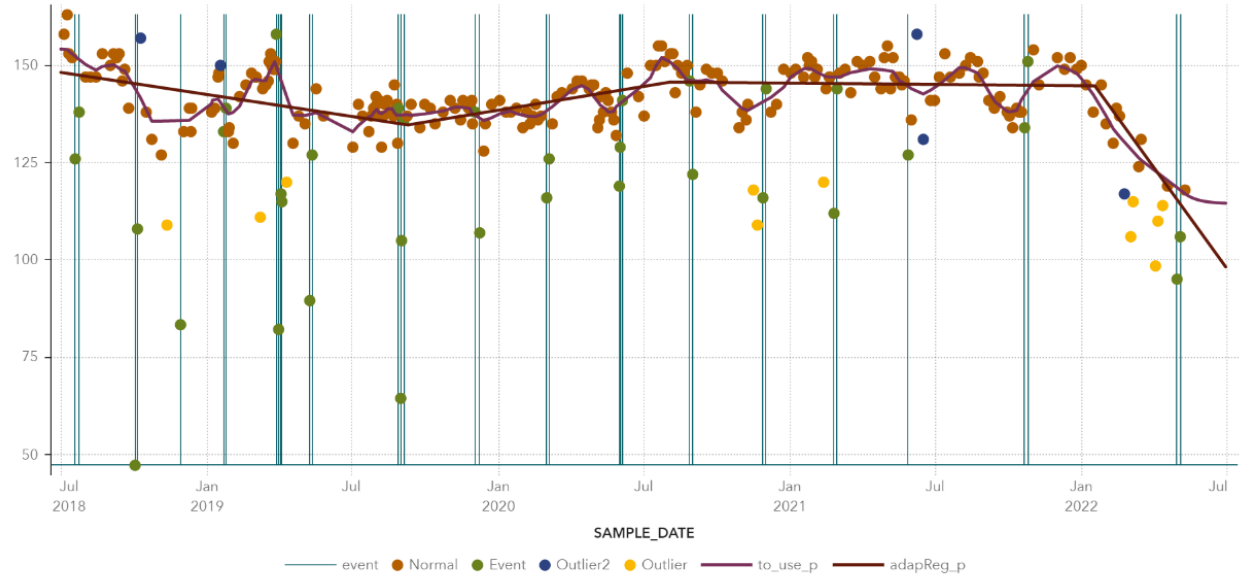


{name='SAMPLE_PARAMETER'}, etc.}

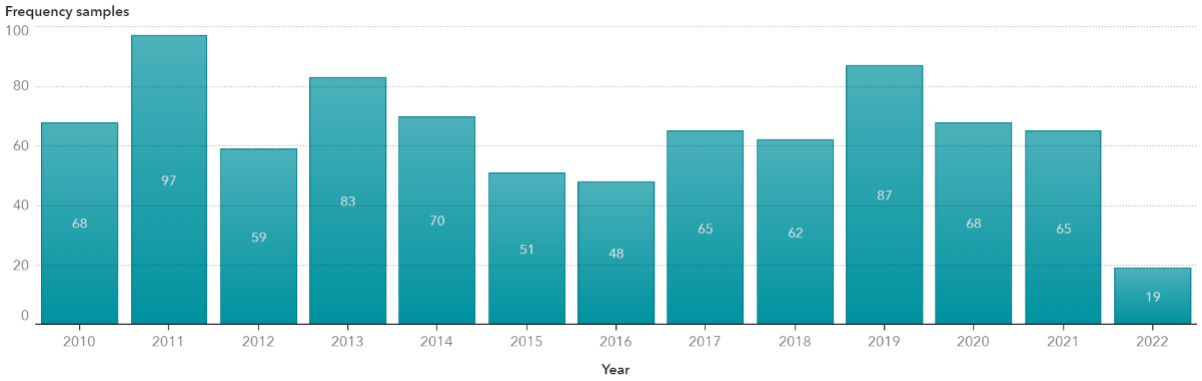
}

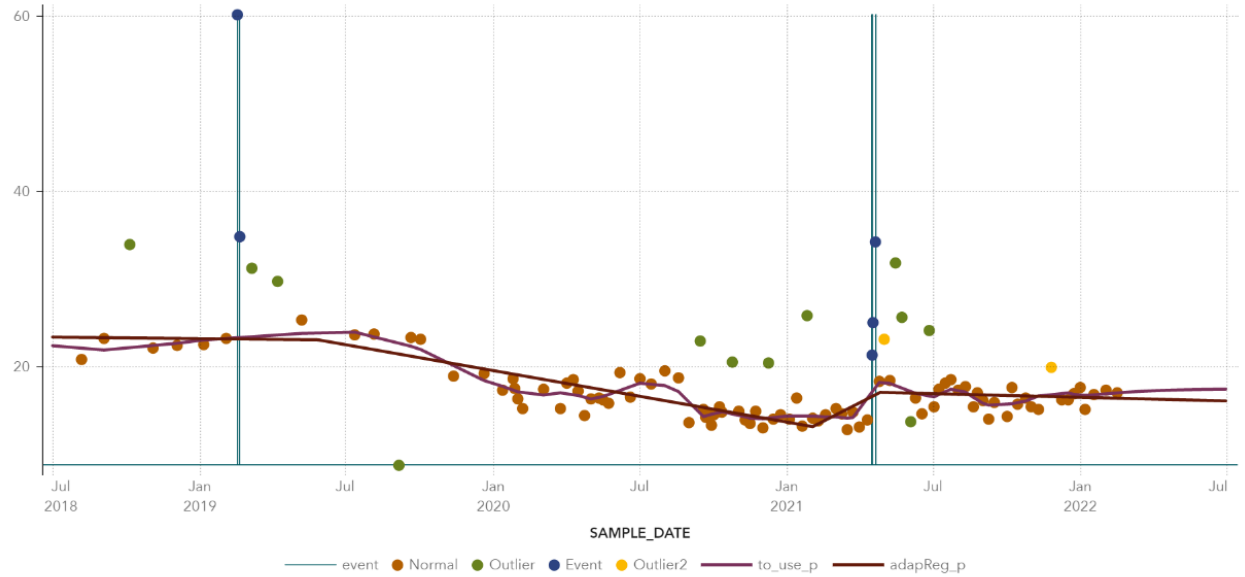
SAMPLE_LOCATION	SAMPLE_PARAMETER	LAST_SRC_MODIFIED_DATE ↓	Run_expantion_Flg
2/7S-28	CO2	24MAY2022:00:00:00	TO_BE_RUN
2/7S-28	H2S_MASS	24MAY2022:00:00:00	TO_BE_RUN
2/7A-14	CO2	23MAY2022:00:00:00	COMPLETED
2/7A-14	H2S_MASS	23MAY2022:00:00:00	COMPLETED

Well events, outliers and smoothed line

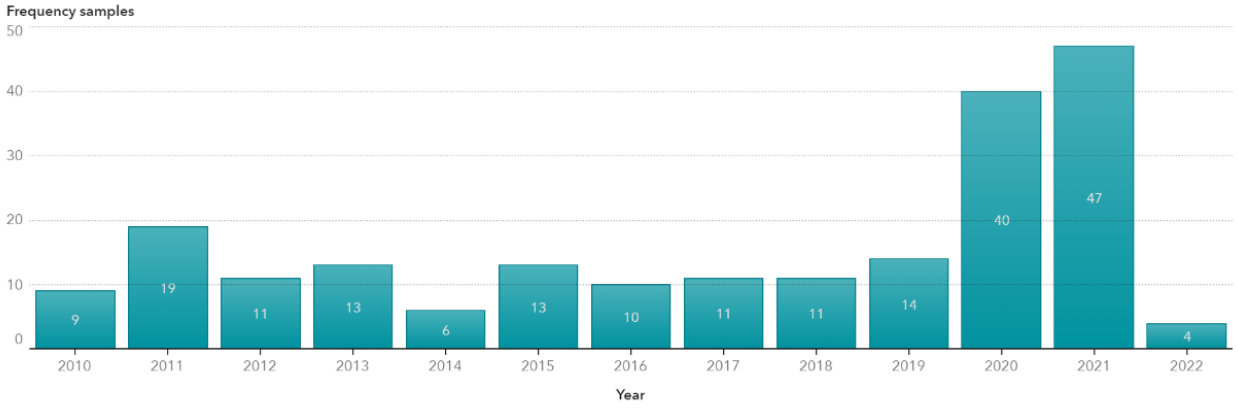


Same well





Different well



The verification/check latest samples dashboard

EKOFISK | ELDFISK | EMBLA | TOR | Plant ▾ | 2/4M-23 ▾ | Location ▾ | Ion - Scale ▾

Select Year

Years ▾

06Jan2022 to 10May2022

06Jan2022 — 10May2022

SAMPLE_DATE	SAMPLE_LOCATION	WELLBORE_OR_SAMPLE_POINT	Sample_count	alarm_value	NormalizedAlarm	No…
10May2022	2/4M-23	2/4-M-23	10	11	1.10	
04May2022	2/4M-23	2/4-M-23	10	0	0.00	
30Apr2022	2/4M-23	2/4-M-23	10	0	0.00	
18Apr2022	2/4M-23	2/4-M-23	10	6	0.60	
12Apr2022	2/4M-23	2/4-M-23	10	13	1.30	
06Apr2022	2/4M-23	2/4-M-23	10	8	0.80	
03Apr2022	2/4M-23	2/4-M-23	10	10	1.00	

SAMPLE_PARAMETER	SAMPLING_RESULT_last	to_use_p	direction	Flag_name	ANALYSIS_PURPOSE
[redacted]	114	121	BelowPred	Outlier	Ion - Scale
	2.8K	3.6K	BelowPred	Outlier	Ion - Scale
	16K	16K	AtPred	Outlier	Ion - Scale
	230	248	BelowPred	Outlier	Ion - Scale
	661	670	AtPred	Normal	Ion - Scale
	333	337	AtPred	Normal	Ion - Scale
	38	37	AtPred	Normal	Ion - Scale