

Delft-FEWS Anwendertreffen **Introducing the new whatif-functionality**

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Outline

- Why a new what-if functionality?
 - What is the Computational Framework ?
- What is the what-if functionality?
- How to use the what-if functionality?
- How to configure ?

Scenario-analysis



WhatIf functionality on the Wiki

[Information about configuration](#)

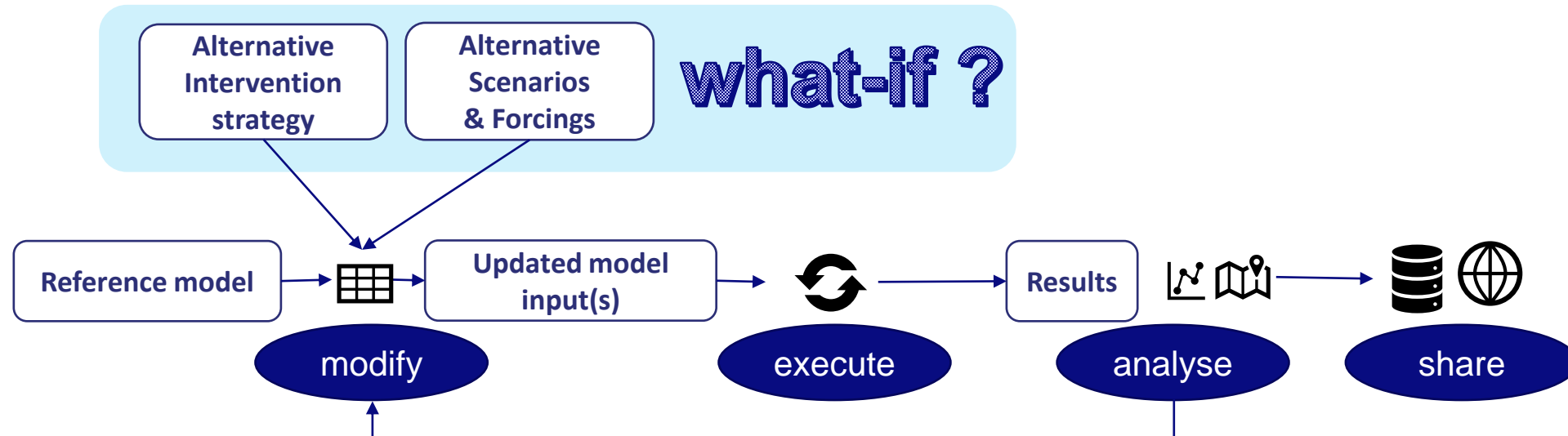
[Information about application](#)

Why?

Customers are interested in what-if scenario analysis:

- during real-time operations
- in model studies

Delft-FEWS is used for those purposes



Why? Application characteristics:

Realtime Operations versus Model Studies

Realtime operations:

- multi-user system (OC/MC/DB/FSS)
- system time (and start time of runs) continuously updated
- automated data removal based on expiry times

Model studies:

- typically single user (Stand-alone)
- fixed system time/start time of the run
- desire for manual control over data removal
- sometimes wish to incorporate non-FEWS displays



Why?

What-if scenario

only applied when what-if **scenario** is **selected** while dispatching a specific workflow

ability to change input data (legacy)

- typical profile timeseries
- module dataset selection
- module parameter selections/adjustments
- properties

Modifiers

always applied when modifier exists

ability to change input data

- timeseries
- location attributes
- spatial
- model parameters

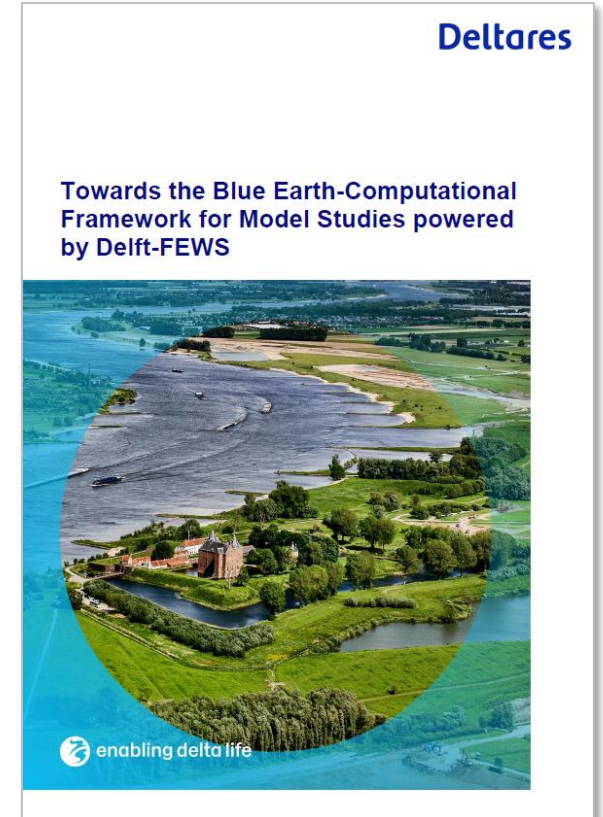
Why?

investigation study 2019

- Improvement wishes
 - Application of modifiers in what-if run only
 - What-if management and access
 - On-the-fly differences
 - Data management
- Renewal of legacy what-if functionality suites the Roadmap Code clean up

Decision

- End of 2019, Deltares decides to improve the existing Delft-FEWS capabilities to facilitate those needs.
- Introduce term ‘Computational Framework’ as an application mode (and architecture choice) for model studies



Computational Framework mode

What has been achieved ?

Software enhancements implemented:

new what-if functionality

- editor allows combination of modifiers, properties, module datasets
- what-if access integrated in IFD
 - what-if editor
 - what-if visualization in TimeSeriesDisplay
 - what-if visualization in SpatialDisplay
- by default executed as non-approved runs

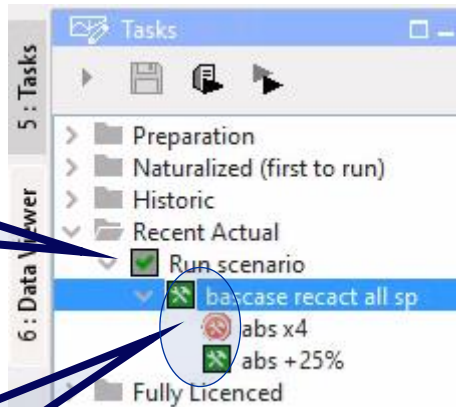
on-the-fly difference plots between selected runs:

- Spatial Display
- TimeSeriesDisplay after selecting function: difference plot





What-If access integrated in IFD

- What-if access via IFD (task/forecast tree)
 - Whatif Editor used for composition, comparing inputs, deleting

IFD-
segment
node

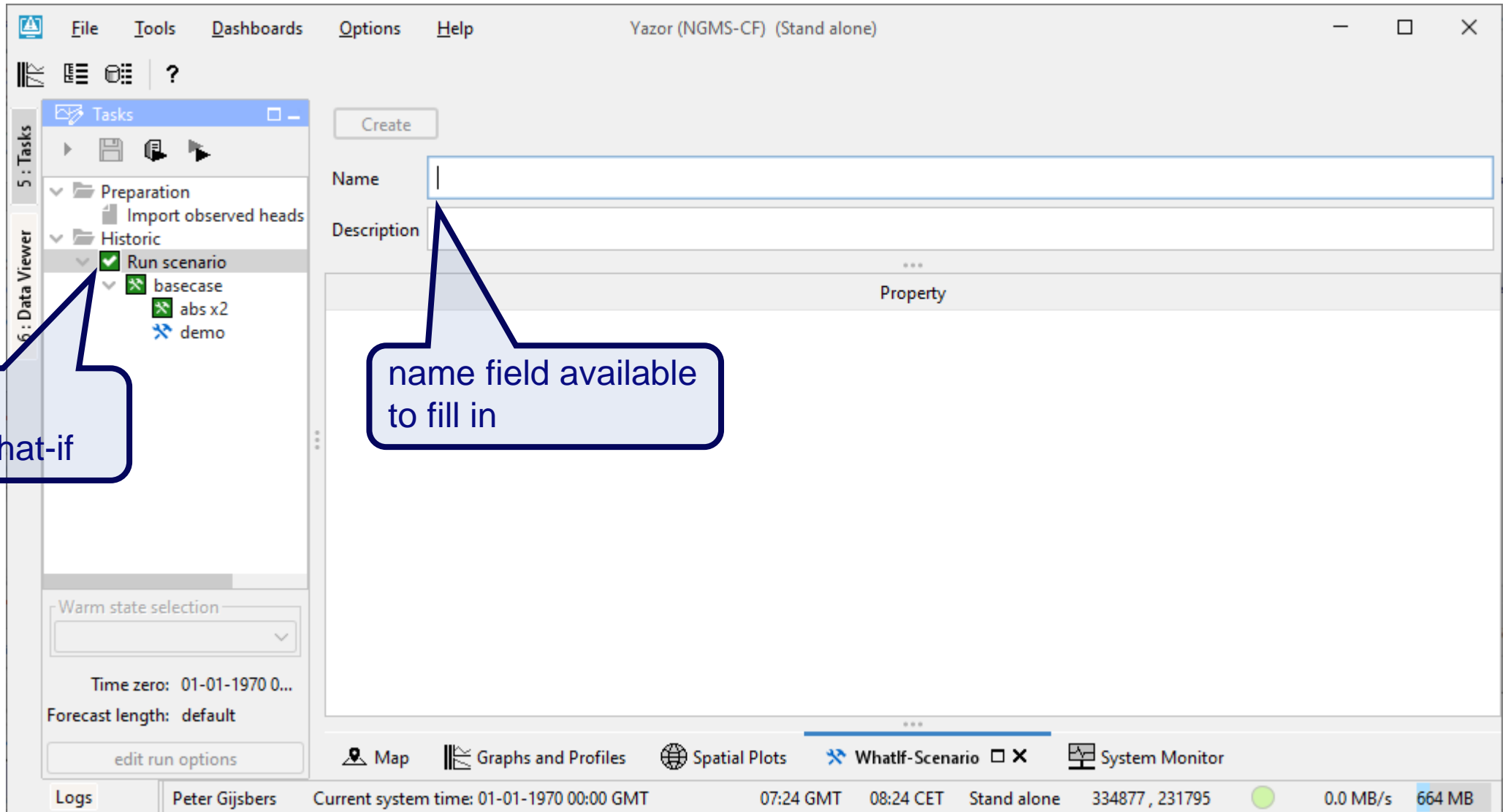


IFD-
what-if
nodes

Icon	Meaning	Status
	whatif defined (not run yet)	Can be changed
	whatif run locally	Can be changed
	whatif run on server	Can not be changed
	whatif run failed	

Deltares

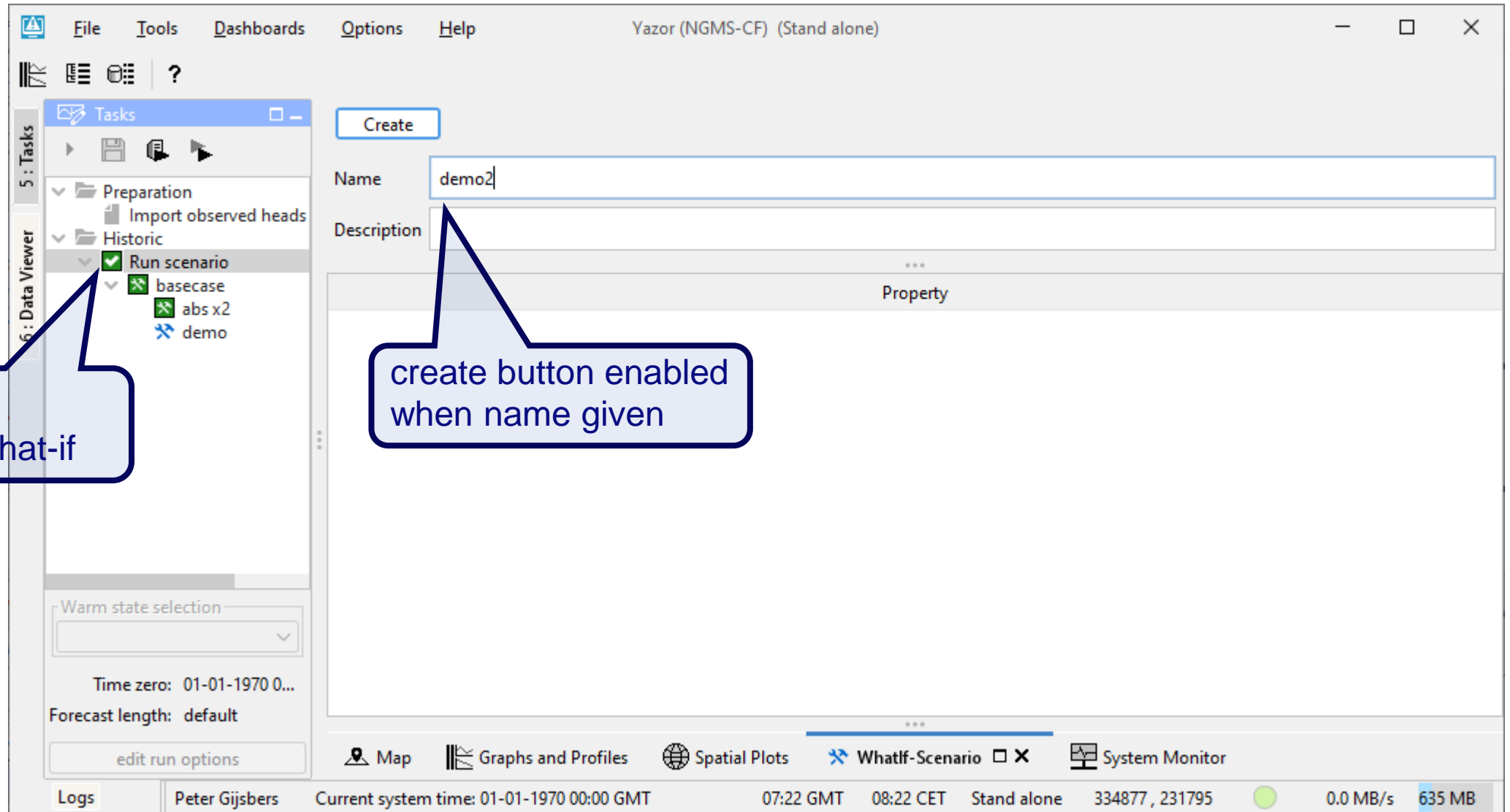
What-If creation



IFD node offering what-if

name field available to fill in

What-If creation



IFD node offering what-if

create button enabled when name given

What-If composition

what-if management

modifiers:

- edit
- copy from
- delete

properties:

- select
- edit

edit embedded modifiers

- timeseries
- location attributes

Copy Historic abstraction series and recharge for reuse in what-if: [1] Run scenario (basecase) 01-01-1970 00:00:00 GMT Current basecas

Operation	Time series	GMT
01-01-1971 00:00		
08-01-1971 00:00		
15-01-1971 00:00	-221.400	0.000
22-01-1971 00:00	-221.400	0.000
01-02-1971 00:00	-221.400	0.000
08-02-1971 00:00	-220.400	0.000
15-02-1971 00:00	-220.400	0.000
22-02-1971 00:00	-220.400	0.000
01-03-1971 00:00	-220.400	0.000
08-03-1971 00:00	-222.300	0.000
15-03-1971 00:00	-222.300	0.000
22-03-1971 00:00	-222.300	0.000
01-04-1971 00:00	-222.300	0.000
08-04-1971 00:00	-223.000	0.000
15-04-1971 00:00	-223.000	0.000
22-04-1971 00:00	-223.000	0.000

What-If composition

Yazor (NGMS-CF) (Stand alone)

File Tools Dashboards Options Help

Copy Apply Delete Export Import

Name: demo

Description: ...

Property	demo
Historic Scenario	
Abstraction adjustments	
Change abstraction rates (Historic)	<input checked="" type="checkbox"/> abs +50% [icon] [icon] [icon]
Add new abstraction wells	<input type="checkbox"/> No modifier defined [icon] [icon] [icon]
Specify abstractions rates for new wells (Historic)	<input type="checkbox"/> No modifier defined [icon] [icon] [icon]
Zonebudget	
Override zonebudget setting	Include all zonebudget (model boundary + qwunits) (slower)
Statistics	
Override statistics setting	Include all statistics (slower) - all layers H, Qsw
Difference to Naturalized scenario	
Override differences setting	Include all differences (slower) - all layers H, Qsw, Qxy, Qz
Number of stress periods from start (used for testing purposes)	
Override number of stress periods (total=2844, timestep=semi-weekly, start=01-01-1970 00:00:00, ...)	All stress periods

Name: [input] Copy

Mod type	Scenario	Name	Summary ^	Locations	Start	End	Valid Time	User	Creation time
Change ...	abs x2	abs x2	Multiply 2.0	BOREHOLE NEAR LIN...	01-01-1970 00:00:00	02-01-2029 00:00:00	--	Peter Gijsbers	19-09-2022 07:10:...

Warm state selection: [dropdown]

Time zero: 01-01-1970 ...

Forecast length: default

edit run options

Map Graphs and Profiles Spatial Plots WhatIf-Scenario [x] System Monitor Timeseries Lister

Logs Peter Gijsbers Current system time: 01-01-1970 00:00 GMT 07:06 GMT 09:06 CEST Stand alone 343259, 232690 0.0 MB/s 594 MB

copy modifiers from:
• spatial modifiers
• parameter modifiers

What-If composition and comparison

5 : Tasks

- Preparation
- Naturalized (first to run)
- Historic
- Recent Actual
 - Run scenario
 - bascase recact all sp
 - abs x4
 - abs +25%
- Early licenced

6 : Data Viewer

select multiple what-if nodes

Test-Itchen (NGMS-AKS) (Operator Client)

Copy Apply Delete Export Import

Name

Description

Property	abs +25%	bascase recact all sp
Recent Actual Scenario		
Abstraction adjustments		
Change abstraction rates (Recent Actual)	<input checked="" type="checkbox"/> abs+25%	<input type="checkbox"/> No modifier defined
Add new abstraction wells	<input type="checkbox"/> No modifier defined	<input type="checkbox"/> No modifier defined
Specify abstractions rates for new wells (Recent Actual)	<input type="checkbox"/> No modifier defined	<input type="checkbox"/> No modifier defined
Zonebudget		
Override zonebudget setting	Include all zonebudget (model boundary + qwunits) (slower)	Include all zonebudget (model boundary + qwunits) (slower)
Statistics		
Override statistics setting	Include all statistics (slower) - all layers H, Qsw	Include all statistics (slower) - all layers H, Qsw
Difference to Naturalized scenario		
Override differences setting	Include all differences (slower) - all layers H, Qsw, Qxy, Qz	Include all differences (slower) - all layers H, Qsw, Qxy, Qz
Number of stress periods from start(used for testing purposes)		
Override number of stress periods (total=1278, timestep=halfmonth, start=01-01-1965 00:00:00)	All stress periods	All stress periods

Map Graphs and Profiles Spatial Plots WhatIf-Scenario System Monitor

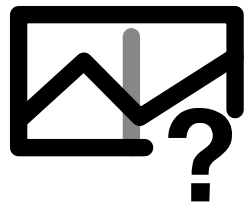
Logs Peter Gijbers Current system time: 26-10-2022 14:00 GMT 15:13 GMT 15:13 UTC mc00 441467, 139190 0.0 MB/s 1.0 GB

Accessibility in multi-user context

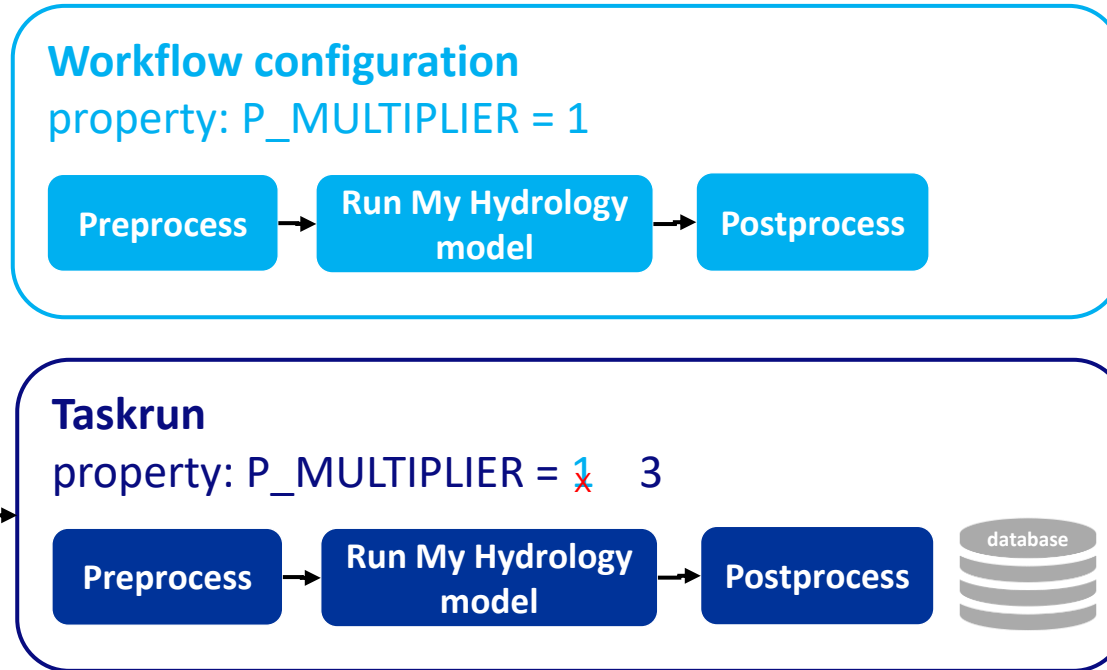
- What-if definitions are only visible in the IFD for all OCs if the what-if has been submitted to the server
- Permission control has not (yet) been implemented for what-if management (creation, deletion)

- Once created, what-ifs can also be selected from the Manual Forecast Display

What-if execution How does it work ?



P_MULTIPLIER = 3



What-if runs are *unapproved* by default

What-if execution

Want to approve the what-if run ?

- Use the Approve option in the Forecast Management dialog

select
and
approve

Forecasts in Central Database

..	T0	Dispatch time	Workflow	What-if s...	Description	FDO	FS...	FSS Group ID	Runti...	Output Ti...	Approve
			01-01-1965 00:00:00	10-10-2022 12:12:28	Run Recent Actual	abs +25%	Run scenari...	Peter Gijbers	481	windows	5 h 47 ...	53 y 103 d	

- Auto-approve before submitting the run
 - configure the visibility of the 'Approve checkbox' of the IFD (Topology.xml):
`<enableAutoApprove>true</enableAutoApprove>`
 - Put a check in the box before submitting the what-if run

Time zero: 01-01-1965 00:00:00
Forecast length: default
Approve:
edit run options

Inspecting results

Access via IFD

Inspecting a what-if run

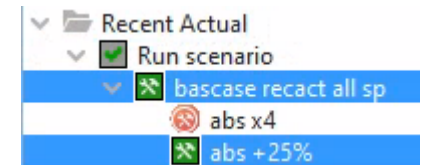
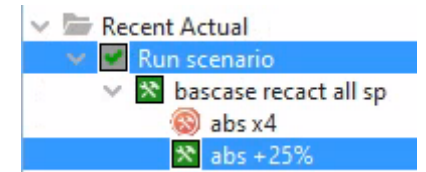
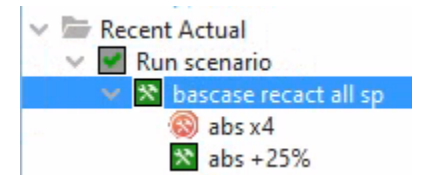
- Select the whatif-node in the IFD
 - The associated timeseries are visualized in the TimeSeries and SpatialDisplay
 - The Current Run is not shown

Inspecting a what-if run and the Current Run

- Select the segment node of the IFD as well as a what-if node

Inspecting multiple what-if runs

- Select multiple what-if nodes



What-If comparison: Spatial Display access via IFD

Choice between Absolute and Relative difference

Legend which run compares to what

Run Recent Actual: Run scenario (bascase recact all sp) 01-01-1965 00:00:00 GMT bascase recact all sp compared to Run Recent Actual: Run scenario (abs +25%) 01-01-1965 00:00:00 GMT abs +25%

© OpenStreetMap contributors

15:15 GMT 15:15 UTC mc00 454462, 140057 0.0 MB/s 1.1 GB

What-If comparison: Time Series Display access via IFD

File Tools Dashboards Options Help Test-Itchen (NGMS-AK) (Operator Client)

Tasks

- Preparation
- Naturalized (first to run)
- Historic
- Recent Actual
 - Run scenario
 - bascase react all sp
 - abs x4
 - abs +25%
- Fully Licenced

Warm state selection

Time zero: 26-10-2022 14:00:00

Forecast length: default

edit run options

Logos Peter Gijbers

Current system time: 26-10-2022 14:00 GMT

15:27 GMT 15:27 UTC mc00 428424, 135388 0.0 MB/s 1.2 GB

195. LYNCH HILL WHITCHURC

Heads (m)

0.016
0.015
0.014
0.013
0.012
0.011
0.010
0.009
0.008
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0.000

01-02-1972 01-01-1978 01-01-1983 01-01-1988 01-01-1993 01-01-1998 01-01-2003 01-01-2008 01-01-2013

Run Recent Actual: [1] Run scenario (abs +25%) 01-01-1965 00:00:00 GMT abs +25%

Run Recent Actual: [2] Run scenario (bascase react all sp) 01-01-1965 00:00:00 GMT bascase react all sp

Map Graphs and Profiles Spatial Plots WhatIf-Scenario System Monitor

Choose which run is your baseline

Choose how to view

Legend shows which what-if is what run

Relative difference(%) Hide original series

H.gw.RecAct [2] : Difference plot

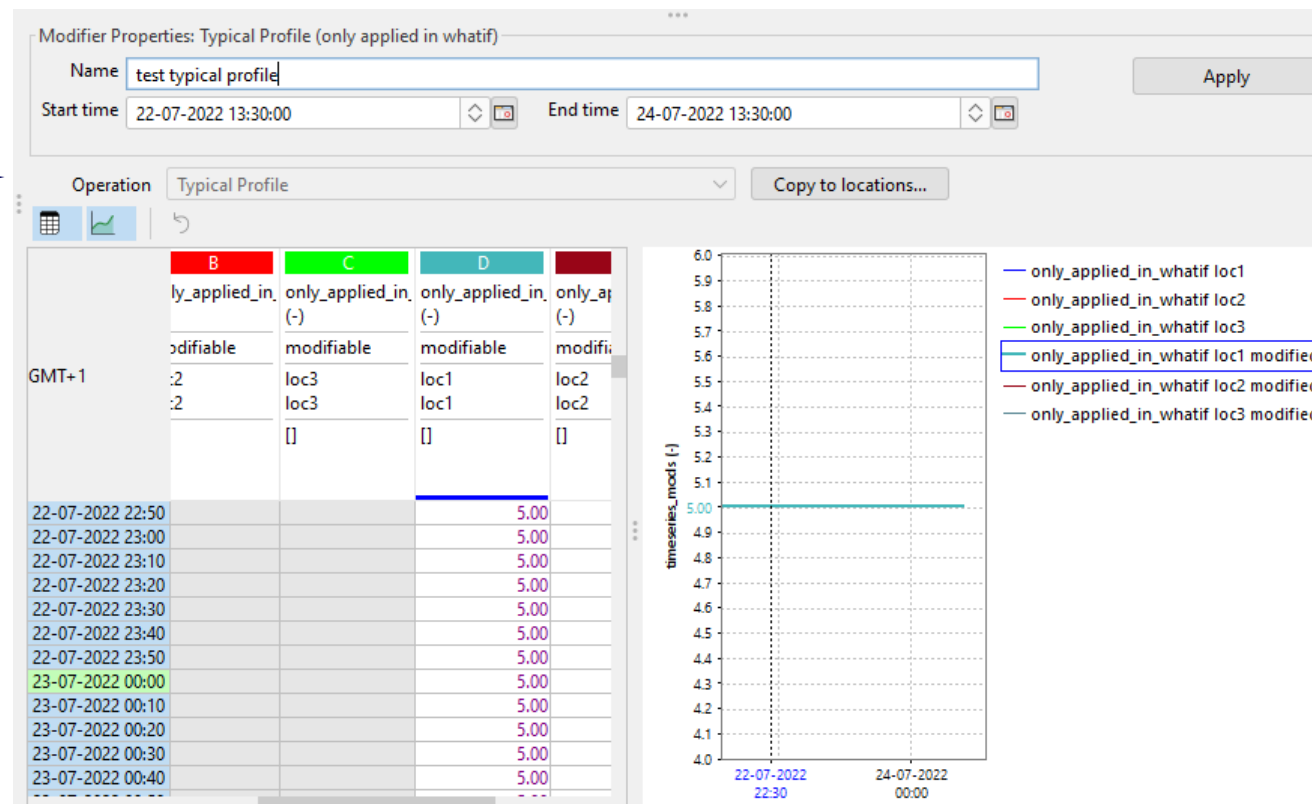
H.gw.RecAct [1] : Difference plot

typicalProfile Modifier

- A typicalProfile modifier applies a timeseries array relative to T0 ('fixed' when creating the modifier)
- Timeshift applied to the array when applying at a different T0 (as is common in live systems)

'fixed' version of a timeseriesModifier (also available as operation choice in normal timeseriesModifier)

'T0' timestamp of the typical profile



Configuration

- The **structure** of a What-If is specified in a WhatIfTemplate:
 - RegionConfigFiles/**WhatIfTemplates.xml**
- A WhatIfTemplate is workflow specific
 - **connection** defined in **WorkflowDescriptors.xml**
- Modifiers can be made what-if-specific:
 - **modifier behavior** defined in **ModifierTypes.xml**

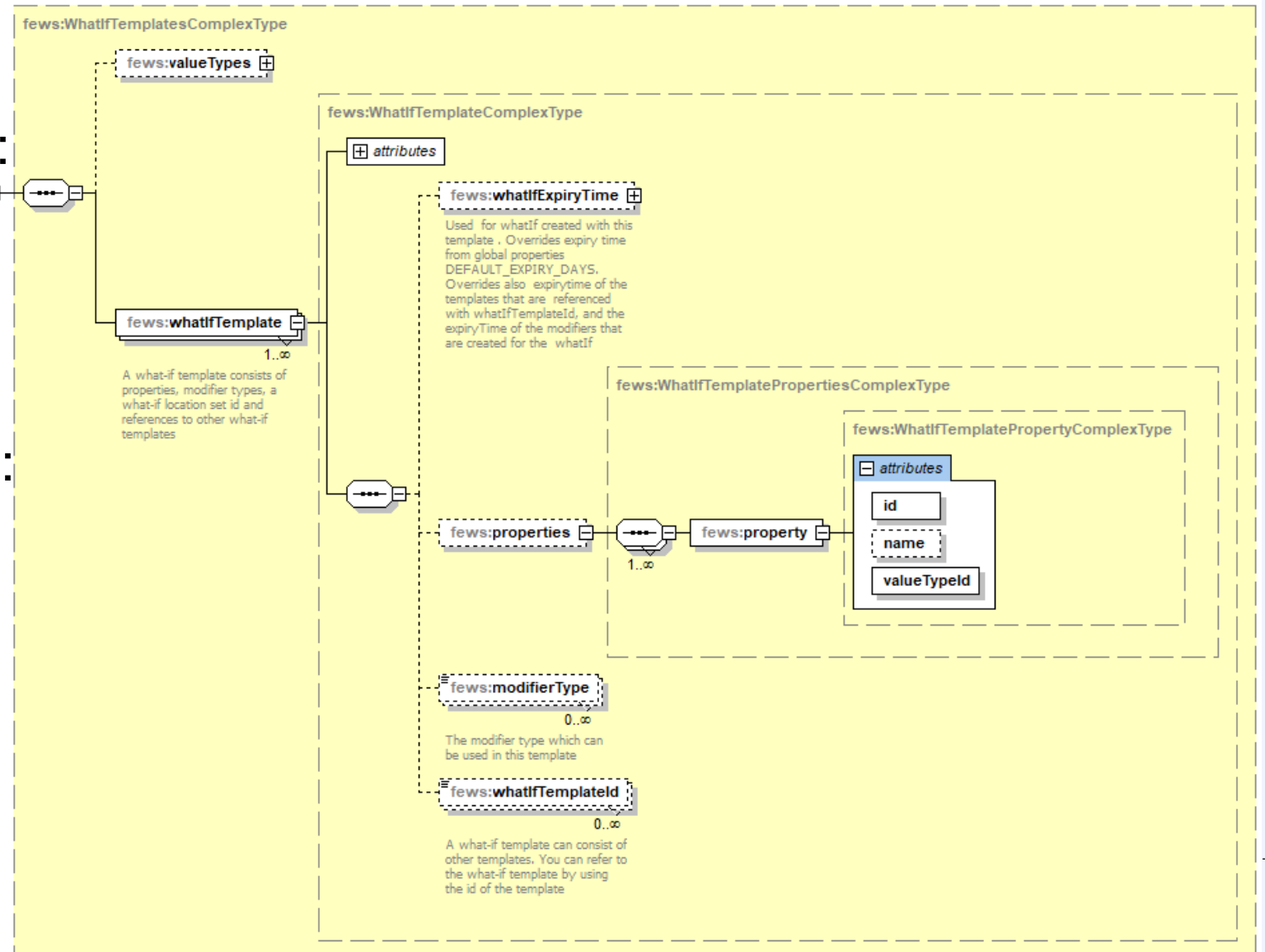
Configuration: WhatIfTemplates.xsd

A **whatif-instance** can hold:

- property values
- references to modifiers included

A **WhatifTemplate** can hold:

- property keys
- Modifier types
- whatif-template nesting

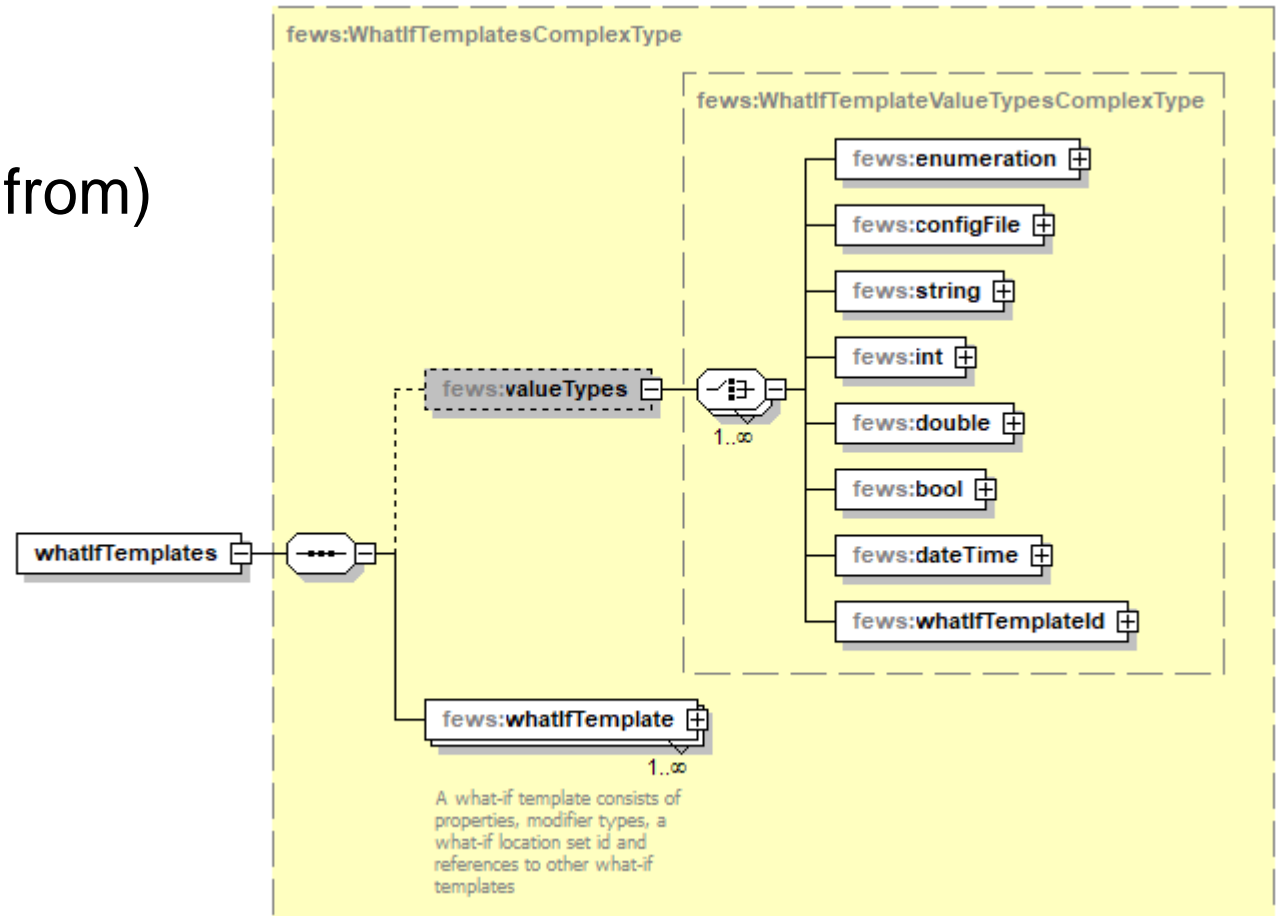


Configuration: WhatIfTemplates.xsd

valueTypes define property keys
(and possibly its values to select from)

Available configuration options:

- string (entry)
- enumeration (selection)
- int (entry)
- double (entry)
- configFile (selection)
 - parameter file
 - moduledataset
 - cold state
- whatIfTemplateId
 - can be used to reference an existing what-if instance to pass on associated timeseries



Configuration: WhatIfTemplates.xml example

- Example property

```
<whatIfTemplate id="$MODELID$_n_stress_hist" name="Number of stress periods from start (used for testing purposes)">  
  <properties>  
    <property id="N_STRESS_PERIOD" valueType="n_stress_period_selection" name="Override number of stress periods"/>  
  </properties>  
</whatIfTemplate>
```

```
<valueTypes>  
  <enumeration id="n_stress_period_selection" default="1000000">  
    <value code="24" label="24 stress periods"/>  
    <value code="48" label="48 stress periods"/>  
    <value code="96" label="96 stress periods"/>  
    <value code="1000000" label="All stress periods"/>  
  </enumeration>
```

Property based
on ValueType

ValueType
definition

Workflow
property key

Number of stress periods from start (used for testing purposes)	
Override number of stress periods (total=2844, timestep=semi-weekly, start=01-01-1970 00:00:00, ...	All stress periods
	24 stress periods
	48 stress periods
	96 stress periods
	All stress periods

Configuration: WhatIfTemplates.xml example







- Example modifier

ModifierType coming from Modifiertypes.xml

```
<whatIfTemplate id="$MODELID$_change_abstractions_hist" name="Abstraction adjustments">  
  <modifierType>change_abstraction_rates_hist</modifierType>  
  <modifierType>add_new_wells</modifierType>  
  <modifierType>new_wells_abstraction_rates_hist</modifierType>  
</whatIfTemplate>
```

Property based
on ValueType

WhatIfTemplate
header

Abstraction adjustments	
Change abstraction rates (Historic)	<input checked="" type="checkbox"/> abs + 50%   
Add new abstraction wells	<input type="checkbox"/> No modifier defined   
Specify abstractions rates for new wells (Historic)	<input type="checkbox"/> No modifier defined   

Configuration: WhatIfTemplates.xml example

- Example whatif-template nesting

```
<whatIfTemplate id="$MODELID$_whatif_hist" name="Historic Scenario">  
  <whatIfTemplatelid>$MODELID$_change_abstractions_hist</whatIfTemplatelid>  
  <whatIfTemplatelid>$MODELID$_zb_hist</whatIfTemplatelid>  
  <whatIfTemplatelid>$MODELID$_n_stress_hist</whatIfTemplatelid>  
</whatIfTemplate>
```

Each whatIfTemplate
in bold

Historic Scenario
Abstraction adjustments
Change abstraction rates (Historic)
Add new abstraction wells
Specify abstractions rates for new wells (Historic)
Zonebudget
Overrule zonebudget setting
Statistics
Overrule statistics setting
Difference to Naturalized scenario
Overrule differences setting
Number of stress periods from start (used for testing purposes)
Overrule number of stress periods (total=2844, timestep=semi-weekly, sta

Configuration: connecting to a workflow

A WhatIfTemplate is connected to a workflow in the WorkflowDescriptors.xml

```
> <workflowDescriptor id="RunHistoric" name="Run Scenario" forecast="true" visible="true" autoApprove="false">  
  <workflowFileName>RunModelWorkflow</workflowFileName>  
  <runExpiryTime unit="hour" multiplier="6"/>  
> <properties>  
  <string key="REFTYPE" value="hist"/>  
  <string key="ZBLEVEL" value="all"/>  
  <string key="STATPROCLEVEL" value="All"/>  
  <string key="DIFPROCLEVEL" value="All"/>  
  <string key="N_STRESS_PERIOD" value="1000000"/>  
  </properties>  
  <timeOut unit="hour" multiplier="12"/>  
  <whatIfTemplateId>$MODELID$_whatif_hist</whatIfTemplateId>  
</workflowDescriptor>
```

reference to
what-if template

Configuration: modifierTypes.xsd

Modifier behavior:

- always apply in workflow (=default)
- only apply if referenced in what-if workflow
- never apply in what-if workflow
- Apply as created

Specified using:

- whatIfModifierType (optional)

```
<timeSeriesModifier id="change_abstraction_rates_hist" name="Change abstraction rates (Historic)">
  <expiryTime unit="day" multiplier="3650"/>
  <expiryTimeDeletedModifiers unit="day" multiplier="365"/>
  <whatIfModifierType>a</whatIfModifierType>
  <timeSeries>
    <moduleInstanceld>always apply in workflow</moduleInstanceld>
    <parameterId>QSF</parameterId>
    <locationSetId>$MODELID$_wells_all_shape</locationSetId>
    <timeSeriesType>simulated forecasting</timeSeriesType>
  </timeSeries>
  <defaultStartTime>time zero</defaultStartTime>
  <defaultEndTime>end run</defaultEndTime>
  <resolveInWorkflow>true</resolveInWorkflow>
  <resolveInPlots>false</resolveInPlots>
</timeSeriesModifier>
```

Configuration: Explorer.xml

- Add the what if editor to your displays in the Explorer.xml

```
<explorerTask name="Whatif">  
  <predefinedDisplay>what if editor</predefinedDisplay>  
  <toolbarTask>true</toolbarTask>  
  <menubarTask>true</menubarTask>  
  <loadAtStartup>true</loadAtStartup>  
</explorerTask>
```

Thank you

Available in Release 2022.01

Questions ?

Opportunities ?

Concerns ?

Demonstration

Typical profile modifier in OC

Contact

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