

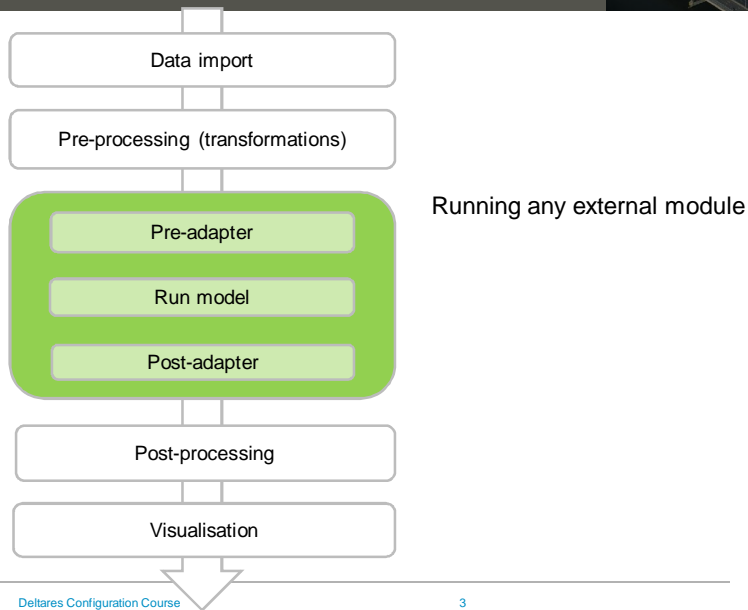


Delft-FEWS
Advanced Configuration Course

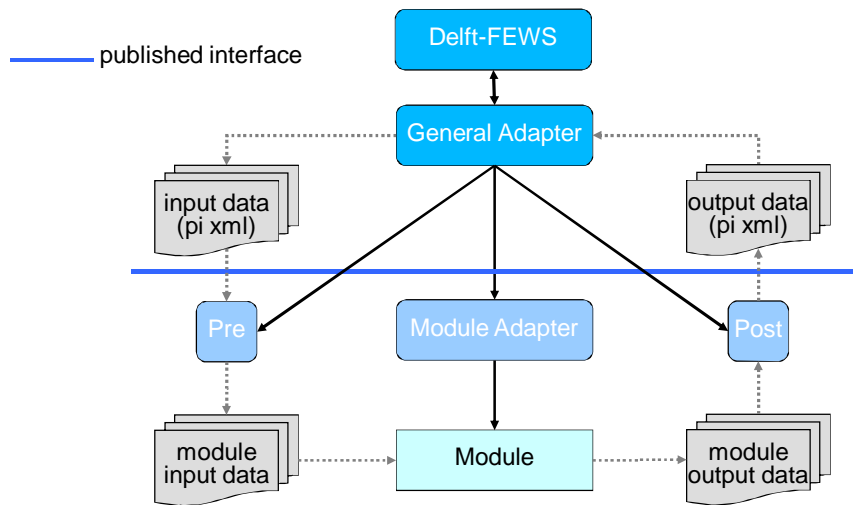


FEWS External Modules/Models

Generic workflow to run a model in FEWS



General Adapter - Concepts



General Adapter – Configuration

general		
<input type="radio"/> description	ARMA Model run	DELFT-FEWS reserved keyword
<input type="radio"/> rootDir	%REGION_HOME%/Modules/arma/addghm	
<input type="radio"/> workDir	%ROOT_DIR%	
<input type="radio"/> exportDir	%ROOT_DIR%/data/xml	
<input type="radio"/> exportIdMap	ARMA_Export_For	
<input type="radio"/> importDir	%ROOT_DIR%/data/xml	
<input type="radio"/> importIdMap	ARMA_Import_For	From global.properties
<input type="radio"/> dumpFileDir	\$GA_DUMPFILEDIR\$	
<input type="radio"/> dumpDir	%ROOT_DIR%	
<input type="radio"/> diagnostic...	%ROOT_DIR%/logs/diag.xml	
activities		
<input checked="" type="checkbox"/> startUpActivities		
<input checked="" type="checkbox"/> exportActivities		
<input checked="" type="checkbox"/> Comment	Execute activities	General Adapter keywords
<input checked="" type="checkbox"/> executeActivities		
<input checked="" type="checkbox"/> importActivities		

General Adapter – Export Activities

Export Activities

Time Series – scalar

Time Series – grids
(map stacks)

Time Series – profile

States

ModuleDataSet

ModuleParameters



Export Activities – Scalar/longitudinal time Series

Exports time series from database to a PI-XML file

Assign File name to export data to

Assign Time Series Sets to export

Written to exportDir

LocationID's & ParameterID's will be translated on export (as indicated in IdMapping)

 <i>Comment</i>	Export time series
exportTimeSeriesActivity	
 description	Export discharge boundaries
 exportFile	export_pi.xml
timeSeriesSets	
	<input checked="" type="checkbox"/> timeSeriesSet
	<input checked="" type="checkbox"/> timeSeriesSet

Export activities - grid time series

Same principle as exporting scalar time series

Supported grid file formats

ASC: ArcView/ARC-INFO grid interchange file

- Time Series as map stack

PCR: PCRaster file format

- Time Series as map stack

BIL: USGS standard grid format

- Time series in one file

Export Activities – Module parameters

DELFT-FEWS administers module parameters
Exports to external module as PI-XML file
Held in Config\ModuleParFiles

exportParameterActivity	
description	Module Parameters
fileName	pi_parameters.xml
moduleInstancelid	ISIS_Eden_Forecast

Export Activities – Module dataset

DELFT-FEWS administers module dataset

- Dataset: native module file
- Held in Config\ModuleDataSets by DELFT-FEWS as a ZIP file

Exports to external module by extracting data in ZIP file

Exported to a “root” directory

exportDataSetActivity	
description	ISIS DAT File
moduleInstancelid	ISIS_Eden_Forecast

Exporting States

DELFT-FEWS can manage module states

What is a state?

- Module initial conditions
- Handled in “native”module format

Type of state;

- Cold State – default initial conditions
- Warm State – initial conditions from a previous run

For each module requiring management of states;

- ZIP file of cold state MUST be available in ColdStates dir.

Exporting States

Defining “how” to export state

moduleInstanceld

stateExportDir

stateConfigFile

stateLocations

- read
- write

From the perspective
of the model!!

Comment	Export state (warm state)
exportStateActivity	
moduleInstanceld	ISIS_Eden_HD_Historical
stateExportDir	%ROOT_DIR%/Eden_HD_States
stateConfigFile	%ROOT_DIR%/Eden_HD_States/input.xml
stateLocations	
type	file
stateLocation	
readLocation	input.zzs
writeLocation	output.zzs
stateSelection	

Exporting States

stateConfigFile

For export: Written by DELFT-FEWS ; read by adapter

For import:Written by adapter ; read by DELFT-FEWS

State	
xs:schemaLo...	http://www.widelift.nl/fews/PI http://fews.widelift.nl/schemas/version1.0/pi-schemas/pi_state.xsd
version	1.2
xmns	http://www.widelift.nl/fews/PI
xmns:xsi	http://www.w3.org/2001/XMLSchema-instance
stateId	Default
timeZone	0.0
dateTime	
date	2005-11-25
time	22:00:00
stateLoc	
type	file
readLocation	D:\FewsTrain\FewsTrain\Modules\VSIS\Eden_HD\Eden_HD_States\input.zzs
writeLocation	D:\FewsTrain\FewsTrain\Modules\VSIS\Eden_HD\Eden_HD_States\output.zzs

Exporting States

Defining “what” to state export; stateSelection

State selection determines length of module run!!!!

Cold State: Always use a cold state to initiate module run

stateSelection	
coldState	
groupid	Default
startDate	
unit	hour
divider	48

Warm State: Use most suitable/recent state in search period

stateSelection	
warmState	
stateSearchPeriod	
unit	hour
start	-48
end	0

- Start 02:00 Jan 05. TO 16:00 04 Jan
- Start 7:30 and TO 07:00 Jan 05
- Start 19:30 and TO 19:00 Jan 05
- Start 02:00 Jan 06. TO 16:00 05 Jan
- Start 07:30 and TO 07:00 Jan 06

Deltares

Deltares Configuration Course 15

General Adapter – Execute Activities

Running modules
 Executables or Java classes
 Arguments can be passed
 Timeout is set in case module “hangs”
 If Diagnostic file indicates error – or non zero return code

- Executable considered to have failed

```

  <comment>Run module post adapter to transform ASCII to XML</comment>
  <executeActivity>
    <description></description>
    <command>
      <className>nl.widelft.fews.adapter.common.PostCommonAdapter</className>
    </command>
    <arguments>
      <argument type="Text">1 %ROOT_DIR%</argument>
      <argument type="Text">2 Config/TFAdapterConfig.xml</argument>
    </arguments>
    <timeOut>8000</timeOut>
  </executeActivity>
  
```

Deltares

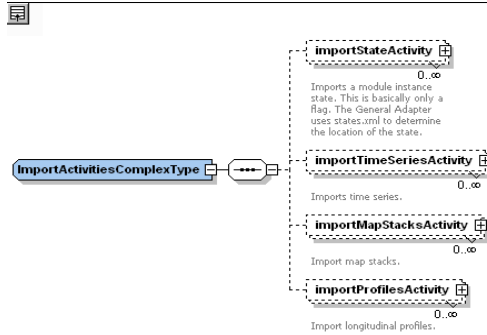
Deltares Configuration Course 16

General Adapter – Import Activities

Import Time Series

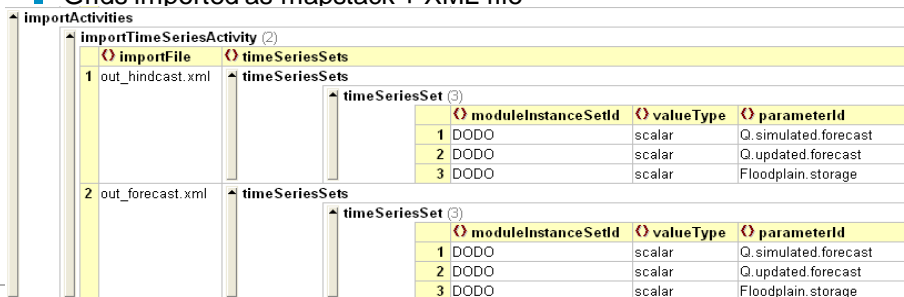
- Scalar
- Longitudinal
- Grid

Import States



General Adapter – Import Activities

- Importing time series
- Same principle as exporting
- File name & Time Series Set to save data to
- IdMapping used to translate locationId's and parameterId's
- Grids imported as mapstack + XML file



General Adapter – Import Activities

- Importing states
- Simple instruction where to find stateConfigFile



Burn-in profiles

- Avoid “abrupt” shock to model on startup
- Mainly relevant to HD modules (stability)

Only applied when starting from a cold state

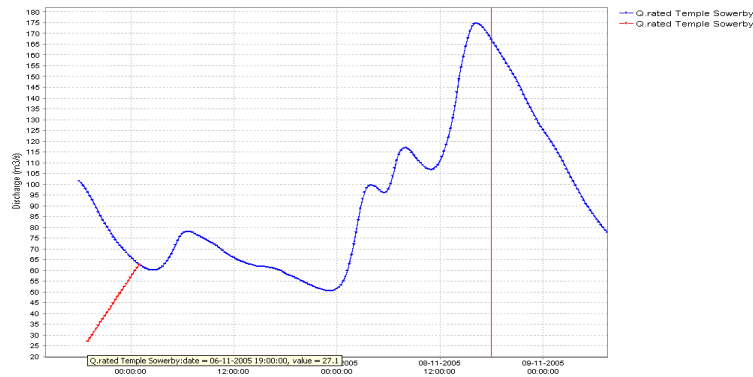
- Identify start value in cold state
- Gradual “climb” to actual value

The screenshot shows a configuration tree for 'burnInProfile'. It is expanded to show 'length' with 'unit' set to 'hour' and 'multiplier' set to '6'. Below it, 'timeSeries (4)' is expanded to show a table with 4 rows.

	parameterId	locationId	initialValue
1	Q.simulated.forecast	762505	31.75
2	Q.simulated.forecast	763308	13.50
3	Q.simulated.forecast	764009	5.25
4	Q.simulated.forecast	765013	9.50

Burn-in profiles

Burn-in at Temple Sowerby



Startup/Shutdown activities

Clean up files from module

- Startup – before running module
- Shutdown – after completing module

startUpActivities	
purgeActivity (3)	
	filter
1	%ROOT_DIR%/logs/*.*
2	%ROOT_DIR%/data/xml/*.*
3	%ROOT_DIR%/data/native/*.*

Module diagnostics/debugging

PI-XML includes module diagnostics exchange

- To be written by module/adaptor
- General Adapter Defines where diagnostics file is expected
- Not all logging passed – use native module log files

External module log inserted into FEWS log

- Most messages DEBUG level
- Error/Fatal: System messages

Detecting module failure

- Error in diagnostics log
- non-zero return code

Using Module Configuration Templates

Module Configuration Templates

Purpose:

- Allows for multiple instances of the same process for various modules using a single General Adapter configuration
- Reduces configuration effort
- Increases consistency

For example:

You want to run a Delft3D Flow simulation for two models

- Use moduleInstanceID: D3D_flow_1h_hc
- Use workflow: D3D_flow_model1 & D3D_flow_model2

Module General Adapter template

Templates are made unique using keywords defined in the workflow

The screenshot shows a configuration tree with the following structure:

- activities
 - startupActivities
 - exportActivities
 - exportStateActivity
 - moduleInstanceID: \$MODULE_INSTANCE_ID\$
 - stateExportDir: %ROOT_DIR%\state\input
 - stateConfigFile: %ROOT_DIR%\state\input\export_states.xml
 - stateLocations: type=file
 - stateSelection
 - exportTimeSeriesActivity
 - description: Export timeseries info
 - exportFile: timeseries.xml
 - timeSeriesSets
 - timeSeries Set
 - moduleInstanceID: import_SMETEOS
 - valueType: scalar
 - parameterid: Wind speed simulated
 - locationSetid: SMODELS.locations
 - timeSeriesType: external historical
 - timeStep: unit=hour multiplier=1
 - relativeViewPeriod: unit=hour start=-1 startOverruable=true end=0
 - readWriteMode: read only
 - exportDataSeriesActivity
 - moduleInstanceID: D3D_flow_SMODELS_SMETEOS

-Text between \$__\$ is a user-defined keyword

Workflow file

–Keywords are passed to the General Adapter from the Workflow as properties

activity (2)	properties	runindependent	moduleinstanceld	moduleConfigFileName						
1	<table border="1"><thead><tr><th>key</th><th>value</th></tr></thead><tbody><tr><td>MODEL</td><td>dcsm5</td></tr><tr><td>METEO</td><td>hirlam72</td></tr></tbody></table>	key	value	MODEL	dcsm5	METEO	hirlam72	false	D3D_flow_dcsm5_hirlam72_fc	D3D_1h_flow_hc
key	value									
MODEL	dcsm5									
METEO	hirlam72									
2	<table border="1"><thead><tr><th>key</th><th>value</th></tr></thead><tbody><tr><td>MODEL</td><td>dcsm5</td></tr><tr><td>METEO</td><td>hirlam72</td></tr></tbody></table>	key	value	MODEL	dcsm5	METEO	hirlam72	false	D3D_flow_dcsm5_hirlam72_fc	D3D_1h_flow_fc
key	value									
MODEL	dcsm5									
METEO	hirlam72									

–Template configuration file!

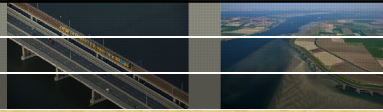
– $\$MODEL\$ = dcsm5$
– $\$METEO\$ = hirlam72$
– $D3D_flow_ \$MODEL\$ \$METEO\$ =$
 $D3D_flow_dcsm5_hirlam72$

Quick guide and wiki for model adapters

<https://publicwiki.deltares.nl/display/FEWSDOC/Quick-start+Guide+for+Adding+an+External+Module+in+FEWS>

<https://publicwiki.deltares.nl/display/FEWSDOC/Model+adapters>

General Adaptor - Exercise



Exercise 12: Add an external module

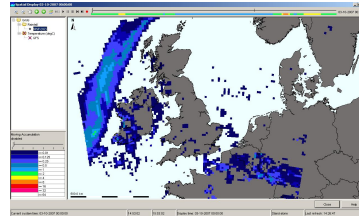


Extracting series from Gridded Data

An aerial photograph of a river delta region. A large dam with multiple piers is visible, crossing a wide river. The surrounding area is a mix of agricultural fields in various shades of green and brown, and some residential or industrial buildings.

Use NWP series in the rainfall runoff model

- NWP gridded forecasts available
1. Make an Import module
 2. Extract NWP cells for Isle of Man
 3. Merge NWP forecast with other data sources
 4. Use NWP forecast in external model



Gridded Data – Exercises

The exercise is split into three sections

1. **Import NWP forecasts (Exercise 13)**
2. Extract scalar series from gridded data (Exercise 14)
3. Using the extracted scalar series in the model (Exercise 15)

Grid Import module

Before importing data, some questions must be answered:

- **What is the data format?**
 - Does FEWS support this data format?
- **What is the coordinate system used in the grid?**
 - Check supported coordinate systems in FEWS.
- **What are the grid dimensions?**
 - Ask data supplier or use a data viewer that supports the format
- **What are the parameters and units used?**
 - Ask data supplier or check on the internet
- **What are the time intervals used in the file?**
- **How long do I want to store the data in the database?**
 - Gridded data can be voluminous

FEWS Time Series Sets: NWP

Properties of time series:

- location Id – or – locationSetId
- parameter Id
- timestep
- relativeViewPeriod

- valueType (scalar, **grid**, profile, ..)
- timeSeriesType (external historical, **external forecast**, ..)
- moduleInstancelId (import, PDM, KW, ISIS, ..)
- readWriteMode

- expiryTime (when to delete from database)
- synchLevel

- simple transformations (delay, multiplier, divider, incremter)
- ensembleId

timeSeriesSet	
moduleInstancelId	ImportNimrod
valueType	grid
parameterId	P.nwp.forecast
locationId	NimrodNWP
timeSeriesType	external forecasting
timeStep	
unit	minute
multiplier	15
readWriteMode	add originals
synchLevel	6

Gridded Data – Exercises

The exercise is split into three sections

1. Import NWP forecasts (Exercise 13)
2. **Extract scalar series from gridded data (Exercise 14)**
3. Using the extracted scalar series in the model (Exercise 15)

Extracting data from a Grid

The FEWS interpolation module can be used to extract series from a grid

For a location

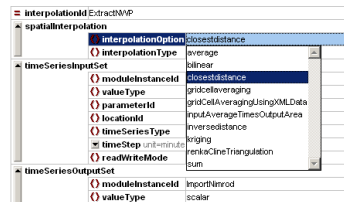
- extract the closest cell center (*closestdistance*)

For a catchment

- extract average of cells within a polygon (*average*)
- compute average of surrounding cells using bi-linear, kriging or inverse distance functions (*bilinear*, *kriging*, ..)

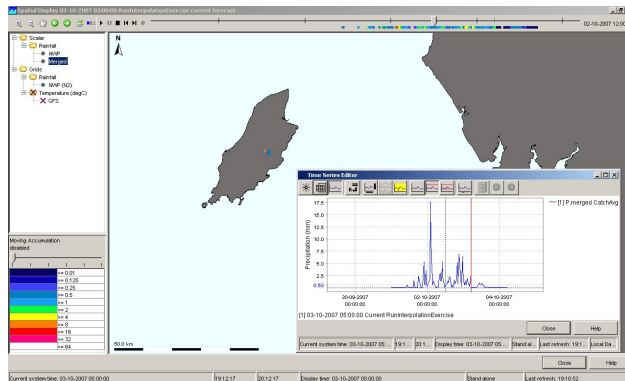
For a different grid

- extract the closest cell center (*closestdistance*)



Display scalar time series in Spatial Display

- With the FEWS Spatial Display it is possible to display, grids and scalar time series
- Some functionality only works with grid series, other only with scalar series.



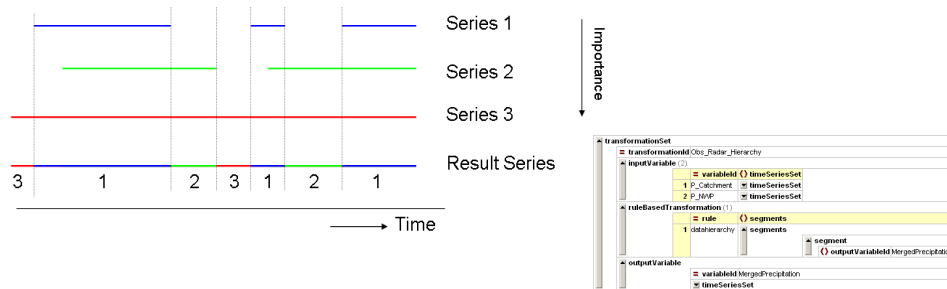
Gridded Data – Exercises

- The exercise is split into three sections
1. Import NWP forecasts (Exercise 13)
 2. Extract scalar series from gridded data (Exercise 14)
 3. Using the extracted scalar series in the model (Exercise 15)

Merge forecast with observed series

The Transformation module is used to merge series into one (*datahierarchy*)

- Merging observed precipitation with nwp forecast



- What is the output series type (external forecast, simulated forecast)?

Add series to External Model

The *RunInterpolationExercise* Workflow contains 7 module instances

	<input checked="" type="checkbox"/> runIndependent	<input checked="" type="checkbox"/> moduleInstanced
1	true	InterpolateExample
2	true	LevelToFlow
3	true	IoM_CatchmentAveragePrecipitation
4	true	InterpolateNimrod
5	true	Merge_Precipitation
6	true	Hydro_Train_Interpolate_Forecast
7	true	Hydro_Train_Forecast

- What can we do to use the P.merged series by the model?
 - Update the Hydro_Train_Interpolate_Forecast: use the P.merged series

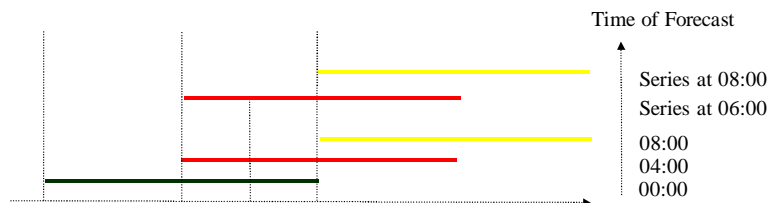
Gridded Data – Exercises

The complete Exercise is split into three sections

1. Import NWP forecasts (Exercise 13)
2. Extract scalar series from gridded data (Exercise 14)
3. Using the extracted scalar series in the model (Exercise 15)

Gridded Data – Exercise 13 - Questions

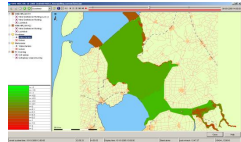
- What forecast do you see?
- How can you see a forecast for 3-10-2007 00:00:00





Issues when using grid data (1)

- **Is it always required to configure the Grid XML file?**
 - **No:** In some cases these grid characteristics are included in the data files (GRIB).
 - Good example are ECMWF Forecasts
 - Bad example are MetOffice local surge models (characteristics only use 2 decimal places)
- **For an irregular grid the Cell centres must be included in the Grid xml file**
 - **No:** it is also possible to use shape files with cell centres.
 - Since December 2008
 - Example: WAQUA models used in The Netherlands



Deltares

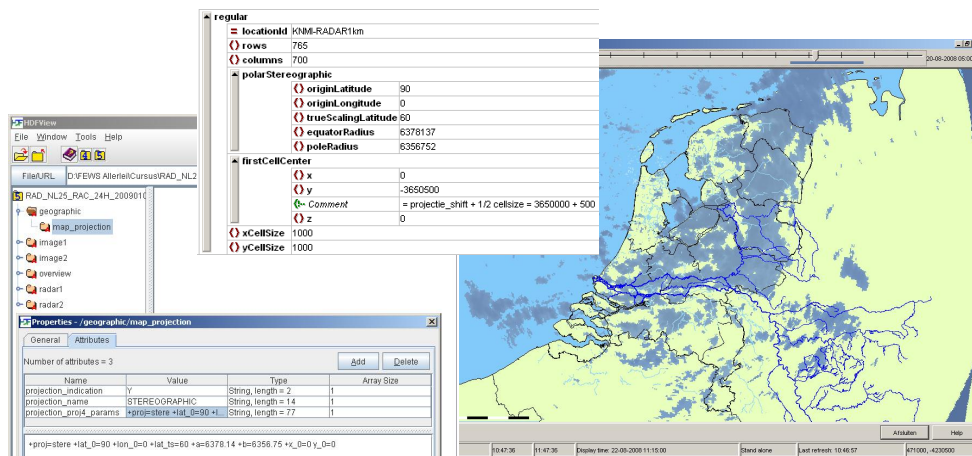
Deltares Configuration Course 44

Issues when using grid data (2)

- In a Client-Server environment all imported grids are only stored in the Central Database
 - **No:** By using synchlevels it is possible to configure the data to be synchronised.
 - Examples of synchlevels will follow later today
- The number of supported geodatum is limited to the enumeration in the config files
 - **Yes:** but
 - New geoDatums can be added by the FEWS Software developers
 - Try to use the polarStereographic or rotatedPoles elements (only regular grids)
 - Example KNMI Radar

Issues when using grid data (3)

KNMI Radar



The screenshot displays a GIS application interface with several windows. The 'regular' window shows the following properties:

- locationId: KNMI-RADAR1km
- rows: 765
- columns: 700

The 'polarStereographic' window shows the following properties:

- originalLatitude: 90
- originalLongitude: 0
- trueScalingLatitude: 90
- equatorRadius: 6378137
- poleRadius: 6356752

The 'firstCellCenter' window shows the following properties:

- x: 0
- y: -3650500
- z: 0
- Comment: = projectie_shift + 1,2; cellsize = 3650000 + 500
- xCellSize: 1000
- yCellSize: 1000

The 'Properties' window shows a table of attributes:

Name	Value	Type	Array Size
projection_indication	Y	String, length = 2	1
projection_name	STEREOGRAPHIC	String, length = 14	1
projection_proj4_params	*proj=stere +lat_0=90 *l*	String, length = 77	1

The background shows a map of Europe with a radar grid overlay.



Error correction

1. Why?
2. Let's start simple
3. Two temperature sensors you want to use to measure temperature difference in incoming and outgoing water of a solar heater system.
4. First you monitor both at the same location for some time....
5. You find a difference of 0.5 oC
6. When using the sensors you add 0.5 oC to the lower sensor to avoid wrong calculations

Deltares

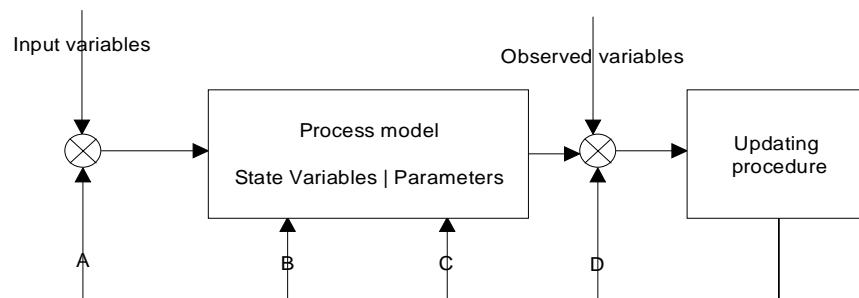
Deltares Configuration Course 48

Data Assimilation/Error correction

Key elements of a forecasting system (Madsen et al, 2000)

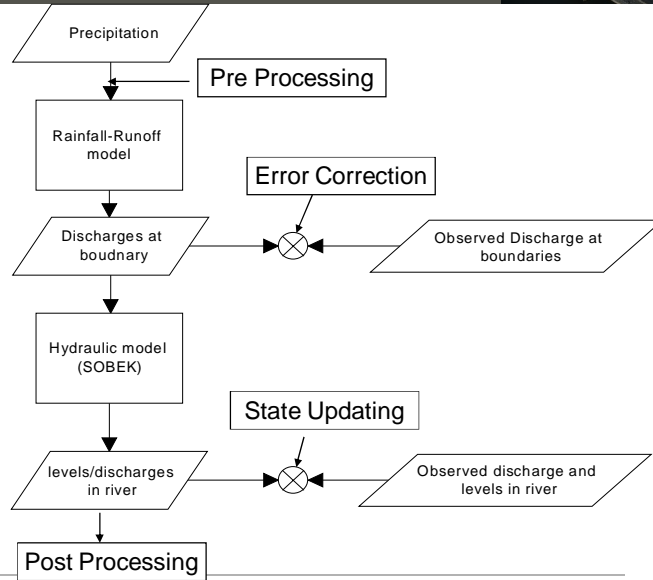
- Real time data acquisition for observed meteorological and hydrological conditions
- Hydrologic and hydraulic models for simulation
- Forecast of meteorological conditions
- Updating and data assimilation

Improving the Forecast



- A: Input correction
- B: State Updating (data assimilation)
- C: Parameter Updating
- D: Postprocessing (including Error Correction)

Data-assimilation in flood forecasting

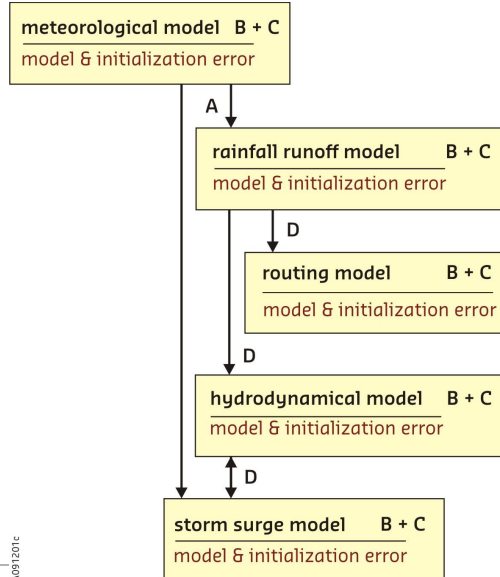


Deltares Configuration Course

51

Deltares

Data-assimilation in flood and storm surge forecasting



04091201c

Deltares Configuration Course

52

Deltares

A: Input Correction

An example of this is the rainfall-runoff model HBV-96 (SMHI) where you can specify a time window (before starting a forecast) in which it is tried (through optimization) to reduce the difference between measurement and model by adjusting the input (temperature and/or rainfall).

B: State Updating

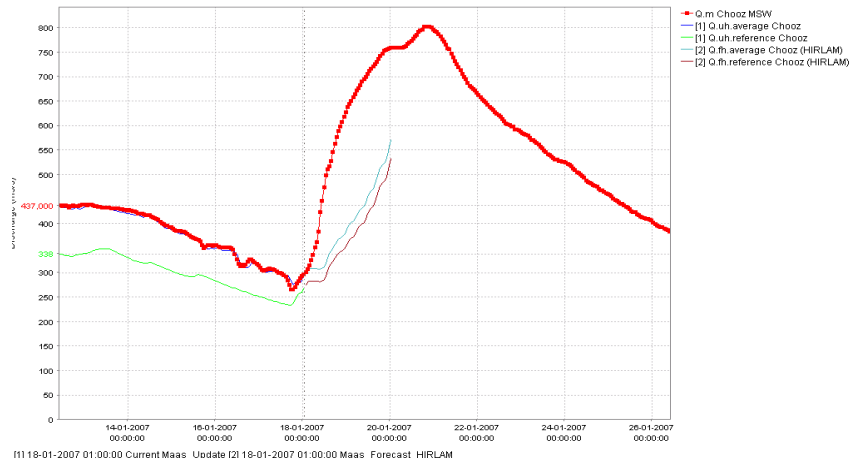
Adjust the model states based on the difference between model and measurement.

This can be done

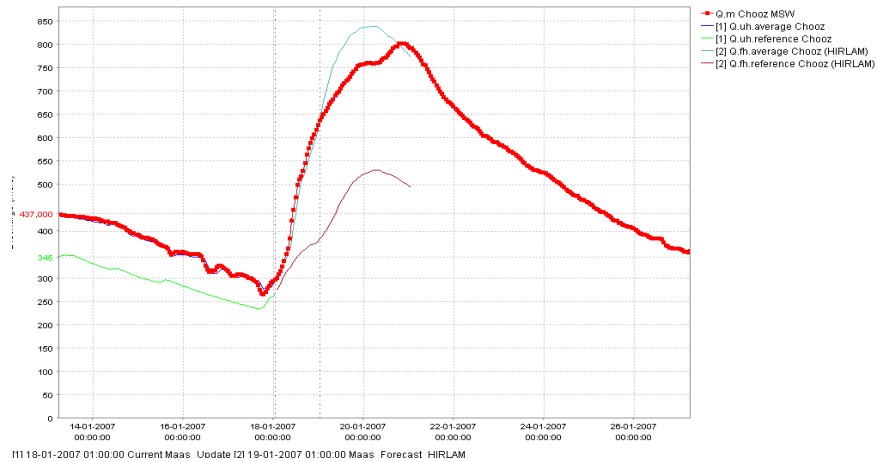
- manually (for instance by the NWS through MODS)
- automatically (for instance through Ensemble Kalman Filtering)

=> Example EnKF for the Meuse (at Chooz)

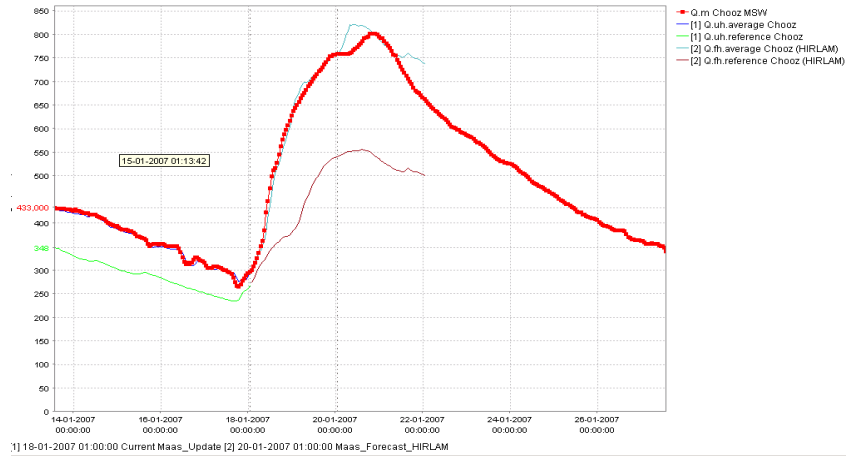
Result of EnKF filtering at Bar etc (Chooz) during the forecast starting at 18-01-2007 01:00.



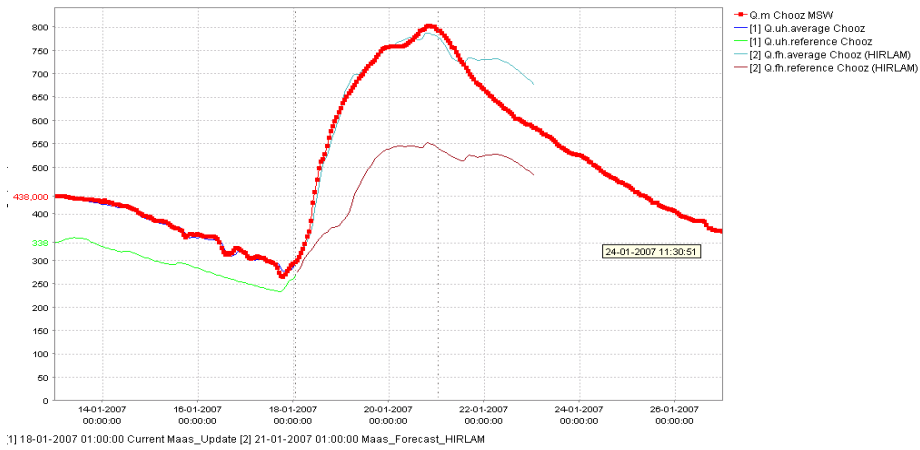
Result of EnKF filtering at Bar etc (Chooz) during the forecast at 19-01-2007 01:00.



Result of EnKF filtering at Bar etc (Chooz) during the forecast 20-01-2007 01:00



Result of EnKF filtering at Bar etc (Chooz) during the forecast 21-01-2007 01:00.



C: Parameter Updating

No example available

By the NWS MODS (manually)

Parameter uncertainty can affect the forecasts

D: Output Processing

This can be done very simple but also complicated (determine uncertainty and all)

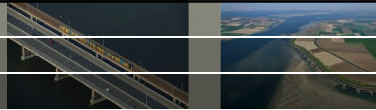
simple methods:

- Adjust Q (correction at start forecast)
- AR or ARMA type error correction

Complicated methods:

- Bayesian Model Averaging: Weighing different forecast into a single forecast based on their past performance and derived an 'uncertainty' band
- Bayesian Processor of Output: Condition a deterministic or ensemble forecast on past performance (remove of biases etc) to derive the predictive uncertainty

AR module Delft-FEWS - 1



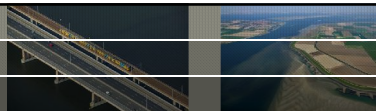
Autoregressive Moving Average Models used for forecasting of stationary timeseries

AR: This part of the model describes how each observation is a function of the previous p observations. For example, if $p = 1$, then each observation is a function of only one previous observation. That is, $Y(t) = c + \phi_1 Y(t-1) + e(t)$

where $Y(t)$ represents the observed value at time t , $Y(t-1)$ represents the previous observed value at time $t - 1$, $e(t)$ represents some random error and c and ϕ_1 are both constants. Other observed values of the series can be included in the right-hand side of the equation if $p > 1$:

$$Y(t) = c + \phi_1 Y(t-1) + \phi_2 Y(t-2) + \dots + \phi_p Y(t-p) + e(t).$$

AR module Delft-FEWS - 2

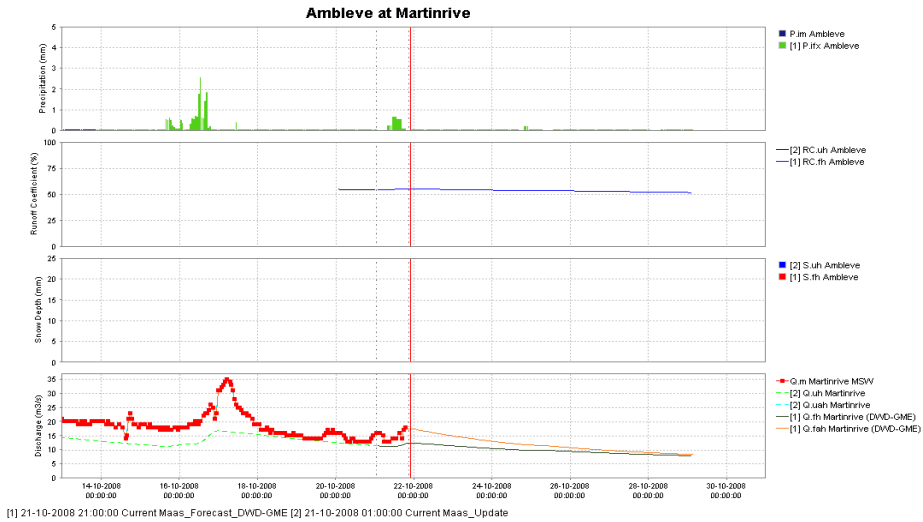
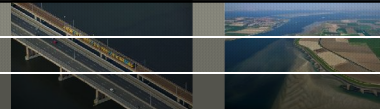


MA: This part of the model describes how each observation is a function of the previous q errors. For example, if $q = 1$, then each observation is a function of only one previous error. That is,

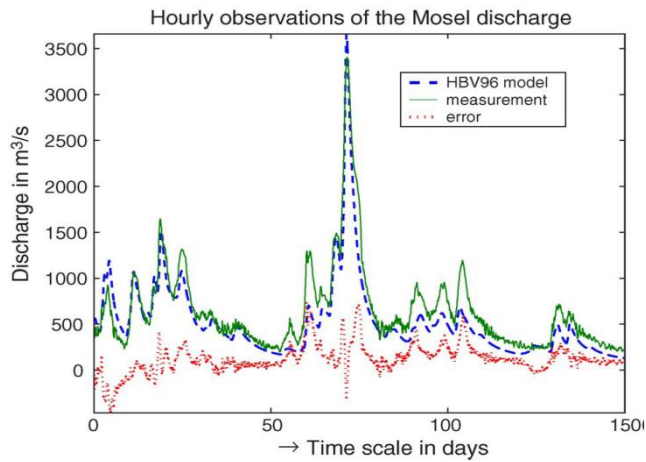
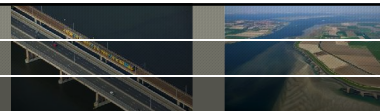
$$Y_t = c + \theta_1 e(t-1) + e(t).$$

Here $e(t)$ represents the random error at time t and $e(t-1)$ represents the previous random error at time $t - 1$. Other errors can be included in the right-hand side of the equation if $q > 1$.

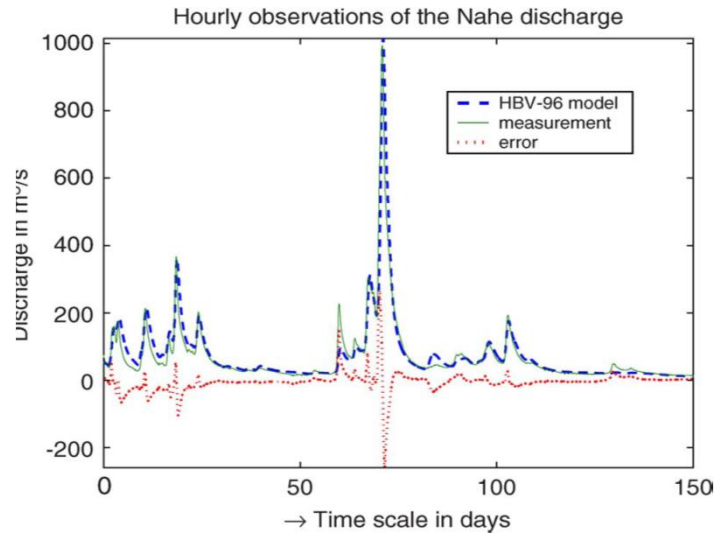
Error Correction



Are the errors stationary?



Stationary?



Deltares Configuration Course

65

Deltares

Stationarity and Configuration of Error Module

mean correction (the mean over the training period is or is not subtracted)

`<subtractMean>>false</subtractMean>`

Box-Cox transformation: $T(y) = (y^\lambda - 1) / \lambda$ for $\lambda = 0$ $T(y) = \log(y)$

can make the data more stationary

`<boxcoxTransformation>>false</boxcoxTransformation>`

`<lambda>0</lambda>`

However be careful the transformation can also result in strange results because small changes in transformed space can be large changes in the real space.

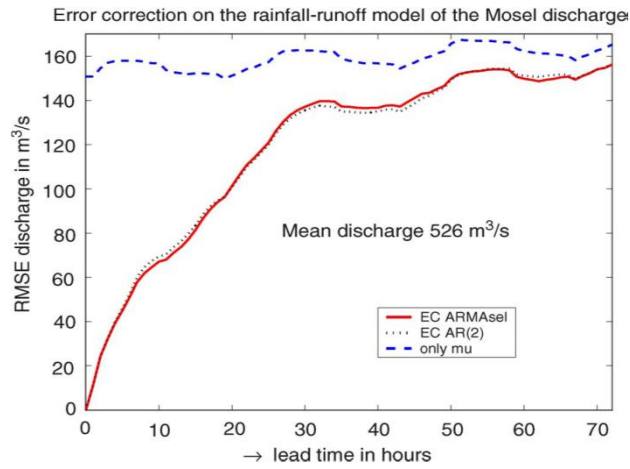
Another way (not implemented!!) would be to use AR-I-MA (AR Integrated MA) type where the difference is taken between time steps to make the data more stationary

Deltares Configuration Course

66

Deltares

Results large catchment (over 150 days daily steps)

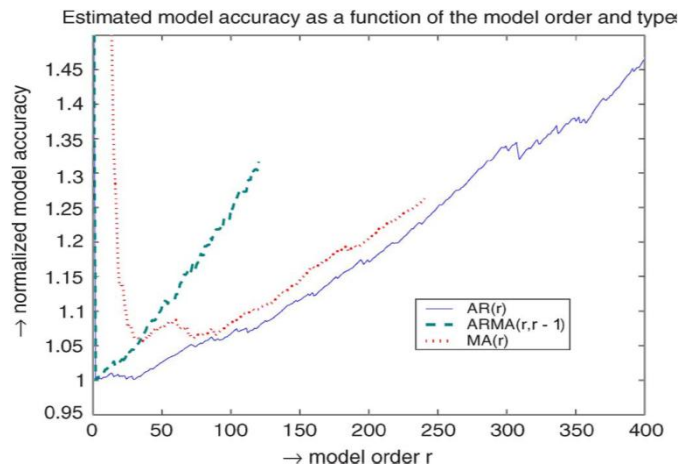


Deltares Configuration Course

67

Deltares

AR, ARMA, MA? Which order?



Deltares Configuration Course

68

Deltares

Order and Configuration of Error Module

The amount of orders and value of coefficients is automatically calculated by the error module and consider up 1,2, ...,10 orders

```
<orderSelection>>true</orderSelection>
```

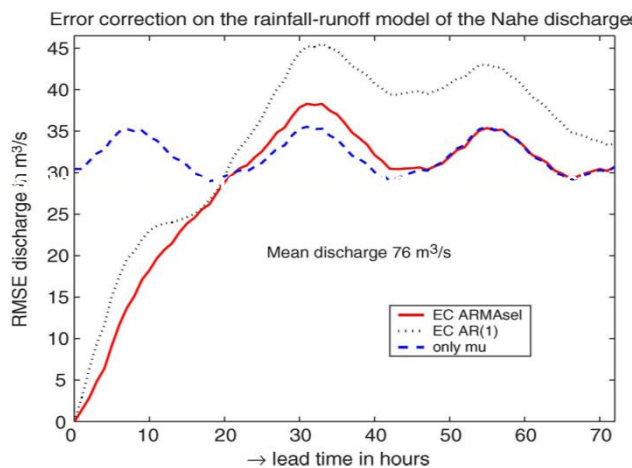
```
<order_ar>10</order_ar>
```

It is possible to put the orderSelection to false and use for instance

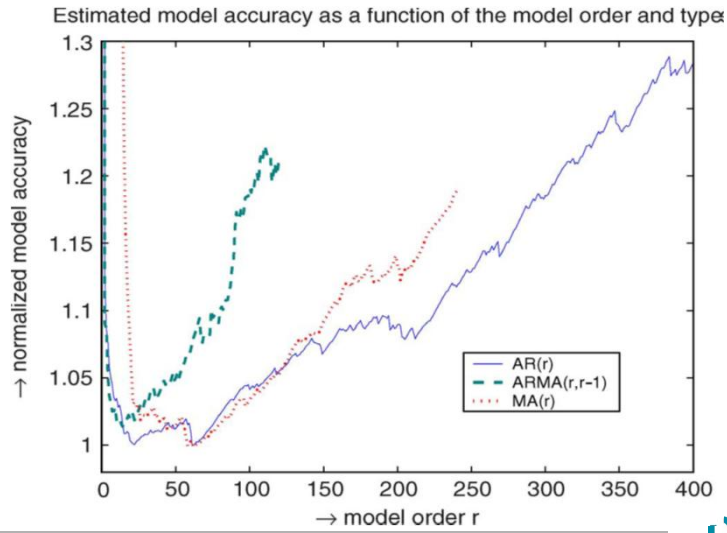
2 or 3 orders and calculate the coefficients automatically by the error module on the basis of the training period

It is also possible to put the orderSelection to false and specify your own coefficients (when determined offline over a calibration period)

Results smaller catchment (over 150 days daily steps)



AR, ARMA, MA? Which order?

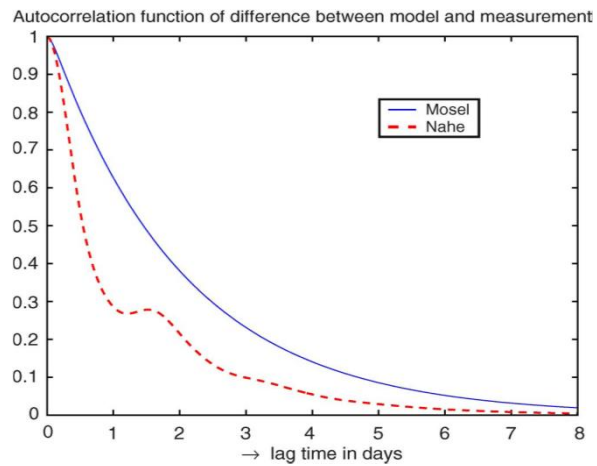


Deltares Configuration Course

71

Deltares

Autocorrelation

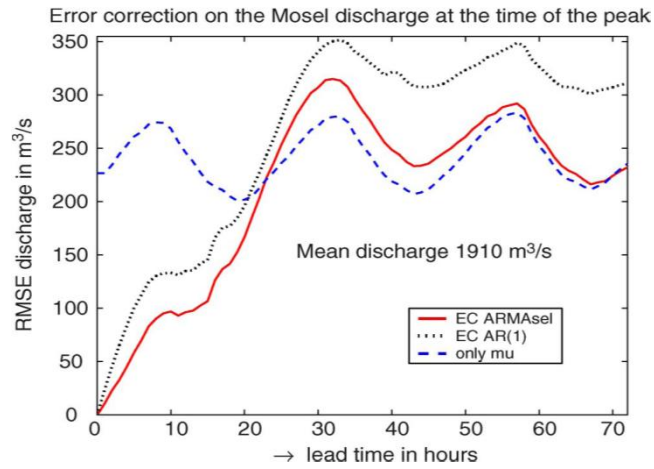


Deltares Configuration Course

72

Deltares

Results large catchment (over peak 10 days daily steps)



Length Training period

TABLE 1
INFLUENCE OF THE HISTORY LENGTH IN HOURS, USED FOR ESTIMATION WITH ARMAsel, ON THE RMSE ACCURACY OF THE MOSEL DISCHARGE ERROR CORRECTION, WHICH IS AVERAGED OVER THE FIRST 12 h OF THE PREDICTION. PREDICTIONS HAVE BEEN MADE OVER THE 150-DAY PERIOD AND OVER A SHORT PERIOD OF TEN DAYS AROUND THE PEAK DISCHARGE

History length in hours	150 day period	10 days, peak period
10	83.5	216.4
20	79.4	203.5
50	62.8	129.5
100	57.8	108.0
200	53.1	80.4
300	51.5	71.9
400	50.4	67.1
500	49.6	<u>66.3</u>
750	<u>49.3</u>	72.6
1000	50.8	85.8
2000	50.7	85.6
3500	50.5	80.8

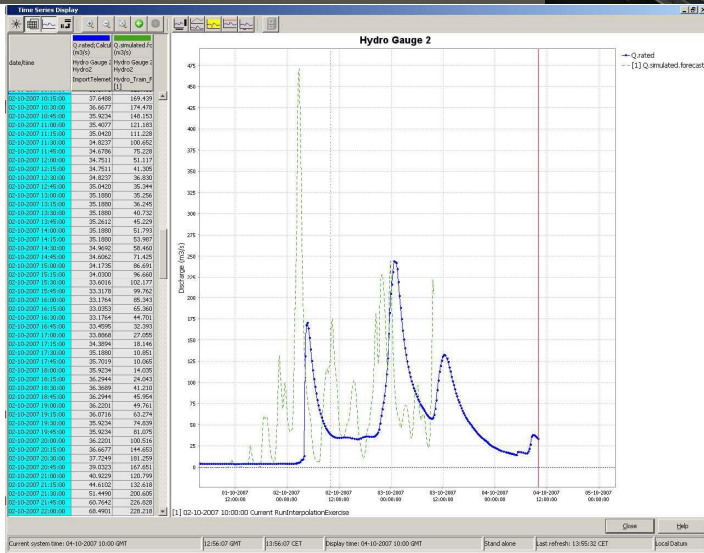
So why do we do error correction?

- To get the best forecast possible
- To make sure the forecasters 'trust' the system
- To make best use of the available data
- To show the uncertainties in the system

Where and how?

- Depends on the hydrological and modelling system
- Some good candidates:
 - Outlet of catchment model (gauged) fed into a routing model
 - Link between two routing models
 - Reservoirs (up/downstream)
 - Suggestions?

Where and how?

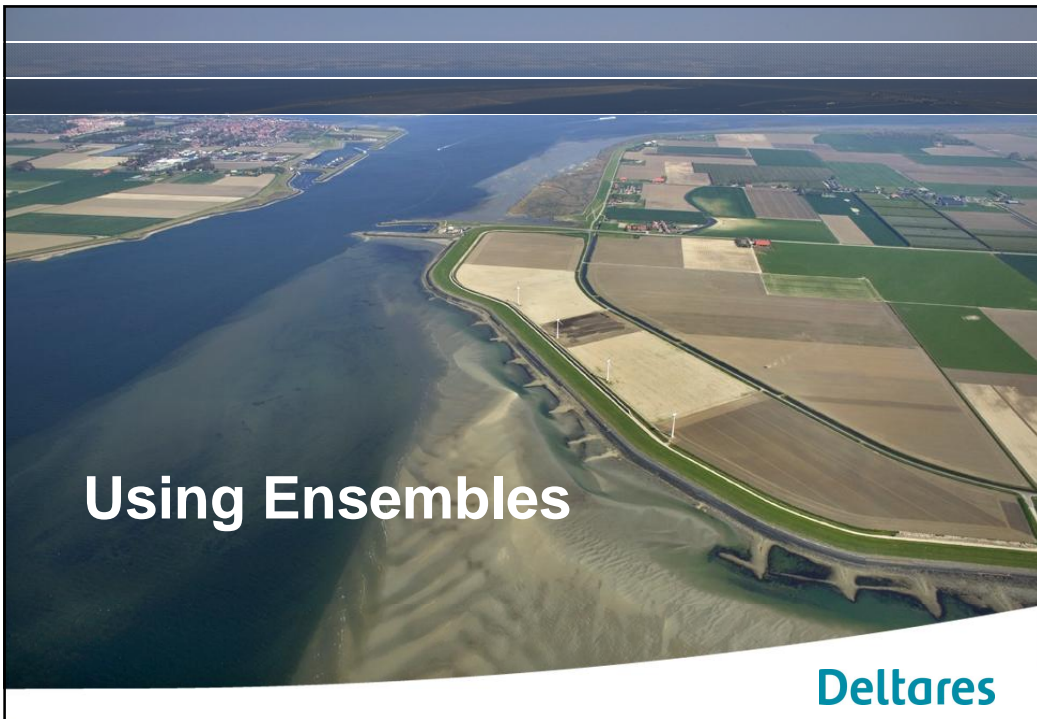


Deltares Configuration Course

77

Deltares

Using Ensembles

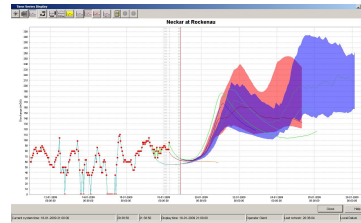
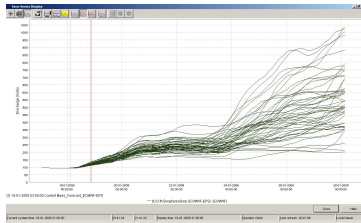


Deltares

Ensemble Forecasting: What is it?

What is an ensemble forecast?

- An ensemble forecasting system samples the uncertainty inherent in weather prediction to provide more information about possible future weather conditions. Rather than producing a single forecast, multiple forecasts are produced by making small alterations to either the starting conditions or the forecast model, or both. (From: UK Met-Office)



FEWS Time Series Sets: Ensemble

Properties of time series:

- location Id – or – locationSetId
- parameter Id
- timestep
- relativeViewPeriod
- valueType (scalar, grid, profile, ..)
- timeSeriesType (external historical, external forecast, ..)
- moduleInstancelId (import, PDM, KW, ISIS, ..)
- readWriteMode
- expiryTime (when to delete from database)
- synchLevel
- simple transformations (delay, multiplier, divider, incremter)
- **ensembleId**

timeSeriesSet	
moduleInstancelId	importKWMI
valueType	scalar
parameterId	P.ens.forecast
locationId	CatchAvg
timeSeriesType	external forecasting
timeStep	unit=hour multiplier=6
readWriteMode	add originals
synchLevel	1
expiryTime	unit=day multiplier=7
ensembleId	EPS

Ensemble in Delft FEWS

- Delft FEWS can import ensemble data sets
 - ECMWF EPS
 - COSMO-LEPS
 - SNRWP-PEPS
 - UK-MetOffice MOGREPS
 - ...
- Delft FEWS can run module instances in ensemble mode
 - The database knows the number of members
 - If an ensemble contains 50 members, the modules are run 50 times
- Only a limited number of functions/displays know about ensembles
 - Statistics, time series display, ..

Ensembles and Workflows

- On importing, the Ensemble Id is configured

timeSeriesSet	
moduleInstanceId	ImportKNMI
valueType	scalar
parameterId	P.ens.forecast
locationId	CatchAvg
timeSeriesType	external forecasting
timeStep	unit=hour multiplier=6
readWriteMode	add originals
syncLevel	1
expiryTime	unit=day multiplier=7
ensembleId	EPS

- Forecast Workflow is using the same Ensemble ID

activity	
runIndependent	true
moduleInstanceId	Hydro_Train_Forecast
ensemble	
ensembleId	EPS
runInLoop	true

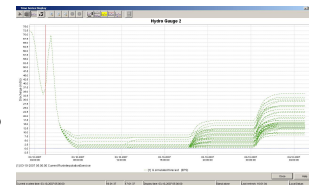
Ensembles and Module Instances

- When running ensembles in loop from a workflow, only configure non-ensemble time series: `<ensembleId>main</ensembleId>`

variableId	timeSeriesSet	moduleInstanceId	valueType	parameterId	locationId	timeSeriesType	timeStep	relativeViewPeriod	readWriteMode	ensembleId
1 P_Catchment	timeSeriesSet	ImportTelemetry	scalar	P.catchment	CatchAvg	external historical	unit=minute multiplier=15	unit=hour start=-96 end=0 startOverrutable=true	read only	main
2 P_NWP	timeSeriesSet	ImportKNMI	scalar	P.ens.forecast	CatchAvg	external forecasting	unit=minute multiplier=15	unit=hour start=-24 end=24 endOverrutable=true	read only	main

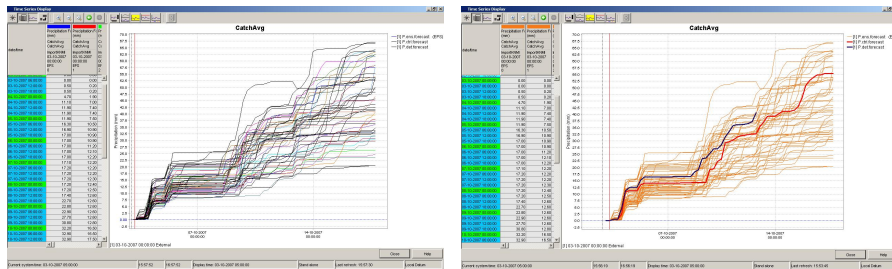
Ensembles – Exercise 16

- Import ECMWF Ensemble forecasts
 - Import KNMI ECMWF ensemble
 - Store the data at location CatchAvg
 - Add and update import module, ID mapping, import workflow, filters, parameters, global.properties, descriptors
 - Add ensemble element to Forecast workflow and Module instances
 - Update Merge_Precipitation module instance
 - Update the Forecast Workflow
- What is strange with the simulated discharge?



Ensembles – Extra Exercise

- Why are the colours of the rainfall Ensemble members all different and of the simulated discharge all green? Can you give the rainfall members also one colour?
- Give the deterministic and control run different colours and a thicker line.



More on Ensembles (1)

- The **Transformation** module allows creation of ensembles, create individual members
- When using ensembles where members have different lengths, use module **forecastLengthEstimator** to determine length of each ensemble member
- Presentation of ensembles in **Spatial Display**, require Ensemble Member ID

2 Member 01	timeSeriesSet	
	moduleInstanceld	ImportECMWF-EPS
	valueType	grid
	parameterId	P_fg
	locationId	ECMWF-EPS
	timeSeriesType	external forecasting
	timeStep	unit=hour multiplier=3
	readWriteMode	read complete forecast
	ensembleId	ECMWF
	ensembleMemberIndex	1

More on Ensembles (2)

- Not all FEWS import functions support ensembles
 - Example: UK MetOffice MOGREPS
 - Each member is stored in a separate 'nimrod' binary file
 - For Importing 24 ensemble members, configure 24 import functions

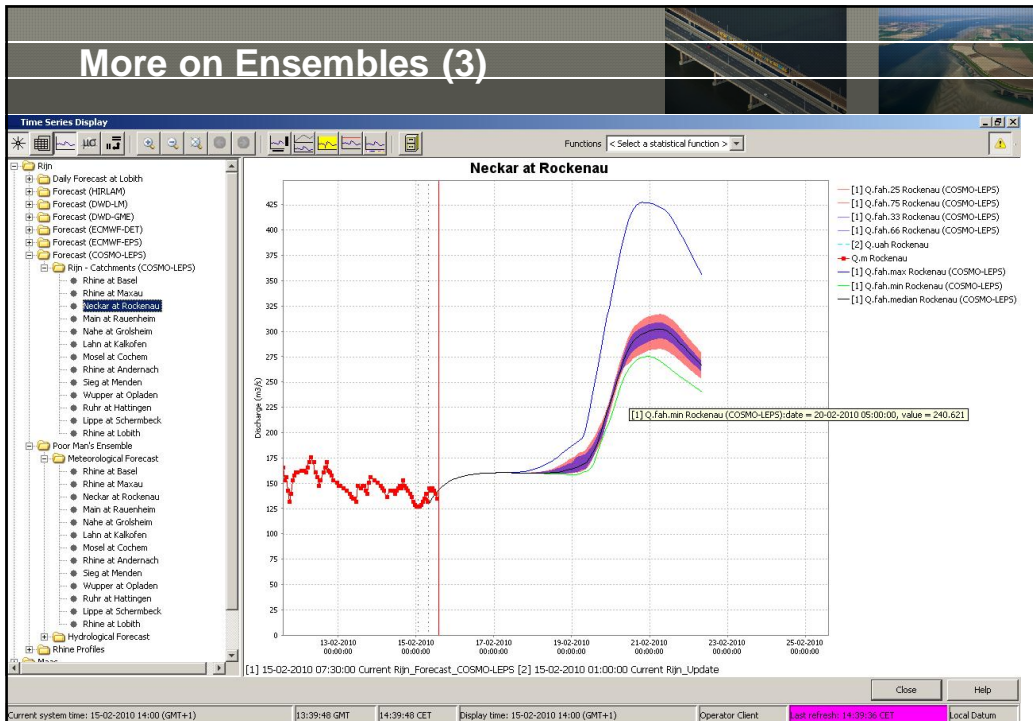
general		timeSeriesSet	
1	general	timeSeriesSet	timeSeriesSet
	importType	moduleInstanceId	ImportMOGREPS
	folder	valueType	grid
	failedFolder	parameterId	P.nwp.forecast
	idMapId	locationId	MOGREPS
	unitConversionsId	timeSeriesType	external forecasting
	dataFeedId	timeStep	unit=hour multiplier=3
		readWriteMode	add originals
		synchLevel	7
		expiryTime	unit=day multiplier=2
		ensembleId	MOGREPS
		ensembleMemberIndex	0
2	general	timeSeriesSet	
3	general	timeSeriesSet	

Deltares Configuration Course

87

Deltares

More on Ensembles (3)



More on Ensembles (4)

The screenshot shows the Altova XML Spy interface with the following configuration details:

- TransformationModule:**
 - version: 1.0
 - xsdns1: http://www.w3.org/2001/XMLSchema-instance
 - xsdns2: http://www.wildbit.nl/ews
 - xmlns:chemat.oct: http://www.wildbit.nl/ews/http://ews.wildbit.nl/schemas/version1.0/transformationModule.xsd
 - input variables: output variables, transformations
 - variable: EPS
 - timeSeriesSet
- Transformation:**
 - 1. Qmin: statisticsEnsemble (inputVariable: EPS, outputVariable: timeSeriesSet)
 - 2. Qmax: statisticsEnsemble
 - 3. Qmedian: statisticsEnsemble
 - 4. Q25: statisticsEnsemble
 - 5. Q33: statisticsEnsemble
 - 6. Q66: statisticsEnsemble
 - 7. Q75: statisticsEnsemble

The status bar at the bottom indicates: Deltares Configuration Course 89

Interactive statistics (1)

The screenshot displays the 'Time Series Display' application for the 'Andernach' location. It includes a data table, descriptive statistics, and a time series plot.

Date/Time	Qm (m ³ /s)
15-02-2010 15:00:00	2164.000
15-02-2010 16:00:00	2140.000
15-02-2010 17:00:00	2140.000
15-02-2010 18:00:00	2140.000
15-02-2010 19:00:00	2140.000
15-02-2010 20:00:00	2140.000
15-02-2010 21:00:00	2133.000
15-02-2010 22:00:00	2117.000
15-02-2010 23:00:00	2102.000
16-02-2010 00:00:00	2095.000
16-02-2010 01:00:00	2095.000
16-02-2010 02:00:00	2095.000
16-02-2010 03:00:00	2087.000
16-02-2010 04:00:00	2072.000
16-02-2010 05:00:00	2057.000
16-02-2010 06:00:00	2057.000
16-02-2010 07:00:00	2043.000
16-02-2010 08:00:00	2035.000
16-02-2010 09:00:00	1999.000
16-02-2010 10:00:00	1978.000
16-02-2010 11:00:00	1922.000
16-02-2010 12:00:00	1881.000
16-02-2010 13:00:00	1855.000
16-02-2010 14:00:00	1855.000
16-02-2010 15:00:00	1855.000
16-02-2010 16:00:00	1865.000
16-02-2010 17:00:00	1888.000
16-02-2010 18:00:00	1908.000
16-02-2010 19:00:00	1929.000
16-02-2010 20:00:00	1936.000
16-02-2010 21:00:00	1936.000
16-02-2010 22:00:00	1936.000
16-02-2010 23:00:00	1929.000
17-02-2010 00:00:00	1922.000
17-02-2010 01:00:00	1915.000

Descriptive statistics:

Statistics entire...	Statistics data ...	Statistics data ...
Mean	2,113.147	2,113.147
Min	1,438.03-02-20...	1,438.03-02-20...
Max	2,984.05-02-20...	2,984.05-02-20...
Sum	849,484.972	849,484.972
Standard deviation	553.206	553.206
Percentile (exce...)	2,927	2,927
Percentile (exce...)	2,769	2,769
Percentile (exce...)	1,905	1,905
Percentile (exce...)	1,582	1,582
Percentile (exce...)	1,474	1,474

Time series info:

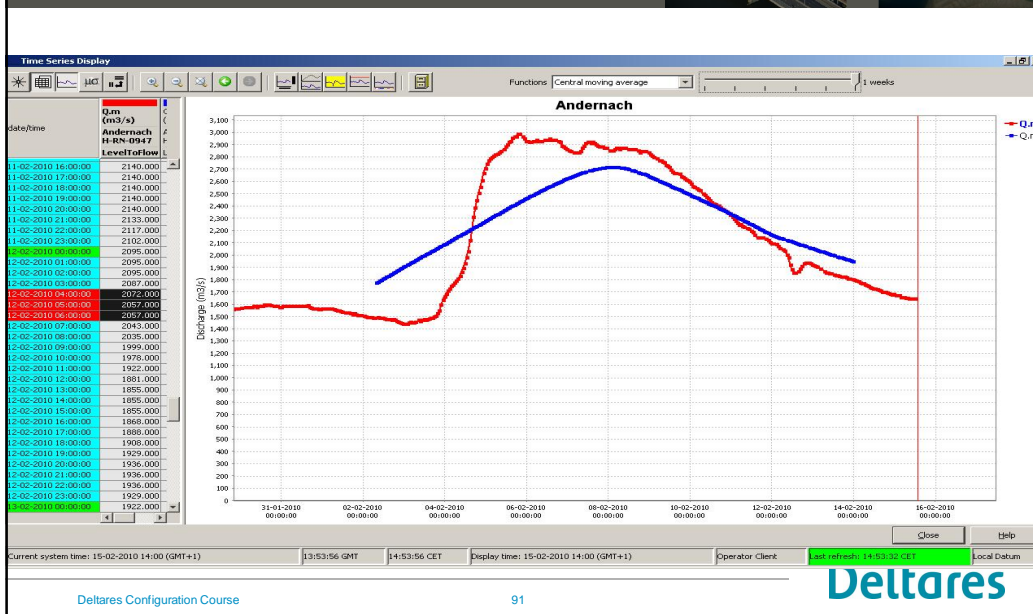
Location id	Statistics entire...	Statistics data ...	Statistics data ...
H-RN-0947	H-RN-0947	H-RN-0947	H-RN-0947
Location name	Andernach	Andernach	Andernach
Parameter id	Qm	Qm	Qm
Parameter name	Discharge (Q.m)...	Discharge (Q.m)...	Discharge (Q.m)...
Module instance	LevelOfFlow	LevelOfFlow	LevelOfFlow
Start time	29-01-2010 20:00:00	29-01-2010 20:00:00	15-02-2010 14:00:00
End time	17-02-2010 12:00:00	15-02-2010 13:00:00	17-02-2010 12:00:00

Data quality:

Statistics entire...	Statistics data ...	Statistics data ...
Nr. of values	449	402
Nr. of completed	45	0
Nr. of corrected	0	0
Nr. of reliables	402	402
Nr. of doubtful	0	0
Nr. of unreliable	0	0
Nr. of missing	47	0

The plot shows a discharge curve peaking at approximately 2,900 m³/s around 06:00 on 16-02-2010. The status bar at the bottom shows: Current system time: 15-02-2010 14:00 (GMT+1), 13:54:20 GMT, 14:54:20 CET, Display time: 15-02-2010 14:00 (GMT+1), Operator Client, last refresh: 14:54:15 CET, Local Datum.

Interactive statistics (2)

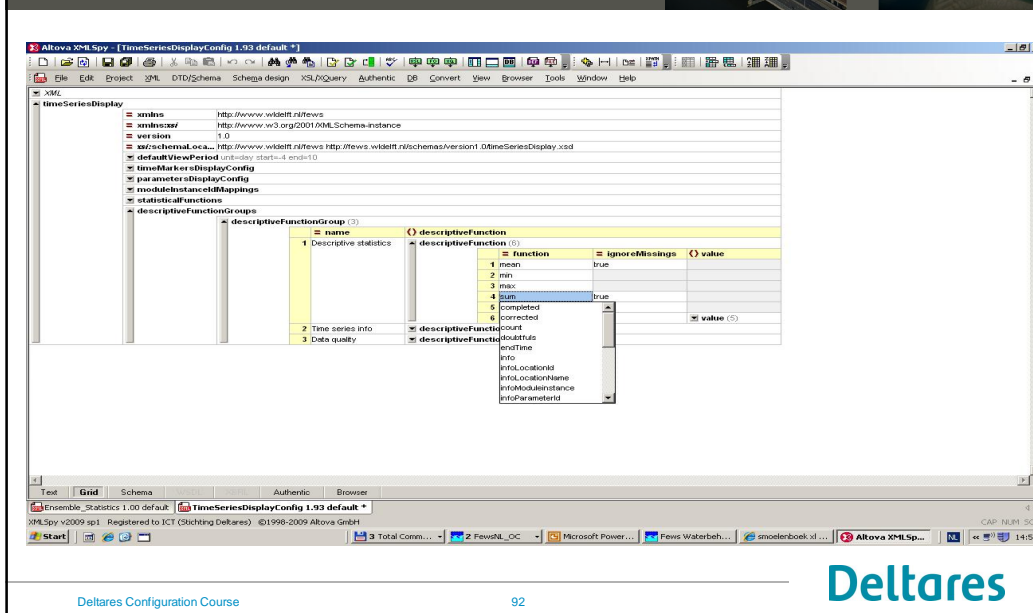


Deltares Configuration Course

91

Deltares

Interactive statistics (3)



Deltares Configuration Course

92

Deltares

Ensembles – Exercise 17

Run statistics transformation module

- Import KNMI ECMWF ensemble

Adding interactive statistics

