



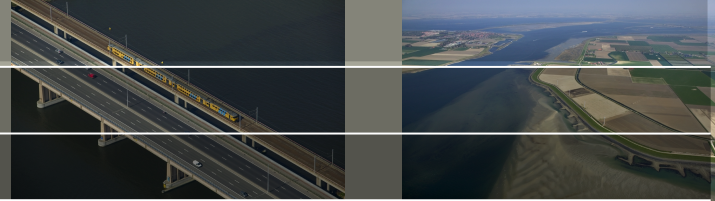
FEWS: A Forecasting Environment

Reservoir System Modeling Technologies Conference

February 22, 2012

Edwin Welles
Deltares USA

Presentation Overview



- Characteristics of any forecast system
- Description of FEWS, a multi-purpose forecast environment
- Example FEWS applications

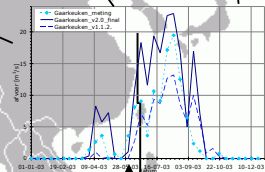
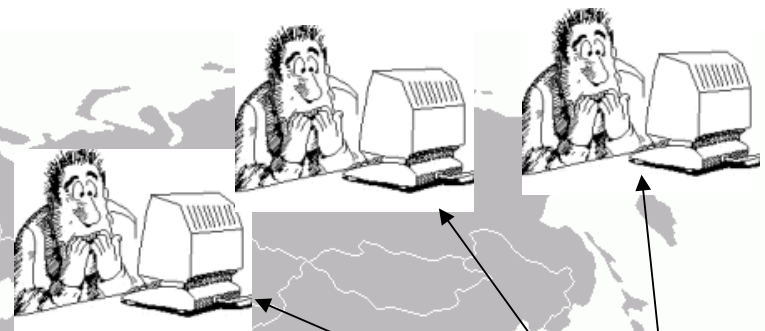
An aerial photograph showing a coastal dike system. The dike is a long, narrow strip of land with a green grassy top and a concrete base. Several white wind turbines are visible along the dike. To the right of the dike is a large area of agricultural fields, some green and some brown. To the left of the dike is a large body of water, likely a river or estuary, with a sandy beach area. In the background, a town or village is visible on the left side.

Forecast Systems

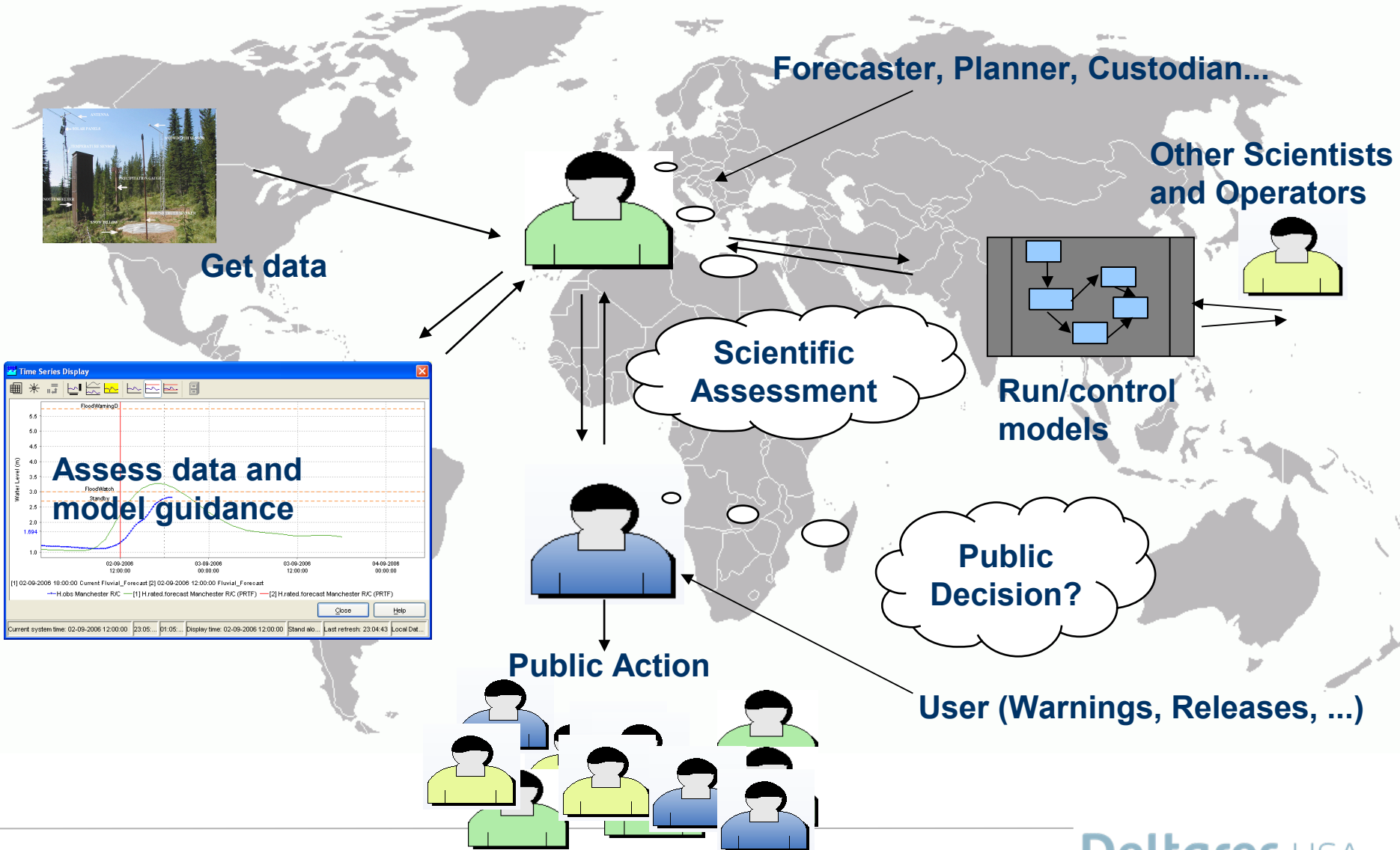
The Goal of a Forecast System

Linking Good Science to

- Water Supply Managers
- Planning Agencies
- Regulators
- Policymakers
- Operational Forecasting
- Emergency Managers
- Public



Elements of a Forecast System



An aerial photograph showing a coastal region. A large body of water is on the left, with a dike or levee system running along the coast. The land behind the dike is divided into agricultural fields of various colors (green, brown, tan). A small town or village is visible in the upper left. The sky is clear and blue.

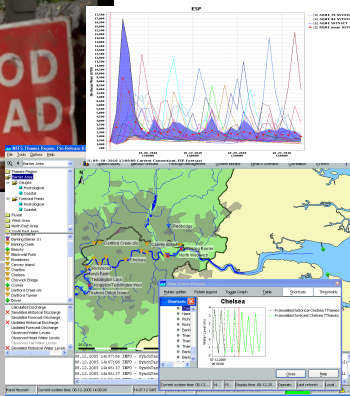
FEWS: Introduction and Architecture

Delft – Flood Early Warning System

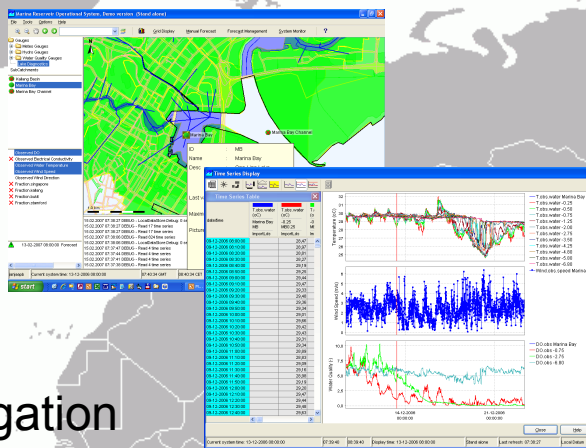
Wide Variety of Applications



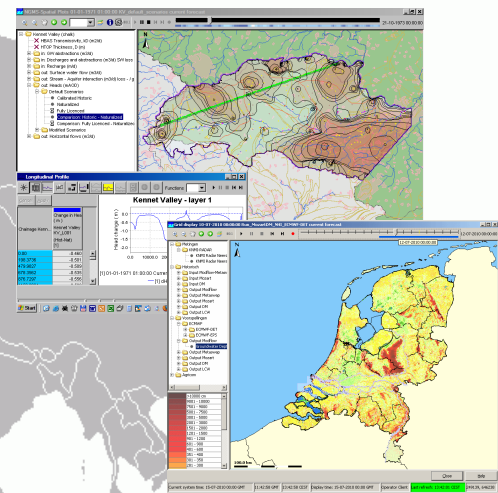
floods & water supply



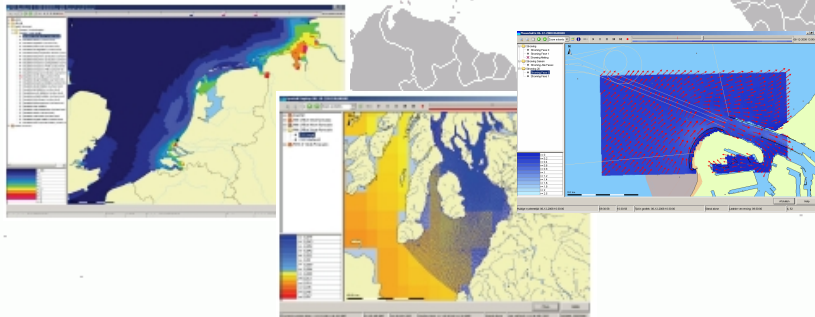
water quality



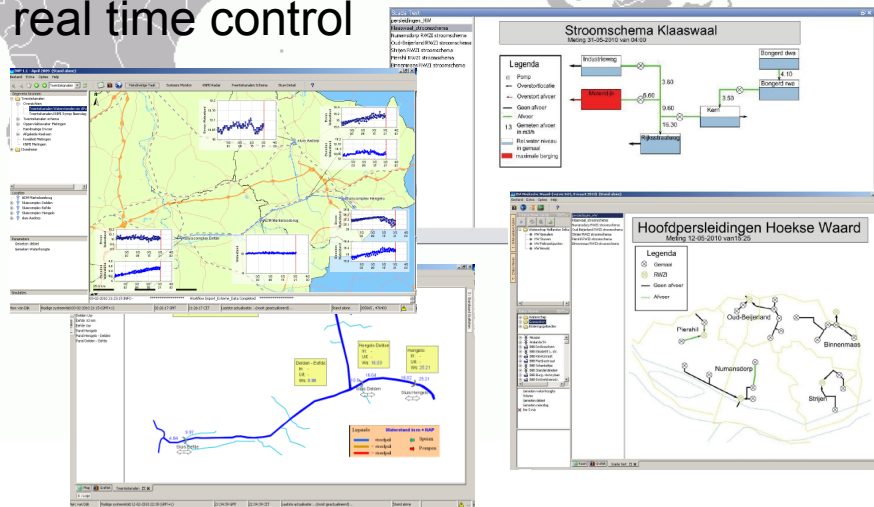
groundwater



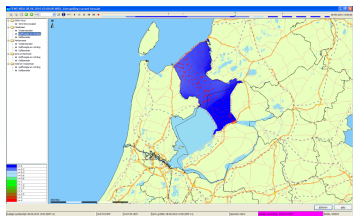
coastal WQ storm surge navigation



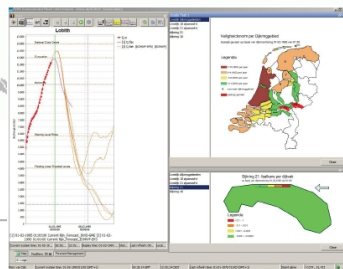
real time control



lakes & reservoirs



dike strength

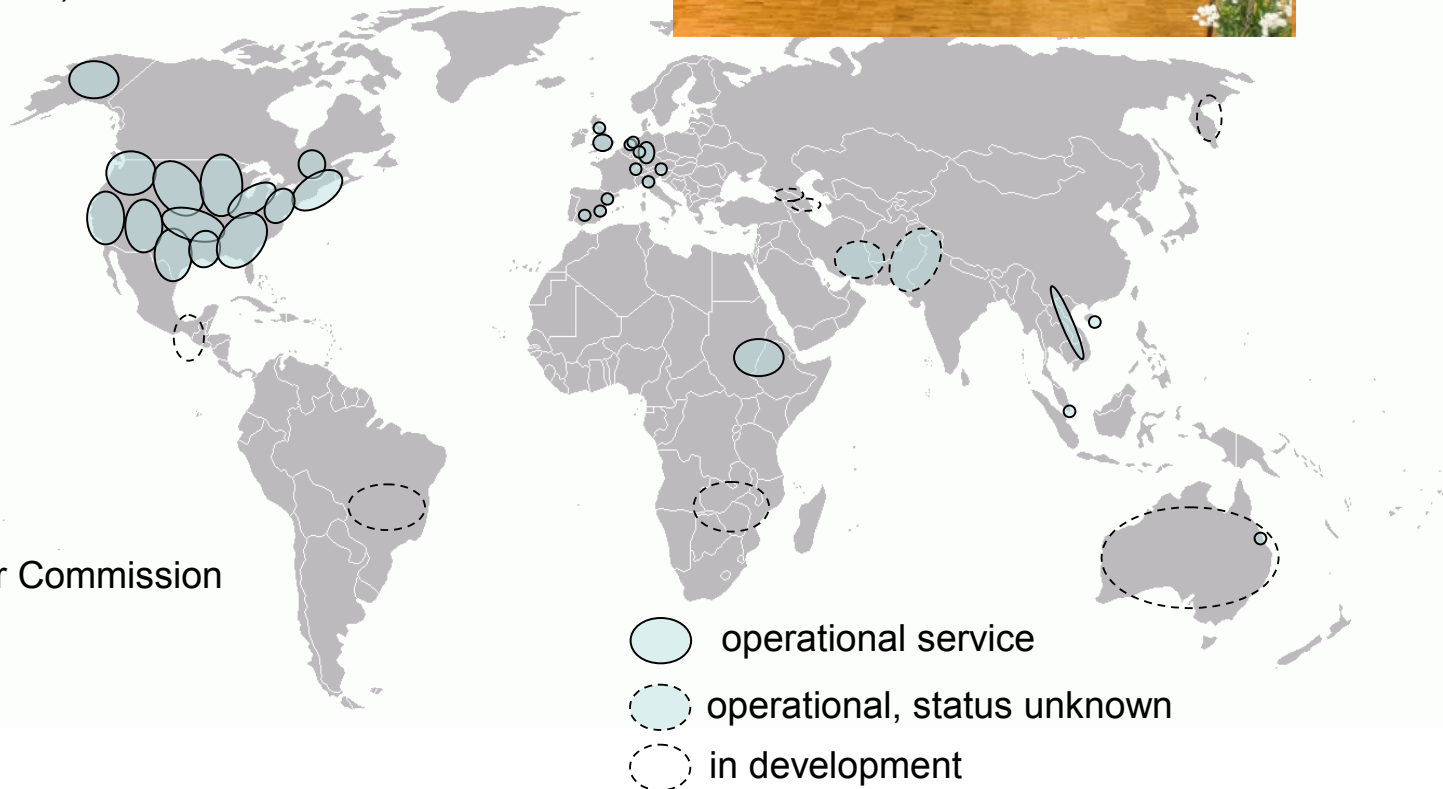




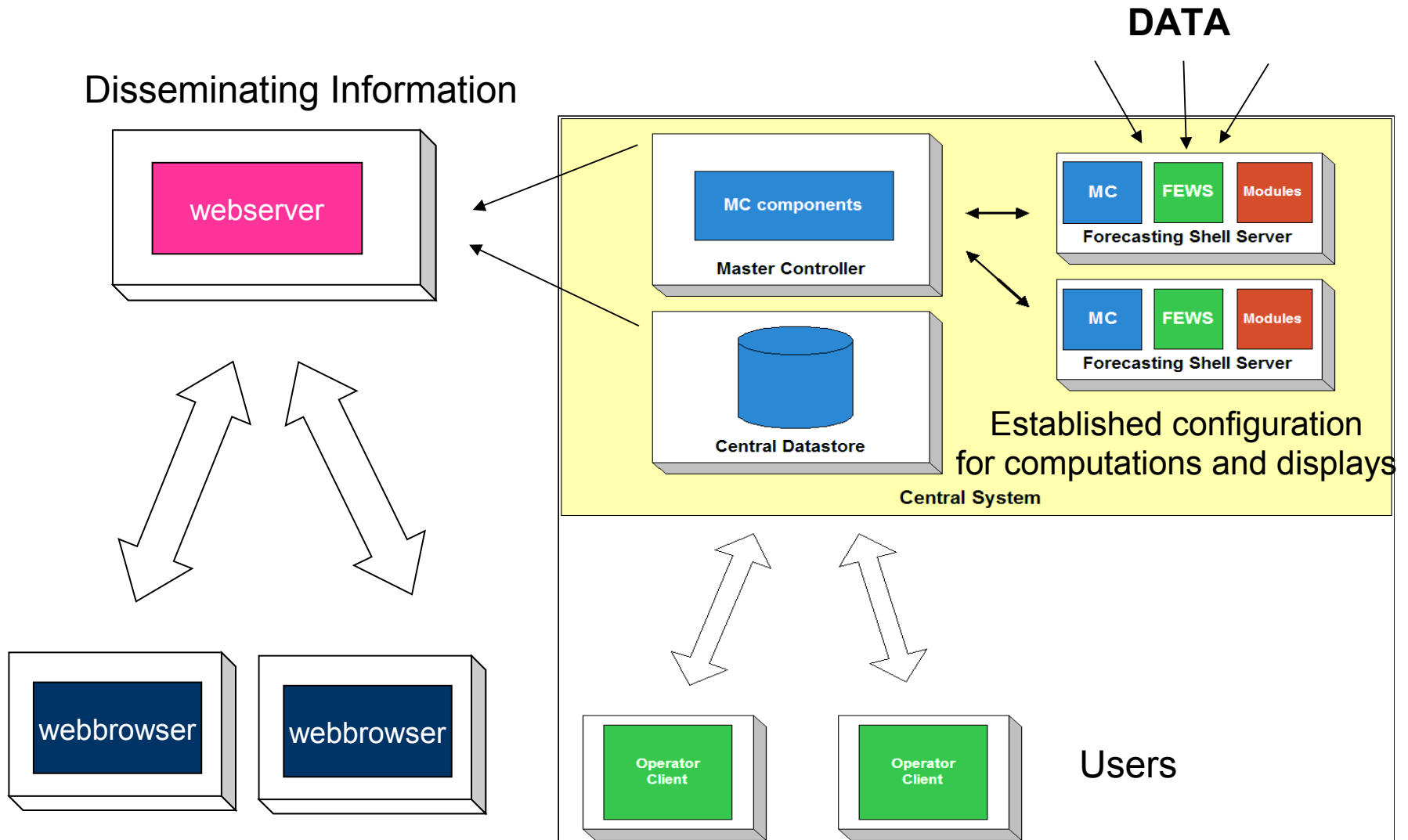
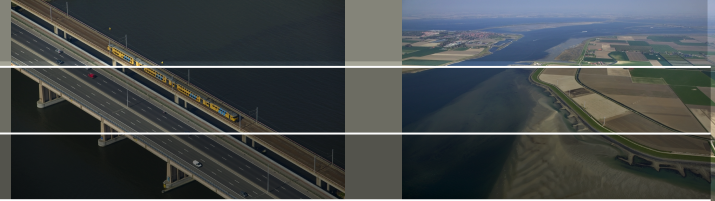
Delft FEWS User Community



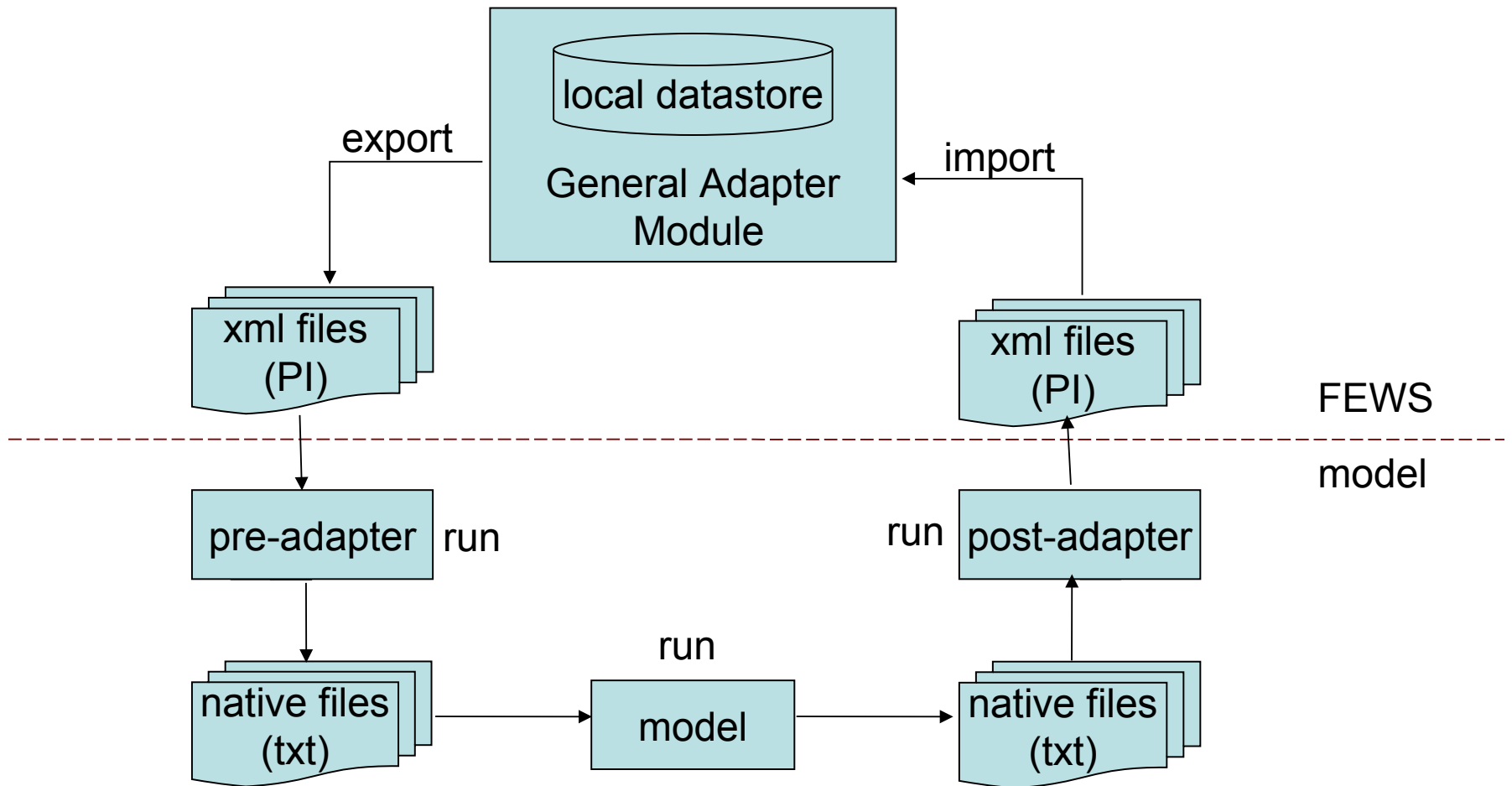
- USA (BPA, NWS)
- Canada
- UK
- Netherlands
- Germany
- Switzerland
- Italy
- Austria
- Spain
- Singapore
- Taiwan
- Mekong River Commission
- Korea
- Australia
- Sudan
- Zambezi
- Mexico
- Brazil



Schematic Overview of FEWS



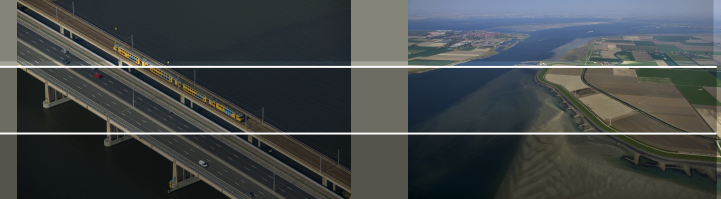
Running models – how does it work



An aerial photograph showing a coastal region. A large body of water is on the left, separated from the land by a dike. The land is divided into various agricultural plots, some green and some brown. A small town or village is visible in the upper left. The sky is clear and blue.

FEWS: Model Control

Situational Awareness



CHPS - Bonneville Power Administration (Stand alone)

File Tools Options Help

Forecasts

BPA

1 : Forecasts

5 : Data Viewer

- BPA
 - Quality Control
 - Forecasting
 - Upper Columbia
 - Kootenay
 - Clark Fork
 - DLGM8 : Clark Fork R at Deer Lodge
 - DRMM8 : Clark Fork R at Drummond
 - RCCM8 : Rock Ck nr Clinton
 - BONM8 : Blackfoot R nr Bonner
 - ABOM8 : Clark Fork R ab Missoula
 - DARM8 : Bitterroot R nr Darby
 - BITM8 : Bitterroot R nr Missoula
 - BELM8 : Clark Fork R bl Missoula
 - STRM8 : St. Regis R nr St Regis
 - SRGM8 : Clark Fork R at St Regis
 - Flathead
 - Pendoreille
 - Spokane
 - Coulee
 - Upper Tribs
 - Salmon
 - Clearwater
 - Lower Snake
 - Yakima
 - Lower Tribs
 - MCMain
 - Willamette
 - ESP and D90
 - Snow updating
 - Upper Columbia

Run options

Warm state selection
12-30-2011 12:00:00

Time zero
01-08-2011 12:00:00

Forecast length
01-18-2011 12:00:00

Run options

6 : Logs 9 : Run Info 7 : Forecaster notes

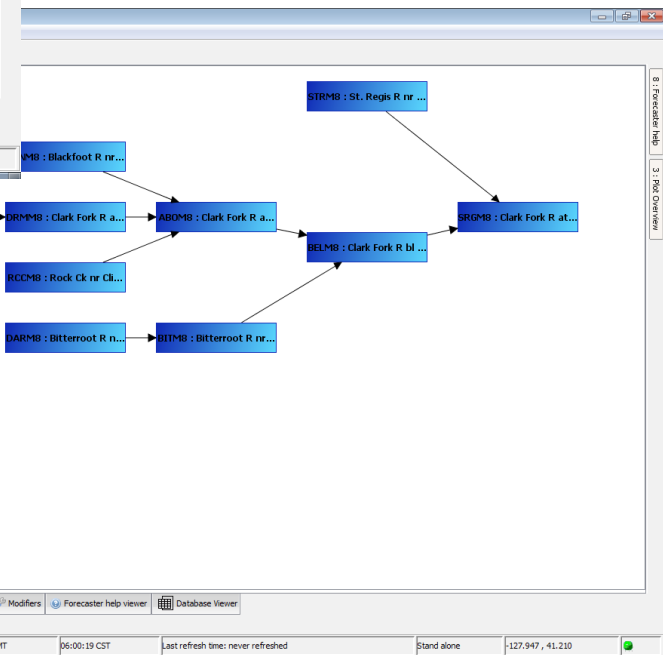
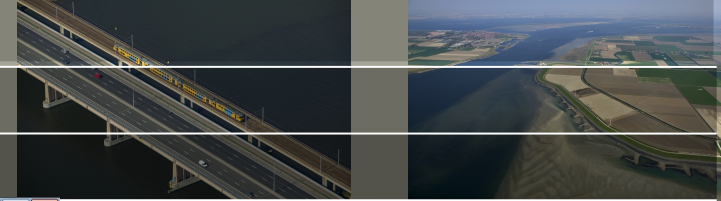
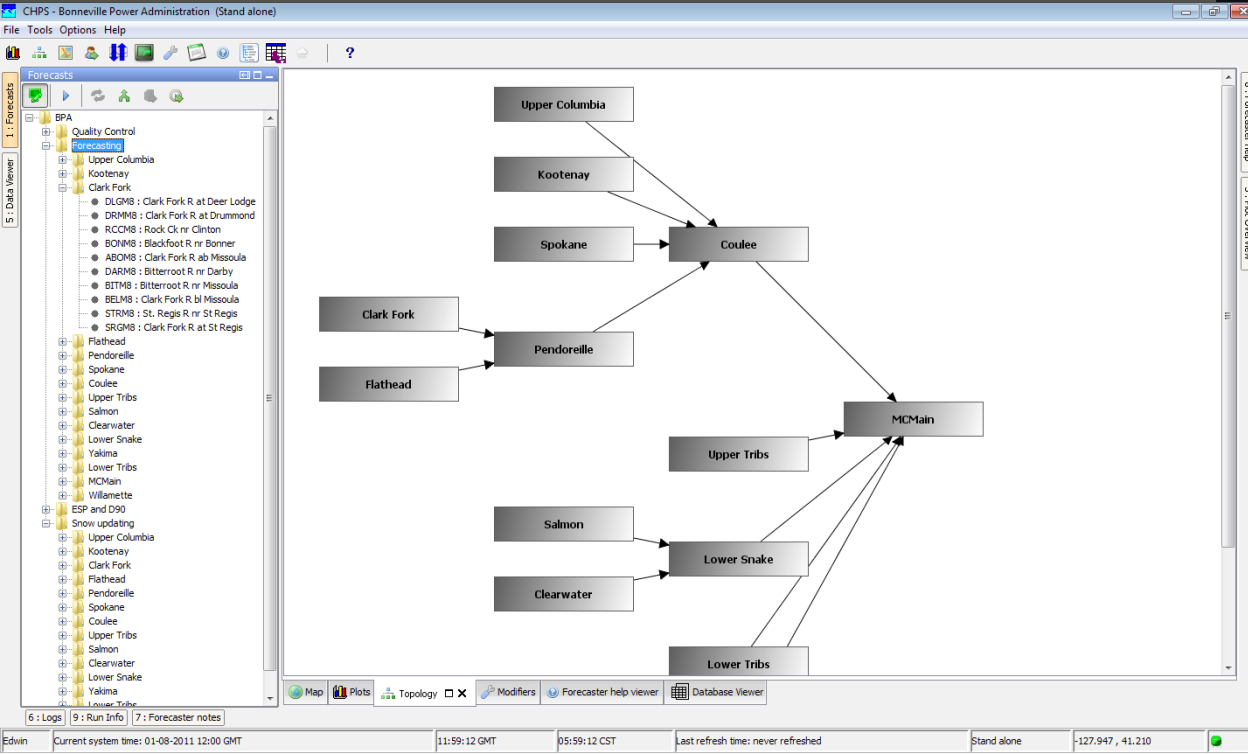
Map Plots Topology Modifiers Forecaster help viewer Database Viewer

500.0 km

8 : Forecaster help 3 : Plot Overview

Edwin Current system time: 01-08-2011 12:00 GMT 11:58:05 GMT 05:58:05 CST Last refresh time: never refreshed Stand alone -107.645, 51.128

Model Connectivity



Model Execution and Display



CHPS - Bonneville Power Administration (Stand alone)

File Tools Options Help

1 : Forecasts

5 : Data Viewer

Forecasts

- BPA
 - Quality Control
 - Forecasting
 - Upper Columbia
 - Kootenay
 - Clark Fork
 - DLGM8 : Clark Fork R
 - DRMM8 : Clark Fork R
 - RCCM8 : Rock Ck nr C
 - BONM8 : Blackfoot R n
 - ABOM8 : Clark Fork R
 - DARM8 : Bitterroot R r
 - BITM8 : Bitterroot R nr
 - BELM8 : Clark Fork R b
 - STRM8 : St. Regis R nr
 - CSGM8 : Clark Fork R

Run options

Cold state selection

Cold States(Default)

Start: 12-12-2011 12:00:00

Time zero

12-20-2011 12:00:00

Forecast length

12-24-2011 12:00:00

Run options

6 : Logs 9 : Run Info 7 : Forecaster notes

DLGM8 - Clark Fork R at Deer Lodge

Discharge (CFS)

Temperature Mean (DEGF)

Rain/Snow

12-17-2011 12:00:00 12-21-2011 12:00:00 12-25-2011 12:00:00 12-29-2011 12:00:00

BPA_MergeMAP: [2] 12-20-2011 12:00:00 Current
DLGM8_Forecast: [1] 12-20-2011 12:00:00 Current

Plots Topology Modifiers Forecaster help viewer Workflow Navigator Datab...

Plot Overview

DLGM8 - Clark Fork R at Deer Lodge

DLGM8 - Clark Fork R at Deer Lodge - FORCINGS

DLGM8 - Clark Fork R at Deer Lodge - RAIN-SNOW

DLGM8 - Clark Fork R at Deer Lodge - SWE

8 : Forecaster help 3 : Plot Overview

edwin Current system time: 12-20-2011 12:00 GMT 13:09:17 GMT 13:09:17 GMT Last refresh time: never refreshed Stand alone -112.110 , 45.471

edwin@localhost:/mnt... CHPS - Bonneville Pow...

Control of Model Input, States, Options

CHPS - Bonneville Power Administration (Stand alone)

File Tools Options Help

1 : Forecasts

5 : Data Viewer

Forecasts

Mod type	Name	Sum...	Start	End	Valid Time	User	Creation time	...	C...
WECHNG	WECHNG_DLGM8U_DLGM8L...	4.4	12-14-20...	12-14-20...	--	edwin	02-10-20...		
TSCHNG	MAT_DLGM8U_DLGM8L	Tim...	12-17-20...	12-31-20...	12-20-20...	edwin	02-10-20...		
TSCHNG	MAT_DLGM8L	Tim...	12-09-20...	12-31-20...	12-20-20...	edwin	02-10-20...		
TSCHNG	MAT_DLGM8U_DLGM8L	Tim...	12-09-20...	12-31-20...	12-20-20...	edwin	02-10-20...		
TSCHNG	MAP_DLGM8U_DLGM8L	Tim...	12-19-20...	12-19-20...	12-20-20...	edwin	02-10-20...		
TSCHNG	MAP_DLGM8U_DLGM8L	Tim...	12-19-20...	12-19-20...	12-20-20...	edwin	02-10-20...		

Create mod WECHNG AESCCHNG Re-run

Modifier Properties

Type: tschng
 Name: MAT_DLGM8U_DLGM8L
 Start time: 12-17-2011 18:00:00
 End time: 12-31-2011 12:00:00
 Valid time: 12-20-2011 12:00:00

Apply Apply To

Locations

DLGM8L
DLGM8U

Operation Time series

date/time	A	B
	MAT (DEGF)	MAT (DEGF)
	DLGM8U - (DLGM8U)	DLGM8U - (DLGM8U)
	clarkfork_M [1]	clarkfork_N [1]
12-18-2011 12:00:00		30.0
12-18-2011 18:00:00		20.0
12-19-2011 00:00:00		20.0

Plots Topology Modifiers Forecaster help viewer Workflow Navigator Dat...

6 : Logs 9 : Run Info 7 : Forecaster notes

edwin Current system time: 12-20-2011 12:00 GMT 13:11:30 GMT 13:11:30 GMT Last refresh time: never refreshed Stand alone -112.110 , 45.471

8 : Forecaster help 3 : Plot Overview

Plot Overview

DLGMS - Clark Fork R at Deer Lodge

DLGMS - Clark Fork R at Deer Lodge - FORCINGS

DLGMS - Clark Fork R at Deer Lodge - RAIN-SNOW

DLGMS - Clark Fork R at Deer Lodge - SWE

BPA_MergeMAP: [1] 1:

Temperature Mean (DEGF)

[1] MAT DLGM8U
[1] MAT DLGM8U modified

An aerial photograph showing a coastal dike system. The dike runs along the edge of a large body of water, separating it from a patchwork of agricultural fields. Some fields are green, while others are brown, indicating different stages of cultivation or harvest. A small town or village is visible on the left side of the dike. The water in the foreground is dark blue, while the water behind the dike is a lighter, turbid greenish-brown. The sky is clear and blue.

FEWS: Displays

Customized Icons for the New England flood

CHPS - Northeast River Forecast Center (Stand alone)

File Tools Options Help

1 : Forecasts

5 : Data Viewer

6 : Logs 7 : Forecaster Notes

Hudson River

Plot Overview

8 : Forecaster Help 3 : Plot Overview

Rondout Creek - Rosendale (ROSN6HUD) Flow

Rain/Snow

ROSN6HUD Forecast

Record Flood
Major Flood
Moderate Flood
Minor Flood
Action stage

ROSN6HUD Forcings

Rain/Snow

ROSN6HUD Sac States

Run options

Warm state selection
08-27-2011 12:00:00

Time zero
09-01-2011 18:00:00

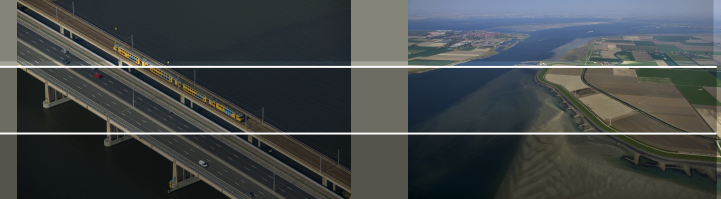
Forecast length

Run options

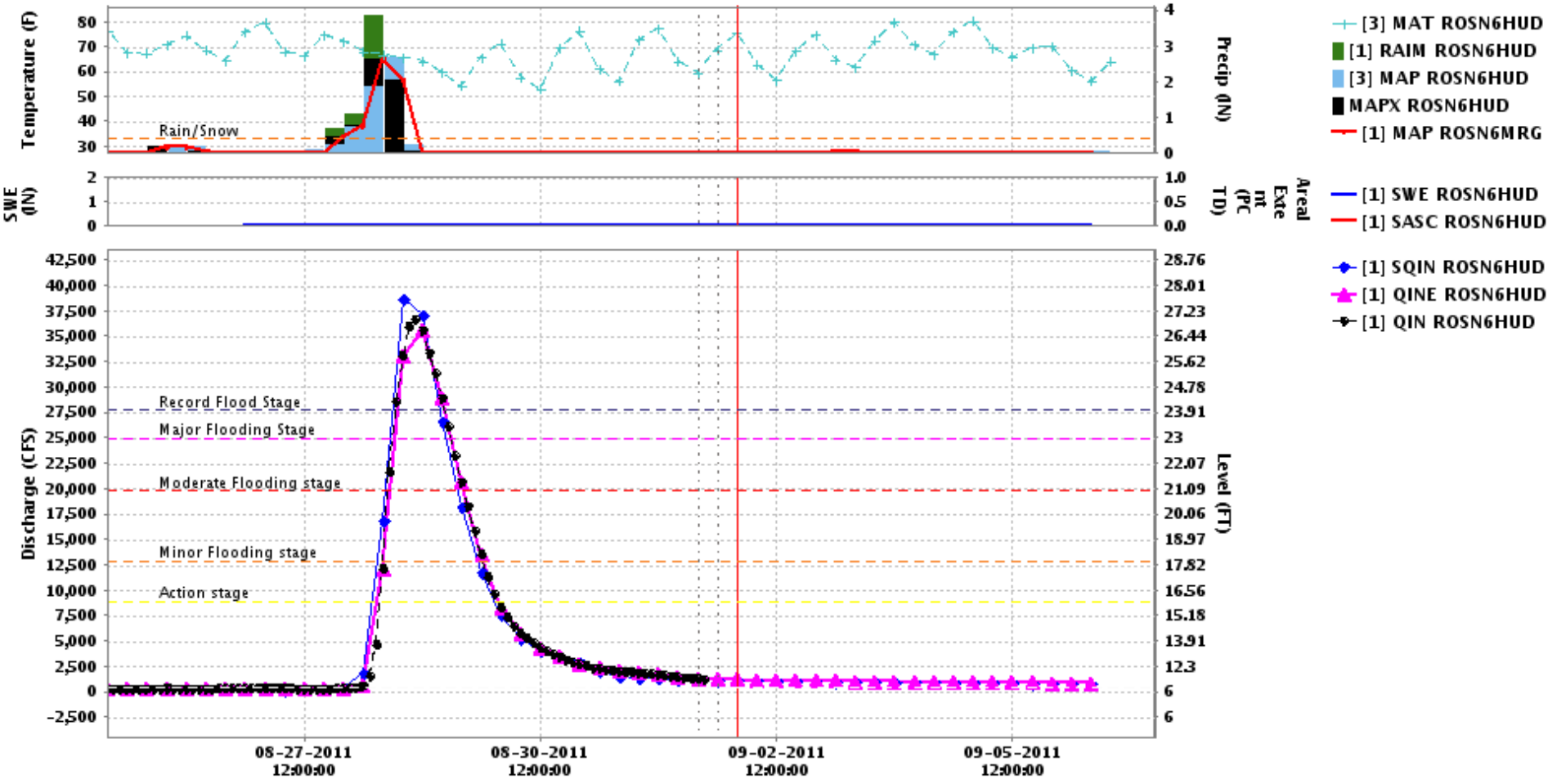
Map Plots Topology Modifiers

fe... Current system time: 09-01-2011 18:00 GMT 21:18:51 GMT 21:18:51 GMT Last refresh time: never refreshed Stand alone -70.734 , 40.503

Threshold crossings

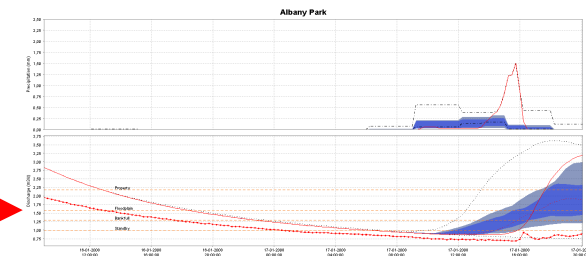
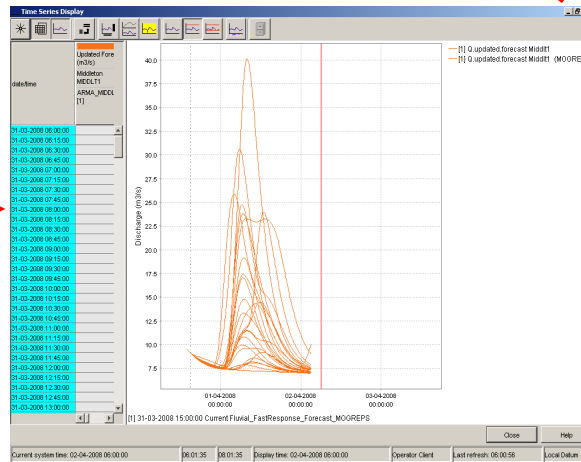
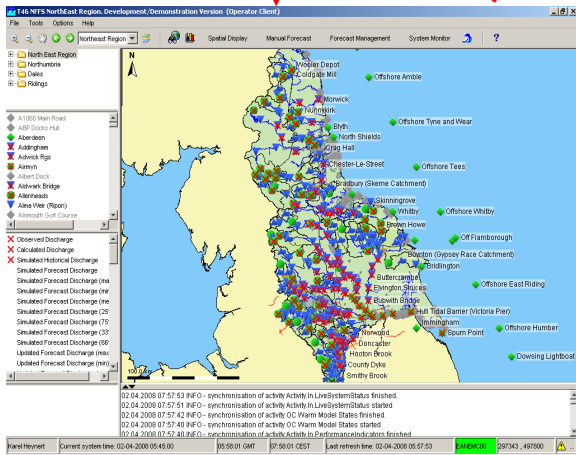
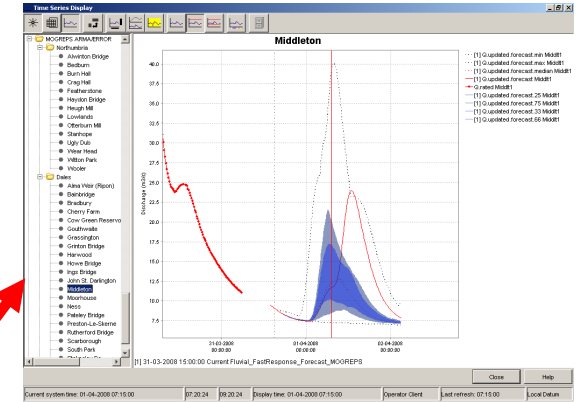
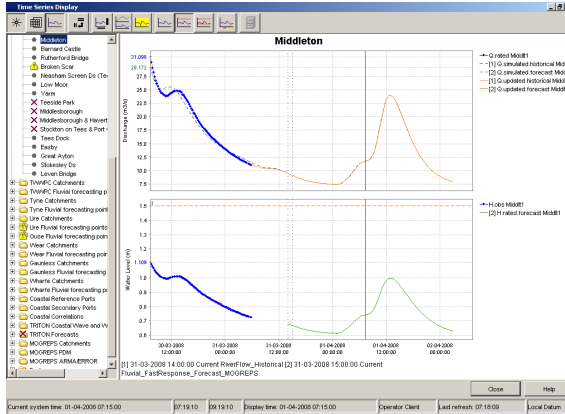
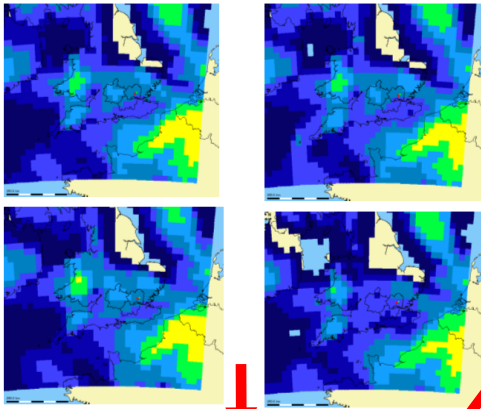


Rondout Creek - Rosendale (ROSN6HUD) Flow



[1] 09-01-2011 12:00:00 Current FFG_FFH [2] 09-01-2011 18:00:00 Current MTRN6HUD_Forecast

Ensemble forecasting in England & Wales



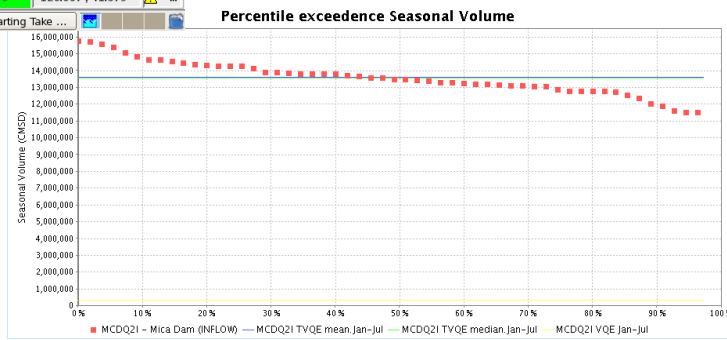
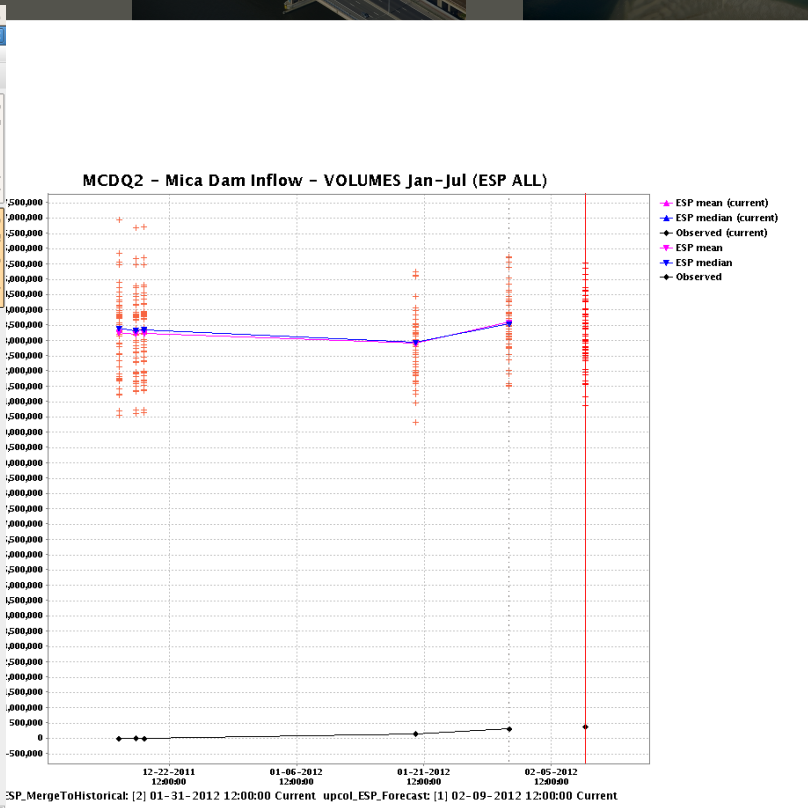
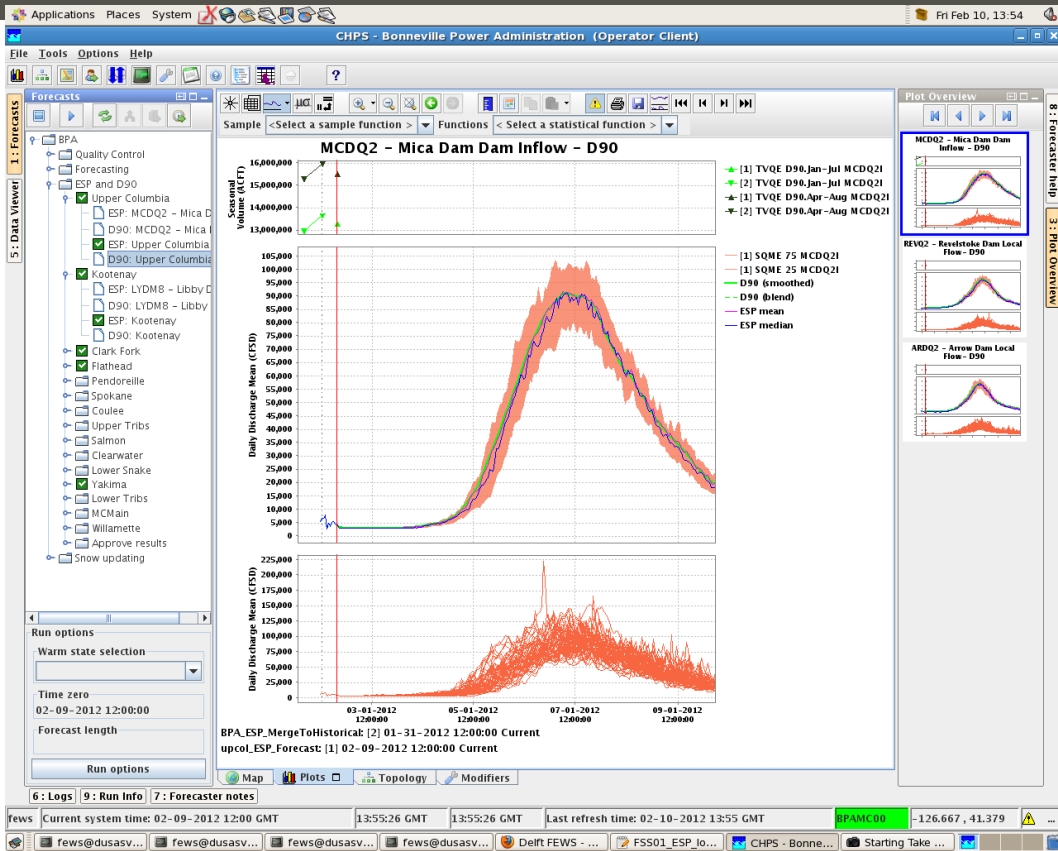
25_4B:Wed Jan 16 09:00:00 GMT 2008 16/01/2008 09:00 GMT 25 ensembles

	10	14	18	22	2	6	10	14	18
Flooded	100	100	100	100	100	100	100	100	100
Blankfill					100	100	100	100	100
Standby					90	100	100	100	100

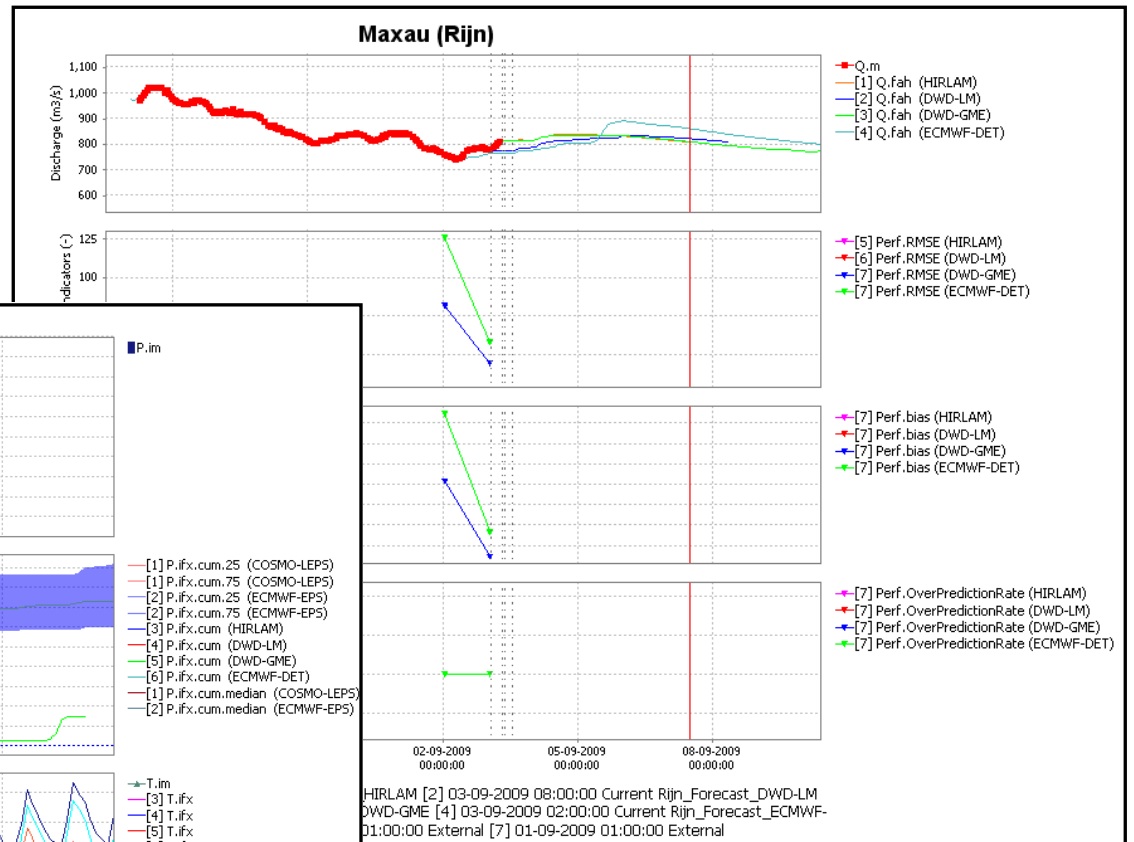
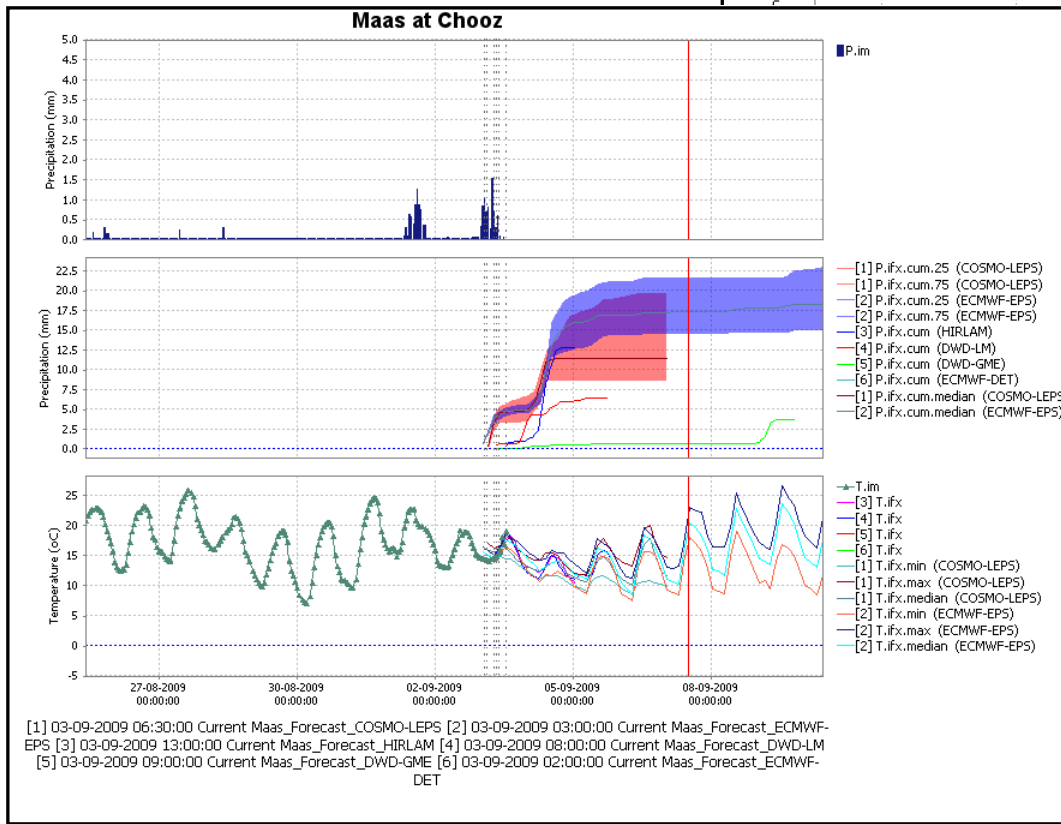
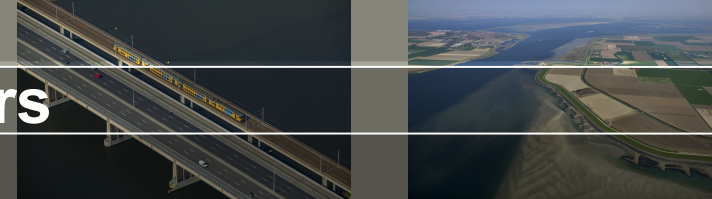
25 ensembles Threshold : Standby

	10	14	18	22	2	6	10	14	18
13/01/2008 21:00 GMT	0	0	0	0	0	0	0	0	0
14/01/2008 09:00 GMT	0	0	0	0	0	0	0	0	0
15/01/2008 09:00 GMT	24	24	24	24	24	24	24	24	24
16/01/2008 09:00 GMT	25	25	25	25	25	25	25	25	25

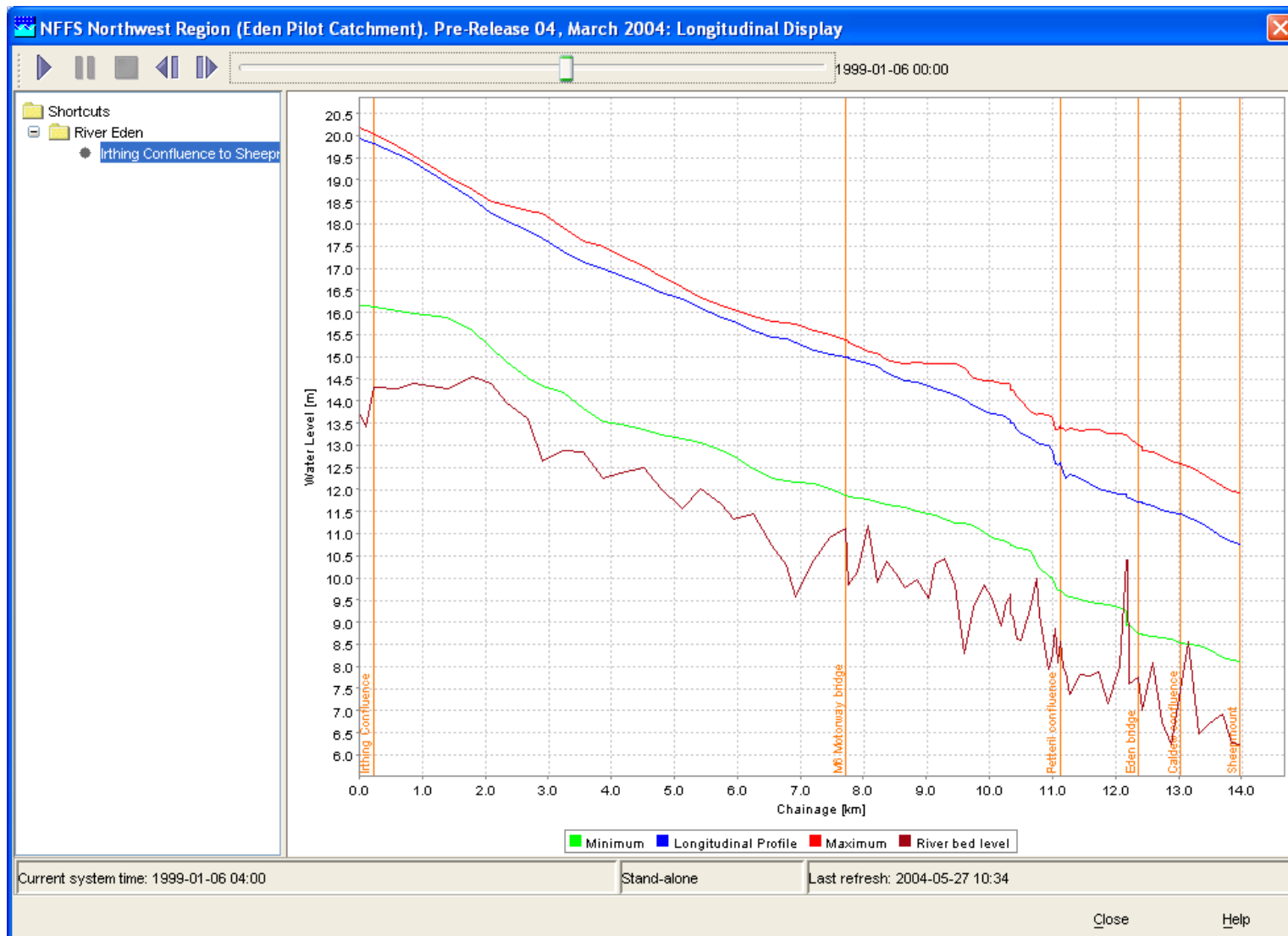
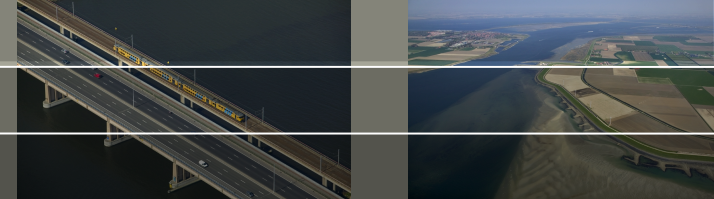
Ensemble streamflow forecasting at BPA



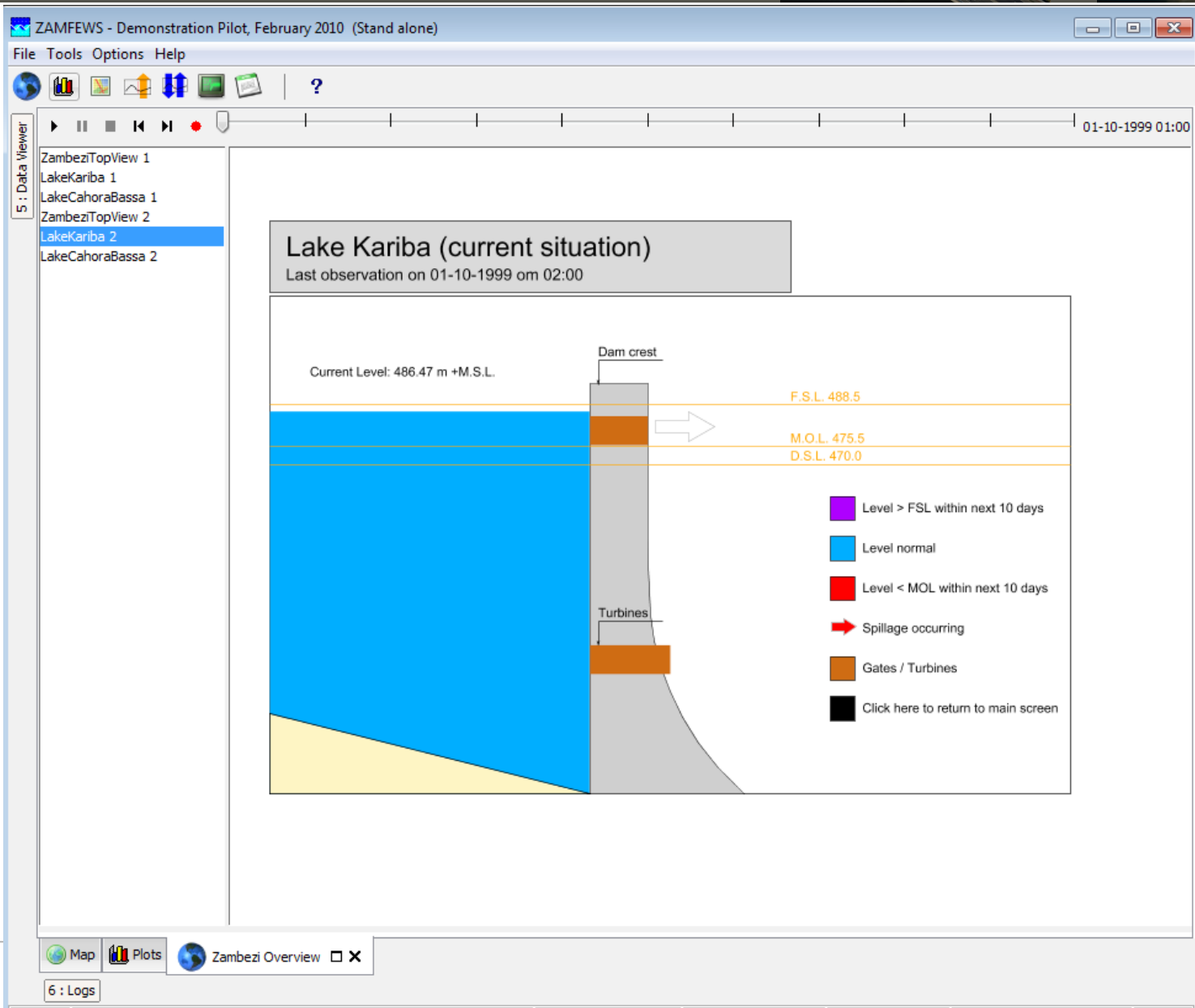
Uncertainty: Performance Indicators



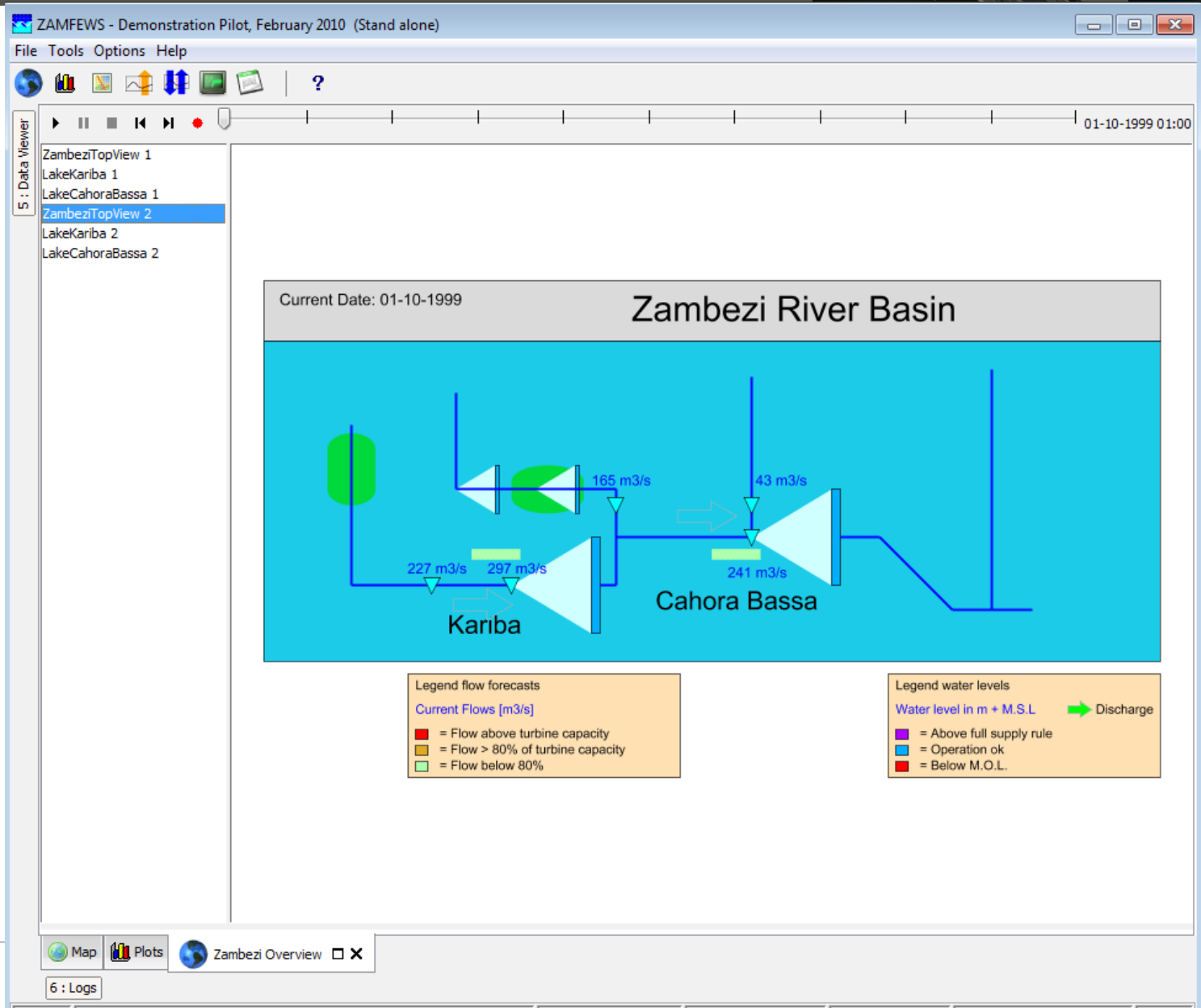
FEWS: Longitudinal Display



FEWS: System Display (1)



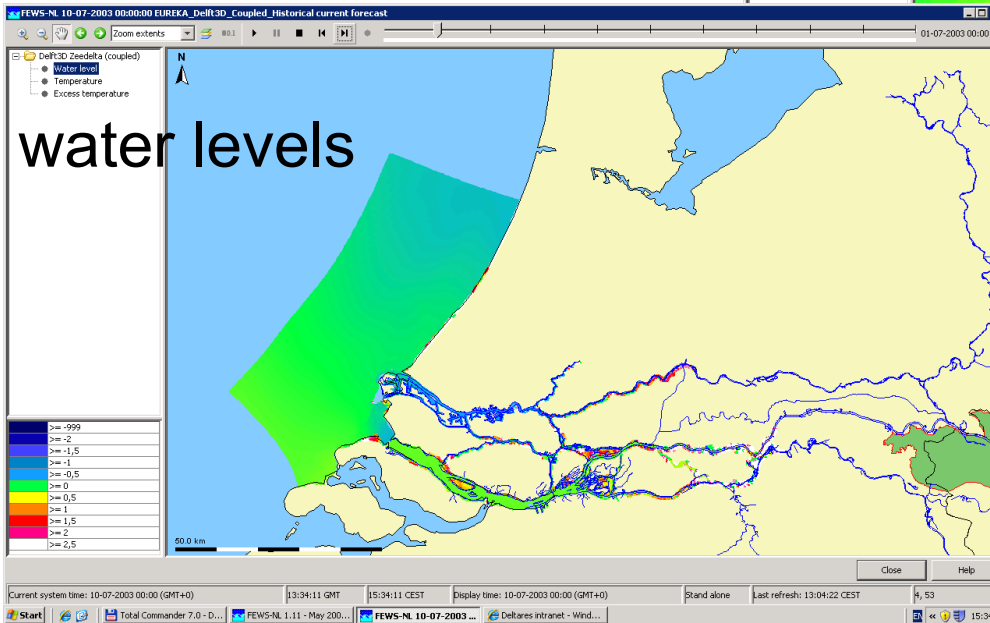
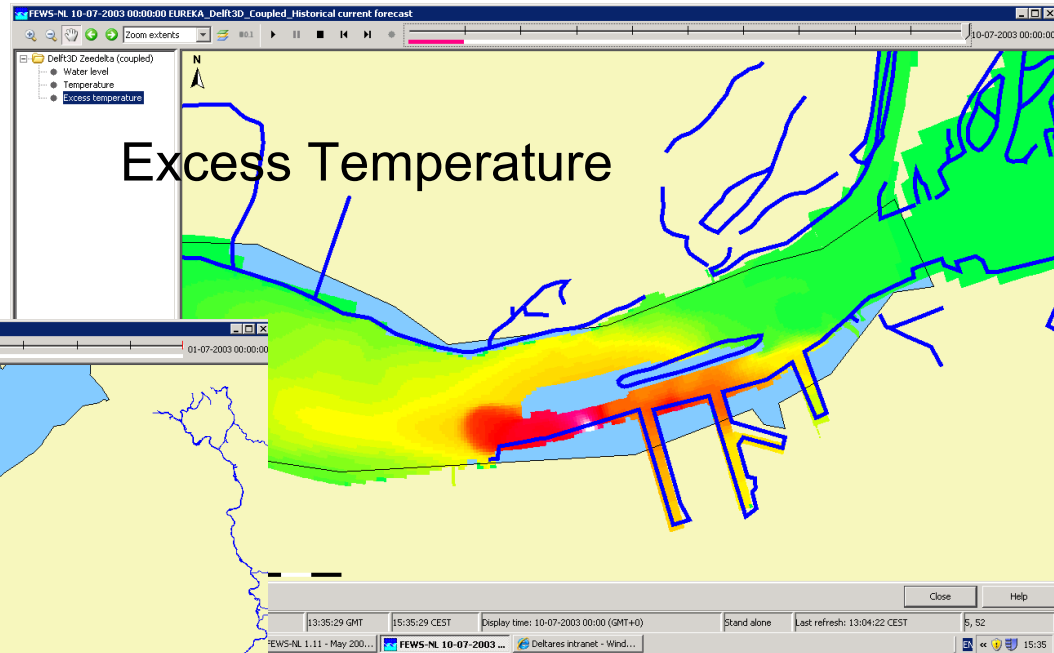
FEWS: System Display (2)



Prototype forecast system for cooling water



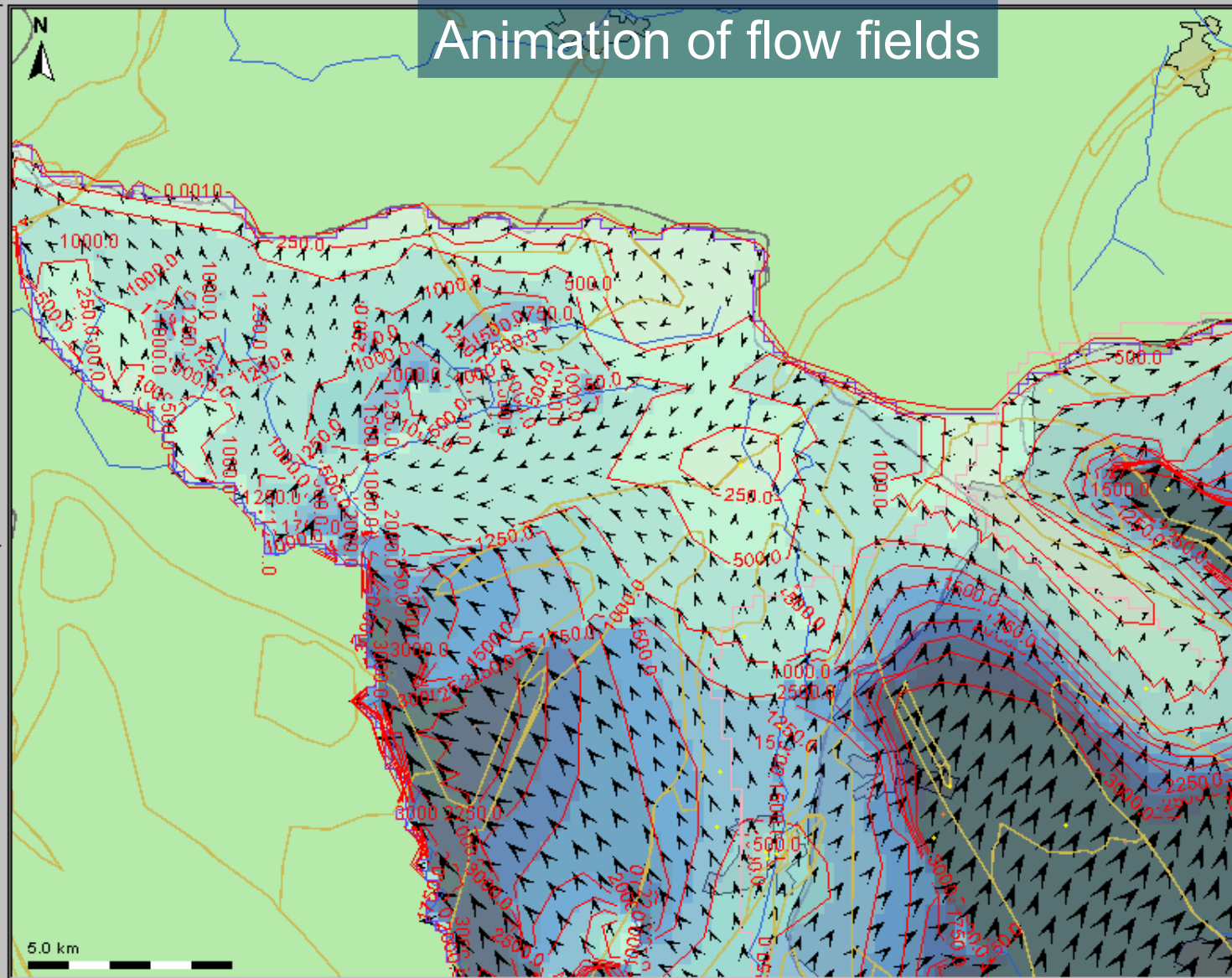
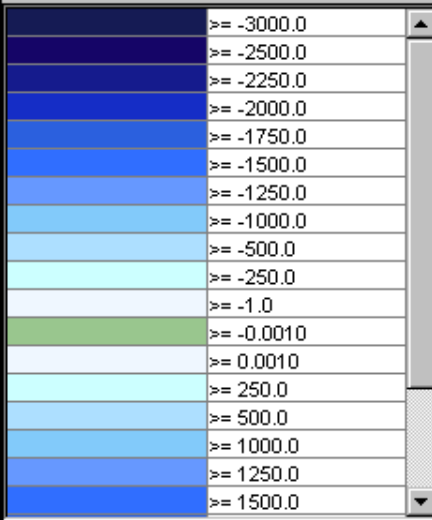
- From North Sea to Basel
- 3D in part of Hollandsch Diep estuary
- 2D till Hagestein and Dreumel
- 1D-2D-3D coupling under FEWS!



Can also model salinity with this setup

Animation of flow fields

- Test and Itchen chalk model
 - Stresses (input)
 - Recharge (QRCH_inp)
 - Responses (simulated)
 - Stream gain(+)/loss(-) (QSTR)
 - Baseflow (QSTR_ACCU)
 - Heads (H)
 - Horizontal flow field (QX, QY)
 - Historic reference
 - Naturalized reference
 - Horizontal flows (QX,QY)
 - What If scenario
 - Aquifer properties
 - West Midlands Worke sandstone model



Close Help



Thank You

Deltares