

Deltares
Enabling Delta Life

The FEWS System and Applications in Canada

Dave Casson, P.Eng. M.Sc.
Micha Werner, Ph.D.
21 February 2019

Presentation Overview

- Introducing Deltares
- Delft-FEWS
- Delft-FEWS in Canada
- Outlook and Plan for Development
- Experiences in Regional, National, International Forecasting Systems



Deltares

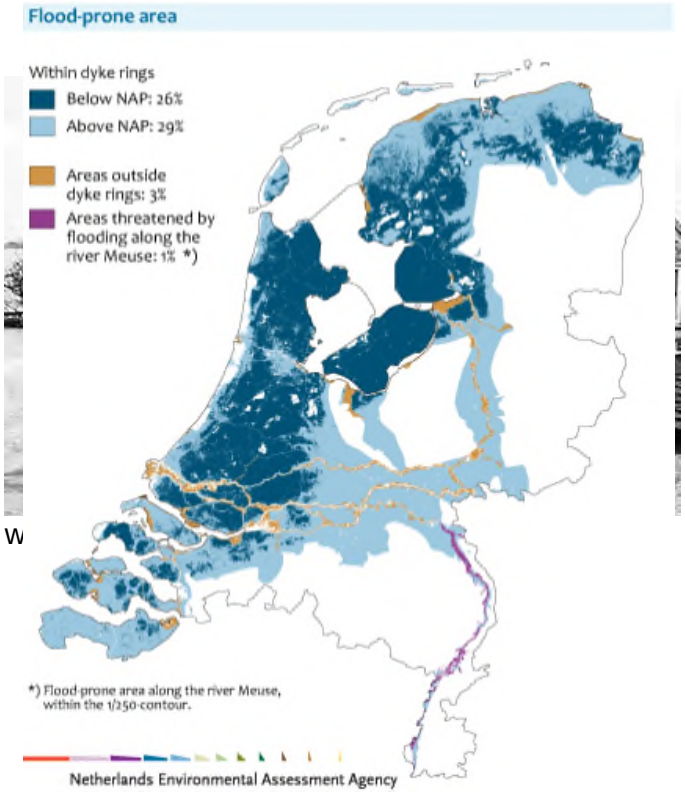
Flood Risk in the Netherlands

- 55% of the Netherlands is at risk of flooding
- 26% of the country is below sea level
- 29% is susceptible to river flooding

- Dutch water boards among oldest forms of local government, dating to 13th century

- 21 regional authorities, elected

- Deltares created to manage scientific research and knowledge as national water center





https://www.pbl.nl/en/dossiers/Climatechange/content/correction-wording-flood-risks

Deltares



- National Research and Development Institute
- Focus on water management and geotechnical engineering
- Knowledge Institute, Not for Profit

- ~800 fte, 2/3 of these are “scientific staff”
- Research, Consultancy, Physical Modeling Facilities
- Open-source philosophy – Dare to Share

Deltares

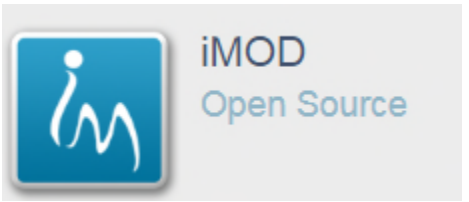
Photo: BBC News, 11 september 2015

Research Institute and Consultancy

- Delft-FEWS is most often used in Canada as an operational product, Deltares as a consultancy.
- Building operational FEWS systems much more engineering than science.
- Focus of Deltares is research and knowledge sharing.
- Deltares can be a research partner, Delft FEWS as a research tool.
  - Collaborative research projects
  - Hosting of researchers in the Netherlands
  - Direct link from science to operations





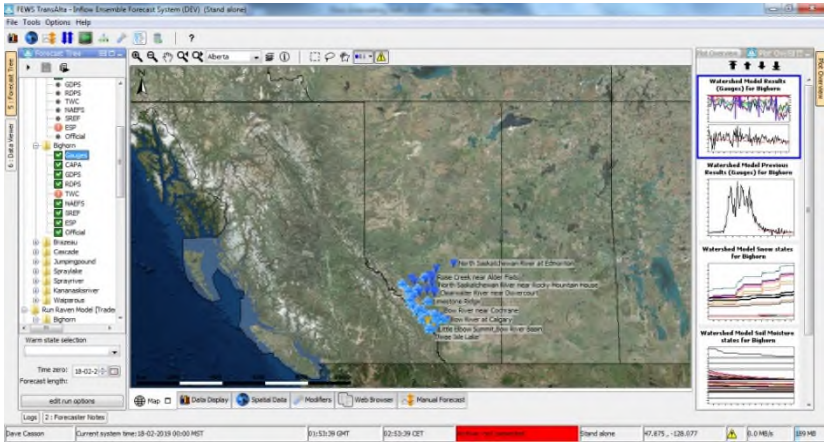




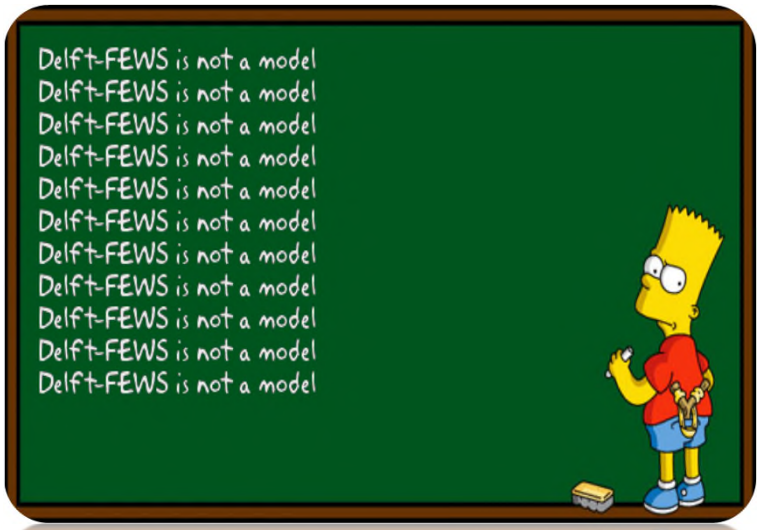


Deltares

Delft-FEWS Introduction



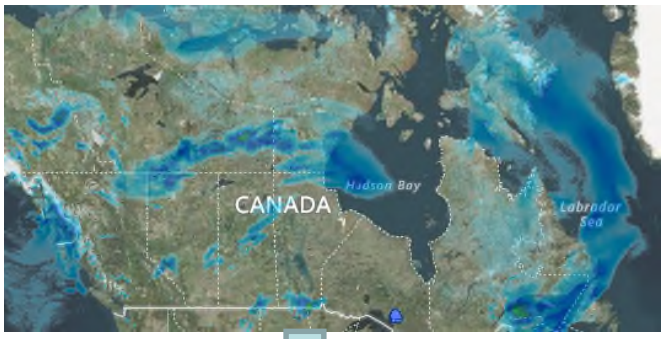
- FEWS = Flood Early Warning System
- A platform for real time forecasting and operational water management
- Highly configurable and flexible. structured workflows to streamline forecasting processes
- Intended to stimulate knowledge sharing and collaboration
- Free software, shareable, no license cost
  - In practice operational systems maintain Support and Maintenance contracts

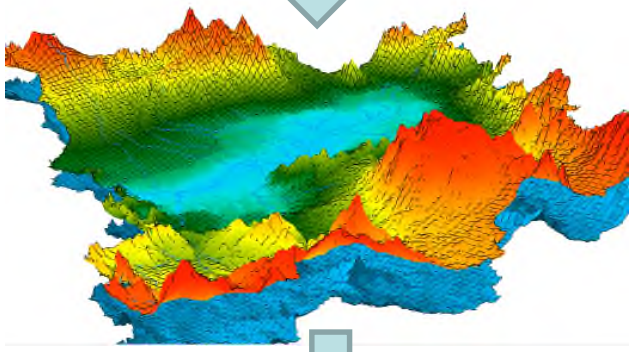


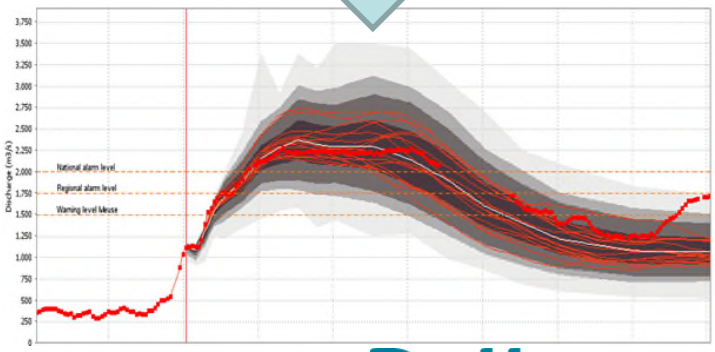
Deltares

Why is Delft-FEWS so widely implemented?

- Builds on existing investment
- Model and data source independent
- Scalable, flexible, configurable, open
- Designed for forecasting
- Institutional tool
- Shared and sustained development, strong user community

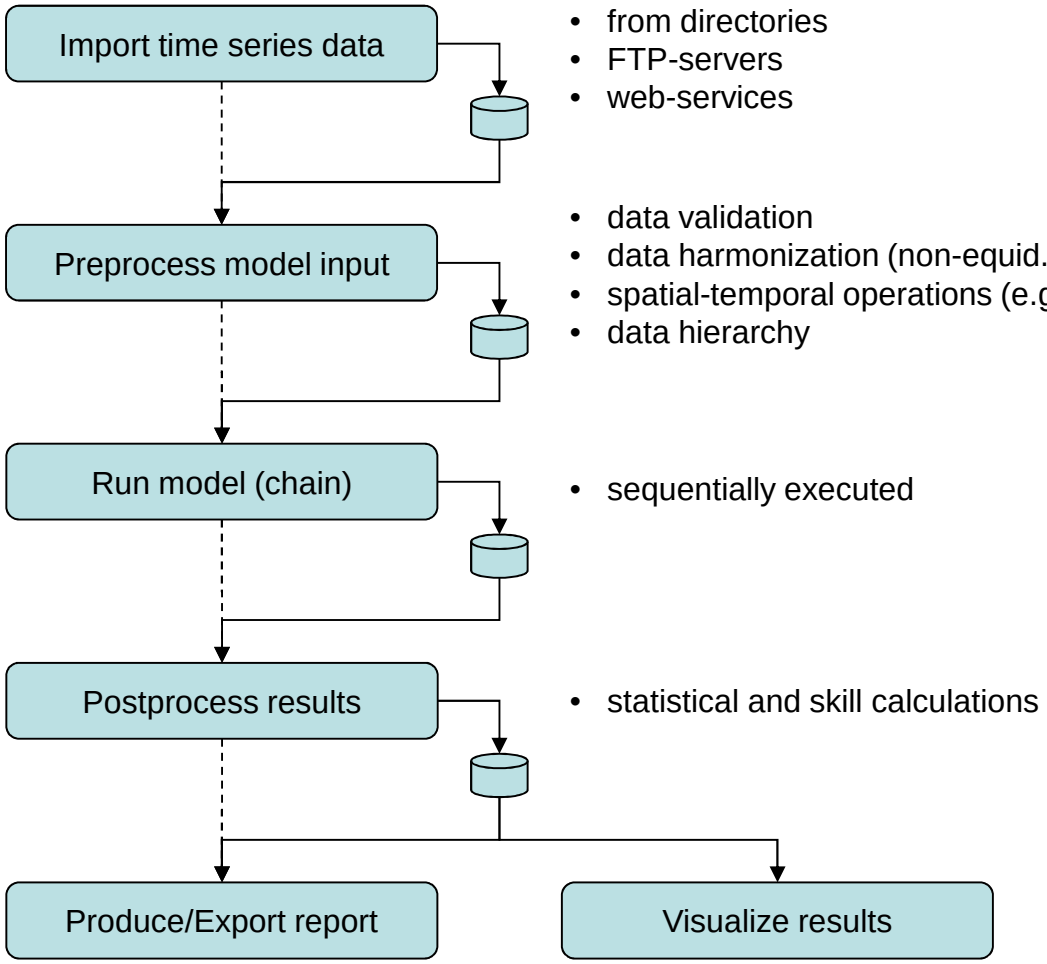






Deltares

Common structure of Delft-FEWS workflow



- from directories
- FTP-servers
- web-services

- data validation
- data harmonization (non-equid.→equid.)
- spatial-temporal operations (e.g. interpolation, (dis-)aggregation)
- data hierarchy

- sequentially executed

- statistical and skill calculations

Automate and schedule

Legend:

(sub)workflow or activity

database

control flow

data flow

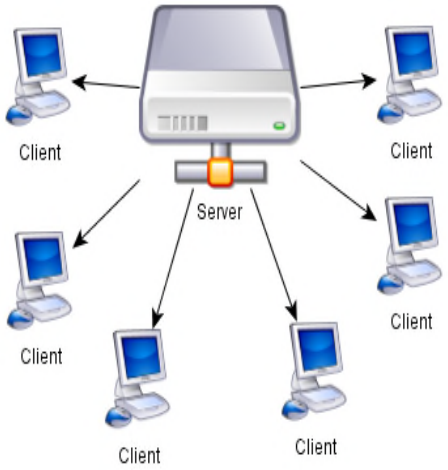
Deltares

Delft FEWS is highly scalable

- Stand Alone
  - Runs on a local computer, with a local database
  - Used to build, test and run workflows



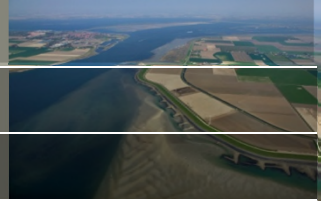
- Operator Client
  - Tasks are scheduled and automated on fixed intervals
  - Clients connect to central backend
  - Calculations are done on designated machines/servers



Deltares

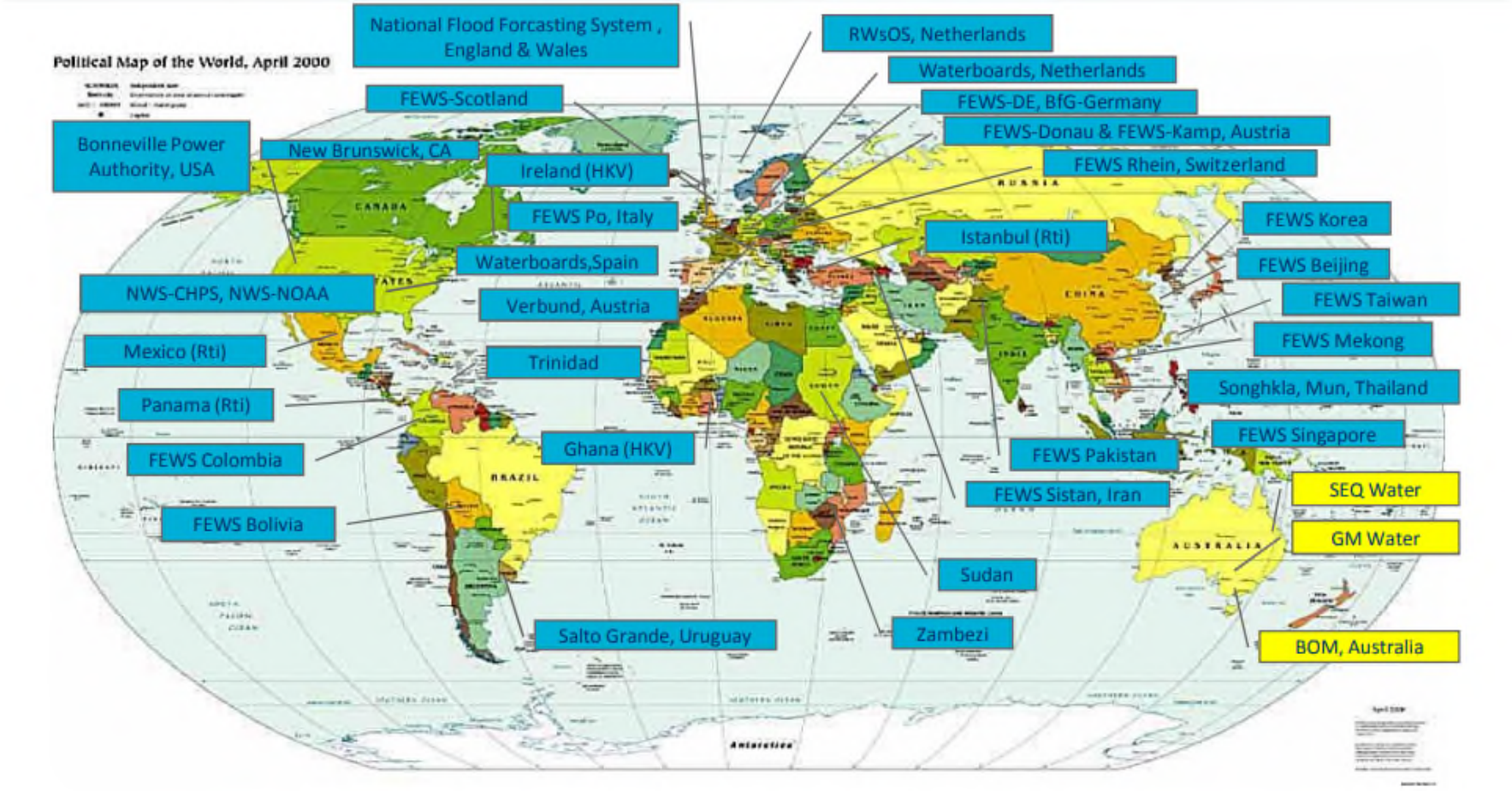
Additional Points





- Currently ingesting a wide variety of ECCC data operationally
- Can run on Amazon and Azure Cloud
- Compatible with a wide variety of database systems
  - WISKI, Aquarius, etc.
- Efficient handling of ensemble NWP data and processing
- Web services to build applications on top
- What does not exist now can be developed and shared

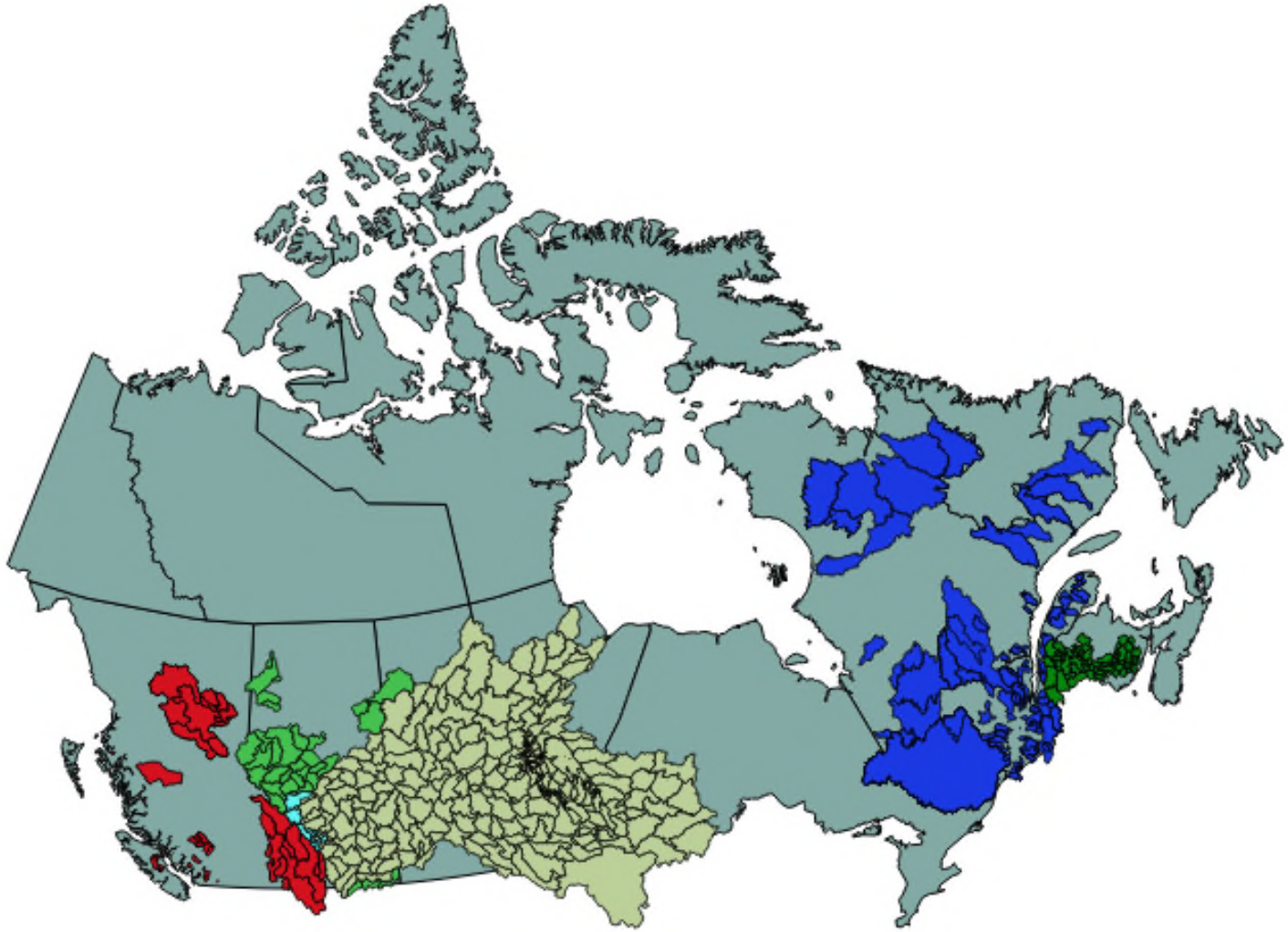
Delft-FEWS Global Snapshot



Iimage Credit: Austrailian Bureau of Meterology

Deltares

Delft-FEWS in Canada



Deltares

Delft-FEWS in Canada

- Adoption of a common system has numerous benefits
  - Sharing of knowledge and development
  - Common data interfaces
  - Institutional learning and support
  - Inter-agency support during flood events
- Need to explore how this relates to roles & mandates of flood forecasting agencies
- Use of Delft-FEWS
  - Can build on, and not displace, existing investment and research.
  - Builds on experience of many other countries and organizations.

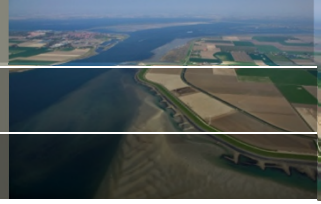


http://o.canada.com/news/photos-spring-flooding-strikes-new-brunswick-and-quebec

Deltares

Delft-FEWS as a Research Tool





Advantages	Disadvantages
• Management of data for hydrological forecasting	• Not used in model building or non-operational calibration
• Well suited for multi-model, forecast comparisons	• Time investment and guidance needed to learn
• Connected to many open source tools (DA, EVS)	• Adaptor development maybe required
• Direct link research to operations	• Operationalizing models in itself is not research
• Highly scaleable, reusable	

Roadmap for Development

- Advantages to a common, shared framework for operational forecasting
- Develop a common method for data ingestion from ECCC
- Develop common methods/adaptors for running models, particularly those active in Canadian research and operations
- Standardize where possible, customize where needed.
- Delft-FEWS is a platform to bring forecast processes together, facilitate communication





Deltares
Enabling Delta Life

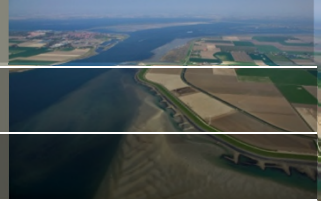
Regional, National, International Forecasting Systems

Some reflections on complementary roles and complexities

Micha Werner
Deltares & IHE Delft Institute for Water Education

Overview

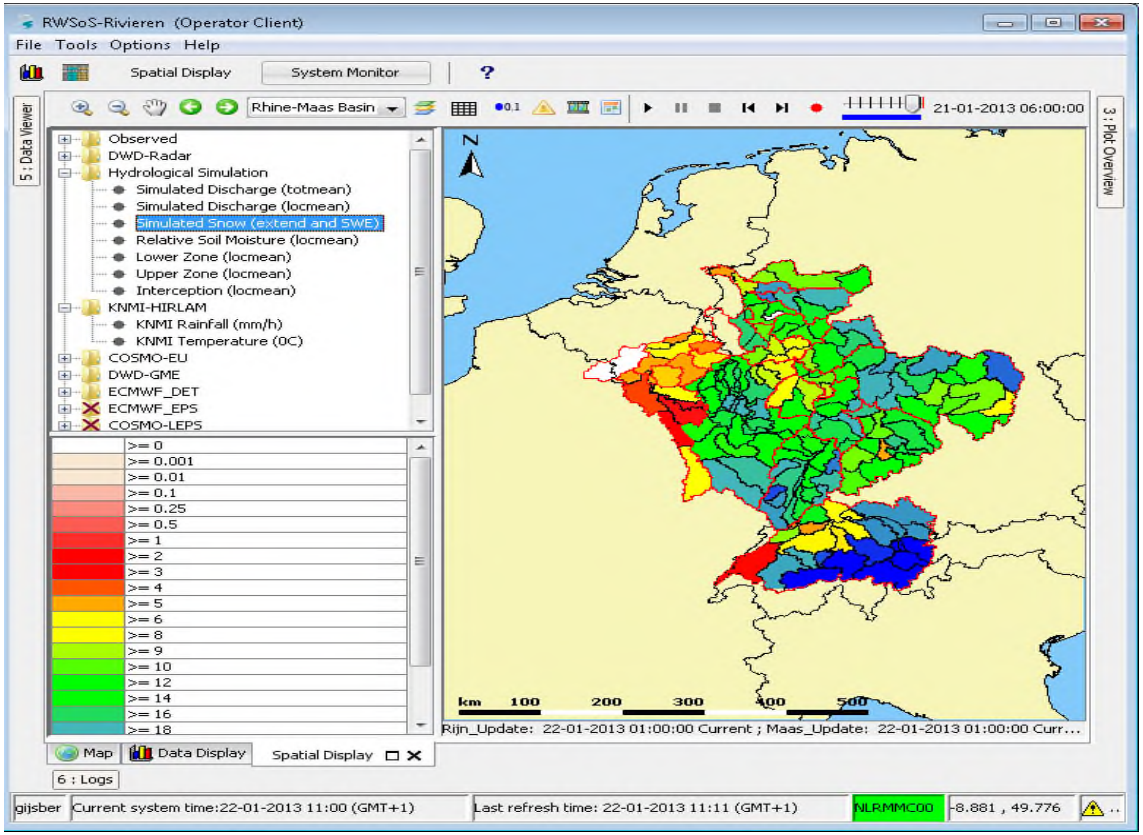




- Why do we do what we do in operational forecasting
  - National / Provincial /State mandate for the provision of real time forecasts to citizens & professional partners
  - National / Regional for the provision of provision of longer term outlooks; pre-warning
  - Academic
- A brief tour of the world to look at some examples …

Deltares

The Rhine basin from the Dutch perspective



RWSoS Rivieren
Operated by National Water Agency; Part of Dutch Ministry of Water Resources (mandated task)

International Basin – hydrology happens upstream of NL/DE border

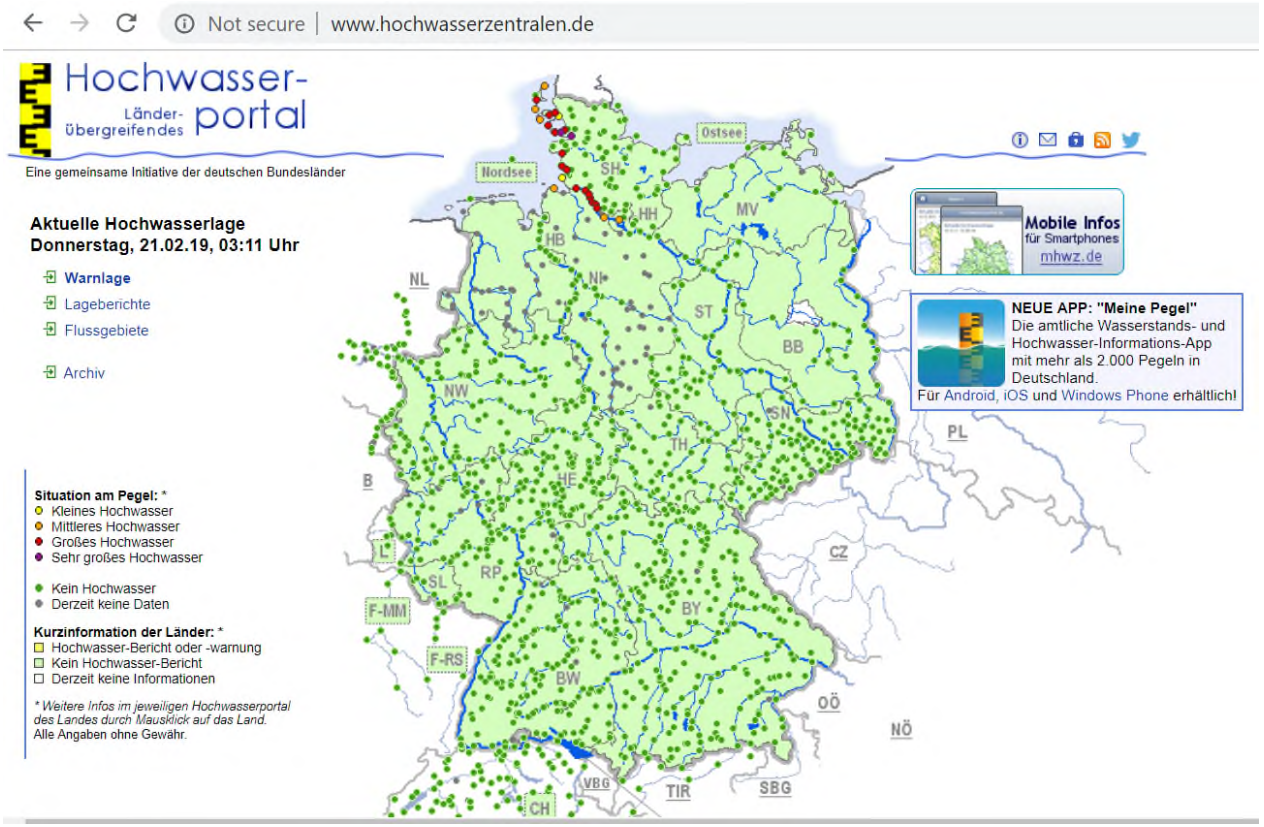
Extensive sharing of data; models; knowledge; research

Agreements on <u>how</u> information is made public by <u>whom</u>

- Geography
- Mandate

Deltares

The Rhine basin from the basin perspective



Operational forecasting systems in the Rhine basin

Wilke et al. reports 26!!

Multiple operational models

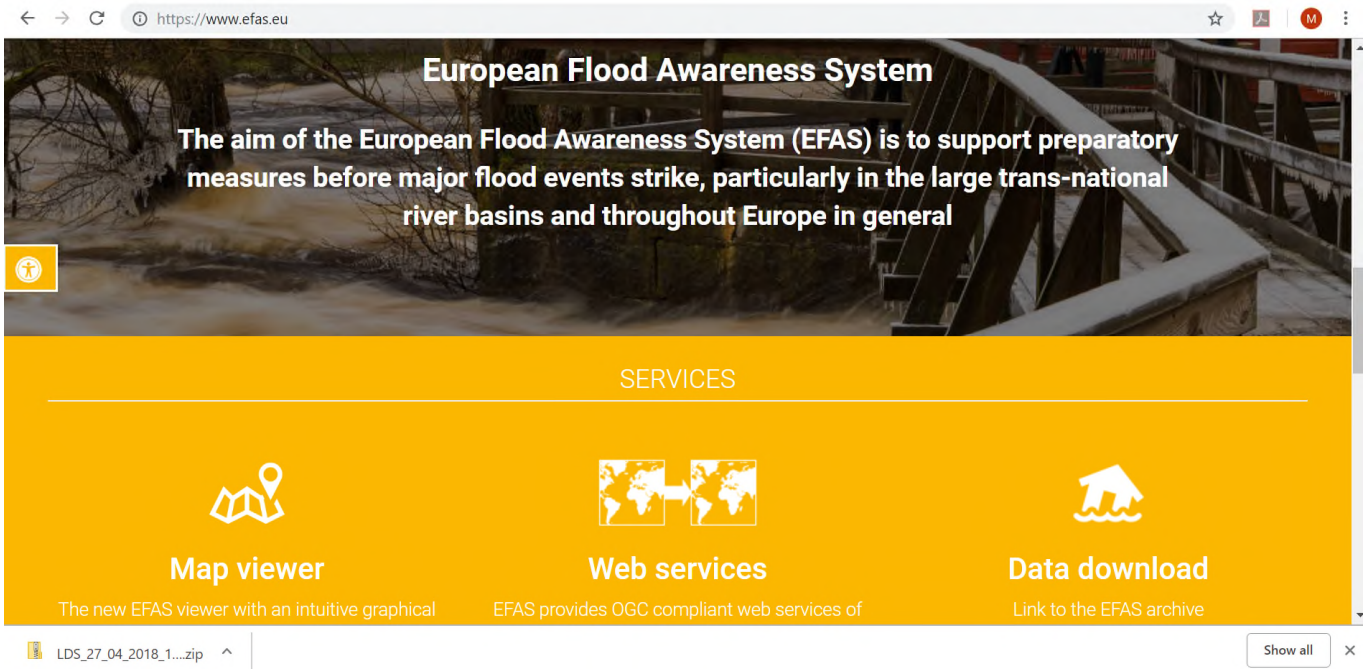
High level of data sharing

Model resolution adapted to meet local needs.

e.g. HBV Model of the Swiss Rhine basin in Dutch and in Swiss System vary considerably in terms of complexity

Deltares

The Rhine basin from the European perspective



Covers all basin in continental Europe

Operated at European level as a Copernicus service.

Single distributed model concept (LISFLOOD)

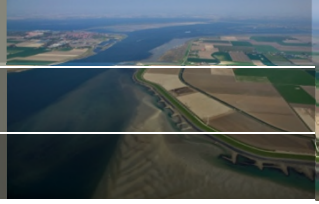
10-day (probabilistic) outlook to serve as a pre-warning

Mixed uptake though varies across Europe depending on established capacities

Deltares

The Rhine basin from the global perspective





Privacy statement | Legal notice | Cookies | Contact | Search on Eur

European Commission

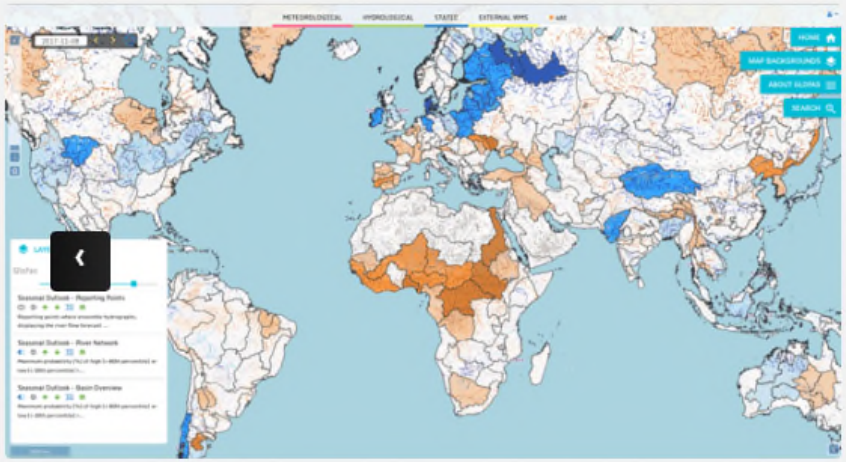
COPERNICUS

Emergency Management Service

Copernicus
Europe's eyes on Earth

European Commission > JRC Science Hub >IES >GloFAS-IS

GLOFAS | Forecast Viewer | User Information | Case studies | Links | Contact Us | Sign in



Seasonal Outlooks

- ✔ Early indication of unusually high or low river flow up to 4 months in advance
- ✔ Comparison with typical and extreme conditions from climatology
- ✔ Visualisation of ensemble hydrographs at specific loca[illegible]s

Read more

It couples state-of-the art weather forecasts with an hydrological model. Find out more!

Deltares

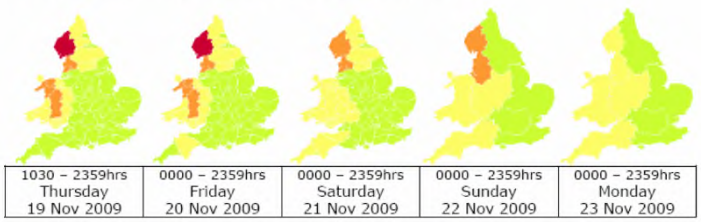
UK: Regional and National Flood Forecasting

FLOODFORECASTINGCENTRE

a working partnership between Environment Agency | Met Office

Flood Guidance Statement 10:30hrs 19th November 2009

Our assessment of daily flood risk for England and Wales is below.



1030 – 2359hrs Thursday 19 Nov 2009	0000 – 2359hrs Friday 20 Nov 2009	0000 – 2359hrs Saturday 21 Nov 2009	0000 – 2359hrs Sunday 22 Nov 2009	0000 – 2359hrs Monday 23 Nov 2009

Key	Very low risk	Low risk	Medium risk	High risk
RIVER & COASTAL FLOODING Probability >100 properties will flood, or extreme danger to life, from rivers or the sea.	<20%	≥20% to <40%	≥40% to <60%	≥60%
EXTREME RAINFALL Probability that ERA thresholds will be met, leading to possible surface water flooding.	<10%	≥10% to <20%	≥20% to <60%	≥60%
Suggested actions	• Business as usual	• Consider liaising with partner organisations • Be aware of the latest weather/flood warnings and alerts	• Consider liaising with partner organisations • Consult surface water flood maps and local flood warning plan maps as appropriate • Consider activating emergency procedures	

FFC provides 5 day outlook

Complements regional flood warning centres

Regional flood warning provide service at designated forecasting points & warning areas

National Centre uses national model to provide national coverage, including ungauged catchments

Regional service issues warnings to public

Deltares

NOAA: River Forecast Centers & National Water Model

River forecast centers provide service at designated river forecast points

Relatively Uniform Data/Model Approach & same forecast production system (CHPS)

Intensive, partly manual, forecast production process

National Water Model developed to complement RFC service for underserved and ungauged catchments

Distributed model approach (WRF-Hydro)

Relies more on automated forecast production process & data assimilaton

Current River Forecast Points (~3,600)



+

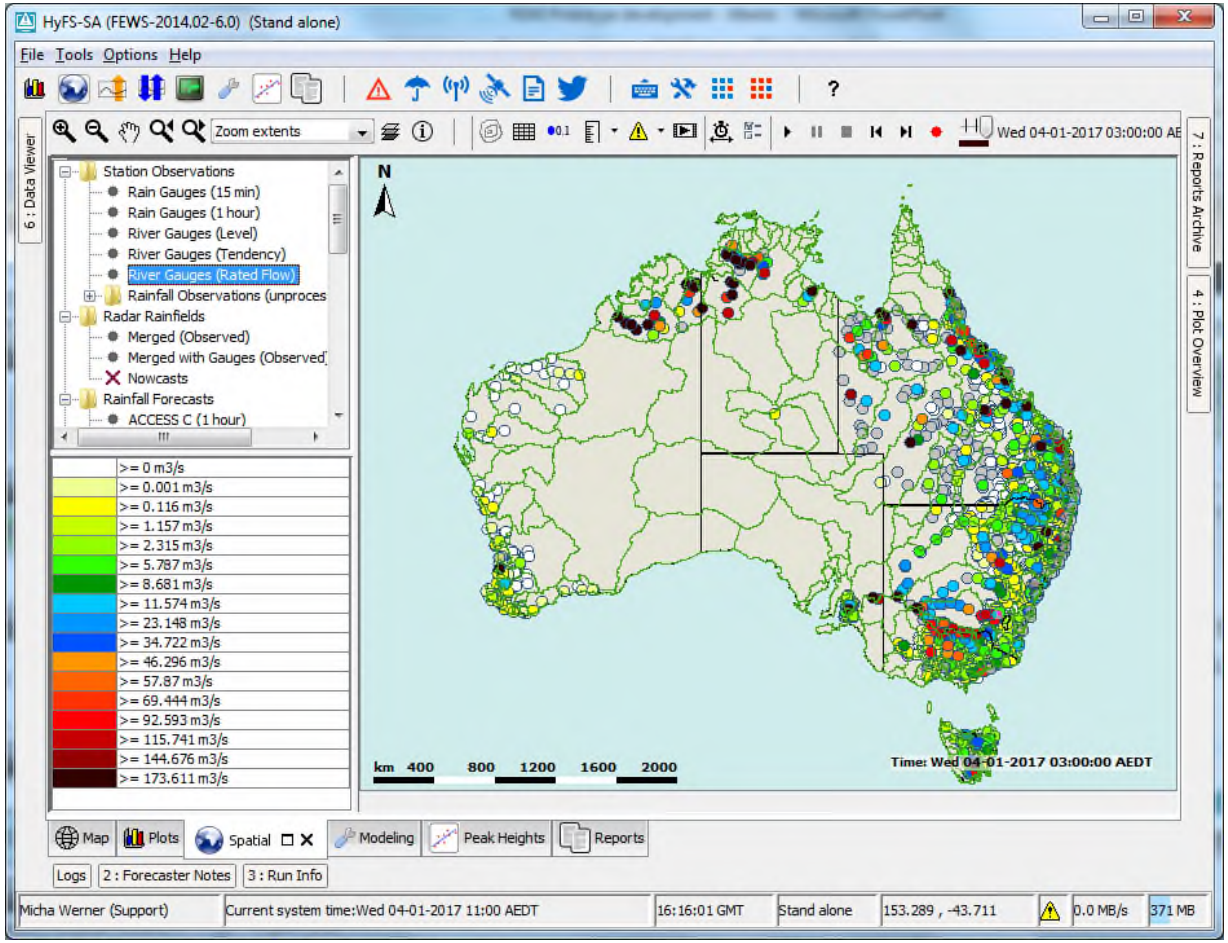
NWM Streamflow Output Points (~2.7 mil)



https://water.noaa.gov/about/nwm

Deltares

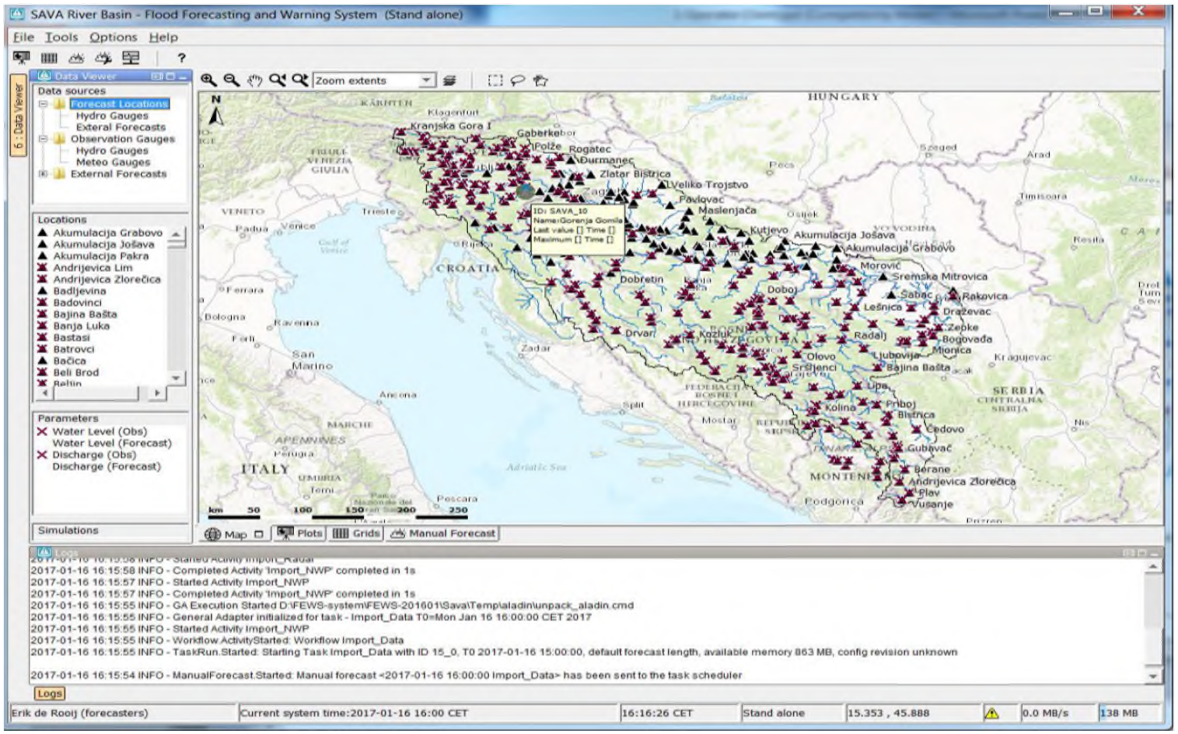
HyFS Bureau of Meteorology, Australia



- National coverage provided as a centralised service from BoM in Melbourne
- State forecasting centres access shared system to co-produce forecasts
- Reliance on BoM Melbourne depends on state capacities, which varies across Australia

Deltares

Sava Basin Flood Forecasting & Warning System

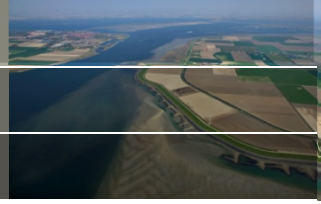


- Basin wide forecast system established under World Bank Project
- 6 Riparian countries & international Sava Basin Commission
- Mixed capacities across national agencies
- (Complex) Governance structure – system structure reflects political reality of the region

Deltares

Concluding remarks





Enabling technologies

- Data, Models
- Platforms such as Delft FEWS to support forecast production

Governance of operational forecasting delivery

- Complementarity of mandates / overlaps?
- Data & Knowledge sharing
- Clarity on who the beneficiaries are of the service
- Capacities, innovation & knowledge management
- Scientific guidance & research collaborations
- Science to operations processes