



VLAAMSE MILIEUMAATSCHAPPIJ

Waterinfo.be

integrated data and information portal
for floods & droughts in Flanders

Kris Cauwenberghs

14th October 2014

Esri European User Conference - Split -Croatia

Overview

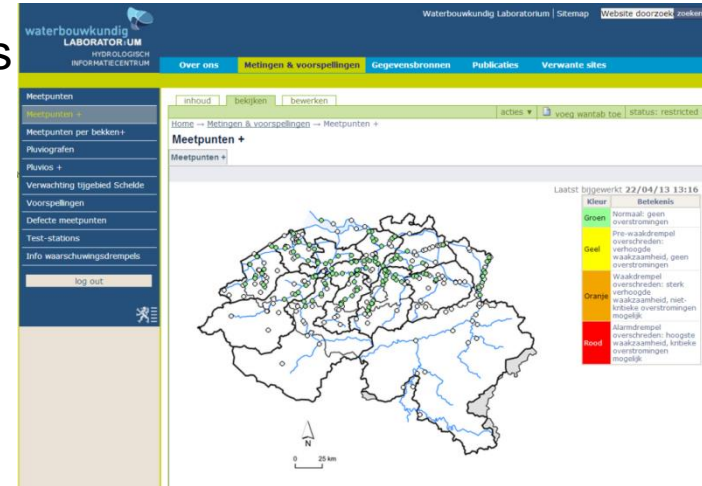
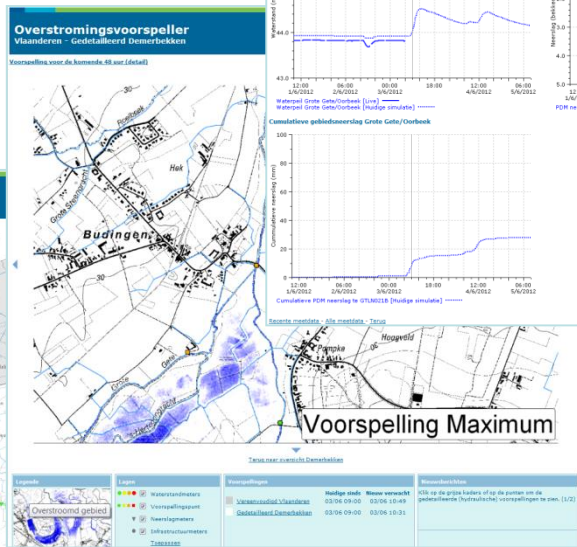
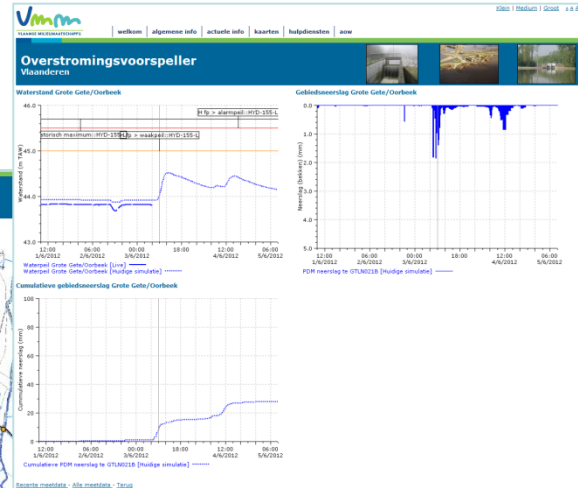
1. About VMM
2. Before the portal
3. Objectives
4. Building the portal
5. Demo
 - a. Concepts
 - b. Content:
 - Actual & forecasted waterinfo on floods & droughts
 - Historic waterinfo
 - Dashboards
6. Conclusions

1. About VMM


- **VMM = Flemish Environment Agency competent for**
 - Waterquality (monitoring, reporting, economic & ecologic supervision on waste water treatment infrastructure, ...)
 - Air quality, Environmental reporting (MiRa)
 - Ground Water (quantity & quality)
 - Waterquantity
 - 1000 FTE
- **Division Operational Watermanagement (AOW)**
 - Operates 1400 km of non-navigable watercourses of 1° category
 - Maintenance, investments & renovations **works**.
 - 250 FTE – 25 mio EUR/y
- **Unit Floodmanagement**
 - Operates hydrologic **telemetry** network (+400 sites) & off-line + real-time hydraulic **models** (4200 km) + www.waterinfo.be
 - R&D unit with about 30 engineers & scientists
 - 3 mio EUR/y

2. Before the portal

- 2 organisations showing 2 different web 1.0 sites
- Heavily used during crisis: (80.000 hits/hr – 3 mio hits for flood nov2010)
- 8 years old



3. Objectives

- **Build one single portal allowing full hydrological content integration:**
 - all measurements, all forecasts and all maps (flood, radar, NWP, ...)
 - for all watercourses in Flanders & coast.
- Make portal **context-aware** for fluvial-, tidal-, pluvial flood & drought crises
- Seperate between **Public vs professional portal** (dashboards)
- **Innovation for a Next-Gen “front-end”:**
 - Use latest technologies (webservices, widgets)
 - Spatial – temporal integration: Dynamic time-enabled mapping
 - Integrate social content
 - Branding:  **Flanders**
State of the art



4. Building the portal

- **Practical**

- Project start: 1/9/2012
- Portal launch: 29/1/2014
- Budget: 1.3 mio EUR (excl. hardware & licences)

- **Contractor: THV Aquaportalis:**

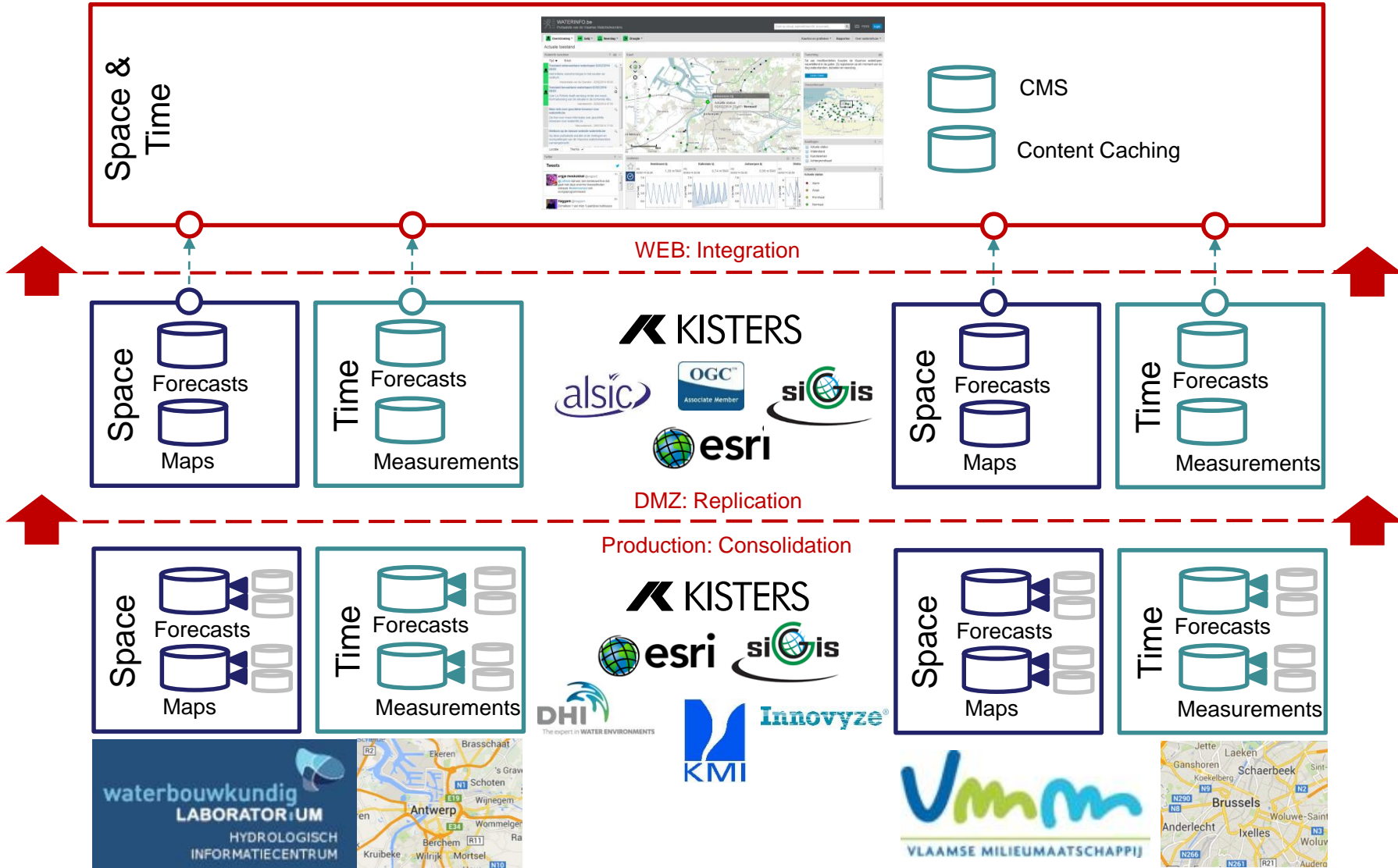
- Content Management System (CMS): ALSIC bvba
- Geografisch Informatie Systeem (GIS): SIGGIS nv
- Time Series Management System (TSM): Kisters AG

- **Projectgroup + workgroups & steering + feedback group.**

- + 50 projectmeetings

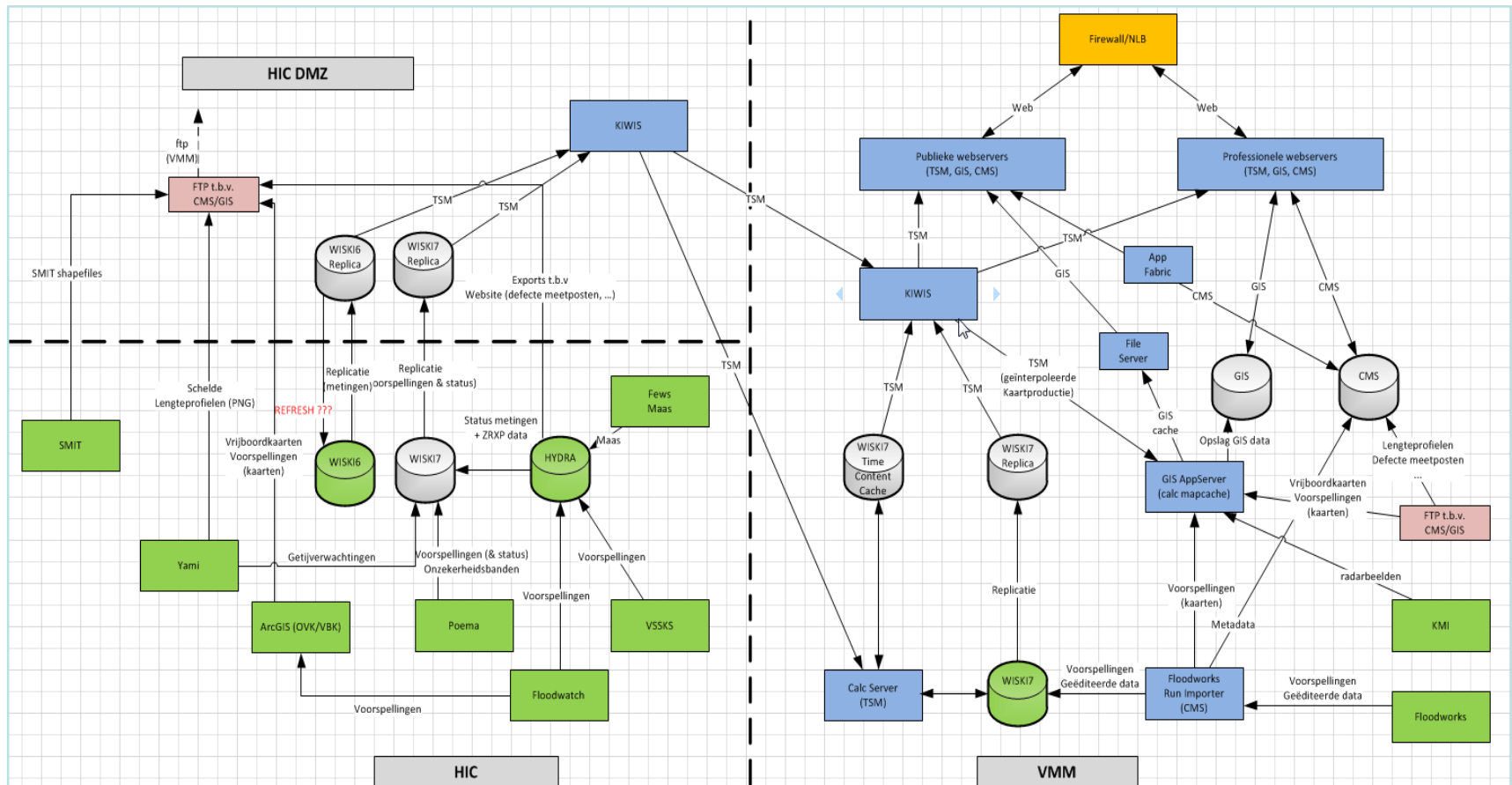


4. Building the portal



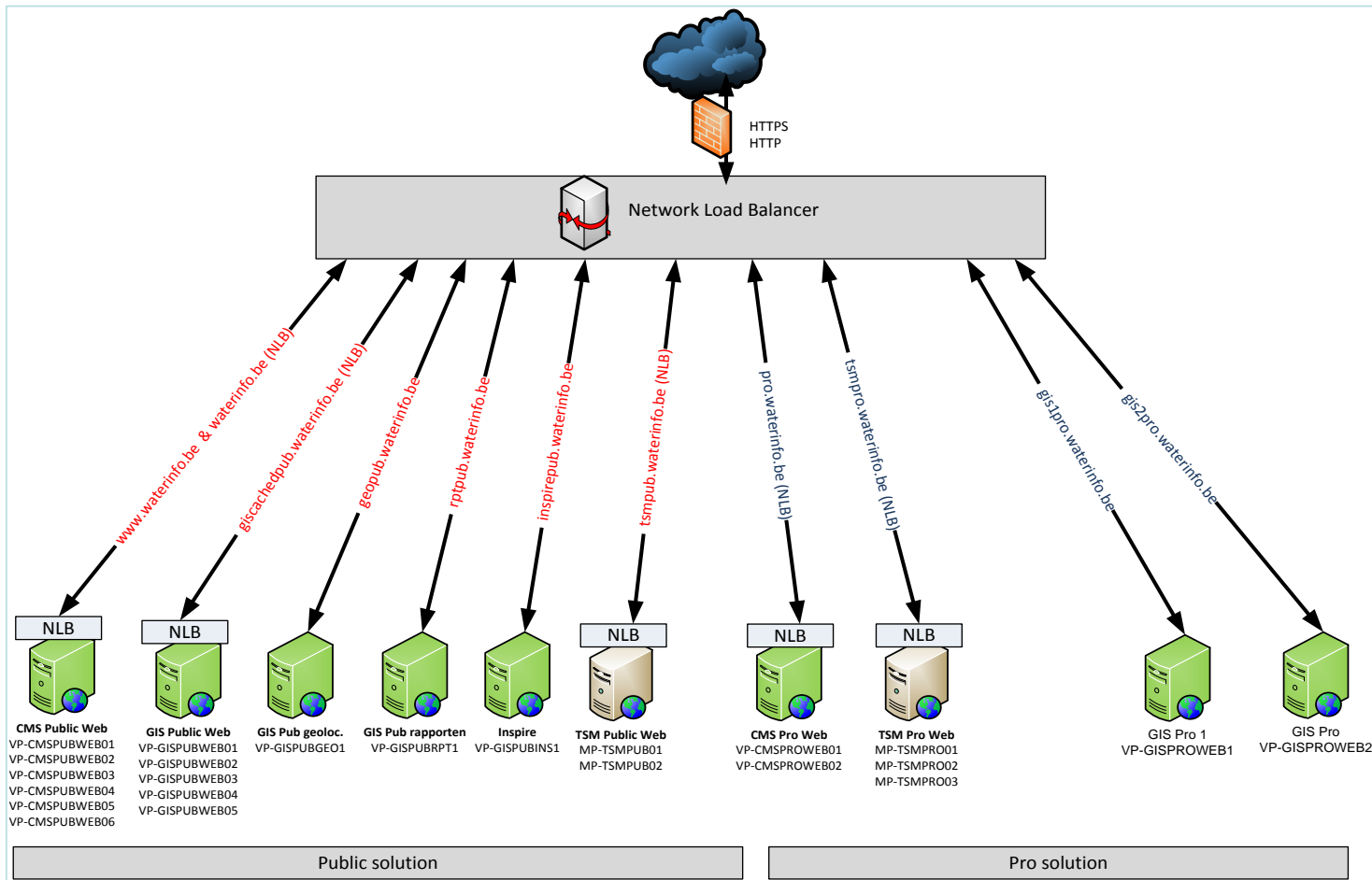
4. Building the portal

- Simplified IT-infrastructure** (LAN- and DMZ-portal server zones @ VMM and HIC)



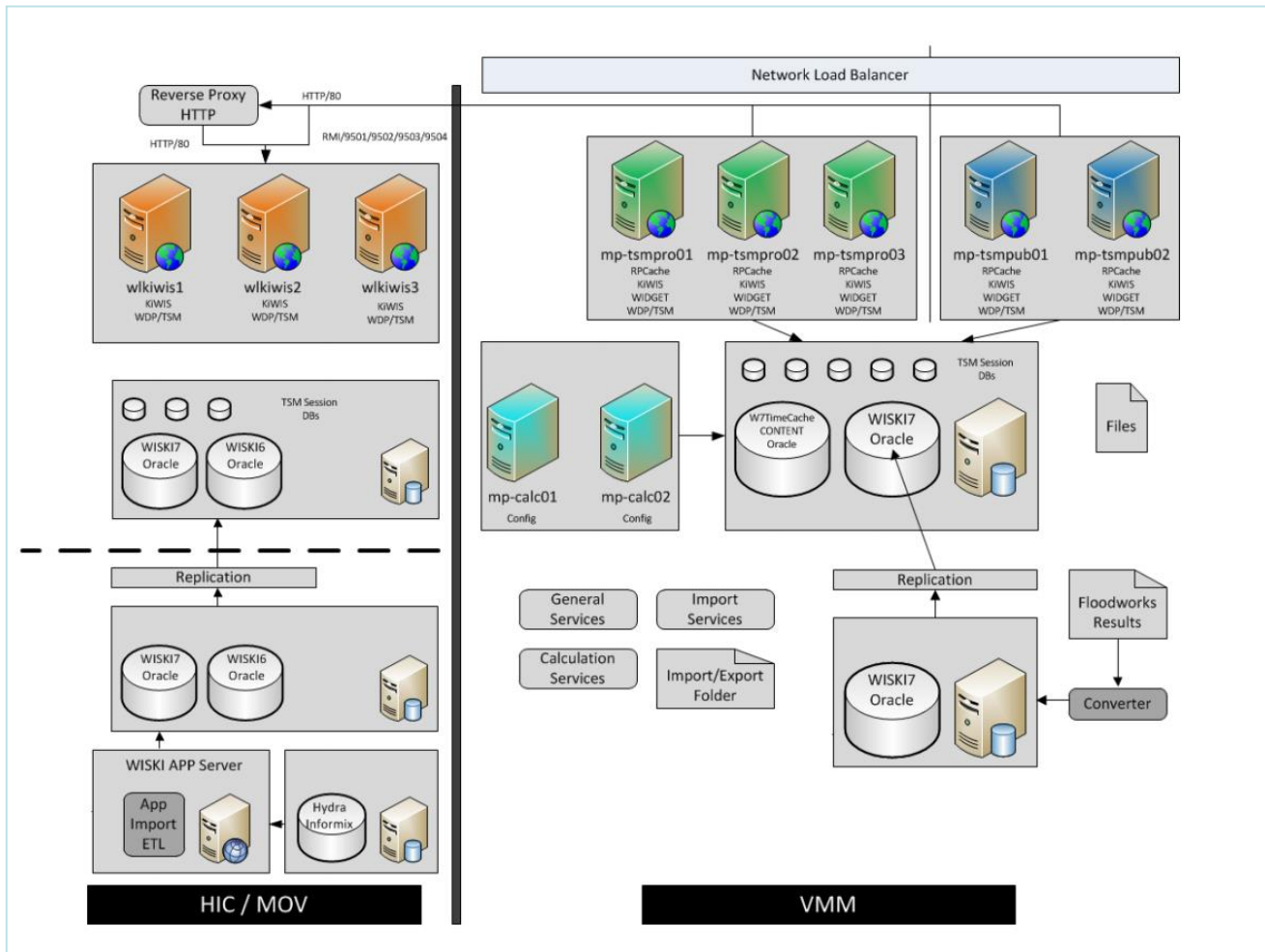
4. Building the portal

- Load balanced webserver farms



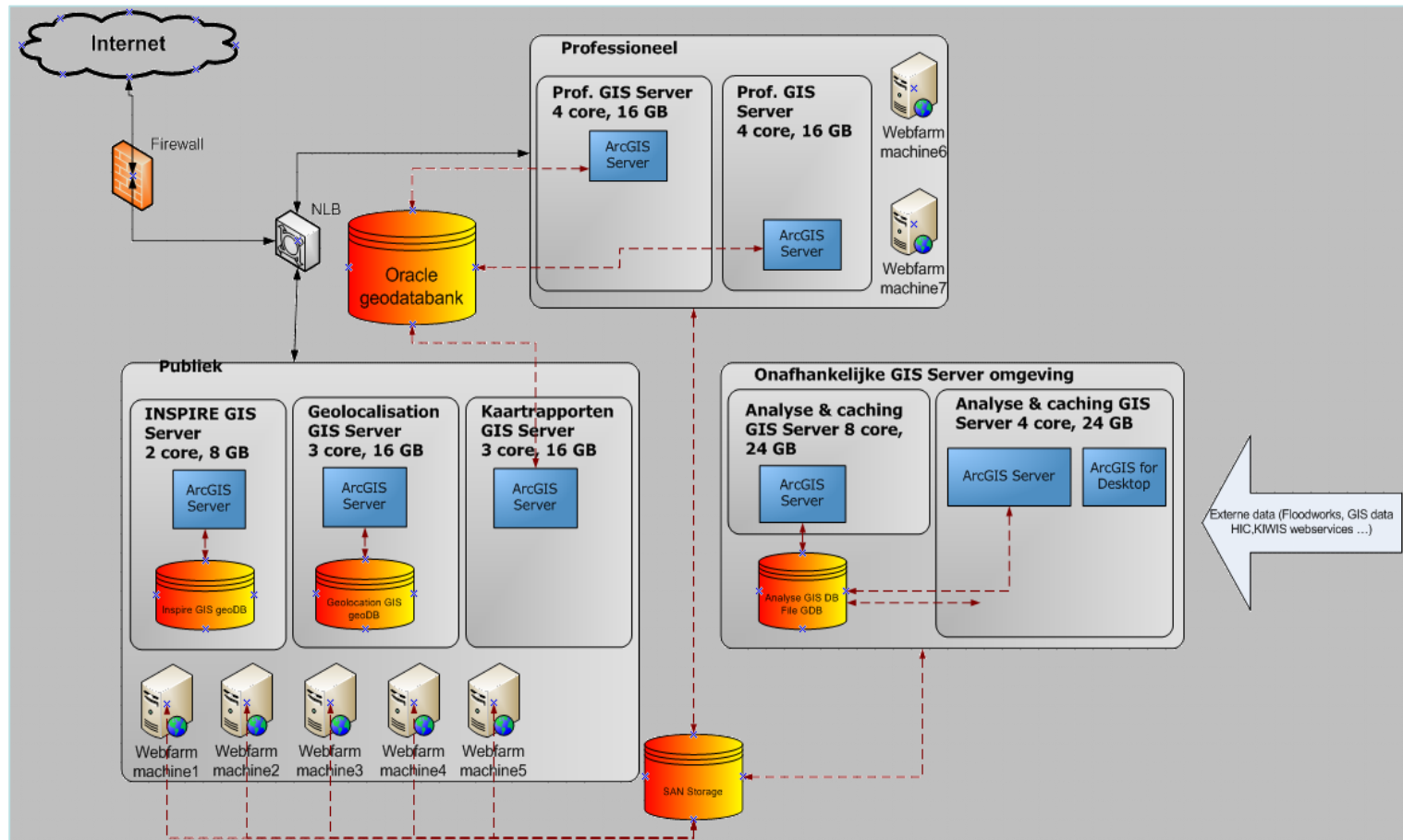
4. Building the portal

- TSM-architecture** (3+5 KiWIS = Kisters Web Interoperability System)



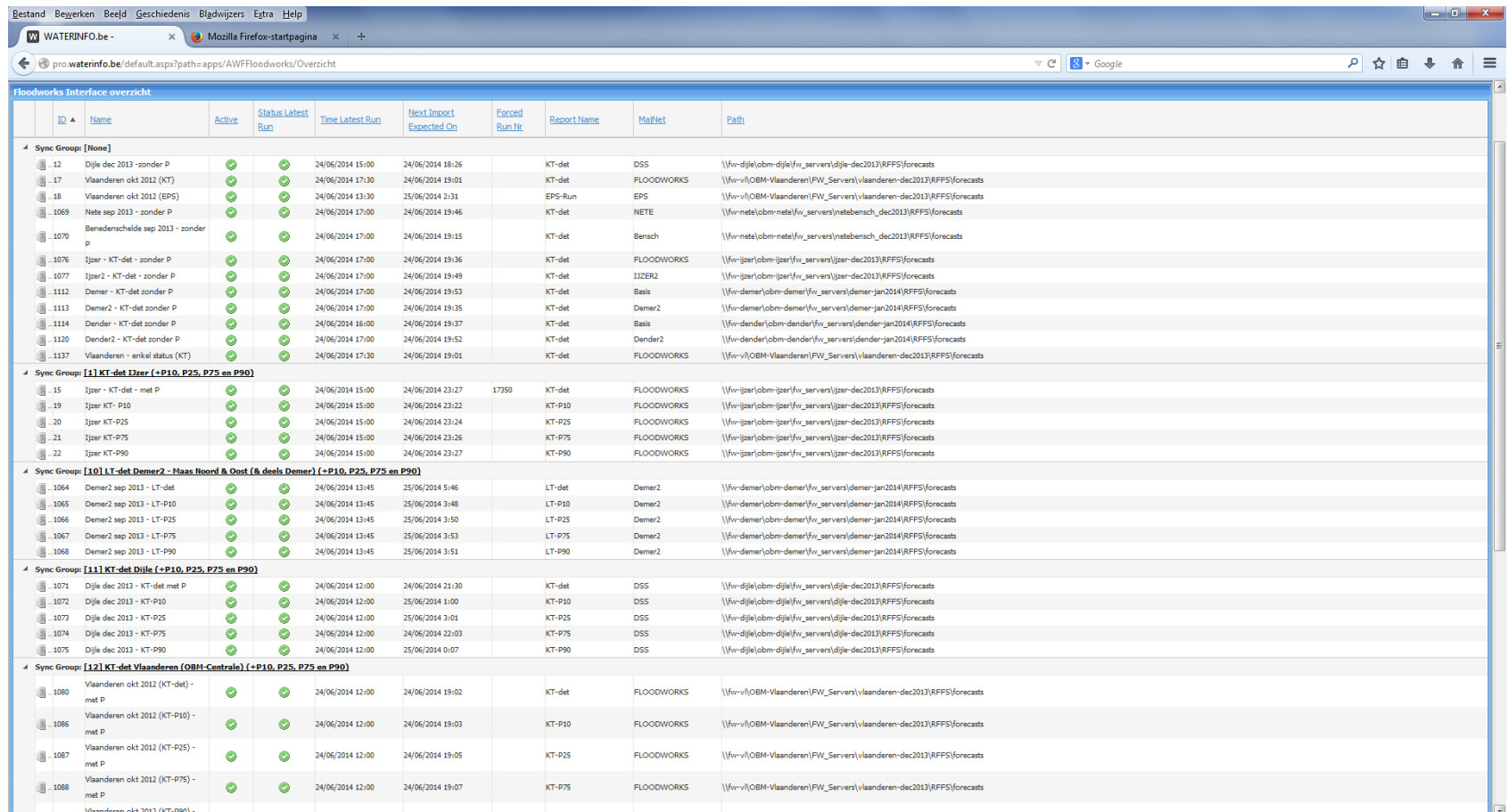
4. Building the portal

- **GIS-architecture** (ArcGIS server 10.1 servers)



4. Building the portal

- FloodWorks importer** (6 FW-servers, 1 det. run/hour + 4 perc. runs/6hours = 240 runs/day @ 100Mb/run)



ID	Name	Active	Status Latest Run	Time Latest Run	Next Import Expected On	Forced Run Nr	Export Name	Maplet	Path
Sync Group: [None]									
12	Dijle dec 2013 - zonder P	✓	✓	24/06/2014 15:00	24/06/2014 18:26		KT-det	DSS	\\fv-dijle\obm-dijle\fv_servers\dijle-dec2013\RFPS\forecasts
17	Vlaanderen okt 2012 (KT)	✓	✓	24/06/2014 17:30	24/06/2014 19:01		KT-det	FLOODWORKS	\\fv-v\OBM-Vlaanderen\FW_Servers\vlaanderen-dec2013\RFPS\forecasts
18	Vlaanderen okt 2012 (EPS)	✓	✓	24/06/2014 13:30	25/06/2014 2:31		EPS-Run	EPS	\\fv-v\OBM-Vlaanderen\FW_Servers\vlaanderen-dec2013\RFPS\forecasts
1069	Nete sep 2013 - zonder P	✓	✓	24/06/2014 17:00	24/06/2014 19:46		KT-det	NETE	\\fv-nete\obm-nete\fv_servers\netabensch_dec2013\RFPS\forecasts
1070	Benedenshelde sep 2013 - zonder P	✓	✓	24/06/2014 17:00	24/06/2014 19:15		KT-det	Bensch	\\fv-nete\obm-nete\fv_servers\netabensch_dec2013\RFPS\forecasts
1076	Ijzer - KT-det - zonder P	✓	✓	24/06/2014 17:00	24/06/2014 19:36		KT-det	FLOODWORKS	\\fv-ijzer\obm-ijzer\fv_servers\ijzer-dec2013\RFPS\forecasts
1077	Ijzer2 - KT-det - zonder P	✓	✓	24/06/2014 17:00	24/06/2014 19:49		KT-det	IJZER2	\\fv-ijzer\obm-ijzer\fv_servers\ijzer-dec2013\RFPS\forecasts
1112	Demer - KT-det zonder P	✓	✓	24/06/2014 17:00	24/06/2014 19:53		KT-det	Basis	\\fv-demer\obm-demer\fv_servers\demer-jan2014\RFPS\forecasts
1113	Demer2 - KT-det zonder P	✓	✓	24/06/2014 17:00	24/06/2014 19:35		KT-det	Demer2	\\fv-demer\obm-demer\fv_servers\demer-jan2014\RFPS\forecasts
1114	Dender - KT-det zonder P	✓	✓	24/06/2014 16:00	24/06/2014 19:37		KT-det	Basis	\\fv-dender\obm-dender\fv_servers\dender-jan2014\RFPS\forecasts
1120	Dender2 - KT-det zonder P	✓	✓	24/06/2014 17:00	24/06/2014 19:52		KT-det	Dender2	\\fv-dender\obm-dender\fv_servers\dender-jan2014\RFPS\forecasts
1137	Vlaanderen - enkel status (KT)	✓	✓	24/06/2014 17:30	24/06/2014 19:01		KT-det	FLOODWORKS	\\fv-v\OBM-Vlaanderen\FW_Servers\vlaanderen-dec2013\RFPS\forecasts
Sync Group: [11] KT-det Ijzer (+P10, P25, P75 en P90)									
15	Ijzer - KT-det - met P	✓	✓	24/06/2014 15:00	24/06/2014 23:27	1730	KT-det	FLOODWORKS	\\fv-ijzer\obm-ijzer\fv_servers\ijzer-dec2013\RFPS\forecasts
19	Ijzer KT-P10	✓	✓	24/06/2014 15:00	24/06/2014 23:22		KT-P10	FLOODWORKS	\\fv-ijzer\obm-ijzer\fv_servers\ijzer-dec2013\RFPS\forecasts
20	Ijzer KT-P25	✓	✓	24/06/2014 15:00	24/06/2014 23:24		KT-P25	FLOODWORKS	\\fv-ijzer\obm-ijzer\fv_servers\ijzer-dec2013\RFPS\forecasts
21	Ijzer KT-P75	✓	✓	24/06/2014 15:00	24/06/2014 23:26		KT-P75	FLOODWORKS	\\fv-ijzer\obm-ijzer\fv_servers\ijzer-dec2013\RFPS\forecasts
22	Ijzer KT-P90	✓	✓	24/06/2014 15:00	24/06/2014 23:27		KT-P90	FLOODWORKS	\\fv-ijzer\obm-ijzer\fv_servers\ijzer-dec2013\RFPS\forecasts
Sync Group: [10] LT-det Demer2 - Maas Hoord & Oost (8 deels Demer) (+P10, P25, P75 en P90)									
1064	Demer2 sep 2013 - LT-det	✓	✓	24/06/2014 13:45	25/06/2014 5:46		LT-det	Demer2	\\fv-demer\obm-demer\fv_servers\demer-jan2014\RFPS\forecasts
1055	Demer2 sep 2013 - LT-P10	✓	✓	24/06/2014 13:45	25/06/2014 3:48		LT-P10	Demer2	\\fv-demer\obm-demer\fv_servers\demer-jan2014\RFPS\forecasts
1066	Demer2 sep 2013 - LT-P25	✓	✓	24/06/2014 13:45	25/06/2014 3:50		LT-P25	Demer2	\\fv-demer\obm-demer\fv_servers\demer-jan2014\RFPS\forecasts
1067	Demer2 sep 2013 - LT-P75	✓	✓	24/06/2014 13:45	25/06/2014 3:53		LT-P75	Demer2	\\fv-demer\obm-demer\fv_servers\demer-jan2014\RFPS\forecasts
1068	Demer2 sep 2013 - LT-P90	✓	✓	24/06/2014 13:45	25/06/2014 3:51		LT-P90	Demer2	\\fv-demer\obm-demer\fv_servers\demer-jan2014\RFPS\forecasts
Sync Group: [11] KT-det Dijle (+P10, P25, P75 en P90)									
1071	Dijle dec 2013 - KT-det met P	✓	✓	24/06/2014 12:00	24/06/2014 21:30		KT-det	DSS	\\fv-dijle\obm-dijle\fv_servers\dijle-dec2013\RFPS\forecasts
1072	Dijle dec 2013 - KT-P10	✓	✓	24/06/2014 12:00	25/06/2014 1:00		KT-P10	DSS	\\fv-dijle\obm-dijle\fv_servers\dijle-dec2013\RFPS\forecasts
1073	Dijle dec 2013 - KT-P25	✓	✓	24/06/2014 12:00	25/06/2014 3:01		KT-P25	DSS	\\fv-dijle\obm-dijle\fv_servers\dijle-dec2013\RFPS\forecasts
1074	Dijle dec 2013 - KT-P75	✓	✓	24/06/2014 12:00	24/06/2014 22:03		KT-P75	DSS	\\fv-dijle\obm-dijle\fv_servers\dijle-dec2013\RFPS\forecasts
1075	Dijle dec 2013 - KT-P90	✓	✓	24/06/2014 12:00	25/06/2014 0:07		KT-P90	DSS	\\fv-dijle\obm-dijle\fv_servers\dijle-dec2013\RFPS\forecasts
Sync Group: [12] KT-det Vlaanderen (OBM-Centrale) (+P10, P25, P75 en P90)									
1080	Vlaanderen okt 2012 (KT-det) - met P	✓	✓	24/06/2014 12:00	24/06/2014 19:02		KT-det	FLOODWORKS	\\fv-v\OBM-Vlaanderen\FW_Servers\vlaanderen-dec2013\RFPS\forecasts
1086	Vlaanderen okt 2012 (KT-P10) - met P	✓	✓	24/06/2014 12:00	24/06/2014 19:03		KT-P10	FLOODWORKS	\\fv-v\OBM-Vlaanderen\FW_Servers\vlaanderen-dec2013\RFPS\forecasts
1087	Vlaanderen okt 2012 (KT-P25) - met P	✓	✓	24/06/2014 12:00	24/06/2014 19:05		KT-P25	FLOODWORKS	\\fv-v\OBM-Vlaanderen\FW_Servers\vlaanderen-dec2013\RFPS\forecasts
1088	Vlaanderen okt 2012 (KT-P75) - met P	✓	✓	24/06/2014 12:00	24/06/2014 19:07		KT-P75	FLOODWORKS	\\fv-v\OBM-Vlaanderen\FW_Servers\vlaanderen-dec2013\RFPS\forecasts
	Vlaanderen okt 2012 (KT-P90) - met P	✓	✓						

5. Demo

WATERINFO.be
Portal of the Flemish Water managers

Search for street_waterinfomessage_documents | PRESS EN | Kris Cauwenberghs admin

4. Actual and forecasted (crisis) themes | **Other historic (non-crisis) themes**

Flood | Tide | Rainfall | Drought

Maps and graphs | Reports | About waterinfo.be | Operator | Administrator | CMS

Current situation

Information
Numerous gauging stations keep close watch on the Flemish watercourses. They continuously register water levels, flows and precipitation.

Waterinfo messages
Tijd Ernst
Hydrologische situatie op 24/06/2014 om 8 uur
De afvoersituatie op de bevaarbare waterlopen is en blijft normaal de komende 48 uur.
Hoogwaterbericht - 24/06/2014 08:00
Toestand onbevaarbare waterlopen 24/06/2014 8u
Geen kritieke overstromingen op de onbevaarbare waterlopen.
Interpretatie van de Operator - 24/06/2014 08:00
Meer info over geschikte browser voor waterinfo.be
Zie hier voor meer informatie over geschikte browsers voor waterinfo.be

Twitter
Tweets
Cameran Peter @cameramanpeter 20h
Mediacentrum op het nieuws. Lijkt verdacht veel op het onze in Sao Paulo...
#wateroverlast #wk2014 http://t.co/y1iOKhcccs
Raymond Bos @Gewoon_Raymond 22 Jun
Mevrouw hete de pers van harte welkom #not #scheldwoorden #wateroverlast #Hallo #zondaghumeur
Water-Gate @inondation_STOP 21 Jun
#WaterGate is een revolutionair concepte bieden aan de ongemakken van #wateroverlast. http://t.co/ztgO5yuk15 http://t.co/fmboNirJRL7

Map
Map overview
Legend
Current Status
● Alarm
● Waak
● Pre-Waak
● Normaal
● Geen Waarde
○ Oude Waarde

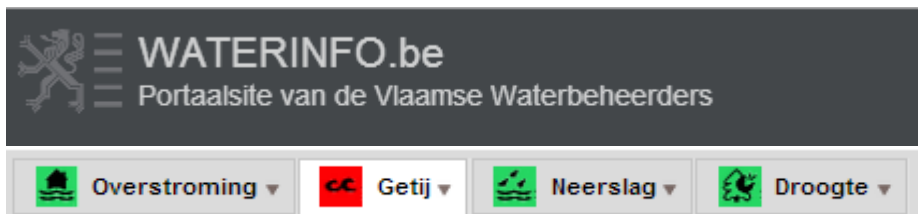
Graphs
Sint-Joris-Weert/Dijle
Waterlevel (H) 24/06/14 04:15 27,29 mTAW
Mere/Molenbeek
Waterlevel (H) 24/06/14 06:45 19,508 m
Antwerpen tij
Waterlevel (H) (H_voorspeld) 26/06/14 07:15 0,13 mTAW

Table overview current status
Bekken / Jruge olders / Centse kanalen
Boven-Scheldebekken / Demerbekken / Ijzerbekken / Netebekk

Live-demo: show nearby stations, play animation for short-term forecasts, add LT-chart from Station page-widget to dashboard, widget-settings in dashboard, search for ..., « about waterinfo.be », ...

5a. Demo concepts

- **Portal theme** = Page with selected content (widgets, maps, parameters, ...)
- Crisis themes: changing **colours and symbols** according situation => changed home-page.
- Colours & symbols repeated in the « **waterinfo-messages** » = hydrologists interpretation



WATERINFO.be
Portaalsite van de Vlaamse Waterbeheerders

Overstroming ▼ Getij ▼ Neerslag ▼ Droogte ▼

Voorspelde toestand - korte termijn: 48u vooruit



Waterinfo berichten

Tijd	Ernst ▼
Hydrologische situatie op 6/12/2013 om 5 uur	
Gevaarlijk stormtij in het tijegebied	

Hoogwaterbericht - 06/12/2013 05:00



Hoogwaterbericht (normaal)

Hydrologische situatie op 6/02/2014 om 17 uur
Bericht opgesteld op 06/02/2014 17:00 door HIC (Leen Boeckx)

- Meteorologische verwachtingen**

Momenteel schuift een regenzone van west naar oost over het land. Vanavond en vannacht is het overwegend zwaarbewolkt of betrokken en krijgen we perioden met regen, in het westen soms vrij veel regen. Neerslagverwachting westen & Noord-Frankrijk: 10-20mm, centrum: 10-15mm, oosten: 5-10mm. Morgen begint de dag met zeer onstuimig weer met regen en soms felle buien (neerslagverwachting: 2-5mm). Na de middag wordt het droger en zijn er opnieuw opklaringen al kunnen er in het oosten nog enkele buien vallen. 's Avonds en in het begin van de nacht is het droog. Zaterdagochtend is het in het centrum en het oosten nog droog met enkele opklaringen, maar in het westen is het al betrokken met regen. Een regenzone verplaatst zich naar het oosten en verlaat kort na de middag ons land. (neerslagverwachting: 2-5mm) Zondag is het wisselend bewolkt met geregeld buien. Maandag blijft het waarschijnlijk droog. De dagen daarna zijn terug wisselvallig met buien.

Bron: Bodemkundige Dienst van België, KMI, MétéoServices
- Gevallen neerslaghoeveelheden**

De voorbije 8 uur viel er in het westen en Noord-Frankrijk 1-3mm neerslag, elders bleef het droog.
Bron: DIREN, Météo-France, SETHY, VMM, KMI, HIC
- Overzicht waterpeilen en afvoeren op significante meetstations**

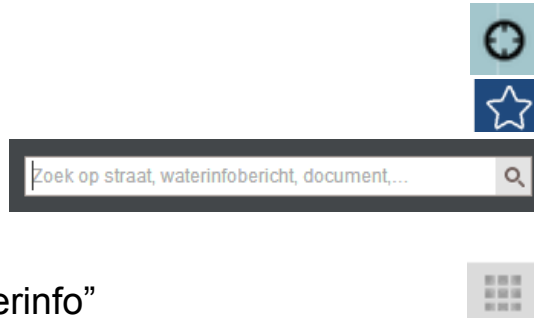
Er zijn op dit moment geen relevante stations waar waarschuwingdrempels overschreden worden.
- Hydrologische verwachtingen**

Voor vannacht en morgenochtend wordt heel wat neerslag verwacht. Vooral in het westen zal dit zorgen voor verhoogde afvoeren. Zowel op de IJzer als op het Kanaal Gent-Oostende worden overschrijdingen van prewaakdrempels verwacht. Problemen worden niet verwacht.

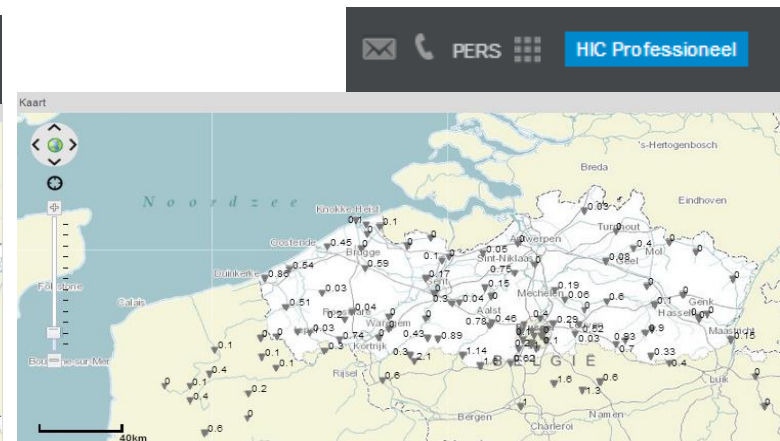
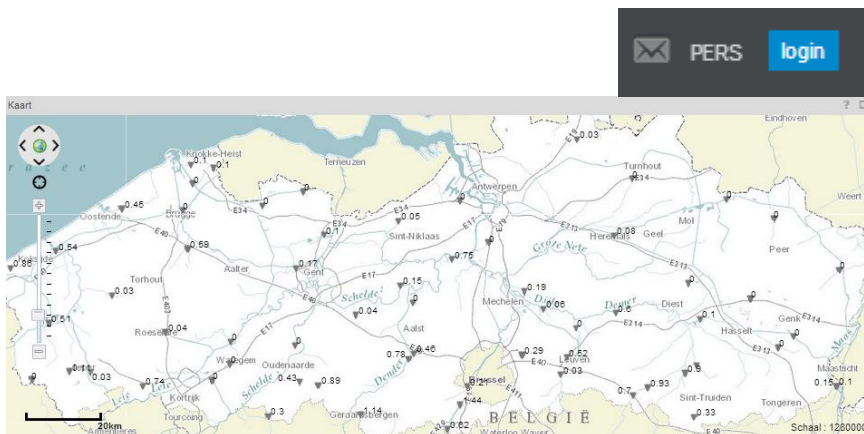
5a. Demo concepts

- **Customizable portal**

- Geolocalise: “show waterinfo near me”
- Favorites: “remember my waterinfo”
- Search: on city, street, river, station, document, ...
- Move and/or hide widgets



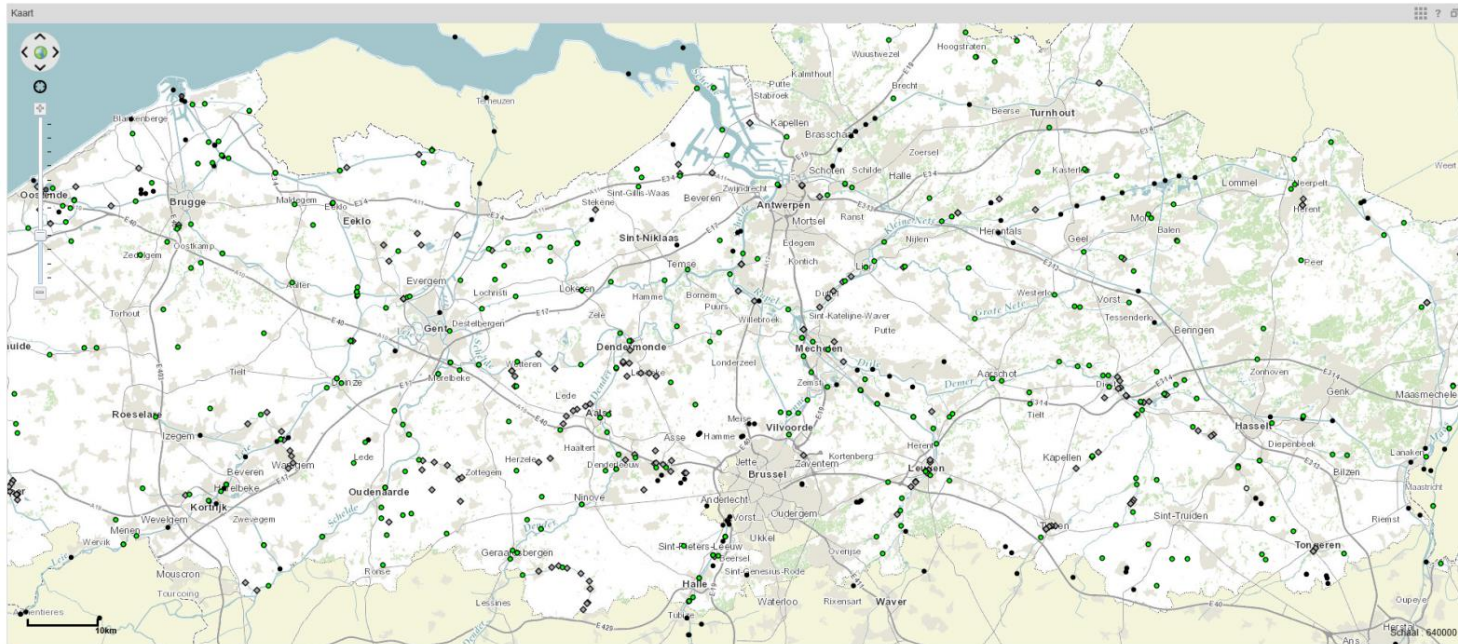
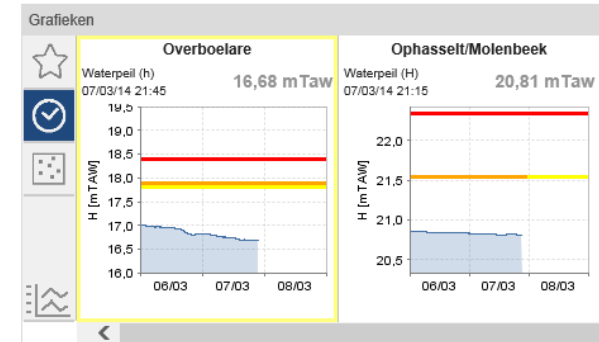
- ! Dashboard for pro's : “show my pre-configured waterinfo”
- ! More info available for professional users (pro.waterinfo.be)



5b. Demo: actual waterinfo

Stations

- 358 sensors showing **alarmstatus** on real-time stage or flow (15')
- 150 **gate and weir** observations (1')
- 122 **raingauges** in and around Flanders
- 1232 model nodes
- + meteo, rainfall shortage, stream velocity, sediment, ...
- ! + sensors outside Flanders (Wallonia, France, Netherlands, ...)



5b. Demo: actual waterinfo

Station page widget:

- **Three rich charts:** areal rainfall+stage+flow
- **Options for:**
 - Tabulating latest timestamps
 - Plotting top-5 historic stage maxima
 - Embedding & downloading this info

! Time period remembered per session

- **Station info:** map, picture, ...
- **More (statistic) info:**
 - Empiric return periods
 - Trend in extreme values
 - Trend in percentiles

Also available for rainfall statistics

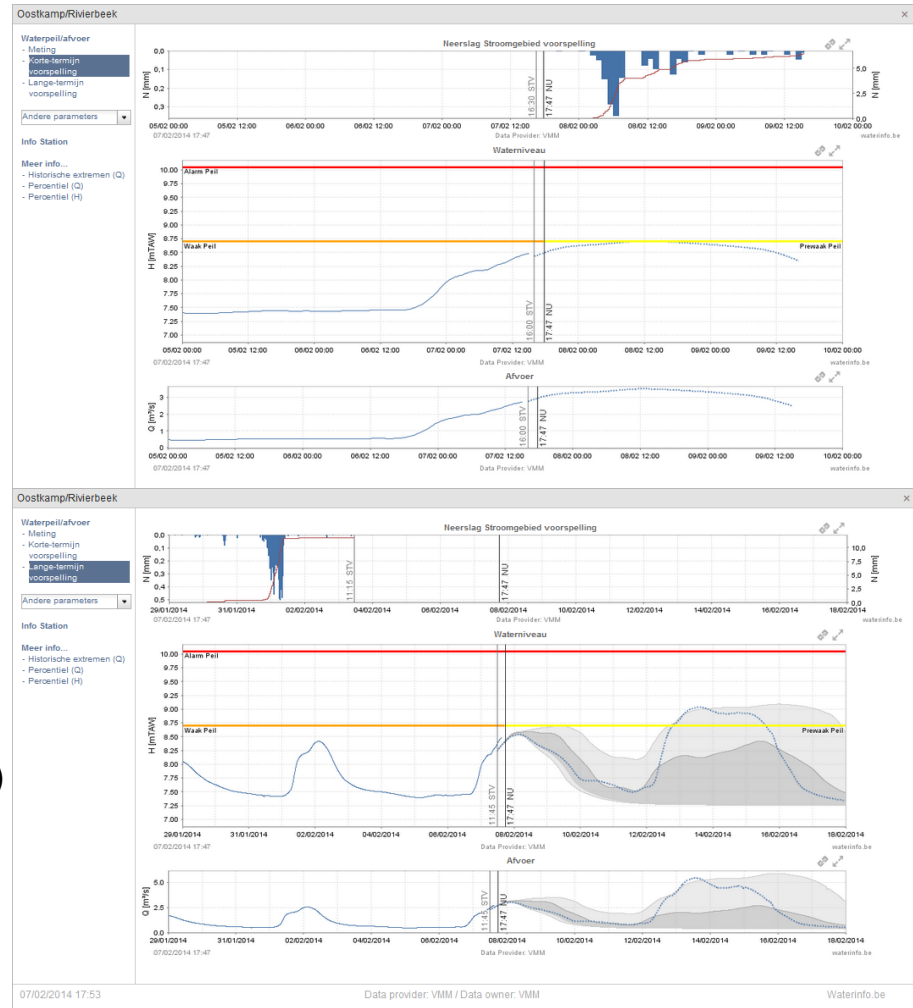


5b. Demo: forecasted waterinfo

Station page widget

- **Short-term forecast (48hrs ahead)**
- 3 forecasts for areal rainfall + stage + flow
- NU = Time now
- STV = Start Tijdstip Voorspelling (Time of Forecast)

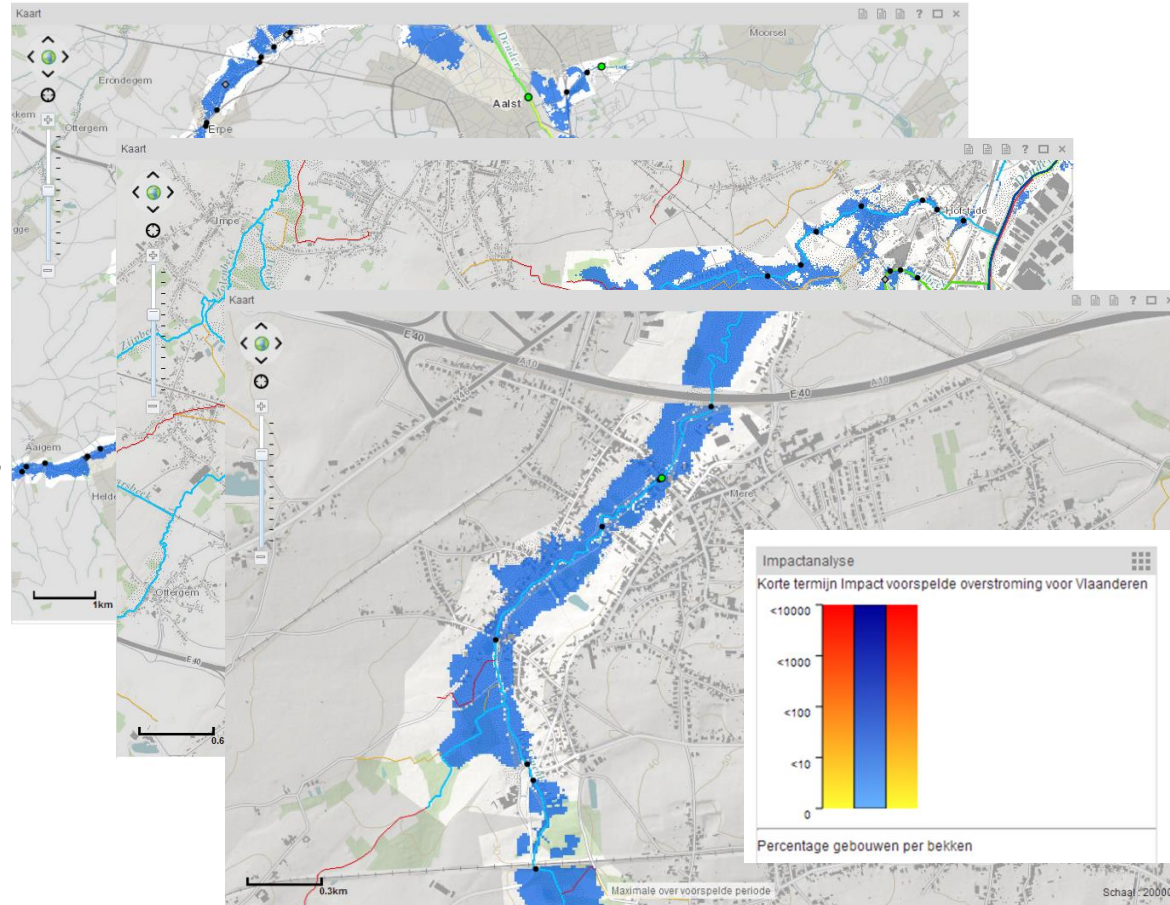
- **Long term forecast (10 days ahead)**
- Uncertainty bands
(4 real-time hydraulic percentile-runs based upon ECMWF P10, 25, 75, 90 rain)



5b. Demo: forecasted waterinfo

Real-time Flood maps

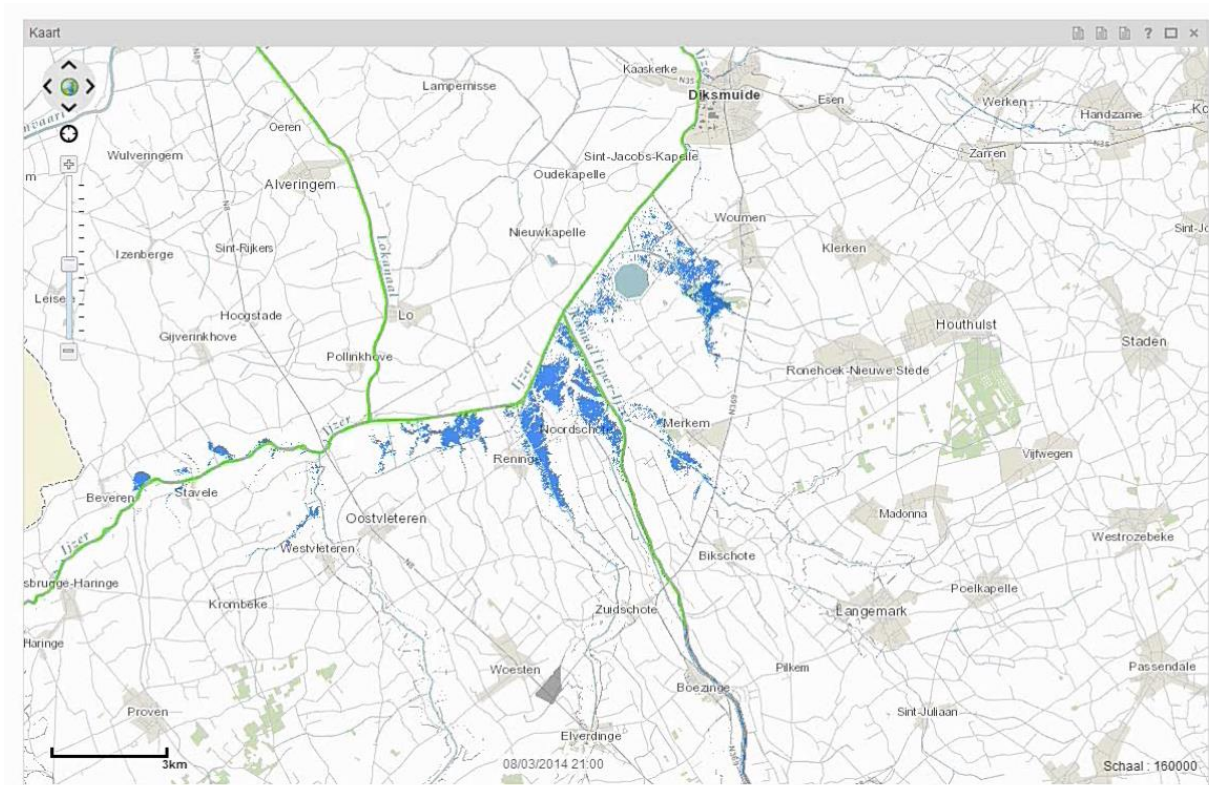
- **Flood extent maps** (1 depth)
- For over 3000 km
- Till scale: 1:20.000
- With time-animation (3 hrs)
- Year round: **2 hourly** generated **map cache** out of all FloodWorks (VMM) & FloodWatch (HIC) modelled floodcontours
- ! Floodextents used for calculating (WPS) **real-time** the **floodimpact** = number of flooded buildings



5b. Demo: forecasted waterinfo

Flood Animation

- River IJzer: real-time flood contours based upon test-run (80mm rain last winter)



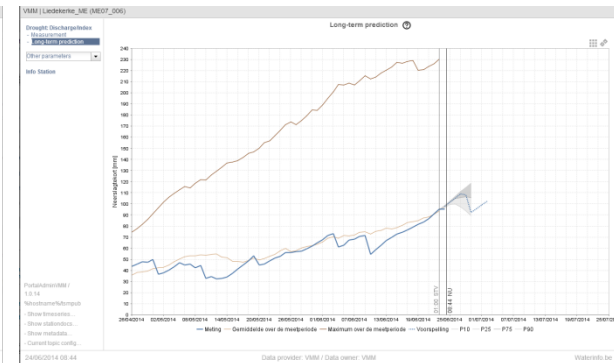
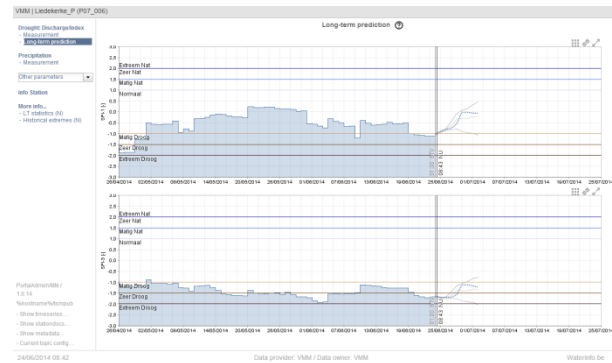
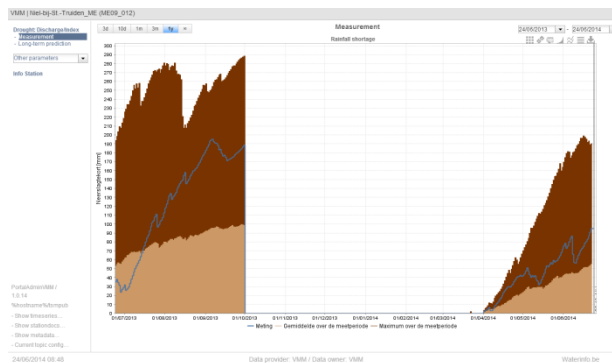
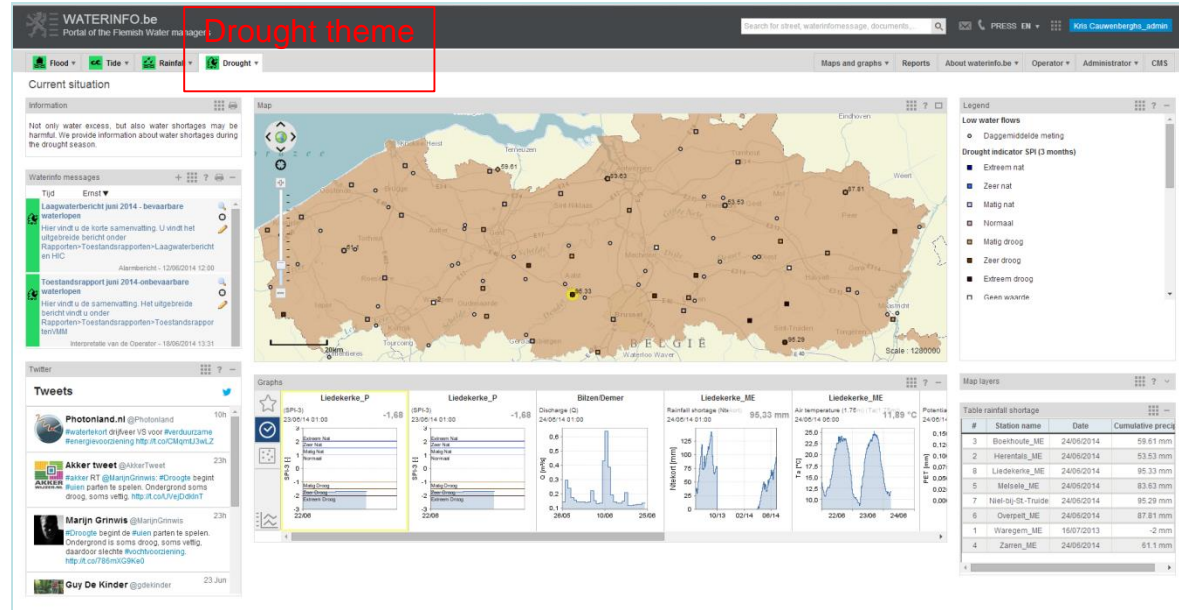
Animation

⏪ ⏩ ⏴ ⏵ ⏶ ⏷ ⏸ ⏹ ⏺ Maximale over voorspelde periode

5b. Demo: forecasted waterinfo

Drought info

- Interpolated background map of current rainfall shortage
- SPI-I en SPI-III charts (actual+forecasted)
- Low water regime (daily flows last month)



5b. Demo: historic content

Hydro-meteorological archive

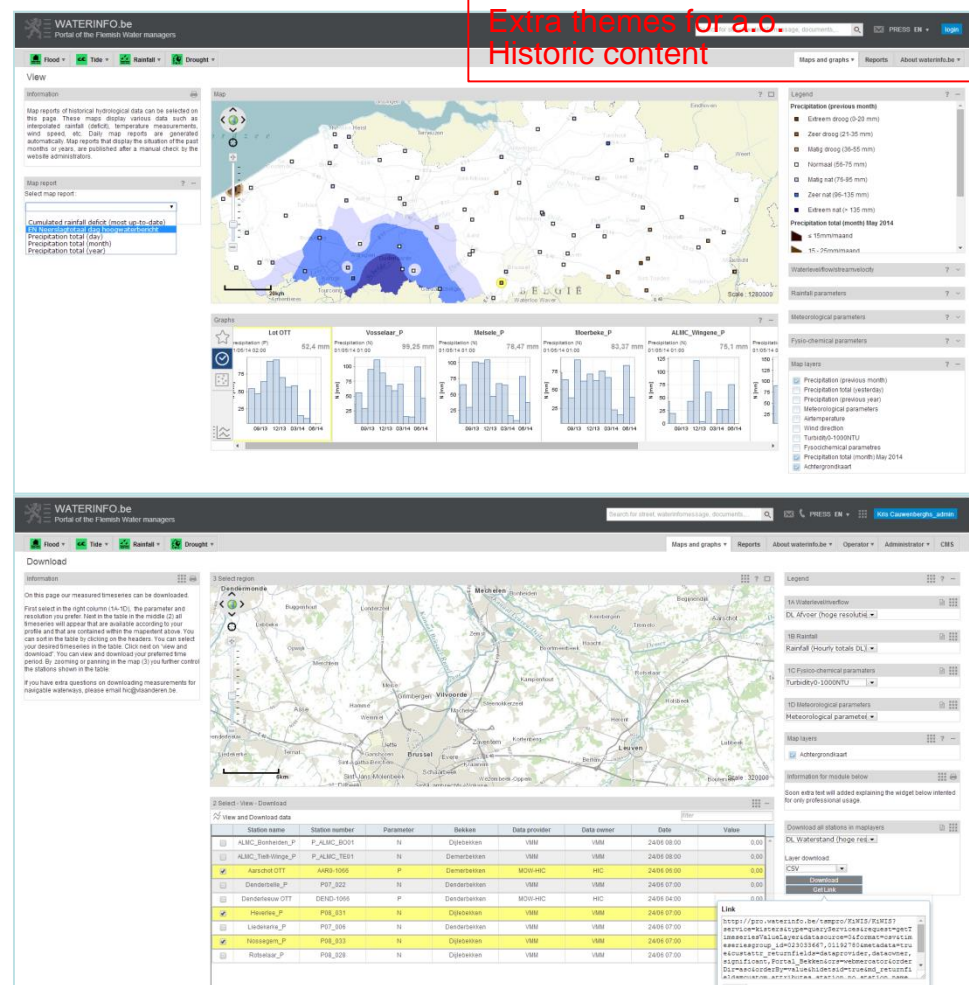
- Map reports showing e.g. rainfall totals for last day(s), month(s), year(s)
- Free consuming of the entire data-archive (all parameters)

Download & share

- Download into Csv, ascii, html, waterML 2.0
- Get link:

http://test.waterinfo.be/tsmtest/KiWIS/KiWIS?service=Kisters&type=queryServices&request=getTimeseriesValues&datasource=1&format=wml2&ts_id=22609042&period=P5Y

http://test.waterinfo.be/tsmtest/KiWIS/KiWIS?service=kisters&type=queryServices&request=getTimeseriesValueLayer&datasource=0&format=ascii×eriesgroup_id=01178048&metadata=true&custattr_returnfields=dataprowider,dataowner,significant,Portal_Bekken&crs=webmercator&orderDir=asc&orderBy=value&hidetsid=true&md_returnfields=custom_attributes,station_no,station_name,ts_name,stationparameter_name,ts_unitsymbol,parametertype_name



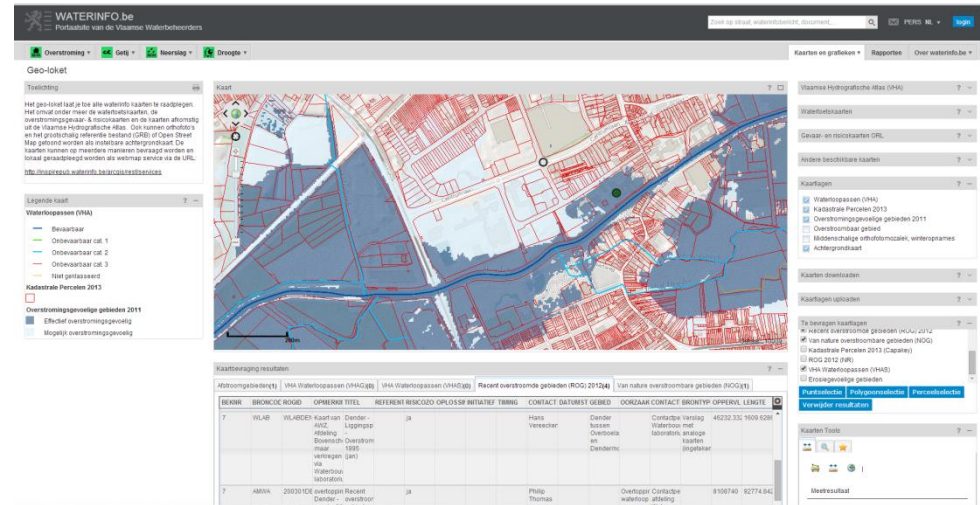
The screenshot shows the WATERINFO.be web application interface. The top navigation bar includes 'Flood', 'Tide', 'Rainfall', and 'Drought'. The main content area is divided into several sections:

- Map:** A map of Belgium showing precipitation data. A red box highlights the 'Extra themes for a.o. Historic content' option in the legend.
- Graphs:** A series of bar charts showing precipitation data for various stations: Let OTT, Vosselaar_P, Melsele_P, Ikerbake_P, and ALMC_Vitvoorde_P. Each chart shows precipitation (mm) over time (08/13 to 08/14).
- Table:** A table listing station data with columns for Station name, Station number, Parameter, Bekken, Data provider, Data owner, Date, and Value. The table includes stations like ALMC_Bosherden_P, ALMC_Tek_Willeg_P, Aarschot_OTT, Denderbelle_OTT, Heidebeke_P, Liedekerke_P, Nieuwgeest_P, and Ruisseau_P.

5b. Demo: historic waterinfo

Geo-portal

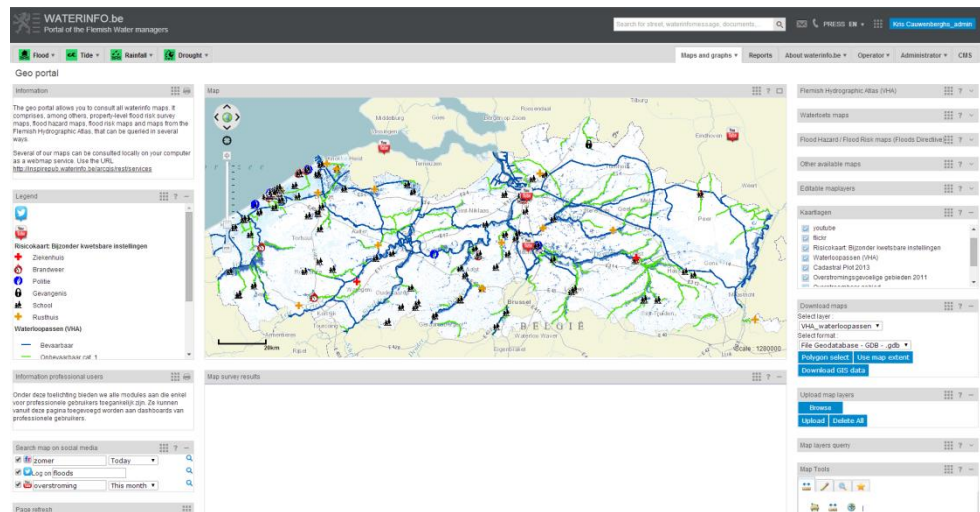
- Historic flood maps (incl. Floods directive maps, inspire-wms)
- Hydrographic network (VHA)
- Cadastral maps, ...
- Consult & query maps (+ pdf-print)
- Download shape and geo-database



! Setup transparency + change order layers

! Only for professional users

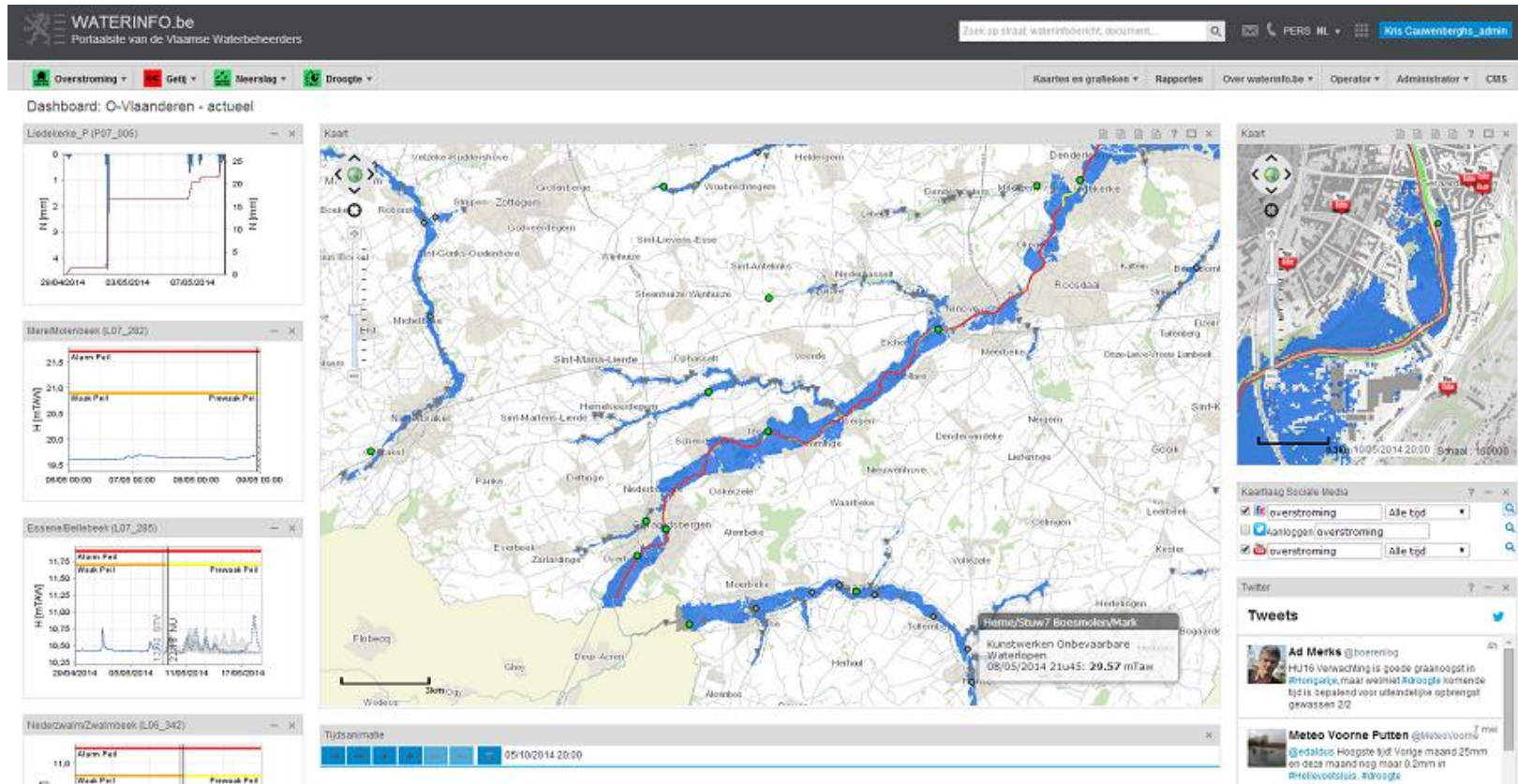
- Uploaden client shape-files
- Web gis-editing tools



5b. Demo: dashboards

Local dashboard example

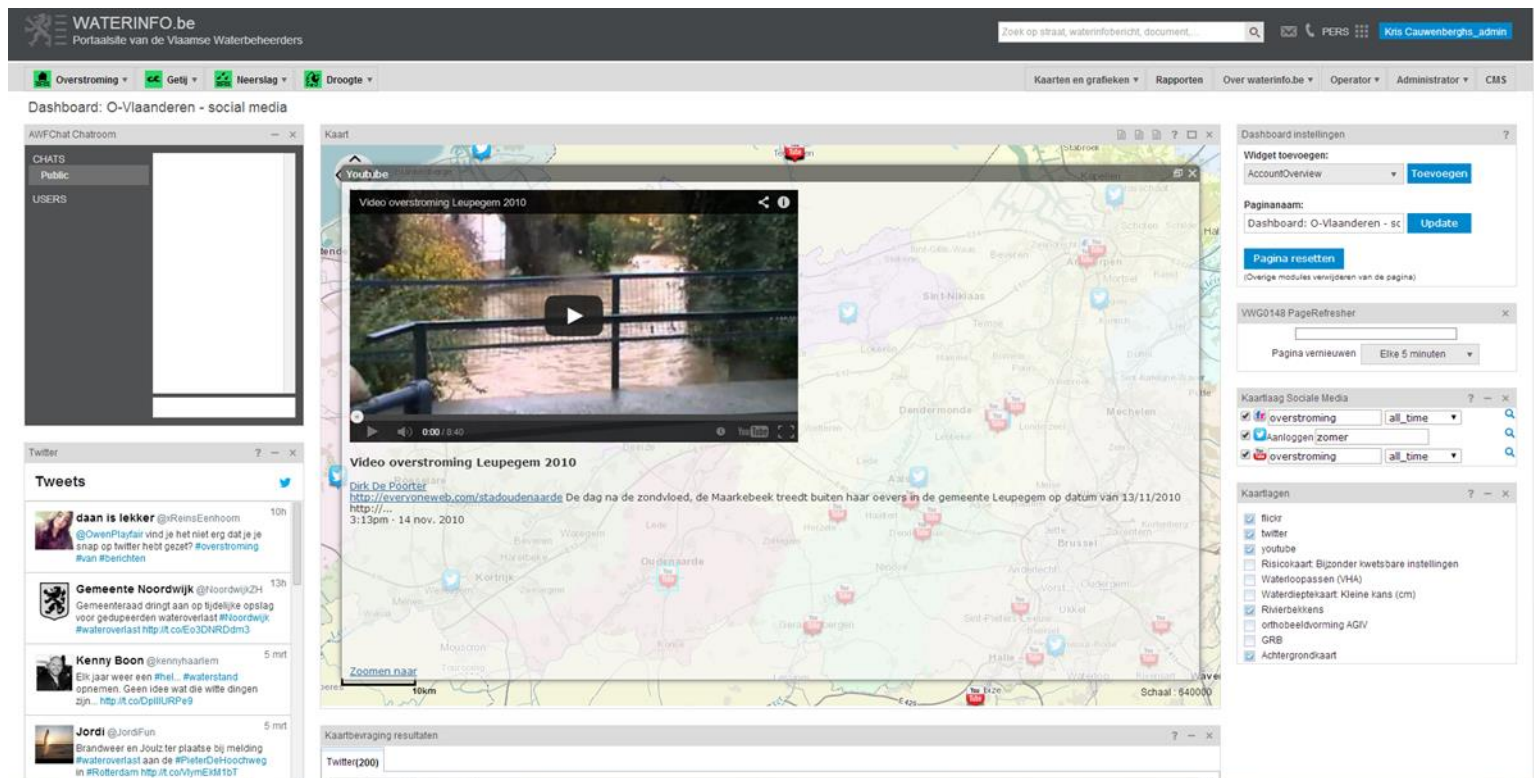
- ! Individual content selection
 - Multiple graphs (observed and forecasted timeseries)
 - Multiple maps (different zoomlevels)



5b. Demo: dashboards

Social media dashboard example

- Central map: showing Flickr, Twitter and You-tube results on selectable keywords + period
- Twitter-feed on keywords like: flooding, stormsurge, drought, ...
- Chat-module (only for operators)



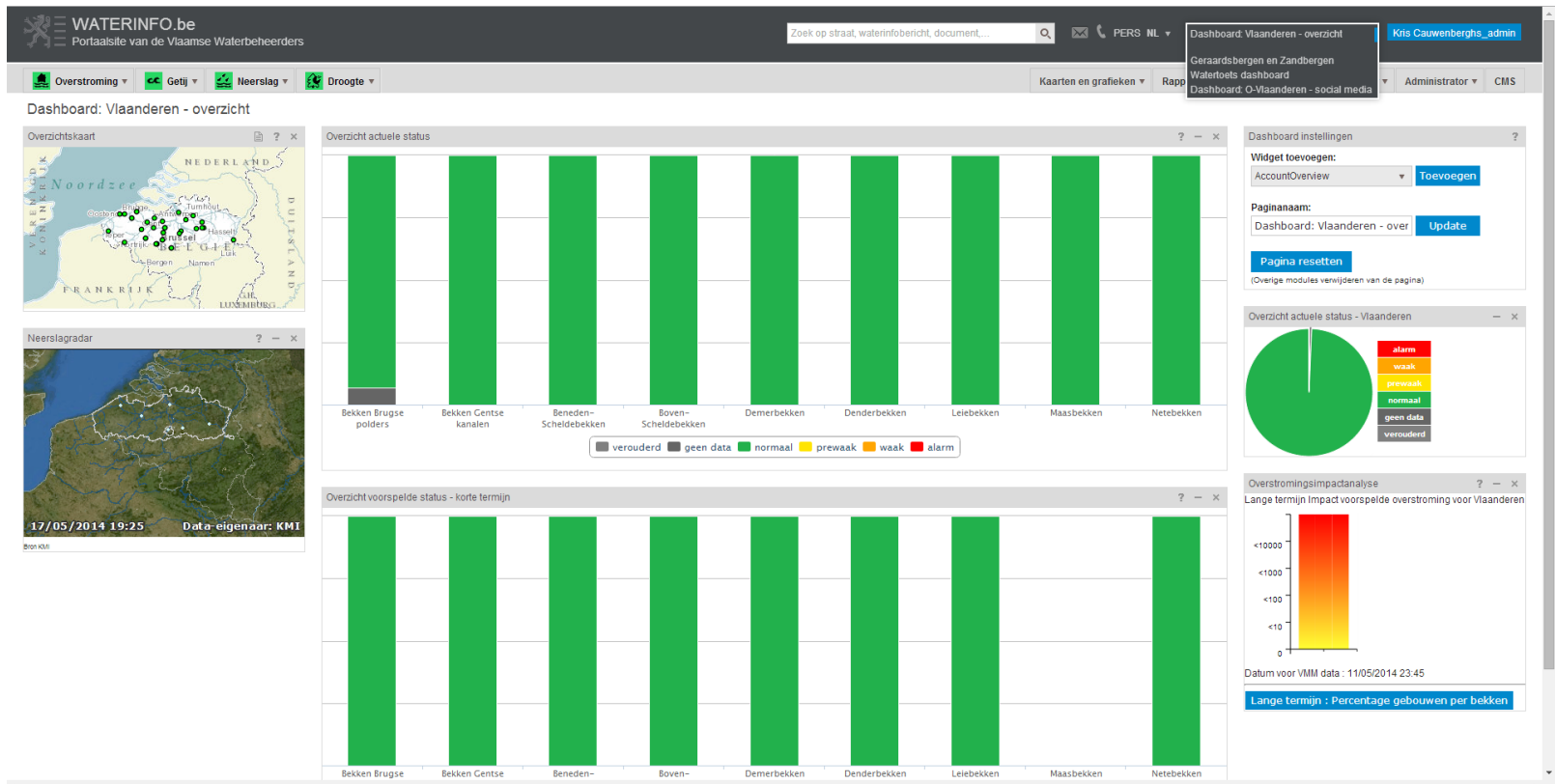
The screenshot displays the WATERINFO.be social media dashboard. At the top, there's a navigation bar with the logo and user information. Below it, a menu bar includes options like 'Overstroming', 'Getij', 'Neerslag', and 'Droogte'. The main content area is titled 'Dashboard: O-Vlaanderen - social media' and is divided into several sections:

- Left Panel:** Contains an 'AIMChat Chatroom' and a 'Twitter' feed with tweets from users like @ReinsEenhoom, @OwenPafar, @kennyhaalem, and @JordiFun.
- Center Panel:** Features a map of the Leupegem area with social media markers. A video player is overlaid on the map, showing a flooded area with the title 'Video overstroming Leupegem 2010'. Below the video, there's a tweet from Dirk De Poorter about a flood event on 13/11/2010.
- Right Panel:** Includes a 'Dashboard instellingen' section with a 'Widget toevoegen' button, a 'Pagina naam' field, and a 'Pagina resetten' button. Below that is a 'PageRefresher' section with a 'Pagina vernieuwen' button and a 'Elke 5 minuten' dropdown. At the bottom right, there's a 'Kaartlaag Sociale Media' section with checkboxes for 'overstroming', 'anloggen zomer', and 'overstroming', and a 'Kaartlagen' section with checkboxes for 'flickr', 'twitter', 'youtube', 'Risicokaart', 'Waterlooppassen', 'Waterdieptekaart', 'Rivierbekkens', 'orthobeeldvorming AGIV', 'GRB', and 'Achtergrondkaart'.

5b. Demo: dashboards

Regional dashboard example

- Clickable bar- and pie-diagrams showing alarm overview



6. Conclusions

1. In less than 2 years a state-of-the art portal has been built (running stable and fast, also under crisis situations)
2. Current web-technology gives huge possibilities for serving lots and complex information to different audiences.
3. Big data processing also within medium size organisations possible.
4. Portal can easily be extended with other info on water quality calamities, groundwater info, ...
5. Portal is inspiration for a Next-Generation backend (running models, sensors, ... in a (service oriented) Water Data Infrastructure)

Questions ?

Thank you !

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www.vmm.be & www.waterinfo.be

<https://nl-nl.facebook.com/vlaamsemilieumaatschappij>

<http://www.vmm.be/water/waterbeheer/waterlopen-beheren-en-overstromingen-aanpakken/aanpakken-van-overstromingen>

<http://www.vmm.be/pub/de-overstromingsvoorspeller/view>