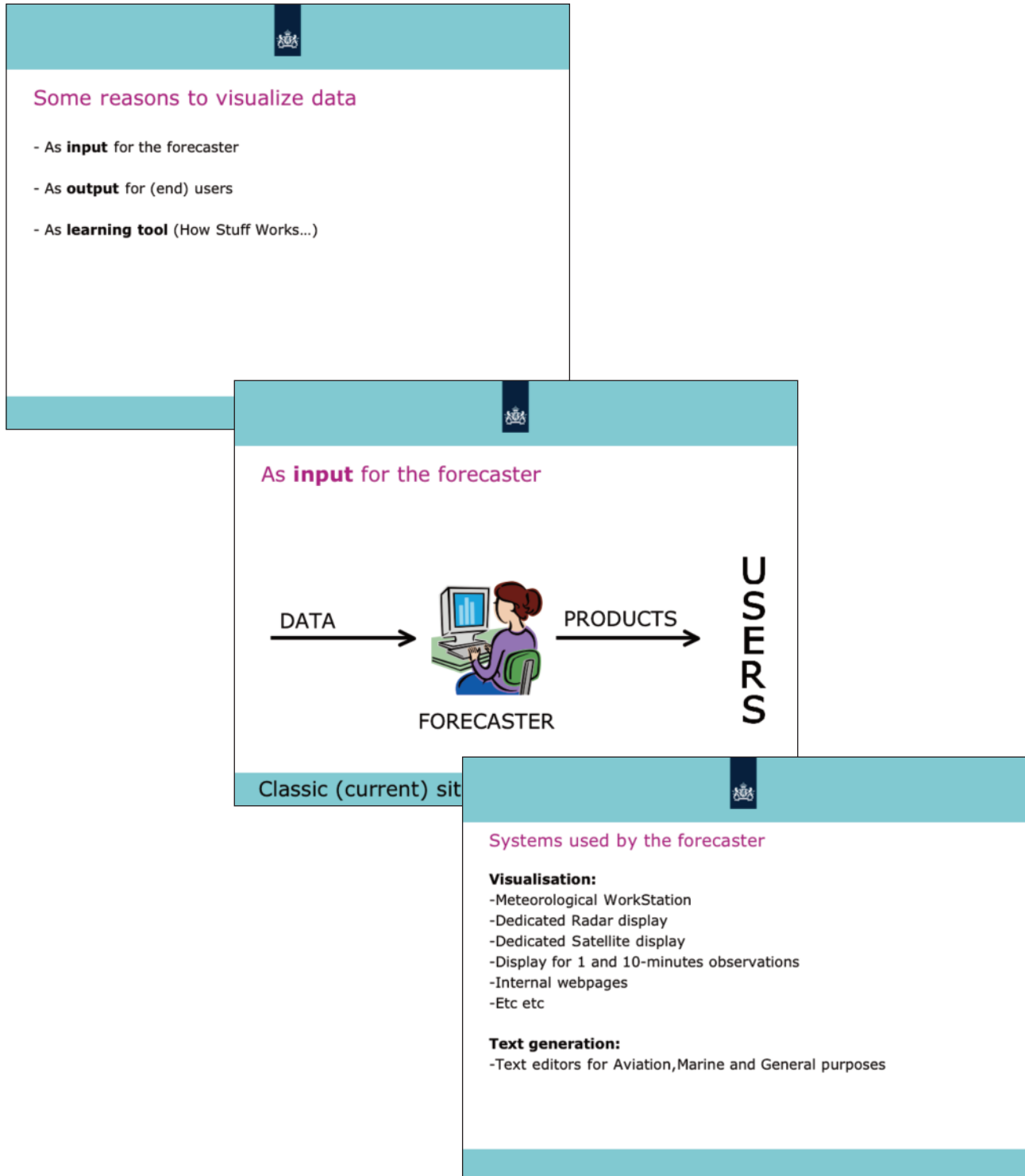


Visualisation tools at KNMI

Kees Lemcke, Royal Netherlands Meteorological Institute (KNMI)

KNMI operational forecasters have a number of systems available for the visualisation of data: a general purpose Meteorological WorkStation (MWS), dedicated systems for satellite data, radar data, and special observations. A growing amount of data is presented with web-applications and this is the way KNMI likes to visualize as much as possible: a new MWS has to be modular and web based. A complex type of visualisation is 3D stereoscopic presentation of model data. KNMI is developing a tool to present the output of numerical models 3D stereoscopic in our 3D-lab as a learning tool for both developers and forecasters.





Meteorological Work Station

- MWS of 3SI (Spatial Software Solutions Inc, USA)
- Started with Metlab Classic in 1992, operational in 1995
- Migration to Smartwindows (KNMI version Metlab2) (2000-2005)
- 'Frozen' since 2007
- 'Standard possibilities':
 - Layers
 - Modeldata
 - Observations
 - Radar
 - Satellite



In 1995 :

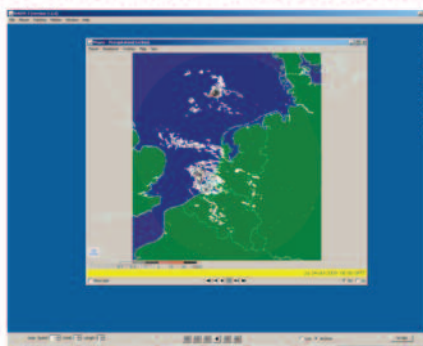
- 1 Head Quarter in De Bilt
- 5 Regional Centres
- 17 Meteorological Work Stations (MWS)

Currently:

- All work centralized in De Bilt, 6 MWS's
- Consultant at Amsterdam Airport, 1 MWS (depending on the weather)

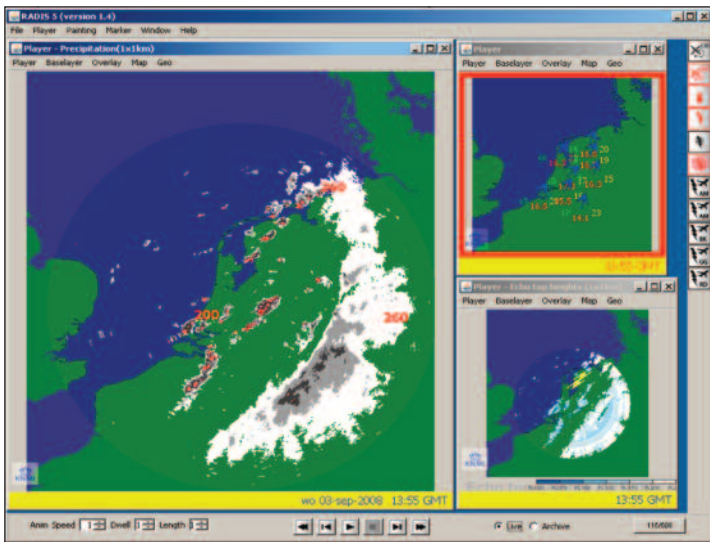


Dedicated Radar display (Web enabled)



Home made

- Precipitation
- extrapolation
- Lightning
- Hail risk
- Echo top heights
- European composite
- Multiple synchronised players



Dedicated Satellite display

CINESAT (TM Gepard,Vienna) offers a large range of analysing tools and postprocessing tools not available in our MWS

10-minutes obs (web based)

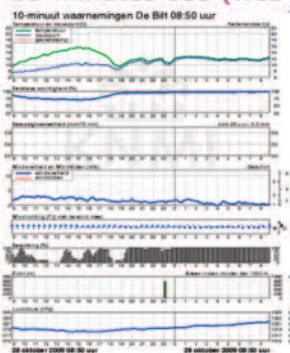
KNMI
Observation network viewer

- Wind
- Humidity
- Temperature (C)
- Rel. Humidity (%)
- Clouds (oktas)
- Pressure (hPa)
- Pressure (hPa) (corrected)
- Cloud Cover (oktas)
- Cloud Base (m)
- Cloud Top (m)
- Cloud Base (ft)
- Cloud Top (ft)
- Station Name

10-sep-2006 11:00:00



10-minutes obs (web based)



Many new products developed by enthusiastic model developers:

- Images produced at their own workstation
- Easy to display with a browser
- Easy loops with a script

No formal request necessary to implement in MWS, just available....

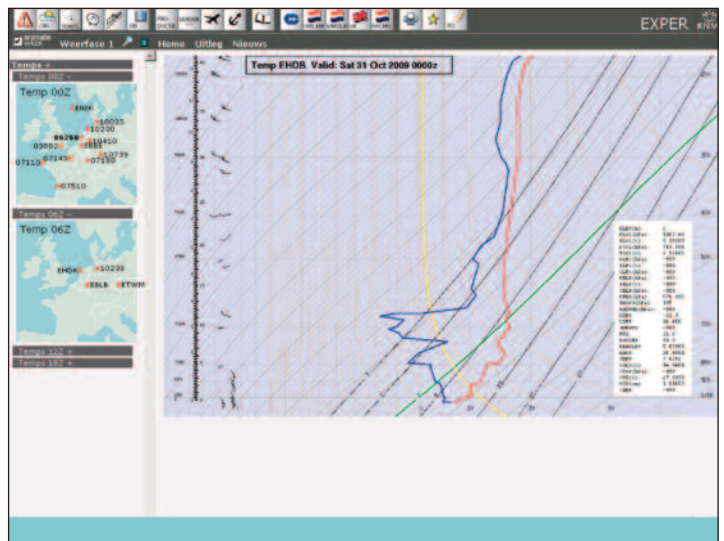
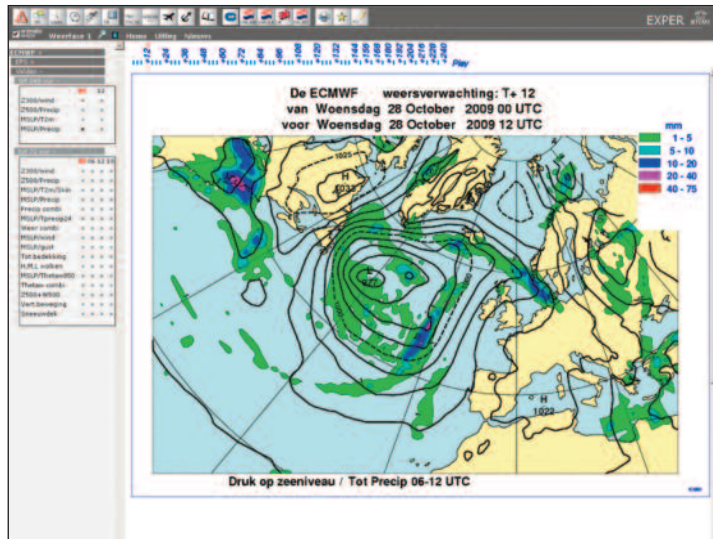
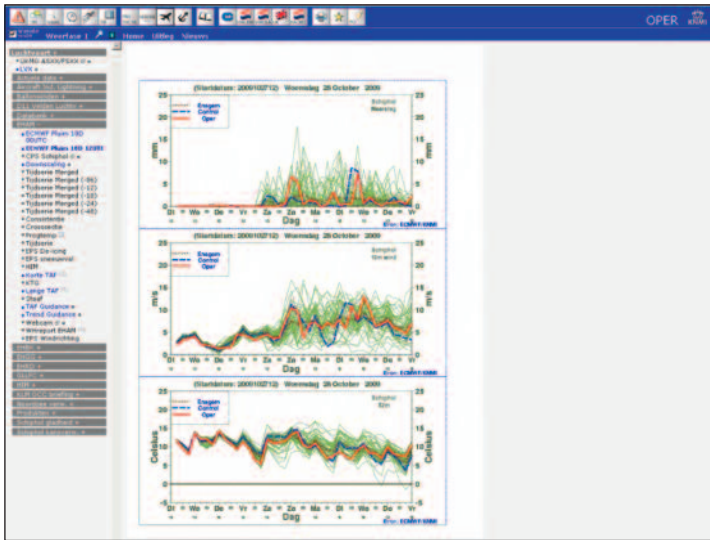
However...

- State of product (Operational or Experimental) not visible for forecaster
- Menu structure necessary
- Possibilities for easy maintenance required



Solution:

- Portal to individual images/web pages
 - Small MySql database
 - All links defined in a product table with state (OPER/EXPER)
 - Menu structure defined in tables





Pros and Cons pre-processed images

- Pros
 - Distributed production
 - Easy to use in portal
 - Easy archiving
- Cons
 - The pre-processing



Alternative

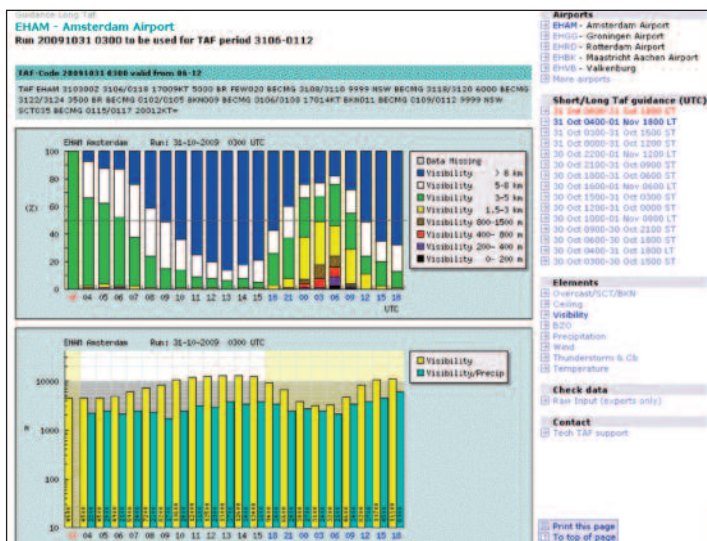
-On demand visualisation

Operational web application (PHP, JpGraph) in use at KNMI:

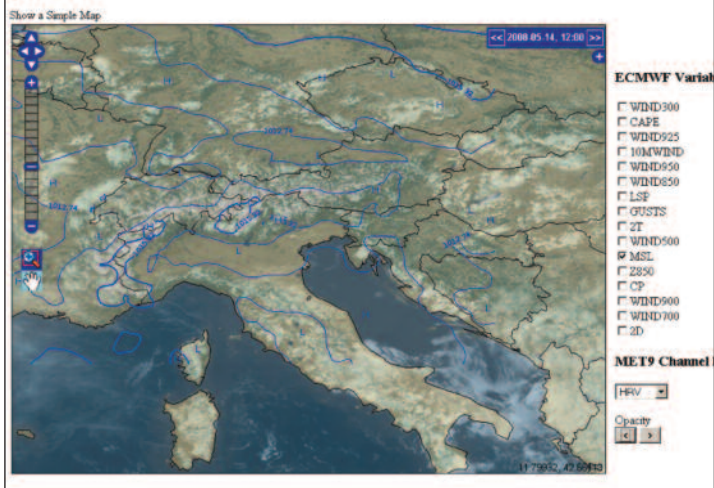
- Guidance for TAF
- Guidance for TREND
- Guidance for road temperature

In 2008 experiment with on demand processing with

- MAGICs++
- Web Mapping Server
- Cinesat satellite images
- Radar images



Simple Magics WMS Example



Systems used by the forecaster

Visualisation:

- Meteorological WorkStation
- Dedicated Radar display
- Dedicated Satellite display
- Display for 1 and 10-minutes observations
- Internal webpages
- Etc etc

Text generation:

- Text editors for Aviation, Marine and General purposes

Work in progress to replace these 3 systems by 1 web based system with links to product groups in the portal

Producteditor

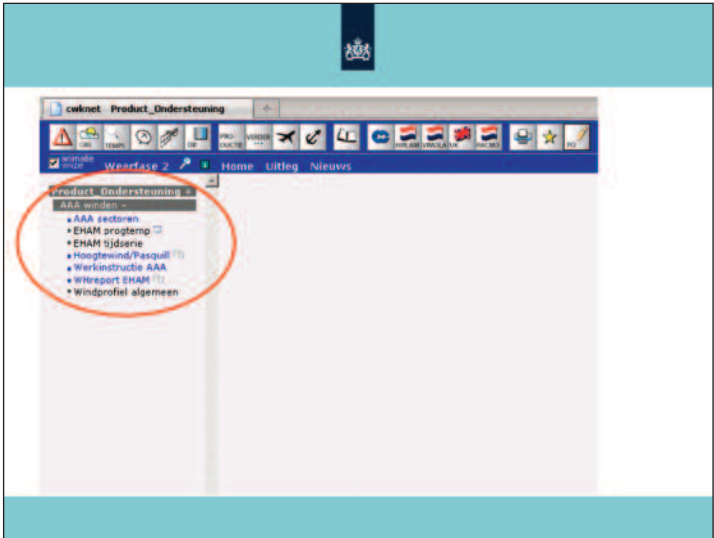
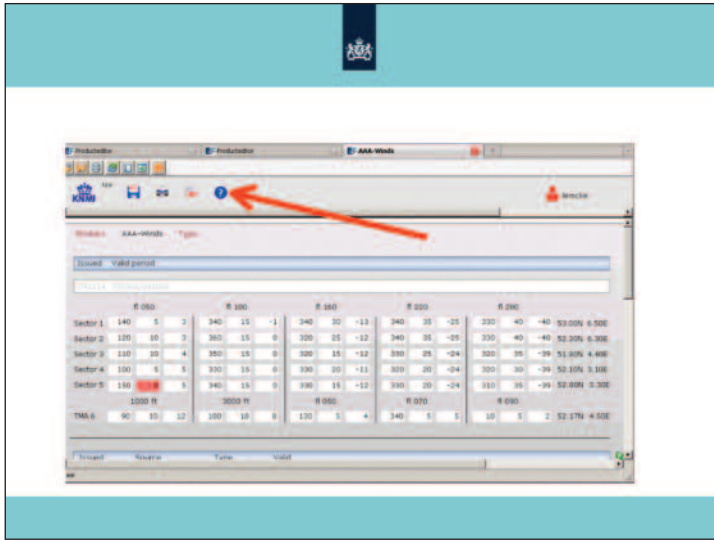
Producteditor

KNMI

Winterschema L1 winterschema
donderdag 29 oktober 2009

OK	Local	UTC	Product	Type	Status	Action
<input type="checkbox"/>	17:00	17:00	Winterschema L1 winterschema	W	OK	
<input type="checkbox"/>	17:30	17:30	Winterschema L1 winterschema	W	OK	
<input type="checkbox"/>	18:00	18:00	Winterschema L1 winterschema	W	OK	
<input type="checkbox"/>	18:30	18:30	Winterschema L1 winterschema	W	OK	
<input type="checkbox"/>	19:00	19:00	Winterschema L1 winterschema	W	OK	
<input type="checkbox"/>	19:30	19:30	Winterschema L1 winterschema	W	OK	
<input type="checkbox"/>	20:00	20:00	Winterschema L1 winterschema	W	OK	
<input type="checkbox"/>	20:30	20:30	Winterschema L1 winterschema	W	OK	
<input type="checkbox"/>	21:00	21:00	Winterschema L1 winterschema	W	OK	
<input type="checkbox"/>	21:30	21:30	Winterschema L1 winterschema	W	OK	
<input type="checkbox"/>	22:00	22:00	Winterschema L1 winterschema	W	OK	
<input type="checkbox"/>	22:30	22:30	Winterschema L1 winterschema	W	OK	
<input type="checkbox"/>	23:00	23:00	Winterschema L1 winterschema	W	OK	
<input type="checkbox"/>	23:30	23:30	Winterschema L1 winterschema	W	OK	
<input type="checkbox"/>	00:00	00:00	Winterschema L1 winterschema	W	OK	
<input type="checkbox"/>	00:30	00:30	Winterschema L1 winterschema	W	OK	
<input type="checkbox"/>	01:00	01:00	Winterschema L1 winterschema	W	OK	
<input type="checkbox"/>	01:30	01:30	Winterschema L1 winterschema	W	OK	
<input type="checkbox"/>	02:00	02:00	Winterschema L1 winterschema	W	OK	
<input type="checkbox"/>	02:30	02:30	Winterschema L1 winterschema	W	OK	
<input type="checkbox"/>	03:00	03:00	Winterschema L1 winterschema	W	OK	
<input type="checkbox"/>	03:30	03:30	Winterschema L1 winterschema	W	OK	
<input type="checkbox"/>	04:00	04:00	Winterschema L1 winterschema	W	OK	
<input type="checkbox"/>	04:30	04:30	Winterschema L1 winterschema	W	OK	
<input type="checkbox"/>	05:00	05:00	Winterschema L1 winterschema	W	OK	
<input type="checkbox"/>	05:30	05:30	Winterschema L1 winterschema	W	OK	
<input type="checkbox"/>	06:00	06:00	Winterschema L1 winterschema	W	OK	
<input type="checkbox"/>	06:30	06:30	Winterschema L1 winterschema	W	OK	
<input type="checkbox"/>	07:00	07:00	Winterschema L1 winterschema	W	OK	
<input type="checkbox"/>	07:30	07:30	Winterschema L1 winterschema	W	OK	
<input type="checkbox"/>	08:00	08:00	Winterschema L1 winterschema	W	OK	
<input type="checkbox"/>	08:30	08:30	Winterschema L1 winterschema	W	OK	
<input type="checkbox"/>	09:00	09:00	Winterschema L1 winterschema	W	OK	
<input type="checkbox"/>	09:30	09:30	Winterschema L1 winterschema	W	OK	
<input type="checkbox"/>	10:00	10:00	Winterschema L1 winterschema	W	OK	
<input type="checkbox"/>	10:30	10:30	Winterschema L1 winterschema	W	OK	
<input type="checkbox"/>	11:00	11:00	Winterschema L1 winterschema	W	OK	
<input type="checkbox"/>	11:30	11:30	Winterschema L1 winterschema	W	OK	
<input type="checkbox"/>	12:00	12:00	Winterschema L1 winterschema	W	OK	
<input type="checkbox"/>	12:30	12:30	Winterschema L1 winterschema	W	OK	
<input type="checkbox"/>	13:00	13:00	Winterschema L1 winterschema	W	OK	
<input type="checkbox"/>	13:30	13:30	Winterschema L1 winterschema	W	OK	
<input type="checkbox"/>	14:00	14:00	Winterschema L1 winterschema	W	OK	
<input type="checkbox"/>	14:30	14:30	Winterschema L1 winterschema	W	OK	
<input type="checkbox"/>	15:00	15:00	Winterschema L1 winterschema	W	OK	
<input type="checkbox"/>	15:30	15:30	Winterschema L1 winterschema	W	OK	
<input type="checkbox"/>	16:00	16:00	Winterschema L1 winterschema	W	OK	
<input type="checkbox"/>	16:30	16:30	Winterschema L1 winterschema	W	OK	
<input type="checkbox"/>	17:00	17:00	Winterschema L1 winterschema	W	OK	
<input type="checkbox"/>	17:30	17:30	Winterschema L1 winterschema	W	OK	
<input type="checkbox"/>	18:00	18:00	Winterschema L1 winterschema	W	OK	
<input type="checkbox"/>	18:30	18:30	Winterschema L1 winterschema	W	OK	
<input type="checkbox"/>	19:00	19:00	Winterschema L1 winterschema	W	OK	
<input type="checkbox"/>	19:30	19:30	Winterschema L1 winterschema	W	OK	
<input type="checkbox"/>	20:00	20:00	Winterschema L1 winterschema	W	OK	
<input type="checkbox"/>	20:30	20:30	Winterschema L1 winterschema	W	OK	
<input type="checkbox"/>	21:00	21:00	Winterschema L1 winterschema	W	OK	
<input type="checkbox"/>	21:30	21:30	Winterschema L1 winterschema	W	OK	
<input type="checkbox"/>	22:00	22:00	Winterschema L1 winterschema	W	OK	
<input type="checkbox"/>	22:30	22:30	Winterschema L1 winterschema	W	OK	
<input type="checkbox"/>	23:00	23:00	Winterschema L1 winterschema	W	OK	
<input type="checkbox"/>	23:30	23:30	Winterschema L1 winterschema	W	OK	

	€ 000	€ 100	€ 150	€ 200	€ 250												
Sector 1	140	5	3	340	15	-1	340	30	-13	340	35	-25	330	40	-40	53.000	6.500
Sector 2	120	10	3	350	15	0	320	25	-12	340	35	-25	330	40	-40	52.000	6.300
Sector 3	110	20	4	350	15	0	320	15	-12	330	25	-24	320	35	-39	51.000	4.400
Sector 4	100	5	5	330	15	0	330	20	-11	330	20	-24	320	30	-39	50.000	3.100
Sector 5	150	5	5	340	15	0	330	15	-12	330	20	-24	310	35	-39	52.000	3.300
Totaal	1200	45	20	3000	75	0	2800	90	-50	2800	100	-100	2700	120	-120	52.000	4.000





For forecast times > 1 day :

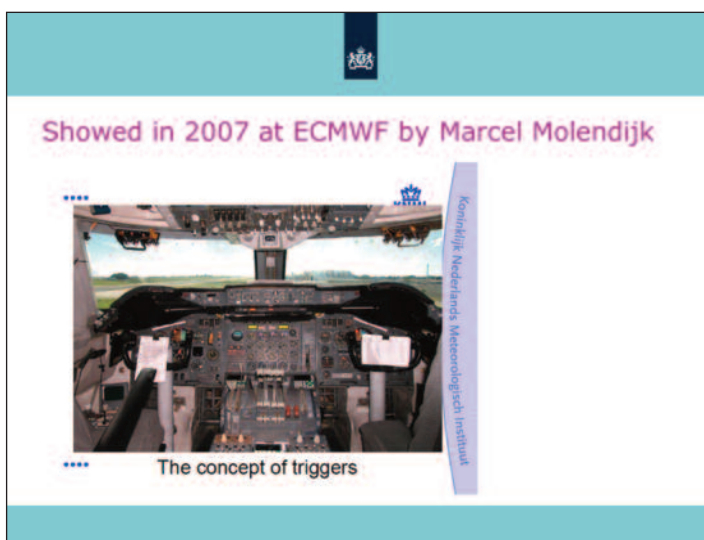
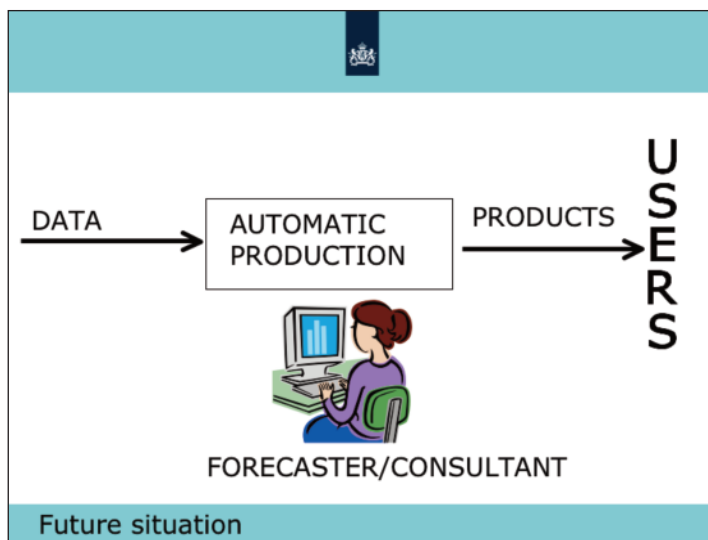
- we use NWP-models directly in the output

For forecast times < 1 day :

In the future direct use of:

- high resolution models
- statistical postprocessing
- short term EPS

This will change the role of the forecaster in the near future



Shown in 2007 at ECMWF by Marcel Molendijk

Koninklijk Nederlands Meteorologisch Instituut

Metaphor with airplane

- Fly on automatic pilot when possible
- Dash board with information and automatic alarms (triggers)

Validheids interval	Trigger N&A	Product (opsig)	Categorie	Drempel en waarde	Locatie	Voorgeschiede actie	Type	Link
0 10 20 30 40 50 60 70 80 90 100		algemeen Vroegge voorspaaanschaaiing	Wind	40% Windsterkte >= 6 Bft 40-60% Bft		voorbereiden advies	FC-PSDD	
0 10 20 30 40 50 60 70 80 90 100	Gitteren 9-13			40% Windsterkte >= 6 Bft 60% Bft	De Kaay			
0 10 20 30 40 50 60 70 80 90 100	Gitteren 9-13			40% Windsterkte >= 6 Bft 60% Bft	Wisingen			
0 10 20 30 40 50 60 70 80 90 100	Gitteren 21-13			40% Windsterkte >= 6 Bft 60% Bft	De Kaay			
0 10 20 30 40 50 60 70 80 90 100	Gitteren 21-13			40% Windsterkte >= 6 Bft 60% Bft	Utrecht			
0 10 20 30 40 50 60 70 80 90 100		algemeen Vroegge voorspaaanschaaiing	Wind	40% Windsterkte >= 6 Bft 40-50% Bft		voorbereiden advies	FC-PSDD	
0 10 20 30 40 50 60 70 80 90 100		algemeen Vroegge voorspaaanschaaiing	Wind	40% Windsterkte >= 21 m/s 50% Bft	De Kaay	voorbereiden advies	FC-PSDD	
0 10 20 30 40 50 60 70 80 90 100		algemeen Vroegge voorspaaanschaaiing	Wind	40% Windsterkte >= 6 Bft 40-60% Bft		voorbereiden advies	FC-PSDD	
0 10 20 30 40 50 60 70 80 90 100		algemeen Vroegge voorspaaanschaaiing	Wind	40% Windsterkte >= 6 Bft 50% Bft	De Kaay	voorbereiden advies	FC-PSDD	
0 10 20 30 40 50 60 70 80 90 100		algemeen Vroegge voorspaaanschaaiing	Wind	40% Windsterkte >= 6 Bft 40-60% Bft		voorbereiden advies	FC-PSDD	
0 10 20 30 40 50 60 70 80 90 100		algemeen Vroegge voorspaaanschaaiing	Wind	40% Windsterkte >= 6 Bft 40-60% Bft		voorbereiden advies	FC-PSDD	

Some reasons to visualize data

- As **input** for the forecaster
- As **output** for (end) users
- As learning tool (How Stuff Works...)



As output for (end) users

- Currently limited amount of graphical info at our public web
- A bit more at the non-public websites (closed user groups)

The screenshot shows the KNMI website homepage with a navigation menu at the top. The main content area is divided into several sections:

- Waarschuwing**: A warning section with a red exclamation mark icon, discussing wind and rain forecasts.
- Verwachting**: A forecast section with a blue cloud icon, discussing temperature and precipitation.
- Nieuws**: A news section with a red exclamation mark icon, featuring articles about October weather and climate science.
- Weerkaart**: A weather map of the Netherlands with a red exclamation mark icon, showing current conditions and a small table below it.
- Neerslagradar**: A radar precipitation map of the Netherlands with a blue cloud icon.
- Weer**: A general weather section with a blue cloud icon, containing links for forecasts, actuals, and health.
- Klimaat**: A climate section with a blue cloud icon, containing links for climate change, scenarios, and news.
- Seismologie**: A seismology section with a blue cloud icon, containing links for news and earthquakes in the Netherlands.
- Achtergrond**: A background section with a blue cloud icon, containing a link for more information.
- Kenniscentrum**: A knowledge center section with a blue cloud icon, containing a link for more information.

The screenshot shows the 'Weer' section of the KNMI website, specifically the 'Waarschuwingen' (Warnings) page. The page features a large map of the Netherlands with a red exclamation mark icon, indicating the location of the warnings. Below the map, there are several sections:

- Waarschuwingen**: A list of warnings, including 'Regenval', 'Watersport en recreatie', 'Scheepvaart', 'Overzicht', and 'Kleinverkeer'.
- Waarschuwingen per regio**: A list of warnings by region, including 'Noord', 'Oost', 'Midden', 'Zuidwest', 'Zuid', and 'Kust en Noordzee'.
- Waarschuwingen Europa**: A list of warnings for Europe, including 'Meteoalarm Europa'.
- Verwachtingen**: A list of forecasts, including 'Overzicht'.
- Actueel**: A list of current information, including 'Overzicht'.



Some reasons to visualize data

- As **input** for the forecaster
- As **output** for (end) users
- As **learning tool** (How Stuff Works...)



As learning tool with old data

- Load data of an archived case in MWS
- Severe Weather Catalogue:
Collection with all kind of information about cases with severe weather in the past.

One of the offline task of the forecasters is to fill the database with relevant data.
It starts with the February 1953 flooding.
- Use the ArchiveViewer

Gevaarlijk Weer
Catalogus Gevaarlijk Weer Nederland
Naslag

Hieronder kunt u gevallen uit de Gevaarlijk Weer Catalogus selecteren. Ook vindt u hier een overzicht van de inhoud van de catalogus.

Selecteren van gevallen uit GWCatalogus

Selecteer datum	Selecteer sector	Selecteer alarmsoort	Selecteer fenomeen	Selecteer alarm
geen-voorkuur	geen-voorkuur	geen-voorkuur	geen-voorkuur	geen-voorkuur

Sort by: datum desc

Overzicht van de in de catalogus opgenomen gevallen van gevaarlijk weer

Aanwezige cases in de catalogus					
2009					
casusdatum	naam	Fenomeen	Afgeleide	Conceptmodel	Overzig
2009-08-20	weeralarm 20 augustus				
2009-07-21	superoork	Ruïen Hogel Windstoten Zware windstoten Wolkbreuk Zeer zware windstoten Zwaar onweer	Turbulentie Windcheer		Schade Hagel schade
2009-07-03	Weeralarm 3 juli 2009				
2009-05-26	Zwaar onweer				
2009-04-09	Stralingsmist gevolgd door advectieve mist en stratus behorende bij een				<input type="button" value="Print deze pagina"/> <input type="button" value="Terug naar boven"/>

Documentatie

- Handleiding

Catalogus modules

- Cases toevoegen
- User management
- Archief management
- Keyword management
- E-learning

Extern system

- Evaluer Weeralarm




As learning tool with old data

- Load data of an archived case in MWS
- Severe Weather Catalogue:
Collection with all kind of information about cases with severe weather in the past. One of the offline task of the forecasters is to fill the database with relevant data. It starts with the February 1953 flooding.
- Use the ArchiveViewer

The screenshot shows the ArchiveViewer interface. At the top, there is a navigation bar with tabs for 'ECHW', 'NIRLAN', 'Liden', 'Waarnemingen', 'Waarkarten', 'Waarschouwingen', 'Verschouwingen', 'Radar', 'Satelliet', and 'Luchtkraat'. Below this is a calendar for the year 2009, with the 19th of July selected. The main content area displays two data tables. The first table is titled 'ECHW_DETIRM (Deterministische verschuwingen ZCHW)' and shows data for 'Temperatuur 2 meter' starting from 000 UTC on 2009-07-19. The second table is titled 'ECHW_EUR Europa' and shows data for 'Neerslag' starting from 000 UTC on 2009-07-19. Both tables have columns for time (000, 005, 010, 015, 020, 025, 030, 035, 040, 045, 050, 055, 060, 065, 070, 075, 080, 085, 090, 095, 100, 105, 110, 115, 120, 125, 130, 135, 140, 145, 150, 155) and values. The interface also includes a 'Legenda kalender' on the right side with options for 'Beknopt dag', 'Weerkaart', 'SWC-dag', and 'SWC-range', and a 'Legenda data-ove' with options for 'Product online' and 'Entren product'.

The screenshot shows the ArchiveViewer interface with a weather map overlay. The map displays a weather system over Europe, with a low pressure system centered over the North Sea and a high pressure system over the Atlantic. The map is titled 'ECHW weersverwachting te 3 van Vrijdag 3 Jul 2009 03 UTC voor Vrijdag 3 Jul 2009 03 UTC'. The interface also shows the same data tables as the previous screenshot, but with the 'Neerslag' table selected. The 'Legenda kalender' and 'Legenda data-ove' are also visible on the right side.





As learning tool (How Stuff Works...)

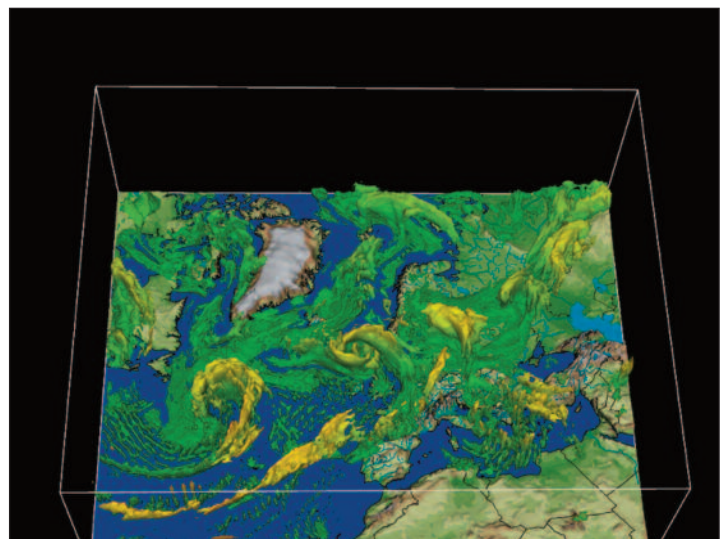
In 2008 KNMI started a project for **3D-stereoscopic** visualisation

3D-LAB

- HIRLAM 3D-viewer available now
- HARMONIE 3D-viewer at the end of the year

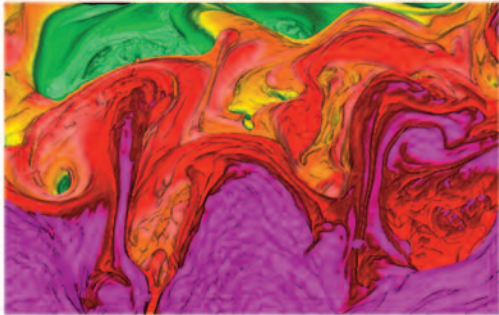
Purpose:

To develop a learning tool for both model developpers and forecasters





Potential Vorticity colored with Theta-w



Conclusions

- Most tools for the forecaster will be webbased in the future
- Automatic forecast when weather permits, manual adaption when necessary
- Forecaster more and more consultant

- 3D-stereographic presentation of numerical models is exiting