The Use of CSPP and IMAPP at Deutscher Wetterdienst

CSPP/IMAPP Users‘ Group Meeting
Madison, Wisconsin
21-23 May 2013

Katja Hungershöfer, Deutscher Wetterdienst (DWD), Germany

Outline

I. Basic facts of Deutscher Wetterdienst (DWD)

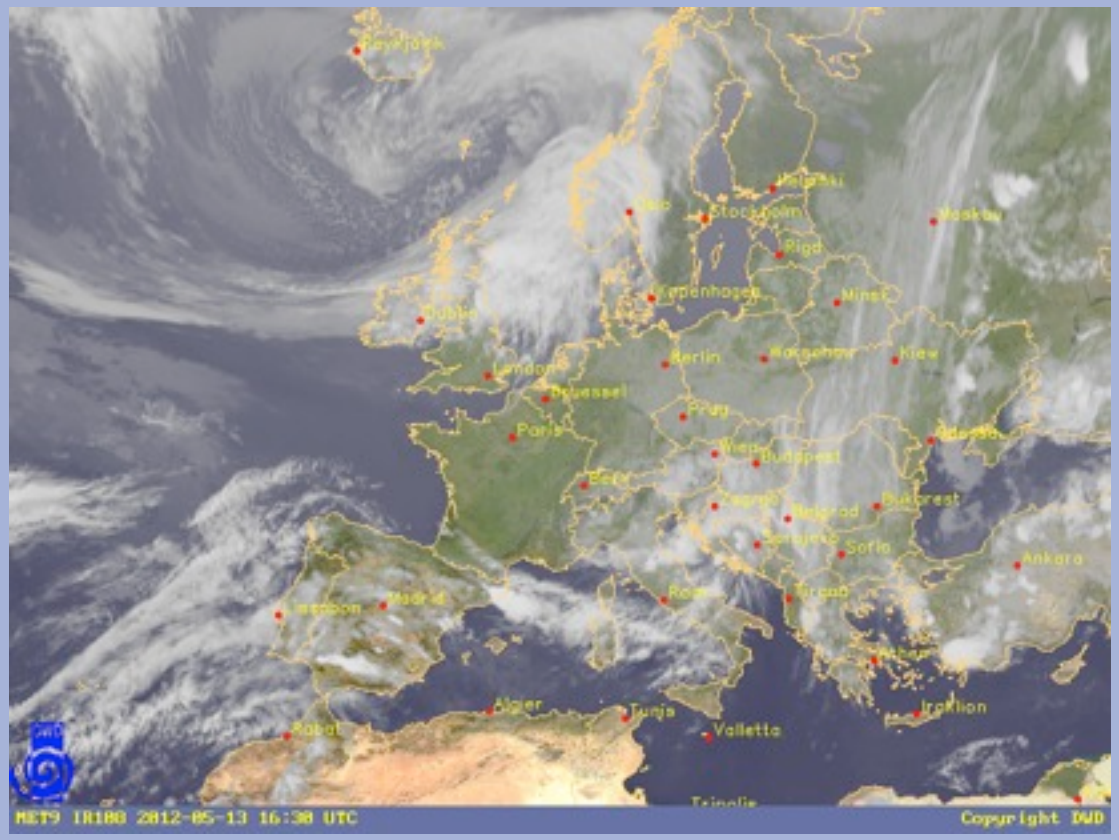
II. The meteorological visualization system NinJo

III. CSPP and IMAPP at DWD

IV. Summary and Outlook

Outline: I. Basic facts about DWD

Deutscher Wetterdienst
Wetter und Klima aus einer Hand



Some facts about DWD

Deutscher Wetterdienst
Wetter und Klima aus einer Hand

- DWD is a public institution with partial legal capacity under the Federal Ministry of Transport, Building and Urban Development
- DWD is responsible for meeting meteorological requirements arising from all areas of economy and society in Germany as laid down in the Law on the Deutscher Wetterdienst.
- Founded in 1952 as National Meteorological Service of the Federal Republic of Germany
- Headquarters in Offenbach am Main, 6 branch offices, 5 regional climate offices, 6 advisory centres for aviation, 17 weather radar sites, 2 observatories
- 2300 employees throughout Germany
- Annual productivity: 90,000 forecasts, 28,000 weather and severe weather warnings, around 465,000 forecasts and warnings for aviation
- Annual Budget: 251 Mio. Euros (2011); 100 millions to international organisations; *2,35 Euros/citizen/year*

DWD Organisation Chart

Deutscher Wetterdienst
Wetter und Klima aus einer Hand

Scientific Advisory Board

PRESIDENT

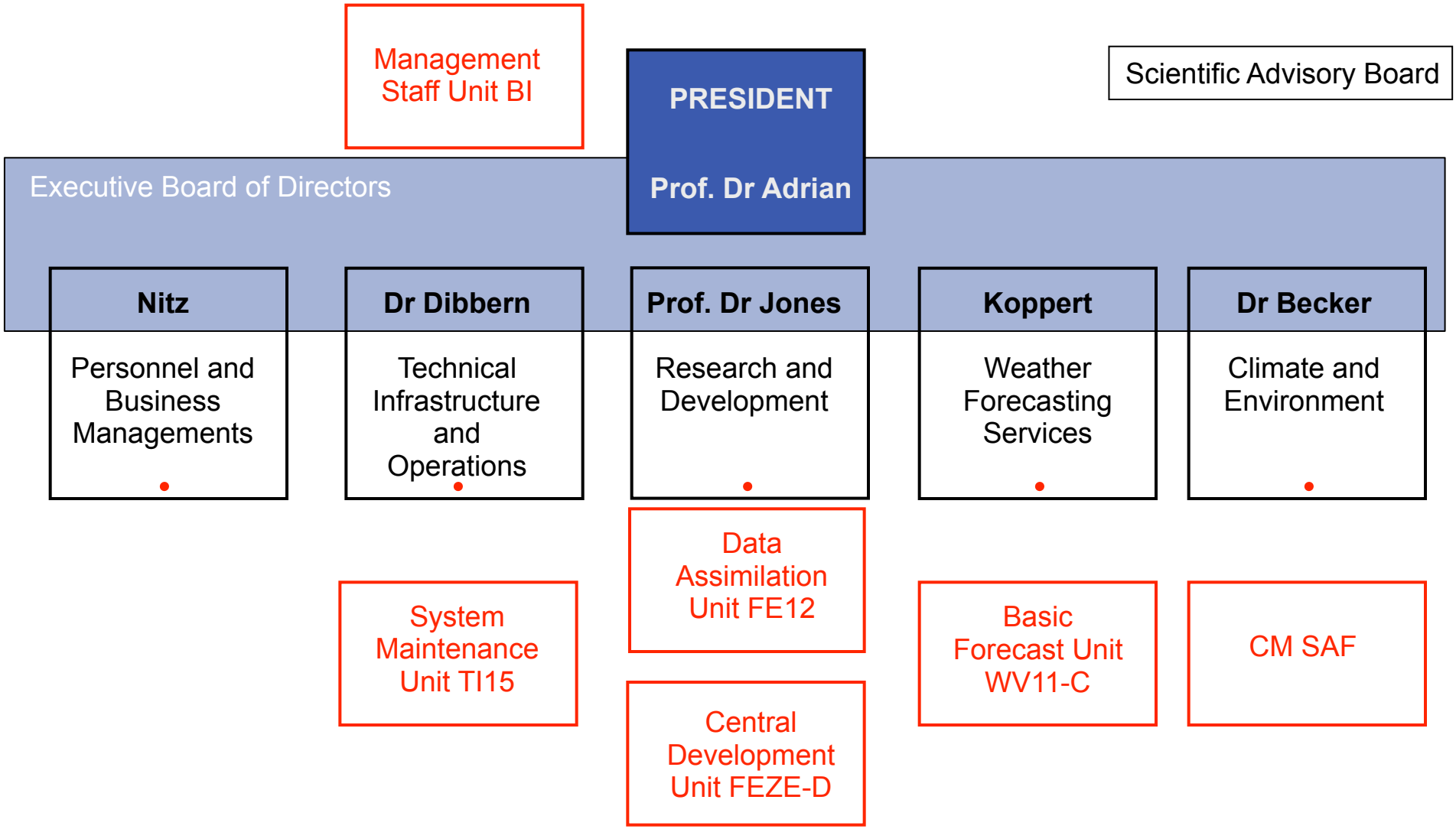
Prof. Dr Adrian

Executive Board of Directors

Nitz	**Dr Dibbern**	**Prof. Dr Jones**	**Koppert**	**Dr Becker**
Personnel and Business Managements	Technical Infrastructure and Operations	Research and Development	Weather Forecasting Services	Climate and Environment

DWD Organisation Chart

Deutscher Wetterdienst
Wetter und Klima aus einer Hand



Outline: II. NinJo

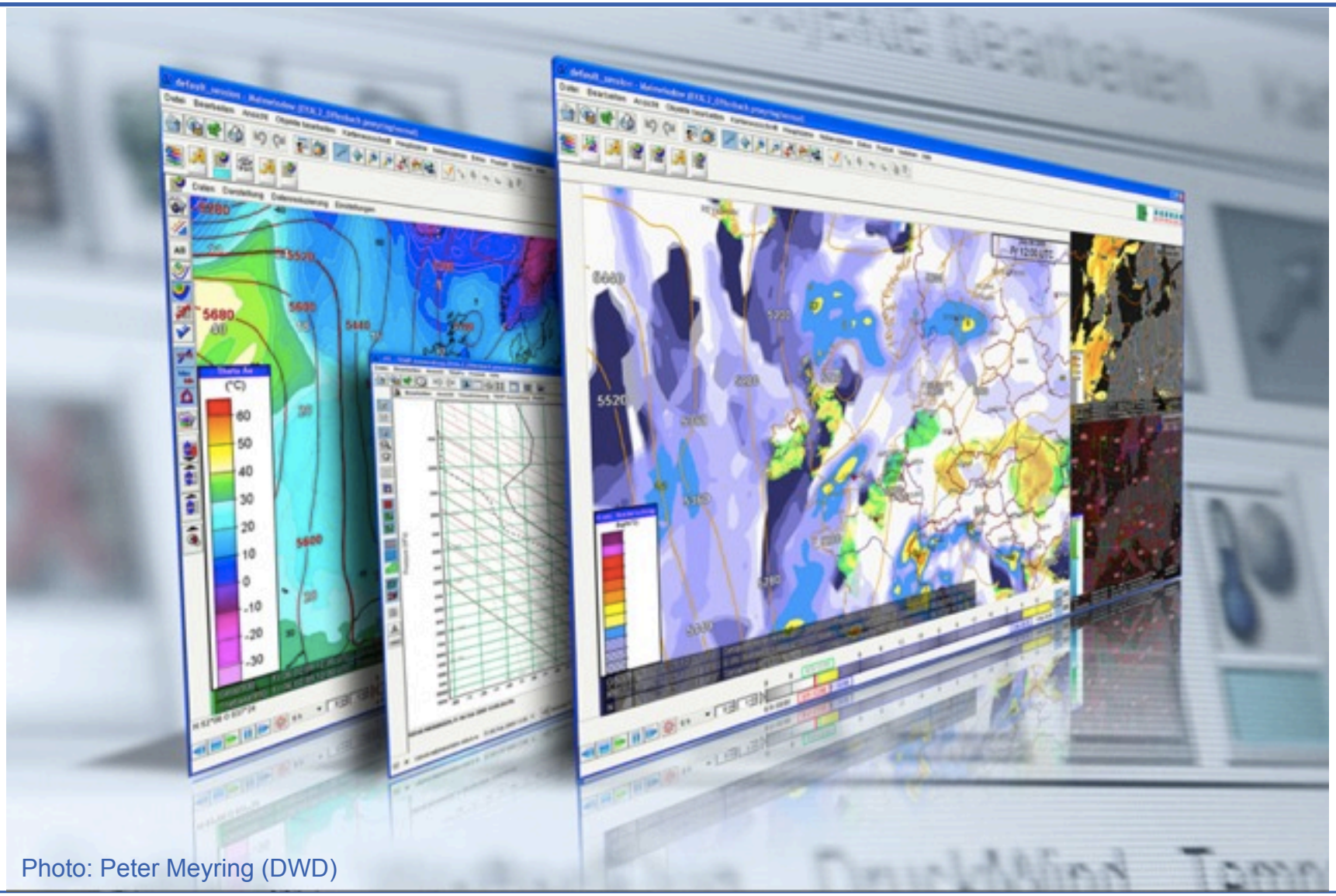


Photo: Peter Meyring (DWD)

NinJo

The NinJo Workstation Software is an ultramodern meteorological workstation system with

- multi-window technology
- layer-based visualisation of different data types
- easily integrates geographic map displays
- diagrams, such as meteograms, cross-sections and tepigrams
- animation and graphical export capabilities
- a flexible client/server architecture
- a high degree of configurability
- multi-lingual (engl/french/german)

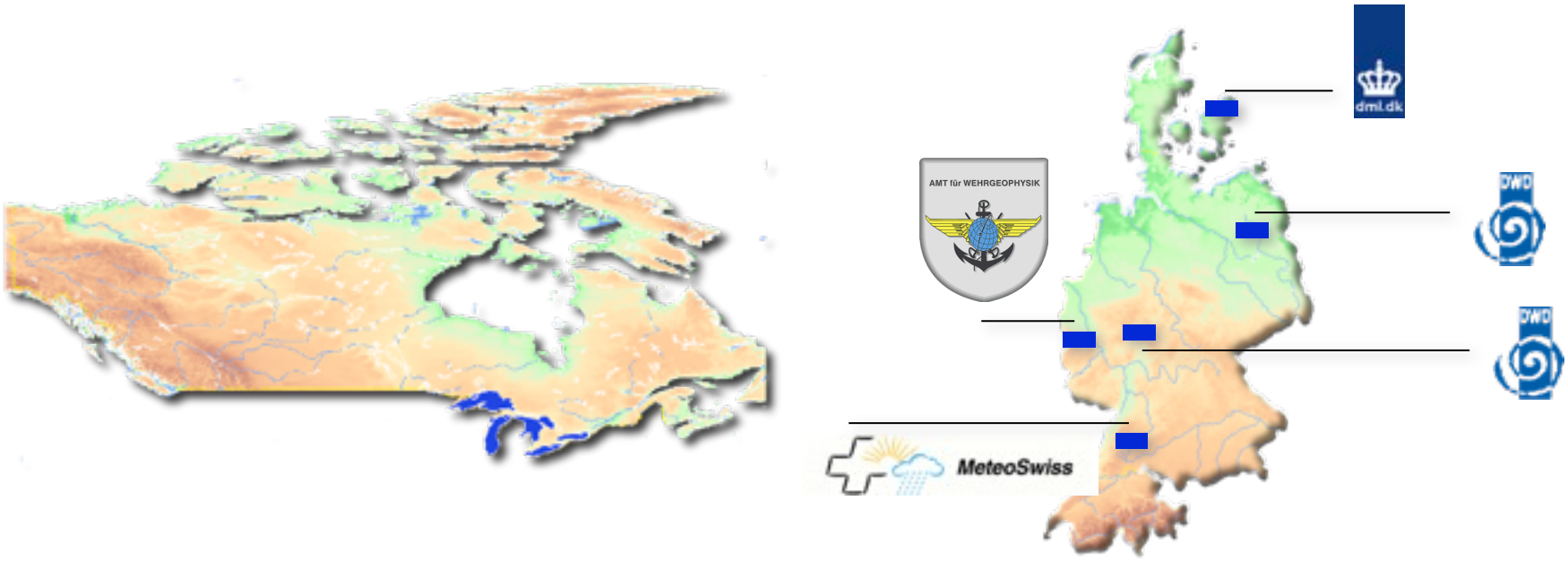
The manifold configuration and visualization possibilities turn NinJo into an excellent tool for routinely generation of forecasts and warnings.

Credit: NinJo Website

NinJo Consortium

Deutscher Wetterdienst
Wetter und Klima aus einer Hand

NinJo is the outcome of a successful international collaboration by various meteorological services with support from experienced IT companies.



Deutscher Wetterdienst
MeteoSwiss
Environment Canada
Meteorological Service of Canada
Service météorologique du Canada
Ernst Basler + Partner
sd&m
software design & management

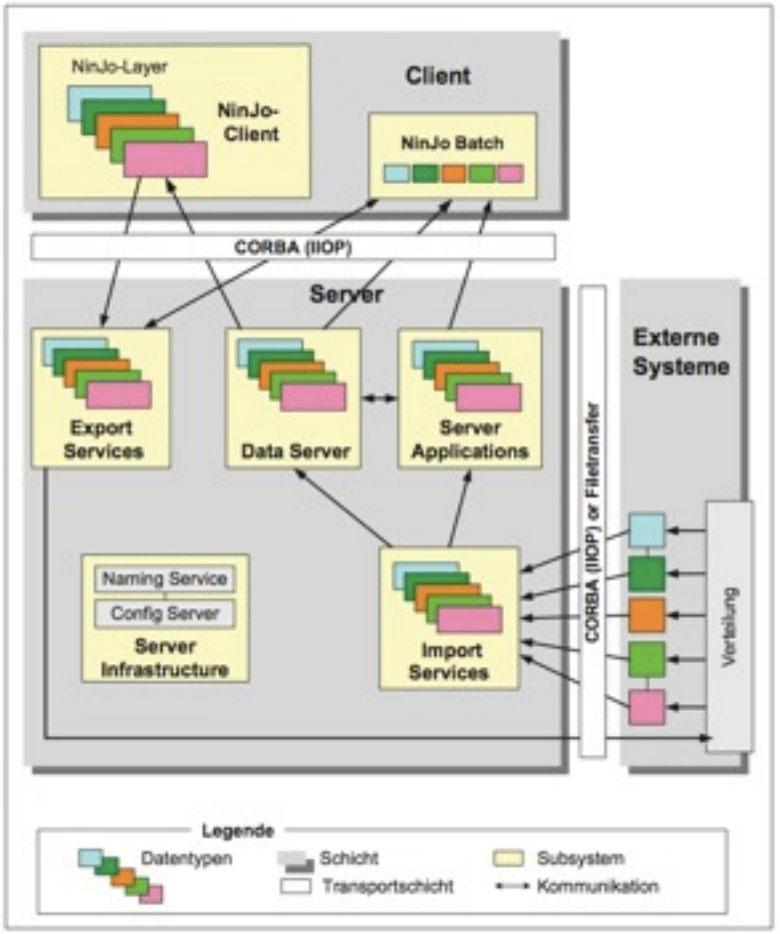
NinJo Consortium Goals

- **Improve forecasting processes**
  - Visualization (OBS, Radar, SAT, NWP, Lightning…)
  - Production (IGE, Warnings, Batch, OSA, MMO)
  - Science algorithms (AutoMon, MesoCycloneDetection,…)
- **Share resources for development and maintenance**
  - Platform independent Java technology (Linux, Windows, Web)
  - Usage of several hardware platforms (Laptops, PC)
  - Support of Thin Client and Web technology
- **Licensing of the resulting software**

  License holders: AEMET, South African Weather Service, Swedish Army, 10-20 german universities

NinJo Client-Server Architecture

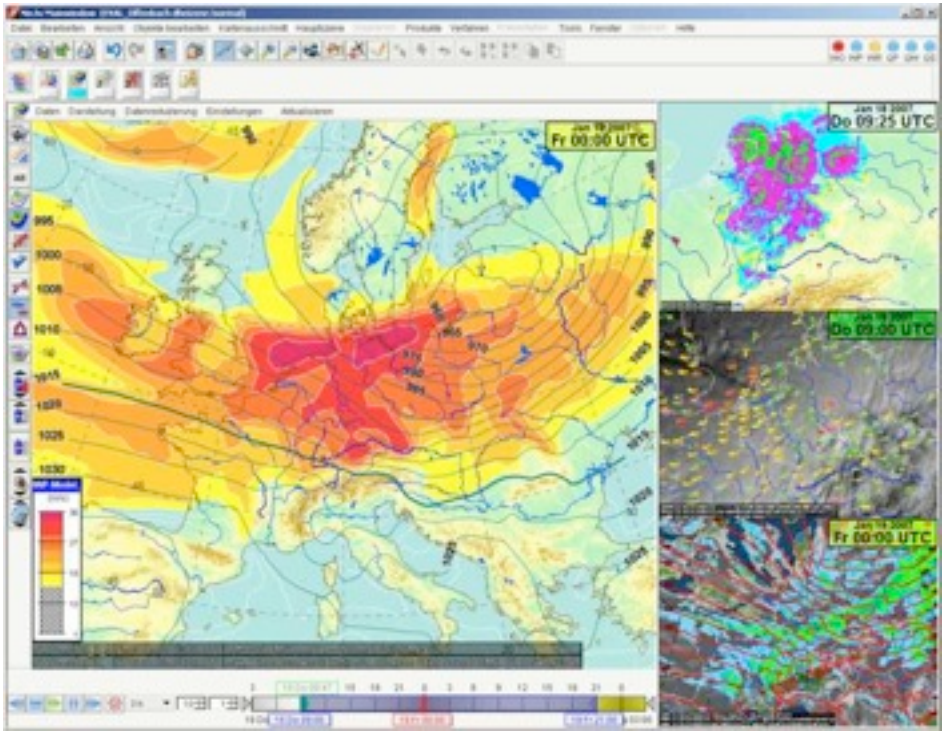
- NinJo uses a client-server architecture.
- The **NinJo server** imports the different data types and stores them.
- The **NinJo Client** is composed of different, independent layers. Each layer displays its own data. User interface.
- **NinJo Batch** allows the automated generation of raster images.



Credit: L. Bock et al. (2012): NinJo Amber-Layer

Client: Visualization Concept

Deutscher Wetterdienst
Wetter und Klima aus einer Hand



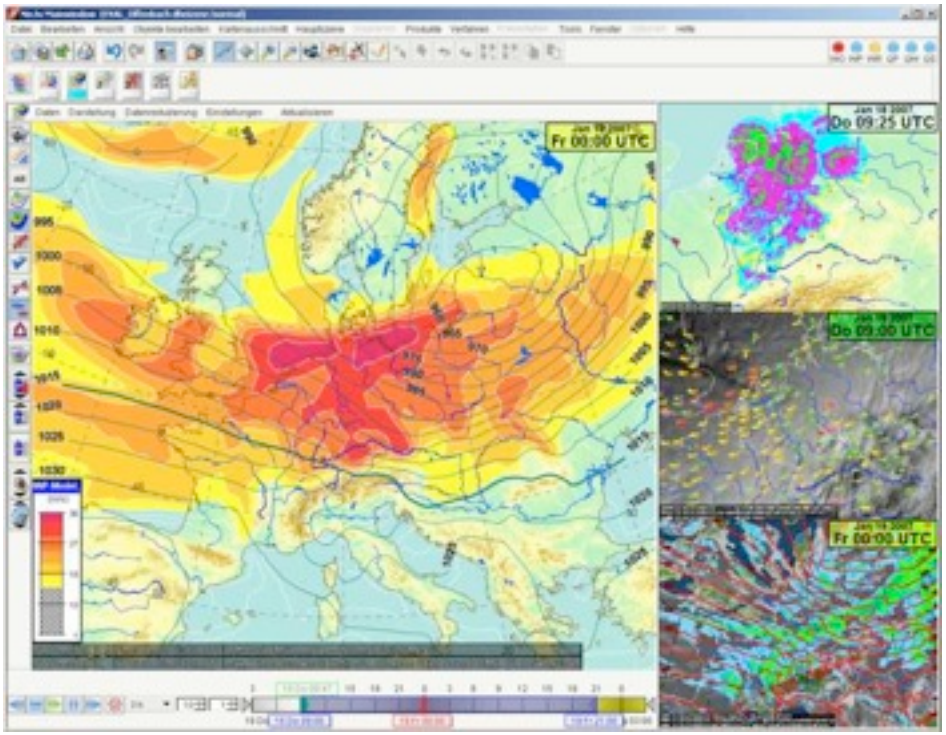
Credit: D. Heizenreder

Client: Visualization Concept

Deutscher Wetterdienst
Wetter und Klima aus einer Hand

DWD

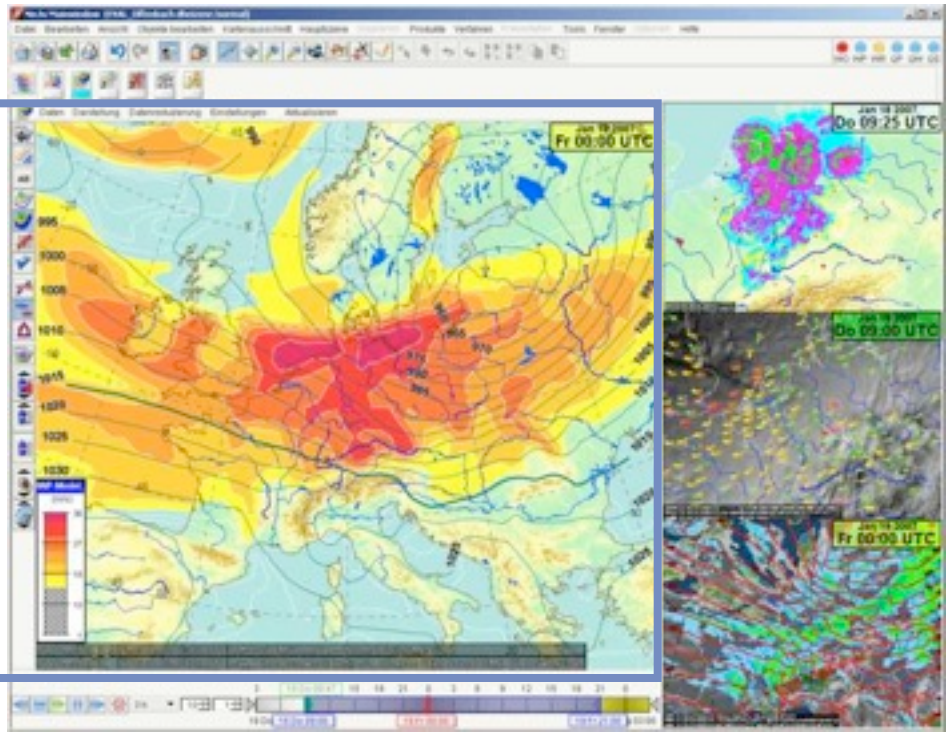
Main Window



Client: Visualization Concept

Main Window

Main scene

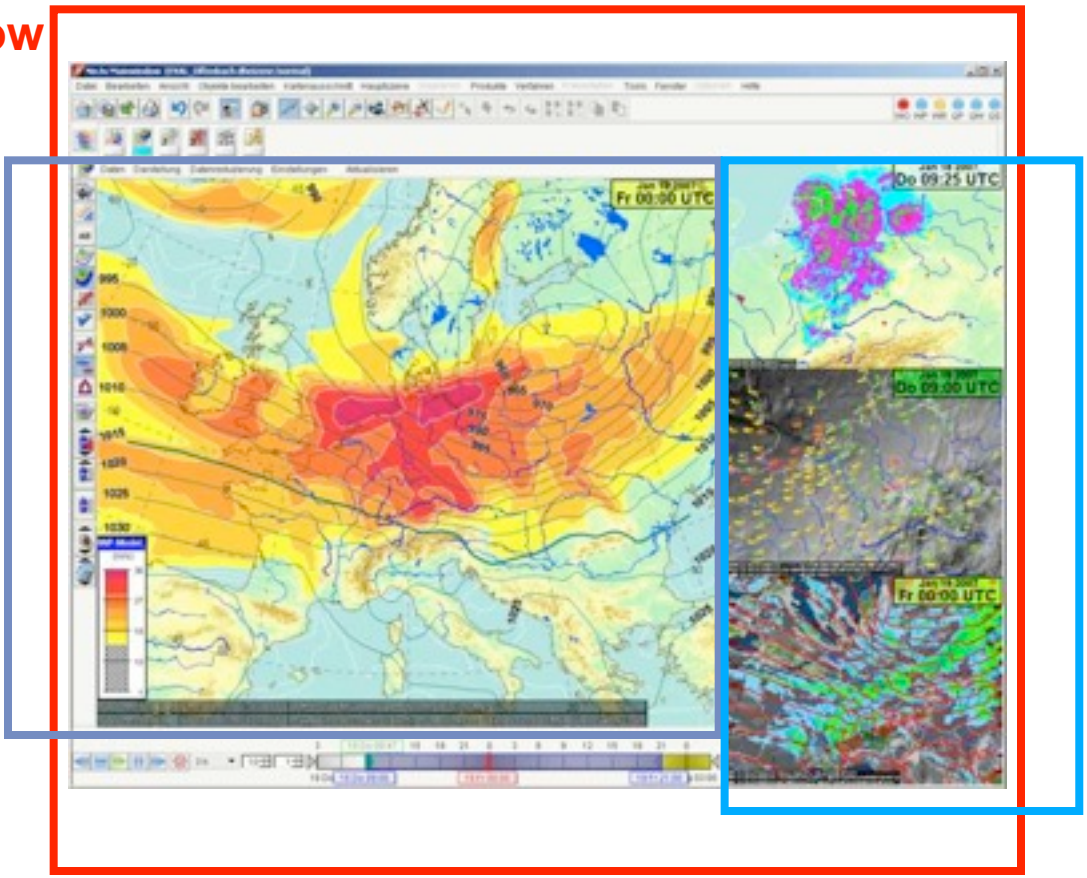


Client: Visualization Concept

Deutscher Wetterdienst
Wetter und Klima aus einer Hand

Main Window

Main scene



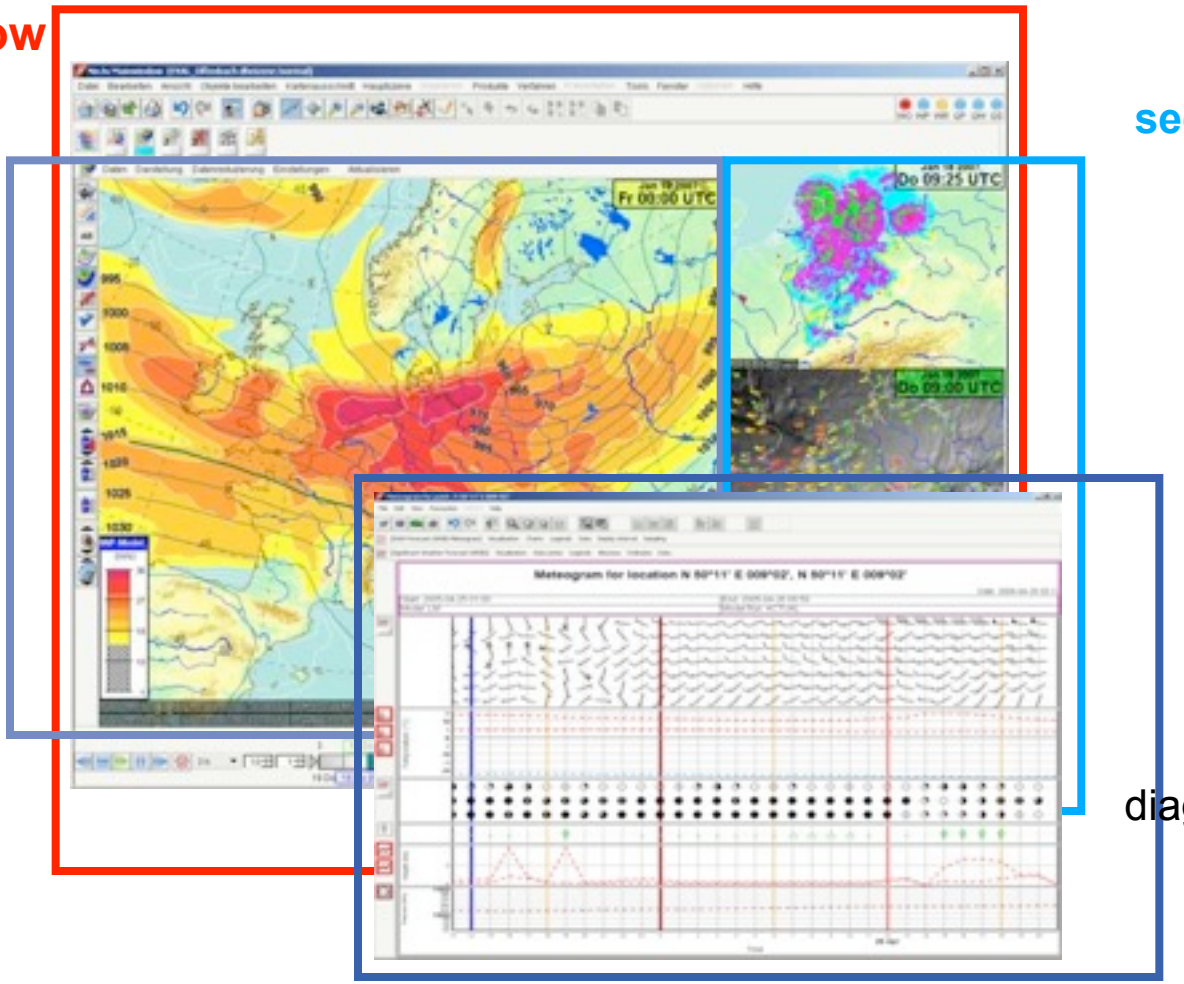
secondary scenes
up to 3,
configurable

Client: Visualization Concept

Deutscher Wetterdienst
Wetter und Klima aus einer Hand

Main Window

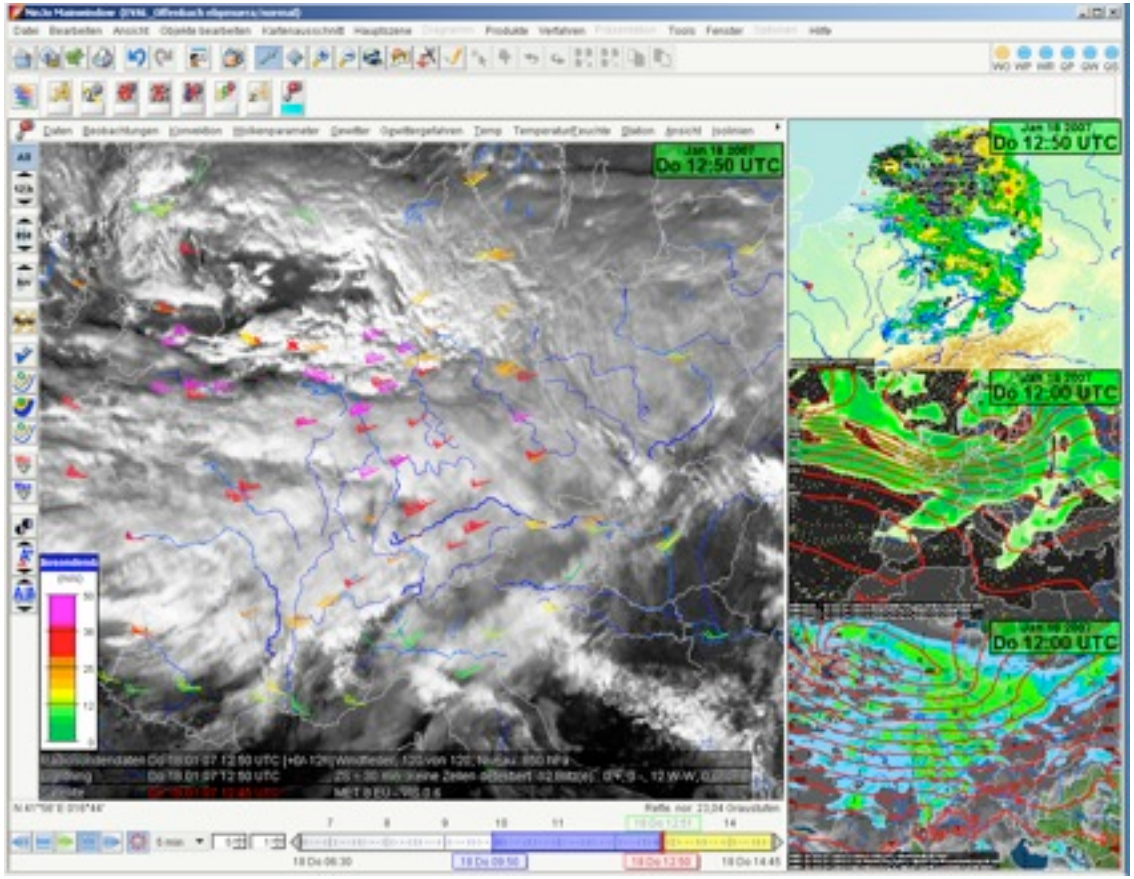
Main scene



secondary scenes
up to 3,
configurable

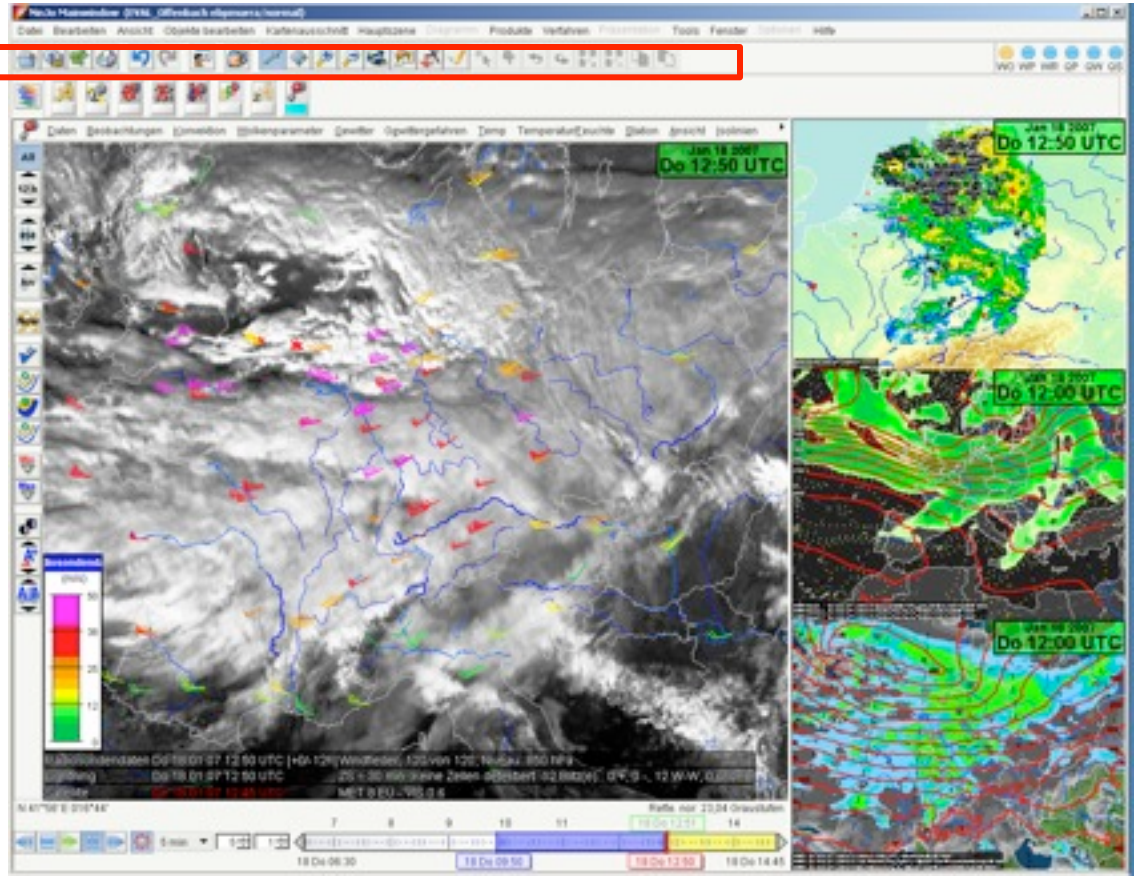
Secondary Windows
Meteograms,
CrossSections,
based on
extendable
diagram framework

Client: Visualization Concept



Client: Visualization Concept

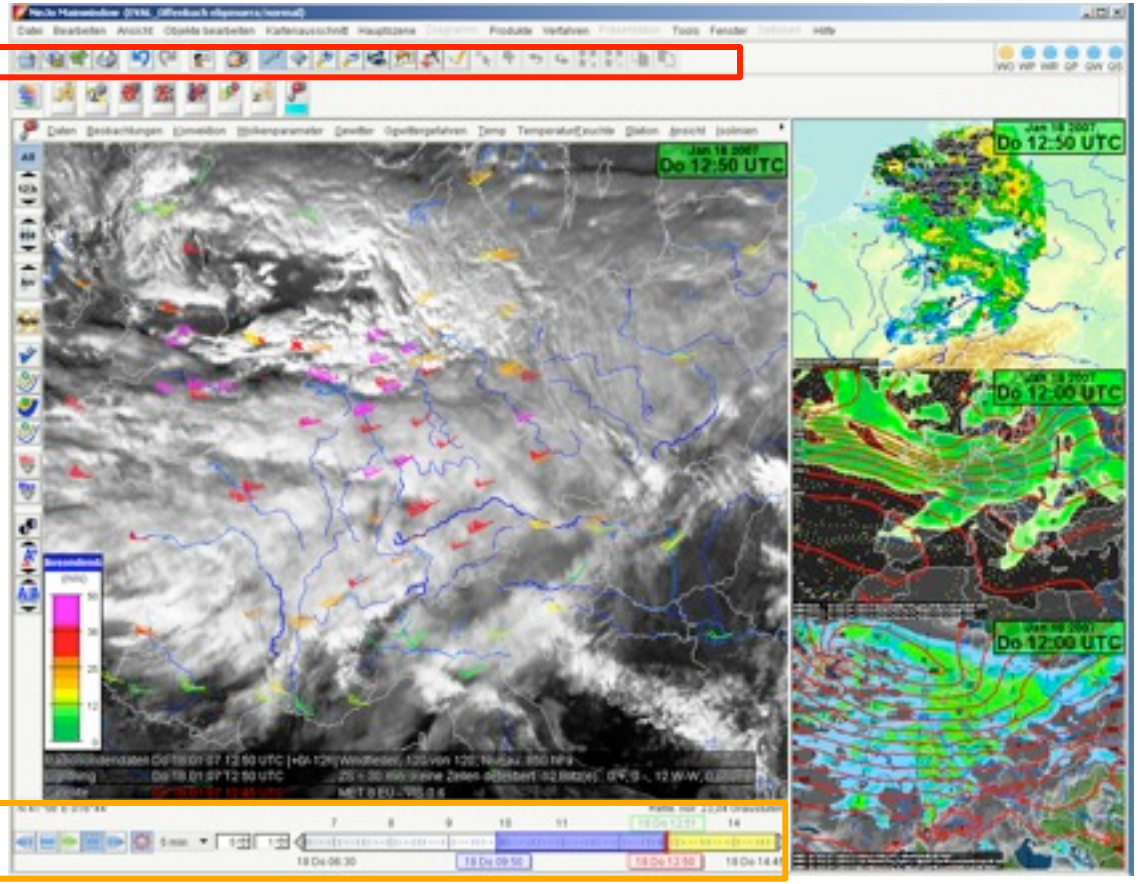
Main
Toolbar



Client: Visualization Concept

Deutscher Wetterdienst
Wetter und Klima aus einer Hand

Main
Toolbar



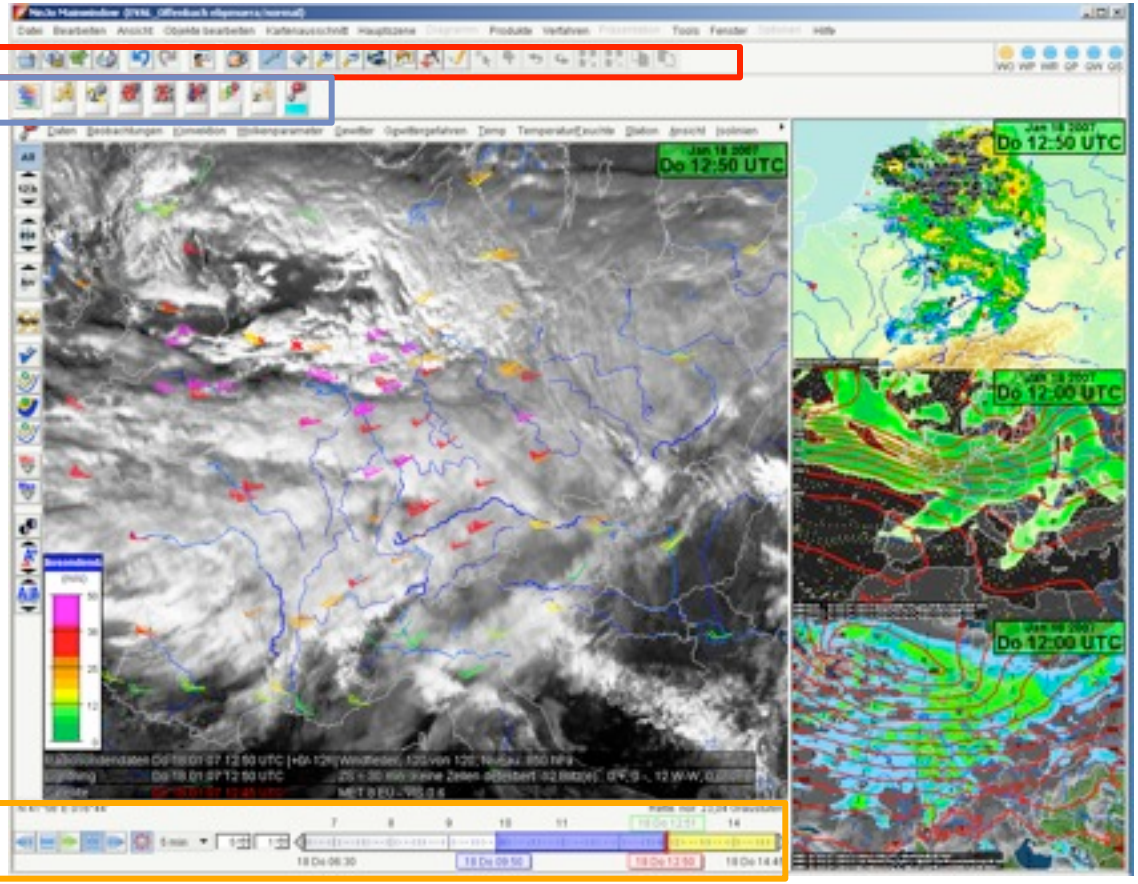
Time
Navigation

Client: Visualization Concept

Deutscher Wetterdienst
Wetter und Klima aus einer Hand

Main Toolbar

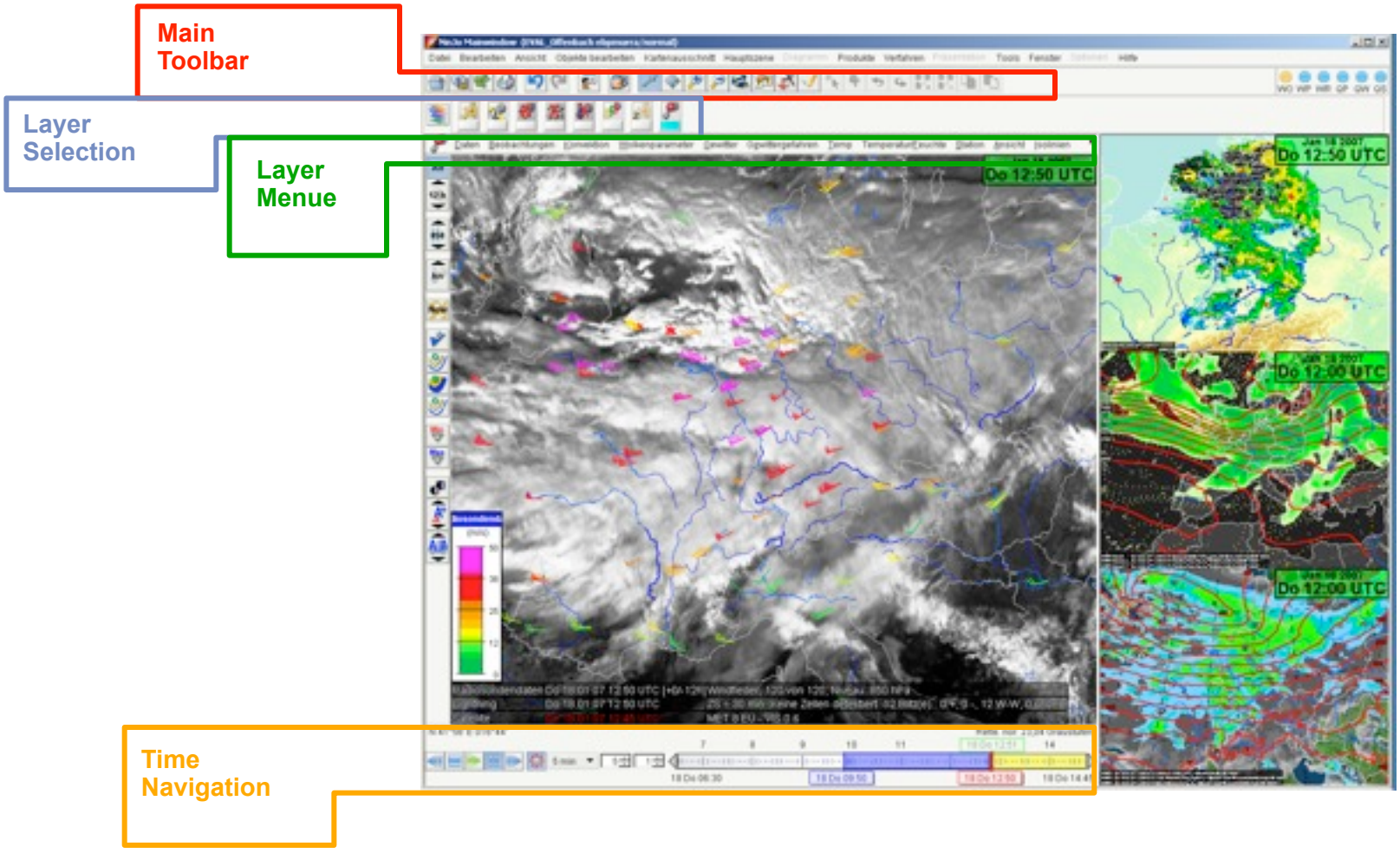
Layer Selection



Time Navigation

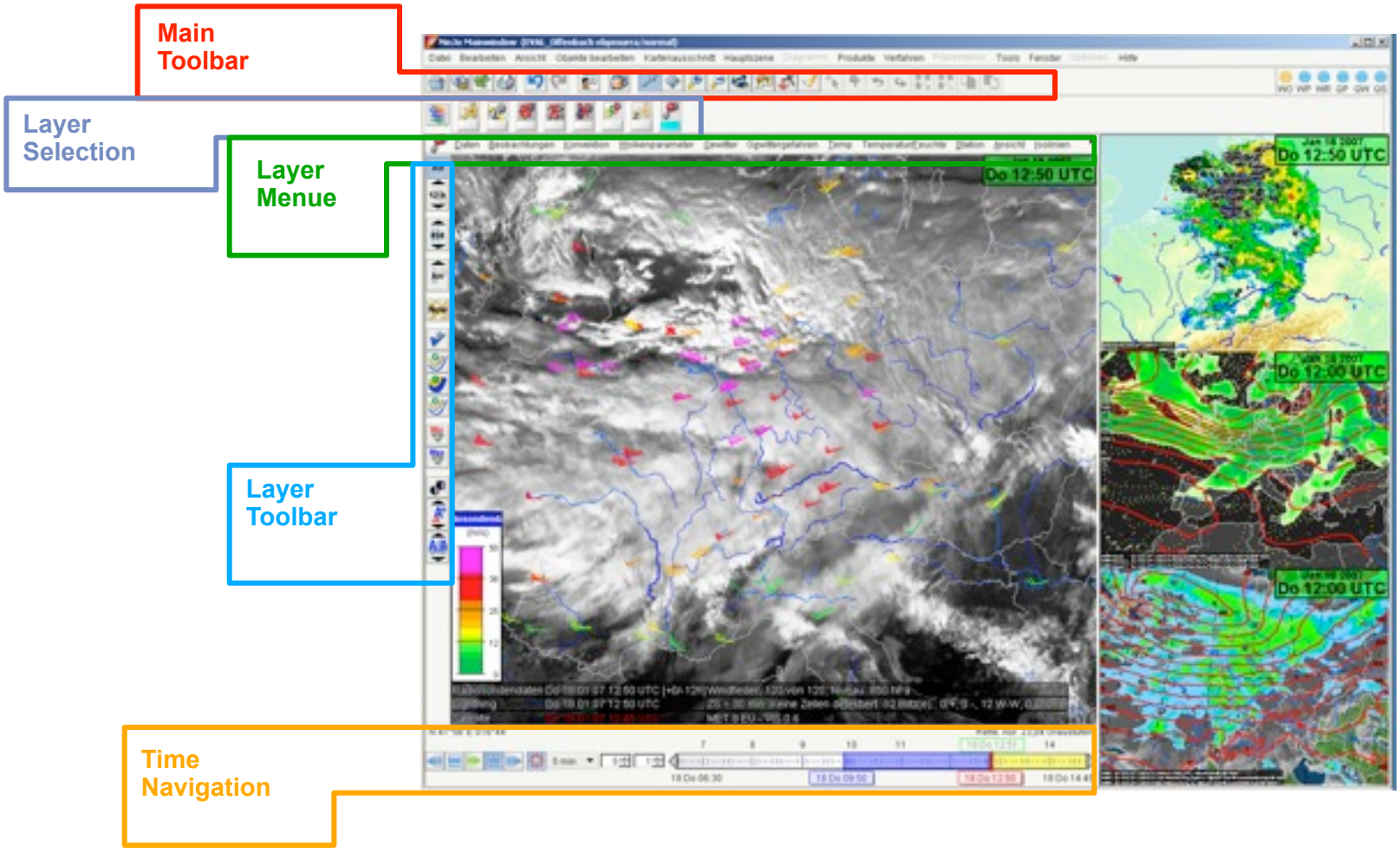
Client: Visualization Concept

Deutscher Wetterdienst
Wetter und Klima aus einer Hand

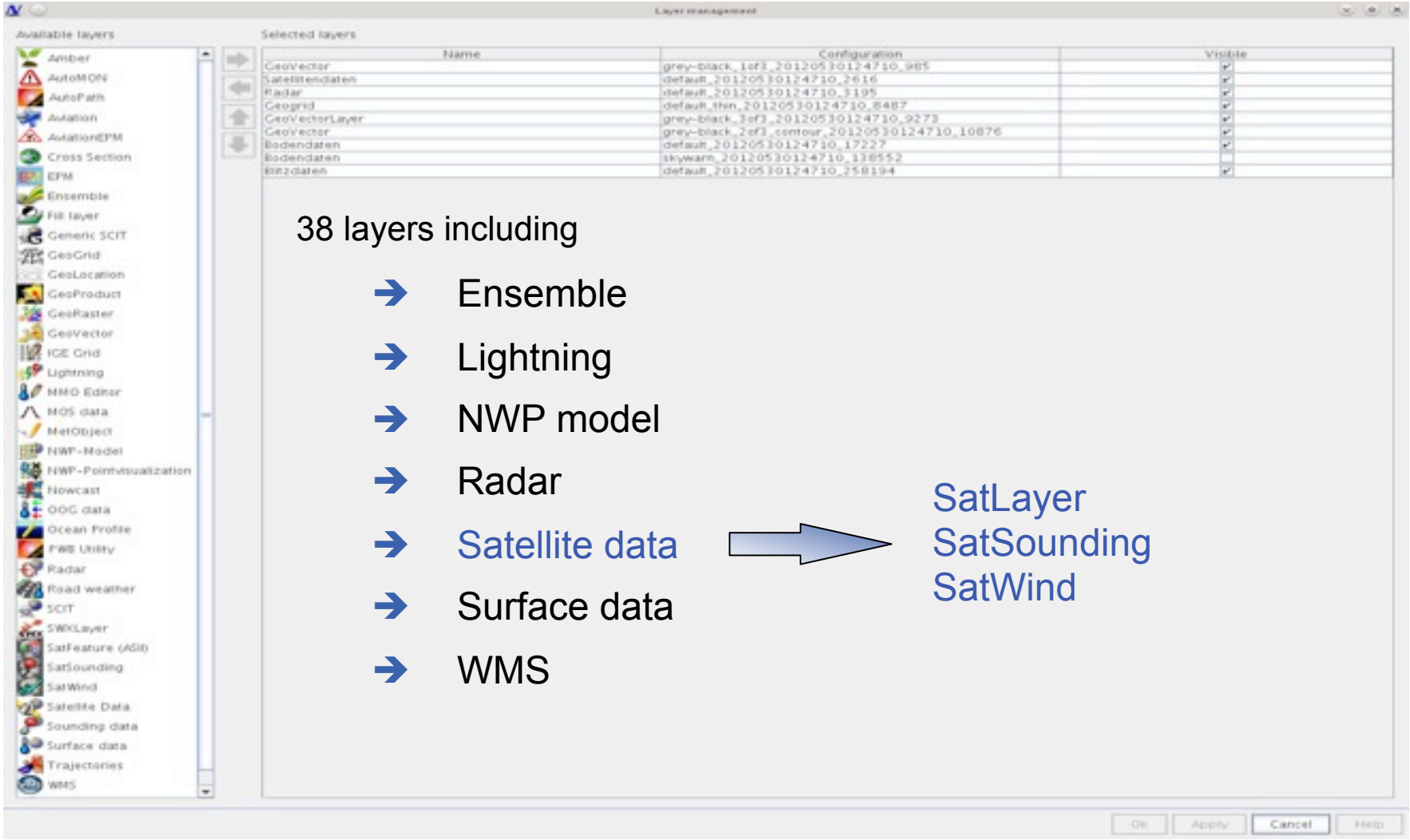


Client: Visualization Concept

Deutscher Wetterdienst
Wetter und Klima aus einer Hand



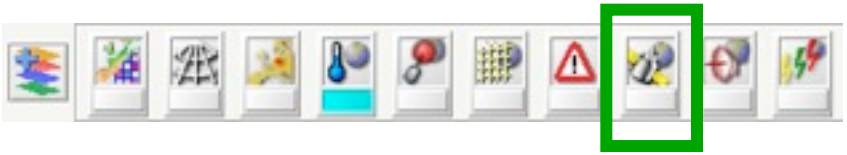
NinJo Layers



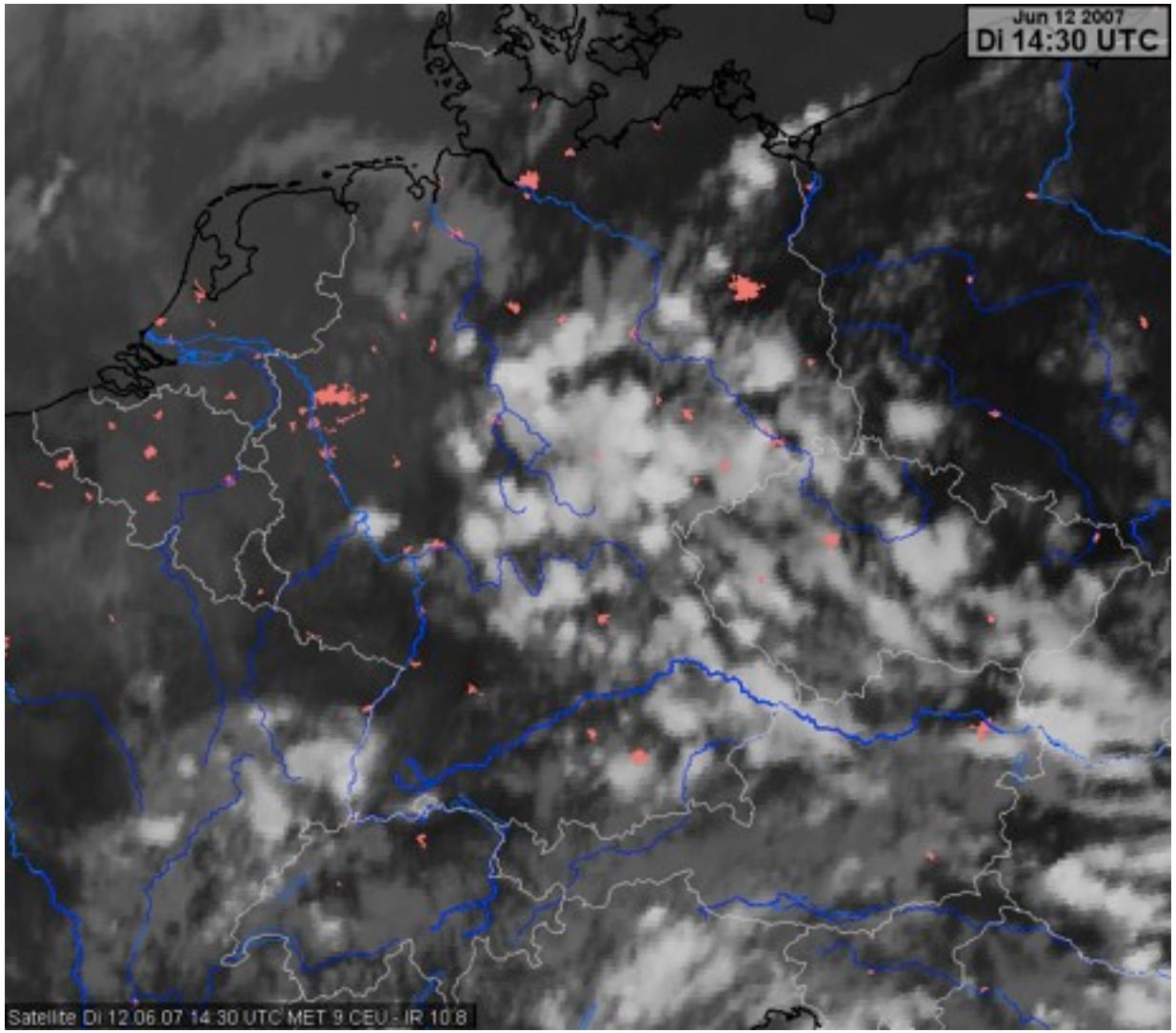
38 layers including

- ➔ Ensemble
- ➔ Lightning
- ➔ NWP model
- ➔ Radar
- ➔ Satellite data → SatLayer, SatSounding, SatWind
- ➔ Surface data
- ➔ WMS

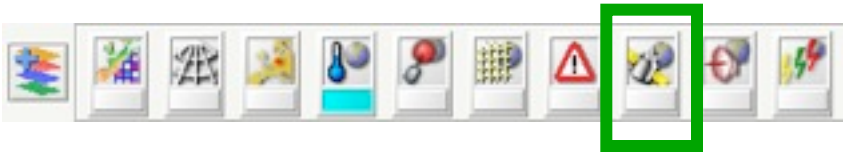
NinJo: Satellite Layer



- all requested satellites (GEO, LEO)
- all requested channels
- channel combinations
- colour composites
- SAF products
- enhancement of contrast
- configuration of colour tables



NinJo: Satellite Layer



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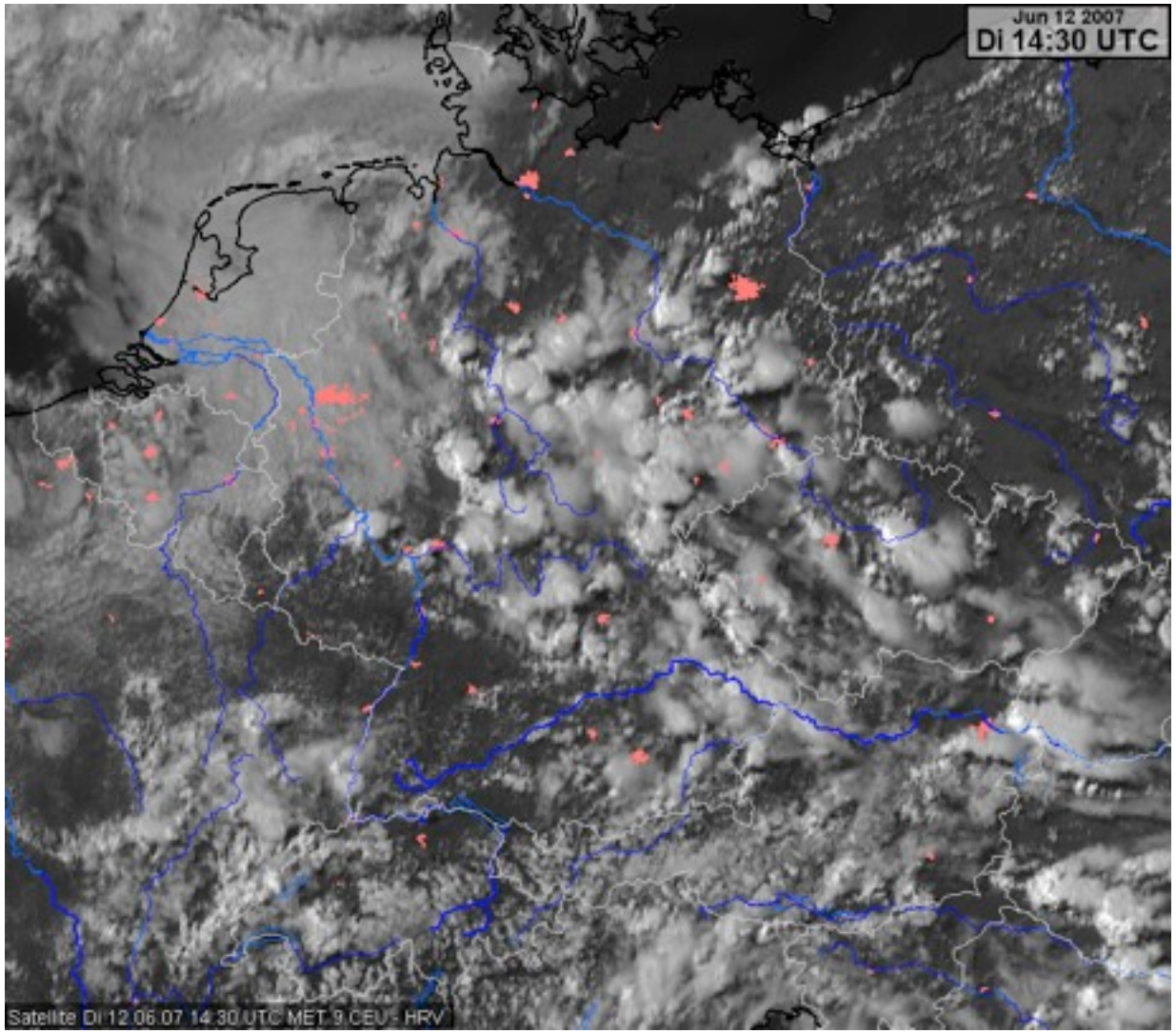

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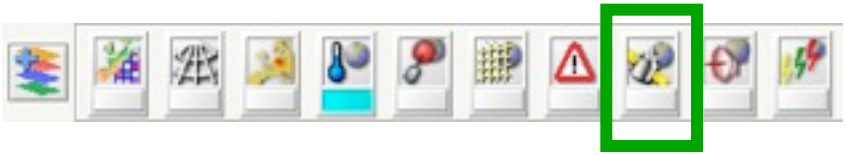

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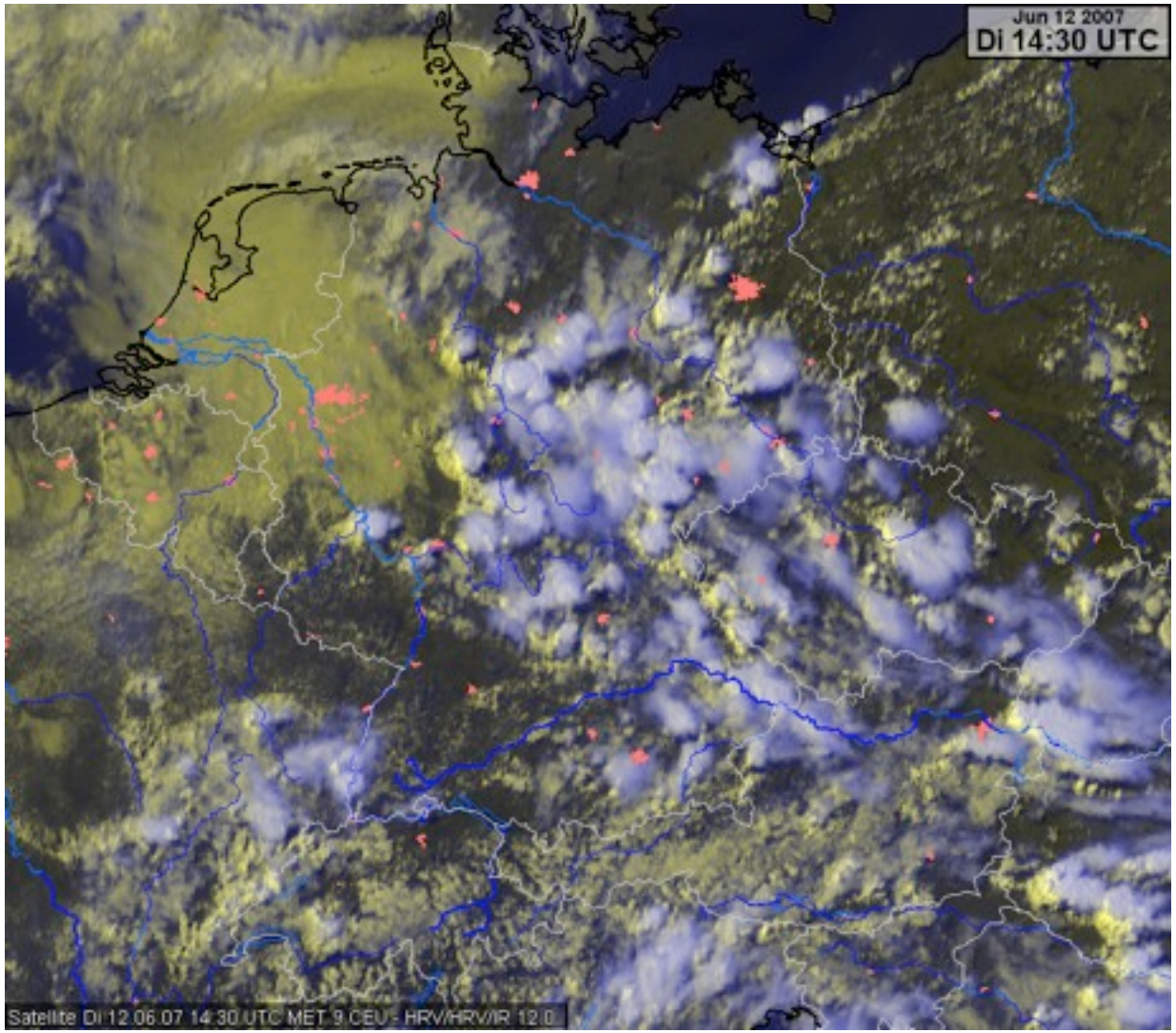

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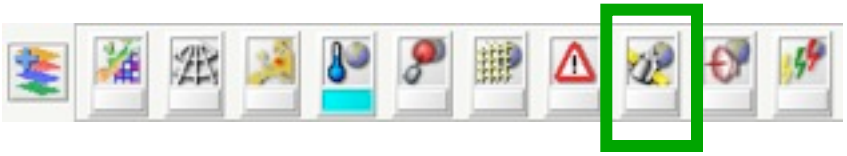

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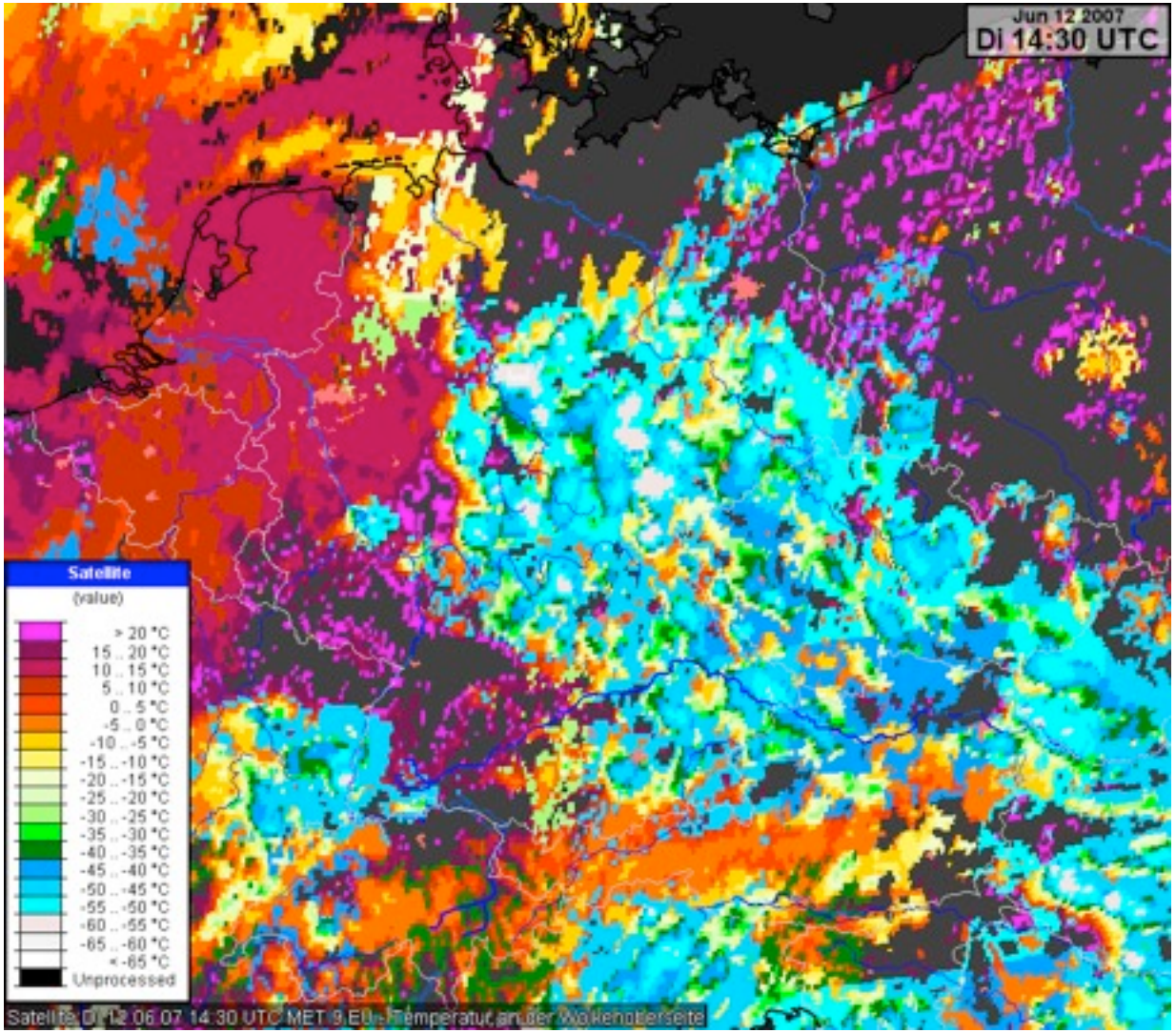
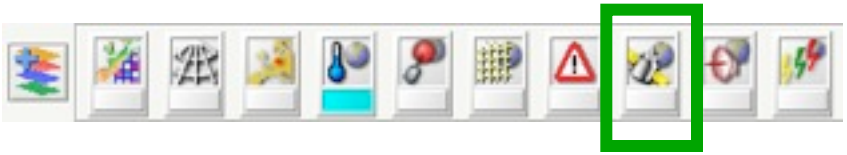


Credit: D. Heizenreder

NinJo: Satellite Layer



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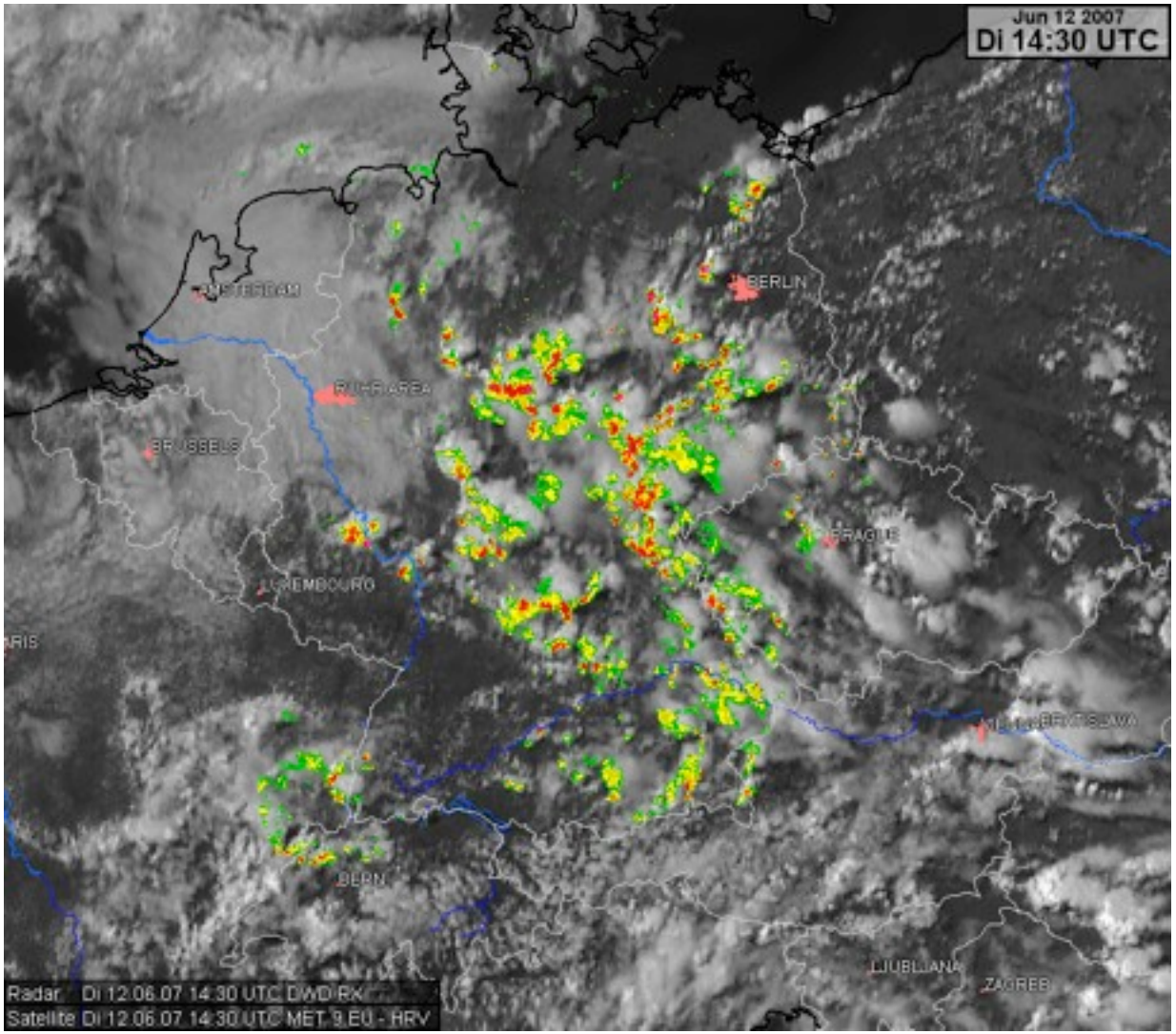

NinJo Sat import

NinJo internal format: tiled, multi-resolution tiff image with customized tags

- **tiff images with NinJo-TIFF-Tags (DWD, DMI)**
  - image itself contains all GEO and NinJo information
  - no conversion needed; customized tags must be written

- **tiff images without NinJo-TIFF-Tags (Environmental Canada)**
  - images include all GEO information (lat, lon, projection, scaling)
  - NinJo data (channel, region) are taken from the file name

- **png and jpeg images with header (BGIS, MCH)**
  - all information provided as string in comment field
  - smaller file size

The NinJo configuration allows the usage of several readers in parallel.

Required Customized Tags

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DWD

No	Name	Object	Content	Definition
33922	**reference_point**	reference_point	[-180..180,-90..90]	upper left corner of the image
33550	**pixel_resolution**	ModelPixelScale		resolution of one pixel (x,y) in lambda/phi
40001	**satellite_name_ID**	SatelliteName ID	long	see **APPENDIX A**
40002	**date_ID**	DateID	long	date in milliseconds since 1970
40003	creation_date_ID	CreationDateID	long	creation date in milliseconds since 1970
40004	**channel_ID**	ChannelID	long	see **APPENDIX B**
40005	headerversion_number	HeaderVersion	0-99	version no. of the header
40006	filename	FileName	String	name of the Satellite image file
40007	data_type_code	DataType	d1: P,G; d2: O,P,.....	Polar, Geostat, Original, Product, Raster, Bufr, ASCII, NIL
40008	number_of_satellite	SatelliteNumber	String	7, 11, F1C
40009	colordepth	ColorDepth	8/16/24/32	Number of bits per pixel
40011	**Xmin**	XMinimum	0-999999	no. of the first column (starting right)
40012	**Xmax**	XMaximum	0-999999	no. of the last column
40013	**Ymin**	YMinimum	0-999999	no. of the first line (starting at the bottom)
40014	**Ymax**	YMaximum	0-999999	no. of the last line
40015	**projection code**	Projection	NPOL,SPOL,PLAT	polar-sterographic North/South, platte carée
40024	**physical_value**	PhysicValue	String	eg. temperature, albedo, ...
40025	**physical_unit**	PhysicUnit	String	Kelvin, Celsius, %, ...
40026	min_gray_value	MinGrayValue	0-255	Minimum gray value
40027	max_gray_value	MaxGrayValue	0-255	Maximum gray value
40028	**gradient**	Gradient		Slope (ie gradient)
40029	**axis_intercept**	AxisIntercept		Axis intercept

Example Tags

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satellite_name_ID (40001)

ID	Name
100014	METEOSAT 1
200014	METEOSAT 2
300014	METEOSAT 3
400014	METEOSAT 4
500014	METEOSAT 5
600014	METEOSAT 6
700014	METEOSAT 7
800014	METEOSAT 8
900014	METEOSAT 9
1000014	IODC
1100014	GOES 11
1200014	GOES 12
1300014	GMS
1400014	NOAA 1
1500014	NOAA 2
1600014	NOAA 3
1700014	NOAA 4
1800014	NOAA 5
1900014	NOAA 6
2000014	NOAA 7
2100014	NOAA 8
2200014	NOAA 9
2300014	NOAA 10
2400014	NOAA 11
2500014	NOAA 12
2600014	NOAA 14
2700014	NOAA 15
2800014	NOAA 16
2900014	NOAA 17
3000014	NOAA 18
3100014	FENGYUN 1C
3200014	FENGYUN 1D
3300014	FENGYUN 1E
3400014	MODIS terra
3500014	MODIS aqua

channel_ID (40004)

ID	Name
100015	VIS 0.6
200015	VIS 0.8
300015	IR 1.6
400015	IR 3.9
500015	WV 6.2
600015	WV 7.3
700015	IR 8.7
800015	IR 9.7
900015	IR 10.8
1000015	IR 12.0
1100015	IR 13.4
1200015	HRV
1300015	Infrared
1400015	Visible
1500015	Water Vapor
1600015	IR 3.7
1700015	Cloud type
1800015	Cloud cover
1900015	Cloud top height
2000015	Cloud top temperature
2100015	Precipitating clouds: light to moderate
2200015	Precipitating clouds: strong
2300015	Convective rain rate
2400015	Total precipitable water
2500015	Layer precipitable water (upper layer)
2600015	Layer precipitable water (mid layer)
2700015	Layer precipitable water (low layer)
2800015	Stability analysis imagery
2900015	Airmass analysis
3000015	Cloud Contour Plot
3100015	Cloud Development Mask
3200015	Extrapolated Images
3300015	Icing Conditions
3400015	Snow Cover Analysis

How does a tiff file look like?

Deutscher Wetterdienst
Wetter und Klima aus einer Hand

DWD

Page 1 VIS

Image Width: 3000 Image Length: 4000
Tile Width: 512 Tile Length: 512
Bits/Sample: 8
Sample Format: unsigned integer
Compression Scheme: LZW
Photometric Interpretation: palette color (RGB from colormap)
Orientation: row 0 top, col 0 lhs
Samples/Pixel: 1
SMin Sample Value: 0
SMax Sample Value: 255
Planar Configuration: single image plane
Color Map: (present)
Tag 33550: 0.003600,0.003600
Tag 33922: 0.000000,0.000000,0.000000,-2.000000,56.000000,0.000000
Tag 40000: NINJO
Tag 40001: 8600014
Tag 40002: 1341142898
Tag 40003: 1362604029
Tag 40004: 14800015
Tag 40005: 2
Tag 40006: npp_viirs_i_01_20120701_114138_dwd_germany.tif
Tag 40007: PORN
Tag 40008:
Tag 40009: 8
Tag 40010: SSEC
Tag 40011: 1
Tag 40012: 3000
Tag 40013: 1
Tag 40014: 4000
Tag 40015: NPOL
Tag 40016: 0.000000
Tag 40017: 0.000000
Tag 40018: 6370000.000000
Tag 40019: 6370000.000000
Tag 40020:
Tag 40021: 60.000000
Tag 40023: 10.000000
Tag 40024: ALBEDO
Tag 40025: %
Tag 40026: 0
Tag 40027: 255
Tag 40028: 0.490196
Tag 40029: 0.000000
Tag 40035: 0.000000
Tag 40041: 0
Tag 40042: 1
Tag 40043: 0

Page 2 VIS

Image Width: 1500 Image Length: 2000
Tile Width: 512 Tile Length: 512
Bits/Sample: 8
Sample Format: unsigned integer
Compression Scheme: LZW
Photometric Interpretation: palette color (RGB from colormap)
Orientation: row 0 top, col 0 lhs
Samples/Pixel: 1
SMin Sample Value: 0
SMax Sample Value: 255
Planar Configuration: single image plane
Color Map: (present)
Tag 33550: 0.007200,0.007200
Tag 33922: 0.000000,0.000000,0.000000,-2.000000,56.000000,0.000000
Tag 40000: NINJO
Tag 40001: 8600014
Tag 40002: 1341142898
Tag 40003: 1362604029
Tag 40004: 14800015
Tag 40005: 2
Tag 40006: npp_viirs_i_01_20120701_114138_dwd_germany.tif
Tag 40007: PORN
Tag 40008:
Tag 40009: 8
Tag 40010: SSEC
Tag 40011: 1
Tag 40012: 1500
Tag 40013: 1
Tag 40014: 2000
Tag 40015: NPOL
Tag 40016: 0.000000
Tag 40017: 0.000000
Tag 40018: 6370000.000000
Tag 40019: 6370000.000000
Tag 40020:
Tag 40021: 60.000000
Tag 40023: 10.000000
Tag 40024: ALBEDO
Tag 40025: %
Tag 40026: 0
Tag 40027: 255
Tag 40028: 0.490196
Tag 40029: 0.000000
Tag 40035: 0.000000
Tag 40041: 0
Tag 40042: 1
Tag 40043: 0

How does a tiff file look like?

Deutscher Wetterdienst
Wetter und Klima aus einer Hand

Page 1 **VIS**

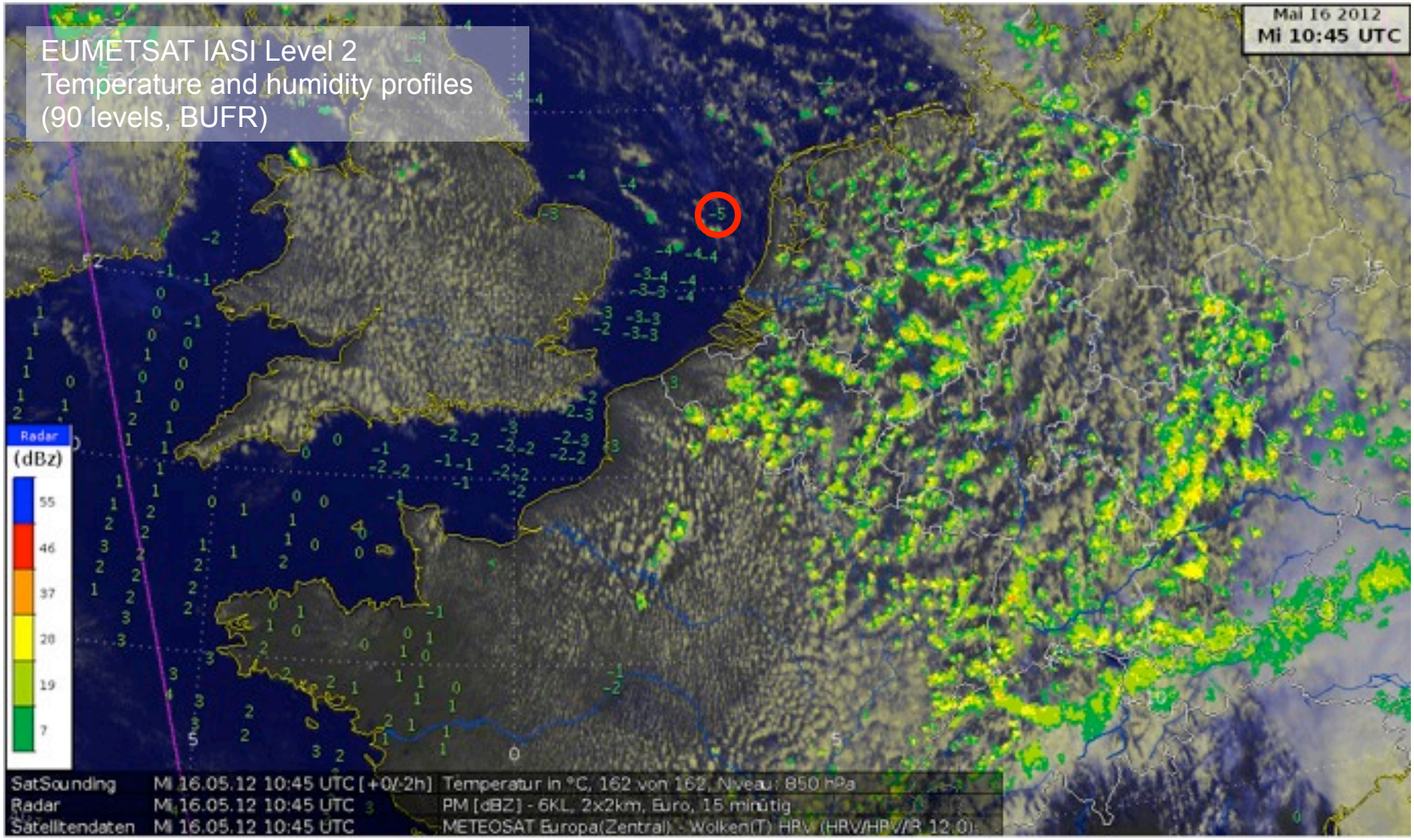
Image Width: 3000 Image Length: 4000
Tile Width: 512 Tile Length: 512
Bits/Sample: 8
Sample Format: unsigned integer
Compression Scheme: LZW
Photometric Interpretation: palette color (RGB from colormap)
Orientation: row 0 top, col 0 lhs
Samples/Pixel: 1
SMin Sample Value: 0
SMax Sample Value: 255
Planar Configuration: single image plane
Color Map: (present)
Tag 33550: 0.003600,0.003600
Tag 33922: 0.000000,0.000000,0.000000,-2.000000,56.000000,0.000000
Tag 40000: NINJO
Tag 40001: 8600014
Tag 40002: 1341142898
Tag 40003: 1362604029
Tag 40004: 14800015
Tag 40005: 2
Tag 40006: npp_viirs_i_01_20120701_114138_dwd_germany.tif
Tag 40007: PORN
Tag 40008:
Tag 40009: 8
Tag 40010: SSEC
Tag 40011: 1
Tag 40012: 3000
Tag 40013: 1
Tag 40014: 4000
Tag 40015: NPOL
Tag 40016: 0.000000
Tag 40017: 0.000000
Tag 40018: 6370000.000000
Tag 40019: 6370000.000000
Tag 40020:
Tag 40021: 60.000000
Tag 40023: 10.000000
Tag 40024: ALBEDO
Tag 40025: %
Tag 40026: 0
Tag 40027: 255
Tag 40028: 0.490196
Tag 40029: 0.000000
Tag 40035: 0.000000
Tag 40041: 0
Tag 40042: 1
Tag 40043: 0

Page 1 **IR**

Image Width: 3000 Image Length: 4000
Tile Width: 512 Tile Length: 512
Bits/Sample: 8
Sample Format: unsigned integer
Compression Scheme: LZW
Photometric Interpretation: palette color (RGB from colormap)
Orientation: row 0 top, col 0 lhs
Samples/Pixel: 1
SMin Sample Value: 0
SMax Sample Value: 255
Planar Configuration: single image plane
Color Map: (present)
Tag 33550: 0.003600,0.003600
Tag 33922: 0.000000,0.000000,0.000000,-2.000000,56.000000,0.000000
Tag 40000: NINJO
Tag 40001: 8600014
Tag 40002: 1341142898
Tag 40003: 1362604029
Tag 40004: 16100015
Tag 40005: 2
Tag 40006: npp_viirs_i_05_20120701_114138_dwd_germany.tif
Tag 40007: PORN
Tag 40008:
Tag 40009: 8
Tag 40010: SSEC
Tag 40011: 1
Tag 40012: 3000
Tag 40013: 1
Tag 40014: 4000
Tag 40015: NPOL
Tag 40016: 0.000000
Tag 40017: 0.000000
Tag 40018: 6370000.000000
Tag 40019: 6370000.000000
Tag 40020:
Tag 40021: 60.000000
Tag 40023: 10.000000
Tag 40024: T
Tag 40025: CELSIUS
Tag 40026: 0
Tag 40027: 255
Tag 40028: -0.500000
Tag 40029: 40.000000
Tag 40035: 0.000000
Tag 40041: 0
Tag 40042: 1
Tag 40043: 0

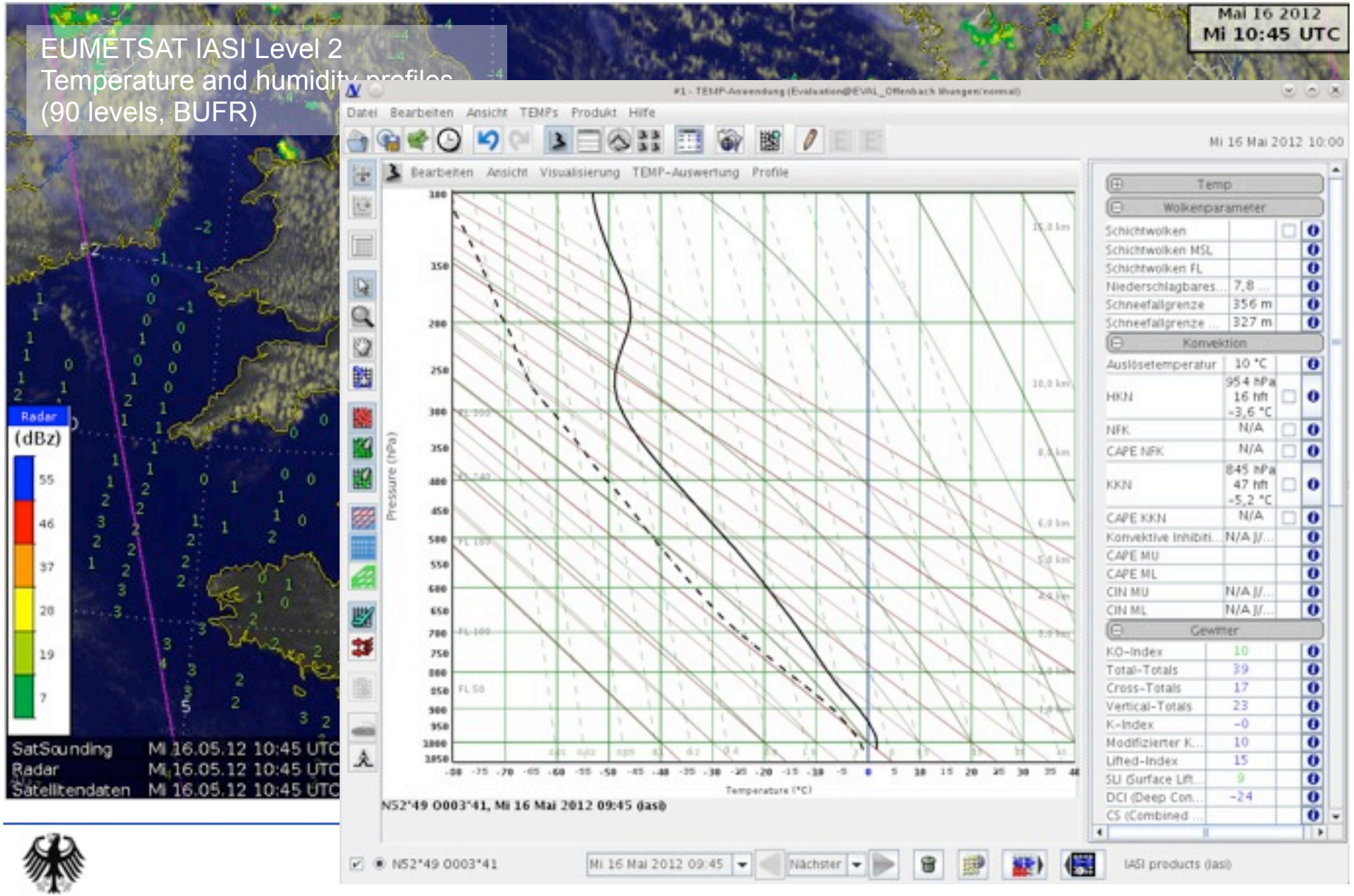
NinJo: SatSounding Layer

Deutscher Wetterdienst
Wetter und Klima aus einer Hand



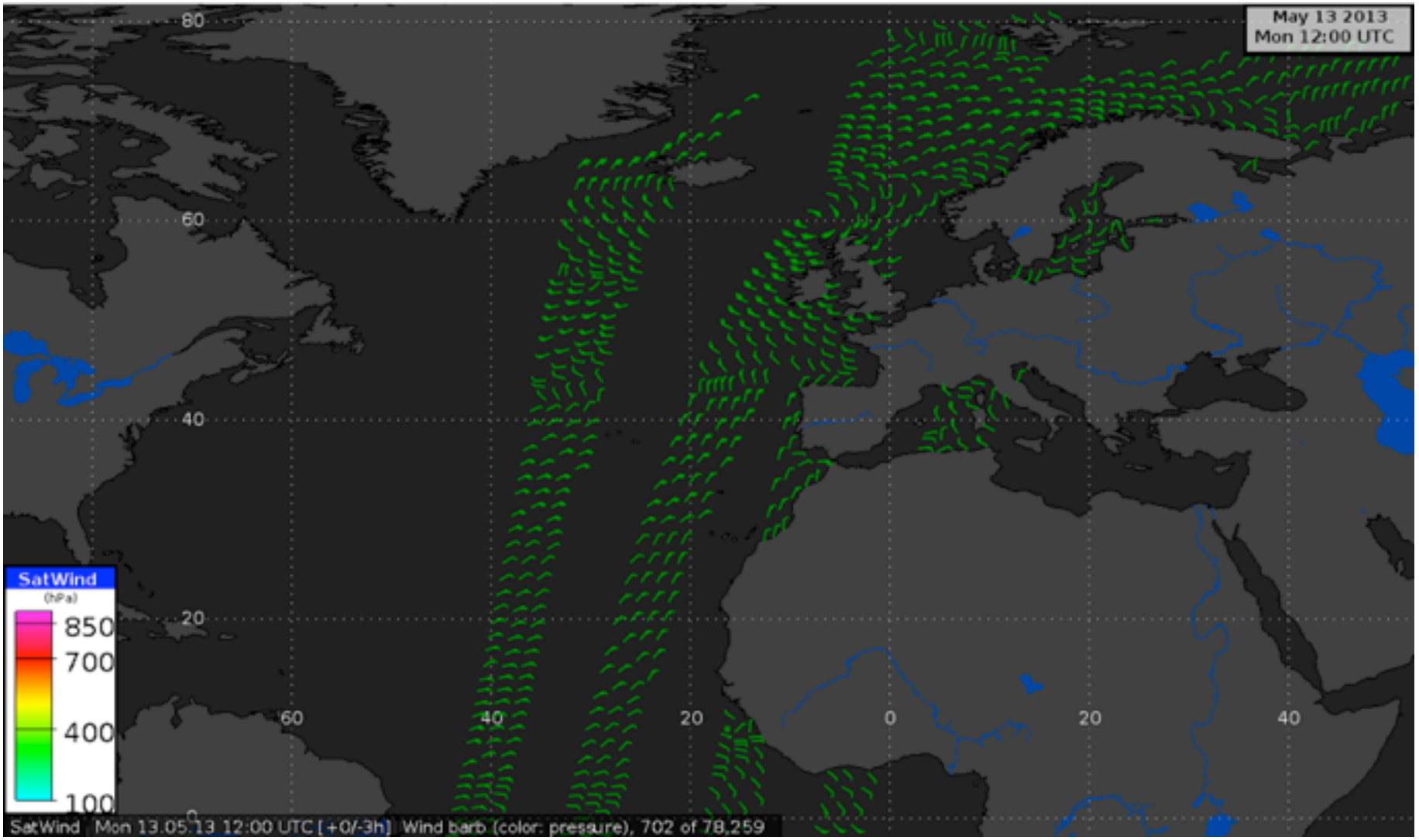
NinJo: SatSounding Layer

Deutscher Wetterdienst
Wetter und Klima aus einer Hand



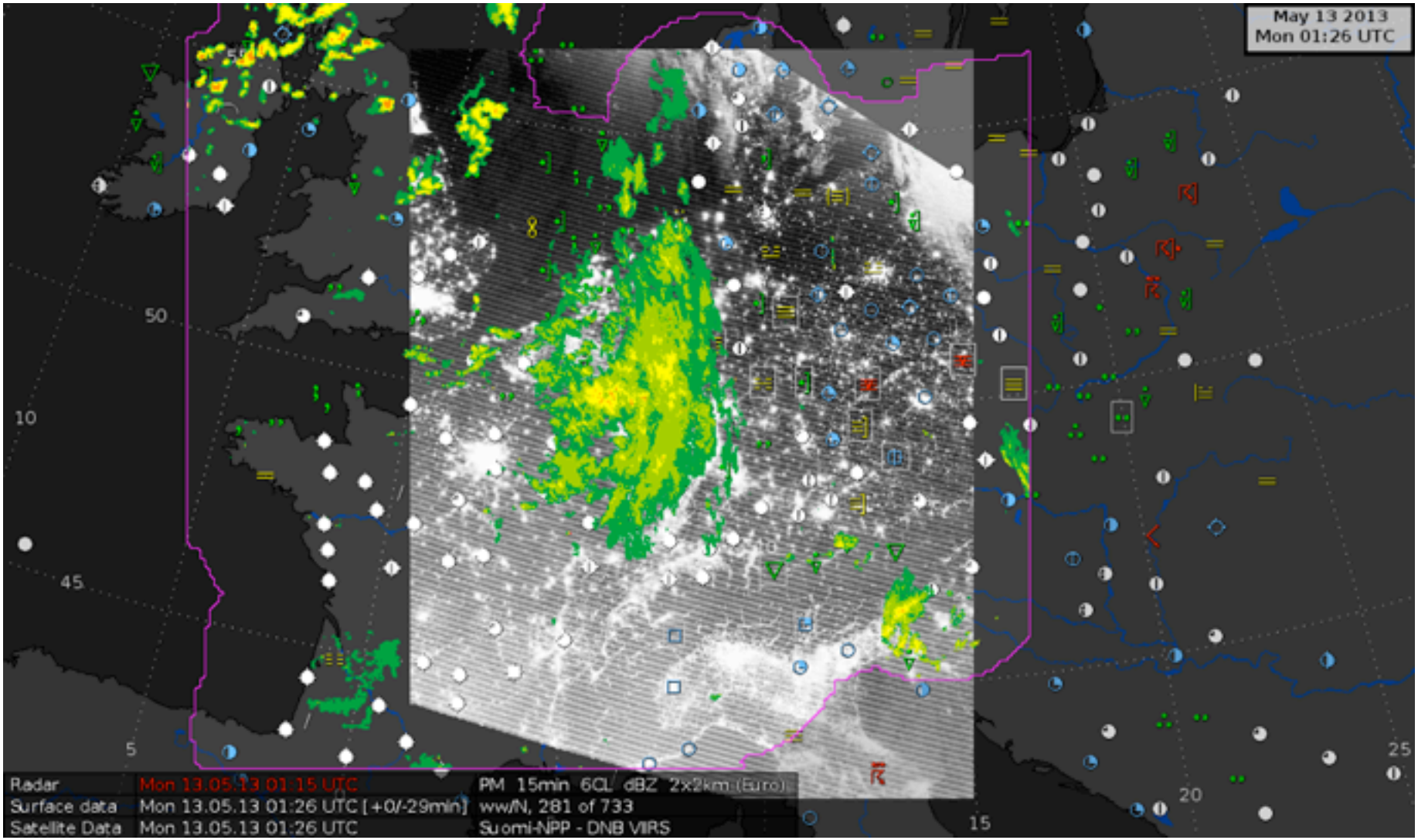
NinJo: SatWind-Layer

Deutscher Wetterdienst
Wetter und Klima aus einer Hand



Outline: III. CSPP and IMAPP at DWD

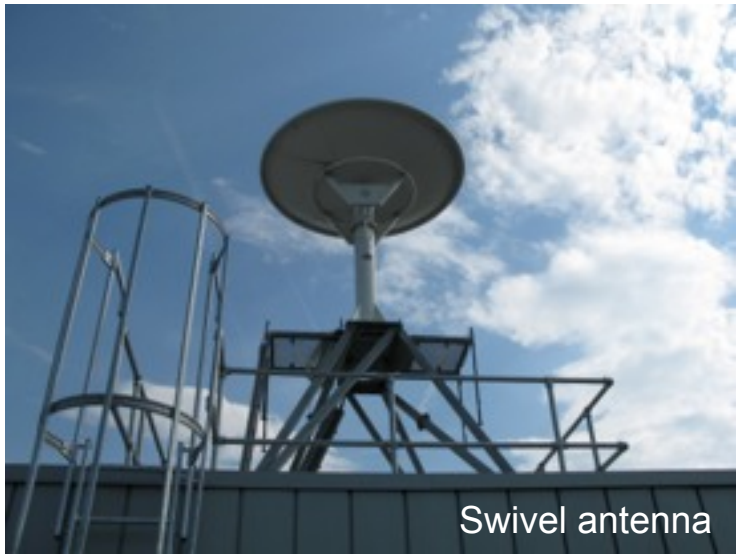
Deutscher Wetterdienst
Wetter und Klima aus einer Hand



Dishes in Offenbach

Deutscher Wetterdienst
Wetter und Klima aus einer Hand

Ku band


Swivel antenna

Pictures: J. Popp

Ku band

C band

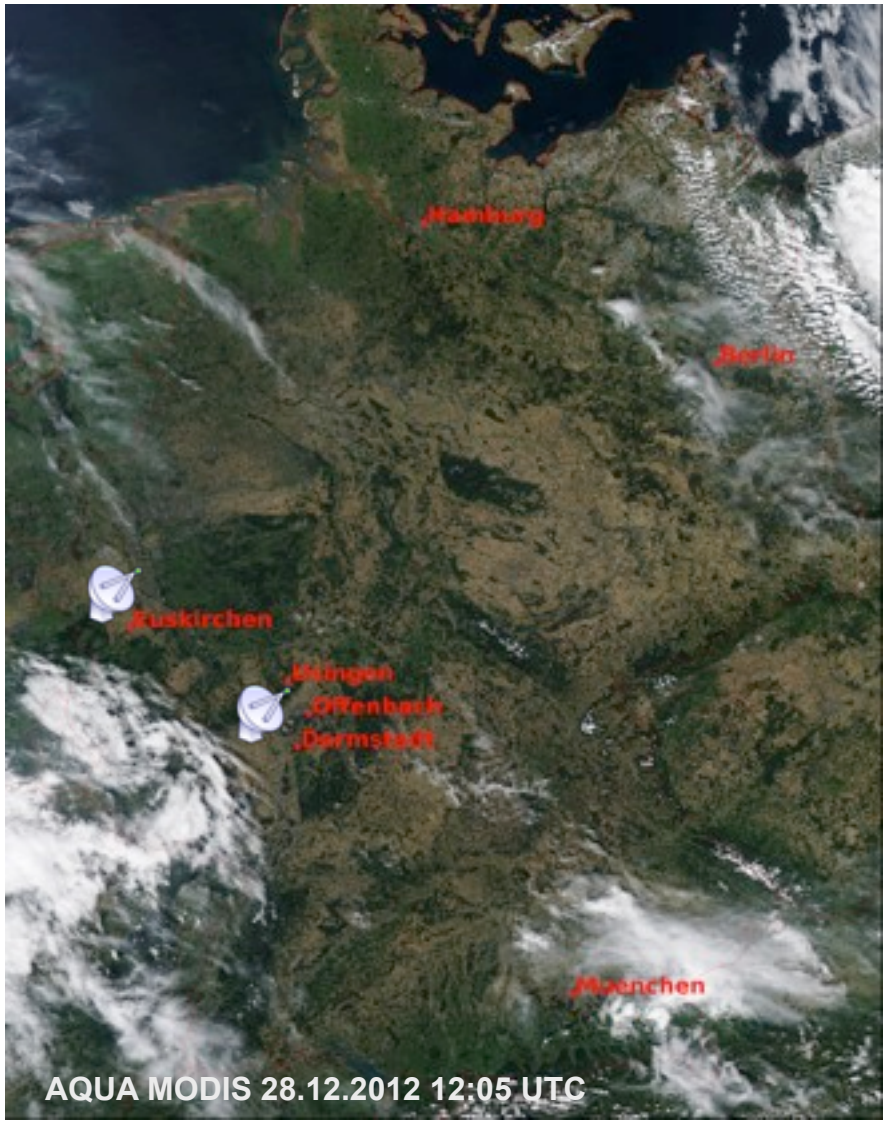
ITT for X-/L- band antenna to be published in May. Signing of the contract within FY2013.

Backup: BGIS

The Bundeswehr Geoinformation Service (BGIS) of the German Federal Armed Forces operates a weather satellite reception system in Euskirchen.

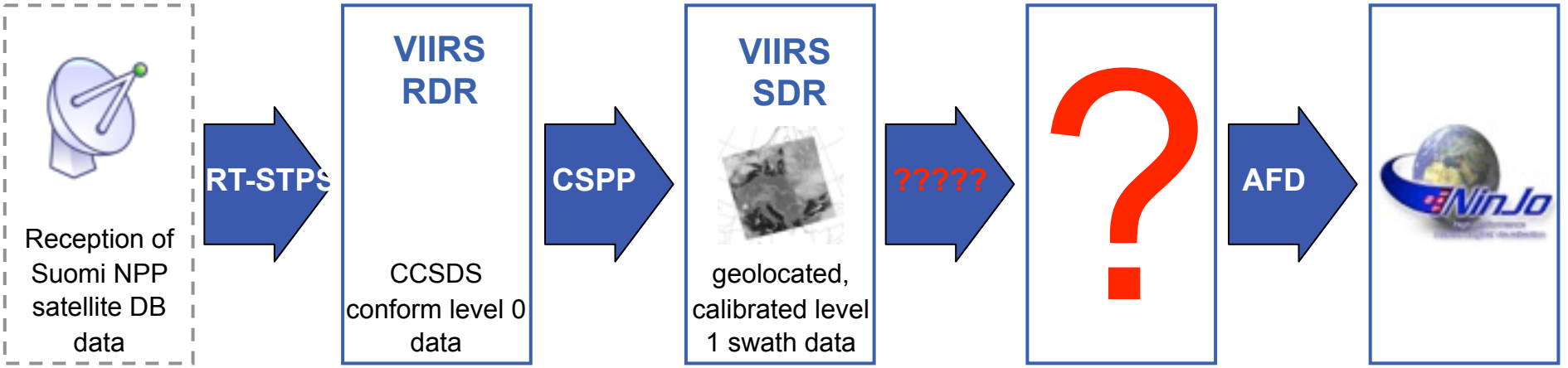
- Equipment
  - EUMETCast
  - L-/X Band (SciSys)

- Backup:
  DWD and BGIS operate as mutual backup system



VIIRS Processing Chain at DWD

Deutscher Wetterdienst
Wetter und Klima aus einer Hand
DWD



TASK: Close the gap between CSPP level 1 swath data and NinJo

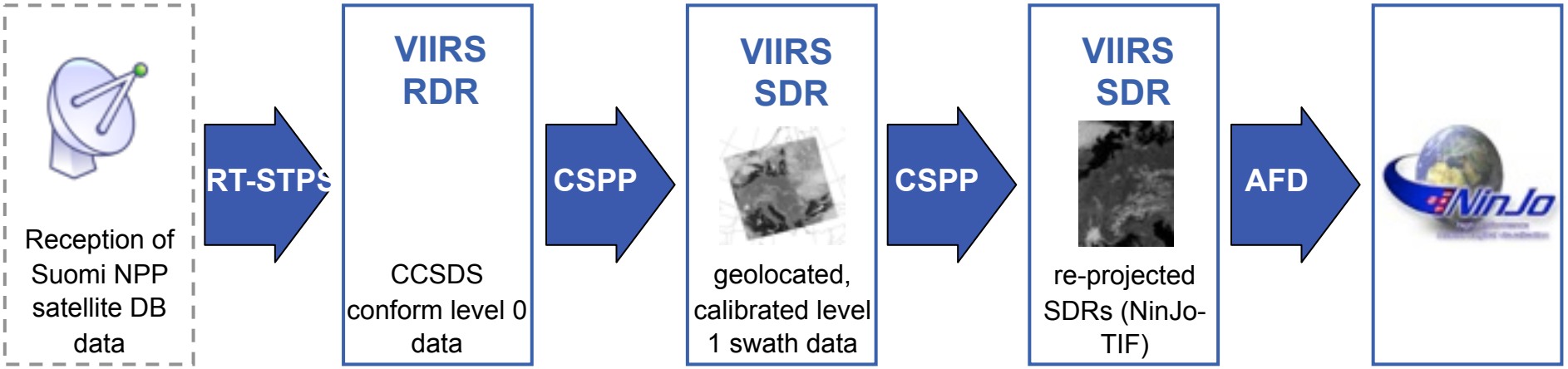
Step 1: Develop a module to create NinJo-compatible images

Step 2: Testmode using a Developer NinJo server-client pair.

Step 3: Incorporation into the official NinJo release

VIIRS Processing Chain at DWD

Deutscher Wetterdienst
Wetter und Klima aus einer Hand



Step 1: Develop a module to create NinJo-compatible images ✓

Step 2: Testmode using a Developer NinJo server-client pair. ✓

Step 3: Incorporation into the official NinJo release ✓ **> NinJo 1.7.1**

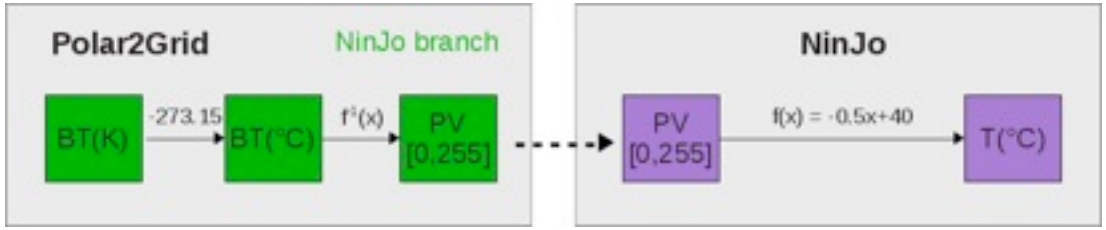
Current status: We are ready for S-NPP VIIRS - thanks to the excellent work of the CSPP team !!

The CSPP - NinJo backend

- uses **Polar2Grid** to obtain reprojected VIIRS images for selected channels
- uses **libtiff** in combination with **newly written python bindings** to write tiff image including customized tags
- Projection and other parameters are taken from the POLAR2GRID configuration
- writes albedo and temperature values for the short- and longwave, respectively.
- creates tiled images
- writes multi-resolution tiffs

germanyext.gpd

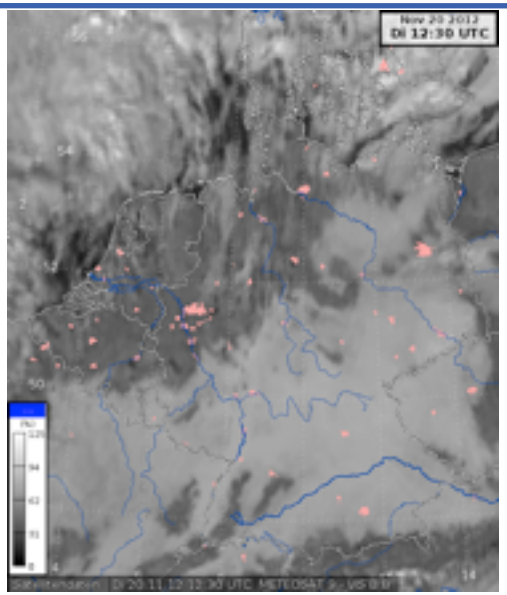
Grid Width: 3000
Grid Height: 4000
Grid Cells per Map Unit: 2.5
Map Projection: Polar Stereographic (ellipsoid)
Map Reference Latitude: 90.0
Map Reference Longitude: 10.0
Map Second Reference Latitude: 60.0
Map Origin Latitude: 56.0
Map Origin Longitude: -2.0
Map Equatorial Radius: 6370000.0 ; m
Map Polar Radius: 6370000.0 ; m
Map Scale: 1000.0 ; meter /map unit

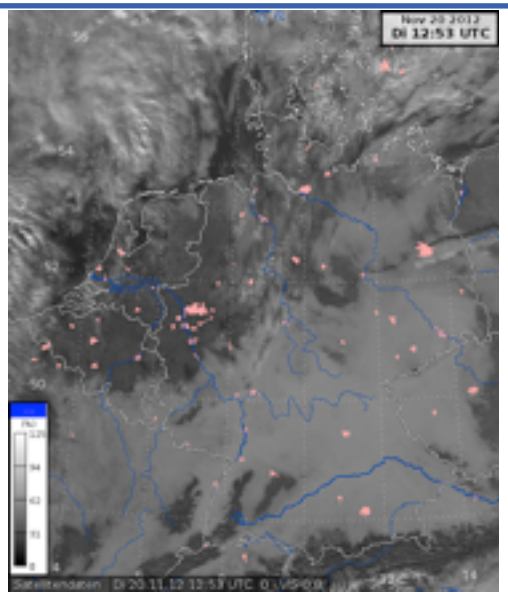


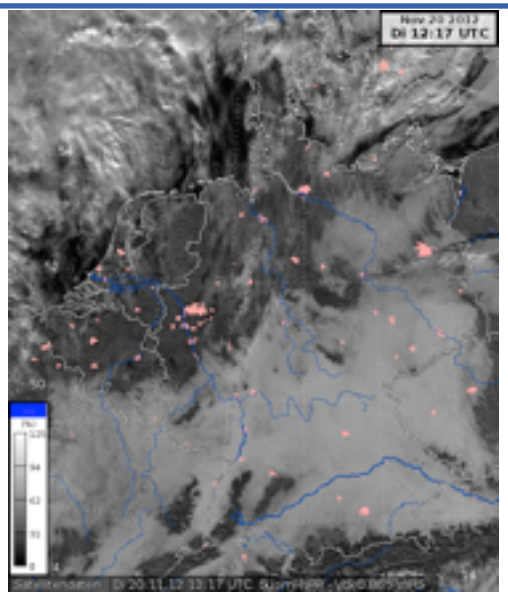
Comparison: SEVIRI/AVHRR/VIIRS

Deutscher Wetterdienst
Wetter und Klima aus einer Hand

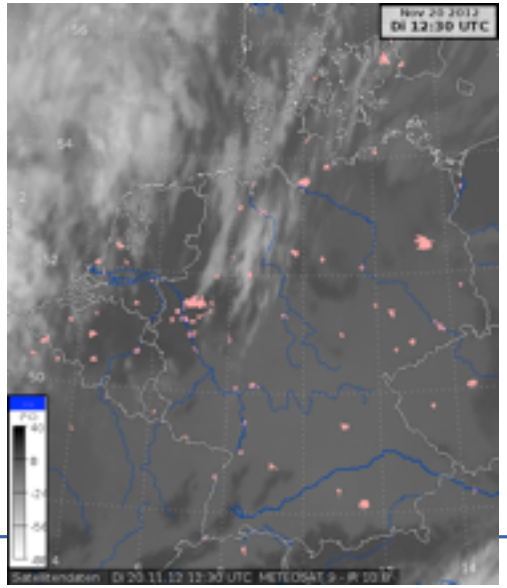
VIS 0.8 µm

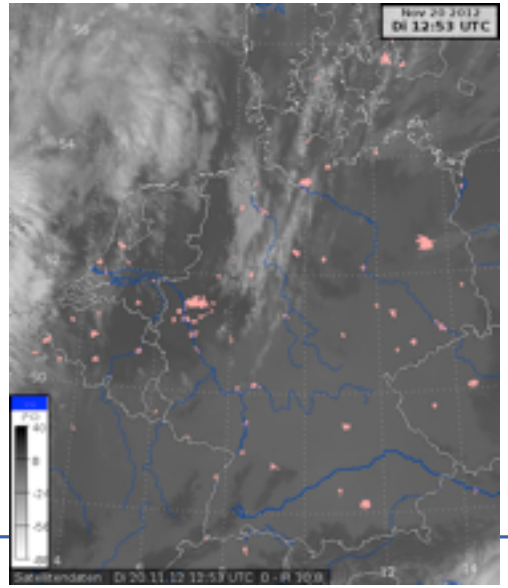


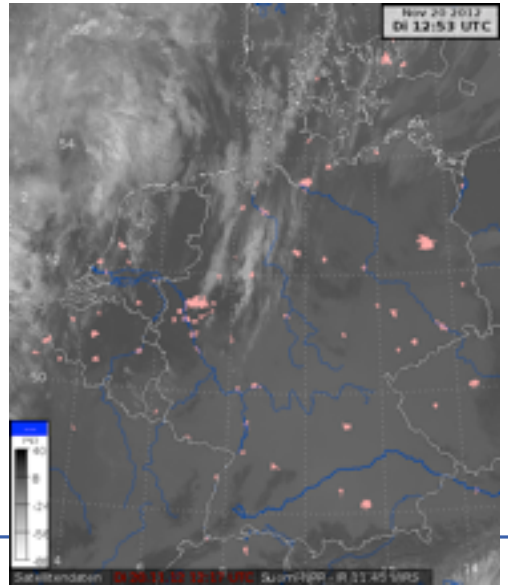




IR 10.8 µm

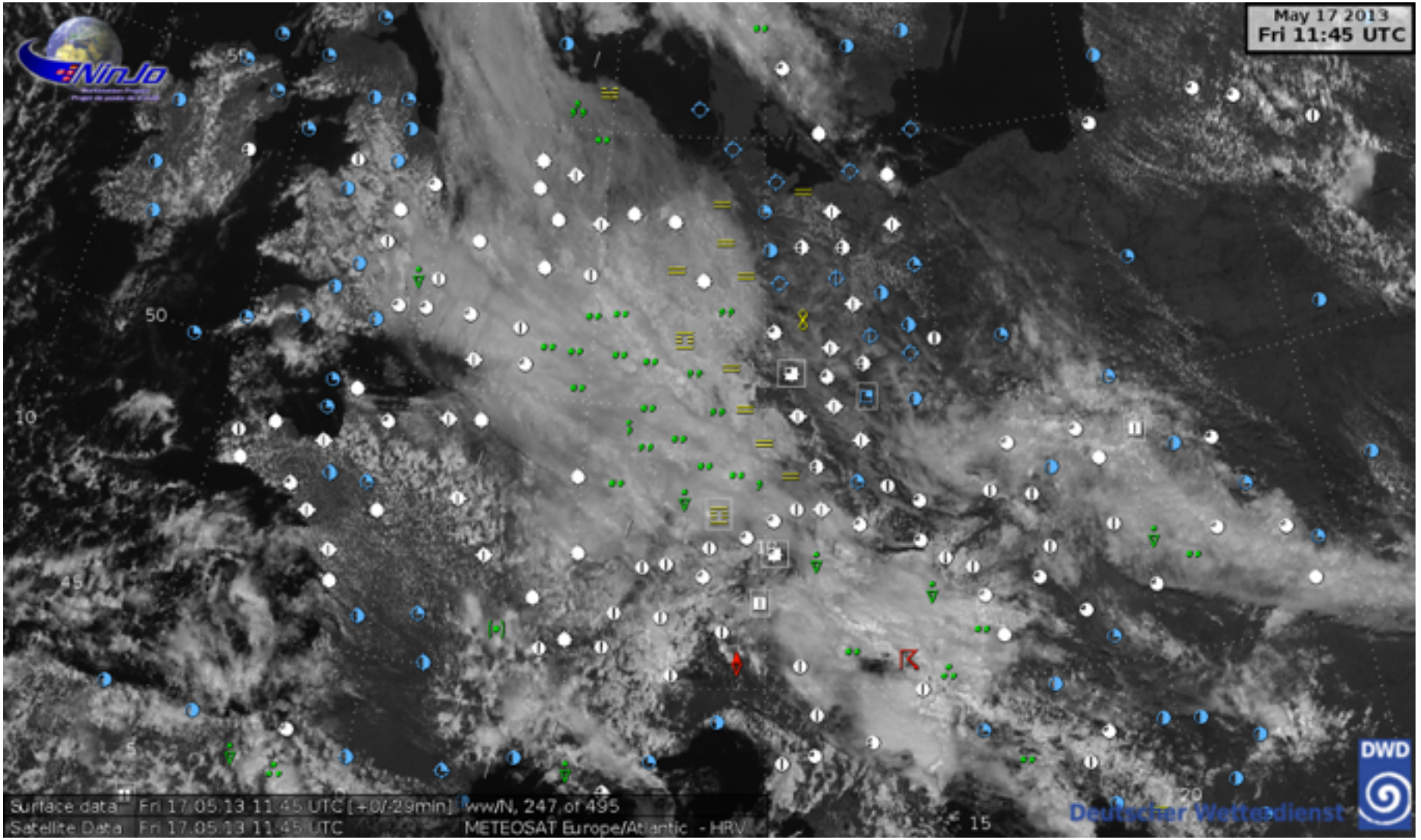






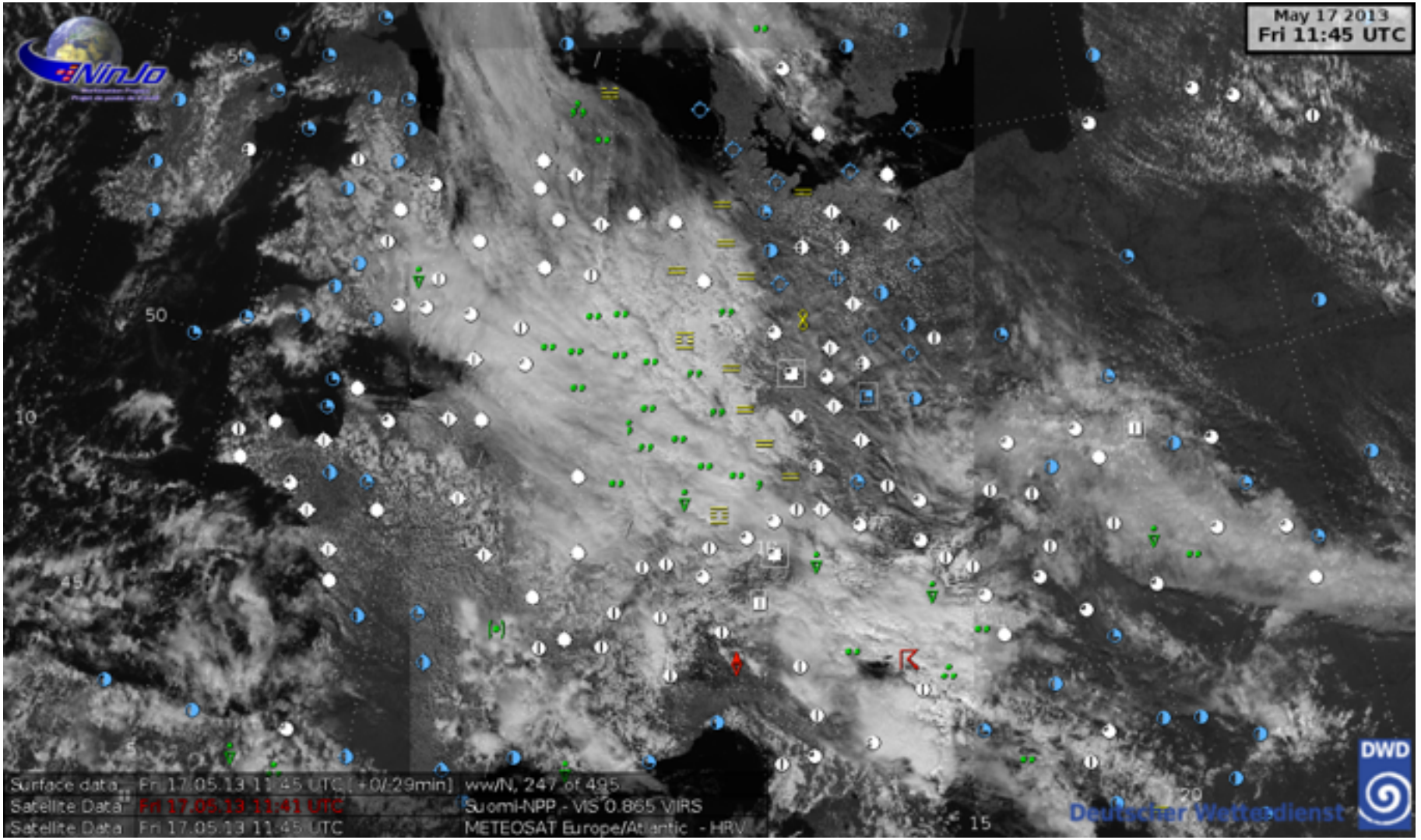
NinJo Screenshots

Deutscher Wetterdienst
Wetter und Klima aus einer Hand



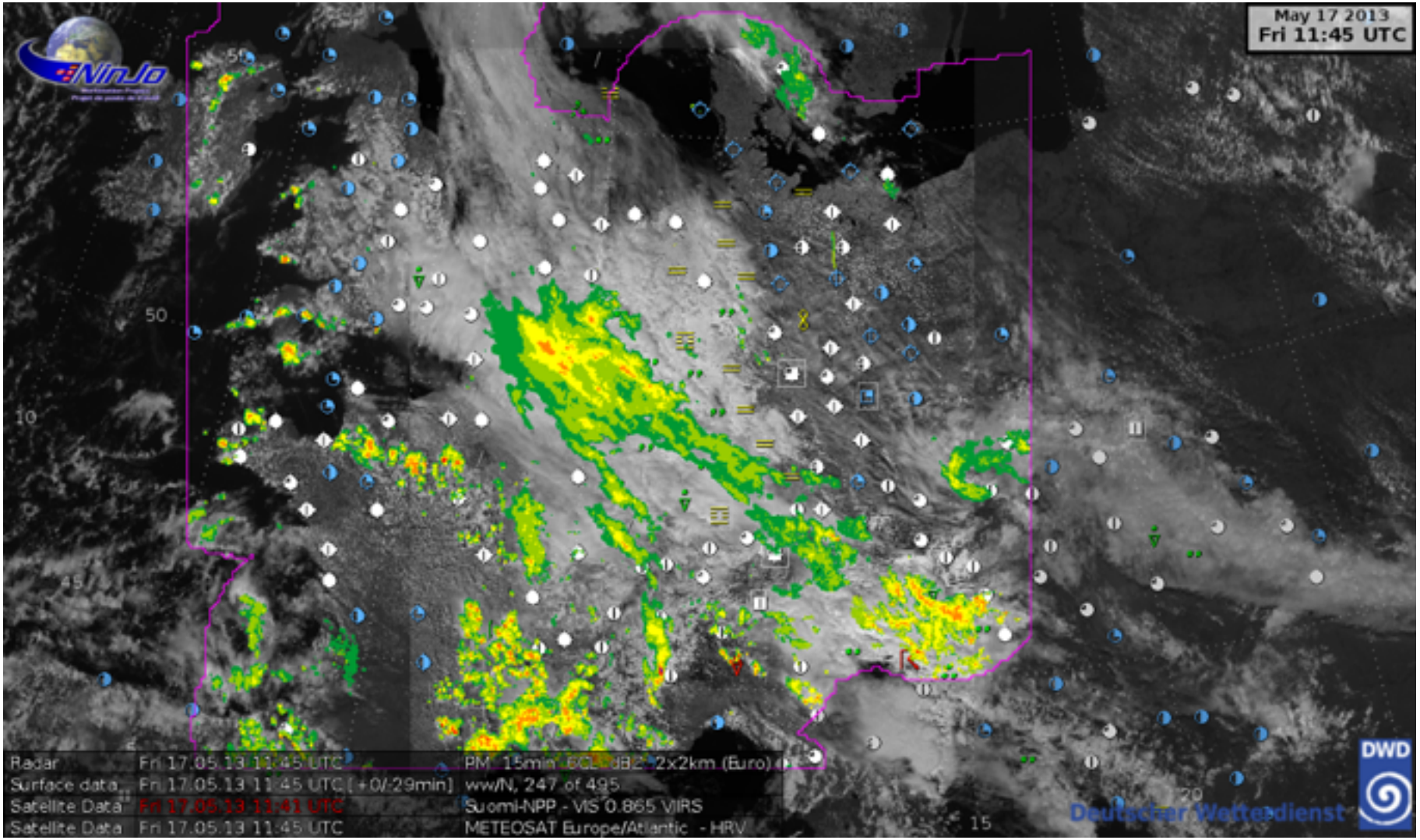
NinJo Screenshots

Deutscher Wetterdienst
Wetter und Klima aus einer Hand

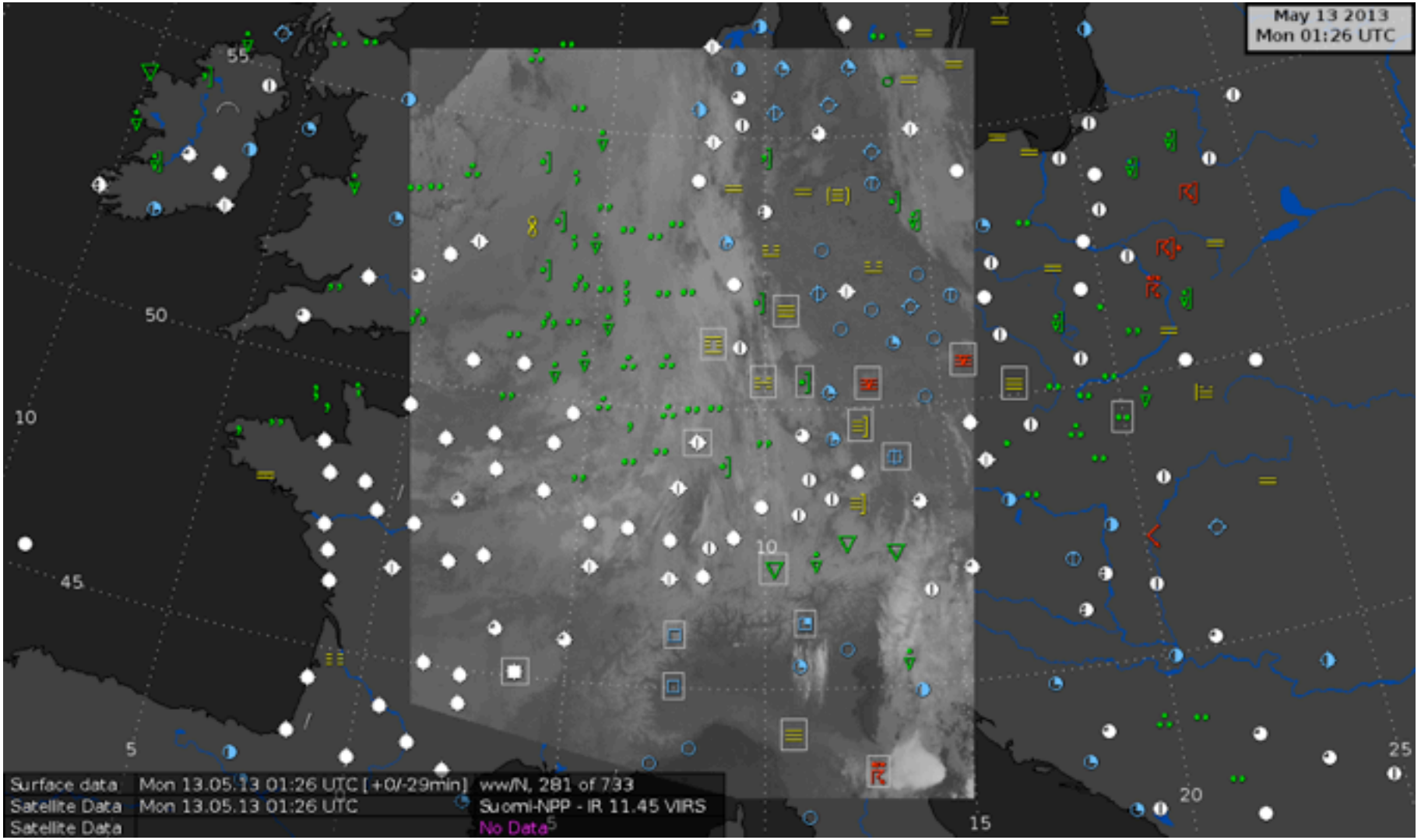


NinJo Screenshots

Deutscher Wetterdienst
Wetter und Klima aus einer Hand

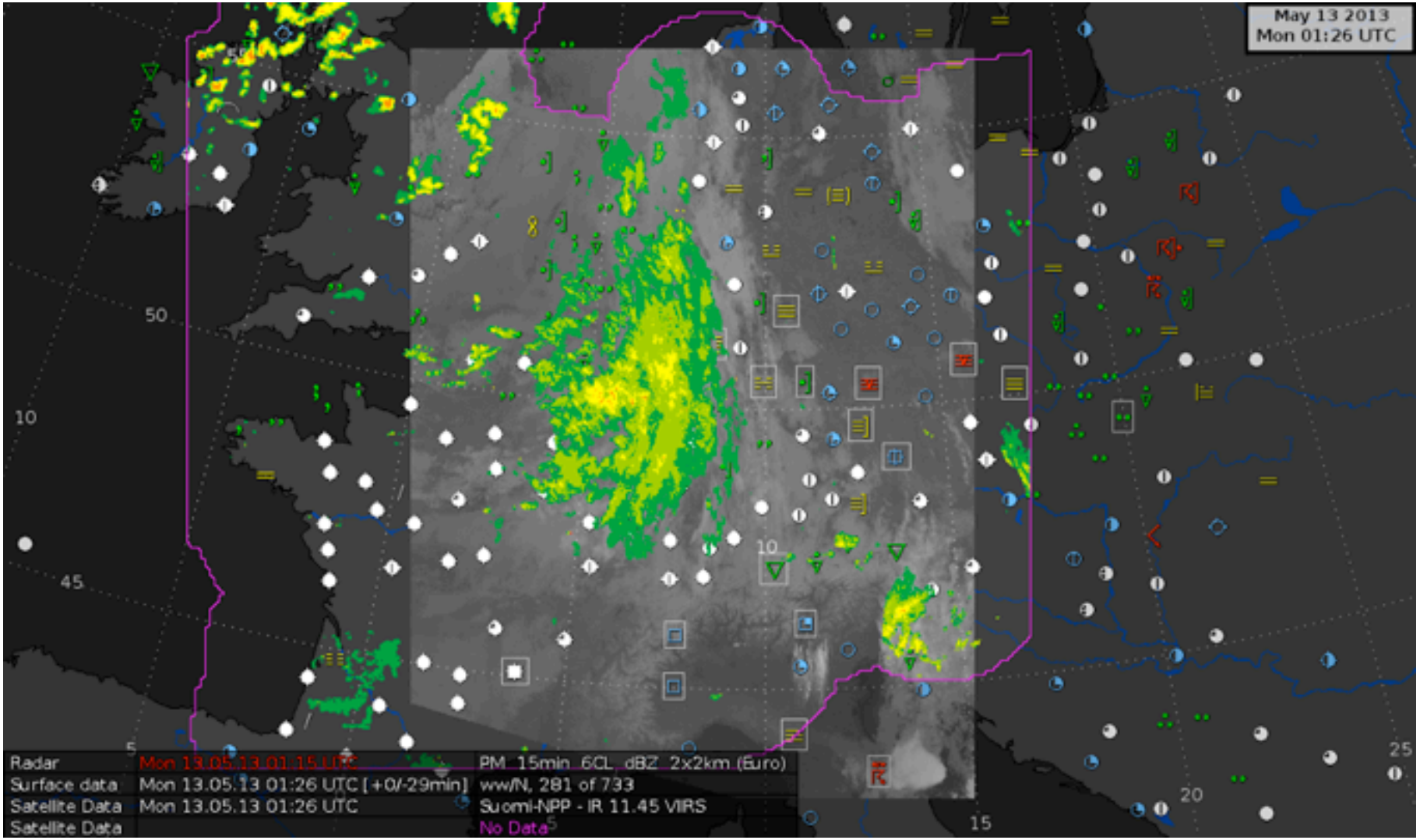


NinJo Screenshots



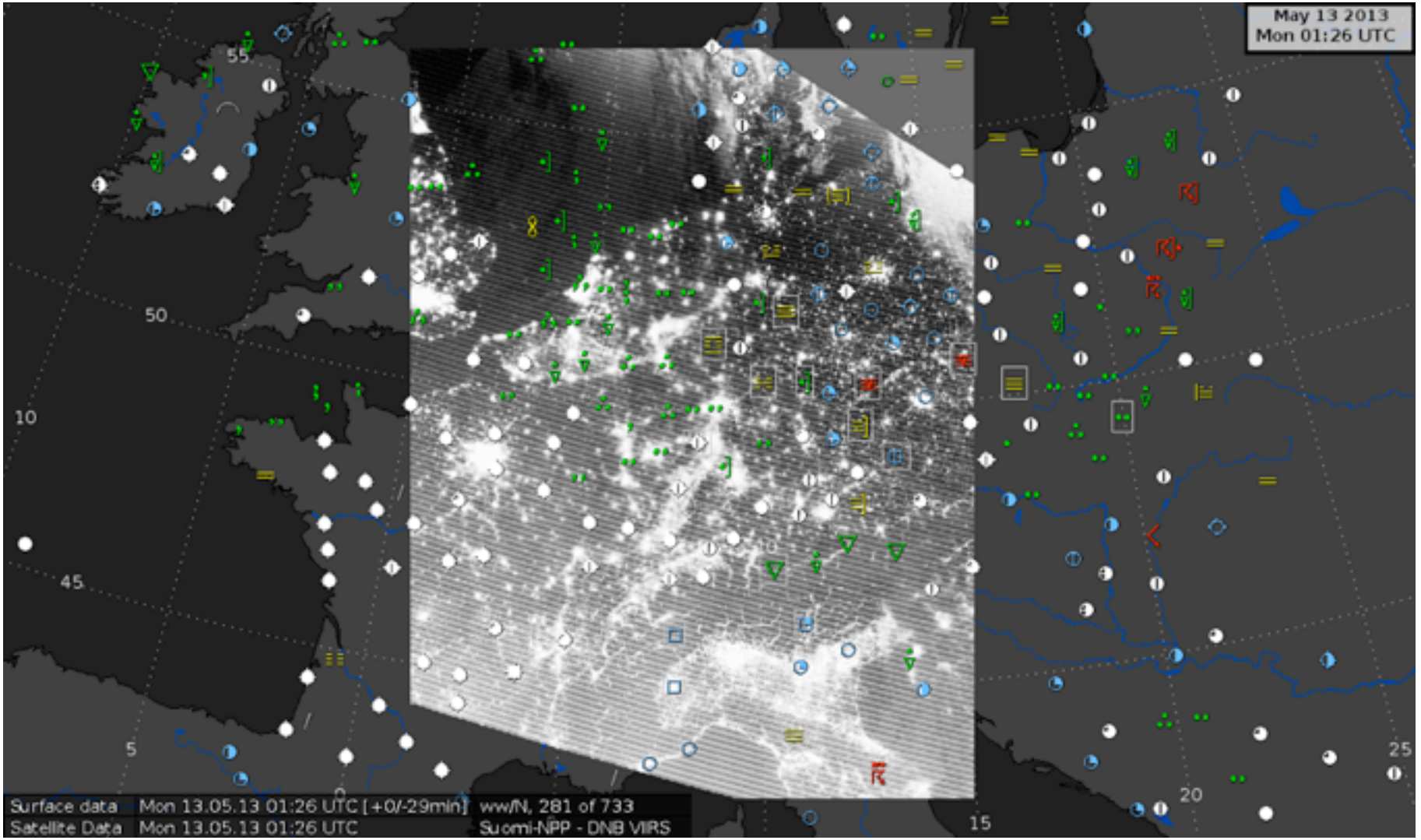
NinJo Screenshots

Deutscher Wetterdienst
Wetter und Klima aus einer Hand



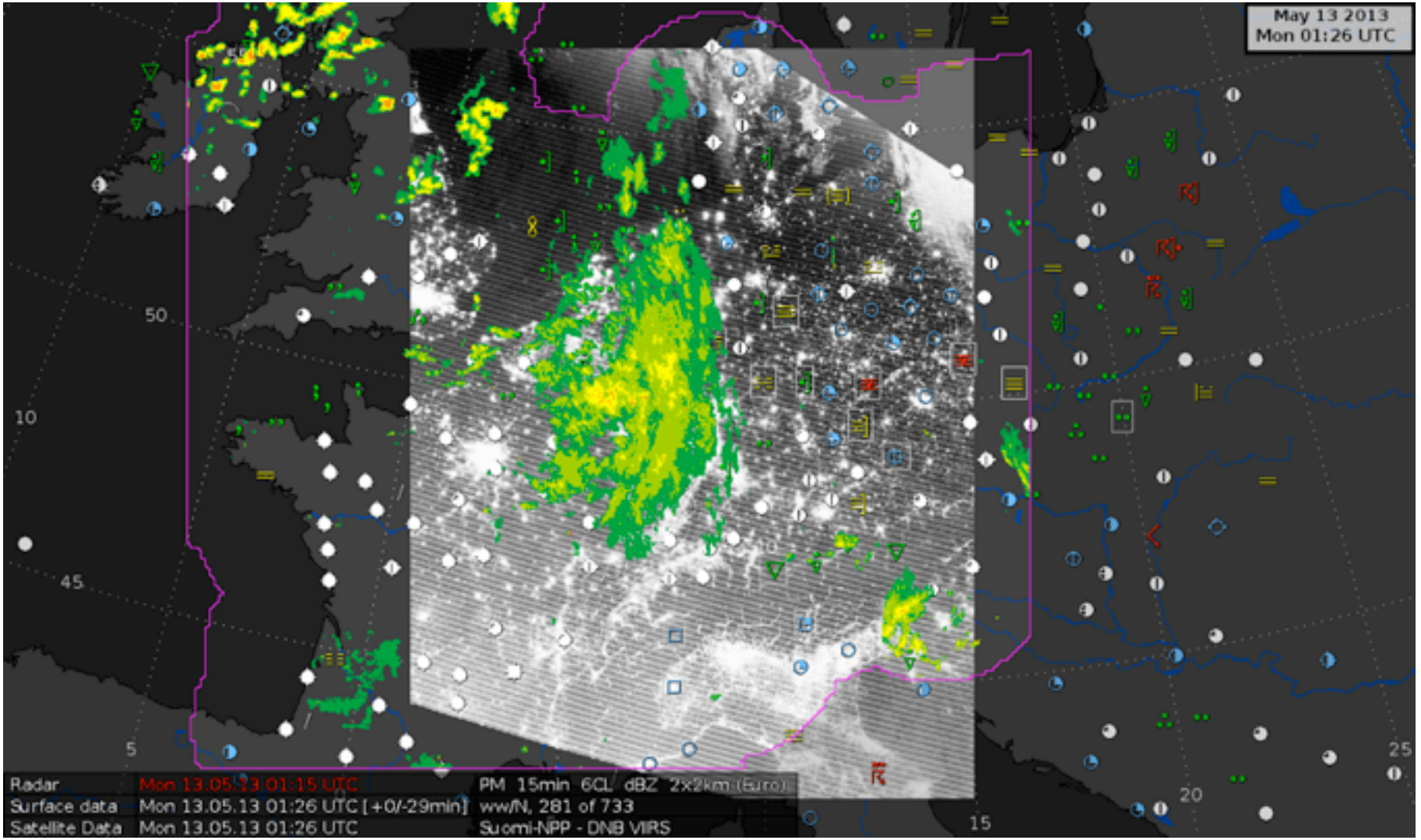
NinJo Screenshots

Deutscher Wetterdienst
Wetter und Klima aus einer Hand

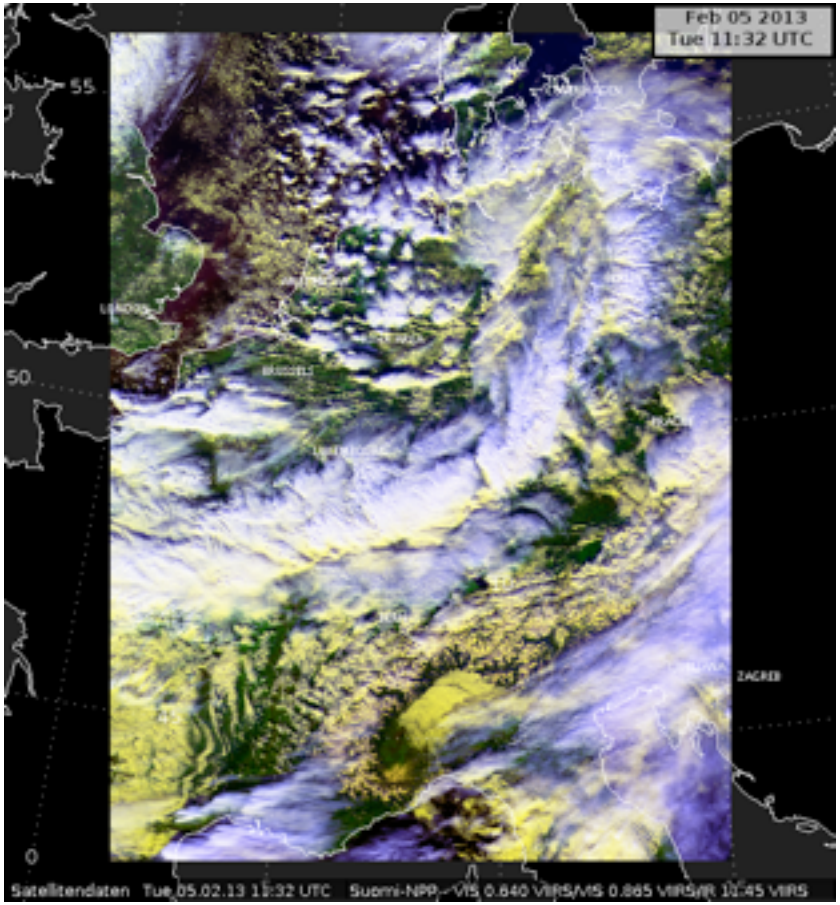


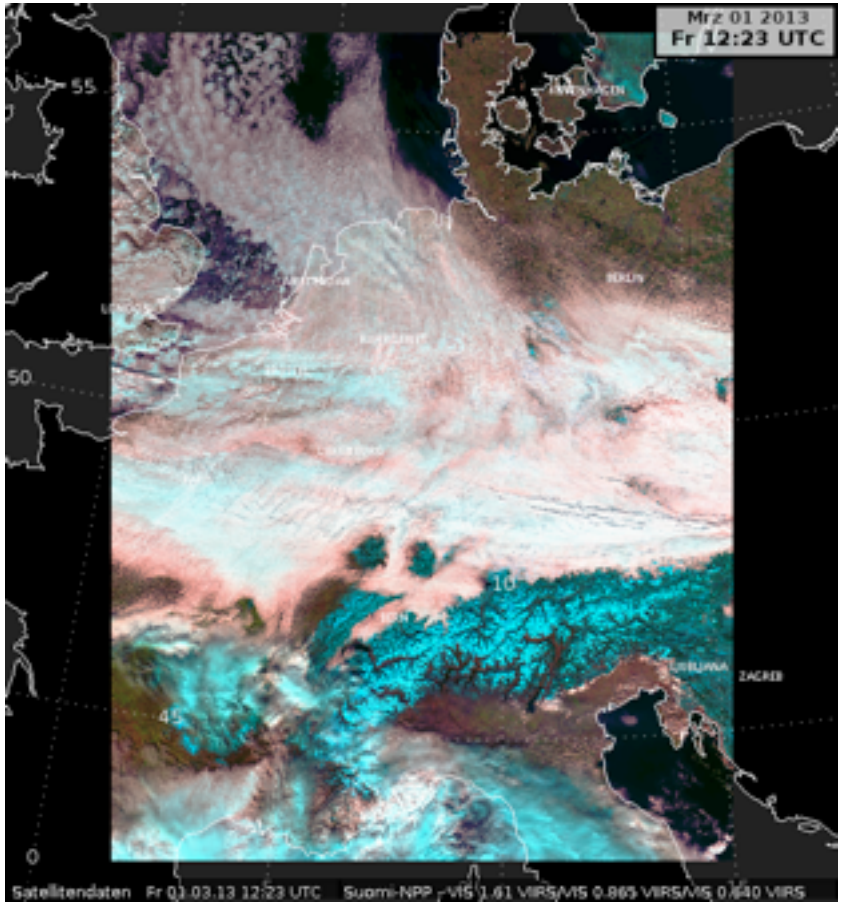
NinJo Screenshots

Deutscher Wetterdienst
Wetter und Klima aus einer Hand



S-NPP VIIRS examples in NinJo



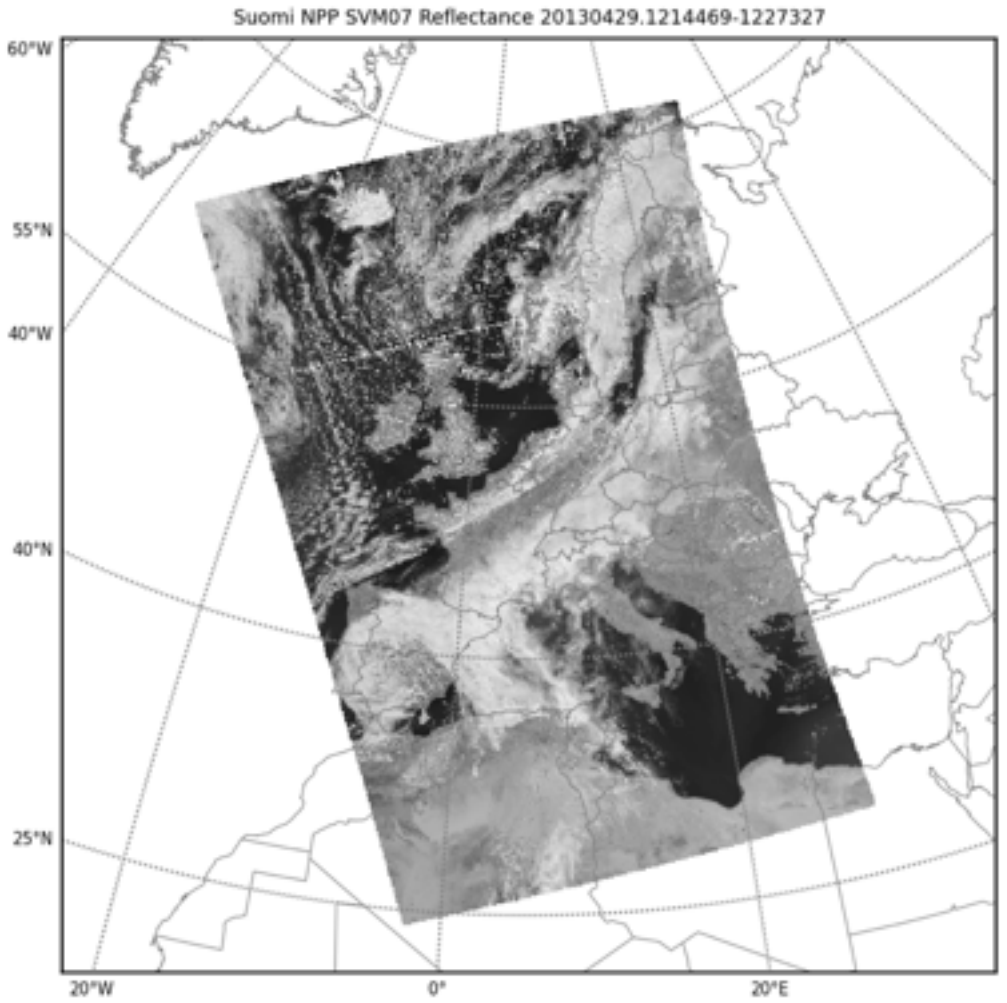


- Strong cold-front across Germany. Inside the strong convection zone the first thunderstorms of the year occurred.
- Norwegian foehn brings sunshine to Schleswig-Holstein and Mecklenburg-West Pomerania.

S-NPP DB data from the BGIS

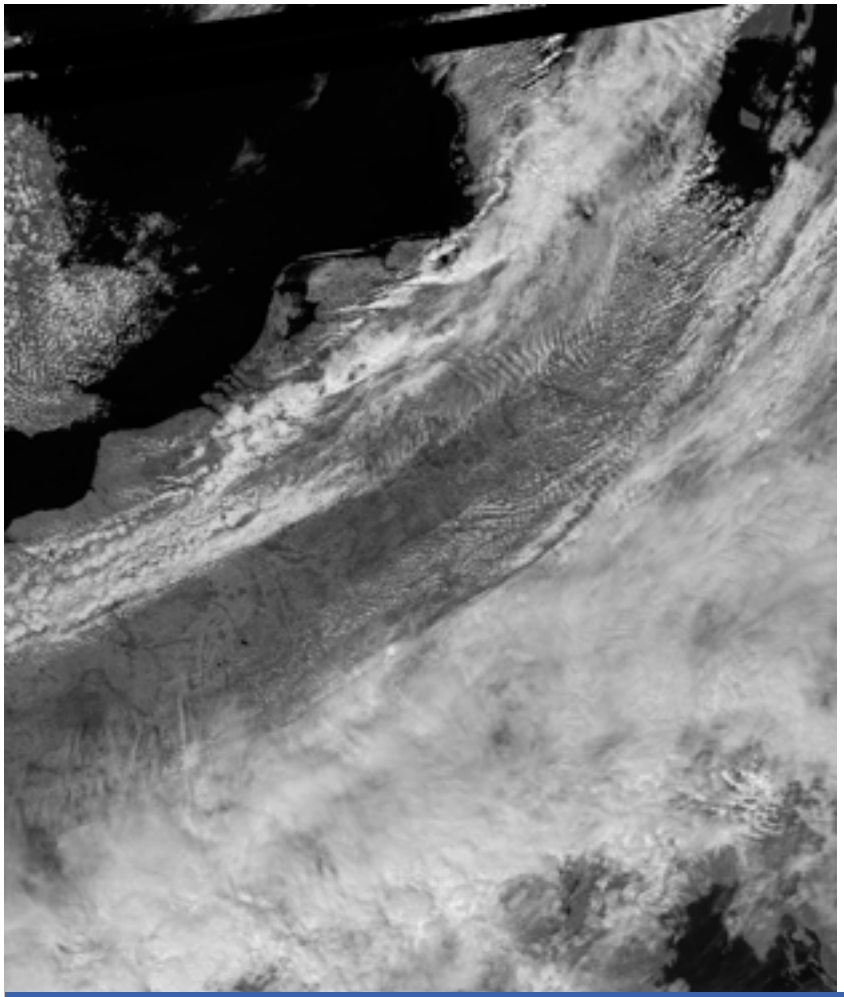
Verify the CSPP processing chain with DB from the BGIS reception system in Euskirchen

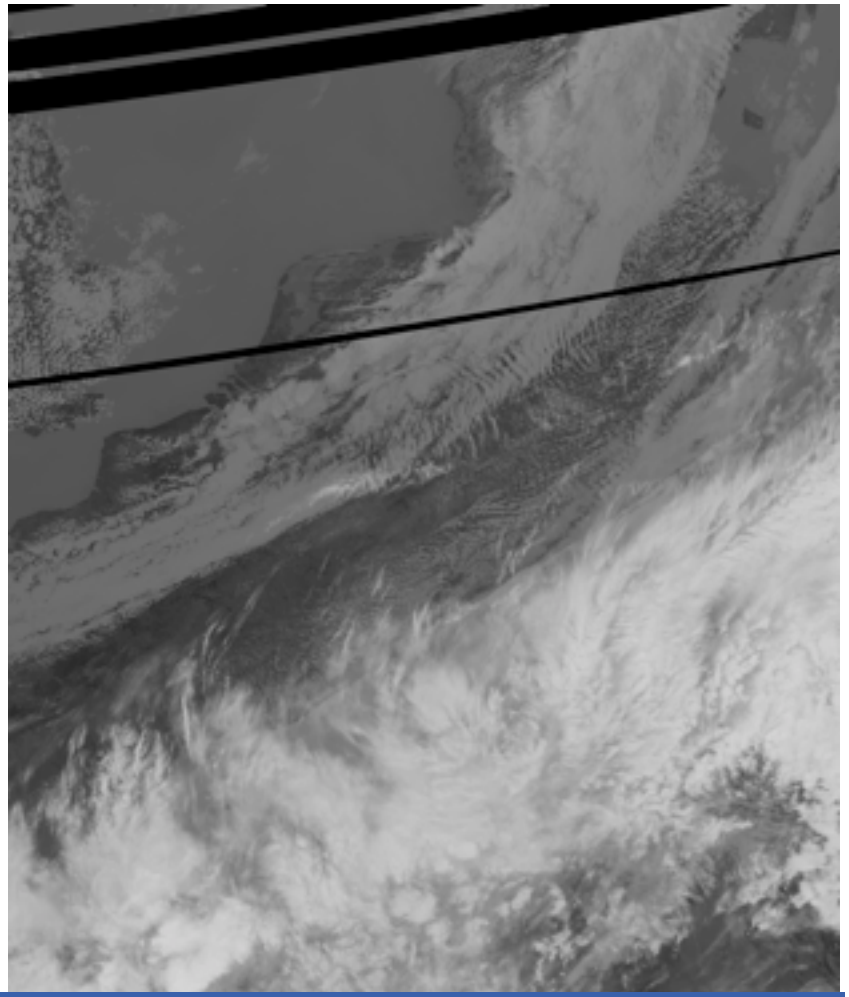
- **data**: S-NPP VIIRS raw files processed with RT-STPS
  - RNSCA_RVIRS_npp.....h5
- **test case**: 29.04.2013 12:15 UTC
- final 10 out of 10 granules processed, 9 successfully
  - computation time
    - real 29m10.707s
    - user 18m13.744s
    - sys 1m54.131s



Quicklook of S-NPP VIIRS band M07

Resulting NinJo-tif images





The processing of the DB data worked immediately without problems.

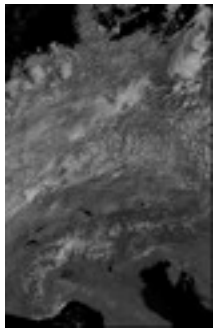
MODIS Chain

Deutscher Wetterdienst
Wetter und Klima aus einer Hand

Current operational chain

Data reception and processing with IMAPP at BGIS

CINESAT



AFD

NinJo

Alternative

Reception with an X-band antenna

Level 0

CCSDS packages as PDS files

IMAPP

Level 1

Geo-referenced (1A), calibrated (1B) data

IDL

Level 1

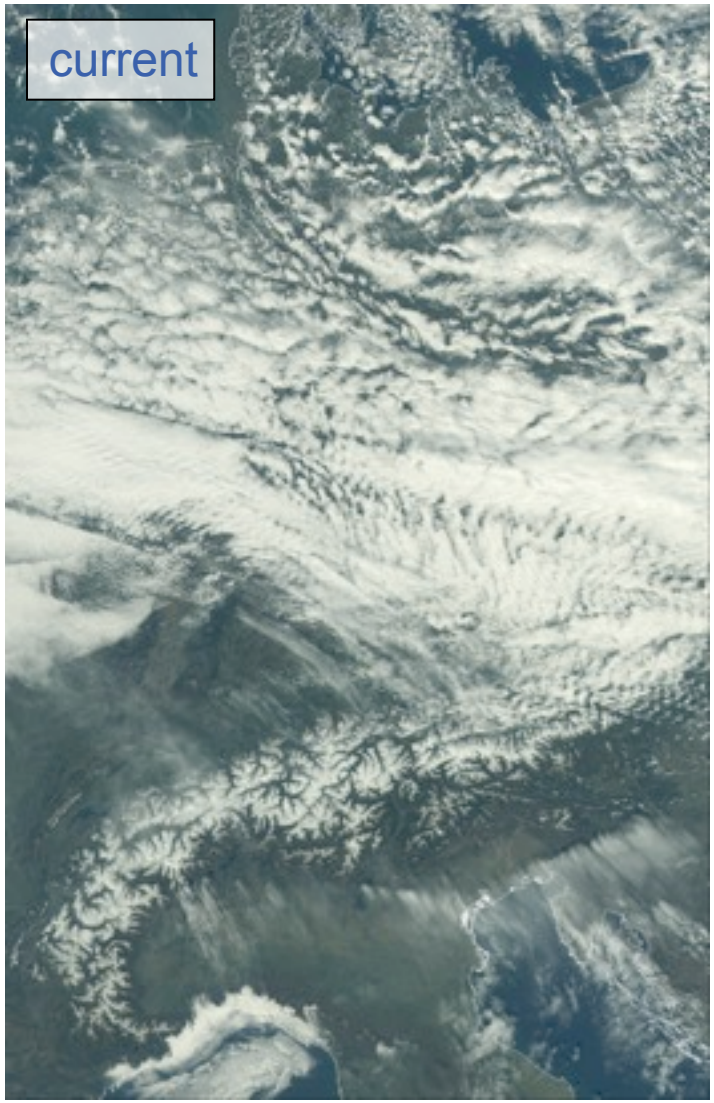
TrueColour Images

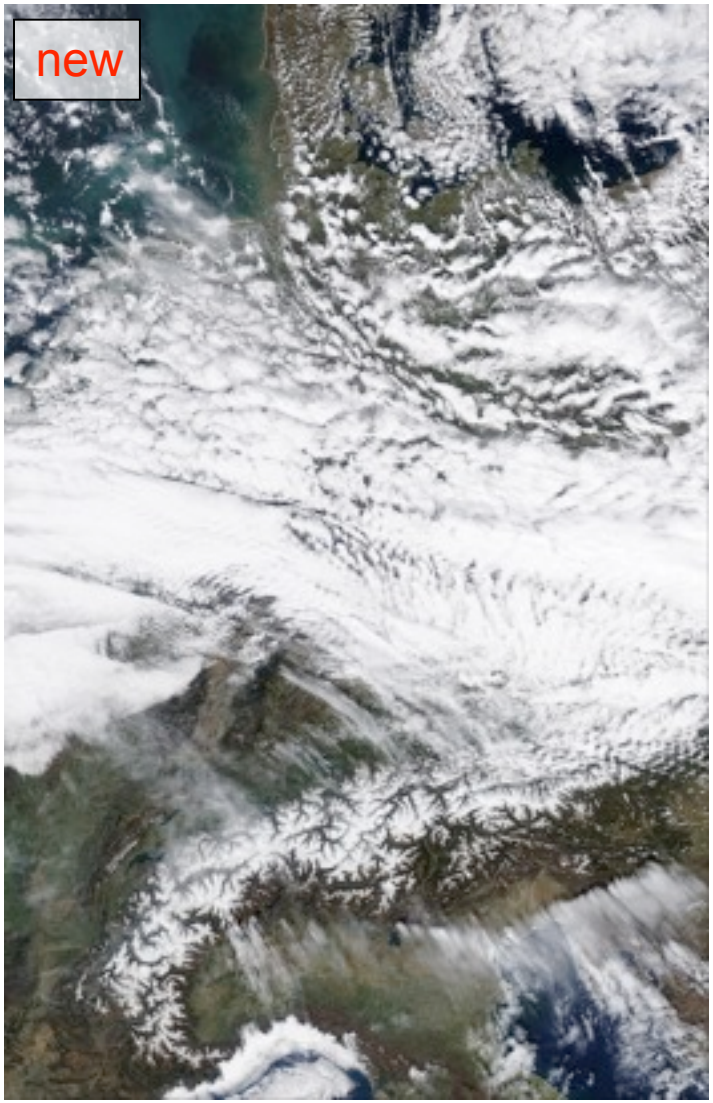
IMAPP

Level 2

Geophysical Products

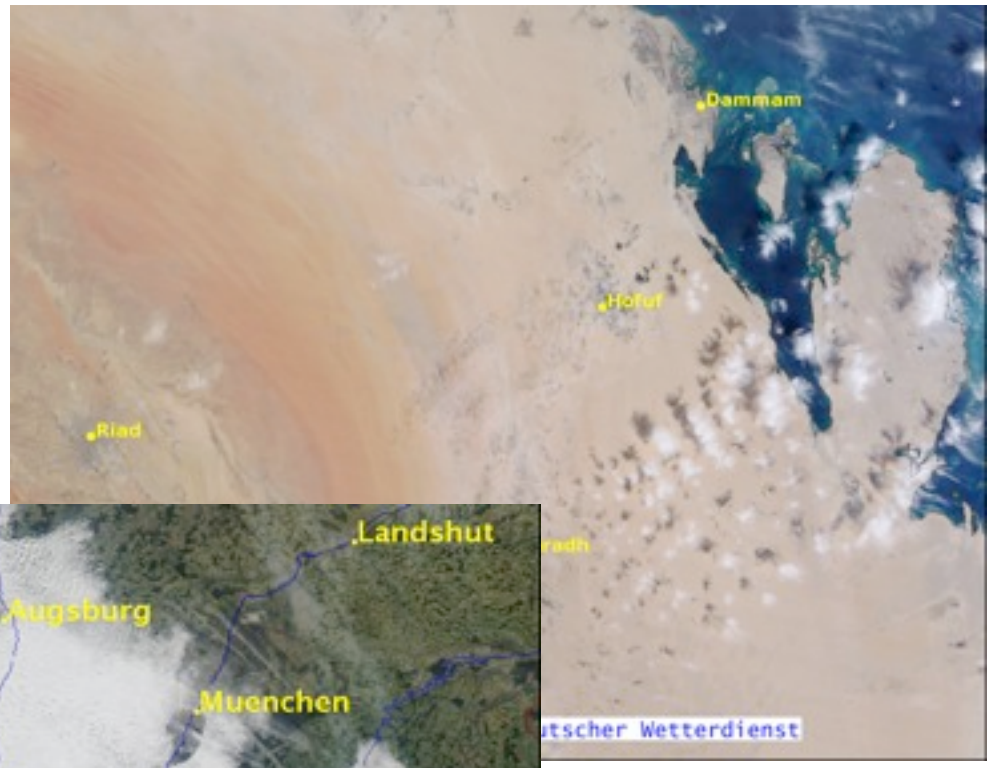
MODIS Comparison: TrueColour

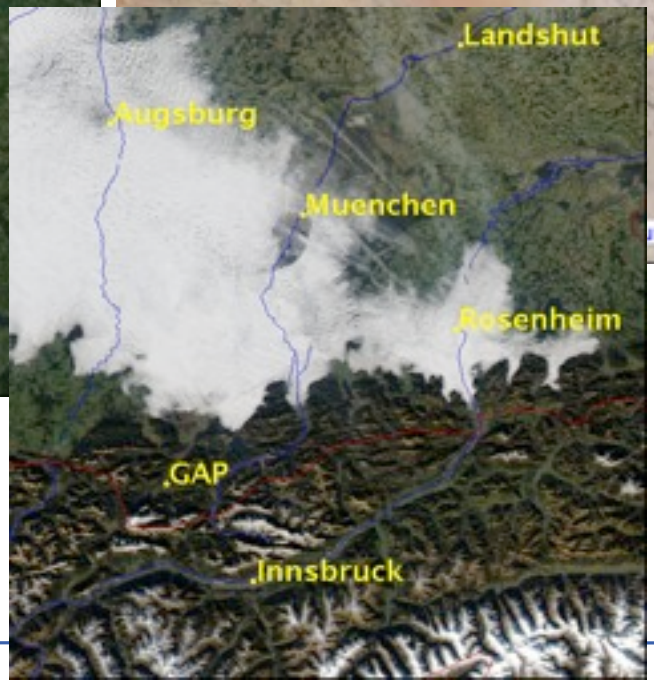




AQUA 201203411210

Examples images for customers





Summary

- The meteorological visualization system NinJo is DWD‘s interface with the different users
- DWD is going to purchase a new X-/L- band antenna this year.
- S-NPP VIIRS processing with CSPP is ready. We are looking forward to see CSPP working with our own DB data.
- CSPP Polar2Grid is extremely helpful to get S-NPP data into NinJo
- IMAPP is used for specific user requests but the data is not used by the forecasters so far

Next Steps

- S-NPP VIIRS true colour images
- check if CSPP_UW_HSRTV output could be converted to BUFR format similar to EUMETSAT's IASI Level 2 data (DWD: BUFR or GRIB)
- CSPP Polar2grid MODIS interface

Thank you for your attention and a big thanks to the CSPP team!