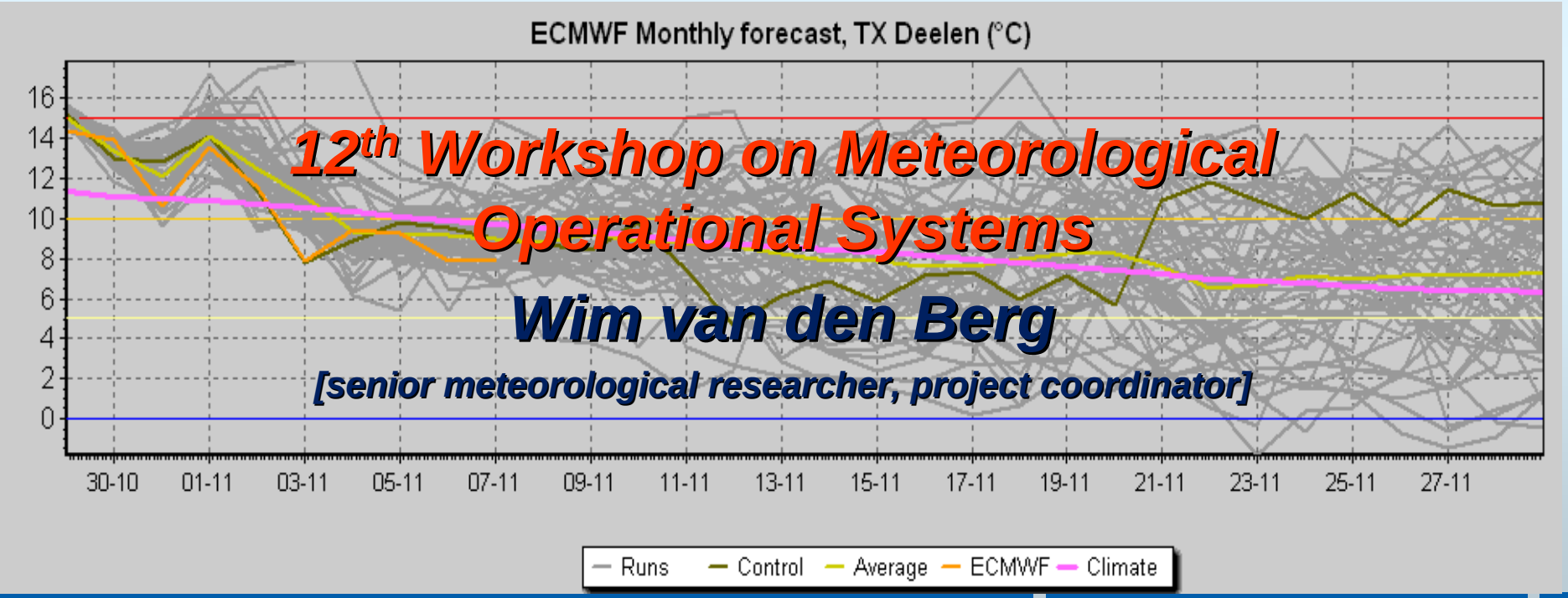
MeteoConsult

New applications using real-time observations and ECMWF model data



12th Workshop on Meteorological Operational Systems

Wim van den Berg

[senior meteorological researcher, project coordinator]

Overview

- MeteoConsult and MeteoGroup

- Use of observations (and/or ECMWF data) in
  - Precipitation and cloud (radiation) now casts applied to MOS
  - Automatic fronts and text
  - Road network forecast

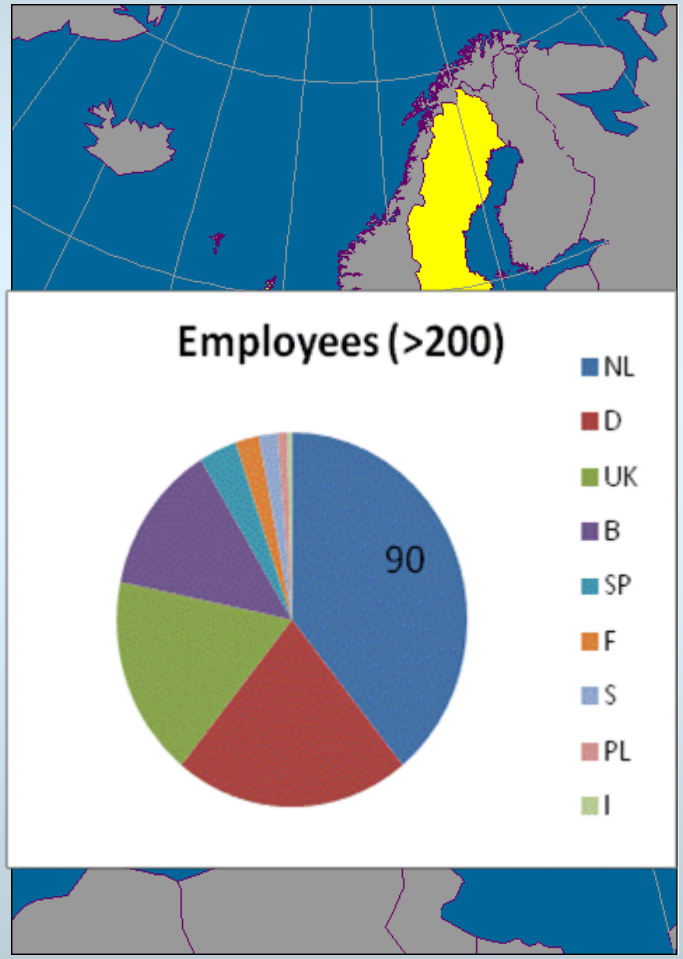
- Some future applications

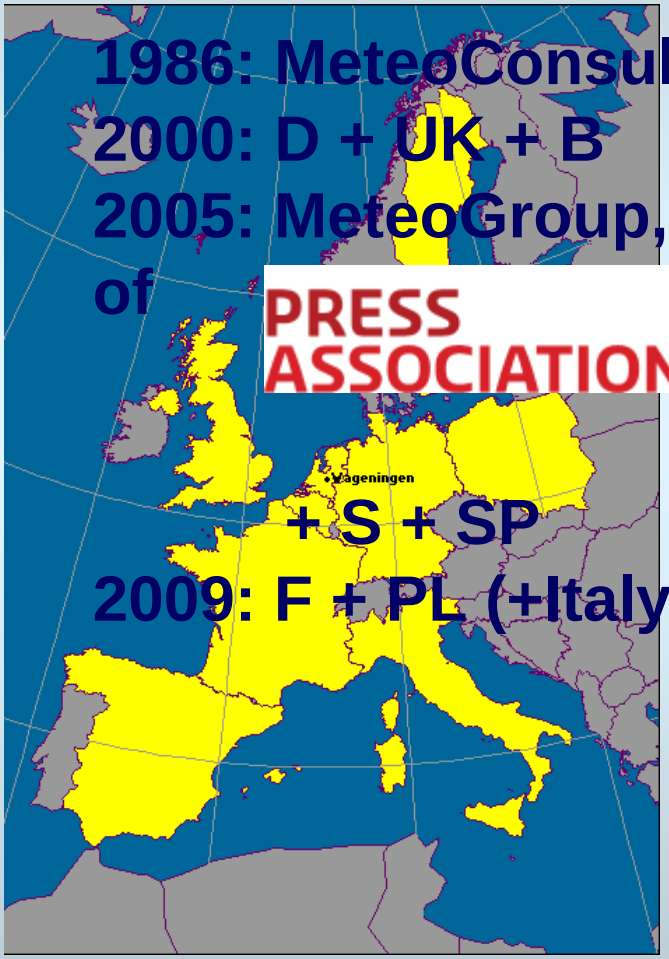
MeteoConsult

Most important markets (2009):

- Marine (offshore, ship routing)
- Weather & Traffic (road, rail)
- Agriculture
- Energy
- Broadcast
- Consumer

MeteoGroup





1986: MeteoConsult NL

2000: D + UK + B

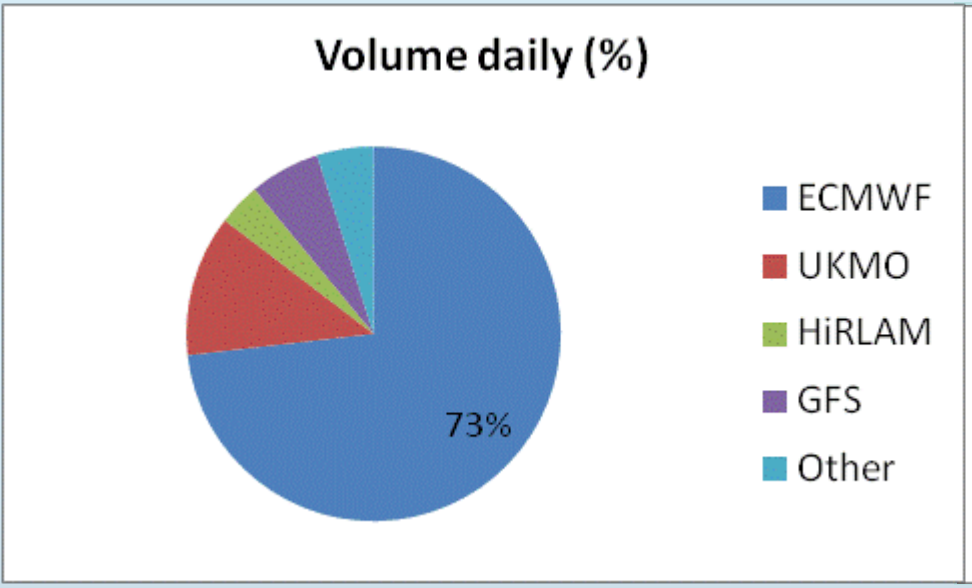
2005: MeteoGroup, part of PRESS ASSOCIATION + S + SP

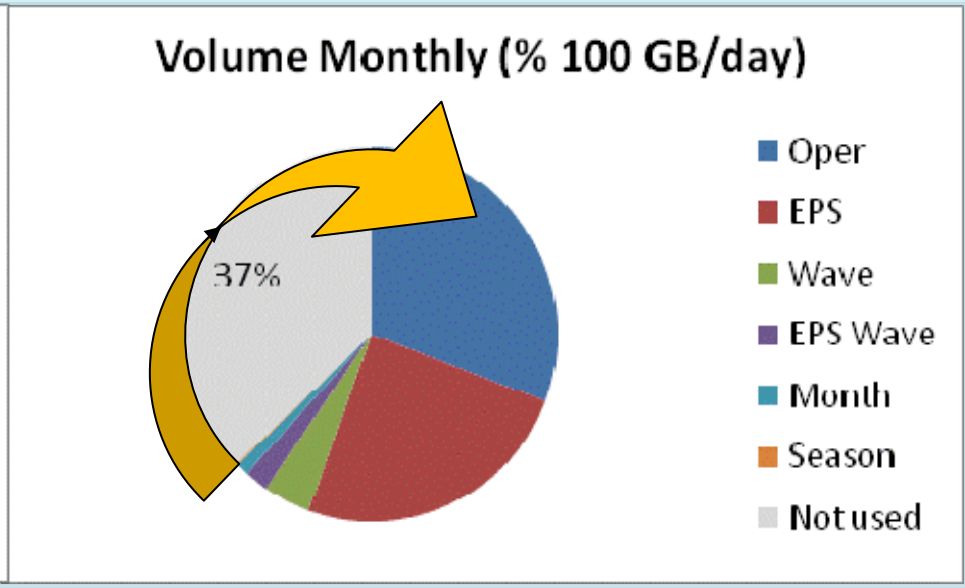
2009: F + PL (+Italy)

Use of ECMWF data

MeteoConsult

Change to IFS cy16: T1279 (EPS T639)





Overview

- MeteoConsult and MeteoGroup

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  - Precipitation and cloud (radiation) now casts applied to ***MOS***
  - Automatic fronts and text
  - Road network forecast

- Future applications

Summary MG *M*odel *O*utput *S*tatistics

MeteoConsult

Historical OBS + Historical MODEL → MOS equations

- Historical OBS
  - ✓ 365 obs minimum
- Historical MODEL
  - ✓ **ECMWF Oper 0.25°**
  - ✓ **ECMWF EPS 0.5°**
  - ✓ GFS 1.0° 0-180
  - ✓ GFS 2.5° 180-384
- MOS equations
  - One equation for
    - ✓ Each station
    - ✓ Each element
    - ✓ Each forecast period

MOS equations + Actual OBS, **Radar,Satellite** + Actual MODEL → MOS forecast

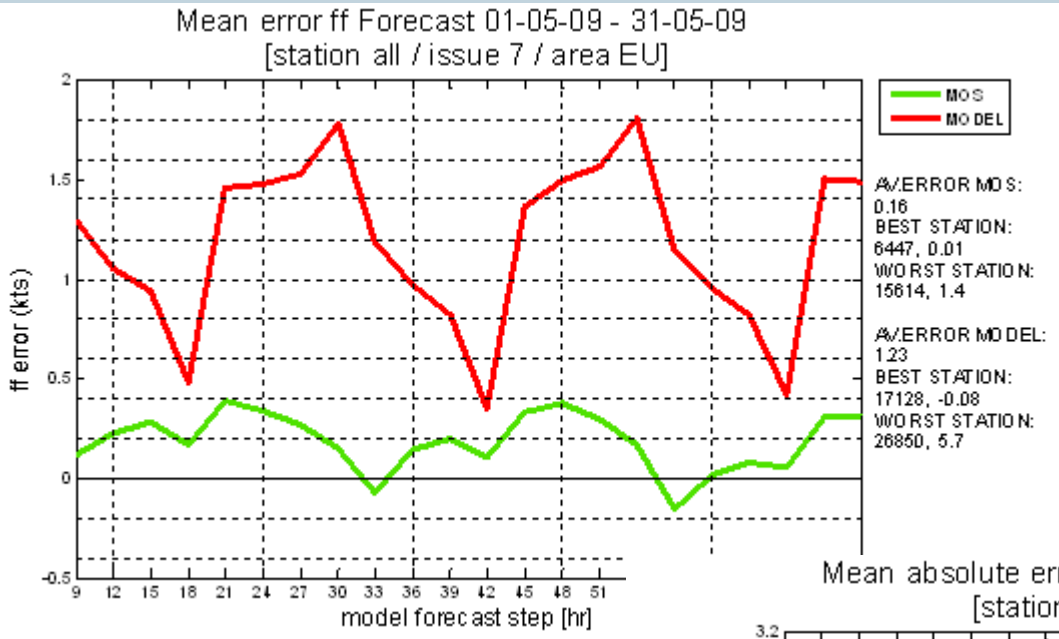
- Actual OBS, **Radar,Satellite**
  - ✓ **Improves nowcast and medium range (bias filters) if available**
- MOS forecast
  - ✓ Long update: 15 days ahead
  - ✓ Short update: 2 days ahead

Summary **MeteoGroup *MOS* *(2)***

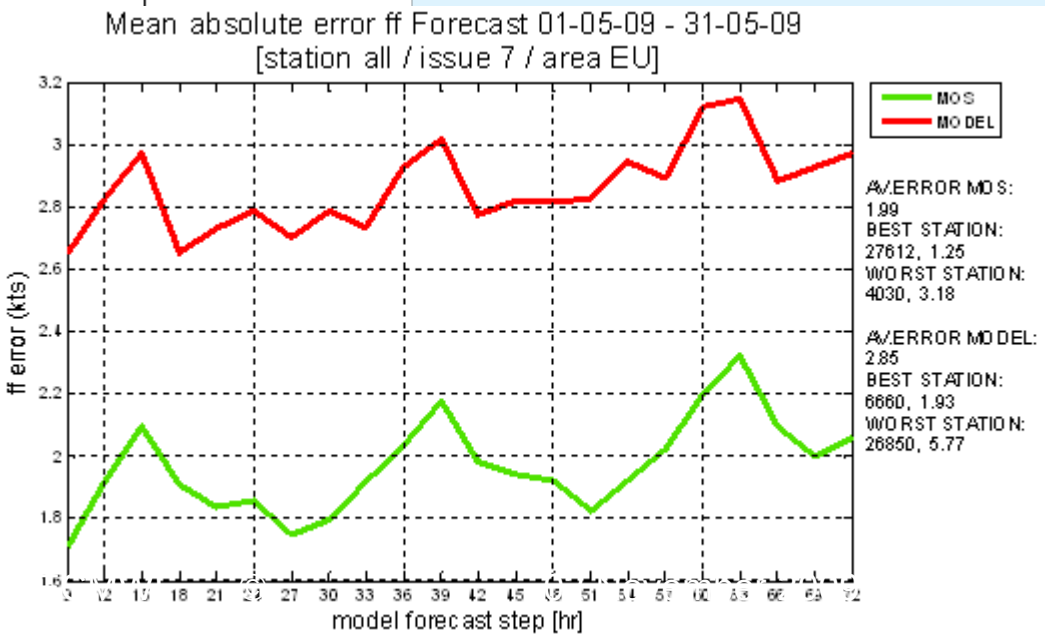
MeteoConsult

- Yearly updates (latest Oct 27)
- Worldwide
- No gaps, all stations have all elements hourly up to D15
- Postprocessing to derive special elements like
  - effective cloudiness
  - minimum & maximum amount of precip, fresh snow
  - type of precip if any
  - most significant weather past period (1,3,6,12,24h)
  - regional weather code
- Editable by forecaster

MOS: Wind verification



Bias (night&early morning) in model strongly reduced



Summary **MeteoGroup *MOS* *(3)***

MeteoConsult

Different types of downscaling

- In time (for elements not observed hourly)

- In space
  - Partial downscaling: element not observed at all
  - Complete downscaling: station without (enough) observations, non-WMO & Road stations, customer location
  - Virtual station: station in similar climate & height copied
  - To grid: downscaling to regular grid (10 or even 1km)

Important for road sites!

Precipitation nowcasts

MeteoConsult

- **Precipitation amount and probability improved with radar**
  1. **Radar declutter**
  2. **Expected radar**
  3. **Application: Radar *MOS***

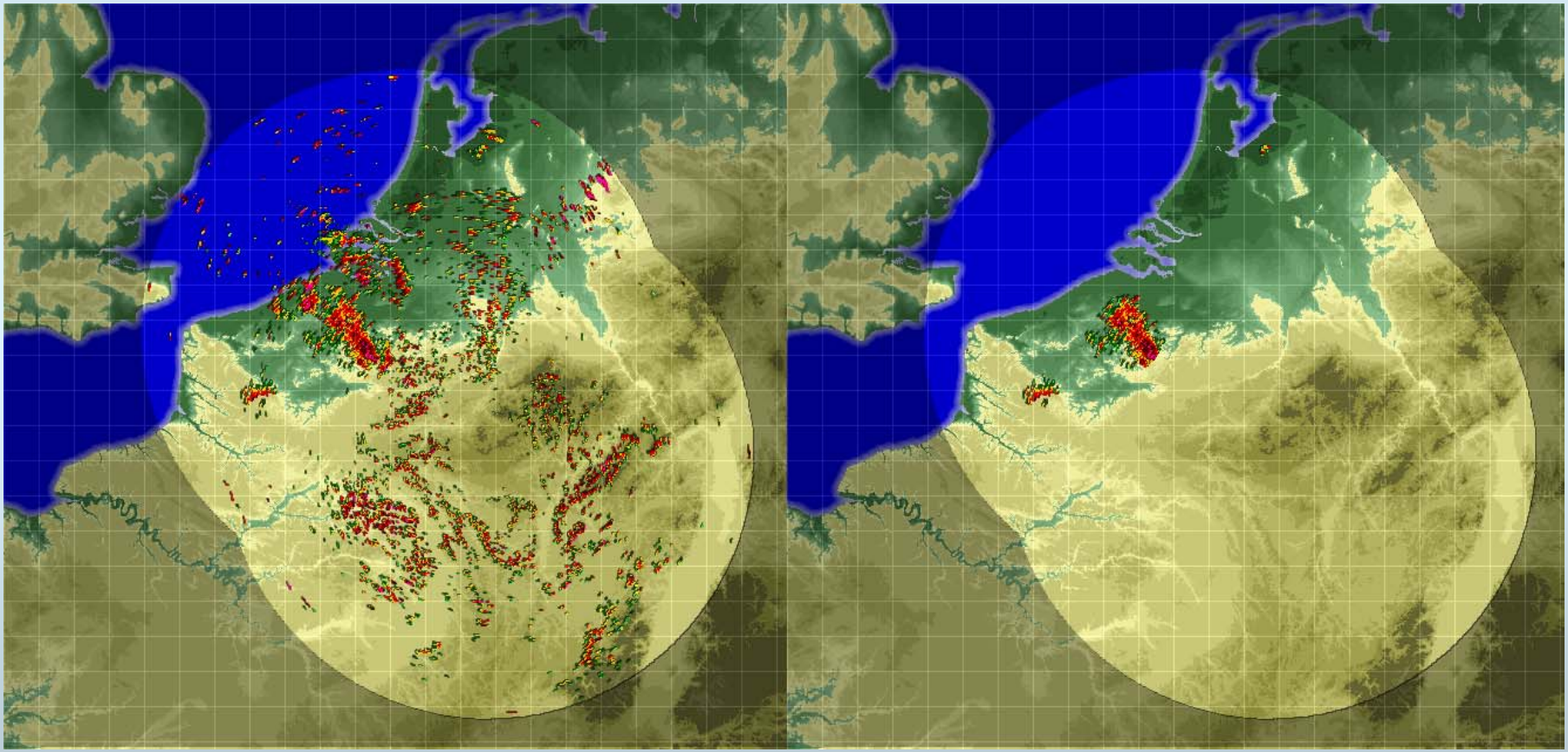
- Precipitation type and weather symbol
  1. Prob. weather types in ***MOS*** adjusted by SYNOP (METAR)
  2. Application: Radar precipitation type & Weather symbol

Both are input for hourly updates of applications like Road Model.

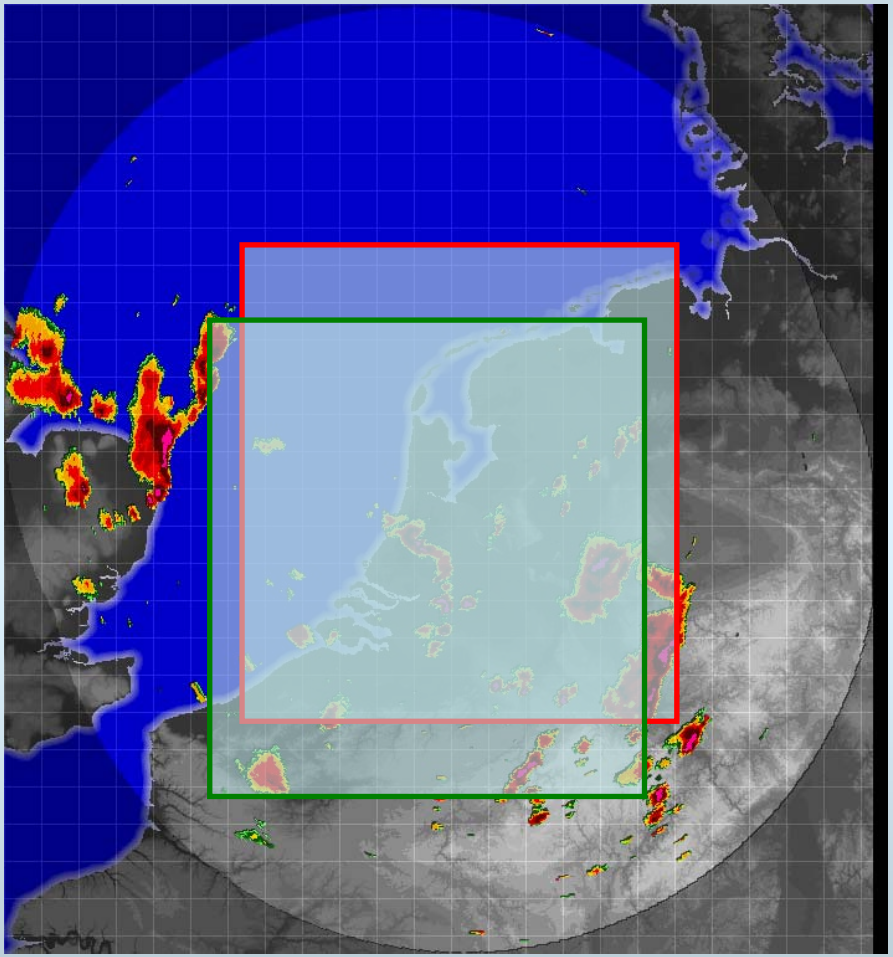
Radar declutter

MeteoConsult

Radar pre-processing, based on combination of methods, for each MG country



Expected Radar



t=-20 mins

- Operational:

  displacement with (ECMWF) pressure level steering winds,

  default or selected by forecaster

- New:

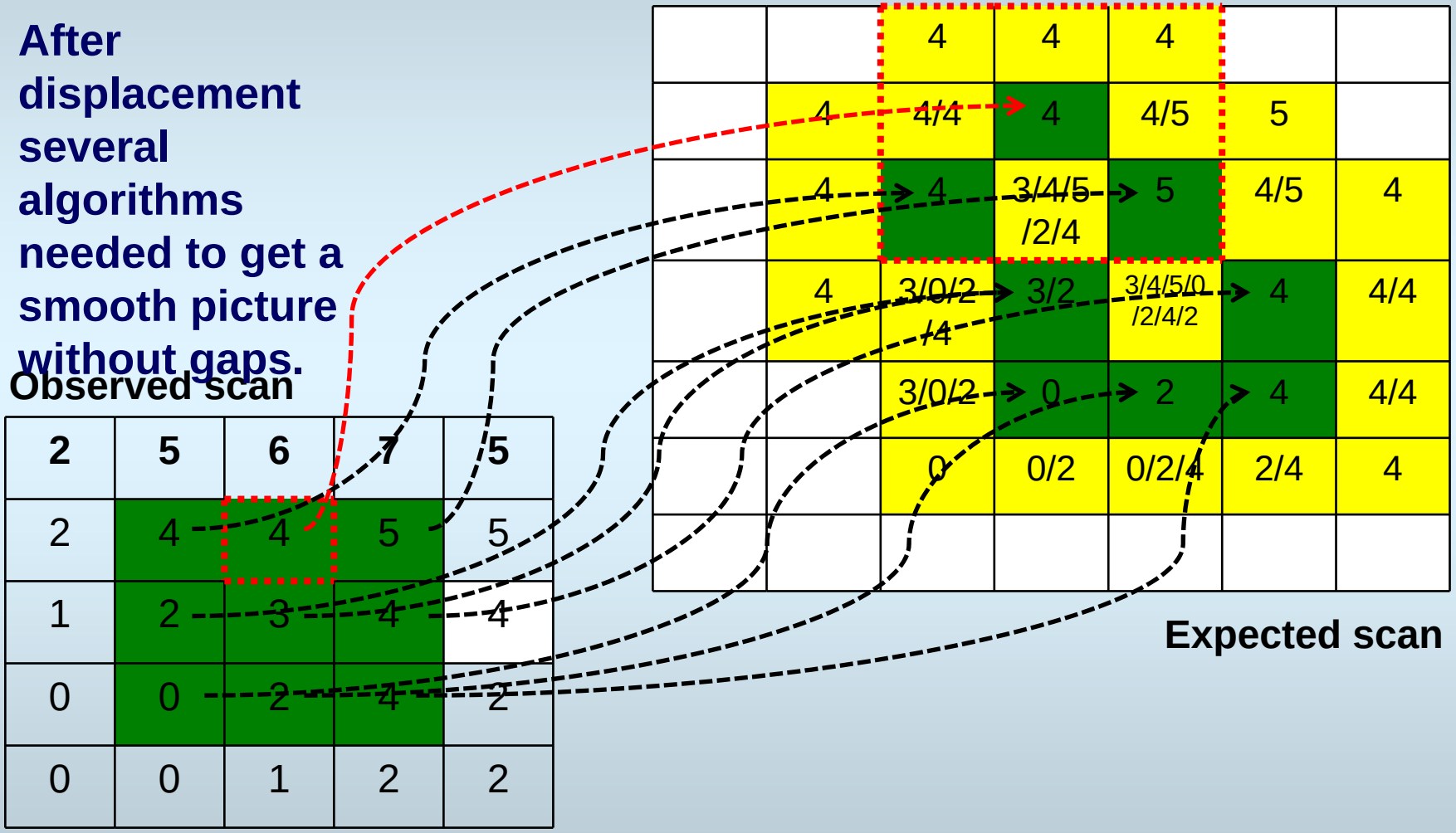
  method based on calculation of the displacement vectors between two radar scans that are 20 min apart in time;

  the algorithm starts with large boxes that stepwise reduce in size to ~10x10km.

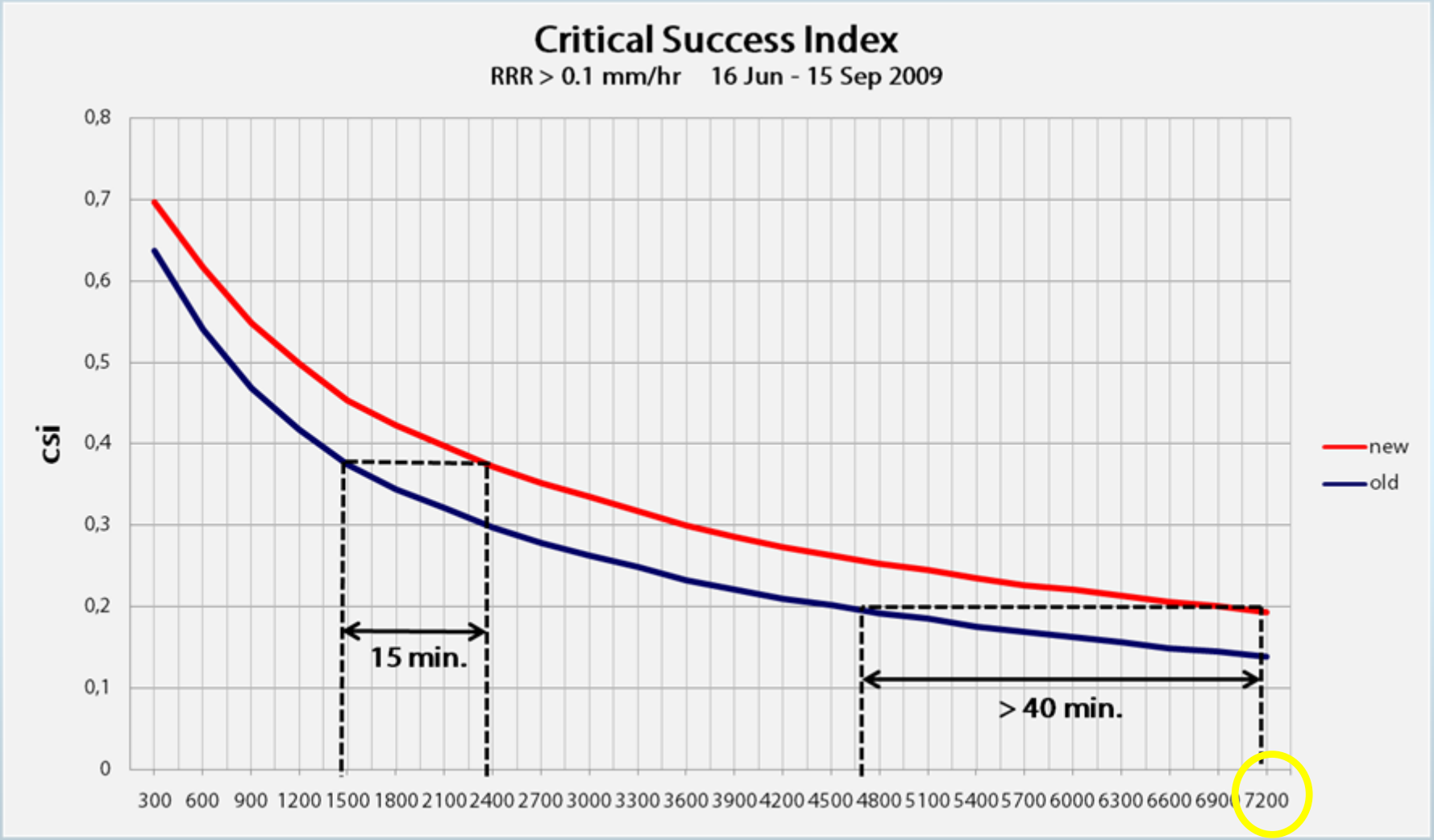
Expected radar (new)

MeteoConsult

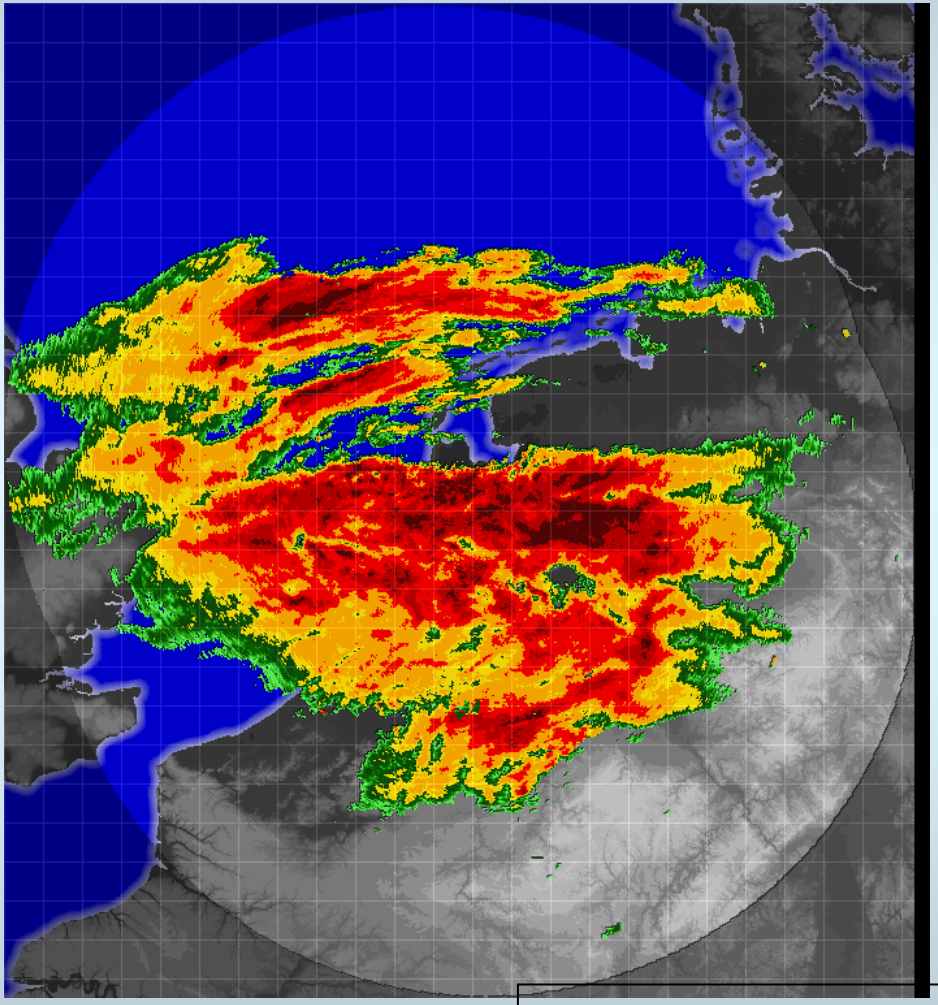
After displacement several algorithms needed to get a smooth picture without gaps.



Verification



Example: 16 Mar. 2008 05-08UTC



Grey topography ***-> observed radar scan 5'***

Coloured topography ***-> computed radar scan 15'***

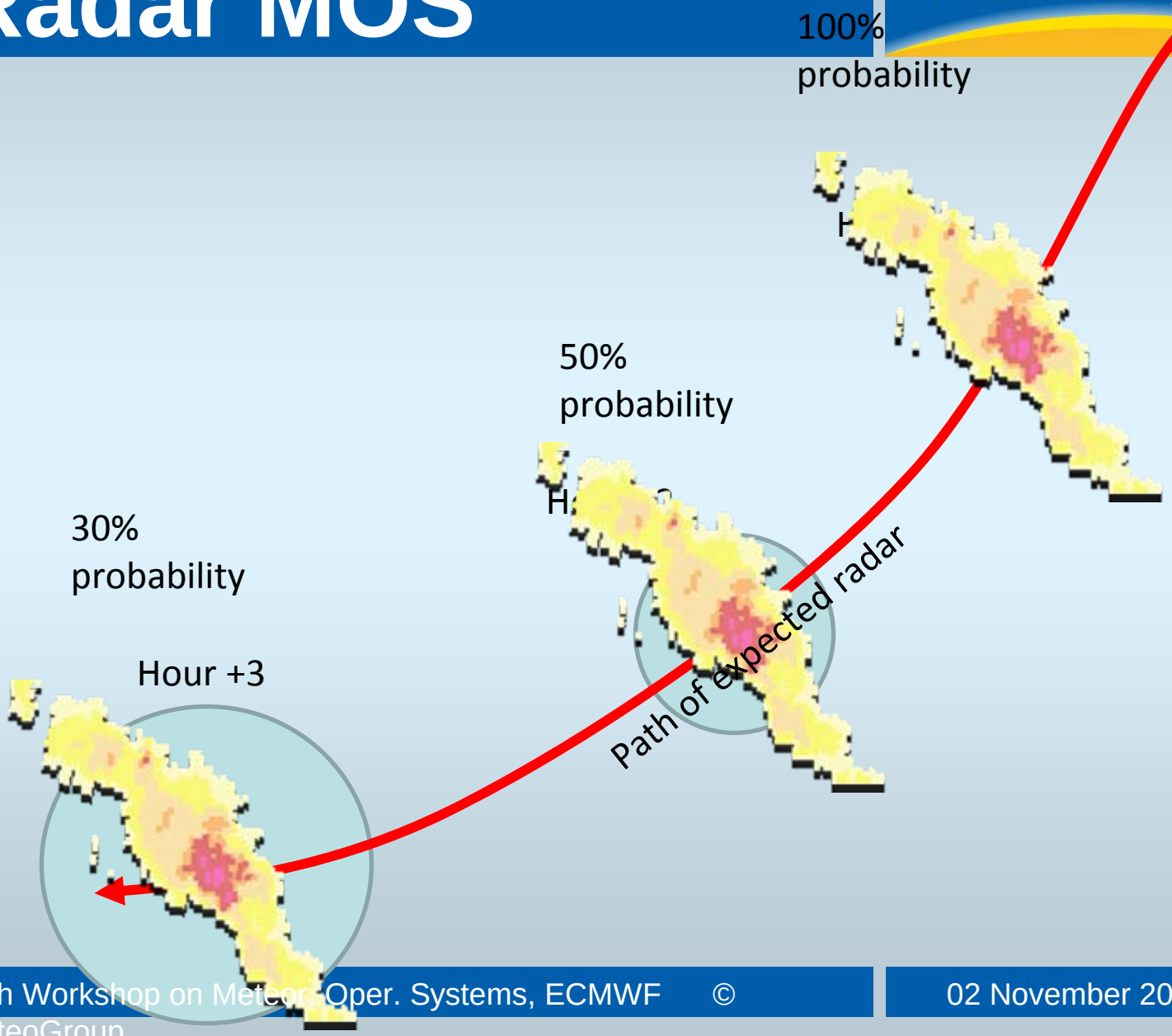
Application: Radar

MOS

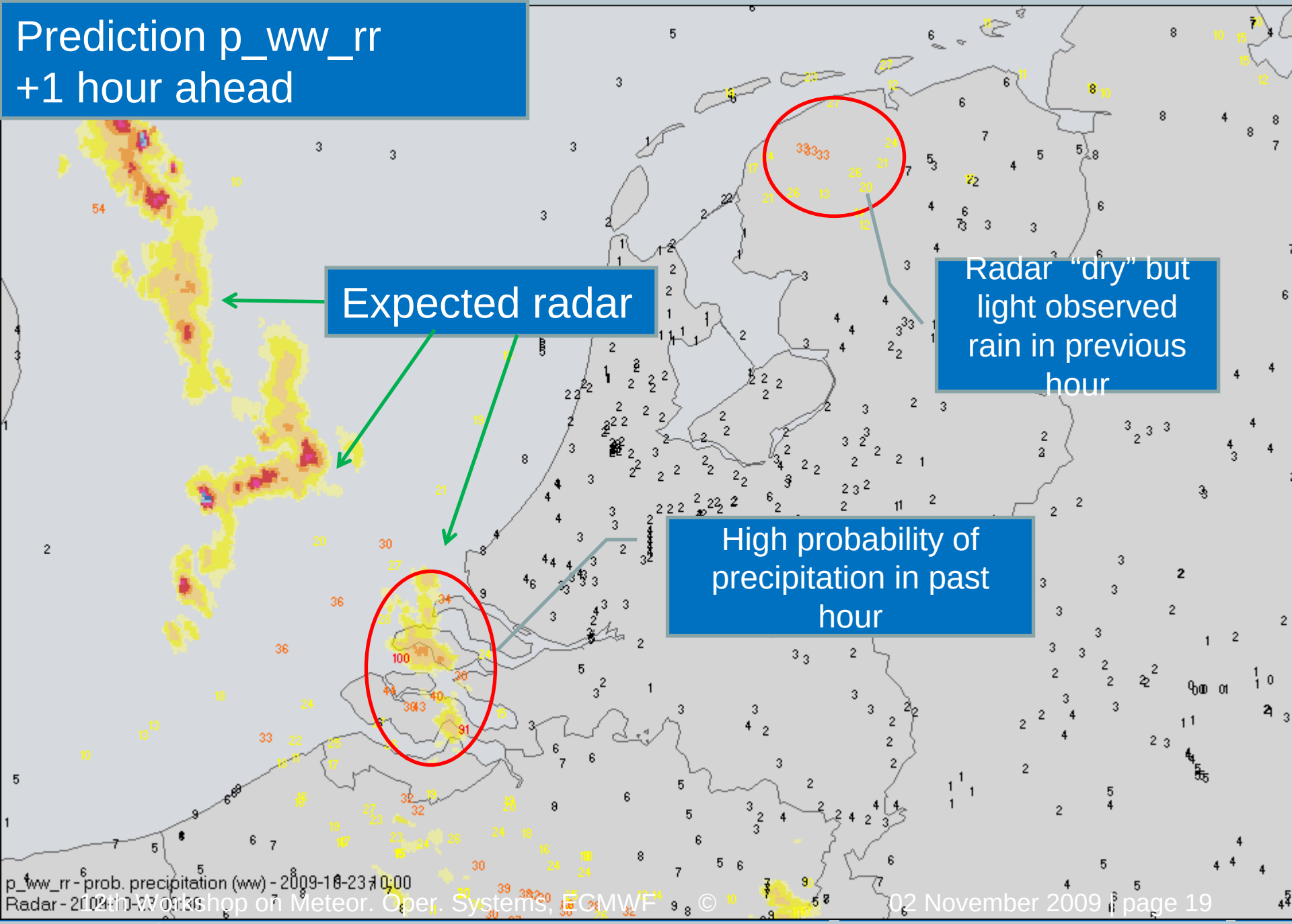
- Nowcast (HH+1,+2,+3) of precipitation amount/probability in ***MOS*** is adjusted by:
  - SYNOP observations (when available)
  - RADAR obs & forecast

    [timestep/radius/intensity of precipitation]

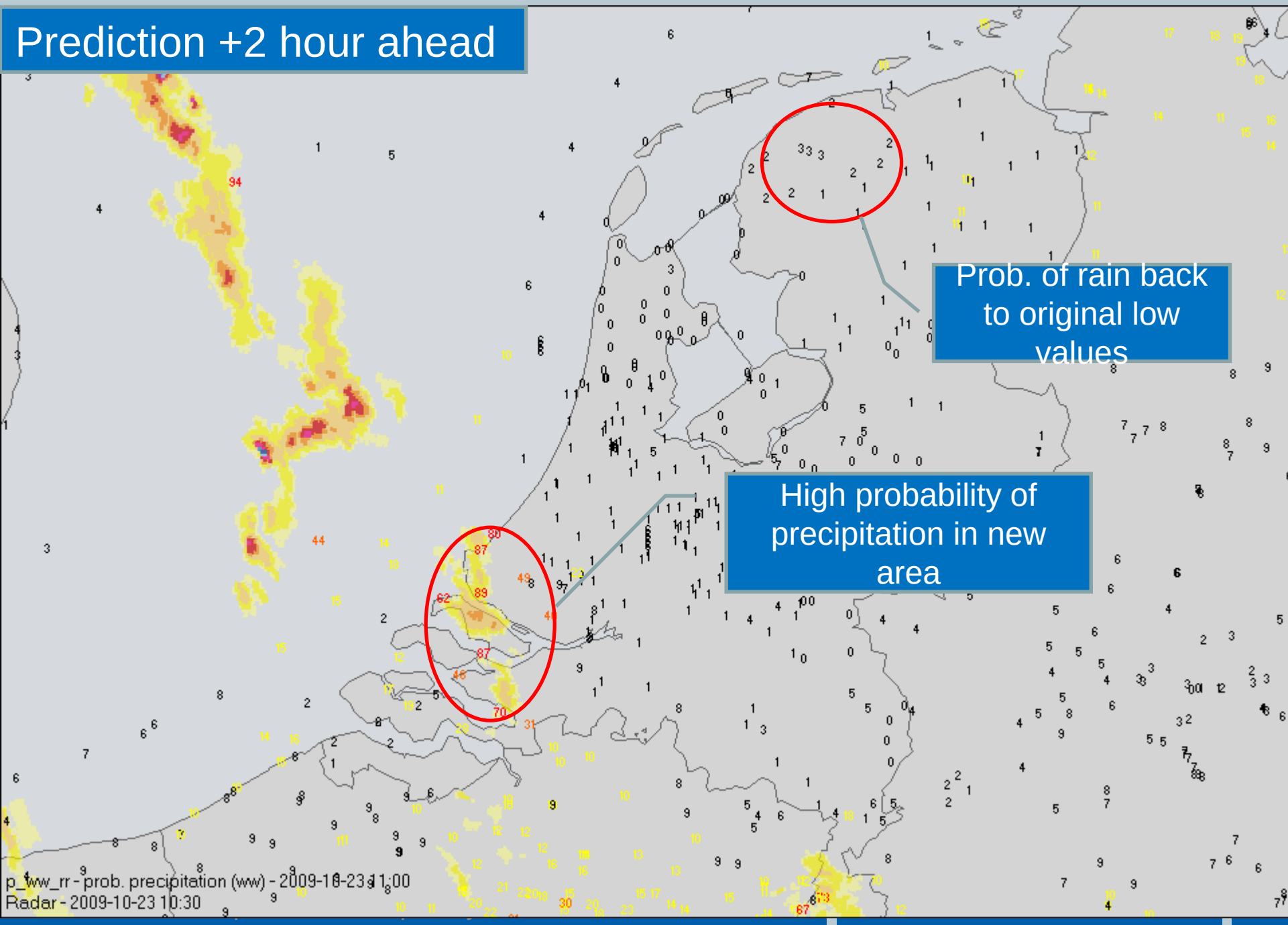
Radar MOS


100%
probability
50%
probability
30%
probability
Hour +3
Path of expected radar

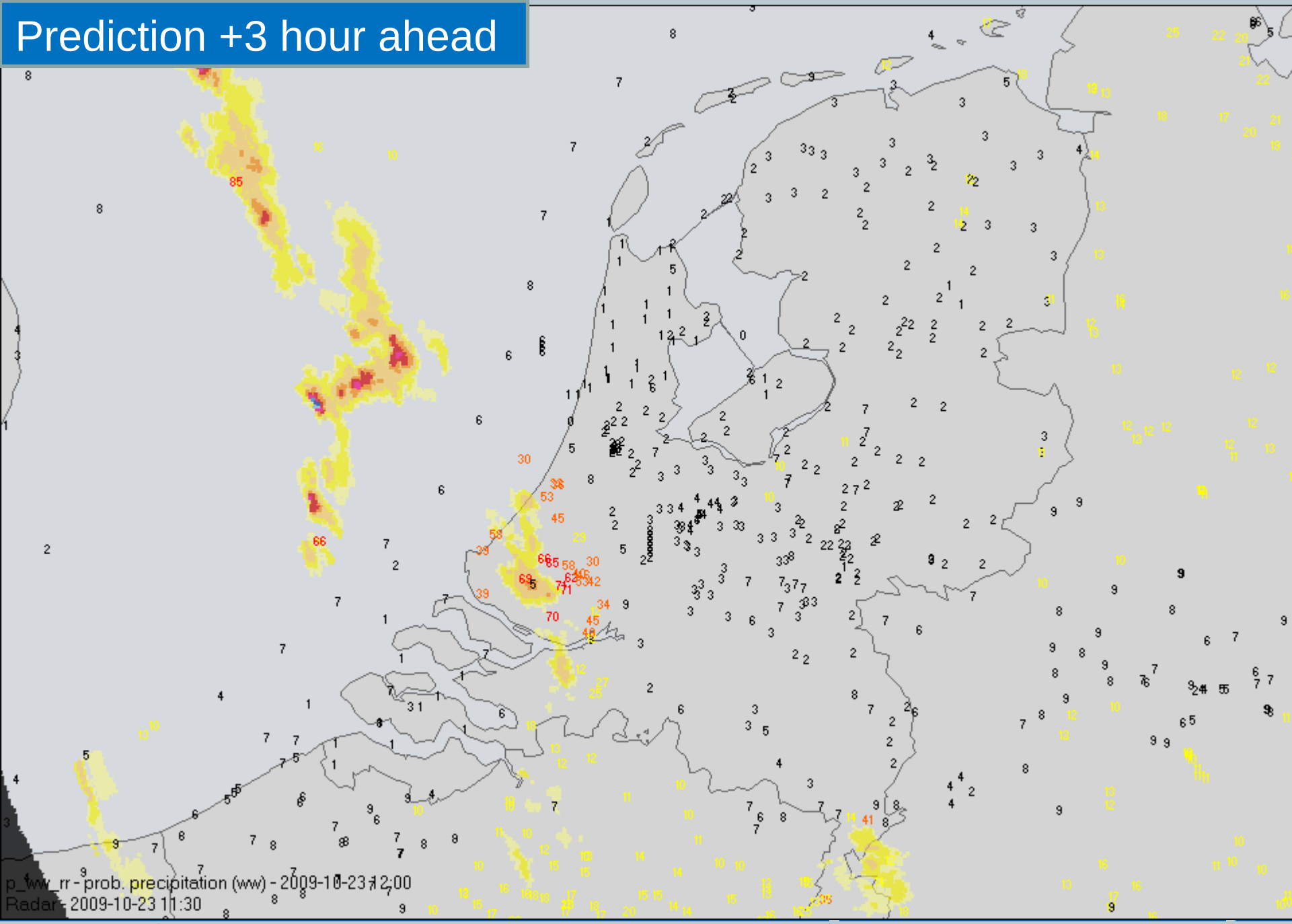
Prediction p_ww_rr +1 hour ahead



Prediction +2 hour ahead



Prediction +3 hour ahead



Precipitation nowcasts

MeteoConsult

- Precipitation amount and probability improved with radar
  1. Radar declutter
  2. Expected radar
  3. Application: Radar *MOS*

- **Precipitation type and weather symbol**
  1. **Prob. weather types in *MOS* adjusted by SYNOP (METAR)**
  2. **Application: Radar precipitation type & Weather symbol**

Both are input for hourly updates of applications like Road Model

Influence Obs → *MOS*

MeteoConsult

- Hourly observations influence directly (up to +6) and indirectly (bias filtering) results,

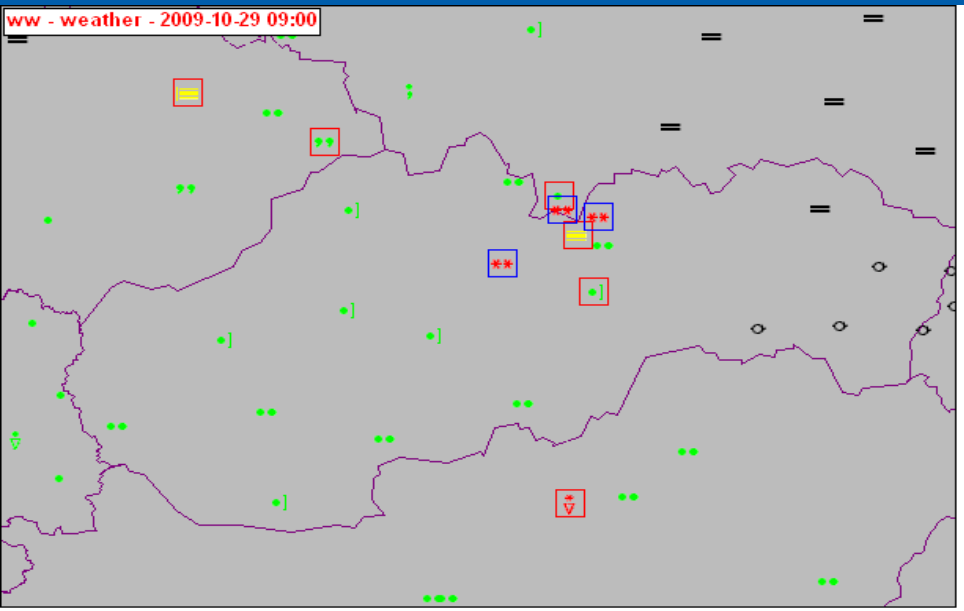
  which affect also elements like:
  - P_ww_rr: probability of wet weather type
  - P_ww_ha: probability of hail
  - P_ww_sn: probability of snow
  - P_ww_fr: probability of freezing rain

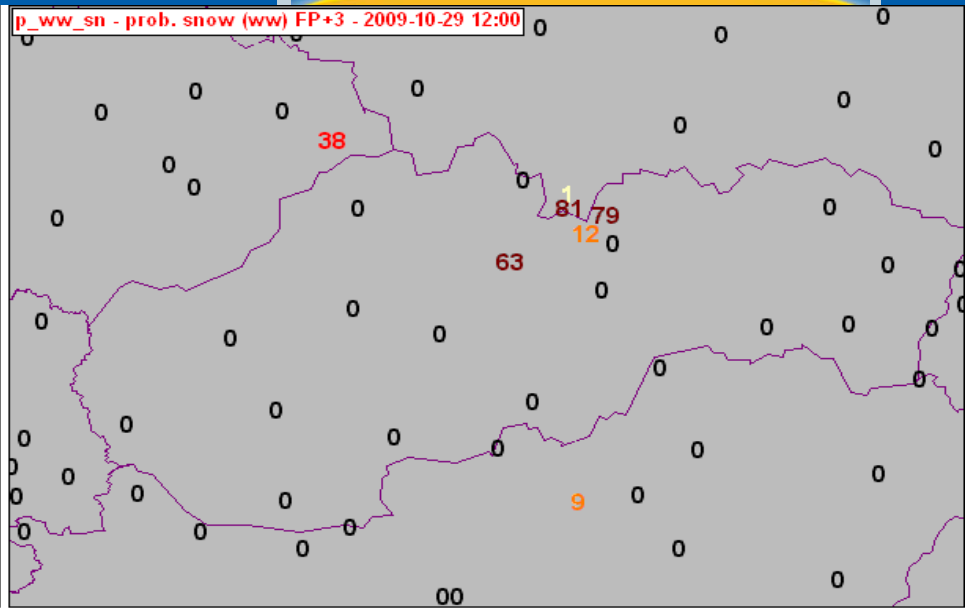
  →improved ***MOS*** precipitation type, weather code

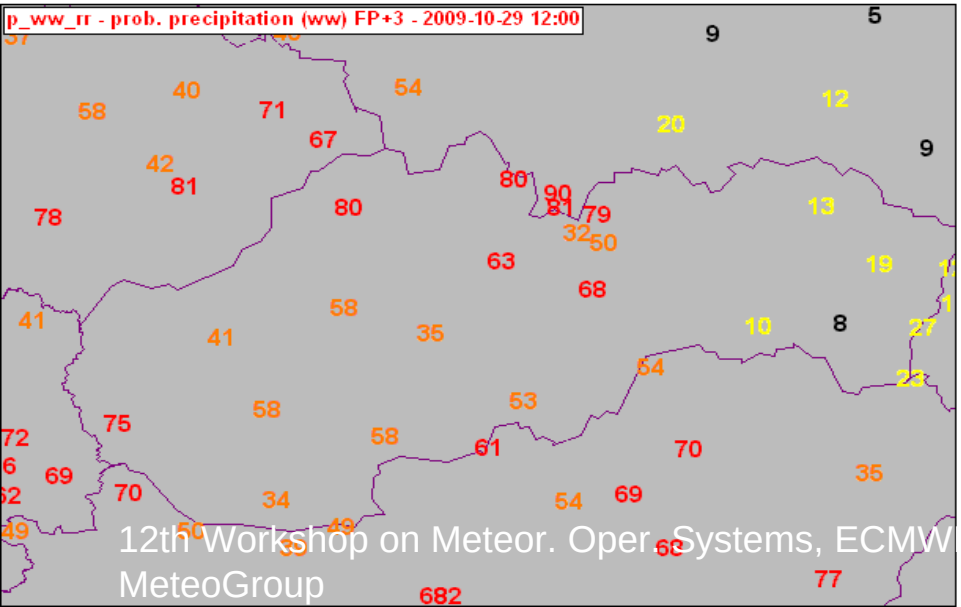
  →improved radar precipitation type

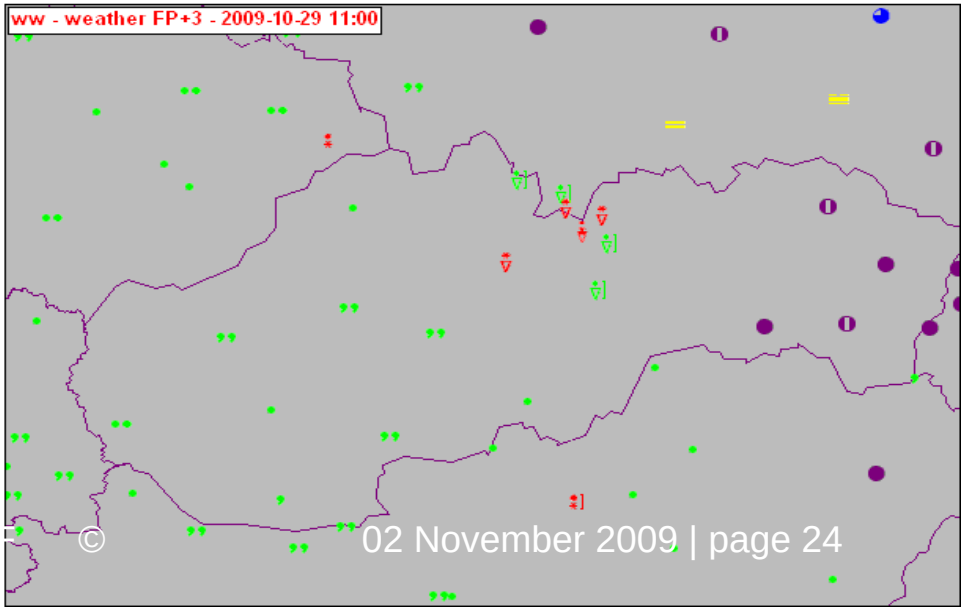
Influence Obs → *MOS*

MeteoConsult





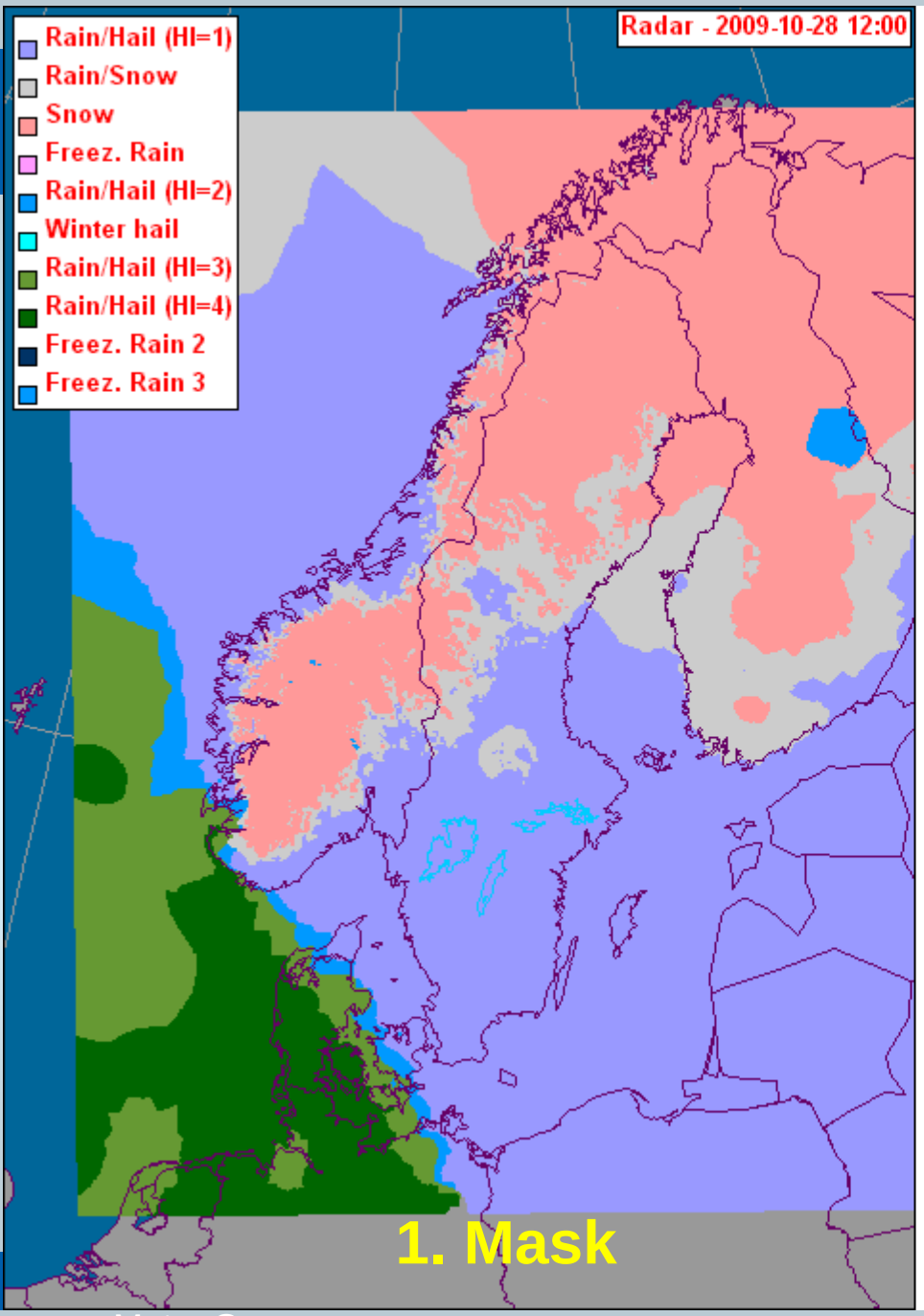


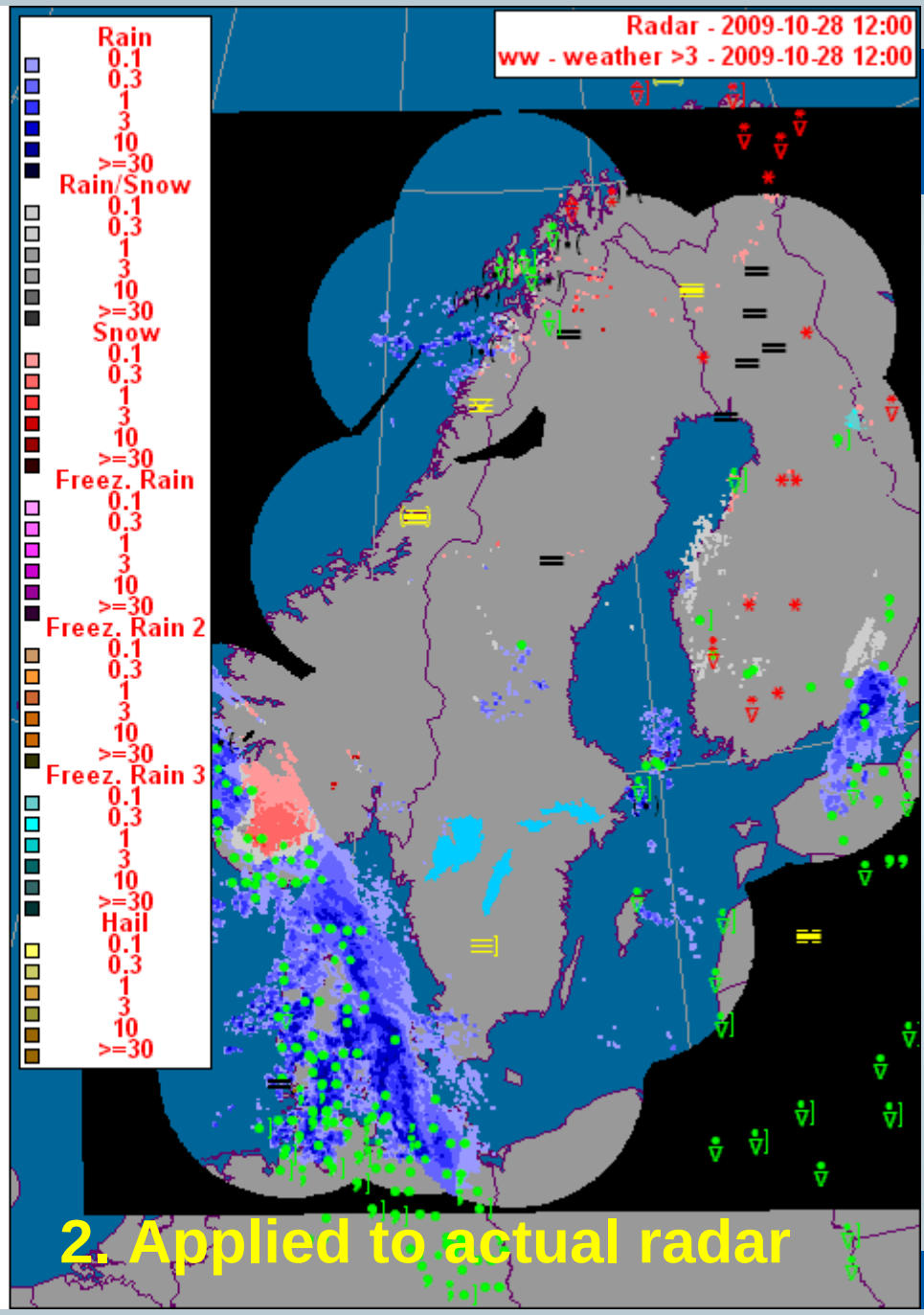


Radar Precip type

MeteoConsult

- Radar precip type based on ***MOS*** (WMO stations and virtual stations offshore) and GTOPO-30 data
  - Rain or summer hail *[ECMWF sigma level TW]*
  - Rain, sleet, snow, winter hail
  - Freezing rain (air, road, air+road) *[Road obs & Road model]*
- Different algorithms over sea, land
- Special algorithms for mountains *[ECMWF derived element snmin, "snow certain above this height"]*


Radar - 2009-10-28 12:00
Rain/Hail (Hl=1)
Rain/Snow
Snow
Freez. Rain
Rain/Hail (Hl=2)
Winter hail
Rain/Hail (Hl=3)
Rain/Hail (Hl=4)
Freez. Rain 2
Freez. Rain 3
1. Mask


Radar - 2009-10-28 12:00
ww - weather >3 - 2009-10-28 12:00
Rain
0.1
0.3
1
3
10
>=30
Rain/Snow
0.1
0.3
1
3
10
>=30
Snow
0.1
0.3
1
3
10
>=30
Freez. Rain
0.1
0.3
1
3
10
>=30
Freez. Rain 2
0.1
0.3
1
3
10
>=30
Freez. Rain 3
0.1
0.3
1
3
10
>=30
Hail
0.1
0.3
1
3
10
>=30
2. Applied to actual radar

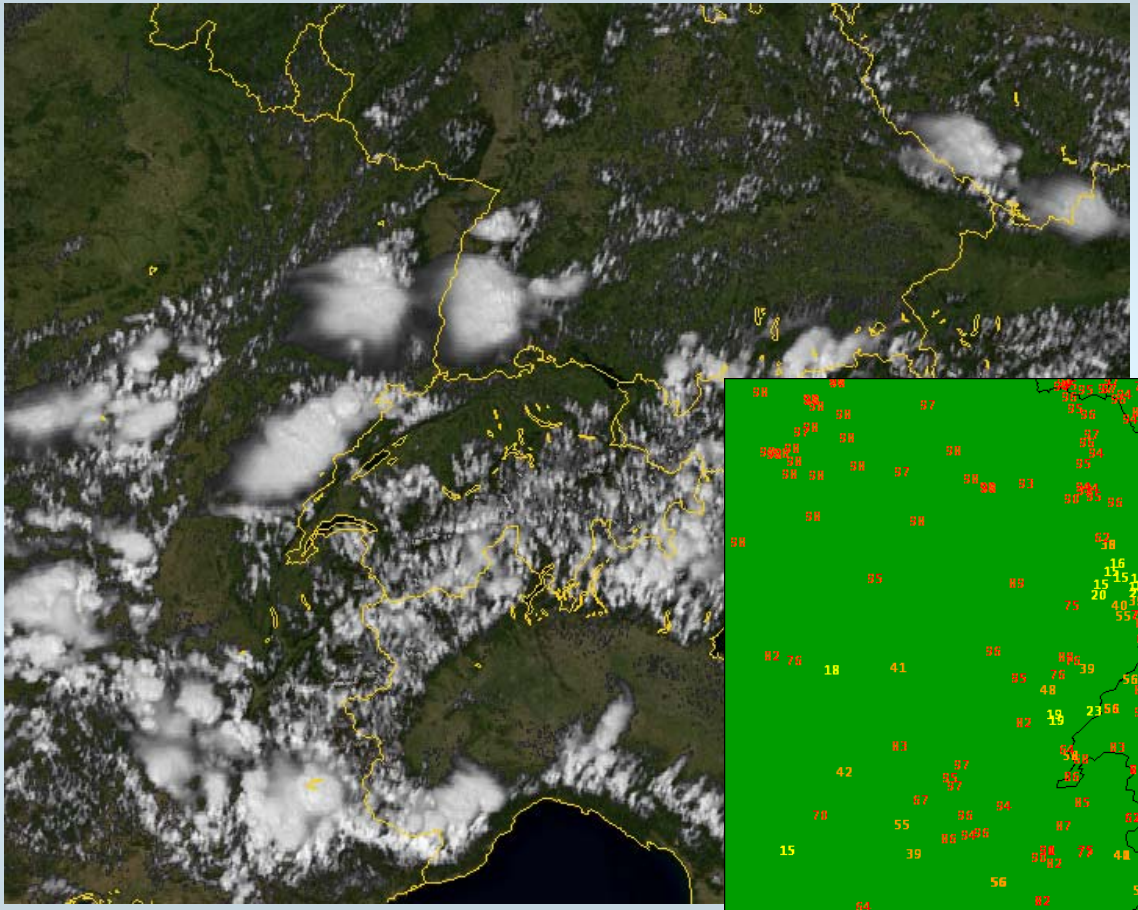
Cloud (radiation) nowcasts

- Effective amount (octa) and global radiation (%), day
  1. MSG satellite picture (VIS)
  2. Expected cloud fields *[steering: ECMWF pressure level winds]*
  3. Application: Satellite *MOS*

- Effective amount (octa), night
  1. History of virtual cloud observations (reversed road model)
  2. *MOS* cloud forecast at Road station

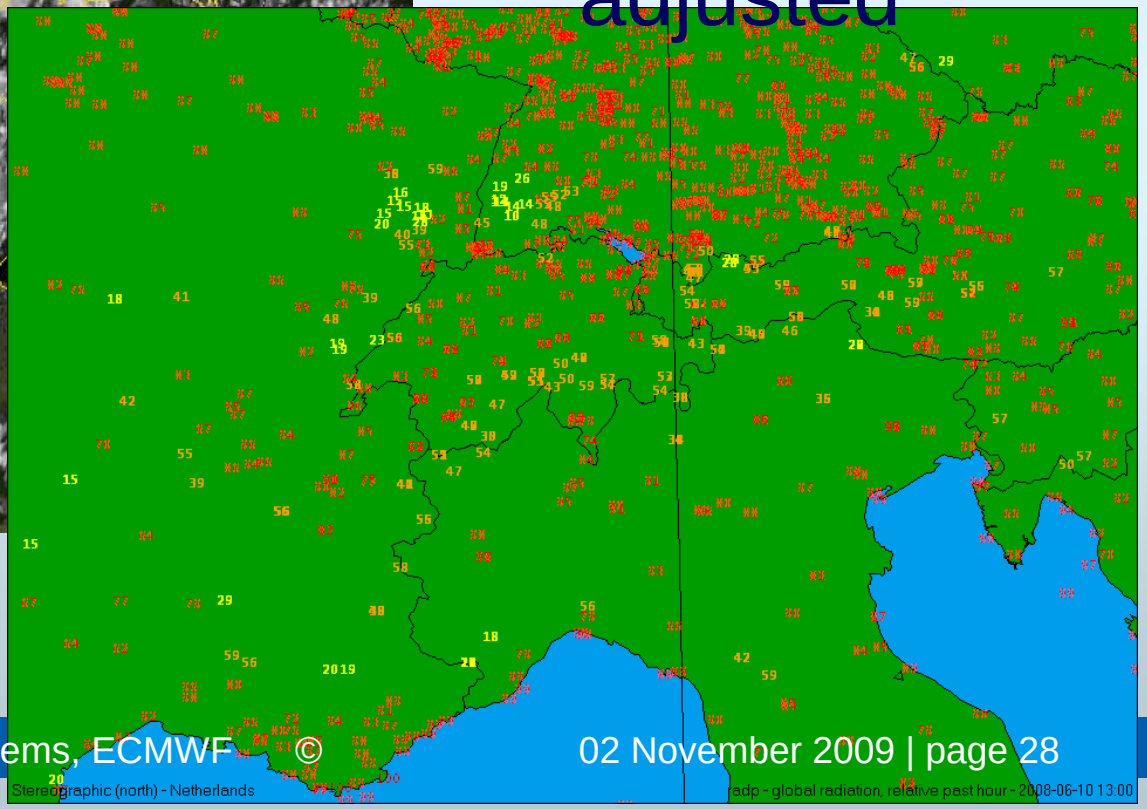
Satellite MOS

MeteoConsult



10 June 2008

Rad(%) adjusted



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Automatic fronts

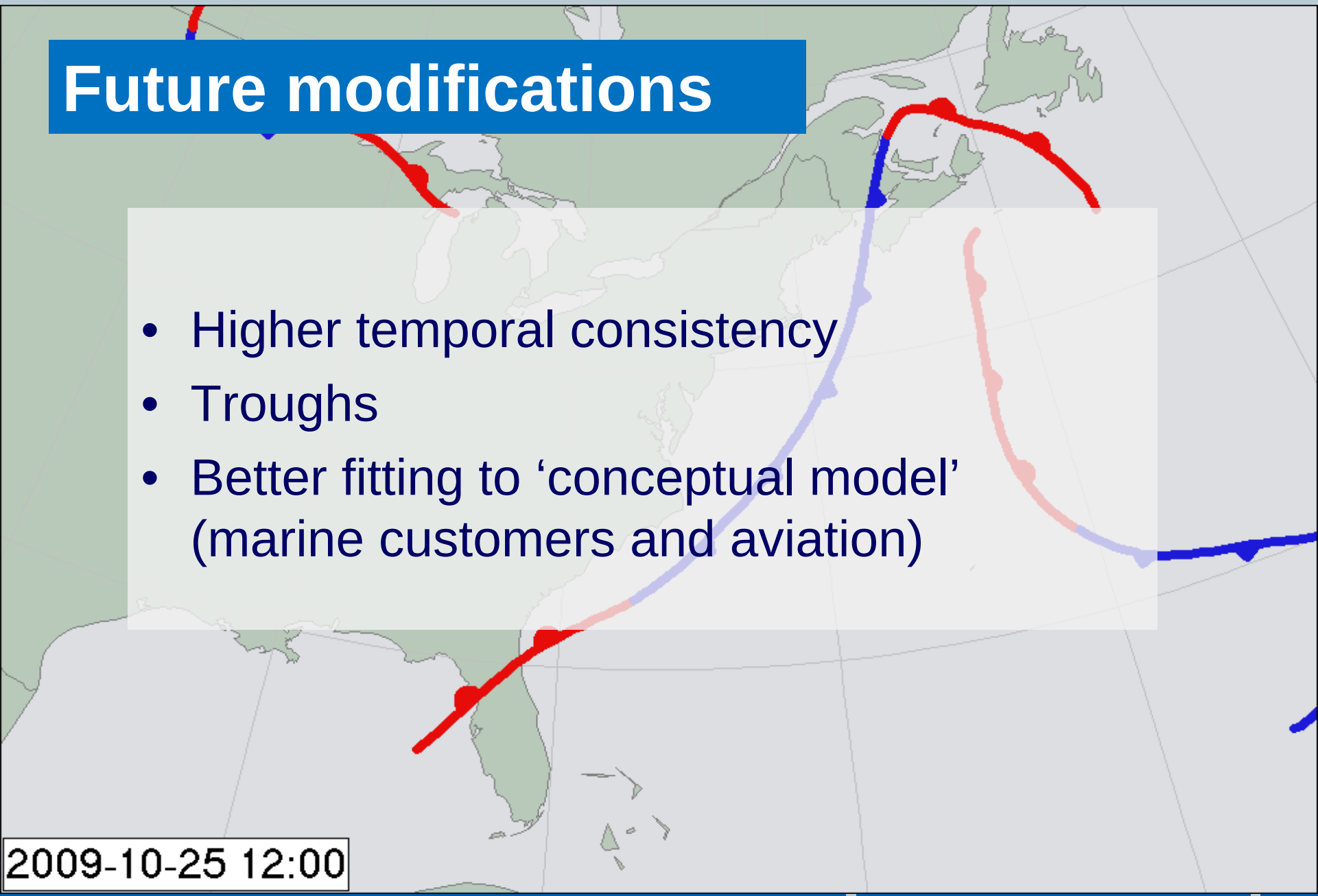
Goal:
Draw significant frontal systems automatically on a weather map.

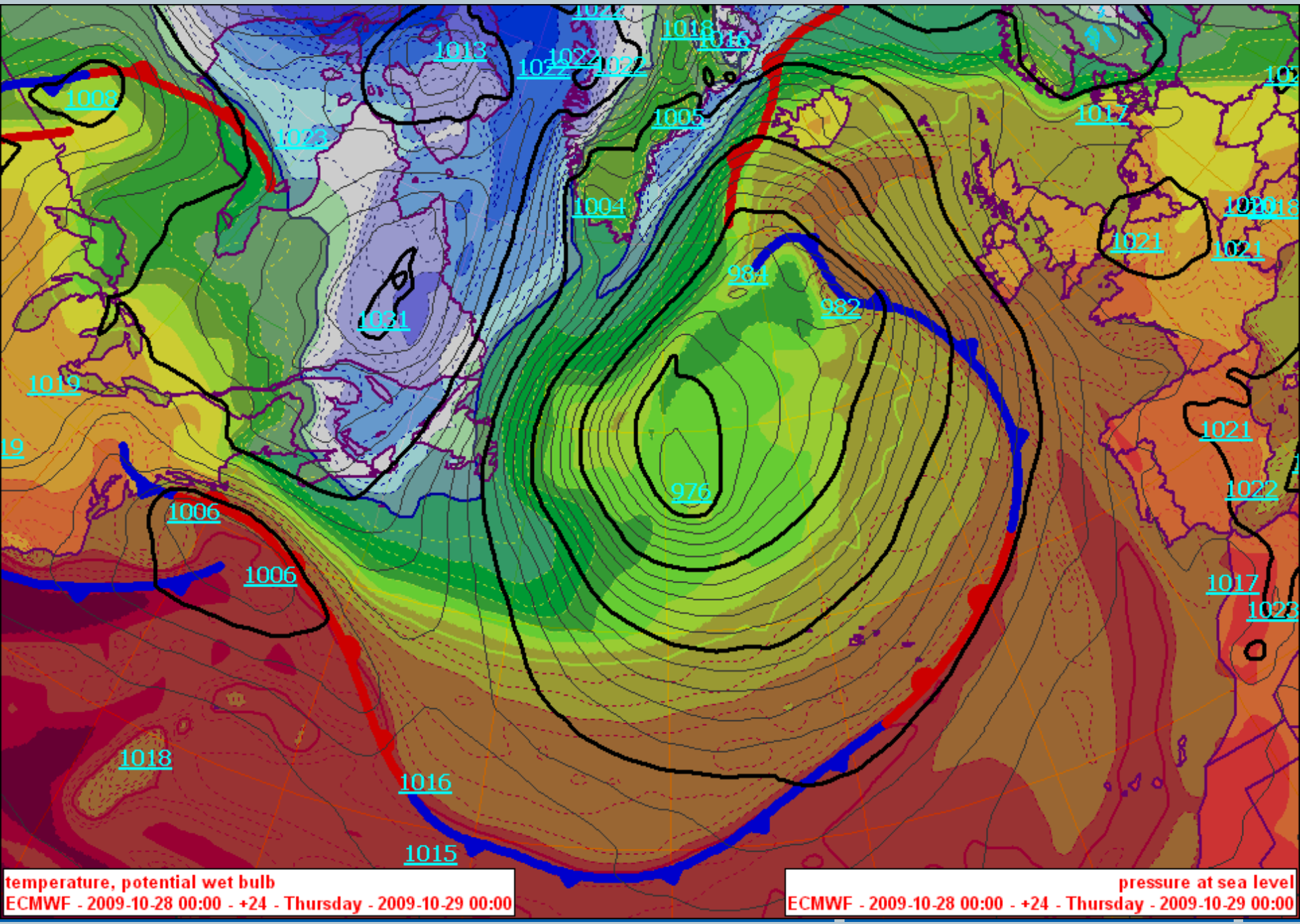
Method:

- Step 1: Determine all frontal systems using
  - ✓ Thermal front parameter at 925 hPa
  - ✓ Relative humidity fields at 925/850/700 hPa
  - ✓ Surface precipitation fields
  - ✓ Θ_w fields
- Step 2: Merge frontal systems that belong to each other
- Step 3: Select significant frontal systems
- Step 4: Determine type of front: cold/warm/occlusion

Future modifications

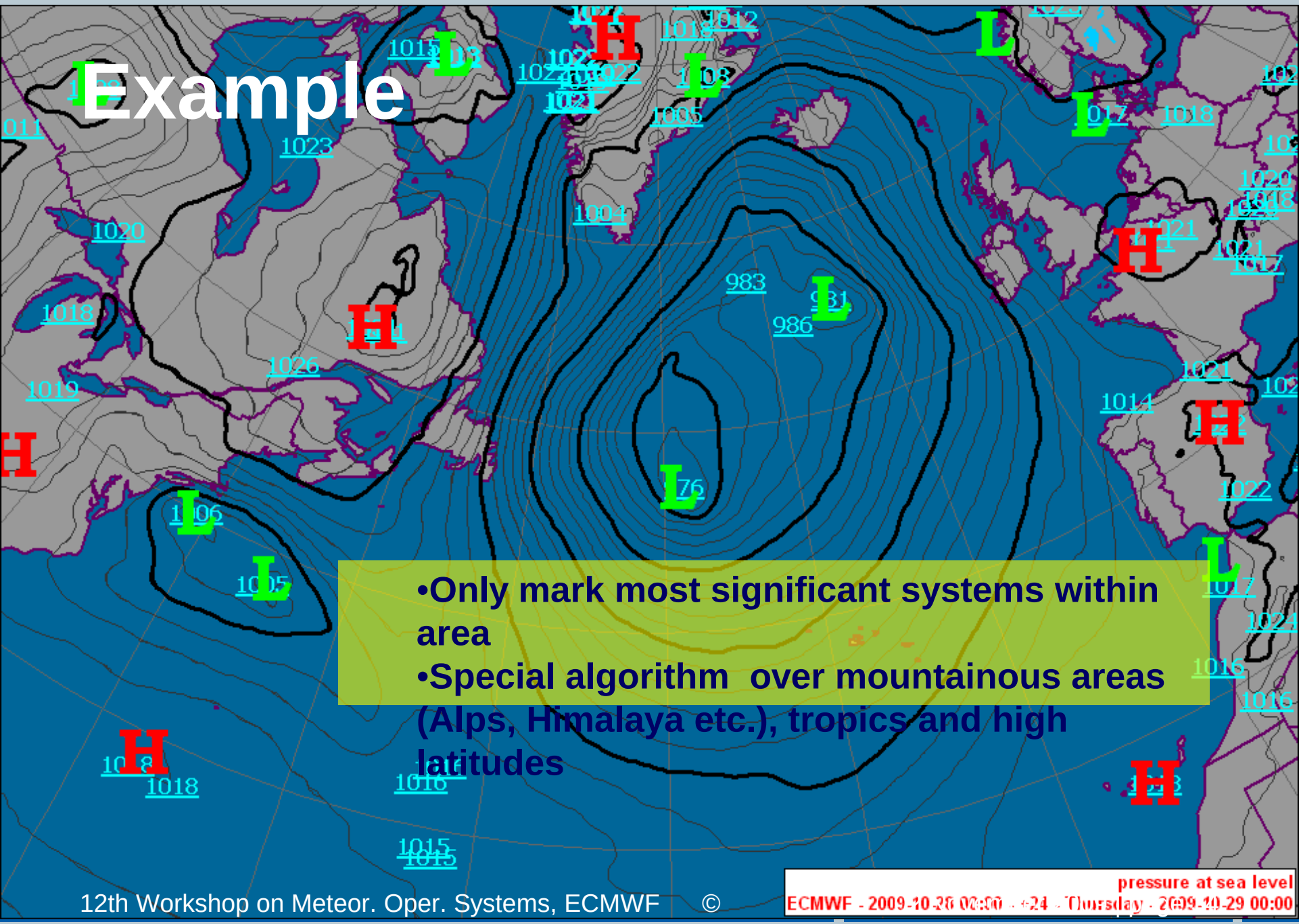
- Higher temporal consistency
- Troughs
- Better fitting to ‘conceptual model’ (marine customers and aviation)




1008
1013
1022
1022
1018
1016
1005
1017
1023
1004
1021
1021
984
982
1031
1019
1021
976
1022
1006
1006
1017
1023
1018
1016
1015
temperature, potential wet bulb
ECMWF - 2009-10-28 00:00 - +24 - Thursday - 2009-10-29 00:00
pressure at sea level
ECMWF - 2009-10-28 00:00 - +24 - Thursday - 2009-10-29 00:00

Marine Autotext

- *Goal:* make automatic forecasts for marine sector to decrease work load of duty forecasters.
- *Based on:* Nautical MeteoBase, a mixture of different models *[ECMWF, UKMO, GFS, HiRLAM]*
- *Text describes for a customer location:*
  - Pressure systems, in order of significance
  - Tropical systems (if present)
  - Local conditions (wind speed and direction, sea temperature, sea and swell height etc.)


Example
•Only mark most significant systems within area
•Special algorithm over mountainous areas (Alps, Himalaya etc.), tropics and high latitudes
pressure at sea level
ECMWF - 2009-10-26 00:00 - +24 - Thursday - 2009-10-29 00:00

Example – autotext

Text for 51.00 N 1.00 W (23-10-2009):

A deepening low pressure system (982 hPa) is positioned over the northern Atlantic (52N/32W) at 12 UTC. On 24 October, it will fill and move northeast. During the next days, it is expected to dissipate.

On 24 October 00 UTC, a deepening low (991 hPa) will be positioned over the northern Atlantic (51N/16W) and is expected to move towards the Hebrides (59N/08W) on that day. Afterwards, it is forecast to fill and to move east.

A high pressure system (1023 hPa) is expected over central Spain (39N/05W) on 24 October.

Local conditions next 72 hrs:

Wind: SW-ly, light, increasing to fresh breeze on 24 October 12 UTC.

Visibility: temporarily moderate.

Sea temperature: 15-16C.

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- Future applications

Road network forecast

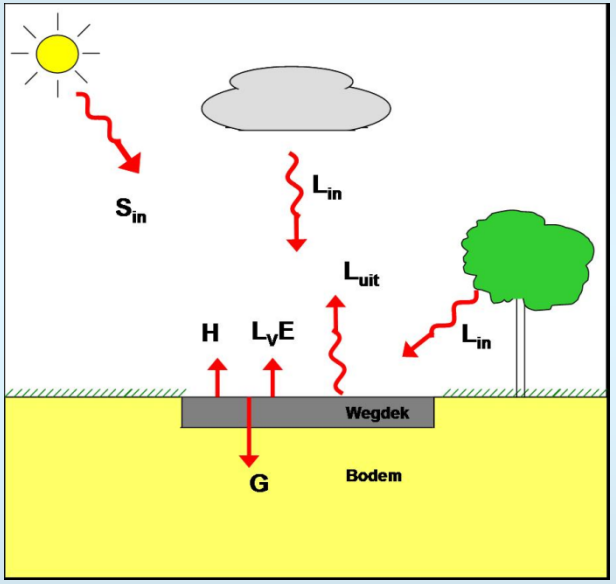
- Road model
  - Physical part, location based
  - Statistical part (ECMWF,….. → ***MOS***)
- Network model
- Network forecast

Road model (site specific)

Input elements (Obs & *MOS*):

- Air temperature
- Cloudiness
- Dewpoint temperature
- Precipitation
- Wind speed
- Soil temperature
- Soil type
- Road type (bridge?)

Energy balance method

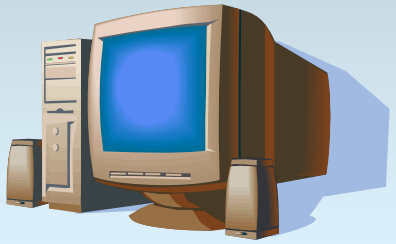


Road surface temperature

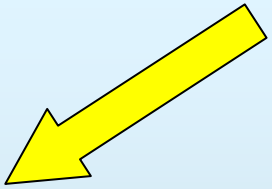
Winter road maintenance = route

MeteoConsult

Weather and
Road condition
forecast along
route

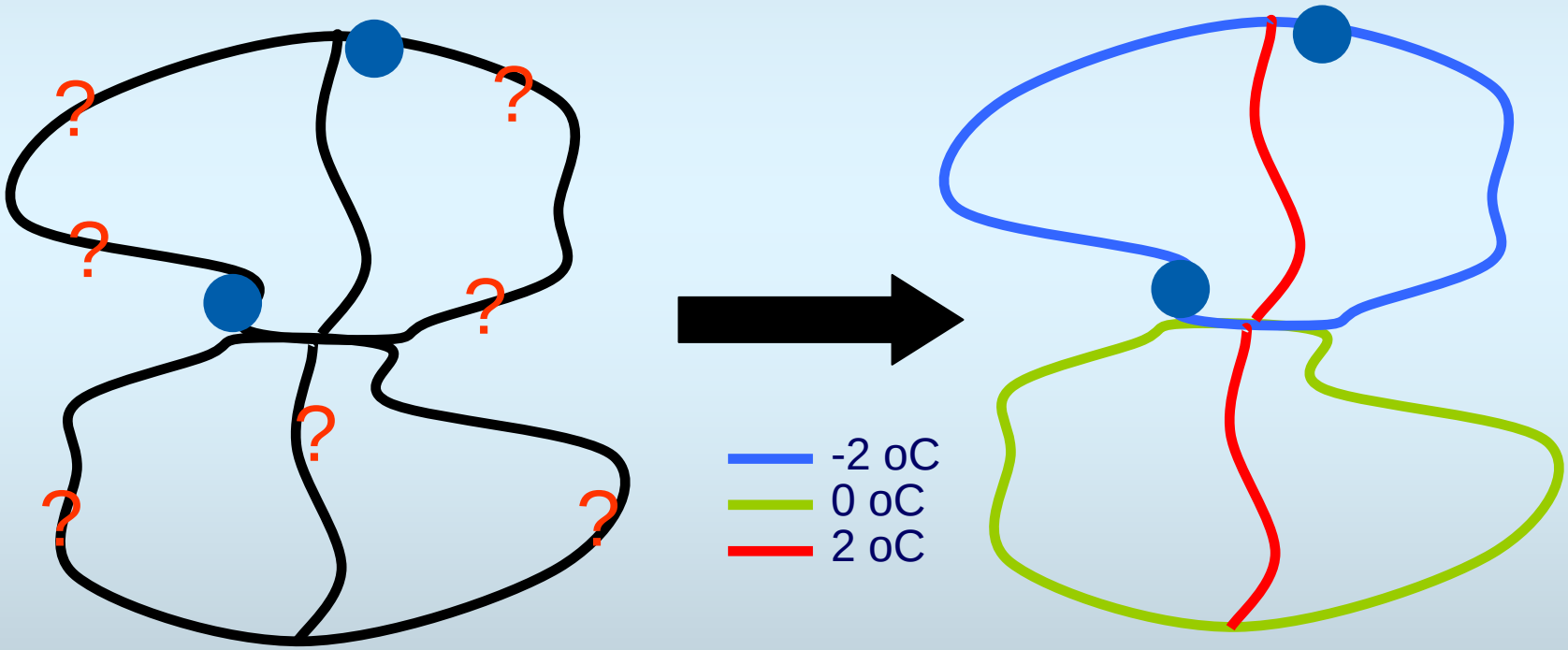


Route and
salting
optimalization



Network model

From **point** forecast to a **route** forecast

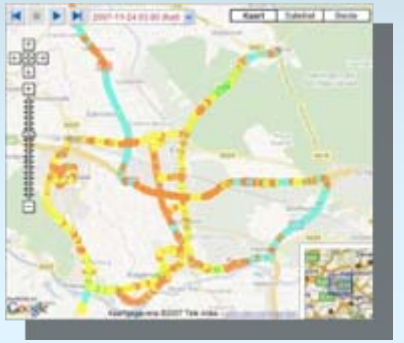


Network model

MeteoConsult

Gridded ***MOS***
high resolution
weather forecast
(10 x10 km)

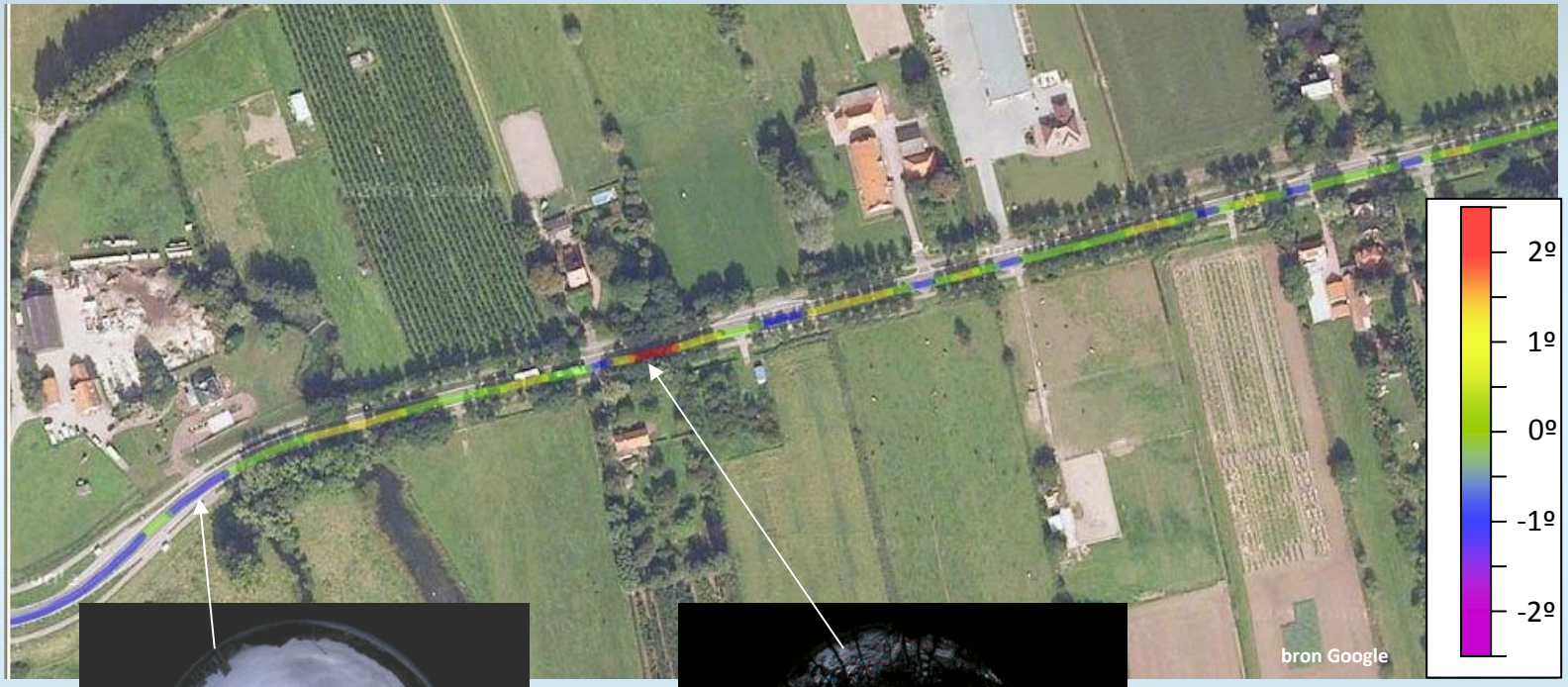
Calculating model for road surface temperatures on routes

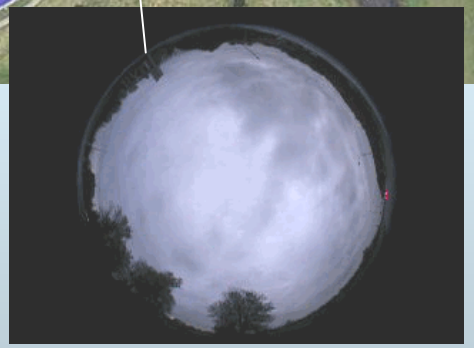


Network forecast

Database with data for all routes:
***sky* and *sun* view factor**

Example Troad & sky-view



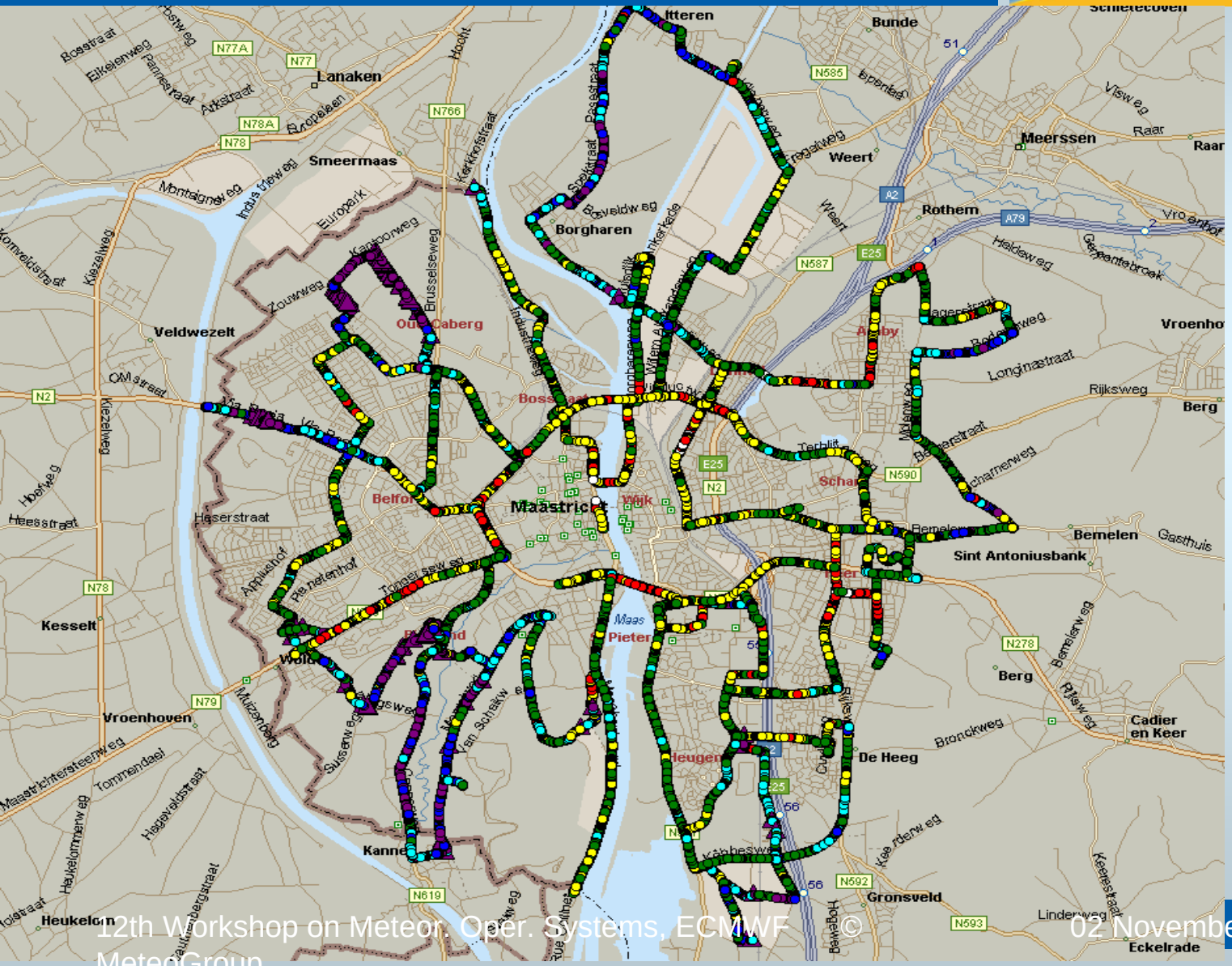


Sky view factor = 0.89

Sky view factor = 0.36

Example thermal map city of Maastricht

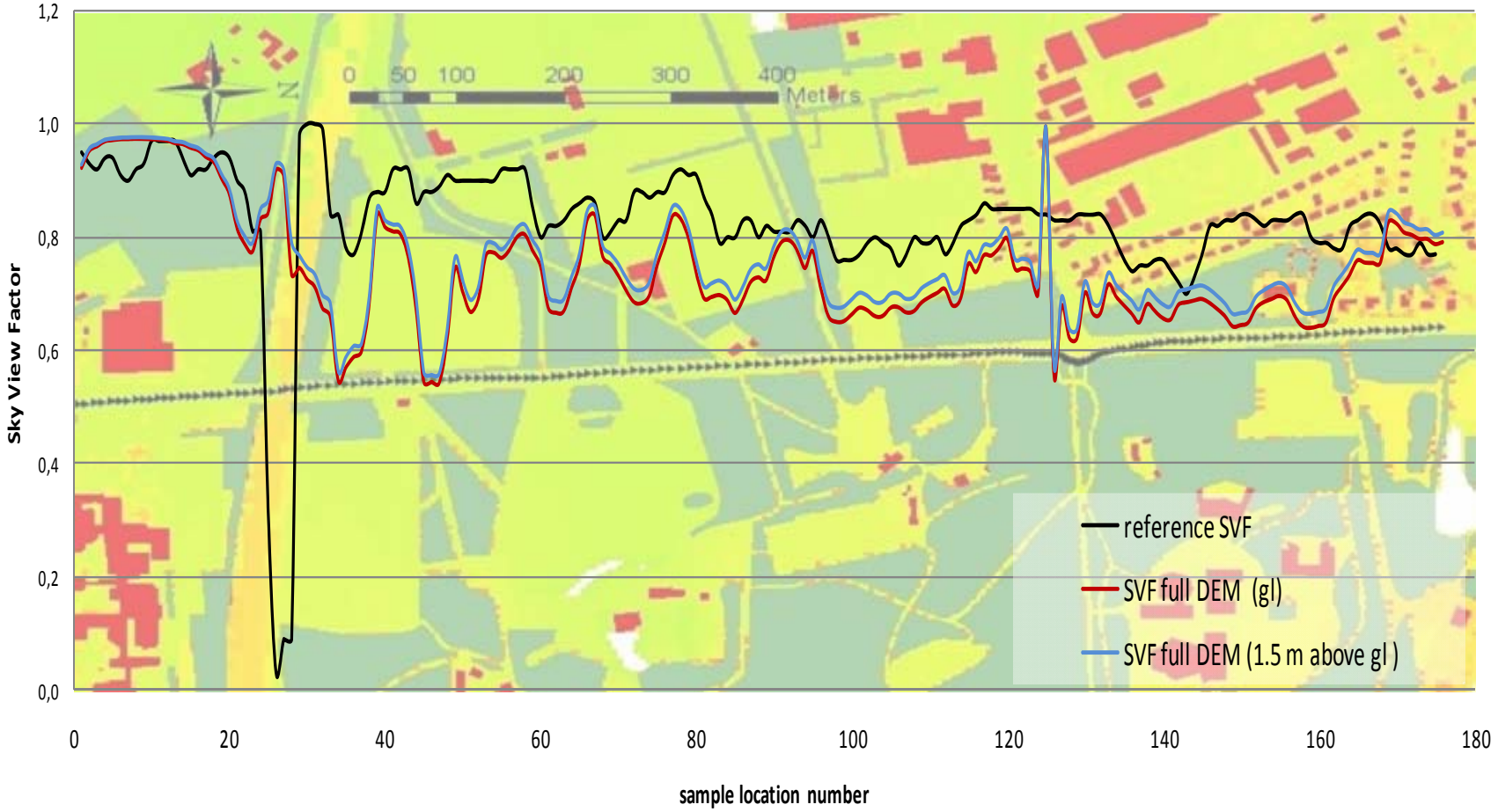
MeteoConsult



GIS sky-view factor?

MeteoConsult

Camera and GIS method, without tree correction



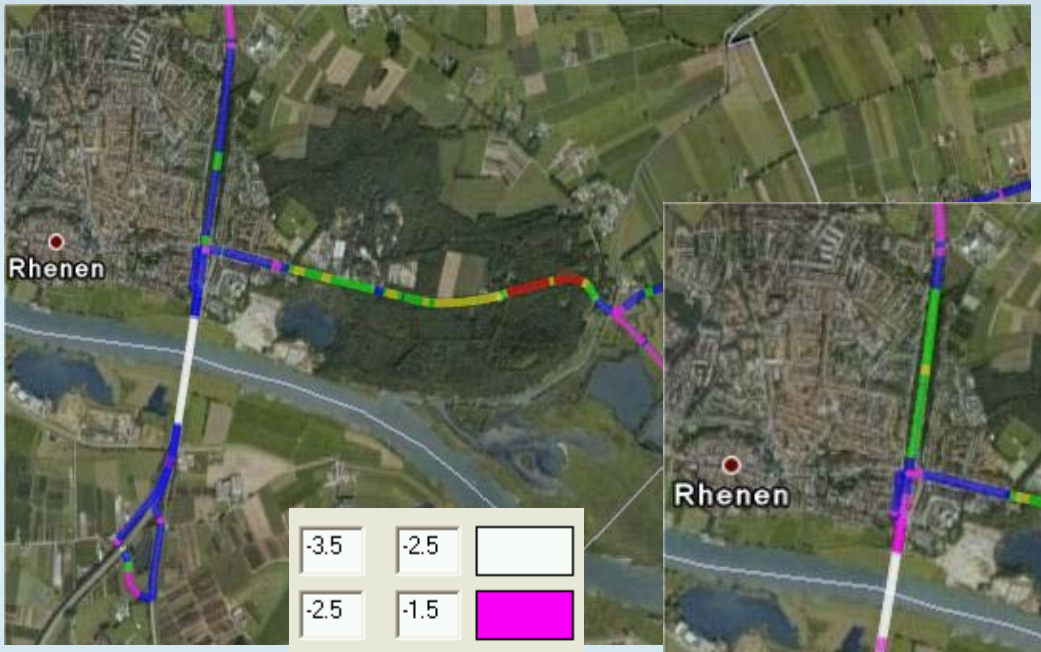
Network forecast: result

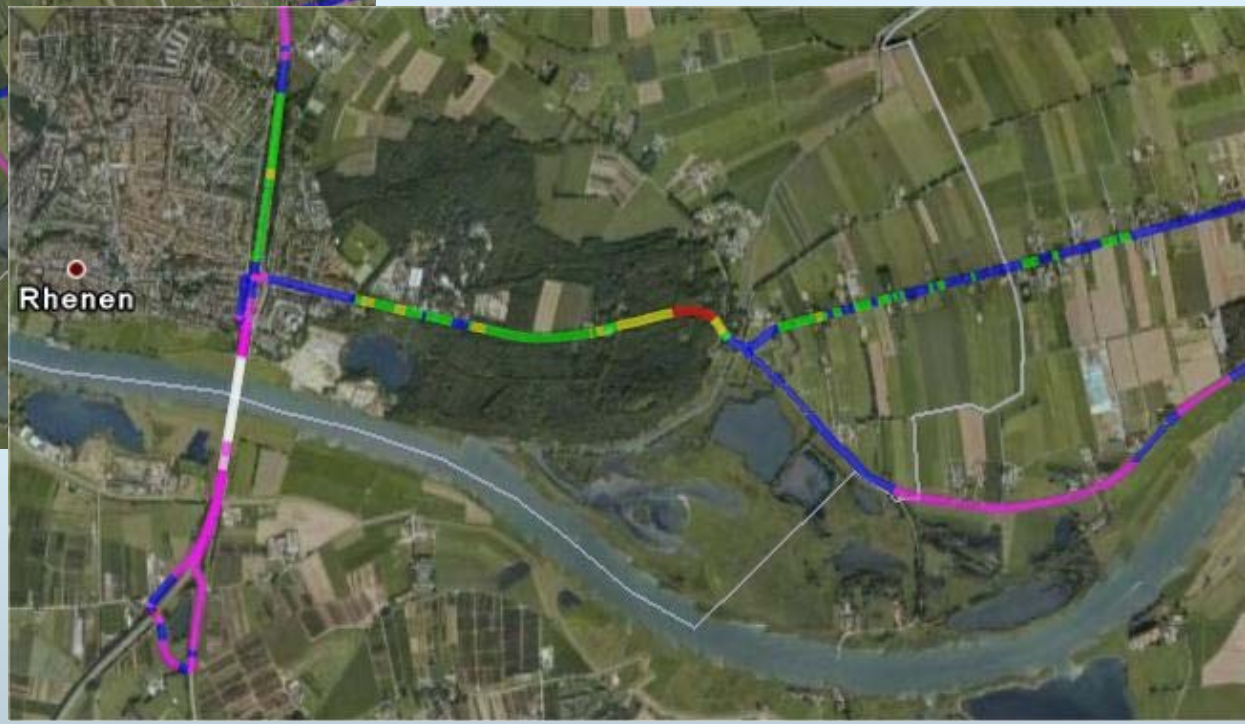
MeteoConsult

Observation (Thermal mapping)

23 January 2007

Forecast (Networkmodel)





-3.5	-2.5
-2.5	-1.5
-1.5	-0.5
-0.5	0.5
0.5	1.5
1.5	2.5
2.5	3.5

Some future applications (1/2)

MeteoConsult

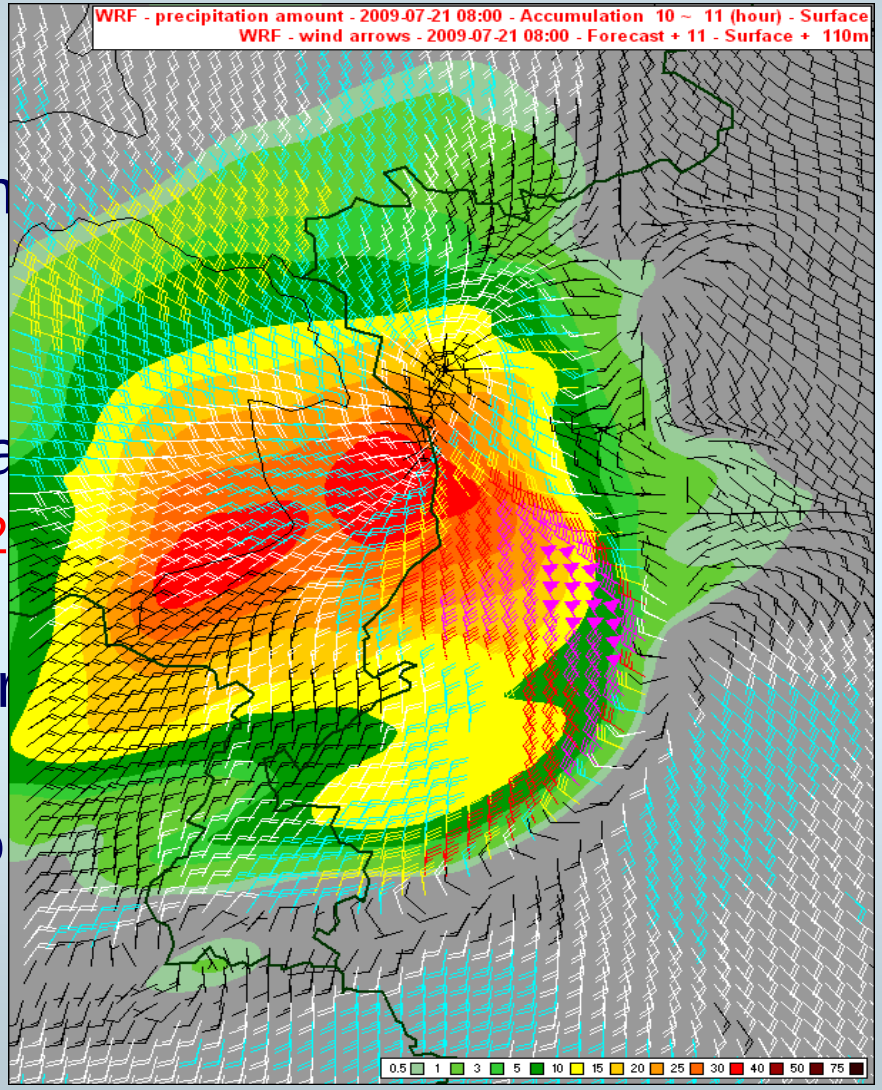
- Integration of high resolution n
  with Radar and ***MOS*** system

- WRF at 9km for Europe, 4x/da

(currently based on ECWMF 00 and 12
SYNOPs)

WRF at 3km in all areas impor
customers

  - Wind at hub height in mountaino
  - Hindcast studies
  - Risk of severe weather



Some future applications (2/2)

MeteoConsult

- Extension of autotext to other customers (e.g. newspapers)

- Integration of Road Expert System and Road Forecast