



Norwegian  
Meteorological Institute  
*met.no*



# Satellite observation delivery requirements for HIRLAM

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# Regional NWP

HIRLAM : Denmark, Sweden, Finland, Netherlands, Iceland, Ireland, Spain, Norway

Other consortia in Europe:

- ALADIN
- LACE
- COSMO
- UK Unified Model



## Niche of regional NWP vs global models

- Faster delivery of forecasts
- Higher resolution
- More frequent updates
- More flexibility with respect to output locally (input to ocean models, dispersion models, hydrological models, warning indices, ...)



# Example regional NWP configuration - met.no

## Domains:

- Large area HIRLAM 20 km resolution (ECMWF boundaries, 3D Var)
- Norway&Northeast Atlantic HIRLAM 10 km (ECMWF boundaries, 3D Var)
- Southern Norway HIRLAM 5 km (HIRLAM 10 km boundaries)
- Southern Norway experimental Unified Model non-hydrostatic 3 km
- MM5 non-hydrostatic 1 km on city areas for air pollution

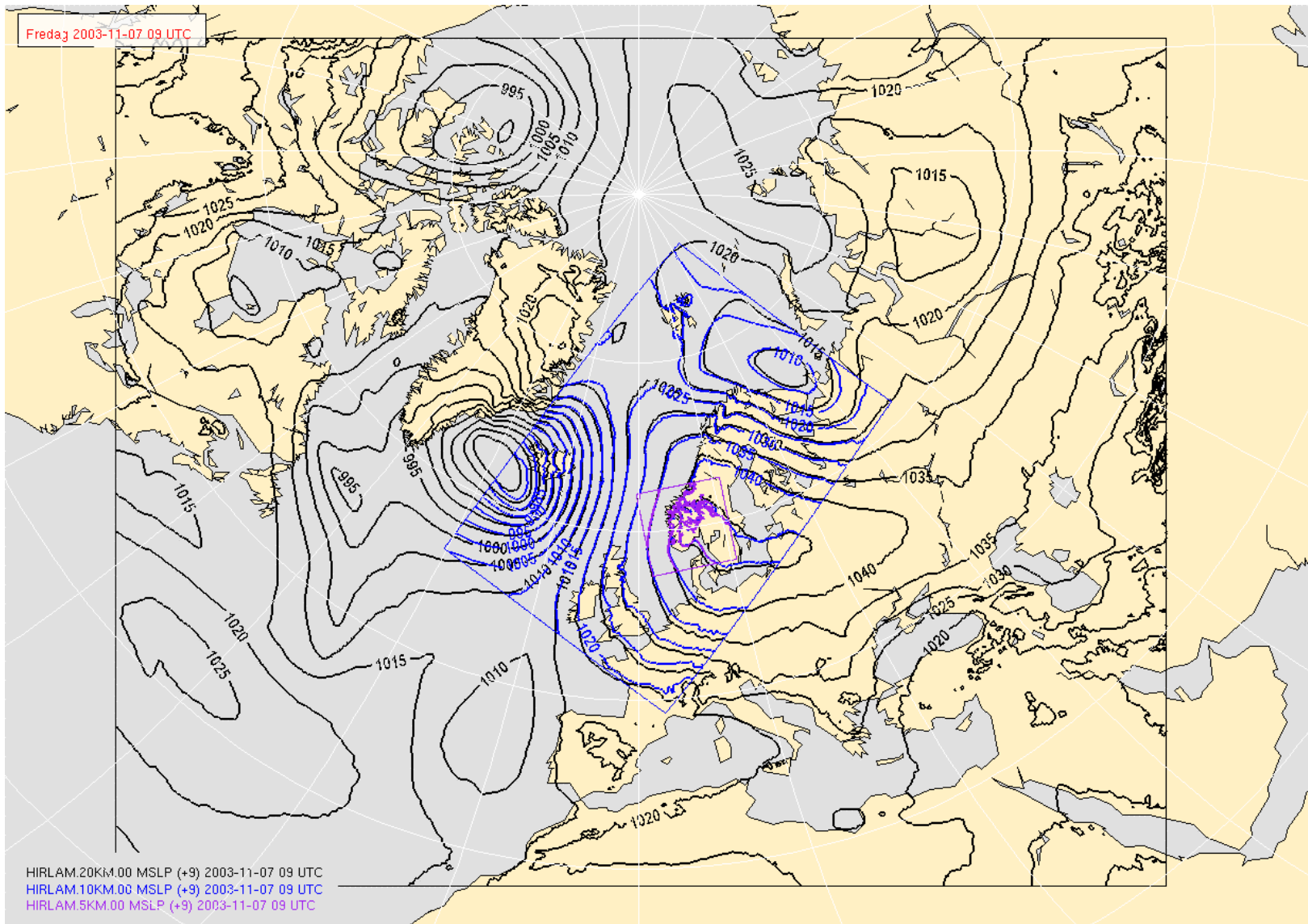
## Cutoff time for assimilation:

- Typically 2 hours for 20 km model

Runs every 6 hrs



# HIRLAM domains at met.no





## Quality of regional models depends on the model itself and ...

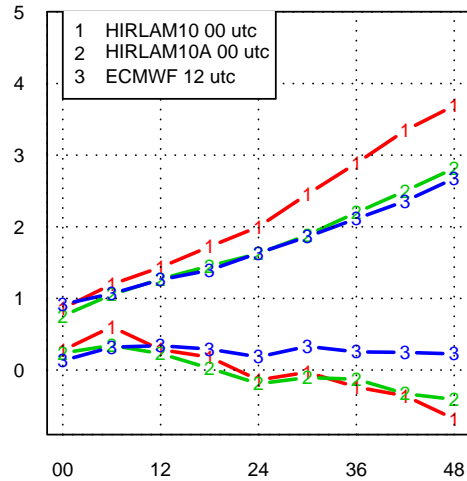
- Quality of lateral boundaries  
(outer model)
- Quality of initial state  
(data assimilation, observation usage)
- Quality of surface forcing  
(surface assimilation scheme)

Relative effect of initial state and lateral boundaries depends on domain size.

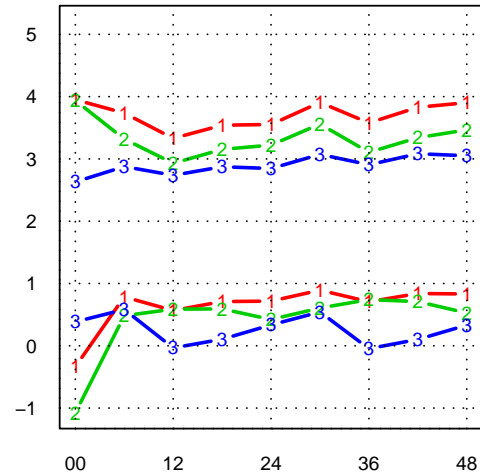
# Example - effect of lateral boundaries on quality



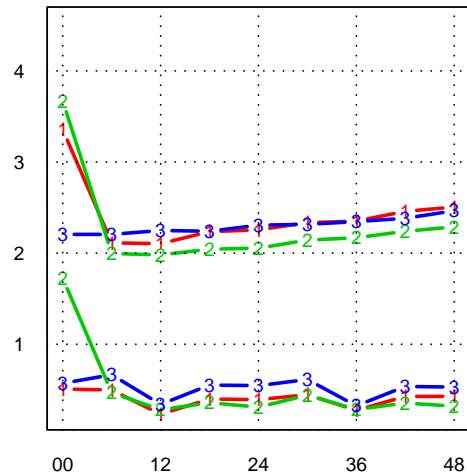
**mslp 1814e**



**t2 1814e**



**ff10 1814e**





# Determining the initial state

## - data assimilation in HIRLAM

- 3D Var operational
- 4D Var development version under testing and optimization





# Observation usage in HIRLAM 3D-Var

- Conventional observations
- AMSU-A assimilation over ocean

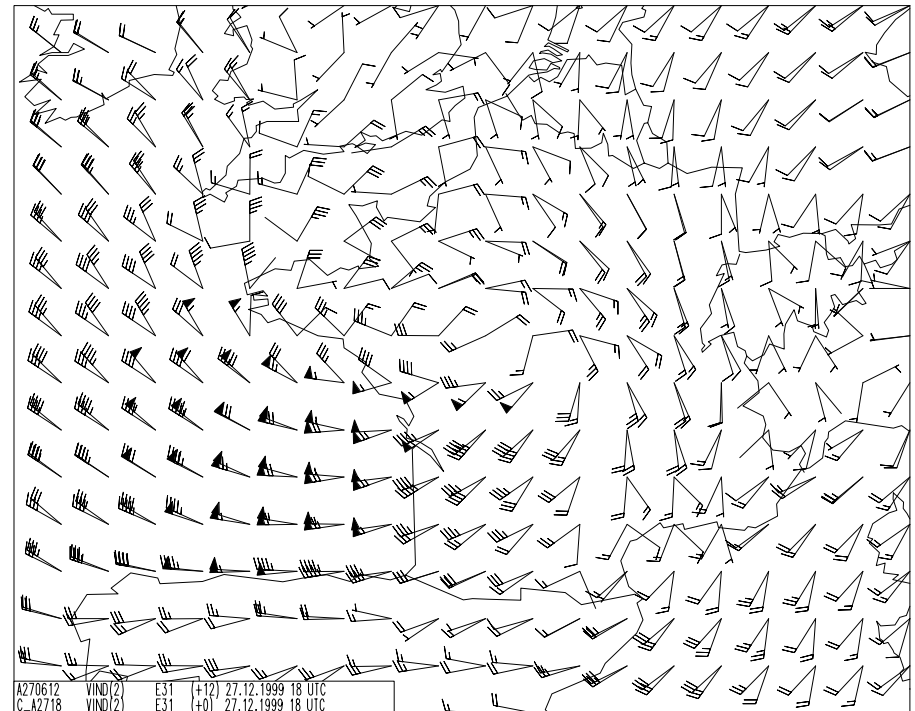
Experimental, not yet operational:

- QuikScat and ERS-2 assimilation
- Radar winds
- Ground based GPS
- HIRS moisture

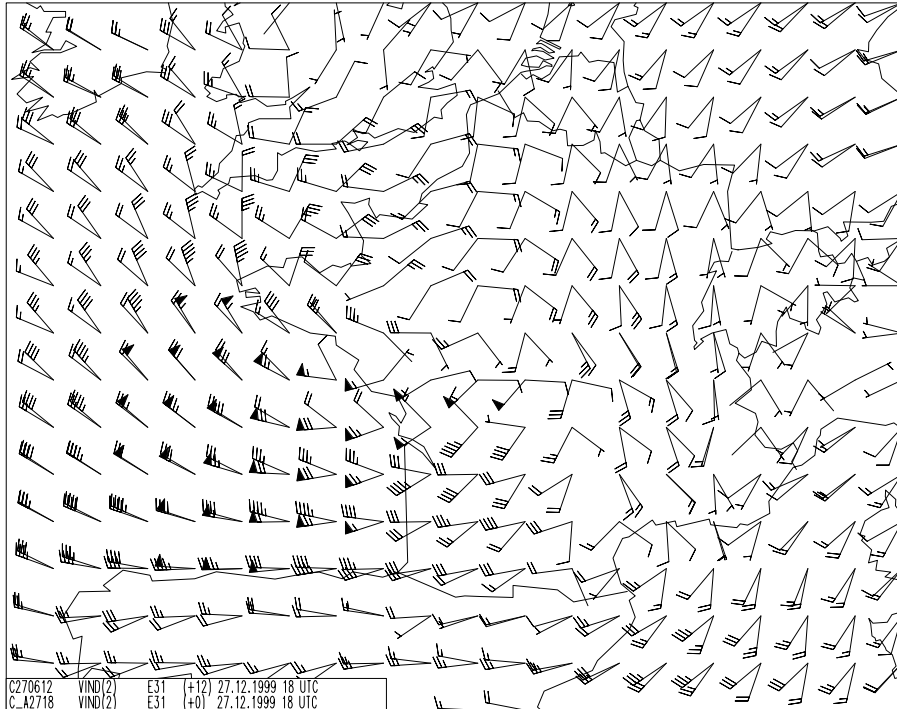
# AMSU-A assimilation - example of impact, French christmas storm 1999



With AMSU-A



Conventional obs only

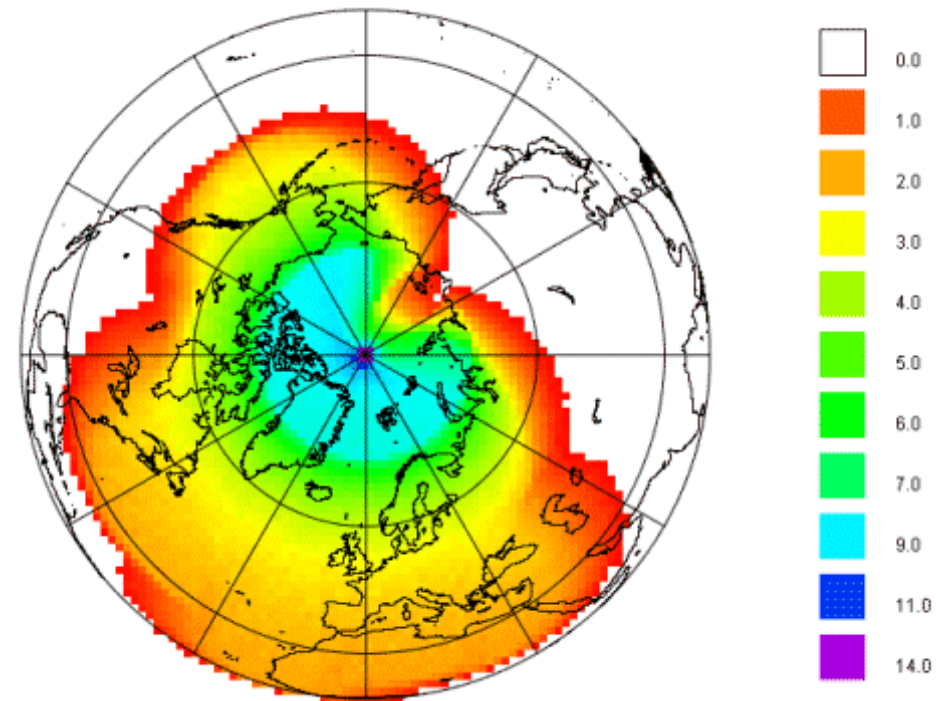
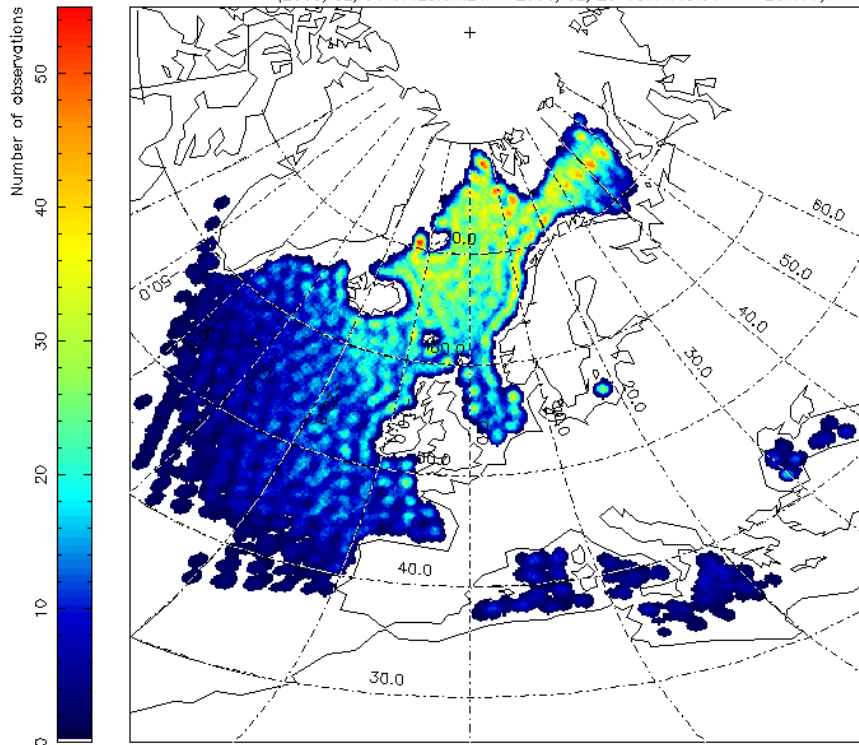




# AMSU - data delivery through EARS

- Delivery within 30 min for most of area

Distribution of observations (Satellite: noaa15, Instrument: amsu-a)  
(2000/02/01 07:23:37.24 - 2000/02/29 18:41:13.01 = 28.471)





## Scatterometer usage

- QuikScat observations received on FTP from NESDIS
- Data delay 2-3 hrs
- Preprocessing with wind retrieval on 100 km resolution to reduce noise
- ERS-2 received on GTS from ESRIN, comparable delay with QuikScat

## Radar and GPS data

- Fast delivery, high frequency observations

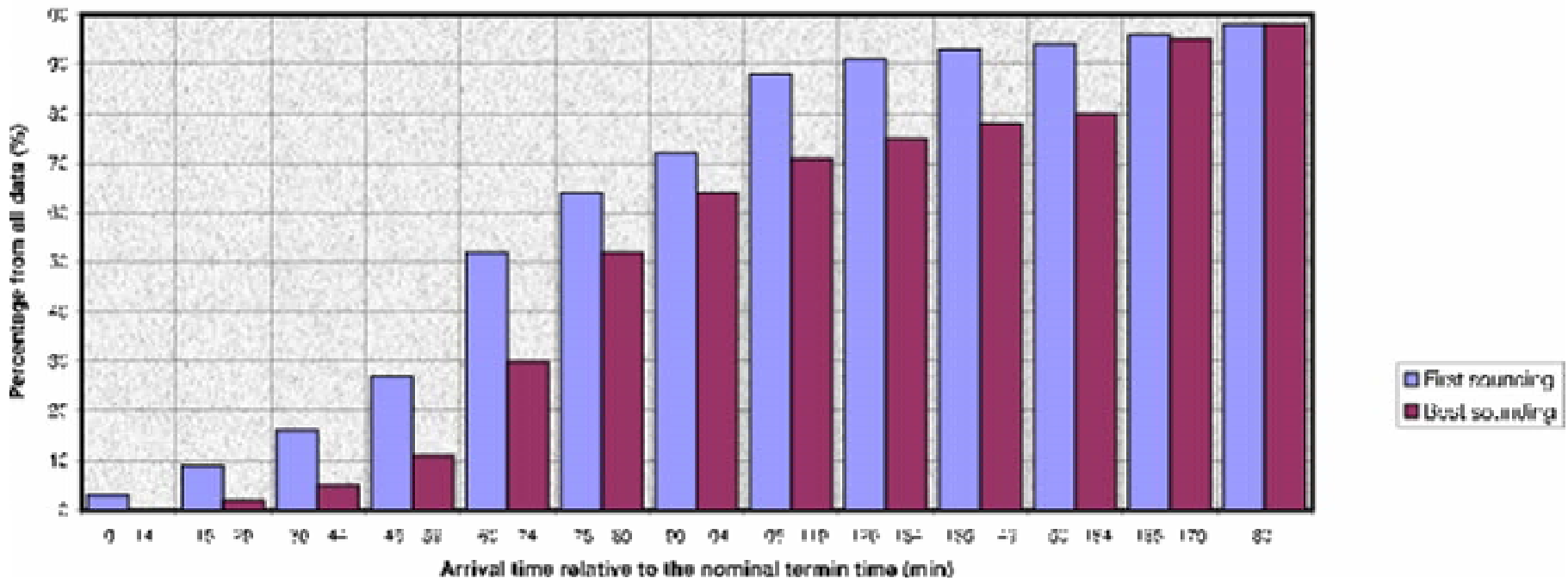
Would like frequent updates and rapid delivery of regional NWP forecasts. What will be the dimensioning factors for data cutoff?



# Dimensioning factor today : radiosonde delivery

Arrival times statistics for radiosondes (Eerola, 2003)

Cumulative frequency of arrival times of TEMP observations





# What will be dimensioning factor for assimilation cutoff in the future?

- ECMWF: More impact from AMSU than sondes
- Not yet so in HIRLAM or for instance Met Office global model
- Methods for exploiting ATOVS likely to improve, also prospects for operational assimilation of AIRS, IASI, ...
- Observations with high temporal and spatial resolution from radars and ground GPS particularly interesting for high resolution modeling. Fast local delivery of those.

Observations with faster delivery than sondes will probably be dimensioning the cutoff time in near future.

Later arriving data can be used in reanalysis cycles.



## New observations needed for regional NWP - summary from EUMETSAT 2001 workshop on Post-MSG requirements

- More wind profile measurements
- More temperature and humidity information within and below clouds
- Surface pressure observations over sea
- Improved precipitation intensity observations
- Soil moisture observations
- Aerosol profile observations

Resolution requirements also given. Anticipates significant developments towards better high-resolution data assimilation.



# Concluding remarks

- Global ECMWF forecasts may become available faster, more frequent and at higher resolution than today
- Regional models at higher resolution can add quality to these forecasts taking smaller scale forcings into account, and can give even faster availability of short range forecasts
- NWP centres with large areas of forecast responsibility will still want to do data assimilation
- Radiosondes will no longer dimension the cutoff time for assimilation in regional NWP. EARS AMSU data, radar and GPS observations will all be available more rapidly than sondes
- Shorter cutoff in regional NWP in the future, 30 minutes rather than 2 hours?





## Concluding remarks (2)

- More frequent analyses. Regional NWP analysis closer to a nowcasting tool.
- EUMETSAT ATOVS Retransmission Service a pioneering effort. Similar service considered for ASCAT. Desirable rather than direct local readout for regional NWP.