Modeling system for dispersion calculations during accidental releases

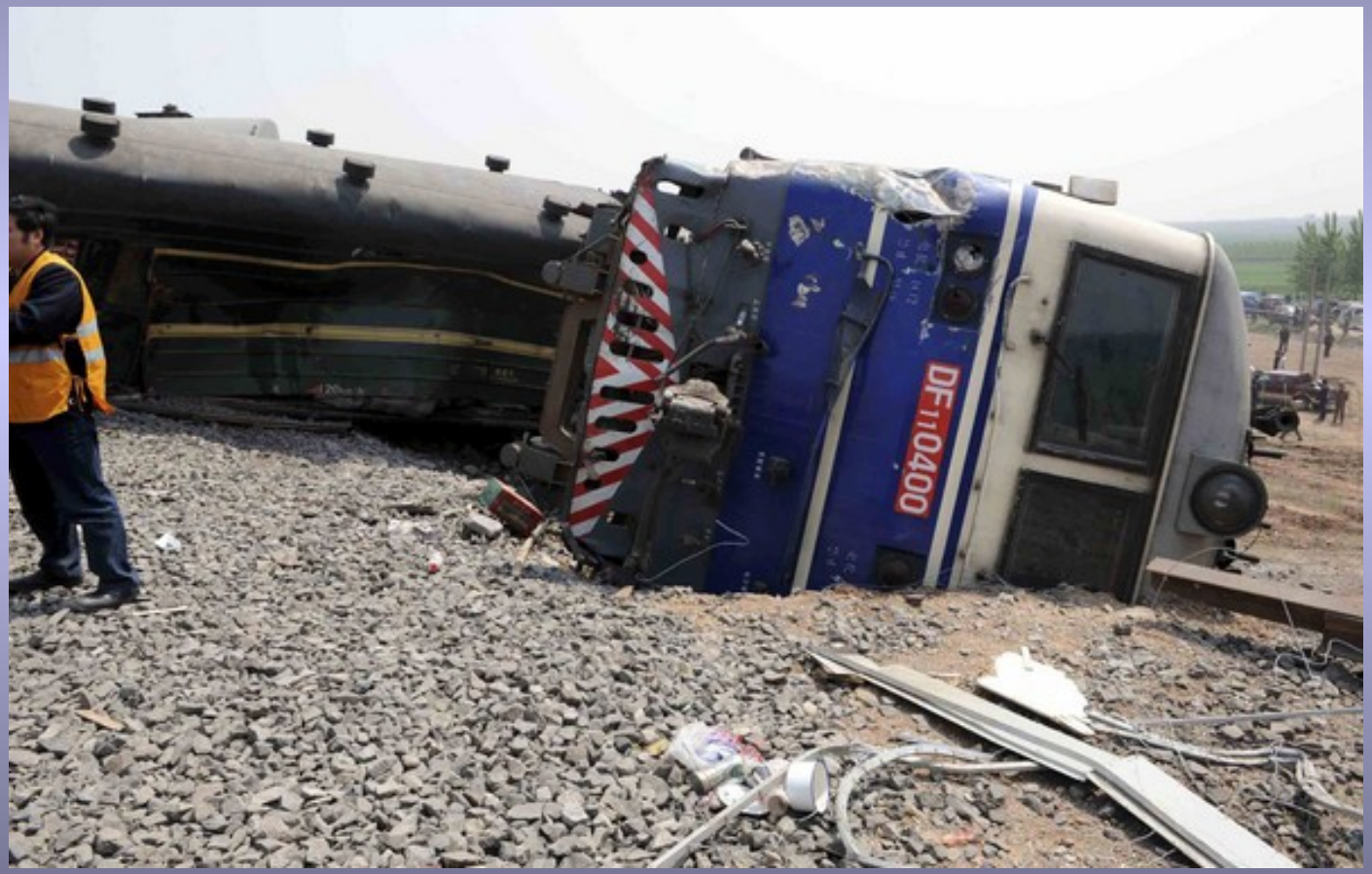
Leif Enger

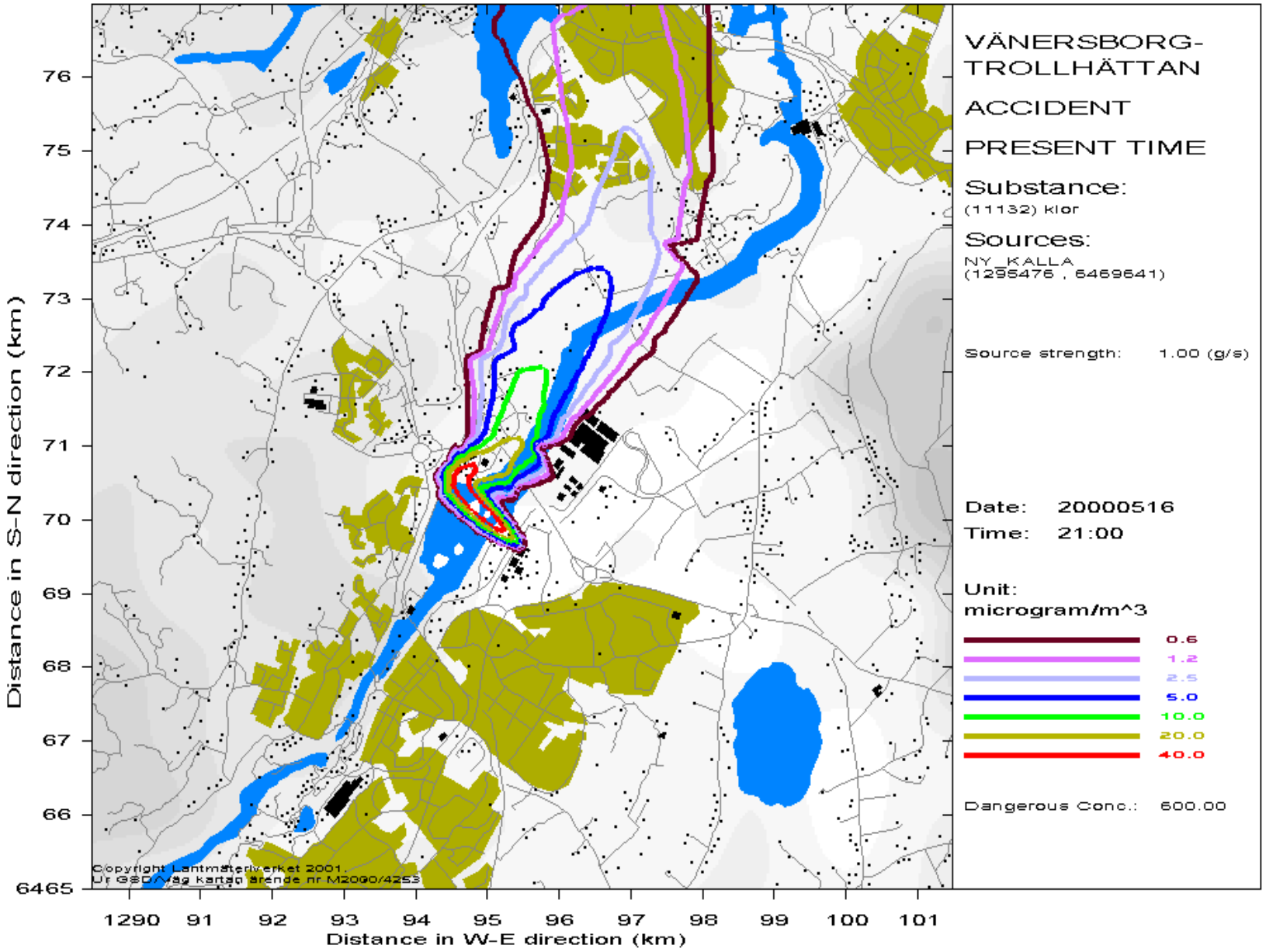
and

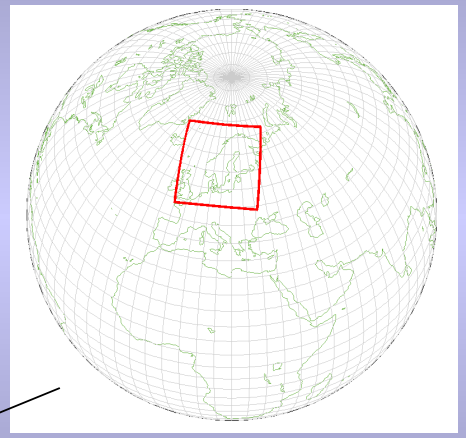
Stefan Söderberg

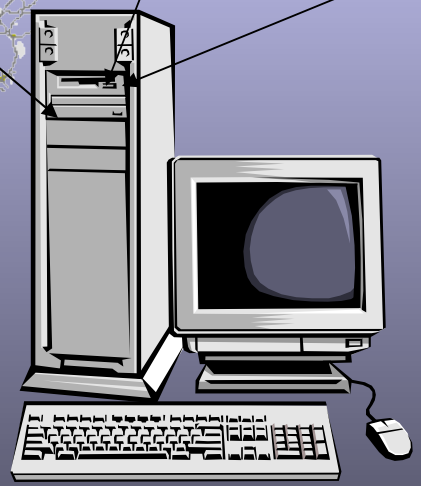
Uppsala, Sweden

Need of dispersion calculation after e.g. a train accident or a truck accident




VÄNERSBORG-
TROLLHÄTTAN
ACCIDENT
PRESENT TIME
Substance:
(11132) klor
Sources:
NY_KALLA
(1295476 , 6469641)
Source strength: 1.00 (g/s)
Date: 20000516
Time: 21:00
Unit:
microgram/m^3
0.6
1.2
2.5
5.0
10.0
20.0
40.0
Dangerous Conc.: 600.00
Distance in S-N direction (km)
76
75
74
73
72
71
70
69
68
67
66
6465
1290
91
92
93
94
95
96
97
98
99
100
101
Distance in W-E direction (km)
Copyright Lantmäteriverket 2001.
Ur GSD-Väg kartan ärende nr M2090/4253





The ALARM system uses a combination of measurements and models

The ALARM system

- Regional model (COAMPS) with 12 km resolution (half Scandinavia)
- Meso-scale model (MIUU) with 1 km resolution (over the accidental area)
- Model database (a large library of simulated wind and turbulence fields)
- Measurements
- Dispersion model

Regional model (COAMPS)

- Prognosis over southern Scandinavia
- 12 km grid resolution
- Every 6 hours, a 30 hours prognosis is performed
- As input (initial and lateral conditions), forecasts from the Global Forecast System (GFS, NOAA) is used
- The synoptic and the regional models are working continuously

Meso-scale model (MIUU) with 1 km resolution (over the accidental area)

- Prognosis over the actual accidental area
- 1 km grid resolution
- This prognosis take care of the local terrain
- Length of prognosis up to 24 hours
- Measurements in the area is used to correct the regional model (COAMPS)
- The MIUU model is used only during accidental release

Model database (library of simulated wind and turbulence fields)

- A large library of wind, humidity and turbulence fields (10 000 meteorological situations) is created
- 1 km resolution for the total area (200x250 km)
- 3 classes of magnitude of the geostrophic wind (4, 8 and 14 m/s)
- Every 12.5 degrees of azimuth
- Four different “seasons”

Measurements

- 10 masts (10 m high) with wind speed, wind direction and temperature profile
- 3 sodars to get wind and wind direction at higher elevations
- Measured data is collected every hour by the computer

Dispersion model

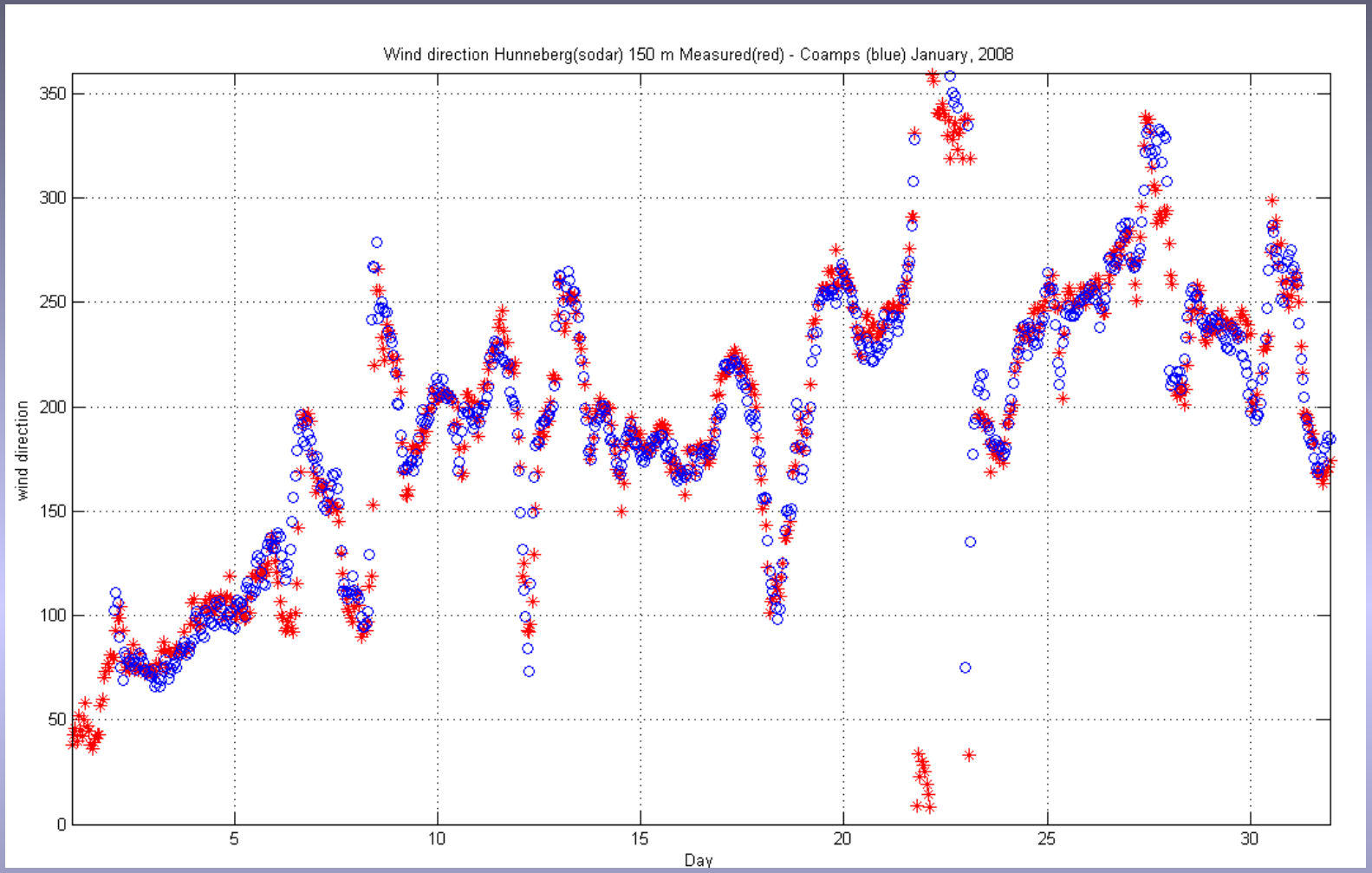
- Semi-Gaussian trajectory model
- Standard deviations are calculated from the model simulated turbulent energy in combination with normalized Eulerian spectra

Emissions, type of source etc

- Data of typical emissions during an accidental release and other source data are provided by the Swedish Rescue Service Agency
- The model is implemented on computers and desktops for the people leading a rescue in the area
- They automatically call up the server (through ftp) with indata for the accident.
- In 2 minutes they get back results for actual time and 2 hours prognosis

Comparison with measurements

- Wind direction at 150 m - sodar against COAMPS
- Wind speed at 150 m - sodar against COAMPS

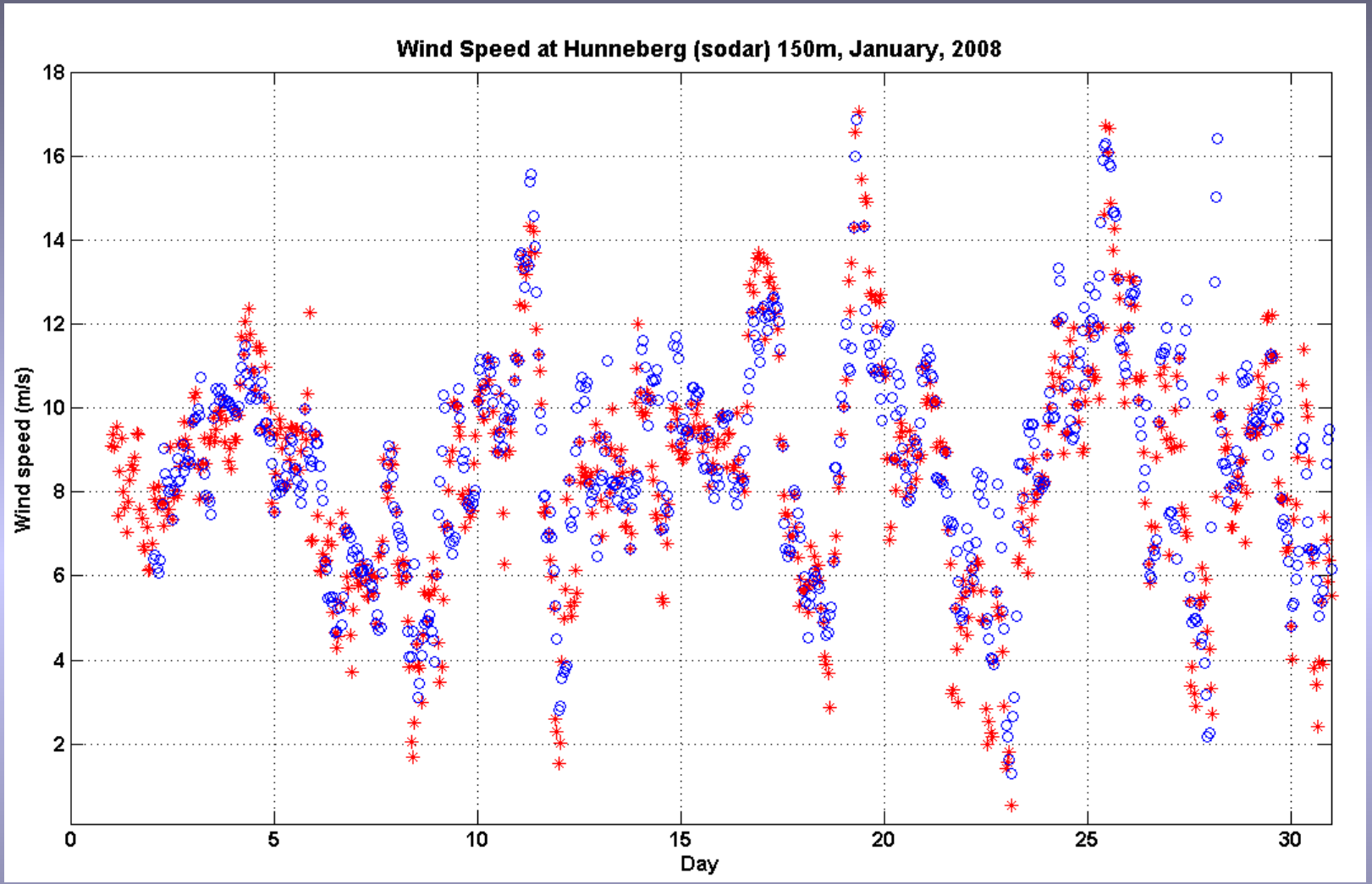


Corrected data with constant 26 degrees

Correlation: 0.97
RMSE: 9 deg

Mean Sodar-Coamps: 0 deg

	$Md_{sod-coamps}$	Corr	RMSE
Nov	-2	0.97	23
Dec	1	0.91	29
Jan	0	0.97	8.8
Feb	7	0.96	3.4
Mars	-5	0.94	1.8
Apr	-7	0.93	1.1
Maj	-18	0.89	3.5
Jun	-1	0.88	0.9
Jul	-11	0.92	0.3
Aug	-8	0.92	5.7
Mean	-4	0.93	8



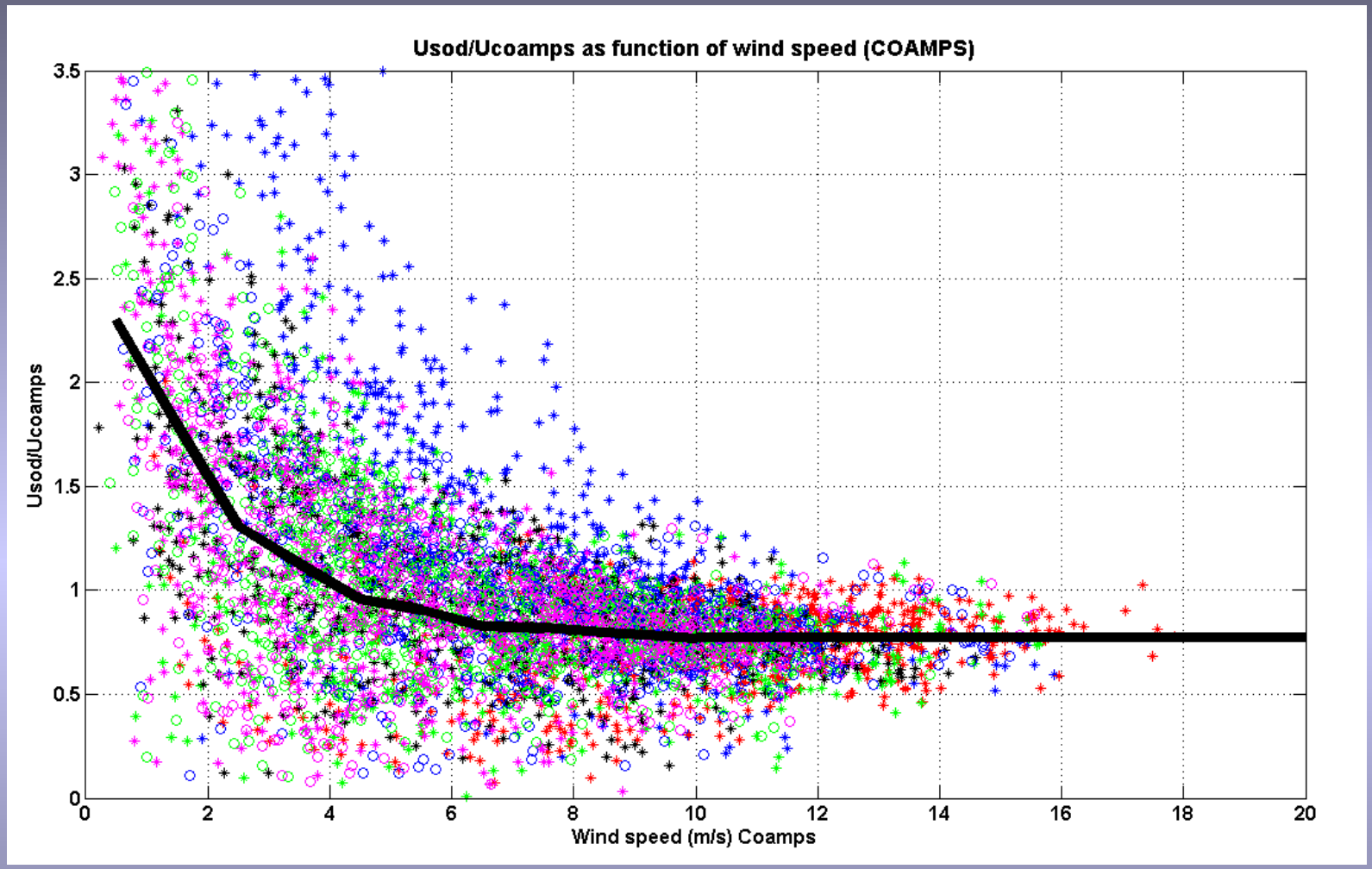
Corrected data

Correlation : 0.84

RMSE: 0.23

Mean sodar: 8.6 m/s

Mean Coamps: 8.8 m/s



Coamps wind speed is corrected with the black line

Correction for 6 hours prognosis

- The new corrected Coamps value at start time is compared with measured sodar value at that time.
- All the six values is multiplied with Ustartsodar/Ucorrected_coamps
- The above figure shows the wind speed with these corrections

	U_{sodar}	U_{coamps}	Corr	RMSE
Nov	6.7	7.0	0.84	0.21
Dec	6.2	6.7	0.94	0.48
Jan	8.6	8.5	0.84	0.05
Feb	7.7	8.1	0.87	0.42
Mars	6.4	6.0	0.79	0.36
Apr	5.5	4.7	0.72	0.72
Maj	4.5	3.6	0.72	0.93
Jun	6.4	5.7	0.82	0.75
Jul	5.1	4.4	0.74	0.76
Aug	5.8	5.2	0.85	0.57
Mean	6.3	6.0	0.81	0.53

Summary

- Measured and corrected forecast wind direction and wind speed at 150 m agree very well
- Dispersion model has already in earlier studies shown good result
- The Alarm-system is a robust, easy to use, and reliable short-term (6-24 h) forecast dispersion system