Schweizerische Eidgenossenschaft
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Swiss Confederation

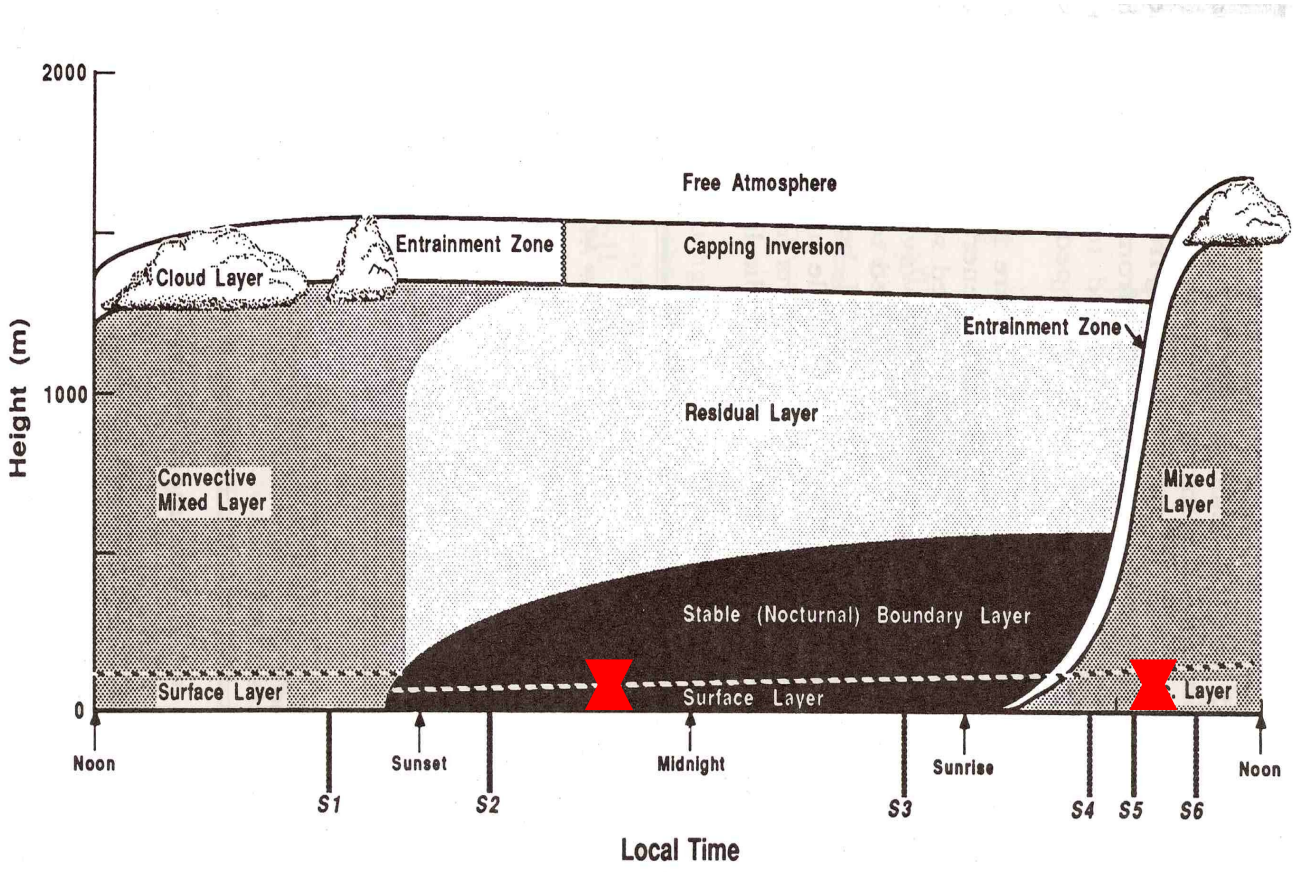
Federal Department of Home Affairs FDHA
Federal Office of Meteorology and Climatology MeteoSwiss

Swiss ground-based remote sensing network and its use in NWP assimilation

Dominique Ruffieux
Christophe Hug
Pierre Huguenin
Bertrand Calpini
Olaf Maier

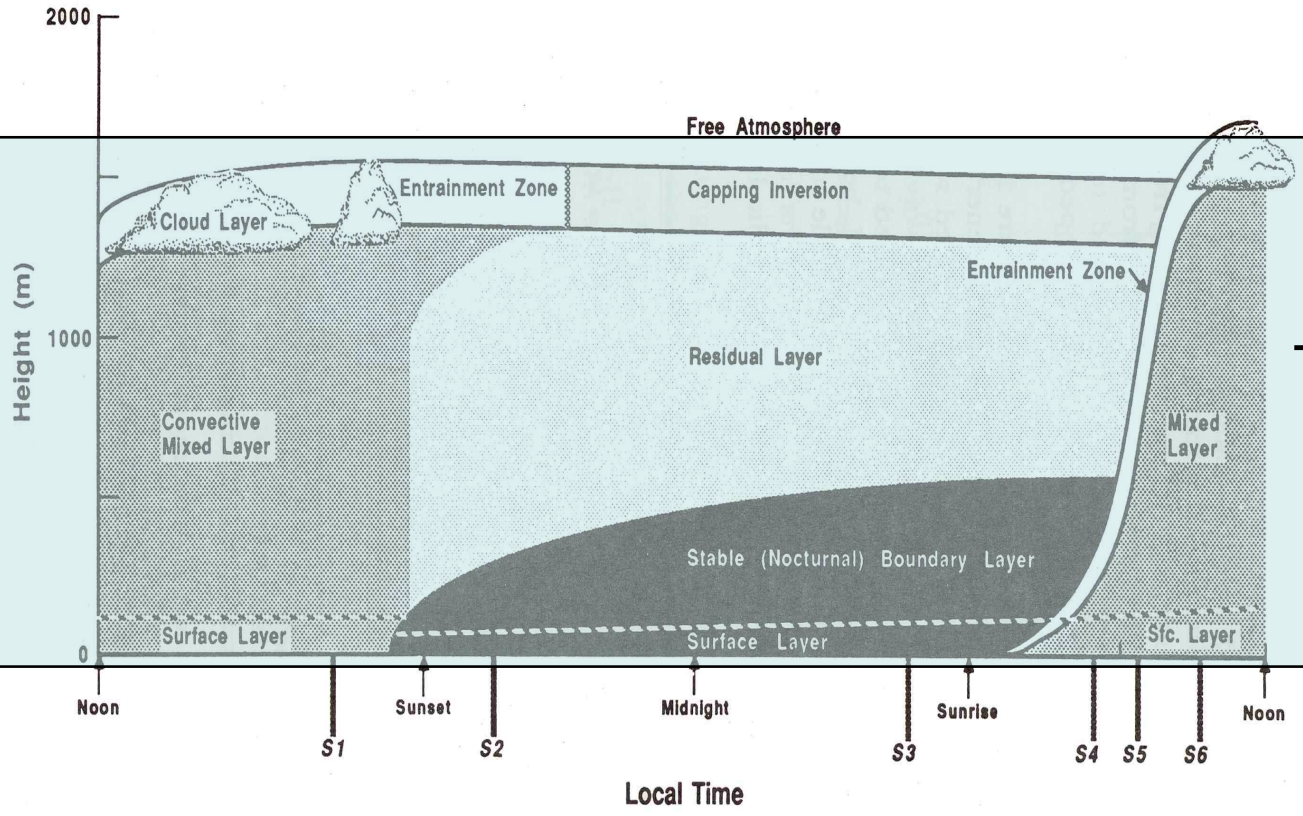
1) Meteorology: back to some basics
2) Goal of the CN-MET project
3) The COSMO-2 NWP model
4) Impact studies
5) Summary

1) Meteorology: back to some basics



« a cold leak »

Stull R.B., 1994 : An Introduction to Boundary Layer Meteorology. Kluwer Academic Publishers, 664pp.



Wind
Temperature
Humidity

The « ideal set of measurements »
over one day

2) Goal of the CN-MET project

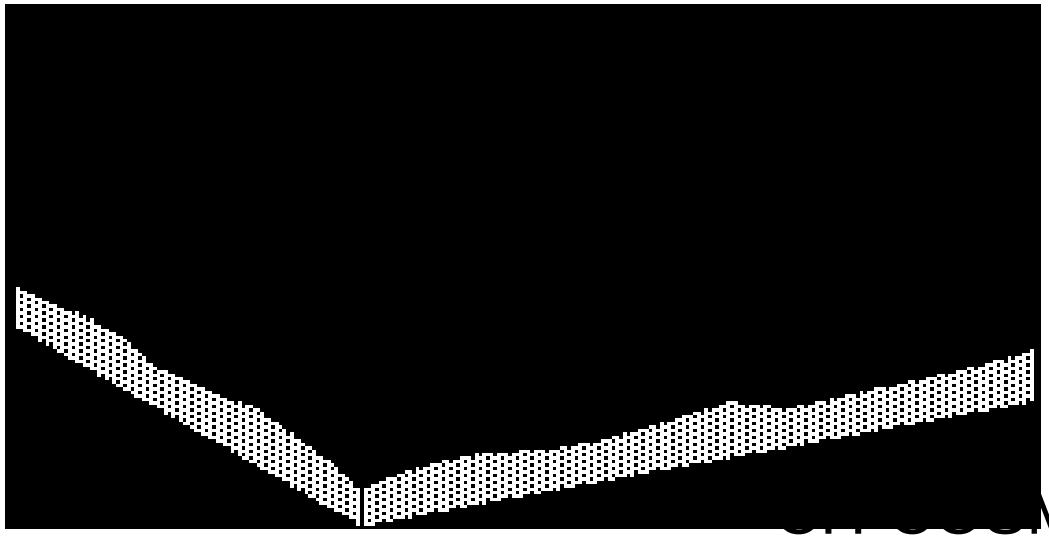

Jura mountains
Switzerland ~ 300km
Alps
Freiburg im Breisgau
Leibdstadt
Schaffhausen
Beznau
Basel-Stadt
Goesgen
Thurgau (Thurgovia)
Aargau
Zürich
(Zurich)
Jura
Solothurn
Muhleberg
Neuchâtel
Payerne, Switzerland
Switzerland
Uri
Vaud

Question :

- How do we ensure the atmospheric surveillance of nuclear power plants within the highly populated Mittelland of Switzerland ?
  - Either by combining tower measurements at the NPP sites and Gaussian types models of dispersion
  - Or by combining :

a dedicated network

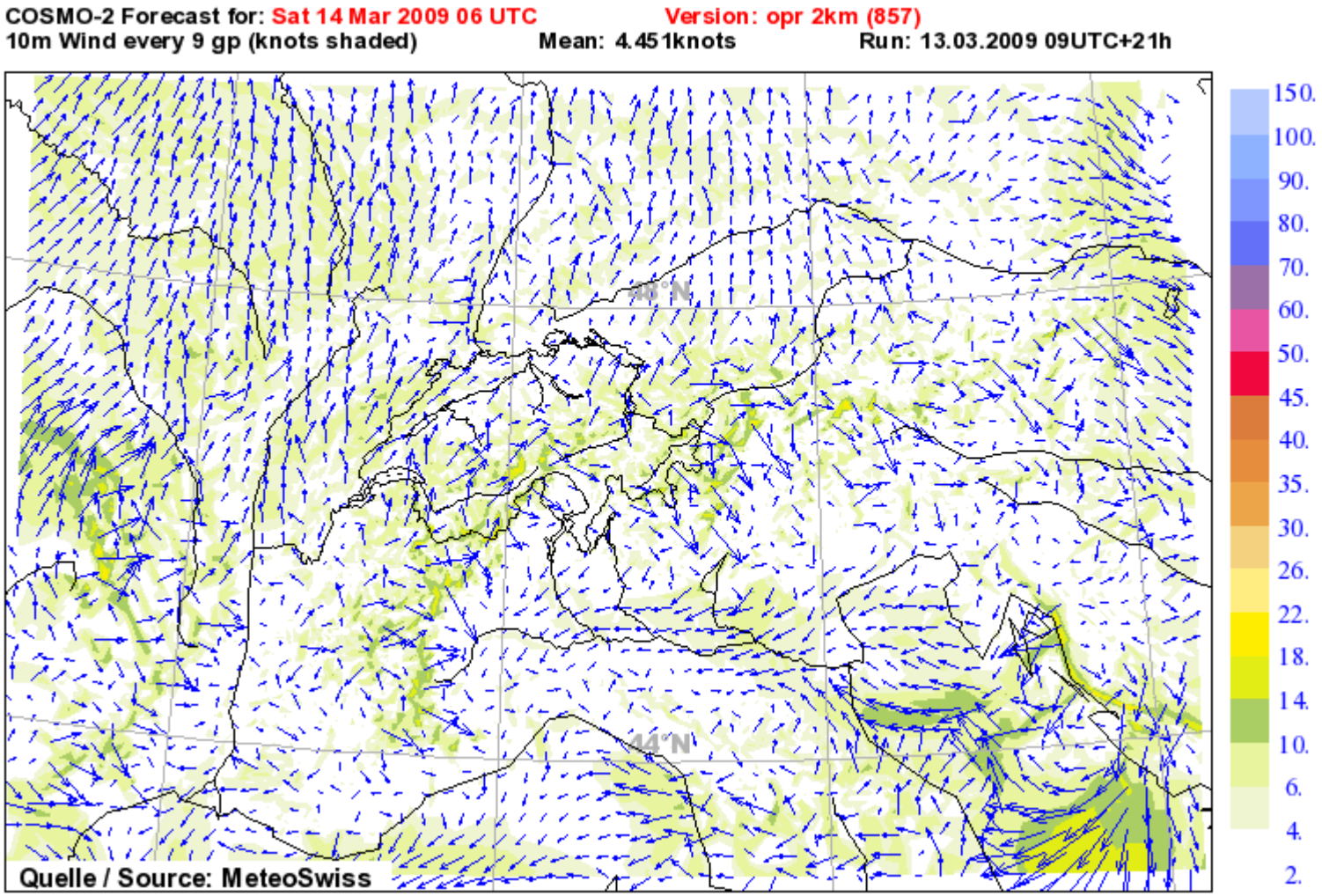
a NWP model



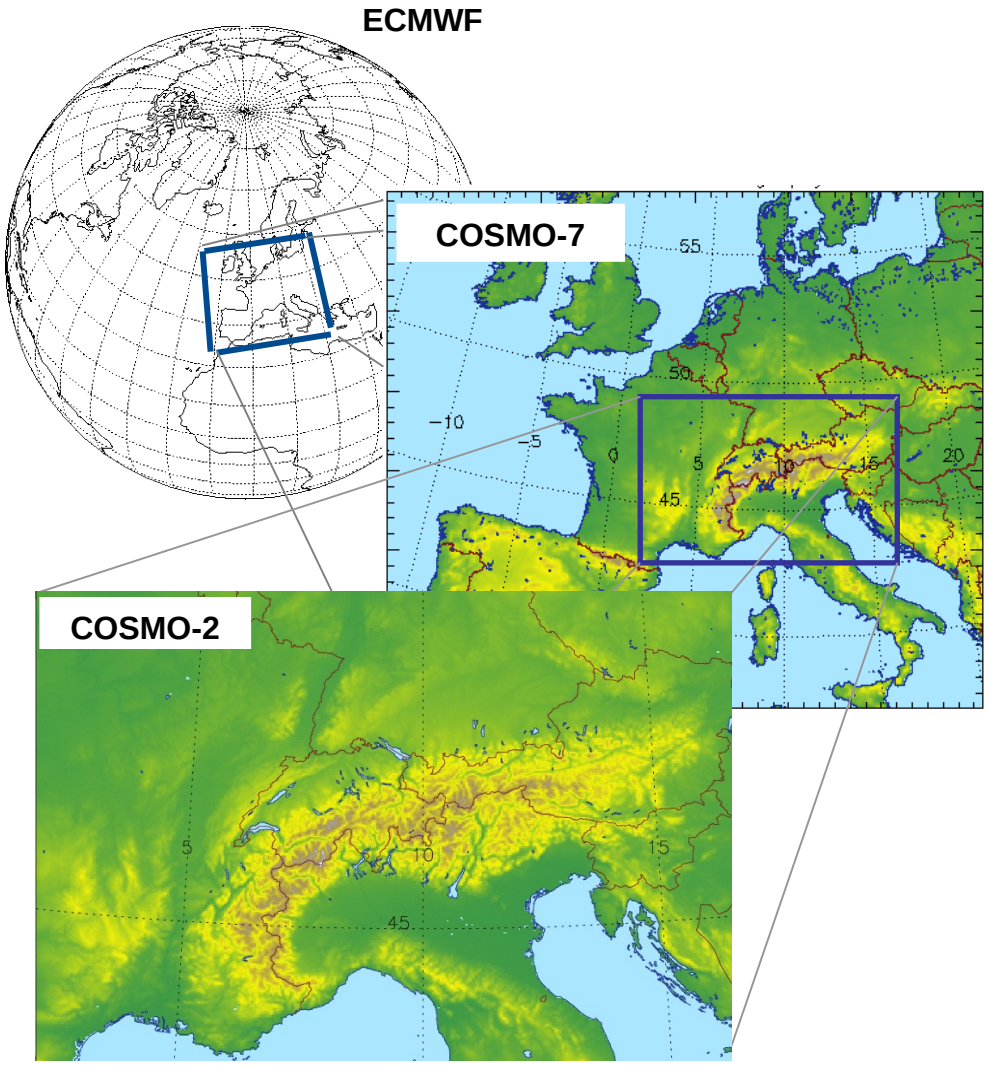
MO-2.2km

CN-MET

Horizontal resolution: 2.2 km

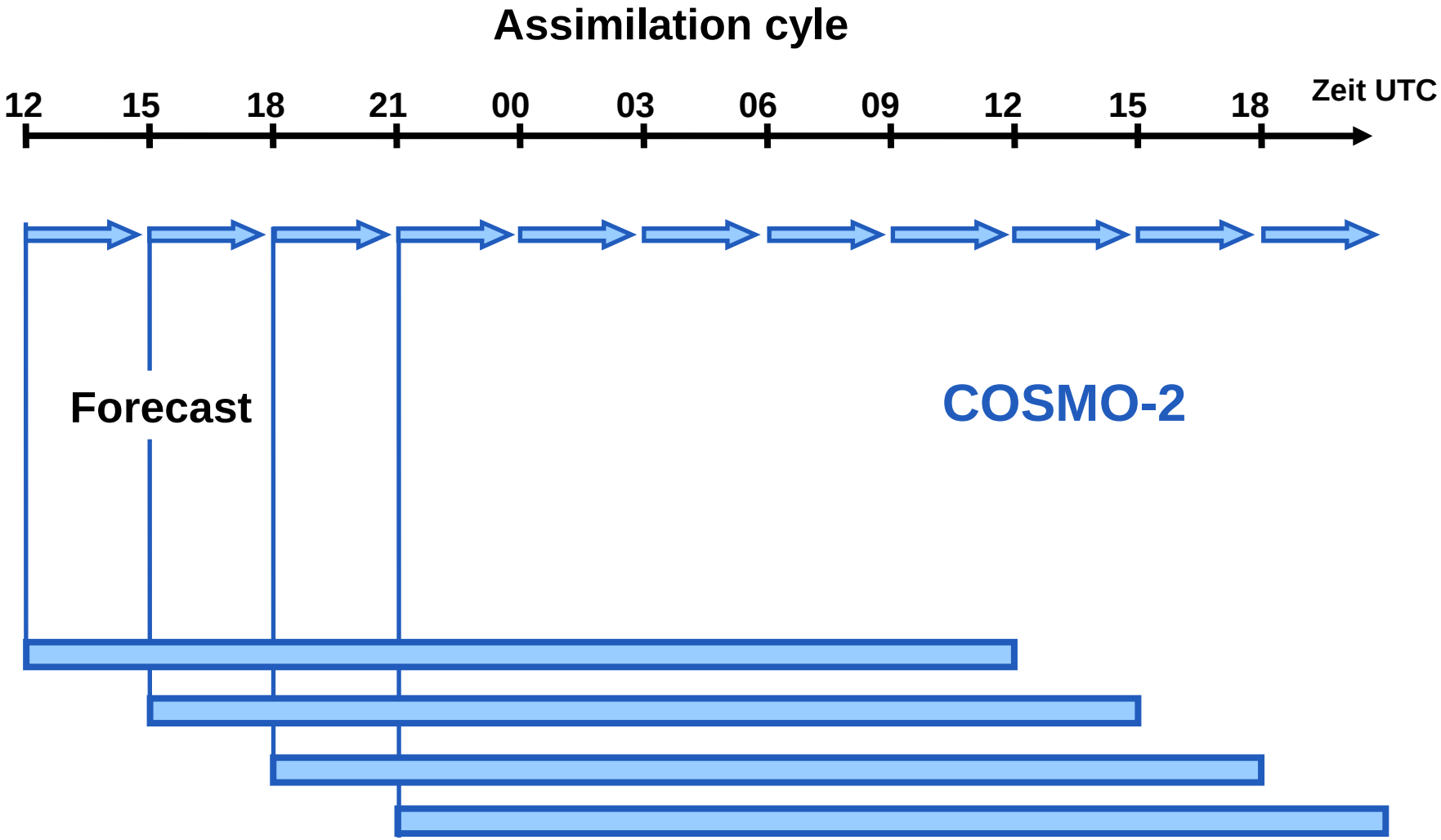


3) The COSMO-2 NWP model



	COSMO-7	COSMO-2
General		
Resolution	6.6 km (0.06 deg)	2.2 km (0.02 deg)
Domain	393 × 338	520 × 350
Number of Layers	60	60
Time step	72 sec.	20 sec.
Lateral Boundary Conditions	ECMWF IFS	COSMO-7
Dynamics		
Kernel	Runge-Kutta	ditto
Horizontal Diffusion	u, v, t on LBC	ditto
Physics		
Deep Convection	parameterized (Tiedtke)	explicit
Microphysical parameterizations	NO graupel	graupel
	cloud ice	ditto
Turbulence	Prognostic TKE	ditto
Radiation	every 60'	every 15'
Soil Model	7 moisture layers	ditto
	8 temperature layers	ditto

Production


Assimilation cyle
12
15
18
21
00
03
06
09
12
15
18
Zeit UTC
Forecast
COSMO-2

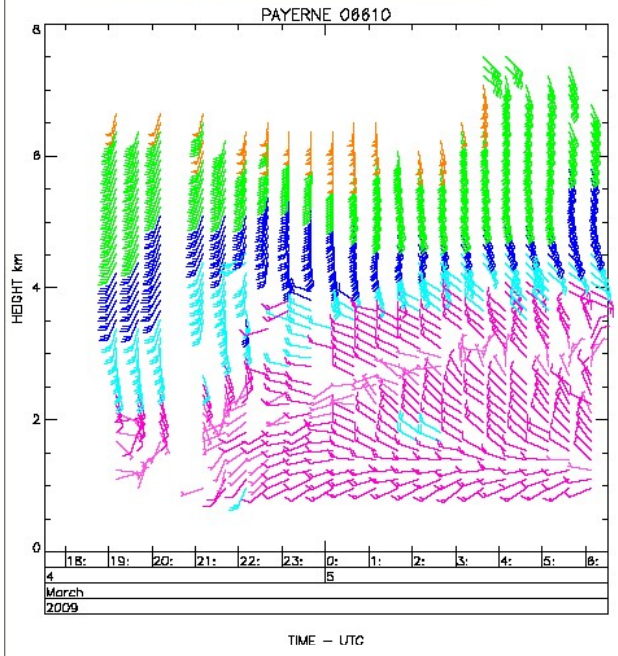
Data assimilation (nudging)

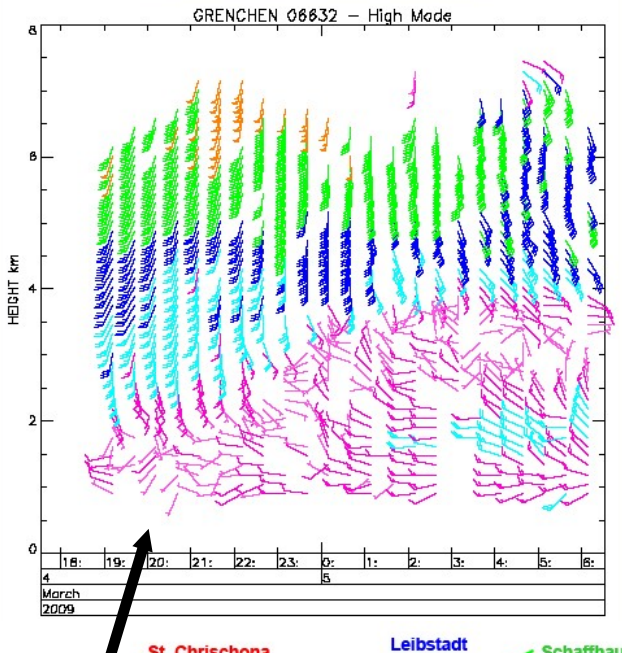
DATA from global measurement networks

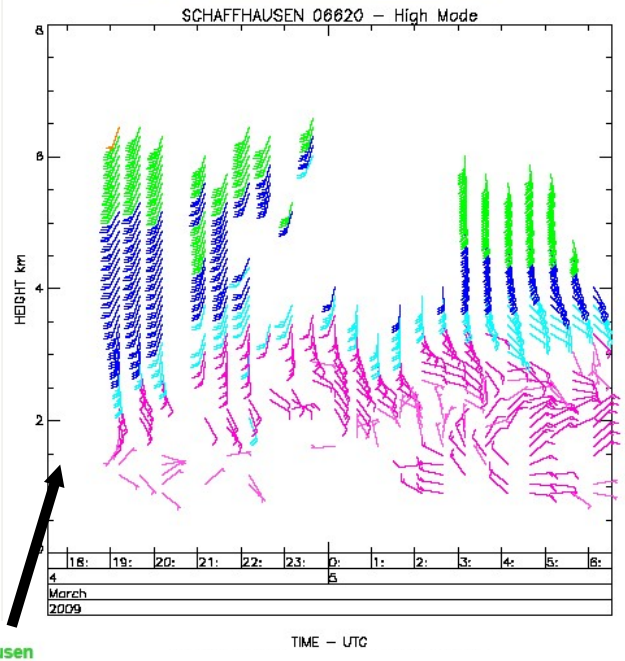
+

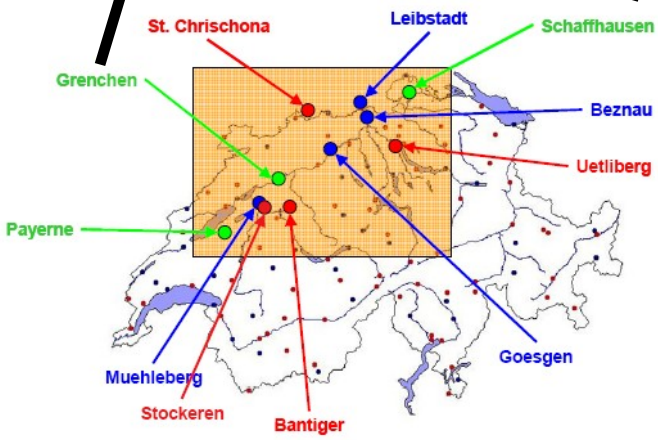
For this presentation, WIND data from

- Radiosounding of Payerne
- Wind profilers of Switzerland


PAYERNE 06610
HEIGHT km
0
2
4
6
8
18: 19: 20: 21: 22: 23: 0: 1: 2: 3: 4: 5: 6:
4
5
March
2009
TIME – UTC


GRENCHEN 06632 – High Mode
HEIGHT km
0
2
4
6
8
18: 19: 20: 21: 22: 23: 0: 1: 2: 3: 4: 5: 6:
4
5
March
2009

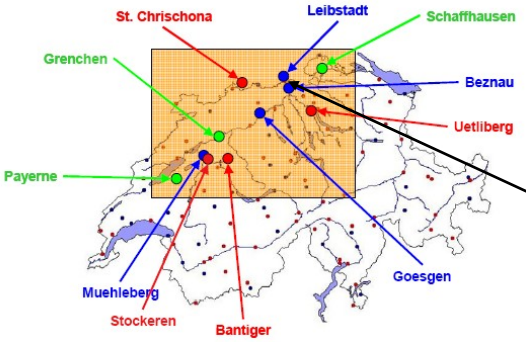

SCHAFFHAUSEN 06620 – High Mode
HEIGHT km
0
2
4
6
8
18: 19: 20: 21: 22: 23: 0: 1: 2: 3: 4: 5: 6:
4
5
March
2009
TIME – UTC


St. Chrischona
Leibstadt
Schaffhausen
Grenchen
Beznau
Uetliberg
Payerne
Goesgen
Muehleberg
Stockeren
Bantiger

4) Impact studies

Independent measurements

- Measurement campaign at Kleindöttingen



a) Case studies

- Examples
  - 19 August, 2008
  - 30 November, 2008

Wetterübersicht vom Dienstag
Résumé météorologique du Mardi

19.8.2008

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Eidgenössisches Departement des Innern EDI
Département fédéral de l'intérieur DFI
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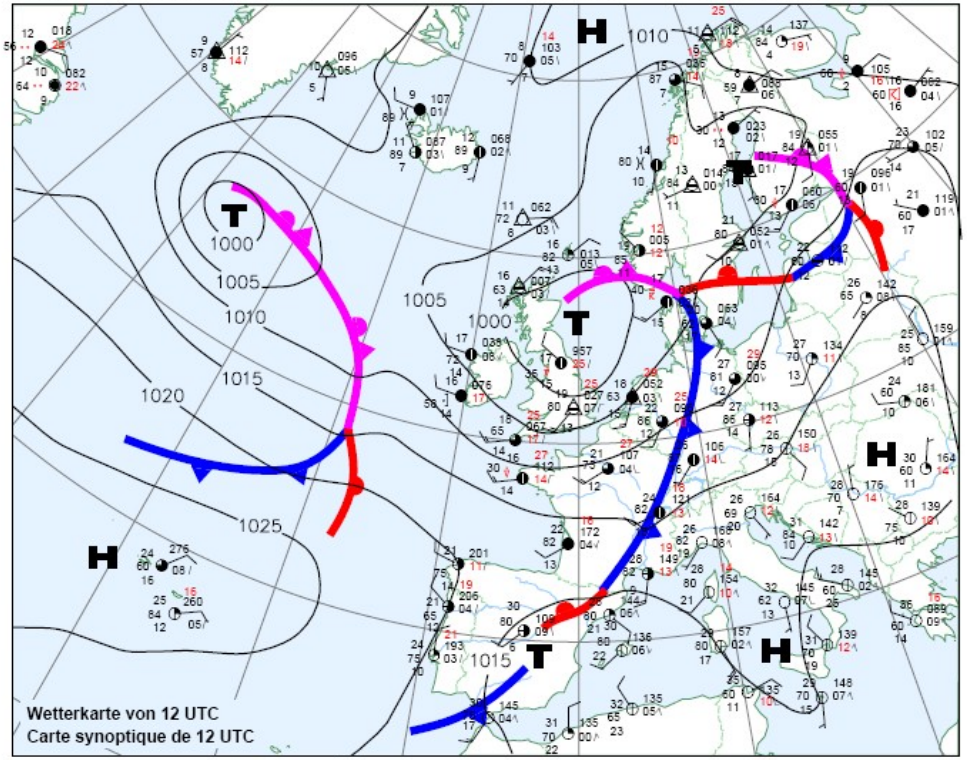
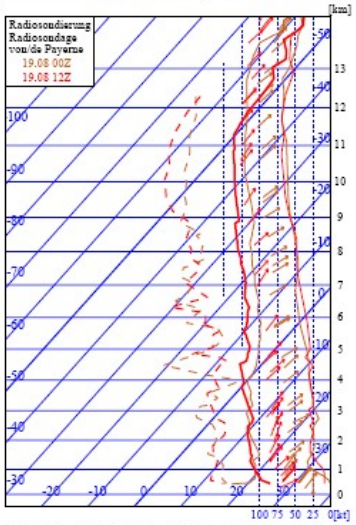
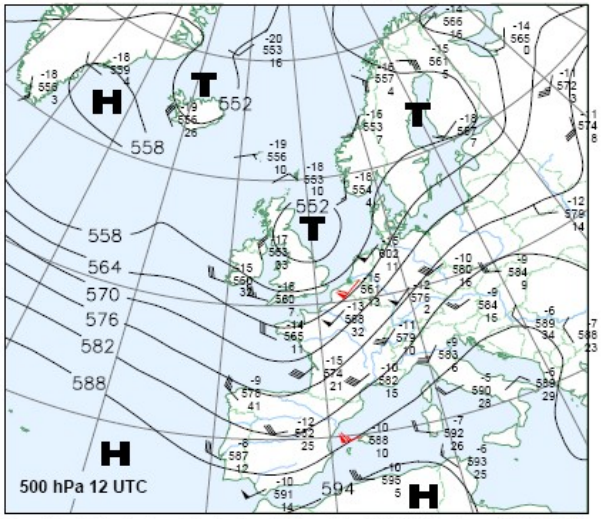


Wetterkarte von 12 UTC
Carte synoptique de 12 UTC

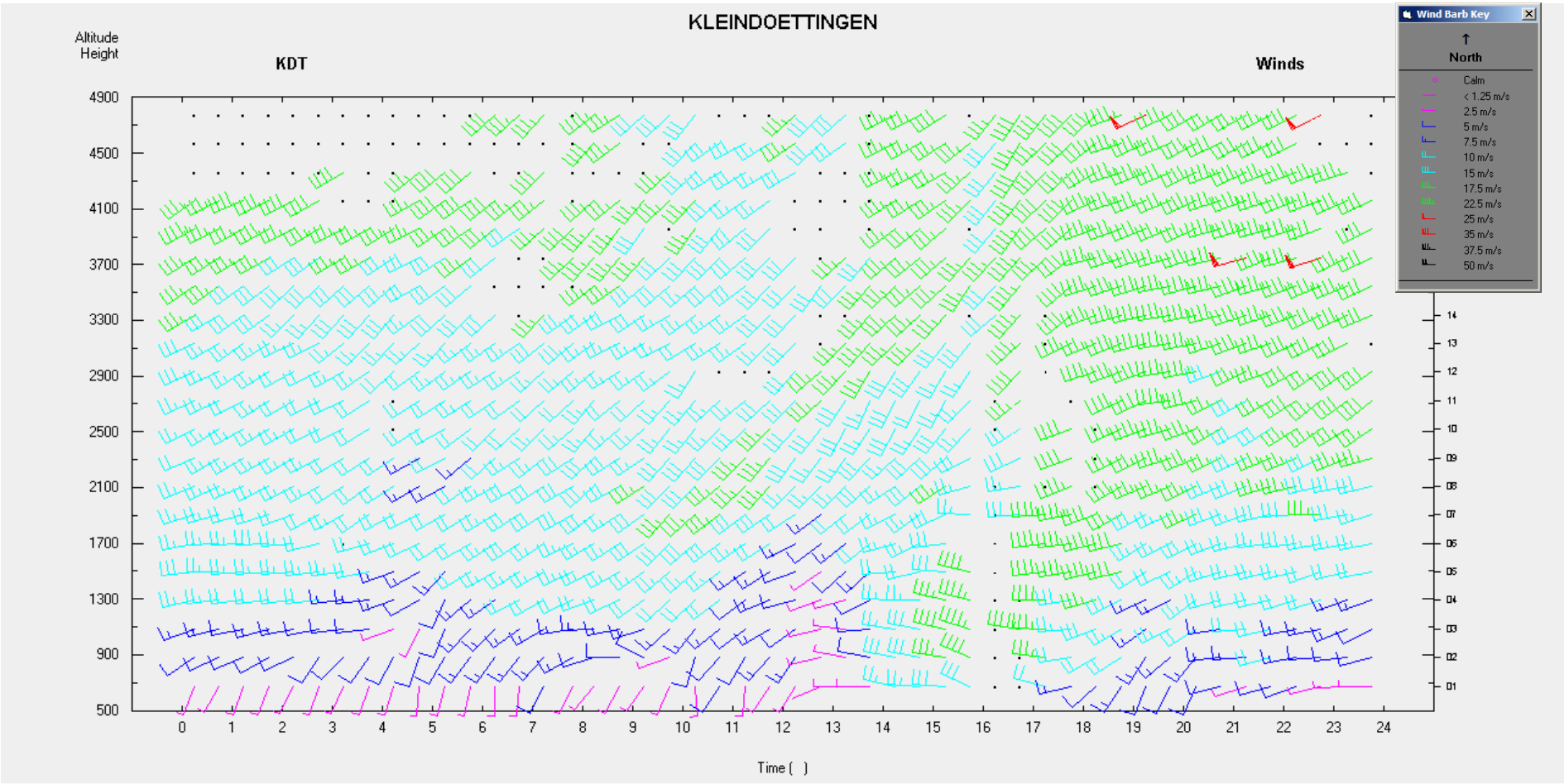




500 hPa 12 UTC

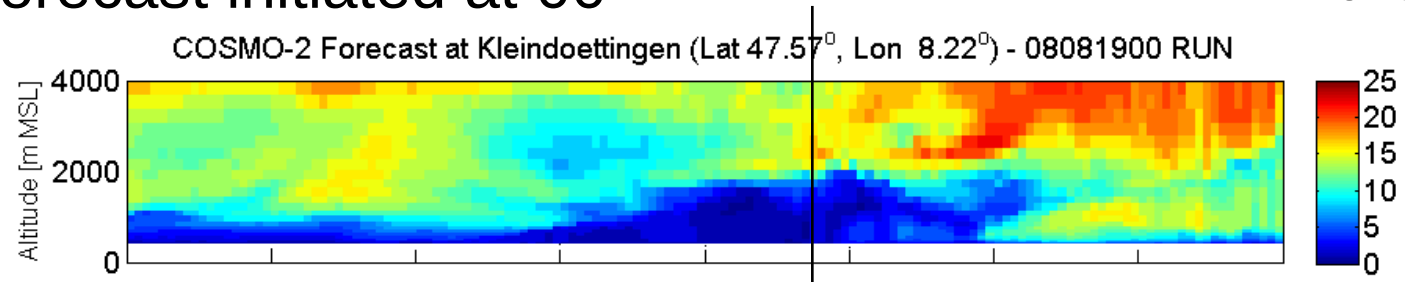
Wetterübersicht mit Karten + Daten ab Telefax Polling / Bulletin météorologique (cartes et données) par télefax polling (Fr. 1.50 / Min.) 0900 162 244
Abonnement: MeteoSchweiz, F. Schacher, Postfach 514, 8044 Zürich

19 August, 2008

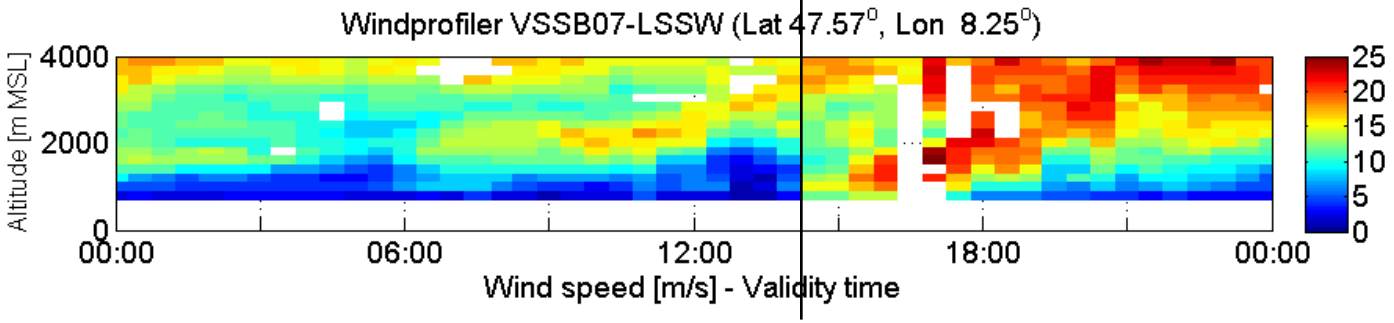


24hours forecast initiated at 00

Wind Speed

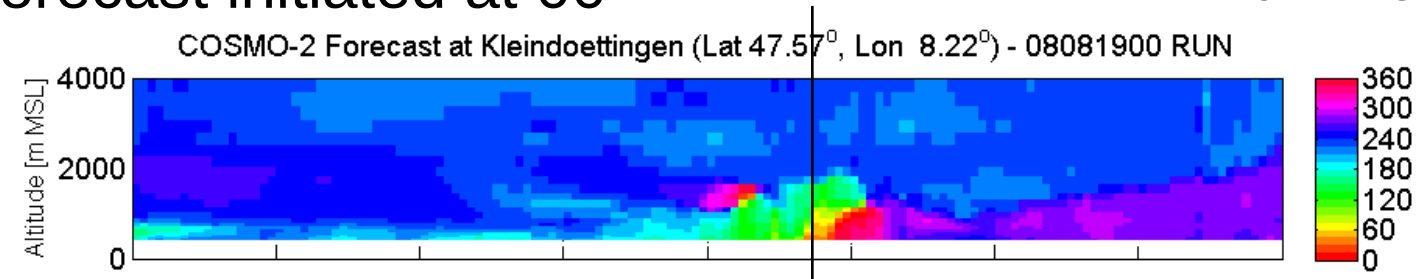


Measurements

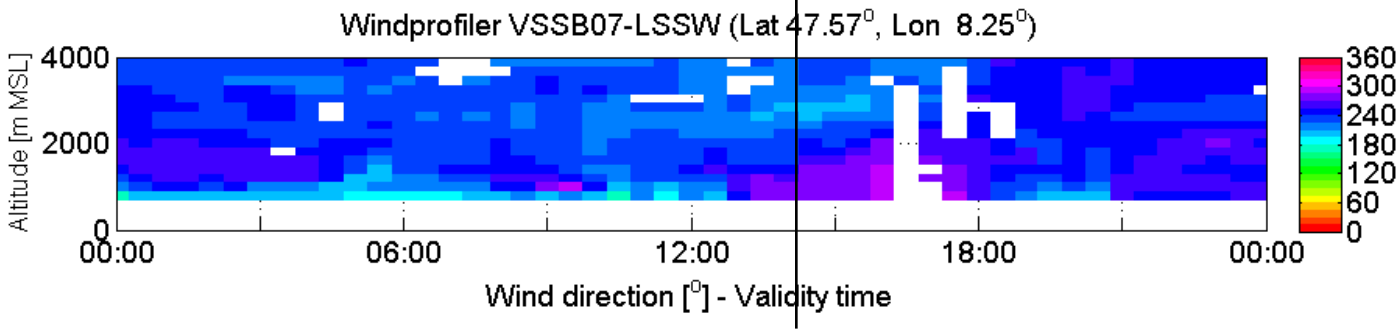


24hours forecast initiated at 00

Wind Direction

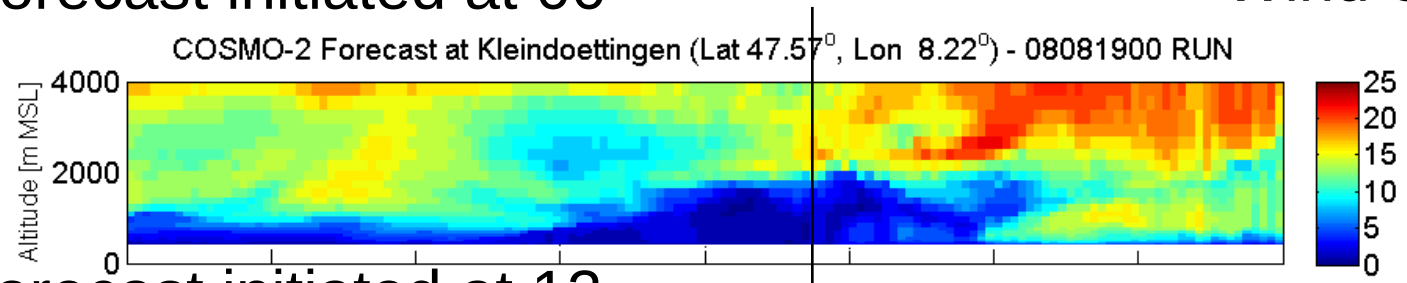


Measurements

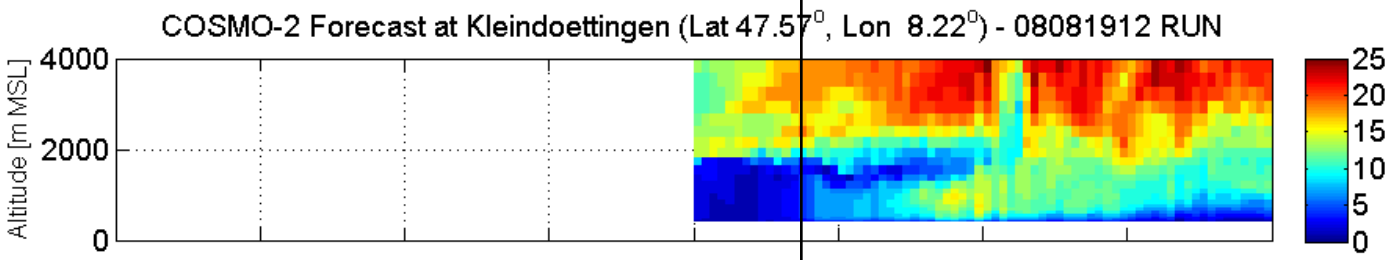


24hours forecast initiated at 00

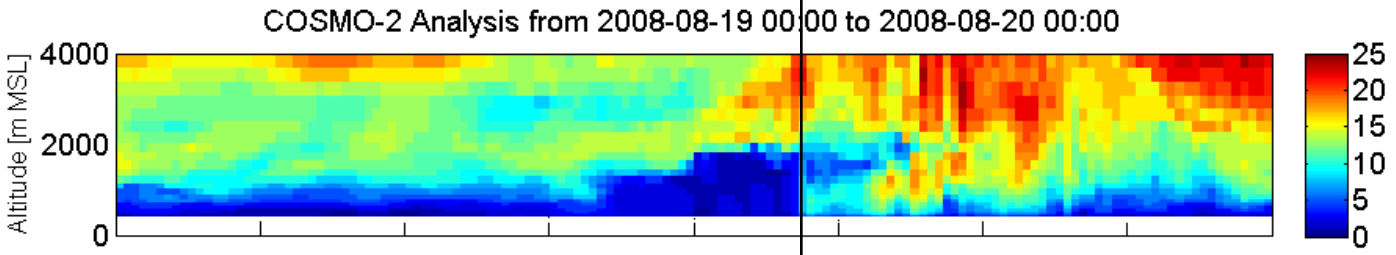
Wind Speed



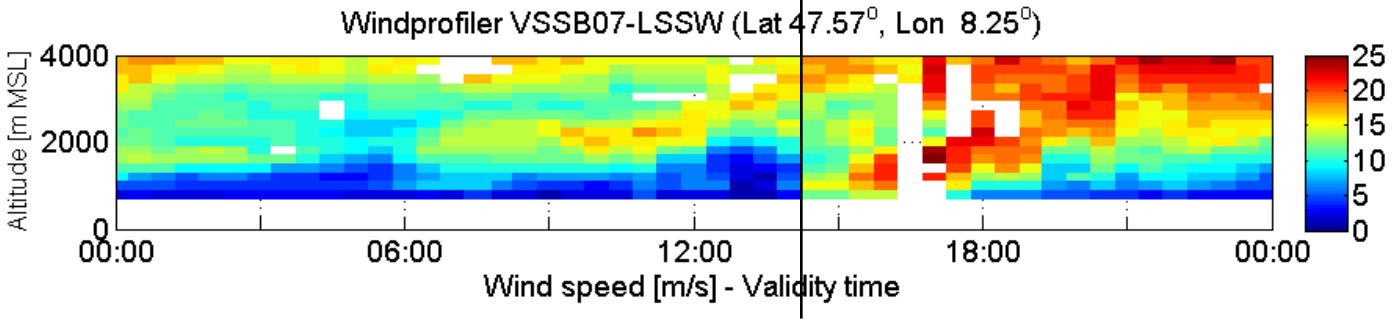
24hours forecast initiated at 12



Analysis

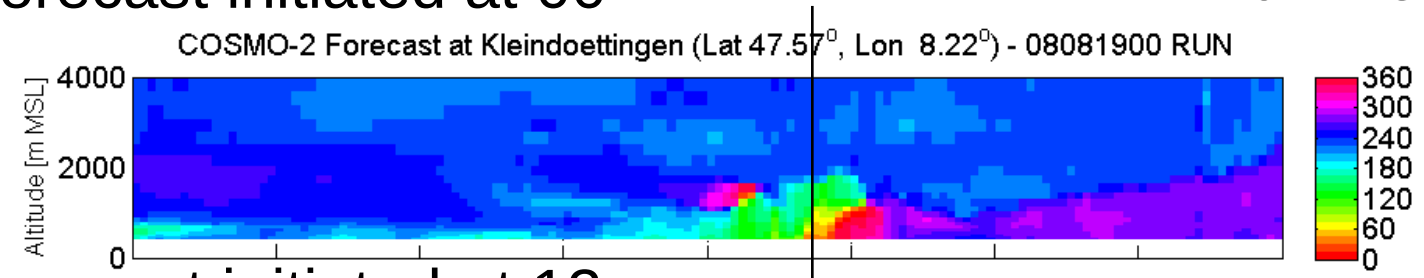


Measurements

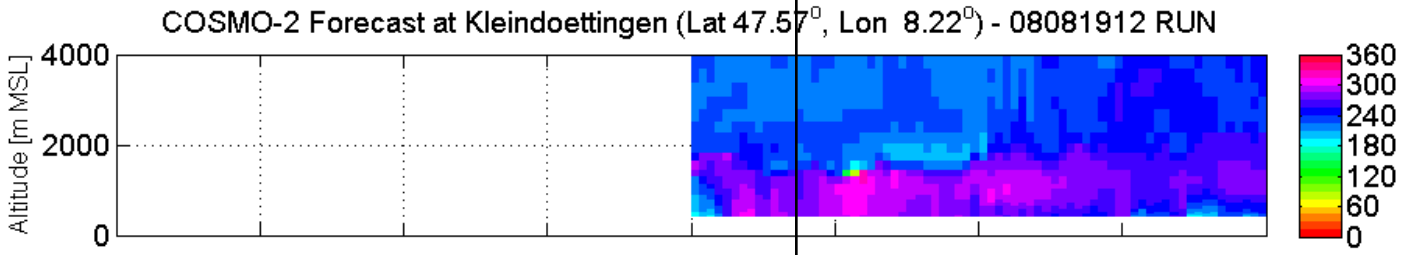


Wind Direction

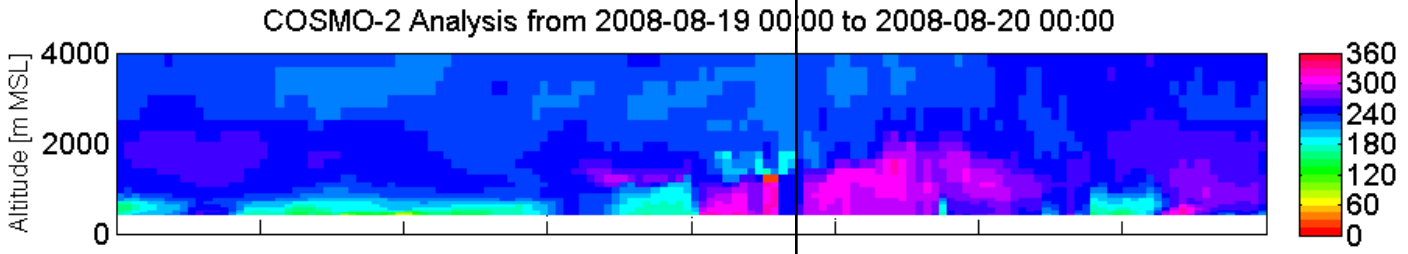
24hours forecast initiated at 00



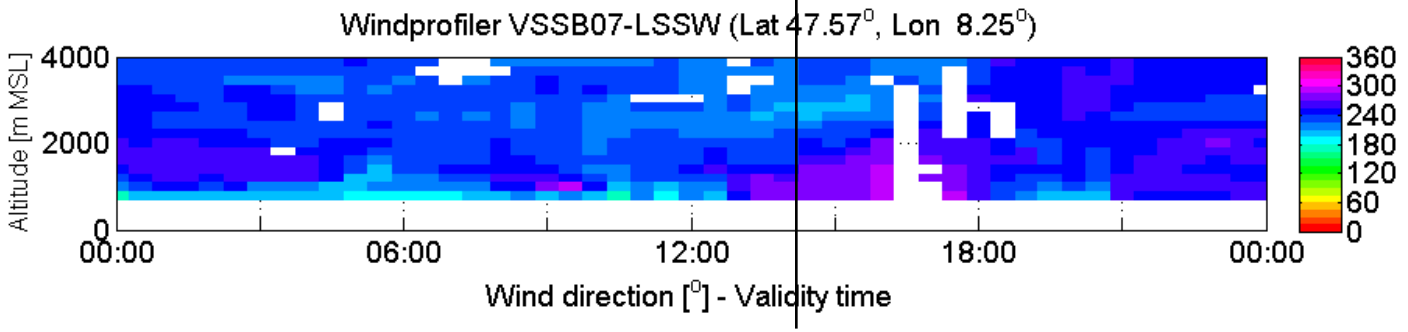
24hours forecast initiated at 12



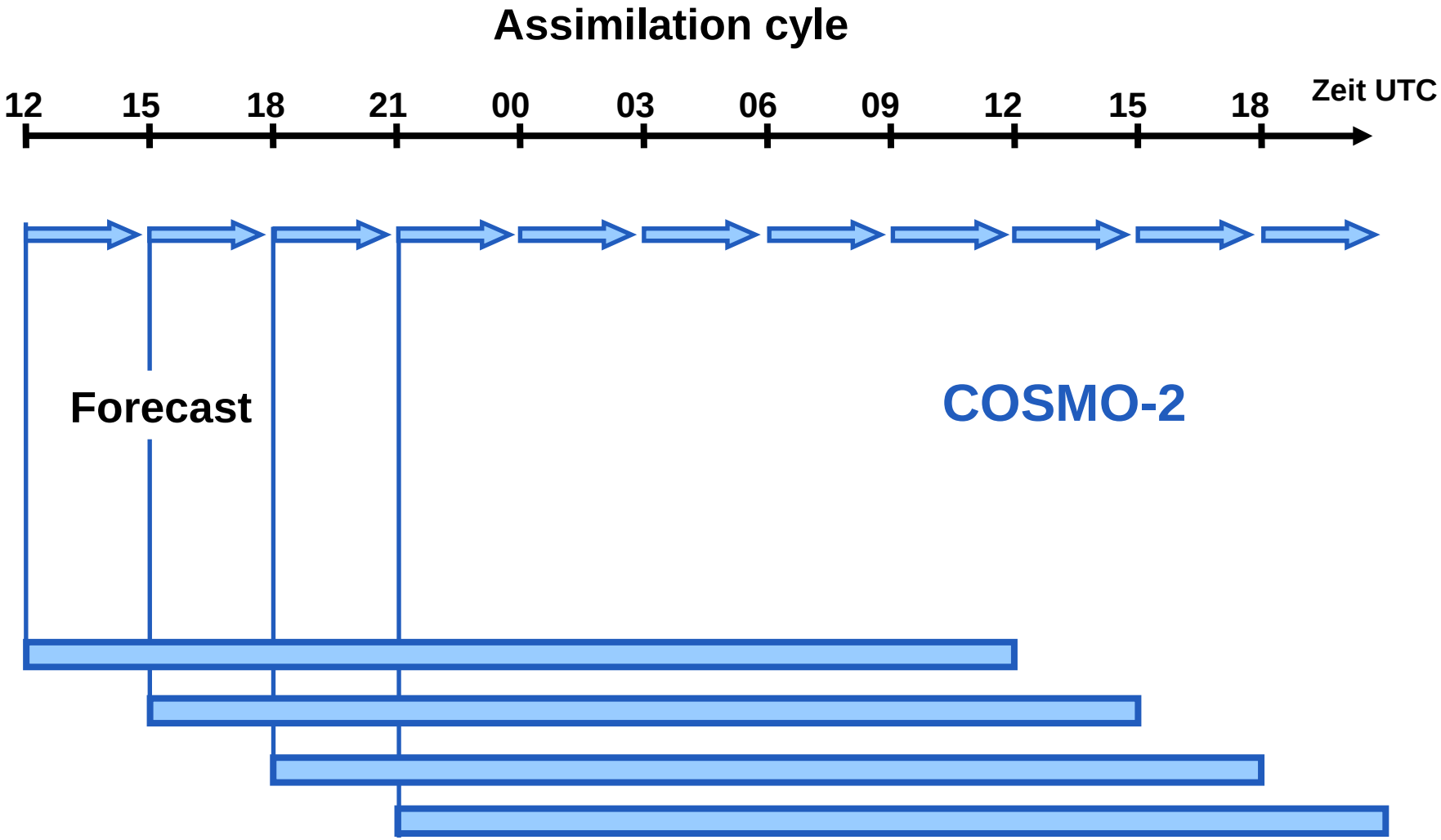
Analysis



Measurements



Production


Assimilation cyle
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Zeit UTC
Forecast
COSMO-2

Wetterübersicht vom Sonntag
Résumé météorologique du Dimanche

30.11.2008

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Eidgenössisches Departement des Innern EDI
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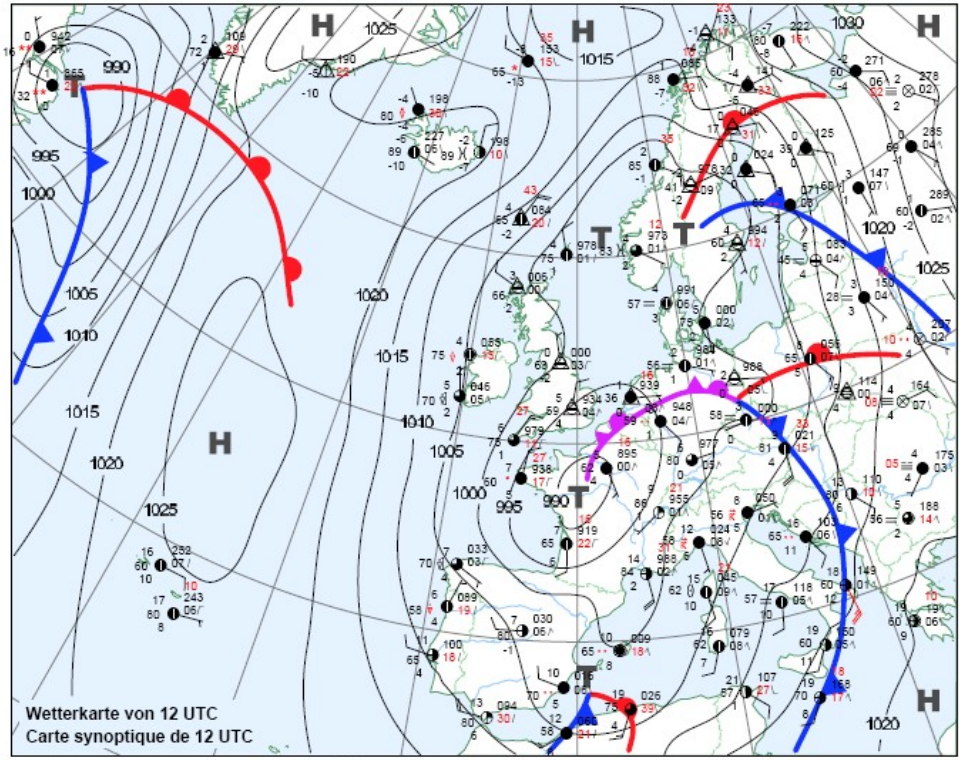

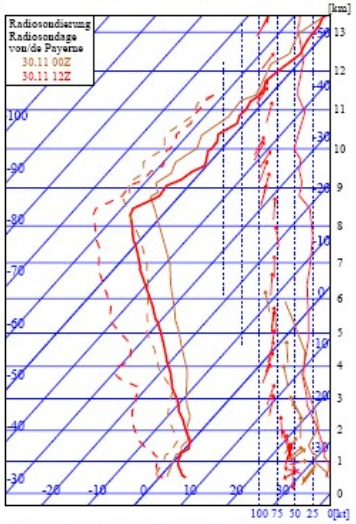

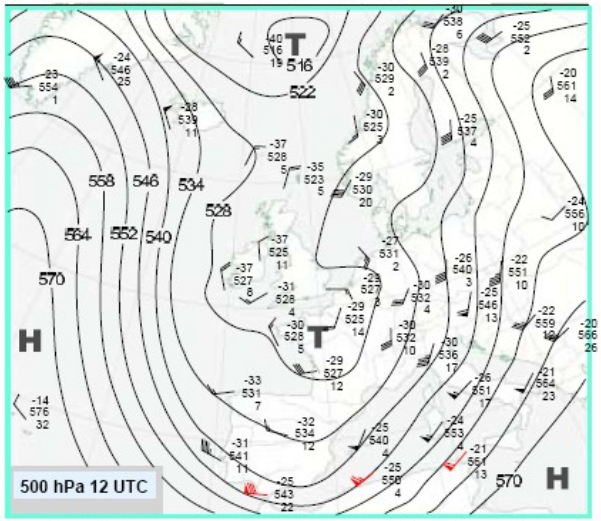

Wetterübersicht mit Karten + Daten ab Telefax Polling / Bulletin météorologique (cartes et données) par télefax polling (Fr. 1.50 / Min.) 0900 162 244
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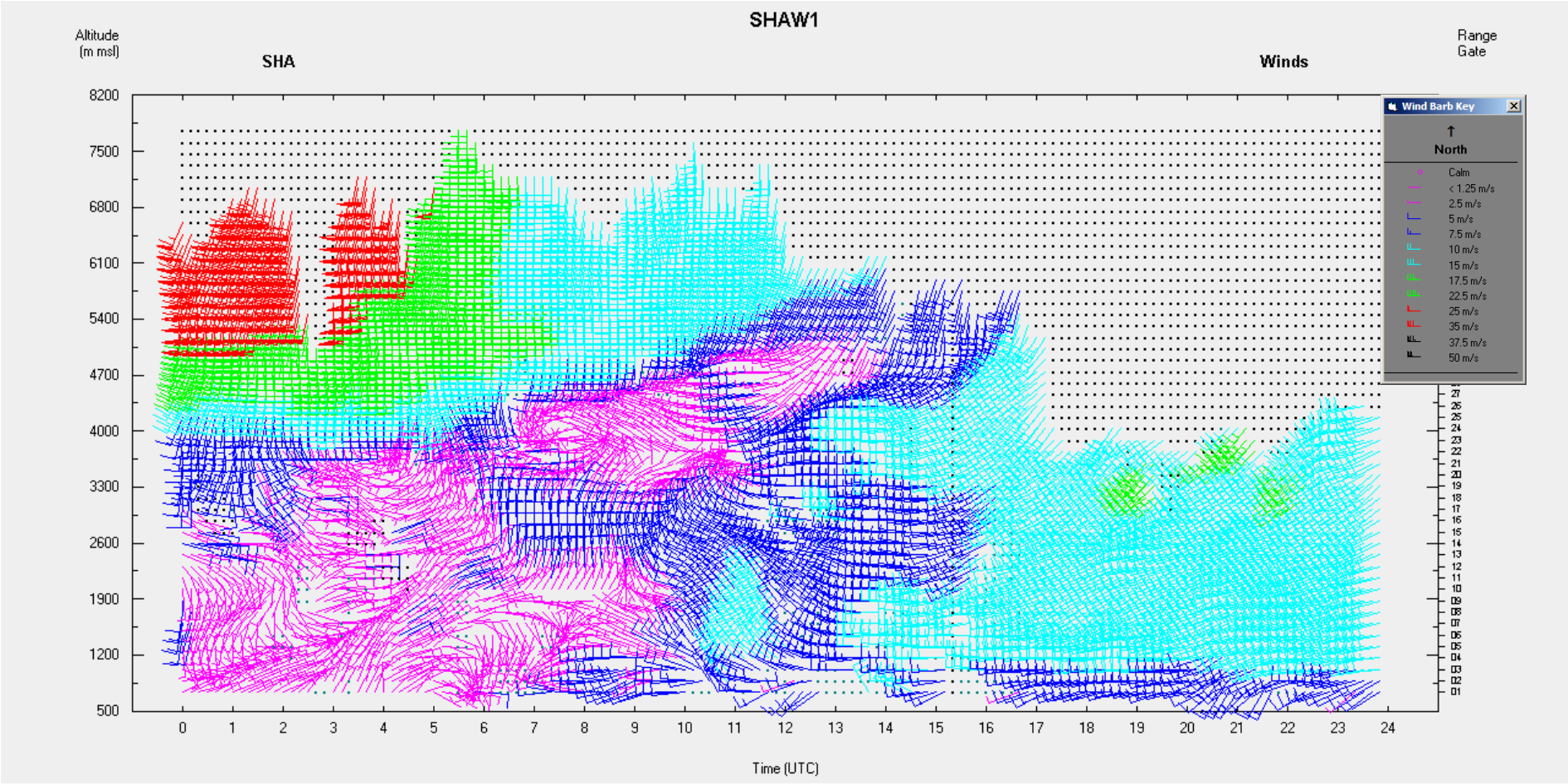
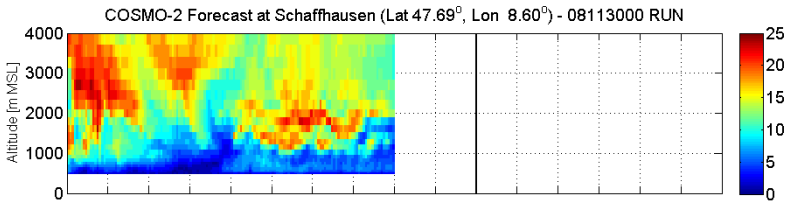
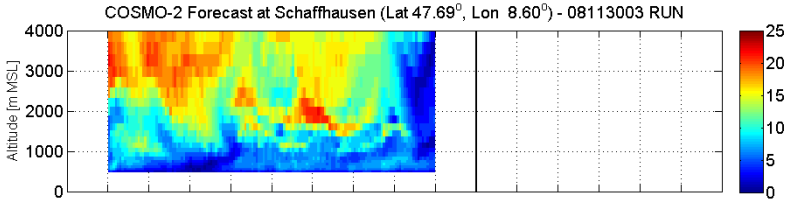
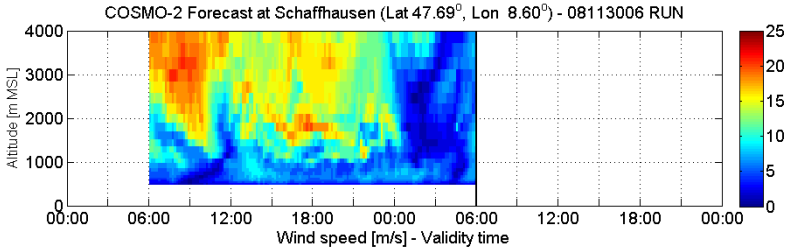
1 December, 2008



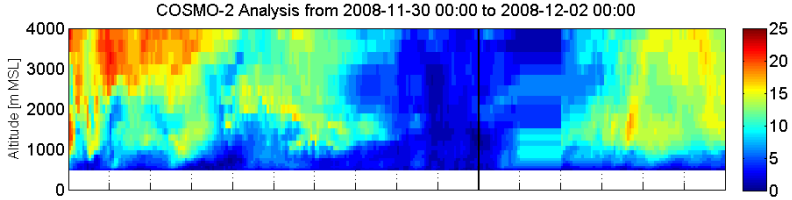
Wind Speed



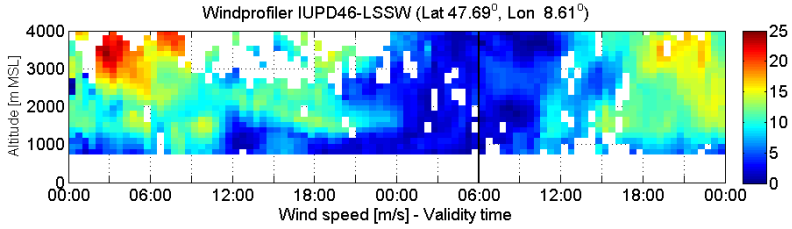




24h Forecast

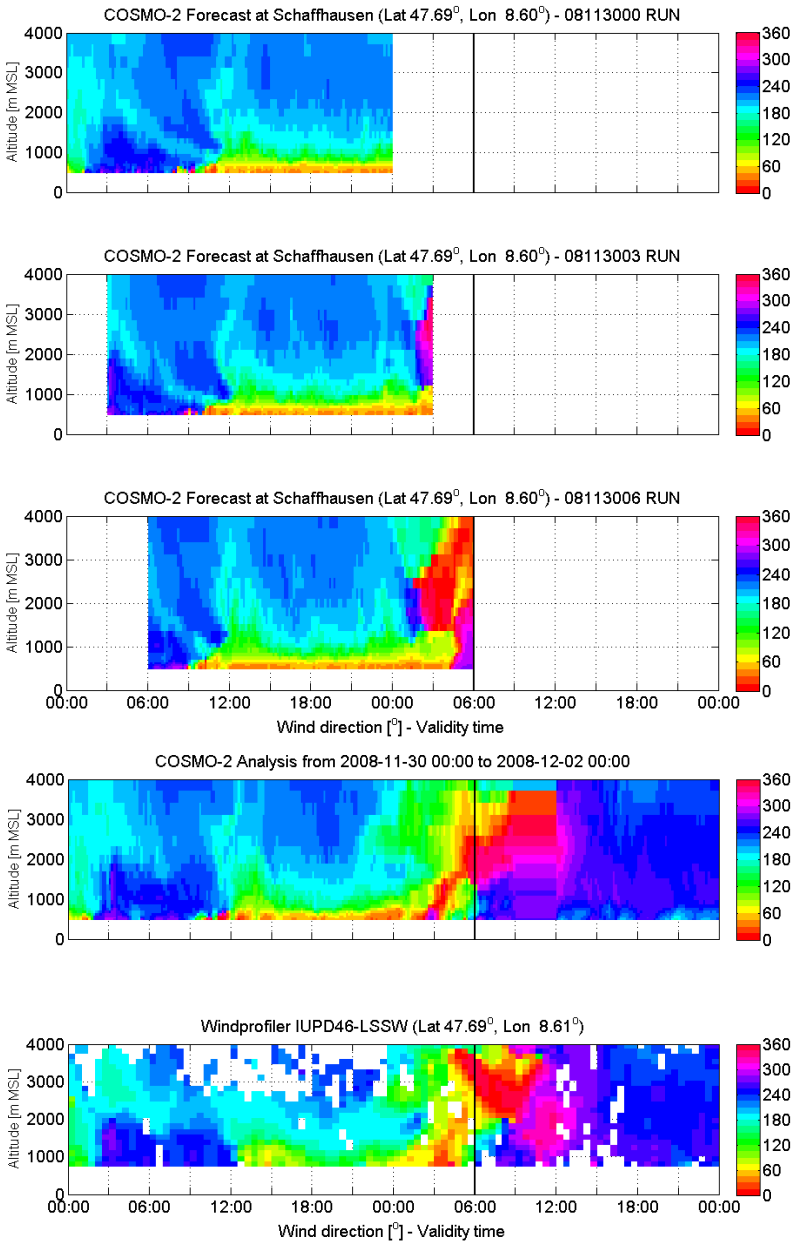


Analysis



WP

Wind Direction

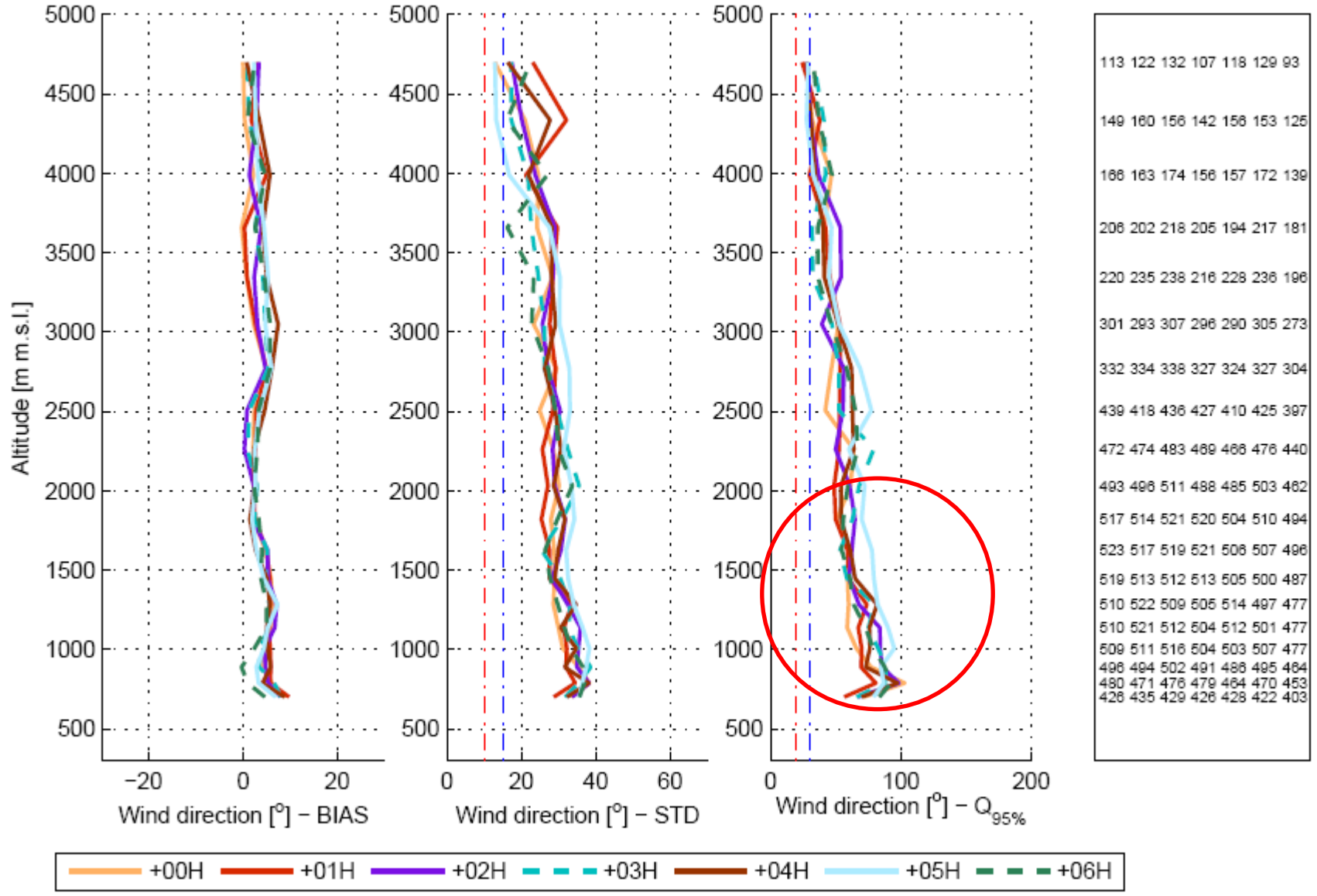


24h Forecast

Analysis

WP

b) Statistics (3 months)


Upper−air Verification profile at KDT (01 Aug 2008 00H − 31 Oct 2008 23H) − COSMO2 − ff >= 2 m/s
Altitude [m m.s.l.]
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
−20
0
20
Wind direction [°] − BIAS
0
20
40
60
Wind direction [°] − STD
0
100
200
Wind direction [°] − Q95%
113 122 132 107 118 129 93
149 160 156 142 156 153 125
166 163 174 156 157 172 139
206 202 218 205 194 217 181
220 235 238 216 228 236 196
301 293 307 296 290 305 273
332 334 338 327 324 327 304
439 418 436 427 410 425 397
472 474 483 469 466 476 440
493 496 511 488 485 503 462
517 514 521 520 504 510 494
523 517 519 521 506 507 496
519 513 512 513 505 500 487
510 522 509 505 514 497 477
510 521 512 504 512 501 477
509 511 516 504 503 507 477
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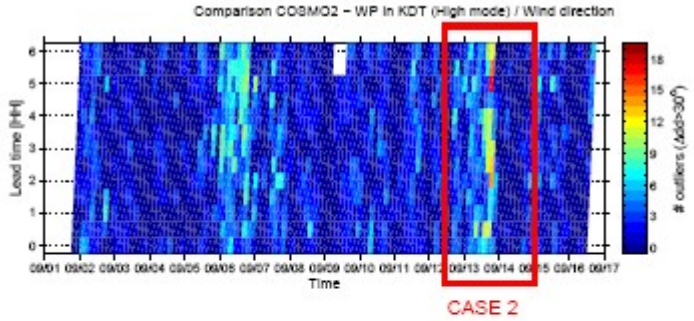
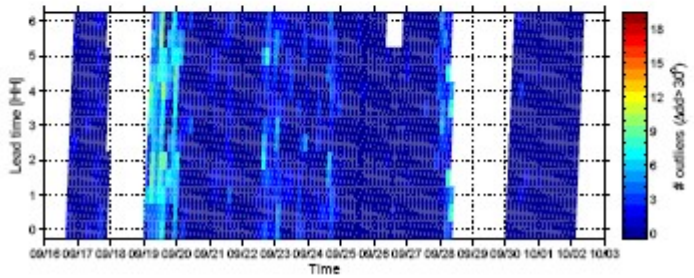
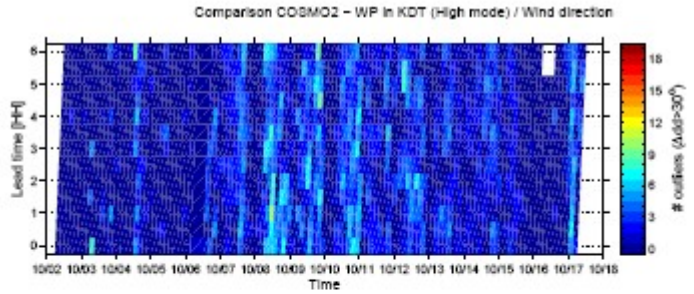
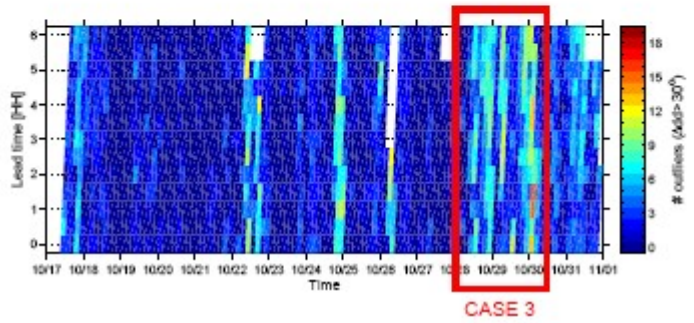
426 435 429 426 428 422 403
+00H
+01H
+02H
+03H
+04H
+05H
+06H









Number of outliers (within the profile) in function of time:

- No decrease of model performance f(lead time)

- Outliers concentrated on specific periods = typical weather situations (foehn,..) and maybe caused by a temporal shift of weather changes related to reality

Summary

The positive impact of ground-based remote sensing data assimilation into NWP model becomes more significant as the NWP model spatial scale becomes higher

Complex topography increases the need for supplementary measurement data to be assimilated in NWP models

Future

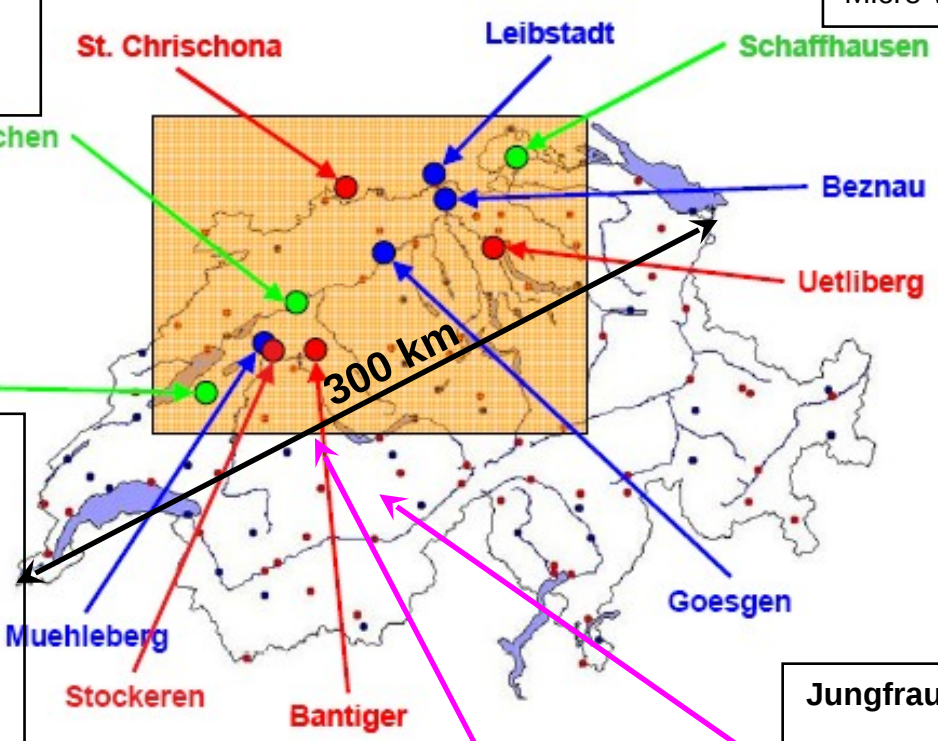
New comparison campaign in 2009

Assimilation of weather radar winds into COSMO-2

Assimilation of temperature + water vapor profiles from radiometers+GPS+? into COSMO-2

COSMO-1 ?

Operational Swiss test bed for ground-based remote sensing



•Wind profiler
•Micro-wave radiometers (T)

•Wind profiler
•Micro-wave radiometers (T)

•Radiosounding (PTU+O3)
•Wind profiler
•Raman water vapor Lidar
•Micro-wave radiometers (T+Water vapor + O3)
•GPS antenna
•Ceilometer
•BSRN
•Surface measurements

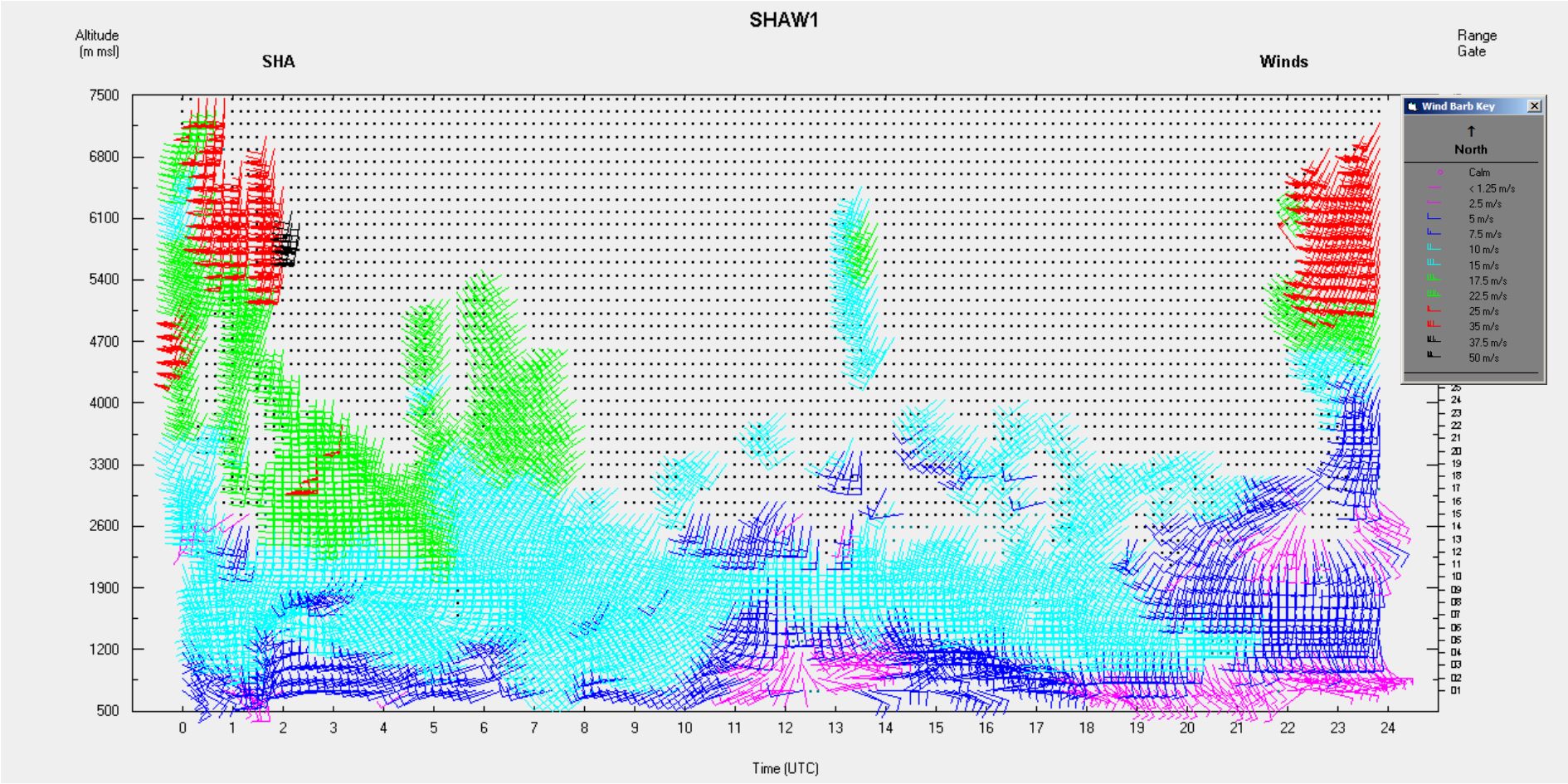
Zimmerwald (Uni Bern)

•Several radiometers
•GPS

Jungfraujoch (3600 m asl)

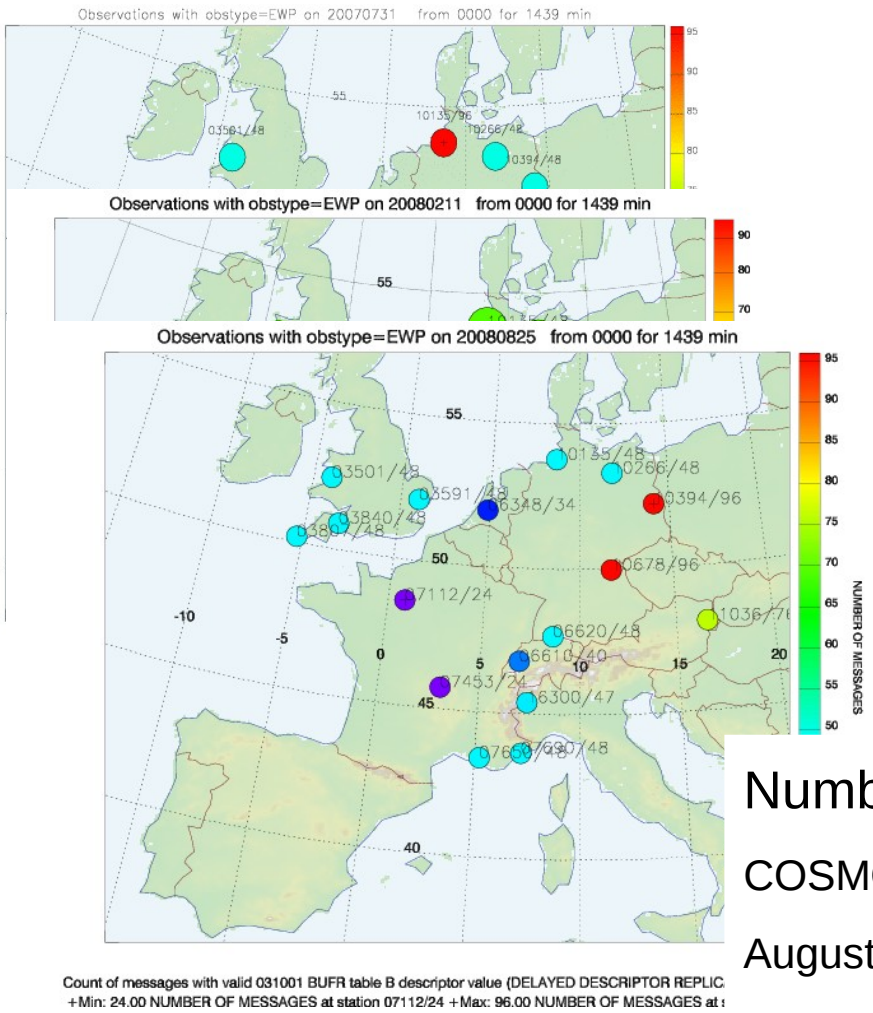
•Trace gases
•Radiation
•GPS

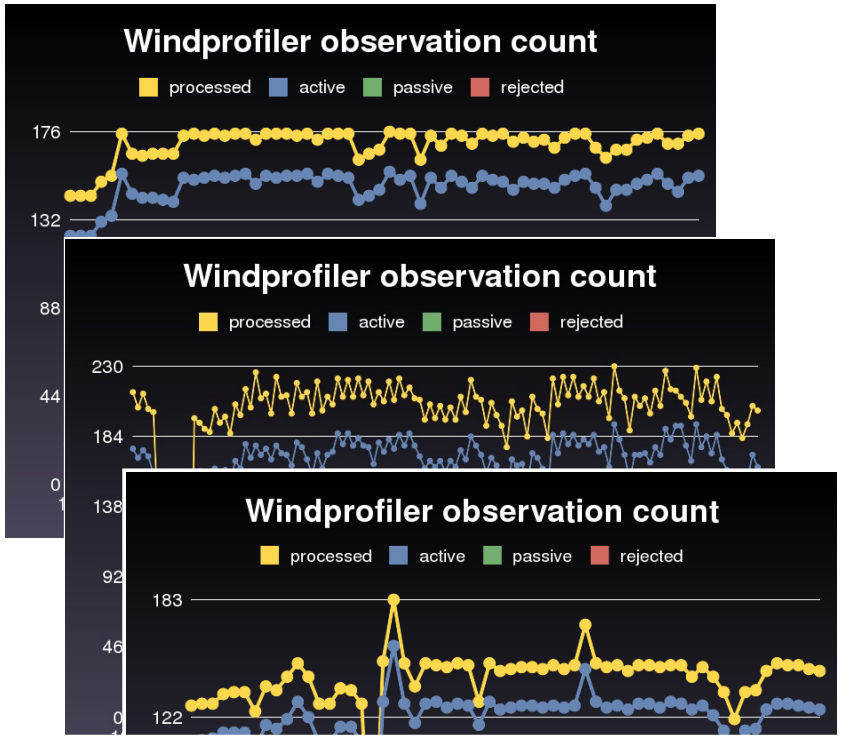
30 November, 2008



Monitoring of the assimilation cycle

Status: Wind Profiler





Number of windprofilers assimilated:

COSMO -7

August 2007: 8 , January 2008: 14, August 2008: 17

COSMO-2

August 2007: 3 , January 2008: 3, August 2008: 8

COST EG-CLIMET – MeteoSwiss activities

- End of project CN-MET
  - Reporting
  - Operational measurement network and COSMO-2 modelling activities
- Aerological station of Payerne involved in the GRUAN activities
  - Radiosounding
  - Lidar
  - Micro-wave radiometers
  - Ceilometer
  - BSRN
  - Etc ..

Swiss COST SG-CLIMET project

The aim of the project is to improve and integrate the different upper-air profiling systems, with the final goal of establishing a reference for upper air temperature and humidity profile measurements.

- Evaluate **humidity** measurements of the different remote sensing systems and cross-compare them with radiosonde profiles to learn about the pros and cons of the different methods.
- Evaluate **temperature** measurements of the different remote sensing systems and cross-compare them with homogenized series of radiosonde profiles to learn about the pros and cons of the different methods.
- Determine an optimal way to improve temporal resolution of radisonde humidity profiles with the help of the LIDAR or other remote sensing systems.
- Determine an optimal way to improve temporal resolution of radiosonde temperature profiles with the help of one or several remote sensing systems.
- Evaluate **IWV values** measured by different systems and test uncertainty as well as availability of the different systems