

# Impact of horizontal and vertical model resolution for stratus simulations in Northern Switzerland with aLMo

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Alpine Model = aLMo

Guy de Morsier

LM-Seminar, Langen,  
March 6, 2006

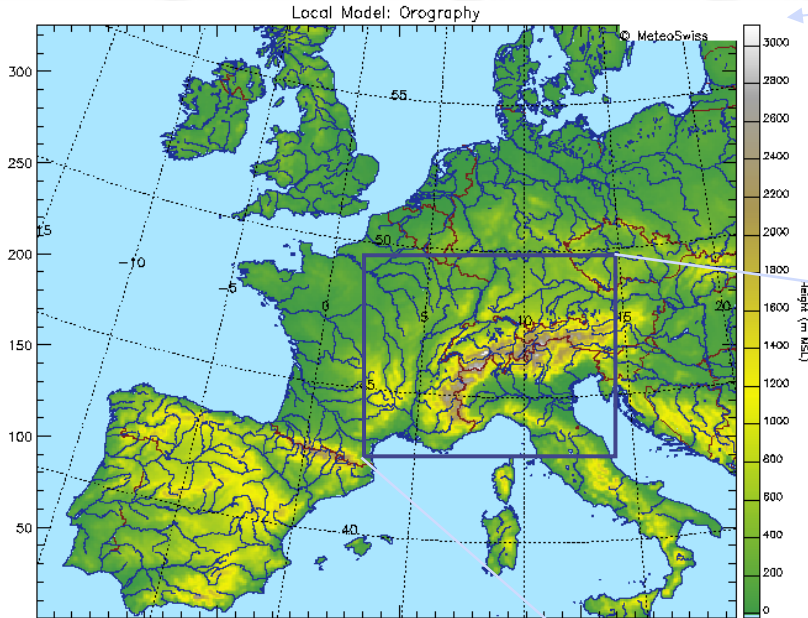


# aLMo2 Design

IFS/ECMWF, 25km, synoptic scale

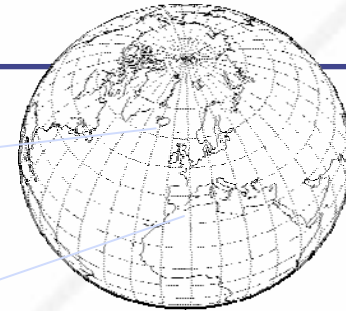


aLMo 7km, 385x325x45, regional scale



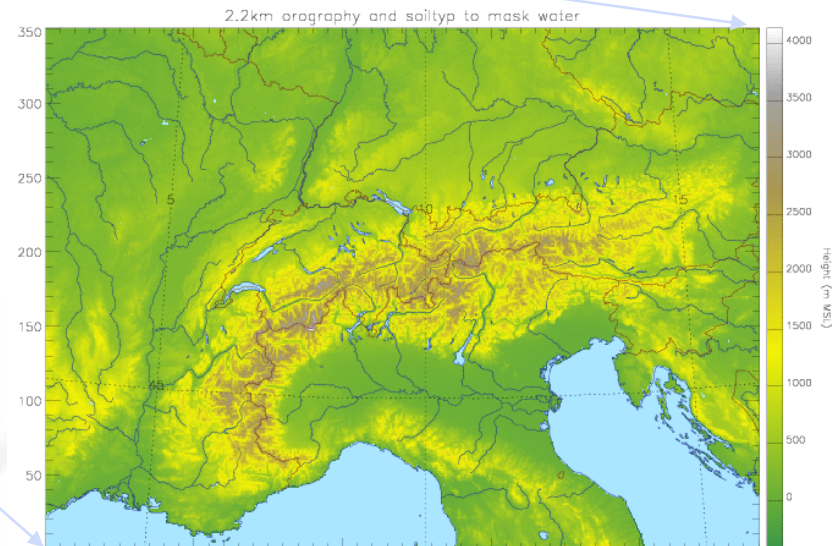
Own assimilation cycle (nudging)

2 daily 72h forecast



4 daily updates

aLMo 2.2km, 480x350x60, local scale



Own assimilation cycle (nudging)

8 daily 18h **nested** forecast

# Contents

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Context: high resolution Alpine Model: aLMo2

- ◆ Configuration
- ◆ Experiments
  
- ◆ Verification results
  - with **SYNOP** stations
  - with **upper-air** soundings
  
- ◆ Summary
- ◆ Outlook

# aLMo2 Configuration and Tests

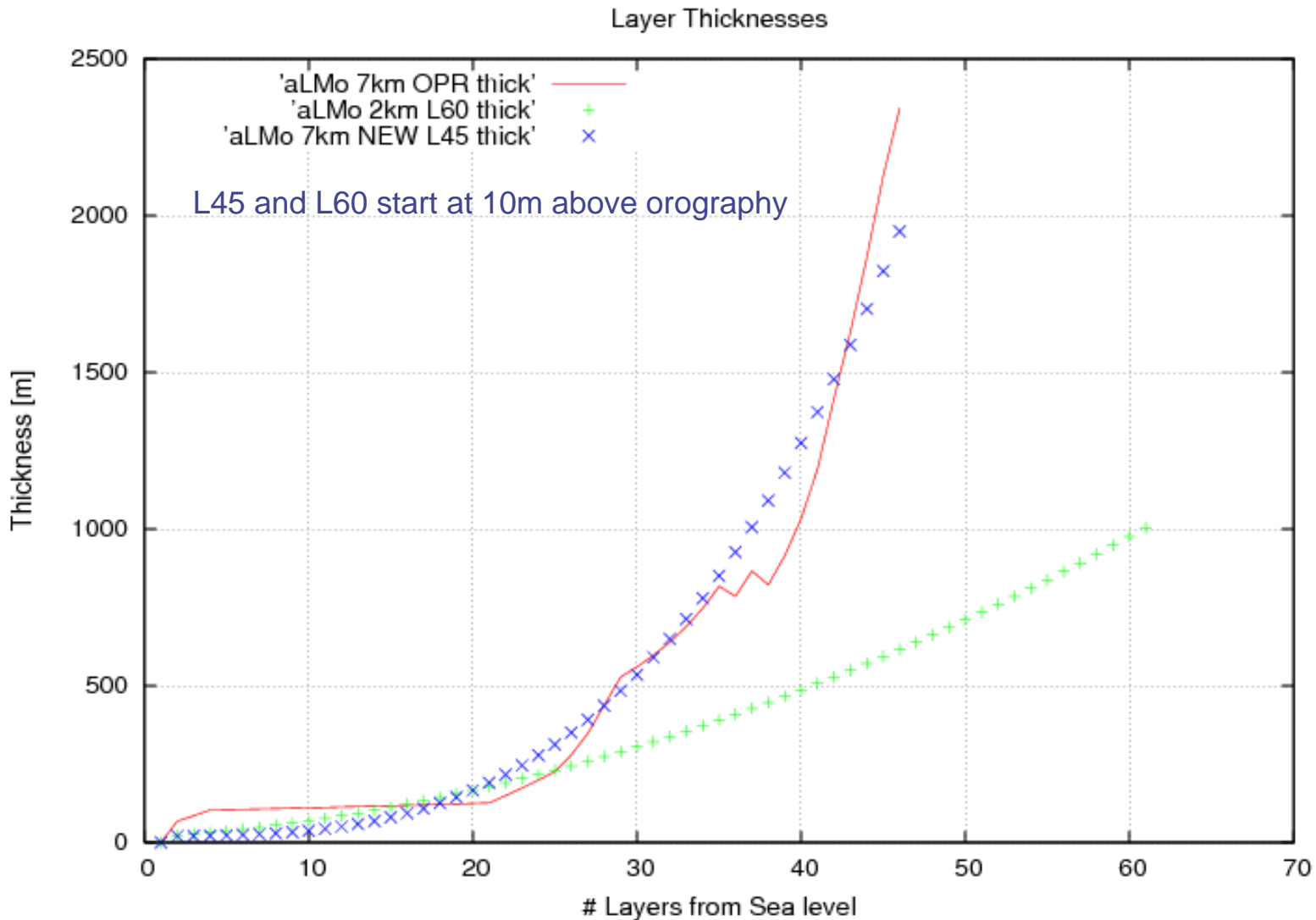


- ◆ Start with the most probable **future** aLMo7 configuration
  - new Runge-Kutta dynamics (RK)
  - TKE, new multi layer soil model
  - new vertical distribution of vertical levels (with first level at ~10m agl)
  
- ◆ **Best** initial & lateral boundary conditions (aLMo7 assim. with IFS analysis)
  - **only** aLMo2 is run in assimilation **and** in forecast mode
  
- ◆ Test cases for evaluation: 10 episodes for a total of 42 days
  - Cloud free (August 2005) and Stratus (Dec. 2004)
  - Convection (May 2002 and 2003)
  - Föhn and Precipitation (MAP IOP 2, Sept. 1999 and Aug. 2004)
  - Strong “Jeanette” (Oct. 2002)
  - WINDBANK (July-October 1997 and 1999) cf. CN-MET project

# aLMo2 Vertical resolutions used



- ◆ Tests with **both** 45 and 60 levels for aLMo2 nested in aLMo7 (only **new** L45)



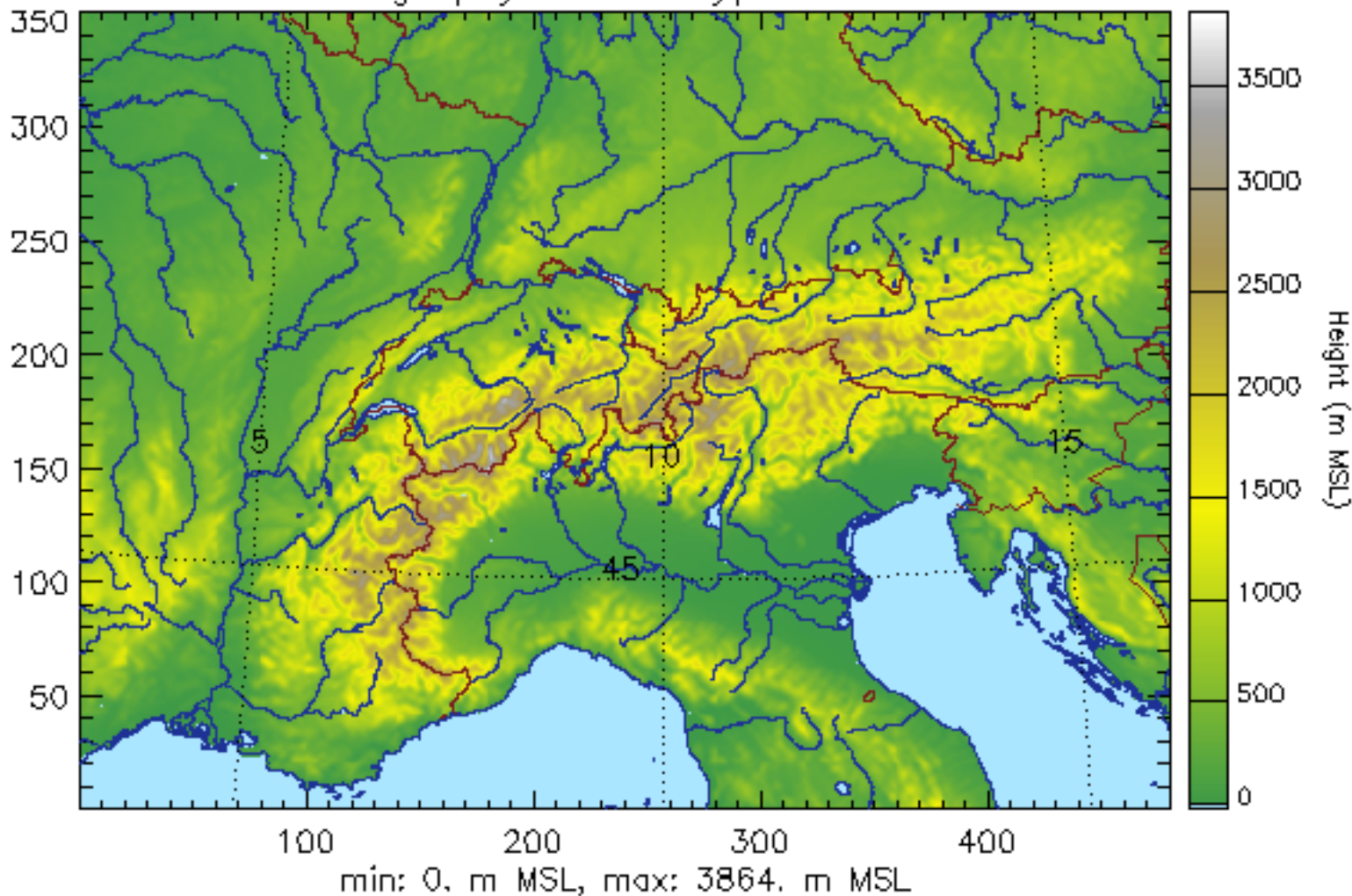


# aLMo2 Horizontal domain



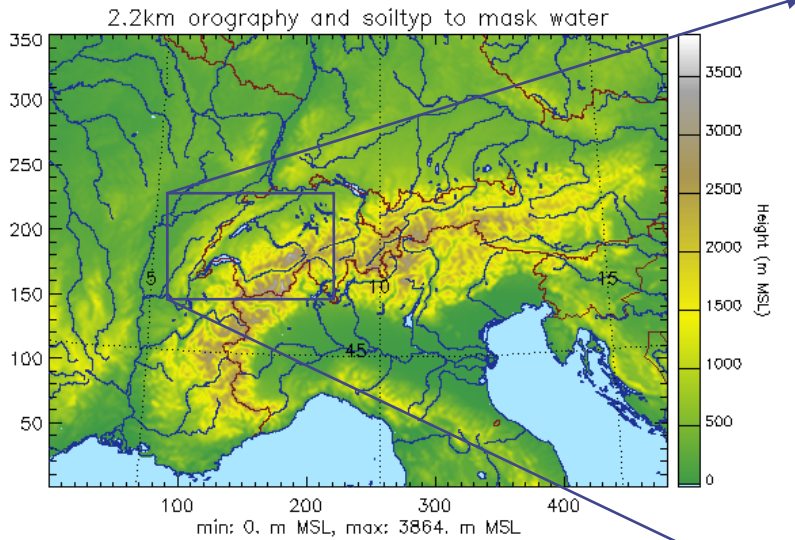
- ◆ L60 orography with ~ 5 grid length filter and broad valley bottom (l\_topo\_z)

2.2km orography and soiltyp to mask water

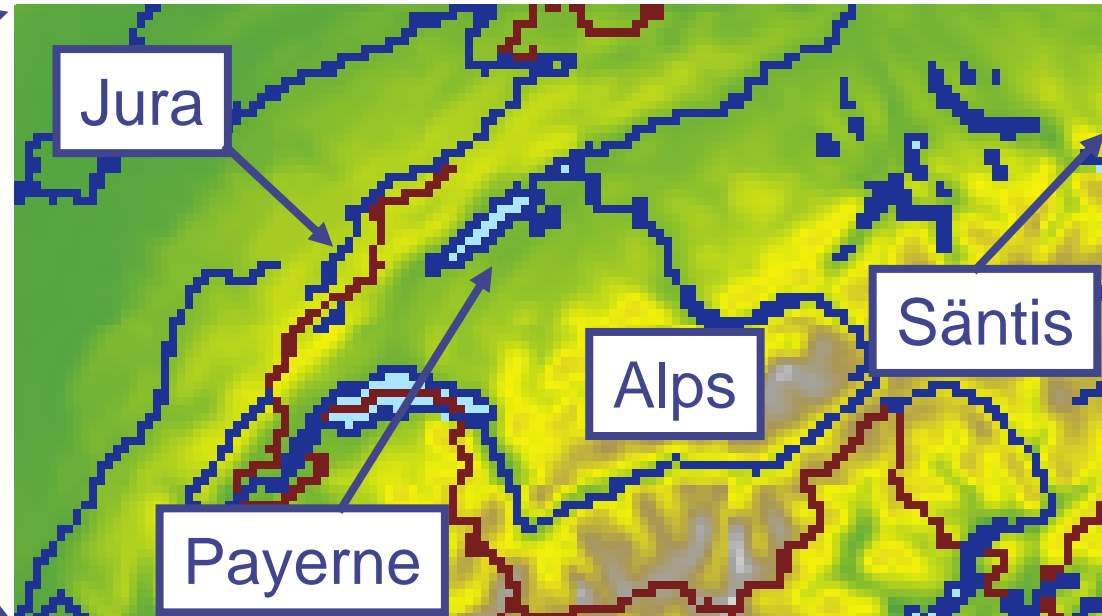


# aLMo2 Domain of interest

## ◆ aLMo2 domain



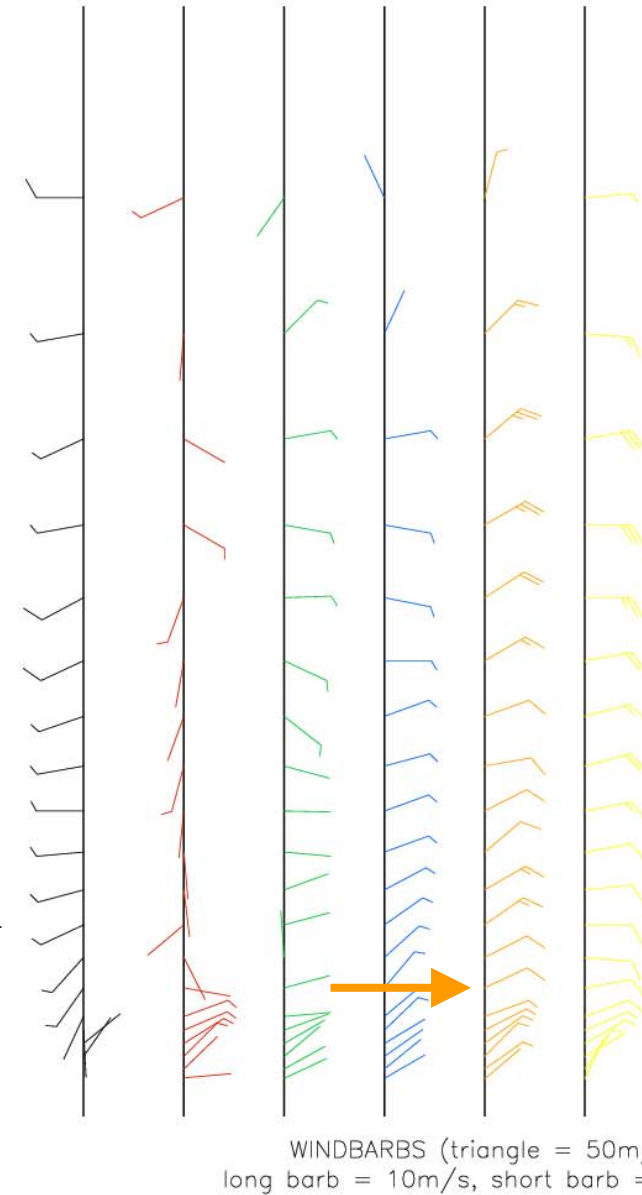
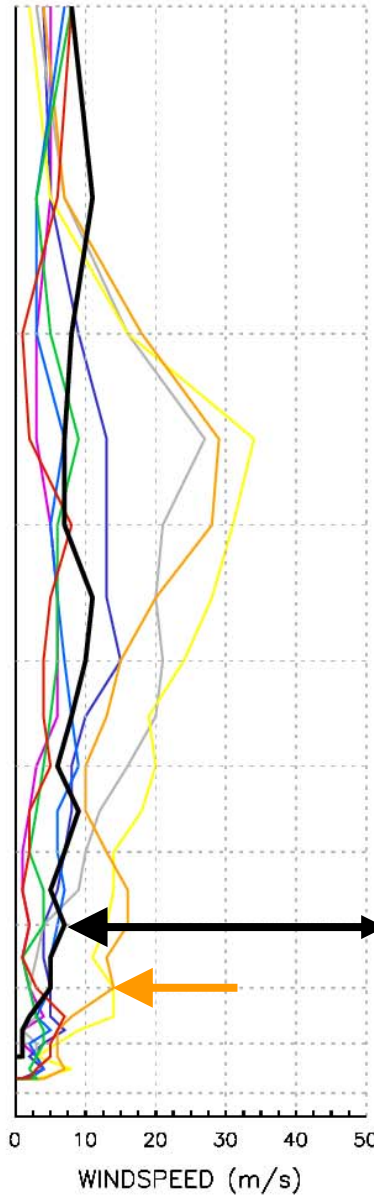
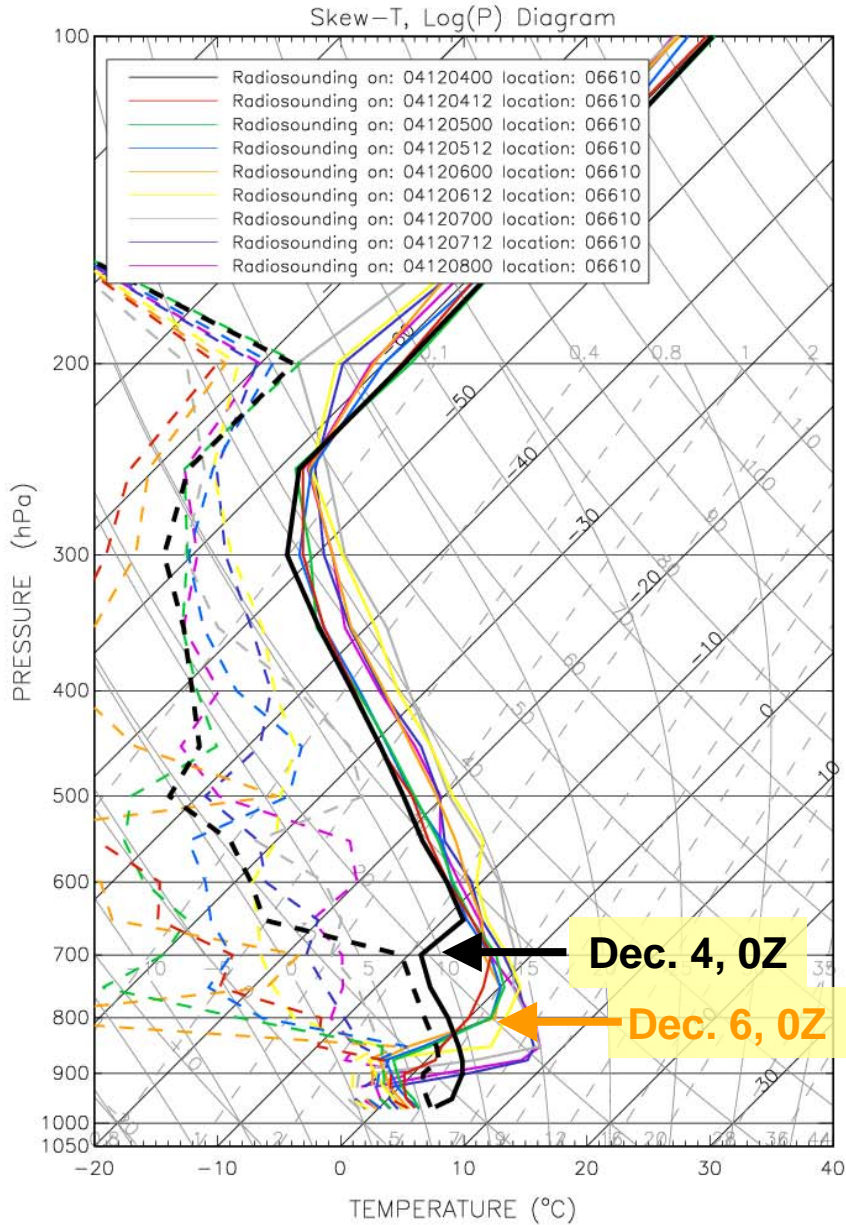
## Swiss Middleland



Jura mountain ranges higher than 1'000m

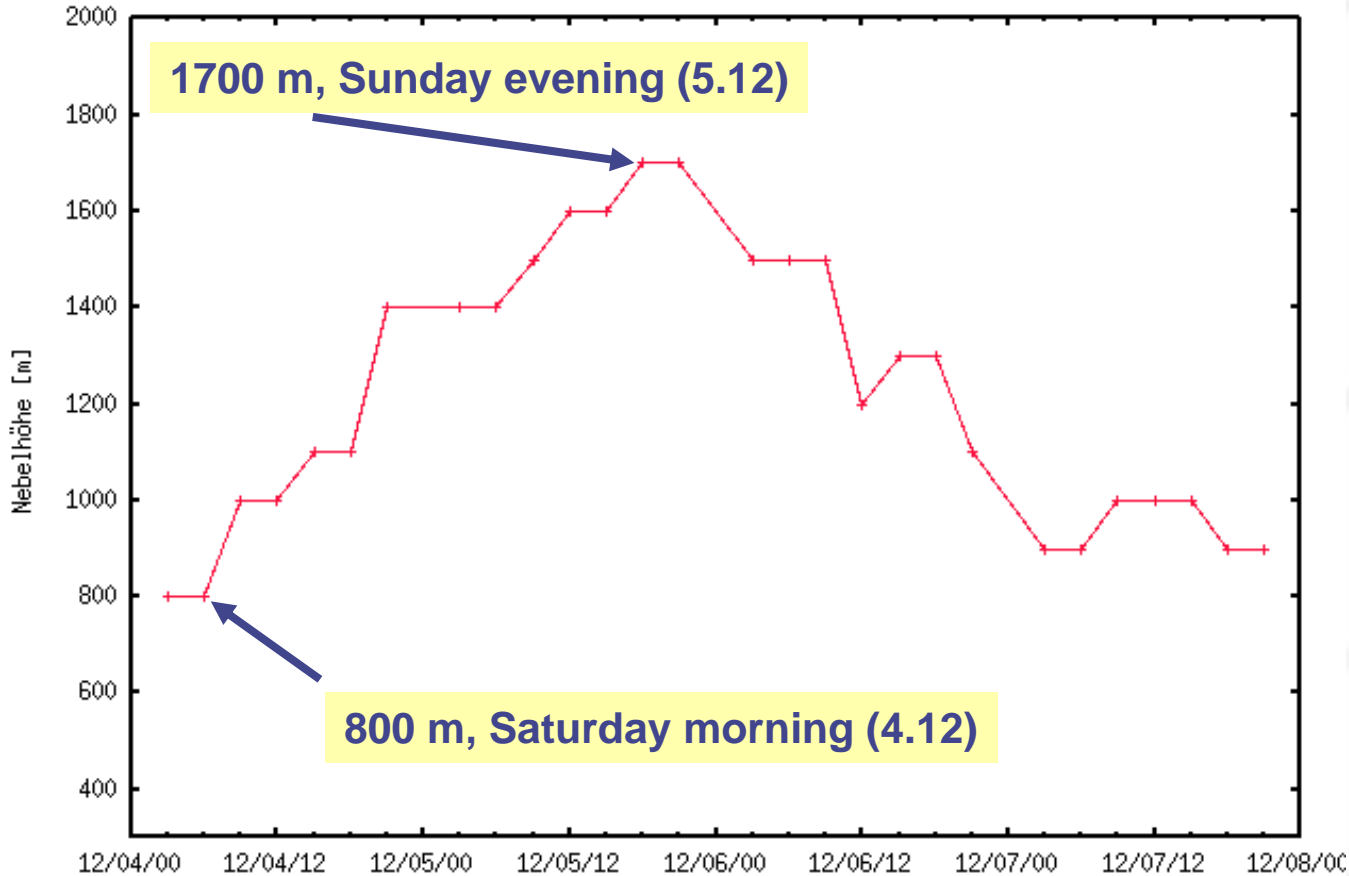
# Radiosonde Payerne

# Dec. 4 – 8 every 12h





Säntis 4.-7. Dezember 2004



◆ top of the low clouds

# Low Level Cloud Cover

Assimilation Mode **L45**



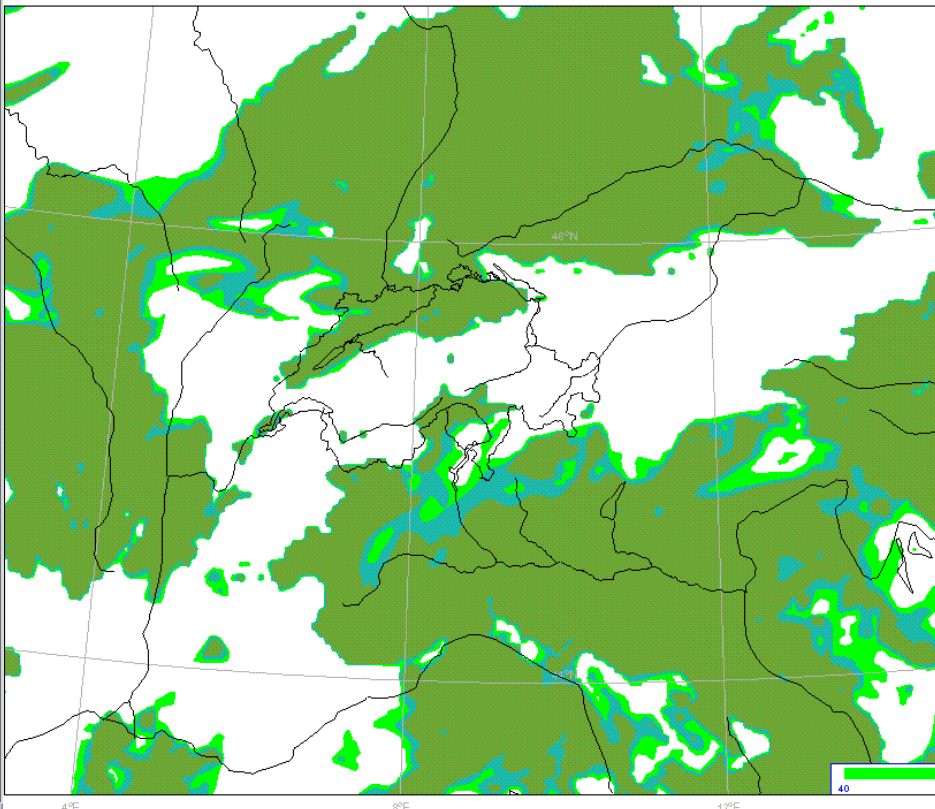
**7km**

**Sun. Dec. 5, 2004, 0 UTC**

**2km**

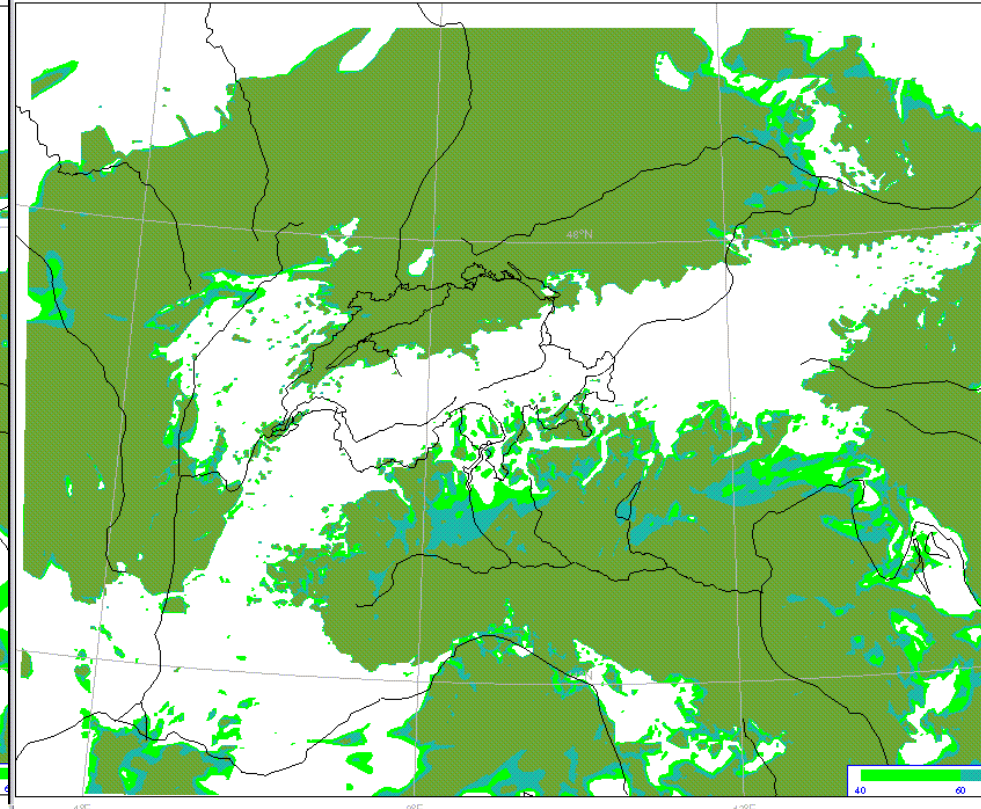
aLMo Analysis for Sunday 5 December 2004 00 UTC  
Low Cloud Cover (p=800-1000hPa or z=2-0km)

Version: aLMo cascade: 7km (959)  
Units: % Mean: 60.308



aLMo Analysis for Sunday 5 December 2004 00 UTC  
Low Cloud Cover (p=800-1000hPa or z=2-0km)

Version: aLMo cascade: 2km (959)  
Units: % Mean: 64.225



# Low Level Cloud Cover

Assimilation Mode **L45**



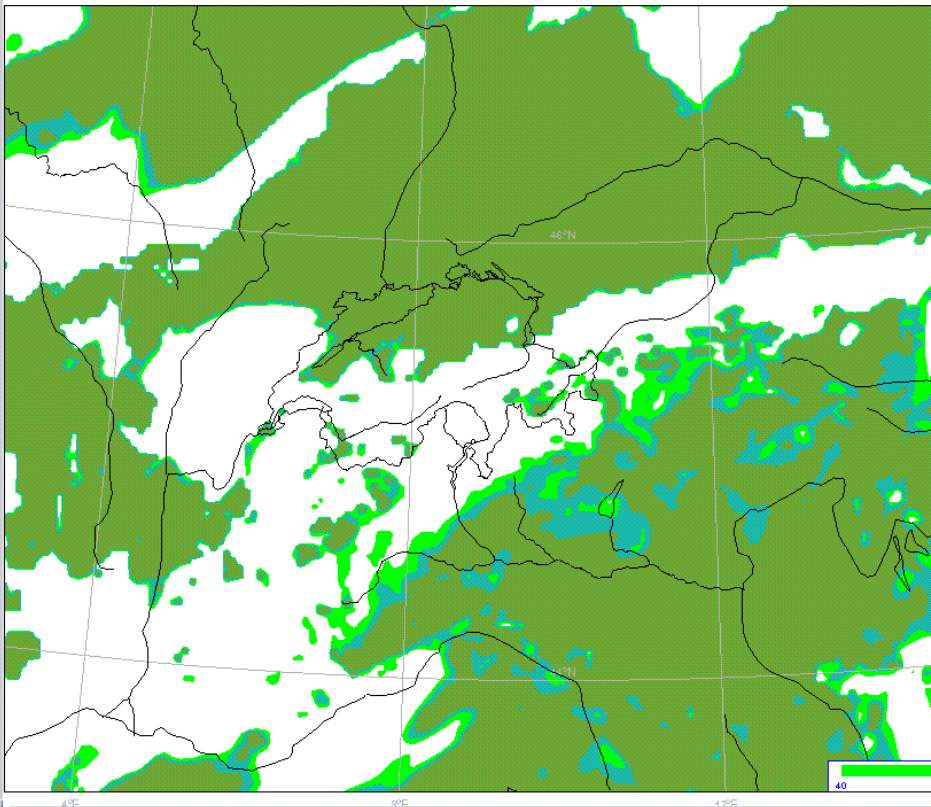
**7km**

**Sun. Dec. 5, 2004, 12 UTC**

**2km**

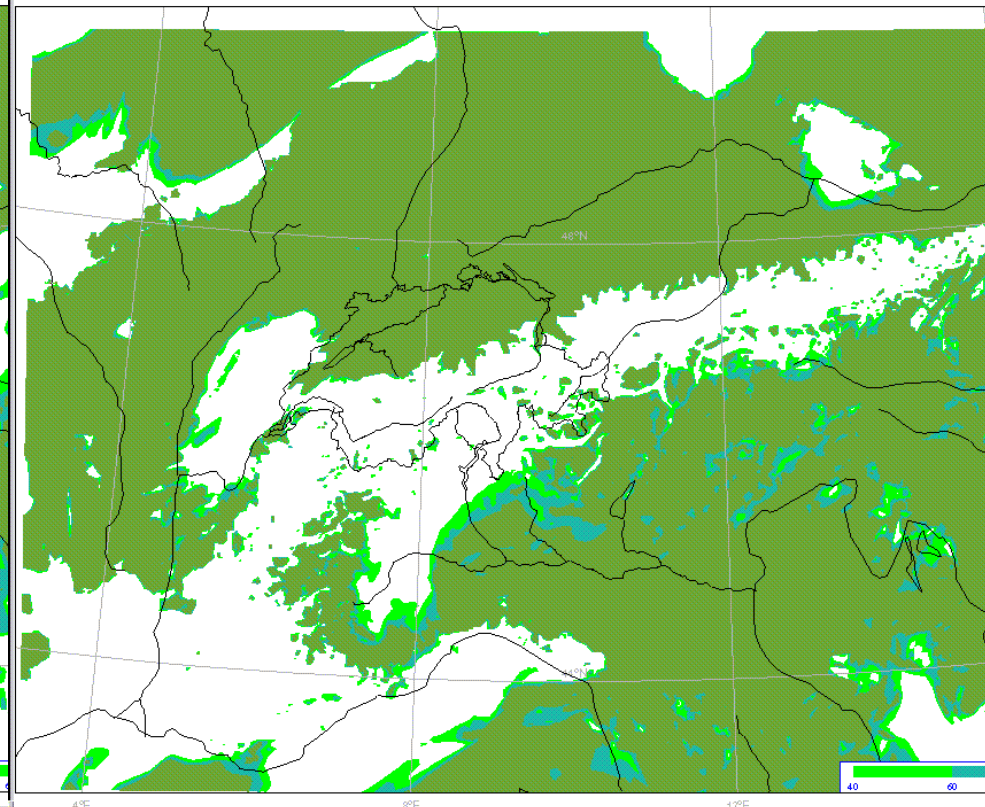
aLMo Analysis for Sunday 5 December 2004 12 UTC  
Low Cloud Cover (p=800-1000hPa or z=2-0km)

Version: aLMo cascade: 7km (959)  
Units: % Mean: 67.785



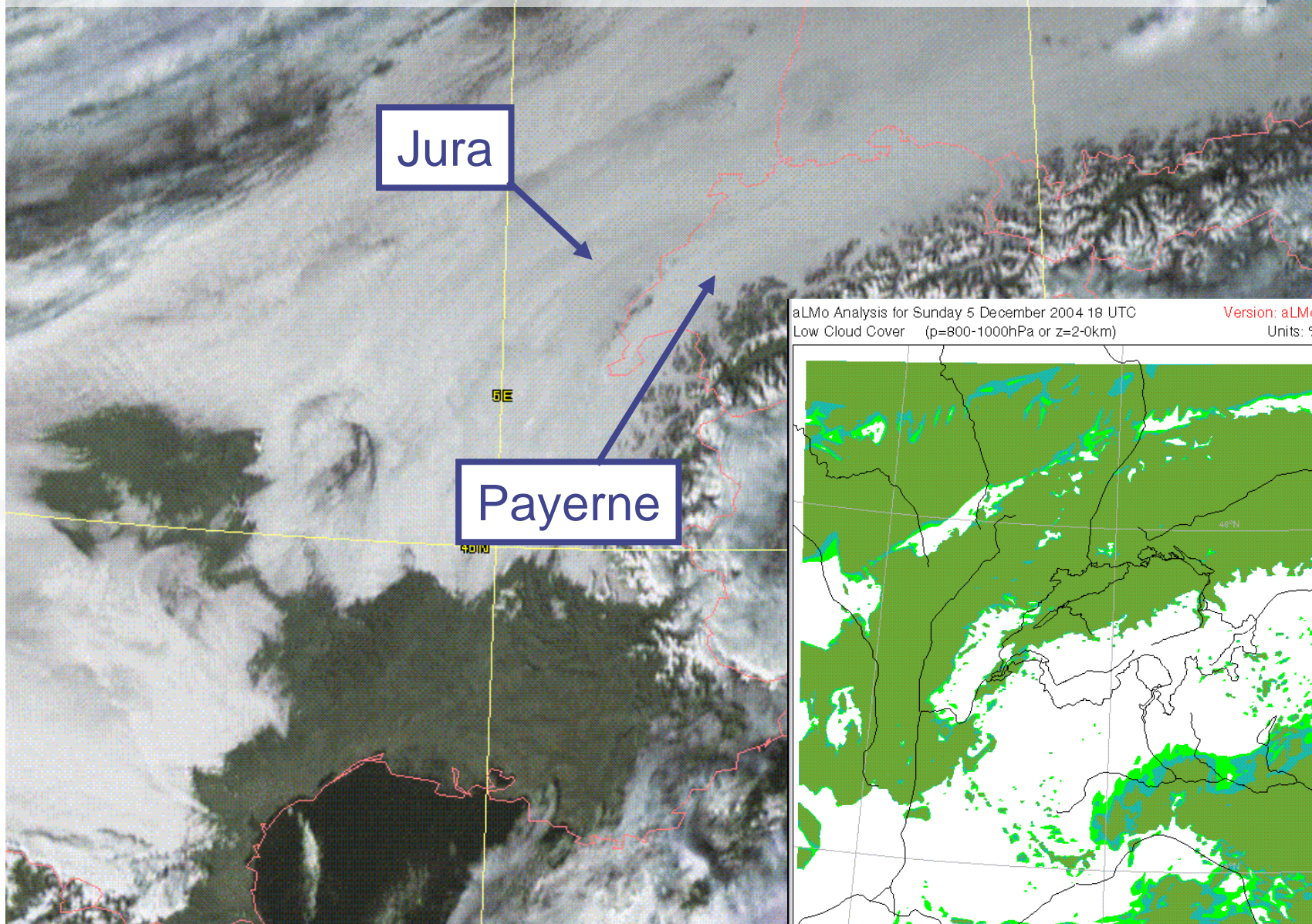
aLMo Analysis for Sunday 5 December 2004 12 UTC  
Low Cloud Cover (p=800-1000hPa or z=2-0km)

Version: aLMo cascade: 2km (959) From  
Units: % Mean: 69.81

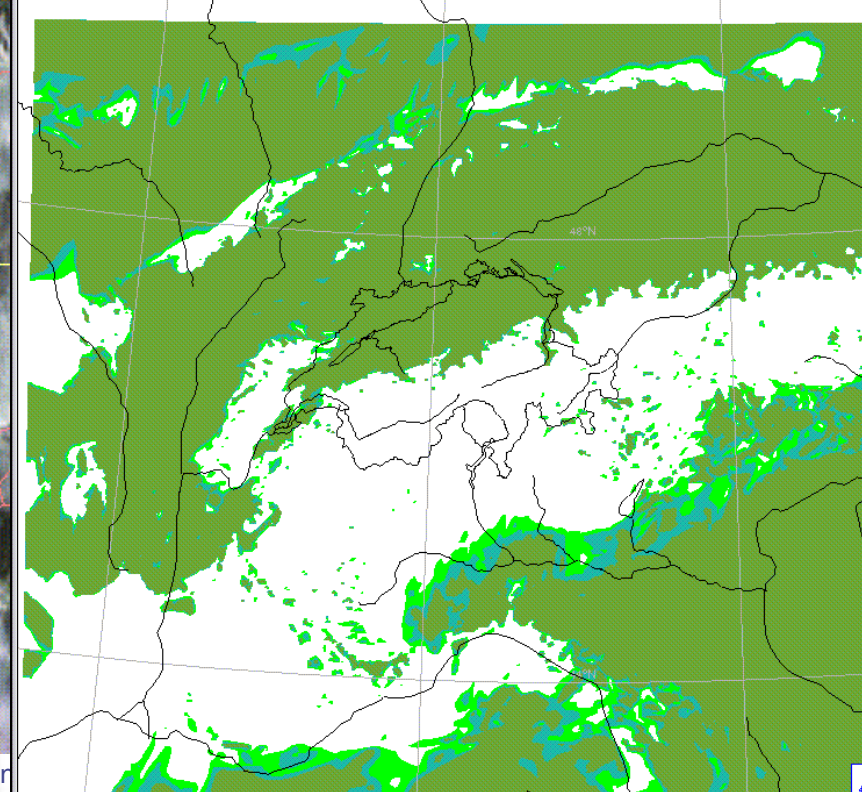


**Meteosat MSG, HRV – channel**  
**Sunday, 5<sup>th</sup> December, 18 UTC**

+ **2km** Assimilation Mode **L45**



aLMo Analysis for Sunday 5 December 2004 18 UTC  
Low Cloud Cover (p=800-1000hPa or z=2-0km)      Version: aLMo cascade: 2km (959)      Units: %      Mean: 6



# Low Level Cloud Cover

2km Assimilation Mode **L60**



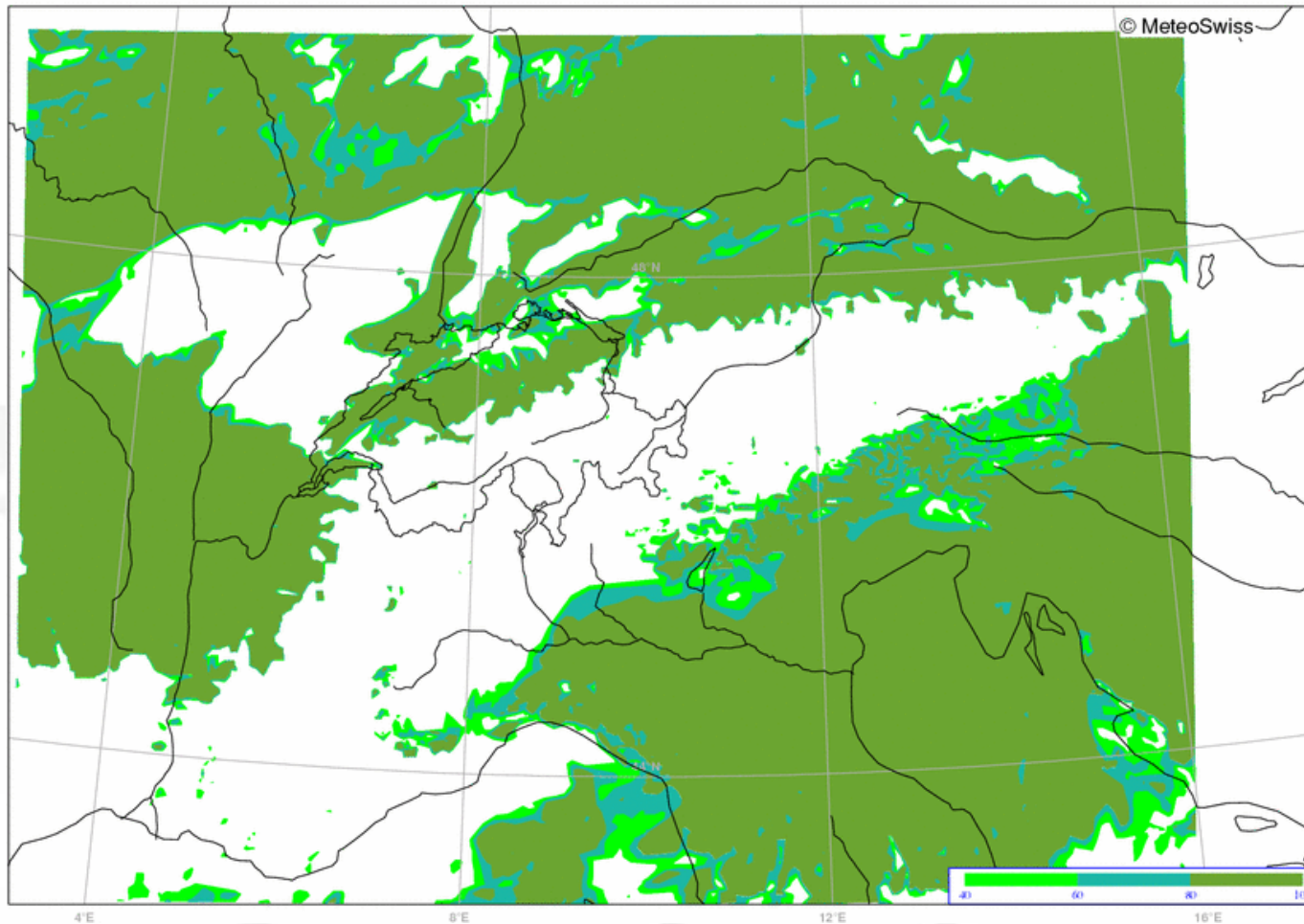
Mon. Dec. 6, 2004, 0 UTC

Leapfrog **L60**

aLMo Analysis for Monday 6 December 2004 00 UTC  
Low Cloud Cover (p=800-1000hPa or z=2-0km)

Version: aLMo cascade: 2km/60 levels (966)  
Units: % Mean: 63.921

From assimilation cycle



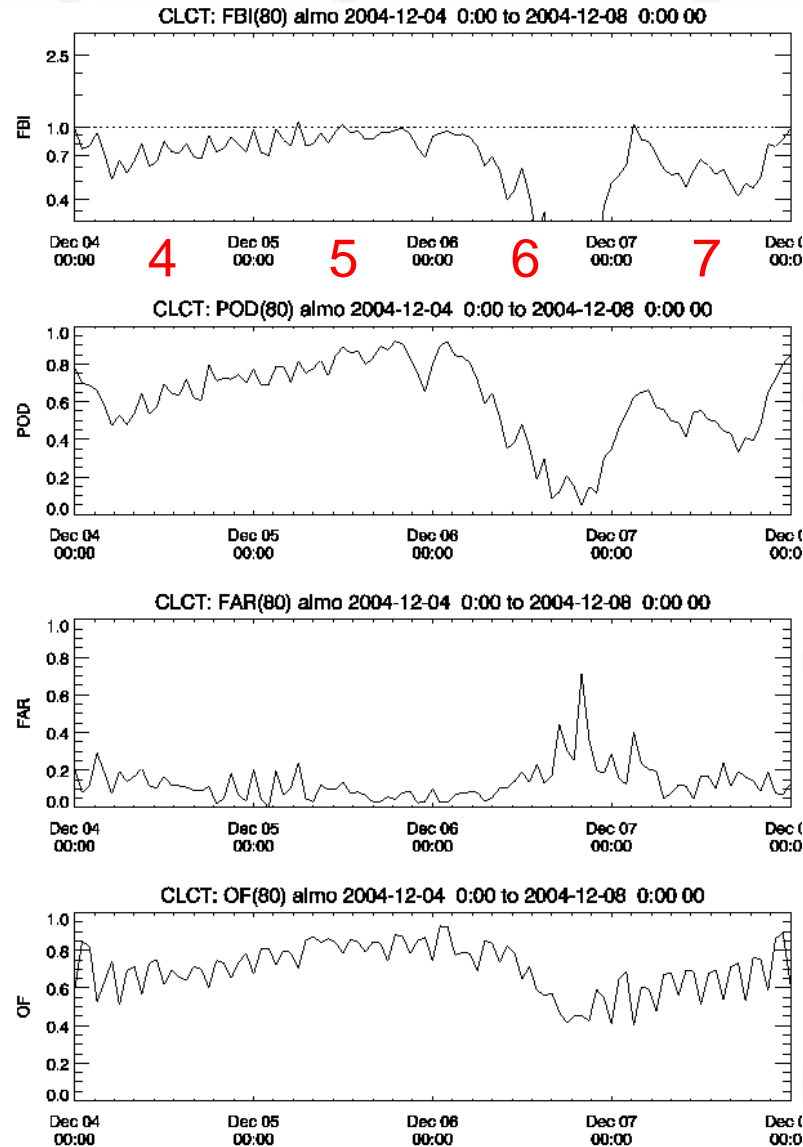
**Conclusion:**

there is **LESS**  
low level  
cloud

probably  
due to the  
use of  
horizontal  
diffusion



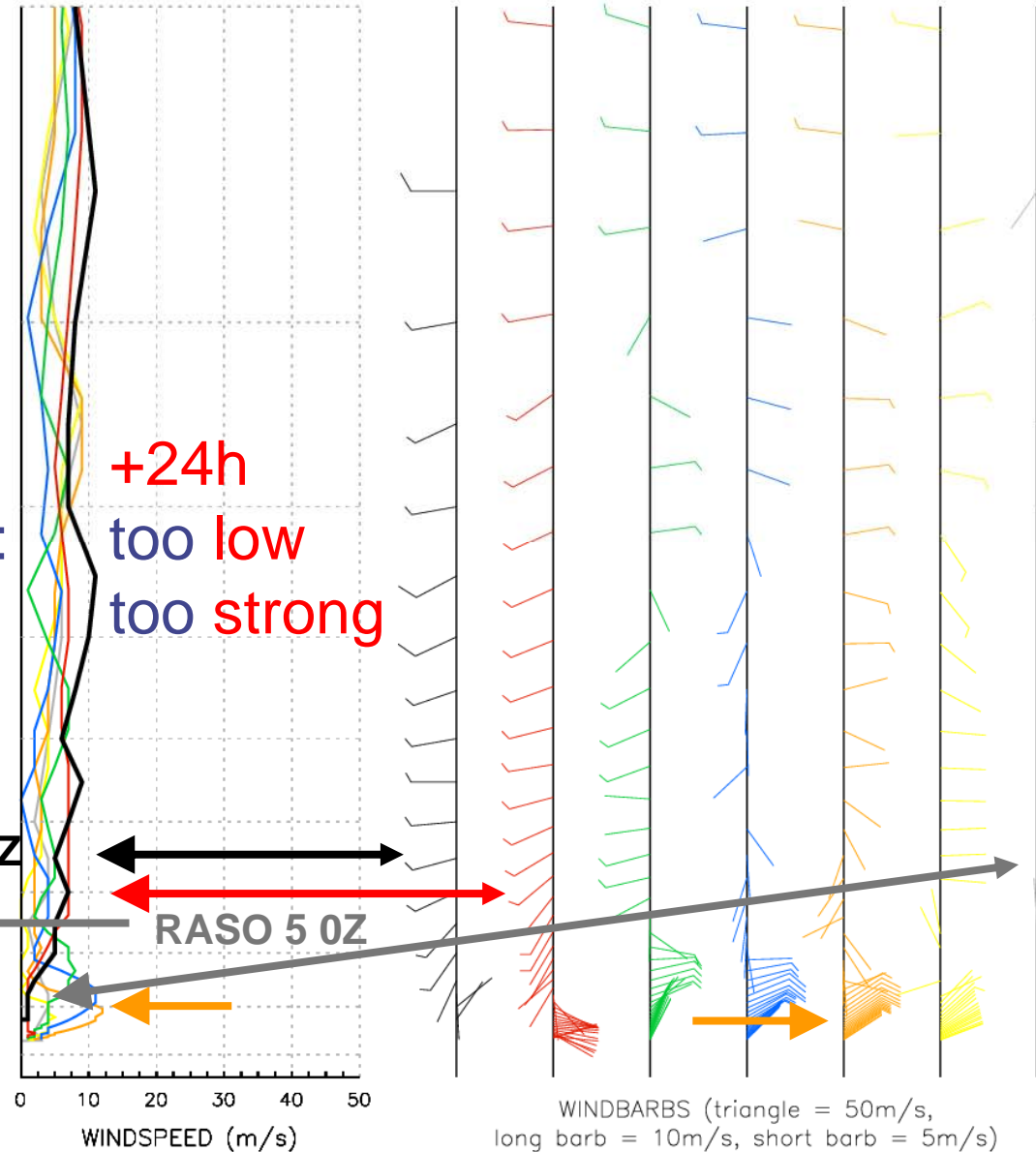
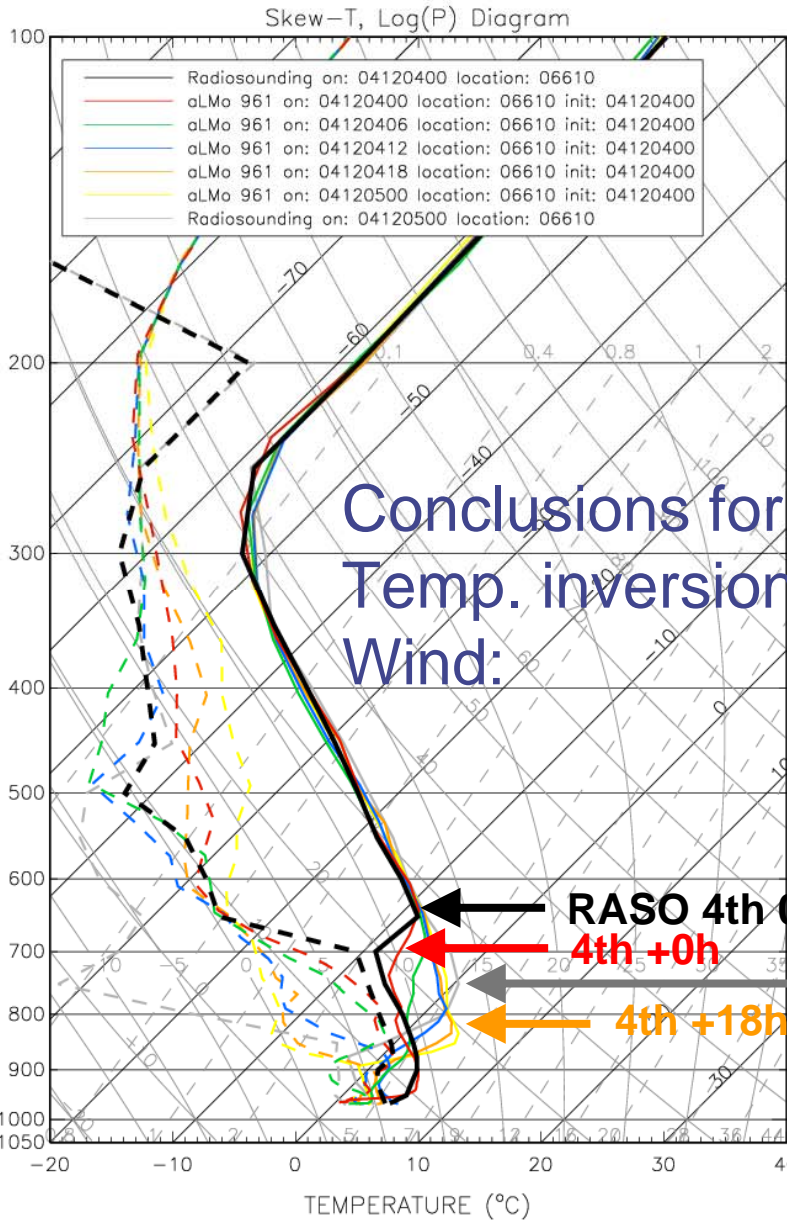
- ◆ Assimilation Mode
- ◆ Stratus period of 4 days in December 2004
- ◆ Total Cloud Cover for the threshold of 80%



# aLMo2 L45 Forecast Mode

Dec. 4 every 6h

Payerne



# aLMo2 L45 Forecast Mode

**Dec. 5**

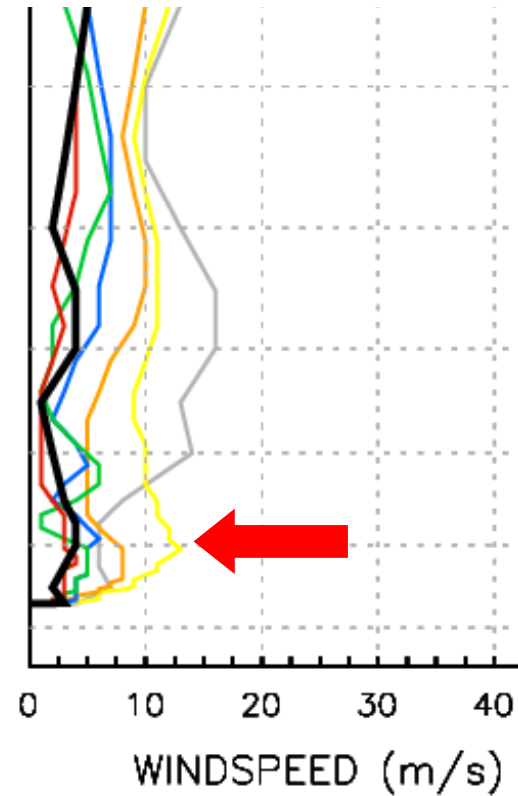
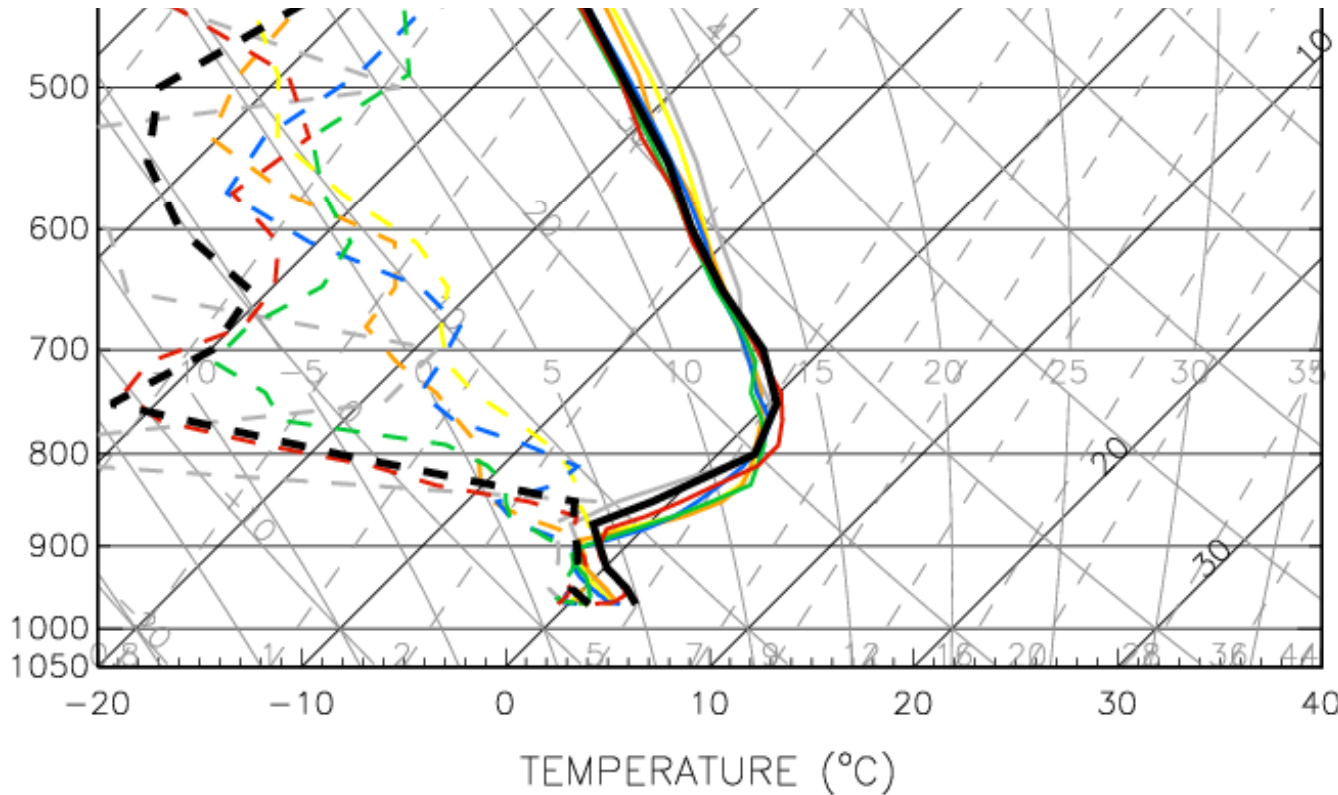
Payerne

Conclusions for  
Temp. inversion:  
Wind:

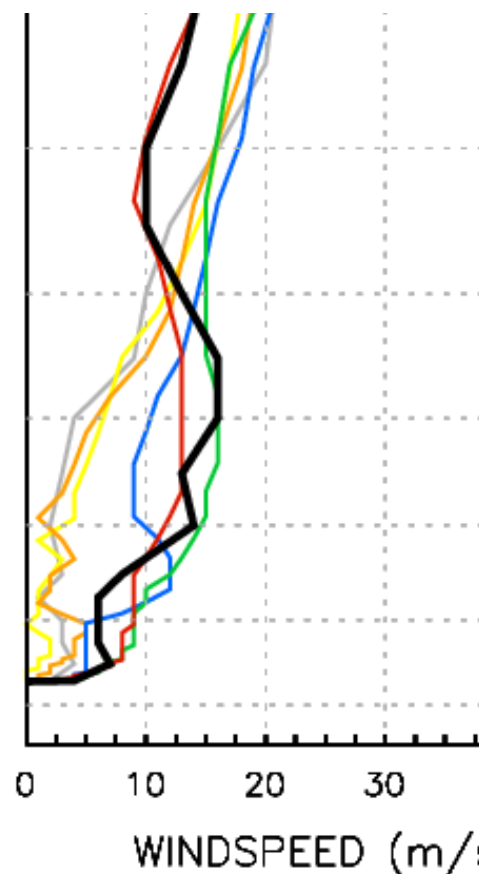
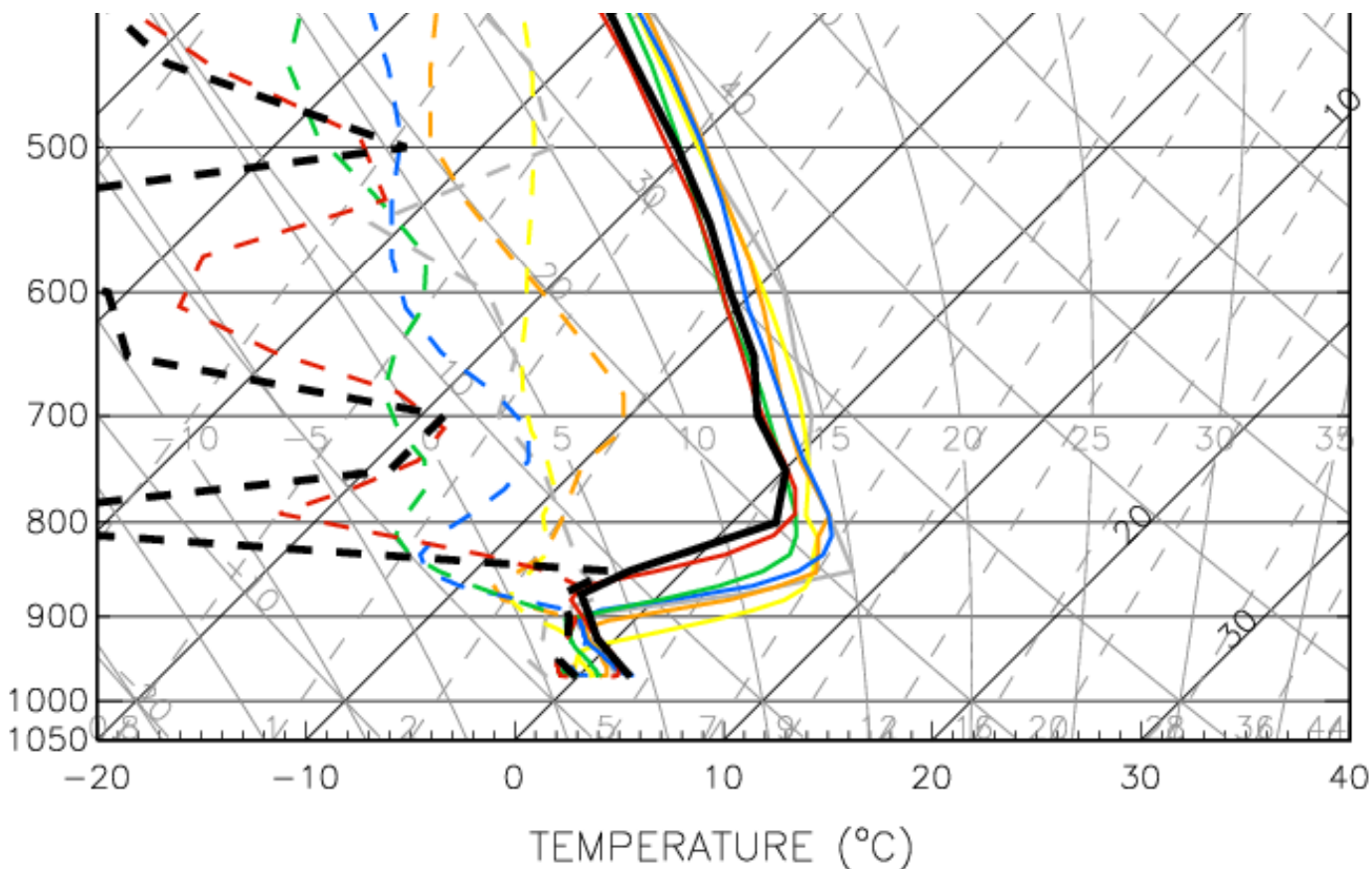
**+24h**

too **low**

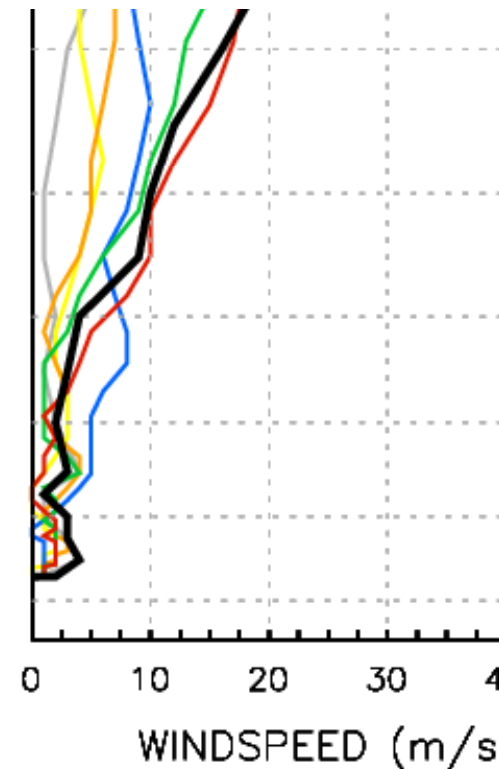
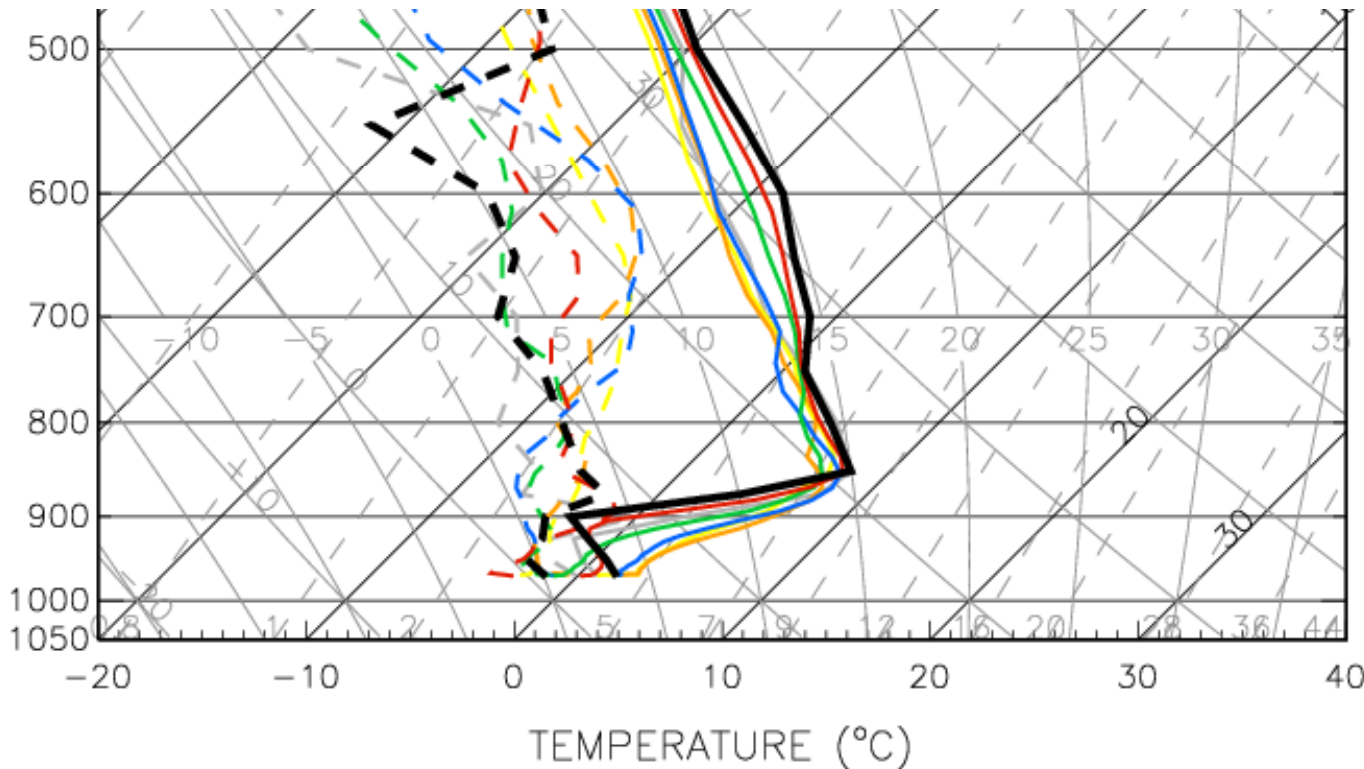
too **strong** (at 900hPa)



- GOOD inversion analysis but too low at end of forecast
- GOOD winds



- very strong inversion (12°C/250m)
- analysis OK but STRONG erosion with forecast time



# Low Level Cloud Cover

Forecast Mode **+24h**



**L45 RK**

**Mon. Dec. 6, 2004, 0 UTC**

**L60 LF**

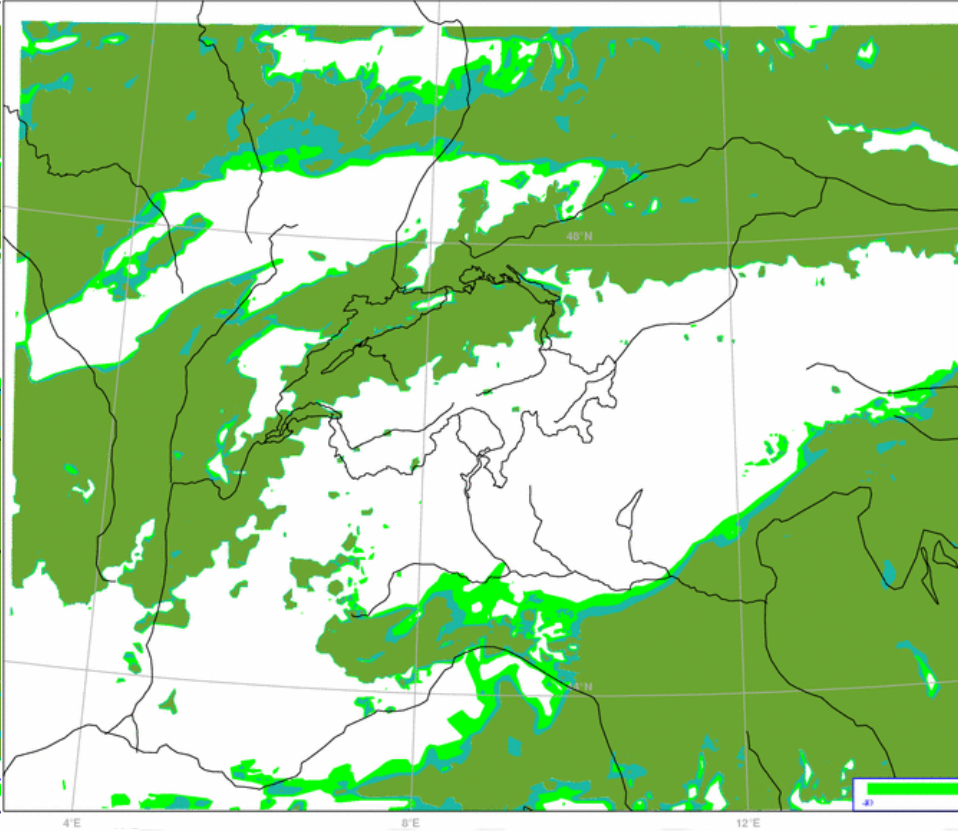
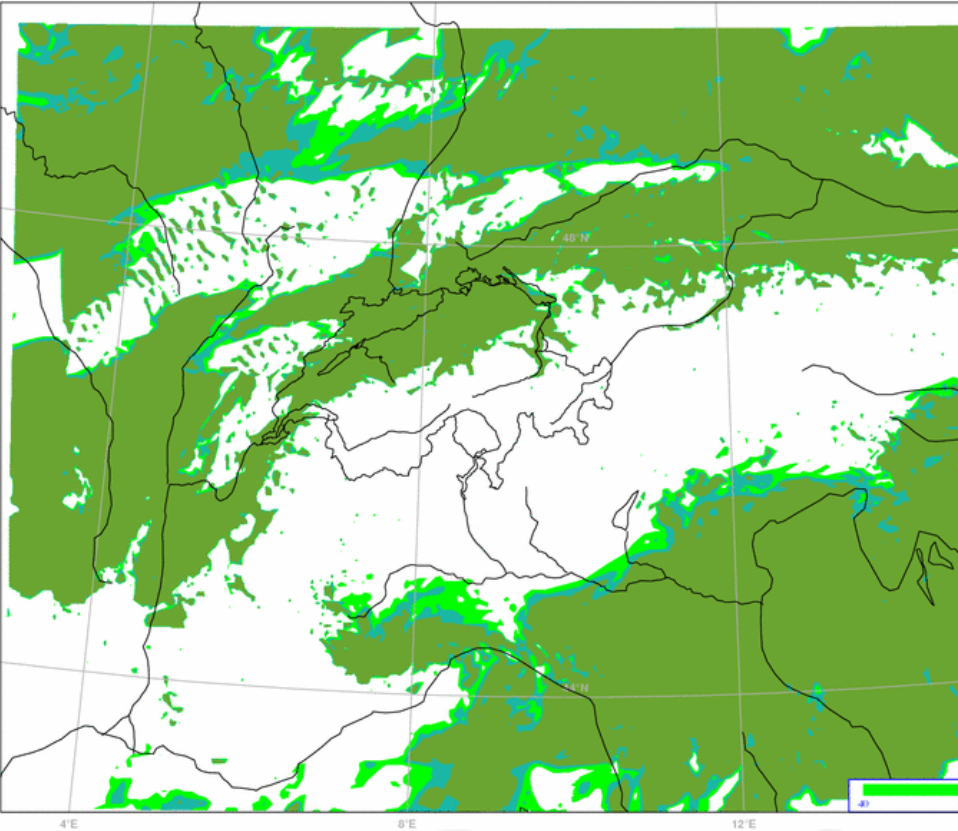
aLMo Forecast 05.12.2004 00 UTC +24h  
Low Cloud Cover (p=800-1000hPa or z=2-0km)

Version: aLMo cascade: 2km (961)  
Units: %

VT: aLMo Forecast 05.12.2004 00 UTC +24h  
Mean: 60.44 Low Cloud Cover (p=800-1000hPa or z=2-0km)

Version: aLMo cascade: 2km (962)  
Units: %

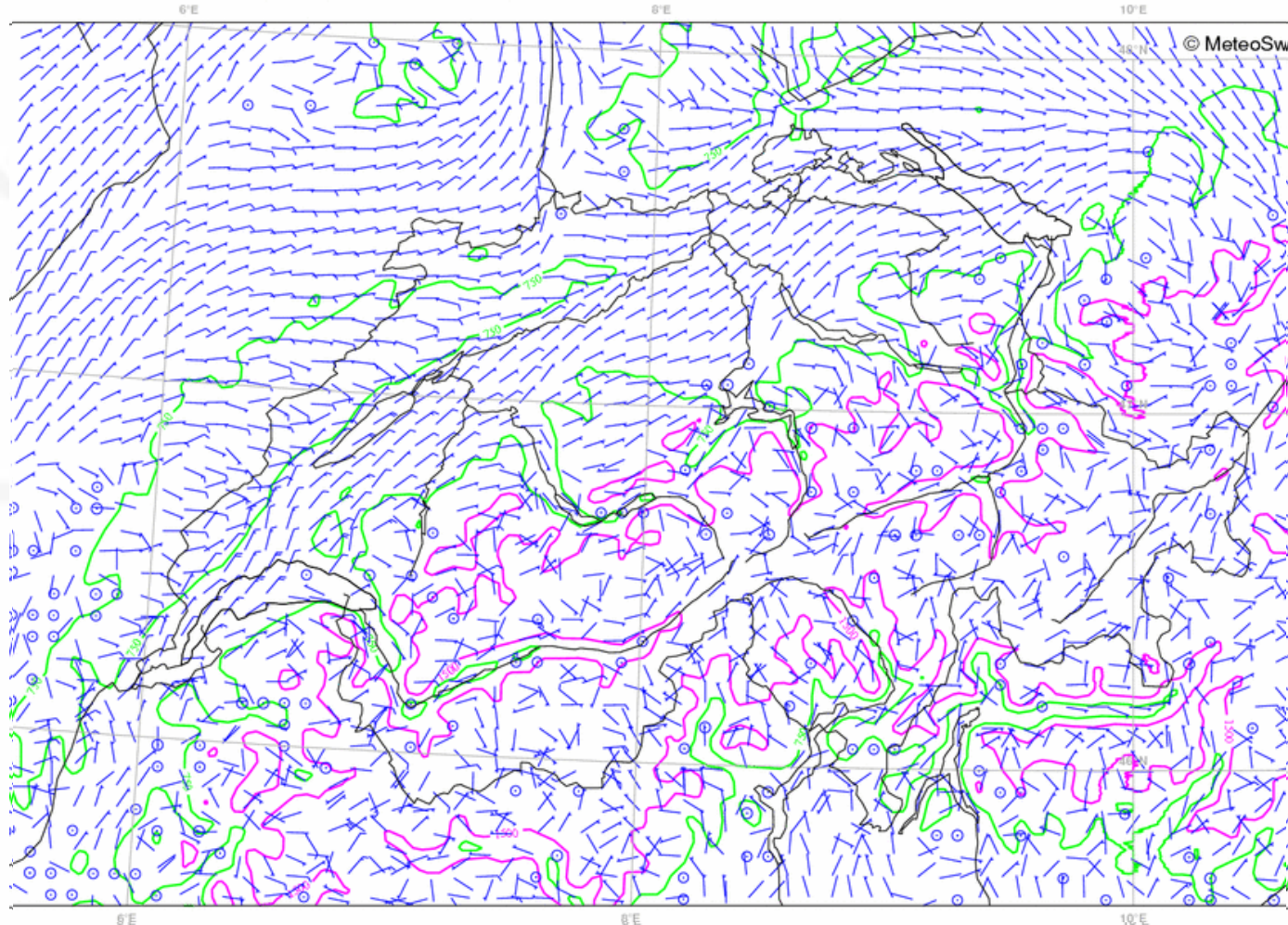
VT: aLMo Forecast 05.12.2004 00 UTC +24h  
Mean: 59.97





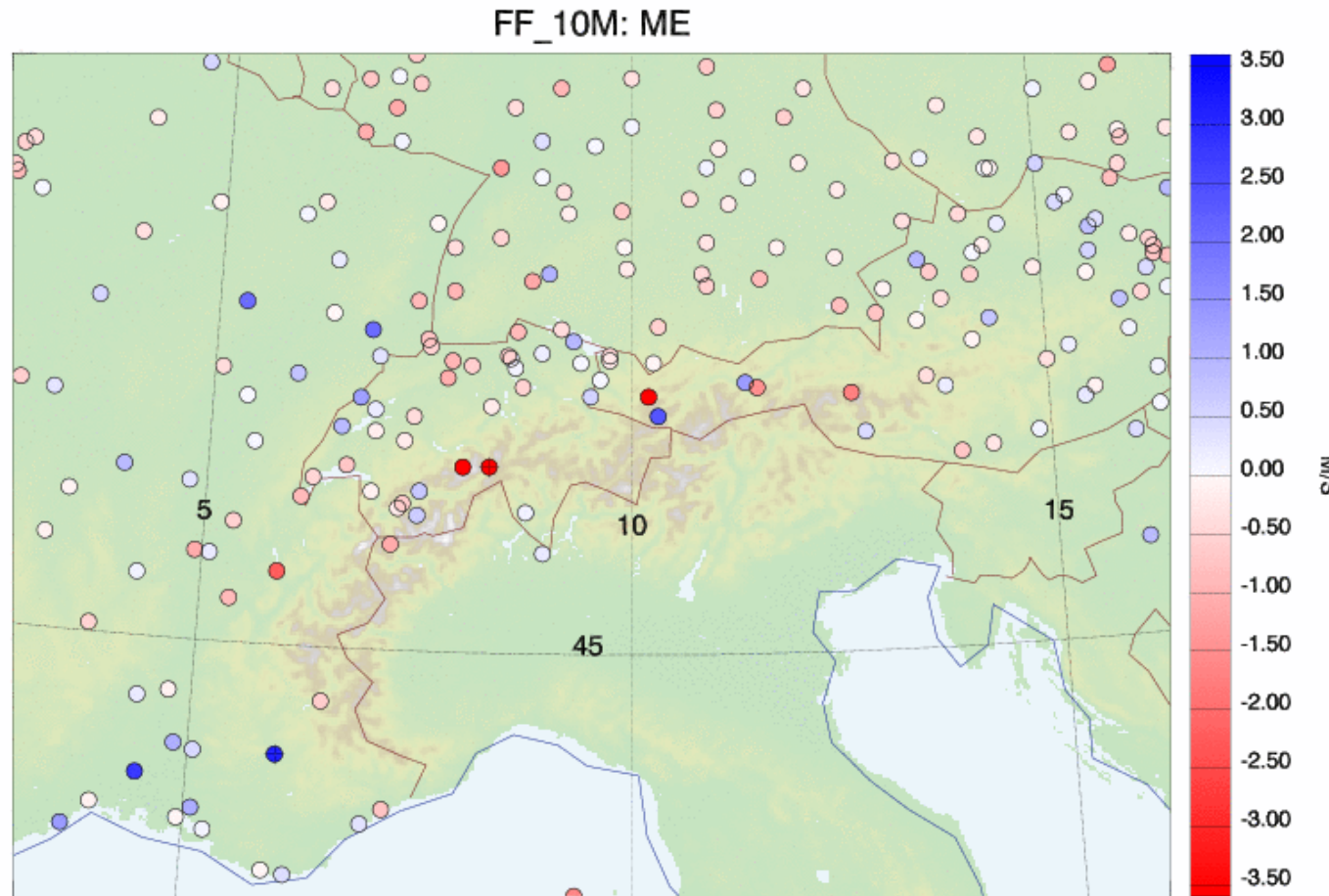
10m (k=45) **L45 +24h** Mon. Dec. 6, 2004, 0 UTC

10m WMO wind flag every 3rd gridpoint and Orography





- ◆ Assimilation Mode
- ◆ Wind strength on first model level (10m)
- ◆ Mean Error



almo 2004-12-04 0:00 to 2004-12-08 0:00 00  
 Min: -4.511 M/S at station 06744 Max: 3.146 M/S at station 07588

# Precipitation (unrealistic drizzle)



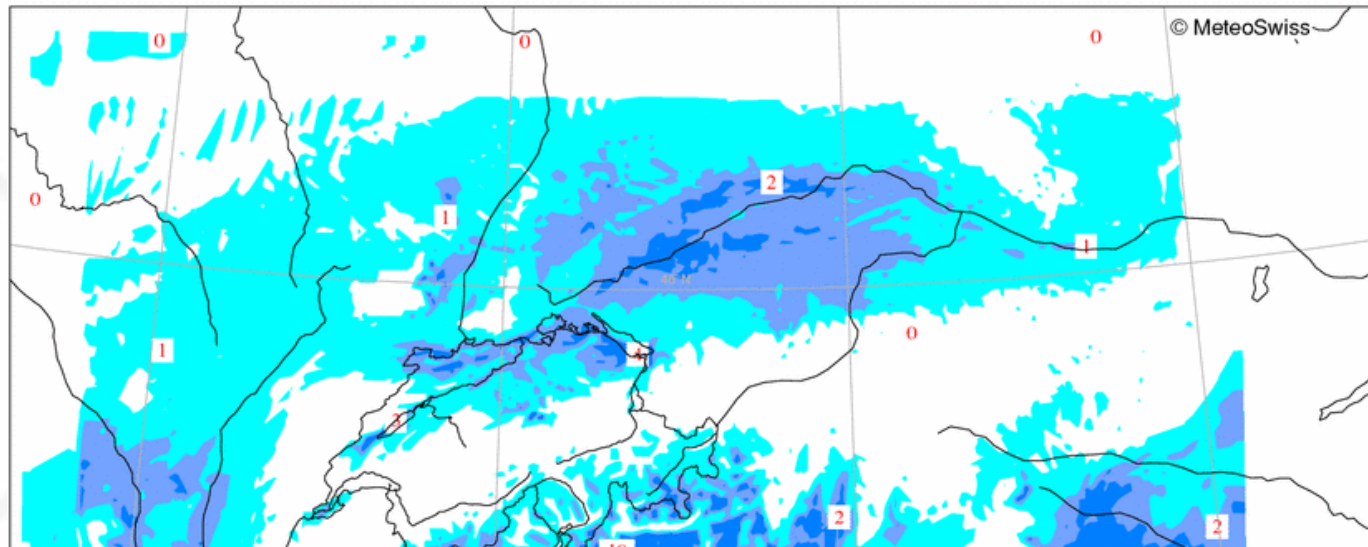
**L45** Forecast Mode

**Mon. Dec. 6, 2004, 0 UTC**

aLMo Forecast 05.12.2004 00 UTC +24h  
24h Sum of total rain and snow in mm

Version: aLMo cascade: 2km (961)  
Mean: 1.984 Max: 239.76

VT: Mon 6 Dec 2004 00 UTC



- ◆ On the first two days (4th, 5th) drizzle at some stations: airport Basel; Zurich; south of the alps

➔ Conclusion: **too much** drizzle



# Summary

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## Positive aspects for both **assimilation** and **forecast** mode:

- ◆ In general, **good** temporal evolution of the **temperature inversion** in both **building up** and **decay** phase
- ◆ aLMo2 is able to simulate the **penetration** of low stratus into the alpine valleys for **both 45 (RK)** and **60 levels (LF)**
- ◆ **Runge-Kutta** dynamics more promising than **Leapfrog**

## Deficiencies:

- ◆ **Less** low level stratus clouds over parts of the Jura Mountains and particularly with low inversions, related to:
  - too strong winds
  - flow across instead of aligned with ridges (not verified)
- ◆ **Too much** drizzle, especially near the lakes and along the rivers



- ◆ Need to **verify winds** with more details:
  - at different locations
  - eventually on horizontal plains
- ◆ Need to use latest developments of RK dynamics
- ◆ Improve **ALL** schemes (dynamics and physics) for less drizzle!

Thank you! ... Questions?

