



MM5/COSMO-DE Model Inter-Comparison and Model Validation

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Assessment of forecast quality using observations of the
FRA airport campaign in 2006/2007



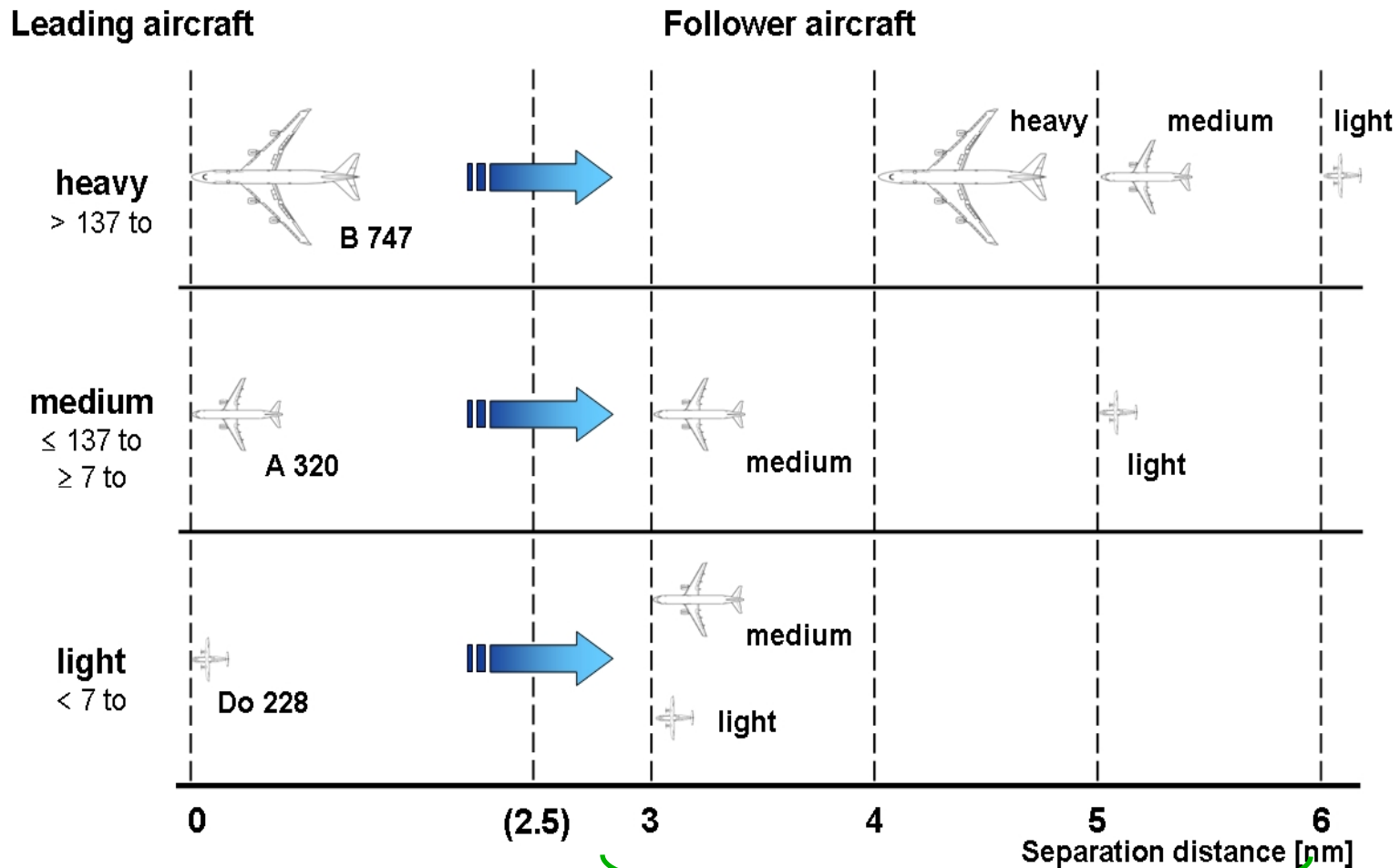
Outline

1. Motivation
2. Instrumentation during the FRA campaign
(21.12. 2006 - 28.02.2007)
3. Configuration of high-res models MM5 and
COSMO
4. A case study
5. Systematic evaluation of wind and temperature
6. Summary & Outlook

Approaching Airport Hongkong

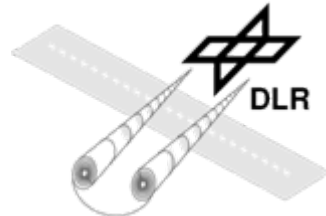


Challenge: Capacity - ICAO rules



meteo measurements
SODAR/RASS USA
3 gates, 0.3 - 1 NM

numerical weather prediction
NOWVIV
10 gates, 2 - 11 NM



WSVBS

wake-vortex prediction
P2P
envelopes for $y(t)$, $z(t)$, $\Gamma(t)$ in 13 gates
for 8 a/c parameter classes (heavy)

glide path adherence statistics
FLIP
standard deviations in 13 gates

safety area prediction
SHAPE
ellipses in 13 gates for HH, HM

wake-vortex monitoring
LIDAR
3 planes, 0.3 - 1 NM

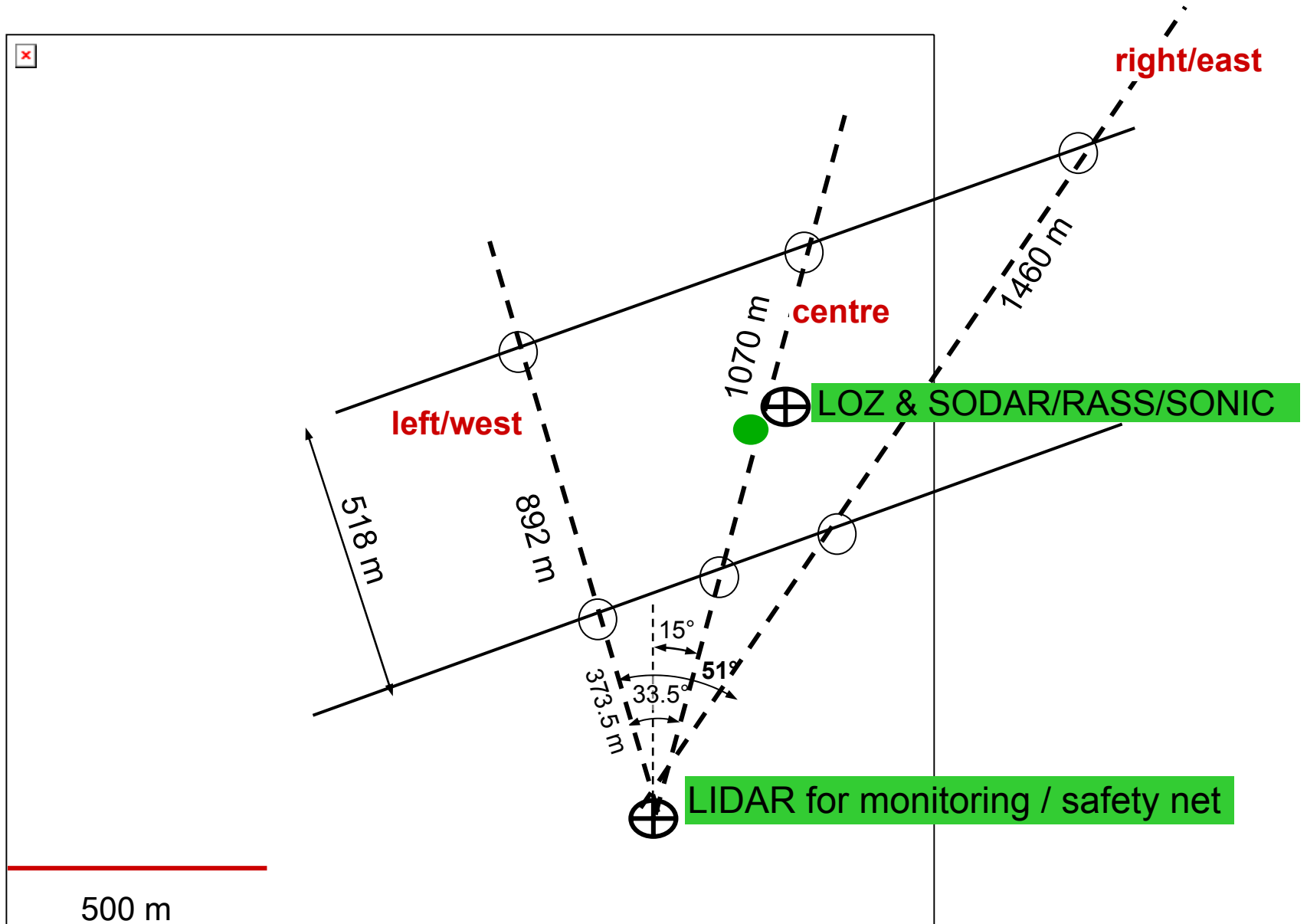
temporal a/c separations
for 6 a/c-rwy class combinations

conflict detection
issue warning / adapt predictions

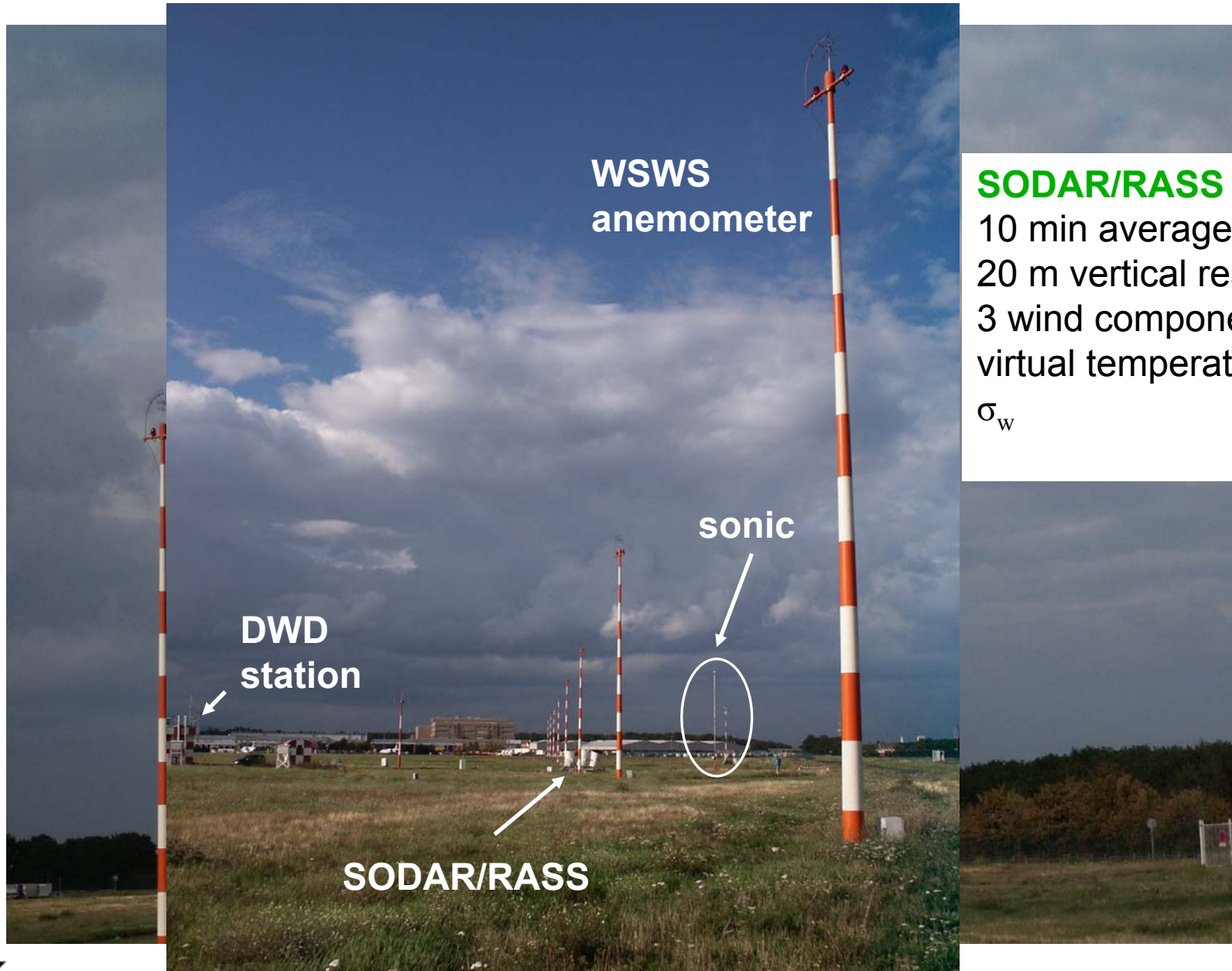
procedures
AMAN
STG, MSR, MSL, ICAO



WSB: set-up at Frankfurt Airport



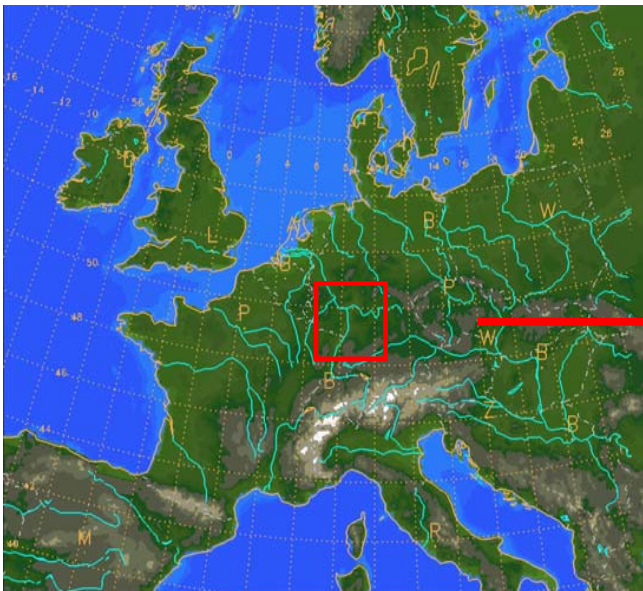
Instrumentation at Frankfurt airport: location and setup



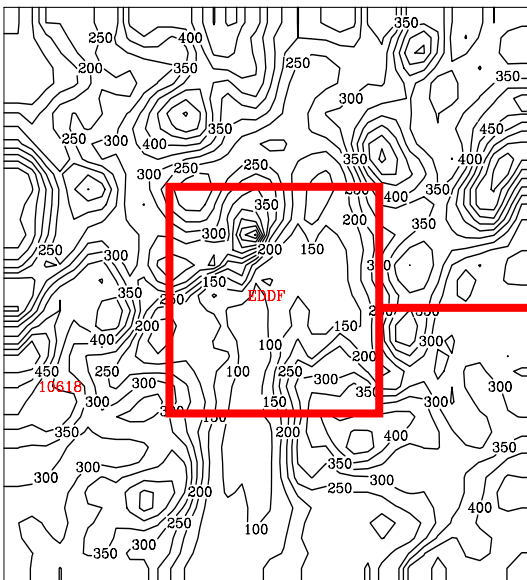
SODAR/RASS

10 min averages
20 m vertical resolution,
3 wind components,
virtual temperature,
 σ_w

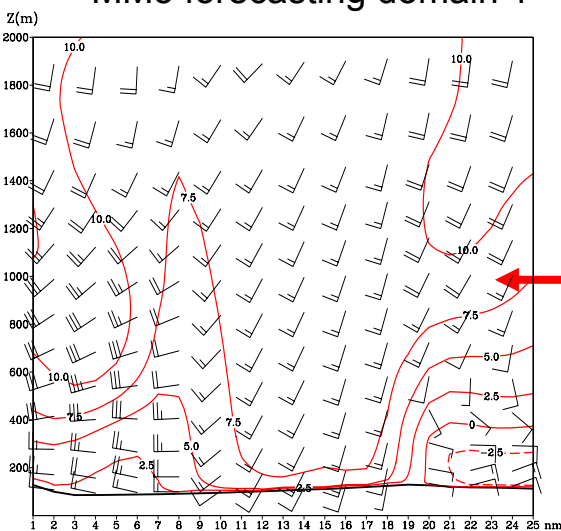
Forecasting for airports: model chain with nesting



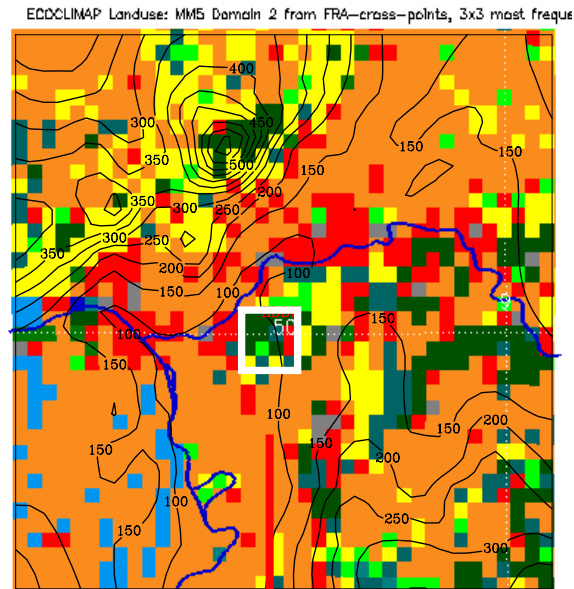
LM1 forecasting domain



MM5 forecasting domain 1



Cross section along glideslope



MM5 forecasting domain 2



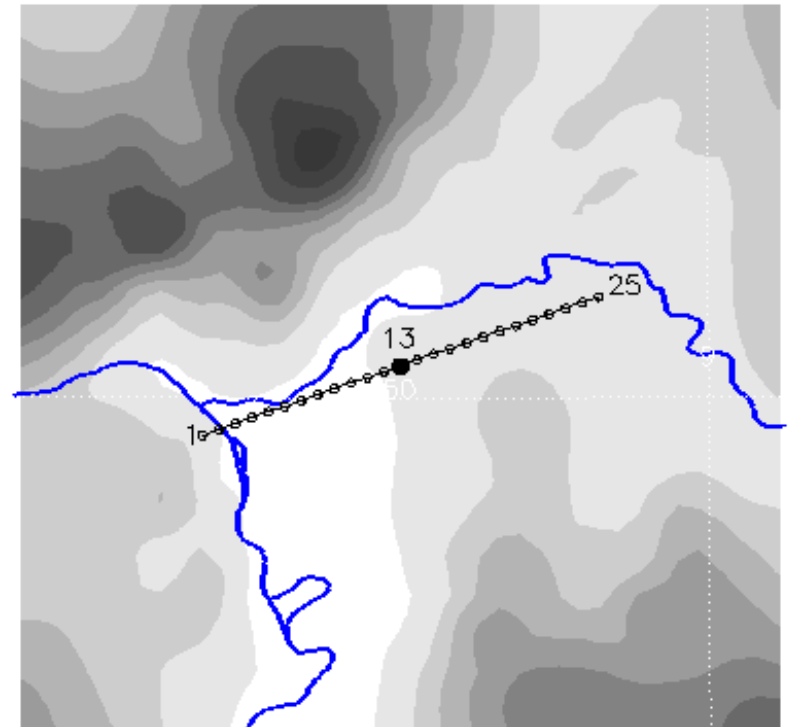
Airport area



Configuration of high res models MM5

MM5

- daily two 24 hr runs: 00 and 12 UTC
- two nested domains: 250 x 250 km² ($\Delta x=6.3$ km), 90 x 90 km² ($\Delta x=2.1$ km)
- 10 min output of wind, temperature, density, tke and edr + BL data.
- vertical resolution 8 – 50 m (26 levels up to $z=1100$ m, in total 60 levels).
- 25 grid points along glide paths (important to consider spatial variations!).
- Forcing with COSMO-EU analyses



7th

Configuration of high res models MM5 and COSMO

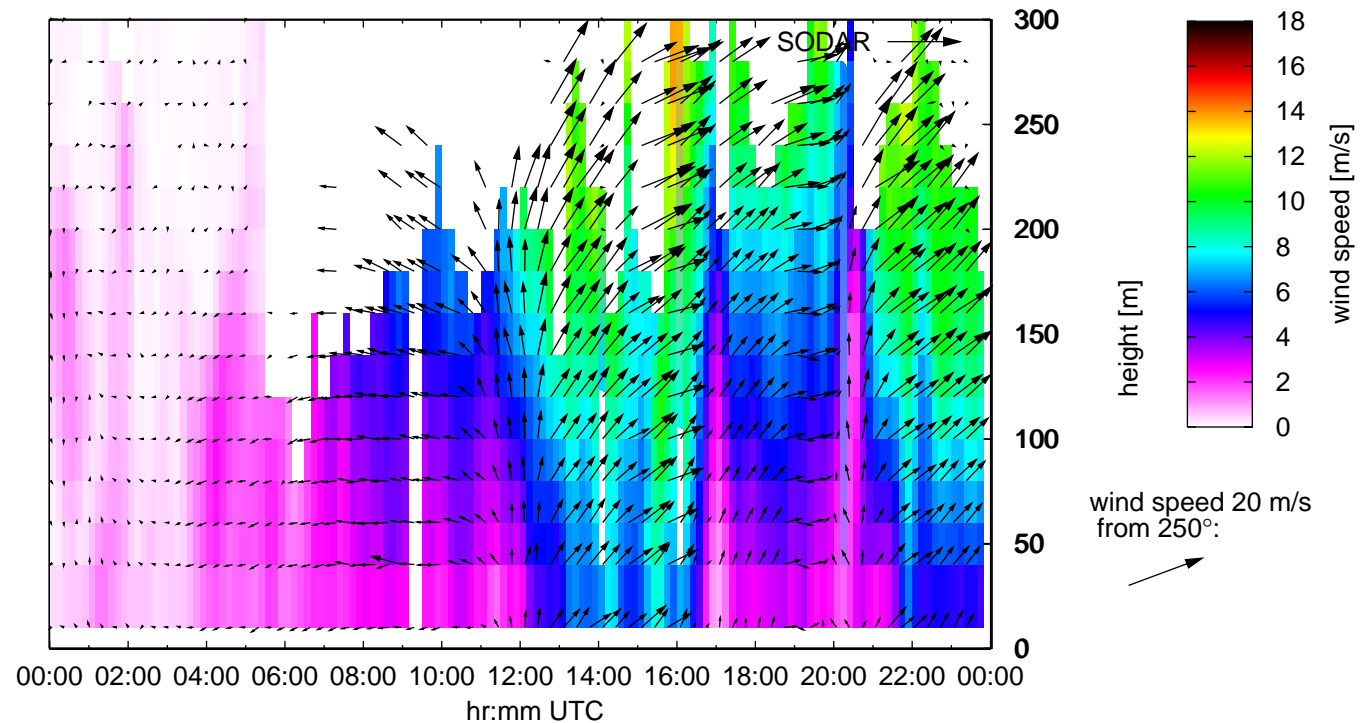
MM5

- daily two 24 hr runs: 00 and 12 UTC
- two nested domains: 250 x 250 km² ($\Delta x=6.3$ km), 90 x 90 km² ($\Delta x=2.1$ km)
- 10 min output of wind, temperature, density, tke and edr + BL data.
- vertical resolution **8 – 50 m** (26 levels up to z=1100 m, in total 60 levels).
- 25 grid points along glide paths (important to consider spatial variations!).
- Forcing with COSMO-EU analyses

COSMO-FRA

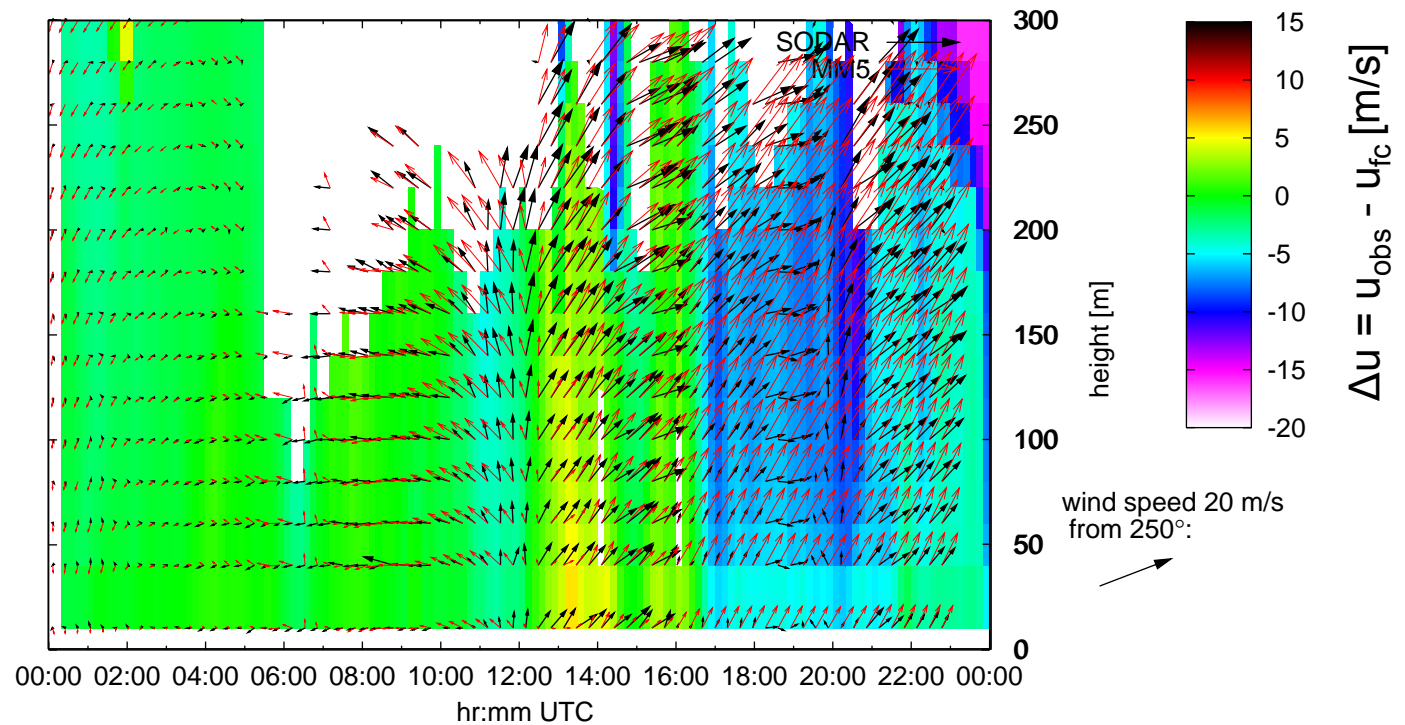
- daily two 24 hr runs: 00 and 12 UTC
- Model domain centered at FRA airport: 280 x 280 km² ($\Delta x=2.8$ km)
- 10 min output of wind, temperature, density, tke
- vertical resolution **15 – 150 m** (13 levels up to z=1100 m, in total 50 levels).
- Forcing with hourly COSMO-EU analyses

SODAR/RASS Measurements 08. February 2007

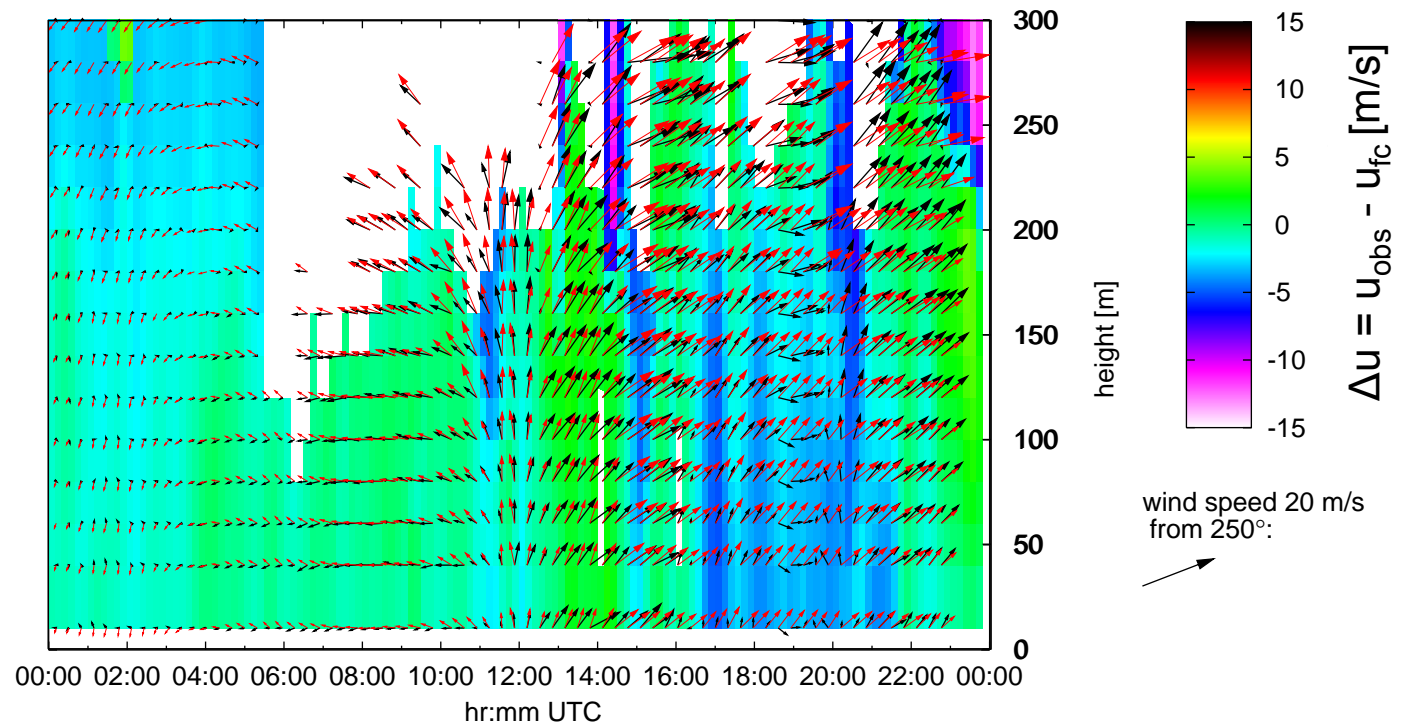


Significant change in wind speed/direction at all heights around 12 UTC

MM5 - SODAR/RASS - Wind Speed 08.02.2007



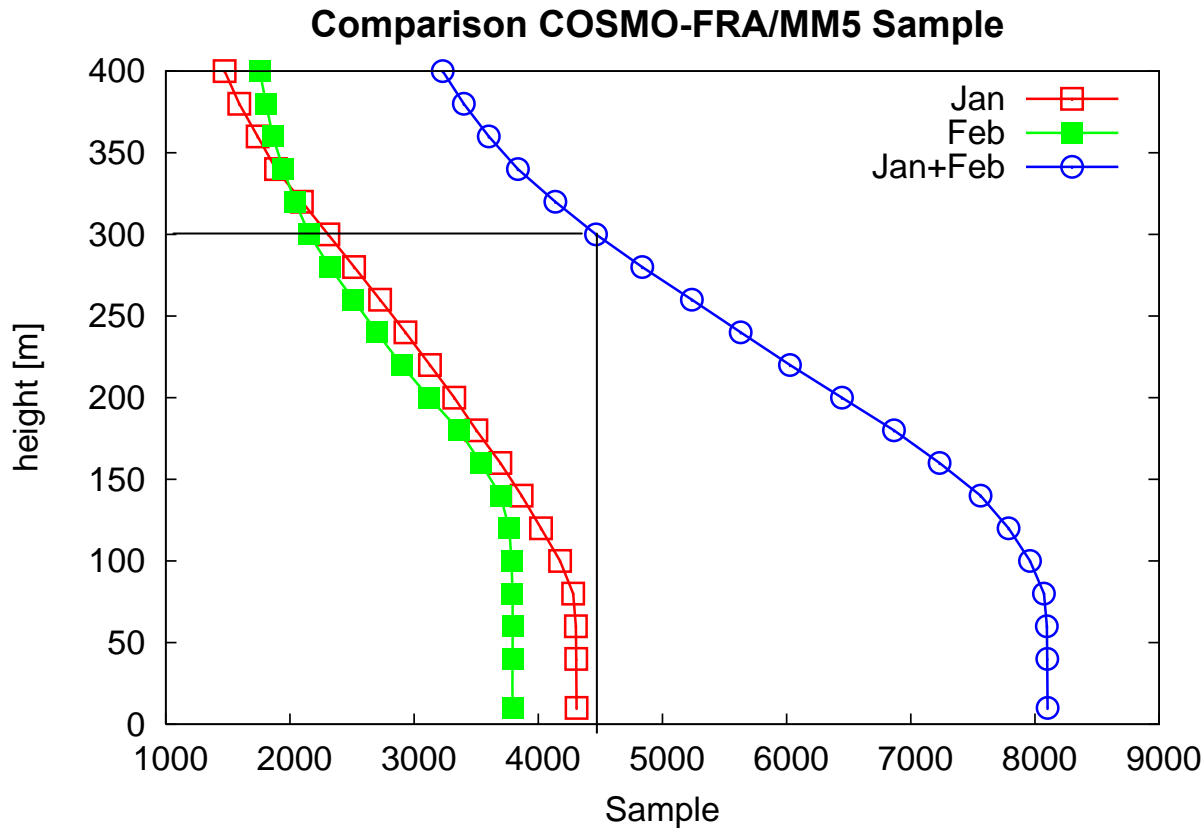
COSMO-FRA - SODAR/RASS - Wind Speed



Results from case study

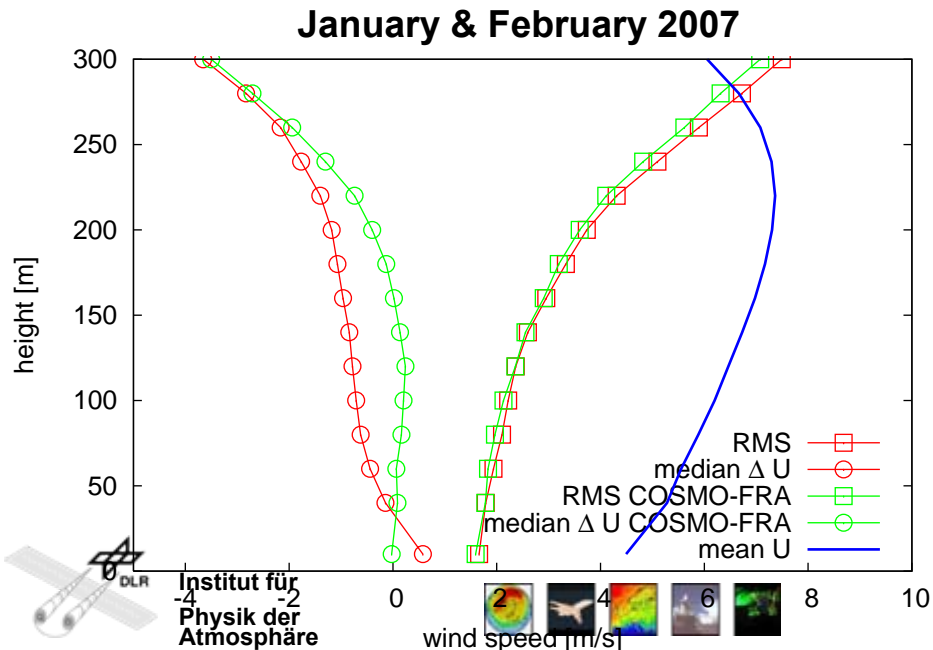
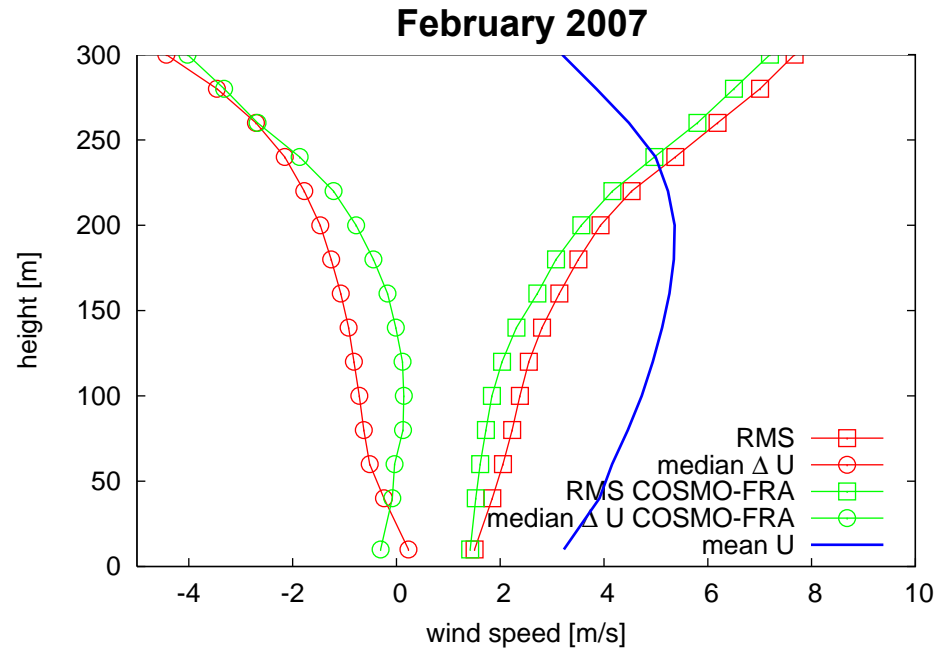
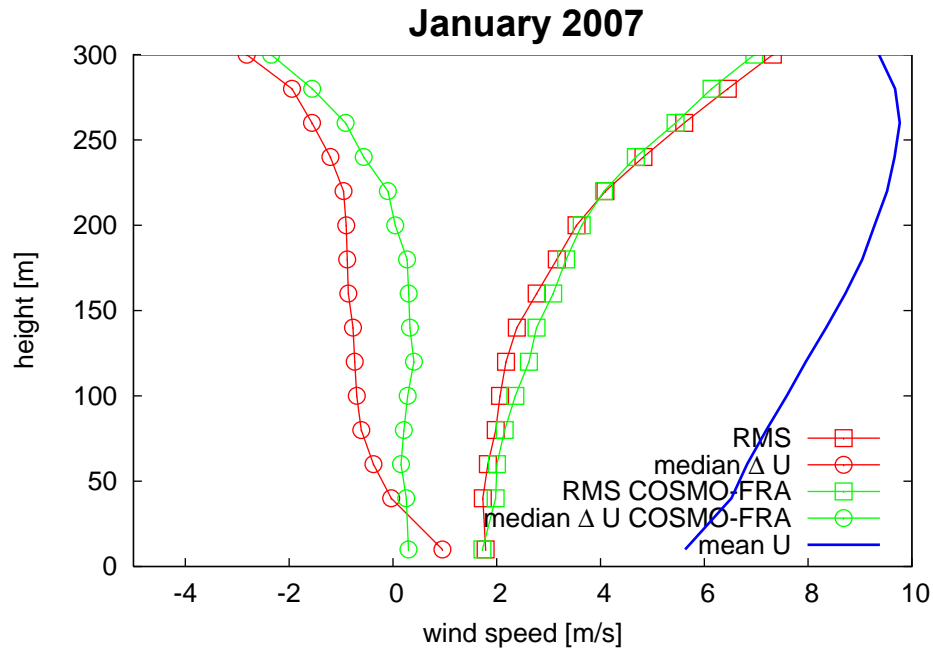
- COSMO_FRA forecast of change in wind speed and direction better than MM5 (~ 90 min delay in latter)
- Overestimation of wind speed by both models

SODAR/RASS - data sample



- 10 min average of wind, T_v , $\sigma(w)$
- Vertical resolution 20 m
- Decreasing data sample above 150 m (less data at high wind speeds)
- Statistical analysis up to max. 300 m

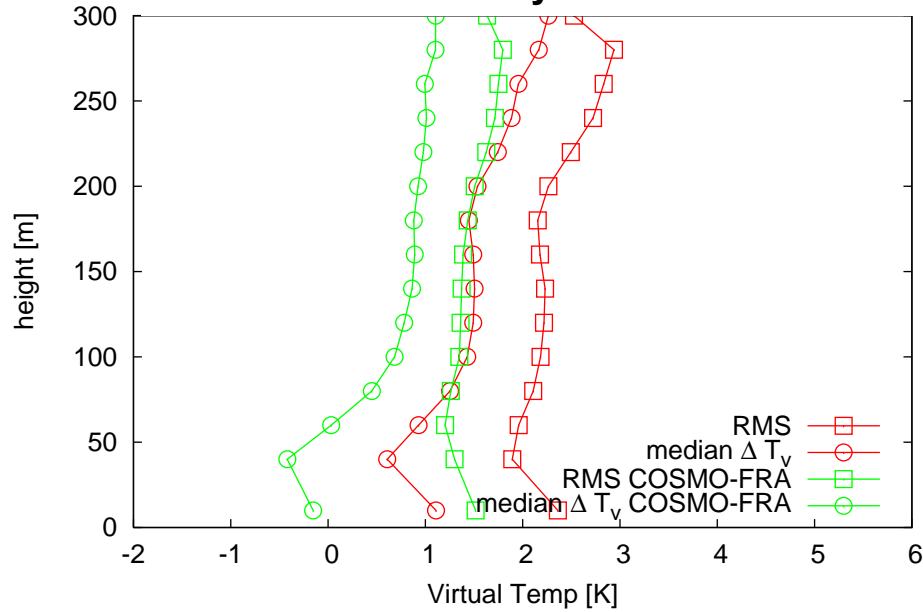
COSMO-FRA/MM5 - SODAR/RASS - wind speed



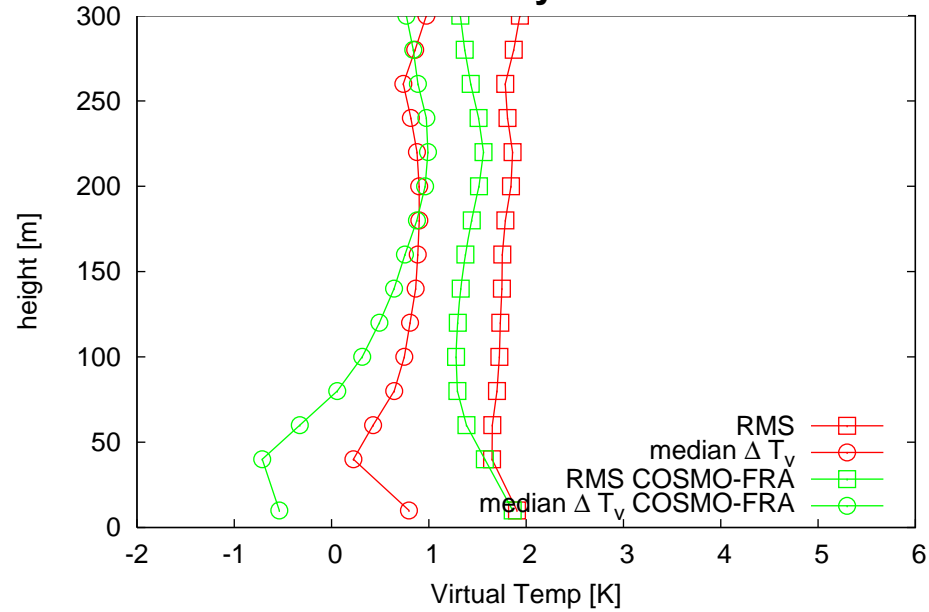
- Only minor differences in RMS
- MM5 slightly better for higher wind speeds (RMS)
- Overestimation of wind speed by MM5

COSMO-FRA/MM5 - SODAR/RASS - virtual Temp

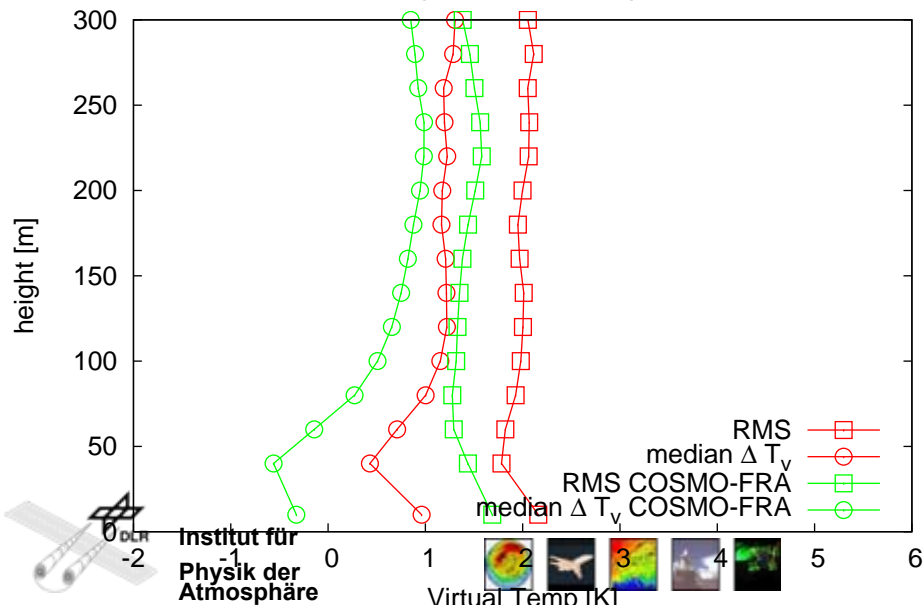
January 2007



February 2007



January & February 2007



- Average error and RMS smaller for COSMO-FRA compared with MM5



Summary & Outlook

Summary:

- Systematic evaluation of high-res MM5 and COSMO-FRA shows only minor differences in RMS for wind speed & wind direction
- Overestimation of wind speed by MM5
- COSMO-FRA forecast of temperature shows smaller errors compared with MM5

Outlook:

- Comparison using WTR data provided by DFS (measurements up to 1650 m)
- Additional case studies (Kyrill)
- Analysis using new COSMO version