EUCOS observing system experiments with the COSMO Local Model

- EUCOS stands for "**EUMETNET Composite Observing System**"
- The main goal of the EUCOS program is to define the **optimum ground based observing sytem** for short range NWP
- Two scenarios have been proposed, both associated with a drastic reduction of the number of **radiosonde** stations over continental Europe and an increased number of **AMDAR** platforms
- A special **observation campaign** took place from 20 September to 14 November 1999 to support observing system experiments
- **Observing system experiments** with both global and limited area models are made to evaluate the impact of the proposed scenarios
- OSE studies have been done with the **ECMWF global model** (T319), with the **DMI-HIRLAM-G** (50km) model and with the high resolution **COSMO Local Model** (7km)

Jean-Marie Bettems
Swiss Federal Office for Meteorology and Climatology
3hd COSMO General Meeting, Athens, October 2001

Experimental set-up (1)

- A **27 days period** was chosen, from 19th October 1999 to 15th November 1999; this period includes seven MAP heavy precipitation events and was also chosen by DMI

- Three observing systems have been considered:
  S1 is the **standard** observing systembefore EUCOS field experiment
  S2 has 37 **radiosonde stations less**, but 13 upgraded stations (-50% bulletins)
  S3 is S2 complemented by 121 **more AMDAR platforms** (+400% bulletins)

- For *each* observing system: a 27 days **continuous assimilation** and a **daily 24h forecast** have been calculated with the non-hydrostatic COSMO Local Model

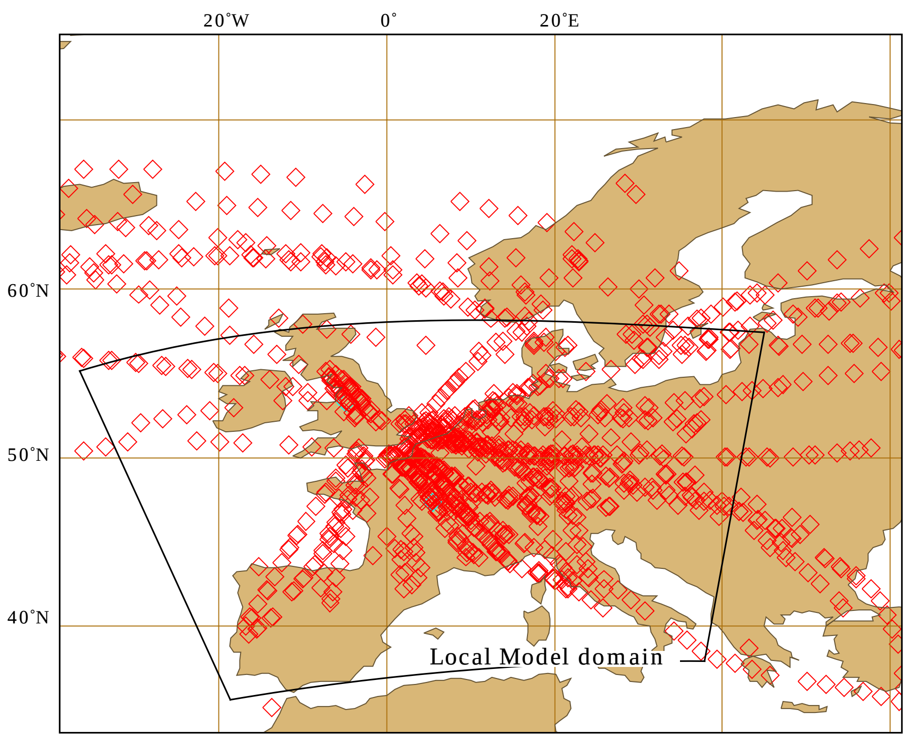
- All experiments were based on the operational configuration of the Local Model installed at MeteoSwiss:
  1. 385x325 mesh, **about 7km horizontal resolution**, 45 layers in the vertical
  2. data assimilation based on the **nudging scheme**, with use of all conventional observing systems (SYNOP, SHIP, DRIBU, AIREP, AMDAR, TEMP, PILOT)
  3. **aicraft data** grouped in multi-level reports before assimilation
  4. **boundary conditions** from the ECMWF operational deterministic forecast (forecast) and from the operational 4d var stream (assimilation)
  5. **soil model** updated once a day from the driving model

- Results have been evaluated with two verification packages:
  1. verification of the **vertical structure of the atmosphere** against a set of 28 radiosondes regularly distributed over the whole LM domain
  2. verification of **near-surface weather parameters over Switzerland**

Experimental set-up (2)

		TEMP	PILOT	AIRCRAFT	SYNOP
S1	active stations	55	12	135	1078
	active reports[a]	202	24	4671	18542
S2	active stations	25	12	135	1078
	active reports	110	24	4671	18542
S3	active stations	25	12	216	1078
	active reports	110	24	21261	18542

Typical number of observations assimilated in 24h



Typical daily coverage of AMDAR platforms in S3

jean-marie.bettems@meteoswiss.ch

Impact of radiosonde network modification

Number of active radiosondes over LM domain reduced from 55 to 25

From the remaining stations 12 have been upgraded to measure every 6 hours

- **Significant degradation of model quality at analysis time**

  both dynamical and thermodynamical fields are affected

  mainly visible in the *distribution* of model fields (meso-β structures)

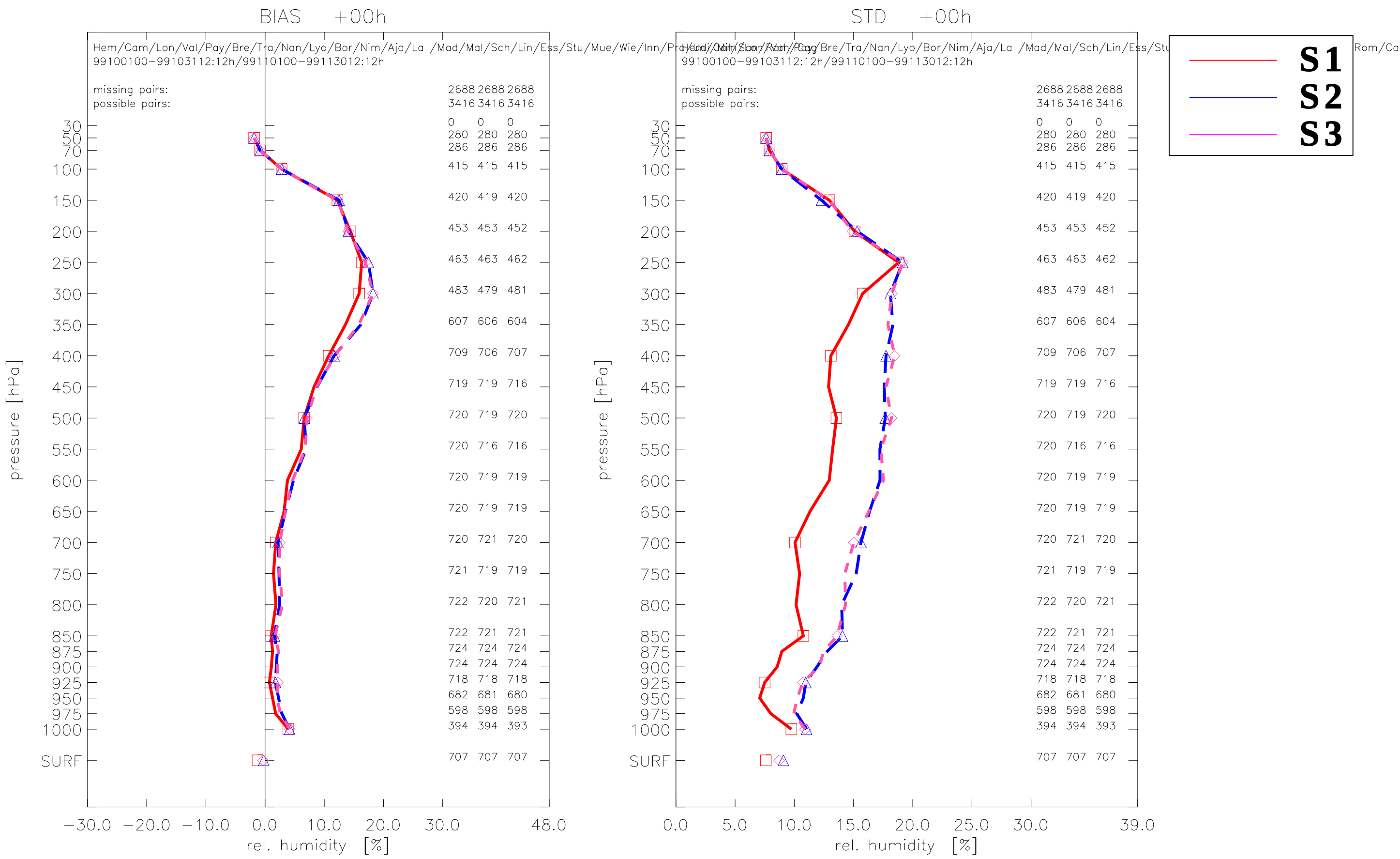
  consistent with the results of an earlier OSSE study [Bettems, 1999]

- **Negative impact in the very short range forecast**

  after 12 hour most differences have disappeared

jean-marie.bettems@meteoswiss.ch

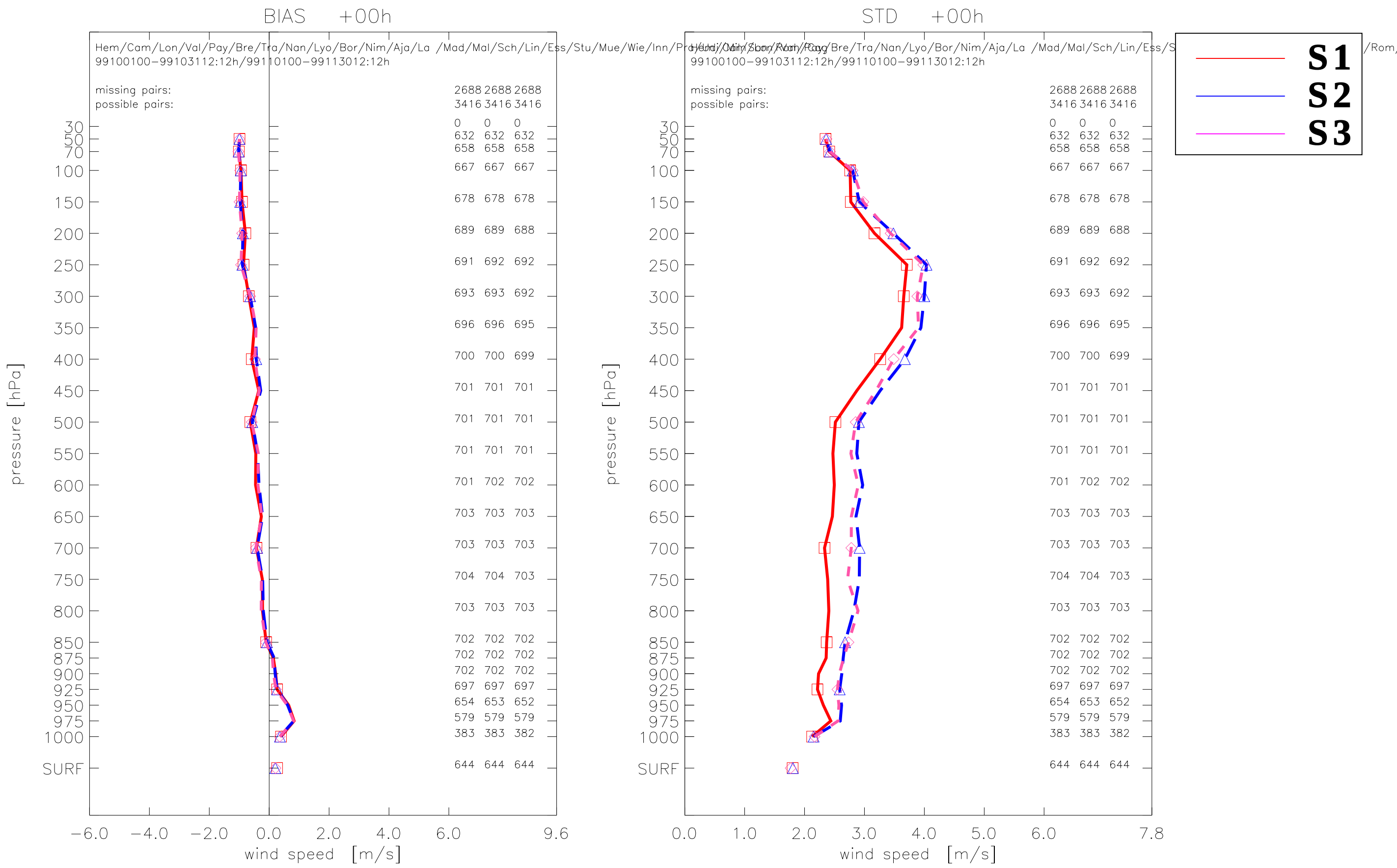
Relative humidity +00h (12UTC)
All stations



Bias **Standard deviation**

Vertical structure of the atmosphere

Wind speed +00h (12UTC)
All stations

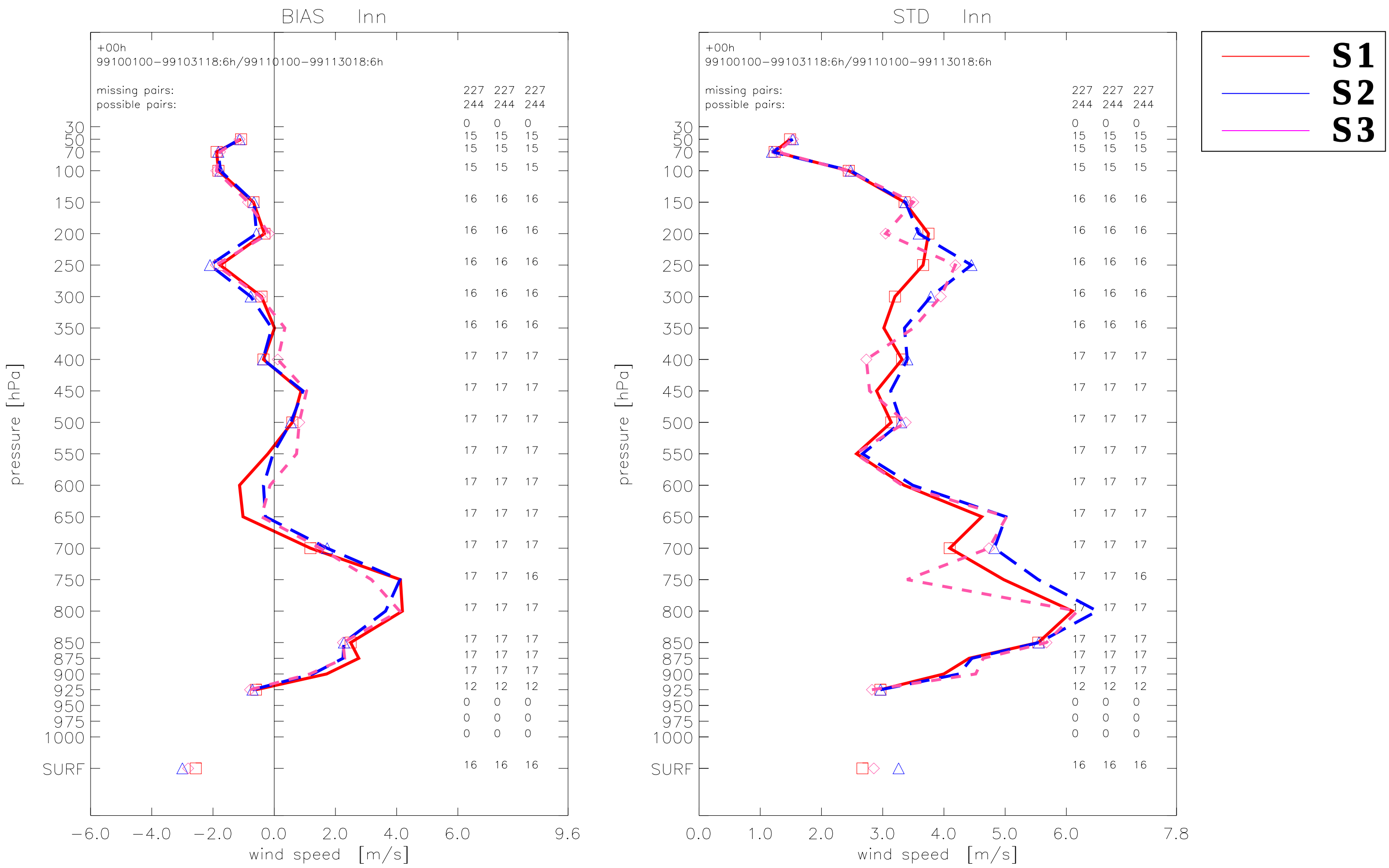


Bias **Standard deviation**

Vertical structure of the atmosphere

Wind speed +00h (12UTC)

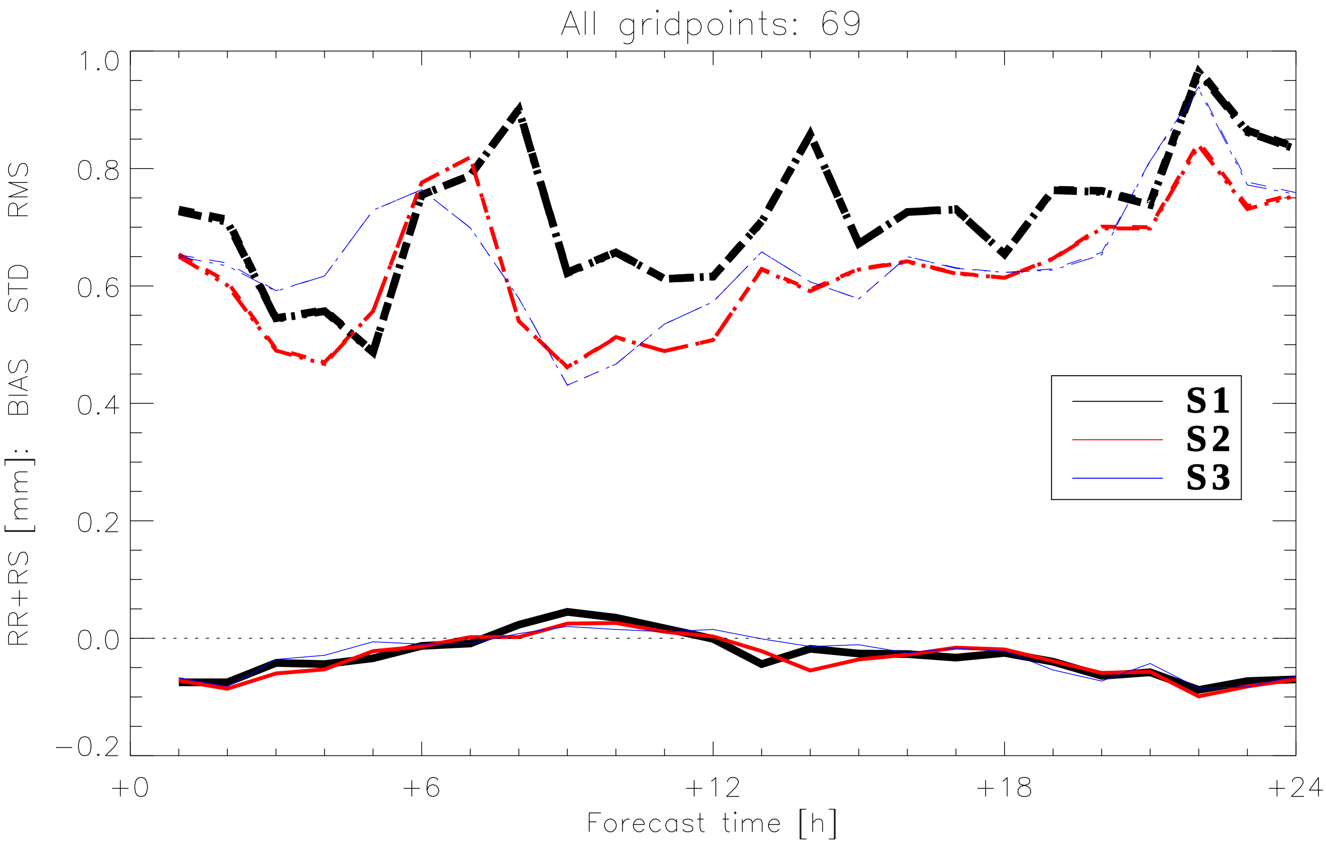
Innsbruck *(not part of S1/S2/S3)*



Bias **Standard deviation**

Total precipitation, mean over 5 grid points
All active ANETZ stations

(Obs. frequence of Payerne RS is double in S2/S3)



Impact of additional AMDAR platforms

Number of active AMDAR platforms in LM domain increased from ~135 to ~216

Number of AMDAR reports increased by a factor 4

- **Over the *whole model domain* the impact is positive but very small**

- **Clear *local* improvement, in regions well covered by AMDAR platforms**

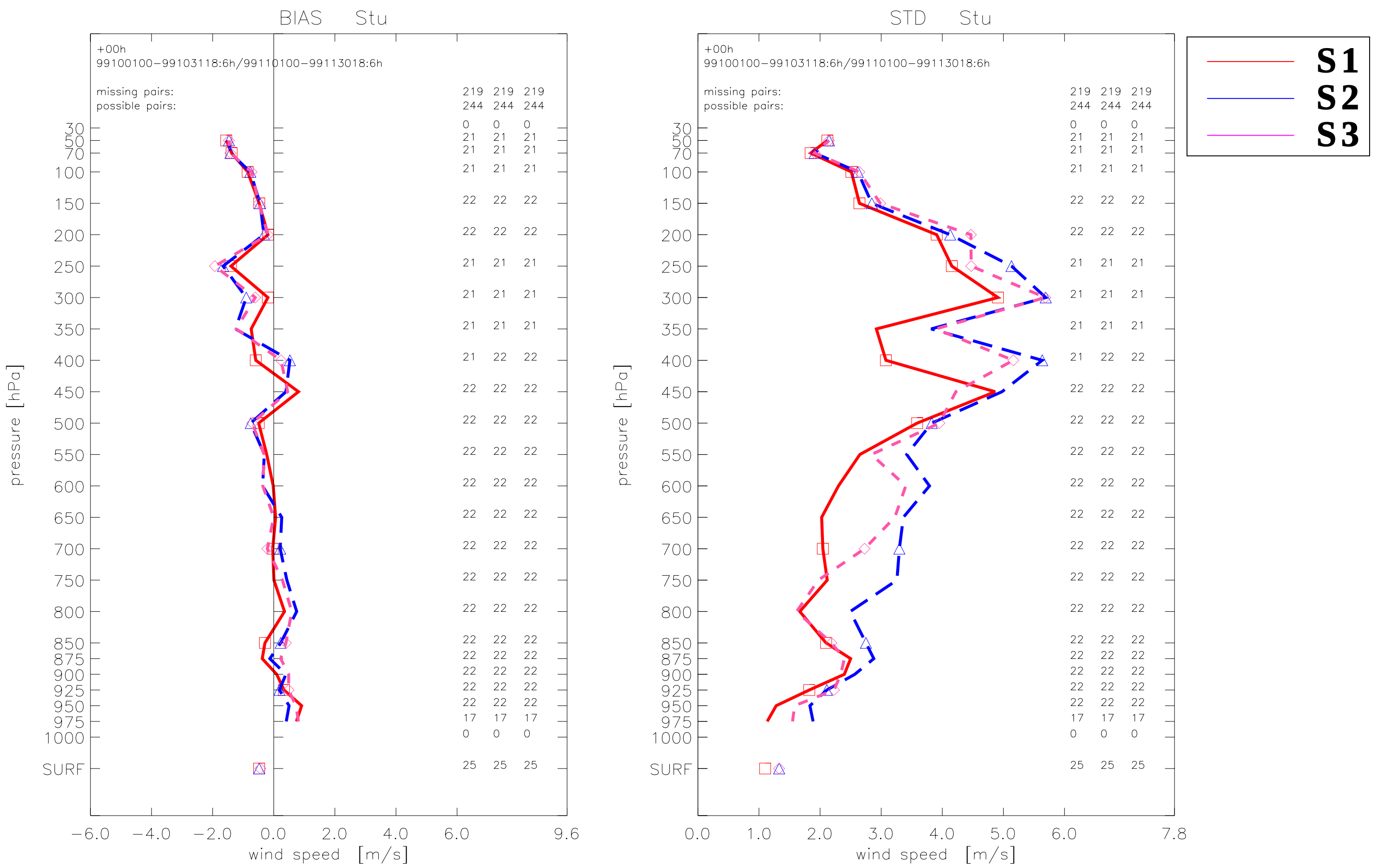
  humidity field is also improved

  does not compensate quality loss brought by the radiosonde network degradation

jean-marie.bettems@meteoswiss.ch

Vertical structure of the atmosphere

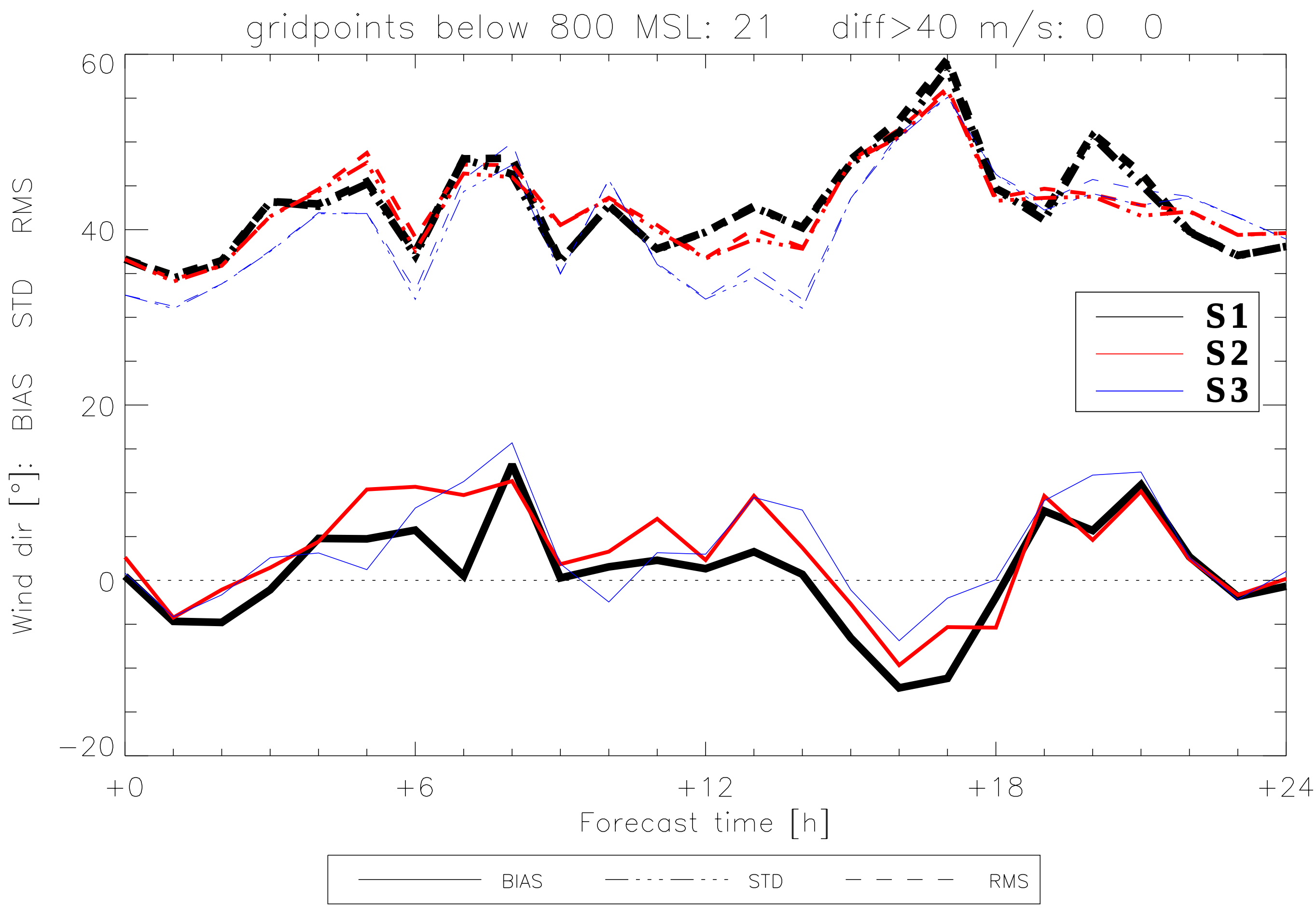
Wind speed +00h (12UTC)
Stuttgart (*many AMDARs around that location*)



Bias **Standard deviation**

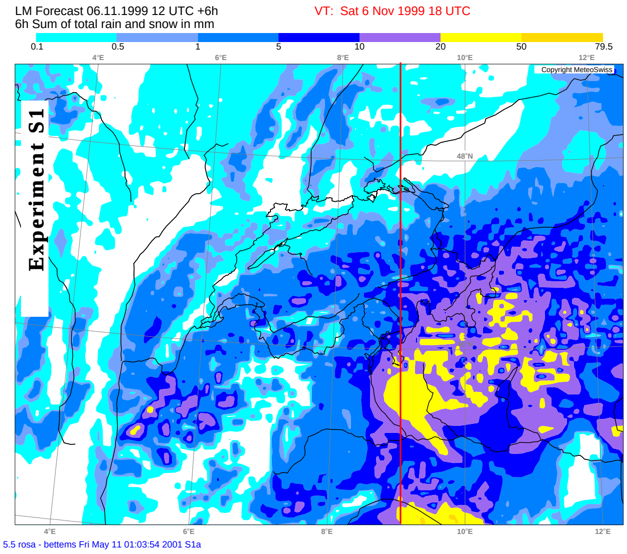
:02

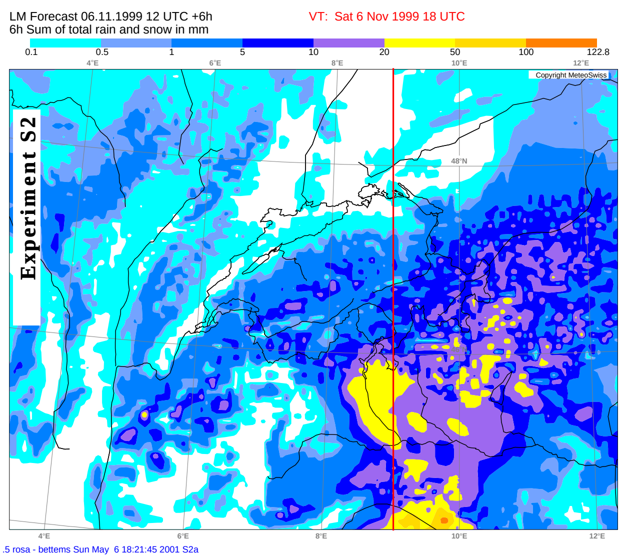
Wind direction
All representative ANETZ stations below 800 m

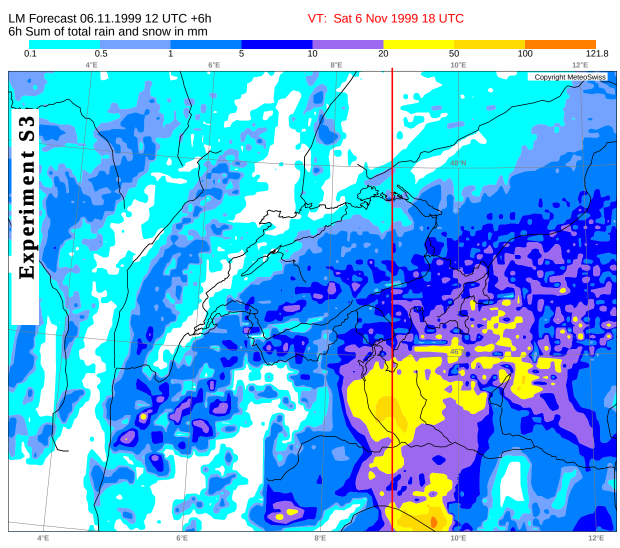


Heavy precipitation case – 6th November 1999

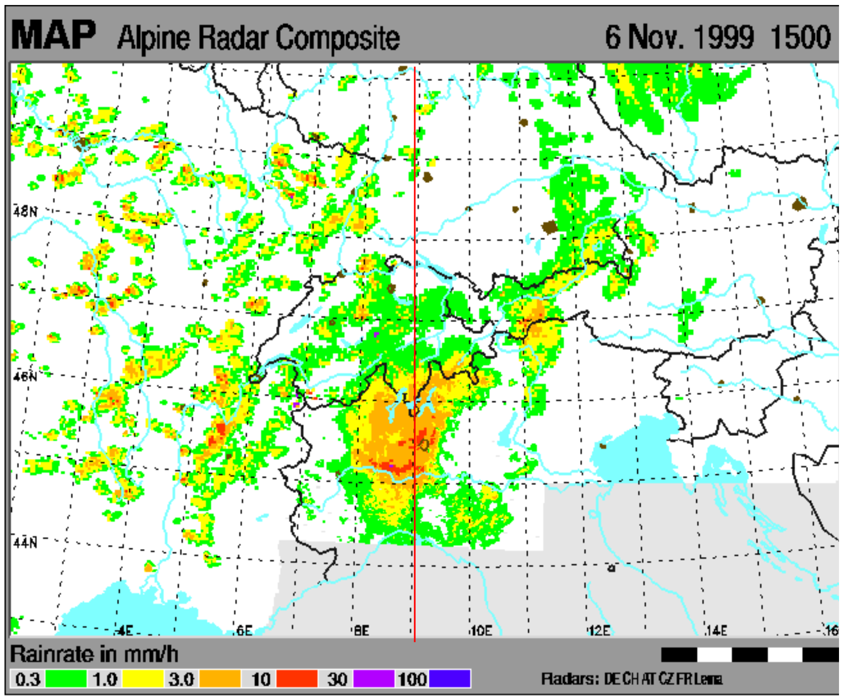
6h precipitation sum from LM (12UTC - 18UTC)







MAP Alpine radar composite



Conclusion

- The results obtained at a higher horizontal resolution with the Local Model (~7 km) **differ substantially** from those obtained with the global ECMWF model (~60 km) or the DMI-HIRLAM-G limited area model (~50 km).

- ECMWF and DMI studies have shown that a reduction of the number of active radiosonde stations had a **very small negative impact**, and that the **additional AMDAR data slightly degrade the forecast quality**.

- This study suggests a **significative degradation of the short range forecast quality** associated with the introduction of the proposed EUCOS scenario, if no compensatory action are taken.

  AMDAR observations have a clear potential, and an improved horizontal coverage would mitigate the expected quality loss.

  However, **additional information about local structures in the humidity field are needed** (e.g. GPS).