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# Verification With Averaged Model Output



# Problem

Initial problem:

- COSMO-1 shows at some stations larger spread of error (STDE) than COSMO-2
- Hypothesis: Higher variability in COSMO-1 could be the cause

General considerations:

- We have in fact a time-representativeness mismatch between model and observation:
  - SYNOP Observations are 10 min averages
  - Standard COSMO model output are instantaneous values
- How does this influence our verification results?

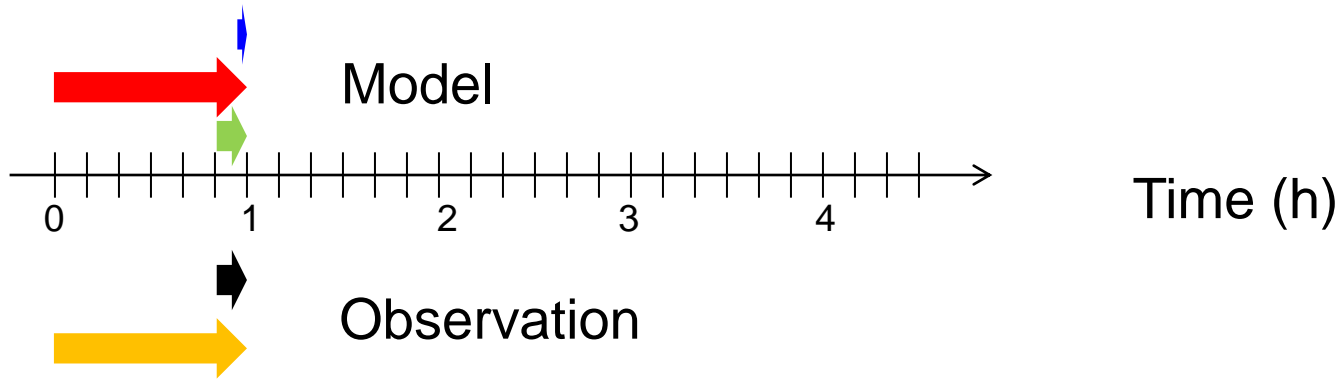


# Data Basis

- Implementation of averaged output in the COSMO source code
- Averaged output in addition to standard COSMO output, available for
  - Autumn: 2014-09-19 12 to 2014-11-30 12 (80% of SON)
  - Winter: 2014-12-01 00 to 2015-02-28 12 (100% of DJF)
  - Spring: 2015-03-01 00 to 2015-04-09 00 (40% of MAM)



# Averaging Intervals



SYNOP: 10 min Average

Model: last time step (COSMO standard output)

Model 1 h average over all COSMO time steps

Model 10 min average over all COSMO time steps

Model 1 h average compared with obs 1 h average



# Expected Results

- Effect depends on variability of value in observation and model
- Model is expected to vary smoothly because only grid scale variation is resolved, sub-grid scale variations are not represented in the grid values.
- Variability in observations depends on parameter, effect tested with fourth experiment using hourly obs averages.
- No impact expected in bias
- Important value is STDE: if it gets smaller, then the small scale variability removed by averaging is non-predictable “noise”



# Results

Important value is STDE (lower right)

- normal «instantaneous» model output, 10 min averaged observations

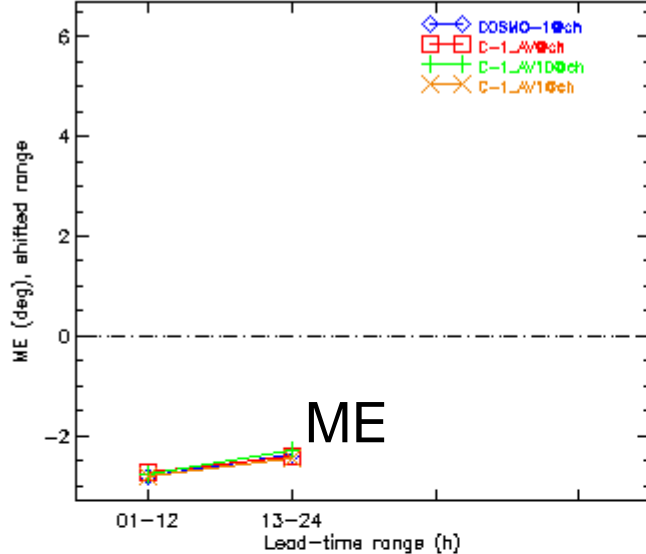
Averaged model output

- 1 h averaged model output, 10 min averaged obs
- 10 min averaged model output, 10 min averaged obs
- 1 h averaged model output, 1 h averaged obs



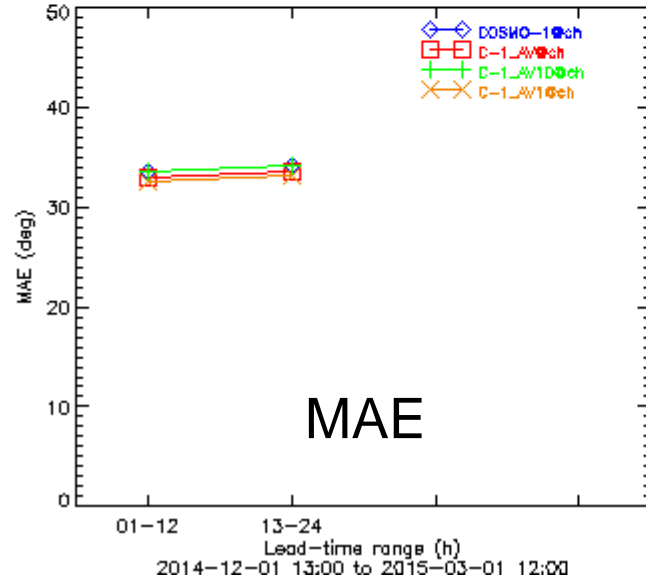
# Wind Direction

DD\_10M: ME COSMO-1@ch C-1\_AV@ch C-1\_AV10@ch C-1\_AV1@ch

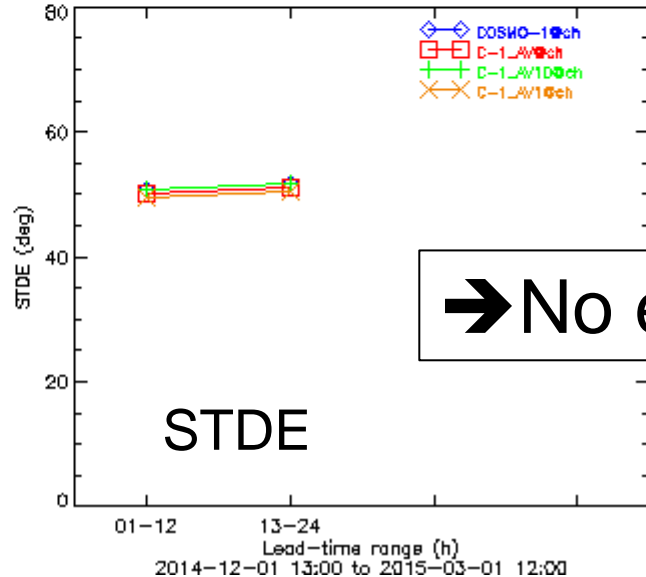


Model instantaneous  
Model 1 h  
Model 10 min  
Model 1 h, Obs 1 h

MAE COSMO-1@ch C-1\_AV@ch C-1\_AV10@ch C-1\_AV1@ch



STDE COSMO-1@ch C-1\_AV@ch C-1\_AV10@ch C-1\_AV1@ch

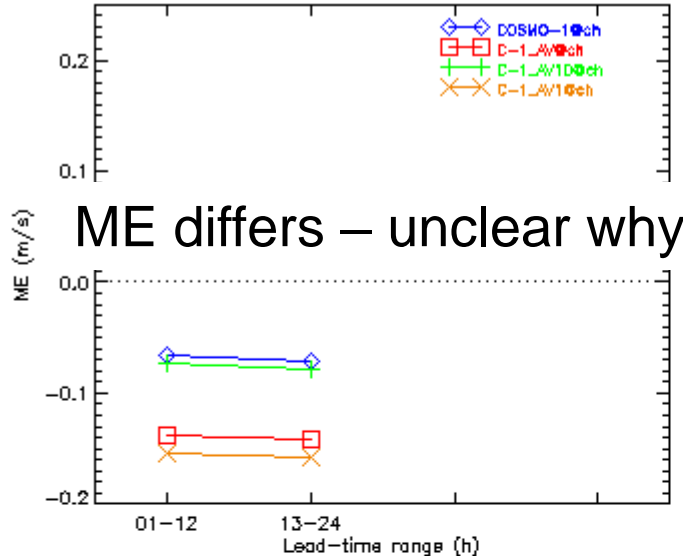


→ No effect!



# Wind Speed

FF\_10M: ME COSMO-1@ch C-1\_AV@ch C-1\_AV10@ch C-1\_AV1@ch

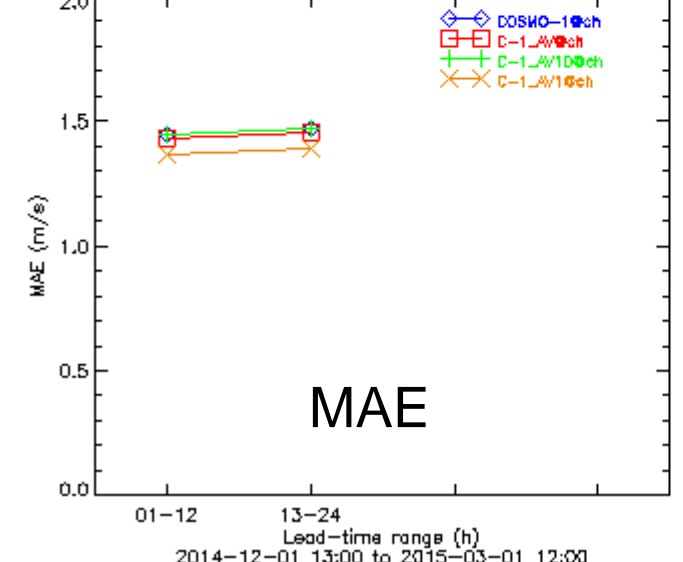


ME differs – unclear why

Model instantaneous  
 Model 1 h  
 Model 10 min  
 Model 1 h, Obs 1 h

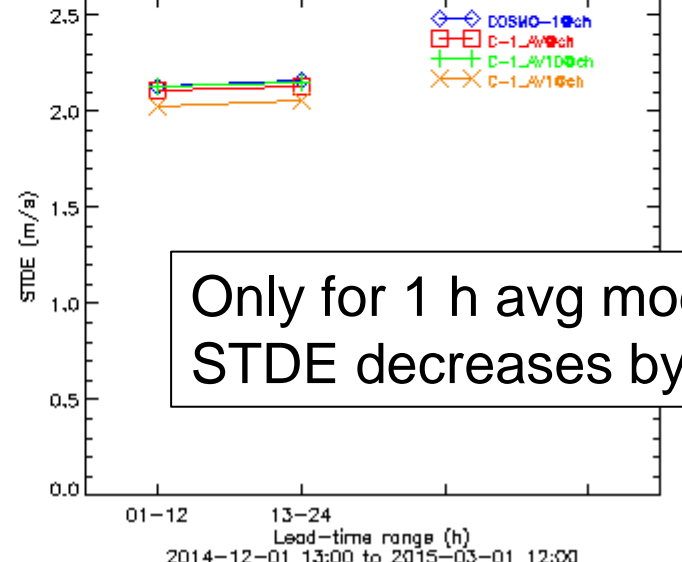
2014-12-01 13:00 to 2015-03-01 12:00

FF\_10M: MAE COSMO-1@ch C-1\_AV@ch C-1\_AV10@ch C-1\_AV1@ch



MAE

FF\_10M: STDE COSMO-1@ch C-1\_AV@ch C-1\_AV10@ch C-1\_AV1@ch

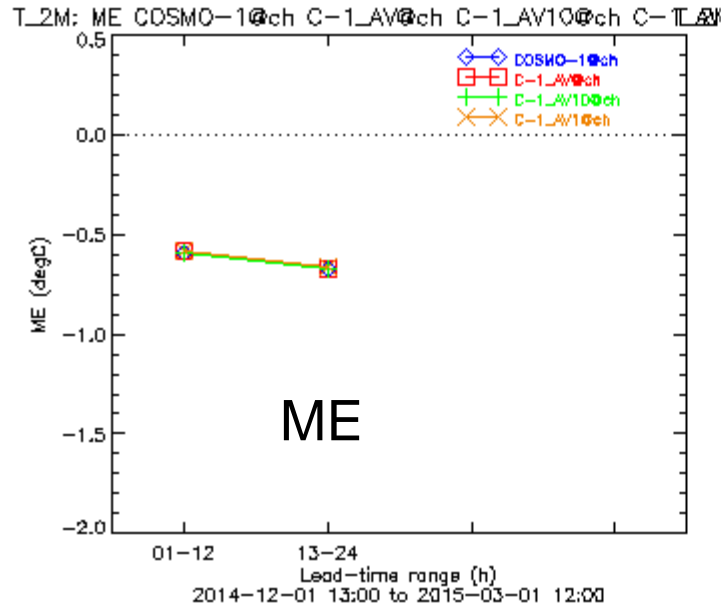


Only for 1 h avg mod/obs:  
 STDE decreases by 5%



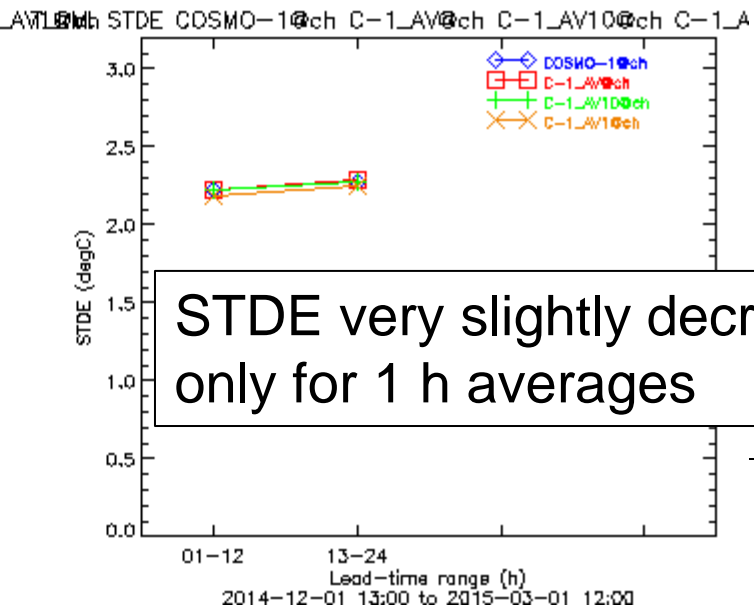
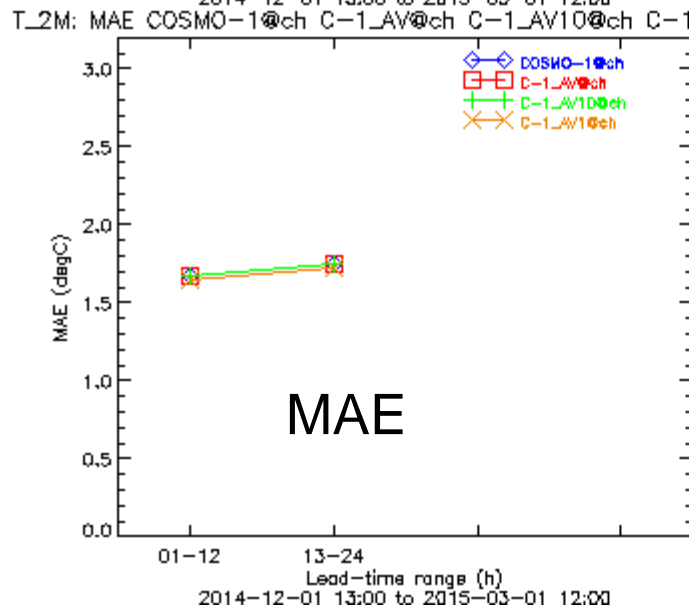


# 2 m Temperature



➔ No effect

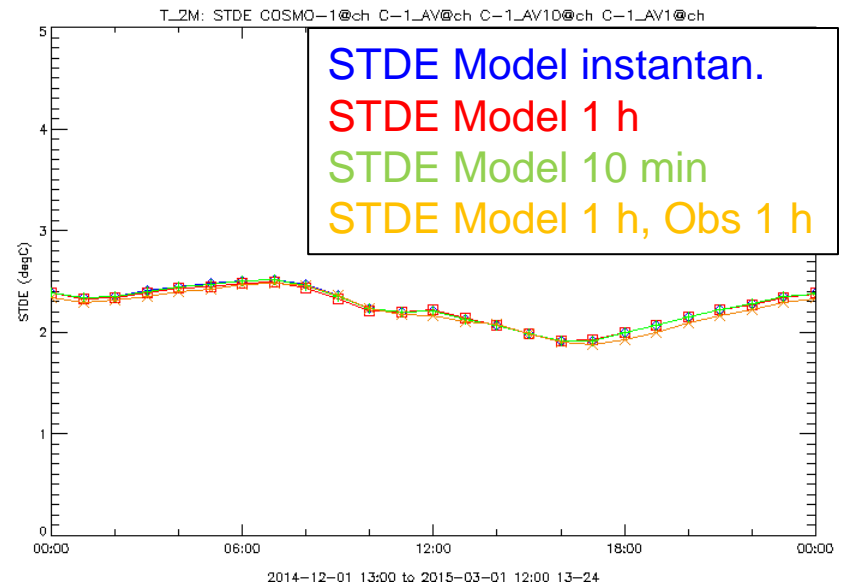
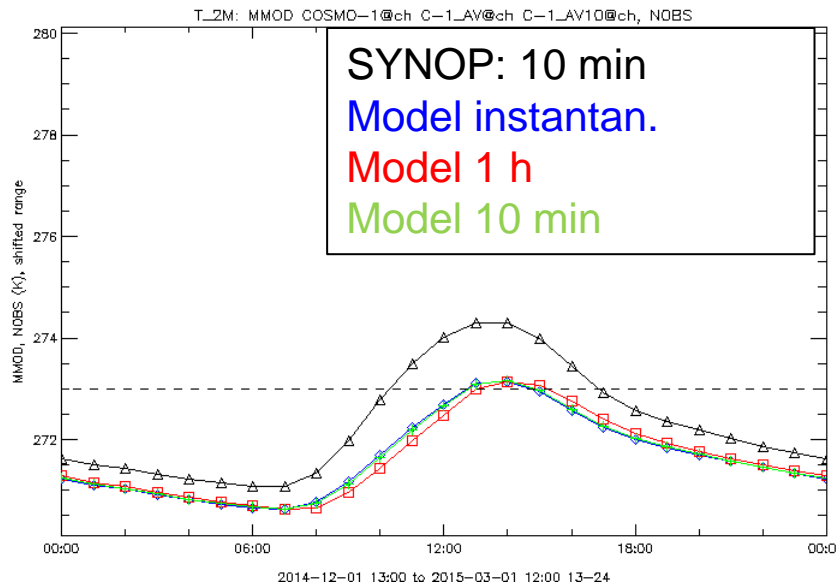
Model instantaneous  
 Model 1 h  
 Model 10 min  
 Model 1 h, Obs 1 h





# Diurnal Cycle Temperature

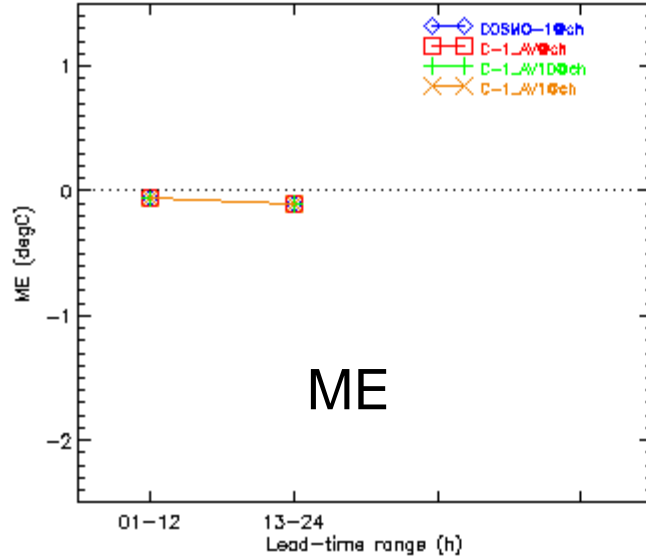
- Averaging results in a shift in diurnal cycle by 30 min to the right due to the time stamp being at the end of the averaging interval
- Shift increases STDE, neutralizing small decrease by averaging 10-11 UTC, 14-16 UTC





# Dewpoint Temperature

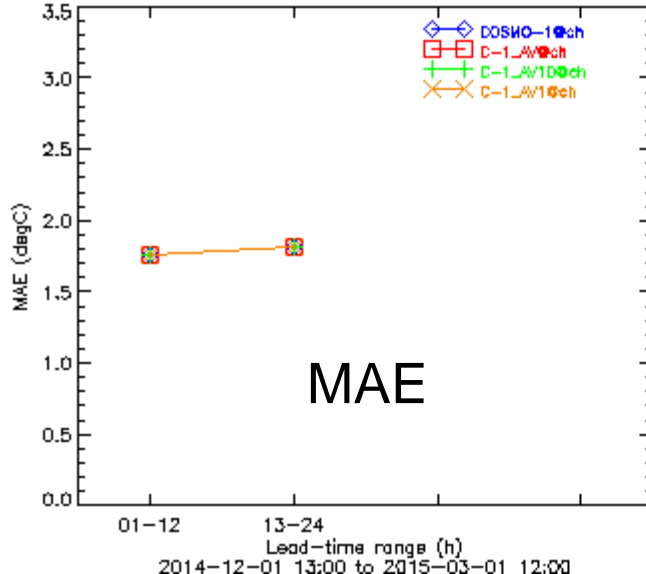
TD\_2M: ME COSMO-1@ch C-1\_LAV@ch C-1\_LAV10@ch C-1\_LAV1@ch



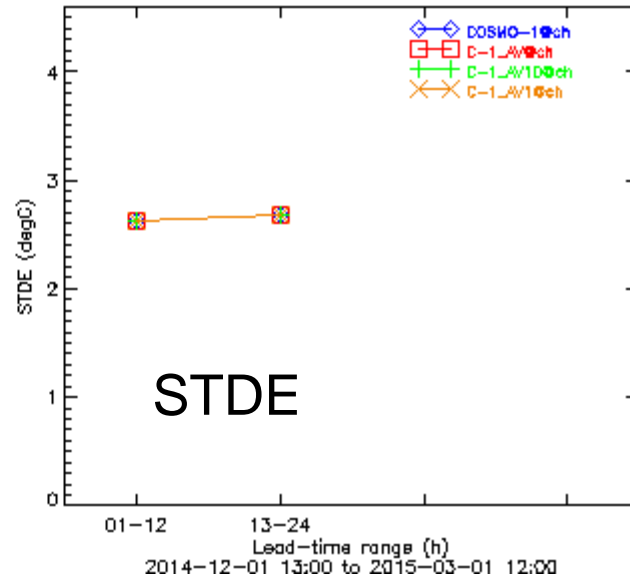
→ No effect

Model instantaneous  
Model 1 h  
Model 10 min  
Model 1 h, Obs 1 h

TD\_2M: MAE COSMO-1@ch C-1\_LAV@ch C-1\_LAV10@ch C-1\_LAV1@ch



TD\_2M: STDE COSMO-1@ch C-1\_LAV@ch C-1\_LAV10@ch C-1\_LAV1@ch





# Summary (1)

- Using 10 min model averages instead of the standard instantaneous COSMO output does hardly change the verification results
- → We do not artificially increase the error when we compare instantaneous model output instead of 10 min averages to 10 min averaged SYNOP observations
- Comparing hourly averages (of model and obs) does decrease the spread of the error (STDE) but only by a very small amount and only for few parameters
- → Largest effect for wind speed, reduction of STDE by 5%
- → Sub-hourly “noise” is not a significant problem



# Summary (2)

- Averaging observation reduces STDE more than averaging model
- → The sub-hourly variability is larger in the observations than in the model