Interaction Subgrid scale Orography-Turbulence in COSMO

Results from case study and common plots

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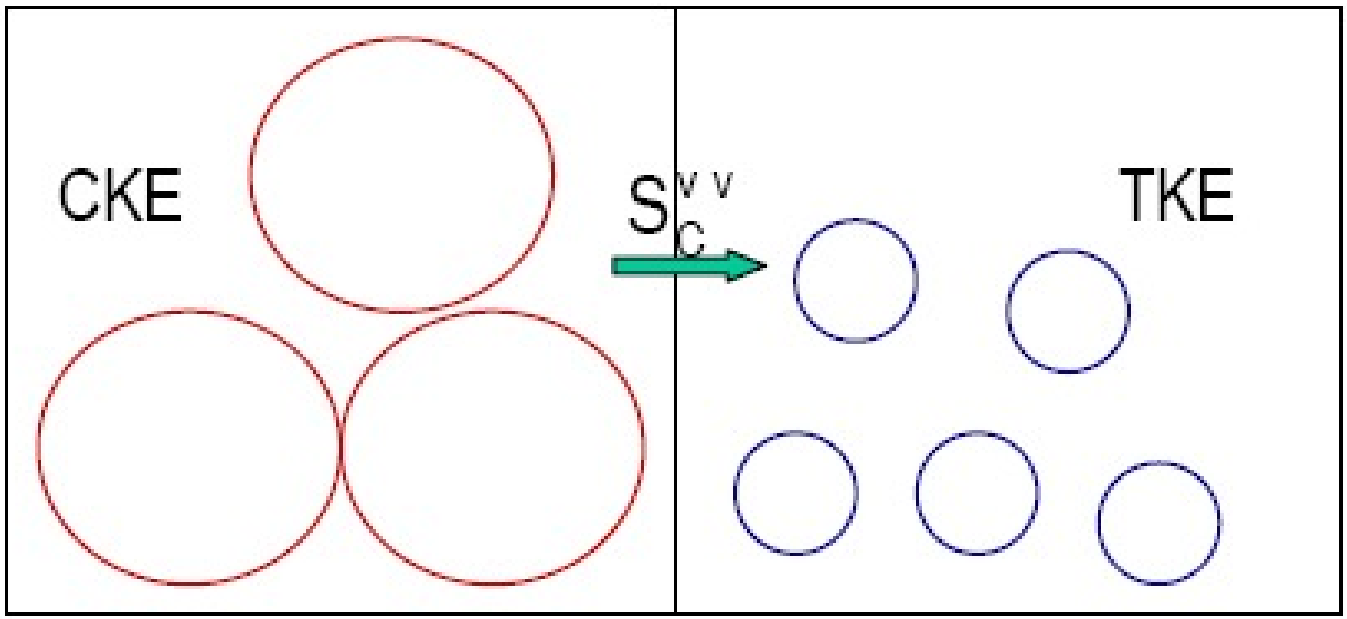
Background

Separated Turbulence Interacting with (non-turbulent and still unresolved) Circulation (STIC)

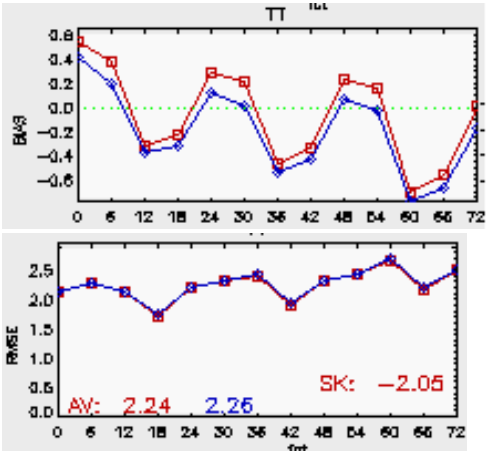
- circulation due to subgrid scale orography (*ltkesso*)
- circulation due to convective plumes (*ltkecon*)
- circulation due to horizontal shear (*ltkeshs*)



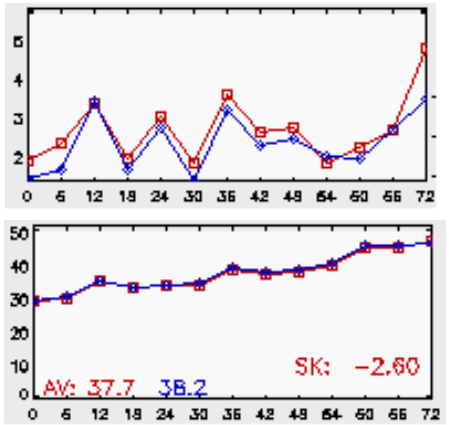
Background

ltkesso tested in a parallel test over COSMO-EU domain (2 months in 2011):

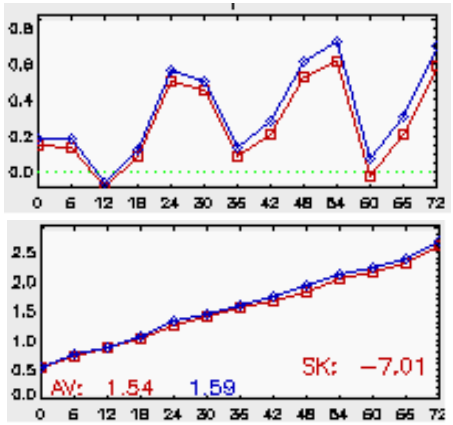
Temperature



Wind speed



Pressure



Experim
Control

(Raschendorfer, 2011)

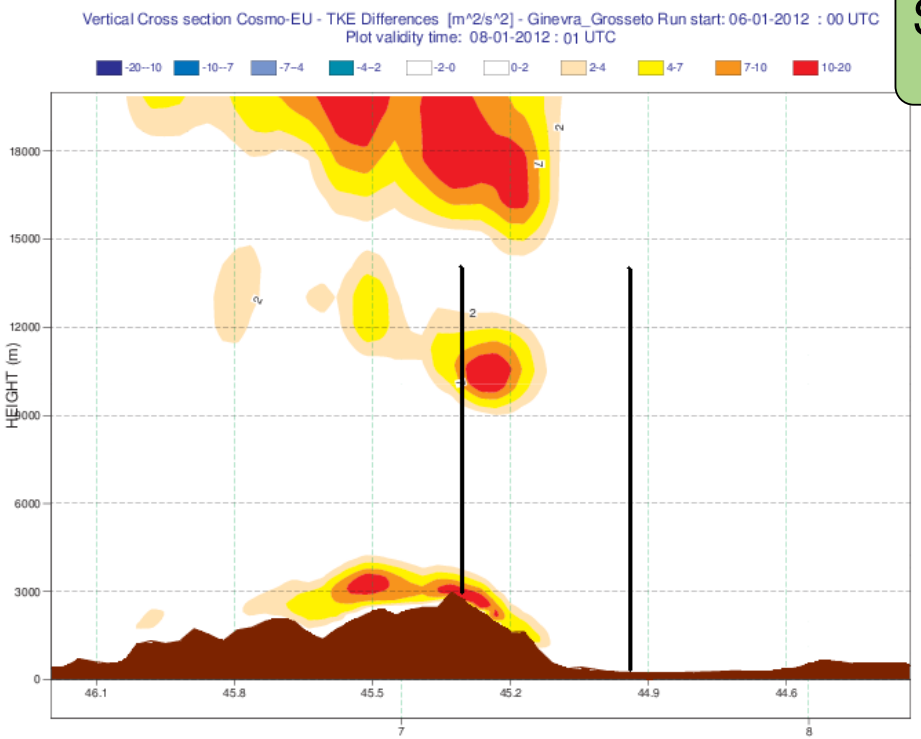
What is the effect of the parameterization on turbulence and dynamical variables in points with high and low SSO?

Case studies

Common plots

Case studies

ΔTKE



SSO scheme slows down the mean flow

MKE sink

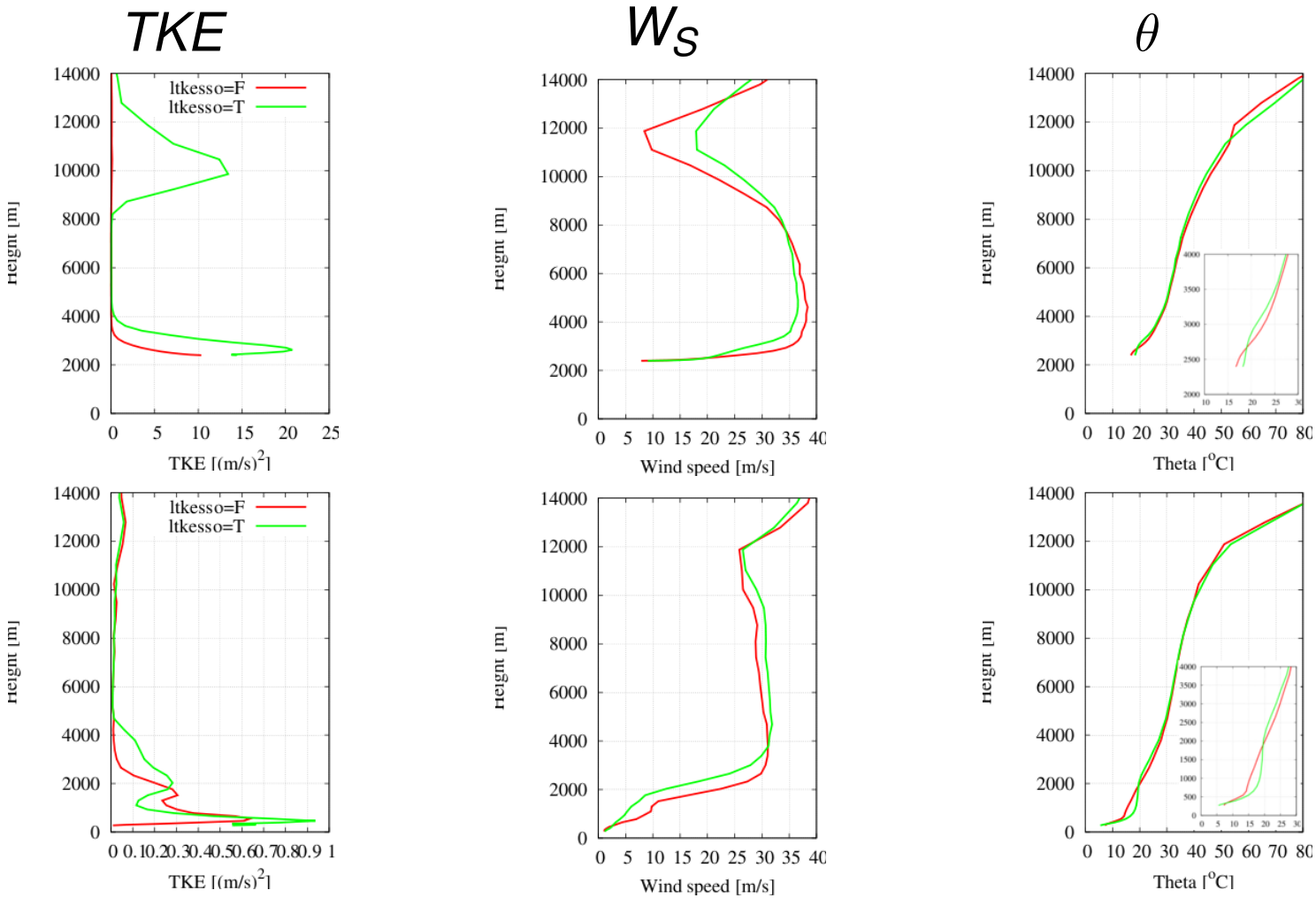
CKE production

TKE production

Case studies

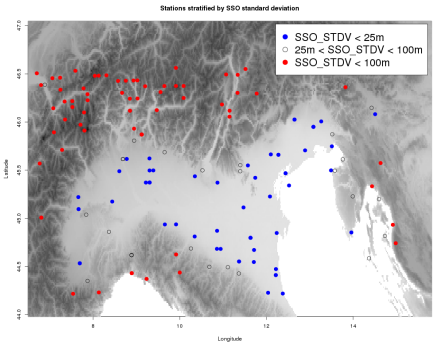
HIGH SSO

LOW SSO



The *TKE* production has a visible impact in cases characterized by low *TKE* (e.g. stable stratification)

Case study verification

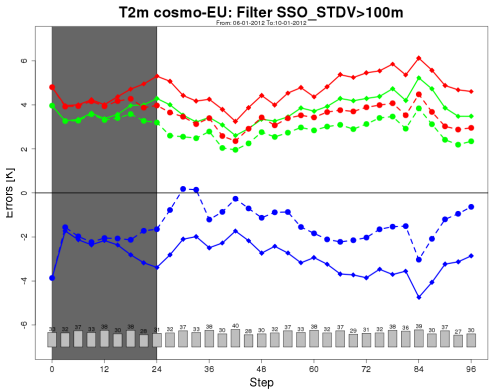


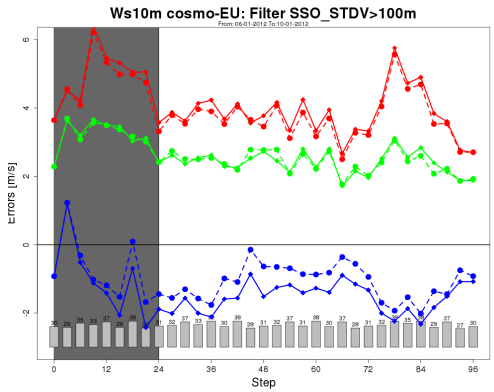
Case 1) Anticyclonic regime

T2m

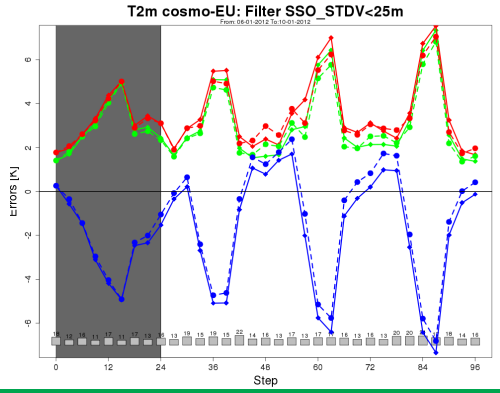
Ws10m

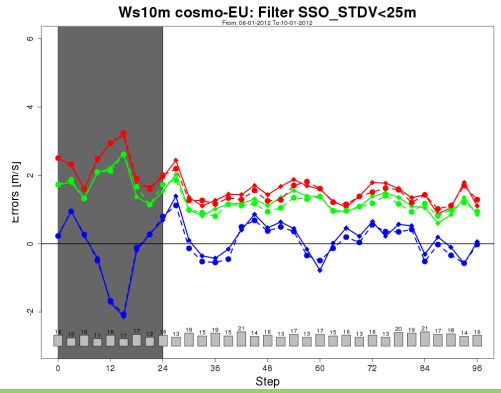
HIGH SSO

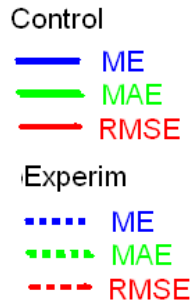




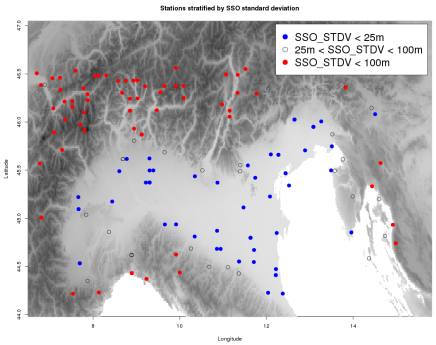
LOW SSO







Case study verification



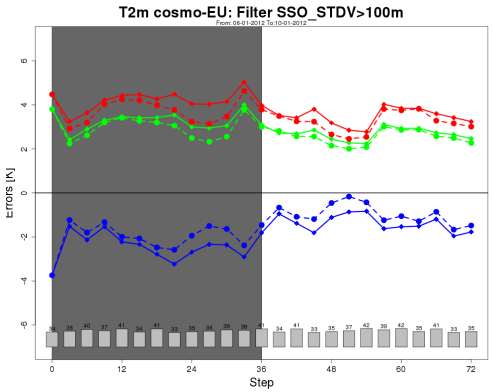
Case 2) Frontal passage

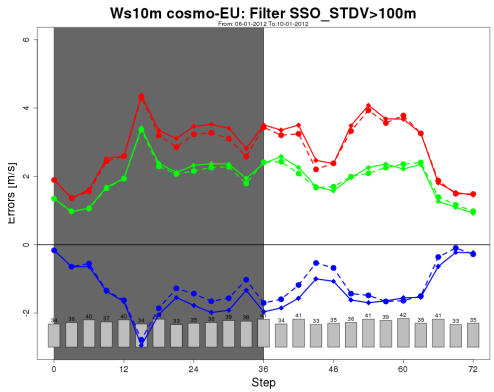
T2m

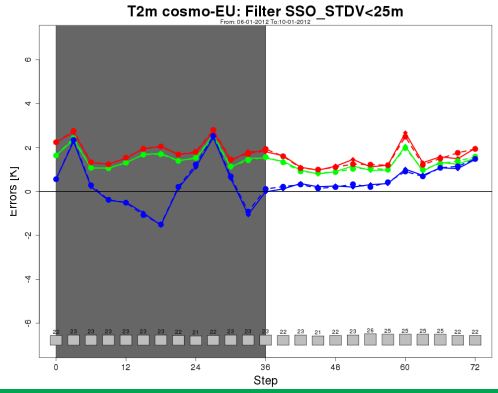
Ws10m

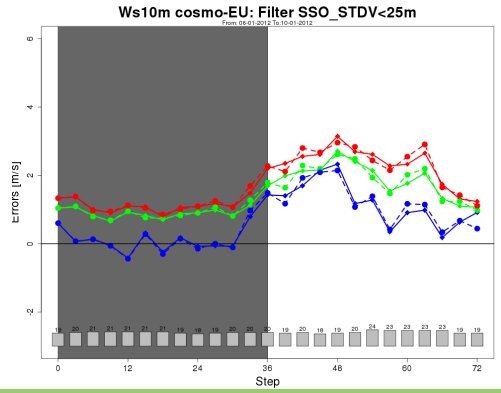
HIGH SSO

LOW SSO





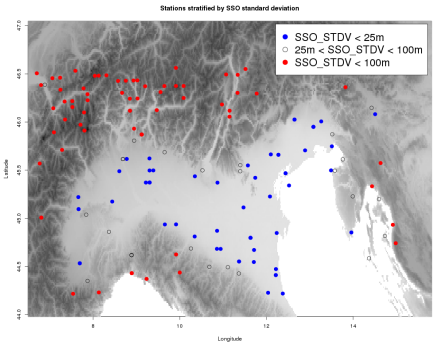




Control
ME
MAE
RMSE

Experim
ME
MAE
RMSE

Case study verification: summary



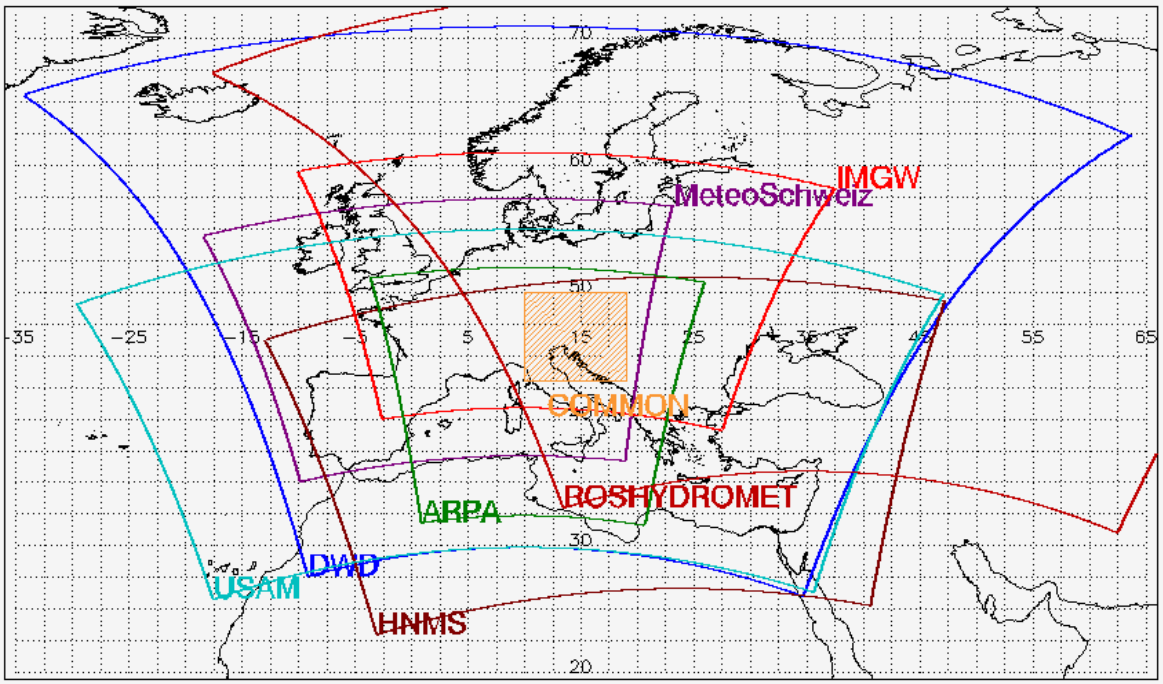
- T2m in points with high SSO shows the largest changes
- sensitivity to the synoptic circulation

	T2m	*Ws*10*m*
HIGH SSO	ME: +2C..+0.5C RMSE: -1.5C..-0.5C	ME: +0.5m/s..0m/s RMSE: -0.5m/s..0m/s
LOW SSO	ME: +0.5C..+0.5C RMSE: -0.5C..0C	ME: not visible RMSE: not visible

Common plots

Aim: confirmation of the results on a longer statistical base.

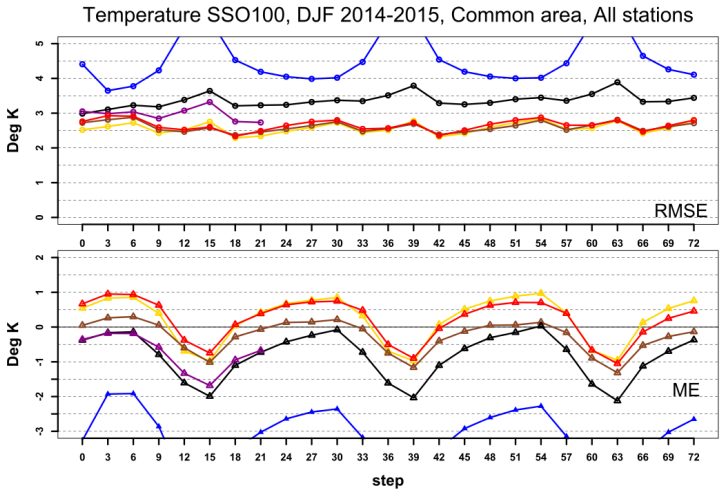
- *ltkesso* is activated in some COSMO members
- Filter the stations on SSO standard deviation base (approx. same number)
- periods: DJF and MAM 2015
- domain: common area

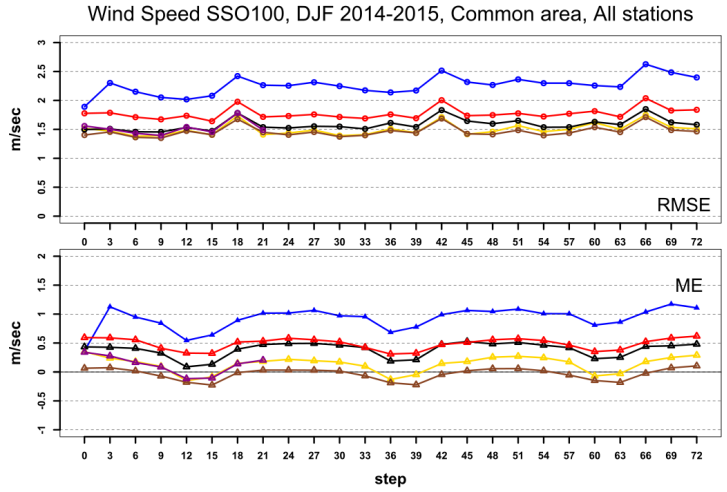


Common plots: DJF

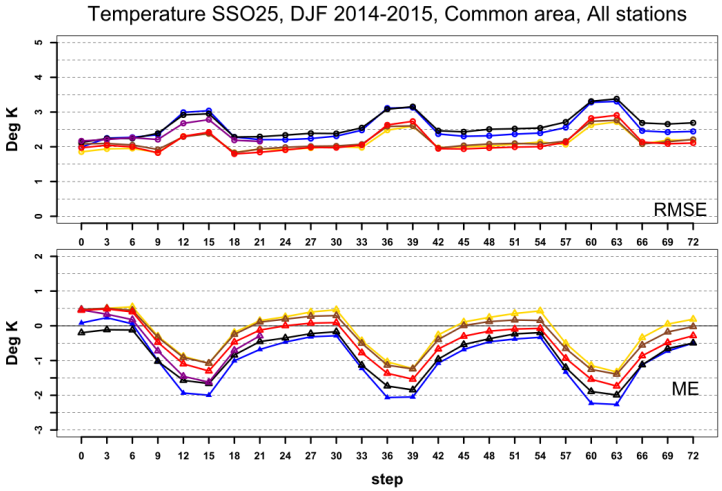
T2m | *Ws10m*

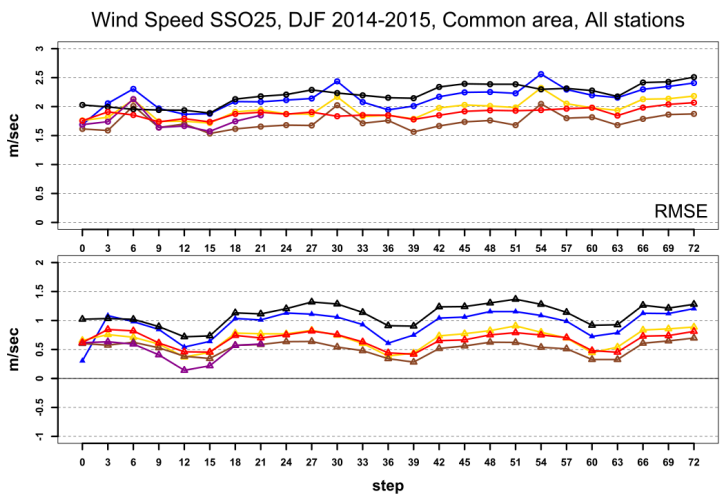
HIGH SSO





LOW SSO





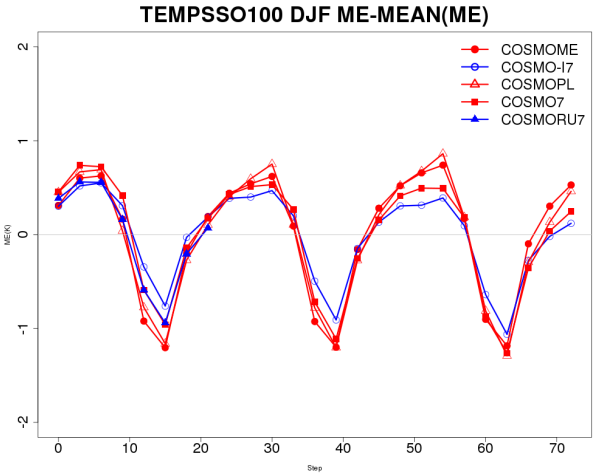
C-GR ✗
C-ME ✓
C-I7 ✗
C-PL ✓
C-RU ✗
C-7 ✓

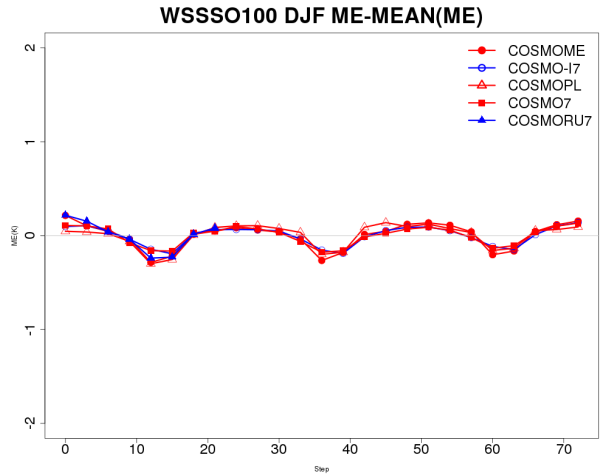
- no trend visible in RMSE

Common plots: DJF

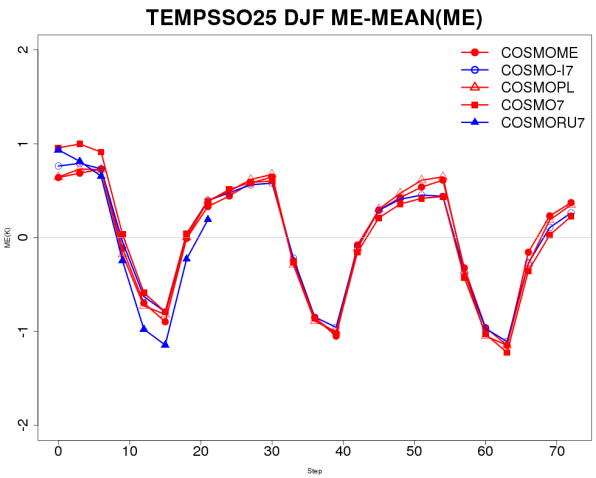
T2m | *Ws10m*

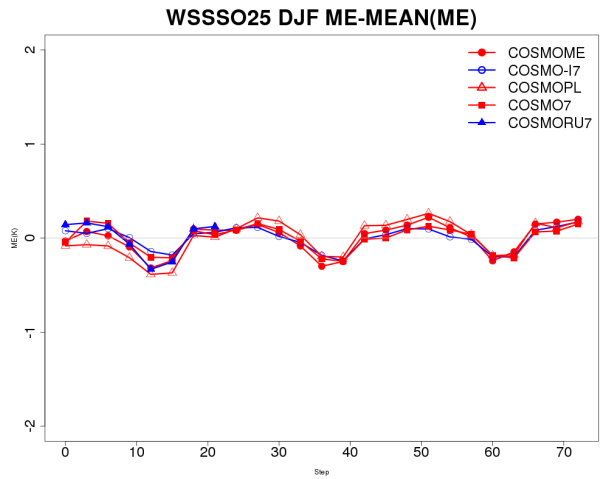
HIGH SSO

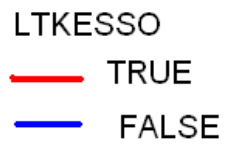




LOW SSO







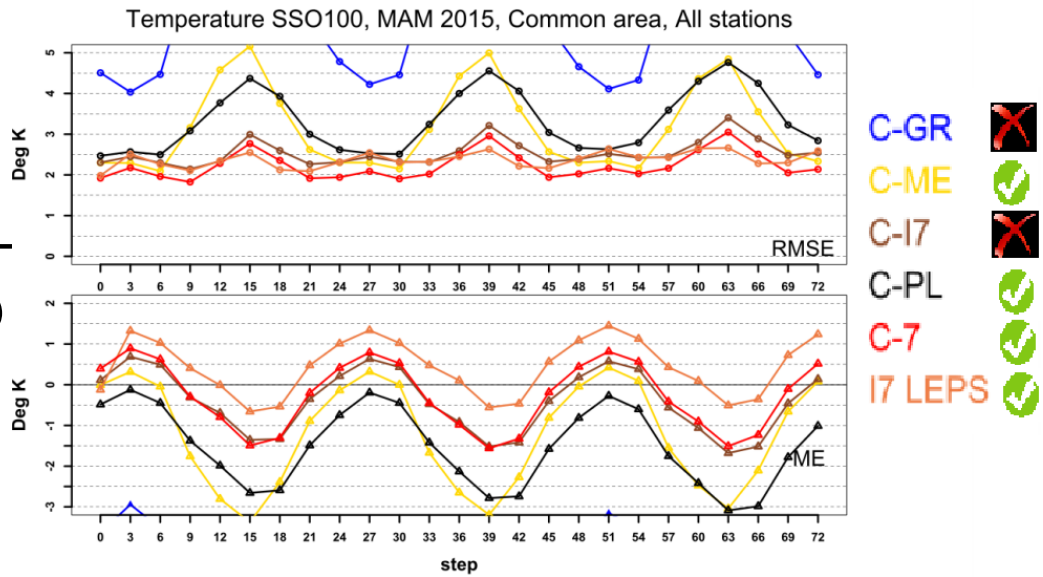
- sensitivity in ME during night (stabler stratification) for T2m in points with high SSO

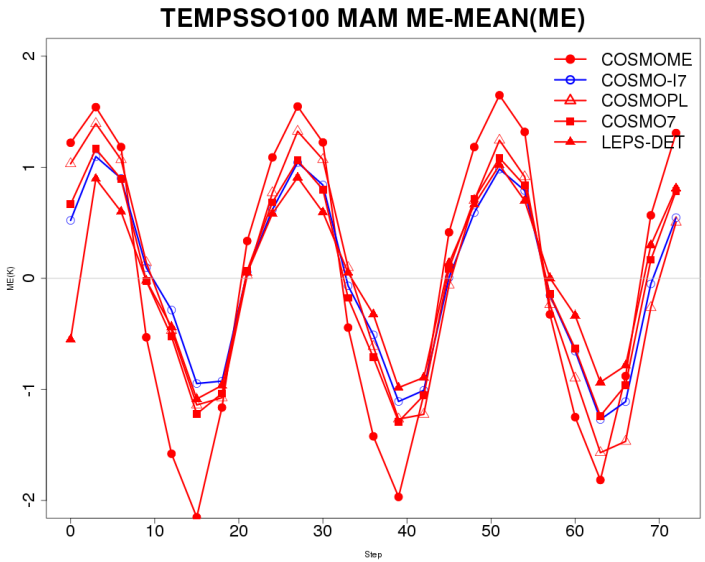
Common plots: MAM

$T2m$

$T2m(ME - Mean(ME))$

HIGH SSO





In MAM the signal in ME is lost: synoptic circulation induces less frequently a stable stratification in points with high SSO.

Conclusions

Not visible a clear signal from the Common Plots analysis

What do we learn?

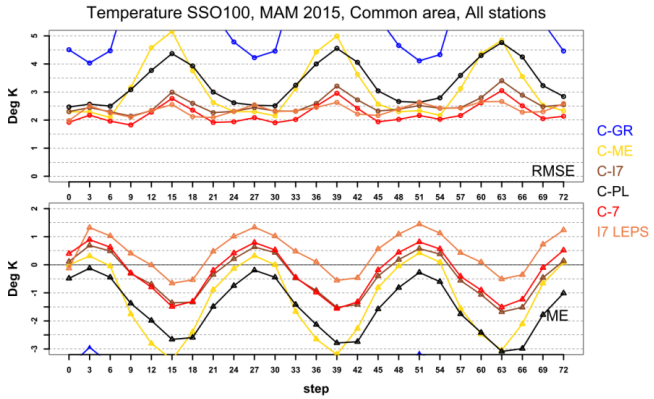
- long statistics smooths out the signal visible in the case studies (only $\Delta T2m$ as big as 2C in the case studies can be detected in the Common Plots)
- ME is more sensitive than RMSE
- some help may come by filtering for meteorological conditions (e.g. stable stratification)

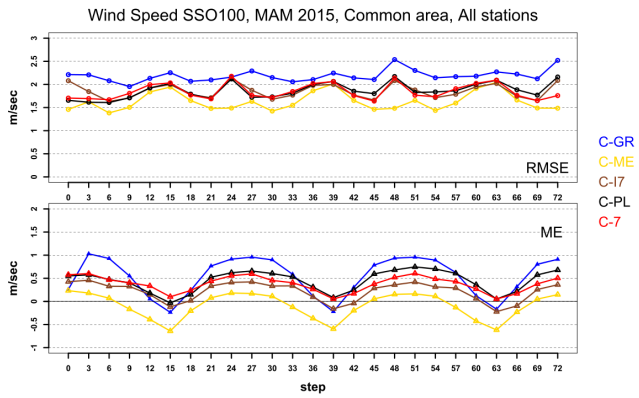
Thank you for the attention!

Common plots: MAM

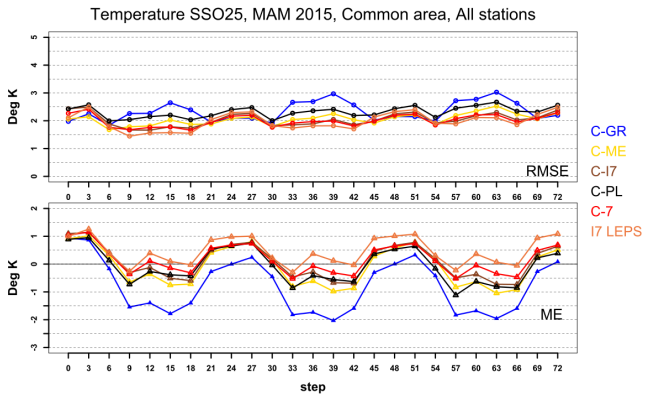
T2m *Ws10m*

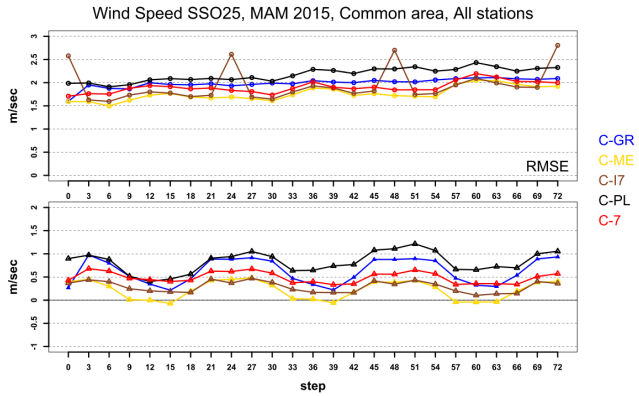
HIGH SSO





LOW SSO





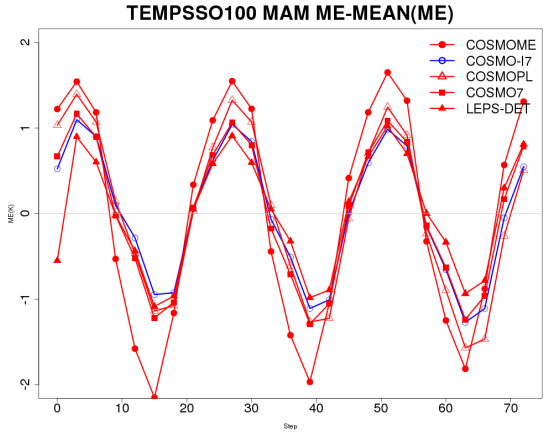
	Itkesso
C-GR	F
C-ME	T
C-I7	F
C-PL	T
C-7	T

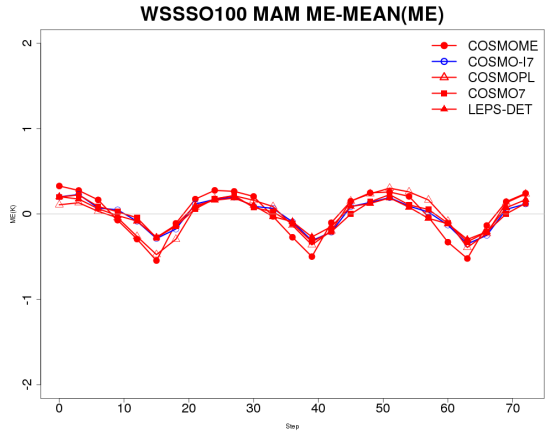
- no trend visible in RMSE (confirmed)

Common plots: MAM

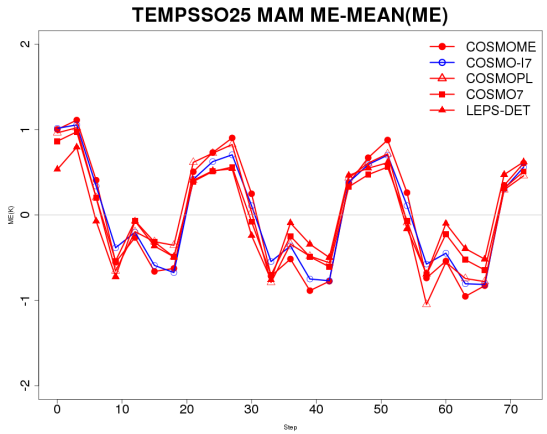
T2m *Ws10m*

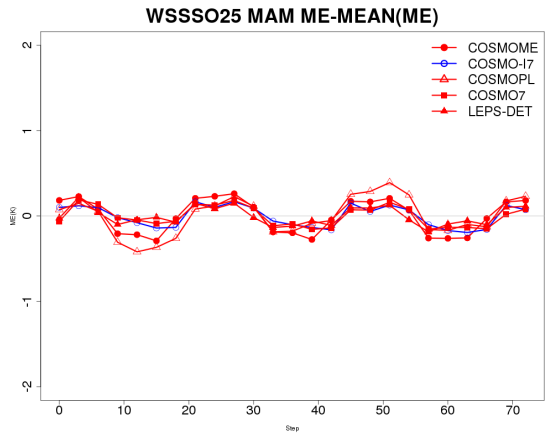
HIGH SSO





LOW SSO





	Itkesso
Red	T
Blue	F

- sensitivity in ME during night in points with high SSO (not confirmed)