



# CALMO-MAX @ CIRA: Sensitivity with COSMO-1 over South Italy

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- Calibration activities have been slowed down due to shortage of personnel at CIRA Laboratory of Meteorology: (Paola resigned from CIRA, Alessandra in maternity leave in 2019).
- COVID-19 outbreak got worse the situation: only smart working without possibility of a collaborative effort to learn the MetaModel (MM).
- Participation to the CALMO-MAX 2020 workshop in Cottbus.
- Publication of the manuscript:

*E.* Bucchignani, A. Voudouri, P. Mercogliano, A Sensitivity Analysis with COSMO-LM at 1 km Resolution over South Italy, **Atmosphere**, 2020, 11(4), 430; DOI:10.3390/atmos11040430



- <u>Only one event has been considered</u>. For this reason, another sensitivity was performed over a different period: **19-20 November 2018**, when Italy was affected by another serious perturbation.
- <u>The internal variability should be evaluated</u>. Further simulations by perturbing the initial conditions have been performed.
- Analysis should be performed <u>not averaging results over the whole domain</u>, but considering several subdomains.
- Although the main aim of the paper was not the choice of the "best" configuration (but only to establish a hierarchy regarding the parameter sensitivity that could be useful in order to apply more advanced optimization techniques), we have indicated that the best configuration among those tested is the c15, because it allows a simultaneous improvement of both temperature and precipitation representation.



#### The domain considered

The domain is centered over Campania region in southern Italy. This area includes three airports, i.e. Capua (military airport "O. Salomone"), Naples (Capodichino civil airport), and Pratica di Mare (military airport "de Bernardi").





The period **3 to 6 November 2017** has been selected as first test case since Italy was affected by an intense perturbation, which caused intense precipitation and triggering different soil impacts.

The second one is **19–20 November 2018** when a low pressure system coming from Western Mediterranean ran over Sardinia first and then hit the south-central regions of Italy, determining intense storms and gusts.

Data: daily precipitation data from 76 stations spread over Campania region, provided by Italian Civil Protection) and made available by ANCE (Associazione Nazionale Costruttori Edili) were used, in order to have a quantitative evaluation over a wider range of stations.

Daily temperature and precipitation data for selected stations located in the southern part of Lazio region were provided by the Sistema nazionale per l'elaborazione e diffusione di dati climatici (SCIA) system.

## Parameters considered in CALMO-MAX

	Min.	Default	Max.	
tkhmin	0.1	0.4	2	
rlam_heat	0.1	1	2	
v0snow	10	20	30	
uc1	0	0.3	1	
radfac	0.3	0.6	0.9	This is not the
kexpdec	0	2	1 🗕	maximum value
fac rootdp	0.5	1	1.5	

parameters selected and related range of values

- uc1 is hard coded in data\_constants.f90
- radfac is called now radqc\_fact

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- kexpdec is a number and is hard coded in sfc\_terra.f90
- fac\_rootdp is one of the parameters of the namelist EPSCTL



### Sensitivity tests for CALMO-MAX

Simple tests

TEST	Parameter
C0	Default
C1	tkhmin at minimum
C2	tkhmin at maximum
C3	rlam_heat at minimum
C4	rlam_heat at maximum
C5	v0snow at minimum
C6	v0snow at maximum
C7	uc1 at minimum
C8	uc1 at maximum
C9	radfac at minimum
C10	radfac at maximum
C11	fac_root_dp at minimum
C12	fac_root_dp at maximum
C13	kexpdec at 0.
C14	kexpdec at 1.

Interaction tests

TEST	Parameter
C15	rlam_heat (min) , uc1 (min)
C16	rlam_heat (min), tkhmin (min)
C17	uc1 (min), v0snow (max)
C18	rlam_heat (min), v0snow (max)

The analysis of results shows that radfac, fac\_root\_dp and kexpdec produce very slight (or no) modifications, so they have been neglected.

The four interaction simulations were performed considering max (min) values of rlam\_heat, uc1, tkhmin, v0snow.



- A reduction of <u>tkhmin</u> causes a decrease of minimum and mean T2m. On the other side, its increase causes a general increase of temperature, especially the minimum value (up to 1.5°C).
- A reduction in <u>rlamheat</u> causes a slight increase of T2m, while its increase does not modify the values of temperature with respect to c0.
- A reduction in <u>uc1</u> causes an increase of the maximum temperature and a reduction of the minimum, while an increase causes a slight reduction of the maximum temperature and a slight increase of the minimum.

- An increase of tkhmin causes a small increase in precipitation
- A reduction in <u>rlam heat</u> causes the largest increase of precipitation, while its increase causes a reduction. In fact, the reduction of this parameter causes an increase of instability, leading to more precipitation.
- An increase in v0snow causes a modest increase of precipitation.



- c15 provides an increase of the maximum temperature and a slight reduction of the minimum and mean T2m. It is also provides an increase of precipitation. This configuration is therefore able to improve the representation of both variables.
- c16 provides slight achievements for precipitation representation.
- c17 provides a slight increase of the maximum T2m and a slight reduction of the minimum and mean T2m, improving the simulation of temperature.
- c18 is able to increase precipitation (improving its representation), along with an improvement of maximum temperature.

TEST	Parameter
C15	rlam_heat (min) , uc1 (min)
C16	rlam_heat (min), tkhmin (min)
C17	uc1 (min), v0snow (max)
C18	rlam_heat (min), v0snow (max)



	OBS	c0	c3	c15	c16	c18
Benevento	28.8	12.7	15.8	21.5	11.1	23.1
Grazzanise	27.2	11.9	14.3	15.1	13.8	18.5
Montemarano	40.6	25.6	21.0	23.5	23.6	30.1
Giffoni	71.0	30.1	27.2	25.5	34.3	38.7

Daily precipitation values for 6 November 2019 for specific ANCE stations, for observational value and model data.

	OBS	c0	c3	c15	c16	c18
Benevento	18.9	13.2	15.6	16.5	11.0	17.5
Grazzanise	25.8	12.0	16.7	20.2	20.4	27.2
Montemarano	45.6	21.6	20.5	21.2	37.2	38.4
Giffoni	5.0	0.0	0.3	2.0	2.5	1.3

Daily precipitation values for 20 November 2018 for specific ANCE stations, for observational value and model data

In Benevento and Grazzanise (low altitude sites) precipitation is largely underestimated by the reference configuration (more than 50%), but relevant improvements are achieved with c15 and c18. In Montemarano (high altitude) precipitation is slightly underestimated by c0, and quite improved by c18. In Giffoni (medium altitude), underestimation with c0 is more than 50%, but improvements are obtained with c16 and especially with c18 also in this case.



- Analyzing the whole set of simulation performed, it results that the best improvement for the representation of the mean T2m is achieved with uc1 at minimum (c7), even better when combined with rlam\_heat at minimum (c15). This configuration allows a good improvement in terms of temperature bias (up to 0.5°C) over this complex orographic area.
- Effects of internal variability on the analysis presented were estimated, resulting in small variations.
- Precipitation biases are partially due to shortcomings of the model in simulating some climate features of the area considered, along with deficiencies in the lateral boundary conditions and internal variability.
- Some parameters have a strong impact and they could be a standalone source of further investigation.
- Usage of the Metamodel (MM).



## THANKS !