

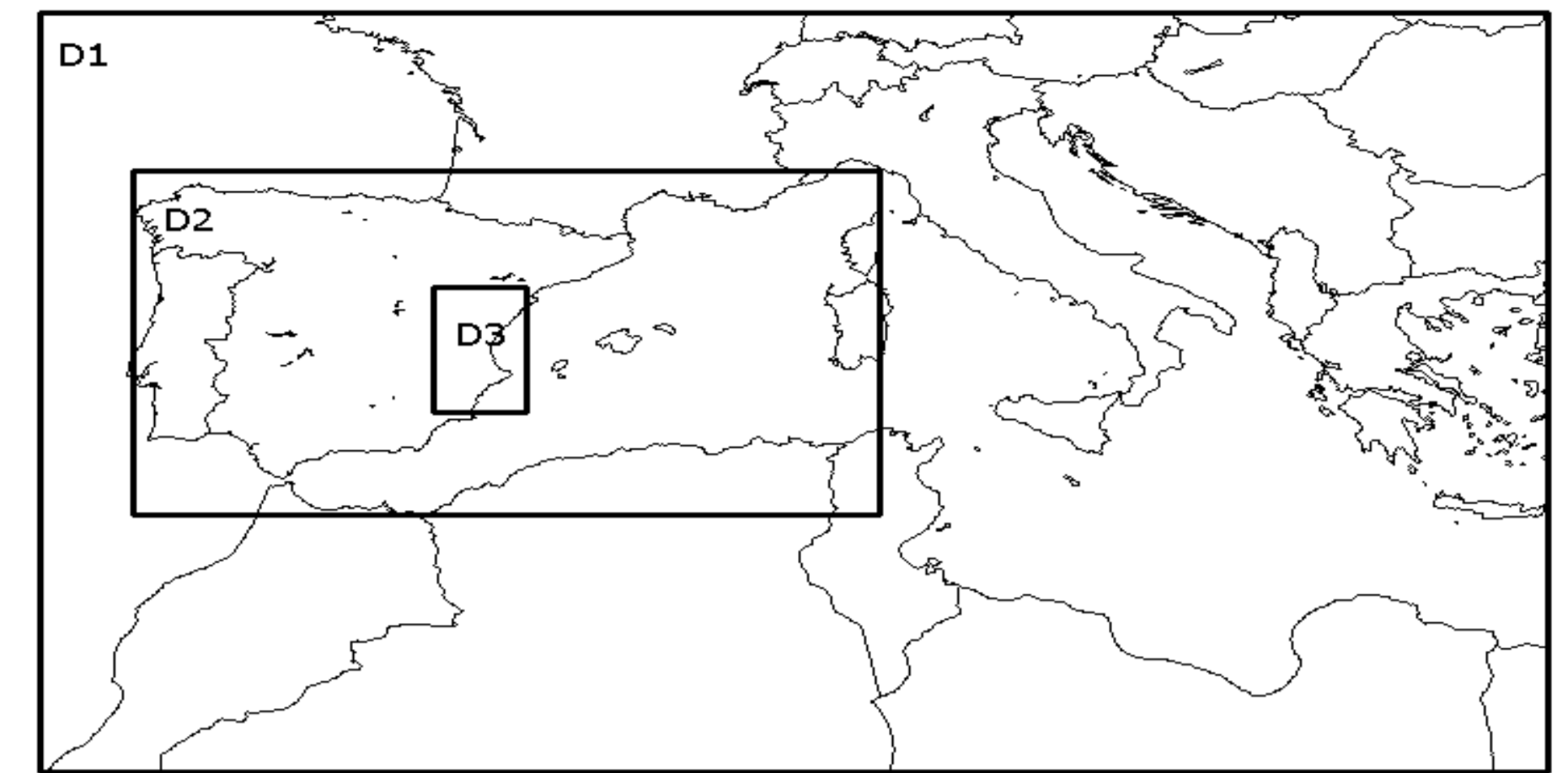
## Introduction and objectives

A knowledge of minimum temperatures during winter is very useful for the general public as well as for organisations and companies whose workers have to operate in the open, as these low temperatures could affect areas as diverse as public health, energy consumption, etc. Accurate forecasting of minimum temperature during winter can help in the forecast of cold-wave conditions and can thus help to minimize the negative impacts of low temperatures on the population. The aim of this work is to evaluate the skill of the Regional Atmospheric Modeling System (RAMS) model to determine daily minimum temperatures during wintertime over the Valencia Region. For this, we have used the real-time configuration of this model running at CEAM Foundation. This work is complemented with the analysis of maximum temperatures in summer (Gómez et al., 2009).

## Model setup and evaluation process

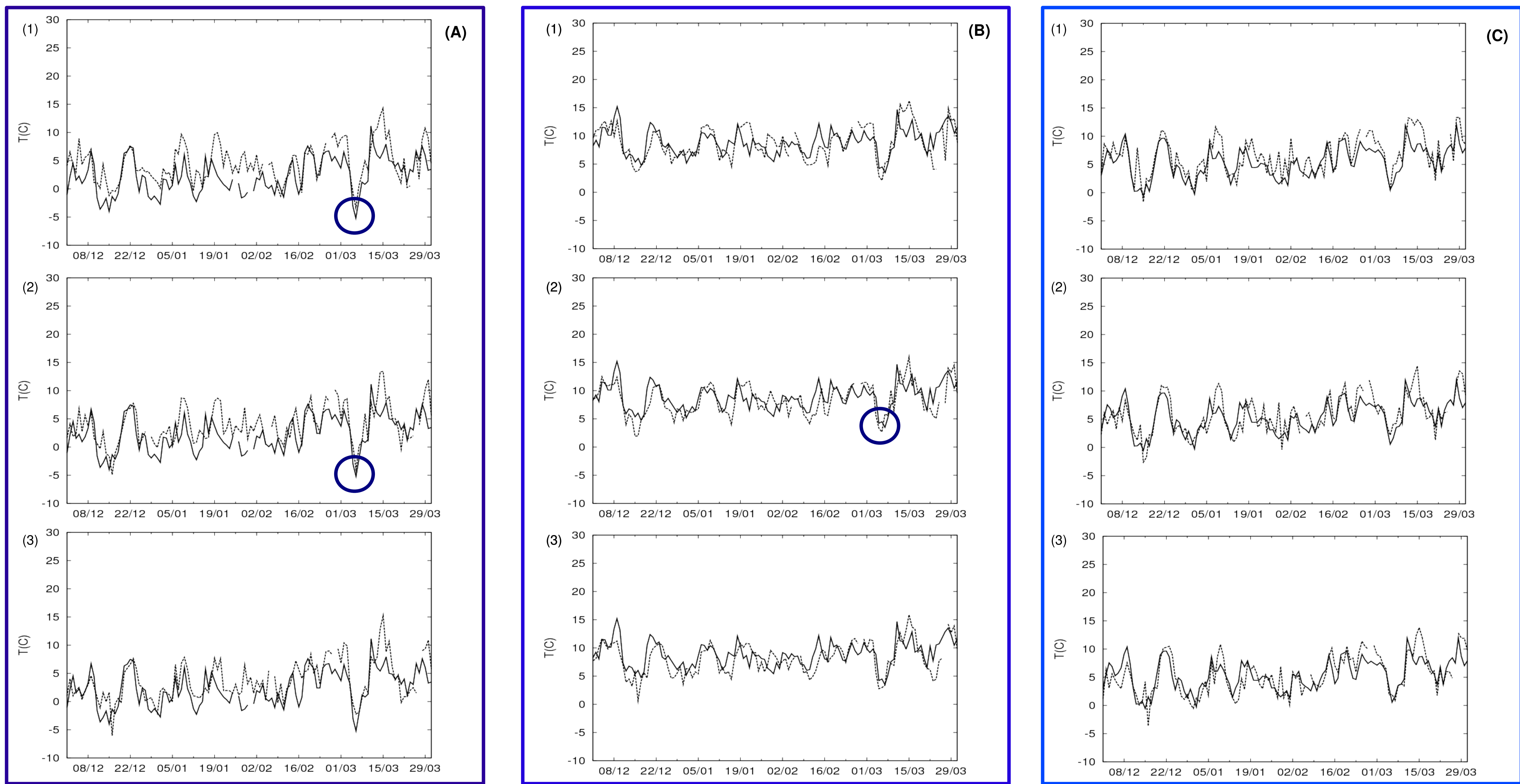
In the CEAM real-time forecasting system, the three-dimensional, nonhydrostatic mode of the Regional Atmospheric Modeling System (RAMS) (Pielke et al., 1992; Cotton et al., 2003) is being used, in its version 4.4. A series of two-way interactive nested domains were configured at increasing horizontal grid spacing of 48, 12 and 3 km, respectively. The vertical discretization is a 24 level stretched vertical coordinate with a 50 m spacing near the surface increasing gradually up to 1000 m near the model top at 11 000 m, and with 9 levels in the lower 1000 m. Atmospheric boundary and initial conditions are derived from the National Centre for Environmental Prediction (NCEP) Global Forecasting System (GFS), available every 6 h at ~100 km resolution globally. A Four-Dimensional Data Assimilation (FDDA) technique is used to define the forcing at the lateral boundaries of the outermost five grid cells of the largest domain.

This operational system is started twice a day (00 and 12 UTC) with a forecast range of three days (today, tomorrow and the day after tomorrow) in both releases. Simulations of these 72 hours between the period 1<sup>st</sup> December 2007 to 30<sup>th</sup> March 2008 and the IVIA agro-climatic station network data have been used to evaluate the model. For this, the hourly RAMS temperatures forecast for each of the IVIA station locations has been used to calculate the minimum temperatures for the corresponding station and for the three day forecasting period used in the operational system implemented at CEAM. This process is similar to the one implemented in Estrela et al. (2007). The results presented in this poster correspond to those obtained for the 00 UTC RAMS forecast and are obtained on the inner model grid, D3, which is centred in the Valencia Region and shows the highest spatial resolution.



## Results

a. Minimum observed (continuous line) and minimum forecasted (discontinuous line) temperatures evolution for the whole 2007-2008 winter season and for today (1), tomorrow (2) and the day after tomorrow (3). We represent the minimum temperature of an inland station (CAM) (A), a coastal one (VIL) (B) and the global minimum temperatures (merging all stations) (C).

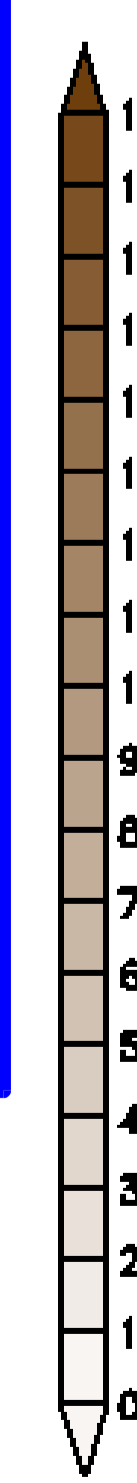
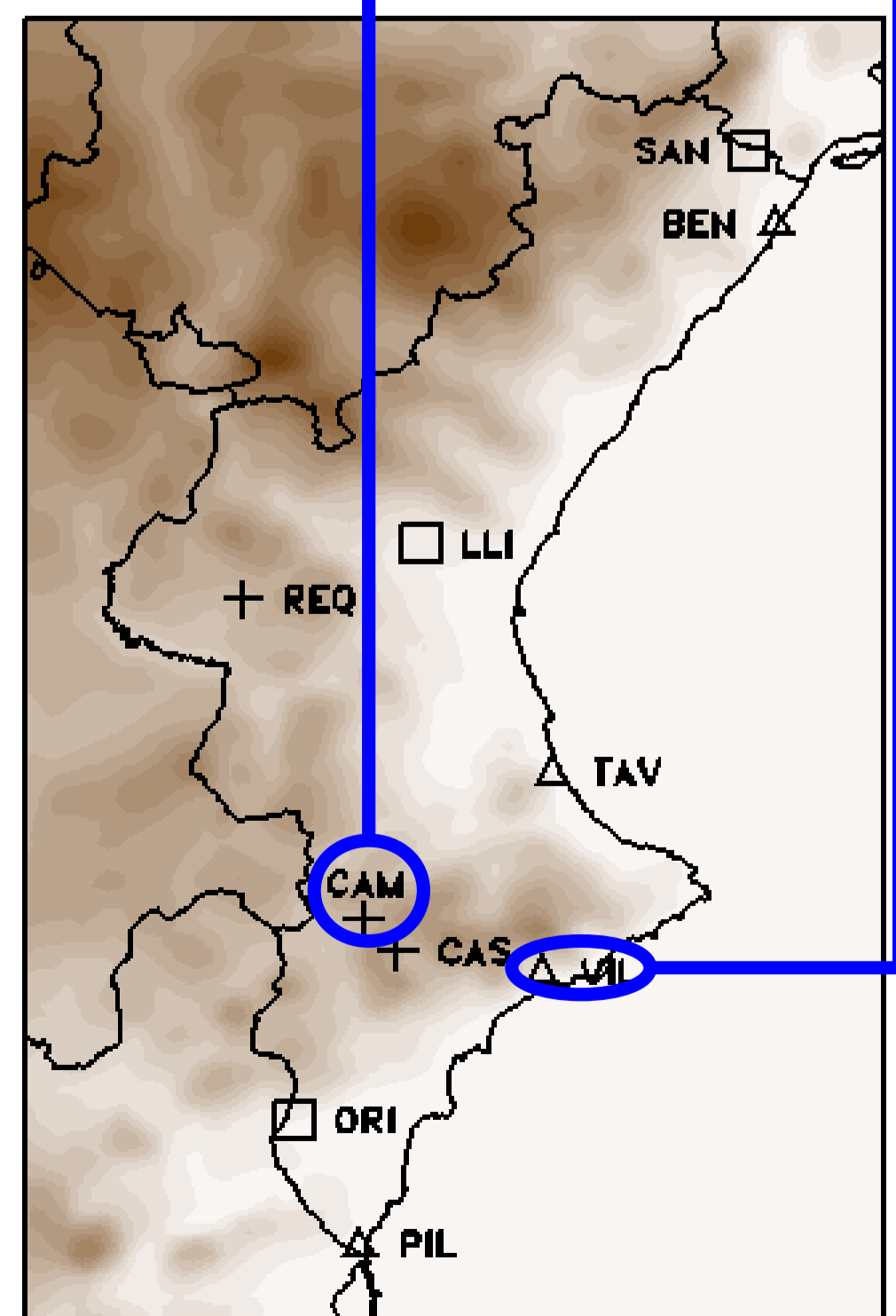


b. Statistical errors for the whole 2007-2008 winter season merging all stations: today (1), tomorrow (2) and the day after tomorrow (3).

Day	AvObs	AvMdl	Bias	RMSE	I. A.	CORR
1	5.38	6.56	1.18	3.43	0.78	0.645
2	5.38	5.86	0.475	3.47	0.77	0.606
3	5.39	5.47	0.0873	3.43	0.78	0.621

c. Statistical errors for the whole 2007-2008 winter season for the first day of simulation and several stations throughout the Valencia Region.

Station	AvObs	AvMdl	Bias	RMSE	IoA	CORR
<i>Coastal Stations</i>						
BEN	6.61	7.27	0.659	2.82	0.795	0.688
TAV	7.41	8.87	1.46	2.95	0.803	0.713
PIL	8.59	8.02	-0.573	2.55	0.76	0.61
<i>Inland Stations</i>						
CAS	3.37	5.84	2.46	3.72	0.666	0.598
CAM	2.25	4.52	2.27	3.5	0.729	0.666
REQ	1.42	1.81	0.393	2.38	0.816	0.878
<i>Pre-coastal Stations</i>						
SAN	5.36	6.3	0.941	3.17	0.759	0.617
LLI	3.52	5.27	1.76	3.58	0.751	0.655
ORI	7.11	6.19	-0.913	3.32	0.774	0.644



## Conclusions

The authors have investigated the skill of the RAMS model in forecasting the daily minimum temperatures during winter. We have analysed the model results by considering the magnitude forecasted by the model and the observed one for each day within the 2007-2008 winter period.

RAMS captures the period cycle of the observed series reasonably well. However, there is a higher displacement between the forecasts and the measurements than the one obtained for the maximum temperatures (Gómez et al., 2009). RAMS is also very stable in forecasting minimum temperatures. This can be appreciated by comparing the graphics obtained for the three days of simulation. Another RAMS characteristic related to minimum temperature is that the model is able to capture very well the observed cold peaks, which correspond to episodes of low temperatures.

The differences observed between the forecast results and the observations in the global evaluation show a general trend toward over-prediction (Bias score values). For coastal stations, the model forecast has a general tendency to over-predict the observations (positive values of the Bias score). For inland stations, the separation between the forecast and the measurement data is higher than that observed for coastal stations (higher values of RMSE and low values of IoA and CORR scores). Besides, these differences have a tendency to over-predict the measurement.

In summary, RAMS produces quite good results for maximum temperatures, but it has more difficulties in forecasting minimum ones. This seems to be related to the RAMS PBL parameterization under stable conditions.

## References

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## Acknowledgements

This work was supported by "GRACCIE" (CSD2007-00067, Programa Consolider-Ingenio 2010) and the contract "Simulación de las olas de calor e invasiones de frío y su regionalización en la Comunidad Valenciana" ("Heat wave and cold invasion simulation and their regionalization at the Valencia Region") by the Regional Government of Valencia *Conselleria de Sanitat*. Fundación CEAM is supported by the Generalitat Valenciana and BANCAIXA. NCEP are acknowledged for providing the GFS meteorological forecasts for RAMS initialization.