Status of the experiments on parameter perturbations towards ICON-LEPS

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WORK OVERVIEW

- The goal of this effort was to gauge the sensitivity of ICON model over a large number of parameters towards the establishment of ICON-LEPS in place of the currently operational COSMO-LEPS.
- The consequent list of the parameters considered of interest for the corresponding perturbations in ICON-LEPS has been decided and ranked according to their estimated signicance by ICON experts, (*Schlemmer etal*, http://cosmo-model.org/content/support/icon/tuning/icon-tuning.pdf).
- Almost all of the parameters were tested over a domain covering the wider area of Greece and Italy for a period of 62 dates from January and July 2020 using the ICON model offered most generously gratis by the Israelli Meteorological service (IMS) along with its set up at ECMWF.
- The model sensitivities are presented for 16 surface fields over the area average of the whole period for the last lead time (132nd hour) of the model run where sensitivity was expected to be on its climax.

SENSITIVITY TESTS BLUEPRINT

24 parameters were considerd.

⊗

3 values/parameter including default.

⊗

The evaluation period consisted of 62 days from year 2020 i.e.: January 1-31, July1-31

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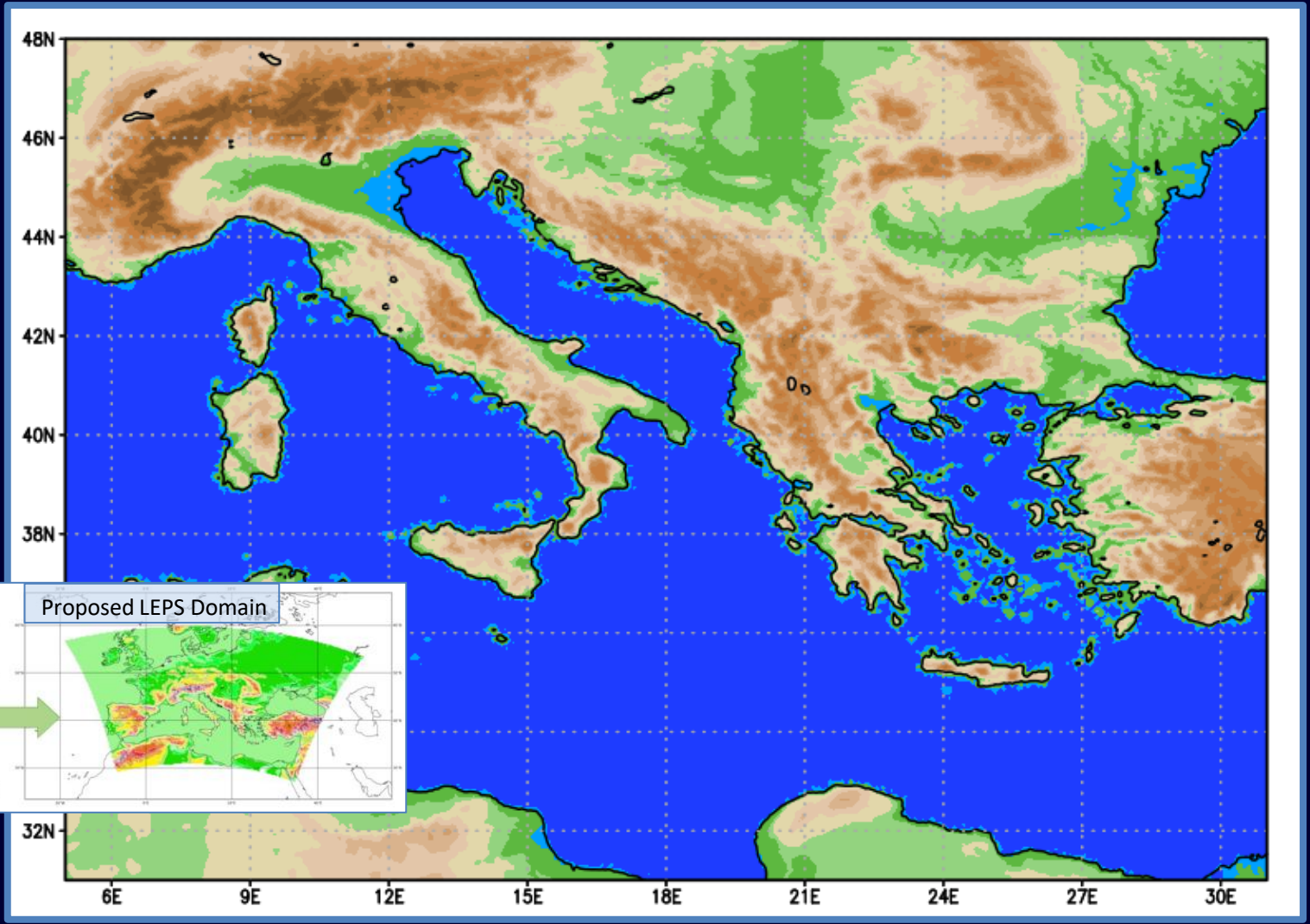
3000 runs based on ICON-IMS (Gratis IMS):

- Horizontal grid size: R3B08 (~6.5km).
- 417x273 grid points (wider area of Greece and Italy), 65 levels.
- Integration time-step: 60 secs.
- Integration period: 132 hs.
- Boundary conditions : 3hr IFS Forecast.
- Computational Cost ~ $5x10^6$ b.u. on Cray X C40 of ECMWF (Gratis HNMS).

Domain under consideration



DESCRIPTION OF PARAMETER LIST

The considered parameters are related with:

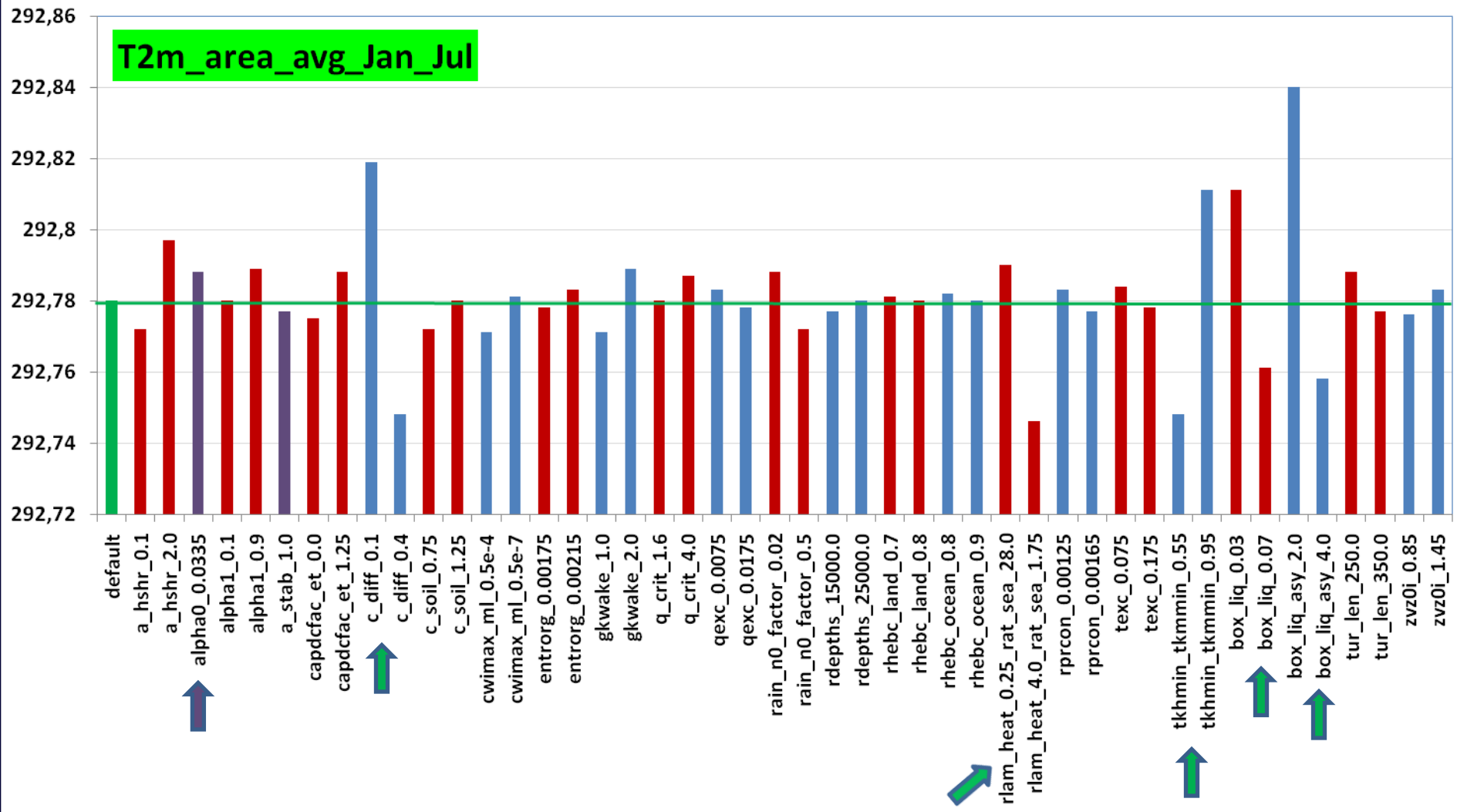
- Subscale Orography_tunning: gkwake
- Grid Scale Microphysics: zvz0i, rain_n0_factor
- Cloud Cover: box_liq, box_liq_asy
- Turbulence: tur_len , rlam_heat (consequent change of rat_sea) , q_crit, a_hshr , a_stab , c_diff , alpha0, alpha1, tkhmin=tkmmin
- Terra: c_soil , cwimax_ml
- Convection: entrorg , rdephts , texc, qexc , rprcon, capdcfac_et , rhebc_land , rhebc_ocean

INVESTIGATED VARIABLES (AREA AVERAGES)

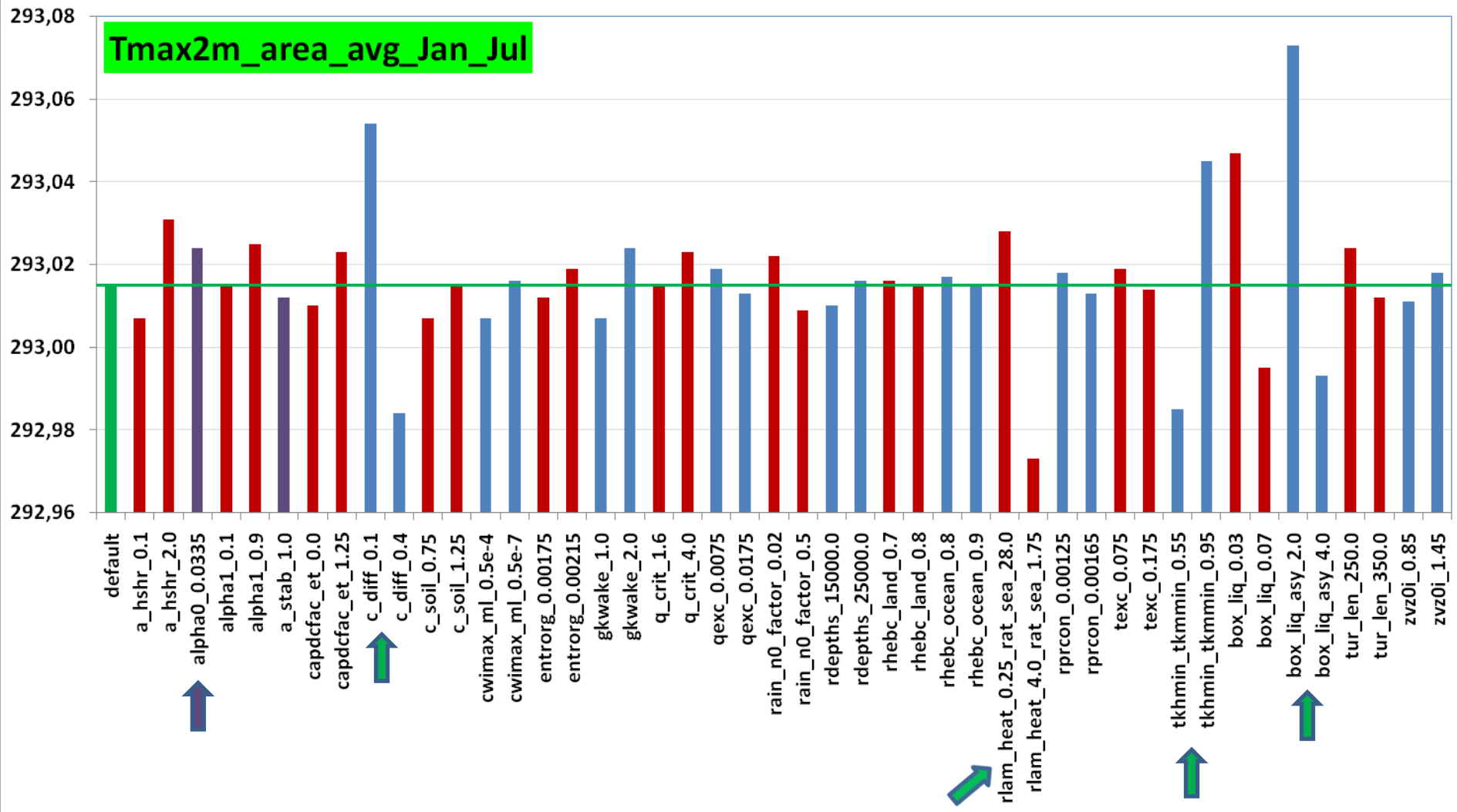
<T2m>	2m Temperature [K]
<Tmax2m>	Max 2m Temperature [K]
<Tmin2m>	Min 2m Temperature [K]
<Td2m>	Dew point 2 m Temperature [K]
<tot_prec>	AccumulatedPrecipitation [kg/m^2]
<pmsl>	Mean sea level Presure [Pa]
<u10m>	10 m wind speed u component [m/s]
<v10m>	10 m wind speed v component [m/s]
<gust10m>	Wind gust 10 m above ground [m/s]
<clcl>	Low cloud cover [1-100]
<clcm>	Medium cloud cover [1-100]
<clch>	High cloud cover [1-100]
<clct>	Total cloud cover [1-100]
<tqv>	Column integrated water vapour [kg/m2]
<tqi>	Total column integrated cloud ice [kg/m2]
<tqc>	Total column integrated cloud water [kg/m2]

! The variables are presented at their 132hr forecast values.

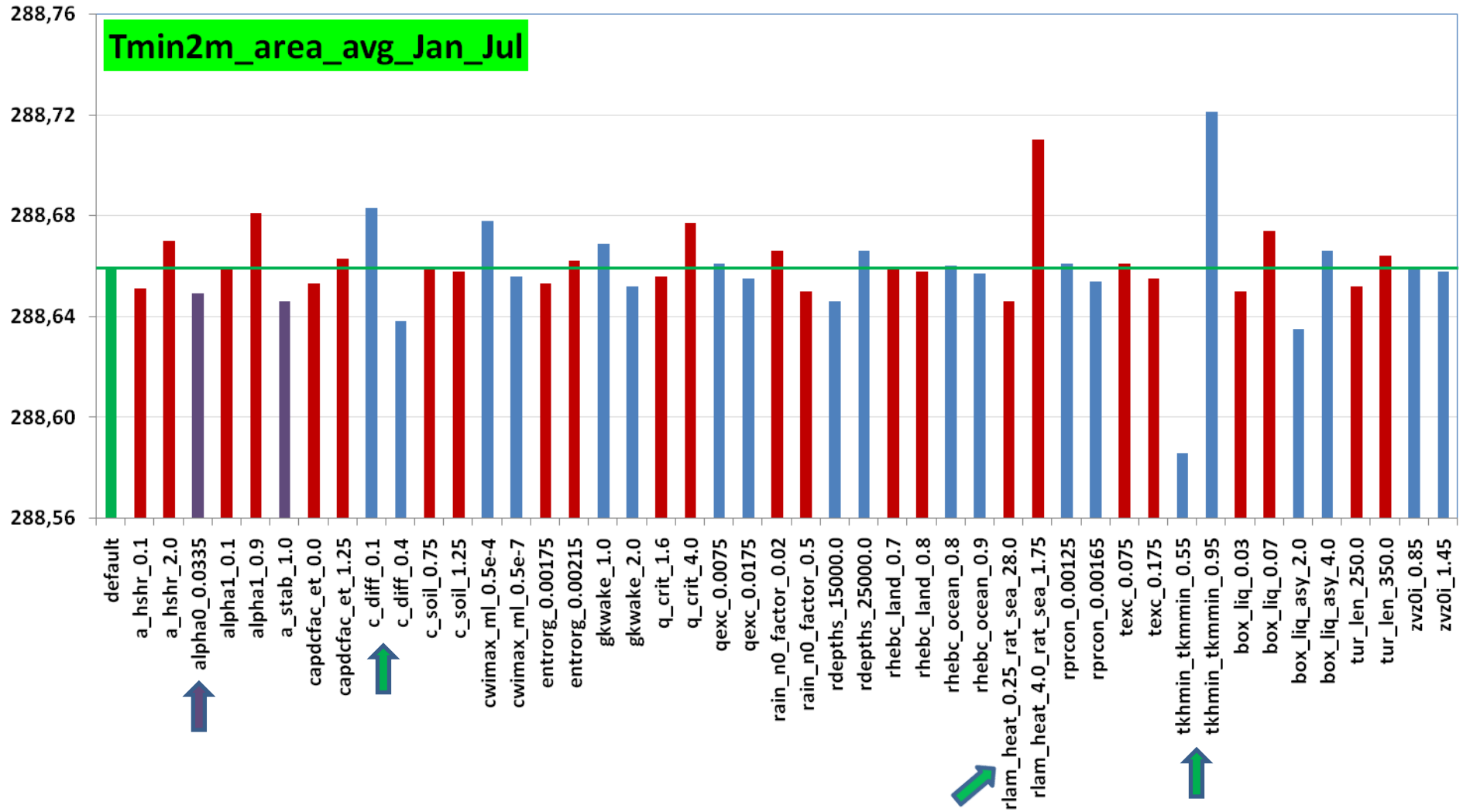
Areal <2m temperature> [K] (132nd hr)



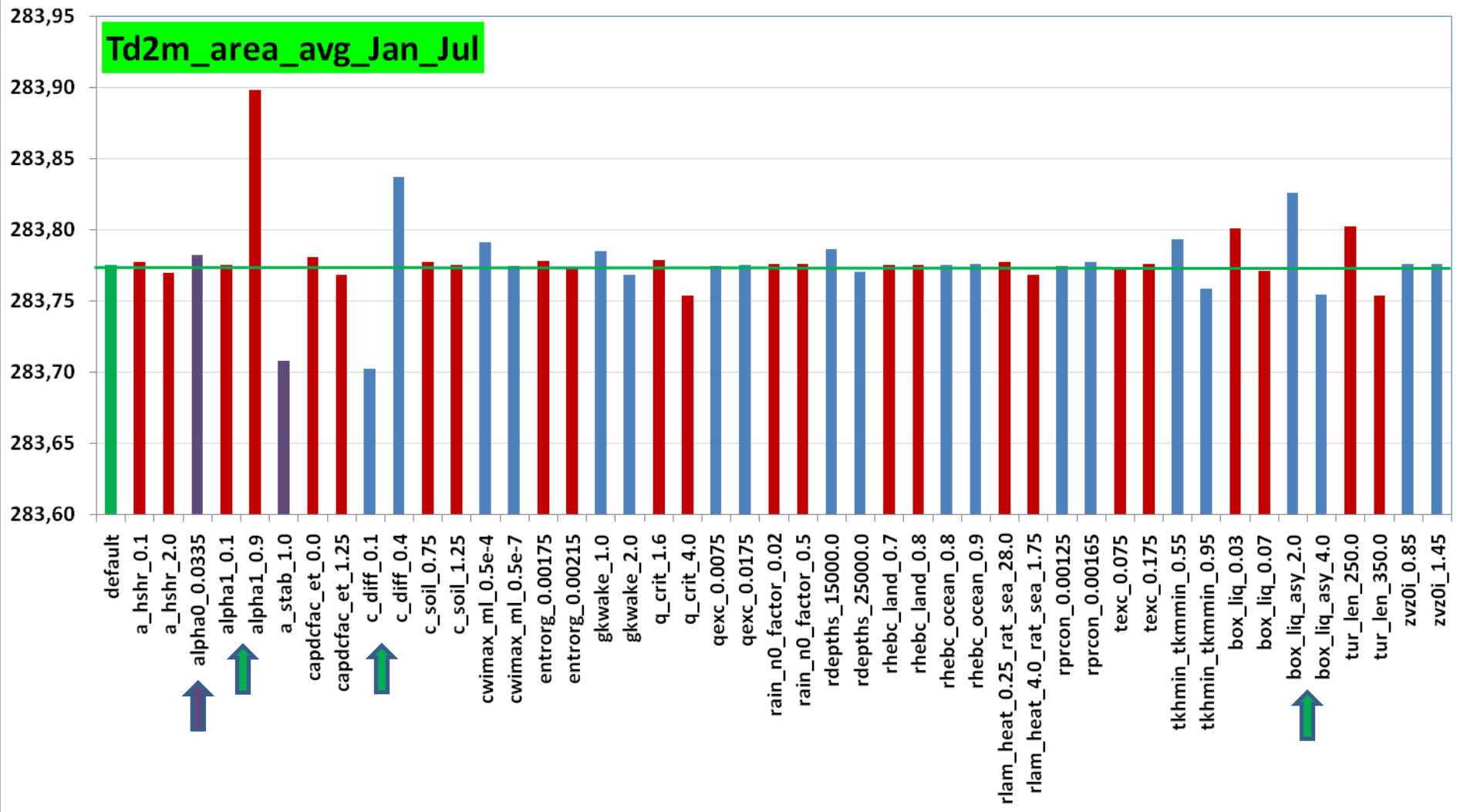
Areal <max 2m temperature> [K] (132nd hr)



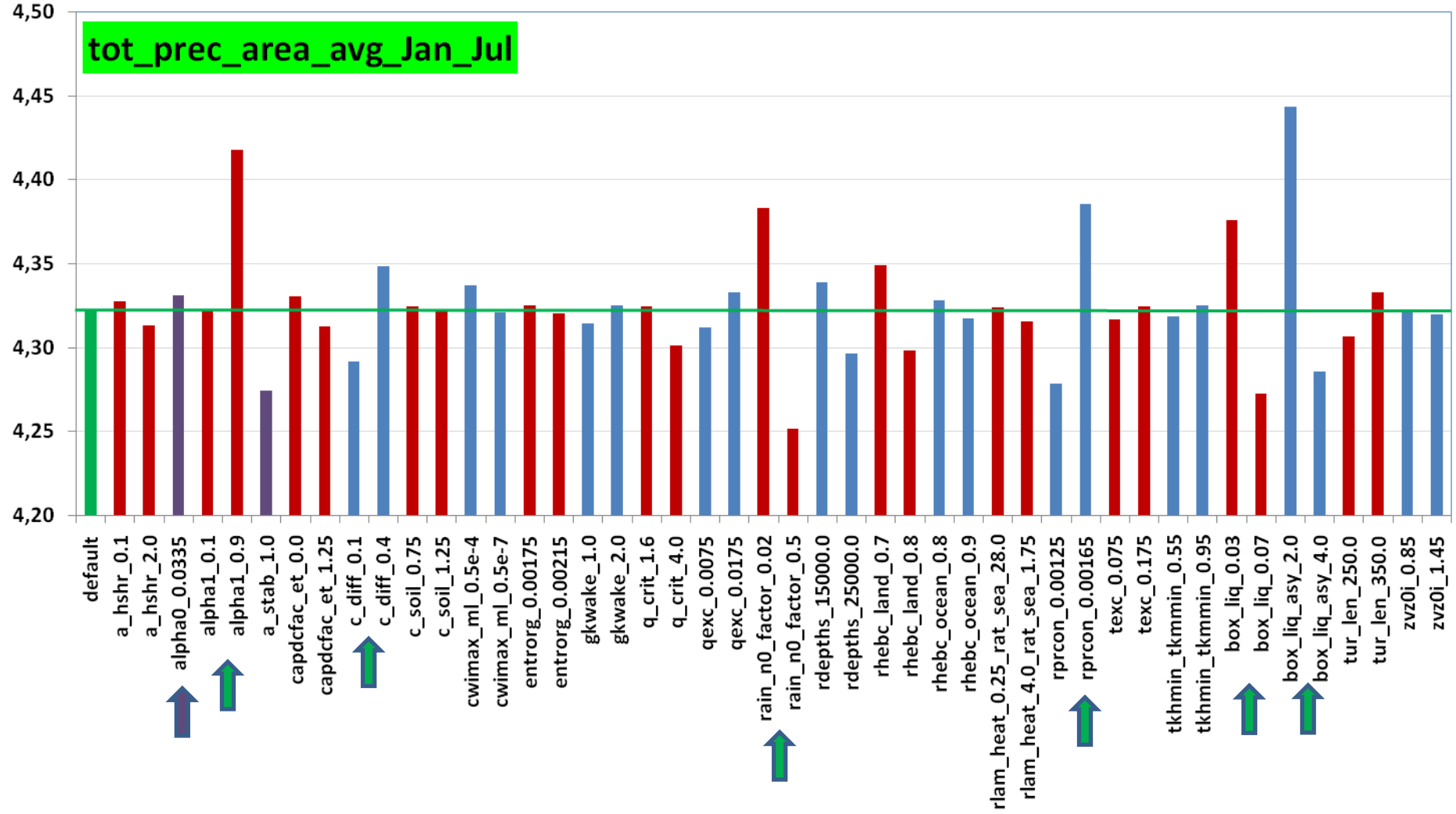
Areal <min 2m temperature> [K] (132nd hr)



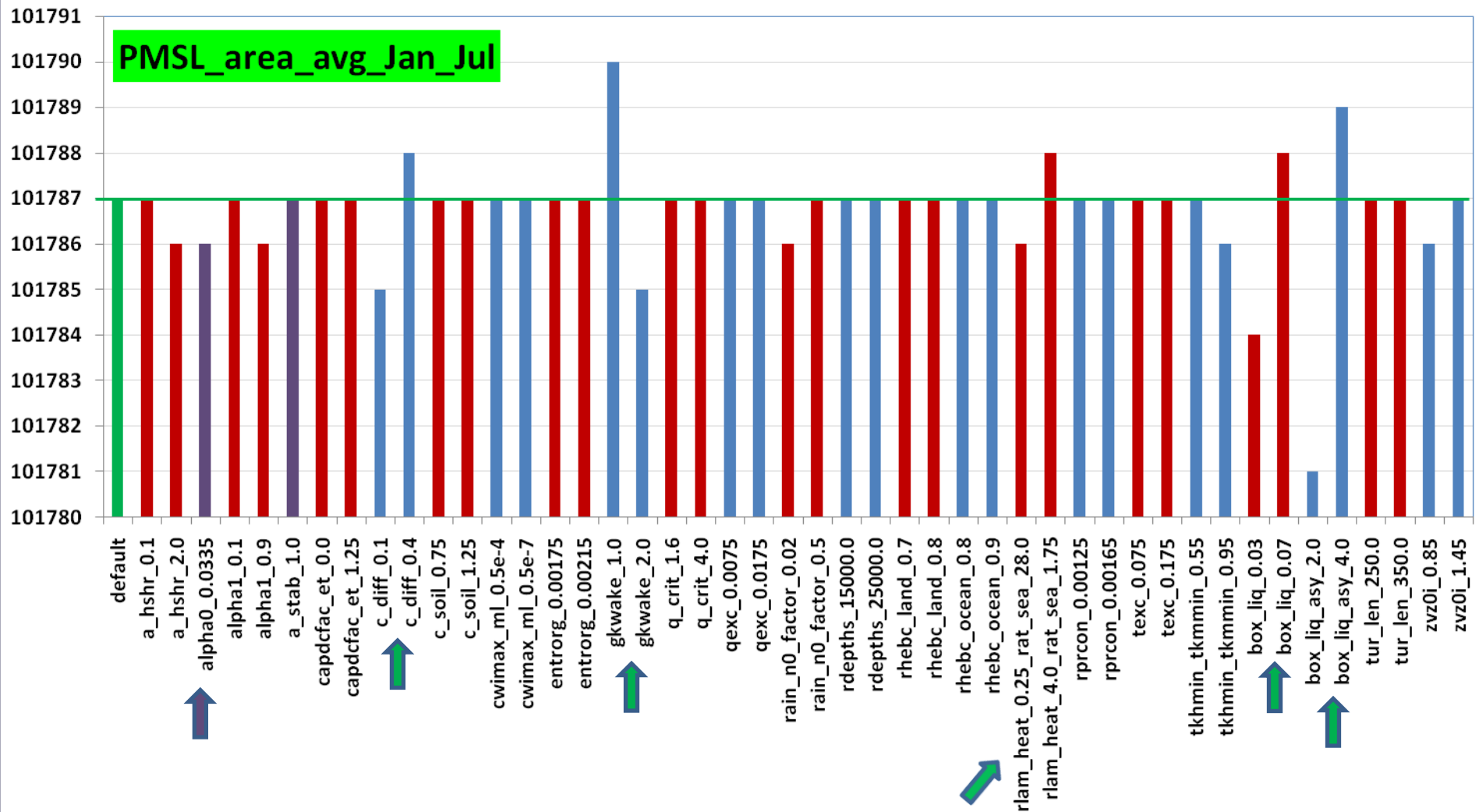
Areal <dew point 2m temperature> [K] (132nd hr)



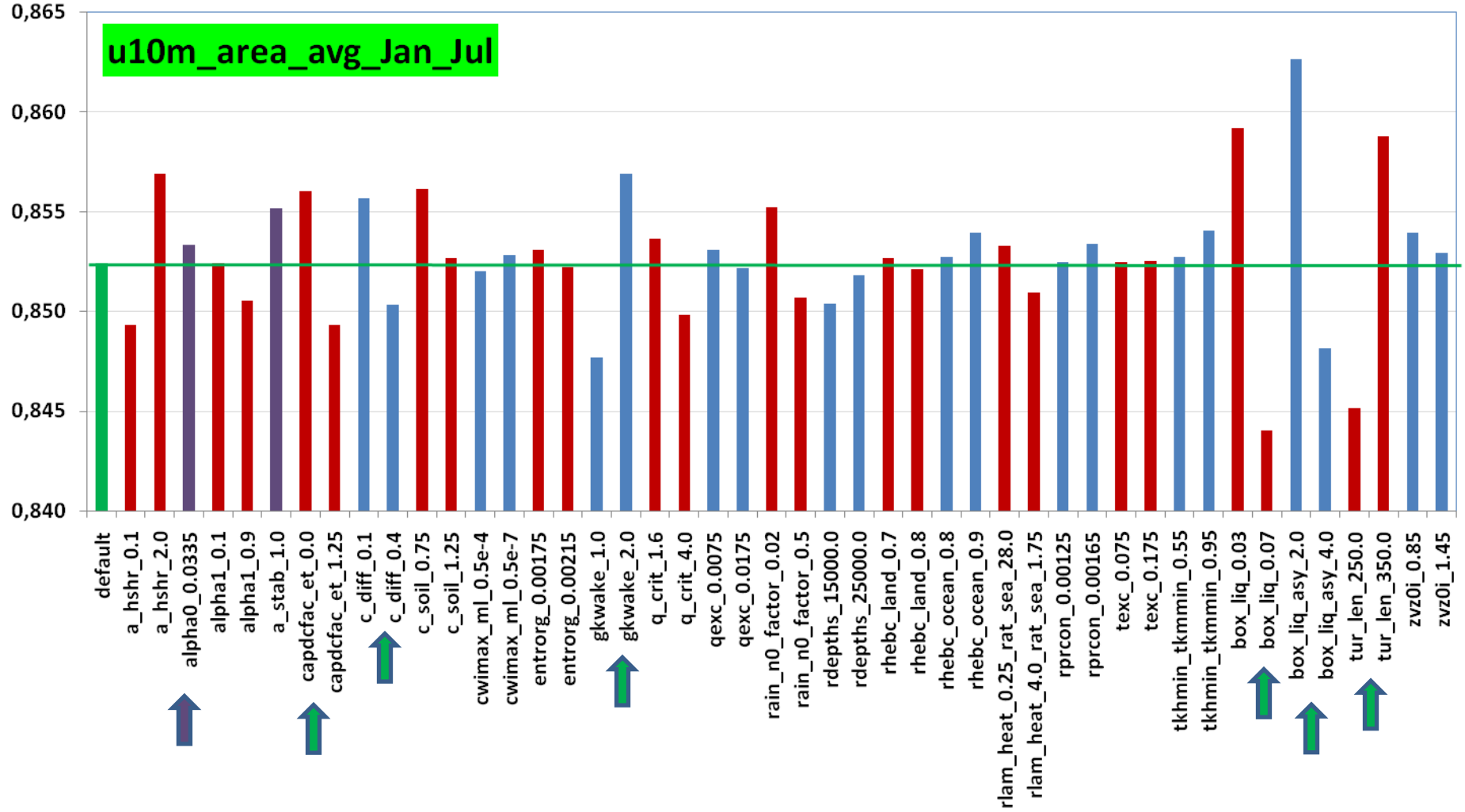
Areal <accumulated precipitation> [kg/m2] (132nd hr)



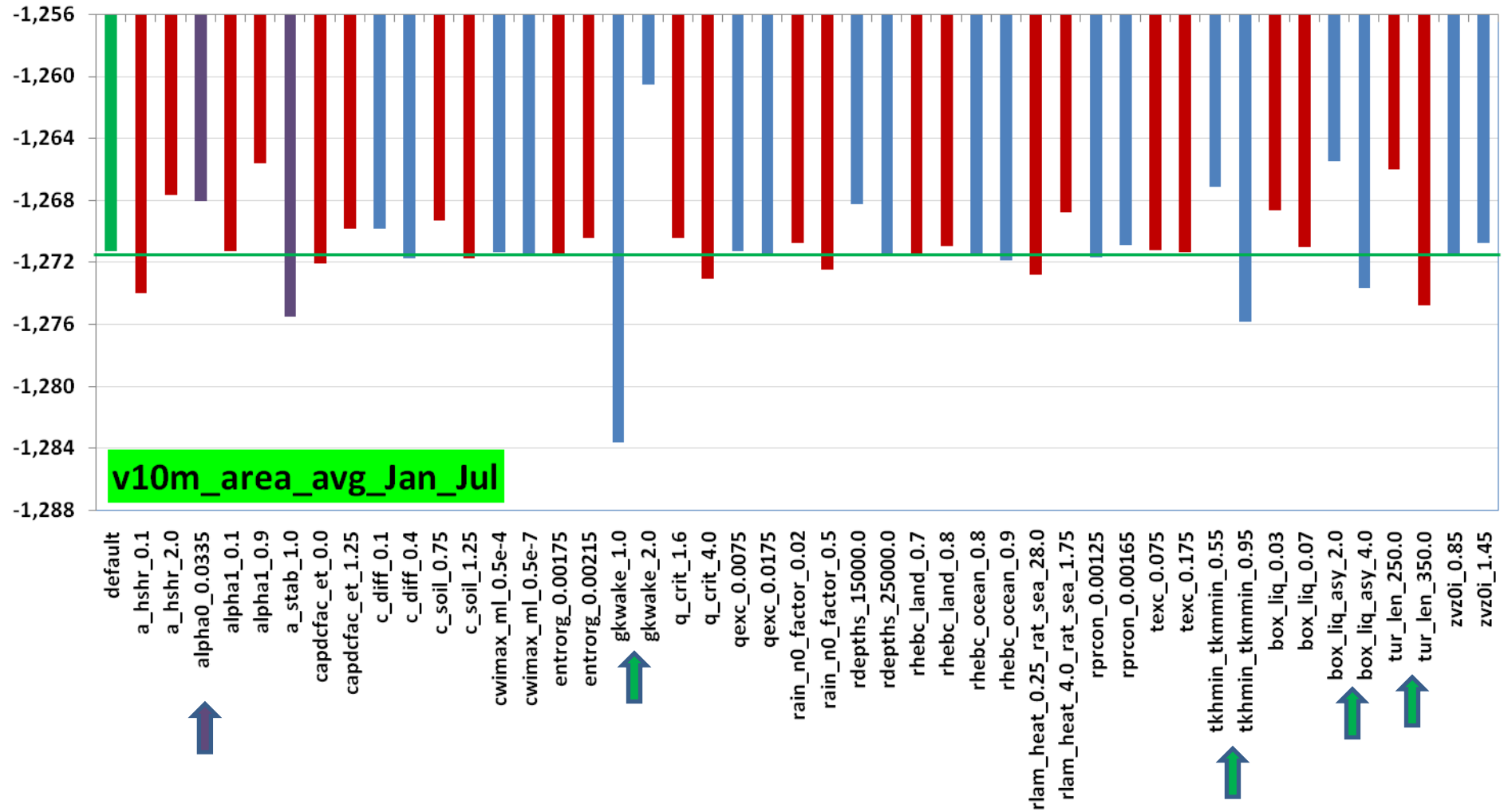
Areal <mean sea level presure> [Pa] (132nd hr)



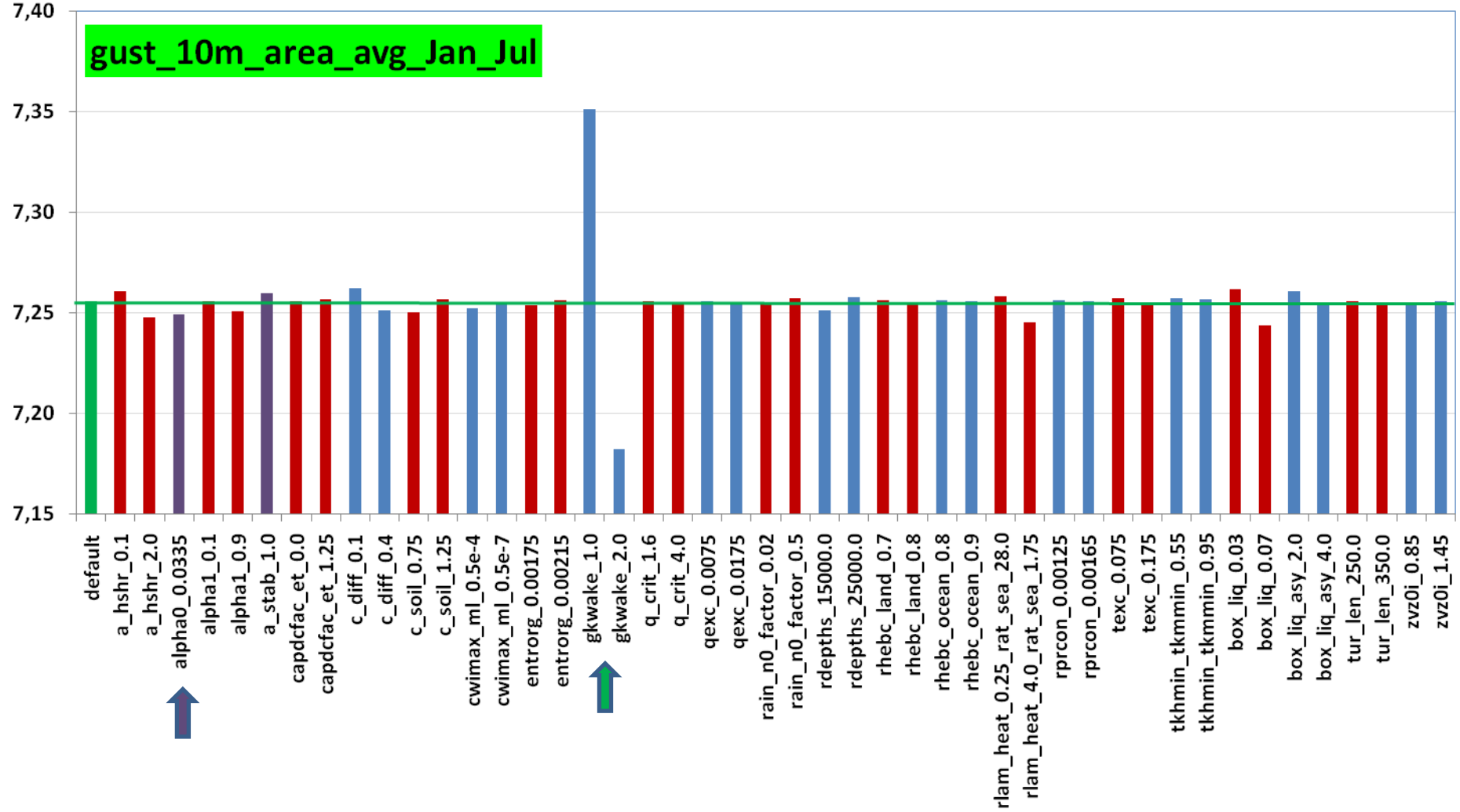
Areal <10m wind speed u component> [m/s] (132nd hr)



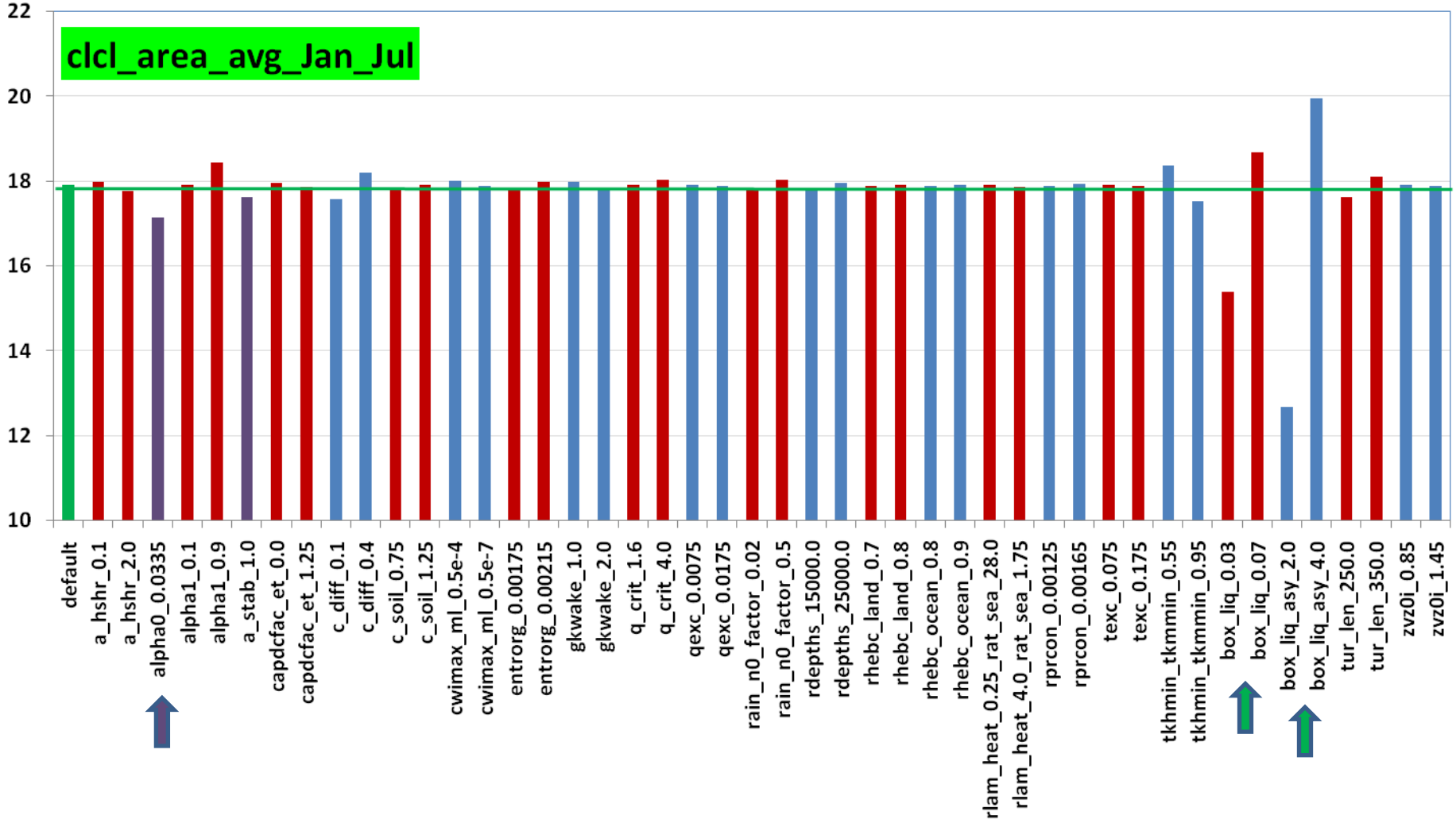
Areal <10m wind speed v component> [m/s] (132nd hr)



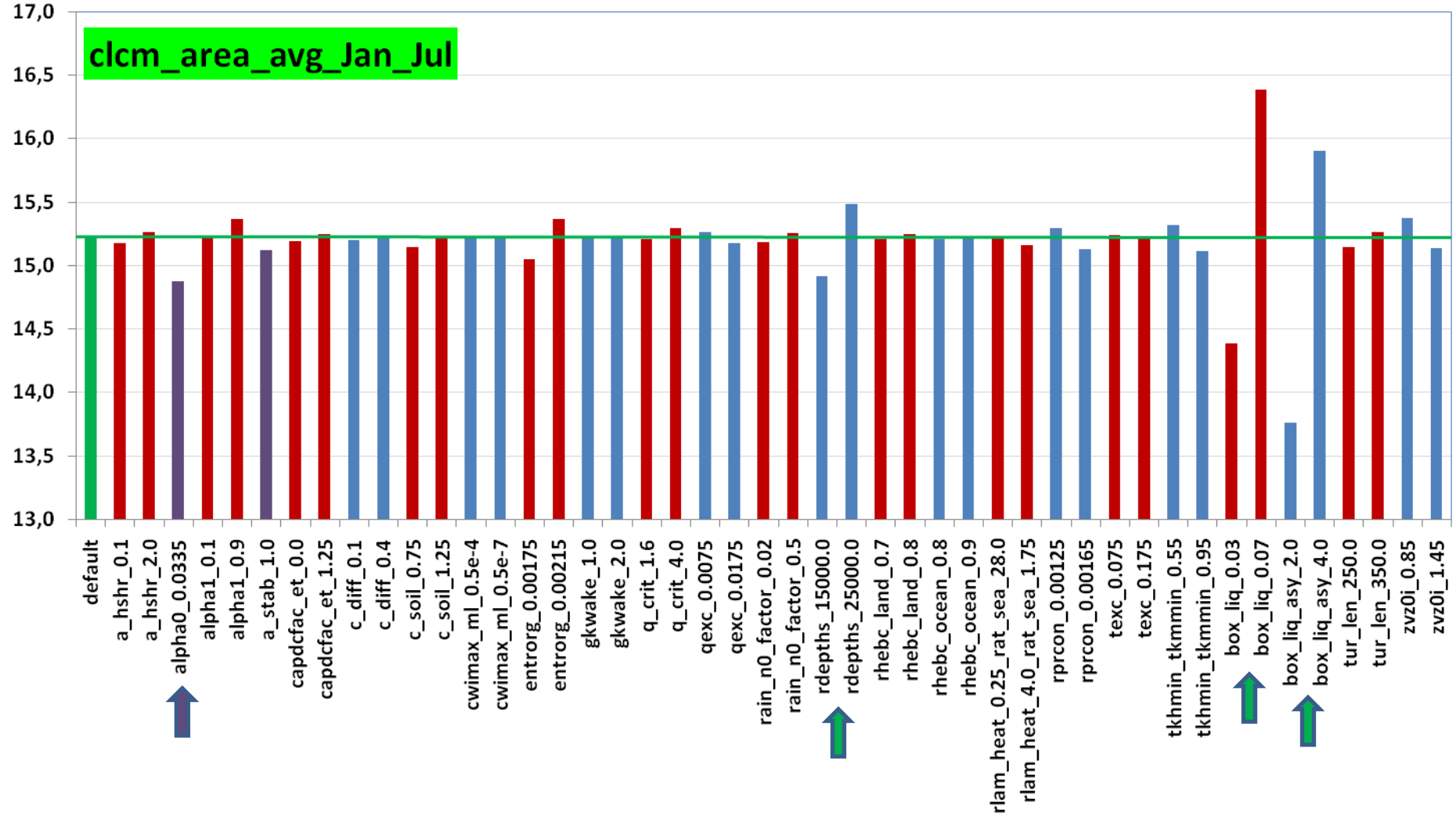
Areal <wind gust 10m above ground> [m/s] (132nd hr)



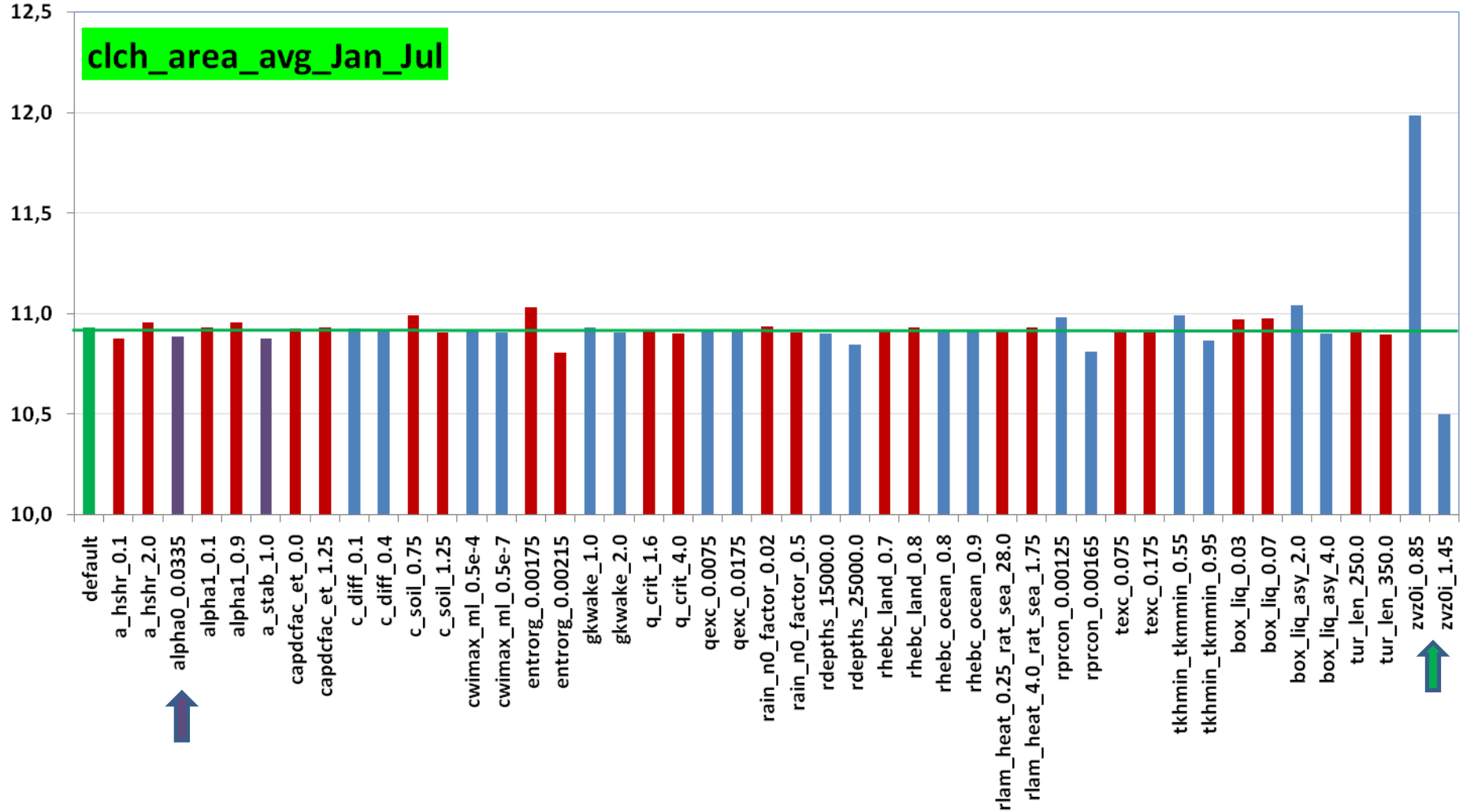
Areal <low cloud cover> [%] (132nd hr)



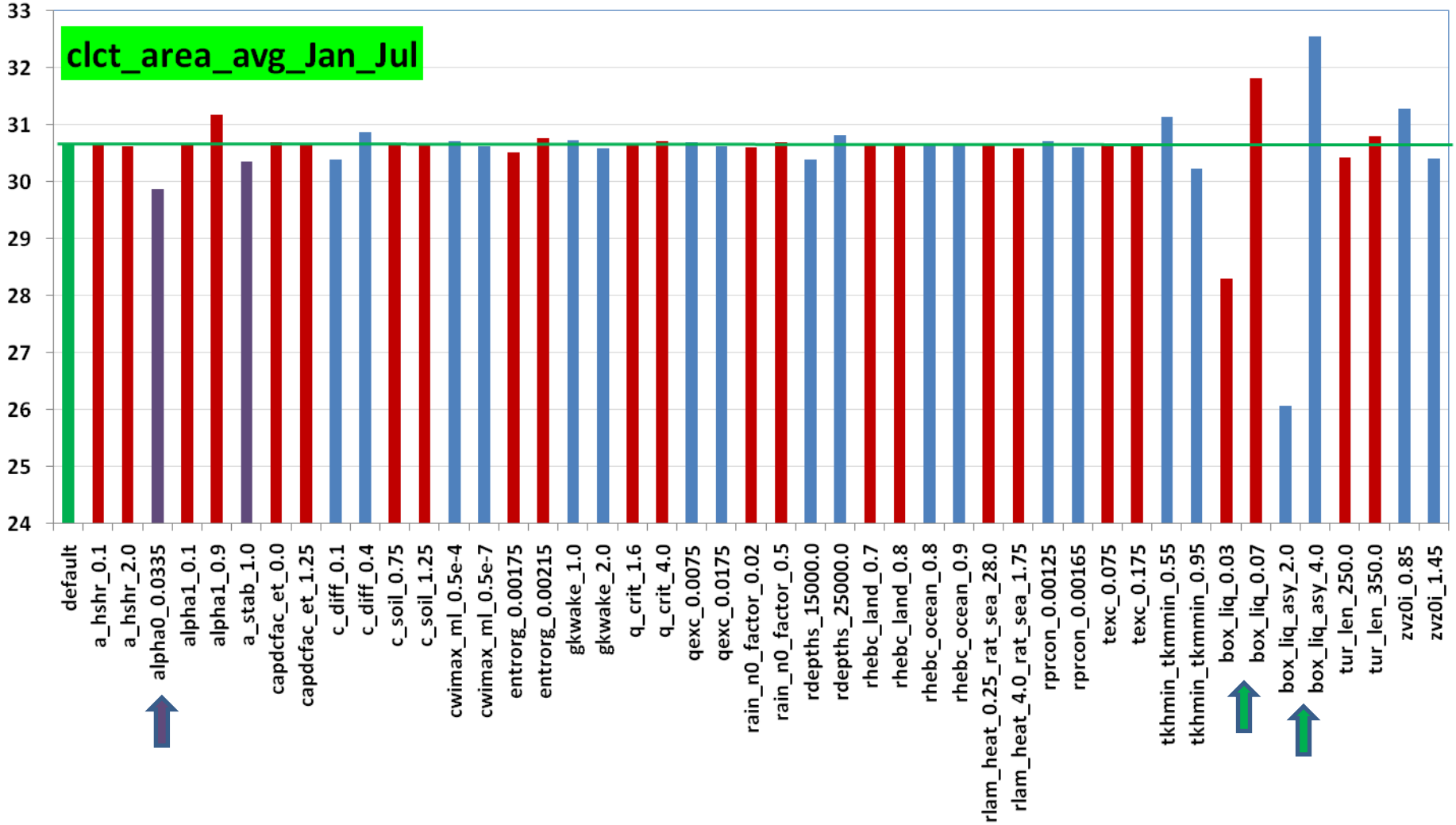
Areal <medium cloud cover> [%] (132nd hr)



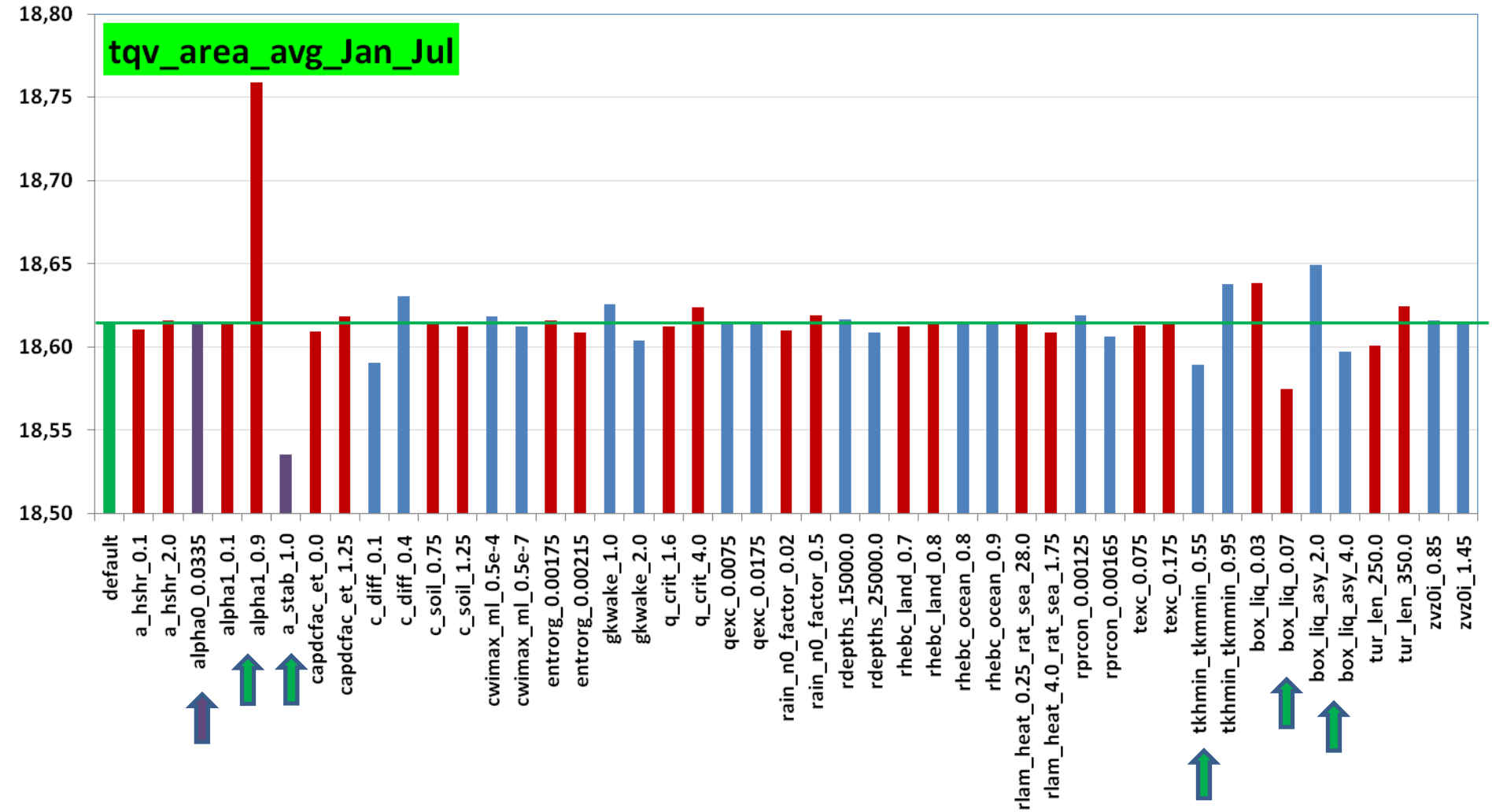
Areal <high cloud cover> [%] (132nd hr)



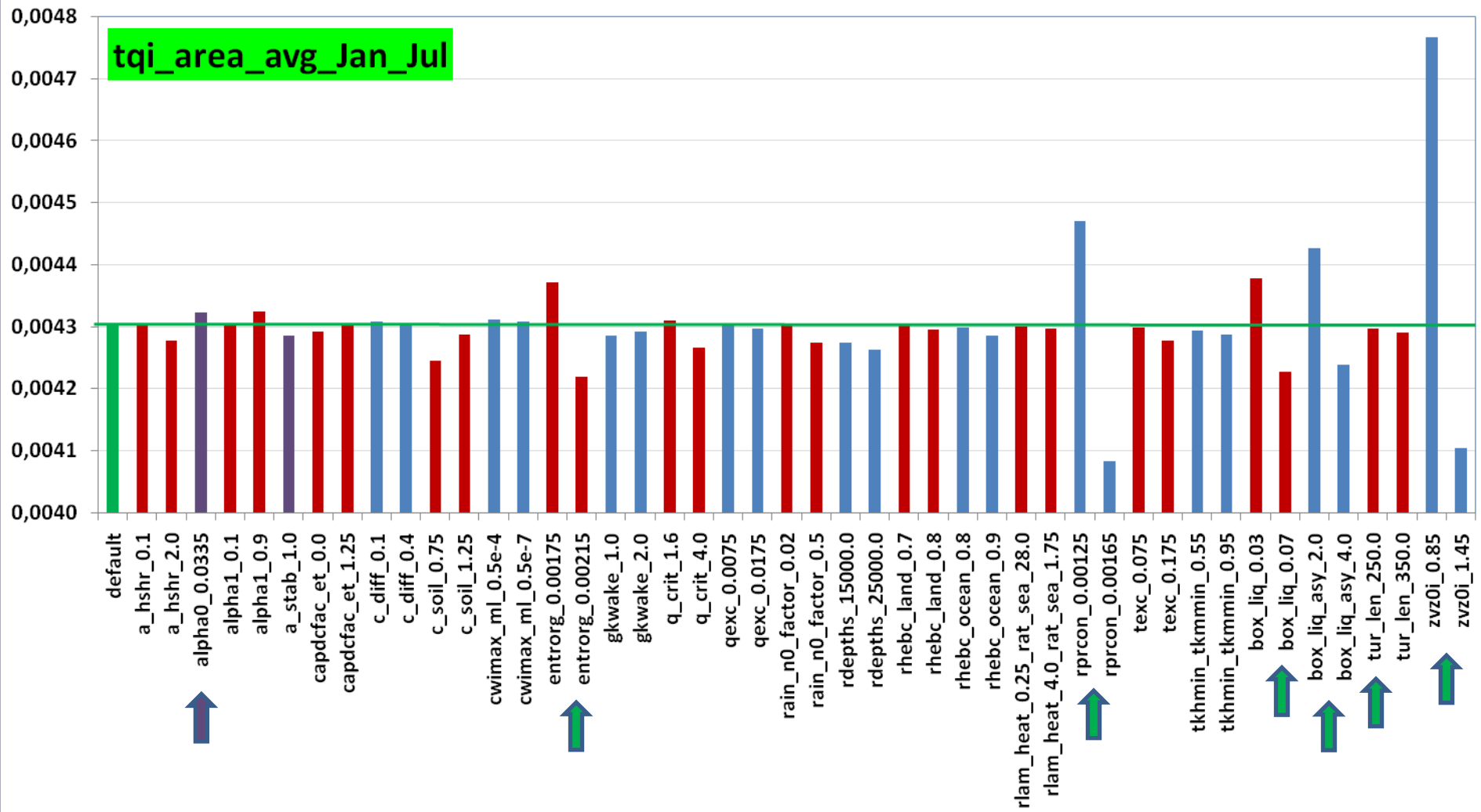
Areal <total cloud cover> [%] (132nd hr)



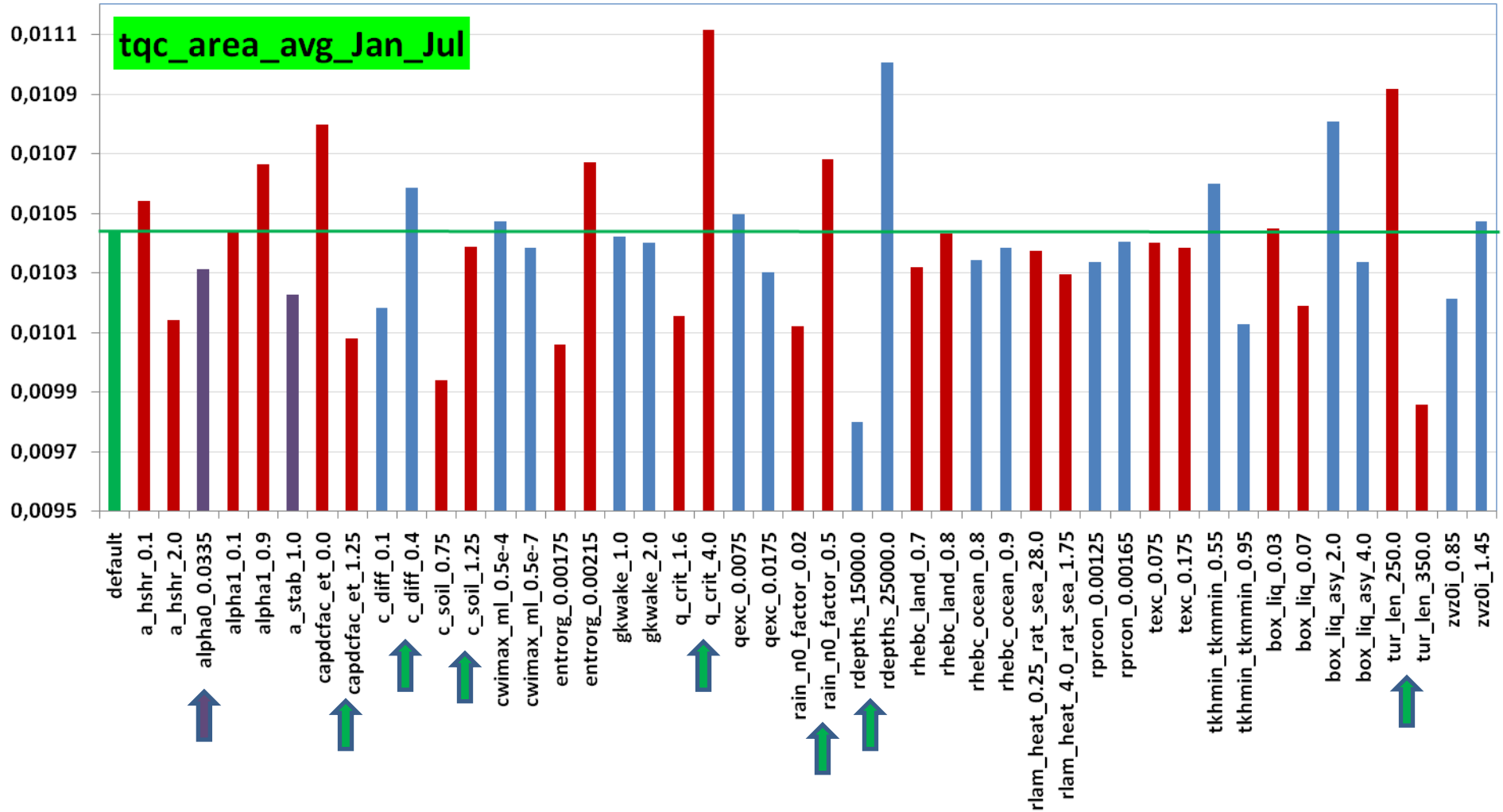
Areal <column integrated water vapor> [kg/m2] (132nd hr)



Areal <column integrated cloud ice> [kg/m2] (132nd hr)



Areal <column integrated cloud water> [kg/m2] (132nd hr)



Dominating parameters table for the considered meteorological fields

				
T2m	2 m Temperature [K]	box_liq_asy	c_diff	tkhmin_tkmmin
Tmax2m	2 m max Temperature [K]	box_liq_asy	c_diff	tkhmin_tkmmin
Tmin2m	2 m min Temperature [K]	tkhmin_tkmmin	rlam_heat_0.25_rat_sea_28.0	c_diff
Td2m	2 m max dew point Temperature [K]	c_diff	box_liq	alpha1
tot_prec	accumulatedPrecipitation [kg/m^2]	box_liq_asy	rain_n0_factor	rprcon
pmsl	mean sea level Presure [Pa]	box_liq	gkwake	c_diff
u10m	10 m wind speed u component [m/s]	box_liq	box_liq_asy	tur_len
v10m	10 m wind speed v component [m/s]	gkwake	tkhmin_tkmmin	box_liq_asy
gust10m	wind gust 10 m above ground [m/s]	gkwake	box_liq	a_hshr
clcl	low cloud cover [1-100]	box_liq_asy	box_liq	alpha0
clcm	medium cloud cover [1-100]	box_liq	box_liq_asy	rdepths
clch	high cloud cover [1-100]	zvz0i	entrorg	rprcon
clct	total cloud cover [1-100]	box_liq_asy	box_liq	zvz0i
tqv	column integrated water vapour [kg/m2]	alpha1	a_stab	box_liq
tqi	total column integrated cloud ice [kg/m2]	zvz0i	rprcon	box_liq_asy
tqc	total column integrated cloud water [kg/m2]	rdepths	tur_len	q_crit

Conclusions and some tentative prospects:

- The impact for the minimum and maximum values for most of the parameters turned out to be important for the considered meteorological fields, in reference to their default values .
- The sensitivity was quite versatile justifying the choice to examine directly a very large number of parameters, probably one of the largest ever in a NWP model.
- Consequently, the advancement towards ICON-LEPS is expected to be a formidable operational but also research challenge for the years to come.
- Due to the inclusion of a large and complicated marine area in the desired integration domain (i.e. the whole Mediterranean) for ICON-LEPS, the project is expected to provide significant advancements in the area of marine meteorology.

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