

SI1: Tuning

Name	code	range	6A	unit	comment
$wk_{dens,oce}$	WDENSO	$[10^{-11}, 10^{-8}]$	1.e-9	m^{-2}	(fixed) wake density over oceans
$\gamma_{Alp,th}$	ALPBLK	[0.2, 0.8]	0.5		$Alp = \gamma_{Alp,th} \times ALP_{thermals} + \gamma_{Alp,wk} \times ALP_{wake}$
$\gamma_{Alp,wk}$	ALPWKK	[0.01, 0.5]	0.25		
$cld_{l,conv}$	CLDLC	[0.1, 1]	0.65	g/kg	threshold for conversion of cloud liquid water to rainfall
$\gamma_{cld,cv}$	CLDCV	[0.5, 10]	1		scaling factor on the convective cloud water for computation of cloud cover
$\gamma_{fall,v}$	FALLV	[0.3, 2.]	0.8		scaling factor on the fall velocity of ice crystals
r_{P_0}	RQSPO	[300, 600]	450	hPa	width of the subgrid scale distribution of total water q_t is $\sigma_{q_t} = r \times q_t$
$r_{\Delta p}$	RQSDP	[50, 300]	100	hPa	where r varies between r_{min} (=0.002) and r_{max} with decreasing
r_{max}	RQSTOP	[0.05, 0.6]	0.4		pressure p as $r = r_{min} + (r_{max} - r_{min}) \{ \tanh[(r_{P_0} - P)/r_{\Delta p}] + 1 \} / 2$
b_0	AERIE	[0.5, 2]	1.3		droplet number concentration $CDNC = 10^{b_0 + b_1 \log(q_{aer})}$, $b_1 = 0.02$ q_{aer} being the concentration of soluble aerosols in $\mu g/m^3$
σ_{cvpr}	SIGDZ	[0.001, 0.02]	0.003		Grid cell fraction covered by unsaturated precipitating downdrafts
$w_{B,srf}$	WBSRF	[0.05, 2.]	0.5	m/s	Deep convection vertical velocity at cloud base (m/s)
$w_{B,max}$	WBMAX	[1.5, 6]	2.8	m/s	$w_B = w_{B,srf} + w_{B,max} / [1. + 500 / (P_s - P_{LFC})]$, where P_s and P_{LFC} are the surface and "Level of Free Convection" pressure in hPa.
EP_{max}	1-OMEPMX	[0.9, 0.9999]	0.999		Rainfall efficiency for deep convection is
$q_{l,crit}$	ELCV	[0.1, 2]	0.3	g/kg	$EP = \min\{\max[1. - q_{l,crit} * (1.0 - T/T_{l,crit})/q_{liq}, 0], EP_{max}\}$
$T_{l,crit}$	TLCV	[-65, -35]	-55	°C	where q_{liq} is the incloud liquid water (in g/kg).
γ_{ice}	REI	[0.5, 1.3]	1.		Scaling factor on an imposed vertical profile of ice particle size
λ_d	DZTH	[0.05, 0.15]	0.07		$z^* = z + \lambda_d z$ for plume detrainment

Table S1: List of parameters varied during the history matching procedure. For each parameter, the minimum and maximum values authorized during the tuning process are given, as well as the value used in the 6A configuration (not used in the tuning procedure). The authorized range arises from the expertise of the parametrization developers. The table is essentially reproduced from (37) and additional explanations on the meaning of the various parameters are given there. The second column gives the name of the parameter used in the tuning procedure. WDENSO CLDCV and OMEPMX are explored with a logarithmic rather than linear sampling.