CSU - RAMS - SCM

RAMSIN Model Namelist Parameters

This document contains details regarding the RAMSIN name-list control file parameters for setting up and running numerical weather simulations using CSU-RAMS-SCM v6.3.02. This is the primary source of guidance in developing an appropriate name-list pertinent to the weather system being simulated.

Updated by:

Stephen Saleeby
Department of Atmospheric Science
Colorado State University

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Variable name	Description
IPRNTSTMT integer	Choice of 0 = No printing, 1= Yes printing: of extraneous print statements to the standard output. These could be useful for debugging but generally adds clutter to the standard output.
ISWRTYP **integer**	Flag specifying options for evaluating shortwave radiative transfer in the model (3 **=** two-stream parameterization developed by Harrington). The Harrington parameterization accounts for each form of condensate (cloud water, rain, pristine ice, snow, aggregates, graupel, and hail) as well as water vapor, and even utilizes information on ice crystal habit. In addition, the scheme adds upper atmospheric levels for radiation computation for cases where the model domain does not extend up to at least 25 km (roughly the height of the ionosphere).
ILWRTYP **integer**	Similar to **ISWRTYP**, but applies to longwave, rather than shortwave, radiation. The same values for **ILWRTYP** apply with the same meaning as for **ISWRTYP**.
RADFRQ **real**	Specifies how often during a model run the radiative parameterization is to be exercised to compute updated values for the radiative contribution to tendencies of both atmospheric and land surface temperatures. The tendencies themselves are applied every timestep of the model integration, but the tendencies are updated only at time intervals specified by **RADFRQ**. Because computing the radiative contribution to temperature tendencies is a relatively computationally expensive process, it is suggested that this computation be done only at intervals of 600 to 1200 seconds (by specifying such values for **RADFRQ**). In most situations, this is often enough to account for changes in radiative transfer.
LEVEL **integer**	Flag that specifies the level of moisture complexity to be activated in the model. This flag is the primary means by which the user tells the model whether to consider the effects of moisture in the simulation, and if so, to what degree. **LEVEL** = 3 – activates the bulk microphysics parameterization, which includes cloud water, drizzle, rain, pristine ice, snow, aggregates, graupel, and hail, or certain subsets of these as specified by **ICLOUD, IDRIZ**, **IRAIN**, **IPRIS**, **ISNOW**, **IAGGR**, **IGRAUP**, and **IHAIL**. This parameterization includes the precipitation process.
ICHECKMIC **integer**	Choices: 0=off, 1=on. Flag for checking microphysics and aerosol variables for NaN values and for negative values of condensate. This check is called after MICRO in subroutine TIMESTEP. Note that INTEL compiler works by default with NaN checking, but for PGI compiler you need to compile with the flag "-Kieee". Runs for **LEVEL**<=3**.**
IMBUDGET **integer**	Choice for computing and outputting microphysics budget variables in each analysis file. These are the "Total" budgets which are summed over time between output write times of ANALYSIS files and then reset to zero. Budgets are not reset on the LITE or MEAN output file frequency. IMBUDGET=0 is off. IMBUDGET=1 computes basic budgets such as vapor growth of all liquid species. IMBUDGET=2 computes more specific budgets such as vapor growth of rain drops. IMBUDGET=3 computes additional custom budgets. A list of output "total" budgets can be determined in mem_micro.f90 and the REVU output variables document. Runs regardless of **LEVEL,** but some output variables are based on **LEVEL** and allocated microphysics variables.
IRIME **integer**	Choice of standard bulk riming (IRIME=0) or hybrid-bin riming of cloud droplets via method of moments (IRIME=1). (Saleeby and Cotton 2008, JAMC).
IPLAWS **integer**	IPLAWS=0 uses original hydrometeor species fall speed power laws from RAMS 4.3. IPLAWS=1 uses non-banded, but newer power laws via Mitchell (1996). IPLAWS=2 uses size banded newer power laws via Mitchell (1996) and modified by Rob Carver and Jerry Harrington (PSU).
ISEDIM **integer**	ISEDIM=0 uses standard hydrometeor sedimentation with relative displacement for binned fall distance. ISEDIM=1 uses a true-bin-hybrid sedimentation that requires extra lookup table dimensions but improved realism in fall distance.
ICLOUD **integer**	Values are 0-5. Values of 1 or 4 are normally very preferable over **ICLOUD =** 2. Cloud droplet number prediction is an option, and is used by setting **ICLOUD** = 5. **ICLOUD =** 5 nucleates cloud droplets from a concentration of cloud condensation nuclei (CCN) that is specified by the user in **CCN_MAX** (see below) in units of number per milligram of air. Other categories of aerosol are available as well (see below). Assumed profiles of aerosols are set in mic_init.f90. The default is exponential decrease with height, similar to pressure, with the lowest model level value set to **CCN_MAX**. Initial concentration in #/mg is roughly equal to #/cm^3 in the lower troposphere but is less than this at higher levels. Aerosols evolve in time after initiation. There is no bulk source function of CCN, but there are flags for options of nucleation scavenging, evaporative regeneration of aerosols, precipitation scavenging, dry deposition, and aerosol radiative impacts. There is also advective and diffusive transport. Further development of aerosol prediction in ***RAMS*** is in progress. **ICLOUD** is relevant only when **LEVEL** is set to 3.

IDRIZ **integer**	Similar to **ICLOUD**, but controls the activation of drizzle rather than cloud. **IDRIZ** cannot = 5 unless **ICLOUD**=5. If **IDRIZ** > 0, then cloud droplets generally pass through the drizzle mode during growth before becoming rain. This slows autoconversion a bit. If **IDRIZ** = 5, then aerosols can nucleate directly to the drizzle mode if the median radius of the activated aerosol distribution > ~1.0 microns.
IRAIN **integer**	Flag that controls the model's treatment of rain water, and is relevant only if **LEVEL** is set to 3. If **IRAIN** is set to 0, rain is not activated, and any process involving the interaction of rain with other water species is not performed. Rain is activated when **IRAIN** is set to a value from 1 to 5. Activation means that the mixing ratio of rain is prognosed from conservation equations which include advective, diffusive, and precipitation tendencies, and source terms resulting from interactions between rain and other forms of water substance. The choice of values for **IRAIN** between 1 and 5 controls the manner in which the mean rain droplet diameter and number concentration are determined. With the flag equal to 1, the mean diameter is specified from a default value in the code, and the number concentration is diagnosed automatically from this mean diameter and the prognosed mixing ratio. When the flag is set to 2, the user specifies the mean diameter (in meters) in the namelist variable **RPARM**, and the number concentration is diagnosed as before. When the flag is set to 3, the user specifies the y-intercept value of the number concentration (this is the number concentration per unit diameter increment, (*i.e.*, number per m^3 per m), evaluated at zero diameter, assuming a Marshall-Palmer (exponential) size distribution. The total number concentration (*i.e.*, the total number of droplets per cubic meter) and the mean diameter are then both diagnosed from the y-intercept value and the prognosed mixing ratio. With a value of 4 for the flag, the user specifies the total number concentration of rain droplets (number per kg of air) directly in the namelist variable **RPARM**, and the mean diameter is automatically diagnosed from this concentration and the prognosed mixing ratio. When the flag is set to 5, the model activates a prognostic equation for rain droplet number concentration, and a special array for this quantity is added. Mean rain droplet diameter is then diagnosed from the prognosed mixing ratio and number concentration. Note that if any of the flags **IRAIN**, **ISNOW**, **IAGGR**, **IGRAUP**, or **IHAIL** is set to 5, the model will override settings of 1, 2, 3, or 4 for **ALL** of the others and make them 5. (Any that are set to zero will remain zero.) Thus, the model requires that if number concentration is predicted for any of these, it must be predicted for all of these species that are active. **IPRIS** is not in this list; it must ALWAYS be set to 5 (if pristine ice is activated). Independently of how flags for the other species are set. The choice of which value of IRAIN to use will depend to a large extent on how the user wishes to constrain the rain field, *i.e.*, whether mean diameter, total number concentration, or both should be allowed to vary. For example, if the user is simulating an observed and documented precipitation event in which, say, mean droplet diameter was measured, it would make sense to specify that diameter as a fixed quantity. Independent selection of microphysical species to be activated versus not activated is controlled through the setting of **IRAIN** and the related parameters **IPRIS**, **ISNOW**, **IAGGR**, **IGRAUP**, and **IHAIL** described below. However, not all possible combinations are intended as valid nor would they function properly without code modification. Activation of all categories simultaneously is the normal practice, although activation of the limited sets {cloud}, {cloud, rain}, {cloud, pristine ice}, {pristine ice}, {pristine ice, snow}, {pristine ice, aggregates}, and {pristine ice, snow, aggregates} are reasonable when only a limited range of microphysical processes need to be considered.
IPRIS **integer**	Similar to **IRAIN**, but controls the activation of pristine ice rather than rain. The descriptions of the various settings given for **IRAIN** apply here, except that if pristine ice is activated at all its number concentration must be predicted as well. Hence, values of 1, 2, 3, and 4 are not permitted for **IPRIS**. If **IPRIS =** 5, ***RAMS*** assumes that ice forming nuclei (**IFN**) have a horizontally homogeneous, vertical profile of **IFN** that decreases with height. The IFN profile is a standard 3D scalar. Aerosol and IFN profiles can be modified in mic_init.f90. However, if **IIFN** = 3, the default IFN profile is not used, but rather the model uses the population of aerosols with D > 0.5 microns as potential IFN. (See Saleeby and van den Heever 2013 and DeMott et al. 2010).
ISNOW **integer**	Similar to **IRAIN**, but controls the activation of snow rather than rain. The descriptions of the various settings given for **IRAIN** apply here.
IAGGR **integer**	Similar to **IRAIN**, but controls the activation of aggregates rather than rain. The descriptions of the various settings given for **IRAIN** apply here.
IGRAUP **integer**	Similar to **IRAIN**, but controls the activation of graupel rather than rain. The descriptions of the various settings given for **IRAIN** apply here.
IHAIL **integer**	Similar to **IRAIN**, but controls the activation of hail rather than rain. The descriptions of the various settings given for **IRAIN** apply here.

CPARM **real**	Similar to **RPARM** below, but applies to cloud water rather than rain. If **ICLOUD** is set to 5 (see above), **CPARM** represents the concentration of cloud concentration nuclei (CCN) in number per kilogram of air. If **ICLOUD** is set to 7, a prognostic CCN field is activated in ***RAMS***, and **CPARM** then represents the initial value (in number per kilogram of air) of the CCN concentration field.
DPARM **real**	Similar to **RPARM**, but applies to drizzle rather than rain.
RPARM **real**	Specifies either a fixed mean diameter (in meters), a fixed y-intercept number concentration per unit diameter increment (number per m^3 per meter), or a fixed total number concentration (in number per kg of air) to be imposed on the rain droplet field, in conjunction with settings 2, 3, and 4, respectively, for the flag **IRAIN** described above. If **IRAIN** is set to 0, 1, or 5, **RPARM** is ignored.
PPARM **real**	Obsolete since pristine ice number concentration must always be prognosed (if pristine ice is active).
SPARM **real**	Similar to **RPARM**, but applies to snow rather than rain.
APARM **real**	Similar to **RPARM**, but applies to aggregates rather than rain.
GPARM **real**	Similar to **RPARM**, but applies to graupel rather than rain.
HPARM **real**	Similar to **RPARM**, but applies to hail rather than rain.
GNU **real array**	Parameter with 8 values, one for each hydrometeor category in the order of cloud, rain, pristine ice, snow, aggregates, graupel, hail, drizzle. It specifies the shape parameter of the gamma distribution that all categories in the bulk microphysics sub-model are assumed to follow. **GNU =** 1 indicates the Marshall-Palmer, or exponential, distribution, in which number concentration decreases monotonically with diameter throughout the size spectrum. Larger values of **GNU** indicate more general gamma distributions, in which the size distribution peaks at a positive diameter. The larger the value of **GNU**, the more narrowly distributed the spectrum is. The intent in using this variable is to specify a shape based on observation. The shape may in general depend on the type of precipitating system (deep convective, wintertime cyclone, etc.), as well as on the hydrometeor category (rain versus hail, for example). Little observational guidance is available to date on appropriate values of **GNU**. A Marshall Palmer distribution has been used in many models, although it may not be the closest of the gamma distribution family to real hydrometeor spectra. Sensitivity experiments with **GNU** in ***RAMS*** have demonstrated that it can sometimes have a significant effect on model results. The user is encouraged to experiment with the values of **GNU**, and to use observational guidance where possible. Ongoing research is aimed at determining appropriate values of **GNU** for each hydrometeor category in different weather situations. Values of 2 are suggested as middle-of-the-road values to start from, but it is sometimes argued that cloud spectra are generally narrower and should have gnu equal to at least 5.
IAEROSOL **integer**	Flag for aerosol categories 1 and 2 (CCN & GCCN). 0=off, 1=on. When turned on, arrays are allocated and initial vertical profiles are set. Runs for **LEVEL <= 3**.
ISALT integer	Flag for sea-salt aerosol categories 5,6,7. There are 3 modes: film drop, jet drop, and spume drop. Value of 0=off, 1=userset profiles, 2=sea-salt model. Runs for **LEVEL <= 3**.
IDUST **integer**	Flag for mineral dust aerosol categories 3,4. There are 2 modes: sub-micron and super-micron. Value of 0=off, 1=userset profiles, 2=dust lofting model. Can have soluble component for nucleation (**AERO_EPSILON**) but is insoluble, without soluble coating for radiative purposes. Runs for **LEVEL <= 3**.
IABCARB integer	Flag for absorbing carbon aerosols categories 8,9. There are 2 modes: 1% black carbon and 2% black carbon. Both are treated similarly for nucleation, but differently for aerosol radiation. 2% BC is more absorbing. Value of 0=off, 1=userset profiles. Can have soluble component for nucleation (**AERO_EPSILON**) but is insoluble, without soluble coating, for radiative purposes. Runs for **LEVEL <= 3**.

IDUSTLOFT integer	Flag to choose which type of dust lofting to turn on. Value of 0 = off, 1 = Idealized lofting from any grid cell with erodible soil and low-vegetation, 2 = Paul Ginoux (2001) erodible fraction database and method. Runs regardless of **LEVEL**. All dust lofting schemes loft as a function of soil moisture and near surface wind speed. See (Saleeby and van den Heever (2013, JAMC) for details on idealized dust lofting scheme.
DUSTFILE character	Is a single-valued character variable giving the name (and path, if any) of the Dust lofting data file to use for surface dust erodible fraction. There are multiple file options in the default "etc" directory of the model release. The ones to choose begin with prefix "DustErodeFrac". If you change the name or location of these file, you need to make the appropriate change here in this flag.
ICCNLEV **integer**	Flag for aerosol microphysics treatment complexity. First note that when multiple aerosol categories are turned on, they will compete for nucleation based on the surface area of the fraction of particles that may nucleate. (see Saleeby and van den Heever 2013, JAMC) **ICCNLEV=0** allows aerosol activation for nucleation but only nucleates additional aerosol in excess of the number of cloud droplets present in a given grid cell. Aerosols are not removed from the domain by nucleation. **ICCNLEV=1** allows aerosol removal upon nucleation of new cloud droplets. Removal from each category starts at the large end of the distribution first. Largest aerosols are removed first and the median radius is then recalculated before the next timestep and will be smaller since the larger aerosols were removed. **ICCNLEV=2** is the same as **ICCNLEV=1** but now we store the nucleated and removed aerosol mass in tracking arrays. A tracking array exists for each hydrometeor species. First, aerosol mass will enter the cloud category tracking array. As cloud is collected or undergoes any transfer to another category, a proportional amount of aerosol mass-within-cloud will be transferred as well. All possible transfers among hydrometeor species is accounted for. Upon hydrometeor evaporation, aerosols will be restored to a regenerated aerosol category. For regeneration, the mass of regenerated aerosols is proportional to the mass of evaporated hydrometeor mass. The number of restored aerosols equals the number of fully evaporated hydrometeors in each category. If the median radius of the regenerated aerosols is < 1 micron, then the aerosols enter the sub-micron regenerated category. If > 1 micron, they enter the super-micron regnerated category. Runs for **LEVEL**=3 only. **NOTE: ICCNLEV=2** will function for single moment microphysics (except ICLOUD must = 5) but any regeneration will be suspect since number concentration may be diagnosed rather than predicted. This could lead to regeneration of unrealistic numbers of aerosols.
IIFN **integer**	Ice nucleation treatment level. **IIFN=0** means no heterogeneous ice nucleation from ice nuclei. **IIFN=1** uses the Meyers formula. **IIFN=2** uses the DeMott et al. (2010,2013) formula. **IIFN=1,2** use constant ice nuclei profiles set up using **CIN_MAX** as a maximum. **IIFN=3** uses the DeMott formula based on the number concentration of aerosols > 0.5 microns in diameter. This is used inconjunction with **ICCNLEV** and responds accordingly depending on whether or not aerosols are removed upon nucleation. Note that if you use IIFN=3 and there are no aerosols > 0.5 micron in diameter, there will be not heterogeneous ice nucleation by condensation freezing or immersion freezing. Contact nucleation is still tied to Meyers scheme at this time. Haze nucleation is tied to the number concentration of aerosol categories 1, which is typically referred to as the general CCN category. Applies conditionally to **LEVEL**=3 or 4.
IIFN_FORMULA integer	Flag to decide which of the DeMott et al. formulas to use for heterogeneous ice nucleation. If flag IIFN = 2 or 3, this flag is used. A value of 1 uses the DeMott et al. (2010) general formula, while a value of 2 uses the DeMott et al. (2014) dust aerosol formula.
IAERORAD **integer**	Aerosol-Radiation Model: 0 = Off, 1 = On. Runs regardless of **LEVEL**.
IAERODEP **integer**	Aerosol wet and dry deposition model: 0 = Off, 1 = On. Runs regardless of **LEVEL**. (precipitation scavenging or wet deposition of aerosols adds such mass to aerosol mass-in-hydrometeors tracking variables if iccnlev>=2)
IAEROPRNT **integer**	Print initial aerosol profiles: 0 = Off, 1 = On. Runs regardless of **LEVEL**.
IAEROHIST **integer**	Re-initialize aerosol profiles upon history restart: 0 = Off, 1 = On. Runs regardless of **LEVEL**.
CIN_MAX **real**	Maximum (lowest model level) ice nuclei concentration used to generate initial vertical profile. Only used if **IIFN**=1or2.

CCN1_MAX **real**	Maximum (lowest model level) CCN (default sub-micron aerosol) concentration used to generate initial vertical profile. Only used if **IAEROSOL**=1.
CCN2_MAX **real**	Maximum (lowest model level) GCCN (default super-micron aerosol) concentration used to generate initial vertical profile. Only used if **IAEROSOL**=1.
DUST1_MAX **real**	Maximum (lowest model level) small dust mode concentration used to generate initial vertical profile. Only used if **IDUST**=1.
DUST2_MAX **real**	Maximum (lowest model level) large dust mode concentration used to generate initial vertical profile. Only used if **IDUST**=1.
SALTF_MAX **real**	Maximum (lowest model level) film drop salt mode concentration used to generate initial vertical profile. Only used if **ISALT**=1.
SALTJ_MAX **real**	Maximum (lowest model level) jet drop salt mode concentration used to generate initial vertical profile. Only used if **ISALT**=1.
SALTF_MAX **real**	Maximum (lowest model level) spume drop salt mode concentration used to generate initial vertical profile. Only used if **ISALT**=1.
ABC1_MAX Real	Maximum (lowest model level) absorbing carbon 1st mode concentration used to generate initial vertical profile. Only used if **IABCARB**=1. Mode 1 is 1% BC and 99% OC.
ABC2_MAX real	Maximum (lowest model level) absorbing carbon 2nd mode concentration used to generate initial vertical profile. Only used if **IABCARB**=1. Mode 2 is 2% BC and 98% OC.
IAERO_CHEM integer array	Aerosol chemistry type (1 = ammonium sulfate, 2 = sodium chloride). Input value for each aerosol category (11 values). The 9 categories in order are: 1. Sub-micron general aerosol, 2. Super-micron general aerosol, 3. Small dust, 4. Large dust, 5. Film mode sea salt, 6. Jet mode sea salt, 7. Spume mode sea salt, 8. Absorbing carbon (1% Black Carbon), 9. Absorbing carbon (2% Black Carbon), 10. Sub-micron regenerated aerosol, 11. Super-micron regenerated aerosol.
AERO_EPSILON real array	Fraction of soluble material on aerosols. Value is 0.0 -> 1.0. Input value for each aerosol category (11 values).
AERO_MEDRAD **real array**	Aerosol log-normal distribution median radius. Values in the model are forced between 0.01 microns and 6.5 microns. Input value for each aerosol category (11 values).
ITRKEPSILON **integer**	Aerosol tracking flags: 0=off, 1=on. Tracking aerosol solubility for regeneration. (overrides default solubility of regenerated aerosol categories in **AERO_EPSILON**)
ITRKDUST **integer**	Aerosol tracking flags: 0=off, 1=on (diagnostic only). Tracking dust sub-species mass mixing ratio within hydrometeors.
ITRKDUSTIFN **integer**	Aerosol tracking flags: 0=off, 1=on (diagnostic only) Tracking mass mixing ratio of dust that served as ice nuclei.