

ICON Namelist Overview

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1 ICON Namelists

1.1 Scripts, Namelist files and Programs

Run scripts starting the programs for the grid generation and the models are stored in run/. These scripts write namelist files containing the specified Fortran namelists. Programs are stored in <icon home>/build/<architecture>/bin/.

Table 1: Namelist files

| Namelist file | Purpose | Made by script | Used by program |
|---------------------|---------------------|-------------------------|-----------------|
| NAMELIST_GRAPH | Generate graphs | create_global_grids.run | grid_command |
| NAMELIST_GRID | Generate grids | create_global_grids.run | grid_command |
| NAMELIST_GRIDREF | Gen. nested domains | create_global_grids.run | grid_command |
| NAMELIST_OCEAN_GRID | Gen. ocean grid | create_ocean_grid.run | grid_command |
| NAMELIST_TORUS_GRID | Gen. torus grid | create_torus_grid.run | grid_command |
| NAMELIST_ICON | Run ICON models | exp.<name>.run | control_model |

1.2 Namelist parameters

The following subsections tabulate all available Fortran namelist parameters by name, type, default value, unit, description, and scope:

- *Type* refers to the type of the Fortran variable, in which the value is stored: I=INTEGER, L=LOGICAL, R=REAL, C=character string
- *Default* is the preset value, if defined, that is assigned to this parameter within the programs.
- *Unit* shows the unit of the control parameter, where applicable.
- *Description* explains in a few words the purpose of the parameter.
- *Scope* explains under which conditions the namelist parameter has any effect, if its scope is restricted to specific settings of other namelist parameters.

Information on the file, where the namelist is defined and used, is given at the end of each table.

2 Namelist parameters for grid generation

2.1 Namelist parameters defining the atmosphere grid

2.1.1 graph_ini (NAMELIST_GRAPH)

| Parameter | Type | Default | Unit | Description | Scope |
|-------------|------|---------|------|--|-------|
| nroot | I | 2 | | root subdivision of initial edges | |
| grid_levels | I | 4 | | number of edge bisections following the root subdivision | |
| lplane | L | .FALSE. | | switch for generating a double periodic planar grid. The root level consists of 8 triangles. | |

Defined and used in: src/grid_generator/mo_io_graph.f90

2.1.2 grid_ini (NAMELIST_GRID)

| Parameter | Type | Default | Unit | Description | Scope |
|-------------|------|---------|------|--|-------|
| nroot | I | 2 | | root subdivision of initial edges | |
| grid_levels | I | 4 | | number of edge bisections following the root subdivision | |
| lplane | L | .FALSE. | | switch for generating planar grid. The root level consists of 8 triangles. | |

Defined and used in: src/grid_generator/mo_io_grid.f90

2.1.3 grid_options (NAMELIST_GRID)

| | | | | | |
|-------------|---|-----|-----|---|--|
| x_rot_angle | R | 0.0 | deg | Rotation of the icosahedron about the x-axis (connecting the origin and [0°E, 0°N]) | |
|-------------|---|-----|-----|---|--|

| Parameter | Type | Default | Unit | Description | Scope |
|----------------|------|---------|------|--|--------------------------|
| y_rot_angle | R | 0.0 | deg | Rotation of the icosahedron about the y-axis (connecting the origin and [90°E, 0°N), done after the rotation about the x-axis. | |
| z_rot_angle | R | 0.0 | deg | rotation of the icosahedron about the z-axis (connecting the origin and [0°E, 90°N), done after the rotation about the y-axis. | |
| itype_optimize | I | 4 | | Grid optimization type 0: no optimization 1: Heikes Randall 2: equal area 3: c-grid small circle 4: spring dynamics | |
| l_c_grid | L | .FALSE. | | C-grid constraint on last level | |
| maxlev_optim | I | 100 | | Maximum grid level where the optimization is applied | i_type_optimize = 1 or 4 |
| beta_spring | R | 0.90 | | tuning factor for target grid length | i_type_optimize = 4 |

Defined and used in: src/grid_generator/mo_io_grid.f90

2.1.4 plane_options (NAMELIST_GRID)

| | | | | | |
|-------------|---|------|----|----------------------------------|---------------|
| tria_arc_km | R | 10.0 | km | length of triangle edge on plane | lplane=.TRUE. |
|-------------|---|------|----|----------------------------------|---------------|

The number of grid points is generated by root level section and further bisections. The double periodic root level consists of 8 triangles. The spatial coordinates are $-1 \leq x \leq 1$, and $-\sqrt{3}/2 \leq y \leq \sqrt{3}/2$. Currently the planar option can only be used as an *f*-plane. Defined and used in: src/grid_generator/mo_io_grid.f90

2.1.5 gridref_ini (NAMELIST_GRIDREF)

| Parameter | Type | Default | Unit | Description | Scope |
|-----------------|-----------------|---------|------|--|---------------|
| grid_root | I | 2 | | root subdivision of initial edges | |
| start_lev | I | 4 | | number of edge bisections following the root subdivision | |
| n_dom | I | 2 | | number of logical model domains, including the global one | |
| n_phys_dom | I | n_dom | | number of physical model domains, may be larger than n_dom (in this case, domain merging is applied) | |
| parent_id | I(n_phys_dom-1) | i | | ID of parent domain (first entry refers to first nested domain; needs to be specified only in case of more than one nested domain per grid level) | |
| logical_id | I(n_phys_dom-1) | i+1 | | logical grid ID of parent domain (first entry refers to first nested domain; needs to be specified only in case of domain merging, i.e. n_dom < n_phys_dom) | |
| l_plot | L | .FALSE. | | produces GMT plots showing the locations of the nested domains | |
| l_circ | L | .TRUE. | | Create circular (.T.) or rectangular (.F.) refined domains | |
| l_rotate | L | .FALSE. | | Rotates center point into the equator in case of l_circ = .FALSE. | lcirc=.FALSE. |
| write_hierarchy | I | 1 | | 0: Output only computational grids 1: Output in addition parent grid of global model domain (required for computing physics on a reduced grid) 2: Output all grids back to level 0 (required for hierarchical search algorithms) | |

| Parameter | Type | Default | Unit | Description | Scope |
|--------------------|------------|-----------------|------|---|---------------|
| bdy_indexing_depth | I | max_rlc (=8) | | Number of cell rows along the lateral boundary of a model domain for which the refin_ctrl fields contain the distance from the lateral boundary; needs to be enlarged when lateral boundary nudging is required for one-way nesting | |
| radius | R(n_dom-1) | 30. | deg | radius of nested domain (first entry refers to first nested domain; needs to be specified for each nested domain separately) | lcirc=.TRUE. |
| hwidth_lon | R(n_dom-1) | 20. | deg | zonal half-width of refined domain (first entry refers to first nested domain; needs to be specified for each nested domain separately) | lcirc=.FALSE. |
| hwidth_lat | R(n_dom-1) | 20. | deg | meridional half-width of refined domain (first entry refers to first nested domain; needs to be specified for each nested domain separately) | lcirc=.FALSE. |
| center_lon | R(n_dom-1) | 90. | deg | center longitude of refined domain (first entry refers to first nested domain; needs to be specified for each nested domain separately) | |
| center_lat | R(n_dom-1) | 30. | deg | center latitude of refined domain (first entry refers to first nested domain; needs to be specified for each nested domain separately) | |

Defined and used in: src/grid_generator/mo_gridrefinement.f90

2.2 Namelist parameters defining the ocean grid (NAMELIST_OCEAN_GRID)

The ocean grids are created by the script run/create_ocean_grid.run

2.2.1 grid_geometry_conditions

| | | | | | |
|-------------------|---------------------|---|---------|--|---------------|
| no_of_conditions | I | 0 | | Number of geometric conditions | |
| patch_shape | I(no_of_conditions) | | | 1=rectangle; 2=circle | |
| patch_center_x | R(no_of_conditions) | | degrees | longitude of patch center | |
| patch_center_y | R(no_of_conditions) | | degrees | latitude of patch center | |
| rectangle_xradius | R(no_of_conditions) | | degrees | half meridional extension of a rectangular patch | patch_shape=1 |
| rectangle_yradius | R(no_of_conditions) | | degrees | half zonal extension of a rectangular patch | patch_shape=1 |
| circle_radius | R(no_of_conditions) | | degrees | radius of a circular patch | patch_shape=2 |

Defined in mo_grid_conditions.f90

2.2.2 create_ocean_grid

| | | | | | |
|---------------------------|----------|---------|--------------|---|--------------------|
| only_get_sea_land_mask | mask | .false. | | .true.:returns the whole grid with a sea-land mask; .false.:returns only the ocean grid | |
| smooth_ocean_boundary | boundary | .true. | | .true.:smooths the ocean boundaries so no triangle has two boundary edges; .false.:no smoothing | |
| input_file | C | | | name of the input grid file | |
| elevation_file | C | | | name of the file containing cell elevation values for the input_file | no_of_conditions=0 |
| elevation_field | C | | | name of the field containing the cell elevation values | no_of_conditions=0 |
| min_sea_depth | R | 0.0 | m (negative) | if cell elevation < min_sea_depth then the cell is consider sea | |
| set_sea_depth | R | 0.0 | m (negative) | if not 0, then sea cells are of set_sea_depth elevation | |
| set_min_sea_depth | R | 0.0 | m (negative) | if not 0, then sea cells have a maximum of set_min_sea_depth elevation | |
| edge_elev_interp_method | | 2 | | compute edge elevation from cells using: linear interpolation=1; min value = 2 | |
| output_refined_ocean_file | C | | | name of the output refined ocean grid file | |

Defined in mo_create_ocean_grid.f90

2.3 Namelist parameters defining the torus grid (NAMELIST_TORUS_GRID)

2.3.1 torus_grid_parameters

| | | | | | |
|--------------------------|---|---|--------|--|--|
| y_no_of_rows | I | | 4 | number of triangle rows of the torus grid | |
| x_no_of_columns | I | | 8 | number of triangle columns of the torus grid | |
| edge_length | R | m | 1000.0 | the triangle edge length | |
| x_center | R | m | 0.0 | the x coordinate of the torus center | |
| y_center | R | m | 0.0 | the y coordinate of the torus center | |
| out_file_name | C | | | the torus grid file name | |
| unfolded_torus_file_name | C | | | the unfolded torus grid file name (for plotting) | |
| ascii_filename | C | | | the unfolded torus grid ascii file name (for plotting) | |

Defined in mo_create_torus_grid.f90. See the run script run/create_torus_grid.run.

3 Namelist parameters defining the ICON model (NAMELIST_ICON)

3.1 grid_ctl

| Parameter | Type | Default | Unit | Description | Scope |
|-----------|------------|---------|------|---|---------|
| nroot | I | 2 | | root subdivision of initial edges | |
| start_lev | I | 4 | | coarsest bisection level | |
| n_dom | I | 1 | | number of model domains, 1 = global domain only | |
| parent_id | I(n_dom-1) | i | | ID of parent domain (first entry refers to first nested domain; needs to be specified only in case of more than one nested domain per grid level) MUST be the same as in gridref_ini | n_dom>1 |

| Parameter | Type | Default | Unit | Description | Scope |
|---------------|----------|---------|------|---|---------------|
| lfeedback | L(n_dom) | .TRUE. | | Specifies if feedback to parent grid is performed. Setting lfeedback(1)=.false. turns off feedback for all nested domains; to turn off feedback for selected nested domains, set lfeedback(1)=.true. and set ".false." for the desired model domains | n_dom>1 |
| patch_weight | R(n_dom) | 0. | | If patch_weight is set to a value > 0 for any of the first level child patches, processor splitting will be performed, i.e. every of the first level child patches gets a subset of the total number of processors corresponding to its patch_weight. A value of 0. corresponds to exactly 1 processor for this patch, regardless of the total number of processors. For the root patch and higher level childs, patch_weight is not used. However, patch_weight must be set to 0 for these patches to avoid confusion. | n_dom>1 |
| lplane | L | .FALSE. | | planar option | |
| corio_lat | R | 0.0 | deg | Center of the f-plane is located at this geographical latitude | lplane=.TRUE. |
| lpatch0 | L | .FALSE. | | If set to .true. an additional patch one level below the root patch is allocated and read so that physics calculations on a coarser grid are possible | |
| lredgrid_phys | L | .FALSE. | | If set to .true. is calculated on a reduced grid (= one grid level higher); requires lpatch0=.TRUE. | |

Defined and used in: src/namelist/mo_grid_nml.f90

Namelist parameters for the ICON models are organized in several thematic Fortran namelists controlling the experiment, and the properties of dynamics, transport, physics etc.

3.2 parallel_ctl

| Parameter | Type | Default | Unit | Description | Scope |
|-----------------|------|---------|------|---|-------|
| n_ghost_rows | I | 1 | | number of halo cell rows | |
| division_method | I | 1 | | method of domain decomposition 0: read in from file 1: use built-in geometric subdivision 2: use METIS | |
| p_test_run | L | .FALSE. | | .TRUE. means verification run for MPI parallelization (PE 0 processes full domain) | |
| l_test_openmp | L | .FALSE. | | if .TRUE. is combined with p_test_run=.TRUE. and OpenMP parallelization, the test PE gets only 1 thread in order to verify the OpenMP parallelization | |
| l_log_checks | L | .FALSE. | | if .TRUE. messages are generated during each synchronization step (use for debugging only) | |
| l_fast_sum | L | .FALSE. | | if .TRUE., use fast (not processor-configuration-invariant) global summation | |
| iorder_sendrecv | I | 1 | | Sequence of send/receive calls: 1 = irectv/send; 2 = isend/rcv; 3 = isend/irectv | |

| Parameter | Type | Default | Unit | Description | Scope |
|--------------|------|---------|------|---|-------|
| itype_comm | I | 1 | | 1: use local memory for exchange buffers 2: use global memory for exchange buffers 3: asynchronous halo communication for dynamical core (NH tria only) | |
| num_io_procs | I | 0 | | Number of I/O processors (running exclusively for doing I/O) | |
| pio_type | I | 1 | | Type of parallel I/O. Only used if number of I/O processors greater number of domains. Experimental! | |

Defined and used in: src/shared/mo_parallel_ctl.f90

3.3 run_nml

| Parameter | Type | Default | Unit | Description | Scope |
|------------|----------|---------|------|--|-------------------|
| lrestart | L | .FALSE. | | If .TRUE., simulation starts from a model state read from restart file(s). | |
| nproma | I | 1 | | chunk length | |
| nlev | I | 31 | | Number of full levels (atm. or ocean) | |
| num_nlev | I(n_dom) | 31 | | Number of full levels (atm.) for each domain | lvert_nest=.TRUE. |
| nshift | I(n_dom) | 0 | | vertical half level of parent domain which coincides with upper boundary of the current domain | lvert_nest=.TRUE. |
| lvert_nest | L | .FALSE. | | If set to .true. vertical nesting is switched on (i.e. variable number of vertical levels) | |
| ntracer | I | 0 | | number of tracers | |
| dtime | R | 600.0 | s | time step | |

| Parameter | Type | Default | Unit | Description | Scope |
|--|----------------------------|----------------------------------|----------------|---|-------|
| | | | | Std. time step for ICOHAM R2B04 = 600s | |
| calendar | I | 1 | | Calendar type: 0=Julian/Gregorian 1=proleptic Gregorian 2=30day/month,360day/year | |
| ini_year ini_month ini_day ini_hour ini_minute ini_second | I I I I I R | 2008 9 1 0 0 0.0 | hr min s | The initial date and time of this run is preset to 2008-09-01 / 00:00:00 UT | |
| end_year end_month end_day end_hour end_minute end_second | I I I I I R | 2008 9 1 1 40 0.0 | hr min s | The end date and time of this run is preset to 2008-09-01 / 01:40:00 UT, which is 10 steps of 600 s after the initial date and time | |
| | | | | Length of the run If "nsteps" is positive, then nsteps*dtime is used to compute the end date and time of the run. Else if any of the "run_..." variables is positive, then these are used to compute the end date and time and, using dtime, also "nsteps". | |

| Parameter | Type | Default | Unit | Description | Scope |
|---|-----------------------|-------------------------|------|---|-------|
| nsteps run_day run_hour run_minute run_second | I I I I R | 0 0 0 0 0.0 | | Else the initial date and time and the end date and time and the time step are used to compute "nsteps". number of time steps of this run. number of whole days of the run number of additional hours of the run number of additional minutes of the run number of additional seconds of the run | |
| iequations | I | 1 | | Equations and prognostic variables. Use positive indices for the atmosphere and negative indices for the ocean. 0: shallow water model 1: hydrostatic atmosphere, T 2: hydrostatic atm., θ -dp 3: non-hydrostatic atmosphere -1: hydrostatic ocean | |
| i_cell_type | I | 3 | | Cell type 3: triangular cells 4: quadrilateral cells (to be done) 6: pentagonal/hexagonal cells | |
| ldynamics | L | .TRUE. | | Read namelist 'dynamics_ctl' and compute adiabatic dynamic tendencies | |
| ltransport | L | .FALSE. | | Read namelist 'transport_ctl' and compute tracer tendencies by transport | |

| Parameter | Type | Default | Unit | Description | Scope |
|-----------------|------|---------|------|---|--------------------------------------|
| iforcing | I | 0 | | Forcing of dynamics and transport by parameterized processes. Use positive indices for the atmosphere and negative indices for the ocean. 0: no forcing 1: Held-Suarez forcing 2: ECHAM forcing 3: NWP forcing 4: local diabatic forcing without physics 5: local diabatic forcing with physics -1: MPIOM forcing (to be done) | |
| ltestcase | L | .TRUE. | | Idealized testcase runs | |
| lcorio | L | .TRUE. | | Coriolis force | |
| itopo | I | 0 | | topography (not yet implemented) | |
| msg_level | I | 10 | | controls how much printout is written during runtime. For values less than 5, only the time step is written. | |
| inextra_2d | I | 0 | | Number of 2D Fields for diagnostic/debugging output. | iequations = 3 (to be done for 1, 2) |
| inextra_3d | I | 0 | | Number of 3D Fields for diagnostic/debugging output. | iequations = 3 (to be done for 1, 2) |
| ltimer | L | .TRUE. | | TRUE: Timer for monitoring thr runtime of specific routines is on (FALSE = off) | |
| ldump_states | L | .FALSE. | | Dump patch/interpolation/grid refinement state of every patch (after subdivision in case of a parallel run) to a Netcdf file and exit program. | |
| lrestore_states | L | .FALSE. | | Restore patch/interpolation/grid refinement states from NetCDF dump files instead of calculating them. | |

Defined and used in: src/namelist/mo_run_nml.f90

3.4 dynamics_ctl (used if run_nml/ldynamics=.TRUE.)

| Parameter | Type | Default | Unit | Description | Scope |
|----------------|------|---------|------|--|--|
| idiv_method | I | 1 | | Method for divergence computation: 1: Standard Gaussian integral. Hydrostatic atm. model: for unaveraged normal components, Non-hydrostatic atm. model: for averaged normal components 2: bilinear averaging of divergence | i_cell_type=3 |
| divavg_cntrwgt | R | 0.5 | | Weight of central cell for divergence averaging | idiv_method= 2 |
| lsi_3d | L | .FALSE. | | 3D GMRES solver or decomposistion into 2D problems | lshallow_water=.FALSE. and itime_scheme=4 |
| itime_scheme | I | 4 | | Time integration scheme: 1: pure advection (no dynamics) 2: 2 time level semi implicit (not yet implemented) 3: 3 time level explicit 4: 3 time level with semi implicit correction 5: standard 4th-order Runge-Kutta method (4-stage) 6: SSPRK(5,4) scheme (5-stage) 3: same as default, but computation of velocity tendencies in corrector step only 4: Matsuno scheme 6: same as default, but usage of velocity tendencies at (nnow+nnew)/2 | iequations=1 or 2 iequations=1 or 2 iequations=1 or 2 iequations=1 or 2 iequations=1 or 2 iequations=3 and i_cell_type=3 iequations=3 and i_cell_type=3 iequations=3 and i_cell_type=3 |

| Parameter | Type | Default | Unit | Description | Scope |
|-------------------|------|---------|------|--|-----------------------------------|
| ileapfrog_startup | I | 1 | | How to integrate the first time step when the leapfrog scheme is chosen. 1 = Euler forward; 2 = a series of sub-steps. | itime_scheme= 3 or 4 |
| asselin_coeff | R | 0.1 | | Asselin filter coefficient | itime_scheme= 3 or 4 |
| si_2tls | R | 0.6 | | weight of time step n+1. Valid range: [0,1] | itime_scheme=2 |
| si_expl_scheme | I | 2 | | scheme for the explicit part used in the 2 time level semi-implicit time stepping scheme. 1 = Euler forward; 2 = Adams-Bashforth 2nd order | itime_scheme=2 |
| si_cmin | R | 30.0 | m/s | semi implicit correction is done for eigenmodes with speeds larger than si_cmin | itime_scheme=4 and lsi_3d=.FALSE. |
| si_coeff | R | 1.0 | | weight of the semi implicit correction | itime_scheme=4 |
| si_offctr | R | 0.7 | | future implicit weight for si correction | itime_scheme=4 |
| si_rtol | R | 1.0e-3 | | relative tolerance for GMRES solver | itime_scheme=4 |
| ldry_dycore | L | .TRUE. | | Assume dry atmosphere | iequations∈{1,2} |
| lref_temp | L | .FALSE. | | Set a background temperature profile as base state | iequations∈{1,2} |

Defined and used in: src/namelist/mo_dynamics_nml.f90

3.5 nonhydrostatic_ctl (used if run_nml/iequations=3)

| Parameter | Type | Default | Unit | Description | Scope |
|----------------|----------|---------|------|---|---------------|
| rayleigh_coeff | R(n_dom) | 0.05 | | Rayleigh damping coefficient (Klemp, Dudhia, Hassiotis: MWR136, pp.3987-4004) | i_cell_type=3 |
| damp_height | R(n_dom) | 7500.0 | m | Height in which Rayleigh damping starts | |

| Parameter | Type | Default | Unit | Description | Scope |
|-----------------|------|----------|------|---|--|
| htop_moist_proc | R | 200000.0 | m | Height above which moist physics and advection of cloud and precipitation variables are turned off | |
| htop_qadv | R | 250000.0 | m | Height above which advection of water vapor is turned off (should be larger than htop_moist_proc; use with care!!!) | |
| k2_updamp_coeff | R | 2.0e6 | | enhanced 2nd order diffusion coefficient in upper damping layer | i_cell_type=6, hdiff_order=3 (Smagorinski) |
| vwind_offctr | R | 0.05 | | Off-centering in vertical wind solver | i_cell_type=3 |
| ivctype | I | 1 | | Type of vertical coordinate: 1: Gal-Chen hybrid 2: SLEVE (uses sleve_ctl) | |
| iadv_rcf | I | 1 | | reduced calling frequency (rcf) for transport 1: no rcf (every dynamics-step) 2: transport every 2. step 4: ... | |
| l_nest_rcf | L | .TRUE. | | Synchronize interpolation/feedback calls with advection (transport) time steps. l_nest_rcf is automatically reset to .FALSE. if iadv_rcf=1 | i_cell_type=3 |
| l_masscorr_nest | L | .FALSE. | | Apply mass conservation correction also in nested domain | i_cell_type=3 |
| iadv_rhotheta | I | 2 | | Advection method for rho and rhotheta: 1: centred differences horiz. + vert. 2: 2nd order Miura horizontal 3: 3rd order Miura horizontal (not recommended) | i_cell_type=3 |

| Parameter | Type | Default | Unit | Description | Scope |
|----------------|------|---------|------|--|---|
| igradp_method | I | 1 | | Discretization of horizontal pressure gradient: 1: conventional discretization with metric correction term 2: Taylor-expansion-based reconstruction of pressure (advantageous at very high resolution) 3: Similar discretization as option 2, but uses hydrostatic approximation for downward extrapolation over steep slopes | i_cell_type=3 |
| l_zdiffu_t | L | .FALSE. | | .TRUE.: Compute Smagorinsky temperature diffusion truly horizontally over steep slopes | i_cell_type=3 .AND. hdiff_order=5 .AND. lhdiff_temp = .true. |
| thslp_zdiffu | R | 0.025 | | Slope threshold above which truly horizontal temperature diffusion is activated | i_cell_type=3 .AND. hdiff_order=5 .AND. lhdiff_temp=.true. .AND. l_zdiffu_t=.true. |
| thhgt_d_zdiffu | R | 200 | m | Threshold of height difference between neighboring grid points above which truly horizontal temperature diffusion is activated (alternative criterion to thslp_zdiffu) | i_cell_type=3 .AND. hdiff_order=5 .AND. lhdiff_temp=.true. .AND. l_zdiffu_t=.true. |
| exner_expol | R | 0.5 | | Temporal extrapolation (fraction of dt) of Exner function for computation of horizontal pressure gradient | i_cell_type=3 |
| l_open_ubc | L | .FALSE. | | .TRUE.: Use open upper boundary condition (rather than w=0) to better conserve sea-level pressure in the presence of diabatic heating | i_cell_type=3 |
| ltheta_up_hori | L | .FALSE. | | upstream biased horizontal advection for theta (see also upstr_beta) | i_cell_type=6 |

| Parameter | Type | Default | Unit | Description | Scope |
|-----------------|------|---------|------|---|---------------|
| upstr_beta | R | 1.0 | | Selection of order for horiz. theta advection: 3rd order=1.0, 4th order=0.0 | i_cell_type=6 |
| gmres_rtol_nh | R | 1.0e-6 | | relative tolerance for convergence in gmres solver | i_cell_type=6 |
| l_impl_vert_adv | L | .TRUE. | | implicit vertical advection for horizontal velocity and potential temperature (Implicit vertical advection for ρ and w is automatically included in the new 5band matrix solver for divergent modes. For theta, one of Daniels schemes is envisaged for the future.) | i_cell_type=6 |

Defined and used in: src/namelist/mo_nonhydrostatic_nml.f90

3.6 sleve_ctl (used if nonhydrostatic_ctl/ivctype=2)

| Parameter | Type | Default | Unit | Description | Scope |
|---------------|------|---------|------|---|-------|
| min_lay_thckn | R | 50 | m | Layer thickness of lowermost layer | |
| top_height | R | 23500.0 | m | Height of model top | |
| stretch_fac | R | 1.0 | | Stretching factor to vary distribution of model levels; values <1 increase the layer thickness near the model top | |
| decay_scale_1 | R | 4000 | m | Decay scale of large-scale topography component | |
| decay_scale_2 | R | 2500 | m | Decay scale of small-scale topography component | |
| decay_exp | R | 1.2 | | Exponent of decay function | |
| flat_height | R | 16000 | m | Height above which the coordinate surfaces are flat | |

Defined and used in: src/namelist/mo_sleve_nml.f90

3.7 diffusion_ctl

| Parameter | Type | Default | Unit | Description | Scope |
|--------------|------|---------|------|--|---|
| lhdifff_temp | L | .TRUE. | | Diffusion on the temperature field | |
| lhdifff_vn | L | .TRUE. | | Diffusion on the horizontal wind field | |
| hdifff_order | I | 4 2 | | Order of ∇ operator for diffusion: -1: no diffusion 2: ∇^2 diffusion 3: Smagorinsky ∇^2 diffusion for the hexagonal model (includes frictional heating if lhdifff_temp=.TRUE.) 4: ∇^4 diffusion 5: Smagorinsky ∇^2 diffusion combined with ∇^4 background diffusion as specified via hdifff_efdt_ratio defaults: 2 for hexagonal model, 4 for triangular model 24 or 42: ∇^2 diffusion from model top to a certain level (cf. k2_pres_max and k2_klev_max below); ∇^4 for the lower levels. | 24 and 42 currently allowed only in the hydrostatic atm model (run_nml/iequation = 1 or 2). |
| k2_pres_max | R | -99. | Pa | Pressure level above which ∇^2 diffusion is applied. | hdifff_order = 24 or 42, and run_nml/iequation = 1 or 2. |
| k2_klev_max | I | 0 | | Index of the vertical level till which (from the model top) ∇^2 diffusion is applied. If a positive value is specified for k2_pres_max, k2_klev_max is reset accordingly during the initialization of a model run. | hdifff_order = 24 or 42, and run_nml/iequation = 1 or 2. |

| Parameter | Type | Default | Unit | Description | Scope |
|------------------|------|---------|------|--|---|
| hdiff_efdt_ratio | R | 1.0 | | ratio of e-folding time to time step (or 2* time step when using a 3 time level time stepping scheme) (only for triangles currently) | |
| hdiff_tv_ratio | R | 1.0 | | Ratio of diffusion coefficients for temperature and normal wind: $T : v_n$ | |
| hdiff_multfac | R | 1.0 | | Multiplication factor of normalized diffusion coefficient for nested domains | n_dom>1 |
| hdiff_smag_fac | R | 0.15 | | Scaling factor for Smagorinsky diffusion | for triangles only with iequations=3, for hexagons with hdiff_order=3 |

Defined and used in: src/namelists/mo_diffusion_nml.f90

3.8 transport_ctl (used if run_nml/ltransport=.TRUE.)

| Parameter | Type | Default | Unit | Description | Scope |
|--------------|------------|---------|------|--|--|
| ihadv_tracer | I(ntracer) | 2 4 | | Horiz. transport scheme: 0: no horiz. transport 1: upwind (1st order) 2: miura (2nd order, lin. reconstr.) 3: miura3 (quadr. or cubic reconstr.) 4: up3 (3rd or 4th order upstream) | if i_cell_type=3 lsq_high_ord ∈ [2,3] if i_cell_type=6 |
| ivadv_tracer | I(ntracer) | 3 | | Vert. transport scheme: 0: no vert. transport 1: upwind (1st order) 2: muscl_cfl (2nd order, handles CFL > 1) 20: muscl (2nd order) 3: ppm_cfl (3 rd order, handles CFL > 1) | |

| Parameter | Type | Default | Unit | Description | Scope |
|---------------|------------|---------|------|--|--|
| | | | | 30: ppm (3rd order) | |
| lvadv_tracer | L | .TRUE. | | calculate vertical tracer advection | |
| lstrang | L | .FALSE. | | splitting into fractional steps - second order Strang splitting (.TRUE.) - first order Godunov splitting (.FALSE.) | |
| ctracer_list | C | " | | list of tracer names | |
| itype_hlimit | I(ntracer) | 3 4 | | Type of limiter for horizontal transport: 0: no limiter 1: semi-monotonous slope limiter 2: monotonous slope limiter 3: monotonous flux limiter 4: positive definite flux limiter | ihadv_tracer='miura' ihadv_tracer='miura' ihadv_tracer='miura[3]' ihadv_tracer='miura[3]', 'iup3[4]' |
| itype_vlimit | I(ntracer) | 1 | | Type of limiter for vertical transport: 0: no limiter 1: semi-monotone slope limiter 2: monotonous slope limiter 4: positive definite flux limiter | |
| iord_backtraj | I | 1 | | order of backward trajectory calculation: 1: first order 2: second order (iterative; currently 1 iteration hardcoded) | ihadv_tracer='miura' |
| igrad_c_miura | I | 1 | | Method for gradient reconstruction at cell center for 2nd order miura 1: Least-squares (linear, non-consv) 2: Green-Gauss 3: gradient reconstruction (RBF) at cell center on the basis of normal gradients at edges | ihadv_tracer=2 |

| Parameter | Type | Default | Unit | Description | Scope |
|----------------|------|---------|------|--|-------------------|
| lclip_tracer | L | .FALSE. | | Clipping negative values | |
| upstr_beta_adv | R | 1.0 | | parameter to select 3rd order (=1) or 4th order (=0) advection, or something inbetween (0..1) | ihadv_tracer=iup3 |
| ivcfl_max | I | 5 | | determines stability range of vertical PPM-scheme in terms of the maximum allowable CFL-number | ivadv_tracer=3 |

Defined and used in: src/namelist/mo_advection_nml.f90

3.9 nwp_phy_ctl

| Parameter | Type | Default | Unit | Description | Scope |
|-----------------|------|---------|------|--|------------------------|
| inwp_gscp | I | 0 | | cloud microphysics and precipitation 0: none 1: hydci (COSMO-EU microphysics) | run_nml/forcing = inwp |
| inwp_convection | I | 0 | | convection 0: none 1: Tiedtke/Bechtold convection | run_nml/forcing = inwp |
| inwp_cldcover | I | 1 | | cloud cover scheme for radiation 0: no clouds (only QV) 1: grid-scale clouds and QV 2: clouds from COSMO turbulence scheme 3: clouds from COSMO SGS cloud scheme | run_nml/forcing = inwp |
| inwp_radiation | I | 0 | | radiation 0: none 1: RRTM radiation 2: Ritter-Geleyn radiation | run_nml/forcing = inwp |

| Parameter | Type | Default | Unit | Description | Scope |
|--------------|----------------|---------------------|---------|---|---|
| inwp_satad | I | 1 | | saturation adjustment 0: none 1: | run_nml/forcing = inwp |
| inwp_turb | I | 0 | | vertical diffusion and transfer 0: none 1: COSMO diffusion and transfer 2: ECHAM diffusion | run_nml/forcing = inwp |
| inwp_sso | I | 0 | | subgrid scale orographic drag 0: none 1: | run_nml/forcing = inwp |
| inwp_surface | I | 0 | | surface scheme 0: none 1: | run_nml/forcing = inwp |
| dt_conv | R (max_dom) | 600. | seconds | time interval of convection call currently each subdomain has the same value | run_nml/forcing = inwp |
| dt_rad | R (max_dom) | 1800. | seconds | time interval of radiation call currently each subdomain has the same value | run_nml/forcing = inwp |
| dt_sso | R (max_dom) | 3600. | seconds | time interval of sso call currently each subdomain has the same value | run_nml/forcing = inwp |
| dt_ccov | R (max_dom) | dt_conv | seconds | time interval of cloud cover call currently each subdomain has the same value | run_nml/forcing = inwp currently is not used |
| dt_gscp | R (max_dom) | iadv_rcf * dtime | seconds | time interval of gscp call each subdomain it is halved | run_nml/forcing = inwp not recommended to change |
| dt_satad | R (max_dom) | iadv_rcf * dtime | seconds | time interval of satad call each subdomain it is halved | run_nml/forcing = inwp not recommended to change |

| Parameter | Type | Default | Unit | Description | Scope |
|--------------|----------------|----------|---------|--|---|
| dt_turb | R (max_dom) | dt_gscp | seconds | time interval of turb call each subdomain it is halved | run_nml/forcing = inwp not recommended to change |
| dt_radheat | R (max_dom) | dt_satad | seconds | time interval of radheat call each subdomain it is halved | run_nml/forcing = inwp not recommended to change |
| imode_turb | I | 3 | | mode for calculation of vertical turbulent flux divergence of 1-st order variables 0,1 :only for COSMO 2 :explicit 3 :implicit without moist corr. 4 :implicit in conserv. vars. | inwp_turb = 1 |
| limpltkediff | L | .TRUE. | | use implicit TKE-diffusion | inwp_turb = 1 |
| lexpcor | L | .FALSE. | | use explicit moist corrections of the implicitly calculated turbulent diffusion | inwp_turb = 1 |
| ltkesso | L | .FALSE. | | calculation of SSO-wake turbulence production for TKE, if SSO-tendencies for momentum are present .TRUE. is currently operational with COSMO | inwp_turb = 1 |
| tur_len | R | 500.0 | m | asymptotic turbulent length scale divided by v' Karman-constant >0 (say in [100, 1000]) | inwp_turb = 1 |
| pat_len | R | 500.0 | m | effective length scale of surface patterns ≥0 | inwp_turb = 1 |
| a_stab | R | 0.0 | | factor for stability correction of turbulent length scale [0, 1] | inwp_turb = 1 |

| Parameter | Type | Default | Unit | Description | Scope |
|------------|------|---------|-------------------|---|---------------|
| tkhmin | R | 0.1 | m ² /s | minimal turbulent diffusion coefficient for heat | inwp_turb = 1 |
| tkmmin | R | 0.1 | | minimal diffusion coefficient for momentum | inwp_turb = 1 |
| c_diff | R | 0.2 | | length scale factors for turbulent transport of TKE | inwp_turb = 1 |
| itype_wcld | I | 2 | | type of water cloud diagnosis for turbulence 1: based on relative hum. 2: statistical saturation adj. | inwp_turb = 1 |
| icldm_turb | I | 2 | | mode of cloud representation in turbulence parameterization -1: ignoring cloud water completely (pure dry scheme) 0: no clouds considered (all cloud water is evaporated) 1: only grid scale condensation possible 2: sub grid scale condensation according to 'itype_wcld' | inwp_turb = 1 |
| itype_tran | I | 2 | | type of the transfer scheme 1: only for COSMO | inwp_turb = 1 |
| rlam_heat | R | 1.0 | | scaling factor of the laminar boundary layer for heat >=0 (the larger the more laminar transport resistance) | inwp_turb = 1 |
| rlam_mom | R | 0.0 | | scaling factor of the laminar boundary layer for momentum >=0 (near 0.0 due to roughness layer form drag) | inwp_turb = 1 |

| Parameter | Type | Default | Unit | Description | Scope |
|-----------|------|---------|------|---|---------------|
| rat_sea | R | 20.0 | | ratio of laminar scaling factors for heat over sea and land >1 (since uppermost water layer is moving with the wind) | inwp_turb = 1 |

Defined and used in: src/namelist/mo_atm_phy_nwp_nml.f90

3.10 radiation_nml

| Parameter | Type | Default | Unit | Description | Scope |
|-----------|------|---------|--------|---|-----------------------------|
| ldiur | L | .TRUE. | | switch for solar irradiation: .TRUE.:diurnal cycle, .FALSE.:zonally averaged irradiation | |
| nmonth | I | 0 | | 0: Earth circles on orbit 1-12: Earth orbit position fixed for specified month | |
| yr_perp | L | -99999 | | year used for lyr_perp = .TRUE. | |
| lyr_perp | L | .FALSE. | | .FALSE.: transient Earth orbit following VSOP87 .TRUE.: Earth orbit of year yr_perp of the VSOP87 orbit is perpetuated | |
| dt_rad | R | 7200. | second | time interval of full radiation computation | run_nml/forcing = iecham |

| Parameter | Type | Default | Unit | Description | Scope |
|---|------|---|------|---|---|
| izenith | I | 3 4 (for iforcing = inwp) | | Choice of zenith angle formula for the radiative transfer computation. 0: Sun in zenith everywhere 1: Zenith angle depends only on latitude 2: Zenith angle depends only on latitude. Local time of day fixed at 07:14:15 for radiative transfer computation ($\sin(\text{time of day}) = 1/\pi$) 3: Zenith angle changing with latitude and time of day 4: Zenith angle and irradiance changing with season, latitude, and time of day (iforcing=inwp only) | |
| irad_h2o irad_co2 irad_ch4 irad_n2o irad_o3 irad_o2 irad_cfc11 irad_cfc12 irad_aero | I | 1 2 3 3 3 2 2 2 2 | | Switches for the concentration of radiative agents 0: 0. 1: prognostic variable 2: global constant 3: externally specified irad_aero = 5: aerosol climatology for run_nml/iforcing = 3 (NWP) when inwp_radiation = 2 irad_o3 = 6: ozone climatology with T5 geographical distribution and Fourier series for seasonal cycle for run_nml/iforcing = 3 (NWP) | Note: until further notice, please use irad_h2o = 1 irad_co2 = 2 and 0 for all the other agents for run_nml/iforcing = 2 (ECHAM). |

| Parameter | Type | Default | Unit | Description | Scope |
|-----------|------|-----------|------|---|-------|
| vmr_co2 | R | 353.9e-6 | | Volume mixing ratio of the radiative agents | |
| vmr_ch4 | | 1693.6e-9 | | | |
| vmr_n2o | | 309.5e-9 | | | |
| vmr_o2 | | 0.20946 | | | |
| vmr_cfc11 | | 252.8e-12 | | | |
| vmr_cfc12 | | 466.2e-12 | | | |

Defined and used in: src/namelist/mo_radiation_nml.f90

3.11 nwp_lnd_nml

| Parameter | Type | Default | Unit | Description | Scope |
|-------------|------|---------|------|--|-------|
| nlev_soil | I | 7 | | number of soil layers | |
| nlev_snow | I | 1 | | number of snow layers for <code>lmulti_snow=.true.</code> | |
| nsfc_subs | I | 1 | | number of tiles | |
| nztlev | I | 2 | | used time integration scheme | |
| lmulti_snow | L | .FALSE. | | .TRUE. for use of multi-layer snow model | |
| lseaice | L | .FALSE. | | .TRUE. for use of sea-ice model | |
| llake | L | .FALSE. | | .TRUE. for use of lake model | |

Defined and used in: src/namelist/mo_nwp_lnd_nml.f90

3.12 echam_phy_nml

| Parameter | Type | Default | Unit | Description | Scope |
|-----------|------|---------|------|---|--------------|
| lrad | L | .TRUE. | | Switch on radiation. | iforcing = 2 |
| lvdifff | L | .TRUE. | | Switch on turbulent mixing (i.e. vertical diffusion). | iforcing = 2 |

| Parameter | Type | Default | Unit | Description | Scope |
|-----------|------|---------|------|--|---|
| lconv | L | .TRUE. | | Switch on cumulus convection. | iforcing = 2 |
| lcond | L | .TRUE. | | Switch on large scale condensation. | iforcing = 2 |
| lcover | L | .FALSE. | | .TRUE. for prognostic cloud cover scheme, .FALSE. for diagnostic scheme. | iforcing = 2 Note: lcover = .TRUE. runs, but has not been evaluated (yet) in ICON. |
| llandsurf | L | .FALSE. | | .TRUE. for surface exchanges | iforcing = 2 Not implemented yet |
| lssodrag | L | .FALSE. | | .TRUE. for subgrid scale orographic drag | iforcing = 2 Not implemented yet |
| lagwdrag | L | .FALSE. | | .TRUE. for atmospheric gravity wave drag | iforcing = 2 Not implemented yet |
| lice | L | .FALSE. | | .TRUE. for sea-ice temperature calculation | iforcing = 2 Not implemented yet |
| lmeltpond | L | .FALSE. | | .TRUE. for calculation of meltponds | iforcing = 2 Not implemented yet |
| lmlo | L | .FALSE. | | .TRUE. for mixed layer ocean | iforcing = 2 Not implemented yet |
| lhd | L | .FALSE. | | .TRUE. for hydrologic discharge model | iforcing = 2 Not implemented yet |
| lmidatm | L | .FALSE. | | .TRUE. for middle atmosphere model version | iforcing = 2 Not implemented yet |

Defined and used in: src/namelist/mo_echam_phy_nml.f90

3.13 echam_conv_ctl

| Parameter | Type | Default | Unit | Description | Scope |
|-----------|------|---------|------|-----------------------------------|-----------------------------------|
| lmfpen | L | .TRUE. | | Switch on penetrative convection. | iforcing = 2 .AND. lconv = .TRUE. |
| lmfmid | L | .TRUE. | | Switch on midlevel convection. | iforcing = 2 .AND. lconv = .TRUE. |

| Parameter | Type | Default | Unit | Description | Scope |
|-----------|------|---------|------|--|-----------------------------------|
| lmfscv | L | .TRUE. | | Switch on shallow convection. | iforcing = 2 .AND. lconv = .TRUE. |
| lmfdd | L | .TRUE. | | Switch on cumulus downdraft. | iforcing = 2 .AND. lconv = .TRUE. |
| lmfdudv | L | .TRUE. | | Switch on cumulus friction. | iforcing = 2 .AND. lconv = .TRUE. |
| iconv | I | 1 | | Choice of cumulus convection scheme. 1: Nordeng scheme 2: Tiedtke scheme 3: hybrid scheme | iforcing = 2 .AND. lconv = .TRUE. |
| cmftau | R | 10800. | | Characteristic convective adjustment time scale. | iforcing = 2 .AND. lconv = .TRUE. |
| cmfctop | R | 0.3 | | Fractional convective mass flux (valid range [0,1]) across the top of cloud | iforcing = 2 .AND. lconv = .TRUE. |
| cmfdeps | R | 0.3 | | Fractional convective mass flux for downdrafts at lfs (valid range [0,1]) | iforcing = 2 .AND. lconv = .TRUE. |
| cprcon | R | 1.0e-4 | | Coefficient for determining conversion from cloud water to rain. | iforcing = 2 .AND. lconv = .TRUE. |
| cminbuoy | R | 0.025 | | Minimum excess buoyancy. | iforcing = 2 .AND. lconv = .TRUE. |
| entrpen | R | 1.0e-4 | | Entrainment rate for penetrative convection. | iforcing = 2 .AND. lconv = .TRUE. |
| entrmid | R | 1.0e-4 | | entrainment rate for midlevel convection. | iforcing = 2 .AND. lconv = .TRUE. |
| entrscv | R | 3.0e-4 | | entrainment rate for shallow convection. | iforcing = 2 .AND. lconv = .TRUE. |
| entrdd | R | 2.0e-4 | | entrainment rate for cumulus downdrafts. | iforcing = 2 .AND. lconv = .TRUE. |
| dlev | R | 3.e4 | Pa | Critical thickness necessary for the onset of convective precipitation. | iforcing = 2 .AND. lconv = .TRUE. |
| nauto | I | 1 | | autoconversion scheme: 1: Beheng (1994) 2: Khairoutdinov and Kogan (2000) | iforcing = 2 .AND. lconv = .TRUE. |

| Parameter | Type | Default | Unit | Description | Scope |
|--------------|------|---------|------|----------------------------------|-----------------------------------|
| lconvmassfix | L | .FALSE. | | aerosol mass fixer in convection | iforcing = 2 .AND. lconv = .TRUE. |

Defined and used in: src/atm_phy_echam/mo_echam_conv_parameters.f90

3.14 echam_vdiff_ctl

| Parameter | Type | Default | Unit | Description | Scope |
|----------------|------|---------|------|--|-----------------|
| lsfc_mon_flux | L | .TRUE. | | Switch on surface momentum flux. | lvdiff = .TRUE. |
| lsfc_heat_flux | L | .TRUE. | | Switch on surface sensible and latent heat flux. | lvdiff = .TRUE. |

Defined and used in: src/namelist/mo_echam_vdiff_nml.f90

3.15 io_ctl

| Parameter | Type | Default | Unit | Description | Scope |
|-------------------|------------|---------------|------|---|------------------------|
| out_expname | C | 'IIIEEEETTTT' | | Outfile basename | |
| lwrite_omega | L | .TRUE. | | write out vertical velocity in pressure coords. | lshallow_water=.FALSE. |
| lwrite_pres | L | .TRUE. | | write out full level pressure | lshallow_water=.FALSE. |
| lwrite_vorticity | L | .TRUE. | | write out averaged vorticity at cells | |
| lwrite_divergence | L | .TRUE. | | write out divergence at cells | |
| lwrite_z3 | L | .TRUE. | | write out geopotential on full levels | lshallow_water=.FALSE. |
| lwrite_tracer | L(ntracer) | .TRUE. | | write out tracer at cells | |
| out_filetype | I | 2 | | Type of output format: 1: GRIB1 (not yet implemented) 2: netCDF | |
| dt_data | R | 21600.0 | s | Output time increment | |
| dt_diag | R | dtime | | diagnostic integral output timestep | |

| Parameter | Type | Default | Unit | Description | Scope |
|------------------|------|------------------------------|------|--|---|
| dt_file | R | 2592000 | s | Time increment of triggering new output file | |
| dt_restart | R | 2592000. | s | time interval for writing restart files | |
| lkeep_in_sync | L | .FALSE. | | Sync output stream with file on disk after each timestep | |
| lwrite_tend_phy | L | .TRUE. .FALSE. (Scope) | | Physics induced tendencies. | .TRUE. if iforcing=iecham .FALSE. else |
| lwrite_radiation | L | .TRUE. .FALSE. (Scope) | | Radiation related fields. | .TRUE. if iforcing=iecham or inwp .FALSE. else |
| lwrite_precip | L | .TRUE. .FALSE. (Scope) | | Precipitation | .TRUE. if iforcing=iecham or inwp .FALSE. else |
| lwrite_cloud | L | .TRUE. .FALSE. (Scope) | | Cloud variables | .TRUE. if iforcing=iecham or inwp .FALSE. else |
| lwrite_tke | L | .TRUE. | | TKE | .FALSE. per Default .TRUE. if set (AND iforcing =nwp) |
| lwrite_surface | L | .FALSE. | | surface variables | .TRUE. if set (AND iforcing =nwp) .FALSE. else |
| lwrite_extra | L | .FALSE. | | debug fields | .TRUE. if inextra_2d /_3d > 0 .FALSE. else |

Defined and used in: src/namelist/mo_io_nml.f90

3.16 interpol_ctl

| Parameter | Type | Default | Unit | Description | Scope |
|-----------|------|---------|------|-------------|-------|
|-----------|------|---------|------|-------------|-------|

| Parameter | Type | Default | Unit | Description | Scope |
|-------------------|----------|----------------------|------|---|-------|
| rbf_vec_kern_c | I | 1 | | Kernel type for reconstruction at cell centres: 1: Gaussian 3: inverse multiquadric | |
| rbf_vec_kern_e | I | 3 | | Kernel type for reconstruction at edges: 1: Gaussian 3: inverse multiquadric | |
| rbf_vec_kern_v | I | 1 | | Kernel type for reconstruction at vertices: 1: Gaussian 3: inverse multiquadric | |
| rbf_vec_scale_c | R(n_dom) | resolution-dependent | | Scale factor for RBF reconstruction at cell centres | |
| rbf_vec_scale_e | R(n_dom) | resolution-dependent | | Scale factor for RBF reconstruction at edges | |
| rbf_vec_scale_v | R(n_dom) | resolution-dependent | | Scale factor for RBF reconstruction at vertices | |
| nudge_max_coeff | R | 0.02 | | Maximum relaxation coefficient for lateral boundary nudging | |
| nudge_efold_width | R | 2.5 | | e-folding width (in units of cell rows) for lateral boundary nudging coefficient | |
| nudge_zone_width | I | 8 | | Total width (in units of cell rows) for lateral boundary nudging zone | |
| llsq_high_consv | L | .TRUE. | | conservative (T) or non-conservative (F) least-squares reconstruction for high order transport | |
| lsq_high_ord | I | 3 | | polynomial order for high order reconstruction 2: quadratic 30: cubic (no 3 rd order cross deriv.) 3: cubic | |

| Parameter | Type | Default | Unit | Description | Scope |
|---------------|------|---------|------|---|----------------------------------|
| i_cori_method | I | 3 | | Selector for tangential wind reconstruction method 1: Almut's method for tangential wind, but PV usage as in TRSK 2: method of Thuburn, Ringler, Skamarock and Klemp (TRSK) 3: Almut's method for tangential wind and PV usage | currently only for i_cell_type=6 |
| l_corner_vort | L | .TRUE. | | switch whether the rhombus averaged corner vorticity is averaged to the hexagon (.TRUE.) or the rhombi are directly averaged to the hexagon (.FALSE.) | i_cori_method=3 |

Defined and used in: src/namelist/mo_interpol_nml.f90

3.17 gridref_ctl

| Parameter | Type | Default | Unit | Description | Scope |
|------------------|------|---------|------|---|---------|
| grf_intmethod_c | I | 2 | | Interpolation method for grid refinement (cell-based dynamical variables): 1: parent-to-child copying 2: gradient-based interpolation | n_dom>1 |
| grf_intmethod_ct | I | 2 | | Interpolation method for grid refinement (cell-based tracer variables): 1: parent-to-child copying 2: gradient-based interpolation | n_dom>1 |
| grf_intmethod_e | I | 4 | | Interpolation method for grid refinement (edge-based variables): 1: inverse-distance weighting (IDW) 2: RBF interpolation | n_dom>1 |

| Parameter | Type | Default | Unit | Description | Scope |
|--------------------|------|---------|------|---|---------|
| | | | | 3: combination gradient-based / IDW 4: combination gradient-based / RBF | |
| grf_velfbk | I | 1 | | Method of velocity feedback: 1: average of child edges 1 and 2 2: 2nd-order method using RBF interpolation | n_dom>1 |
| grf_scalfbk | I | 2 | | Feedback method for dynamical scalar variables (T, p_{sfc}): 1: area-weighted averaging 2: bilinear interpolation | n_dom>1 |
| grf_tracfbk | I | 2 | | Feedback method for tracer variables: 1: area-weighted averaging 2: bilinear interpolation | n_dom>1 |
| grf_idw_exp_e12 | R | 1.2 | | exponent of generalized IDW function for child edges 1/2 | n_dom>1 |
| grf_idw_exp_e34 | R | 1.7 | | exponent of generalized IDW function for child edges 3/4 | n_dom>1 |
| rbf_vec_kern_grf_e | I | 1 | | RBF kernel for grid refinement (edges): 1: Gaussian 2: $1/(1 + r^2)$ 3: inverse multiquadric | n_dom>1 |
| rbf_scale_grf_e | R | 0.5 | | RBF scale factor for grid refinement (edges) | n_dom>1 |
| denom_diffu_t | R | 135 | | Denominator for lateral boundary diffusion of temperature | n_dom>1 |
| denom_diffu_v | R | 200 | | Denominator for lateral boundary diffusion of velocity | n_dom>1 |

Defined and used in: src/namelist/mo_gridref_nml.f90

3.18 Namelist parameters for testcases (NAMELIST_ICON)

The ICON model code includes several experiments, so-called test cases, for the shallow water model as well as the 3-dimensional atmosphere. Depending on the specified experiment, initial conditions and boundary conditions are computed internally.

3.18.1 testcase_ctl (Scope: ltestcase=.TRUE. and iequations=[0,1,2] in run_nml)

| Parameter | Type | Default | Unit | Description | Scope |
|------------|------|---------|------|--|---|
| ctest_name | C | 'JWw' | | Name of test case: 'SW_GW': gravity wave 'USBR': unsteady solid body rotation 'Will_2': Williamson test 2 'Will_3': Williamson test 3 'Will_5': Williamson test 5 'Will_6': Williamson test 6 'GW': gravity wave (nlev=20 only!) 'LDF': local diabatic forcing test without physics 'LDF-Moist': local diabatic forcing test with physics initialised with zonal wind field 'HS': Held-Suarez test 'JWs': Jablonowski-Will. steady state 'JWw': Jablonowski-Will. wave test 'JWw-Moist': Jablonowski-Will. wave test including moisture 'APE': aqua planet experiment 'MRW': mountain induced Rossby wave 'MRW2': modified mountain induced Rossby wave 'PA': pure advection 'SV': stationary vortex 'DF1': deformational flow test 1 | lshallow_water=.TRUE. lshallow_water=.TRUE. lshallow_water=.TRUE. lshallow_water=.TRUE. lshallow_water=.TRUE. lshallow_water=.TRUE. lshallow_water=.FALSE. lshallow_water=.FALSE. and iforcing=4 lshallow_water=.FALSE., and iforcing=5 lshallow_water=.FALSE. lshallow_water=.FALSE. lshallow_water=.FALSE. lshallow_water=.FALSE. lshallow_water=.FALSE. lshallow_water=.FALSE. lshallow_water=.FALSE. lshallow_water=.FALSE., ntracer = 2 |

| Parameter | Type | Default | Unit | Description | Scope |
|---------------------|------|-----------|------------|--|--|
| | | | | 'DF2': deformational flow test 2 'DF3': deformational flow test 3 'DF4': deformational flow test 4 'RH': Rossby-Haurwitz wave test | lshallow_water=.FALSE. |
| rotate_axis_deg | R | 0.0 | deg | Earth's rotation axis pitch angle | cctest_name= 'Will_2', 'Will_3', 'JWs', 'JWw', 'PA', 'DF1234', |
| gw_brunt_vais | R | 0.01 | 1/s | Brunt Vaisala frequency | cctest_name= 'GW' |
| gw_u0 | R | 0.0 | m/s | zonal wind parameter | cctest_name= 'GW' |
| gw_lon_deg | R | 180.0 | deg | longitude of initial perturbation | cctest_name= 'GW' |
| gw_lat_deg | R | 0.0 | deg | latitude of initial perturbation | cctest_name= 'GW' |
| jw_uptb | R | 1.0 | m/s (?) | amplitude of the wave perturbation | cctest_name= 'JWw' |
| mountctr_lon_deg | R | 90.0 | deg | longitude of mountain peak | cctest_name= 'MRW(2)' |
| mountctr_lat_deg | R | 30.0 | deg | latitude of mountain peak | cctest_name= 'MRW(2)' |
| mountctr_height | R | 2000.0 | m | mountain height | cctest_name= 'MRW(2)' |
| mountctr_half_width | R | 1500000.0 | m | mountain half width | cctest_name= 'MRW(2)' |
| mount_u0 | R | 20.0 | m/s | wind speed for MRW cases | cctest_name= 'MRW(2)' |
| rh_wavenum | I | 4 | | wave number | cctest_name= 'RH' |
| rh_init_shift_deg | R | 0.0 | deg | pattern shift | cctest_name= 'RH' |
| ihs_init_type | I | 1 | | Choice of initial condition for the Held-Suarez test. 1: the zonal state defined in the JWs test case; other integers: isothermal state (T=300 K, ps=1000 hPa, u=v=0.) | cctest_name= 'HS' |
| lhs_vn_ptb | L | .TRUE. | | Add random noise to the initial wind field in the Held-Suarez test. | cctest_name= 'HS' |
| hs_vn_ptb_scale | R | 1. | m/s | Magnitude of the random noise added to the initial wind field in the Held-Suarez test. | cctest_name= 'HS' |
| lrh_linear_pres | L | .FALSE. | | Initialize the relative humidity using a linear function of pressure. | cctest_name= 'JWw-Moist', 'APE', 'LDF-Moist' |

| Parameter | Type | Default | Unit | Description | Scope |
|-----------------|------|---------|------|---|---|
| rh_at_1000hpa | R | 0.75 | | relative humidity 0, 1 at 1000 hPa | ctest_name= 'JWw-Moist', 'APE', 'LDF-Moist' |
| linit_tracer_fv | L | .TRUE. | | Finite volume initialization for tracer fields | ctest_name='PA' |
| ape_sst_case | C | 'sst1' | | SST distribution selection 'sst1': Control experiment 'sst2': Peaked experiment 'sst3': Flat experiment 'sst4': Control-5N experiment 'sst_qobs': Qobs SST distribution exp. | ctest_name='APE' |
| ildf_init_type | I | 0 | | Choice of initial condition for the Local diabatic forcing test. 1: the zonal state defined in the JW's test case; other: isothermal state (T=300 K, ps=1000 hPa, u=v=0.) | ctest_name= 'LDF' |
| ldf_symm | L | .TRUE. | | Shape of local diabatic forcing: .TRUE.: local diabatic forcing symmetric about the equator (at 0 N) .FALSE.: local diabatic forcing asym. about the equator (at 30 N) | ctest_name= 'LDF', 'LDF-Moist' |

Defined and used in: src/testcases/mo_hydro_testcases.f90

3.18.2 nh_testcase_ctl (Scope: ltestcase=.TRUE. and iequations=3 in run_nml)

| Parameter | Type | Default | Unit | Description | Scope |
|--------------|------|---------|------|---|-------|
| nh_test_name | C | 'jabw' | | testcase selection 'zero': no orography 'bell': bell shaped mountain at 0E,0N | |

| Parameter | Type | Default | Unit | Description | Scope |
|-----------|------|---------|------|--|-------|
| | | | | 'schaer': hilly mountain at 0E,0N 'jabw': Initializes the full Jablonowski Williamson test case. 'jabw_s': Initializes the Jablonowski Williamson steady state test case. 'jabw_m': Initializes the Jablonowski Williamson test case with a mountain instead of the wind perturbation (specify mount_height). 'mrw_nh': Initializes the full Mountain-induced Rossby wave test case. 'mrw2_nh': Initializes the modified mountain-induced Rossby wave test case. 'mwbr_const': Initializes the mountain wave with two layers test case. The lower layer is isothermal and the upper layer has constant brunt vaisala frequency. The interface has constant pressure. 'PA': Initializes the pure advection test case. 'HS_nh': Initializes the Held-Suarez test case. At the moment with an isothermal atmosphere at rest (T=300K, ps=1000hPa, u=v=0, topography=0.0). 'HS_jw': Initializes the Held-Suarez test case with Jablonowski Williamson initial conditions and zero topography. | |

| Parameter | Type | Default | Unit | Description | Scope |
|------------------------|------|-----------|---------|--|---|
| | | | | 'APE_nh': Initializes the APE experiments. At the moment with T=300K, ps=1013.25hPa, u=v=w=0). | |
| jw_up | R | 1.0 | m/s | amplitude of the u-perturbation in jabw test case | nh_test_name='jabw' |
| u0_mrw | R | 20.0 | m/s | wind speed for mrw case | nh_test_name='mrw(2)_nh' |
| mount_height_mrw | R | 2000.0 | m | maximum mount height in mrw(2) and mwbr_const | nh_test_name='mrw(2)_nh' and 'mwbr_const' |
| mount_half_width | R | 1500000.0 | m | half width of mountain in mrw(2), mwbr_const and bell | nh_test_name='mrw(2)_nh', 'mwbr_const' and 'bell' |
| mount_lonctr_mrw_deg | R | 90. | degrees | lon of mountain center in mrw(2) and mwbr_const | nh_test_name='mrw(2)_nh' and 'mwbr_const' |
| mount_latctr_mrw_deg | R | 30. | degrees | lat of mountain center in mrw(2) and mwbr_const | nh_test_name='mrw(2)_nh' and 'mwbr_const' |
| u0_mwbr_const | R | 20.0 | m/s | wind speed for mwbr_const case | nh_test_name='mwbr_const' |
| temp_i_mwbr_const | R | 288.0 | K | temp at isothermal lower layer for mwbr_const case | nh_test_name='mwbr_const' |
| p_int_mwbr_const | R | 70000. | Pa | pres at the interface of the two layers for mwbr_const case | nh_test_name='mwbr_const' |
| bruntvais_u_mwbr_const | R | 0.025 | 1/s | constant brunt vaissala frequency at upper layer for mwbr_const case | nh_test_name='mwbr_const' |
| mount_height | R | 100.0 | m | peak height of mountain | nh_test_name='bell' |
| layer_thickness | R | -999.0 | m | thickness of vertical layers | If layer_thickness < 0, the vertical level distribution is read in from externally given HYB_PARAMS_XX. |

| Parameter | Type | Default | Unit | Description | Scope |
|---------------------|------|----------|-------|---|--|
| n_flat_level | I | 2 | | level number for which the layer is still flat and not terrain-following | layer_thickness > 0 |
| nh_u0 | R | 0.0 | m/s | initial constant zonal wind speed | nh_test_name = 'bell' |
| nh_t0 | R | 300.0 | K | initial temperature at lowest level | nh_test_name = 'bell' |
| nh_brunt_vais | R | 0.01 | 1/s | initial Brunt-Vaisala frequency | nh_test_name = 'bell' |
| torus_domain_length | R | 100000.0 | m | length of slice domain | nh_test_name = 'bell', lplane=.TRUE. |
| rotate_axis_deg | R | 0.0 | deg | Earth's rotation axis pitch angle | nh_test_name= 'PA' |
| lhs_nh_vn_ptb | L | .TRUE. | | Add random noise to the initial wind field in the Held-Suarez test. | nh_test_name= 'HS_nh' |
| lhs_fric_heat | L | .FALSE. | | add frictional heating from Rayleigh friction in the Held-Suarez test. | nh_test_name= 'HS_nh' |
| hs_nh_vn_ptb_scale | R | 1. | m/s | Magnitude of the random noise added to the initial wind field in the Held-Suarez test. | nh_test_name= 'HS_nh' |
| rh_at_1000hpa | R | 0.7 | 1 | relative humidity at 1000 hPa | nh_test_name= 'jabw', nh_test_name= 'mrw' |
| qv_max | R | 20.e-3 | kg/kg | specific humidity in the tropics | nh_test_name= 'jabw', nh_test_name= 'mrw' |
| ape_sst_case | C | 'sst1' | | SST distribution selection 'sst1': Control experiment 'sst2': Peaked experiment 'sst3': Flat experiment 'sst4': Control-5N experiment 'sst_qobs': Qobs SST distribution exp. | nh_test_name='APE_nh' |
| linit_tracer_fv | L | .TRUE. | | Finite volume initialization for tracer fields | ctest_name='PA' |

Defined and used in: src/testcases/mo_nh_testcases.f90

4 Externally provided data

4.1 ext_par_ctl (Scope: itopo=1 in run_nml)

| Parameter | Type | Default | Unit | Description | Scope |
|--------------------|------|----------|------|-----------------------------------|------------------------|
| n_iter_smooth_topo | I | 35 | | iterations of topography smoother | itopo = 1 |
| fac_smooth_topo | R | 0.015625 | | pre-factor of topography smoother | n_iter_smooth_topo > 0 |

Defined and used in: src/namelists/mo_global_variables.f90

4.2 Information on vertical level distribution

The hydrostatic and nonhydrostatic models need hybrid vertical level information to generate the terrain following coordinates. The hybrid level specification is stored in <icon home>/hyb_params/HYB_PARAMS_<nlev>. The **hydrostatic** model assumes to get **pressure based** coordinates, the **nonhydrostatic** model expects **height based** coordinates. For further information see <icon home>/hyb_params/README.