Section 4

COMMON BLOCKS

This section first describes common blocks that are not associated with pointer addresses (4.1) and then those that are associated with pointers (4.2). The name of each common block (listed alphabetically) is followed by a brief description of the block's general contents. The definition, dimension, and units for all variables (or constants) within each common block are also given in alphabetical order along with the beginning pointer > address for those having pointers.

4.1 Common Blocks Without Pointers

4.1.1 ADDR0

/ADDR0/ holds a storage array for pointer addresses.

IAXALL (**NUMVAR**, **MAXNES**): storage array for pointer addresses.

4.1.2 ARASCH1

/ARASCH1/ holds arrays used in the Arakawa-Schubert convection scheme.

KDT (**MIXA, MJXA, MAXNES**); time-step counter denoting how long convection has been active.

OUTTQ (**MIXA**, **MJXA**, **MKXA**, **MAXNES**); q_v tendency (kg kg^{-1} s^{-1}).

OUTTT (**MIXA**, **MJXA**, **MKXA**, **MAXNES**); T tendency (K s^{-1}).

PRETT (**MIXA**, **MJXA**, **MAXNES**); rainfall rate (mm s^{-1}).

4.1.3 ASSEL

/ ASSEL / stores constants for the Asselin filter.

XMUT (**MIX**, **MJX**, **MAXNES**); constants for Asselin filter.

XMUU (**MIX**, **MJX**, **MAXNES**); constants for Asselin filter.

XNUT (**MIX**, **MJX**, **MAXNES**); constants for Asselin filter.

XNUU (**MIX**, **MJX**, **MAXNES**); constants for Asselin filter.

4.1.4 BLANK

Two BLANK common blocks contain matrix operation arrays and some other variables used for the split-explicit scheme.

A (**KX**, **KX**); a matrix operator used in the calculation of array **AM** for vertical modes.

A1 (**KX**, **KX**); local array in VMODES that holds a variable used in the matrix operations.

A2 (**KX**, **KX**); local array in VMODES that holds a variable used in the matrix operations.

A3 (**KX**, **KX**); local array in VMODES that holds a variable used in the matrix operations.

A4 (**KX**, **KX**); local array in VMODES that holds a variable used in the matrix operations.

ALPHA1 = **HYDROS*TBARH / PS** (K cb^{-1}) in Daley's variational scheme.

ALPHA2 = **HWEIGH** in Daley's variational scheme.

CPFAC (**MKX**); summed sigma-weighted inverse of the **TAU** matrix (kg J^{-1}) for vertical modes.

D1 (**KX**, **KX**); local array in VMODES that holds a variable used in the matrix operations.

D2 (**KX**, **KX**); local array in VMODES that holds a variable used in the matrix operations.

DSIGMA (**MKX**); thickness of the sigma layer.

E1 (**KX**, **KX**); local array in VMODES that holds a variable used in the matrix operations.

E2 (**KX**, **KX**); local array in VMODES that holds a variable used in the matrix operations.

E3 (**KX**, **KX**); local array in VMODES that holds a variable used in the matrix operations.

G1 (**KX**, **KX**); local array in VMODES that holds a variable used in the matrix operations.

G2 (**KX**, **KX**); local array in VMODES that holds a variable used in the matrix operations.

G3 (**KX**, **KX**); local array in VMODES that holds a variable used in the matrix operations.

HWEIGH (**MKX**); a weighting factor for temperature in Daley's variational scheme.

HYDROC (**MKX**, **KXP1**); hydrostatic matrix (K) for vertical modes used as a multiplier of the log (**SIGMA**∗**P**S+**PT**) vector.

HYDROR (**MKX**, **MKX**); matrix inverse of **HYDROS** for vertical mode calculations.

HYDROS (**MKX**, **MKX**); hydrostatic matrix for vertical modes used as a multiplier of the T vector.

PD = **PS - PTOP**, where **PS** is the average value of p*.

PS p* (cb) averaged.

PT top of model (cb).

R gas constant for dry air (= 287.04 J kg^{-1} K^{-1}).

S1 (**KX**, **KX**); local array in VMODES that holds a variable used in the matrix operations.

S2 (**KX**, **KX**); local array in VMODES that holds a variable used in the matrix operations.

SIGMAH (**KXP1**); half-sigma levels.

TAU (**KX**, **KX**); local matrix variable in VMODES that is coupled with the gas constant and has units (J kg^{-1}).

TBARF (**KXP1**); average temperature (K) on the full-sigma levels.

TBARH (**MKX**); average temperature (K) on the half-sigma levels.

T**HETAF** (**KXP1**); average potential temperature (K) on the full-sigma levels.

THETAH (**KX**); average potential temperature (K) on the half-sigma levels.

TWEIGH (**KX**); sigma weighted **TBARH** (K).

VARPA1 (**MKX**, **KXP1**); array used in Daley's variational scheme for determination of p_s changes (cb^2 K^{-1}).

VARPA2 (**KXP1**, **KXP1**); array used in Daley's variational scheme for determination of p_s changes (cb^2).

W1 (**KX**, **KX**); local array in VMODES that holds a variable used in the matrix operations.

W2 (**KX**, **KX**); local array in VMODES that holds a variable used in the matrix operations.

W3 (**KXP1**, KX); local array in VMODES that holds a variable used in the matrix operations.

X1 (**KX**, **KX**); local array in VMODES that holds a variable used in the matrix operations.

4.1.5 CFD

/CFD/ contains scratch arrays used for FDDA.

BLDUM2D (**MIXF**, **MJXF**); scratch array used for analysis nudging.

DUM2D (**MIXF**, **MJXF**); scratch array used for analysis nudging.

SCR2D (**MIXF**, **MJXF**); scratch array used for analysis nudging.

4.1.6 CFDDAGD

/CFDDAGD/ contains nudging coefficients and weighting factors for FDDA. (Second index varies over type of analysis nudging: 1 = 3-D analysis nudging, 2 = surface analysis nudging within PBL).

GP (**MAXSES**, 2); analysis nudging coefficient (s^{-1}) for p*.

GQ (**MAXSES**, 2); analysis nudging coefficient (s^{-1}) for mixing ratio.

GR (**MAXSES**); analysis nudging coefficient (m^2 s^{-1}) for vorticity.

GT (**MAXSES**, 2); analysis nudging coefficient (s^{-1}) for temperature.

GV (**MAXSES**, 2); analysis nudging coefficient (s^{-1}) for wind.

TFAC (**MAXNES**, 2); temporal weighting factor for analysis nudging.

ZFAC (**MAXNES**, 2, **MKXF**); vertical weighting factor for analysis nudging.

4.1.7 DEPAR2

/DEPAR2/ stores arrays used for the finer-domain boundary interpolations.

IG0 (**MJX**, **MIX**); grid-point **I** value.

JG0 (**MJX**, **MIX**); grid-point **J** value.

XIG (9); **I**-direction distance in grid-point units from finer to coarser grid point.

XJG (9); **J**-direction distance in grid-point units from finer to coarser grid point.

4.1.8 HEADER

/HEADER/ contains arrays holding record header information.

MIF (**NUMVALS**, **NUMPROGS**); integer data arrays of record header information.

MRF (**NUMVALS**, **NUMPROGS**); real data arrays of record header information.

4.1.9 HEADERC

/HEADERC/ contains arrays providing character descriptions of record information.

MIFC (**NUMVALS**, **NUMPROGS**); character descriptions of the integer variables in **MIF**.

MRFC (**NUMVALS**, **NUMPROGS**); character descriptions of the real variables in **MRF**.

4.1.10 HUGE

/HUGE/	holds the main storage array for MM5.
ALLARR	(**IRHUGE**, **MAXNES**); stores all real variables needed for restart.
INTALL	(**IIHUGE, MAXNES**); stores all integer variables needed for restart.

4.1.11 JRG

/JRG/	contains constants that are used for the mixed phase explicit-moisture routine (EXMOISR).
ACRCR	used in collection of cloud water by rain (s^{-1} $m^{-3-\mathbf{BVT}}$).
ACRCS	used in collection of cloud water by snow (s^{-1} $m^{-3-\mathbf{BVTS}}$).
ACRIS	used in collection of cloud ice by snow (s^{-1} $m^{-3-\mathbf{BVTS}}$).
AP	used in equation for heterogeneous freezing of cloud droplets (= .66 K).
ATO	constant in Fletcher's formula (K^{-1}).
BACRCR	used in collection of cloud water by rain.
BACRCS	used in collection of cloud water by snow.
BACRIS	used in collection of cloud ice by snow.
BP	used in equation for heterogeneous freezing of cloud droplets (= 100 m^{-3} s^{-1}).
BR	used in formula for fall speed of rain.
BS	used in formula for fall speed of snow.
CNP	used in equation for heterogeneous freezing of cloud droplets (= 1.E10 m^{-3}).
DEPR1	used for evaporation of rain (m^{-4}).
DEPR2	used for evaporation of rain ($m\ s^{-1}$).
DEPR3	used for evaporation of rain.
DEPR4	used for evaporation of rain.

DEPS1 used for sublimation of snow (m^{-4}).

DEPS2 used for sublimation of snow ($m\ s^{-1}$).

DEPS3 used for sublimation of snow.

DEPS4 used for sublimation of snow.

DRAIN density of rain (= 1000 kg m^{-3}).

FRAIN used in fall speed formula ($s^{-1}\ m^{1-\mathbf{BVT}}$).

FSNOW used in fall speed formula ($s^{-1}\ m^{1-\mathbf{BVTS}}$).

HGFR value at which homogeneous freezing of cloud water occurs (= 233 K).

PMS1 used in the equation for melting of snow (m^{-4}).

PMS2 used in the equation for melting of snow ($m\ s^{-1}$).

PMS3 used in the equation for melting of snow.

PMS4 used in the equation for melting of snow.

TOPR top of slope parameter in Marshall-Palmer size distribution for rain (kg m^{-7}).

TOPS top of slope parameter in Marshall-Palmer size distribution for snow (kg m^{-7}).

TNO constant in Fletcher's formula (m^{-3}).

XM01 used in formula for initiation of cloud ice (kg).

XSMAX used in conversion of cloud ice to snow (kg).

4.1.12 LANDUSE

/LANDUSE/ contains data for surface land use categories.

ALBD (13, 2); Albedo (percent).

SCFX (13); Scale factor for calculating the new albedo due to snow cover effects.

SFEM (13, 2); Surface emissivity (fraction).

SFHC (13, 2); Surface heat capacity per unit volume (J $m^{-3}\ K^{-1}$).

SFZ0 (13, 2); Surface roughness length (cm).

SLMO (13, 2); Soil moisture availablity (fraction).

THERIN (13, 2); Thermal inertia (0.01 cal cm^{-2} K^{-1} $s^{-0.5}$)

4.1.13 MIC

/MIC/ contains prognostic variables at time t+1, tendencies, and scratch arrays.

HSCR1 (**MIX**, **MJX**); a 2-D scratch (**I**, **J**) array.

HSCR2 (**MIX**, **MJX**); a 2-D scratch (**I**, **J**) array.

HSCR3 (**MIX**, **MJX**); a 2-D scratch (**I**, **J**) array.

HSCR4 (**MIX**, **MJX**); a 2-D scratch (**I**, **J**) array.

IPTN (**MJX**); used for determining the noise ratio for hydrostatic runs.

PHI (**MJX**, **MIX**, **MKX**); geopotential (m^2 s^{-2}).

PSC (**MJX**, **MIX**); p* at time t+1 (cb).

PTEN (**MIX**, **MJX**); the tendency of p* (cb s^{-1}).

PTNTOT (**MJX**); pressure tendency (cb s^{-1}).

PT2TOT (**MJX**); time derivative of the pressure tendency (cb s^{-2}).

QCC (**MJXM**, **MIXM**, **MKXM**); p^*q_c at time t+1 (cb kg kg^{-1}).

QDOT (**MJX**, **MIX**, **KXP1**); vertical sigma velocity, $d\sigma / dt$ (s^{-1}). For the nested domain, the boundary values are computed from coarser-domain tendencies.

QIC (**MJXIC**, **MIXIC**, **MKXIC**); p^*q_i at time t+1 (cb kg kg^{-1}).

QNIC (**MJXIC**, **MIXIC**, **MKXIC**); p^*q_{ni} at time t+1 (cb kg kg^{-1}).

QRC (**MJXM**, **MIXM**, **MKXM**); p^*q_r at time t+1 (cb kg kg^{-1}).

QVC (**MJXM**, **MIXM**, **MKXM**); p^*q_v at time t+1 (cb kg kg^{-1}).

TC (**MJX**, **MIX**, **MKX**); p*T at time t+1 (cb K).

UC (**MJX**, **MIX**, **MKX**); p*U at time t+1 (cb m s^{-1}).

UCC (**MJX**, **MIX**, **MKX**); temporary p*U tendency (cb m s^{-2}).

UCD (**MJX**, **MIX**, **MKX**); temporary p*U tendency (cb m s^{-2}).

VC (**MJX**, **MIX**, **MKX**); p*V at time t+1 (cb m s^{-1}).

VCC (**MJX**, **MIX**, **MKX**); temporary p*V tendency (cb m s^{-2}).

VCD (**MJX**, **MIX**, **MKX**); temporary p*V tendency (cb m s^{-2}).

4.1.14 NESLEV

/NESLEV/ holds variables providing the finer-domain information.

LEVIDN (**MAXSES**); nest level.

NSTTOT total number of active domains.

NUMLV (**NLNES**, **MAXSES**); total number of active domains on given nest level.

NUMNC (**MAXSES**); identifier of mother domain.

4.1.15 NHCNST

/NHCNST/ stores variables (or constants) needed for the nonhydrostatic option.

BET beta parameter for time-averaging in implicit scheme (= 0.4).

DTS short time step (s) in SOUND < (**DX**/(speed of sound)).

GAMMA ratio of heat capacities c_p / c_v.

ISTEP number of short time steps (**DTS**) per leapfrog step (= 4).

P0 reference sea-level pressure (Pa).

TLP lapse rate of reference temperature (K) with respect to log (pressure).

TS0 reference sea-level temperature (K).

4.1.16 NHTENS

/NHTENS/ contains slow tendencies for SOUND routine.

PPTENS (**MIXNH**, **MJXNH**, **MKXNH**); p' slow tendency (Pa s^{-1}).

UTENS (**MIXNH**, **MJXNH**, **MKXNH**); U velocity slow tendency (m s^{-2}).

VTENS (**MIXNH**, **MJXNH**, **MKXNH**); V velocity slow tendency (m s^{-2}).

WTENS (**MIXNH**, **MJXNH**, **KXP1NH**); W slow tendency (m s^{-2}).

4.1.17 PARAM2

/PARAM2/ contains logicals and integers pertaining to selection of model options.

ALBLND albedo over land, used when **ISFPAR** = 0.

BDYTIM time (min) after which boundary conditions are needed or the final time of the present boundary conditions.

IABSOR sponge absorber at top of model, (0=no;1=yes).

IACTIV (**MAXSES**); is nested domain active, (0=no;1=yes).

IBLTYP (**MAXSES**); will bulk PBL or Blackadar PBL be used in the model:
= 0; frictionless.
= 1; bulk PBL.
= 2; multi-level Blackadar PBL.

IBMOIST will initial and boundary conditions be provided for water/ice variables, (0=no;1=yes).

IBOUDY (**MAXSES**); indicates type of lateral boundary conditions:
= 0; fixed.
= 1; relaxation.
= 2; time dependent (from observations or large-scale model).
= 3; time and inflow/outflow dependent. Nonhydrostatic boundary contitions.
= 4; sponge.

ICDCON (**MAXSES**); are drag coefficients constants when using bulk PBL, (0=no;1=yes--function of terrain height only).

ICLOUD (**MAXSES**); will the radiation effects due to clouds be considered. Used if surface heat and moisture fluxes are calculated (**ISFFLX**=1) and ground temperature is predicted from the budget (**ITGFLG**=1), (0=no;1=yes).

ICOR3D will full Coriolis force including vertical component be considered (nonhydrostatic option only), (0=no;1=yes).

ICUPA (**MAXSES**); what type of cumulus parameterization will be employed:

= 1; none.

= 2; Anthes-Kuo scheme.

= 3; Grell scheme.

= 4; Arakawa-Schubert scheme.

ICUSTB will the stability check in the Kuo cumulus parameterization scheme be activated, (0=no;1=yes).

IDRY (**MAXSES**); is this run a moist or dry forecast, (0=moist;1=dry).

IEXICE will explicit moisture scheme with ice-physics effects be used, (0=no, 1=yes).

IFDRY is this a fake dry run, (no latent heat release) (0=no;1=yes).

IFEED feedback option:

= 0; one-way.

= 1; MM4 method.

= 2; no smoothing.

= 3; light smoothing.

IFPRT is printer output desired, (0=no;1=yes).

IFRAD will radiative cooling of the atmosphere be considered:

= 0; no.

= 1; use simple radiation routine.

= 2; use full radiation (LWRAD and SWRAD).

IFREST is this run restarted from a saved file, (.T. or .F.).

IFSAVE will a saved file will be written for restart, (.T. or .F.).

IFSNOW (**MAXSES**); will snow-cover data be considered, (0=no;1=yes).

IFTAPE will output be saved on files for INTERP, (0=no;1=yes).

IFUPR will upper radiative boundary conditions be used, (0=no;1=yes).

IMOIAV (**MAXSES**); is moisture availability a function of time, (0=no;1=yes).

IMOIST (**MAXSES**); will cumulus parameterization or explicit moisture be used.
= 0; dry case with passive, moisture variables (including q_v).
= 1; no explicit moisture.
= 2; explicit moisture.

IMOVCO (**MAXSES**); counter for how often nested domain is moved.

IMOVE (**MAXSES**); will nested domain be moved, (0=no;1=yes).

IMOVEI (**MAXSES**, 10); number of grid points to move nested domain in the **I**-direction.

IMOVEJ (**MAXSES**, 10); number of grid points to move nested domain in the **J**-direction

IMOVET (**MAXSES**, 10); when in minutes will nested domain be moved.

I**MVDIF** will moist-adiabatic vertical diffusion in clouds be included, (0=no;1=yes).

IOVERW (**MAXSES**); will interpolated nested domain be overwritten with user's own analysis, (0=no;1=yes).

ISFFLX (**MAXSES**); will surface heat and moisture fluxes be calculated, (0=no;1=yes).

ISFOUT will output of surface / terrain parameters be printed (**IFPRT**=1), (0=no;1=yes).

ISFPAR (**MAXSES**); are surface / land-use parameters variable or constant. Used only if (**ISFFLX** = 1 and **ITGFLG**=1), (0=constant;1=variable).

ISHALLO (**MAXSES**); will shallow convection be used, (0=no;1=yes).

ITGFLG (**MAXSES**); indicates the method for calculating ground temperature (**ISFFLX**=1):
= 1; it will be calculated from the budget.
= 2; it will be calculated from a sinusoidal function. (not available)
= 3; it will be determined from specified constants.

ITQPBL tendencies at the boundaries will be computed in HIRPBL (**IBLTYP**=2) when **IBOUDY** = 1, 2, 3, or 4, (0=no;1=yes).

IVMIXM	(**MAXSES**); will vertical mixing of momentum be considered (**IBLTYP**=2), (0=no;1=yes).
IXTIMR	restart time (min) into forecast.
MASCHK	time-step frequency for printout of mass conservation information.
NESTI	(**MAXSES**); origin location in mother domain of nested domain in **I**-direction.
NESTIX	(**MAXSES**); **I**-dimension of nested domain.
NESTJ	(**MAXSES**); origin location in mother domain of nested domain in **J**-direction.
NESTJX	(**MAXSES**); **J**-dimension of nested domain.
NTRAD	(**MAXSES**); number of time steps between radiation computations, (=**RADFRQ** / **DTMIN**).
NTSAVE	number of times output has been written to a file for restart (**IFSAVE**=.T.) and the run is restarting from a saved file (**IFREST**=.T.).
NTTAPE	number of times output for INTERP has been written, (**IFTAPE**=1;**IFREST**=.T.).
PRTFRQ	interval (min) for printer output (**IFPRT**=1).
PRTTIM	time (min) for printer output (computed from **PRTFRQ**).
RADFRQ	frequency (min) that solar radiation is computed (**ISFFLX**=1;**ITGFLG**=1).
SAVFRQ	interval (min) between save operations (**IFSAVE**=.T.).
SAVTIM	time (min) for saving data for restart (computed from **SAVFRQ**).
TAPFRQ	interval (min) of output data for INTERP (**IFTAPE**=1).
TAPTIM	time (min) for outputting data for INTERP (computed from **TAPFRQ**).
TBDYBE	initial time (min) of the present boundary conditions, output from **BDYIN.**
THINLD	thermal inertia over land when **ISFPAR** = 0 (cal cm^{-2} K^{-1} $s^{-1/2}$).
XENNES	ending time of computations for a given nested domain.
XMAVA	moisture availability, when **ISFPAR** = 0.
XSTNES	beginning time of computations for a given nested domain.
ZZLND	roughness length (m) over land, when **ISFPAR** = 0.

4.1.18 PARAM3

/PARAM3/ holds constants used for physical processes and indices used to specify grid-point location or vertical level.

A (**MKX**); half-sigma levels where (**A** (**K**)=0.5∗ (**SIGMA** (**K**+1)+**SIGMA** (**K**))).

ALPHA constant used in Brown and Campana (1978) scheme (= 0.2495).

BETA constant used in Brown and Campana scheme (= 1.-2.∗**ALPHA**).

CD exchange coefficient for momentum over land (= 0.002).

CDSEA exchange coefficient for momentum over water (= 0.0015).

CH exchange coefficient for heat over land (= 0.002).

CHSEA exchange coefficient for heat over water (= 0.0015).

CP specific heat at constant pressure for dry air (= 1004 J kg^{-1} K^{-1}).

DECLIN solar declination angle for each day of the forecast (radians).

DECTIM time (in min) after which solar declination must be recalculated.

DEGRAD conversion factor from degrees to radians (= $2 * \pi / 360$ = 0.0174533).

DELTMX maximum time step (s) allowed in the model (= **DT**).

DPD constant to compute the longitude of the sun measured in the ecliptic plane from the vernal equinox (Julian day = 81) (= 360/365=0.986301).

DSIGMA (**MKX**); thickness of sigma levels (i.e. **SIGMA** (**K**+1) - **SIGMA** (**K**)).

EOMEG earth’s angular velocity (= 7.2722E-5 s^{-1}).

G gravity (= 9.8 m s^{-2}).

GMT Greenwich Mean Time of the initial data (hours).

GNU constant used in Asselin time filter for all prognostic variables (= 0.1).

GNUHF = **GNU.**

ICON (**MJX**); counter for points at which cumulus parameterization is invoked.

ICONS (**MJX**); number of shallow convection points.

IRDTT a counter for keeping track the total number of free convective points (in HIRPBL) which exceed certain critical values.

ISKF number of input files to be skipped at the beginning of a simulation.

ISPGD number of dot-point slices on the boundary affected by sponge or relaxation boundary conditions (=**NSPGD**-1).

ISPGX same as **ISPGD** but for cross points (=**NSPGX**-1).

JOUT index for variables at time t+1 (temporary storage for variable transfer).

JULDAY Julian date of the initial data set.

JXSEX (**MAXNES**); **J**-index of the north-south vertical slice for printer output.

KARMAN Von Karman constant (= 0.4).

KCHI sigma level of the base of high clouds.

KCLO sigma level of the base of low clouds.

KCMD sigma level of the base of middle clouds.

KTIR sigma level most representative of the atmospheric temperature for downward IR calculations.

KXOUT (**MAXNES**); **K**-level of the horizontal slice for printer output.

K700 sigma level ~ 700 mb, where maximum **THETAE** is regarded as origin of air parcel that produces cloud.

MDATE time and date of the initial data set in yymmddhh format.

OMU constant used in Asselin time filter for all prognostic variables (= .1 - .2 $*$ **GNU**).

OMUHF constant used in Asselin time filter for all prognostic variables (= 1. - 2. $*$ **GNUHF**).

PTOP pressure (cb) at the top of the model.

PTOP4 = 4. $*$ **PTOP**.

QCON (**MKX**); used to compute the vertical interpolation coefficients for q_v (= (**SIGMA** (**K**) - **A** (**K**)) / (**A** (**K**-1) - **A** (**K**))).

R gas constant for dry air (= 287 J kg^{-1} K^{-1}).

ROVCP = **R** / **CP**.

ROVG = **R** / **G** (m K^{-1}).

SIGMA (**KXP1**); full sigma levels.

SOLCON solar constant (= 1395.6 J m^{-2} s^{-1}).

STBOLT Stefan Boltzmann's constant (= 5.67051E-8 J m^{-2} s^{-1} K^{-4}).

TIMAX maximum forecast time (min).

TRAN (46, 13); transmission coefficient, a function of precipitable water and path length (read in).

TWT (**MKX**, 2); coefficient used for vertical interpolation of temperature.

WGTD (**NSPGD**); sponge coefficient for dot-point variables.

WGTX (**NSPGX**); sponge coefficient for cross-point variables.

4.1.19 PARFDDA

/ PARFDDA / contains integers and constants pertaining to selection of FDDA options. For arrays dimensioned (**MAXSES**, 2), second index varies over type of analysis nudging: 1 = 3-D analysis nudging, 2 = surface analysis nudging within PBL.

DCON = 1 / **DPSMX** used for observation nudging.

DIFTIM (**MAXSES**, 2); time (min) between input analyses for analysis nudging.

DIFZ height above ground level (m) of lowest half-level.

DPSMX maximum p* change (cb) allowed within influence range of a surface observation used for observation nudging.

FDAEND (**MAXSES**); time (min) for termination of FDDA.

FDASTA (**MAXSES**); time (min) for initiation of FDDA.

GIP (**MAXSES**); observation-nudging coefficient (s^{-1}) for p*.

GIQ (**MAXSES**); observation-nudging coefficient (s^{-1}) for mixing ratio.

GIT (**MAXSES**); observation-nudging coefficient (s^{-1}) for temperature.

GIV (**MAXSES**); observation-nudging coefficient (s^{-1}) for wind.

I4D (**MAXSES**, 2); will FDDA analysis nudging be employed, (0=no;1=yes).

I4DI (**MAXSES**); will FDDA observation nudging be employed, (0=no;1=yes).

I4DITOT flag set to nonzero if observation nudging is active on any mesh.

IBLNOP (**MAXSES**, 4); flag for choice of surface-analysis nudging options:

= 0; apply surface-analysis nudging correction from the surface layer to every PBL layer.

= 1; compute surface-analysis nudging correction for each PBL layer by differencing surface-layer observed value and model-simulated value at each layer. Second index varies over variable.

IDQ indicator flag used when **IMOISP** = 1.

IDQN indicator flag used when **IMOISP** = 1.

IMOIS (**MAXSES**, 2); will the mixing ratio be nudged from analyses, (0=no;1=yes).

IMOISP (**MAXSES**, 2); will the mixing ratio be nudged, (0=no;1=yes), based on analyzed precipitation.

INDT (**MAXSES**, 2); flag for type of temporal weighting used for analysis nudging (0=no;1=user defined variation; 2=variation for surface-analysis nudging based on data density).

INDXY (**MAXSES**, 2); flag for type of horizontal weighting used for analysis nudging (0=no;1=user defined variation).

INDZ (**MAXSES**, 2); flag for type of vertical weighting used for analysis nudging (0=no;1=user defined variation).

INONBL (**MAXSES**, 4); will PBL fields be nudged from 3-D analyses when not using surface-analysis nudging within PBL. (0=yes; 1=exclude certain variables depending on integer value of second index).

INOPRO (**MAXSES**, 2); flag to withhold processing for specific analyses in surface-analysis nudging.

INT4 (**MAXSES**, 2); will temporal interpolation of analysis be employed for for analysis nudging, (0=no;1=yes).

IONF observation-nudging frequency in coarse grid time steps for observation-nudging calculations.

IPSTR (**MAXSES**, 2); flag for analysis nudging of p* in the hydrostatic version of MM5, (0=no;1=yes).

IROT (**MAXSES**); will vorticity be nudged from analyses, (0=no;1=yes).

ISMOIS (**MAXSES**); will the mixing ratio be nudged from observations, (0=no;1=yes).

ISPSTR (**MAXSES**); flag for observation nudging of p* in the hydrostatic version of MM5, (0=no;1=yes).

ISTEMP (**MAXSES**); will the temperature be nudged from observations, (0=no;1=yes).

ISWIND (**MAXSES**); will the wind field be nudged from observations, (0=no;1=yes).

ITEMP (**MAXSES**, 2); will the temperature be nudged from analyses, (0=no;1=yes).

IUN1 input unit number for 3-D analysis-nudging file.

IUN2 input unit number for 3-D analysis-nudging file.

IWIND (**MAXSES**, 2); will the wind field be nudged from analyses, (0=no;1=yes).

IWINDS (**MAXSES**, 2); will logarithmic-wind adjustment of analyzed surface wind speed be used before applying it throughout the PBL, (0=no;1=yes),

IWTSIG (**MAXSES**); flag for applying observation-nudging correction on pressure (0) or sigma (1) surfaces.

NPFG coarse-grid time-step frequency for select diagnostic print of analysis nudging.

NPFI coarse-grid time-step frequency for select diagnostic print of observation nudging.

NPFV vertical frequency for select diagnostic print of FDDA information.

NSTA number of observations available within time window for observation nudging.

PFREE user-defined pressure level (cb) where terrain effect becomes small.

RINBLW radius of influence (km) for surface analysis nudging where the horizontal weighting function depends on surface data density.

RINFMN multiplier for observation-nudging influence radius (**RINXY**) at the surface.

RINFMX multiplier for observation-nudging influence radius (**RINXY**) at the **PFREE** level.

RINP horizontal radius of influence (km) used when **IMOISP** = 1.

RINSIG vertical radius of influence (in sigma) for distance-weighted nudging corrections (for observation nudging).

RINXY default horizontal radius of influence (km) for distance-weighted nudging corrections (for observation nudging).

TIMANL (**MAXSES**); model time (min) of observed analysis for analysis nudging.

TIMOBP (**MAXSES**); model time (min) of a precipitation analysis.

TWINDO (time window)/2 (min) over which an observation will be used for nudging.

WNDFAC correction factor for surface wind speed adjustment to lowest model half-level in surface-analysis nudging.

XTIMT model time (min) of target analyses for analysis nudging.

XTIM1 model time (min) of initial analyses used in temporal interpolation for analysis nudging.

XTIM2 model time (min) of final analyses used in temporal interpolation for analysis nudging.

XTNEX model time (min) for next call to IN4DGD for input of nudging analysis files.

4.1.20 PBLDIM

/PBLDIM/ holds integers defining PBL top (level) and time step.

KNPBLH (**MJX**); **K**-level where PBL top is located in the north boundary slice.

KPBL2D (**MIX**, **MJX**); top (level) of the PBL.

KSPBLH (**MJX**); **K**-level where PBL top is located in the south boundary slice.

MITER0 = **DT**∗60/**DTMITE** + .99

4.1.21 PMOIST

/PMOIST/ stores constants used for both explicit and convective moisture calculations.

AVT constant used for terminal velocity of raindrops (= 841.99667 $m^{1-\mathbf{BVT}}$ s^{-1}).

AVTS constant used for terminal velocity of snow (= 11.72 $m^{1-\mathbf{BVTS}}$ s^{-1}).

BETA constant in Fletcher's formula (= 0.6).

BVT constant used for terminal velocity of raindrops (= 0.8).

BVTS constant used for terminal velocity of snow (= 0.41).

CONF condensation threshold (= 1.).

EP1 constant used in computing virtual temperature (= 0.608).

EP2 constant used in computing saturation mixing ratio (= 0.622).

G3PB constant for cloud microphysics, $(\Gamma(3.\mathbf{BVT})=\mathbf{G4PB}/(3.\mathbf{BVT}))$, gamma refers to the gamma-function.

G4PB constant for cloud microphysics, $(\Gamma(4.\mathbf{BVT})=17.837425)$.

G5PB constant for cloud microphysics, $(\Gamma(5.\mathbf{BVT})=1.8273)$.

HYDPRE (**MAXNES**); will water-loading effects be considered in hydrostatic equation (**IMOIST**=2), (0=no;1=yes).

IEVAP (**MAXNES**); will evaporation effects be considered (**IMOIST**=2):
< 0; The evaporation of rainwater only is not considered.
= 0; No evaporation is considered for rain or cloud.
>0; The evaporation is considered.

N0R constant used in Marshall-Palmer distribution of raindrops (=8.E6 m^{-4}).

PPI constant used for cloud (rain) microphysics, (= 1./**PI**∗**N0R** m^4).

PPIS constant used for cloud (snow) microphysics, (= 1./**PI**∗**N0S**∗0.1 m^4).

PRAC constant for accretion of cloud droplets (= **PI**∗**N0R**∗**AVT**∗**G3PB**∗0.25 $m^{-3-\mathbf{BVT}}$).

PRACS constant for accretion of cloud snow (= **PI**∗**N0S**∗**AVTS**∗**G3PBS**∗0.25 ∗ **ESI** $m^{-3-\mathbf{BVTS}}$).

PREC1 constant used for evaporation rate of raindrops (= 2∗**PI**∗**N0R**∗0.78 m^{-4}).

PREC2 constant used for evaporation rate of raindrops
= 2∗**PI**∗**N0R**∗0.32∗**AVT** $^{1/2}$ ∗**G5PB** $m^{-3.5-0.5\mathbf{BVT}}$).

PRECS1 constant used for evaporation rate of snow (= 4.∗**N0S**∗.65 m^{-4}).

PRECS2 constant used for evaporation rate of snow
(= 4.∗**N0S**∗.44∗**AVTS** $^{1/2}$ ∗**G5PBS** $m^{-3.5-0.5\mathbf{BVTS}}$).

QCK1 constant auto conversion rate (= 1.E-3 kg kg^{-1} s^{-1}).

QCTH threshold for the onset of auto conversion (kg kg^{-1}).

QDCRIT threshold of moisture convergence for the onset of precipitation (cb kg kg^{-1} s^{-1}).

QWGHT (**MKX**); redistribution function in Kuo scheme for moisture flux due to convection.

RV gas constant for water vapor (= 461.5 J kg^{-1} K^{-1}).

SVPT0 constant used in computing saturation vapor pressure (= 273.15 K) correction.

SVP1 constant used in computing saturation vapor pressure (= 0.6112 cb).

SVP2 constant used in computing saturation vapor pressure (= 17.67).

SVP3 constant used in computing saturation vapor pressure (= 29.65 K).

TO freezing point (= 273.15 K).

TWGHT (**MKX**, 5: **MKX**, 1: **MKX**-3); heating profile for the Kuo cumulus parameterization.

VQFLX (**MKX**, 5: **MKX**, 1: **MKX**-3); weight function for eddy fluxes of convective moisture in Kuo scheme.

VTC constant used for terminal velocity of raindrops (= **AVT**∗**G4PB** / 6 $m^{1-\mathbf{BVT}}$ s^{-1}).

VTCS constant used for terminal velocity of snow (= **AVTS**∗**G4PBS** / 6 $m^{1-\mathbf{BVTS}}$ s^{-1}).

XLF0 latent heat of fusion (= .3337E6 J kg^{-1}).

XLS latent heat of sublimation (= **XLV** (T)+**XLF0** J kg^{-1}).

XLV latent heat of vaporization (= 2.5E6 J kg^{-1}).

XLV0 constant in **XLV** (T) (= 3.15E6 J kg^{-1}), where **XLV** (T)=**XLV0**-**XLV1**∗T.

XLV1 constant in **XLV** (T) (= 2370 J kg^{-1} K^{-1}).

XLVOCP = **XLV** / **CP** (K).

XMMAX mass of largest ice crystal (= 9.4E-10 kg).

XMO mass of initial ice crystal $\left(= (12.9E\text{-}6 / 16.3)^2 \text{ kg}\right)$.

XMOIST (**MAXSES**); will moisture effects be used in the thermodynamic equation, (0=no;1=yes).

XN0 constant in Fletcher's formula (= 0.01 m^{-3}).

4.1.22 PSANET

/PSANET/ stores arrays used for finer-domain boundary interpolations.

PSANE (2, **MIX**); two outermost columns (east).

PSANN (2, **MJX**); two outermost rows (north).

PSANS (2, **MJX**); two outermost rows (south).

PSANW (2, **MIX**); two outermost columns (west).

4.1.23 SIZE

/SIZE/ contains size informatin for the model input data and the surface analysis file (used in FDDA).

NUM3D An integer constant that is the number of 3-D fields in the model initial condition set (i.e., u, v, w, t, q_v).

NUM2D An integer constant that is the number of 2-D fields in the model initial condition set (i.e., ground temperature, coriolis, terrain elevation).

NUM1D An integer constant that is the number of 1-D fields in the model initial condition set (currently not used, NUM1D=0).

NUM0D An integer constant that is the number of 0-D fields in the model initial condition set (currenlty not used, NUM0D=0)

NUMLEVEL **NUMLEVEL**=**NUM3D**+**NUM2D**+**NUM1D**+**NUM0D**.

NUM3DS An integer constant that is the number of 3-D fields in the surface analysis nudging data set (currently not used, NUM3DS=0).

NUM2DS An integer constant that is the number of 2-D fields in the surface analysis nudging data set (i.e., u, v, w, t, q_v).

NUM1DS An integer constant that is the number of 1-D fields in the surface analysis nudging data set (currently not used, NUM1DS=0).

NUM0DS An integer constant that is the number of 0-D fields in the surface analysis nudging data set (currently not used, NUM0DS=0).

NUMLEVELS **NUMLEVELS**=**NUM3DS**+**NUM2DS**+**NUM1DS**+**NUM0DS**.

4.1.24 SOUNDL

/SOUNDL/ contains work arrays for SOUND routine.

E (**MIX, MJX, MKXP1**) work array.

F (**MIX, MJX, MKXP1**) work array.

4.1.25 WORKSP

/WORKSP/ holds a working array used in ZX4LP.

DWKSP (2500); working space in ZX4LP.

4.2 Common Blocks With Pointers

(The coarser-domain common blocks appear in alphabetical order paired with each associated finer-domain block).

4.2.1 ADDR1

/ADDR1/ holds three-dimensional prognostic variables at time t (**XXA**) and time t-1 (**XXB**). /ADDR1/ is for the coarser-domain variables.

IAQCA> **QCA** (**MIXM**, **MJXM**, **MKXM**); p*q_c (cb kg kg^{-1}) at time t.

IAQCB> **QCB** (**MIXM**, **MJXM**, **MKXM**); p*q_c (cb kg kg^{-1}) at time t-1.

IAQIA> **QIA** (**MIXIC**, **MJXIC**, **MKXIC**); p*q_i (cb kg kg^{-1}) at time t.

IAQIB> **QIB** (**MIXIC**, **MJXIC**, **MKXIC**); p*q_i (cb kg kg^{-1}) at time t-1.

IAQNIA> **QNIA** (**MIXIC**, **MJXIC**, **MKXIC**); p*q_{ni} (cb kg kg^{-1}) at time t.

IAQNIB> **QNIB** (**MIXIC**, **MJXIC**, **MKXIC**); p*q_{ni} (cb kg kg^{-1}) at time t-1.

IAQRA> **QRA** (**MIXM**, **MJXM**, **MKXM**); p*q_r (cb kg kg^{-1}) at time t.

IAQRB> **QRB** (**MIXM**, **MJXM**, **MKXM**); p*q_r (cb kg kg^{-1}) at time t-1.

IAQVA> **QVA** (**MIX**, **MJX**, **MKX**); p*q_v (cb kg kg^{-1}) at time t.

IAQVB> **QVB** (**MIX**, **MJX**, **MKX**); p*q_v (cb kg kg^{-1}) at time t-1.

IATA> **TA** (**MIX**, **MJX**, **MKX**); p*T (cb K) at time t.

IATB> **TB** (**MIX**, **MJX**, **MKX**); p*T (cb K) at time t-1.

IAUA> **UA** (**MIX**, **MJX**, **MKX**); p*U (cb m s^{-1}) at time t.

IAUB> **UB** (**MIX**, **MJX**, **MKX**); p*U (cb m s^{-1}) at time t-1.

IAVA> **VA** (**MIX**, **MJX**, **MKX**); p*V (cb m s^{-1}) at time t.

IAVB> **VB** (**MIX**, **MJX**, **MKX**); p*V (cb m s^{-1}) at time t-1.

4.2.2 ADDRN1

/ADDRN1/ is identical to /ADDR1/ except that it is for finer domains instead of the coarser domain, and both variable and address names are slightly changed. For the finer-domain variables, the letter "N" is usually appended to the coarser-domain name such that **UA** becomes **UAN** etc. For the finer-domain addresses, the letter "N" is inserted after the first letter in the coarser-domain name such that **IAUA** becomes **INAUA** etc.

4.2.3 ADDR2

/ADDR2/ holds two-dimensional arrays relating to diagnostic variables, physical processes, and terrestrial information. /ADDR2/ is for the coarser-domain variables.

IAAL> **ALB** (**MIX**, **MJX**); albedo (0< **ALB** <1).

IACG> **CAPG** (**MIX**, **MJX**); thermal capacity of ground slab (J m^{-2} K^{-1}).

IACR> **COSROT** (**MIX**, **MJX**); cos (theta) where theta is angle between y-axis and north.

IAEF> **EF** (**MIX**, **MJX**); other component of Coriolis parameter (s^{-1}).

IAEM> **EMISS** (**MIX**, **MJX**); emissivity.

IAF> **F** (**MIX**, **MJX**); Coriolis parameter (s^{-1}).

IAGL> **GLW** (**MIX**, **MJX**); long-wave radiation (J s^{-1} m^{-2}).

IAGS> **GSW** (**MIX**, **MJX**); shortwave radiation (J s^{-1} m^{-2}).

IAHX> **HFX** (**MIX**, **MJX**); sensible heat flux (J s^{-1} m^{-2}).

IAHO> **HOL** (**MIX**, **MJX**); exchange coefficient for heat and moisture. If HIRPBL is used, **HOL** = PBL height/Monin-Obukov length.

IAHT> **HT** (**MIX**, **MJX**); terrain height times gravity (m^2 s^{-2}).

IAMA> **MAVAIL** (**MIX**, **MJX**); moisture availability.

IAMO> **MOL** (**MIX**, **MJX**); exchange coefficient for momentum when using bulk PBL. If HIRPBL is used, **MOL**=kT* where T* is the eddy temperature (K).

IAMD> **MSFD** (**MIX**, **MJX**); inverse map-scale factor for dot points.

IAMX> **MSFX** (**MIX**, **MJX**); inverse map-scale factor for cross points.

IAPL> **PBL** (**MIX**, **MJX**); planetary boundary layer height (m).

IAPR> **PRW** (**MIX**, **MJX**); precipitable water (cm).

IAPA> **PSA** (**MIX**, **MJX**); p* (cb) at time t.

IAPSI> **PSAINI** (**MIX**, **MJX**); initial p* (cb).

IAPB> **PSB** (**MIX**, **MJX**); p* (cb) at time t-1.

IAQX> **QFX** (**MIX**, **MJX**); latent heat flux (J s^{-1} m^{-2}).

IARC> **RAINC** (**MIX**, **MJX**); accumulated convective rain (cm).

IARN> **RAINNC** (**MIX**, **MJX**); accumulated non-convective rain (cm).

IARP> **RAINP** (**MIX**, **MJX**); scratch array.

IARE> **REGIME** (**MIX**, **MJX**); bulk Richardson number (**BR**) when using bulk PBL, for HIRPBL, **REGIME** stores the PBL classes:
= 1; nighttime stable conditions when **BR** >0.2.
= 2; damped mechanical turbulent conditions when 0.0<**BR**<0.2.
= 3; forced convective conditions when **BR** <0.0 and **HOL** <1.5.
= 4; free convection conditions when **BR** <0.0 and **HOL** >1.5.

IASA> **SATBRT** (**MIX**, **MJX**); land use category.

IASH> **SHC** (**MIX**, **JMX**); dry soil heat capacity (J m^{-3} K^{-1}) when **IMOIAV**=1.

IASR> **SINROT** (**MIX**, **MJX**); sin(theta) where theta is angle between y-axis and north.

IASC> **SNOWC** (**MIX**, **MJX**); snow-cover data.

IATGA> **TGA** (**MIX**, **MJX**); ground temperature (K) at time t.

IATGB> **TGB** (**MIX**, **MJX**); ground temperature (K) at time t-1.

IATH> **THC** (**MIX**, **MJX**); thermal inertia (**IMOIAV**=0) or thermal conductivity (**IMOIAV**=1) based on **SHC** and **MAVAIL** (J m^{-1} s^{-1} K^{-1}).

IATM> **TMN** (**MIX**, **MJX**); constant temperature of infinite reservoir below slab (K)

IAUT> **UST** (**MIX**, **MJX**); friction velocity (u_*) (m s^{-1}).

IALD> **XLAND** (**MIX**, **MJX**); grid point type of surface, (1=land, 2=water).

IALT> **XLAT** (**MIX**, **MJX**); latitude (degrees).

IALO> **XLONG** (**MIX**, **MJX**); longitude (degrees).

IAZN> **ZNT** (**MIX**, **MJX**); roughness length (m).

IAZO> **ZOL** (**MIX**, **MJX**); if HIRPBL is used, **ZOL** = height / Monin-Obukov length.

4.2.4 ADDRN2

/ADDRN2/ is identical to /ADDR2/ except that it is for finer domains instead of the coarser domain, and both variable and address names are slightly changed. For the finer-domain variables, the letter "N" is usually appended to the coarser-domain name such that **EF** becomes **EFN** etc. For the finer-domain addresses, the letter "N" is inserted after the first letter in the coarser-domain name such that **IAEF** becomes **INAEF** etc.

4.2.5 ADDR3

/ADDR3/ stores finer-domain boundary values and tendencies. /ADDR3/ is for the coarser-domain variables.

IAPE> **PEB** (**MIX**, **NSPGX**); east boundary value of p* (cb).

IAPET> **PEBT** (**MIX**, **NSPGX**); east boundary tendency of p* (cb s^{-1}).

IAPN> **PNB** (**MJX**, **NSPGX**); north boundary value of p* (cb).

IAPNT> **PNBT** (**MJX**, **NSPGX**); north boundary tendency of p* (cb s^{-1}).

IAPS> **PSS** (**MJX**, **NSPGX**); south boundary value of p* (cb).

IAPST> **PSBT** (**MJX**, **NSPGX**); south boundary tendency of p* (cb s^{-1}).

IAPW> **PWB** (**MIX**, **NSPGX**); west boundary value of p* (cb).

IAPWT> **PWBT** (**MIX**, **NSPGX**); west boundary tendency of p* (cb s^{-1}).

IAQCE> **QCEB** (**MIXM**, **MKXM**, **NSPGX**); east boundary value of p^*q_c (cb kg kg^{-1}).

IAQCET> **QCEBT** (**MIXM**, **MKXM**, **NSPGX**); east boundary tendency of p^*q_c (cb kg kg^{-1} s^{-1}).

IAQCN> **QCNB** (**MJXM**, **MKXM**, **NSPGX**); north boundary value of p^*q_c (cb kg kg^{-1}).

IAQCNT> **QCNBT** (**MJXM**, **MKXM**, **NSPGX**); north boundary tendency of p^*q_c (cb kg kg^{-1} s^{-1}).

IAQCS> **QCSB** (**MJXM**, **MKXM**, **NSPGX**); south boundary value of p^*q_c (cb kg kg^{-1}).

IAQCST> **QCSBT** (**MJXM**, **MKXM**, **NSPGX**); south boundary tendency of p^*q_c (cb kg kg^{-1} s^{-1}).

IAQCW> **QCWB** (**MIXM**, **MKXM**, **NSPGX**); west boundary value of p^*q_c (cb kg kg^{-1}).

IAQCWT> **QCWBT** (**MIXM**, **MKXM**, **NSPGX**); west boundary tendency of p^*q_c (cb kg kg^{-1} s^{-1}).

IAQE> **QEB** (**MIX**, **MKX**, **NSPGX**); east boundary value of p^*q_v (cb kg kg^{-1}).

IAQET> **QEBT** (**MIX**, **MKX**, **NSPGX**); east boundary tendency of p^*q_v (cb kg kg^{-1} s^{-1}).

IAQIE> **QIEB** (**MIXIC**, **MKXIC**, **NSPGX**); east boundary value of p^*q_i (cb kg kg^{-1}).

IAQIET> **QIEBT** (**MIXIC**, **MKXIC**, **NSPGX**); east boundary tendency of p^*q_i (cb kg kg^{-1} s^{-1}).

IAQIN> **QINB** (**MJXIC**, **MKXIC**, **NSPGX**); north boundary value of p^*q_i (cb kg kg^{-1}).

IAQINT> **QINBT** (**MJXIC**, **MKXIC**, **NSPGX**); north boundary tendency of p^*q_i (cb kg kg^{-1} s^{-1}).

IAQIS> **QISB** (**MJXIC**, **MKXIC**, **NSPGX**); south boundary value of p^*q_i (cb kg kg^{-1}).

IAQIST> **QINST** (**MJXIC**, **MKXIC**, **NSPGX**); south boundary tendency of p^*q_i (cb kg kg^{-1} s^{-1}).

IAQIW> **QIWB** (**MIXIC**, **MKXIC**, **NSPGX**); west boundary value of p^*q_i (cb kg kg^{-1}).

IAQIWT> **QIWBT** (**MIXIC**, **MKXIC**, **NSPGX**); west boundary tendency of p^*q_i (cb kg kg^{-1} s^{-1}).

IAQN> **QNB** (**MJX**, **MKX**, **NSPGX**); north boundary value of p^*q_v (cb kg kg^{-1}).

IAQNT> **QNBT** (**MJX**, **MKX**, **NSPGX**); north boundary tendency of p^*q_v (cb kg kg^{-1} s^{-1}).

IAQNIE> **QNIEB** (**MIXIC**, **MKXIC**, **NSPGX**); east boundary value of p^*q_{ni} (cb kg kg^{-1}).

IAQNIET> **QNIEBT** (**MIXIC**, **MKXIC**, **NSPGX**); east boundary tendency of p^*q_{ni} (cb kg kg^{-1} s^{-1}).

IAQNIN> **QNINB** (**MJXIC**, **MKXIC**, **NSPGX**); north boundary value of p^*q_{ni} (cb kg kg^{-1}).

IAQNINT> **QNINBT** (**MJXIC**, **MKXIC**, **NSPGX**); north boundary tendency of p^*q_{ni} (cb kg kg^{-1} s^{-1}).

IAQNIS> **QNISB** (**MJXIC**, **MKXIC**, **NSPGX**); south boundary value of p^*q_{ni} (cb kg kg^{-1}).

IAQNIST> **QNISBT** (**MJXIC**, **MKXIC**, **NSPGX**); south boundary tendency of p^*q_{ni} (cb kgkg^{-1} s^{-1}).

IAQNIW> **QNIWB** (**MIXIC**, **MKXIC**, **NSPGX**); west boundary value of p^*q_{ni} (cb kg kg^{-1}).

IAQNIWT> **QNIEWT** (**MIXIC**, **MKXIC**, **NSPGX**); west boundary tendency of p^*q_{ni} (cb kg kg^{-1} s^{-1}).

IAQRE> **QREB** (**MIXM**, **MKXM**, **NSPGX**); east boundary value of p^*q_r (cb kg kg^{-1}).

IAQRET> **QREBT** (**MIXM**, **MKXM**, **NSPGX**); east boundary tendency of p^*q_r (cb kg kg^{-1} s^{-1}).

IAQRN> **QRNB** (**MJXM**, **MKXM**, **NSPGX**); north boundary value of p^*q_r (cb kg kg^{-1}).

IAQRNT> **QRNBT** (**MJXM**, **MKXM**, **NSPGX**); north boundary tendency of p^*q_r (cb kg kg^{-1} s^{-1}).

IAQRS> **QRSB** (**MJXM**, **MKXM**, **NSPGX**); south boundary value of p^*q_r (cb kg kg^{-1}).

IAQRST> **QRSBT** (**MJXM**, **MKXM**, **NSPGX**); south boundary tendency of p^*q_r (cb kg kg^{-1} s^{-1}).

IAQRW> **QRWB** (**MIXM**, **MKXM**, **NSPGX**); west boundary value of p^*q_r (cb kg kg^{-1}).

IAQRWT> **QRWBT** (**MIXM**, **MKXM**, **NSPGX**); west boundary tendency of p^*q_r (cb kg kg^{-1} s^{-1}).

IAQS> **QSB** (**MJX**, **MKX**, **NSPGX**); south boundary value of p^*q_v (cb kg kg^{-1}).

IAQST> **QSBT** (**MJX**, **MKX**, **NSPGX**); south boundary tendency of p^*q_v (cb kg kg^{-1} s^{-1}).

IAQW> **QWB** (**MIX**, **MKX**, **NSPGX**); west boundary value of p^*q_v (cb kg kg^{-1}).

IAQWT> **QWBT** (**MIX**, **MKX**, **NSPGX**); west boundary tendency of p^*q_v (cb kg kg^{-1} s^{-1}).

IATE> **TEB** (**MIX**, **MKX**, **NSPGX**); east boundary value of p*T (cb K).

IATET> **TEBT** (**MIX**, **MKX**, **NSPGX**); east boundary tendency of p*T (cb K s^{-1}).

IATN> **TNB** (**MJX**, **MKX**, **NSPGX**); north boundary value of p*T (cb K).

IATNT> **TNBT** (**MJX**, **MKX**, **NSPGX**); north boundary tendency of p*T (cb K s^{-1}).

IATS> **TSB** (**MJX**, **MKX**, **NSPGX**); south boundary value of p*T (cb K).

IATST> **TSBT** (**MJX**, **MKX**, **NSPGX**); south boundary tendency of p*T (cb K s^{-1}).

IATW> **TWB** (**MIX**, **MKX**, **NSPGX**); west boundary value of p*T (cb K).

IATWT> **TWBT** (**MIX**, **MKX**, **NSPGX**); west boundary tendency of p*T (cb K s^{-1}).

IAUE> **UEB** (**MIX**, **MKX**, **NSPGD**); east boundary value of p*U (cb m s^{-1}).

IAUET> **UEBT** (**MIX**, **MKX**, **NSPGD**); east boundary tendency of p*U (cb m s^{-2}).

IAUI1> **UI1** (**MJX**, **MKX**); U value in the **I**=1 vertical slice (m s^{-1}).

IAUI2> **UI2** (**MJX**, **MKX**); U value in the **I**=2 vertical slice (m s^{-1}).

IAUIL> **UIL** (**MJX**, **MKX**); U value in the **I**=**IL** vertical slice (m s^{-1}).

IAUILX> **UILX** (**MJX**, **MKX**); U value in the **I**=**ILX** vertical slice (m s^{-1}).

IAUJ1> **UJ1** (**MIX**, **MKX**); U value in the **J**=1 vertical slice (m s^{-1}).

IAUJ2> **UJ2** (**MIX**, **MKX**); U value in the **J**=2 vertical slice (m s^{-1}).

IAUJL> **UJL** (**MIX**, **MKX**); U value in the **J**=**JL** vertical slice (m s^{-1}).

IAUJLX> **UJLX** (**MIX**, **MKX**); U value in the **J**=**JLX** vertical slice (m s^{-1}).

IAUN> **UNB** (**MJX**, **MKX**, **NSPGD**); north boundary value of p*U (cb m s^{-1}).

IAUNT> **UNBT** (**MJX**, **MKX**, **NSPGD**); north boundary tendency of p*U (cb m s^{-2}).

IAUS> **USB** (**MJX**, **MKX**, **NSPGD**); south boundary value of p*U (cb m s^{-1}).

IAUST> **USBT** (**MJX**, **MKX**, **NSPGD**); south boundary tendency of p*U (cb m s^{-2}).

IAUW> **UWB** (**MIX**, **MKX**, **NSPGD**); west boundary value of p*U (cb m s^{-1}).

IAUWT> **UWBT** (**MIX**, **MKX**, **NSPGD**); west boundary tendency of p*U (cb m s^{-2}).

IAVE> **VEB** (**MIX**, **MKX**, **NSPGD**); east boundary value of p*V (cb m s^{-1}).

IAVET> **VEBT** (**MIX**, **MKX**, **NSPGD**); east boundary tendency of p*V (cb m s^{-2}).

IAVI1> **VI**1 (**MJX**, **MKX**); V value in the **I**=1 vertical slice (m s^{-1}).

IAVI2> **VI**2 (**MJX**, **MKX**); V value in the **I**=2 vertical slice (m s^{-1}).

IAVIL> **VIL** (**MJX**, **MKX**); V value in the **I**=**IL** vertical slice (m s^{-1}).

IAVILX> **VILX** (**MJX**, **MKX**); V value in the **I**=**ILX** vertical slice (m s^{-1}).

IAVJ1> **VJ**1 (**MIX**, **MKX**); V value in the **J**=1 vertical slice (m s^{-1}).

IAVJ2> **VJ**2 (**MIX**, **MKX**); V value in the **J**=2 vertical slice (m s^{-1}).

IAVJL> **VJL** (**MIX**, **MKX**); V value in the **J**=**JL** vertical slice (m s^{-1}).

IAVJLX> **VJLX** (**MIX**, **MKX**); V value in the **J=JLX** vertical slice (m s^{-1}).

IAVN> **VNB** (**MJX**, **MKX**, **NSPGD**); north boundary value of p*V (cb m s^{-1}).

IAVNT> **VNBT** (**MJX**, **MKX**, **NSPGD**); north boundary tendency of p*V (cb m s^{-2}).

IAVS> **VSB** (**MJX**, **MKX**, **NSPGD**); south boundary value of p*V (cb m s^{-1}).

IAVST> **VSBT** (**MJX**, **MKX**, **NSPGD**); south boundary tendency of p*V (cb m s^{-2}).

IAVW> **VWB** (**MIX**, **MKX**, **NSPGD**); west boundary value of p*V (cb m s^{-1}).

IAVWT> **VWBT** (**MIX**, **MKX**, **NSPGD**); west boundary tendency of p*V (cb m s^{-2}).

4.2.6 ADDRN3

/ADDRN3/ is identical to /ADDR3/ except that it is for finer domains instead of the coarser domain, and both variable and address names are slightly changed. For the finer-domain variables, the letter “N” is usually appended to the coarser-domain name such that **PEB** becomes **PEBN** etc. For the finer-domain addresses, the letter “N” is inserted after the first letter in the coarser-domain name such that **IAPE** becomes **INAPE** etc.

4.2.7 ADDR4

/ADDR4/ contains constants or variables pertaining to the model time step, grid size, advection of mass, and total mass in the domain. /ADDR4/ is for the coarser-domain variables.

IAC0> **C200**; = **KARMAN** ∗ **KARMAN** ∗ **DX**/4.

IAC1> **C201**; = (100.-**PTOP**)/**DXSQ.**

IAC3> **C203**; = 1./**DXSQ**.

IADT> **DT**; time step (s).

IADT2> **DT2**; = 2 ∗ **DT.**

IADTM> **DTMIN**; = **DT**/60. (min).

IADX> **DX**; grid size (m).

IADX2> **DX2**; = 2 ∗ **DX**.

IADX4> **DX4**; = 4 ∗ **DX**.

IADX8> **DX8**; = 8 ∗ **DX**.

IAD16> **DX16**; = 16 ∗ **DX**.

IADXQ> **DXSQ**; = **DX** ∗ **DX**.

IAFNG> **FNUDGE**; relaxation coefficient for relaxation boundary conditions.

IAGNG> **GNUDGE**; relaxation coefficient for relaxation boundary conditions.

IAIL> **IL**; number of dot points in the y-direction.

IAILX> **ILX**; = **IL** - 1.

IAILM> **ILXM**; = **ILX** - 1.

IAJL> **JL**; number of dot points in the x-direction.

IAJLX> **JLX**; = **JL** - 1.

IAJLM> **JLXM**; = **JLX** - 1.

IAKL> **KL**; number of vertical layers (half-levels).

IAKM> **KLM**; = **KL** - 1.

IAKP1> **KLP1**; = **KL** + 1.

IAKTU> **KTAU**; time-step counter.

IAKTR> **KTAUR**; time-step counter used when restarting.

IADMA> **TDADV**; total air mass (kg) advected through lateral boundaries.

IADMI> **TDINI**; total air mass (kg) initially in the domain.

IAQMA> **TQADV**; total water substance (kg) advected through lateral boundaries.

IAQME> **TQEAV**; total water vapor (kg) evaporated from ground.

IAQMI> **TQINI**; total water substance (kg) initially in the domain.

IAQMR> **TQRAI**; total accumulated rainfall (kg) on the ground.

IAXK> **XKHMAX**; maximum horizontal diffusion coefficient (m^2 s^{-1}).

IAXK> **XKHZ**; constant part of the horizontal diffusion coefficient (m^2 s^{-1}).

IAXT> **XTIME**; forecast time (min).

4.2.8 ADDRN4

/ADDRN4/ is identical to /ADDR4/ except that it is for finer domains instead of the coarser domain, and both variable and address names are slightly changed. For the finer-domain variables, the letter “N” is usually appended to the coarser-domain name such that **DT** becomes **DTN** etc. For the finer-domain addresses, the letter “N” is inserted after the first letter in the coarser-domain name such that **IADT** becomes **INADT** etc.

4.2.9 ADDR5

/ADDR5/ holds three-dimensional storage arrays of the observed analysis variables and tendencies that are needed for analysis-nudging FDDA. /ADDR5/ is for the coarser-domain variables.

IFQBO> **QBO** (**MIXF**, **MJXF**, **MKXF**); storage array of observed analysis of p^*q_v (cb kg kg^{-1}).

IFQBT> **QBOTEN** (**MIXF**, **MJXF**, **MKXF**); storage array of observed tendency of p^*q_v (cb kg kg^{-1} min^{-1}).

IFTBO> **TBO** (**MIXF**, **MJXF**, **MKXF**); storage array of observed analysis of p^*T (cb K).

IFTBT> **TBOTEN** (**MIXF**, **MJXF**, **MKXF**); storage array of observed tendency of p^*T (cb K min^{-1}).

IFUBO> **UBO** (**MIXF**, **MJXF**, **MKXF**); storage array of observed analysis for p^*U (cb m s^{-1}).

IFUBT> **UBOTEN** (**MIXF**, **MJXF**, **MKXF**); storage array of observed tendency of p^*U (cb m s^{-1} min^{-1}).

IFVBO> **VBO** (**MIXF**, **MJXF**, **MKXF**); storage array of observed analysis of p^*V (cb m s^{-1}).

IFVBT> **VBOTEN** (**MIXF**, **MJXF**, **MKXF**); storage array of observed tendency of p^*V (cb m s^{-1} min^{-1}).

IFVOR> **VORDIF** (**MIXF**, **MJXF**, **MKXF**); difference of observed and model vorticity (s^{-1}).

4.2.10 ADDRN5

/ADDRN5/ is equivalent to /ADDR5/ except that it is for finer domains instead of the coarser domain and it only contains addresses. The address names are different in that the second letter in the coarser- domain names (always “F”) is changed to “G” for the finer-domain address names.

4.2.11 ADDR6

/ADDR6/ contains variable arrays and weighting arrays used in analysis-nudging FDDA. /ADDR6/ is for the coarser-domain variables.

IFDMI> **DMI** (**MIXF**, **MJXF**); horizontal array used for analysis nudging of mixing ratio based on observed precipitation.

IFDMS> **DMSCR** (**MIXF**, **MJXF**); horizontal array used for analysis nudging of mixing ratio based on observed precipitation.

IFIPR> **IPRE** (**MIXF**, **MJXF**); horizontal array used for analysis nudging of mixing ratio based on observed precipitation.

IFIPS> **IPSCR** (**MIXF**, **MJXF**); horizontal array used for analysis nudging of mixing ratio based on observed precipitation.

IFMPD> **MPSD** (**MIXF**, **MJXF**); map-scale factor on dot points used for analysis nudging of vorticity.

IFMPX> **MPSX** (**MIXF**, **MJXF**); map-scale factor on cross points used for analysis nudging of vorticity.

IFPSB> **PSBD** (**MIXF**, **MJXF**); model p* (cb) on dot points at time t-1.

IFPSO> **PSO** (**MIXF**, **MJXF**); observed p* (cb) on cross points.

IFPSC> **PSOC** (**MIXF**, **MJXF**); observed p* (cb) on cross points interpolated in time.

IFPSD> **PSOD** (**MIXF**, **MJXF**); observed p* (cb) on dot points interpolated in time.

IFPST> **PSOTEN** (**MIXF**, **MJXF**); observed p* tendency (cb min^{-1}) on cross points.

IFWCS> **WCS** (**MIXF**, **MJXF**); horizontal weighting array on cross points used for analysis nudging.

IFWDT> **WDT** (**MIXF**, **MJXF**); horizontal weighting array on dot points used for analysis nudging.

IFWQ> **WQ** (**MIXF**, **MJXF**); horizontal array used for analysis nudging of mixing ratio based on observed precipitation.

4.2.12 ADDRN6

/ADDRN6/ is equivalent to /ADDR6/ except that it is for finer domains instead of the coarser domain, and it only contains addresses. The address names are different in that the second letter in the coarser-domain names (always “F”) is changed to “G” for the finer-domain address names.

4.2.13 ADDR7

/ADDR7/ stores weighting and p* arrays and time/date identification variables needed for surface-analysis nudging FDDA within the PBL. /ADDR7/ is for the coarser-domain variables.

IFBLPC> **BLPOC** (**MIXF**, **MJXF**); observed p* (cb) on cross points and used for surface analysis nudging.

IFBLPD> **BLPOD** (**MIXF**, **MJXF**); observed p* (cb) on dot points and used for surface analysis nudging.

IFBLWS> **BLWCS** (**MIXF**, **MJXF**); horizontal weighting array on cross points and used for nudging in the PBL.

IFBLWT> **BLWDT** (**MIXF**, **MJXF**); horizontal weighting array on dot points and used for nudging in the PBL.

IFBLWN> **BLWNV** (**NVAR**, **MIXF**, **MJXF**); storage array for horizontal weighting function based on surface data density and used for surface-analysis nudging.

IFIDC> **IDCHK** (**NCHA**, **NVAR**); array identifying what variables at **IDDATE** dates to exclude from surface-analysis nudging.

IFIDD> **IDDATE** (**NCHA**); array identifying what dates to exclude from surface analysis nudging.

IFIDH> **IDHK** (**NVAR**); data-quality flag array used by the **INOPRO** option.

IFIQC> **IQCHK** (**NTIM**, **NVAR**); flag indicating quality of data (based on density) for surface-analysis nudging in PBL (if = 0, data are not used for FDDA).

IFNTB> **NTB** (**NVAR**); position counter from 1 to **NTIM** for **SFCTIM** and **SFCOBS** arrays.

IFNTE> **NTE** (**NVAR**); position counter from 1 to **NTIM** for **SFCTIM** and **SFCOBS** arrays.

IFSFCO> **SFCOBS** (**NTIM**, **NVAR**, **MIXF**, **MJXF**); storage array for surface analyses of each variable at each time used for surface-analysis nudging.

IFSFT> **SFCTIM** (**NTIM**); corresponding model time (min) for each observed surface analysis.

IFTIB> **TIMB** (**NVAR**); beginning bracketing time (min) for temporal interpolation of observed surface analysis.

IFTIE> **TIME** (**NVAR**); ending bracketing time (min) for temporal interpolation of observed surface analysis.

IFWXY> **WXYTOP** (**MIXF**, **MJXF**); horizontal weighting array based on topography and optionally used to compute weighting function for surface analysis nudging.

4.2.14 ADDRN7

/ADDRN7/ is equivalent to /ADDR7/ except that it is for finer domains instead of the coarser domain and it only contains addresses. The address names are different in that the second letter in the coarser- domain names (always “F”) is changed to “G” for the finer-domain address names.

4.2.15 ADDR8

/ADDR8/ contains variables providing information concerning location, time, and deviation from forecast of observations used for observation-nudging FDDA. /ADDR8/ is for the coarser-domain variables.

IFERR> **ERRF** (6, **NIOBF**); difference between observed and model values at the observation location (first index varies over variable).

IFRIO> **RIO** (**NIOBF**); coarse-grid location of each nudging observation in the **I** (north-south) direction.

IFRJO> **RJO** (**NIOBF**); coarse-grid location of each nudging observation in the **J** (east-west) direction.

IFRKO> **RKO** (**NIOBF**); half-sigma location of each nudging observation in the vertical direction.

IFSVWT> **SAVWT** (4, **MIXF**, **MJXF**, **MKXF**); storage array used with **IONF** option holding the (weights $*$ corrections) at each grid point for each variable. (First index varies over variable.)

IFTIM> **TIMEOB** (**NIOBF**); model time (hr) of each nudging observation within time window.

IFVAR> **VAROBS** (5, **NIOBF**); storage array for nudging observations within time window (first index varies over variable).

4.2.16 ADDRN8

/ADDRN8/ is equivalent to /ADDR8/ except that it is for finer domains instead of the coarser domain and it only contains addresses. The address names are different in that the second letter in the coarser- domain names (always “F”) is changed to “G” for the finer-domain address names.

4.2.17 ADDRNC

/ADDRNC/ is equivalent to /ADDRNN/ except that it is for coarser domains instead of the finer domain and it only contains addresses. The address names are different in that the third letter in the finer-domain names (always “N”) is changed to “C” for the coarser-domain address names.

4.2.18 ADDRNN

/ADDRNN/ stores grid-point information relating to the location of the finer-domain boundaries or overlapping areas.

INN23> **IEN** (**MAXSES**); ending grid point (**I**-direction) for overwriting nested boundaries.

INN20> **INM1**; = **INORTH -** 1.

INN21> **INM2**; = **INORTH -** 2.

INN4> **INORTH**; **I-**coordinate (large domain) for north boundary of nested domain (= **NESTI** + (**INX -** 1) / **IRATIO**).

INN19> **INP1**; = **INORTH** + 1.

INN18> **INP2**; = **INORTH** + 2.

INN16> **ISM1**; = **ISOUTH -** 1.

INN17> **ISM2**; = **ISOUTH -** 2.

INN5> **ISOUTH**; **I-**coordinate (large domain) for south boundary of nested domain (= **NESTI**).

INN15> **ISP1**; = **ISOUTH** + 1.

INN14> **ISP2**; = **ISOUTH** + 2.

INN22> **ISTAR** (**MAXSES**); beginning grid point (**I-**direction) for overwriting nested boundaries.

INN26> **ISTO** (**MAXSES**); grid-point location specifying where to overwrite nested boundaries of overlapping nest.

INN2> **JEAST**; **J-**coordinate (large domain) for east boundary of nested domain (= **NESTJ** + (**JNX -** 1) / **IRATIO**).

INN25> **JEN** (**MAXSES**); ending grid point (**J-**direction) for overwriting nested boundaries.

INN8> **JEM1**; = **JEAST -** 1.

INN9> **JEM2**; = **JEAST -** 2.

INN7> **JEP1**; = **JEAST** + 1.

INN6> **JEP2**; = **JEAST** + 2.

INN24> **JSTAR** (**MAXSES**); beginning grid point (**J-**direction) for overwriting nested boundaries.

INN27> **JSTO** (**MAXSES**); grid-point location specifying where to overwrite nested boundaries of overlapping nest.

INN3> **JWEST**; **J**-coordinate (large domain) for west boundary of nested domain (= **NESTJ**).

INN12> **JWM1**; = **JWEST** - 1.

INN13> **JWM2**; = **JWEST** - 2.

INN11> **JWP1**; = **JWEST** + 1.

INN10> **JWP2**; = **JWEST** + 2.

INN1> **NUMNES**; integer defining domain for which addresses are computed.

4.2.19 ADDRSP

/ADDRSP/ holds arrays pertaining to calculation of divergence and geopotential in vertical mode space for the split-explicit scheme.

/ADDRSP/ is for the coarser-domain variables.

ISPAM> **AM** (**MKX**, **NSPLIT**); = **ZMATX**∗**A** (K), where **A** is a 2-D matrix operator defined in the split-explicit routines.

ISPAN> **AN** (**NSPLIT**); = **DSIGMA**∗**ZMATX**

ISPBZ> **BZ** (**MKX**, **KXP1**); used in the transformation of geopotential from sigma space to vertical mode space (J kg^{-1} K^{-1}).

ISPCZ> **CZ** (**MKX**, **MKX**); used in the transformation of geopotential from sigma space to vertical mode space (J kg^{-1}).

ISPDS> **DSTOR** (**MIX**, **MJX**, **NSPLIT**); stores divergence **DELD** in the split-explicit scheme (cb s^{-1}).

ISPDTA> **DTAU** (**NSPLIT**); short-time step (s) for the split-explicit scheme.

ISPHB> **HBAR** (**MKX**); equivalent depths (m^2 s^{-2}) of the vertical modes.

ISPHS> **HSTOR** (**MIX**, **MJX**, **NSPLIT**); stores geopotential **DELH** in the split-explicit scheme (m^2 s^{-2}).

ISPM> **M** (**NSPLIT**); ratio (longtime step / short-time step) for the split-explicit scheme.

ISPZMX> **ZMATX** (**MKX**, **MKX**); a matrix used in the transformation of divergence from sigma space to vertical mode space.

ISPZMR> **ZMATXR** (**MKX**, **MKX**); matrix inverse of **ZMATX.**

4.2.20 ADDNSP

/ADDNSP/ is equivalent to /ADDRSP/ except that it is for finer domains instead of the coarser domain and it only contains addresses.The address names are different in that the second letter in the coarser domain names (always "S") is changed to "O" for the finer-domain address names.

4.2.21 ADDRV

/ADDRV/ is for the Navy PBL scheme which is not used in Version 1.

4.2.22 ADDRVN

/ADDRVN/ is for the Navy PBL scheme which is not used in Version 1.

4.2.23 NHCNS

/NHCNS/ contains reference-state arrays for the nonhydrostatic option. /NHCNS/ is for the coarser-domain variables.

INHPS0> **PS0** (**MIXNH**, **MJXNH**); reference surface pressure (Pa).

INHT0> **T0** (**MIXNH**, **MJXNH**, **MKXNH**); reference temperature (K).

4.2.24 NNCNS

/NNCNS/ is identical to /NHCNS/ except that it is for finer domains instead of the coarser domain, and both variable and address names are slightly changed. For the finer-domain variables, the letter "N" is appended to the coarser-domain name such that **PS0** becomes **PS0N** etc. The address names are different in that the third letter in the coarser- domain names (always "H") is changed to "N" for the finer-domain address names.

4.2.25 NONHYD

/NONHYD/ holds three-dimensional prognostic variables and tendencies for the nonhydrostatic option. /NONHYD/ is for coarser-domain variables.

INHPPA> **PPA** (**MIXNH**, **MJXNH**, **MKXNH**); p*p' (cb Pa) at time t.

INHPPB> **PPB** (**MIXNH**, **MJXNH**, **MKXNH**); p*p' (cb Pa) at time t-1.

INHWA> **WA** (**MIXNH**, **MJXNH**, **KXP1NH**); p*W (cb m s^{-1}) at time t.

INHWB> **WB** (**MIXNH**, **MJXNH**, **KXP1NH**); p*W (cb m s^{-1}) at time t-1.

4.2.26 NNNHYD

/NNNHYD/ is identical to /NONHYD/ except that it is for finer domains instead of the coarser domain, and both variable and address names are slightly changed. For the finer-domain variables, the letter “N” is usually appended to the coarser-domain name such that **PPA** becomes **PPAN** etc. For the finer-domain addresses, the letter “N” replaces the third letter “H” in the coarser-domain name such that **INHPPA** becomes **INNPPA** etc.

4.2.27 NONHYDB

/NONHYDB/ stores nested-domain boundary values and tendencies for the nonhydrostatic option. /NONHYDB/ is for coarser-domain variables.

INHPPE> **PPEB** (**MIXNH**, **MKXNH**, **NSPGX**); p*p' (cb Pa) at east boundary.

INHPPET> **PPEBT** (**MIXNH**, **MKXNH**, **NSPGX**); p*p' (cb Pa s^{-1}) tendency at east boundary.

INHPPN> **PPNB** (**MJXNH**, **MKXNH**, **NSPGX**); p*p' (cb Pa) at north boundary.

INHPPNT> **PPNBT** (**MJXNH**, **MKXNH**, **NSPGX**); p*p' (cb Pa s^{-1}) tendency at north boundary.

INHPPS> **PPSB** (**MJXNH**, **MKXNH**, **NSPGX**); p*p' (cb Pa) at south boundary.

INHPPST> **PPSBT** (**MJXNH**, **MKXNH**, **NSPGX**); p*p' (cb Pa s^{-1}) tendency at south boundary.

INHPPW> **PPWB** (**MIXNH**, **MKXNH**, **NSPGX**); p*p' (cb Pa) at west boundary.

INHPPWT> **PPWBT** (**MIXNH**, **MKXNH**, **NSPGX**); p*p' (cb Pa s^{-1}) tendency at west boundary.

INHWE> **WEB** (**MIXNH**, **KXP1NH**, **NSPGX**); p*W (cb m s^{-1}) at east boundary.

INHWET> **WEBT** (**MIXNH**, **KXP1NH**, **NSPGX**); p*W (cb m s^{-2}) tendency at east boundary.

INHWN> **WNB** (**MJXNH**, **KXP1NH**, **NSPGX**); p*W (cb m s^{-1}) at north boundary.

INHWNT> **WNBT** (**MJXNH**, **KXP1NH**, **NSPGX**); p*W (cb m s^{-2}) tendency at north boundary.

INHWS> **WSB** (**MJXNH**, **KXP1NH**, **NSPGX**); p*W (cb m s^{-1}) at south boundary.

INHWST> **WSBT** (**MJXNH**, **KXP1NH**, **NSPGX**); p*W (cb m s^{-2}) tendency at south boundary.

INHWW> **WWB** (**MIXNH**, **KXP1NH**, **NSPGX**); p*W (cb m s^{-1}) at west boundary.

INHWWT> **WWBT** (**MIXNH**, **KXP1NH**, **NSPGX**); p*W (cb m s^{-2}) tendency at west boundary.

4.2.28 NNNHYDB

/NNNHYDB/ is identical to /NONHYDB/ except that it is for finer domains instead of the coarser domain, and both variable and address names are slightly changed. For the finer-domain variables, the letter “N” is appended to the coarser-domain name such that **PPEB** becomes **PPEBN** etc. For the finer-domain addresses, the letter “N” replaces the third letter “H” in the coarser-domain name such that **INHPPE** becomes **INNPPE** etc.

4.2.29 RADIAT

/RADIAT/ holds a three-dimensional tendency array for radiation. /RADIAT/ is for the coarser-domain variables.

IRTT> **RTTEN** (**MIX**, **MJX**, **MKX**) total radiative temperature tendency (K s^{-1}).

4.2.30 RADIATN

/RADIATN/ is equivalent to /RADIAT/ except that it is for finer domains instead of the coarser domain and it only contains an address. The address name is different in that the letter “N” is inserted after the first letter in the coarser-domain name such that **IRTT** becomes **INRIT**.

4.2.31 UPRAD

/UPRAD/ contains a two-dimensional array for the upper radiative boundary condition. /UPRAD/ is for the coarser-domain variables.

IUPR> **TMASK**(-6:6, -6:6) array for upper radiative boundary condition (m s^{-1} Pa^{-1}).

4.2.32 UPRADN

/UPRADN/ is equivalent to /UPRAD/ except that it is for finer domains instead of the coarser domain and it only contains an address. The address name is different in that the letter “N” is inserted after the first letter in the coarser-domain name such that **IUPR** becomes **INUPR**.