Geoscientific
Model Development

Supplement of

Superparameterised cloud effects in the EMAC general circulation model (v2.50) – influences of model configuration

Harald Rybka and Holger Tost

Correspondence to: Harald Rybka (harald.rybka@dwd.de) and Holger Tost (tosth@uni-mainz.de)

This supplement includes a detailed description of the experiments performed with EMAC (v2.50). It should help users to easily repeat the simulations given the correct submodel namelist settings and necessary input data.

Table 1 provides an overview of mandatory namelists in order to perform the control simulation (CTRL) or any kind of superparametrised EMAC simulation (SP-EMAC). Namelists that need to be adapted are marked with an asterisk and shown below in more detail.

Submodel	CTRL	SP-EMAC	short description
AEROPT	x	x	calculation of aerosol optical properties
CLOUD	x		cloud parametrisation
CLOUDOPT	x	x	cloud optical properties
CONVECT	x		convection parametrisation
CRM		x	cloud resolving model
CVTRANS*	x	x	convective tracer transport routine
JVAL	x	x	calculation of photolysis rates
ORBIT	x	x	Earth orbit caclulations
RAD	x	x	radiative transfer calculations
SURFACE	x	x	surface properties
TROPOP	x	x	calculation of tropopause diagnostics

Table 1: Overview of submodels applied to the control simulation (CTRL) and SP-EMAC simulations.

In order to use the convective tracer transport routine (CVTRANS) the correct channels need to be specified within the namelist setup. Simulations which use the convection parametrisation need to use diagnostic variables calculated within the convection subroutine. Figure 1 shows the CVTRANS namelist setup for the control simulation. Considering vertical subgrid-scale motions diagnostics (updrafts, downdrafts, entrainment and detrainment rates) are calculated within the cloud resolving model. These can be used as input variables for the submodel CVTRANS. Figure 2 displays the changes of variable and channel names within the 'CPL' group of the CVTRANS namelist. A complete setup of namelists for the control simulation and SP-EMAC simulations is given as a zipped archive within the supplement.

The input data that is used to initiate the model and applied as boundary conditions are the following:

- AMIP II sea surface temperatures (Taylor et al., 2000)

- AMIP II sea ice content (Taylor et al., 2000)

- ozone climatology (Fortuin and Kelder, 1998)

- leaf area index and land surface data climatology (Hagemann, 2002)

```f90
! -*- f90 -*-
&CTRL
 bulk      = T,
 seg_plume = F,
 sc_trans  = 2,  ! interaction of transport and convective scavenging
                 ! 1 = convective transport after scavenging
                 ! 2 = convective transport splitted by scavenging
                 !     first part until top level of rain production,
                 !     then scavenging, then second part
                 ! 3 = as 2 but the second transport from bottom of
                 !     convection to top of convection (might overestimate
                 !     the convective transport)
                 ! 4 = as 1, but considering only a convective column
                 !     of approx. 5 % (determined by updraft strength),
                 !     also for scavenging if active
                 ! 5 = as 2, but considering only a convective column
                 !     of approx. 5 % (determined by updraft strength),
                 !     also for scavenging if active
 lcvt_gp = T,    ! transport of gridpoint tracers active
 lcvt_lg = F,    ! transport of mapped lagrangian tracers active
/
&CPL
 umass    = 'convect','massfu',
 dmass    = 'convect','massfd',
 entru    = 'convect','u_entr',
 detru    = 'convect','u_detr',
 entrd    = 'convect','d_entr',
 detrd    = 'convect','d_detr',
 raincv   = 'convect','cv_precflx',
 snowcv   = 'convect','cv_snowflx',
 covcv    = 'convect','cv_cover',
 c_top    = 'convect','conv_top',
 mass     = 'ECHAM5','grmass',
 vol      = 'ECHAM5','grvol',
 press    = 'ECHAM5','press',
 pressi   = 'ECHAM5','pressi',
/
```

Figure 1: CVTRANS namelist for CTRL simulation

```f90
! -*- f90 -*-
&CTRL
bulk       = T,
 seg_plume = F,
 sc_trans  = 2,
 lcvt_gp = T,
 lcvt_lg = F,
&CPL
 umass    = 'crm','massfu',
 dmass    = 'crm','massfd',
 entru    = 'crm','u_entr',
 detru    = 'crm','u_detr',
 entrd    = 'crm','d_entr',
 detrd    = 'crm','d_detr',
 raincv   = 'crm','pflx',
 snowcv   = 'crm','pflx',
 covcv    = 'crm','cv_cover',
 c_top    = 'crm','conv_cth',
 mass     = 'ECHAM5','grmass',
 vol      = 'ECHAM5','grvol',
 press    = 'ECHAM5','press',
 pressi   = 'ECHAM5','pressi',
/
```

Figure 2: CVTRANS namelist for SP-EMAC simulations

References

J. P. F. Fortuin and H. Kelder. An ozone climatology based on ozonesonde and satellite measurements. *Journal of Geophysical Research: Atmospheres*, 103 (D24):31709–31734, 1998. doi: 10.1029/1998JD200008.

S. Hagemann. An improved land surface parameter dataset for global and regional climate models. 2002. doi: 10.17617/2.2344576. URL `http://pubman.mpdl.mpg.de/pubman/item/escidoc:2344576`.

K. E. Taylor, D. Williamson, and F. Zwiers. AMIP II Sea Surface Temperature and Sea Ice Concentration Boundary Conditions. *PCMDI Rep.*, 60, 01 2000.