Model Information of Potential Use to the IPCC Lead Authors and the AR4.

MIROC3.2(medres)

31 January 2005

I. Model identity:

A. Institution, sponsoring agency, country

CCSR/NIES/FRCGC, Japan
CCSR = Center for Climate System Research, University of Tokyo
NIES = National Institute for Environmental Studies
FRCGC = Frontier Research Center for Global Chance, Japan Agency for Marine-Earth Science and Technology (JAMSTEC)
(The University of Tokyo is a National University Corporation and NIES and JAMSTEC are Independent Administrative Institutions)

B. Model name (and names of component atmospheric, ocean, sea ice, etc. models)

Coupled model: MIROC3.2 (Model for Interdisciplinary Research on Climate)
Atmospheric model: CCSR/NIES/FRCGC AGCM5.7b
Ocean & sea ice model: COCO3.3 (CCSR Ocean Component model)
Land surface model: MATSIRO (Minimal Advanced Treatments of Surface Interaction and Runoff)

C. Vintage (i.e., year that model version was first used in a published application)

2004

D. General published references and web pages

K-1 model developers (2004): K-1 coupled model (MIROC) description, K-1 technical report, 1, H. Hasumi and S. Emori (eds.), Center for Climate System Research, University of Tokyo, 34pp.
(http://www.ccsr.u-tokyo.ac.jp/kyosei/hasumi/MIROC/tech-repo.pdf)

E. References that document changes over the last ~5 years (i.e., since the IPCC TAR) in the coupled model or its components. We are specifically looking for references that document changes in some aspect(s) of model performance.

Not available, unfortunately. Currently, we do not have a plan to describe them.

F. IPCC model version's global climate sensitivity ($KW^{-1}m^2$) to increase in CO_2 and how it was determined (slab ocean expt., transient expt--Gregory method, ±2K Cess expt., etc.)

1.4 $KW^{-1}m^2$ for the high-resolution version
(4.3 K $2xCO_2$ sensitivity with 3.1 Wm^{-2} adjusted tropopause forcing)
1.3 $KW^{-1}m^2$ for the medium-resolution version
(4.0 K $2xCO_2$ sensitivity with 3.1 Wm^{-2} adjusted tropopause forcing)
determined by slab ocean experiments.

G. Contacts (name and email addresses), as appropriate, for:

1. coupled model
   Seita Emori (emori@nies.go.jp) for the high-resolution version
   Toru Nozawa (nozawa@nies.go.jp) for the medium-resolution version
2. atmosphere
   Seita Emori (emori@nies.go.jp)
3. ocean

Hiroyasu Hasumi (hasumi@ccsr.u-tokyo.ac.jp)

4. sea ice

   Hiroyasu Hasumi (hasumi@ccsr.u-tokyo.ac.jp)

5. land surface

   Seita Emori (emori@nies.go.jp)

6. vegetation

   N/A (no interactive vegetation in the IPCC version)

7. other?

   Aerosols

   Toshihiko Takemura (toshi@riam.kyushu-u.ac.jp) and Seita Emori (emori@nies.go.jp)

II. Besides atmosphere, ocean, sea ice, and prescription of land/vegetated surface, what can be included (interactively) and was it active in the model version that produced output stored in the PCMDI database?

A. atmospheric chemistry?

   Interactive version exists but not included in the IPCC version.

B. interactive biogeochemistry?

   Interactive version exists but not included in the IPCC version.

C. what aerosols and are indirect effects modeled?

   Mineral dust, sea salt, sulfate, black carbon and organic carbon.
   Direct effects (scattering and absorption) and indirect effects (1st and 2nd kinds) modeled. (TAR = the same but aerosols distributions are calculated off-line and prescribed by 3D data)

D. dynamic vegetation?

   Interactive version exists but not included in the IPCC version.

E. ice-sheets?

   Interactive version exists but not included in the IPCC version.

III. List the community based projects (e.g., AMIP, C4MIP, PMIP, PILPS, etc.) that your modeling group has participated in and indicate if your model results from each project should carry over to the current (IPCC) version of your model in the PCMDI database.

AMIP: have participated in some phases, but a new version of AMIP integration has been provided to the PCMDI database, which is fully consistent with the atmospheric part of the IPCC version coupled model.

OMIP: participated in its pilot phase (P-OMIP), where a limited number of models (institutes) were involved for a feasibility study. However, the project failed to develop into a full-blown phase and now defunct (no extensive intercomparison realized). The model resolution for P-OMIP is different from either of our IPCC version models.

CMIP coordinated experiments for THC sensitivity: participated with the IPCC version (medium resolution).

C4MIP: intend to participate in phase 1 with a coupled carbon-climate model based on the IPCC version of the climate model (medium resolution).

PMIP: have participated and intend to participate in the current phase with the IPCC version coupled model (medium resolution).

PILPS: participated in phase 2e, but with a version different from the land surface component in the IPCC version coupled model.

CFMIP: participated with the IPCC version slab models (medium resolution version submitted and high resolution version intended to be submitted). An experimental version of the medium resolution model with higher sensitivity than the IPCC version has also been provided (See the special comment provided in IV. A. 4 below).

IV. Component model characteristics (of current IPCC model version):

A. Atmosphere

1. resolution

    T106 L56 in the high-resolution version

    T42 L20 in the medium-resolution version

    (TAR = T21 L20)

2. numerical scheme/grid (advective and time-stepping schemes; model top; vertical coordinate and number of layers above 200 hPa and below 850 hPa)

    Advection:

    Spectral transformation method except for tracer advection

    Finite difference scheme with Piecewise Parabolic Method (PPM) and flux-form Semi-Lagrangian for tracer advection (water vapor, cloud water, aerosols and aerosol precursors)

    (TAR = spectral advection also for tracers)

    Time-stepping: leap-frog

    Model top:

    40 km in the high-resolution version

    30 km in the medium-resolution version

    Vertical coordinate: pressure normalized by surface pressure (sigma)

    Layers above 200hPa:

    29 in the high-resolution version and 8 in the medium-resolution version.

    Layers below 850hPa:

    10 in the high-resolution version and 5 in the medium-resolution version.

    (TAR = same vertical coordinate as the current medium-resolution version)

3. list of prognostic variables (be sure to include, as appropriate, liquid water, chemical species, ice, etc.). Model output variable names are not needed, just a generic descriptive name (e.g., temperature, northward and eastward wind components, etc.)

    Atmospheric physics:

    temperature, northward and eastward wind components, surface pressure, specific humidity, cloud water (note: though cloud water is advected separately from water vapor, they are merged and diagnostically separated again at each time step; maybe better to say total water is prognostic), and cloud base mass flux of cumulus convection

    (TAR = exclude cloud base mass flux)

    Aerosols:

    mineral dust (4 size bins), sea salt (2 size bins), sulfate, SO_2, DMS, black carbon and organic carbon.

(TAR = distributions of mineral dust, sea salt, sulfate, black carbon, organic carbon and number concentration of all aerosols that can act as CCN are calculated off-line and prescribed by 3D data)

4. name, terse descriptions, and references (journal articles, web pages) for all major parameterizations. Include, as appropriate, descriptions of:
   a. clouds
      Prognostic total water scheme based on Le Treut and Li (1991) with 2nd indirect effect of aerosols based on Berry (1967)
   b. convection
      Prognostic closure of Arakawa-Schubert based on Pan and Randall (1998) with empirical suppression condition based on Emori (2001)
      (TAR = diagnostic closure, without suppression condition)
   c. boundary layer
      Level 2 closure of Mellor and Yamada (1974, 1982) with moist effect based on Smith (1990)
      (TAR = simple most effect based on moist Ri number)
   d. SW, LW radiation
      Two-stream discrete ordinate method / k-distribution method by Nakajima et al. (2000) with maximum-random cloud overlapping based on Geleyn and Hollingsworth (1979)
      (TAR = random cloud overlapping)
   e. Internal gravity wave drag
      McFarlane (1987)

Special comment on causes of the difference in climate sensitivity among CCSR/NIES1 and 2 in TAR and the current versions.

The 2xCO_2 climate sensitivities of CCSR/NIES1 and 2 in TAR are 3.6 K and 5.1 K, respectively, while those of the current versions are 4.3 K for the high-resolution version and 4.0 K for the medium-resolution version. We can make the following two comments to explain a part of the causes of these differences:

1. Radiation parameter table, which represents absorption properties of various gasses at various wavelengths, is different between CCSR/NIES1 and 2. The both versions of the table are based on the same HITRAN data base, but with different optimization. Superiority or inferiority is not obvious when the results from them are compared with that from HITRAN. This implies uncertainty in modeled clear-sky radiative forcing. For the current IPCC versions, we used the table same as in CCSR/NIES1 in TAR, which tends to give lower sensitivity.
2. The other is obviously due to various feedbacks, especially from clouds. Though not all the formulation or parameter changes related to this are traceable, two points that have certainly lowered the climate sensitivity of our model can be raised:
   2a. Temperature range for the existence of mixed phase (liquid +ice) cloud is -25 deg C ~ -5 deg C in the TAR versions, while it is -15 deg C ~ 0 deg C in the current IPCC versions.
   2b. When cloud ice melts, it is converted to cloud water in the TAR versions, while it is converted to rain in the current IPCC versions.

The version called ‘higher-sensitivity version’ we have provided to CFMIP is the same as the current IPCC version except that the above two points are the same as in the TAR versions (It will be comprehensively described in Ogura et al., in preparation). The climate sensitivity of this version is 6.3 K and much higher than CCSR/NIES 1 in TAR, which means there are some other unidentified changes that have substantially enhanced the climate sensitivity of this model from TAR to the current IPCC version.

B. Ocean

1. resolution

    0.28125 degree in longitude, 0.1875 degree in latitude, and 47 vertical levels in the high-resolution version

    1.4 degree in longitude, 0.5-1.4 degree in latitude, and 43 vertical levels in the medium-resolution version

    (TAR = 2.8 degree in longitude and latitude and 17 vertical levels)

2. numerical scheme/grid, including advection scheme, time-stepping scheme, vertical coordinate, free surface or rigid lid, virtual salt flux or freshwater flux

    Advection scheme:

    An upstream-weighted multi-dimensional third-order scheme (UTOPIA) for tracer advection (TAR = a hybrid of the first-order upstream and second-order centered schemes)

    A pseudo-enstrophy preserving momentum advection scheme in the high-resolution version; the second-order centered advection scheme in the medium-resolution version (TAR = same as in the medium-resolution version)

    Time-stepping scheme:

    The forward time-stepping for tracer advection and the leap-frog for the others (TAR = leap-frog for all)

    Vertical coordinate:

    Hybrid of sigma and z , with the sigma coordinate for the upper 50 m (TAR = z)

    Free surface or rigid lid:

    Free surface (TAR = rigid lid)

    Virtual salt flux or freshwater flux:

    Freshwater flux (TAR = virtual salt flux)

3. list of prognostic variables and tracers

    zonal and meridional velocity, temperature, salinity, sea surface height

4. name, terse descriptions, and references (journal articles, web pages) for all parameterizations. Include, as appropriate, descriptions of:

    a. eddy parameterization

        Isopycnal layer thickness diffusion (Gent and McWilliams, 1995) and isopycnal diffusion (Cox, 1987), with weak background horizontal Laplacian diffusion (TAR = horizontal Laplacian diffusion only)

    b. bottom boundary layer treatment and/or sill overflow treatment

        Bottom boundary layer parameterization of Nakano and Suginohara (2002) (TAR = not applied)

    c. mixed-layer treatment

Turbulence closure of Noh and Kim (1999) (TAR = no special treatment with 50 m-thick top layer)

d. sunlight penetration

Exponential decay following Rosati and Miyakoda (1988) (TAR = all the solar insolation is absorbed in the top layer)

e. tidal mixing

not applied

f. river mouth mixing

not applied

g. mixing isolated seas with the ocean

Diffusive exchange of tracers and sea surface height at unrepresented straits

h. treatment of North Pole "singularity" (filtering, pole rotation, artificial island?)

Pole rotation in the high-resolution version and filtering in the medium-resolution version (TAR = artificial island)

C. sea ice

1. horizontal resolution, number of layers, number of thickness categories

   0.28125 degree in longitude and 0.1875 degree in latitude, zero layer, and two thickness categories in the high-resolution version

   1.4 degree in longitude and latitude, zero layer, and two thickness categories in the medium-resolution version

   (TAR = 5.6 degree in longitude and latitude, zero layer, and one thickness category)

2. numerical scheme/grid, including advection scheme, time-stepping scheme,

   Advection scheme:

   The second-order centered scheme (TAR = no advection)

   Time-stepping scheme:

   The leap-frog scheme

3. list of prognostic variables

   concentration, grid-mean thickness, zonal and meridional velocity

4. completeness (dynamics? rheology? leads? snow treatment on sea ice)

   dynamics with the EVP rheology (TAR = no dynamics)

   leads represented by concentration (TAR = no leads)

   explicit snow-cover representation on sea ice, with snow-ice formation considered (TAR = no snow-ice formation)

5. treatment of salinity in ice

   constant salinity prescribed for sea ice

6. brine rejection treatment

   estimated from the difference between sea ice and sea water salinity

7. treatment of the North Pole "singularity" (filtering, pole rotation, artificial island?)

   Pole rotation in the high-resolution version and filtering in the medium-resolution version (TAR = artificial island)

D. land / ice sheets (some of the following may be omitted if information is clearly included in cited references.

1. resolution (tiling?), number of layers for heat and water

T106 2x2 tiling for the high-resolution version
T42 without tiling for the medium-resolution version
5 layers for heat and water
(TAR = T21 without tiling, 3 layers for heat, 1 layer bucket for water)

2. treatment of frozen soil and permafrost
   Prognostic ice water content in soil
   (TAR = not treated)
3. treatment of surface runoff and river routing scheme
   TOPMODEL for producing surface runoff and TRIP (Oki and Sud, 1998) for river routing
   River grid resolution is 0.5 degree for the high-resolution version and T42 for the medium-resolution version
   (TAR = bucket runoff with T21 TRIP)
4. treatment of snow cover on land
   Prognostic snow mass, up to 3 layers for heat conduction, constant density, sub-grid snow cover tiling
   (TAR = 1 layer embedded in the top soil layer)
5. description of water storage model and drainage
   Treated consistently with the TOPMODEL and TRIP
   (TAR = bucket)
6. surface albedo scheme
   Dependent on surface and leaf optical property and LAI (LAI is prescribed by monthly data)
   Prognostic snow albedo (Wiscombe and Warren, 1980)
   (TAR = dependent on land cover type, no seasonal variation, diagnostic snow albedo dependent on snow mass and temperature)
7. vegetation treatment (canopy?)
   Canopy considered for radiation, turbulent flux exchange and interception of precipitation, Farquhar-Ball-type stomatal control coupled with photosynthesis
   (TAR = no explicit canopy)
8. list of prognostic variables
   Soil temperature, soil moisture and soil ice content for each of 5 layers, canopy water storage, snow mass, snow albedo, surface and canopy skin temperature (though heat capacity is zero, treated similarly to prognostic variables) and river water storage
   (TAR = soil temperature for each of 3 layers, bucket soil moisture, snow mass, surface skin temperature and river water storage)
9. ice sheet characteristics (How are snow cover, ice melting, ice accumulation, ice dynamics handled? How are the heat and water fluxes handled when the ice sheet is melting?)
   Snow over ice sheet is treated similarly to that over the other land-cover types except that when snow mass over ice sheet exceeds a certain limit (1000 kg/m^2), it is treated as 'glacier' and flows into the ocean through the river routing model. When ice sheet is melting, latent heat of melting changes the ice sheet temperature. But the melt water disappears to avoid the ice sheet being infinite source of water.

E. coupling details
   1. frequency of coupling

3 hours

2. Are heat and water conserved by coupling scheme?
   Yes, they are.
3. list of variables passed between components:
   a. atmosphere – ocean
      atmosphere to ocean:
         zonal and meridional wind, temperature and specific humidity at the lowest atmospheric level, surface pressure, downward radiation flux and precipitation
      ocean to atmosphere:
         zonal and meridional surface stress, sensible and latent heat flux and upward radiation flux
   b. atmosphere – land
      atmosphere to land:
         zonal and meridional wind, temperature and specific humidity at the lowest atmospheric level, surface pressure, downward radiation flux and precipitation
      land to atmosphere:
         zonal and meridional surface stress, sensible and latent heat flux and upward radiation flux
   c. land – ocean
      land to ocean: runoff water flux
   d. sea ice – ocean
      zonal and meridional interfacial stress, heat flux, and water (not freshwater but saline water) flux due to ice formation/melt
   e. sea ice – atmosphere
      atmosphere to sea ice:
         zonal and meridional wind, temperature and specific humidity at the lowest atmospheric level, surface pressure, downward radiation flux and precipitation
      sea ice to atmosphere:
         zonal and meridional surface stress, sensible and latent heat flux and upward radiation flux
4. Flux adjustment? (heat?, water?, momentum?, annual?, monthly?).
   No flux adjustment is applied.

V. Simulation Details (report separately for each IPCC simulation contributed to database at PCMDI):

Experiments for the high-resolution version

A. IPCC "experiment" name
   Pre-industrial control experiment for high-resolution version
B. Describe method used to obtain initial conditions for each component model
   1. If initialized from a control run, which month/year.
   2. For control runs, describe spin-up procedure.
      109 year spin-up of the coupled model from an arbitrary chosen snapshot result of a previous version of the model.

C. For pre-industrial and present-day control runs, describe radiative forcing agents (e.g., non-anthropogenic aerosols, solar variability) present. Provide references or web pages containing further information as to the distribution and temporal changes in these agents.

They can be categorized as follows:

(a.) Agents prescribed: solar variability, volcanic aerosols, well-mixed GHGs (CO_2, CH_4, N_2O, 13 halo-carbons), tropospheric and stratospheric ozone, land use

(b) Emissions prescribed: sulfate aerosols (fossil fuel combustion), black carbon and organic carbon (fossil fuel combustion, agricultural waste burning, fuelwood consumption and forest fires)

(c) Emissions diagnosed from modeled conditions: soil dust, sea salt, DMS-origin sulfate

(d) Background emission prescribed (constant even throughout perturbed runs): Terpene-origin organic carbon, continuous volcanic eruption-origin sulfate

All of the agents in (a) and emissions in (b) are fixed at the 1900 values.

Reference currently not available. (Nozawa et al., in preparation)

D. For perturbation runs, describe radiative forcing agents (e.g., which greenhouse gases, which aerosols, ozone, land surface changes, etc.) present. Provide references or web pages containing further information as to the distribution and temporal changes in these agents.

A. 1%/year CO2 increase experiment (to doubling) for high-resolution version
B. The same initial condition as the pre-industrial control experiment
D. The same forcing agents as the pre-industrial control experiment are present. All of the agents in (a) and emissions in (b) are fixed at the 1900 values except that CO_2 concentration is increased by 1%/year compounded.

Note that the length of integration is 80 years and stabilization part is not calculated.

A. Climate of the 20th Century experiment (20C3M) for high-resolution version
B. The same initial condition as the pre-industrial control experiment
D. The same forcing agents as in the pre-industrial control experiment are present. All of the agents in (a) and emissions in (b) are changed according to historical data.
Reference currently not available. (Nozawa et al., in preparation)

Note that the length of integration is 101 years from 1900 to 2000.

A. 720 ppm stabilization experiment (SRES A1B) for high-resolution version
B. The initial condition is the end of the 20C3M experiment.
D. The same forcing agents as in the pre-industrial control experiment are present. All of the anthropogenic agents in (a) except land use and all of the emissions in (b) are changed according to the SRES A1B scenario. Solar variability and volcanic aerosols are fixed at the 2000 values.
Reference currently not available. (Nozawa et al., in preparation)

Note that the length of integration is 100 years from 2001 to 2100 and stabilization part is not calculated.

A. 550 ppm stabilization experiment (SRES B1) for high-resolution version
B. The initial condition is the end of the 20C3M experiment.
D. The same forcing agents as in the pre-industrial control experiment are present. All of the anthropogenic agents in (a) except land use and all the emissions in (b) are changed

according to the SRES B1 scenario. Solar variability and volcanic aerosols are fixed at the 2000 values.
Reference currently not available. (Nozawa et al., in preparation)

Note that the length of integration is 100 years from 2001 to 2100 and stabilization part is not calculated.

A. Slab ocean control experiment for high-resolution version
B. The initial condition is the end of the 6-year calibration run for producing ‘q-flux’ data with SST and sea ice restored to present-day observation.
C. The same forcing agents as in the pre-industrial control experiment are present. All of the agents in (a) and emissions in (b) are fixed at the 1900 values including the CO_2 concentration (295.9 ppm)..

A. 2xCO2 equilibrium experiment for high-resolution version
B. The initial condition is taken from a 2xCO2 equilibrium experiments of a previous version of slab model at the same resolution.
D. The same forcing agents as in the pre-industrial control experiment are present. All of the agents in (a) and emissions in (b) are fixed at the 1900 values except that the CO_2 concentration is doubled (591.8 ppm).

A. AMIP experiment for high-resolution version
B. Initiated after 2-year spin-up of the atmospheric model forced by SST of the year 1979 from a restart of a previous version of the model, which has been spun-up for 10 years to reduce drift of deep soil temperature and moisture.
D. The same forcing agents as in the pre-industrial control experiment are present. The standard data and values of AMIP2 are used for SST, sea ice extent and GHGs concentration. Sea ice thickness used is a monthly climatology derived from an ice-ocean model (COCO). For aerosols emissions, data for the mean of 1979-1996 are used.

Experiments for the medium-resolution version

A. Pre-industrial control experiment for medium-resolution version
B. 300 year spin-up of the coupled model from an arbitrary chosen snapshot result of a previous version of the model.
C. They can be categorized as follows:
(a.) Agents prescribed: solar variability, volcanic aerosols, well-mixed GHGs (CO_2, CH_4, N_2O, 13 halo-carbons), tropospheric and stratospheric ozone, land use
(b) Emissions prescribed: sulfate aerosols (fossil fuel combustion), black carbon and organic carbon (fossil fuel combustion, agricultural waste burning, fuelwood consumption and forest fires)
(c) Emissions diagnosed from modeled conditions: soil dust, sea salt, DMS-origin sulfate
(d) Background emission prescribed (constant even throughout perturbed runs): Terpene-origin organic carbon, continuous volcanic eruption-origin sulfate
All of the agents in (a) and emissions in (b) are fixed at the 1850 values.

A. 1%/year CO2 increase experiment (to doubling) for medium-resolution version

B. The same initial condition as the pre-industrial control experiment for run #1, a snapshot result at year 100 of the pre-industrial control experiment for run #2, a snapshot result at year 200 of the pre-industrial control experiment for run #3.

D. The same forcing agents as the pre-industrial control experiment are present. All of the agents in (a) and emissions in (b) are fixed at the 1850 values except that CO_2 concentration is increased by 1%/year compounded.

Note that the length of integration is 70 years and stabilization part is not calculated for run #2 and #3.

A. 1%/year CO2 increase experiment (to quadrapling) for medium-resolution version

B. The same initial condition as the pre-industrial control experiment for run #1, a snapshot result at year 100 of the pre-industrial control experiment for run #2, a snapshot result at year 200 of the pre-industrial control experiment for run #3.

D. The same forcing agents as the pre-industrial control experiment are present. All of the agents in (a) and emissions in (b) are fixed at the 1850 values except that CO_2 concentration is increased by 1%/year compounded.

Note that the length of integration is 140 years and stabilization part is not calculated for run #2 and #3.

A. Climate of the 20th Century experiment (20C3M) for medium-resolution version

B. The same initial condition as the pre-industrial control experiment for run #1, a snapshot result at year 100 of the pre-industrial control experiment for run #2, a snapshot result at year 200 of the pre-industrial control experiment for run #3.

D. The same forcing agents as in the pre-industrial control experiment are present. All of the agents in (a) and emissions in (b) are changed according to historical data.
Reference currently not available. (Nozawa et al., in preparation)

Note that the length of integration is 151 years from 1850 to 2000.

A. Committed climate change experiment for medium-resolution version

B. The initial condition is the end of the 20C3M experiment.

D. The same forcing agents as in the pre-industrial control experiment are present. All of the agents in (a) and emissions in (b) are fixed at the 2000 values.
Reference currently not available. (Nozawa et al., in preparation)

A. 720 ppm stabilization experiment (SRES A1B) for medium-resolution version

B. The initial condition is the end of the 20C3M experiment for corresponding ensemble member.

D. The same forcing agents as in the pre-industrial control experiment are present. All of the anthropogenic agents in (a) except land use and all of the emissions in (b) are changed according to the SRES A1B scenario. Solar variability and volcanic aerosols are fixed at the 2000 values.
Reference currently not available. (Nozawa et al., in preparation)

Note that the length of integration is 100 years from 2001 to 2100 and stabilization part is not calculated for run #2 and #3.

A. 550 ppm stabilization experiment (SRES B1) for medium-resolution version

B. The initial condition is the end of the 20C3M experiment for corresponding ensemble member.

D. The same forcing agents as in the pre-industrial control experiment are present. All of the anthropogenic agents in (a) except land use and all the emissions in (b) are changed according to the SRES B1 scenario. Solar variability and volcanic aerosols are fixed at the 2000 values.
   Reference currently not available. (Nozawa et al., in preparation)

Note that the length of integration is 100 years from 2001 to 2100 and stabilization part is not calculated for run #2 and #3.

A. Slab ocean control experiment for medium-resolution version
B. The initial condition is the end of the 15-year calibration run for producing 'q-flux' data with SST and sea ice restored to present-day observation.
C. The same forcing agents as in the pre-industrial control experiment are present. All of the agents in (a) and emissions in (b) are fixed at the 1850 values including the CO_2 concentration (285.4 ppm).

A. 2xCO2 equilibrium experiment for medium-resolution version
B. The same initial condition as the slab ocean control experiment.
D. The same forcing agents as in the pre-industrial control experiment are present. All of the agents in (a) and emissions in (b) are fixed at the 1850 values except that the CO_2 concentration is doubled (570.9 ppm).

A. AMIP experiment for medium-resolution version
B. Initiated after 10-year spin-up of the atmospheric model forced by SST of the year 1978 from a restart of a previous version of the model.
D. The same forcing agents as in the pre-industrial control experiment are present. The standard data and values of AMIP2 are used for SST, sea ice extent and GHGs concentration. Sea ice thickness used is a monthly climatology derived from an ice-ocean model (COCO). For aerosols emissions, data for the mean of 1979-1996 are used.