# PMIP4 CESM dust data

## Data files

- each variable for each climate period is in a separate file. In the `conc` (dust concentration) case, which contains the three-dimensional dust concentration in the atmosphere, ancillary variables are also included in the same file, i.e. those necessary to fully describe the vertical coordinate (lev, ilev, hyai, hybi, hyam, hybm, PS)
- file names = `PMIP4_DUST_Albani_<field>_<expt>.nc`
  - `field` = see Variables section below
  - `expt` = `PI` (pre-Industrial), `MH` (mid-Holocene) or `LGM` (Last Glacial Maximum)
    - The gaussian weights file does not depend on the experiment: `PMIP4_DUST_Albani_gw.nc`

## Dimensions

- nb_time = 12
  - 12 time steps in each file, corresponding to the climatological monthly averages (with the exception of `erod`, the soil erodibility variable), indicated as days since 2020-01-01 00:00:00. They are assumed to all have equal weight
  - time = [ 14, 44, 74, ... 284, 314, 344 ]
- nb_lat, nb_lon = 192, 288 (0.95 x 1.25 degrees)
  - latitude_values = [ -90, -89.05759, -88.11518, ... 88.11518, 89.05759, 90 ]
  - longitude_values = [ 0, 1.25, 2.5, ... 356.25, 357.5, 358.75 ]
- size_bin = 4 (dust particle size classes)
  - dust size bin edges = 0.1, 1.0, 2.5, 5.0, 10.0 µm (diameters)
  - size values = [1, 2, 3, 4]
    - 1 = 0.1-1.0 µm, 2 = 1.0-2.5 µm, 3 = 2.5-5.0 µm, 4 = 5.0-10.0 µm (diameters)
- nb_levels = 26 hybrid sigma-pressure levels
  - only for the `conc` variable
  - check the `PMIP4_DUST_Albani_conc_<expt>.nc` files for details about the hybrid coordinates

## Variables

### 2D dust fields

- **erod**: Soil erodibility
  - soil_erodibility
  - dimensions: [latitude, longitude]
  - units: binary (`0` or `1`)
    `0` = non-erodible grid cell
    `1` = erodible grid cell
- **emis**: Dust emission flux (size-resolved)

    - tendency_of_atmosphere_mass_content_of_dust_dry_aerosol_particles_due_to_emission
    - dimensions: [time, size, latitude, longitude]
    - units: kg m-2 s-1
- **load**: Dust load (size-resolved)
    - atmosphere_mass_content_of_dust_dry_aerosol_particles
    - dimensions: [time, size, latitude, longitude]
    - units: kg m-2
- **aot**: Dust Aerosol Optical Thickness (size-resolved) at 550 nm
    - atmosphere_optical_thickness_due_to_dust_dry_aerosol_particles
    - dimensions: [time, size, latitude, longitude]
    - units: 1 (*unitless*)
- **ddep**: Dust dry deposition flux (size-resolved)
    - tendency_of_atmosphere_mass_content_of_dust_dry_aerosol_particles_due_to_dry_deposition
    - dimensions: [time, size, latitude, longitude]
    - units: kg m-2 s-1
- **wdep**: Dust wet deposition flux (size-resolved)
    - tendency_of_atmosphere_mass_content_of_dust_dry_aerosol_particles_due_to_wet_deposition
    - dimensions: [time, size, latitude, longitude]
    - units: kg m-2 s-1
- **rfts**: Dust Direct Radiative Forcing (TOA, SW)
    - toa_net_downward_shortwave_radiative_forcing_due_to_dust_dry_aerosol_particles
    - dimensions: [time, latitude, longitude]
    - units: W m-2
- **rftl**: Dust Direct Radiative Forcing (TOA, LW)
    - toa_net_downward_longwave_radiative_forcing_due_to_dust_dry_aerosol_particles
    - dimensions: [time, latitude, longitude]
    - units: W m-2
- **rfss**: Dust Direct Radiative Forcing (surface, SW)
    - surface_net_downward_shortwave_radiative_forcing_due_to_dust_dry_aerosol_particles
    - dimensions: [time, latitude, longitude]
    - units: W m-2
- **rfsl**: Dust Direct Radiative Forcing (surface, LW)
    - surface_net_downward_longwave_radiative_forcing_due_to_dust_dry_aerosol_particles
    - dimensions: [time, latitude, longitude]
    - units: W m-2

## 3D dust field

- **conc**: Dust concentration (size resolved)
    - mass_concentration_of_dust_dry_aerosol_particles_in_air
    - dimensions: [time, size, lev, latitude, longitude]
    - units: kg m-3

The `PMIP4_DUST_Albani_conc_<exp>.nc` files also store the ancillary variables necessary to fully describe the vertical coordinate

- **ilev**: hybrid level at interfaces (1000*(A+B))
    - atmosphere_hybrid_sigma_pressure_coordinate

    - dimensions: [ilev]
    - units: 1
    - p(n,k,j,i) = a(k)*p0 + b(k)*ps(n,j,i)
    - a: hyai b: hybi p0: P0 ps: PS
- **PS**: Surface pressure
    - surface_air_pressure
    - dimensions: [time, latitude, longitude]
    - units: Pa
- **hyam**
    - hybrid A coefficient at layer midpoints
- **hybm**
    - hybrid B coefficient at layer midpoints
- **hyai**
    - hybrid A coefficient at layer interfaces
- **hybi**
    - hybrid B coefficient at layer interfaces

# References

Please cite **at least one** of the following papers


- Albani, S., Mahowald, N. M., Perry, A. T., Scanza, R. A., Zender, C. S., Heavens, N. G., Maggi, V., Kok, J. F., and Otto-Bliesner, B. L.: **Improved dust representation in the Community Atmosphere Model**, J. Adv. Model. Earth Syst., 6, 541–570, doi:10.1002/2013MS000279, 2014.
    - Note: this paper describes the LGM simulation

- Albani, S., Mahowald, N. M., Winckler, G., Anderson, R. F., Bradtmiller, L. I., Delmonte, B., François, R., Goman, M., Heavens, N. G., Hesse, P. P., Hovan, S. A., Kang, S., Kohfeld, K. E., Lu, H., Maggi, V., Mason, J. A., Mayewski, P. A., McGee, D., Miao, X., Otto-Bliesner, B. L., Perry, A. T., Pourmand, A., Roberts, H. M., Rosenbloom, N., Stevens, T., and Sun, J.: **Twelve thousand years of dust: the Holocene global dust cycle constrained by natural archives**, Clim. Past, 11, 869-903, doi:10.5194/cp-11-869-2015, 2015.
    - Note: this paper describes the mid-Holocene simulation

- Albani, S., Mahowald, N. M., Murphy, L. N., Raiswell, R., Moore, J. K., Anderson, R. F., McGee, D., Bradtmiller, L., Delmonte, B., Hesse, P. P., and Mayewski, P. A.: **Paleodust variability since the Last Glacial Maximum and implications for iron inputs to the ocean**, Geophys. Res. Lett., 43, doi:10.1002/2016GL067911, 2016.
    - Note: this paper describes the pre-Industrial simulation and compares it to the mid-Holocene and LGM simulations in previous papers


# Download

You will find below a table with all the available data files, and their *md5sum* checksum (if you want to check that you download was OK, you can just type `md5sum file.nc` and compare the result to what is displayed in the table).

If you want to download a file, click on the PMIP4 CESM dust data download link and then on the file

you need.

| md5sum output | Data file |
|---|---|
| 8859ab3b77ce01008785b05fec5cc459 | PMIP4_DUST_Albani_aot_LGM.nc |
| a99c8627d21cdc67ab989437b0808e00 | PMIP4_DUST_Albani_aot_MH.nc |
| 118d105d29a7da31e5a443fba87c4e96 | PMIP4_DUST_Albani_aot_PI.nc |
| 5fa086e300324080614db8175b223220 | PMIP4_DUST_Albani_conc_LGM.nc |
| e7c929737c681bde8cde11198578af9e | PMIP4_DUST_Albani_conc_MH.nc |
| bf0baa1a003a2d85d306d62e2b5f20f9 | PMIP4_DUST_Albani_conc_PI.nc |
| 3727a77888c8809a0f87c8e51e37668b | PMIP4_DUST_Albani_ddep_LGM.nc |
| 568f5f2ecc516a618b27aebbf6ac8475 | PMIP4_DUST_Albani_ddep_MH.nc |
| 01db9ba162a3ec1f8bd0d0bc2abcc63a | PMIP4_DUST_Albani_ddep_PI.nc |
| d29ad13c7508a0389ef0740c83069d1a | PMIP4_DUST_Albani_emis_LGM.nc |
| 7ecaf8a616bd31ccb600c8162ad8f815 | PMIP4_DUST_Albani_emis_MH.nc |
| 5eff212c3cfc96bacc119eedfe0ee91e | PMIP4_DUST_Albani_emis_PI.nc |
| e14a6ffba0b74a9211ad67e9642b5987 | PMIP4_DUST_Albani_erod_LGM.nc |
| 5d6f767abbca1e560a5fc326e828aee1 | PMIP4_DUST_Albani_erod_MH.nc |
| 24e8470134020cecdc552afd2dddf425 | PMIP4_DUST_Albani_erod_PI.nc |
| 1cf6720ad615ad97b50842298fd02f51 | PMIP4_DUST_Albani_gw.nc |
| 6c7f9d1a84c36540b42ea6bb1eeadf59 | PMIP4_DUST_Albani_load_LGM.nc |
| 76079e93089a87e3fd128b9895db3297 | PMIP4_DUST_Albani_load_MH.nc |
| 2e121549b158cf9dad1761ea681ca835 | PMIP4_DUST_Albani_load_PI.nc |
| e47e21fa07df86629e1de6b38459eae0 | PMIP4_DUST_Albani_rfsl_LGM.nc |
| 46a397182b1c0324173a0bd84b8bf9b9 | PMIP4_DUST_Albani_rfsl_MH.nc |
| f9bb094451dd31a8b6d92ba320944307 | PMIP4_DUST_Albani_rfsl_PI.nc |
| 1359e872a421df6970da5e3e50f453cd | PMIP4_DUST_Albani_rfss_LGM.nc |
| cfb9261506308e84d90d1041a8cafb19 | PMIP4_DUST_Albani_rfss_MH.nc |
| 6b3e529f314775270fd87007c45d4e1b | PMIP4_DUST_Albani_rfss_PI.nc |
| a43755b757169c516d2aad9cdffa1456 | PMIP4_DUST_Albani_rftl_LGM.nc |
| fb7474a2c61668f9f2b5d88199fdf03b | PMIP4_DUST_Albani_rftl_MH.nc |
| b2de8b84a236764234a9abc9cbd3bbb7 | PMIP4_DUST_Albani_rftl_PI.nc |
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| 5ad9e6586b2bc7771a7b1b0688767476 | PMIP4_DUST_Albani_rfts_MH.nc |
| 98b9b2a122b9b9c86bd432e6d1dac502 | PMIP4_DUST_Albani_rfts_PI.nc |
| 182e86d78be48fc5c2c1ec57f13aa021 | PMIP4_DUST_Albani_wdep_LGM.nc |
| f83c22185608042a92107609f59ef658 | PMIP4_DUST_Albani_wdep_MH.nc |
| 1dc20b285c666765cf9ea61e53a20549 | PMIP4_DUST_Albani_wdep_PI.nc |

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