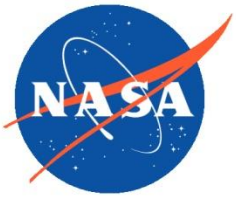

National Aeronautics and Space Administration Goddard Earth Science Data Information and Services Center (GES DISC)

README Document for MERRA2 Data Products

Last Revised 10/5/2015

Goddard Earth Sciences Data and Information Services Center (GES DISC)
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Revision History

Revision Date	*Changes*	*Author*

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1.0 Introduction

This document provides basic information for using MERRA2 Gridded Output products.

The second Modern-Era Retrospective analysis for Research and Applications (MERRA-2) is a NASA atmospheric reanalysis that begins in 1980. It replaces the original MERRA reanalysis (Rienecker et al., 2011) using an upgraded version of the Goddard Earth Observing System Model, Version 5 (GEOS-5) data assimilation system. MERRA-2 includes updates to the model (Molod et al., 2012; 2014) and to the Global Statistical Interpolation (GSI) analysis scheme of Wu et al. (2002). Details of the MERRA-2 system, including major changes from the MERRA system, are detailed in the companion GMAO Office Note No. 10. The major motivation for replacing MERRA with MERRA-2 is the fact that the MERRA data assimilation system was frozen in 2008 and is not capable of ingesting several important new data types: as the older satellite instruments fail, the number of observations available for assimilation in MERRA is decreasing rapidly. MERRA-2 uses GEOS-5, Version 5.12.4, which is able to use the newer microwave sounders and hyperspectral infrared radiance instruments, among other instruments. McCarty et al. (2015) describes the MERRA-2 observing system.

To View specific data set information like file naming convention, temporal and spatial information please visit the MERRA-2: File Specification document on the GMAO Publications site.
(http://gmao.gsfc.nasa.gov/pubs/office_notes/)

2.0 Products/Parameters

Products

This section lists the variables in each data collection. More details on the variable definitions may be found in the GEOS-5 Variable Definition Glossary, available at the GMAO web page. In the tables, variable names refer to HDF names, which are uppercase.

Constants

const_2d_asm_Nx (M2C0NXASM): Constant Model Parameters

Frequency: *constant from 03:00 UTC (time-invariant)*

Spatial Grid: *2D, single-level, full horizontal resolution*

Dimensions: *longitude=576, latitude=361, time=1*

Granule Size: *~6 MB*

Name	***Dim***	***Description***	***Units***
AREA	tyx	agrid cell area	m^2
FRLAKE	tyx	fraction of lake	1
FRLAND	tyx	fraction of land	1
FRLANDICE	tyx	fraction of land ice	1
FROCEAN	tyx	fraction of ocean	1
PHIS	tyx	surface geopotential height	$m^2\ s^{-2}$
SGH	tyx	isotropic stdv of GWD topography	m

Instantaneous Two-Dimensional Collections

inst1_2d_asm_Nx (M2I1NXASM): Single-Level Diagnostics

Frequency: *1-hourly from 00:00 UTC (instantaneous)*

Spatial Grid: *2D, single-level, full horizontal resolution*

Dimensions: *longitude=576, latitude=361, time=24*

Granule Size: *~194 MB*

Name	***Dim***	***Description***	***Units***
DISPH	tyx	zero plane displacement height	m
PS	tyx	surface pressure	Pa
QV10M	tyx	10-meter specific humidity	kg kg^{-1}
QV2M	tyx	2-meter specific humidity	kg kg^{-1}
SLP	tyx	sea level pressure	Pa
T10M	tyx	10-meter air temperature	K
T2M	tyx	2-meter air temperature	K
TO3	tyx	total column ozone	Dobsons
TOX	tyx	total column odd oxygen	kg m^{-2}
TQI	tyx	total precipitable ice water	kg m^{-2}
TQL	tyx	total precipitable liquid water	kg m^{-2}
TQV	tyx	total precipitable water vapor	kg m^{-2}
TROPPB	tyx	tropopause pressure based on blended estimate	Pa
TROPPT	tyx	tropopause pressure based on thermal estimate	Pa
TROPPV	tyx	tropopause pressure based on EPV estimate	Pa

TROPQ	tyx	tropopause specific humidity using blended TROPP estimate	kg kg^{-1}
TROPT	tyx	tropopause temperature using blended TROPP estimate	K
TS	tyx	surface skin temperature	K
U10M	tyx	10-meter eastward wind	m s^{-1}
U2M	tyx	2-meter eastward wind	m s^{-1}
U50M	tyx	eastward wind at 50 meters	m s^{-1}
V10M	tyx	10-meter northward wind	m s^{-1}
V2M	tyx	2-meter northward wind	m s^{-1}
V50M	tyx	northward wind at 50 meters	m s^{-1}

inst1_2d_int_Nx (M2I1NXINT): Vertically Integrated Diagnostics

Frequency: *1-hourly from 00:00 UTC (instantaneous)*

Spatial Grid: *2D, single-level, full horizontal resolution*

Dimensions: *longitude=576, latitude=361, time=24*

Granule Size: *~100 MB*

Name	***Dim***	***Description***	***Units***
CPT	tyx	vertically integrated enthalpy	J m^{-2}
KE	tyx	vertically integrated kinetic energy	J m^{-2}
MASS	tyx	atmospheric mass	kg m^{-2}
THV	tyx	vertically integrated virtual potential temperature	K
TOX	tyx	total column odd oxygen	kg m^{-2}
TQI	tyx	total precipitable ice water	kg m^{-2}
TQL	tyx	total precipitable liquid water	kg m^{-2}

TQV	tyx	total precipitable water vapor	kg m^{-2}

inst1_2d_lfo_Nx (M2I1NXLFO): Land Surface Forcings

Frequency: *1-hourly from 00:00 UTC (instantaneous)*

Spatial Grid: *2D, single-level, full horizontal resolution*

Dimensions: *longitude=576, latitude=361, time=24*

Granule Size: *~61 MB*

Name	***Dim***	***Description***	***Units***
HLML	tyx	surface layer height	m
PS	tyx	surface pressure	Pa
QLML	tyx	surface specific humidity	1
SPEEDLML	tyx	surface wind speed	m s^{-1}
TLML	tyx	surface air temperature	K

inst3_2d_gas_Nx (M2I3NXGAS): Aerosol Optical Depth Analysis

Frequency: *3-hourly from 00:00 UTC (instantaneous)*

Spatial Grid: *2D, single-level, full horizontal resolution*

Dimensions: *longitude=576, latitude=361, time=8*

Granule Size: *~9 MB*

Name	***Dim***	***Description***	***Units***
AODANA	tyx	Aerosol Optical Depth Analysis	1

AODINC	tyx	Aerosol Optical Depth Analysis Increment	1

Instantaneous Three-Dimensional Collections

inst3_3d_aer_Nv (M2I3NVAER): Aerosol Mixing Ratio

Frequency: *3-hourly from 00:00 UTC (instantaneous)*

Spatial Grid: *3D, model-level, full horizontal resolution*

Dimensions: *longitude=576, latitude=361, level=72, time=8*

Granule Size: *~4.0 GB*

Name	***Dim***	***Description***	***Units***
AIRDENS	tzyx	air density	kg m^{-3}
BCPHILIC	tzyx	Hydrophilic Black Carbon	kg kg^{-1}
BCPHOBIC	tzyx	Hydrophobic Black Carbon	kg kg^{-1}
DELP	tzyx	pressure thickness	Pa
DMS	tzyx	Dimethylsulphide	kg kg^{-1}
DU001	tzyx	Dust Mixing Ratio (bin 001)	kg kg^{-1}
DU002	tzyx	Dust Mixing Ratio (bin 002)	kg kg^{-1}
DU003	tzyx	Dust Mixing Ratio (bin 003)	kg kg^{-1}
DU004	tzyx	Dust Mixing Ratio (bin 004)	kg kg^{-1}
DU005	tzyx	Dust Mixing Ratio (bin 005)	kg kg^{-1}
LWI	tyx	land(1) water(0) ice(2) flag	1
MSA	tzyx	Methanesulphonic acid	kg kg^{-1}
OCPHILIC	tzyx	Hydrophilic Organic Carbon (Particulate Matter)	kg kg^{-1}

OCPHOBIC	tzyx	Hydrophobic Organic Carbon (Particulate Matter)	kg kg^{-1}
PS	tyx	surface pressure	Pa
RH	tzyx	relative humidity after moist	1
SO2	tzyx	Sulphur dioxide	kg kg^{-1}
SO4	tzyx	Sulphate aerosol	kg kg^{-1}
SS001	tzyx	Sea Salt Mixing Ratio (bin 001)	kg kg^{-1}
SS002	tzyx	Sea Salt Mixing Ratio (bin 002)	kg kg^{-1}
SS003	tzyx	Sea Salt Mixing Ratio (bin 003)	kg kg^{-1}
SS004	tzyx	Sea Salt Mixing Ratio (bin 004)	kg kg^{-1}
SS005	tzyx	Sea Salt Mixing Ratio (bin 005)	kg kg^{-1}

inst3_3d_asm_Np (M2I3NPASM): Assimilated Meteorological Fields

Frequency: *3-hourly from 00:00 UTC (instantaneous)*

Spatial Grid: *3D, pressure-level, full horizontal resolution*

Dimensions: *longitude=576, latitude=361, level=42, time=8*

Granule Size: *~1.1 GB*

Name	***Dim***	***Description***	***Units***
EPV	tzyx	ertels potential vorticity	K m^2 kg^{-1} s^{-1}
H	tzyx	edge heights	m
O3	tzyx	ozone mass mixing ratio	kg kg^{-1}
OMEGA	tzyx	vertical pressure velocity	Pa s^{-1}
PHIS	tyx	surface geopotential height	m^2 s^{-2}

PS	tyx	surface pressure	Pa
QI	tzyx	mass fraction of cloud ice water	kg kg^{-1}
QL	tzyx	mass fraction of cloud liquid water	kg kg^{-1}
QV	tzyx	specific humidity	kg kg^{-1}
RH	tzyx	relative humidity after moist	1
SLP	tyx	sea level pressure	Pa
T	tzyx	air temperature	K
U	tzyx	eastward wind	m s^{-1}
V	tzyx	northward wind	m s^{-1}

inst3_3d_asm_Nv (M2I3NVASM): Assimilated Meteorological Fields

Frequency: *3-hourly from 00:00 UTC (instantaneous)*

Spatial Grid: *3D, model-level, full horizontal resolution*

Dimensions: *longitude=576, latitude=361, level=72, time=8*

Granule Size: *~2.1 GB*

Name	***Dim***	***Description***	***Units***
CLOUD	tzyx	cloud fraction for radiation	1
DELP	tzyx	pressure thickness	Pa
EPV	tzyx	ertels potential vorticity	K m^2 kg^{-1} s^{-1}
H	tzyx	mid layer heights	m
O3	tzyx	ozone mass mixing ratio	kg kg^{-1}
OMEGA	tzyx	vertical pressure velocity	Pa s^{-1}

PHIS	tyx	surface geopotential height	$m^2\ s^{-2}$
PL	tzyx	mid level pressure	Pa
PS	tyx	surface pressure	Pa
QI	tzyx	mass fraction of cloud ice water	$kg\ kg^{-1}$
QL	tzyx	mass fraction of cloud liquid water	$kg\ kg^{-1}$
QV	tzyx	specific humidity	$kg\ kg^{-1}$
RH	tzyx	relative humidity after moist	1
SLP	tyx	sea level pressure	Pa
T	tzyx	air temperature	K
U	tzyx	eastward wind	$m\ s^{-1}$
V	tzyx	northward wind	$m\ s^{-1}$

inst3_3d_chm_Nv (M2I3NVCHM): Carbon Monoxide and Ozone Mixing Ratio

Frequency: *3-hourly from 00:00 UTC (instantaneous)*

Spatial Grid: *3D, model-level, full horizontal resolution*

Dimensions: *longitude=576, latitude=361, level=72, time=8*

Granule Size: *~532 MB*

Name	***Dim***	***Description***	***Units***
AIRDENS	tzyx	air density	$kg\ m^{-3}$
CO	tzyx	Carbon Monoxide (All Sources)	$mol\ mol^{-1}$
DELP	tzyx	pressure thickness	Pa
O3	tzyx	ozone mass mixing ratio	$kg\ kg^{-1}$

PS	tyx	surface pressure	Pa

inst3_3d_gas_Nv (M2I3NVGAS): Aerosol Mixing Ratio Analysis Increments

Frequency: *3-hourly from 00:00 UTC (instantaneous)*

Spatial Grid: *3D, model-level, full horizontal resolution*

Dimensions: *longitude=576, latitude=361, level=72, time=8*

Granule Size: *~402 MB*

Name	***Dim***	***Description***	***Units***
AIRDENS	tzyx	air density	kg m^{-3}
BCINC	tzyx	Black Carbon Mixing Ratio Analysis Increments	kg kg^{-1}
DUINC	tzyx	Dust Mixing Ratio Analysis Increments	kg kg^{-1}
OCINC	tzyx	Organic Carbon Mixing Ratio Analysis Increments	kg kg^{-1}
SSINC	tzyx	Sea-salt Mixing Ratio Analysis Increments	kg kg^{-1}
SUINC	tzyx	Sulfate Mixing Ratio Analysis Increments	kg kg^{-1}
DELP	tzyx	pressure thickness	Pa

inst6_3d_ana_Np (M2I6NPANA): Analyzed Meteorological Fields

Frequency: *6-hourly from 00:00 UTC (instantaneous)*

Spatial Grid: *3D, pressure-level, full horizontal resolution*

Dimensions: *longitude=576, latitude=361, level=42, time=4*

Granule Size: *~509 MB*

Name	*Dim*	*Description*	*Units*
H	tzyx	Geopotential height	m
O3	tzyx	Ozone mixing ratio	kg kg^{-1}
PS	tyx	Surface pressure	Pa
QV	tzyx	Specific humidity	kg kg^{-1}
SLP	tyx	Sea-level pressure	Pa
T	tzyx	Air temperature	K
U	tzyx	Eastward wind component	m/s
V	tzyx	Northward wind component	m/s

inst6_3d_ana_Nv (M2I6NVANA): Analyzed Meteorological Fields

Frequency: *6-hourly from 00:00 UTC (instantaneous)*

Spatial Grid: *3D, model-level, full horizontal resolution*

Dimensions: *longitude=576, latitude=361, level=72, time=4*

Granule Size: *~831 MB*

Name	*Dim*	*Description*	*Units*
DELP	tzyx	Layer pressure thickness	Pa
O3	tzyx	Ozone mixing ratio	kg kg^{-1}
PS	tyx	Surface pressure	Pa
QV	tzyx	Specific humidity	kg kg^{-1}
T	tzyx	Air temperature	K

U	tzyx	Eastward wind component	m/s
V	tzyx	Northward wind component	m/s

Time Averaged Two-Dimensional Collections

statD_2d_slv_Nx (M2SDNXSLV): Single-Level Diagnostics

Frequency: *daily from 00:30 UTC (aggregated statistics)*

Spatial Grid: *2D, single-level, full horizontal resolution*

Dimensions: *longitude=576, latitude=361, time=1*

Granule Size: *~2 MB*

Name	***Dim***	***Description***	***Units***
HOURNORAIN	tyx	time-during an hour with no precipitation	s
T2MMAX	tyx	2-meter air temperature	K
T2MMEAN	tyx	2-meter air temperature	K
T2MMIN	tyx	2-meter air temperature	K
TPRECMAX	tyx	Maximum precipitation rate during the period	kg m^{-2} s^{-1}

tavg1_2d_adg_Nx (M2T1NXADG): Aerosol Diagnostics (extended)

Frequency: *1-hourly from 00:30 UTC (time-averaged)*

Spatial Grid: *2D, single-level, full horizontal resolution*

Dimensions: *longitude=576, latitude=361, time=24*

Granule Size: *~779 MB*

Name	*Dim*	*Description*	*Units*
BCDP001	tyx	Black Carbon Dry Deposition Bin 001	kg m^{-2} s^{-1}
BCDP002	tyx	Black Carbon Dry Deposition Bin 002	kg m^{-2} s^{-1}
BCEM001	tyx	Black Carbon Emission Bin 001	kg m^{-2} s^{-1}
BCEM002	tyx	Black Carbon Emission Bin 002	kg m^{-2} s^{-1}
BCEMAN	tyx	Black Carbon Anthropogenic Emissions	kg m^{-2} s^{-1}
BCEMBB	tyx	Black Carbon Biomass Burning Emissions	kg m^{-2} s^{-1}
BCEMBF	tyx	Black Carbon Biofuel Emissions	kg m^{-2} s^{-1}
BCHYPHIL	tyx	Black Carbon Hydrophobic to Hydrophilic	kg m^{-2} s^{-1}
BCSD001	tyx	Black Carbon Sedimentation Bin 001	kg m^{-2} s^{-1}
BCSD002	tyx	Black Carbon Sedimentation Bin 002	kg m^{-2} s^{-1}
BCSV001	tyx	Black Carbon Convective Scavenging Bin 001	kg m^{-2} s^{-1}
BCSV002	tyx	Black Carbon Convective Scavenging Bin 002	kg m^{-2} s^{-1}
BCWT001	tyx	Black Carbon Wet Deposition Bin 001	kg m^{-2} s^{-1}
BCWT002	tyx	Black Carbon Wet Deposition Bin 002	kg m^{-2} s^{-1}
DUAERIDX	tyx	Dust TOMS UV Aerosol Index	1
DUDP001	tyx	Dust Dry Deposition Bin 001	kg m^{-2} s^{-1}
DUDP002	tyx	Dust Dry Deposition Bin 002	kg m^{-2} s^{-1}
DUDP003	tyx	Dust Dry Deposition Bin 003	kg m^{-2} s^{-1}
DUDP004	tyx	Dust Dry Deposition Bin 004	kg m^{-2} s^{-1}
DUDP005	tyx	Dust Dry Deposition Bin 005	kg m^{-2} s^{-1}
DUEM001	tyx	Dust Emission Bin 001	kg m^{-2} s^{-1}
DUEM002	tyx	Dust Emission Bin 002	kg m^{-2} s^{-1}
DUEM003	tyx	Dust Emission Bin 003	kg m^{-2} s^{-1}

DUEM004	tyx	Dust Emission Bin 004	kg m^{-2} s^{-1}
DUEM005	tyx	Dust Emission Bin 005	kg m^{-2} s^{-1}
DUEXTTFM	tyx	Dust Extinction AOT [550 nm] - PM 1.0 um	1
DUSCATFM	tyx	Dust Scattering AOT [550 nm] - PM 1.0 um	1
DUSD001	tyx	Dust Sedimentation Bin 001	kg m^{-2} s^{-1}
DUSD002	tyx	Dust Sedimentation Bin 002	kg m^{-2} s^{-1}
DUSD003	tyx	Dust Sedimentation Bin 003	kg m^{-2} s^{-1}
DUSD004	tyx	Dust Sedimentation Bin 004	kg m^{-2} s^{-1}
DUSD005	tyx	Dust Sedimentation Bin 005	kg m^{-2} s^{-1}
DUSV001	tyx	Dust Convective Scavenging Bin 001	kg m^{-2} s^{-1}
DUSV002	tyx	Dust Convective Scavenging Bin 002	kg m^{-2} s^{-1}
DUSV003	tyx	Dust Convective Scavenging Bin 003	kg m^{-2} s^{-1}
DUSV004	tyx	Dust Convective Scavenging Bin 004	kg m^{-2} s^{-1}
DUSV005	tyx	Dust Convective Scavenging Bin 005	kg m^{-2} s^{-1}
DUWT001	tyx	Dust Wet Deposition Bin 001	kg m^{-2} s^{-1}
DUWT002	tyx	Dust Wet Deposition Bin 002	kg m^{-2} s^{-1}
DUWT003	tyx	Dust Wet Deposition Bin 003	kg m^{-2} s^{-1}
DUWT004	tyx	Dust Wet Deposition Bin 004	kg m^{-2} s^{-1}
DUWT005	tyx	Dust Wet Deposition Bin 005	kg m^{-2} s^{-1}
OCDP001	tyx	Organic Carbon Dry Deposition Bin 001	kg m^{-2} s^{-1}
OCDP002	tyx	Organic Carbon Dry Deposition Bin 002	kg m^{-2} s^{-1}
OCEM001	tyx	Organic Carbon Emission Bin 001	kg m^{-2} s^{-1}
OCEM002	tyx	Organic Carbon Emission Bin 002	kg m^{-2} s^{-1}
OCEMAN	tyx	Organic Carbon Anthropogenic Emissions	kg m^{-2} s^{-1}
OCEMBB	tyx	Organic Carbon Biomass Burning Emissions	kg m^{-2} s^{-1}

OCEMBF	tyx	Organic Carbon Biofuel Emissions	kg m^{-2} s^{-1}
OCEMBG	tyx	Organic Carbon Biogenic Emissions	kg m^{-2} s^{-1}
OCHYPHIL	tyx	Organic Carbon Hydrophobic to Hydrophilic	kg m^{-2} s^{-1}
OCSD001	tyx	Organic Carbon Sedimentation Bin 001	kg m^{-2} s^{-1}
OCSD002	tyx	Organic Carbon Sedimentation Bin 002	kg m^{-2} s^{-1}
OCSV001	tyx	Organic Carbon Convective Scavenging Bin 001	kg m^{-2} s^{-1}
OCSV002	tyx	Organic Carbon Convective Scavenging Bin 002	kg m^{-2} s^{-1}
OCWT001	tyx	Organic Carbon Wet Deposition Bin 001	kg m^{-2} s^{-1}
OCWT002	tyx	Organic Carbon Wet Deposition Bin 002	kg m^{-2} s^{-1}
SO2EMAN	tyx	SO2 Anthropogenic Emissions	kg m^{-2} s^{-1}
SO2EMBB	tyx	SO2 Biomass Burning Emissions	kg m^{-2} s^{-1}
SO2EMVE	tyx	SO2 Volcanic (explosive) Emissions	kg m^{-2} s^{-1}
SO2EMVN	tyx	SO2 Volcanic (non-explosive) Emissions	kg m^{-2} s^{-1}
SO4EMAN	tyx	SO4 Anthropogenic Emissions	kg m^{-2} s^{-1}
SSAERIDX	tyx	Sea Salt TOMS UV Aerosol Index	1
SSDP001	tyx	Sea Salt Dry Deposition Bin 001	kg m^{-2} s^{-1}
SSDP002	tyx	Sea Salt Dry Deposition Bin 002	kg m^{-2} s^{-1}
SSDP003	tyx	Sea Salt Dry Deposition Bin 003	kg m^{-2} s^{-1}
SSDP004	tyx	Sea Salt Dry Deposition Bin 004	kg m^{-2} s^{-1}
SSDP005	tyx	Sea Salt Dry Deposition Bin 005	kg m^{-2} s^{-1}
SSEM001	tyx	Sea Salt Emission Bin 001	kg m^{-2} s^{-1}
SSEM002	tyx	Sea Salt Emission Bin 002	kg m^{-2} s^{-1}
SSEM003	tyx	Sea Salt Emission Bin 003	kg m^{-2} s^{-1}
SSEM004	tyx	Sea Salt Emission Bin 004	kg m^{-2} s^{-1}
SSEM005	tyx	Sea Salt Emission Bin 005	kg m^{-2} s^{-1}

SSEXTTFM	tyx	Sea Salt Extinction AOT [550 nm] - PM 1.0 um	1
SSSCATFM	tyx	Sea Salt Scattering AOT [550 nm] - PM 1.0 um	1
SSSD001	tyx	Sea Salt Sedimentation Bin 001	kg m^{-2} s^{-1}
SSSD002	tyx	Sea Salt Sedimentation Bin 002	kg m^{-2} s^{-1}
SSSD003	tyx	Sea Salt Sedimentation Bin 003	kg m^{-2} s^{-1}
SSSD004	tyx	Sea Salt Sedimentation Bin 004	kg m^{-2} s^{-1}
SSSD005	tyx	Sea Salt Sedimentation Bin 005	kg m^{-2} s^{-1}
SSSV001	tyx	Sea Salt Convective Scavenging Bin 001	kg m^{-2} s^{-1}
SSSV002	tyx	Sea Salt Convective Scavenging Bin 002	kg m^{-2} s^{-1}
SSSV003	tyx	Sea Salt Convective Scavenging Bin 003	kg m^{-2} s^{-1}
SSSV004	tyx	Sea Salt Convective Scavenging Bin 004	kg m^{-2} s^{-1}
SSSV005	tyx	Sea Salt Convective Scavenging Bin 005	kg m^{-2} s^{-1}
SSWT001	tyx	Sea Salt Wet Deposition Bin 001	kg m^{-2} s^{-1}
SSWT002	tyx	Sea Salt Wet Deposition Bin 002	kg m^{-2} s^{-1}
SSWT003	tyx	Sea Salt Wet Deposition Bin 003	kg m^{-2} s^{-1}
SSWT004	tyx	Sea Salt Wet Deposition Bin 004	kg m^{-2} s^{-1}
SSWT005	tyx	Sea Salt Wet Deposition Bin 005	kg m^{-2} s^{-1}
SUDP001	tyx	Sulfate Dry Deposition Bin 001	kg m^{-2} s^{-1}
SUDP002	tyx	Sulfate Dry Deposition Bin 002	kg m^{-2} s^{-1}
SUDP003	tyx	Sulfate Dry Deposition Bin 003	kg m^{-2} s^{-1}
SUDP004	tyx	Sulfate Dry Deposition Bin 004	kg m^{-2} s^{-1}
SUEM001	tyx	Sulfate Emission Bin 001	kg m^{-2} s^{-1}
SUEM002	tyx	Sulfate Emission Bin 002	kg m^{-2} s^{-1}
SUEM003	tyx	Sulfate Emission Bin 003	kg m^{-2} s^{-1}
SUEM004	tyx	Sulfate Emission Bin 004	kg m^{-2} s^{-1}

SUPMSA	tyx	MSA Prod from DMS Oxidation [column]	kg m^{-2} s^{-1}
SUPSO2	tyx	SO2 Prod from DMS Oxidation [column]	kg m^{-2} s^{-1}
SUPSO4AQ	tyx	SO4 Prod from Aqueous SO2 Oxidation [column]	kg m^{-2} s^{-1}
SUPSO4G	tyx	SO4 Prod from Gaseous SO2 Oxidation [column]	kg m^{-2} s^{-1}
SUPSO4WT	tyx	SO4 Prod from Aqueous SO2 Oxidation (wet dep) [column]	kg m^{-2} s^{-1}
SUSD001	tyx	Sulfate Settling Bin 001	kg m^{-2} s^{-1}
SUSD002	tyx	Sulfate Settling Bin 002	kg m^{-2} s^{-1}
SUSD003	tyx	Sulfate Settling Bin 003	kg m^{-2} s^{-1}
SUSD004	tyx	Sulfate Settling Bin 004	kg m^{-2} s^{-1}
SUSV001	tyx	Sulfate Convective Scavenging Bin 001	kg m^{-2} s^{-1}
SUSV002	tyx	Sulfate Convective Scavenging Bin 002	kg m^{-2} s^{-1}
SUSV003	tyx	Sulfate Convective Scavenging Bin 003	kg m^{-2} s^{-1}
SUSV004	tyx	Sulfate Convective Scavenging Bin 004	kg m^{-2} s^{-1}
SUWT001	tyx	Sulfate Wet Deposition Bin 001	kg m^{-2} s^{-1}
SUWT002	tyx	Sulfate Wet Deposition Bin 002	kg m^{-2} s^{-1}
SUWT003	tyx	Sulfate Wet Deposition Bin 003	kg m^{-2} s^{-1}
SUWT004	tyx	Sulfate Wet Deposition Bin 004	kg m^{-2} s^{-1}

tavg1_2d_aer_Nx (M2T1NXAER): Aerosol Diagnostics

Frequency: *1-hourly from 00:30 UTC (time-averaged)*

Spatial Grid: *2D, single-level, full horizontal resolution*

Dimensions: *longitude=576, latitude=361, time=24*

Granule Size: *~476 MB*

Name	*Dim*	*Description*	*Units*
BCANGSTR	tyx	Black Carbon Angstrom parameter [470-870 nm]	1
BCCMASS	tyx	Black Carbon Column Mass Density	kg m^{-2}
BCEXTTAU	tyx	Black Carbon Extinction AOT [550 nm]	1
BCFLUXU	tyx	Black Carbon column u-wind mass flux	kg m^{-1} s^{-1}
BCFLUXV	tyx	Black Carbon column v-wind mass flux	kg m^{-1} s^{-1}
BCSCATAU	tyx	Black Carbon Scattering AOT [550 nm]	1
BCSMASS	tyx	Black Carbon Surface Mass Concentration	kg m^{-3}
DMSCMASS	tyx	DMS Column Mass Density	kg m^{-2}
DMSSMASS	tyx	DMS Surface Mass Concentration	kg m^{-3}
DUANGSTR	tyx	Dust Angstrom parameter [470-870 nm]	1
DUCMASS	tyx	Dust Column Mass Density	kg m^{-2}
DUCMASS25	tyx	Dust Column Mass Density - PM 2.5	kg m^{-2}
DUEXTT25	tyx	Dust Extinction AOT [550 nm] - PM 2.5	1
DUEXTTAU	tyx	Dust Extinction AOT [550 nm]	1
DUFLUXU	tyx	Dust column u-wind mass flux	kg m^{-1} s^{-1}
DUFLUXV	tyx	Dust column v-wind mass flux	kg m^{-1} s^{-1}
DUSCAT25	tyx	Dust Scattering AOT [550 nm] - PM 2.5	1
DUSCATAU	tyx	Dust Scattering AOT [550 nm]	1
DUSMASS	tyx	Dust Surface Mass Concentration	kg m^{-3}
DUSMASS25	tyx	Dust Surface Mass Concentration - PM 2.5	kg m^{-3}
OCANGSTR	tyx	Organic Carbon Angstrom parameter [470-870 nm]	1
OCCMASS	tyx	Organic Carbon Column Mass Density	kg m^{-2}
OCEXTTAU	tyx	Organic Carbon Extinction AOT [550 nm]	1
OCFLUXU	tyx	Organic Carbon column u-wind mass flux	kg m^{-1} s^{-1}

OCFLUXV	tyx	Organic Carbon column v-wind mass flux	kg m^{-1} s^{-1}
OCSCATAU	tyx	Organic Carbon Scattering AOT [550 nm]	1
OCSMASS	tyx	Organic Carbon Surface Mass Concentration	kg m^{-3}
SO2CMASS	tyx	SO2 Column Mass Density	kg m^{-2}
SO2SMASS	tyx	SO2 Surface Mass Concentration	kg m^{-3}
SO4CMASS	tyx	SO4 Column Mass Density	kg m^{-2}
SO4SMASS	tyx	SO4 Surface Mass Concentration	kg m^{-3}
SSANGSTR	tyx	Sea Salt Angstrom parameter [470-870 nm]	1
SSCMASS	tyx	Sea Salt Column Mass Density	kg m^{-2}
SSCMASS25	tyx	Sea Salt Column Mass Density - PM 2.5	kg m^{-2}
SSEXTT25	tyx	Sea Salt Extinction AOT [550 nm] - PM 2.5	1
SSEXTTAU	tyx	Sea Salt Extinction AOT [550 nm]	1
SSFLUXU	tyx	Sea Salt column u-wind mass flux	kg m^{-1} s^{-1}
SSFLUXV	tyx	Sea Salt column v-wind mass flux	kg m^{-1} s^{-1}
SSSCAT25	tyx	Sea Salt Scattering AOT [550 nm] - PM 2.5	1
SSSCATAU	tyx	Sea Salt Scattering AOT [550 nm]	1
SSSMASS	tyx	Sea Salt Surface Mass Concentration	kg m^{-3}
SSSMASS25	tyx	Sea Salt Surface Mass Concentration - PM 2.5	kg m^{-3}
SUANGSTR	tyx	SO4 Angstrom parameter [470-870 nm]	1
SUEXTTAU	tyx	SO4 Extinction AOT [550 nm]	1
SUFLUXU	tyx	SO4 column u-wind mass flux	kg m^{-1} s^{-1}
SUFLUXV	tyx	SO4 column v-wind mass flux	kg m^{-1} s^{-1}
SUSCATAU	tyx	SO4 Scattering AOT [550 nm]	1
TOTANGSTR	tyx	Total Aerosol Angstrom parameter [470-870 nm]	1
TOTEXTTAU	tyx	Total Aerosol Extinction AOT [550 nm]	1

TOTSCATAU	tyx	Total Aerosol Scattering AOT [550 nm]	1

tavg1_2d_chm_Nx (M2T1NXCHM): Carbon Monoxide and Ozone Diagnostics

Frequency: *1-hourly from 00:30 UTC (time-averaged)*

Spatial Grid: *2D, single-level, full horizontal resolution*

Dimensions: *longitude=576, latitude=361, time=24*

Granule Size: *~45 MB*

Name	***Dim***	***Description***	***Units***
COCL	tyx	CO Column Burden	kg m^{-2}
COEM	tyx	CO Emission	kg m^{-2} s^{-1}
COLS	tyx	CO Chemical Loss	kg m^{-2} s^{-1}
COPD	tyx	CO Chemical Production	kg m^{-2} s^{-1}
COSC	tyx	CO Surface Concentration in ppbv	$1e^{-9}$
LWI	tyx	land(1) water(0) ice(2) flag	1
TO3	tyx	total column ozone	Dobsons

tavg1_2d_csp_Nx (M2T1NXCSP): COSP Satellite Simulator

Frequency: *1-hourly from 00:30 UTC (time-averaged)*

Spatial Grid: *2D, single-level, full horizontal resolution*

Dimensions: *longitude=576, latitude=361, time=24*

Granule Size: *~123 MB*

Name	*Dim*	*Description*	*Units*[1]
ISCCPALB	tyx	isccp cloud albedo	1
ISCCPCLDFRC	tyx	isccp total cloud area fraction	1
MDSCLDFRCH2O	tyx	modis cloud fraction water mean	1
MDSCLDFRCHI	tyx	modis cloud fraction high mean	1
MDSCLDFRCICE	tyx	modis cloud fraction ice mean	1
MDSCLDFRCLO	tyx	modis cloud fraction low mean	1
MDSCLDFRCMID	tyx	modis cloud fraction mid mean	1
MDSCLDFRCTTL	tyx	modis cloud fraction total mean	1
MDSCLDSZH20	tyx	modis cloud particle size water mean	m
MDSCLDSZICE	tyx	modis cloud particle size ice mean	m
MDSCLDTOPPS	tyx	modis cloud top pressure total mean	Pa
MDSH2OPATH	tyx	modis liquid water path mean	Kg m^{-2}
MDSICEPATH	tyx	modis ice water path mean	Kg m^{-2}
MDSOPTHCKH2O	tyx	modis optical thickness water mean	1
MDSOPTHCKH2OLG	tyx	modis optical thickness water logmean	1
MDSOPTHCKICE	tyx	modis optical thickness ice mean	1
MDSOPTHCKICELG	tyx	modis optical thickness ice logmean	1
MDSOPTHCKTTL	tyx	modis optical thickness total mean	1
MDSOPTHCKTTLLG	tyx	modis optical thickness total logmean	1

tavg1_2d_flx_Nx (M2T1NXFLX): Surface Flux Diagnostics

[1] All units in the first version of MERRA-2 COSP output were incorrectly listed as non-dimensional in the data file's metadata. This table includes corrected Units.

Frequency: *1-hourly from 00:30 UTC (time-averaged)*

Spatial Grid: *2D, single-level, full horizontal resolution*

Dimensions: *longitude=576, latitude=361, time=24*

Granule Size: *~379 MB*

Name	***Dim***	***Description***	***Units***
BSTAR	tyx	surface bouyancy scale	m s-2
CDH	tyx	surface exchange coefficient for heat	kg m^{-2} s^{-1}
CDM	tyx	surface exchange coefficient for momentum	kg m^{-2} s^{-1}
CDQ	tyx	surface exchange coefficient for moisture	kg m^{-2} s^{-1}
CN	tyx	surface neutral drag coefficient	1
DISPH	tyx	zero plane displacement height	m
EFLUX	tyx	total latent energy flux	W m^{-2}
EVAP	tyx	evaporation from turbulence	kg m^{-2} s^{-1}
FRCAN	tyx	areal fraction of anvil showers	1
FRCCN	tyx	areal fraction of convective showers	1
FRCLS	tyx	areal fraction of nonanvil large scale showers	1
FRSEAICE	tyx	ice covered fraction of tile	1
GHTSKIN	tyx	Ground heating for skin temp	W m^{-2}
HFLUX	tyx	sensible heat flux from turbulence	W m^{-2}
HLML	tyx	surface layer height	m
NIRDF	tyx	surface downwelling nearinfrared diffuse flux	W m^{-2}
NIRDR	tyx	surface downwelling nearinfrared beam flux	W m^{-2}
PBLH	tyx	planetary boundary layer height	m

PGENTOT	tyx	Total column production of precipitation	kg m^{-2} s^{-1}
PRECANV	tyx	anvil precipitation	kg m^{-2} s^{-1}
PRECCON	tyx	convective precipitation	kg m^{-2} s^{-1}
PRECLSC	tyx	nonanvil large scale precipitation	kg m^{-2} s^{-1}
PRECSNO	tyx	snowfall	kg m^{-2} s^{-1}
PRECTOT	tyx	total precipitation from atm model physics	kg m^{-2} s^{-1}
PRECTOTCORR	tyx	Bias corrected total precipitation	kg m^{-2} s^{-1}
PREVTOT	tyx	Total column re-evap/subl of precipitation	kg m^{-2} s^{-1}
QLML	tyx	surface specific humidity	1
QSH	tyx	effective surface specific humidity	kg kg^{-1}
QSTAR	tyx	surface moisture scale	kg kg^{-1}
RHOA	tyx	air density at surface	kg m^{-3}
RISFC	tyx	surface bulk richardson number	1
SPEED	tyx	surface wind speed	m s^{-1}
SPEEDMAX	tyx	surface wind speed	m s^{-1}
TAUGWX	tyx	surface eastward gravity wave stress	N m^{-2}
TAUGWY	tyx	surface northward gravity wave stress	N m^{-2}
TAUX	tyx	eastward surface stress	N m^{-2}
TAUY	tyx	northward surface stress	N m^{-2}
TCZPBL	tyx	transcom planetary boundary layer height	m
TLML	tyx	surface air temperature	K
TSH	tyx	effective surface skin temperature	K
TSTAR	tyx	surface temperature scale	K
ULML	tyx	surface eastward wind	m s^{-1}
USTAR	tyx	surface velocity scale	m s^{-1}

VLML	tyx	surface northward wind	m s^{-1}
Z0H	tyx	surface roughness for heat	m
Z0M	tyx	surface roughness	m

tavg1_2d_int_Nx (M2T1NXINT): Vertically Integrated Diagnostics

Frequency: *1-hourly from 00:30 UTC (time-averaged)*

Spatial Grid: *2D, single-level, full horizontal resolution*

Dimensions: *longitude=576, latitude=361, time=24*

Granule Size: *~1.3 GB*

Name	***Dim***	***Description***	***Units***
AUTCNVRN	tyx	autoconversion loss of cloud water	kg m^{-2} s^{-1}
BKGERR	tyx	vertically integrated kinetic energy residual for BKG energy conservation	W m^{-2}
COLCNVRN	tyx	accretion loss of cloud water to rain	kg m^{-2} s^{-1}
COLCNVSN	tyx	accretion loss of cloud water to snow	kg m^{-2} s^{-1}
CUCNVCI	tyx	convective source of cloud ice	kg m^{-2} s^{-1}
CUCNVCL	tyx	convective source of cloud water	kg m^{-2} s^{-1}
CUCNVRN	tyx	convective production of rain water	kg m^{-2} s^{-1}
DHDT_ANA	tyx	total potential energy tendency due to analysis	W m^{-2}
DHDT_BKG	tyx	vertically integrated potential energy tendency due to gravity wave background	W m^{-2}
DHDT_CUF	tyx	vertically integrated potential energy tendency due to cumulus friction	W m^{-2}
DHDT_DYN	tyx	vertically integrated potential energy tendency due to dynamics	W m^{-2}

DHDT_FRI	tyx	vertically integrated potential energy tendency due to friction	W m^{-2}
DHDT_GWD	tyx	vertically integrated potential energy tendency across gwd	W m^{-2}
DHDT_MST	tyx	vertically integrated potential energy tendency across moist	W m^{-2}
DHDT_ORO	tyx	vertically integrated potential energy tendency due to orographic gravity waves	W m^{-2}
DHDT_PHY	tyx	total potential energy tendency due to physics	W m^{-2}
DHDT_RAD	tyx	vertically integrated potential energy tendency across radiation	W m^{-2}
DHDT_RAY	tyx	vertically integrated potential energy tendency due to Rayleigh friction	W m^{-2}
DHDT_RES	tyx	vertically integrated cpt tendency residual	W m^{-2}
DHDT_TRB	tyx	vertically integrated potential energy tendency across turbulence	W m^{-2}
DKDT_ANA	tyx	total kinetic energy tendency due to analysis	W m^{-2}
DKDT_BKG	tyx	vertically integrated kinetic energy dissipation due to gravity wave background	W m^{-2}
DKDT_DYN	tyx	vertically integrated kinetic energy tendency due to dynamics	W m^{-2}
DKDT_GWD	tyx	vertically integrated kinetic energy tendency across gwd	W m^{-2}
DKDT_GWDRES	tyx	vertically integrated kinetic energy residual for total energy conservation	W m^{-2}
DKDT_INT	tyx	vertically integrated kinetic energy dissipation due to diffusion	W m^{-2}
DKDT_MST	tyx	vertically integrated kinetic energy tendency across moist	W m^{-2}
DKDT_ORO	tyx	vertically integrated kinetic energy dissipation due to orographic gravity waves	W m^{-2}
DKDT_PHY	tyx	vertically integrated kinetic energy tendency due to physics	W m^{-2}
DKDT_PHYPHY	tyx	vertically integrated kinetic energy tendency across physics	W m^{-2}

DKDT_RAY	tyx	vertically integrated kinetic energy dissipation due to Rayleigh friction	W m^{-2}
DKDT_SRF	tyx	vertically integrated kinetic energy dissipation due to surface friction	W m^{-2}
DKDT_TOP	tyx	vertically integrated kinetic energy dissipation due to topographic friction	W m^{-2}
DKDT_TRB	tyx	vertically integrated kinetic energy tendency across turbulence	W m^{-2}
DMDT_ANA	tyx	vertically integrated mass tendency due to analysis	kg m^{-2} s^{-1}
DMDT_DYN	tyx	vertically integrated mass tendency due to dynamics	kg m^{-2} s^{-1}
DMDT_PHY	tyx	vertically integrated mass tendency due to physics	kg m^{-2} s^{-1}
DOXDT_ANA	tyx	vertically integrated ozone tendency due to analysis	kg m^{-2} s^{-1}
DOXDT_CHM	tyx	vertically integrated odd oxygen tendency due to chemistry	kg m^{-2} s^{-1}
DOXDT_DYN	tyx	vertically integrated ozone tendency due to dynamics	kg m^{-2} s^{-1}
DOXDT_FIL	tyx	vertically integrated ox adjustment from filling	kg m^{-2} s^{-1}
DOXDT_PHY	tyx	vertically integrated odd oxygen tendency due to physics	kg m^{-2} s^{-1}
DPDT_ANA	tyx	mountain work tendency due to analysis	W m^{-2}
DPDT_DYN	tyx	mountain work tendency due to dynamics	W m^{-2}
DPDT_PHY	tyx	mountain work tendency due to physics	W m^{-2}
DQIDT_ANA	tyx	vertically integrated ice water tendency due to analysis	kg m^{-2} s^{-1}
DQIDT_DYN	tyx	vertically integrated ice water tendency due to dynamics	kg m^{-2} s^{-1}
DQIDT_FIL	tyx	vertically integrated qi adjustment from filling	kg m^{-2} s^{-1}
DQIDT_MST	tyx	vertically integrated ice tendency due to moist processes	kg m^{-2} s^{-1}
DQIDT_PHY	tyx	vertically integrated ice tendency due to physics	kg m^{-2} s^{-1}
DQLDT_ANA	tyx	vertically integrated liquid water tendency due to analysis	kg m^{-2} s^{-1}
DQLDT_DYN	tyx	vertically integrated liquid water tendency due to dynamics	kg m^{-2} s^{-1}

DQLDT_FIL	tyx	vertically integrated ql adjustment from filling	kg m^{-2} s^{-1}
DQLDT_MST	tyx	vertically integrated liquid water tendency due to moist processes	kg m^{-2} s^{-1}
DQLDT_PHY	tyx	vertically integrated liquid water tendency due to physics	kg m^{-2} s^{-1}
DQVDT_ANA	tyx	vertically integrated water vapor tendency due to analysis	kg m^{-2} s^{-1}
DQVDT_CHM	tyx	vertically integrated water vapor tendency due to chemistry	kg m^{-2} s^{-1}
DQVDT_DYN	tyx	vertically integrated water vapor tendency due to dynamics	kg m^{-2} s^{-1}
DQVDT_FIL	tyx	vertically integrated qv adjustment from filling	kg m^{-2} s^{-1}
DQVDT_MST	tyx	vertically integrated water vapor tendency due to moist processes	kg m^{-2} s^{-1}
DQVDT_PHY	tyx	vertically integrated water vapor tendency due to physics	kg m^{-2} s^{-1}
DQVDT_TRB	tyx	vertically integrated water vapor tendency due to turbulence	kg m^{-2} s^{-1}
DTHDT_ANA	tyx	vertically integrated THV tendency due to analysis	K kg m^{-2} s^{-1}
DTHDT_DYN	tyx	vertically integrated THV tendency due to dynamics	K kg m^{-2} s^{-1}
DTHDT_PHY	tyx	vertically integrated THV tendency due to physics	K kg m^{-2} s^{-1}
EVAP	tyx	evaporation from turbulence	kg m^{-2} s^{-1}
EVPCL	tyx	evaporation loss of cloud water	kg m^{-2} s^{-1}
EVPRN	tyx	evaporation loss of precip water	kg m^{-2} s^{-1}
FRZCL	tyx	net freezing of cloud condensate	kg m^{-2} s^{-1}
FRZRN	tyx	net freezing of precip condensate	kg m^{-2} s^{-1}
HFLUX	tyx	sensible heat flux from turbulence	W m^{-2}
LSCNVCI	tyx	statistical source of cloud ice	kg m^{-2} s^{-1}
LSCNVCL	tyx	statistical source of cloud water	kg m^{-2} s^{-1}
LSCNVRN	tyx	spurious rain from RH cleanup	kg m^{-2} s^{-1}
LWGNET	tyx	surface net downward longwave flux	W m^{-2}
LWTNET	tyx	upwelling longwave flux at toa	W m^{-2}

PRECCU	tyx	convective rainfall	kg m^{-2} s^{-1}
PRECLS	tyx	large scale rainfall	kg m^{-2} s^{-1}
PRECSN	tyx	snowfall	kg m^{-2} s^{-1}
QTFILL	tyx	vertically integrated total water adjustment from filling	kg m^{-2} s^{-1}
SDMCI	tyx	sedimentation loss of cloud ice	kg m^{-2} s^{-1}
SUBCI	tyx	sumblimation loss of cloud ice	kg m^{-2} s^{-1}
SUBSN	tyx	sumblimation loss of precip ice	kg m^{-2} s^{-1}
SWNETSRF	tyx	surface net downward shortwave flux	W m^{-2}
SWNETTOA	tyx	toa net downward shortwave flux	W m^{-2}
UFLXCPT	tyx	eastward flux of atmospheric enthalpy	J m^{-1} s^{-1}
UFLXKE	tyx	eastward flux of atmospheric kinetic energy	J m^{-1} s^{-1}
UFLXPHI	tyx	eastward flux of atmospheric potential energy	J m^{-1} s^{-1}
UFLXQI	tyx	eastward flux of atmospheric ice	kg m^{-1} s^{-1}
UFLXQL	tyx	eastward flux of atmospheric liquid water	kg m^{-1} s^{-1}
UFLXQV	tyx	eastward flux of atmospheric water vapor	kg m^{-1} s^{-1}
VFLXCPT	tyx	northward flux of atmospheric enthalpy	J m^{-1} s^{-1}
VFLXKE	tyx	northward flux of atmospheric kinetic energy	J m^{-1} s^{-1}
VFLXPHI	tyx	northward flux of atmospheric potential energy	J m^{-1} s^{-1}
VFLXQI	tyx	northward flux of atmospheric ice	kg m^{-1} s^{-1}
VFLXQL	tyx	northward flux of atmospheric liquid water	kg m^{-1} s^{-1}
VFLXQV	tyx	northward flux of atmospheric water vapor	kg m^{-1} s^{-1}

tavg1_2d_lfo_Nx (M2T1NXLFO): Land Surface Forcings

Frequency: *1-hourly from 00:30 UTC (time-averaged)*

Spatial Grid: *2D, single-level, full horizontal resolution*

Dimensions: *longitude=576, latitude=361, time=24*

Granule Size: *~59 MB*

Name	*Dim*	*Description*	*Units*
LWGAB	tyx	surface absorbed longwave radiation	W m^{-2}
PARDF	tyx	surface downwelling par diffuse flux	W m^{-2}
PARDR	tyx	surface downwelling par beam flux	W m^{-2}
PRECCUCORR	tyx	liquid water convective precipitation, bias corrected	kg m^{-2} s^{-1}
PRECLSCORR	tyx	liquid water large scale precipitation, bias corrected	kg m^{-2} s^{-1}
PRECSNOCORR	tyx	Snowfall, bias corrected	kg m^{-2} s^{-1}
SWGDN	tyx	Incident shortwave land	W m^{-2}
SWLAND	tyx	Net shortwave land	W m^{-2}

tavg1_2d_lnd_Nx (M2T1NXLND): Land Surface Diagnostics

Frequency: *1-hourly from 00:30 UTC (time-averaged)*

Spatial Grid: *2D, single-level, full horizontal resolution*

Dimensions: *longitude=576, latitude=361, time=24*

Granule Size: *~200 MB*

Name	*Dim*	*Description*	*Units*
BASEFLOW	tyx	baseflow flux	kg m^{-2} s^{-1}
ECHANGE	tyx	rate of change of total land energy	W m^{-2}
EVLAND	tyx	Evaporation land	kg m^{-2} s^{-1}
EVPINTR	tyx	interception loss energy flux	W m^{-2}

EVPSBLN	tyx	snow ice evaporation energy flux	W m^{-2}
EVPSOIL	tyx	baresoil evap energy flux	W m^{-2}
EVPTRNS	tyx	transpiration energy flux	W m^{-2}
FRSAT	tyx	fractional area of saturated zone	1
FRSNO	tyx	fractional area of land snowcover	1
FRUNST	tyx	fractional area of unsaturated zone	1
FRWLT	tyx	fractional area of wilting zone	1
GHLAND	tyx	Ground heating land	W m^{-2}
GRN	tyx	greeness fraction	1
GWETPROF	tyx	ave prof soil moisture	1
GWETROOT	tyx	root zone soil wetness	1
GWETTOP	tyx	surface soil wetness	1
LAI	tyx	leaf area index	1
LHLAND	tyx	Latent heat flux land	W m^{-2}
LWLAND	tyx	Net longwave land	W m^{-2}
PARDFLAND	tyx	surface downwelling par diffuse flux	W m^{-2}
PARDRLAND	tyx	surface downwelling par beam flux	W m^{-2}
PRECSNOLAND	tyx	snowfall land; bias corrected	kg m^{-2} s^{-1}
PRECTOTLAND	tyx	Total precipitation land; bias corrected	kg m^{-2} s^{-1}
PRMC	tyx	water profile	m^{-3} m^{-3}
QINFIL	tyx	Soil water infiltration rate	kg m^{-2} s^{-1}
RUNOFF	tyx	overland runoff including throughflow	kg m^{-2} s^{-1}
RZMC	tyx	water root zone	m^{-3} m^{-3}
SFMC	tyx	water surface layer	m^{-3} m^{-3}
SHLAND	tyx	Sensible heat flux land	W m^{-2}

SMLAND	tyx	Snowmelt flux land	kg m^{-2} s^{-1}
SNODP	tyx	snow depth	m
SNOMAS	tyx	Total snow storage land	kg m^{-2}
SPLAND	tyx	rate of spurious land energy source	W m^{-2}
SPSNOW	tyx	rate of spurious snow energy	W m^{-2}
SPWATR	tyx	rate of spurious land water source	kg m^{-2} s^{-1}
SWLAND	tyx	Net shortwave land	W m^{-2}
TELAND	tyx	Total energy storage land	J m^{-2}
TPSNOW	tyx	surface temperature of snow	K
TSAT	tyx	surface temperature of saturated zone	K
TSOIL1	tyx	soil temperatures layer 1	K
TSOIL2	tyx	soil temperatures layer 2	K
TSOIL3	tyx	soil temperatures layer 3	K
TSOIL4	tyx	soil temperatures layer 4	K
TSOIL5	tyx	soil temperatures layer 5	K
TSOIL6	tyx	soil temperatures layer 6	K
TSURF	tyx	surface temperature of land incl snow	K
TUNST	tyx	surface temperature of unsaturated zone	K
TWLAND	tyx	Avail water storage land	kg m^{-2}
TWLT	tyx	surface temperature of wilted zone	K
WCHANGE	tyx	rate of change of total land water	kg m^{-2} s^{-1}

tavg1_2d_ocn_Nx (M2T1NXOCN): Ocean Surface Diagnostics

Frequency: *1-hourly from 00:30 UTC (time-averaged)*

Spatial Grid: *2D, single-level, full horizontal resolution*

Dimensions: *longitude=576, latitude=361, time=24*

Granule Size: *~113 MB*

Name	***Dim***	***Description***	***Units***
EFLUXICE	tyx	sea ice latent energy flux	W m^{-2}
EFLUXWTR	tyx	open water latent energy flux	W m^{-2}
FRSEAICE	tyx	ice covered fraction of tile	1
HFLUXICE	tyx	sea ice upward sensible heat flux	W m^{-2}
HFLUXWTR	tyx	open water upward sensible heat flux	W m^{-2}
LWGNTICE	tyx	sea ice net downward longwave flux	W m^{-2}
LWGNTWTR	tyx	open water net downward longwave flux	W m^{-2}
PRECSNOOCN	tyx	ocean snowfall	kg m^{-2} s^{-1}
QV10M	tyx	10-meter specific humidity	kg kg^{-1}
RAINOCN	tyx	ocean rainfall	kg m^{-2} s^{-1}
SWGNTICE	tyx	sea ice net downward shortwave flux	W m^{-2}
SWGNTWTR	tyx	open water net downward shortwave flux	W m^{-2}
T10M	tyx	10-meter air temperature	K
TAUXICE	tyx	eastward stress over ice	N m^{-2}
TAUXWTR	tyx	eastward stress over water	N m^{-2}
TAUYICE	tyx	northward stress over ice	N m^{-2}

TAUYWTR	tyx	northward stress over water	N m^{-2}
TSKINICE	tyx	sea ice skin temperature	K
TSKINWTR	tyx	open water skin temperature	K
U10M	tyx	10-meter eastward wind	m s^{-1}
V10M	tyx	10-meter northward wind	m s^{-1}

tavg1_2d_rad_Nx (M2T1NXRAD): Radiation Diagnostics

Frequency: *1-hourly from 00:30 UTC (time-averaged)*

Spatial Grid: *2D, single-level, full horizontal resolution*

Dimensions: *longitude=576, latitude=361, time=24*

Granule Size: *~209 MB*

Name	***Dim***	***Description***	***Units***
ALBEDO	tyx	surface albedo	1
ALBNIRDF	tyx	surface albedo for near infrared diffuse	1
ALBNIRDR	tyx	surface albedo for near infrared beam	1
ALBVISDF	tyx	surface albedo for visible diffuse	1
ALBVISDR	tyx	surface albedo for visible beam	1
CLDHGH	tyx	cloud area fraction for high clouds	1
CLDLOW	tyx	cloud area fraction for low clouds	1
CLDMID	tyx	cloud area fraction for middle clouds	1
CLDTOT	tyx	total cloud area fraction	1
EMIS	tyx	surface emissivity	1
LWGAB	tyx	surface absorbed longwave radiation	W m^{-2}

LWGABCLR	tyx	surface absorbed longwave radiation assuming clear sky	W m^{-2}
LWGABCLRCLN	tyx	surface absorbed longwave radiation assuming clear sky and no aerosol	W m^{-2}
LWGEM	tyx	longwave flux emitted from surface	W m^{-2}
LWGNT	tyx	surface net downward longwave flux	W m^{-2}
LWGNTCLR	tyx	surface net downward longwave flux assuming clear sky	W m^{-2}
LWGNTCLRCLN	tyx	surface net downward longwave flux assuming clear sky and no aerosol	W m^{-2}
LWTUP	tyx	upwelling longwave flux at toa	W m^{-2}
LWTUPCLR	tyx	upwelling longwave flux at toa assuming clear sky	W m^{-2}
LWTUPCLRCLN	tyx	upwelling longwave flux at toa assuming clear sky and no aerosol	W m^{-2}
SWGDN	tyx	surface incoming shortwave flux	W m^{-2}
SWGDNCLR	tyx	surface incoming shortwave flux assuming clear sky	W m^{-2}
SWGNT	tyx	surface net downward shortwave flux	W m^{-2}
SWGNTCLN	tyx	surface net downward shortwave flux assuming no aerosol	W m^{-2}
SWGNTCLR	tyx	surface net downward shortwave flux assuming clear sky	W m^{-2}
SWGNTCLRCLN	tyx	surface net downward shortwave flux assuming clear sky and no aerosol	W m^{-2}
SWTDN	tyx	toa incoming shortwave flux	W m^{-2}
SWTNT	tyx	toa net downward shortwave flux	W m^{-2}
SWTNTCLN	tyx	toa net downward shortwave flux assuming no aerosol	W m^{-2}
SWTNTCLR	tyx	toa net downward shortwave flux assuming clear sky	W m^{-2}
SWTNTCLRCLN	tyx	toa net downward shortwave flux assuming clear sky and no aerosol	W m^{-2}
TAUHGH	tyx	in cloud optical thickness of high clouds(EXPORT)	1
TAULOW	tyx	in cloud optical thickness of low clouds	1

TAUMID	tyx	in cloud optical thickness of middle clouds	1
TAUTOT	tyx	in cloud optical thickness of all clouds	1
TS	tyx	surface skin temperature	K

tavg1_2d_slv_Nx (M2T1NXSLV): Single-Level Diagnostics

Frequency: *1-hourly from 00:30 UTC (time-averaged)*

Spatial Grid: *2D, single-level, full horizontal resolution*

Dimensions: *longitude=576, latitude=361, time=24*

Granule Size: *~393 MB*

Name	***Dim***	***Description***	***Units***
CLDPRS	tyx	cloud top pressure	Pa
CLDTMP	tyx	cloud top temperature	K
DISPH	tyx	zero plane displacement height	m
H1000	tyx	height at 1000 mb	m
H250	tyx	height at 250 hPa	m
H500	tyx	height at 500 hPa	m
H850	tyx	height at 850 hPa	m
OMEGA500	tyx	omega at 500 hPa	Pa s^{-1}
PBLTOP	tyx	pbltop pressure	Pa
PS	tyx	surface pressure	Pa
Q250	tyx	specific humidity at 250 hPa	kg kg^{-1}
Q500	tyx	specific humidity at 500 hPa	kg kg^{-1}

Q850	tyx	specific humidity at 850 hPa	kg kg^{-1}
QV10M	tyx	10-meter specific humidity	kg kg^{-1}
QV2M	tyx	2-meter specific humidity	kg kg^{-1}
SLP	tyx	sea level pressure	Pa
T10M	tyx	10-meter air temperature	K
T250	tyx	air temperature at 250 hPa	K
T2M	tyx	2-meter air temperature	K
T2MDEW	tyx	dew point temperature at 2 m	K
T2MWET	tyx	wet bulb temperature at 2 m	K
T500	tyx	air temperature at 500 hPa	K
T850	tyx	air temperature at 850 hPa	K
TO3	tyx	total column ozone	Dobsons
TOX	tyx	total column odd oxygen	kg m^{-2}
TQI	tyx	total precipitable ice water	kg m^{-2}
TQL	tyx	total precipitable liquid water	kg m^{-2}
TQV	tyx	total precipitable water vapor	kg m^{-2}
TROPPB	tyx	tropopause pressure based on blended estimate	Pa
TROPPT	tyx	tropopause pressure based on thermal estimate	Pa
TROPPV	tyx	tropopause pressure based on EPV estimate	Pa
TROPQ	tyx	tropopause specific humidity using blended TROPP estimate	kg kg^{-1}
TROPT	tyx	tropopause temperature using blended TROPP estimate	K
TS	tyx	surface skin temperature	K
U10M	tyx	10-meter eastward wind	m s^{-1}
U250	tyx	eastward wind at 250 hPa	m s^{-1}
U2M	tyx	2-meter eastward wind	m s^{-1}

U500	tyx	eastward wind at 500 hPa	m s^{-1}
U50M	tyx	eastward wind at 50 meters	m s^{-1}
U850	tyx	eastward wind at 850 hPa	m s^{-1}
V10M	tyx	10-meter northward wind	m s^{-1}
V250	tyx	northward wind at 250 hPa	m s^{-1}
V2M	tyx	2-meter northward wind	m s^{-1}
V500	tyx	northward wind at 500 hPa	m s^{-1}
V50M	tyx	northward wind at 50 meters	m s^{-1}
V850	tyx	northward wind at 850 hPa	m s^{-1}
ZLCL	tyx	lifting condensation level	m

tavg3_2d_glc_Nx (M2T3NXGLC): Land Ice Surface Diagnostics

Frequency: *3-hourly from 01:30 UTC (time-averaged)*

Spatial Grid: *2D, single-level, full horizontal resolution*

Dimensions: *longitude=576, latitude=361, time=8*

Granule Size: *~4 MB*

Name	***Dim***	***Description***	***Units***
ASNOW_GL	tyx	fractional area of glaciated surface snowcover	1
RUNOFF	tyx	runoff flux	kg m^{-2} s^{-1}
SNICEALB	tyx	aggregated snow ice broadband albedo	1
SNOMAS_GL	tyx	snow mass over glaciated surface	kg m^{-2}
SNOWDP_GL	tyx	snow depth over glaciated surface	m

WESNEXT	tyx	total snow mass residual due to densification	kg m^{-2} s^{-1}
WESNSC	tyx	top snow layer mass change due to sub con	kg m^{-2} s^{-1}

Time Averaged Three-Dimensional Collections

tavg3_3d_asm_Nv (M2T3NVASM): Assimilated Meteorological Fields

Frequency: *3-hourly from 01:30 UTC (time-averaged)*

Spatial Grid: *3D, model-level, full horizontal resolution*

Dimensions: *longitude=576, latitude=361, level=72, time=8*

Granule Size: *~2.1 GB*

Name	***Dim***	***Description***	***Units***
CLOUD	tzyx	cloud fraction for radiation	1
DELP	tzyx	pressure thickness	Pa
EPV	tzyx	ertels potential vorticity	K m^2 kg^{-1} s^{-1}
H	tzyx	mid layer heights	m
O3	tzyx	ozone mass mixing ratio	kg kg^{-1}
OMEGA	tzyx	vertical pressure velocity	Pa s^{-1}
PHIS	tyx	surface geopotential height	m^2 s^{-2}
PL	tzyx	mid level pressure	Pa
PS	tyx	surface pressure	Pa
QI	tzyx	mass fraction of cloud ice water	kg kg^{-1}
QL	tzyx	mass fraction of cloud liquid water	kg kg^{-1}
QV	tzyx	specific humidity	kg kg^{-1}

RH	tzyx	relative humidity after moist	1
SLP	tyx	sea level pressure	Pa
T	tzyx	air temperature	K
U	tzyx	eastward wind	m s^{-1}
V	tzyx	northward wind	m s^{-1}

tavg3_3d_cld_Np (M2T3NPCLD): Cloud Diagnostics

Frequency: *3-hourly from 01:30 UTC (time-averaged)*

Spatial Grid: *3D, pressure-level, full horizontal resolution*

Dimensions: *longitude=576, latitude=361, level=42, time=8*

Granule Size: *~446 MB*

Name	***Dim***	***Description***	***Units***
CFCU	tzyx	updraft areal fraction	1
CLOUD	tzyx	cloud fraction for radiation	1
DTRAIN	tzyx	detraining mass flux	kg m^{-2} s^{-1}
INCLOUDQI	tzyx	in cloud cloud ice for radiation	kg kg^{-1}
INCLOUDQL	tzyx	in cloud cloud liquid for radiation	kg kg^{-1}
QI	tzyx	mass fraction of cloud ice water	kg kg^{-1}
QL	tzyx	mass fraction of cloud liquid water	kg kg^{-1}
RH	tzyx	relative humidity after moist	1
TAUCLI	tzyx	in cloud optical thickness for ice clouds	1
TAUCLW	tzyx	in cloud optical thickness for liquid clouds	1

tavg3_3d_cld_Nv (M2T3NVCLD): Cloud Diagnostics

Frequency: *3-hourly from 01:30 UTC (time-averaged)*

Spatial Grid: *3D, model-level, full horizontal resolution*

Dimensions: *longitude=576, latitude=361, level=72, time=8*

Granule Size: *~691 MB*

Name	***Dim***	***Description***	***Units***
CFCU	tzyx	updraft areal fraction	1
CLOUD	tzyx	cloud fraction for radiation	1
DELP	tzyx	pressure thickness	Pa
DTRAIN	tzyx	detraining mass flux	kg m^{-2} s^{-1}
INCLOUDQI	tzyx	in cloud cloud ice for radiation	kg kg^{-1}
INCLOUDQL	tzyx	in cloud cloud liquid for radiation	kg kg^{-1}
PS	tyx	surface pressure	Pa
QI	tzyx	mass fraction of cloud ice water	kg kg^{-1}
QL	tzyx	mass fraction of cloud liquid water	kg kg^{-1}
RH	tzyx	relative humidity after moist	1
TAUCLI	tzyx	in cloud optical thickness for ice clouds	1
TAUCLW	tzyx	in cloud optical thickness for liquid clouds	1

tavg3_3d_mst_Ne (M2T3NEMST): Moist Processes Diagnostics

Frequency: *3-hourly from 01:30 UTC (time-averaged)*

Spatial Grid: *3D, model-level edge, full horizontal resolution*

Dimensions: *longitude=576, latitude=361, level=73, time=8*

Granule Size: *~253 MB*

Name	***Dim***	***Description***	***Units***
CMFMC	tzyx	cumulative mass flux	kg m^{-2} s^{-1}
PFICU	tzyx	3D flux of ice convective precipitation	kg m^{-2} s^{-1}
PFILSAN	tzyx	3D flux of ice nonconvective precipitation	kg m^{-2} s^{-1}
PFLCU	tzyx	3D flux of liquid convective precipitation	kg m^{-2} s^{-1}
PFLLSAN	tzyx	3D flux of liquid nonconvective precipitation	kg m^{-2} s^{-1}
PLE	tzyx	edge pressure	Pa

tavg3_3d_mst_Np (M2T3NPMST): Moist Processes Diagnostics

Frequency: *3-hourly from 01:30 UTC (time-averaged)*

Spatial Grid: *3D, pressure-level, full horizontal resolution*

Dimensions: *longitude=576, latitude=361, level=42, time=8*

Granule Size: *~305 MB*

Name	***Dim***	***Description***	***Units***

CMFMC	tzyx	cumulative mass flux	kg m^{-2} s^{-1}
DQRCU	tzyx	convective rainwater source	kg kg^{-1} s^{-1}
DQRLSAN	tzyx	large scale rainwater source	kg kg^{-1} s^{-1}
PFICU	tzyx	3D flux of ice convective precipitation	kg m^{-2} s^{-1}
PFILSAN	tzyx	3D flux of ice nonconvective precipitation	kg m^{-2} s^{-1}
PFLCU	tzyx	3D flux of liquid convective precipitation	kg m^{-2} s^{-1}
PFLLSAN	tzyx	3D flux of liquid nonconvective precipitation	kg m^{-2} s^{-1}
REEVAPCN	tzyx	evap subl of convective precipitation	kg kg^{-1} s^{-1}
REEVAPLSAN	tzyx	evap subl of non convective precipitation	kg kg^{-1} s^{-1}

tavg3_3d_mst_Nv (M2T3NVMST): Moist Processes Diagnostics

Frequency: *3-hourly from 01:30 UTC (time-averaged)*

Spatial Grid: *3D, model-level, full horizontal resolution*

Dimensions: *longitude=576, latitude=361, level=72, time=8*

Granule Size: *~275 MB*

Name	***Dim***	***Description***	***Units***
DELP	tzyx	pressure thickness	Pa
DQRCU	tzyx	convective rainwater source	kg kg^{-1} s^{-1}
DQRLSAN	tzyx	large scale rainwater source	kg kg^{-1} s^{-1}
PS	tyx	surface pressure	Pa
REEVAPCN	tzyx	evap subl of convective precipitation	kg kg^{-1} s^{-1}
REEVAPLSAN	tzyx	evap subl of non convective precipitation	kg kg^{-1} s^{-1}

tavg3_3d_nav_Ne (M2T3NENAV): Vertical Coordinates (Edges)

Frequency: *3-hourly from 01:30 UTC (time-averaged)*

Spatial Grid: *3D, model-level edge, full horizontal resolution*

Dimensions: *longitude=576, latitude=361, level=73, time=8*

Granule Size: *~185 MB*

Name	*Dim*	*Description*	*Units*
PLE	tzyx	edge pressure	Pa
ZLE	tzyx	edge heights	m

tavg3_3d_odt_Np (M2T3NPODT): Ozone Tendencies

Frequency: *3-hourly from 01:30 UTC (time-averaged)*

Spatial Grid: *3D, pressure-level, full horizontal resolution*

Dimensions: *longitude=576, latitude=361, level=42, time=8*

Granule Size: *~502 MB*

Name	*Dim*	*Description*	*Units*
DOXDTANA	tzyx	total ozone analysis tendency	mol mol^{-1} s^{-1}
DOXDTCHM	tzyx	tendency of odd oxygen mixing ratio due to chemistry	mol mol^{-1} s^{-1}
DOXDTDYN	tzyx	tendency of ozone due to dynamics	kg kg^{-1} s^{-1}
DOXDTMST	tzyx	tendency of odd oxygen due to moist processes	kg kg^{-1} s^{-1}
DOXDTTRB	tzyx	tendency of odd oxygen due to turbulence	kg kg^{-1} s^{-1}

tavg3_3d_qdt_Np (M2T3NPQDT): Moist Tendencies

Frequency: *3-hourly from 01:30 UTC (time-averaged)*

Spatial Grid: *3D, pressure-level, full horizontal resolution*

Dimensions: *longitude=576, latitude=361, level=42, time=8*

Granule Size: *~693 MB*

Name	*Dim*	*Description*	*Units*
DQIDTDYN	tzyx	tendency of ice water due to dynamics	kg kg^{-1} s^{-1}
DQIDTMST	tzyx	total ice water tendency due to moist	kg kg^{-1} s^{-1}
DQIDTTRB	tzyx	tendency of frozen condensate due to turbulence	kg kg^{-1} s^{-1}
DQLDTDYN	tzyx	tendency of liquid water due to dynamics	kg kg^{-1} s^{-1}
DQLDTMST	tzyx	total liq water tendency due to moist	kg kg^{-1} s^{-1}
DQLDTTRB	tzyx	tendency of liquid condensate due to turbulence	kg kg^{-1} s^{-1}
DQVDTANA	tzyx	total specific humidity analysis tendency	kg kg^{-1} s^{-1}
DQVDTCHM	tzyx	tendency of water vapor mixing ratio due to chemistry	kg kg^{-1} s^{-1}
DQVDTDYN	tzyx	tendency of specific humidity due to dynamics	kg kg^{-1} s^{-1}
DQVDTMST	tzyx	specific humidity tendency due to moist	kg kg^{-1} s^{-1}
DQVDTTRB	tzyx	tendency of specific humidity due to turbulence	kg kg^{-1} s^{-1}

tavg3_3d_rad_Np (M2T3NPRAD): Radiation Diagnostics

Frequency: *3-hourly from 01:30 UTC (time-averaged)*

Spatial Grid: *3D, pressure-level, full horizontal resolution*

Dimensions: *longitude=576, latitude=361, level=42, time=8*

Granule Size: *~422 MB*

Name	*Dim*	*Description*	*Units*
CLOUD	tzyx	cloud fraction for radiation	1
DTDTLWR	tzyx	air temperature tendency due to longwave	K s^{-1}
DTDTLWRCLR	tzyx	air temperature tendency due to longwave for clear skies	K s^{-1}
DTDTSWR	tzyx	air temperature tendency due to shortwave	K s^{-1}
DTDTSWRCLR	tzyx	air temperature tendency due to shortwave for clear skies	K s^{-1}

tavg3_3d_rad_Nv (M2T3NVRAD): Radiation Diagnostics

Frequency: *3-hourly from 01:30 UTC (time-averaged)*

Spatial Grid: *3D, model-level, full horizontal resolution*

Dimensions: *longitude=576, latitude=361, level=72, time=8*

Granule Size: *~758 MB*

Name	*Dim*	*Description*	*Units*
CLOUD	tzyx	cloud fraction for radiation	1
DELP	tzyx	pressure thickness	Pa
DTDTLWR	tzyx	air temperature tendency due to longwave	K s^{-1}
DTDTLWRCLR	tzyx	air temperature tendency due to longwave for clear skies	K s^{-1}
DTDTSWR	tzyx	air temperature tendency due to shortwave	K s^{-1}
DTDTSWRCLR	tzyx	air temperature tendency due to shortwave for clear skies	K s^{-1}
PS	tyx	surface pressure	Pa

tavg3_3d_tdt_Np (M2T3NPTDT): Temperature Tendencies

Frequency: *3-hourly from 01:30 UTC (time-averaged)*

Spatial Grid: *3D, pressure-level, full horizontal resolution*

Dimensions: *longitude=576, latitude=361, level=42, time=8*

Granule Size: *~1016 MB*

Name	***Dim***	***Description***	***Units***
DTDTANA	tzyx	total temperature analysis tendency	K s^{-1}
DTDTDYN	tzyx	tendency of air temperature due to dynamics	K s^{-1}
DTDTFRI	tzyx	tendency of air temperature due to friction	K s^{-1}
DTDTGWD	tzyx	air temperature tendency due to GWD	K s^{-1}
DTDTMST	tzyx	tendency of air temperature due to moist processes	K s^{-1}
DTDTRAD	tzyx	tendency of air temperature due to radiation	K s^{-1}
DTDTTOT	tzyx	tendency of air temperature due to physics	K s^{-1}
DTDTTRB	tzyx	tendency of air temperature due to turbulence	K s^{-1}

tavg3_3d_trb_Ne (M2T3NETRB): Turbulence Diagnostics

Frequency: *3-hourly from 01:30 UTC (time-averaged)*

Spatial Grid: *3D, model-level edge, full horizontal resolution*

Dimensions: *longitude=576, latitude=361, level=73, time=8*

Granule Size: *~1.5 GB*

Name	*Dim*	*Description*	*Units*
KH	tzyx	total scalar diffusivity	$m^2 s^{-1}$
KHLK	tzyx	entrainment heat diffusivity from Lock	$m^2 s^{-1}$
KHLS	tzyx	scalar diffusivity from Louis	$m^2 s^{-1}$
KHRAD	tzyx	radiation driven scalar diffusivity from Lock scheme	$m^2 s^{-1}$
KHSFC	tzyx	surface driven scalar diffusivity from Lock scheme	$m^2 s^{-1}$
KM	tzyx	total momentum diffusivity	$m^2 s^{-1}$
KMLK	tzyx	entrainment momentum diffusivity from Lock	$m^2 s^{-1}$
KMLS	tzyx	momentum diffusivity from Louis	$m^2 s^{-1}$
PLE	tzyx	edge pressure	Pa
RI	tzyx	Richardson number from Louis	1

tavg3_3d_trb_Np (M2T3NPTRB): Turbulence Diagnostics

Frequency: *3-hourly from 01:30 UTC (time-averaged)*

Spatial Grid: *3D, pressure-level, full horizontal resolution*

Dimensions: *longitude=576, latitude=361, level=42, time=8*

Granule Size: *~820 MB*

Name	*Dim*	*Description*	*Units*
KH	tzyx	total scalar diffusivity	$m^2 s^{-1}$
KHLK	tzyx	entrainment heat diffusivity from Lock	$m^2 s^{-1}$
KHLS	tzyx	scalar diffusivity from Louis	$m^2 s^{-1}$
KHRAD	tzyx	radiation driven scalar diffusivity from Lock scheme	$m^2 s^{-1}$

KHSFC	tzyx	surface driven scalar diffusivity from Lock scheme	$m^2 s^{-1}$
KM	tzyx	total momentum diffusivity	$m^2 s^{-1}$
KMLK	tzyx	entrainment momentum diffusivity from Lock	$m^2 s^{-1}$
KMLS	tzyx	momentum diffusivity from Louis	$m^2 s^{-1}$
RI	tzyx	Richardson number from Louis	1

tavg3_3d_udt_Np (M2T3NPUDT): Wind Tendencies

Frequency: *3-hourly from 01:30 UTC (time-averaged)*

Spatial Grid: *3D, pressure-level, full horizontal resolution*

Dimensions: *longitude=576, latitude=361, level=42, time=8*

Granule Size: *~1.1 GB*

Name	***Dim***	***Description***	***Units***
DUDTANA	tzyx	total eastward wind analysis tendency	$m\ s^{-2}$
DUDTDYN	tzyx	tendency of eastward wind due to dynamics	$m\ s^{-2}$
DUDTGWD	tzyx	tendency of eastward wind due to GWD	$m\ s^{-2}$
DUDTMST	tzyx	zonal wind tendency due to moist	$m\ s^{-2}$
DUDTTRB	tzyx	tendency of eastward wind due to turbulence	$m\ s^{-2}$
DVDTANA	tzyx	total northward wind analysis tendency	$m\ s^{-2}$
DVDTDYN	tzyx	tendency of northward wind due to dynamics	$m\ s^{-2}$
DVDTGWD	tzyx	tendency of northward wind due to GWD	$m\ s^{-2}$
DVDTMST	tzyx	meridional wind tendency due to moist	$m\ s^{-2}$
DVDTTRB	tzyx	tendency of northward wind due to turbulence	$m\ s^{-2}$

Digital Object Identifier (DOI) Tables

Digital Object Identifiers are attached to each MERRA-2 variable collection. Users should cite the data used in research papers following these DOI's.

Example Citation:

Global Modeling and Assimilation Office (GMAO) (2015), *inst3_3d_asm_Cp: MERRA-2 3D IAU State, Meteorology Instantaneous 3-hourly (p-coord, 0.625x0.5L42), version 5.12.4*, Greenbelt, MD, USA: Goddard Space Flight Center Distributed Active Archive Center (GSFC DAAC), Accessed **Enter User Data Access Date** at doi: 10.5067/VJAFPLI1CSIV.

Note that complete citations for each file collection are provided at the GES-DISC download site.

Table 6.1 DOI's for MERRA-2 hourly file collections.

Descriptive ShortName	ShortName	DOI NAME
inst1_2d_asm_Nx	M2I1NXASM	10.5067/3Z173KIE2TPD
inst1_2d_int_Nx	M2I1NXINT	10.5067/G0U6NGQ3BLE0
inst1_2d_lfo_Nx	M2I1NXLFO	10.5067/RCMZA6TL70BG
inst3_3d_asm_Np	M2I3NPASM	10.5067/QBZ6MG944HW0
inst3_3d_aer_Nv	M2I3NVAER	10.5067/LTVB4GPCOTK2
inst3_3d_asm_Nv	M2I3NVASM	10.5067/WWQSXQ8IVFW8
inst3_3d_chm_Nv	M2I3NVCHM	10.5067/HO9OVZWF3KW2
inst3_3d_gas_Nv	M2I3NVGAS	10.5067/96BUID8HGGX5
inst3_2d_gas_Nx	M2I3NXGAS	10.5067/HNGA0EWW0R09
inst6_3d_ana_Np	M2I6NPANA	10.5067/A7S6XP56VZWS
inst6_3d_ana_Nv	M2I6NVANA	10.5067/IUUF4WB9FT4W
statD_2d_slv_Nx	M2SDNXSLV	10.5067/9SC1VNTWGWV3
tavg1_2d_adg_Nx	M2T1NXADG	10.5067/HM00OHQBHKTP
tavg1_2d_aer_Nx	M2T1NXAER	10.5067/KLICLTZ8EM9D
tavg1_2d_chm_Nx	M2T1NXCHM	10.5067/3RQ5YS674DGQ
tavg1_2d_csp_Nx	M2T1NXCSP	10.5067/H0VVAD8F6MX5
tavg1_2d_flx_Nx	M2T1NXFLX	10.5067/7MCPBJ41Y0K6
tavg1_2d_int_Nx	M2T1NXINT	10.5067/Q5GVUVUIVGO7
tavg1_2d_lfo_Nx	M2T1NXLFO	10.5067/L0T5GEG1NYFA
tavg1_2d_lnd_Nx	M2T1NXLND	10.5067/RKPHT8KC1Y1T
tavg1_2d_ocn_Nx	M2T1NXOCN	10.5067/Y67YQ1L3ZZ4R
tavg1_2d_rad_Nx	M2T1NXRAD	10.5067/Q9QMY5PBNV1T
tavg1_2d_slv_Nx	M2T1NXSLV	10.5067/VJAFPLI1CSIV
tavg3_3d_mst_Ne	M2T3NEMST	10.5067/JRUZ3SJ3ZJ72
tavg3_3d_trb_Ne	M2T3NETRB	10.5067/4I7ZI35QRH8K
tavg3_3d_nav_Ne	M2T3NENAV	10.5067/N5WAKNS1UYQN

tavg3_3d_cld_Np	M2T3NPCLD	10.5067/TX10URJSKT53
tavg3_3d_mst_Np	M2T3NPMST	10.5067/0TUFO90Q2PMS
tavg3_3d_rad_Np	M2T3NPRAD	10.5067/3UGE8WQXZAOK
tavg3_3d_tdt_Np	M2T3NPTDT	10.5067/9NCR9DDDOPFI
tavg3_3d_trb_Np	M2T3NPTRB	10.5067/ZRRJPGWL8AVL
tavg3_3d_udt_Np	M2T3NPUDT	10.5067/CWV0G3PPPWFW
tavg3_3d_odt_Np	M2T3NPODT	10.5067/S0LYTK57786Z
tavg3_3d_qdt_Np	M2T3NPQDT	10.5067/A9KWADY78YHQ
tavg3_3d_asm_Nv	M2T3NVASM	10.5067/SUOQESM06LPK
tavg3_3d_cld_Nv	M2T3NVCLD	10.5067/F9353J0FAHIH
tavg3_3d_mst_Nv	M2T3NVMST	10.5067/ZXTJ28TQR1TR
tavg3_3d_rad_Nv	M2T3NVRAD	10.5067/7GFQKO1T43RW
tavg3_2d_glc_Nx	M2T3NXGLC	10.5067/9ETB4TT5J6US

Table 6.2 DOI's for MERRA-2 monthly mean file collections.

Descriptive ShortName	ShortName	DOI NAME
instM_2d_asm_Nx	M2IMNXASM	10.5067/5ESKGQTZG7FO
instM_2d_int_Nx	M2IMNXINT	10.5067/KVTU1A8BWFSJ
instM_2d_lfo_Nx	M2IMNXLFO	10.5067/11F99Y6TXN99
instM_2d_gas_Nx	M2IMNXGAS	10.5067/XOGNBQEPLUC5
instM_3d_asm_Np	M2IMNPASM	10.5067/2E096JV59PK7
instM_3d_ana_Np	M2IMNPANA	10.5067/V92O8XZ30XBI
tavgM_2d_adg_Nx	M2TMNXADG	10.5067/RZIK2TV7PP38
tavgM_2d_aer_Nx	M2TMNXAER	10.5067/FH9A0MLJPC7N
tavgM_2d_chm_Nx	M2TMNXCHM	10.5067/WMT31RKEXK8I
tavgM_2d_csp_Nx	M2TMNXCSP	10.5067/BZPOTGJOQKLU
tavgM_2d_flx_Nx	M2TMNXFLX	10.5067/0JRLVL8YV2Y4
tavgM_2d_int_Nx	M2TMNXINT	10.5067/FQPTQ4OJ22TL
tavgM_2d_lfo_Nx	M2TMNXLFO	10.5067/5V7K6LJD44SY
tavgM_2d_lnd_Nx	M2TMNXLND	10.5067/8S35XF81C28F
tavgM_2d_ocn_Nx	M2TMNXOCN	10.5067/4IASLIDL8EEC
tavgM_2d_rad_Nx	M2TMNXRAD	10.5067/OU3HJDS973O0
tavgM_2d_slv_Nx	M2TMNXSLV	10.5067/AP1B0BA5PD2K
tavgM_2d_glc_Nx	M2TMNXGLC	10.5067/5W8Q3I9WUFGX
tavgM_3d_cld_Np	M2TMNPCLD	10.5067/J9R0LXGH48JR
tavgM_3d_mst_Np	M2TMNPMST	10.5067/ZRZGD0DCK1CG
tavgM_3d_rad_Np	M2TMNPRAD	10.5067/H3YGROBVBGFJ
tavgM_3d_tdt_Np	M2TMNPTDT	10.5067/VILT59HI2MOY
tavgM_3d_trb_Np	M2TMNPTRB	10.5067/2YOIQB5C3ACN
tavgM_3d_udt_Np	M2TMNPUDT	10.5067/YSR6IA5057XX

tavgM_3d_odt_Np	M2TMNPODT	10.5067/Z2KCWAV4GPD2
tavgM_3d_qdt_Np	M2TMNPQDT	10.5067/2ZTU87V69ATP
statM_2d_slv_Nx	M2SMNXSLV	10.5067/KVIMOMCUO83U
const_2d_asm_NX	M2C0NXASM	10.5067/ME5QX6Q5IGGU

Table 6.3 DOI's for MERRA-2 monthly diurnal mean file collections.

Descriptive ShortName	ShortName	DOI NAME
instU_2d_asm_Nx	M2IUNXASM	10.5067/BOJSTZAO2L8R
instU_2d_int_Nx	M2IUNXINT	10.5067/DGAB3HFEYMLY
instU_2d_lfo_Nx	M2IUNXLFO	10.5067/FC3BVJ88Y8A2
instU_2d_gas_Nx	M2IUNXGAS	10.5067/TVJ4MHBED39L
instU_3d_asm_Np	M2IUNPASM	10.5067/6EGRBNEBMIYS
instU_3d_ana_Np	M2IUNPANA	10.5067/TRD91YO9S6E7
tavgU_2d_adg_Nx	M2TUNXADG	10.5067/YZJJXZTFCX6B
tavgU_2d_aer_Nx	M2TUNXAER	10.5067/KPUMVXFEQLA1
tavgU_2d_chm_Nx	M2TUNXCHM	10.5067/5KFZ6GXRHZKN
tavgU_2d_csp_Nx	M2TUNXCSP	10.5067/9PH5QU4CL9E8
tavgU_2d_flx_Nx	M2TUNXFLX	10.5067/LUHPNWAKYIO3
tavgU_2d_int_Nx	M2TUNXINT	10.5067/R2MPVU4EOSWT
tavgU_2d_lfo_Nx	M2TUNXLFO	10.5067/BTSNKAJND3ME
tavgU_2d_lnd_Nx	M2TUNXLND	10.5067/W0J15047CF6N
tavgU_2d_ocn_Nx	M2TUNXOCN	10.5067/KLNAVGAX7J66
tavgU_2d_rad_Nx	M2TUNXRAD	10.5067/4SDCJYK8P9QU
tavgU_2d_slv_Nx	M2TUNXSLV	10.5067/AFOK0TPEVQEK
tavgU_2d_glc_Nx	M2TUNXGLC	10.5067/7VUPQC736SWX
tavgU_3d_cld_Np	M2TUNPCLD	10.5067/EPW7T5UO0C0N
tavgU_3d_mst_Np	M2TUNPMST	10.5067/ZRSN0JU27DK2
tavgU_3d_rad_Np	M2TUNPRAD	10.5067/H140JMDOWB0Y
tavgU_3d_tdt_Np	M2TUNPTDT	10.5067/QPO9E5TPZ8OF
tavgU_3d_trb_Np	M2TUNPTRB	10.5067/2A99C60CG7WC
tavgU_3d_udt_Np	M2TUNPUDT	10.5067/DO715T7T5PG8
tavgU_3d_odt_Np	M2TUNPODT	10.5067/M8OJ09GZP23E
tavgU_3d_qdt_Np	M2TUNPQDT	10.5067/S8HJXIR0BFTS

3.0 Options for Reading the Data

3.1 Command Line Utilities

3.1.1 Grads

The Grid Analysis and Display System (GrADS) is a suite of executable well suited for the visualization of MERRA data. MERRA HDF files are self-describing with respect to the gradshdf executable and the sdsopen command within the executable.

GrADS Example

The following brief example demonstrates how to open a MERRA tavg1_2d_slv_Nx and create an image of cloud top temperatures over the eastern United States.

To open the file for reading type 'gradshdf' at the system prompt and choose the landscape or portrait mode.

To open a file type the file name at the GrADS prompt (ga->):

```
ga-> sdfopen MERRA300.prod.assim.tavg1_2d_slv_Nx.20001231.hdf
```

GrADS will respond with:

```
Scanning self-describing file:  /var/tmp/MERRA300.prod.assim.tavg1_2d_slv_Nx.20001231.hdf
SDF file MERRA300.prod.assim.tavg1_2d_slv_Nx.20001231.hdf is open as file 1
LON set to 0 360
LAT set to -90 90
LEV set to 0 0
Time values set: 2000:12:31:0 2000:12:31:0
```

For a brief description of the file as well as a list of parameters available in the file:

```
ga-> q file
File 1 : MERRA reanalysis. GEOS-5.2.0
  Descriptor: MERRA300.prod.assim.tavg1_2d_slv_Nx.20001231.hdf
  Binary: MERRA300.prod.assim.tavg1_2d_slv_Nx.20001231.hdf
  Type = Gridded
  Xsize = 540  Ysize = 361  Zsize = 1  Tsize = 24
  Number of Variables = 38
    slp 0 -999 Sea level pressure
```

ps 0 -999 Time averaged surface pressure
u850 0 -999 Eastward wind at 850 hPa
u500 0 -999 Eastward wind at 500 hPa
u250 0 -999 Eastward wind at 250 hPa
v850 0 -999 Northward wind at 850 hPa
v500 0 -999 Northward wind at 500 hPa
v250 0 -999 Northward wind at 250 hPa
t850 0 -999 Temperature at 850 hPa
t500 0 -999 Temperature at 500 hPa
t250 0 -999 Temperature at 250 hPa
q850 0 -999 Specific humidity at 850 hPa
q500 0 -999 Specific humidity at 500 hPa
q250 0 -999 Specific humidity at 250 hPa
h850 0 -999 Height at 850 hPa
h500 0 -999 Height at 500 hPa
h250 0 -999 Height at 250 hPa
omega500 0 -999 Vertical pressure velocity at 500 hPa
u10m 0 -999 Eastward wind at 10 m above displacement height
u2m 0 -999 Eastward wind at 2 m above the displacement height
u50m 0 -999 Eastward wind at 50 m above surface
v10m 0 -999 Northward wind at 50 m above the displacement height
v2m 0 -999 Northward wind at 2 m above the displacement height
v50m 0 -999 Northward wind at 50 m above
t10m 0 -999 Temperature at 10 m above the displacement height
t2m 0 -999 Temperature at 2 m above the displacement height
qv10m 0 -999 Specific humidity at 10 m above the displacement height
qv2m 0 -999 Specific humidity at 2 m above the displacement height
tsrad 0 -999 Radiative skin temperature
disph 0 -999 Displacement height
tropp 0 -999 Tropopause pressure
tropt 0 -999 Tropopause temperature
tropq 0 -999 Tropopause specific humidity

To view an image of the Cloud-top temperature (cldtmp):

ga-> d cldtmp
Contouring: 200 to 300 interval 10

This will create an image of the cloud-top temperatures shown as contours in a separate window.

To create a PNG image of the eastern United States in a file called ‘cldtmpUSeast.png’:

ga-> set lat 30, 45
ga-> set lon -85, -70
ga-> clear
ga->d cldtmp
ga-> printim cldtmpUSeast.png

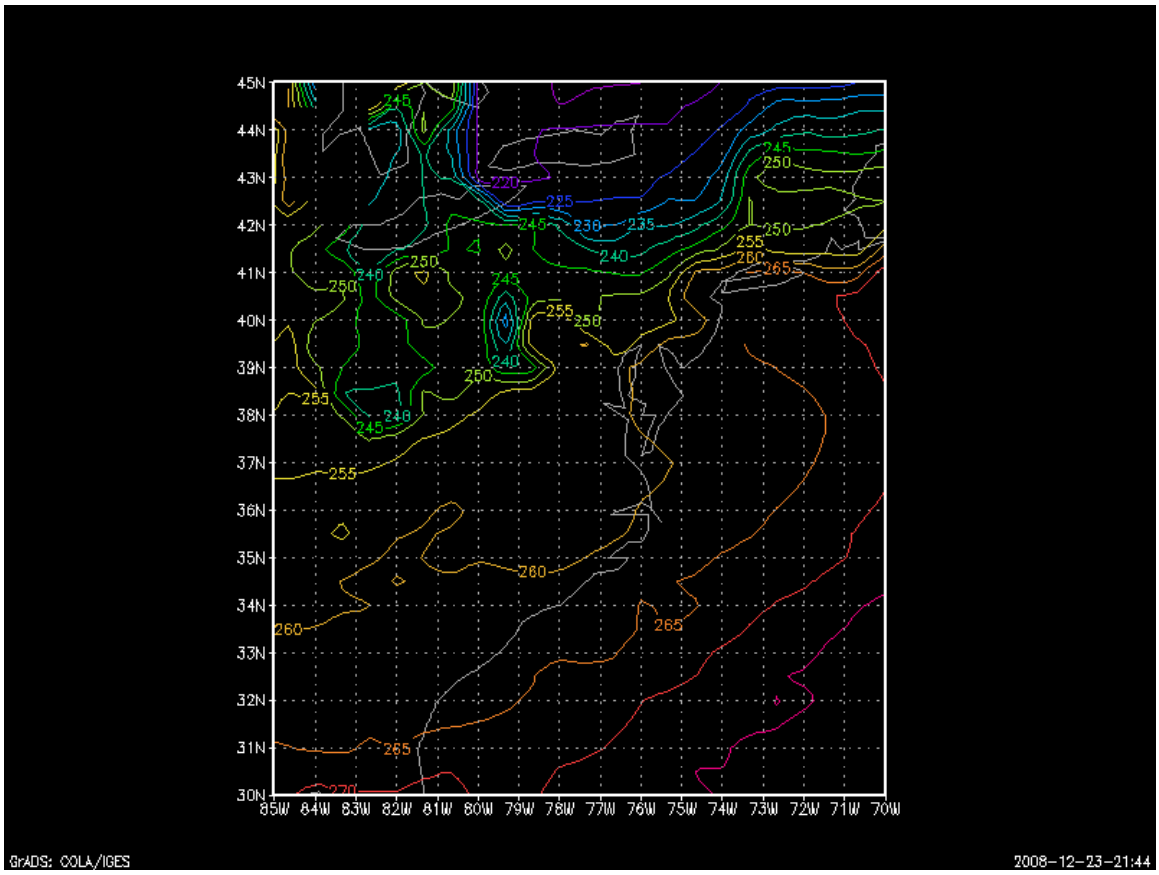

Figure 1 cldtmpUSeast.png

GrADS can do much more than was demonstrated above, including

- Calculating statistical data from variables
- Plotting and overlaying variables
- Comparing datasets
- Regridding data

For more information on Grads visit **http://www.iges.org/grads/** and for more information and to download gradshdf and other grads tools see **http://www.iges.org/grads/downloads.html**.

3.1.2 hdp and ncdump

The HDF Toolkit ships with two binary executables, *hdp* and *ncdump*, that can be used to extract values from any HDF file.

These are also available as standalone executables in the utilities subdirectory for each operating system at: ftp://ftp.hdfgroup.org/HDF/HDF_Current/bin, e.g., ftp://ftp.hdfgroup.org/HDF/HDF_Current/bin/linux/utilities.

To dump entire file:

hdp <file name>
ncdump <file name>

To dump an SDS

hdp dumpsds -d -n <SDS name> <MERRA file>

or

ncdump –v <SDS name> <MERRA file>

SDS names are listed in Appendix D and can be obtained from a MERRA file by searching for the string "Variable Name" in the SDS headings, for example:

```
hdp dumpsds -h MERRA300.prod.assim.tavg3_3d_qdt_Cp.20001231.hdf | grep 'Variable Name'
Variable Name = DQVDTMST
Variable Name = DQVDTTRB
Variable Name = DQVDTCHM
Variable Name = DQVDTDYN
Variable Name = DQVDTANA
Variable Name = DQIDTMST
Variable Name = DQIDTTRB
Variable Name = DQIDTDYN
Variable Name = DQLDTMST
Variable Name = DQLDTTRB
Variable Name = DQLDTDYN
Dimension Variable Name = XDim:EOSGRID
Dimension Variable Name = YDim:EOSGRID
Dimension Variable Name = Height:EOSGRID
Dimension Variable Name = TIME:EOSGRID
Variable Name = XDim
```

Variable Name = YDim
Variable Name = Height
Variable Name = Time

4.0 Data Services

You can begin to familiarize yourself with the MERRA data by visiting the GES DISC:
http://disc.sci.gsfc.nasa.gov/
or if you already know the data product you want to access you can do so directly through the search and download interface:
http://mirador.gsfc.nasa.gov/
You can also subset the data and regrid using the MERRA-2 Data Subsetter
http://disc.sci.gsfc.nasa.gov/daac-bin/FTPSubset2.pl
MERRA data is also available through OPeNDAP, GDS, and as data subsets. Links to these services can be found at GES DISC MERRA-2 DATA HOLDINGS page and filter the Source on the left hand side to only include "Models/Analyses MERRA-2 ".
If you need assistance or wish to report a problem:

Email: gsfc-help-disc@lists.nasa.gov
Voice: 301-614-5224
Fax: 301-614-5268
Address:
Goddard Earth Sciences Data and Information Services Center
NASA Goddard Space Flight Center
Code 610.2
Greenbelt, MD 20771 USA

5.0 More Information

Bosilovich, Michael, 2008. **NASA's Modern Era Retrospective-analysis for Research and Applications: Integrating Earth Observations**. *Earthzine*. E-Zine Article.

M. Bosilovich, J. Chen, F. R. Robertson and R. F. Adler, 2008. **Evaluation of Global Precipitation in Reanalyses**. *Journal of Applied Meteorology and Climatology*. Journal Article

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Hdp and HDFview were created by the HDF Group.

Ncdump was produced by Unidata