getech

Atlas of Earth Systems Modelling

Jurassic Palaeoclimate Model Results

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Table of Contents

List of Figures

List of Tables

Executive Summary

Earth systems modelling provides powerful tools for predicting depositional systems through time that can help minimise exploration risks in New Ventures operations. As part of the Earth system modelling module of the *Globe* exploration platform, Getech has developed an extensive series of Stage-level digital atlases for the Jurassic using the HadCM3L coupled ocean-atmosphere General Circulation Model. These atlases are being used to develop lithofacies prediction models, including marine and terrestrial source, and reservoir facies. The results are also being used in our focussed exploration studies around the world. The models are built on Getech's global palaeogeographies (*Globe* core deliverables) and carried out by the world-leading modelling group led by Professor Paul Valdes at the University of Bristol. Model results are quantitatively tested against Getech's extensive observational databases of the Present Day and the past.

Study Aims

This issue of the "Atlas of Earth Systems Modelling: Jurassic Climate Model Results" provides climate model (HadCM3L) results for nine atmospheric, seven oceanic, one storm and three surface variables over geological time. The issue also covers the Jurassic in 11 Stage-level timeslices. The variables provided are surface temperature, atmospheric temperature at 1.5 m, atmospheric circulation, total precipitation, total evaporation, precipitation-evaporation, runoff, surface air pressure, snow depth at surface, ocean circulation (for nine depth levels), ocean salinity (for nine depth levels), ocean temperature (for nine depth levels), upwelling (for nine depth levels), mixed layer depth, sea ice concentration, sea ice thickness, eddy kinetic energy, soil moisture (four soil levels combined to produce total soil moisture), and vegetation which has two categories: biomes (Biome4 model results) and Köppen classification. All atmospheric and storms results include mean annual, seasonal and monthly values, as do the results for soil moisture, sea ice thickness, sea ice concentration and mixed layer depth. The ocean results with multiple depth levels are provided as mean annual and seasonal values only (ocean circulation, ocean salinity, ocean temperature and upwelling). The vegetation layers are mean annual values only.

Report Structure

The report is split into four parts: 1) Introduction to General Circulation Models (Chapter 1), which provides a brief overview of their definition and practical usage; 2) Coupled Ocean-Atmosphere HadCM3L Model (Chapter 2), which details the particular General Circulation Model used in this study, including the boundary conditions that were set and the variables used; 3) Getech Conversion Methods (Chapter 3), which outlines the processing used to convert the original NetCDF files, provided by the University of Bristol, into ArcGIS™ format and 4) the format of the final delivered mxd (Chapter 4). The references used within this report are detailed in Chapter 5. An Appendix (Appendix 1) provides details of additional variables that are available upon request.

CHAPTER 1

Introduction to General Circulation Models

1. Introduction to General Circulation Models

General Circulation Models (GCMs) are sophisticated three-dimensional models of the atmosphere and oceans that, although computationally expensive, are used to provide information for areas where no or limited data are available. The models can also be used to test the sensitivity of the climate system to forcing (DeConto et al., 1999), e.g. increasing CO_2 levels or changes to palaeogeography. These models use the fundamental physics (e.g. Newton's Laws of Motion, Thermodynamics) governing the climate as a starting point to provide numerical representations of the Earth's climate system. GCMs now include parameters such as plant physiology, soil heat, ice formation and water dynamics.

Atmospheric GCMs divide the Earth into a grid extending vertically into the atmosphere and ocean GCMs extend down into the ocean (see Figure 1.1); both grids typically extend from 10 to 20 levels (DeConto et al., 1999). The atmospheric columns include wind vectors, humidity, clouds, temperature and height with vertical exchange between levels and horizontal exchange between columns (see Figure 1.1). The oceans include current vectors, temperature and salinity with vertical and horizontal exchange between layers of momentum, heat and salts by diffusion, convection and upwelling, and horizontal exchange by diffusion and advection (see Figure 1.1). Coupled ocean-atmosphere GCMs are the most complex type of GCM. In these coupled models, the Atmospheric GCM is coupled to the Ocean GCM by surface heat balance, wind stress and freshwater flux. This coupling is important as the oceans play a role in regulating the Earth's energy budget through storage and transfer of energy (DeConto et al., 1999). Although these are the most computationally expensive model type, they also provide the most realistic representation of the Earth's systems.

A key factor in GCMs is the input palaeogeography model used, which has been shown in sensitivity tests to play an important role in ocean circulation and heat transport as well as global climate (DeConto et al., 1999). In all of the variable runs carried out for this study, Getech's global palaeogeographies (version 1.0) were used as a template for the individual timeslices. Also included are the modelled vegetation cover and other surface characteristics such as snow cover, soil water and carbon storage present for each surface grid box.

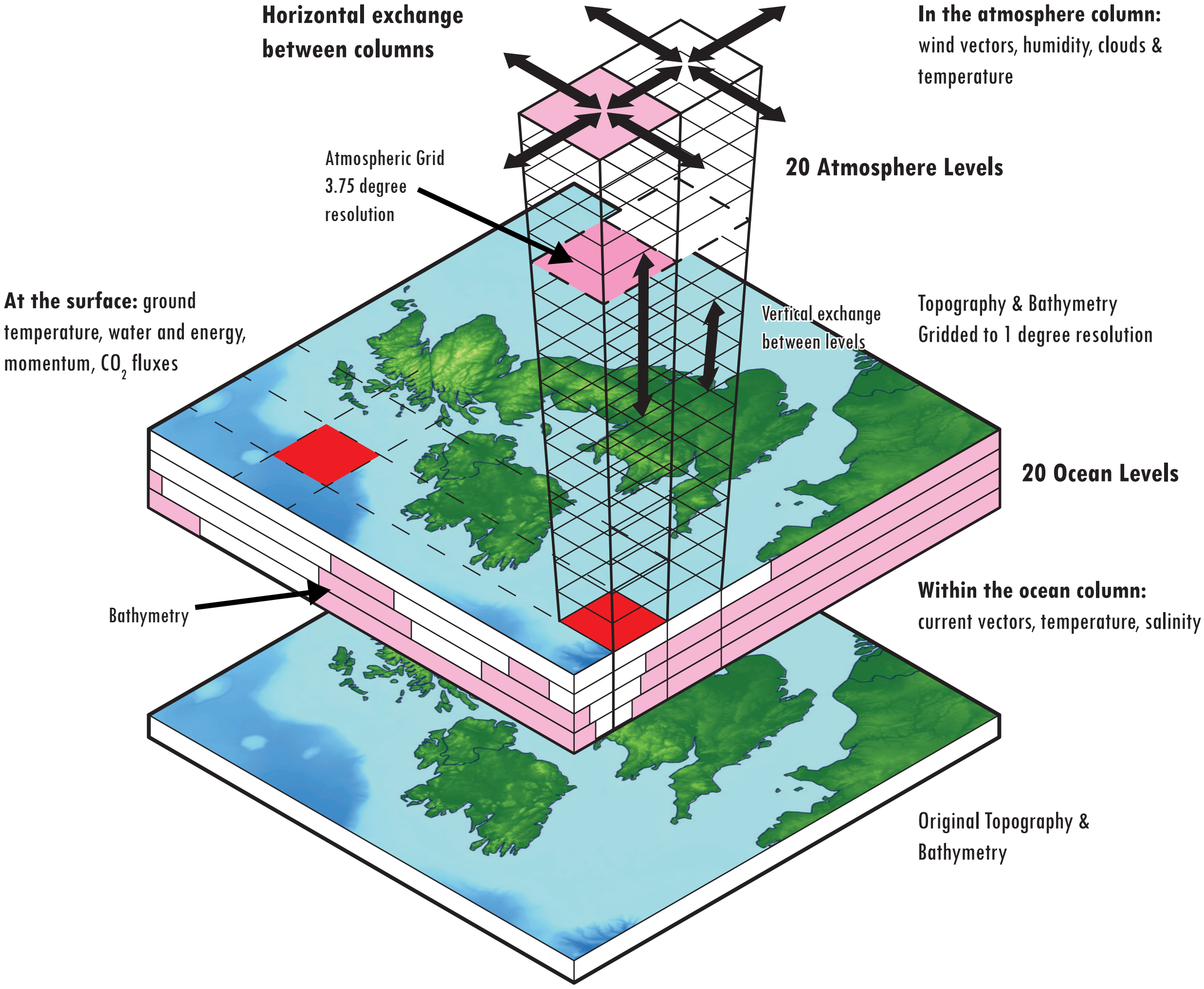

Figure 1.1: *A schematic representation of the elements of a climate model. This shows the division of the earth system into a series of grid cells.*

CHAPTER 2

Coupled Ocean-Atmosphere HadCM3L Model

2. Coupled Ocean-Atmosphere HadCM3L Model

2.1 HadCM3L Model

The climate, ocean and vegetation model results are based on the HadCM3L coupled ocean-atmosphere model (Unified Model Vn4.5 or UM), developed by the Hadley Centre of the UK Met Office. The model simulations were run on Getech's behalf by Dr Claire Loptson at the University of Bristol. This model is used for weather and future climate prediction and performs favourably when compared to other climate models, as evaluated by the Coupled Model Intercomparison Project, CMIP3. The model is run in three phases: during Phase I it is allowed to run for 50 model years with low CO_2 and no dynamic vegetation for stability reasons; phase II is ~500 years of spin up with the appropriate CO_2 value for the Stage being modelled, and model-predicted vegetation which evolves through the simulation and, finally, in Phase III the model is run for a further ~100 years with lakes turned on. The full suite of model outputs is turned on, and averages are calculated over the last ~40 years of the simulation. The whole modelling process takes 2–3 months of real time. The model is configured to output daily, monthly, seasonal and annual results for approximately 100 different variables for 20 levels in the ocean and 19 levels in the atmosphere, with a horizontal resolution of 2.5° of latitude by 3.75° of longitude.

It should be noted that problems were encountered with running the HadCM3L model for the Oxfordian Stage. When the results were received from Bristol University, it was noted that anomalously high values of ocean circulation vectors and ocean salinity were present in the Arctic region. Upon investigation it was found that the basemaps had some peninsulas in the Arctic region with small inlets, below the resolution the model can resolve. This would normally have made the model unstable; thus leading to it crashing and alerting the modellers to a problem, but, in this instance, the model continued to run, producing the very high values. The land sea mask was modified to remove the inlets that were causing the problem. It was then found that adjustments were required to the maximum orographic height at both poles to force the model to run; the height was capped at 2,500 m in both poles and at 1,500 m in the highest latitude five gridcells of Antarctica. This makes the height in these regions lower than in the Kimmeridgian and Callovian Stages to either side of the Oxfordian. Drs Loptson and Lunt are currently working on determining what has caused this problem, but, as yet, there is no geographical feature identified that could have caused the model to become unstable.

2.2 Boundary Conditions

The boundary conditions set for the model are the Getech *Globe* Palaeogeography Vol 3, v1.0 (2013) basemaps, the atmospheric CO_2, and solar constant (Gough, 1981). All other variables are calculated internally by the model according to the fundamental fluid dynamics and physics of the atmosphere and ocean, and the biology of the land surface. In contrast to earlier models, HadCM3L does not require flux correction to maintain an acceptable Present Day simulation, and so is fully appropriate for simulating past climates.

The basic model is coupled to the Met Office Surface Exchange Scheme 2 (MOSES 2) tiled land-surface model that calculates the surface CO_2 fluxes associated with photosynthesis and plant respiration (Cox, 2001). MOSES 2 is designed to complement the TRIFFID (Top-down Representation of Interactive Foliage and Flora Including Dynamics) global vegetation dynamic model (Cox, 2001) also used in this set up. TRIFFID simulates varieties of trees, grasses, shrubs, soil, inland water, and ice (Cox, 2001).

The atmospheric composition is assumed to have been constant during the Jurassic; therefore the model simulations use CO_2 levels set at 1,120 ppmv. The methane (CH_4) was set at 760 ppbv and Nitrus Oxide (N_2O) at 270 ppbv for all runs. The climatologies were calculated over the final ~40 years of the simulations.

2.3 Timeslices/Variables (NetCDFs)

This section contains details of the timeslices and variables that were provided to Getech in netCDF file format and used for this study.

2.3.1 Timeslices

This study focuses on the Jurassic and provides one timeslice per Stage (Table 2.1 contains a list of the timeslices that were examined for the project).

Stage	NetCDF Code
Tithonian	tdssk
Kimmeridgian	tdssj
Oxfordian	tdssr
Callovian	tdssh
Bathonian	tdssg
Bajocician	tdssf
Aalenian	tdsse
Toarcian	tdssd
Pliensbachian	tdssc
Sinemurian	tdssb
Hettangian	tdssa

Table 2.1: Stage and netCDF simulation name.

The set of variables detailed below (sections 2.3.2 to 2.3.5) were produced for each of the timeslices in Table 2.1. Where stated, the units used in the netCDF files from the University of Bristol have been converted to standard, more easily accessible units in the ArcGIS™ mxd, e.g. kg m^2 per 30 minutes to mm/day.

2.3.2 Atmospheric Variables

Surface Temperature

This is the temperature at the Earth's surface in Kelvin. This was converted to degrees Centigrade for the final mxd.

Feature Raster Dataset Name:		t_srf (suffixed with month, season or mean annual, e.g. _jan (January); _djf (December, January, February) or _mat (Mean Annual))
Mxd Layers Created:	*Monthly:*	January
		February
		March
		April
		May
		June
		July
		August
		September
		October
		November
		December
	Seasonal:	December, January, February
		March, April, May
		June, July, August
		September, October, November
	Annual:	Mean Annual Surface Temperature

Atmospheric Temperature at 1.5 m

This is the temperature in Kelvin of the atmosphere at 1.5 m above the Earth's surface, but it was converted to degrees Centigrade for the final mxd. This represents the temperature experienced by the faunal and floral climate proxies used for verification of the model. This section includes the Cold Month Mean (CMM) at 1.5 m, which is the mean value of the coldest month in each individual grid cell, and the Warm Month Mean (WMM) at 1.5 m, which is the mean value of the warmest month for each individual grid cell. The coldest and warmest month will vary for each grid cell depending on its location, e.g. December is cold in the Northern Hemisphere but hot in the Southern Hemisphere.

Feature Raster Dataset Names: t_1_5m, cmm, wmm (suffixed with month, season or mean annual, e.g. _jan (January); _djf (December, January, February) or _mat (Mean Annual))

Mxd Layers Created: *Monthly:*

January

February

March

April

May

June

July

August

September

October

November

December

Seasonal:	December, January, February
	March, April, May
	June, July, August
	September, October, November
Annual:	Mean Annual Surface Temperature at 1.5 m
Additional:	Cold Month Mean
	Warm Month Mean

Atmospheric Circulation

We have combined the meridional (v) and zonal (u) components of the wind vector supplied by the University of Bristol to generate an azimuth (wind direction) and velocity, which is then used in surface wind coverage. This is in units of metres per second.

Feature Class Names:		cur_uv_mm_10m (suffixed with the month, season or mean annual, e.g. _jan (January); _djf (December, January, February) or _ann (Mean Annual))
Mxd Layers Created:	*Monthly:*	January
		February
		March
		April
		May
		June
		July
		August
		September
		October
		November
		December
	Seasonal:	December, January, February
		March, April, May
		June, July, August
		September, October, November
	Annual:	Mean Annual Atmospheric Circulation

Total Precipitation

This is the amount of water precipitation (and snow as water equivalent) reaching the Earth's surface for each grid cell in kilograms per metre squared per 30 minutes. This was converted to millimetres per day for the mxd. The model generates precipitation in a grid cell once the cell reaches the saturation vapour pressure (i.e. the pressure exerted by the water vapour when the rate of evaporation equals the rate of condensation). In general, moisture will fall as rain rather than snow if the temperature of the lowest atmospheric level is greater than 273 Kelvin (-0.15 °C).

Feature Raster Dataset Name: prec_srf (suffixed with month, season or mean annual, e.g. _jan (January); _djf (December, January, February) or _map (Mean Annual))

Mxd Layers Created:

Monthly:

January

February

March

April

May

June

July

August

September

October

November

December

Seasonal:

December, January, February

March, April, May

June, July, August

September, October, November

Annual:

Mean Annual Precipitation

Total Evaporation

Evaporation is the change in state of water from a liquid to a gas (water vapour). This requires the absorption of energy (as latent heat) which can then be transported with the air parcel. The rate of evaporation depends on the temperature and the availability of moisture to evaporate. We combined the values of evaporation from the surface (in kilograms per metre squared per 30 minutes), canopy evaporation (in kilograms per metre squared per 30 minutes), sublimation from the surface (in kilograms per metre squared per 30 minutes) and evaporation from the sea (in kilograms per metre squared per second) in order to produce total monthly and seasonal evaporation. All values were converted to millimetres per day for the mxd. The Mean Annual Evaporation (MAE) was provided in a separate netCDF File, and was given in millimetres per day.

Feature Raster Dataset Name: tot_evap (suffixed with month, season or mean annual, e.g. _jan (January); _djf (December, January, February) or _ann (Mean Annual))

Mxd Layers Created: *Monthly:*

January

February

March

April

May

June

July

August

September

October

November

December

Seasonal: December, January, February

March, April, May

June, July, August

September, October, November

Annual: Mean Annual Evaporation

Precipitation-Evaporation

This is the average total precipitation minus the average total evaporation, which provides a measure of aridity. Values can be positive or negative, and were initially provided in the units detailed above in the sections on Total Precipitation and Total Evaporation, but these were converted to millimetres per day for the mxd. The seasonal values were calculated from the average Total Precipitation and average Total Evaporation values, but the Mean Annual Precipitation-Evaporation (in millimetres per day) was provided as a separate netCDF file.

Feature Raster Dataset Name:		pminuse (suffixed with month, season or mean annual, e.g. _jan (January); _djf (December, January, February) or _ann (Mean Annual))
Mxd Layers Created:	*Monthly:*	January
		February
		March
		April
		May
		June
		July
		August
		September
		October
		November
		December
	Seasonal:	December, January, February
		March, April, May
		June, July, August
		September, October, November
	Annual:	Mean Annual Precipitation-Evaporation

Total Runoff

We have combined the Slow Runoff (amount of excess water when soil levels 2–4 (10–15 cm) are all saturated) and Fast Runoff (amount of excess water when soil level 1 (0–10 cm) is saturated) netCDF components supplied by the University of Bristol to generate the Total Runoff. Fast runoff results after a sudden downpour or storm in which the rate of inflow of precipitation into layer 1 exceeds the outflow through gravitational leakage, etc. If the precipitation persists, then layer 1 will ultimately fill and spill out as runoff. This sort of runoff will be far more important for redistributing sediment on the surface than slow runoff. In areas of highly seasonal rainfall it might be represented as flash flooding. Both fast and slow runoffs were provided in kilograms per metre squared per 30 minutes, but we later converted these to millimetres per day for the mxd. The colour scheme on the data layers was chosen to maximise detail, and it should be assumed that the maximum is 16 mm/day or greater.

Feature Raster Dataset Name: runoff_tot (suffixed with month, season or mean annual, e.g. _jan (January); _djf (December, January, February) or _ann (Mean Annual))

Mxd Layers Created: *Monthly:*

January

February

March

April

May

June

July

August

September

October

November

December

Seasonal:	December, January, February
	March, April, May
	June, July, August
	September, October, November
Annual:	Mean Annual Total Runoff

Surface Air Pressure

This is the pressure in Pascals that is exerted on the Earth's surface by the atmosphere. This was converted to hectopascals for the mxd.

Feature Raster Dataset Name: p_surf (suffixed with month, season or mean annual, e.g. _jan (January); _djf (December, January, February) or _masp (Mean Annual))

Mxd Layers Created:

Monthly:

January

February

March

April

May

June

July

August

September

October

November

December

Seasonal:

December, January, February

March, April, May

June, July, August

September, October, November

Annual:

Mean Annual Surface Pressure

Snow Depth at Surface

The amount of snow expressed as water equivalent. Precipitation is considered to fall as snow when the temperature of the lowest atmospheric level falls below 273 Kelvin (-0.15 °C). This is in kilograms per metre squared per 30 minutes but was converted to mm/day for the mxd.

Feature Raster Dataset Name:	snw_dpth (suffixed with month, season or mean annual, e.g. _jan (January); _djf (December, January, February) or _masd (Mean Annual))

Mxd Layers Created: *Monthly:*

January

February

March

April

May

June

July

August

September

October

November

December

Seasonal:	December, January, February
	March, April, May
	June, July, August
	September, October, November
Annual:	Mean Annual Snow Depth

2.3.3 Ocean Variables

Ocean Circulation

We have combined the meridional (v) and zonal (u) components of the ocean current vector supplied by the University of Bristol to generate an azimuth (ocean current direction) and velocity, which is then used in the ocean current coverage. The ocean circulation is given for nine depth levels: 5 m, 47.85 m, 95.75 m, 203.7 m, 447.05 m, 995.55 m, 2,116.16 m, 2,731.45 m and 3,962.05 m. The names of these levels have been rounded for clarity (Surface, 50 m, 100 m, 200 m, 500 m, 1,000 m, 2,000 m, 3,000 m and 4,000 m). The mxd shows the combined values in cm s^{-1}.

Feature Class Names: cur_uv (suffixed by the water depth, e.g. _c95 for 95.75 m (100 m),and with season or mean annual, e.g. _djf (December, January, February) or _ann (Mean Annual))

Mxd Layers Created:

Seasonal:

December, January, February

March, April, May

June, July, August

September, October, November

Annual:

Mean Annual Ocean Circulation

Ocean Salinity

This is salinity for each ocean layer in parts per thousand ((psu-35)/1000). The ocean salinity is given for nine depth levels: 5 m, 47.85 m, 95.75 m, 203.7 m, 447.05 m, 995.55 m, 2,116.16 m, 2,731.45 m and 3,962.05 m. The names of these levels have been rounded for clarity (Surface, 50 m, 100 m, 200 m, 500 m, 1,000 m, 2,000 m, 3,000 m and 4,000 m). This has been converted to PSU for the mxd.

Feature Raster Dataset Name: sl (suffixed by the water depth, e.g. sl95 for 95.75 m (100 m), and with season or mean annual, e.g. _djf (December, January, February) or _ann (Mean Annual))

Mxd Layers Created:	*Seasonal:*	December, January, February
		March, April, May
		June, July, August
		September, October, November
	Annual:	Mean Annual Ocean Salinity

Ocean Temperature

This is ocean temperature for each ocean layer in degrees Centigrade. The ocean temperature is given for nine depth levels: 5 m, 47.85 m, 95.75 m, 203.7 m, 447.05 m, 995.55 m, 2,116.16 m, 2,731.45 m and 3,962.05 m. The names of these levels have been rounded for clarity (Surface, 50 m, 100 m, 200 m, 500 m, 1,000 m, 2,000 m, 3,000 m and 4,000 m).

Feature Raster Dataset Name: t (suffixed by the water depth, e.g. _95 for 95.75 m (100 m), and with season or mean annual, e.g. _djf (December, January, February) or _ann (Mean Annual))

Mxd Layers Created:	*Seasonal:*	December, January, February
		March, April, May
		June, July, August
		September, October, November
	Annual:	Mean Annual Ocean Temperature

Upwelling (Vertical Velocity)

This is the vertical velocity of the water in each grid cell within each specified ocean level. Negative values indicate downwelling; positive upwelling is given in centimetres per second. Upwelling is important for primary productivity as it brings nutrients to the surface. The ocean temperature is given for nine depth levels: 10 m, 55.5 m, 113 m, 242.6 m, 534.7 m, 1,193.2 m, 1,808.5 m, 3,039.1 m and 3,654.4 m. The names of these levels have been rounded for clarity (Surface, 50 m, 100 m, 200 m, 500 m, 1,000 m, 2,000 m, 3,000 m and 4,000 m). These were converted to centimetres per day.

Feature Raster Dataset Name: vv (suffixed by the water depth, e.g. _113 for 113m (100 m), and with season or mean annual, e.g. _djf (December, January, February) or _ann (Mean Annual))

Mxd Layers Created:	*Seasonal:*	December, January, February
		March, April, May
		June, July, August
		September, October, November
	Annual:	Mean Annual Upwelling

Mixed Layer Depth

The mixed layer is one in which active turbulence has produced homogenized oceanic tracers (e.g. temperature, salinity and density) above a layer of more rapid vertical changes. It is the depth in metres to the mixed layer which is a proxy for deep water formation, with increasing depth reflecting increasing down-welled water.

Feature Raster Dataset Name: mixlyr (suffixed with month, season or mean annual, e.g. _jan (January); _djf (December, January, February) or _ann (Mean Annual))

Mxd Layers Created: *Monthly:*

January

February

March

April

May

June

July

August

September

October

November

December

Seasonal:	December, January, February
	March, April, May
	June, July, August
	September, October, November
Annual:	Mean Annual Mixed Layer Depth

Sea Ice Concentration

This is the concentration of sea ice present; it is measured in units of fractional coverage % (0–1).

Feature Raster Dataset Name: icecon (suffixed with month, season or mean annual, e.g. _jan (January); _djf (December, January, February) or _masic (Mean Annual))

Mxd Layers Created:

Monthly:

January

February

March

April

May

June

July

August

September

October

November

December

Seasonal:

December, January, February

March, April, May

June, July, August

September, October, November

Annual:

Mean Annual Sea Ice Concentration

Sea Ice Thickness

This is the thickness of sea ice present; it is measured in units of metres.

Feature Raster Dataset Name: icedpt (suffixed with month, season or mean annual, e.g. _jan (January); _djf (December, January, February) or _masit (Mean Annual))

Mxd Layers Created:

Monthly:

January

February

March

April

May

June

July

August

September

October

November

December

Seasonal:

December, January, February

March, April, May

June, July, August

September, October, November

Annual:

Mean Annual Sea Ice Thickness

2.3.4 Storm Variables

Eddy Kinetic Energy

This is a proxy for storminess in the atmosphere. Eddy Kinetic Energy (EKE) records the amount of eddy-scale (10s to 100s km) energy transfer. This is of minor importance in low-latitudes, where energy transport is dominated by zonal mechanisms (Hadley atmospheric cells); however, it is of maximum importance at the mid-latitudes, where mixing of cold polar and warm tropical air creates turbulence in the atmosphere. The results are from the 850 hPa (~1.5 km) level representing the near surface. A temporal filter (High Pass Variability Hoskins Filter) is applied in order to remove small-scale features that may obscure the overall patterns. This is given in units of m^2/sec^2.

Feature Raster Dataset Name: eke_850 (suffixed with the month, season or mean annual, e.g. _jan (January); _djf (December, January, February) or _ann (Mean Annual))

Mxd Layers Created: *Monthly:*

January

February

March

April

May

June

July

August

September

October

November

December

Seasonal:	December, January, February
	March, April, May
	June, July, August
	September, October, November
Annual:	Mean Annual Eddy Kinetic Energy

2.3.5 Surface Variables

Soil Moisture

This is the total absolute amount of moisture held in layers 1 (0–10 cm), 2 (10–25 cm), 3 (25–65 cm), and 4 (65–150 cm). This will vary depending on the type of soil represented in the model, which in this case is a generic soil similar to a medium loam. The initial value of layer 4 is specified but is then allowed to interact with the rest of the system until equilibrium is reached – this can take decades of model time. Soil moisture is measured in units of kg/m^2.

Feature Raster Dataset Name: sm (suffixed with the month, season or mean annual, e.g. _jan (January); _djf (December, January, February) or _ann (Mean Annual))

Mxd Layers Created: *Monthly:*

January

February

March

April

May

June

July

August

September

October

November

December

Seasonal:	December, January, February
	March, April, May
	June, July, August
	September, October, November
Annual:	Mean Annual Soil Moisture

Köppen Classification

The Köppen Classification Scheme (also known as the Köppen-Geiger Scheme) is included in this study as it is a widely known and understood classification of dominant climate regions (see Figure 2.1). The letters used represent 1st, 2nd and 3rd order climate classifications. The 1st order group is based on the average annual precipitation, average monthly precipitation and average monthly temperature. The scheme is then further subdivided into 2nd order categories based on precipitation, and 3rd order categories based on temperature (see the table in Figure 2.1). An example of the use of this classification scheme is the U.S. states located along the Gulf of Mexico which are designated "Cfa". The "C" represents Temperate (mild mid-latitude) category, the second letter "f" stands for the German word feucht or moist (no dry season) and the third letter "a" indicates that it has hot summer temperatures.

The climate regions were calculated using the temperature and precipitation generated by the GCM. It should be noted that the Köppen Scheme is often too detailed to compare with palaeoclimate proxy data, but is easier for the less-detailed Basic than Full Köppen outputs (see below). The Full Köppen schemes have been altitude corrected to sea-level by first converting all the temperatures to the values that they would be if they were at sea-level, by assuming a lapse-rate correction. The Köppen Scheme is based on Present Day classifications of climate regions; therefore, it may not always be applicable to past climate zones that have no Present Day equivalents. Where this is the case, the model will classify the environment into the Köppen zone that most closely matches the data.

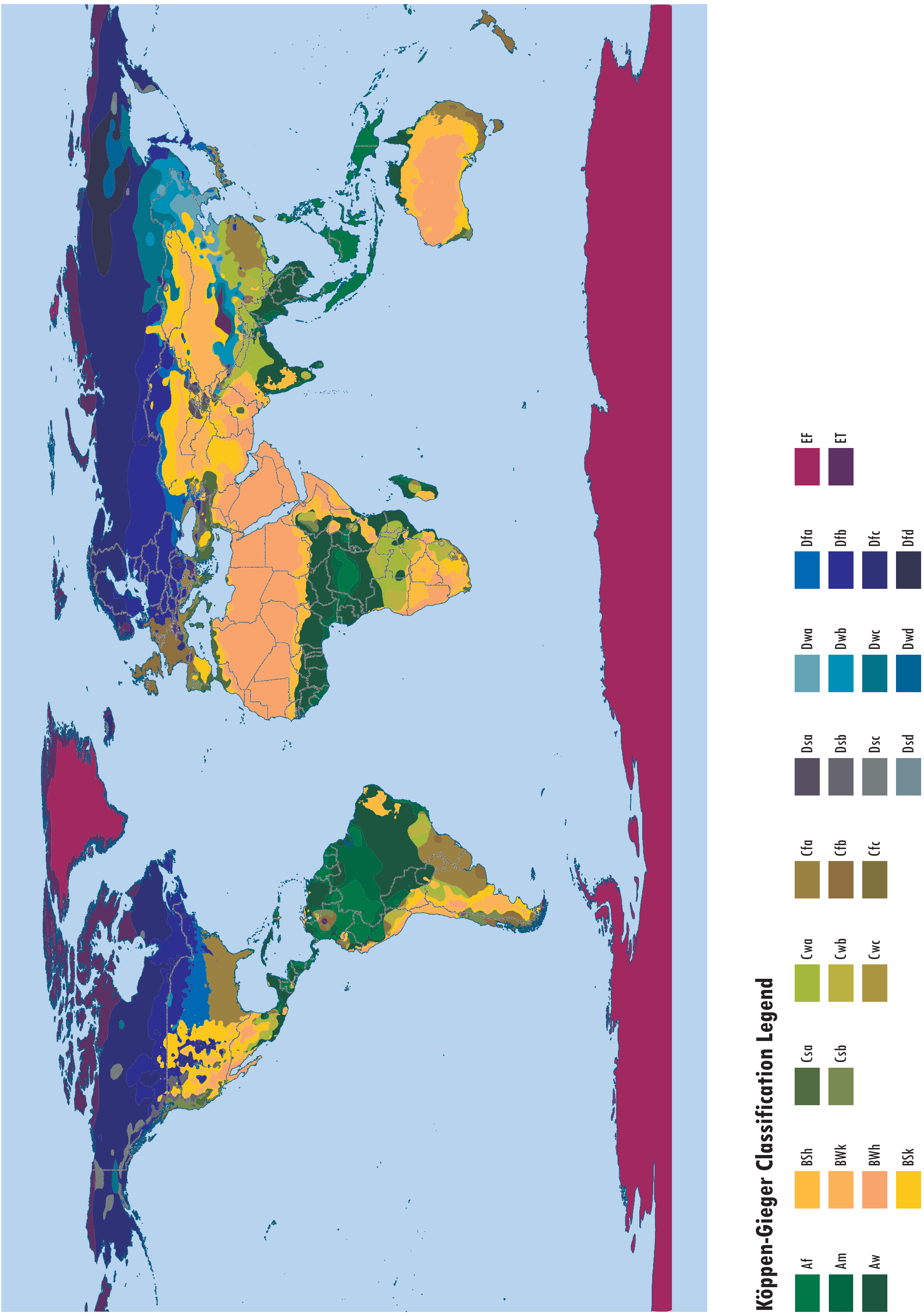

Figure 2.1: *Full Köppen-Geiger classification scheme.*

Key to World Köppen-Geiger Climate Classification Map

1st Order	*2nd Order*	*3rd Order*	*Description*
A			Tropical
	f		Rainforest
	m		Monsoon
	w		Savannah
B			Arid
	W		Desert
	S		Steppe
		h	Hot
		k	Cold
C			Temperate
	s		Dry Summer
	w		Dry Winter
	f		Without Dry Season
		a	Hot Summer
		b	Warm Summer
		c	Cold Summer
D			Cold
	s		Dry Summer
	w		Dry Winter
	f		Without Dry Season
		a	Hot Summer
		b	Warm Summer
		c	Cold Summer
		d	Very Cold Summer
E			Polar
	T		Tundra
	F		Frost

Basic Köppen Scheme

The Basic Köppen Scheme used in this study uses six letters to divide the world into six major climate regions: Tropical Rainy – A, Dry Climates – B, Warm Temperate Rainy – C, Cold Boreal Forest – , Tundra/Polar – E, and Cold (High Altitude) – H, plus water. This is a greatly simplified version of the original Köppen-Geiger Scheme with water and H = Cold (High Altitude) added (see Figure 2.3.5.1). These climate regions are based on the average annual precipitation, average monthly precipitation and average monthly temperature.

Feature Raster Dataset Name:		kopbas_ann
Mxd Layers Created:	*Annual:*	Basic Koppen Scheme

Full Köppen Scheme (corrected to sea-level)

Thirty climate regions are defined in the Full Köppen Scheme (see Figure 2.3.5.2) based on the original Köppen-Geiger Scheme, plus water and H = Cold (High Altitude).

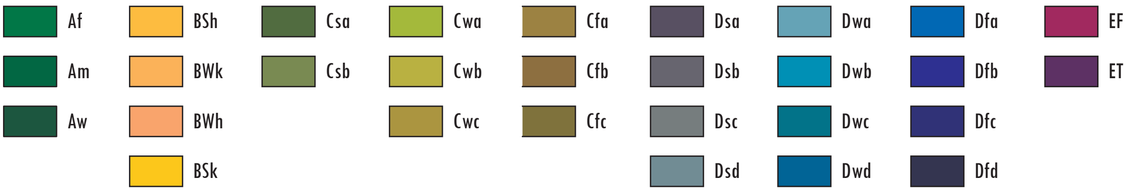

Figure 2.2: Legend used for the Full Köppen Scheme.

Letters correspond to those given in the table shown in Figure 2.3.5.1., plus water and H =Cold (High Altitude), which were added after Köppen created his system.

Feature Raster Dataset Name: kopfull_ann

Mxd Layers Created: *Annual:* Full Koppen Scheme (corrected to sea level)

Biomes

The surface variables also include biomes which are the combined dominant forms of plant life and the prevailing climate produced by the University of Bristol's Biome4 model, which was used in the ocean-atmosphere GCM. Twenty-nine biomes are defined within this model (see Figure 2.3).

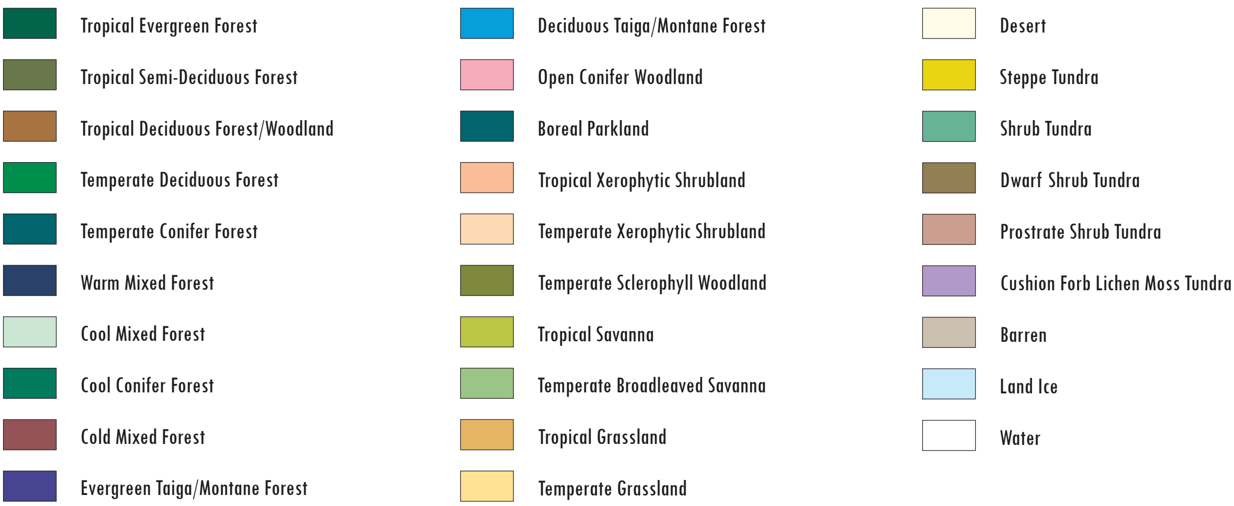

Figure 2.3: *Legend used for the Biome4 Model.*

Mean Annual Biome4

This is the biomes present as calculated by the model with climate generated by the GCM, CO_2 set at 340 ppm, and soils were constant.

Feature Raster Dataset Name: biome_mab4

Mxd Layers Created: Mean Annual Biome4

Mean Annual Biome4 CO2

This is the biomes present as calculated by the model with climate and CO_2 generated by the GCM, and soils were constant.

Feature Raster Dataset Name: biome_mab4co2

Mxd Layers Created: *Annual:* Mean Annual Biome4 CO2

To make them more user-friendly the Identify pointer within the mxd shows the biome type from the legend, rather than the number assigned to that biome within the Biome4, Biome4 CO_2, Full Köppen Scheme and Basic Köppen Scheme layers. To use this function click on the Identify tool, and from the "Identify from" drop-down menu select "<Visible layers>"; the vegetation type will then be listed in the box that pops up.

CHAPTER 3

Getech Conversion Methods

3. Getech Conversion Methods

The outputs from the HadCM3L model are multi-dimensional netCDF grids, with a rectangular cell size of 3.75° longitude by 2.5° latitude and an extent of 0° to 360° in longitude by -90° to 90° latitude. In order to be comparable with other Getech products, we needed to provide the grids at a cell size of 0.5° in the range -180° to 180°. The process used for this conversion is shown in Figure 3.1.

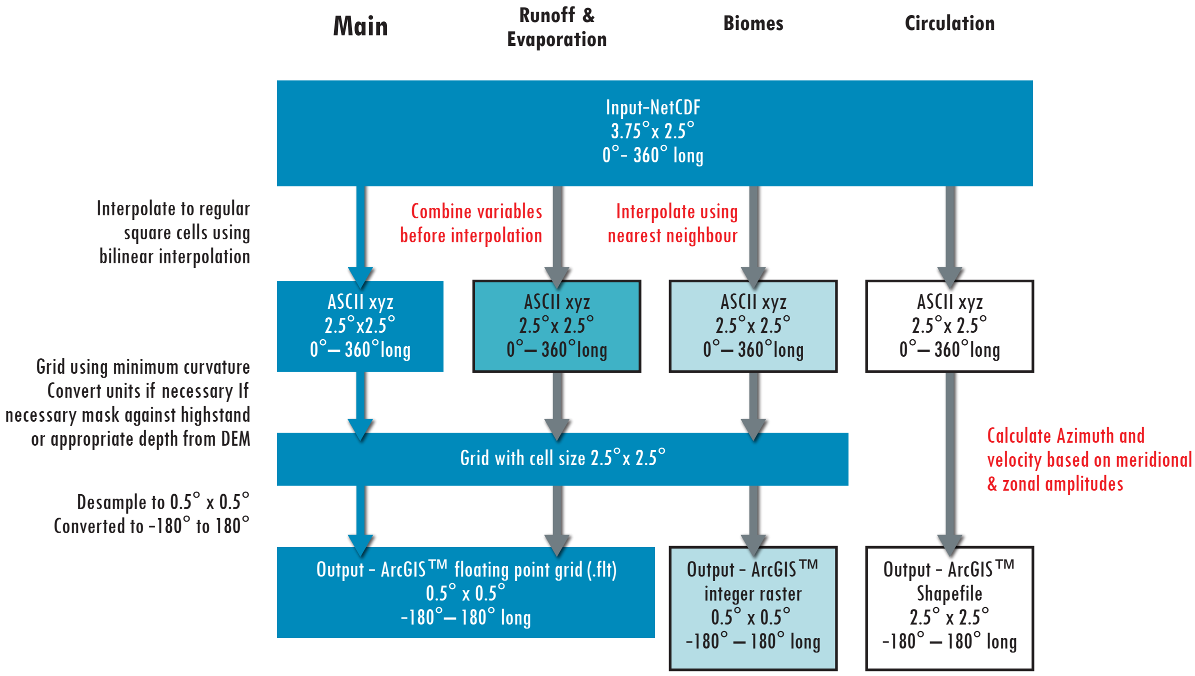

Figure 3.1: Flow chart showing the process used to create the ArcGIS™ files for the mxd.

The main process is shown on the left, with the alternate processes for biomes, runoff and evaporation, and circulation shown to the right. Changes to the main process are highlighted in red for the alternative methods.

The main process depicted in Figure 3.1 was appropriate for most variables as the majority were continuous data; hence, bilinear interpolation has been used to resample to a regular 2.5° by 2.5° cell size. A minority of variables needed adjustments to the main process, such as the Biomes variable, which have a discrete value per cell, and hence required a nearest neighbour technique to be applied to ensure no inappropriate smoothing/interpolation during resampling. Additionally, the Biomes variable required the final grid to be an integer raster, unlike other variables. Multiple layers (e.g. total runoff and total evaporation) required more than one variable from the netCDFs to be added together prior to resampling to ensure consistency at the coastlines once the cell size was regularised. Circulation, both atmospheric and oceanic, need to be output as point files so that the direction and magnitude of the circulation could be displayed as a proportional arrow pointing in the direction of motion. Many layers were not global and, due to the block nature of the large original cell size, required expansion and clipping to the coastline. This was done by using a large blanking distance (grid expansion distance from points) when gridding the data, then masking against the highstand coastline. Certain oceanic layers are depth specific, so were masked against the DEM (Digital Elevation Model) grid for the top of the depth layer. To perform these processes, a combination of ArcGIS™ Spatial Analyst and Geosoft Oasis has been employed to ensure minimum alteration to the original data; any differences from the Bristol netCDFs will be due to the interpolation applied to smooth the data, and resampling from the rectangular cell size of 3.75° by 2.5° to 0.5° by 0.5° required for future analysis of the results. Circulation was kept at a resolution of 2.5° x 25° for clarity.

CHAPTER 4

Mxd Format

4. Mxd Format

An ArcGIS™ v10 mxd is supplied for each of the 11 timeslices; this and all supporting files (feature raster datasets and feature classes within the geodatabase) are supplied in geographic coordinate system, WGS84, to allow for integration with other Getech *Globe* deliverables. Three displays are given within the mxd for each timeslice: World_Mollweide, providing a global view; North Polar Orthographic and South Polar Orthographic, both giving more detailed polar views.

For consistency, the feature raster datasets and feature classes have the same filename structure within each timeslice. Additionally, every feature raster dataset and feature class has metadata attached which gives the Stage name and a description of that file. This metadata was added because the naming structure means that if these feature raster datasets and feature classes are moved to different locations and renamed, then identification of the timeslice may not be possible. The naming convention also means that if the feature raster datasets and feature classes are added to an SDE database, searching will be difficult as they will appear with the same name but no visible age identifier. The metadata can be accessed within ArcCatalog™ by navigating to the timeslice required in the left-hand panel, and opening the geodatabase, e.g. Tithonian_Jan_2015_issue1, left click on the layer you are interested in, e.g. icedpt_djf (ice depth for December, January, February), and click on the "Description" tab in the right-hand panel to view the full metadata. The metadata also includes the Plate Model and Palaeogeography version numbers, the Model Name and the Issue details.

In addition to the variables listed in Tables 4.1a–d, all of the timeslices within the mxd include modern country outlines rotated to the relevant Stage; hillshade, created using Getech's global palaeogeographic maps, and sea-level highstand for the appropriate Stage, created as part of the global (*Globe* core deliverable) palaeogeographic mapping project.

Variable	Units	Timescale	Depth Level (where appropriate)
Atmosphere			
Surface Temperature	degrees C	*Monthly:* January, February, March, April, May, June, July, August, September, October, November, December *Seasonal:* December/January/February March/April/May June/July/August September/October/November *Annual:* Mean Annual Surface Temperature	N/A
Atmospheric Temperature at 1.5 m	degrees C	*Monthly:* January, February, March, April, May, June, July, August, September, October, November, December *Seasonal:* December/January/February March/April/May June/July/August September/October/November *Annual:* Mean Annual Atmospheric Temperature at 1.5 m *Additional:* Cold Month Mean at 1.5 m; Warm Month Mean at 1.5 m	N/A
Atmospheric Circulation	m/s	*Monthly:* January, February, March, April, May, June, July, August, September, October, November, December *Seasonal:* December/January/February March/April/May June/July/August September/October/November *Annual:* Mean Annual Atmospheric Circulation	N/A
Total Precipitation	mm/day	*Monthly:* January, February, March, April, May, June, July, August, September, October, November, December *Seasonal:* December/January/February March/April/May June/July/August September/October/November *Annual:* Mean Annual Total Precipitation	N/A

Table 4.1a: Variables included within the project mxd.

Variable	Units	Timescale	Depth Level (where appropriate)
Atmosphere			
Surface Temperature	mm/day	*Monthly:* January, February, March, April, May, June, July, August, September, October, November, December *Seasonal:* December/January/February March/April/May June/July/August September/October/November *Annual:* Mean Annual Total Evaporation	N/A
Precipitation-Evaporation	mm/day	*Monthly:* January, February, March, April, May, June, July, August, September, October, November, December *Seasonal:* December/January/February March/April/May June/July/August September/October/November *Annual:* Mean Annual Precipitation-Evaporation	N/A
Total Runoff	mm/day	*Monthly:* January, February, March, April, May, June, July, August, September, October, November, December *Seasonal:* December/January/February March/April/May June/July/August September/October/November *Annual:* Mean Annual Total Runoff	N/A
Surface Air Pressure	hPa	*Monthly:* January, February, March, April, May, June, July, August, September, October, November, December *Seasonal:* December/January/February March/April/May June/July/August September/October/November *Annual:* Mean Annual Surface Pressure	N/A
Snow Depth at Surface	mm/day	*Monthly:* January, February, March, April, May, June, July, August, September, October, November, December *Seasonal:* December/January/February March/April/May June/July/August September/October/November *Annual:* Mean Annual Snow Depth at Surface	N/A

Table 4.1b: Variables included within the project mxd continued.

Variable	Units	Timescale	Depth Level (where appropriate)
Oceans			
Ocean Circulation	cm/s	*Seasonal:* December/January/February March/April/May June/July/August September/October/November *Annual:* Mean Annual Ocean Circulation	Surface, 50 m, 100 m, 200 m, 500 m, 1,000 m, 2,000 m, 3,000 m, 4,000 m
Ocean Salinity	PSU	*Seasonal:* December/January/February March/April/May June/July/August September/October/November *Annual:* Mean Annual Ocean Salinity	Surface, 50 m, 100 m, 200 m, 500 m, 1,000 m, 2,000 m, 3,000 m, 4,000 m
Ocean Temperature	degrees C	*Seasonal:* December/January/February March/April/May June/July/August September/October/November *Annual:* Mean Annual Ocean Temperature	Surface, 50 m, 100 m, 200 m, 500 m, 1,000 m, 2,000 m, 3,000 m, 4,000 m
Upwelling (Vertical Velocity)	cm/day	*Seasonal:* December/January/February March/April/May June/July/August September/October/November *Annual:* Mean Annual Upwelling	Surface, 50 m, 100 m, 200 m, 500 m, 1,000 m, 2,000 m, 3,000 m, 4,000 m
Mixed Layer Depth	m	*Monthly:* January, February, March, April, May, June, July, August, September, October, November, December *Seasonal:* December/January/February March/April/May June/July/August September/October/November *Annual:* Mean Annual Mixed Layer Depth	N/A
Sea Ice Concentration	% (0– 1)	*Monthly:* January, February, March, April, May, June, July, August, September, October, November, December *Seasonal:* December/January/February March/April/May June/July/August September/October/November *Annual:* Mean Annual Sea Ice Concentration	N/A

Table 4.1c: Variables included within the project mxd continued.

Variable	Units	Timescale	Depth Level (where appropriate)
Oceans			
Sea Ice Thickness	m	*Monthly:* January, February, March, April, May, June, July, August, September, October, November, December *Seasonal:* December/January/February March/April/May June/July/August September/October/November *Annual:* Mean Annual Sea Ice Thickness	Surface, 50 m, 100 m, 200 m, 500 m, 1,000 m, 2,000 m, 3,000 m, 4,000 m
Storms			
Eddy Kinetic Energy	M^2s^{-2}	*Monthly:* January, February, March, April, May, June, July, August,September, October, November, December *Seasonal:* December/January/February March/April/May June/July/August September/October/November *Annual:* Mean Annual Eddy Kinetic Energy	Surface, 50 m, 100 m, 200 m, 500 m, 1,000 m, 2,000 m, 3,000 m, 4,000 m
Surface			
Soil Moisture	kg/m^2	*Monthly:* January, February, March, April, May, June, July, August, September, October, November, December *Seasonal:* December/January/February March/April/May June/July/August September/October/November *Annual:* Mean Annual Soil Moisture	Surface, 50 m, 100 m, 200 m, 500 m, 1,000 m, 2,000 m, 3,000 m, 4,000 m
Basic Köppen Scheme	1–7	*Annual:* Mean Annual Basic Köppen	Surface, 50 m, 100 m, 200 m, 500 m, 1,000 m, 2,000 m, 3,000 m, 4,000 m
Full Köppen Scheme (corrected to sea-level)	1–32	*Annual:* Mean Annual Full Köppen (corrected to sea-level)	N/A
Mean Annual Biome4 CO^2	1–29	*Annual:* Mean Annual Biome4 CO^2	
Mean Annual Biome4	1–29	*Annual:* Mean Annual Biome4	N/A

Table 4.1d: Variables included within the project mxd continued.

Please note that, for clarity, the ocean depth levels are labelled as the nearest appropriate number in metres, e.g 95.75 m is rounded to 100 m, and 2,116.15 m rounded to 2,000 m (Table 4.2). To find the depth modelled within the mxd, right click on the appropriate layer and go to "properties" and click on the "source" tab. In the "Data Source" box the "Raster" or "Feature class" name is given which includes the depth, e.g. sl_55_djf is vertical velocity at 55.5 m for December, January, February and cur-uv_c95_djf is the circulation (meridional and zonal) for a depth of 95.75 m in December, January, February. Most of the variable measurements are taken at the mid point of the grid cells (e.g. Ocean Salinity) although some are taken from the bottom of the grid cells (e.g. Upwelling, vertical velocity).

Displayed in mxd	Source File Label (suffixed with season code)	Grid Depth
Half Grid		
Surface		
50 m	sl5	5m
100 m	sl47	47.85 m
200 m	sl95	95.75 m
500 m	sl203	203.70 m
1,000 m	sl447	447.05 m
2,000 m	sl995	995.55 m
3,000 m	sl2116	2,116.15 m
4,000 m	sl2731	2,731.45 m
Bottom Grid	sl3962	3,962.05 m
Surface		
50 m	vv_10	10 m
100 m	vv_55	55.5 m
200 m	vv_113	113 m
500 m	vv_242	242.60 m
1,000 m	vv_534	534.70 m
2,000 m	vv_1193	1,193.20 m
3,000 m	vv_1808	1,808.50 m
4,000 m	vv_3039	3,039.10 m
	vv_4269	4,269.10 m

Table 4.2: Water depth levels used within mxd.

The legends used for each variable are designed to be kept consistent through time and with those used by the University of Bristol. As such, they have to represent both icehouse and hothouse periods which cover a large range of temperatures, etc. The colour schemes were chosen to maximise detail, but it should be noted that in some cases the maximum calculated model values will be values equal to, or more than, the maximum value shown on the legend and the minimum modelled value may be equal to, or less than, the minimum legend value. Absolute minimum and maximum values can be seen by right clicking on the data layer, selecting "Properties and Source", then scrolling down the properties to "Statistics" where you will find listed the minimum, maximum, mean and standard deviation values for that layer.

Where the data layers do not represent global variables (e.g. runoff, which is only onshore, and salinity, which is marine), the data has been interpolated (based on surrounding values) and clipped to the coastline. It should be noted that this means that the data shown on the smaller offshore islands is entirely interpolated and not based on the topographic features of those islands and model calculations.

In addition to the mxd and geodatabase, detailed above, we now also provide the data layers as .lyr files that can be dragged directly into a blank mxd with the legends already applied, for ease of use. These .lyr files can be found within each timeslice folder in a sub-folder called "(Stage Name) Layer Files". Each of these sub-folders contains further folders that split the palaeoclimate data into sections (Atmosphere, Cultural, Oceans, Storms, and Surface) that contain the relevant layer files (.lyr).

CHAPTER 5

References

5. References

DeConto, R. M., Thompson, S. L. and Pollard, D. 1999. Recent advances in paleoclimate modeling toward better simulations of warm paleoclimates. Warm climates in earth history. Cambridge University Press, Ch. 2, p. 21-49.

Getech, 2013. Getech's Atlases of Global Palaeogeography: Jurassic. Report Number G1318.

Gough, D.O., 1981. Solar interior structure and luminosity variations. Solar Physics, vol. 74 (1), p. 21-34.

Appendix 1

A1. Additional Variables

Below is a list of additional variables, produced by Bristol University using the HadCM3L model, which were not included in this deliverable; they were omitted for clarity and due to a number of them only being required for specialist climate research. If any of the additional variables are required, they can be processed and provided for an additional cost. Please contact Paul Carey (paul.carey@getech.com), our Sales and Marketing Director, for further details and prices.

A1.1 Atmosphere

MoistureQTFlux_mm_hyb

Long Name: QT SOURCE/SINK IN QT_POSS KG/M2/S

Standard Name: none

Processing: monthly_mean_hybrid_coords

Units: kg m-2 s-1

cldamount_mm_hby

Long Name: LAYER CLOUD AMOUNT IN EACH LAYER

Standard Name: none

Processing: monthly_mean_hybrid_coords

Units: 0-1

lowCloud_mm_ua

Long Name:	LOW CLOUD AMOUNT
Standard Name:	none
Processing:	monthly_mean_unspecified_vertical _coord_(atmos)
Units:	-

medCloud_mm_ua

Long Name:	MEDIUM CLOUD AMOUNT
Standard Name:	none
Processing:	monthly_mean_unspecified_vertical _coord_(atmos)
Units:	-

highCloud_mm_ua

Long Name:	HIGH CLOUD AMOUNT
Standard Name:	none
Processing:	monthly_mean_unspecified_vertical_coord_(atmos)
Units:	-

QCL_mm_hyb

Long Name:	CLOUD LIQUID WATER AFTER DYN CLOUD
Standard Name:	atmosphere_cloud_liquid_water_content
Processing:	monthly_mean_hybrid_coords
Units:	kg kg-1

QCF_mm_hyb

Long Name:	CLOUD ICE CONTENT AFTER DYNAM CLOUD
Standard Name:	atmosphere_cloud_ice_content
Processing:	monthly_mean_hybrid_coords
Units:	kg kg-1

totCloud_mm_ua

Long Name:	TOTAL CLOUD AMOUNT - RANDOM OVERLAP
Standard Name:	none
Processing:	monthly_mean_unspecified_vertical_coord_(atmos)
Units:	0-1

totCloudranmax_mm_ua

Long Name:	TOTAL CLOUD AMOUNT MAX/RANDOM OVERLAP
Standard Name:	none
Processing:	monthly_mean_unspecified_vertical_coord_(atmos)
Units:	0-1

Solar_mm_s3_srf

Long Name:	NET DOWN SURFACE SW FLUX: SW TS ONLY
Standard Name:	surface_net_downward_shortwave_flux
Processing:	monthly_mean_sampled_3_hourly_at_surface
Units:	W m-2

downSOL_mm_TOA

Long Name: INCOMING SW RAD FLUX (TOA):ALL TSS

Standard Name: toa_incoming_shortwave_flux

Processing: monthly_mean_at_top_of_atmosphere

Units: W m-2

upSOL_mm_s3_TOA

Long Name: OUTGOING SW RAD FLUX (TOA)

Standard Name: toa_outgoing_shortwave_flux

Processing: monthly_mean_sampled_3_hourly_at_top_of_atmosphere

Units: W m-2

clskyUpSol_mm_s3_TOA

Long Name: CLEAR-SKY (II) UPWARD SW FLUX (TOA)

Standard Name: toa_outgoing_shortwave_flux_assuming_clear_sky

Processing: monthly_mean_sampled_3_hourly_at_top_of_atmosphere

Units: W m-2

clskyDownSol_mm_s3_srf

Long Name: CLEAR-SKY (II) DOWN SURFACE SW FLUX

Standard Name: surface_downwelling_shortwave_flux_in_air_assumingrsdscs

Processing: monthly_mean_sampled_3_hourly_at_surface

Units: W m-2

clskyUpSol_mm_s3_srf

Long Name: CLEAR-SKY (II) UP SURFACE SW FLUX

Standard Name: surface_upwelling_shortwave_flux_in_air_assuming_crsuscs

Processing: monthly_mean_sampled_3_hourly_at_surface

Units: W m-2

swhr_mm_hyb

Long Name: SW HEATING RATES: ALL TIMESTEPS

Standard Name: tendency_of_air_temperature_due_to_shortwave_heatitntsw

Processing: monthly_mean_hybrid_coords

Units: K s-1

csswhr_mm_s3_hyb

Long Name: CLEAR-SKY SW HEATING RATES

Standard Name: tendency_of_air_temperature_due_to_shortwave_heatinone

Processing: monthly_mean_sampled_3_hourly_hybrid_coords

Units: K s-1

downSol_Seaice_mm_s3_srf

Long Name: TOTAL DOWNWARD SURFACE SW FLUX

Standard Name: surface_downwelling_shortwave_flux_in_air

Processing: monthly_mean_sampled_3_hourly_at_surface

Units: W m-2

solar_mm_s3_trop

Long Name:	NET DOWNWARD SW FLUX AT THE TROP
Standard Name:	tropopause_net_downward_shortwave_flux
Processing:	monthly_mean_sampled_3_hourly_at_tropopause
Units:	W m-2

upSol_mm_s3_trop

Long Name:	UPWARD SW FLUX AT THE TROP
Standard Name:	not_found
Processing:	monthly_mean_sampled_3_hourly_at_tropopause
Units:	W m-2

longwave_mm_s3_srf

Long Name:	NET DOWN SURFACE LW RAD FLUX
Standard Name:	surface_net_downward_longwave_flux
Processing:	monthly_mean_sampled_3_hourly_at_surface
Units:	W m-2

olr_mm_s3_TOA

Long Name:	OUTGOING LW RAD FLUX (TOA)
Standard Name:	not_found
Processing:	monthly_mean_sampled_3_hourly_at_top_of_atmosphere
Units:	W m-2

csolr_mm_s3_TOA

Long Name: CLEAR-SKY (II) UPWARD LW FLUX (TOA)

Standard Name: not-found

Processing: monthly_mean_sampled_3_hourly_at_top_of_atmosphere

Units: W m-2

ilr_mm_s3_srf

Long Name: DOWNWARD LW RAD FLUX: SURFACE

Standard Name: none

Processing: monthly_mean_sampled_3_hourly_at_surface

Units: W m-2

csilr_mm_s3_srf

Long Name: CLEAR-SKY (II) DOWN SURFACE LW FLUX

Standard Name: not_found

Processing: monthly_mean_sampled_3_hourly_at_surface

Units: W m-2

lwhr_mm_s3_hyb

Long Name: LW HEATING RATES

Standard Name: tendency_of_air_temperature_due_to_longwave_heatintntlw

Processing: monthly_mean_sampled_3_hourly_hybrid_coords

Units: K s-1

cslwhr_mm_s3_hyb

Long Name: CLEAR-SKY LW HEATING RATES

Standard Name: tendency_of_air_temperature_due_to_longwave_heatinnone

Processing: monthly_mean_sampled_3_hourly_hybrid_coords

Units: K s-1

longwave_mm_s3_trop

Long Name: NET DOWNWARD LW FLUX AT THE TROP

Standard Name: not_found

Processing: monthly_mean_sampled_3_hourly_at_tropopause

Units: W m-2

ilr_mm_s3_trop

Long Name: TOTAL DOWNWARD LW FLUX AT THE TROP

Standard Name: none

Processing: monthly_mean_sampled_3_hourly_at_tropopause

Units: W m-2

atmosCorr_mm_ua

Long Name: ATMOS ENERGY CORR'N IN COLUMN W/M2

Standard Name: not_found

Processing: monthly_mean_unspecified_vertical_coord_(atmos)

Units: W m-2

botmelt_mm_srf

Long Name:	HEAT FLUX THROUGH SEA ICE (GBM) W/M2
Standard Name:	not_found
Processing:	monthly_mean_at_surface
Units:	W m-2

soilHeatFlux_mm_soil

Long Name:	HT FLUX FROM SURF TO DEEP SOIL LEV 1
Standard Name:	downward_heat_flux_in_soil
Processing:	monthly_mean_on_soil_levels
Units:	W m-2

CDrag_mm_srf

Long Name:	CD
Standard Name:	not_found
Processing:	monthly_mean_at_surface
Units:	-

CH_mm_srf

Long Name:	CH
Standard Name:	not_found
Processing:	monthly_mean_at_surface
Units:	-

windShear_mm_hyb

Long Name:	SURFACE LAYER WIND SHEAR
Standard Name:	not_found
Processing:	monthly_mean_hybrid_coords
Units:	-

sh_mm_hyb

Long Name:	SURFACE & B.LAYER HEAR FLUXES W/M2
Standard Name:	none
Processing:	monthly_mean_hybrid_coords
Units:	W m-2

taux_mm_hyb

Long Name:	X-COMP OF SURF & BL WIND STRESS N/M2
Standard Name:	surface_downward_eastward_stress
Processing:	monthly_mean_hybrid_coords
Units:	N m-2

tauy_mm_hyb

Long Name:	Y-COMP OF SURF & BL WIND STRESS N/M2
Standard Name:	surface_downward_northward_stress
Processing:	monthly_mean_hybrid_coords
Units:	N m-2

moistureFlux_mm_hyb

Long Name: SURF & BL TOTL MOISTURE FLUX KG/M2/S

Standard Name: none

Processing: monthly_mean_hybrid_coords

Units: kg m-2 s-1

wme_mm_srf

Long Name: WIND MIXING EN'GY FLUX INTO SEA W/M2

Standard Name: not_found

Processing: monthly_mean_at_surface

Units: W m-2

sh_mm_srf

Long Name: SURFACE SH FLUX FROM SEA (GBM) W/M2

Standard Name: surface_upward_sensible_heat_flux

Processing: monthly_mean_at_surface

Units: W m-2

lh_mm_srf

Long Name: SURFACE SH LATENT HEAT FLUX W/M2

Standard Name: surface_upward_latent_heat_flux

Processing: monthly_mean_at_surface

Units: W m-2

topmelt_mm_srf

Long Name: SEAICE TOP MELTING LH FLUX (GBM) W/M2

Standard Name: not_found

Processing: monthly_mean_at_surface

Units: W m-2

temp_mm_ds0_1_5m

Long Name: TEMPERATURE AT 1.5M

Standard Name: not_found

Processing: monthly_mean_sampled_daily_at_0hrs_1.5m_above_surface

Units: K

q_mm_1_5m

Long Name: SPECIFIC HUMIDITY AT 1.5M

Standard Name: specific_humidity

Processing: monthly_mean_1.5m_above_surface

Units: kg kg-1

moistureFlux_mm_srf

Long Name: TOTAL SURF MOIST FLUX PER TIMESTEP

Standard Name: none

Processing: monthly_mean_at_surface

Units: kg m-2 s-1

rh_mm_1_5mm

Long Name:	RELATIVE HUMIDITY AT 1.5M
Standard Name:	relative_humidity
Processing:	monthly_mean_1.5m_above_surface
Units:	-

wind_mm_10m

Long Name:	10 METRE WIND SPEED M/S
Standard Name:	wind_speed
Processing:	monthly_mean_10m_above_surface
Units:	m s-1

dewT_mm_1_5m

Long Name:	DEWPOINT AT 1.5m (K)
Standard Name:	none
Processing:	monthly_mean_1.5m_above_surface
Units:	K

transpiration_mm_srf

Long Name:	TRANSPIRATION RATE KG/M2/S
Standard Name:	not_found
Processing:	monthly_mean_at_surface
Units:	kg m-2 s-1

lsrain_mm_srf

Long Name:	LARGE SCALE RAINFALL RATE KG/M2/S
Standard Name:	not_found
Processing:	monthly_mean_at_surface
Units:	kg m-2 s-1

lssnow_mm_srf

Long Name:	LARGE SCALE SNOWFALL RATE KG/M2/S
Standard Name:	not_found
Processing:	monthly_mean_at_surface
Units:	kg m-2 s-1

cvrain_mm_srf

Long Name:	CONVECTIVE RAINFALL RATE KG/M2/S
Standard Name:	not_found
Processing:	monthly_mean_at_surface
Units:	kg m-2 s-1

cvsnow_mm_srf

Long Name:	CONVECTIVE SNOWFALL RATE KG/M2/S
Standard Name:	not_found
Processing:	monthly_mean_at_surface
Units:	kg m-2 s-1

convcld_mm_hyb

Long Name: CONV.CLOUD AMOUNT ON EACH MODEL LEV

Standard Name: not_found

Processing: monthly_mean_hybrid_coords

Units: -

convCldWater_mm_hyb

Long Name: CONV CLOUD CONDENSED WATER KG/KG

Standard Name: not_found

Processing: monthly_mean_hybrid_coords

Units: kg kg-1

rain_mm_srf

Long Name: TOTAL RAINFALL RATE: LS+CONV KG/M2/S

Standard Name: not_found

Processing: monthly_mean_at_surface

Units: kg m-2 s-1

snow_mm_srf

Long Name: TOTAL SNOWFALL RATE: LS+CONV KG/M2/S

Standard Name: snowfall_flux

Processing: monthly_mean_at_surface

Units: kg m-2 s-1

precip_mm_ds0_srf

Long Name: TOTAL PRECIPITATION RATE KG/M2/S

Standard Name: precipitation_flux

Processing: monthly_mean_sampled_daily_at_0hrs_at_surface

Units: kg m-2

snowmeltHflx_mm_srf

Long Name: LAND SNOW MELT HEAT FLUX W/M2

Standard Name: not_found

Processing: monthly_mean_at_surface

Units: W m-2

canopyWater_mm_can

Long Name: CANOPY WATER CONTENT

Standard Name: not_found

Processing: monthly_mean_at_canopy_height

Units: kg m-2

soiltemp_mm_soil

Long Name: DEEP SOIL TEMP. AFTER HYDROLOGY DEGK

Standard Name: 3

Processing: monthly_mean_on_soil_levels

Units: K

SoilMoist_mm_soil

Long Name:	UNFROZEN SOIL MOISTURE FRACTION
Standard Name:	mass_fraction_of_unfrozen_water_in_soil_moisture
Processing:	monthly_mean_on_soil_levels
Units:	-

frozenSoilMoist_mm_soil

Long Name:	FROZEN SOIL MOISTURE FRACTION
Standard Name:	mass_fraction_of_frozen_water_in_soil_moisture
Processing:	monthly_mean_on_soil_levels
Units:	-

snowmelt_mm_srf

Long Name:	LAND SNOW MELT RATE KG/M2/S
Standard Name:	not_found
Processing:	monthly_mean_at_surface
Units:	kg m-2 s-1

canopyThru_mm_can

Long Name:	CANOPY THROUGHFALL RATE KG/M2/S
Standard Name:	not_found
Processing:	monthly_mean_at_canopy_height
Units:	kg m-2 s-1

srfRunoff_mm_srf

Long Name: SURFACE RUNOFF RATE KG/M2/S

Standard Name: not_found

Processing: monthly_mean_at_surface

Units: kg m-2 s-1

subsrfRunoff_mm_srf

Long Name: SUB-SURFACE RUNOFF RATE KG/M2/S

Standard Name: not_found

Processing: monthly_mean_at_surface

Units: kg m-2 s-1

ke_mm_ua

Long Name: TOTAL KE PER UNIT AREA X10E-6 J/M2

Standard Name: atmosphere_kinetic_energy_content

Processing: monthly_mean_unspecified_vertical_coord_(atmos)

Units: J

mountainTorque_mm_bl

Long Name: mountain torque per unit area N/m

Standard Name: not_found

Processing: monthly_mean_boundary_layer

Units: N m-1

p_mm_trop

Long Name:	PRESSURE AT TROP LEV-NEED HT, TEMP
Standard Name:	tropopause_air_pressure
Processing:	monthly_mean_at_tropopause
Units:	Pa

temp_mm_trop

Long Name:	TEMP AT TROP LEVEL - NEED HT, PRESS
Standard Name:	tropopause_air_temperature
Processing:	monthly_mean_at_tropopause
Units:	K

ht_mm_trop

Long Name:	HEIGHT OF TROP - NEED TEMP, PRESS
Standard Name:	height
Processing:	monthly_mean_at_tropopause
Units:	m

p_mm_msl

Long Name:	PRESSURE AT MEAN Sea-level
Standard Name:	air_pressure_at_sea_level
Processing:	monthly_mean_at_mean_sea_level
Units:	Pa

theta_mm_hyb

Long Name: THETA AFTER TIMESTEP

Standard Name: air_potential_temperature

Processing: monthly_mean_hybrid_coords

Units: K

q_mm_hyb

Long Name: SPECIFIC HUMIDITY AFTER TIMESTEP

Standard Name: specific_humidity

Processing: monthly_mean_hybrid_coords

Units: kg kg-1

convcld_mm_ua

Long Name: CONV CLOUD AMOUNT AFTER TIMESTEP

Standard Name: not_found

Processing: monthly_mean_unspecified_vertical_coord_(atmos)

Units: -

CCCWaterPath_mm_ua

Long Name: CONV CLOUD LIQUID WATER PATH

Standard Name: not_found

Processing: monthly_mean_unspecified_vertical_coord_(atmos)

Units: kg m-2

blht_mm_bl

Long Name: BOUNDARY LAYER DEPTH AFTER TIMESTEP

Standard Name: atmosphere_boundary_layer_thickness

Processing: monthly_mean_boundary_layer

Units: m

iceconc_mm_srf

Long Name: SEA ICE FRACTION AFTER TIMESTEP

Standard Name: sea_ice_area_fraction

Processing: monthly_mean_at_surface

Units: 0-1

icedepth_mm_srf

Long Name: SEA ICE DEPTH (MEAN OVER ICE) M

Standard Name: sea_ice_thickness

Processing: monthly_mean_at_surface

Units: m

A1.2 Ocean

HTN_mm_uo

Long Name: GBM HTN INTO OCEAN BUDGET W/M**2

Standard Name: none

Processing: monthly_mean_unspecified_vertical_coord_(ocean)

Units: W m-2

carryheat_mm_uo

Long Name: CARYHEAT AFTER ROW CALCULATION W/M2

Standard Name: none

Processing: monthly_mean_unspecified_vertical_coord_(ocean)

Units: W m-2

zMeanTT_mm_uo

Long Name: MEAD DIAGNOSITICS: TEMPERATURE W

Standard Name: none

Processing: monthly_mean_unspecified_vertical_coord_(ocean)

Units: -

zMeanSS_mm_uo

Long Name: MEAD DIAGNOSITCS: SALINITY KG/S

Standard Name: none

Processing: monthly_mean_unspecified_vertical_coord_(ocean)

Units: -

anomSeaiceHflux_mm_uo

Long Name: ANOM.HEAT SINK AT OCN FLOOR W/M2

Standard Name: M2

Processing: monthly_mean_unspecified_vertical_coord_(ocean)

Units: W m-2

srfSalFlux_mm_uo

Long Name: WATER_FLUX*SALINITY/DENSITY m Gs**-1

Standard Name: none

Processing: monthly_mean_unspecified_vertical_coord_(ocean)

Units: m s-1

uVelSeaice_mm_uo

Long Name: U COMPONENT OF ICE VELOCITY (M.S-1)

Standard Name: eastward_sea_ice_velocity

Processing: monthly_mean_unspecified_vertical_coord_(ocean)

Units: m s-1

vVelSeaice_mm_uo

Long Name:	V COMPONENT OF ICE VELOCITY (M.S-1)
Standard Name:	northward_sea_ice_velocity
Processing:	monthly_mean_unspecified_vertical_coord_(ocean)
Units:	m s-1

HTNintoICE_mm_uo

Long Name:	GBM HTN INTO ICE BUDGET W/M**2
Standard Name:	none
Processing:	monthly_mean_unspecified_vertical_coord_(ocean)
Units:	W m-2

temp_mm_uo

Long Name:	OCN TOP-LEVEL TEMPERATURE K
Standard Name:	sea_water_temperature
Processing:	monthly_mean_unspecified_vertical_coord_(ocean)
Units:	degC

HTNICEwhenICY_mm_uo

Long Name:	GBM HTN INTO OCN WHERE ICY W/M**2
Standard Name:	none
Processing:	monthly_mean_unspecified_vertical_coord_(ocean)
Units:	W m-2

snowdepthonseaice_mm_uo

Long Name: GBM SNOWDEPTH ON SEA-ICE M

Standard Name: none

Processing: monthly_mean_unspecified_vertical_coord_(ocean)

Units: W m-2

uStressIceOc_mm_uo

Long Name: U CPT OF OCEAN STRESS ON ICE Pa

Standard Name: downward_eastward_stress_at_sea_ice_base

Processing: monthly_mean_unspecified_vertical_coord_(ocean)

Units: Pa

vStressIceOc_mm_uo

Long Name: V CPT OF OCEAN STRESS ON ICE Pa

Standard Name: downward_northward_stress_at_sea_ice_base

Processing: monthly_mean_unspecified_vertical_coord_(ocean)

Units: Pa

uCoriolis_mm_uo

Long Name: U CPT OF CORIOLIS STRESS ON ICE Pa

Standard Name: none

Processing: monthly_mean_unspecified_vertical_coord_(ocean)

Units: Pa

vCoriolis_mm_uo

Long Name: V CPT OF CORIOLIS STRESS ON ICE Pa

Standard Name: none

Processing: monthly_mean_unspecified_vertical_coord_(ocean)

Units: Pa

dSeaiceConcdt_mm_uo

Long Name: d/dt AICE DYNAMICS s-1

Standard Name: none

Processing: monthly_mean_unspecified_vertical_coord_(ocean)

Units: s-1

dSeaiceDepthdt_mm_uo

Long Name: d/dt HICE DYNAMICS m s-1

Standard Name: none

Processing: monthly_mean_unspecified_vertical_coord_(ocean)

Units: m s-1

dSeaiceSnowDepthdt_mm_uo

Long Name: d/dt GBM SNOWDEPTH DYNAMICS m s-1

Standard Name: none

Processing: monthly_mean_unspecified_vertical_coord_(ocean)

Units: m s-1

dSeaiceDepthdtdiff_mm_uo

Long Name: d/dt HICE DIFFUSION m s-1

Standard Name: none

Processing: monthly_mean_unspecified_vertical_coord_(ocean)

Units: m s-1

dSeaiceConcdttherm_mm_uo

Long Name: d/dt AICE THERMODYN s-1

Standard Name: none

Processing:Processing: monthly_mean_unspecified_vertical_coord_(ocean)

Units: s-1

dSeaiceDepthdttherm_mm_uo

Long Name: d/dt HICE THERMODYN m s-1

Standard Name: none

Processing: monthly_mean_unspecified_vertical_coord_(ocean)

Units: m s-1

dSeaiceSnowDepthdttherm_mm_uo

Long Name: d/dt GBM SNOWDEPTH THERMODYN m s-1

Standard Name: none

Processing: monthly_mean_unspecified_vertical_coord_(ocean)

Units: m s-1

uStressIce_mm_uo

Long Name: U CPT OF INTERNAL ICE STRESS Pa

Standard Name: none

Processing: monthly_mean_unspecified_vertial_coord_(ocean)

Units: Pa

vStressIce_mm_uo

Long Name: V CPT OF INTERNAL ICE STRESS Pa

Standard Name: none

Processing: monthly_mean_unspecified_vertical_coord_(ocean)

Units: Pa

temp_mm_dpth

Long Name: PTOTENTIAL TEMPERATURE (OCEAN) DEG.C

Standard Name: sea_water_temperature

Processing: monthly_mean_depth_levels

Units: degC

snowdepth_mm_mm_uo

Long Name: SNOW DEPTH (OCEAN)

Standard Name: surface_snow_thickness_where_sea_ice

Processing: monthly_mean_unspecified_vertical_coord_(ocean)

Units: m

carryheatice_mm_uo

Long Name: GBM CARYHEAT MISC HEAT FLUX (ICE)W/M2

Standard Name: none

Processing: monthly_mean_unspecified_vertical_coord_(ocean)

Units: W m-2

OcIceHflux_mm_uo

Long Name: GBM HEAT FLUX: OCEAN TO ICE (OCN) W/M2

Standard Name: upward_sea_ice_basal_heat_flux

Processing: monthly_mean_unspecified_vertical_coord_(ocean)

Units: W m-2

carrySalt_mm_uo

Long Name: RATE OF SALINITY CHANGE (ICE) PSU/S

Standard Name: none

Processing: monthly_mean_unspecified_vertical_coord_(ocean)

Units: psu s-1

TAUX_mm_uo

Long Name: TAUX: X_WINDSTRESS N/M2 A

Standard Name: surface_downward_eastward_stress

Processing: monthly_mean_unspecified_vertical_coord_(ocean)

Units: N m-2

TAUY_mm_uo

Long Name:	TAUY: Y_WINDSTRESS N/M2 A
Standard Name:	surface_downward_northward_stress
Processing:	monthly_mean_specified_vertical_coord_(ocean)
Units:	N m-2

WME_mm_uo

Long Name:	WME: WIND MIXING ENERGY FLUX W/M2 A
Standard Name:	wind_mixing_energy_flux_into_ocean
Processing:	monthly_mean_unspecified_vertical_coord_(ocean)
Units:	W m-2

SOL_mm_uo

Long Name:	SOL: PEN.SOLAR*LF INTO OCEAN W/M2 A
Standard Name:	none
Processing:	monthly_mean_unspecified_vertical_coord_(ocean)
Units:	W m-2

HTNpenhtflxocn_mm_uo

Long Name:	HTN: NONPEN.HT.FLX*LF INTO OCN W/M2 A
Standard Name:	none
Processing:	monthly_mean_unspecified_vertical_coord_(ocean)
Units:	W m-2

PLE_mm_uo

Long Name:	PLE: PRECIP-EVAP INTO OCEAN KG/M2/S A
Standard Name:	none
Processing:	monthly_mean_unspecified_vertical_coord_(ocean)
Units:	kg m-2 s-1

outflow_mm_uo

Long Name:	RIVER OUTFLOW INTO OCEAN KG/M2/S A
Standard Name:	water_flux_into_ocean_from_rivers
Processing:	monthly_mean_unspecified_vertical_coord_(ocean)
Units:	kg m-2 s-1

snowfall_mm_uo

Long Name:	SNOWFALL INTO OCN/ONTO ICE KG/M2/S A
Standard Name:	snowfall_amount
Processing:	monthly_mean_unspecified_vertical_coord_(ocean)
Units:	kg m-2 s-1

sublim_mm_uo

Long Name:	SUBLIMATION FROM SEAICE KG/M2/S A
Standard Name:	none
Processing:	monthly_mean_unspecified_vertical_coord_(ocean)
Units:	kg m-2 s-1

anomSaltFlux_mm_mm_uo

Long Name:	P-E FLUX CORRECTION KG/M2/S A
Standard Name:	none
Processing:	monthly_mean_unspecified_vertical_coord_(ocean)
Units:	kg m-2 s-1

A1.3 Sediments

tmonthm50

Long Name: Number of with temperature less than -50C

Units: number_months

tmonthm30

Long Name: Number of with temperature less than -30C

Units: number_months

tmonthm20

Long Name: Number of with temperature less than -20C

Units: number_months

tmonthm10

Long Name: Number of with temperature less than -10C

Units: number_months

tmonthm05

Long Name: Number of with temperature less than -5C

Units: number_months

tmonthp00

Long Name: Number of with temperature less than 0C

Units: number_months

tmonthp05

Long Name: Number of with temperature less than 5C

Units: number_months

tmonthp10

Long Name: Number of with temperature less than 10C

Units: number_months

tmonthp20

Long Name: Number of with temperature less than 20C

Units: number_months

tmonthp25

Long Name: Number of with temperature less than 25C

Units: number_months

tmonthp30

Long Name: Number of with temperature less than 30C

Units: number_months

pmonth10

Long Name: Number of with precip. less than 10mm

Units: number_months

pmonth20

Long Name: Number of with precip. less than 20mm

Units: number_months

pmonth30

Long Name: Number of with precip. less than 30mm

Units: number_months

pmonth40

Long Name: Number of with precip. less than 40mm

Units: number_months

pmonth60

Long Name: Number of with precip. less than 60mm

Units: number_months

pmonthe010

Long Name: Number of with precip. exceeding 10mm

Units: number_months

pmonthe020

Long Name: Number of with precip. exceeding 20mm

Units: number_months

pmonthe030

Long Name: Number of with precip. exceeding 30mm

Units: number_months

pmonthe040

Long Name: Number of with precip. exceeding 40mm

Units: number_months

pmonthe060

Long Name: Number of with precip. exceeding 60mm

Units: number_months

pmonthe080

Long Name: Number of with precip. exceeding 80mm

Units: number_months

pmonthe100

Long Name: Number of with precip. exceeding 100mm

Units: number_months

pmonthe120

Long Name: Number of with precip. exceeding 120mm

Units: number_months

precipsd

Long Name: Standard deviation of monthly mean precipitation

Units: mmdays-1

pratiosd

Long Name: Stan.dev.of monthly mean precip./abs(precip.)

Units: non-dimensional

pminusemonth

Long Name: Number of with P-E>0

Units: number_months

coal

Long Name: Coal distribution based on precip. only

Units: 0-1

vertisola

Long Name: Vertisol distribution based on monthly prec. 40.0

Units: 0-1

vertisolb

Long Name: Vertisol distribution based on monthly prec. 60.0

Units: 0-1

vertisolc

Long Name: Vertisol distribution based on monthly prec. 80.0

Units: 0-1

vertisold

Long Name: Vertisol distribution based on std dev.

Units: 0-1

calcretea

Long Name: Calcrete distribution based on prec. and monthly temp

Units: 0-1

calcreteb

Long Name: Calcret distribution based on prec. and MAT temp

Units: 0-1

lateritea

Long Name: Laterite distribution P-E>0 8 month, T>20 6mon

Units: 0-1

lateriteb

Long Name: Laterite distribution P-E>0 8 month, T>25 6mon

Units: 0-1

lateritec

Long Name: Laterite distribution (P-E>0 11 mon, T>25 8mon)

Units: 0-1

laterited

Long Name: Laterite distribution (P-E>0 6 mon, T>23 8mon)

Units: 0-1

lateritee

Long Name: Laterite distribution (P-E>0 9 mon, T>23 8mon)

Units: 0-1

bauxitea

Long Name: Bauxite Distribution based on MAT>22 and P>1200

Units: 0-1

bauxiteb

Long Name: Bauxite Distr MAT>22, P>1200, dry 6mon<60

Units: 0-1

bauxitec

Long Name: Bauxite Distr MAT>22, P>1200< dry3mon<60

Units: 0-1

sandseas

Long Name: Sand seas

Units: 0-1

evapa

Long Name: Evaporite distribution (method a)

Units: 0-1

evapb

Long Name: Evaporite distribution (method b)

Units: 0-1

coral

Long Name: Coral reefs

Units: 0-1

perma

Long Name: Continuous Permafrost (based on 1m Tsoil)

Units: 0-1

permb

Long Name: Continuous Permafrost (based on 0.1m Tsoil)

Units: 0-1

permc

Long Name: Continuous Permafrost (based on Tsurf)

Units: 0-1

permd

Long Name: Continous Permafrost (based on T2m)

Units: 0-1

dperma

Long Name: Discontinous Permafrost (based on 1m Tsoil)

Units: 0-1

dpermb

Long Name: Discontinous Permafrost (based on 0.1 Tsoil)

Units: 0-1

dpermc

Long Name: Discontinous Permafrost (basedo n Tsurf)

Units: 0-1

dpermd

Long Name: Discontinous Permafrost (based on T2m)

Units: 0-1

growseas

Long Name: Growing Season Map (in months)

Units: 0-1

peat

Long Name: Peat Prediction Map (in percentage)

Units: 0-1

tmonthm50_cor

Long Name: Number of months with temperature less than -50C (Alt Cor)

Units: number_months

tmonthm30_cor

Long Name: Number of months with temperature less than -30C (Alt Cor)

Units: number_months

tmonthm20_cor

Long Name: Number of months with temperature less than -20C (Alt Cor)

Units: number_months

tmonthm10_cor

Long Name: Number of months with temperature less than -10C (Alt Cor)

Units: number_months

tmonthm05_cor

Long Name: Number of months with temperature less than -5C (Alt Cor)

Units: number_months

tmonthp00_cor

Long Name: Number of months with temperature less than 0C (Alt Cor)

Units: number_months

tmonthp05_cor

Long Name: Number of months with temperature less than 5C (Alt Cor)

Units: number_months

tmonthp10_cor

Long Name: Number of months with temperature less than 10C (Alt Cor)

Units: number_months

tmonthp20_cor

Long Name: Number of months with temperature less than 20C (Alt Cor)

Units: number_months

tmonthp25_cor

Long Name: Number of months with temperature less than 25C (Alt Cor)

Units: number_months

tmonthp30_cor

Long Name: Number of months with temperature less than 30C (Alt Cor)

Units: number_months

coal_cor

Long Name: Coal distribution based on precip. only (Alt Cor)

Units: 0-1

vertisola_cor

Long Name: Vertisol distribution based on monthly prec. 40.0 (Alt Cor)

Units: 0-1

vertisolb_cor

Long Name: Vertisol distribution based on monthly prec. 60.0 (Alt Cor)

Units: 0-1

vertisolc_cor

Long Name: Vertisol distribution based on monthly prec. 80.0 (Alt Cor)

Units: 0-1

vertisold_cor

Long Name: Vertisol distribution based on std dev. (Alt Cor)

Units: 0-1

calcretea_cor

Long Name: Calcrete distribution based on precip. and monthly temp (Alt Cor)

Units: 0-1

calcreteb_cor

Long Name: Calcrete distribution based on precip. and MAT temp (Alt Cor)

Units: 0-1

lateritea_cor

Long Name: Laterite distribution P-E>0 8 month, T>20 6 mon (Alt Cor)

Units: 0-1

laterite b_cor

Long Name: Laterite distribution P-E>0 8 month, T>25 6 mon (Alt Cor)

Units:: 0-1

lateritec_cor

Long Name: Laterite distribution (P-E>0 11 month, T>25 8 mon) (Alt Cor)

Units: 0-1

laterited_cor

Long Name: Laterite distribution (P-E>0 6 month, T>23 8 mon) (Alt Cor)

Units:: 0-1

lateritee_cor

Long Name: Laterite distribution (P-E>0 9 month, T>23 8 mon) (Alt Cor)

Units: 0-1

bauxitea_cor

Long Name: Bauxite Distribution based on MAT >22 and P> 1200 (Alt Cor)

Units: 0-1

bauxiteb_cor

Long Name: Bauxite Distr MAT >22, P> 1200, dry 6 mon <60 (Alt Cor)

Units: 0-1

bauxitec_cor

Long Name: Bauxite Distr MAT >22, P> 1200, dry 3 mon <60 (Alt Cor)

Units: 0-1

sandseas_cor

Long Name: Sand seas (Alt Cor)

Units: 0-1

evapa_cor

Long Name: Evaporite distribution (method a) (Alt Cor)

Units:: 0-1

evapb_cor

Long Name: Evaporite distribution (method b) (Alt Cor)

Units: 0-1

coral_cor

Long Name: Coral reefs (Alt Cor)

Units: 0-1

perma_cor

Long Name: Continuous Permafrost (based on 1m Tsoil) (Alt Cor)

Units: 0-1

permb_cor

Long Name: Continuous Permafrost (based on 0.1m Tsoil) (Alt Cor)

Units: 0-1

permc_cor

Long Name: Continuous Permafrost (based on Tsurf) (Alt Cor)

Units: 0-1

permd_cor

Long Name: Continuous Permafrost (based on T2m) (Alt Cor)

Units: 0-1

dperma_cor

Long Name: Discontinuous Permafrost (based on 1m Tsoil) (Alt Cor)

Units: 0-1

dpermb_cor

Long Name: Discontinuous Permafrost (based on 0.1m Tsoil) (Alt Cor)

Units: 0-1

dpermc_cor

Long Name: Discontinuous Permafrost (based on Tsurf) (Alt Cor)

Units: 0-1

dpermd_cor

Long Name: Discontinuous Permafrost (based on T2m) (Alt Cor)

Units: 0-1

growseas_cor

Long Name:: Growing Season Map (in months) (Alt Cor)

Units: 0-1

peat_cor

Long Name: Peat Prediction Map (in percentage) (Alt Cor)

Units: 0-1

wchillcare

Long Name: Wind Chill (Care Rating)

Units: non-dim

apptemp

Long Name: Apparent Temp (in C)

Units: C

apptempcare

Long Name: Apparent Temp (Care Rating)

Units: non-dim

wchill_cor

Long Name: Wind Chill (in C) (Alt Cor)

Units: C

wchillcare_cor

Long Name: Wind Chill (Care Rating) (Alt Cor)

Units: non-dim

apptemp_cor

Long Name: Apparent Temp (in C) (Alt Cor)

Units: C

apptempcare_cor

Long Name: Apparent Temp (Care Rating) (Alt Cor)

Units: non-dim

holdbio

Long Name: Holdridge Biotemperature

Units: C

precipann

Long Name: Mean Annual Precipitation

Units: mm

holdridge

Long Name: Modified Holdridges Life Zones based AHS scheme

Units: non-dim

growseasmon

Long Name: Growing Season Degree Mon (Kutz and Zieg)

Units: non-dim

waltert10

Long Name: Walter Climate Month T>10 (from Kutz and Zieg)

Units: non-dim

walterp40

Long Name: Walter Climate Month P>40 (from Kutz and Zieg)

Units: non-dim

walterwet

Long Name: Water Climate West Winter (from Kutz and Zieg)

Units: non-dim

walterdry

Long Name: Walter Climate Dry Summer (from Kutz and Zieg)

Units: non-dim

waltermed

Long Name: Walter Climate Med Climate (from Kutz and Zieg)

Units: non-dim

regiongsdm1

Long Name: Region changed by GSDM crit1 (from Kutz and Zieg)

Units: non-dim

regiongsdm2

Long Name: Region changed by GSDM crit2 (from Kutz and Zieg)

Units: non-dim

walterbiomes

Long Name: Walter Climate and Biomes (from Kutz and Zieg)

Units: non-dim

holdbio_cor

Long Name: Holdridge Biotemperature (Alt Cor)

Units: C

precipann_cor

Long Name: Annual Mean Precipitation (Alt Cor)

Units: mm

holdridge_cor

Long Name: Modified Holdridges Life Zones based AHS scheme (Alt Cor)

Units: non-dim

growseasmon_cor

Long Name: Growing Season Degree Month (from Kutz and Zieg) (Alt Cor)

Units: non-dim

waltert10_cor

Long Name: Walter Climate Month T>10 (from Kutz and Zieg) (Alt Cor)

Units: non-dim

walterp40_cor

Long Name: Walter Climate Month P>40 (from Kutz and Zieg) (Alt Cor)

Units: non-dim

walterwet_cor

Long Name: Walter Climate Wet Winter (from Kutz and Zieg) (Alt Cor)

Units: non-dim

walterdry_cor

Long Name: Walter Climate Dry Summer (from Kutz and Zieg) (Alt Cor)

Units: non-dim

waltermed_cor

Long Name: Walter Climate Med Climate (from Kutz and Zieg) (Alt Cor)

Units: non-dim

regiongsdm1_cor

Long Name: Region changed by GSDM crit1 (from Kutz and Zieg) (Alt Cor)

Units: non-dim

regiongsdm2_cor

Long Name: Region changed by GSDM crit2 (from Kutz and Zieg) (Alt Cor)

Units: non-dim

walterbiomes_cor

Long Name: Walter Climate and Biomes (from Kutz and Kieg) (Alt Cor)

Units: non-dim

ts_cor

Long Name: 2m Temperatures (orog corrected)

Units: non-dim

albedo_noice

Long Name: Snow Free Surface Albedo (non-ice)

Units: 0-1

albedo_ice

Long Name: Snow Free Surface Albedo (land-ice)

Units: 0-1

fnoice

Long Name: Regions: of globe with No Permanent Ice

Units: 0-1

fice

Long Name: Regions:of globe with Permanent Ice

Units: 0-1

jant

Long Name: January 2 metre Temperatures (in C)

Units: C

jult

Long Name: July 2 metre Temperatures (in C)

Units: C

mat

Long Name: Mean Annual 2 metre Temperatures (in C)

Units: C

jjat

Long Name: June to Aug mean 2 metre Temperatures (in C)

Units: C

wwmcmm

Long Name: WWM-CCM mean 2 metre Temperature (in C)

(equivalent to Mean Annual Range in Temperature (MART)

Units: C

whencmm

Long Name: When coldest month (1=Jan 12=Dec)

Units: months

whenwmm

Long Name: When warmest month (1=Jan 12=Dec)

Units: C

csm

Long Name: Cold seas mean 2 metre Temperatures (in C)

Units: C

wsm

Long Name: Warm seas mean 2 metre Temperatures (in C)

Units: C

wsmcsm

Long Name: WSM-CSM mean 2 metre Temperatures (in C)

Units: C

whencsm

Long Name: When coldest season (1=DJF 4=SON)

Units: seas

whenwsm

Long Name: When warmest season (1=DJF 4=SON)

Units: seas

drymon

Long Name: Dry month mean (in mm/day)

Units: mm/day

wetmon

Long Name: Wet month mean (in mm/day)

Units: mm/day

wetdrymon

Long Name: WETMON-DRYMON (in mm/day)

Units: mm/day

whendrymon

Long Name: When driest month (1=Jan 12=Dec)

Units: months

whenwetmon

Long Name: When wettest month (1=Jan 12=Dec)

Units: months

drysea

Long Name: Dry seas mean (in mm/day)

Units: mm/day

wetsea

Long Name: Wet seas mean (in mm/day)

Units: mm/day

wetdrysea

Long Name: WETSEA-DRYSEA mean (in mm/day)

Units: mm/day

whendrysea

Long Name: When driest season (1=DJF 4=SON)

Units: seas

whenwetsea

Long Name: When wettest season (1=DJF 4=SON)

Units: seas

map

Long Name: Mean Annual Precipitation (in mm/year)

Units: mm/year

janp

Long Name: January Mean Precipitation (in mm/month)

Units: mm/month

julp

Long Name: July Mean Precipitation (in mm/month)

Units: mm/month

djfp

Long Name: Dec to Feb Mean Precipitation (in mm/3months)

Units: mm/3months

jjap

Long Name: June to August Mean Precipitation (in mm/3months)

Units: mm/3months

pregro

Long Name: Precip when temp > +10 C (in mm)

Units: mm

premean

Long Name: Mean Precip when temp > +10 C (in mm/month)

Units: mm/month

lengro

Long Name: Length of growing season (temp>+10C) (in months)

Units: months

predry

Long Name: Precip during 3 consecutive dry months (in mm)

Units: mm

prewet

Long Name: Precip during 3 consecutive wet months (in mm)

Units: mm

whenwettest3

Long Name: When wettest consecutive 3 months (mid-point months 1=Jan etc)

Units: months

whendriest3

Long Name: When driest consecutive 3 months 9mid-point months 1=Jan etc)

Units: months

jant_cor

Long Name: January 2 metre Temperatures (in C)(Alt Cor)

Units: C

jult_cor

Long Name: July 2 metre Temperatures (in C)(Alt Cor)

Units: C

mat_cor

Long Name: Mean Annual 2 metre Temperatures (in C)(Alt Cor)

Units: C

djft_cor

Long Name: Dec to Feb mean 2 metre Temperatures (in C) (Alt Cor)

Units: C

jjat_cor

Long Name: June to August mean 2 metre Temperatures (in C) (Alt Cor)

Units: C

cmm_cor

Long Name: Cold month mean 2 metre Temperatures (in C) (Alt Cor)

Units: C

wmm_cor

Long Name: Warm month mean 2 metre Temperatures (in C) (Alt Cor)

Units: C

wmmcmm_cor

Long Name: WMM-CMM mean 2 metre Temperatures (in C)(Alt Cor)

Units: C

whencmm_cor

Long Name: When coldest month (1=Jan 12=Dec) (Alt Cor)

Units: months

whenwmm_cor

Long Name: When warmest month (1=Jan 12=Dec) (Alt Cor)

Units: months

csm_cor

Long Name: Cold seas mean 2 metre Temperatures (in C) (Alt Cor)

Units: C

wsm_cor

Long Name: Warm seas mean 2 metre Temperatures (in C) (Alt Cor)

Units: C

wsmcsm_cor

Long Name: WSM-CSM mean 2 metre Temperatures (in C)(Alt Cor)

Units: C

whencsm_cor

Long Name: When coldest season (1=DJF 4=SON) (Alt Cor)

Units: seas

whenwsm_cor

Long Name: When warmest month (1=Jan 12=Dec) (Alt Cor)

Units: seas

pregro_cor

Long Name: Mean Precip when temp >+10C (in mm/month) (Alt Cor)

Units: mm/month

premean_cor

Long Name: Mean Precip when temp > +10C (in mm/month) (Alt Cor)

Units: mm/month

lengro_cor

Long Name: Length of growing season (temp>+10C) (in months) (Alt Cor)

Units: months

predry_cor

Long Name: Precip during 3 consecutive dry months (in mm) (Alt Cor)

Units: mm

prewet_cor

Long Name: Precip during 3 consecutive wet months (in mm) (Alt Cor)

Units: mm

pann

Long Name: Precipitation (annual mean) (in mm/day)

Units: mm/day

evapann

Long Name: Evaporation (annual mean) (in mm/day)

Units: mm/day

pminuseann

Long Name: Precipitation-Evaporation (in mm/day)

Units: mm/day

pminuseann1

Long Name: Precipitation-Evaporation (in cm/year)

Units: cm/year

salinity

Long Name: Sea-Surface Salinity (in %%)

Units: psu

delta18o

Long Name: Delta O18 smow (%%) surface waters

Units: per-mil

detla18o_pacific

Long Name: Delta O18 smow (%%) surface waters (Pacific Calib)

Units: per-mil

delta18o_salinity

Long Name: Delta O18 smow (%%) surface waters (Salinity Calib)

Units: per-mil

koppenbasic

Long Name: Basic Koppen Classification

Units: non-dim

koppenfull

Long Name: Detailed Koppen Classification

Units: non-dim

albedop

Long Name: Planetary Albedo

Units: 0-1

netsolar

Long Name: Net Solar TAO Radiation

Units: WM-2

albedos

Long Name: Surface Albedo

Units: 0-1

netsurfsolar

Long Name: Net Surface Solar Radiation

Units: Wm-2

nettotaltoa

Long Name: Net TOA Radiation

Units: Wm-2

netsurf

Long Name: Net Surface Energy Balance

Units: Wm-2

netsurfrad

Long Name: Net Surface Radiation

Units: Wm-2

netsolaratmos

Long Name: Net Solar Radiation (absorbed in atmosphere)

Units: Wm-2

netlongwaveatmos

Long Name: Net Longwave Radiation (absorbed in atmosphere)

Units: Wm-2

netradiationatmos

Long Name: Net Radiative Balance (absorbed in atmosphere)

Units: Wm-2

sgp

Long Name: sgp parameter

Units: non-dim

enth

Long Name: Moist Enthalpy (in J/Kg)

Units: J/kg

enthsurf

Long Name: Moist Enthalpy at surface (in J/Kg)

Units: J/kg

enthmsl

Long Name: Moist Enthalpy at msl (in J/kg)

Units: J/kg

enth1000

Long Name: Moist Enthalpy at 1000hPa (in J/kg)

Units: J/kg

mse

Long Name: Moist Static Energy (in J/kg)

Units: J/kg

msesurf

Long Name: Moist Static Energy at surface (in J/kg)

Units: J/kg

msemsl

Long Name: Moist Static Energy at msl (in J/kg)

Units: J/kg

mse1000

Long Name: Moist Static Energy at 1000hPa (in J/kg)

Units: J/kg

A1.4 Surface/Vegetation

PhenLeafturnPFT_snp_srf

Long Name: PHENOLOGICAL LEAF TURNOVER RATE PFTS

Standard Name: none

Processing: snapshot_at_surface

Units: s-1

AcLeafTurnPFT_snp_srf

Long Name: MEAN LEAF TRNVR RATE PFTS FOR PHENOL

Standard Name: none

Processing: snapshot_at_surface

Units: s-1

LAI_PFT_snp_srf

Long Name: LEAF AREA INDEX PFTS AFTER PHENOLOGY

Standard Name: leaf_area_index

Processing: snapshot_at_surface

Units: -

canopyCond_mm_srf

Long Name:	CANOPY CONDUCTANCE M/S
Standard Name:	none
Processing:	monthly_mean_at_surface
Units:	-

GPP_mm_srf

Long Name:	GROSS PRIMARY PRODUCTIVITY KG C/M2/S
Standard Name:	gross_primary_productivity_of_carbon
Processing:	monthly_mean_at_surface
Units:	-

NPP_mm_srf

Long Name:	NET PRIMARY PRODUCTIVITY KG C/M2/S
Standard Name:	net_primary_productivity_of_carbon
Processing:	monthly_mean_at_surface
Units:	-

plantResp_mm_surf

Long Name:	PLANT RESPIRATION KG/M2/S
Standard Name:	plant_respiration_carbon_flux
Processing:	monthly_mean_at_surface
Units:	-

canopyHeight_mm_srf

Long Name:	CANOPY HEIGHT OF VEGETATED FRACTION
Standard Name:	canopy_height
Processing:	monthly_mean_at_surface
Units:	m

canopyEvap_T_mm_srf

Long Name:	CANOPY EVAPORATION ON NON-ICE TILES
Standard Name:	water_evaporation_flux_from_canopy_where_land
Processing:	monthly_mean_at_surface
Units:	kg m-2 s-1

evapoTrans_mm_srf

Long Name:	TRANSPIRATION+SOIL EVP NON-ICE TILES
Standard Name:	none
Processing:	monthly_mean_at_surface
Units:	kg m-2 s-1

GPP_PFT_mm_srf

Long Name:	GROSS PRIMARY PRODUCTIVITY ON PFRS
Standard Name:	gross_primary_productivity_of_carbon
Processing:	monthly_mean_at_surface
Units:	kg C m-2 s-1

sensHflx_T_mm_srf

Long Name: SURFACE SENSIBLE HEAT FLUX ON TILES

Standard Name: none

Processing: monthly_mean_at_surface

Units: W m-2

NPP_PFT_mm_srf

Long Name: NET PRIMARY PRODUCTIVITY ON PFTS

Standard Name: net_primary_productivity_of_carbon

Processing: monthly_mean_at_surface

Units: kg C m-2 s-1

plantResp_PFT_mm_srf

Long Name: PLANT RESPIRATION ON PFTS KG C/M2/S

Standard Name: plant_respiration_carbon_flux

Processing: monthly_mean_at_surface

Units: kg C m-2 s-1

soilResp_mm_srf

Long Name: SOIL RESPIRATION KG C/M2/S

Standard Name: none

Processing: monthly_mean_at_surface

Units: kg C m-2 s-1

BulkRich_mm_srf

Long Name: BULK RICHARDSON NUMBER ON TILES

Standard Name: none

Processing: monthly_mean_at_surface

Units: -

snowCover_mm_srf

Long Name: FRACTIONAL SNOW COVER

Standard Name: surface_snow_area_fraction

Processing: monthly_mean_at_surface

Units: 0-1

soilEvap_mm_srf

Long Name: EVAP FROM SOIL SURF : RATE KG/M2/S

Standard Name: water_evaporation_flux

Processing: monthly_mean_at_surface

Units: kg m-2 s-1

canopyEvap_mm_can

Long Name: EVAP FROM CANOPY : RATE KG/M2/S

Standard Name: water_evaporation_flux_from_canopy_where_land

Processing: monthly_mean_at_canopy_height

Units: kg m-2 s-1

srfSublim_mm_srf

Long Name:	SUBLIM.SURFACE (GBM) : RATE KG/M2/S
Standard Name:	none
Processing:	monthly_mean_at_surface
Units:	kg m-2 s-1

potEvap_mm_srf

Long Name:	POTENTIAL EVAPORATION RATE KG/M2/S
Standard Name:	none
Processing:	monthly_mean_at_surface
Units:	kg m-2 s-1

fractPFTssnowadj_mm_srf

Long Name:	SNOW-ADJUSTED TILE FRACTIONS
Standard Name:	none
Processing:	monthly_mean_at_surface
Units:	-

temp_mm_srf

Long Name:	SOIL CARBON CONTENT (B.LAYER) KGC/M2
Standard Name:	water_evaporation_flux
Processing:	monthly_mean_at_surface
Units:	kg C m-2

waterContent_T_mm_srf

Long Name:	CANOPY WATER ON NON-ICE TILES KG/M2
Standard Name:	none
Processing:	monthly_mean_at_surface
Units:	kg m-2

waterCapac_T_mm_srf

Long Name:	CANOPY CAPACITY NON_ICE TILES KG/M2
Standard Name:	none
Processing:	monthly_mean_at_surface
Units:	-

snowtemp_mm_srf

Long Name:	SNOW TEMPERATURE K
Standard Name:	water_evaporation_flux
Processing:	monthly_mean_at_surface
Units:	K

roughnessLength_T_mm_srf

Long Name::	ROUGHNESS LENGTH ON TILES M
Standard Name:	surface_roughness_length
Processing:	monthly_mean_at_surface
Units:	m

leafTurnPFT_mm_srf

Long Name: LEAF TURNOVER RATE ON PFTS

Standard Name: none

Processing: monthly_mean_at_surface

Units: 360days

potEvapTiles_mm_srf

Long Name: POTENTIAL EVAP RATE ON TILES KG/M2/S

Standard Name: not_found

Processing:: monthly_mean_at_surface

Units: kg m-2 s-1

A1.5 Storms

t2m_totalold

Long Name: Surface Air Temperature: total transients (old style)

Units: K**2

t2m_lowold

Long Name: Surface Air Temperature: low pass transients (old style)

Units: K**2

t2m_highold

Long Name: Surface Air Temperature: high pass transients (old style)

Units:: K**2

t2m_totalnew

Long Name: Surface Air Temperature: total transients (new style)

Units: K**2

t2m_lownew

Long Name: Surface Air Temperature: low pass transients (new style)

Units: K**2

t2m_highnew

Long Name: Surface Air Temperature: high pass transients (new style)

Units: K**2

tsurf_totalold

Long Name: Surface Temperature: total transients (old style)

Units: K**2

tsurf_lowold

Long Name: Surface Temperature: low pass transients (old style)

Units: K**2

tsurf_highold

Long Name: Surface Temperature: high pass transients (old style)

Units: K**2

tsurf_totalnew

Long Name: Surface Temperature: total transients (new style)

Units: K**2

tsurf_lownew

Long Name: Surface Temperature: low pass transients (new style)

Units: K**2

tsurf_highnew

Long Name: Surface Temperature: high pass transients (new style)

Units: K**2

precip_totalold

Long Name: Precipitation: total transients (old style)

Units: mmday-1**2

precip_lowold

Long Name: Precipitation: low pass transients (old style)

Units: mmday-1**2

precip_highold

Long Name: Precipitation: high pass transients (old style)

Units: mmday-1**2

precip_totalnew

Long Name: Precipitation: total transients (new style)

Units: mmday-1**2

precip_lownew

Long Name: Precipitation: low pass transients (new style)

Units: mmday-1**2

precip_highnew

Long Name: Precipitation: high pass transients (new style)

Units: mmday-1**2

mslp_totalold

Long Name: MSLP Pressure: total transients (old style)

Units: Pa**2

mslp_lowold

Long Name: MSLP Pressure: low pass transients (old style)

Units: Pa**2

mslp_highold

Long Name: MSLP Pressure: high pass transients (old style)

Units: Pa**2

mslp_totalnew

Long Name: MSLP Pressure: total transients (new style)

Units: Pa**2

mslp_lownew

Long Name: MSLP Pressure: low pass transients (new style)

Units:: Pa**2

mslp_highnew

Long Name: MSLP Pressure: high pass transients (new style)

Units: Pa**2

pstar_totalold

Long Name: Surface Pressure: total transients (old style)

Units: Pa**2

pstar_lowold

Long Name: Surface Pressure: low pass transients (old style)

Units: Pa**2

pstar_highold

Long Name: Surface Pressure: high pass transients (old style)

Units: Pa**2

pstar_totalnew

Long Name: Surface Pressure: total transients (new style)

Units: Pa**2

pstar_lownew

Long Name: Surface Pressure: low pass transients (new style)

Units: Pa**2

pstar_highnew

Long Name: Surface Pressure: high pass transients (new style)

Units: Pa**2

sm_totalold

Long Name: Soil Moisture: total transients (old style)

Units: kgm-2**2

sm_lowold

Long Name: Soil Moisture: low pass transients (old style)

Units: kgm-2**2

sm_highold

Long Name: Soil Moisture: high pass transients (old style)

Units: kgm-2**2

sm_totalnew

Long Name: Soil Moisture: total transients (new style)

Units: kgm-2**2

sm_lownew

Long Name: Soil Moisture: low pass transients (new style)

Units: kgm-2**2

sm_highnew

Long Name: Soil Moisture: high pass transients (new style)

Units: kgm-2**2

theta_btmlev_totalold

Long Name: Surface Theta: total transients (old style)

Units: K**2

theta_btmlev_lowold

Long Name: Surface Theta: low pass transients (old style)

Units: K**2

theta_btmlev_highold

Long Name: Surface Theta: high pass transients (old style)

Units: K**2

theta_btmlev_totalnew

Long Name: Surface Theta: total transients (new style)

Units: K**2

theta_btmlev_lownew

Long Name: Surface Theta: low pass transients (new style)

Units: K**2

theta_btmlev_highnew

Long Name: Surface Theta: high pass transients (new style)

Units: K**2

q2m_totalold

Long Name: Near Surface Humidity: total transients (old style)

Units: kgkg-1**2

q2m_lowold

Long Name: Near Surface Humidity: low pass transients (old style)

Units: kgkg-1**2

q2m_highold

Long Name: Near Surface Humidity: high pass transients (old style)

Units: kgkg-1**2

q2m_totalnew

Long Name: Near Surface Humidity: total transients (new style)

Units: kgkg-1**2

q2m_lownew

Long Name: Near Surface Humidity: low pass transients (new style)

Units: kgkg-1**2

q2m_highnew

Long Name: Near Surface Humidity: high pass transients (new style)

Units: kgkg-1**2

hxh_totalold

Long Name: Height variance: total transients (old style)

Units: m**2

hxh_lowold

Long Name: Height variance: low pass transients (old style)

Units: m**2

hxh_highold

Long Name: Height variance: high pass transients (old style)

Units: m**2

hxh_totalnew

Long Name: Height variance: total transients (new style)

Units: m**2

hxh_lownew

Long Name: Height variance: low pass transients (new style)

Units: m**2

hxh_highnew

Long Name: Height variance: high pass transients (new style)

Units: m**2

uxu_totalold

Long Name: Zonal Wind Variance: total transients (old style)

Units: ms-1**2

uxu_lowold

Long Name: Zonal Wind Variance: low pass transients (old style)

Units: ms-1**2

uxu_highold

Long Name: Zonal Wind Variance: high pass transients (old style)

Units: ms-1**2

uxu_totalnew

Long Name: Zonal Wind Variance: total transients (new style)

Units: ms-1**2

uxu_lownew

Long Name: Zonal Wind Variance: low pass transients (new style)

Units: ms-1**2

uxu_highnew

Long Name: Zonal Wind Variance: high pass transients (new style)

Units: ms-1**2

vxv_totalold

Long Name: Meridional Wind Variance: total transients (old style)

Units: ms-1**2

vxv_lowold

Long Name: Meridional Wind Variance: low pass transients (old style)

Units: ms-1**2

vxv_highold

Long Name: Meridional Wind Variance: high pass transients (old style)

Units: ms-1**2

vxv_totalnew

Long Name: Meridional Wind Variance: total transients (new style)

Units: ms-1**2

vxv_lownew

Long Name: Meridional Wind Variance: low pass transients (new style)

Units: ms-1**2

vxv_highnew

Long Name: Meridional Wind Variance: high pass transients (new style)

Units: ms-1**2

wxw_totalold

Long Name: Omega Variance: total transients (old style)

Units: Pas-1**2

wxw_lowold

Long Name: Omega Variance: low pass transients (old style)

Units: Pas-1**2

wxw_highold

Long Name: Omega Variance: high pass transients (old style)

Units: Pas-1**2

wxw_totalnew

Long Name: Omega Variance: total transients (new style)

Units: Pas-1**2

wxw_lownew

Long Name: Omega Variance: low pass transients (new style)

Units: Pas-1**2

wxw_highnew

Long Name: Omega Variance: high pass transients (new style)

Units: Pas-1**2

qxq_totalold

Long Name: Upper Air Humidity Variance: total transients (old style)

Units: kgkg-1**2

qxq_lowold

Long Name: Upper Air Humidity Variance: low pass transients (old style)

Units: kgkg-1**2

qxq_highold

Long Name: Upper Air Humidity Variance: high pass transients (old style)

Units: kgkg-1**2

qxq_totalnew

Long Name: Upper Air Humidity Variance: total transients (new style)

Units: kgkg-1**2

qxq_lownew

Long Name: Upper Air Humidity Variance: low pass transients (new style)

Units: kgkg-1**2

qxq_highnew

Long Name: Upper Air Humidity Variance: high pass transients (new style)

Units: kgkg-1**2

TxT_totalold

Long Name: Upper Air Temperature Variance: total transients (old style)

Units: K**2

TxT_lowold

Long Name: Upper Air Temperature Variance: low pass transients (old style)

Units: K**2

TxT_highold

Long Name: Upper Air Temperature Variance: high pass transients (old style)

Units: K**2

TxT_totalnew

Long Name: Upper Air Temperature Variance: total transients (new style)

Units: K**2

TxT_lownew

Long Name: Upper Air Temperature Variance: low pass transients (new style)

Units: K**2

TxT_highnew

Long Name: Upper Air Temperature Variance: high pass transients (new style)

Units: K**2

PVxPV_totalold

Long Name: PV Variance: total transients (old style)

Units: kgm2s-1kg-1**2

PVxPV_lowold

Long Name:: PV Variance: low pass transients (old style)

Units: kgm2s-1kg-1**2

PVxPV_highold

Long Name: PV Variance: high pass transients (old style)

Units: kgm2s-1kg-1**2

PVxPV_totalnew

Long Name: PV Variance: total transients (new style)

Units: kgm2s-1kg-1**2

PVxPV_lownew

Long Name:: PV Variance: low pass transients (new style)

Units: kgm2s-1kg-1**2

PVxPV_highnew

Long Name: PV Variance: high pass transients (new style)

Units: kgm2s-1kg-1**2

uxv_totalold

Long Name: u x v: total transients (old style)

Units: ms-1**2

uxv_lowold

Long Name: u x v: low pass transients (old style)

Units: ms-1**2

uxv_highold

Long Name: u x v: high pass transients (old style)

Units: ms-1**2

uxv_totalnew

Long Name: u x v: total transients (new style)

Units: ms-1**2

uxv_lownew

Long Name:: u x v: low pass transients (new style)

Units: ms-1**2

uxv_highnew

Long Name: u x v: high pass transients (new style)

Units: ms-1**2

uxw_totalold

Long Name: u x omega: total transients (old style)

Units: ms-1Pas-1

uxw_lowold

Long Name: u x omega: low pass transients (old style)

Units: ms-1Pas-1

uxw_highold

Long Name: u x omega: high pass transients (old style)

Units: ms-1Pas-1

uxw_totalnew

Long Name: u x omega: total transients (new style)

Units: ms-1Pas-1

uxw_lownew

Long Name: u x omega: low pass transients (new style)

Units: ms-1Pas-1

uxw_highnew

Long Name: u x omega: high pass transients (new style)

Units: ms-1Pas-1

uxq_totalold

Long Name: u x q: total transients (old style)

Units: ms-1kgkg-1

uxq_lowold

Long Name: u x q: low pass transients (old style)

Units: ms-1kgkg-1

uxq_highold

Long Name: u x q: high pass transients (old style)

Units: ms-1kgkg-1

uxq_totalnew

Long Name: u x q: total transients (new style)

Units: ms-1kgkg-1

uxq_lownew

Long Name: u x q: low pass transients (new style)

Units: ms-1kgkg-1

uxq_highnew

Long Name: u x q: high pass transients (new style)

Units: ms-1kgkg-1

vxq_totalold

Long Name: v x q: total transients (old style)

Units: ms-1kgkg-1

vxq_lowold

Long Name: v x q: low pass transients (old style)

Units: ms-1kgkg-1

vxq_highold

Long Name: v x q: high pass transients (old style)

Units: ms-1kgkg-1

vxq_totalnew

Long Name: v x q: total transients (new style)

Units: ms-1kgkg-1

vxq_lownew

Long Name: v x q: low pass transients (new style)

Units: ms-1kgkg-1

vxq_highnew

Long Name: v x q: high pass transients (new style)

Units: ms-1kgkg-1

wxq_totalold

Long Name: w x q: total transients (old style)

Units: Pas-1kgkg-1

wxq_lowold

Long Name: w x q: low pass transients (old style)

Units: Pas-1kgkg-1

wxq_highold

Long Name: w x q: high pass transients (old style)

Units: Pas-1kgkg-1

wxq_totalnew

Long Name: w x q: total transients (new style)

Units: Pas-1kgkg-1

wxq_lownew

Long Name: w x q: low pass transients (new style)

Units: Pas-1kgkg-1

wxq_highnew

Long Name: w x q: high pass transients (new style)

Units: Pas-1kgkg-1

uxT_totalold

Long Name: u x T: total transients (old style)

Units: ms-1K

uxT_lowold

Long Name: u x T: low pass transients (old style)

Units: ms-1K

uxT_highold

Long Name: u x T: high pass transients (old style)

Units: ms-1K

uxT_totalnew

Long Name: u x T: total transients (new style)

Units: ms-1K

uxT_lownew

Long Name: u x T: low pass transients (new style)

Units: ms-1K

uxT_highnew

Long Name: u x T: high pass transients (new style)

Units: ms-1K

vxT_totalold

Long Name: v x T: total transients (old style)

Units: ms-1K

vxT_lowold

Long Name: v x T: low pass transients (old style)

Units: ms-1K

vxT_highold

Long Name: v x T: high pass transients (old style)

Units: ms-1K

vxT_totalnew

Long Name: v x T: total transients (new style)

Units: ms-1K

vxT_lownew

Long Name: v x T: low pass transients (newstyle)

Units: ms-1K

vxT_highnew

Long Name: v x T: high pass transients (new style)

Units: ms-1K

wxT_totalold

Long Name: w x T: total transients (old style)

Units: Pas-1K

wxT_lowold

Long Name: w x T: low pass transients (old style)

Units: Pas-1K

wxT_highold

Long Name: w x T: high pass transients (old style)

Units: Pas-1K

wxT_totalnew

Long Name: w x T: total transients (new style)

Units: Pas-1K

wxT_lownew

Long Name: w x T: low pass transients (new style)

Units: Pas-1K

wxT_highnew

Long Name: w x T: high pass transients (new style)

Units: Pas-1K

eke_totalold

Long Name: Eddy Kinetic Energy: total transients (old style)

Units: ms-1**2

eke_lowold

Long Name: Eddy Kinetic Energy: low pass transients (old style)

Units: ms-1**2

eke_totalnew

Long Name: Eddy Kinetic Energy: total transients (new style)

Units: ms-1**2

eke_lownew

Long Name: Eddy Kinetic Energy: low pass transients (new style)

Units: ms-1**2

eke_highnew

Long Name: Eddy Kinetic Energy: high pass transients (new style)

Units: ms-1**2

E-vec-x_totalold

Long Name: E-Vector (x-comp): total transients (old style)

Units: ms-1**2

E-vec-x_lowold

Long Name: E-Vector (x-comp): low pass transients (old style)

Units: ms-1**2

E-vec-x_highold

Long Name: E-Vector (x-comp): high pass transients (old style)

Units: ms-1**2

E-vec-x_totalnew

Long Name: E-Vector (x-comp): total transients (new style)

Units: ms-1**2

E-vec-x_lownew

Long Name: E-Vector (x-comp): low pass transients (new style)

Units: ms-1**2

E-vec-x_highnew

Long Name: E-Vector (x-comp): high pass transients (new style)

Units: ms-1**2

E-vec-y_totalold

Long Name: E-Vector (y-comp): total transients (old style)

Units: ms-1**2

E-vec-y_lowold

Long Name: E-Vector (y-comp): low pass transients (old style)

Units: ms-1**2

E-vec-y_highold

Long Name: E-Vector (y-comp): high pass transients (old style)

Units: ms-1**2

E-vec-y_totalnew

Long Name: E-Vector (y-comp): total transients (new style)

Units: ms-1**2

E-vec-y_lownew

Long Name: E-Vector (y-comp): low pass transients (new style)

Units: ms-1**2

E-vec-y_highnew

Long Name: E-Vector (y-comp): high pass transients (new style)

Units: ms-1**2