JRA-3Q Data Format

1.25-degree latitude/longitude grid data

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Information Infrastructure Department
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Contents

1. Introduction

This document provides an overview of products (1.25-degree latitude/longitude grid data) stemming from the Japanese Reanalysis for Three Quarters of a Century (JRA-3Q) conducted by the Japan Meteorological Agency for the period from the late 1940s onward (Kobayashi et al. 2021).

2. Product overview

1. Latitude/longitude grids
2. Data points: 288×145
3. Grid spacing: 1.25×1.25 degree
4. Time interval: every 6 hours (hourly or daily for some types), monthly statistics
5. Data volume: approx. 200 GB/year
6. Data format: Gridded Binary Edition 2 (GRIB2)

3. GRIB2 format

The JRA-3Q product is encoded with GRIB2 as outlined below.

See the Manual on Codes I.2 (WMO 2022) for the information quoted in the tables here.

Section 0 – Indicator section

Octet No.	Contents	Value	Notes
1-4	GRIB (coded according to the International Alphabet No. 5)	GRIB	
5-6	Reserved		
7	Discipline - GRIB Master table number (see Code table 0.0)	******	
8	GRIB edition number	2	
9-16	Total length of GRIB message in octets (including Section 0)	******	

Section 1 – Identification section

Octet No.	Contents	Value	Notes
1-4	Length of section in octets	21	
5	Number of section	1	
6-7	Identification of originating/generating centre (see Common Code table C-11)	34	Tokyo (RSMC), Japan Meteorological Agency
8-9	Identification of originating/generating subcentre (allocated by originating/ generating centre)	241	Reanalysis project
10	GRIB master table version number (see Common Code table C-0)	21	Version implemented on 2 May 2018
11	Version number of GRIB Local tables used to augment Master tables (see Code table 1.1)	1	
12	Significance of reference time (see Code table 1.2)	******	
13-14	Year (4 digits)	******	
15	Month	******	
16	Day	******	
17	Hour	******	
18	Minute	0	
19	Second	0	
20	Production status of processed data in this GRIB message (see Code table 1.3)	3	Re-analysis products
21	Type of processed data in this GRIB message (see Code table 1.4)	******	

Section 2 – Local use section

Octet No.	Contents	Value	Notes
1-4	Length of section in octets	17	
5	Number of section	2	
6-7	Local use		
8-9	Local use		
10-11	Local use		
12-13	Local use		
14-17	Stream	******	

Section 3 – Grid definition section

Octet No.	Contents	Value	Notes
1-4	Length of section in octets	72	
5	Number of section	3	
6	Source of grid definition (see Code table 3.0)	0	Specified in Code table 3.1
7-10	Number of data points	41760	
11	Number of octets for optional list of numbers	0	
12	Interpretation of list of numbers (see Code table 3.11)	0	There is no appended list
13-14	Grid definition template number (see Code table 3.1)	0	Latitude/longitude
15	Shape of the Earth (see Code table 3.2)	6	Earth assumed spherical with radius of 6 371 229.0 m
16	Scale factor of radius of spherical Earth		
17-20	Scaled value of radius of spherical Earth		
21	Scale factor of major axis of oblate spheroid Earth		
22-25	Scaled value of major axis of oblate spheroid Earth		
26	Scale factor of minor axis of oblate spheroid Earth		
27-30	Scaled value of minor axis of oblate spheroid Earth		
31-34	Ni - number of points along a parallel	288	
35-38	Nj - number of points along a meridian	145	
39-42	Basic angle of the initial production domain	0	
43-46	Subdivisions of basic angle used to define extreme longitudes and latitudes, and direction increments		
47-50	La1 - latitude of first grid point	90000000	
51-54	Lo1 - longitude of first grid point	0	
55	Resolution and component flags (see Flag table 3.3)	0x30	i direction increments given j direction increments given Resolved u- and v- components of vector quantities relative to easterly and northerly directions
56-59	La2 - latitude of last grid point	-90000000	
60-63	Lo2 - longitude of last grid point	358750000	
64-67	Di - i direction increment	1250000	
68-71	Dj - j direction increment	1250000	
72	Scanning mode (see Flag table 3.4)	0	Points of first row or column scan in the +i (+x) direction Points of first row or column scan in the –j (–y) direction Adjacent points in i (x) direction are consecutive

Section 4 – Product definition section

Octet No.	Contents	Value	Notes
1-4	Length of section in octets	******	
5	Number of section	4	
6-7	Number of coordinate values after template or number of information according to 3D vertical coordinate GRIB2 message	0	
8-9	Product definition template number (see Code table 4.0)	******	
10-xx	Product definition template (see template 4.X, where X is the product definition template number given in octets 8-9)		
[xx+1]-nn	Optional list of coordinate values or vertical grid information		

From the tenth octet onward, product definition template 4.8 is used for two-dimensional average diagnostic fields (fcst_phy2m125), isobaric average diagnostic fields (fcst_phyp125), land surface average diagnostic fields (fcst_phyland125) and monthly statistics (all types), and 4.0 is used elsewhere.

Product definition template 4.0 – analysis or forecast at a horizontal level or in a horizontal layer at a point in time

Octet No.	Contents	Value	Notes
10	Parameter category (see Code table 4.1)	******	
11	Parameter number (see Code table 4.2)	******	
12	Type of generating process (see Code table 4.3)	******	
13	Background generating process identifier (defined by originating centre)	141	Japanese Reanalysis for Three Quarters of a Century (JRA-3Q)
14	Analysis or forecast generating process identifier (defined by originating centre)		
15-16	Hours of observational data cut-off after reference time	65534	
17	Minutes of observational data cut-off after reference time	0	
18	Indicator of unit of time range (see Code table 4.4)	1	Hour
19-22	Forecast time in units defined by octet 18	******	
23	Type of first fixed surface (see Code table 4.5)	******	
24	Scale factor of first fixed surface	******	
25-28	Scaled value of first fixed surface	******	
29	Type of second fixed surface (see Code table 4.5)	******	
30	Scale factor of second fixed surface	******	
31-34	Scaled value of second fixed surface	******	

Product definition template 4.8 – average, accumulation and/or extreme values or other statistically processed values at a horizontal level or in a horizontal layer in a continuous or

non–continuous time interval

Octet No.	Contents	Value	Notes
10	Parameter category (see Code table 4.1)	******	
11	Parameter number (see Code table 4.2)	******	
12	Type of generating process (see Code table 4.3)	******	
13	Background generating process identifier (defined by originating centre)	141	Japanese Reanalysis for Three Quarters of a Century (JRA-3Q)
14	Analysis or forecast generating process identifier (defined by originating centre)		
15-16	Hours after reference time of data cut-off	65534	
17	Minutes after reference time of data cut-off	0	
18	Indicator of unit of time range (see Code table 4.4)	1	Hour
19-22	Forecast time in units defined by octet 18	******	
23	Type of first fixed surface (see Code table 4.5)	******	
24	Scale factor of first fixed surface	******	
25-28	Scaled value of first fixed surface	******	
29	Type of second fixed surface (see Code table 4.5)	******	
30	Scale factor of second fixed surface	******	
31-34	Scaled value of second fixed surface	******	
35-36	Year	******	
37	Month	******	
38	Day	******	
39	Hour	******	
40	Minute	0	
41	Second	0	
42	n - number of time range specifications describing the time intervals used to calculate the statistically processed field	******	
43-46	Total number of data values missing in statistical process	0	
	47-58 Specification of the outermost (or only) time range over which statistical processing is done		
47	Statistical process used to calculate the processed field from the field at each time increment during the time range (see Code table 4.10)	******	
48	Type of time increment between successive fields used in the statistical processing (see Code table 4.11)	******	
49	Indicator of unit of time for time range over which statistical processing is done (see Code table 4.4)	1	Hour
50-53	Length of the time range over which statistical processing is done, in units defined by the previous octet	******	
54	Indicator of unit of time for the increment between the successive fields used (see Code table 4.4)	1	Hour
55-58	Time increment between successive fields, in units defined by the previous octet (see Notes 3 and 4)	******	
	59-nn These octets are included only if n > 1, where nn = 46 + 12 x n		
59-70	As octets 47 to 58, next innermost step of processing		
71-nn	Additional time range specifications, included in accordance with the value of n. Contents as octets 47 to 58, repeated as necessary		

Section 5 – Data representation section

Octet No.	Contents	Value	Notes
1-4	Length of section in octets	******	
5	Number of section	5	
6-9	Number of data points where one or more values are specified in Section 7 when a bit map is present, total number of data points when a bit map is absent.	******	
10-11	Data representation template number (see Code table 5.0)	******	
12-nn	Data representation template (see template 5.X, where X is the data representation template number given in octets 10-11)		

From the tenth octet onward, data representation template 5.3 is used for six-hourly, hourly and daily data, and 5.0 is used for monthly statistics and climatological normals.

Data representation template 5.0 – Grid point data – simple packing

Octet No.	Contents	Value	Notes
12-15	Reference value (R) (IEEE 32-bit floating-point value)	******	
16-17	Binary scale factor (E)	******	
18-19	Decimal scale factor (D)	******	
20	Number of bits used for each packed value for simple packing, or for each group reference value for complex packing or spatial differencing	******	
21	Type of original field values (see Code table 5.1)	0	Floating point

Data representation template 5.3 – Grid point data – complex packing and spatial differencing

Octet No.	Contents	Value	Notes
12-21	Same as data representation template 5.0		
22	Group splitting method used (see Code table 5.4)	******	
23	Missing value management used (see Code table 5.5)	******	
24-27	Primary missing value substitute	******	
28-31	Secondary missing value substitute	******	
32-35	NG - number of groups of data values into which field is split	******	
36	Reference for group widths	******	
37	Number of bits used for the group widths (after the reference value in octet 36 has been removed)	******	
38-41	Reference for group lengths	******	
42	Length increment for the group lengths	******	
43-46	True length of last group	******	
47	Number of bits used for the scaled group lengths (after subtraction of the reference value given in octets 38-41 and division by the length increment given in octet 42)	******	
48	Order of spatial differencing (see Code table 5.6)	******	
49	Number of octets required in the data section to specify extra descriptors needed for spatial differencing (octets 6-ww in data template 7.3)	******	

Section 6 – Bit-map section

Octet No.	Contents	Value	Notes
1-4	Length of section in octets	******	
5	Number of section	6	
6	Bit-map indicator (see Code table 6.0)	******	
7-nn	Bit-map - Contiguous bits with a bit to data point correspondence, ordered as defined in Section 3. A bit set to 1 implies the presence of a data value at the corresponding data point, whereas a value of 0 implies the absence of such a value.	******	

Section 7 – Data section

Octet No.	Contents	Value	Notes
1-4	Length of section in octets	******	
5	Number of section	7	
6-nn	Data in a format described by data template 7.X, where X is the data representation template number given in octets 10-11 of Section 5.		

From the sixth octet onward, data representation template 7.3 is used for six-hourly, hourly and daily data, and 7.0 is used for monthly statistics and climatological normals.

Data template 7.0 – Grid point data – simple packing

Octet No.	Contents	Value	Notes
6-nn	Binary data values - binary string, with each (scaled) data value	******	

Data template 7.3 – Grid point data – complex packing and spatial differencing

Octet No.	Contents	Value	Notes
6-ww	First value(s) of original (undifferenced) scaled data values, followed by the overall minimum of the differences. The number of values stored is 1 greater than the order of differentiation, and the field width is described at octet 49 of data representation template 5.3	******	
[ww+1]-xx	NG group reference values (X1 in the decoding formula), each of which is encoded using the number of bits specified in octet 20 of data representation template 5.0. Bits set to zero shall be appended where necessary to ensure this sequence of numbers ends on an octet boundary	******	
[xx+1]-yy	NG group widths, each of which is encoded using the number of bits specified in octet 37 of data representation template 5.2. Bits set to zero shall be appended as necessary to ensure this sequence of numbers ends on an octet boundary	******	
[yy+1]-zz	NG scaled group lengths, each of which is encoded using the number of bits specified in octet 47 of data representation template 5.2. Bits set to zero shall be appended as necessary to ensure this sequence of numbers ends on an octet boundary	******	
[zz+1]-nn	Packed values (X2 in the decoding formula), where each value is a deviation from its respective group reference value	******	

Section 8 – End section

Octet No.	Contents	Value	Notes
1-4	"7777" (coded according to the International Alphabet No. 5)	7777	

4. Output parameters[1]

4.1. Surface analysis fields (anl_surf125)

Code figures	Parameter	Units	Level
0, 1, 64	Total column integrated water vapour	kg m^{-2}	1 (Ground or water surface): 8 (Nominal top of the atmosphere)
0, 0, 2	Potential temperature	K	1 (Ground or water surface)
0, 1, 13	Water equivalent of accumulated snow depth	kg m^{-2}	1 (Ground or water surface)
0, 3, 0	Pressure	Pa	1 (Ground or water surface)
0,194, 6	Energy stored in light snow	J m^{-2}	1 (Ground or water surface)
0,194, 7	Amount of light snow	kg m^{-2}	1 (Ground or water surface)
0, 3, 1	Pressure reduced to MSL	Pa	101 (Mean sea level)
0, 0, 0	Temperature	K	103 (Specified height level above ground 2m)
0, 0, 7	Dewpoint depression (or deficit)	K	103 (Specified height level above ground 2m)
0, 1, 0	Specific humidity	kg kg^{-1}	103 (Specified height level above ground 2m)
0, 1, 1	Relative humidity	%	103 (Specified height level above ground 2m)
0, 2, 2	u-component of wind	m s^{-1}	103 (Specified height level above ground 10m)
0, 2, 3	v-component of wind	m s^{-1}	103 (Specified height level above ground 10m)

Note: The saturated vapor pressure used to calculate dewpoint depression (or deficit) and relative humidity from specific humidity is the value from over liquid water at a temperature of 273.15K or higher, over ice at a temperature of 258.15K or lower, and the weighted average of the two with proportions linearly dependent on temperatures between 258.15 and 273.15K.

4.2. Snow depth analysis fields (anl_snow125)

Code figures	Parameter	Units	Level
0, 1, 11	Snow depth	m	1 (Ground or water surface)

4.3. Isobaric analysis fields (anl_p125)

There are 45 isobaric surfaces (1,000, 975, 950, 925, 900, 875, 850, 825, 800, 775, 750, 700, 650, 600, 550, 500, 450, 400, 350, 300, 250, 225, 200, 175, 150, 125, 100, 85, 70, 60, 50, 40, 30, 20, 10, 7, 5, 3, 2, 1, 0.7, 0.3, 0.1, 0.03 and 0.01 hPa).

[1] The code figures in the tables indicate discipline, parameter category and parameter number. Parameter names conform to the notation of the Manual on Codes I.2 (WMO 2022).

Code figures	Parameter	Units	Filename
0, 0, 0	Temperature	K	anl_p125_tmp
0, 0, 7	Dewpoint depression (or deficit)	K	anl_p125_depr
0, 1, 0	Specific humidity	$kg\ kg^{-1}$	anl_p125_spfh
0, 1, 1	Relative humidity	%	anl_p125_rh
0, 2, 2	u-component of wind	$m\ s^{-1}$	anl_p125_ugrd
0, 2, 3	v-component of wind	$m\ s^{-1}$	anl_p125_vgrd
0, 2, 4	Stream function	$m^2\ s^{-1}$	anl_p125_strm
0, 2, 5	Velocity potential	$m^2\ s^{-1}$	anl_p125_vpot
0, 2, 8	Vertical velocity (pressure)	$Pa\ s^{-1}$	anl_p125_vvel
0, 2, 12	Relative vorticity	s^{-1}	anl_p125_relv
0, 2, 13	Relative divergence	s^{-1}	anl_p125_reld
0, 3, 5	Geopotential height	gpm	anl_p125_hgt

Note: The saturated vapor pressure used to calculate dewpoint depression (or deficit) and relative humidity from specific humidity is the value from over liquid water at a temperature of 273.15K or higher, over ice at a temperature of 258.15K or lower, and the weighted average of the two with proportions linearly dependent on temperatures between 258.15 and 273.15K.

4.4. Isentropic analysis fields (anl_isentrop125)

There are 36 isentropic surfaces (270, 280, 290, 300, 310, 320, 330, 340, 350, 360, 370, 380, 390, 400, 425, 450, 475, 500, 550, 600, 650, 700, 750, 800, 850, 900, 950, 1,000, 1,250, 1,500, 1,750, 2,000, 2,500, 3,000, 3,500 and 4,000K).

Code figures	Parameter	Units	Filename
0, 1, 0	Specific humidity	$kg\ kg^{-1}$	anl_isentrop125_spfh
0, 2, 2	u-component of wind	$m\ s^{-1}$	anl_isentrop125_ugrd
0, 2, 3	v-component of wind	$m\ s^{-1}$	anl_isentrop125_vgrd
0, 2, 6	Montgomery stream function	$m^2\ s^{-2}$	anl_isentrop125_mntsf
0, 2, 8	Vertical velocity (pressure)	$Pa\ s^{-1}$	anl_isentrop125_vvel
0, 2, 14	Potential vorticity	$K\ m^2\ kg^{-1}\ s^{-1}$	anl_isentrop125_pvort
0, 3, 0	Pressure	Pa	anl_isentrop125_pres
0, 3, 5	Geopotential height	gpm	anl_isentrop125_hgt
0,194, 38	Square of Brunt-Vaisala frequency	s^{-2}	anl_isentrop125_bvf2

4.5. Land surface analysis fields (anl_land125)

There are seven soil layers (2, 5, 12, 30, 50, 100 and 150 cm from the top).

Code figures	Parameter	Units	Level
2, 3,192	Ground temperature	K	1 (Ground or water surface)
2,193, 1	Canopy temperature	K	1 (Ground or water surface)
2,193, 2	Liquid water storage on canopy	kg m^{-2}	1 (Ground or water surface)
2,193, 3	Ice storage on canopy	kg m^{-2}	1 (Ground or water surface)
2,193, 4	Liquid water storage on groundcover	kg m^{-2}	1 (Ground or water surface)
2,193, 5	Ice storage on groundcover	kg m^{-2}	1 (Ground or water surface)
2, 0, 38	Soil volumetric ice content (water equivalent)	m^3 m^{-3}	106 (Depth below land surface):106 (Depth below land surface)
2, 3, 10	Liquid volumetric soil moisture (non-frozen)	m^3 m^{-3}	106 (Depth below land surface):106 (Depth below land surface)
2, 3, 18	Soil temperature	K	106 (Depth below land surface):106 (Depth below land surface)

4.6. Two-dimensional instantaneous diagnostic fields (fcst_surf125)

Code figures	Parameter	Units	Level
0, 1, 64	Total column integrated water vapour	kg m^{-2}	1 (Ground or water surface): 8 (Nominal top of the atmosphere)
0, 1, 69	Total column integrated cloud water	kg m^{-2}	1 (Ground or water surface): 8 (Nominal top of the atmosphere)
0, 1, 70	Total column integrated cloud ice	kg m^{-2}	1 (Ground or water surface): 8 (Nominal top of the atmosphere)
0, 14, 0	Total ozone	DU	1 (Ground or water surface): 8 (Nominal top of the atmosphere)
0, 1, 11	Snow depth	m	1 (Ground or water surface)
0, 1, 13	Water equivalent of accumulated snow depth	kg m^{-2}	1 (Ground or water surface)
0, 2, 30	Frictional velocity	m s^{-1}	1 (Ground or water surface)
0, 3, 0	Pressure	Pa	1 (Ground or water surface)
0,194, 6	Energy stored in light snow	J m^{-2}	1 (Ground or water surface)
0,194, 7	Amount of light snow	kg m^{-2}	1 (Ground or water surface)
0, 6, 1	Total cloud cover	%	100 (Isobaric surface):100 (Isobaric surface)
0, 6, 3	Low cloud cover	%	100 (Isobaric surface):100 (Isobaric surface)
0, 6, 4	Medium cloud cover	%	100 (Isobaric surface):100 (Isobaric surface)
0, 6, 5	High cloud cover	%	100 (Isobaric surface):100 (Isobaric surface)
0, 3, 1	Pressure reduced to MSL	Pa	101 (Mean sea level)
0, 0, 0	Temperature	K	103 (Specified height level above ground 2m)
0, 0, 7	Dewpoint depression (or deficit)	K	103 (Specified height level above ground 2m)
0, 1, 0	Specific humidity	kg kg^{-1}	103 (Specified height level above ground 2m)
0, 1, 1	Relative humidity	%	103 (Specified height level above ground 2m)
0, 2, 2	u-component of wind	m s^{-1}	103 (Specified height level above ground 10m)
0, 2, 3	v-component of wind	m s^{-1}	103 (Specified height level above ground 10m)

Note: The saturated vapor pressure used to calculate dewpoint depression (or deficit) and relative humidity from specific humidity is the value from over liquid water at a temperature of 273.15K or higher, over ice at a temperature of 258.15K or lower, and the weighted average of the two with proportions linearly dependent on temperatures between 258.15 and 273.15K.

4.7. Isobaric forecast fields (fcst_p125)

There are 45 isobaric surfaces (1,000, 975, 950, 925, 900, 875, 850, 825, 800, 775, 750, 700, 650, 600, 550, 500, 450, 400, 350, 300, 250, 225, 200, 175, 150, 125, 100, 85, 70, 60, 50, 40, 30, 20, 10, 7, 5, 3, 2, 1, 0.7, 0.3, 0.1, 0.03 and 0.01 hPa).

Code figures	Parameter	Units	Filename
0, 0, 0	Temperature	K	fcst_p125_tmp
0, 0, 7	Dewpoint depression (or deficit)	K	fcst_p125_depr
0, 1, 0	Specific humidity	kg kg^{-1}	fcst_p125_spfh
0, 1, 1	Relative humidity	%	fcst_p125_rh
0, 2, 2	u-component of wind	m s^{-1}	fcst_p125_ugrd
0, 2, 3	v-component of wind	m s^{-1}	fcst_p125_vgrd
0, 2, 4	Stream function	m^2 s^{-1}	fcst_p125_strm
0, 2, 5	Velocity potential	m^2 s^{-1}	fcst_p125_vpot
0, 2, 8	Vertical velocity (pressure)	Pa s^{-1}	fcst_p125_vvel
0, 2, 12	Relative vorticity	s^{-1}	fcst_p125_relv
0, 2, 13	Relative divergence	s^{-1}	fcst_p125_reld
0, 3, 5	Geopotential height	gpm	fcst_p125_hgt
0, 6, 7	Cloud amount	%	fcst_p125_cdca
0, 14, 1	Ozone mixing ratio	kg kg^{-1}	fcst_p125_o3mr
0,194, 41	Cloud water	kg kg^{-1}	fcst_p125_cwat

Note: The saturated vapor pressure used to calculate dewpoint depression (or deficit) and relative humidity from specific humidity is the value from over liquid water at a temperature of 273.15K or higher, over ice at a temperature of 258.15K or lower, and the weighted average of the two with proportions linearly dependent on temperatures between 258.15 and 273.15K.

4.8. Land surface forecast fields (fcst_land125)

There are seven soil layers (2, 5, 12, 30, 50, 100 and 150 cm from the top).

Code figures	Parameter	Units	Level
2, 0, 1	Surface roughness	m	1 (Ground or water surface)
2, 3,192	Ground temperature	K	1 (Ground or water surface)
2,193, 1	Canopy temperature	K	1 (Ground or water surface)
2,193, 2	Liquid water storage on canopy	kg m^{-2}	1 (Ground or water surface)
2,193, 3	Ice storage on canopy	kg m^{-2}	1 (Ground or water surface)
2,193, 4	Liquid water storage on groundcover	kg m^{-2}	1 (Ground or water surface)
2,193, 5	Ice storage on groundcover	kg m^{-2}	1 (Ground or water surface)
2, 0, 38	Soil volumetric ice content (water equivalent)	m^3 m^{-3}	106 (Depth below land surface):106 (Depth below land surface)
2, 3, 10	Liquid volumetric soil moisture (non-frozen)	m^3 m^{-3}	106 (Depth below land surface):106 (Depth below land surface)
2, 3, 18	Soil Temperature	K	106 (Depth below land surface):106 (Depth below land surface)

4.9. Ocean surface boundary conditions (bnd_ocean125)

There are four layers of sea ice (7, 14, 51 and 78 cm from the top).

Code figures	Parameter	Units	Level
10, 2, 0	Ice cover	Proportion	1 (Ground or water surface)
10, 2, 8	Ice temperature	K	1 (Ground or water surface)
10, 3, 0	Water temperature	K	1 (Ground or water surface)
10, 2, 8	Ice temperature	K	160 (Depth below sea level):160 (Depth below sea level)

Note: Water temperatures in sea ice areas are estimated from sea ice concentrations.

4.10. Two-dimensional average diagnostic fields (fcst_phy2m125)

Code figures	Parameter	Units	Level
0,194, 8	Vertically integrated zonal water vapour flux	kg m^{-1} s^{-1}	1 (Ground or water surface): 8 (Nominal top of the atmosphere)
0,194, 9	Vertically integrated meridional water vapour flux	kg m^{-1} s^{-1}	
0, 0, 10	Latent heat net flux	W m^{-2}	1 (Ground or water surface)
0, 0, 11	Sensible heat net flux	W m^{-2}	
0, 1, 37	Convective precipitation rate	kg m^{-2} s^{-1}	
0, 1, 52	Total precipitation rate	kg m^{-2} s^{-1}	
0, 1, 53	Total snowfall rate water equivalent	kg m^{-2} s^{-1}	
0, 1, 54	Large scale precipitation rate	kg m^{-2} s^{-1}	
0, 1, 79	Evaporation rate	kg m^{-2} s^{-1}	
0, 2, 17	Momentum flux, u-component	N m^{-2}	
0, 2, 18	Momentum flux, v-component	N m^{-2}	
0, 3, 0	Pressure	Pa	
0, 4, 7	Downward short-wave radiation flux	W m^{-2}	
0, 4, 8	Upward short-wave radiation flux	W m^{-2}	
0, 4, 52	Downward short-wave radiation flux, clear sky	W m^{-2}	
0, 4, 53	Upward short-wave radiation flux, clear sky	W m^{-2}	
0, 5, 3	Downward long-wave radiation flux	W m^{-2}	
0, 5, 4	Upward long-wave radiation flux	W m^{-2}	
0, 5, 8	Downward long-wave radiation flux, clear sky	W m^{-2}	
0,194, 28	Zonal momemtum flux by short gravity wave	N m^{-2}	
0,194, 29	Meridional momemtum flux by short gravity wave	N m^{-2}	
0,194, 30	Zonal momemtum flux by long gravity wave	N m^{-2}	
0,194, 31	Meridional momemtum flux by long gravity wave	N m^{-2}	
0, 4, 7	Downward short-wave radiation flux	W m^{-2}	8 (Nominal top of the atmosphere)
0, 4, 8	Upward short-wave radiation flux	W m^{-2}	
0, 4, 53	Upward short-wave radiation flux, clear sky	W m^{-2}	
0, 5, 4	Upward long-wave radiation flux	W m^{-2}	
0, 5, 6	Net long-wave radiation flux, clear sky	W m^{-2}	

4.11. Isobaric average diagnostic fields (fcst_phyp125)

Code figures	Parameter	Units	Filename
0, 0, 22	Temperature tendency due to short-wave radiation	$K\ s^{-1}$	fcst_phyp125_ttswr
0, 0, 23	Temperature tendency due to long-wave radiation	$K\ s^{-1}$	fcst_phyp125_ttlwr
0, 3, 27	Updraught mass flux	$kg\ m^{-2}\ s^{-1}$	fcst_phyp125_umflx
0,194, 1	Adiabatic heating rate	$K\ s^{-1}$	fcst_phyp125_adhr
0,194, 2	Large scale condensation heating rate	$K\ s^{-1}$	fcst_phyp125_lrghr
0,194, 3	Convective heating rate	$K\ s^{-1}$	fcst_phyp125_cnvhr
0,194, 4	Vertical diffusion heating rate	$K\ s^{-1}$	fcst_phyp125_vdfhr
0,194, 12	Adiabatic moistening rate	$kg\ kg^{-1}\ s^{-1}$	fcst_phyp125_admr
0,194, 13	Large scale moistening rate	$kg\ kg^{-1}\ s^{-1}$	fcst_phyp125_lrgmr
0,194, 14	Convective moistening rate	$kg\ kg^{-1}\ s^{-1}$	fcst_phyp125_cnvmr
0,194, 15	Vertical diffusion moistening rate	$kg\ kg^{-1}\ s^{-1}$	fcst_phyp125_vdfmr
0,194, 18	Adiabatic zonal acceleration	$m\ s^{-1}\ s^{-1}$	fcst_phyp125_adua
0,194, 19	Adiabatic meridional acceleration	$m\ s^{-1}\ s^{-1}$	fcst_phyp125_adva
0,194, 20	Convective zonal acceleration	$m\ s^{-1}\ s^{-1}$	fcst_phyp125_cnvua
0,194, 21	Convective meridional acceleration	$m\ s^{-1}\ s^{-1}$	fcst_phyp125_cnvva
0,194, 22	Vertical diffusion zonal acceleration	$m\ s^{-1}\ s^{-1}$	fcst_phyp125_vdfua
0,194, 23	Vertical diffusion meridional acceleration	$m\ s^{-1}\ s^{-1}$	fcst_phyp125_vdfva
0,194, 24	Orographic gravity wave zonal acceleration	$m\ s^{-1}\ s^{-1}$	fcst_phyp125_gwdoua
0,194, 25	Orographic gravity wave meridional acceleration	$m\ s^{-1}\ s^{-1}$	fcst_phyp125_gwdova
0,194, 26	Non-orographic gravity wave zonal acceleration	$m\ s^{-1}\ s^{-1}$	fcst_phyp125_gwdnua
0,194, 27	Non-orographic gravity wave meridional acceleration	$m\ s^{-1}\ s^{-1}$	fcst_phyp125_gwdnva

4.12. Land surface average diagnostic fields (fcst_phyland125)

Code figures	Parameter	Units	Level
2,193, 6	Interception loss	$W\ m^{-2}$	1 (Ground or water surface)
2,193, 8	Transpiration	$W\ m^{-2}$	1 (Ground or water surface)
2,193, 9	Water runoff	$kg\ m^{-2}\ s^{-1}$	1 (Ground or water surface)
2,193, 9	Water runoff	$kg\ m^{-2}\ s^{-1}$	106 (Depth below land surface 349cm)

5. Invariant data

5.1. Surface geopotential (LL125_surf)

Code figures	Parameter	Units	Level
0, 3, 4	Geopotential	m^2 s^{-2}	1 (Ground or water surface)

5.2. Land surface information (LL125_land)

Code figures	Parameter	Units	Level
2, 0, 0	Land cover (0 = sea, 1 = land)	Proportion	1 (Ground or water surface)

6. Physical constants

Quantity	Value
Stefan-Boltzmann constant σ	5.67 x 10^{-8} W m^{-2} K^{-4}
Earth's radius	6.371 x 10^{6} m
Angular speed of Earth's rotation	7.29245 x 10^{-5} rad s^{-1}
Gravitational acceleration	9.80665 m s^{-2}
Gas constant for dry air	287.04 J K^{-1} kg^{-1}
Specific heat of dry air at constant pressure c_p	1004.6 J K^{-1} kg^{-1}
Latent heat of vaporization	2.507 x 10^{6} J kg^{-1}
Solar constant	1365 W m^{-2}

7. Climatological normals

Climatological normals have been calculated for the period from 1991 to 2020 using the methods described below.

7.1. Daily mean smooth climatological normals

This calculation involves two steps. In the first, daily values are computed using six-hourly values for analysis and instantaneous forecast fields and averages from the beginning of forecasts up to six hours for average diagnostic fields, and a simple average is then taken for the base period for each day of the year except leap days. In the second, Lanzcos low-pass filtering (Duchon 1979) with 121-term weight factors and a 60-day cutoff is applied to the time sequence of daily values to treat the high-frequency variation remaining in the daily values calculated in the first step. Climatological normals for leap days are derived by averaging the smooth climatological normals for 28th February and 1st March.

The concept of this method is quite simple. It should be noted that monthly means calculated from daily means do not coincide with those outlined above due to the difference in treatment for leap days and with the presence or absence of filtering.

7.2. Monthly mean climatological normals

Monthly mean climatological normals are calculated by simply averaging historical monthly mean values.

References

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