ICON Database Reference Manual

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Contents

Chapter 1

Available output fields in GRIB2-format

In GRIB2, a variable is uniquely defined by the following set of metadata:

- *Discipline* (see GRIB2 code table 4.2)
- *ParameterCategory* (see GRIB2 code table 4.2)
- *ParameterNumber* (see GRIB2 code table 4.2)
- *typeOfFirstfixedSurface* and *typeOfSecondFixedSurface* (see GRIB2 code table 4.5)
- *stepType* (instant, accum, avg, max, min, diff, rms, sd, cov, ...)

A documentation of the official WMO GRIB2 code tables can be found here: `http://www.wmo.int/pages/prog/www/WMOCodes/WMO306_vI2/LatestVERSION/WMO306_vI2_GRIB2_CodeFlag_en.pdf`
In the following, *typeOfFirstFixedSurface* and *typeOfSecondFixedSurface* will be abbreviated by *LevTyp 1/2*.

1.1 Deprecated output fields

With the launch of ICON, the following former GME output fields will no longer be available:

- **OMEGA** [Pa/s]: Vertical velocity in pressure coordinates $\omega = \frac{\mathrm{d}p}{\mathrm{d}t}$. Since ICON is a nonhydrostatic model, the vertical velocity **W** [m/s] is provided, instead (see Section 1.2).
- **BAS_CON** [–]: Level index of convective cloud base. Instead, **HBAS_CON** [m] should be used.
- **TOP_CON** [–]: Level index of convective cloud top. Instead, **HTOP_CON** [m] should be used.
- **T_S** [K]: Temperature at the soil-atmosphere-, or soil-snow-interface. Note that T_S = T_SO(0), thus T_S is redundant.
- **W_G1**, **W_G2** [mm H2O]: Soil water content in upper layer (0 to 10 cm) and middle layer (10 to 100 cm), respectively. If needed, these fields can be derived from **W_SO**.
- **FIS** [$\mathrm{m}^2\,\mathrm{s}^{-1}$]: Surface Geopotential. Instead, **HSURF** [m] should be used (see Section 1.2).

1.2 New output fields

New output fields that will become available with the launch of ICON are:

- **W** [m/s]: vertical velocity in height coordinates $w = \frac{\mathrm{d}z}{\mathrm{d}t}$ (3D field)
- **DEN** [kg/m^3]: density of moist air (3D field)
- **HSURF** [m]: Geometric Height of the earths surface above sea level (2D field)
- **HHL** [m]: Geometric Height of model half levels above sea level (3D field)

1.3 Available output fields listed in tabular form

1.3.1 Time-constant (external parameter) fields

Table 1.1: *Time-constant fields (Date D=000000)*

ShortName	Description	Discipline	Category	Number	Lev-Typ 1/2	stepType	Unit
HSURF	Geometric height of the earths surface above msl	0	3	6	1/101	inst	m
HHL	Geometric height of model half levels above msl	0	3	6	105/101	inst	m
RLAT	Geographical latitude	0	191	1	1/–	inst	Deg. N
RLON	Geographical longitude	0	191	2	1/–	inst	Deg. E
FR_LAND	Land fraction (possible range $[0, 1]$)	2	0	0	1/–	inst	1
ROOTDP	Root depth of vegetation	2	0	32	1/–	inst	m
EMIS_RAD	Longwave surface emissivity	2	3	199	1/–	inst	1
RSMIN	Minimum stomatal resistance	2	0	16	1/–	inst	$\mathrm{s\,m^{-1}}$
SSO_STDH	Standard deviation of sub-grid scale orography	0	3	20	1/–	inst	m
SSO_GAMMA	Anisotropy of sub-gridscale orography	0	3	24	1/–	inst	1
SSO_THETA	Angle of sub-gridscale orography	0	3	21	1/–	inst	rad
SSO_SIGMA	Slope of sub-gridscale orography	0	3	22	1/–	inst	1
PLCOV_MX	Plant covering degree in the vegetation phase	2	0	4	1/–	max	1
T_2M_CL	Climatological 2 m temperature (used as lower bc. for soil model)	0	0	0	103/–	inst	K

1.3.2 Multi-level fields on native hybrid vertical levels

Table 1.2: *Hybrid multi-level forecast ($VV > 0$) and initialised analysis ($VV = 0$) products*

ShortName	Description	Discipline	Category	Number	Lev-Typ 1/2[1]	stepType	Unit
U	Zonal wind	0	2	2	105/105	inst	$\mathrm{m\,s^{-1}}$
V	Meridional wind	0	2	3	105/105	inst	$\mathrm{m\,s^{-1}}$
W	Vertical wind	0	2	9	105/–	inst	$\mathrm{m\,s^{-1}}$
T	Temperature	0	0	0	105/105	inst	K
DEN	Density of moist air	0	3	10	105/105	inst	$\mathrm{kg\,m^{-3}}$
QV	Specific humidity	0	1	0	105/105	inst	$\mathrm{kg\,kg^{-1}}$
QC	Cloud mixing ratio[2]	0	1	22	105/105	inst	$\mathrm{kg\,kg^{-1}}$
QI	Cloud ice mixing ratio[2]	0	1	82	105/105	inst	$\mathrm{kg\,kg^{-1}}$
QR	Rain mixing ratio[2]	0	1	24	105/105	inst	$\mathrm{kg\,kg^{-1}}$
QS	Snow mixing ratio[2]	0	1	25	105/105	inst	$\mathrm{kg\,kg^{-1}}$
CLC	Cloud cover	0	6	22	105/105	inst	%
O3	Ozone mixing ratio[3]	0	14	1	105/105	inst	$\mathrm{kg\,kg^{-1}}$

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1.3.3 Multi-level fields interpolated to pressure levels

The following pressure levels are available: 1000, 950, 925, 900, 850, 700, 500, 400, 300, 250, 200, 150, 100, 50, 10, hPa.

[1] Levekl type 105 (Hybrid level) will be replaced by 150 (Generalized vertical height coordinate), once the GRIB_API is able to cope with it

[2] for the time being, erroneously encoded as mixing ratios instead of specific quantities

[3] not clear yet, whether ozone will be provided as output field

Table 1.3: *Multi-level forecast ($VV > 0$) and initialised analysis ($VV = 0$) products interpolated to pressure levels*

ShortName	Description	Discipline	Category	Number	Lev-Typ 1/2	stepType	Unit
FI	Geopotential	0	3	4	100/–	inst	$m^2 s^{-2}$
U	Zonal wind	0	2	2	100/–	inst	$m s^{-1}$
V	Meridional wind	0	2	3	100/–	inst	$m s^{-1}$
W	Vertical wind	0	2	9	100/–	inst	$m s^{-1}$
T	Temperature	0	0	0	100/–	inst	K
RELHUM	Relative humidity (with respect to water)	0	1	1	100/–	inst	%

1.3.4 Single-level fields

Table 1.4: Single-level forecast ($VV > 0$) and initialised analysis ($VV = 0$) products

ShortName	Description	Discipline	Category	Number	Lev-Typ 1/2	stepType	Unit
PS	Surface pressure (not reduced)	0	3	1	1/–	inst	Pa
T_SNOW	Temperature of the snow surface	0	0	18	1/–	inst	K
T_G	Ground temperature (temperature at sfc-atm interface)	0	0	0	1/–	inst	K
QV_S	Surface specific humidity	0	1	0	1/–	inst	$kg kg^{-1}$
W_SNOW	Snow depth water equivalent	0	1	60	1/–	inst	$kg m^{-2}$
W_I	Plant canopy surface water	2	0	13	1/–	inst	$kg m^{-2}$
TCM	Turbulent transfer coefficient for momentum (surface)	0	2	29	1/–	inst	1
TCH	Turbulent transfer coefficient for heat and moisture (surface)	0	0	19	1/–	inst	1
ASOB_S	Net short-wave radiation flux at surface (average since model start)	0	4	9	1/–	avg	$W m^{-2}$

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Table 1.4: *continued*

ATHB_S	Net long-wave radiation flux at surface (average since model start)	0	5	5	1/–	avg	$W\,m^{-2}$
ASOB_T	Net short-wave radiation flux at TOA (average since model start)	0	4	9	8/–	avg	$W\,m^{-2}$
ATHB_T	Net long-wave radiation flux at TOA (average since model start)	0	5	5	8/–	avg	$W\,m^{-2}$
ALB_RAD	Surface albedo for visible range, diffuse	0	19	1	1/–	inst	%
RAIN_GSP	Large scale rain (accumulated since model start)	0	1	77	1/–	accu	$kg\,m^{-2}$
SNOW_GSP	Large snowfall water equivalent (accumulated since model start)	0	1	56	1/–	accu	$kg\,m^{-2}$
RAIN_CON	Convective rain (accumulated since model start)	0	1	76	1/–	accu	$kg\,m^{-2}$
SNOW_CON	Convective snowfall water equivalent (accumulated since model start)	0	1	55	1/–	accu	$kg\,m^{-2}$
TOT_PREC	Total precipitation (accumulated since model start)	0	1	52	1/–	accu	$kg\,m^{-2}$
RUNOFF_S	Surface water runoff (accumulated since model start)[3]	2	0	5	106/–	accu	$kg\,m^{-2}$
RUNOFF_G	Soil water runoff (accumulated since model start)[3]	2	0	5	106/–	accu	$kg\,m^{-2}$
U_10M	Zonal wind at 10m above ground	0	2	2	103/–	inst	$m\,s^{-1}$
V_10M	Meridional wind at 10m above ground	0	2	3	103/–	inst	$m\,s^{-1}$
T_2M	Temperature at 2m above ground	0	0	0	103/–	inst	K
TD_2M	Dew point temperature at 2m above ground	0	0	6	103/–	inst	K
VMAX_10M	Maximum wind at 10 m above ground	0	2	22	103/–	max	$m\,s^{-1}$
Z0	Surface roughness (above land and water)	2	0	1	1/–	inst	m
CLCT	Total cloud cover	0	6	1	1/–	inst	%
CLCH	High level clouds[3]	0	6	22	100/100	inst	%
CLCM	Mid level clouds[3]	0	6	22	100/100	inst	%
CLCL	Low level clouds[3]	0	6	22	100/1	inst	%

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Table 1.4: *continued*

TQV	Total column integrated water vapour	0	1	64	1/–	inst	$kg\,m^{-2}$
TQC	Total column integrated cloud water	0	1	69	1/–	inst	$kg\,m^{-2}$
TQI	Total column integrated cloud ice	0	1	70	1/–	inst	$kg\,m^{-2}$
TQR	Total column integrated rain[3]	0	1	45	1/–	inst	$kg\,m^{-2}$
TQS	Total column integrated snow[3]	0	1	46	1/–	inst	$kg\,m^{-2}$
HBAS_CON	Height of convective cloud base above msl	0	6	26	2/101	inst	m
HTOP_CON	Height of convective cloud top above msl	0	6	27	3/101	inst	m
HZEROCL	Height of 0 degree Celsius isotherm above msl	0	3	6	4/101	inst	m
ASHFL_S	Sensible heat net flux at surface (average since model start)	0	0	11	1/–	avg	$W\,m^{-2}$
ALHFL_S	Latent heat net flux at surface (average since model start)	0	0	10	1/–	avg	$W\,m^{-2}$
FR_ICE	Sea ice cover (possible range: $[0, 1]$)	10	2	0	1/–	inst	1
T_ICE	Sea ice temperature (at ice-atm interface)	10	2	8	1/–	inst	K
H_ICE	Sea ice thickness (Max: 3 m)	10	2	1	1/–	inst	m
FRESHSNW	Fresh snow factor (weighting function for albedo indicating freshness of snow)	0	1	203	1/–	inst	1
RHO_SNOW	Snow density	0	1	61	1/–	inst	$kg\,m^{-3}$
H_SNOW	Snow depth	0	1	11	1/–	inst	m

Table 1.5: Multi-level forecast ($VV > 0$) and initialised analysis ($VV = 0$) products of the soil model

ShortName	**Description**	**Discipline**	**Category**	**Number**	**Lev-Typ 1/2**	**stepType**	**Unit**
T_SO	Soil temperature	2	3	18	106/–	inst	K

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[3]Output fields not yet available, but planned.

Table 1.6: *Soil model: vertical distribution of levels and layers*

level no.	depth [cm]	layer no.	upper/lower bounds [cm]
0	0.0		
1	0.5	1	0.0 — 1.0
2	2.0	2	1.0 — 3.0
3	6.0	3	3.0 — 9.0
4	18.0	4	9.0 — 27.0
5	54.0	5	27.0 — 81.0
6	162.0	6	81.0 — 243.0
7	486.0	7	243.0 — 729.0
8	1458.0	8	729.0 — 2187.0

Table 1.5: Multi-level forecast ($VV > 0$) and initialised analysis ($VV = 0$) products of the soil model

ShortName	Description	Discipline	Category	Number	Lev-Typ 1/2	stepType	Unit
W_SO	Soil moisture integrated over individual soil layers (ice + liquid)	2	3	20	106/106	inst	$\mathrm{kg\,m^{-2}}$
W_SO_ICE	Soil ice content integrated over individual soil layers	2	3	22	106/106	inst	$\mathrm{kg\,m^{-2}}$

Soil temperature is defined at the soil depths given in Table 1.6 (column 2). Levels 1 to 8 define the full levels of the soil model. A zero gradient condition is assumed between levels 0 and 1, meaning that temperatures at the surface-atmosphere interface are set equal to the temperature at the first full level depth. (0.5 cm). Temperatures are prognosed for levels 1 to 7. At the lowermost level (1458 cm) the temperature is fixed to the climatological average 2 m-temperature.

Soil moisture W_SO is prognosed for layers 1 to 6. In the two lowermost layers W_SO is time constant.

1.3.5 Surface fields interpolated to msl

Table 1.7: *Forecast ($VV > 0$) and initialised analysis ($VV = 0$) products interpolated to msl*

ShortName	**Description**	**Discipline**	**Category**	**Number**	**Lev-Typ 1/2**	**stepType**	**Unit**
PMSL	Surface pressure reduced to msl	0	3	1	101/–	inst	Pa