

WORLD METEOROLOGICAL ORGANIZATION
COMMISSION FOR BASIC SYSTEMS

THIRD MEETING OF
INTER-PROGRAMME EXPERT TEAM ON
DATA REPRESENTATION AND CODES

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ITEM 2.3

ENGLISH ONLY

Space Weather in GRIB2

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Summary and Purpose of Document

The document proposes a methodology for reporting space weather in GRIB2.

ACTION PROPOSED

The team is requested to approve the contents for validation.

DISCUSSION

At the IPET-DRC II meeting in Brasilia (August 2010), the team discussed ideas for the representation of space weather in GRIB2. This was initiated by a topical paper from the U.S., and the results are documented in item 2.3.11 of the final report from the meeting.

In accordance with the guidance provided by IPET-DRC II, the NCEP Space Weather Prediction Center (SWPC) has worked closely with the UKMO and AFWA over the past year to develop a formal proposal for validation. We hope to validate these new additions in the coming months so they can be adopted for fast-track implementation in May 2012.

PROPOSAL

Rename Code table 3.2 as “Shape of the reference system” and add the following new entries:

Code table 3.2 – *Shape of the reference system*

Code figure	Meaning
9	Earth model assumed WGS84 with corrected geomagnetic coordinates (latitude and longitude) defined by Gustafsson et al., 1992
10	Sun assumed spherical with radius = 695,990,000 m (Allen, C.W., 1976 <i>Astrophysical Quantities</i> (3 rd Ed.; London: Athlone)) and Stonyhurst latitude and longitude system with origin at the intersection of the solar central meridian (as seen from Earth) and the solar equator (Thompson, W, <i>Coordinate systems for solar image data</i> , A&A 449, 791–803 (2006)).
11	Sun assumed spherical with radius = 695,990,000 m (Allen, C.W., 1976 <i>Astrophysical Quantities</i> (3 rd Ed.; London: Athlone)) and Carrington latitude and longitude system that rotates with a sidereal period of 25.38 days (Thompson, W, <i>Coordinate systems for solar image data</i> , A&A 449, 791–803 (2006)).

Add the following new entries to Code table 4.5:

Code table 4.5 - *Fixed surface types and units*

Code figure	Meaning
170	Ionospheric D-region level
171	Ionospheric E-region level
172	Ionospheric F1-region level
173	Ionospheric F2-region level

In Code table 0.0, rename existing entry #3 as “Satellite products” and add new entry #4:

Code table 0.0 - *Discipline of processed data in the GRIB message, number of GRIB Master table*

Code figure	Meaning
3	Satellite products
4	Space weather products

Add the following new entries to Code table 4.1:

Code table 4.1 - *Parameter category by product discipline*

Product Discipline 4 – Space Weather Products	
Category (octet 10)	Description
0	Temperature
1	Momentum
2	Charged particle mass and number
3	Electric and magnetic fields
4	Energetic particles
5	Waves
6	Solar electromagnetic emissions
7	Terrestrial electromagnetic emissions
8	Imagery
9	Ion-neutral coupling
10-191	Reserved
192-254	Reserved for Local Use
255	Missing

Add the following new entries to Code table 4.2:

Code table 4.2 - *Parameter number by product discipline and parameter category*

Product discipline 4 – Space weather products, parameter category 0: Temperature

Number	Parameter	Units
0	Temperature	K
1	Electron temperature	K
2	Proton temperature	K
3	Ion temperature	K
4	Parallel temperature	K
5	Perpendicular temperature	K
6-191	Reserved	
192-254	Reserved for Local Use	
255	Missing	

Product discipline 4 – Space weather products, parameter category 1: Momentum

Number	Parameter	Units
0	Velocity magnitude (Speed)	m s^{-1}
1	1st vector component of velocity (coordinate system dependent)	m s^{-1}
2	2nd vector component of velocity (coordinate system dependent)	m s^{-1}
3	3rd vector component of velocity (coordinate system dependent)	m s^{-1}
4-191	Reserved	
192-254	Reserved for Local Use	
255	Missing	

Product discipline 4 – Space weather products, parameter category 2: Charged particle mass and number

Number	Parameter	Units
0	Particle number density	m ⁻³
1	Electron density	m ⁻³
2	Proton density	m ⁻³
3	Ion density	m ⁻³
4	Vertical electron content	m ⁻²
5	HF absorption frequency	Hz
6	HF absorption	dB
9	Spread F	m
10	h'F	m
11	Critical frequency	Hz
13	Scintillation	Numeric
14-191	Reserved	
192-254	Reserved for Local Use	
255	Missing	

Product discipline 4 – Space weather products, parameter category 3: Electric and magnetic fields

Number	Parameter	Units
0	Magnetic field magnitude	T
1	1st vector component of magnetic field	T
2	2nd vector component of magnetic field	T
3	3rd vector component of magnetic field	T
4	Electric field magnitude	V m ⁻¹
5	1st vector component of electric field	V m ⁻¹
6	2nd vector component of electric field	V m ⁻¹
7	3rd vector component of electric field	V m ⁻¹
8-191	Reserved	
192-254	Reserved for Local Use	
255	Missing	

Product discipline 4 – Space weather products, parameter category 4: Energetic particles

Number	Parameter	Units
0	Proton flux (differential)	$(\text{m}^2 \text{ s sr eV})^{-1}$
1	Proton flux (integral)	$(\text{m}^2 \text{ s sr})^{-1}$
2	Electron flux (differential)	$(\text{m}^2 \text{ s sr eV})^{-1}$
3	Electron flux (integral)	$(\text{m}^2 \text{ s sr})^{-1}$
4	Heavy ion flux (differential)	$(\text{m}^2 \text{ s sr eV/nuc})^{-1}$
5	Heavy ion flux (integral)	$(\text{m}^2 \text{ s sr})^{-1}$
6	Cosmic ray neutron flux	h^{-1}
7-191	Reserved	
192-254	Reserved for Local Use	
255	Missing	

Product discipline 4 – Space weather products, parameter category 5: Waves

Number	Parameter	Units
0-191	Reserved	
192-254	Reserved for Local Use	
255	Missing	

Product discipline 4 – Space weather products, parameter category 6: Solar electromagnetic emissions

Number	Parameter	Units
0	Integrated Solar Irradiance	W m^{-2}
1	Solar X-ray Flux (XRS Long)	W m^{-2}
2	Solar X-ray Flux (XRS Short)	W m^{-2}
3	Solar EUV Irradiance	W m^{-2}
5	Solar Spectral Irradiance	$\text{W m}^{-2} \text{ nm}^{-1}$
6	F10.7	$\text{W m}^{-2} \text{ Hz}^{-1}$
7	Solar radio emissions	$\text{W m}^{-2} \text{ Hz}^{-1}$
8-191	Reserved	
192-254	Reserved for Local Use	
255	Missing	

Product discipline 4 – Space weather products, parameter category 7: Terrestrial electromagnetic emissions

Number	Parameter	Units
0	Limb intensity	$\text{m}^{-2} \text{s}^{-1}$
1	Disk intensity	$\text{m}^{-2} \text{s}^{-1}$
2	Disk intensity day	$\text{m}^{-2} \text{s}^{-1}$
3	Disk intensity night	$\text{m}^{-2} \text{s}^{-1}$
4-191	Reserved	
192-254	Reserved for Local Use	
255	Missing	

Product discipline 4 – Space weather products, parameter category 8: Imagery

Number	Parameter	Units
0	X-ray radiance	$\text{W sr}^{-1} \text{m}^{-2}$
1	EUV radiance	$\text{W sr}^{-1} \text{m}^{-2}$
2	H-alpha radiance	$\text{W sr}^{-1} \text{m}^{-2}$
3	White light radiance	$\text{W sr}^{-1} \text{m}^{-2}$
4	Call-K radiance	$\text{W sr}^{-1} \text{m}^{-2}$
5	White light coronagraph radiance	$\text{W sr}^{-1} \text{m}^{-2}$
6	Heliospheric radiance	$\text{W sr}^{-1} \text{m}^{-2}$
7	Thematic mask	numeric
8-191	Reserved	
192-254	Reserved for Local Use	
255	Missing	

Product discipline 4 – Space weather products, parameter category 9: Ion-neutral coupling

Number	Parameter	Units
0	Pedersen conductivity	S m^{-1}
1	Hall conductivity	S m^{-1}
2	Parallel conductivity	S m^{-1}
3-191	Reserved	
192-254	Reserved for Local Use	
255	Missing	