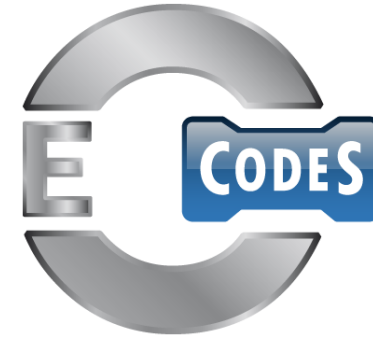# GRIB Keys

ecCodes GRIB Training Course
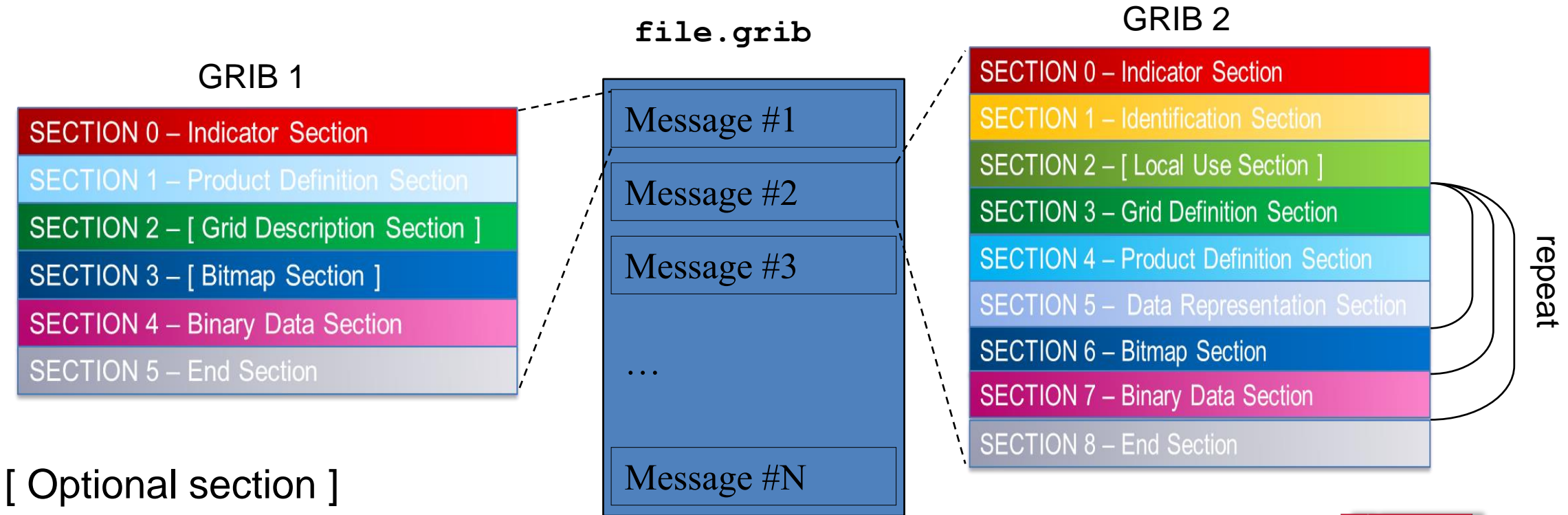
Xavier Abellan

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GRIB format


```
47 52 49 42 00 00 66 01 00 00 1C 01 62 01 FF 80 33 6D 00 01 06 0C    GRIB  f       b ˇÄ3m
05 0C 00 0C 00 C8 05 00 00 00 15 00 00 00 00 00 32 02 2B 0A 00 F8          »         2 +  ˙
01 90 80 33 C2 00 16 76 88 00 68 1A 00 76 F2 00 64 00 64 40 00 00    êÄ3¬  và h  vÚ d d@
00 00 80 55 F0 80 9C 40 00 00 00 00 43 3E B0 71 00 00 00 00 00 00    ÄU♣Äú@     C>∞q
0C 08 80 11 3C 1F 09 7C 00 00 37 37 37 37                            Ä  <  l  7777
```

GRIB 2

file.grib

GRIB 1

Message #1

Message #2

Message #3

…

Message #N

repeat

[Optional section]

GRIB edition 1 message

```
47 52 49 42 00 00 66 01 00 00 1C 01 62 01 FF 80 33 6D 00 01 06 0C   GRIB  f     b ˇÄ3m
05 0C 00 0C 00 C8 05 00 00 00 15 00 00 00 00 00 32 02 2B 0A 00 F8         »          2 +  ˉ
01 90 80 33 C2 00 16 76 88 00 68 1A 00 76 F2 00 64 00 64 40 00 00   éÄ3¬  và h  vÚ d d@
00 00 80 55 F0 80 9C 40 00 00 00 00 43 3E B0 71 00 00 00 00 00 00   ÄU•Äú@     C>∞q
0C 08 80 11 3C 1F 09 7C 00 00 37 37 37 37                           Ä < | 7777
```

==============   MESSAGE 1 (length=4284072)

1-4	identifier = GRIB
5-7	totalLength = 4284072
8	editionNumber = 1

=================== SECTION_1 (length=52, padding=0) ====================

1-3	section1Length = 52
4	table2Version = 128
5	centre = 98 [European Center for Medium-Range Weather Forecasts (grib1/0.table)]
6	generatingProcessIdentifier = 141
7	gridDefinition = 255
8	section1Flags = 128 [10000000]
9	indicatorOfParameter = 129 [Geopotential (m**2 s**-2) (grib1/2.98.128.table)]
10	indicatorOfTypeOfLevel = 1 [Surface (of the Earth, which includes sea surface) (grib1/3.table)]
11-12	level = 0
13	yearOfCentury = 16
14	month = 2
15	day = 24
16	hour = 0
17	minute = 0
18	unitOfTimeRange = 1 [Hour (grib1/4.table)]

...

GRIB edition 2 message

```
==============        MESSAGE 1 ( length=4284160 )
1-4        identifier = GRIB
5-6        reserved = MISSING
7          discipline = 0 [Meteorological products (grib2/tables/5/0.0.table) ]
8          editionNumber = 2
9-16       totalLength = 4284160
====================    SECTION_1 ( length=21, padding=0 )    ====================
1-4        section1Length = 21
5          numberOfSection = 1
6-7        centre = 98 [European Centre for Medium-Range Weather Forecasts (grib1/0.table) ]
8-9        subCentre = 0
10         tablesVersion = 5 [Version implemented on 4 November 2009 (grib2/tables/1.0.table) ]
11         localTablesVersion = 0 [Local tables not used  (grib2/tables/5/1.1.table) ]
12         significanceOfReferenceTime = 1 [Start of forecast (grib2/tables/5/1.2.table) ]
13-14      year = 2016
15         month = 2
16         day = 22
17         hour = 12
18         minute = 0
19         second = 0
20         productionStatusOfProcessedData = 0 [Operational products (grib2/tables/5/1.3.table) ]
21         typeOfProcessedData = 1 [Forecast products (grib2/tables/5/1.4.table) ]
====================    SECTION_2 ( length=17, padding=0 )    ====================
1-4        section2Length = 17
...
```

ecCodes approach

- ecCodes uses a **key / value approach** to access the information in a GRIB message

  numberOfPointsAlongAParallel ➜ Number of points along a parallel

  numberOfPointsAlongAMeridan ➜ Number of points along a meridian

- Each key has a native type (real, integer, string)

  - conversions are provided from one type to another when possible

- The set of keys available changes from one message to another depending on:

  - the GRIB edition

  - the content of the message

- Changing a key can cause some other keys to disappear or become available

ecCodes approach

• The value of a key is not always coded in the GRIB message because it can be the result of the combination of several other keys through a given algorithm or just temporary (transient). Therefore we talk about

– **CODED** keys (coded in the message as they are)

– **COMPUTED** keys (temporary or computed from other keys)

• Aliases are available for some of the keys

numberOfPointsAlongAParallel ➜ Ni or Nx or numberOfColumns

numberOfPointsAlongAMeridan ➜ Nj or Ny or numberOfRows

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Keys and parameters for GRIB – THE Reference

- GRIB Parameters Database

  - http://apps.ecmwf.int/codes/grib/param-db

- GRIB keys

  - http://apps.ecmwf.int/codes/grib/format/grib1/

  - http://apps.ecmwf.int/codes/grib/format/grib2/

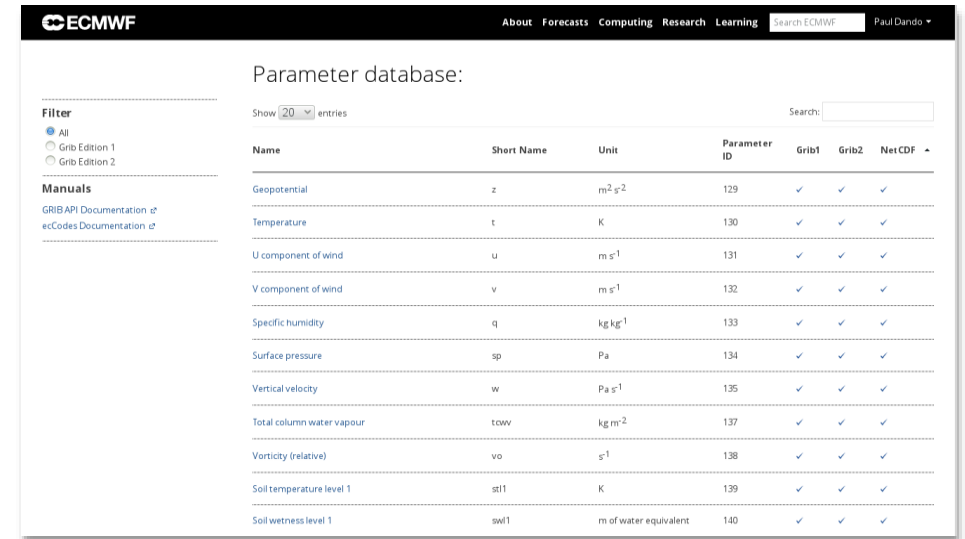 - http://apps.ecmwf.int/codes/grib/format/edition-independent/

- Disclaimer

  The official copy of the FM-92 GRIB document from which the relevant information contained in the following pages is copied can be obtained from the WMO web site: http://www.wmo.int/pages/prog/www/WMOCodes.html

ecCodes keys

- GRIB Tools: the easiest way to inspect a GRIB file and to find the keys:

    – grib_ls   to get a summary of the content

    – grib_dump   to get a more detailed view

- We will cover the tools later on in the course

- Most of what will follow will make more sense once you've had more hands-on experience!

Namespaces

- A namespace is a name for a set of keys

- A key belonging to a namespace can be get/set by prefixing it with the namespace or simply without any prefix:

  – time.step == step

  – parameter.paramId == paramId

- Several namespaces are available e.g.

  – parameter

  – time

  – geography

  – vertical

  – statistics

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ecCodes keys – file related

Key name	Description
count	Message number in a file
countTotal	Message number in a set of files
offset	Position in bytes of the start of a message in a file

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ecCodes keys – data values

Key name	Description
values	array of all the data values and missing values
numberOfCodedValues	number of values coded in the data section (excluding missing values)
numberOfPoints	number of grid points or size of the values array
numberOfMissing	number of missing values
max, min, average...	statistical information about the field
...	

ecCodes keys – parameter

- The definition of the parameter is very different in the two editions

GRIB 1 keys	GRIB 2 keys
centre	discipline
table2Version	parameterCategory
indicatorOfParameter	parameterNumber
levelType	typeOfFirstFixedSurface
level	scaleFactorOfFirstFixedSurface
…	scaledValueOfFirstFixedSurface
	typeOfSecondFixedSurface
	scaleFactorOfSecondFixedSurface
	scaledValueOfSecondFixedSurface
	productDefinitionTemplateNumber
	…

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ecCodes keys – parameter

- ecCodes provides some edition-independent keys to identify a parameter

Key name	Example value
paramId	151
shortName	msl
centre	ecmf (or 98)
name	Mean sea level pressure
unit	Pa

- This set of keys is the parameter *namespace*

ecCodes keys – time

Start of forecast run	Example values
dataDate	20160224 (YYYYMMDD)
dataTime	0, 600, 1200, 1800

Forecast step	Example values
stepType	instant, accum, avg, max, min, …
stepUnits	s, m, h, 3h, 6h, 12h, D, M, Y, 10Y, 30Y, C
startStep	0, 3, …
endStep (= step)	0, 3, ..
stepRange	3-6, 6 ("startStep-endStep" , "endStep")

Validity of the forecast	Example values
validityDate	20160224 (YYYYMMDD)
validityTime	0, 300, 1200, 1800

ecCodes keys – vertical and geography

Vertical namespace	Example values
typeOfLevel	hybrid, surface, depthBelowLandLayer, isobaricInhPa, …
level	0, 1, 137, 1000, 850, …

Geography namespace	Example values
Ni (Nx)	720
Nj (Ny)	361
gridType	reduced_gg, regular_ll, sh, …
latitudeOfFirstGridPointInDegrees	90.0, 55.5, …
longitudeOfFirstGridPointInDegrees	0.0, 350.0, …
latitudeOfLastGridPointInDegrees	-90.0, 35.0, …
longitudeOfLastGridPointInDegrees	360.0, 50.0, …
iDirectionIncrementInDegrees	0.5, …
jDirectionIncrementInDegrees	0.5, …
N	640, 320, …
…	…

ecCodes keys – geography arrays

- latitudes, longitudes

  – array with all the latitudes/longitudes for each point of the grid

- latLonValues

  – array with all the latitudes/longitudes/values for each point of the grid

  – (lat1,lon1,value1,lat2,lon2,value2,…,latN,lonN,valueN)

ecCodes keys – gridTypes

- For GRIB edition 1 and 2 :
  - regular_ll
  - reduced_ll
  - mercator
  - lambert
  - polar_stereographic
  - UTM
  - simple_polyconic
  - albers
  - miller
  - rotated_ll
  - stretched_ll
  - stretched_rotated_ll
  - regular_gg
  - rotated_gg
  - stretched_gg
  - stretched_rotated_gg
  - reduced_gg
  - sh
  - rotated_sh
  - stretched_sh
  - stretched_rotated_sh
  - space_view

- For edition 2 only:
  - triangular_grid
  - equatorial_azimuthal_equidistant
  - azimuth_range
  - cross_section
  - Hovmoller
  - time_section
  - lambert_azimuthal_equal_area

ecCodes keys – gridType

- For the following gridTypes a list of the latitudes and longitudes of the grid points can be obtained with grib_get_data (tools) and through a grib_iterator in C/F90/Python.

regular_ll	regular latitude-longitude
reduced_ll	reduced latitude-longitude
regular_gg	regular gaussian
lambert	lambert conformal
polar_stereographic	polar stereographic
space_view	space view perspective

ecCodes keys – packingType

- For GRIB edition 1 and 2:

    - grid_simple

    - grid_simple_matrix

    - grid_second_order

    - spectral_complex

    - spectral_simple

- For edition 2 only:

    - grid_simple_log_preprocessing

    - grid_jpeg

    - grid_png

    - grid_ieee

ecCodes keys – MARS

- There is a namespace consisting of all the MARS keywords:

Key name	Example values
date	20160224 (YYYYMMDD)
time	0000, 0600, 1200, 1800
step	3, 6, 9, 12, …
class	od, …
stream	oper, enfo,…
expver	0001
type	an, fc, cf, pf, …
levtype	sfc, pl, ml
levelist	500, 850, …
param	151.128

Questions?

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