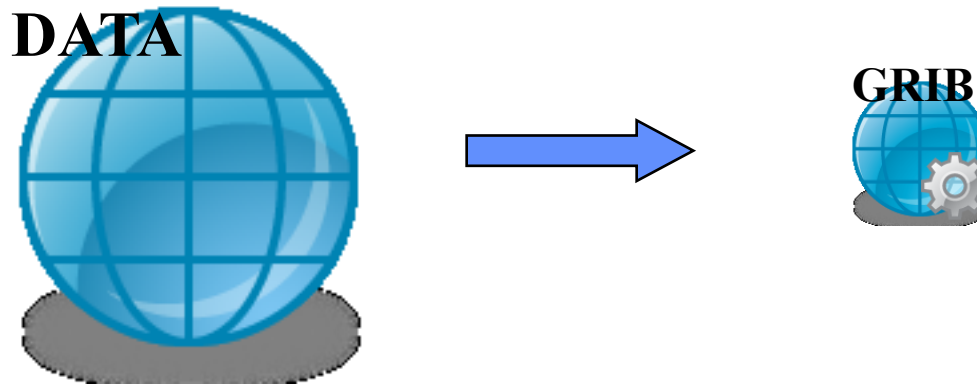


# **GRIB API**

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# GRIB

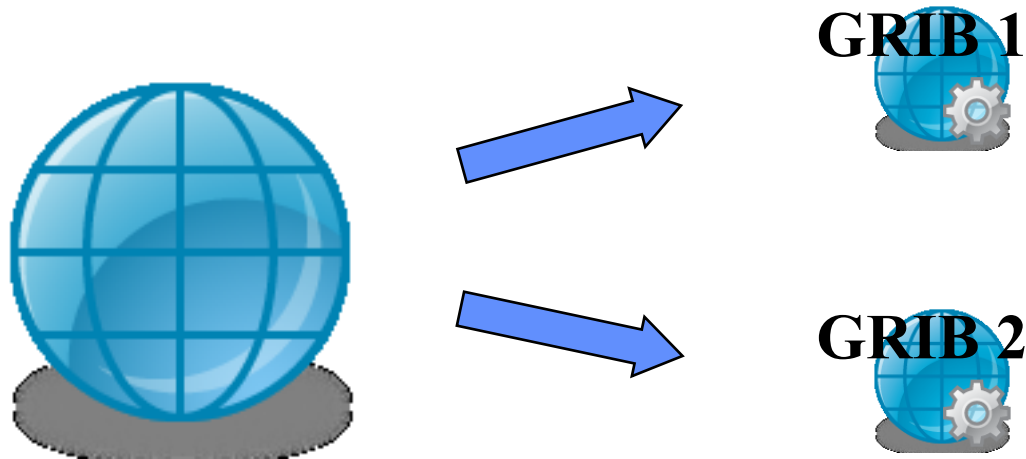
GRIB is a **binary** format to **exchange** and **store** general regularly-distributed information.



Acronyms: Initially “**GRI**dded **B**inary” but later expanded to “**G**eneral **R**egularly-distributed **I**nformation in **B**inary form”.

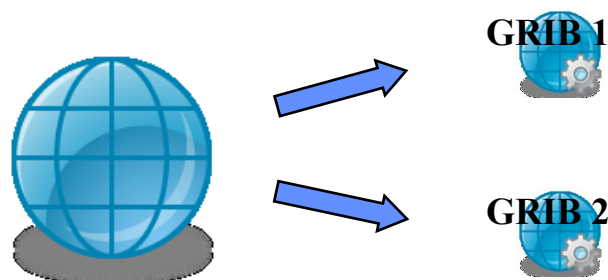
# GRIB edition 1 vs. 2

- Two different versions of the coding standard are available at the moment (edition 1 and 2).
- The **coding principles** in both editions are similar, but their **implementation is very different**.



# GRIB edition 1 vs. 2

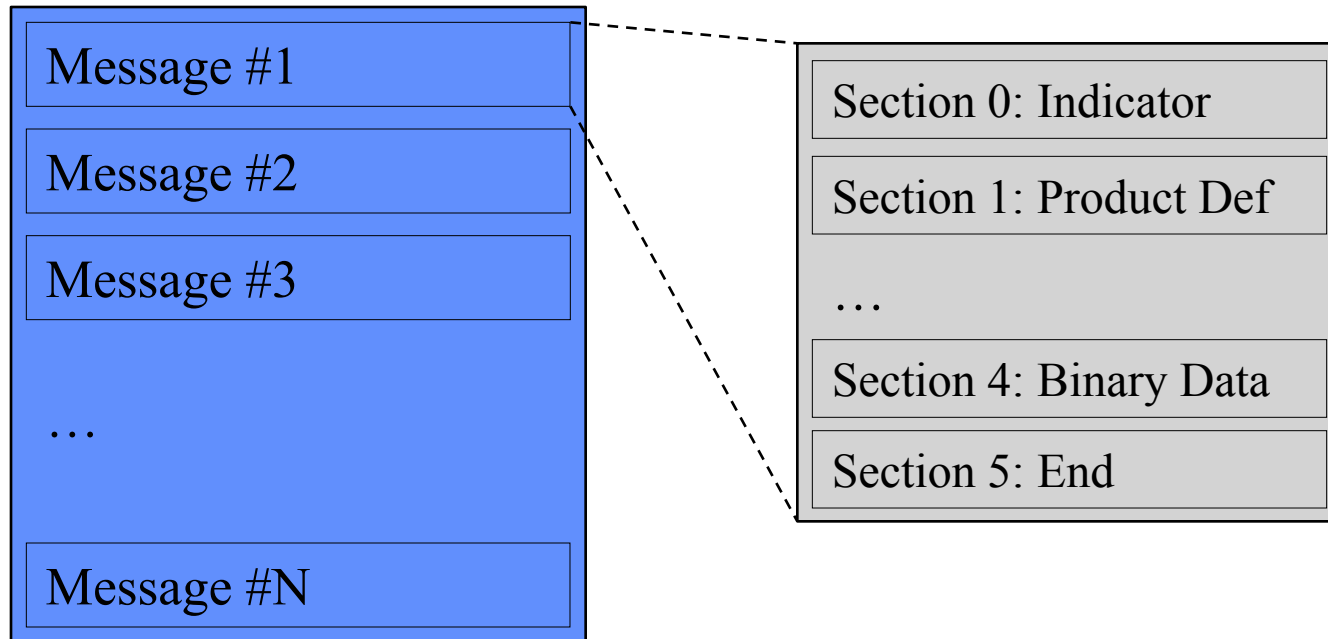
- Different structure. They both have sections (**with different meaning**).
- GRIB 2 is more flexible because of its template/table structure.
- In GRIB 2 several variables are defined with more precision (e.g. angles are in micro-degrees)
- In GRIB 2 the description of the data (parameter, time, statistics,...) is more complex and is template/table based (**prone to become even more complex**)



# GRIB Structure

- A **file** may contain one or more **GRIB messages**
- Each message contains several **sections**
- **Note:** A file can contain a mix of editions 1 and 2

File: eps.grib



# GRIB 1 vs. 2: Different Sections

## GRIB 1

- SECTION 0 Indicator
- SECTION 1 Product definition
- SECTION 2 Grid Description
- SECTION 3 Bitmap
- SECTION 4 Binary Data
- SECTION 5 End (7777)

## GRIB 2

- SECTION 0 Indicator
- SECTION 1 Identification
- SECTION 2 Local Use
- SECTION 3 Grid Definition
- SECTION 4 Product Definition
- SECTION 5 Data Representation
- SECTION 6 Bitmap
- SECTION 7 Binary Data
- SECTION 8 End (7777)

repeat



# GRIB 1 vs. 2: GRIB 2 Templates

```
===== SECTION 3 ( length=200, padding=0 ) =====
1-4      section3Length = 200
5        numberOfSection = 3
6        sourceOfGridDefinition = 0 [Specified in Code table 3.1 ]
7-10     numberOfDataPoints = 6114
11       numberOfOctetsForOptionalListOfNumbersDefiningNumberOfPoints = 2
12       interpretationOfListOfNumbersDefiningNumberOfPoints = 1 [Numbers
        define number of points corresponding to full coordinate circles ]
13-14    gridDefinitionTemplateNumber = 40 [Gaussian latitude/longitude]

15       shapeOfTheEarth = 0 [Earth assumed spherical with radius=6,367,470 m]
16       scaleFactorOfRadiusOfSphericalEarth = MISSING
17-20    scaledValueOfRadiusOfSphericalEarth = MISSING
21       scaleFactorOfMajorAxisOfOblateSpheroidEarth = MISSING
22-25    scaledValueOfMajorAxisOfOblateSpheroidEarth = MISSING
26       scaleFactorOfMinorAxisOfOblateSpheroidEarth = MISSING
27-30    scaledValueOfMinorAxisOfOblateSpheroidEarth = MISSING
31-34    numberOfPointsAlongAParallel = MISSING
35-38    numberOfPointsAlongAMeridian = 64
39-42    basicAngleOfTheInitialProductionDomain = 0
43-46    subdivisionsOfBasicAngle = MISSING
47-50    latitudeOfFirstGridPoint = 87864000
51-54    longitudeOfFirstGridPoint = 0
55       resolutionAndComponentFlags = 0
56-59    latitudeOfLastGridPoint = -87864000
60-63    longitudeOfLastGridPoint = 357188000
64-67    iDirectionIncrement = MISSING
68-71    numberOfParallelsBetweenAPoleAndTheEquator = 32
72       scanningMode = 0
73-200   pl = (64,128) {2.0000000000e+01, 2.7000000000e+01, ...}
=====
```

# GRIB 1 vs. 2: GRIB 2 Templates

```
===== SECTION_4 ( length=770, padding=0 ) =====
1-4      section4Length = 770
5        numberOfSection = 4
6-7      numberOfVerticalCoordinateValues = 184
8-9      productDefinitionTemplateNumber = 0
          [Analysis or forecast at a horizontal
           level or in a horizontal layer at a point in time]

10       parameterCategory = 0 [Temperature (grib2/4.1.0.table) ]
11       parameterNumber = 0 [Temperature (K) (grib2/4.2.0.0.table) ]
12       typeOfGeneratingProcess = 0 [Analysis (grib2/4.3.table) ]
13       backgroundGeneratingProcessIdentifier = 255
14       generatingProcessIdentifier = 130
15-16    hoursAfterReferenceTimeOfDataCutoff = 0
17       minutesAfterReferenceTimeOfDataCutoff = 0
18       indicatorOfUnitOfTimeRange = 1 [Hour (grib2/4.4.table) ]
19-22    forecastTime = 0
23       typeOfFirstFixedSurface = 100 [Isobaric surface (Pa) (grib2/4.5.table) ]
24       scaleFactorOfFirstFixedSurface = 0
25-28    scaledValueOfFirstFixedSurface = 0
29       typeOfSecondFixedSurface = 255 [Missing (grib2/4.5.table) ]
30       scaleFactorOfSecondFixedSurface = MISSING
31-34    scaledValueOfSecondFixedSurface = MISSING
35-770   pv = (184,736) {0.0000000000e+00, 2.0000400543e+00,...}
=====
```



# GRIB 1 vs. 2: different units

## GRIB 1

- LatitudeOfFirstGridPoint is in **milli**-degrees

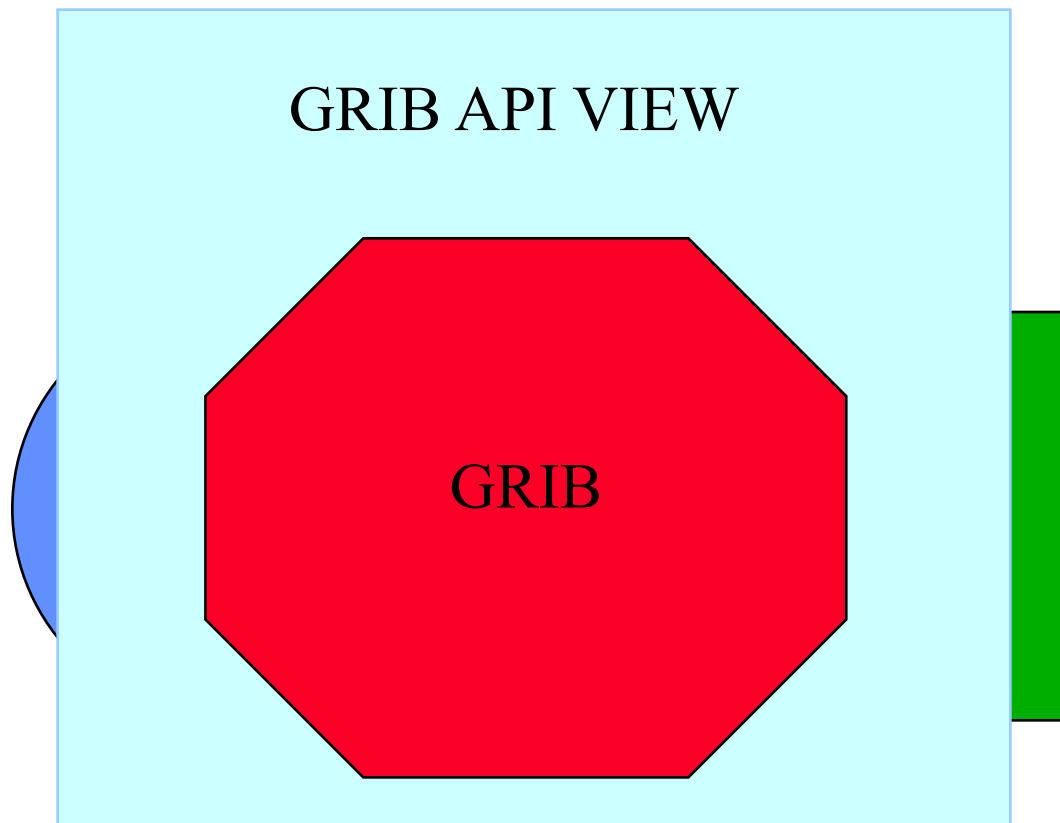
## GRIB 2

- LatitudeOfFirstGridPoint is in **micro**-degrees

or in an arbitrary unit defined by the fraction of two parameters:

**basicAngleOfTheInitialProductionDomain/  
subdivisionsOfBasicAngle**

# GRIB 1 vs. 2



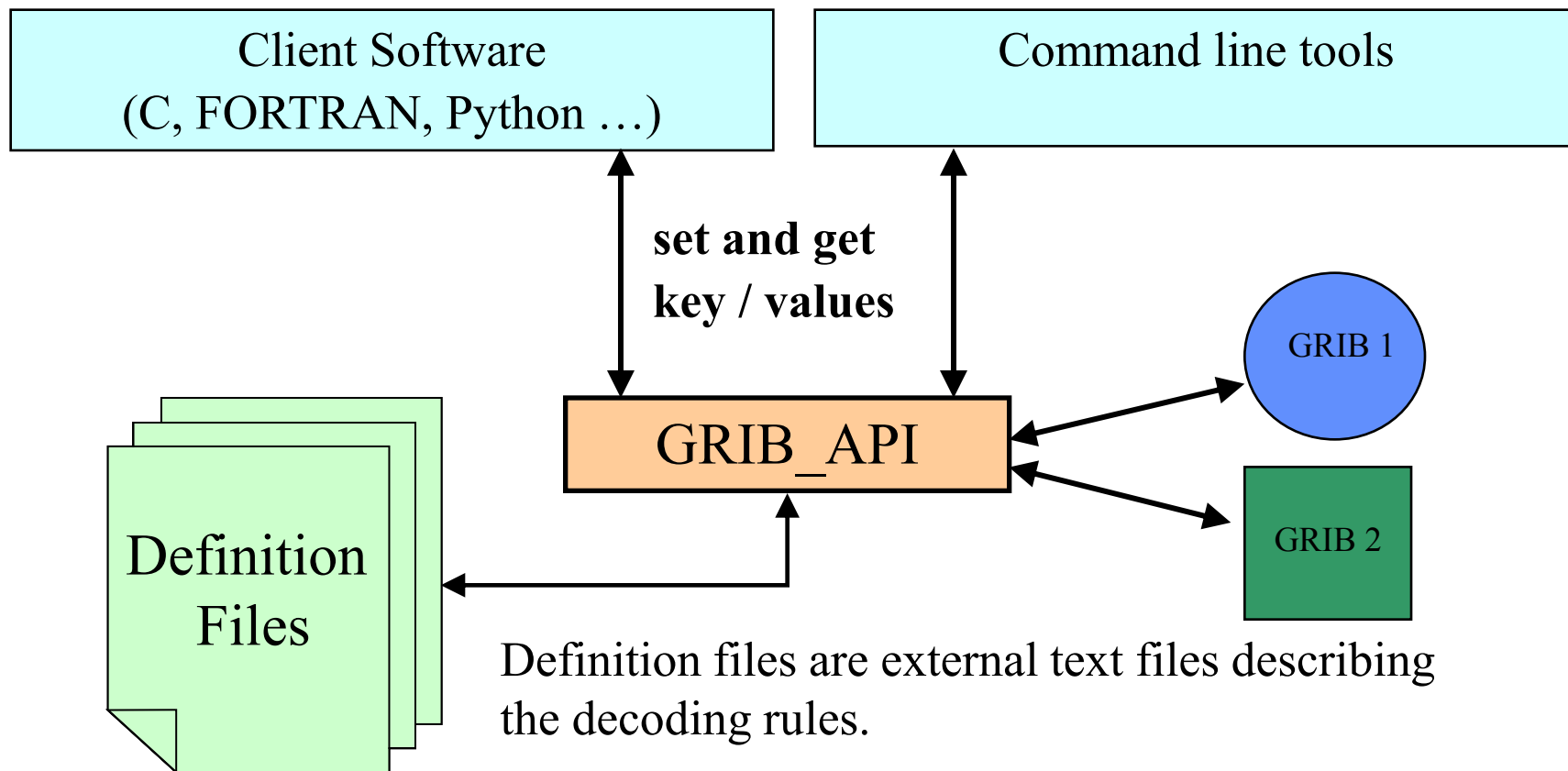
# GRIB API

- GRIB API main requirement is to **decode/encode both editions with the SAME function calls**.
- GRIB API has to be **flexible** enough to be easily updated for new template and tables.
- GRIB API should **hide the binary layer** of the message, providing the user a higher level of access.
- GRIB API must provide a way to **convert data between the two grib editions**.
- GRIB API provides interfaces for Fortran, C and python.
- GRIB API provides **more services** to the user helping to manage easily geography (data are always in a geographic context).

# GRIBEX vs. GRIB API

- GRIBEX provides an array based access to the GRIB message.
  - ksec2(2) => Number of points along a parallel
  - ksec2(3) => Number of points along a meridian
  - ...
- GRIB API provides a key/value based approach
  - NumberOfPointsAlongAParallel => Number of points along a parallel
  - NumberOfPointsAlongAMeridan => Number of points along a meridian
  - ...

# GRIB API - Design



Definition files are external text files describing the decoding rules.

New decoding rules can be added without rebuilding the grib\_api

# GRIB 1 vs. 2

**COMPUTED**

latitudeOfFirstGridPointInDegrees=40

**CODED**

latitudeOfFirstGridPoint=40000

**CODED**

latitudeOfFirstGridPoint=40000000

# GRIB 1 vs. 2

**COMPUTED**



gridType=reduced\_gg

gg =  
Gaussian  
Grid

**CODED**



dataRepresentationType=4  
numberOfPointsAlongAParallel=MISSING  
ijDirectionIncrementGiven=0  
pl = {...}

**CODED**



gridDefinitionTemplateNumber=40  
numberOfPointsAlongAParallel=MISSING  
iDirectionIncrementGiven=0  
iDirectionIncrement=MISSING  
pl = {...}

# GRIB API: available interfaces

- **C native interface** exposes all the functionalities in an object oriented style.
- **Fortran 90** provides an easy access to the main functionalities of the library from Fortran 90.
- **Python** provides access to the C functions from python.
- **GRIB tools** provide a command line interface of the API
- All the interfaces provide a way to **set/get** the same **key/values** pairs from the messages.



## GRIB API: available interfaces ( C )

```
h = grib_handle_new_from_file(context,in,&err);  
grib_get_double(h,"latitudeOfFirstGridPointInDegrees",  
                &latitudeOfFirstGridPointInDegrees);  
grib_set_long(h,"centre",centre);  
grib_set_string(h,"date",date,&len);  
grib_handle_delete(h);
```

# GRIB API: available interfaces (Fortran 90)

```
call grib_new_from_file(ifile,igrib,iret)
```

```
call grib_get(igrib,'latitudeOfFirstGridPointInDegrees',  
             latitudeOfFirstPointInDegrees)
```

```
call grib_set(igrib,'centre',centre)
```

```
call grib_set(igrib, 'date','20070212')
```

```
call grib_release(igrib)
```

# GRIB API: available interfaces ( Python )

```
gid = grib_new_from_file(f)
```

```
lat = grib_get(gid, 'latitudeOfFirstGridPointInDegrees')
```

```
grib_set(gid, 'centre', centre)
```

```
grib_set(gid, 'date', date)
```

```
grib_release(gid)
```

# GRIB API: available interfaces (tools)

```
grib_get -p latitudeOfFirstGridPointInDegrees regular_latlon_surface.grib1
```

```
grib_set -s centre=ecmf,date=20070212 regular_latlon_surface.grib1 out.grib1
```

# Help and Support

- For issues, bugs and requests:  
**[Software.Support@ecmwf.int](mailto:Software.Support@ecmwf.int)**
- New wiki for GRIB API:  
**<https://software.ecmwf.int/wiki/display/GRIB>**
- Please use the Forums for general discussions:  
**<https://software.ecmwf.int/wiki/display/GRIB/Forums>**



# Questions ?