Migration to GRIB2 -> 50r2

Computer representatives meeting 2025

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Migration technical lead and coordinator

ECMWF

Terms of reference

Scope

- Migrate all parameters
- Only new data produced, no conversion of existing data
- Migrate our entire software stack: I/O routines in models, interpolation, plotting, indexing, archiving, dissemination

Requirements

- Minimize disruptions to our operations and to our users
- Maintain consistency with existing data
- Provide tools to ease the migration
- Take advantage of the rich metadata
- Support Member states
- Fully WMO compliant, avoid local encoding

Before the migration (up to cycle 49r1)

- Extend GRIB2 with templates and parameters
- Prepare ecCodes definitions for the necessary changes

During the migration (cycles 49r2, 50r1 and 50r2)

- Mixture of GRIB1/GRIB2 and full GRIB2 handled correctly in parallel
- Software pipeline deals with data from before/after the migration

After the migration (from cycle 51r1)

- Continue to handle old data correctly

Migration preparation: New templates, new parameters

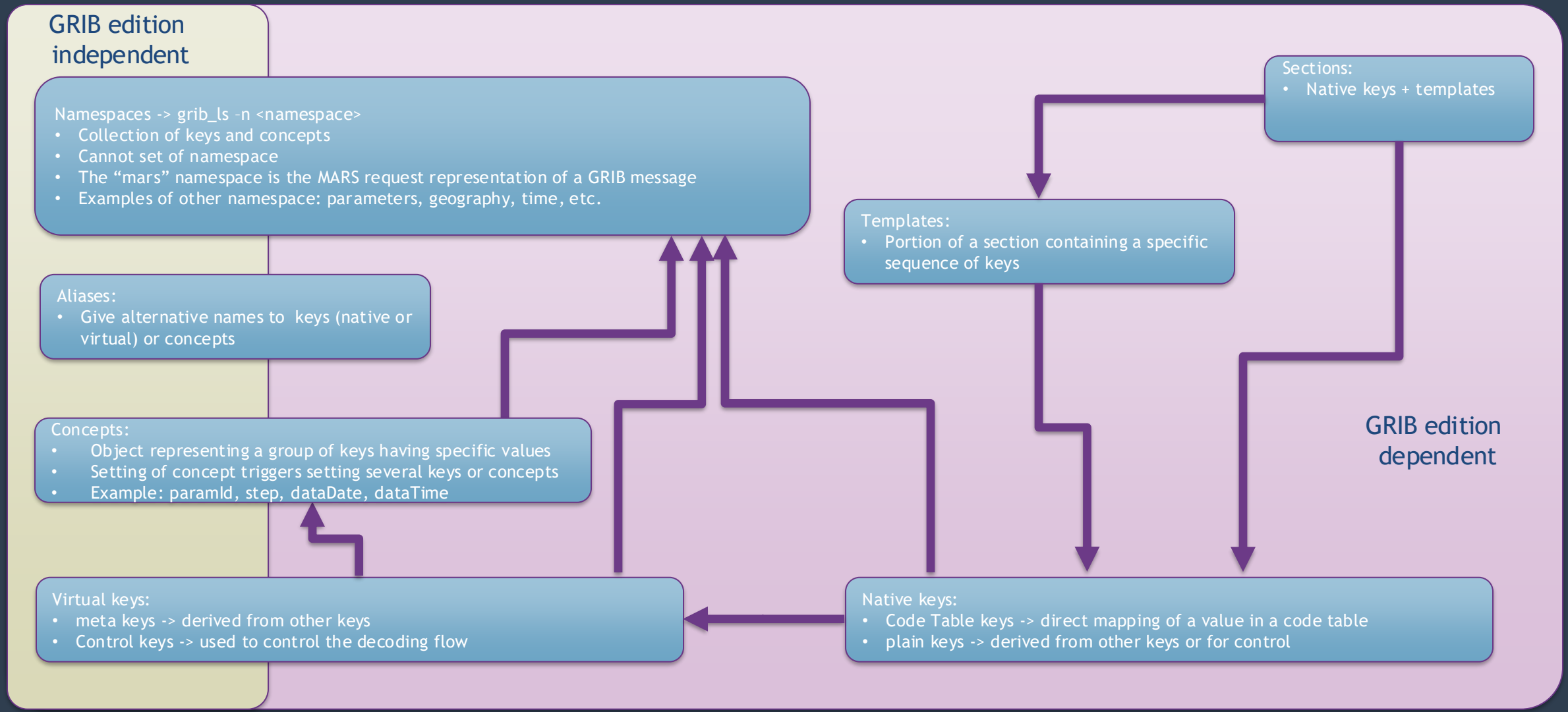
Templates (~80 new templates added)

- Wave spectra (frequency/direction) and wave period templates
- Anomalies, EFI, SOT templates
- Tile templates for land surface modelling
- Probability templates with focal statistics
- Quantile based templates
- Large ensembles (>255 members)

Parameters

- Heat stress
- Soil/snow/ice model levels/layers
- Hydrological parameters
- Ocean, ice and waves
- Destination Earth and ERA6 parameters

ecCodes terminology: keys, concepts, namespaces, templates and sections



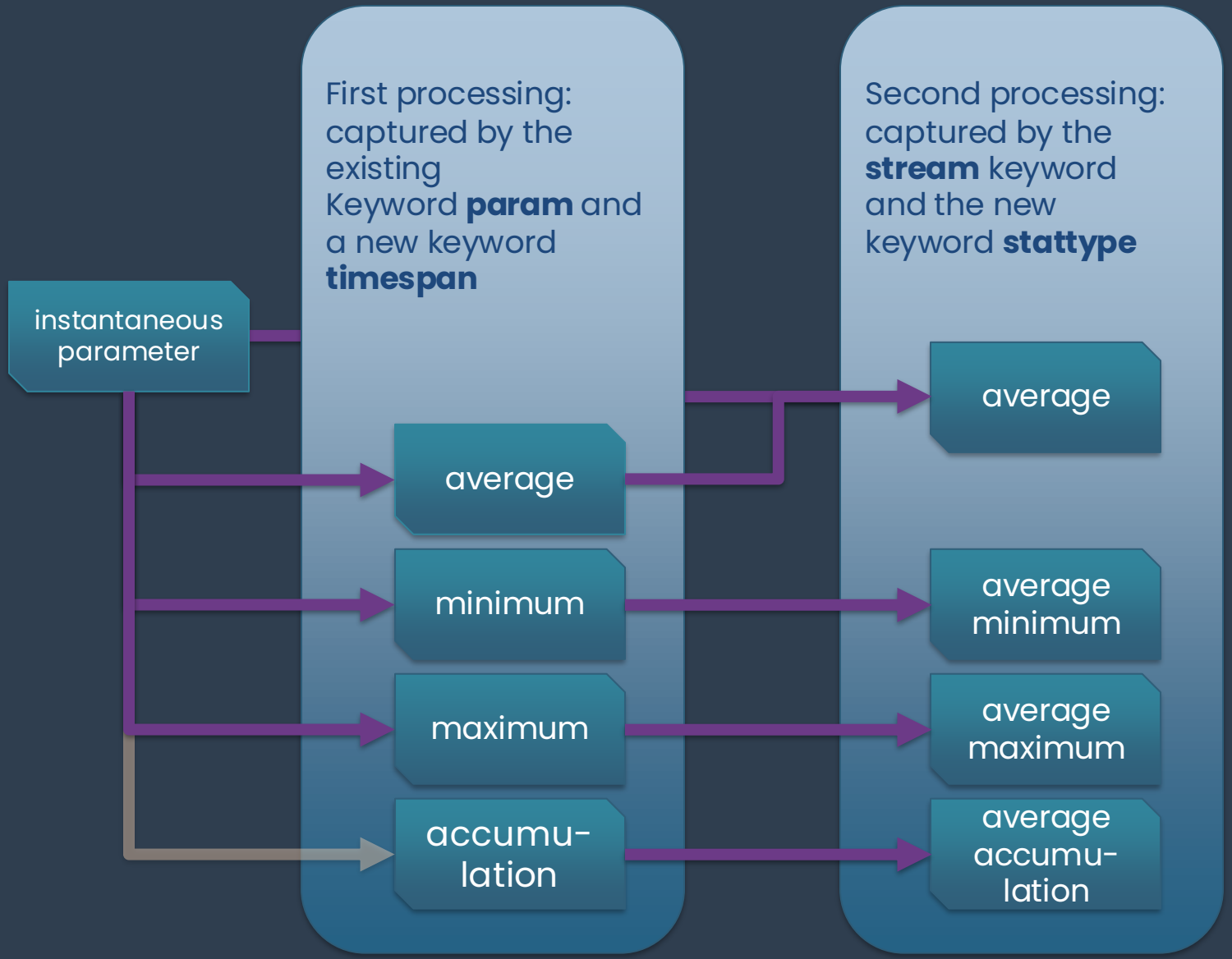
Concepts paramId - shortName

probability of accumulated total precipitation at surface of at least 25mm	
GRIB1 (ECMWF)	GRIB2 (WMO)
table2Version = 131 indicatorOfParameter = 98 timeRangeIndicator=4 (accumulation)	productDefinitionTemplateNumber = 9 (probability) discipline = 0 (meteorology) parameterCategory = 1 (Moisture) parameterNumber = 52 (Total* precipitation rate) typeOfFirstFixedSurface = 1 (surface) typeOfStatisticalProcessing = 1 (Accumulation) probabilityType = 3 (above lower limit) scaledValueOfLowerLimit = 25 scaleFactorOfLowerLimit = 0 (no scaling)

In ecCodes, these 2 representations share:

- the same paramId: 131098
- the same shortName: tpg25

New model for parameters



Parameters changes across the migration

- All parameters containing a time range will be deprecated:
  - In the last XX hours
  - Since previous post-processing
  - The range will be handled by the new keyword timespan

- Parameters without WMO units will be deprecated

- Parameters will be indexed differently in some cases:
  - Soil temperature on soil level 1 to 4, rather than four parameters on level sfc
  - Parameters at a specific height in metres: 50m, 100m, 200m, etc.
    - All on levtype height level "hl" with a base parameter rather than many different parameters on levtype sfc.
    - In this context, parameters <=10m will not change, e.g. 2t and 10u/v

Standardisation of shortNames and time post-processing

- The shortNames will be standardized and use prefixes to indicate their first level of type of time processing:
  - 2t, min_2t, max_2t, avg_2t
- The length of the first level of time processing is captured by a new keyword timespan:
  - timespan=1h (hourly), timespan=3h (3-hourly) , timespan=from-start (special, for accumulations)
- Any additional time processing (type and length) will be captured by the stream and a new keyword stattype:
  - stream=sttd (statistical processing for deterministic)and stream= stte (for ensemble)
  - Statype=Monthly means, monthly maxima, monthly manima
  - Similar stattype for weekly means, daily means, 5-days maximum, etc.
- This will allow future development for other processing and gives a flexible and generalisable structure.

Handling legacy encoding

- GRIB2 prescribes the units of parameters
  - Precipitation in kg m-2 vs m
  - Cloud cover in % vs (0-1)
  - ….
- ECMWF produces all precipitation parameters in “metres of water”
  - 1 kg m^{-2} ~ 1mm
  - Conversion factor ~10^3

- In GRIB1 and sometimes GRIB2, instantaneous paramIds have been used to encode monthly means
  - By introducing the correct encoding with separate paramIds, we break these parameters
  - Special handling to continue to decode these parameters correctly
  - Prevent writing more of these

ChemId for atmospheric composition

- The number of paramIds used in atmospheric composition is problematic
- Conceptually these parameters are 2 dimensional:
  - A physical property
  - chemical species and aerosols
- We are splitting the existing paramIds into a pair of keywords:
  - paramId : now only representing the property
  - chemId : representing the chemical species and aerosols
- We also considered extracting the emission sources into a separate keyword but decided not to do so

Wavelength keyword for optical parameters

- We are introducing a new “wavelength” keyword to capture the dependency of the optical parameters into a separate degree of freedom.
- This will have an impact on the existing optical parameters, particularly in atmospheric composition:
  - optical depths
  - Parameters “at XXX nm”
- It will support other IFS developments: simulated satellite images, etc.
  - channels

modelName and modelVersion

- We are introducing 2 new important helper keys to enrich the metadata:
  - modelName (IFS, AIFS, EFAS, etc.)
  - modelVersion (cy50r2, vX.Y, etc.)
- In specific cases, these can be used as a MARS keyword when the data is archived e.g. LDAS.

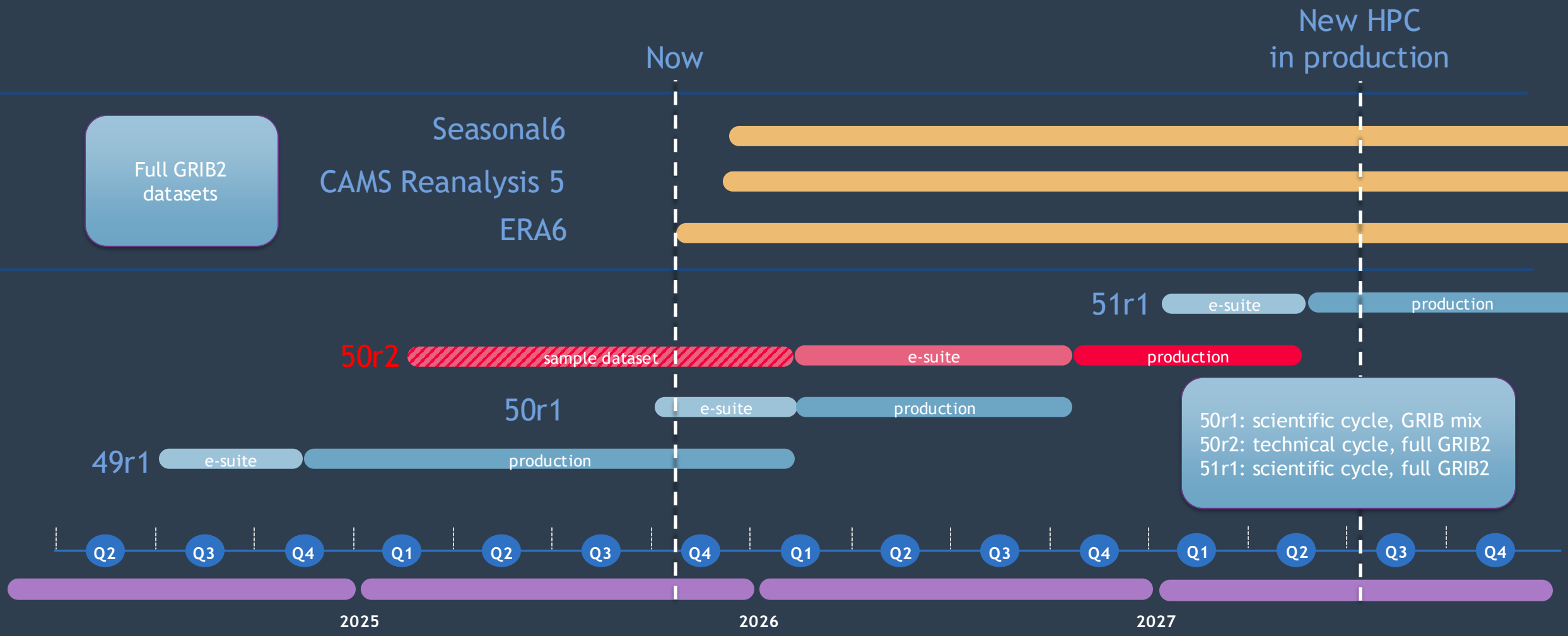
Wave streams

- discontinued from 50r2
- Move regular wave parameters and 2D wave spectra into respective atm streams:
  - Wave -> oper , waef -> enfo, etc.
- Still logically separated from atm parameters in the MARS catalogue using a paramtype node in the tree
  - paramtype=base -> atm parameters
  - paramtype=wave -> regular wave parameters
  - paramtype=wave_spectra -> 2D wave spectra
- Future use of paramtype: chemical, optical, tile

Tools to support the migration

- Reference Dataset
  - First prototype available – will be incrementally updated to cover all operational data.
  - Available on the HPC: **`/ec/vol/marsdev4/MTG2_sample_dataset`**
  - Available at https://data.ecmwf.int/mtg2_sample/
- MARS request translator
  - Provide a tool to help users migrate their requests
  - Support conversion of dissemination requests
- Robust conversion tool: GRIB1 -> GRIB2
  - We will not support the reverse conversion

Timeline


New HPC
in production
Now
Full GRIB2
datasets
Seasonal6
CAMS Reanalysis 5
ERA6
51r1
e-suite
production
50r2
sample dataset
e-suite
production
50r1
e-suite
production
49r1
e-suite
production
50r1: scientific cycle, GRIB mix
50r2: technical cycle, full GRIB2
51r1: scientific cycle, full GRIB2
Q2
Q3
Q4
Q1
Q2
Q3
Q4
Q1
Q2
Q3
Q4
Q1
Q2
Q3
Q4
2025
2026
2027

StayTuned!

Thank you!

ecCodes release notes

MTG2 homepage

Parameter changes

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MTG2 reference dataset

In Focus article