

MARS – Introduction and basic concepts

MS Computing training course

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Contents

- **Introduction**
- **MARS architecture**
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- **Practical session**

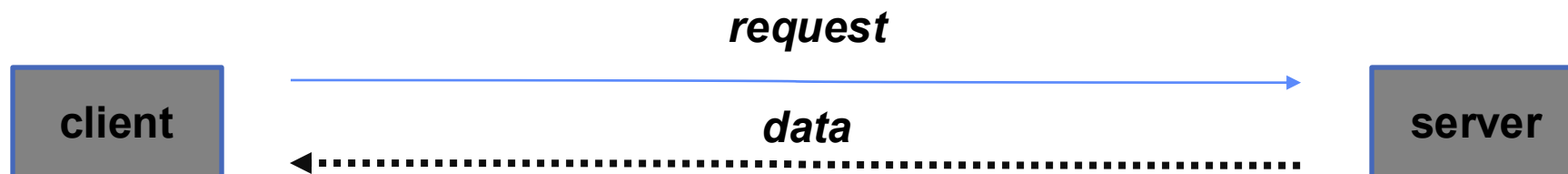
Meteorological Archival and *Retrieval* System

- Meteorological data (GRIB: fields, BUFR, ODB: observations)
- Large amount of data (size of archive & number of fields)
- Operational & Research environment
- Batch & interactive modes
- Large number of users with different requirements:
 - large datasets rarely ↔ few fields very often
- Heterogeneous environment



Introduction – MARS components

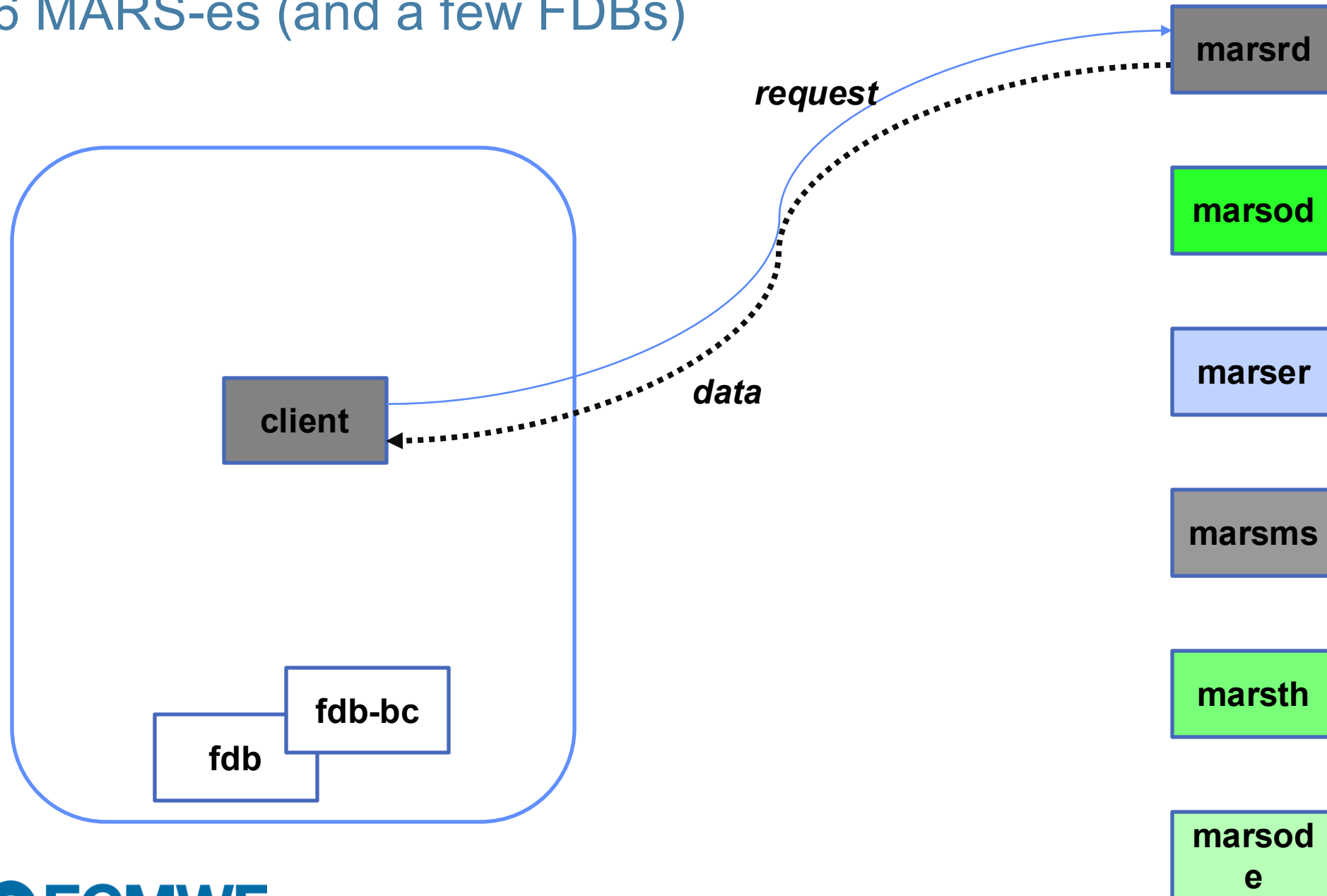
- Client/Server architecture
- Clients: Atos HPCF and Web MARS virtual machine
- Servers: supercomputers, dedicated servers
- Several databases
- Tape library



MARS Architecture – Servers

- Reports Database (RDB), on-line observations (for Operations only)
- Fields Database (FDB)
 - Data produced by most recent cycles or experiments
 - Very fast access (on-line data)
 - Suitable for model input
- ODB server, on-line ODB on supercomputer
- Main Archives (multiple servers)
 - Dedicated Linux servers / clustered architecture (~200 servers)
 - 17 PB of disk space
 - Tape management SW: HPSS
 - Automated Tape Libraries: IBM and SpectraLogic

6 MARS-es (and a few FDBs)



Introduction – Some figures

- Operational forecast since 1985
- Analysis, forecast and observations since 1900 (ERA-20C)
- 718 PB exabytes of data
- ~ 400 TB archived per day
- ~ 7000 users with access to MARS
- 1000 active users/day executing ~ 1.5 million requests/day
- ~ 350 TB retrieved daily on average with peaks over 600 TB/day (without FDB)
- Average retrieve of 540 TB / day from FDB
- System handles about 13,000 tape mounts / day
- Only 2.4 % of the data is on disk

What is a PiB?

(Assuming reading from/writing to disk at 100 MiB/s)

	Bytes	Seconds	Days	Months
MiB	1,048,576	0.01		
GiB	1,073,741,824	~10		
TiB	1,099,511,627,776	10,485	0.12	
PiB	1,125,899,906,842,624	10,737,418	124	> 4
EiB	1,152,921,504,606,846,976			

Copying 1 PiB | | 99 days, 13:07:39

remaining

Tape libraries



Terminology – Forecast lead times

- **Medium-range**

the ensemble forecasts of weather, at the space and time-scales represented by the relevant model, up to 15 days ahead, respectively, and the associated uncertainty

- **Extended-range (monthly, previously known as Sub-seasonal)**

ensembles of individual forecasts and post-processed products of average conditions (e.g. weekly averages) up to 46 days ahead, and the associated uncertainty

- **Long-range (SEAS)**

ensembles of individual forecasts and post-processed products of average conditions (e.g. monthly averages) up to 13 months ahead, and the associated uncertainty

Terminology – ... more

- Re-forecast

forecasts run for past decades necessary to estimate the model climate and the level of skill and to generate some of the operational products

- IFS

`Integrated Forecasting System`, *the NWP system* used at ECMWF

- AIFS

`Artificial Intelligence Forecasting System`, *the ML system* used at ECMWF

<https://confluence.ecmwf.int/display/DAC/File+naming+convention+and+format+for+real-time+data>

www.ecmwf.int/en/forecasts/documentation-and-support

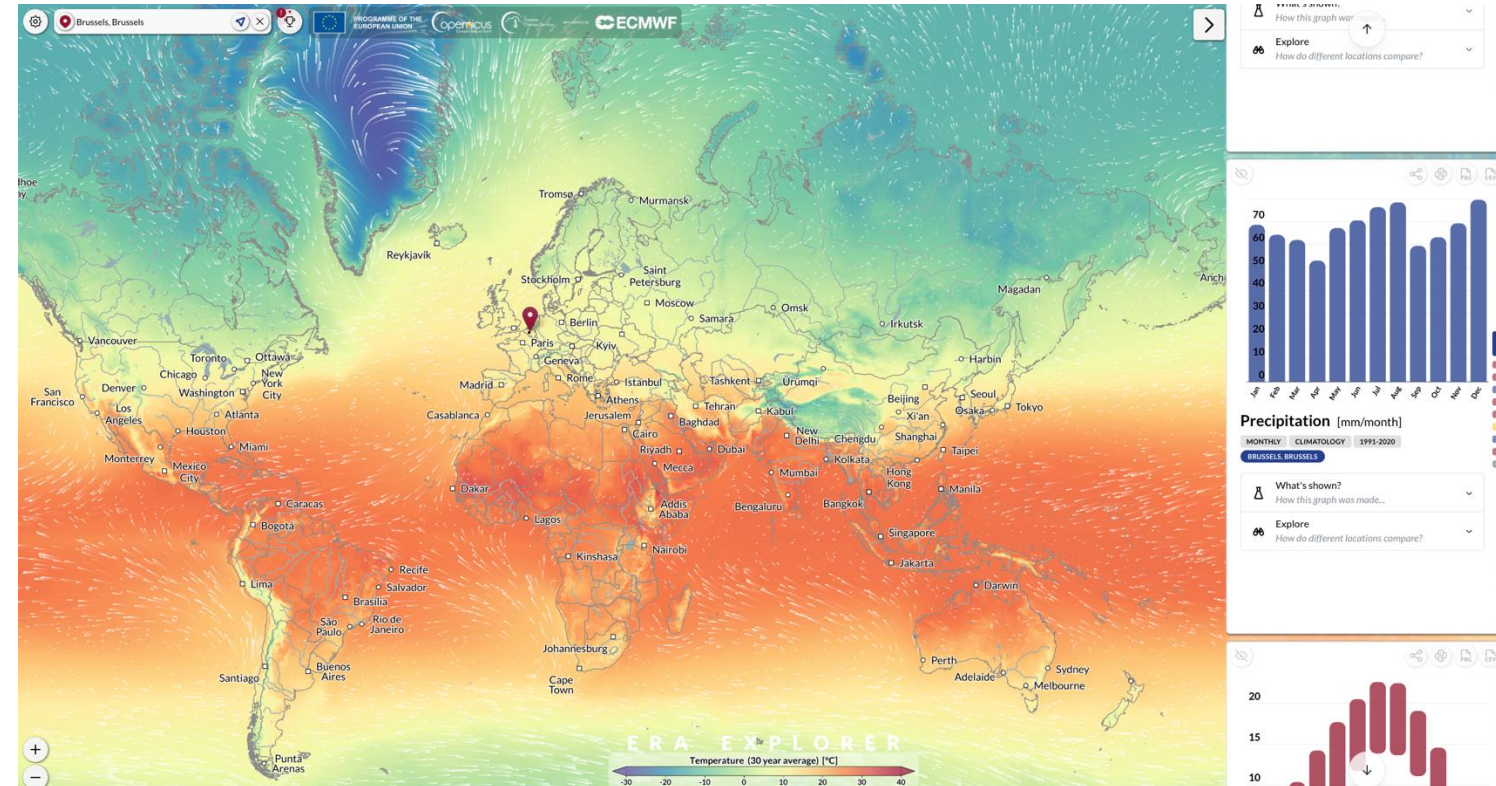
Meteorological content – Reanalysis datasets

Browse reanalysis datasets

ECMWF uses its forecast models and data assimilation systems to 'reanalyse' archived observations, creating global data sets describing the recent history of the atmosphere, land surface, and oceans.

Dataset	Time period	Atmosphere	Atmospheric composition	Ocean waves	Ocean sub-surface	Land surface	Sea ice	Observation Feedback Archive	Download using MARS web interface (unless stated otherwise)
ERA5	1940-present	✓		✓		✓			Get ERA5 from the Climate Data Store
ERA5-Land	1950-present					✓			Get ERA5-Land from the Climate Data Store
ERA-Interim	1979-August 2019	✓		✓		✓			Users are strongly advised to migrate to ERA5 from the Climate Data Store (CDS)
ERA-Interim/Land	1979-2010					✓			Users are strongly advised to migrate to ERA5-Land from the Climate Data Store (CDS)
CERA-SAT	2008-2016	✓		✓	✓	✓	✓		
CERA-20C	1901-2010	✓		✓	✓	✓	✓		
ERA-20CM	1900-2010	✓		✓		✓			
ERA-20C	1900-2010	✓		✓		✓		✓	
ERA-20CL	1900-2010					✓			Contact ECMWF

ERA5 dataset

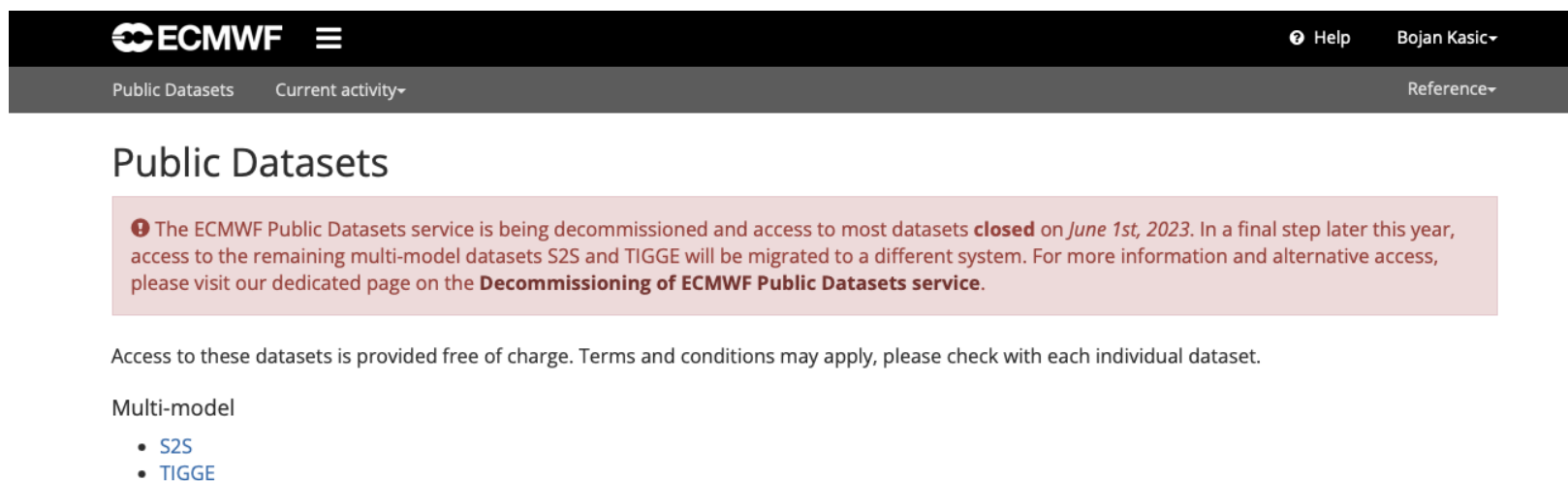


<https://www.ecmwf.int/en/forecasts/datasets/browse-reanalysis-datasets>

<https://climate.copernicus.eu/climate-reanalysis>

Access to ECMWF Public DataSets

- TIGGE
- S2S
- Can be download from a web browser or using Web API python client
- <https://apps.ecmwf.int/datasets/>
- <https://confluence.ecmwf.int/display/DAC/Decommissioning+of+ECMWF+Public+Datasets+Service>



The screenshot shows the ECMWF Public Datasets website. The header includes the ECMWF logo, a menu icon, and user information (Help, Bojan Kasic). The main navigation bar has links for Public Datasets, Current activity, and Reference. The main content area is titled "Public Datasets" and features a prominent red warning box stating that the service is being decommissioned and access to most datasets is closed on June 1st, 2023. Below this, a paragraph states that access to the remaining multi-model datasets S2S and TIGGE will be migrated to a different system. A section titled "Multi-model" lists S2S and TIGGE as the remaining datasets.

ECMWF

Public Datasets Current activity Reference

Public Datasets

! The ECMWF Public Datasets service is being decommissioned and access to most datasets **closed** on *June 1st, 2023*. In a final step later this year, access to the remaining multi-model datasets S2S and TIGGE will be migrated to a different system. For more information and alternative access, please visit our dedicated page on the **Decommissioning of ECMWF Public Datasets service**.

Access to these datasets is provided free of charge. Terms and conditions may apply, please check with each individual dataset.

Multi-model

- S2S
- TIGGE

Meteorological content – Data formats

WMO formats

- Fields in GRIB (**GR**id **I**n **B**inary) v 1 and 2, ECMWF local extensions
 - Spherical Harmonics (upper-air fields, T_{CO}1279)
 - Gaussian Grid (surface fields, O1280)
 - Latitude/Longitude (wave and ocean products)
- Observations in BUFR (**B**inary **U**niversal **F**orm **R**epresentation)
 - Instrument specific

ECMWF/IFS format

- ODB (**O**bservational **D**ata **B**ase)
 - Observation feedback

MARS language

Mechanism to *name* fields

Request syntax:

```
verb,  
    keyword1    = value1,  
    ...         = value2,  
    keywordN    = valueN
```

- **verb**: action to be taken (e.g. retrieve, [list](#), read)
- **keyword**: a known MARS variable, e.g. type or date
- **value**: value assigned to the keyword, e.g. Analysis or temperature
- Description of all keywords is available in Confluence:

<https://confluence.ecmwf.int/display/UDOC/Keywords+in+MARS+and+Dissemination+requests>

MARS language

- **verb** and **keyword=value** separated by commas, but last one
- Spaces and tab characters are ignored
- *****, **!** and **#** comment until end-of-line
- Directives are not case sensitive
- Values: predefined names, numeric values or strings (filenames)
- Abbreviations: enough letters to uniquely identify keyword or value
- Acronyms: usually initial letters of names
- **/** is used as list separator → specify pathnames in quotes

MARS language – Retrieve request

retrieve,

action

```
class      = od,  
stream     = oper,  
expver     = 1,
```

identification

```
date       = -3,  
time       = 12,
```

date & time related

```
type       = analysis,  
levtype    = model levels,  
levelist   = 1/to/137,  
param      = 130,
```

data related

```
grid       = 2.5/2.5,  
area       = 75/-25/10/60
```

post-processing

```
target     = "analysis"
```

storage

MARS language – Identification of archive

class	ECMWF classification (od, rd, ai, ea, ...)
stream	originating forecasting system or (oper, wave, enfo, seas, ...)
expver	version of the experiment (01 operational, 11, abcd)
domain	area covered by the data (Global, Mediterranean, ...)
origin	originating centre of the data (kwbc, egrr, ...)
system	seasonal forecast operational system (1, 2, 3)
 model	different model identifier (aifs-single, aifs-ens, ...)
method	to specify how the seasonal forecast is produced, e.g. in System 2, method=0 for runs without ocean assimilation (0, 1, ..., 3)

MARS language - Date & time

time	base time or observation time (00, 06, 09:30, ...)
date	base date of the model (-1, 20010225, ...)
step	forecast time-step [hours] from base time (12, 24, 240, ...)
reference	reference forecast time step for EPS tube (96,...)
refdate	date of real-time forecast associated to re-forecast/hindcast (stream=mnfh)
hdate	base date of a re-forecast/hindcast (stream=enfh)
range	observations: period in minutes from base time (360,...) ocean fields: extension of the time series/average
fcmonth	month from seasonal forecast base date (1, 6, ...)
fcperiod	period, in days, for an averaged field (26-32)

MARS language – Fields

type	type of field (an, fc, cf, pf...)
levtype	type of level (pl, ml, sfc, pt, pv, sol)
levelist	levels for the specified levtype (off if levtype=sfc)
param	meteorological parameter (t, temperature, 130, 30.128)
number	ensemble member (1, 2, ...), but also cluster number, SOT %
channel, instrument, ident	simulated satellite data keys
diagnostic, iteration	sensitivity forecast products
frequency, direction	2-d wave spectra products
product, section, latitude, longitude	ocean products

MARS language – Observations & images

type	type of observations or images (ob, fb, ai, af, im)
obstype	observation subtype (s, air) or image channel
ident	WMO observation station number or satellite identifier
duplicates	whether duplicated observations are to be kept or not
block	WMO block number for observation
time	analysis time (types ai, af) or observations time (types ob, fb, im)
range	denotes the period, in minutes, starting from time

MARS language – Storage

- target** UNIX pathname where retrieved data is stored
- source** UNIX pathname from where to read data
- fieldset** temporary storage; can be considered a MARS variable

Unix pathnames (using /) have to be enclosed in quotes, e.g.

```
target = “/scratch/{uid}/analysis”
```

MARS language - Post-processing (1/2)

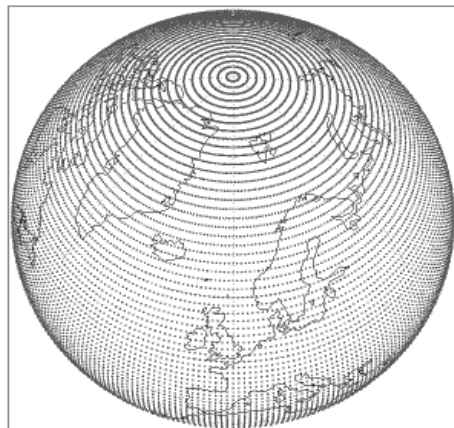
grid

output grid mesh

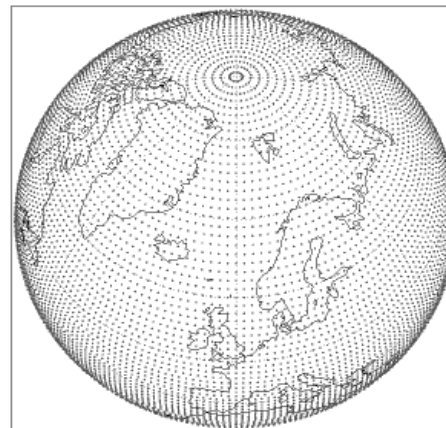
- Latitude/longitude increments in degrees (2.5/2.5)
- Type and resolution of Gaussian grid, e.g.
 - grid = F320 – full (or regular) Gaussian grid
 - grid = N320 – ECMWF original reduced Gaussian grid (only selected resolutions supported)
 - grid = O320 – ECMWF octahedral (reduced) Gaussian grid:
<https://confluence.ecmwf.int/display/FCST/Introducing+the+octahedral+reduced+Gaussian+grid>

All above with 320 latitude lines between the pole and equator

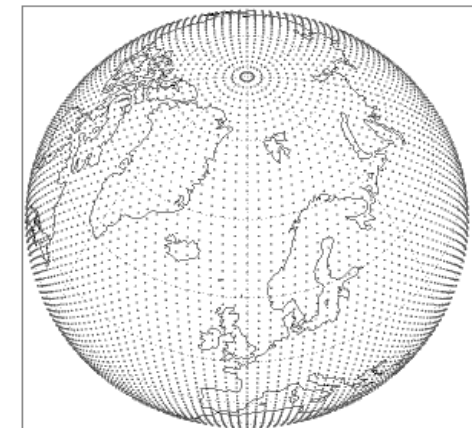
F80 regular (or full)



N80 original reduced



O80 octahedral reduced

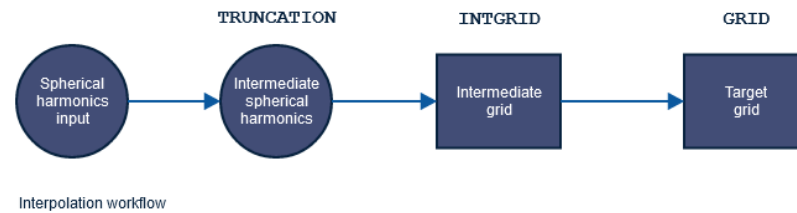


MARS language - Post-processing (2/2)

area desired sub-area in degrees (north/west/south/east) e.g.
area=75/-25/10/60

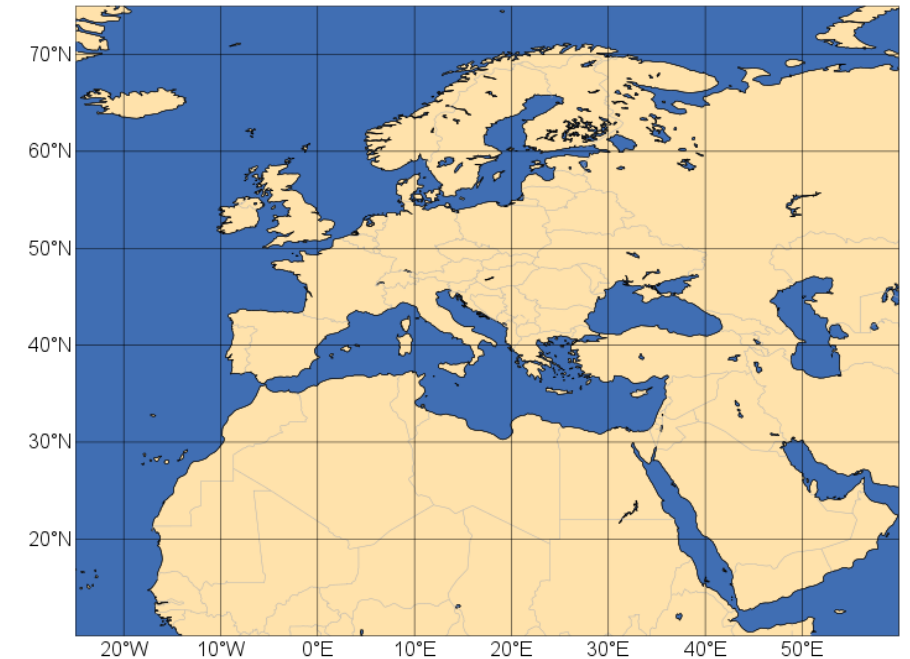
frame number of grid points from sub area inwards (5)

**truncation,
intgrid**



rotation lat/lon of South Pole

accuracy number of bits per data value in GRIB (16)



MARS language – Execution control

expect number of expected fields (1000, any, ...)

database where to look for the data

use hint about frequency of use (infrequent)

MARS language – Values

- Expected number of fields is computed by multiplying number of values after expansion of ranges

date = 20020101/to/20020131, 31 days

param = 165.128/166.128/235.128, 3 parameters

93 fields in total

- Certain keywords accept **all** as valid value. This should be avoided in general because it prevents MARS from calculating number of fields.

levelist = all

- Most keywords accept **off** as valid value

levtype = surface,

levelist = off

Request examples – Operational analysis

Retrieval of sea surface temperature for first 10 days of May 2002, all synoptic times. It retrieves 40 fields.

```
retrieve,  
    class    = od,  
    stream   = oper,  
    expver   = 1,  
    date     = 2023-10-01/to/2023-10-10,  
    time     = 00/06/12/18,  
    type     = an,  
    levtype  = sfc,  
    param    = 34.128,  
    target   = "an.grb"
```

Retrieving data – Calling MARS in a script

- directives from input stream

```
mars <<EOF
retrieve,
    type    = an,
    date    = -7,
    target  = "$SCRATCH/my_an"
EOF
```

- directives from file

```
cat > my_request <<EOF
retrieve,
    type    = an,
    date    = -7,
    target  = "$SCRATCH/my_an"
EOF
mars my_request
```

Retrieving data – Hints

- Default values: minimize their use
- No semantic check (only syntax is checked)
- MARS messages
 - INFO request execution and report
 - WARNING unusual aspect of execution
 - ERROR system or data errors
 - FATAL terminates execution

MARS Catalogue – apps.ecmwf.int/mars-catalogue/

Web interface to entire archive content

- Content browsing of *every* field in the archive
 - more up to date than static content documentation
- URL based on MARS requests (can be edited & bookmarked)
- Real-time (dynamic access to metadata)
- Create MARS requests (without checking availability)
- Check availability of data
- Retrieval in GRIB and NetCDF for few fields

MARS Catalogue

- <https://apps.ecmwf.int/mars-catalogue/>



MARS intorduction, basic concepts, and advance us

ECMWF

MARS Catalogue

Current activity

Reference

MARS Catalogue

The MARS Catalogue allows you to browse the contents of the whole MARS archive.

Choose the class:

Operational data

Operational archive

class=od

ECMWF Re-Analyses

15 years reanalysis (ERA15)

40 years reanalysis (ERA40)

ERA Interim

ERA-CLIM2 coupled reanalysis of the 20th-century (CERA-20C)

ERA-CLIM2 coupled reanalysis of the satellite era (CERA-SAT)

ERA-CLIM model integration for the 20th-century (ERA-20CM)

ERA-CLIM reanalysis of the 20th-century using surface observations only (ERA-20C)

class=er

class=e4

class=e1

class=ep

class=et

class=em

class=e2

Copernicus

Copernicus Atmosphere Monitoring Service (CAMS, previously MACC)

Copernicus Climate Change Service (C3S)

Copernicus Emergency Management Service (CEMS)

Copernicus Emergency Management Service - Global wildfire

Copernicus regional reanalysis

ERAS

ERAS/LAND

class=mc

class=c3

class=ce

class=gw

class=rr

class=ea

class=l5

ECMWF Experiments

Research department

Test

class=rd

class=te

Special datasets

DEMETER

Data Targeting System

ECSN

ELDAS

ENSEMBLES

EURO4M

MERSEA

NOAA/CIRES 20th Century Reanalysis version II

PROVOST

Sub-seasonal to seasonal prediction project (S2S)

TIGGE

TOST

UERRA

WMO Lead Centre Wave Forecast Verification

YOPP

YOTC

class=dm

class=dt

class=cs

class=e1

class=en

class=rm

class=me

class=nr

class=pv

class=s2

class=ti

class=to

class=ur

class=lw

class=yp

class=yt

Member States Projects

ALADIN-LAEF

COSMO-LEPS

Member States projects

class=la

class=co

class=ms

Member States IFS Experiments

Austria

Belgium

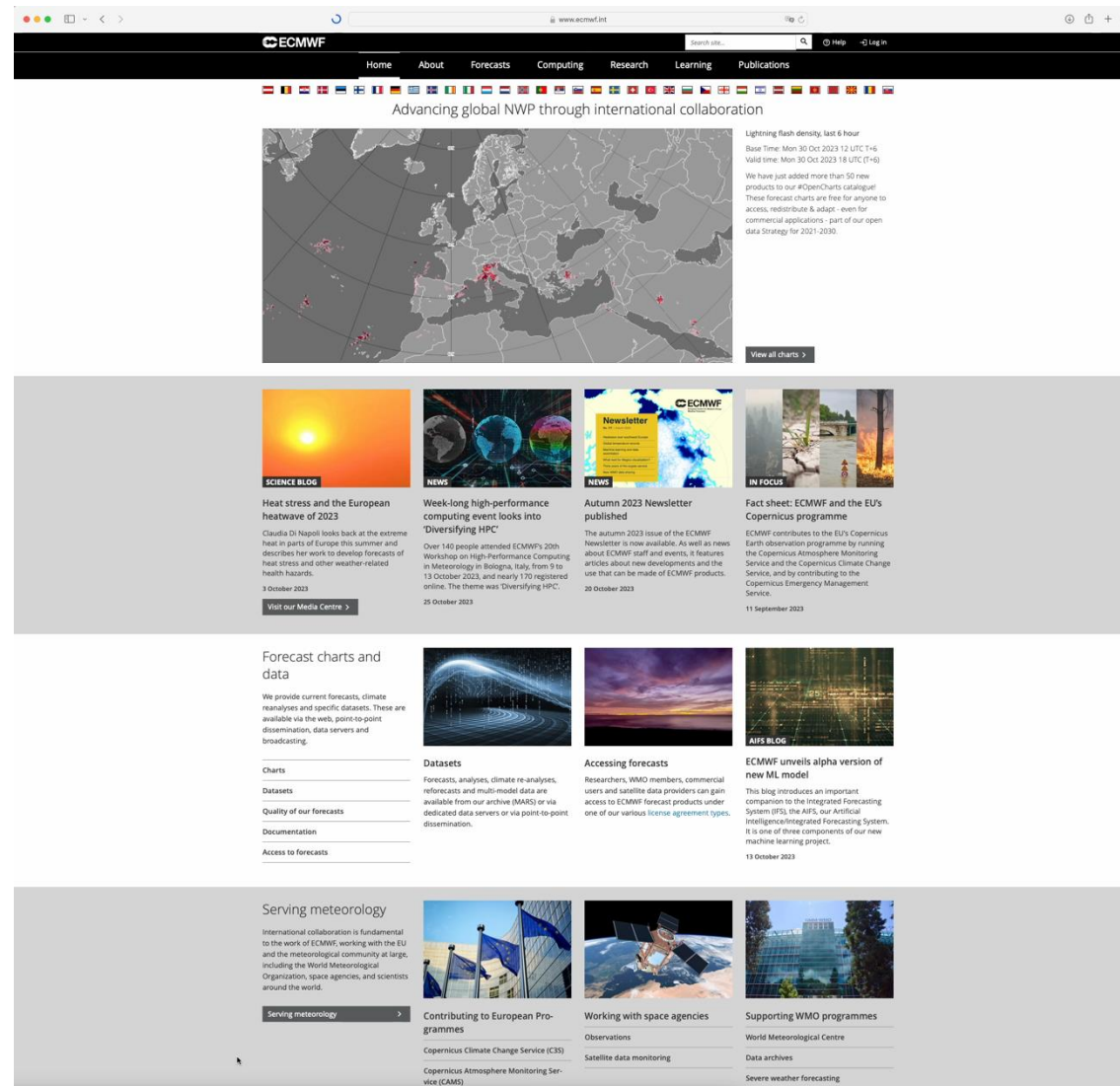
Denmark

class=at

class=be

class=dk

MARS Catalogue



MARS activity – apps.ecmwf.int/mars-activity/

Server activity / MARS queue

- Show system activity
- Monitor your requests
- Learn how the queuing system works
 - Reason for queued requests

ECMWF

Current activity

Help

Bojan Kasic

Reference

MARS server activity

195 active jobs / 271 total jobs

Sort by: user

My activity

No activity for user usbk

Other activity

1210842581@qq.com

RETRIEVE

TI

SFC

bol-webmars-public-svc-blue-005

12 hours 21 minutes 40 seconds

QUEUED

| On marsth-core, the total number of Requests from ECMWF Web API with more than 10 tape mounts [source] is limited to 1

34,100 fields, 3.89262 Gbytes online, 36.8454 Gbytes on 14 tapes warning: accessing damaged tapes XD024500, XD033400, nodes: hpss mvr000 mvr001, libraries: ibmlib08

3277409407@qq.com

RETRIEVE

TI

SFC

bol-webmars-public-svc-blue-006

13 hours 1 minute 10 seconds

QUEUED

| On marsth-core, the total number of Requests from ECMWF Web API with more than 10 tape mounts [source] is limited to 1

600 fields, 26.1764 Mbytes on 17 tapes, nodes: hpss, libraries: ibmlib08

18008349012@163.com

RETRIEVE

TI

SFC

bol-webmars-public-svc-blue-004

12 hours 54 minutes 9 seconds

QUEUED

| On marsth-core, the total number of Requests from ECMWF Web API with more than 10 tape mounts [source] is limited to 1

161,200 fields, 1.95335 Gbytes online, 6.39095 Gbytes on 33 tapes, nodes: hpss mvr000 mvr001, libraries: ibmlib04 ibmlib08

camsprod3583

RETRIEVE

MC

20170901

compute-0003.camsprod.copernicus-atmosphere.eu

34 minutes 25 seconds

240 fields, 61.274 Mbytes on 1 tape, nodes: hpss, libraries: ibmlib07

Reading retrieved data - tools

Some useful tools

- ecCodes
 - `grib_ls`, `grib_dump`, ...
- Metview examiners
 - `metview -e <grib|bufr|netcdf|odb> <file>`
- CDO - Climate Data Operators
 - See <https://code.zmaw.de/projects/cdo>

MARS Architecture - Request execution

- 1) Check syntax (MARS language and request syntax)
- 2) Print request to be processed
- 3) Query all Supercomputer's FDB
- 4) Query main archives (if data not in FDB)
- 5) Transfer data
- 6) Post-processing while transferring (if needed)
- 7) Report on result

Request execution (1/3) – checking MARS language and request syntax

```
mars - INFO - 20231029.192717 - Welcome to MARS
mars - INFO - 20231029.192717 - MARS_HOME=/usr/local/apps/mars/configs/prod
mars - INFO - 20231029.192717 - MARS Client build stamp: 20231005140652
mars - INFO - 20231029.192717 - MARS Client bundle version: 6.33.16.2
mars - INFO - 20231029.192717 - package mars-client version: 6.33.16
mars - INFO - 20231029.192717 - package mir version: 1.18.0
mars - INFO - 20231029.192717 - package odc version: 1.4.6
mars - INFO - 20231029.192717 - package fdb version: 5.11.23
mars - INFO - 20231029.192717 - package metkit version: 1.10.15
mars - INFO - 20231029.192717 - package eckit version: 1.24.4
mars - INFO - 20231029.192717 - package eccodes version: 2.32.0
retrieve,
  class=od,
  date=-7,
  expver=1,
  levtype=sfc,
  param=165.128/166.128,
  step=24,
  stream=oper,
  time=12:00:00,
  type=fc,
  area = europe,          # As the area is not compatible with the grid,
  grid = 0.57/0.57,       # MARS will expand the area to make it fit.
  target = "/ec/res4/scratch/usbk/10u_10v.grb"
```

```
mars - INFO - 20231029.192717 - Processing request 1
```

Request execution (2/3) – print request

```
RETRIEVE,  
  CLASS   = OD,  
  TYPE    = FC,  
  STREAM  = OPER,  
  EXPVER  = 0001,  
  REPRES  = GG,  
  LEVTYPE = SFC,  
  PARAM   = 165.128/166.128,  
  DATE    = 20231022,  
  TIME    = 1200,  
  STEP    = 24,  
  DOMAIN  = G,  
  TARGET  = "/ec/res4/scratch/usbk/10u_10v.grb",  
  RESOL   = AUTO,  
  AREA    = 73.5/-27/33/45,  
  GRID    = 0.57/0.57
```

Request execution (3/3)

Query FDB

mars - INFO - 20231029.192717 - Requesting 2 fields
mars - INFO - 20231029.192717 - FDB home /home/fdbprod
mars - INFO - 20231029.192717 - FDB home /home/fdbbc
mars - INFO - 20231029.192717 - Setting SO_SNDBUF to 33554432 (32.00 M)
mars - INFO - 20231029.192717 - Current value is 32768 (32.00 K)
mars - INFO - 20231029.192717 - Setting SO_RCVBUF to 33554432 (32.00 M)
mars - INFO - 20231029.192717 - Current value is 43690 (42.67 K)

Query main
archive because
the data was not
found in FDB

mars - INFO - 20231029.192717 - Calling mars on 'marsod-core', local port is 48587
mars - INFO - 20231029.192717 - Callback at address 10.100.192.202, port 48587
mars - INFO - 20231029.192717 - Mars client is on ac6-202.bullx (10.100.192.202) 48587
mars - INFO - 20231029.192717 - Mars server is on 10.112.5.10 42673
mars - INFO - 20231029.192717 - Server task is 270 [marsod]
mars - INFO - 20231029.192717 - Request cost: 2 fields, 25.1858 Mbytes online, nodes: mvr004 [marsod]
mars - INFO - 20231029.192717 - The efficiency of your requests in the last 12 hours is 100% [marsod]

Transferring data
and postprocessing

mars - INFO - 20231029.192717 - Transferring 26409176 bytes
mars - INFO - 20231029.192718 - 2 fields retrieved from 'marsod'
mars - INFO - 20231029.192718 - 2 fields have been interpolated on 'ac6-202.bullx'

Reporting results

mars - INFO - 20231029.192718 - Request time: wall: 1 sec
mars - INFO - 20231029.192718 - Read from network: 25.19 Mbyte(s) in < 1 sec [140.77 Mbyte/sec]
mars - INFO - 20231029.192718 - Writing to target file: 36.09 Kbyte(s) in < 1 sec [26.19 Mbyte/sec]
mars - INFO - 20231029.192718 - Memory used: 114.19 Mbyte(s)
mars - INFO - 20231029.192718 - No errors reported

Retrieving data – Data access

- Archived data
 - Available to all registered users
- Current (valid) data, i.e. data for which the value of
$$(\text{DATE} + \text{TIME} + \text{STEP}) + 24 \text{ hours} \geq \text{current date/time}$$
 - Needs special registration
 - Contact your Computing Representative
- Boundary Conditions Project & COSMO-LEPS
 - Restricted to participating MS / individual users
- Restrictions for Observations, TIGGE, EUROSIP...
- Data is available according to dissemination schedule, see
 - <https://confluence.ecmwf.int/display/DAC/Dissemination+schedule>
 - For time-critical retrievals, use time-critical framework (option 1)

Additional resources

- MARS documentation
<https://confluence.ecmwf.int/display/UDOC/MARS+user+documentation>
- Web Applications
apps.ecmwf.int/mars-catalogue/
apps.ecmwf.int/mars-activity/
- FAQ
<https://confluence.ecmwf.int/display/UDOC/MARS+FAQ>
- ECMWF real-time datasets
www.ecmwf.int/en/forecasts/datasets
- IFS Documentation
www.ecmwf.int/en/forecasts/documentation-and-support/changes-ecmwf-model/ifs-documentation
- ecCodes Documentation
<https://confluence.ecmwf.int/display/ECC/ecCodes+Home>

MARS Practical

Point your browser to

<https://confluence.ecmwf.int/display/UDOC/MS+computing+training+courses>

and follow the instructions (Only Basic MARS usage: Simple retrieves and Post-processing)

More examples are available on:

<https://confluence.ecmwf.int/display/UDOC/MARS+example+requests>

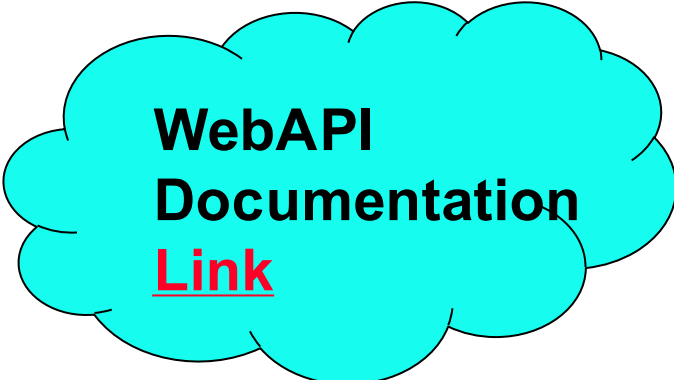
if you wish to practice later at home.

WebAPI

Web API

The Web API is a thin client

- Provides access to full MARS archive to users with the access and ECMWF Public Datasets
 - Delivers data directly to the users' machine
- Alternative to retrieve – transfer jobs on the HPC
- Limitations:
 - Does not use ecCodes nor any interpolation library
 - You can only use **retrieve** or **list** verbs. compute, read, write... are not available
 - You can **not** use **multi-target** using the keywords, only one final single file can be transferred at the end of the execution.
 - You can only execute **one action** at the time



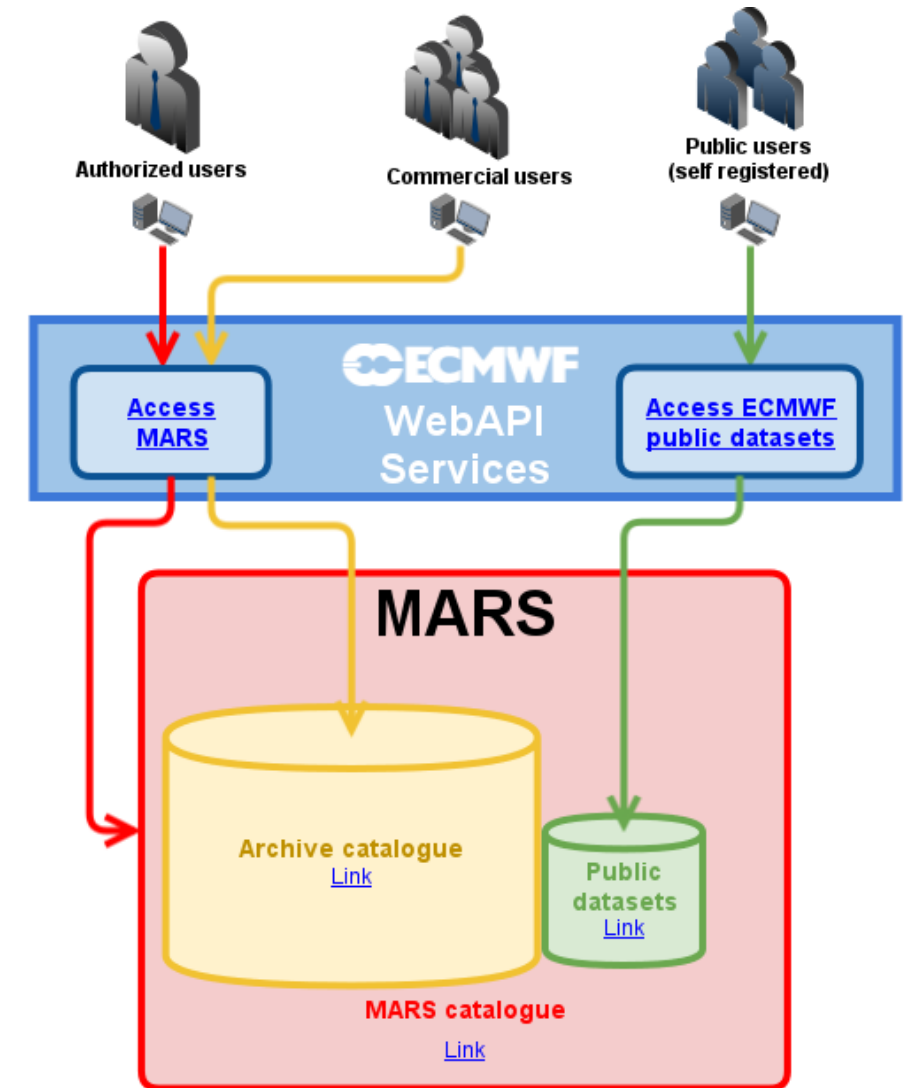
**WebAPI
Documentation
[Link](#)**

MARS client on ECS vs WebAPI

	Client on ECS	webAPI
Client supported language	Bash script	Python API and Bash script
Multiple target support	Yes, via MARS and ecCodes keywords	No
Interaction with MARS server	Client executed on ECS where the request is submitted	Additional queueing system on webMAR where the client is run. 1 or 2 active requests per user.
Interpolation	More computing power on client side for interpolation – faster.	Less computing power – slower.
Size limits per request	No size limit	Limit on target file: 600,000 fields 75 GB
Target destination	Delivers data to ECS/HPC	Delivers data directly to users local machine
Local ecCodes	Yes; compute, read, write supported	No; compute, read, write not supported

Data Server – Web API

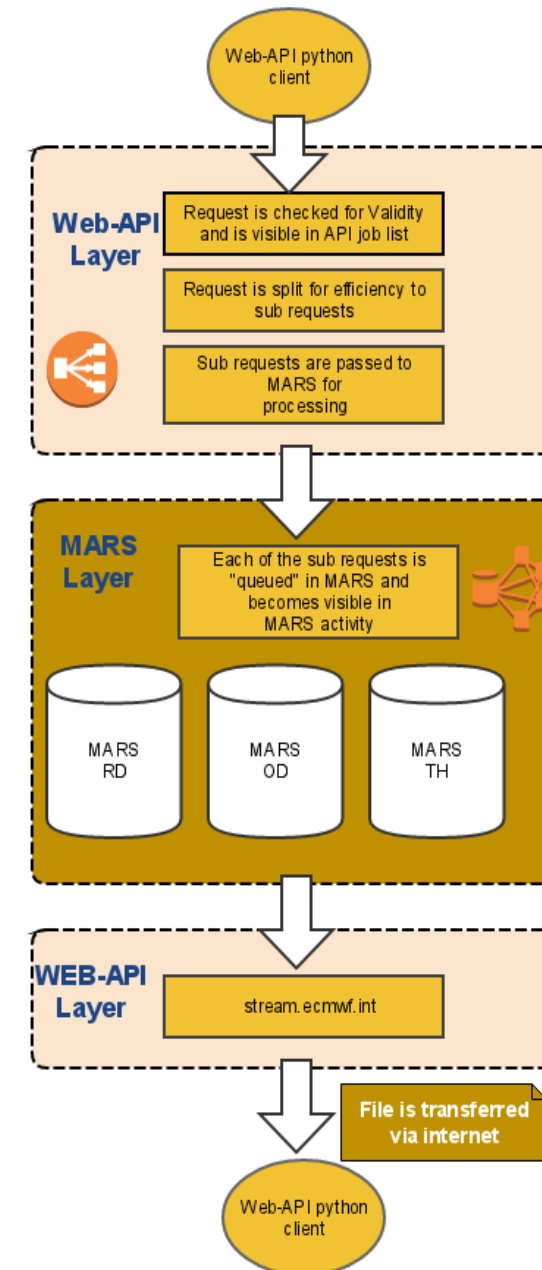
Who	Data discovery	Access method
Public user	<u>Public Datasets</u>	<u>Access ECMWF Public Datasets</u>
Commercial user	<u>Archive catalogue</u>	<u>Access MARS</u>
Authorized user	<u>MARS catalogue</u>	<u>Access MARS</u>



<https://confluence.ecmwf.int/display/WEBAPI/ECMWF+Web+API+Home>

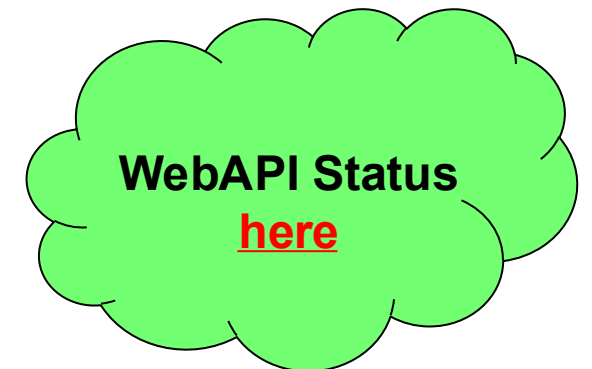
Web API – Lifecycle Overview

- User submits a request via the Web API
- Request travels through multiple phases:
 1. Submission & validation
 2. Queueing & QoS control
 3. Activation on WebAPI Level
 4. Activation on Mars Level
 5. Completion or abortion
 6. File transfer to user



Web API – 1. Submission & Validation

- Request received and queued in the Web API
- Backend service checks for validity
- A new record created in MongoDB containing:
 - Request details (user, host, timers, status, etc.)
- Request status initially: “Queued”
- Visible on Web API activity, but not yet on MARS activity



Web API – 2. Queueing, Limits, and QoS Rules

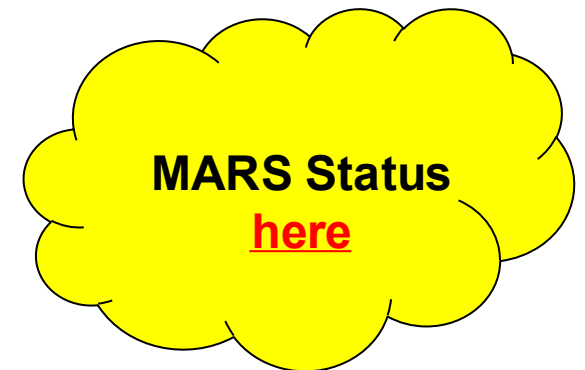
- The queue time depends on:
 - Priorities, system load, and limitations
- Request Limits:
 - **20 queued** requests per user
 - **2 active request** (varies based on load)
- Targe File Limits:
 - **75 GB and 600,000 fields** (50GB for public users)
- If user exceeds limits → new requests rejected
- QoS limitations and priorities:
 - The total maximum number of active requests
 - The maximum number of active requests per user
 - The maximum number of queued requests per user

Web API – 3. Activation on Web API Level

- When slot available & QoS rules allow → request becomes **Active on WebAPI**
- Web API splits the request into smaller sub-requests for performance
 - e.g., one year of daily data split into 12 monthly chunks
- Each sub-request validated and sent to MARS clients
- Execution distributed across available web hosts

Web API – 4. Activation on MARS Level

- Each sub-request enters the MARS queue
- Becomes visible on MARS activity
- MARS QoS limitations:
 - marsod-core: max 6 requests with 1 tape mount
 - marsth-core: max 12 requests with 1 tape mount
 - Improve retrieval efficiency to reduce queue times
- When a MARS slot opens → status changes to Active
- A request can be Active at API but still Queued on MARS
- Request record periodically updated with status
- Web API client performs asynchronous HTTP checks for progress



Web API – 5. Completion and Error Handling

- When all sub-requests complete → system merges sub-files into final output
- Final status: “Complete”
- If an error occurs → status becomes “Aborted”
- Completed data ready for transfer to the user

Web API – 6. Final phase – data delivery to user

- Web API client transfers completed file to user's local disk
- After transfer → file deleted from ECMWF system
- Transfer may fail due to network connectivity
- Client checks file size → retries if incomplete
- Up to 10 automatic retries
- If still unsuccessful → user can **manually download from Job List**

My Web-API activity

Web-API job information and corresponding results (if any) are available for up to **72h** from the time of job completion, then permanently removed. Note that in some cases, due to storage limitations, job results could end up being removed earlier. Please ensure you download your job results as soon as they become available.

Showing activity for user:

Search:

Showing 1 to 17 of 17 entries

Previous **1** Next

id	user	status	name	service	client	submitted	duration	result	cancel?
68ee935663bd28e423678e57	maes	complete	mars			14/10 18:15:50	00:01:29	download (1.5 MB)	

Manual
Download Link

Web API – Access Method 1: Web-MARS

- Website
- MARS Catalogue
 - Archive Catalogue
 - Public Datasets for S2S and TIGGE (will be migrated)
- Check for availability
- View the MARS request
- Estimate download size
- Retrieve the selection in GRIB or NetCDF (experimental)

Web API - Access Method 2: ecmwfapi python client

```
#!/usr/bin/env python
from ecmwfapi import ECMWFService

server = ECMWFService("mars")
server.execute(
    {
        "class": "od",
        "date": "20231015",
        "expver": "1",
        "levtype": "sfc",
        "param": "167.128",
        "step": "0/to/240/by/12",
        "stream": "oper",
        "time": "00",
        "type": "fc"
    },
    "target.grib")
```

Examples for retrieving **large** datasets efficiently:

<https://confluence.ecmwf.int/display/WEBAPI/Retrieval+efficiency>

Web API - Access Method 3: Earthkit-data library

- Earthkit-data is a python library for **retrieving**, inspecting, and transforming meteorological data
- Earthkit-data can connect to the:
 - **WebAPI** and **Mars Client**
 - **Polytope** server (will be explained later)
 - Others (CDS, ecmwf-open-data, etc)
- `from_source("mars", *args, ...)`
- Incubating stage of software maturity

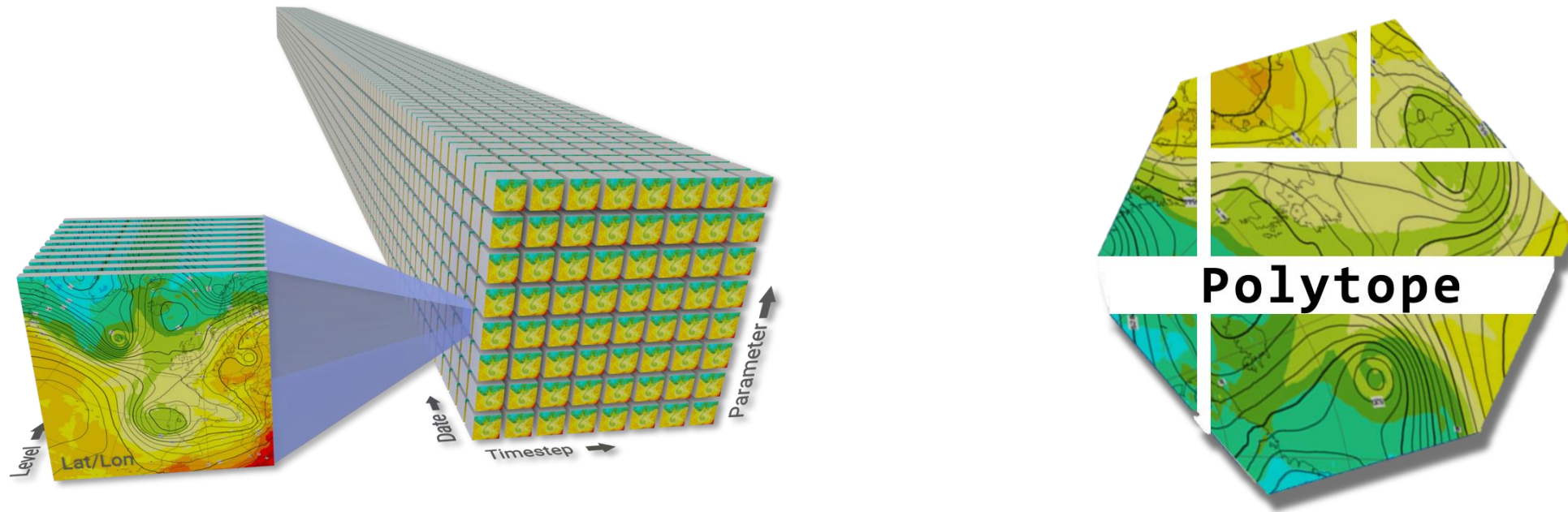


**Link to earthkit-data
[documentation](#)**

Polytope

POLYTOPE - Intro

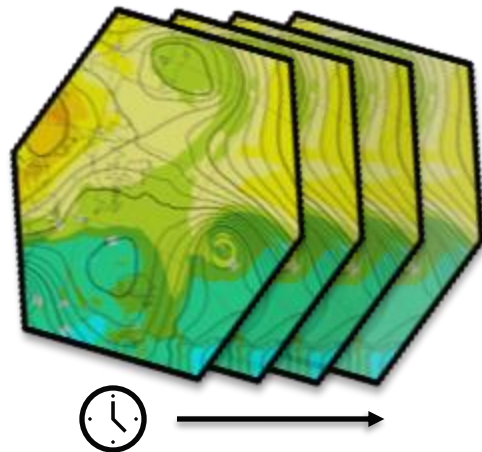
Polytope is a data service specialized to efficiently serve datacube data.



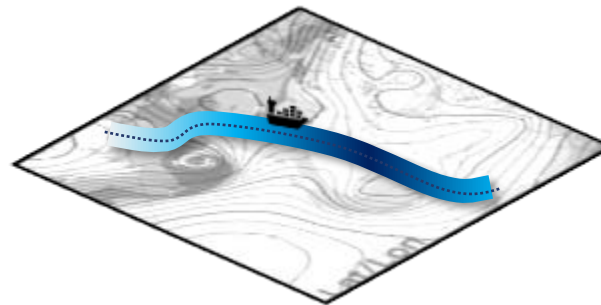
POLYTOPE - Feature Extraction

Polytope's key feature is the ability to directly extract features from a datacube, as well as whole fields, without any intermediate copies.

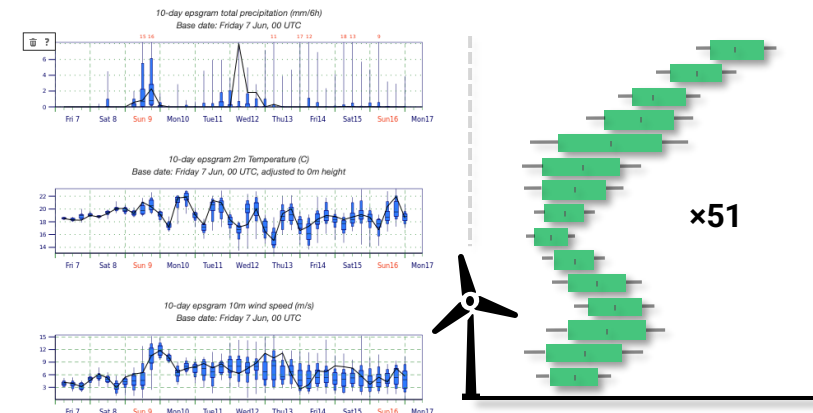
Regions and Series



Spatiotemporal Trajectories



Point Data



and more...

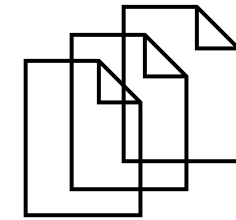
Polytope - Global Fields Request

Request Global fields

Returns GRIB

Further processing of data required if whole field not required

```
{  
  "class": "od",  
  "stream": "enfo",  
  "type": "pf",  
  "date": "20231205",  
  "time": "0000",  
  "levtype": "sfc",  
  "expver": "0001",  
  "param": "228/49/164/165/166/167",  
  "number": "1/to/50",  
}
```



**Grib
Files**

Polytope - Global Fields Request

Request Feature

Returns CovJSON output

Can immediately begin using data with other earthkit tools

```
{
  "class": "od",
  "stream": "enfo",
  "type": "pf",
  "date": "20231205",
  "time": "0000",
  "levtype": "sfc",
  "expver": "0001",
  "param": "228/49/164/165/166/167",
  "number": "1/to/50",
  "feature": {
    "type": "timeseries",
    "points": [[ 51.5, 2.1 ]],
    "range": {
      "start": 0,
      "end": 9
    }
  }
}
```



```
{
  "type": "CoverageCollection",
  "domainType": "PointSeries",
  "coverages": [
    {
      "mars:metadata": {
        "class": "od",
        "stream": "enfo",
        "levtype": "pl",
        "date": "20231205",
        "number": "0",
      },
      "type": "Coverage",
      "domain": {
        "type": "Domain",
        "axes": {
          "x": {"values": [51.5]},
          "y": {"values": [2.1]},
          "t": {
            "values": [
              "2017-01-01 00:00:00",
              "2017-01-01 01:00:00",
              "2017-01-01 02:00:00",
              "2017-01-01 03:00:00",
              "2017-01-01 04:00:00",
              "2017-01-01 05:00:00",
              "2017-01-01 06:00:00",
              "2017-01-01 07:00:00",
              "2017-01-01 08:00:00",
              "2017-01-01 09:00:00",
            ]
          }
        },
      },
      "ranges": {
        "t2m": {
          "type": "NdArray",
          "datatype": "float",
          "shape": [3],
          "axisNames": ["t"],
          "values": [
            264.93115234375,
            263.83115234375,
            265.12313132266,
            264.93115234375,
            263.83115234375,
            265.12313132266,
            264.93115234375,
            263.83115234375,
            265.12313132266,
            264.93115234375,
          ]
        },
      },
    },
  ],
  "referencing": [...],
  "parameters": {...}
}
```

Polytope – How to Access Polytope?

- Earhtkit-data library
- `from_source("polytope", collection, *args, address=None, ...)`
- Datasets Available through Polytope:
 - Operational Forecasts (last 2 days)
 - AIFS Open Data Forecasts (last 3-5 days)
 - DestinE Digital Twins

Summary – Methods Covered

Method	Connects to	Data accessible
web browser (webMars)	webapi only	mars catalogue, archive catalogue, public datasets
ecmwfapi python library	webapi only	mars catalogue, archive catalogue, public datasets
earthkit-data source:mars	webapi and mars	mars catalogue, archive catalogue, public datasets
earhtkit-data source:polytope	polytope server	Operational Forecast, AIFS single, Destine Data

Practicals

Start a jupyterhub session at <https://jupyterhub.ecmwf.int/>

Clone this Github repo: <https://github.com/ecmwf-training/2025-computing-training-week>

Go to mars folder and start with Readme 😊

MARS – Efficient retrievals and best practices

Retrieving data

Request scheduling

- Queuing system
 - Priorities:
 - Based on user, request age, request cost (number of tapes and fields)
 - Limits on MARS servers:
 - Total number of archive requests
 - Total number of retrieve requests
 - Total number of requests accessing off-line data (data on tapes)
 - The total number of requests accessing X tapes
 - The total number of requests per user
 - The total number of requests per user for offline data
 - The total number of requests per user for offline data accessing X tapes
 - The total number of Requests from ECMWF Web API per user
-
- The diagram uses two large curly braces on the right side of the list to categorize the limits. A green brace groups the first four items (Total number of archive requests, Total number of retrieve requests, Total number of requests accessing off-line data (data on tapes), and The total number of requests accessing X tapes) under the label 'Global'. A blue brace groups the remaining four items (The total number of requests per user, The total number of requests per user for offline data, The total number of requests per user for offline data accessing X tapes, and The total number of Requests from ECMWF Web API per user) under the label 'Per user'.

Data collocation

- MARS tree
- Archive objects (tape-files)
 - **For operational data class=od**
 - 1 file per month of AN (1 level type, all times, levels, params) - [Link to MARS catalogue](#)
 - 1 file per forecast (1 level type, all steps, levels, params) - [Link to MARS catalogue](#)
 - 1 file per EPS forecast (1 level type, all steps, members, levels, params) - [Link to MARS catalogue](#)
 - Some exceptions exist for surface data in 48R1
 - **For ERA5 data, class=ea**
 - 1 file per month of ERA 5, forecast and analysis (1 level type, all levels, times, steps, params) - [Link to MARS Catalogue](#)
 - **For operational AIFS data class=ai**
 - 1 file per month of single forecast (1 level type, all times, levels, params) [Link to MARS Catalogue](#)
 - 1 file per EPS forecast (1 level type, all steps, members, levels, params) [Link to MARS catalogue](#)

Retrieving data – Efficiency

1. Explore data in archive catalogue - collocation
2. Estimate amount of data (list command)
 - Number of fields (up to hundreds of thousand / request)
 - Data size (up to 10s of Terabytes / request)
3. Check computing resources on client side:
 - Quota for storage space. Ideally write target file to SCRATCH or HPCPERM
 - Walltime in parent batch job
 - Memory in parent batch job – if interpolation of large grids is specified
4. Retrieve as much data from the same tape as possible
5. **Avoid constantly accessing the same tape**
6. Do not create unnecessary sub-archives in ECFS

Explore data in archive catalogue – collocation and estimate amount of data

MARS Catalogue

Current activity-

MARS Catalogue

Step (145 values)	Number (50 values)	Level (14 values)	Parameter (12 values)
16	39	200	Divergence
17	40	250	Geopotential
18	41	300	Ozone mass mixing ratio
19	42	400	Relative humidity
20	43	500	Specific humidity
21	44	600	Stream function
22	45	700	Temperature
23	46	850	U component of wind
24	47	925	V component of wind
25	48	1000	Velocity potential

- [Check for availability](#)
- [View the MARS request](#)
- [Estimate download size](#)
- [Retrieve the selection in GRIB](#)
- [Retrieve the selection in NetCDF](#)

Note about availability

Some of the fields may not be archived at all levels or all forecast time steps. Before retrieving data you may want to check the availability of the requested fields. For that, follow the [Check for availability](#) link.

Retrieving

In order to retrieve data, you must select at least one item in the lists above. You can select more than one item in each list.

[< Return to selection](#)

cost

Final request

Stream:	Ensemble prediction system
Level:	10, 50, 100 to 300 by 50, 400 to 700 by 100, 850, 925, 1000
Type:	Perturbed forecast
Number:	1 to 50
Step:	0 to 24 by 3
Version:	1

[See full request](#)

The status of the request is: **complete**

Number of tapes:	1
Number of tape files:	1
Number of disk files:	0
Number of online fields:	0
Number of fields:	45000
Online size:	0.0 kB
Number of offline fields:	45000
Off line size:	253.9 GB
Size:	253.9 GB

Request output

```
EXPECT = ANY,
OUTPUT = COST,
DATABASE = marsod
mars - INFO - 20251014.101519 - Web API request id: 68ee22b78167806f9b06e169
mars - INFO - 20251014.101519 - Setting SO_SNDBUF to 33554432 (32.00 M)
mars - INFO - 20251014.101519 - Current value is 8192 (8.00 K)
mars - INFO - 20251014.101519 - Setting SO_RCVBUF to 33554432 (32.00 M)
mars - INFO - 20251014.101519 - Current value is 43690 (42.67 K)
mars - INFO - 20251014.101519 - Calling mars on 'marsod-core', local port is 60524
mars - INFO - 20251014.101520 - Server task is 3217 [marsod]
mars - INFO - 20251014.101520 - Request performed on database 'marsod'
mars - INFO - 20251014.101520 - Memory used: 22.14 Mbyte(s)
mars - INFO - 20251014.101520 - No errors reported
Process '['nice', 'mars', '/tmp/20251014-1010/35/tmp-_mars-pzCeb0-cb9f5a7ec913bdda10c1f8e89dbd56ca.req']' finished
```

In case of **problems**, please check the [troubleshooting page](#).

List

- Alternative to the archive catalogue on the web:
 - Amount of data
 - Number of fields
 - Number of tapes. (directive '**output=cost**' required)
 - Suitable for batch mode
- Default is **all**, except for **class**, **expver**, **stream**, **type** and **date**.
- It does list only the archive, not the Fields Database.
- Can keep a report specifying **target**.

Estimate amount of data list action

```
list,  
# output = cost,  
class = od,  
date = 20200101,  
expver = 1,  
levtype = sfc,  
param =  
8.128/22.228/29.228/33.128/45.128/57.128/59.128/134.128/136.128/141.128/151.128/164.1  
28/165.128/166.128/167.128/169.128/186.128/187.128/188.128/205.128/206.128/246.228/2  
47.228,  
step =  
0/3/6/9/12/15/18/21/24/27/30/33/36/39/42/45/48/51/54/57/60/63/66/69/72/75/78/81/84/8  
7/90/93/96/99/102/105/108/111/114/117/120/123/126/129/132/135/138/141/144/150/156/  
162/168/174/180/186/192/198/204/210/216/222/228/234/240,  
time = 00/12,  
type = fc,  
stream = oper
```

List output

```
class = od
date = 2020-01-01
expver = 1
file[0] = hpss:/mars/prod/od/o/oper/fc/sfc/marsodoper/0001/fc/20200101/sfc/1200/973003.20200206.015029
id = 973003
levtype = sfc
month = 202001
stream = oper
time = 12:00:00
type = fc
year = 2020
file length missing offset param step
0 13204588 . 30376750 8.128 0
0 13204588 . 188831806 22.228 0
0 13204588 . 280684868 29.228 0
0 13204588 . 320298632 33.128 0
...
0 13204588 . 254639830208 205.128 240
0 13204588 . 254653034796 206.128 240
0 13204588 . 255068976704 246.228 240
0 13204588 . 255082181292 247.228 240
```

Grand Total:

=====

Entries : 2,990

Total : 40,339,676,520 (37.5693 Gbytes)

mars - INFO - 20231031.155352 - Request performed on database 'marsod'

mars - INFO - 20231031.155352 - Memory used: 31.47 Mbyte(s)

mars - INFO - 20231031.155352 - No errors reported

Use directive
'output=cost' for summary
report.

With “output = cost” option

```
size=40339676520;  
number_of_fields=2990;  
online_size=40339676520;  
off_line_size=0;  
number_of_tape_files=0;  
number_of_disk_files=47;  
number_of_online_fields=2990;  
number_of_offline_fields=0;  
number_of_tapes=0;
```


Check availability

MARS Catalogue

Step (145 values)	Number (50 values)	Level (14 values)	Parameter (12 values)
0	1	10	Divergence
1	2	50	Geopotential
2	3	100	Ozone mass mixing ratio
3	4	150	Relative humidity
4	5	200	Specific humidity
5	6	250	Stream function
6	7	300	Temperature
7	8	400	U component of wind
8	9	500	V component of wind
9	10	600	Velocity potential

- Check for availability
- View the MARS request
- Estimate download size
- Retrieve the selection in GRIB
- Retrieve the selection in NetCDF

Note about availability

Some of the fields may not be archived at all levels or all forecast time steps. Before retrieving data you may want to check the availability of the requested fields. For that, follow the *Check for availability* link.

Retrieving

In order to retrieve data, you must select at least one item in the lists above. You can select more than one item in each list.

[Return to selection](#)

availability

Final request

Stream:	Ensemble prediction system
Level:	10, 50, 100 to 300 by 50, 400 to 700 by 100, 850, 925, 1000
Type:	Perturbed forecast
Number:	1 to 50
Step:	0 to 24 by 3
Version:	1
Type of level:	Pressure levels
Time:	00:00:00
Date:	20241106
Parameter:	Divergence, Geopotential, Ozone mass mixing ratio, Relative humidity, Specific humidity, Stream function, Temperature, U component of wind, V component of wind, Velocity potential
Class:	Operational archive

The status of the request is: **complete**

Stream:	Ensemble prediction system
Year:	2024
Number:	1 to 50
Month:	202411
Step:	0 to 24 by 3
Version:	1
Type of level:	Pressure levels
Time:	00:00:00
Date:	20241106
Type:	Perturbed forecast
Class:	Operational archive
Parameter:	Stream function, Velocity potential
Level:	200
Parameter:	Divergence, Geopotential, Ozone mass mixing ratio, Relative humidity, Specific humidity, Temperature, Vorticity (relative)
Level:	10, 50, 100 to 300 by 50, 400 to 700 by 100, 850, 925, 1000

Request output

EXPECT	= ANY,
OUTPUT	= TREE,
DATABASE	= marsod
mars - INFO	- 20251014.102851 - Web API request id: 68ee25e216718e0b4f5d9a46
mars - INFO	- 20251014.102851 - Setting SO_SNDBUF to 33554432 (32.00 M)
mars - INFO	- 20251014.102851 - Current value is 8192 (8.00 K)
mars - INFO	- 20251014.102851 - Setting SO_RCVBUF to 33554432 (32.00 M)
mars - INFO	- 20251014.102851 - Current value is 43690 (42.67 K)
mars - INFO	- 20251014.102851 - Calling mars on 'marsod-core', local port is 33017
mars - INFO	- 20251014.102851 - Server task is 524 [marsod]
mars - INFO	- 20251014.102851 - Request performed on database 'marsod'
mars - INFO	- 20251014.102851 - Memory used: 22.15 Mbyte(s)
mars - INFO	- 20251014.102851 - No errors reported
Process '['nice', 'mars', '/tmp/20251014-1020/ce/tmp-_mars-7074CP-fc2f7af6d800ebe8b818d68f24de11ae.req']'	finished

In case of **problems**, please check the [troubleshooting page](#).

Things to avoid when possible

- **Using "all"**

- **Eg. "Levelist = all", "steps = all", "number = all", etc.**
- Disables counter of number of fields and therefore there is no guarantee all requested fields are retrieved. It is better to explicitly specify all values e.g.
- Levelist = 1/to/137/by/1
- Number = 1/to/50
- Steps = 0/to/24/by/3

- **Expect = any**

- It is better to write a clean request which doesn't ask for files which are not available. You can use MARS catalogue to do this for you.
- Again, it disables counter of number of fields. MARS doesn't know how many fields are requested and even when all requested data is available on-line, MARS will still go to the tape system to check if anything in addition is available there.

Impact of increased ensemble resolution in cyc49R1

< Return to selection

cost

Final request

Stream:	Ensemble prediction system
Type:	Perturbed forecast
Number:	1 to 50
Step:	0 to 90, 93 to 144 by 3, 150 to 360 by 6
Version:	1
Type of level:	Surface
Time:	12:00:00
Date:	20241106
Parameter:	2 metre temperature
Class:	Operational archive

The status of the request is: **complete**

Number of tapes:	1
Number of tape files:	1
Number of disk files:	0
Number of online fields:	0
Number of fields:	1625
Online size:	0.0 kB
Number of offline fields:	1625
Off line size:	20.0 GB
Size:	20.0 GB

Request output

EXPECT	= ANY,
OUTPUT	= COST,
DATABASE	= marsod
mars - INFO	- 20251014.105545 - Web API request id: 68ee2c30403b4a7288679698
mars - INFO	- 20251014.105545 - Setting SO_SNDBUF to 33554432 (32.00 M)
mars - INFO	- 20251014.105545 - Current value is 8192 (8.00 K)
mars - INFO	- 20251014.105545 - Setting SO_RCVBUF to 33554432 (32.00 M)
mars - INFO	- 20251014.105545 - Current value is 43690 (42.67 K)
mars - INFO	- 20251014.105545 - Calling mars on 'marsod-core', local port is 33837
mars - INFO	- 20251014.105545 - Server task is 7735 [marsod]
mars - INFO	- 20251014.105545 - Request performed on database 'marsod'
mars - INFO	- 20251014.105545 - Memory used: 22.16 Mbyte(s)
mars - INFO	- 20251014.105545 - No errors reported
Process '['nice', 'mars', '/tmp/20251014-1050/da/tmp-_mars-BZsbmA-dc9a0acddb6c1400327a17668be93c9f.req']'	finished

In case of **problems**, please check the [troubleshooting page](#).

< Return to selection

cost

Final request

Stream:	Ensemble prediction system
Type:	Perturbed forecast
Number:	1 to 50
Step:	0 to 90, 93 to 144 by 3, 150 to 360 by 6
Version:	1
Type of level:	Surface

[See full request](#)

The status of the request is: **complete**

Number of tapes:	2
Number of tape files:	3
Number of disk files:	5
Number of online fields:	1550
Number of fields:	7250
Online size:	19.1 GB
Number of offline fields:	5700
Off line size:	70.1 GB
Size:	89.2 GB

Request output

EXPECT	= ANY,
OUTPUT	= COST,
DATABASE	= marsod
mars - INFO	- 20251014.104710 - Web API request id: 68ee2a2dd730d628e15da716
mars - INFO	- 20251014.104710 - Setting SO_SNDBUF to 33554432 (32.00 M)
mars - INFO	- 20251014.104710 - Current value is 8192 (8.00 K)
mars - INFO	- 20251014.104710 - Setting SO_RCVBUF to 33554432 (32.00 M)
mars - INFO	- 20251014.104710 - Current value is 43690 (42.67 K)
mars - INFO	- 20251014.104710 - Calling mars on 'marsod-core', local port is 38995
mars - INFO	- 20251014.104710 - Server task is 9504 [marsod]
mars - INFO	- 20251014.104710 - Request performed on database 'marsod'
mars - INFO	- 20251014.104710 - Memory used: 22.16 Mbyte(s)
mars - INFO	- 20251014.104710 - No errors reported
Process '['nice', 'mars', '/tmp/20251014-1040/8d/tmp-_mars-VdIoc1-c71a6f0f22841bb460d353beed1ef956.req']'	finished

In case of **problems**, please check the [troubleshooting page](#).

Impact of increased ensemble resolution in cyc49R1

- Implemented on 12th Nov 2024, 06 UTC
- In MARS catalogue
- Due to increased size SFC distributed accross 3 tape files
- Why my enfo request takes significantly more time for dates after 12th November 2024 even if I request same grid as before and therefore size of target file is same as it was in previous cycle?
- Solution to be implemented: Introduction of new 50TB tapes (currently MARS is using 20TB tapes)

MARS Catalogue

Current activity

Reference

< Return to selection

cost

Final request

Stream:

Ensemble prediction system

Type:

Perturbed forecast

Number:

1 to 50

Step:

0 to 50

Version:

1

Type of level:

Surface

Time:

12:00:00

Date:

20241116

Parameter:

2 metre temperature

Class:

Operational archive

The status of the request is: **complete**

Number of tapes:

1

Number of tape files:

1

Number of disk files:

2

Number of online fields:

250

Number of fields:

2550

Online size:

3.1 GB

Number of offline fields:

2300

Off line size:

28.3 GB

Size:

31.4 GB

Request output

EXPECT = ANY,

OUTPUT = COST,

DATABASE = marsod

mars - INFO - 20251014.105148 - Web API request id: 68ee2b42d730d628e15da717

mars - INFO - 20251014.105148 - Setting SO_SNDBUF to 33554432 (32.00 M)

mars - INFO - 20251014.105148 - Current value is 8192 (8.00 K)

mars - INFO - 20251014.105148 - Setting SO_RCVBUF to 33554432 (32.00 M)

mars - INFO - 20251014.105148 - Current value is 43690 (42.67 K)

mars - INFO - 20251014.105148 - Calling mars on 'marsod-core', local port is 54898

mars - INFO - 20251014.105148 - Server task is 7618 [marsod]

mars - INFO - 20251014.105148 - Request performed on database 'marsod'

mars - INFO - 20251014.105148 - Memory used: 22.16 Mbyte(s)

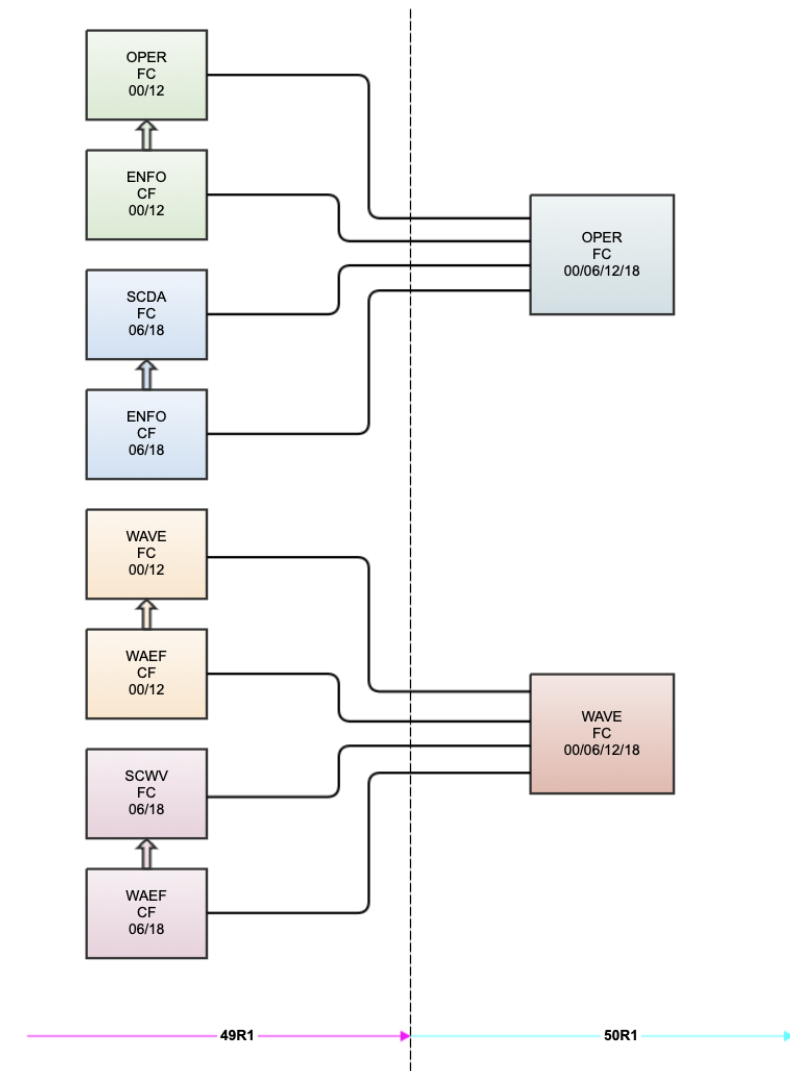
mars - INFO - 20251014.105148 - No errors reported

Process '['nice', 'mars', '/tmp/20251014-1050/a2/tmp-_mars-3FHiN3-7da85bcb629b3a1221c844a545a2cd41.req']' finished

In case of **problems**, please check the [troubleshooting page](#).

Impact of upcomming changes with 50R1 cycle – Q1 2026

- Since cyc 49R1, deterministic forecast (stream=oper, type=fc) and control forecast (stream=enfo, type=cf) are bit identical
- In 50R1, stream=enfo, type=cf will be discontinued
- Deterministic forecasts for 06 and 18 UTC initialisation time are now under stream=scda while 00 and 12 UTC are under stream=oper. All 4 model initialisation times will be merged in stream=oper



How to ask for help with data download from MARS

- Use: <https://support.ecmwf.int>
- Always provide your MARS request and the full output
- If you are planning to download large amount of data (e.g., forecasts for an entire year or longer period), you can get in touch to make sure the data is download efficiently
- User activity on MARS servers is monitored. Users with very inefficient activity might be contacted by us to improve the efficiency.

Migration to GRIB2 – 50R2 cycle impact on MARS

Parameters with levtype=sol

```
retrieve,  
  class=od,  
  stream=oper,  
  expver=1,  
  date=-2,  
  time=00:00:00,  
  type=fc,  
  step=0,  
  levtype=sol,  
  levelist=1/2/3/4/5,  
  param=228141,  
  target="output_sd.grib2"
```

**Introduced
at IFS cy48r1**

Chemical species

```
retrieve,  
  class=mc,  
  stream=oper,  
  expver=1,  
  date=-2,  
  time=00:00:00,  
  type=fc,  
  step=0,  
  levtype=ml,  
  levelist=1/to/137,  
  param=402000, # Mass mixing ratio  
  chem=no2,     # Nitrogen dioxide  
  target="output_no2.grib2"
```

Changes to MARS retrievals – sub-hourly forecast time steps

Specifying step units

```
retrieve,  
  class=od,  
  stream=oper,  
  expver=1,  
  date=-2,  
  time=00:00:00,  
  type=fc,  
  levtype=sfc,  
  stepunits=m  
  step=15/30/45/60,  
  param=228,  
  target="output_tp.grib2"
```

```
retrieve,  
  class=od,  
  stream=oper,  
  expver=1,  
  date=-2,  
  time=00:00:00,  
  type=fc,  
  levtype=sfc,  
  step=15m/30m/45m/60m,  
  param=228,  
  target="output_tp.grib2"
```


Degraded status – one of the tape libraries supporting MARSOD unavailable

- Run a request for data residing on a tape inside ibmlib08 library and monitor the request output
- The request will be queued until the tape library is made available again

Mon 13/Oct/2025 13:00:01

ACQUISITION

Start

System Session Starts: ECPDS ACQ, DISS & AUX Update

Yes

Mon 13/Oct/2025 08:27:39

End

System Session Ends: Migration of grafana-prod and grafana-test Teleport ...

Mon 13/Oct/2025 08:00:01

Start

System Session Starts: Migration of grafana-prod and grafana-test Teleport ...

Yes

Fri 10/Oct/2025 13:53:34

DISSEMINATION

End

System Session Ended: ECPDS (DISS) Cluster Recovery

UPCOMING OR STILL RUNNING

PAST

↑ Post date (Local ☐ UTC)

Duration

Tue 14/Oct/2025 06:30:00

6h

Tue 14/Oct/2025 06:30:00

33h

Tue 14/Oct/2025 12:00:00

1h

Wed 15/Oct/2025 09:00:00

30'

Wed 15/Oct/2025 11:00:00

4h

Wed 15/Oct/2025 13:00:00

1h

Thu 16/Oct/2025 09:00:00

15'

Thu 16/Oct/2025 12:00:00

1h

Thu 16/Oct/2025 12:30:00

3h

Thu 16/Oct/2025 12:30:00

30'

CONNECTIVITY

BOLOGNA DC - OSNET initial commissioning 2

Potential Service Downtime

WEB-SERVICES

RMDCN Technifo update

Definite Service Downtime

1-10 of 29

<

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Adding and cabling drives in IBMLIB08

×

Description

MARS and ECFS activity have to be stopped on IBMLIB08 and the drives emptied.

Title

Adding and cabling drives in IBMLIB08

Date

Wed 15/Oct/2025 11:00:00 UTC

Duration

240

Type

System Sessions

Impact

Service Degraded

User Impact

g HPSS configuration to ...

Service Degraded

traLogic library

Service Degraded

Potential Service Downtime

Definite Service Downtime

Service Degraded

Potential Service Downtime

Service Degraded

Potential Service Downtime

Potential Service Downtime

Definite Service Downtime

1-10 of 10

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Practicals

- <https://confluence.ecmwf.int/display/UDOC/MS+computing+training+courses>
- Advance MARS usage
 - Efficiency

MARS – Advanced use

Read: filtering

- Read requests can be used to filter/manipulate already retrieved data.
- Read UNIX file specified by **source**.
- Data written to a file specified by **target** .
- Read doesn't need all directives.

```
read,  
  source      = "myfile",  
  levelist    = 1000,  
  grid        = 2.5/2.5,  
  target      = "only_1000"
```

Not available with
the MARS WebAPI.

Multi-target

- Can organise GRIB target files depending on values of MARS language keywords or of ecCodes key
- MARS Keyword (as echoed by MARS) enclosed in **square** brackets:

```
retrieve,  
  type      = an,  
  expver    = 1,  
  levtype   = sfc,  
  date      = 20010101,  
  time      = 00/06/12/18,  
  target    = "analysis.[time]"  
  ...
```

Not available with
the MARS WebAPI.

```
mars - INFO - 20020515.1237 - Creating target name: analysis.0000  
mars - INFO - 20020515.1237 - Creating target name: analysis.0600  
mars - INFO - 20020515.1237 - Creating target name: analysis.1200  
mars - INFO - 20020515.1237 - Creating target name: analysis.1800
```

Set env. variable **MARS_MULTITARGET_STRICT_FORMAT=1** to use directive values as reported by MARS.

Multi-target

- ecCodes key name enclosed in curly brackets:

```
retrieve,  
  type          = an,  
  param         = t/u/v,  
  expver = 1,  
  levtype = sfc,  
  date          = 20010101,  
  time          = 00/06/12/18,  
  target        = "analysis.{shortName}"  
  ...
```

Not available with
the MARS WebAPI.

mars - INFO - 20140222.164526 - Creating target name: analysis.t

mars - INFO - 20140222.164527 - Creating target name: analysis.u

mars - INFO - 20140222.164527 - Creating target name: analysis.v

Multiple requests

- More than one request in a single call to MARS.
- Append to target:

retrieve,
date **= 20010101,**
time **= 12,**
type **= an,**
target **= “analysis”**

retrieve,
date **= 20000101,**
time **= 12,**
type **= an,**
target **= “analysis”**

Available with the
MARS WebAPI and
client.

Multiple requests

- Parameter inheritance
 - Parameters not set in the second request (and subsequent ones) are inherited from the previous one:

```
retrieve,  
    class      = od,  
    expver     = 1,  
    stream     = oper,  
    date       = -10,  
    time       = 12,  
    type       = an,  
    target     = "analysis"  
  
retrieve,  
    type       = fc,  
    step       = 24/to/72/by/24,  
    target     = "forecast"
```

- Unwanted inherited parameters are removed by specifying “**off**”,

Fieldset

- Temporary storage for further processing:

retrieve,

class	= od,
expver	= 1,
stream	= oper,
date	= -10,
levtype	= ml,
levelist	= 1/to/60,
param	= t,
time	= 12,
type	= an,
fieldset	= analysis

Not available with
the MARS WebAPI.

Fieldset

- ‘analysis’ above can be seen as a variable to be referenced in a further request.
- At the end of the call to MARS, all fieldsets are released.
- Write requests save fieldsets into UNIX files:

```
write,  
  fieldset    = analysis,  
  target      = "data.grb"
```

Not available with
the MARS WebAPI.

Compute

- Computations on GRIB fields with same shape:
 - `fieldset`
 - `formula`
 - Scalar values allowed
 - Predefined functions in formula, e.g.

```
compute,  
formula      = "x/2+log(y)*x",  
fieldset     = z
```

Not available with
the MARS WebAPI.

where x and y are two fieldsets which have been initialised beforehand.

Compute

- Mixing fields and scalars:
 - Compute on 2 fields is a field
 - Compute on a field and a scalar is a field
 - Compute on 2 scalars is a scalar
- Bitmaps and missing values:
 - Not considered on computations but copied
- GRIB headers on result of **compute** are incorrect. They are copied from the first fieldset!

Not available with
the MARS WebAPI.

Compute: example

```
retrieve,  
  class = od,  
  expver = 1,  
  stream = oper,  
  type = analysis,  
  date = -10,  
  time = 12,  
  levtype = sfc,  
  param = 165.128, # u  
  grid = 1/1,  
  fieldset = u  
retrieve,  
  param = 166.128, # v  
  fieldset = v  
compute,  
  formula = "sqrt(u*u + v*v)",  
  fieldset = speed write,  
  fieldset = speed,  
  target = "windspeed"
```

Not available with
the MARS WebAPI.

Practicals: Advanced MARS usage

- <https://confluence.ecmwf.int/display/UDOC/MS+computing+training+courses#MScomputingtrainingcourses-AdvancedMARSusage>