LAB 3 : Data Resources netCDF

(Network Common Data Form)

What is netCDF?

- **NetCDF** (network Common Data Form) is an interface for array-oriented data access and a library that provides an implementation of the interface. The **NetCDF** library also defines a machine-independent format for representing scientific data. Together, the interface, library, and format support the creation, access, and sharing of scientific data.
- **NetCDF** maintains a collection of **reanalysis datasets** for use in climate diagnostics and attribution.

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❑**LAB 3 :Data Resources netCDF**

❑**What is netCDF and Define Reanalysis datasets?**

❑LAB3: مصادر البيانات netcdf

❑ما هو Netcdf؟ وما هي **Reanalysis datasets** تحليل مجموعة البيانات؟

❑ NetCDF) وهو نموذج البيانات الشائع للشبكة العالمية للمعلومات (الانترنت) وهي مكتبة الكترونية لتجهيز البيانات لجميع المتخصصين في علوم الجو، حيث تعتبر واجهة الوصول للبيانات عبر الانترنت، حيث ان عملية الوصول الى البيانات عملية مهمة في البحث اولتحليل مشكلة محددة في علوم الجو، تتم عملية جمع البيانات من خلال مشاركة ملفات NetCDF(Network Common Data Form)

❑ يحتوي ملف بيانات NetCDF على مجاميع من مجموعات بيانات إعادة التحليل لاستخدامها في تشخيص المناخ وخصائصه .

LAB 3 : Data Resources netCDF

- **Reanalysis datasets** are created by assimilating ("inputting") climate observations using the same climate model throughout the entire reanalysis period in order to reduce the affects of modeling changes on climate statistics. Observations are from many different sources including ships, satellites, ground stations, RAOBS, and radar.
- Currently, PSD makes available these reanalysis datasets to the public in our standard **NetCDF format.**
- **PSD is Physical Sciences Division in ESRL Earth System Research Laboratory of NOAA NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION**

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- وتسمى البيانات المسحوبة من هذا الموديل Reanalysis datasets وهي بيانات مدخلة بواسطة موديلات خاصة لتحليلها بعد جمعها من خلال عمليات الرصد المختلفة عبر السفن والاقمار الصناعية والمحطات الارضية والرصد عبر الراديو ساوند والرادار.
- توجد على شبكة المعلومات العالمية الكثير من المواقع الخاصة بمراكز الطقس والمناخ التي توفر بيانات العناصر الانوائية للكرة الأرضية ولفترات طويلة منها:
- NOAA: المركز الوطني الامريكي لإدارة المحيطات والجو.
- NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
- PSD وهو قسم متخصص في NOAA قسم علوم الفيزياء **Physical Sciences Division** في مختبرات ابحاث انظمة الارض **ESRL Earth System Research Laboratory** التابع لـ **NOAA**

LAB 3 : Data Resources netCDF

- **NCEP**: National Centers for Environmental Prediction (9 centers) College Park, Maryland, USA
  https://www.weather.gov/ncep/ المركزالوطني لتنبؤات البيئة
- **NCAR**: National Center for Atmospheric Research Boulder, Colorado, USA
  https://ncar.ucar.edu/ المركز الوطني لابحاث علوم الجو
- **ECMWF**: European Centre for Medium-Range Weather Forecasts
  . https://www.ecmwf.int/ المركز الأوروبي لتنبؤات الطقس متوسطة المدى

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- ❑ NATIONAL Centers for Environmental Prediction(9 centers),
- ❑ **NCEP** : College Park,Maryland,USA
  https://www.weather.gov/ncep/ المركزالوطني لتنبؤات البيئة
- ❑ NCAR : **N**ational **C**enter for **A**tmospheric **R**esearch , Boulder,
- ❑ Colorado, USA
  https://ncar.ucar.edu/ المركز الوطني لابحاث علوم الجو
- ❑ • ECMWF :المركز الأوروبي لتنبؤات الطقس متوسطة المدى .
- ❑ European Centre for Medium-Range Weather Forecasts
  . https://www.ecmwf.int/ المركز الأوروبي لتنبؤات الطقس متوسطة المدى

LAB 3 : NetCDF Data Model

- **NetCDF (Network Common Data Form)**

Topics Covered:

1. The **ncdisp** command : Open NetCDF File
2. The **ncinfo** command : Get Information About NetCDF File
3. The **ncread** command : Read Data from NetCDF File

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- NetCDF (Network Common Data Form)
- المواضيع المطلوبة في هذا المختبر
- الامر ncdisp : فتح ملفات nc-file
- الامر ncinfo : ارجاع معلومات ملف nc-file
- الامر ncread : ارجاع بيانات ملف nc-file

LAB 3 : NetCDF Data Model

❑ **A quick guide on how to use Matlab netCDF functions**

A netCDF file contains two parts:

- A "header" that describes the names, dimensions, etc., of the variables stored in the file.
- And the main body that contains the real data.

❑ To process a netCDF file, we need to first extract the information in the header and determine what portion/segment of the data we want to use.

- ❖ This is usually done by using a set of stand-alone tools. we will discuss in Part (A).
- ❖ Once the content of a netCDF file is known, it is rather straight forward to read the data as will be discussed in Part (B).

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❑دليل سريع حول كيفية استخدام وظائف MATLAB NETCDF

❑يحتوي ملف NetCDFعلى جزأين:

❑"الرأس" **header** يصف الأسماء والأبعاد ، وما إلى ذلك ، من المتغيرات التي يتم حفظها في الملف.

❑والجسم الرئيسي**main body** الذي يحتوي على البيانات الحقيقية.

❑لمعالجة ملف NetCDF، نحتاج أولاً إلى استخراج المعلومات في الرأس وتحديد جزء/شريحة من البيانات التي نريد استخدامها.

❑ عادة ما يتم ذلك باستخدام مجموعة من الأدوات المستقلة. سنناقش في الجزء (A).

❑بمجرد معرفة محتوى ملف NetCDF، يكون التقدم إلى الأمام لقراءة البيانات كما ستتم مناقشته في الجزء (B).

LAB 3 : NetCDF Data Model

Part (A) Inspect the content of a netCDF file

We will use the netCDF data file, PRESSURE_9.nc, as an example to explain how the MATLAB functions work. This file, extracted and downloaded from the NOAA ESRL-PSD web portal (www.esrl.noaa.gov/psd), contains the Atmospheric model CMAP gridded data for the long-term Mean sea level pressure for the global domain on a regular longitude latitude grid for the climatological means for January, February, ..., December.

OR use this link for retrieve data from The European Centre for Medium-Range Weather Forecasts (ECMWF)

http://apps.ecmwf.int/datasets/data/interim-full-daily

http://apps.ecmwf.int/datasets/data/macc-reanalysis/levtype=sfc/

https://www.ecmwf.int/en/forecasts/datasets/reanalysis-datasets/era5

NetLab Computer Networks Research Lab

- الجزء (A) مخصص لمحتوى ملف NetCDF
- سنستخدم ملف بيانات NetCDF، Pressure_9.nc، كمثال لشرح كيفية عمل وظائف MATLA B. يحتوي هذا الملف ، الذي تم استخلاصه وتنزيله من موقع الويب (www.esrl.noaa.gov/psd)
- NOAA ESRL-PSD من موقع المركز الوطني الامريكي لإدارة المحيطات والجو
- حيث يحتوي على (CMAP gridded data) نموذج بيانات شبكية CMAP بعيد المدى(long-term) لبيانات الغلاف الجوي للضغط الجوي عند مستوى سطح البحر (MSL :Mean Sea Level)

على المدى الطويل لكل خارطة العالم على خط الطول المنتظم لشبكة خط العرض لقيم معدلات المناخ لشهر كانون الثاني ، شباط ، ... ، كانون الاول.

- أو استخدم هذا الرابط لاسترداد البيانات من المركز الأوروبي لتوقعات الطقس المتوسطة المدى

(ECMWF :The European Centre for Medium-Range Weather Forecasts)

http://apps.ecmwf.int/datasets/data/interim-full-daily

http://apps.ecmwf.int/datasets/data/macc-reanalysis/levtype=sfc/

https://www.ecmwf.int/en/forecasts/datasets/reanalysis-datasets/era5

LAB 3 : NetCDF Data Model

•ERA5

•ERA5 is **the latest climate reanalysis produced by ECMWF**

•ERA5 provides hourly estimates of a large number of atmospheric, land and oceanic climate variables. The data cover the Earth on a 30km grid and resolve the atmosphere using 137 levels from the surface up to a height of 80km. ERA5 includes information about uncertainties for all variables at reduced spatial and temporal resolutions.

•Quality-assured monthly updates of ERA5 (1959 to present) are published within 3 months of real time. Preliminary daily updates of the dataset are available to users within 5 days of real time.

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NetLab Computer Networks Research Lab

- ERA5 هو أحدث تحليل مناخي أنتجته ECMWF
- يوفر ERA5 تقديرات كل ساعة لعدد كبير من متغيرات المناخ في الغلاف الجوي والأرض والمحيطات. تغطي البيانات الأرض على شبكة 30 كم وتغطي بيانات الغلاف الجوي باستخدام 137 مستوى من السطح حتى ارتفاع 80 كم. يتضمن ERA5 معلومات لجميع المتغيرات حتى في حالة انخفاض الدقة المكانية والزمانية.
- يتم نشر تحديثات شهرية من سنة 1959 والى الوقت الحالي في غضون 3 أشهر من الوقت الفعلي. تتوفر تحديثات يومية أولية لمجموعة البيانات للمستخدمين في غضون 5 أيام من الوقت الفعلي.

LAB 3 : NetCDF Data Model

•ERA5 is the fifth generation of the European Centre for Medium-Range Weather Forecasts (ECMWF)

•Atmospheric Reanalysis, A reanalysis is the "most complete picture currently possible of past weather and climate." Reanalyses are created from assimilation of a wide range of data sources via numerical weather prediction (NWP) models. Meteorologically valuable variables for land and atmosphere were ingested and converted from grib data to Zarr (with no other modifications) to surface a cloud-optimized version of ERA5. In addition, an open-sourced code base is provided to show the providence of the data as well as demonstrate common research workflows. This dataset includes both raw (grib) and cloud-optimized (zarr) files.

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- ERA5 هو الجيل الخامس من المركز الأوروبي للتنبؤات الجوية متوسطة المدى (ECMWF)،
- إعادة التحليل هي "الصورة الأكثر اكتمالا الممكنة حاليا للطقس والمناخ في الماضي." يتم إنشاء عمليات إعادة التحليل من استيعاب مجموعة واسعة من مصادر البيانات عبر نماذج التنبؤ العددي بالطقس (NWP). تم استيعاب المتغيرات ذات القيمة الأرصاد الجوية للأرض والغلاف الجوي وتحويلها من بيانات grib إلى Zarr (بدون تعديلات أخرى)
- لعرض نسخة محسّنة من السحابة من ERA5. بالإضافة إلى ذلك ، يتم توفير قاعدة رموز مفتوحة المصدر لإظهار توفير البيانات وكذلك إظهار تدفقات العمل البحثية المشتركة.
- تتضمن مجموعة البيانات هذه كلاً من الملفات الأولية (grib) وطريقة حفظ الملفات السحابية zarr

LAB 3 : NetCDF Data Model

•GRIB is a file format for the storage and transport of gridded meteorological data, such as Numerical Weather Prediction model output. It is designed to be self-describing, compact and portable across computer architectures. The GRIB standard was designed and is maintained by the World Meteorological Organization (WMO)

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- GRIB هو تنسيق ملف لتخزين ونقل بيانات الأرصاد الجوية الشبكية ، مثل مخرجات نموذج التنبؤ العددي بالطقس. وهي مصممة لتكون ذاتية الوصف ومضغوطة وقابلة للحمل عبر سيرفرات الحاسبات . تم تصميم معيار GRIB والمحافظة عليه من قبل المنظمة العالمية للأرصاد الجوية (WMO).

LAB 3 : NetCDF Data Model

- A preliminary ERA5 dataset from 1950 to 1978 is also available on the Climate data store (CDS) (1959-1978 is superseded by the quality assured dataset).
- ERA5 combines vast amounts of historical observations into global estimates using advanced modelling and data assimilation systems.
- ERA5 replaces the ERA-Interim reanalysis which stopped being produced on 31 August 2019. You can read about the key characteristics of ERA5 and important changes relative to ERA-Interim.
-

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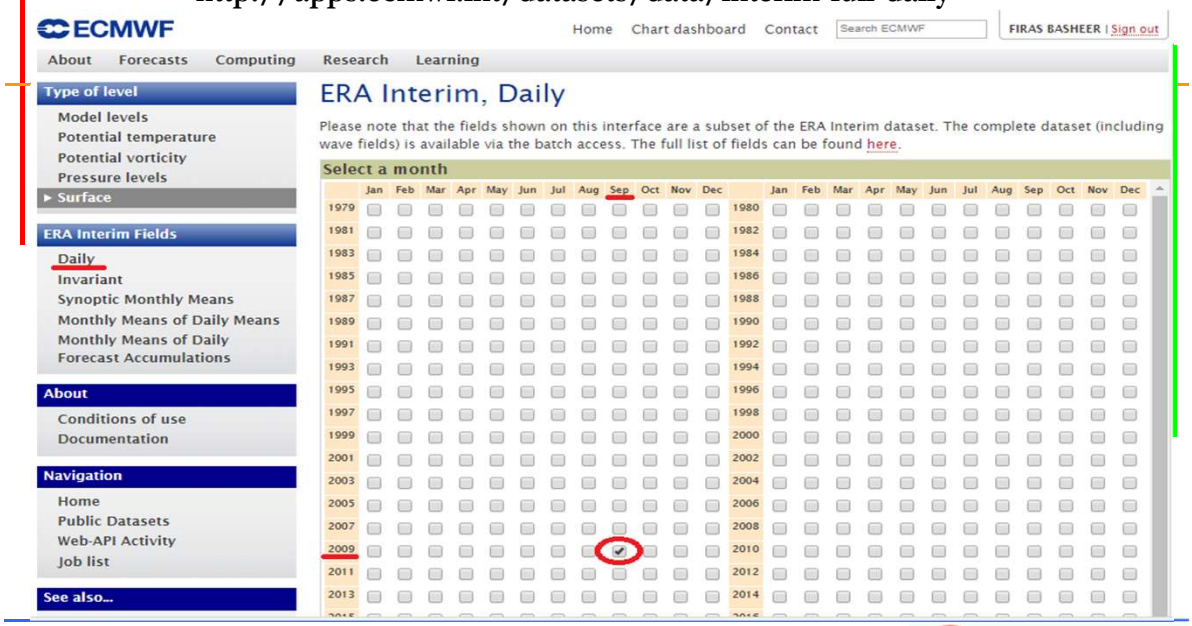
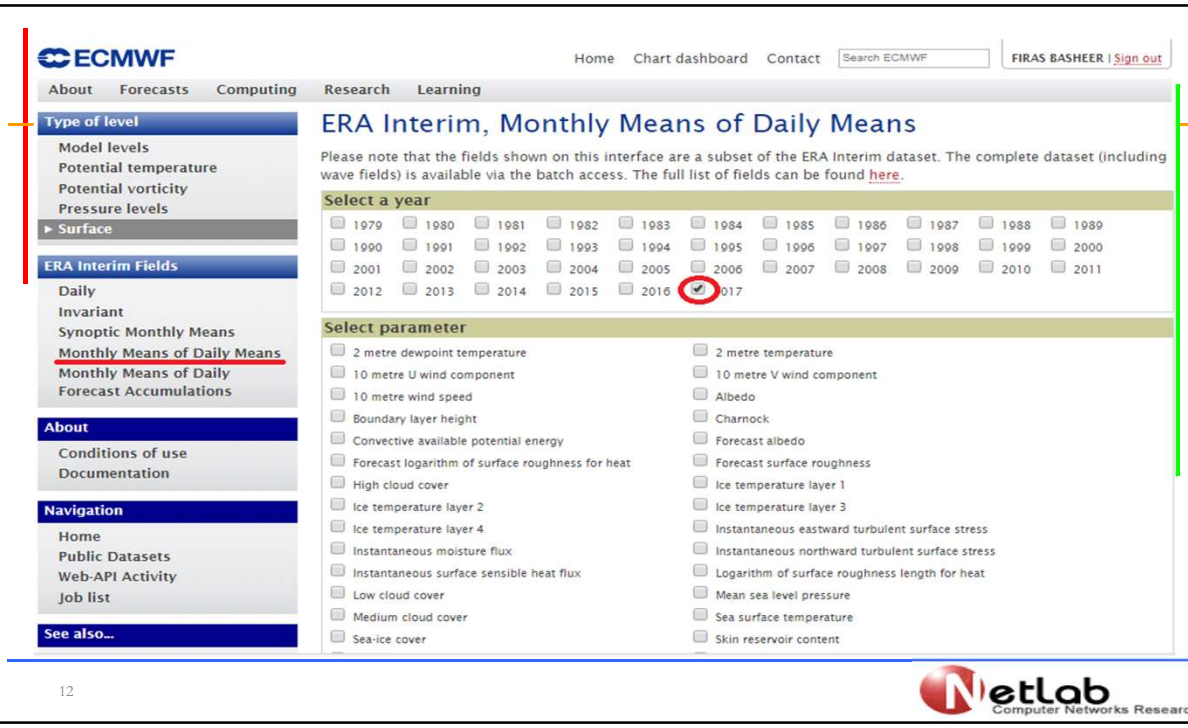
- تتوفر أيضًا مجموعة بيانات أولية ERA5 من 1950 إلى 1978 في ارشيف بيانات المناخ (CDS) (1959-1978)
- يجمع ERA5 بين كميات هائلة من الملاحظات التاريخية في تقديرات عالمية باستخدام النمذجة المتقدمة وأنظمة استيعاب البيانات.
- يستبدل ERA5 تحليل ERA- المؤقت الذي توقف إنتاجه في 31 أغسطس 2019.

يمكنك أن تقرأ عن الخصائص الرئيسية لـ ERA5 والتغييرات المهمة المتعلقة بـ ERA-I nterim.

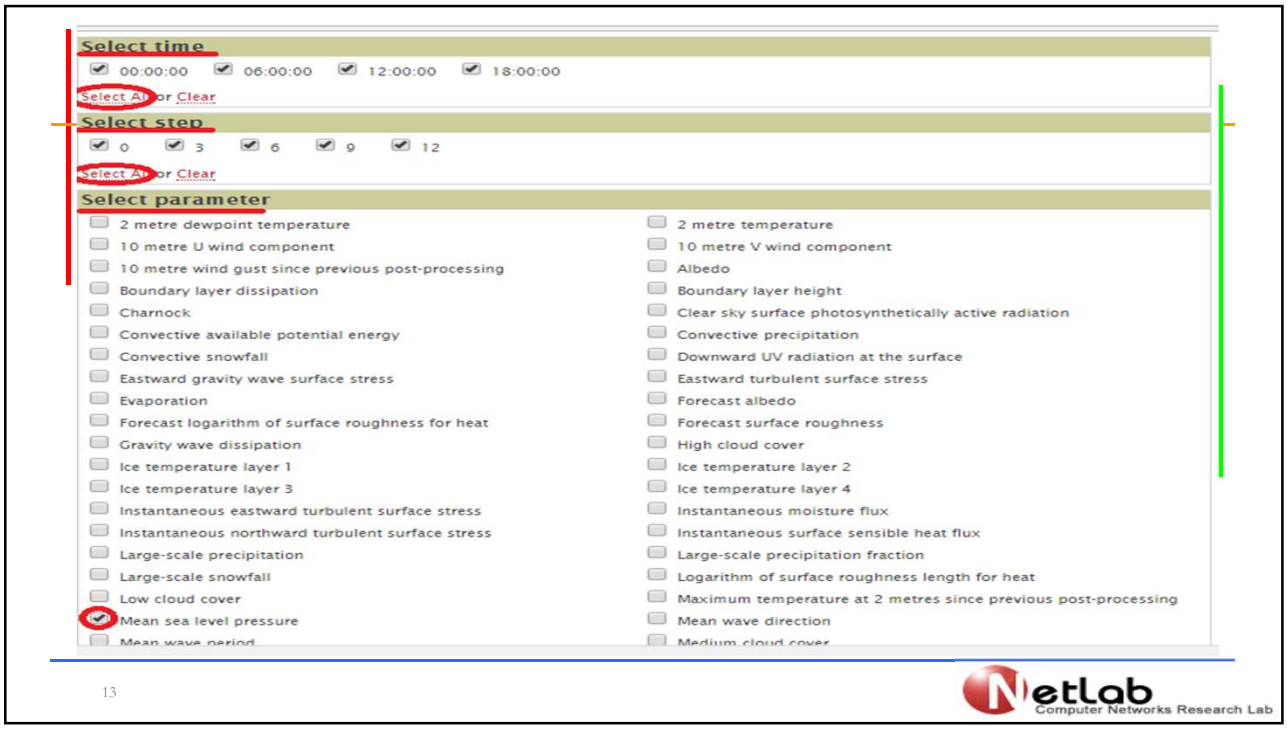
http://apps.ecmwf.int/datasets/data/interim-full-daily



11



12


Select time
00:00:00
06:00:00
12:00:00
18:00:00
Select All or Clear
Select step
0
3
6
9
12
Select All or Clear
Select parameter
2 metre dewpoint temperature
2 metre temperature
10 metre U wind component
10 metre V wind component
10 metre wind gust since previous post-processing
Albedo
Boundary layer dissipation
Boundary layer height
Charnock
Clear sky surface photosynthetically active radiation
Convective available potential energy
Convective precipitation
Convective snowfall
Downward UV radiation at the surface
Eastward gravity wave surface stress
Eastward turbulent surface stress
Evaporation
Forecast albedo
Forecast logarithm of surface roughness for heat
Forecast surface roughness
Gravity wave dissipation
High cloud cover
Ice temperature layer 1
Ice temperature layer 2
Ice temperature layer 3
Ice temperature layer 4
Instantaneous eastward turbulent surface stress
Instantaneous moisture flux
Instantaneous northward turbulent surface stress
Instantaneous surface sensible heat flux
Large-scale precipitation
Large-scale precipitation fraction
Large-scale snowfall
Logarithm of surface roughness length for heat
Low cloud cover
Maximum temperature at 2 metres since previous post-processing
Mean sea level pressure
Mean wave direction
Mean wave period
Medium cloud cover
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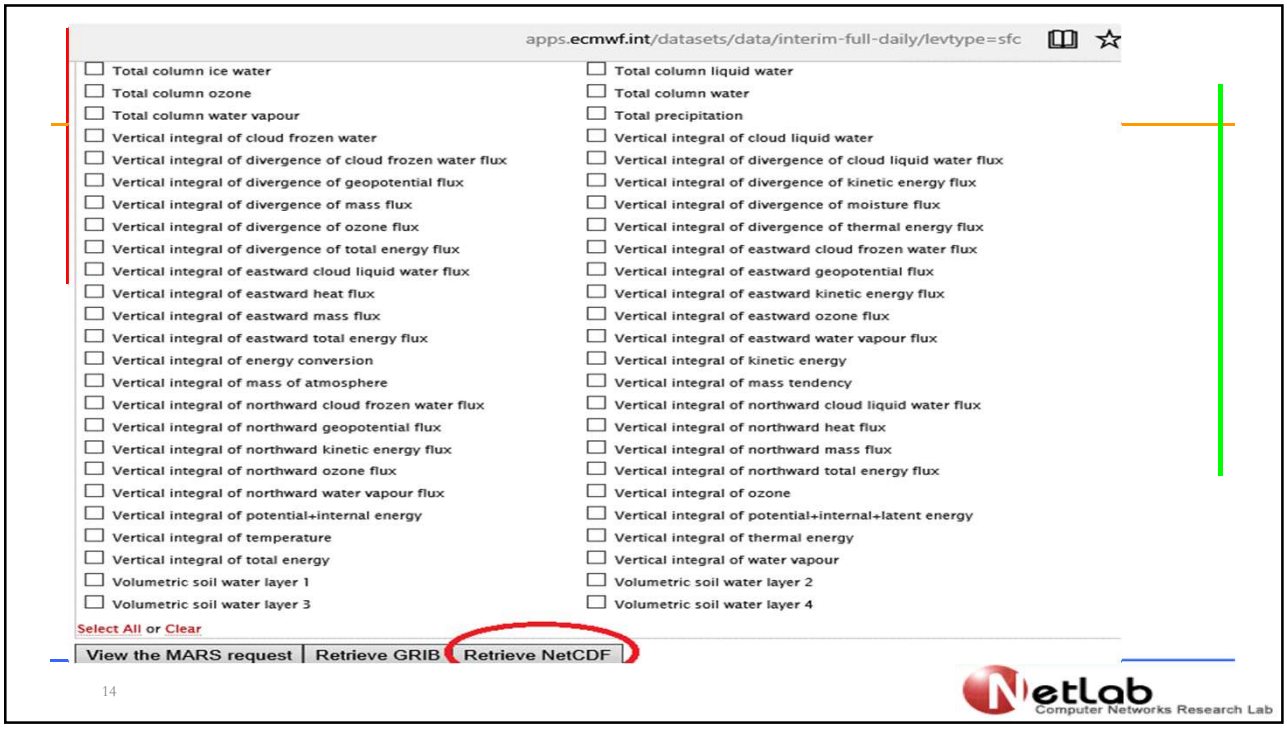
apps.ecmwf.int/datasets/data/interim-full-daily/levtype=sfc
Total column ice water
Total column liquid water
Total column ozone
Total column water
Total column water vapour
Total precipitation
Vertical integral of cloud frozen water
Vertical integral of cloud liquid water
Vertical integral of divergence of cloud frozen water flux
Vertical integral of divergence of cloud liquid water flux
Vertical integral of divergence of geopotential flux
Vertical integral of divergence of kinetic energy flux
Vertical integral of divergence of mass flux
Vertical integral of divergence of moisture flux
Vertical integral of divergence of ozone flux
Vertical integral of divergence of thermal energy flux
Vertical integral of divergence of total energy flux
Vertical integral of eastward cloud frozen water flux
Vertical integral of eastward cloud liquid water flux
Vertical integral of eastward geopotential flux
Vertical integral of eastward heat flux
Vertical integral of eastward kinetic energy flux
Vertical integral of eastward mass flux
Vertical integral of eastward ozone flux
Vertical integral of eastward total energy flux
Vertical integral of eastward water vapour flux
Vertical integral of energy conversion
Vertical integral of kinetic energy
Vertical integral of mass of atmosphere
Vertical integral of mass tendency
Vertical integral of northward cloud frozen water flux
Vertical integral of northward cloud liquid water flux
Vertical integral of northward geopotential flux
Vertical integral of northward heat flux
Vertical integral of northward kinetic energy flux
Vertical integral of northward mass flux
Vertical integral of northward ozone flux
Vertical integral of northward total energy flux
Vertical integral of northward water vapour flux
Vertical integral of ozone
Vertical integral of potential+internal energy
Vertical integral of potential+internal+latent energy
Vertical integral of temperature
Vertical integral of thermal energy
Vertical integral of total energy
Vertical integral of water vapour
Volumetric soil water layer 1
Volumetric soil water layer 2
Volumetric soil water layer 3
Volumetric soil water layer 4
Select All or Clear
View the MARS request
Retrieve GRIB
Retrieve NetCDF
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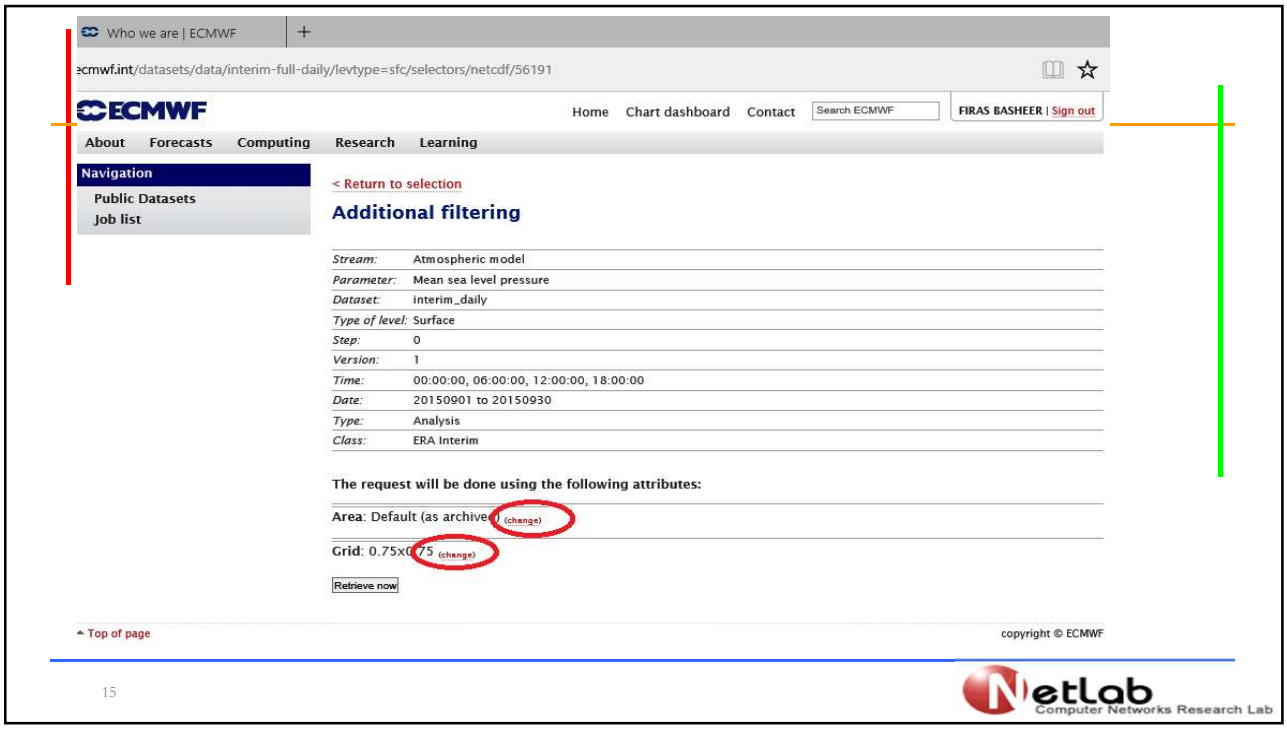

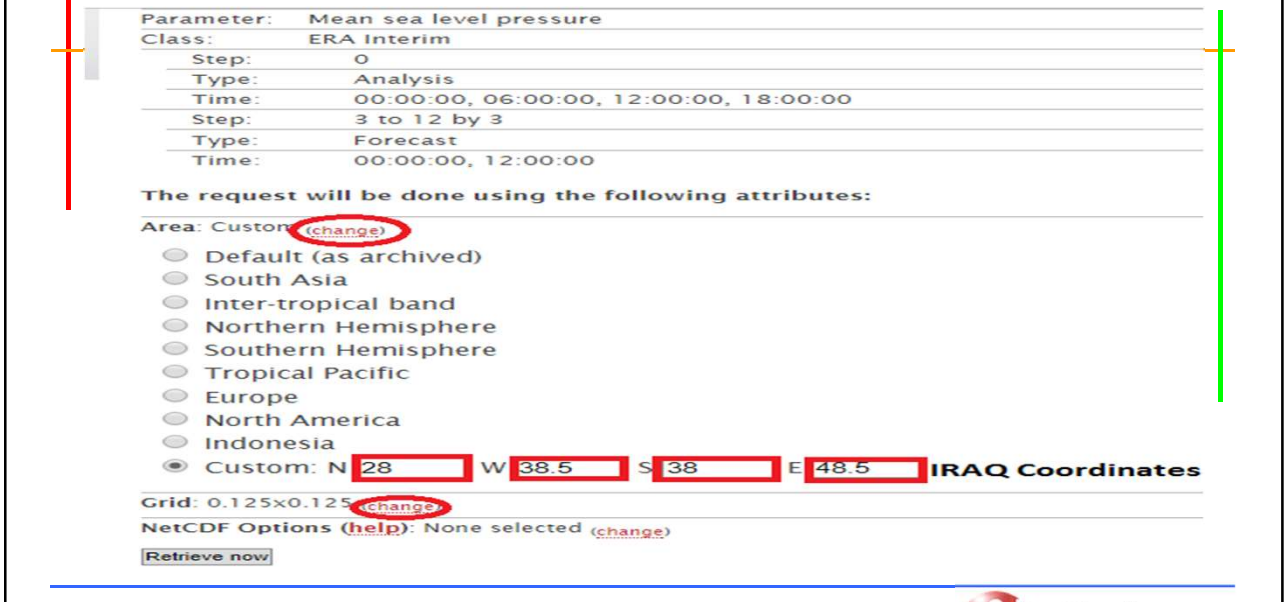

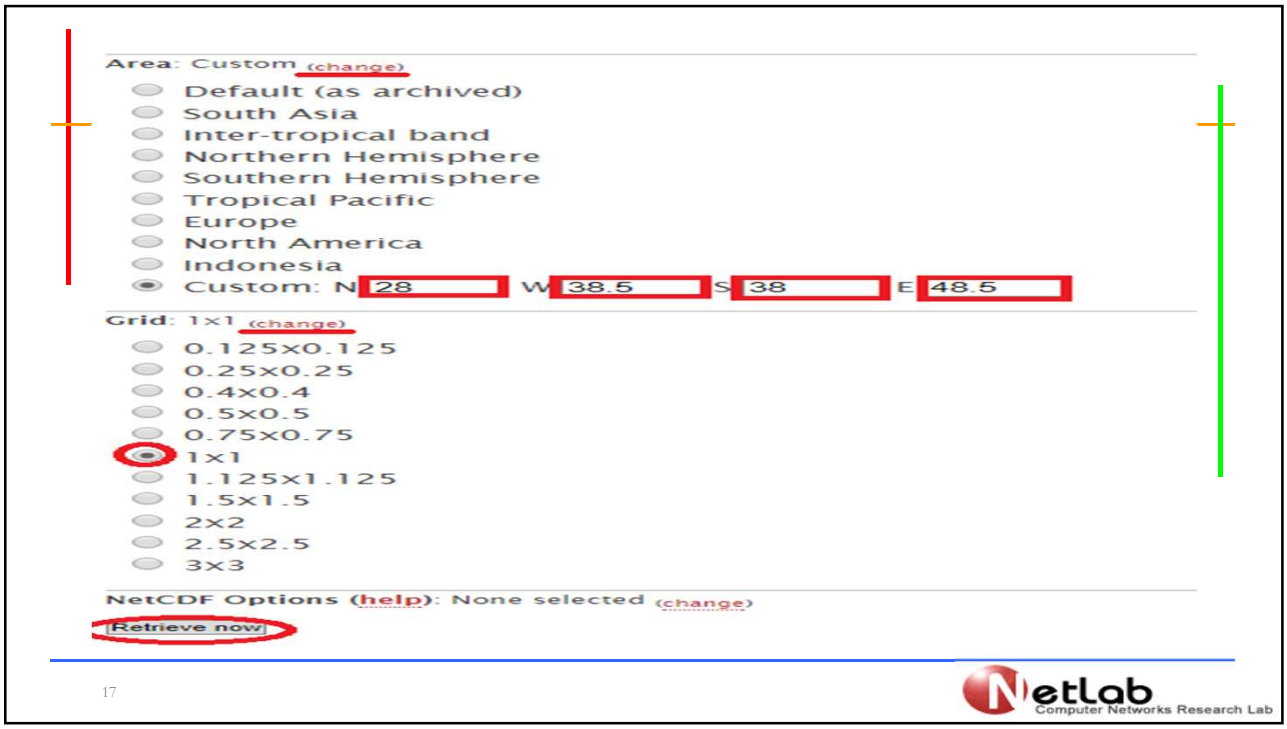
Area: Custom (change)
Default (as archived)
South Asia
Inter-tropical band
Northern Hemisphere
Southern Hemisphere
Tropical Pacific
Europe
North America
Indonesia
Custom: N 28 W 38.5 S 38 E 48.5
Grid: 1x1 (change)
0.125x0.125
0.25x0.25
0.4x0.4
0.5x0.5
0.75x0.75
1x1
1.125x1.125
1.5x1.5
2x2
2.5x2.5
3x3
NetCDF Options (help): None selected (change)
Retrieve now!
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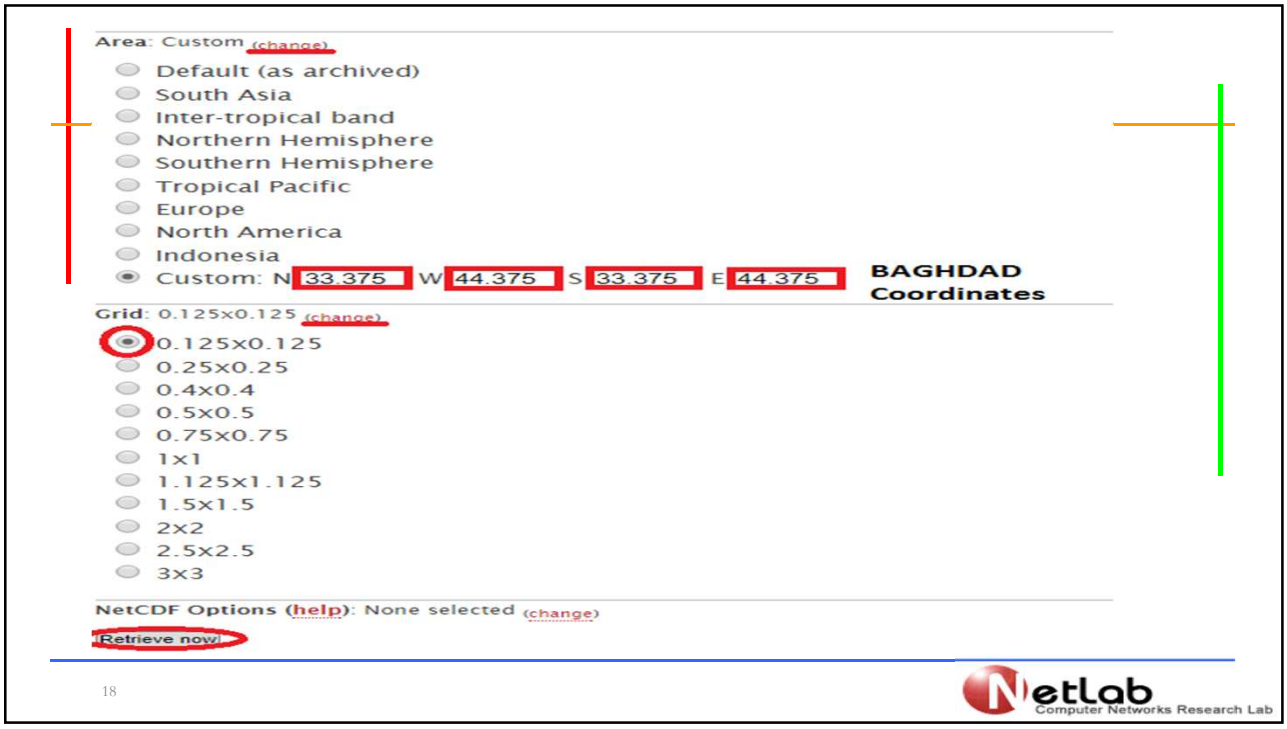
Computer Networks Research Lab


Area: Custom (change)
Default (as archived)
South Asia
Inter-tropical band
Northern Hemisphere
Southern Hemisphere
Tropical Pacific
Europe
North America
Indonesia
Custom: N 33.375 W 44.375 S 33.375 E 44.375
BAGHDAD Coordinates
Grid: 0.125x0.125 (change)
0.125x0.125
0.25x0.25
0.4x0.4
0.5x0.5
0.75x0.75
1x1
1.125x1.125
1.5x1.5
2x2
2.5x2.5
3x3
NetCDF Options (help): None selected (change)
Retrieve now!
18
NetLab
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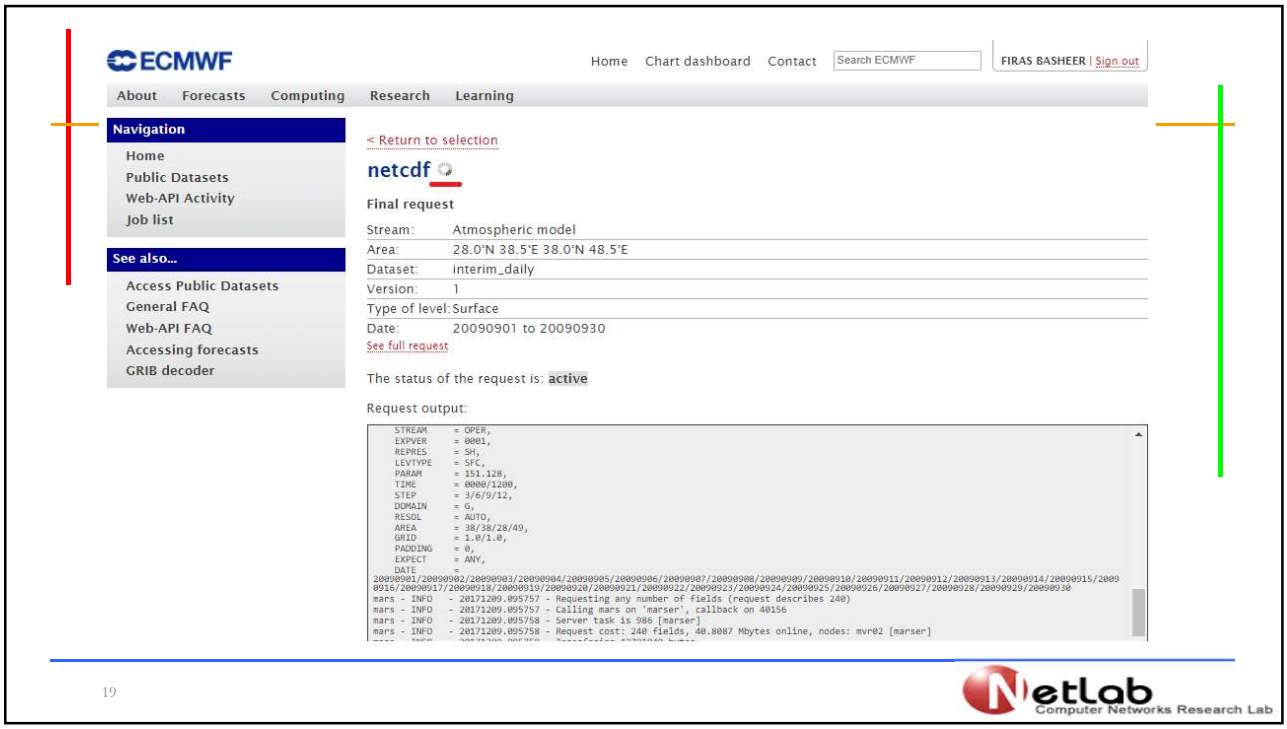
ECMWF
Home
Chart dashboard
Contact
Search ECMWF
FIRAS BASHEER | Sign out
About
Forecasts
Computing
Research
Learning
Navigation
Home
Public Datasets
Web-API Activity
Job list
See also...
Access Public Datasets
General FAQ
Web-API FAQ
Accessing forecasts
GRIB decoder
< Return to selection
netcdf
Final request
Stream: Atmospheric model
Area: 28.0°N 38.5°E 38.0°N 48.5°E
Dataset: interim_daily
Version: 1
Type of level: Surface
Date: 20090901 to 20090930
See full request
The status of the request is: active
Request output:
STREAM = OPER,
EXPVER = 0001,
REPRES = SH,
LEVTYPE = SFC,
PARAM = 151.128,
TIME = 0000/1200,
STEP = 3/6/9/12,
DOMAIN = G,
RESOL = AUTO,
AREA = 38/38/28/49,
GRID = 1.0/1.0,
PADDING = 0,
EXPECT = ANY,
DATE =
mars - INFO - 20171209.095757 - Requesting any number of fields (request describes 240)
mars - INFO - 20171209.095757 - Calling mars on 'marser', callback on 40156
mars - INFO - 20171209.095758 - Server task is 986 [marser]
mars - INFO - 20171209.095758 - Request cost: 240 fields, 40.8087 Mbytes online, nodes: mvr02 [marser]

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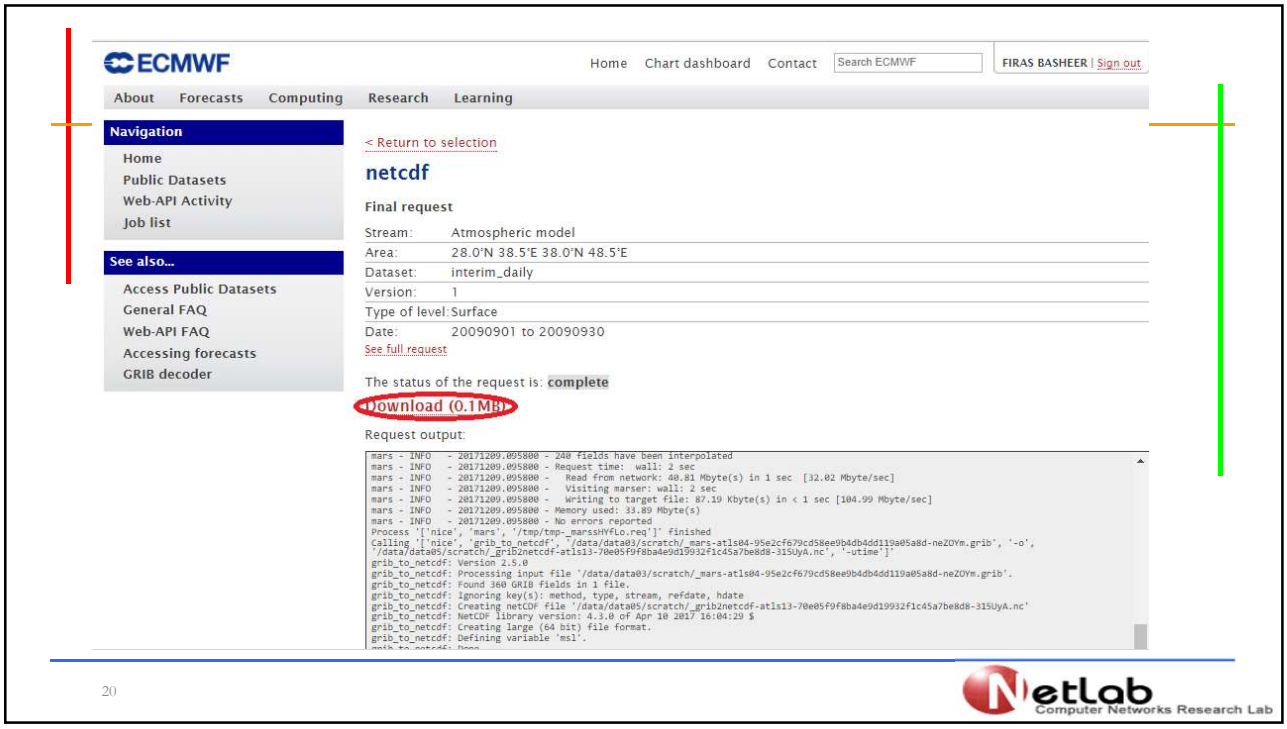
ECMWF
Home
Chart dashboard
Contact
Search ECMWF
FIRAS BASHEER | Sign out
About
Forecasts
Computing
Research
Learning
Navigation
Home
Public Datasets
Web-API Activity
Job list
See also...
Access Public Datasets
General FAQ
Web-API FAQ
Accessing forecasts
GRIB decoder
< Return to selection
netcdf
Final request
Stream: Atmospheric model
Area: 28.0°N 38.5°E 38.0°N 48.5°E
Dataset: interim_daily
Version: 1
Type of level: Surface
Date: 20090901 to 20090930
See full request
The status of the request is: complete
Download (0.1MB)
Request output:
mars - INFO - 20171209.095800 - 240 fields have been interpolated
mars - INFO - 20171209.095800 - Request time: wall: 2 sec
mars - INFO - 20171209.095800 - Read from network: 40.81 Mbyte(s) in 1 sec [32.02 Mbyte/sec]
mars - INFO - 20171209.095800 - Visiting marser: wall: 2 sec
mars - INFO - 20171209.095800 - Writing to target file: 87.19 Kbyte(s) in < 1 sec [104.99 Mbyte/sec]
mars - INFO - 20171209.095800 - Memory used: 33.89 Mbyte(s)
mars - INFO - 20171209.095800 - No errors reported
Process '['nice', 'mars', '/tmp/tmp-_marssHYfLo.req']' finished
Calling '['nice', 'grib_to_netcdf', '/data/data03/scratch/_mars-atls04-95e2cf679cd58ee9b4db4dd119a05a8d-neZOYm.grib', '-o', '/data/data05/scratch/_grib2netcdf-atls13-70e05f9f8ba4e9d19932f1c45a7be8d8-315UyA.nc', '-utime']'
grib_to_netcdf: Version 2.5.0
grib_to_netcdf: Processing input file '/data/data03/scratch/_mars-atls04-95e2cf679cd58ee9b4db4dd119a05a8d-neZOYm.grib'.
grib_to_netcdf: Found 360 GRIB fields in 1 file.
grib_to_netcdf: Ignoring key(s): method, type, stream, refdate, hdate
grib_to_netcdf: Creating netCDF file '/data/data05/scratch/_grib2netcdf-atls13-70e05f9f8ba4e9d19932f1c45a7be8d8-315UyA.nc'
grib_to_netcdf: NetCDF library version: 4.3.0 of Apr 10 2017 16:04:29 $
grib_to_netcdf: Creating large (64 bit) file format.
grib_to_netcdf: Defining variable 'msl'.

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LAB 3 : Part(A) NetCDF Data Model(Header)

1.The ncdisp command

Display contents of NetCDF data source in Command Window

Syntax

1- ncdisp(source)

Displays as text in the Command Window ,all the group ,dimensions, variable definitions, and all attributes in the NetCDF data source

2- ncdisp(source,location)

Displays information about the variable or group specified by location in source.

3- ncdisp(source,location,modestr)

Displays the contents of the location in source according to the value of modestr.

LAB 3 : Part(A) NetCDF Data Model(Header)

Step 0: Display/check the header of the netCDF file

It is strongly recommended that the information in the header be examined before one uses the data in a netCDF file.

1- ncdisp(source)

1- ncdisp(source) source — Name of NetCDF file

Displays all the groups, dimensions, variable definitions, and all attributes in the NetCDF data source, as text in the Command Window.

Example:

```
>>ncdisp('PRESSURE_9.nc')
```

LAB 3 : Part(A) NetCDF Data Model(Header)

Step 0: Display/check the header of the netCDF file

1- ncdisp(source)

>>ncdisp('PRESSURE_9.nc')

Global Attributes:

history = '2017-12-09 09:58:01 GMT by grib_to_netcdf-2.5.0:

Dimensions:

longitude = 12

latitude = 11

time = 241 (UNLIMITED)

LAB 3 : Part(A) NetCDF Data Model(Header)

Step 0: Display/check the header of the netCDF file

1- ncdisp(source)

>>ncdisp('PRESSURE_9.nc')

Variables:

longitude

Size: 12x1

Dimensions: longitude

Datatype: single

Attributes:

units = 'degrees_east'

long_name = 'longitude'

LAB 3 : Part(A) NetCDF Data Model(Header)

Step 0: Display/check the header of the netCDF file

1- ncdisp(source)

```
>>ncdisp('PRESSURE_9.nc')

latitude
        Size:      11x1
        Dimensions: latitude
        Datatype:   single
        Attributes:
                units     = 'degrees_north'
                long_name = 'latitude'
```


LAB 3 : Part(A) NetCDF Data Model(Header)

Step 0: Display/check the header of the netCDF file

1- ncdisp(source)

>>ncdisp('PRESSURE_9.nc')

```
time
        Size:      241x1
        Dimensions: time
        Datatype:   int32
        Attributes:
                units     = 'hours since 1900-01-01 00:00:0.0'
                long_name = 'time'
```


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LAB 3 : Part(A) NetCDF Data Model(Header)

Step 0: Display/check the header of the netCDF file

1- ncdisp(source)

```
>>ncdisp('PRESSURE_9.nc')

 msl
        Size:      12x11x241
        Dimensions: longitude,latitude,time
        Datatype:   int16
        Attributes:
units         = 'Pa'
                long_name     = 'Mean sea level pressure'
                standard_name = 'air_pressure_at_sea_level'
```


LAB 3 : Part(A) NetCDF Data Model(Header)

Step 0: Display/check the header of the netCDF file

2- ncdisp(source,location)

```
>>ncdisp('PRESSURE_9.nc','longitude')
Dimensions:
        longitude = 12
Variables:
   longitude
        Size:      12x1
        Dimensions: longitude
        Datatype:   single
        Attributes:
                units     = 'degrees_east'
                long_name = 'longitude'
```

LAB 3 : Part(A) NetCDF Data Model(Header)

Step 0: Display/check the header of the netCDF file

2- ncdisp(source,location)

```
>>ncdisp('PRESSURE_9.nc','latitude')
Dimensions:
        latitude = 11
Variables:
   latitude
        Size:      11x1
        Dimensions: latitude
        Datatype:   single
        Attributes:
                units     = 'degrees_north'
                long_name = 'latitude'
```

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LAB 3 : Part(A) NetCDF Data Model(Header)

Step 0: Display/check the header of the netCDF file

2- ncdisp(source,location)

```
>>ncdisp('PRESSURE_9.nc','time')
Dimensions:
        time = 241
Variables:
   time
        Size:      241x1
        Dimensions: time
        Datatype:   int32
        Attributes:
                units     = 'hours since 1900-01-01 00:00:0.0'
                long_name = 'time'
```

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NetLab Computer Networks Research Lab

LAB 3 : Part(A) NetCDF Data Model(Header)

Step 0: Display/check the header of the netCDF file

2- ncdisp(source,location)

```
>>ncdisp('PRESSURE_9.nc','msl')
Dimensions:
        longitude = 12
        latitude  = 11
        time      = 241   (UNLIMITED)
Variables:
   msl
        Size:      12x11x241
        Dimensions: longitude,latitude,time
        Datatype:   int16
```


LAB 3 : Part(A) NetCDF Data Model(Header)

Step 0: Display/check the header of the netCDF file

2- ncdisp(source,location)

>>ncdisp('PRESSURE_9.nc','msl')

```
 Attributes:
units       = 'Pa'
              long_name     = 'Mean sea level pressure'
              standard_name = 'air_pressure_at_sea_level'
```


NetLab Computer Networks Research Lab

LAB 3 : Part(A) NetCDF Data Model(Header)

Step 0: Display/check the header of the netCDF file

3- ncdisp(source,location,modestr)

source Text string specifying the name of the NetCDF file

location Text string specifying the location of the variable or group in the NetCDF file .

Set location to / (forward slash) to display the entire contents of the file.

Default: /

modestr specifies the type of display .

'min' Display group hierarchy and variables definitions.

'full' Display group hierarchy with dimensions, attributes, and variable definitions.

Default :full

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LAB 3 : Part(A) NetCDF Data Model(Header)

3- ncdisp(source,location,modestr)

>> ncdisp('PRESSURE_9.nc', '/' , 'min')

Source: D:\MATLAB\PRESSURE_9.nc
Format: 64bit
Variables:
longitude
Size: 12x1
Dimensions: longitude
Datatype: single
latitude
Size: 11x1
Dimensions: latitude
Datatype: single
time
Size: 241x1
Dimensions: time
Datatype: int32
msl
Size: 12x11x241
Dimensions: longitude,latitude,time
Datatype: int16

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LAB 3 : Part(A) NetCDF Data Model(Header)

3- ncdisp(source,location,modestr)

```
>> ncdisp('PRESSURE_9.nc', '/' , 'full')
```

Is the same command

```
>>ncdisp('PRESSURE_9.nc')
>>ncdisp('PRESSURE_9.nc', 'msl' , 'min')
```

```
Source:
        D:\MATLAB\PRESSURE_9.nc
Format: 64bit
Variables:
   msl
        Size:      12x11x241
        Dimensions: longitude,latitude,time
        Datatype:   int16
```


LAB 3 : Part(A) NetCDF Data Model(Header)

2.The ncinfo command Return information about NetCDF data source

Syntax

```
finfo = ncinfo(source)
vinfo = ncinfo(source,varname)
ginfo = ncinfo(source,groupname)
```

```
>> finfo=ncinfo('PRESSURE_9.nc')
>> finfo_msl=ncinfo('PRESSURE_9.nc','msl')
```

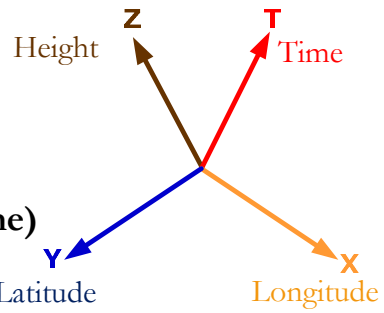
```
finfo =
      Filename: 'D:\MATLAB\PRESSURE_9.nc'
          Name: '/'
    Dimensions: [1x3 struct]
     Variables: [1x4 struct]
    Attributes: [1x2 struct]
        Groups: []
        Format: '64bit'
```

LAB 3 : Part(B) NetCDF Data Model(Contains)

1.The ncread command

A NetCDF dataset contains :

- ❑ Dimensions
- ❑ Variables
- ❑ Attributes



- ❑ Dimensions
  - ➢ Longitude
  - ➢ Latitude
  - ➢ Time

❑ Variables(long , lat ,time)

Variables

long

lat		
	10	11
	12	13

For each location **one** value so for this **ex.** we have **four** locations .

LAB 3 : Part(B) NetCDF Data Model(Contains)

A NetCDF dataset contains :

- ❑ Dimensions
- ❑ Variables
- ❑ Attributes

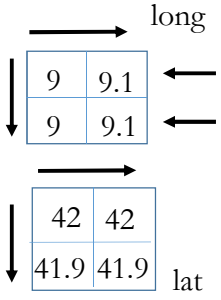
- ❑ Dimensions
  - ➢ Longitude
  - ➢ Latitude
  - ➢ Time

❑ Variables(long , lat ,time)

Variables

long

lat		
	10	11
	12	13

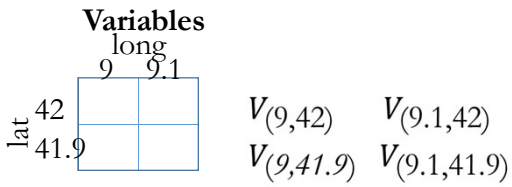


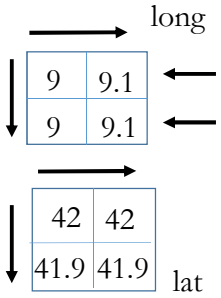
LAB 3 : Part(B) NetCDF Data Model(Contains)

A NetCDF dataset contains :

- ❑ Dimensions
- ❑ Variables
- ❑ Attributes

- ❑ Dimensions
  - ➢ Longitude
  - ➢ Latitude
  - ➢ Time
- ❑ Variables(long , lat ,time)





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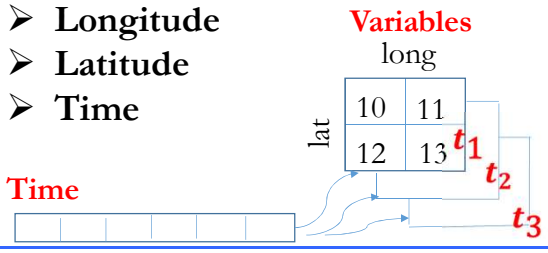
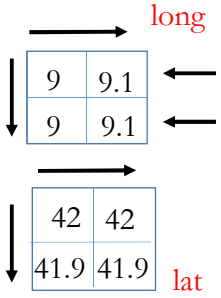
LAB 3 : Part(B) NetCDF Data Model(Contains)

A NetCDF dataset contains :

- ❑ Dimensions
- ❑ Variables
- ❑ Attributes

- ❑ Dimensions
  - ➢ Longitude
  - ➢ Latitude
  - ➢ Time
- ❑ Variables(long , lat ,time)





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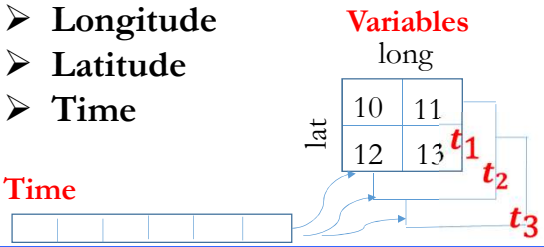
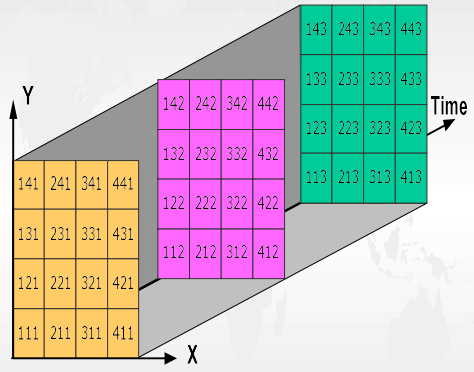
LAB 3 : Part(B) NetCDF Data Model(Contains)

A NetCDF dataset contains :

- ❑ Dimensions
- ❑ Variables
- ❑ Attributes

- ❑ Dimensions
  - ➢ Longitude
  - ➢ Latitude
  - ➢ Time





❑ Variables(long , lat ,time)

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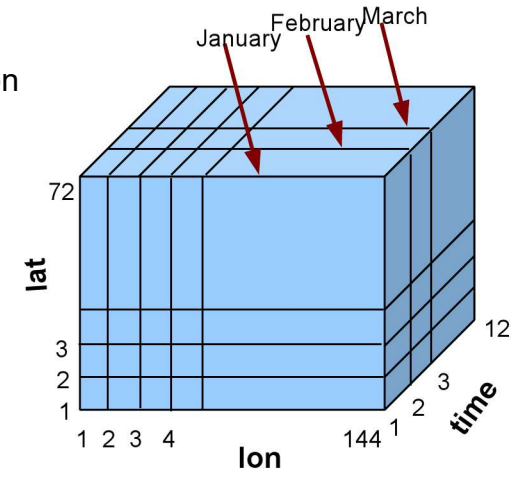
LAB 3 : Part(B) NetCDF Data Model(Contains)

❑ Here, we use the "normal" convention with each of the indices, i, j, and k, starting from 1.



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LAB 3 : NetCDF Data Model

1. Dimensions (for example, time, latitude, longitude, or height.)

A dimension may be used to represent a real physical dimension, for example, time, latitude, longitude, or height. A dimension might also be used to index other quantities, for example station or model-run-number.
A netCDF dimension has both a name and a length.

2. Variables (represents an array of values of the same type, which store the bulk data.)

Variables are used to store the bulk of the data in a netCDF dataset. A variable represents an array of values of the same type. A scalar value is treated as a 0-dimensional array. A variable has a name, a data type, and a shape described by its list of dimensions specified when the variable is created. A variable may also have associated attributes, which may be added, deleted or changed after the variable is created.

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LAB 3 : NetCDF Data Model

3. Attributes (are used to store data about the data ,ancillary data or metadata).

NetCDF attributes are used to store data about the data (ancillary data or metadata), similar in many ways to the information stored in data dictionaries and schema in conventional database systems. Most attributes provide information about a specific variable. These are identified by the name (or ID) of that variable, together with the name of the attribute.

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LAB 3 : Part(B) NetCDF Data Model(Contains)

3.The ncread command Read data from variable in NetCDF data source

Syntax

vardata = ncread(source,varname)

- **source** Text string specifying the name of the NetCDF file
- **Varname** Text string specifying the name of a variable in the NetCDF file
- **Vardata** The data in the variable, **ncread** uses the MATLAB datatype that is the closest type to the corresponding NetCDF datatype .

Example:

```
>> ncdisp('PRESSURE_9.nc', '/' , 'min' )
>>long=ncread('PRESSURE_9.nc' , 'longitude' )
```

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LAB 3 : Part(B) NetCDF Data Model(Contains)

3.The ncread command

vardata = ncread(source,varname)

Example:

```
>> ncdisp( 'PRESSURE_9.nc', '/' , 'min')
>>long=ncread( 'PRESSURE_9.nc' , 'longitude')
>>lat=ncread( 'PRESSURE_9.nc' , 'latitude')
>>time=ncread( 'PRESSURE_9.nc' , 'time')
>>msl=ncread( 'PRESSURE_9.nc' , 'msl')
```

Example(1) :-

Retrieve data from nc-file (PRESSURE_9.nc) to read again in excel sheet for Iraq region .

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LAB 3 : NetCDF Data Model

```
% Example 1: This is program to transfer data from
% netCDF source file to excel sheet
% Retrieve data for All grid
clc, clear all
format longE
% Step 1 : Display all varaibles in nc file using
% command: ncdisp
filename='PRESSURE_9.nc';
ncdisp( filename, '/','min')
%%%%%%%%%%%%%%%%%%%%%%%%%
```

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LAB 3 : NetCDF Data Model

```
% Step 2 : Read varaibles from nc file by command: ncread
variable=input('write your main variable=','s');
msl=ncread(filename,variable);
long=ncread(filename,'longitude');
lat=ncread(filename,'latitude');
time=ncread(filename,'time');
msl=0.01*msl;      % 1mb=0.01*Pa
```

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LAB 3 : NetCDF Data Model

```
% Step 3 : Read all longitude and latitude for all grid
% in 2-D (2 dimensional) of array
m=numel(long);% m:number of element of longitude
n=numel(lat); % n:number of element of latitude
h=0;g=0;
for i=1:n
    for j=1:m
         h=h+1;
        latt(h)=lat(i);
        longg(h)=long(j);
    end
end
latt1=[longg ; latt];
```


LAB 3 : NetCDF Data Model

```
% Step 4 :Convert 3-D array to 2-D array for all
% stations
mm=length(time);
for i=1:n
    for j=1:m
        g=g+1;
        MSL(:,g)=msl(j,i,:);
     end
end
```

LAB 3 : NetCDF Data Model

```
% Step 5 :Convert time from netCDF format to MATLAB
% format using its units and sort data in nc file
time=double(time);
A=time./24+datenum('1900-01-01 0:0:0');
[time,I] = sort(A);
MSL=MSL(I,:);
yy=year(time);mm=month(time);dd=day(time);hh=hour(time);
Date=[yy mm dd hh];
% Step 6:Display data in excel sheet or save data in .mat
% file
C={'LOCATION:IRAQ','FROM','TO','Longitude';'DATE','1/9/200
9','30/9/2009','Latitude'};
DD={'Year','Month','Day','Hour'};
```

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LAB 3 : NetCDF Data Model

```
for i=1:n*m
     X(i)={'Pressure (mb)'};
end
fileName='PRESSURE_9.xlsx';
sheet =1 ;
xlswrite(fileName,C,sheet,'A1')
xlswrite(fileName,DD,sheet,'A3')
xlswrite(fileName,latt1,sheet,'E1')
xlswrite(fileName,X,sheet,'E3')
xlswrite(fileName,Date,sheet,'A4')
xlswrite(fileName,MSL,sheet,'E4')
save PRESSURE_9
```

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LAB 3 : NetCDF Data Model

>> NC_FILE

Variables:

longitude

Size: 12x1

Dimensions: longitude

latitude

Size: 11x1

Dimensions: latitude

time

Size: 241x1

Dimensions: time

msl

Size: 12x11x241

Dimensions: longitude,latitude,time

write your main variable=msl

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Example(1) :- Retrieve data from nc-file to read again in excel sheet for all location

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	LOCATION:IRAQ	FROM	TO	Longitude	38	39	40	41	42	43	44	45	46
2	DATE	01/09/2009	30/09/2009	Latitude	38	38	38	38	38	38	38	38	38
3	Year	Month	Day	Hour	Pressure (mb)	Pressure (mb)	Pressure (mb)	Pressure (mb)	Pressure (mb)	Pressure (mb)	Pressure (mb)	Pressure (mb)	Pressure (mb)
4	2009	9	1	0	1011.195727	1008.988508	1007.183011	1006.616669	1008.339856	1012.477471	1015.979128	1015.281745	1015.65644
5	2009	9	1	3	1011.818581	1009.884909	1008.081869	1007.519213	1009.23421	1013.423012	1016.821475	1016.478312	1016.968896
6	2009	9	1	6	1012.115061	1010.471727	1008.809146	1008.370159	1009.943468	1013.48239	1016.758412	1016.780934	1016.519262
7	2009	9	1	9	1010.300555	1008.717417	1007.358278	1007.112986	1008.529046	1011.495483	1014.368554	1014.117938	1013.616707
8	2009	9	1	12	1008.049109	1006.445906	1005.403312	1005.395941	1006.825925	1010.260833	1013.465191	1012.006543	1011.443886
9	2009	9	1	15	1006.832067	1005.13386	1004.3599	1004.587583	1006.344759	1010.086794	1013.407451	1012.14864	1012.503269
10	2009	9	1	18	1008.195711	1006.093324	1005.276367	1005.736648	1007.818559	1012.052407	1015.497143	1014.727278	1015.599519
11	2009	9	1	21	1009.122416	1006.768594	1005.614616	1006.031489	1008.267374	1012.425464	1015.893132	1015.822698	1016.50452
12	2009	9	2	0	1009.607267	1007.377934	1006.098238	1006.351721	1008.46844	1012.524973	1016.104436	1016.302226	1016.618771
13	2009	9	2	3	1010.47705	1008.224376	1006.731739	1006.801764	1008.641659	1012.33824	1015.770282	1015.989366	1016.289121
14	2009	9	2	6	1011.380413	1009.421352	1007.90865	1007.697346	1009.033144	1012.212113	1015.392311	1015.556931	1015.339894
15	2009	9	2	9	1009.871396	1008.159265	1006.741158	1006.431164	1007.649844	1010.090889	1012.599503	1012.544629	1012.136765
16	2009	9	2	12	1007.954923	1006.326741	1005.111747	1005.015513	1006.289067	1008.502838	1010.386141	1009.428314	1009.119549
17	2009	9	2	15	1007.767781	1006.144922	1004.939755	1004.849665	1006.330426	1008.648211	1010.173609	1008.368931	1008.636336
18	2009	9	2	18	1009.321434	1007.715364	1006.489723	1006.17072	1007.624455	1010.239539	1012.15683	1010.716609	1011.540119
19	2009	9	2	21	1009.882862	1008.278431	1006.970479	1006.523712	1007.806683	1010.448795	1012.676489	1012.136765	1012.766989
20	2009	9	3	0	1010.038882	1008.533551	1007.283749	1006.874655	1008.024948	1010.692039	1013.217852	1013.098686	1013.344797
21	2009	9	3	3	1010.595806	1009.03642	1007.893498	1007.750172	1009.074094	1011.984839	1014.638416	1014.393943	1014.472977
22	2009	9	3	6	1011.585164	1010.224797	1009.134701	1009.001612	1010.217835	1012.995492	1015.51639	1014.950457	1014.391896
23	2009	9	3	9	1010.115459	1008.895142	1007.887765	1007.630597	1008.699809	1011.010632	1013.140865	1012.525792	1011.858303
24	2009	9	3	12	1008.338218	1007.176049	1006.341073	1006.246478	1007.436493	1009.635522	1011.346424	1010.32103	1009.863615

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LAB 3 : NetCDF Data Model

>> load pressure_9

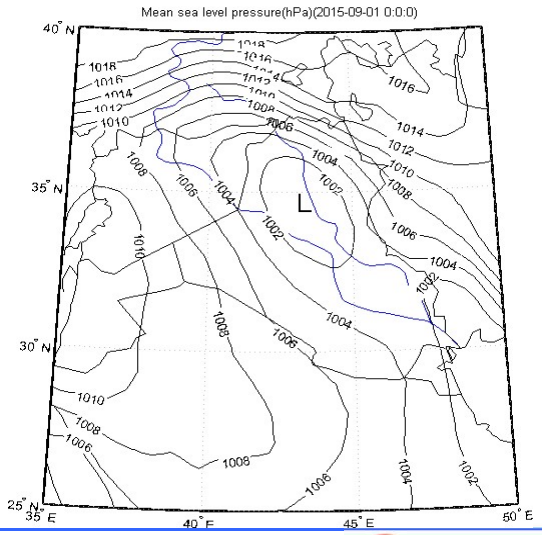
>>map_pressure(MSL,longg,latt,time)

input hour=9

input day=9

input month=9

input year=2009



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LAB 3 : NetCDF Data Model

>> NC_FILE

Variables:

longitude

Size: 12x1

Dimensions: longitude

latitude

Size: 11x1

Dimensions: latitude

time

Size: 241x1

Dimensions: time

msl

Size: 12x11x241

Dimensions: longitude,latitude,time

write your main variable=msl

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LAB 3 : NetCDF Data Model

	A	B	C	D	E	F	G
1	LOCATION:IRAQ	FROM	TO	Longitude	44.375		
2	DATE	01/09/2009	30/09/2009	Latitude	33.375		
3	Year	Month	Day	Hour	Pressure (mb)		
4	2009	9	1	0	1002.919		
5	2009	9	1	3	1003.381		
6	2009	9	1	6	1004.433		
7	2009	9	1	9	1003.442		
8	2009	9	1	12	1001.978		
9	2009	9	1	15	1002.047		
10	2009	9	1	18	1003.093		
11	2009	9	1	21	1003.003		
12	2009	9	2	0	1002.876		
13	2009	9	2	3	1004.017		
14	2009	9	2	6	1005.26		
15	2009	9	2	9	1004.522		
16	2009	9	2	12	1002.861		
17	2009	9	2	15	1002.797		
18	2009	9	2	18	1003.614		
19	2009	9	2	21	1003.116		
20	2009	9	3	0	1002.611		
21	2009	9	3	3	1003.529		
22	2009	9	3	6	1005.149		
23	2009	9	3	9	1004.225		
24	2009	9	3	12	1002.602		

ورقة1 ورقة٢

Example(2) :-

Retrieve data from nc-file to read again in excel sheet for Baghdad only .

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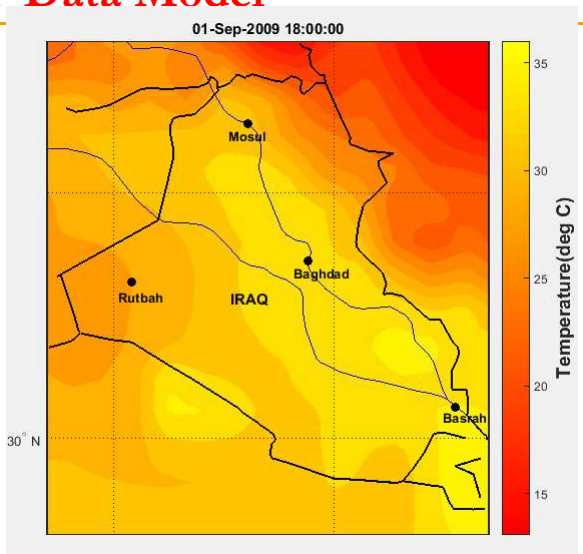
LAB 3 : NetCDF Data Model

```
>> load temp_9
>>map(MSL,longg,latt,time)
input hour=18
input day=1
input month=9
input year=2009
```



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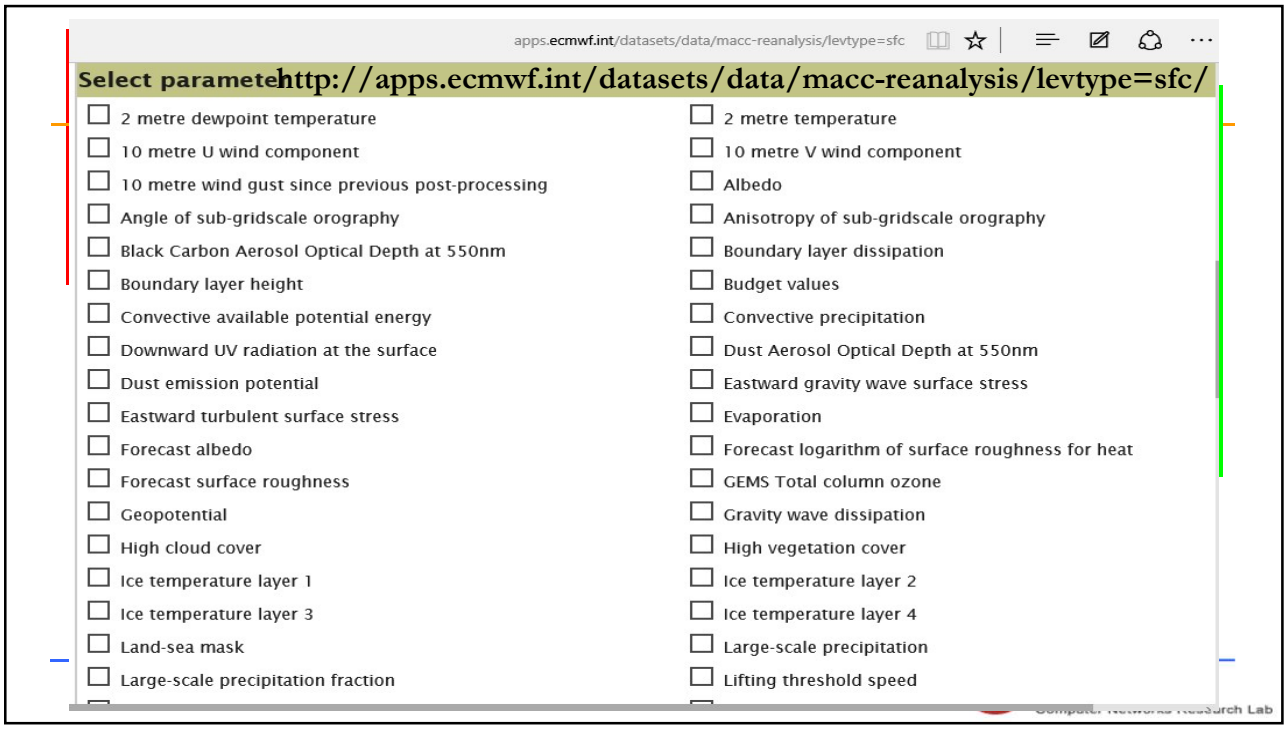
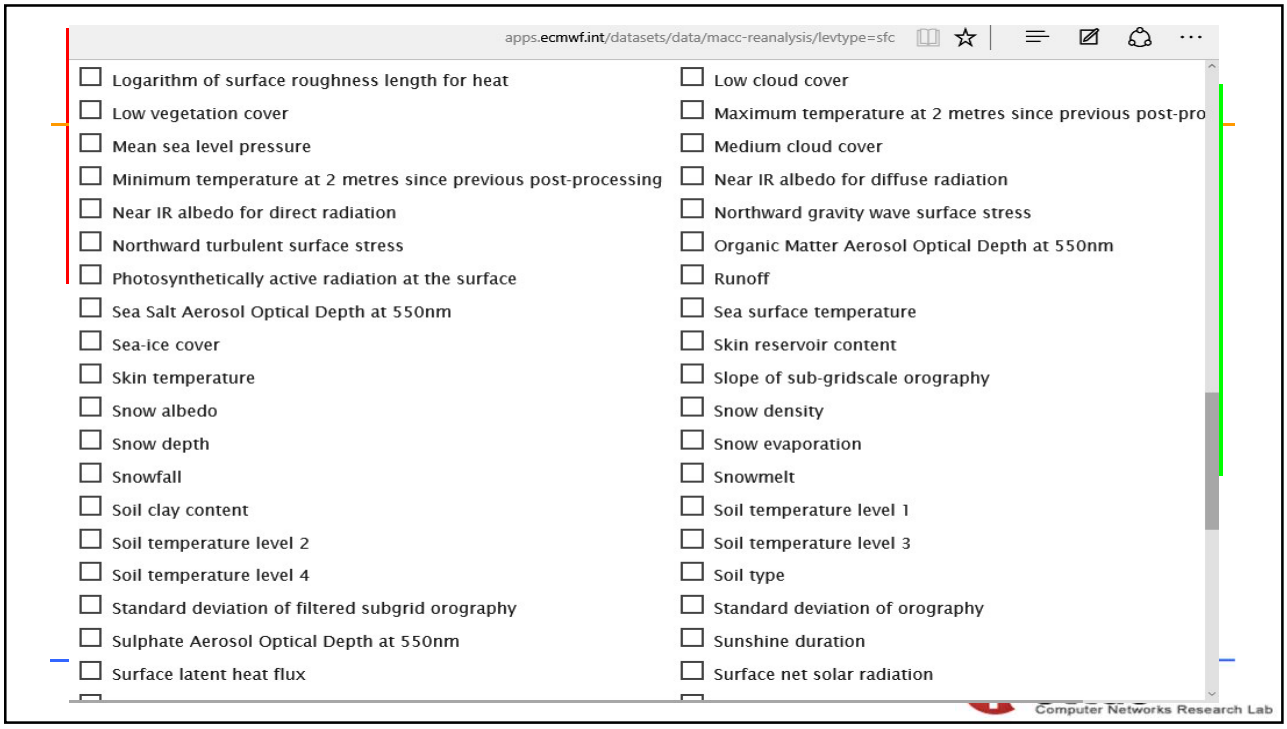

apps.ecmwf.int/datasets/data/macc-reanalysis/levtype=sfc
Select paramete
http://apps.ecmwf.int/datasets/data/macc-reanalysis/levtype=sfc/
2 metre dewpoint temperature
2 metre temperature
10 metre U wind component
10 metre V wind component
10 metre wind gust since previous post-processing
Albedo
Angle of sub-gridscale orography
Anisotropy of sub-gridscale orography
Black Carbon Aerosol Optical Depth at 550nm
Boundary layer dissipation
Boundary layer height
Budget values
Convective available potential energy
Convective precipitation
Downward UV radiation at the surface
Dust Aerosol Optical Depth at 550nm
Dust emission potential
Eastward gravity wave surface stress
Eastward turbulent surface stress
Evaporation
Forecast albedo
Forecast logarithm of surface roughness for heat
Forecast surface roughness
GEMS Total column ozone
Geopotential
Gravity wave dissipation
High cloud cover
High vegetation cover
Ice temperature layer 1
Ice temperature layer 2
Ice temperature layer 3
Ice temperature layer 4
Land-sea mask
Large-scale precipitation
Large-scale precipitation fraction
Lifting threshold speed


apps.ecmwf.int/datasets/data/macc-reanalysis/levtype=sfc
Logarithm of surface roughness length for heat
Low cloud cover
Low vegetation cover
Maximum temperature at 2 metres since previous post-pro
Mean sea level pressure
Medium cloud cover
Minimum temperature at 2 metres since previous post-processing
Near IR albedo for diffuse radiation
Near IR albedo for direct radiation
Northward gravity wave surface stress
Northward turbulent surface stress
Organic Matter Aerosol Optical Depth at 550nm
Photosynthetically active radiation at the surface
Runoff
Sea Salt Aerosol Optical Depth at 550nm
Sea surface temperature
Sea-ice cover
Skin reservoir content
Skin temperature
Slope of sub-gridscale orography
Snow albedo
Snow density
Snow depth
Snow evaporation
Snowfall
Snowmelt
Soil clay content
Soil temperature level 1
Soil temperature level 2
Soil temperature level 3
Soil temperature level 4
Soil type
Standard deviation of filtered subgrid orography
Standard deviation of orography
Sulphate Aerosol Optical Depth at 550nm
Sunshine duration
Surface latent heat flux
Surface net solar radiation
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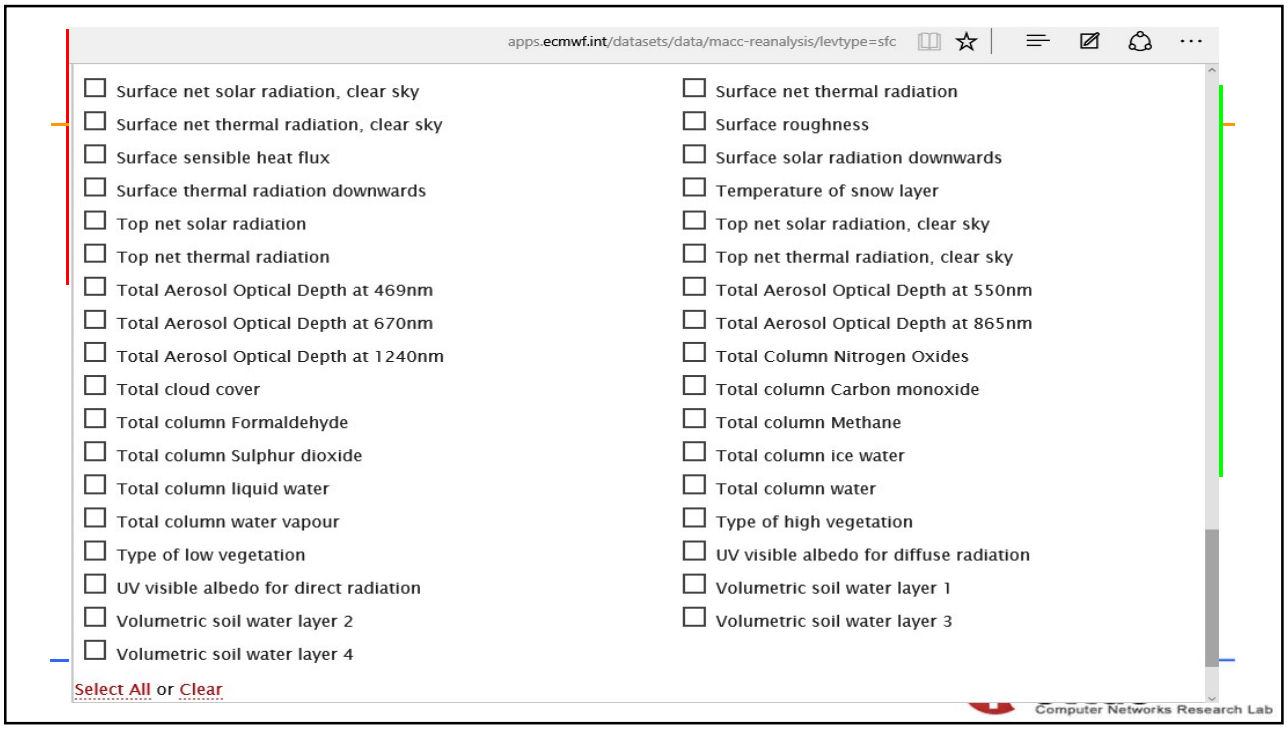
apps.ecmwf.int/datasets/data/macc-reanalysis/levtype=sfc
Surface net solar radiation, clear sky
Surface net thermal radiation, clear sky
Surface sensible heat flux
Surface thermal radiation downwards
Top net solar radiation
Top net thermal radiation
Total Aerosol Optical Depth at 469nm
Total Aerosol Optical Depth at 670nm
Total Aerosol Optical Depth at 1240nm
Total cloud cover
Total column Formaldehyde
Total column Sulphur dioxide
Total column liquid water
Total column water vapour
Type of low vegetation
UV visible albedo for direct radiation
Volumetric soil water layer 2
Volumetric soil water layer 4
Surface net thermal radiation
Surface roughness
Surface solar radiation downwards
Temperature of snow layer
Top net solar radiation, clear sky
Top net thermal radiation, clear sky
Total Aerosol Optical Depth at 550nm
Total Aerosol Optical Depth at 865nm
Total Column Nitrogen Oxides
Total column Carbon monoxide
Total column Methane
Total column ice water
Total column water
Type of high vegetation
UV visible albedo for diffuse radiation
Volumetric soil water layer 1
Volumetric soil water layer 3
Select All or Clear
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