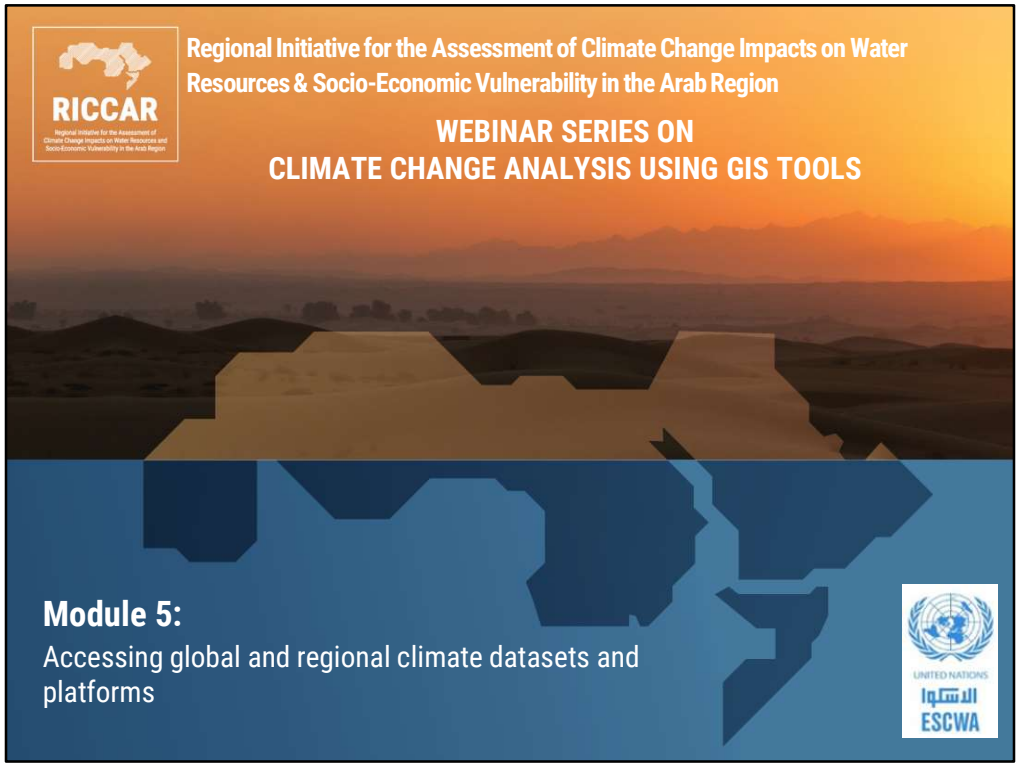
RICCAR
Regional Initiative for the Assessment of Climate Change Impacts on Water Resources & Socio-Economic Vulnerability in the Arab Region
WEBINAR SERIES ON
CLIMATE CHANGE ANALYSIS USING GIS TOOLS
Module 5:
Accessing global and regional climate datasets and platforms
UNITED NATIONS
ESCWA

# Webinar Series

- **Module 1:** RICCAR regional climate modelling and hydrological modelling datasets: An introduction
- **Module 2:** Viewing NetCDF regional climate modeling datasets in GIS
- **Module 3:** Extracting tabular data from NetCDF climate files for use in other models and applications
- **Module 4:** Creating a regional climate model ensemble using GIS and extreme events indices
- ✓**Module 5:** Accessing global and regional climate datasets and platforms
- **Module 6:** RICCAR integrated vulnerability assessment methodology

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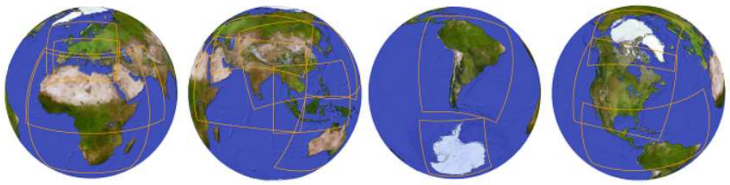
# Module 5: Contents

- What is CORDEX?
- Accessing and navigating the ESGF open source platform
- Accessing maps and dataset from the RICCAR Data Portal

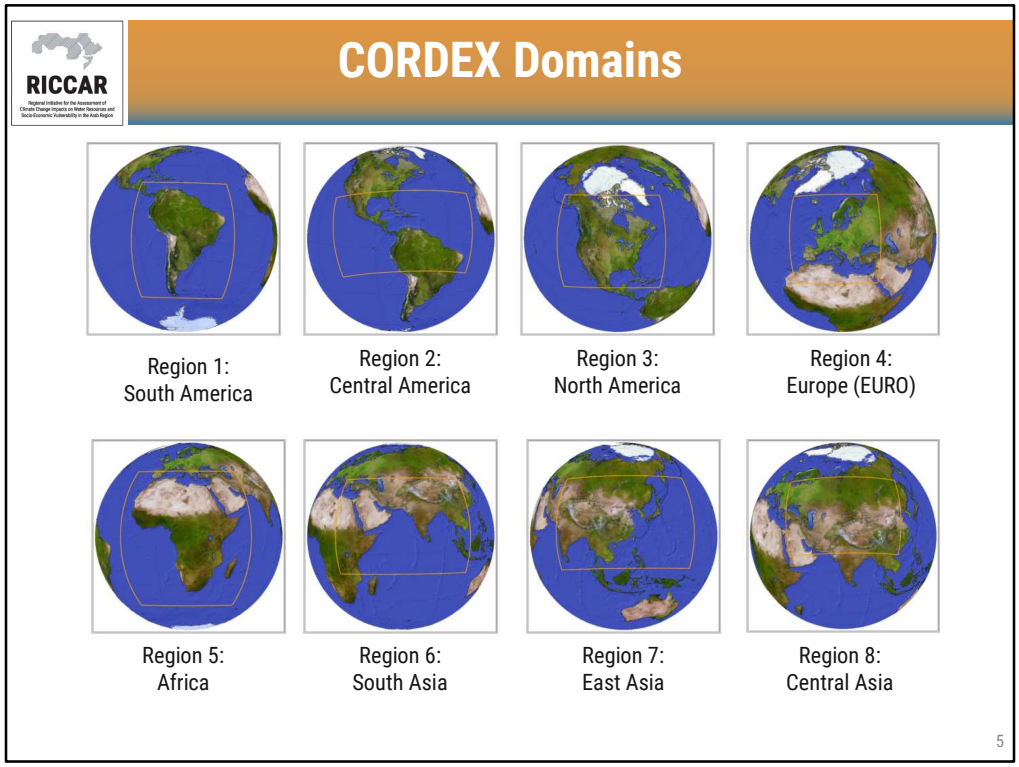
3

# What is CORDEX?

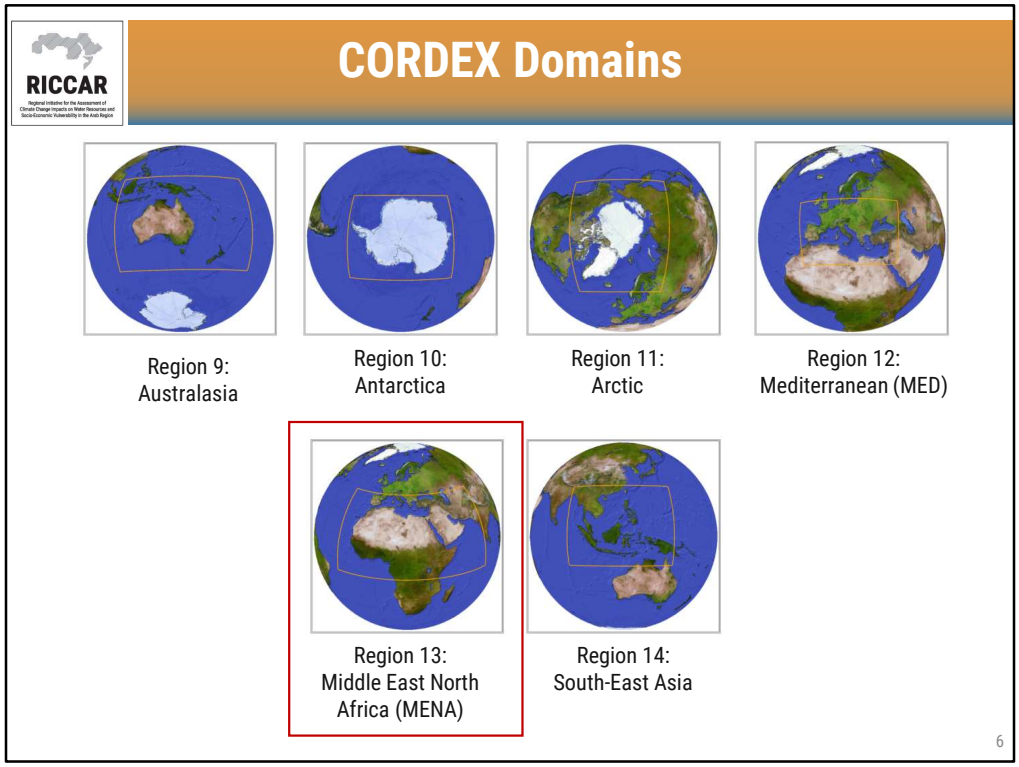
- Coordinated Regional Downscaling Experiment (CORDEX)
  - Initiated by World Climate Research Program (WCRP) in 2009
  - Need for coordinated framework for evaluating and improving regional climate downscaling techniques



4




A "domain" is a region for which the regional downscaling is taking place, for example the African "domain" covers the whole of the African continent. Although some domains tend to partially overlap with other domains, each domain has its own set of modelling boundary conditions and differences in resultant outputs.




RICCAR data is nested within the Region 13: Middle East North Africa domain

Note that the upcoming Mashreq Domain RCM outputs will not be considered part of CORDEX.

# MENA-CORDEX Contributors

| Acronym | Contributor | Country | Contact |
|---|---|---|---|
| BOUN | Bogazici University, Istanbul | Turkey | Levent Kurnaz |
| CLMcom | CLM Community / Centro EuroMediterraneo sui Cambiamenti Climatici (CMCC), Capua | Italy | Edoardo Bucchignani |
| GERICS | Climate Service Center, Hamburg | Germany | Andreas Haensler |
| CYI | Energy Environment & Water Research Center (EEWRC), The Cyprus Institute, Nicosia | Cyprus | George Zittis |
| DMN | Direction de la Météorologie Nationale, Casablanca | Morocco | Fatima Driouech |
| ICBA | International Centre for Biosaline Agriculture, Dubai | United Arab Emirates | Rashyd Zaaboul |
| SMHI | Rossby Centre, Swedish Meteorological and Hydrological Institute (SMHI), Norrkoping | Sweden | Grigory Nikulin |

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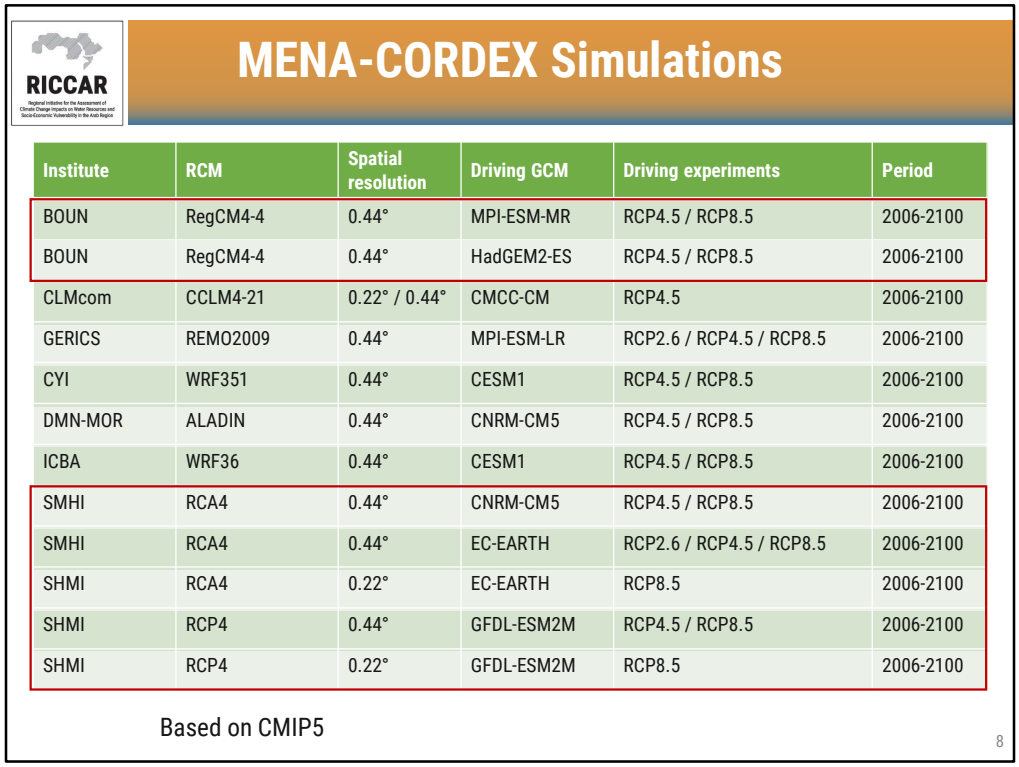


| Institute | RCM | Spatial resolution | Driving GCM | Driving experiments | Period |
|---|---|---|---|---|---|
| BOUN | RegCM4-4 | 0.44° | MPI-ESM-MR | RCP4.5 / RCP8.5 | 2006-2100 |
| BOUN | RegCM4-4 | 0.44° | HadGEM2-ES | RCP4.5 / RCP8.5 | 2006-2100 |
| CLMcom | CCLM4-21 | 0.22° / 0.44° | CMCC-CM | RCP4.5 | 2006-2100 |
| GERICS | REMO2009 | 0.44° | MPI-ESM-LR | RCP2.6 / RCP4.5 / RCP8.5 | 2006-2100 |
| CYI | WRF351 | 0.44° | CESM1 | RCP4.5 / RCP8.5 | 2006-2100 |
| DMN-MOR | ALADIN | 0.44° | CNRM-CM5 | RCP4.5 / RCP8.5 | 2006-2100 |
| ICBA | WRF36 | 0.44° | CESM1 | RCP4.5 / RCP8.5 | 2006-2100 |
| SMHI | RCA4 | 0.44° | CNRM-CM5 | RCP4.5 / RCP8.5 | 2006-2100 |
| SMHI | RCA4 | 0.44° | EC-EARTH | RCP2.6 / RCP4.5 / RCP8.5 | 2006-2100 |
| SHMI | RCA4 | 0.22° | EC-EARTH | RCP8.5 | 2006-2100 |
| SHMI | RCP4 | 0.44° | GFDL-ESM2M | RCP4.5 / RCP8.5 | 2006-2100 |
| SHMI | RCP4 | 0.22° | GFDL-ESM2M | RCP8.5 | 2006-2100 |

- Scenarios listed only include the projected datasets (not historical)
- Note that only the SMHI and BOUN datasets are available for public use at present
- Only the SMHI datasets were bias-corrected and used for RICCAR
- CMIP 5: Coupled Model Intercomparison Project 5 (most recently completed global modelling outputs)

## Coming soon: CMIP6

At **minimum**, climate modelling outputs must consider

- 1 historical modelling output (1950-2014)
- 1 projected modelling output (2015-2100)
  - 2 projections: SSP5-8.5 and SSP1-2.6

Shared socio-economic pathways

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- First outputs expected 2021
- Unclear if new RCMs will be released for CORDEX-MENA domain

# Why access CORDEX (raw RCM) datasets?

- Additional climate parameters (i.e. wind speed, relative humidity)
- Smaller spatial resolution (i.e. 0.11° / ~12.5 km)
- Smaller temporal resolution (i.e. 1 hr, 3 hr, 6 hr)

Do not mix bias-corrected modelling outputs with raw RCM outputs

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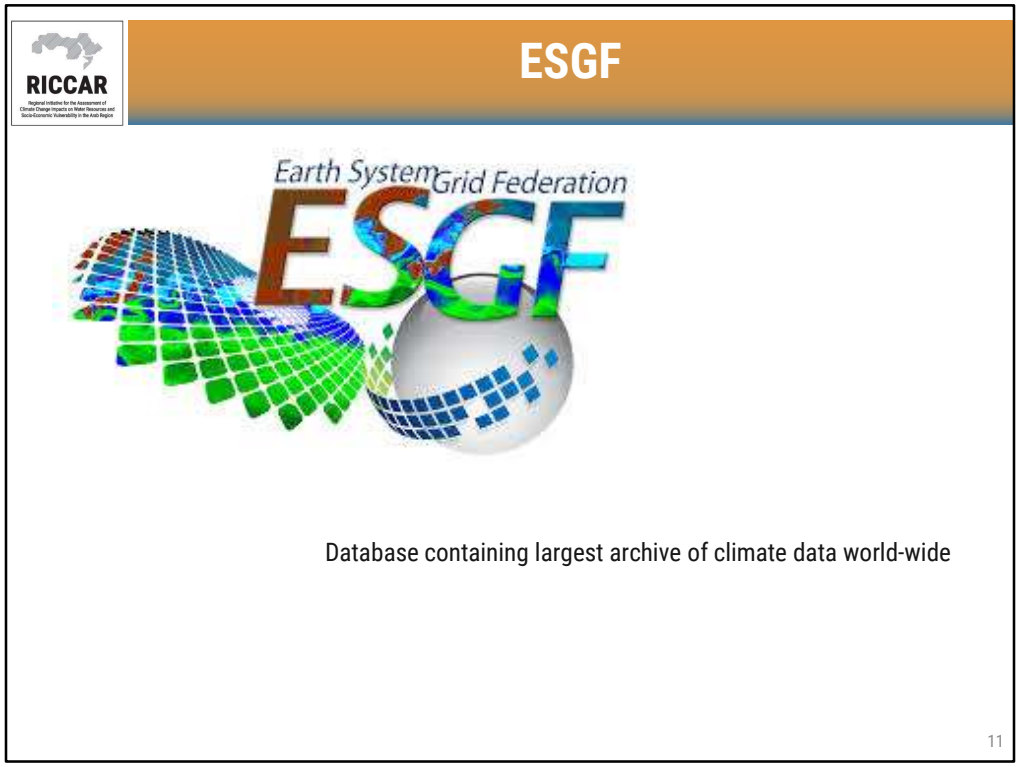
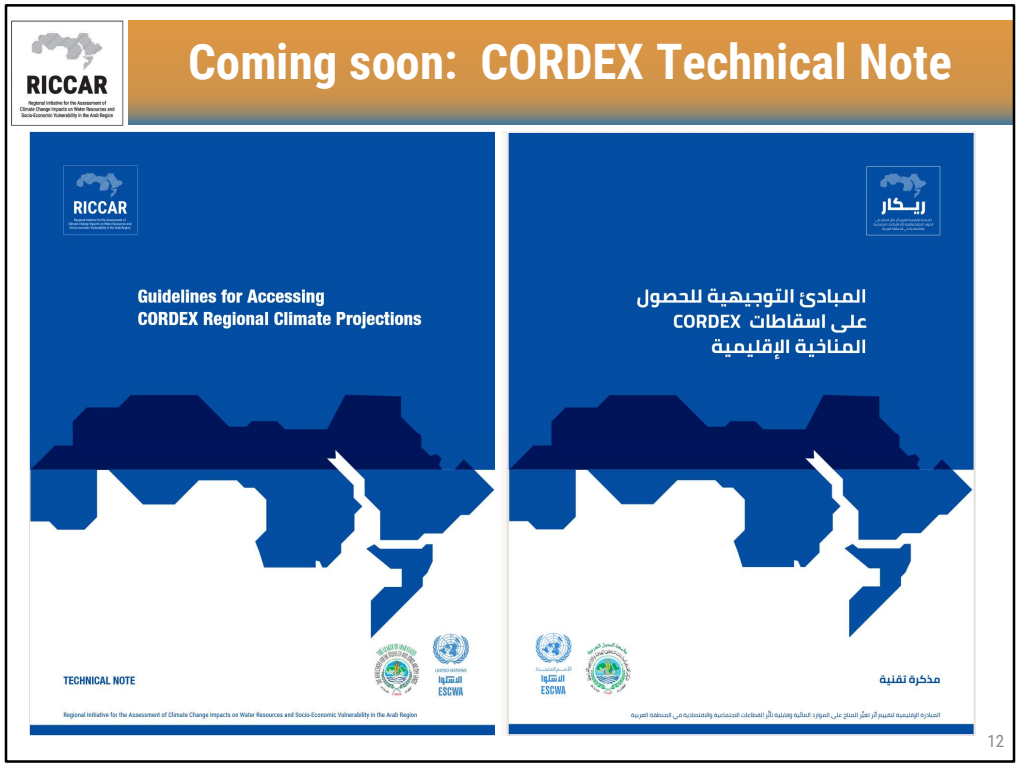
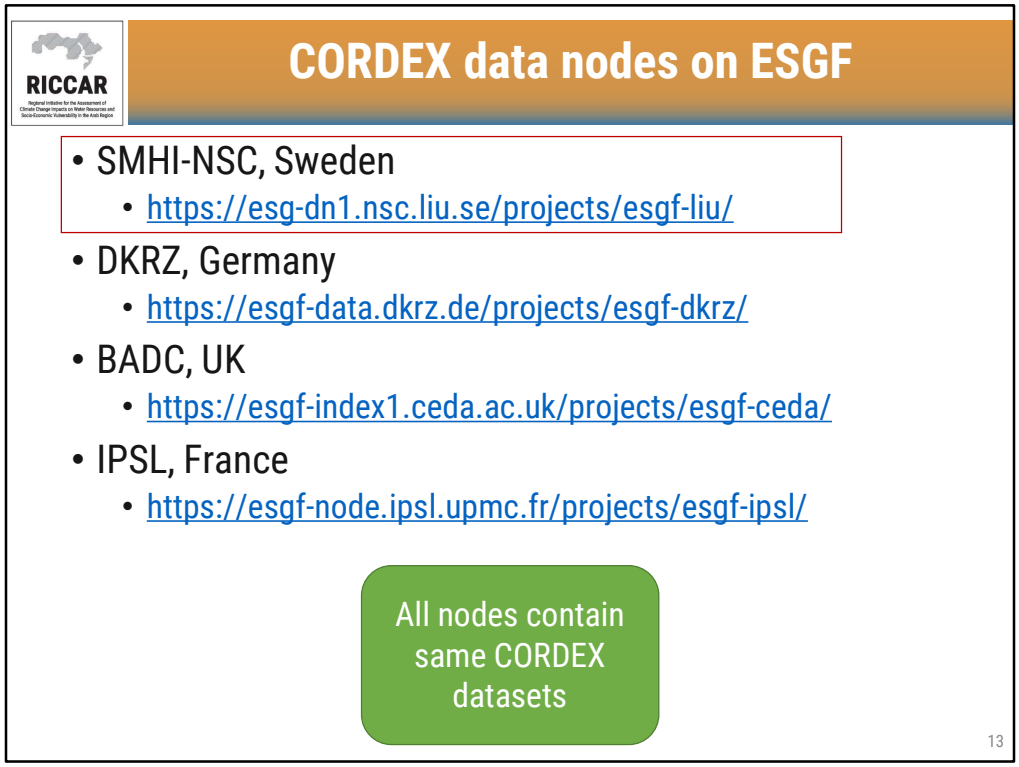



- CORDEX data is available from the ESGF database (English only).


RICCAR
Coming soon: CORDEX Technical Note
RICCAR
Guidelines for Accessing
CORDEX Regional Climate Projections
TECHNICAL NOTE
ESCWA
ريكار
المبادئ التوجيهية للحصول
على اسقاطات CORDEX
المناخية الإقليمية
مذكرة تقنية
ESCWA
12




- Several data nodes are available for use. Personal preference is the SMHI database.

Hosted by
Powered by
Welcome, Guest. | Login | Create Account
ESGF@LiU in cooperation with SMHI
You are at the ESG-DN1.NSC.LIU.SE node
Home
About Us
Contact Us
Technical Support
ESGF@LiU in cooperation with SMHI
Search & Download Data
Simple Text Search
Go
More search options
Federated ESGF-CoG Nodes
ESGF@CEDA
ESGF@DKRZ
ESGF@DOE/LLNL
ESGF@IPSL
ESGF@NASA/NCCS
ESGF@NCI
ESGF@NOAA/ESRL
ESGF@NOAA/GFDL
ESGF@PIK
Browse Projects
This
All
My
Tags
Parent projects (0)
Peer projects (0)
Child projects (5)
CLIPC
CMIP5
cmip6-liu
CORDEX
SPECS
Enter Tag
Reset
Go
Start typing, or use the 'Delete' key to show all available tags.
ESGF-LIU Tags: None
The Earth System Grid Federation (ESGF) maintains a global system of federated data centers that allow access to the largest archive of climate data world-wide.
ESGF portals like this one provide access to the output of the climate models contributing to the next assessment report of the Intergovernmental Panel on Climate Change IPCC through the Coupled Model Intercomparion Project CMIP. The WGCM Infrastructure Panel is the official CMIP document home.
This ESGF datanode, at the National Supercomputer Centre, Linköping, is Sweden's first datanode in the ESGF framework, and is part of the European IS-ENES Infrastructure. It is a joint activity of NSC and the Swedish Meteorological and Hydrological Institute (SMHI). NSC is an independent organization within Linköping University (LiU), and is funded by the Swedish Research Council via SNIC (Swedish National Infrastructure for Computing).
Search Data
The following projects require an ESGF Account (create account) and some also require a Group Registration (see links in table below) to access their data.
Search data for...
Register to...
All project
(see below for project-specific registration details)
CMIP6: Coupled Model Intercomparison Project Phase 6
CMIP6 Data Search
CMIP5: Coupled Model Intercomparison Project Phase 5
CMIP5 Data Search
CMIP5 Research
CMIP5 Commercial
CORDEX: Coordinated Regional Climate Downscaling Experiment
CORDEX Data Search
Please perform an HTTP download of a single file to register for CORDEX access. Registration links will follow soon.
SPECS: Seasonal-to-decadal climate Prediction for the improvement of European Climate Services
SPECS Data Search
Please perform an HTTP download of a single file to register for SPECS access. Registration links will follow soon.
CLIPC: Climate Information Platform for Copernicus
CLIPC Data Search
This data is publicly available without registration.
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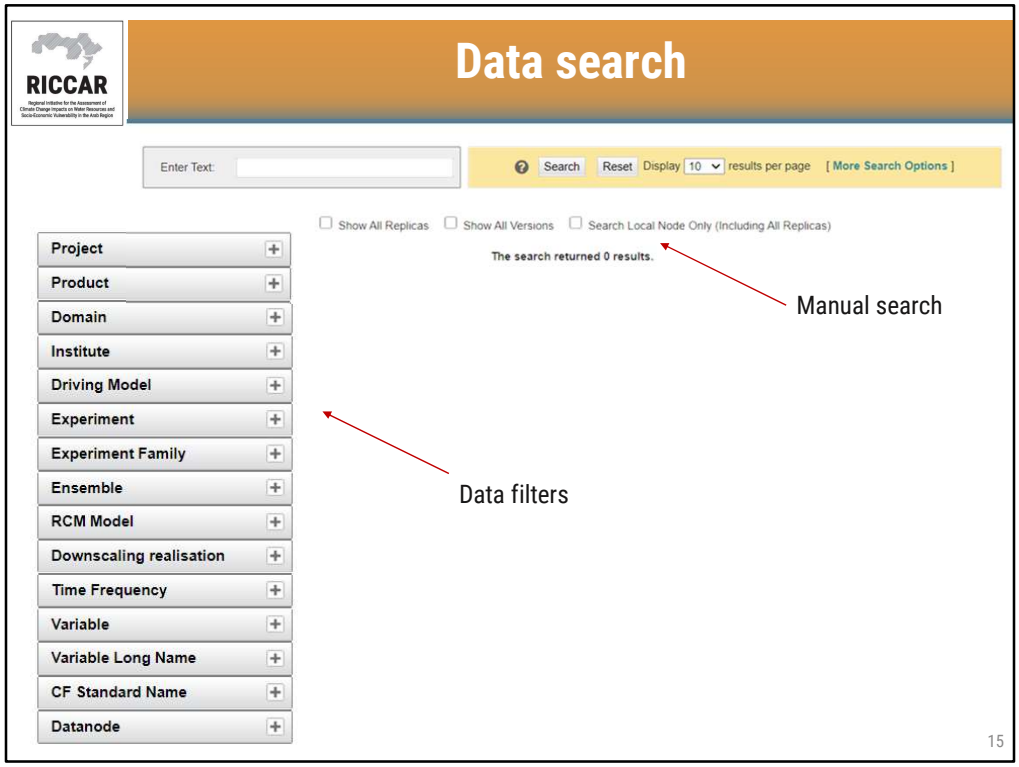
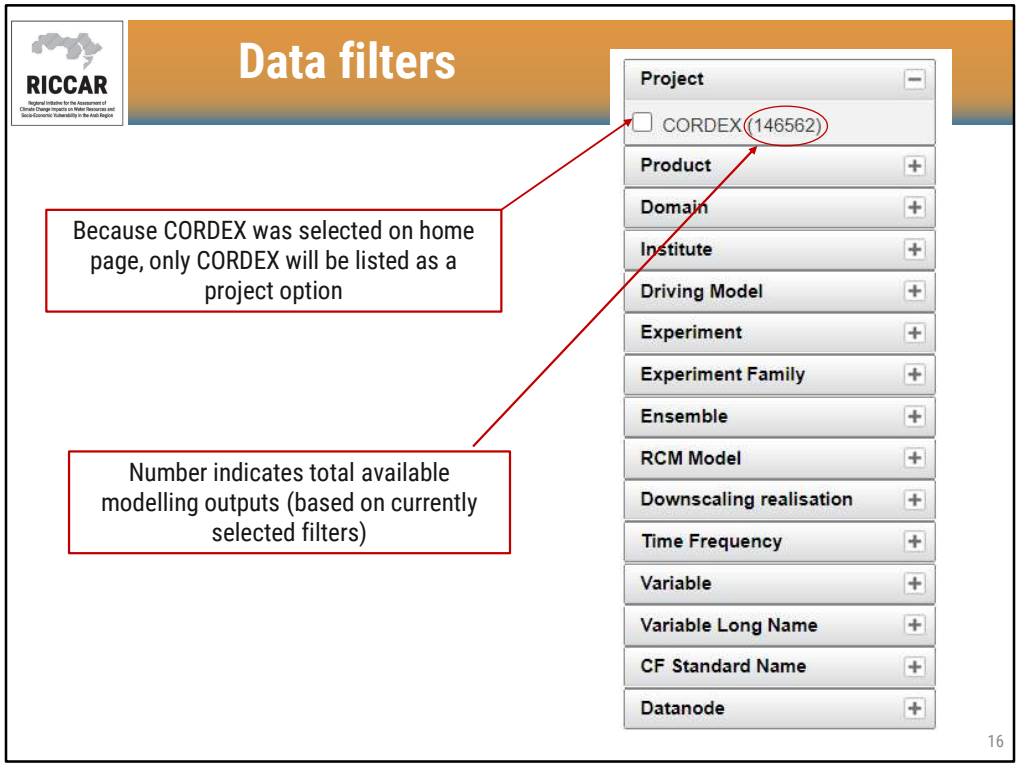

RICCAR
Data search
Enter Text:
Search
Reset
Display 10 results per page
[ More Search Options ]
Show All Replicas
Show All Versions
Search Local Node Only (Including All Replicas)
The search returned 0 results.
Manual search
Project
Product
Domain
Institute
Driving Model
Experiment
Experiment Family
Ensemble
RCM Model
Downscaling realisation
Time Frequency
Variable
Variable Long Name
CF Standard Name
Datanode
Data filters
15

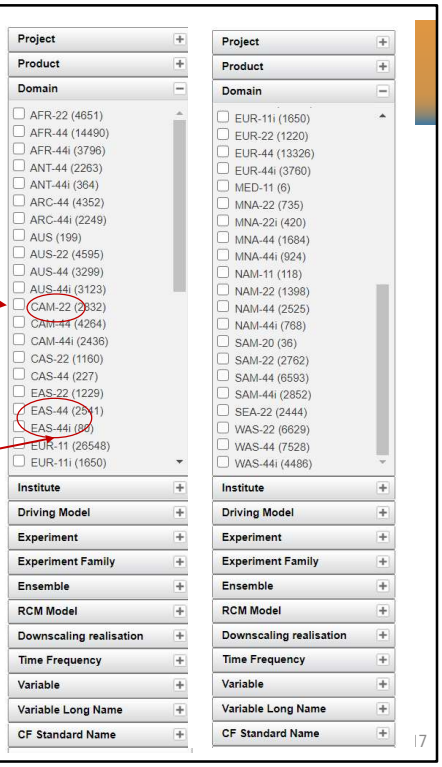


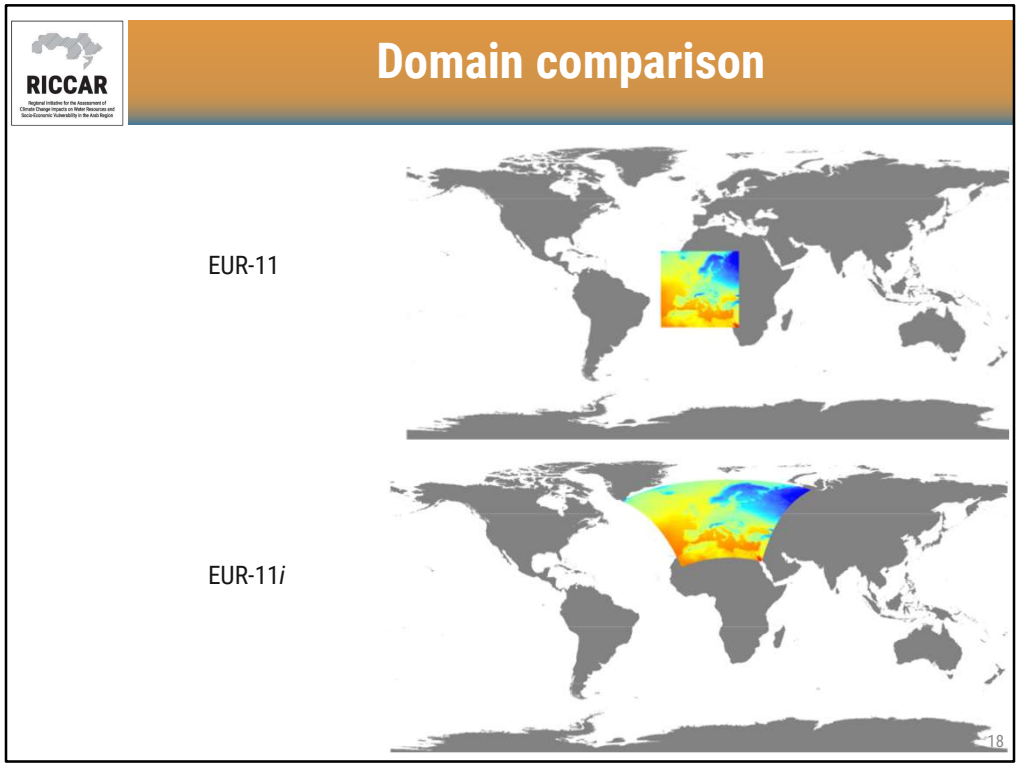

Similarly, for CORDEX data, under “Product”, there will only be 1 option: “output ”.

# Data filters: Domain

- Domain abbreviation followed by the spatial resolution
  - 11: 0.11° (~12.5 km)
  - 22: 0.22° (~25 km)
  - 44: 0.44° (~25 km)

- Domains without an *i* following are in native computational grid (may differ from conventional latitude/longitude)
- Domains with an *i* following have been interpolated to conventional latitude/longitude (often available for monthly and seasonal data only)

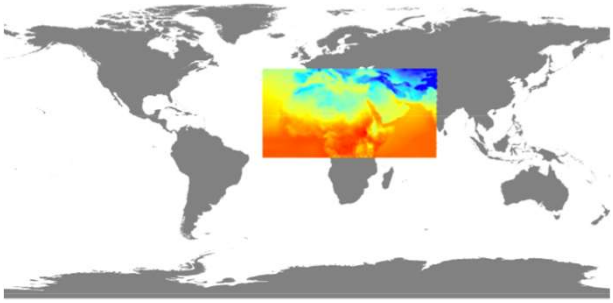




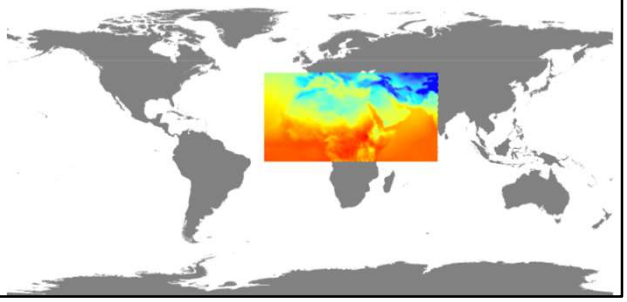

- Domain EUR-11 is based on a rotated domain for computational purposes. The coordinates are rlon and rlat rather than longitude (lon) and latitude (lat). Thus, the resultant raster is in a different projection than the background shapefile (which is in WGS84).

# Domain comparison

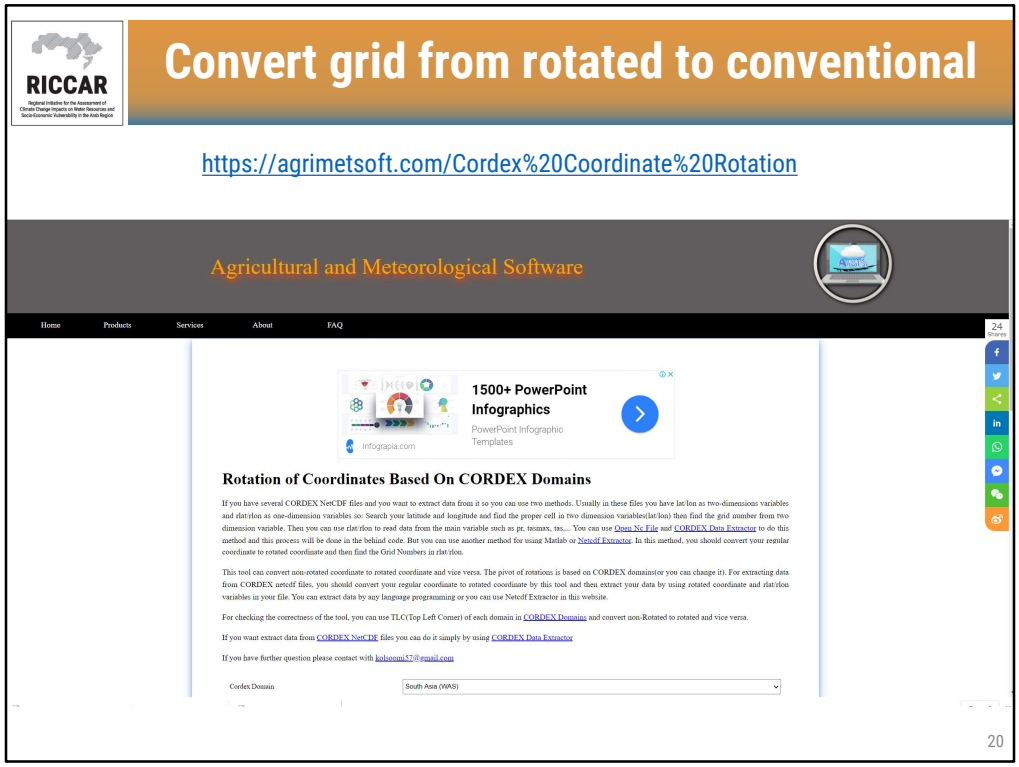
MNA-44



MNA-44*i*



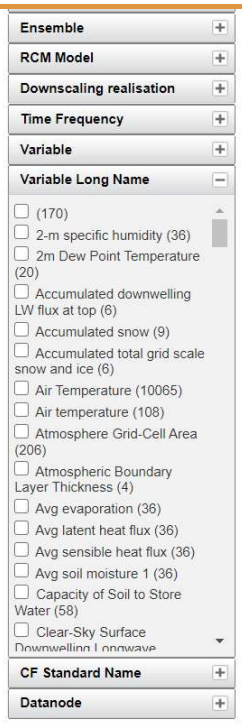
For the MNA domain, the rotated computational coordinates and conventional latitude/longitude coordinates are nearly the same




- Can convert point location coordinates using free tool shown.
- Conversion of entire NetCDF (or raster) requires MatLab program or proprietary software from Agrimetsoft. (Can see website shown for more details.)

# Data filters

Select climate parameter either by its abbreviation (Variable) or full name (Variable Long Name)



## Common CORDEX Variables

| Variable | Units | Long Name |
|---|---|---|
| tas | K | Near-Surface Air Temperature |
| tasmax | K | Daily Maximum Near-Surface Air Temperature |
| tasmin | K | Daily Minimum Near-Surface Air Temperature |
| pr | kg $m^{-2}$ $s^{-1}$ | Precipitation |
| hurs | % | Near-Surface Relative Humidity |
| sfcWind | m $s^{-1}$ | Near-Surface Wind Speed |
| sfcWindmax | m $s^{-1}$ | Daily Maximum Near-Surface Wind Speed |
| clt | % | Total Cloud Fraction |
| sund | s | Duration of sunshine |
| prhmax | kg $m^{-2}$ $s^{-1}$ | Daily Maximum Hourly Precipitation Rate |
| evspsblpot | kg $m^{-2}$ $s^{-1}$ | Potential Evapotranspiration |
| mrros | kg $m^{-2}$ $s^{-1}$ | Surface Runoff |
| mrro | kg $m^{-2}$ $s^{-1}$ | Total Runoff |

Full list at: https://is-enes-data.github.io/CORDEX_variables_requirement_table.pdf

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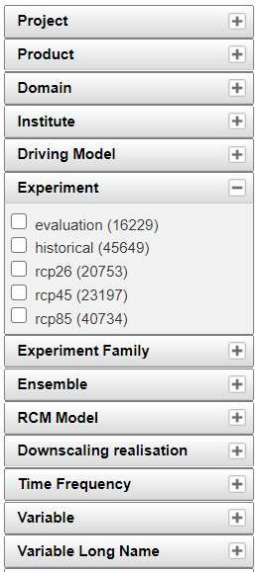
- Note that potential evapotranspiration, surface runoff, and total runoff from CORDEX is based on the RCM outputs themselves, whereas evapotranspiration and runoff data from RICCAR is based on regional hydrological modelling.
- Preferred to select “near-surface” measurements (i.e. tas; near-surface air temperature) instead of “surface” (i.e. ts: surface temperature) because surface considers conditions of the ground surface itself. Near-surface concerns the air near the ground.

# Data filters: Experiment

Evaluation: ERA-Interim data
Historical: 1950-2005
RCPs: 2006-2100 for each RCP

Evaluation data helps to determine bias in each RCM

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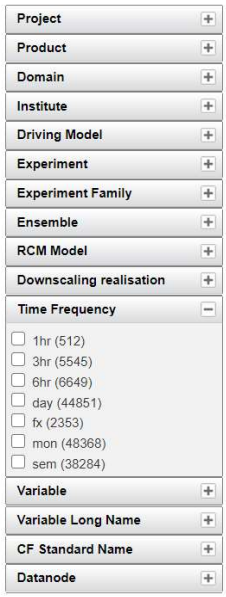
# Data filters: Time Frequency

| | |
|---|---|
| 1 hr: | 1-hourly |
| 3 hr: | 3-hourly |
| 6 hr: | 6 hourly |
| day: | Daily |
| fx: | Time independent |
| mon: | monthly |
| sem: | Seasonally |

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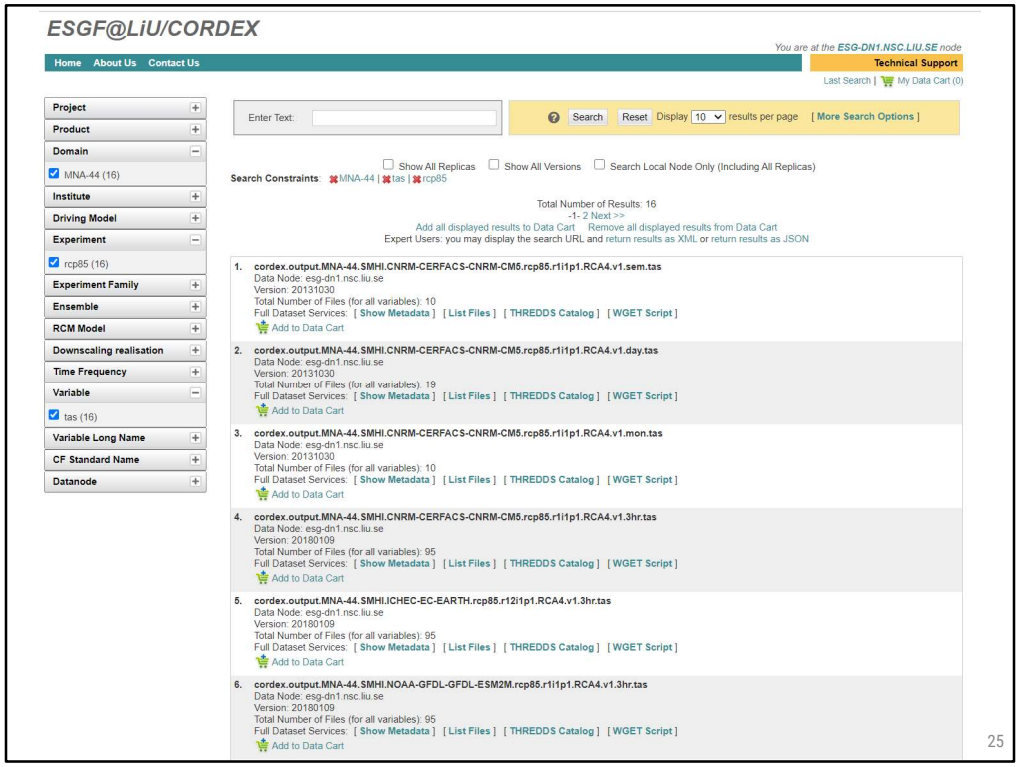
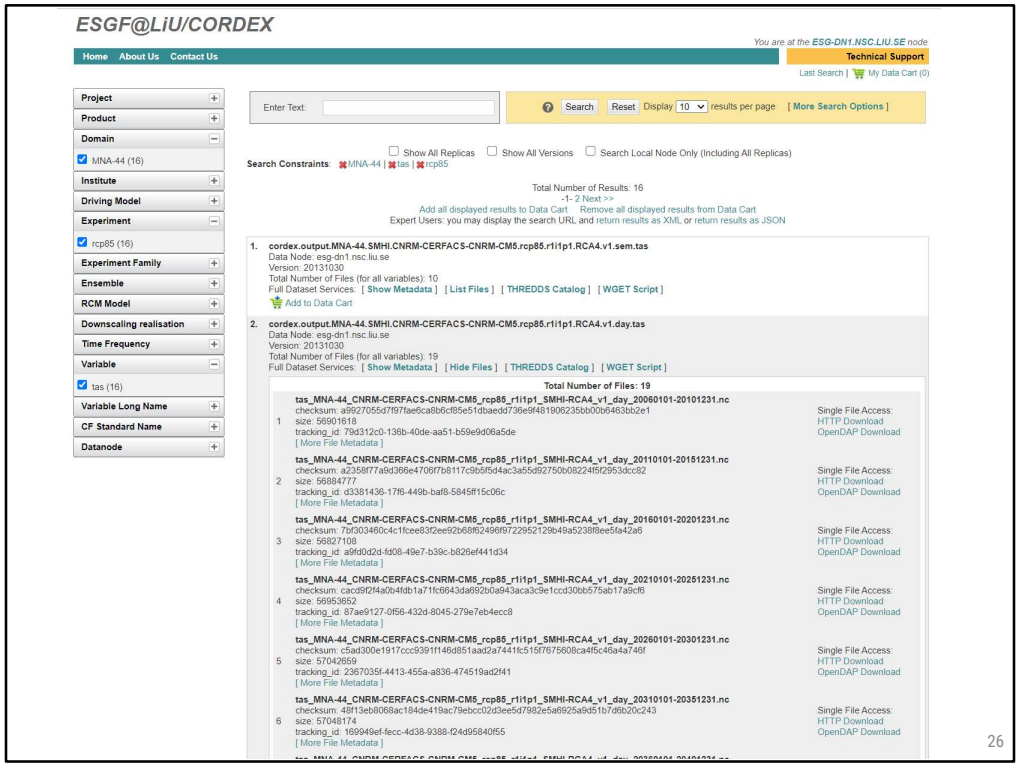
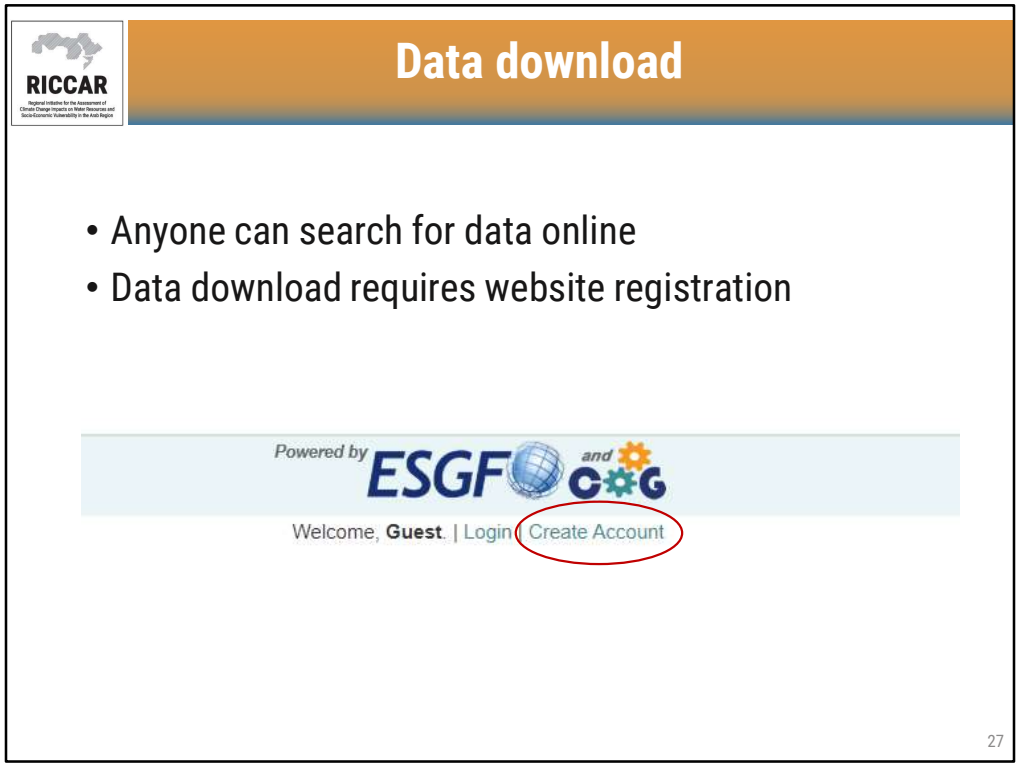


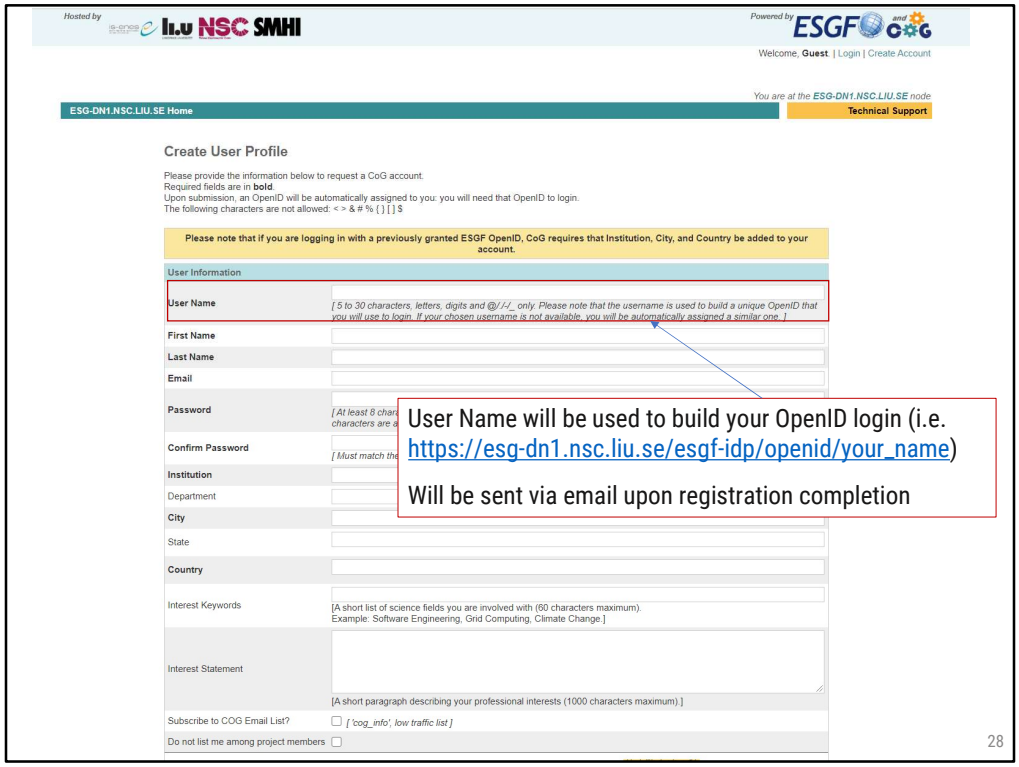

Search results with MNA-44 domain, tas variable, and RCP8.5 experiment selected as filters



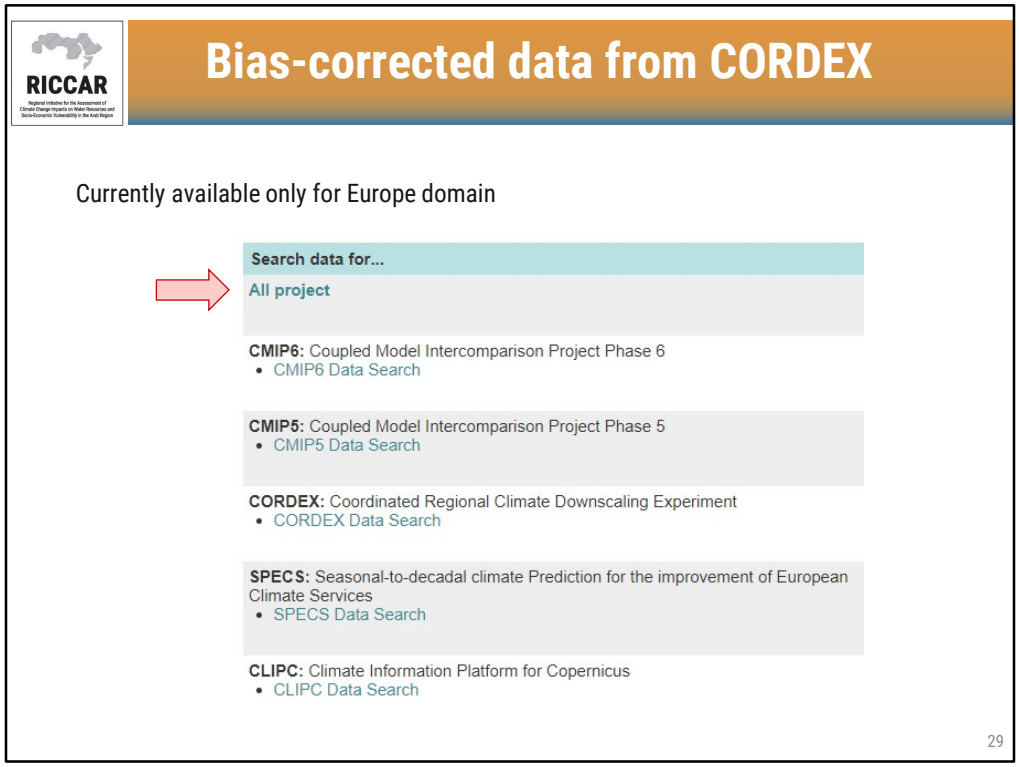

- Select “List Files” to show the available NetCDF files. Daily data is often in 5-year periods as shown.
- Naming convention is similar to RICCAR NetCDF files.



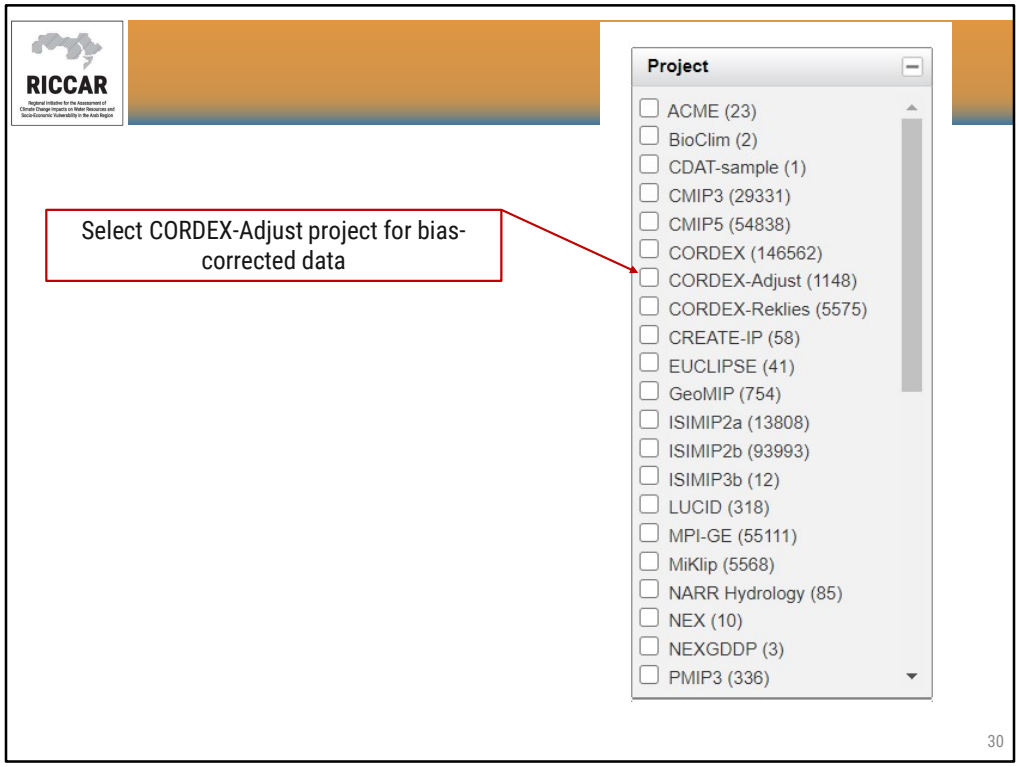

- The ESGF is open-access.
- To create account, link is in upper right corner of website.



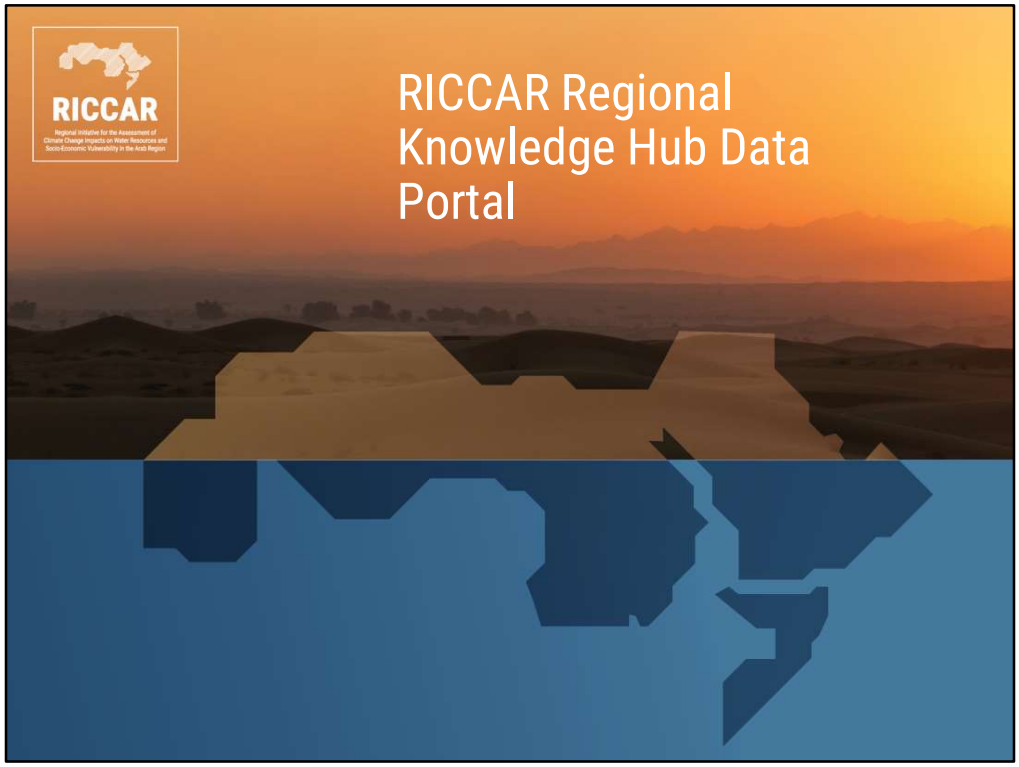

- Remaining fields are self-explanatory
- COG is the website front of the ESGF. Subscribing to the email list is optional.

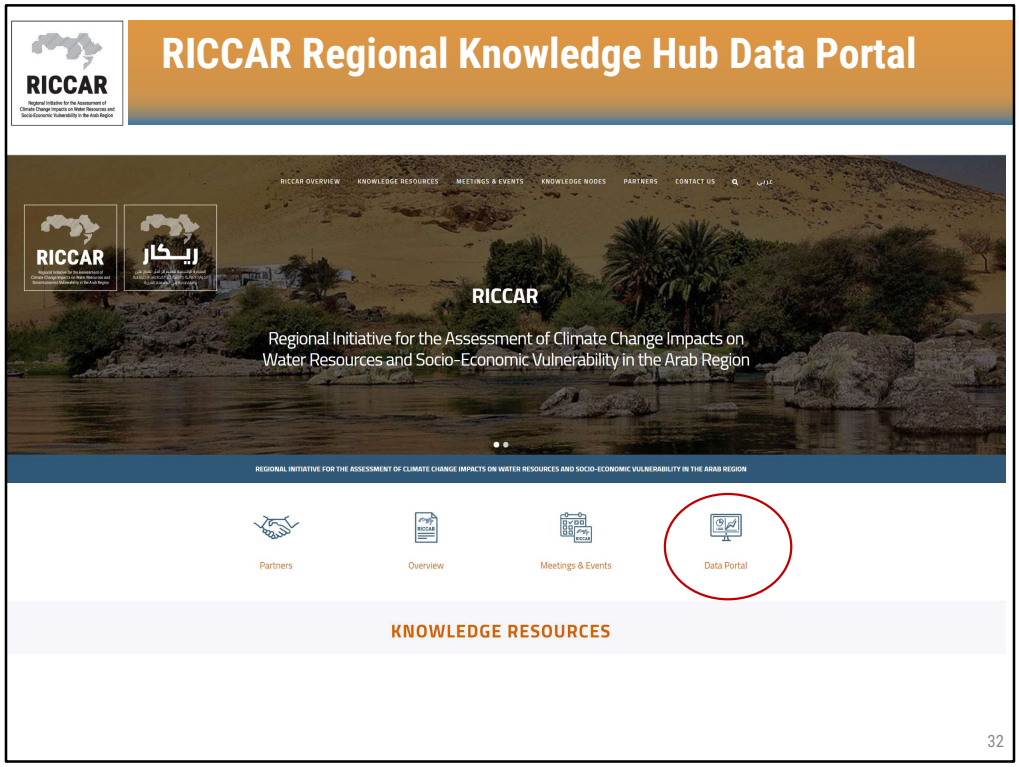


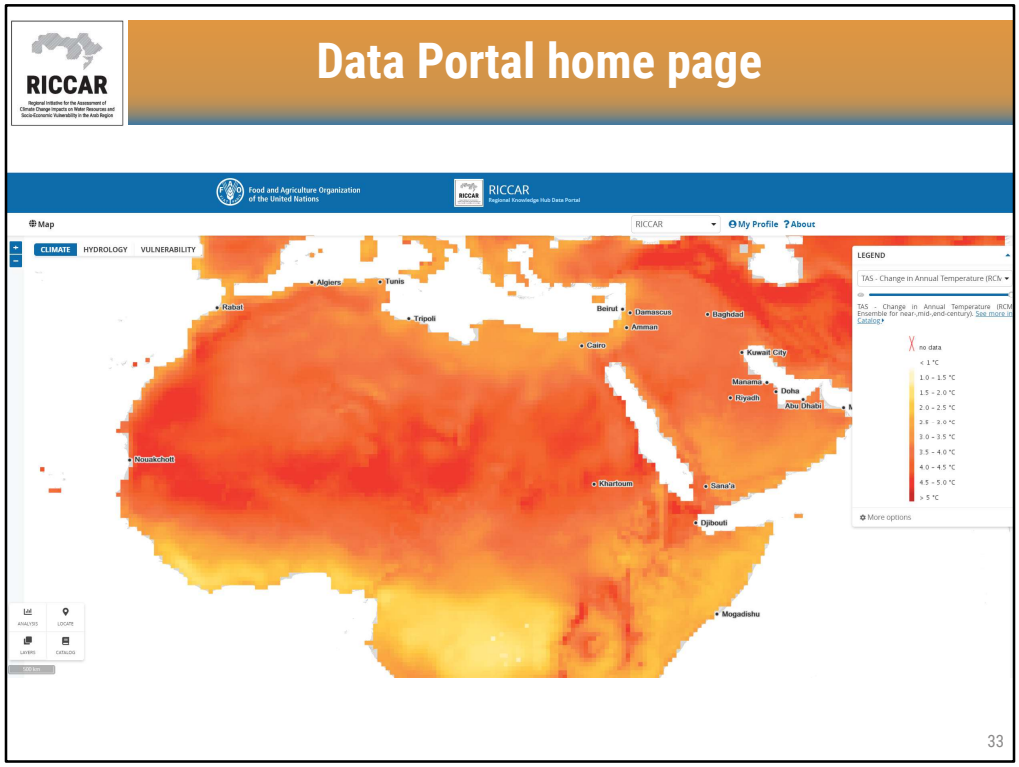

- Select “All project” on ESGF data node home page.



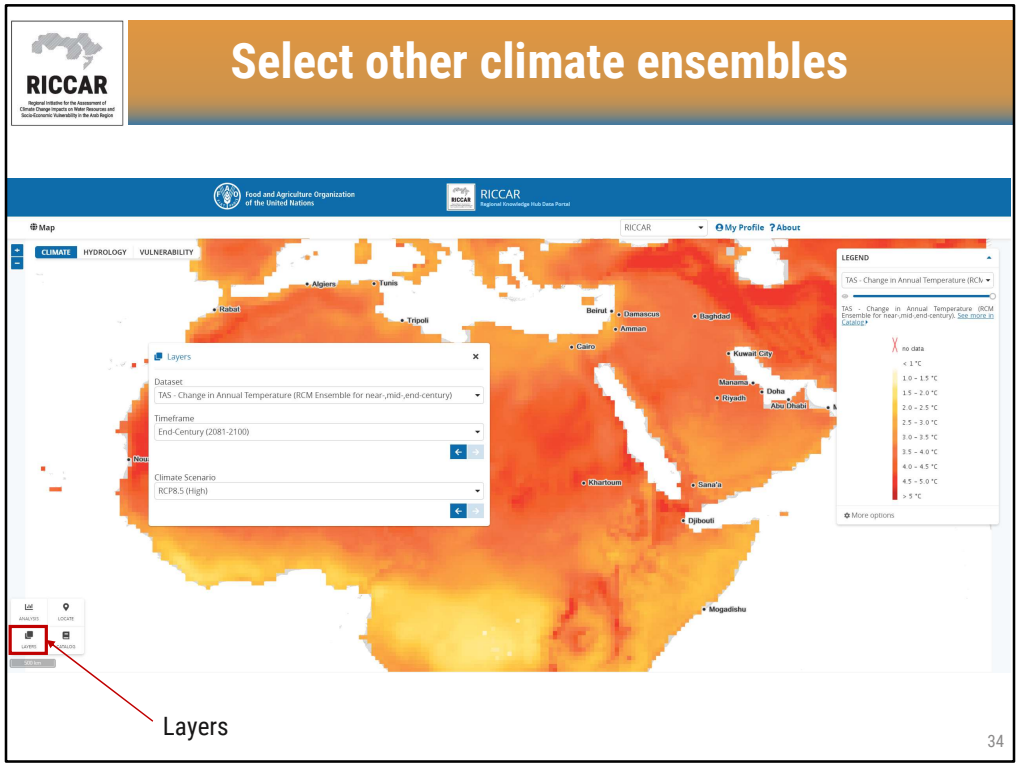

- CORDEX-Reklies refers to a high-resolution dynamical downscaling project for the . EURO-CORDEX domain (ReKliEs-De: Regionale Klimaprojektionen Ensemble für Deutschland). Coverage includes Germany and relevant water basins.
- Other climate databases are available for users.


RICCAR
RICCAR Regional Knowledge Hub Data Portal


RICCAR
RICCAR Regional Knowledge Hub Data Portal
RICCAR OVERVIEW
KNOWLEDGE RESOURCES
MEETINGS & EVENTS
KNOWLEDGE NODES
PARTNERS
CONTACT US
RICCAR
Regional Initiative for the Assessment of Climate Change Impacts on Water Resources and Socio-Economic Vulnerability in the Arab Region
REGIONAL INITIATIVE FOR THE ASSESSMENT OF CLIMATE CHANGE IMPACTS ON WATER RESOURCES AND SOCIO-ECONOMIC VULNERABILITY IN THE ARAB REGION
Partners
Overview
Meetings & Events
Data Portal
KNOWLEDGE RESOURCES
32

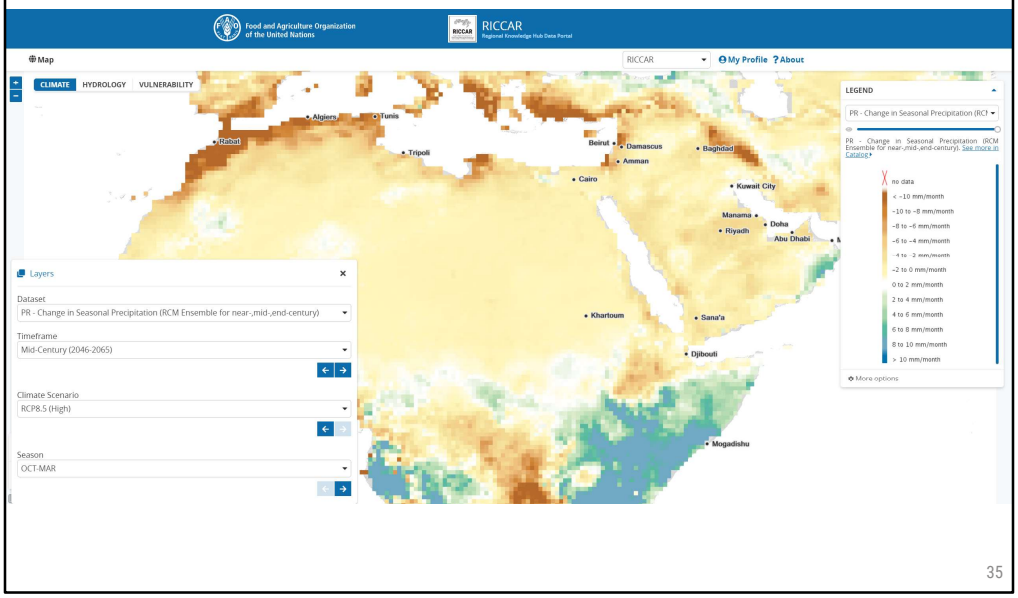


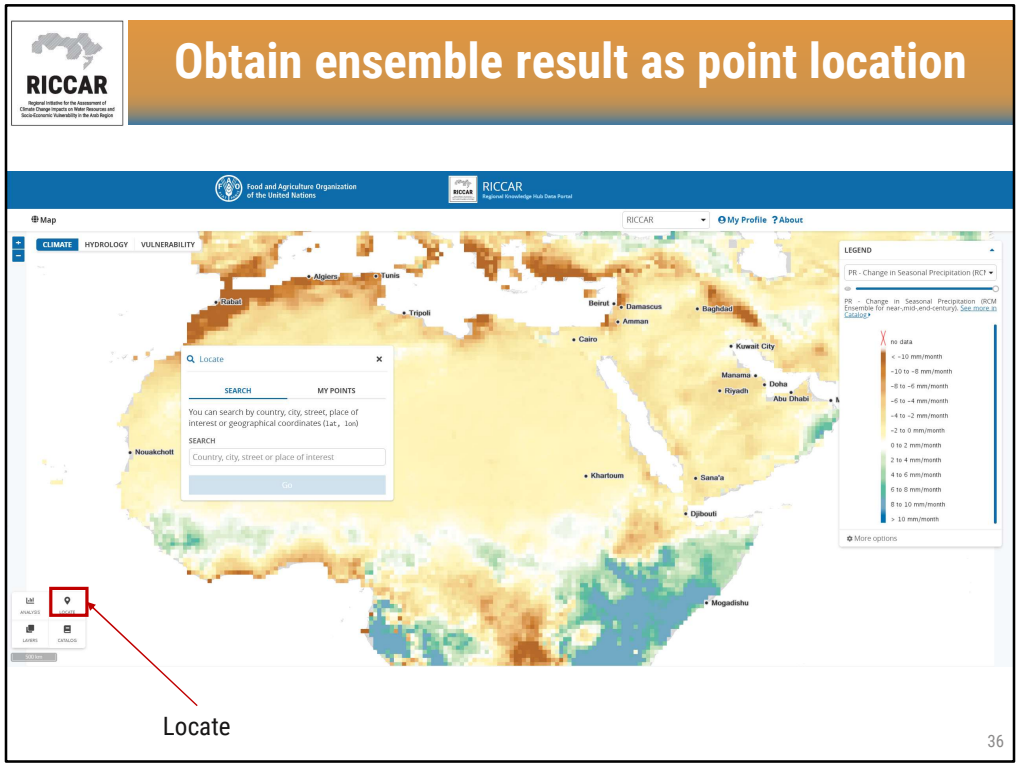

- Data portal is maintained by FAO (one of RICCAR partners).
- Can view climate data and hydrology data ensembles as well as vulnerability assessment data.




- Note that although the RICCAR regional knowledge hub has a mirror website in Arabic, there are no current plans to develop an Arabic mirror site for the data portal. The data portal is solely available in English.
- Improvements to the data portal are ongoing. If you have suggestions for improvement, please send an email.

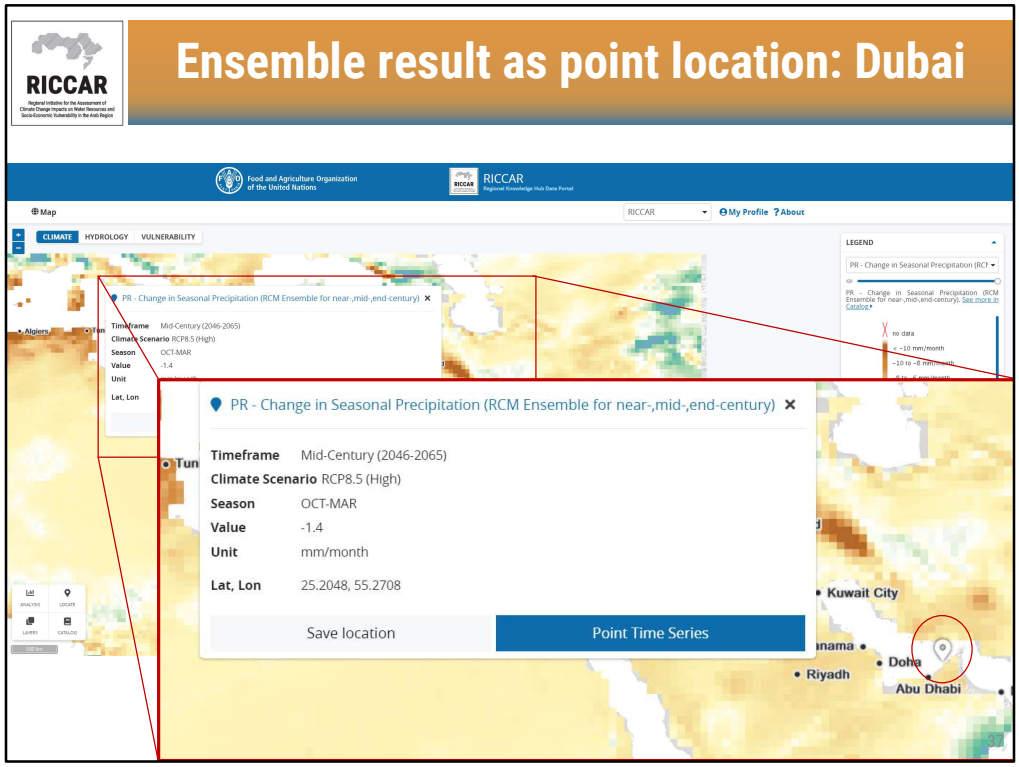
# Seasonal precipitation – mid-century – RCP8.5

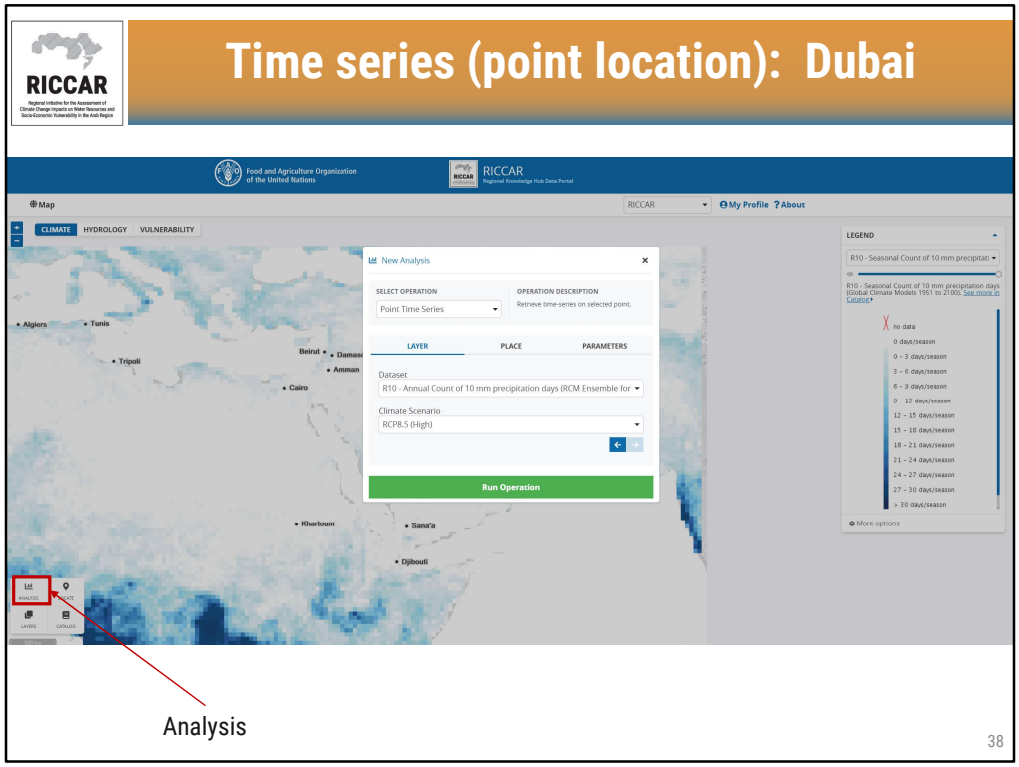





- Can obtain data at point location by name or by geographic latitude, longitude coordinates
- Note that only major cities can be located by name, using only commonly used international spelling.

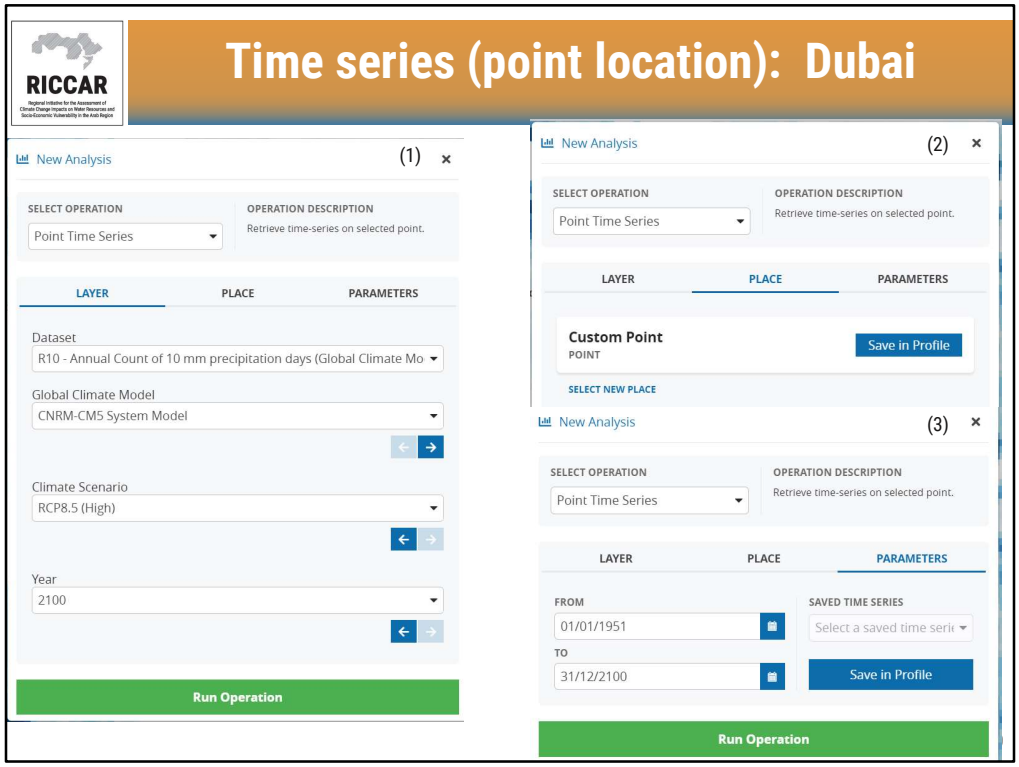
# Ensemble result as point location: Dubai





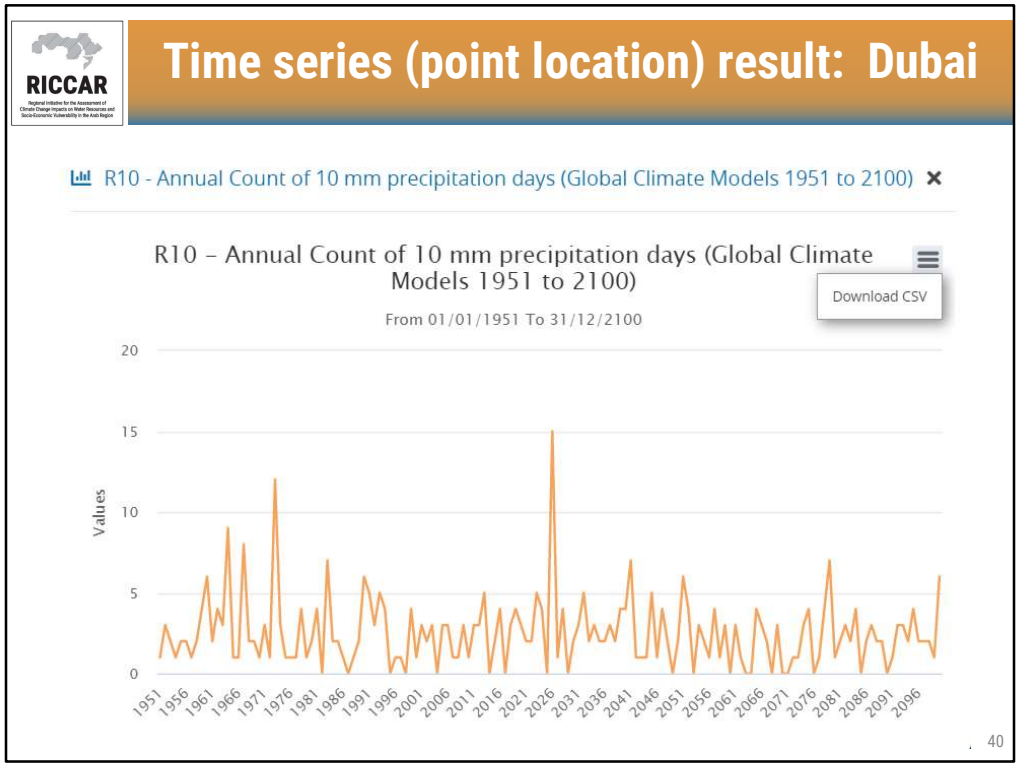

- Currently only available for extreme climate indices
- Requires account registration (upper right corner)

# Time series (point location): Dubai

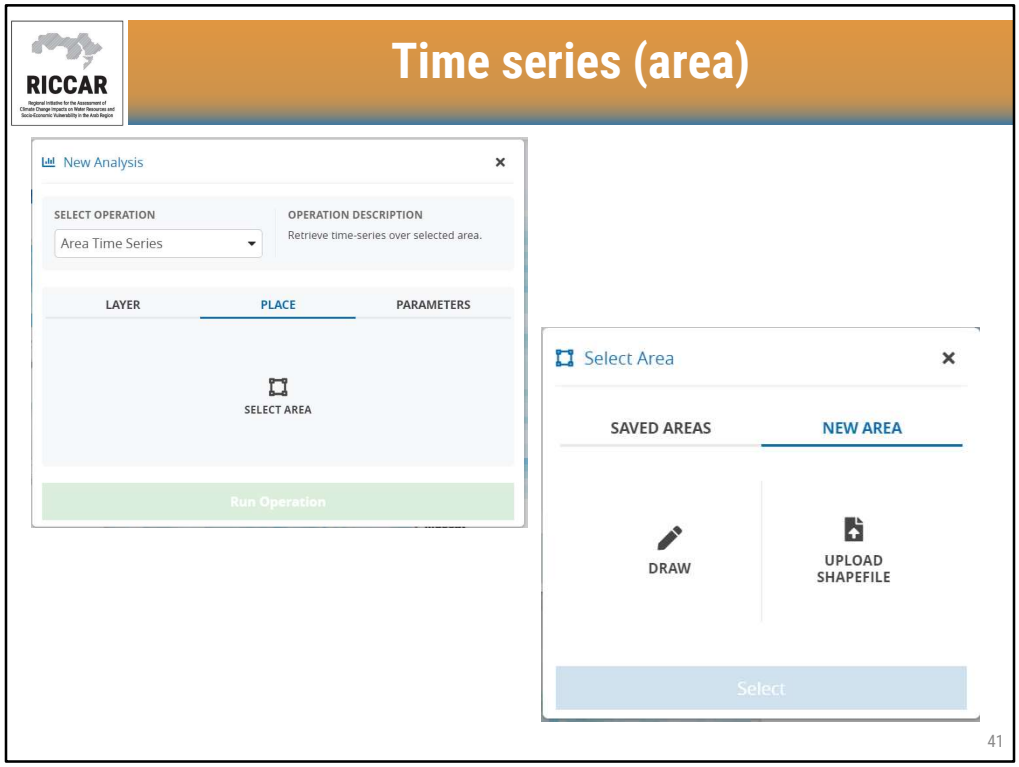



1. Select dataset (only currently available for extreme climate indices), the driving GCM, and the climate scenario. (Note that year is not applicable.)
2. Select point location.
3. Select time period

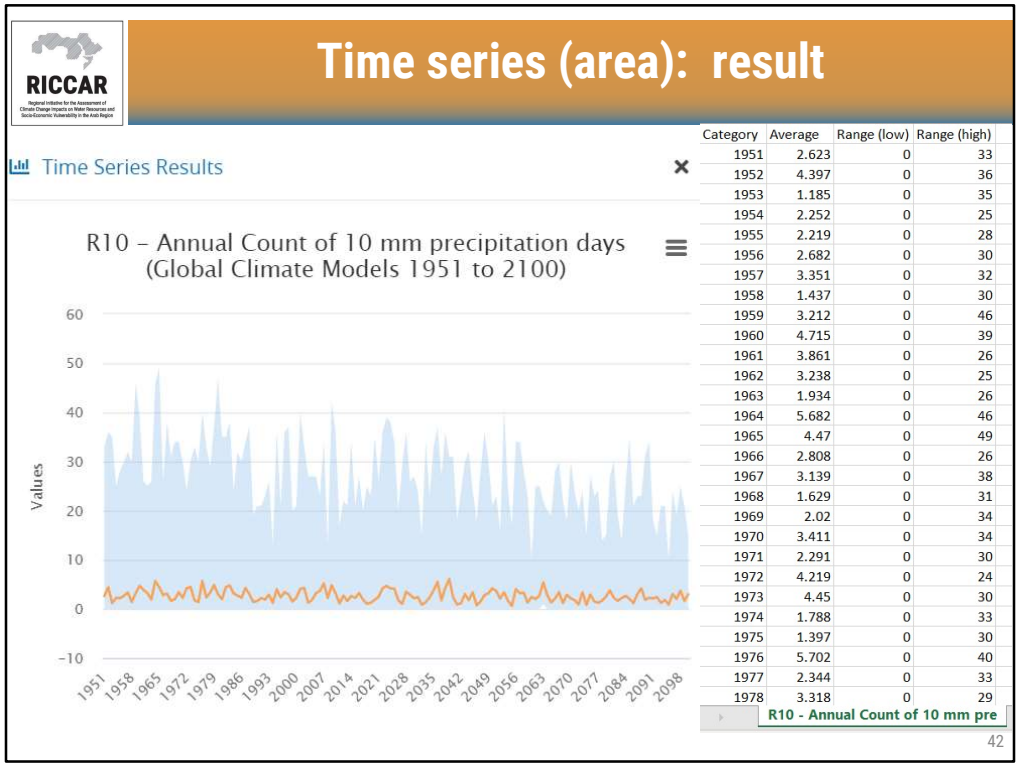
- Note that parameters can be saved to user profile.
- Note that only 1 driving GCM can be completed at a time.
- It is planned to improve the analysis tool (i.e. remove “year” for step 1).



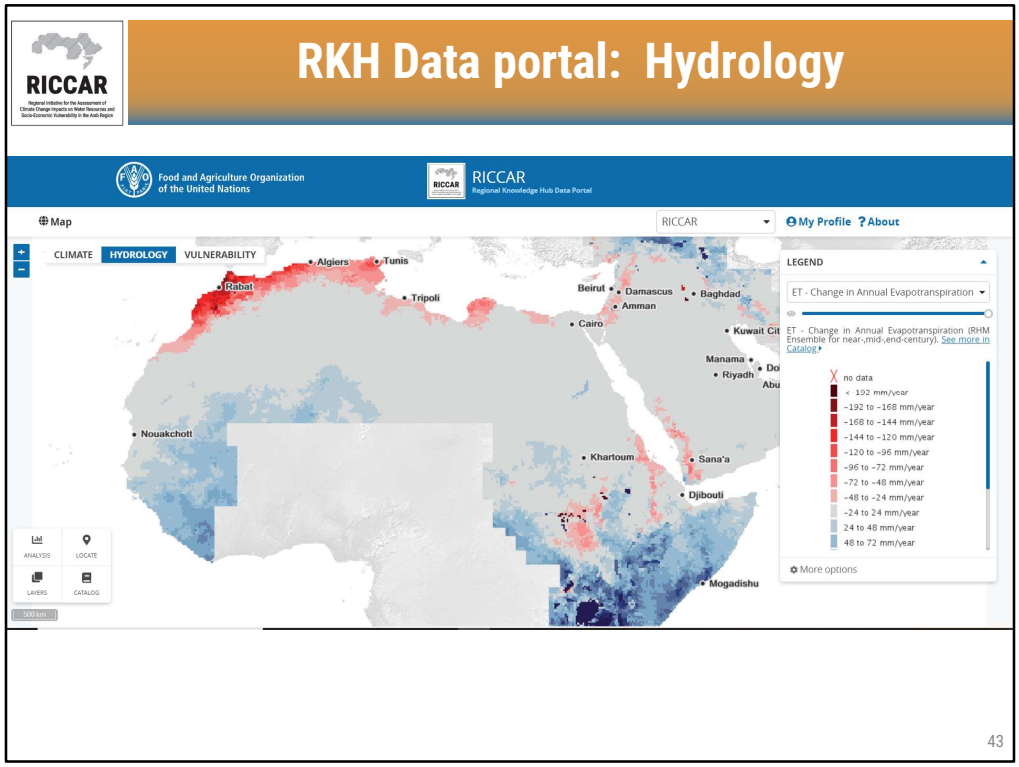

- Result can be exported to .csv file



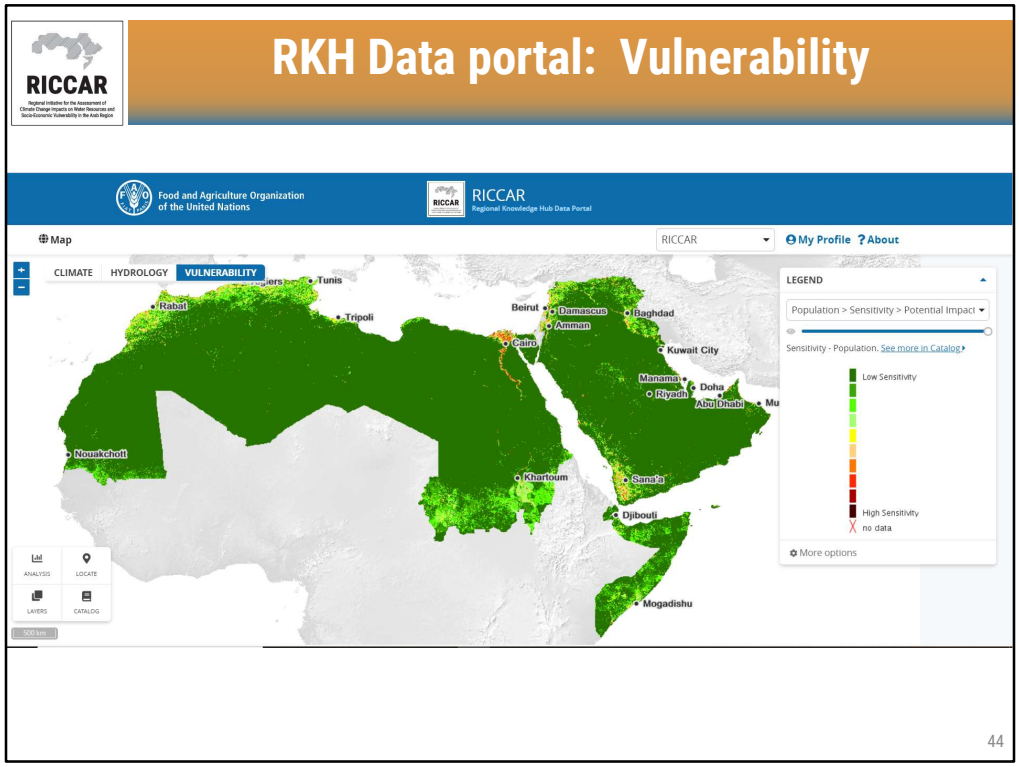

- Area can be defined by drawing a polygon on the screen or by uploading a shapefile (i.e. basin boundaries).
- Note is it recommended to use only simple shapefiles with only 1 polygon rather than multiple non-continuous polygons (i.e. multiple cropland areas).



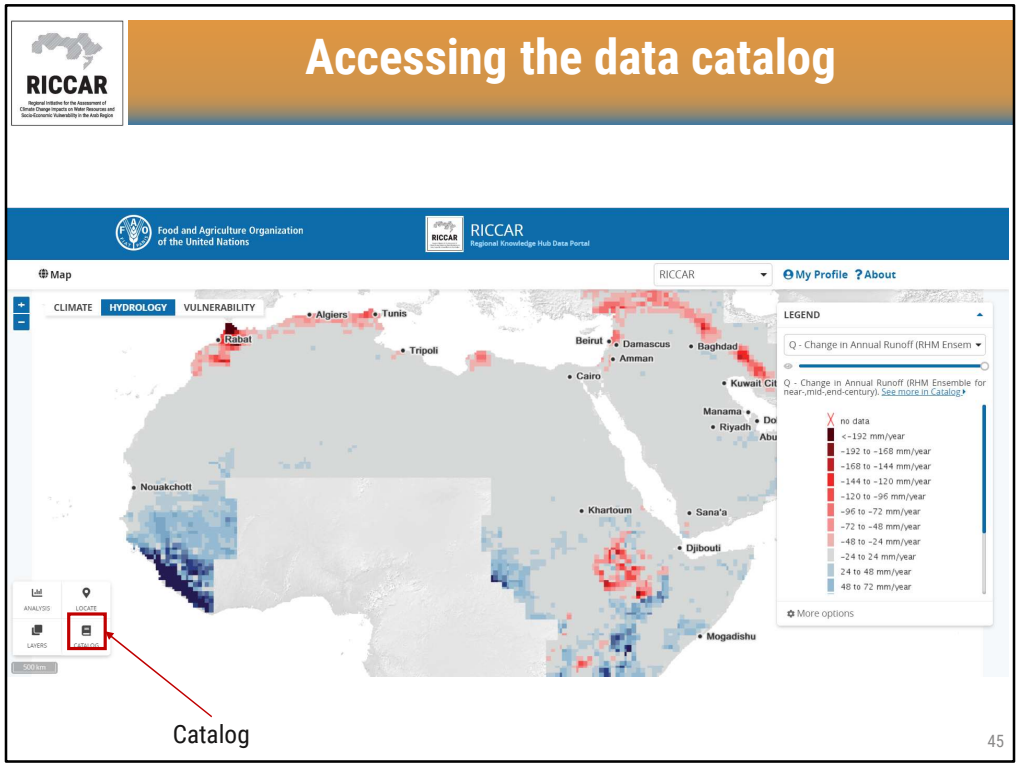

- Result based on a manually drawn polygon around the Jordan River Basin.
- Results for the GFDL-ESM2M driving GCM.
- Graphical results shown in data portal with orange line indicating the areal average and the blue shaded area showing the range.
- Results can be exported as .csv file.
- Currently only available for extreme climate indices (not temperature nor precipitation).



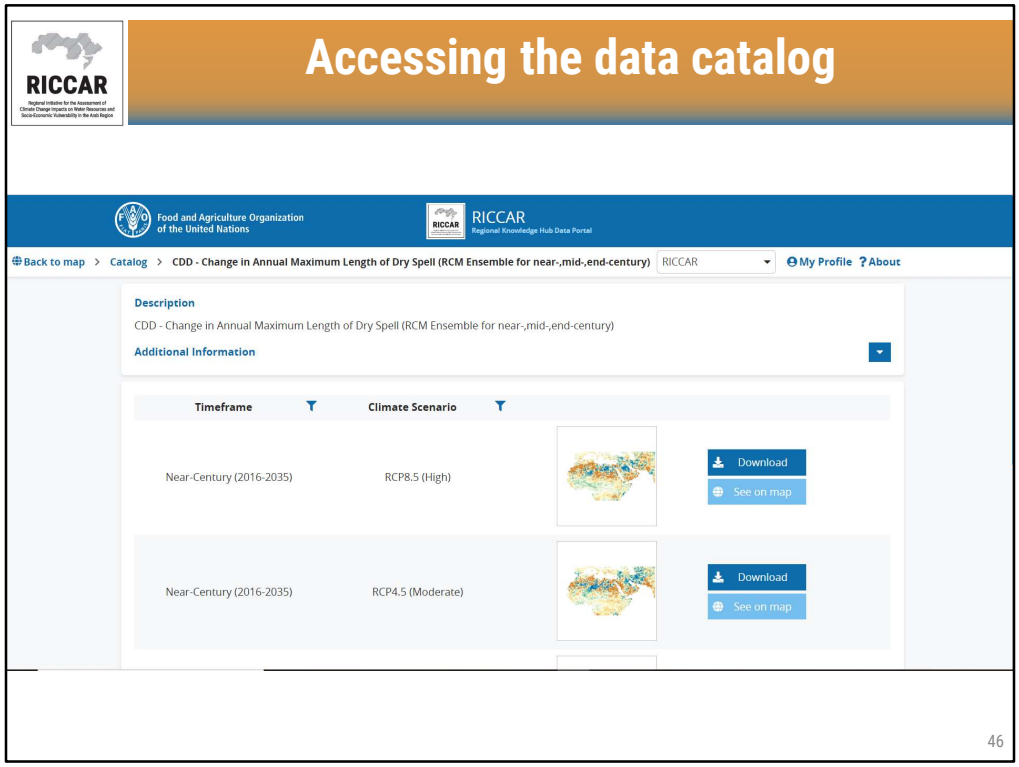

- Can obtain ensemble outputs (reference period, near-century, mid-century, or end-century) based on 2 different regional hydrological models (RHM): VIC and HYPE.
- Available results include evapotranspiration and runoff.
- Current view is evapotranspiration, end-century, RCP8.5, using the HYPE model.




- Vulnerability assessments to be discussed during module 6.
- Current view is the population density indicator.




- Current view is runoff, end-century, RCP8.5, using the VIC model.




- Can download rasters of the climate and hydrology ensembles.
- NetCDF files are not yet available online but currently working on it.
- Can download raster of the vulnerability assessment indicators and outputs for actual values, classified values, indicator factsheets, and statistical data. (More to be discussed about vulnerability assessments during module 6.)

## RKH Data Portal Demographics

| Month/Year | Algeria | Bahrain | Djibouti | Egypt | Iraq | Jordan | Kuwait | Lebanon | Libya | Morocco | Oman | Palestine | Saudi Arabia | Sudan | Syria | Tunisia | UAE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total Users | | | | | | | | | | | | | | | | | |
| Sep-19 | - | - | - | 2 | - | 1 | - | 3 | - | - | - | - | - | - | - | 1 | - |
| Oct-19 | - | - | - | 7 | - | 1 | - | 13 | - | - | - | - | - | - | - | - | 2 |
| Nov-19 | - | - | - | 5 | - | 7 | - | 4 | - | - | - | 2 | - | - | - | - | 4 |
| Dec-19 | - | - | - | 7 | - | 3 | - | 7 | - | 3 | - | - | 4 | - | - | 5 | - |
| Jan-20 | - | 1 | - | 9 | 4 | 2 | - | 16 | - | - | - | - | - | - | - | - | 1 |
| Feb-20 | - | - | - | 5 | - | 2 | - | 3 | - | 1 | - | - | 1 | 1 | - | - | 1 |
| Mar-20 | - | - | - | 8 | 2 | 1 | - | 5 | - | - | - | - | - | - | - | - | 1 |
| Apr-20 | - | - | - | 5 | 1 | - | 1 | 6 | - | - | - | - | 1 | - | - | - | 10 |
| May-20 | - | - | - | 9 | - | - | - | 1 | - | 2 | - | - | 1 | - | - | - | - |
| Jun-20 | 2 | 3 | 1 | 3 | 4 | 3 | 1 | 11 | 2 | 2 | 2 | 2 | - | 1 | 8 | 2 | 7 |

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- The RKH data portal was launched in March 2019, but analytics have been tracked only since September 2019.

## RKH Data Portal Demographics

| | Total users | | New users | | Sessions | |
|---|---|---|---|---|---|---|
| | Globally | Arab States | Globally | Arab States | Globally | Arab States |
| Sep-19 | 22 | 7 | 19 | 7 | 135 | 36 |
| Oct-19 | 54 | 23 | 46 | 19 | 267 | 76 |
| Nov-19 | 67 | 22 | 55 | 20 | 296 | 58 |
| Dec-19 | 141 | 29 | 114 | 19 | 339 | 68 |
| Jan-20 | 51 | 33 | 40 | 29 | 115 | 70 |
| Feb-20 | 31 | 14 | 18 | 8 | 61 | 30 |
| Mar-20 | 23 | 17 | 16 | 12 | 46 | 33 |
| Apr-20 | 36 | 24 | 31 | 22 | 62 | 47 |
| May-20 | 30 | 13 | 26 | 12 | 47 | 19 |
| Jun-20 | 92 | 54 | 85 | 50 | 120 | 67 |

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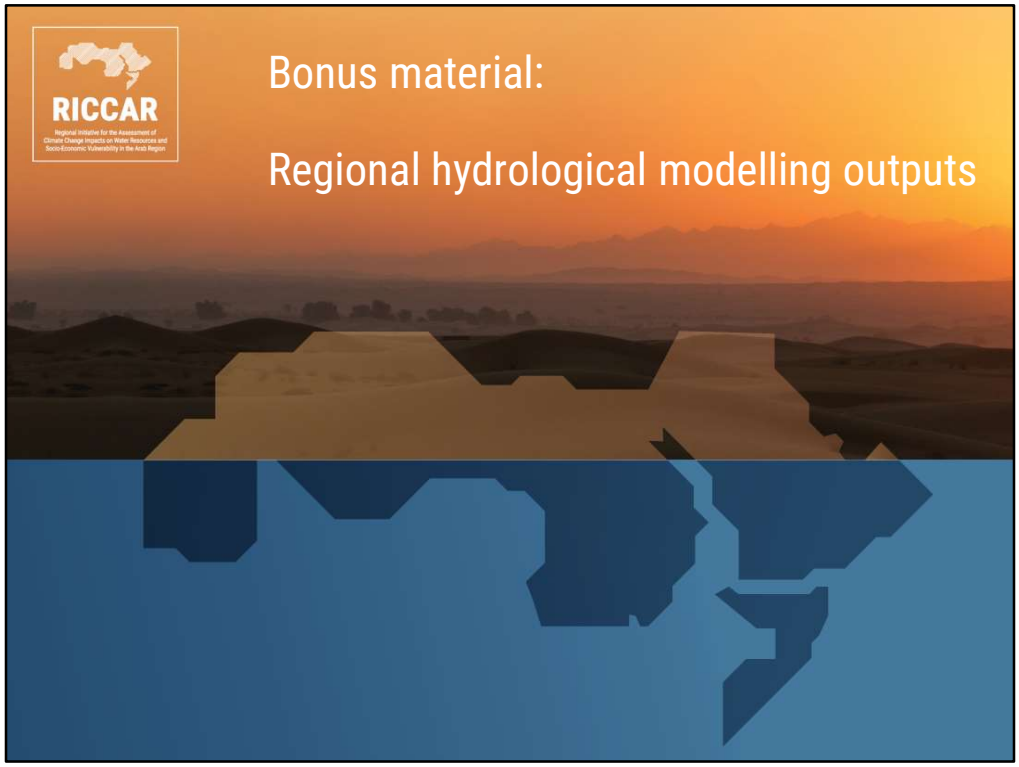
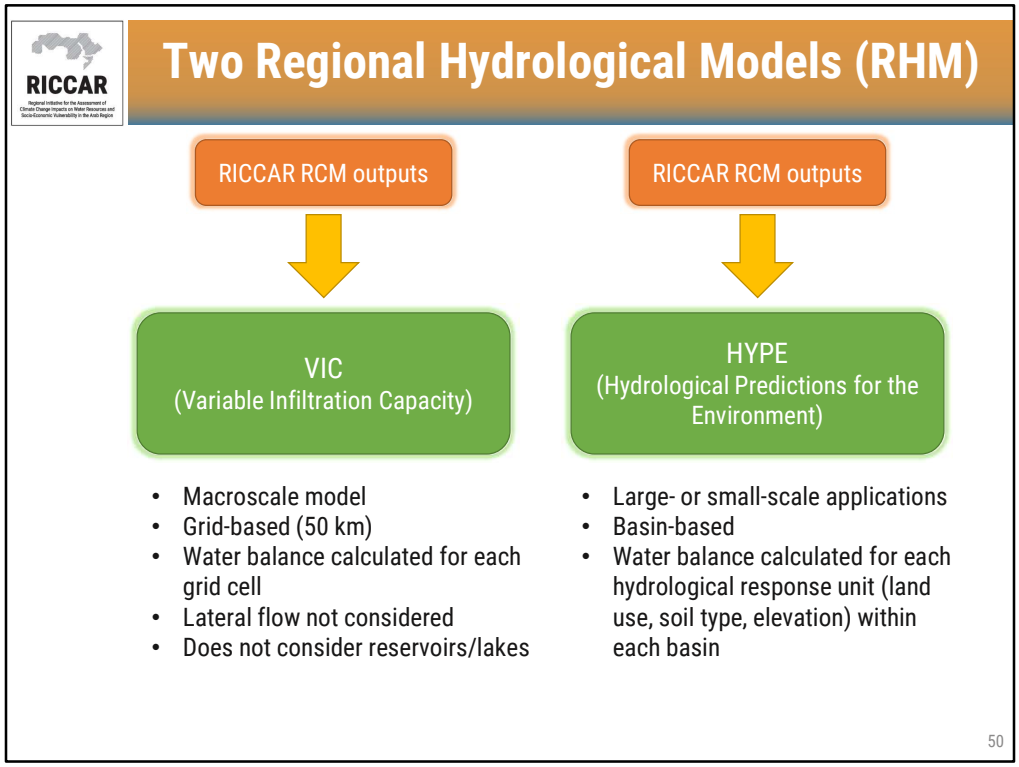
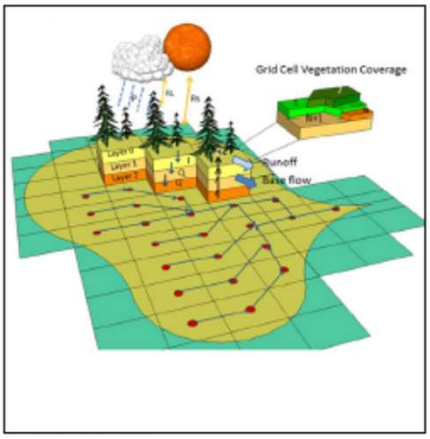
- Users outside the Arab region include Europe (primarily Italy and Germany), other countries within the Arab/MENA domain (most in Ethiopia), and users from the USA, India, and South Korea.


RICCAR
Regional Initiative for the Assessment of Climate Change Impacts on Water Resources and Socio-Economic Vulnerability in the Arab Region
Bonus material:
Regional hydrological modelling outputs

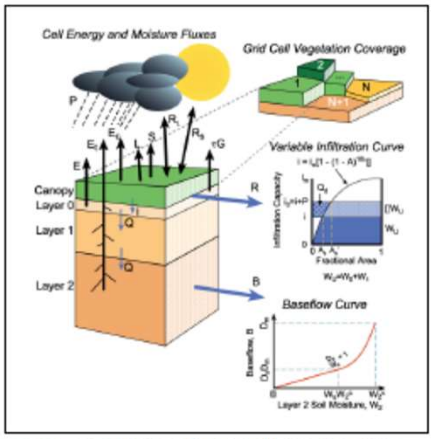



- Both the VIC and HYPE models used the bias-corrected RCM outputs from RICCAR as data input.
- Often asked which RHM output to use. RICCAR used both models for comparative purposes because of the high uncertainties in the results due to limited observed data (evapotranspiration and runoff). Similarly, it is generally advised to use both outputs for comparison for other studies within the Arab region. However, if time/budget only allows for 1 RHM, I recommend the HYPE model results due to the model characteristics described.
- The goal of modelling was to produce reasonable representation of change in hydrological processes across the region. The RHM approach does not replace the need to carry out local studies that address water resources management in more detail but it does help to identify key areas that would potentially benefit from more detailed studies.

## VIC conceptual model and hydrologic processes




Source: Hamlet et al., 2010




Source: University of Washington Computational Hydrology Group, 2016

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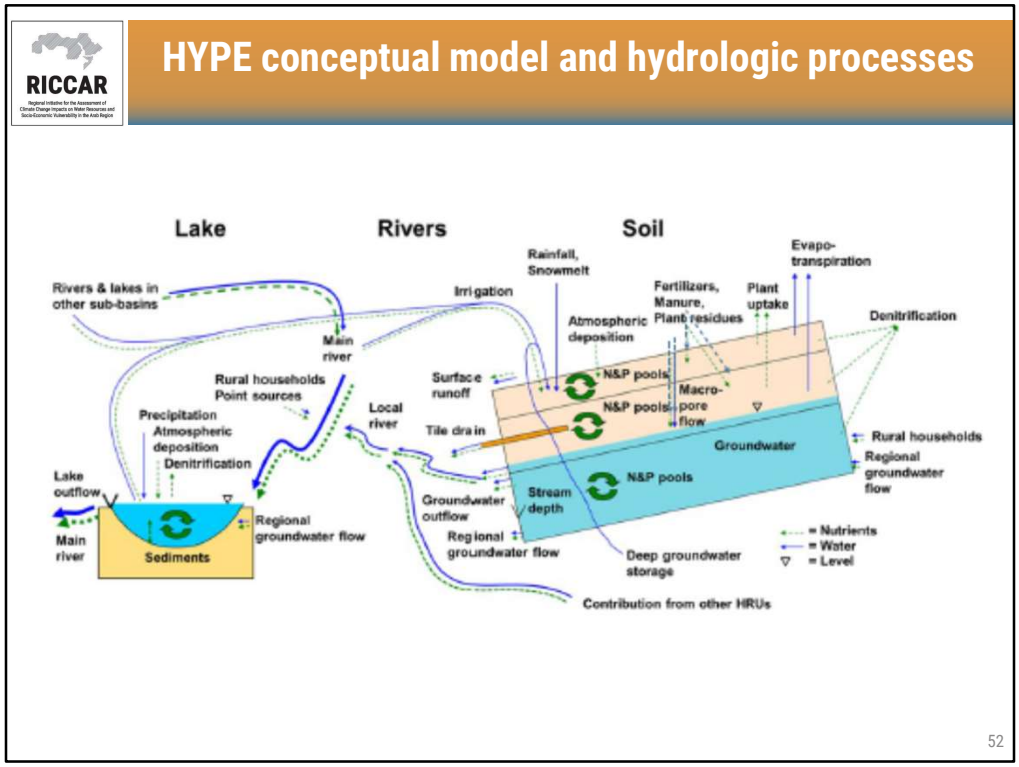
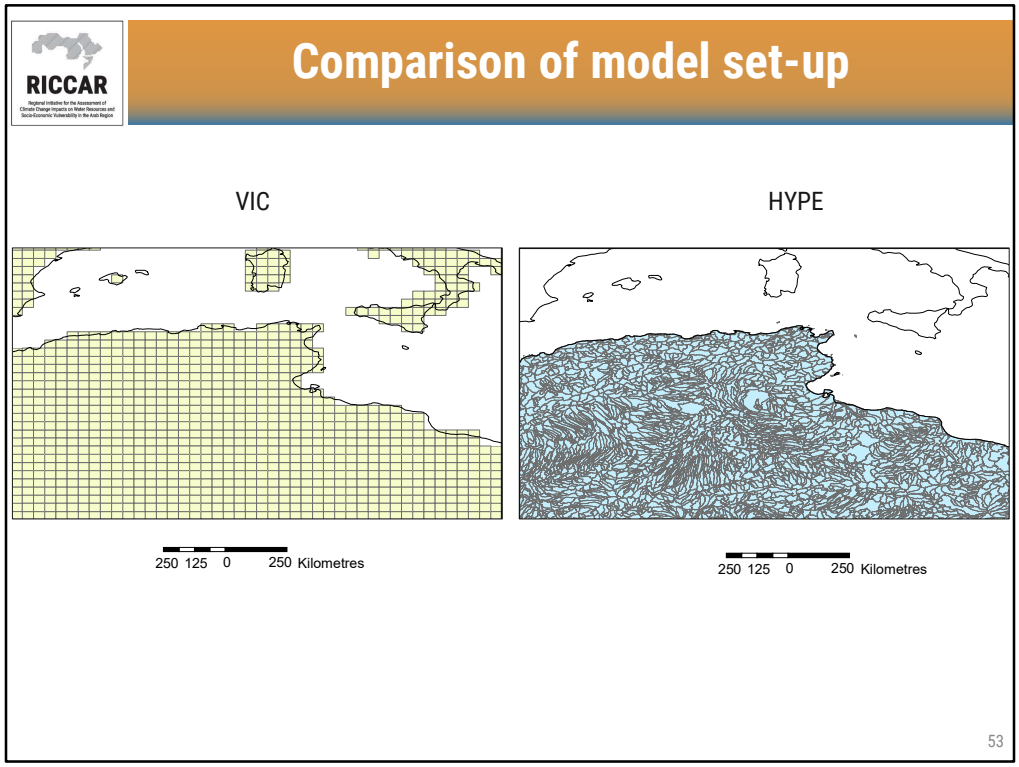
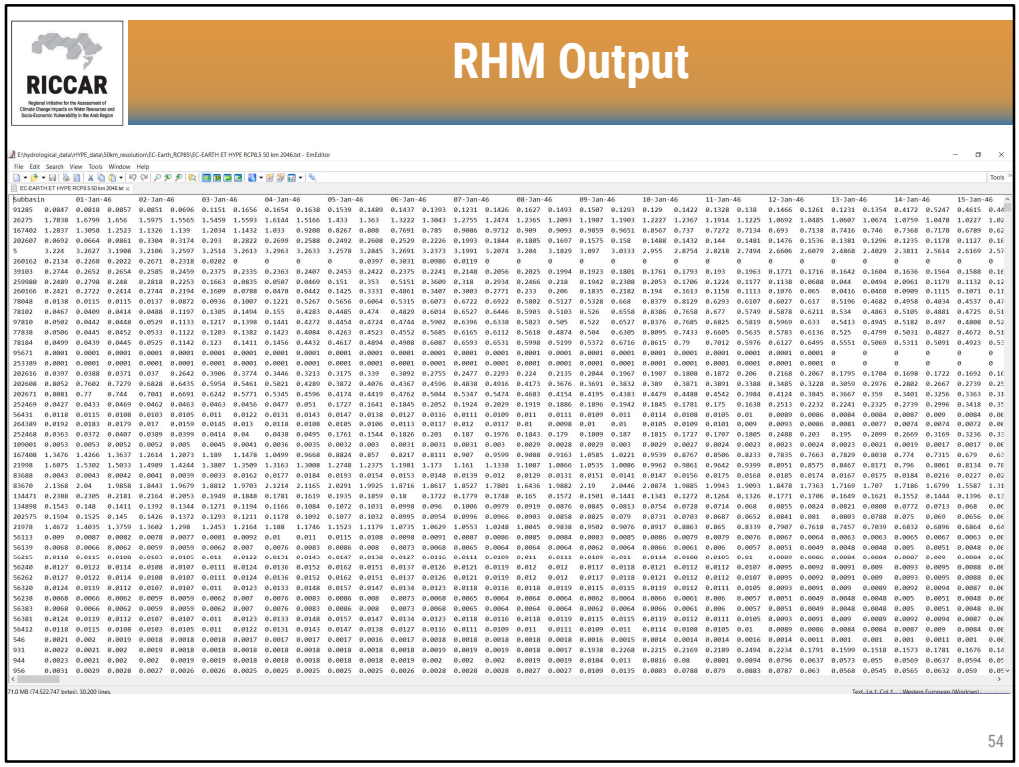
- For more information refer to the Technical Note (shown on last slide), available in English only.



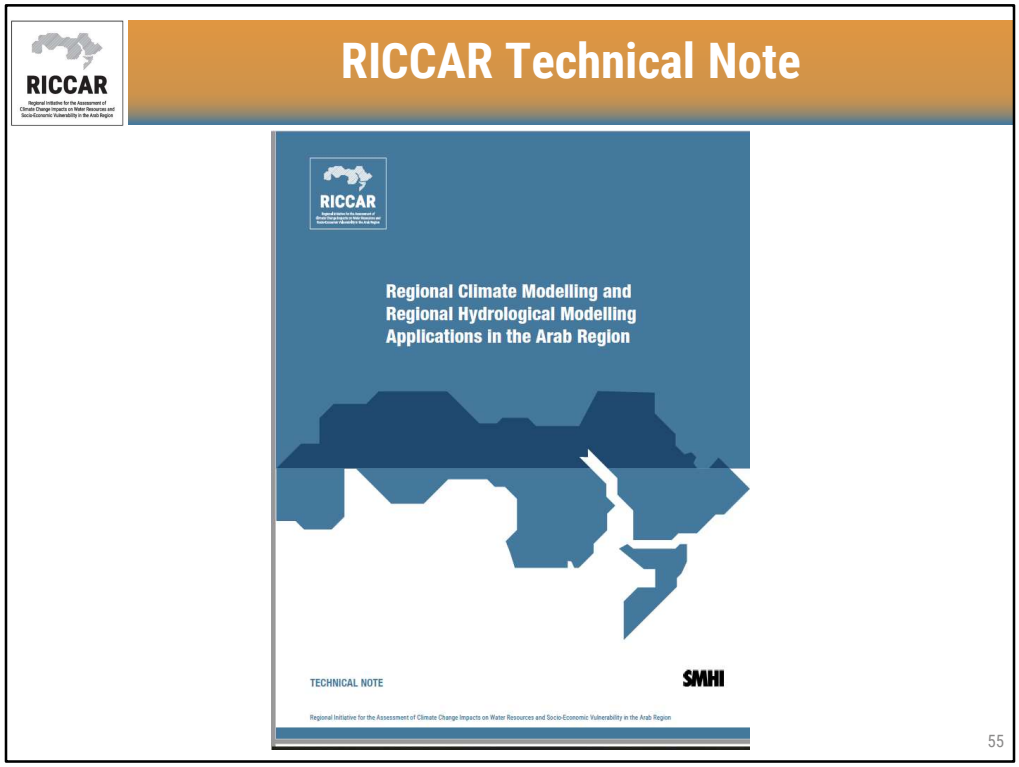

- For more information refer to the Technical Note (shown on last slide), available in English only.




- VIC grid based on 0.44° / ~50 km (same as the RCM outputs)
- HYPE subbasins obtained from HydroSHEDS database




- Shown is sample RHM output. The files are in tabular format which pairs with the shapefiles shown on the previous slide.
- Data is available upon request.




- For more details on climate and hydrological modelling, refer to the Technical Note.
- http://www.riccar.org/regional-climate-modelling-and-regional-hydrological-modelling-applications-arab-region?language_content_entity=en

RICCAR
Thank You
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