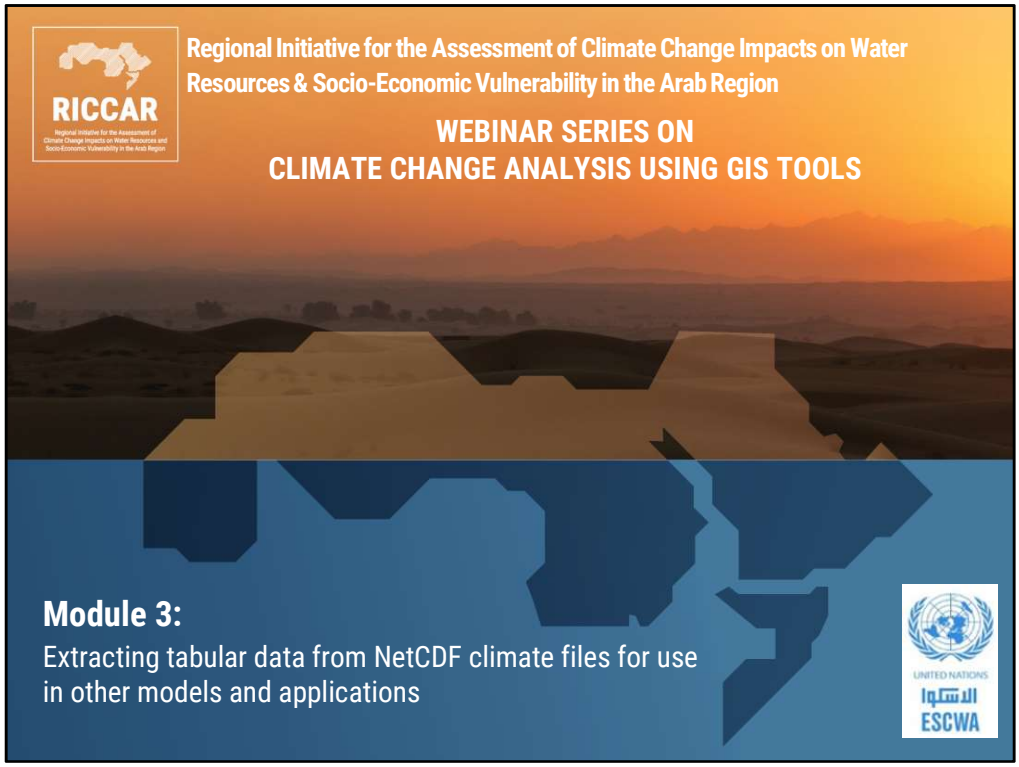


www.riccar.org
www.unescwa.org

Webinar Series

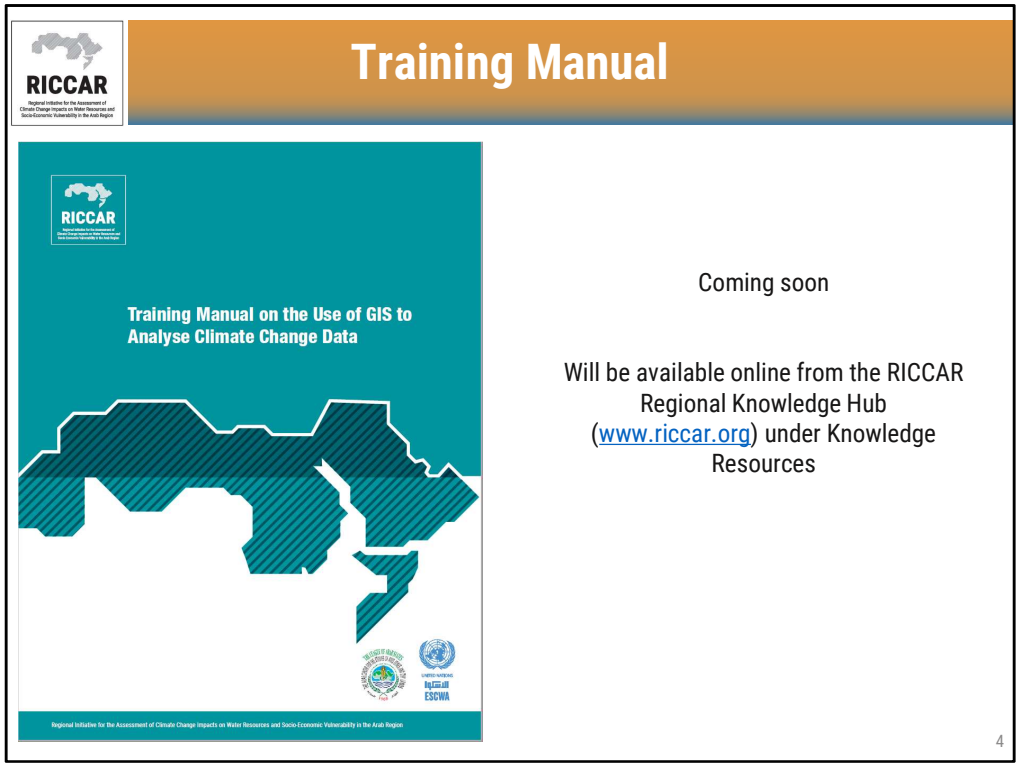
- **Module 1:** RICCAR regional climate modelling and hydrological modelling datasets: An introduction
- **Module 2:** Viewing NetCDF regional climate modeling datasets in GIS
- ✓**Module 3:** Extracting tabular data from NetCDF climate files for use in other models and applications
- **Module 4:** Creating 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

2

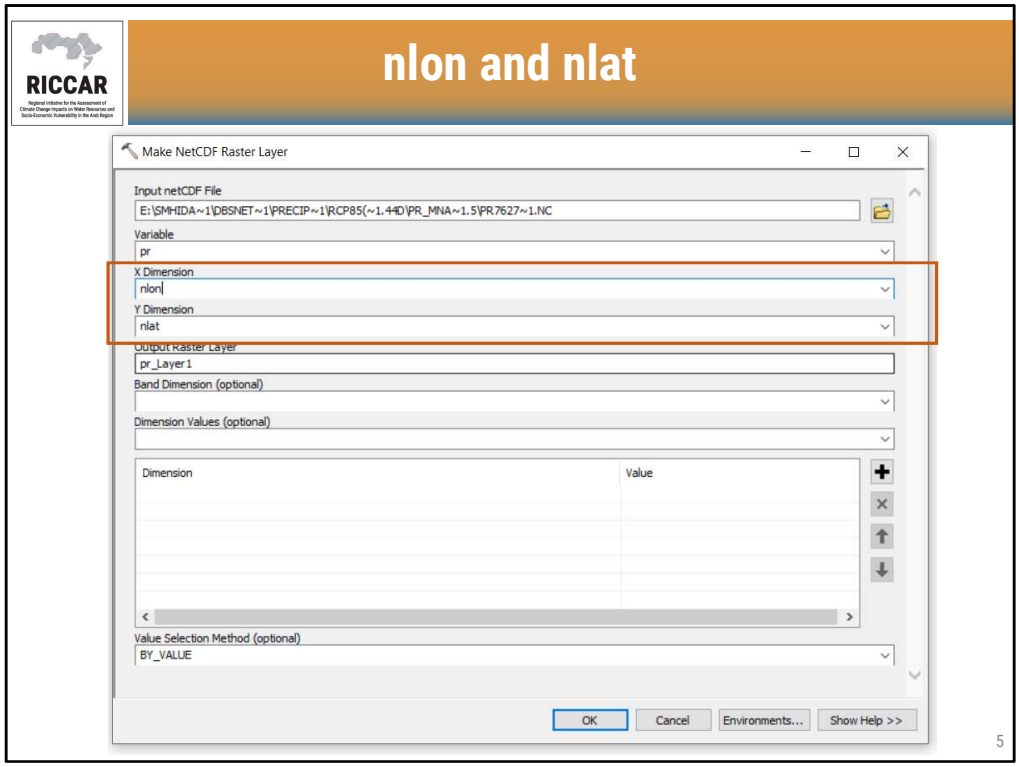
Module 3: Contents

- Extracting time series datasets from NetCDF
- How to extract daily climate data for a given location for use in other models and applications
- Benefits and utilization of ArcMap Model Builder for NetCDF files

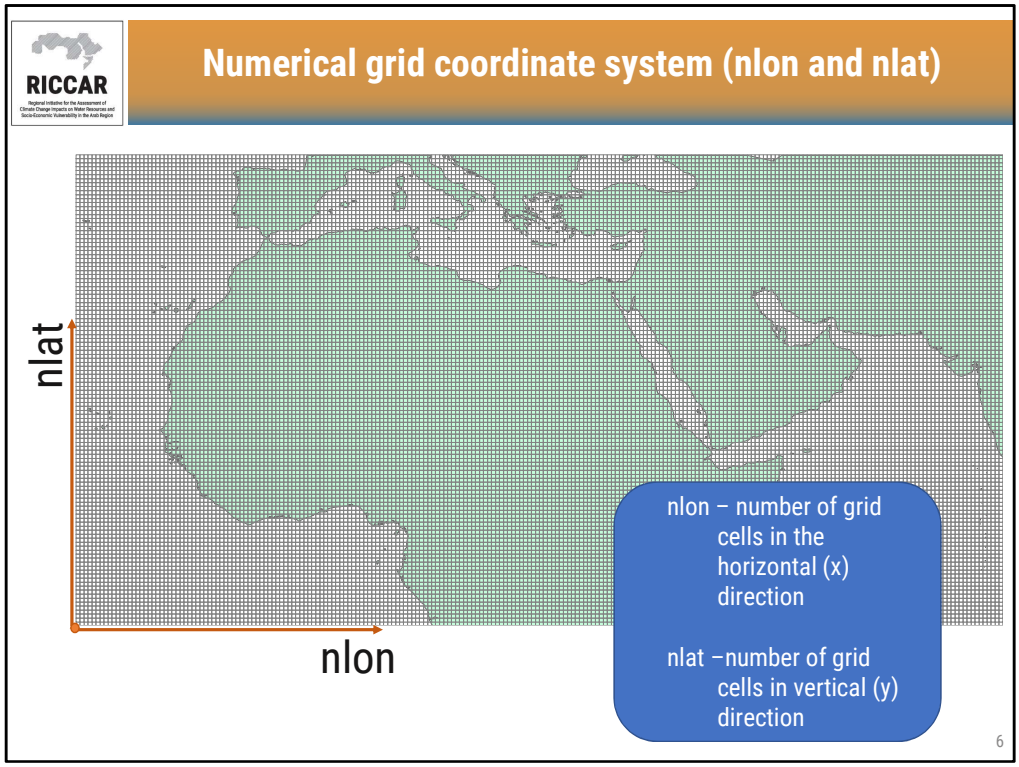
3



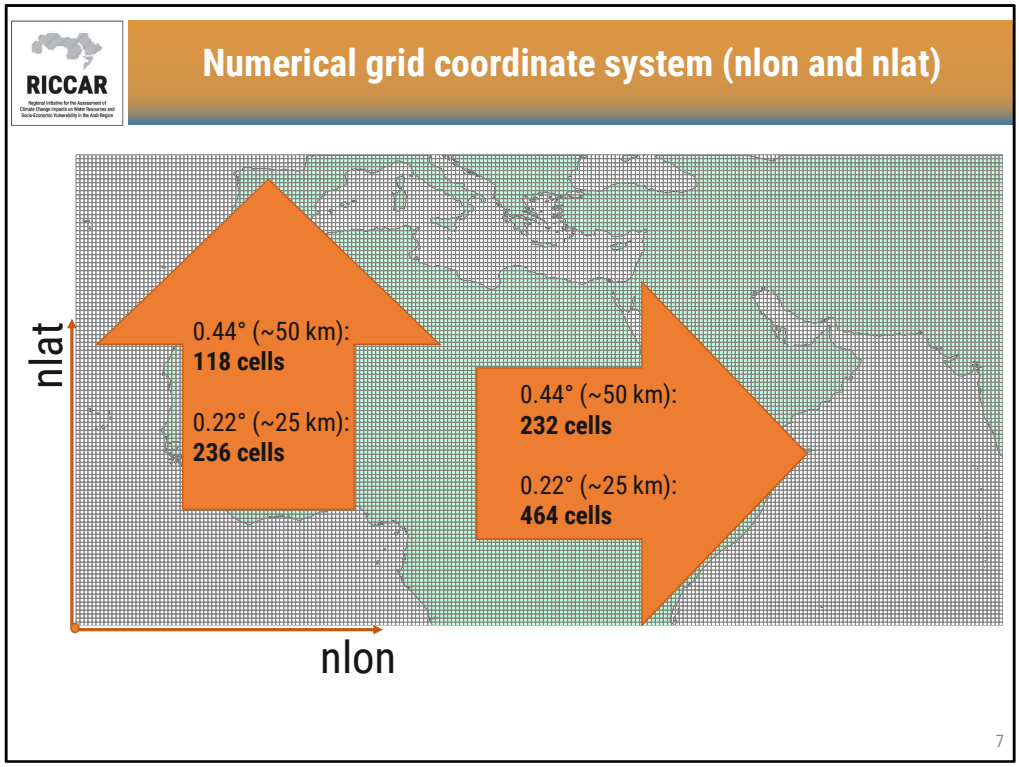
- Information included in this module is detailed in this training manual and relevant sections will be referenced.
- Manual is currently being finalized and will be available online. We will let participants know when it becomes available. It will be available in both English and Arabic.



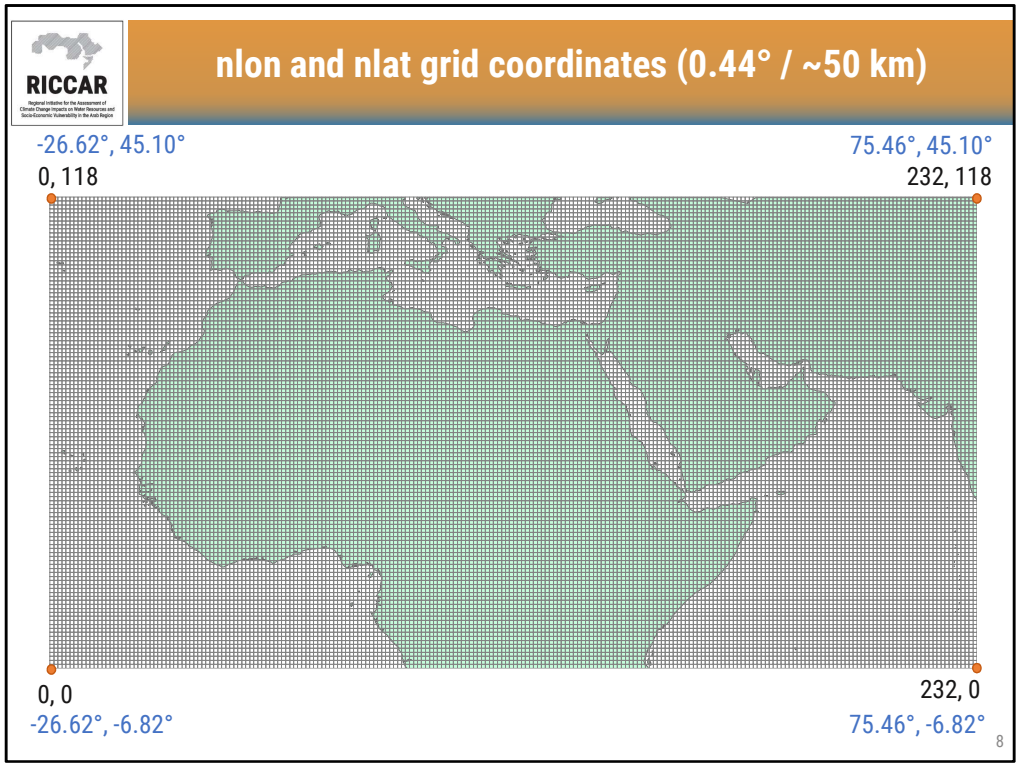
- Webinar 2 discussed the Make NetCDF Raster Layer Tool. When using this tool with the RICCAR NetCDF file, the X and Y dimensions were populated automatically with nlon and nlat. These were changed instead to lon (for longitude) and lat (for latitude) before creating the raster layer



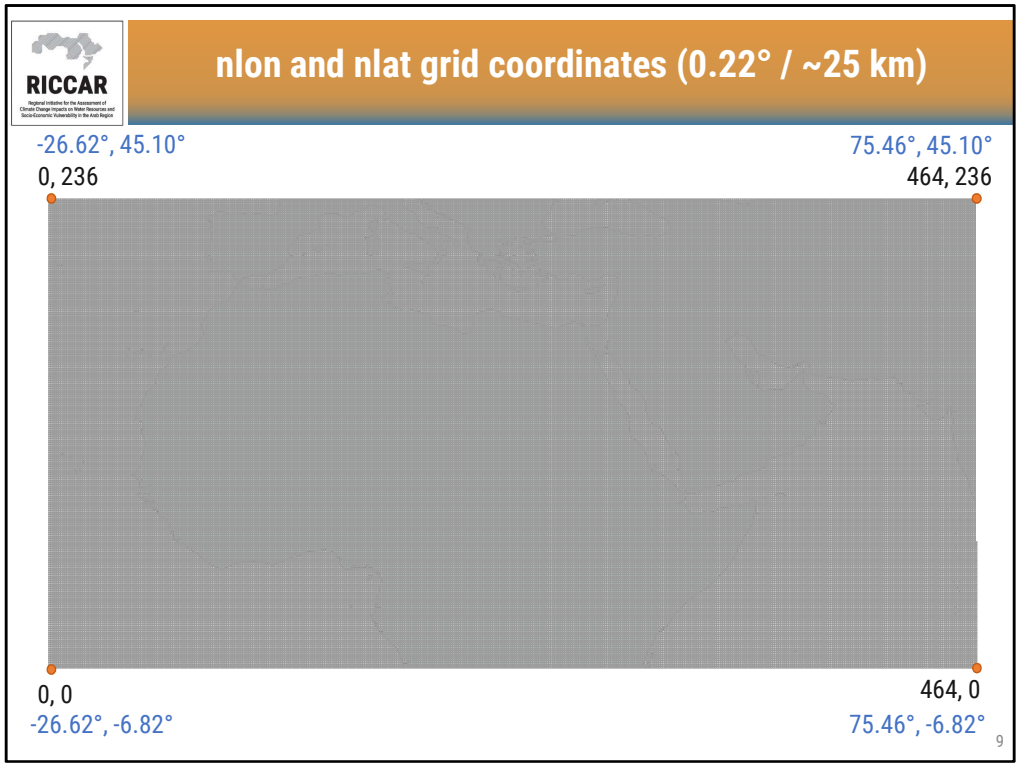
- nlon and nlat grid originates in bottom left corner of the domain
- RICCAR Training Manual on the Use of GIS to Analyse Climate Change Data Section 3.3.1



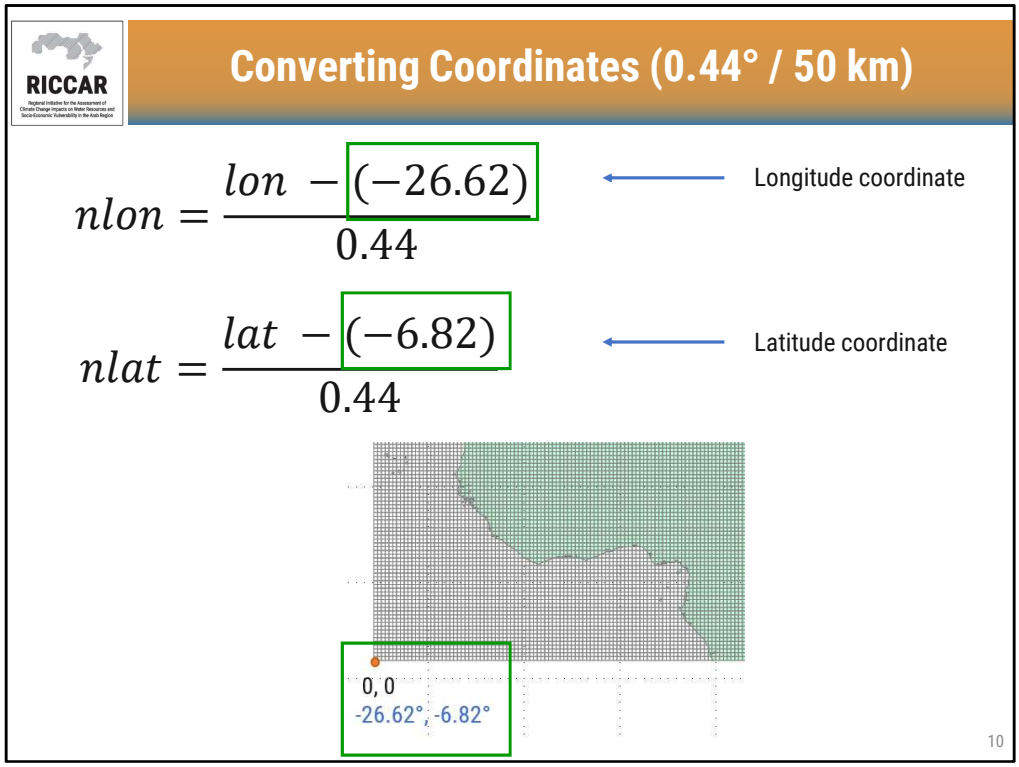
- In the vertical Y direction, there are 118 grid cells for the 0.44 deg (50 km) datasets and 236 grid cells for the 0.22 deg (25 km) datasets.
- In the horizontal X direction, there are 232 grid cells for the 0.44 deg (50 km) datasets and 464 grid cells for the 0.22 deg (25 km) datasets.



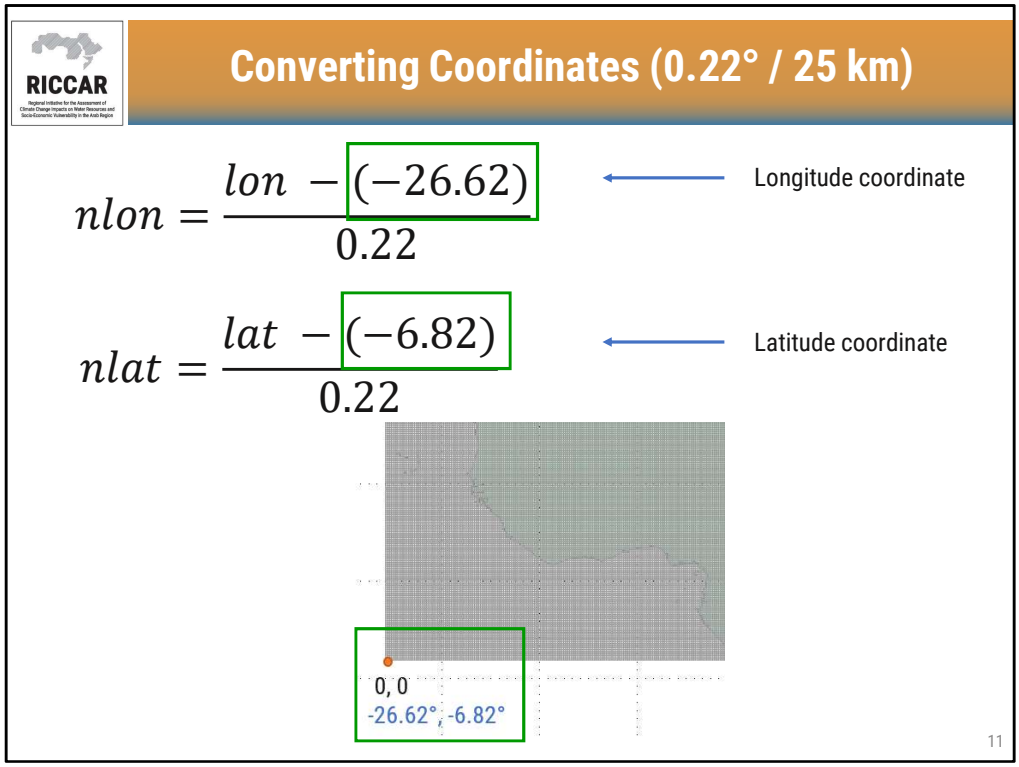
- Values in black are nlon and nlat coordinates at each corner of the 0.44 degrees/50 km domain
- Values in blue are the conventional longitude and latitude coordinates at each corner



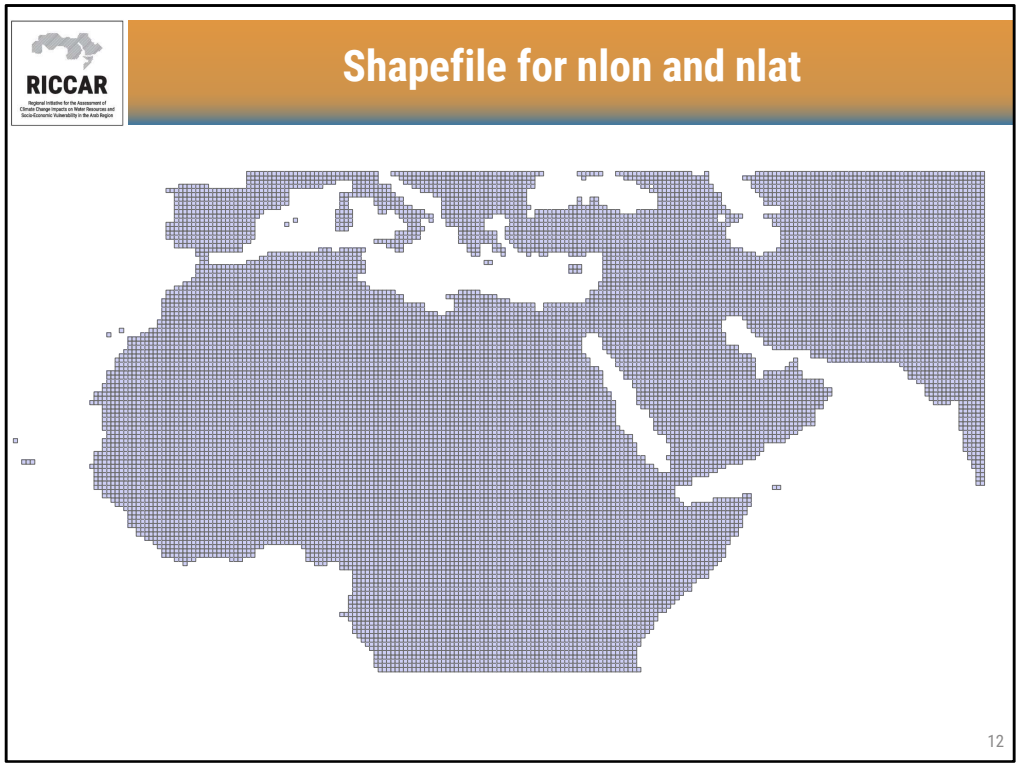
- Values in black are nlon and nlat coordinates at each corner of the 0.22 degrees/25 km domain
- Values in blue are the conventional longitude and latitude coordinates at each corner



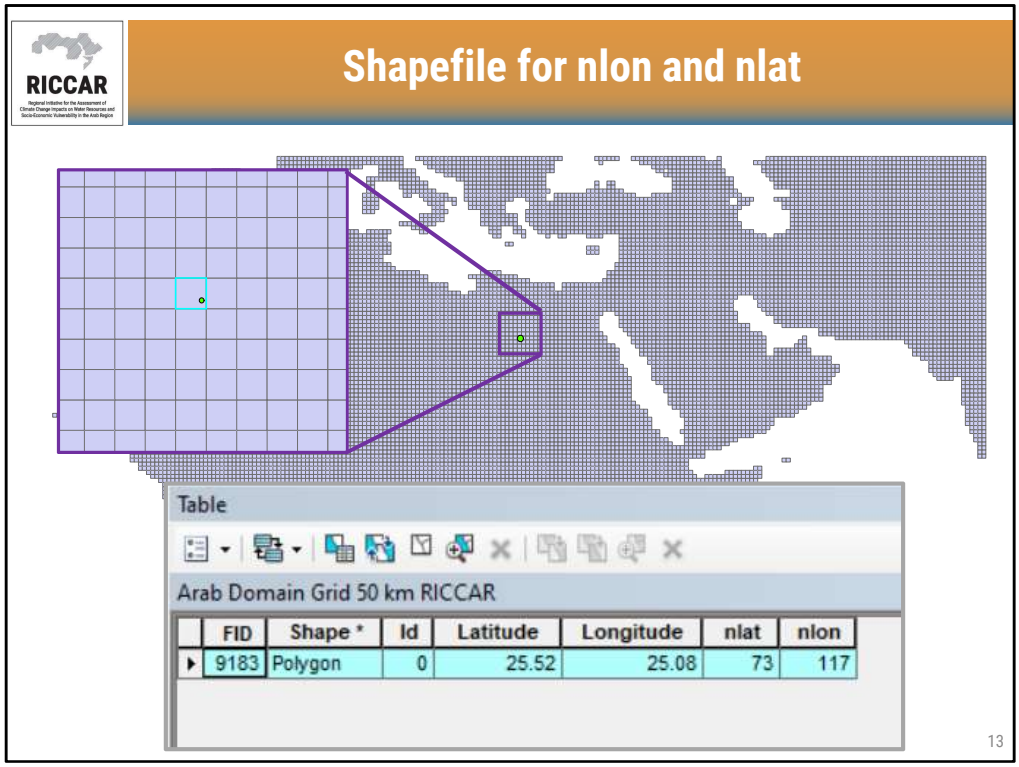
- Conventional longitude and latitude coordinates can be converted to nlon and nlat using an equation based on the grid size.
- Note that nlon and nlat coordinates must be positive integer values.



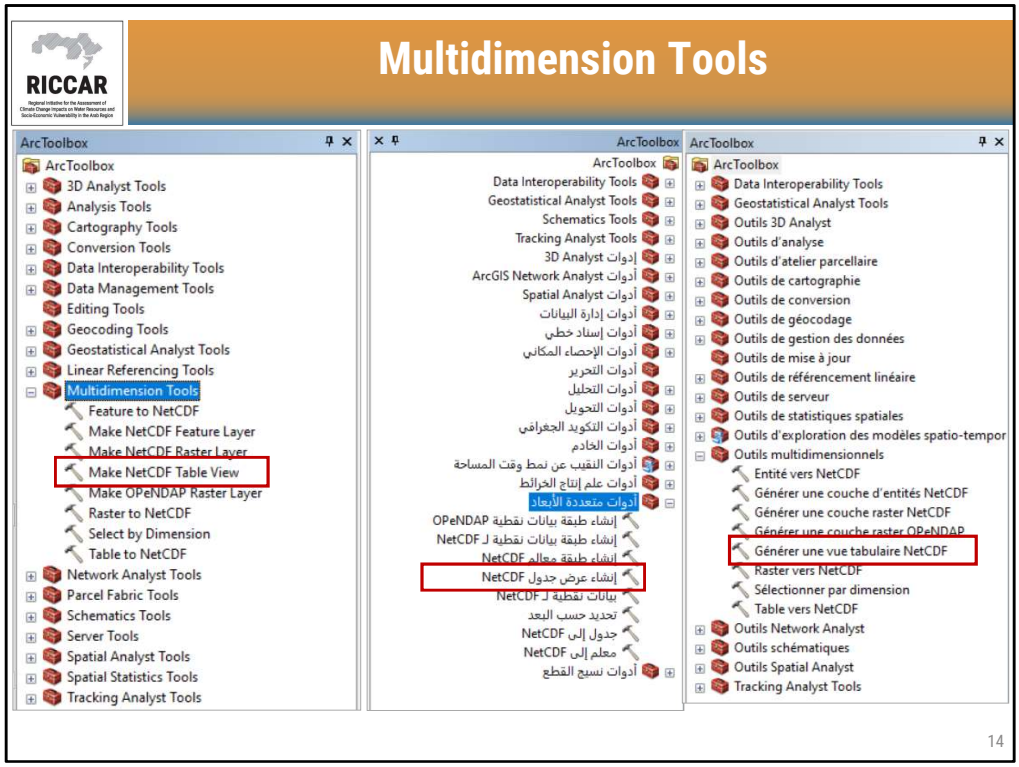
- Conventional longitude and latitude coordinates can be converted to nlon and nlat using an equation based on the grid size.
- Note that nlon and nlat coordinates must be positive integer values.



- Using the equations to convert does not always work due to rounding values, particularly for coordinates that may be located near the edge of grid pixel.
- Shapefile to compare longitude and latitude to nlon and nlat is available from the data files for this module or on request



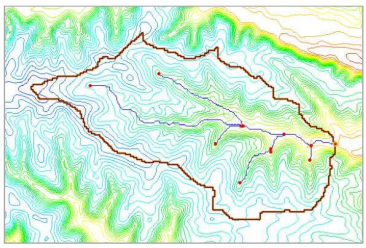
- For example to determine nlon and nlat for a point location
- For this point, the nlat and nlon coordinates are 73 and 117, respectively from the shapefile attributes table
- The latitude and longitude coordinates shown in the attributes table represent the grid cell centroid

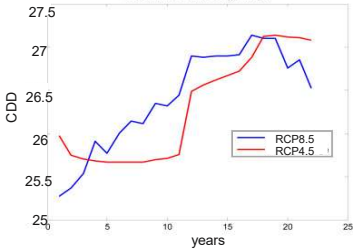


- nlat and nlon will be used to Make NetCDF Table View

Reasons for using Make NetCDF Table View

- Create time series data based on point location
  - Useful for modelling inputs (i.e. hydrological models)
  - Analyse projected trends based on the RCM outputs

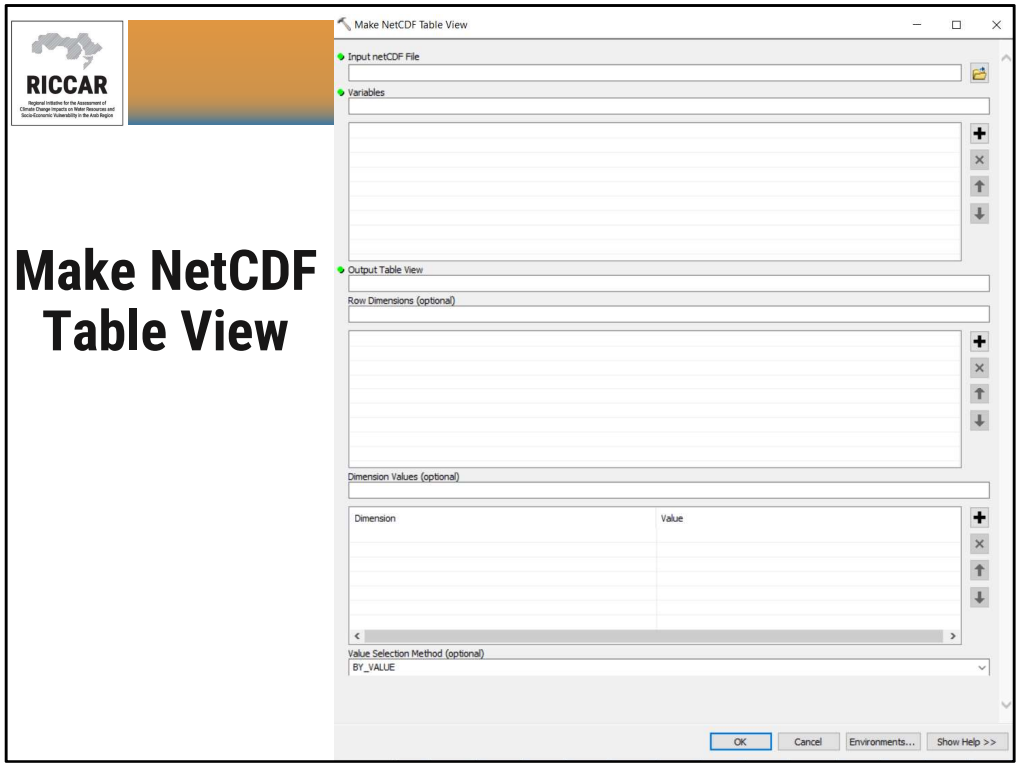




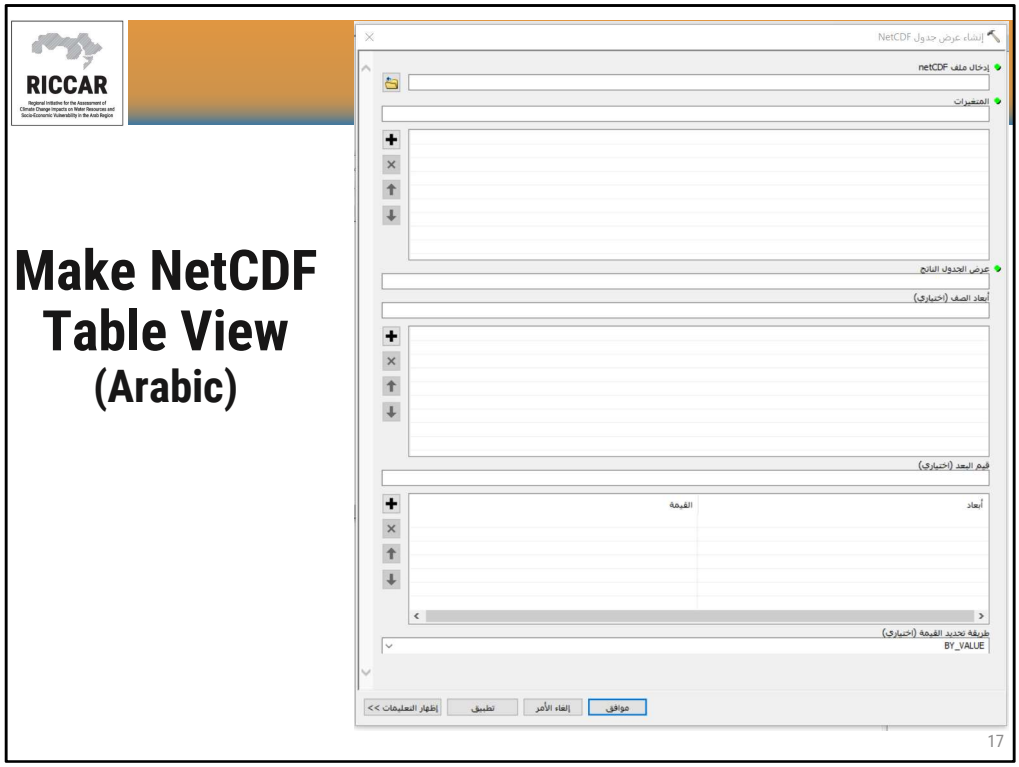
Note that ArcMap GIS is limited to creating tables for one point location at a time

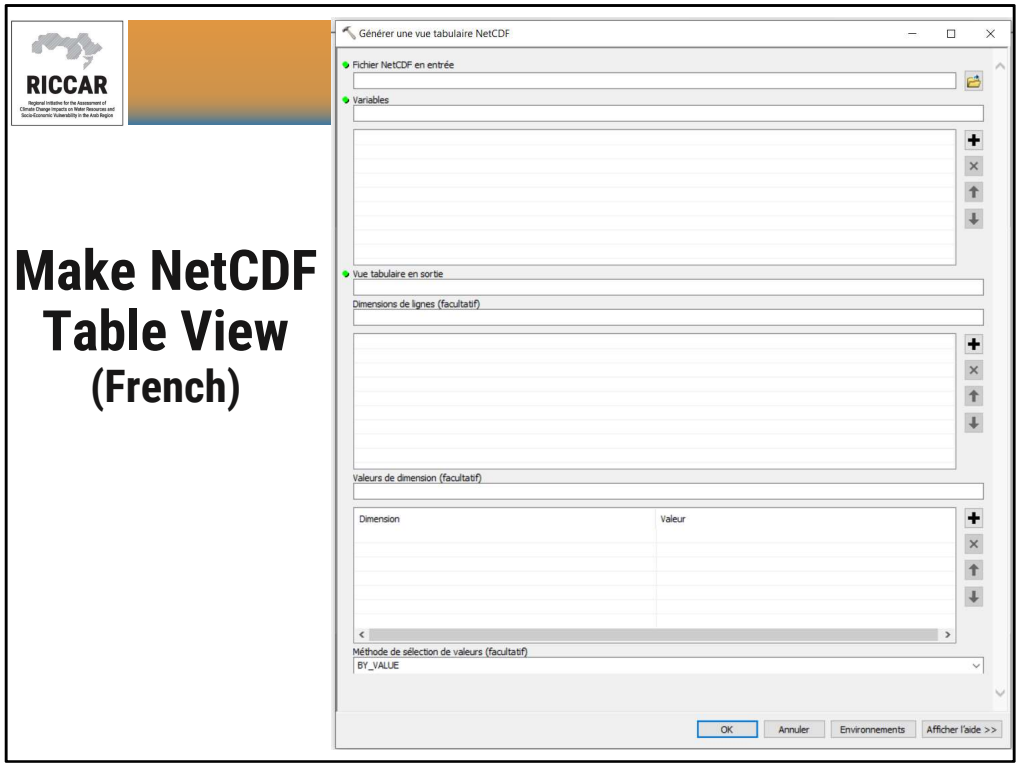
Time series analysis for an entire area (polygon) must be done for each individual grid cell and results averaged

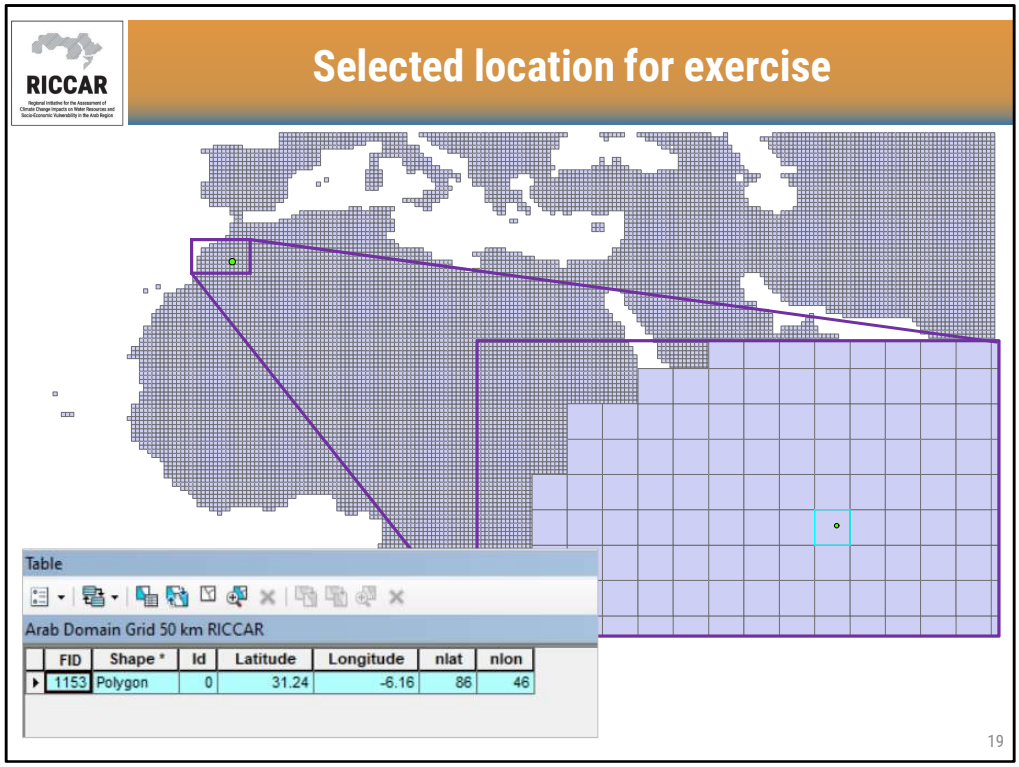
15



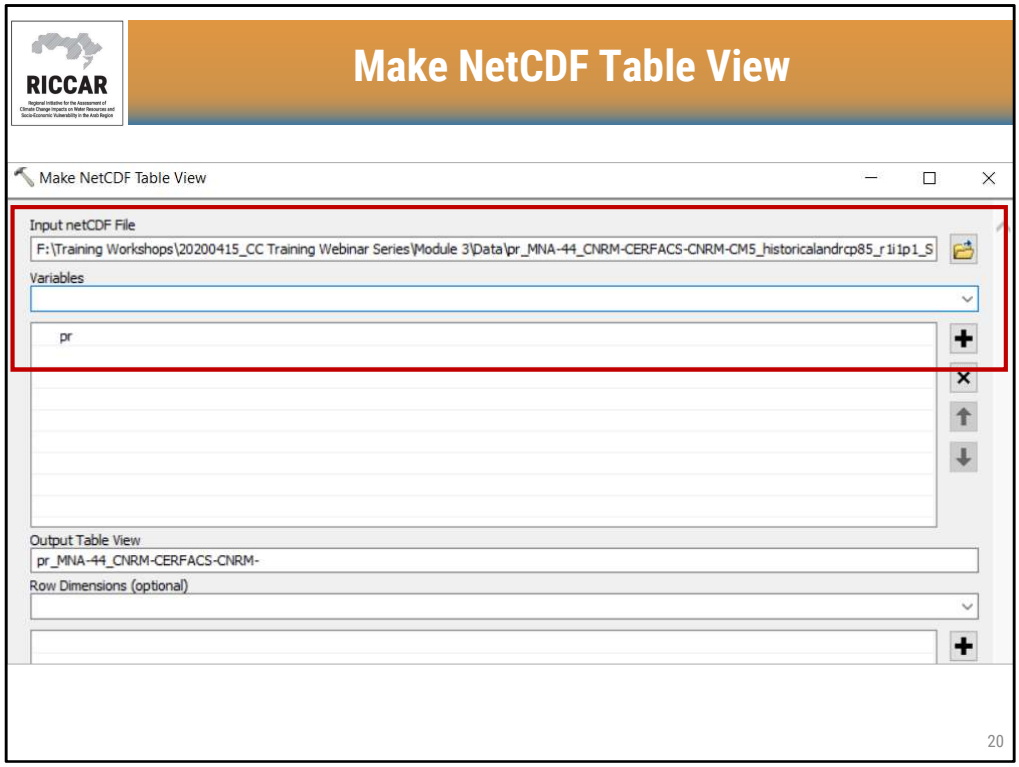
- RICCAR Training Manual on the Use of GIS to Analyse Climate Change Data Section 3.3.2


RICCAR
Make NetCDF Table View (Arabic)
إنشاء عرض جدول NetCDF
إدخال ملف netCDF
المتغيرات
عرض الجدول الناتج
أبعاد الصف (اختياري)
قيم البعد (اختياري)
أبعاد
القيمة
طريقة تحديد القيمة (اختياري)
BY_VALUE
إظهار التعليمات >>
تطبيق
إلغاء الأمر
موافق
17

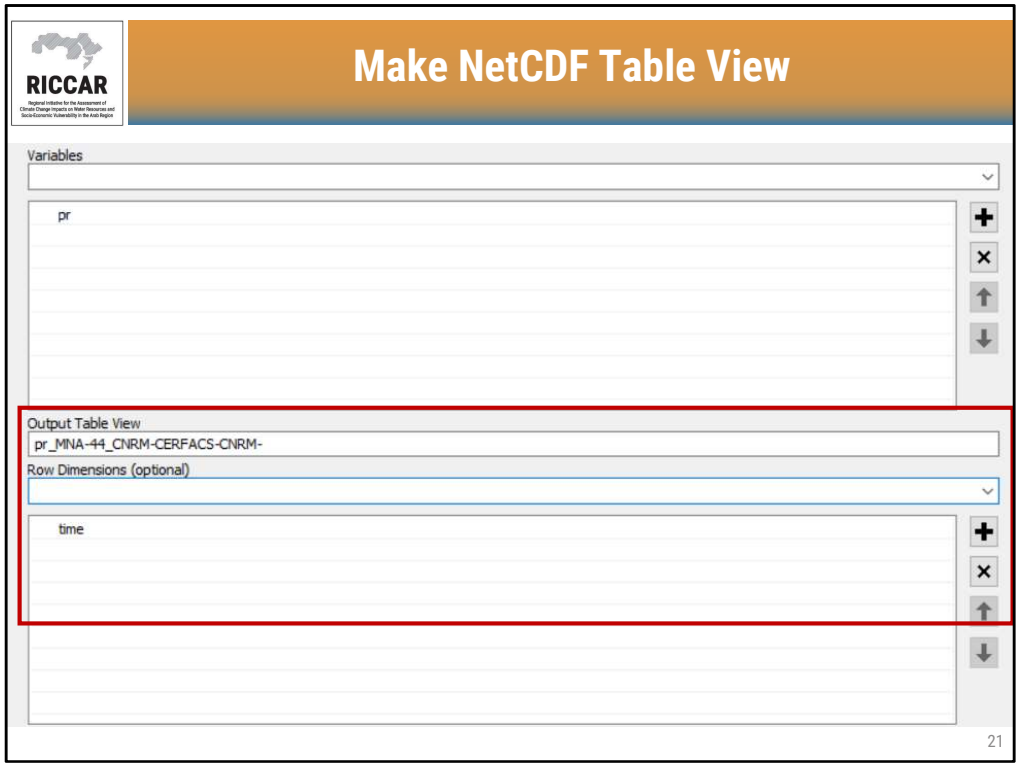

RICCAR
Make NetCDF Table View
(French)
Générer une vue tabulaire NetCDF
Fichier NetCDF en entrée
Variables
Vue tabulaire en sortie
Dimensions de lignes (facultatif)
Valeurs de dimension (facultatif)
Dimension
Valeur
Méthode de sélection de valeurs (facultatif)
BY_VALUE
OK
Annuler
Environnements
Afficher l'aide >>



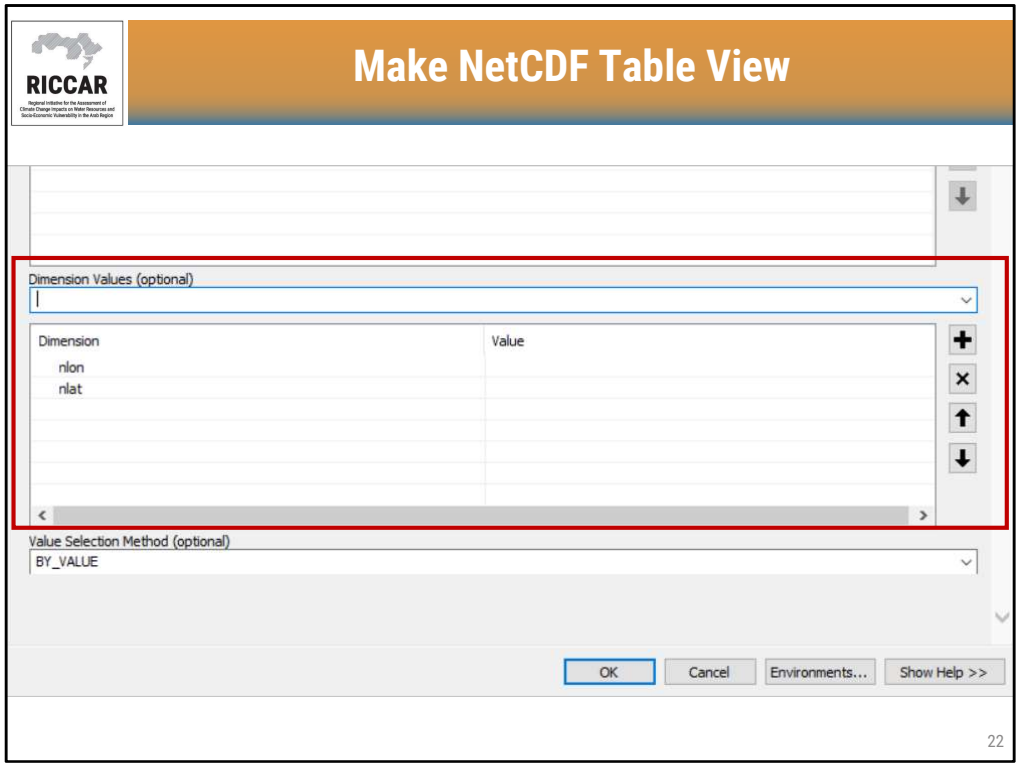
- Marked location has an nlat coordinate of 86 and an nlon coordinate of 46



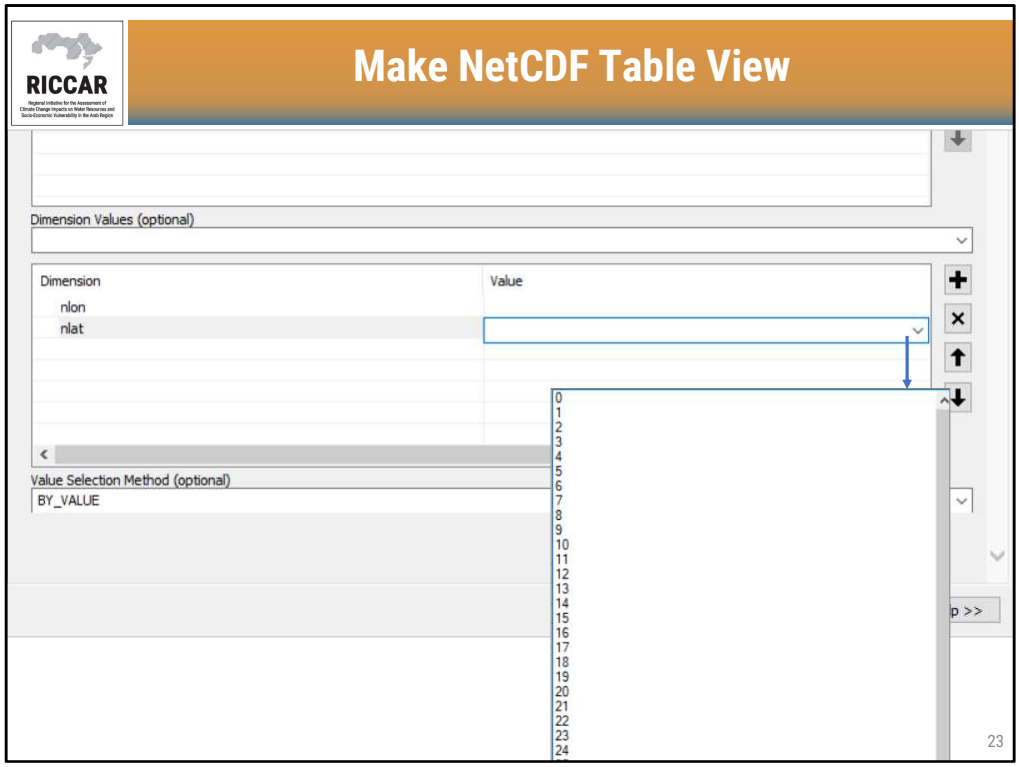
- Select the NetCDF file and choose the appropriate variable (pr for precipitation), similar to the Make NetCDF Raster Layer tool discussed during webinar module 2. The example uses the 2046 NetCDF file (same as for Module 2).
- More than one variable can be selected. (Not applicable for RICCAR and most other climate datasets.)



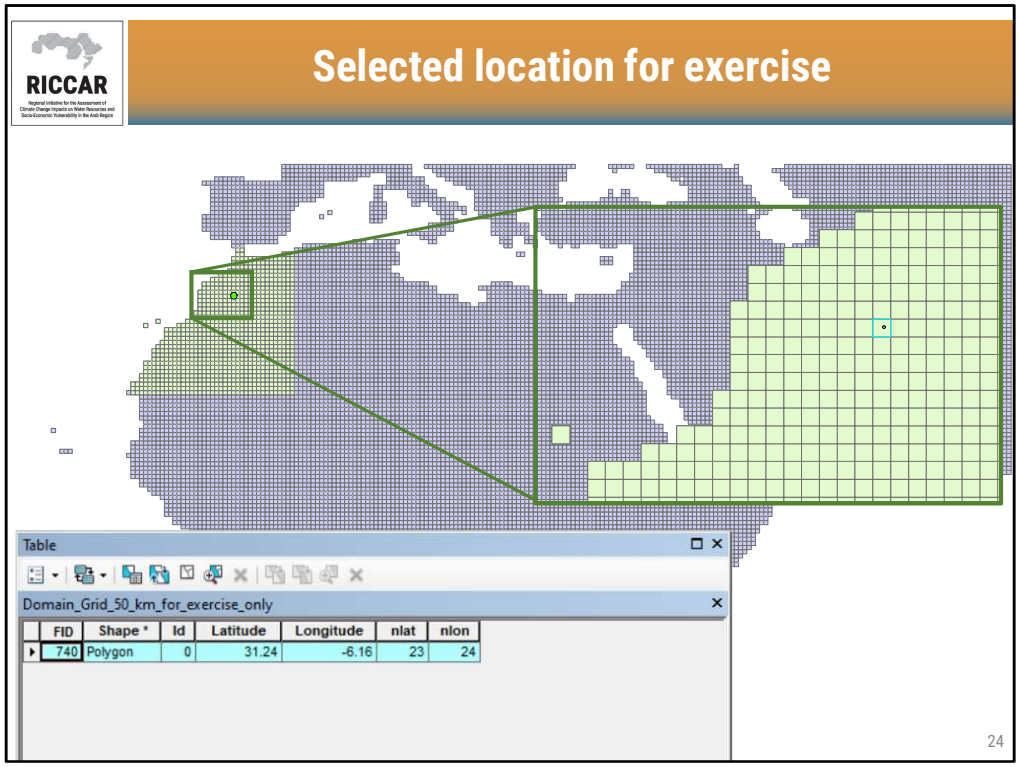
- For the Output Table View, either leave the default name (as shown here) or this can be user defined.
- Row dimensions are selected using the drop down arrow. Time should be selected. More than one row dimension can be added (not applicable for RICCAR and most other climate datasets).



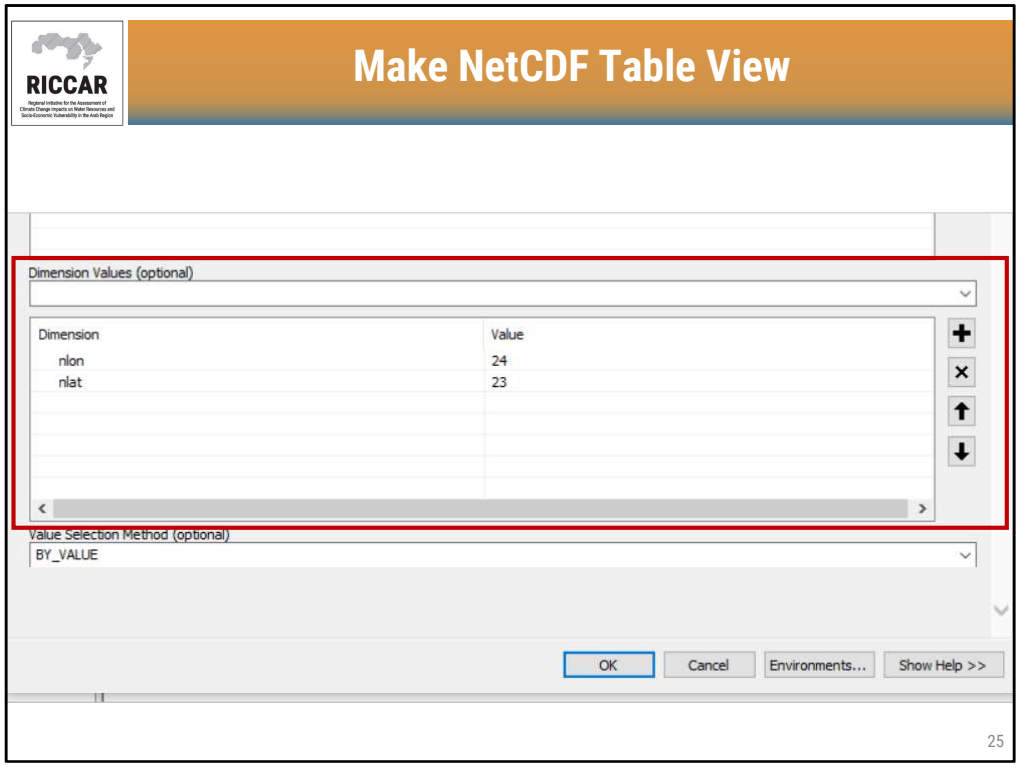
- For the dimension values enter nlon and nlat. For RICCAR data 0.44 deg/50 km, lon (for longtitude) and lat (for latitude) will not be an option.

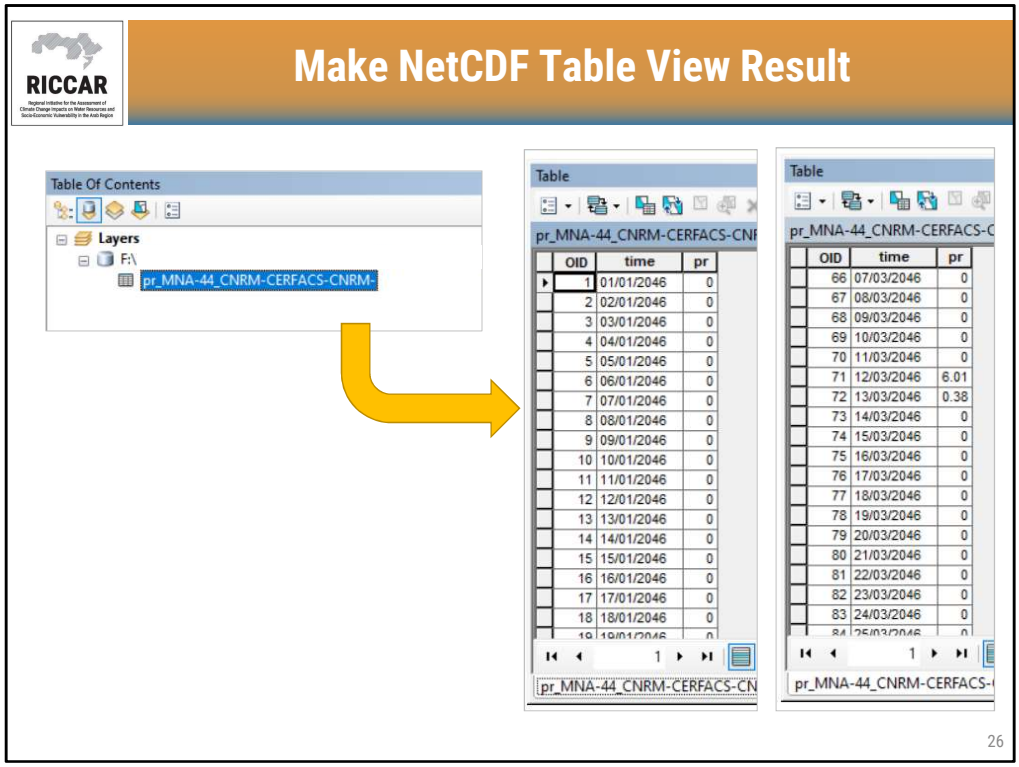


- Recommended to enter nlon and nlat values via the dropdown box.



- Note that because the NetCDF file provided for the exercise is an extracted NetCDF, the nlon and nlat coordinate system reset based on the bottom left corner of the extracted dataset.
- Instead of entering 46 for nlon and 86 for nlat (coordinates based on entire Arab domain as shown on slide 19), the revised coordinates are 24 (nlon) and 23 (nlat).
- Shapefile for the extracted NetCDF grid is named Domain_Grid_50_km_for_exercise_only

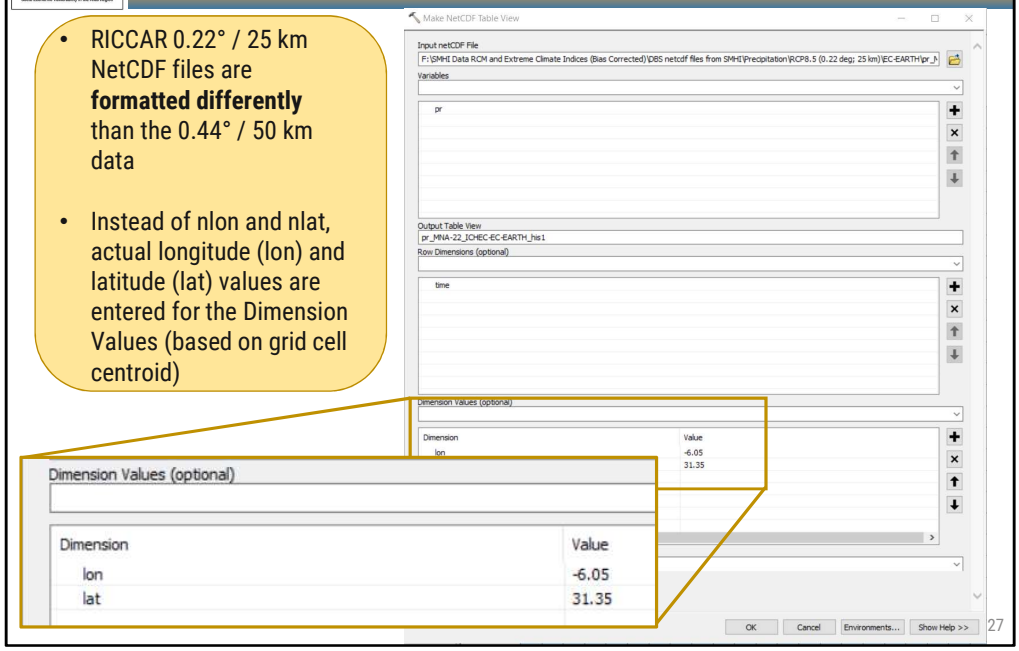

RICCAR
Make NetCDF Table View
Dimension Values (optional)
Dimension
Value
nlon
24
nlat
23
Value Selection Method (optional)
BY_VALUE
OK
Cancel
Environments...
Show Help >>
25



- Resultant table of NetCDF values found in Table of Contents
- Table of values represent precipitation (pr) for each time slice in the NetCDF file with values of mm/day
- Non-zero values can be found by scrolling table of values

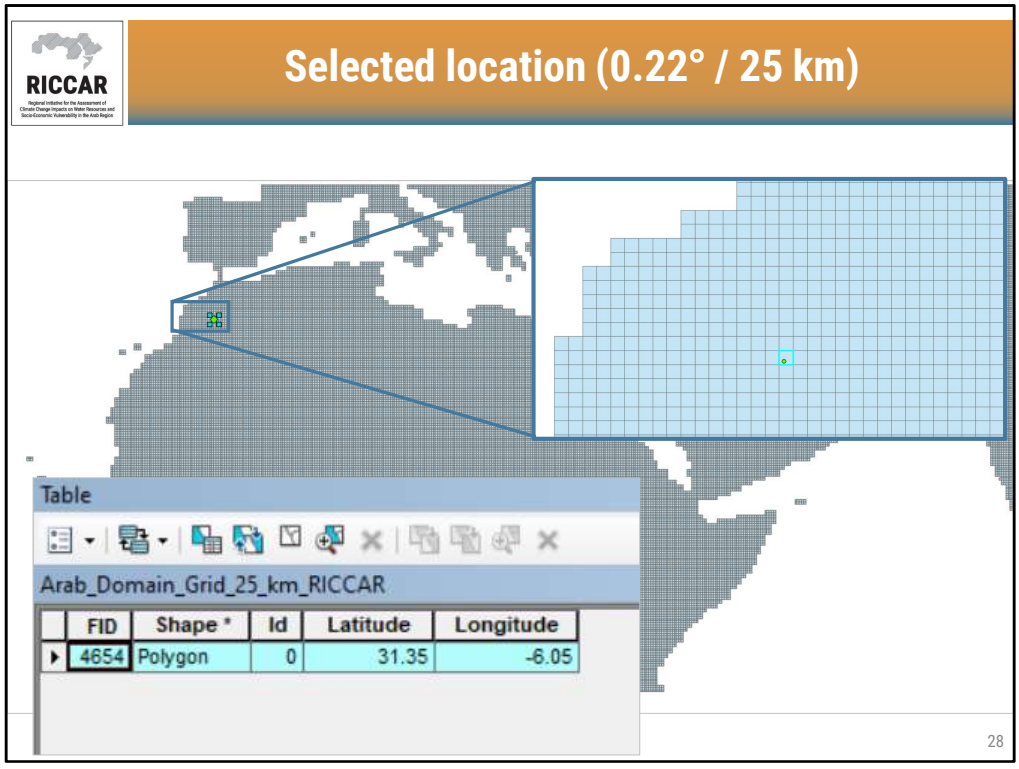
Make NetCDF Table View (0.22° / 25 km data)

- RICCAR 0.22° / 25 km NetCDF files are **formatted differently** than the 0.44° / 50 km data
- Instead of nlon and nlat, actual longitude (lon) and latitude (lat) values are entered for the Dimension Values (based on grid cell centroid)

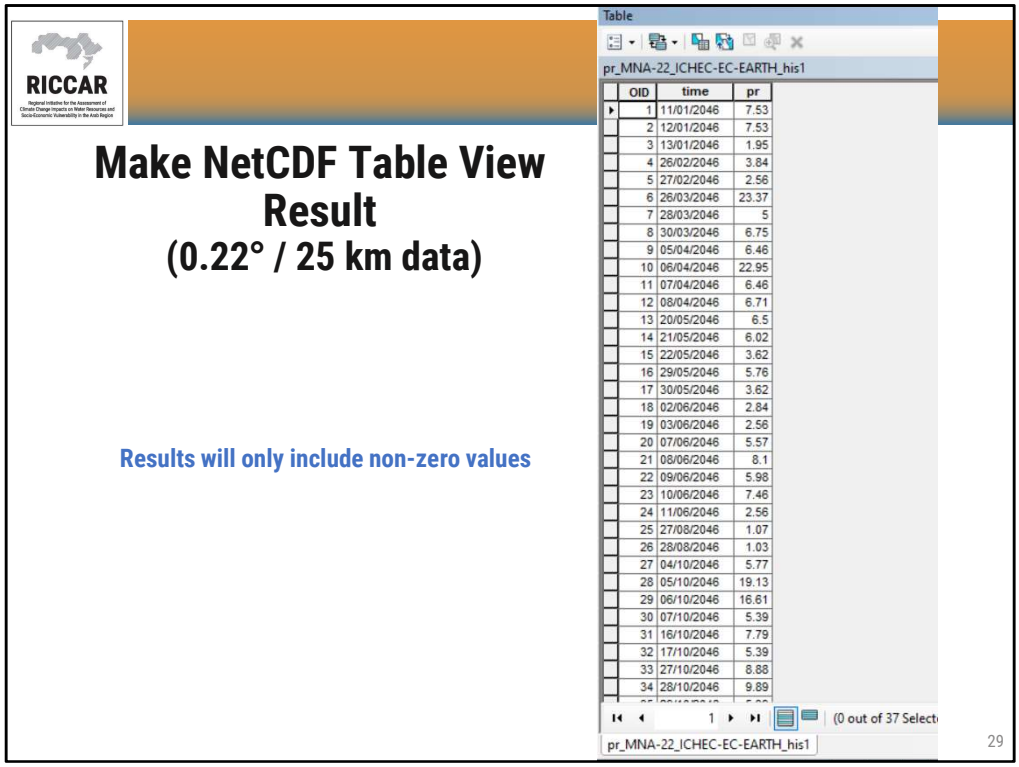


Dimension Values (optional)
Dimension
Value
lon
-6.05
lat
31.35

27



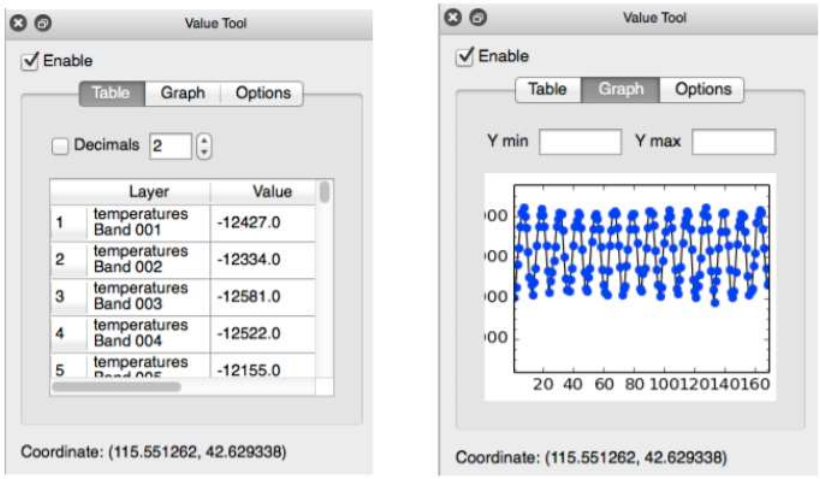
- Locating grid cell and corresponding longitude and latitude coordinates of the cell centroid



- Users must manually enter zero values (assumed to be on days not listed such as 1/1/2046)
- Entering zero values manually only applicable for precipitation as temperature data will always be > 0

Make NetCDF Table View in QGIS

- Must use a plugin (either Value tool or gdal2xyz tool)
- Load NetCDF dataset (Layer > Add Raster Layer)

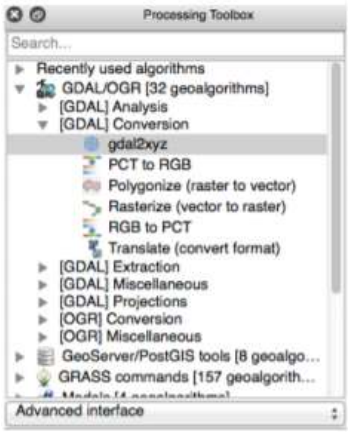


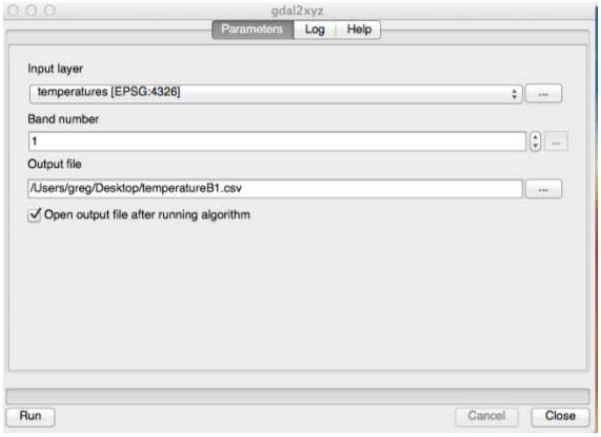
http://www.ggiuliani.ch/download/netcdf_qgis_GG.pdf 30

- Value tool plug-in displayed which is a docket widget that allows to explore NetCDF raster layers as tables or graphs
- Select location by clicking on raster layer and coordinate will be shown at bottom

Make NetCDF Table View in QGIS

- Must use a plugin (either Value tool or gdal2xyz tool)
- Add tool available in Processing > Toolbox < under GDAL/OGR > [GDAL] Conversions



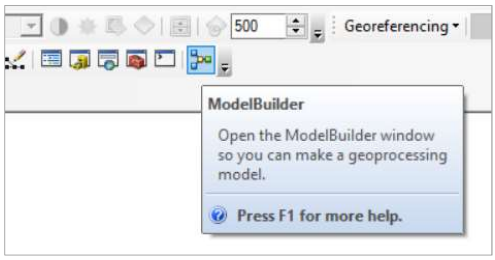


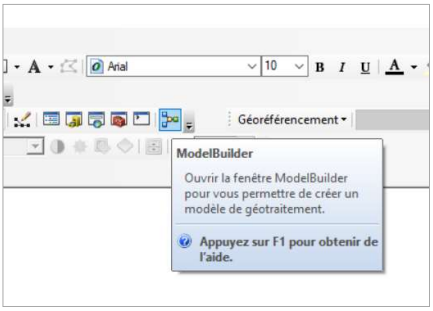
http://www.ggiuliani.ch/download/netcdf_qgis_GG.pdf

31

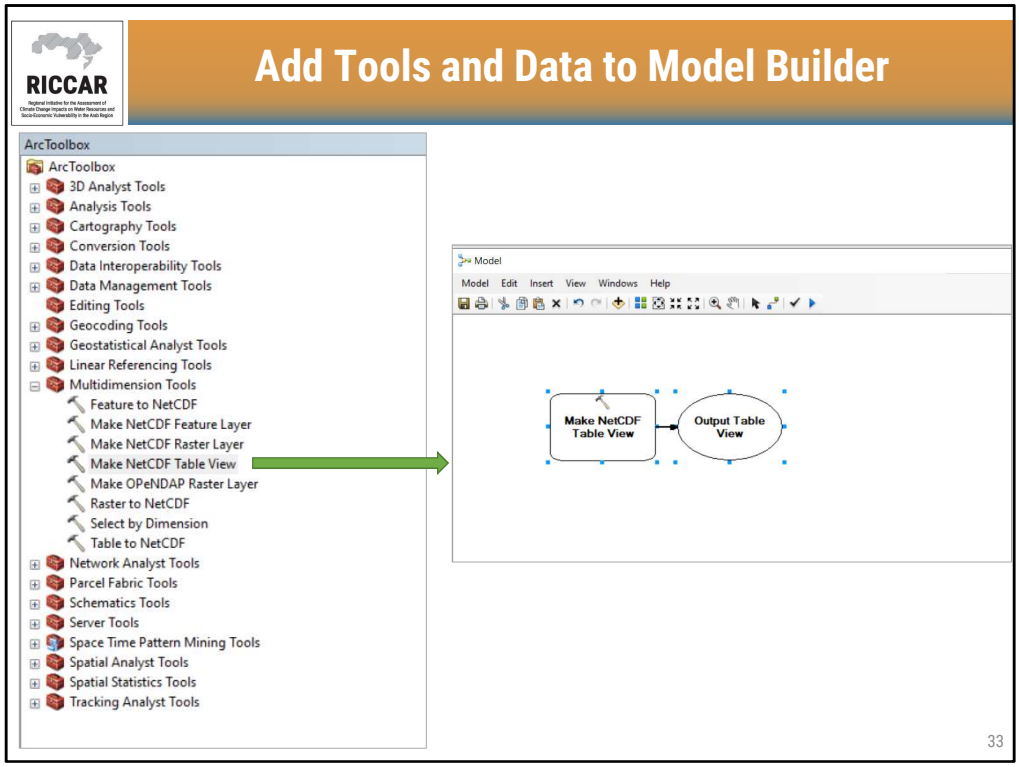
- Gdal2xyz tool
- Select a time slice and give name to Output file (in .csv format) and click run.
- Each line of the resultant .csv will include the XY coordinate and corresponding variable

Use Model Builder to Create Time Series

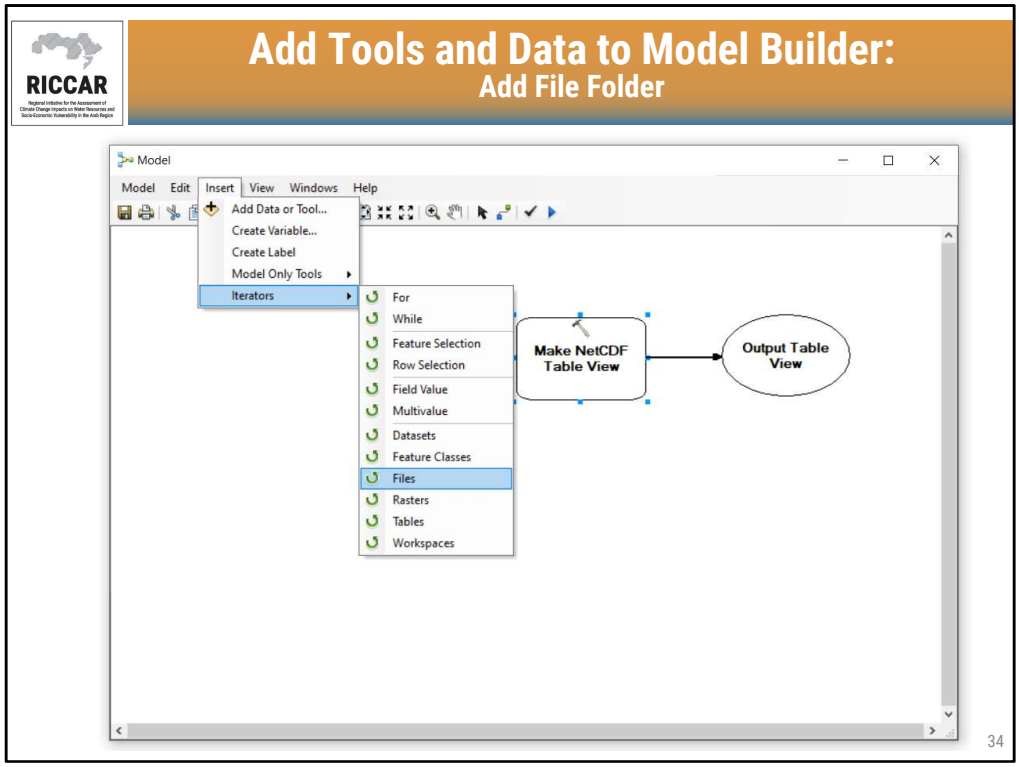




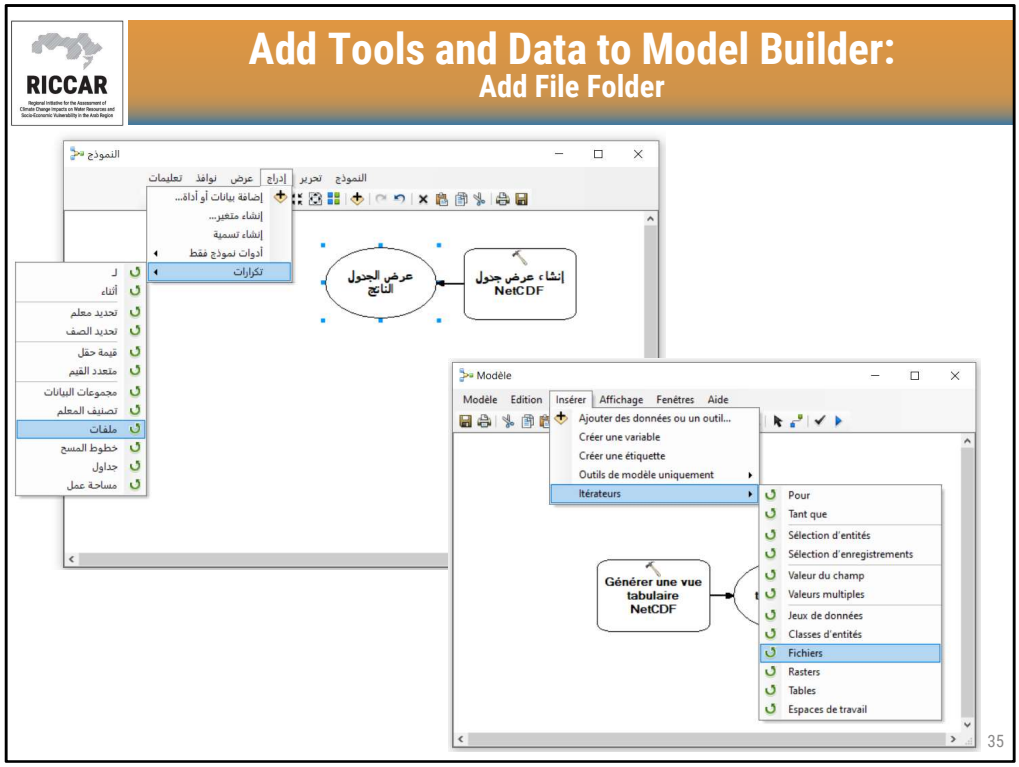
32

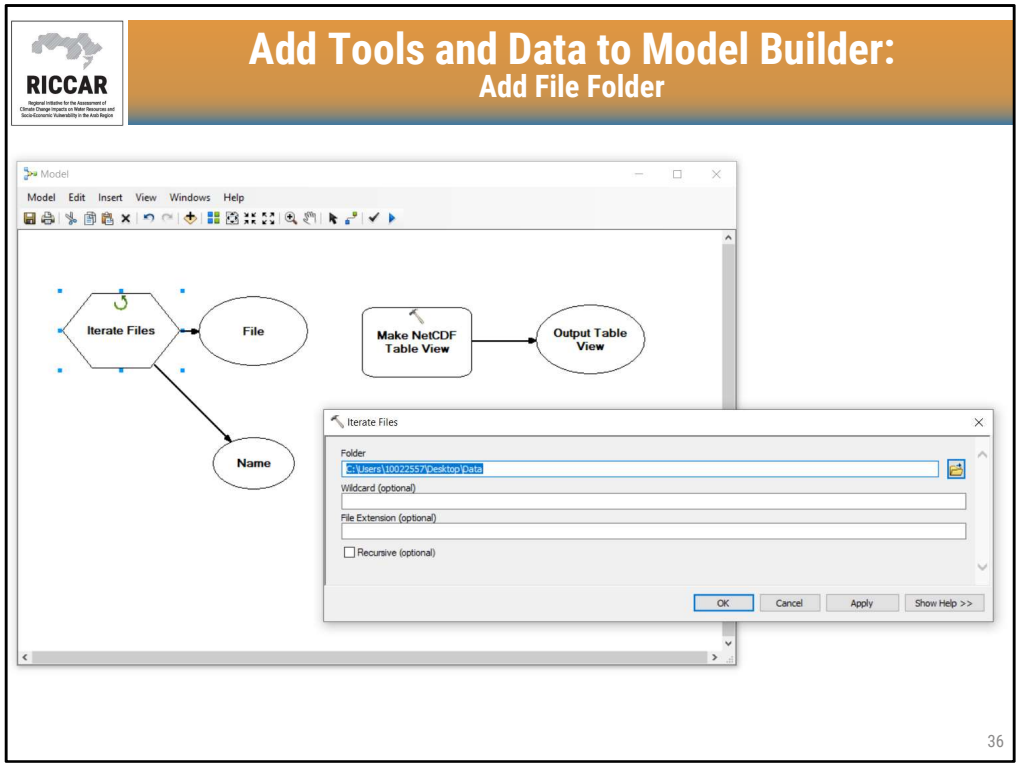


- Tools are added by dragging from the ArcToolbox to the Model Builder workspace
- RICCAR Training Manual on the Use of GIS to Analyse Climate Change Data Section 3.3.3

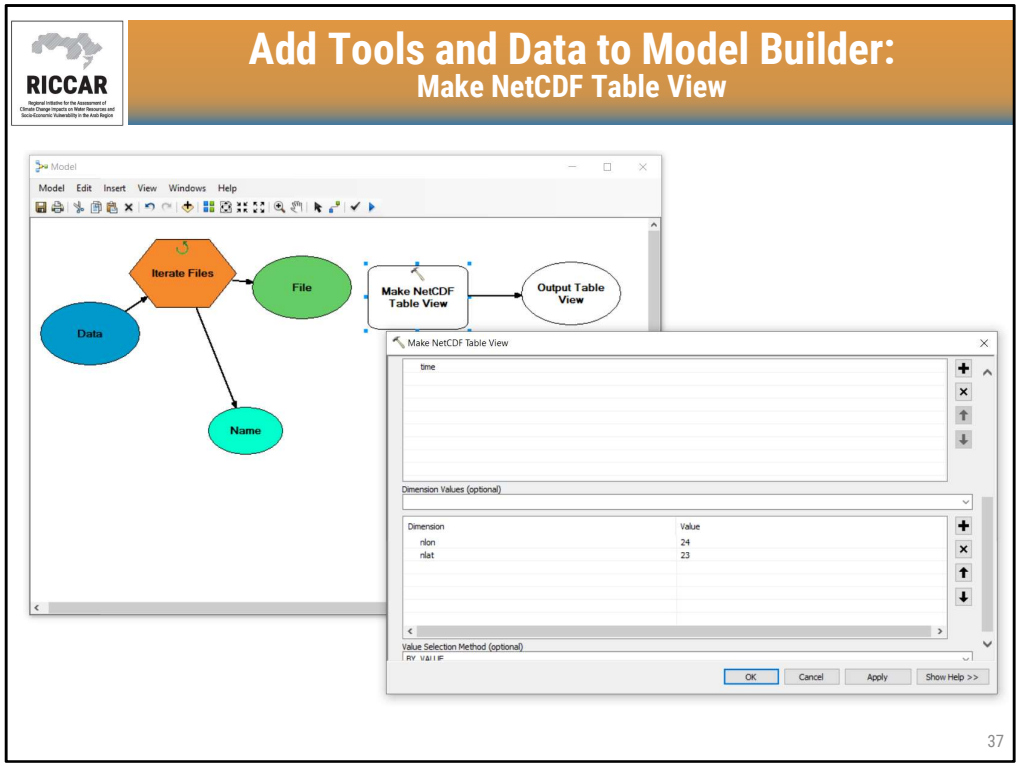


- Choose the NetCDF files by selecting Iterators > Files
- All of the NetCDF files should be in a single folder. It is recommended the folder be placed on the computer Desktop to keep the full file name as short as possible.

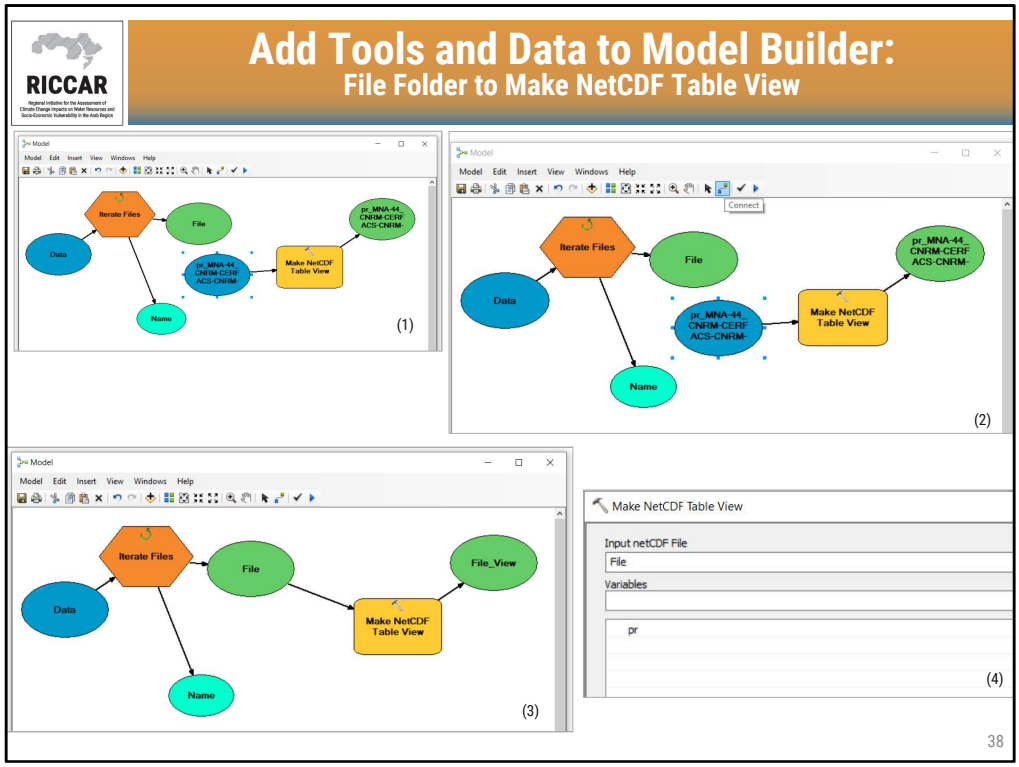

RICCAR
Add Tools and Data to Model Builder:
Add File Folder
النموذج
تعليمات
نوافذ
عرض
إدراج
تحرير
النموذج
إضافة بيانات أو أداة...
إنشاء متغير...
إنشاء تسمية
أدوات نموذج فقط
تكرارات
عرض الجدول الناتج
إنشاء عرض جدول NetCDF
تحديد معلم
تحديد الصف
قيمة حقل
متعدد القيم
مجموعات البيانات
تصنيف المعلم
ملفات
خطوط المسح
جداول
مساحة عمل
Modèle
Modèle
Edition
Insérer
Affichage
Fenêtres
Aide
Ajouter des données ou un outil...
Créer une variable
Créer une étiquette
Outils de modèle uniquement
Itérateurs
Pour
Tant que
Sélection d'entités
Sélection d'enregistrements
Valeur du champ
Valeurs multiples
Jeux de données
Classes d'entités
Fichiers
Rasters
Tables
Espaces de travail
Générer une vue tabulaire NetCDF
35



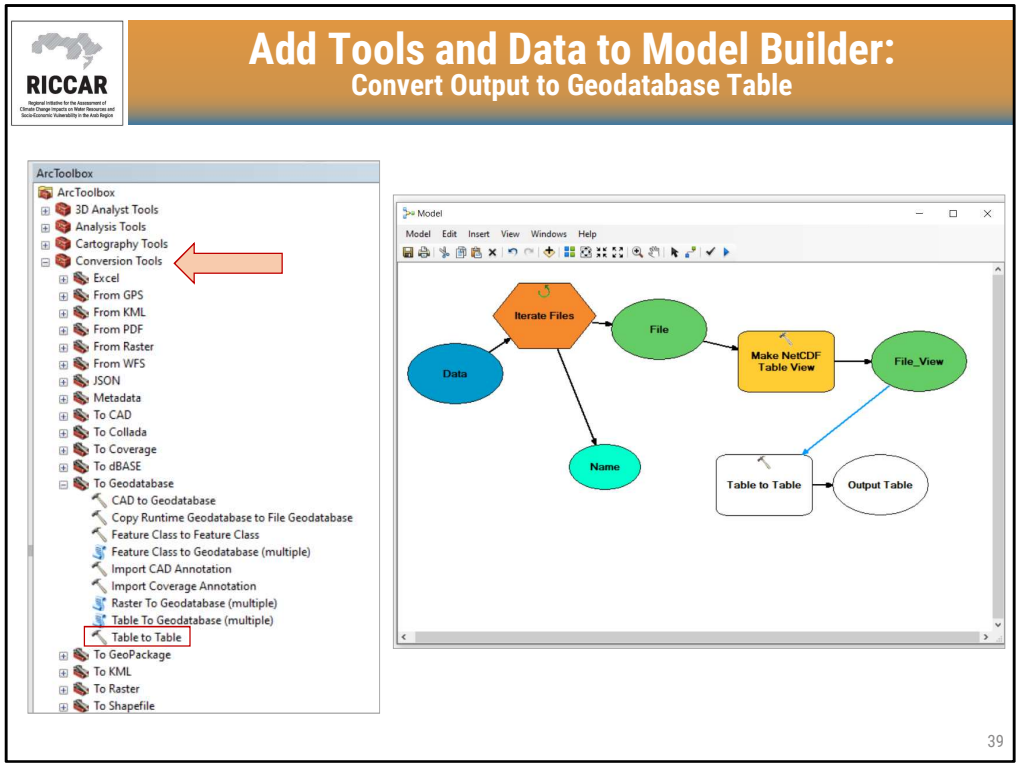
- Double click on the Iterate Files hexagon in the Model Builder workspace and select the entire **folder** using the dropdown box where the NetCDF files are saved
- After pressing OK when completed, the Iterate Files hexagon and data, file, and name ovals will automatically colorize



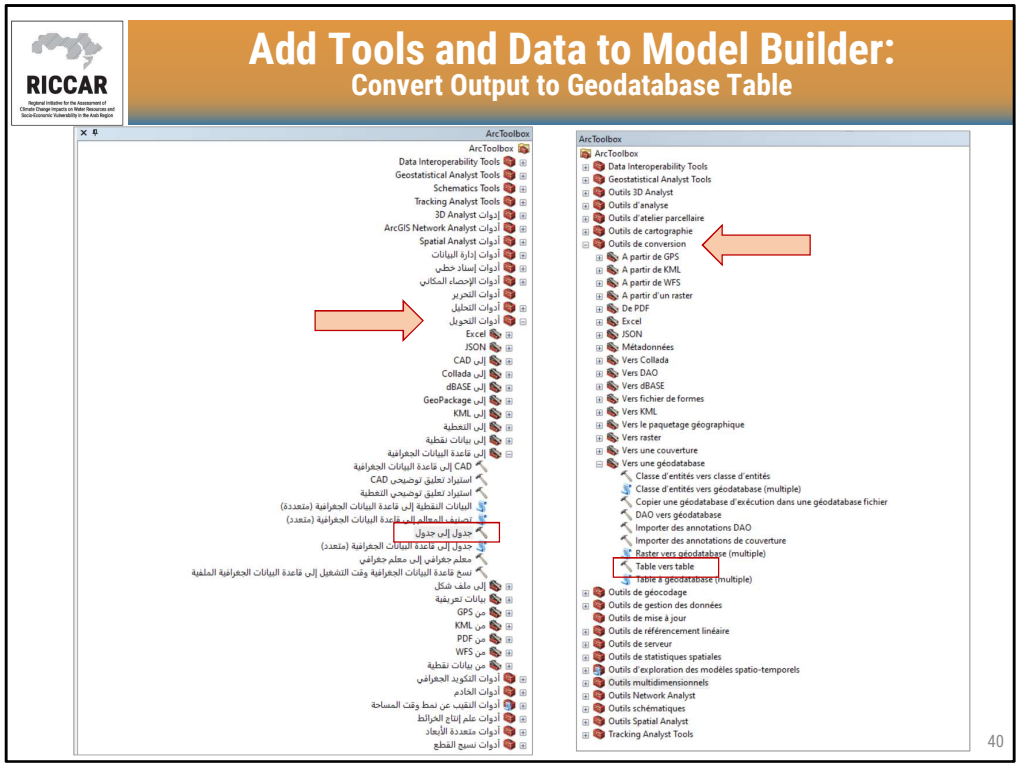
- Add information in the Make NetCDF Table View using **any** of NetCDF files in the file folder
- The selected location is the same as before (from slide 24) and is based on the Morocco extracted NetCDF files



- Rather than run the model based on the 1 NetCDF file used to populate the Make NetCDF Table View, select the File oval to perform the tool on all NetCDF files
- The result from the previous slide will be similar to (1)
- Use the connect tool to connect the File oval to the Make NetCDF Table View rectangle (2)
- The blue oval (in this example shows pr_MNA-44_CNRM-CERFACS-CNRM) will not longer be connected and instead the File oval will be connected to the Make NetCDF Table View rectangle (3). The blue oval can be deleted as it is no longer used.
- The Make NetCDF Table View tool will then shown the Input NetCDF file as File rather than the original NetCDF file name (4). The Variables, Row Dimensions, and Dimension Values populated by the single NetCDF file will remain the same.



- The output from the Make NetCDF Table View tool needs to be converted to a Geodatabase by adding the Table to Table tool found under Conversion Tools > To Geodatabase
- Connect the File_View oval to the Table to Table rectangle


RICCAR
Add Tools and Data to Model Builder:
Convert Output to Geodatabase Table
ArcToolbox
ArcToolbox
Data Interoperability Tools
Geostatistical Analyst Tools
Schematics Tools
Tracking Analyst Tools
3D Analyst إدوات
ArcGIS Network Analyst أدوات
Spatial Analyst أدوات
أدوات إدارة البيانات
أدوات إسناد خطي
أدوات الإحصاء المكاني
أدوات التحرير
أدوات التحليل
أدوات التحويل
Excel
JSON
CAD إلى
Collada إلى
dBASE إلى
GeoPackage إلى
KML إلى
إلى التغطية
إلى بيانات نقطية
إلى قاعدة البيانات الجغرافية
CAD إلى قاعدة البيانات الجغرافية
استيراد تعليق توضيحي CAD
استيراد تعليق توضيحي التغطية
البيانات النقطية إلى قاعدة البيانات الجغرافية (متعددة)
تصنيف المعالم إلى قاعدة البيانات الجغرافية (متعدد)
جدول إلى جدول
جدول إلى قاعدة البيانات الجغرافية (متعدد)
معلم جغرافي إلى معلم جغرافي
نسخ قاعدة البيانات الجغرافية وقت التشغيل إلى قاعدة البيانات الجغرافية الملفية
إلى ملف شكل
بيانات تعريفية
من GPS
من KML
من PDF
من WFS
من بيانات نقطية
أدوات التكويد الجغرافي
أدوات الخادم
أدوات التقيب عن نمط وقت المساحة
أدوات علم إنتاج الخرائط
أدوات متعددة الأبعاد
أدوات نسيج القطع
ArcToolbox
ArcToolbox
Data Interoperability Tools
Geostatistical Analyst Tools
Outils 3D Analyst
Outils d'analyse
Outils d'atelier parcellaire
Outils de cartographie
Outils de conversion
A partir de GPS
A partir de KML
A partir de WFS
A partir d'un raster
De PDF
Excel
JSON
Métadonnées
Vers Collada
Vers DAO
Vers dBASE
Vers fichier de formes
Vers KML
Vers le paquetage géographique
Vers raster
Vers une couverture
Vers une géodatabase
Classe d'entités vers classe d'entités
Classe d'entités vers géodatabase (multiple)
Copier une géodatabase d'exécution dans une géodatabase fichier
DAO vers géodatabase
Importer des annotations DAO
Importer des annotations de couverture
Raster vers géodatabase (multiple)
Table vers table
Table à géodatabase (multiple)
Outils de géocodage
Outils de gestion des données
Outils de mise à jour
Outils de référencement linéaire
Outils de serveur
Outils de statistiques spatiales
Outils d'exploration des modèles spatio-temporels
Outils multidimensionnels
Outils Network Analyst
Outils schématiques
Outils Spatial Analyst
Tracking Analyst Tools
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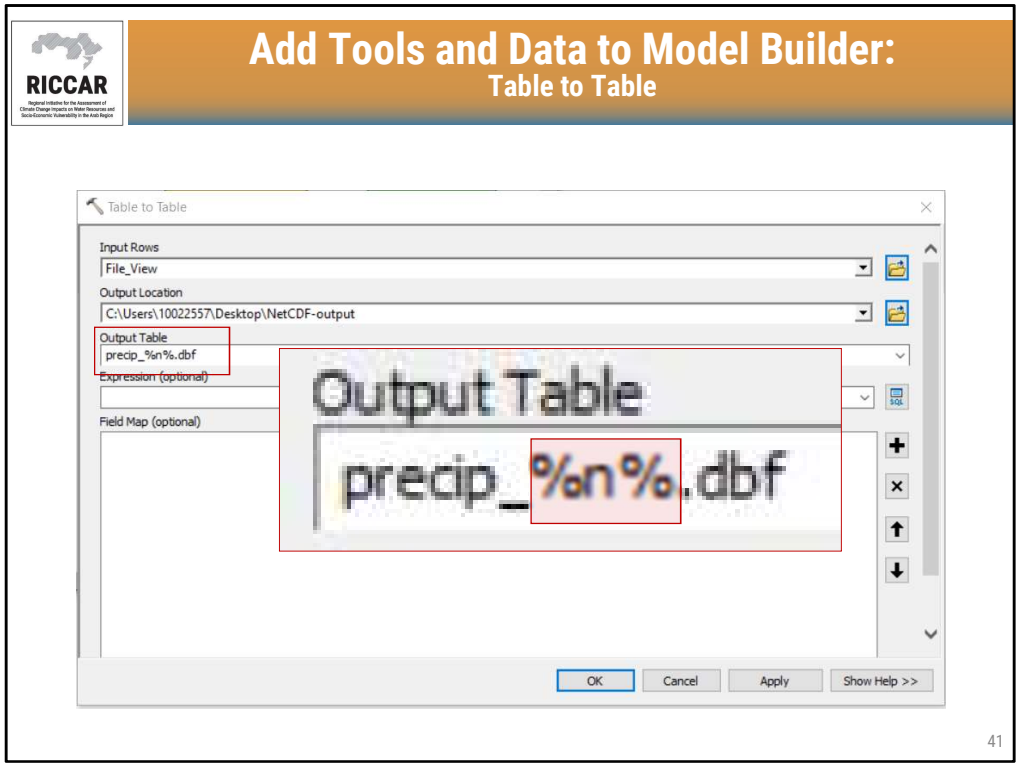
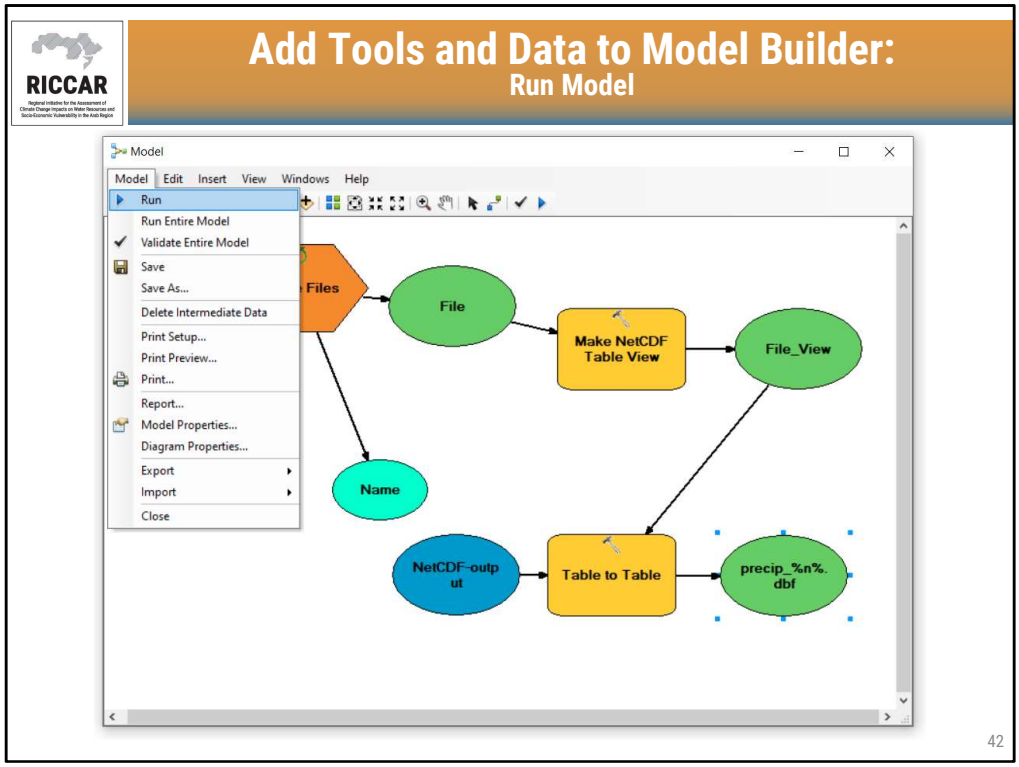
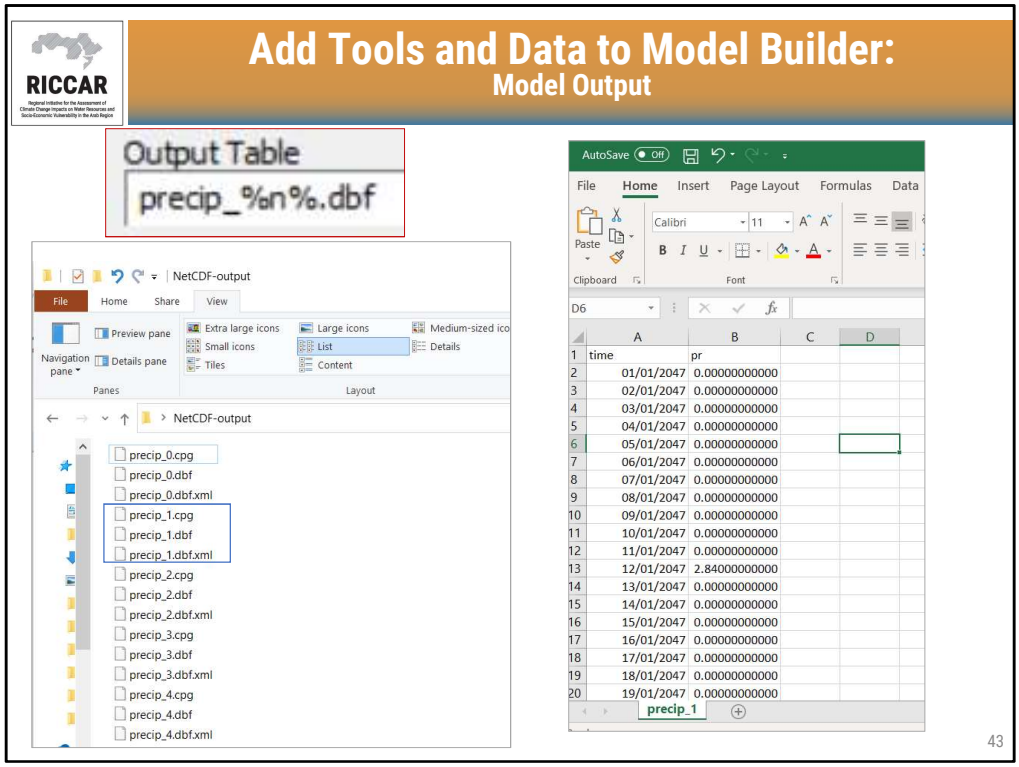


- The Output Location is user-defined and is a folder (not a single file)
- The Output Table is also user-defined and is a .dbf file type
- Recommended to include %n% in the Output Table file name. This will create multiple output tables with a unique number for each, starting from 0, in chronological order



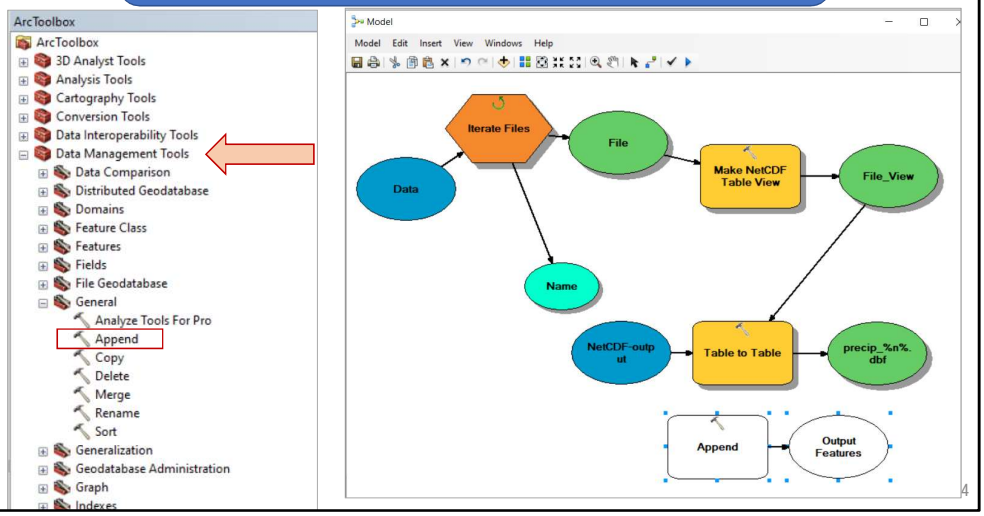
- Once the Table to Table data is entered, the Model Builder workspace will look similar to what is shown
- At this point, run the model



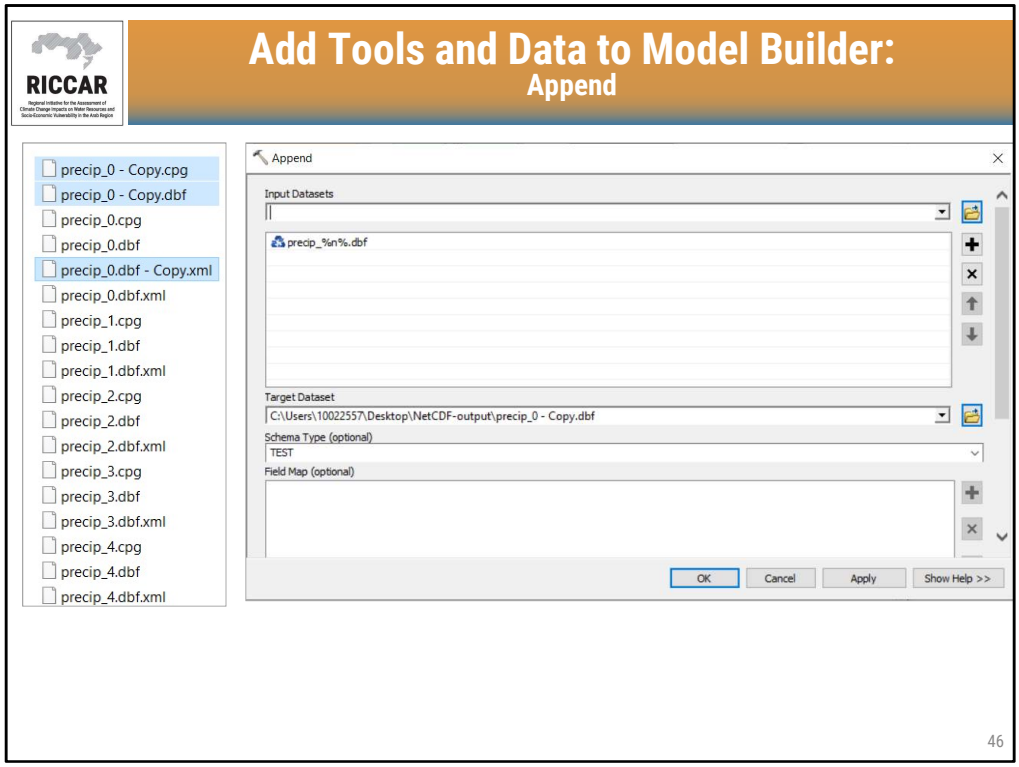
- The output will appear similar the screen in the folder. The file names are based on what was user-defined
- Each geodatabase table includes 3 files grouped together (.cpg, .dbf, and .dbf.xml)
- Each output .dbf file can be opened in Excel or other compatible software with similar results as shown. (The shown results are from the precip_1 files, which have been determined from the 2047 NetCDF file.)

Add Tools and Data to Model Builder:
Append

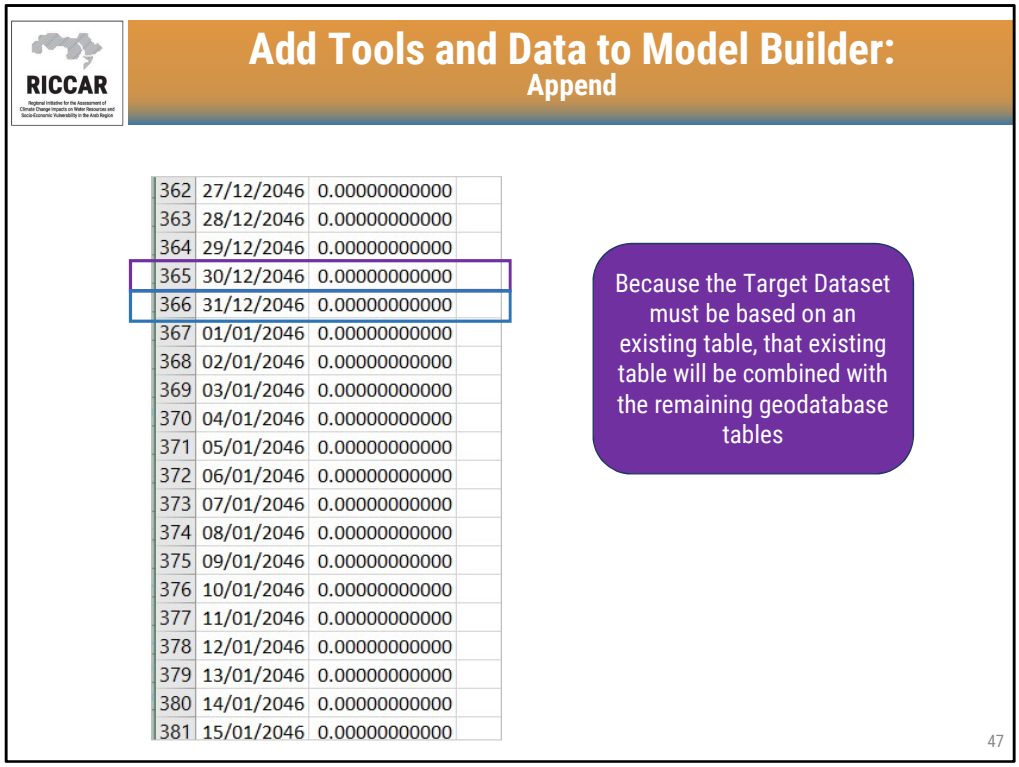
- Geodatabase tables are created for every single NetCDF file
- To combine them into a single table, the Append Tool is used



Add Tools and Data to Model Builder:
Append



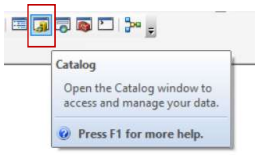
- Add parameters to Append tool
- The Input Datasets are selected using the dropdown box. Select the same file name used as the Output Table for the Table to Table tool. (In this example, it is precip_%n%.dbf).
- The Target Dataset is user-defined and must be based on an existing file. The target dataset must have the same file structure as the other output files (.cpg, .dbf, and .dbf.xml). A simple way to do this is just copy/paste the first geodatabase table



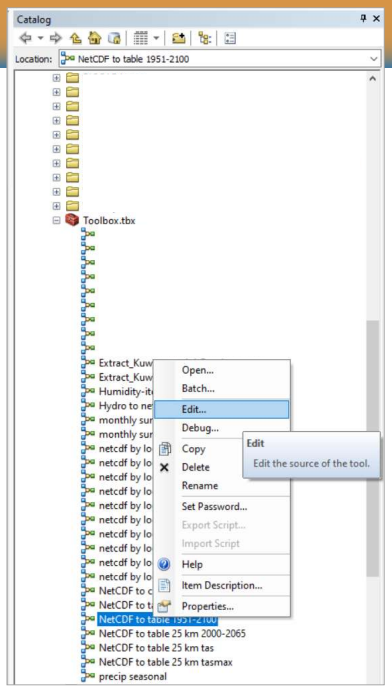
- Results are based on the duplicated geodatabase (precip_0 – copy) shown on slide 46
- Copy/paste a new file to enter in the Target Dataset or otherwise the results will continue to append one another

Accessing Created Models

- Models can be saved in user Toolbox, accessed from the Catalog



- To run model, select Edit (not Open)



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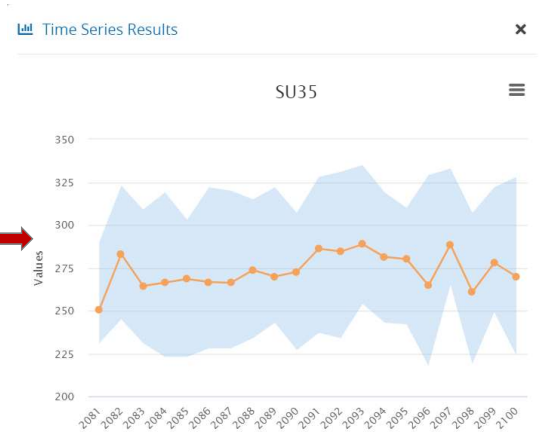
Time Series Data for Multiple Locations

- Make NetCDF Table View will only work for single point location at a time
- Multiple point locations cannot be performed using Model Builder
- Calculate results for an area by calculating for each grid cell individually

- Alternatives
  - NetCDF Extractor developed by Agrimetsoft (https://agrimetsoft.com/netcdf-extractor)
  - RICCAR Regional Knowledge Hub Data Portal (will report averaged results)



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RICCAR
Thank You
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