

Climate Data Availability in Arab Region

By

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1. Introduction

The permanent availability of Climate data to evaluate climate change and variability is an urgent need for assessing the vulnerability of water resources in Arab Region. This requires a continuous flux of climate data among Arab nations as well as between International Climate Centers and a unified Arab Climate Center (ACC). Naturally, this needs governmental regulation by the Arab States. The complete Data set at the ACC can be used freely by the Arab users to make researches and Long Range Forecast (LRF) of Climate Change and Variability as well as issuing a climate report on a routine bases. Such LRF and Reports give an actual image for Policy Maker in the Arab countries to take the appropriate actions to minimize the Vulnerability especially in water resources.

In this report, we will give a glance on current climate change, main factors control climate in Arab land, the ACC objectives, data availability and sources and the need to condense current observational-network-stations, reanalysis of past and recent Climate data and capacity building in data assimilation system domain, and a concise of this report and recommendations. In addition, an annex will be attached about monthly and annual variation in Nile River Flood.

2. Glance on current Climate Change

Global Temperature increased by $0.74 \pm 0.18 \text{ C}^0$ during the last century due increasing in greenhouse gas concentrations from human activity. This conclusion has been endorsed by most of scientific researchers and science academies. On other hand, Intergovernmental Panel on Climate Change (IPCC) reports indicate that surface temperature will probably raise further 1.1 C^0 to 6.4 C^0 during twenty-first century. These expected increases in temperature are mainly due to External Radiative Forcing (ERF) of greenhouse gases, solar luminosity and volcanic eruptions, while the small gradual increase due to Earth's orbit-variations around the sun is not noticeable because of its long cycle of about 40000 years. In addition, Satellite temperature measurements indicated that temperature of lower troposphere has increased by 0.22 C^0 per decade since 1979. Recently, World Meteorological Organization (WMO) concluded that 2005 was the second warmest year behind the El Nino year of 1998.

The Assessment Report by IPCC of vulnerability due to regional climate change claimed that in Nile Basin and other rivers in Africa Runoff may be decreased in spite of the expected increase in precipitation by about 5%. This may be due to the large hydrological role played by evaporation. In the Arab countries that situated in the zonal belt from the north coast of Africa to latitude 15^0 N , precipitation may decreased by 20%, while it will increased by about 7% in eastern part of Africa in the last decade of current century. In Arab states that situated in South West Asia, precipitation may increase by about 10-50 mm, especially in autumn season. Again, the expected raise in temperature may reduce these values due increase in evaporation.

3. Main Factors Control Climate in Arab Land

The Arab region extends over an area of 14 million km^2 . About 87% of this area is a desert land, while 1% is planted by irrigated crops and 2% is irrigated by erratic rainfall or

ground water. Most of Arab Countries, either in Africa or in south west Asia, are situated in the arid climatic zone due to the existence of wide spread inversion that associated with trade winds and the subsidence of air in the vicinity of subtropical high belt that extends around latitude 30° N in the Northern Hemisphere. Such situation stops formation of rainy clouds in the area. However, accidental events of severe rainfall and flash floods take place in internal regions especially in spring and autumn as a result of insertion of tropical humid air from Indian Ocean into subsiding cold air from southern parts of middle latitude. On the other hand, moving troughs and depression over Mediterranean in winter cause moderate spells of rainfall on the north line coast of Arab countries in North Africa with heavy rainfall over East Mediterranean countries, especially when a deep depression resides for many days over Cyprus Island in east Mediterranean.

The great renewable water resource comes from rivers that run in Arab land such as Tigris, Euphrates, Yarmouk, Jordan, and Nile. Most of these Rivers originate from the outside political boundaries of Arab land, which may cause future disputes about water shortage. Many studies have been made about the runoff in the first four Rivers and have indicated that there has been gradual decrease in the discharge amounts in them. These decreases may refer to the establishment of many projects in the routes of these Rivers by the neighboring Countries. This makes Arab States be in need to unify their plan for facing future shortage in renewable water resources.

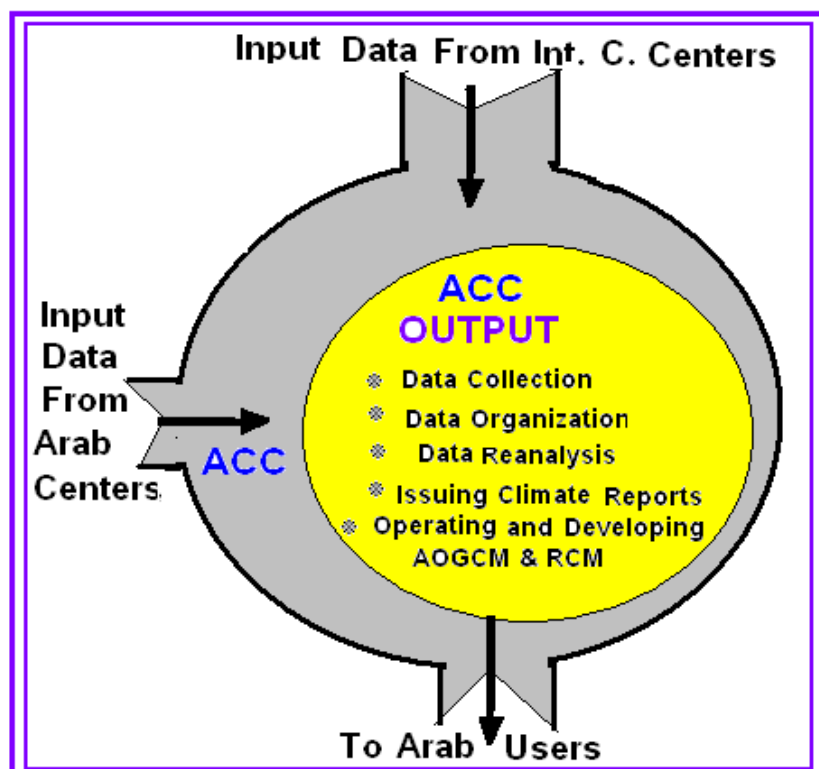
The Nile River, the longest River in Africa and in the world with ten African States along its basin, has multi resources that have made the amount of water discharge be quasi-steady since the Pharos era. However, the attached annex at the end of this report depicts annual discharge at Aswan dam in the foregoing 13 decades, spells of dry and wet periods, percentage of monthly discharge, analysis of monthly discharges by Empirical Orthogonal Function (EOF), and possible significant periods in flood amounts.

4. Arab Climate Center (ACC)'s objectives

We have suggested in the introduction of this report that the Arab states would better establish an Arab Climatic Center (ACC) that all Arab countries participate in its establishment. The ACC may be an entity of a Meteorological Service at one of Arab States. The objectives of ACC are summarized as follow:

- a- Collecting available Meteorological, Climatic, and hydrological data of the Atmosphere as well as those of Oceans at available global Stations and at grid points. The target of doing so is to control data qualitatively, and reanalyze them. The complete data set of Arab region and those of the world may compose a data Bank in the ACC and its branches in Arab states.
- b- From the collected Data at the ACC and at its branches, different records of all variables should be updated and reanalyzed on a routine basis in cooperation with National Climate Data Center (NCDC) that has the world's largest active archive of weather data, National Center of Environmental Prediction (NCEP) in USA, World Climate Research Program (WCRP), and Global Climate Observing System (GCOS) of World Meteorological Organization (WMO).
- c- The ACC should be equipped with appropriate tools for computing and reanalyzing the collected Data. Capacity building of selected team from all Arab Countries may be built on suitable Regional Climate Models (RCMs) and Atmospheric Ocean General Circulation Models (AOGCMs) to process and reanalyze data in the ACC for making researches, Long Range Forecasting (LRF) and issuing reports on climate changes and their consequences on Renewable water Resources in Arab land.

- d- ACC and Meteorological services in all Arab states are invited to interchange information and data among them with free charge. However, a brief of ACC objectives is depicted in Figure below.
- e- With respect to Meteorological and Hydrological raw data, the head of Meteorological, Hydrological, Environmental, and Agriculture Services in different Arab States may make appropriate arrangements to solve this problem. Since, types and record lengths of many variables of raw data are not equal among Arab Meteorological services. Besides, some Arab countries regard raw data of some records are national treasures that have cost these countries so much efforts and a lot of money in the past.
- f- It is better to improve the current Meteorological observations Network at surface and upper air by condensing their number and improving their quality in the domain of the Sahara and at coastal zones. Such addition of new stations will improve our understanding and assessment of climate change and variability. In addition, this will help in any future establishment of Clean Energy projects from Wind Farms and from the Sun.



5. Data Availability and Sources

The available actual past Meteorological, Hydrological, Oceanographic, and Climatic data can be obtained from different Arab Meteorological services, and WMO publications either printed or on CD-ROMs. The CLimatic NOrmals (CLINO) of most variables of all world Surface Meteorological Stations and Ship Stations can be available from WMO and, World Weather Records (WWR) in U. S. Department of commerce, in Washington, D. C. Also, if these data sets are available at the some Arab Meteorological services, it will be easy to organize them and put them in binary format and collect them in the suggested ACC for future use. In the same time, current synoptic and upper air observations at standard hours of the day are stored in the ACC for researches and for issuing climatic reports. Data may be

available from above mentioned sources free of charge or can be self organized by the ACC members.

However, there are some American services and centers that can supply a variety of climatic data either those of the surface air or those of the upper Atmosphere. Some of these data are free of charge and other with a charge that must be paid in advance. Among these American services, NCDC publications on Climates of the world that contains the data of average temperature, precipitation for approximately 800 stations throughout the world. Also, Monthly Climatic Data for the World (MCDW) are available for surface and upper air. The surface elements included are pressure, temperature, vapor pressure, precipitation, cloud cover, and percent of long term averaged sunshine. The upper air data consist of geopotential height, temperature, dew point depression, and mean vector of wind at standard constant pressure levels. These data are available free at web site: <http://www7.ncdc.noaa.gov/IPS/mcdw.html>. Also, weakly and Monthly gridded data set (1° Latitude x 1° Longitude) of the Sea Surface Temperature (SST) are available at the web site; <http://www.cdc.noaa.gov/data/gridded/data.noaa.oisst.v2.html>

The NCDC Foreign Data collection consists over 100,000 volumes of Publications printed in foreign countries and exchanged with National Oceanic and Atmospheric Administration (NOAA) for US Climate Publications. The collection contains worldwide average Meteorological Data on a country-by-country basis. Also, These Data are available at Hamburg Marine Data Center in Germany.

However, the collected Meteorological, Hydrological, and SST may be organized and distributed by Authorized Arab specialists that operate in the suggested ACC or in any Arab Meteorological Service.

6. Reanalysis of Past and Current Data

In the near foregoing years, advanced Meteorological and climate services around the world have had to use analyses that supported the real-time weather forecasting according to the previous regulations of WMO. These analyses are very inhomogeneous in time as there have been big improvements in the data assimilation system. This played havoc with climate monitoring as these improvements have produced changes in the apparent climate. For example, changes in recent data assimilation systems have indicated apparent change in the value of Hadley cell strength. As a result, the National Center for Environmental Prediction (NCEP and National Center for Atmospheric Research (NCAR) in USA have planned for a project called " Reanalysis Project" to produce a retroactive record of more 50 years of global analyses of atmospheric fields in the support of the needs of the research and climate studies. This effort involved the recovery of land surface, ship observations, real-time upper air measurements, satellite observations, and other related data. These data were then quality controlled and assimilated with a data assimilation systems kept unchanged over the analysis period. The reanalysis data assimilation system continues to be used with current data in real time (Climate Data Assimilation System or CDAS), so that its products are available from the year 1948 up current year. In addition to gridded reanalysis fields, it includes forecasts 8-days forecast as well as Binary Universal Format Representation (BUFR) archive of the atmospheric observations. These products can be obtained from NCAR, National Centers for Environmental Prediction (NCEP), NOAA, and Climate Diagnostics Center (CDC) in USA.

Activities and plans of atmospheric reanalysis are now going on in NCEP in USA, the European Centre for Medium Range Weather Forecasts (ECMWF), and Japan Meteorological Agency (JMA). The ECMWF has already encompassed the European Reanalysis project ERA-40, which covers the period from September 1957 to August 2002. Also, JMA has encompassed reanalysis project JRA-25 that covers the period from 1979 to 2004. In addition, Global Modeling and Assimilation Office (GMAO) at NASA are going to begin the Modern

Era Retrospective-analysis for Research and Application (MERRA) to extend the reanalysis from 1979 onwards. In the same time, the World Research Programme (WCRP) with its specialized panels may help to promote and maximize benefits to community that use reanalysis products. However, ACC, Arab researchers, Meteorological and Climate centers in Arab States can use these products and may participate in developing reanalysis methodology in our area.

World Ocean Circulation Experiment (WOCE) has advised to evolve ocean data assimilation into a quantitative approach of combining ocean circulation models with ocean observations. Data assimilation in the ocean in a mathematical rigorous way will describe and elucidate time-varying ocean circulation and its interaction with other component of climate system. Also, this will improve data bases in ocean, help in studying climate dynamics in the ocean over the last several decades, and will increase Atmospheric Ocean General Circulation Model's (AOGCM) accuracy. Again, the Arab countries are requested to follow up these activities and participate in developing them.

7. Report Concise and Recommendations

From the foregoing discussion, one can recommend the following actions that can be taken by Arab Countries

- To make climate data be easily available among Arab States, it is recommended that an Arabic Center of Climate (ACC) be established by an agreement among Arab Governments.
- The Suggested ACC may be an independent entity or as a part of one Arabian Meteorological Services that has branches in Arab state with each branch has a specified complementary task of ACC works.
- The tasks of the ACC and its branches are to collect past and current Atmospheric, hydrologic, and oceanographic, reanalysis these data, put them in a suitable format to be used by researchers, climate Model , making Long Range Forecasting, and issuing climate changes report of the region, especially those related to water resources.
- It is recommended that current Meteorological observations Network at surface and upper air be upgraded by condensing their number and improving their quality in the domain of the Sahara and at coastal zones. Such addition of new stations will improve our understanding and assessment of climate change and variability. Also, this will help in any future establishment of Clean Energy Projects from wind Farms and the Sun.
- It is also recommended that Arab Governments finance grants to small scientists in Capacity building in the domain of data assimilation system as well as in operating and developing AOGCMs.
- Arab countries are recommended to face together the deterioration in water resources in the future by consensus actions and sayings.
- There are many international centers that can supply past and current Atmospheric, hydrologic, oceanographic, and reanalyzed data at world Meteorological Stations on land and ocean and at gridded point of the earth's surface and ocean. Some data are free of charge and other is requested in advance by a defined charge.
- Raw Data and reanalyzed data are available at CLINO of WMO, CDC, and European Centre for Medium Rang Weather Forecasts (ECMWF), Japan Meteorological Agency (JMA), Climate Data Assimilation System or CDAS, NECP and National Center for Atmospheric Research (NCAR), Climate marine Center at Hamburg in Germany, and GMAO at NASA. However, Free gridded data of Sea Surface

Temperature are free available at the two web sites;
<http://www.cdc.noaa.gov/data/gridded/data.noaa.oisst.v2.html>
<http://www7.ncdc.noaa.gov/IPS/mcdw.htm> and

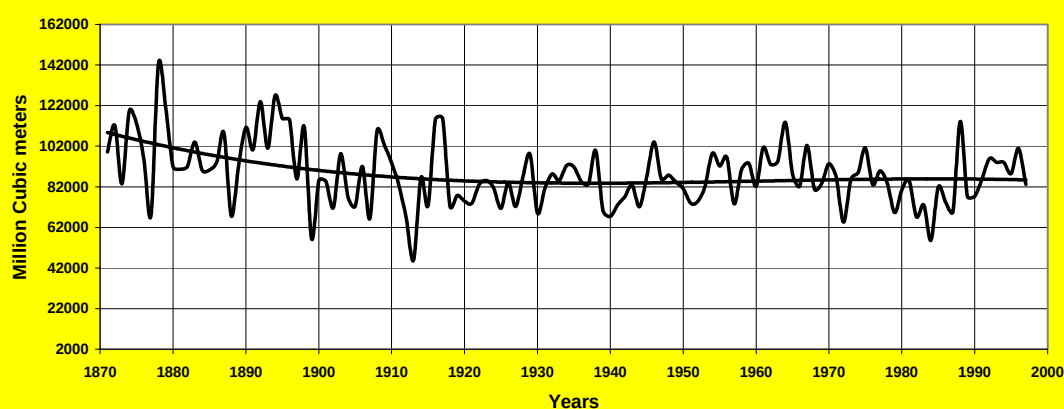
- Finally, the concerned Arab States may seek about an agreement to exchange processed data among them and the roles of using raw data. We belief that the idea of establishment an ACC may help to solve data availability easily among Arab States.

8. Some references

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Annex for Case Study on Nile River Flood

**Fig. 1 Annual Flood (Million Cubic meters) of Nile River
with Poly. Trend of order 3 in the period 1871 - 1997**



**Fig. 2 Percentage of Monthly Normals of Natural Flood
of Main Nile River Downstream at Aswan**

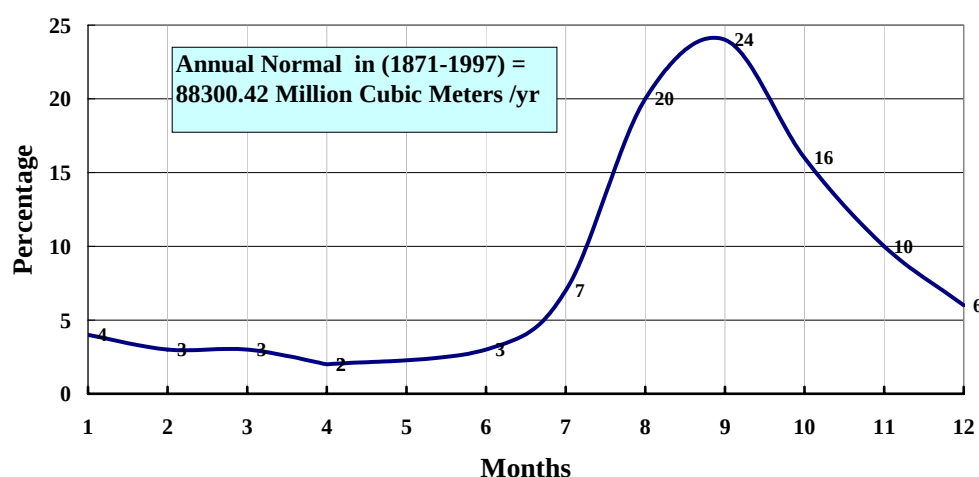


Table 1. *Classification of variability of Nile River Flood relative to Annual Normal.*

Class of Nile Flood	Deviation % from Normal	No. of Years
Relative Draughts	< -50%	98 Years
Far Below Normal	(-50% -> -30%)	11 years
Tolerable Below Normal	(-30% -> -20%)	11 years
Tolerable Above Normal	[+20% -> +35%)	12 years
Far Above Normal (Inundation)	More Than or Equal 40%	3 years
Annual Normal in the Period 1871-1997 = 883000.55 Million Cubic Meters		

Fig. 3 The First Three EOF of Nile River Flood

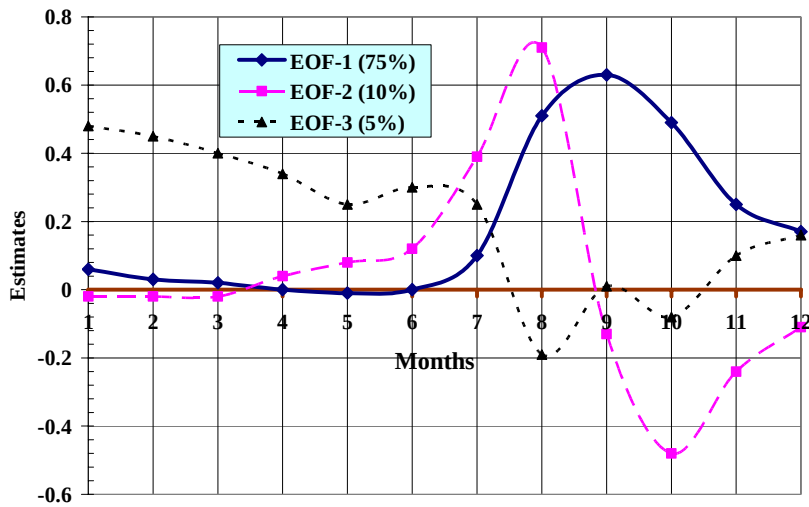
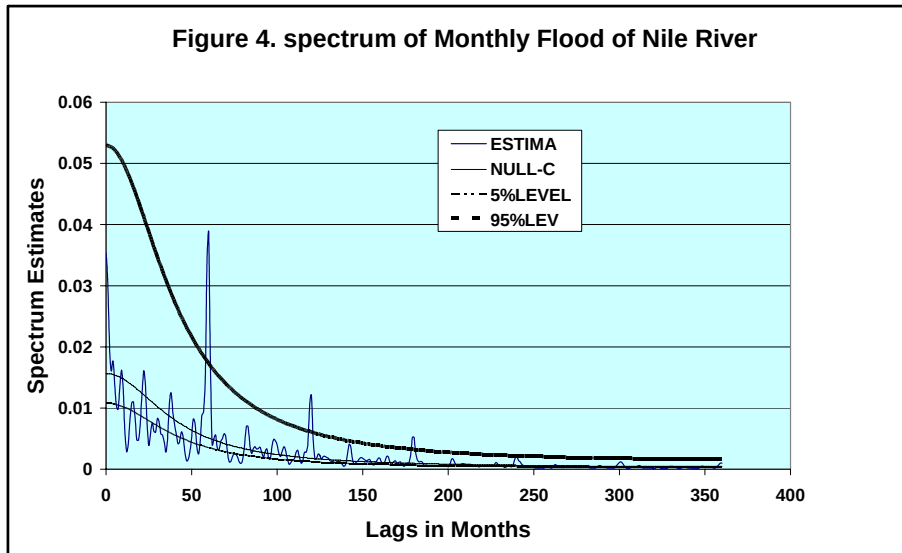


Figure 4. spectrum of Monthly Flood of Nile River



From the foregoing four Figures and Table, one can see that the most devastating flood in 1878 culminated to 142.378 milliard cubic meters while absolute minimum flood in 1913 deteriorated to only 45.879 milliard cubic meters. However, Nile River has multi-sources that cause its flood. There were years of severe drought and other of devastating flood, but the wet spells were slightly more than those of dry ones. The existence of quasi biannual cycle in the series of annual flood may be referred to the effect of the quasi biannual oscillation in the atmosphere on Nile flood with long path that originates from tropical regions. Also, the maximum flood of Nile River takes place in the months of August, September, and October. The Flood in these three months is represented by the first EOF. However, we have given here Nile River Flood study as an example among Rivers running in the Arab lands, where two Arab countries of Sudan and Egypt participate in its basin and receive about 90% and 97% of their needs of fresh water from Nile. This urges the two countries to face the future arrangement together with the aid of other Arab countries.