Climate Data and
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THE INDIAN OCEAN DATA RESCUE INITIATIVE - INDARE

IMPLEMENTATION PLAN

(Adopted by the INDARE steering committee in September 2014)

World Meteorological Organization
Weather • Climate • Water

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Introduction

At its sixteenth session, the World Meteorological Organization's Congress in 2011 adopted a resolution on climate data requirements (CG-16 Res.16) deciding to accelerate Data Rescue worldwide as part of the WMO priorities for climate data and climate monitoring efforts. Furthermore the Global Framework for Climate Services (GFCS) which fosters and guides efforts for cost effective socioeconomic development, disaster risk reduction and climate change adaptation, includes as part of its implementation plan , the acceleration of the recovery of historical climate records. Within this global context, WMO and partner organizations promote the initiation and implementation of regional and subregional climate data initiatives and foster collaborative approaches to work on climate data in an end to end approach, including, but not limited to, the recovery, digitization, quality control and homogenisation of the historical climate data. Such initiatives offer also excellent opportunities to use best practices and tools to analyze climate data and generate additional information on climate change and climate risks at national scale and the scale of the region of interest. The INdian Ocean DAta REscue (INDARE) initiative was launched at the first international workshop on the recovery of climate heritage in the Indian ocean rim countries and islands, 21-24 April Maputo, Mozambique 2014. The participants consisted of several directors of National Meteorological and Hydrological Services, international and regional institutions representatives, and national and international climate experts. They agreed to develop an implementation plan of the INDARE initiative. A steering committee was established in consultation with the countries to finalize the implementation plan and develop the working structure and annual work-plans. The steering committee met in Geneva in 29 September-1 October 2014. It adopted the implementation plan and developed the INDARE working structure and the work plan for 2014-2015.

Executive summary

The Indian Ocean Data Rescue Initiative (INDARE) will enhance the quality and quantity of historical terrestrial and marine weather and climate observations in the region and the provision of relevant climate information to improve decision-making and policy formulation. It will equally ensure long term collaboration among countries in the Indian Ocean on the exchange of climate data/information and climate services. In addition, INDARE will improve the ability of the National Hydrological and Meteorological Services (NHMSs) to issue timely early warnings to safeguard the life and property of the citizens. Such data improvements will also lead to better historical 3D dynamical reanalysis, which can then be tailored and/or downscaled to higher resolutions for the full range of climate applications (e.g. impacts, extremes and risks) and the Global Framework for Climate Services (GFCS) needs. On the other hand the recovered historical data in the region will be important to address the UNFCCC and IPCC needs, by providing critical information at national and regional level for climate assessment and adaptation.

The implementation plan is expected to run over a time period of 3 years starting from 2014. Activities and actions are expected to be carried out in the short, medium and/or long term. Participating countries are expected to play a significant role in carrying out these activities. International projects and organizations along with WMO and GFCS are expected to guide the implementation and provide support in mobilizing resources.

I- Vision and long term goals

Vision*:* To work and participate towards enhanced and accelerated availability of high-quality historical long-term weather data and metadata over land and sea in the Indian Ocean rim countries and islands.

Long term goal*s:* The INdian Ocean DAta REscue (INDARE) aims at generating reliable climate instrumental timeseries and historical reanalysis that both improve the monitoring, prediction and projection of climate extremes, and providing useful information and services for decision making in a timely manner. To achieve this goal INDARE will help to locate existing disperse data, provide them to the originating countries, enhance and safeguard climate records to prevent them from being lost, and to convert historical long-term climate records into accessible and digitized climate datasets to improve weather and climate analyses and reanalysis in support of climate adaptation and to inform socioeconomic sectors. It also seeks to assist in implementing climate data modernization projects in the countries based on WMO standards and modern specifications.

II- Expected outcomes

While fostering Data Rescue on national and regional scales over the Indian Ocean, INDARE activities will contribute to mainly four broad areas: modernization of the database, capacity development, climate information generation and supporting GFCS implementation. As such, INDARE will also be a part of ongoing international data initiatives across the region, such as the International Atmospheric Circulation Reconstructions over the Earth (ACRE) Initiative (Allan *et al.,* 2011), International Environmental Data Rescue Organization (IEDRO), International Surface Temperature Initiative (ISTI) (Thorne *et al.,* 2011), International Climate Assessment & Dataset (ICA&D), Southern African Science Service Centre for Climate Change and Adaptive Land Use (SASSCAL), Tanzania Meteorological Agency Climate Services Development Project. In addition, through ACRE, it will be linked to instrumental and documentary data recovered as a result of cross/multi/inter-disciplinary activities involving the social sciences and humanities – such as the UK Arts and Humanities Research Council (AHRC)-funded Network Project '*Collaborative research on the meteorological and botanical history of the Indian Ocean, 1600-1900*'. This section briefly outlines in the following pages four main expected outcomes of INDARE.

Expected Outcome 1: Capacity development

Infrastructure capacity

i) Facilitate and develop international collaboration with donors and funding agencies to foster resource mobilization, both financial and in-kind, to invest in the provision, installation and updating of equipment and computing facilities that support DAta Rescue (DARE) and Climate Data Management Systems (CDMS)

ii) Connect NMHSs in the region with worldwide data and information systems to facilitate greater access to scientific and technological knowledge for improving local data bases and related knowledge and training

Human capacity

i) Promote use of best practices in data management, quality control of data and homogenization, plus data analysis tools, through training and training of the trainers for mass capacity building; and advanced training workshops with international climate experts

ii) Promote international cooperation through exchange of expert visits

iii) Use other innovative approaches to overcome the possible shortage of human capacities, by considering involvement of universities, crowd sourcing, volunteers, etc.

Expected Outcome 2: Climate database modernization

i) Comprehensive and electronic/web based inventory of existing digitized long-term climate records and those that remain to be digitized. The inventory should include both archives of the still active stations as well as the existing archives of the silent stations. This will be part of the ongoing WMO Commission for Climatology project called I-DARE.

ii) Data and metadata management including imaging/scanning, digitization, composing, formatting, archiving and exchange of climate data with recognizing national data policies and based on WMO best practices and modern Climate Data Managements System Specifications.

iii) Develop intersections with, and contribute to, leading international initiatives recovering, imaging and digitizing climate records, and so play a vital role in the development of high quality climate data sets, reanalysis and information on climate extremes – especially in conjunction with ACRE, ICA&D, IEDRO and ISTI activities.

Expected Outcome 3: Climate information generation

Climate change adaptation

i) Enable NMHSs to better contribute to climate change adaptation programs and initiatives, including the UNFCCC Nairobi Work Program (NWP) and the Indian Ocean Commission's (IOC) Regional Climate Change Adaptation Strategy (2012-2020)

ii) Generate information based on observations, reanalyses and well calibrated models for understanding vulnerability and impacts of climatic variability and climate change; and contribute to informed adaptation planning, measures and actions based on multi-sectoral assessment for which climate data is a key ingredient

Climate Risk Management

i) Understanding climate extremes to address climate risks such as those related to droughts, heat waves, floods, landslides, sea level raise, storm surges, etc. This includes assessments of the frequency and intensity of climate extremes based on state-of-the-art knowledge and methodologies

ii) Long term data analysis, including the responses of socio-ecological-environmental systems to climate stresses

iii) Develop a more in depth understanding of global and regional climate variability and related teleconnection drivers to enable improvements in forecasting and climate prediction skill across the region (such as El Niño and Southern Oscillation, Indian Ocean Dipole, Madden-Julian Oscillation, Southern/Northern Annular Mode and Pacific Decadal Oscillation) on monthly, seasonal and decadal time scales.

Expected Outcome 4: Supporting GFCS implementation

Provide a strong and modern data foundation for implementing GFCS to help NMHSs work with different sectors, and to provide the best data and information in the forms required for supporting the priority areas of GFCS (http://www.gfcs-climate.org/priority-areas). The data serves for a large spectrum of climate services as examples but not limited to:

i) Timely and accurate information tailored for user needs, such as trends on growing degree days and growing season length to help in improving management decisions, productivity and prevent losses; (Agriculture and food security sectors).

ii) Providing appropriate historical and timely information on weather and climate extremes to support the implementation of early warning systems, and contribute to national and regional climate adaptation by increasing countries resilience to these extremes (Disaster Risk Reduction sector)

iii) Provide information on extremes such as heat waves and cold and wet spells and their prediction, thus aiding preventative measures and saving lives (Health sector)

iv) Climate information such as standardized precipitation indices, monthly maximum consecutive rainfall for various time periods and consecutive dry days will improve water resource management decisions (Water sector)

III- Activities

1- ***DAta REscue (DARE)***

Assist the NMHSs in identifying and locating original records and ensuring their imaging/scanning, digitizing and preservation in an accelerated manner - this will be done in conjunction with ACRE, ICA&D, IEDRO, ISTI, HISTOR and SASSCAL, and other initiatives

2- Climate Data Management Systems

Assist and guide NMHSs in using the WMO data management best practices, based on the newly established specifications of the Climate Data Management System (CDMS), as a framework for the modernization of climate data management infrastructure of the Indian Ocean rim countries and islands (Appendix A). This should be performed through the following four steps:

Step1 Diagnose existing systems, needs and gaps for CDMS

Step2 Develop and carry out country-based projects for implementing and operating modern CDMSs based on WMO specifications

Step3 Support the JCOMM-IODE-Marine Climate Data System by contributing marine data (atmosphere and ocean)

Step4 Support the establishment of Centers of Marine-Meteorological and Oceanographic Climate Data (CMOCs)

3- Climate Assessment

Establish climate data sets and climate assessment initiatives which will enable countries to use state-of-the-art methodologies and software for undertaking climate change analysis in an operational manner. The Activity will feed among other goals the IPCC climate assessment activities at national, regional and global level. This activity will be carried out by developing harmonized standard tools, as per ICA&D a joint initiative of the CCl Expert Team on Data Rescue and the Expert Team on Climate Change Detection and Indices ETCCDI, for use amongst the Indian Ocean countries (Appendix B) and making available critical data and products necessary for climate change assessment including:

- Long term timeseries for temperature, precipitation, pressure and wind
- Climate indices as developed by the Expert Team on Climate Change Detection and Indices (ETCCDI) that will provide additional information on the extremes (Appendix C)

4 - Climate services information system

Set up a web based information system for hosting and managing INDARE information resources using a dedicated portal. A host country from the region will be needed to maintain the system. The information system will include

- Description of INDARE goals, people, contact list, working groups and documentation
- Inventory of climate records and other INDARE activities and restricted access to INDARE community,
- Provide information and visualization through interactive applications showcases
- Link to relevant technical reference and guidance material.

5- Capacity development

- Undertake a survey that will help in mapping the region's needs at national and regional levels, in terms of human capacity, tools, training and education
- Organize thematic workshops for expanding knowledge and technology transfer and make best use of international and regional expertise and infrastructure to help achieve the expected outcomes as indicated above
- Support the development and implementation of Data Rescue and Climate Data Management modernization activities at NMHSs

6- Coordination

i) Set up a Steering Committee (SC) and four working groups (WG) from the NMHSs of the Indian Ocean region and international and regional organizations to guide and advise on the detailed steps and needs for the successful implementation of activities: WG1 on best practices and capacity development, WG2 on INDARE infrastructure, WG3 on international collaboration and networking and WG4 on communication and resource mobilization

ii) Nominate focal points designated by each of the collaborating countries to identify needs and provide contributions to the activities

iii) Develop reference document on INDARE and related communication mechanisms

7- Timeline and key actions

Short term (6 months)

Designation of focal points designated by the NMHSs, and setting up four working groups

Medium term (1-2 years)

Development of INDARE technical document

Organization of training workshops on Data Rescue and Climate Data Management

Establishment of inventories of digitized and non-digitized data to aid the recovery of missing records

Assessment of gaps in DARE equipment and activities

Start acceleration of DARE activities at NMHSs

Longer term (2-3 years)

Get modern functionalities built into CDMS

Develop ICAD&D System for climate services

INDARE web based information system is operational

IV Recommendations

1- The Steering Committee recognized the value and importance of ongoing sensitization of the national policy and decision makers (when possible and/or relevant) on these very important activities in order to help facilitate a good implementation of the INDARE project at national and regional level and improve decision making and policy formulation.

2- Provide formal reporting to the WMO and GFCS governing bodies to ensure a high level oversight, political endorsement and help securing funding and resource mobilization. The reporting could be also addressed to other international and regional institutions (i.e., UNFCCC-SBSTA, AMCOMET, ACPC, SADC, IGAD, APN, IOC.)

V. Appendices

Appendix A: The WMO Climate Data Management Systems specifications

The Climate Data Management System (CDMS) specifications document establishes a framework to define the required functionality of a CDMS in terms of mandatory, recommended and optional functionality. The framework comprises a set of inter-related components, each of which describes a specific functional requirement of a CDMS, and contains -where appropriate- references to further information. All components are classified as being required (i.e. mandatory), recommended (i.e. best practice) or optional (more advanced functionality).

A CDMS is an integrated computer based system that facilitates the effective archival, management, analysis, delivery and utilization of a wide range of integrated climate data.

The framework comprises a set of inter-related building blocks called Components (Figure 1A). Each Component describes a specific functional requirement of a CDMS, and contains where appropriate, references to further information.

Not all components are required within every CDMS. Components are classified as being **Required** (i.e. mandatory), **Recommended** (i.e. best practice) and **Optional** (more advanced functionality).

The National Meteorological and Hydrological Services (NMHSs) may find this component classification relevant as a guide to assist them to implement CDMS functionality that they can afford to maintain for the long term to effectively manage and utilise climate data and it is expected that WMO and NMHSs will take some time to make the necessary changes to their CDMS.

It is not expected that a CDMS should contain all of its functionality within a single package of software. The components have been designed to group similar functionality together. In many cases the functionality of components can be catered to by existing off the shelf, open source and proprietary software applications. There will however be some effort required to integrate these components together.

This framework can be thought of as taxonomy, defining a common set of terms for CDMS Components. It is anticipated that the framework will underpin future work to compare the functionality available in competing CDMS. A set of policies and governance processes should effectively manage climate data. These policies should be implemented as a global framework to facilitate better integration of climate data between NMHSs and to ease the workload required for regional and global analysis of climate data.

To this end, there are proposals currently being discussed to establish a global Climate Data Framework, such as the High Quality Global Data Management Framework for Climate.

The intended audiences of this CDMS Specification include NMHSs, CDMS procurement staff; climate data managers; systems integrators; CDMS developers, architects and vendors.

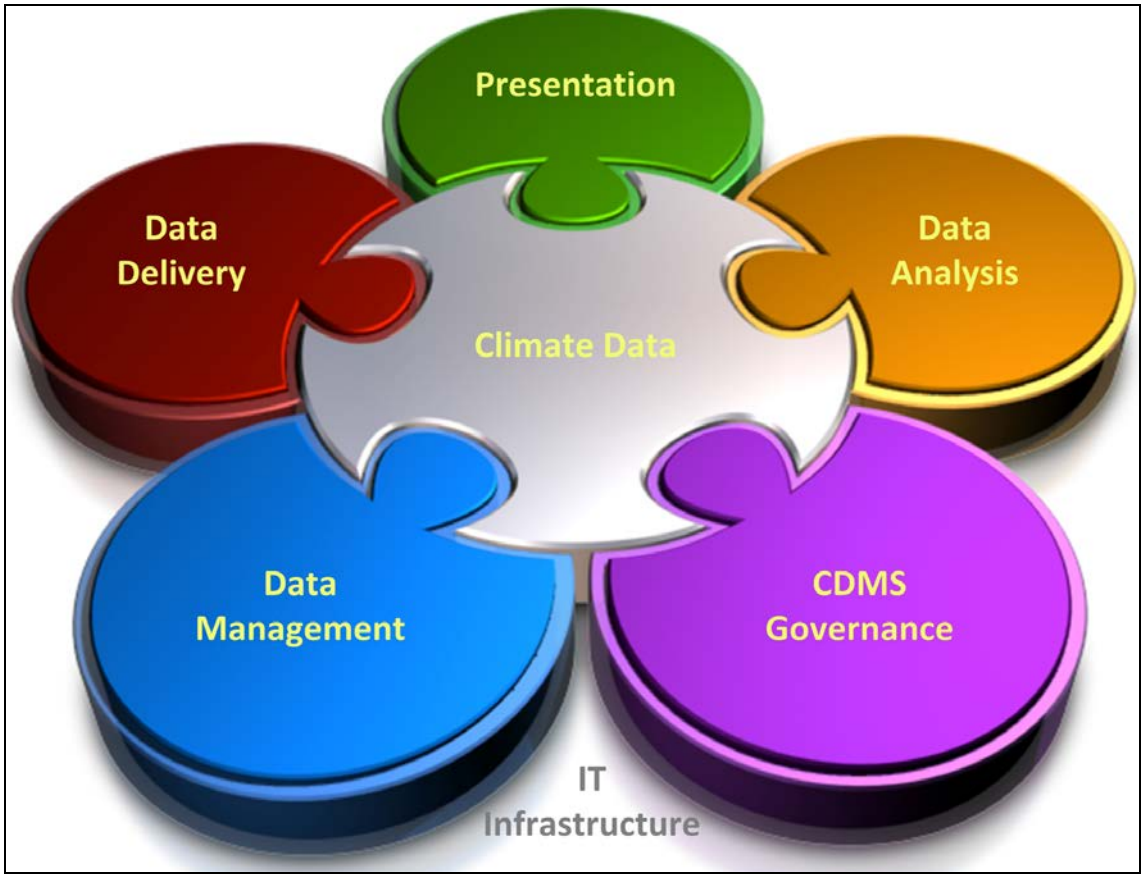


Figure A 1 High level components of CDMS

Appendix B: The International Climate Assessment & Dataset (ICA&D)

In view of the objectives of the GFCS, a case study on climate services across border by the Royal Netherlands Meteorological Institute promote the setting up of an International Climate Assessment & Dataset (ICA&D) that aims to extend the ongoing climate services offered by ECA&D, WACA&D, SACA&D and LACA&D globally by regional cooperation (Figures B1 to B5). The ICA&D concept successfully combines the work of the Expert Team on Climate Change Detection and Indices (ETCCDI) and that of the activities of WMO's Expert Team on Data Rescue (ET-DARE). The services include time series of daily climate data digitized by NHMSs. In fact, in order to inform on climate adaptation efforts, publicly available climate datasets are vital for regional and global research on climate variability and related extremes. In many NHMSs, high resolution historical data are only available in paper format and thus, the need for Data Rescue (DARE) activities to locate and digitize the historical data.

The ICA&D concept

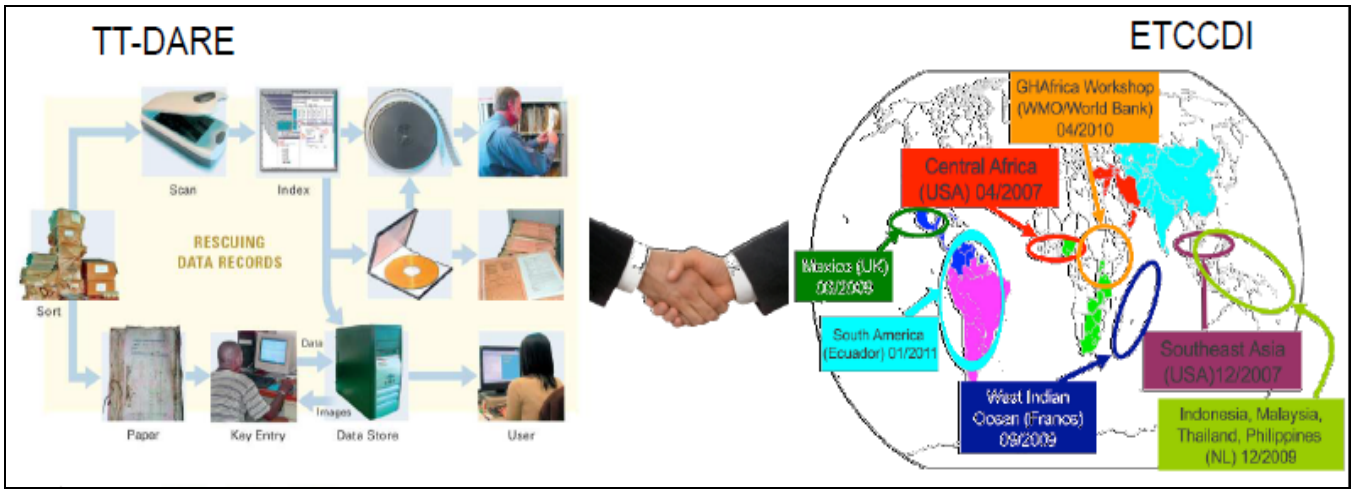


Figure B1 ICA&D concept that combines the work of ETCCDI and TT-DARE (Source: ICA&D, 2013)

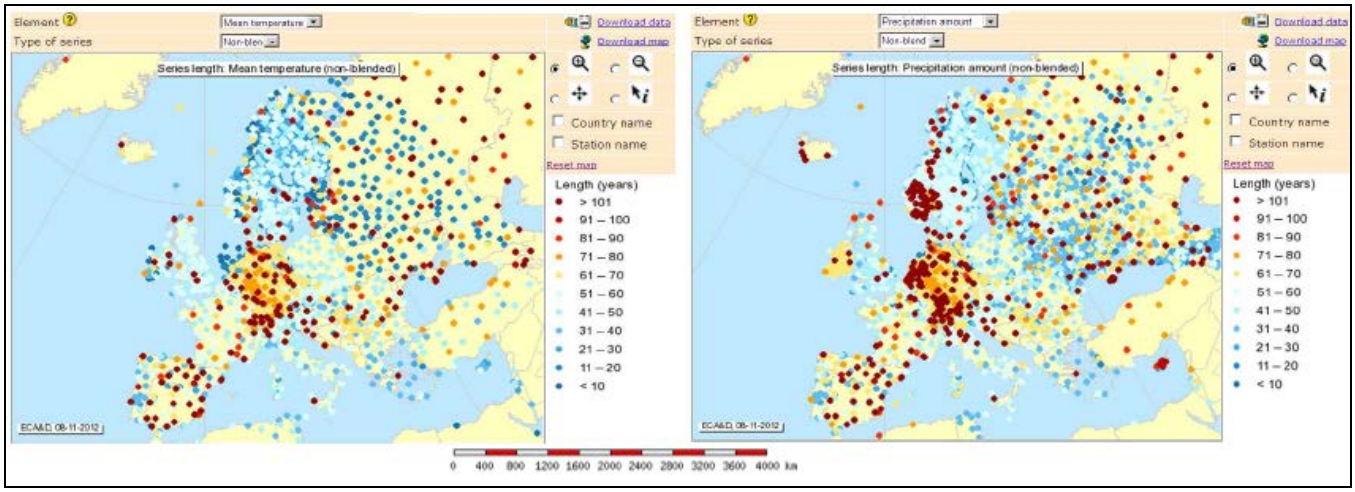


Figure B2 European Climate Assessment & Dataset. The map shows the length of available station series for mean temperature and precipitation (source: ICA&D, 2013)

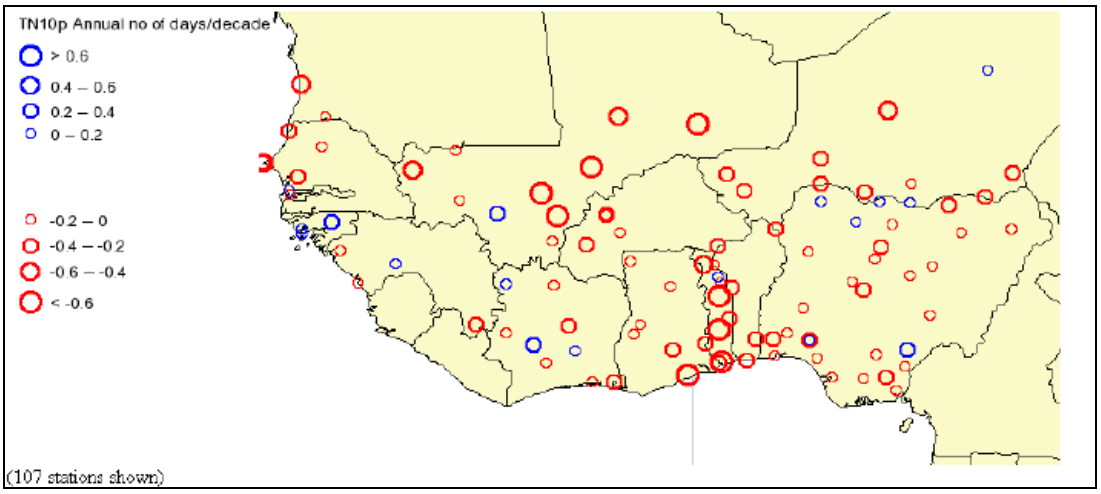


Figure B3 Series from the ETCCDI workshop on indices in the Western Africa**.**

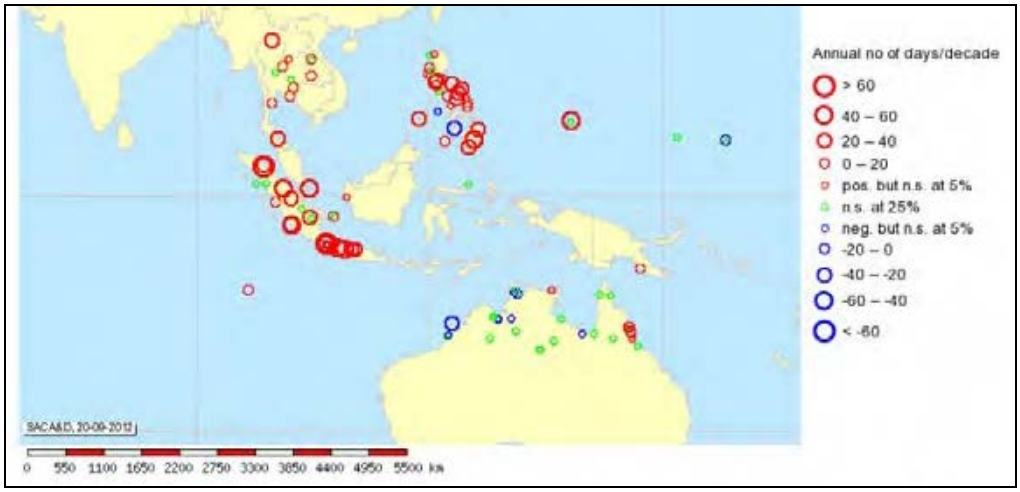


Figure B4 Trends in the warm nights in South Asia

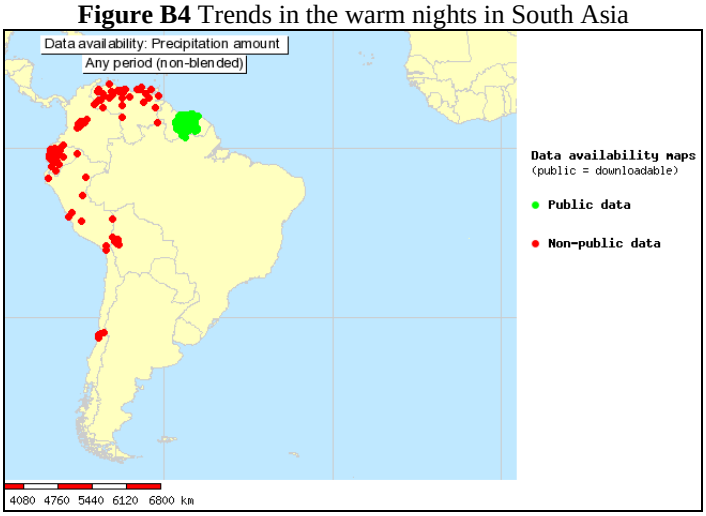
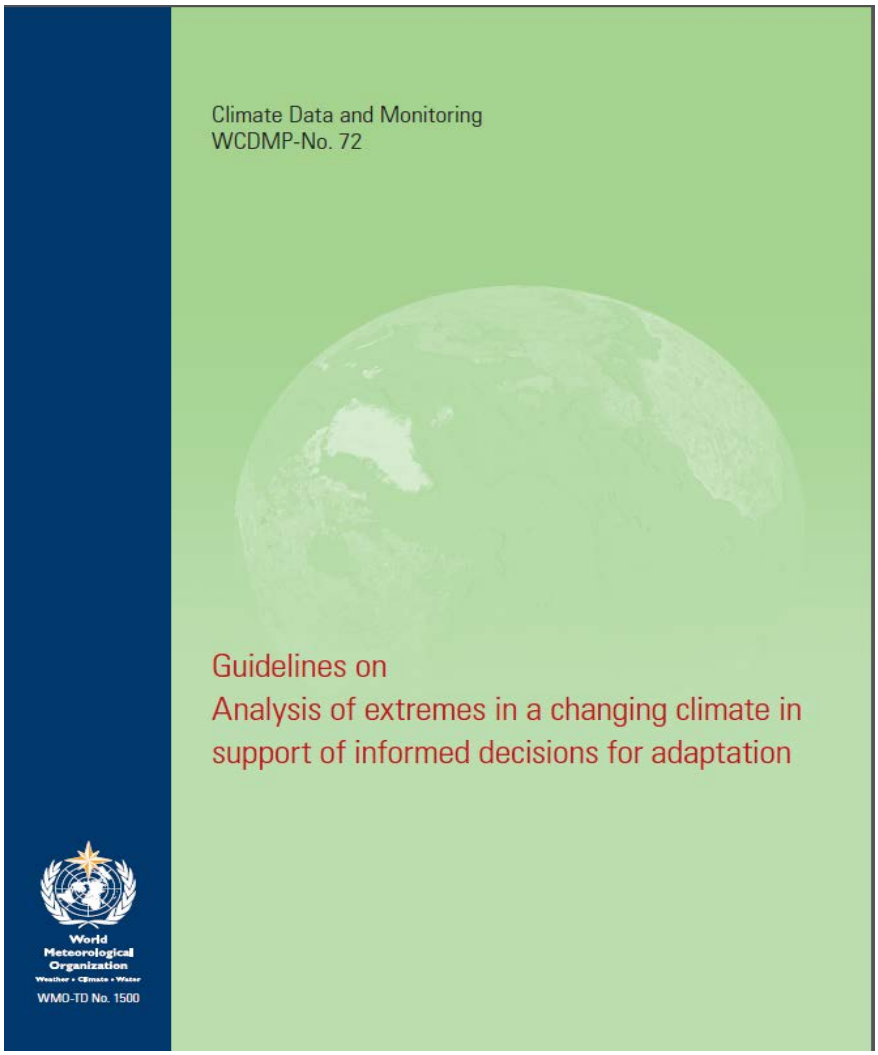


Figure B5 the data availabity in the Latin America. Green indicates the publicly available dataset, and red shows those that a commercially available (Source: ICA&D, 2013)

Appendix C: The Expert Team on Climate Change Detection and Indices / list of indices

In view of understanding climate variability and related extremes, the ETCCDI has been established to develop a list of climate change indices contributing to climate services. These indices detect help in decision-making and formulating policies towards climate change adaptation. The technique consist of detecting the inhomogeneities in climate datasets, homogenize the dataset and to generate trends accordingly. The list of ETCCDI indices are described in the WMO guidelines on Analysis of extremes in a changing climate in support of decisions for adaptation, page 49-52.



Link to access to these guidelines http://eca.knmi.nl/documents/WCDMP_72_TD_1500_en_1.pdf

Appendix D: The international ACRE initiative

The international Atmospheric Circulation Reconstructions over the Earth (ACRE) initiative both undertakes and facilitates the recovery of historical instrumental surface terrestrial and marine global weather observations to underpin 3D dynamical reanalyses spanning the last 200-250 years. Such reanalyses outputs can then be tailored and/or downscaled to higher resolution for the full range of climate applications (e.g. impacts, extremes and risks) and Global Framework for Climate Services (GFCS) needs worldwide (see Figure D1).

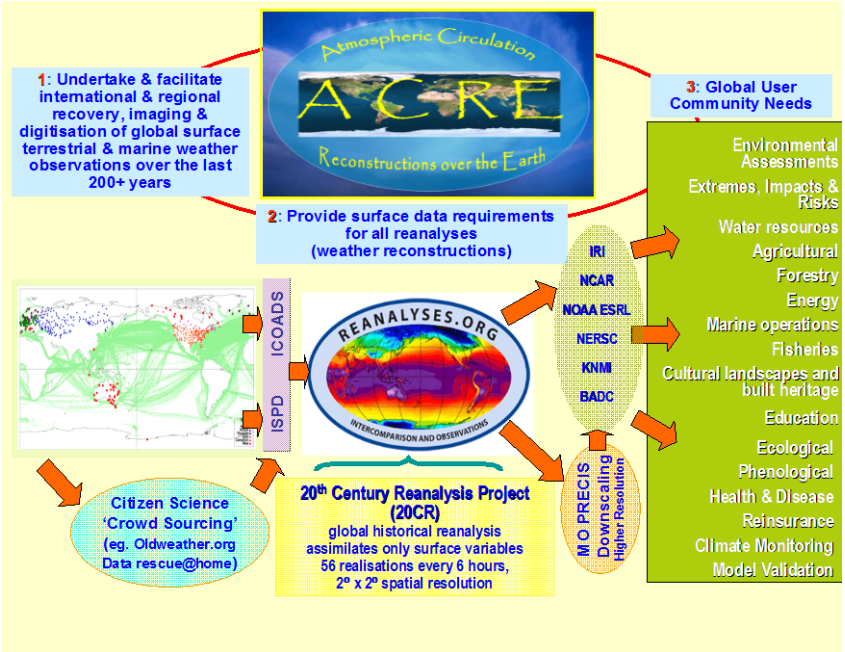


Figure D1: DATA -> REANALYSES -> USERS The International ACRE Inititaive Structure

The international ACRE initiative (http://www.met-acre.org/) is run by a consortium of nine core partners, and provides an umbrella that links together some 100+ projects, institutions, organisations, and data rescue and climate applications activities around the globe (see Fig D2).

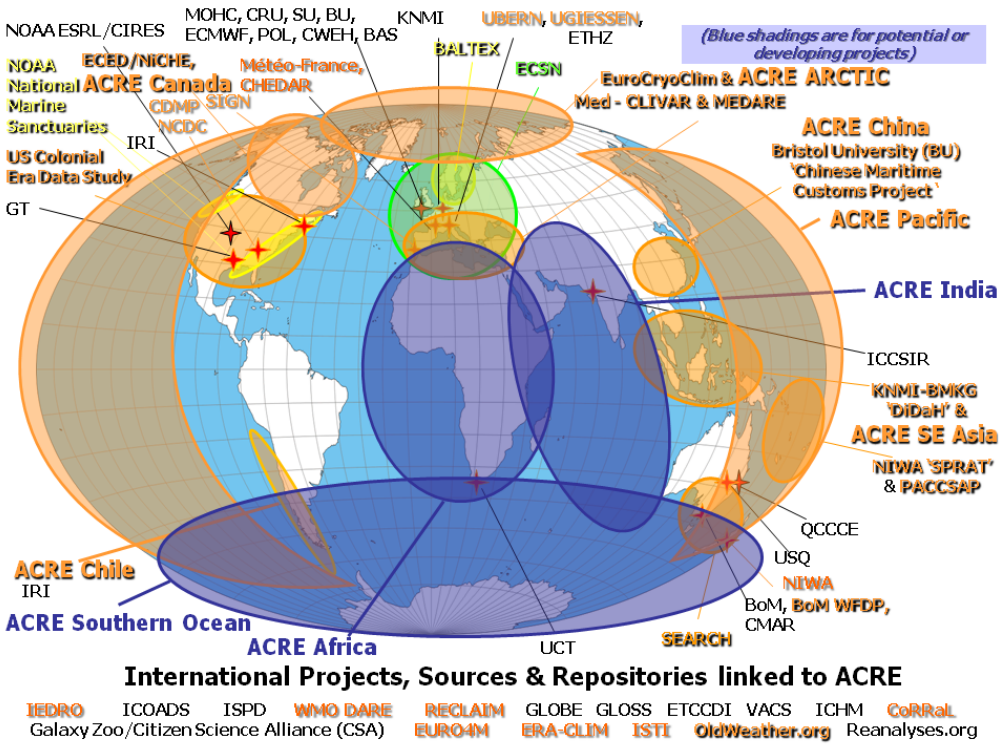


Figure D2: International institutions, projects linked to ACRE plus coverage of ACRE Regional Foci: In this context note ACRE Africa and ACRE India regional data foci.

ACRE's international to regional activities facilitate, coordinate and undertake historical surface terrestrial and marine instrumental data recovery, imaging, digitization, quality control, archiving, access and preservation (in international repositories) in a sustainable manner. Specific data variables are, in turn, assimilated into all reanalyses (http://reanalyses.org/), especially the 3D global dynamical historical reanalyses of its main US partner, the US NOAA ESRL and CIRES (at the University of Colorado) - the ACRE-facilitated 20th Century Reanalysis (20CR) - as well as the ERA-20C reanalysis from the EU FP7 ERA-CLIM/ERA-CLIM2 (European Reanalysis of Global Climate Observations) and that from the EU FP7 EURO4M/EURRA (European Reanalysis and Observations for Monitoring/European Regional Reanalysis) projects. Dynamical downscaling (such as by the Met Office PRECIS team model) will then provide the facility to take the above reanalyses down to finer resolution (25 km to 100 m).

The initiative has major, developing, regional foci with ACRE Africa and ACRE India (Figure D2), and links closely with Citizen Science, Social Sciences, Humanities and Arts projects, which extend its activities far beyond climate science into inter/cross/multidisciplinary engagements, and provide the basis for access to expertise for training in data rescue, scanning and digitisation tools and techniques for analyses and interpretation of historical documentary weather observations.

Details of all aspects of ACRE activities in 2014 can be found at: http://www.met-acre.org/Home/2014%20ACRE.docx?attredirects=0&d=1 Yearly global maps of the status of terrestrial station observations of synoptic pressure in the International Surface Pressure Data Set (ISPD) – whether hard copy, imaged/scanned, digitised or in the latest version of the ACRE-facilitated 20th Century Reanalysis Project (20CR): (http://badc.nerc.ac.uk/browse/badc/corral/images/metobs/VIEW_ISPD_STATION_PLOTS.html). The longer term plan is to improve these maps and to integrate them with the International Comprehensive Ocean-Atmosphere Data Set (ICOADS) marine data compilations.

Appendix E: The International Surface Temperature Initiative (ISTI)

The International Surface Temperature Initiative (ISTI) was instigated in 2010 and brings together climate scientists, meteorologists, statisticians and measurement scientists. It is an entirely voluntary based effort. It aims to create an end-to-end process to improve estimations of land surface air temperatures. There exist four central strands:

1. Creating improved fundamental data holdings of LSAT which includes inter-alia, data recovery, data rescue, data sharing and merging data from globally disparate sources.
2. Encouraging the creation of new global and regional homogenized products from the fundamental data holdings.
3. Benchmarking homogenization algorithm performance against realistic analogs produced synthetically.
4. Serving of products and advice.

To date most effort has been on the databank construction and a first version is very close to release – pending solely institutional approval of processes by NOAA's National Climatic Data Center. The merged product is around 32,000 stations and produced by bringing together 50 sources containing over 250,000 candidate series. Many of the series are duplicative. The merge attempts to create the most complete set of monthly data for truly unique stations. Sources with maximum and minimum and with greater data provenance are given priority.

Submissions to the databank are strongly encouraged and can be made at synoptic, daily or monthly granularity. Any submissions shall be shared with appropriate archives (e.g ISPD if submissions include pressure). Submissions can be carried out in a number of ways as detailed at www.surfacetemperatures.org/databank . More information on the initiative as a whole can be found at www.surfacetemperatures.org.

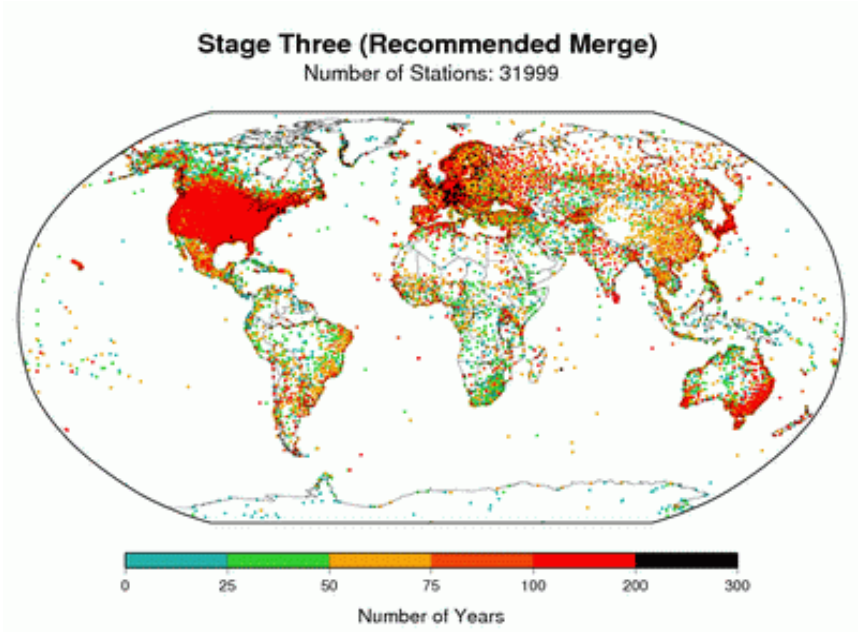


Figure E1: Station records in the close to final release version of the databank. Long records over plot shorter records. Significant spatial gaps exist.

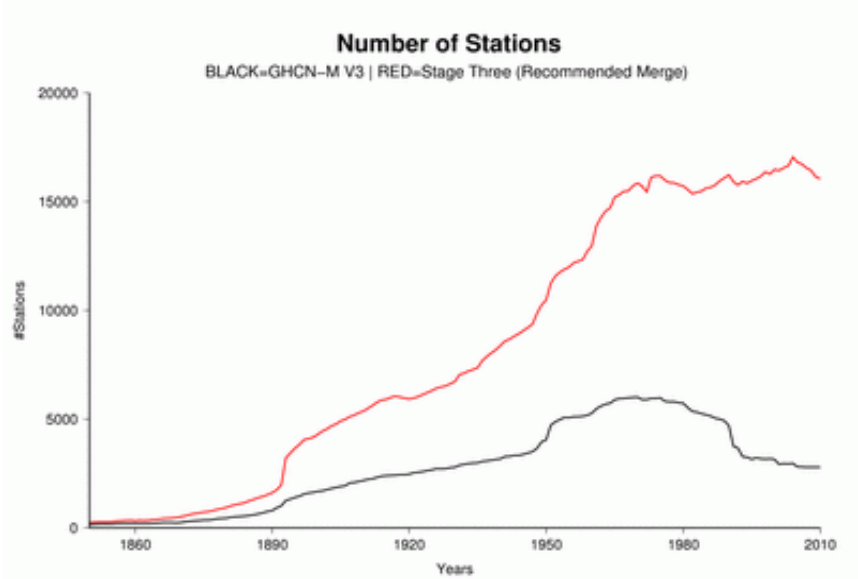


Figure E2:Comparison of the number of stations in the release through time to the station count in GHCNv3 used by NOAA NCDC and NASA GISS to inform their global products.

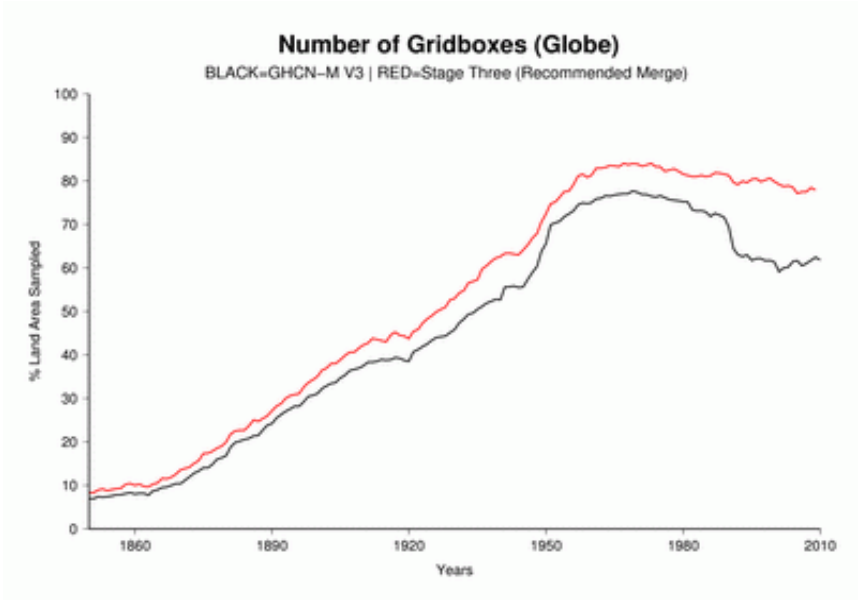


Figure E4: As previous but now by number of 5 degree land gridboxes sampled

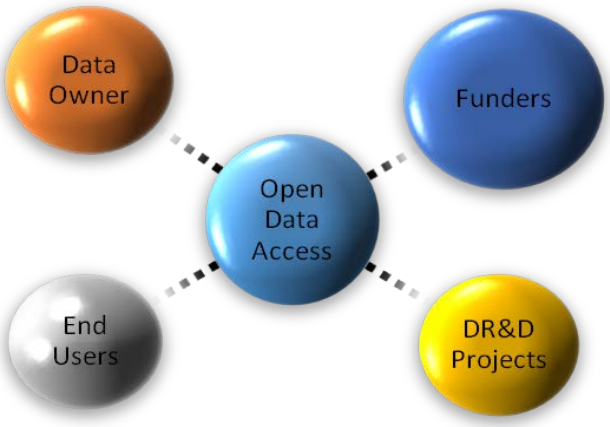
Appendix F: The International Environmental Data Rescue Organization (IEDRO)

IEDRO is a US-based, 501(c) (3) nonprofit organization, staffed by volunteers who rescue and digitize historic weather observations primarily from developing nations. Efforts are supported and endorsed by the U.S .National Oceanic and Atmospheric Administration (NOAA), the World Meteorological Organization (WMO), U.S. Agency for International Development (USAID), and other international and within-country groups concerned with the preservation, digitization and applications of historic weather data.

Mission

To locate, rescue, image, digitize and share historic climate data enabling developing countries to adapt and mitigate the effects of climate change .In pursuing this mission, IEDRO strongly believes that successful implementation of modern climate services depends fundamentally on improving availability, sharing and exchange of real time and historic climate data. IEDO DARE is founded on five Pillars:

- Locate – Identify Data in Need of Preservation and Funding in Search of Data
- Rescue – Inventory and Image Data (Preserve)
- Archive – Imaged Data Repository
- Digitize – Convert into Usable Digital Format
- Access – Open Data Access with respecting national and international data policies



Activities

Since 2005, IEDRO has conducted data rescue missions in thirteen countries worldwide including five African countries on the eastern side of that continent and/or boarding the Indian Ocean: Kenya, Tanzania, Malawi, Zambia and Mozambique.

Prior to 2011, our activities were centered around locating and photographing at risk historic hydrometeorological observations. However, with the need for digitizing those rescued

records, IEDRO has embarked on several programs to provide the digitization of those records and their entry into open and unrestricted data bases.

DARE projects in Africa

With NOAA funding, IEDRO has rescued and had digitized over 300,000 historic upper-air observations from: Kenya, Tanzania, Malawi, Zambia and Mozambique. These were added to the open and unrestricted NOAA world data base.

IEDRO has also scanned over 12,000 precipitation strip charts, 4,000 from Africa in preparation for using a newly developed program to get the analog data on those charts digitized and added to a world data base.

DARE project with African Centre of Meteorological Applications for Development (ACMAD)

With funding from Belgium, WMO sent experts in 46 African countries to locate and image hydromet data in 1980s-early 1990s [DARE-I]. Microfiches of over 30 million old observations from about 1000 sites were produced with copies sent to participating countries. The microfiche master set was handed over to ACMAD around the mid 1990s. With funding from USAID we are working with ACMAD to convert these nearly 2,000,000 microfiched images of historic weather observations into digital images as the first step in getting those data digitized. Additionally, in discussions with USAID and ACMAD, IEDRO will work with the International Research Institute (IRI) at Columbia University to identify hydrometeorological applications that use these digitized historic data for the production of value-added products to benefit all National Meteorological and Hydrologic Services (NMHS) and their citizens. With ACMAD's support, IEDRO is involved in the following:

- Inventorying all the DARE-I microfiches (about 100 thousand) to ensure all theh DARE-I images have been rescued.
- Scanning all DARE-I images and storing them in a digital format (i.e. JPEG)
- Training of ACMAD/country experts on scanning of microfiches, creation of images library , data keying and entry into the national and continental databases
- Providing an efficient and accurate method to get the data on these rescued microfiche into a digital data base
- With the availability of sufficient funding, we hope to provide on the job training on data rescue and data applications at ACMAD for countries and organize workshops to produce climate indices, Atlases and other added value products using rescued data with each country expert bringing back a copy of digitized data in a Climsoft managed database interfaced with application tools (RCLIMDEX, CPT, Excell, GIS macros…) for climate monitoring and forecasting products .

Appendix G: Tanzania Meteorological Agency Climate Services Development Project.

The Tanzania Meteorological Agency (TMA) and the Met Office in the UK have just started (March 2014) an 18 month Climate Services Development Project funded by the UK Department for International Development (DFID). The Project is aligned with both the UK Millennium Development Goals and the Global Framework for Climate Services (GFCS).

The project has two phases: a user engagement phase, to identify and document the user requirements for the climate vulnerable socio-economic sectors in Tanzania; and a data rescue phase to create a digital database of the high priority historical paper-based meteorological data to underpin the creation of user-relevant climate services in Tanzania. The outputs from this project will form a firm foundation for the development and delivery of effective climate services within Tanzania.

Appendix H: Collaborative research on the meteorological and botanical history of the Indian Ocean, 1600-1900.

The Centre for World Environmental History (CWEH – University of Sussex) in the UK is leading an UK Arts and Humanities Research Council (AHRC)-funded Network Project "Collaborative research on the meteorological and botanical history of the Indian Ocean, 1600-1900". The purpose of the network is to facilitate collaborative research on the meteorological and botanical history of the Indian Ocean World (IOW) in order to gain deeper understanding of the nature of climate-society interactions through history and inform contemporary adaptation and disaster management (http://www.sussex.ac.uk/cweh/newsandevents/conferences/iow).

This pioneering project will integrate the eclectic disciplines involved in study of society-climate interactions in the IOW, both past and present, in order to benefit research into developmental and policy issues, climatology and cultural studies of the environment. The network will also forge and strengthen engagement between non-academics and academics of various disciplines, and to develop institutional and academic partnerships in the UK, Europe, India, Sri Lanka, China, Southeast Asia, Australia and East Africa. Ultimately, the network will provide a technical roadmap towards a digitisation project to facilitate wider access to the materials mentioned.

Appendix I: The Southern African Science Service Centre for Climate Change and Adaptive Land Management (SASSCAL)

SASSCAL - a Regional Science Service Centre (RSSC) in Southern Africa -,is a joint initiative of Angola, Botswana, Namibia, South Africa, Zambia, and Germany, responding to the challenges of global change (http://www.sasscal.org/).

The current processes of global change, which include, for example, demographic change, climate change and the globalisation of economic systems, are an enormous challenge for societies worldwide. Climate change is affecting the lives of millions of people in Africa, Europe and many other parts of the world. Current projections on future developments indicate that there is an urgent need to develop concepts on how to adapt to these challenges in due course. Science and research offer proactive approaches to deal with the current and future changes expected. The role of science is to be understood as a service to those societies that are most severely affected by climate change and to provide the relevant decision-makers with evidence-based results and advice.

The establishment of a Southern African Science Service Centre for Climate Change and Adaptive Land Management could create added value for the whole southern African region. It should be conceptualised and operationalised to complement the excellent existing research and capacity development infrastructures and research initiatives in the region. It should be embedded in the regional and national research.

Mission:

To conduct problem-oriented research in the area of adaptation to climate and change and sustainable land management, and provide evidence-based advice for all decision-makers and stakeholders to improve the livelihoods of people in the region and to contribute to the creation of an African knowledge-based society.

Objectives:

In order to meet the demands of target groups such as policy-makers and governmental administration, farmers, practitioners and other regional and local stakeholders affected by climate change, the center(s) should have the following three main objectives that are closely interrelated and that should be taken into account with equal priority:

- Trans-disciplinary, applied oriented research for people
- Services and advice for policy, decision makers and stakeholders
- Capacity development

The initiative is based on a decade of successful scientific cooperation and goes beyond research projects towards a new quality i.e. the establishment of research infrastructures. In parallel to this initiative in southern Africa, in West Africa a West African Science Service Center on Climate change and Adapted Land Use (WASCAL) is presently being developed.

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WMO guidelines and reference documents on climate Data and Monitoring
http://www.wmo.int/pages/prog/wcp/wcdmp/series.php

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