Evolution of CLIMSOFT Climate Data Management System

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Training Workshop on Objective Climate Forecasts for Agriculture and Food Security Sector in Eastern and Southern Africa

Elephant Hills Hotel, Victoria Falls, 30 August to 4 September 2021

Climate Data Processing Before Advent of the PC

- Before the advent of computers, long-term storage of climate observation data was on paper records.
- Typically, observations recorded in the daily observation register at prescribed observation hours was transcribed onto monthly climate returns containing summarized observation records for each month for a given observing station.
- This manual process of transcribing meteorological observation data from one paper record to another was laborious and prone to human error.
- The storage of the paper records and retrieval of required climate information was another challenging exercise.
- With the introduction of computers in NMHSs, climate data was initially stored on punch cards.

Image of Monthly Climate Return

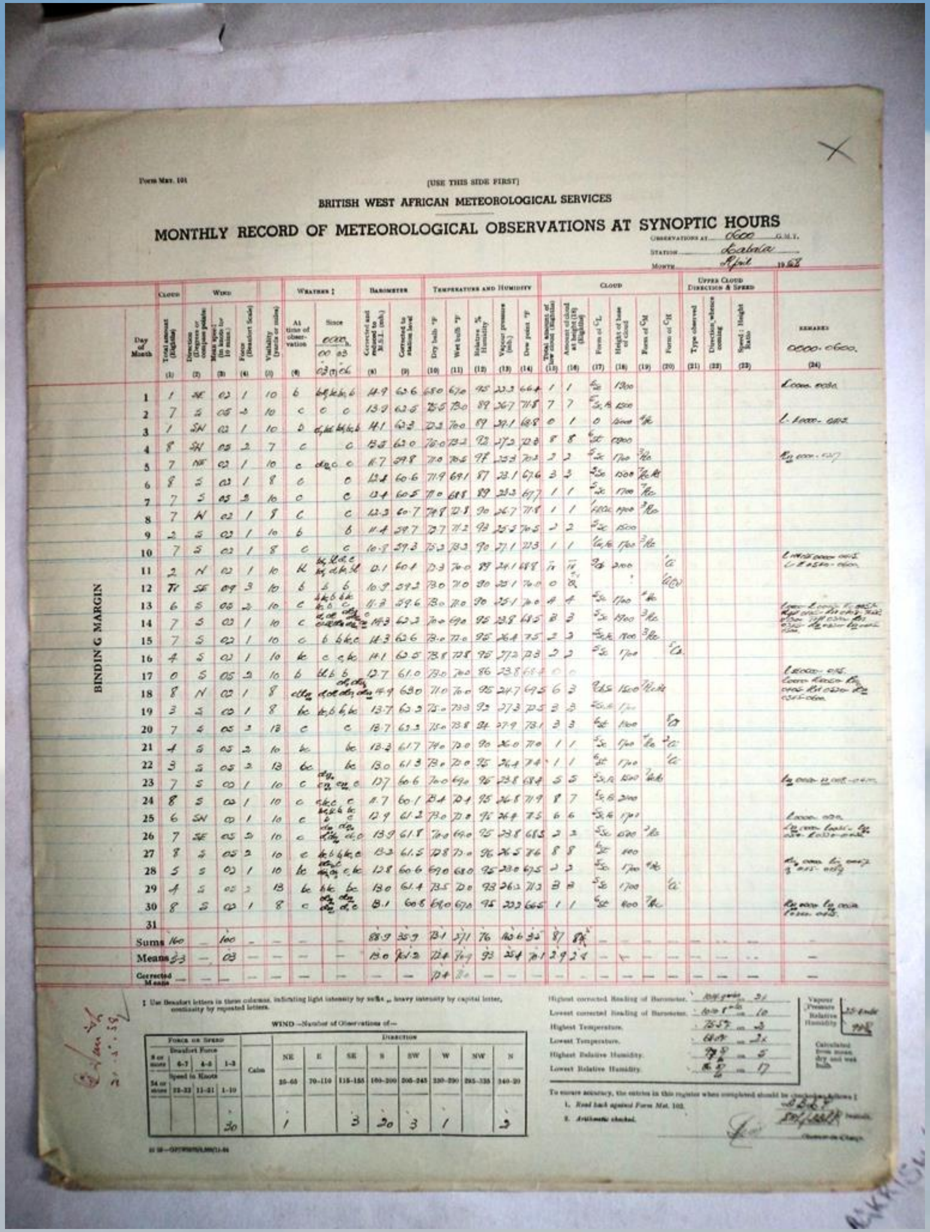
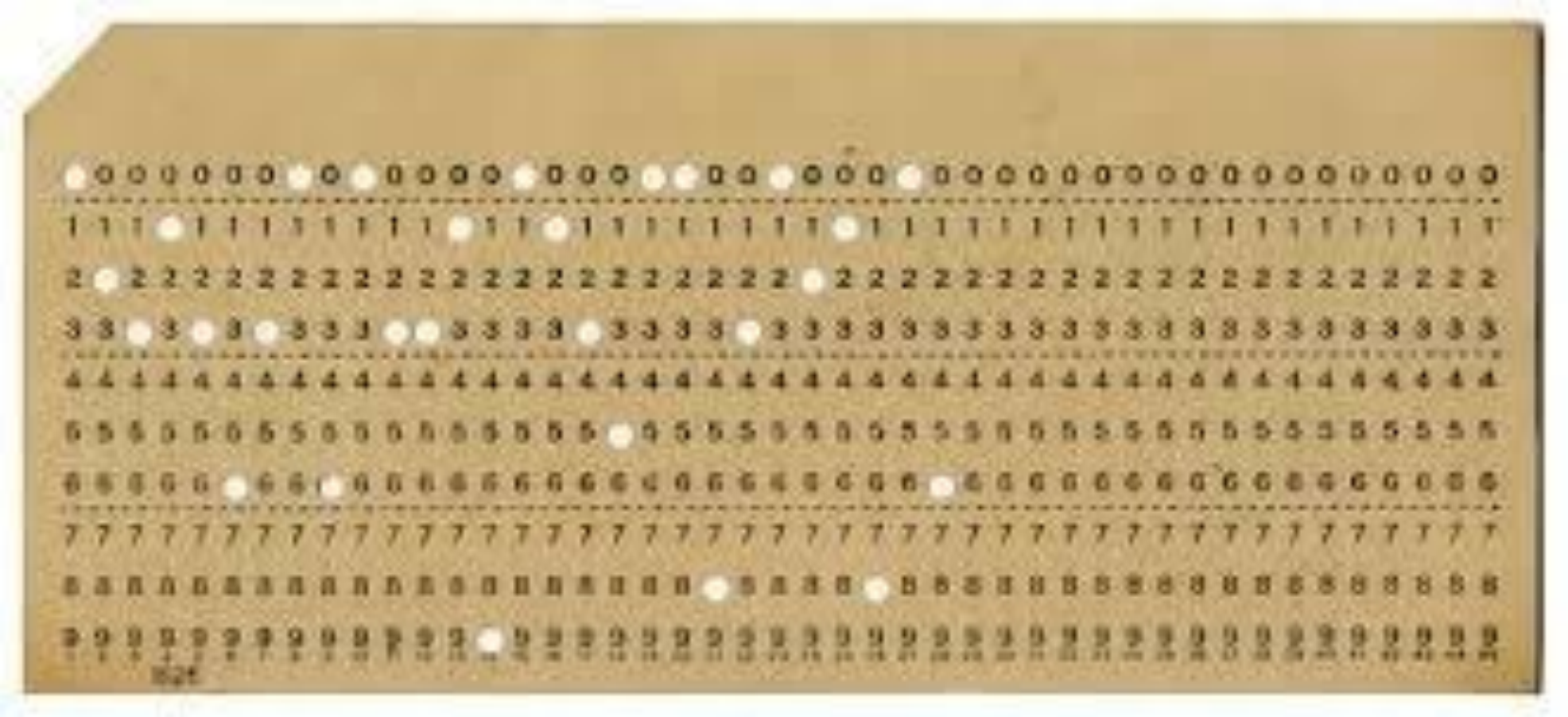


Image of Punch Card



CLICOM Era (1985 – 1999)

- As the use of computers became widespread, especially the desktop PC, WMO established the CLICOM project in 1985
- CLICOM is acronym for CLIMatic COMputing
- CLICOM software was originally developed at NOAA, USA
- CLICOM is considered one of the most successful WMO projects
- In 1999 CLICOM was operating in about 140 members countries of WMO
- One of the major accomplishments of the project was the establishment of CLICOM Area Support Centres (ASCs) viz, Santiago (Chile), Kuala Lumpur (Malaysia), Bridgetown (Barbados) and Moscow (Russian Federation).
- Much of the success of CLICOM was attributed to convenient packaging of hardware, CLICOM software, commercial software and adequate training
- Key development tools for CLICOM were FORTRAN, DataEase and DOS
- In the late 1990s CLICOM had reached its limit of development, with the release of CLICOM version 3.1
- Some of the challenges faced by CLICOM version 3.1 were the adaptation of the software to run on then emerging Operating Systems like Windows NT, and the emergence of more popular Windows-based DBMS like Oracle and MS Access
- A need arose for WMO to find ways for NMHSs to move towards new CDMS

Initial Steps of WMO Plans for future CDMS

- May, 1997, CCl meeting on future CDMS, Toulouse, France
- November 1998, CCl Task Group came up with list of requirements for future CDMS and proposed options to follow
- December 1998, CCl Working Group on Climate Data agreed with option preferred by Task Group to set up mechanism for evaluating prototypes of future CDMS
- March 1999, specification criteria table for future CDMS was completed. A questionnaire was also developed to identify NMHSs that were prepared to share their CDMS and those that were interest in assisting with a testing phase
- May – July 1999, WMO “Training Seminar on Climate Data Management Focusing on CLICOM/CLIPS Development and Evaluation”, ACMAD, Niger. **This was the seminar that gave birth to CLIMSOFT.**

WMO Training Seminar on Climate Data Management Focusing on CLICOM/CLIPS Development and Evaluation (3 May – 10 July 1999)

- One of the objectives of the workshop was “To explore the feasibility and desirability of developing a simplified and more modern version of the CLICOM project software based on Visual Basic programming language and MS Access database management system that could be attractive to those developing countries that are not yet successfully operating a CLICOM system.”
- Participants were drawn from a total of thirteen African countries: six French speaking countries (Benin, Cameroun, Côte d’Ivoire, Gabon, Guineé and Niger) and seven English speaking countries (Ethiopia, Gambia, Ghana, Kenya, Nigeria, Tanzania and Zimbabwe).
- Instructors were Ian Dale (University of Reading, UK), Peter Muraya (ICRAF, Kenya), Steve Palmer (UK Met Office), Steve Shaddock (WMO), Azzedine Saci (Algeria), Denis Stuber (Météo France), Radim Tolasz (Czech Hydromet)and Prof Roger Stern (University of Reading UK).
- The UK government provided 13 PCs plus copies of Office 97 and Visual Basic 6.0 for use by the participants, and the host ACMAD offered resource staff.

Start of New CDMS Development after the ACMAD Training Seminar

- Having been motivated by ideas from the 1999 training seminar at ACMAD, the development of a new CDMS was started in the Zimbabwe Met Service that same year.
- A small, rather informal team in the Zimbabwe Met Service was setup to work on the software development.
- The development work was done on the sidelines of the officially defined duties.

WMO Questionnaire on New CDMSs (1999)

- Towards the end of 1999, WMO sent out a questionnaire to identify NMHSs that were developing or had developed a CDMS they were willing to share with other NMHS.
- Following that questionnaire, there was a WMO CCl Task Group meeting held in Geneva from 3 to 5 May 2000, on Future WMO Climate Data Management Systems.

Analysis of WMO Questionnaire on New CDMSs (2000)

WMO Members offering to make their CDMSs available for use by other Members

	WMO Member	WMO Region	RDBMS used	Start date	Notes
1	Argentina	III	ORACLE	June 2000	
2	Australia	V	ORACLE	operational	
3	Brazil	III	ORACLE		
4	Czech Republic	VI	ORACLE	operational	
5	France	VI	ORACLE	end 2001	
6	Guinea	I	ACCESS		based on model developed at 1999 ACMAD workshop
7	Hungary	VI	ORACLE	operational	
8	Jordan	VI	ORACLE	01/01/2000	
9	Malaysia	V	ORACLE	April 2001	based on Australian model
10	Morocco	I	ORACLE	end 2002	
11	Peru	III	ACCESS		
12	Russian Federation	VI	any with JDBC **	end 2000	
13	Tunisia	I	ORACLE	February 2000	
14	United Kingdom	VI	ACCESS/generic SQL	not applicable	demonstration only, based on the Met. Office operational db
15	Zimbabwe	I	ACCESS		based on model developed at 1999 ACMAD workshop

Developments Towards CDMS Project with UKMO Sponsorship

- In 2000, having noted the positive developments of a new CDMS in the Zimbabwe Met Service, Prof Roger Stern paved the way for a proper project with sponsorship from the UK Met Office.
- The new CDMS under development was initially called Clicom2000.
- The UK Met Office then started by working on the strengthening of capacity in the CDMS development in Zimbabwe.
- An initial step involved making arrangements for Peter Muraya to visit ZIMMET in year 2000 to provide mentoring on CDMS development

Emergence of CLIMSOFT Core Development Team (2001)

- The UK Met Office in collaboration with WMO arranged a CDMS development meeting in Nairobi, bringing together 3 programmers namely Abdul Aziz Barry (Guineé), Samuel Machua (Kenya) and Albert Mhanda (Zimbabwe) under mentorship of Peter Muraya (Kenya).
- The name “CLIMSOFT”, an acronym for CLIMatological SOFTware, emerged during that meeting.

WMO CDMS Evaluation (2002)

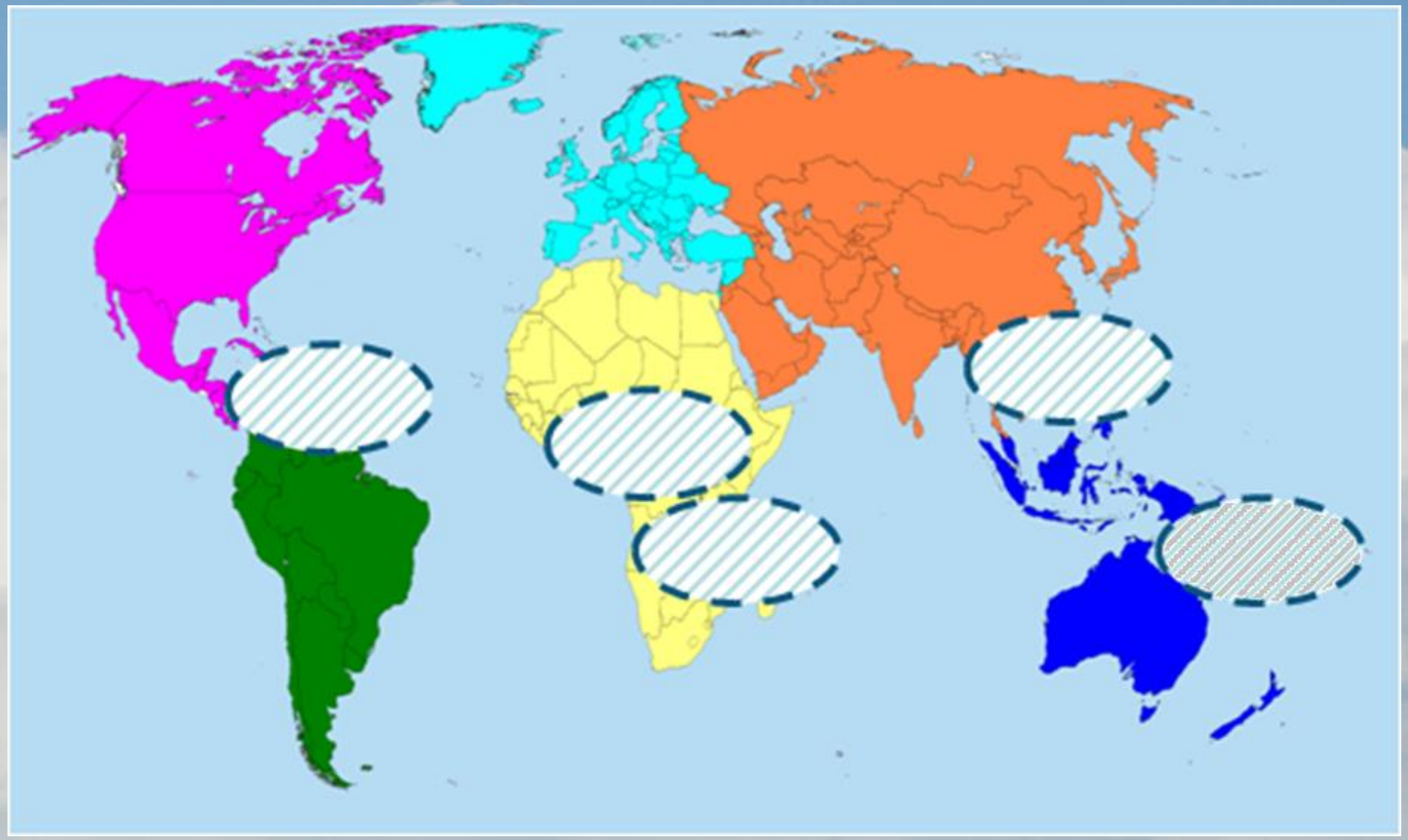
- In May 2002, a WMO CDMS evaluation meeting was held in Geneva, on the basis of the questionnaire analyzed in 2000. WMO drew up a final list of 7 countries for the evaluation.

	Country	**CDMS**
1	Australia	ADAM/iADAM
2	Czech Republic	CLIDATA
3	France	CLISYS
4	Jordan	CDMS
5	Russian Federation	CLIWARE
6	Tunisia	BDCLIM
7	Zimbabwe (*incorporating contribution from Guinea and Kenya*)	CLIMSOFT

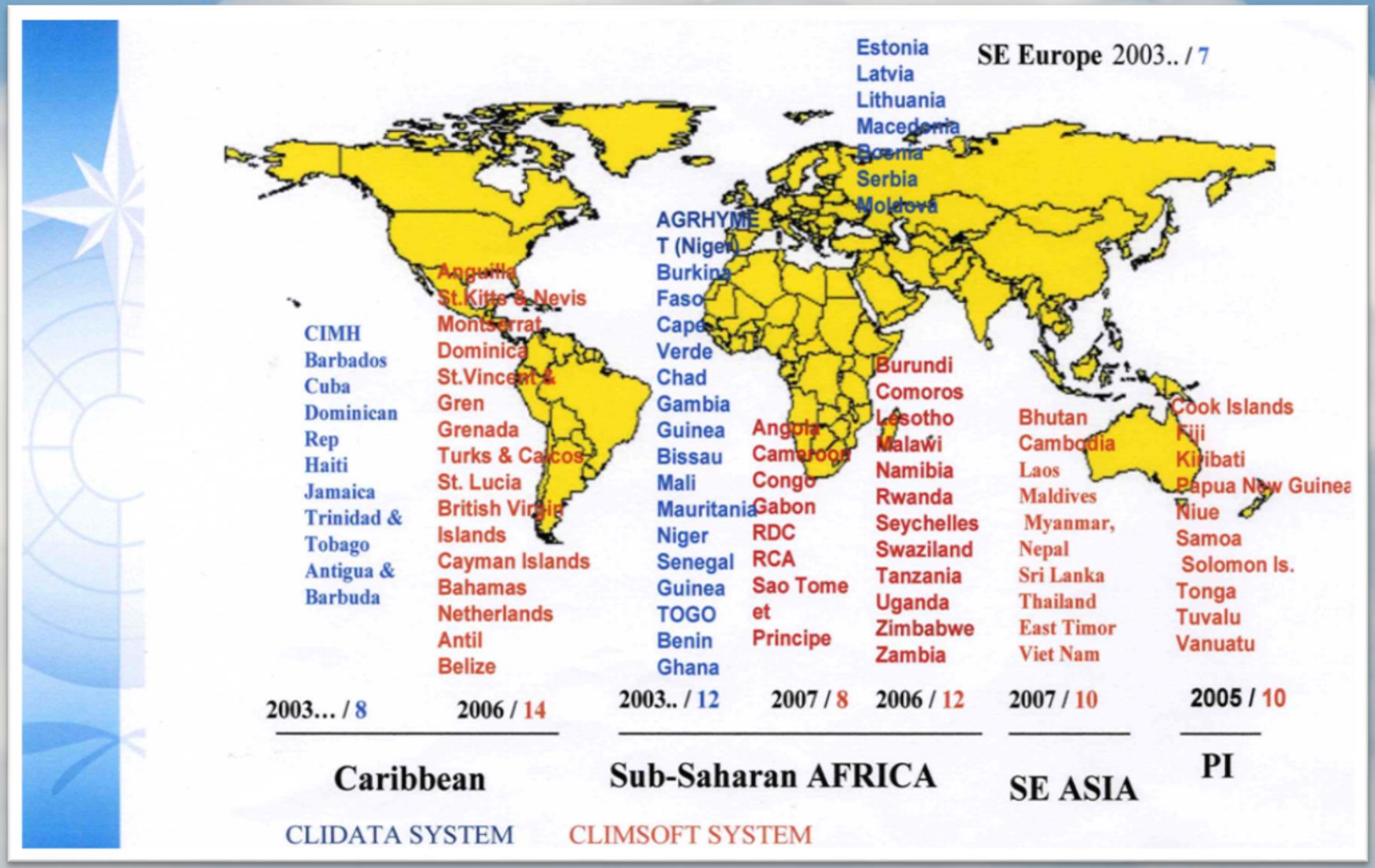
Distribution of CLIMSOFT CDMS after WMO Evaluation

- At the 2002 CDMS evaluation in Geneva, WMO noted the potential of CLIMSOFT as deserving support for implementation in developing countries.
- The CDMS was then distributed mostly through training workshops organized by WMO and UKMO.
- Onsite implementation was arranged in some countries, mostly to reinforce workshop training.
- BoM, Australia, initially supported implementation of CLIMSOFT in SW Pacific but later developed and distributed a new system called CliDE in that region.
- Some training activities on CLIMSOFT were conducted at ACMAD under AfDB project called Institutional Support for African Climate Institutions Project (ISACIP) Project

Overall Distribution of CLIMSOFT by Geographical Region



Early Distribution of CLIMSOFT and CLIDATA (by Geographical Region and Country)



Onsite CLIMSOFT Implementation (by Lead Developers)

1. Bhutan	8. Malawi
2. Botswana	9. Sierra Leone
3. Comoros	10. South Sudan
4. Guineé (*Lead Developer location – AAB)*	11. Sudan
5. Kenya (*Lead Developer location – SM*)	12. Zambia
6. Lesotho	13. Zimbabwe (*Lead Developer location – AM)*
7. Madagascar	14. ACMAD

CLIMSOFT Training under ISACIP Project at ACMAD (2011-13)

1. Burkina Faso	9. Guinea Bissau
2. Cameroon	10. Mali
3. Central African Republic (RCA)	11. Mozambique
4. Comoros	12. Niger
5. Djibouti	13. Nigeria
6. DRC	14. Tchad
7. Gabon	15. Togo
8. Gambia	16. Zambia

SASSCAL Contribution to CLIMSOFT

- SASSCAL is an acronym for Southern African Science Service Centre for Climate Change and Adaptive Land Management
- This a project involving Germany and five countries in Southern Africa namely Angola, Botswana, Namibia, South Africa and Zambia.
- SASSCAL became a partner on the CLIMSOFT project alongside WMO, UK Met Office, ACMAD, and NMHSs of Guineé, Kenya and Zimbabwe
- SASSCAL actively supported the implementation of CLIMSOFT in Angola, Botswana and Zambia.

Steps Towards Enhanced Support of CLIMSOFT Users

- The CDMS was originally targeted at NMHSs in developing countries. Part of the idea was to also equip the NMHSs with the capacity to maintain and customize the CDMS unlike other CDMSs where software maintenance was left entirely to the supplier.
- Online discussion forum was setup through the Met-elearning Moodle providing a platform for a wide community to share experiences and assist one another in solving implementation problems.
- One of the resolutions of the WMO RA I 15th Session held in Morocco in 2010 was to set up a CLIMSOFT Desk at ACMAD to support training and distribution of CLIMSOFT in Africa.

Move Towards Open Source Community Development Model

- CLIMSOFT was naturally suited for community development, starting with three lead developers in different African countries.
- The idea of an open-source approach to the further development of CLIMSOFT was accepted by the CLIMSOFT Project Steering Committee that was formed in Nairobi in July 2014.
- It was agreed that members of the steering committee would be comprised of the PR of Zimbabwe (Chair), PR of Kenya (Deputy Chair), PR of Guinea, ACMAD, WMO representative for East & Southern Africa, *plus representatives of UKMO and SASSCAL as ex-officio members.*
- A Technical Advisory Group (TAG) led by the original CLIMSOFT developers was also set up.
- With a view to sustainability, further steps were agreed to bring in more developers on board, starting with enhancing the capacity of a few identified potential developers from NMHSs in Africa.

Major Features of Successive CLIMSOFT Versions

Version	Major Characteristics
1 (2002)	- Entity relationships based on auto-numbers - System made up of three databases:- Temp work file, Intermediate database and Main database - One table for observation values in Intermediate and Main databases - Data transfer operations depended on Logbook (System developed for ICRAF by Peter Muraya) - Different attributes on an observation stored in different rows:Obs_val, obs_flag, obs_period, with observation_type as a separate table - Date and Time stored in four separate columns as Year, Month, Day and Time - Lon, Lat stored in different columns as deg, min, sec, NS, EW - Database storage in MS Access

Features of Successive CLIMSOFT Versions (*..Cont'd*)

Version	Major Characteristics
2 (2005)	- Logbook data transfer modules replaced by MS Access queries and VB routines. - Back-end database to MS Access introduced (SQLServer, MySQL, PostgreSQL). Connection to back-end database through Open Database Connectivity (ODBC) technology - Data ingestion from AWS

Features of Successive CLIMSOFT Versions (*..Cont'd*)

Version	Major Characteristics
3 (2007)	- Some earlier entities "phenomenon", "phenomenon_class", originally borrowed from CLIDATA were removed. "observation_type" was also removed - "station_location" table introduced - Date and time stored as one field - Output for RClimDex, CPT - Real-time data ingestion from AWS - TDCF encoding - Paper Archive introduced though not fully implemented - Ingestion of data from GTS, satellite estimates and NWP output - Lon lat stored as real numbers

Features of Successive CLIMSOFT Versions (…*Cont'd*)

Version	Major Characteristics
4 (2015)	- Developed in VB.NET - Use of MS Access database as front-end dropped - Previous three layers of databases combined into one database - MariaDB adopted as default database engine - ODBC connection replaced by direct connection to database from VB.NET code - Element_code changed to element_id - Pushing key-entry data to remote server with local backup

Features of Successive CLIMSOFT Versions (…*Cont'd*)

Version	Major Characteristics
5 (2021)	- Major changes in database design largely influenced by the needs of National Adaptation Planning (NAP) project - Data model re-designed to allow storage of geometrical data types (points and polygons) - Observation table partitioned to separate hourly/sub-hourly, daily and monthly data - Quality Control status flags changed to distinguish values that have gone through QC without errors and those values that have been QC'd and produced errors - New table has been added to store data on the movement of severe weather systems like tropical cyclones - Daily extremes determined by month instead of absolute extremes for all months - Provision for storing data on climate change indices generated from RClimDex - CDMS now interfaced with systems on climate change (GHG inventory database system, database on Ozone depleting substances, RClimDex - Flexible start month in the display of seasonal rainfall - Automated installation of database

Current Status

- Following the unsuccessful attempt to sustain the CLIMSOFT project at ACMAD, subsequent efforts to keep the project afloat as envisaged at the Nairobi meeting in 2016, soon fizzled out with the apparent demise of the fledgling CLIMSOFT Steering Committee.
- However, the development of the CDMS is gathering new momentum in Zimbabwe as the latest version of CLIMSOFT has now become an integrated climate and climate change system code-named ClimsoftPlus.
- Meanwhile, WMO is working on a concept for the development of an open-source climate data management system (OpenCDMS) with contributions expected from a broad section of the meteorological community. The idea is aimed at coming up with a "**Reference Climate Data Management Tool Set**". The strategy "aims to ensure that all nations have access to software tools they need to help them manage climate information to internationally accepted standards".

“Africa should not just wait to be exploited or influenced. No. We should be part of the conversation. We should raise ourselves to a level where there are certain terms we dictate in the conversation because we have a lot to offer.”, Paul Kagame

Thank You