

Development of a climate data visualization tool for interpretation of empirical results from climate model: Does it add value to different stakeholders?

UbuntuNet – Connect
Kigali, Rwanda –2013

Co-Authors

- i. Dr. Camilius SANGA
- ii. Neema SUMARI
- iii. Prof. Siza D. TUMBO

*Sokoine University of Agriculture,
Chuo Kikuu, Morogoro, Tanzania*

Presentation outline

- Introduction
- Methodology
- Results & Discussion
- Conclusion

Introduction

- Recently, there have been many researches done to address the effect of climate change
- The effect of climate change without integrating.
- Different researchers in different area of specialization include climatology, computer science, computer engineering, social science, chemists, physicists e.t.c.
- Little integration with other disciplines is the major weakness

Cont...

- Researchers in climate, crop and socio-economics have different predictions on climate change
- Simplifying data visualization remains a major challenge
- This paper presents a tool for data visualization for general purpose as well as climate data.

Data visualization

- Data visualization is the field dealing with visual representation of abstract data into more clear graphical way (Nocke et al., 2008).
- A graph must be able to communicate the information easily and effectively to the user.
- Since simulation models result into many outputs files consisting of spatial and complex data, there is need of a tool for data visualization

Data visualization (cont)

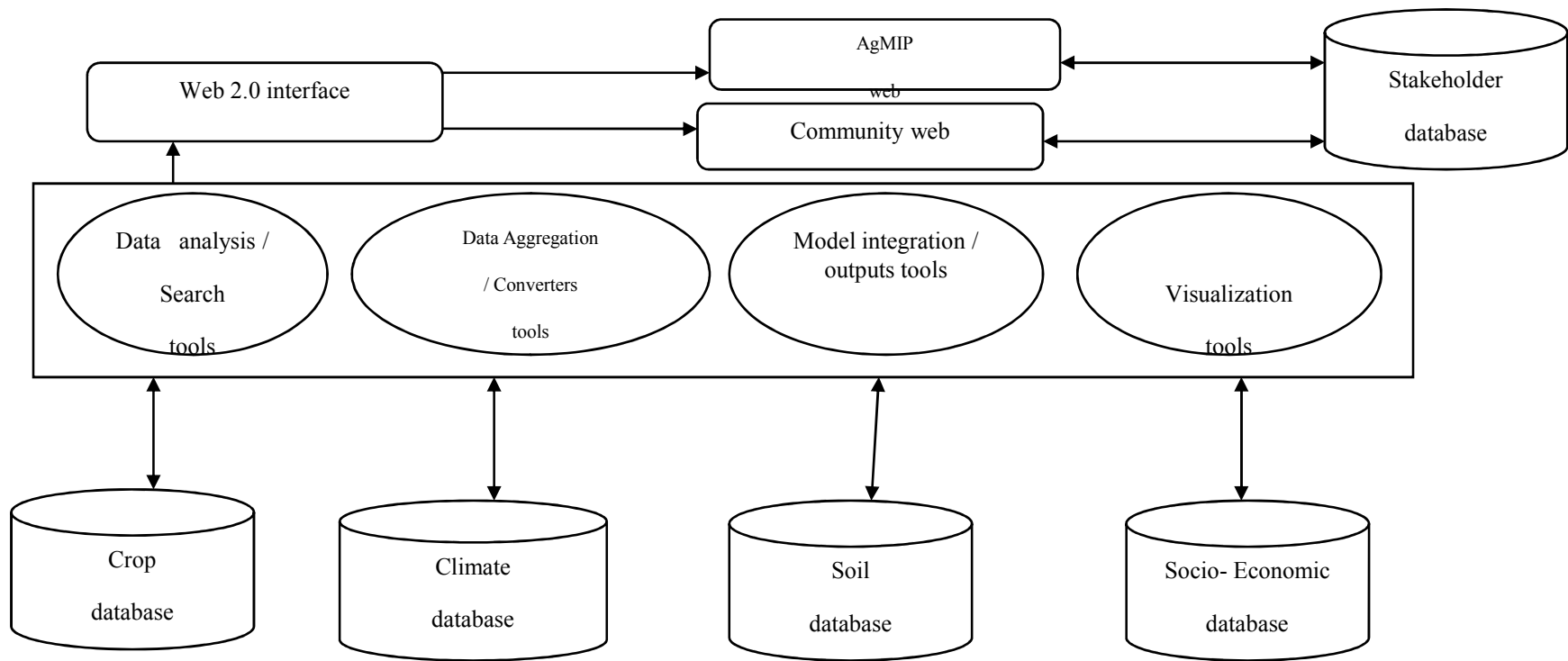
- Climate visualization tool are difficult to develop because of:
 - Heterogeneity of climate data and stakeholders
 - multidisciplinary nature of the experts needed to partner in looking for either general or specific purpose visualization system

Data visualization (cont...)

- The reasons for recently increased availability of tools for visualization of data related to climate are
 - advancement of ICT with resulted into lowering cost for computing devices (IPCC, 2007).
 - the need to assess climate in relation to other areas of science (for example socio-economic, crop and IT) (Rosenzweig et al., 2012a)
 - the computer methods, techniques and algorithms for developing interactivity for data visualization tools have increased substantially (Neset et al., 2009).

Data visualization (4)

- The good example of climate visualization tool is the web based climate visualization tool developed by University of the Cape Town (<http://cip.csag.uct.ac.za/webclient2/app/>).
- The problem of this type of general purpose visualization tool is that
 - it is not dynamic to accommodate any user inputs
 - and thus, does not allow any user to enter and analyse data.



- Data collection for climate, crop, soil and socio- economic datasets
- Set according to data types
- Archives into different databases for calibrating and validating a range of climatic, crop , and economic models
- Data conversion tools depending on available data to AgMIP data format
- System to enhance continous interaction /disemination / communication of key findings to all stakeholders including policy and decision makers at different levels through appropriate discussion groups/ blogs/ wiki etc and use of Dropbox / Google documents

Methodology

- The study involved an action oriented research
- Literature review
- a web- based visualization tool was developed using
 - iterative incremental software engineering methodology
- Existing data were collected from Tanzania Meteorology Agency (TMA) headquarter in Dar es Salaam

Action research methodology used

Phase	Specific Activities
Diagnosing	<ul style="list-style-type: none">• Semi-structured interviews with researchers,• Use of checklists by inspecting data available in national agricultural research centres• Assessing available literature review and climate data from TMA
Action planning	<ul style="list-style-type: none">• inception workshop in Enttebe, Uganda• several writeshop in Tanzania, Ethiopia, Kenya
Action taking	<ul style="list-style-type: none">• developing climate data visualization tool using prototype approach<ul style="list-style-type: none">• climate data visualization tool analysis and design• climate data visualization tool implementation• climate data visualization tool evaluation
Evaluation	<ul style="list-style-type: none">• climate data visualization tool demonstration to different researchers in workshop• Group Discussions with different researchers from Kenya, Uganda, Ethiopia and Tanzania to get their feedback
Specifying learning	<ul style="list-style-type: none">• Presentations in conference

Study area

- The simulated data which were used in this paper were collected from different weather stations. It consisted of weather data for 30 years from 1980 to 2010
 - Dar es Salaam airport,
 - Dodoma airport,
 - Mtwara airport,
 - Musoma MET,
 - Same MET,
 - Tanga airport,
 - Mbeya MET,
 - Mahenge MET,
 - Kisarawe Agriculture,
 - Lindi Agriculture and
 - Bukoba MET weather stations.

AgMIP data format for MET station

```
TZBU0QXX - Notepad
File Edit Format View Help
*WEATHER DATA : BUKOBA MET. STATION, Tanzania from bcMERRA output
@ INSI LAT LONG ELEV TAV AMP REFHT WNDHT
NLHA 51.967 5.633 7.0 -99.0 -99.0 1.5 2.0
@DATE YYYY MM DD SRAD TMAX TMIN RAIN WIND DEWP VPRS RHUM
1980001 1980 1 1 2.5 1.4 -1.2 6.2 3.5 0.2 6.2 92
1980002 1980 1 2 3.5 1.4 -6.5 0.0 1.7 -1.9 5.3 78
1980003 1980 1 3 1.5 0.1 -8.2 0.2 2.2 -3.0 4.9 80
1980004 1980 1 4 0.7 3.5 -0.3 3.0 4.5 1.1 6.6 84
1980001 1980 1 1 2.5 1.4 -1.2 4.2 3.5 0.2 6.2 92
1980002 1980 1 2 3.5 1.4 -6.5 15.4 1.7 -1.9 5.3 78
1980003 1980 1 3 1.5 0.1 -8.2 7.2 2.2 -3.0 4.9 80
1980004 1980 1 4 0.7 3.5 -0.3 7.5 4.5 1.1 6.6 84
```

RESULTS & DISCUSSION

- The data can be into different file formats but the challenge was how linking can be done without losing their original format (Wei & Cook, 2009).
- This led the system analyst to use the techniques of data warehouse in designing the data visualization tool.
- The reason behind this was that there were voluminous quantities of weather data which need to be cleaned, filtered, extracted, transformed and loaded into a knowledge engine ready for mining, searching and reporting (Fayyad et al., 1996).
- This process helped data fusion from different data sources and data formats (e.g. excel, database, flat files) stored for 30 years starting from 1980 to 2010.

Continuation

IJM15

- After the above data has been linked for visualization using AgMIP weather File Reader
- visualization results which specifying the range of date which one need to get its graph
- The type of graph can be for solar radiation, maximum temperature, minimum temperature, precipitation (rainfall), wind speed, dew point temperature, vapour pressure and relative humidity in a period of 30 years.

Slide 16

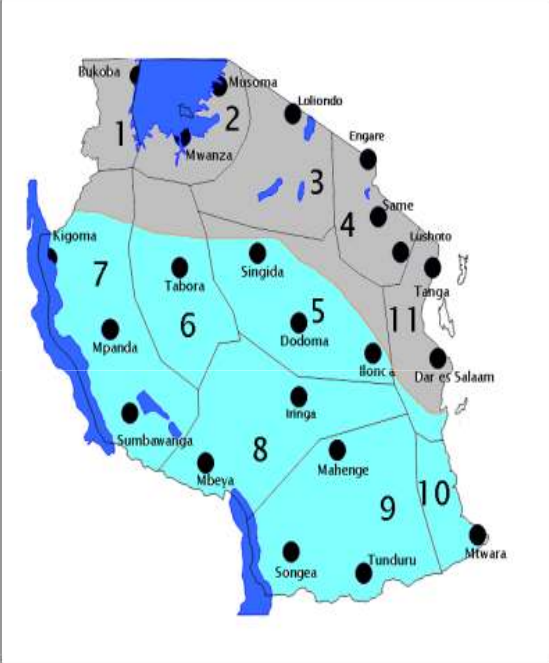
IJM15

The rule is broken again here

IJM, 11/13/2013

AgMIP weather file reader

AgMIP - Weather File Reader | © June 2013



The map shows 11 numbered regions in Tanzania with station locations marked by black dots:

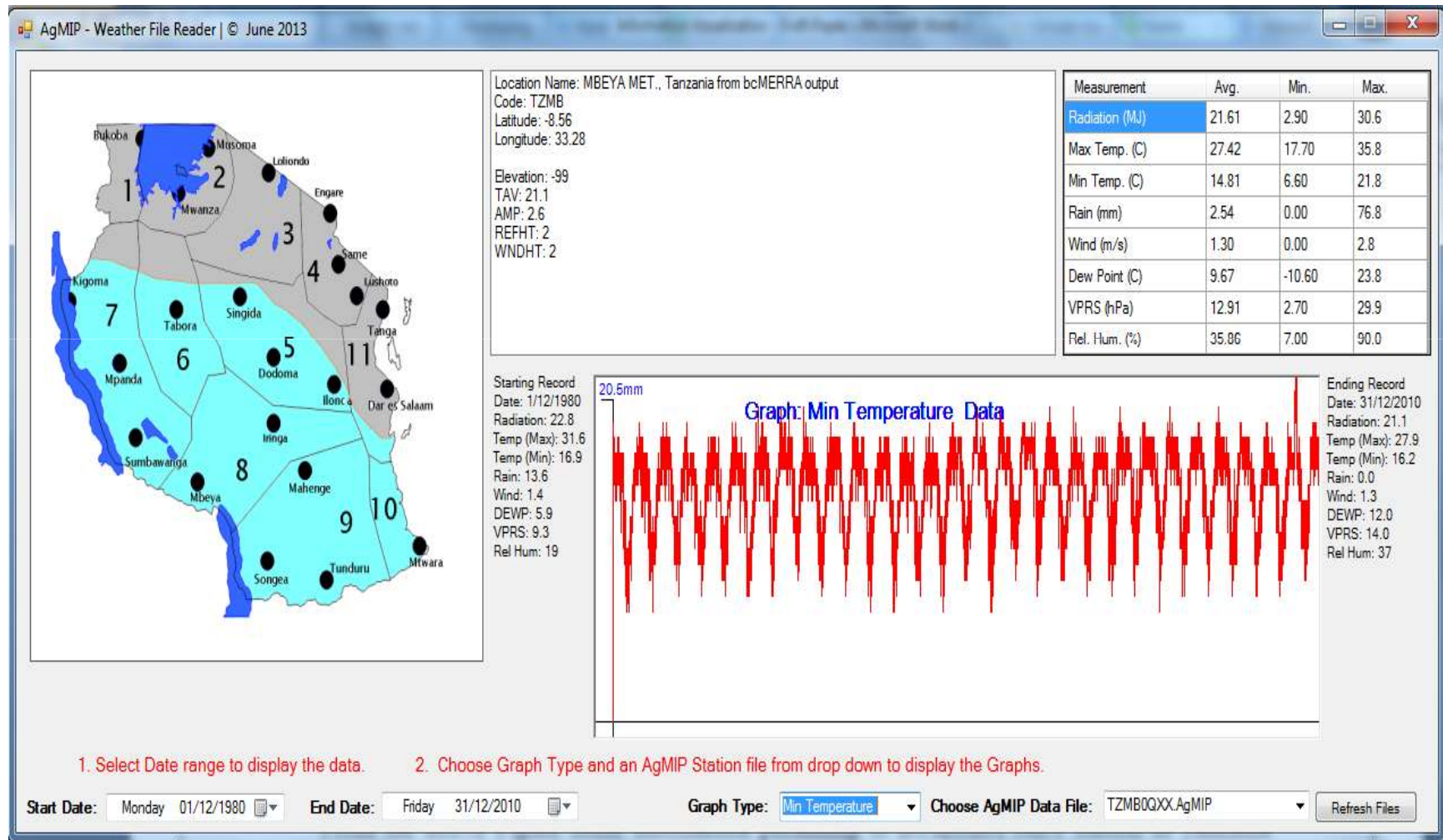
- 1: Bukoba, Masoma
- 2: Mwanza
- 3: Luliondo, Engare
- 4: Same, Lushoto
- 5: Singida, Dodoma
- 6: Tabora
- 7: Kigoma
- 8: Mpanda, Sumbawanga, Mbeya
- 9: Ininga, Mahenge
- 10: Songea, Tunduru
- 11: Tanga, Dar es Salaam

Measurement	Avg.	Min.	Max.
-------------	------	------	------

1. Select Date range to display the data. 2. Choose Graph Type and an AgMIP Station file from drop down to display the Graphs.

Start Date: Friday 01/01/2010 End Date: Friday 31/12/2010 Graph Type: Precipitation (Rain) Choose AgMIP Data File: TZBUQXXX.AgMIP Refresh Files

Output for the AgMIP - Weather Data Reader for Mbeya



Cont....

- The previous graph depicts the climate data for 30 years that is why temporal data abstraction technique was used in presenting the visualization of its climate data. IJM
- Its advantage is that it has wide applicability in representing different scenarios of data regardless of the origin of data.
- This technique is very useful for users who are experts in climate otherwise, for normal users it is difficult to understand the graphs produced by this technique.

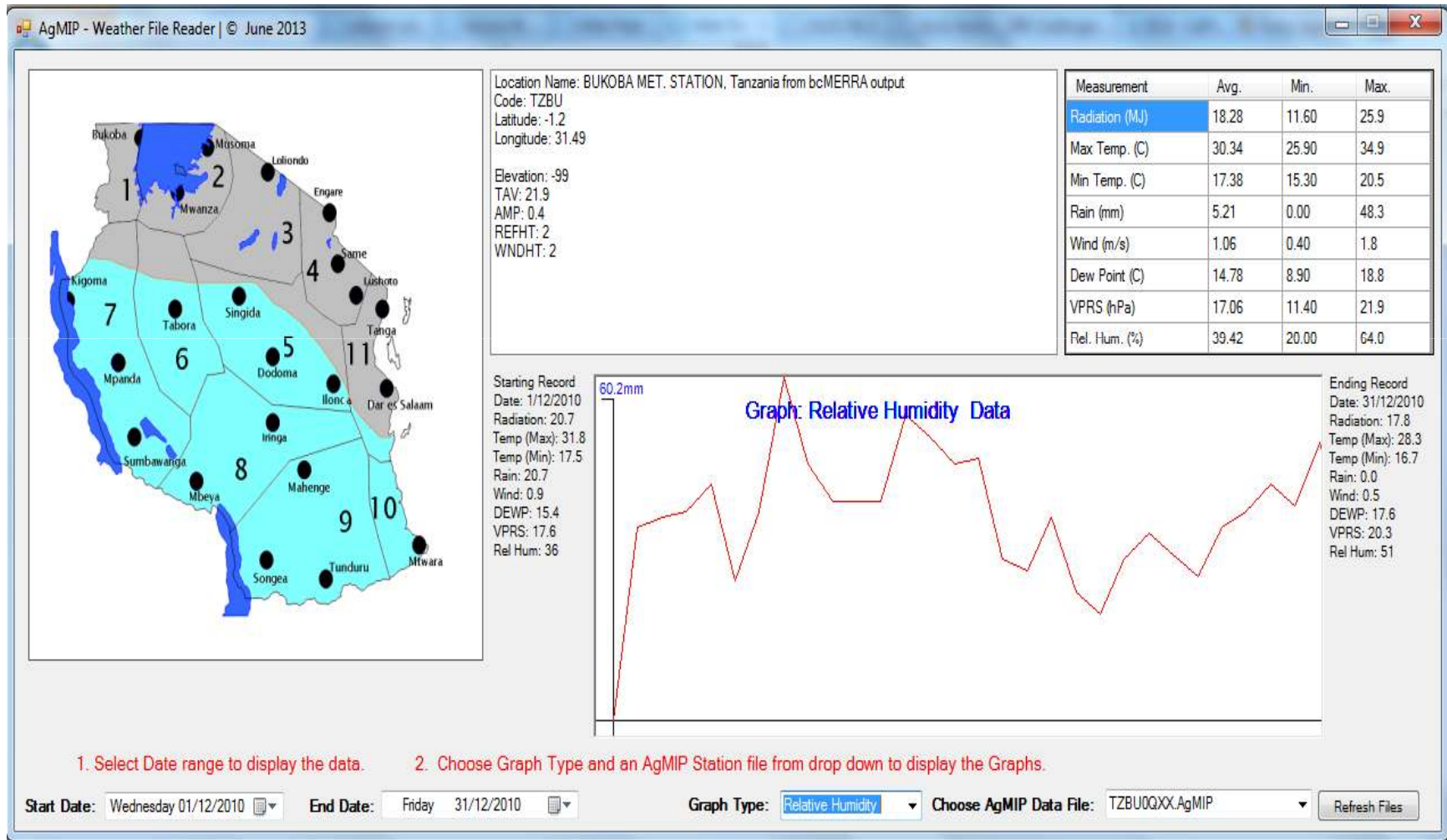
Slide 19

IJM16

Reduce the wording here

IJM, 11/13/2013

Output for the AgMIP – Relative Humidity Data Reader for Bukoba



Cont...

IJM1

- In previous Figure, the technique used was principal component analysis, and clustering of larger volumes of time-oriented data.
- Their advantage is that the user can get the abstracted view of data very easily (Aigner et al., 2008; Li, & Kraak, 2012).
- Also, another advantage is that the user can get the abstracted view of data very easily (Aigner et al., 2008).
- The PCA and clustering techniques are very good for normal user because of its detailed representation of data which can be understood by notice user.

Slide 21

IJM17

Reduce the wording here

IJM, 11/13/2013

Conclusion

- In our paper, we have presented the climate data visualization tool which allows
 - interactive display of map as per multi-dimensional data sets from multiple parameters of climate data after being analysed by climate models as per needs of different stakeholders.
- The tool has been developed using a participatory approach which was done easily because of the use of various communication channels
 - workshop,
 - writeshop,
 - blogs,
 - discussion forum,
 - social media pagethat supported different processes of research.

Cont....

- The developed tool is easy to use by different categories of users. It needs no prior knowledge in order to use it.
- Ladstädter et al. (2010) mentioned that climate data visualization tool must have the following novel characteristics, namely:
 - easy to visualize,
 - Easy to analyze and
 - Easy to explore features of interest such as trends, differences between datasets, or interdependencies between available parameters.

Thanks for Listening

Welcome for

Q

&

A