United Nations
Economic Commission for Africa

ACPC
African Climate Policy Centre

Current Progress of Work stream I: NWP and EWS Deployments

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Content

- Background & perspective - nature of the problem
- Conceptual design and development of NWP & EWS
  - E-infrastructure concepts
  - Architecture of the Weather-On-Demand (WOD) system
  - Client-Server implementation of the GFCS Climate Services Information System using RAMADDA
  - Data Analysis and Visualization: Client-Server implementation with RAMADDA and IDV
- Implementation strategy/deployments: African SIDS and Pan-African/Continental
- Conclusion
- Demonstrations

Background

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Climate Products and Services for Development Planning

	Next hour to 10 days	Season to year	Decade	Long term climate change
USERS	Local and national emergency service Governmental authorities Public	Local and national emergency service Construction companies Food suppliers	Urban planners Local to national govt Banks Companies	Legislators
APPLICATION	emergency planning activation and response Eg: evacuation	Urban & coastal areas seasonal preparation of Stocking of constrution materials	Long-term strategic planning Infrastructure development Land use zoning and planning Building codes	Adaptation planning
SERVICE	Short to medium term weather forecasts Eg tropical cyclone, storm surge, flood	Probabilistic seasonal to inter annual forecast eg: probabilities of severity and intensity of extreme events	Decadal climate trend analysis	Climate change scenarios

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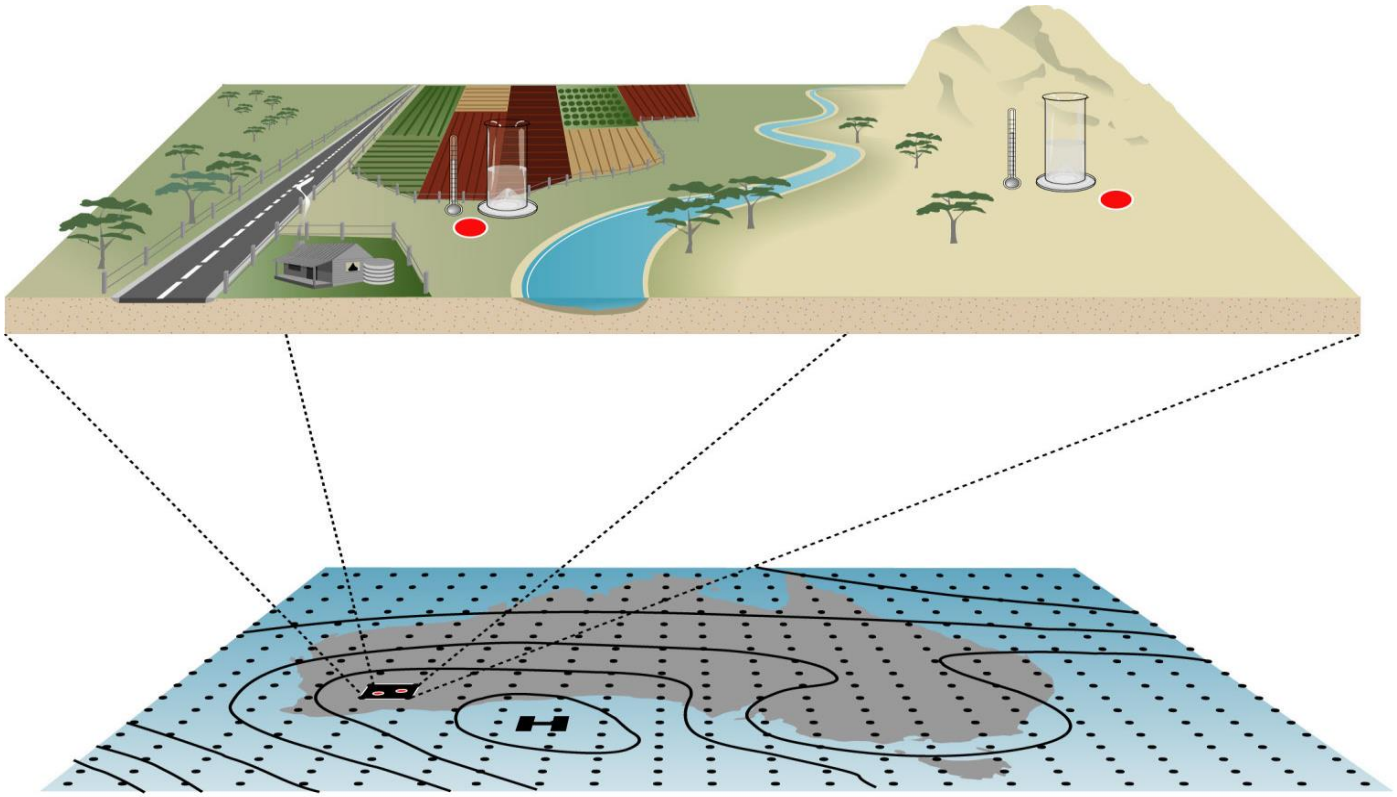
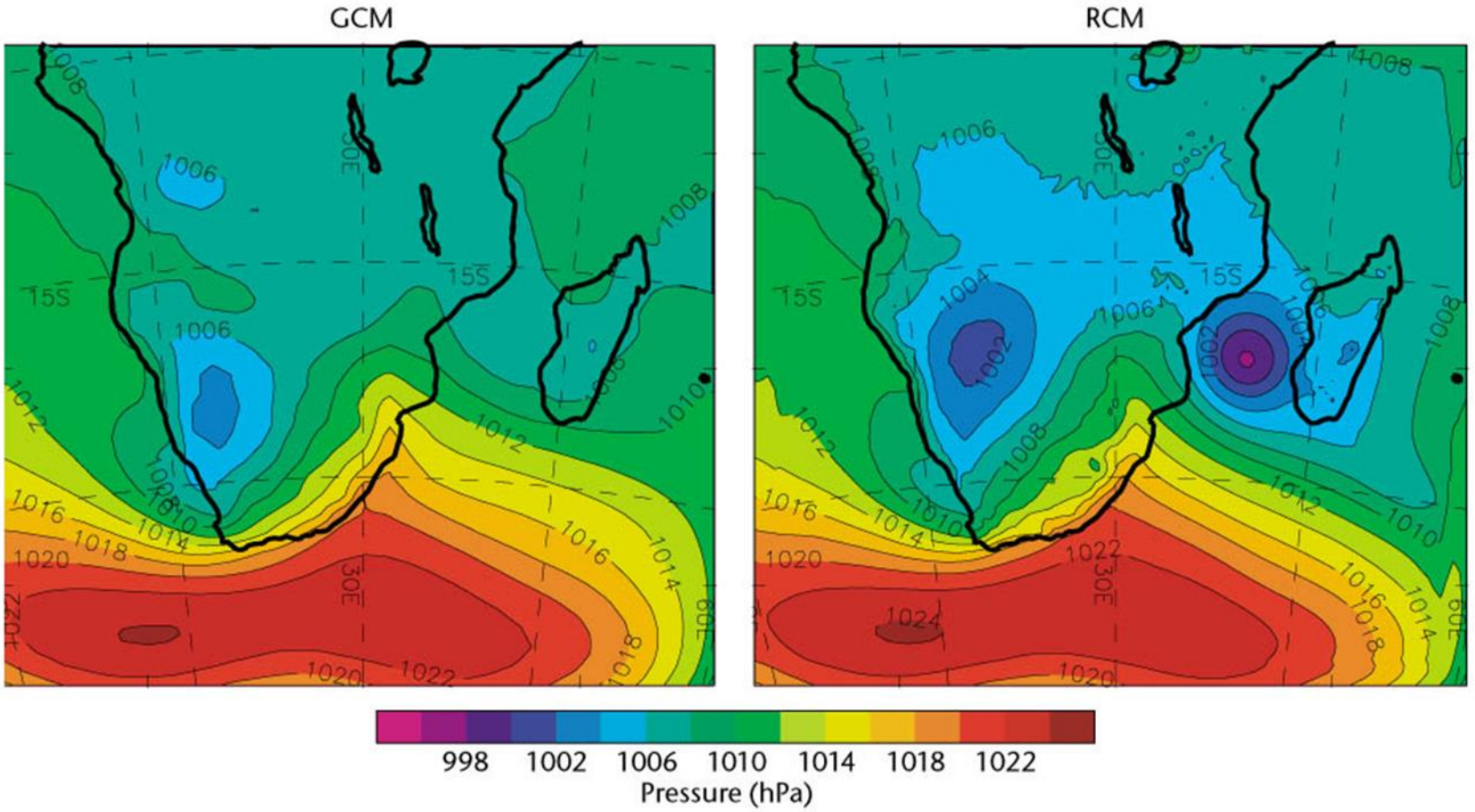
Downscaling

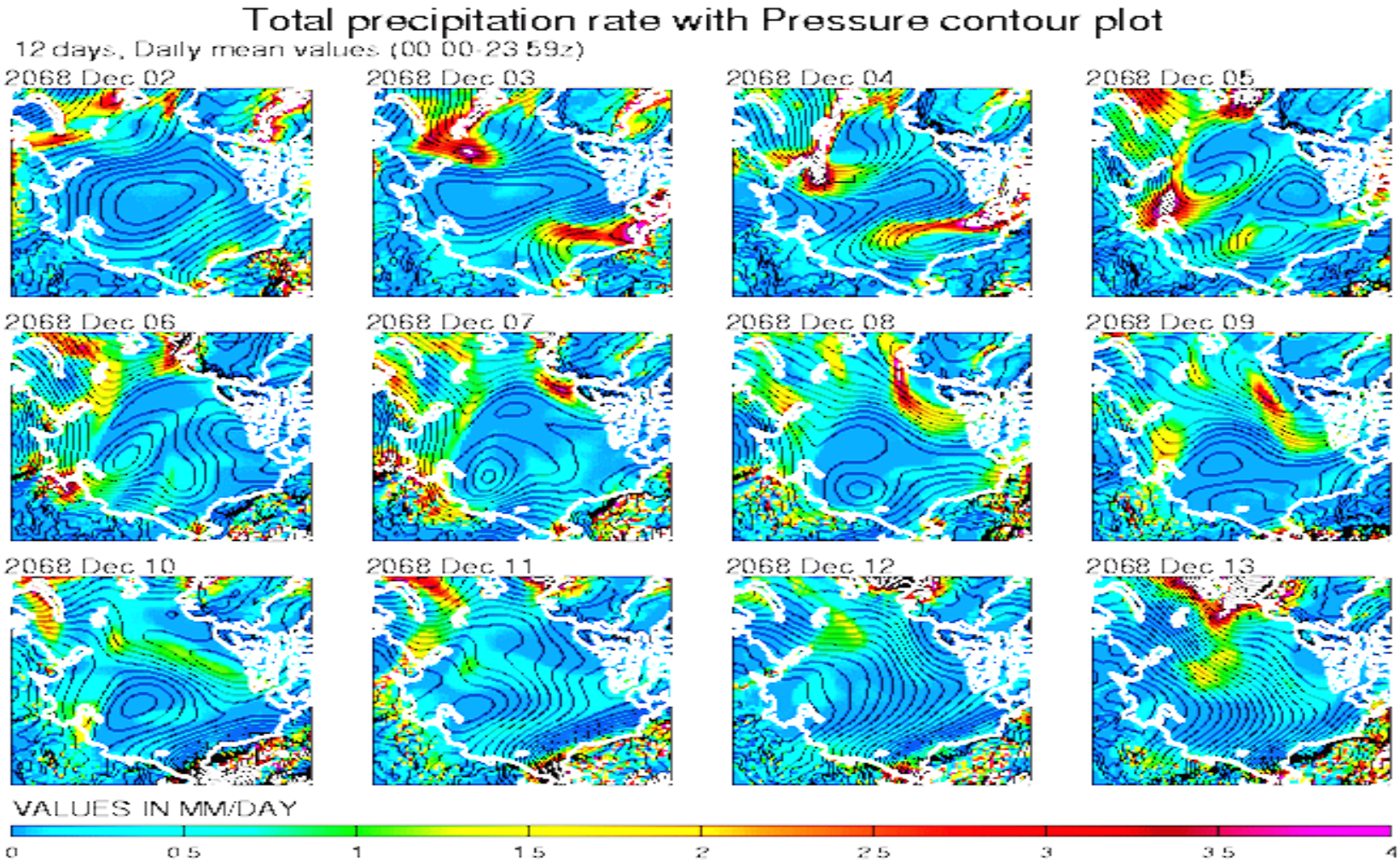


… from a global climate model (GCM) grid to the point of interest.

RCMs simulate extreme events e.g. tropical cyclones

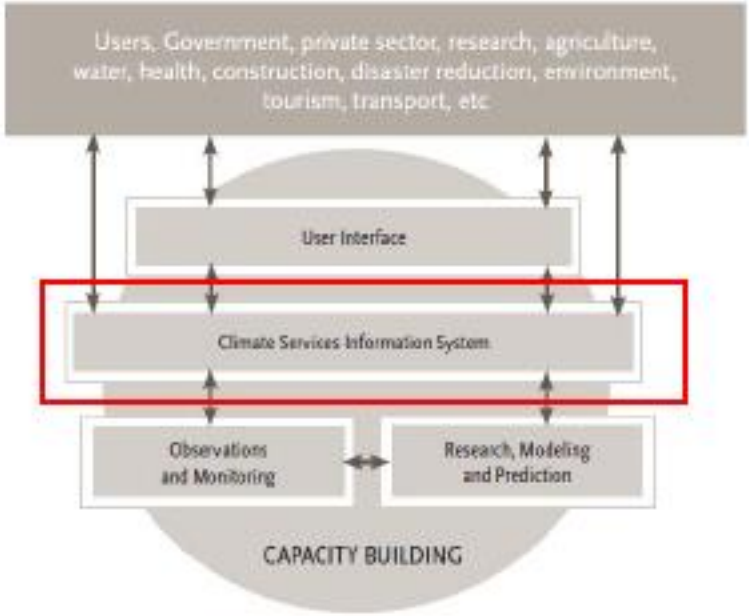


Regional climate models (RCMs) simulate high resolution weather and climate



Climate Services Information System (CSIS)

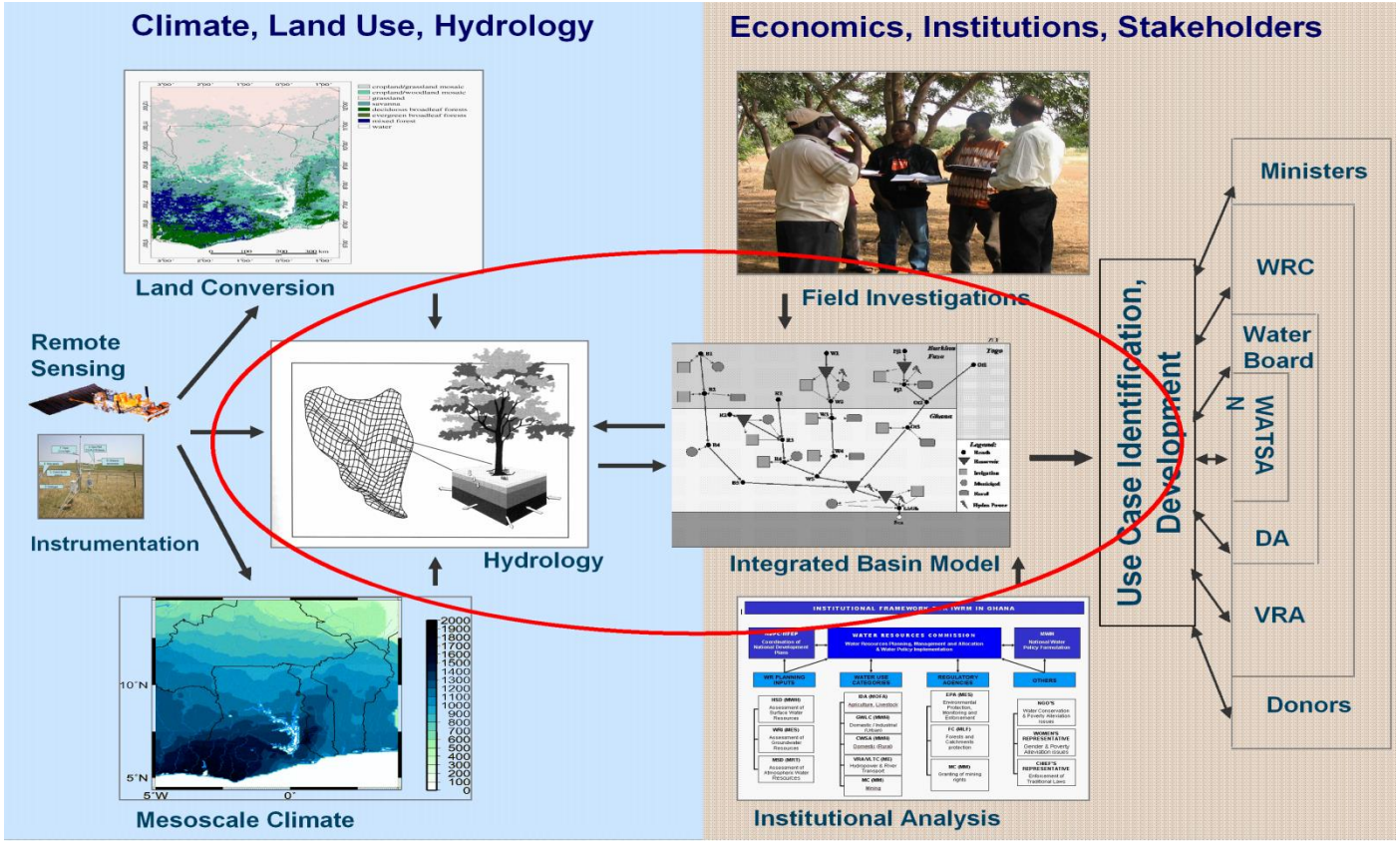
- Component of the Global Framework for Climate Services (GFCS) responsible for generation and dissemination of climate information.
- 'Operational centre' of the GFCS consisting of climate monitoring, prediction and projection.
- HLT report (p. 192): 'This is the system needed to collect, process and distribute climate data and information according to the needs of users as well as to the procedures agreed by governments and other data owners.'



Conceptual Framework of GFCS

Source: NCAR

Integrated and Comprehensive CIS Framework



Multi-disciplinary, multi-sectoral participatory action

Challenges to Delivery of Climate Information Services in Africa (WMO regional survey, 1996)

- Over 88 % of NMHS are challenged in delivering climate information services to support DRR
- 92% lack appropriate application software
- 96% need upgrading of operational infrastructure to support DRR
- 92% need technical training on production of climate products and services
- 85% say lack of effective co-ordination with other agencies involved in DRR impacts negatively on operations
- Significant investment required for effective delivery of CIS (at least $6mil per country)
- Very low capacity to assess economic utility of CIS

Design and Development

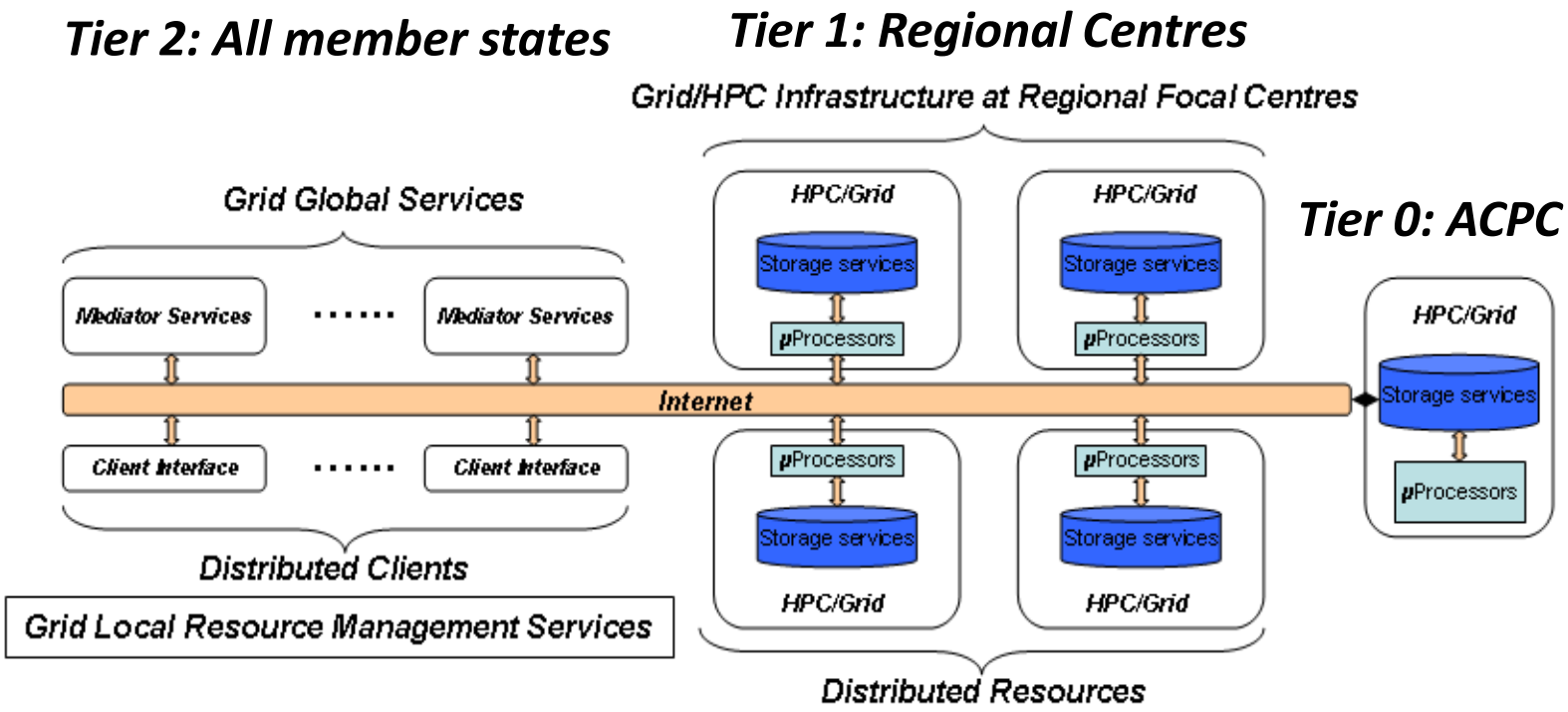
Approach - Multi-Tier Infrastructure

- Main Reasons
  - Climate modelling & analysis is far too expensive for countries to do it individually
  - Mission critical system based on the data repository should rely on high availability of e-infrastructure
  - Economics of Scale:
    - Cost-effective and more sustainable to have a shared system
- Long-term Reasons:
  - Sustainable approach on long term basis requires that there are no single point of failures

E-Infrastructure Concepts

- The e-infrastructure should be distributed and easily available to all users
- The e-infrastructure which would house the datasets would also have the capability of providing computationally-intensive services for modelling, data analysis and visualisation.
- The data analysis and visualisation component would be provided through a data portal complemented with a collection of Open source tools, data and methods (e.g. IDV, Google Earth/Map, VCDAT, OpenGIS, R, RClimdex, CDO, NCO, ClimSoft, etc).

ACPC Multi-Tier Data Infrastructure



Tier 0: Contains all open source data and tools in addition to ACPC data
Tier 1: Collaborating Centres with specialized data and tools (ICPAC)
Tier 2: All member countries accessing infrastructure via web interfaces

ACPC-ISOR Partnership: Objectives

The specific objectives of the collaboration were the following:

- Build capacity of NMHS staff on the use of the WRF atmospheric model for weather and seasonal forecasting, interpretation of model results, and the use of observations to verify and improve model simulations.
- Establish an Opensource state-of-the-art platform for integrating short to medium range weather forecasts, as well as seasonal forecasts, into already existing infrastructure at NMHS and RCCs.
- Improve understanding of existing model results and forecast verification, for improving decision-making on the time scale of days to weeks.

E-infrastructure requirements

Climate Models

A typical 50 km resolution simulation of 100-by-100 grid (e.g. West Africa) with atmospheric sulphur-cycle, for a 30-year simulation (2010):

- 2.5 months for 1 core
- 3 weeks for 4 cores
- 2 weeks for 8 cores

WOD infrastructure (Continental & SIDS)

9 km Pan African model 10-day forecast:

- 64 cores, 32x16GM RAM, 16x4TB HD, 3.3GHz
- 180GB per run (less than 3 hours)

1 km African SIDS model 7 days forecast (e.g. Guinea-Bissau)

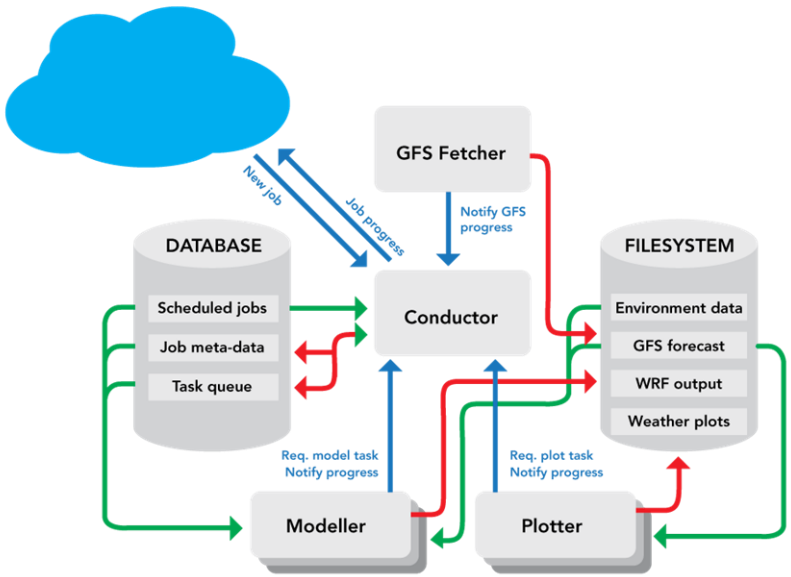
- 32 cores, 16 x 4GB RAM, 6 x 4.0TB HD, 2.3GHz
- 3GB per run (less than 3 hours)

Postprocessor(e.g. product generation, plotting)

- 16 cores, 4 x 4.0TB, 6 x 16GB RAM, 2.5 GHz

Architecture of the Weather-on-Demand (WOD) Infrastructure Numerical Weather Prediction & Early Warning System

The WOD system is built around a database, large file systems, the WRF-Chem atmospheric model and it's utilities and services



Conductor manages resources of the WOD system.

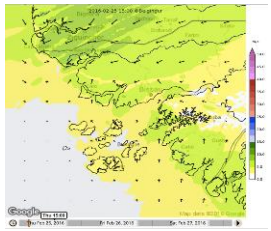
GFS Fetcher downloads weather data from NOAA as it becomes available, converts it into a format suitable for the WRF-Chem weather model

Modeler polls the Conductor for Tasks for running the weather model and notifies it on progress and completion.

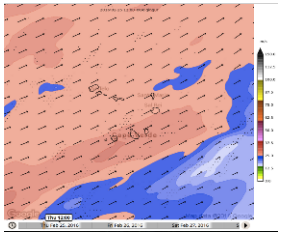
Plotter polls the Conductor for Tasks for generating weather plots

Major Implementations

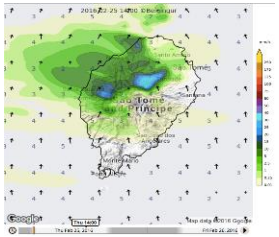
African SIDS Implementation (wind and rainfall)



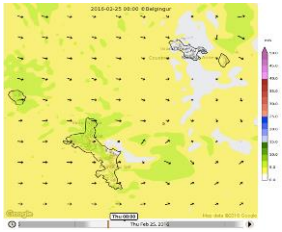
Guinea-Bissau



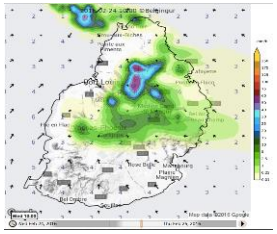
Cabo Verde



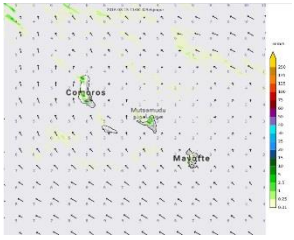
Sao Tome & Principe



Seychelles

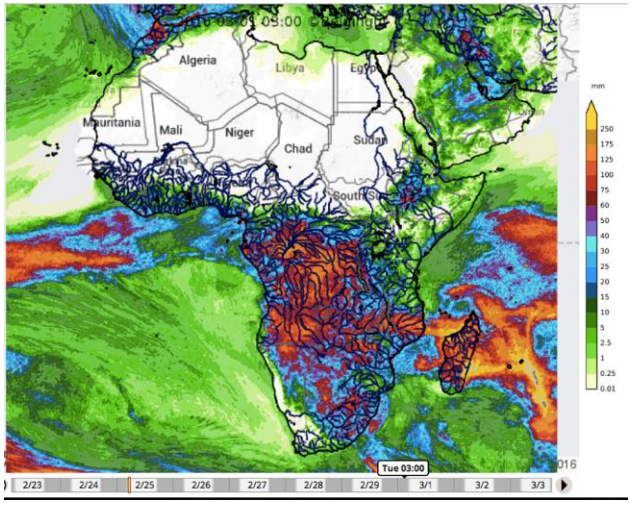


Mauritius

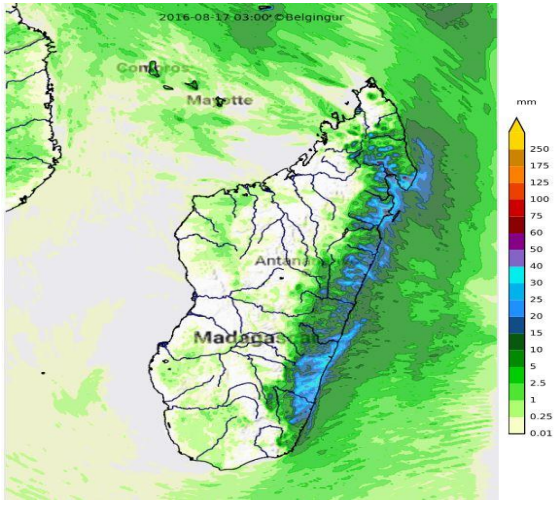


Comoros

Pan African Implementation (Accumulated rainfall)



Madagascar Implementation (Accumulated rainfall)



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http://uneca.belgingur.is/map/gnb.5-1.1.full/composite/2016-08-12T00:00+03:00

Thematic Real-time Environmental Distributed Data Services Data Server (THREDDS)

- THREDDS Data Server (TDS):
  - a web-based server which provides metadata and data access
  - provides several data access protocols (e.g. OPeNDAP and HTTP)
  - developed, distributed and supported by Unidata
  - written in Java and easily implemented by the Tomcat server

- Access to data sources is now available to users around the world using standard web browsers and appropriately enabled applications:
  - Integrated Data Viewer (IDV, Unidata)
  - McIDAS-V (McV, UW/SSEC)
  - VCDAT

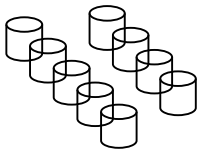
Repository for Archiving, Managing and Accessing Diverse Data (RAMADDA)

- **RAMADDA:**
  - a recent development effort in Unidata
  - a Java-base server that runs under Tomcat or can be run as a standalone application
  - content management system with a focus on earth science data
  - publishing platform
  - collaboration environment
  - extensible framework
  - implements a front end to THREDDS Data Server functionality

- **RAMADDA** provides new opportunities for data access:
  - preview/browse functions
  - collections search facility
  - federated servers provide transparent access to geographically-distributed data holdings

- ACPC data are currently being made available via RAMADDA on the ICTP Cluster

RAMADDA Publishing



Web UI

APIs
HTTP & FTP

Harvesters

Basic Services
CRUD
Search (federated)
Access control
Event notification
…

Viewing
Output Handlers

HTML
RSS
Catalog
OAI-PMH
OPeNDAP
KML
…

HTML

RSS

Catalog

Etc.

File, image, chat,Wiki page, link, script, …
DIF, THREDDS, …

Folders, Entries, Metadata,…

RDMS

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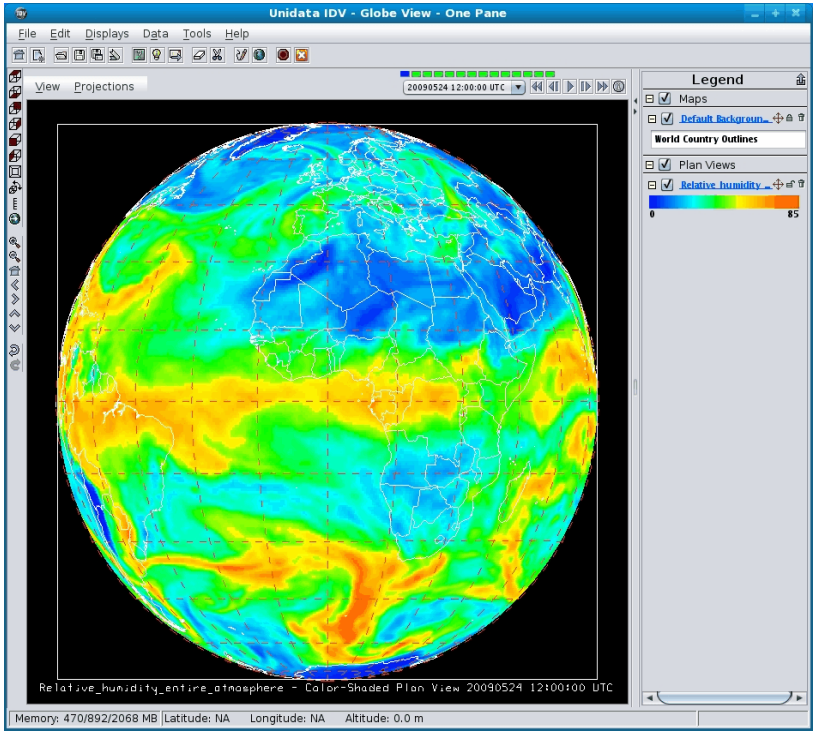
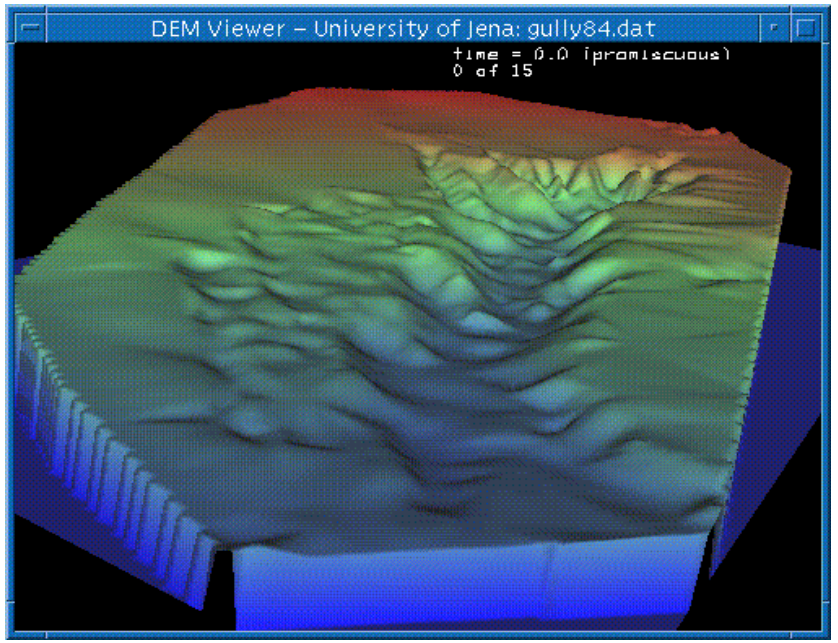
Integrated Data Viewer

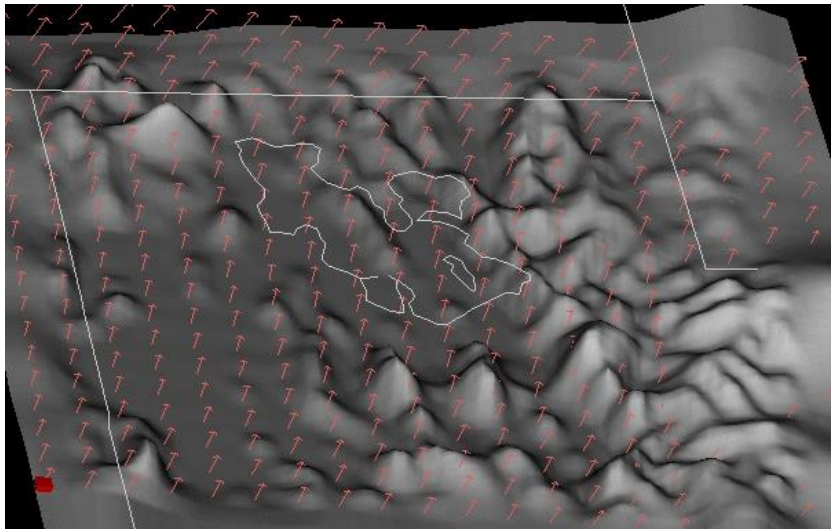
- A Java based software framework for analyzing and visualizing geoscience data based on the VISAD
- Provides the ability to analyze & display :
  - satellite imagery
  - gridded model output
  - surface, upper-air, wind profiler, lightning,
  - radar data
  - and much more …
- Can create a variety of displays:
  - 2-D horizontal contours/color-filled contours
  - 3-D iso-surfaces
  - vertical cross sections
  - interactive data probing
  - and much more…



IDV's Engine: VisAD's Data Model

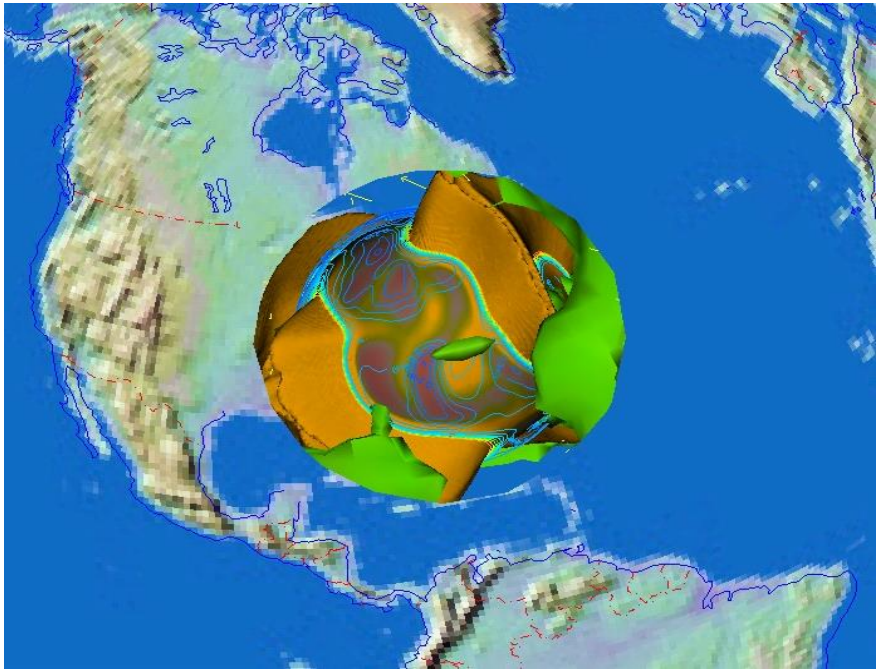
- Designed to support virtually any numerical data
- Metadata can be integrated into each data object
- Supports mathematical operations as well as evaluation and resampling of data
- Supports spatial and temporal co-location of data
- Supports data sharing among different users, different data sources and different scientific disciplines
- May be used independently of the display model





The IDV can integrate displays of a variety of geoscientific and other data including

- Scientific
- Georeferenced netCDF data
- Common atmospheric formats (grid, satellite, radar)
- Spatial
- ESRI shapefiles (e.g. map boundaries)
- ArcInfo ASCIIGRID (e.g., DEM)
- OGC Standards (WMS)
- Educational
- HTML
- Quicktime

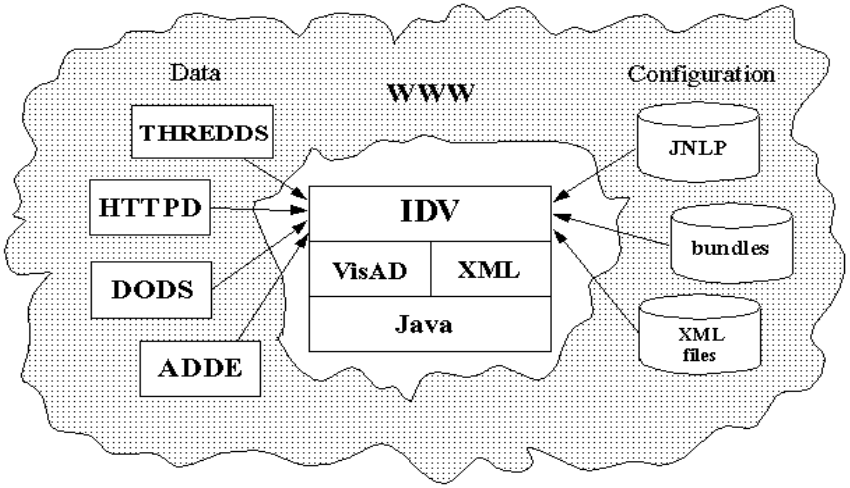


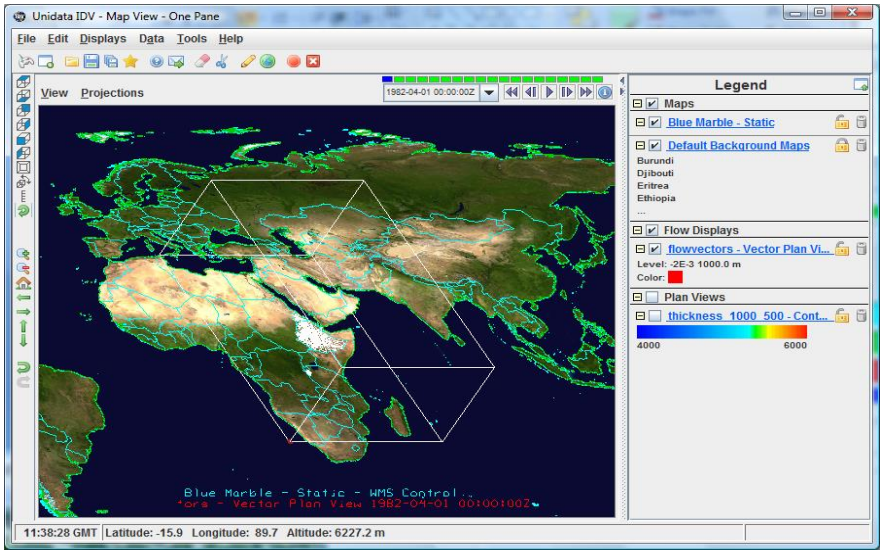
Coastlines (shapefile), topo image (jpg), and view into the mantle of geodynamical temperature model and seismic tomography

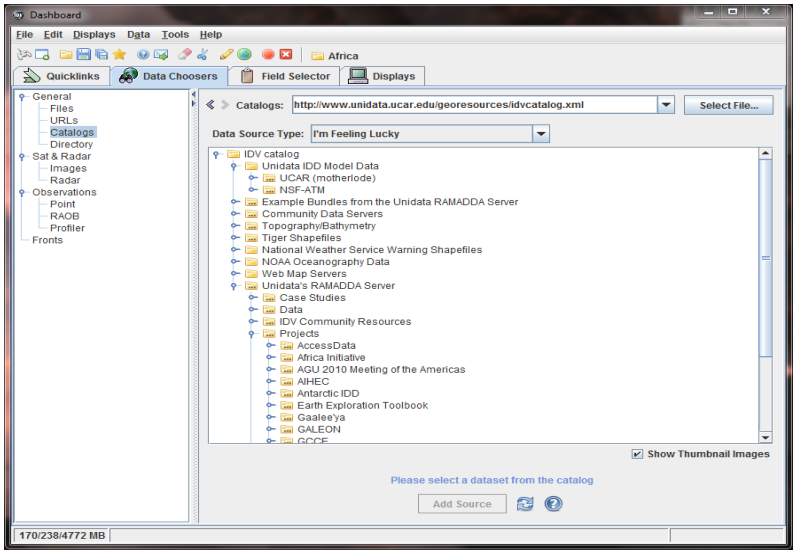
Source: NCAR

Web enabled features of IDV

- Client/Server data access
- XML Configuration
- XML Persistence
- Integrated HTML Viewer
- Use of Java Web Start
- Real-time collaboration







Source: NCAR

Implementation Strategy

Implementation Strategy

Support to countries:

- Analysis, design and implementation of national activities
- Accessing, collecting and analyzing data on climate variability and change and impacts
- Build capacities of countries to establish and use e-infrastructure (ICT, data, tools & network of institutions) to inform decision making
- Establish a community of practice to sustain the established systems

Implementation of strategy

- Build and strengthen strategic networks at different levels - national, regional and international
- Establish a Helpdesk to enable rapid resolution of problems
- Establish a local network of problem-solvers, mentors and advisors for all countries

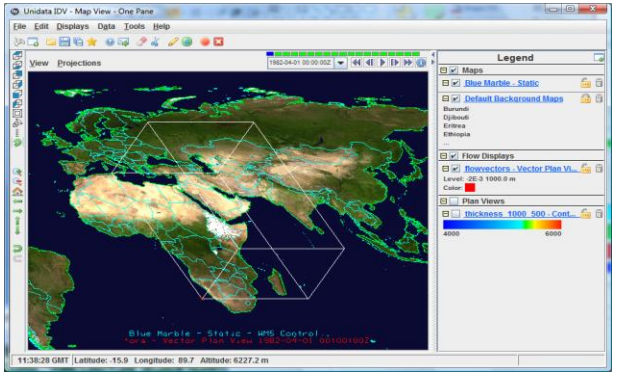
In-country technical support to focus on:

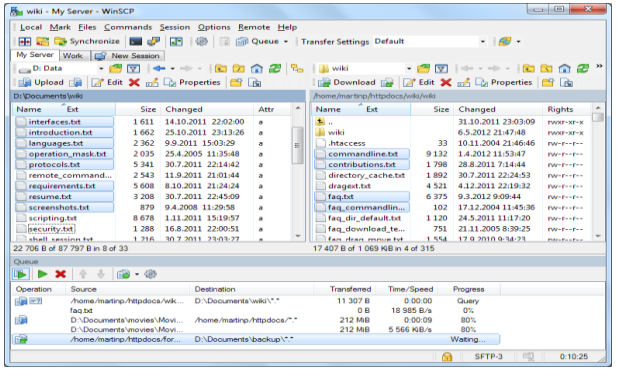
- Data collection, analysis and application of tools and methods
- Acquisition, use and management of data and information management e-infrastructure

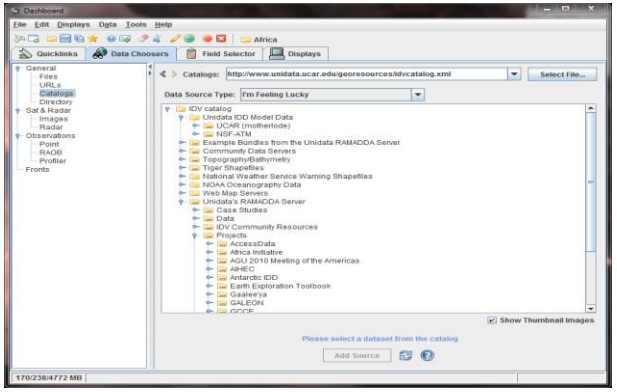
Summary & Conclusion 1

- First time such an e-infrastructure is being widely deployed continentally
- State-of-the-art and cost-effective – based on Opensource tools and data
- Existing systems cost at least $200K per country in addition to cost of boundary data ($3.5k per country per year) and annual license/subscription fees
- Our system cost $625K for both SIDS and Pan-African with no license fees as it based on Open source tools
- African Community of practice established – knowledge contribution from all participating member states
- Climate Services Information System installed/deployed by and maintained ACPC experts
- Data analysis and visualization system installed/deployed by ACPC experts

Summary & Conclusion 2







- Enabling tools for data transfer and remote access to HPC and related infrastructure established
- Strategic partnerships being established at national, regional and globally
- Outlook for the future include further development of interface, in-country customization, extensive capacity building and R&D

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Thank You

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