Status of climate prediction and climate services provision in Southern Africa and the Role of SADC-CSC in monitoring and predicting climate and providing climate services

WMO Workshop on Climate Monitoring including the implementation of Climate Watch Systems in RA-I with focus on Eastern and Southern Africa
Swan Lake Lodge, Pretoria,
South Africa
15-18 April 2013

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Outline

- Introduction
- Climate System
- Climate monitoring:

  -global

  -ground
- Climate prediction:
- -statistical

  -global SSTs as predictors

  -dynamical

  -outlook products
- Concluding remarks

Outline-cont’d

- SADC Meteorology Sector
- RISDP& Met Chap of Protocol of TCM
- Role of SADC Climate Services Centre
- Operational Activities
- Capacity Building
- SARCOF
- CSC Products
- Resource mobilization efforts
- Challenges & Opportunities
- Concluding remarks

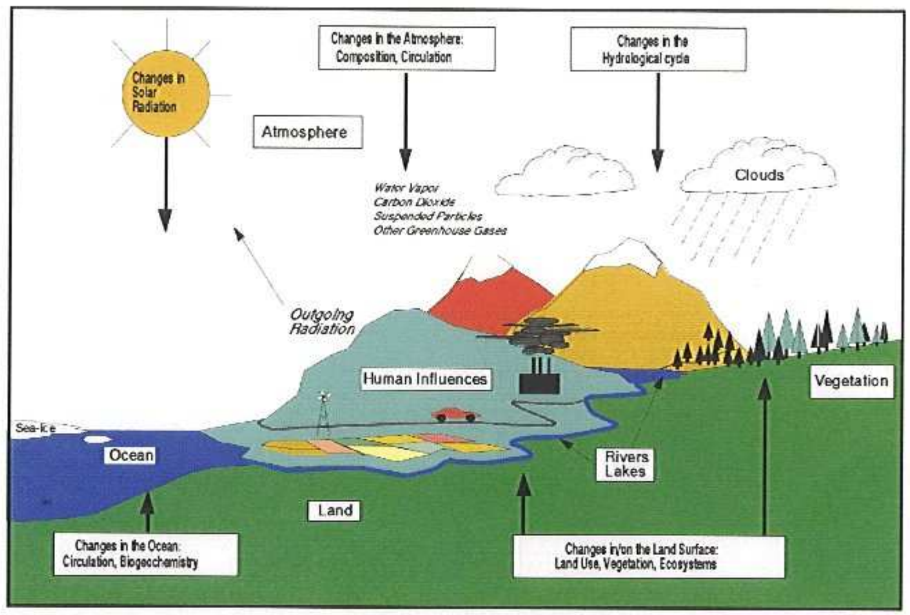
Introduction

- Prediction of future state of Atmosphere
  - Understanding the physics of the atmosphere
  - Using computer models (high power)
  - Important for application in socio-economic sectors
- Basic approaches
  - Analogue, Stats and Dynamical

Climatology

- Tropical maritime climate-high rainfall& humidity
  - Tropical cyclone-indirect effect (wind & moisture)
  - Monsoon circulation-two season
    - Northwest (Nov-Mar) & Southeast (Apr-Oct)
  - ITCZ- (behind sun meridional movement)
    - influence rainfall pattern

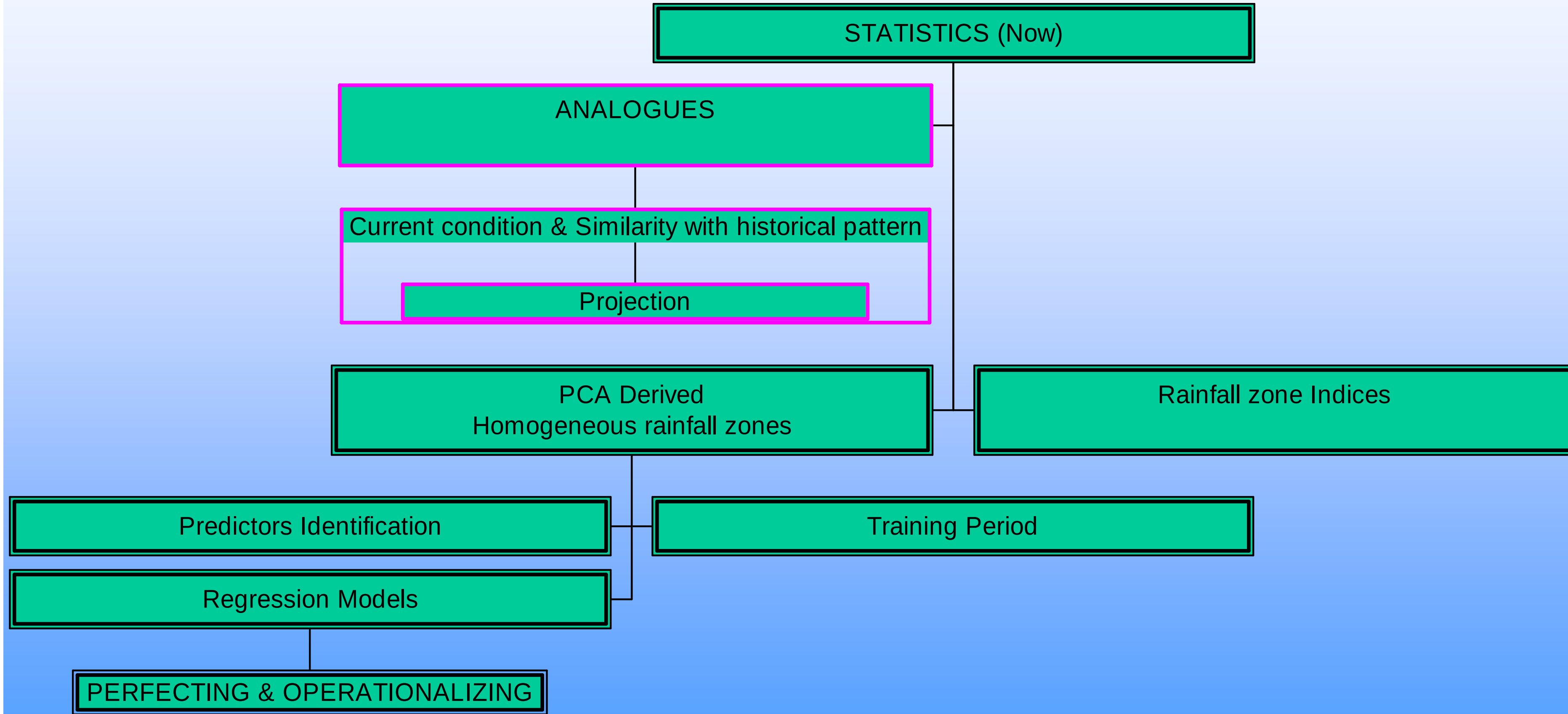
Global climate system



The complexities of the global system are illustrated in this diagram. Interactions and feedbacks within the system abound. Global change models must account for all these factors, physical, chemical, and biological to reduce the uncertainties regarding global, regional, and local climate change.

Seasonal Climate Prediction in Southern Africa: Current and Future Trend

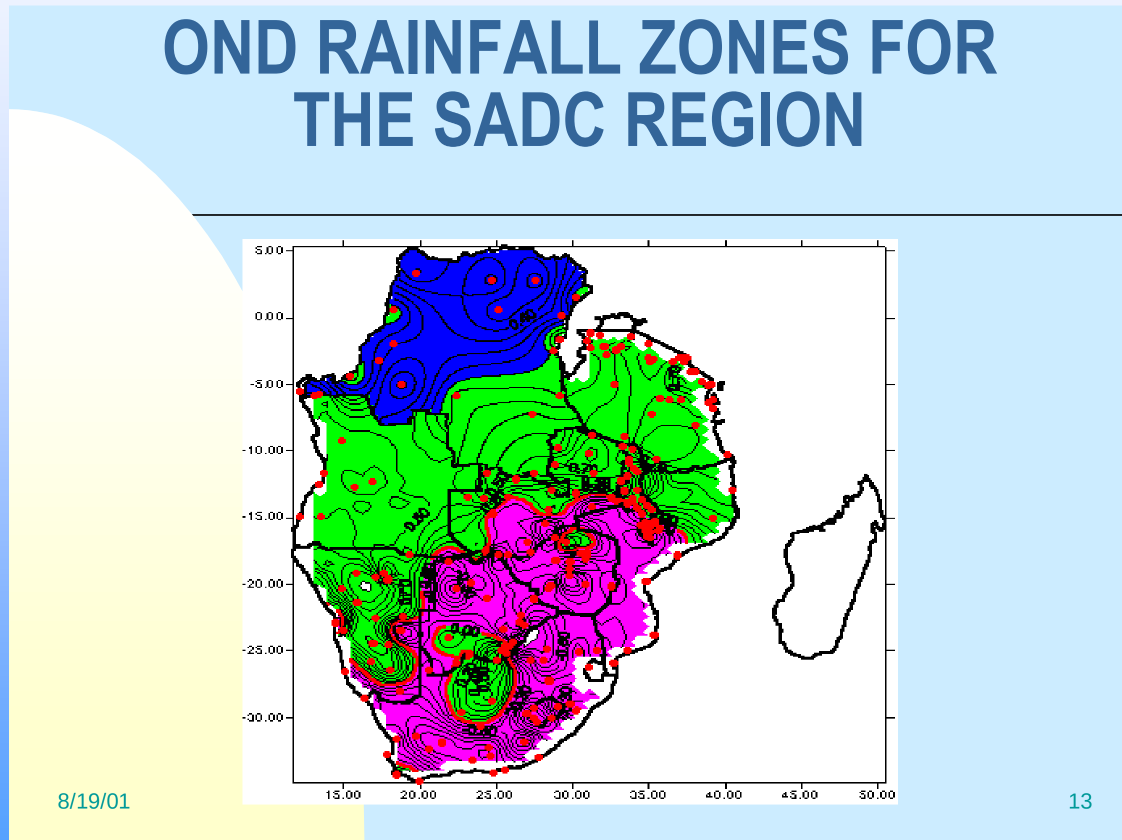
Seasonal Climate Prediction in Southern Africa: Current and Future Trend



This table compares simple and complex models with reference to the different uses to which they can be put (see text for discussion and clarification).

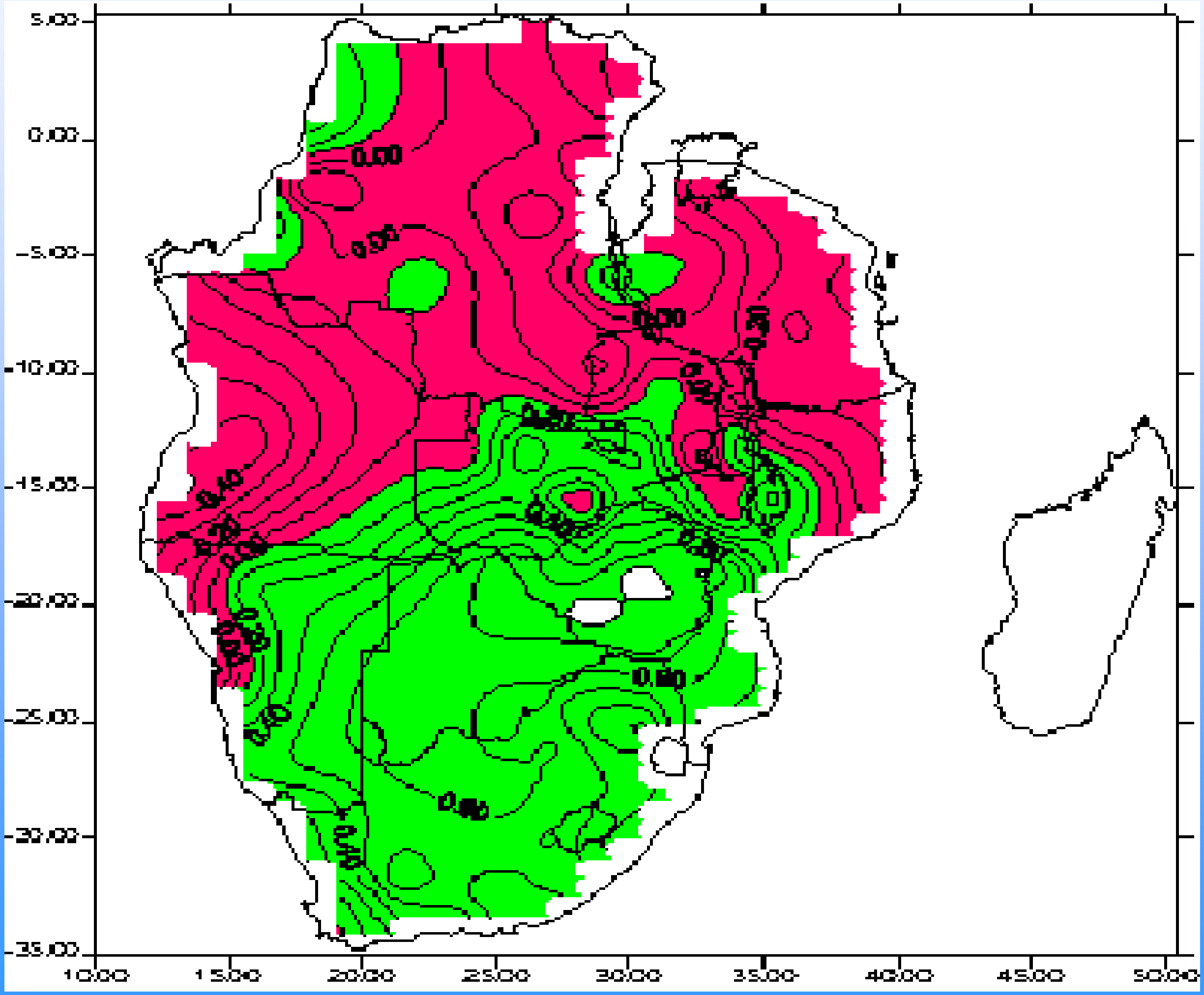
Simple Models	*Complex Models*
Generally produce zonally- or globally-averaged results, and only for temperature and temperature changes, not for other variables such as rainfall.	Simulate the past and present geographical variation of temperature, as well as other variables of climatic interest such as rainfall, evaporation, soil moisture, cloudiness, and winds; and provide credible continental scale changes of at least some of these variables.
Cannot simulate possible changes in climatic variability as output consists of the climate change signal only.	Have the potential to simulate changes in important modes of interannual variability (e.g., *El Niño*) as well as mean values.
The effects of physical processes are approximated based on globally- or zonally-averaged computations with low temporal resolution.	Many physical processes are directly simulated, necessitating the use of a short time-step but allowing resolution of the diurnal cycle.
Climate sensitivity and other subsystem properties must be specified based on the results of complex models or observations. These properties can be readily altered for purposes of sensitivity testing.	Climate sensitivity and other subsystem properties are computed based on a combination of physical laws and sub-grid scale model parametrizations.
Sufficiently fast that multiple scenarios can be simulated, and that runs with a wide range of parameter values can be executed. Can be initialized in a steady state at little computational cost.	Computational cost strongly limits the number of cases that can be investigated and the ability to initialize in a steady state.
Useful for sensitivity studies involving the interaction of large-scale climate system components.	Useful for studying those fundamental processes which can be resolved by the model.
Analysis is easy because simple models include relatively few processes. Interpretation of simple model results may give insights into the behaviour of more complex models.	Model behaviour is the result of many interacting processes, as in the real world. Studies with complex models indicate what processes need to be included in simple models and, in some cases, how they can be parametrized.
One-dimensional models cannot simulate climatic surprises, for example sudden ocean circulation changes. Two-dimensional ocean models can give some insight into such changes.	AOGCMs can simulate major changes in ocean circulation but the timing and nature of such changes may not yet be reliable.

Seasonal Climate Prediction in Southern Africa: Current and Future Trend



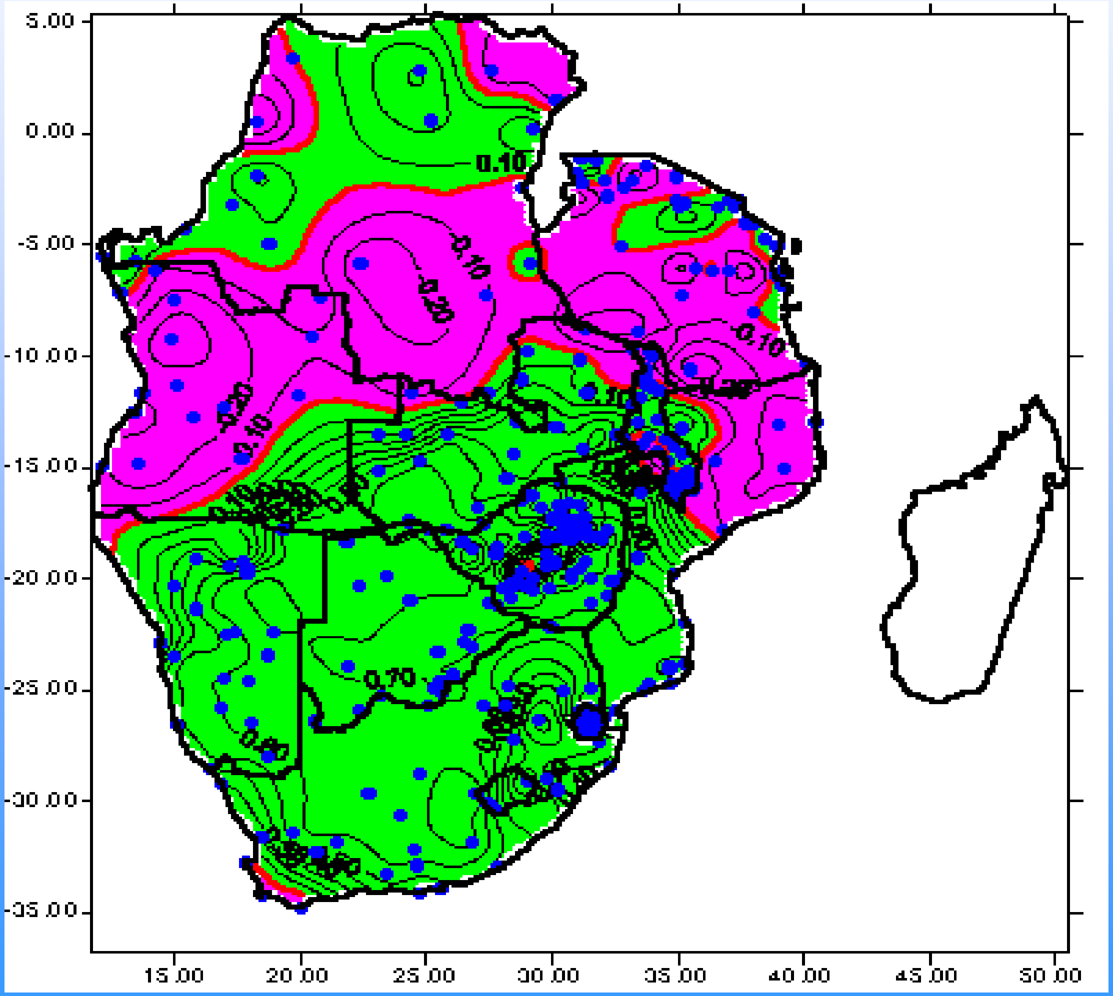
Seasonal Climate Prediction in Southern Africa: Current and Future Trend

NDJ RAINFALL ZONES FOR THE SADC REGION



Seasonal Climate Prediction in Southern Africa: Current and Future Trend

JFM RAINFALL ZONES FOR THE SADC REGION



ANOVA

Dep Var: INDICES N: 21 Multiple R: 0.798 Squared multiple R: 0.637

Adjusted squared multiple R: 0.573 Standard error of estimate: 0.612

Effect	Coefficient	Std Error	Std Coef	Tolerance	t	P(2 Tail)
CONSTANT	-0.113	0.217	0.000	.	-0.523	0.608
EI	0.161	0.053	0.454	0.974	3.062	0.007
ATI_EQ	-0.107	0.032	-0.491	0.978	-3.324	0.004
SP_JAS	0.163	0.044	0.548	0.994	3.739	0.002

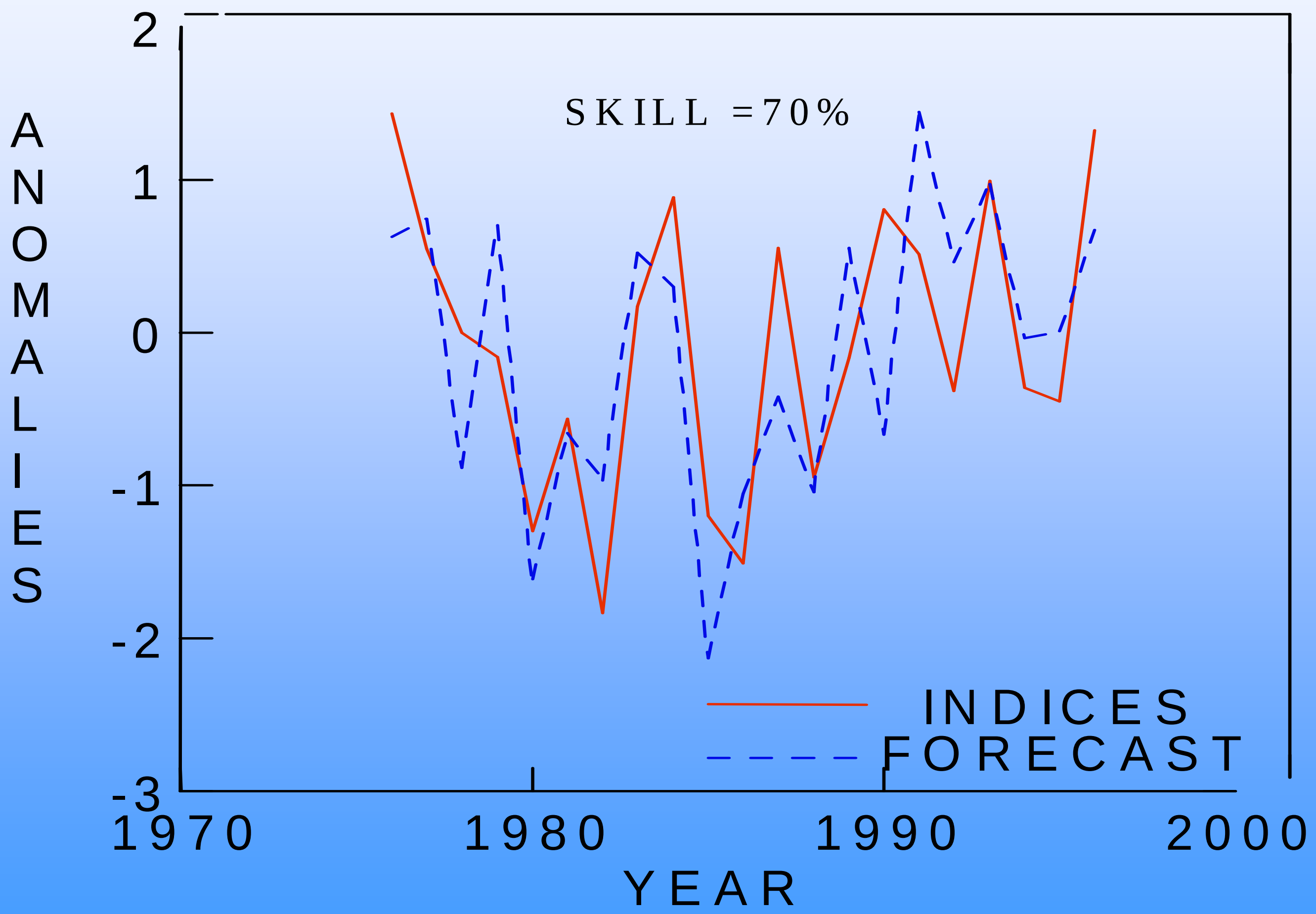
Analysis of Variance

Source	Sum-of-Squares	df	Mean-Square	F-ratio	P
Regression	11.157	3	3.719	9.943	0.001
Residual	6.359	17	0.374		

Durbin-Watson D Statistic 2.447

First Order Autocorrelation -0.301

Model skill (cont…)



Cases and boundary category

Case number	YEAR	INDICES
1	1982.000	-1.837
2	1986.000	-1.512
3	1980.000	-1.297
4	1985.000	-1.203
5	1988.000	-0.946
6	1981.000	-0.562
7	**1995.000**	**-0.449**
8	1992.000	-0.383
9	1994.000	-0.361
10	1989.000	-0.167
11	1979.000	-0.159
12	1978.000	-0.001
13	1983.000	0.172
14	**1991.000**	**0.510**
15	1977.000	0.548
16	1987.000	0.554
17	1990.000	0.804
18	1984.000	0.884
19	1993.000	0.993
20	1996.000	1.324
21	1976.000	1.432

Mean boundary value for the terciles 1) -0.416 =33.3% 2) 0.529 = 66.6%

FORECAST (probability)

ANOVA AND CONTIGENCY TABLE : MODELS	ANOVA				CONTINGENCY TABLE					Skill	Hit Skill Score
	MR	R2	F Ratio	P	C %	Detection		FAR 1ST ORDER			
						Dry	Wet	Dry	Wet		
SEYCHELLES JFM_MODEL	***0.798***	***0.637***	***9.93***	***0.001***	***61.9***	***85.7***	***57.1***	***28.6***	***0.0***	***70%***	***0.428***

POD (WET) = 4/ (0 + 3 + 4)*100 = 4/7*100 = 57.1%

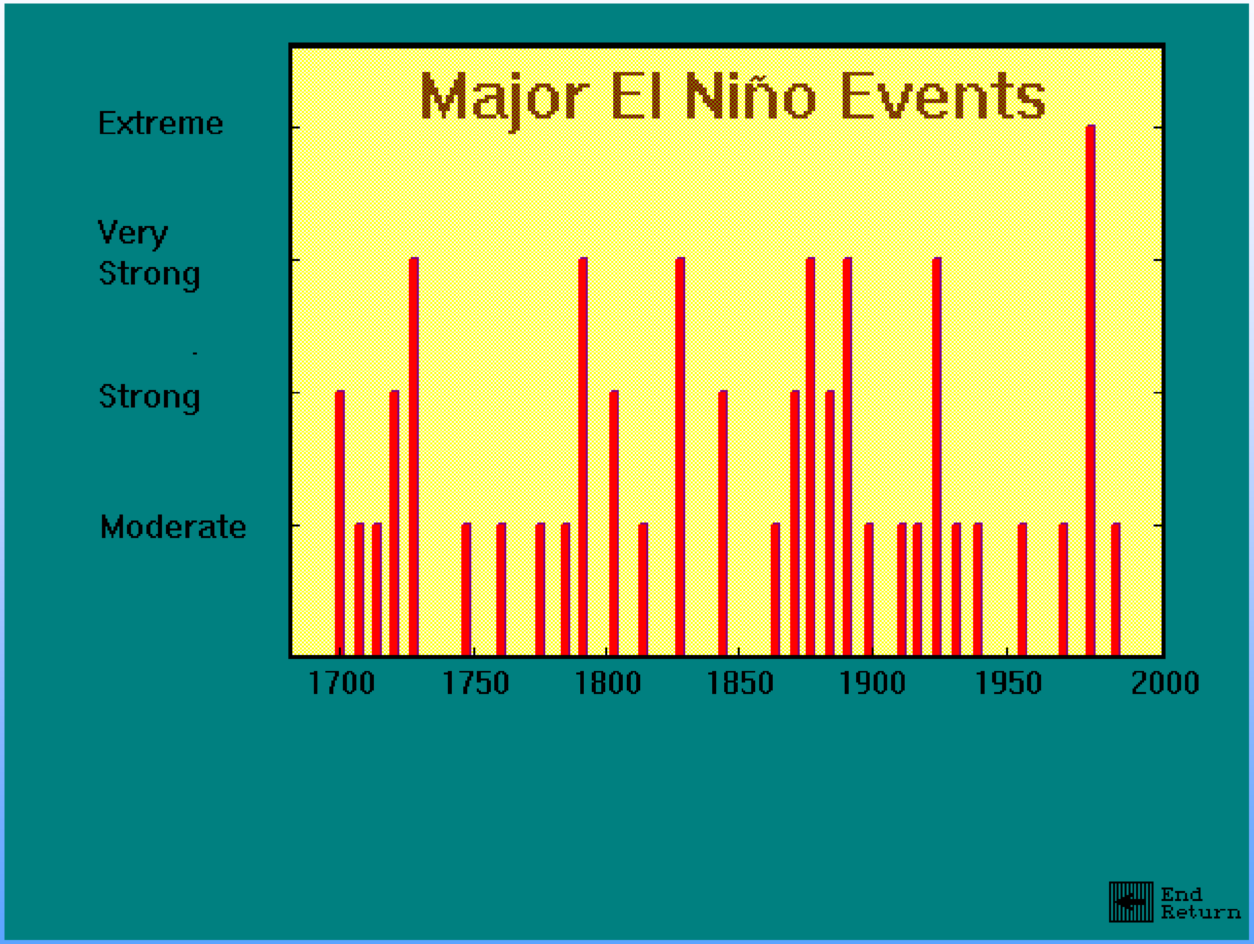
FA DRY = 2/9*100 = 22.2%

FA NORM = 2/7*100 = 28.6%

THIS IMPLIES:

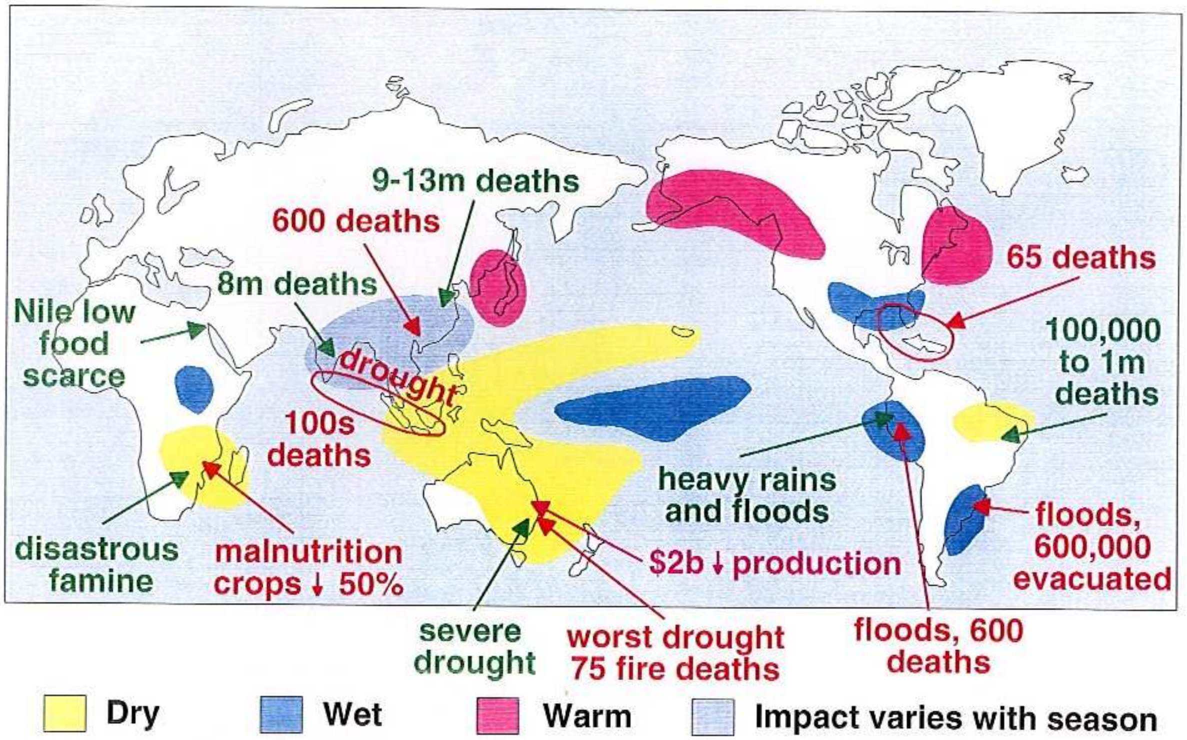
ABOVE NORM = 55%
NORM = 25%
BELOW NORM =20%

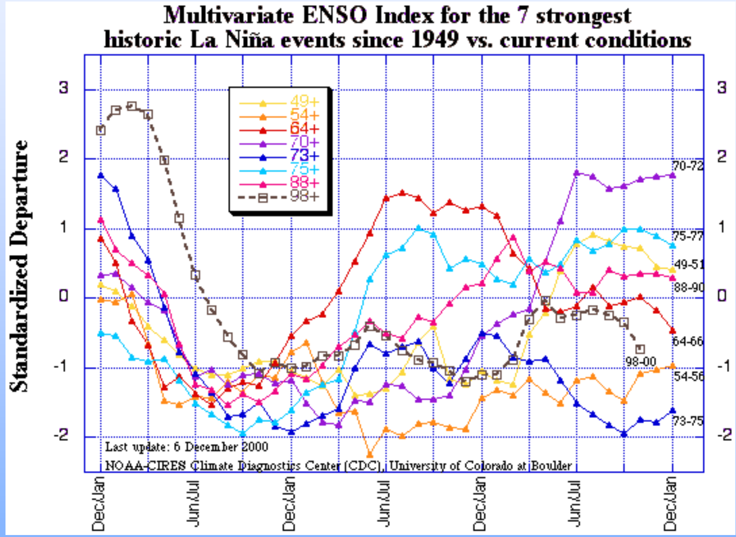
EMPHASIS ON ABOVE NORMAL RAINFALL FOR JFM_2001


Major El Niño Events
Extreme
Very
Strong
Strong
Moderate
1700
1750
1800
1850
1900
1950
2000
End
Return

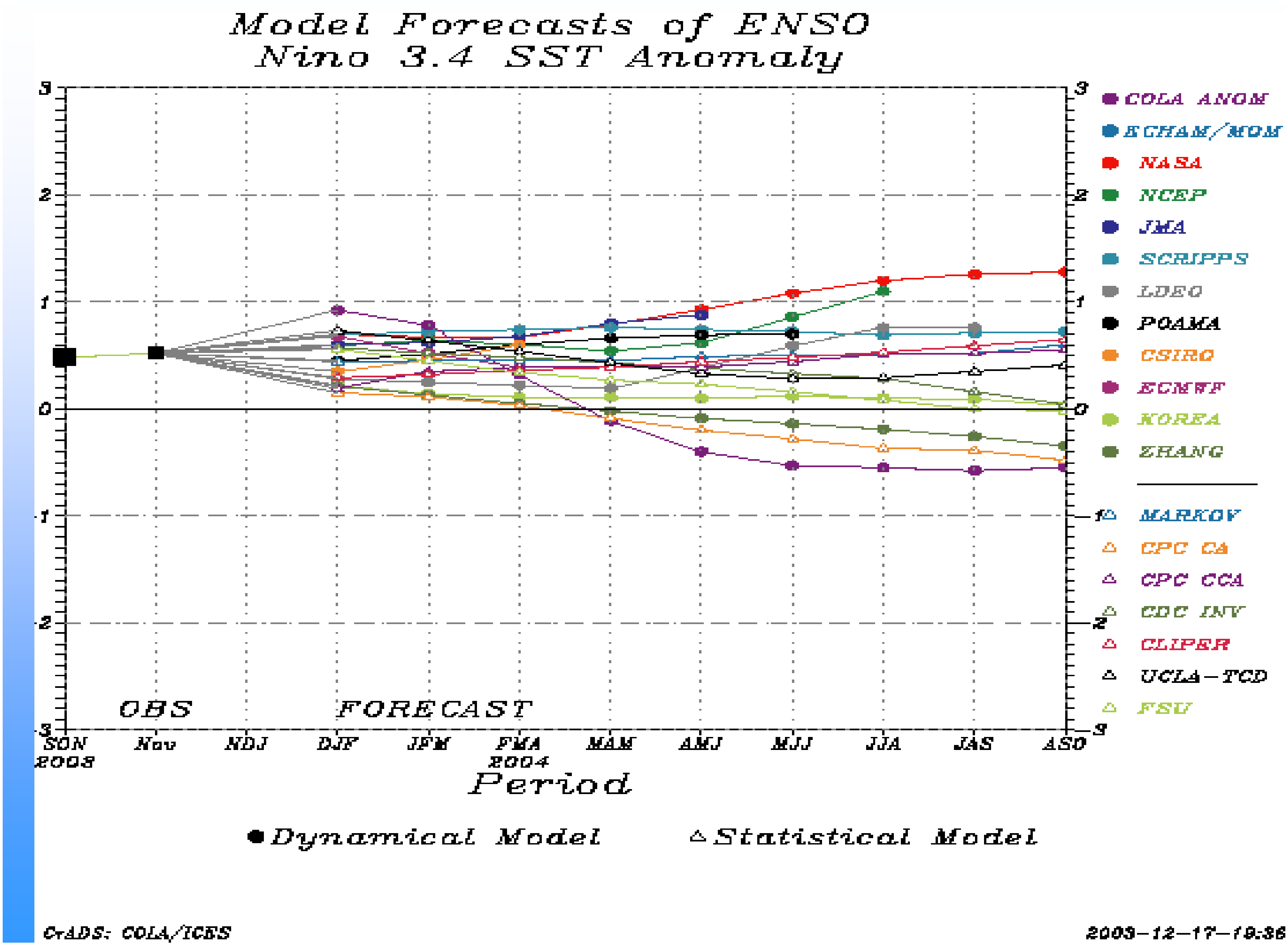
Comparison between 3 major El Nino episodes

1877-78 — 1982-83 — 1993-95



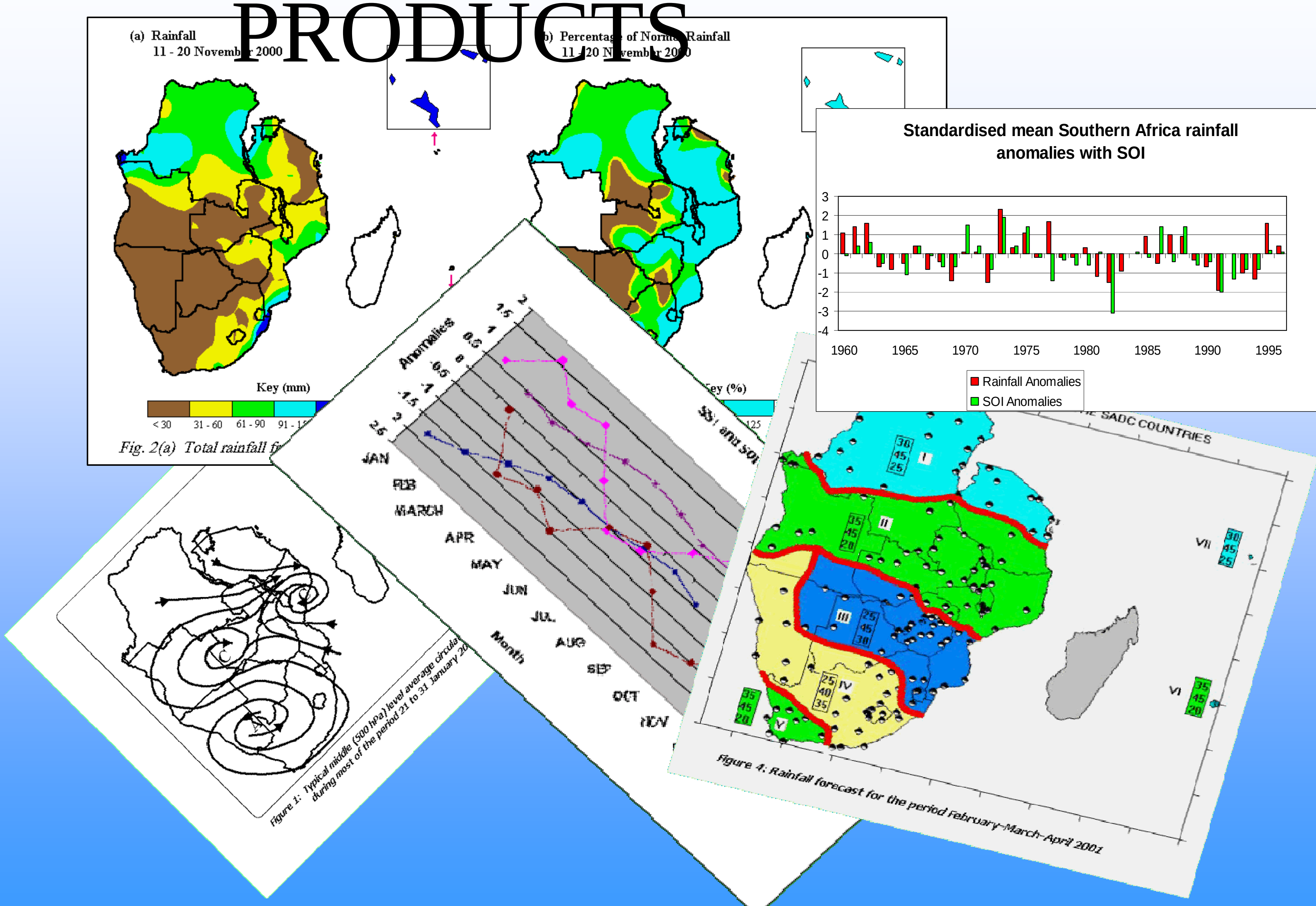


Multivariate ENSO Index for the 7 strongest historic La Niña events since 1949 vs. current conditions
Standardized Departure
49+
54+
64+
70+
73+
75+
88+
98+
70-72
75-77
49-51
88-90
64-66
98-00
54-56
73-75
Last update: 6 December 2000
NOAA-CIRES Climate Diagnostics Center (CDC), University of Colorado at Boulder
Dec/Jan
Jun/Jul
Dec/Jan
Jun/Jul
Dec/Jan
Jun/Jul
Dec/Jan



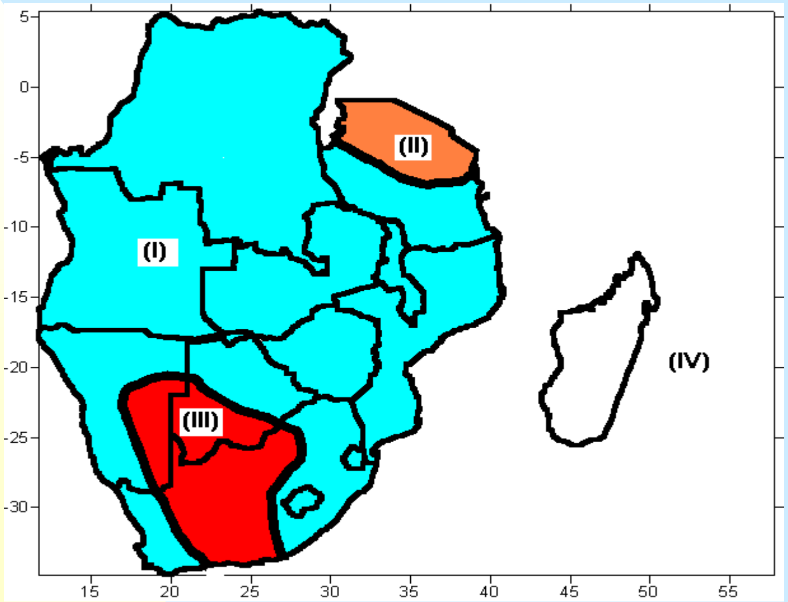
Model Forecasts of ENSO
Nino 3.4 SST Anomaly
COLA ANOM
ECHAM/MOM
NASA
NCEP
JMA
SCRIPPS
LDEO
POAMA
CSIRO
ECMWF
KOREA
ZHANG
MARKOV
CPC CA
CPC CCA
CDC INV
CLIPER
UCLA-TCD
FSU
OBS
FORECAST
SON 2003
Nov
NDJ
DJF
JFM
FMA 2004
MAM
AMJ
MJJ
JJA
JAS
ASO
Period
Dynamical Model
Statistical Model
GrADS: COLA/IGES
2003-12-17-19:36

TOOL AND PRODUCTS

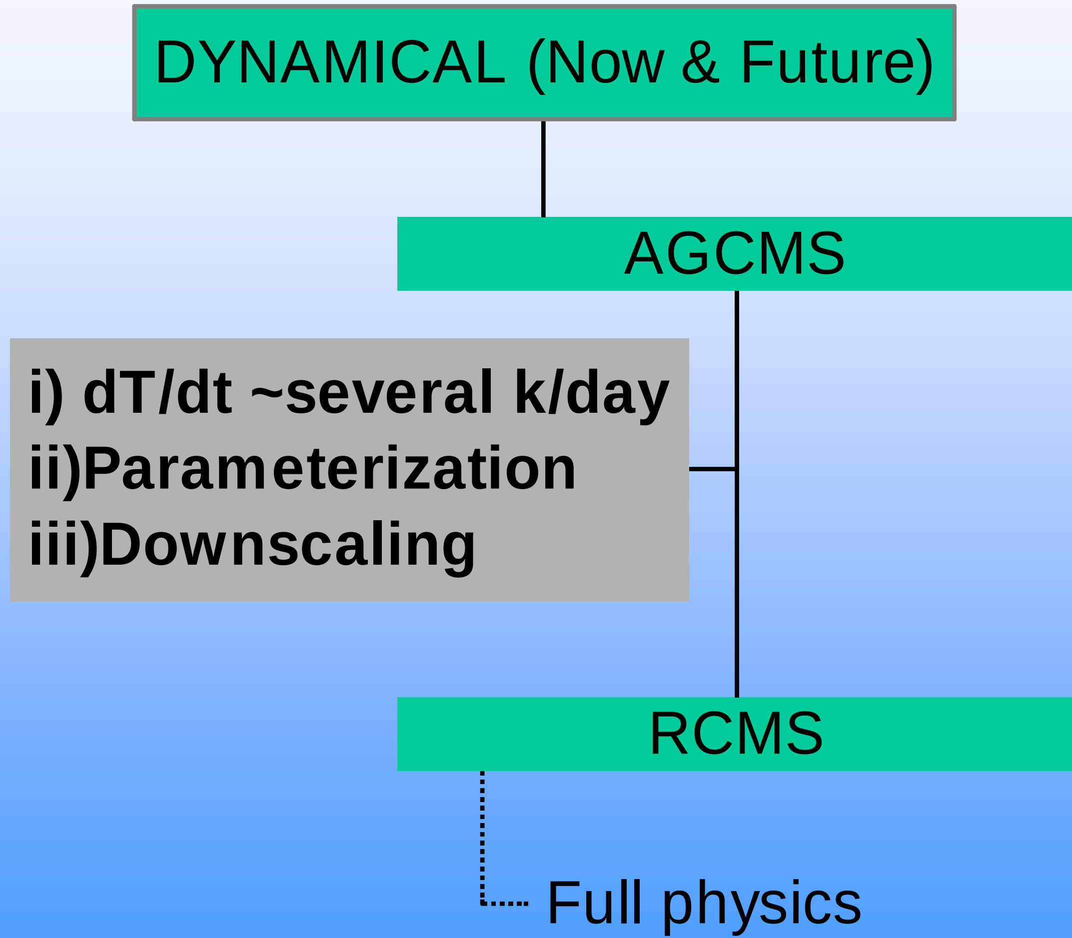


Seasonal Climate Prediction in Southern Africa: Current and Future Trend

DJF RAINFALL ZONES FOR SADC REGION



Seasonal Climate Prediction in Southern Africa: Current and Future Trend



Basic Equations of models

In terms of terrain following coordinates (x, y, σ), these are the equations for the nonhydrostatic model's basic variables excluding moisture.

Pressure

$$\frac{\partial p'}{\partial t} - \rho_0 g w + \gamma p \nabla \cdot \mathbf{V} = -\mathbf{V} \cdot \nabla p' + \frac{\gamma p}{T}\left(\frac{\dot{Q}}{c_p} + \frac{T_0}{\theta_0} D_\theta\right) \qquad (1)$$

Momentum (x-component)

Basic Equations of models

8: MM5

$$\frac{\partial u}{\partial t} + \frac{m}{\rho}\left(\frac{\partial p'}{\partial x} - \frac{\sigma}{p^*}\frac{\partial p^*}{\partial x}\frac{\partial p'}{\partial \sigma}\right) = -\mathbf{V}\cdot\nabla u + v\left(f + u\frac{\partial m}{\partial y} - v\frac{\partial m}{\partial x}\right) - ew\cos\alpha - \frac{uw}{r_{earth}} + D_u \qquad 2)$$

Momentum (y-component)

$$\frac{\partial v}{\partial t} + \frac{m}{\rho}\left(\frac{\partial p'}{\partial y} - \frac{\sigma}{p^*}\frac{\partial p^*}{\partial y}\frac{\partial p'}{\partial \sigma}\right) = -\mathbf{V}\cdot\nabla v - u\left(f + u\frac{\partial m}{\partial y} - v\frac{\partial m}{\partial x}\right) + ew\sin\alpha - \frac{vw}{r_{earth}} + D_v \qquad 3)$$

Momentum (z-component)

$$\frac{\partial w}{\partial t} + \frac{\rho_0}{\rho}\frac{g}{p^*}\frac{\partial p'}{\partial \sigma} + \frac{g}{\gamma}\frac{p'}{p} = -\mathbf{V}\cdot\nabla w + g\frac{p_0}{p}\frac{T'}{T_0} - \frac{gR_d}{c_p}\frac{p'}{p} + e(u\cos\alpha - v\sin\alpha) + \frac{u^2+v^2}{r_{earth}} + D_w \qquad 4)$$

Thermodynamics

$$\frac{\partial T}{\partial t} = -\mathbf{V}\cdot\nabla T + \frac{1}{\rho c_p}\left(\frac{\partial p'}{\partial t} + \mathbf{V}\cdot\nabla p' - \rho_0 g w\right) + \frac{\dot{Q}}{c_p} + \frac{T_0}{\theta_0}D_\theta \qquad 5)$$

Advection terms can be expanded as

Basic Equations of models

$$\mathbf{V} \cdot \nabla A \equiv mu\frac{\partial A}{\partial x} + mv\frac{\partial A}{\partial y} + \dot{\sigma}\frac{\partial A}{\partial \sigma} \qquad 6)$$

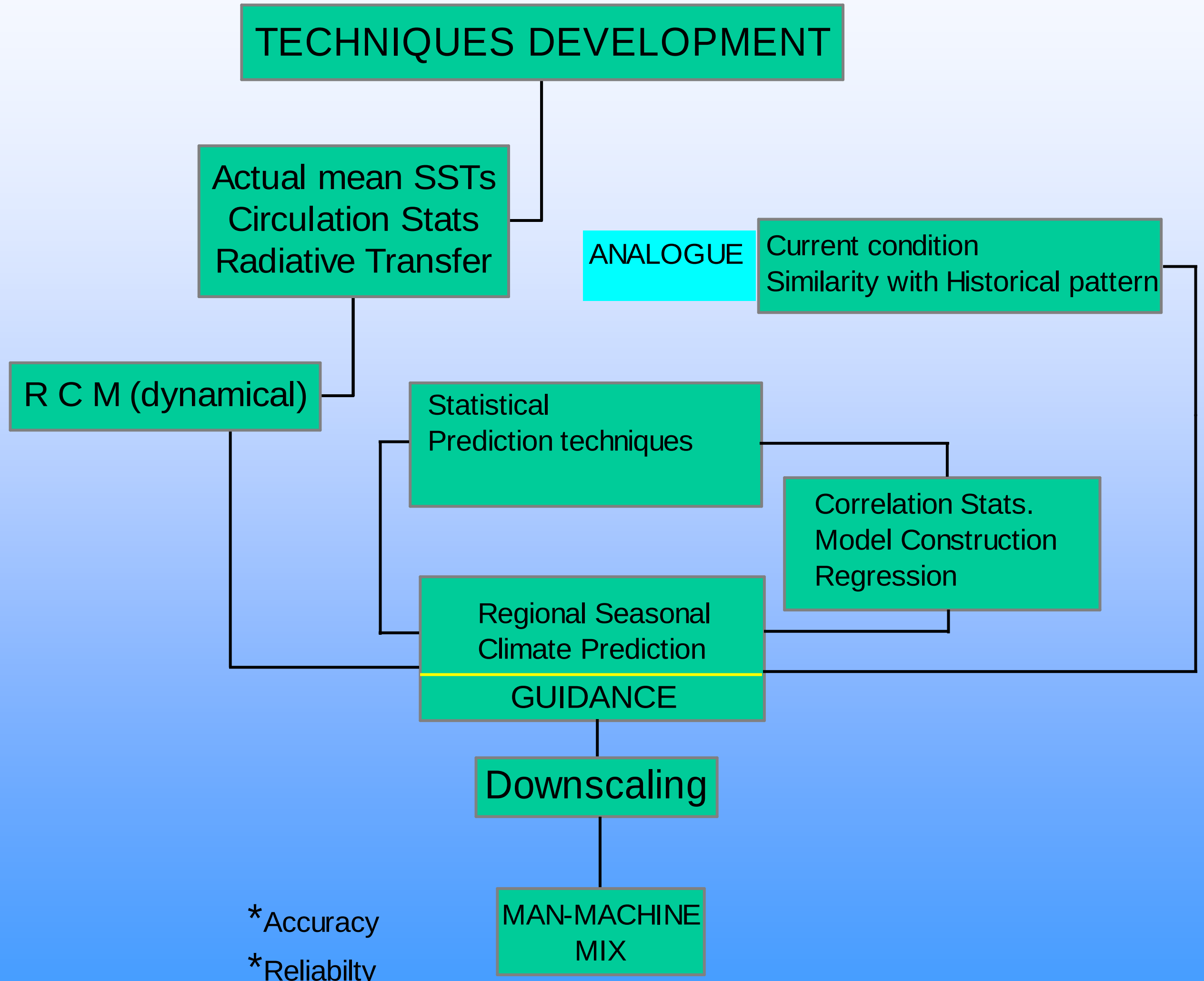
where

$$\dot{\sigma} = -\frac{\rho_0 g}{p^*}w - \frac{m\sigma}{p^*}\frac{\partial p^*}{\partial x}u - \frac{m\sigma}{p^*}\frac{\partial p^*}{\partial y}v \qquad 7)$$

Divergence term can be expanded as

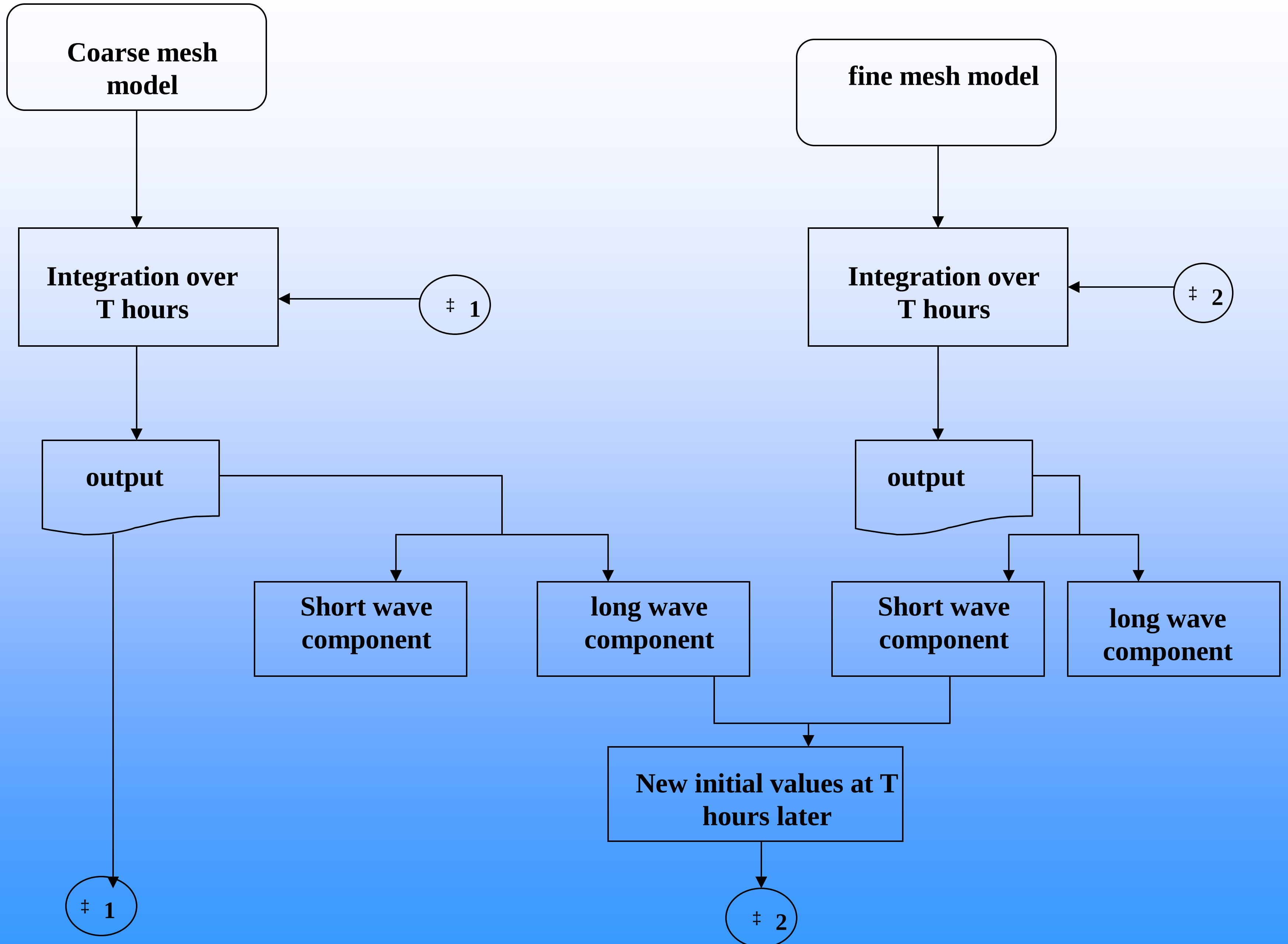
$$\nabla \cdot \mathbf{V} = m^2\frac{\partial}{\partial x}\left(\frac{u}{m}\right) - \frac{m\sigma}{p^*}\frac{\partial p^*}{\partial x}\frac{\partial u}{\partial \sigma} + m^2\frac{\partial}{\partial y}\left(\frac{v}{m}\right) - \frac{m\sigma}{p^*}\frac{\partial p^*}{\partial y}\frac{\partial v}{\partial \sigma} - \frac{\rho_0 g}{p^*}\frac{\partial w}{\partial \sigma} \qquad 8)$$

Seasonal Climate Prediction in Southern Africa: Current and Future Trend



*Accuracy
*Reliabilty
*Skill

Model Schemes



Limitations

- Inadequate observations
- Inexact definition of climate
- Incomplete understanding of system
- Cost of running models
- Other resources
- Affordability of developing countries

Seasonal Climate Prediction in Southern Africa: Current and Future Trend

The future will be dominated by dynamical modelling. These require substantial improvements in skills in order to be more reliable tools.

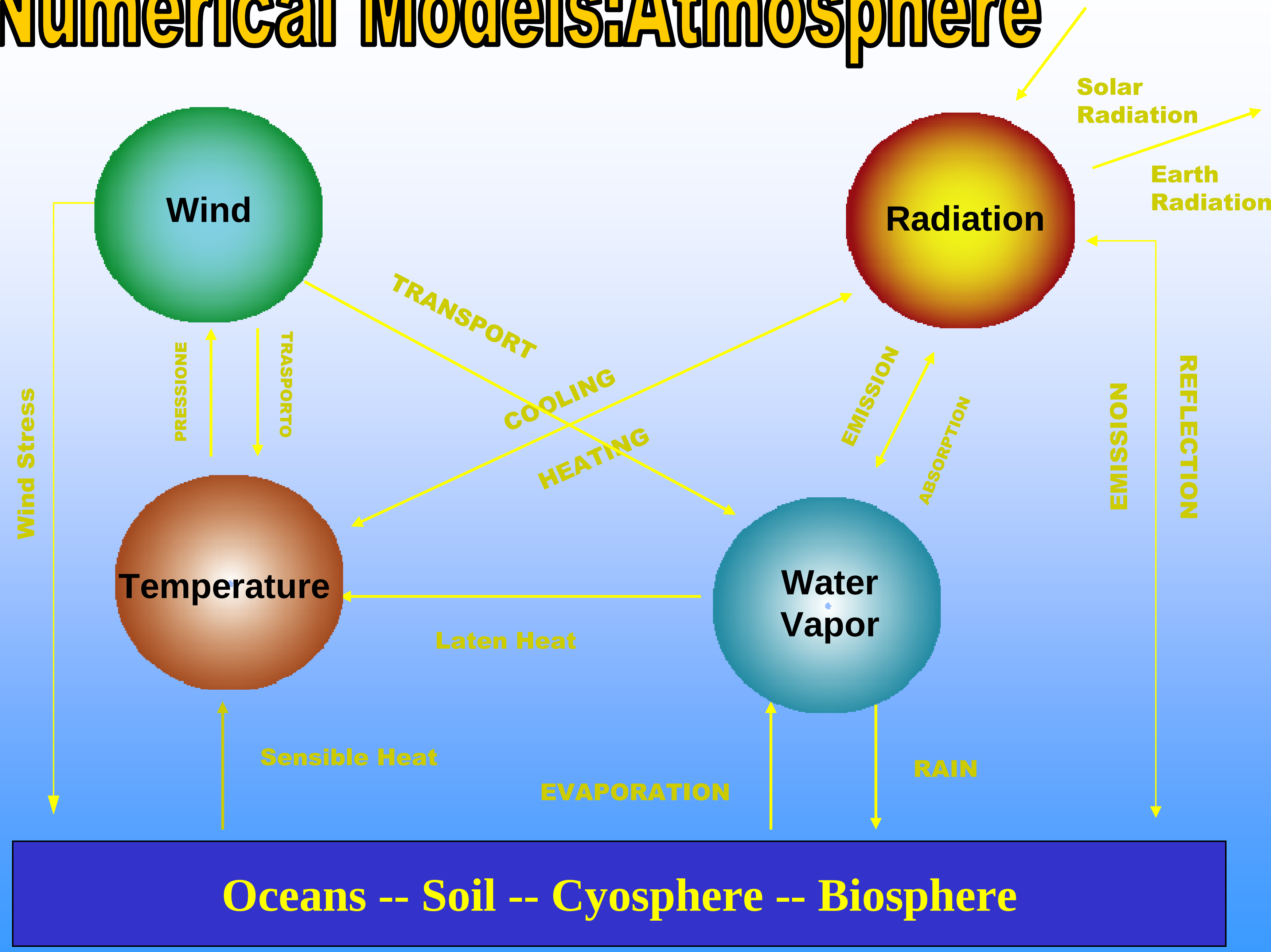
The End and Thank You

Numerical Models

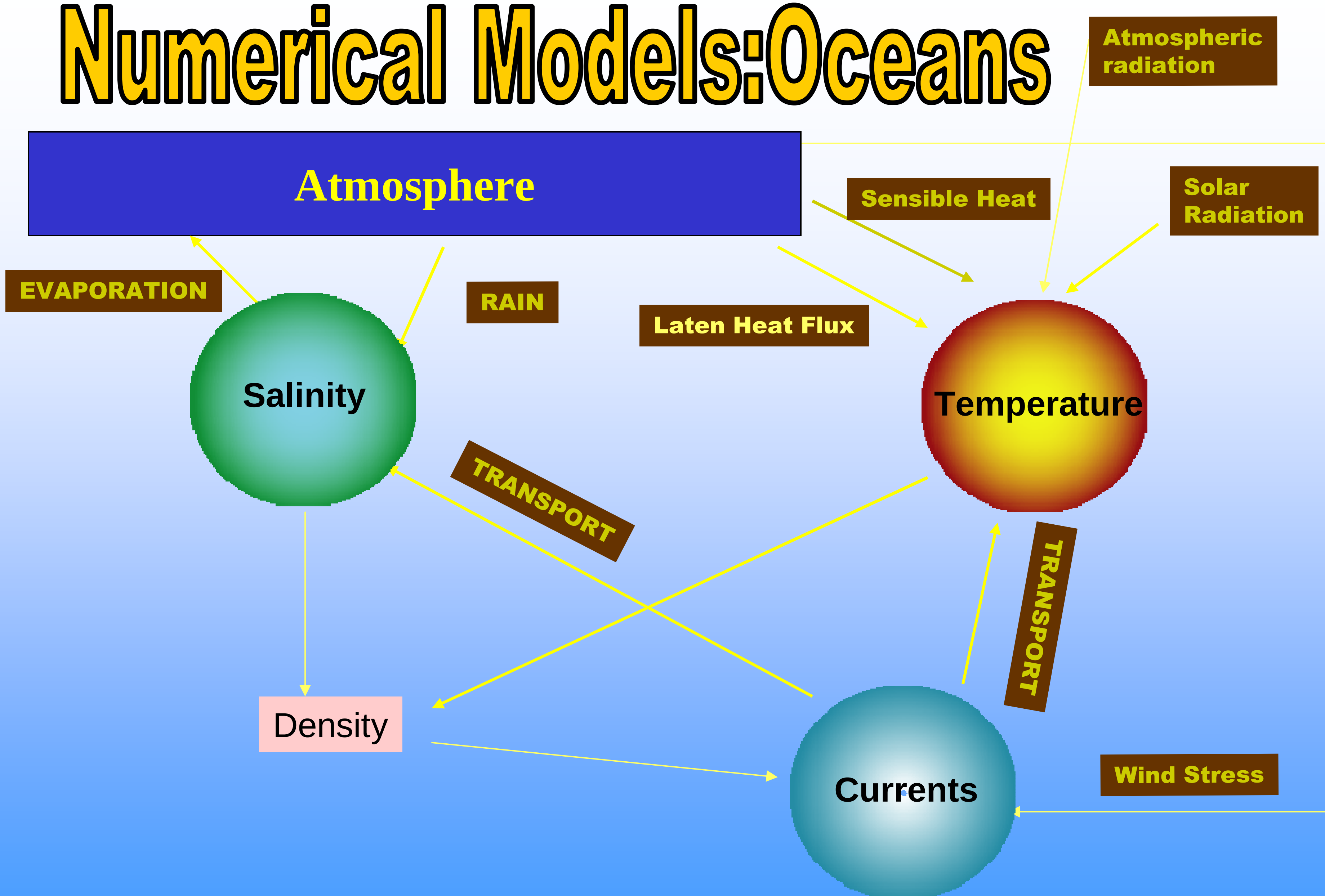
The only hope we have to be able to understand and possibly predict some of these changes is to use numerical models to investigate the dynamics of atmosphere-ocean dynamics.

Atmospheric and ocean numerical models can be put together (coupled) and numerically integrated for hundreds or thousands of years, depending on the realism of the models involved

Numerical Models:Atmosphere



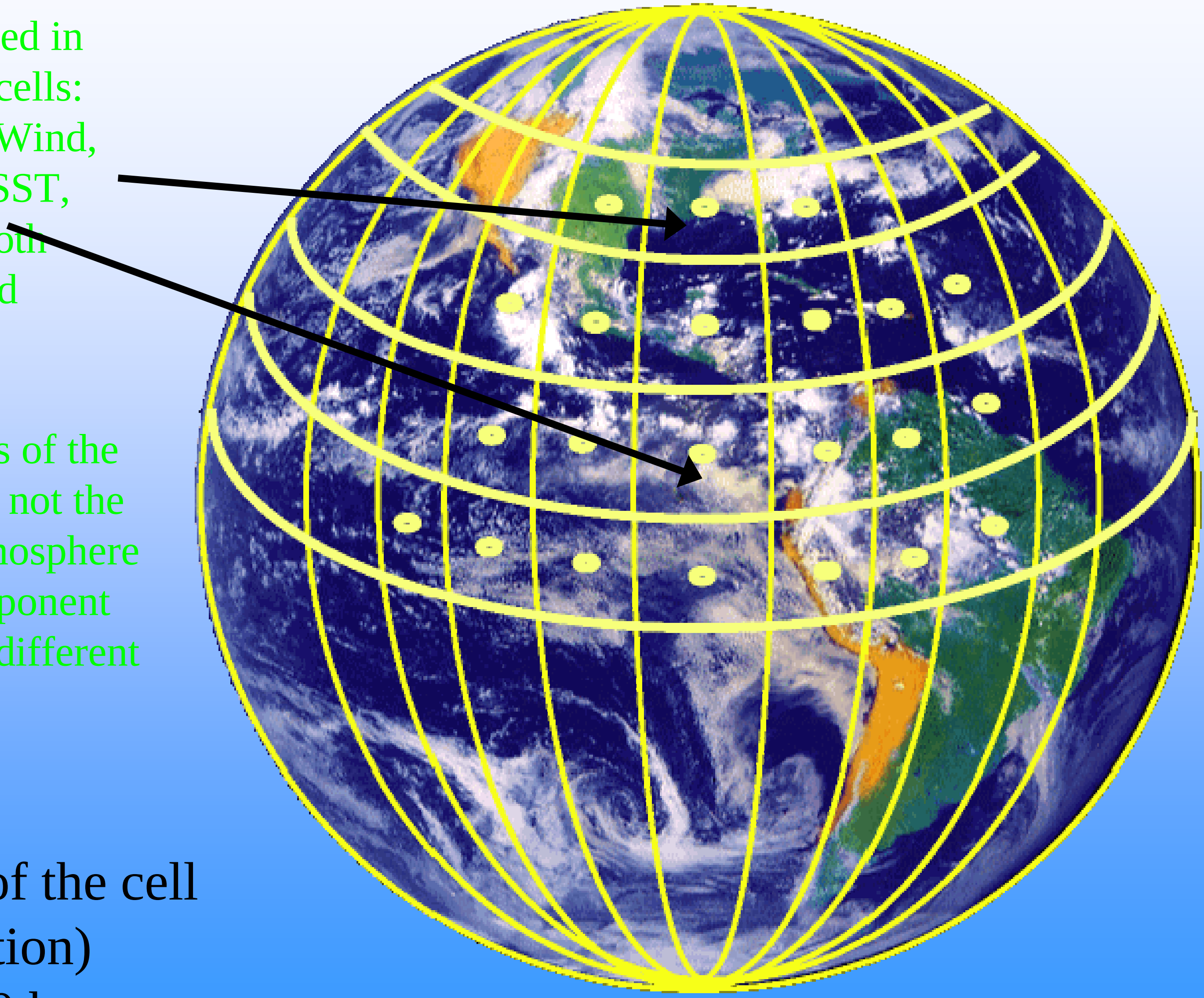
Numerical Models:Oceans



Discretization Methods

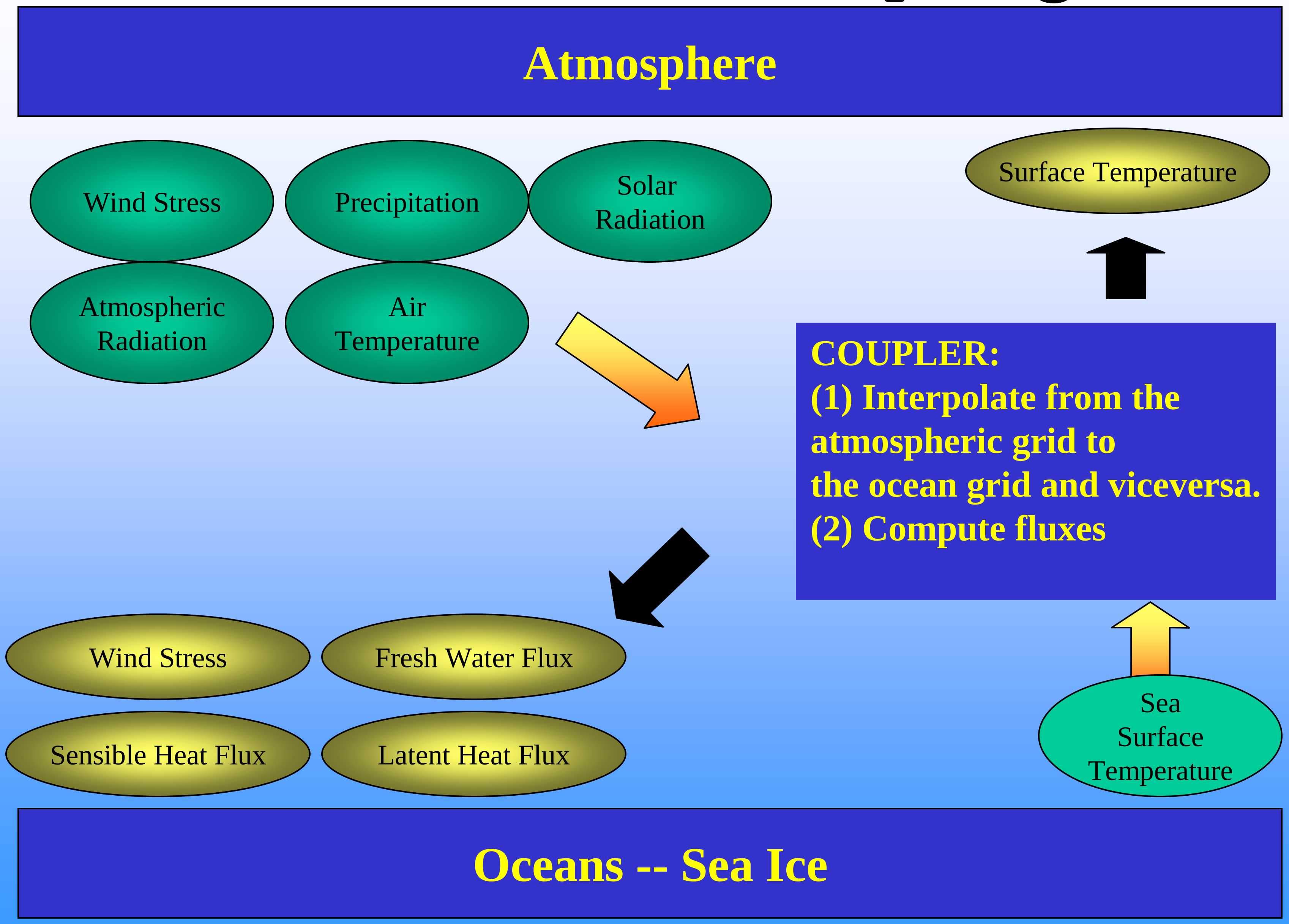
The atmosphere and the ocean are divided in computational cells: (Temperature, Wind, Rain, Sea Ice, SST, Salinity, …) both horizontally and vertically.

The dimensions of the cell are usually not the same in the atmosphere and ocean component because of the different dynamics.



Dimension of the cell
(resolution)
200-300 km

Numerical Models:Coupling

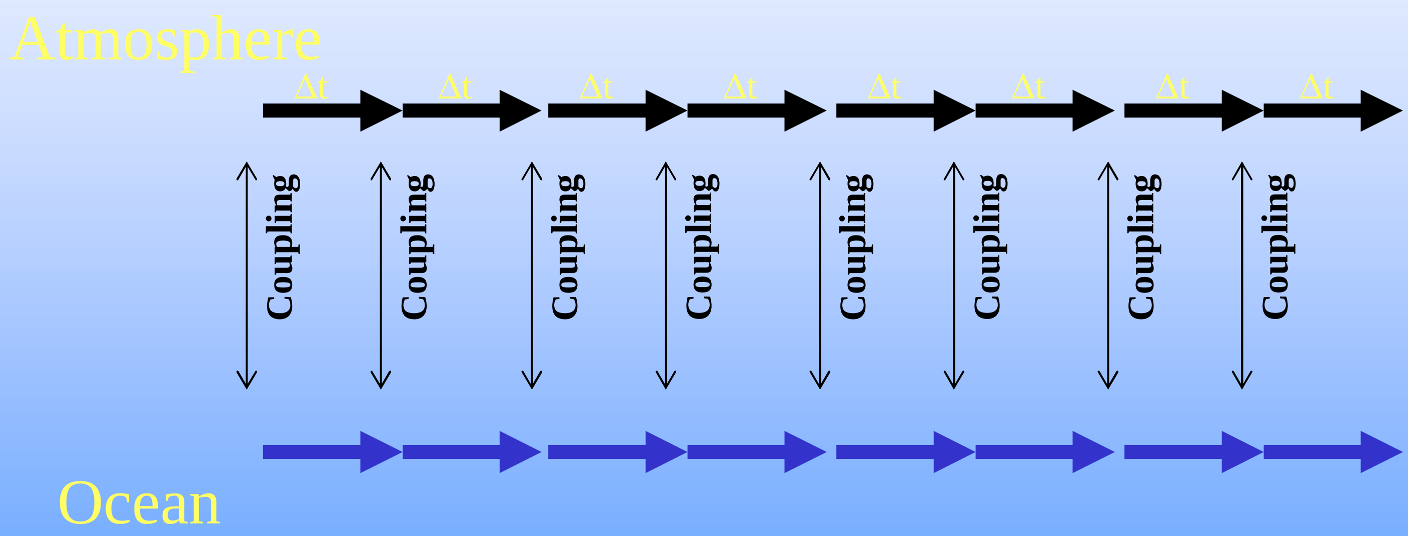


Very Large Computers are needed

Project of the Earth Simulator Computer (Japan) :
objective, a global
coupled model with 5km resolution

Experimental Strategy (1)

The main problem is how to synchronize the time evolution of the atmosphere with the evolution of the ocean. The most natural choice is to have a complete synchronization (synchronous coupling):

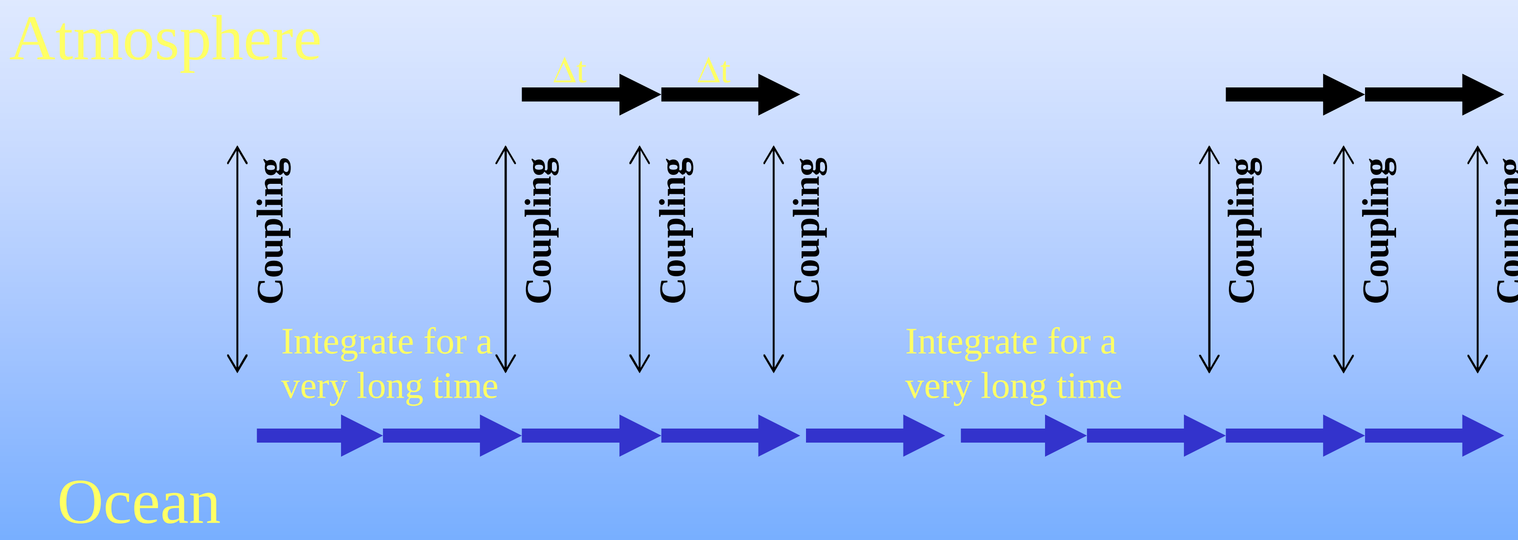


This choice would require to have similar time steps for both models, for instance 30min for the atmospheric model and 2 hours for the ocean model.

Computationally very expensive

Experimental Strategy (2)

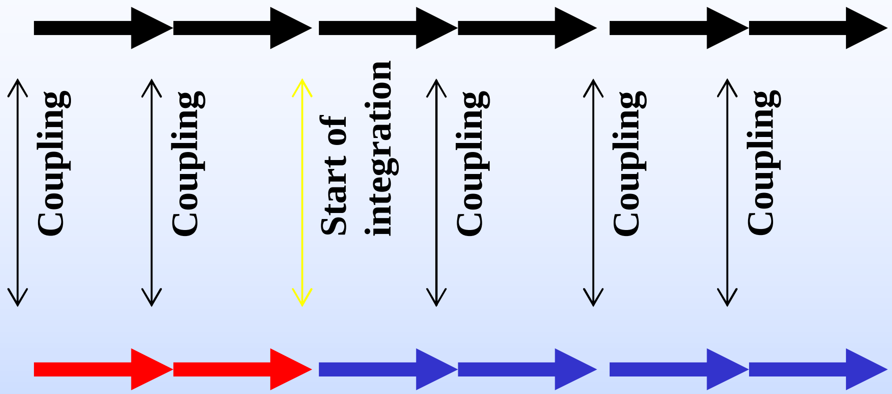
Another possibility is to exploit the different time scales using the fact that the ocean changes much more slowly than the atmosphere (asynchronous coupling):



This choice save computational time at the expense of accuracy, but for very long simulations (thousands of years) may be the only choice.

Initialization

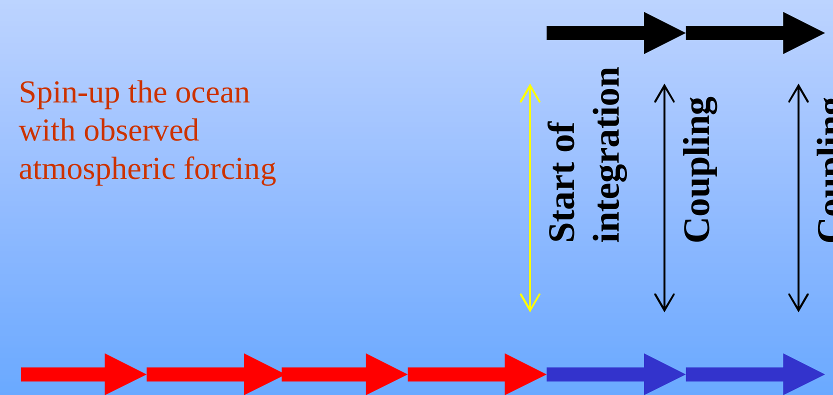
Robust Diagnostic



Integrate the coupled model for a period, e.g. two years, but impose observed surface temperature and salinity

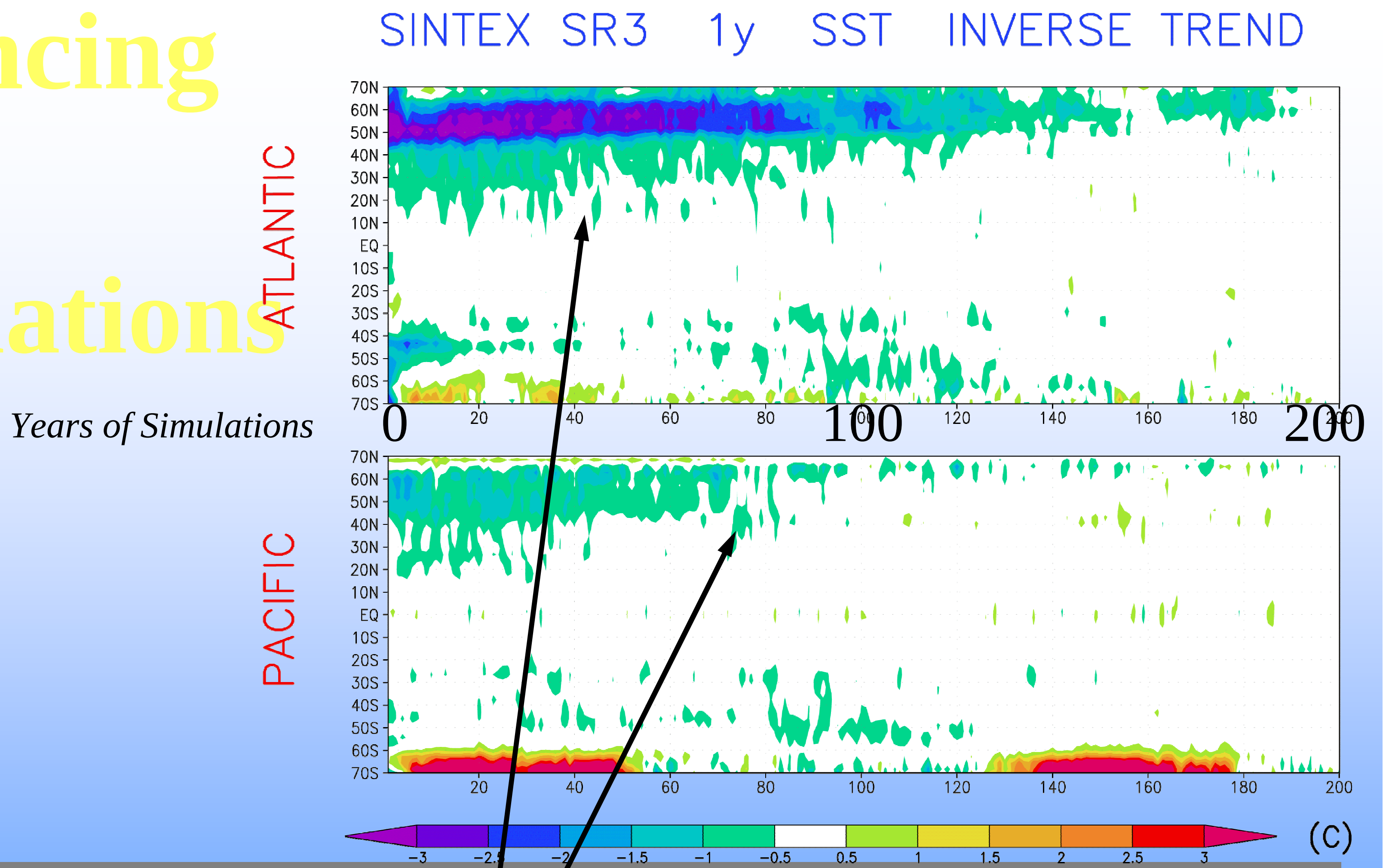
Spin-up

Spin-up the ocean with observed atmospheric forcing



But sometimes the models are simply started from climatological conditions or, in the case of climate change experiments, the procedure may become much more sophisticated to account for effects from soil and ice.

Balancing the simulations



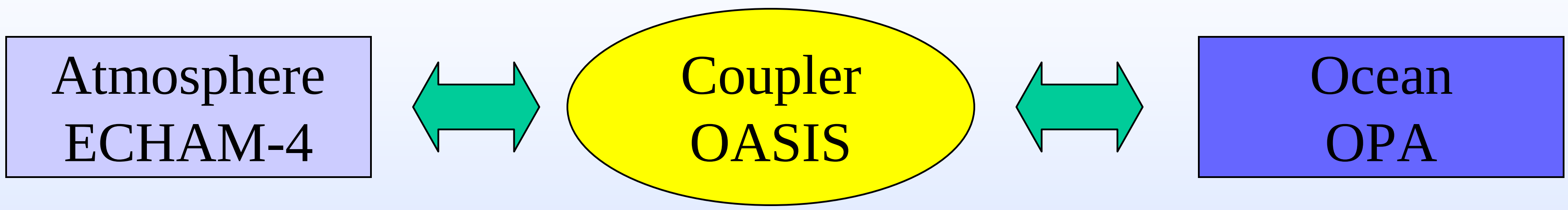
Coupled model are much more sensitive than either ocean or atmosphere model alone. There no constraints imposed, as the SST for the atmospheric simulations or the surface winds for the ocean, that can help in guiding the model toward a realistic climate state. The only forcing is given by the external solar radiation and the model must be capable of realizing its own balanced climate state. The model drift from the initial condition as it slowly reaches for its own equilibrium, if the model is realistic the final equilibrium will be very similar to the what we think is the present Earth climate, if the initial condition is well balanced the drift will be small and smooth.

What coupled models can do

The first coupled models had large drifts to an unrealistic climate state. It was then proposed to include a correction to partially correct for the poor fluxes that were exchanged between the models. This correction, known as “flux-adjustment” allowed early experiments, but is becoming less necessary in modern models.

The following slides will show some of the results from an integration of a coupled model, developed at our institution in collaboration with LODYC in Paris, within the context of a project sponsored by the European Union, SINTEX. The results are however pretty typical of the behaviour of coupled models.

The SINTEX coupled model



ECHAM-4:
Max-Planxk -Institute,
Hamburg
Roeckner et al., 1996)
Global
Spectral T30 (3.75 x 3.75 deg)
19 Vertical levels

OPA 8.1:
LODYC, Paris,
Madec et al., 1998)
Global
2 deg longitude
0.5 - 2 deg latitude
31 Vertical Levels
Climatological Sea Ice

Coupling every 3 Hours *No Flux Adjustment*

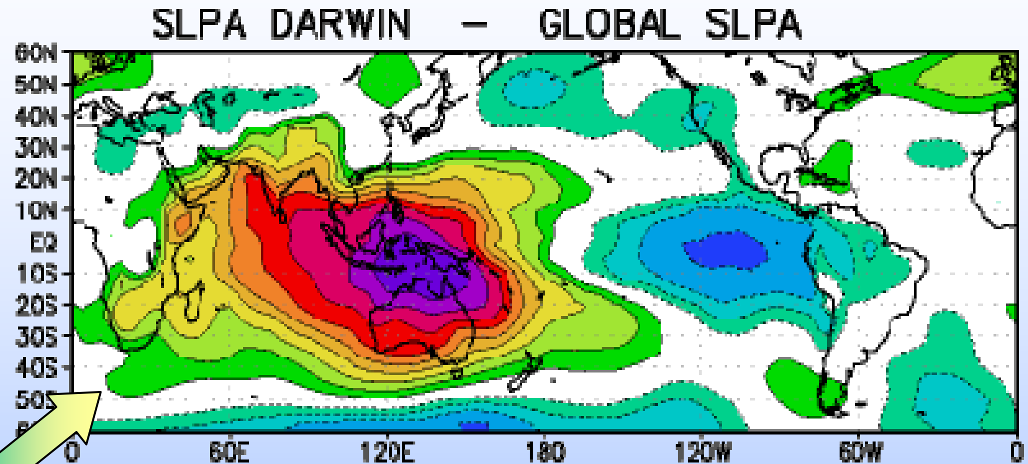
Review of Southern African Regional Climate Outlook Forum (SARCOF)

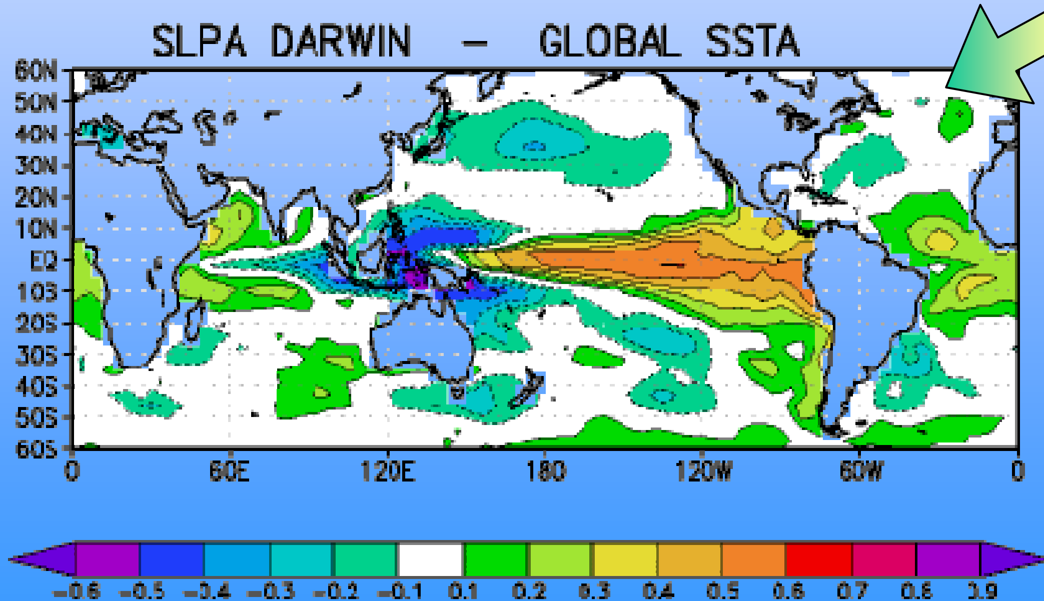
SADC Climate Services Centre

Gaborone

Teleconnections

Correlations between the Sea Level Pressure in Darwin and global SLP in the coupled model. The correlations are very realistic

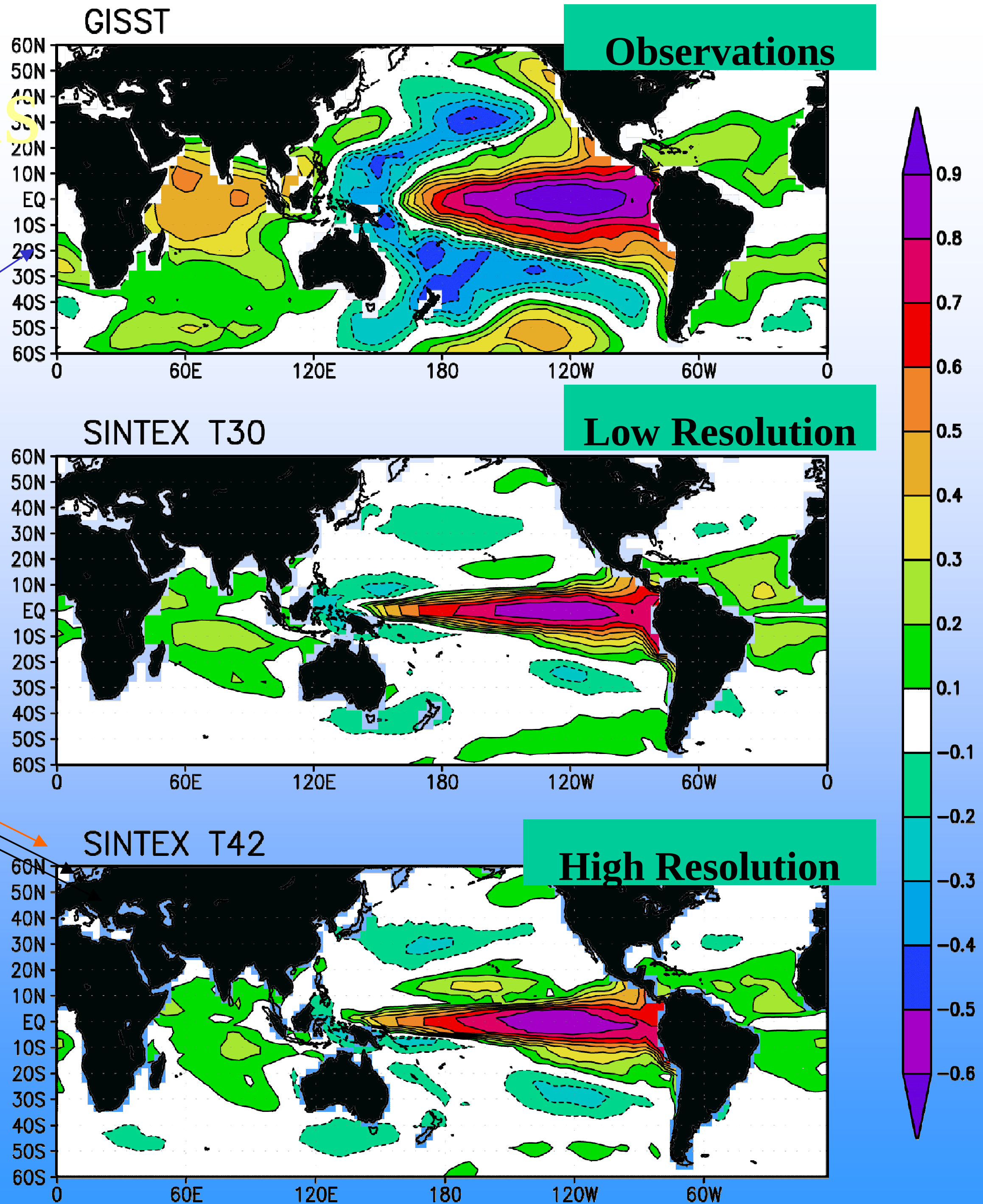




Correlations between the Sea Level Pressure in Darwin and global SST in the coupled model. Also in this case the basic teleconnections are there, but the quality is barely satisfactory.

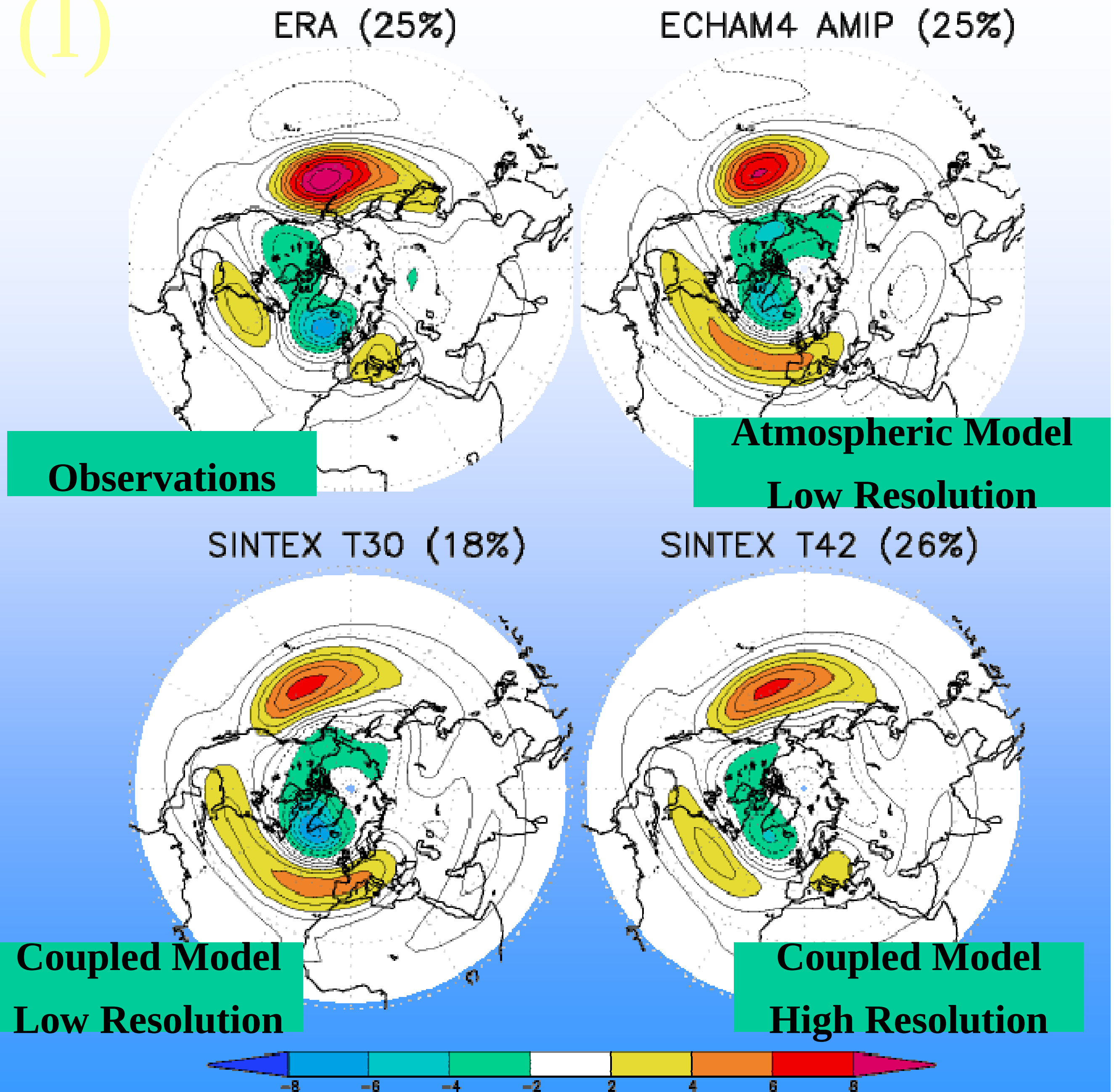
Teleconnections

Correlations between the Sea Surface Temperature in the equatorial Pacific (NINO3) and global SST. Results from observations and two 200 years simulations of coupled model are shown, at lower resolution and at a higher resolution . The models reproduce global patterns, but the propagation of the teleconnections into the midlatitude is still poorly represented.



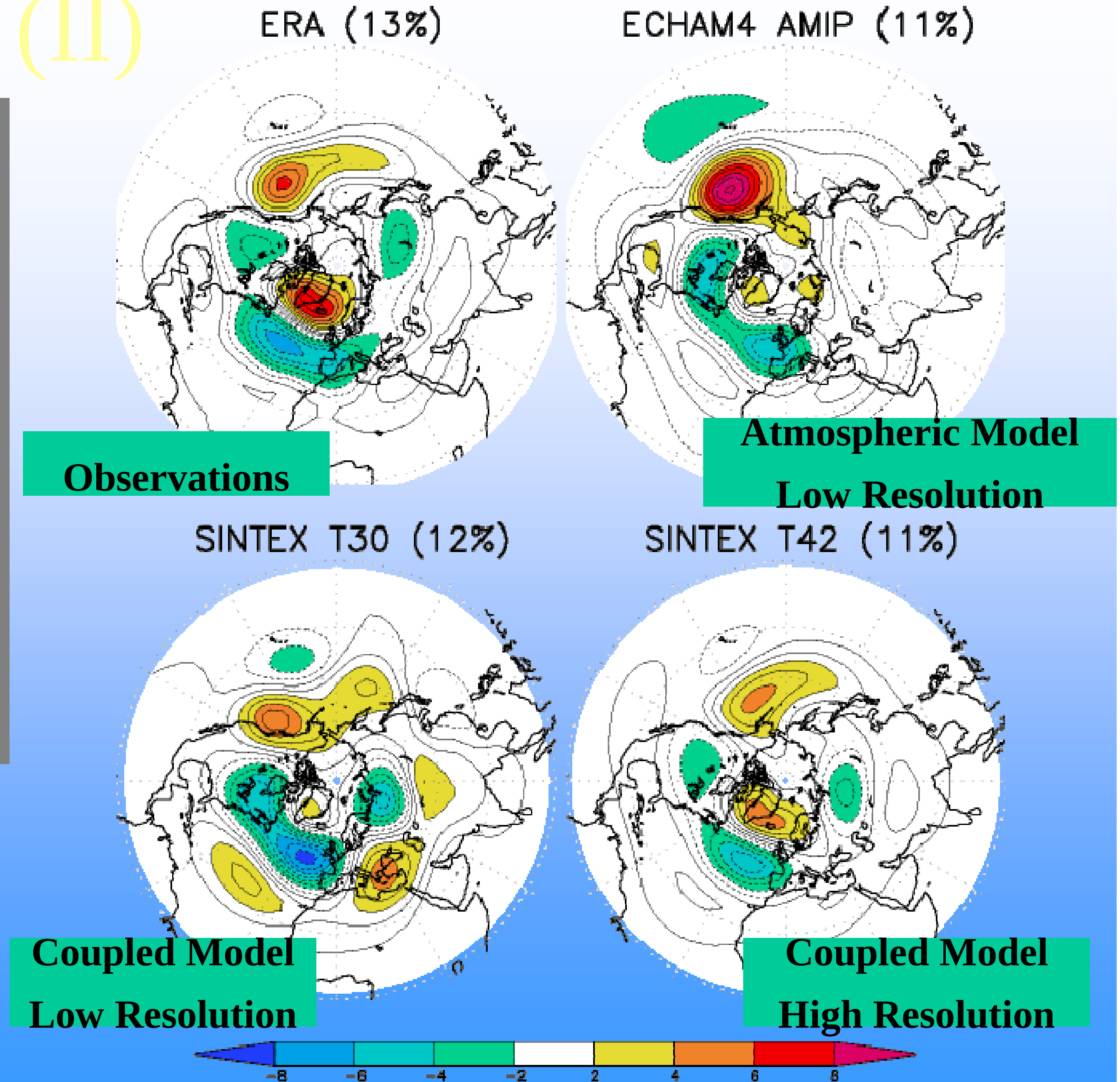
Variability (I)

Empirical Orthogonal Patterns from coupled models, atmospheric-only models and observations. It is here shown the first EOF for Winter (JFM) Z500 . The models, especially the high resolution coupled model, shows a good resemblance with observations, indicating that the modes of variability of the model are close to the real one.

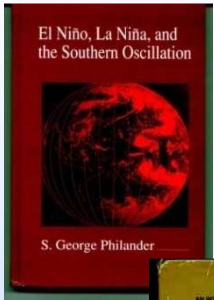


Variability (II)

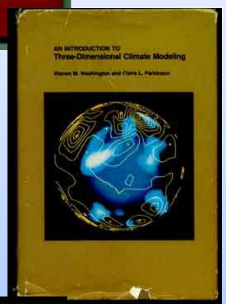
Empirical Orthogonal Patterns from coupled models, atmospheric-only models and observations. It is here shown the second EOF for Winter (JFM) Z500 . This is interesting to show that aldo the higher order modes are captured and that the partition of variance between the modes is also realistic.



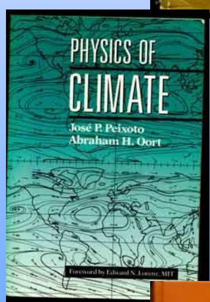
Books



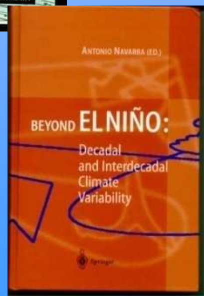
G. Philander,
El Nino, La Nina and the Southern Oscillation, Academic Press
A complete monography on the most important coupled phenomenon



Washington and Parker, 3-D climate modeling, Academic Press
A comprehensive treatment of the numerical techniques used in coupled models



Peixoto and Oort, The Physics of climate, AIP Press
The climate system at work, a compendium of what the observations are telling us.



A. Navarra (ed.), Beyond El Nino, Springer Verlag
A recent collection of results from several important modeling groups, useful to have more informations on the performance of coupled models

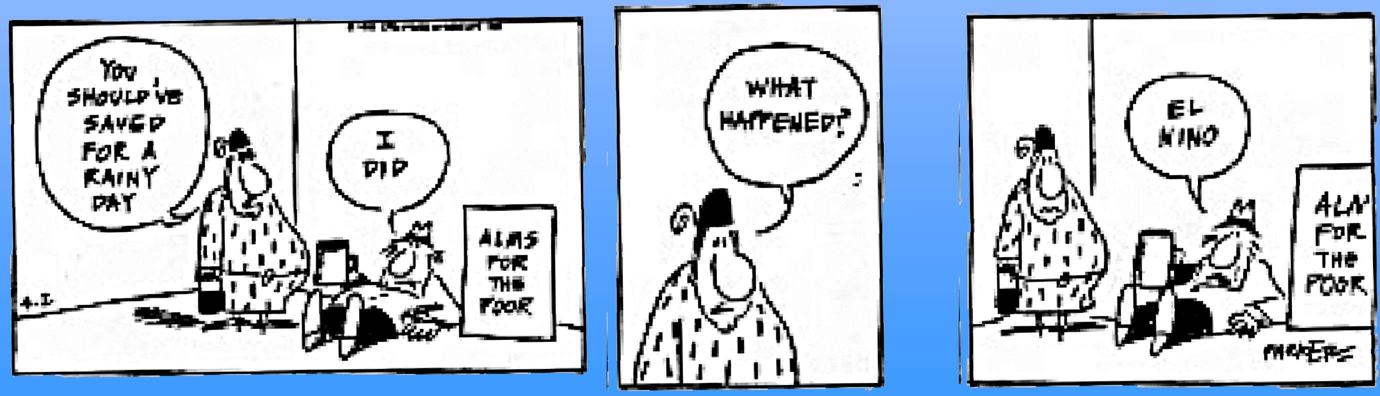
Web Sites

- www.clivar.com
  - Site of the international CLIVAR program and of the Coupled Model Intercomparison Project (CMIP)
- www.dkrz.de
  - Center of Climate Research, Hamburg, Germany
- www.gfdl.gov
  - Geophysical Fluid Dynamics Laboratory, NOAA, USA
- www.noaa.gov
  - The extensive site put together by NOAA, USA

Conclusion

Really, there should be no conclusion. We have only started to understand the behaviour of coupled models and there is still a long way to go. Open problem involved the regulatory mechanisms of variability at longer and longer time scales and the a proper treatment of ice and land processes. Maybe we should follow the following advice:

WIZARD of ID



b1

SADC CSC REGIONAL CLIMATE SERVICE DELIVERY FOR SOCIETY IN SOUTHERN AFRICA DEVELOPMENT COMMUNITY

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Slide 52

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b1 bgaraganga, 1/30/2011

Format of Presentation

- SADC Meteorology Sector
- RISDP& Met Chap of Protocol of TCM
- Role of SADC Climate Services Centre
- Operational Activities
- Capacity Building
- SARCOF
- CSC Products
- Resource mobilization efforts
- Challenges & Opportunities

Objectives of SADC Meteorology Programme

- The objective for the Meteorological Sector is to establish systems and infrastructure that are fully integrated, efficient and cost effective to meet the requirements of the users, and to minimise adverse effects associated with the severe weather and climate phenomena. This objective is espoused in the Meteorology Chapter of the SADC Protocol on Transport Communications and Meteorology.
- **This is consistent with RISDP**

Regional Indicative Strategic Development Plan

- The Regional Indicative Strategic Development Plan (RISDP) is underpinned by the SADC vision, which charts the direction for the development of the region. The Declaration "Towards the Southern African Development Community", adopted in Windhoek, Namibia, on 17 August 1992, by Heads of State or Government of Southern African States, calls upon all countries and people of Southern Africa to develop a vision of a shared future, a future within a regional community.
- The SADC vision is one of a common future, a future in a regional community that will ensure economic well-being, improvement of the standards of living and quality of life, freedom and social justice and peace and security for the peoples of Southern Africa. This shared vision is anchored on the common values and principles and the historical and cultural affinities that exist between the peoples of Southern Africa.

Protocol Of Transport, Communications And Meteorology

- The development of seamless, integrated, efficient, safe, cost effective and responsive transport, communications and meteorology systems is important to the realization of the general objectives of SADC. The SADC Protocol on Transport, Communications and Meteorology, signed in 1996 and effected in 1998, provides the legal and broad policy framework for cooperation, and defines the strategic goals for the transport, communications and meteorology sectors.

Regional Meteorological Support Network

The support network recognizes that among other things:

- the scientific and technical potential of specialised services at national centres is optimally utilised, especially in agrometeorological aspects of food, early warning, remote sensing, data archiving, drought monitoring, seasonal outlooks, climate analysis, ***etc***.

Climate Services Centre

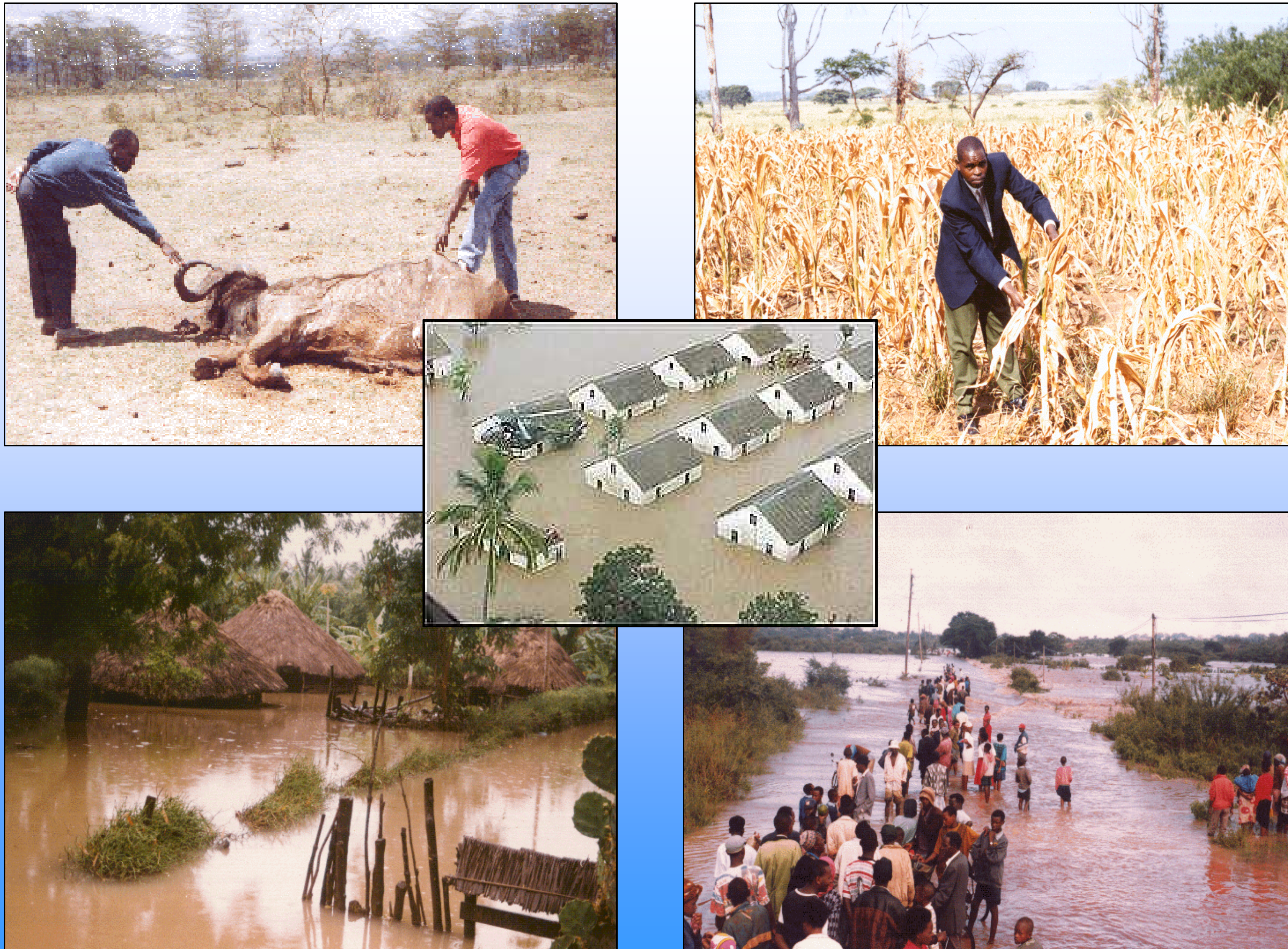
Consistent with the RISDP & Protocol (TMC), the SADC Climate Services Centre (CSC) is an institution of Southern African Development Community (SADC) comprising 15 member states with well over 250 million inhabitants.

It is against the realization that:

- SADC countries experience recurrent climatic extremes such as droughts, floods, tropical cyclones, which often result in negative impacts on socio-economic development of the Member States.
- The region is also susceptible to epidemiological diseases such as malaria and cholera that are influenced by climatic factors.

Climate Services Centre

Responsible for monitoring and predicting of climatic extremes such as floods and droughts in a timely manner with respect to their intensity, geographical extent, duration and impact upon various socio-economic sectors and giving early warning for the formulation of appropriate strategies to combat their adverse effects thus contributing to minimizing their negative impacts.



HISTORICAL BACKGROUND OF CSC

- ❑ Established in 1989/90 together with Drought Monitoring Centre (DMC) Nairobi (now ICPAC) by African Gvts with WMO as Executing Agency. Together responsible for 22 countries of Eastern and Southern Africa
- ❑ Central objective to have regional approaches in mitigating adverse climate impacts to socioeconomic developments.
- ❑ Initial funding from UNDP
- ❑ Next funding from the Belgian Government, with a condition that SADC gradually takes over the funding of the then DMC Harare.
- ❑Since April 2002, core activities are funded by SADC.
- ❑However, programme activities are still being funded by cooperating partners:WMO, USAID, NOAA and others.

ROLE OF THE SADC CSC

1) OBJECTIVE

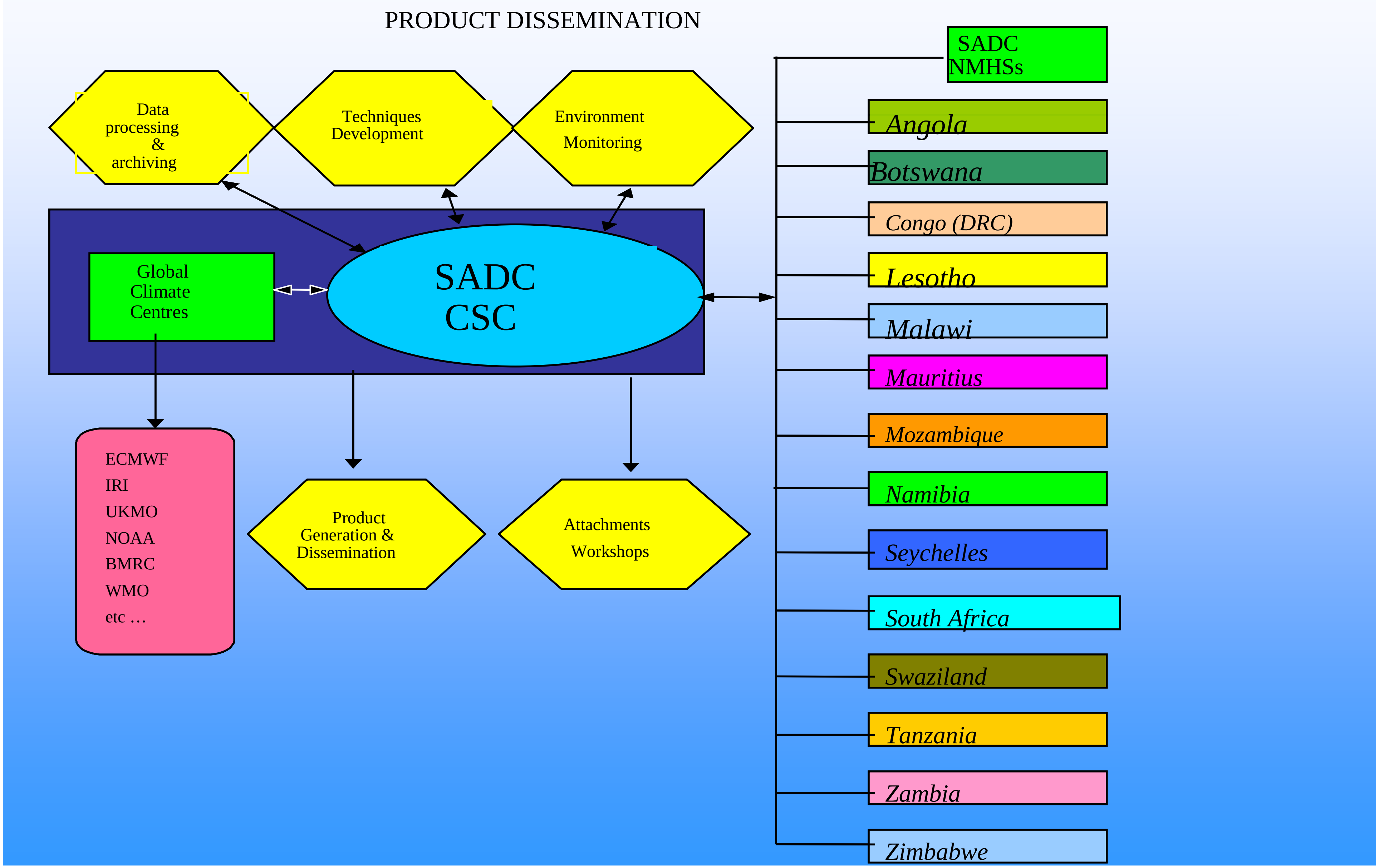
To contribute to mitigation of adverse impacts of extreme climate variations on socioeconomic development.

- This is achieved through the monitoring of near real-time climatic trends and generating medium-range (10-14 days) and long-range climate outlook products on monthly and seasonal (3-6 months) timescales.
- These products are disseminated in timely manner to the communities of the sub-region principally through the NMHSs, regional organizations, and also directly through email services to various users who include media agencies. Our products are readily available on our website: http:www.sadc.int, e.mail address is: dmc@sadc.int

- The provision of products and services enables the formulation of appropriate strategies to combat the adverse effects of climate extremes on socio-economic development.
- Since establishment, the centre has played an important and useful role in providing the sub-region with weather and climate advisories and more importantly, timely early warning on drought, floods and other extreme climate events.

2. OPERATIONAL ACTIVITIES

- Developing and archiving of global, regional and national quality controlled climate databanks
- Providing of climate monitoring, prediction and application services,
- Conducting training and capacity building activities in the generation and application of climate products,
- Organizing the Climate Outlook Forum for the SADC region,
- Enhancing the interactions with the user-community through regional workshops and application pilot projects.


PRODUCT DISSEMINATION
Data processing & archiving
Techniques Development
Environment Monitoring
Global Climate Centres
SADC CSC
ECMWF
IRI
UKMO
NOAA
BMRC
WMO
etc …
Product Generation & Dissemination
Attachments Workshops
SADC NMHSs
Angola
Botswana
Congo (DRC)
Lesotho
Malawi
Mauritius
Mozambique
Namibia
Seychelles
South Africa
Swaziland
Tanzania
Zambia
Zimbabwe

3. CAPACITY BUILDING ACTIVITIES

- Training SADC (NMHSs) staff on developing climate monitoring and prediction techniques of NMHSs through Southern Africa Region Climate Outlook Forum (SARCOF) process.
- Developing synergies with sister organization in order to provide best practice in climate diagnosis& prediction.
- Strengthening links with users from sectors such as health, food security (early warning systems), water resources management, media, tourism industry, etc.

4. SOUTHERN AFRICA REGIONAL CLIMATE OUTLOOK FORUM

The SADC DMC/CSC organized the sixteen Southern Africa Climate Outlook forums (SARCOF),

- It provided a consensus seasonal climate outlook form for the SADC region.

- Strengthened interaction between the users and the climate scientists to enhance the application of meteorology to the reduction of climate related risks to food security, water resources and health for sustainable socio-economic development in the SADC region

Definition

- Regional seasonal outlook prediction and application process adopted by 15 SADC member states

Background

- SARCOF was established under the auspices of the workshop organized by DMC, SADC and IRI in Victoria Falls, Zimbabwe in Oct. 1996 .
- The first forum was held in Kadoma, Zimbabwe in 1997

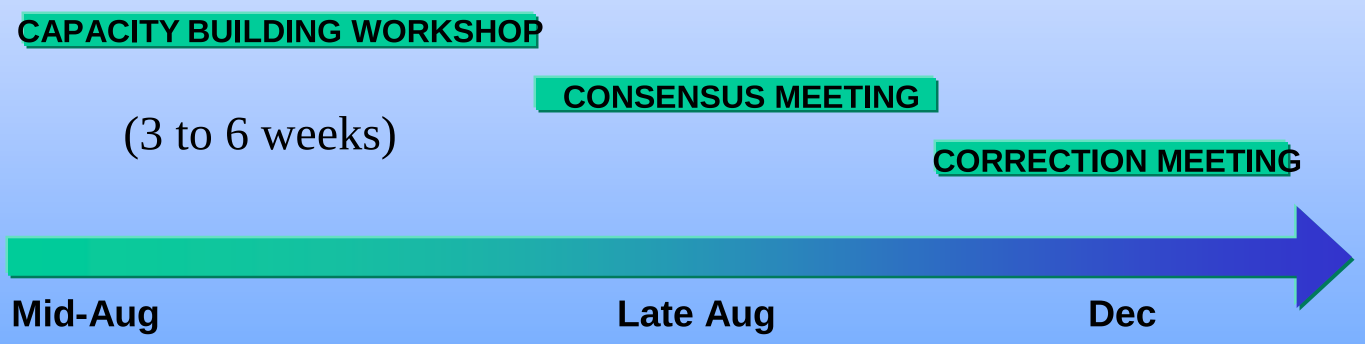
15 SADC countries participating in SARCOF

- Angola, Botswana, DRC, Lesotho, Madagascar, Malawi, Mauritius, Mozambique, Namibia, Seychelles, South Africa, Swaziland, Tanzania, Zambia, Zimbabwe

Objective

- Promote technical and scientific capacity in producing, disseminating, and applying climate forecast information in weather sensitive sectors.

The SARCOF Process



In Addition

National Dissemination Workshops

Timetable of SARCOF events

Venue	Workshops	Consensus Meetings	Correction Meetings
Zim(Kadoma)		Sep. 1997	
Nam(Windhoek)			Dec. 1997
Zim(Harare)		Sep. 1998	
Swaz(Mbabane)			Dec. 1998
R.S.A (Pretoria)	Aug/Sep 1999		
Moz(Maputo)		Sep. 1999	
Zim(Harare)			Dec. 1999
Zim(Harare)	Aug/Sep 2000		
Bots(Gaborone)		Sep. 2000	

Special Features of Southern Africa

- Members of SADC
- Experience common weather and climate patterns
- Prone to natural disasters
- Susceptible to epidemiological diseases
- Livelihood dependant on agriculture

Institutional Frame-work

I. Regional Bodies:

- CSC Gaborone
- SADC I& S
- SADC/ REWU
- ACMAD/ICPAC
- NMHSs
- Training Institutions

II. International Organizations

- WMO
- IRI
- Climate Prediction Centre-NCEP
- NOAA/OGP

Participants of SARCOF Process

- **Meteorological Issues**

 - **Weather forecasters**
 - **Directors of NMS**
 - **Climate experts**

- **Applications**

 - **Agriculture**
 - **Hydrology & Water Resources**
 - **Finance**
 - **Insurance**
 - **Development institutions**
 - **Donor support agencies**

Representatives of the Media

Capacity Building Workshops Activities

1. Basic Computer Appreciation
2. Demarcating Regions by Homogenous Zones
3. Developing Statistical/Empirical Seasonal Rainfall Forecasts Models
4. Validation of Forecasts Models
5. Formulation of Forecast

Capacity Building Workshop, Harare, Aug. 6th-17th Sep. 2000

SARCOF Meetings Activities

- Present various results of research on climate and its impact on economic sectors in the region
- Present seasonal forecasts from various sources (International Forecast Centres, Regional Research Institutions, CSC)
- Formulate consensus forecast for the region for the coming rainy season

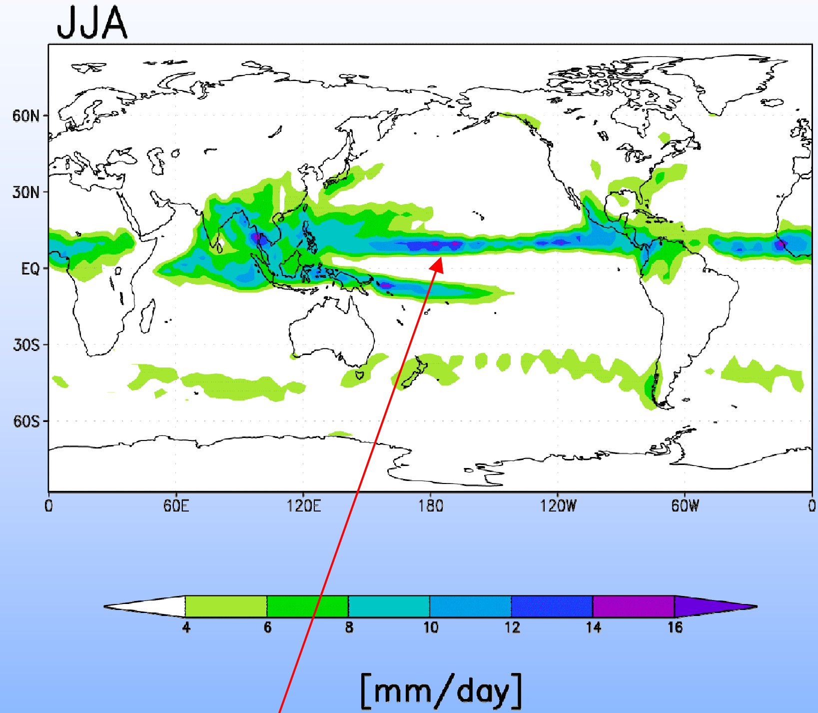
Benefits Achieved

- Capacity building of weather forecasters, media & users.
- Technical upgrade of NMSs (initially each NMS was issued with PC hardware & software).
- Development of national prediction model.
- Improved accuracy of seasonal forecasts in the region.
- Regular issuance of user-tailored forecasts information by NMSS.
- Improved cooperation between NMSs and users.

Institutionalisation & Sustainability Issues

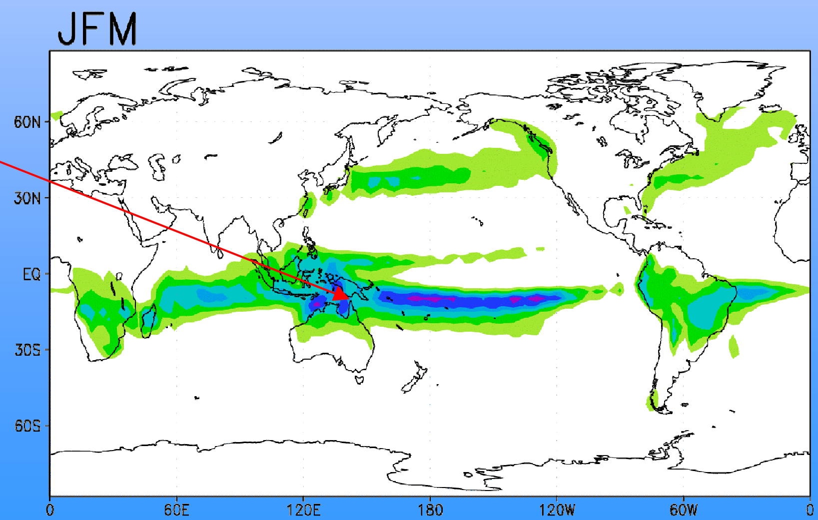
- Institutional Strengthening
- Funding

Precipitation



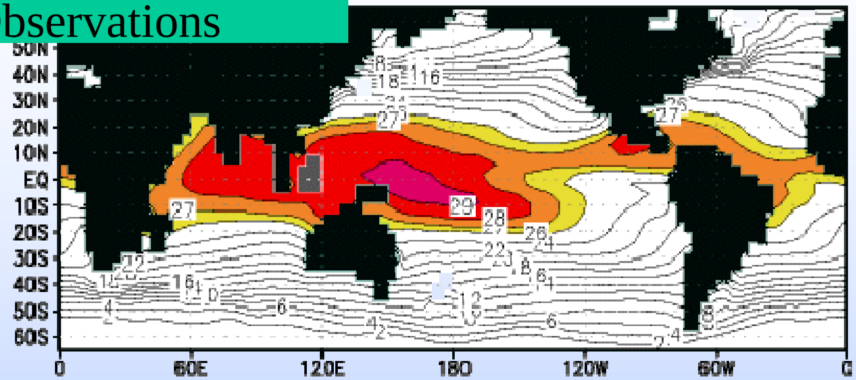
Coupled models can reproduce precipitation pretty well on a global scale, including the tropical ITCZ and monsoon circulation, but the pattern follow too much the seasonal oscillation of the sun

The rain is too much concentrated in the summer hemisphere and the South Pacific Convergence Zone does not have the right shape

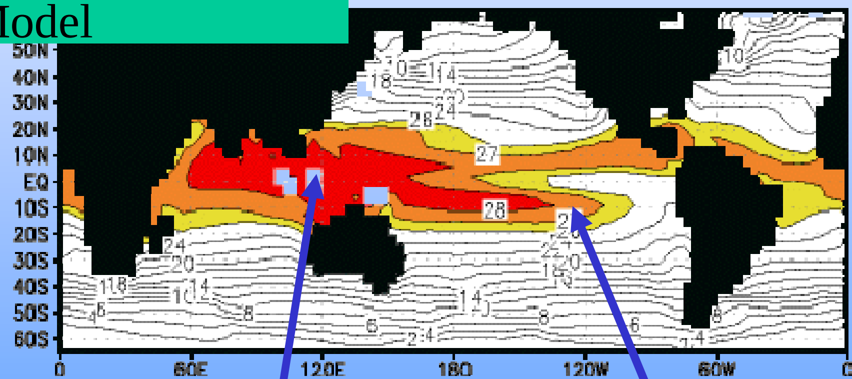


Sea Surface Temperature

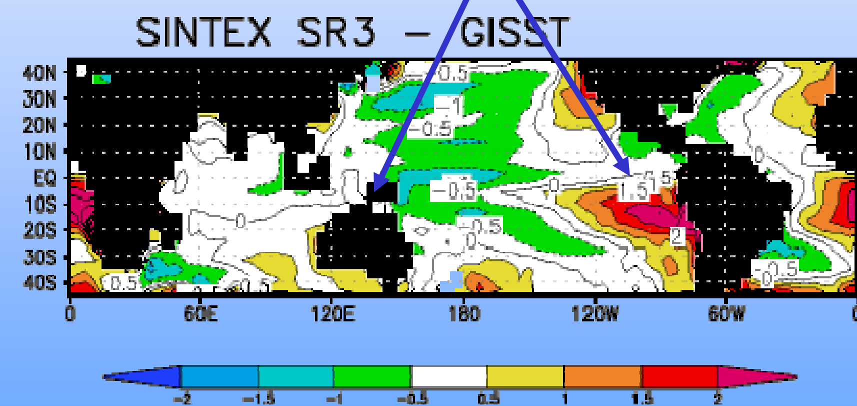
Observations



Model



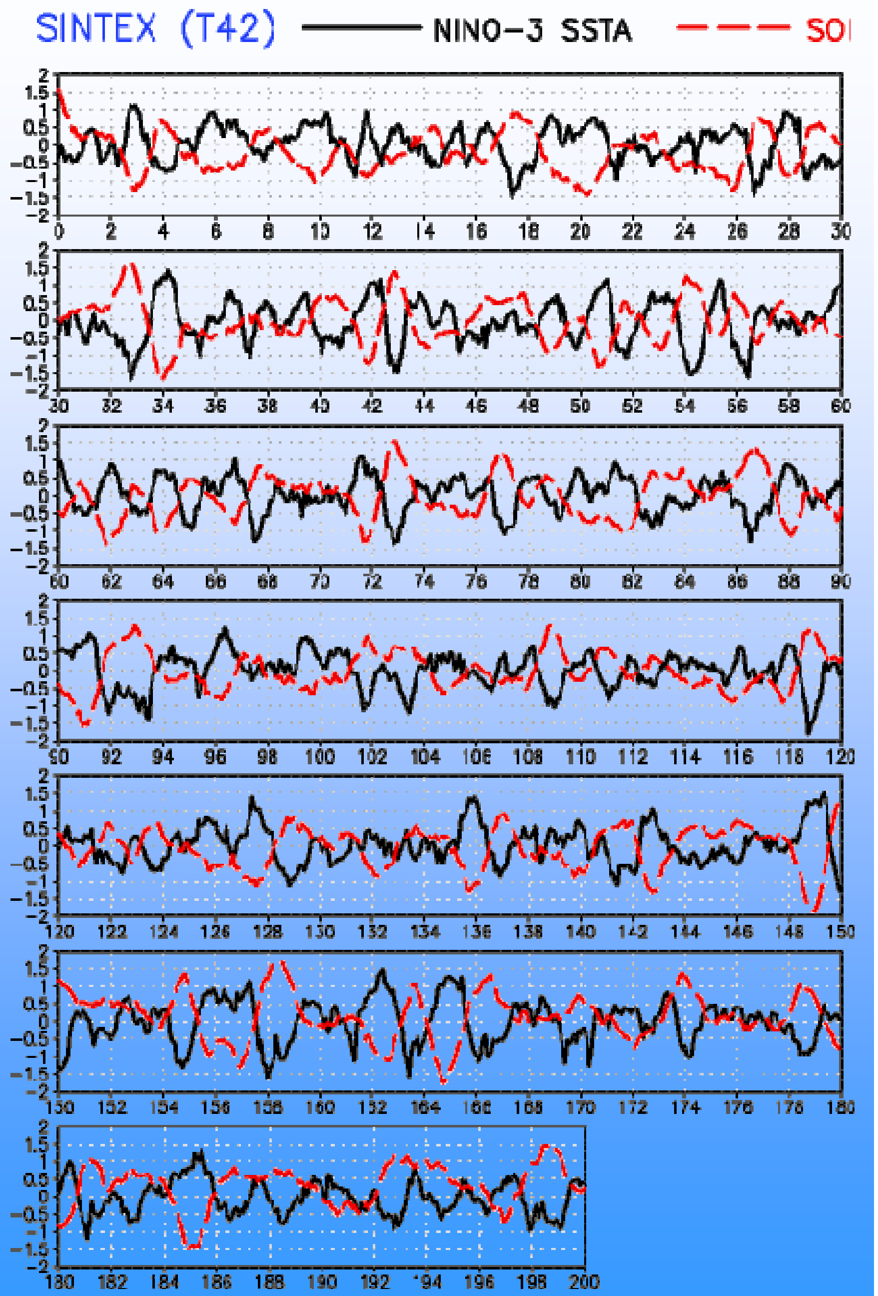
Coupled models can reproduce the over-all pattern, but they tend to be warmer than observations in the eastern oceans and colder in the western portions of the oceans



Marine Temperature in the <u>model</u> are too narrowly confined to the equator, the observations are wider

Southern Oscillation

Coupled models can reproduce the strong coupling between Sea Level Pressure and Sea Surface Temperature as it is shown in this 200 years time series of the Southern Oscillation Index (SOI) and of the SST in the NINO3 area from a simulation. The anticorrelation is pretty clear and the model display a realistic interannual variability



VERIFICATION OF SEASONAL TO INTERNANNUAL CLIMATE PREDICTIONS

Presented

By

B. J. Garanganga

CONTENTS 1

- What is verification?
- Why bother?
- Introduction-care is needed!
- Terminology (bias, skill, ….)
- Performance measures
  - categorical & probabilistic
  - continuous & discrete

CONTENTS 2

WHAT IS VERIFICATION

- “check truth or correctness of”

- “Process of determining the quality of forecasts”

- “an objective analysis of the degree to which a series forecasts compares and contrasts with the equivalent observations over the period”

WHY BOTHER WITH VERIFICATION

Support better decision making-scientific/Admin

- assess relative performance
- assist with consensus forecasting

- Application of forecasts

- “how good are your forecasts?”
- “who should use them”
- provides information to derive full value
- used to help estimate value

HINDCAST V. REAL-TIME FORECAST

- hindcast verification is major focus here-why?

CARE IS NEEDED

- Tornado forecasts Percent correct V. hit rate V. Value
- above “average” forecasts
- impact of trends

PERFORMANCE MEASURES

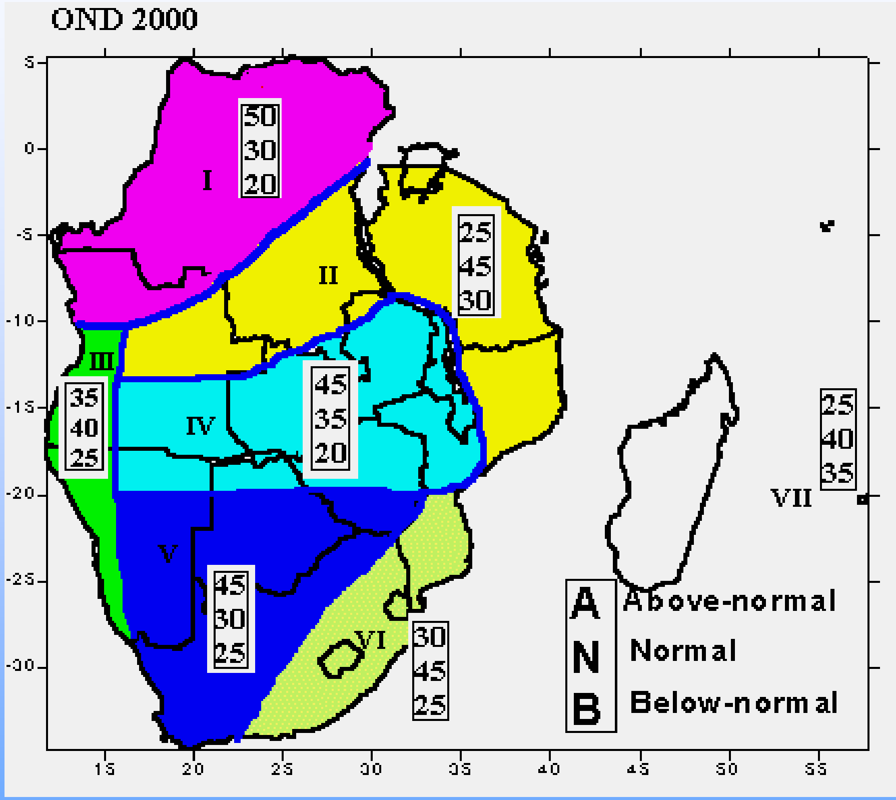
- 1. Percent correct = 100(2680)/2803
  = 96.6%

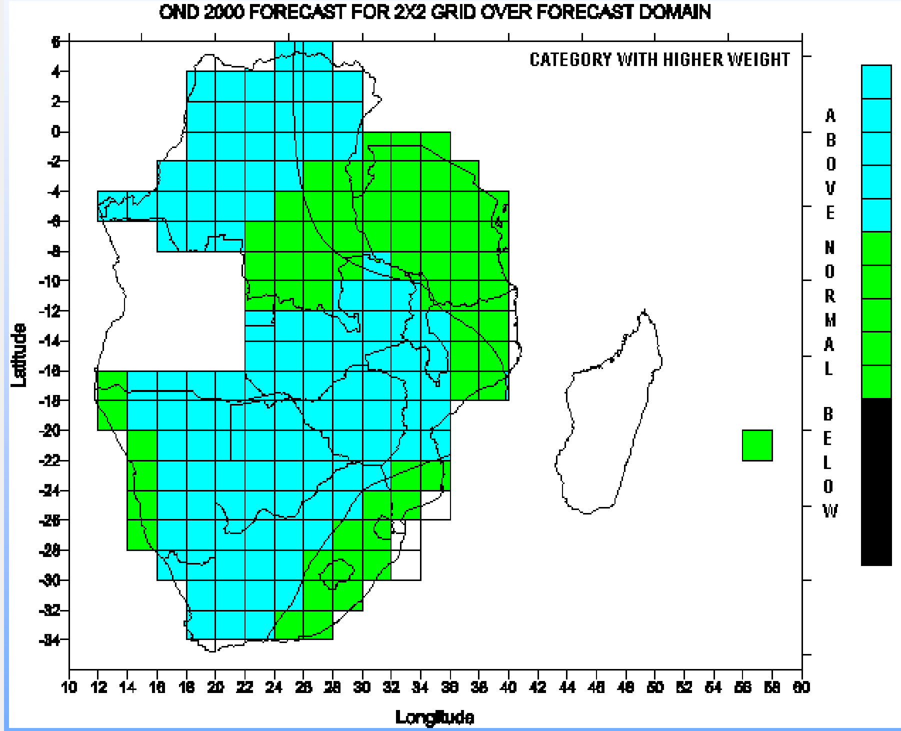
- 2. Percent correct = 100(72+2680)/2803
  = 98.2%!!

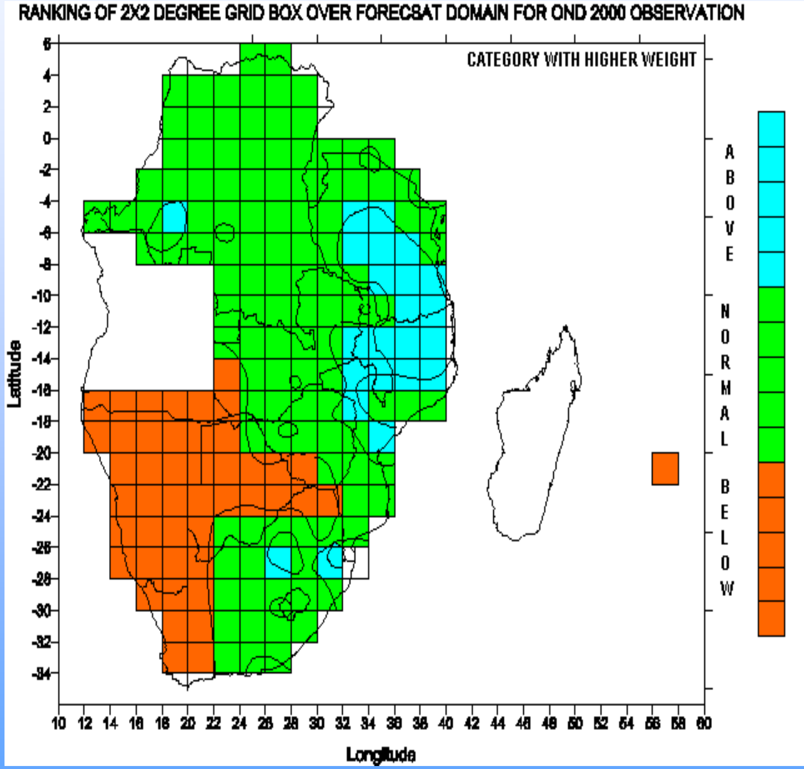
CONCLUSIONS: VERIFICATION

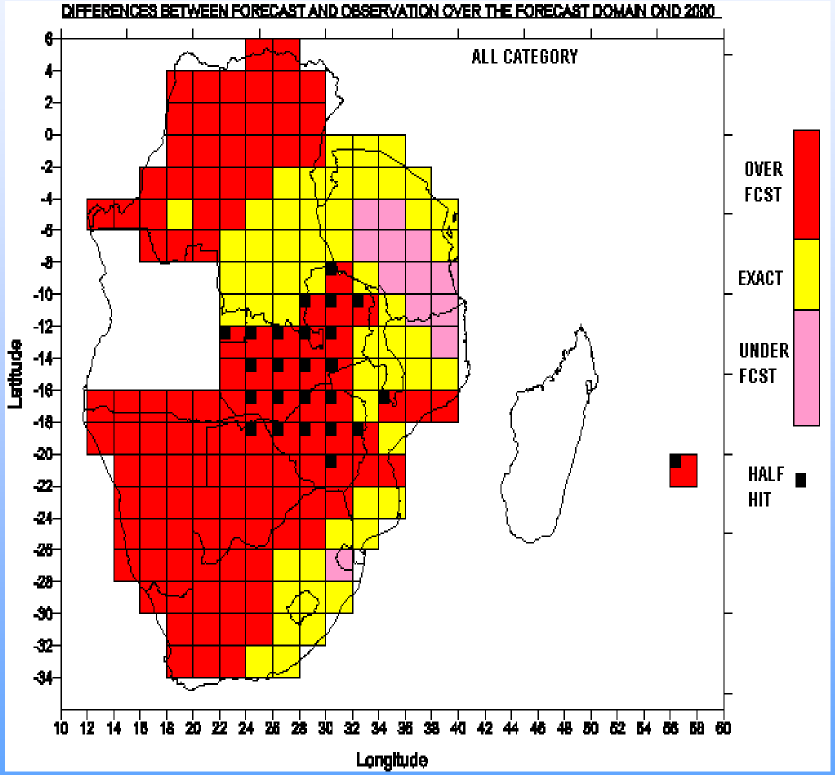
- is crucial
- requires care
- is user dependent
- is not the same as value
- requires more than one measure

SUMMARY


OND 2000
I
50
30
20
II
25
45
30
III
35
40
25
IV
45
35
20
V
45
30
25
VI
30
45
25
VII
25
40
35
A Above-normal
N Normal
B Below-normal


OND 2000 FORECAST FOR 2X2 GRID OVER FORECAST DOMAIN
CATEGORY WITH HIGHER WEIGHT
Latitude
Longitude
ABOVE
NORMAL
BELOW


RANKING OF 2X2 DEGREE GRID BOX OVER FORECSAT DOMAIN FOR OND 2000 OBSERVATION
CATEGORY WITH HIGHER WEIGHT
ABOVE
NORMAL
BELOW
Latitude
Longitude


DIFFERENCES BETWEEN FORECAST AND OBSERVATION OVER THE FORECAST DOMAIN OND 2000
ALL CATEGORY
OVER FCST
EXACT
UNDER FCST
HALF HIT
Latitude
Longitude