

**REPORT ON THE CLIPS TRAINING WORKSHOP FOR  
REGIONAL ASSOCIATION II**

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## **Report on the CLIPS Training Workshop for Regional Association II**

### **1.0 Opening of the workshop**

- 1.1 The CLIPS training workshop for western part of the World Meteorological Organization (WMO) Regional Association II (RA II) was held in Doha, Qatar from 26 September to 7 October, 2004. Participants to the workshop included national Climate Information and Prediction Services (CLIPS) Focal Points and other climate experts from fourteen countries in the region and resource persons familiar with the CLIPS training curriculum and the climate of the region (**Annex1**).
- 1.2 Dr. Buruhani Nyenzi, Chief, World Climate Applications and CLIPS Division on behalf of the WMO Secretary General informed the participants that the main objectives of the workshop were to train CLIPS Focal Points from the region in developing climate information and prediction products; to introduce them to the basics and developments in seasonal prediction; and provide an opportunity to exchange issues on climate information and prediction products. He emphasized the need for effective, accurate and timely seasonal forecasting and well established early warning mechanisms that can enable Governments and stakeholders to plan and put into motion appropriate actions for mitigating against the adverse impacts brought by climate related extreme events. In this regard he informed participants of WMO's commitment to work with the NMHSs and other partners in the region.
- 1.3 The workshop was opened at 10:00 a.m. by Mr. Ibrahim Abdul Kadar, Vice Chairman of the Qatar Civil Aviation Authority. Present at the opening ceremony were Mr. Ahmad Abdallah Mohamed, Acting Director of the Department of Meteorology and Permanent Representative of Qatar with WMO, and Mr. Abdul Majeed Issa, Director of Bahrain Meteorological Service and Acting President of WMO Regional Association II. Mr Abdul Majeed Issa informed the participants that climate is one area in which the National Meteorological and Hydrological Services in the region have had little or no training especially on climate variability, climate change and the CLIPS area. He suggested a need to develop a regional strategy to address these shortcomings through various capacity building activities including workshops. Mr. Kadar expressed on behalf of the government of Qatar their appreciation for WMO holding the workshop in the country. He emphasized the importance his government attaches in supporting the activities of the Department of Meteorology, especially the workshop. He invited WMO to hold more workshops in Qatar and wished the meeting successful deliberations. The programme of the workshop is given in **Annex II**.
- 1.4 The objectives and roles of "CLIPS" were elaborated in the introductory presentation at the beginning of the workshop. It was emphasized that CLIPS helps to build capacity of NMHSs in provision of climate information and products by training experts and developing infrastructure for long-range forecasting. The relation between climate variability and change was elaborated with the emphasis that CLIPS addresses issues related to climate variability.

### **2.0 Climate Variability in the sub-region**

- 2.1 Discussions on the first day of the workshop were devoted to reviewing the various climate variability characteristics in the sub-region and the associated

causal mechanisms. Climate variability of the Indian Monsoon and in the Middle East and its causes and relation to the ENSO phenomenon and the Indian Monsoon were discussed. The influence of tropical cyclones to the climate variability in the region was also discussed. Finally the workshop discussed the fundamentals of global seasonal to inter-annual prediction and some aspects of intra-seasonal variability in the region and the associated data requirements for seasonal to inter-annual climate prediction.

- 2.2 Dr. Nazemosadat outlined the importance of rainfall in 'Middle East', which is basically a rain-shadow region, and emphasized the need for understanding the forces governing rainfall in the region. The roles of ENSO, NAO and Indian SSTA in governing the climate variability over the 'Middle East' were also elaborated. Sri M. Krishnamurty presented the climate variability of the Indian Monsoon. In this regard the areas affected by the monsoon, its component and semi-permanent systems were addressed. Furthermore the monsoon multi-decadal behaviour and its impacts on the climate of the region were highlighted. He also pointed out that tropical disturbances and cyclones forming over the Arabia Sea and Bay of Bengal contribute significantly to climate variability of that region.
- 2.3 The fundamentals of global seasonal to inter-annual prediction and some aspects of intra seasonal variability in the region were given by Dr Jean-Pierre Céron. Participants were informed about long-range forecasts and climate forecasts as well as the different forecasts, lead periods, and the scientific bases for the long range forecasts. It was pointed out that the process is complex due to the evolution of the atmosphere, which is partly driven by the evolution of external conditions such as SSTs, snow-cover extent and soil moisture etc. It was pointed out that average monthly and seasonal forecasts have some skill and also depend on the scale of the phenomenon. However, different forcings have variability on different scales varying from inter-annual to the decadal and multi-decadal states. It was further pointed out that predictability on daily scale is restricted to some 10-12 days.
- 2.4 Dr Richard Washington provided light on different types of data that are used in seasonal to inter-annual climate prediction. These include station observations and satellite data for both atmospheric, land and oceanic areas. It was emphasized that these data can help to derive some useful climate information in the region such as the understanding and monitoring of the climate variability, prediction of climate, and initialization and validation of models. It was also pointed out that lack of availability of data was common in the Southern Hemisphere and especially in Africa and Asian subcontinents. He also mentioned that different centres such as NCEP and ECMWF are creating quality datasets through reanalysis projects. Newly generated gridded datasets of observed station data were also introduced. Finally, model generated data from atmospheric and coupled model data were introduced.
- 2.5 Participants made presentations on current national/regional meteorological capabilities in data management. The presentations indicated that countries have long-period meteorological data, which have many gaps. It was clear that countries use different systems for data management and some of these systems are outdated. However there are some countries that indicated they have well-developed data management systems while others need help to develop such systems. Countries expressed need for capacity building of experts in data management and equipment.

### **3.0 Empirical Models**

- 3.1 In his introduction on empirical models, Dr. Jean-Pierre Céron mentioned that there are two complimentary issues in seasonal forecasting, which are: the scientific interest dealing with quality, and; the users' orientation, namely the usefulness and the value of the forecast. He pointed out that ensemble forecasts are better than single model forecasts because of the nature of the behaviour of the atmosphere on its initial conditions, problems in data assimilations, errors in models, and natural variability of the climate etc. The uncertainty of the model can be sampled using several models, stochastic physics and by modifying some of its parameters.
- 3.2 Model evaluation can be performed through various approaches, both direct and indirect, which can help to assess the adaptation, usefulness, improvement from users' point of view, and verification etc. Furthermore downscaling the products can be done from two aspects, namely spatially and temporally, and they both can be done through statistical and dynamical approaches. He further cautioned that seasonal forecasts are probabilistic; dealing with the mean state and therefore one product may not be useful everywhere, for all the seasons or for all parameters.
- 3.3 With regard to the creation of empirical models, Dr Céron described some major aspects of statistical models. These included the choice of the model, predictands, calibration of the model, evaluation of the quality of the model, and its operational implementation. Furthermore users' requirements need to be taken into account. Furthermore it was explained that selecting the predictands also plays a significant role. Statistical methods such as regression analysis, using contingency tables etc. are useful to select the predictand. Use of few predictands was highly recommended.
- 3.4 Calibration of the model may be performed through designing the learning and test periods independently. Comparison with other model results, studying the model errors and consideration of the users' points of view need to be addressed.
- 3.5 The operational value of statistical models includes their availability in time, caution about lack of some predictors, suitability for users' applications, dissemination and translation.
- 3.6 Dr. Richard Washington elaborated on data requirements for empirical models. The major basic requirements for empirical models are that the dataset should be long enough and there should be a physical hypothesis on which to base the predictions. It was mentioned that global datasets that can be used for empirical models are available from the CRU (UK), NCEP, ECMWF, etc. He mentioned that there are problems in using the available data in empirical models due to missing values and gaps, inhomogeneities, quality, impacts of outlier and dipole problems, which need to be treated with an understanding.

### **4.0 ENSO Dynamics and modeling**

- 4.1 Dr. Washington introduced the idea of how the atmosphere is coupled to the ocean in terms of evaporation/precipitation, heat or exchange of momentum via wind stress. He explained the principle of Ekman transport in the Pacific as a result of the Pacific Ocean surface wind stress. The resultant component is the movement of subsurface oceanic water resulting in upwelling and cooling SSTs in the central and eastern Equatorial Pacific. He pointed out that the cold phase, referred as the La Niña, occur when the trade winds are stronger than usual

leading to the spread of cooler SSTs, and a cold tongue of cool water is advected westward by the trade winds. El Niño is the warm phase that occurs when the trade wind stress either weakens or reverses wind direction, thus allowing warm water to move eastwards to cover much of the Pacific basin. He also illustrated the importance of subsurface warm oceanic water movement to the east, which makes up the memory for the SSTs' predictability, which is a major source of predictability for seasonal forecasting.

- 4.2 It was explained that on the average most of the strong El Niño events developed in spring (April-June) and reach their peak in December-February. The concept of the Southern Oscillation Index (SOI) was also introduced, which is the pressure difference between Tahiti and Darwin. It is negative or positive during El Niño and La Niña conditions respectively.
- 4.3 The idea of teleconnection, as related to the ENSO global impacts, was explained. The eastward shift of convection in the Pacific leads to anomalous atmospheric diabatic heating, which affects the global general circulation resulting in regional climatic variations distant from the Pacific causing various climatic impacts in different parts of the globe. However, Dr. Washington showed maps indicating that there is a tendency for the surface of the globe as a whole to be hotter and cooler during the El Niño and La Niña conditions respectively.
- 4.4 Dr Washington concluded by providing an overview of ENSO indices. These include ocean-based indices calculated from area-averages of SSTs: Niño 4 is important for the convection threshold of 27.5 C, Niño 3 has the largest variability, Niño 1 and 2 frequently indicate the first warming signal, and Niño 3.4 is good for the shifting convection trigger. The atmospheric counterpart, the SOI, was also covered, along with multivariate indices.
- 4.5 The basic fundamentals of ENSO (Niño 3.4) prediction were presented by Dr. Céron. He pointed out that there are several ways to forecast SSTs in the Pacific, but the needed forecasts are the monthly average SST anomalies in which the annual cycle effect is removed. Most of the forecasts are in deterministic form and not probabilities. The latter are important for the initial state of the oceanic and atmospheric models where sampling of the SSTs may lead to different initial conditions. It is very important to take information under the surface; also model forecasts are very sensitive to the effects of wind stress. Verification of SST forecasts is based on correlations and Root Mean Square Error (RMSE). He elaborated various aspects of modeling that are related to ENSO prediction, which include problems in low cloud parameterization, identification of the mode-driving SSTs, and data assimilation.
- 4.6 Dr. M. Krishnamurty introduced the idea of how land, ocean and atmosphere interaction (ENSO, Indian Ocean Dipole) might affect the strength of the monsoon and the tropical cyclones in the region. The history of utilizing the SOI as a predictand was explained indicating that El Niño events are related to changes in the east-west slope of sea-level in the tropical Pacific. He explained that there is a link between interannual variability in summer monsoon rainfall over India and the ENSO phenomenon. A majority of El Niño year events are associated with drought years over India while La Niña years are associated with high rainfall that may be associated with flooding.
- 4.7 Dr. Nazemosadat explained the role of the Indian and Pacific oceans on the climate variability of the Middle East. He lamented that due to huge amounts of heat inserted into the tropical Pacific atmosphere during periods of higher than normal SSTs, the wind circulation changes from surface to upper levels affecting

the whole globe. El Niño conditions weaken the Indian monsoon and warm the Arabian Sea thus weakening the pressure gradient and reducing the wind speed. La Niña conditions make the pressure gradient stronger thus bringing more rainfall in the region. However, there is need to study more on the impacts of ENSO on precipitation in different parts of the region.

- 4.8 Presentations on the dynamics of ENSO were concluded with the set of presentations on this important mode of coupled climate variability. Dr Washington went over some material presented in previous lectures relating to ocean waves (Kelvin and Rossby), Ekman transport, upwelling and downwelling. The presentation went on to discuss theories for ENSO, including the early work by Bjerknes, Wyrtki and the numerical modeling efforts of the 1980s and 1990s. The lecture went through the Delayed Oscillator explanation of ENSO in detail, using an idealized model simulation of wind stress imposed on the Pacific. The lecture concluded by looking briefly at the results from the PRISM project, where a variety of ocean and atmosphere models were coupled in order to determine whether the ocean or the atmosphere controlled the periodicity and amplitude of ENSO.

## **5.0 Dynamical Modeling**

- 5.1 Dr. Céron gave an illustration for a typical operational model run through a block of diagrams where at time  $t$  initial conditions along with boundary conditions are fed into the model resulting to a forecast at time  $t+1$ . The time step could be 2 or 10 days for short range forecasting and a longer time step for long-range forecasting, for example around 2-10 months for seasonal forecasting. And when there are series of forecasts, the previous forecast gives the initial state for the next forecast.
- 5.2 The various processes involved in modeling were defined and elaborated. These included need for data assimilation to create a model initial situation from scarce observations and the parameterization to build and fine-tune the model through using factors such as radiation, convection, diffusion, clouds, precipitation. He highlighted the different types of grids used to solve the dynamics of the models and that the models use different forms of grids to calculate parameterization factors such as radiation, convection, diffusion, clouds, precipitation and others. He pointed out that discretization reduces the problem of numerical instability through dividing the atmosphere into cubes for easy simulation. Vertical discretization and time discretization were illustrated through block diagrams and equations. The atmosphere is cut into slices, which are not regularly spaced in vertical discretization. The models are not homogenous and need high resolution at the surface and more or less constant pressure increments in the troposphere, and constant altitude increment in the stratosphere. In the time discretization, he explained the centered method to discretize advection terms and decentered method to discretize physical parameterizations. He also showed some graphs that showed the improvement in numerical prediction over the years, and lamented that huge amounts of data are being produced by models, which are of little use to forecasters.
- 5.3 Dr Richard Washington gave a talk on the basics of numerical oceanic and coupled models. The oceans are important for determining climate anomalies. The atmosphere alone cannot give realistic descriptions of the climate. They should be coupled with ocean models because of teleconnections and the thermohaline circulation. Some key ocean processes were explained through

illustrations. It was explained that the oceans interact with the atmosphere through heating, evaporation, precipitation and winds.

- 5.4 The dynamics of the oceans were explained through primitive equations, which generally govern the motion of fluid. It was said that ocean models have resolutions between 1 degree to 1/12 degree horizontally as oceans have very small eddies. Oceans are generally represented by grid boxes that are smaller in comparison with those of atmospheric models. Some key ocean processes such as Ekman suction, Ekman pumping and eddy mixing were also discussed, and he informed the meeting that these processes are important for temperature distribution in the ocean. Deliberation was also made on various ocean waves, namely equatorial Kelvin waves and Rossby waves that set the time scale for the ENSO system. Further elaborations were made on the numerical oceanic and coupled models through the PRISM project climate components and some products that illustrated global SST simulation.
- 5.5 Dr Washington explained the need for ensemble forecasts. He explained that the atmosphere is very sensitive to initial conditions, which is strange but not unusual. He explained the concept through a game of pinball, which showed that even though the system is fixed, the trajectory of the ball was unpredictable as the initial force of the ball changes from one release to the next release. So the ensemble forecast was needed to overcome this problem of sensitivity to initial conditions. Ensembles can be constructed by a collection of predictions that collectively explore the possible future outcomes, and multimodel ensembles are a combination of ensembles of individual ensemble systems where the ensemble members derive from more than one model. Furthermore, the limitations of numerical forecasting were explained and how the ensemble forecasting can help to reduce them.
- 5.6 Dr Nazemosadat stressed the need for the development of regional modelling and also studies aimed at understand the background information in the region. He reiterated the existing correlation between the Indian Ocean systems and the climate variability in the Middle East region and suggested that climate research for the Middle East region is vital considering the low precipitation and high evapotranspiration. He also said that the Indian Ocean plays an important role in the economy of the Middle East region and needs further understanding.
- 5.7 Dr. Nyenzi made a presentation on the role of Regional Climate Centers in the provision of climate services and guidelines. He stated that while the real work for RCCs began in May 1999 during the 13<sup>th</sup> Congress, WMO endorsed it recently during the 14<sup>th</sup> Congress held May 2003. However, he stated that how, when and where these RCCs will be established is the sole responsibility of the WMO Regional Associations. He pointed out that the sustainability of the RCCs once they are established is the responsibility of the host NMHSs or institutions. He further said that guidelines have been developed to help RAs in establishing RCCs. The meeting was informed that progress is being made by the RAs with the process of establishing RCCs, and for RA II a Task Team was scheduled to meet in Tokyo, Japan in late October 2004 to discuss and prepare a recommendation to the president of RA II on how the region could proceed with the establishment of its RCC(s).
- 5.8 Presentations were made by the participants on current capabilities in climate prediction, and the uses of climate information and predictions in their countries. These presentations indicated that many countries, except for India and Iran, do not have capabilities in climate predictions. However, a few countries provide

climate information to users in different sectors. Many countries indicated that there is a high potential for demand by the general public on climate information and prediction products. Many of them have plans to strengthen their capacity in climate prediction through training experts and acquiring the necessary infrastructure and software to enable them to downscale global products. Some of the countries have plans to work with local institutions/Universities to develop capacity in long range forecasting.

## **6.0 Forecast Verification**

- 6.1 Dr. Céron explained the concept of forecast quality and its measurement, and provided examples of forecast verification scores. He explained that the method of forecast verification depends upon the type of information provided in the forecast. Heike (hit) scores provide information on how many times the forecast was correct while the skill score, a relative measure of the forecast quality, compares the quality of the forecast to that of a reference set of forecasts. The verification scores are the absolute measure of the forecast quality. He further defined the concept of Linear Error in Probability Space (LEPS), a categorical verification system, and of correlation, which is a measure of association rather than of forecast accuracy. He cautioned that forecast errors could be large, even with a perfect correlation, because of unconditional biases.
- 6.2 Verification of probabilistic forecasts was also discussed. It was explained that a probabilistic forecast could never be wrong because all outcomes are possible although the forecast level of confidence can be correct or incorrect depending on its reliability. Forecast reliability is a function of forecast accuracy and gives the desired characteristic of the forecast. It was further mentioned that a good forecast must address consistency, quality and value. The meeting was informed that the most important aspects of forecast quality were the most likely outcome must be the one that occurs most frequently, estimates of forecast uncertainty (forecast probabilities) must be reliable, and forecast probabilities should be sharp.
- 6.3 Dr. Céron also explained the WMO Standardized Verification System, which ensures that inter-comparison of results from different models can be made, that the verification addresses specific issues, that calculations are made in a consistent manner. The SVS also assists in the further development of the models, and in determining the potential uses of a model.
- 6.4 The meeting was informed that the WMO Standardised Verification System provides an opportunity for Inter-centre exchange of skills, general standards for assessment from all producers, information to be attached to disseminated products and information to users.
- 6.5 Dr Washington made a presentation on verification of rainfall, temperature, and precipitation forecasts. He elaborated on the limits to the skill of seasonal forecasting, assessment on forecasting skills, etc. He emphasised the need to run the model from different initial conditions because the nature of the atmosphere is chaotic. He said that it is not an easy task to model the atmosphere considering the horizontal grid that contains many boxes and many levels in the vertical. He pointed out that there are some positive examples such as the ability in forecasting global maximum temperature on a monthly basis, while on the other hand he cited an example of models' failure to predict the 2002 drought in India during the monsoon.

- 6.6 Dr. Simon Mason illustrated the performance and the score of probabilistic forecast. He highlighted the fact that if the forecast is based on one event then the forecast will not be reliable, but if we consider more than one factor, the probabilistic forecast would be better. Therefore combining more information from different sources would lead to better forecasts. He showed some examples to emphasize that the models forecast temperature better than they do rainfall.
- 6.7 Dr. Mason also talked about the climate variability and how good models are in predicting tropical cyclones. He showed that models are not good in forecasting tropical cyclones over the Indian Ocean, but do well in other regions. He stressed the fact that models will give better results if forecasts are made by combining information from a variety of models; for example, use three different models with ten different initial conditions rather than running the same model thirty times. He said that in order to increase the reliability of the forecast, multi-model combination is required.
- 6.8 On the issue of the forecast value, he said that there are three aspects that have to be considered to distinguish a good forecast from a bad forecast. These were given as consistency, quality (which includes accuracy and skill by making comparison with other forecasts), and value. However he said that there is no simple relationship between quality and value and illustrated the impact of good and bad forecasts, which could lead to saving or losing money.
- 6.9 The presentations were followed by practical exercises on probabilistic predictions and other issues related to presentations on verification.

## **7.0 Communicating Forecasts**

- 7.1 The lecture "*Simple Concepts of Probabilities*" was presented by Dr. Simon Mason. His presentation was divided into three parts: probability and events, interpretations of probability, and conditional probabilities. He explained the meaning of probability and events by giving some examples. He further explained the extreme values of probabilities and the concept of interpretations of probability with regard to likelihood and complement. He also emphasized that there are two main ways to obtain probabilities depending on the situation of event. These are the relative frequency (how often the event occurs) and the subjective interpretation, that is to find out from the current atmospheric condition what is going to happen next. Finally, he explained conditional probabilities. He emphasised the need to consider the difference between reliability and resolution. Reliability indicates whether or not the forecast probabilities are correct, whereas resolution shows if the outcome is dependent on the forecast or not?
- 7.2 On explaining terciles, Dr. Mason highlighted the objectives and roles of terciles on probability forecasting. He explained the concept of terciles and the procedure for obtaining terciles. In order to obtain terciles first the data must be arranged in ascendant order and then categorized into three groups as below-normal, near-normal, and above-normal. Then identify the limit of each group by defining the specific percentiles (33%).
- 7.3 Dr. Mason demonstrated the concept of chaos by using practical examples and graphics. He showed that if there was a slight difference in initial conditions this would lead to different forecasts. An individual forecast would then be useless even if we knew the physics perfectly. He introduced the Lorenz attractor that illustrates how the atmosphere is sensitive to infinitely small differences in initial conditions. Two major sources of uncertainty were pointed out as errors in initial conditions and in model formulation. In order to provide more reliability on

forecasting there is a need for a model to be run a number of times, which gives an *ensemble* of forecasts, and for different models to be run, which gives *multi-model ensembles*.

- 7.4 Dr. Mason described the various cognitive illusions and difficulties that people have in assessing probabilities. He discussed the problems that one encounters in using seasonal climate predictions. These problems include the framing effect and availability and described them in detail. He emphasised the need to be wary of perceptual problems when trying to communicate probabilistic forecasts, and stressed the importance of expressing forecasts in a number of ways. He noted that forecasters need to pre-empt a tendency for people to focus on a single analogue year, and highlighted the dangers of this narrow focus. Examples were presented illustrating the mathematical complexities in interpreting probabilities and the resultant counterintuitive results obtained when forecasting events with low climatological probabilities. A number of examples illustrated the propensity for forecasters to be overconfident, and thus the need to construct forecasts by drawing on a range of expertise was reiterated. However, the dangers involved in consensus building were highlighted.
- 7.5 Dr. Oludhe gave a presentation on deterministic and probabilistic prediction. He started the presentation by stating that the advances in the science of weather and climate prediction and more so, seasonal prediction, has made it possible to predict the future climate ranging from shorter time-spans to periods of more than three months. Such forecasts he said have been used to minimise destruction of property, loss of life, enhance agricultural production and food security as well as provide critical information required for decision-making processes among many others. In his presentation, he highlighted the basic concepts of probability and made a distinction between deterministic and probabilistic forecasts. He further gave some highlights of the procedures used in seasonal climate prediction using empirical statistical methods. He mentioned that seasonal climate forecasting procedures normally start by examining the historical climate records (rainfall or temperature), or any climatological database, and that the database should be long enough, complete and of good quality. He further added that a standard 30-year period generally is sufficient for seasonal climate forecasting. Dr. Oludhe finally presented the tercile method for communicating probabilistic forecasts and also gave examples from Kenya. Queries were raised as to how far the policy makers take up probabilistic forecasts. To this some delegates said that while in the past it was difficult to convince the policy makers, now they are gradually beginning to listen to probabilistic forecasts.

## **8.0 Climate Information Systems**

- 8.1 Dr. Simon Mason gave the introduction of 'Climate Information Systems'. The main role of Climate Information System is to provide information that enables and persuades people and organizations to take action to minimize negative impacts of climate variability (or maximize positive impacts). He pointed out the climate information involves the state of art exploitation of the past climate records as well as contemporary climate monitoring activities. He explained how weather data and information are obtained from the data sources through in situ measurements, remote sensing and model output. He emphasized the need for data to be continuous, homogeneous, and appropriate, following the WMO set standards. He emphasised the need to manage data through quality assurance process. He explained the WMO Resolution 40 which provides policy on data exchange. However he informed the participants that provision of climate information is a service to different users. Finally he concluded that the

generation and provision of 'Climate Information' is as successful as the quality and reliability of Data collection, Data Management, Data and product presentation and Users interface.

- 8.2 Dr. Oludhe defined as the average condition of weather elements (Rainfall, Temperature Pressure, Humidity etc) of a given place taken over a long period of time, usually more than 30 years. He noted that Climate information is becoming important to various sectors that play a big role in the socio-economic development of any country. To achieve it effectively and efficiently National Meteorological and Hydrological Services need to establish and maintain adequate weather observation networks. Establish and maintain national and international communications, have the capability to process data and disseminate timely forecast to the various users, and develop and maintain links with climate information users. He emphasized that it is necessary to have collaboration between meteorological services and the health sector. He also added that displaying Bio-climatic maps can minimize the health hazards caused by climate.
- 8.3 Dr. Nyenzi made a presentation on application of climate information and products to the livestock sector. He introduced this by using example from the SADC region. He said that the agricultural production in SADC region depends on weather and climate patterns. Utilisation of climate information in livestock production is very important. He pointed out that the climatic factors affecting livestock production are precipitation, temperature, humidity, solar radiation and wind speeds. It pointed out that most of the livestock production depends on weather He concluded that correct prediction and information of weather and climate can improve food security and livestock products.
- 8.4 Mr. Ning Ying in his presentation on Climate Information and its application in water resources management highlighted that the water resources situation in the World, causes of water resources shortage, and basic Concepts n water resources management as related to climate information. He remarked that only 2.5 % of the world's water is fresh. Most of the developing countries face chronic fresh water availability problem. He said that human activities induced deterioration of water resources environment and Global Climate changes make global water resource unstable. Lastly he emphasized that the accuracy of climate prediction need to be improved so that water managers can derive maximum benefit from this information.

## **9.0 Dissemination and Applications**

### **10.0 The Way Forward and Recommendations**

### **11.0 Closing of the workshop**

## WORLD METEOROLOGICAL ORGANIZATION

CLIPS TRAINING WORKSHOP  
FOR REGIONAL ASSOCIATION IIDOHA, QATAR  
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## WORLD METEOROLOGICAL ORGANIZATION

CLIPS TRAINING WORKSHOP  
FOR REGIONAL ASSOCIATION IIDOHA, QATAR  
26 SEPTEMBER – 7 OCTOBER 2004

## TENTATIVE PROGRAMME

<b>Sunday, 26 September</b>		
0830 – 0900		Registration
<b>0900 – 1000</b>	<b>WMO / HOST</b>	<b>Workshop Opening</b>
<b>1000 – 1030</b>	<b>Coffee break</b>	
<b>CHAIRMAN:</b>	<b>RAPPORTEUR:</b>	
<b>Time</b>	<b>Lead</b>	<b>TOPIC</b>
		<b>Introduction and Background</b>
1030 - 1130	Buruhani Nyenzi	Background to Workshop
1130 – 1200	Dr. Nazem O-Sadat	Climate variability in the Middle-East region; its causes and relationship to ENSO and Indian Monsoon.
1200 – 1230	M.Krishnamurty	Climate variability of the Indian Monsoon.  <i>Delegates will be expected to synthesise the information presented in this lecture in a format suitable for presentation to the user-community, and should consider different levels of presentation that would be suitable for users with different levels of sophistication.</i>
1230 - 1300		Discussion
<b>1300 - 1400</b>	<b>Lunch Break</b>	
1400 – 1445	Jean-Pierre Céron	Fundamentals of global seasonal to inter-annual prediction and some aspects of Intraseasonal Variability in the region. <i>A background to the science of seasonal climate forecasting. PP version available.</i>
1445 - 1530	M. Krishnamurty	Influence of the Indian Ocean Tropical Cyclones to the climate variability of the region.
<b>1530 - 1600</b>	<b>Coffee Break</b>	
1600 - 17.00	Richard Washington	Data requirements for seasonal to inter-annual climate prediction
1700 - 1730		Discussion

<b>Monday, 27 September</b>		
<b>CHAIRMAN:</b>		<b>RAPPORTEUR:</b>
0830 - 0900	Buruhani Nyenzi	Synopsis of Sunday's presentations/Discussion
<b>Time</b>	<b>Lead</b>	<b>TOPIC</b>
		<b>Empirical models</b>
0900 - 1030	Jean-Pierre Céron	Introduction to empirical models. <i>An overview of some of the different statistical methods available; their strengths and weaknesses, assumptions etc.</i> <i>PP version available</i>
<b>1030 – 1100</b>	<b>Coffee break</b>	
1100 – 1230	Jean-Pierre Céron	Creating empirical models. <i>A step-by-step introduction to the construction of a simple correlation and regression-based forecast model, including cross-validation, and contingency table analysis.</i> <i>PP version available</i>
1230 – 1300		Discussion
<b>1300 – 1400</b>	<b>Lunch break</b>	
1400 – 1430	Richard Washington	Data requirements for empirical models. <i>A discussion of data types, quality issues, problems of artificial skill etc.</i> <i>PP version available.</i>
1430 – 1500	M. Krishnamurty	Climate Data Quality Control procedures used in the region.
1500 – 1530		Discussion
<b>1530 - 1600</b>	<b>Coffee break</b>	
1600 – 1730		Country & regional presentations (10 mins each). Current national / regional meteorological capabilities in Data Management.  <i>Afghanistan, Bahrain, Bangladesh, Bhutan, India, Iran, Iraq, RDMEC.</i>  Discussions
<b>Tuesday, 28 September</b>		
<b>CHAIRMAN:</b>		<b>RAPPORTEUR:</b>
0830 – 0900	Participant	Synopsis of Monday's presentations/Discussion.
<b>Time</b>	<b>Lead</b>	<b>TOPIC</b>
		<b>ENSO Modelling</b>
0900 - 1000	Richard Washington	Dynamics of the ENSO. <i>Introduction to ENSO dynamics, the canonical ENSO evolution, phase-locking to annual cycle.</i> <i>PP version available.</i>
1000 – 1030	Richard Washington	<i>Overview of the ENSO indices such as Niño (1, 2, 3, 3.4) and SO. SST, atmospheric circulation /convection teleconnections patterns etc.</i> <i>PP version available</i>
<b>1030 - 1100</b>	<b>Coffee break</b>	
1100 - 1130	Jean-Pierre Céron	Fundamentals of ENSO (Niño3.4) prediction. <i>Introduction to dynamical and statistical prediction models – their bases, strengths and weaknesses, and operational skill.</i>
1130 - 1200		Discussion

1200 - 1300	M. Krishnamurty	Roles of the Indian and Pacific Oceans on the climate variability of the region. <i>Need to high light the relationship and differences within the Basins and how they influence seasonal forecast.</i> Discussion
<b>1300 - 1400</b>	<b>Lunch break</b>	
1400 - 1500	Dr. Nazem O-Sadat	Roles of the Indian Ocean on the climate variability of Middle East. Discussion
1500 - 1530		Country presentations (10 mins each). Current national Meteorological capabilities in Data Management.  <i>Kuwait, Maldives, Nepal, Oman.</i> Discussions
<b>1530 - 1600</b>	<b>Coffee break</b>	
1600 - 1730		Country presentations (10 mins each). Current national Meteorological capabilities. Contd....  <i>Pakistan, Qatar, Yemen, Saudi Arabia, Sri Lanka, UAE</i> Discussions
<b>Wednesday, 29 September</b>		
<b>CHAIRMAN:</b>		<b>RAPPORTEUR:</b>
0830 – 0900	Participants	Synopsis of Tuesday's presentations/Discussion
<b>Time</b>	<b>Lead</b>	<b>TOPIC</b>
		<b>Dynamical Modelling</b>
0900 – 1000	Jean-Pierre Céron	Basics of numerical atmospheric modelling. <i>A simple introduction to atmospheric GCMs.</i>  <i>PP version available</i>
1000 – 1030	Richard Washington	Basics of numerical oceanic and coupled modelling. <i>A simple introduction to oceanic GCMs and coupled models.</i>  <i>PP version available</i>
<b>1030 – 1100</b>	<b>Coffee break</b>	
1100 – 1130	Jean-Pierre Céron	Basics of numerical oceanic and coupled modelling. Contd...
1130 – 1200		Discussion
1200 – 1300	Expert	RDMEC Climate modelling programmes and facilities. <i>An introduction of the where the RDMEC is heading to in terms of Climate modelling and the facilities in place for this activity including a guided tour to see the facilities.</i>
<b>1300 – 1400</b>	<b>Lunch break</b>	
1400 – 1445	Buruhani Nyenzi	Regional Climate Centres and their role in provision of climate services.  Discussion
1445 - 1530	Buruhani Nyenzi	Guidelines for Establishing RCCs.
<b>1530 – 1600</b>	<b>Coffee break</b>	
1600 – 1730	Richard Washington	Ensembles: reasons for and methods of producing. <i>An introduction to methods of producing forecast ensembles and probabilistic predictions. PP version available.</i>  <i>Discussion</i>

<b>Thursday, 30 September</b>		
<b>CHAIRMAN:</b>		<b>RAPPORTEUR:</b>
0830 – 0900	Participant	Synopsis of Wednesday's presentations/Discussion
<b>Time</b>	<b>Lead</b>	<b>TOPIC</b>
		<b>Dynamical Modelling cont....</b>
0900 – 1030		Country Presentations (10 mins each). Current capabilities in Climate Prediction; uses of climate information and predictions; needs for the future: <i>Afghanistan, Bahrain, Bangladesh, Bhutan, India, Iran, Iraq, RDMEC, ....</i> <i>Discussions</i>
<b>1030 – 1100</b>	<b>Coffee Break</b>	
1100 – 1130		Country Presentations (10 mins each). <i>Current capabilities in Climate Prediction; uses of climate information and predictions; needs for the future. Contd...</i> <i>Discussions</i>
1130 – 1300		Country Presentations (10 mins each). Current capabilities in Climate Prediction; uses of climate information and predictions; needs for the future: <i>Kuwait, Maldives, Nepal, Oman, Pakistan, Qatar, Yemen, Saudi Arabia, Sri Lanka, UAE</i> <i>Discussions</i>
<b>1300 – 1400</b>	<b>Lunch Break</b>	
<b>Time</b>	<b>Lead</b>	<b>TOPIC</b>
		<b>Verification</b>
1400 – 1530	Jean-Pierre Céron	Basics of verification. <i>An overview of forecast quality and its measurement.</i>  The WMO verification system. <i>A more detailed introduction to the WMO SVS – RMSS and ROC.</i> <i>PP version available</i>
<b>1530 – 1600</b>	<b>Coffee Break</b>	
1600 – 1800	Richard Washington	Verification hands-on exercise (deterministic forecasts)
<b>Sunday, 3 October</b>		
<b>CHAIRMAN:</b>		<b>RAPPORTEUR:</b>
0830 – 0900	Participants	Synopsis of Thursday's presentations/Discussion
<b>Time</b>	<b>Lead</b>	<b>Topic</b>
		<b>Verification (continued)</b>
0900 – 0930	Expert	Verification methods used within the region (if available)
0930 – 1030	Simon Mason	Verification of rainfall / temperature predictions – how good are operational forecasts? <i>An honest look at the operational performance of seasonal climate forecasts.</i> <i>PP version available</i> <i>Discussion</i>
<b>1030 - 1100</b>	<b>Coffee break</b>	
1100 - 1130	Richard Washington	Dynamics of ENSO
1130 - 1230	Simon Mason	Forecast value. <i>Measuring forecast value, as opposed to forecast quality</i> <i>PP version available</i> <i>Discussion</i>

1230 - 1300	xxxxx	Application of climate information in disaster management.
<b>1300 - 1400</b>	<b>Lunch break</b>	
1400 - 1600	Simon Mason	Verification hands-on exercise (probabilistic predictions)
<b>1600 - 1630</b>	<b>Coffee break</b>	
1630 - 1730	Simon Mason	Communicating the science of seasonal climate prediction. <i>A roll-playing exercise in which the delegates will be asked to provide a layman's explanation of questions drawn from lectures to date.</i>
<b>Monday, 4 October</b>		
<b>CHAIRMAN:                      RAPPORTEUR:</b>		
0830 - 0900	Participants	Synopsis of Sunday's presentations/Discussion
<b>Time</b>	<b>Lead</b>	<b>TOPIC</b>
		<b>Communicating Forecasts</b>
0900 - 1030	Simon Mason	Simple Concepts of probability including conditional probabilities and generation of terciles.
<b>1030 - 1100</b>	<b>Coffee break</b>	
1100 – 1200	Simon Mason	Chaos. <i>A simple introduction to the problem of chaos and probability concepts.</i> <i>PP version available</i>
1200 - 1245	Christopher Oludhe	Deterministic vs. probabilistic prediction. Explaining probability forecasts – conveying uncertainty. <i>An introduction to the communication of forecast probabilities.</i> <i>PP version available</i>
1245 - 1300		Discussion
<b>1300 - 1400</b>	<b>Lunch break</b>	
1400 - 1515	Richard Washington	Cognitive illusions. <i>An introduction to some common pitfalls in communicating forecasts.</i> <i>PP version available</i>
1515 - 1530		Discussion
<b>1530 - 1600</b>	<b>Coffee break</b>	
1600 - 1730	Simon Mason	Presentation and interpretation of the forecast. <i>A roll-playing exercise in which the delegates will be asked to communicate seasonal climate forecasts meaningfully to end-users.</i>
<b>Tuesday, 5 October</b>		
<b>CHAIRMAN:                      RAPPORTEUR:</b>		
0830-0900	Participants	Review of Monday's presentations/Discussion
<b>Time</b>	<b>Lead</b>	<b>TOPIC</b>
		<b>Climate Information Systems</b>
0900-1030	Simon Mason	Climate information. <i>The importance of data and monitoring – What to do when predictability is poor?</i> <i>PP version available</i>
<b>1030 - 1100</b>	<b>Coffee break</b>	
1100 - 1130	Christopher Oludhe	Climate applications. <i>Some possible uses of climate information.</i> <i>PP version available</i>
1130 - 1200	xxxxx	Application of climate information in Health.
1200 - 1230	xxxxx	Application of climate information in livestock management.
1230 - 1300	Ning Ying	Application of climate information in Water Resources.
<b>1300 - 1400</b>	<b>Lunch break</b>	

1400 - 1530	Buruhani Nyenzi	Open discussion on the perspective of use of climate information and prediction services in the region. <i>Something like a SWOT analysis of CLIPS-type activities in the region (A rapporteur will be needed).</i>
<b>1530 - 1600</b>	<b>Coffee break</b>	
1600 - 1730	Buruhani Nyenzi	Open discussion on the perspective of use of climate information and prediction services in the region (contd.)
<b>Wednesday, 6 October</b>		
<b>CHAIRMAN:</b>		<b>RAPPOREUR:</b>
0830 - 0900	Participants	Review of Tuesday's seminar topics/Discussion
<b>Time</b>	<b>Lead</b>	<b>TOPIC</b>
		<b>Proposal Development</b>
0900 - 1030	Buruhani Nyenzi	Background to Project Formulation and Management and an exercise in planning an Applications Project.  <i>Brief presentation on principles of project management.</i>  <i>Delegates to draw up mock proposals of CLIPS activities to be conducted after the workshop. Proposals to be addressed to the NMHS Director. Delegates to work within existing resource constraints, and with realistic budget requests (if appropriate).</i>
<b>1030 - 1100</b>	<b>Coffee break</b>	
1100 - 1300	Buruhani Nyenzi	Background to Project Formulation and Management and an exercise in planning an Applications Project, cont'd
<b>1300 - 1400</b>	<b>Lunch break</b>	
<b>Time</b>	<b>Lead</b>	<b>TOPIC</b>
		<b>Dissemination &amp; Application</b>
1400 - 1430	Patrick Luganda	The role of the media in the dissemination of climate information.
1430 - 1500	Ning Ying	Application of climate information and prediction services in production and management of crops.
1500 - 1530		Discussion
<b>1530 - 1600</b>	<b>Coffee break</b>	
1600 - 1630	Ning Ying	Application of climate information in Agriculture and Food Security.
1630 - 1700	xxxxx	Application of climate information in Natural Resources, Environment, Forestry, Wildlife and Tourism.
1700 - 1730	Christopher Oludhe	Application of climate information in Energy, Industry, Transport and Communications.
1730 - 1800	xxxxx	Application of climate information in Human Settlement and Public Safety.
<b>Thursday, 7 October</b>		
<b>CHAIRMAN:</b>		<b>RAPPOREUR:</b>
0830 - 0900	Participants	Synopsis of Wednesday's presentations/Discussion.
<b>Time</b>	<b>Lead</b>	<b>TOPIC</b>
		<b>Users' Perspectives. The Way Forward</b>
0900 - 1030	xxxxx	Decision making with climate predictions and information. <i>Delegates to learn how forecasts are used, and to get a greater awareness of user-requirements, constraints etc.</i>
<b>1030 - 1100</b>	<b>Coffee break</b>	
		<b>PLENARY</b>

1100 - 1200	Buruhani Nyenzi	Open discussion on steps forward in seasonal to inter-annual prediction in the Sub-Region. <i>Build on from SWOT analysis to discuss possible CLIPS-related projects. Possibly include some mock presentations so delegates can refine their ideas.</i>
1200 - 1300	<b>WMO/HOST</b>	<b>CLOSING</b>
1300 - 1400	<b>Lunch break</b>	