Regional Workshop for the Integration of the Seasonal Forecasts with Hydrologic
Information for the sectors associated to water in the West of South America

1. Inaugural session

In the city of Guayaquil, Ecuador in the Auditorium of the building "Fundación El Universo", at 9 AM on Monday, 25 January 2010, the opening ceremony of the Regional Workshop for the Integration of the Seasonal Forecasts with Hydrological Information for the sectors associated to water in the West of South America took place.

The event began with the speech of Dr. Claudio Caponi, who speaking as representative of the World Meteorological Organization (WMO), thanked the participants for attending the workshop, reiterating the commitment of WMO to improve and extend the climatic services at regional level in close collaboration with the national hydrological and meteorological services (SMHNs). He emphasized the importance of the coordination to improve the flow of climate information in the community and expressed its confidence that this Regional Workshop will reinforce the ties between the meteorological and hydrological services of the countries located in the West of South America.

Dr. Affonso Mascarenhas, International Director of CIIFEN, outlined the importance of the cooperation between the SMHNs of the region in this integration of climate forecasts initiative with the hydrological information for the sectors associated to water resources in the West of South America.

Dr. Mercy Borbor, representative of the National Secretariat of Risk Management - SNGR, stressed the need for specialized information products for the sectors and the relationship of Inter-cooperation between national institutions, which is generated with joint work in benefit of the development sectors.

Engineer Guillermo Gallardo, Executive Director of INAMHI, in his competence as Permanent Representative of WMO in Ecuador explained the importance of the hydrological information in the various national plans of the Government and the need to improve the information services to the strategic sectors. He ended his participation by declaring the Workshop open.

The event agenda is described in the Annex "A". The workshop was attended by 36 participants, including representatives of meteorological and hydrological services of Bolivia, Chile, Ecuador, Peru, Venezuela and experts from Brazil, New Zealand, United States and France. Colombia delegates were unable to attend because of the difficulties in the process of authorization for their participation; the official communication was received the day of the inauguration event. The roll of participants is listed in the Annex "B".

2. Session 1: Global capabilities atregional and national levels in the implementation of water services

2.1 Conference: Perspectives of the World Meteorological Organization about the Hydrological Services. (Dr. Claudio Caponi - WMO).

Dr. Caponi began his speech explaining the creation of WMO, its objectives, structure and organization. He detailed the role of WMO in the field of the hydrology and water resources, emphasizing article 2, literal e) of the WMO Convention which indicates as a mission of the organization to *support operational hydrology activities and promote a close cooperation between the meteorological and hydrological services.*

WMO fulfills this mission trough the Program of Hydrology and Water Resources, which has as main objectives for the period 2008-2011 the application of hydrology to satisfy the development and sustainable use of water, mitigate hazards associated with water resources and an effective environmental management at national and international levels. In this regard, four sub-programs on Basic Systems have been established in Hydrology, Hydrological Forecasting, Building Capabilities and Cooperation on issues related to water.

The speaker described the activities of the WMO linked to Climate and Water; presenting the conclusions of a Conference about the climate information needs in water resources planning, which are the evidence of the lack of communication between climate information providers and managers of water resources, and also the urgent requirement to quantify the uncertainty in climate prediction and research into ways of improving the use of probabilistic climate products by water managers. The speaker ended his speech addressing the International Framework for Climate Services (MISC), product of the agreement reached after the World Climate Conference of the WCC-3 and the implications for the Hydrological Component. In particular, he stressed that the WMO Commission for Hydrology was very interested in supporting the development of Hydrologic Perspectives in Western South America, since it was seen as a first step towards the establishment of similar worldwide initiatives as contribution to the MISC.

2.2 Conference: The CIIFEN experience on the implementation of climate services on the West coast of South America. (Dr. Affonso Mascarenhas-CIIFEN).

Dr. Mascarenhas began his presentation detailing the mission, vision, projects and information products developed by CIIFEN, as well as its contribution for the bulletin El Niño / La Niña Update of WMO. He emphasized the accomplishment in achieving climate applications online, dynamic and statistical modeling, regional climatic database, increasing of the percentage of visits to the web site of the institution and building capabilities in the region.

The speaker stressed out the mechanisms used in the region for the dissemination of climate information, identification of end-users, mechanisms of communications, signing agreements, community workshops and cooperation partnerships with the private sector. Another work undertaken at the regional level is the contribution to the Atlas of the Dynamics of the Andean Territory, Population and Property exposed to natural Threats, released in 2009 for the countries of the Andean sub-region, in coordination with the Andean Community of Nations- CAN, in the framework of the PREDECAN project.

Dr. Mascarenhas ended his speech detailing the work done on climate change and analysis of the vulnerability of ecosystems and populations exposed to the effects of climate variability and climate change. The future plans of the CIIFEN were also presented.

2.3 Conference: Implementation of the Climate Forum on the West Coast of South America. (Oc. Rodney Martínez – CIIFEN)

The Oceanographer Martinez began his presentation referring to the third World Climate Conference WCC-3 and their legacy showing the global framework for the construction of a World System of Climate Services. Lines of action 3, 4 and 5 of this global framework, seek to strengthen systems and information services, reinforce mechanisms for information and interface with the end users, and the construction capabilities through education and training.

The speaker made emphasis on the evolution of the Seasonal Forecasts in the region, the success of the regional climate forums maintained since 2004, the progress on regional climate modeling statistical and dynamic database and lessons learned from the regional process. To conclude, he exposed some approximations for the consolidation of regional hydrological services, denoting the existing resources, limitations, needs and opportunities for the region, especially considering that a sustainable institutional network has been consolidated for the improvement of national capabilities. The regional platform has become an installed capabilities for future work in the development of forecasting or hydrological prospects for the region.

2.4 Conference: Regional capabilities to provide services to the water-related sectors. Dr. David Matamoros (Centre for water and Sustainable Development – ESPOL).

Dr. Matamoros began his presentation addressing the problems of the management of water in Ecuador and its distribution according to the use by production sectors, highlighting that the coastal region is the one with a lesser geographical availability of the resource (10%) in comparison with the demand (90%). Similarly he exposed the diseases transmitted by vectors, pollution of water, food and the problems in the management and distribution of the resource.

He presented the capabilities of the **Centre for Water and Sustainable Development of ESPOL** in Ecuador, on which the water is addressed as integrator element of multiple scientific disciplines ranging from basic sciences to public policies. It is also mentioned the strategic importance of improvement of hydrological information services for water resources management and the urgent need to prepare new human talent of inter-agency cooperation at the national and international level.

2.5 Conference: Regional activities of the HYBAM project. Dr. Luc Bourrel (IRD).

Dr. Bourrel made a presentation on the HYBAM regional project in the Amazon basin and its extension to the Pacific coast. He exposed the hydro-geo-dynamics of the Amazon basin, the transference of water and solid material from the Andes to the Amazonian plain and finally to the Atlantic Ocean, as well as the impacts of climate variability over these transfers.

The HYBAM project, which began in 1984 in Bolivia, later was extended to Brazil in the year of 1994, then it started in Ecuador in 2000, and from 2003 to 2006 in Colombia and Peru. This project is developed through agreements between the IRD (Research Institute for Development - France) and universities and national institutions of the studied countries, such as ANA (Brazil), SENAMHI (Bolivia and Peru) and INAMHI (Ecuador). The overall objective of the HYBAM project is to understand the hydro-sediments behavior of the Amazon basin and to quantify the liquid, solid and geochemical flows from the Andes to the outlet in the Atlantic, including the problems of erosion in the Andes and sedimentation in the Plains.

Since 2007, one of the problems of the research guidelines of the HYBAM program has been the study of regimes and hydrological and sedimentary balance of the basins of the Pacific side (Ecuador, Peru, Chile) to be compared with the studied basins on the Amazon side of the mountain range and to study the impact of the ENSO (El Niño-La Niña) and its distribution along the continent.

The first results obtained in the basin of the River Esmeraldas (North of Ecuador) were presented, which is useful to make a comparative analysis of the hydro-sediments behavior of the Amazonian Basin (in this case, the Napo River) and the basins of the Pacific side of the mountain range with a particular emphasis on the impact of the climate phenomenon of the ENSO (El Niño - La Niña) on Hydrology (relationship climate-rainfall and flow).

2.6 Conference: National capabilities in hydrological and climate services in Bolivia. Meteorologist Gualberto Carrasco and Engineer Hubert Gallardo (SENAMHI-Bolivia).

The speaker began his presentation with information about the institution, highlighting the evolution of the amount of hydrometric stations in Bolivia, noting an increase in the last 5 years with stations that belong to other institutions which coordinate the sending of data to the national service. It is explained that currently SENAMHI has a database with information from 319 hydrographic stations distributed along Bolivia and describes the activities undertaken in hydrology and information validation, database update, maintenance of the network, expansion of the network and inter-institutional agreements.

On the meteorological side, the speaker explained the processing system and storage of data and information products, which are being generated in the institution (SISMET). The presentation concluded with the report of some areas for improvement in the SENAMHI to generate information products useful to the users of the development sectors of the country.

2.7 Conference: National Capabilities in Hydrological and Climate Services in Chile. Met. Jeannette Calderón-DMCh and Engineer Luis Moreno (DGA).

Engineer Moreno presented the needs of information for the management of the water resources in Chile, as well as existing capabilities, climate forecasting and possible approaches in response to the problem.

Among one of the strengths it was shown the hydrologic database of the country, which has records since 1950 to date, according to the data collected from 153 rainfall stations and 36 thermo-rainfall stations.

The proposals presented aimed towards specific studies to the hydrological sector and strengthening the capabilities of forecast to work in conceptual physical models of causes effect relationship with climatic series and downscaling data for river basins level.

2.8 Conference: National Capabilities in Hydrological and Climate Services in Ecuador. Engineer Fernando García and Engineer Oscar Chimborazo - INAMHI

The presentation of Engineer García on behalf of the National Institute of Meteorology and Hydrology of Ecuador focused on the progress achieved in the calculation of the income forecast of the Amaluza reservoir in the province of

Azuay. This information is relevant to the management of the Paute Hydroelectric Central Station, taking into consideration that it is the main generator of electricity for domestic supply in the country. The generation of energy in the station has been calculated as 60% of the nation total. Products generated periodically correspond to short and mid term meteorological and hydrological forecasts.

2.9 Conference: National Capabilities in Hydrological and Climate Services in Peru. Engineer Waldo Lavado and Engineer Wilmer Pulache - SENAMHI-Peru.

The presentation of Engineer Lavado began showing in detail the hydrologic activities of SMHN in Peru, which at the time is working in surveillance, alert and research and technical advice in hydrology, monitoring of water quality and monitoring of hydrological drought. Regarding the information products of the General Direction of Hydrology and Water Resources, there are available technical documents with information in newsletters, hydrological alerts, monitoring reports, water balance and a hydrological atlas of Peru basins.

The speaker listed the information products, applicability and availability through the institutional web site.

2.10 Conference: National Capabilities in Hydrological and Climate Services in Venezuela. Met. Carlos Ojeda – SEMETAVIA and Engineer Rafael Navas – INAMEH.

Engineer Navas, presented on behalf of the INAMEH, the prequels to the creation of the National Institute of Meteorology of Venezuela, with the approval of the legal framework in 2006 and the start of the working activities in 2008, becoming its mission to regulate and coordinate the national hydro-meteorological activities. The speaker explained the organizational structure, monitoring network, data collection system and planning for the implementation of numerical models for climate and hydrological forecasting.

Meteorologist Ojeda, presented on behalf of the SEMETAVIA the seasonal forecast prepared in his institution, the tool, methodology and the capability to generate climate products. The speaker explained in detail the methodology used for the preparation of the forecast, from the processing of the data, the model application and verification of the results.

2.11 Conference: National Capabilities in Hydrological and Climate Services in Colombia. Met. Oscar Martínez and Christian Euscátegui-IDEAM (sent through email and presented to the participants)

The Hydrology component also provides its services by daily monitoring the levels of the major rivers in the country and its tributaries, reporting to the population with enough time in advance the threats by floods or droughts levels that represent a restriction for river navigation.

Currently the IDEAM has more than 1400 pluviométricas stations, 520 climatological stations of different categories with information of parameters such as temperature, humidity, wind, solar, brightness, and more than 800 hydrological stations; on average, the Institute has close to 50 years of historical data series information that is publicly available through the Technical Archive Office. The hydrological forecasts performed by IDEAM are qualitative in nature, currently there is no hydrological model operating with quantitative results. Despite the fact that hydrological modeling history in the Institute is not new and dates from more than 30 years; early on, the major constraint to operate such models was the amount of information required by these, not only on the hydrological conditions, but also the detailed geographical aspects that were not available at that time. During the past two years, for hydrologic modeling, the Office of Hydrology has advanced on this achievement not only with financial but also with technical resources, to the surveying and implementation of the information for a hydrological model for the middle and lower part of the main river basin of the country(Cauca and Magdalena river basin), whose extension is about 1500 km in length, with an area of 280,000 km2 and with a mean contributions flow to the Caribbean Sea in the city of Barranquilla in the order of 7000 m3/s.

In Colombia, about 75% of the electric power generation comes from the Hydroelectric sector. The country is interconnected and the companies that generate energy are almost entirely on the private sector, including the largest ones with their own hydro-meteorological monitoring network for their specific purposes. The IDEAM provides to this sector information about the state of the levels of the tributary basins to the hydroelectric system, and once a month the Institute, through the Meteorology Department conducts a presentation about the climate projections in short and medium term to include this information on models of supply and demand in the sector.

Regarding the hydrologic prediction in short and medium term for Colombia, IDEAM does not have a seasonal model to estimate the behavior of the rivers in the short and medium terms. Nevertheless, as it was explained before, based on the daily tracking of the main water ways of the country, added to the climate prediction performed by the Department of Meteorology through a dynamic and statistical modeling, the most likely scenario is estimated. This information is distributed in a monthly document (Climate Prediction and Alerts Bulletin), which is sent to several government agencies.

IDEAM prepares and presents special weather predictions with projection in the short, medium and long terms to the hydro-electric sector of the country, which are reunited in the Operational Committees, Forecasting Flows Committee, National Operational Council, and the Committee for Energy Monitoring. It is important to notice that in the past, the country suffered the effects of an energy rationing for 13 months, between 1991 and 1992, which caused economical losses of US$ 10 million daily. The reservoirs "dried" because of the drought associated with El Niño (ENSO). Since this event happened the sector included the climate variable in the hydrological modeling of the rivers that feed the reservoirs of the country.

The country produces most of its energy (80%) from water and 20% from thermal generators. The projection of water availability determines the cost of energy in the stock market.

3. Session 2: Regional and National needs for hydrological forecasting for users of the energy, irrigation and sanitation sectors.

SUMMARY SESSION 1:
Dr. Mascarenhas began the session by summarizing the elements exposed by the institutions:

- The disconnection between hydrological and climatic activities that happen in most cases.
- The necessity of institutional coordination in cases where the issues are handled in several institutions.
- The need to learn from each other tools, fundaments, limitations and levels of uncertainty that exist in the forecasts.
- Instruments limitations.
- The need for new staff.
- The existing asymmetries between the SMHNs of the region.
- The valuable information available in analog format that must be digitalized.
- The need to increase efforts in the research and definition of conceptual physical models.
- The limitations of the models and the need to measure the uncertainty and to conduct verification processes for the products.

3.1 Conferencia: Necesidades Regionales de la Información Hidrológica en el sector agua. Dr. David Matamoros – UNESCO-PHI-LAC

Dr. David Matamoros in his speech details the components of the UNESCO Water Sciences Division focusing on the explanation in the International Hydrological Programme component created in 1975. A reference was made to the organizational structure, to the national committees and to the focal points in Latin America and the Caribbean, which at the moment has 36 Member States.

Watershed management advances and the 2009 program works in 91 basins in 67 countries of the Member States. The speaker unveils the different themes of PHI that will be achieved until the year 2013, issues such as the effects of changes in watershed management, the management of resources, education for sustainable development, details of the various programmes and projects running in Latin America and the Caribbean, the intervention of UNESCO in the education of the universities oriented to hydro-meteorology in: formal education, applied research and products such as technical publications issued by the UNESCO on this subject.

3.2 Conference: New Zealand experience in the implementation of Hydrological Perspectives. Mr. Roddy Henderson - NIWA

Mr. Henderson described the activities of the National Weather Center in New Zealand, the influence of climate forums, hydrological forums, applications for the water resources sector and hydroelectric power generation. The National Weather Center, established in 1999, performed seasonal climate forums, soil studies and flow analysis. The information is disseminated once a month through a website, media and publications on the Climate Update. Climate and water databases have open access to the public and are managed by NIWA. The hydrological database has 600 stations, while the ground humidity observation network is composed of 70 monitoring stations.

The speaker explained which ones are the sources of information to obtain the hydrological perspective. These include local and global models as well as data. They are combined using an expert consensus process to produce the prediction of three months of water resources.

The predictions for precipitation, temperature, flow and applications are displayed, and they are very useful and relevant about the energy sector and water resources. Skill measures of the forecast were also shown, to emphasize the importance of the validation. The Exhibitor ended by highlighting that the water perspective forums allow you to know the interest of users, dissemination systems to end users and decisions makers, and also the link and communication that exists between hydrologists and climatologists.

3.3 Experiences of IRI en Hydrologic Perspectives. Dr. Walter Baethgen – IRI

Dr. Baethgen intervention focuses on the experience of the IRI in hydrological forums. The IRI research topics include the approach, methods and tools in which IRI works that are applicable to different socio-economic sectors including the management of water resources.

The speaker described the components used in hydrological research, the first one consisting on the generation of the seasonal Climate Forecast as product for decision-makers, development and implementation of plans. The second one called Climate Services is focused on the Management of Climate Risk by providing information and climatic products, integrated to socio-economical information to assist in the process of decision-making in various priority and vulnerable areas. The advances achieved by IRI in climate forecasts, with the use of state of the art technology and implementation models, is oriented to the development of methods for the validation of forecasts, and increasing the spatial resolution of the products ("downscaling").

Dr. Baethgen presented a work in different countries with coupled models for the generation of a seasonal forecast for rainfall, with forecasts of flows (calculation of expected levels to produce energy) and including the characterization and uncertainty quantification systems. He also introduced new techniques in development at the IRI to disaggregate time series on daily basis based on probabilistic forecasts.

3.4 Conference: Hydrological services required by the Energy sector. Dr. Alvaro Murcia - National Centre -Colombia

Dr. Alvaro Murcia on behalf of the National Office began his speech with an explanation of the current situation in the electricity sector in Colombia, its evolution and its organizational structure. He showed the development of electric power in Colombia, the impact of El Niño on the electricity sector and the experience of the industry with the current El Niño event. Dr. Murcia during his dissertation said that the behavior of the climate in the equatorial Pacific, in particular the positive phase of ENSO has a decisive impact on the climate in Colombia and in particular the electric sector. Rainfall is reduced dramatically and consequently so is runoff of river basins, which are used in the generation of electricity.

The speaker explained the impact on precipitation in the presence of a typical El Niño, showing a minor deficit in precipitation, affecting the water supply in the major reservoirs of Colombian territory. This experience forced the implementation of political reforms in long and medium terms, to assure the mechanism to guarantee the availability of the resource, to implement emergency plans and to use the climate services in the political decision-making process; all of which will be materialized in the application for appropriate operational planning expected for the generation of energy. The speaker indicated that climate information in the current El Niño 2009-2010 (with severe impacts in Colombia) facilitated decision-making in time to avoid rationing power over the territory. Industry in Colombia, marked by an evolution of the sector, had noticeable changes, influenced by regulations at the legislative level, which influenced in a positive way.

The characteristics of the interconnected system of Colombia - SIC, is interconnected with Venezuela, Ecuador and by the year 2013 it will be connected with Panama. The demand is 54 Tera-Watts per year, the reservoir produces 15.5 Tera Watts annually. Energy and water regulation is not dictated by the storage capacity of small reservoirs. The market has the option to buy stocks or by contracts. Stock prices increased in the El Niño event 97-98 period, due to the low water availability and currently the trend is repeating with the 2009-10 El Niño. The speaker indicates that in the period 1991-92, the demand was supplied with energy produced by reservoirs, thermal plants and he showed the levels of rationing. Unlike today, hydrological scenarios are used to meet the demand for energy, to end avoid rationing, during the 2009-10 El Niño event.

Planning-level enhancements boosts with the contribution of climate information.

The Exhibitor concluded that the reliability of the information related to climate behavior is the key to the work done. With this in mind, they are working on agreements with IDEAM to work on joint planning and on the improvement of information products currently available.

3.5 Hydrological services required for the water supply and sanitary sector. Dr. Miguel Ángel Ontiveros PROAPAC-GTZ-BOLIVIA

Dr. Ontiveros began his presentation by enhancing the millennium development goals, specifically with target 10, and with a view of the current situation in Bolivia in this issue, explaining with statistical tables the position of Bolivia regarding the countries of Latin America and the Caribbean, in relation to the provision of water and sanitation. According to the statistics Bolivia is the third country with the lowest HDI in the region, reflected among other indexes with the low level of coverage of basic services.

Dr. Ontiveros details the imperative need to establish aid mechanisms for decision-making, as a first option to have a system of hydro-meteorological information in conjunction with socio-demographic information, the political will to carry out a new strategy for the management of water resources with legislation and regulations.

Overall, the inequity levels in the distribution of resources, the poor quality of drinking water, the discontinuance of supply service and the problems of pollution, made urgent the need of a new political framework for the management of water resources in Bolivia. In this context, the Ministry of environment and water, through the Vice-Minister of drinking water and basic sanitation, in coordination with PROAPAC-GTZ (PNAPSB), recognized the need for a change in the orientation of policies in the sector, and suggest the promotion of the Integrated Water Resources Management (IWRM) as a main tool to solve different problems.

3.6 Linking of the sectoral needs with hydrological capacities in the region. Dr. Mark Airton de Souza – Brazil

Dr. Airton began his speech, by presenting the national energy matrix, the sources of supply and the control of the states on the resource. The speaker displayed a series of data with precipitation anomalies in years with ENSO which allow an analysis of droughts and its temporal variation.

The Brazilian experience on resource management is presented with the activities of the rivers integration project, to feed hydrographic systems that will be used in the generation of hydroelectric power in the Northeast sector of the country, occupying an area of 18,27 % of the national territory.

Among the activities developed for semi-arid regions, we can give emphasis on the prognosis of drought in the long term, surface and underground water resources management, monitoring of flows, analysis of social, economic, and environmental impacts and activities of reduction and mitigation of impacts. The speaker highlights how the seasonal rainfall predictions can be useful, especially for the sectors of energy, agriculture and water supply. To do this, it is necessary to add this information to the different subsystems of hydrological analysis in the field of river basins.

The speaker concluded by detailing the implementation of models for flood forecasting in the Amazon River basin by the Water National Agency ANA.

3.7 Information needs for administrators of water resources in Venezuela. Engineer Rafael Navas - INAMEH.

Engineer Navas showed examples of simulation of estimated floods for rivers supplying important water basins in Venezuela; he also showed a simulation of flood carried out for the city of Cumana, with the implementation of the hydrological model HEC GeoRAS.

The speaker emphasized the need for hydrological information and products adjusted for short, medium and long term to ensure the provision of the resource to the population. It is highlighted the lack of data for the implementation of models in the country. Among the presented proposals it is noted the coordination of technical working groups and promotion of workshops on implementation of the water resource application tools.

3.8 Information needs for administrators of water resources in Peru. Engineer Waldo Lavado - SENAMHI.

Engineer Lavado started his presentation with the distribution of population by basins in the country, locating the majority the population located on the slope of the Pacific with the 60.4%. However the surface water availability stresses on the slopes of the Amazon with the 97.8%.

The speaker displays a chart with the main areas with critical water availability forecasted by the year 2025, which denotes the Southeast Pacific countries.

The retreat of glaciers, the quality of the water, pollution issues, possible water conflicts between the sectors of production and development, even regional conflicts by contamination of binational rivers are displayed as urgent topics to address policy and its effective applicability to government agencies linked to the management of the water within their national jurisdictions.

The speaker showed the consumption of water resource by sectors of production, highlighting that hydroelectricity represents 81% of the total energy produced in Peru.

3.9 Information needs for administrators of water resources in Chile. Engineer Luis Moreno DGA.

Engineer Moreno, on behalf of the National Hidrometric Service, which belongs to the General Directorate of Water (DGA), presented the work done by the institution, its functions, the national hydrometric network, the National Bank of Water (BNA), the modernization of the networks, products and services and work proposals in water resource management.

The speaker said that the information on various parameters is recorded in a database of the National Bank of Water (BNA) system. This computer system scans, processes, and stores the information obtained from the RHN, which is also administered and maintained by the DGA. This system is part of a System of Integrated Management of Water Resources (SIGIRH), which integrates data of water rights, organizations of users, among others.

Among the measurements carried out by the SHN are water levels in rivers, precipitation, temperature, snow accumulation, flow rates, level of the lakes and water quality. The speaker detailed the advantages of the satellite monitoring system, with 235 stations in the country. Products and services include the permanent hydrological monitoring, information on the internet for users and the public, reports of national hydrological situation, availability of water for irrigation and power, flood alerts and alert environmental outcome.

Among the proposals for the sector arises the continuation of the process of modernization, density increase of the river-measurements and hydro-meteorological network and improvement on the delivery of information to the users.

4. Session 3: Identification of seasonal hydrological forecasts by sectors, challenges and opportunities for its implementation at regional and national level.

4.1 Working groups

He working groups worked on the identification of existing capabilities for provision of water services, based on the following guide questions:

1) In monthly scales, hydrological forecasting is important, why?

2) Why this demand is not currently present if it is how it is served?

3) Who represents the demand, which would be the priority sectors and why?

4) If you deploy pilot projects to implement this forecast. What are criteria to select the places of implementation?

5) Who should be the actors involved in this process?

6) What are the main barriers to implement hydrological forecasts?

7) Is the effort for implementation of hydrological forecast at national level justified by the existing demand?

8) What are the opportunities that are considered to be helpful to this implementation?

QUESTIONS	GROUP 1 –WG1	GROUP 2 –WG2	GROUP 3 - WG3
1. At the monthly scale the hydrologic forecasting is important, why?	1. Operation of reservoirs for hydroelectric generation purposes, water supply and general operation of hydraulic infrastructure 2. Water Supply Sector - start raising awareness and restriction. 3. Mobilization of livestock farming planning. 4. Insurance, development Banks. 5. Planning of civil protection measures (ideally).	1. On a scale of months it is useful to some kind of crop agriculture, however, it is necessary to project in six months for other crops and increases the degree of uncertainty in the forecast. 2. If used for making purchasing decisions, energy and disaster.	1. Yes, a scale of months is required to provide seasonal forecast on water availability for irrigation season and securing energy supply. In addition to prepare for floods or drought situations on a seasonal scale.
2. Why this demand is not currently present and if any how is it treated?	Such demand do not exist, because people do not realize that it is possible to produce this kind of forecast.	1. The demand is there but it cannot always be met, due to a lack of stations at specific sites, which are largely provided by private sectors.	1. There is a wide diversity of situations at the regional level. The demand exists but it is not massive. This appears in a massive way when there is a critical situation. The information is delivered via: -Information of the institution, newsletters -Newspapers. -Meetings with user organizations, other institutions.
3. Who is the demand, which are the priority sectors and why?	No answer	1. Hydroelectric (for energy security), agriculture (crop irrigation) and sanitation (potable water supply to the population).	1. Currently comes from the energy sector, irrigation and supply. 2. The situation is different depending on priority and the country with different combinations. 3. Also for the provision of risk situations in civil defense sector. 4. Demand also matters in relation to the scale of regulation works. 5. Differences also occur if users are public or private sector, since the latter shows no great interest.

4. If pilot projects would be implemented, to implement this outcome, what are the criteria for selecting implementation sites?	If the implementation of pilot basins (one or more per country), but from the beginning with a regional focus. The worst that can happen is that they are as many regions as watersheds, in which case we should add other basins to improve the Regionalization. Criteria: Information, predictability, user sector (hydroelectric), superficial spreading	1. Identify a watershed with availability of information with the priority demands for energy, water supply. 2. That is a naturalized basin without human factors. 3. Influence on the development impact 4. Basin size 5. If there are actors who can contribute as private institutions concerned.	The following criteria are important: 1. That there is a requirement. 2. There is an interlocutor. 3. Define what the goal can be multipurpose or only for irrigation, energy or supplies. 4. Historical hydrometeorological information, validated, with appropriate and desirable spatial distribution with a minimum 30 years continues to date. 5. Watershed area, with a minimum size to allow, as the objective, or project implementation experience to other similar basins or larger. 6. Select a region with better fit or skill.
5. Who should be the actors involved in this process?	1. SMNs, SHNs, academic sectors, representatives of the users sector, IRI, WMO-CHy, CIIFEN, UNESCO ?	1. Hydroelectric, farmers, sanitation companies, decision makers (local government, regional and national) institutions of water management, research universities.	1. Representatives of user organizations. 2. National institutions that generate information and predictions. 3. International organizations that bring experience and knowledge in climate and hydrological forecasts. 4. Academic institutions. 5. Institution to serve as a bridge between the different organizations and actors of the process.
6. What are the main barriers to implementing hydrological forecasts?	1. Reliability of climate predictions, integration of climate and hydrological communities, institutional considerations to involve the "owner" of information, support from the highest authorities of the project SMHNs, skills and human resources, predictability in itself in the region	1. Hydrometeorological monitoring networks are divided and insufficient. 2. The availability of hydrological information is limited and not shared. 3. Lack of training of human resources. 4. Most river basins are natural effect of anthropogenic 5. Lack of financing for private and other sectors.	1. Lack of users of the existence of these products, their usefulness and limitations. 2. Lack of data especially in climatology and hydrology. 3. Validation of climate forecasting results. 4. Compatibility with input weather forecasts for hydrological forecasting. 5. Access data from various public sources and / or private, or NGOs. 6. Continued technical ability involved in several initiatives and projects.

7. Do you consider the effort of implementing the wide seasonal hydrologic forecasts are justified by the existing high demand?	1. It is justified by the potential demand rather than by the actually existing.	1. Yes, because it contributes to better decision making IWRM (Integrated Water Resources Management)	1. However justified its use and demand is emerging. 2. Currently the demand is low and is varied depending on the situation of each country and the needs of each user sector. 3. Their demand will increase in time due to climate variability and its economic, social and health and integrity of individuals. 4. The scale seasonal hydrologic forecasts will be a fundamental tool to support the management of water resources to the extent of their growing ESCAC decadal scale, population growth, reduction of glaciers, climate change, etc.
8. Which are the opportunities that could help this implementation?	1. The existence operational seasonal climate forecasting, coordination of CIIFEN, the ongoing process of creation of the Global Framework for Climate Services, the current drought situation in various countries	1. Knowledge of seasonal forecasting to time to climate variability is an opportunity to implement projects developed by the CIIFEN 2. The experiences of other countries that are more advanced in seasonal forecasting applied to hydrology.	1. The opportunity exists when there are situations of extreme events, as they are watching and analyzing the consequences on the national and regional economy, health and integrity of individuals. 2. The increasing scarcity of water resources, increasing population, decreasing glaciers, climate change, the more frequent presence of El Niño and La Niña represent other opportunities. 3. The expectations generated by the recent Third World Climate Conference, Geneva
9. What would be the recommended next steps to implement this process?	1. Designation of focal points hydrology - the operational counterpart that has continuity (each country to support WMO and CIIFEN) 2. Establish a working agenda at national level between the two focal points, including: selection of river pilots, collection of information, technical exchanges on the methodology used in	1. Generating a working group at the regional level. 2. To describe the regional level in river pilots. 3. Identify a watershed with availability of information with the priority demands for energy, water supply. 4. That is a naturalized basin without human factors 5. Influence on the development	1. Define working group at national level which facilitates the definition of a local pilot. 2. Create working group at the regional level to coordinate the actions of the pilot with national institutions. This group should include representatives of industry climate and hydrology. 3. Promote regional project work to enable communication between the current workshop participants, generating a

	seasonal forecasting (focal points from each country) 3. Regular monitoring of activities as part of CIIFEN 4. CH Engage in the process (WMO) 5. Investigate the possibility of involving PROHIMET (C. Caponi) 6. Establishment of a working group coordinated by CIIFEN that could meet on a day to be added in the next Climate Forum in November.	impact 6. Basin size 7. If there are actors who can contribute as private institutions concerned.	communication network, capacity building, research and support in the implementation of pilot experiences in each country, allowing continuation of the initiative and formalize the commitment and participation of each institution. 4. Participants to designate a representative or technical level that assumes the responsibility to promote or shape above.

5. Sesión 4: Definition of possible technical approaches to the integration of climate forecasts for hydrological forecasting in the West región of Southamerica

The plenary discussed several options; the current system of seasonal forecasts in Western South America is shown in the figure 1. A statistical Downscaling is done in the region based on oceanic and statistical which are processed by the Climate Predicatability Tool developed by the IRI as predictors for the three months rainfall probabilistic prognosis.

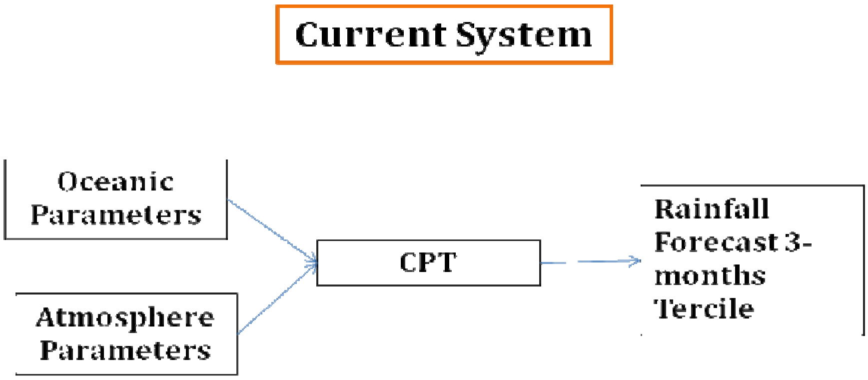

Fig. 1

The first option (fig. 2), more simple considers the use of the CPT based on oceanic and atmospheric parameters and significant hydorlogical predictors that through the CPT generate a prognosis of flows for three months. This option even if it can be easily deployed, it involves a series of omissions or simplifications than for a hydrological perspective can lead to great uncertainty.

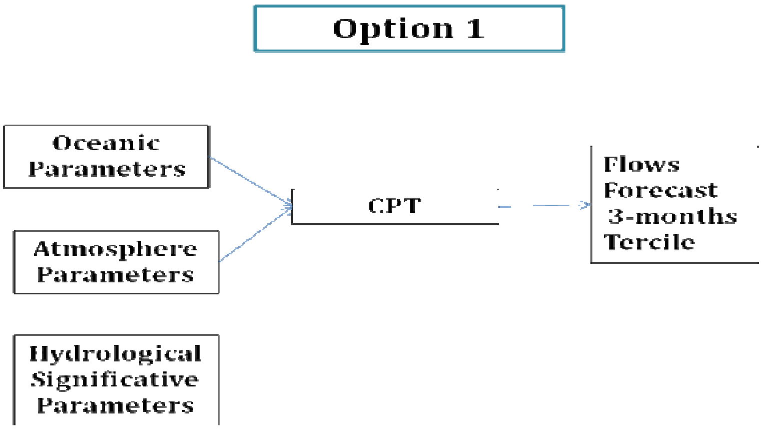

Fig.2

The second option suggests that, based on the climate forecast that is currently being conducted, to gets the probability distribution function (or the cumulative probability function) curve. For this role and taking into account the climate data observed, statistical methods are being used (Non Homogeneous Hidden Markov, or methods developed in the IRI described by Robertson el al, 2007 and Verbist et al, 2009, to disaggregate seasonal forecasts of precipitation in daily time series for different weather stations basin.) The result of this disaggregation is a group (hundreds) of daily possible realizations of data for precipitation for each weather station that keep the (likely) statistical properties of the original climate forecast. These achievements are used as input to one or more hydrological models for each basin and these hydrological models are used to make probabilistic forecasts for the next three months. The results of these flow forecasts can be expressed as percentiles, but a probability function can also be used. (Figures 3, 4 and 5).

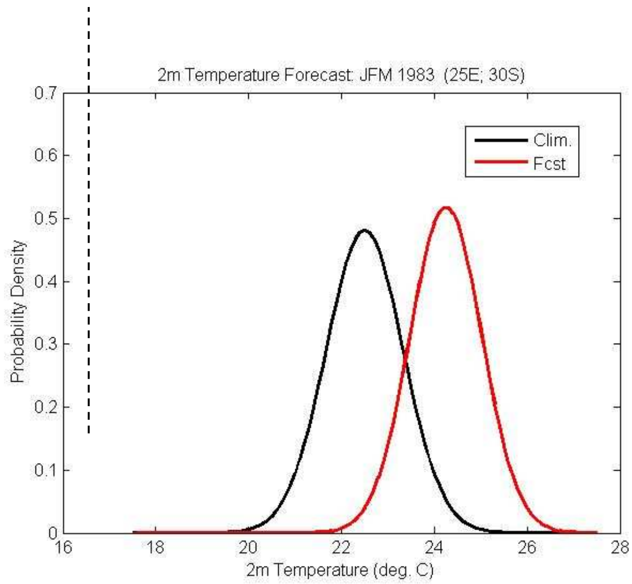

Fig. 3 Examples of probability and cumulative probability curves (Climatology versus prognosis). These are the curves used to disaggregate quarterly data series of daily data

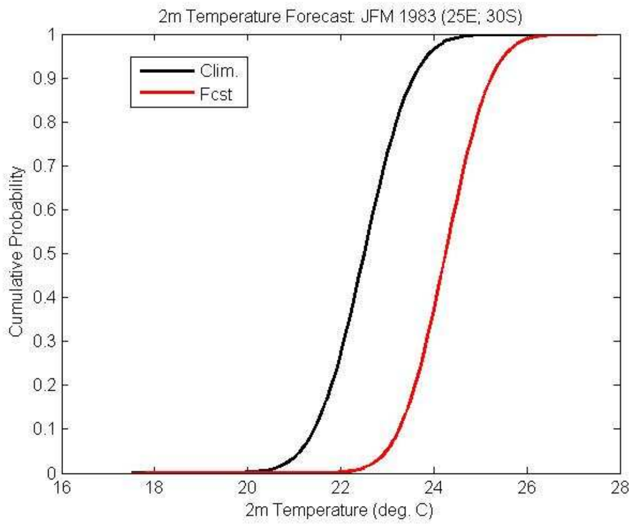

Fig. 4

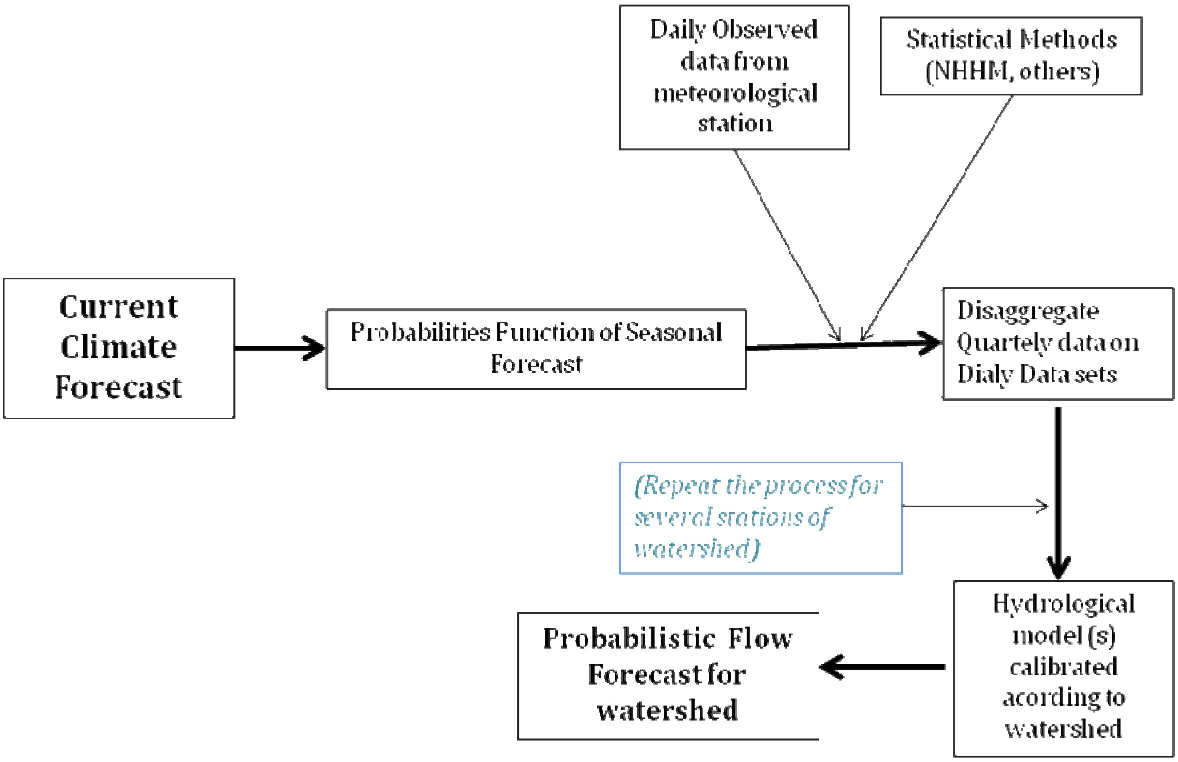

Fig. 5

6. **Sesión 5: W**orking Groups: definition of possible technical approaches to the integration of climate forecasts for hydrological forecasting by country.

The responses of different countries are summarized in the following table:

QUESTIONS	BOLIVIA	CHILE	ECUADOR	PERU	VENEZUELA
10. At the monthly scale the hydrologic forecasting is important, why?	1. Considering a quarterly frame timescale it is important to the operation of reservoirs for hydroelectric generation purposes. 2. Water supply sector, start prevention and/or restrictions (excess or deficit rainfall) 3. Agriculture and livestock (cattle mobilization planning, agricultural work) 4. Agricultural insurance 5. Planning civil defense measures, to activate the Emergency Operations Centers (EOC's)	1. On a monthly scale serves, to some type of crop for agriculture, however, it is necessary to project in six months for other crops and increases uncertainty in the forecast. 2. Yes, it is useful for decisions making on purchases, energy and disasters.	1. It is important to the operation of dams for purposes: hydropower generation, water supply and generally for the operation of hydraulic infrastructure. 2. In the field of drinking water supplies and irrigation: starting with awareness measures for use planning, farming, livestock.	1. Yes, for hydroelectric purposes, agricultural and sanitation. But ideally to have these daily at the large climatic variability that exists in Peru.	1. Yes, for operation of reservoirs for hydroelectric generation, water supply (irrigation, urban supply) 2. In addition to preparing for situations of flooding in large basins. 3. Water Supply Sector - start raising awareness and restraint. 4. Planning of civil protection measures (ideally).
11. Why there is not demand currently and if any how is it treated?	1. Such demand doesn´t exist, because people do not realize that it is possible to produce this kind of forecast.	1. The demand is there but can not always be met due to the lack of stations at specific sites, which is largely provided only by private sectors	1. The demand is very small and it is due to lack of knowledge of the national capabilities.	1. If there is demand but short specific studies already completed or subjective weather forecasts from	1. The demand does not exist, because people do not realize that there is the possibility of producing this type of forecasting
12. Who is the demand, which are the priority sectors and why?	1. In this regard the demand is limited especially in the climatological and hydrological field.	1. Hydroelectric (for energy security), agriculture (crop irrigation) and sanitation (potable water supply to the population).	1. Hydropower sector demand, CELEC, Hidropaute, Agoyan. 2. The priority sectors would be the hydroelectric sector, agriculture and drinking water.	1. The demand comes from the agricultural, energy, sanitation, mining and vulnerability to extreme events	1. There is demand for information, however there may be interested sectors such as energy (CORPOELEC), Agriculture (INIA), Water Supply (HIDROVEN).

13. If pilot projects would be implemented to implement this outcome, what are the criteria for selecting implementation sites?	1. If the implementation of pilot basins (one or more per country), but from the beginning with a regional focus. The worst that can happen is that they are as many regions as watersheds, in which case we should add other basins to improve gradually regionalization. Criteria: Information, predictability, user sector (hydroelectric), superficial spreading	1. Identificar una cuenca hidrológica con disponibilidad de información con las demandas prioritarias como energía, suministro de agua. Que sea una cuenca naturalizada sin efectos antrópicos. 2. Influencia en el impacto del desarrollo 3. Tamaño de la cuenca 4. Hay actores involucrados que puedan aportar como Instituciones privadas interesadas.	1. It will be implemented as a pilot Paute River Basin, because in this sector is located Hydroelectric country's largest reservoir and Mazar, also because it has a network of hydrometeorological stations with sufficient coverage, with data sets in Most have periods of more than 20 years.	1. For knowledge of watersheds and projects already developed and the implications for energy, sanitation, agriculture and mining are the basins of the river Rimac and Chancay-Lambayeque.	In each basin. the following criteria are important: 1. That there is a requirement. 2. Hydrometeorological Information that has historical, validated, with appropriate spatial distribution date. 3. Watershed area, with a minimum size to allow, as the objective, or project implementation experience to other similar watershed or larger. 4. -Choose a region with the best fit with the weather forecast.
14. Who should be the actors involved in this process?	1. Basically SENAMHI, academics, industry representatives, users, IRI, WMO-CHy, CIIFEN, UNESCO, IRD	1. Hydroelectric plants, farmers, sanitation companies, decision makers (local government, regional and national) institutions of water management, research universities.	1. The institutions that should be involved at regional and national levels: -STAGE -CGPAUTE -CELC-Hidropaute -INAMHI -University of the Azuay province	1. SENAMHI 2. ANA 3. Irrigation Special Projects 4. Sanitary Utilities 5. Utilities 6. Universities 7. Mining Companies 8. Local Governments, Regional and National 9. INDECI 10. NGOs and other national research institutions and foreign	1. SEMETAVIA, Inameh, academia (UCV, LUZ, CIDEAT), industry representatives, users (CORPOELEC, HIDROVEN, MINAM, INIA, PC), IRI, WMO-CHy, CIIFEN
15. What are the main barriers to implementing hydrological forecasts?	1. Reliability of climate forecasting, integration of climate and hydrological communities, institutional	1. Hydrometeorological monitoring networks are divided are insufficient. 2. The availability of hydrological information	1. The reliability of weather forecasting, support from the highest institutional authorities and the placement of these activities within an	1. Financial resources 2. Having a clear policy within the SENAMHI to develop this service 3. Lack of real time information and	1. Lack of knowledge of the users of the existence of these products, their utility and limitations. 2. Lack of hydrological data 3. Integration of climate

	considerations to involve the private sector for an exchange of information (private networks), support from the highest authorities of SENAMHI the project, technical capacity and limited human resources.	is limited and not shared. 3. Lack of training of human resources. 4. Most watersheds are not natural for human factors. 5. Lack of financing for private and other sectors.	improved institutional operational planning and technical skills of human resources.	information disseminated in various institutions 4. Reliability of climate forecasts 5. Compatibilities between climate and hydrological forecasts 6. Lack of information on other variables of the hydrological cycle (evapotranspiration, floors, etc.).	and hydrological communities. 4. Validation of climate forecasting results. 5. Institutional considerations to involve the "owner" of information 6. Continued technical skills involved in various initiatives and projects. 7. Support from the highest authorities of the project SMHNs
16. Do you consider the effort of implementing the wide seasonal hydrologic forecasts are justified by the high demand?	1. It is justified by the potential demand rather than by the actually existing	1. Yes, because it contributes to better decision making IWRM (Integrated Water Resources Management)	1. Requirement is justified by the hydroelectric sector although this could increase potential demand for unsolicited uma.	1. Our demand are required for weather and/or extreme events because we do not have something operating in this regard. But by knowing our experience in this field we will generate a higher demand.	1. It is justified by the potential demand rather than by existing one
17. What are the present opportunities considered that this implementation could help?	1. The existence of the operational seasonal climate forecasting, coordination of CIIFEN, the ongoing process of creation of the Global Framework for Climate Services, the current weather conditions (excess and deficit of precipitation extremes and by region).	1. Knowledge of seasonal forecasting to time to climate variability is an opportunity to implement projects developed by the CIIFEN 2. The experiences of other countries that are more advanced in seasonal forecasting applied to hydrology.	1. The pilot basin has been selected from a network of stations, historical information and from real time, and lessons learned on 10 years of activity accumulated in the production of seasonal forecasts. As aids we have outputs on statistical models and dynamic in what is	1. Knowledge of weather forecasting tools at national level 2. Some experiences in hydrological modeling 3. Past experience	1. The seasonal climate forecast, that is already operational. 2. The growing scarcity of, water resources, increasing population, climate change, the more frequent presence of the phenomenon of boy and girl, are other opportunities. 3. The expectations raised in the recent Third World

			known as climate mode.		Climate Conference, Geneva.
18. What would be the recommende d next steps to implement this process??	1. Designation of focal points hydrology - the operational counterpart that has continuity (each country with support from WMO and CIIFEN). 2. Establish a working agenda at national level between the two focal points, including: selection of river pilots, collection of information, technical exchanges on the methodology used in seasonal forecasting (focal points from each country) 3. Regular monitoring of activities as part of CIIFEN 4. Conduct a local forum to socialize the idea and engage as many institutions that can strengthen the local research group and also meet potential users of future products.	1. Generating a working group at the regional level. 2. To describe the regional level in river pilots. 3. Identify a watershed with availability of information with the priority demands for energy, water supply. That is a naturalized basin without human factors. 4. Influence on the development impact 5. Basin size 6. If there are actors who can contribute as private institutions concerned.	1. That the WMO request to the national counterpart (INAMHI) appoint a country coordinator to be responsible and promote the participation of persons em the process, um formation of working group, definition of the pilot basin, build national capacity. Identify baseline of actors who work em the theme of seasonal forecasts, collection of basic hydrometeorological information. Definition of methodology uma work agreement with the region.	1. Political decision of the Institution 2. Potential applicants 3. Training team (CLIMATE-HYDROLOGY) 4. Select pilot basins 5. Validation of initial results	1. WMO funding 2. CIIFEN regional coordinator for technology transfer, positive and negative experiences in the region.
19. What do you think could be the role of WMO and CIIFEN in this process?	1. The main role of the WMO would be able to obtain resources through the World Bank, CAF, UNDP and others to invest in continuous training and	1. No answer	1. WMO's role would be to coordinate with the national technical and financial input and CIIFEN as regional coordinator.	1. The role of WMO is to select those involved in this process and engage the SMH to them to continue doing this work and develop workshops to share	1. WMO funding 2. CIIFEN regional coordinator for technology transfer, positive and negative experiences in the region.

	further meetings or see the possibilities of training to get em group members that are more advanced in this topic meanwhile the CIIFEN should be the coordinator of activities at the regional level in a manner similar to the seasonal prediction.			experiences on the first results. 2. The role of CIIFEN is to channel projects for training and / or strengthening of networks of hydrological and flow measurement equipment through regional projects.	

7. Discussion of the Regional Action Plan

Based on the discussion of needs, technical feasibility and existing capabilities, participants agreed the following action plan:

REGIONAL ACTION PLAN

ACTIVITY	RESPONSABLE	DATE
1. Delivery Meeting Report	CIIFEN-WMO	01-April-2010
2. Nomination Request focal points for the initiative to form the Working Group Meeting Final Report and Action Plan	WMO	30- April -2010
3. Hydrologic Focal Point Designation	Countries	31-May2010
4. National meetings among focal points in each country to discuss details and reporting requirements of the CPT, pre-agreed pilot watersheds and prepare a national program of activities	Countries	31-July-2010
5. Steps to CHy, PROHIMET and others to gain greater technical involvement in hydrological issues	WMO	31-July-2010
6. Definition of pilot basins in each country and stations and data involved	Countries	31-August-2010
7. Training IRI NHHM regional coaches and / or other methodologies	WMO -CIIFEN-IRI	II Semester-2010
8. Participation of hydrologists in the COF-10 and regional training	WMO -CIIFEN	November-2010
9. Inventory and validation of information required by watershed	Countries	November - 2010
10. Alternative Experiments 1 including check	Countries -CIIFEN	December-2010
11. Preparation of methodological guide for preparation of data	IRD	August- 2010
12. Operational phase	WMO -CIIFEN-Countries	II Semester 2011
13. National meetings with the sectors	WMO -CIIFEN-Countries	II Semester -2011

14. NHHM Regional Training and / or methods referred to in paragraph 8) above	CIIFEN	March - 2011
15. Alternative 2 including experimental verification	Countries –CIIFEN-WMO -IRI-IRD-GTZ	December - 2011

8. Closure of the Regional Workshop

Dr. Caponi thanked the SMHNs for coordination in the seasonal forecast and their commitment to the strengthening of the capabilities in the Andean countries. Dr. Mascarenhas thanked those who were present, for their active participation in the workshop and the importance of this regional activity and reiterated the commitment of CIIFEN, to continue working together with the countries and strengthen national and regional climate services.

Immediately the regional workshop was closed at 16 h 30 on Thursday, January 28th, 2010.