WORLD METEOROLOGICAL ORGANIZATION

FINAL REVIEW MEETING FOR THE WORLD EXPO 2010 NOWCASTING SERVICES (WENS) DEMONSTRATION PROJECT AND CAPACITY-BUILDING WORKSHOP

SHANGHAI, CHINA, 14-18 NOVEMBER 2011

FINAL REPORT

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At the kind invitation of the Government of China, the "Final Review Meeting for the World Expo 2010 Nowcasting Services (WENS) Demonstration Project and Capacity-Building Workshop", was held in Shanghai, China, from 14 to 18 November 2011. The Meeting was opened by the Co-Chairperson of the WENS Science Steering Group (SSG), Mr Gerald Fleming. Welcoming all the participants, Mr Fleming recalled that the Demonstration Project had commenced with the establishment of the SSG in 2008, and that an Interim Review Meeting of the SSG had been held in late 2009. The operational period of the Project coincided with the Shanghai World Expo, which had been held from 1 May to 31 October 2010. The purpose of this Meeting was to review the Project, to collect the lessons learned, and to consider how best to carry forward the work.

Dr Tang Xu, Director-General of the Shanghai Meteorological Service (SMS), provided more detail on the background and history of the Project from its inception to the end of its implementation. Dr Tang Xu expressed his special thanks to the Nowcasting system owners who had taken an active part in the Project; Australian Bureau of Meteorology (BoM) for STEPS; Hong Kong Observatory (HKO) for SWIRLS, the China Meteorological Administration (CMA) / Beijing Meteorological Services (BMS) for BJANC, SMS for NoCAWS, Shanghai Typhoon Institute for STI-WARR, and CMA for SWAN. He also thanked the World Meteorological Organization (WMO) for its support throughout the Project.

Ms Haleh Kootval, Chief of Public Weather Services Programme with WMO, welcomed the participants on behalf of Secretary-General of WMO, Mr Michel Jarraud, and thanked the SMS for the excellent scientific and logistical support which had facilitated the smooth running of the Project.

Overview of the WENS Demonstration Project

Following the adoption of the agenda and agreement to the working arrangements, Dr Jianhua DAI of the SMS provided an overview of the WENS Project. The emphasis of the Project was, from the outset, on services and on the 0-6 hr time range. Adopted in 2008 as a WMO Demonstration Project, the period from January to July 2009 was primarily devoted to the purchase of hardware and to the establishment of a network to support the operational phase of the Project. During April and May 2009, experts from HKO and the BoM provided training to SMS and BMS personnel. This period also saw a requirement analysis which identified five categories of users: forecasters; end-users such as organizers of the Expo; Government Departments; specialised users; and the public.

During the summer of 2009, there was a trial period for the systems and the networks. Later that year, just 186 days before the opening date of the Expo, an Interim Meeting was held at which plans for the operational phase were refined. This meeting also saw the plans for the social and economic evaluation aspects of the Project being developed.

As part of the Project, new procedures for issuing early warnings were established; among the most important of these was the provision to key users of advance notification of the warnings before public dissemination.

The operational phase of WENS commenced on 26 April 2010 and ran for 184 consecutive days, with nowcasting information generated by the participating systems providing advice and warnings to the Expo organizers and other users. During the period of the Expo, 30 warnings of severe weather were issued, encompassing thunderstorms, strong winds and heavy rain.

The Expo brought together 246 countries, regions and international exhibitors, and was visited by a total of more than 70 million people over the six months it was open. The day of highest attendance saw just over 1 million people visit the site. The emphasis of the Project was to help produce 0-6 hr forecasts and warnings of high-impact weather. The Project used the facilities of six (6) weather radars running scans at six (6) minute-intervals; 133 Automatic Weather Stations (AWS) and four (4) radiosonde stations. The Numerical Weather Prediction (NWP) model STI-WARR ran a 12-hr mesoscale forecast updated hourly, on nested domains of 512 km square, 256 km square, and 128 km square, all centered on the Expo site.

The lead time of warnings issued was 85 minutes on average; the Probability of Detection (POD) was 83% with a False Alarm Ratio (FAR) of 17%. The WENS proved to be good at forecasting Mesoscale Convective Systems, but had more difficulty with local severe thunderstorms and with tropical cyclones (although there was only one cyclone during the operational phase, and this passed by at some distance from Shanghai).

Reviewing the six (6) participating systems, and noting that Quantified Precipitation Forecast (QPF) is a product common to all the six (6) systems, Dr DAI noted that there was no single best solution. Evaluation of the systems was not straight-forward and was done subjectively by forecasters. Real-time verification system may be introduced to nowcasting operations in order to support choosing the best QPF product and generating a performance-weighted QPF product based on the performance of each system. There was a clear need for more impact evaluation, and improved dissemination of products and communication with users.

An important aspect was that forecasters would be trained to identify the strengths and weaknesses of each system so that they would be in a position to select the best product for issuing a warning in an operational context, given that the lead time in nowcasting is very short.

Another outcome was the need for a reliable automatic verification system. The verification scheme developed in CMA was a 3-year project, but it was clear that verification was very “patchy”; it was very difficult to predict the accuracy of nowcasting techniques in the short term, given that they were dealing with low-probability high-impact events.

One of the challenges of the Final Review Meeting was how to translate the problems identified during WENS into research focus areas for the future. Nowcasting is still far from mature as a science and the perceived usefulness to the operational forecaster still needs to be addressed.

Scientific and Technical Support Required for Nowcasting Systems

In a presentation on this topic, also delivered by Dr Jianhua DAI, the components for the WENS Project were outlined, as follows:

- Observations;
- Nowcasting tools;
- Scientific issues;
- NWP models;
- Services, products and assessments; and,
- Forecasters / Service Coordinators.

It was noted that successful nowcasting was heavily reliant on forecasters paying close attention to observations, of which those delivered by synchronised and rapidly-delivered radar information were critical. Synchronised AWS data in the same time frame as the radar sweeps was also required. One problem was the low detection efficiency of some of the observational equipment. Models were very important in pointing out the potential for severe weather development; indeed a future focus area for modelling might be on e.g., convection initiation as a key problem.

In the discussion on this topic, Dr Alan Seed (BoM) noted the commencement of the Strategic Radar Enhancement Project in Australia. This was a $50 million project, with 1/3 of the staff involved working on Quality Control (QC). Cleaning up radar imagery to make sure that anomalous propagation echoes do not get into the NWP models was an important issue. There was a demonstration project planned for Sydney in 2014 which aimed to assimilate 1.5 km resolution NWP with radar. As a technique, blending NWP, nowcasting and radar data worked best at higher latitudes as dynamical rain was more predictable, and thus easier to blend, than convective and tropical-type precipitation. It was clear that this area of blending NWP with nowcasting products and the assimilation of radar data into NWP was an important area for further development.

In the discussion on the density of rain gauge networks, it was noted that there is a network of 300 rain gauges in the vicinity of Sydney; with 200 around Melbourne. In the case of Shanghai, WENS used a network of 215 gauges on a grid of 5 km in the downtown area, and 10 km in the suburbs. For Hong Kong, China, the rain gauge density is even higher with about 160 gauges over a landmass of about 1,100 sq km, equivalent to an average separation of about 2.6 km.

Because of the many different severe weather climatologies there is no single “black box” approach to providing an optimal nowcasting system. Among the different algorithms employed by the different systems, some might be better for e.g., severe thunderstorms, while others might handle line squalls more effectively.

During discussions on this topic, the Meeting considered the question of the limited resources of developing countries, and how best to make use of such resources that do exist. Among the problems that were identified were:

1. High cost of radar systems;
2. Difficulty in accessing the raw radar data due to proprietary issues;
3. Lack of communication infrastructure and limitations in bandwidth which make it difficult to collect all the data in one central server;
4. Lack of experience and skills to use radar data for nowcasting; and,
5. Insufficient training of forecasters.

The Meeting considered how best to address these issues, and wondered whether WMO might be able to facilitate a community model of a nowcasting system: making reference to the successful example of the WRF model.

Technical Assessment of the Participating Systems:

The technical assessment of each system is summarized below:

BJ-ANC, presented by Dr CHEN Mingxuan (BMS)

- Boundary layer convergence was very important for storm development;
- Proper training of forecasters in nowcasting techniques is crucial; and,
- Localised storms posed the most difficult forecasting problem.

SWAN, presented by Dr FENG Yerong (Guangdong Meteorological Service)

- SWAN under-estimated rainfall in the Tropical Cyclone case;
- Using real-time rain gauge data for calibration would be an improvement;
- Also needs to improve blending between extrapolation and meso-scale NWP;
- SWAN uses different Z/R relationships in different installations throughout China; and,
- SWAN does not have the capability to archive interesting situations for case studies and training.

NoCAWS, presented by Dr DAI Jianhua (SMS)

- It proved difficult to get an accurate estimation of location – this was much more difficult than purely spatial resolution; and,
- There were five (5) different types of Z/R relationship used; it was important to have a choice to best fit the actual situation.

STI-WARR, presented by Dr CHEN Baode (STI)

- This was the only NWP model employed in the WENS Project. It ran on a 3 km horizontal grid with 51 vertical levels; and,
- Good results were recorded from the model for an extreme temperature case (> 40 deg C) on 13 August 2010.

STI-WARR produced a good forecast for a thunderstorm/line squall event;

- It also produced a good 9 hr forecast for dense fog;

- However, it was poor in predicting a convective storm on 8 August 2010;
- The model was run from a warm start every hour, with a cold start at 2 p.m. (local time) each day. This cold start time was later changed to 2 a.m. to avoid starting from cold when convection was already well-underway;
- During the Project there were changes to the data assimilation. The Global Positioning System (GPS) data of precipitable water was omitted as it was contaminating the analysis and resulting in an over-dry atmosphere; and,
- The model produced a short-range ensemble. However, very extreme rain was not well-forecast by using the Ensemble Mean, although use of the Mean proved to be better for "normal" rain.

SWIRLS, presented by Mr Linus YEUNG (HKO)

- SWIRLS used a suite of radar products generated from the SWAN radar mosaic data by SMS – a successful collaboration experience among the developers involved;
- SWIRLS produced a rich assortment of products including echo-motion vectors, Quantitative Precipitation Estimate (QPE), QPF, Probability of Precipitation (PoP), forecast reflectivity, storm-cell and severe weather nowcasts; a good appraisal was received from SMS forecasters;
- Some products, in particular severe weather nowcasts, are highly sensitive to radar data quality; the issues noted initially were much improved after face-to-face interactions with the SWAN developers at the start of the WENS operation;
- SWIRLS provided QPF products based on radar extrapolation only. Due to resource and time constraints, its nowcast-NWP blending sub-system was not installed;
- In parallel with the WENS operation, SWIRLS was also installed in India in support of the Commonwealth Games; one lesson learnt from the Indian radars, which run on a 15-minute cycle, was that echo tracking became difficult and substantial algorithm tunings were required;
- At HKO, rainfall nowcasting operation has been improved by moving to optical-flow based QPF and enhancing the mesoscale NWP model for blended QPF; and,
- HKO also provides rainfall nowcasts for the public through a Google Earth API web interface; the QPF output is formatted in KML files to allow easy downstream usage.

STEPS, presented by Dr Alan Seed (BoM)

- STEPS is run in Australia from a server in Melbourne (employing an SQL database) with clients country-wide. Long-term storage is in NetCDF;
- STEPS provides Radar QPE and QPF;
- There are 50 clients and the system generates products for ten (10) distinct areas. This amounts to 2,000 products per hour and 10,000 hits per hour on the one server;
- Five (5) days worth of data are stored on the SQL server; this amounts to a data volume of 100GB;
- The clients run visualisation software, web visualisation applications and some hydrology;

- The data from individual radars are adjusted and corrected by reference to the gauge network before the radar mosaic is created;
- STEPS provides a 60 minute accumulation – this is really an ensemble mean rather than a deterministic forecast and gives the lowest RMS error but does not capture the extremes. There is a need to teach forecasters how to use this as it is not obvious how to interpret it correctly;
- Future changes include moving from a server to product protocol; and,
- There is a whole system connected with STEPS for archiving interesting data for case studies and training – this is a non-trivial task.

Forecasters Assessment of Each System

In presenting the views of the operational forecasters of SMS on the various systems, Dr DAI Jianhua noted that each forecaster seemed to have their own favourites and there was no clear consensus as to which system was the most popular or useful. However he did note that the severe weather products of SWIRLS were very much liked by the forecasters.

Social and Economic Assessment

This was a very important aspect of the WENS Project; perhaps the first time that a full and proper social and economic assessment had been carried out in conjunction with the scientific aspects of such a project.

The assessments were carried out through expert workshops, on-line surveys and face-to-face interviews. In the assessments of Government Agencies and weather sensitive sectors, the results show that:

- The total evaluation from each user group scored higher than 80 points for all categories. The highest scores are for satisfaction. Lead time scored higher than accuracy;
- Type of weather is one of the factors affecting the user evaluation; and,
- Expectation is one of the factors affecting the user evaluation: the higher the level of user expectation, the lower the level of satisfaction.

In the assessments of public satisfaction, it emerged that forecast accuracy and lead-time were deemed to be satisfactory, but that the understanding of forecasts was a problem.

Analysis of response by level of education revealed that those with lower levels of education tended to receive their weather information through television, while those with higher levels made more use of SMS and web. In terms of satisfaction ratings, there was no evident relationship between levels of satisfaction and age, gender or level of education.

As regards lead-time, short lead-times were desirable, with lead-times as low as 12 minutes fully acceptable.

Statistical analysis of the questionnaires indicated that the validity of the assessment exercise was high. The variables that bore on “satisfaction” were:

- Usefulness;
- Accuracy;
- Lead-time; and,
- Content,

with "content" having the greatest influence. Understanding of the forecast was clearly very important, indicating that the education of the public with some meteorological knowledge was always beneficial.

In a case-study on a power-utility, lead-time was judged to be more important than accuracy (though both scored highly).

Among the most important conclusions of the social and economic assessment were:

1. The design of questionnaires was an issue;
2. Content is a critical aspect, and is closely related to comprehension;
3. Proper training for the investigators was crucial; and,
4. The timing of survey with respect to high-impact weather events had a large bearing on the potential result.

User Feedback

Dr Xu DING of the Expo Bureau addressed the Meeting. Dr DING noted that the Expo operations were very dependent upon the success of WENS. The placing of a forecaster in the Expo Operations Centre was very helpful.

Commenting on the accuracy of the forecasts, he noted that these appeared to be close to 100%. All rain events were correctly forecast, and in good time. There were a few false alarms, but no missed events. He would be recommending to the Russia Federation, which would be hosting the Expo in 2020, that a project similar to WENS also be organized.

Dr Jun CHEN, from one of the power utilities, expressed his thanks to meteorologists and to WENS, in particular, for the high-quality of the services received. Correct forecasting of power load was very important; the consumption of power was closely related to temperature. Summer was the period of maximum power demand in Shanghai. Some of the available power was locally-generated, but some was taken in from elsewhere.

It was their experience that the impact forecast prepared by SMS of power loads was very accurate and useful.

Review of the Tailored and Interactive Expo Weather Services

In presenting this topic, Mr J.J. Wakrat recalled that the Shanghai World Expo encompassed 246 countries and organizations, was visited by 73 million people, had 80,000 volunteers on-site, and required an infrastructural investment of $45 billion. For the duration of the event air traffic into Shanghai increased by 34%, the number of hotel nights by 17%, and foreign investment by 14%.

Challenges included the duration of the Expo, the location, the number of visitors, the number of events and the numbers visiting individual pavilions (some welcomed up to 60,000 visitors per day). The Expo Weather Services were both a service to the exhibition and an exhibition of services, as exemplified by the Meteoworld Pavilion.

As regards the service to the exhibition, the SMS staff was very proactive and went out to the users with the important weather messages when necessary. This was made possible by understanding the potential chain of events that followed a weather event (particularly a severe weather event) and the possible domino effect which multiplied the impacts. In terms of the impacts of weather, the work of the SMS included forecasting the:

- Numbers of visitors from day to day;
- Likely number of cases of heat stress, dehydration, stomach problems, etc. (based primarily on temperature);
- Consumption of water; and,
- Consumption of power.

There were 1,709 special weather forecasts prepared, as well as 73 special weather warnings, of which 38 related to high temperatures. Among the points which emerged from the experience of delivering the Expo Weather Services were:

1. Current forecast techniques do not meet the unique requirements of user groups;
2. Automation as standardisation need to be enhanced;
3. Capacity-building is needed, both in technology and in human resources; and,
4. The management of Met Services needs to be strengthened.

Review of the Expo 2010 Refined Weather Forecasting

The review, presented by Dr Yang, commenced with the reflection that the SMS shared information including hydrological, traffic, and even bacterial information with many agencies. The products, procedures and standards all reflected the needs of the users.

Challenges included the integration of short- and medium-range forecasting with nowcasting. Going from deterministic to probabilistic forecast formulation was also a major issue. He envisaged three elements to the forecast system:

1. Movement of weather systems at the synoptic scale;
2. Greater precision in the localisation of weather events, especially severe weather events; and,
3. Sensitivity to user's requirements / translation of weather forecasts into impact forecasts.

Discussing the specifics of radar use, he further noted a variety of Z/R relationships that were employed in Shanghai, each of them tailored for specific weather types. He also outlined the flood warning system, which was communicated through a colour system, ranging from blue through purple, yellow, and orange to red. Forecasts also extended to providing water-level forecasts (from QPE / QPF) for Taipei Lake.

NWP model biases depend on a number of factors, including the season, the time of day, and the synoptic set-up. Models tend to under-perform with respect to the diurnal variation. While most of the participants aimed to provide a seamless forecast service from the time horizon of 1 hr to 10 days, it was necessary to draw on a variety of technologies and techniques to derive the optimal consensus forecast.

Summary of WENS Experiences

Mr Linus YEUNG (HKO) noted that the use of multiple systems to provide for all weather types and situations was a very good point with regard to WENS. The Project demonstrated that technology could support operational services needed to facilitate a major event like the Expo. The occasion allowed for a valuable exchange of scientific ideas. The biggest problem was always time, which was never enough and local priorities always tended to take precedence. The benefits brought by the participants back to their home institutions, while considerable, were largely intangible and difficult to quantify. This aspect of similar projects in the future might be more clearly enunciated.

Dr Alan Seed (BoM) noted that WENS was a valuable experience and represented for him an excellent opportunity to network with the developers of other nowcasting systems. It was also valuable to take a forecast system into a different part of the world and expose it to a very different climatology. There was also great benefit in working with another operational service; the operational side of such a big project was crucial.

Dr Mingxuan CHEN (BMS) noted that the quantitative evaluation and assessment of the social and economic benefits represented a major achievement of WENS. Dr Zhaohong YUAN (SMS) expressed his view that the WENS Project had been a very valuable experience for his organization.

Dr Baode CHEN (STI) reflected that it was a unique experience being the only NWP model contributing to such a project. There had been much hard work involved, but good progress made in all respects. An emerging challenge was to successfully blend NWP and nowcasting together in the future.

Summarising this topic, Dr Tang Xu stated that, following on from what had been learned, quantitative benefits assessments will be commenced for regular SMS services. This will be a useful tool for gauging the value of these services to Shanghai society. He hoped that this Project might be extended, especially in regard to capacity-building and training.

Future Activities Related to WENS

Introducing this final topic of the Meeting, Ms TAO Liying outlined a number of possible desired outcomes and future activities. In the discussion that followed, these were elaborated and subsequent actions were identified.

Publications of WENS Experience

1. It was decided to publish the results of the WENS Demonstration Project in a WMO Technical Document as an in-depth report on WENS covering all the technical aspects and issues of the Project.

a. *Action – SMS to develop a data policy with respect to the use of data flowing from WENS in publications and in training activities.*
b. *Action – SMS to coordinate the draft within six months and the final draft within 12 months, with contributions from all systems providers and participants with a target publication date of December 2012.*

2. In addition, it was agreed to publish a series of articles for journals such as Bulletin of the American Met Society, the WMO Bulletin, Weather and Society and other appropriate publications.

a. *Action – SMS to submit a summary article, consisting of the Project objectives, the development of the activities, and the issues of providing a weather service to the Expo, to BAMS for consideration by June 2012.*
b. *Action - SMS to submit a summary paper on the social and economic benefits to the WMO Bulletin by June 2012.*

Capacity-Building

It was recalled that an outcome of the WENS Demonstration Project would be helping to build the capacities of less-developed countries in Nowcasting and sharing the experiences of WENS where these were relevant. As a first step, the Final Review Meeting was followed by a capacity-building workshop for Cambodia, Lao People's Democratic Republic, Thailand and Viet Nam. Material flowing from the Project could be used in the preparation of WMO training activities which might be undertaken for other developing countries in the future.

Possible Task Team to Carry Forward the Work of WENS

The Meeting suggested that a Task Team (TT) might be established to build on the results of the WENS Demonstration Project. This TT might focus on different aspects of the delivery of nowcasting services, with a special focus on impact-based forecasting and in the context of Megacities.

The possible future activities flowing from the WENS Project might be summarised as follows:

1. Keeping WENS Systems running in Shanghai

a. Multi-systems nowcasting approach as input into impact or end-user decision-support systems;

2. Publications to be prepared and submitted

a. WMO Technical Note to give an in-depth report of the Project;
b. Technical aspects to be dealt with in a publication for BAMS, or similar; and,
c. Social and economic aspects to be separately written up and submitted to the WMO Bulletin;

3. Establishment of an Inter-Commission Task Team (ICT) on nowcasting services in the context of megacities

a. Targeted, meaningful and actionable impact-based forecasts; and,
b. Focus on the environment of megacities;

4. Continue research on benefits assessment and evaluation; and,

5. Develop mobile weather service app as an example of a further refinement of service delivery.

The Meeting adopted the follow-up actions specified. Dr Tang Xu and expressed his thanks on behalf of the SMS to all the participants of the Project, but especially the system owners who had greatly contributed to the Project. Following these remarks, the final session of the Meeting closed on Friday, 18 November 2011.

LIST OF ANNEXES TO THE FINAL REPORT OF THE "FINAL REVIEW FOR THE WORLD EXPO 2010 NOWCASTING SERVICES (WENS) DEMONSTRATION PROJECT AND CAPACITY-BUILDING WORKSHOP" (SHANGHAI, CHINA, 14-18 NOVEMBER 2011)

Annex I: List of Meeting and Capacity-Building Workshop Participants

Annex II: Agenda

Annex III: Programme

PARTICIPANTS AT THE "FINAL REVIEW FOR THE WORLD EXPO 2010 NOWCASTING SERVICES (WENS) DEMONSTRATION PROJECT AND CAPACITY-BUILDING WORKSHOP" (SHANGHAI, CHINA, 14-18 NOVEMBER 2011)

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AGENDA FOR THE "FINAL REVIEW FOR THE WORLD EXPO 2010 NOWCASTING SERVICES (WENS) DEMONSTRATION PROJECT AND CAPACITY-BUILDING WORKSHOP" (SHANGHAI, CHINA, 14-18 NOVEMBER 2011)

AGENDA

1. OPENING OF WENS REVIEW MEETING

2. ORGANIZATION OF THE MEETING

2.1 Adoption of the agenda
2.2 Working arrangements

3. OVERVIEW OF WENS

3.1 Success and Challenges
3.2 Other relevant projects

4. SCIENTIFIC AND TECHNOLOGICAL SUPPORT REQUIRED FOR NOWCASTING SERVICES

5. TECHNICAL REVIEW OF EACH SYSTEM: STRENGHTS AND WEAKNESSES; LESSONS LEARNT; HOW TO IMPROVE EACH SYSTEM

5.1 BJANC
5.2 SWAN
5.3 NOCAWS
5.4 STI-WARR
5.5 SWIRLS
5.6 STEPS

6. FORECASTER'S ASSESSMENT OF EACH SYSTEM AND THE INTEGRATED SYSTEM

7. SOCIAL AND ECONOMIC IMPACT ASSESSMENT

8. REVIEW OF THE EXPO 2010 REFINED WEATHER FORECASTING

9. REVIEW OF THE TAILORED AND INTERACTIVE EXPO WEATHER SERVICE

10. INTEGRATION OF MEDIUM, SHORT-RANGE FORECASTING AND NOWCASTING

11. SUMMARY OF WENS EXPERIENCE

12. FUTURE ACTIVITIES RELATED TO WENS

12.1 Publication of WENS experience

i) Technical aspects
ii) Service delivery aspects including socio-economic impacts
iii) Learning experience for developing countries on the path of developing /using nowcast products

12.2 Training workshops using the WENS experience

CONCLUSION OF THE REVIEW MEETING

13. OPENING OF THE WENS CAPACITY-BUILDING WORKSHOP

14. INTRODUCTION TO NOWCASTING: HOW NOWCASTING WORKS

15. APPLICATION AND USE OF RADAR TECHNOLOGY IN NOWCASTING

16. NOWCASTING USING SATELLITE IMAGERY

17. PARTICIPANTS DESCTRIPTION OF OWN FORECASTING SYSTEMS INCLUDING NOWCASTING (IF APPLICABLE) THE FRAMEWORK OF THE SWFDP SE ASIA PROJECT

18. VISIT TO THE FORECASTING OFFICE OF SMS

19. CASE STUDY IN THE APPLICATION OF NOWCASTING, USING WENS EXPERIENCE

20. REVIEW OF THE REVIEW MEETING AND WORKSHOP

21. CLOSE

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"FINAL REVIEW FOR THE WORLD EXPO 2010 NOWCASTING SERVICES (WENS) DEMONSTRATION PROJECT AND CAPACITY-BUILDING WORKSHOP" (SHANGHAI, CHINA, 14-18 NOVEMBER 2011)

PROGRAMME

Monday, 14 November 2011

	DAY 1		
0900-0930	**1. Opening**	• Host • Ms Haleh Kootval (WMO Secretariat)	30 minutes
0930-0940	**2. Organization of the Meeting** • Adoption of the agenda • Working arrangements	• Chairperson	20 minutes
0940-1030	**3. Overview of WENS** • Success and challenges • Other relevant projects	• SMS lead • Any of the system providers	50 minutes
1030-1100	**COFFEE / TEA BREAK**		**30 minutes**
1100-1200	**4. Scientific and Techonological Support Required for Nowcasting Services**	• SMS	60 minutes
1200-1330	**LUNCH BREAK**		**90 minutes**
1330-1500	**5. Technical Review of Each System: Strengths and Weaknesses; Lessons Learnt; How to Improve Each System, icluding forecaster's assessment of each system and the integrated system** • BJANC • SWAN • NOCAWS	• The particpants from the three system providers	90 minutes
1500-1530	**COFFEE / TEA BREAK**		**30 minutes**
1530-1700	**5. Technical Review (continued)** • STI-WARR • SWIRLS • STEPS	• The participants from the three system providers	90 minutes

Tuesday, 15 November 2011			
	DAY 2		
0900-1030	**6. Forecaster's Assessement of Each System and the Integrated System** **7. Social and Economic Impact Assessment Panel discussion with a few user representatives who benefited from WENS**	• SMS • SMS	90 minutes
1030-1100	**COFFEE / TEA BREAK**		**30 minutes**
1100-1200	**8. Review of the Expo 2010 Seamless Weather Forecasting**	• SMS to lead	60 minutes
1200-1330	**LUNCH BREAK**		**90 minutes**
1330-1430	**9. Review of the Tailored and Interactive Expo Weather Service**	• SMS to lead	60 minutes
1430-1500	**10. Integration of Mesoscale Forecasting, Short-range Forecasting and Nowcasting**	• SMS to lead	30 minutes
1500-1530	**COFFEE / TEA BREAK**		**30 minutes**
1530-1600	**10. Integration of Mesoscale Forecasting, Short-range Forecasting and Nowcasting (continued)**	• SMS to lead	30 minutes
1600-1700	**11. Summary of WENS Experience**	• SMS and all system providers	60 minutes

Wednesday, 16 November 2011			
	DAY 3		
0900-1030	**12. Future Activities Related to WENS** • Publication of WENS experience i. Technical aspects ii. Service delivery aspects including socio-economic impacts iii. Learning experience for developing countries on the path of developing / using nowcasting products • Training workshops on nowcasting using WENS experience	• All participants	90 minutes
1030-1100	**COFFEE / TEA BREAK**		**30 minutes**
1100-1200	**12. Future Activities Related to WENS (continued)** • Socio-economic benefits related to WENS: use of surveys and other information gathering techniques **Conclusion of the Review Meeting**	• SMS	60 minutes
1200-1330	**LUNCH BREAK**		**90 minutes**
1330-1400	**13. Opening of WENS Capacity-Building Workshop** • **Introduction of the participants**	• SMS • All participants	30 minutes
1400-1500	**14. Introduction to Nowcasting: How Nowcasting works**	• Mr Dai Jianhua (SMS)	60 minutes
1530-1600	**COFFEE / TEA BREAK**		**30 minutes**
1600-1700	**14. Introduction to Nowcasting: How Nowcasting works (continued)**	• Mr Linus Yeung (HKO)	60 minutes
Thursday, 17 November 2011			
	DAY 4		
0900-1000	**15. Application and Use of Radar Technology in Nowcasting**	• Ms Shao Lingling (SMS)	60 minutes

1000-1030	**16. Application and Use of Satellite Imagery in Nowcasting**	• Mr Alan Seed (BOM)	30 minutes
1030-1100	**COFFEE / TEA BREAK**		**30 minutes**
1100-1200	**16. Application and Use of Satellite Imagery in Nowcasting (continued)**	• Mr Alan Seed (BOM)	60 minutes
1200-1330	**LUNCH BREAK**		90 minutes
1330-1500	**17. Trainees Description of Own Forecasting Systems Including Nowcasting (if applicable) in the Framework of the SWFDP SE Asia Project**	• All trainees	90 minutes
1500-1530	**COFFEE / TEA BREAK**		30 minutes
1530-1700	**18. Visit to the Forecasting Office of SMS**	• SMS	90 minutes
	Friday, 18 November 2011		
	DAY 5		
0900-1030	**19. Case Study in the Application of Nowcasting Using WENS Experience**	• Mr Dai Jianhua	90 minutes
1030-1100	**COFFEE / TEA BREAK**		**30 minutes**
1100-1200	**19. Case Study in the Application of Nowcasting Using WENS Experience (continued)**	• SMS to lead, all system providers	60 minutes
1200-1330	**LUNCH BREAK**		**90 minutes**
1330-1500	**19. Case Study in the Application of Nowcasting Using WENS Experience (continued)**	• SMS to lead, all system providers	90 minutes
1530-1600	**COFFEE / TEA BREAK**		**30 minutes**
1600-1700	**20. Review of the Workshop**	• All participants	60 minutes
1700	**21. Closure of the Review Meeting and Workshop**		

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