Annual Report 2012

KMA Korea Meteorological Administration

Korea Meteorological Administration
Annual Report 2012

CONTENTS

WATCHING THE SKY FRIENDLY
SERVING THE PEOPLE FAITHFULLY

MESSAGE FROM ADMINISTRATOR

Prompt, Accurate and Valuable Meteorological Services

Since weather is resulted by a combination of complex atmospheric phenomena, information obtained by one country is not enough to issue accurate weather forecasts. Nations around the world produce their weather forecasts by sharing data with each other. To acquire precise weather data, it is essential to have cutting-edge observation instruments, advanced data quality management, and strong international cooperation.

Now, meteorological data are being used not just for weather forecasting but for more and wider areas. They serve as crucial basic data to help the government establish a wide array of policies and make important decisions on water and energy management and green growth. Meteorological information is becoming increasingly valuable to individuals, companies and countries in areas ranging from disaster prevention to agriculture, fisheries, environment, national defense, health and industries.

In 2012, Korea was affected by meteorological disasters, including three consecutive large-scale typhoons and floods which had enormous social and economic impacts. The KMA was at the forefront to minimize the damage by providing prompt and accurate weather information and forecasts. KMA's tireless efforts all year round for a variety of sectors such as forecasts, climate, IT and international cooperation have made great progress in domestic weather service and in international exchanges with other partner nations.

Domestically, the KMA enhanced its omnidirectional capacity in monitoring climate change by adding a monitoring center at Dok-do to existing networks in Anmyon-do and Jeju-do, while raising the efficiency of using national resources by establishing an integrated radar operations center.

Internationally, the KMA was committed to joining forces to address global issues including extreme weather events caused by climate change by taking part in international meetings such as WMO Executive Council and WMO Extraordinary Congress on GFCS. Collaborations in a number of areas have been facilitated through bilateral meetings with many countries including Germany, Mongolia, Vietnam, Russia, Indonesia, the UK, Russia and India. In particular, as GISC-Seoul was endorsed by the WMO EC in June 2012, the KMA is now able to play a key role as the world's 6th hub of in collecting and distributing global weather data.

In addition, the KMA successfully hosted the 4th session of the Joint WMO-IOC Technical Commission for Oceanography and Marine Meteorology (JCOMM) in Yeosu, Korea and diversified collaboration with international organizations by signing an MoU with the World Bank and the Comprehensive Nuclear Test Ban Treaty Organization (CTBTO).

Extreme weather events due to climate change and massive scale of meteorological disasters are looming large as new threats to national competitiveness and national security. When weather forecasts and climate prediction information are reflected in national affairs, life and property of the people could be better protected and social, economic and cultural added-value be created.

As the KMA presents this annual report which includes its activities and outcomes achieved in 2012, I sincerely hope this will be of use to the WMO, NMHSs and all the meteorological experts with interests in the KMA.

LEE Ilsoo

Administrator
Korea Meteorological Administration

Introduction

KMA News Highlights

A Look Back

KMA NEWS HIGHLIGHTS

1 One on One Weather Services through Regional Weather Officers

In April 2012, the Regional Weather Officer Program kicked off in 181 cities and counties in Korea. When severe weather events including typhoons, heavy rains and heavy snows are predicted, Regional Weather Officers visited frequently-affected areas to provide accurate and detailed regional weather information. The officers also analyze the impact of climate change on industries in a region and offer customized weather information. Such efforts have made significant progress in weather disaster prevention in each region of the country.

Regional Weather Officers, Giving Advice and Support to Local Organizations for Disaster Prevention

2 Wider Weather Service Support for Special Events

The KMA strengthened weather service support for national events in 2012. In particular, the KMA played an important role by producing specific weather information for each event such as EXPO 2012 Yeosu Korea, Nuclear Security Summit 2012 Seoul, and the Launch of NARO space rocket.

3 Strengthened International Cooperation in Meteorology

As the scope of meteorological tasks has broadened ranging from weather forecasting including typhoons, earthquake·tsunami analysis to communication, weather industry and support for developing countries, international cooperation activities flourished in 2012. Of those activities, notable achievements include the KMA administrator CHO Seokjoon's election as chairperson of TC AWG, MoU between the CTBTO and the KMA, and MoU with World Bank.

44th Session of the UNESCAP/WMO Typhoon committee

4 Hosting JCOMM in Yeosu for the First Time in Asia

The Living Ocean and Coast World Exposition in Yeosu

The Fourth Session of the Joint WMO-IOC Technical Commission for Oceanography and Marine Meteorology (JCOMM) was held in Yeosu, Republic of Korea, from 23 to 31 May 2012 in conjunction with EXPO 2012 Yeosu Korea. The Session took place under the theme of 'Save the Future with the JCOMM' to develop joint national measures. It ended in success with participation of over 300 experts in meteorology and oceanography including delegations from 54 countries, the WMO Secretary-General, the IOC Executive Secretary, the IOC Chairperson and the co-presidents of JCOMM.

4th Session of JCOMM

5 Korea Hit by Three Typhoons in a Row

2012 was the first year that the Korean peninsula was consecutively struck by a series of typhoons, namely, Denbin-14, Bolaven-15, and Sanba-16. Four typhoons including Kanoon-7, landed on the country, which was the record high in 50 years since 1962.

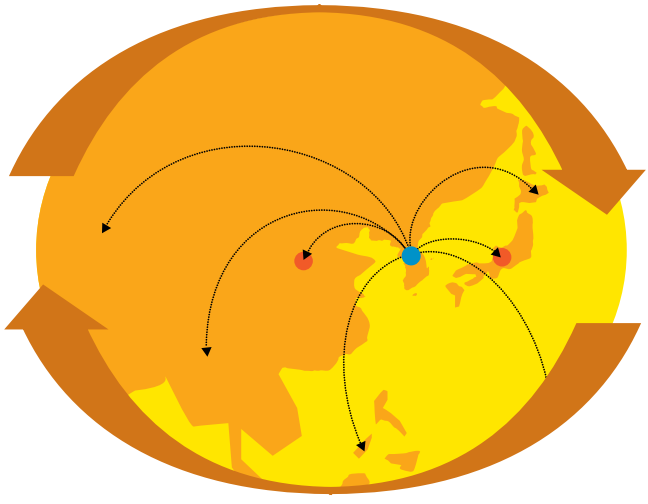
6 The One and Only Chugugi (the World's First Rain Gauge) Unveiled 40 Years after Restitution

Geumyoung Chugugi

On 19 March 2012, commemorating the World Meteorological Day, the KMA showed the Geumyoung Chugugi (National Treasure - 561) to the public for the first time in 40 years since it was restituted from Japan. The unveiled rain gauge is the only remaining Chugugi originally installed in Gongju, Korea before taken away to Japan by Yada Yuwooji, then head of the weather observation station during Japanese colonial rule. On 3 April 1971, it was returned to the Central Weather Station (former KMA) where the treasure has been kept.

7 Hosting GISC in Seoul

The WMO endorsed Seoul to be the world's sixth host of a Global Information System Centre (GISC-Seoul), a hub for collecting and distributing global weather data at the 64th WMO Executive Council on 30 June 2012. Through GISC-Seoul, the KMA is now able to make significant contribution to weather/climate data and technology of the WMO Information System (WIS) for 191 WMO Members.



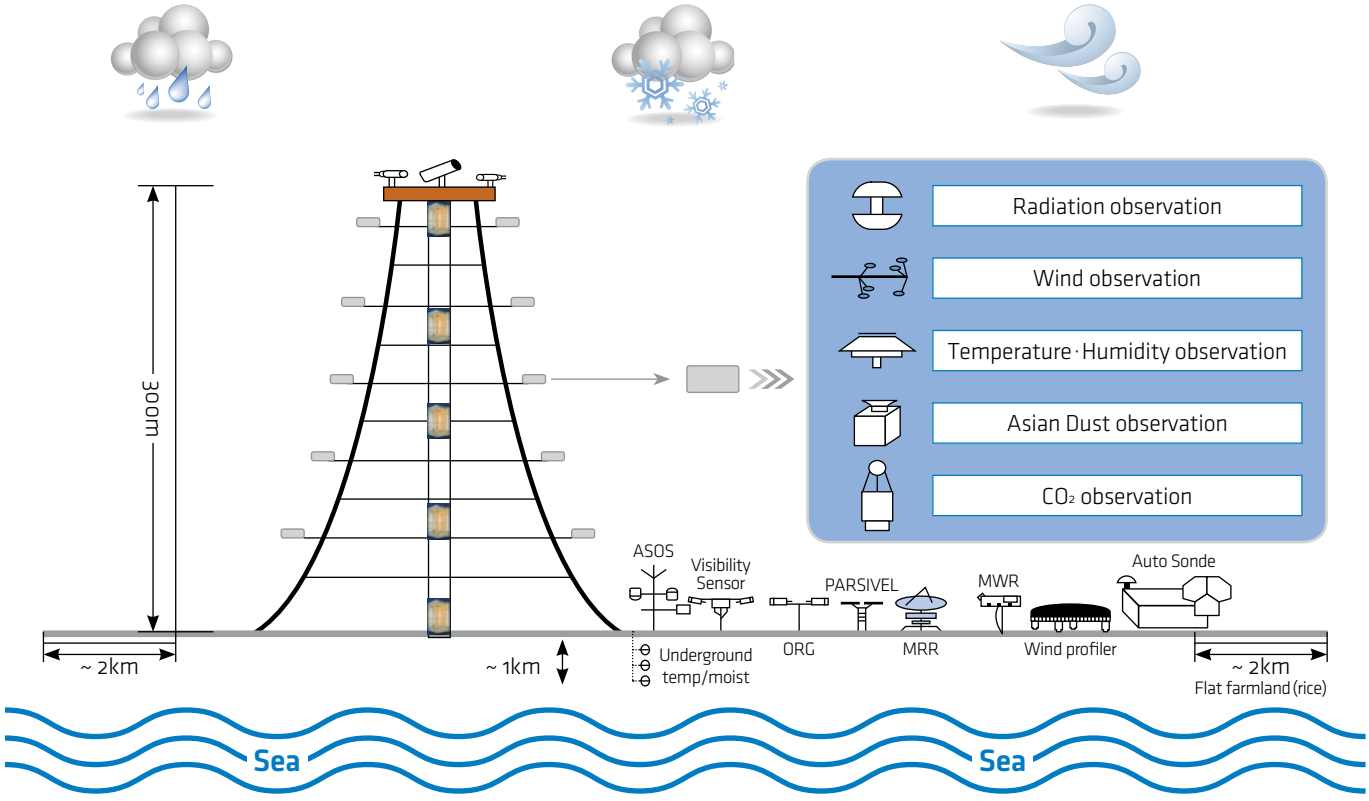
8 Enhanced Capability for Monitoring Weather/Climate of the Korean Peninsula

Image view of Korea Global Atmosphere Watch Center at Ulleungdo Dokdo

Upgrading weather observation instruments and equipment is essential to accurate prediction of weather/climate. KMA's internationally renowned observation capability has allowed Korea to play a pivotal role in weather observation area and to establish climate change monitoring system on the three sides (east, west and south) of the Korean peninsula.

- The WMO designated the Boseong Global Standard Observatory as a testbed and Chupungnyeong as a lead observatory.
- 300 m comprehensive weather observation tower is scheduled to be built in 2013 in Boseong.
- Ulleungdo Dokdo Station (UDS) as part of Korea Global Atmosphere Watch Center was launched to monitor east side of Korea.

Diagram on comprehensive weather observation tower



A LOOK BACK

Month	Key Events	Venue
January	· Two KMA observation sites designated as important centers for the WMO activities (20 Jan.)	Seoul
February	· The 44th Typhoon Committee - Dr. Kantanar Award presented to the KMA (6-11 Feb.)	China
	· Fourth session of the WMO RA II Management Group (29 Feb.-2 Mar.)	Doha
March	· World Meteorological Day - Celebration Ceremony and Other events in Seoul (23 Mar.)	Seoul
	· International High-level Meteorology Policy Workshop (21-23 Mar.)	Seoul
	· Fourth Bilateral Meeting between the KMA and DWD (5-8 Mar.)	Seoul
	· Capacity Building Programme for Radar Operation and Data Application (4-17 Mar.)	Seoul
	· The oldest rain gauge in the world was open to the public (23 Mar.)	Seoul
	· Vice-Minister of Nature, Environment and Tourism of Mongolia visited for a consultation meeting (16 Mar.)	Seoul
	· Support for Capabilities on Flood Forecasting and Warning System in the Philippines (26 Mar.-6 Apr.)	Seoul
April	· The KMA, First Grant of COMS Data Receiving and Analysis System in Sri Lanka (5 April)	Colombo
	· Bilateral Meeting Between the KMA and HKO (2-4 Apr.)	Hong Kong, China
	· Implementing Forecast and Warning Service for Space Weather (1 Apr.)	Seoul
	· Workshop for Industrial Usage of Weather and Climate Prediction Information (2 Apr.)	Seoul
May	· Fourth session of the JCOMM (23-31 May)	Yeosu
	· Advisory Working Group meeting of ESCAP/WMO Typhoon Committee (28-29 May)	Seoul
	· The 2nd Bilateral Meeting Between the KMA and NHMS (16 May)	Seoul
	· The 5th Bilateral Meeting Between the KMA and NAMEM (30 Apr.-5 May)	Ulaanbaatar
	· MoU between the KMA and HKO (30 May)	Seoul
June	· WMO EC meeting (25 Jun.-3 Jul.)	Geneva
	· WMO's approval of GISC Seoul (27 Jun.)	Geneva
	· The 7th Bilateral Meeting between the KMA and Roshydromet (20-22 Jun.)	Saint-Petersburg
	· MoU Signing Ceremony for the KMA-Met Office Meteorological Cooperation (26 Jun.)	Geneva
August	· KMA-NOAA Collaboration to support a training workshop for developing countries (7-17 Aug.)	San José
September	· The 2nd Bilateral Meeting between the KMA and MoES (20 Sep.)	Seoul
	· MoU Signing Ceremony for the KMA-BMKG Meteorological Cooperation (6-7 Sep.)	Jakarta
	· The 4th Asian GAW Workshop on Greenhouse Gases (24-25 Sep.)	Jeju
	· Capacity Building Programme for Analysis of COMS data (2-22 Sep.)	Seoul
October	· WMO Extraordinary Session of the WMO Congress (26-31 Oct.)	Geneva
	· Africa Capacity Building Programme for Weather Disaster Response (14 Oct.-4 Nov.)	Seoul
	· MoU between the KMA and CTBTO (31 Oct.)	Vienna
November	· Meeting with delegation from QMD to discuss meteorological cooperation (14-16 Nov.)	Seoul
	· Meeting to promote meteorological cooperation between the KMA and Saudi Arabia (15 Nov.)	Seoul
	· MoU between the KMA and World Bank (2 Nov.)	Washington D.C.
	· The 1st GISC Seoul International Workshop (6-9 Nov.)	Jeju
	· The 2nd International Workshop on CORDEX-East Asia (6-8 Nov.)	Jeju
	· The 5th International Cooperation Workshop (27-30 Nov.)	Jeju
December	· The 15th Session of WMO RA II (13-19 Dec.)	Doha

A LOOK BACK

20 January

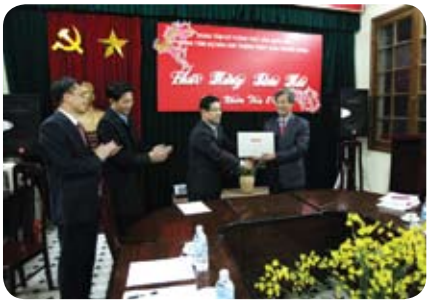
On January 20, the Boseong site was designated as a CIMO Testbed and the Chupungnyeong site as a CIMO Lead Center after one year and four month-long evaluation process by the WMO.

Now Boseong became one of the world's four Testbeds along with Richard Assmann of Germany, Payerne of Switzerland and Sodankylä of Finland while Chupungnyeong one of the world's three Lead Centers along with Lindenberg of Germany and B. Castelli of Italy.

In the future, the Boseong Testbed will serve as the WMO's Centre of Excellence which is devoted to developing common observation techniques to deal with climate change and hazardous weather. The Chupungnyeong Lead Center will be a reference observatory for verification and standardization of meteorological methods and instruments.

The KMA will contribute to standardizing world's meteorological techniques based on the two sites through various international joint studies under the leadership of the WMO.

1-3 February



Since 2010, the KMA has been cooperating with the National Hydro-Meteorological Service of Vietnam for its modernization project to better cope with hazardous weather and climate change.

In February, as part of such efforts, the KMA successfully transferred and installed TAPS-2 (Typhoon Analysis and Prediction System) developed by the National Typhoon Center to NHMS and provided a training for local meteorologists and engineers on the operation and expansion of the system. It was confirmed that TAPS-2 English Version was properly recognized by the system. Active cooperation between the two countries through joint research and technical support is anticipated.

6 February

In line with the WMO-KOICA East Africa Climate Prediction Support Program (2009-2011), the KMA assisted IGAD Climate Prediction and Applications Centre (ICPAC) to establish Regional Climate Centre (RCC).

While working to establish Climate Prediction System on a basis of continuous cooperation with the WMO and ICPAC, the KMA sent its partner SBIS Co,. Ltd, to Kenya for running a training course on the operation of the PC cluster and the website in ICPAC in February.

Building on such achievements, the KMA will strengthen its cooperation with Africa and expand its support.

6-11 February

The KMA delegation participated in the 44th Session of the UNESCAP/WMO Typhoon Committee held in Hangzhou, China, on 6-11 Feb.

At the Session, participants from 11 countries including Korea, the US, China and Japan looked back on their achievements and performance in 2011; made a 2012-2016 plan; shared short and long range forecast skills, and urban-flood prevention skills; and discussed various relevant policies.

The KMA, a founding member of the Committee since 1968, has tried to contribute to the Committee activities by providing satellite data, technology transfer, and training courses.

The KMA was honored during the meeting by receiving the prestigious Kintanar Award. The KMA expressed deep appreciation to the Committee and accepted the chairmanship of Advisory Working Group for next year.

29 February-2 March

The KMA attended the RA II MG-4 held in Doha, Qatar, on 29 Feb-2 Mar. The meeting was to prepare for the 15th RA II Session (Dec. 2012, Qatar) and to discuss the urgent issues such as the development of RA II strategic operational plans (2012-2015). During the meeting, the KMA introduced current development of OpenWis program, preparation for GISC-Seoul, a plan to establish a regional training center for GFCS.

5-8 March

On 6 March, the KMA and DWD held their Fourth Bilateral Meeting in Seoul attended by two heads of both Services. Both sides agreed to work together on research and development of urban weather service, invention of a user interface of agro-meteorological models for developing countries and operation of Global Information System Centers. The meeting is expected to accelerate the KMA's efforts to develop comprehensive weather service for urban areas.

The KMA and DWD signed an MoU on Meteorological Cooperation in 2000 and have actively promoted technical exchanges on various areas including applied meteorology, information and telecommunications and climate data.

4-17 March

The KMA has continued its efforts to expand its training programs for Asian and African countries which are one of the main focus of KMA ODA programs. As part of such effort, the KMA offered a course on radar operation and radar data application for 16 staff members from NMHSs in Asian and African developing countries for two weeks from 4-17 March. The course consisted of four sessions: radar observation and operation; radar purchase and set-up; radar data production and analysis; radar data application, focusing on practical radar operation skills. The course was launched this year and will continue to be expanded.

21-23 March

The KMA held the High-level Policy Workshop with high ranking officials from six countries, Laos, Malaysia, Mongolia, Sri Lanka, the Philippines and Tanzania, for 3 days from 21 to 23 March to explore how to strengthen developing countries' meteorological capability through international cooperation.

At the workshop, the KMA introduced its current status of weather related ODA projects, and their successful experiences in cooperation, followed by the discussion on the international cooperation including ODA. Currently, the KMA is actively engaged in capacity building projects for developing countries and international cooperation programs.

26 March-6 April

With the financial assistance from KOICA, the KMA's project for the establishment of an early warning and monitoring system for disaster mitigation in the Philippines was undertaken in the metro-Manila region from 2010 to 2012. All the systems were installed completely in January and are currently in operation. Regarding the systems, the KMA invited 12 experts from Philippine Atmospheric Geophysical and Astronomical Services Administration (PAGASA) and disaster prevention centers to provide them with training on system operation, management and early warning system.

The training was made up of primary lectures about flood forecasting and warning, which was implemented in September 2011, and various lectures needed for equipment operation, such as flood forecasting and warning system, and observation and early warning system. The KMA is expected to contribute to fostering response capabilities against natural disasters in the Philippines through the training.

2-4 April 2012

The KMA delegation visited Hong Kong Observatory (HKO) from 2-4 April 2012. During the visit, both sides discussed cooperation measures on various areas such as aviation weather, climate model and utilization of satellite data.

As the President of WMO Commission of Aeronautical Meteorology (CAeM), HKO is producing aviation weather data and performing forecast service for major cities worldwide. Both discussed how to hold joint seminars on processing of satellite data, analyzing technology and research of climate model, and to cooperate in data exchange as the KMA now has its own meteorological satellite. The discussion provided both with an opportunity to upgrade weather technology and strengthen partnership.

5 April

The Donation ceremony of COMS data receiving and analysis system to Sri Lanka was held at Department of Meteorology in Sri Lanka, on 5 April. The KMA has implemented developing and establishing COMS data receiving and analysis system in Sri Lanka in collaboration with KOICA since March 2011.

This system, whose small and medium sized-receiving system was successfully made in Korea last year, is the first to be established overseas. The Sri Lanka-tailored system featuring COMS data receiving, processing, analysis, service, storage, management, monitoring and control was developed and established. A trial run of the system was completed in March 2012. In addition, by sending Korean experts to Sri Lanka and inviting Sri Lanka experts to Korea, the KMA opened training courses on how to install and operate the system, analyze and utilize satellite data, which would help raise efficiency of forecast production in Sri Lanka.

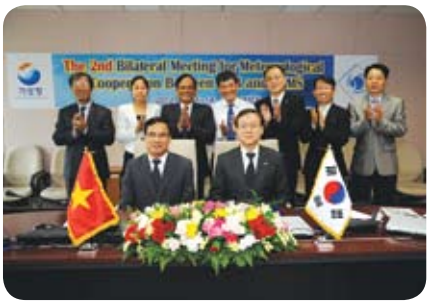
Both organizations expect that COMS data receiving and analysis system will contribute to adaptation to climate change and decrease in damage from natural disasters.

30 April-5 May

The KMA delegation visited National Agency for Meteorological and Environment Monitoring (NAMEM) of Mongolia for the 5th bilateral meeting from 30 April to 5 May. Both sides discussed future cooperation on 8 main areas such as aviation meteorology, NWP model, development of wind resource map and enhancement of joint research on Asian dust.

This year marks the 10th anniversary of the MoU signed by the KMA and NAMEM. For the decade, both sides have had vibrant meterological cooperation and exchange of related technologies including expansion of joint observatory network for Asian dust, training on numerical forecast and climate data rescue project.

16 May



The KMA hosted the second Korea-Vietnam Bilateral Meeting with National Central Hydro-Meteorological Forecasting Center (NHMS) headed by Mr. Nguyen Van Tue in Seoul on 16 May.

At the meeting, both sides discussed various issues such as training on typhoon analysis system and ODA cooperation.

In particular, the KMA decided to accelerate its projects to support developing countries, taking vietnam as the example of a nation with increasing socio-economic damage done by weather disasters including flood and typhoon stemming from abnormal weather conditions. In addition, both agreed to improve hydrological capability of Hong and Mekong river in Vietnam through joint ODA support programme.

28-29 May

The KMA hosted AWG meeting of ESCAP/WMO Typhoon Committee on 28-29 May in Seoul. The meeting was joined by 25 members of the committee including Mr. Chi Ming SHUN, the Director of HongKong Observatory and Mr. Olavo Rasquinho, Secretary of the Typhoon Committee.

AWG, consisting of WGM, WGH, WGDRR and TRCG, is in charge of setting directions of the committee and reviewing main issues and decisions made at the 44th session in China on 6-11 February. As the former chairperson of the last AWG session, Director General of Forecast Bureau of the KMA presided over the session leading negotiations over follow-up measures of the last session, strategies and budget set-up and effective management of the committee and its future direction.

23-31 May

The KMA successfully hosted the Fourth session of the Joint WMO-IOC Technical Commission for Oceanography and Marine Meteorology (JCOMM-4) on 23-31 May 2012 in Yeosu, Republic of Korea.

The meeting was attended by about 200 delegates, invited experts and other participants from the WMO and IOC Member/Member States and relevant international organizations. It is said that the world's three biggest events are the Olympics, World Cup Games and the World Expo. JCOMM-4 was held in conjunction with the World Expo, and estimated to be the best case that maximized the meeting's effect.

20-22 June

The KMA delegation visited Saint-Petersburg, Russia to attend the 7th bilateral meeting between the KMA and Roshydromet on 20-22 June.
During the meeting, both sides discussed measures to expand cooperation for the successful hosts of 2014 Sochi Winter Olympics and 2018 Pyeongchang Winter Olympics, including joint participation in the international meteorological programmes, mutual exchange of professional forecasters and sharing know-hows.

26 June

During the WMO EC (25 June-3 July, Geneva), the KMA signed an MoU with Met Office for comprehensive meteorological cooperation such as development on NWP model at the WMO headquarters.
The KMA and Met Office laid a foundation for cooperation in a variety of areas including weather forecasting, observation, communication, weather · climate technology, applied meteorology, meteorological research and development, and expert training. Besides, both established the cooperation system for expanding and strengthening opportunity of expert exchange.

25 June-3 July

As the 64th Session of WMO EC was held in Geneva, Switzerland from June 25 to July 3, seven KMA staff members participated in the meeting.
Participants at the Council reviewed 2011 financial status and human resources management as well as the implementation plan on Global Framework for Climate Services (GFCS). They also reviewed the implementation plan of the WMO five top priorities and its outcome.

6-7 September

The KMA delegation visited Badan Meteorologi, Klimatologi, Dan Geofisika (BMKG), the meteorological authority in Indonesia for two days (6-7 Sept.) to sign an MoU for meteorological cooperation and to attend the 1st bilateral meeting. Both sides discussed cooperation in forecasting, satellite and NWP model, and cooperative measures for exchange of data and experts on earthquake and tsunami in the future.

The KMA and BMKG agreed on technology cooperation in forecasting, earthquake and climate service. In particular, both sides talked about a number of cooperative measures: providing consultation on aeronautical meteorological services that received ISO certification and; holding joint seminars on satellite data processing and analysis technology of the KMA's own weather satellite, dubbed COMS.

20 September

The KMA held the second bilateral meeting between MoES (Ministry of Earth Science) and the KMA in its headquarters on September 20. At the meeting, four people including Ms. Swati Basu from MoES attended.

The meeting was meaningful since the meeting laid the foundation for the consistent and strategic cooperation activities after the two sides signed an MoU in 2010.

Main parts of the agreement include restoration of climate data, technology exchange over satellite data processing, forecasting technology cooperation, CORDEX data accumulation and development of management system. The cooperation in those areas is expected to bring about active technology exchange in forecasting and climate.

24-25 September

For the joint response to climate change through Global Atmosphere Watch (GAW) in Asia, the KMA hosted "the fourth Asian GAW workshop on Greenhouse Gases" in Jeju on 24-25 September with around 60 GAW experts at home and abroad from Indonesia, Malaysia, India and Australia. This workshop mainly consisted of members of Asian GAW Greenhouse Gases Working Group (GGWG) created at the third workshop in 2011.

Under the topic of "Greenhouse Gases (GHG) Monitoring Activities," the participants at the workshop shared information over each country's ongoing policies for GHG monitoring, current status of GHG, the relevant activities, technology and analysis results of GHG monitoring and discussed measures to boost cooperation among countries.

26-31 October

WMO Extraordinary Congress was held in Geneva from 26 to 31 October 2012. Eight Korean officials attended the Session. The Session approved GFCS (Global Framework for Climate Services) Implementation Plan, establishment of the governance and the financial support process. The KMA will continue its efforts to successfully implement GFCS including voluntary contribution fund.

31 October

For the purpose of improving accuracy in analysis of a tsunami, the KMA signed an MoU with Comprehensive Nuclear Test Ban Treaty Organization (CTBTO) in Vienna, Austria on 31 October, regarding earthquake data exchange and cooperation in technology exchange.

2 November

Administrator CHO Seokjoon and Mr. Francis Ghesquiere, Manager of the World Bank's Global Facility for Disaster Reduction & Recovery (GFDRR), signed an MoU at the headquarters of the World bank on 2 November.

The MoU between the KMA and WB has laid a foundation for strategic partnership on climate change to develop joint projects targeting developing countries. It will also offer an opportunity to share Korea's knowledge and experience in weather and climate and bolster R&D capabilities in developing countries.

6-9 November

The KMA hosted "The 1st GISC Seoul International Workshop" in Jeju on 6-9 November to share operative technology for worldwide exchange of meteorological data. Seven GISC operators (ROK, China, Japan, Australia, France, the UK and Germany) endorsed by the WMO together discussed exchange of the global weather and climate data, the management system and the current service status.

27-30 November

The KMA invited five working-level officials in charge of international cooperation from Mongolia, Vietnam, China, Uzbekistan and Japan to the International Cooperation Workshop in Jeju on 27-30 November. Through the workshop, the KMA shares the current status of and future plans for international cooperation with other countries not only to enhance cooperation but also to expand the human resource network.

13-19 December

The KMA attended the WMO RAII Session, which was held in Doha, Qatar from 13 to 19 December 2012. As a member of the WMO RA II, the KMA delegation voiced its opinions on regional issues. The delegation discussed effective measures to link regional issues to the WMO's current issues as a WMO EC member.

Overview

HISTORY

Oct. 2008
Digital Forecast service starts off

May. 2007
The KMA Administrator elected to the WMO Executive Council

Jul. 2005
The KMA Administrator promoted to the rank of Vice Minister

Oct. 2004
Supercomputer No.2 introduced

Jun. 1999
Supercomputer No.1 introduced

Dec. 1998
The KMA relocates to new headquarters

Jul. 1993
Dedicated Seoul-Beijing international communication network launched

Dec. 1990
The Office promoted to an Administration (renamed "Korea Metorological Administration (KMA)"

Jan. 1989
Meteorological observations at Sejong Base in Antarctica commences

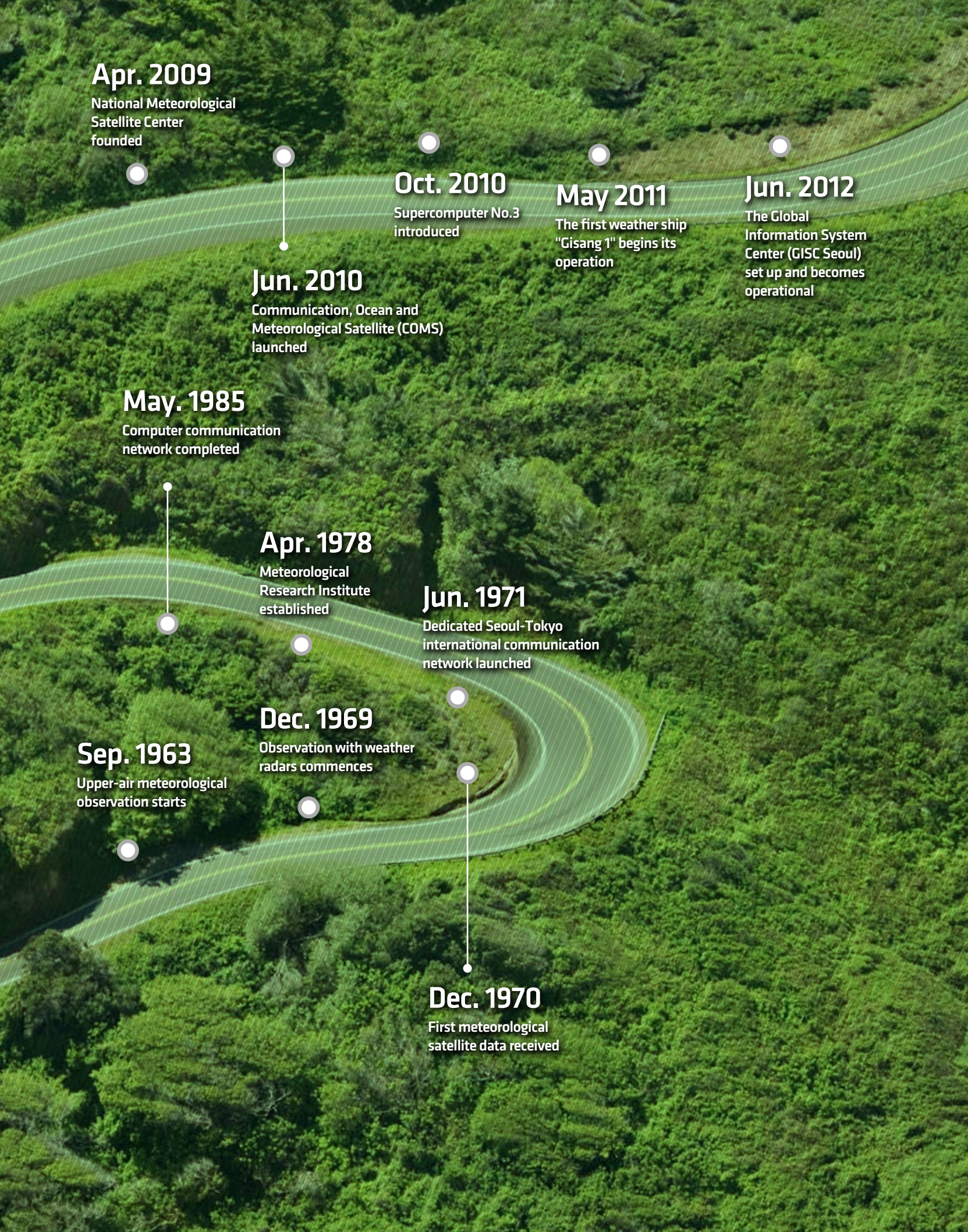
Mar. 1904
Korea starts modern meteorological observation (Busan, Mokpo, Incheon, Wonsan, Yongampo)

Aug. 1949
National meteorological service established under the name "Central Meteorological Office (CMO)"

Feb. 1956
Korea joins the World Meteorological Organization (WMO)

Jan. 1959
Aviation meteorological Services begins

Aug. 1961
Meteorological Services Act enacted


Apr. 2009
National Meteorological Satellite Center founded
Jun. 2010
Communication, Ocean and Meteorological Satellite (COMS) launched
Oct. 2010
Supercomputer No.3 introduced
May 2011
The first weather ship "Gisang 1" begins its operation
Jun. 2012
The Global Information System Center (GISC Seoul) set up and becomes operational
May. 1985
Computer communication network completed
Apr. 1978
Meteorological Research Institute established
Jun. 1971
Dedicated Seoul-Tokyo international communication network launched
Dec. 1969
Observation with weather radars commences
Sep. 1963
Upper-air meteorological observation starts
Dec. 1970
First meteorological satellite data received

ORGANIZATION

1 Function & Organization

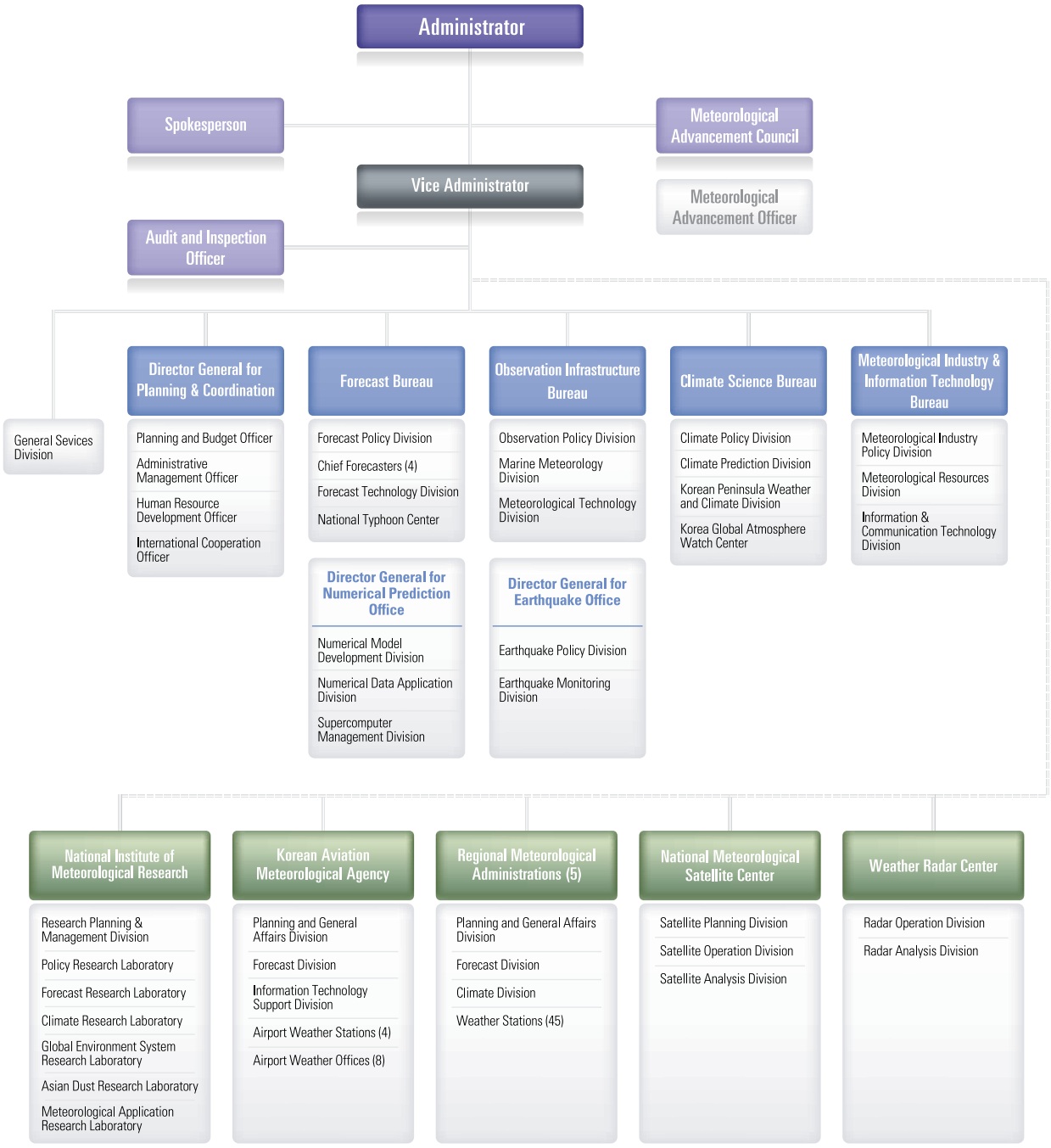
The KMA is a central governmental organization of the Republic of Korea under the Ministry of Environment (MOE). Its mission is to observe atmosphere, make a forecast, produce weather and climate information and conduct research.

The KMA conducts observation at sea, on land and from sky for 365 days a year and produces weather forecasts with a broad range of data collected from countries around the world. Based on observation and forecasts, it is in charge of various tasks regarding earthquake, volcano, climate change, weather/climate industry, hydrology and cosmical meteorology.

In the era of climate change, the KMA is responsible for the national meteorological tasks that protect citizens' lives and properties, create future competitiveness and elevate the status of the ROK in the world.

The KMA consists of five regional administrations in Busan, Gwangju, Gangwon, Daejeon and Jeju, 45 weather observatories, the National Institute of Meteorological Research (NIMR), the National Meteorological Satellite Center, the Weather Radar Center and the Korea Aviation Meteorological Agency. In order to implement more complex meteorological tasks, its human resources and the organization are becoming more sophisticated and professional.

2 Organizational Structure



3 Human Resources

As the modern society has rapidly become more global and turned into knowledge and information-intensive one, the demand for a variety of specialized meteorological services is increasingly on the rise. To sustain qualified workforce for more advanced meteorological services, the KMA recruited master's and doctor's degree holders through a special employment, and hired Grade 9 public officials in meteorology to secure working-level workforce additionally. Breaking the newly employed into educational background, four (4) Doctors and nine (9) Masters were hired through a special employment, and 40 Grade 9 public officials were hired through the KMA's open recruitment. As of the end of 2012, there are 434 master's and doctor's degree holders (103 doctors and 331 masters), and 1,142 staff members (81.3%) have more than bachelor's degrees.

[Table] Employed qualified workforce(As of Dec. 31 2012)

(Unit: person)

Category	Degree	By year									Average
		Total	2012	2011	2010	2009	2008	2007	2006	2005	
Special recruit-ment	Doctor	52	4	1	5	4	-	12	14	12	
	Master	82	9	5	4	6	1	23	17	17	
	Bachel-or	19	4	2	2	-	1	2	6	2	
	Total	153	17	8	11	10	2	37	37	31	
Open recruitment		295	46	39	30	2	45	58	42	33	
Aggregate total		448	63	47	41	12	47	95	79	64	

4 Budget

Budget Overview

The KMA's 2012 budget is divided into general accounts and special accounts for innovative city construction. The estimated revenue is KRW 2.119 billion, down by KRW 34 million or 1.6% from that of 2011 while the estimated expenditure is KRW 309.239 billion, up by KRW 20.363 billion or 7.0% year-on-year (General accounts: KRW 293.551 billion; special accounts for innovative city construction: KRW 15.688 billion).

The estimated expenditure in general accounts is classified into labor costs (KRW 74.588 billion, up by KRW 4.780 billion or 6.8% YoY), basic expenses (KRW 17.028 billion, up by KRW 348 million or 2.1% YoY) and major project expenses (KRW 201.935 billion, up by KRW 10.178 billion or 5.3% YoY). Those expenses account for 25.4%, 5.8% and 68.8%, respectively.

The major project expenses include budgets for general projects, R&D and digitalization projects taking up KRW 70.845 billion (35.1%), KRW 77.947 billion (38.6%) and KRW 53.143 billion (26.3%), respectively.

As the NIMR and the Meteorological Radio Transmission Station moved to Seogipo in Jeju and Gimcheon in North Gyeongsang Province under the relocation plan of the public organizations, the estimated expenditure of special accounts for innovative city construction is set at KRW 15.688 billion (up by KRW 5.057 billion or 47.6% YoY).

Meanwhile, the expenses for building new government offices were transferred from the general accounts to the National Property Management Fund under the Ministry of Strategy & Finance (MOSF) from 2012, setting at KRW 19.720 billion for purposes like building new weather observatories in Jeonju.

Estimated Revenue and Expenditures Statements

The 2012 estimated revenue consists of asset (KRW 12 million), current transfer (KRW 508 milllion), sales revenue of goods and services (KRW 1.561 billion), government's property sales (KRW 37 million) and money for replacing revenue (KRW 1 million).

Based on programs, the estimated expenditure may be subdivided into weather forecast (KRW 41.785 billion), weather observation (KRW 44.919 billion), climate change science (KRW 12.951 billion), weather industry information (KRW 23.589 billion), weather research (KRW 60.109 billion), executive agency operation (KRW 11.241 billion) and weather administrative support (KRW 98.957 billion) in general accounts, and weather administrative support (KRW 15.688 billion) in special accounts for innovative city construction.

Meanwhile, the National Property Management Fund under the MOSF earmarked KRW 11.863 billion for building KMA's facilities and KRW 1.067 billion for building KMA's official residences.

Major projects with increased budget among general projects include establishment of early earthquake warning system (KRW 10.100 billion, up by KRW 4.940 billion) in the reinforcement project for earthquake observation network, and construction and operation project of maritime observation vessels (KRW 1.970 billion, up by KRW 1.070 billion) for

2012 Estimated Expenditures Based on Program

(unit: KRW million)

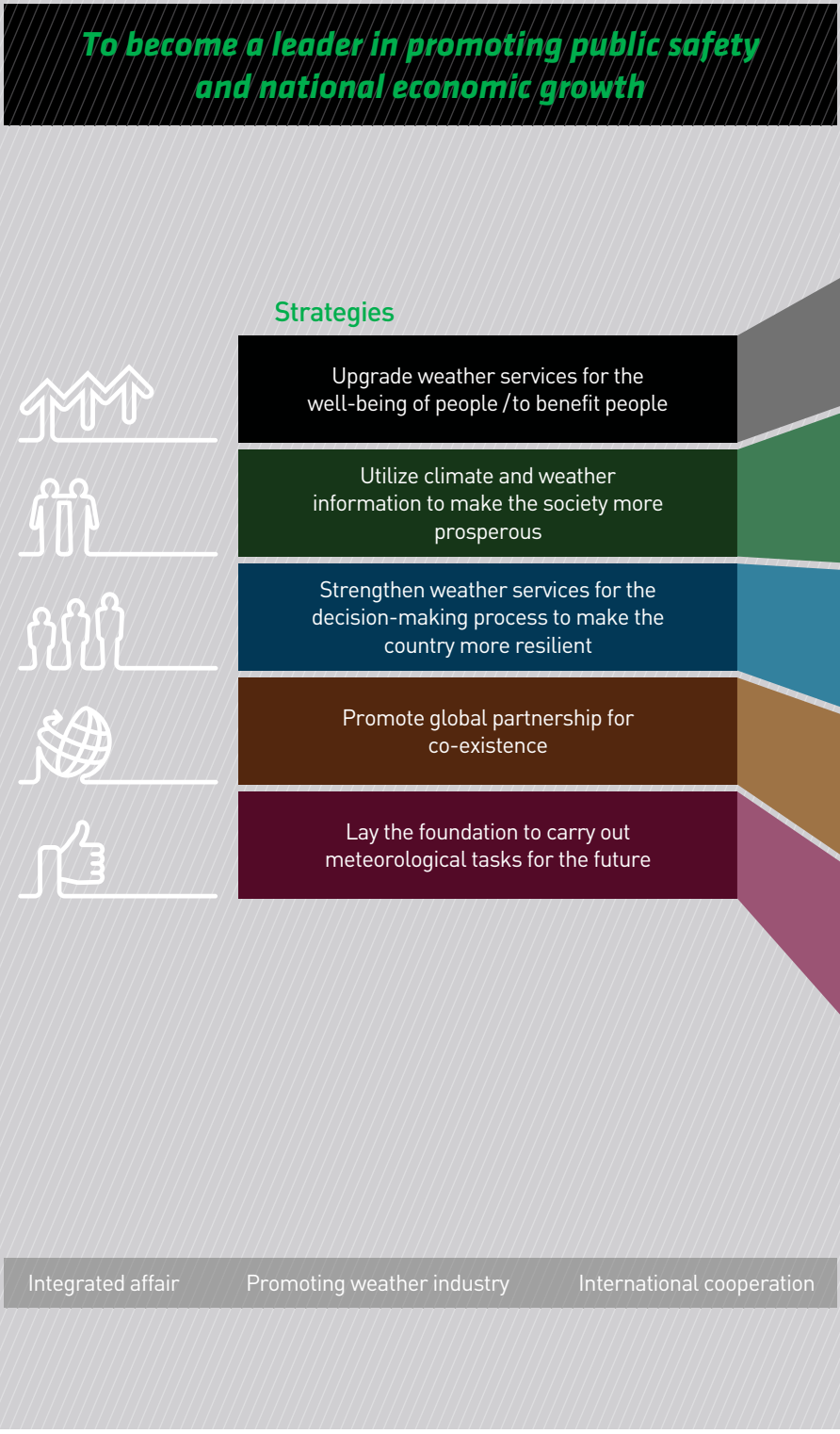
Classification	'11 budget (A)	'12 budget (B)	up(Δ)down (B-A)	up(Δ)down (B-A/A)
Total	288,876	309,239	20,363	7.0%
[General accounts]	278,245	293,551	15,306	5.5%
1. Weather forecast	34,258	41,785	7,527	22.0%
2. Weather observation	41,453	44,919	3,466	8.4%
3. Climate change science	9,682	12,951	3,269	33.8%
4. Weather industry information	20,817	23,589	2,772	13.3%
5. Weather research	48,160	60,109	11,949	24.8%
6. Executive agency operation	10,666	11,241	575	5.4%
7. Weather administrative support	113,209	98,957	Δ14,252	Δ12.6%
[Special accounts for innovative city construction]	10,631	15,688	5,057	47.6%
1. Weather administrative support (relocation of the Meteorological Radio Transmission Station and the National Institute of Meteorological Research)	10,631	15,688	5,057	47.6%

*** Among the weather administrative support, the building project of new government offices is transferred to the National Property Management Fund from 2012. (KRW 18.326 billion in 2011 ⇒ KRW 19.720 billion in 2012)**

VISION & STRATEGY

efficient operation of Gisang 1 (497-ton observation vessel). In terms of R&D project, KRW 10.027 billion (up by KRW 6.881 billion) is allocated to Korean-version NWP model development project to develop its own NWP model by 2019. The budget for weather industry support and application technology development project is set at KRW 3.274 billion, up by KRW 1.274 billion for the support of developing weather industry technology and facilitating weather industry market. The budget for digitalization project increases by KRW 1.489 billion to KRW 4.189 billion since building the integrated management system for regional and global climate data and the system on automatic quality control was reflected in the national climate data management and establishment project for service system.

There are six new projects (KRW 9.937 billion in total) including introduction and operation of multi-purpose aircraft (KRW 1.176 billion), support for building and operating infrastructure of weather and climate tasks in developing countries (KRW 661 million), establishment of long-term forecasting service system for responding to extreme climate events (KRW 1 billion), development of geostationary weather satellite (KRW 4 billion), development of integrated, next-generation smart weather service for urban areas and agriculture (KRW 3 billion), and establishment of the national hydrological and meteorological prediction information system (KRW 100 million).



Implementation plan

- Build capacities against severe weather events with improving NWP models and setting up advanced forecasting system
- Provide local weather services to the public by advancing weather service and its delivery system

- Support adaptation and countermeasures against climate change with production of high-quality information on climate change science
- Enhance climate data availability with integrated management of national climate data and improving its service system
- Develop strategic products for weather service and implement technology transfer & equipment localization

- Establish earthquake early warning system and response system against volcano eruption crisis
- Extend forecasting period and subdivide forecasting areas
- Create social and economic weather service by integrating weather information with non-weather factors

- Promote differentiated weather cooperation between Seoul and Pyongyang
- Strengthen KMA's roles within international organizations and supports for developing countries
- Establish weather economic community among South Korea, China and Japan and global weather cooperation system

- Develop Korean-version NWP models and secure world-class NWP technology
- Establish stereographic weather observation network based on sophisticated equipment
- Facilitate R&D for enhancing meteorological technology
- Expand the understanding and the base of meteorological science through distribution of meteorological culture

THE TOP TWELVE ISSUES FACING THE KMA

Forecasts

NWP

Provides scenario for evolution of severe weather, made more extreme by climate change. Improves capability during natural disasters

Training

Competent staff for each professional area command an advanced infrastructure to enlarge its economic value

International Cooperation

Accelerates meteorological advancement through exchanges of specialized technology with partner nations. Expands the domestic weather industry

Foreign Contributors

Forecast

Situational awareness and capacity building of forecasters enable high quality & customized forecasts and warning services

Observations

The Foundation : Quality Data

High-Quality AWS Network

KMA's rigorous QA/ QC system will provide high-quality weather data across Korea

Marine

Very accurate & high value marine monitoring, prediction, and service information enable the ROK to save lives and diminish economic loss

Aviation

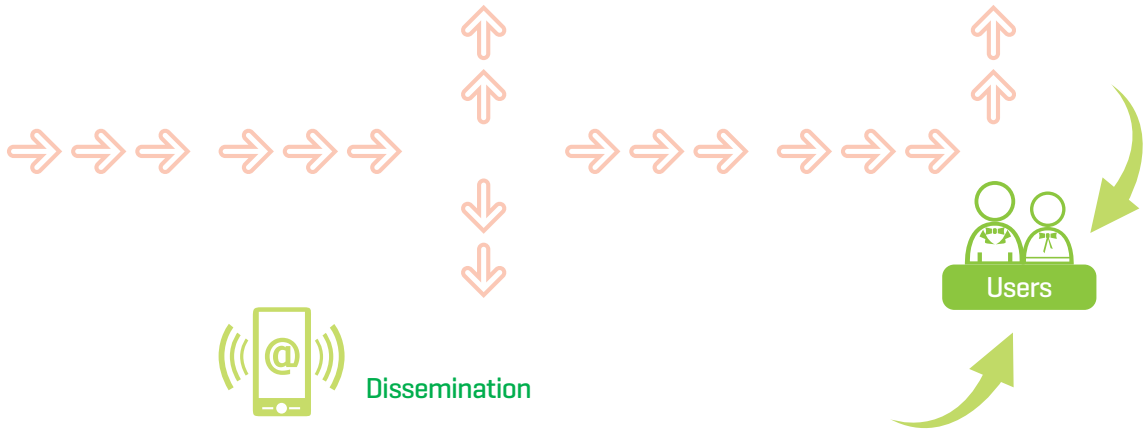
User-tailored information plus computer workstations improve safety, efficiency, and regularity of international air navigation

Climate service

Real-time and high-quality climate system is operated to develop a climate change-ready society

K-NCDC

Development of integrated services of climate and weather data gives a base to promote the application of data and to raise the value of its information



Dissemination

An advanced information dissemination system becomes an efficient channel for KMA's communication of perishable information to the decision makers across Korea

Dual-Polarization Radars

Cutting-edge radar network and high value radar information enable the KMA to increase the accuracy of its forecasts and warnings

Advanced Satellite Observations

KMA's independent satellite network will improve its capabilities to monitor and respond to natural disasters by observing weather and climate from the space

PROGRESS ON THE TOP TWELVE ISSUES FACING THE KMA

Issue 1 Establish an Integrated Radar Operations Center to efficiently use the national resources

By establishing a cross-governmental radar data system, radar data from 23 stations (11 under KMA, 3 under MLIT, 9 under MND) are being collected and jointly used. For more user-friendly system, a web portal and data display and downloads have become available. To accelerate the R20 process through close cooperation between radar users and research community (relevant organizations, academia and industries), Joint Experiment for Comparison and Verification of Radar Rainfall Estimates was conducted by the KMA, NIMR, MLIT, MND, Kyongbuk University, Dongkuk University, Bukyung University, Sejong University and Inha University. After successful negotiation with the US Army, the KMA obtained the land and started designing for a radar test bed to develop radar technology. The KMA has also been committed to enhancing radar operation and application of techniques by promoting the establishment of a radar test bed comparison observatory in Jincheon, Chungcheong Province.

Issue 2 Build a system to integrate data from various observing network

To provide accurate snowfall, snowfall observation methods have been improved and observation network has been extended thereby offering CCTV snowfall data through DRR/weather information system. Quality Rank System was launched in order to step up the quality of weather data from relevant organizations after establishing plans for climate data quality rank system and improving standards for weather data rank system. Multi-purpose weather aircraft is to be introduced for more stereoscopic observation of weather data.

Issue 3 Improve forecasters' capability to respond to hazardous weather events

It has been 3 years since the KMA started to put efforts in 2010 to set up an advanced forecast system where the whole process of weather monitoring/analysis, forecasts/warnings and distribution is carried out promptly. In 2012, the KMA developed real-time auto-alarm function of High Impact Weather (HIW) and displayed probabilistic prediction data thereby enhancing monitoring function. The development of 3-dimensional display of weather data has supported forecaster's analysis works. To train forecasters, HIW training simulator and remotely-controlled training site was put in place. The KMA also raised public awareness on forecasts by developing various functions such as the weather image overlaying feature (stellite and radar images) through advancement of graphicast.

Issue 4 Reassess roles of future forecasters, while reorganizing the system to produce forecasts

The Forecast Analysis Office, a TF team was formed in October 2010 to analyze scenarios of HIW (heavy rain, heat wave, tropical night, cold wave and heavy snow) occurrence which has serious social and economic impact. The office has surveyed and analyzed the regional characteristics, causes and statistics of HIW and calculated a weighted value for each HIW by identifying disaster risks. The results have become a base data to reassess roles of forecasters. Benefits of Regional Weather Officer Program, a pilot project since 2011, have spread to 178 places in April 2012 offering region-specific weather information service and consulting service for weather-related decision-making.

Issue 5 Issue a 'Warn-on-Forecast' for Korea

The KMA has laid the foundation to use LIDER ceilometer data in order to enhance rainfall prediction capacity of very short-range prediction models. Combining a very short-range prediction model and a wave model has enabled better prediction of very short-range sea-surface wind. HIW prediction system became operational in May 2012 to constantly provide information on HIW events. The system offers detailed predication data for metropolitan cities and regions which are used for flash flood forecasting and the time series of surface variables which are used for forecasting of heat waves, cold waves, dry weather and tropical nights.

Issue 6 Improve marine weather services for ocean safety

9 new wave buoys and 4 coastal disaster prevention observation systems were installed (15 coastal systems and 30 wave buoys in total as of 2012) and outdated observation equipment was replaced for stable and high quality marine observation data. Port weather services to provide tailored information were extended to Pyoung-Taek Port in 2012. A smart application (http://marine.kma.go.kr) was developed to offer real time marine weather information for small vessels which have been unable to have the benefit of information services. Mobile text message service for fishers and other marine workers was launched in September 2012.

Issue 7 User-oriented smart weather services

Last December, the KMA revamped its Korean and English websites to enhance the public's accessibility to weather information. Simplified main page and weather page contributes to better delivery of information and map-based weather service was newly introduced. 7 day forecasts for the KMA website and weather app are issued on a 12 hour basis. A system for joint use of observation data from 26 agencies has been built with a view to strengthening decision-support in disaster prevention area.

Issue 8 Establish a Korean National Climate Data Center (K-NCDC) to share climate data across Korea

The project for establishing national climate data management and service system has continued for the 2nd year, which will be the foundation for a Korean National Climate Data Center (K-NCDC). The project enables QC for different algorithms, locations and factors by developing technology for quality control. This means that QC can be conducted on selected algorithm for certain locations and factors to produce various QC results. For advanced services, more locations, customized data and various applied services have been added. The KMA improved the web portal (https://sts.kma.go.kr) to allow users to enjoy easy and convenient access to such data.

Issue 9

Global Framework for Climate Services (GFCS)

The KMA established an implementation plan for GFCS to present the current international and domestic status of GFCS and KMA policy directions. As a part of efforts for national climate change response, regional meteorological administrations and special weather report stations have promoted regional climate information services. Meetings and workshops were organized to help climate change scenario users better understand the scenarios. In addition, the KMA has strived to develop regional, seasonal weather information contents and related technology.

Issue 10

Lead the meteorological cooperation in the international community, while strengthening weather diplomacy

The KMA has stepped up its involvement in the WMO management group activities by expanding the participation in the WMO EC and technical committees. While continuously strengthening the role of existing centres endorsed by the WMO in Korea, the KMA has also become the host of GISC Seoul. The KMA supported the modernization of weather services in developing countries through various projects such as capacity-building training in East Africa, a project to set up satellite receiving system in Lao PDR and the expert dispatch program for Mongolia, Vietnam and Uzbekistan. The KMA has also reached out to neighboring countries for cooperation by hosting meteorological cooperation meetings. For example, a meeting with Russia was held to facilitate the cooperation for vibrant exchange between regional meteorological administrations in both countries.

Issue 11

Ensure safety and efficiency for air navigation

Basic designing has started to replace more than 9 year-old airport meteorological radar in the Incheon International Airport to improve and enhance the capacity for HIW detection. Two LIDERs are being built in Kimpo and Jeju airports to detect wind shears which greatly affect the take-off and landing of aircraft. The KMA has worked on standardized data processing system and earmarked a fund for integrated aeronautical weather information system which unifies and automates the forecasting procedure of weather analysis, forecasts generation, dissemination in an efficient manner.

Issue 12

Monitor and respond to natural disasters through satellite observations

The KMA has worked out the Basic Plan for Stationary Weather Satellite to develop a next-generation satellite in preparation for the expiration of the current weather satellite. Research on the low-orbit weather satellite is in the pipeline. The KMA has been supportive of the development of precipitation estimate methods using satellite and algorithm to calculate the diameter of typhoons. Icing detection technology for aircraft has been enhanced. There has also been support for satellite data utilization technologies including development of satellite data preprocessing and meteorological factor production technology; calculation of high-resolution clear-air luminance to enhance numerical forecasts; sensitivity tests of sea ice/snowfall NWP models.

WEATHER STATUS IN 2012

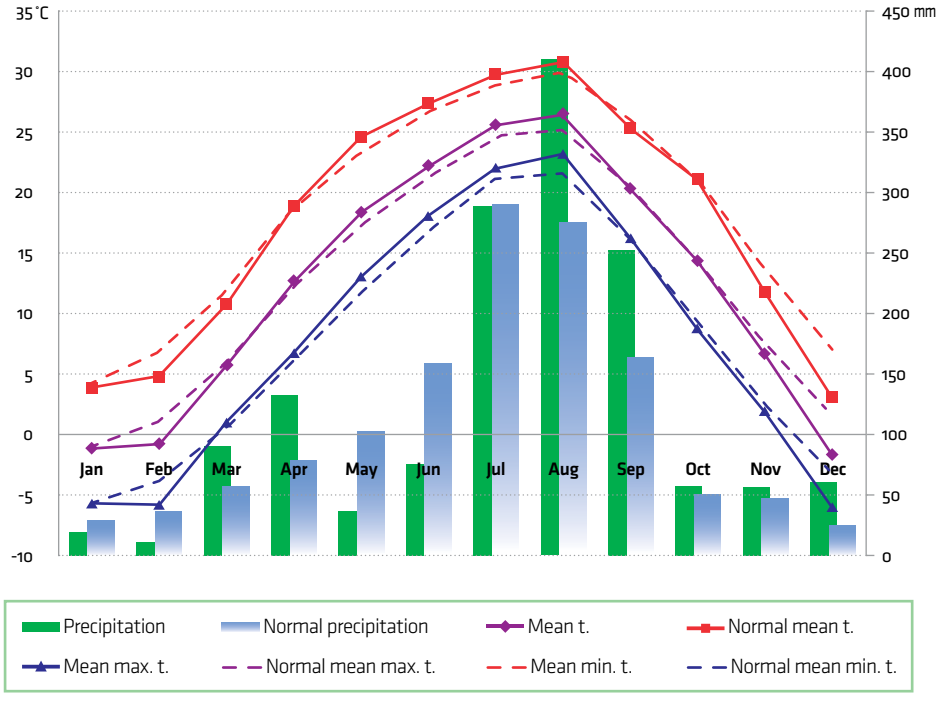
The annual average and the highest temperatures of the country stood at 12.3℃ and 17.6℃, down by 0.2℃ and 0.5℃, respectively, from normal years while the average lowest temperature was 7.8℃, up by 0.1℃. The average precipitation was 1478.9mm, 13% higher than usual. The number of days with more than 30mm in one-hour maximum precipitation was 2.5, 0.8 day more than usual while the number of days with more than 80mm daily rainfalls was 3.3, 1.0 day more than that of normal years.

Seoul's annual average temperature was 12.2℃, with its average highest of 16.7℃ and the lowest of 8.5℃, down by 0.3℃, 0.3℃ and 0.1℃, respectively, from normal years. The annual precipitation was 1646.3mm, 14% higher than usual and the number of rainy days was 110, 1.1 days more than usual. The number of days with more than 30mm in one-hour maximum precipitation was 4, 1.0 day more than that of normal years while there was no day with over 150mm in daily precipitation.

The unprecedented phenomenon in 2012 was that three typhoons such as Bolaven, Tembin and Sanba made landfalls on the Korean peninsula from late August to mid September.

By history, the long-term weather trend shows that the country and Seoul's average temperatures have continued to rise and the increase in the lowest average temperature is bigger than that in the highest average. The annual average lowest temperature for Seoul in the 2000s has greatly increased at 9.1℃ compared to 1.2℃ and 3.1℃ in the 1970s and 1920s, respectively. The annual average number of rainy days (30mm in one-hour maximum precipitation and more than 80mm in daily precipitation) in the 2000s increased by about 1.5 times nationwide and about 2~3 times for Seoul, compared with that in the 1970s. The annual average insolation duration decreased by 180 hours nationwide and 144.3 hours for Seoul when compared with that in the 1970s.

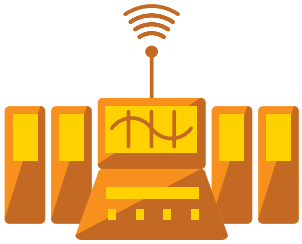
■ Monthly Average Temperatures and Precipitation in 2012 in Korea (45 areas)



NATIONAL METEOROLOGICAL SERVICES PROCESS

OBSERVATION

Conditions of sea and air are observed in three dimensions from sky, ground, sea and space.



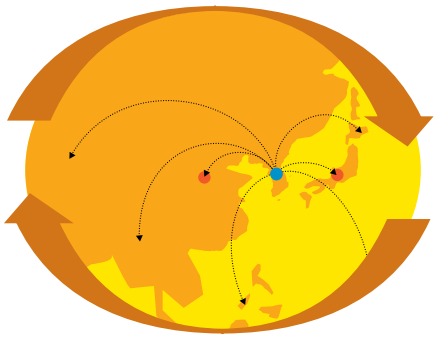
Production of NWP via Supercomputer

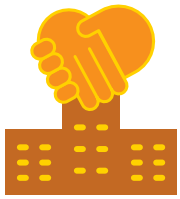
The third supercomputer in operation at the KMA produces NWP necessary for weather forecast by calculating numerical information only in one second, which requires about 600 million people for one year to complete the calculation.

METEOROLOGICAL TELECOMMUNICATION

Real-time Regional and Global Data Collection · Processing · Distribution via GTS

Nationwide meteorological agencies including the KMA are connected by meteorological communication network consisting of wired-only communication and satellite communication. Through the network, observation data are received and sent in the form of letters, numbers, voices and images rapidly and consistently. In addition, global meteorological data are collected, exchanged and then inserted into the KMA's supercomputer in real time through Global Telecommunication System (GTS).



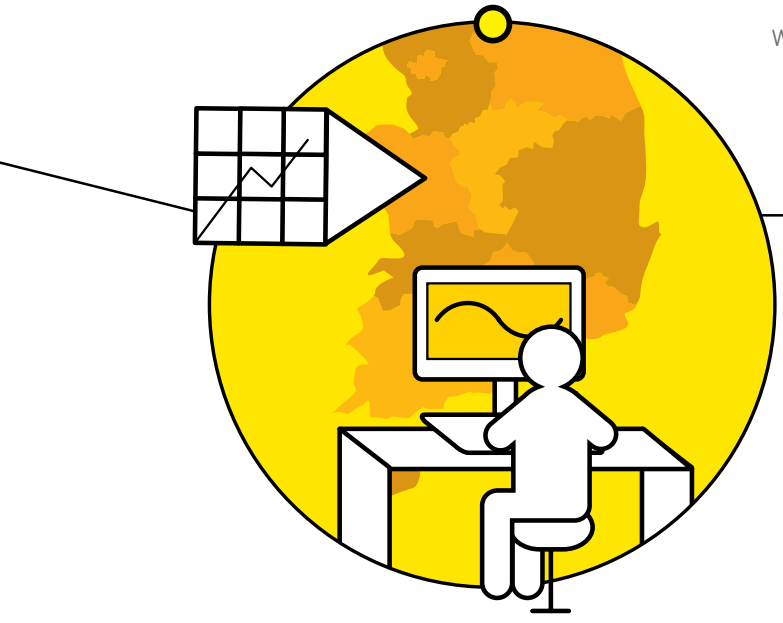


INTEGRATED AFFAIR

Government agencies, state-run institutions, research labs and universities collaborate and achieve new results.

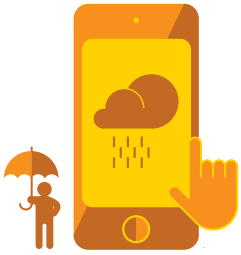
WEATHER FORECAST

Based on a number of regional and global observation data, current meteorological conditions and the result of NWP models along with expertise and experiences of forecasters, weather forecast is generated.



NOTICE

Weather forecast is provided via various media outlets, such as broadcasting, newspapers and the internet.

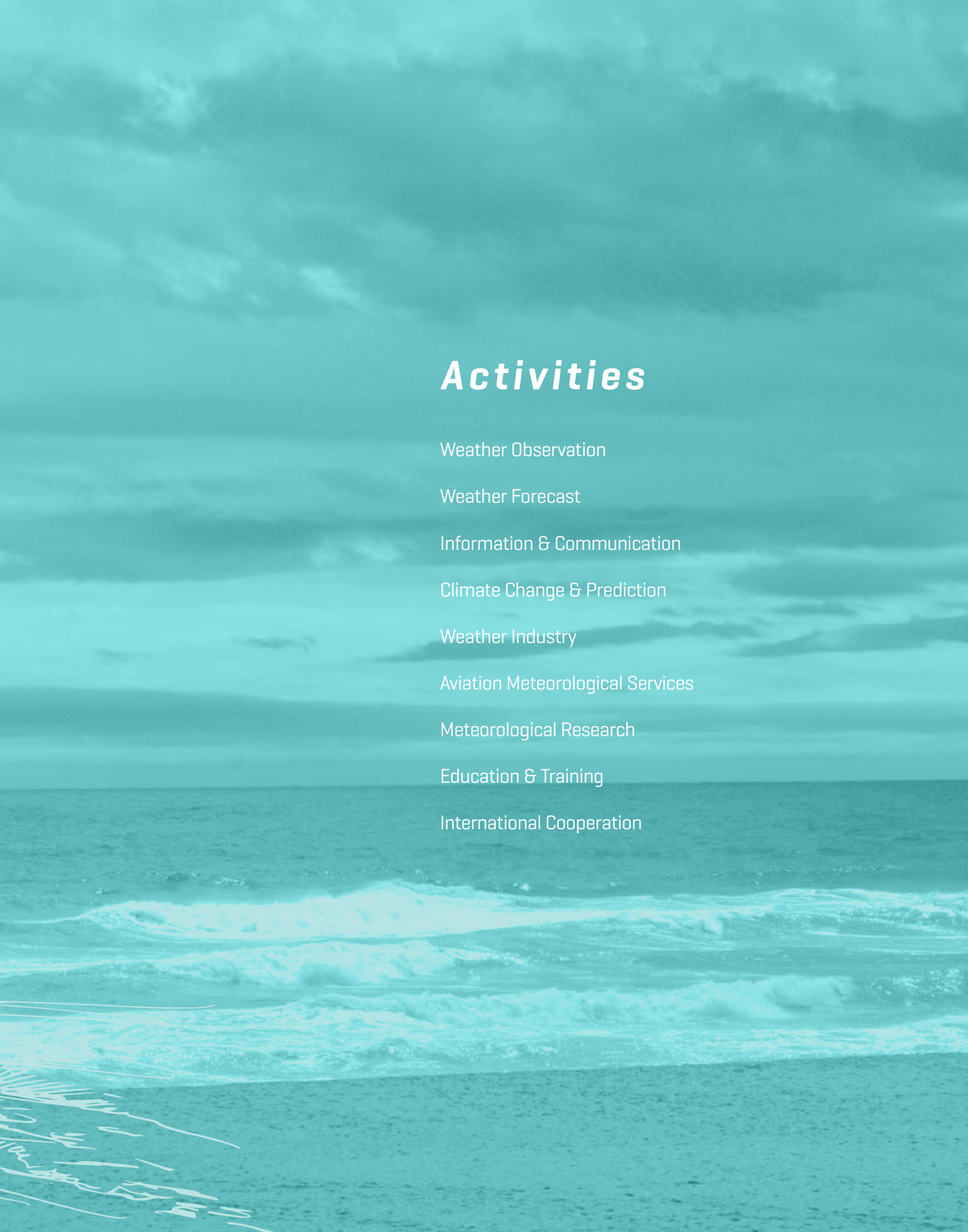


SERVICE

A variety of weather and climate services are offered for the health and the life of the public and industry.

INTERNATIONAL COOPERATION

The KMA transfers its improved meteorological technologies to developing countries and actively engages in weather and climate policies of the international community.



Activities

Weather Observation

Weather Forecast

Information & Communication

Climate Change & Prediction

Weather Industry

Aviation Meteorological Services

Meteorological Research

Education & Training

International Cooperation

WEATHER OBSERVATION

1 Surface Observation

There are two types of automatic surface observation networks operated by the KMA: ASOS network for synoptic surface observation and AWS network for monitoring severe weather. The KMA started to install ASOS at the synoptic weather stations in 1995 for the purpose of automation of surface observation, and now operates a total number of 80 ASOSs nationwide as of the end 2012.

The KMA set up the "Master Plan for the Enhancement of Automatic Weather Equipment" in March 2010 to produce high-quality of observational data by developing high-tech methods for automatic surface observation and automatizing observation elements that used to be measured with the eye. The KMA has completed the implementation of the Master Plan to replace the existing equipment with advanced ones for 197 sites, including seven ASOSs in 2012.

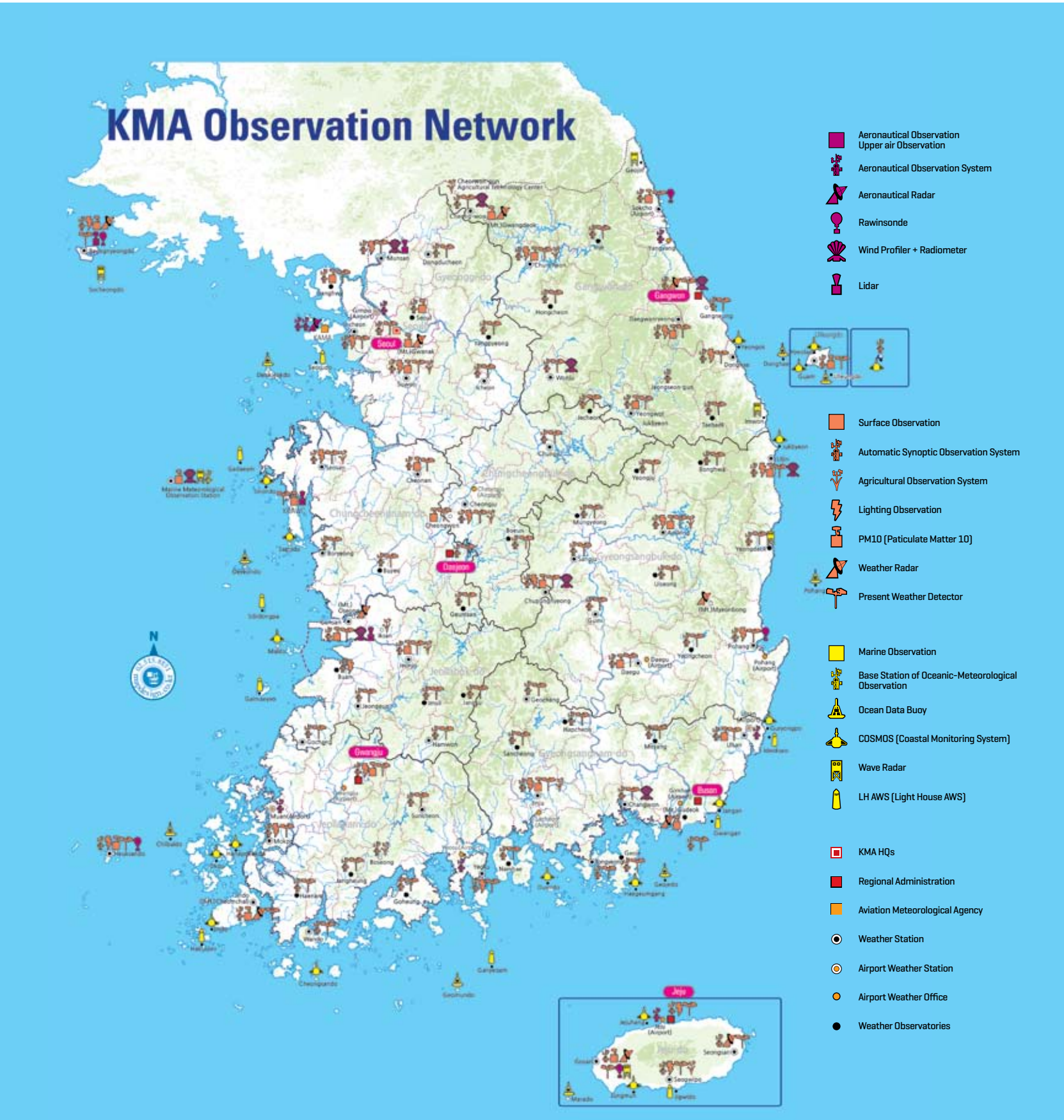
2 Upper-Air Observation

The KMA performs GPS-based rawinsonde observations. Currently, there are seven upper-air weather stations (Sokcho, Baengnyeong-do, Osan, Pohang, Gwangju, Heuksando and Gosan) registered in the WMO.

Beside the synoptic upper-air network, the KMA operates nine wind profilers to improve time and spatial resolutions of upper-air observation and nine radiometers to measure temperature and humidity of upper atmosphere. Using these instuments, the KMA collects vertical profile data of upper-air wind direction and speed, temperature, humidity every ten minutes from nine sites.

The KMA also participates in the AMDAR Programme and has been collecting aeronautical meteorological observation data since 2006 (currently, 14 planes from Korean Air and five planes from Asiana Airlines are taking part in the AMDAR project).

KMA Observation Network



3 Marine Meteorological Observation

Establishment of observation networks at sea in Korea started in 1996 by introducing and installing ocean data buoys. As of the end of 2012, 9 ocean data buoys, 9 lighthouse AWSs, 6 wave radars, 27 coastal wave buoys, 15 long-wave monitoring equipment, 2 port weather observation systems (including 3 wave buoys), 1 base station of oceanic-meteorology observation, 1 weather ship (498 tons), 3 ship AWSs and 7 drifting buoys are in operation.

Marine Weather Voice Broadcast Service

On 3 January 2012, Korea launched a marine weather voice broadcast service for vessels operating in Southeast Asian Oceans including Korea's coastal and offshore seas, East China Sea and West Kyushu Sea. The service is available without any additional cost since it is delivered through the existing communication equipment (SSB transceivers) of the vessels. By tuning the radio to 5,857.5kHz, vessels are able to use detailed weather information including marine forecasts, marine warnings and present weather in coastal areas. The service is provided 24/7, 365 days a year in Korean, English, Japanese and Chinese. In particular, voice broadcast immediately releases the news when marine preliminary special reports and special reports are issued so that vessels can promptly escape from the high impact weather and prevent accidents caused by it.

Marine Weather Mobile Web-Service and Text Message Service

The services allow users to access regional marine weather information in graphics, texts and voice. Users can check information such as real-time observation data, weather maps, satellite data, prediction data and ocean surface temperatures in graphics.

※ Without installing an application, the services are available by simply going to http://marine.kma.go.kr on smart phones.

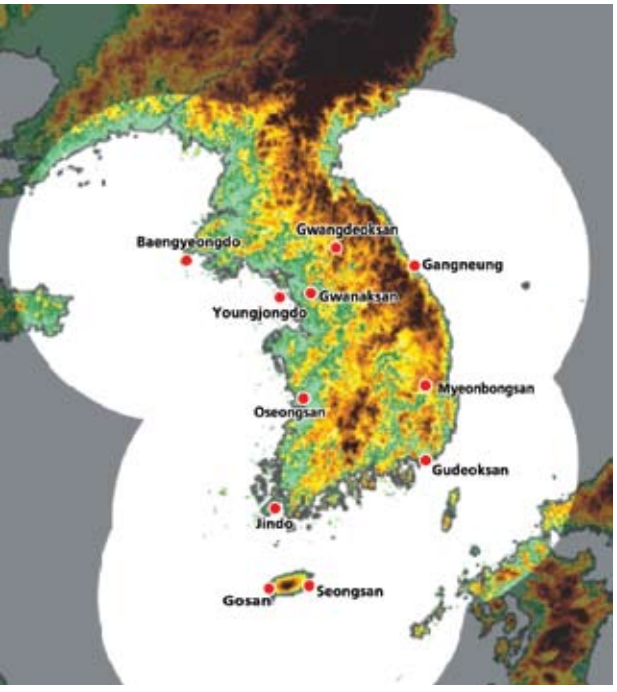
4 Asian Dust Observation

For smooth forecasting & warning services on Asian Dust, the KMA has operated BAMs (Beta Attenuation Monitors/PM_{10}) designed to observe the ground concentration of Asian Dust in 28 stations nationwide and LIDAR (Light Detection and Ranging) in four stations to measure vertical profile of Asian Dust.

The KMA is making real-time observations on Asian Dust through these nationwide solid monitoring sites, as well as performing regular inspections and calibration tests on observatory equipments for data quality advancement and stable operation of the monitoring sites.

In addition, the KMA is monitoring the Asian Dust in the source regions through the 'Hwangsa Monitoring Network' including the KMA-CMA Joint SDS (Sand and Dust Storm) Stations (Tongliao, Dalian, Huimin, Yushe, Jurihe, Siping, Dandong, Qingdao, Chifeng, Erenhot, Wulatezhongqi, Dongsheng, Yanan, Hami, Dunhuang in China) and the Dust Storm Monitoring Towers (Naiman in China and Nomgon, Erdene in Mongolia).

5 Weather Radar Observation

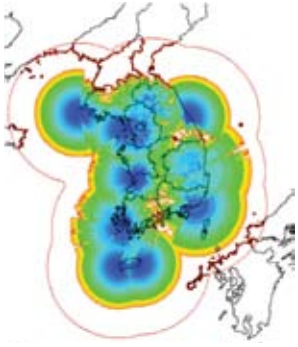
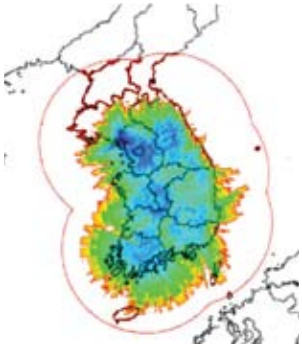
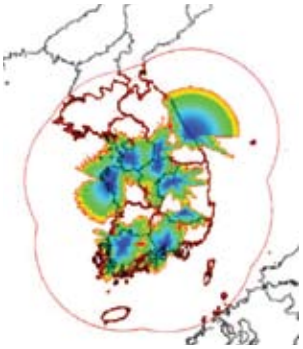
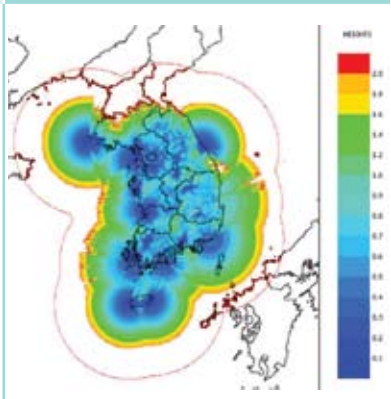


The first radar observation began with the installment of the first weather radar on Mt. Gwanak. Currently, there are 12 weather radars of eight S-band, three C-band and one laboratory X-band.

The most common weather radar in Korea is S-band which is considered the most suitable for observation of regional torrential rain and typhoon in the summer. The radar moves in the range of 0° at the lowest altitude angle to 24° at the highest, producing solid observation data of the atmosphere. The observatory data from the radar are reviewed through quality management process, used to provide radar-AWS's accumulated amount of rainfall and utilized as basic data for radar precipitation prediction/verification system and forecasting of dangerous weather conditions and other types of numerical figures.

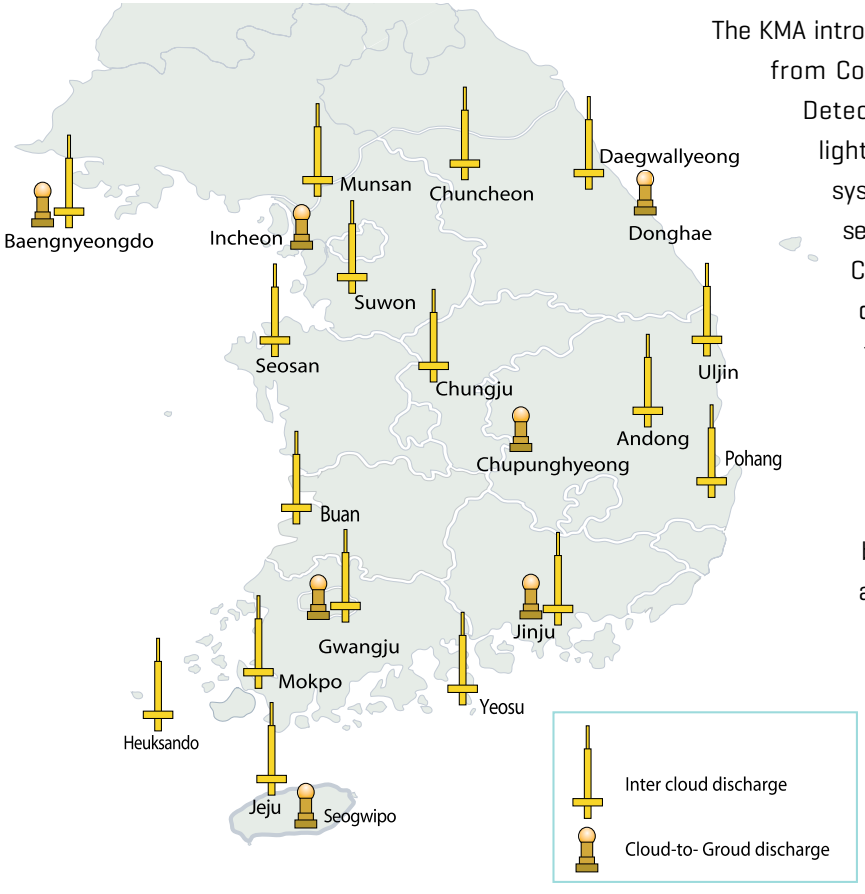
In 2012, the KMA laid a groundwork for an integrated radar network by setting up a data processing system to store and process radar data from 3 governmental bodies - the KMA, MLIT (Ministry of Land, Infrastructure and Transport) and MND (Ministry of National Defense). Major achievements in radar observation includes the development of surface wind and downburst algorithm through a research on the QC algorithm optimized for the Korean environment to produce radar-based wind data. To improve the radar rainfall estimation techniques, the KMA has analyzed technical causes of time and spatial errors of operating radar rainfall estimation system and improved rainfall type algorithm and bright band calibration algorithm to enhance the original technology of a new radar rainfall estimation system.

■ The Weather Radar Network

Before Joint Use of Radar Data (White areas: blind spots of each authority)			After Joint Use of Radar Data (Most of blind spots covered)
			
KMA	MLIT	MND	

6 Lightning Observation

■ Locations of IMPACT and LDAR



The KMA introduced and has operated the 'IMProved Accuracy from Combined Technology [IMPACT]' and 'Lightning Detection And Ranging system [LDAR]' to observe lightning and provide information on lightning. The system is composed of a group of spectrometers, seven IMPACT ESPs and 17 LDARs.

Current system is able to monitor ground and cloud discharge and has higher accuracy in finding the location of lightning by employing more improved composite method than Direction Finding. Real-time lightning information such as location, polarity and strength are displayed in various manners. As lightning tracking has become possible, a range of convenient services are available such as warning service to notify the approach of lightnings to high-risk areas. Such services are also of great use for monitoring high impact weather.

7 Meteorological Satellite Observation

Since a weather satellite, Chollian (COMS) started its operation on 1 April 2011, National Weather Satellite Center of the KMA has provided a regular broadcasting service (HRIT/LRIT regular broadcasting of the WMO standards for 2.2 billion people in 30 Asia-Pacific countries) through the satellite and has offered data service to 21 relevant groups including army, broadcasting companies and disaster safety organizations through ground network. Various channels including homepage and intranet Web are being used to enable users to have an access to satellite images and analyzed images in real time.

National Weather Satellite Center succeeded to develop CMDP using home-grown technology through industry-academia research collaboration in 2003 thereby producing not only information on weather events but also 16 kinds of weather·environment information including temperatures of sea and land surface. In April and August 2011, regular services for 10 products were launched and 4 additional products for operating services such as precipitable water, sea ice/snowfall, land surface temperature and clear air radiance and 2 products for research such as insolation reaching earth surface and aerosol optical depth have been produced since January 2012. CMDPS products are used for weather forecasts and HIW prediction while contributing to raising the accuracy of NWP models.

The Center also prepares for potential disasters and hazards which may result from space weather events in case of solar maximum and it sets about space weather service by using SOHO (Solar and Heliospheric Observatory) and SDO (Solar Dynamics Observatory) satellite data for the stable operation of COMS satellite. A legal ground for space weather forecast and warnings were laid by revising Meteorological Act in September 2011 which allowed the beginning of public service for space weather forecast and warnings.

A project to develop the next generation geostationary weather satellite took off in 2012 with the aim of launching a next Korean weather satellite in 2017 when the current COMS satellite comes to an end of its life. Two separate satellites, one for weather observation and the other for ocean-environment observation are under development. The weather satellite (GEO-KOMPSAT-2A) is expected to be launched in 2017 while the ocean-environment satellite (GEO-KOMPSAT-2B) in 2018.

COMS vs. GEO-KOMPSAT-2A

	COMS	GEO-KOMPSAT-2A
Channels	5	16
Spatial Resolution (km)	1/4 (VIS/IR)	0.5, 1/2 (VIS/IR)
Temporal Resolution (min)	25 (Full Disk)	10 (Full Disk)
Level-2 Products	16	~58
Data Rate (Mbps)	2.6	~70
Life time (years)	7	10
Main Purpose of use	Weather Forecasting	+ NWP + CM

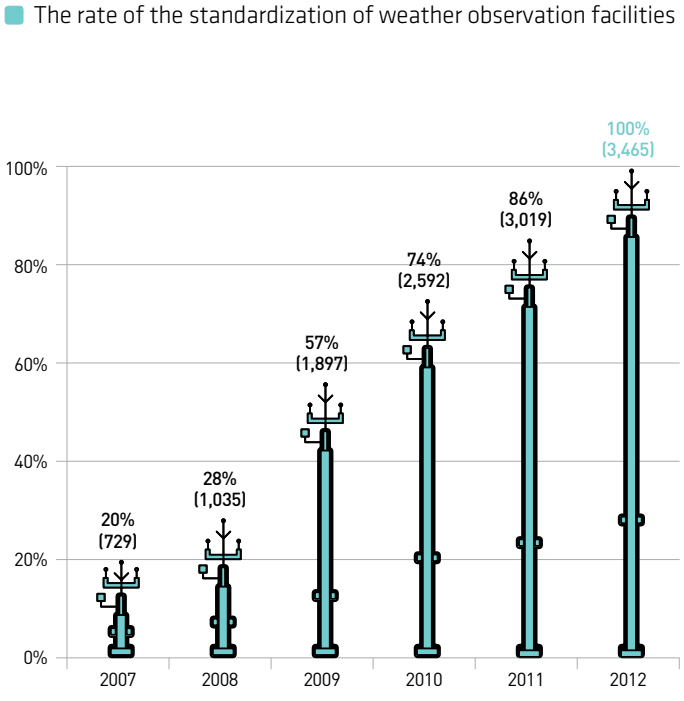
8 Global Atomosphere Watch

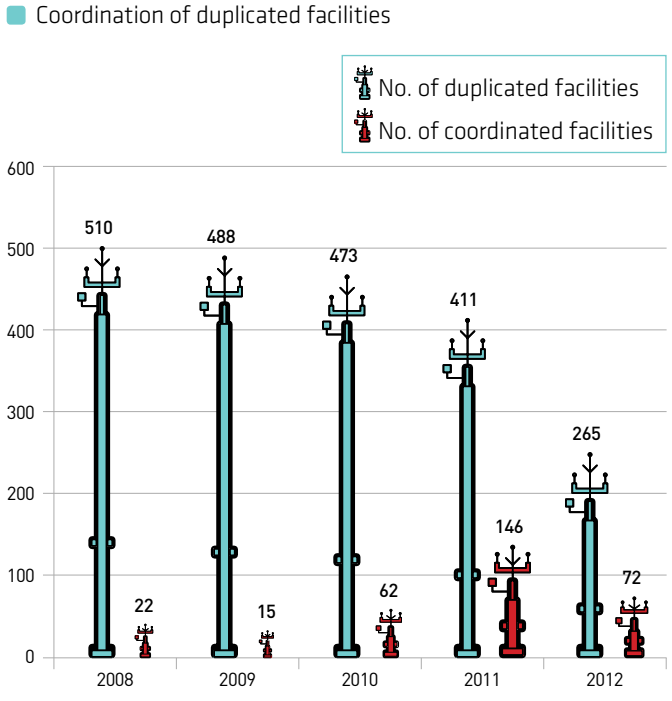
The KMA has been monitoring the global atmosphere since 1987 in order to actively support the government's efforts for establishment of policies on global environmental changes, and striving to provide and systematically manage a variety of global atmospheric monitoring data which help to objectively and scientifically understand climate change on the Korean Peninsula and the world. Currently, Korea Global Atmosphere Watch Center in Anmyeondo, a regional GAW station, is playing a pivotal role for monitoring the climate change in the nation by measuring 37 different kinds of parameters. In 2008, Jeju Gosan Station (JGS) was founded in Jeju and in 2013 the construction of Ulleungdo Dokdo Station (UDS) will be completed to make a triangular monitoring system on the Korean Peninsula.

Several weather stations also function as secondary climate change monitoring agencies. Among them, Pohang weather station observes ozone layers, total ozone, ozone vertical distribution and UV Radiation by installing observation instruments for ozone in the stratosphere and UV Radiation. The Mokpo weather station and Kangwon Regional Meteorological Administration were added to supplementary observatories for UV Radiation to monitor climate change.

The Standardization of Weather Observation Facilities

The KMA has pushed forward with the standardization of weather observation to facilitate the sharing of observation data since 2007 by improving the environment of observation facilities run by 26 observation organizations other than the KMA such as government agencies, local governments and public organizations and by eliminating the duplicated facilities. The rate of the standardization of weather observation facilities (The rate of facilities above standard) recorded 20% while as of the end of 2012, the rate reached 100% as 3,465 facilities of all 26 observation bodies (including KMA) were awarded an excellent grade. When facilities operated by other government agencies, local governments and public organizations were overlapped by those of the KMA within 1 km range, the location of such facilities were rearranged. 72 duplicated facilities were removed thereby avoiding investment overlap and the waste of budget.





Standard Weather Station

KMA's standard weather stations were designated as a Testbed (Boseong) and a Lead Centre (Chupungnyeong) by WMO in January 2012. The WMO came to a decision on the designation after the evaluation of as long as one year and four months since the 15th Session of the Commission for Instruments and Method of Observation (CIMO) in October 2010 where 18 weather stations in 9 countries, namely the United States, Italy, Switzerland, Finland, Turkey, German, Russia, the Netherlands and Korea expressed the willingness to host Testbeds and Lead Centres. The Testbed in Boseong is expected to serve as Centre of Excellence. A 300 m comprehensive weather observation tower will be built in 2013. Using the tower, the Testbed will carry out the development of integrated observation techniques in the face of HIW events; research on atmospheric boundary layer observation; and research to verify high layer data and data from remote control observation. Meanwhile, Lead Centre in Chupungnyeong is preparing for a range of experiments for comparative observation to fulfil its role to standardize the performance of weather observation instruments and to verify operating technology.

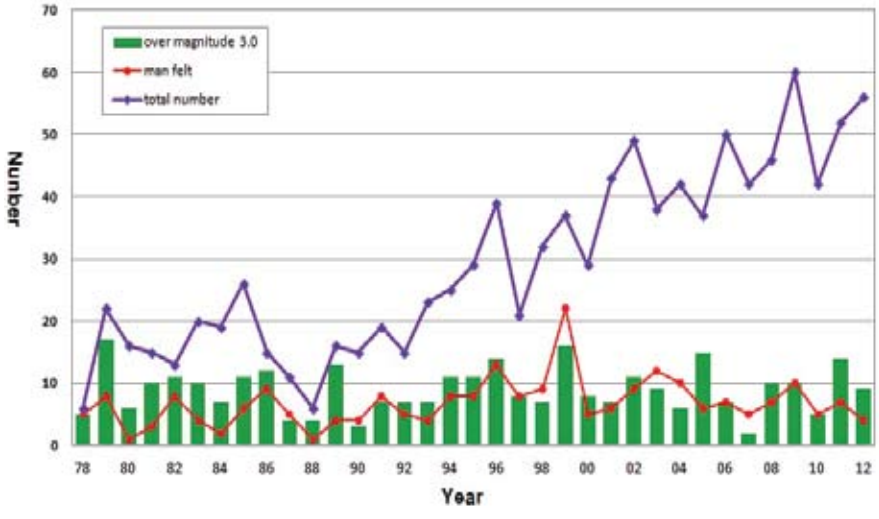
1) In 2012, the WMO CIMO designated 4 stations in Richard Assmann, Germany; Payerne, Switzerland; Sodankyla, Finland; and Boseong, Korea as a Testbed and 3 stations in Lindenberg, Germany; B. Castelli, Italy; and Chupungnyeong, Korea as a Lead Centre.

Earthquake Observation and Response

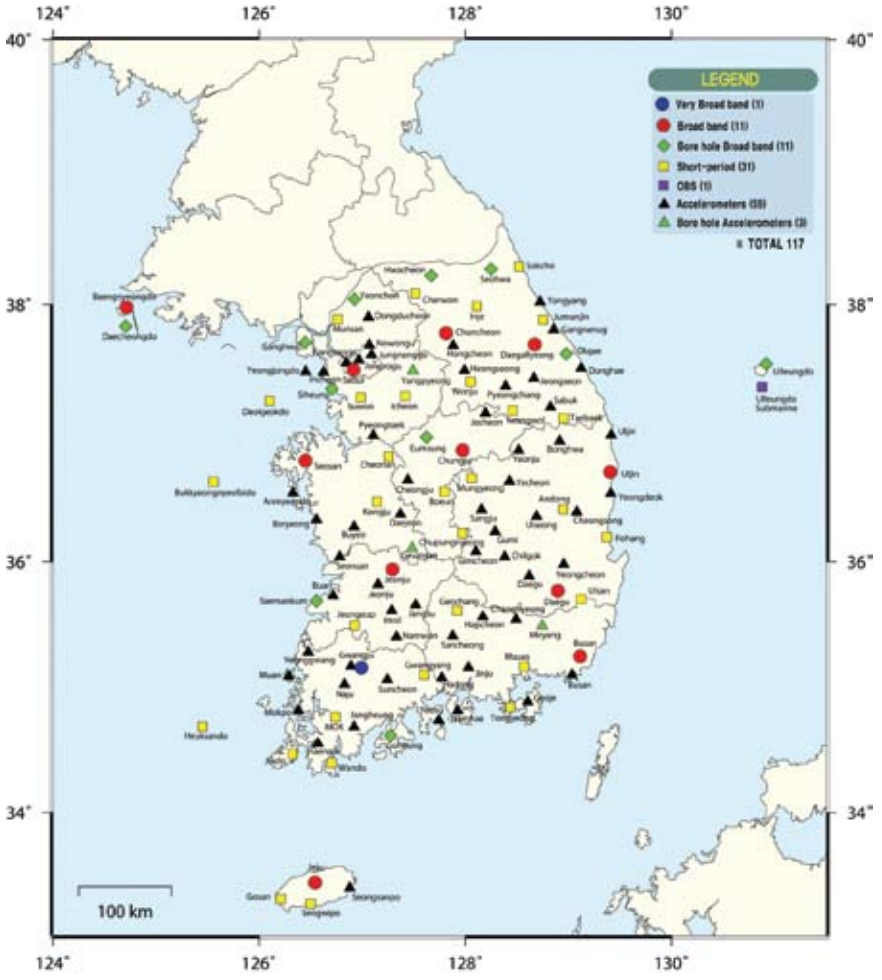
In 2012, 56 times of earthquakes over magnitude 2.0 occurred in and around Korea. Four of them are man-felt earthquakes, and a total of nine are greater than magnitude 3.0. Around 12:46 on 11 May, a magnitude 3.9 earthquake, being recorded at the highest of this year, rattled some windows and doors of houses in Muju and Namwon, the south-western part of Korea. The epicenter was located 5 kilometer ENE of Muju, Jeollabuk-Do Province. It was recorded an intensity of four in MMI around the center of earthquake and slightly felt by a few sensitive people in Daegu, Daejeon, and other places up to 200 km away from the epicenter.

An earthquake figure seems to show that the frequency of earthquakes has been increasing since 1990 when modernized seismological networks and analysis system began to operate in the KMA. However, the number of earthquakes which are felt by people and greater than 3.0 in magnitude remains unchanged.

■ The frequency of earthquakes



In order to expand a seismological network, the KMA has installed 10 additional borehole seismographic stations and replaced three old accelerometers with borehole types, operating a total of 127 seismic stations in 2012. In addition, one infrasound observatory was set up in Cheolwon, Gangwon Province. As a result, the KMA is operating two infrasound stations in Yanggu and Cheolwon and one geomagnetic observatory in Cheongyang to monitor and study earthquake precursors and geo-magnetism.



National Network of Seismic Stations

Earthquake warning messages are currently issued for a limited number of users within two minutes. Since 2011, the KMA has pursued a plan to develop the earthquake early warning system by 2015 which enables the dissemination of the earthquake warning to the public within 50 seconds after the occurrence of any inland earthquakes greater than magnitude 3.5. The plan will be carried out along with three other projects: projects for expanding national seismic networks, developing the earthquake early warning software and rapid earthquake information release system.

In order to cooperate with other countries, the KMA has signed an MoU with the Indonesian Meteorological, Climatological and Geophysical Agency (Badan Meteorologi, Kilmatologi, Dan Geofisika, BMKG) on 6 September and the Russian Regional Agency on 17 October. In particular, MoU with the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO) opened a way to sharing data from 7 seismic stations in countries around the Korean peninsula (3 in Russia, 1 in Japan, 1 in Thailand, 1 in Mongolia and 1 in Kazakhstan) and enhancing capacity for monitoring and analyzing large-scale earthquakes and tsunamis occurring around the Korean Peninsula and Asia. The KMA has also consolidated the tsunami monitoring system in the East Sea and the Asia Pacific by receiving tide level data from 22 sites managed by JMA.

WEATHER FORECAST

1 Weather Forecast and Warnings

The KMA releases warning, typhoon information or weather information to protect public lives and property when dangerous weather conditions such as heavy rain and typhoon are expected. The KMA also issues, Dong-Nae forecast (Digital forecast), 7 day forecast and one-month or three-month forecast, which are released on a regular basis to help the public enjoy their activities and work.

Very Short-range Forecast delivers information on 8 weather conditions including temperature, rainfall, rainfall types, relative humidity, wind direction, wind speed, sky condition and lightning and 4 predicted conditions including rainfall types, rainfall, sky condition and lightning possibility. The forecast is issued every hour to inform weather conditions for up to next 6 hours on the Korean Peninsula.

Dong-Nae forecast (Digital forecast), a weather forecasting service supporting people's lifestyle and activities, divides the whole country in grids of 5km x 5km and shows 12 elements for eight times a day at three-hour intervals, including temperature (per hour, maximum, minimum), forms and probability of precipitation, precipitation, snow, sky conditions, wind direction, wind speed, humidity and ocean wave height in a form of text, time-series and graphics.

7 day forecast provides information such as weather forecast, land and ocean conditions, maximum and minimum temperature and ocean wave height for six days from the day after tomorrow, twice a day.

One-month forecast predicts the trend of synoptic pattern, temperature and precipitation forecast on a 10-day basis.

Three-month forecast covers the trends of synoptic pattern, temperature and precipitation forecast on a monthly basis.

Warning is to inform or warn the public when serious disasters are expected due to weather conditions. Weather warning includes advisories and warnings, covering heavy rain, heavy snow, storm surge, typhoon, strong wind, wind waves, Asian Dust, dry weather, cold wave and heat wave.

2 Mid and Short Range Forecasts

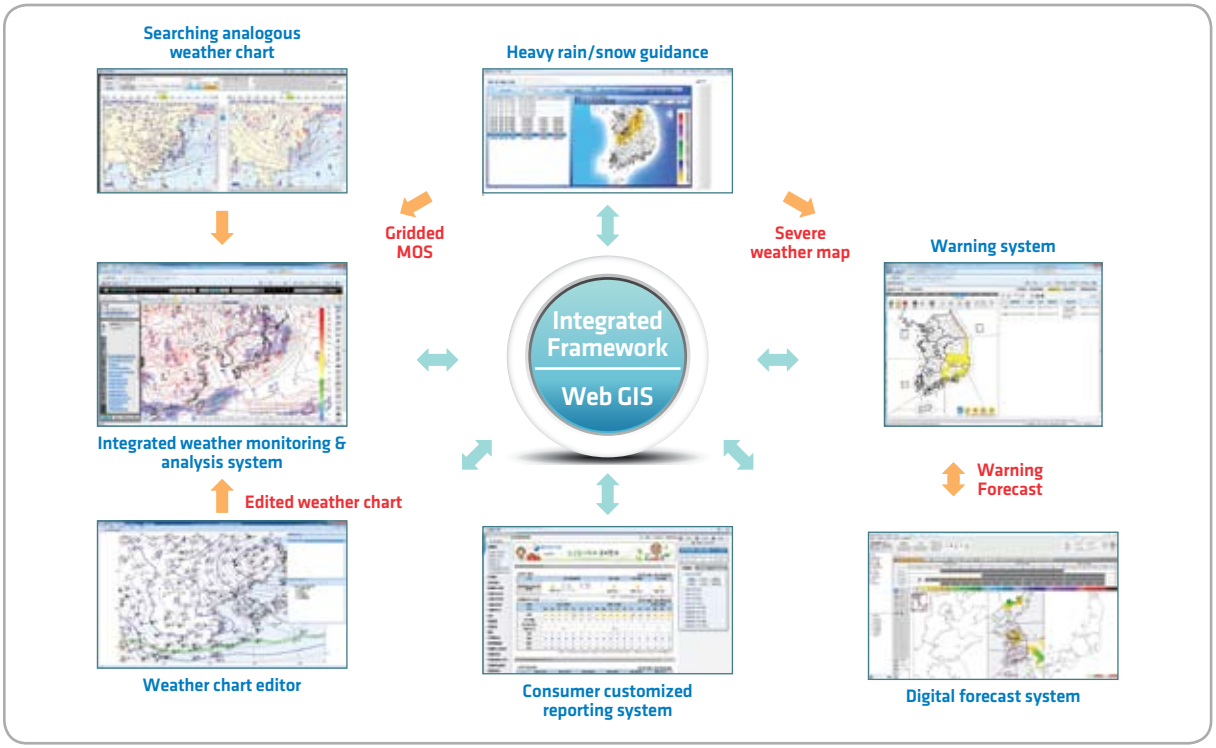
Needs for more specified forecasts such as forecasts for the week ahead have been on the rise for the information necessary for industries and activities during weekends despite the fact that forecasts for the week ahead are less accurate than short range forecasts. To meet such increasing needs, forecasts for the week ahead are now issued on a 12 hour basis (morning/afternoon) instead of previous 24 hour basis using a super-computer based prediction technology and a cutting-edge weather satellite data assimilation technology. The service has been provided twice a day (at 06:00 and 18:00) since 18 December, 18:00.

The forecasts for the week ahead are available on the KMA homepage, Disaster Prevention Weather Information Portal Service System, mobile Web and the KMA App. The service is expected to make weather information more useful.

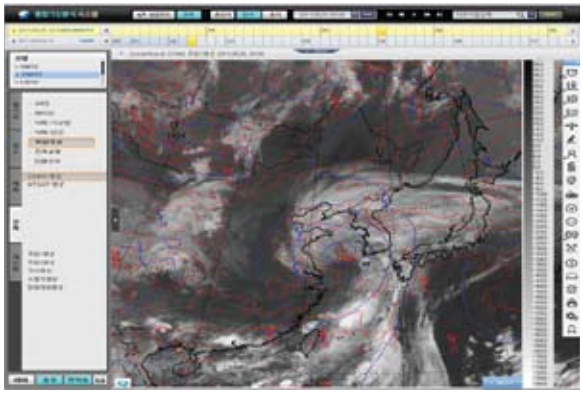
■ KMA Mobile Web

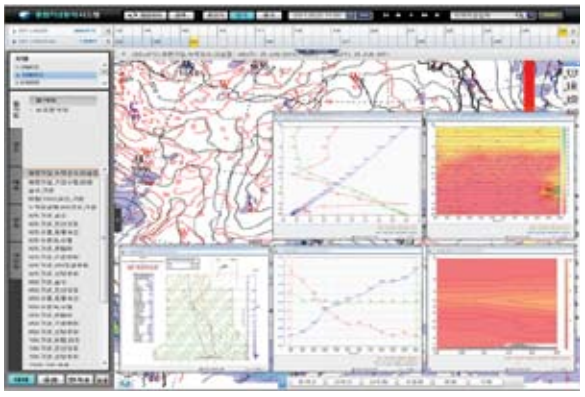
Establishing advanced forecasting system

The KMA has been undertaking a project to develop, improve, operate and distribute an advanced forecasting system since 2010. Through those projects, smart forecasting systems were developed and have been in operation. The system exclusive for forecasters is an integrated system that promptly handles weather monitoring and analysis, production of forecasts and warning, and delivery. In addition, the KMA has strived to seek more scientific and advanced forecasting technology, such as searching analogous weather charts, practical technology for severe weather map, and development of subjective forecasting guidance. Forecaster training system is being built, including training simulator for forecasters' situation awareness and response capability against high impact weather events. Training statements of basic, intermediate and advanced levels are also under development. Lastly, the KMA is operating or developing customer-oriented services, such as customized reporting service, mobile weather report and 3D-weather display programs.



Components of advanced forecasting system with Web GIS-based integrated framework





Integrated weather monitoring & analysis system is one of smart forecasting systems where weather data are monitored and analyzed at the same time. The system helps forecasters quickly and easily analyze forecasting-related weather data, such as satellite, radar, NWP models and observation data, through a number of tools and display.

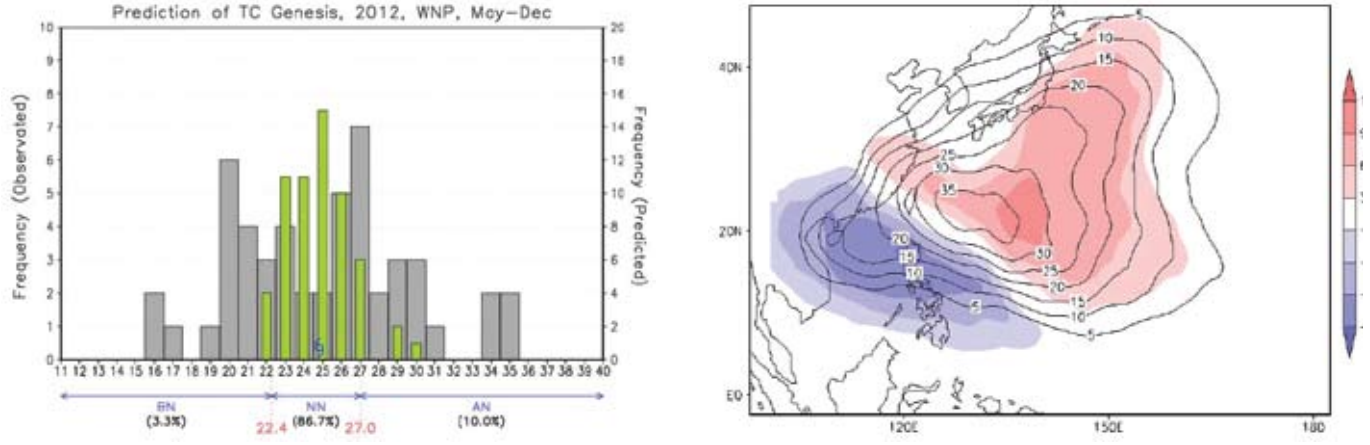
3 Typhoon Forecast

National Typhoon Center was established in Seogwipo City, Jeju Special Self-Governing Province in April 2008 to systematically and effectively respond to ever-growing typhoon disasters along with climate change. The center observes and forecasts all types of typhoons occurring in the northwest pacific region and all information on typhoon is promptly delivered to the public and disaster prevention centers. It employs satellites, radar, AWS and buoy to analyze weather and ocean conditions on a real-time basis and utilizes numerical model data to predict typhoon direction and intensity.

To ensure sufficient time for early detection of and response to typhoons, test-runs of 24 hour forecasts for Tropical Depression (TD) before the development of typhoons and after the weakening of typhoons in the Western North Pacific have been conducted 4 times a day (at 04:00, 10:00, 16:00 and 22:00) since May 2012.

During the period with high risk of typhoons (May-December), the center produces seasonal typhoon forecasts twice a year, one in May for summer season(June-August), the other in August for Autumn (September-November). The forecast is based on 3 prediction model data: NTC_KNU, NTC_COAPS and NTC_SNU. NTC_NKU and NTC_COAPS are used to predict the number of typhoons affecting Northwest Pacific and the Korean peninsula while NTC SNU is used to predict the path of typhoons.

Figure bellow shows the distribution of probability of typhoon frequency and path types produced by KTC_ KNU and NTC_SNU models and released in May. The center is implementing AOP 11-'establishing a web-based portal system to predict seasonal typhoon, one of annual operating plans of WMO Typhoon Committee. A prototype of portal system containing seasonal prediction information such as result of 3 models from Typhoon Center and ECMWF is under test run.



Typhoon genesis seasonal prediction from NTC_KNU system (left) and track pattern probability from NTC_SNU system (right).

Web-based typhoon seasonal prediction portal system prototype

4 Numerical Weather Prediction System

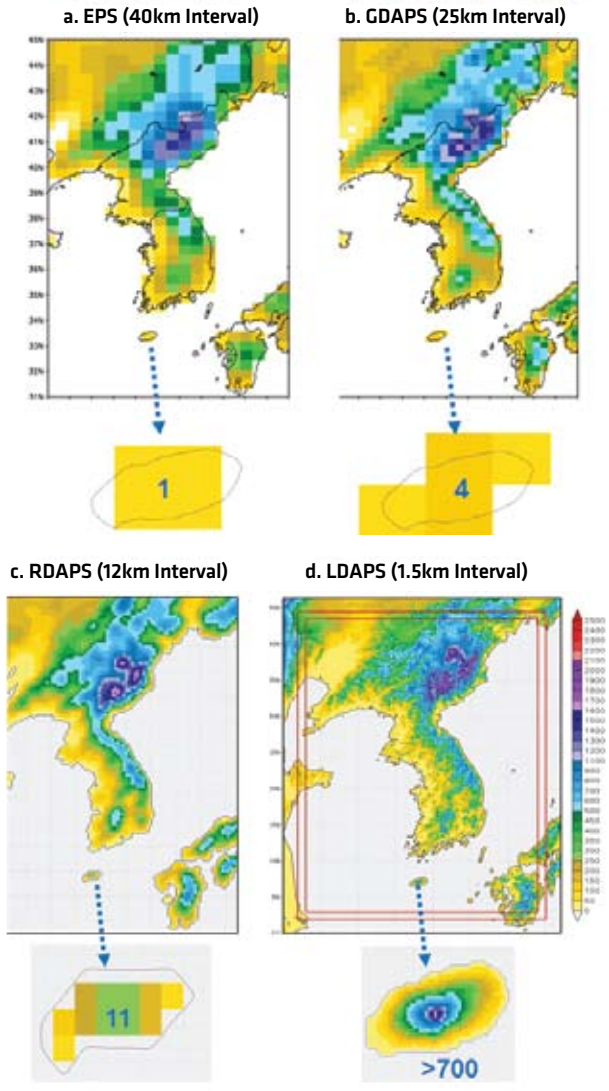
Current KMA's NWP system is comprised of Global Data Assimilation and Prediction System (GDAPS), Regional Data Assimilation and Prediction System (RDAPS), Local Data Assimilation and Prediction System (LDAPS), Korea Local Analysis and Prediction System (KLAPS) and various applied system derived from these systems.

The applied systems include wave models, statistic models, and typhoon models. Among wave models (WaveWatch-III, WWIII) are global, regional and local/coastal wave models while mid-term temperature model, 3 hour temperature model and Kalman Filter Model fall under the category of statistic models. Such models are operated once to 4 times a day depending on the subject of prediction and the results are immediately sent to forecasters to be used for weather services.

UM 1.5kmL70 became operational on 15 May 2012 to predict detailed weather conditions on the Korean Peninsula after a successful one year trial run and stability test. The model with 1.5km horizontal resolution, 70 vertical layers and the maximum level of 40 km provides 24 hour prediction data 4 times a day.

Local NWP model

In 15 May 2012, the KMA started to run local NWP models over the areas including the Korean Peninsula and some parts of China and Japan with 1.5 km horizontal resolution with a view to enhancing predictability of weather conditions (for example, surface temperature, wind, increase and decrease of precipitation according to topography) of areas where weather conditions are easily affected by surface and geographical features.

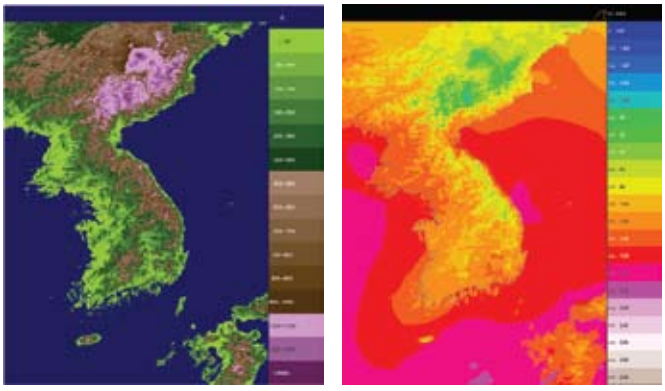


Topographical heights used by each model (a) Ensemble model (40 km), (b) Global (25 Km), regional (12 km), (d) local model (1.5 km)

The figure represents the topography of the Korean Peninsula reflected in respective model of Ensemble, global, regional and local models run by the KMA. The global model displays Jeju Island with four grid points while local model with 700 grid points making nearly real heights of the Halla Mountain reflected in the model. (d) covers the entire area of the local model.

Development and enhancement of forecasting guidance, using statistical models

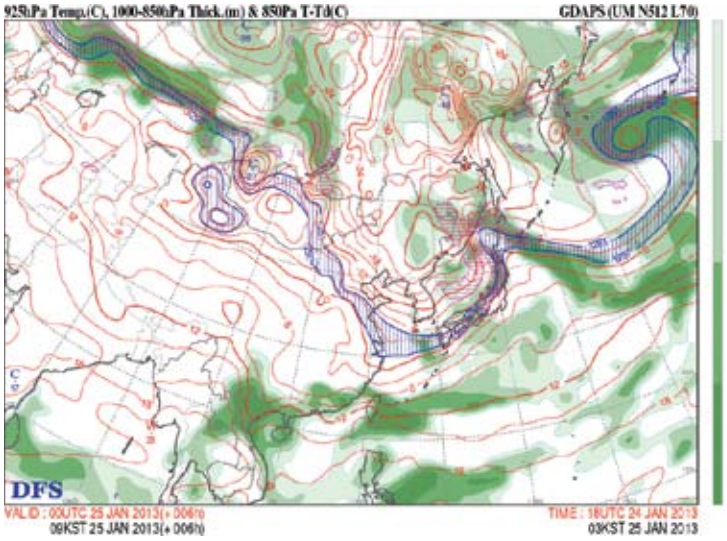
The KMA introduced a downscaling model from the United Kingdom Meteorological Office (UKMO) and developed a generic technology that enables the model to apply to Dongnae forecast (digital forecast). The downscaling model was implanted to the KMA's supercomputers and enhanced to be fit for Dongnae forecast in forecasting areas. Images bellow describe the surrounding areas of the Korean peninsula and temperature prediction data used in the downscaling model which helps predict detailed temperature in complicated terrain on the Korean peninsula. The KMA is planning to provide forecasting guidance for Dongnae forecast with conventional statistical models by developing downscaling models continuously.



Terrain in downscaling models (left) and case of temperature prediction (right)

Improved NWP graphic data

In 2012, NWP graphic data was enhanced to focus on weather phenomena and new guidance was included. Data for typhoon, heavy snowfall and strong wind forecasts were added. 7-day weather forecasts using ensemble data have been improved while various projects for international cooperation have taken place. To bolster international collaboration, a related homepage was upgraded and two new projects were launched on top of existing supports to 238 cities in 18 countries of RA II region. The KMA has undertaken SWFDP-SeA (Severe Weather Forecasting Demonstration Project in Southeast Asia) for 75 cities in 4 Southeast Asian nations and provided city-specific forecasts and NWP forecasts guidance on 71 cities in 10 East African countries. In order to vertically analyze the atmosphere, thickness was ameliorated and 1000-850 hPa thickness was newly introduced.



Geological thickness diagram over 1000-850 hPa

Website for international cooperation in NWP service.

INFORMATION & COMMUNICATION

1 COMIS (COmbined Meteorological Information System)

The COmbined Meteorological Information System (COMIS) is the KMA's core system for collecting, processing, storing and disseminating domestic and international data. This system enables objective and quantitative processing of weather data according to ever-changing data based on data analysis and numerical forecasting and it also made possible comprehensive analysis and application of different weather data such as synoptic weather, upper air, ocean and satellite data. COMIS consists of applications using web server, web applied server, relational database and large storage based on Blade Linux system.

In 2010's, a next era into COMIS-3 began. Among detailed activities promoted are advancing applied system to spur work efficiency and user convenience setting up consistent system through standardization of weather data exchange/processing; and improving IT infrastructure resource and operating environment.

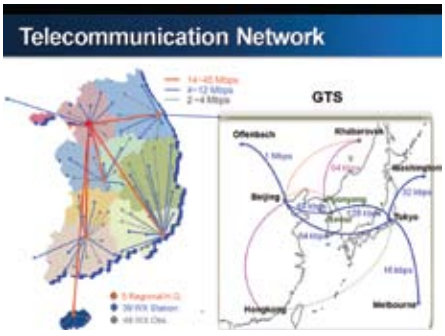
The project is composed of three phases (2011-2013). During the first phase (2011), analysis and designing were conducted. The second phase was to introduce necessary data processing resources, to collet and process data and to improve web portal. For the final phase, upgrade of infrastructure and ensuring continuity of works are planned to be promoted.

2 Meteorological ICT Network

To promote swift and reliable collection and exchange of data on surface, ocean, upper air, satellite, radar, earthquake, weather images and IP-based verbal information, the KMA operates its meteorological ICT network which connects 105 weather authorities including the KMA HQs through dedicated line and satellite communication. And it also runs the meteorological observatory network linking about 850 meteorological instruments nationwide in remote areas. In addition, the KMA exchanges global

meteorological data with the WMO through the Global Telecommunication System during committed time.

Domestic Interface



Telecommunication Network

3 Internet Services on Weather Information

The KMA has made a extensive renewal to its web interface to enhance its mobile weather services and to make it more convenient for users using touch screen. The KMA has offered mobile weather information to the public on mobile devices (http://m.kma.go.kr) since April 2011. The information available includes warning reports, current weather, digital weather forecast, weather images and various life weather indicies.

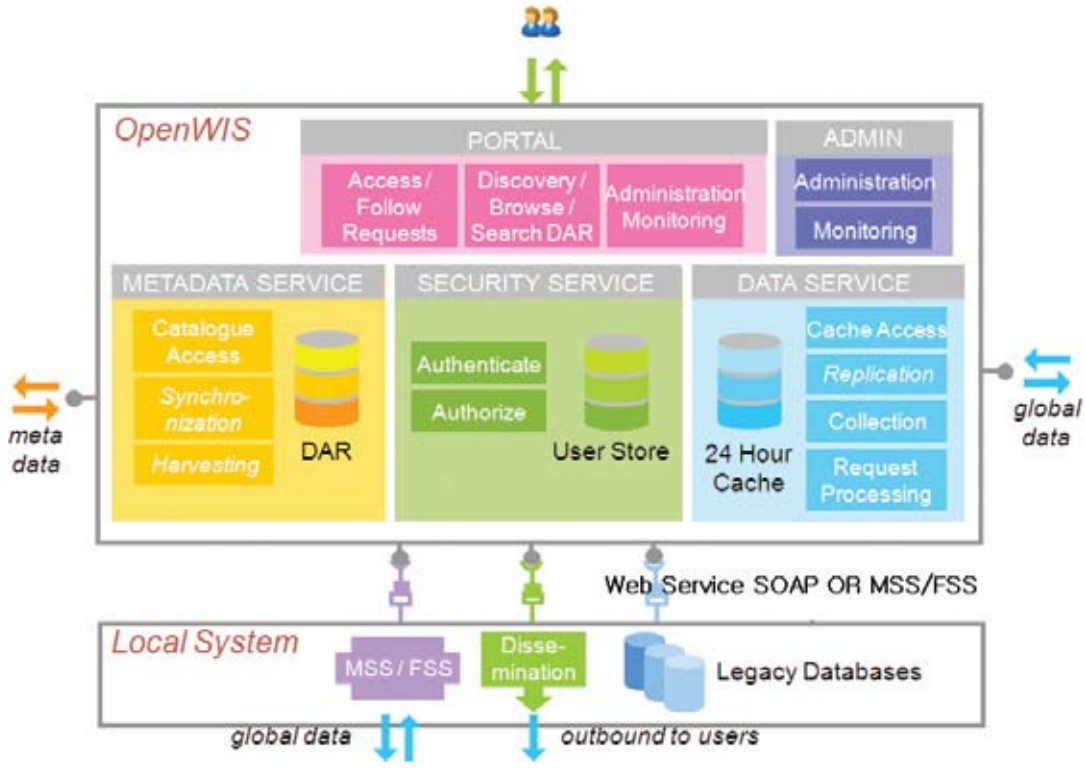
KMA's mobile web in English, Japanese, and Chinese

WINC [1] service for non-smart mobile phones is also available with consideration for information-marginalized individuals and socially unprivileded ones. Weather information can be accessed on mobile devices by simply keying quite a few number in.

4 WMO Information System (WIS)

Since April 2010, 5 agencies in 4 countries, Korea, UK, France and Australia have joined for OpenWIS project, an international joint project to develop WIS core software. With completion of the project in 2012, those agencies came to acquire key technology to operate GISC.

OpenWIS



The KMA has become the world's 6th host of GISC (GISC Seoul), a hub of collecting and distributing global weather data, which was endorsed by WMO in June 2012. Hosting GISC enabled Korea to establish an infrastructure of new paradigm to collect and provide weather/climate data in real time, which will help respond to climate change and support risk management regimes in major national policies.

1) WINC : Wireless Internet Numbers for Contents. It is serviced in Korea

CLIMATE CHANGE & PREDICTION

As part of efforts to provide customized hydro-meteorological information to enhance the monitoring and prediction capability, the KMA published "2011 Precipitation by River Basins" based on rainfall analysis by river basins in 2011 and released "weekly, monthly and seasonal precipitation statistics by river basins" for agencies responsible for water management and drought/flood prevention. It also offered "12-Hour Areal Precipitation Estimates for 26 Basins" through the Realtime Hydro-Meteorological Monitoring and Prediction Website on a trial basis. To establish the Drought Early Warning System to respond to climate change, the Administration provided drought information within the organization by utilizing "the Drought Early Warning System" which monitors and predicts meteorological and hydrological drought indices.

Having attended the 14th Session of the WMO Commission for Hydrology (Nov. 4-16, 2011, Geneva) to identify hydro-meteorological issues and enhance international cooperation with leading countries in the area, the KMA plans to introduce hydro-meteorological policies considering strategic priorities of the Commission for Hydrology from 2016 to 2019, and provide optimal hydro-meteorological information to minimize flood and drought demage.

The KMA and the NOAA have co-established and operated the WMO Lead Centre for Long-Range Forecast Multi-Model Ensemble (http://www.wmolc.org), in order to share global climate prediction information with other countries and improve climate prediction reliability by developing better prediction technology. The KMA, as a leading centre for long-range forecast of the WMO, develops standardization tools for global climate prediction data being produced from 12 WMO Global Producing Centres for LRF, contributing to sharing and exchanging high-quality global climate prediction data and enhancing climate prediction technology.

1 Climate Change Scenario

The KMA has been operating web-based climate change scenarios providing system through the Climate Change Information Centre since 2010 and has offered new scenarios since 2012 as a new scenario was introduced for the IPCC 5th Accessment Report. New scenarios are presented in higher resolutions than the old version so that they are more likely to be utilized in multiple areas. To enhance convenience for users, the web server has been scaled up and service has improved. The website offers diverse information including the globe (135km), Korean Peninsular (12.5km) and South Korea (1km) climate change scenarios, Climate Extreme Indices and applied climate information.

The KMA has focused on enhancing communication to broaden utilization of climate change scenarios. In April and September, the Climate Scenario User Council Meeting was held twice. On Oct 23, the National Climate Change Scenario Workshop was held to discuss various ways to utilize scenarios and to support government policy with government departments, local governments and research centres.

In particular, the KMA helped to utilize climate change scenarios in establishing climate change adaptation strategies of local governments in 2012. In July, the KMA set up the one-on-one system by assigning a Regional Weather Station for 16 local governments respectively and conducted a training on utilizing climate change scenario in establishing their adaption programs. Also, it published 「Guideline to Use the Web-based Climate Change Scenario Providing System」 (Feb) and 「2012 Climate Change Scenario Understanding and Utilization」 (Dec).

Production process of climate change scenarios

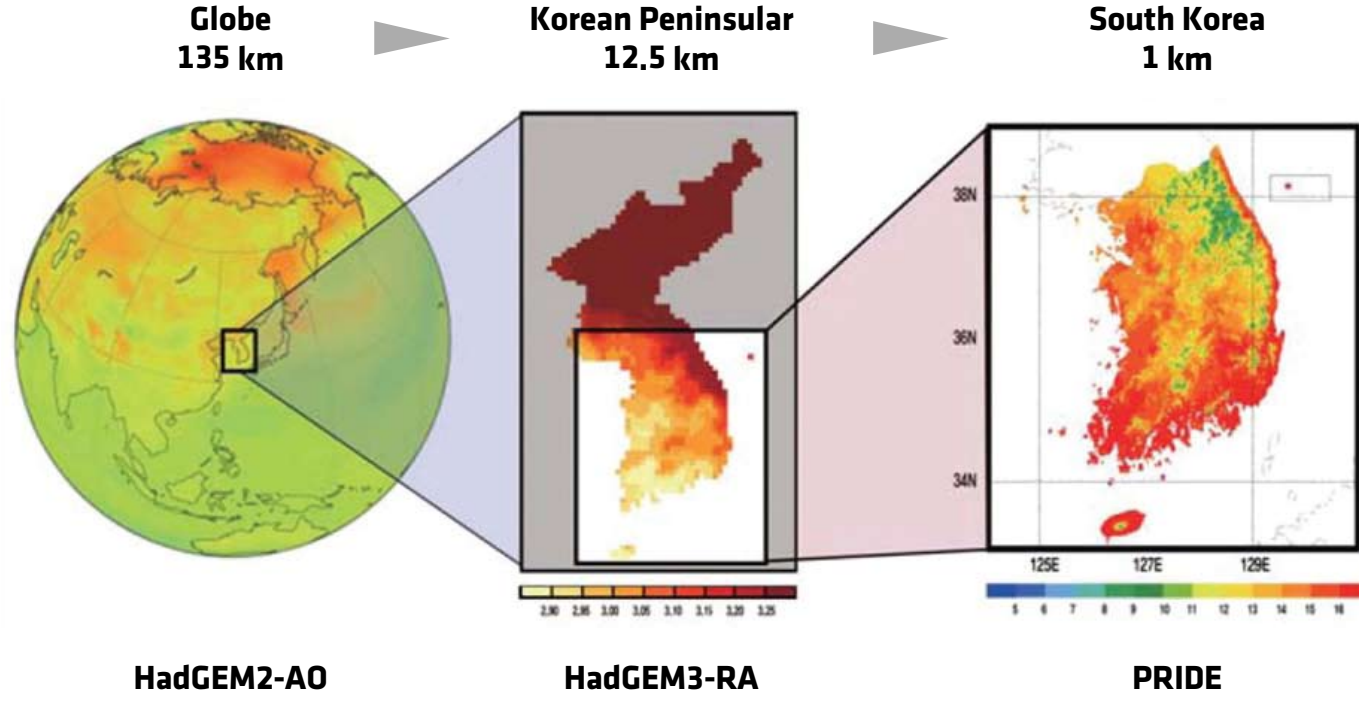


Table Information of provided web-based climate change scenarios

	Globe	The Korean Peninsula	South Korea	Extreme Climate Indices	Information for Administrative Districts
Scenario	RCP 4.5/8.5	RCP 4.5/8.5	RCP 4.5/8.5	RCP 8.5	RCP 4.5/8.5
Spatial Range	long.: 0~360 lat.: -90~90	long.: 111.0~144.625 lat.: 26.5~48.875	South Korea	South Korea	73 stations, 16 Metropolitan Cities and Provinces, 230 Administrative Districts
Time Range	1860~2100	1950~2100	2000~2100	2000~2100	Temperature, precipitation : 2000~2100 Relative humidity : 1950~2100
Spatial Resolution	about 135km	12.5km	1km	1km	-
Time Resolution	Monthly	Daily, Monthly	Daily, Monthly	Yearly	Daily, Monthly
Information	Temperature (Maximum, Minimum, Mean), Precipitation, Relative Humidity, etc.	Temperature (Maximum, Minimum, Mean), Precipitation, Relative Humidity, etc.	Temperature (Maximum, Minimum, Mean), Precipitation, Relative	Temperature Index (Tropical night, Heat wave, Frost, Ice, and Summer days, Growing season length)	Temperature (Maximum, Minimum, Mean), Precipitation, Relative Humidity, Surface and Sea Level Pressure, Mean and Maximum Wind Speed, etc.

2 Regional Climate Service

Recognizing the fact that the climate change impact varies from region to region and different strategies are required in different regions depending on seriousness of climate change, the KMA started Regional Climate Service Project in 2011. The project helps local governments respond to climate change, come up with counter-measures, protect the public from climate change-induced dangers and produce and provide customized, high-quality climate information, thereby boosting the local economy and achieving low carbon green growth.

To provide customized climate information required by local businesses, the KMA implemented 15 and 12 projects in 2011 and 2012 respectably by delievering climate change information to individual industrial sectors including agriculture, fisheries, manufacture and tourism. As a result, climate information was utilized in tangerine farming in Jeju Island, wetland in Jeolla Province, fisheries in Gangwon Province and special vegetables in Chungcheong Province on a trial basis and it will be more widely used after verification in each field.

Global Framework Climate Services

A High-level Task Force was formed to establish the Global Framework for Climate Services (GFCS) in 2010, and released a report to present the framework and implementation principals of the GFCS, which was adopted at the 16th WMO Congress (May 2011). The GFCS Implementation Plan was drafted through three times of GFCS Task Force Meeting and thoroughly reviewed at the 64th Session of WMO Executive Council (Jun. 25-Jul. 3, 2012).

The GFCS Implementation Plan, governance and budget for GFCS Secretariat were approved at the WMO Extraordinary Session on GFCS (Oct. 2012) and the Plan will used as a guideline for individual countries to establish the GFCS.

While actively participating in international efforts to build the GFCS such as drafting the WMO GFCS Implementation Plan and engaging in Task Team Activities, the KMA has consolidated the foundation for new climate services by developing a Execution Plan to become a leading country in meteorology (Jul. 2012) and conducting a feasibility study on setting up the GFCS (Dec. 2012).

The KMA-NOAA Collaboration to Support a Training Workshop for Developing Countries

The KMA and NOAA jointly sponsored a training workshop for developing countries on climate variability and change (the 4th International Training Workshop Climate Variability and Change) held in San José, Costa Rica on 7-17 August, 2012.

ROK-US Joint Workshop on Climate Variability and Prediction

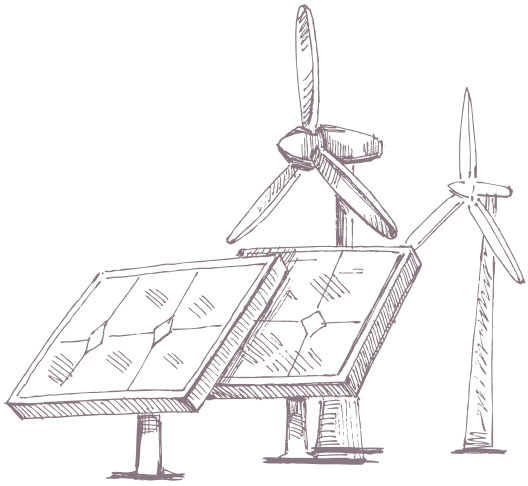
The workshop consisted of four sessions: Session 1 Global Annual Cycle and Monsoons, Session 2 Intra-seasonal and Inter-annual Modes of Variability, Session 3 Diagnostics and Predictability and Session 4 Climate Predictions, Applications and Services. The KMA made contribution to the workshop by sending Korean experts in climate monitoring, predictions and climate services. The experts offered lectures and practice programs on MME theory, the application of the WMO LC data and climate information services.

The KMA will continue to support training programs to help enhance climate prediction capability of developing nations in cooperation with NOAA. The KMA is also planning to expand support to help develop capacity of developing nations in adaptation and reducing vulnerability to climate change.

3 National Climate Data Management and Service System

The KMA established an independent National Climate Data Management and Service System and began to provide quality climate data for the public in 2011, and enhanced quality and reliability of national climate data and expanded service for the public by allocating 4.2 billion won in the 2nd Phase Program (Mar. 26-Nov. 21, 2012).
The KMA improved the system to enhance consistency of climate data by linking with other systems and optimized DB to utilize diverse climate date. It also developed a systemic quality control procedure (quasi realtime - non realtime - periodical verification) with 16 quality control algorithms to improve accuracy of the data while developing and implementing quality verification tools by utilizing distribution contour, image data and time series data of the surrounding area.

WEATHER INDUSTRY



1 Service Improvement and Expansion on Weather Information for Daily Life

To meet the demand for weather information related with the public safety and health, the KMA has continued to develop and improve public health weather indices, ranging from asthma·stroke indices in 2004 to enhanced cold index in 2011. In 2012, the four public health weather indices such as cold index, asthma·lung disease indices, stroke index and skin disease index were offered even to rural areas (town, villages and counties). Based on the advice and recommendations of medical and statistical experts, the KMA made efforts to provide more accurate and useful public health weather indices by enhancing the calculation methods. The KMA produced six (6) new PR videos that contain professional explanation on six major indices (ultraviolet index, discomfort index, food poisoning index, sensible temperature, cold index and pollen concentration index) to make the public better understand weather information for daily life.

2 Standardized Market Size of Weather and Climate Industry

Even though weather and climate industry has accelerated its integration with a variety of fields, it is generally underestimated since the estimation deals with only sales of weather businesses. Thus, the industry needs to be redefined in terms of market size of weather and climate industry. The market size is the total amount generated directly from weather and climate information and includes weather information distribution, weather finance, weather-related R&D and sales from other relevant industry in the sales of weather businesses. The market size in 2012 increased to KRW 321.6 billion, up by 44% (KRW 98.4 billion), compared to that in 2011 (KRW 223.2 billion). The sales increased to KRW 166.3 billion, up by 55.6% (KRW 59.4 billion), compared to that in 2011 (KRW 106.9 billion). Overall, the market size of the weather and climate industry exceeded KRW 300 billion for the first time.

3 Expanded Recognition on Weather Information

The KMA is operating the weather management certification system and Korea's weather information award to promote the use of weather information by the public and to raise the public's awareness on the economic value.
The weather management certification is granted to companies (institutions) whose sales do not exceed 20% among the total sales for creating added values by using weather information in their management and for acquiring safety from natural disasters. In 2012 when the system started, 43 businesses (institutions) were granted the certificate and 15 people from 10 businesses (institutions) received customized training for two (2) days.

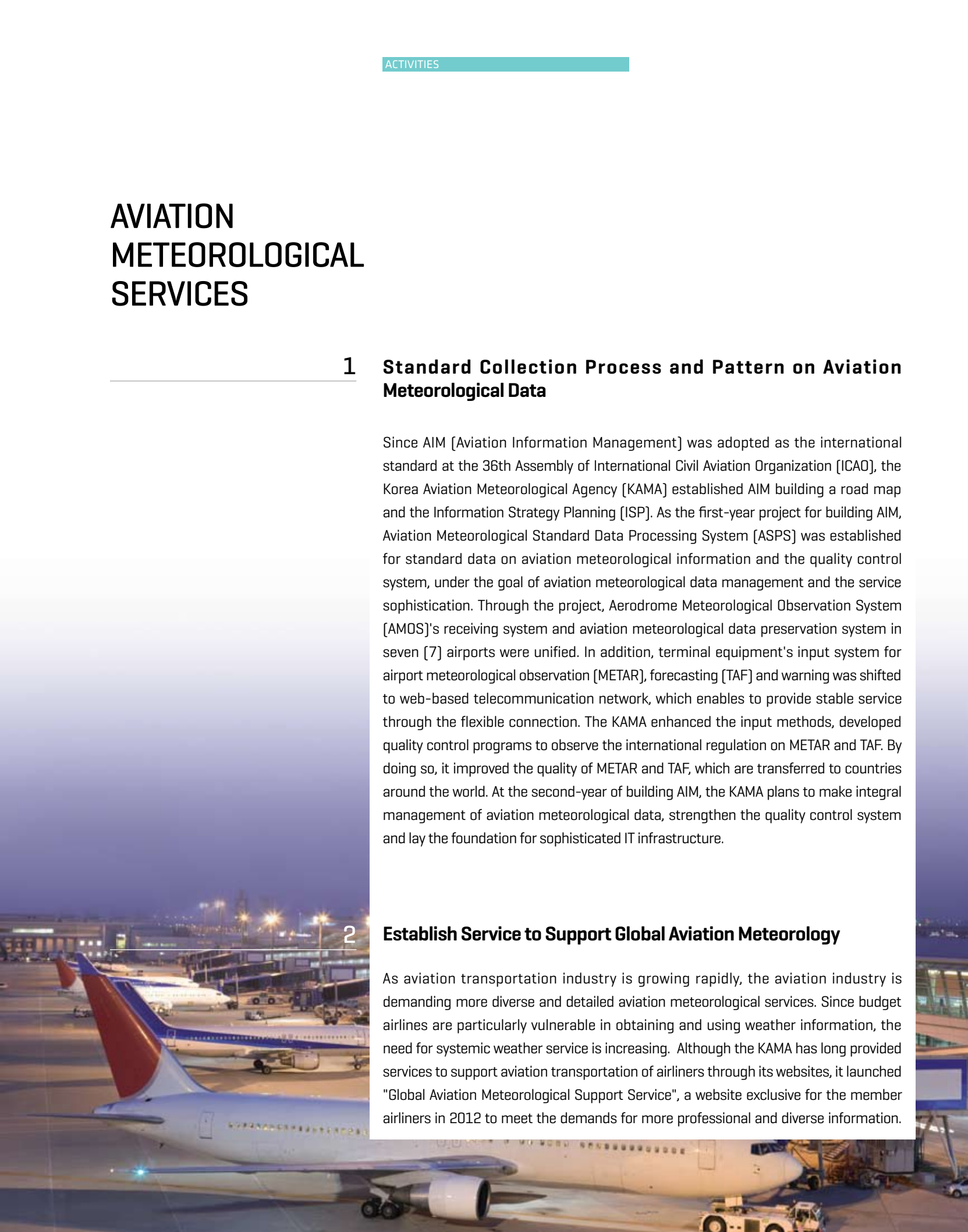
4 R&D Investment to Enhance Technology of Weather Industry

By acquiring KRW 3.274 billion budget in 2012, the KMA designated and supported 27 different research tasks such as Weavigation service technology for smart devices, expanded the range of use in the weather information service and laid the foundation to enter into overseas market by developing automated visual observation equipment and core technology of weather observation equipment. Through the operation of four task-research groups such as task-research group on weather robot development, the KMA found out 20 new preliminary tasks that have high potential to commercialize. With the help of the Korean Intellectual Property Office, the KMA implemented survey on the trend of patent technology in six research tasks at development·application stages to discover tasks that the KMA can preoccupy in core and source patents.

AVIATION METEOROLOGICAL SERVICES

1 Standard Collection Process and Pattern on Aviation Meteorological Data

Since AIM (Aviation Information Management) was adopted as the international standard at the 36th Assembly of International Civil Aviation Organization (ICAO), the Korea Aviation Meteorological Agency (KAMA) established AIM building a road map and the Information Strategy Planning (ISP). As the first-year project for building AIM, Aviation Meteorological Standard Data Processing System (ASPS) was established for standard data on aviation meteorological information and the quality control system, under the goal of aviation meteorological data management and the service sophistication. Through the project, Aerodrome Meteorological Observation System (AMOS)'s receiving system and aviation meteorological data preservation system in seven (7) airports were unified. In addition, terminal equipment's input system for airport meteorological observation (METAR), forecasting (TAF) and warning was shifted to web-based telecommunication network, which enables to provide stable service through the flexible connection. The KAMA enhanced the input methods, developed quality control programs to observe the international regulation on METAR and TAF. By doing so, it improved the quality of METAR and TAF, which are transferred to countries around the world. At the second-year of building AIM, the KAMA plans to make integral management of aviation meteorological data, strengthen the quality control system and lay the foundation for sophisticated IT infrastructure.



2 Establish Service to Support Global Aviation Meteorology

As aviation transportation industry is growing rapidly, the aviation industry is demanding more diverse and detailed aviation meteorological services. Since budget airliners are particularly vulnerable in obtaining and using weather information, the need for systemic weather service is increasing. Although the KAMA has long provided services to support aviation transportation of airliners through its websites, it launched "Global Aviation Meteorological Support Service", a website exclusive for the member airliners in 2012 to meet the demands for more professional and diverse information.

Along with the conventional aviation meteorological information, the Service provides NWP data such as vertical time series in the global airports and customized integrated checks on aviation meteorology by flight. The Global Aviation Meteorological Support Service is scheduled to start its operation in April after the test operation and the users' reviews by March in 2013.

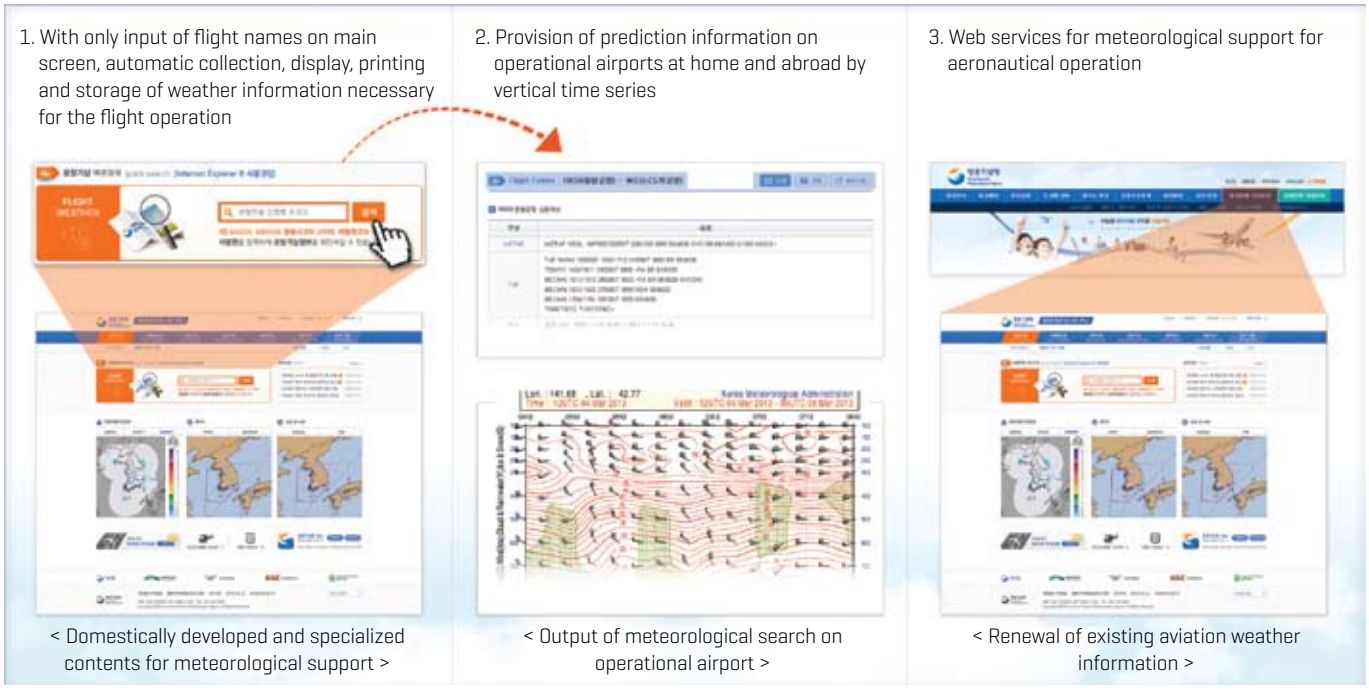


Diagram of Global Aviation Meteorological Support Service and its Website

3 Support Modernizing Aviation Meteorological Service in Mongolia

The KAMA's delegation visited the National Agency for Metrology and Environment Monitoring of Mongolia (NAMEM) and the Aviation Meteorological Center (AMC) for three days from 1st to 3rd August in 2012 to support the modernization of aviation meteorological service and to enhance the relationship between the KMA and NAMEM. During the visit, the KAMA's staff explained the modernization project, which will be implemented in 2013, and conducted a field survey. Introduction of quality control system, a standard recommendation by ICAO, was urgent in the Mongolian aviation meteorology. To address this issue, KAMA secured budget in 2012 to support projects for developing countries such as introducing QMS and setting up a system to receive information from World Area Forecast System. The projects will be consecutively undertaken from 2013 to 2016.

METEOROLOGICAL RESEARCH

1 Very short-term forecasting technique

In order to improve the accuracy in predicting the very short-range digital forecast, NIMR have developed new current weather analysis technique in KLAPS. A method was to compute combined precipitation (CP) for analysis of high resolution precipitation in Korea. The result has been adopted in operation of digital forecast service since 2 February 2012. Extending Automatic Weather System (AWS) coverage and more secure data transfer methods minimized uncertainties in ocean and North Korea which are mainly caused by lack of observations and low quality PPIO of radar. More reliable data enabled us to produce re-analysed information in high resolution (Spatial resolution of 5km in every hour for the past 6 years, from 2006 to 2011). The CP in conjunction with Korea Local Analysis and Prediction System (KLAPS) yielded its type in three categories (snow, rain and mixed) as in the same spatial and temporal scale as CP.

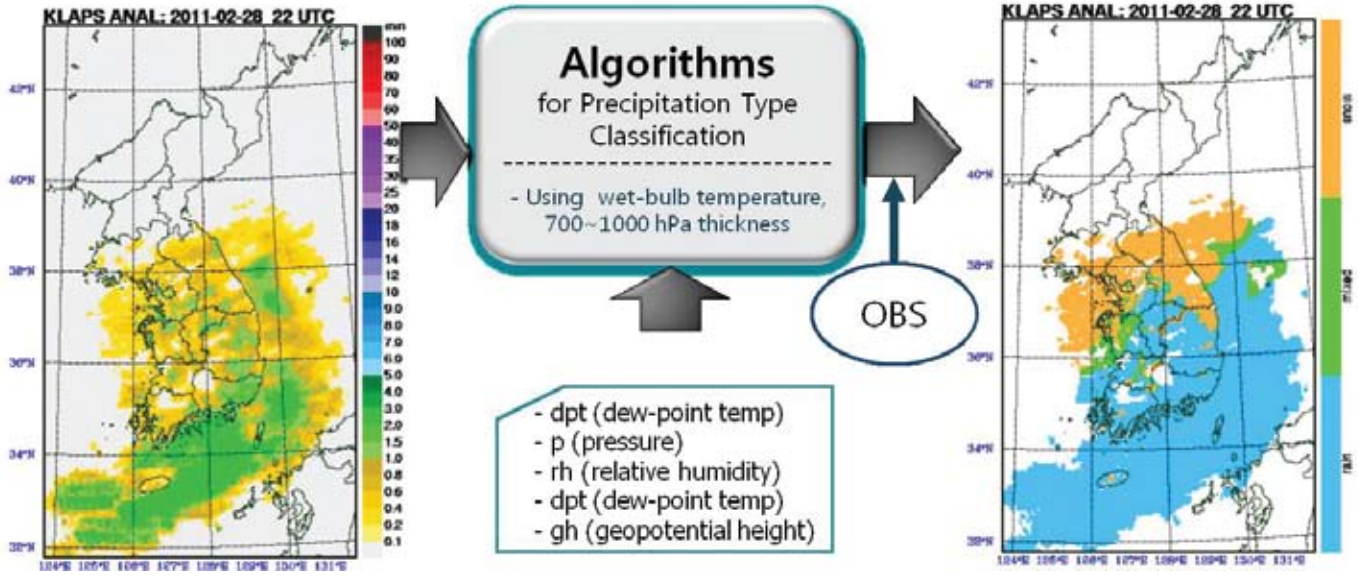
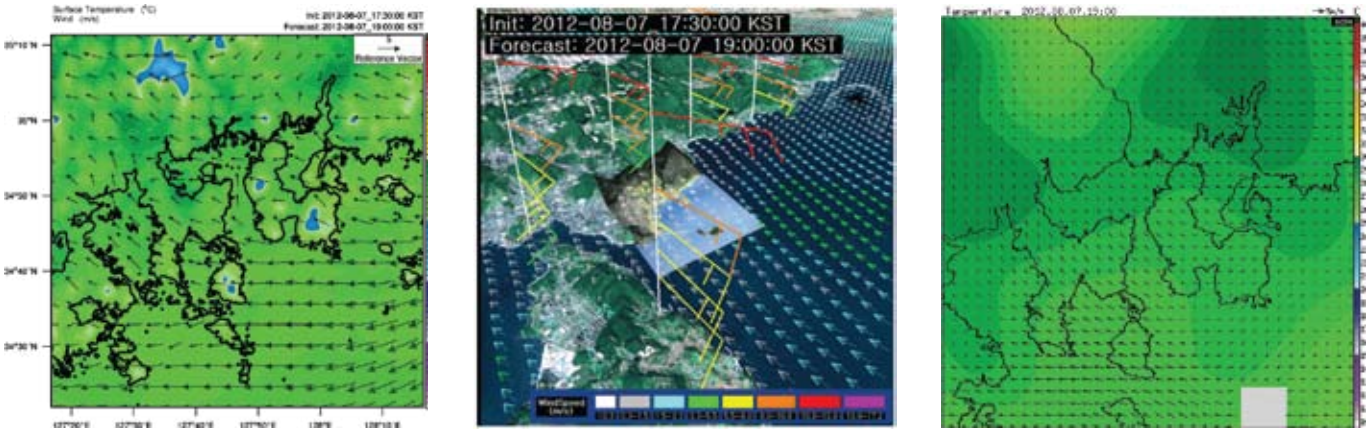


Diagram showing production of precipitation type reanalysis data Peninsula

2 Realtime atmospheric information in Yeosu EXPO

KLAPS based weather support was built for Yeosu EXPO from 12 May to 12 August 2012. It provided 6-hour prediction in 1km resolution updating every half an hour, which included precipitation Korea Nowcasting System (KONOS) and lightening forecast in the region. Realtime online 3D visualization helped the public to access those information, 98,992 clicks between 7 May and 12 August 2012. Data quality was < 3 degree and < 2 ms^{-1} for ground temperature and wind speed, respectively.

(a) (b) (c)



Model forecast results (a) surface temperature, wind vector of 1 km resolution and (b) surface wind vector of 100 m resolution and 5 sounding around Yeosu EXPO (c) AWS observation data at 1000 UTC 7 August 2012.

3 Climate change scenarios

The NIMR produced global and regional climate change scenarios and to access the future climate change to support climate change adaptation. To achieve this goal, experiment of anthropogenic aerosol effects on long-term climate, a historical (1860-2005) simulation and future (2006-2100) climate projection based on four RCP scenarios (RCP2.6, 4,5, 6.0, 8.5) were performed using HadGEM2-AO global climate model. And based on the global climate change scenario of HadGEM2-AO, the regional climate change scenarios on the Korean Peninsula with a horizontal resolution of 12.5 km was reproduced using HadGEM3-RA regional climate model.

We investigate the possible changes in global mean temperature, precipitation, vertical structure of temperature and atmospheric circulation in response to global warming with the results of the CMIP5 ensemble mean. For this purpose, two 30-yr periods for

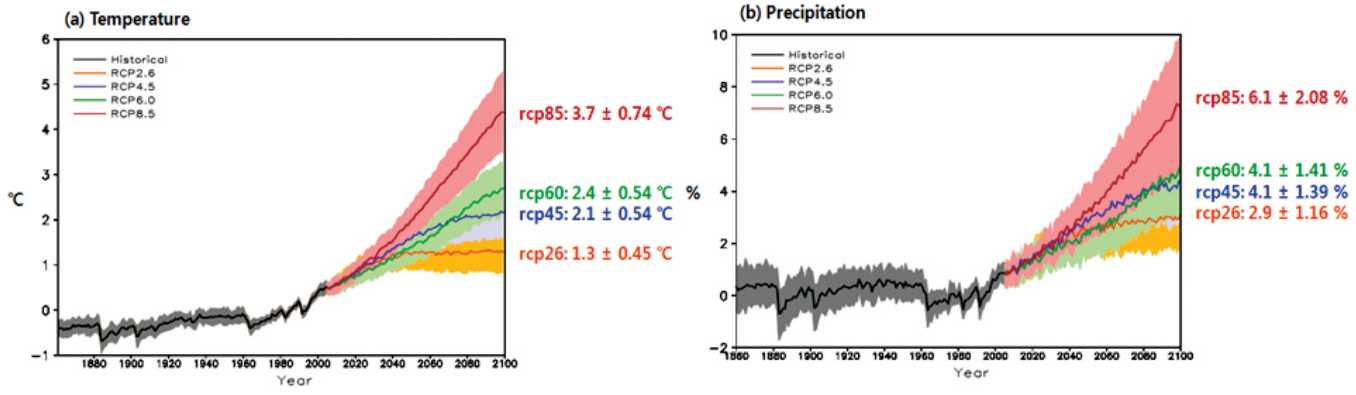
the historical run (1971-2000) and the future (2071-2100) climate simulations based on the RCP 2.6, 4.5, and 8.5 are compared.

The results of climate change for multi-model means at the end of the 21st century (2071-2100) relative to 1971-2000 are given in the following table and figure. The global temperature increases over most land areas, especially in the northern inland. The precipitation can decrease or increase depending on regions.

Projection of the global mean temperature and precipitation from multi-model mean at the end of the 21st century

		RCP2.6 (420ppm*)	RCP4.5 (540ppm*)	RCP6.0 (670ppm*)	RCP8.5 (940ppm*)
Global mean	Temperature** (℃)	+1.3±0.45	+2.1±0.54	+2.4±0.54	+3.7±0.74
	Precipitation** (%)	+2.9±1.16	+4.1±1.39	+4.1±1.41	+6.1±2.08

* The concentration of carbon dioxide in 2100.
** The anomaly for the future(2071-2100) as compared to the present level (1971-2000).

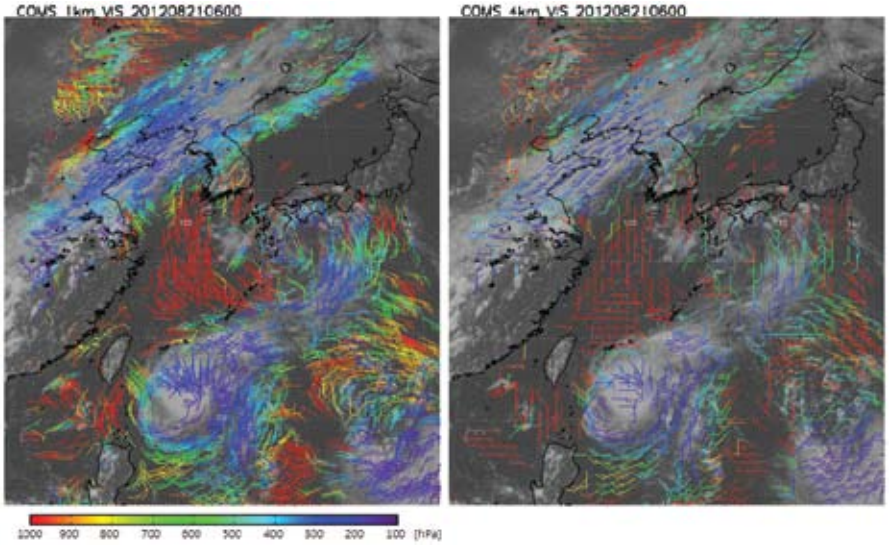


Multi-model means of surface air temperature (top) and precipitation (bottom) change, relative to 1971-2000. Lines show the multi-model means, shading denotes the standard deviation range of individual model annual means.

4 Construction of retrieval algorithm of COMS mesoscale Atmospheric Motion Vector (AMV)

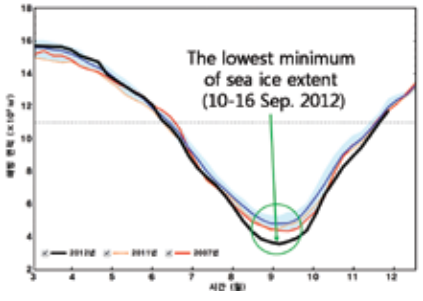
The algorithm to retrieve mesoscale atmospheric motion vectors (AMVs) is improved using COMS visible channel images with 1km resolution in Expanded Northern Hemisphere (ENH) region and optimized as characteristics of COMS Meteorological Imager (MI) sensor. Mesoscale AMVs depict better atmospheric flow of mesoscale phenomena likes tropical cyclone with large curvature than synoptic AMVs. As using the visible channel, mesoscale AMVs detect low level winds well. Since Quality Indicator

(QI) has limitation to consider the ageostrophic characteristics of mesoscale AMVs, the Expected Error (EE) is adopted. To consider both QI and EE, threshold values are optimized as QI ≥ 0.85 and EE ≤ 4 ms-1. By adopting EE, the mesoscale AMVs seem to represent the atmospheric flow well, and errors are improved in comparison with sonde, and NWP winds.



Distribution of Mesoscale AMVs (Left) and synopscale AMVs (Right) for 0600 UTC on August 21, 2012. The color of AMVs indicates the vector's height and only 50% of all vectors are displayed.

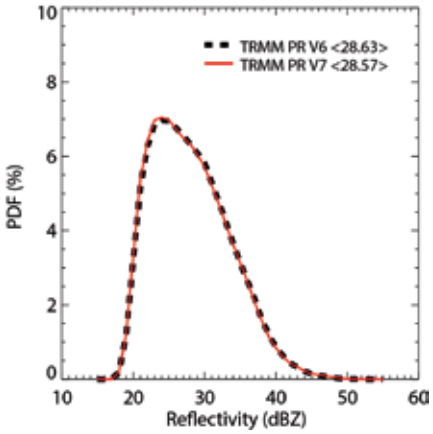
5 Arctic Sea Ice Monitoring and Analysis by SSMIS



Time series of sea ice extent in Arctic Sea

The NIMR has conducted "Polar Sea Ice Monitoring and Analysing System" using Special Sensor Microwave Sounder (SSMIS) data in 2012 and regularly monitors the change of Arctic sea ice. Results of monitoring show that Arctic sea ice broke the 2007 record in August and recorded the lowest minimum in 2012 summer. The relationship between sea ice and environment over the Arctic region in 2012 was analyzed using National Centers for Environmental Prediction (NCEP)/National Center of Atmospheric Research (NCAR). Air temperature in Barents-Kara area had been higher than climatology since 2011. Due to this effect, sea ice over the Barents-Kara did not expand to the average area in spring, had been rapidly melting from middle June and almost completely melted at the end of July. much more sea ice over the Beaufort sea and Laptev sea was melted in 2012 summer than in the past. Sea ice over Chukchi sea was rapidly melted by strong storm in early August.

6 Study for Global Precipitation Measurement (GPM) Satellite Utilization



Probability density of reflectivtiy of TRMM/PR over Korean Penisula during August 2006 to August 2011.

The improvement of new algorithm products (V7) of TRMM were assessed by using statistical validation system developed by NIMR in 2011. Even though the probability distribution of V7 was very similar to previous algorithm products (V6) in the reflectivity, it was found that V7 showed slightly improved performance than V6 when compared to ground radar. It was also found that the negative bias was dominant alike in V6, but the usability of V7 was improved because the differences of reflectivity has been stable and diminished after 2009.

There were few differences in the comparison of reflectivity profile according to versions and even in the higher altitude where attenuation effect was small. Therefore, it was analyzed that the new algorithm is less effective over the Korean peninsula, so V7 rain rate showed less accuracy than V6 rain rate when compared with ground observation. Eventually, we concluded that the new TRMM algorithm was not appropriate method for rainfall over the Korean peninsula.

7 Establishment of infrastructure for observing the severe weather at the southwest part of Korea

X-band dual-polarization radar produces the information of precipitation system that exists in the atmosphere such as location, movement, and form of precipitation (rain, snow, hail etc). It has been utilized in various microphysical studies of precipitation system and hydrometeorology. It can also perform the study of quantitative

(a) location of X-POL

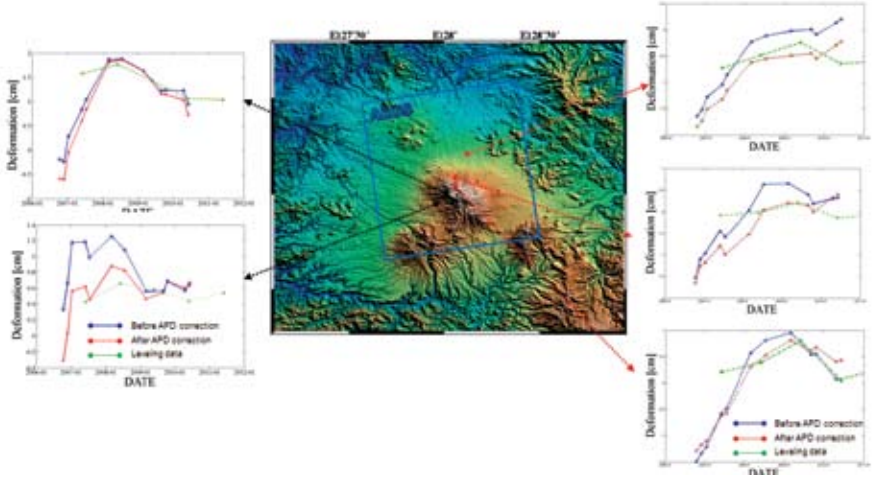
(b) installation of radar

(a) Locations of X-POL. in the Muan site and S-band radars in the Osungsan and the Jindo site. (b) Installation of X-POL.

precipitation estimates and the classification of hydrometeors at the previous study scope of operational radar network reinforcement.
From this perspective, the possibility of detailed observation and operational support of the metropolitan area was confirmed. X-band dual-polarization radar moved from Incheon meteorological observatory to Muan research radar observatory to construct the southwest coast intensive observation network on April 21, 2012. The observation infrastructure was built to monitor severe weather developed at the south-western region of Korea using the dual-polarization radar.

8 Study of crustal movement investigation for Baekdu mountain using SAR images

We study Sinabung volcano that erupted in August, 2010 in Indonesia after 400 years of quiet for system development of monitoring surface deformation measurement around Beakdu mountain using SAR data. There are 80 interferograms which maintained good coherence to analysis ground surface deformation analysis with 20 ALOS PALSAR data from 2007 to 20011. Sinabung volcano has gradual inflation for around 2 cm/yr before eruption and sharply deflation around 7 cm/yr at the point with one of the maximum amount after eruption. By using this mean surface deformation rate map before 2010 eruption, depth of magma source of Sinabung volcano estimates about 400 m depth. Figure below displays measurement of surface deformation from 2007 to 2011 using time-series surface deformation technique by SAR images in Mt. Beakdu and this technique is one of efficient way for monitoring volcanic activity.



Compare time-series surface deformation result using ALOS PALSAR and surveying data

9 Development of the world-leading meteorological sensors Automatic cloud observation system

In developing the automatic cloud observation system (ACOS), the accuracy of software was evaluated in 2009 and the hardware was improved to reduce the size and weight in 2010. In 2011, an ACOS ver. 3 was installed in Gochang observatory. In 2012, a commercialized version (ver. 4) of ACOS was developed and installed in Chupungyeong weather station. A relay device was developed to reduce the noise problem between the sensors since ver. 3 and improved in ver. 4.

10 Weighing and drainage cross-modal precipitation measuring system

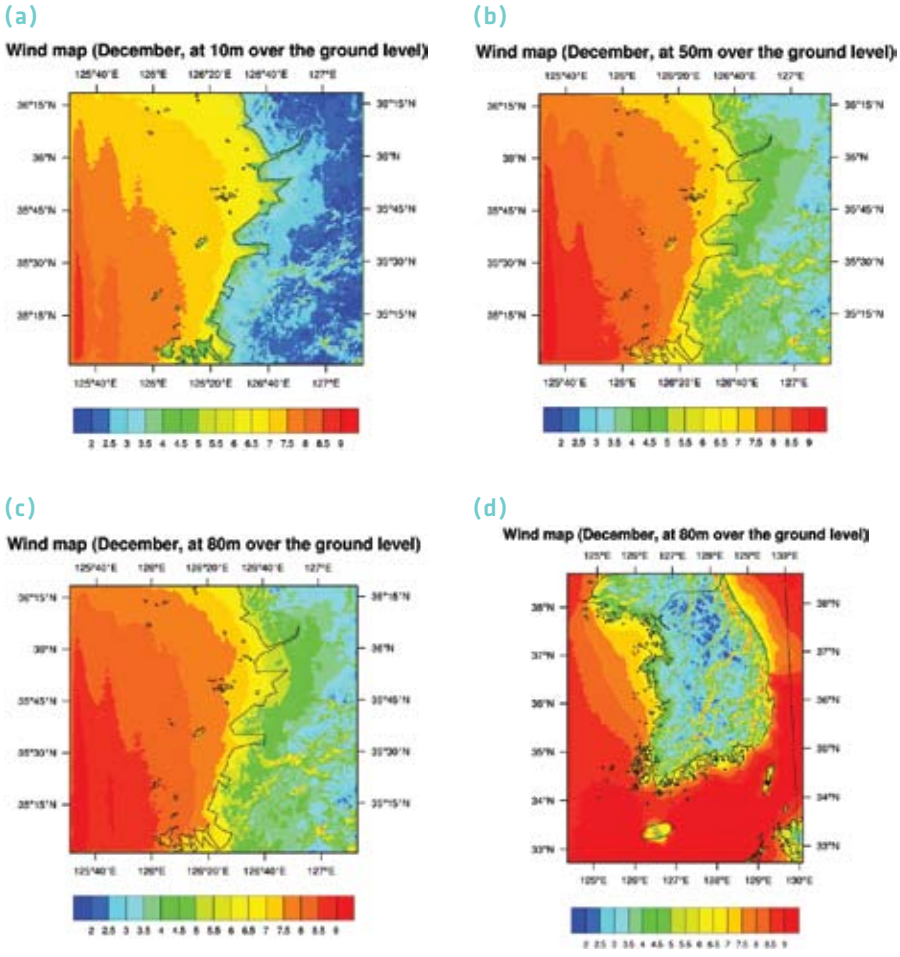
Using the first international patented technology in the KMA, the prototype of the weighing and drainage cross-modal precipitation measuring system was manufactured in 2010. This precipitation measuring system was improved and its performance and properties were developed by localizing its supplies. Moreover, using the continuous improvement of the patented duplex structure and automatic draining system, the manual operation is minimized and the troubleshooting is simplified. In 2012, the intercomparison study between the previous precipitation measuring system and the weighing and drainage cross-modal precipitation measuring system was investigated in order to reduce the error.

Automatic Cloud Observation instrument (left) and precipitation measuring system (right)

11 Developing the technique to support the green energy policy

The NIMR developed wind resource maps in 1 km and 333 m resolutions over the Korean Peninsula and the Gangwon Province, respectively. In response to the recent increasing research tendency to the wind farm on the sea, NIMR developed a wind resource map over the south-west region of the Yellow Sea in 333 m resolution. According to the wind map, the areal mean wind speed over the domain is more than 5 m s^{-1} that satisfies the wind turbine operation condition, 3 m s^{-1}. This map reflects detailed coast lines of land and island by its high resolution.

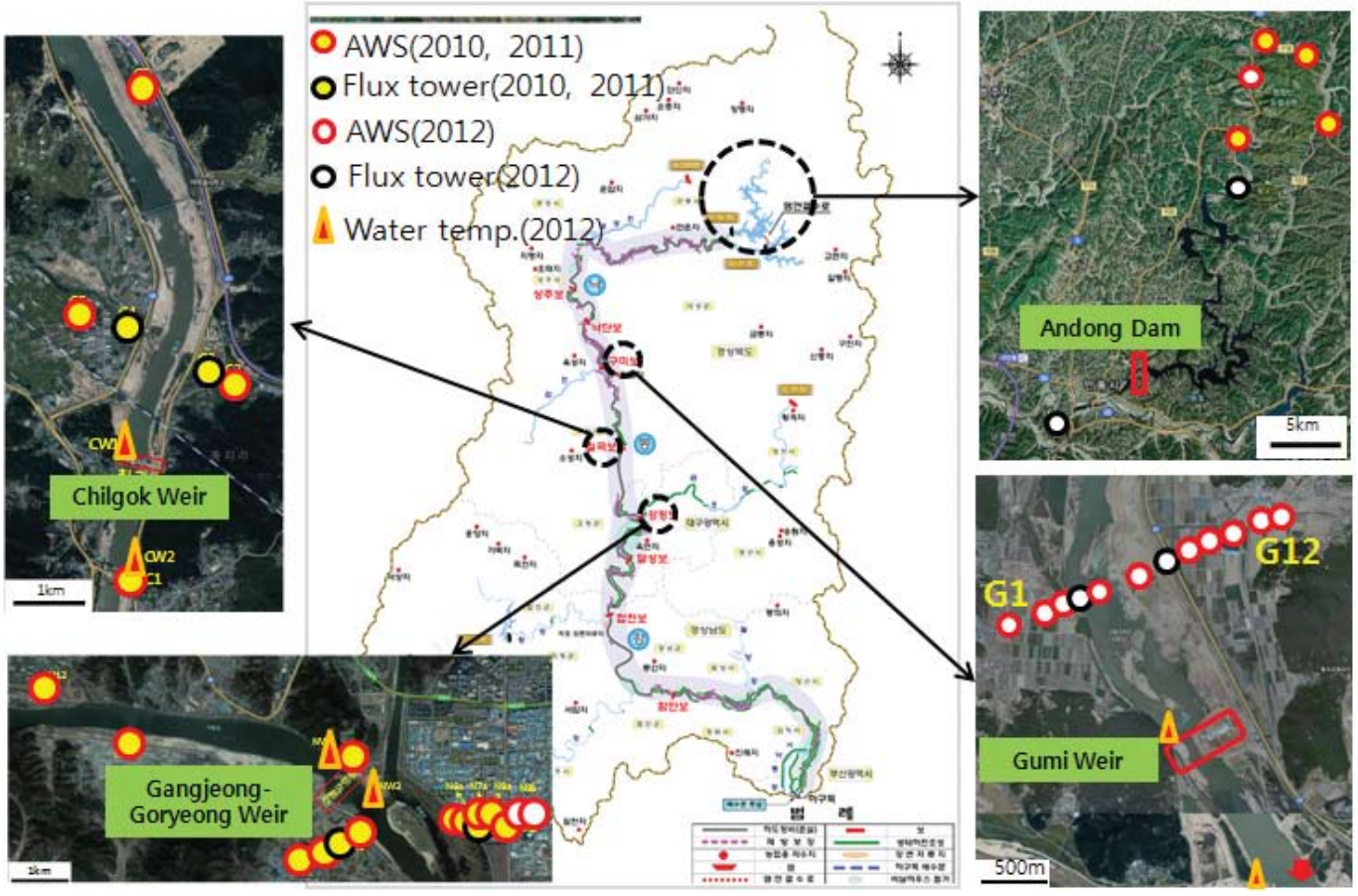
The NIMR's wind resource maps are provided to the institutes, universities, and wind energy societies, and companies for their research or investigation in choosing the place of wind turbine.



333 m horizontal resolution wind map at 10 m (a), 50 m (b), and 80 m (c) over the ground level and 1 km horizontal resolution wind map at 80 m (d) over the ground level on December.

12 Establishment of meteorological changes and hydrometeorological monitoring network at the Nakdong River

Increasing areas of watercourses in the Nakdong River basin due to large- scale development project over national rivers have led to the need for meteorological impact analysis. In this respect, the Nakdong River was selected as the test bed and the meteorological changes and hydrometeorological monitoring network was established. 33 micrometeorological observation sites, near Gangjeong-Goryeong Weir, Chilgok Weir and Gumi Weir where significant changes in water environment took place, were established. Also, for the technical development of hydrometeological monitoring and predicting system, the observation sites were constructed, in 2011 and 2012 respectively, near the Andong Dam which lacks a dense observation system and where flow discharge can be accurately measured. Components of the hydrometeorological observation system include multi-sensor, rain gauge and so on. Via the USN network, observed data are sent to the monitoring system and displayed in real-time.



Current status of the hydrometeorological/ meteorological impact analysis monitoring network at the Nakdong River.

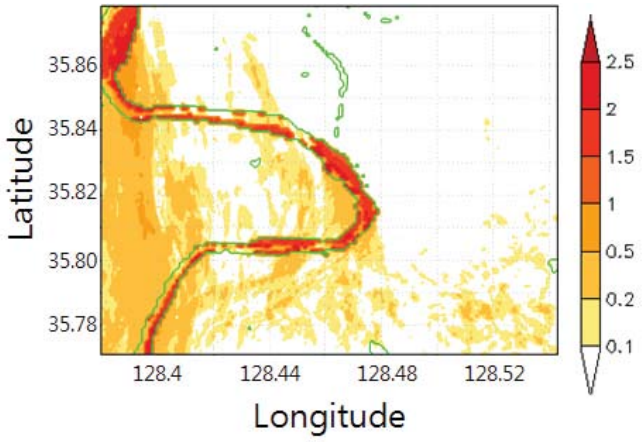
13 Numerical modeling foundation for micro-meteorological changes

Environment assessment is required because big projects such as construction and engineering work induce micro-meteorological changes. We chose the Nakdong River area in South Korea as research object where water surface was artificially extended and analyzed changes in air temperature, humidity and wind speed to investigate micro-meteorological changes.

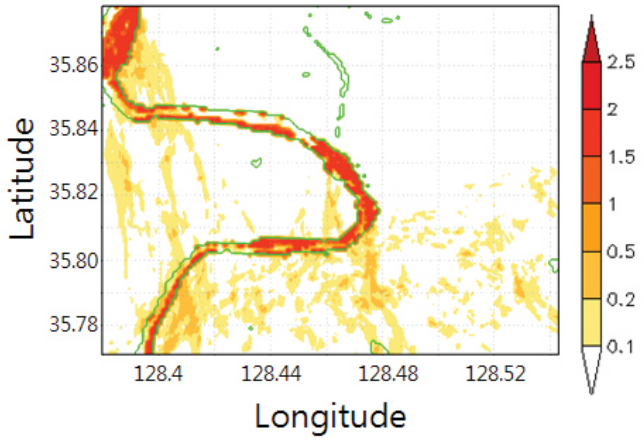
Influence of physically calculated water surface temperature variation was analyzed in this study. WRF Model version 3.2 and 5-layer model from MM5 (Fifth-Generation Penn State/NCAR Mesoscale Model) by land surface model was used. Thermal inertia in relation to surface temperature was set to consider thermal energy transportation by the convection.

Diurnal variation of surface temperature was calculated and some different results between preceding and this study existed. Changes in air temperature and humidity arising from extension of river area were generally smaller than preceding study. And daily-averaged magnitude and range of local meteorological effect evaluation index were smaller and narrower.

(a) constant water surface temperature



(b) varying water surface temperature



Local meteorological effect evaluation index calculated based on meteorological parameters (temperature, mixture ratio and wind speed) according to water surface temperature

EDUCATION & TRAINING

The KMA has been providing training to the invited staff members from NMHSs in developing nations to nurture their adaptation capacity against climate change and to transfer meteorological technology to them. The training includes radar operation and data utilization course, ICT course, COMS course and Africa Capacity Building Programme for Weather Disaster Response. In alliance with the support projects in developing countries, the KMA carried out the training on flood forecasting·warning system for the Philippines and the operation training on Typhoon Analysis and Prediction System-2 (TAPS-2) for Vietnam.

1 Training on Radar Operation and Data Utilization

The KMA secured a budget for the ODA program and offered a course on radar operation and radar data application for developing countries from 4 to 17 March in 2012. The course is aimed at building early response capacities against severe weather events by strengthening radar operation capacity and improving data utilization technology at NMHSs in developing countries. Radar plays an important role in early observation of severe weather and is expected to make big contributions to disaster prevention in developing countries. The KMA has also supported experts to foster their radar utilization capacity, established radar human resources network and transferred the knowledge to set up the infrastructure.

2 Courses on Capacity Building for Response to Meteorological Disasters in Africa

The KMA operated the Africa Capacity Building Programme for Weather Disaster Response (14 Oct.-3 Nov. 2012) for 12 climate and forecast experts from 12 African countries to help those countries better respond to and adapt to climate change. As part of KMA's projects for Africa, the programme is aimed at capacity building, helping African countries predict and address disasters related to weather, water and climate and providing African meteorological offices with KMA's technologies for climate prediction and NWP. Combining practice with theory education, the programme consisted of modules for long-range forecast and climate prediction, climate data management and restoration, severe weather forecast and the relevant policy activities.

3 Programme for Better Meteorological Services Using ICT Technologies

The KMA conducted the Programme for Better Meteorological Services Using Information and Communication Technologies or ICT (8 Apr.-5 May 2012) for 13 trainees from 9 NMHSs in Southeast Asia and Africa. The programme is aimed at promoting developing countries' ICT capabilities for meteorology by introducing Korea's ICT, which is recognized as one of the world's best by the WMO, and presenting guidelines for meteorological service development based on KMA's advanced ICT meteorological services. The programme consisted of applicable ICT, meteorological services using ICT, national ICT policies and international cooperation, and helped the participants better understand and develop meteorological services.

4 Training Course on Analysis of COMS Stellite Data

The KMA operated a training course titled "Analysis of COMS Data", targeting 19 trainees from 13 nations in the Asia-Pacific region where COMS data are currently being used. The course is designed to help those in charge receive COMS data and take advantage of them in forecasting, leading to disaster mitigation in developing countries. The course contained a number of education programs such as COMS data processing, ground station system, satellite image analysis and the use in forecasting with a focus on the effective use of COMS data. Through those programmes, the participants were able to enhance their ability to use COMS data.

5 Training on Flood Forecasting and Warning System in the Philippines

With the financial assistance from KOICA, the KMA's project for the establishment of an early warning and monitoring system for disaster mitigation in the Philippines was implemented in the metro-Manila region from 2010 to 2012. All the systems were completed in January and are currently in operation. Regarding the systems, the KMA invited 12 experts from Philippine Atmospheric Geophysical and Astronomical Services Administration (PAGASA) and disaster prevention centers to provide them with training on system operation, management and early warning system.

The training was made up of primary lectures about flood forecasting and warning, which was implemented in September 2011, and various lectures needed for equipment operation, such as flood forecasting and warning system, and observation and early warning system. The KMA is expected to contribute to fostering response capabilities against natural disasters in the Philippines through the training.

6 Technical assistance for Mongolian NWP operation

The KMA and WMO are jointly supporting Numerical Prediction Programs for the NWP development in Asian countries. As part of the efforts, the KMA has been providing NWP skills and training programs to National Agency for Meteorology and Environment Monitoring (NAMEM), Mongolia since 2003.

From Feb. 6 to 20, the KMA offered a two-week long training course on meso-scale NWP data assimilation and action learning for NWP and supercomputer experts from Mongolia. The training is expected to contribute to NWP capability of NAMEM.

7 Working-level training for forecasters from Vietnam

The KMA operated a working-level programme from 5 Nov. 2012 to 25 Jan. 2013, targeting four (4) invited forecasters from the National Hydro-Meteorological Service (NHMS). The programme focused on promoting expertise and practical capacities related with forecasting in the field of NWP model, forecast research, satellite and radar.

The KMA is committed to strengthening the cooperation relationship with the NHMS for the sustainable development.

INTERNATIONAL COOPERATION

The KMA pursues multilateral cooperation with international organization including the WMO. The WMO is a specialized agency of the United Nations. It is the UN system's authoritative voice on the state and behaviour of the Earth's atmosphere, its interaction with the oceans, the climate it produces and the resulting distribution of water resources. Established in 1951, the WMO has a membership of 191 Member States and Territories (on 1 January 2013) and the Republic of Korea joined the WMO in 1956 as the 68th member. As weather, climate and the water cycle know no national boundaries, international cooperation at a global scale is essential for the development of meteorology and operational hydrology. The WMO provides the framework for such international cooperation.

One of the most significant achievements in cooperation with international organizations in 2012 was that the KMA was endorsed as the Global Information System Center (GISC Seoul) at the 64th WMO Executive Council on 27 June 2012. The approval of GISC Seoul manifests that Korea has acquired a status to independently collect and distribute global meteorological data in real time. Another notable achievement was that the Forth Session of Joint WMO-IOC Technical Commission for Oceanography and Marine Meteorology (JCOMM) was successfully held in Yeosu where 2012 World EXPO was taking place. The success was attributed to integrated, cross-governmental administration among related ministries and local governments.

1 The 64th Session of WMO Executive Council

As the 64th Session of WMO Executive Council (EC) was held in Geneva, Switzerland from June 25 to July 3, seven KMA officials participated in the meeting.

Global Framework for Climate Services (GFCS) was the top agenda. The implementation plan of GFCS and draft of governance and the WMO and Member's contributions were mostly discussed.

The EC designated Korea and Australia as the GISC. By hosting GISC, Korea is able to establish an infrastructure of new paradigm to collect weather/climate data from all over the world in real time raising accuracy of region-specific NWP and to provide key information to reponses against climate change in real time.

2 WMO Extraordinary Session of the WMO Congress

WMO Extraordinary Session of the WMO Congress was held in Geneva, Switzerland on 29- 31 October 2012. Administrator CHO Seokjoon led the Korean delegation consisting of seven Korean officials. The extraordinary session was called to discuss ways to implement GFCS. The Session approved GFCS (Global Framework for Climate Services) implementation plan, establishment of the governance and the financial support process.

Most of Members were supportive of the establishment of Intergovernmental Board (IB) for GFCS. It was highlighted that stable fund, understanding between users and providers and cooperation with overseas partners are critical for successful implementation of GFCS.

3 The 15th Session of WMO RAII

The WMO RAII Session was held in Doha from 13 to 19 December 2012 at the kind invitation of the government of Qatar. The session had 103 participants form 35 members and related international organizations. Korea also sent its delegation of 13 experts. Members shared the current status of public weather services, disaster reduction, climate research, WMO WIGOS and WIS, capacity building, strengthening cooperation with partners in the region while reviewing the RAII activities during the last session. For RAII to be more efficient and effective, members examined the organization of RAII and discussed the strategic operating plan (SOP) 2012~2015 and relocation of the secretariat for the Asia-Southwest Pacific.

Mr. Ahmed Abdulla M Ali, the head of Qatar weather service was elected the president of the WMO RAII and Mr. Qamar-uz-Zaman Chaudhry from Pakistan weather service was re-elected as vice-president. It was also officially announced that Dr. PARK Chungkyu, ex-director general of the KMA was appointed as director of Regional Office for Asia and the South-West Pacific (RAP)

4 Hosting the 4th session of the JCOMM

The KMA successfully hosted the Fourth session of the Joint WMO-IOC Technical Commission for Oceanography and Marine Meteorology (JCOMM-4) on 23-31 May 2012 in Yeosu, Republic of Korea. The meeting was attended by about 191 delegates, invited experts and other participants from 54 WMO and IOC Member/Member States and relevant international organizations. The Korean delegation of 13 government officials led by Mr. PARK Kwanyoung, Director General of Observation Infrastructure participated in the session. The session discussed the decisions of the WMO and IOC which affect the plan of JCOMM and reaffirmed that for the implementation of Global Climate Observing System (GCOS) and the development of GFCS, the major contribution that JCCOM can make is to complete the ocean observation system.

The session was jointly hosted by the KMA, Yeosu city and organizing committee of EXPO 2012 Yeosu Korea and recognized as a good practice of holding an international conference through effective cross-governmental administration among related ministries and local governments. The session also has become an opportunity to promote JCOMM activities in Korea.

During the session, a range of KMA's technology from marine weather voice broadcasting, digitalweather broadcasting to smart applications were on display drawing much attention from participants.

5 Mandatory Contributions in WMO and Contribution of Trust Fund

The share of Korea's mandatory contribution to the WMO is on the rise. With 2.23% increase in 2012, Korea has become the 11th largest contributor among 191 member countries. Korea's mandatory contributions over the past 5 years are as follows.

In addition, Korea made voluntary contribution to the Trust Fund for activities such as

Korea's contributions to WMO over the past 5 years

(Unit : Swiss francs)

Year	2008	2009	2010	2011	2012
amount share (%)	1,336,430 (2.14)	1,336,430 (2.14)	1,336,430 (2.14)	1,392,635 (2.23)	1,455,075 (2.23)

WMO Voluntary Cooperative Programme ($30,000), ESCAP/WMO Typhon Committee ($12,000), WMO AMDAR programme ($4,000), THORPEX ($1,000), IPCC ($125,217), GEO ($77,768) and IOC tsunami programme ($1,000).

6 Other WMO Activities

With the KMA Administrator CHO Seokjoon serving as member of Executive Committee, Korea has played a leading role in the WMO activities as a member of the WMO management group. Korea was committed to establishing GFCS implementation plan by being part of GFCS Task Team (ECTT-GFCS), and actively involved in the WMO technical commission activities including the 4th Commission for Hydrology (CHy) held in Geneva on 6-14 November 2012 and the 15th WMO Commission for Basic System (CBS) in Jakarta on 10-15 September 2012.

The KMA continues to operate the WMO Commission for Instruments and Methods of Observation (CIMO) Testbed in Boseong, the CIMO Lead Center in Chupungnyeong and World Calibration Center for SF6. As GISC Seoul was endorsed at the 64th WMO Executive Council (27 June 2012), it is expected that the KMA will also serve as a global hub of collecting and distributing data in real time.

7 International Cooperation in Meteorological Technology

This year, the KMA carried out a range of technical cooperation in meteorology. The KMA signed MoUs with HKO (Hong Kong, China), Met Office (the UK) and BMKG (Indonesia) laying a foundation for further cooperation. There was also a meaningful progress in extending cooperation in the Northeast Asia region by agreeing to facilitate active exchanges among regional administrations in Korea and in Russia (Busan and Primorsky Kray regional administrations).
Such vibrant cooperation and exchanges will allow the KMA to further reach out to the world.

Germany

On 5-8 March, the KMA and DWD held their Fourth Meeting for Cooperation in Seoul attended by two heads of both Services. 3-member delegation from DWD and the KMA delegates had valuable time to review the implementation of agenda decided at the third meeting and to discuss new agenda for the next two years. Both sides agreed to work together on research and development of urban weather service, invention of a user interface of agro-meteorological models for developing countries and operation of Global Information System Centers and to continue their efforts to foster cooperative relations.

Vietnam

On 17 May, the KMA had the 2nd Bilateral Meeting Between the KMA and NHMS. Main topics on the agenda were an MoU with Ministry of Natural Resources and Environment of Vietnam, ODA projects, sending retired KMA experts, joint research and expert exchanges. At the meeting, MoU on cooperation and exchange between regional meteorological administrations of the two countries (Busan of Korea and Northeast Region of Vietnam) was concluded. With regard to this, four forecasters from NHMS were invited for training from 5 November 2012 to 25 January 2013. The training course took place not only at the headquarters but also at regional administrations. Last December, deputy director of Vietnam weather services paid a visit to the KMA to benchmark KMA's advanced meteorological technology and know-hows (on 18-21 December 2012).

Hong Kong, China

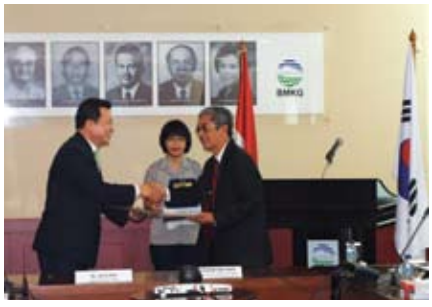
The KMA concluded an MoU with HKO on 30 May for meteorological cooperation. The MoU was signed one month after both sides had a meeting to discuss ways to work together at HKO from 2 to 4 April. Major areas of cooperation with HKO which has outstanding technology in aviation aeronautical meteorology include aeronautical weather area such as wind shear and wind gusts, satellite area and the development of climate prediction and NWP models.

Mongolia

The 5th Bilateral Meeting Between the KMA and NAMEM (30 Apr.-5 May) was held in Ulaanbaatar, Mongolia. The KMA sent 5-member delegation for this meeting where both parties discussed cooperation in climate/numerical models, data sharing and joint research on Asian Dust and renewable energy including wind power and sending KMA experts to Mongolia. Since continuous supports are likely to be required for the operation of a super computer, exchange of experts will be accelerated. 24 heads of regional administration of NAMEM also visited Korea from 29 October to 2 November to benchmark KMA's meteorological technology.

Russia

The 7th Bilateral Meeting Between the KMA and Roshydromet (20-22 Jun.) took place in Saint-Petersburg on 21 June. Both parties had discussions on current areas of cooperation including weather/climate and satellite data exchange, and weather service for sports events as well as on new areas such as WIS operation, radar data exchange and cooperation between regional administrations. As a part of efforts to implement what was discussed at the meeting, last October, officials from Busan regional administration went to Vladivostok to have a meeting with the regional weather office of Primorsky Kray, Russia. For the meeting, 'Gisang 1', a weather ship also left on a voyage to Russia. Both countries will work together to play leading roles in marine weather area using weather ships and to jointly support the weather services for Winter Olympic Games.



Indonesia

The KMA delegation visited Badan Meteorologi, Klimatologi, Dan Geofisika (BMKG), the meteorological authority in Indonesia for two days (6-7 Sept.) to sign an MoU for meteorological cooperation and to attend the 1st bilateral meeting. Last 2004, Indonesia was devastated by tsunami which took 130,000 lives and since then a great deal of programs for disaster reduction were introduced recognizing the importance of weather/earthquake services.

The KMA and BMKG agreed on technology cooperation in forecasting, earthquake and climate service. In particular, both sides talked about a number of cooperative measures such as supports for aeronautical meteorological services and holding joint seminars on satellite data processing and analysis technology.

India

The KMA concluded an MoU for meteorological cooperation with MoES (Ministry of Earth Science), India on 29 September 2010. Based on the MoU, the two nations have pursued cooperation in various areas such as the development of NWP model and satellite data exchanges. After the first bilateral meeting the second one took place at the KMA's headquarters on 20 September 2012. Main parts of the agreement include restoration of climate data, technology exchange over satellite data processing, forecasting technology cooperation. The cooperation in those areas are expected to bring great progress to technological advancement of both sides. More efforts will be put to expand areas of cooperation to activities related to ODA projects.

England

On 26 June (Geneva), the KMA struck an MoU for Meteorological Cooperation with Met Office well known for world's best NWP model. The MoU has laid the groundwork for bilateral cooperation in a range of areas from weather forecasts, observation, communication to training and for broader exchanges of human resource. In particular, cooperation in NWP model would help the KMA spur efforts to develop its own NWP model thereby upgrading its meteorological capacity. Cooperation between the KMA and Met office is expected to be further extended to more various fields including satellite, space weather, weather industry and research on oceans.

8 Supports for Developing Countries

The Early Warning and Monitoring System for Disaster Mitigation in the Philippines

On 28 January 2012, the KMA completed the project to establish the Early Warning and Monitoring System for Disaster Mitigation in Metro Manila in cooperation with KOICA. This project installed 49 instruments in total: 4 AWS, 6 rain gauges, 10 water level gauges, 20 warning posts and 9 emergency warning instruments. Additional supports were provided for observation data servers and flood forecast & warning system. Such instruments and systems were of significant help in minimizing the damage caused by typhoon Bopha which hit hard the central part of the Philippines. If such systems are established and operated in other areas frequently affected by typhoons and heavy rains, it will help the nation not only reduce losses in life and property but also have better response capability to natural disasters.

Satellite Receiving System in Sri Lanka

The KMA has pushed ahead with a project to set up Sri Lanka Stellite Receiving System worth 2 million dollars since 2010 in cooperation with KOICA and in April 2012, donation ceremony was held in Sri Lanka. The project aimed to install stellite receiving and analysis system which allows data from the Korea weather satellite 'Chollian' to be used for climate change adaptation and weather disaster reduction. The system was built along with education and training on satellite data analysis and application methods through expert exchanges so that the system can be used to produce forecasts in a way tailored to the weather environment of Sri Lanka. The donated system is the first small and mid-scale receiving system made in Korea to be built overseas. 6 kinds of systems customized to Sri Lanka were developed and installed for receiving, processing and analyzing data from satellite 'Chollian' and for service, storage/management and monitoring/control. Trial run was completed in March this year. The system is expected to make great contributions to climate change adaptation and disaster reduction in Sri Lanka.

Modernization of Weather Services in Vietnam

As a part of supports for modernization project, the KMA has promoted the 'Project for Response to Meteorological Disasters in Vietnam' since 2010. The aims of project are to transfer Typhoon Analysis and Prediction System-2 : TAPS-2 to Vietnam and to operate education and training to pass down techniques for operating system. As a result, TAPS was successfully transferred to NHMS and training programs took place on 11-13 June 2012 to help NHMS run and manage TAPS on its own. The project contributed to minimizing the damage from typhoons in Vietnam and it was a good opportunity to promote the KMA's advanced forecasting system and technology to developing countries.

Regional Climate Center in East Africa

The KMA joined hands with WMO and KOICA to support their joint project for establishing a climate system in East Africa (2009-2012, worth $400,000) by setting up a computer cluster for Regional Climate Center in East Africa. The tri-lateral cooperation among the WMO, the KMA and Africa has helped reinforce Africa's capability of responses against climate change. The project was also meaningful for the KMA since Korean companies had an opportunity to participate in the work to establish $150,000-worth system. On-site application and adaptation of the system was concluded in February 2013.

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