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The sky is our friend, and the public, our sky

National Center for Meteorological Supercomputer

국가기상슈퍼컴퓨터센터

Providing prompt and accurate weather information services

The National Center for Meteorological Supercomputer strives to produce prompt and accurate weather forecasts.

NCMS

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The sky is our friend, and the public, our sky

Lately, as abnormal weather conditions are becoming more commonplace due to climate change stemming from global warming, people's lives are being affected more and more by the weather, and their property and even their lives are under threat. Furthermore, with increasing demands for reliable weather information for outdoor activities and the industrial economy, weather forecasting is increasing in importance for daily life, and social and economic activities.

The supercomputer center produces the numerical weather prediction (NWP) model data that underlie the production of valuable weather information. As a world-class meteorological supercomputing organization, it also seeks stable operation of the supercomputing facilities, establishes related policy, develops related techniques, and cooperates with other organizations.

There have been many evaluations of the socioeconomic impacts of meteorological supercomputing. Without doubt, it has changed the paradigm of weather forecasting, and been a major driver of its continuous improvement. We at the supercomputer center are making our best efforts to protect people's lives and property, always with the thought 'the sky is our friend, and the public, our sky'.

Director of National Center for Meteorological Supercomputer

At the Heart of Scientific Meteorological Forecasting,

The Meteorological Supercomputer

The National Center for Meteorological Supercomputer will be always with you.

History

1988 Introduced a midrange computer (CDC Cyber 932) for weather analysis (August)

1990 Korea Meteorological Administration promoted to a higher level in government, and the new 'Numerical Weather Prediction Division' formed

1995 Introduced a new midrange computer (Fujitsu VPX-220) for weather forecasting (March)

1999 Introduced the initial phase of the 1st meteorological supercomputer (NEC SX-4) (April)

2000 Introduced the final phase of the 1st meteorological supercomputer (NEC SX-4) (September)

2004 Introduced the initial phase of the 2nd meteorological supercomputer (Cray X1) (October)

2005 Formation of the 'Supercomputer Team' within the 'Information Management Office' (July)
Introduced the final phase of the 2nd meteorological supercomputer (Cray X1E) (August)

2007 Formation of the 'Numerical Weather Forecasting Center' within the 'Forecast Bureau' (March)
* Numerical Model Development Team, Numerical Data Application Team, Numerical Model Management Team

2008 Renamed from 'Numerical Weather Forecasting Center' to 'Numerical Prediction Office' (March)
* Numerical Model Development Division, Numerical Data Application Team, Numerical Model Management Team

2009 Renamed from 'Numerical Model Management Team' to 'Supercomputer Management Team' (April)

2010 Opened the 'National Center for Meteorological Supercomputer' (March)
- Ochang-eup, Cheongwon-gun, Chungcheongbuk-do

'Supercomputer Management Team' reorganized under the 'Supercomputer Management Division' (April)

Introduced the initial phase of the 3rd meteorological supercomputer (Cray XT5) (June)

Introduced the final phase of the 3rd meteorological supercomputer (Cray XE6) (December)

A Cornerstone in Weather Forecasting,

National Center for Meteorological Supercomputer

The Korea Meteorological Administration (KMA) decided to construct the National Center for Meteorological Supercomputer within the Ochang Science and Industrial Complex, in Cheongwon-gun, Chungcheongbuk-do, aimed at stable operation of meteorological supercomputing. It was completed in March 2010 after a construction period of 1 year and 8 months, starting in June 2008. The National Center for Meteorological Supercomputer - equipped with dual supercomputer rooms, large capacity uninterrupted power supply (UPS) systems and thermo hydrostat controls, and fire extinguishing equipment - provides an optimized environment for operating meteorological supercomputers 24 hours a day, 365 days a year.
Even in an emergency, when external power is completely cut off, the center is able to operate for more than 48 hours powered from generators and stored fuel.

- **Construction period** : June 2008 ~ March 2010
- **Address** : 72 Jungsimsangeop 2-ro, Ochang-eup, Cheongwon-gun, Chungcheongbuk-do
- **Lot area** : 23,092m²
- **Architectural area** : 7,052m²
- **Computational facilities** : 2,074m²
- **Infrastructure** : 2,506m²
- **Work facilities** : 779m²
- **Facilities for common use** : 1,693m²

"Striving to operate the best supercomputer center in Korea"

Main Roles

Introduction and Operation of Supercomputers
- Introduction of meteorological supercomputers and related systems
- Operation and management of the supercomputer and responding to system failures
- Training and technical support for supercomputer users

Operation of NWP Models
- Establishment and optimization of the operational NWP system
- Monitoring of NWP model operation and responding to system failures
- Management and provision of NWP products

Management of the National Center for Meteorological Supercomputer
- Management and protection of the National Center for Meteorological Supercomputer's building facilities
- Maintenance of the supercomputer's infrastructure (electricity, communication, thermo hydrostat control, fire extinguishing equipment, etc.)

Infrastructure within the National Center for Meteorological Supercomputer

Substation facilities (8,000KW)
Transforms the high-voltage (22,900V) electricity received from KEPCO to the low voltage required by the supercomputer.

Emergency power generator
Produces emergency electric power in cases of power failure.

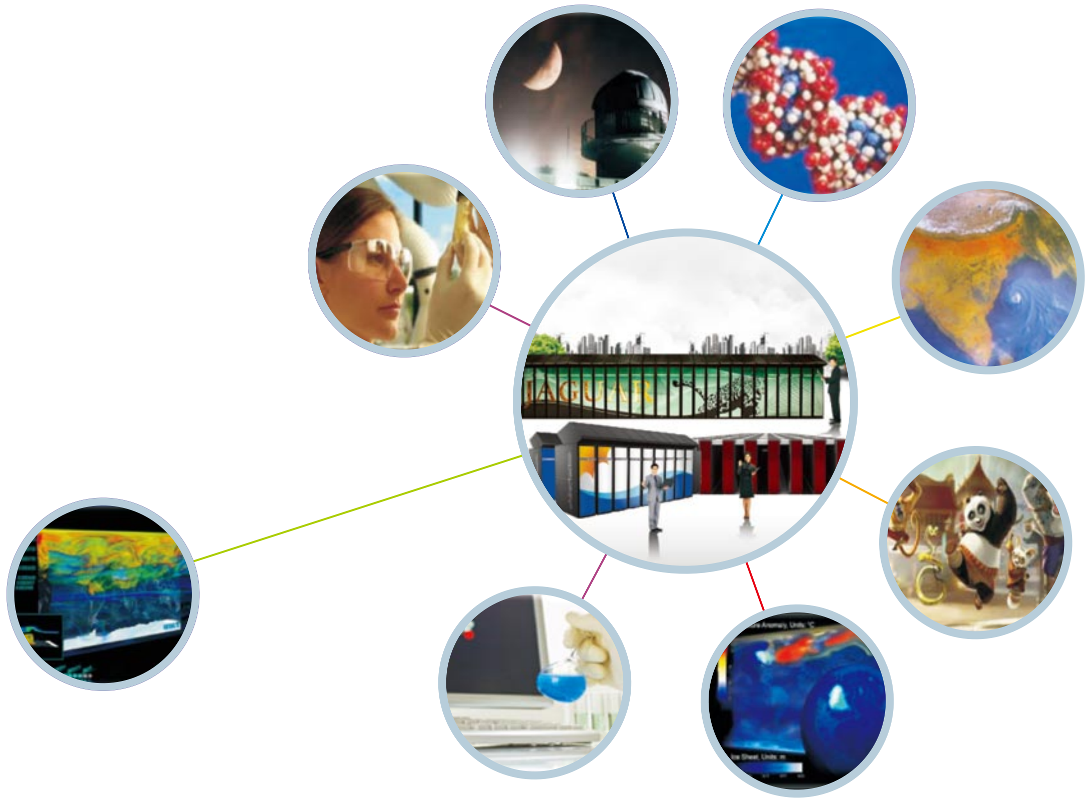
UPS (4,740 batteries)
Provides emergency power from batteries when an unexpected power disruption occurs.

Cooling facilities (450RT×4 sets)
Remove heat generated by the supercomputer.

What is a Supercomputer?

What is a Supercomputer?

A supercomputer is a “computer at the frontline of current processing capacity, particularly speed of calculation”. Demand for such computers comes from applications that demand intensive numerical computation. The performance of a supercomputer is usually measured in Flops (floating-point operations per second). Since 1993, the fastest 500 supercomputers have been ranked in the “TOP500” list (http://top500.org), released twice a year, in June and November.
In general, computers which rank in the TOP500 list are called supercomputers.



Supercomputers with high performance are essential tools in cutting-edge science and technology, such as particle physics, astronomy and astrophysics, climate, weather and biotechnology. Numerical simulation using supercomputers plays a valuable role in providing an alternative to expensive, dangerous or impractical field or laboratory experiments. Supercomputers are thus widely used for high value-added activities, including cinema production, oil exploration, financial services, aircraft and automobile development, and in industries that make high-technology products.

History of Supercomputers

History of Supercomputers

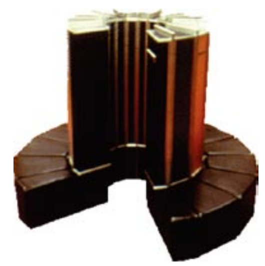
The ENIAC, the first electronic general purpose computer

The ENIAC, developed by John Mauchly and John Presper Eckert at the University of Pennsylvania between 1943 and 1946, was originally designed to compute ballistic firing tables for the U.S. Army. In addition to ballistics, the ENIAC solved many complex scientific problems in weather prediction, random-number studies, cosmic-ray studies and other scientific applications.

The CDC 6600, the first supercomputer

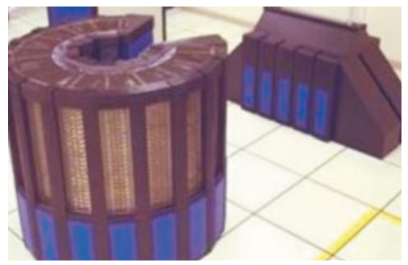
The CDC 6600 was the first supercomputer manufactured by CDC (Control Data Corporation) in 1964. With a performance of about 1 MFlops (Mega Flops), it was faster than all other computers of its time.

The Cray-1, a famous supercomputer



Cray Research Inc., one of the most famous supercomputer manufacturers, was founded in 1972 by Seymour Cray, who designed the first supercomputer. Since then, Cray Research Inc. has been a leader of the supercomputing market, beginning with the manufacture and marketing of the Cray-1 system that went on to become one of the best-known and most successful supercomputers in history.

The Cray-2S, the first supercomputer in Korea



The first supercomputer in Korea was the Cray-2S system, which was introduced in 1988 by the Korea Institute of Science & Technology. It was used for weather forecasting by the Korea Meteorological Administration, for the generation of 3-dimensional maps of the Korean Peninsula, for the safety analysis of nuclear power plants, and for several other uses until its decommissioning in 1993.

KMA Supercomputers

KMA Supercomputers

KMA's 3rd Supercomputer (2010) has approximately 3,600 times the performance of KMA's 1st Supercomputer (1999)

1st KMA Supercomputer | NEC SX5 / 2000. 6. / 224 GFLOPS

- Vector system, NEC SX-5 from NEC in Japan
- Used as a main system from June 1999 through December 2005
- Now retired, and used for exhibitions
- Able to calculate in a second what would take 167,000 people 1 year

90 times

2nd KMA Supercomputer | CRAY X1E / 2005. 11. / 18.5 TFLOPS

- Vector system, Cray X1E from Cray Inc. in the U.S.
- Used as a main system until the end of 2010, after installation in 2005
- Used to produce climate change scenarios since the end of 2010
- Able to calculate in a second what would take 15 million people 1 year

41 times

3rd KMA Supercomputer | CRAY XE6 / 2010. 11. / 758 TFLOPS

- Scalar system, Cray XE6 from Cray Inc. in the U.S.
- MPP (massively parallel processing) structure with good scalability
- Used for weather forecasting and climate and meteorological research since its introduction in 2010
- Able to calculate in a second what would take 600 million people 1 year

Performance Comparison of KMA Supercomputers

Types	1st Supercomputer	2nd Supercomputer	3rd Supercomputer
System	NEC SX-5	CRAY X1E	CRAY XE6
Installation year	2000	2005	2010
Number of core	28	1,024	90,240
Theoretical performance	0.224 TF	18.5 TF	758 TF
Memory capacity	0.219 TB	4 TB	120 TB
Shared data storage device	RAID3 (3.78 TB)	RAID5 (88 TB)	RAID6 (3990 TB)
Network storage device	RAID5 (4 TB)	RAID5 (320 TB)	RAID6 (7475 TB)
Backup storage capacity	14 TB	1024 TB (LTO-2) 1024 TB (LTO-3)	6640 TB (LTO-4)

KMA 3rd Supercomputer

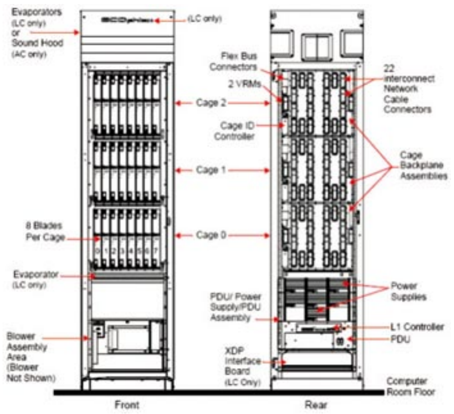
3rd KMA Supercomputer, Specifications

KMA selected the Cray XE6 system with scalar processors for its 3rd supercomputer. The KMA Cray XE6-based facility is composed of two physically separated systems : "Haeon" for operations, and "Haedam" for research and operational backup.

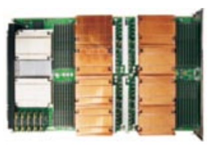
▶ KMA 3rd Supercomputer Cray XE6 "Haeon"

▶ KMA 3rd Supercomputer Cray XE6 "Haedam"

Each system is configured with a 20-cabinet Cray XE6™ system. Each cabinet can be populated with any combination of 24 blades (compute or service), with easy deployment. Each blade has 4 nodes, and each node 1 or 2 AMD processors configured with 16 or 32 GB of memory depending on the type of node. Both "Haeon" and "Haedam" are equipped with 470 compute blades, 45,120 CPU cores and 60 TB of memory, providing each system with a theoretical performance of 379 TFlops. The system uses Cray's scalable Gemini high-performance interconnect for communication between nodes, with one Gemini ASIC implemented for each pair of nodes.



▶ Cabinet structure for Cray XE6



▶ Compute Blade

▶ Service Blade

Type	Detailed specifications
Processor	12-core 64bit 2.1GHz AMD Opteron (Magny-Cours)
	512KB L2 cache per core, 12MB shared L3 cache
Memory	32GB DDR3 SDRAM per compute node
Cabinet	24 Blades, 2304 cores per system cabinet
Inter-connect	2 Gimini ASIC chips per compute blade
	48 switch ports per Gemini chip
	3-D torus interconnect
I/O	InfiniBand, 10G Ethernet, FC
Power	54 kW per cabinet
Cooling	ECOphlex liquid cooling
Parallel File System	external Lustre file system
	DDN S2A9900 storage
Operating System	Cray Linux Environment include SUSE Linux SLES11
Compiler / Library	PGI, GNU, PathScale, Cray Compiler Environment
	Support for Fortran 77, 90, 95; C/C++
	MPI 2.0, Cray SHMEM, other standard MPI lib.
Job scheduling	PBS Pro. Job management system

Technology Trends in Supercomputing

Technology Trends in Supercomputing

The performance of supercomputers has been improving by a factor of 1,000 every 11 years, and exascale (10^{18} Flops) supercomputers are expected to appear by 2019.

The performance of supercomputers is rapidly growing, on average by a factor of more than 10 every 4 years. This is much higher than Moore's law, which states that the number of transistors on integrated circuits doubles every 18 months. Recently, each six-monthly release of the TOP500 list has contained around 200 new systems, displacing previous list members. In particular, the No. 1 ranking on the list has been constantly changing as the battle to produce the world's most powerful supercomputer rages. The U.S. claimed the No. 1 and 2 positions on the latest TOP500 list (November 2012), followed by Japan and then China.

- 1997 : 1 TF appeared
- 2008 : 1 PF (1000 TF)
- 2019 : 1 EF (1000 PF) is expected

X 1set = 10GF (3GHz dual-core)
X 100sets = 1TF (3GHz dual-core)
X 100,000sets = 1PF (1 quadrillion operations a second)

KMA's 3rd Supercomputer Cray XE6 "Haeon" and "Haedam" achieved ranks of 78 and 79 respectively in November 2012.

* TOP 500 (Nov. 2012)

Rank	Site	System	Cores	Rmax (TFlop/s)	Rpeak (TFlop/s)	Power (kW)
1	DOE/SC/Oak Ridge National Laboratory United States	Titan - Cray XK7 , Opteron 6274 16C 2.200GHz, Cray Gemini interconnect, NVIDIA K20x Cray Inc.	560640	17590.0	27112.5	8209
2	DOE/NNSA/LLNL United States	Sequoia - BlueGene/Q, Power BQC 16C 1.60 GHz, Custom IBM	1572864	16324.8	20132.7	7890
3	RIKEN Advanced Institute for Computational Science (AICS) Japan	K computer, SPARC64 VIIIfx 2.0GHz, Tofu interconnect Fujitsu	705024	10510.0	11280.4	12660
⋮						
78	Korea Meteorological Administration Korea, South	Haeon - Cray XE6 12-core 2.1 GHz Cray Inc.	45120	316.4	379.0	
79	Korea Meteorological Administration Korea, South	Haedam - Cray XE6 12-core 2.1 GHz Cray Inc.	45120	316.4	379.0	

▶ Titan (USA)

▶ 3rd KMA Supercomputer [Haeon], [Haedam]

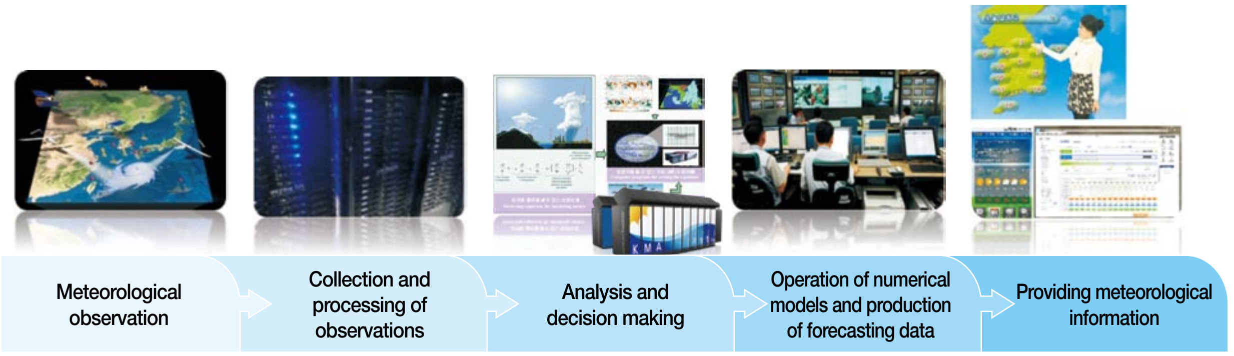
Supercomputers and Weather Forecasting

Supercomputers and Weather Forecasting

Owing to the invention of weather recording instruments, use of weather maps, and the development of instant long-range communications, modern weather forecasting began in the mid-1800s with the issuing of daily weather forecasts in the form of weather maps. In the 20th Century, weather forecasting became more scientifically advanced with the invention of computers and enhanced knowledge of numerical prediction.

Numerical weather prediction is an objective and theoretical approach to forecasting future weather using NWP models. Employing high-performance computers, NWP models solve complex mathematical equations based on the physical laws that determine the behavior of the atmosphere. Before NWP began, weather forecasting was subjective, based on the experience of human forecasters.
The basic idea of NWP was developed long before the computer was invented, and realized in the 1950s when computers came into use.

- 1904: V. Bjerknes, Norwegian meteorologist - proposed the theoretical feasibility of numerical forecasting
- 1922: L.F Richardson, English mathematician and meteorologist - pioneered the first numerical weather prediction by hand
- 1950: John von Neumann, R. G.J Charney, R. Fjortoft and others - the first successful numerical weather prediction using the first electronic computer, ENIAC
- 1954: Swedish Meteorological and Hydrological Institute - developed the world's first operational numerical weather prediction system
- 1957: The U.S. and Japanese Meteorological Agencies began operational numerical weather prediction



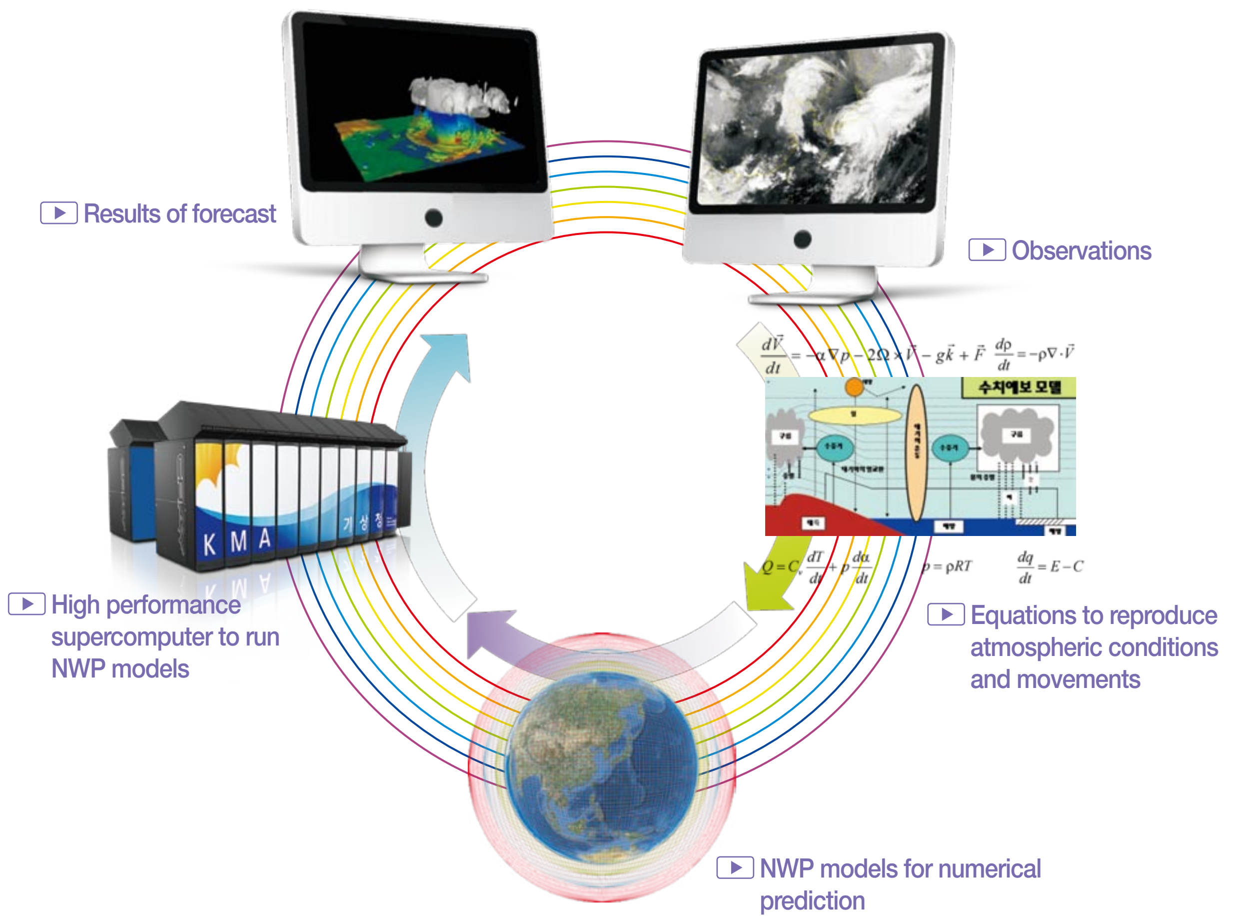
Meteorological observations are no longer just provided as tables or directly analysed to produce weather charts. Instead they are used as input to NWP systems which then provide numerical forecast data to the forecasters. Thus forecasting has become more objective and accurate.
As NWP systems are required to perform complex calculations and manipulate huge data volumes within short time scales, enormous computing resources are necessary to carry out NWP.

Numerical Weather Prediction (NWP)

Concept of an NWP model

The basic idea of NWP is that future weather can be predicted from observed initial conditions if the equations governing atmospheric conditions are sufficiently known. An NWP model is a tool to realize this concept.

An NWP model is a computer program developed to simulate weather systems based on the dynamical and physical equations governing atmospheric conditions and movements. The atmosphere is continuous in space and time, and the governing equations are nonlinear partial differential equations which are impossible to solve through analytical methods. Therefore, the atmosphere has to be parceled and represented as a finite set of numerical values on spaced grid points.

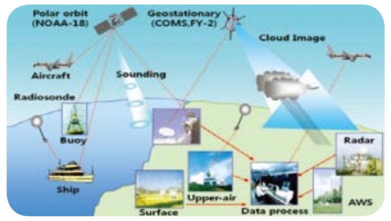


Because they are so computationally intensive, NWP models are typically coded using advanced parallelization techniques to take advantage of high performance parallel computers.

Key Components of NWP Technology

Key Components of NWP Technology

NWP requires a combination of in-situ and remote-sensing observations, data assimilation, super high speed communications, high performance supercomputing, computing science, graphical processing techniques, and scientific knowledge of weather systems. In the past few years, NWP systems have been advancing rapidly through the application of cutting-edge technologies and international collaboration.

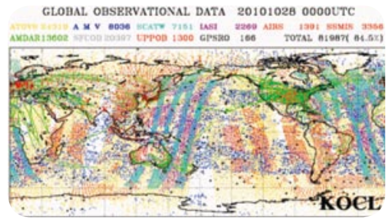


Observation technology

3-dimensional observations of the entire globe using cutting-edge observation technology and instruments such as AWS, satellite and radar

Super high speed communication technology

This technology collects huge amounts of observational and analysis data from countries all over the world as quickly as possible

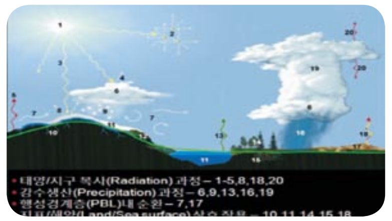


Data assimilation technology

Data assimilation processes the various observations acquired from satellite, radar and so on to produce 3-dimensional input data for numerical models

Supercomputing technology

Allows NWP models to be run effectively through the optimized use of computing resources

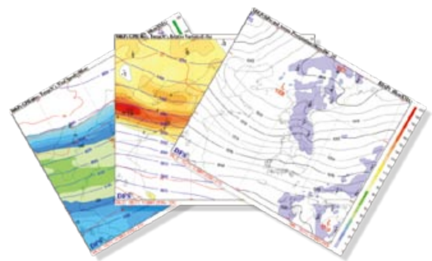


Scientific knowledge of weather systems

Scientific interpretation of natural phenomena using physical equations

Computing science

Helps produce optimized parallel programs to solve the governing equations effectively on supercomputers



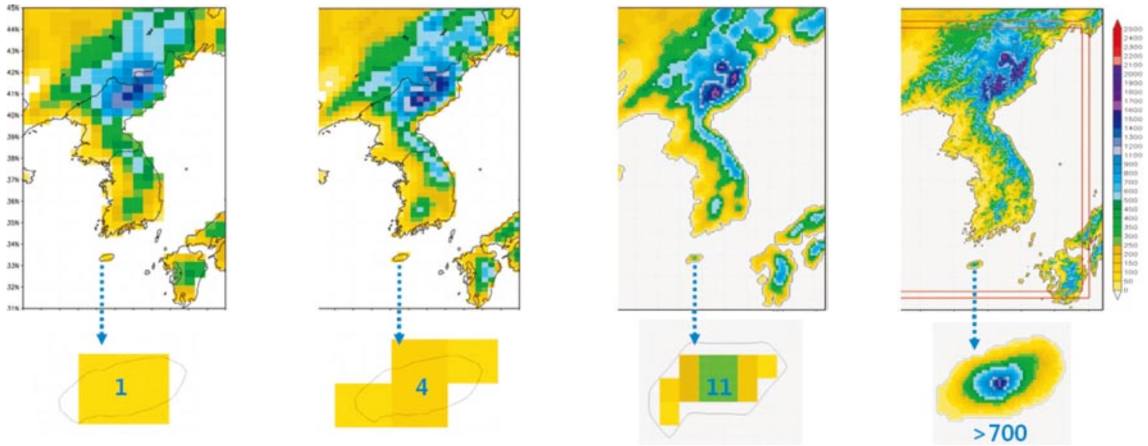
Graphical processing

Produces visualizations of NWP model output for effective analysis

Key Components of NWP Technology

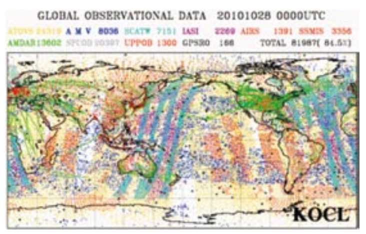
High Resolution NWP Model

The grid size of a model is called its spatial resolution. As models with higher resolution can depict finer-scale features, the transition to higher resolution models is a key component in improving forecast accuracy. Regional dangerous meteorological phenomenon such as severe rain storms, gusts and heavy snowfall with the potential to cause damage, serious social disruption, or loss of human life can have scales of a few kilometers or less. Thus, models with horizontal resolution of a few kilometers or less are required to forecast such phenomena.

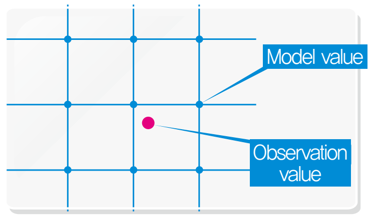


A high resolution NWP model with more realistic orographic forcing can provide much more detailed information. Increasing the spatial resolution, however, is extremely costly. In general, increasing the resolution of a model by a factor of two means about ten times as much computing power will be required.

Data Assimilation



▶ Observation data



▶ NWP model grid

Initial conditions representing current states are required to predict the weather using NWP models. The more accurate the initial conditions, the better the forecast quality. The process of combining observations and short-range forecasts to obtain initial conditions is called data assimilation. Data assimilation provides the gridded initial conditions required by the model by merging model data with various observations (for example synoptic observations, satellite and radar data) irregularly distributed in space and time.

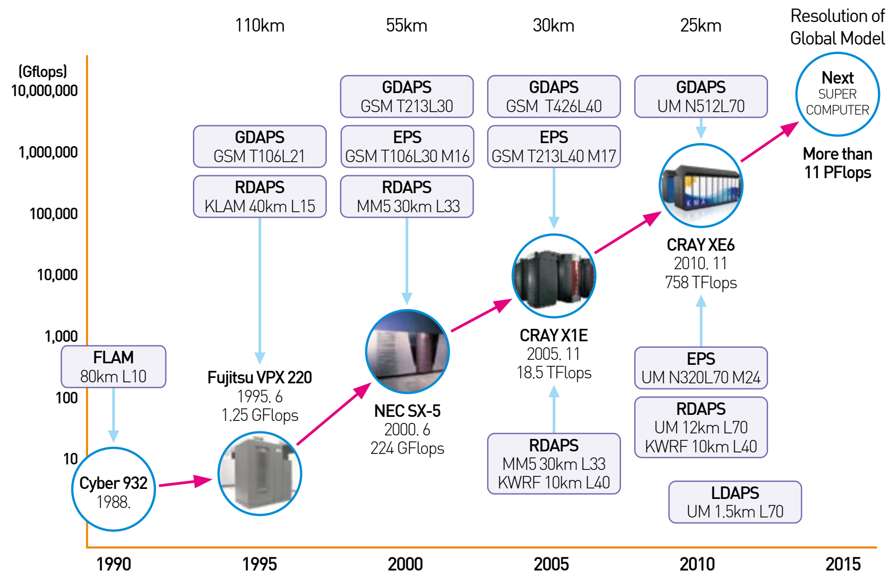
The current global NWP model operated by the Korea Meteorological Administration has more than 55 million grid points, but there are typically only 100 thousand observations - two orders of magnitude fewer than the number of grid points of the model.

The ability to make reliable forecasts requires both that NWP models can represent the atmosphere realistically, and that initial conditions be known accurately. High resolution models with poor quality initial conditions may lead to inaccurate weather forecasts.

History of NWP in Korea

History of NWP in Korea

Sweden, the U.S. and Japan began operational numerical weather prediction in the 1950s, but in Korea operational NWP was not begun until the late 1980s; almost 30 years later than the advanced countries. In 1985, KMA established a "Plan for operational numerical weather prediction", and began to analyze the numerical models of European countries such as Ireland and Sweden to develop models suited for Korea. In 1991, KMA started operational numerical prediction using ALAM (Asia Limited Area Model) and FLAM (Fareast Limited Area Model), which were the first operational models. KMA formed the 'Numerical Weather Prediction Division' to take charge of numerical weather prediction, and began operational numerical weather prediction and services in the late 1990s.



To operate the numerical prediction system, KMA introduced the CDC Cyber 932 in 1988 as the first computing server, and also used a supercomputer - the Cray-2S introduced by the Korea Institute of Science and Technology (KIST). KMA introduced the Fujitsu VPX 220 in 1995, and began to run the Global Data Assimilation and Prediction System (GDAPS) in 1997, which made it possible to open an era of independent numerical weather prediction.

Since KMA's 1st supercomputer was introduced in 1999, KMA has been operating high resolution numerical models running on supercomputers.

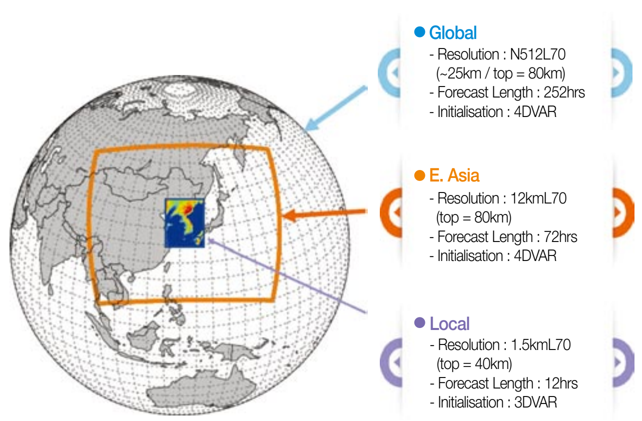
Year	Model	Horizontal Resolution	Levels	System
1991	Asia Limited Area Model (ALAM)	160km	10	CDC Cyber 932
	Fareast Limited Area Model (FLAM)	80km	10	KIST(SERI) Cray-2S
1993	Korea Limited Area Model (KLAM)	40km	16	KIST(SERI) Cray Y-MP
1997	Global Data Assimilation & Prediction System (GDAPS) T106L21	110km	21	Fujitsu VPX-220
1999	Regional Data Assimilation & Prediction System (RDAPS)	30km	33	KMA NEC SX-5
2001	Global Data Assimilation & Prediction System (GDAPS) T213L30	55km	30	KMA NEC SX-5
	Ensemble Prediction System (EPS) T106	110km	30	KMA NEC SX-5
2005	Global Data Assimilation & Prediction System (GDAPS) T426L40	30km	40	KMA CRAY X1E
	Ensemble Prediction System (EPS) T213	55km	40	KMA CRAY X1E
2011	Global Data Assimilation & Prediction System (GDAPS) N512L70	25km	70	KMA CRAY XE6
	Regional Data Assimilation & Prediction System (RDAPS) 12km L70	12km	70	KMA CRAY XE6
	Ensemble Prediction System (EPS) N320	40km	70	KMA CRAY XE6
2012	Local Data Assimilation & Prediction System (LDAPS) 1.5km L70	1.5km	70	KMA CRAY XE6

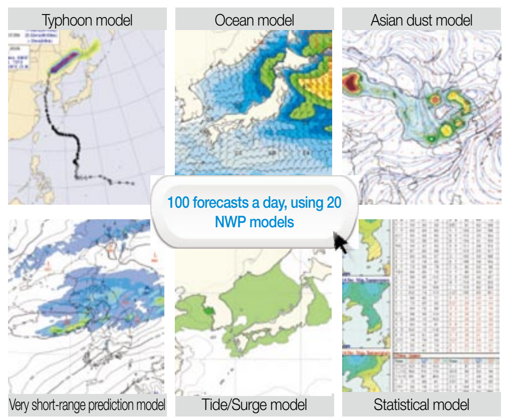
Current Status for NWP models at KMA

Current Status for NWP Models at KMA

Using the 3rd supercomputer, KMA runs more than 100 short and medium-range forecasts a day, using 20 NWP models. In addition, the supercomputer is also used to run models for long-range forecasting and climate research.

KMA's NWP system for short and medium-range forecasting combines a global model, 2 regional models, a local model, and various application and statistical models. The global model (UM N512L70) is at the core of the forecasting system, predicting weather for the entire globe without any boundary conditions. The regional models carry out their predictions using boundary conditions from the global model. The regional models for East Asia include UM 12km L70 and KWRF 10km. A UM 1.5 km high resolution local model is run to forecast potentially dangerous weather on the Korean Peninsula.





Model			Horizontal Resolution	Levels	Forecast Length	Remarks
Global Data Assimilation & Prediction System (GDAPS)			25km	70	10.5 days	Medium-range prediction for the globe
Ensemble Prediction System (EPS)			40km	70	10 days	
Regional Data Assimilation & Prediction System (RDAPS)			12km	70	72 hours	Short-range prediction for East Asia
Regional model (KWRF)			10km	40	72 hours	
Local Data Assimilation & Prediction System (LDAPS)			1.5km	70	24 hours	Prediction of potentially dangerous weather on the Korean Peninsula
Korea Local Analysis & Prediction System (KLAPS)			5km	22/40	12 hours	Very short-range prediction for the Korean Peninsula
Application and statistical model	Wave model	GWW3	60km	-	10.5 days	Prediction of global wave heights
		RWW3	8km	-	72 hours	Prediction of Asia wave heights
		CWW3	1km	-	24 hours	Prediction of coastal wave heights
	Regional Tide / Surge Model (RTSM)		8km	-	72 hours	Prediction of Asia wave heights
	Asian Dust Aerosol Model (ADAM2)		30km	-	72 hours	Prediction of Asian dust
	Typhoon model (DBAR)		35km	-	72 hours	Prediction of strength and path of typhoons
	Digital Forecast / Statistical model		-	-	2~10 days	Prediction of temperature, precipitation probability

Impact of NWP models

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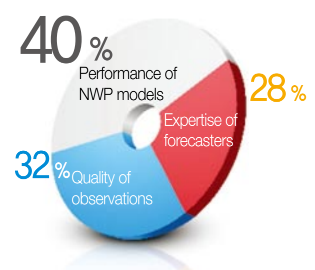
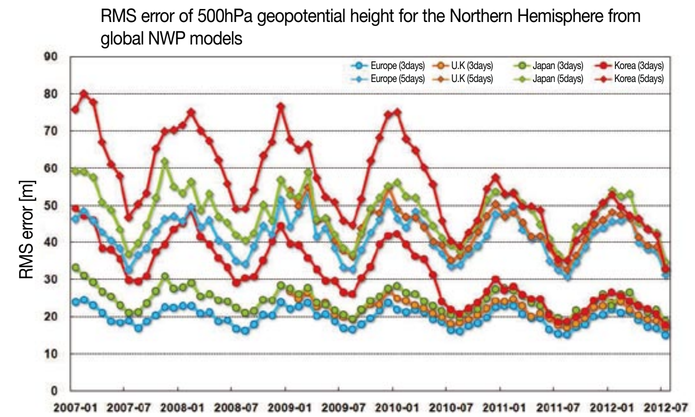
NWP changed the paradigm of weather forecasting to become more scientific and objective. Before NWP began, weather forecasting was subjective and based on the expertise of human forecasters.

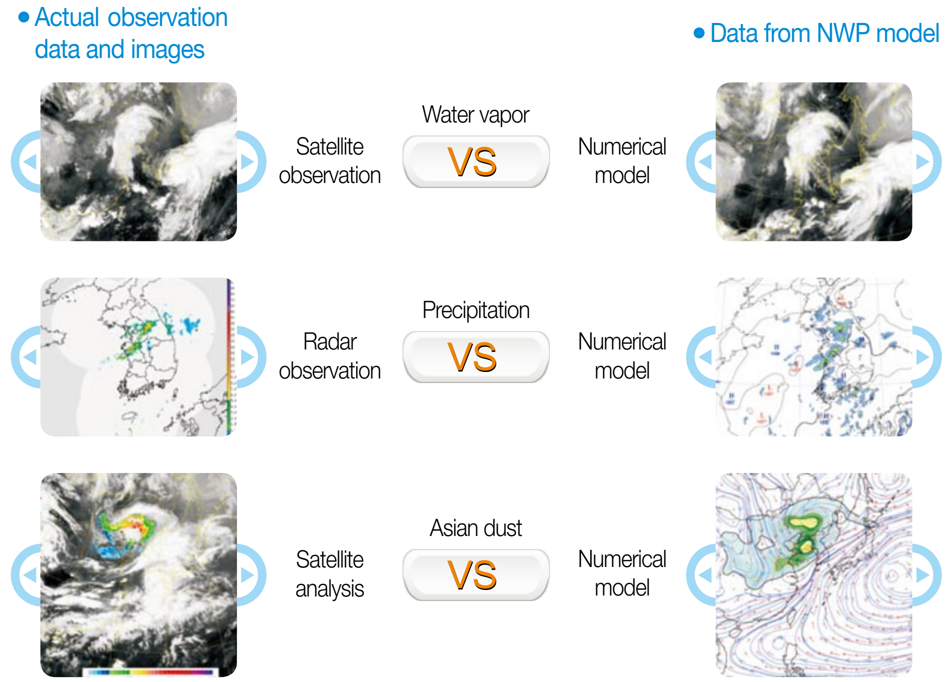
According to a recent analysis, the performance of numerical models and the quality of the observations and systems used to produce the initial conditions account for around 72% of the skill of weather forecasts.



▶ Factors affecting the weather forecast



The accuracy of our numerical weather prediction has greatly improved recently. Our 2010 upgrade - including the introduction of the 3rd supercomputer, new NWP models, and greater observation usage – brought our performance into line with other advanced countries.



Social Contributions of NWP and Supercomputing

Social Contributions of NWP and Supercomputing

Spreading Effects to Society and the Economy

The analysis and prediction information produced by supercomputers supports scientific and optimized decision making for national policy and potentially dangerous situations such as natural disasters. For such purposes, various information not only for the atmosphere, but also the earth system including the ocean, biosphere and cryosphere is required. This information is used in various areas to protect people's lives and assets from disasters, to respond to climate change, to manage water resources and energy, and to manage and protect ecosystems etc..

Supporting developing countries with numerical model prediction data

- 309 cities from 28 countries (twice a day)
- Korea changed from an aid recipient to a donor country

Responding to climate change

- Producing climate change scenarios to establish national plans for response to climate change

National Center for Meteorological Supercomputer together with the people of Korea

The National Center for Meteorological Supercomputer conducts various activities to operate the meteorological supercomputers effectively, and to increase the use of supercomputers in meteorological society.

Courses teaching Fortran and parallel programming to supercomputer users receive good responses from employees in KMA, and also researchers in university atmospheric science departments and other institutes. In addition, the supercomputer center shares experience and knowledge related to numerical models and supercomputing through workshops, external affairs and field trips with many institutes and organizations at home and abroad.

Education

Events and Workshops

Field trips