The Development of Modeling, Simulation and Visualization Services for the Earth Sciences in the National Supercomputing Center of Korea

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Supercomputing Service Center
National Institute of Supercomputing & Networking
Korea Institute of Science and Technology Information

Presentation Outline

- Government supported Research Institute
- Personnel : About 350
- Annual revenue : USD 120M
- Location : Daejeon

I **Infrastructure**

Supercomputer, Network

II **User Support**

Users, Requirements, Services

III **Achievements**

Modeling, Simulation, Visualization

IV **Future Plans**

Decision Making Support System

I.1 Supercomputer (1/2)

2016 ?
30PF ?

1988	1993	2001	2008
1st	2nd	3rd	4th

2 GF
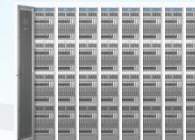
Cray-2S
1st SC System
in Korea
until 1993

16 GF

Cray C90
2nd SC System
in Korea
until 2001

80 GF

NEC SX-5
3rd SC System
in Korea
until 2008

240 GF

NEC SX-6
3rd SC System
in Korea
until 2008

2.85 TF

IBM e1350

24.1 TF

Sun C48 cluster
4th SC System

297.3 TF

Sun C48 cluster
4th SC System

1988	1993	1997	2000	2001	2002	2003	2008	2009
2GF	16GF	131GF	242GF	786GF	5.2 TF	8.6 TF	29.9 TF	358.0 TF

Cray T3E

115 GF

HP GS320
HPC160/320

111 GF

PC Cluster
128node

435 GF

IBM p690
3rd SC system
in Korea
until 2009

4.36 TF

IBM p690+
3rd SC System
in Korea
until 2008

3.7 TF

IBM p595
4th SC System

5.9 TF

IBM p595
4th SC System

30.7 TF

I.1 Supercomputer (2/2)

KISTI Machine Room

Total 358.0 TF

Nick Name	GAIA 1	GAIA 2	TACHYON 1	TACHYON 2
Processor Type	POWER5+ 2.3 GHz	POWER6 5.0 GHz	AMD B. 2.0 GHz	Intel X5570 2.93 GHz
No. of Node	10	24	192	3200
No. of Core	640	1,536	3,008 (3,072)	25,408 (25,600)
Peak Performance (TF)	5.9	30.7	24.1 (24.6)	297.3 (299.5)
Disk Storage (TB)	63	273	203	1203
Official Service Open	Jan., 2008	Oct., 2009	Sep., 2008	Jan., 2011
Operation Period	6 year	4 year	5 year	3 year
Service Close (plan)	June, 2014	Dec., 2014	Dec., 2015	?

I.2 Network (1/2)

KREONET **K**orea **R**esearch **E**nvironment **O**pen **NET**work
National Research Network for R&D community in Korea
National-wide Optical Gigabit Network Facility *(10~200Gbps)*
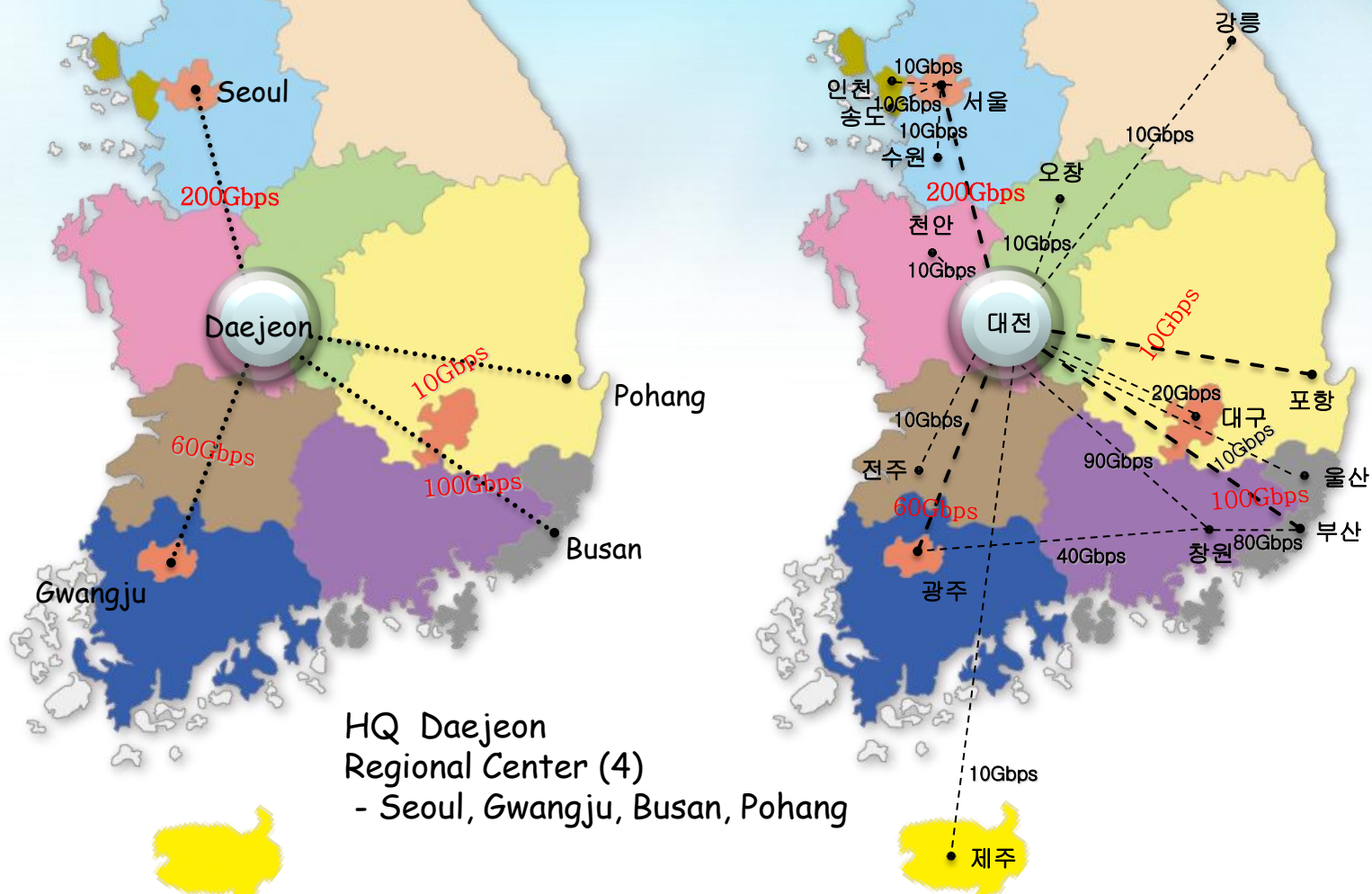
HQ Daejeon
Regional Center (4)
 - Seoul, Gwangju, Busan, Pohang

I.2 Network (2/2)

GLORIAD **GLO**bal **RI**ng Network for Advanced Application Development
Global Research Network for R&D community in the world
World-wide Optical Gigabit Network Facility *(10Gbps)*

GLORIAD
USA-Russia-China-Korea-(Canada-Netherlands)
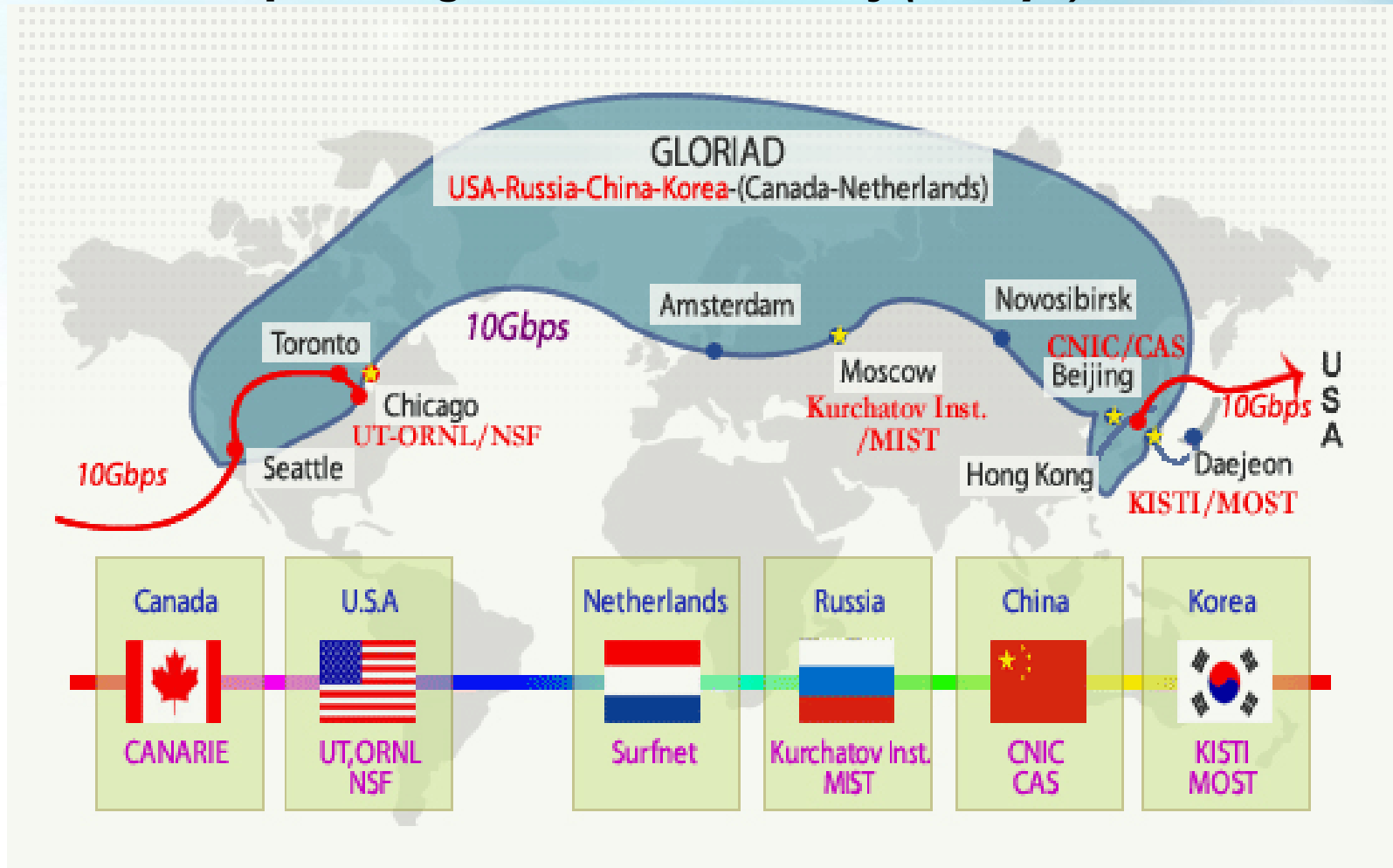
II.1 Major Users

	Operation	**Research**
ATMOS.	대한민국공군 REPUBLIC OF KOREA AIR FORCE Dedicated nodes (gaia1- 2, gaia2 -1) K water 한국수자원공사 Korea Water Resources Corporation Dedicated nodes (tachyon2 – 200)	PUKYONG NATIONAL UNIVERSITY 뉴경대학교 VERI LUX TAS MEA 부산대학교 PUSAN NATIONAL UNIVERSITY KOPRI Korea Polar Research Institute
A / O	기상청 Korea Meteorological Administration nimr 국립기상연구소 KISTI is a KMA's Backup Site.	Dedicated nodes (tachyon2 – 250) YONSEI UNIVERSITY 1885 JEJU NATIONAL UNIVERSITY 1952 제주대학교 Dedicated nodes (tachyon2 – 100)
Ocean	국립해양조사원 National Oceanographic Research Institute Dedicated nodes (tachyon2 – 200)	KUNSAN NATIONAL UNIVERSITY KIOST KOREA INSTITUTE OF OCEAN SCIENCE & TECHNOLOGY

Providing

Scientific & Technological Support for

Modeling

Model Development

Simulation

Numerical Experiment

Visualization

Data Analysis
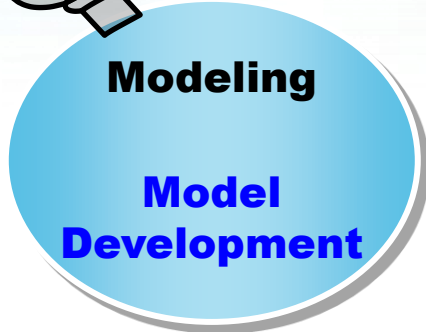
Huge Computing Resources
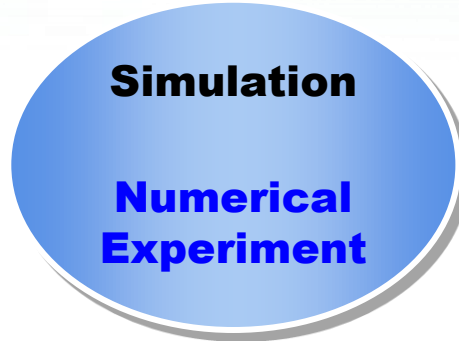
Easy Available Environment
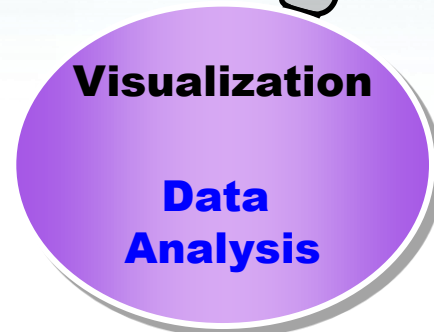
Realistic Visual Representation

Modeling

$$speed\ up(n) = \frac{single\ process\ run\ time}{multiple\ processes\ (n)\ run\ time}$$

Supporting Code Optimization & Providing Computing Resources
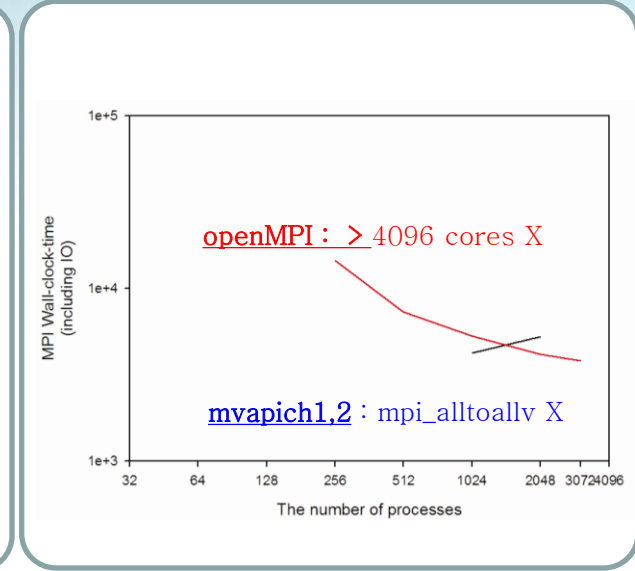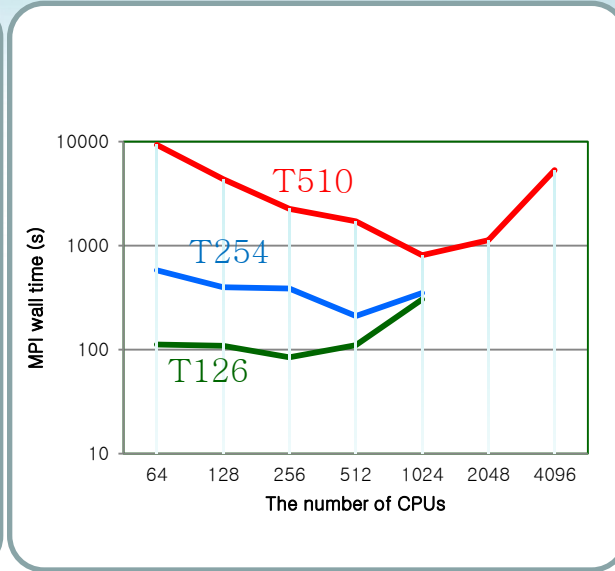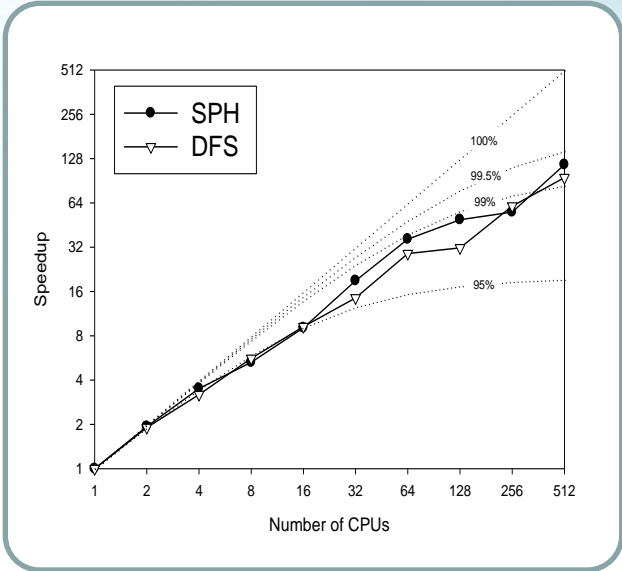
- Computing Resources (> 2000 cores ~ 24 TF)
- Parallel library & Optimization

- Model Development
- Model Operation

Simulation

Providing
Easy Available
Environment

Select computing system

Server environmental setup

Analysis simulation results

Display on Google Earth

Gaia2

Tachyon2

Web-Based User Interface, WUI
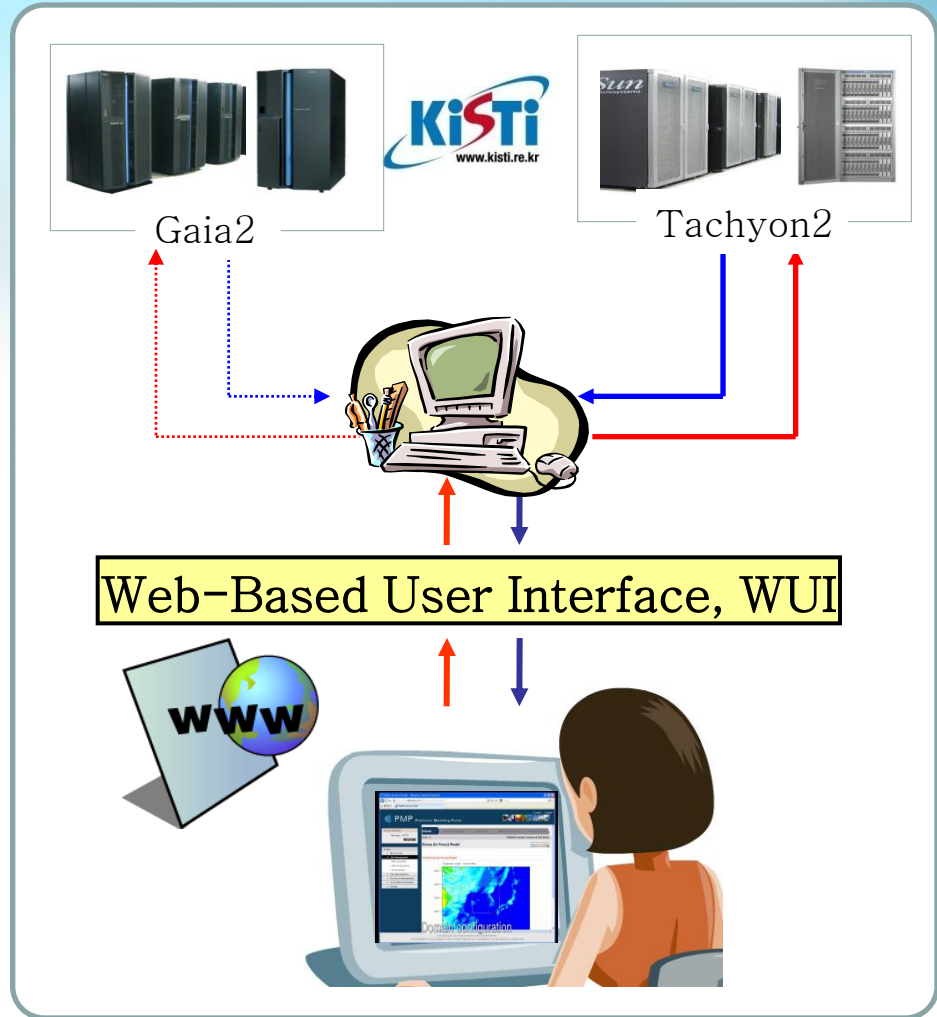
Visualization

Realistic
Visual Representation

AvizoGreen
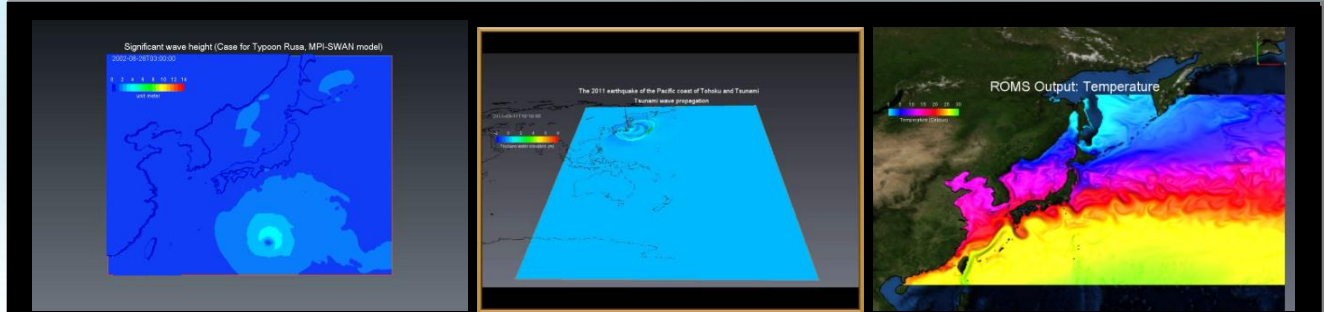
virtual Global explorer and observatory
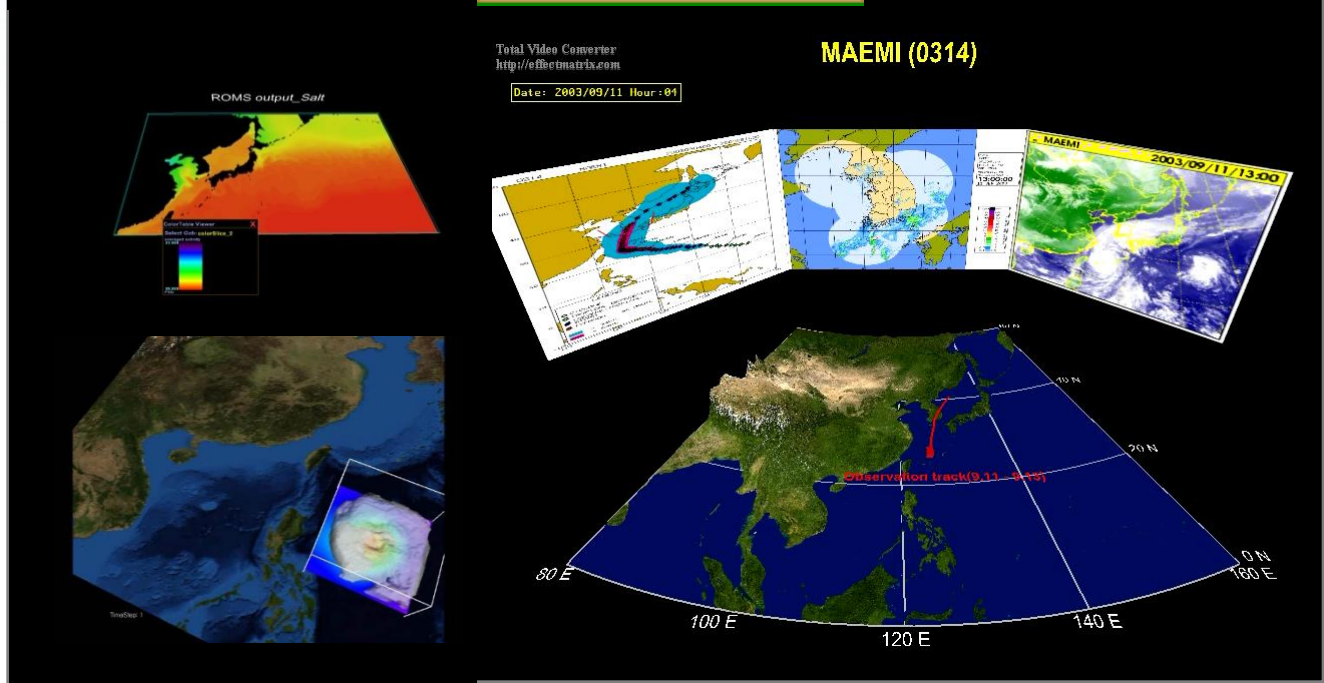
VAPOR
Visualization & Analysis Platform

III.1 Achievements (1/6)

Modeling

- ✓ Supporting the Development of the Numerical Model "GRIMs" (Global Regional Integrated Model system)
  - • Improving the Scalability of MPI code up to 4,000 cores with YONSEI University.

- ✓ Supporting the Ocean Data Assimilation System using "MOM4" (Modular Ocean Model 4)
  - • Memory Optimization of MPI code with Korea Institute of Ocean Science & Technology.

- ✓ Developing the High-resolution Regional Ocean Model based on MOM4
  - • Optimization up to 36*43 grids per the partitioned domain using 640 cores
  - • Getting ready for much high-resolution domains

Modeling

MODEL RESOLUTION
NORTH-PACIFIC: 1/12°
GLOBAL : 1/4°
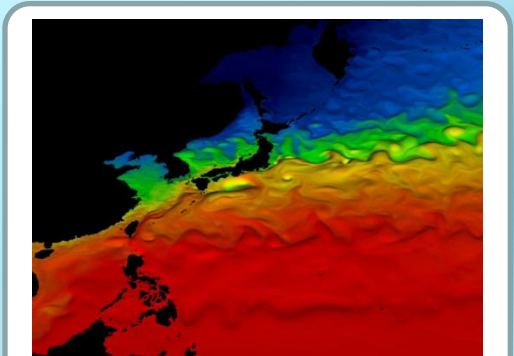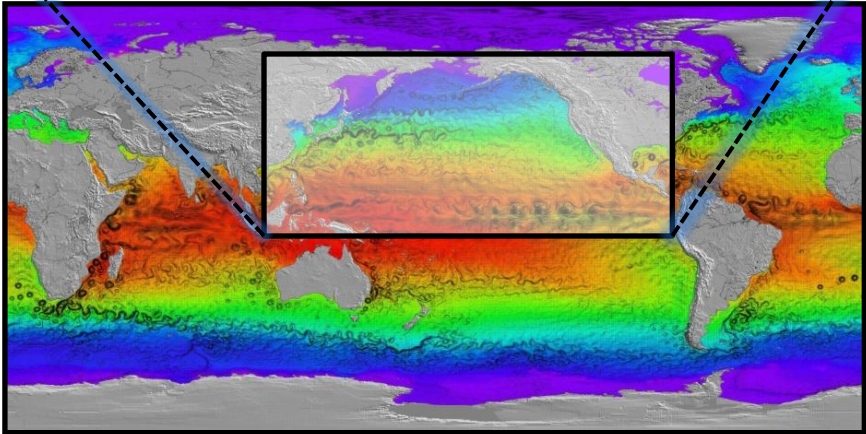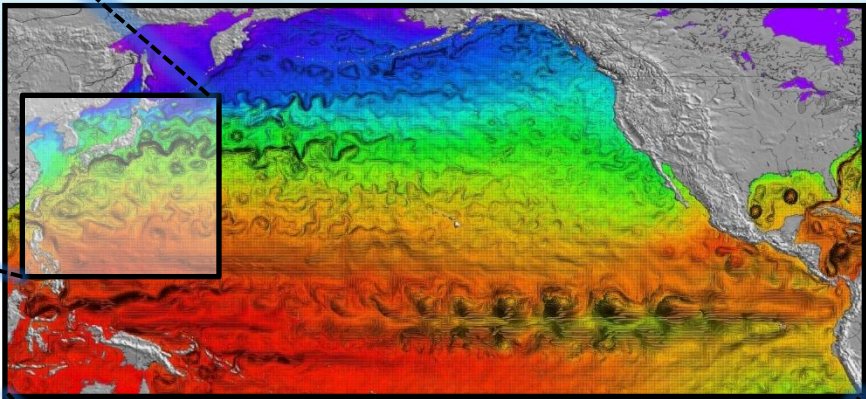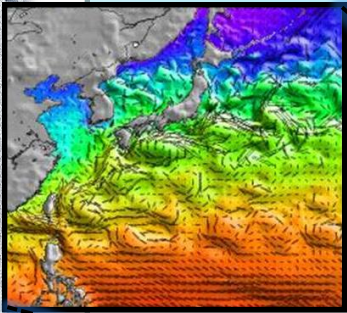
Provided by KIM @ YONSEI

CPU : 200 core
Memory : 100 GB

Provided by HONG @ YONSEI
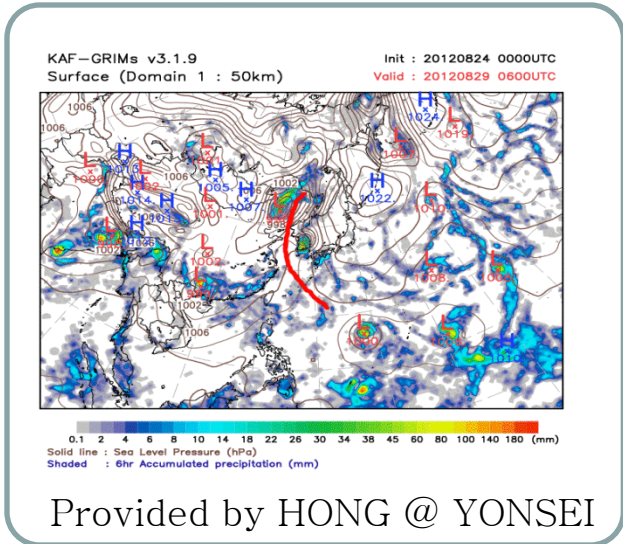
III.3 Achievements (3/6)

Simulation

Design & Implementation of Web/GRID Portals @ KSC

2001	2007	2008~2010	2011	2012	2013

2001.12.
CAM3 Web Portal
(new)

KSC 2nd
Supercomputer
(NEC SX-6)
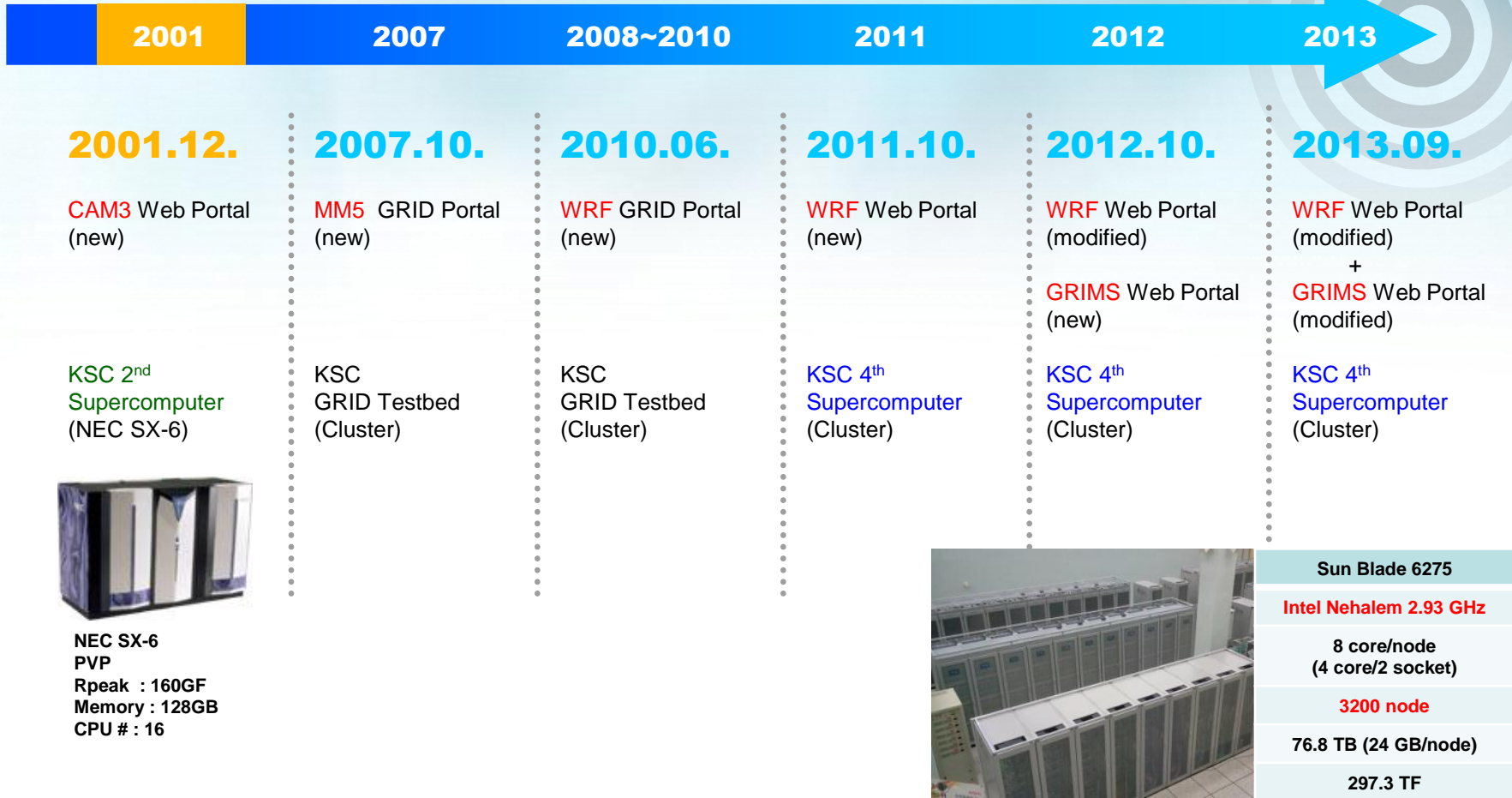
NEC SX-6
PVP
Rpeak : 160GF
Memory : 128GB
CPU # : 16

2007.10.
MM5 GRID Portal
(new)

KSC
GRID Testbed
(Cluster)

2010.06.
WRF GRID Portal
(new)

KSC
GRID Testbed
(Cluster)

2011.10.
WRF Web Portal
(new)

KSC 4th
Supercomputer
(Cluster)

2012.10.
WRF Web Portal
(modified)

GRIMS Web Portal
(new)

KSC 4th
Supercomputer
(Cluster)

2013.09.
WRF Web Portal
(modified)
+
GRIMS Web Portal
(modified)

KSC 4th
Supercomputer
(Cluster)

Sun Blade 6275
Intel Nehalem 2.93 GHz
8 core/node (4 core/2 socket)
3200 node
76.8 TB (24 GB/node)
297.3 TF

Simulation

Visualization

Realistic
Visual Representation

Communication, Ocean, Meteorological Satellite
(the 7th meteorological satellite in the world)
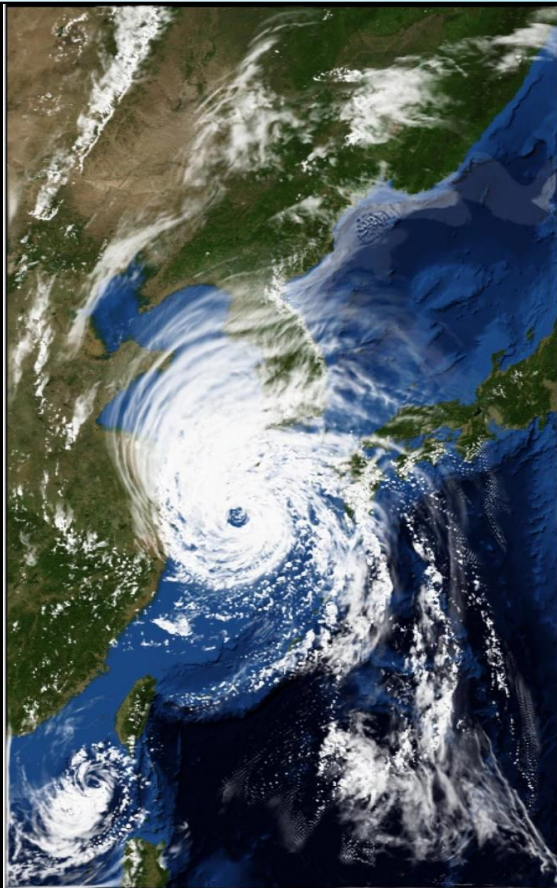
WRF Model Prediction
(2012-08-27 11:00 KST)
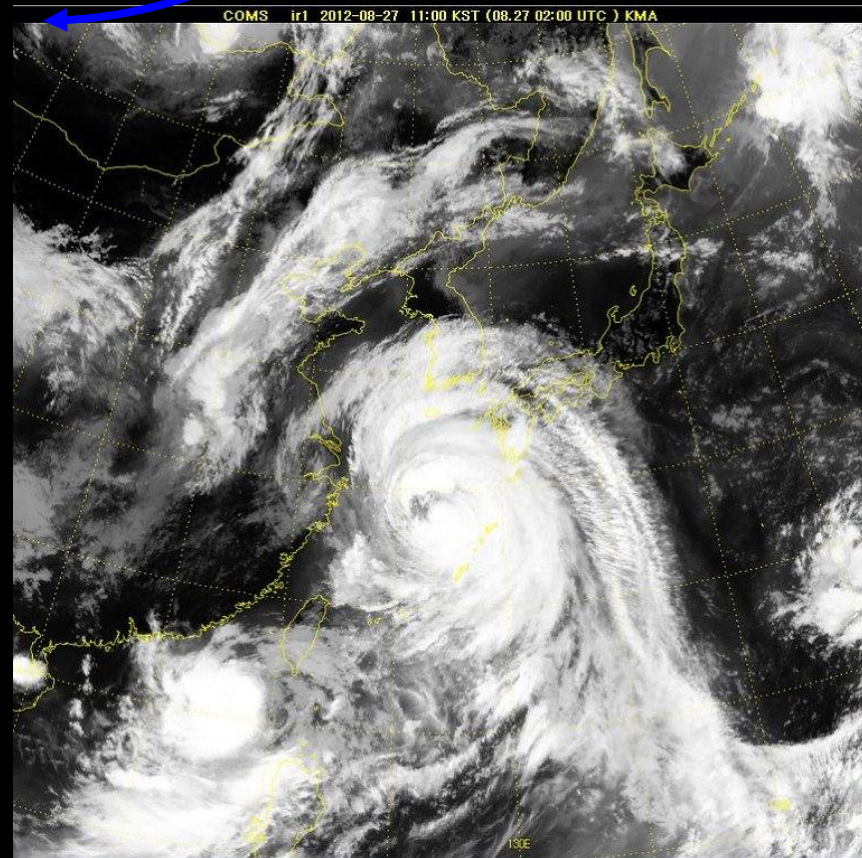
COMS Observation
(2012-08-27 11:00 KST)

Ocean
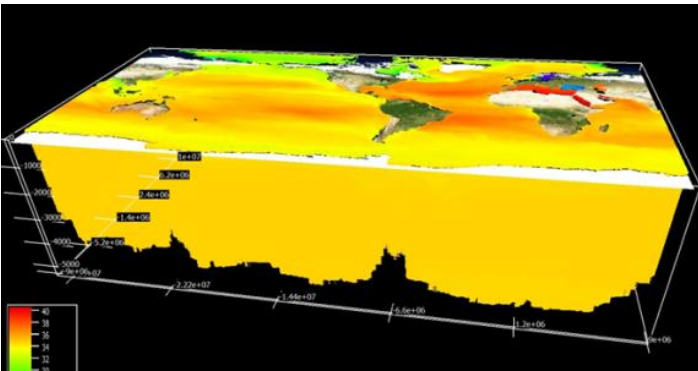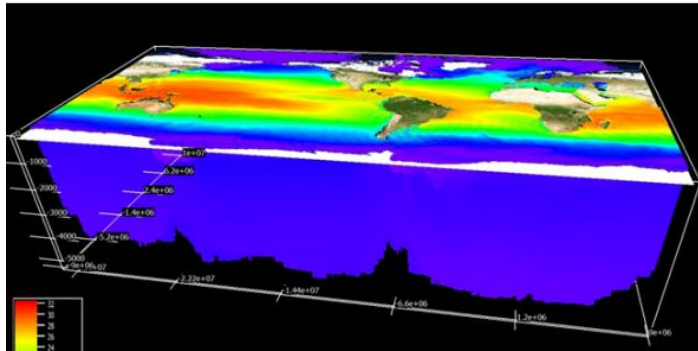
Atmosphere

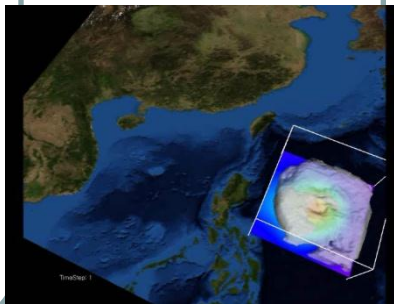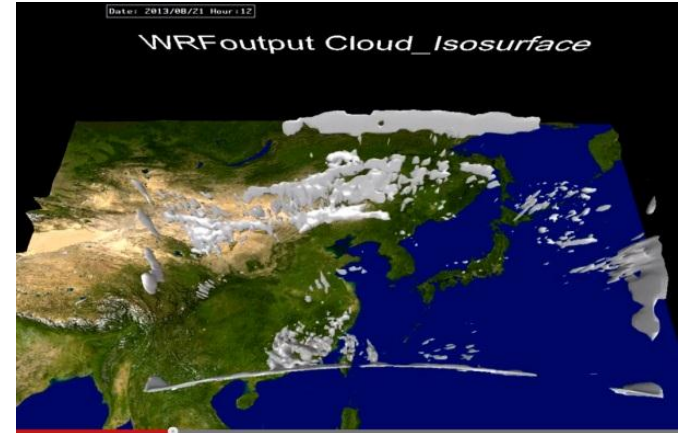Monthly mean potential temperature (upper)
and salinity (bottom) of January visualized
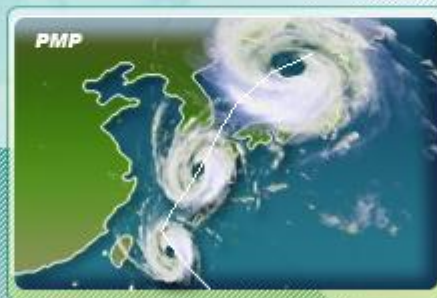by VAPOR2.2.4 (will be released soon)

Provided by CHAOS TEAM @ KISTI

태풍-홍수 재해대응
의사결정지원시스템

Decision Making Support System (Prototype)
In the preparation of Typhoon-induced flood-disaster

KGEOSS

PMP

Visualization

관측자료시스템

예측모델링시스템

자료표출시스템

Observation
Data Colleting System

Prediction
Data Generating System
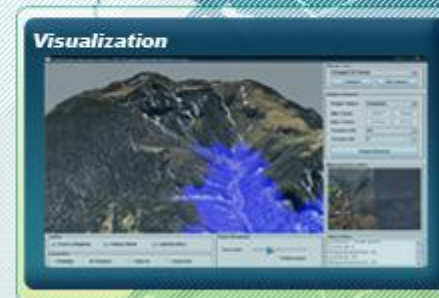
Analysis
Data Visualization System

Related to the Old Project: (Period) 2007 ~ 2010 (Fund) USD 2.2M for 2.5 year

Engineering Challenge : Design & Deployment

Observation → Prediction → Analysis → Visualization

Decision Making Support System, DMSS
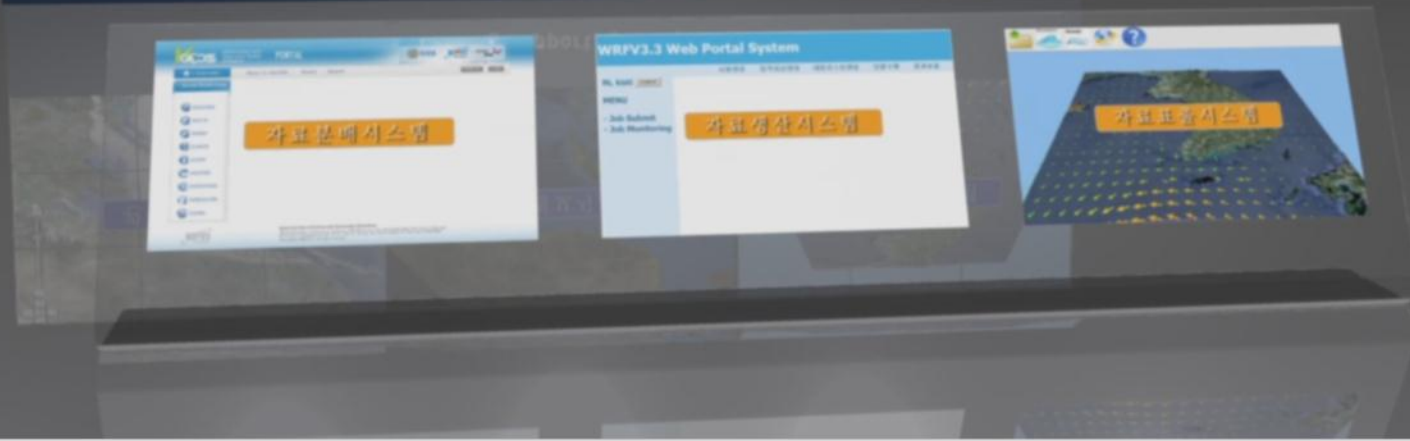
Related to the New Project: (Period) 2014 ~ 2018 (Fund) USD 3M for every year

IV. 2 Fine Resolution Modeling

Scientific Challenge : Accuracy Improvement
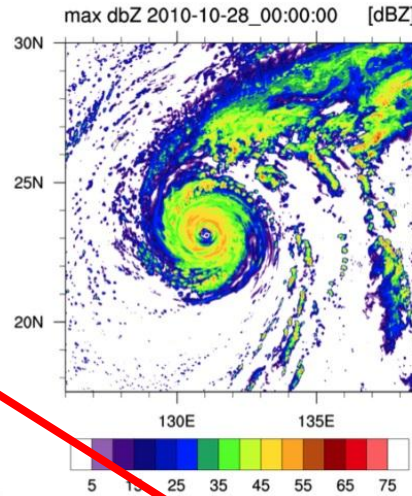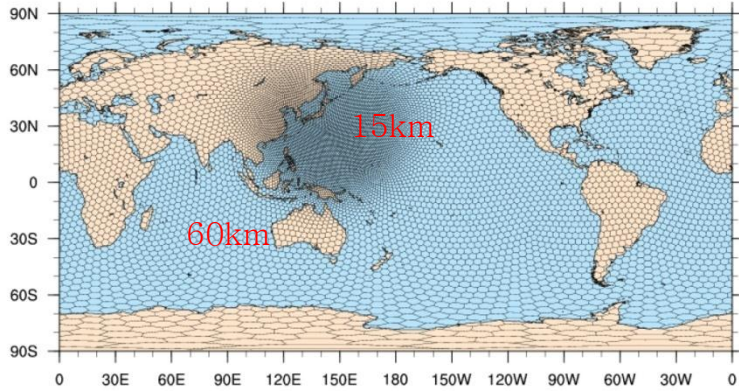
Model Development
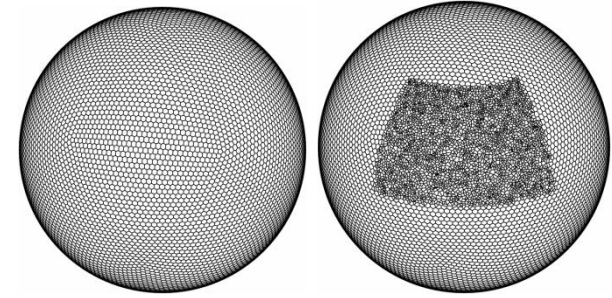
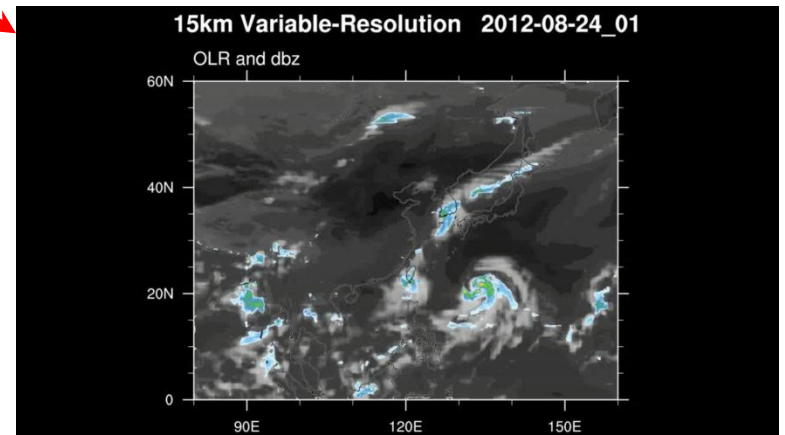
Next Generation
Weather Prediction Model (MPAS)

Model Validation
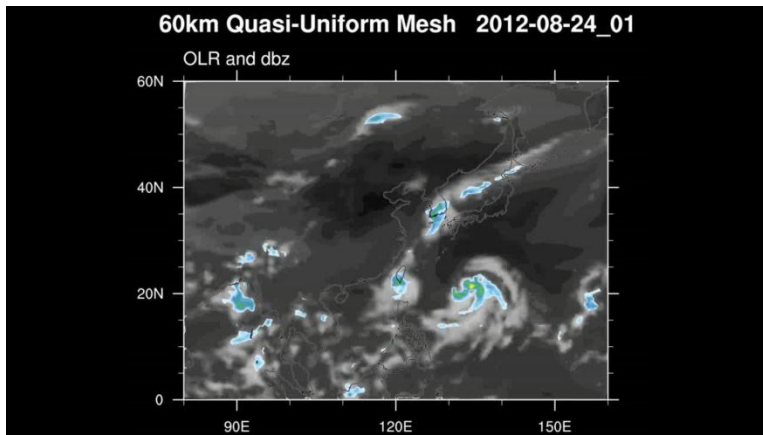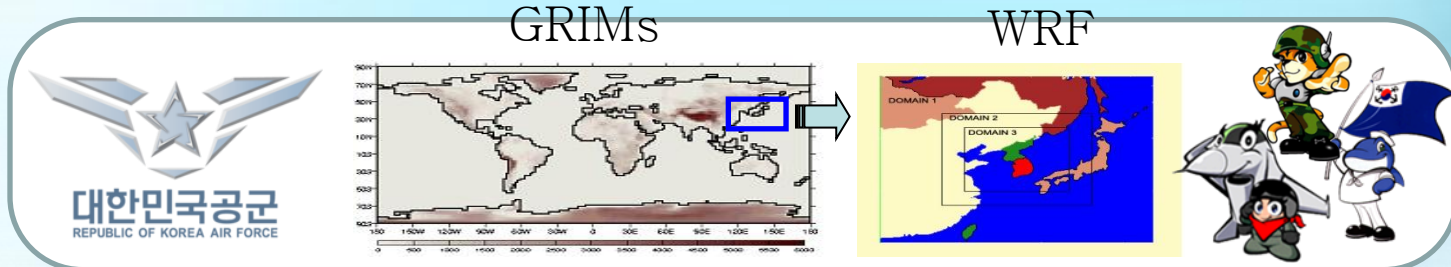
Typhoon Simulation

Bolaven & TEMBIN

Done by SHPark (NCAR Scientist) using KISTI Supercomputer (August 22, 2013)

IV.3 Coupling Simulation (Portals)

GRIMs   WRF

Coupling of
KSC-GRIMs & KSC-WRF portal
→ WRF can use GRIMs Output directly

IV.4 Realistic Visualization
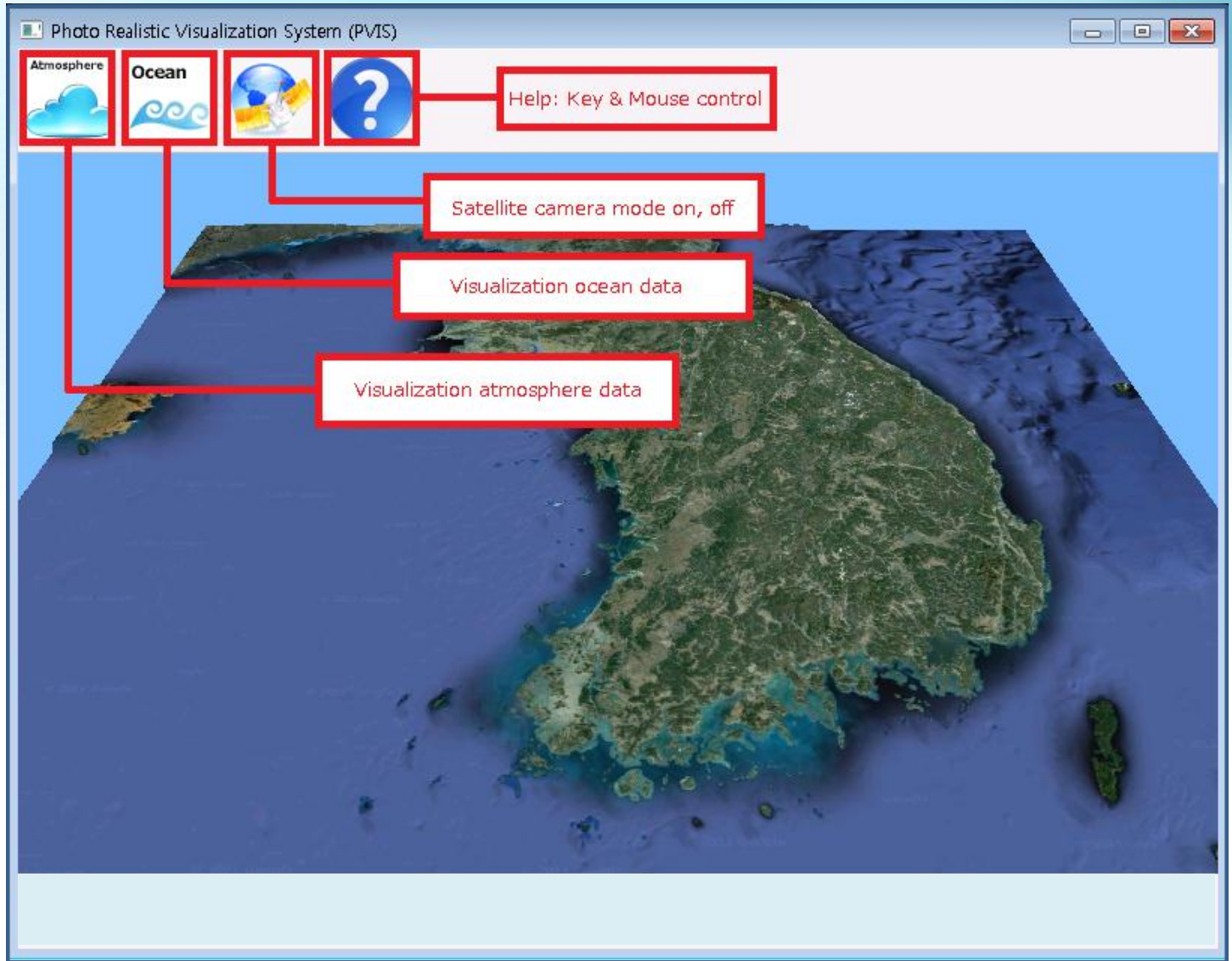

Ocean 1

Ocean 2

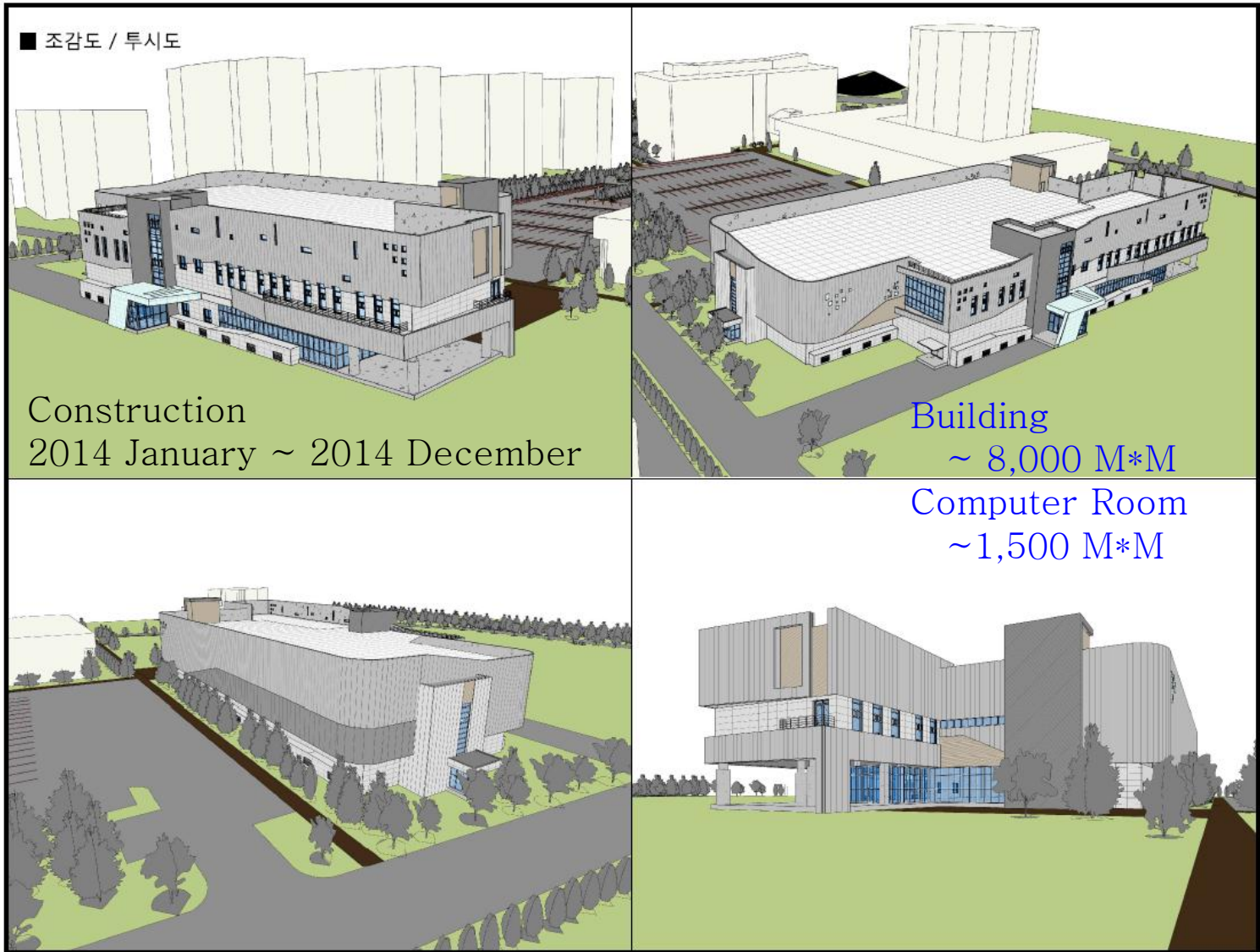Flying Mode

Satellite Mode

Flying

Flood

KISTI New Computer Building

조감도 / 투시도

Construction
2014 January ~ 2014 December

Building
~ 8,000 M*M
Computer Room
~1,500 M*M

Thank You !

http://chaos.ksc.re.kr