2016 Space Weather Week

NATIONAL RADIO RESEARCH AGENCY

R.O.K. Space Weather Operation

28 April 2016

NATIONAL RADIO RESEARCH AGENCY

KiChang Yoon, Sunhak Hong, Young-O Choi, Gwan-sik Wi

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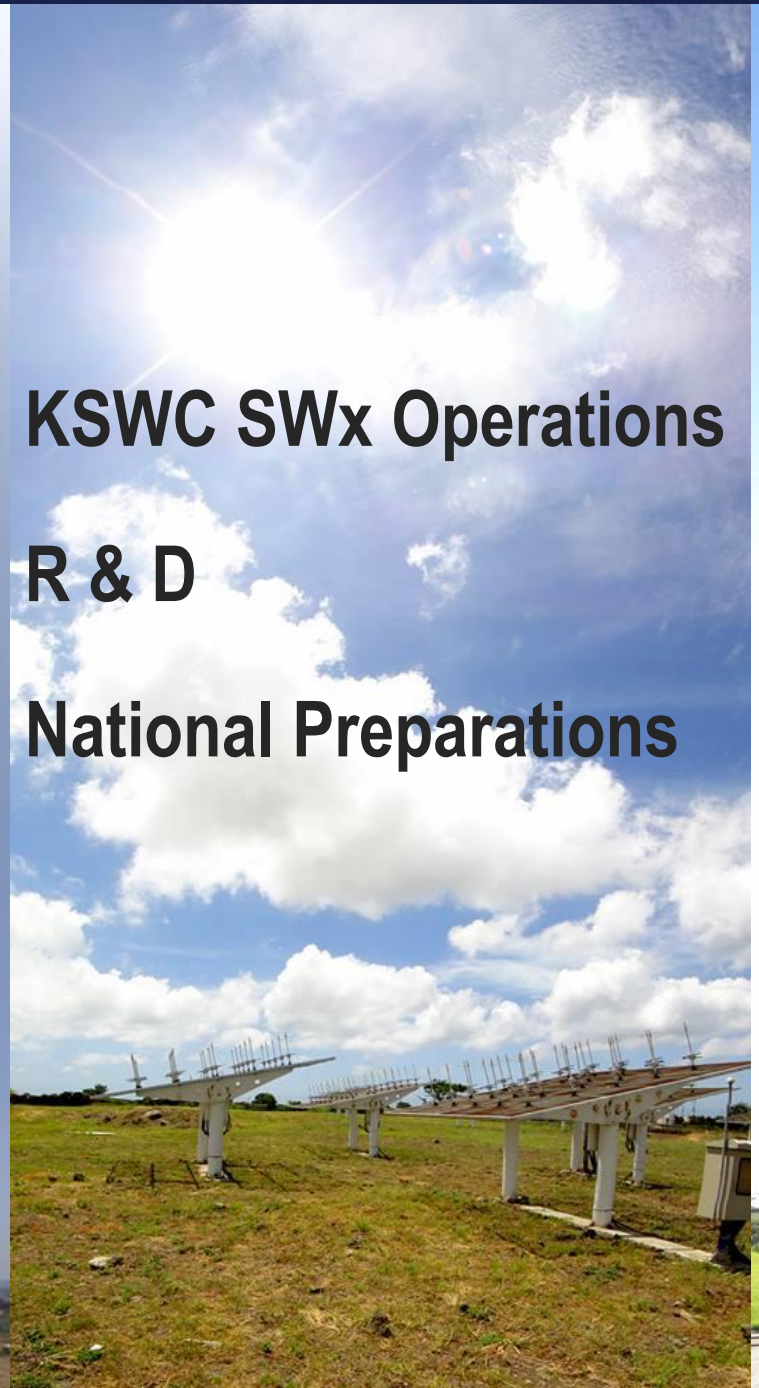


1. KSWC SWx Operations

2. R & D

3. National Preparations

R.O.K Space Weather Capability

NATIONAL RADIO RESEARCH AGENCY
KOREAN SPACE WEATHER CENTER

Official agency for space weather forecast & alert in US

SPACE WEATHER PREDICTION CENTER

Operation Center for space weather Forecast & Alert, R&D

- Support USG Space program
- R&D

Official source to deliver space weather products & services in Korea

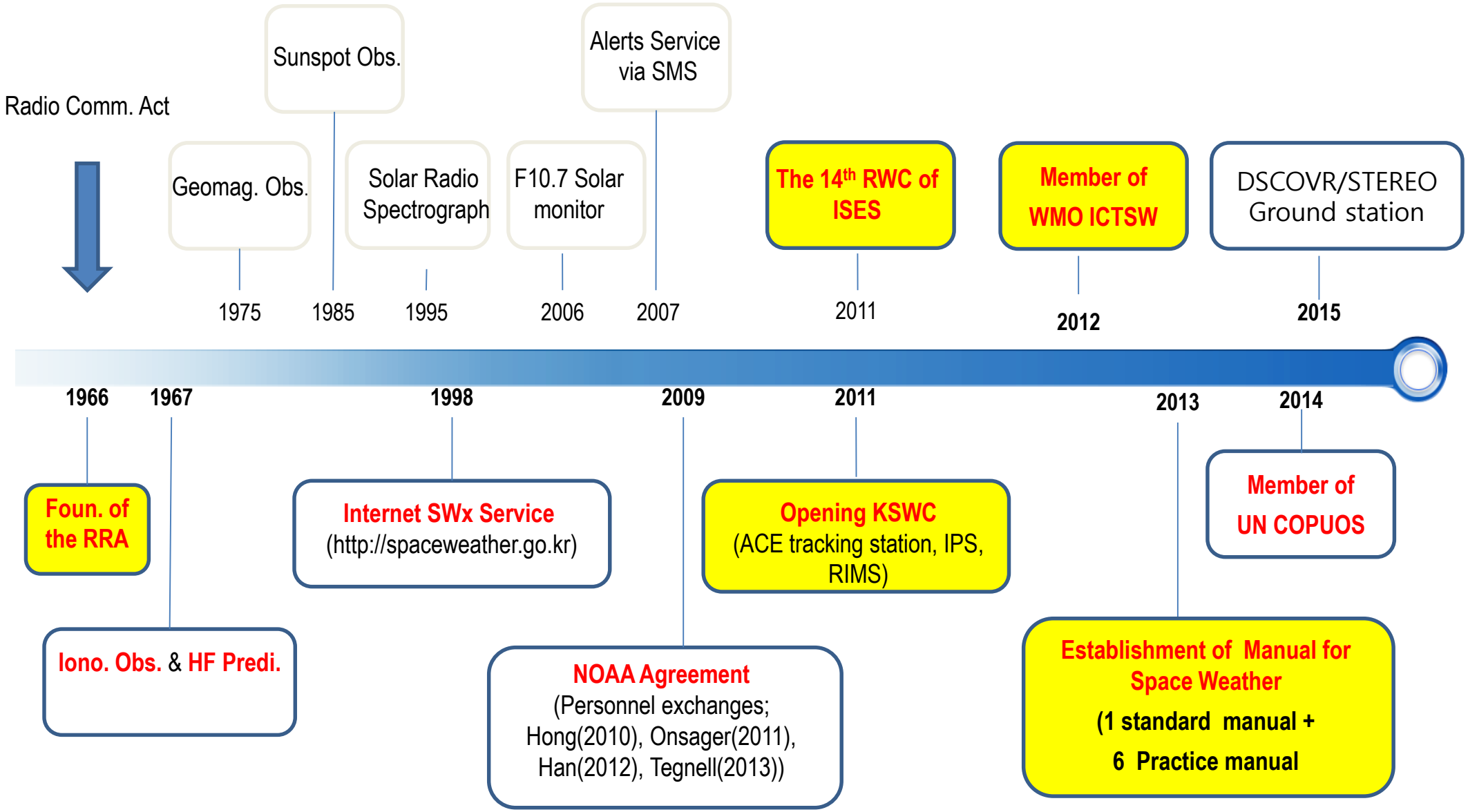
KOREAN SPACE WEATHER CENTER (KSWC)

Operation Center Forecast & Alert, R&D, Observation

- Space weather effect on (terrestrial) climate, weather, meteorological satellite
- R&D
- Research on ionosphere, mesosphere in polar region

RRA Space Weather

NATIONAL RADIO RESEARCH AGENCY
KOREAN SPACE WEATHER CENTER



KSWC Overview

NATIONAL RADIO RESEARCH AGENCY
KOREAN SPACE WEATHER CENTER

➢ **The primary action agency of emergency measure to severe SWx, and the RWC Korea of International Space Environment Service**

MSIP MINISTRY OF SCIENCE, ICT AND FUTURE PLANNING

└ **RRA** NATIONAL RADIO RESEARCH AGENCY

└ **KSWC** KOREAN SPACE WEATHER CENTER

Since August 2011

- Planning Division
- R&D Division
- Forecast Division
- Observation Division

ISES

2011

Regional Warning Center
Sunhak Hong

World Meteorological Organization

2012

Member of ICTSW
KiChang Yoon

COPUOS

2014

Delegate for Space Weather
Sunhak Hong

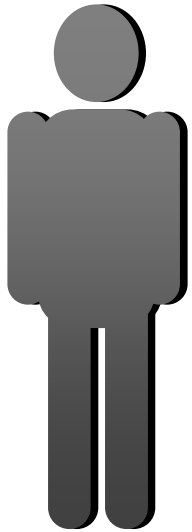
ITU

1980S~

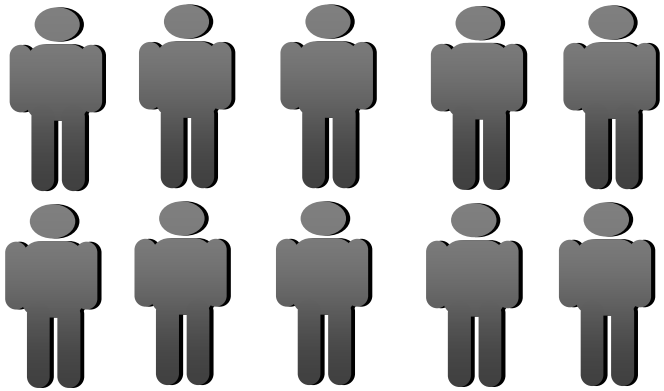
Leading Agency of ROK
JunChel Moon

KSWC Global Partner

Since 2011…



80 times



2 times

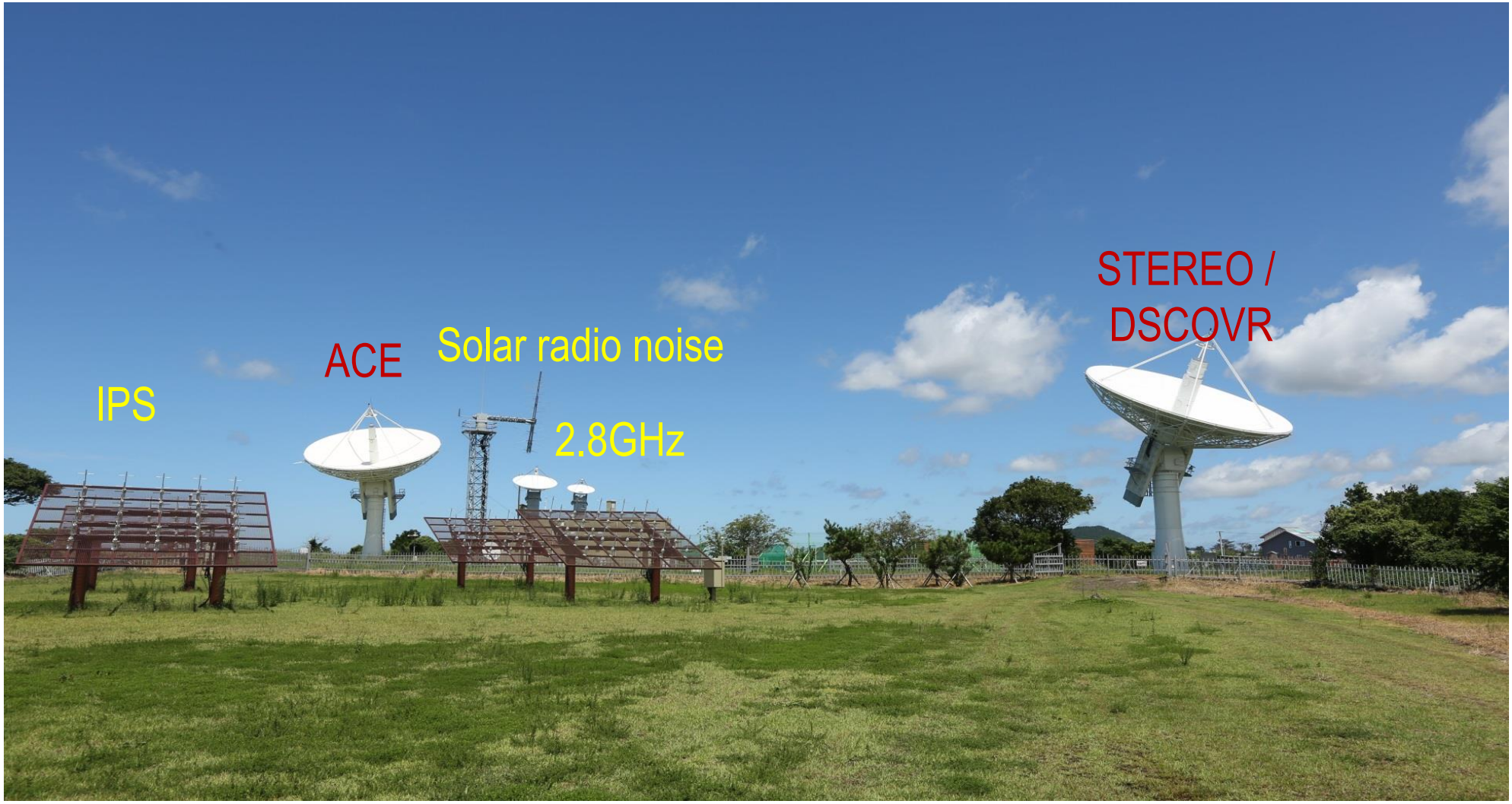
Total of observation Fac. : 20

KSWC Operations – Observation network

NATIONAL RADIO RESEARCH AGENCY
KOREAN SPACE WEATHER CENTER

KSWC Operations – Observation at Jeju

NATIONAL RADIO RESEARCH AGENCY
KOREAN SPACE WEATHER CENTER



KSWC Operations – operational work flow

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KOREAN SPACE WEATHER CENTER

Observation

Ground Based

- Ionosondes (x2) & TEC (x5)
- Mag (x3)
- SRS (30MHz~2.5GHz)
- F10.7 Meter
- IPS
- RIMS (30MHz~18GHz)
- GIC Monitor (x3)

Space

- ACE, DSCOVR, STEREO Tracking

Products

Alerts & White Alerts

3-hourly Condi. & Forecast

3-day Forecast(daily)

27-day Forecast(weekly)

HF Prediction(monthly)

Models & Services

ASSA, IPS-Enlil, NAIRAS, IRI-VOACAP, GIC, etc. (29ea.)

SMS · Email · WWW · FAX

Customers

- Satellite
- Comm.
- Defense
- Aviation
- Power

KBS · olleh kt · KARI · SaTReC · MBC · tu · SK telecom · 한국아마추어무선연맹 THE KOREAN AMATEUR RADIO LEAGUE · 합동참모본부 · nis 국가정보원 · 항공교통센터 · KOREAN AIR · ASIANA AIRLINES · MOTIE MINISTRY OF TRADE, INDUSTRY & ENERGY · 한국전력공사

KSWC Operations – GIC monitoring

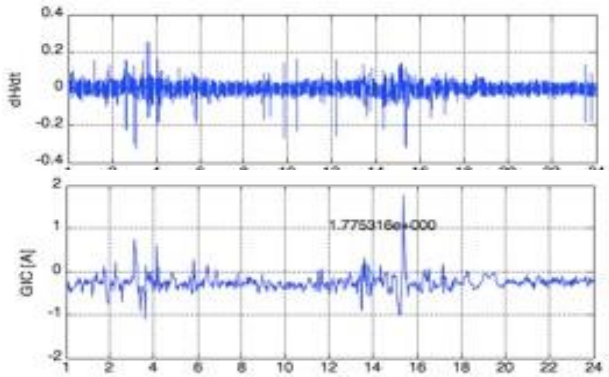
➢ GIC Measurement & Analysis

- ✓ GIC monitoring over 765KV & 154KV transmission facilities
- ✓ the first GIC monitoring systems in Korea
- ✓ 10A GIC was recorded during G3 storm period of Oct 2012

***765KV** (Singapyung, Oct. 2012)*

765KV (Sintaebak, 2Q. 2013)

154KV (Jeju, 2Q. 2013)



HIOKI SENSOR UNIT 9555-10

HIOKI UNIVERSAL CLAMP ON CT 9279

KSWC Operations – R & D

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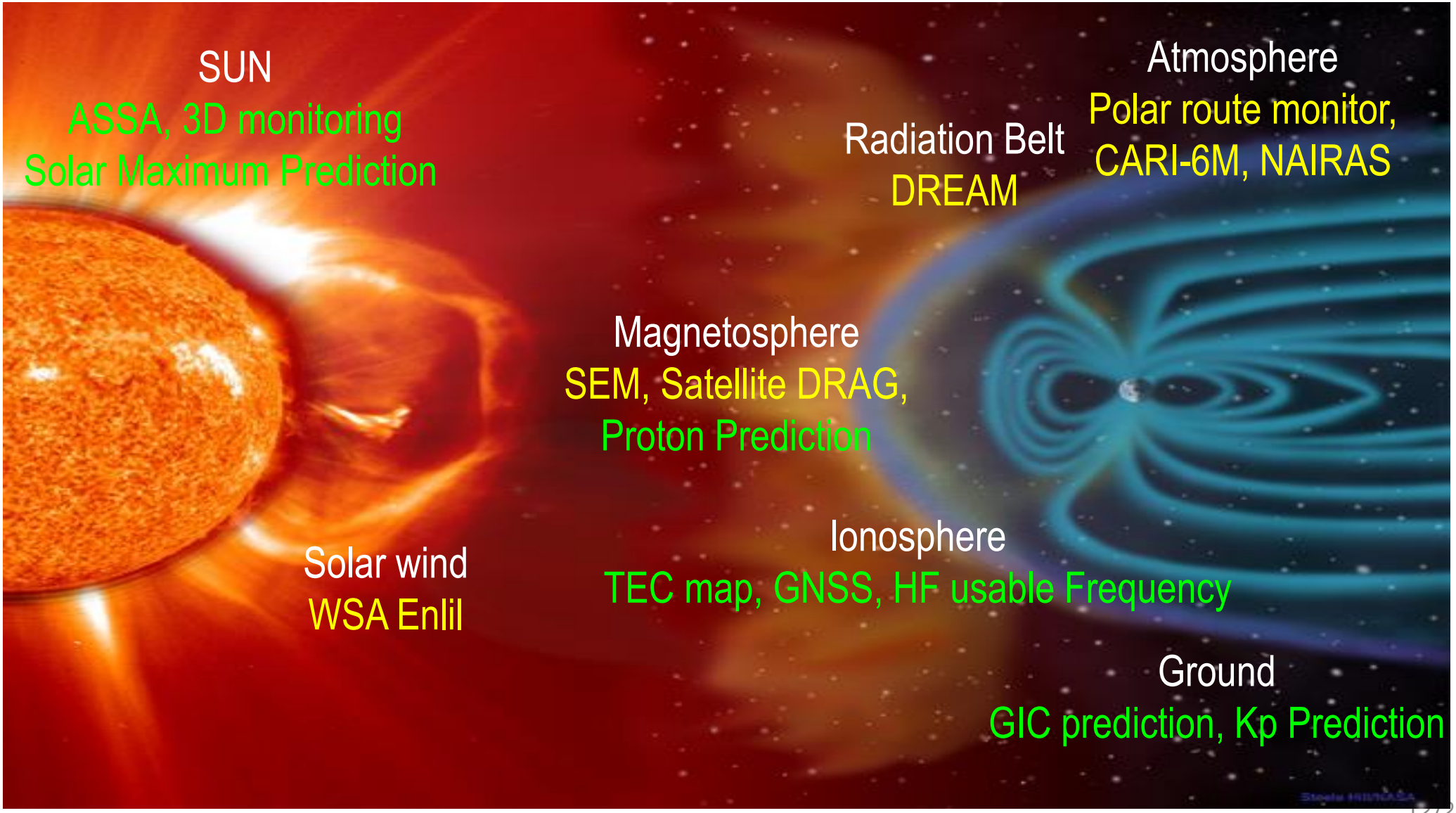
KOREAN SPACE WEATHER CENTER

- Developed by KSWC



KSWC Operations – R & D

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Solar Activity	ASSA Updates solar cycle prediction
Solar Wind	WSA-Enlil + Cone (Dr. Dusan Odstrcil & SWPC) IPS Solar Wind Reconstruction (Dr. Bernard Jackson & STELab. of Nagoya Univ.)
Satellite	**GEO environment monitor** **LEO satellite drag prediction** **Transitioning DREAM Model**
Aviation	**polar route SWx monitor** **SAFE(radiation dose prediction)**
Power Grid	local GIC prediction local GIC map
Navigation	local TEC map local GPS ionospheric error map
Communications	local ionospheric model (IRI-2012 + VOACAP + local data) **real-time usable HF frequency**

R & D – ASSA Update for flare Prediction

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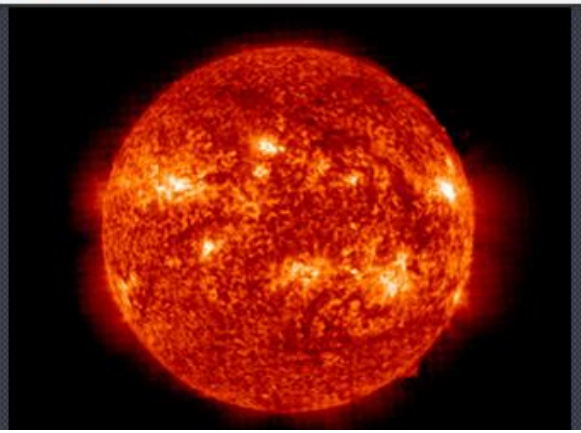
http://www.spaceweather.go.kr/assa

ASSA Automatic Solar Synoptic Analyzer

About | ASSA Program | Latest Results | Feedback



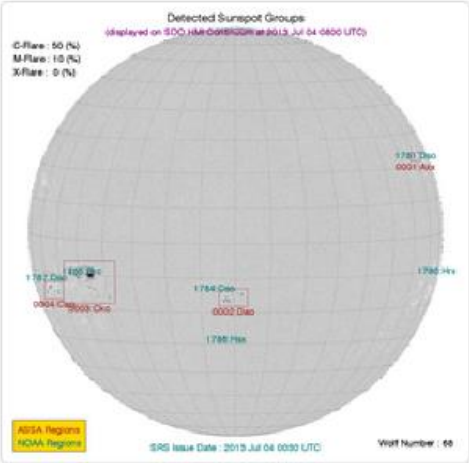
ASSA Categories

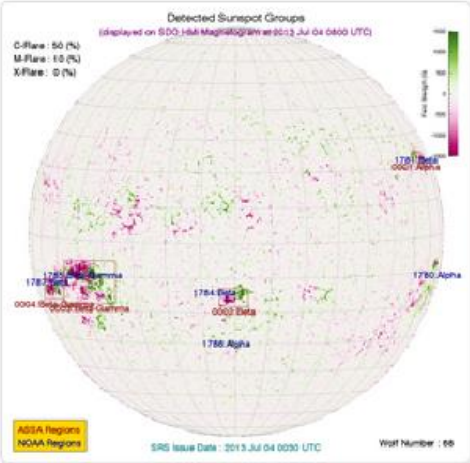
ASSA consists of the following three categories

* sunspot group identification and classification
* coronal hole detection
* filament detection

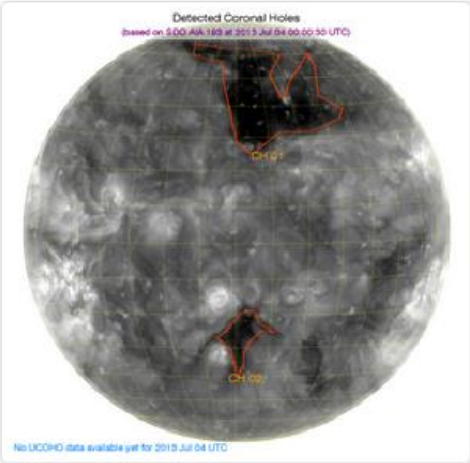
For each category, ASSA receives necessary solar raw images and processes them in a designated procedure to yield resultant output files.

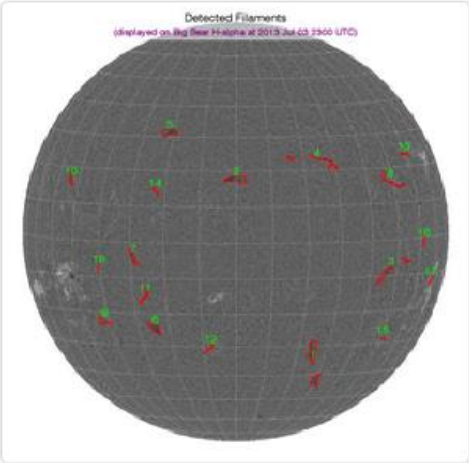
Latest Results





TEXT INFO





TEXT INFO

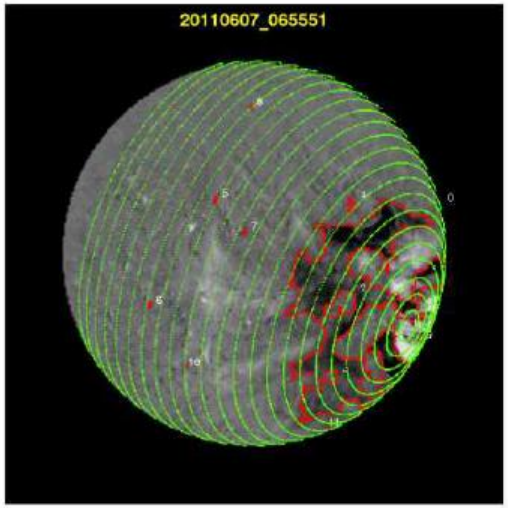
R & D – ASSA Update for flare Prediction

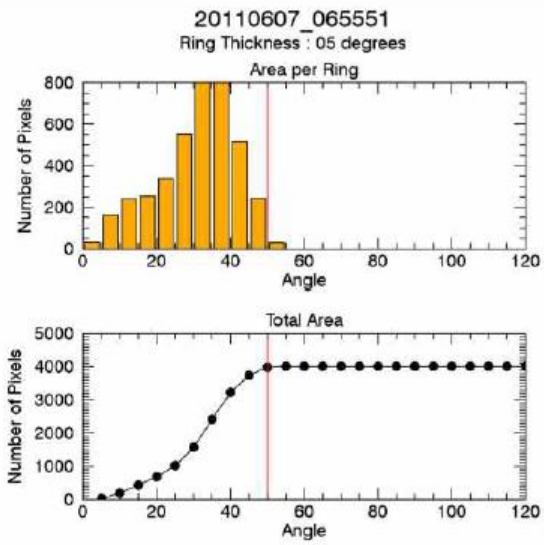
NATIONAL RADIO RESEARCH AGENCY
KOREAN SPACE WEATHER CENTER

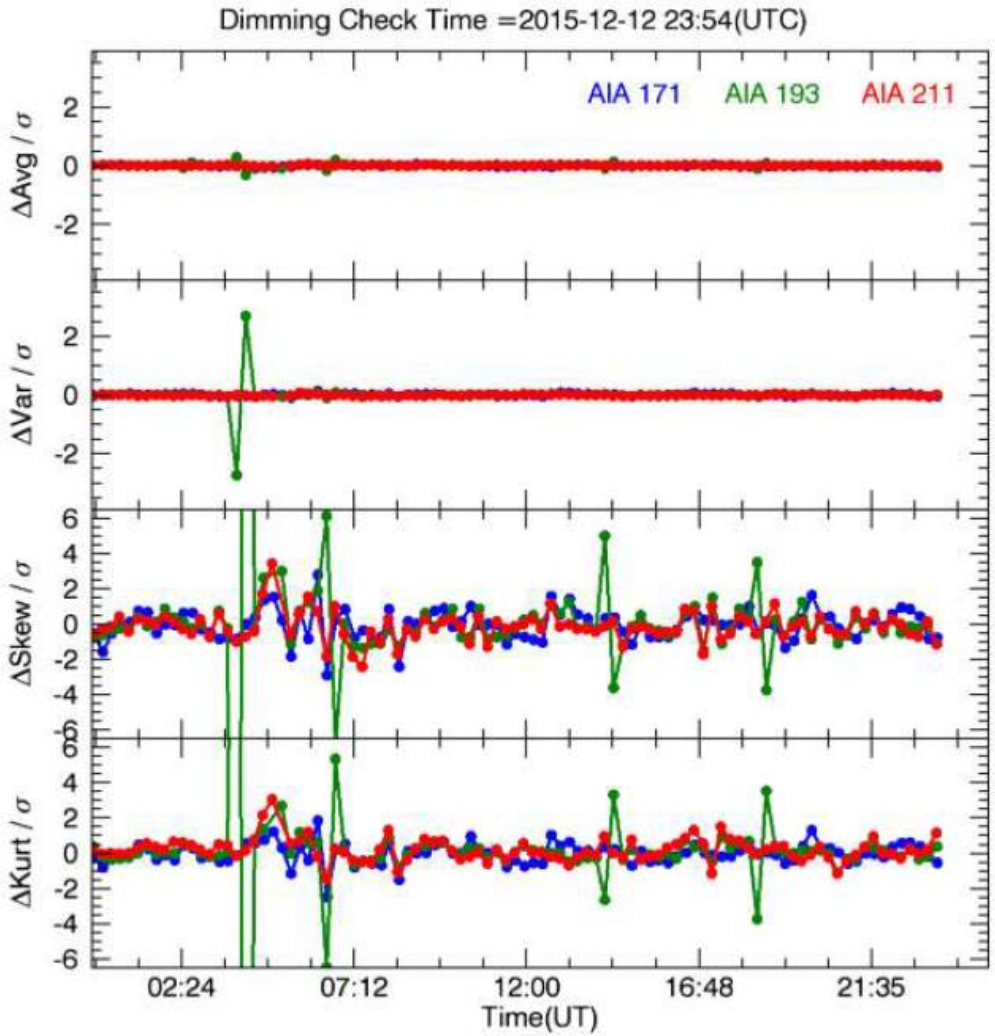
http://www.spaceweather.go.kr/assa

ASSA + EUV Dimming

- ✓ ASSA 2.0 Release for Flare prediction
- ✓ Solar Dimming Monitoring System
  - SDO AIA 193 + 171 + 211
- ✓ Correlation EUV Dimming-CME : 0.5



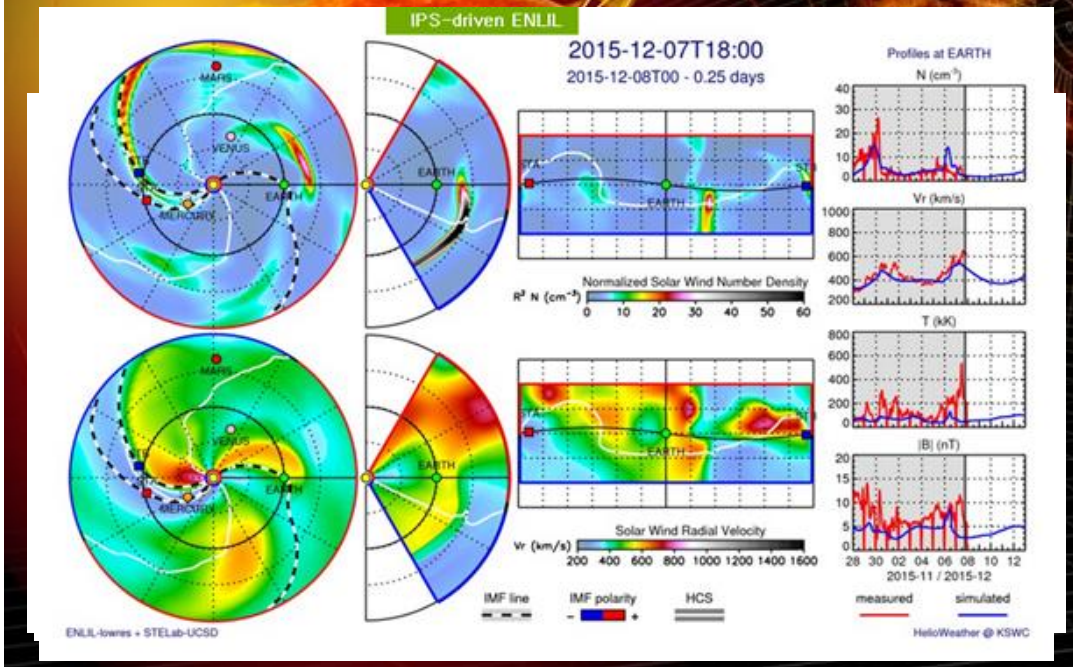




R & D – Solar wind prediction

Interplanetary Space

Solar Wind(CME, CIR)



WSA-ENLIL-CONE (SWPC, GMU)

IPS tomography (UCSD, STELab)

IPS-driven ENLIL (GMU, UCSD)

R & D – Solar wind prediction

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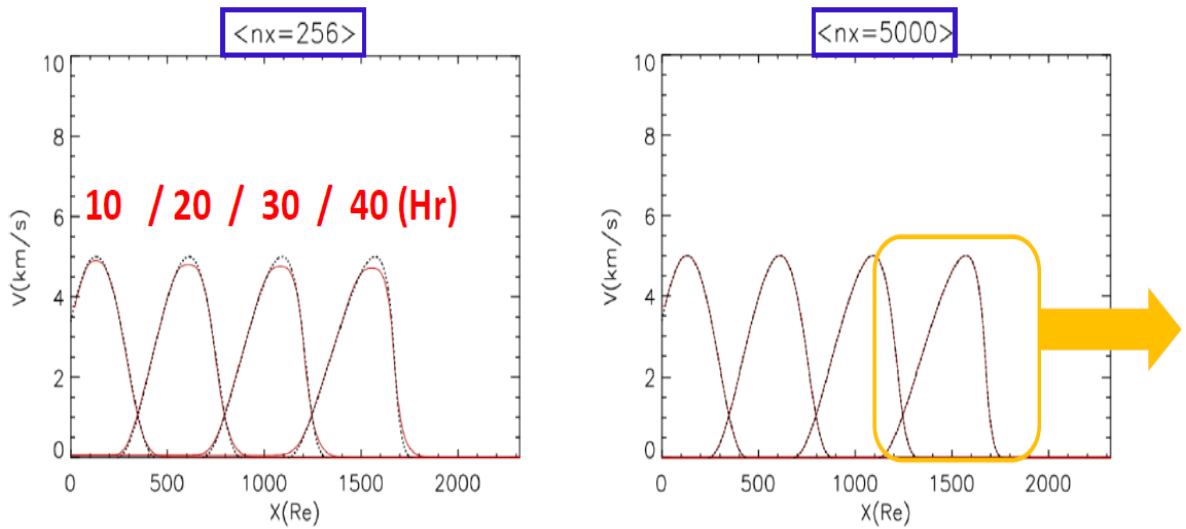
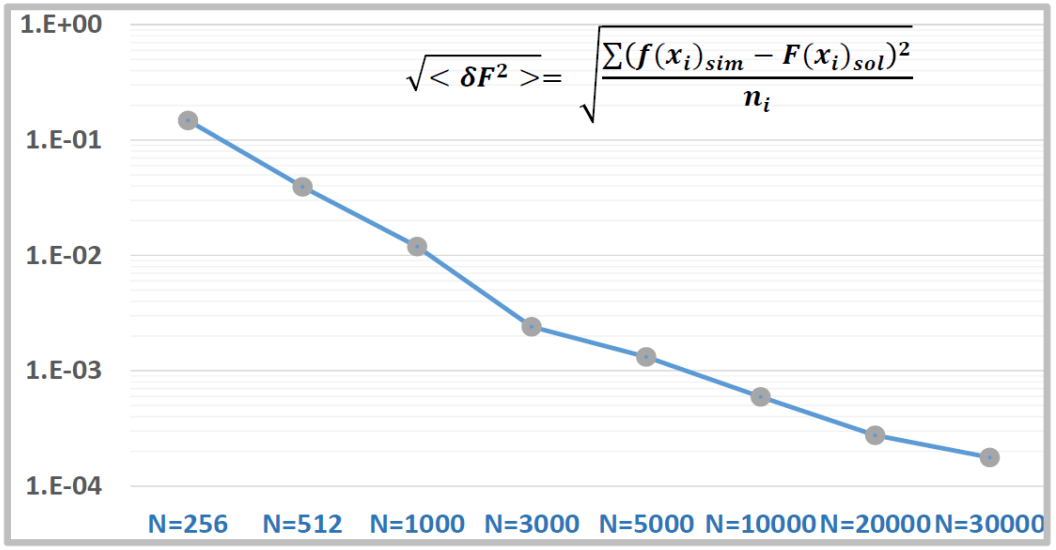
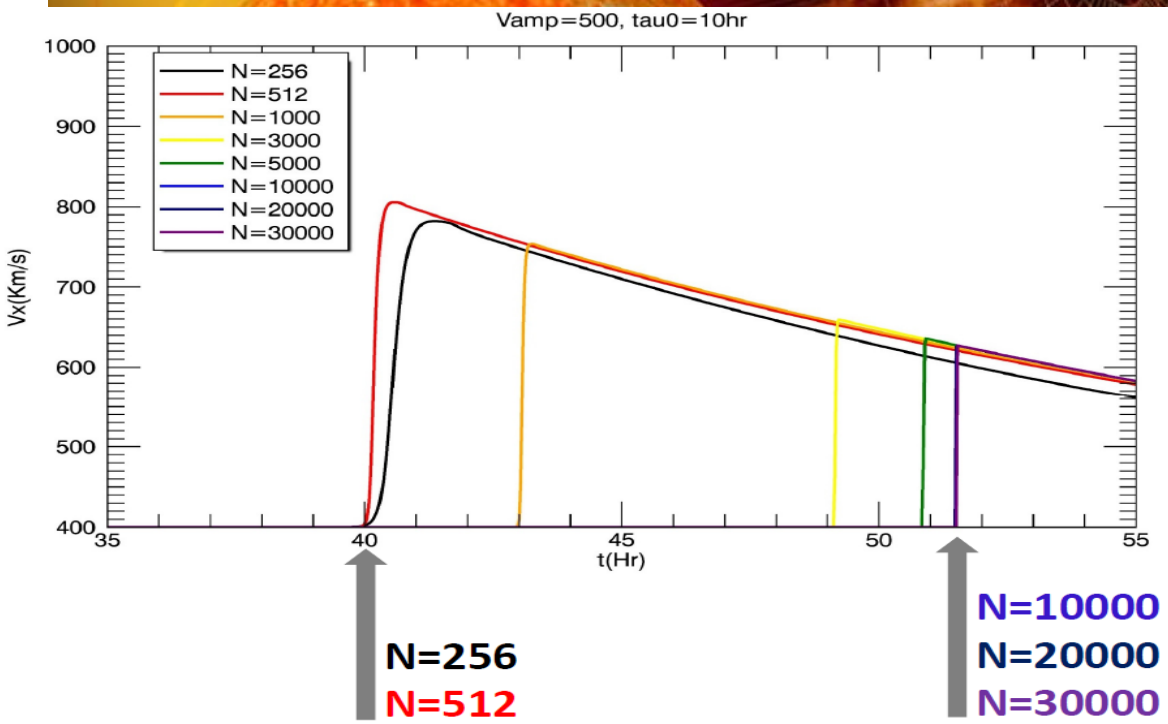
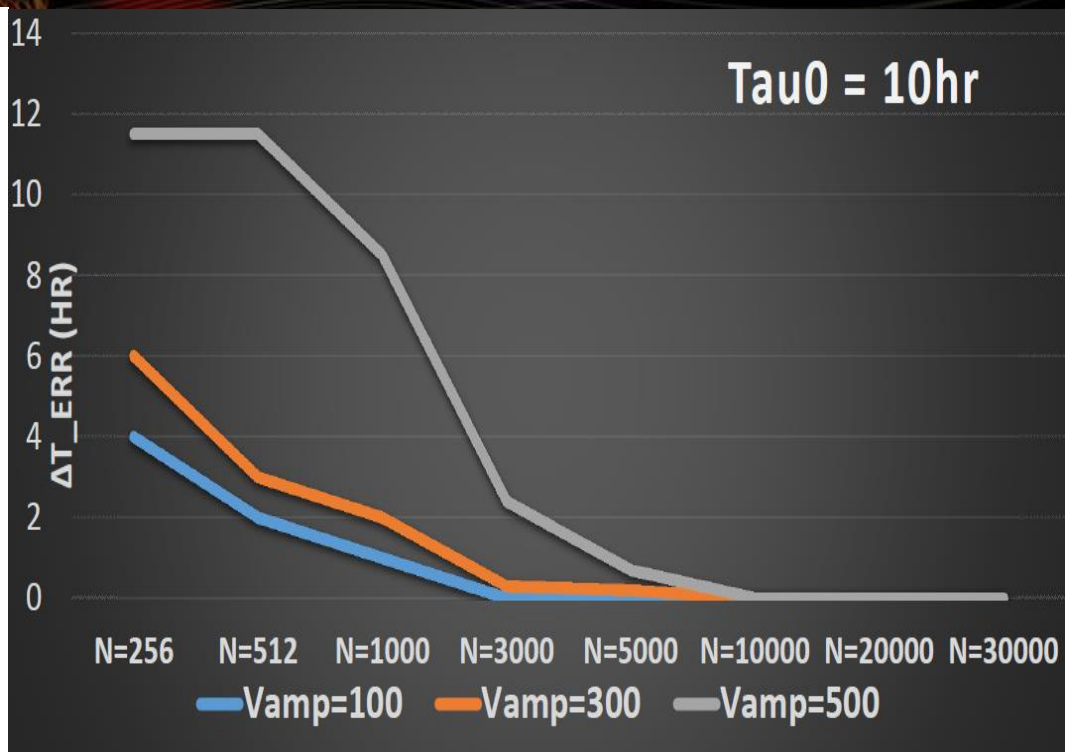
Simulation tests *vs.* Exact Solutions



Standard deviation of numerical error







R & D – for satellites

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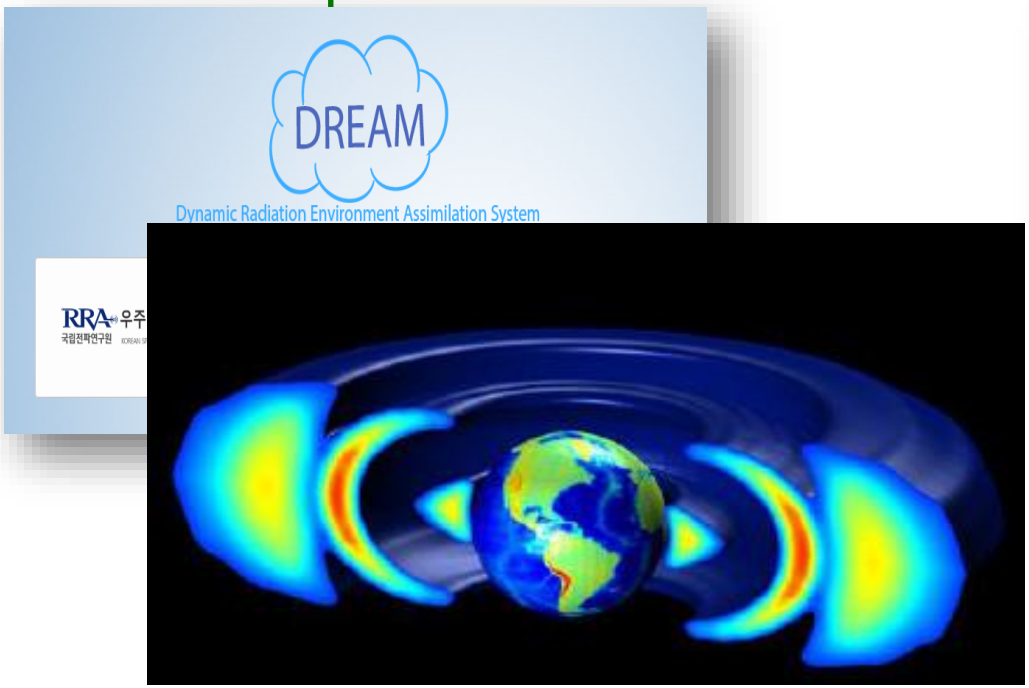
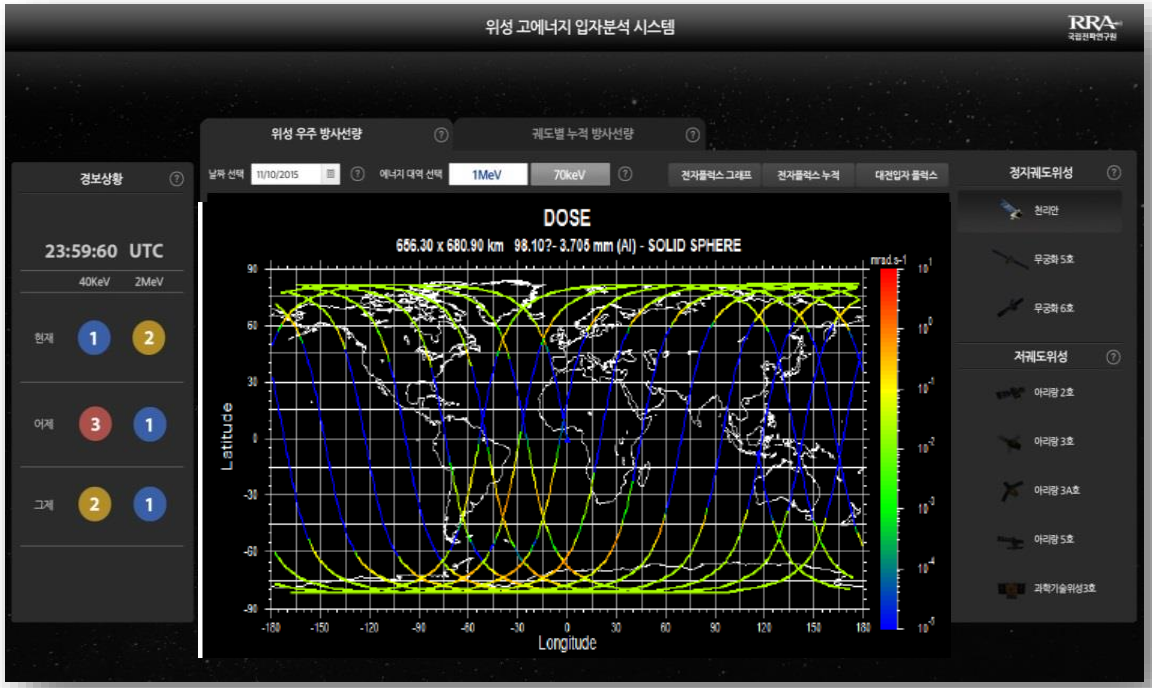
DREAM Operation

- ✓ LANL-RRA-NOAA + ESA will join
- ✓ DREAM (LOS Alamos National LAB) + New physical model (KSWC)
- ✓ RT Electron flux in Radiation Belt
- ✓ GOES-R particle data will be used



Satellite Service

- ✓ Radiation Dose for ROK Satellites
  - COMS, ARIRANG 2,3,3A & KSAT 5 & 6,
  - Radiation Hazard Warning



R & D – for Aviation

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KOREAN SPACE WEATHER CENTER

Space Radiation Measurement

✓ ARMAS-Lite Project

* Automated Radiation Measurements for Aviation Safety

- KSWC, SET, NOAA/SWPC, NASA, NSF
- fly with NOAA & NCAR airplanes

✓ Will measure real-time space radiation for commercial aircrafts

- Study on Dosemeter's airworthiness

SAFE(SAFETY Aviation Flight Environment)

✓ NAIRAS (NASA) + CARI-6M(FAA)

✓ Radiation Dose of all flights

✓ Input : flight Time, airport, airline

✓ Adopted by ROK airlines

R & D – for Aviation

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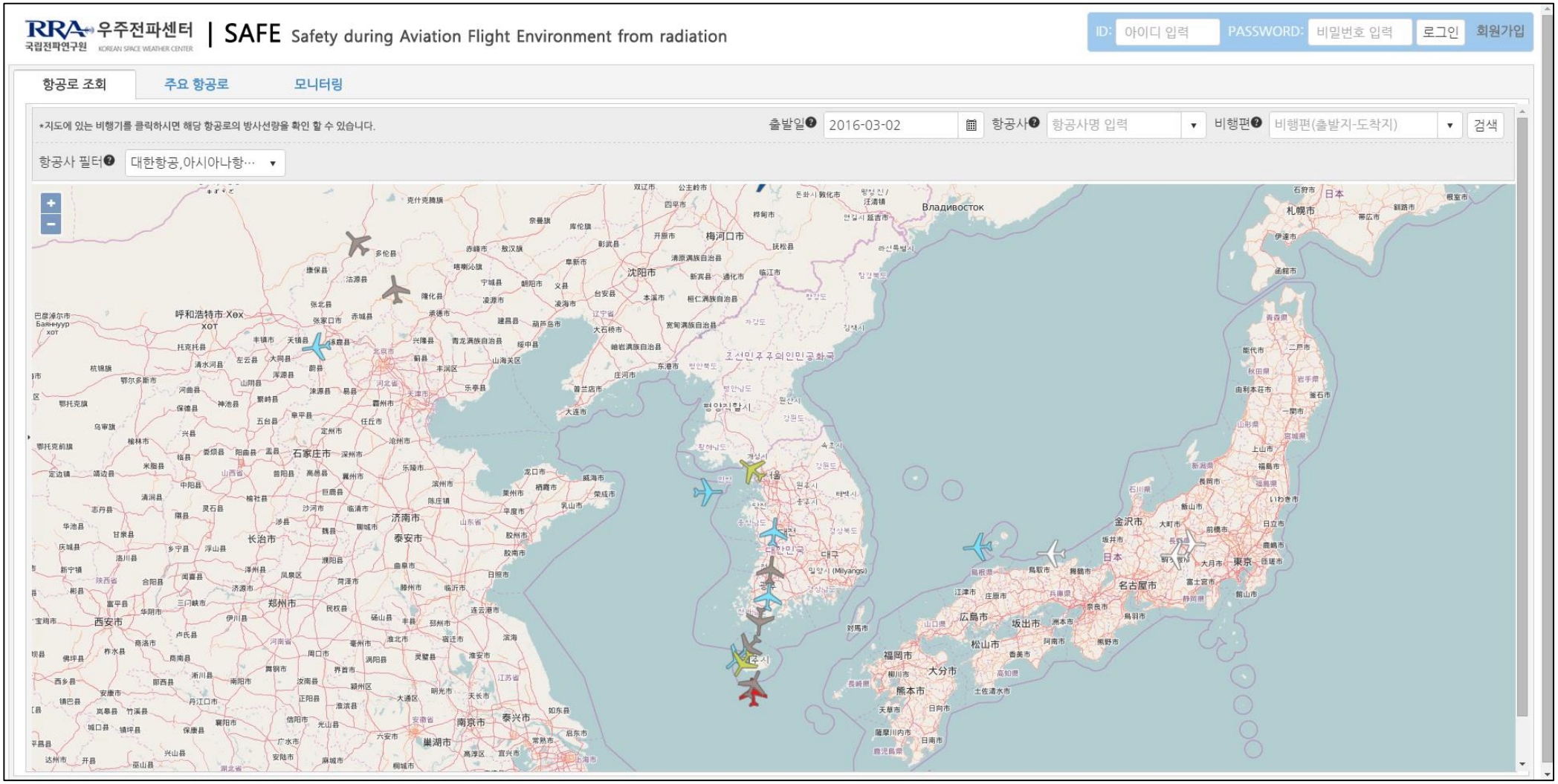
KOREAN SPACE WEATHER CENTER

SAFE Demo



R & D – for HF Users

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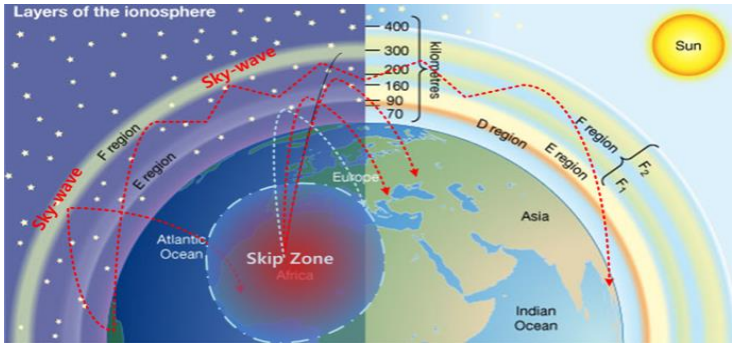
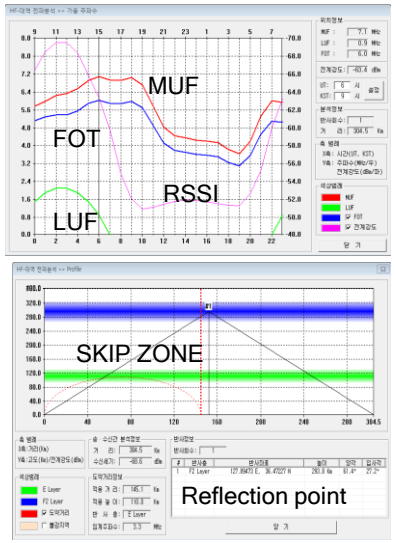
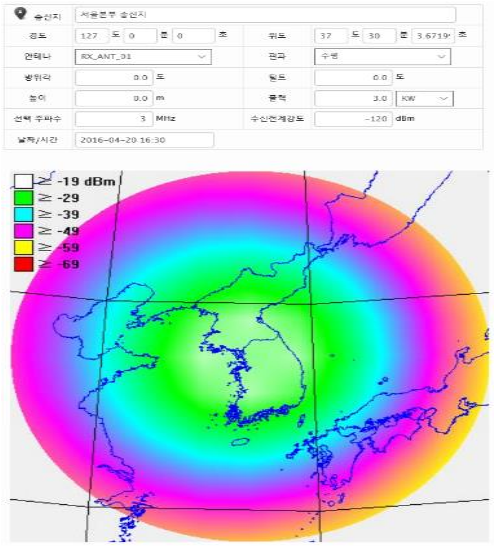
KOREAN SPACE WEATHER CENTER

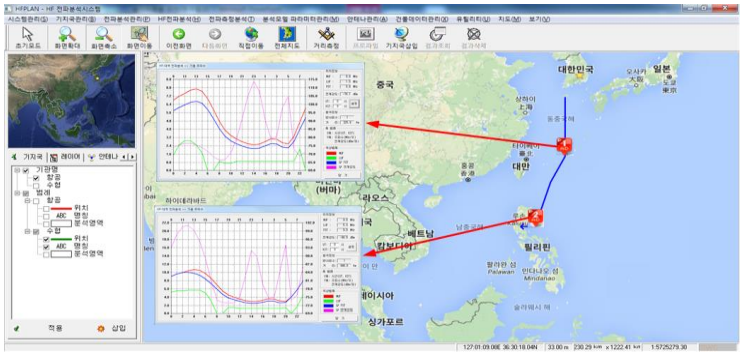
Prediction of point-point and point-region of usable HF frequency from Ionospheric Assimilation model

- Operation of Korea ionospheric assimilation model based on the ionosonde measurements
- Prediction of usable HF frequency based on Korea ionospheric assimilation model
- Provides web services in real-time
  (http://spaceweather.rra.go.kr/models/prehf1)









<Point-Point analysis> <Point-Region analysis> <Maritime analysis>

<Aircraft way-point analysis>

Data Access - www.spaceweather.go.kr

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Korean Space Weather Center
RRA NATIONAL RADIO RESEARCH AGENCY

Regional Warning Center for International Space Environment Service

HOME | FAQ | SITE MAP | KOREAN

2013-10-26 15:30 (KST)
2013-10-26 06:30 (UTC)

Alerts & Forecasts | Forecast Models | Real Time Data | Space Weather | Instruments | About the Center

Today's Forecast/ Prediction

Real time data

[Click for more detailed images]

Ionosphere

Icheon Ionosphere (foF2) | Jeju Ionosphere (foF2) | Icheon Ionosphere (ionogram) | Jeju Ionosphere (ionogram) | Icheon TECs | Jeju TECs

Geomagnetic activity

Icheon geomagnetic | Gangneung geomagnetic | Jeju geomagnetic | K_p Index | K_K Index

The Sun

Sunspot activity (28GHz) | Solar radio activities Icheon | Jeju | Solar Radio Noise Monitor

Solar Wind

SOLAR WIND: Mag field & Plasma | Low Energy Electrons & Protons | Solar Wind Ground scope for Solar Wind

Would you like to know the impact of space weather on the Earth?

More detailed information for the nonprofessional on space weather, radio communications and satellites etc. GO

Educational cartoons on space weather for kids GO

Obervation Data Go

Space Weather Report Go

National Preparation(1)

Radio Wave ACT

Article 51(Establishment & Implementation of basic plan for the management of Space Weather Risks)

The Minister of Science, ICT and Future Planning shall establish and implement a **basic plan for the management of space weather risks** including following in order to prepare, control and recover against disasters due to variation of space weather conditions in every 5 years.

1. Matters concerning **observation** and **surveillance** of variation of **space weather conditions;**
2. Matters concerning **forecasts and alerts** of space weather risks;
3. Matters concerning **R&D** (Research and Development) and **international cooperation** for the prevention of and preparing against space weather risks.
4. Other matters necessary to provide against space weather risks.

National Preparation(2)

Disaster ACT

Framework ACT on the Management of Disaster and Safety

Addendum 3-2(Agency of risk Management)

…

(Space Weather Risk) The Ministry of Science, ICT and Future Planning

…

National Preparation(3)

National Plan for Space Weather Risk
(2012~2017)

2012.12.

Ministry of Science, ICT and Future Planning

Guideline for Space Weather Risk

2012.12.

Ministry of Science, ICT and Future Planning

Vision

"Safe Korea without Space Weather Risk"

- Total plan for SW policy
- 5-year plan(R&D, obs, forecast)

Description

Describes SW effect

- Response action to mitigate damages

National Preparation(4)

NATIONAL RADIO RESEARCH AGENCY
KOREAN SPACE WEATHER CENTER

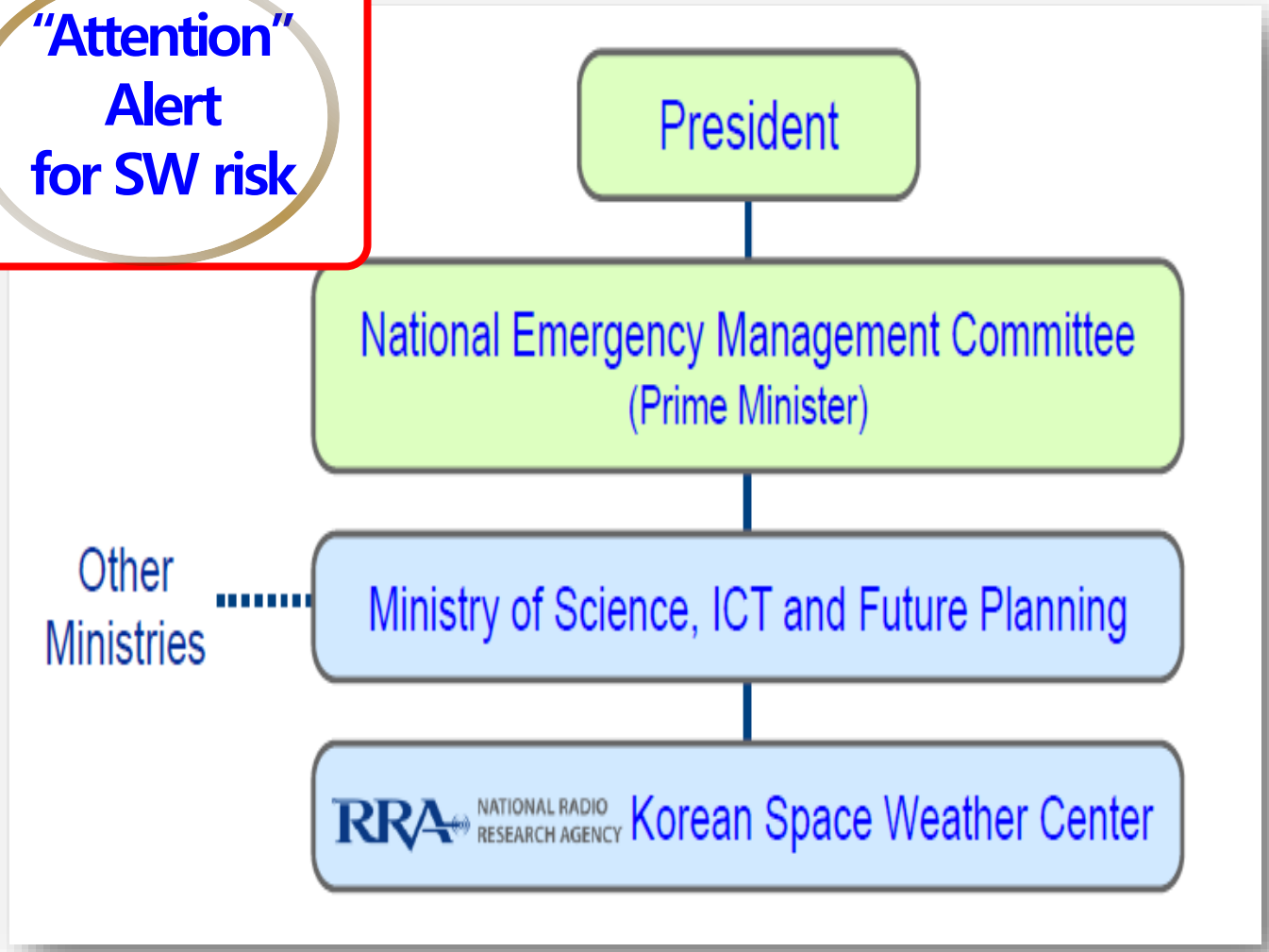
Standard Manual
for
Space Weather Risk

2013.2.

Ministry of Science, ICT and Future Planning

G4(18. Mar, 2015)

"Attention"
Alert
for SW risk



All ministries followed predefined procedures based on KSWC's SWx information !

National Preparation(5)

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Exercise & Training for managing Space Weather Risk

2014

2015

With the Ministry of Public Safety and Security + 8 related Ministries

Space Weather International Conference

NATIONAL RADIO RESEARCH AGENCY
KOREAN SPACE WEATHER CENTER

2011

2012

2013

2014

2015

2nd Space Radiation Seminar

4th Asia-Oceania Space Weather Alliance Workshop

- The Risk of Space Weather, Regional Action -

24-27 Oct, 2016

Welcome !

NATIONAL RADIO RESEARCH AGENCY

KOREAN SPACE WEATHER CENTER

Thank you!

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Sunhak Hong (sunhak.hong@gmail.com)

www.facebook.com/rwcjeju

RRA Space Weather

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