WMO WWRP 4th International Symposium on Nowcasting and Very-short-range Forecast 2016(WSN16)
25-29 July 2016, Hong Kong

Introduction to the ICE-POP2018 (International Collaborative Experiments for Pyeongchang 2018 Olympic & Paralympic winter games)

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National Institute of Meteorological Sciences
Korea Meteorological Administration

History of ICE-POP 2018

- Propose RDP at SSC/WWRP/WMO (Nov. 2014)
- **RDP/FDP Kick-off meeting (Oct. 2015.)**
  - ✓ Naming, structure WG
  - ✓ Participants: 6 countries, (7 institutions)
- Submit Conceptual Paper to WWRP/WMO (Nov. 2015)
- **WMO endorse ICE-POP 2018 (Dec. 2015)**
- Present ICE-POP 2018 in NMRWG/WWRP (Dec. 2015)
- **Observation WG meeting (Mar. 2016)**
  - ✓ Participants: US NASA, UCLM(Spain), EC(Canada), US CSU
  - ✓ Observation Network(Field Campaign) with participants' instruments
- **Build Korea Trust Fund for ICE-POP2018 at WMO(Jun 2016)**
- **NWP physics/Verification meeting (Sep 2016)**
  - ✓ Participants(to be): EC, NCAR, KIAPS, NMB/NIMS, FMI
- **Special session at KMS conference (Oct 2016)**
- **2nd ICE-POP 2018 Workshop (Nov 2016)**

WMO OMM

WEATHER CLIMATE WATER
TEMPS CLIMAT EAU

World Meteorological Organization
Organisation météorologique mondiale
Organización Meteorológica Mundial
Всемирная метеорологическая организация
المنظمة العالمية للأرصاد الجوية
世界气象组织

Secrétariat
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GENEVA, 17 March 2016

CERTIFICATION

To Whom It May Concern:

This is to certify that the International Collaborative Experiments for PyeongChang Winter Olympic Games and Paralympic 2018 (ICE-POP2018) was endorsed on 27 November 2015 by the World Weather Research Programme (WWRP) Scientific Steering Committee as a WMO/WWRP Research and Development Project/Forecast Demonstration Project. Lead agency for the project is the Korea Meteorological Administration. Dr Dong-Kyou Lee, was appointed on the same day as Principal Investigator while Dr Sangwon Joo will be in charge of both scientific and administrative aspects of this research project.

(P. Ruti)
Chief,
World Weather Research Division
Research Department

[Paricipants by country]
Australia, Austria, Canada, China, Finland, Russia, Rep. Korea, Spain, Swiss, United States [10]
[Paricipants by agency]
BOM, ZAMG, EC, CMA, CAMS, FMI, Roshydromet, KMA, NIMS, UCLM, EPFL, CIRA, CSU, NASA, NCAR, NOAA, SBU[17]

Organization of ICE-POP 2018

ICE-POP 2018 ⟷ Nowcasting and Mesoscale Research Working Group/ **WWRP/ WMO**

Organizing WG
- Administrative works
- IT support & data sharing

Advisory group
Scientific advice
(13 Korean scientists)

Observation WG
- observation network
- observation campaign

Chair: Stella Melo [EC]
Chair: BC Choi
Paul Joe,Walter Petersen
Matthew Schwaller
Francisco Tapiador
Alexis Burne,Pavlos Kollias
Liping Huang, GyuWon Lee

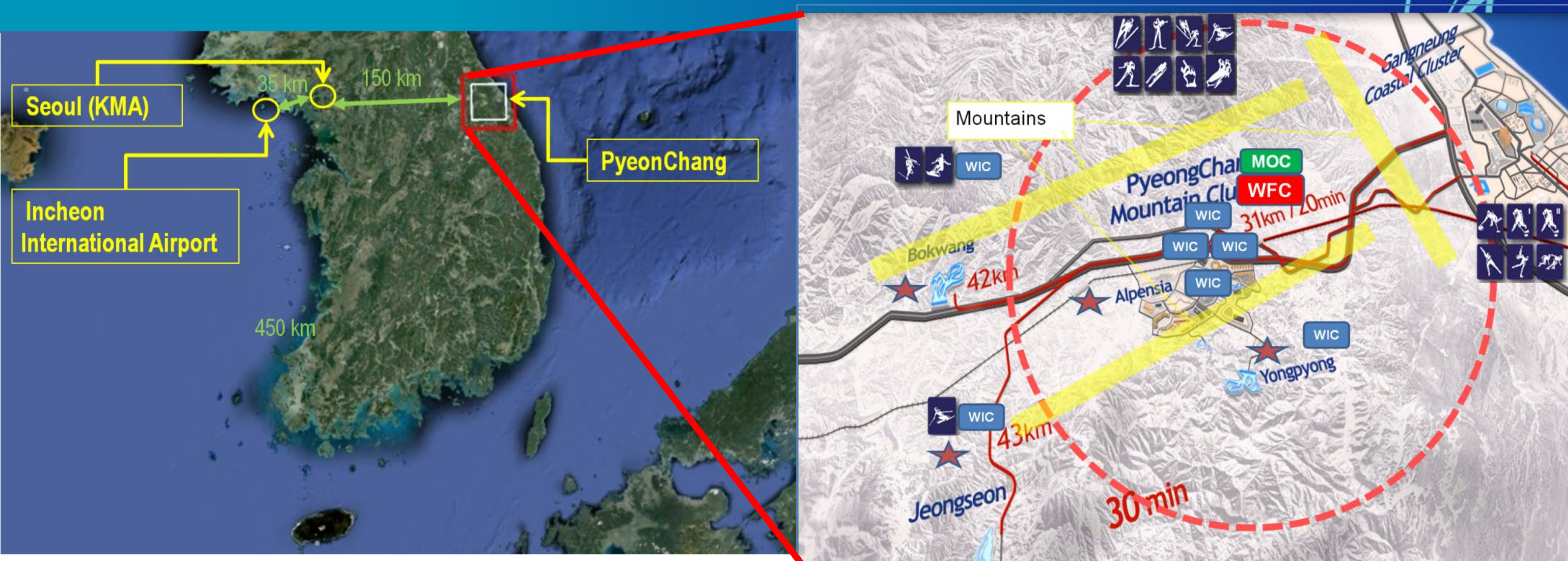
NWP WG
- Nowcasting & NWP model
- To operate model for FDP

Chair: Zoltan Toth [NOAA]
Chair: Sangwon Joo
Yuanfu Xie,Jenny Sun
Jian Sun,Gdaly S. Rivin
Benedikt Bica,Tsengdar Lee
Zhining Tao,Soyung Ha
Steve Albers, Hugh Morrison
Jason Milbrandt, Gultepe
Ismail, Stephen Belair, Chris
Kummerow,…

Evaluation WG
- Model verification & evaluation

Chair: Pertti Nurmi [FMI]
Chair: DongJoon Kim
Dmitry Kiktev
Peter Steinle

PyeongChang 2018 Olympic Area & Venues



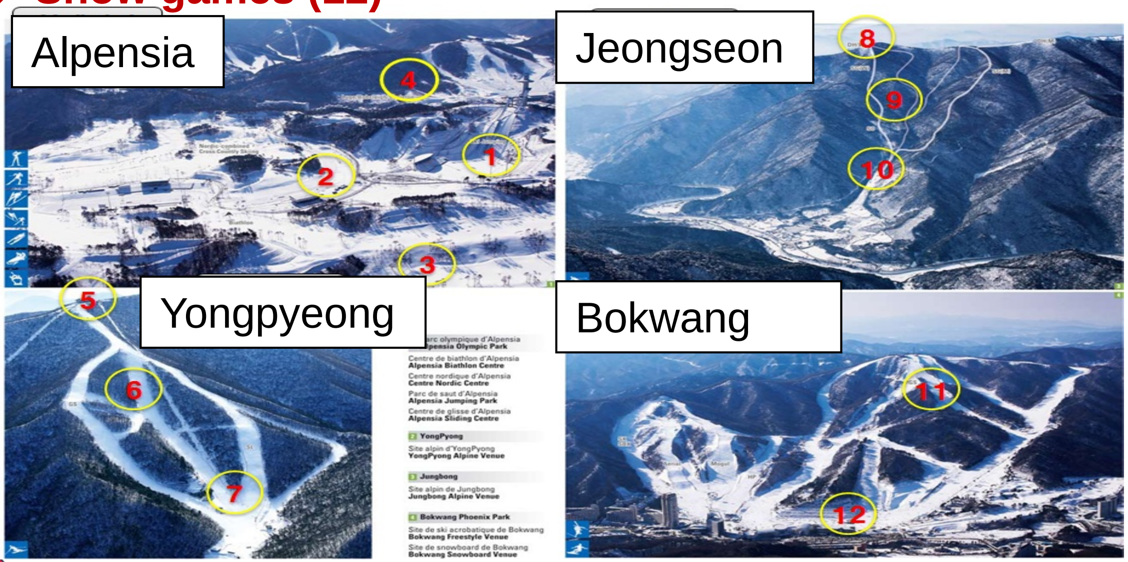
	Workforce	Services
MOC (Main Operation Centre)	Chief forecaster	Weather Briefings to MOC, IOC,
WFC (Weather Forecast	Lead forecaster Venue forecasters	Venue weather forecasting Communication with media 24hours/7days operation
WIC (Weather Information Centre)	Venue communicators (All outdoor venues 1 or 2 forecasters each Volunteers	Weather counselling to managers and related to each competition venue Weather observation

KMA plan for Forecast Services

Forecast name	Forecast lead time	Update Frequency
Nowcasting	2 hours (Site forecasts)	15mim
Very-Short range	1 day (Site forecast)	1hour
Short-range	3 days (Site & Map)	3 hour
Medium-range	Up to 10 days	12hour

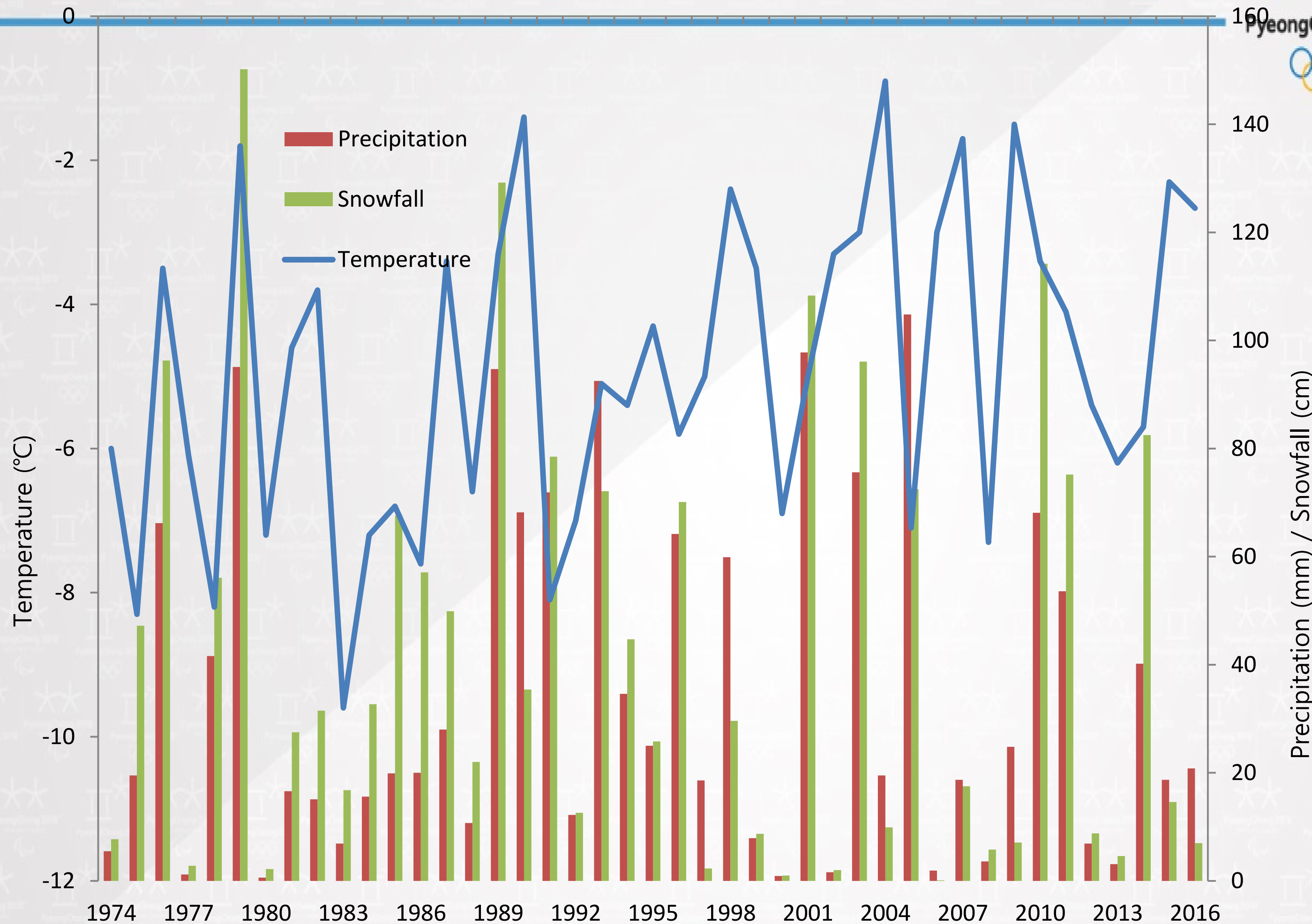
- Main concern is **wind(Gust), precipitation(type, amount), visibility, temperature.**
- 40 forecasters for the test event (17) and Oympic games (18)

❖ **Snow games (12)**



❖ **Ice games (1):**

Olympic period(Feb.9~25) Characteristics (Mountain)



Temp(℃): -9.6(1983)/-0.4(2004)/-2.7(2016), Precipitation(mm): 104.8(2005)/0.6(1980)/20.8(2016)
Snowfall(cm): 150.2(1979)/0.1(2006)/7.0(2016)

Courtesy to Jang Ho Lim

Extreme records, Olympic period(Feb.9~25)

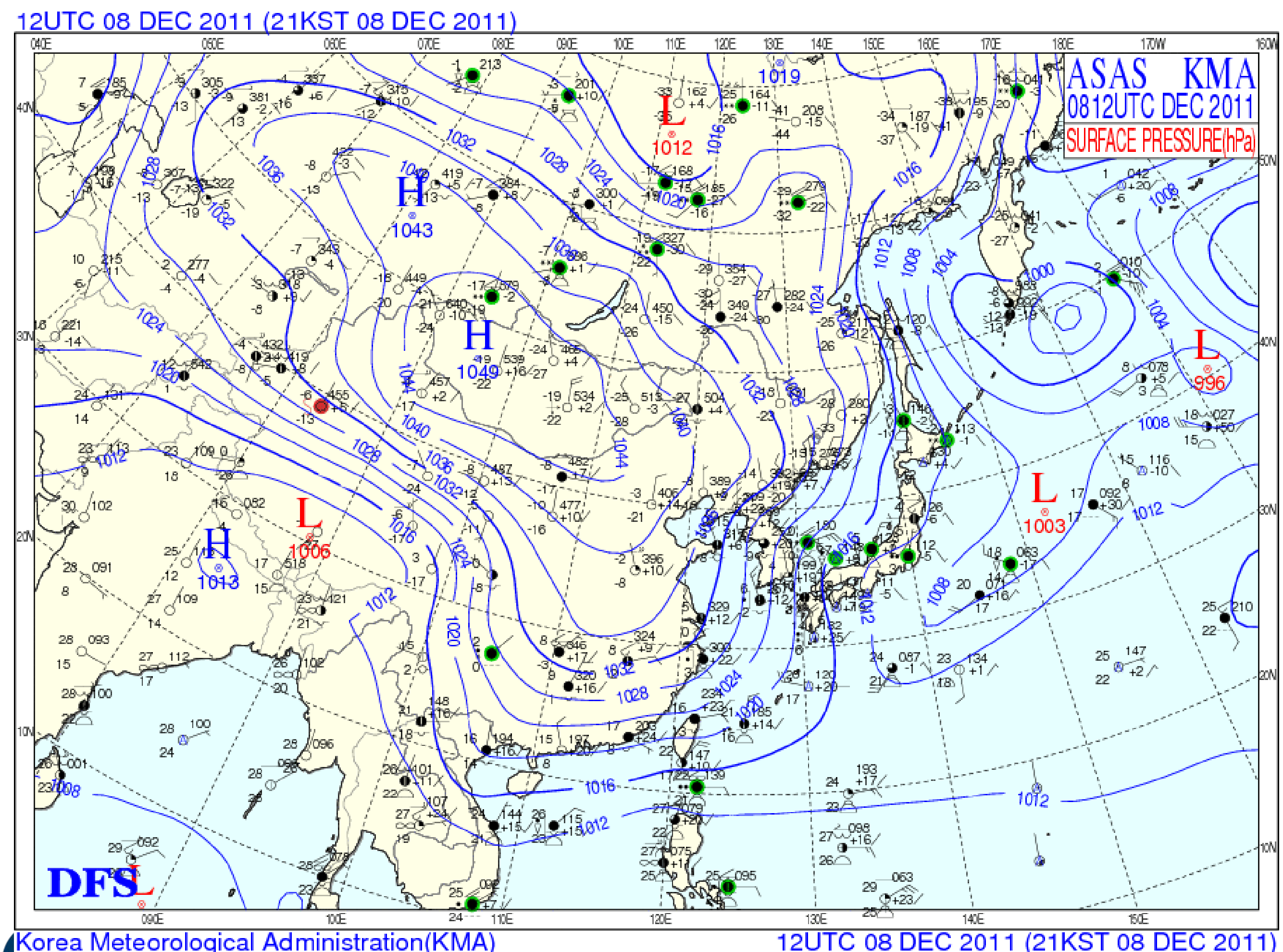
Elements		Value	Date
Ave. Temp.(℃)	High	10.5	2009.02.13
	Low	-18.1	1991.02.23
Max. Temp.(℃)	High	16.5	2004.02.20
	Low	-13.4	1977.02.16
Min. Temp.(℃)	High	3.6	2009.02.13
	Low	-27.6	1978.02.15
Sea level Press.(hPa)	High	1044.5	2008.02.18
	Low	989.1	2009.02.13
Humidity(%)	Low	10.0	2004.02.19
Wind speed(m/s)	High	22.7	1990.02.20
Gust speed(m/s)	High	34.2	1991.02.21
Day precipitation(mm)	High	68.3	1989.02.25
Day max. snowfall(cm)	High	87.0	1989.02.25

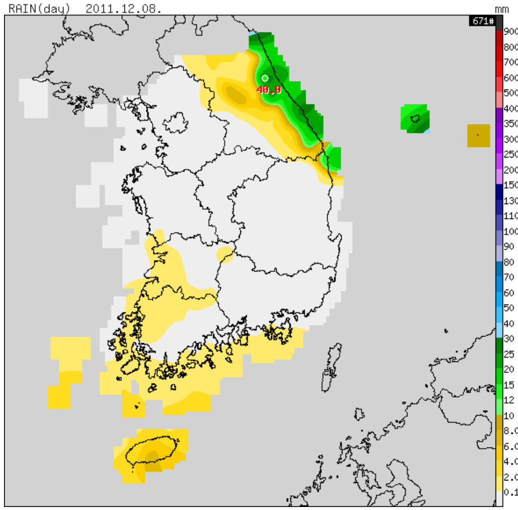
Courtesy to Jang Ho Lim

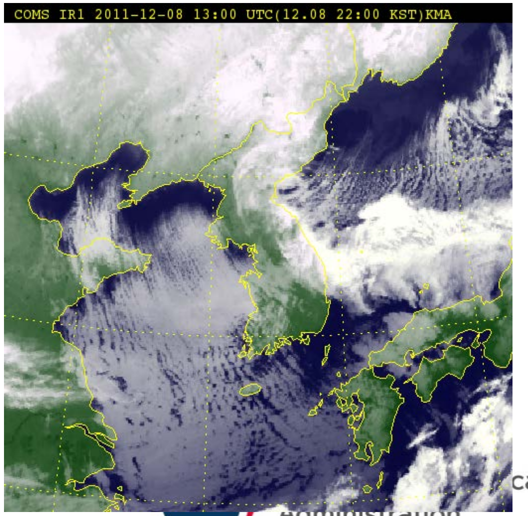
Heavy snowfall condition in PyeongChang Area

- Weather Pattern for Snow(Rank II) **[Weather Challenges]**

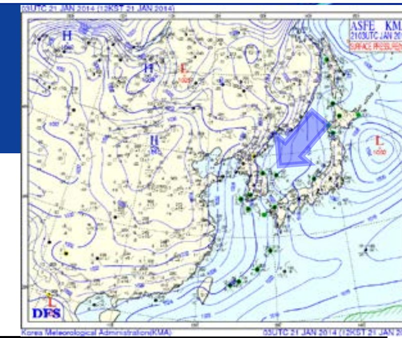
- East Snow Storm(ESS) [22% in cases of 2003-2012 DJFM, > 10 mm]







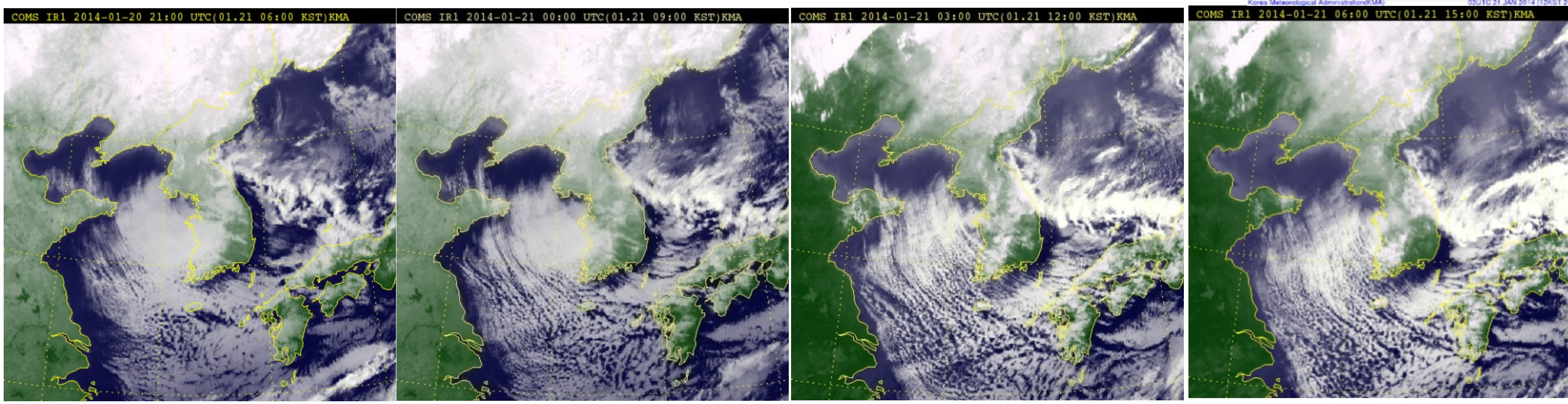
Heavy snowfall condition

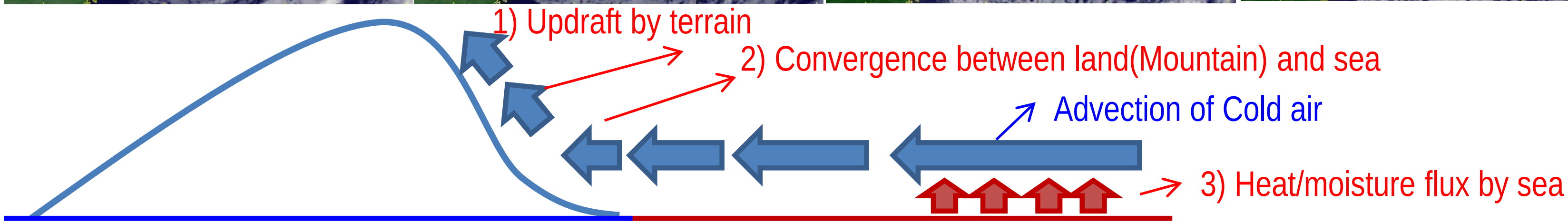


- Mechanism for East Snow Storm(ESS)

- Target Phenomenan for PyeongChang RDP/FDP

[2014. 1. 21 case]

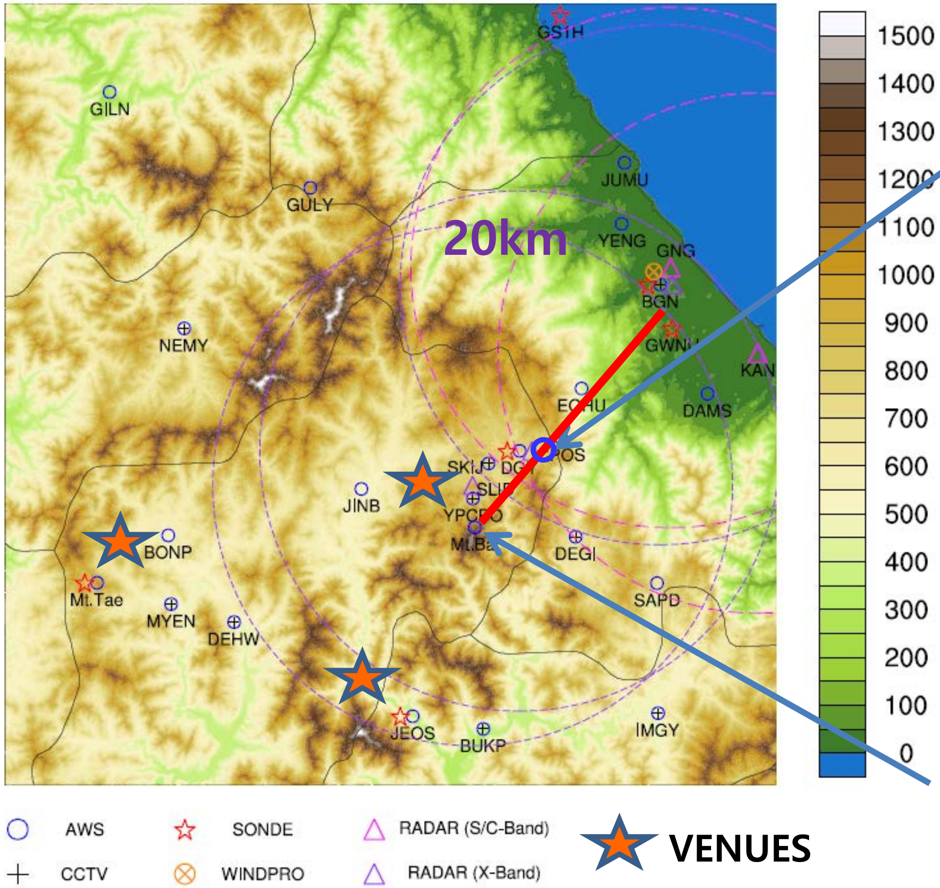


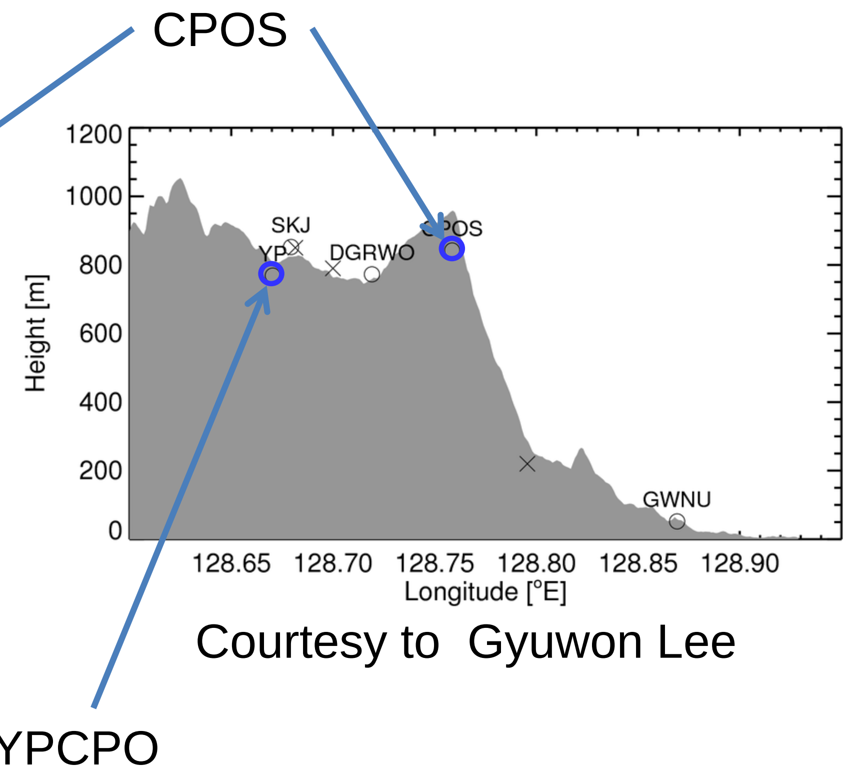


•WSS is well predicted but **ESS has low predictability** due to the interaction between large scale and small scale is not simulated properly in current NWP system and cause severe damages at the east coast of the Korean peninsula.

•For the PyeongChang Olympics, massive observations are available in the regional and it is a good change to contribute to improve the poor predictability related winter snow storms.

Complex Topography over the area



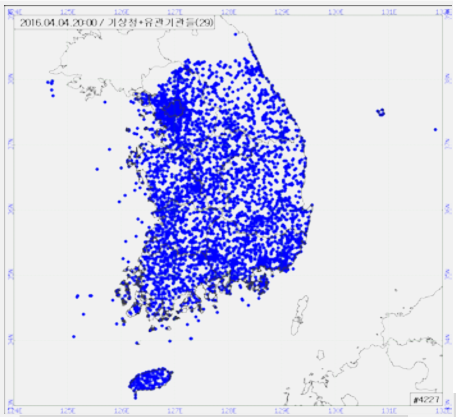


Courtesy to Gyuwon Lee

- Venues are located in a small area with complex terrain (sub km scale) and steep in the coastal region
- Heavy snow depends on the small scales flows, stability, and phase changes in a low level and conventional observation is not designed for that
- Snow weather is not captured well in the operation radar/surface observation network

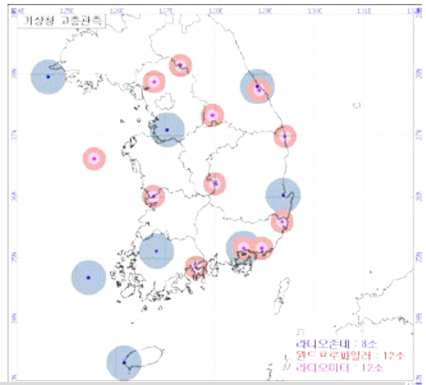
Operational observation at KMA

< Surface>



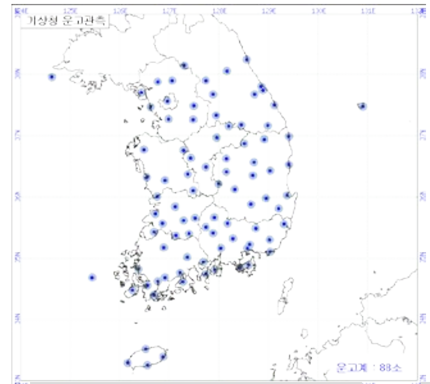
Surface obs: 4172
5km resolution

< Upper level>



RAOBs : 8
Wind profiler : 12
M. Radiometer : 12

< Cloud height>

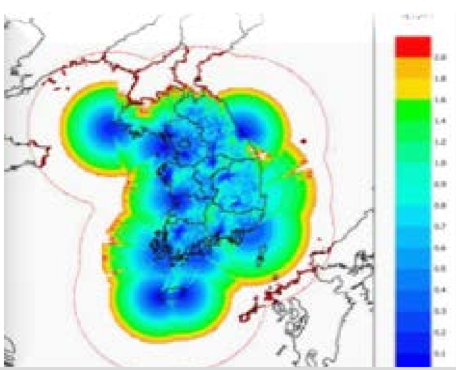


Celiometer : 92

< Ocean>

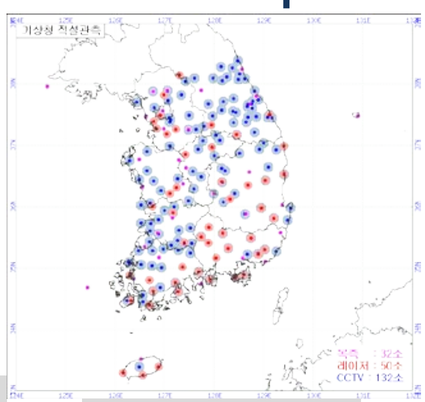
Buoy : 17
Costal wave buoy : 48
Lightning house AWS : 9

< Radar>



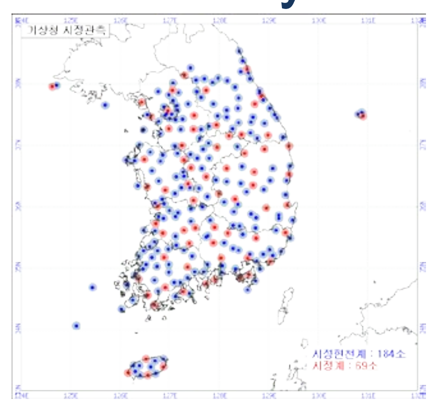
KMA : 11
M. of Defense : 9
M. of Land & Trans : 7

< Snow depth>



Manned : 22
Laser : 55
CCTV : 169

< Visibility>



+Weather sensor : 215
Visibility : 76

< Others>

GEO(1): 5Ch,128.2°E

Ship(1): ASAP, AWS,GPS

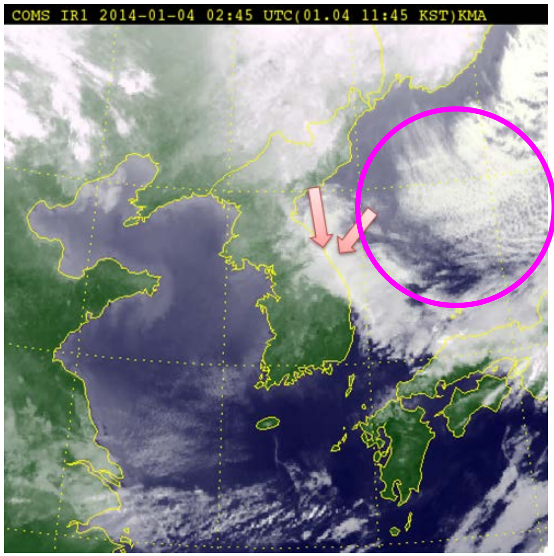
Lightning ; 21

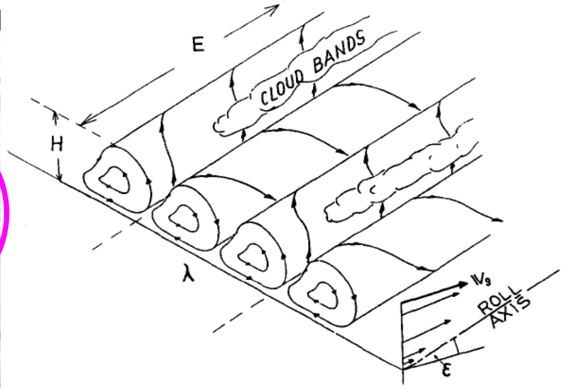
Soil property: 82

Aircraft:Dropsonde, SFMR, PIP,CCP,SEA WCM2000,

Scientific Issue in ICE-POP 2018

▪ Understanding of HCR(Horizontal Convective Rolls)





(Brown, 1980)

[Condition for Occurence]

- Surface heat flux
- Low-level wind shear
- Thermal/dynamic Instability

[Characteristics]

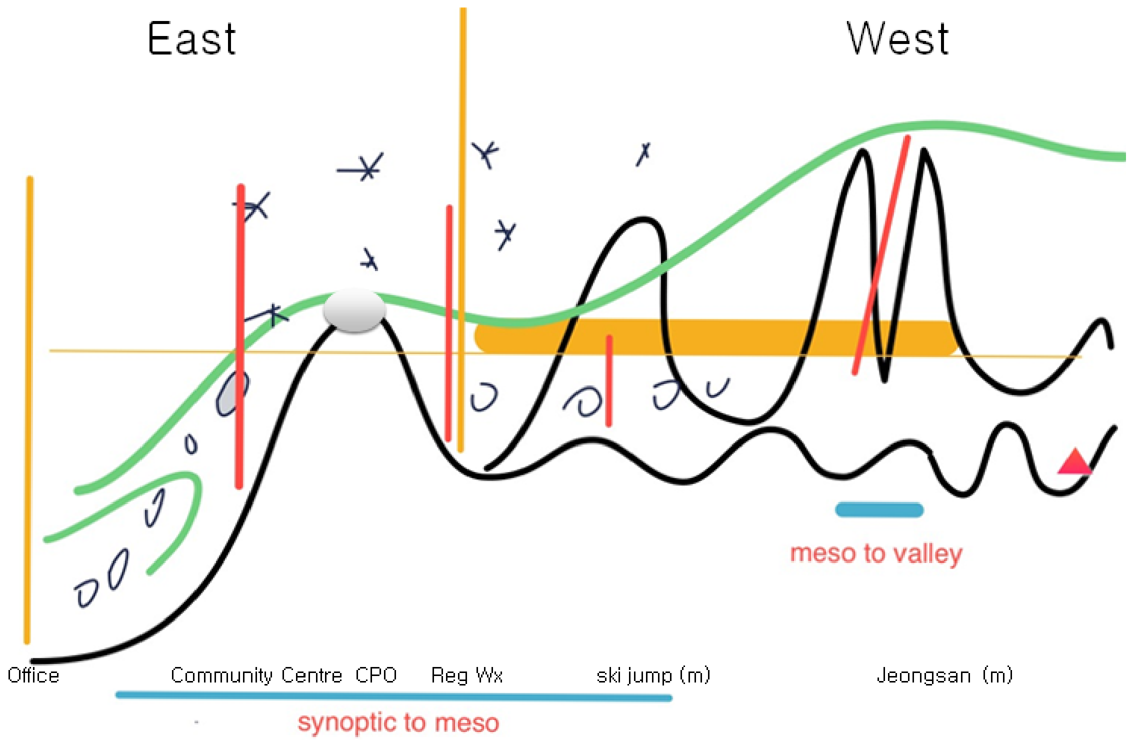
- Vertical extent:1-2 km
- Wavelength: 2-20 km
- Aspect ratio: 2-15
- Downstream extent:10-1000 km
- M. wind -20~+30
- life time:1-72 h

[Issues]

- Initiation of convection is not well understood
  - Difficult to capture updraft branches by observation
  → Aircraft, Satellite(Surface Heat Flux)
- Low-level wind shear/ water vapor variability and convergence are important
  - Difficulty to observe over ocean
  → X-band/Cloud radar reflectivity, Wind retrieval from radar

Scientific Issue in ICE-POP 2018

- **Coastal convergence and Microphysical Process induced by Mountain**



(Paul Joe, 2016)

[Issues]

- Costal convergence zone
- Interaction between synoptic and mesoscale
- Flow changes at complex terrain
- MP phase change & snow size distribution over mountain
- Visibility from low level cloud

→ Dual pol X-band/Cloud radar

→ Supersite with disdrometer

→ 3D camera for snow

→ Improvement of Snow MP

→ Visibility & low level cloud

Goal & Work flow of ICE-POP 2018

GOAL: Advancing seamless prediction from nowcasting to short-range forecast for winter weathers over complex terrains with intensive observation campaign

12

RDP

IOP

- High resolution 3D structure
- Multi spectral Radar
- Microphysics

- Develop Nowcasting
- Develop high resolution NWP
  - DA
  - Snow Physics
  - Evaluation
- Understand snow formation processes

- Contribute a science community in terms of winter weather

FDP

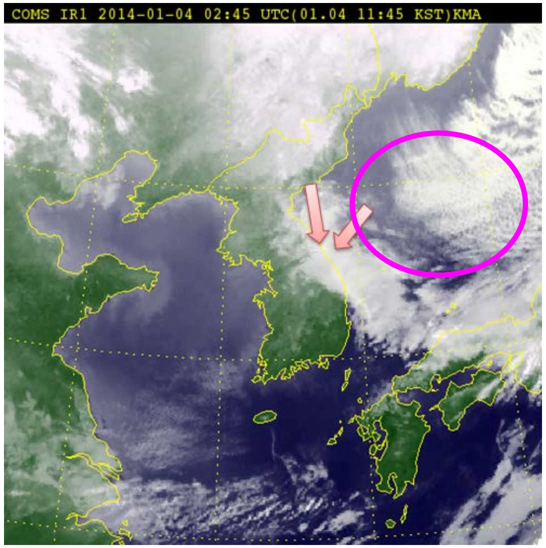
- Nowcasting
- NWP products
- Statistical gudiance
- Weather monitoring

Public

Olympic forecasters

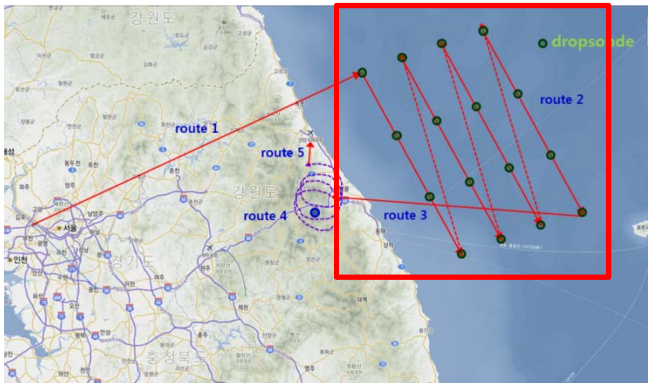
IOC, LOC

Observation network over the ocean

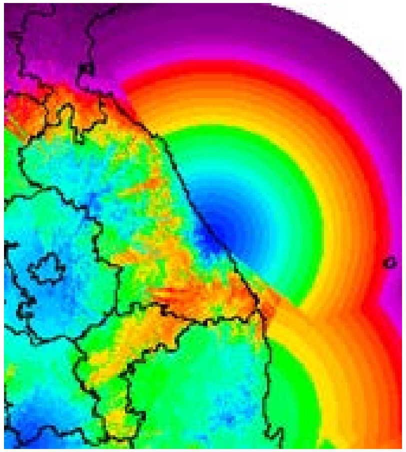


- Air-sea flux from satellite
  - COMS, Himarwari8 & LEO

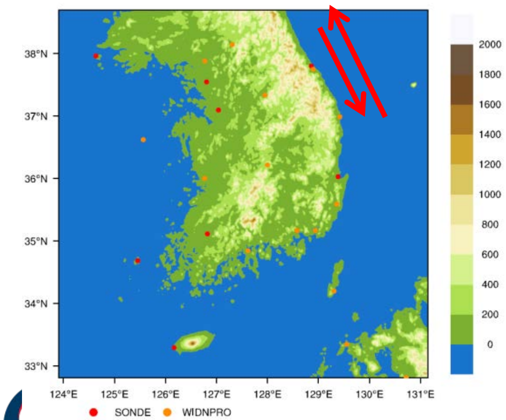
  (KMA with Brent Roberts [US NASA])



- Aircraft measurements
  - CCNC200, CCP, SEA WCM2000
  - 16 drops per flight and 4 receivers
  - 3D structure can be captured



- Radar scan from the coast
  - S-band and C-band radar
  - RHI scan to the open sea



- Sea surface condition & ASAP from ship
  - 6 hourly RAOBs
  - Move round the sea near Gangrung

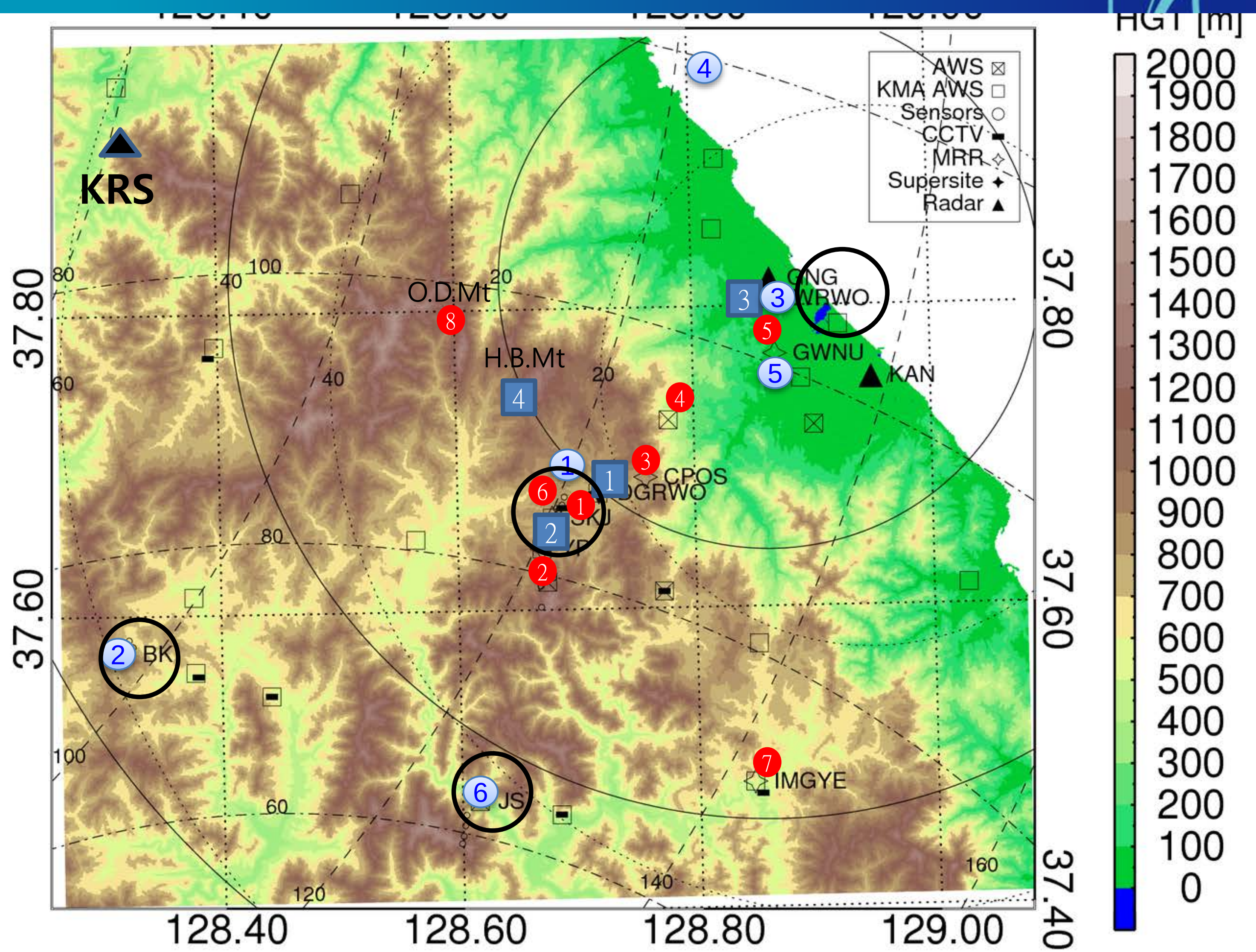
Observation network over the complex terrain

◯ **Venue**

1 Radarsite 1(DGWO)
2 Radarsite 2(APOS)
3 Radarsite 3(GWWO)
4 Radarsite 4(HBOS)

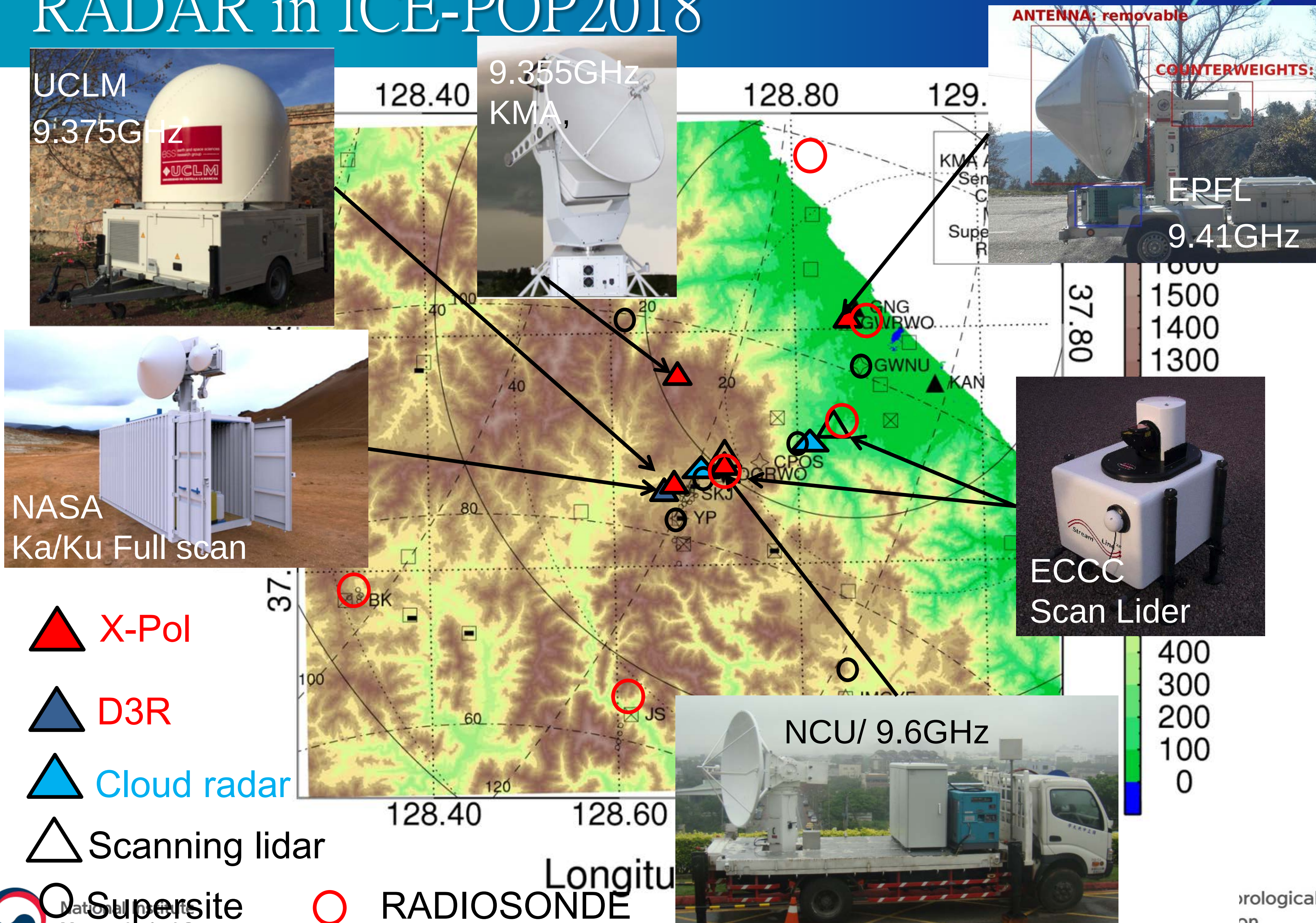
1 Sondesite 1(DGWO)
2 Sondesite 2(BKOS)
3 Sondesite 3(GWWO)
4 Sondesite 4(OBS Ship)
5 Sondesite 5(GWNU)
6 Sondesite 6(JSOS)

1 Supersite 1(MHOS)
2 Supersite 2(YPOS)
3 Supersite 3(CPOS)
4 Supersite 4(EUOS)
5 Supersite 5(GWNU)
6 Supersite 6(SJOS)
7 Supersite 7(IGOS)
8 Supersite 8(ODOS)



GNG: Gangneung radar(S-band, Operational radar/KMA)
KAN: Airforces Radar(C-band), GRS: S-band dual-pol

RADAR in ICE-POP2018



Supersite 1 (MH) instruments

VertiX
(9.41GHz)

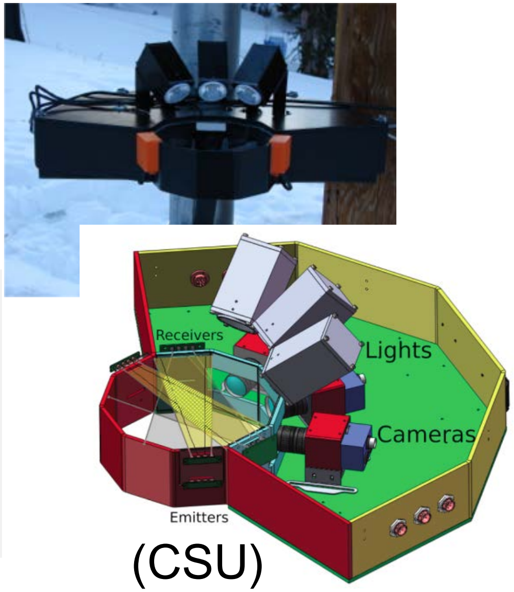
Cloud radar
(W-band)

R2G(R2 Geonor)

MRR(24GHz)

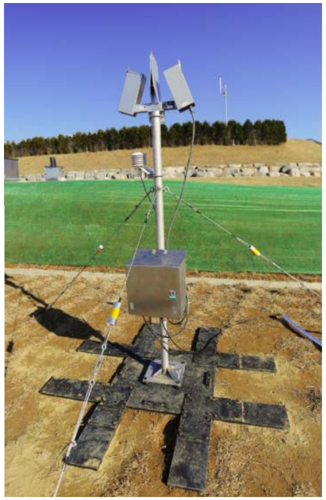
2DVD

MASC



(CSU)

POSS



(EC)

Parsivel

Nowcasting and NWP for ICE-POP 2018

Country	Agency	Model
Austria	ZAMG	INCA(Winter Nowcasting over complex terrain)
Canada	ECCC	Surface near-surface model, INTW, IGEM-LAM 0.25K
		Develop snow microphysics (P3 scheme)
China	CMA	GRAPES-??km
Russia	Roshydromet	COSMO – 0.17 K
UK	MetOffice	UM – 0.2K
US	NASA	NU-WRF(NASA Unified WRF)
	NOAA/CIRA	Cloud Analysis Nowcasting (CAN)
	NCAR	FINECAST(based on VDRAS)
		Develop snow microphysics (P3 scheme)
		MPAS-0.2K
Spain	UCLM	Size & density distribution of WRF microphysics
Korea	KMA	UM 4dVar RUC-1.5K(VDAPS), UM downscaling -0.1K(HPS)
	KIAPS	Physical process tuning

Scientific Challenges

- **To coordinate comparison study of sub km scale NWP** models in mesoscale winter weather condition over complex terrain with dense observation networks **to understand predictability of NWP models**
  - GEM-LAM(0.2K), COSMO(0.17K), UM(0.2K), MPAS(0.2K), UM Downscaling(0.1K) is to join the comparison and wait a contribution from GRAPES.
- **To evaluate** the benefit of different **nowcasting approaches to develop seamless prediction** from nowcasting to short-range NWP prediction
  - MAPLE, INCA, CAN, FINECAST, INTW will be operated to support forecasters
  - Analysis, prediction and blending method will be evaluated to understand the optimal way seamless prediction with nowcating and NWP prdiction
- **To advance physical processes** of snow microphysics, surface processes over land and ocean, and fog/low level cloud processes
  - The Predicted Particle Properties(P3) scheme will be calibrated with the observation and some of the RDP models
  - Fog/low level cloud physics in NWP
  - Land surface model and interaction with atmosphere will be compared
- To create valuable, reliable and accessible thermodynamical and hydrometeorological **observation data sets** for winter weather over a complex terrain through IOP
  - Ground validation of satellite (i.e. ADM Aeolus GPM snow retrieval)
- To understand microphysical processes over complex terrain such as snow size, shape vertical structure with **multi-frequency radar and various microphysical observations** Radarsite 1 and supersites) with better quality control

Implementation Plan

Test Event — Test Event — Olympic

2015 — 2016 — 2017 — 2018

Observation

RAOB
Ship
Mobil Vehicle

Wind lider
Parsivel

X band
Aircraft

X band R
Cloud R
Satellite
(Geocloud,flux
Hourly SST)

DC3
Ka/Ku radar

Final Report

&

Paper in Special Volume

Model

KMA NWP
+Guidiace
VDAPS

CAN
FINECAST
INCA
VDAPS

GEM-LAM
INTW
COSMO
NuWRF
MPAS
GRAPES
UM(Reading)

Real time Service

Workshop

Preliminary evaluation & progress report

Progress report , Operation Check up

Summary

- ICE-POP2018 is endorsed as an official RDP/FDP by WMO at 27 November 2015
  - Up to now 10 countries are joined the ICE-POP 2018 to advance seamless prediction from nowcasting to short-range forecast for winter weathers over complex terrains by developing intensive observation network and numerical models.

- Intensive observation network was designed to produce reliable thermdynamic and hydrophysical observation
  - 4 x-band rdar, 3 cloud radars, 2 wind liders, and ground instruments (8 supersites) are joined IOP together with operational observation at KMA
  - Aircraft will cover oceans and upper level hydrometeor observations.
  - Sea condition will be observed by the ship and satellite.
  - The data sharing system is installed and will be available before 17 winter for the ICE-POP participants and will be released later.

- Several nowcasting systems and high resolution NWP models joined to advance seamless prediction from nowcasting to very-short range prediction
  - 5 nowcating systems and 7 sub km scale NWP models join the project
  - DA capability of assimilating the IOP data is under development
  - Forecast communication method tools are being develped.

Thank you