International Research & Development Proposal to WWRP/WMO

WWRP advances society's ability to cope with high impact weather through research focused on improving the accuracy, lead time and utilization of weather prediction.

Participating countries (plan): Australia, Austria, Brazil, Canada, France, Germany, Hong Kong, Japan, Korea, USA

Workshop for RDP/WWRP/WMO (25 Oct., 2012, Tokyo)

" Social System Reformation Program for Adaption to Climate Change"
Strategic Funds for the Promotion of Science and Technology (JST/MEXT)

Tokyo Metropolitan Area Convection Studies for Extreme Weather Resilient Cities (TOMACS)

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Kagoshima University, Japan

Seminor,
05 SEP,2014, Ecole des Ponts ParisTech

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- HISTORICAL REVIEW OF X-BAND WEATHER RADAR IN JAPAN
- RESEARCH PROJECTS USING X-BAND POLARIMETRIC RADAR

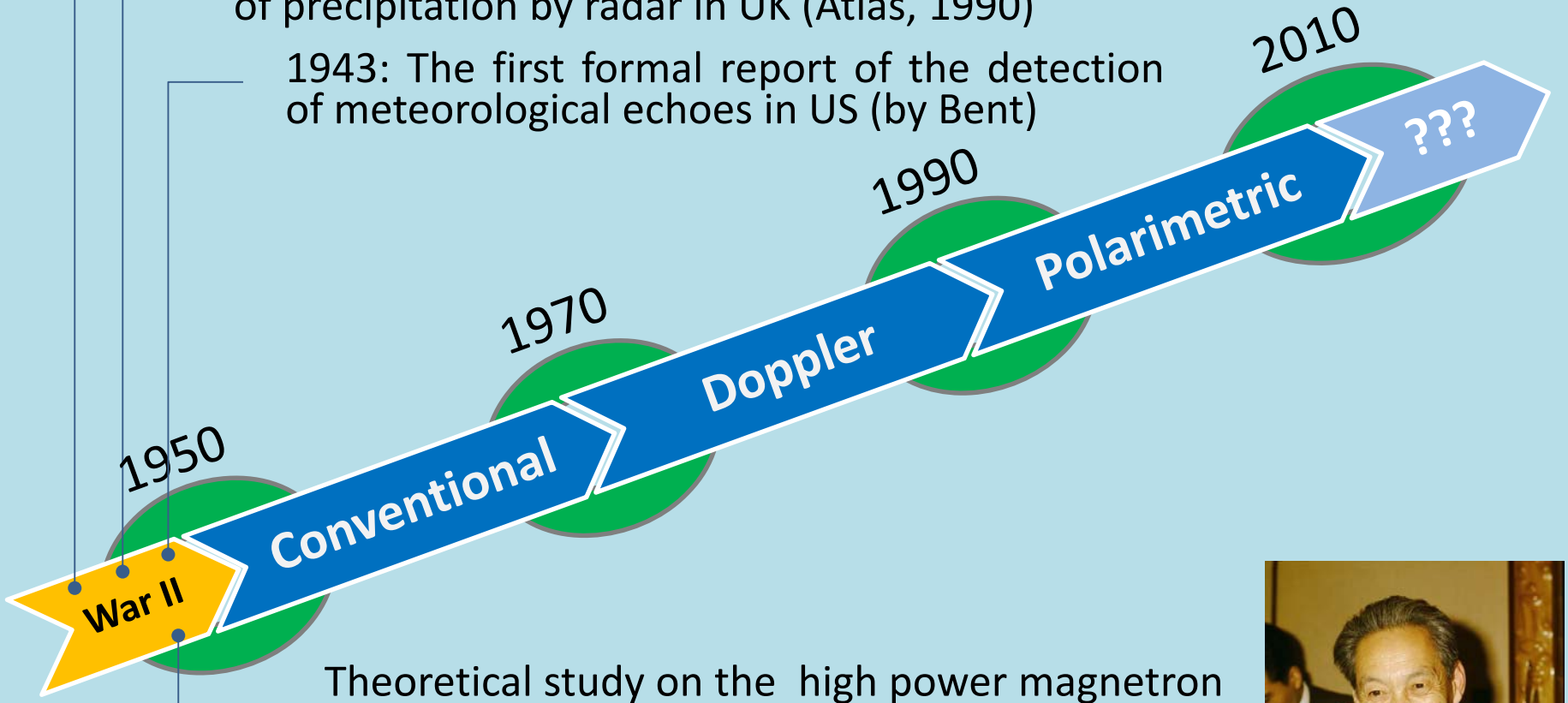
HISTORICAL BRIERF REVIEW OF X-BAND WEATHER RADAR IN JAPAN

THE PRE-DAWN OF WEATHER RADAR

1935-: The first demonstration of radar by Watson Watt et al. (Great Britain)

Late 1940 or early 1941: The first echo detection of precipitation by radar in UK (Atlas, 1990)

1943: The first formal report of the detection of meteorological echoes in US (by Bent)



Theoretical study on the high power magnetron transmitter by Dr. Tomonaga who received the Novel Prize with Julian Schwinger and Richard Feynman in 1965

CONVENTIONAL WEATHER RADAR

1955-: C-band operational (JMA)

1964: Mt. Fuji S-band (JMA)

1950

1970

1990

2010

War II

Conventional

Doppler

Polarimetric

???

1969: Transportable X-band (NIED)

1954: The first Japanese X-band meteorol radar (MRI)

1952: The first X-band marine radar equipment (JRC, 1952)

1951: The GHQ allowed Japanese gov to make marine radar

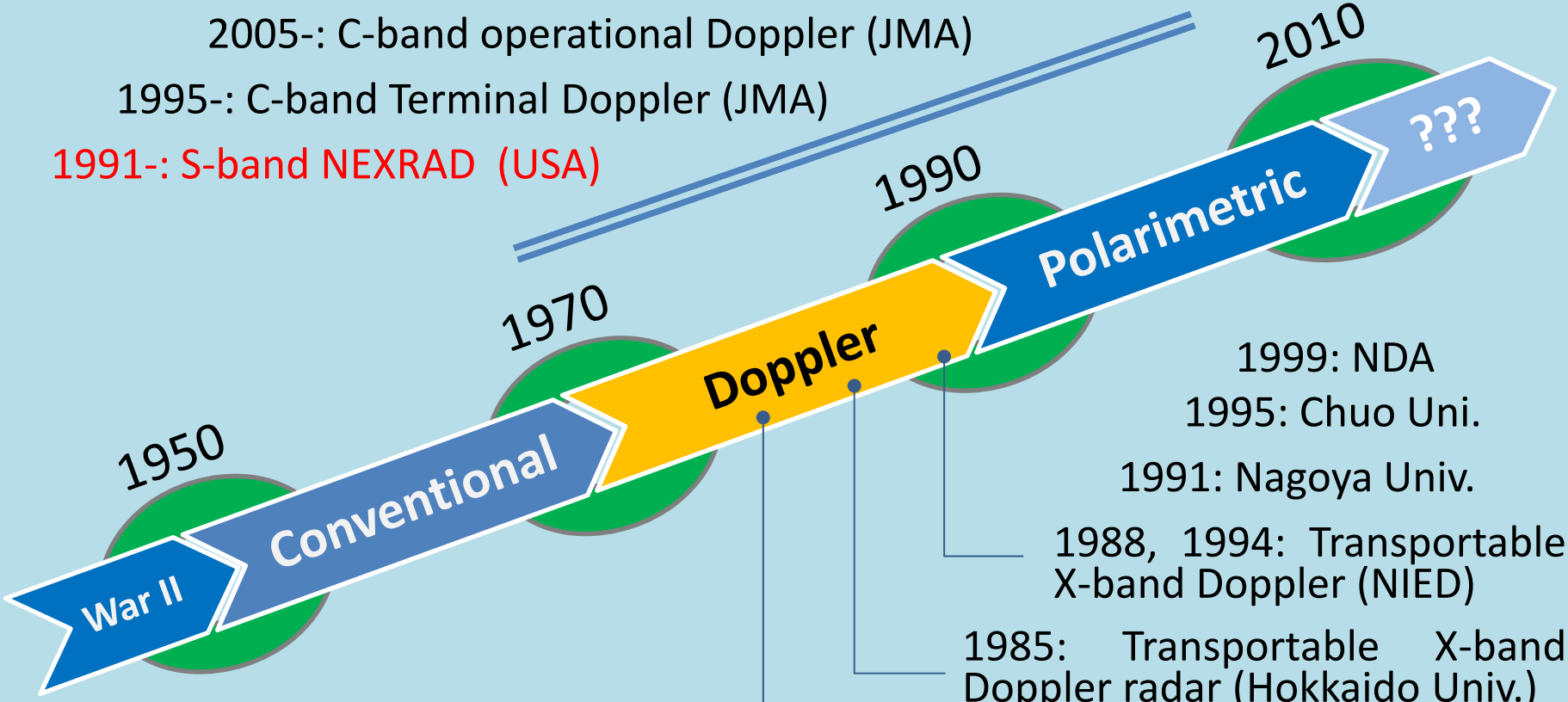
DOPPLER WEATHER RADAR

C-band wavelength are used for operational weather radars. A total of 20 radars are Doppler (except TDWR)

2005-: C-band operational Doppler (JMA)

1995-: C-band Terminal Doppler (JMA)

1991-: S-band NEXRAD (USA)



1999: NDA

1995: Chuo Uni.

1991: Nagoya Univ.

1988, 1994: Transportable X-band Doppler (NIED)

1985: Transportable X-band Doppler radar (Hokkaido Univ.)

1981: The first Japanese X-band Doppler radar (MRI)

X-band Doppler radars were used in research institutes and universities in Japan.

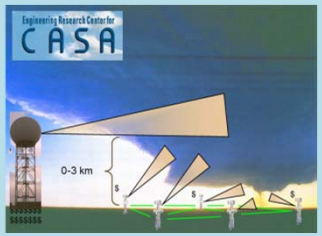
Summary after World War II

- Rapid development of conventional weather radar for precipitation measurements
- C-band and S-band are selected for operational radar
- Expectation for X-band dropped off due to the severe rainfall attenuation
- Common recognition: X-band is not suitable for QPE

Polarimetric Technique after 1990

- Specific differential phase for QPE
- S-, C-, then X-band
- Revaluation of X-band wavelength for QPE
  - High sensitivity of differential phase shift
  - High spatiotemporal resolution
  - Small size and easier to set up
- X-band is suitable to gap-filling radar and urban radar network

X-BAND POLARIMETRIC WEATHER RADAR



2012-: RAINGAIN in Europe

2012-: CASA DFW-WARN

2007-: CASA OK Experiment

2004-: CASA network radar

1997: ETL/NOAA “Hydro” radar

2000: MP radar (NIED)

2006-: X-NET (NIED et al)

2009-: Operational XRAIN (MLIT)

2010-: TOMACS (JST)

2012: Phased array (Osaka Univ. et al)

1950 War II

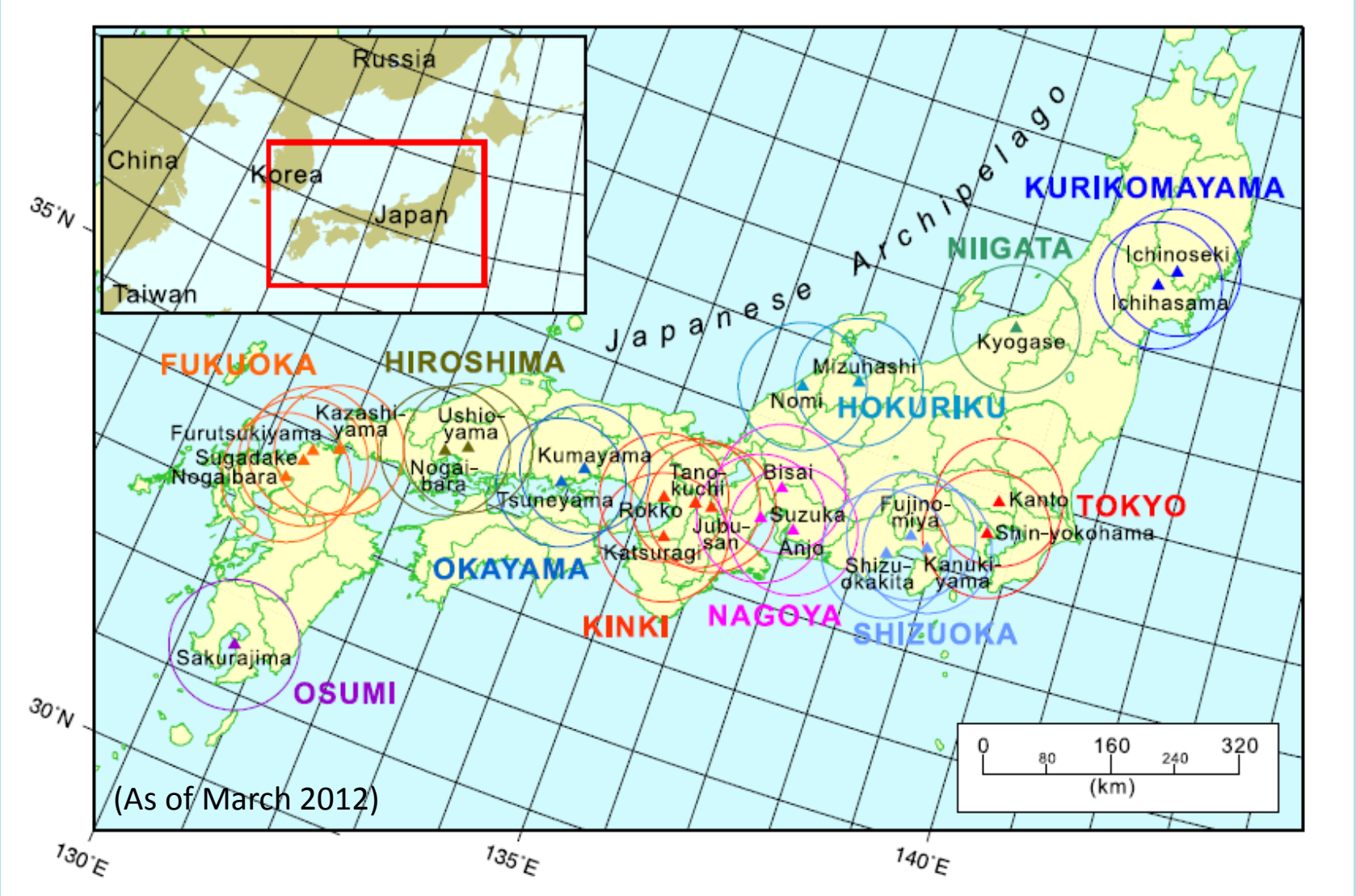
1970 Conventional

1990 Doppler

2010 Polarimetric

???

XRAIN: X-band Polarimetric Radar Network of MLIT



The Ministry of Land, Infrastructure, Transport and Tourism (MLIT) started to construct X-band polarimetric radar network in 2009 to monitor heavy rainfall in urban areas. A total of 27 (35) radars are operating in 2012 (2013).