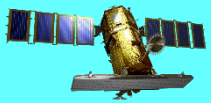


Korea Aerospace Research Institute
KOMPSAT-5 Mission Operations
45 Eoeun-dong, Yuseong-gu Daejeon, 305-333, Korea

KOMPSAT-5 Geolocation Accuracy Analysis with Mongolia and CEOS Calibration Site

19 Nov 2019

Korea Aerospace Research Institute

Horyung Jeong, Donghyun Kim, Dochul Yang and Donghan Lee

Agenda

- **Brief Introduction about K5 Imaging Mode**
  - System Operations Overview
  - K5 Image Quality for Enhanced Mode
- **Mongolia CAL Site for KOMPSAT-5**
  - Introduction about Mongolia CAL Site for KOMPSAT-5
  - Mongolia CAL Site Maintenance Activity
- **Geolocation Measurement Results**
  - K5 Geolocation Measure via Mongolia Site
  - K5 Geolocation Measure via CEOS targets (referred to CEOS website)
- **Conclusion**

System Operations Overview

KOMPSAT-5 Satellite
- Dawn-dusk frozen orbit
- Altitude 550 km
- 06:00 am MLT of A.N.
- 28 days repeat ground track/daily revisit time

X-band downlink
- Greater than 300Mbps
- Image data including Ancillary data

S-band downlink
- 4.096 kbps
- AOPOD GPS and SOH data

S-band uplink
- 4 kbps
- Commands,S/W loads

COSI Image
- High Resolution Mode : 1 m GR / 5 km SW
- Standard Mode : 3 m GR / 30 km SW
- Wide Swath Mode : 20 m GR / 100 km SW

X-band antenna

KGS
(KOMPSAT-5 Ground Segment)

S-band antenna

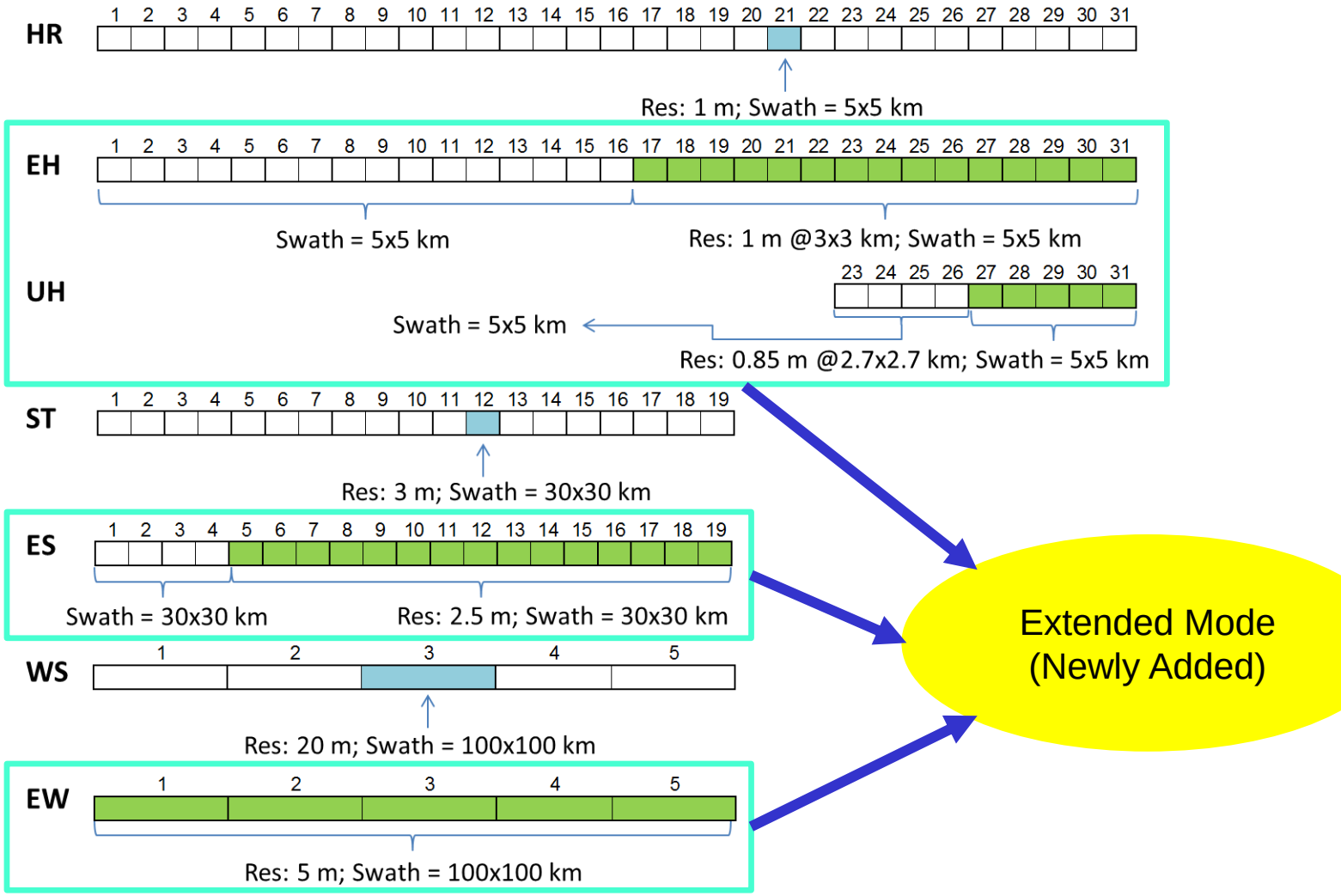
Cmd & Tlm

Urgent looking mode change mission
or contingency support

Sejong (South Pole)

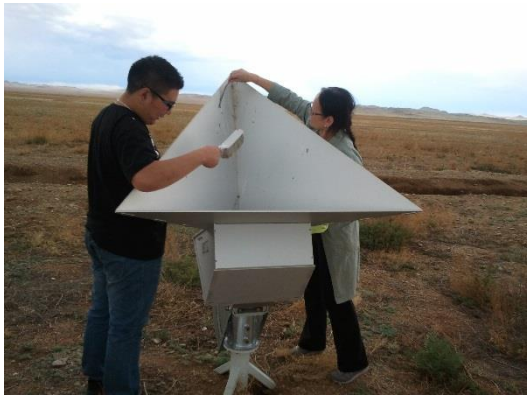
K5 Image Quality for Enhanced Mode

- **K5 System Image Quality for Enhanced Mode**



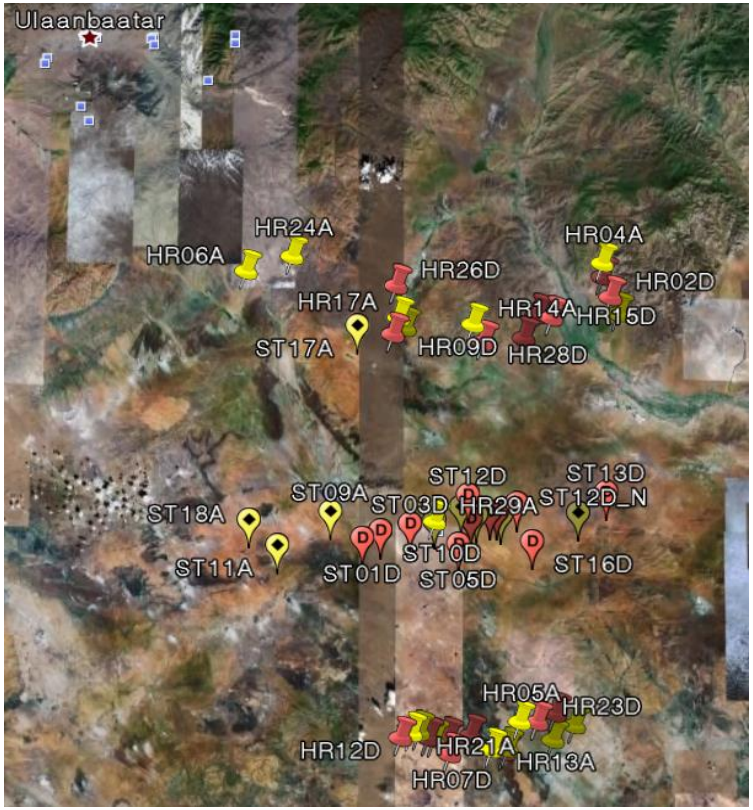
Introduction about Mongolia CAL Site for KOMPSAT-5

- **Introduction about Mongolia CAL Site for KOMPSAT-5**
  - 52 CRs consisting of 20 ST and 32 HR CR are installed in Mongolia CAL site
  - Background level of Mongolia is very low and it is very suitable for SAR calibration site
  - No artificial buildings and structures exist around Mongolia calibration site



CR for High-Resolution Mode

CR for Standard Mode



CR Deployment in Mongolia CAL Site

Mongolia CAL Site Maintenance Activity

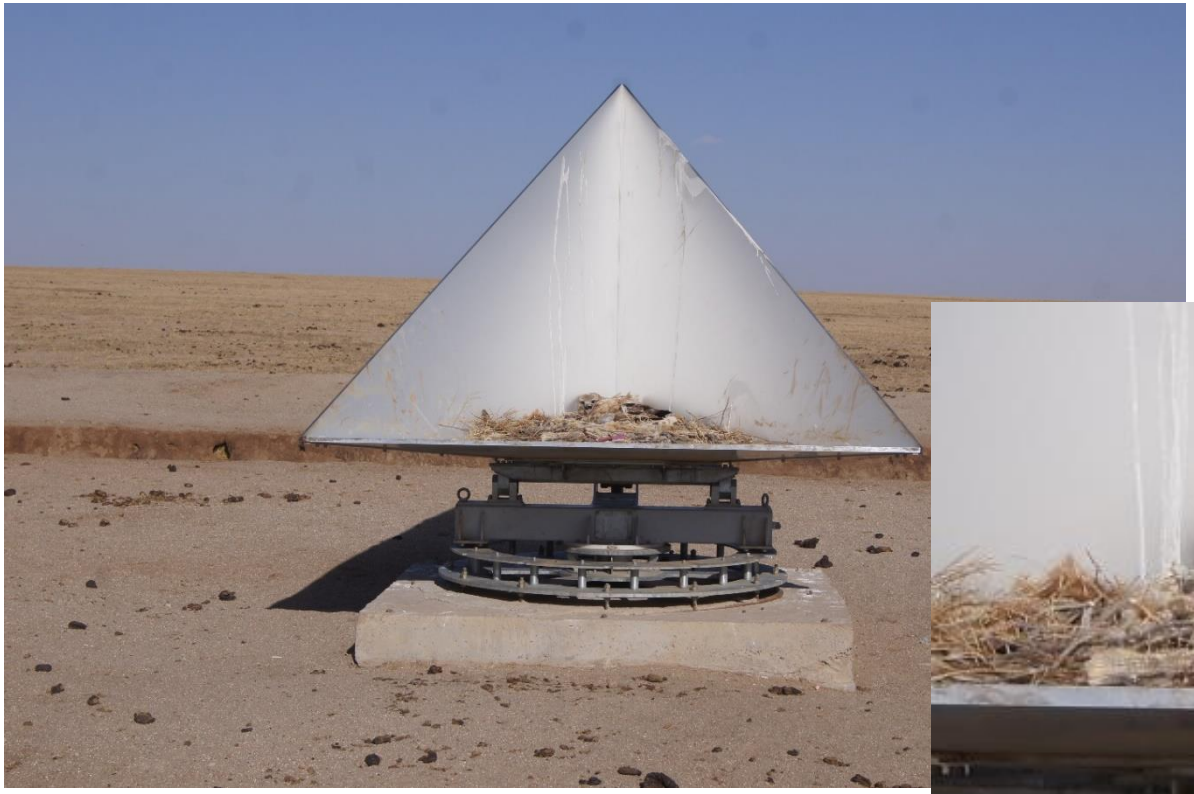
- **Maintenance of Mongolia CAL Site**
  - KARI contract with NRSC(National Remote Sensing Center), Mongolia national institute, to maintain optic and SAR CAL targets every year
  - Main activities for Mongolia CR
    - **Cleaning CR surface**
    - **Checking and adjusting CR elevation and azimuth angle to point K5 orbit**
    - **Repairing or replacing CR parts (if needed)**

Before Cleaning

After Cleaning

Mongolia CAL Site Maintenance Activity

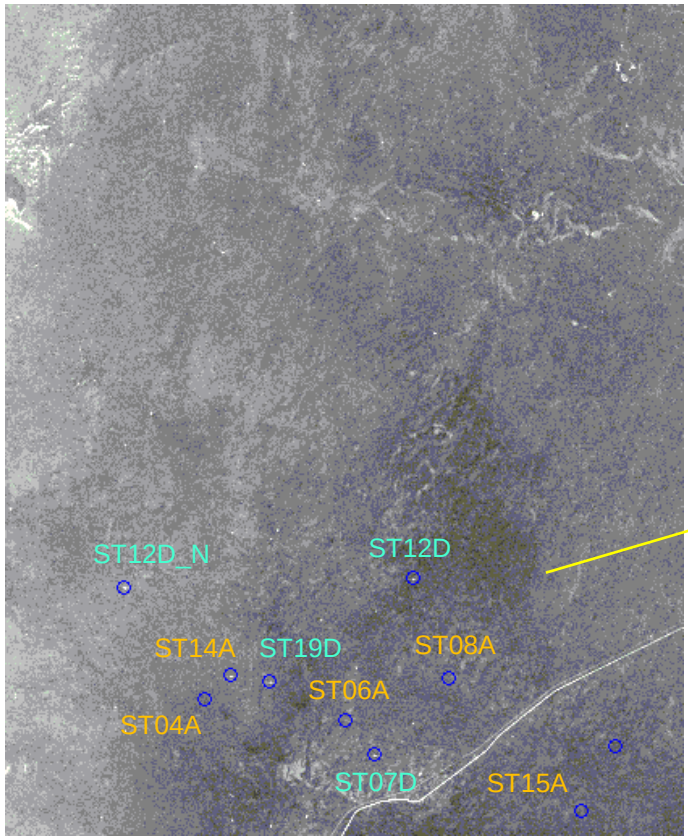
- **Special Case to Degrade CR Impulse Response**
  - Bird nest on CR plate
  - Cleaning activity was performed after young bird upbringing was completed



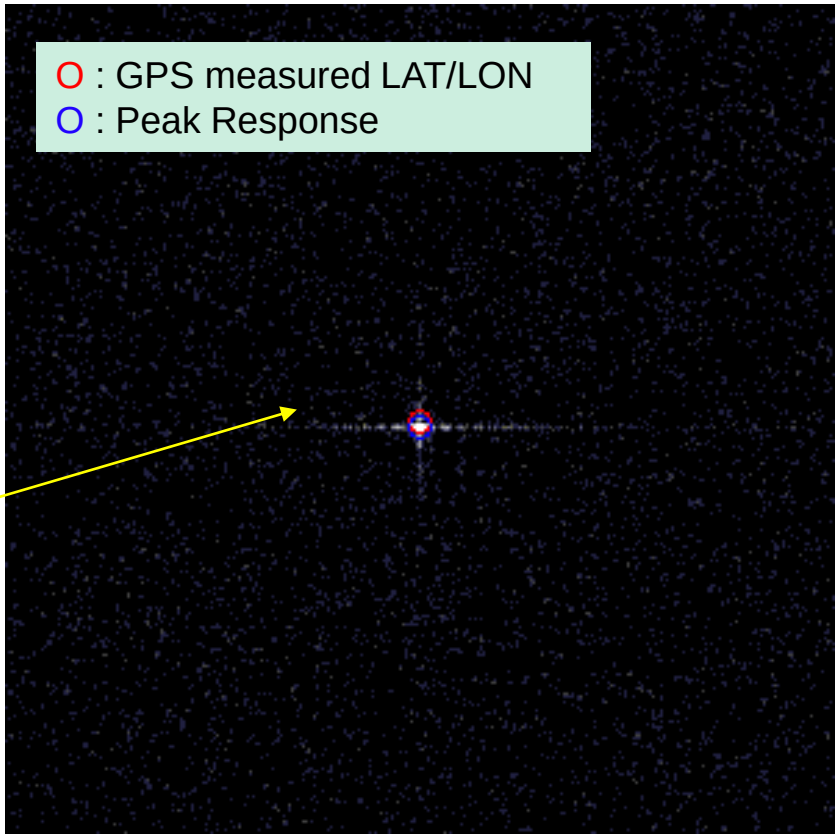
ST15A CR (before maintenance)

K5 Geolocation Measure via Mongolia Site

- **Example of K5 CR image (Mongolia CAL site)**
  - In case of ST, about 5~7 CRs were included in images
  - In case of HR, about 1~3 CRs were included in images



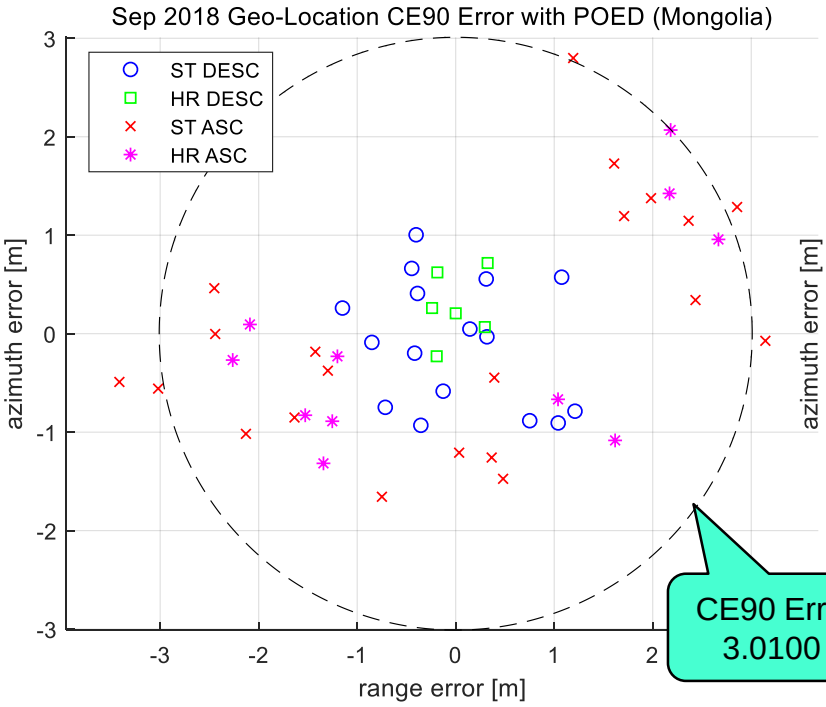
ST12 DESC acquired in 20/Jan2014



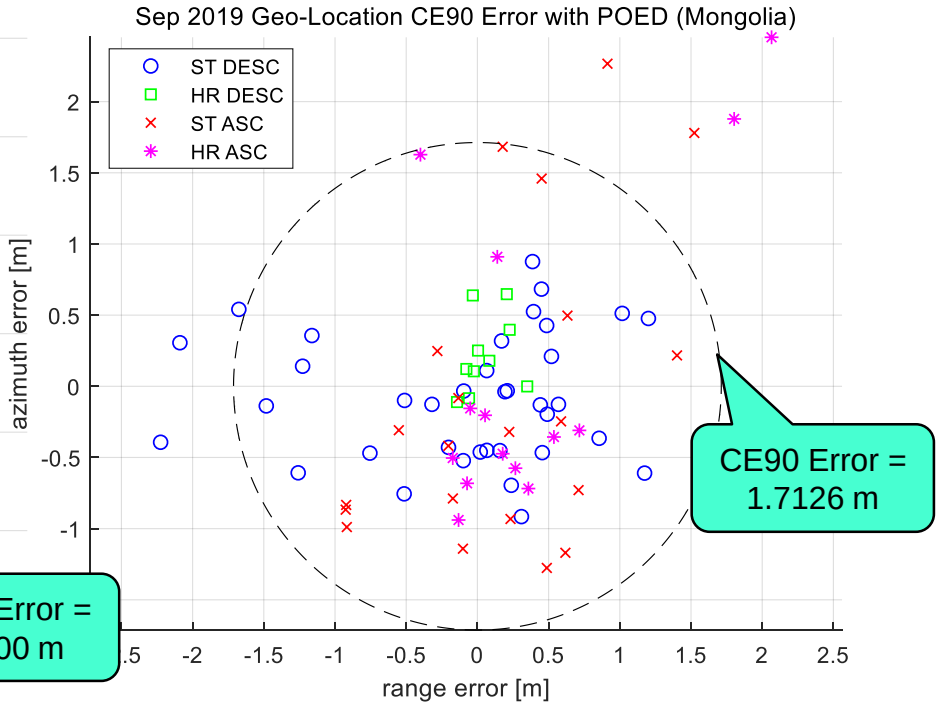
ST12D CR response (zoom-in)

K5 Geolocation Measure via Mongolia Site

- **Geolocation Comparison btw. Sep 2018 & 2019 (Mongolia)**
  - Geolocation measured in Sep 2018 is slightly large because of heavy rain on Mongolia site
  - However, CE90 error was recovered in Sep 2019 after CR condition becomes normal



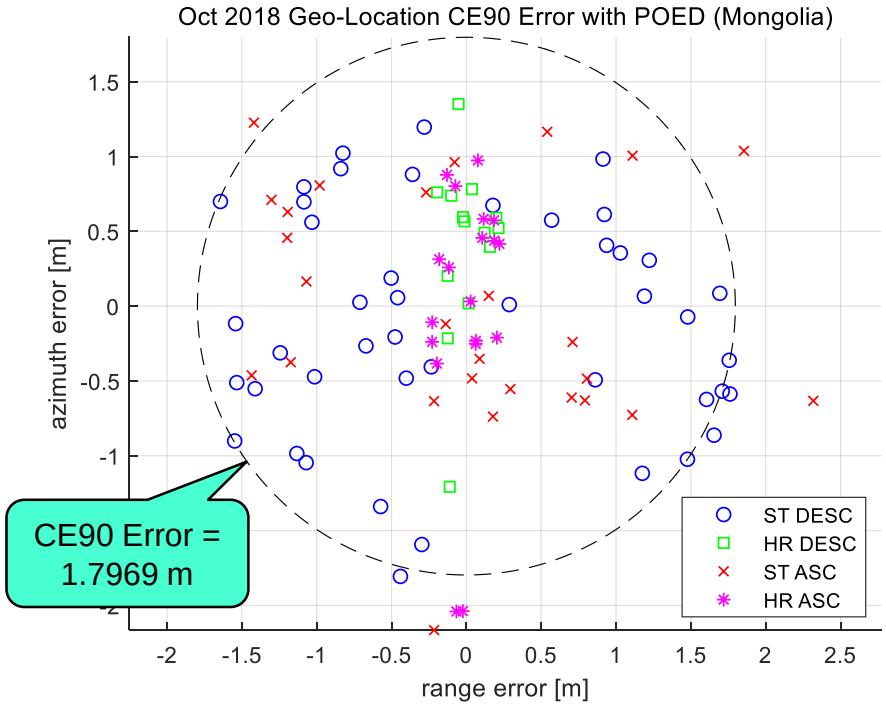
K5 geolocation from Mongolia CR, Sep 2018



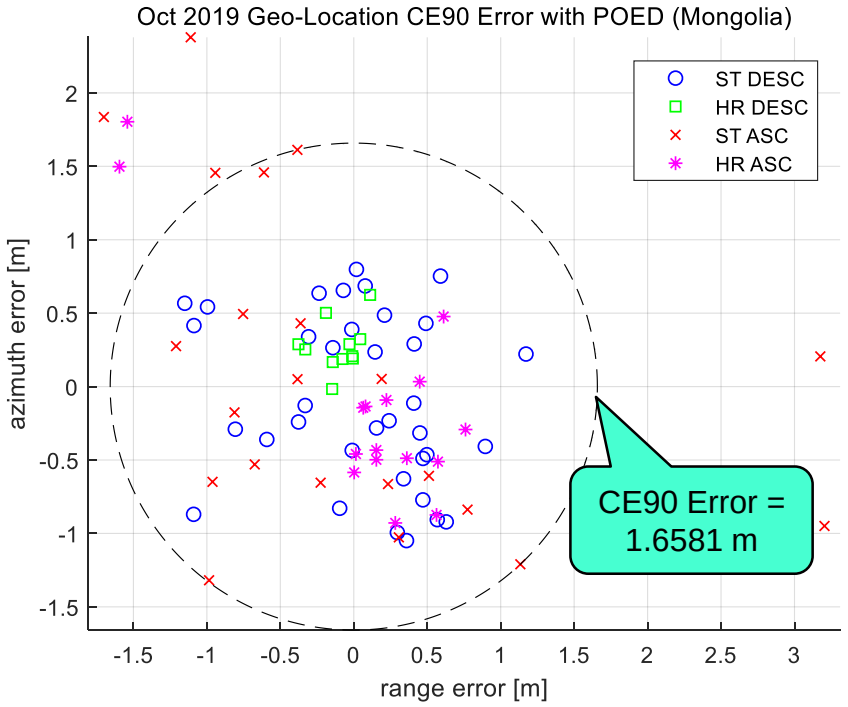
K5 geolocation from Mongolia CR, Sep 2019

K5 Geolocation Measure via Mongolia Site

- **Geolocation Comparison btw. Oct 2018 & 2019 (Mongolia)**
  - CE90 error in Oct 2019 maintained as that of Oct 2018
  - Every October month is recommended time to survey CRs because the weather is clear and little rain



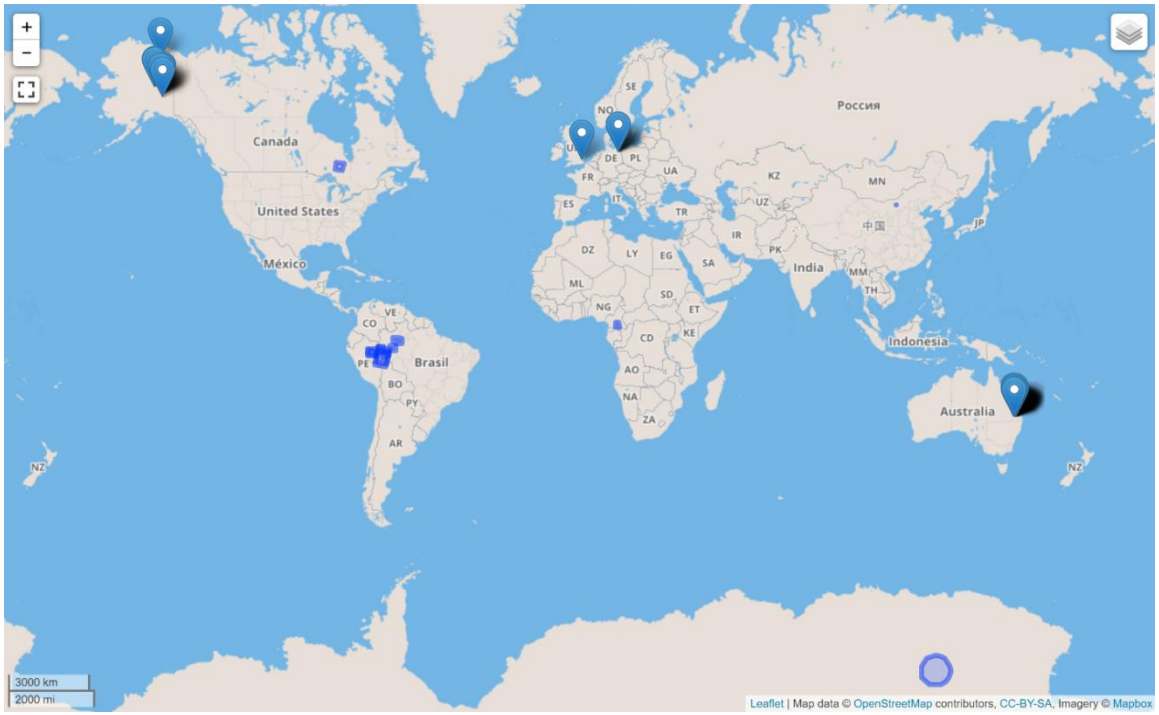
K5 geolocation from Mongolia CR, Oct 2018



K5 geolocation from Mongolia CR, Oct 2019

K5 Geolocation Measure via CEOS Target

- **Targets for K5 geolocation measurement**
  - Rosamond(USA), Argentina and Italy site
  - Germany in CEOS webpage
    - **Referred to KML file in** http://sarcv.ceos.org/targets/
  - Alaska site was excluded because of little K5 access chance
  - Distributed targets are also referred to evaluate K5 Doppler centroid



K5 Geolocation Measure via CEOS Target

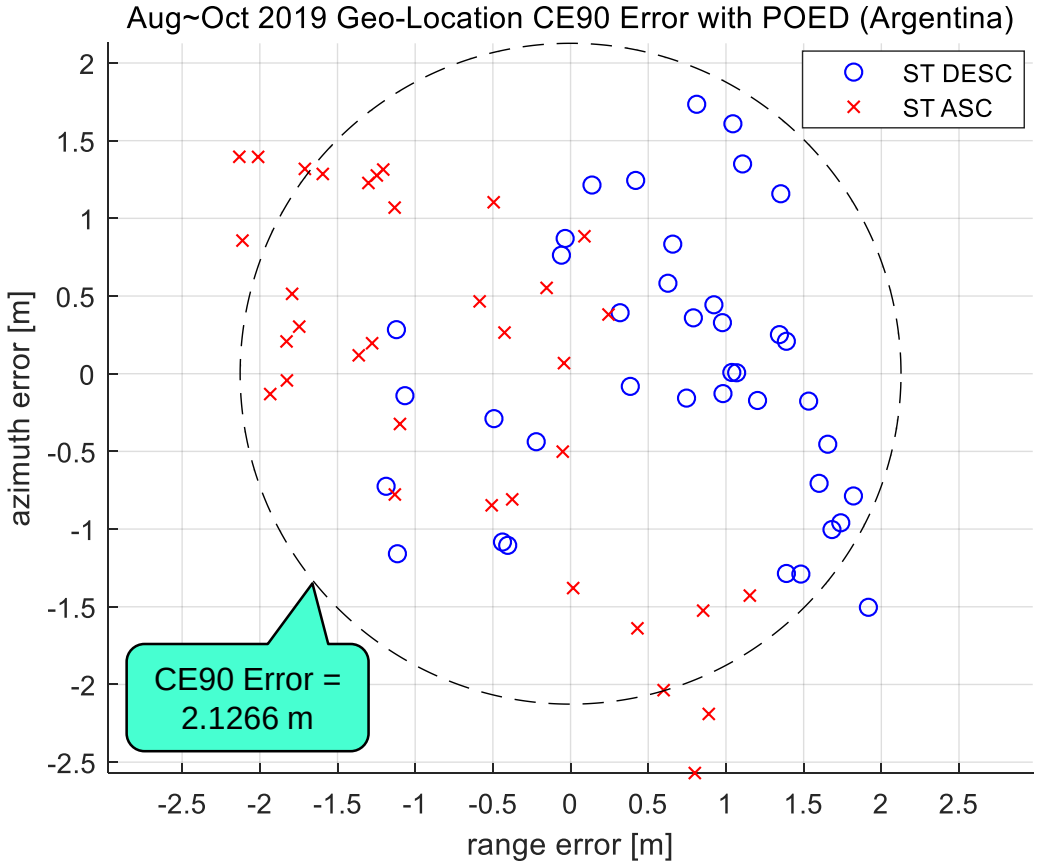
- **Brief Information About Image Acquisition from Argentina Site**
  - Imaging time for measurement : from Aug to Oct 2019
  - Number of CRs in the site : 14
  - Summary of target information

	Aug	Sep	Oct
# of ASC images	4	3	0
# of DESC images	2	1	1
# of point targets included all images	38	28	8
Acquisition Mode	ES	ES	ES

Argentina CR image acquired in 23/Oct/2019

K5 Geolocation Measure via CEOS Target

- **K5 Geolocation Measured from Argentina CR**
  - Geolocation of ST mode was measured
  - CE90 is about 2.1266 m and it is similar to Mongolia measurement

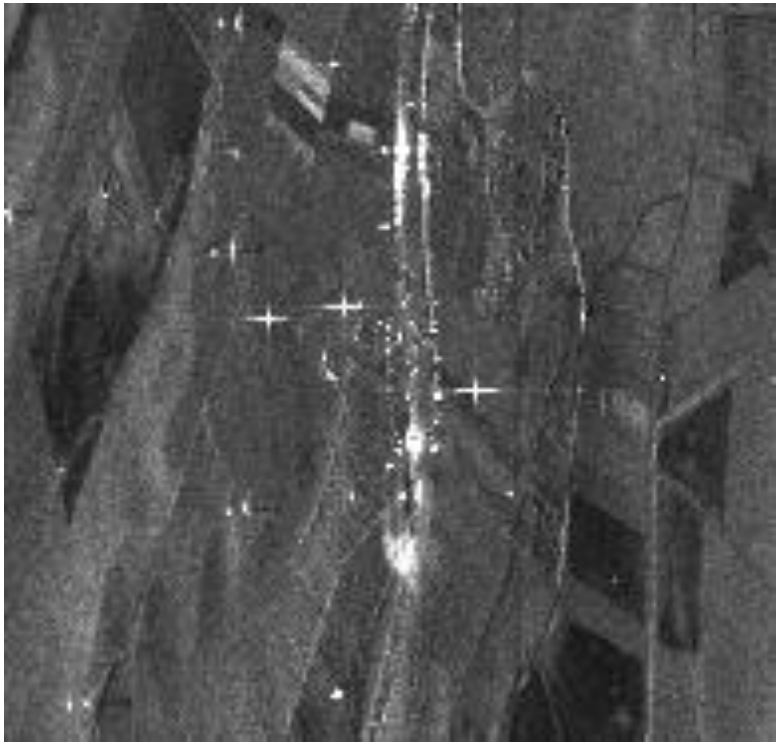


K5 geolocation from Argentina CR, Aug~Oct 2019

K5 Geolocation Measure via CEOS Target

- **Brief Information About Image Acquisition from Italy Site**
  - Imaging time for measurement : from Aug to Oct 2019
  - Number of CRs in the site : 4 & 7
  - Summary of target information

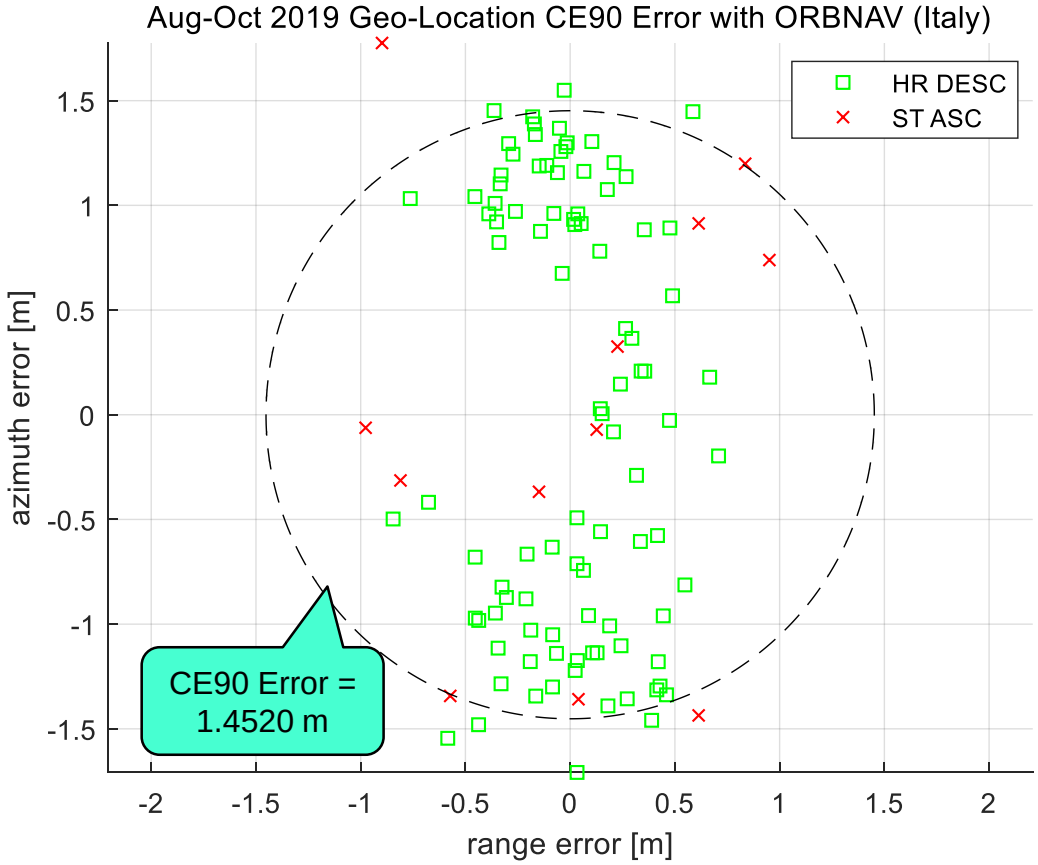
	Aug	Sep	Oct
# of ASC images	7	4	3
# of DESC images	5	6	4
# of point targets included all images	70	64	42
Acquisition Mode	HR & ST	HR & ST	HR & ST



Italy CR image acquired in 26/Oct/2019

K5 Geolocation Measure via CEOS Target

- **K5 Geolocation Measured from Italy CR**
  - Geolocation of ST & HR mode was measured
  - CE90 is about 1.4520 m and it is similar to Mongolia measurement



K5 geolocation from Italy CR, Aug~Oct 2019

K5 Geolocation Measure via CEOS Target

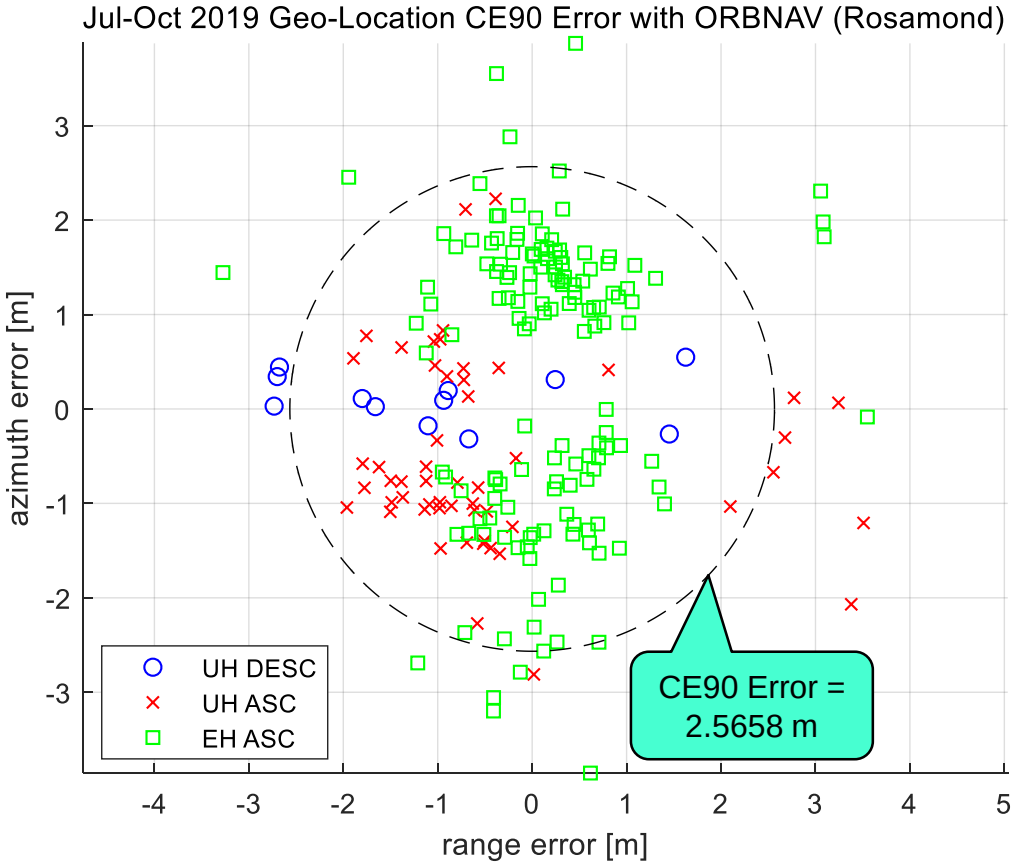
- **Brief Information About Image Acquisition from USA(Rosamond) Site**
  - Imaging time for measurement : from Aug to Oct 2019
  - Number of CRs in the site : 35
  - Summary of target information

	Aug	Sep	Oct
# of ASC images	6	6	6
# of DESC images	2	3	2
# of point targets included all images	108	128	114
Acquisition Mode	EH & UH	EH & UH	EH & UH

Rosamond CR image acquired in 11/Oct/2019

K5 Geolocation Measure via CEOS Target

- **K5 Geolocation Measured from USA(Rosamond) CR**
  - Geolocation of UH & EH mode was measured
  - CE90 is about 2.5658 m and it is similar to Mongolia measurement



K5 geolocation from USA(Rosamond) CR, Aug~Oct 2019

K5 Geolocation Measure via CEOS Target

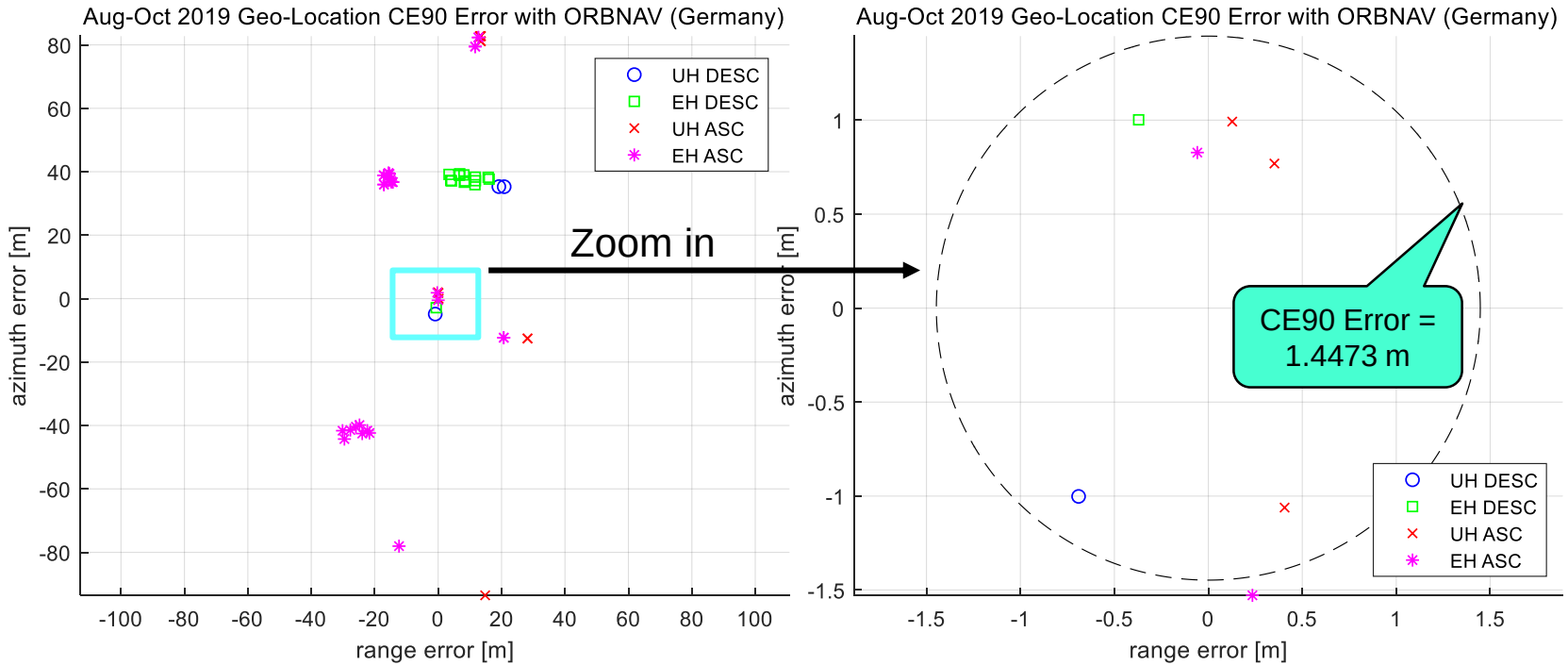
- **Brief Information About Image Acquisition from Germany Site**
  - Imaging time for measurement : from Aug to Oct 2019
  - Number of CRs in the site : 4
  - Summary of target information

	Aug	Sep	Oct
# of ASC images	5	5	5
# of DESC images	5	7	5
# of point targets included all images	19	21	19
Acquisition Mode	EH & UH	EH & UH	EH & UH

Germany CR image acquired in 20/Oct/2019

K5 Geolocation Measure via CEOS Target

- **K5 Geolocation Measured from Germany CR**
  - Almost geolocation measurements showed very large CE90
    - **It is expected that CR elevation angles were mismatched with K5 incidence angle, and therefore SW detect other object as CR**
  - However, CE90 measured from exactly detected 7 points is about 1.4473 m and it is similar to Mongolia measurement



K5 geolocation from Germany CR, Aug~Oct 2019

Conclusion

- **CE90 measured from Mongolia CR is good and maintained from 2018 well**

- **CE90 measured from CR sited recorded in CEOS DB is also good and similar as that measured from Mongolia site**
  - Some cases (such as Germany site) KARI SW cannot detect peak response of CR in the image because incidence angle of K5 beam is not matched with CR elevation angle


Thank you !!
전 · 천 · 후 영상레이더(SAR)위성
다목적실용위성5호