Microwave characteristics of ice on Lake Saroma observed by PALSAR-2 and Pi-SAR-2L
(A study on microwave measurement of sea ice physical parameters)

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ABSTRACT

The main objective of this research is to investigate the possible use of SAR data to monitor sea ice in the southern region of the Sea of Okhotsk. There are a lot of SAR satellites operating in orbit, and most satellites can observe the ground targets with various observation parameters. We would like to find out the suitable observation parameters for monitoring sea ice in relatively thin sea ice area. ALOS-2/PALSAR-2 and Pi-SAR-2L acquired the data covering the southern region of Sea of Okhotsk including Lake Saroma in the end of February 2015. We could not get good in-situ data simultaneously with the SAR observations due to the bad ice conditions in the east part of the lake. However, we found that there were various ice conditions, such as relatively thin ice and open water area, in the west part of the lake.

By taking profiles of polarimetric parameters along the line crossing from west to east coast of the lake, it was found that VV to HH backscattering ratio at higher incidence angle was correlated with sea ice thickness. In addition, we found that the scattering entropy could not always detect open water, because we have very low backscattering coefficient in the open water area with no surface wind. It is possible to improve sea ice detection accuracy by combining polarization correlation with the scattering entropy.

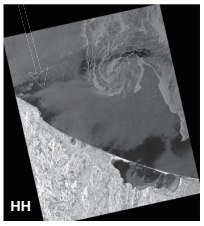
RESEARCH OBJECTIVES

- ☑ Investigate the possible use of SAR data to monitor sea ice in the southern region of the Sea of Okhotsk.
- ☑ Results will be applied to ALOS-2/PALSAR-2 data.

OBSERVATION EXPERIMENT IN 2015

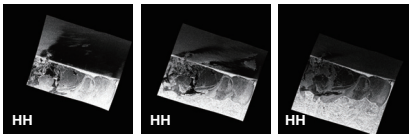
- ☑ PALSAR-2 data were acquired including Lake Saroma.
- ☑ Airborne L-band SAR (Pi-SAR-2L) data at three different incidence angle were acquired.
- ☑ Various ice types were available in the wes part of the lake

PALSAR-2 observation



PALSAR-2 (Feb.23,2015)

Pi-SAR-2L observation



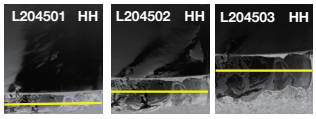
L204501 @25deg. L204502 @35deg. L204503 @45deg.

Pi-SAR-2L (Feb.24,2015)

TEST SITE: LAKE SAROMA

The Sea of Okhotsk is located in the most southerly region of the northern hemisphere, where sea ice exists only during wintertime. Since the extent of sea ice in this area is related to local as well as global climate change, an application for monitoring sea ice by using remote sensing data in this region has been studied. Our test site, Lake Saroma, is located the southern edge of this area.

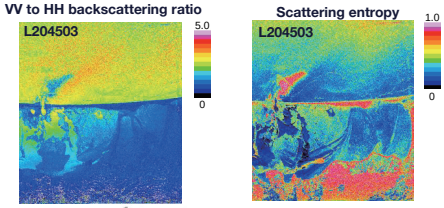
	ALOS-2	Pi-SAR-2L
Bandwidth	14/28/42/85 MHz	85 MHz
Sampling frequency		100 MHz
Height	628 km	6 -12 km
Image width	25-490 km	<= 20 km
AD(I/Q)		8 bits I + Q
Range resolution	1 m	1.76 m
Azimuth resolution	3 m	3.2 m
NE sigma zero	-28 dB	-35 dB
Incidence angle	8-70 deg,	10-62 deg.
Polarimetry	full	full
Pulse length		10-30 micro-sec.
Tx power	5.1 kW	3.5 kW

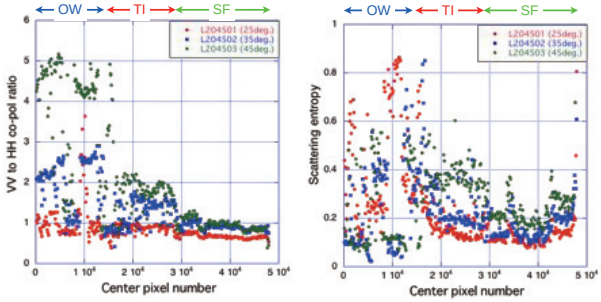


OW: Open Water
TI: Thin Ice
SF : Smooth First year ice

Pi-SAR-2L data analysis

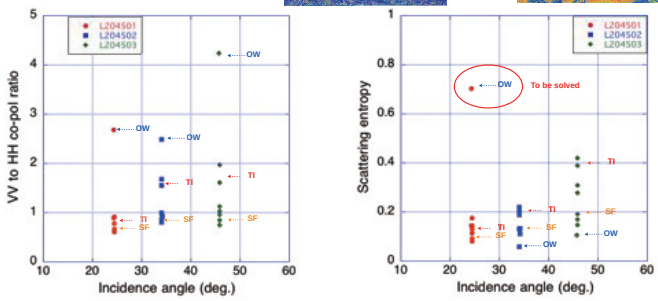
1. Data acquired were Level 1.1.
2. Location and incidence angle were calculated by using facter.m information provided by JAXA.
3. Calculate polarimetric characteristics along the line crossing the lake.





(a) (b)

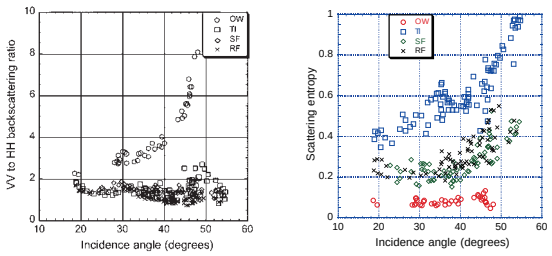
Profiles of polarimetric parameters along the horizontal line. (a) VV to HH backscattering ratio and (b)scattering entropy.



(a) (b)

Incidence angle characteristics for (a) VV to HH backscattering ratio and (b) scattering entropy.

Most results are consistent with our previous work shown below



H. Wakabayashi, T. Matsuoka, K. Nakamura and F. Nishio : Polarimetric characteristics of sea ice in the Sea of Okhotsk observed by airborne L-band SAR, IEEE Trans. on Geosci. and Remote Sensing , 42(11), pp. 2412-2425, 2004.

SUMMARY

- ☑ ALOS-2/PALSAR-2 and Pi-SAR-2L acquired the data covering the southern region of Sea of Okhotsk including Lake Saroma in the end of February 2015.
- ☑ By taking profiles of polarimetric parameters extracted from Pi-SAR-2L data along the line crossing from west to east coast of the lake, the followings were found.
  - ✓VV to HH backscattering ratio at higher incidence angle was correlated with sea ice thickness.
  - ✓Scattering entropy could mostly discriminate open water and ice cover.
- ☑ Calm open sea had very high scattering entropy, because it has very low backscattering coefficient close to noise equivalent sigma-0.
  - ✓Since the correlation between HV and VH polarizations can be used to detect noise level, this parameter is a candidate to detect open water with no surface wind.

FUTURE WORK

- ☑ Comparison between SAR data and in-situ data should be conducted.
- ☑ Develop a method to detect calm open sea by using polarimetric parameters.

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