Studies on sea ice and polynya off the Cape Darnley Antarctica, using ALOS-PALSAR and other satellite data

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Antarctic Coastal Polynya

Sea Ice Factory

Dense water formation

Antarctic Bottom Water (AABW)

(Morales Maqueda et al., 2004)

Based on heat flux calculation and SSM/I (passive microwave)

(Tamura et al., 2008, GRL)

Cape Darnley

Ross Sea

2nd highest production

Highest ice production

Cape Darnley polynya

Ross Ice Shelf Polynya
ALOS PALSAR imagery (31 Jul 2007)

- 1st-year ice
- Streaks of new ice
- Iceberg tongue
- Pack ice region
- Cape Darnley Polynya

Antarctic Continent
Cape Darnley Polynya
The second highest sea ice production

Final scientific purpose

1. What is formation mechanism of the polynya? Why such large ice production occurs?

2. Is Antarctic bottom water formed there? If so, how are formation process, volume, relation with ice production?

Purpose using PALSAR data: PALSAR data provides

1. Comparison & validation for AMSR & SSM/I sea ice algorithm

2. Detailed structure of the Cape Darnley Polynya and its seasonal variation because of the high resolution

3. Discrimination of ice thickness & type, and fast ice → Towards sea ice algorithm of PALSAR
Comparison of ALOS PALSAR with AMSR & SSM/I thin ice algorithm
July 31, 2007
Case of September 2, 2008

Surface temp. from MODIS

Ice thickness from MODIS using heat flux calculation

Antarctic continent

Ice thickness from AMSR thin ice algorithm

Antarctic continent

ASAR from ESA

Grounded iceberg tongue
Iceberg tongue

Iceberg tongue has not changed!

Cape Darnley Polynya

(19 Jul 2006)
Formation mechanism of Cape Darnley polynya

Filtering effect of Iceberg tongue

Westward coastal current

100km

Offshoreward wind

Grounded iceberg tongue

Supernal image

Accumulated first-year ice

Cross section
Polarimetric mode

HH backscatter

VV to HH backscattering ratio

(21 Aug 2008)

New ice

Thick ice

Fast ice

(20 Aug 2008)
Conclusion

1. PALSAR & ASAR data provide good validation data for AMSR & SSM/I thin ice algorithm

2. PALSAR images clarify the detailed structure of the Cape Darnley Polynya:
   - The polynya is identified as area of new ice streaks with the dimension of more than 100km x 100km
   - West of the polynya, grounded iceberg tongue is formed

3. A formation mechanism of the polynya is proposed:
   - Filtering effect of the iceberg tongue with the Antarctic Coastal Current is very important as well as the offshoreward wind

4. Polarimetric mode possibly discriminates ice thickness and ice type → Towards sea ice algorithm of PALSAR

Cape Darnley Polynya
The second highest sea ice production
Is Antarctic bottom water formed there?
Ice Profiling Sonar

ADCP (ice drift)

Microwave radiometer SAR (PALSAR, ASAR)

Time series of thickness → topography of ice

(Fukamachi et al., 2006)

In the Okhotsk Sea
Moorings in Cape Darnley polynya (Feb 2010 – Feb 2011)

1. Good site for satellite truth of sea ice algorithm: PALSAR, AMSR, SSM/I etc.
2. Unknown area of Antarctic Bottom Water
3. Formation processes of Antarctic coastal polynya
Thank you!