Jennifer.Sobiech@awi.de

Monitoring ice-onset on lakes and rivers in northern Siberia with TerraSAR-X imagery

Jennifer Sobiech, Wolfgang Dierking

Motivation
- 15-40% of the Arctic land surface is covered by lakes and rivers.
- The presence of ice on water bodies strongly influences the energy flux.
- Freeze-up happens during the Polar night → no optical images available for monitoring.
- The timing of ice onset is an important variable for climate change monitoring.

Location
Central Lena River Delta, Northern Siberia at 72°N, 126°E

Climate conditions
Air temperatures measured in Tiksi, RU, 120 km south-east of the image location
(Data: NOAA National Climate Data Center, US)

TerraSAR-X Time Series Fall 2012
Stripmap Image mode, HH-polarization. Pixel size after geocoding: 13.2 m x 13.2 m. 3x3 Lee filtered.

Can we detect ice-onset via thresholding of the radar intensities?
The red ellipse on the uppermost lake in the first image marks the test area for the histograms to the right.

Ice onset in detail: Where is water, where is ice?

Water (?) → Water affected by wind shows higher radar intensities than smooth ice without inclusions of air bubbles.

Ice (?) → Simple thresholding might miss the ice onset due to misinterpretation of dark new ice as water or bright wind-roughened water surfaces as ice.

Detection of ice conditions during winter:
High vs. low backscatter at the lake shores:

Low backscatter values occur when the ice is frozen to the bottom.

High backscatter values might indicate rough ice conditions or high volumes of air bubbles in the ice.

Ground truth data are needed!

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