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, Nothern Siberia at 72°N, 126°E

Climate conditions

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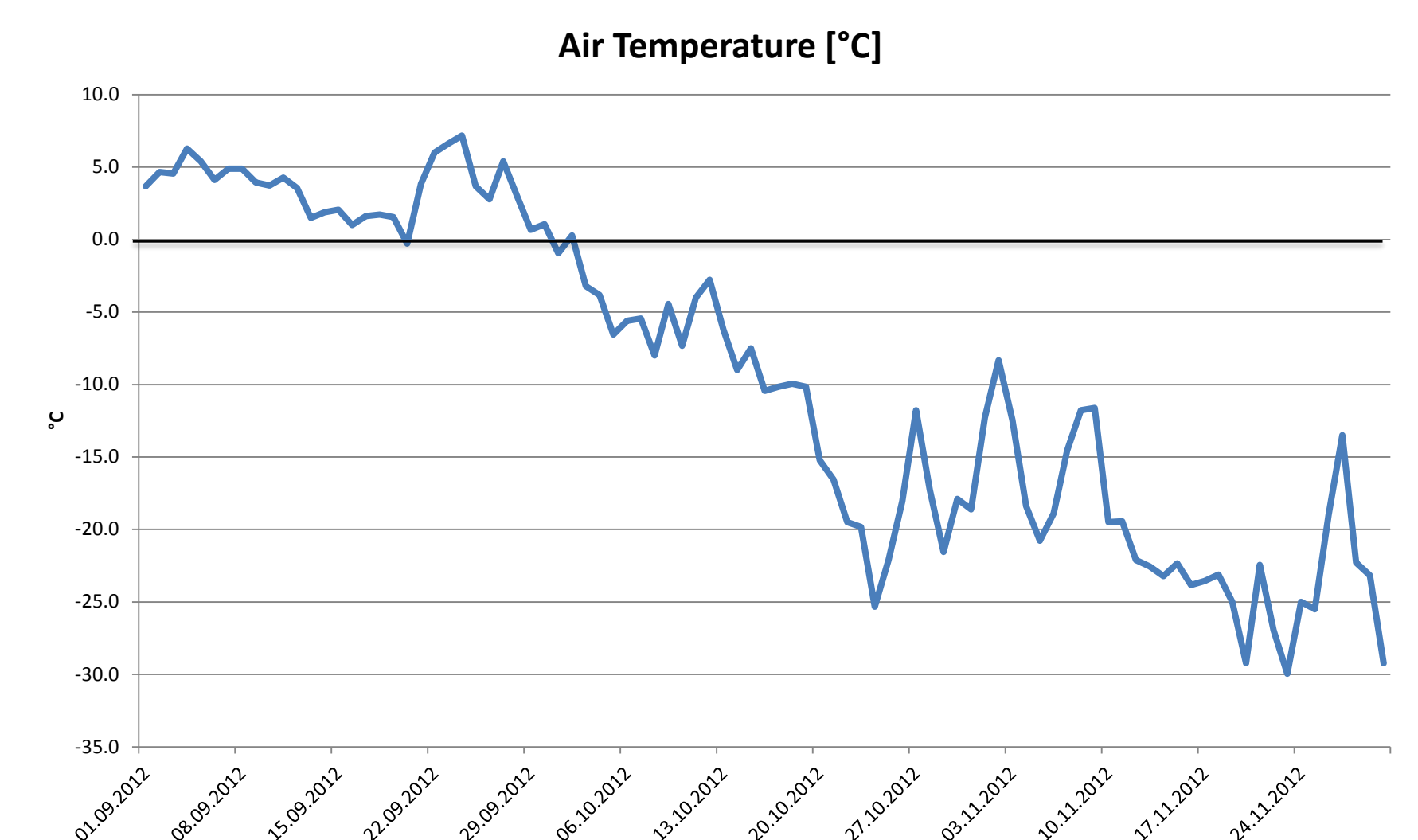(Data: NOAA National Climate Data Center, US)

Fig. 1: Air temperatures in Tiksi September – November 2012 (Data source: NOAA)

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.

10.6 km

25.9.2012   6.10.2012   17.10.2012   28.10.2012   8.11.2012   19.11.2012   30.11.2012

Fig. 2: TerraSAR-X time series fall 2012

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.
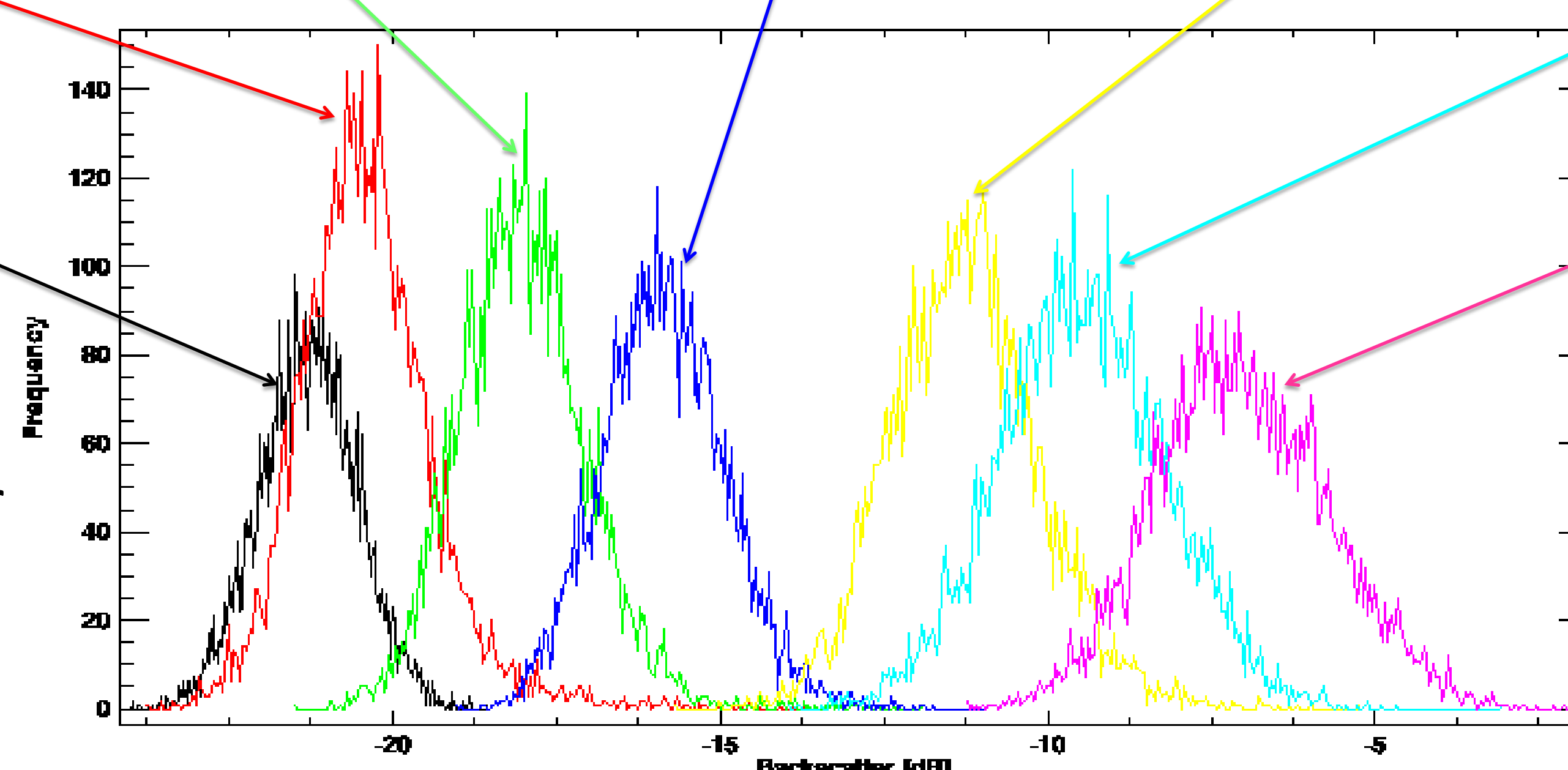

Fig. 3: Histograms of the backscatter intensity distributions of the lake in the time series shown in Fig. 2

→ Backscattered radar intensity increases from open water to ice covered conditions, but initial ice-formation might be missed.

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

6.10.2012

Fig. 4: TerraSAR-X image subset

Water (?)

Ice (?)

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

→ Simple thresholding might miss the ice onset due to missinterpretation of dark new ice as water or bright wind-roughened water surfaces as ice.

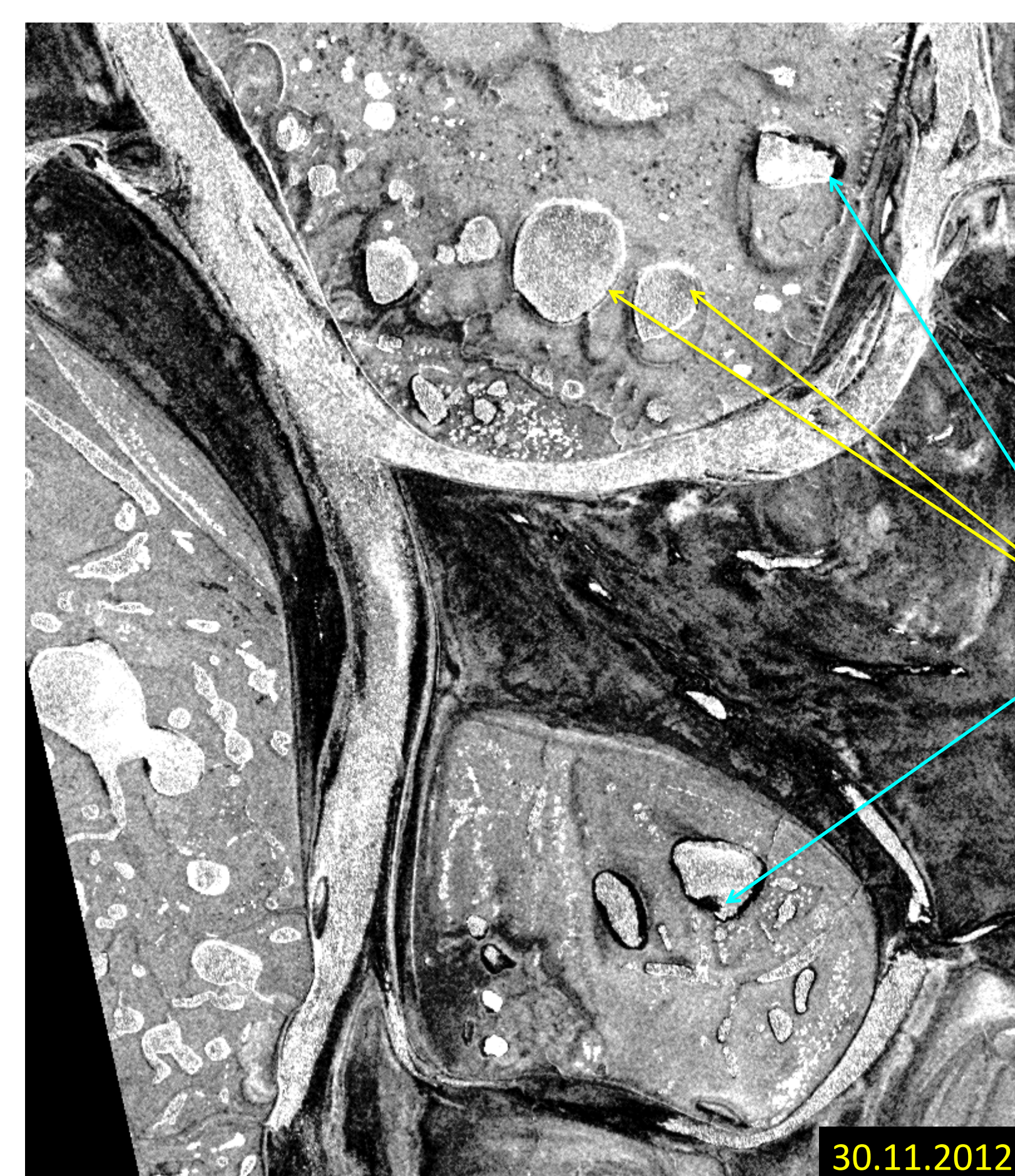### Detection of ice conditions during winter:

30.11.2012

Fig. 5: TerraSAR-X image subset

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!