PROCESSING ALTIKA SEA ICE MEASUREMENTS USING WAVEFORM CLASSIFICATION

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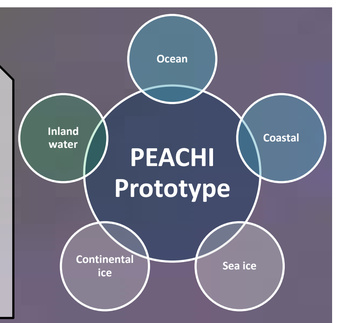
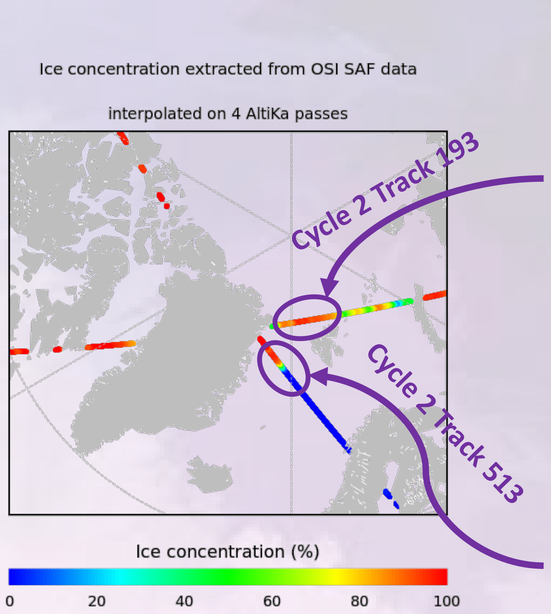


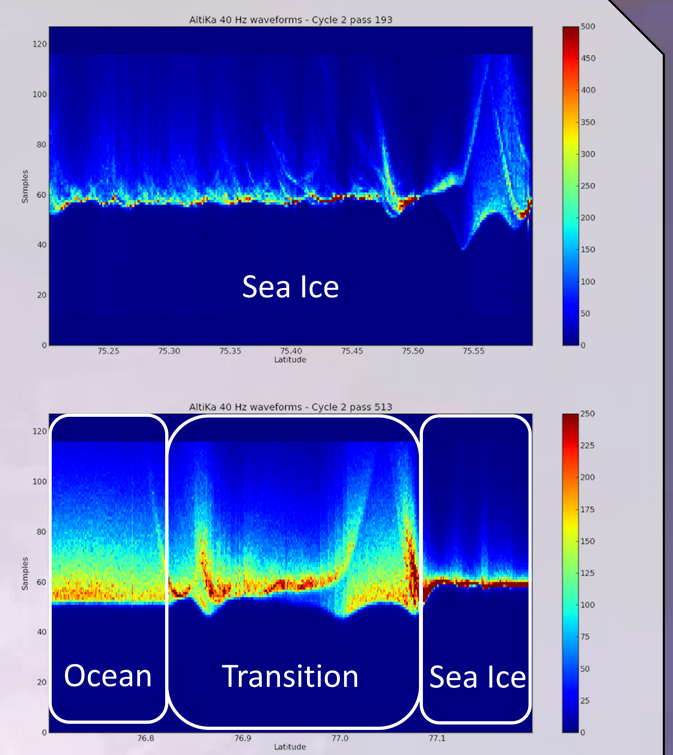
Why a waveform classification is helpful to process sea ice data ?

Sea ice covered regions are characterized by a large number of different surfaces with a multitude of **backscattering properties rapidly evolving with time**. The backscattering properties from each of these surfaces (first year ice, multiyear ice, fast ice, leads, polynyas, etc. …) result in **rapid changes of the returned echo shape**. Two examples are given in the following figures:

• Cycle 2 Track 513: The transition between ocean and sea ice shown by the OSI SAF ice concentration product interpolated on the AltiKa track clearly impacts the altimeter echo shape. Ocean waveforms have a “Brown” shape whereas sea ice waveforms are more peaky.

• Cycle 2 Track 193: Even on a track over iced region, many different echo shapes can be observed (peaks, trailing edge and leading edge perturbations, etc. …) depending directly of the surface type and the variation of the ice backscattering properties.





➔ **A waveform classification can provide important information of the observed surface**

Methodology and waveform classes

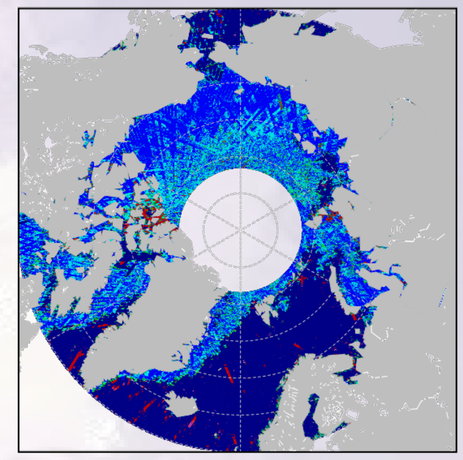
Brownian classes	Brownian disturbed	Linear noise
1, 10	7, 14	15

Brown + peak	Peak	Noise/multi-peaks
6, 5	2, 4, 8	3

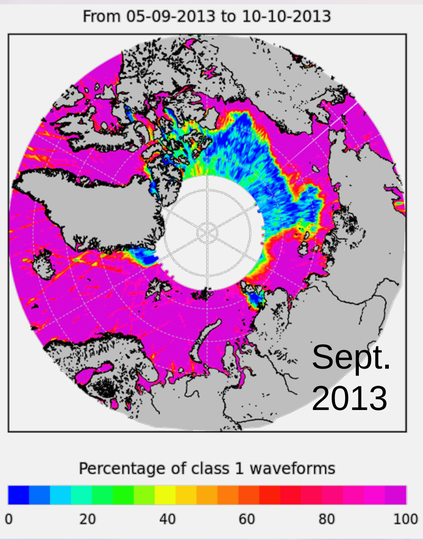
Unknown	9

In the frame of the **PEACHI** project supported by CNES, a waveform classification was developed to distinguish different shapes of AltiKa 40 Hz waveforms over all surfaces (ocean, coastal areas, sea ice, continental ice and hydrology) but with a specific focus on sea ice. The classification algorithm is based on a **neural network algorithm** which attributes to an AltiKa echo one of the twelve defined classes from the following parameters:

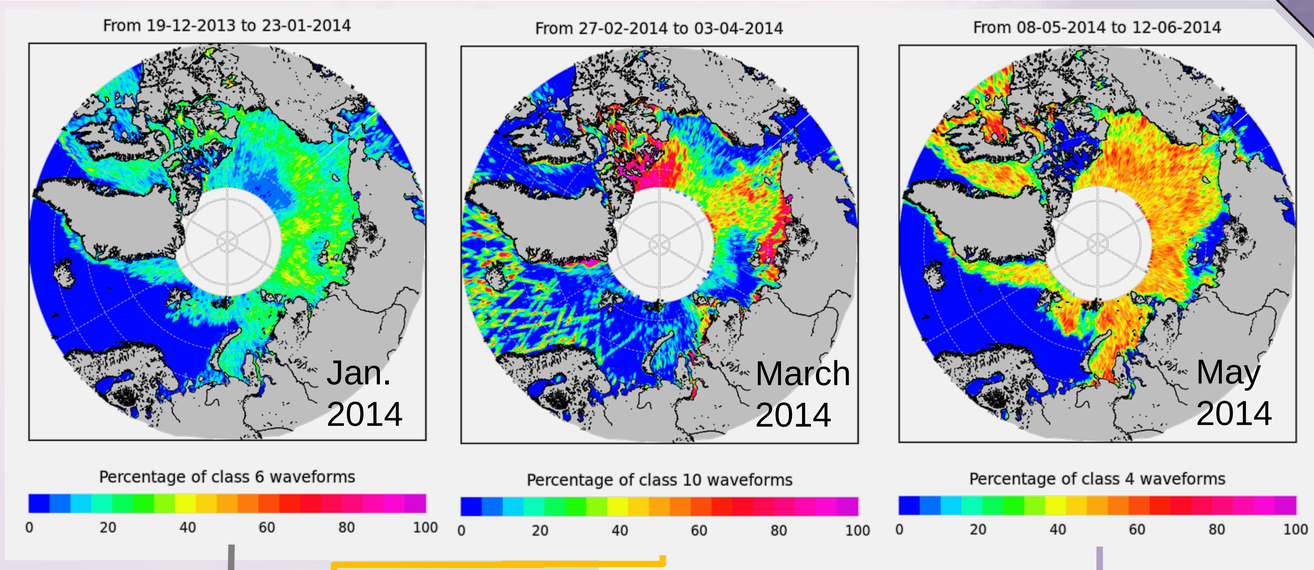
- ➢ geometrical parameters computed directly on the waveform
- ➢ available retracking geophysical estimates
- ➢ distance to the nearest coast



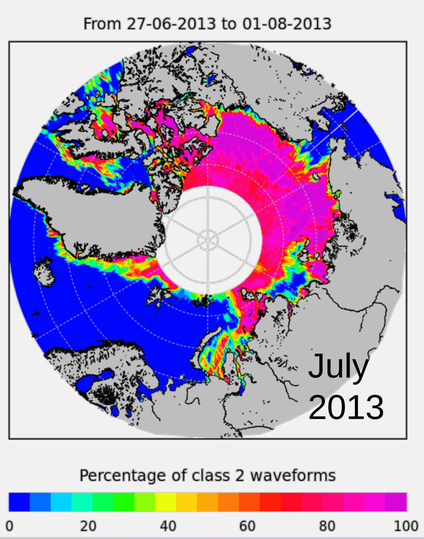
Results in the Arctic Ocean

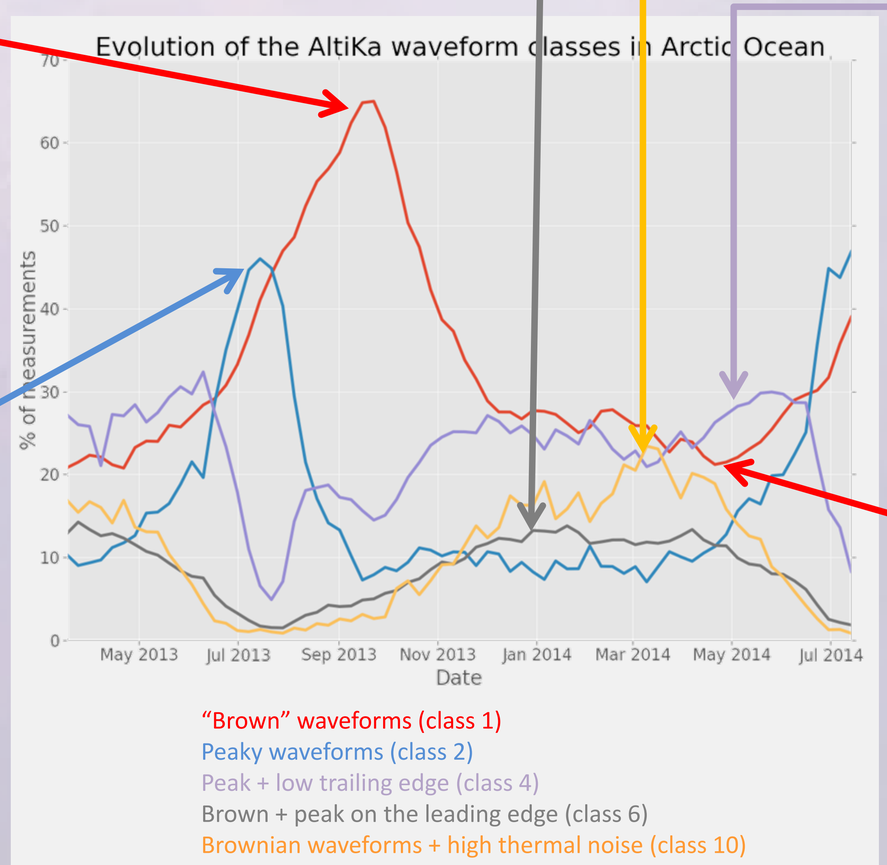


The class **1** (ocean waveforms) **maximum** population matches the **minimum of sea ice expansion**.



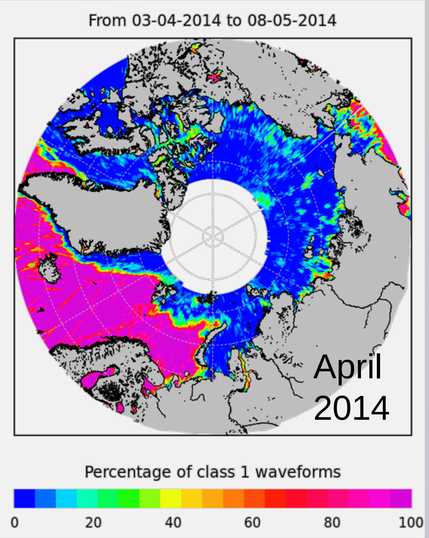
A class **2** (peaky shape) population peak is clearly visible **during ice melting**. It can be linked to the emergence of highly reflective surfaces (leads, thin water layer over sea ice, …)





Classes **4 & 6 are only found over sea ice**. Their maximum population corresponds to the **maximum ice cover**.
Class **10** describes **very low signal to noise ratio conditions**. It happens when ocean measurements are impacted by rain cells and may be due to snow presence over sea ice.

The class **1 minimum** population matches the **maximum of sea ice expansion**.



The AltiKa waveform classification is available in **PEACHI** products at : http://odes.altimetry.cnes.fr