

Submitted to IGARSS'00  
Oral Presentation  
Topic: Ocean and Sea Ice Dynamics

**A Comparison of Floe Size Distributions from Several Summer  
Periods in the Beaufort and Chukchi Seas**

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Model results indicate that understanding summer heat and freshwater balance in the polar oceans requires knowledge of how much heat goes into vertical and lateral sea ice melt. In addition to thickness, two of the key ice parameters that affect melt rate are ice concentration and floe size. Smaller ice floes and more open water enables more heat to go into lateral melt preferentially to vertical melt, thereby enhancing warming of the upper ocean and increasing stratification. A series of studies have been undertaken to address these issues.

In this study we obtain the characteristics of sea ice during summer melt from three different summer periods in the Arctic: 1992, 1997, and the SHEBA summer of 1998. We use RADARSAT and ERS SAR imagery to determine floe size, ice concentration, and radar backscatter, and SSM/I to determine the ice edge. We also incorporate meteorological measurements from buoys and in situ measurements from SHEBA. We compare these results to earlier floe size distributions described by Rothrock and Thorndike in 1984 in terms of their cumulative number distribution parameter. We also examine changes in floe size in relation to ice concentration and storm events.

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# **Outline**

**Recent Results**

**Floe measurements**

**Seasonal and regional comparison of floe size distributions**

# Recent Results

- **Response from large storm on floe size distributions– ERS1 SAR from 1992**

- Changes in floe size distribution related to significant increases in open water, including both shift toward smaller floe size and increase in number of floes after storm passage

- >Suggests periodic importance of lateral melt in pack ice, coincides with more open water

Holt and Martin, Effects of storms on the 1992 summer sea ice cover of the Beaufort, Chukchi, and East Siberian Seas, submitted J. Geophysical Res., Oct. 1999)

## Recent Results - 2

### •Floe Size Distributions over SHEBA region to compare with M. Hopkins (CRREL) numerical model - ERS2 SAR 1998

- Comparatively few successful results, likely due to either/both overall difference in pack ice characteristics (more small floes, more brash, harder to discern floe edges) or more surface wetness
- Awaiting numerical model results to complete comparison
- Derive smallest floe sizes from Reconnaissance imagery, also useful for validation with SAR

# **Seasonal and regional comparison of Floe Size Distributions**

- 1992 / 1998 comparison of ERS SAR results
- Comparisons with Rothrock / Thorndike paper (J. Geophys.Res, 1984)

# **SAR Measurements**

## **Floe Size Algorithm**

- 1) Separates floes from water - best results when water is brighter than ice**
- 2) Eliminates irregular shaped-floes (connected, branchy) = DISCARDED**

*Ref: Soh, Holt, and Tsatsoulis, chapter in Tsatsoulis and Kwok (eds),  
Analysis of SAR Data of the Polar Oceans, Springer, 1998.*

- 3) Slope correction - reduce incidence angle dependency in SAR by increasing contrast between ice and ocean, results in significant improvement in useful measurements. in Ref: Holt & Martin, 2000**

## **Open Water Concentration Algorithm**

- 1) Visually separate ice and ocean by adjusting the threshold as well as the slope of the incidence angle dependence in backscatter between ice and ocean.**

*Ref: Comiso and Kwok, J.Geophys.Res, Dec 1997*

## **Onset summer snow melt and fall ice freeze-up**

- 1) Derived from C-band radar backscatter**

*Ref: Winebrenner et al., JGR, 1994, 1996).*