

Investigation on Ice Melting by Simultaneous Thermometry and Velocimetry Method in Oil



Masafumi Yamazaki

Dr. Mitsugu Hasegawa

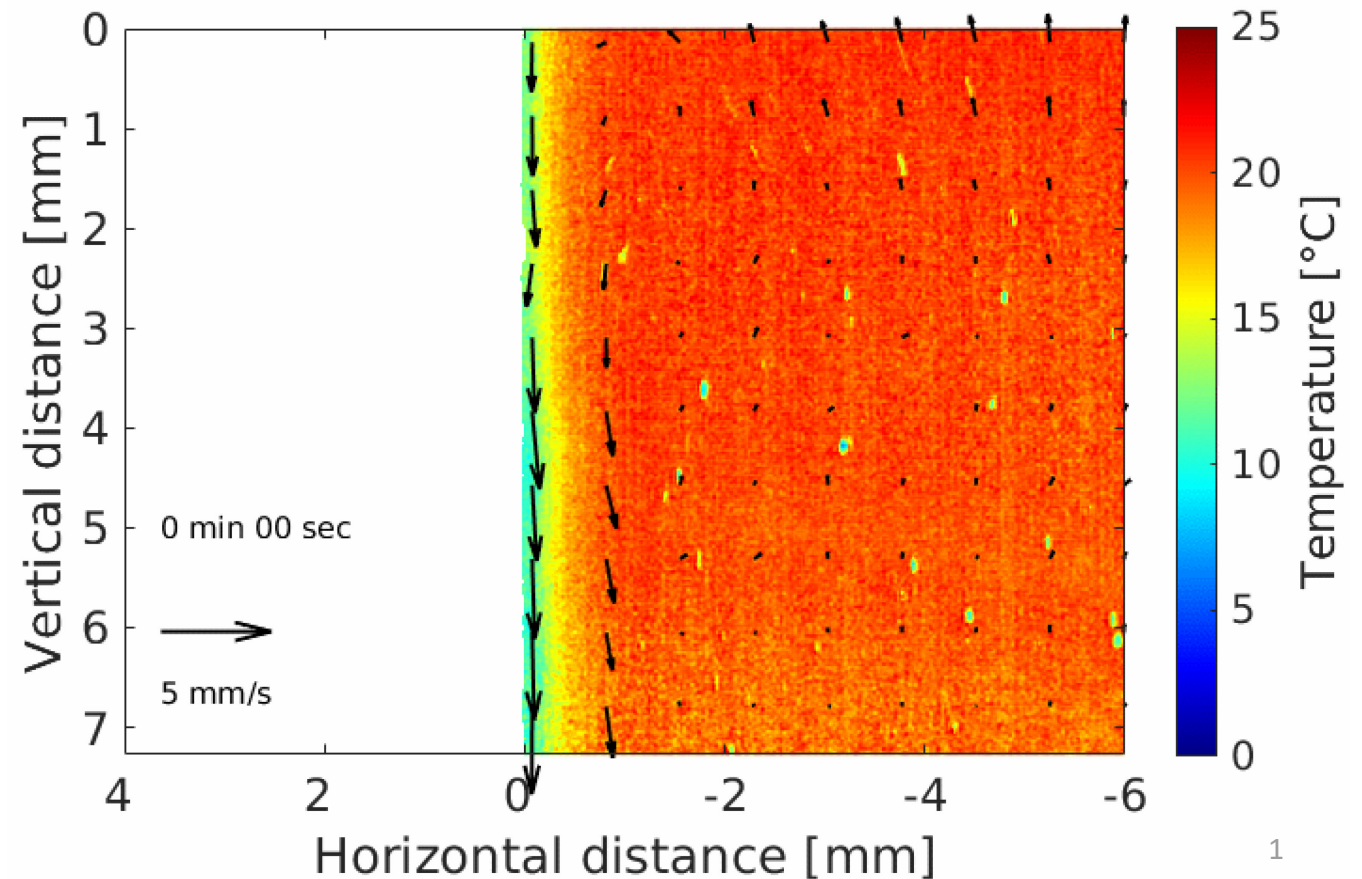
Dr. Hirotaka Sakaue



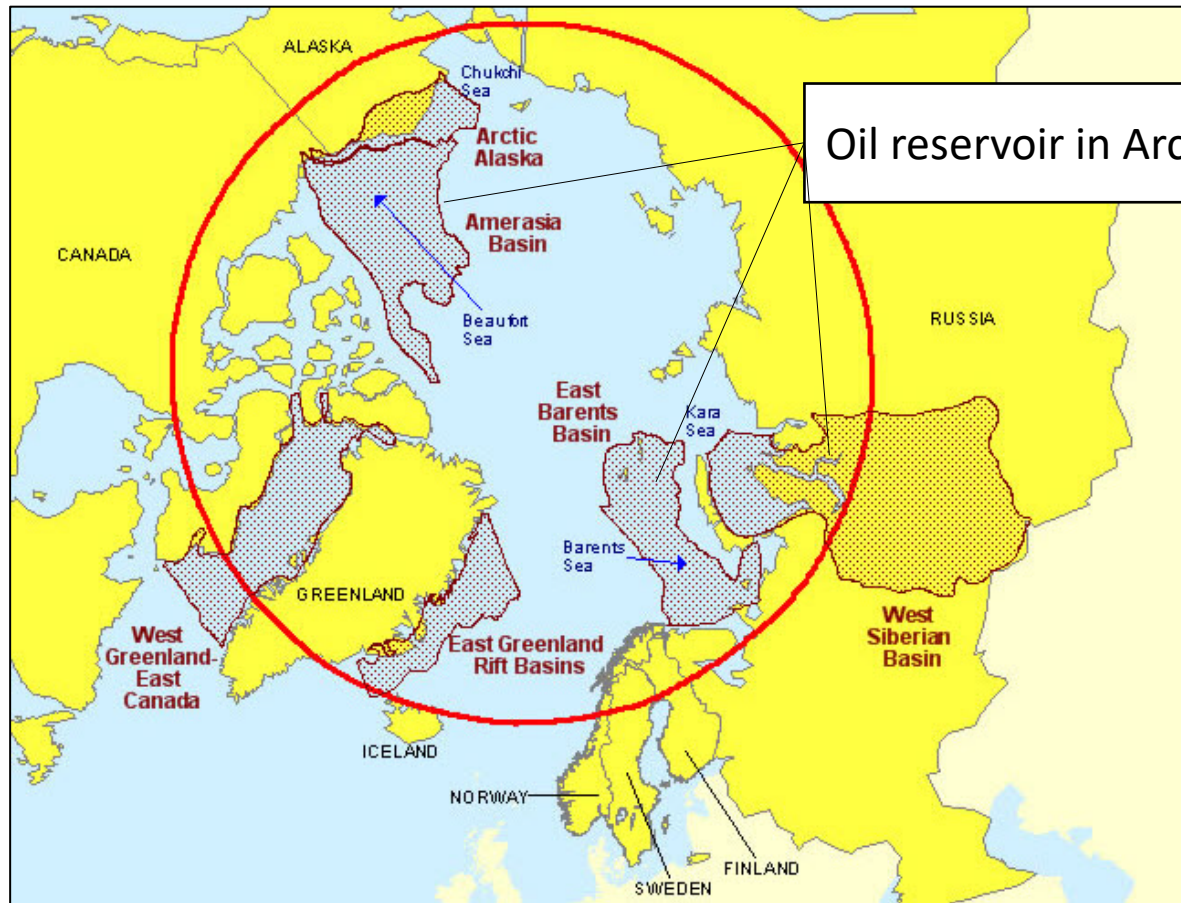
Dr. Sharanya Nair

Dr. Hamed F. Farahani

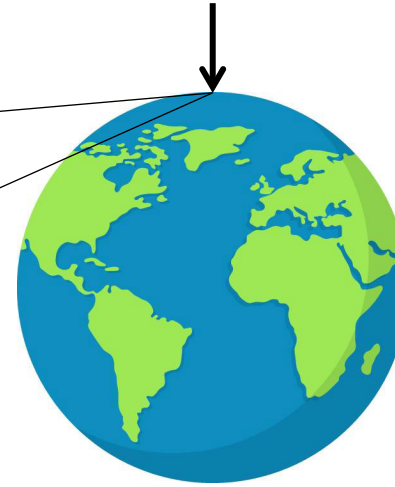
Dr. Ali S. Rangwala



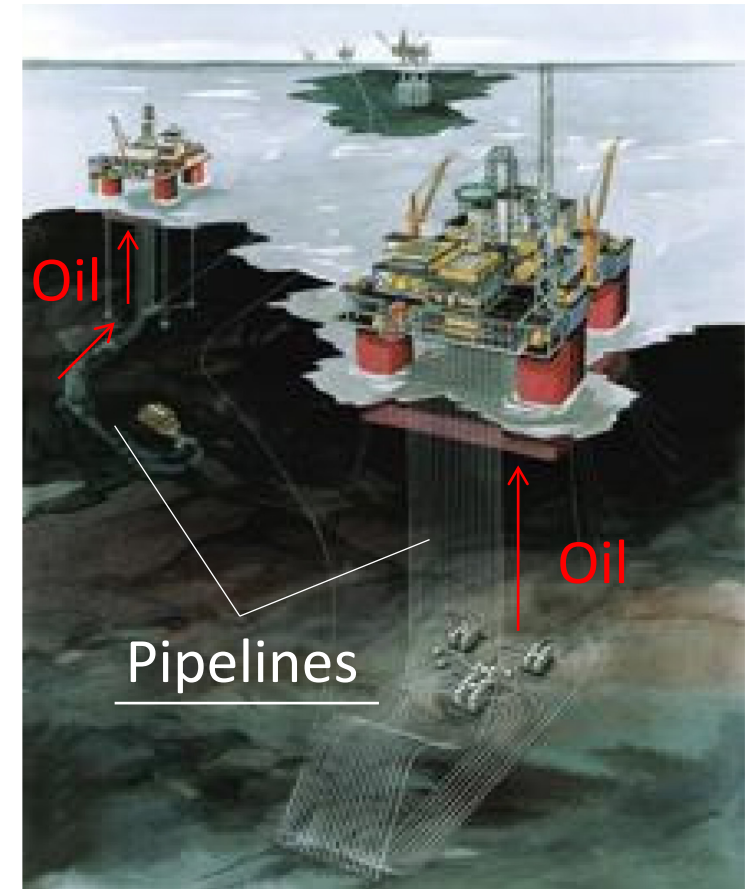
Oil Spills in Arctic



U.S. Energy Information Administration

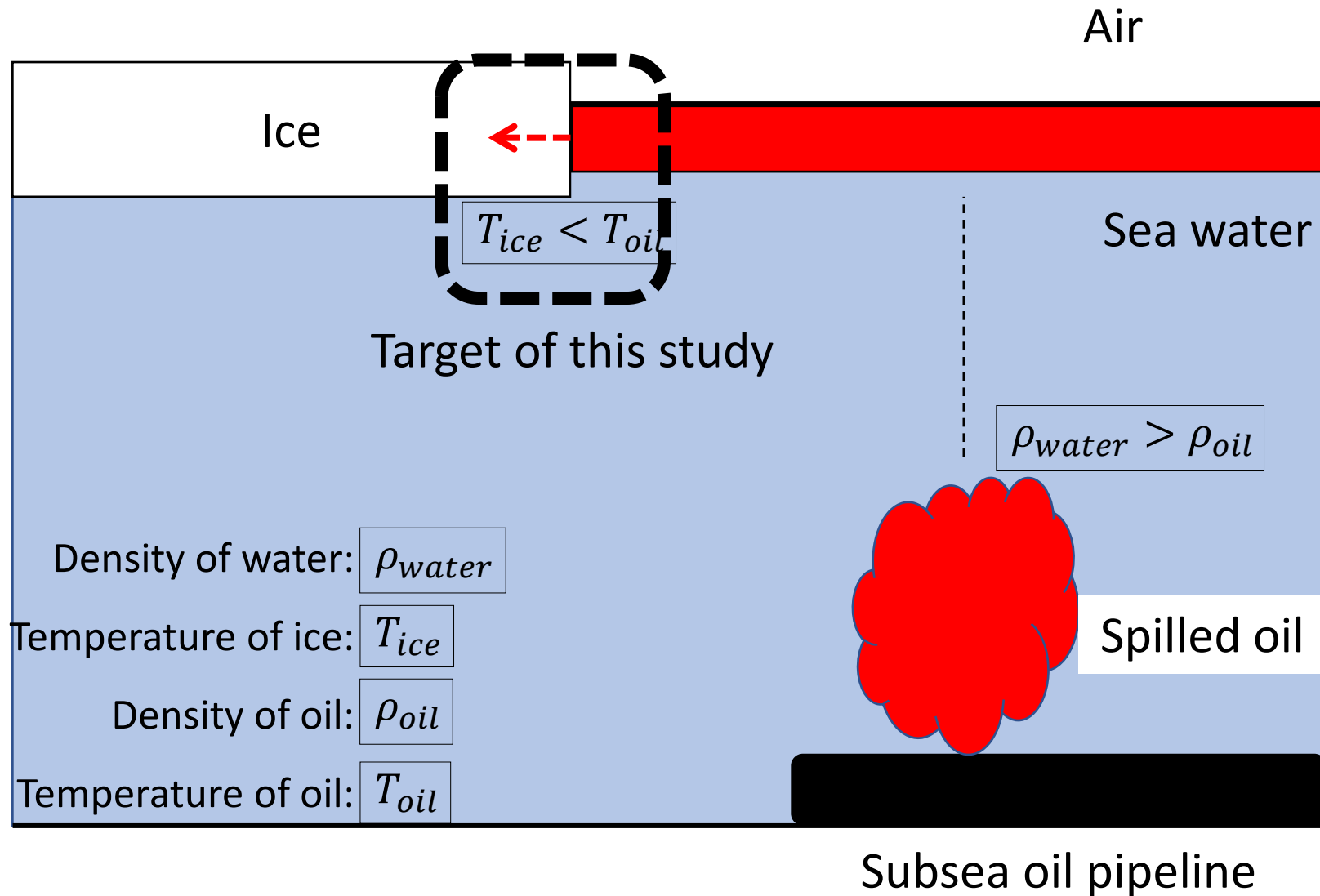


Oil production facility



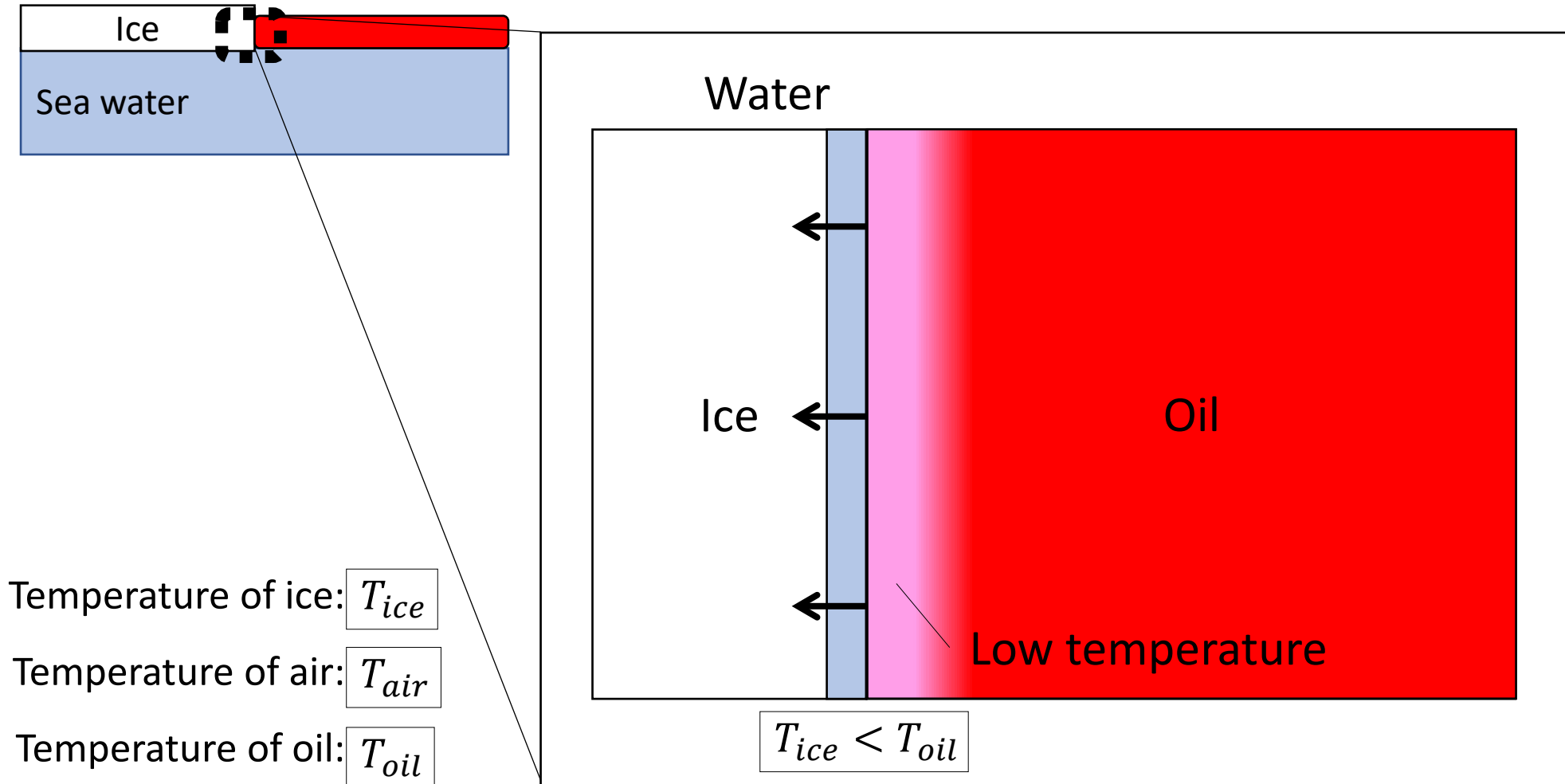
<https://new.abb.com/oil-and-gas/production-book/facilities-processes>

Spilled Oil Trajectory



Ice Melting Mechanism

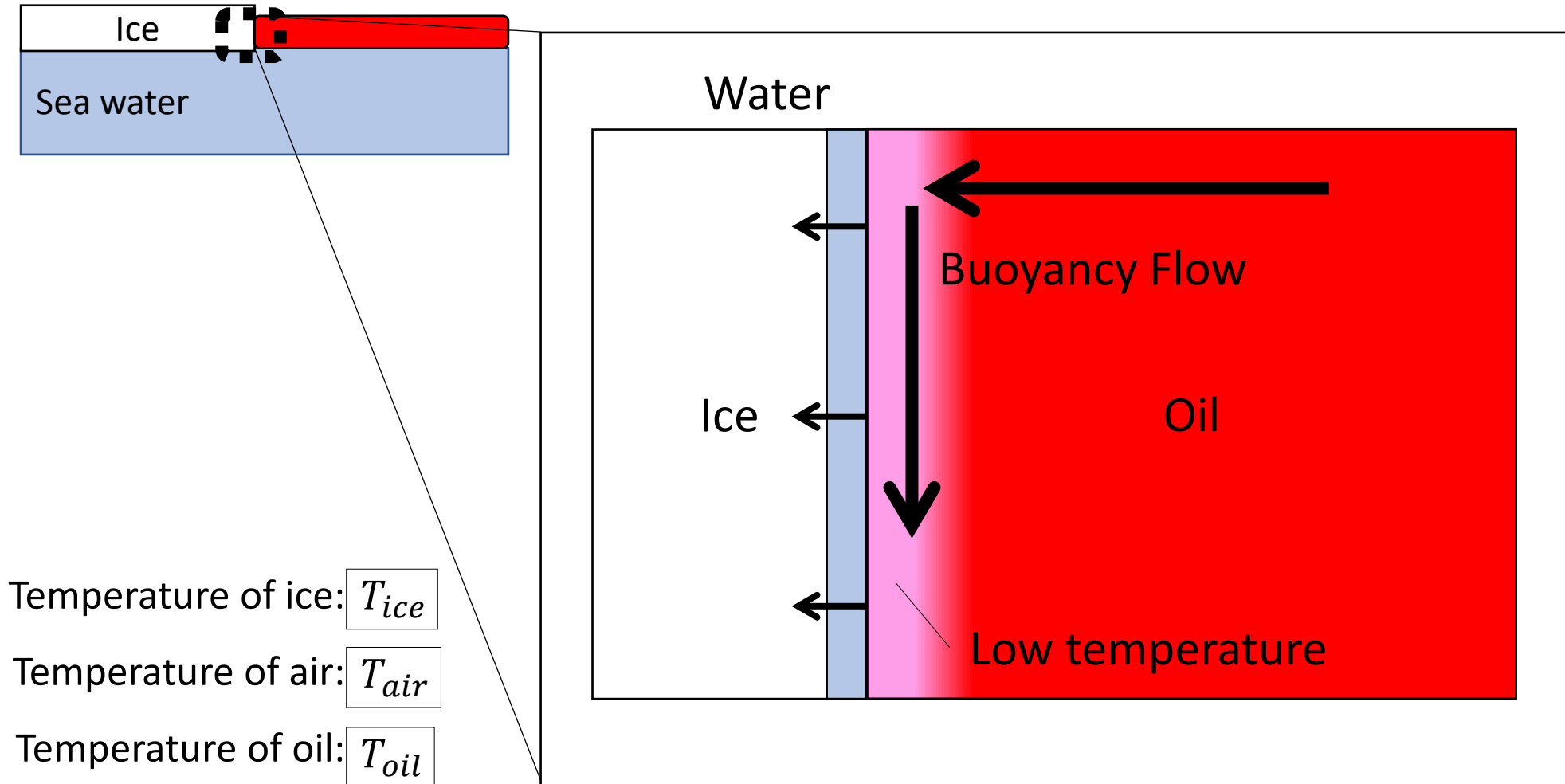
✓ Thermometry in Oil



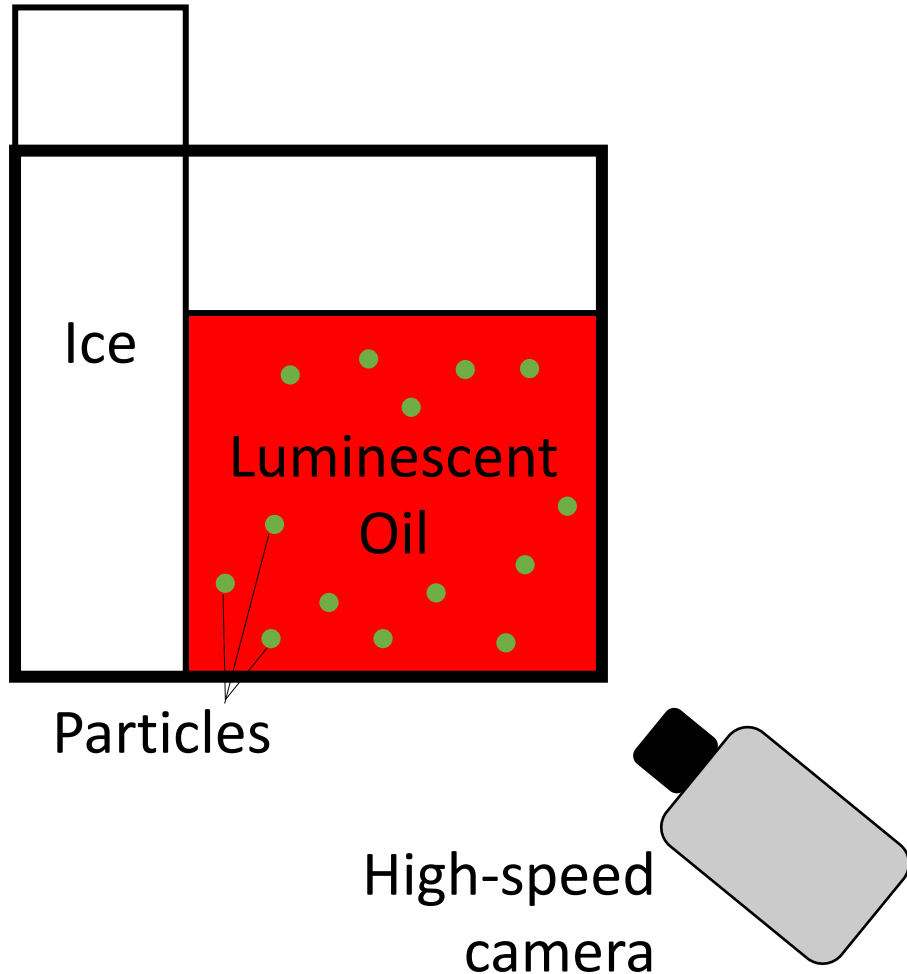
Ice Melting Mechanism

✓ Thermometry in Oil

✓ Velocimetry in Oil



Simultaneous Thermometry and Velocimetry



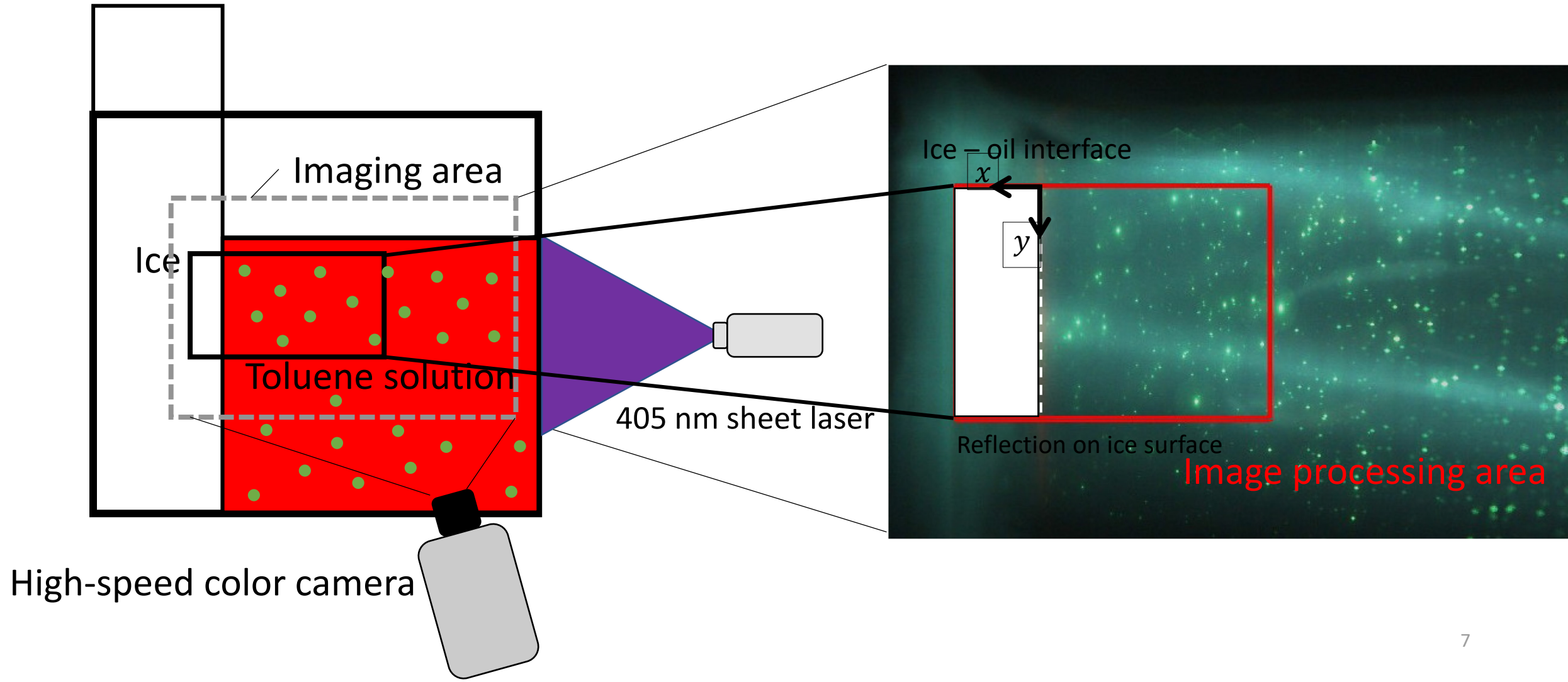
Thermometry: Dual-luminescent imaging

- Dissolves temperature-sensitive/-insensitive luminophore
- Measures temperature from ratio of luminescence
- Luminescence must be separately acquired

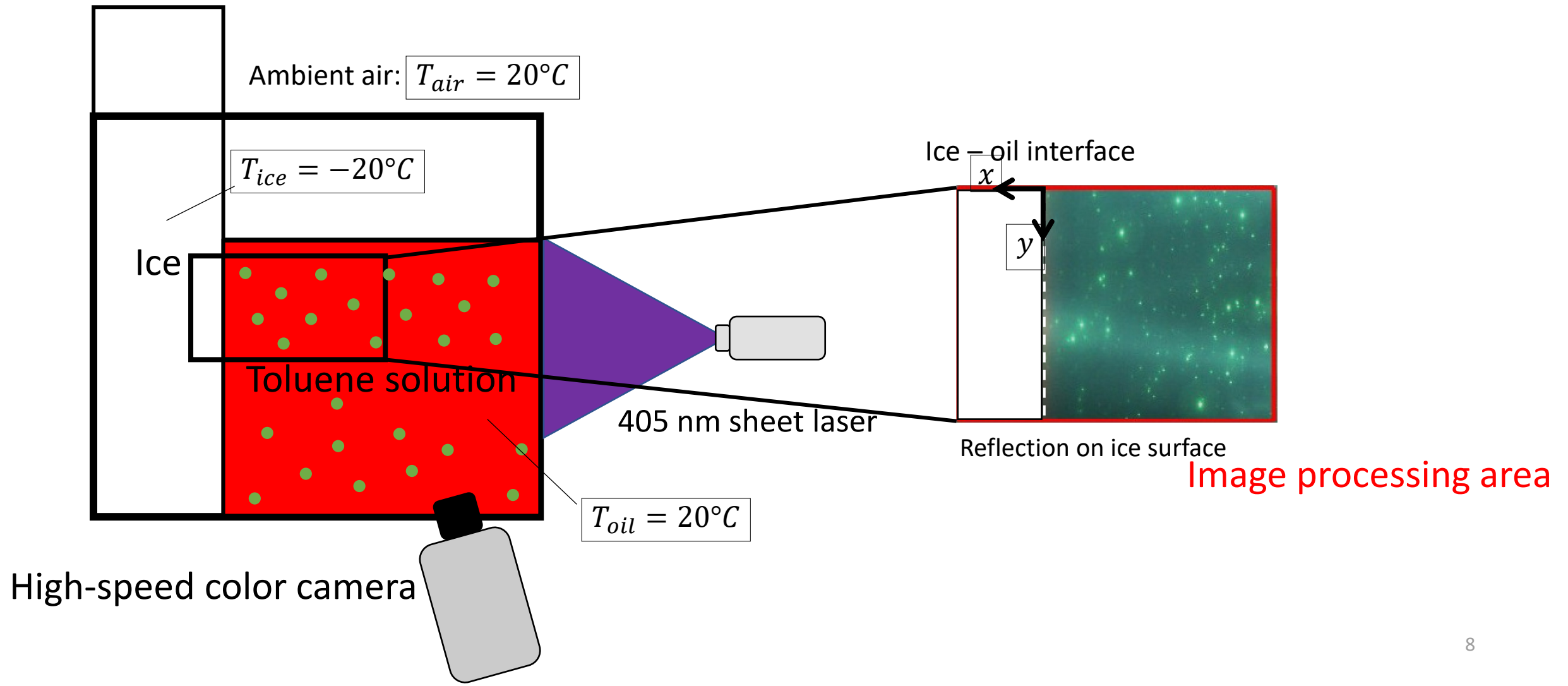
Velocimetry: Particle image velocimetry

- Tracks movement of particles in oil between two images
- Measures velocity from displacements of particles
- Signal from particles must not interfere with luminescence

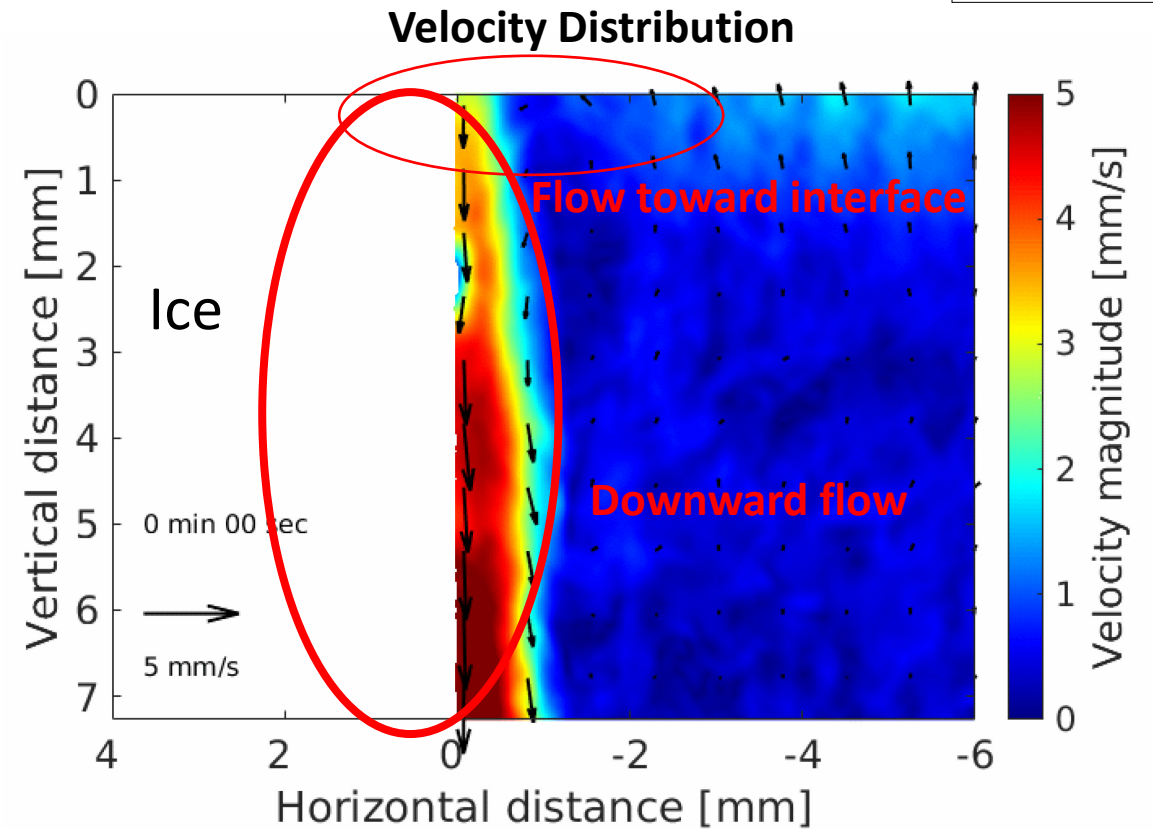
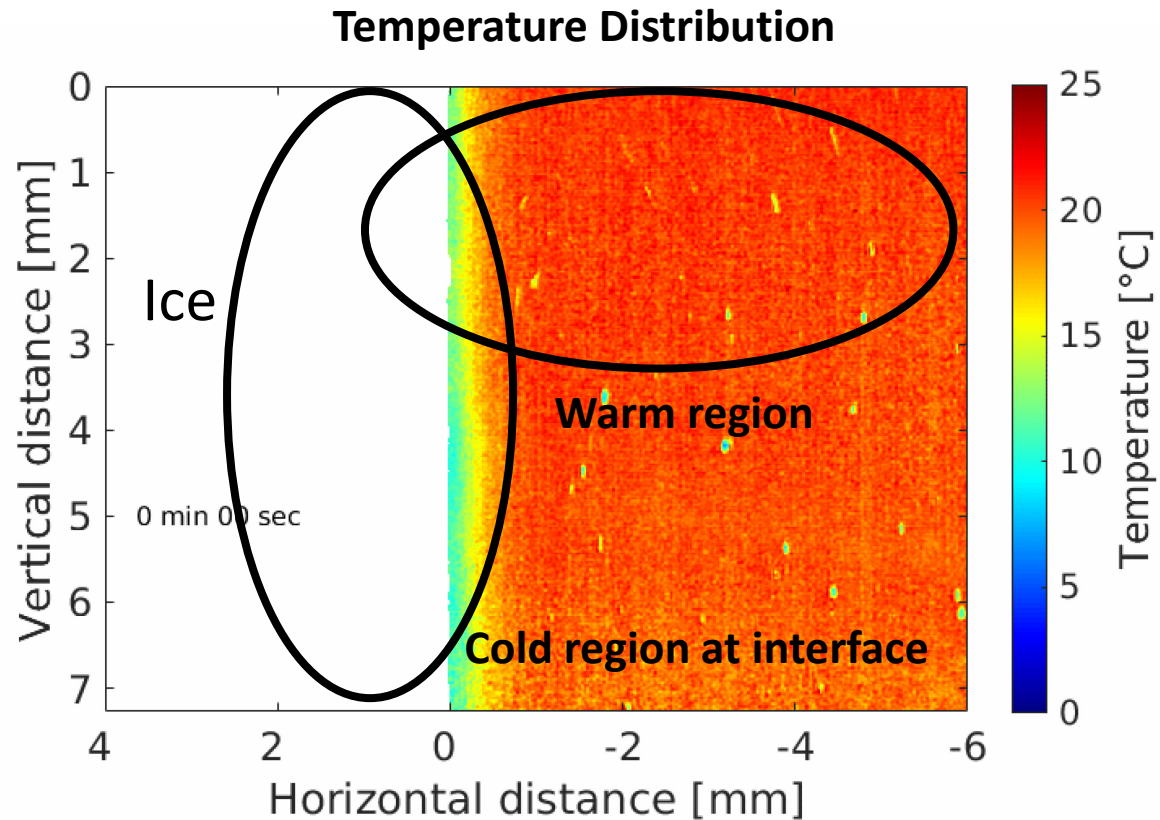
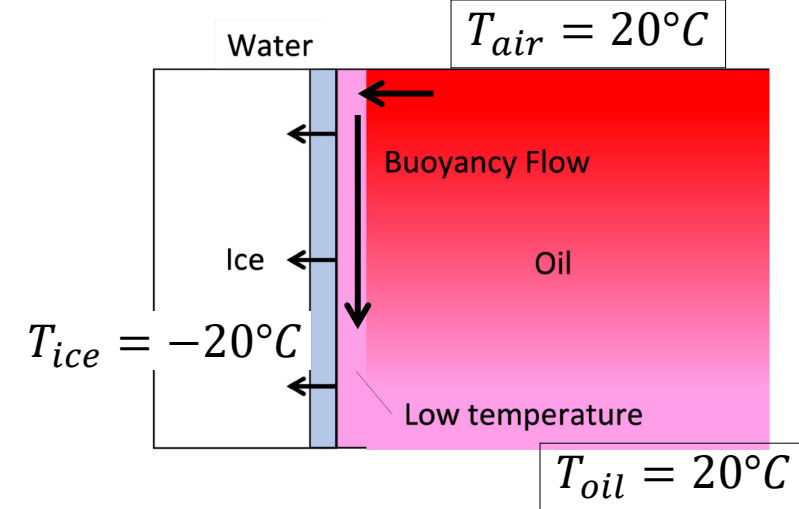
Experimental Setup



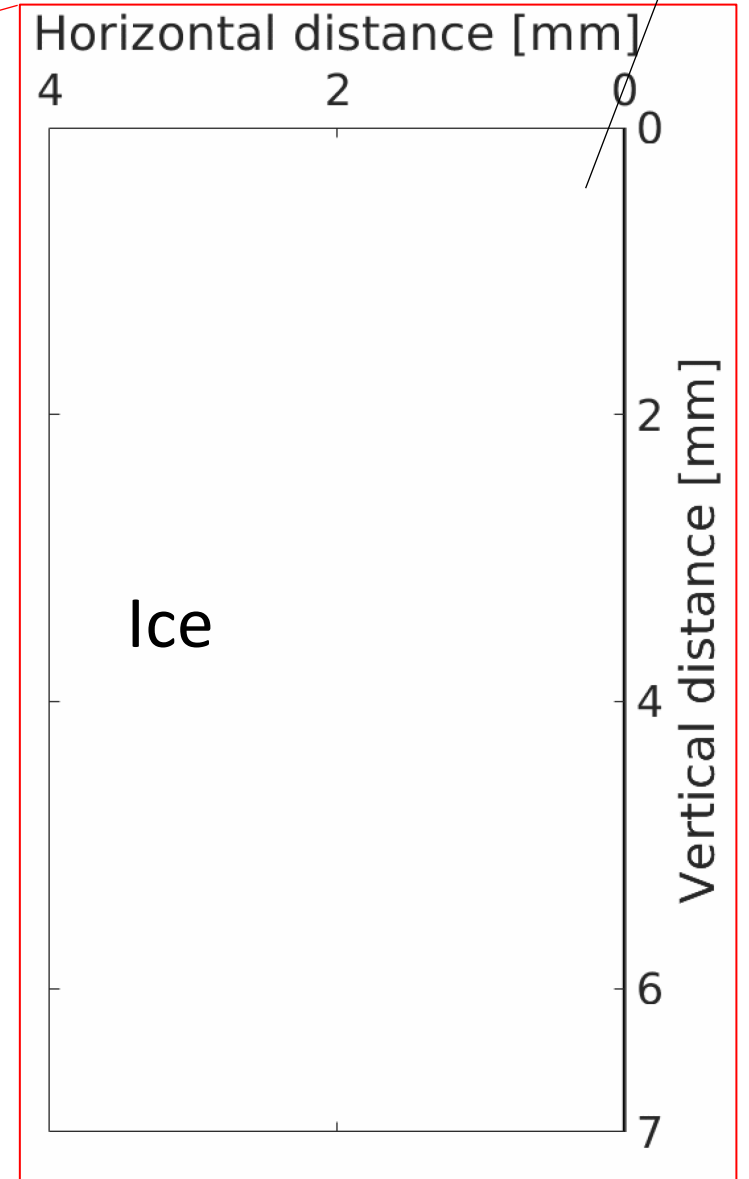
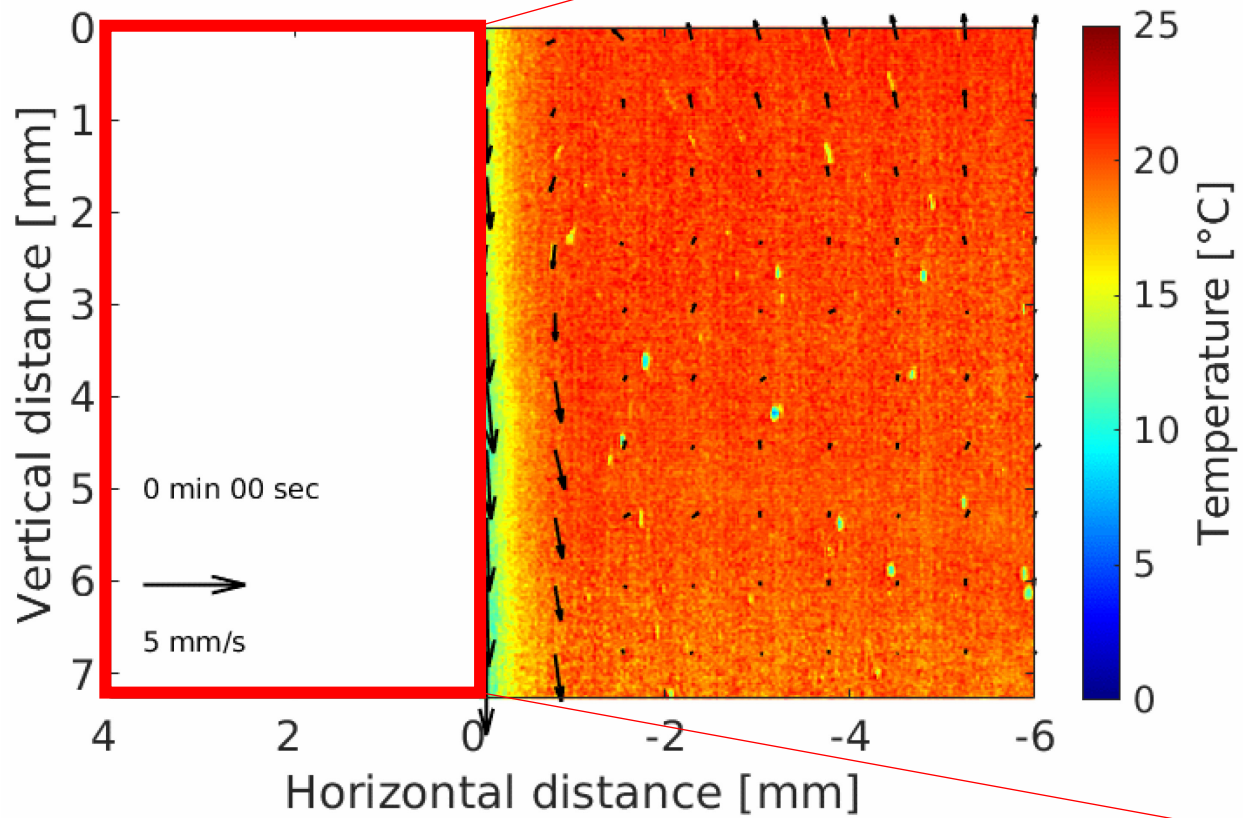
Experimental Setup



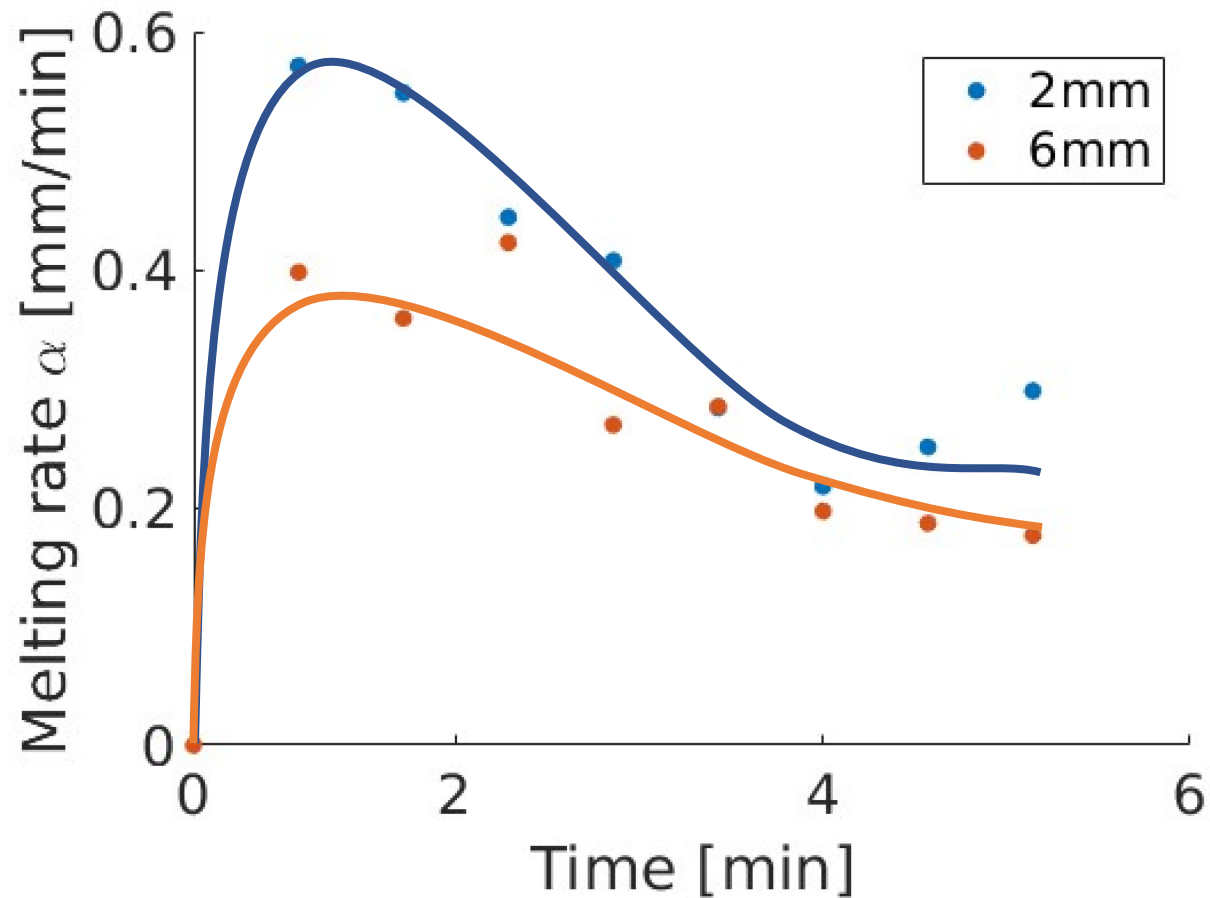
Thermometry and Velocimetry in Oil (toluene solution)



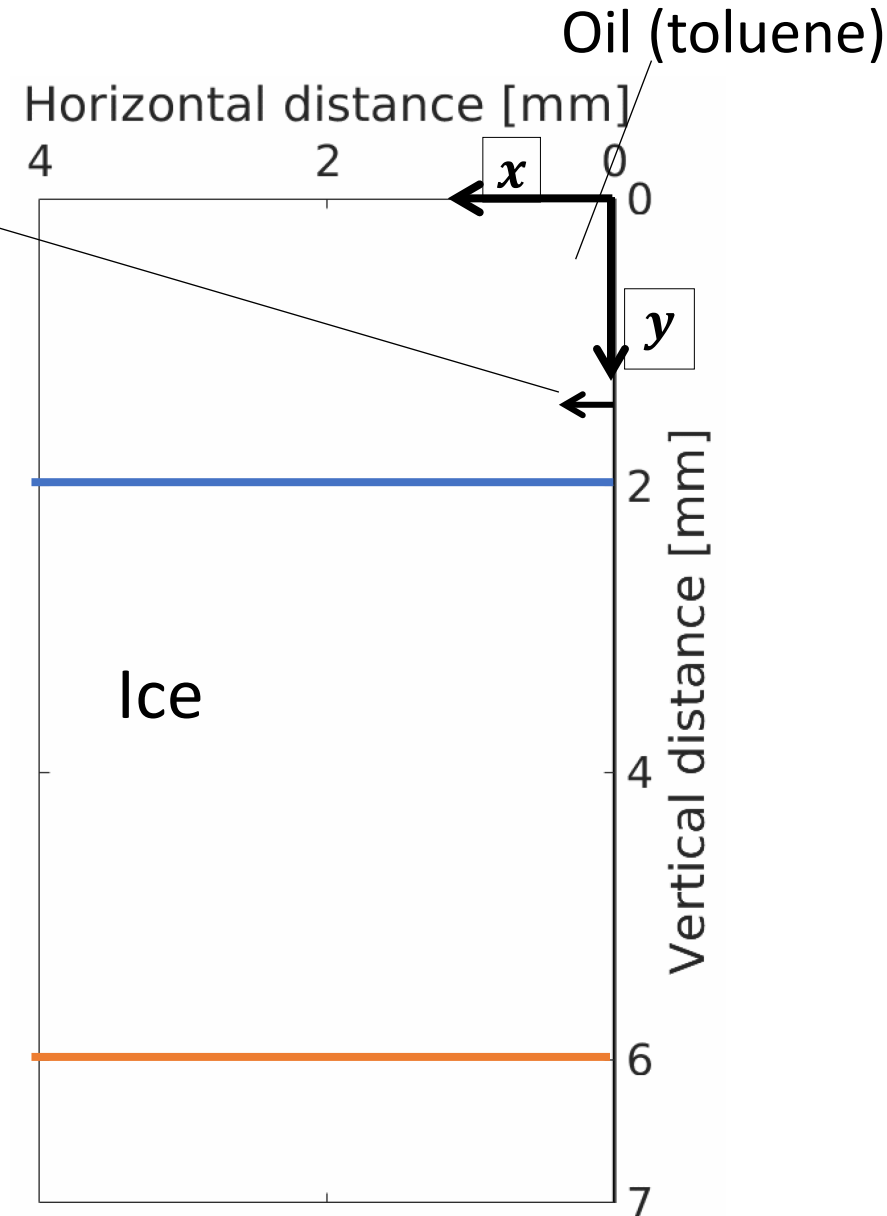
Ice Melting Process



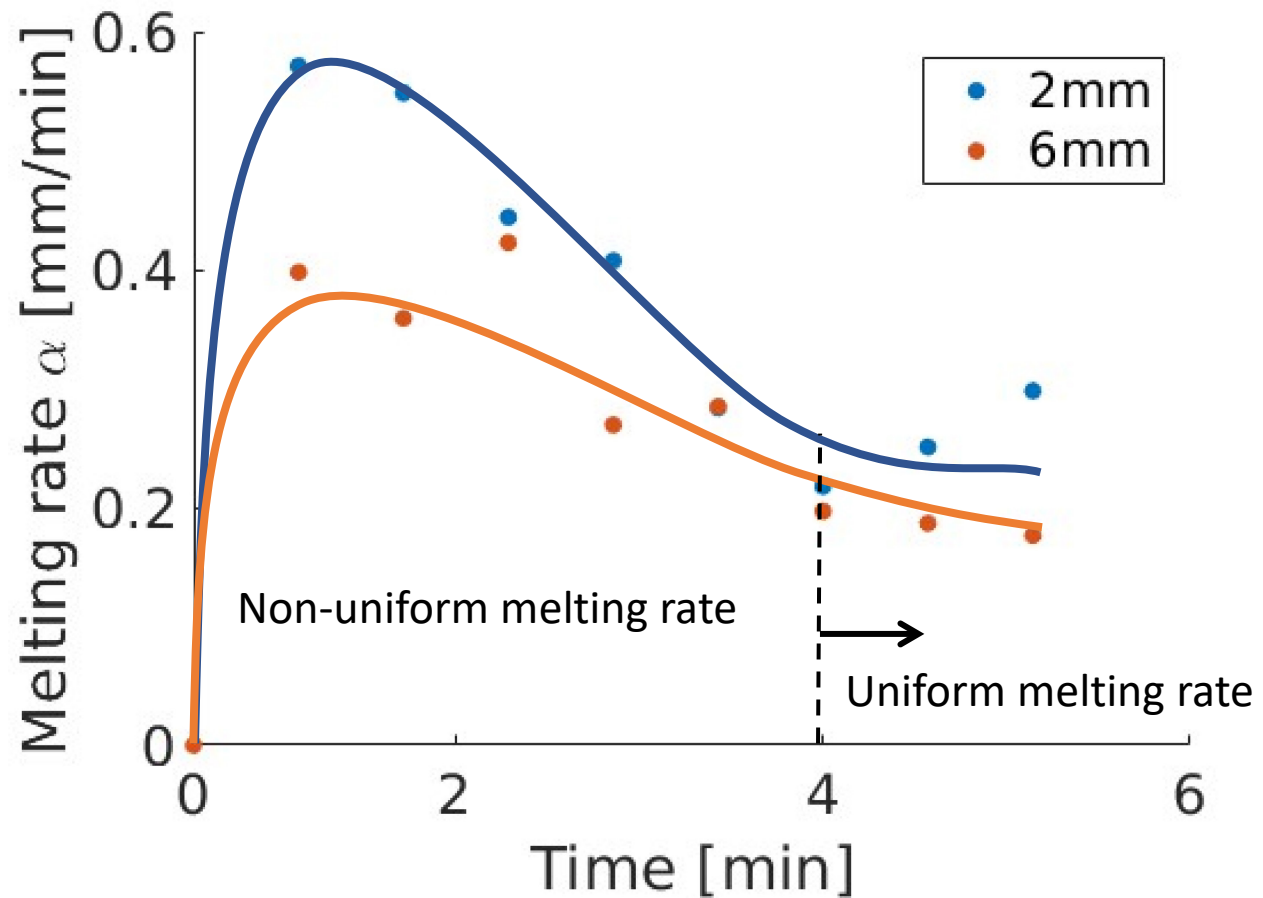
Ice Melting Process



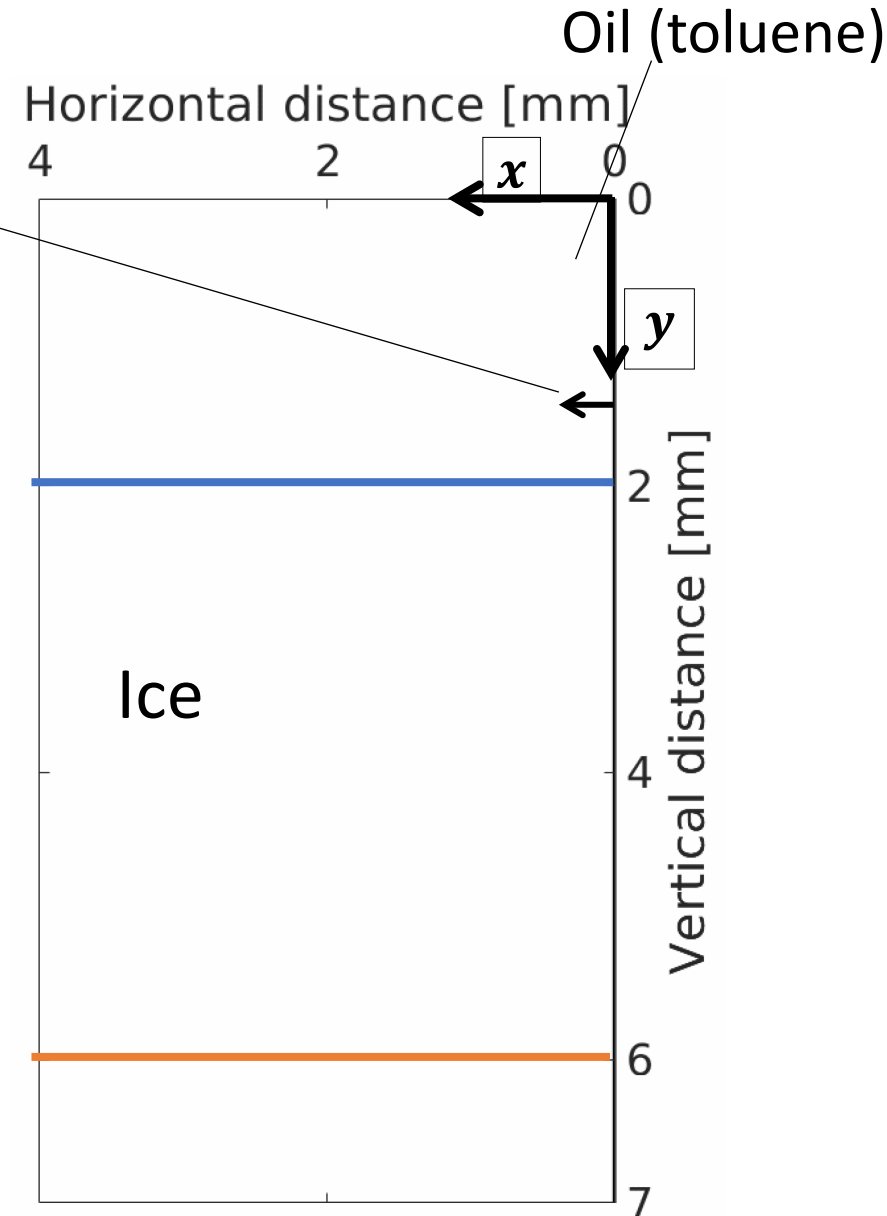
Melting rate: $\alpha = \frac{\Delta x}{\Delta t}$



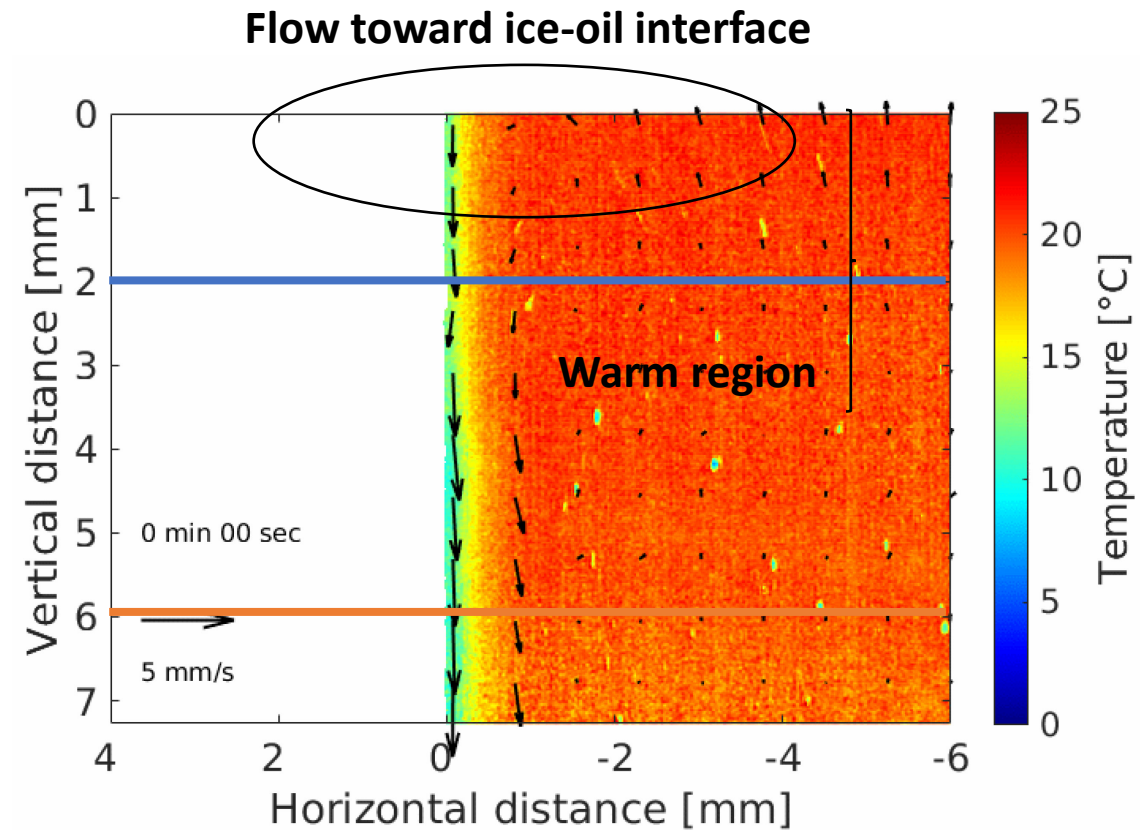
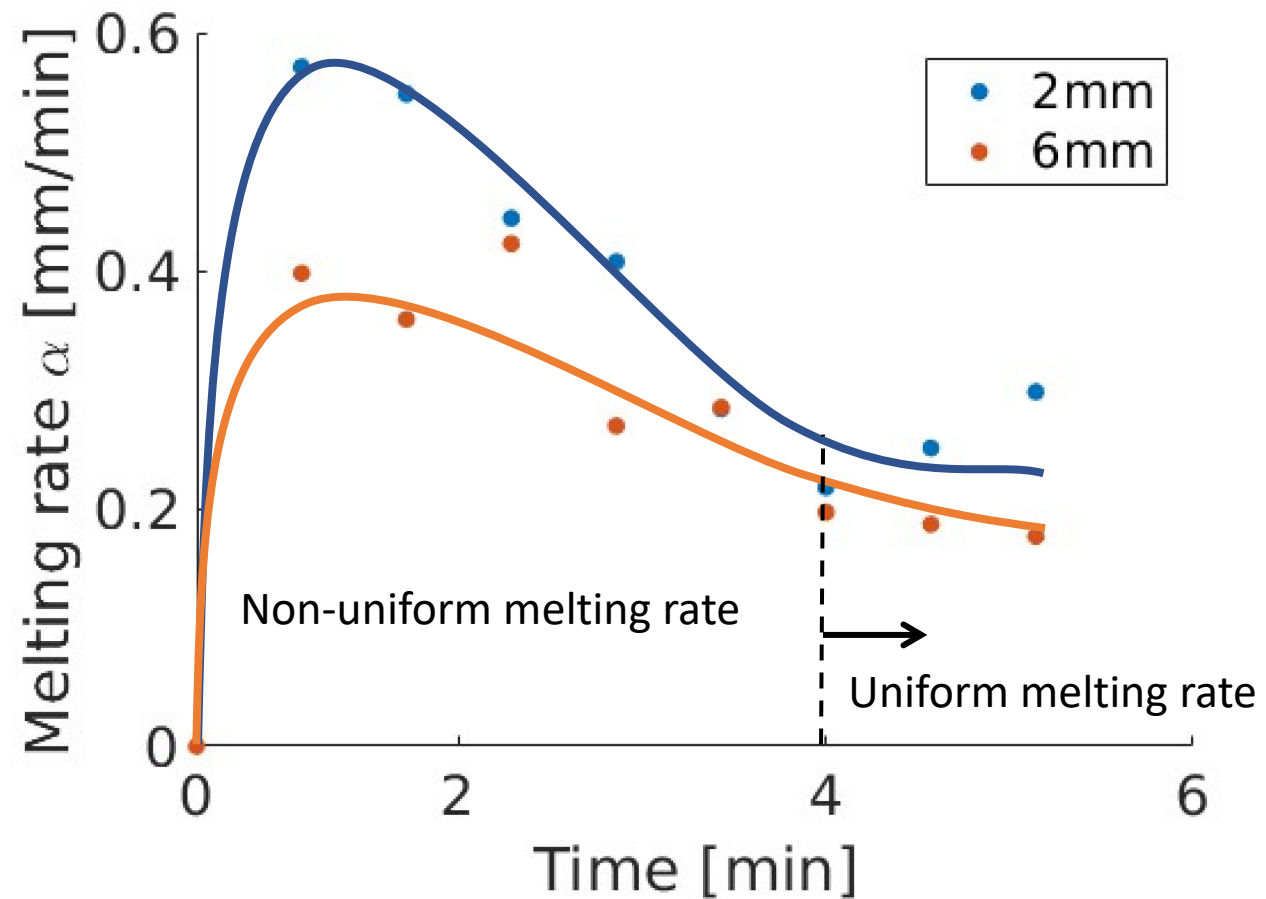
Ice Melting Process



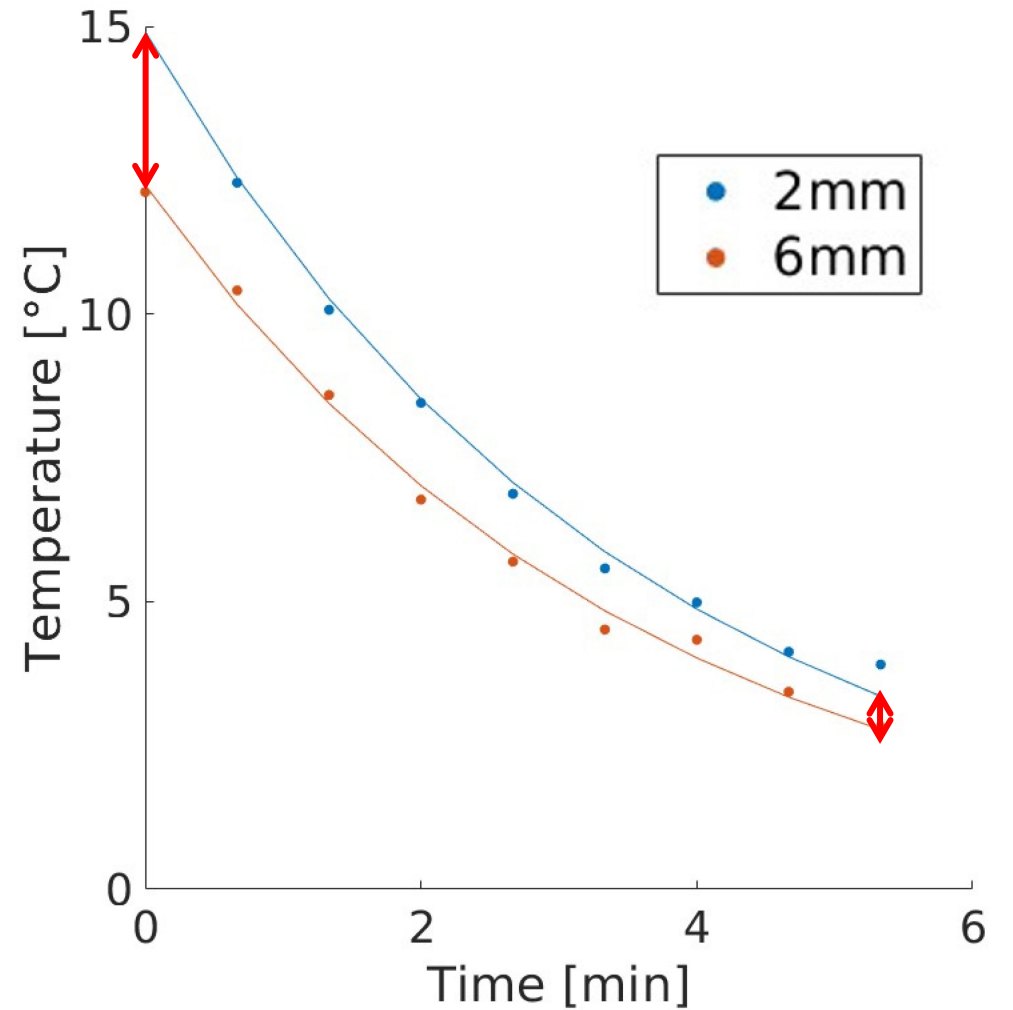
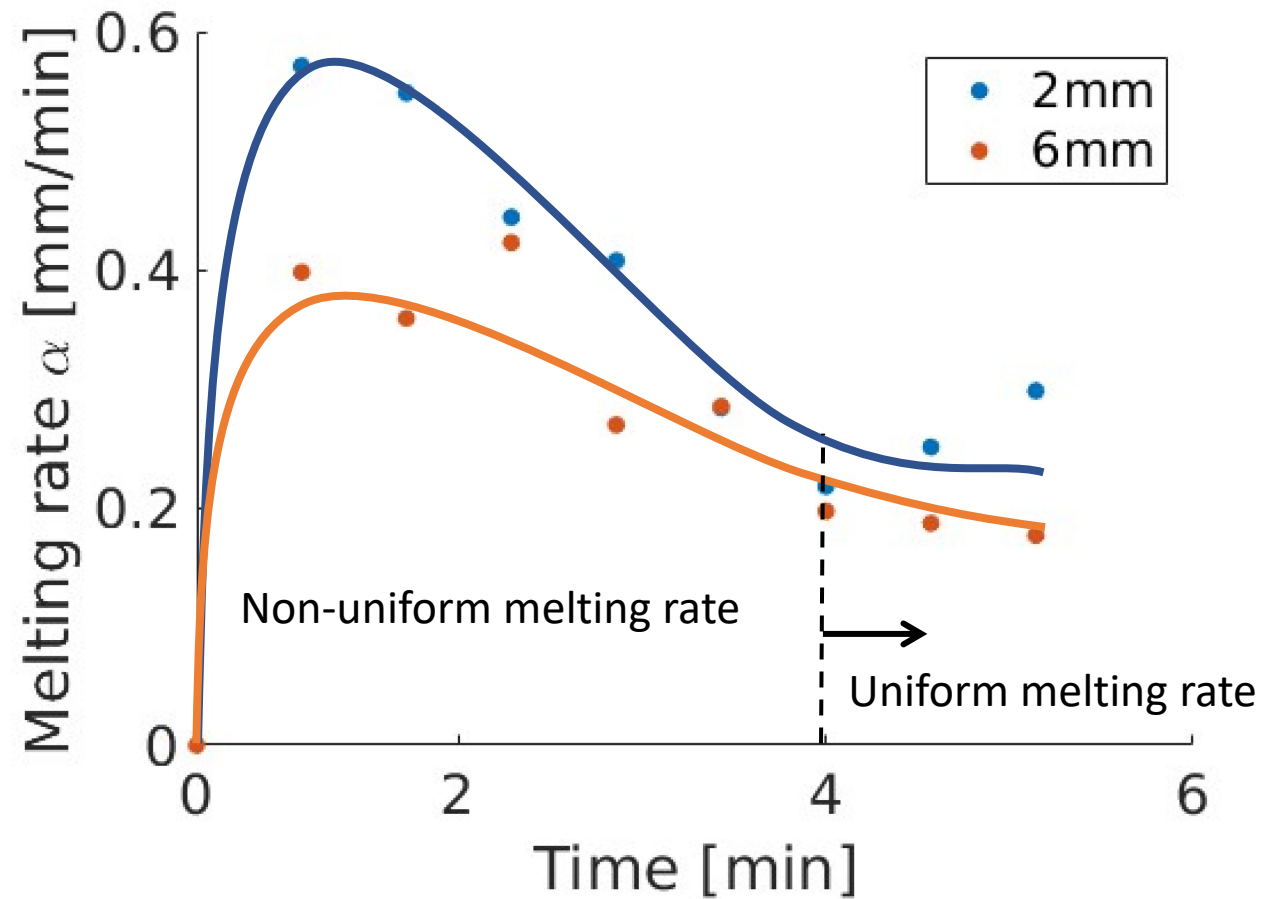
Melting rate: $\alpha = \frac{\Delta x}{\Delta t}$



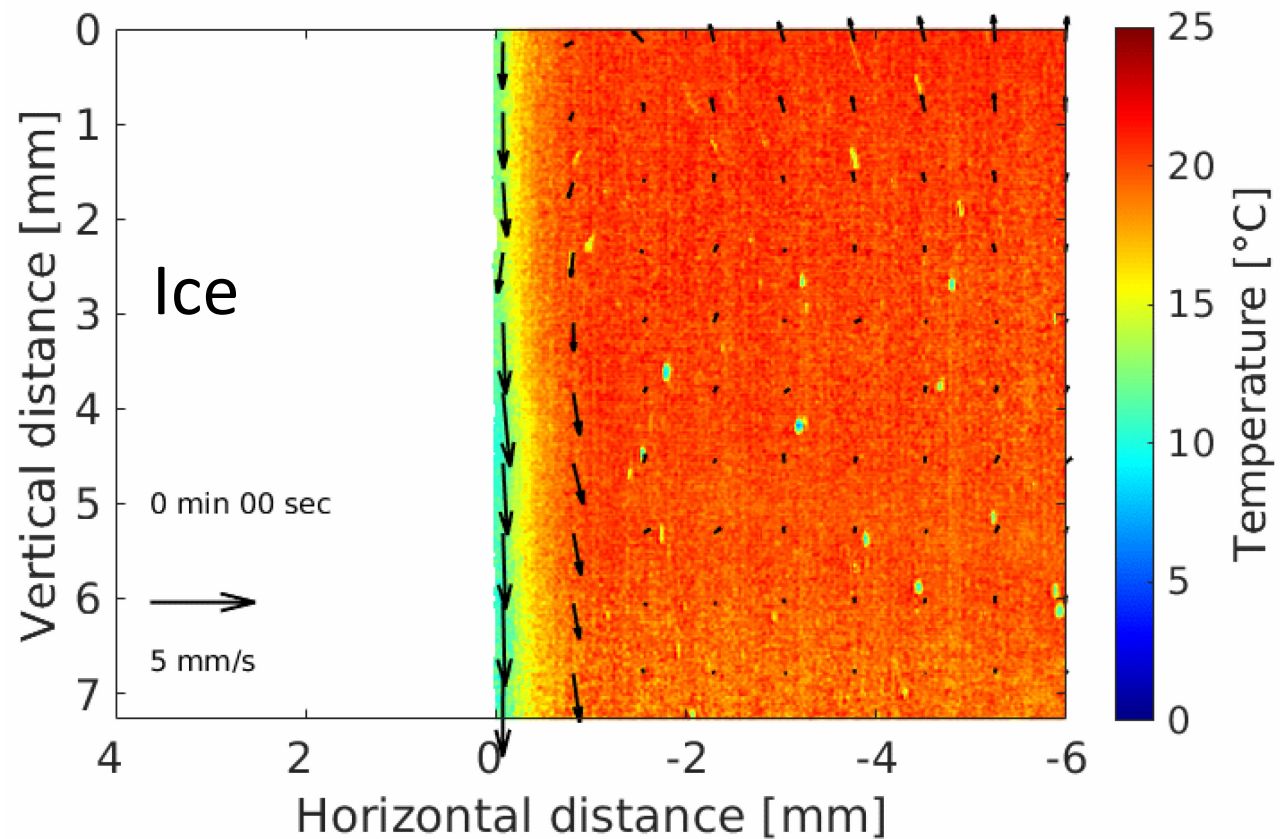
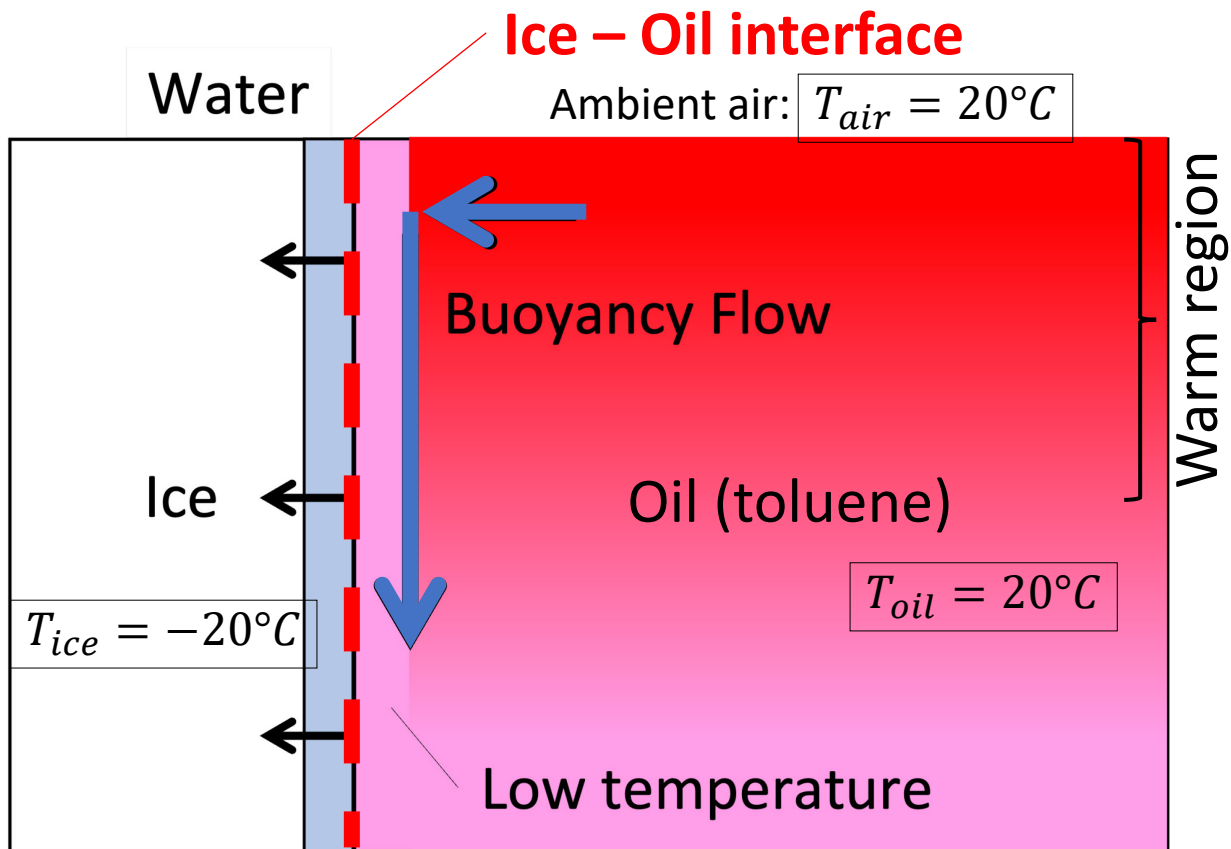
Ice Melting Process



Ice Melting Process

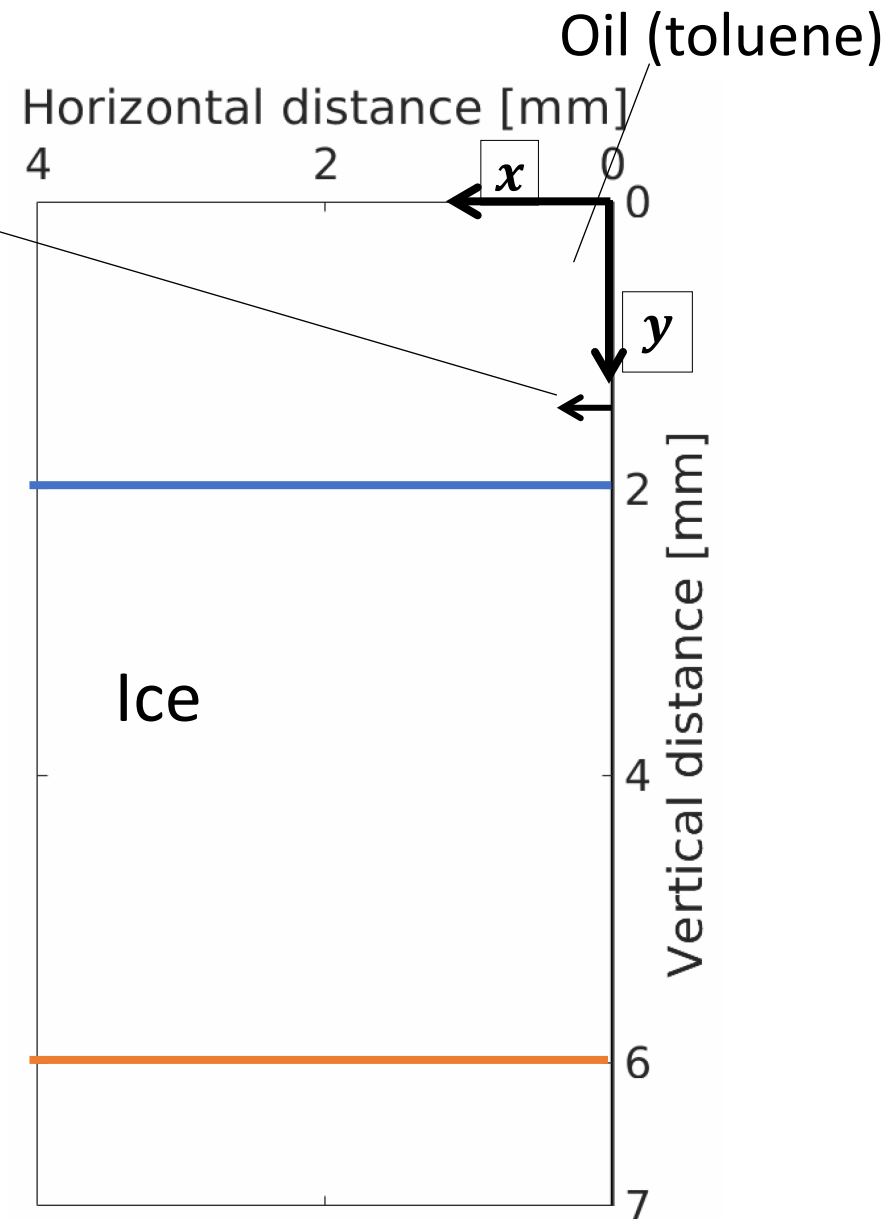
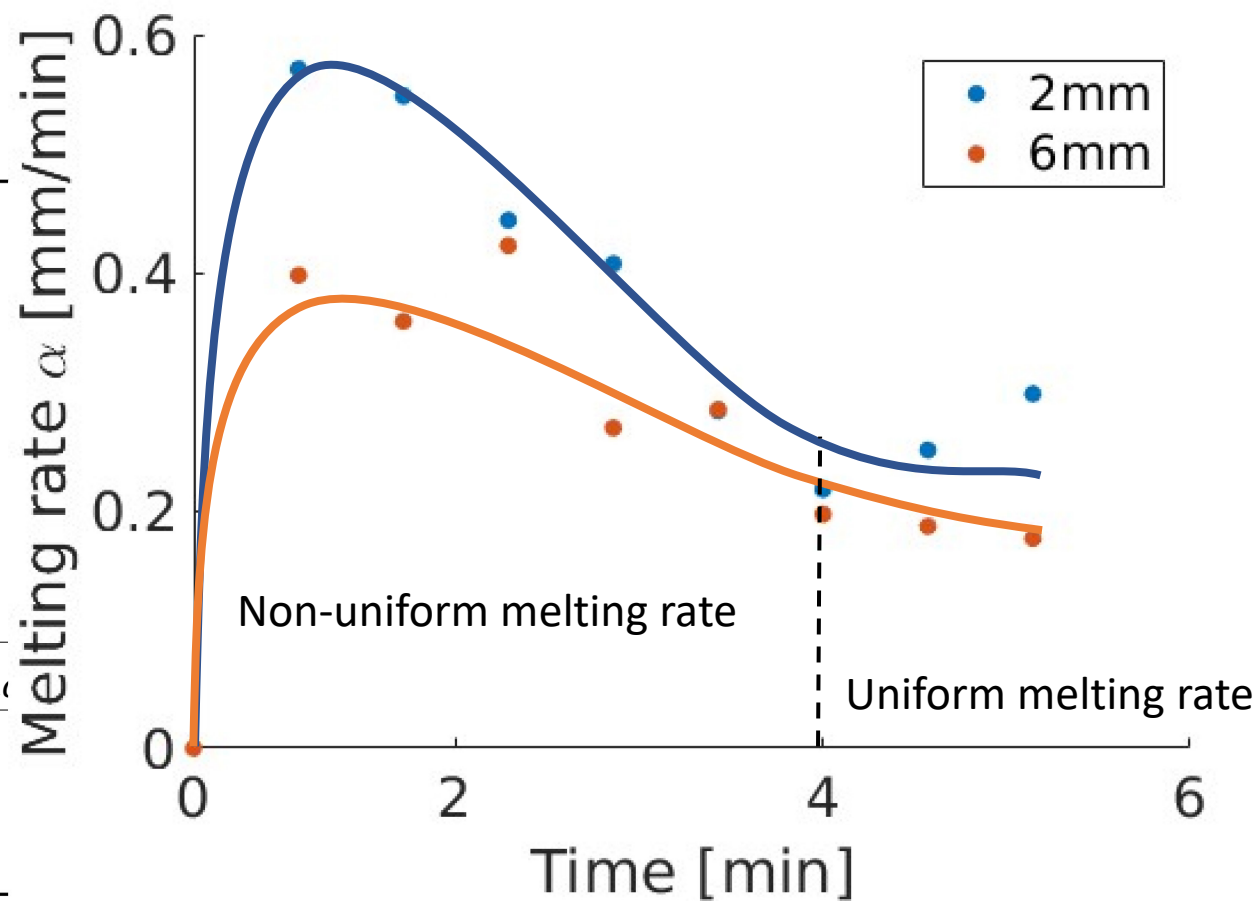


Summary

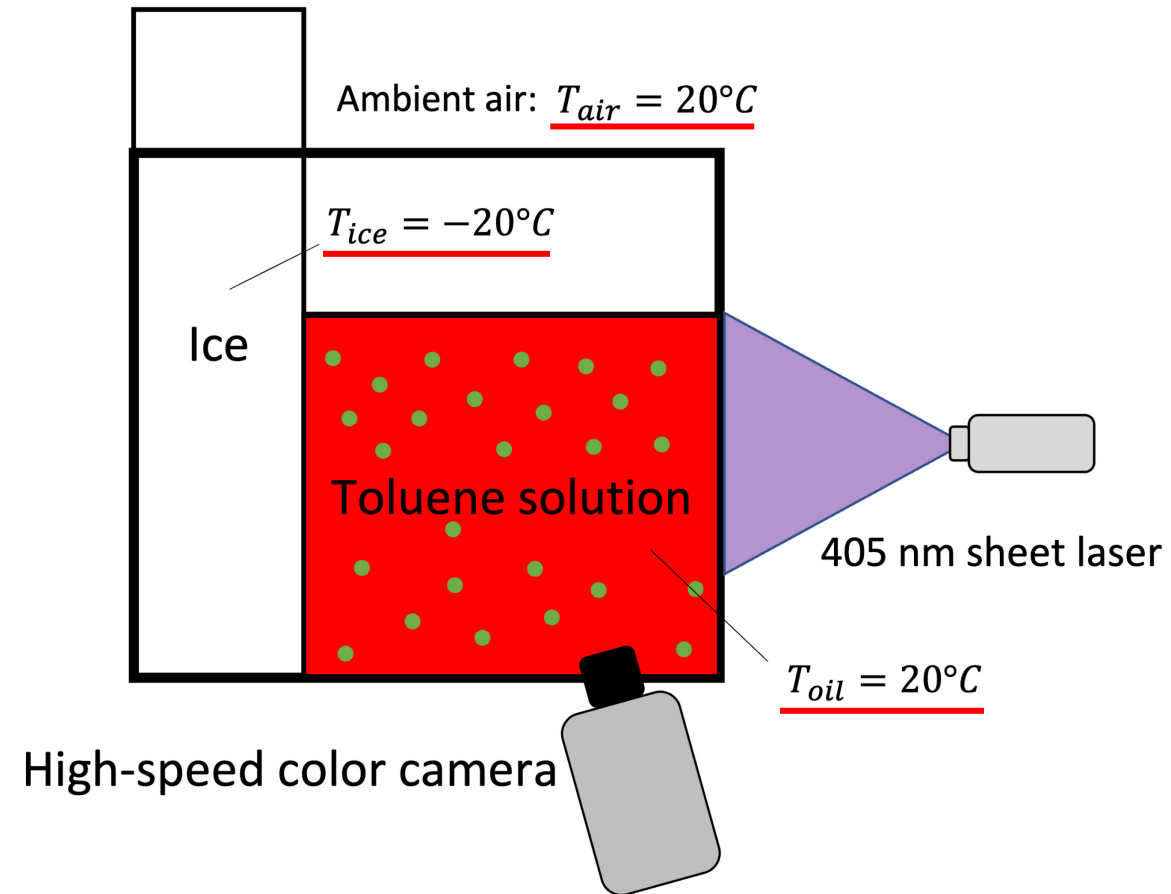
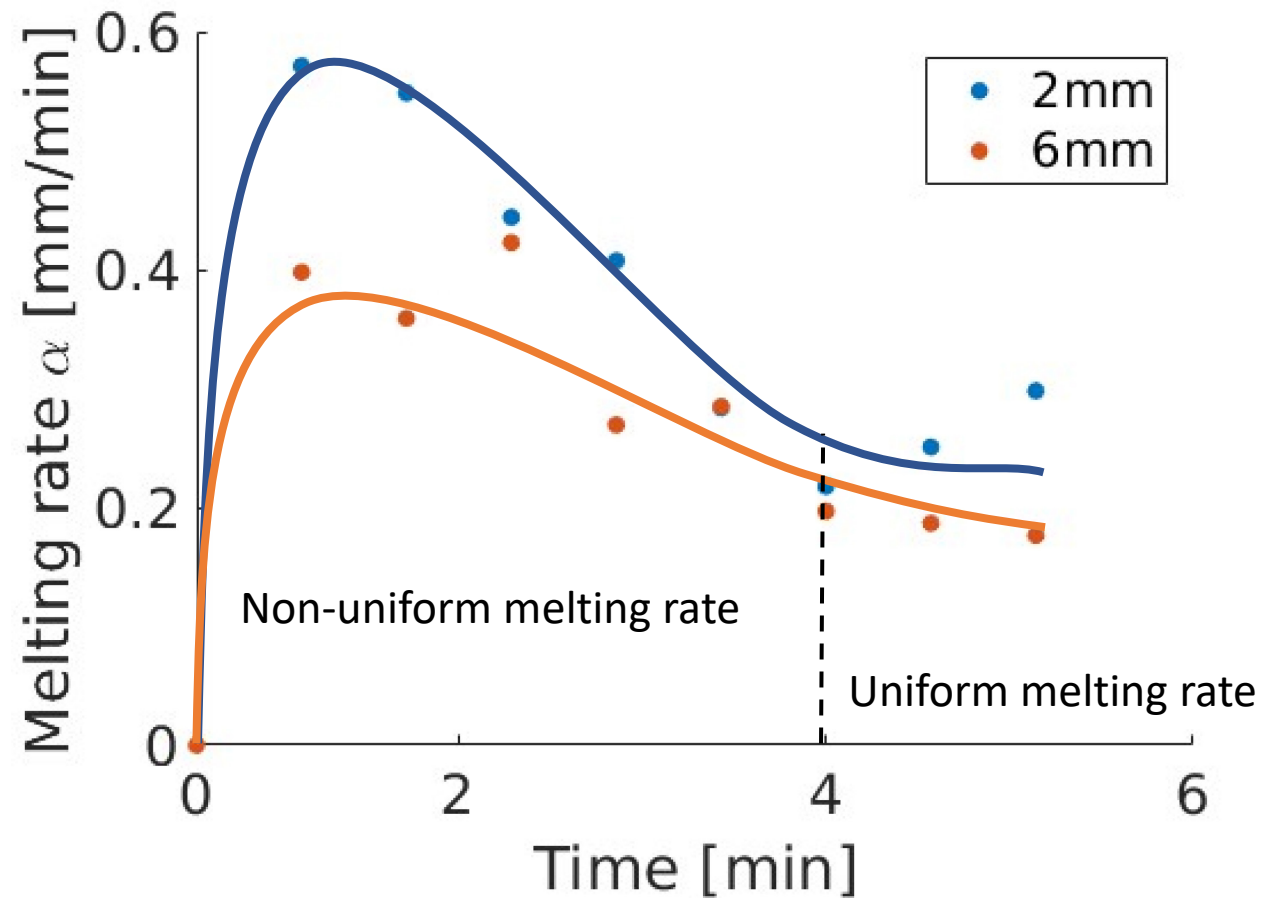


Summary

Melting rate: $\alpha = \frac{\Delta x}{\Delta t}$



Future work



Acknowledgement

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