Melting and Condensation Analysis of Natural Ice

Melting/condensation analysis is tackled macroscopically using scSTREAM

Analysis Process using Temperature Recovery Method

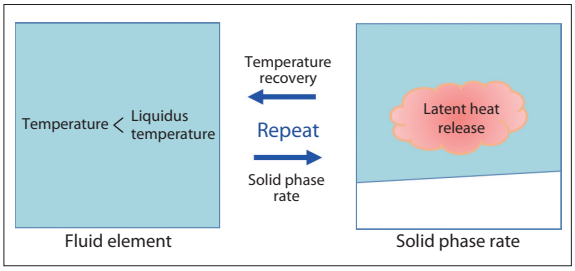

Figure 1: Temperature recovery method

- Define the volume fraction of solid in a fluid as solid phase rate.
- Assume equilibrium at solid-liquid interface and solve the change in solid phase rate by temperature recovery method.
- As shown in Figure 1, solve temperature of fluid element, and if temperature is below liquidus temperature (which matches solidus temperature for pure matter such as pure water), calculate solid phase rate from latent heat and specific heat.
- Next, recover temperature of fluid element by releasing (generating) latent heat equivalent to solid phase rate and by solving temperature of fluid element again.
- Repeat the above to find solid phase rate and temperature of fluid element.

Melting and Condensation Analysis of Natural Ice

Analysis Model

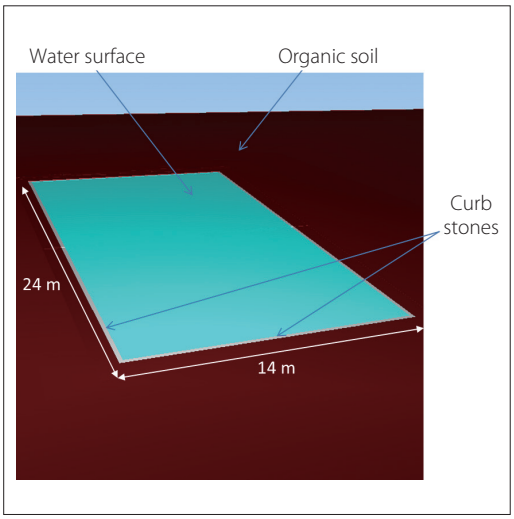

Figure 2: Water pond

Water pond	24 m long× 14 m wide× 0.5 m deep, surrounded by curb stones and organic soil
Top surface of pond	-8 ˚C Heat transfer coefficient 10 W/(m²K)
Bottom surface of pond	4 ˚C (heat conduction)
Analysis method	Transient analysis
Notes	Flow of water is not solved

Analysis Results

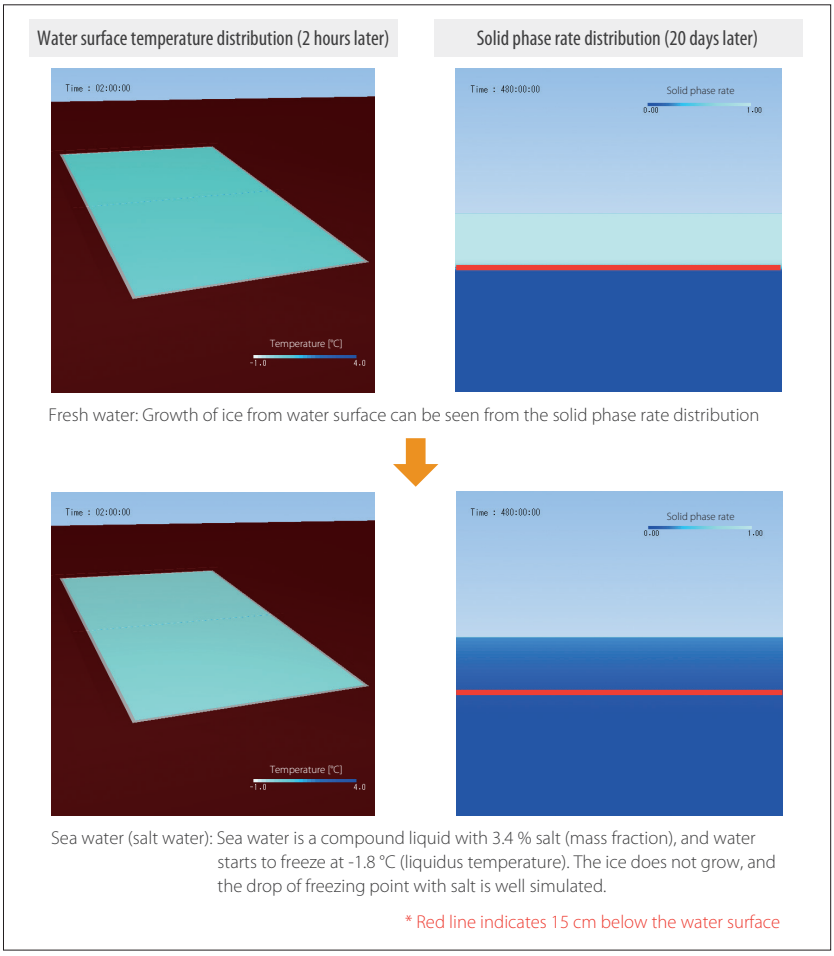

Figure 3: Analysis results showing fresh water (top) and sea water (bottom)

Notes

Figure 3 shows water surface temperature distribution after 2 hours and solid phase rate distribution after 20 days. From the result of fresh water, it can be seen that temperature drops almost uniformly at water surface, and ice grows from the surface. When fresh water is replaced with salt water such as sea water, ice does not grow, and the drop of freezing point with salt is well simulated.