Degradation of Ice Wedges in Northern Alaska in Response to Recent Warmer Temperatures

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Ice Wedge Abundance

Ice wedges occupy 20% or more of older terrain units
Sensitivity of Ice Wedges

- 2-3 m across top, 2-4 m deep
- Covered by 35-45 cm of soil
- Form near the surface from winter contraction cracking
- Sensitive to active-layer dynamics
- Not always evident by surface features
- Can be thousands of years old
• Coring at 46 locations in three study areas

• Degradation proceeds along ice wedges in a continuum of stages of development

Thaw front on ice wedge by early August
Advanced Degradation

- Tussocks 100s of years old
- Ice wedges 1000s of yrs old
- These ages indicate degradation to this extent has not happened for 100s to 1000s of years

Initial Stabilization

New Sedge Peat
Dead Tussocks
• 93% (n=202) of easily visible large pits (>9 m²) in 2001 not evident in 1982
• Area increased from 1.0% in 1982 to 5.4% in 2001
Extent of Ice Wedge Degradation

Water-filled pits (red) in indicate recent degradation, 3.8% of area. Potentially could affect ~20% of area.

~20,000 thermokarst pits in study area

Based on spectral analysis of waterbodies

Waterbody Classes

- Not flooded in 1945 or 2001
- Flooded in both years
- Flooded only in 1945
- Flooded only in 2001

3 x 5 km area
Conclusions

- Prevalence of dead tussocks (100s yrs) and large wedges (1000s yrs) indicate ice-wedge degradation is highly unusual.

- Analysis of 1945, 1982, and 2001 airphotos reveal 93% of the degradation has occurred since 1982.

- Spectral analysis of thermokarst pits in two separate areas (3 x 5 km each), as well as observations from Teshekpuk Lake to Arctic Refuge, confirm the degradation is widespread.

- Thermokarst is causing radical changes in microtopography, redistribution of water on the landscape, carbon accumulation and gas exchange, and plant communities.