

# Seasonal Temperature Variations and CO<sub>2</sub> Sublimation Activity Near the Martian South Pole

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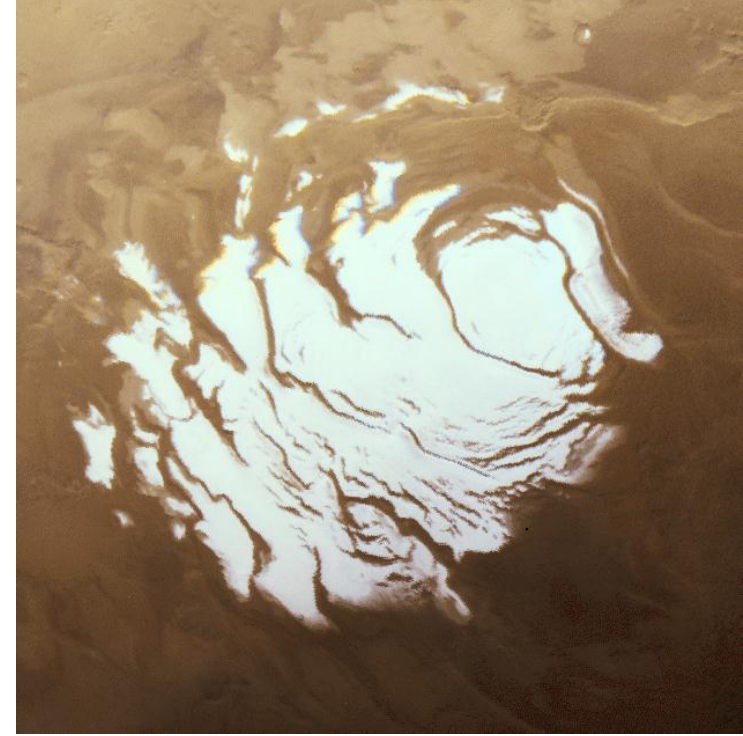


# The South Pole of Mars

- Seasonal layer of CO<sub>2</sub> ice
- Seasons on Mars measured in Solar Longitude
- CO<sub>2</sub> ice sublimates in spring and summer
- Visible Images
- Thermal Infrared Images

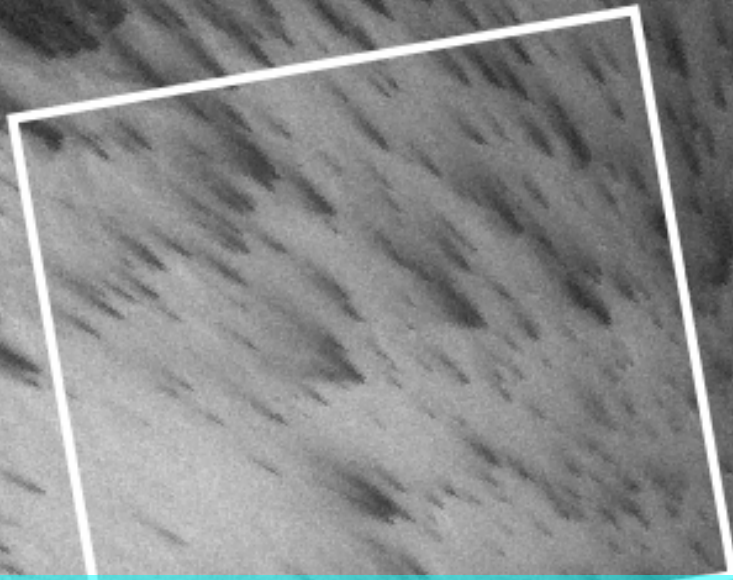
South Polar ice cap, NASA.gov

THEMIS camera onboard NASA's Mars Odyssey spacecraft



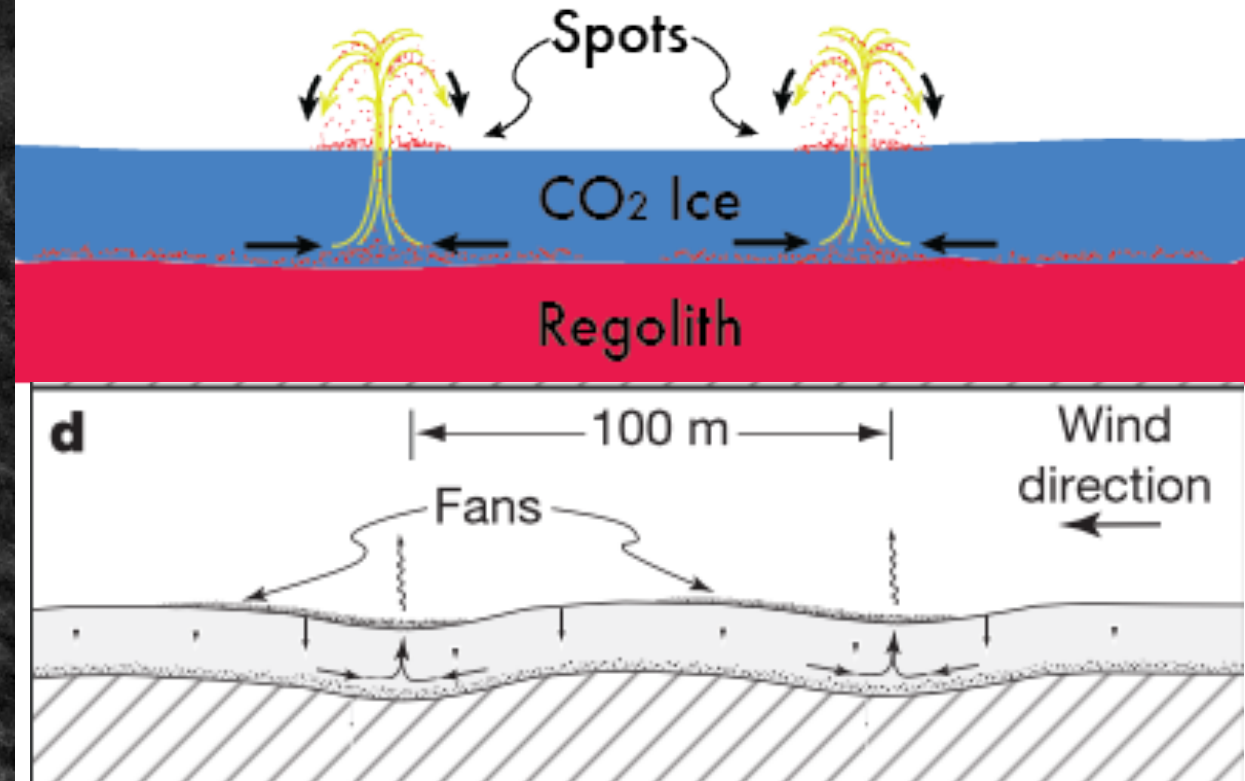
# How Do Spots and Streaks Form?

Dark spots and streaks



- Pressure builds
- CO<sub>2</sub> gas jets erupt spewing dust
- Dust deposited on surface

- Ice layer is on top of regolith
- Sublimation occurs from bottom of CO<sub>2</sub> ice layer

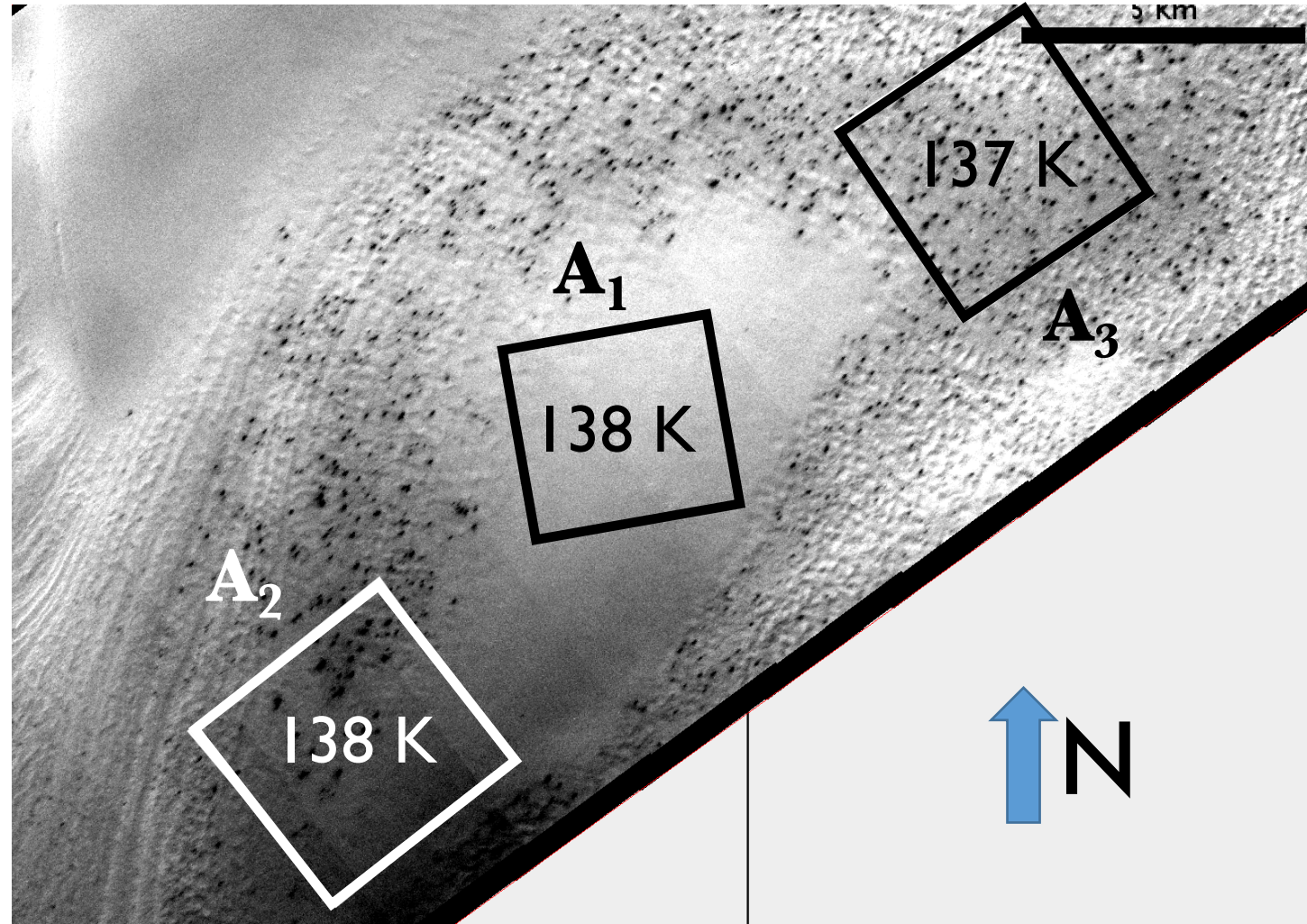


Basal sublimation model, (Kieffer, Christensen, Titus 2006)



# THEMIS Visible Images

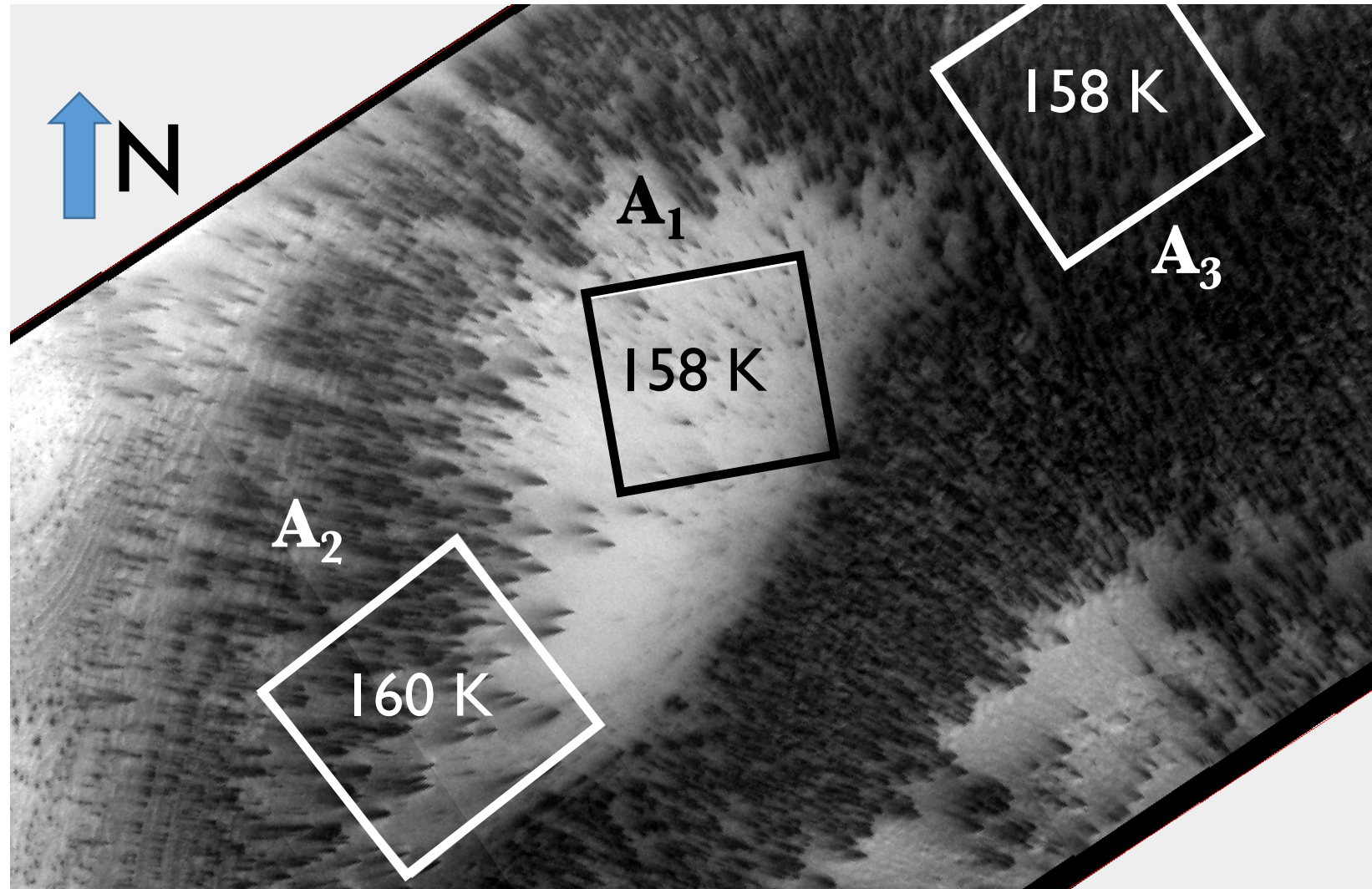
- Area of Study: 86°S/99°E
- 4 km x 4 km regions
- Visible image in early spring (Ls 175°)
- Regions A2 & A3 have many dark spots
- A1 dark spots have yet to form



**CO<sub>2</sub> ice-covered surface near the South Pole of Mars at Ls = 174.8°**

# Progression of CO<sub>2</sub> Sublimation

- Sublimation of CO<sub>2</sub> ice in full swing
- A1 and A2 have dark streaks oriented NW
- A3 covered with dark material
- Temperatures have warmed up to ~160K

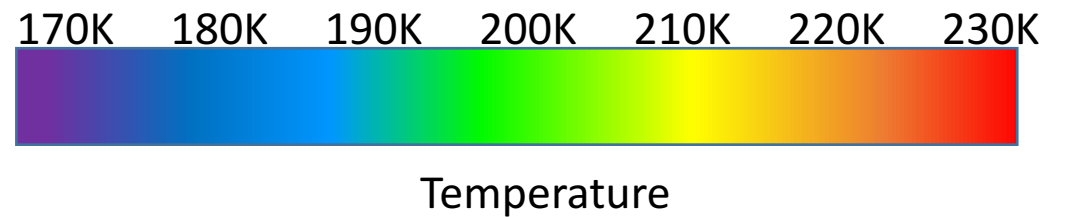
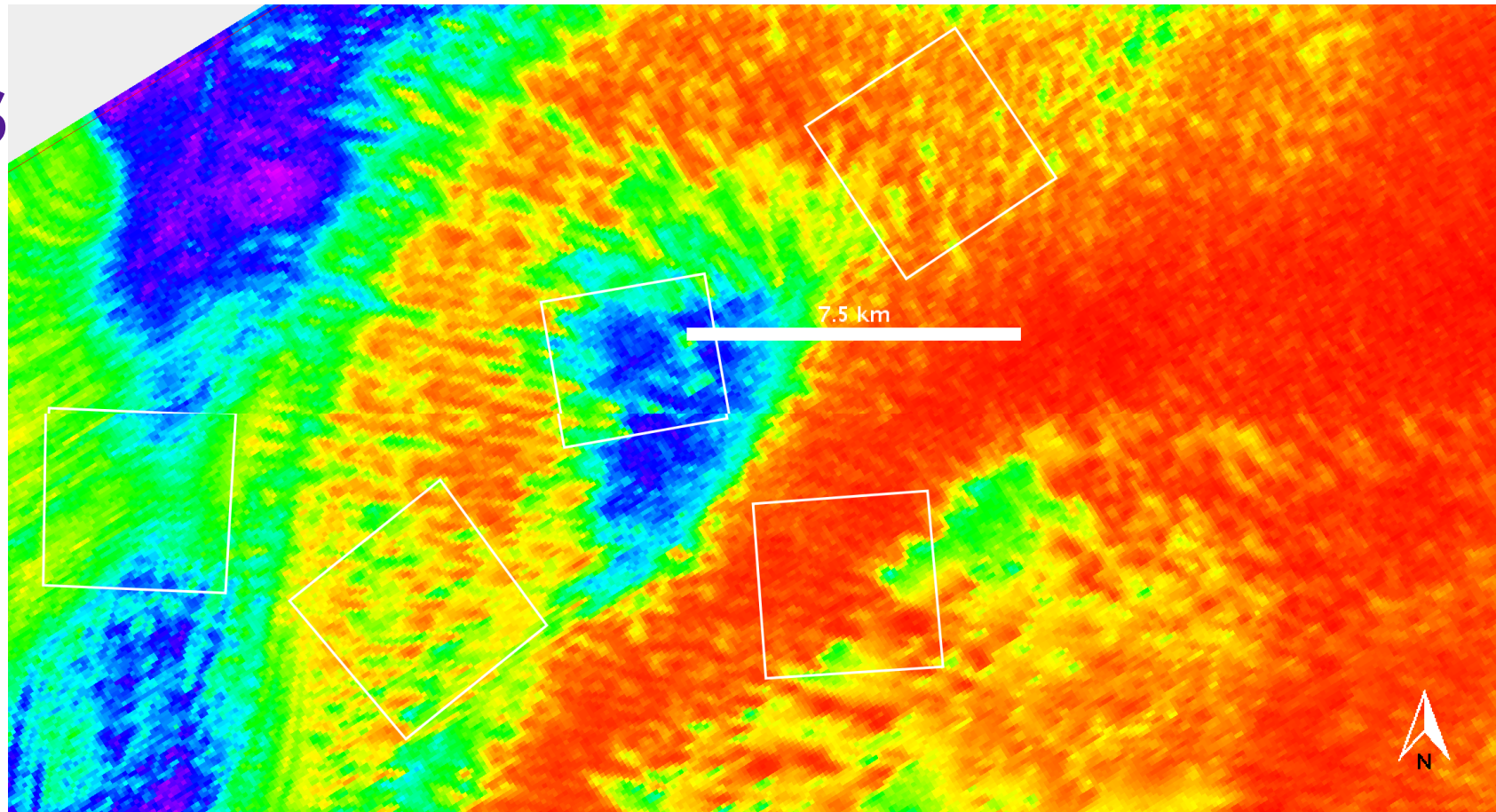


**Effects of CO<sub>2</sub> gas jets and deposition 71 sols later at Ls 213°**



# Thermal Infrared Studies

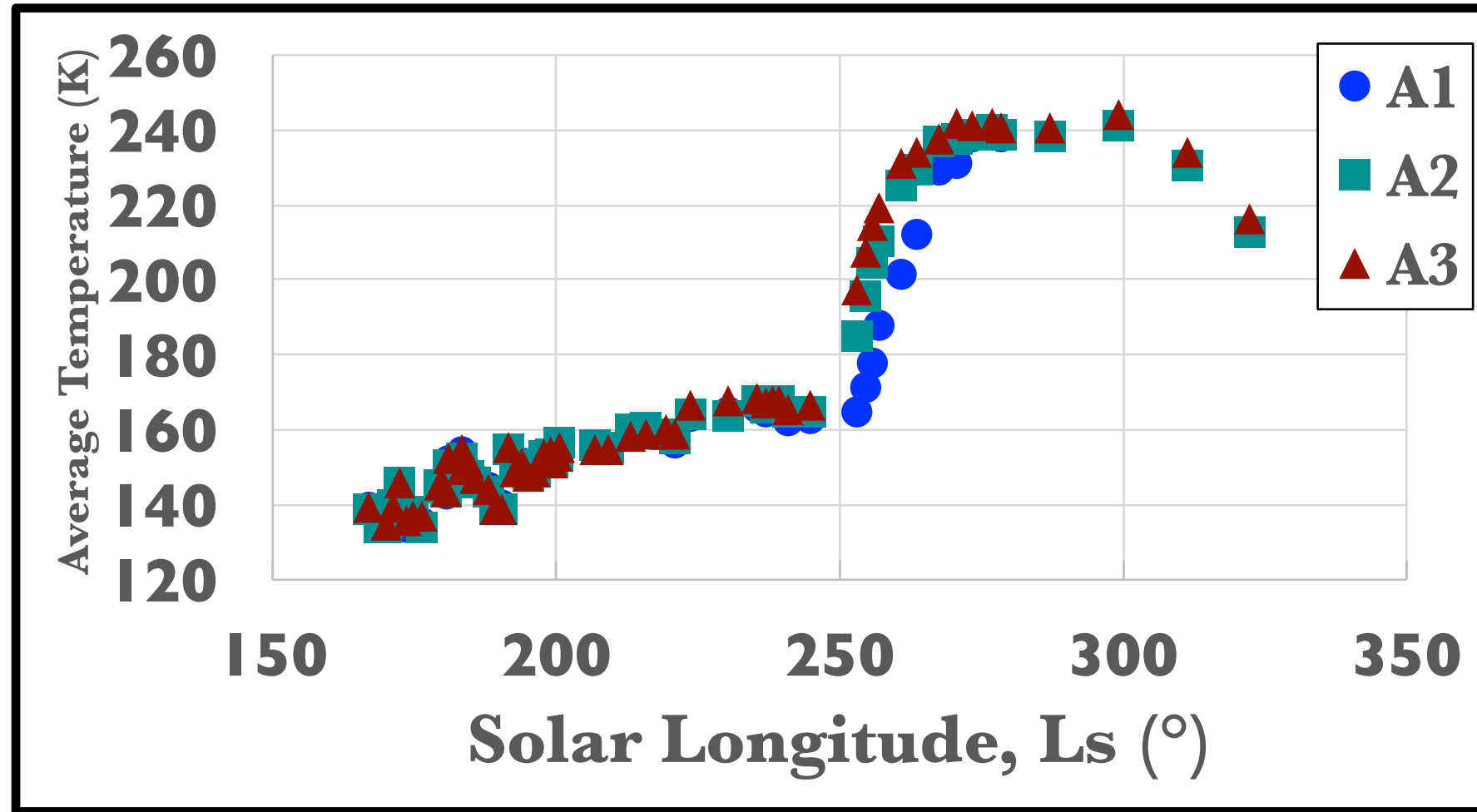
- THEMIS Thermal Infrared Image
- Average temperatures calculated using JMARS software
- Area A1 is colder than A2 and A3



**THEMIS Infrared Image (false-color) at Ls 257°**

# Seasonal Temperature Variations

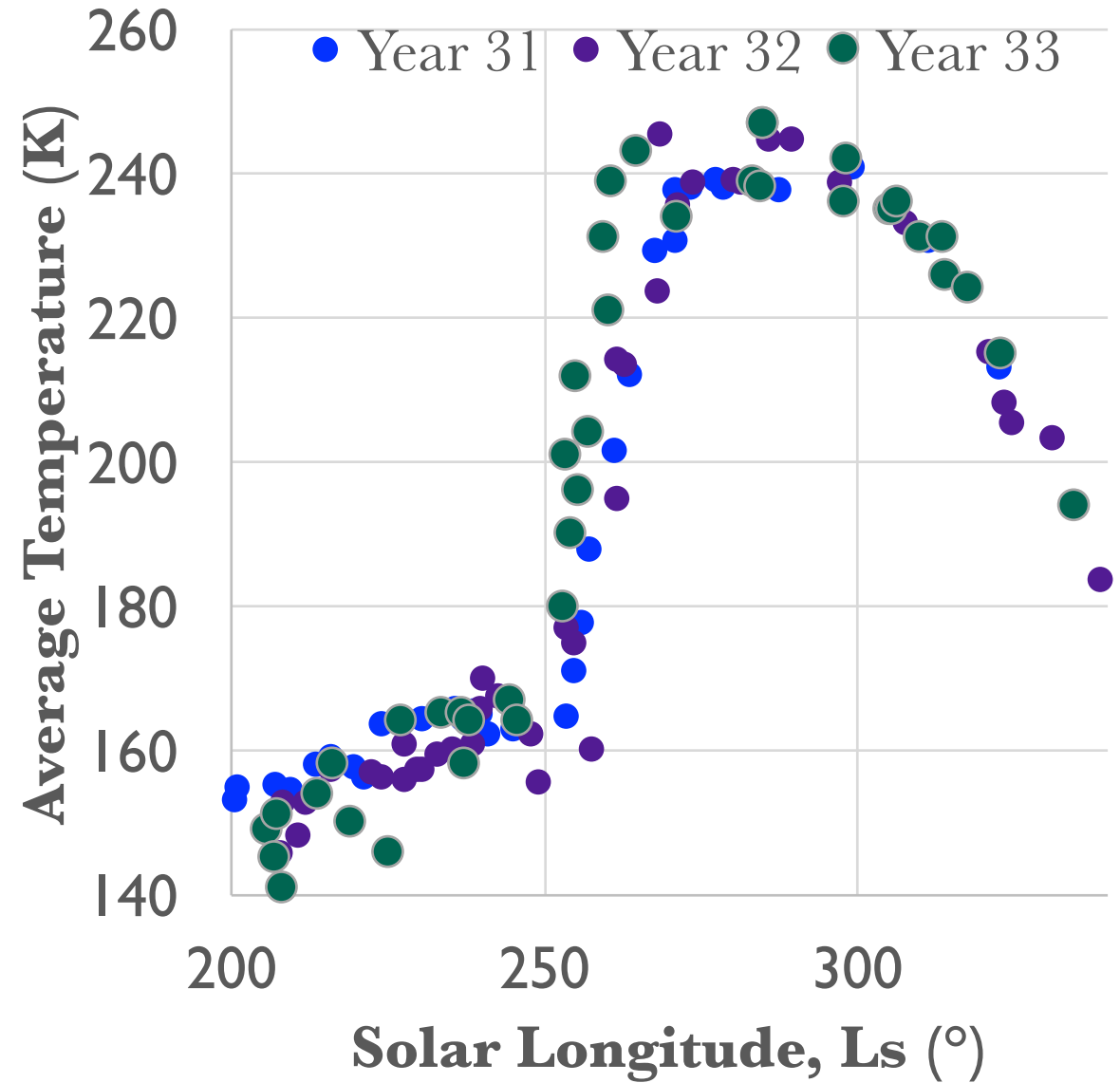
- Temperature gradually increases from Ls 170° to 250°
- Sharp increase at Ls 250°
- Maximum temperature ~245K



**Average Surface Temperatures for Areas A1, A2, A3 as a function of Ls for Mars Year 31.**

# Year-to-Year Variability

- Average temperatures for area A1 for Mars years 31, 32, and 33
- Sharp increase at Ls 250° is repeatable from year to year
- Surface cools off ~Ls 300°



**Average Temperatures vs. Ls for Area A1 for Mars Years 31, 32, and 33.**



# Conclusions

- ♂ Surface temperatures increase gradually from 140 K to 160 K during the spring season (Ls 170° - 245°).
- ♂ The rapid increase in temperature corresponding to sublimation of CO<sub>2</sub> ice happens at the end of spring (Ls 250° – 270°).
- ♂ The maximum surface temperatures of ~ 245K correspond to the temperature of the defrosted terrain.

# Acknowledgments

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ASU/NASA Space Grant Program

