Conductive Heat Flux Derived from Flux Plates

- Conductive heat flux values from five flux plates show noticeable difference in observed flux values across differing soil moisture types.
- Conductive heat flux is much more variable in dry soil (Figure B – green circle).
- Noticeably higher magnitude of variability throughout all soil types (Figure A).

Conductive Heat Flux Derived from Thermistors

- Variability between conductive heat flux values derived from thermistors was greater in July than March.
- Dry soil types are more variable in winter months since no water to freeze in dry soil (Figure D).
- Wet soil type is the most variable during summer months (Figure C).

Figure A and B show conductive heat flux values derived from five different direct flux plate measurements with the corresponding soil moisture content at the tower site. Noticeable variability observed between flux plates.

This map shows how conductive heat flux is varying across the Tiksi station within a 2 km x 2 km satellite view (i.e. dry soil, mid soil, wet soil). Notice how soil properties and moisture content influence the conductive heat flux values.

Figure E and F show conductive heat flux values derived from a soil flux equation using measurements from four different soil thermistor strings for the months of July (thawing permafrost) and March (frozen permafrost).

Conductive Heat Flux Depth Contour Maps

- Conductive heat flux values dissipate almost completely around 30 cm depth in tundra soil.
- During July (Figure E) conductive heat flux values higher than ~5 Wm⁻² dissipate around a depth of 30 cm.
- During March (Figure F) conductive heat flux values higher than ~5 Wm⁻² have a shallower flux dissipation around a depth of 10 cm.

Conclusion

- Frozen state of permafrost in March shows more stability as conductive heat flux goes to zero.
- Thawing state of permafrost in July shows more variability in conductive heat flux.
- Conductive heat flux values differ greatly across the site due to the active layer experiencing thawing differently.
- Conductive heat flux value will be very dependent on soil and water properties at an instrument’s location (i.e. soil thermal conductivity and soil heat capacity).
- Range in conductive heat flux values can vary between 25-50 Wm⁻² at one specific Arctic station.

Contour plots show how conductive heat flux values dissipate through the permafrost during thawing months.

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Background: Tiksi Station

Analysis of the components of the surface energy budget is necessary for better understanding the energy exchanges of the Arctic region. The Arctic field site chosen for this study is located in Tiksi, Russia (71.6°N, 128.9°E). At Tiksi station a 20 meter meteorological tower is surrounded by five flux plates and four thermistor strings from which conductive heat fluxes can be measured and derived respectively. The flux plates and thermistor strings are distributed in a variety of regimes including wet tundra, mid tundra and dry tundra soils.

Conductive heat fluxes from around the Tiksi tower are compared for one winter (March) and are distributed in a variety of regimes including wet tundra, mid tundra and dry tundra soils.

Conductive heat flux values dissipate almost completely around 30 cm depth in tundra soil.

Range in conductive heat flux values can vary between 25-50 Wm⁻² at one specific Arctic station.

Contour plots show how conductive heat flux values dissipate through the permafrost during thawing months.

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