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CONTROL ID: 957633

TITLE: Determination of Anisotropic Thermal Conductivity with Thermal Needle Probe Measurements

PRESENTATION TYPE: Assigned by Committee (Oral or Poster)

CURRENT SECTION/FOCUS GROUP: Cryosphere (C)

CURRENT SESSION: C09. Monitoring, Measuring, and Modeling Snow Processes

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Title of Team:

ABSTRACT BODY: A new method for measuring thermal conductivity is being adapted from the standard method of measuring isotropic thermal conductivity with needle probes, ASTM D5334, in order to enable the dertermination of an anisotropic thermal conductivity. This method will have particular relevance to measuring thermal conductivity of natural snowpacks where conductivity can be strongly anisotropic due to vertical thermal gradients, compaction and metamorphosis. Needle probes, such as specified in ASTM D5334, consist of a thin needle embedded with a constant-flux heating element and a thermocouple or thermistor. Thermal conductivity of the surrounding material is calculated analytically using needle temperature data as a function of time.

This new method uses finite element numerical solutions for apparent thermal conductivity as a function of actual anisotropic thermal conductivity and needle orientation. Values for anisotropic thermal conductivity are determined by curve-fitting a function relating apparent results of the ASTM method at given needle orientations and the actual solutions. The results of the numerical simulations may then be applied to the measurement of actual anisotropic materials. Unlike ASTM D5334, multiple measurements at different orientations are required, and relies the number of free variables in the heat equation (with an upper bound of six for a symmetric conductivity matrix, which may be reduced with further simplifications).

The applicability and feasibility of this technique for improving arctic climate models, which can strongly depend on snow conductivity, will be discussed.

INDEX TERMS: [0736] CRYOSPHERE / Snow, [0794] CRYOSPHERE / Instruments and techniques, [0770] CRYOSPHERE / Properties, [0798] CRYOSPHERE / Modeling.

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Previously Presented Material:

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