Snow albedo and its physical controls from the NASA Surface Biology and Geology (SBG) imaging spectrometer mission: Global distribution of cal/val from INARCH

Thomas Painter, NASA Jet Propulsion Laboratory

Abstract:

Decades of satellite, airborne, and ground observations clearly show increased melting of glaciers and ice sheets, declines in sea ice, and decreasing spring snow cover. This increased melting of cryosphere cover makes Earth more absorptive of sunlight and moves enormous volumes of stored water from frozen state to liquid, raising sea level and changing water availability to large populations. However, the distribution of forcings controlling this accelerated melting is poorly known.

Atmospheric warming from greenhouse gases is contributing to this acceleration but its magnitude is uncertain due to our uncertainties in the controls on the dominant contributor to annual melt, absorbed sunlight, itself controlled by albedo. Despite this crucial role of albedo and solar radiation in snow and ice melt, sparse measurements have kept us from understanding the global distribution of controls on albedo, grain size (GS) and impurities, and from accurately modeling melt processes worldwide. Such an understanding is crucial to determining cryosphere melt and projecting its future behavior. To understand the current distribution of these powerful snow process forcings and their relative importance, the 2017 Earth Science Decadal Survey adopted the *Surface Biology and Geology* VSWIR imaging spectrometer concept as a Designated Measurement.

Here we describe the spectroscopic retrievals of snow grain size, radiative forcing by dust and black carbon, spectral albedo, and broadband albedo as used with the NASA Airborne Visible/Infrared Imaging Spectrometer (Classic and Next Generation) and the NASA Airborne Snow Observatory. We present the uncertainties in global to mesoscale climate modeling of snow melt from current uncertainties in grain size and radiative forcing. We present the mission requirements for such retrievals and the associated science in the context of the *SBG* concept.

Most germane to INARCH is a proposal described here to supplement the INARCH network's measurements with in situ VSWIR spectrometers to provide calibration and validation of snow spectral hemispherical-directional reflectance factors, snow albedo, snow grain size, and radiative forcing by light absorbing particles. INARCH's growth globally and the measurements of SBG will be synergistic in providing cryosphere and water cycle process understanding to ultimately constrain physically-based models.