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Improving melt onset detection in mountainous regions from a new, enhanced-resolution passive microwave climate record

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Funded by NASA MEaSUREs, we have completed reprocessing historical gridded passive microwave brightness temperature (TB) data into a new Earth System Data Record (ESDR). The Calibrated, Enhanced-Resolution EASE-Grid 2.0 Brightness Temperature (CETB) ESDR uses the most mature available Level 2 satellite passive microwave (SMMR, SSM/I-SSMIS, AMSR-E) records from 1978 to 2016, and state-of-the-art numerical methods to increase image spatial resolution. The image reconstruction methods, improving spatial resolutions to $\sim$3 km for the highest-frequency channels, are enabling new analysis of derived cryospheric variables, including sea ice concentrations, snow water equivalent and ice- and snow-melt onset. Passive microwave detection of melt onset is based on time series evaluation of diurnal amplitude variation (DAV) in 18 and/or 36 GHz vertically-polarized TBs. The DAV signal is sensitive to changes in near-surface liquid water that characterize melt onset, melt intensification and refreezing. Conventional-resolution (25 km) TB grids have successfully detected snow melt states in seasonal snow and glacial environments at high latitudes. However, due to mixed pixels at such coarse resolutions, previous analysis has been impractical in glacier-marginal zones, in regions near water bodies and in mountainous regions. We summarize recent analysis using the new CETB product, which includes the full record of intercalibrated six SSM/I and four SSMIS sensors. Together with the AMSR-E record, these overlapping TB measurements provide a rich time series to evaluate melt timing across boundaries and transition zones that had previously been impossible. We analyze melt onset detection compared to observed river discharge timing, as well as melt onset variability and recent trends in melt onset, in the high-relief Hunza basin (area $\sim$13,000 sq. km, at 36N, 74E) of the Upper Indus River.