Estimation of Melting Layer Altitudes from Dual-Polarization Weather Radar Observations

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Introduction

Radar data algorithms, such as the estimates of surface rainfall intensity and hydrometer classification, require information about the melting layer height (MLHGT). Often MLHGT is considered constant while it is well known that MLHGT varies in time and space.

Weather radar has the sufficient resolution to observe these variations, and the melting layer is clearly observed by the dual-polarization weather radar. Here, we present a radar based method of melting layer height estimation which is capable to map these variations for improved performances of near-real-time applications.

Bayesian inference of MLHGT from fuzzy classifications of melting snow and of not melting snow

Implementation in IRIS™/RVP900™ software

Data examples

- Maximum variability characterizes the local climatology.
- Correlation time transforms the confidences of the radar based estimates from the past to the current time.
- Melting layer thickness is a constant in local climatology.
- Number of azimuth sectors is the scale of adaptive resolution.
- Vertical binning is a technical grid parameter.
- Minimum radar confidence is a threshold for quality control.
- Minimum sizes of radar based cluster is a quality threshold.

Summary

- We develop and implement an operational configurable method for estimating melting layer altitudes in near-real-time from dual-polarization Doppler weather radar observations.
- PPI and RHI scans are supported.
- The method accumulates locations of precipitation recognized as melting or not melting snow in a grid of likelihoods updated for each observation in a Bayesian approach. The altitudes of the melting layer can be estimated at a high spatial and temporal resolution.
- The estimates of melting layer altitude are reported as a map in Earth coordinates in a Cartesian MLHGT product in the IRIS™ radar data format. The method can be scheduled to run at the radar computer, or it can be scheduled to process observations from radar networks routed to the central processing analysis facility, in near-real-time. The MLHGT results are uploaded to the RVP900™ signal processor and they are used as inputs and constraints to hydrometer identification as well as in the dual-polarization corrections for rain induced attenuation.
- The MLHGT method has been evaluated in conditions of warm and cool season, with direct validation with respect to independent upper air soundings. The MLHGT estimates, the estimates of their uncertainty, and of radar confidence are found to perform consistently. The remote MLHGT estimates and the 0°C isotherms derived from in-situ temperature profiles are found to agree at the level of 100 m.