# Microphysical Insights from Coincident Multi-Frequency and Polarimetric Radar Observations During OLYMPEX

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The OLYMPEX field campaign took place over the Olympic Peninsula of Washington during winter 2015-2016. During the intensive observing period, several aircraft flights obtained multi-frequency airborne radar measurements at X-, Ku-, Ka, and W-band from radars aboard the ER-2 and DC-8 aircraft. In addition, ground radars at S- and X-band performed RHI scans under the aircraft ground tracks. These coincident datasets provide a wealth of complementary information about the hydrometeor particle sizes, shapes, and orientations.

In order to synthesize these measurements and test the robustness of scattering models, an optimal estimation retrieval based upon a Hitschfeld-Bordan profiling algorithm has been developed. This algorithm retrieves profiles of the particle size distribution parameters $N_w$ and $D_m$, and, in the ice phase, relative proportions of aggregate, pristine, and rimed particles, using scattering models with different size-density and size-aspect ratio relationships. Under this formulation, only the pristine particles are horizontally aligned and capable of producing non-zero $Z_{DR}$ and $K_{DP}$.

From the nadir-looking airborne multifrequency radars, we find that aggregates may be readily distinguished from rimed and pristine particles owing to their uniqueness in triple-frequency space. However, rimed and pristine particles occupy a similar region in this space and thus polarimetric measurements greatly enhance their identification in our retrieval framework. With these capabilities we will present analyses of three-dimensional hydrometeor mapping obtained during various OLYMPEX cases. Some features retrieved in these cases include a layer of enhanced aggregation about 2km above the melting layer, hypothesized to be maintained by orographic uplift. This layer is often situated above a layer of denser, aligned particles. Regions of riming and supercooled liquid water beneath generating cells are also identified by our retrieval algorithm. Comparisons to in-situ observations and evaluation of scattering models will be presented.

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