Figure Captions.

Fig. 1. Satellite images (visible channel) of area along coasts of southern Washington, Oregon, and northern California for the three study periods. Images are from GOES–7 for 950914 and 950915, and form NOAA–14 for 950916. Areas covered by aircraft flights are outlined with boxes.

Fig. 2a. Vertical profiles of temperature (T, °C), total specific humidity (q_t, g kg^{-1}), equivalent potential temperature (θ_E, K), potential temperature (θ, K), wind direction (*wdir*, °true) and wind speed (*wmag*, m s^{-1}) for 950914. The data include approach and departure soundings into and out of the study area and all data from within the study area. Data are plotted as averages over 25–m height intervals. Heavy lines in the temperature panels indicate the vertical extents of the clouds.

Fig. 2b. Same as Fig. 2a but for 950915.

Fig. 2c. Same as Fig. 2a but for 950916.

Fig. 3 Detailed data for temperature (T, °C), specific humidity (q, g kg^{-1}), and equivalent potential temperature (θ_E, K) from a series of ascents and descents through the cloud on 950914. Each point represents 1 s of data. Cloud depth is indicated by the heavy vertical line in the first panel. Points within the main cloud layer (330 to 550 m) lie along slightly different, but constant, θ_E lines in all but one of the sequences.

Fig. 4. Examples of vertical cross–sections of radar reflectivity (Z) and of Doppler velocity (V, m s^{-1}, positive upward) for the three days discussed in the text.

Fig. 5. Horizontal cross–sections of radar reflectivity (Z) obtained with the radar in the side–looking position. Altitudes are indicated above each image. Orientation with respect to North is preserved for images from different altitudes for given days.

Fig. 6. Contributions to total reflectivity by two size ranges of hydrometeors. Reflectivity $(Z_{calc})_{\mathrm{fssp}}$, calculated from the drop size distributions measured by the FSSP probe (<45 μm diameter), is shown by a dotted line and $(Z_{calc})_{twodc}$, from the 2D–C probe (>50 μm), by a dashed line. These data combine measurements made during several ascents and descents through each cloud.

Fig. 7a. Vertical profiles of radar reflectivity (Z), Doppler velocity (V, positive–up), and the Z–V correlation coefficient, for the up–looking radar data shown for 950914 in Fig. 4. In the Z and V profiles, the heavy solid lines show the mean values while the other lines show $\pm$ one standard deviation from the means (triple dots), the 50% ranges (dotted) and the 90% ranges (thin).

Fig. 7b. – same as Fig. 7a, but for the image shown for 950915 in Fig. 4.

Fig. 7c. – same as Fig. 7a, but for the image shown for 950916 in Fig. 4.

Fig. 8. Vertical air velocity from the in situ probes versus the radar reflectivity 60 m to the side of the aircraft for the data shown in the higher altitude images of Fig. 5. The upper panels show individual data points, each point representing 3.4 m of flight path. In the lower panel, horizontal lines show the correlation coefficients for the entire data segments and different symbols indicate the coefficients over 1/2, 1/4 and 1/8th of the segments (the symbols are placed at the mid–points of the intervals).

Fig. 9. Correlation coefficients between the aircraft–measured vertical wind (w) and the radar reflectivity (Z_{calc})$_{twodc}$ calculated from drop size distributions measured by the 2D–C probe as functions of altitude. Values indicated by diamonds are based on 1–Hz data from the ascent and descent soundings with roughly 70, 40 and 30 points per height interval for the three days. Additional data from continuous level flight segments of 4–6 km length (50–70 seconds of data) are indicated by circles. Thick vertical lines indicate the altitude of the cloud layer for each case.

Fig. 10. The same vertical cross–sections of radar reflectivity (Z) and Doppler velocity (V) as those shown in Fig. 4, but with Z and V contour levels changed to highlight areas having relatively low reflectivities and large negative (downward) velocities.

Fig. 11a. Traces of aircraft–measured vertical winds (w), temperature (T), LWC, droplet concentration and calculated reflectivity for an ascent through cloud top at on 950914. The numbers above the top panel are aircraft altitudes. The LWC was derived from the CSIRO probe. Droplet concentration and reflectivity are based on FSSP data.

Fig. 11b. Same as Fig. 11a, except for a gradual descent into cloud on 950915. The LWC content in this figure is based on FSSP data. Aircraft altitudes are indicated at the bottom of the top panel.

Fig. 12. Correlation coefficients for vertical air velocity versus mass of drizzle drops (>50 μm diameter) at different altitudes based on data collected with 90–m resolution during a series of ascents and descents through the cloud layer on 950916. The depth of the cloud layer is indicated by a heavy vertical line.

Fig. 13. Profiles of LWC calculated from drop–size distributions measured by the FSSP probe. Data for each day are combined from several soundings. Mean values are indicated by asterisks, the thick bars encompass the 50th percentiles, and the thin bars show the range of values to the 90th percentiles. Broken lines show LWC values that would occur for adiabatic ascents of saturated parcels.

Fig. 14. Profiles of "dispersion" values for LWC for 950914 and 950915, plotted as functions of normalized cloud depth (ϕ). The first panel shows dispersions calculated as the 50–percentile range of LWC values divided by the means at each level; the second panel uses the 90–percentiles. Each panel contains data from the FSSP (asterisks for 950914; diamonds for 950915) and the CSIRO probe (solid line for 950914 only).

Fig. 15. Profiles of droplet concentrations for 950914 (asterisks) and for 950915 ("+"), plotted as functions of normalized cloud depth (ϕ). The diamonds show average concentrations from horizontal aircraft passes on 950915.

Fig. 16. Average drop size distributions (FSSP and 2D–C data) for horizontal passes at different levels on 950914 and 950915. The labels indicate the geometric height above sea surface (m msl) and the corresponding normalized cloud depth level (ϕ).

Fig. 17. Drop size distributions as functions of altitude on 950914 and 950915. From right to left, alternating heavy and thin lines indicate the differential concentrations for each of the 15 size bins used for the FSSP data (3 to 45 μm in 3–μm intervals) and for 5 size bins extracted from the 2D–C data (50–100 μm, 100–150 μm, etc.). In each panel, the dashed lines are the first and second FSSP size bins, respectively.

Fig. 18a. Profiles of variance and skewness for aircraft–measured vertical winds (w, asterisks and diamonds) and radar Doppler velocities (V, + signs) on 950914. Diamonds refer to vertical wind

data from horizontal aircraft passes, while asterisks refer to data from ascents and descent soundings. The Doppler velocities are from a data segment of approximately 5 km length.

Fig. 18b. – as Fig. 18a, but for 950915.

Fig. 18c. – as Fig. 18a, but for 950916.

Fig. 19. The relationship between droplet concentration and vertical air velocity during level flight segments within clouds. Each point in the upper panels is a sample from approximately 10 m horizontal distance. The histograms in the lower panels show the droplet concentrations associated with air velocities differing from the means by more than 0.5 standard deviation.

Fig. 20. Spectral and cospectral densities for radar reflectivity (Z) and Doppler velocity (V) as functions of altitude on 950914 and 950916. Data are from 5 to 20–km segments of up–looking radar data. In the first two panels the contour values are base–10 logarithms of spectral density; in the third panel the contour values are actual cospectral densities. The red–to–violet color progression corresponds to a numerical progression from positive to negative.