Clouds First Report Altostratus/Stratocumulus deck over Boulder, CO

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Assignment: Clouds First
Course/Section: ATLS 4151
Cloud type: Altostratus / Stratocumulus
Capture date/time (local): Oct 10, 2025 10:25 AM
Location: Boulder, Colorado (40.0°N, 105.3°W)
Camera direction & angle: Facing W, ~45° above the horizon
Image URL: flowvis.org/2025/10/10/kai-hansen-3/

This image was made for the Clouds First assignment to document and analyze a post-frontal stratiform deck along the Front Range. My intent was to capture the sheeted, layered structure and basal texture characteristic of altostratus with stratocumulus elements, and relate those features to the synoptic regime following a cold frontal passage (stable, moist air with weak lift). Earlier false starts included higher-contrast exposures that clipped bright layers; the final frame balances highlight preservation with mid-tone texture.

- Location: Boulder, CO
- Direction / elevation: Camera pointed west toward the Divide at roughly 45° elevation
- Date & time: Oct 10, 2025 (*insert exact local time*)
- Weather context observed: Before: a cold front moved through. After: clouds remained present with calm surface winds.

The scene shows a continuous, gray mid-level sheet with subtle cellular patches: consistent with altostratus having stratocumulus embedded near its base. Such post-frontal environments commonly sustain broad stratiform layers via gentle ascent and residual moisture rather than deep convection (see foundational analyses of frontal systems and stratiform organization in Hobbs 1978 and Houze 1976).

To assess stability and expected cloud heights, I used the GJT (Grand Junction, CO) 18Z 08 Oct 2025 sounding. The profile indicates negligible convective instability (CAPE ~0) and a positive lifted index, i.e., a stable column favoring stratiform layers. The LCL near ~616 hPa (~4.0 km MSL) implies bases ~2.4 km AGL over Boulder, squarely mid-level and consistent with altostratus/stratocumulus. The moisture/temperature traces approach saturation aloft, supporting a layered deck with weak turbulent corrugation near the base. The persistence of the deck after frontal passage matches classic descriptions of post-frontal stratiform cloud shields and rainband remnants that become increasingly shallow and layered as forcing relaxes (Browning 1996; Hobbs 1978).

The basal texture, undulating, cellular features, points to turbulence driven by cloud-top radiative cooling and shear in a stratocumulus-topped layer. This mechanism and its mixed-layer dynamics are canonically treated by Lilly (1968) and validated by aircraft observations showing cloud-top cooling as the dominant buoyancy source and shear-modulated turbulence spectra (Nicholls 1984; Nucciarone & Rogers 1991). These processes imprint the familiar cellular patterning without requiring deep convection.

Bottom line: Expected cloud types for a stable, post-frontal setup are stratiform layers (St/Sc/As), which is exactly what appears in the image (Houze 1976; Hobbs 1978).

> **Closest skew-T used:** 72476 GJT — **18Z 08 Oct 2025** (University of Wyoming archive; chosen as the nearest standard-time profile broadly representative of upstream air feeding the Front Range).

- Camera: Apple iPhone 16 Pro (digital)
- Image size: 4233 × 2333 px (sRGB IEC61966-2.1)
- Lens: 6.765 mm focal (≈ 24 mm full-frame equivalent)

- Exposure: f/1.8, 1/120 s, Metering: Pattern, Exposure program: Normal
- Framing/approach: ~45° elevation to include the layered sheet and textured basal elements while avoiding horizon clutter; composition emphasizes tonal gradients across the deck.
- Processing: Global contrast + mid-tone adjustments; gentle highlight recovery to retain translucency in brighter bands; light clarity/texture to reveal Sc undulations. No local dodging/burning or compositing.
- Optional fields: Field of view and subject distance omitted (not critical for clouds).

The image reveals a post-frontal, stable stratiform sky where mid-level moisture forms a continuous sheet with shallow turbulent structuring at the base.
Strengths: Tonal balance preserves translucent layering alongside basal texture; the westward look suggests upstream feed over the mountains.
Limits: Without a solar reference or wider panorama, horizontal continuity and vertical extent are implied rather than explicit.
Fluid physics shown: Radiatively cooled, shear-influenced stratocumulus dynamics overlaying a broader stratiform sheet: classical mixed-layer behavior per Lilly (1968) and subsequent field observations (Nicholls 1984; Nucciarone & Rogers 1991).

Next steps: A short time-lapse or panorama would better capture advection and layer evolution; pairing with same-day 00Z/12Z soundings would tighten altitude estimates.

References

- **Hobbs, P. V.** (1978). *Organization and structure of clouds and precipitation on the mesoscale and microscale in cyclonic storms.* **Reviews of Geophysics, 16**(4), 741–755. AGU Publications
- **Houze, R. A., Jr.** (1976). *Dynamics and cloud microphysics of the rainbands in an occluded frontal system.* **Journal of the Atmospheric Sciences, 33**(10), 1921–1936. American Meteorological Society Journals
- **Lilly, D. K.** (1968). *Models of cloud-topped mixed layers under a strong inversion.* **Quarterly Journal of the Royal Meteorological Society, 94**(401), 292–309. Royal Meteorological Society+1
- **Nicholls, S.** (1984). *The dynamics of stratocumulus: Aircraft observations and comparisons with a mixed-layer model.* **Quarterly Journal of the Royal Meteorological Society, 110**(466), 783–820. Royal Meteorological Society

- **Nucciarone, J. J., & Rogers, D. P.** (1991). *Aircraft measurements of turbulence spectra in the marine stratocumulus cloud-topped boundary layer.* **Journal of the Atmospheric Sciences, 48**(22), 2382–2392. American Meteorological Society Journals

- **Turton, J. D., & Nicholls, S.** (1987). *A study of the diurnal variation of stratocumulus using a mixed-layer model.* **Quarterly Journal of the Royal Meteorological Society, 113**(475), 969–1009. Semantic Scholar

- **Browning, K. A.** (1996). *Variation of frontal and precipitation structure along a cold front.* **Quarterly Journal of the Royal Meteorological Society, 122**(536), 1845–1872. Royal Meteorological Society