WEATHER TO FLY

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"Modified Convergence Lines: The El Mirage Shear Line"

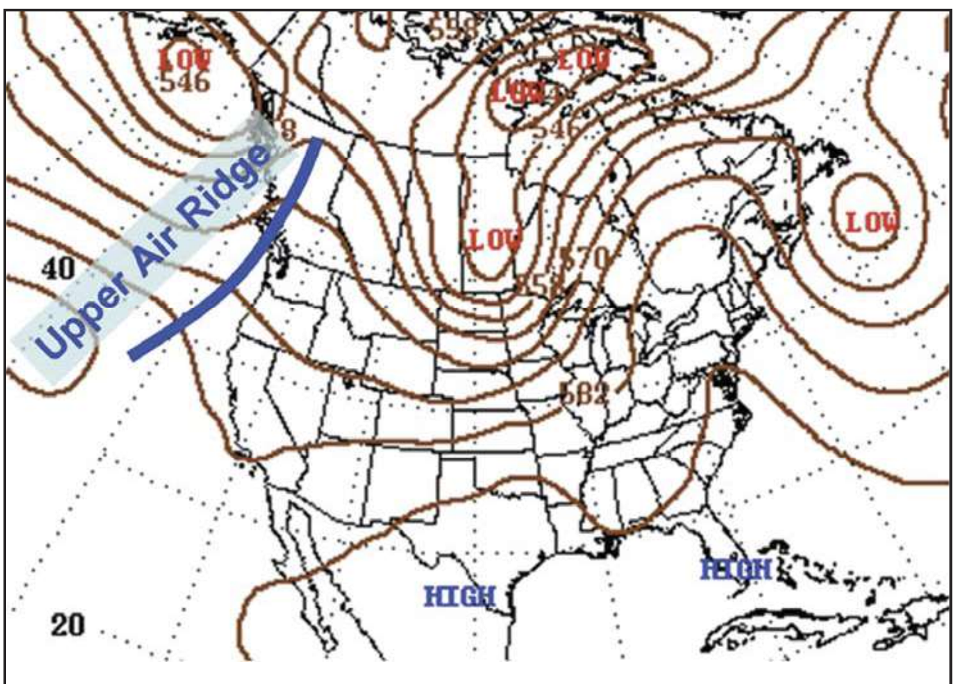
Differing wind speeds and/or wind directions can result in convergence of air and, subsequently, the development of lift useful for soaring flight. In previous discussions we have defined convergence lines and given examples of convergent lift in Sea Breeze Fronts, Terrain-induced Convergence Lines (*Tehachapi* and *Elsinore Shear Lines*), and Terrain-Channeled Convergence Lines (*Mono Lake* and the *Flying "M" Shear Lines*). However, one of the most historical and pronounced convergence lines is that of the "*El Mirage Shear Line*." Numerous articles and references have well-documented this steady, strong lift-producer across the Mojave Desert of Southern California, so this article is intended as a review and work toward a comprehensive listing of the types of convergence lift.

Understanding that air density differences result in pressure differences that subsequently establish pressure gradient forces resulting in inland air movement along coastlines, sea breeze effects on coastal plains can result in air movement well inland from that coastline air mass displacement. Such is the case of the El Mirage Shear Line. During the warm-season months along the Southern California Coast, a sea-breeze typically develops daily in response to late morning heating over the Los Angeles Basin and the Southern California Coastal Plain. The onset of the sea breeze along the coast generally results in passage of a classic sea-breeze front by 1:00 PM PDT about 10 miles inland through the vicinity of downtown Los Angeles with a continued push inland toward the Inland Empire by 3:00 PM PDT in the vicinity of Ontario (60 miles inland from the coast).

A classic sea breeze frontal passage typically is marked by a lowering in temperature (cooling), a change in the moisture content (increased dew points), and either a wind shift and/or an increase in the wind speed and increased gustiness of the wind field. Especially in regard to Southern California sea breezes, there is also a marked change in the visibility as the Los Angeles megalopolis leads to degraded visibilities with the sea breeze frontal passage.

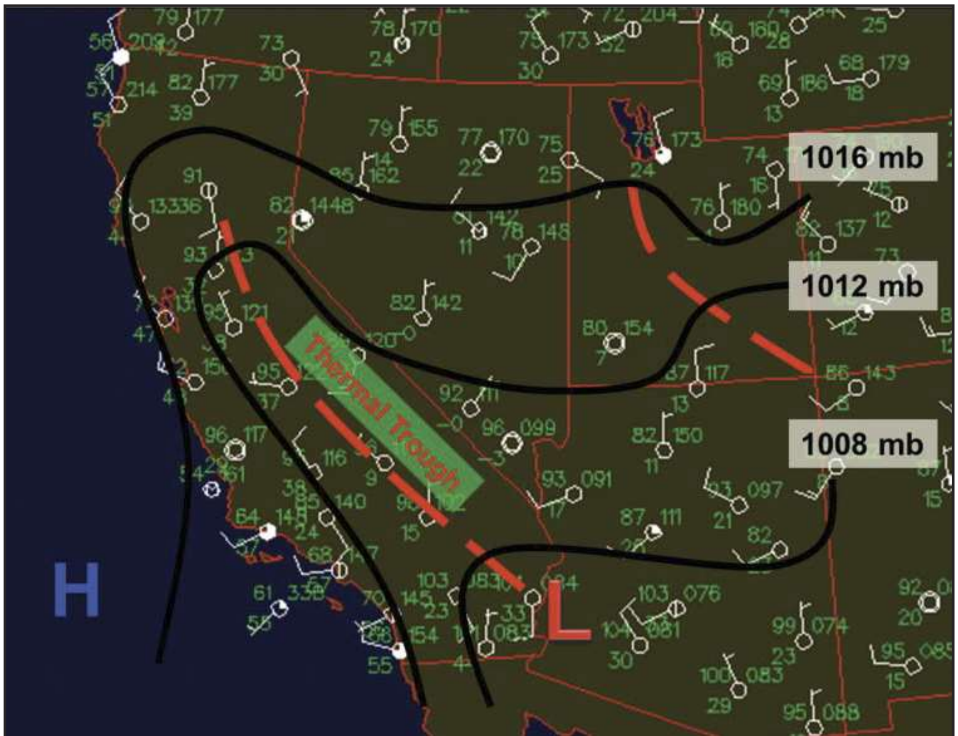
During the warm-season months along the West Coast of the United States with its Mediterranean Climate, High Pressure tends to dominate the upper air pattern over or just upstream of California (***See Chart #1: Upper Air 500 Mb Pressure Level; June 11, 2012).*** When High Pressure dominates the upper air pattern, only small, diurnal or day-to-day changes tend to occur in the mean sea level (MSL) pressure field over Southern California. Intense surface heating in the deserts of Southern California by the late morning hours results in a lowering of surface pressure in Mojave Desert due to the decrease in air density immediately adjacent to the superheated desert ground, i.e., establishment of thermal low pressure. Thermal low pressure is often depicted on Surface Pressure Charts as a trough axis of low pressure through Interior Central California that extends into the Desert Southwest of the United States ***(See Chart #2: Surface Pressure Chart; June 11, 2012)***. MSL pressure over the western Los Angeles Basin compared to the MSL pressure over the Mojave Desert by late morning hours results in a well-defined onshore pressure gradient.

By early afternoon, as mentioned, the sea breeze is already underway on the coastal plain and pushing through the Los Angeles Basin on its way through the "Inland Empire" around Ontario, Riverside, and San Bernardino. However, this push of air through the L.A. Basin associated with the classic sea breeze reinforces the widespread pressure gradient toward the inland desert region of California as the inland thermal low deepens and intensifies with continued daytime heating. The lowest MSL pressure from thermal heating develops over the area of strongest heating, i.e., the Mojave Desert. Subsequently with this intense heating over the Mojave Desert, air begins to move inland through the passes of Southern California into the desert regions. Specifically, air is pulled into the Mojave Desert through Cajon



Upper Air 500 Mb Pressure Level; June 11, 2012

Pass which separates the San Bernardino Mountains and the San Gabriel Mountains of California, Soledad Pass located in the San Gabriel Mountains, and air from the San Joaquin Valley also begins to flow through the Tehachapi Pass and onto the floor of the northern Mojave Desert around the town of Mojave (***See Diagram #1: Initial Mojave Desert Shear Line Development***). In a diurnal cycle, the air in the Mojave Desert during the late morning hours is relatively calm or light. However, the air being pulled into the desert sets up areas of speed convergence and subsequent "lift lines" develop where this incoming air begins to interact with the "calm" desert air. The air flowing through the Cajon Pass initially forms the well-defined "El Mirage Shear Line" that sets up in an arc from just east of Pearblossom, arching toward El Mirage Dry Lake, and then to the area south of Victorville (***Reference Diagram #1: Initial Mojave Desert Shear Line Development***). Simultaneously or soon thereafter, convergence lines also begin to appear on the Mojave Desert side of Soledad and Tehachapi Passes due to the intensifying pressure gradient. Depending on local pressure gradient forces, sometimes these desert shear lines will remain quasi-stationary over the desert floor through mid-afternoon thereby providing a long-lasting source of convergence lift for the El Mirage area and in proximity to other passes into the desert. However, the convergence or shear lines will eventually push into the desert deeper and subsequently provide a general west-southwest wind flow over the Mojave Desert by late in the afternoon (***See Diagram #2: Mojave Desert Late Afternoon Wind Flow***).

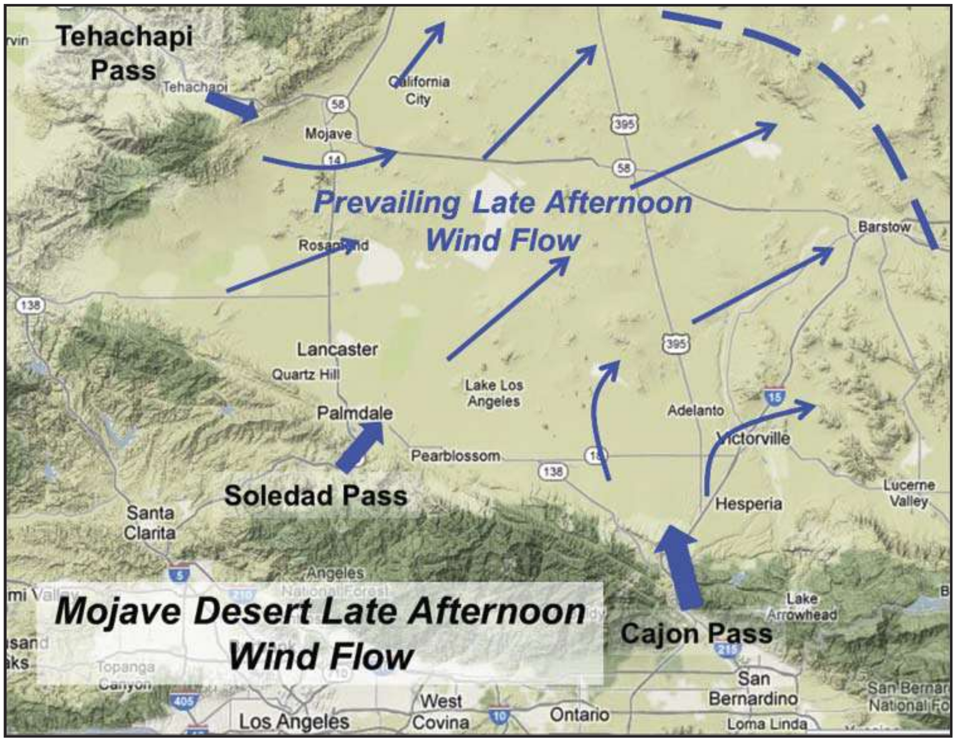


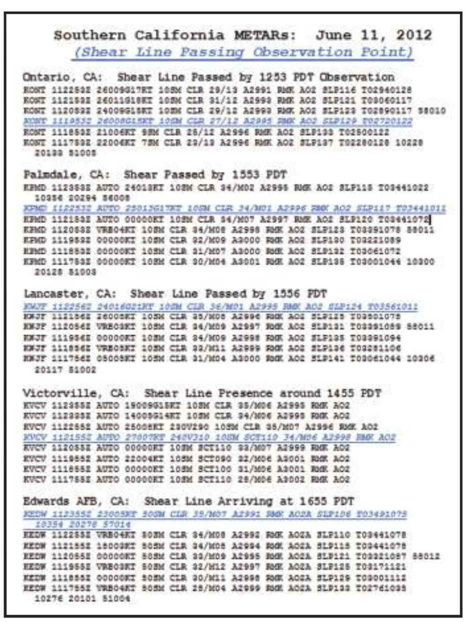
Surface Pressure Chart; June 11, 2012

Reference the METAR weather observations for the Inland Empire and Mojave Desert locations at Ontario(ONT), Palmdale(PMD), Lancaster(WJF), Victorville(VCV), and Edwards Air Force Base(EDW) on June 11, 2012. A classic sea breeze would reflect pressure differences providing the pressure gradient force, a drop in temperatures, a rise in dew point temperatures, wind speed, gust, and direction changes, and an air mass acuity change. The inland moving air from the L.A. Basin into the Mojave Desert may not exhibit all the features of the classic sea breeze. However, at least one if not all the above characteristics does certainly exist to show the change in overall low-level air mass characteristics with shear line passages. Note the "highlighted blue" METARs that indicated the arrival of a shear line at the observation location (***See Text Box: Southern California METARs***). The air that is pulled into the desert is not true marine air as its arrival timing is too early for its source region to be that from the coast, nor does it have the temperature and moisture characteristics of a marine environment. Certainly the wind speed, gust factor, and direction change along with a visibility degradation does occur with shear line passage. Thermal strength is enhanced on the shear line with the convergence. The temperature does not drop appreciably immediately at the shear line location, but cool air advection is occurring behind the shear line and thermal strength becomes weaker and more diffuse with time in comparison to the thermal field in front of the shear line. Sometimes the moisture field ahead of the desert shear lines depicts the convergence lift with cumulus clouds while the air behind the shear lines reflects the weaker lift conditions marked by cloud-free areas (***See Visible Satellite Image: Mojave Desert Shear Lines Marked by Cloud Lines; March 23, 2000; 22Z***).

In years spent forecasting for the Region 12 Competition Soaring Contests at California City, thermal strength generally could be reasonably predicted for tasking purposes. But the presence of shear lines dramatically influenced thermal strengths due to the assistance of the uplift due to convergence. It is was not uncommon for soaring pilots to report that lift rates in thermals in convergence along the El Mirage Shear Line exceeding 1500 feet per minute (fpm) compared to lift rates over the general Mojave Desert averaging only 500 to 800 fpm. Furthermore, competition tasks that penetrated the shear lines behooved competitors to consider avoiding flight in the weaker thermal environment behind the shear line in favor of "running the shear line" with its strong, dependable lift even if the flight path resulted in an arc between task points. Aforementioned, slight changes in the alignment and strengths of the pressure gradients over the Southern California area from day-to-day resulted in significant changes in the initial arrival, movement, and speed of the shear line(s) as it was pulled into the desert from the pass(s).

Again, I want to underscore that the air mass arriving on the Mojave Desert floor is not marine in nature. The air has been modified to reflect source regions over inland Southern California areas even as its initial push inland toward the desert may have been encouraged from the more classic (marine) sea breeze push at the coast. The El Mirage Shear Line essentially develops due to density differences from the Inland Empire source region versus that of the Mojave Desert. The convergence at the El Mirage Shear Line is a result of the modification of the same driving parameters associated with a sea breeze even though the convergence line is occurring much farther inland.




Southern California METARs: June 11, 2012
(Shear Line Passing Observation Point)

Ontario, CA: Shear Line Passed by 1253 PDT Observation
KONT 112253Z 26009G17KT 10SM CLR 29/13 A2991 RMK AO2 SLP116 T02940128
KONT 112153Z 26011G18KT 10SM CLR 31/12 A2993 RMK AO2 SLP121 T03060117
KONT 112053Z 24009G16KT 10SM CLR 29/12 A2993 RMK AO2 SLP123 T02890117 58010
KONT 111953Z 26008G15KT 10SM CLR 27/12 A2995 RMK AO2 SLP129 T02720122
KONT 111853Z 21006KT 9SM CLR 25/12 A2996 RMK AO2 SLP133 T02500122
KONT 111753Z 22006KT 7SM CLR 23/13 A2996 RMK AO2 SLP137 T02280128 10228
20133 51005

Palmdale, CA: Shear Passed by 1553 PDT
KPMD 112353Z AUTO 24018KT 10SM CLR 34/M02 A2995 RMK AO2 SLP115 T03441022
10356 20294 56008
KPMD 112253Z AUTO 25013G17KT 10SM CLR 34/M01 A2996 RMK AO2 SLP117 T03441011
KPMD 112153Z AUTO 00000KT 10SM CLR 34/M07 A2997 RMK AO2 SLP120 T03441072
KPMD 112053Z VRB04KT 10SM CLR 34/M08 A2998 RMK AO2 SLP123 T03391078 58011
KPMD 111953Z 00000KT 10SM CLR 32/M09 A3000 RMK AO2 SLP130 T03221089
KPMD 111853Z 00000KT 10SM CLR 31/M07 A3000 RMK AO2 SLP132 T03061072
KPMD 111753Z 00000KT 10SM CLR 30/M04 A3001 RMK AO2 SLP135 T03001044 10300
20128 51003

Lancaster, CA: Shear Line Passed by 1556 PDT
KWJF 112256Z 24016G21KT 10SM CLR 36/M01 A2995 RMK AO2 SLP124 T03561011
KWJF 112156Z 26005KT 10SM CLR 35/M08 A2996 RMK AO2 SLP125 T03501078
KWJF 112056Z VRB03KT 10SM CLR 34/M09 A2997 RMK AO2 SLP131 T03391089 58011
KWJF 111956Z 00000KT 10SM CLR 34/M09 A2998 RMK AO2 SLP135 T03391094
KWJF 111856Z VRB05KT 10SM CLR 33/M11 A2999 RMK AO2 SLP136 T03281106
KWJF 111756Z 05005KT 10SM CLR 31/M04 A3000 RMK AO2 SLP141 T03061044 10306
20117 51002

Victorville, CA: Shear Line Presence around 1455 PDT
KVCV 112355Z AUTO 19009G18KT 10SM CLR 35/M06 A2995 RMK AO2
KVCV 112335Z AUTO 14005G14KT 10SM CLR 34/M06 A2995 RMK AO2
KVCV 112255Z AUTO 25008KT 230V290 10SM CLR 35/M07 A2996 RMK AO2
KVCV 112155Z AUTO 27007KT 240V310 10SM SCT110 34/M06 A2998 RMK AO2
KVCV 112055Z AUTO 00000KT 10SM SCT110 33/M07 A2999 RMK AO2
KVCV 111955Z AUTO 22004KT 10SM SCT090 32/M06 A3001 RMK AO2
KVCV 111855Z AUTO 00000KT 10SM SCT100 31/M06 A3001 RMK AO2
KVCV 111755Z AUTO 00000KT 10SM SCT110 28/M06 A3002 RMK AO2

Edwards AFB, CA: Shear Line Arriving at 1655 PDT
KEDW 112355Z 23005KT 50SM CLR 35/M07 A2991 RMK AO2A SLP106 T03491075
10354 20278 57014
KEDW 112255Z VRB04KT 50SM CLR 34/M08 A2992 RMK AO2A SLP110 T03441078
KEDW 112155Z 18003KT 50SM CLR 34/M08 A2994 RMK AO2A SLP115 T03441078
KEDW 112055Z 00000KT 50SM CLR 33/M09 A2995 RMK AO2A SLP121 T03321087 58012
KEDW 111955Z VRB03KT 50SM CLR 32/M12 A2997 RMK AO2A SLP125 T03171121
KEDW 111855Z 00000KT 50SM CLR 30/M11 A2998 RMK AO2A SLP129 T03001112
KEDW 111755Z VRB04KT 50SM CLR 28/M04 A2999 RMK AO2A SLP133 T02761035
10276 20101 51004