Compare and contrast summer heat wave versus strong delta breeze

viii. summer heat wave

description: persistent high temperatures

criteria: >100 F for at least 3 days, at least 1 day must be >105 F

samples: 42 (17 at 850 mb)

synoptic situation: occurs in summer. Need to develop offshore flow. The winds need not be calm, but are usually fairly light.

SLP: The climatological pattern is for a large high to be centered off the west coast and a thermal low to be centered near or in AZ. This pattern sets up large scale, geostrophic northerlies over the region. Slight shifts in the relative positions and shapes of these two centers can determine if the wind has a westerly easterly component as well. However, those shifts are precisely what tips the balance between sea breeze and heat wave. For the heat wave pattern shown here, notice that the isobars over northern CA have an east-west orientation, suggesting that the ageostrophic wind tends to have a northerly component. Hence the surface winds will tend to be northerly, and hot. Notice also that the gradient is fairly weak, implying weak winds. A flow from the north will also have some subsidence warming. See fig.

850 mb: a large high is centered off CA coast, with N or NE flow over the region. The thermal low is roughly in the four corners area. The result is a northerly flow with a weak offshore component. See fig.

500 mb: the warm temperatures occur through a considerable depth, hence the upper levels have a high over CA or NV. Max heights should be >5920 m during intense episodes. The 5880 contour often extends into WA and covers most of the western U.S. Upper level winds will are light. See fig.

ix. summer sea breeze ("delta breeze")

description: the cooler periods of the mid-summer season that may or may not be due to a (weak) front passage.

criteria: wind direction at SAC (or SMF) between 180-260^{o} ; wind speed ≥15 kts; maximum T >10 F cooler on day of the event than the previous day.

samples: 32 (21 at 850 mb)

synoptic situation: occurs in summer. Need to develop an onshore flow of sufficient strength to reach past the forecast city (e.g. Sacramento). A shift in wind direction is not sufficient if the winds remain weak or do not persist long enough (e.g. >12 hrs) to bring in air from the Pacific. (Generally, the winds are higher in the delta).

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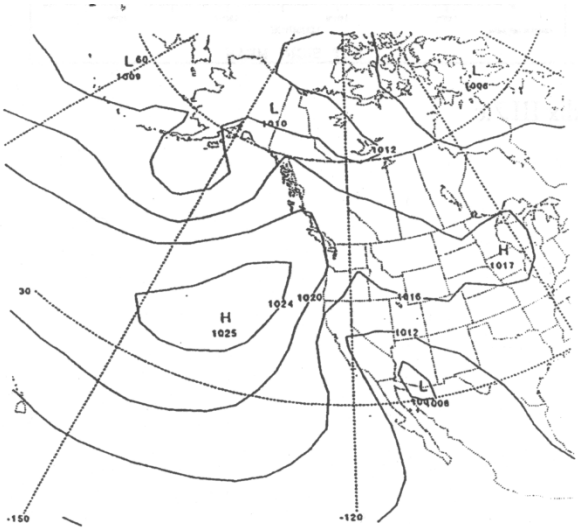
to have a westerly component. Hence while the large scale surface winds will tend to be northwesterly, and topography channels cool air from the Pacific to create SW winds in the Sacramento valley and NW winds in the San Joaquin. Notice also that the gradient is stronger than for the heat wave, implying stronger winds. It is difficult to see in the composite figures but the trough axis may be further inland (possibly in NV) than in the heat wave case (where it is near of off the coast).

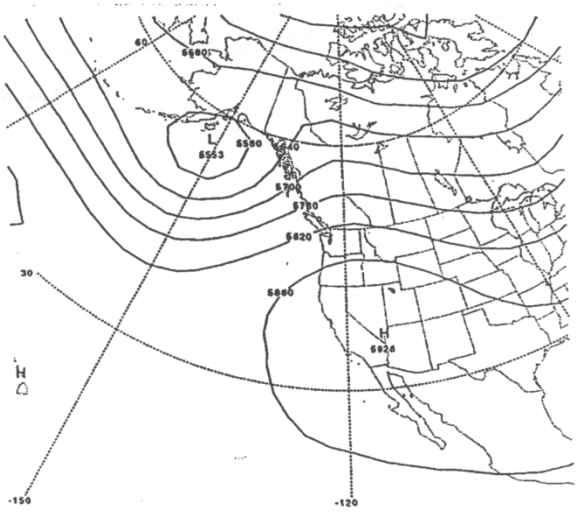
850 mb: The difference from the heat wave case is a bit more noticable in the 850 map than the SLP map. The high is a bit further off the coast and the thermal low has moved to the northern Great Basin (e.g. ID). This makes the northerly flow have a component onshore.

500 mb: The differences from the heat wave situation are even more pronounced at 500 mb. The composite figure shows a weak trough approaching CA. Associated with such a trough will be PVA that, even though it is weak, allows vertical mixing of the cooler air (referred to locally as "deepening of the marine layer"). Accompanied by the change to an onshore component at lower levels, this situation brings a deep layer of cool air inland, accentuating the cooling. See fig.

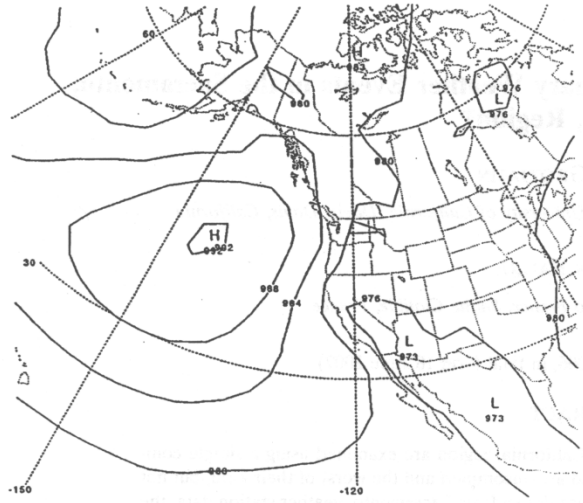
Composite maps of SLP and 500 hPa geopotential height for heat waves and strong delta breezes are on the next page. While the SLP changes are subtle, the upper air and temperature patterns are somewhat reversed between the two situations (as are the surface winds).



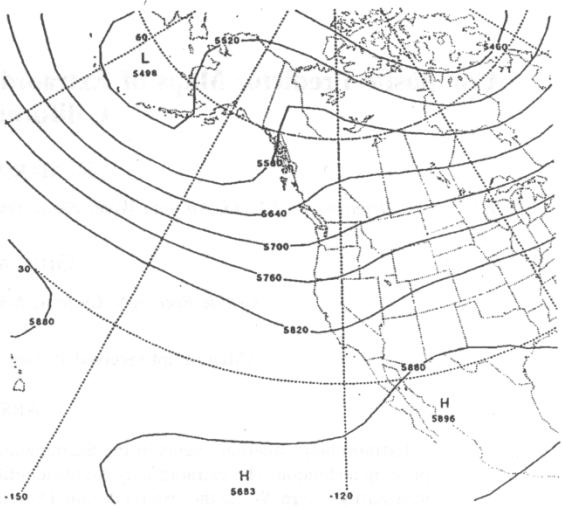
SLP FOR SUMMER HEAT WAVE



MEAN 500 MB PATTERN SUMMER HEAT WAVE



MEAN SLP FOR DELTA BREEZE



500 MB -

SEA BREEZE