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WIND DIVERGENCE FORCING OF THE CLOUDINESS ALONG THE CALIFORNIA COAST

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1. INTRODUCTION

Numerical experiments were made using Mesoscale Model 5 (MM5) with a horizontal resolution of 9 km to simulate the sea level winds, and wind divergence along California and Northern Baja California for all of June 1996. In addition, a nested domain with a 3 km grid was done of the area around Point Conception that extended along the coast from Point Sur to Los Angeles. The MM5 setup included mixed-phase moisture, Grell cumulus, cloud radiation and Gayno-Seaman boundary layer effects. Further details may be seen in Koračin and Dorman (2001).

A strong, low level atmospheric inversion capes an atmospheric marine layer warm season along the California's. This layer supports hydraulic dynamics of super critical flow (Winant et al. 1988; Samelson 1992; Dorman et al. 1999; Dorman et al. 2000 and others), and transcritical flow (Rogerson 1998; Dorman and Winant 2000). A pronounced layer effect is the interaction of the marine layer moving past a cape or bend in the coast. A compression bulge forms on the upwind side where in the marine layer slows and the marine layer thickens. An expansion fan forms on the downwind side, where the marine layer accelerates and thins. In an examination of the Northern and Central California coast, Koračin and Dorman (2001) show that these compression bulges are associated with sea level convergence and expansion fans are associated with sea level divergence. These features dominate the inner 100 – 200 km of the coastal zone. The case is re-examined here with a smaller grid separation and geographical coverage that extends from the Oregon Border to mid-Baja California.

2. WIND ALONG CALIFORNIA AND BAJA CALIFORNIA

The surface wind field (Fig. 1) has a large, California scale wind maximum extending from Cape Mendocino in Northern California to past Point Conception in Southern California. Edwards (2000) established that this feature is a California scale expansion fan associated with the bend in the Northern California coast. The southern California Bight has weak and generally westerly winds starting at the East end of the Santa Barbara Channel and extending past San Diego. A little farther south, northerly winds are re-established, resulting in moderate winds along Baja California. Faster winds are in the immediate Baja California lees. Islands in weaker wind areas have banner tails of very weak winds.

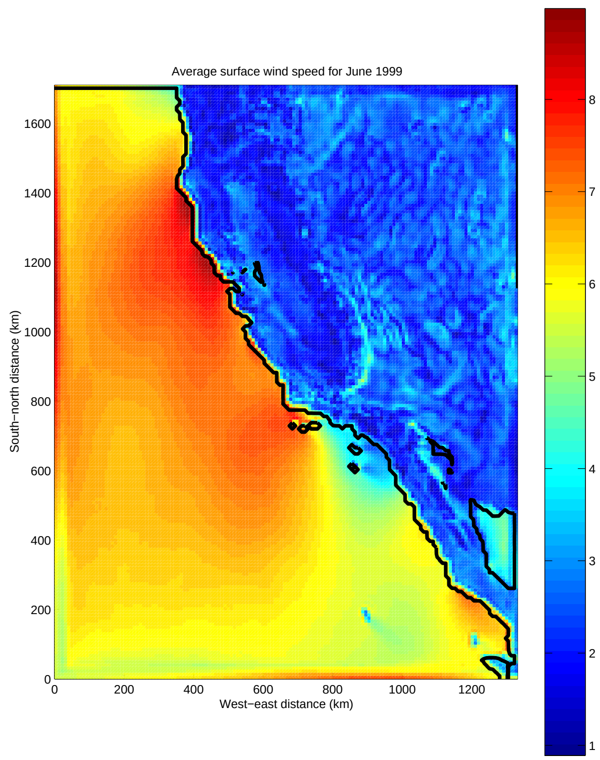

Figure 1. 10-m winds for June 1999.

The wind divergence field is dominated by couplets of convergence and divergence centered about each major cape (Fig 2). This extends along Baja California. The convergence zones are due to slowing sea level winds in a compression bulge while the divergent zones are due to accelerating winds in an expansion fan.

3. WIND AND WIND DIVERGENCE ABOUT POINT CONCEPTION

Three-km grid modeling was about Point Conception, California. Presented are the June 1-4, 1999 averages. This smaller scale reveals the extensive structure in the 10-m winds (Fig. 3) and the 10-m wind divergence (Fig. 4).

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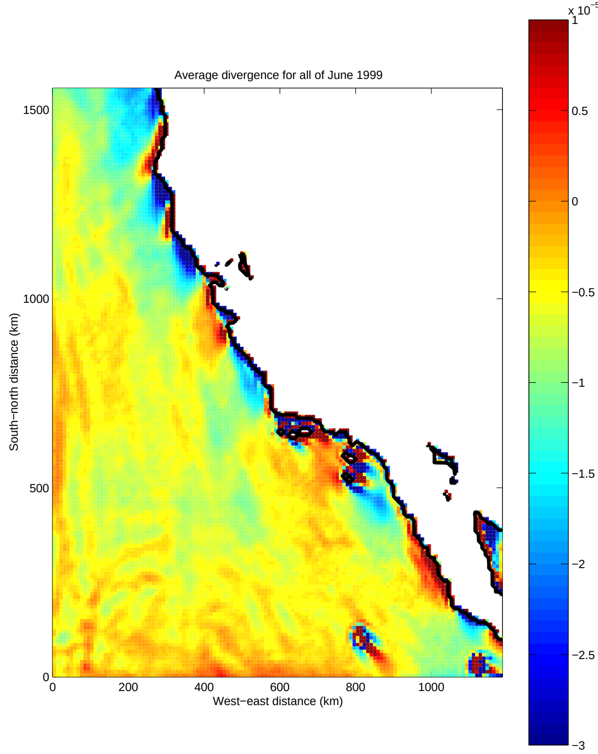

Figure 2. 10-m wind divergence for June 1999.

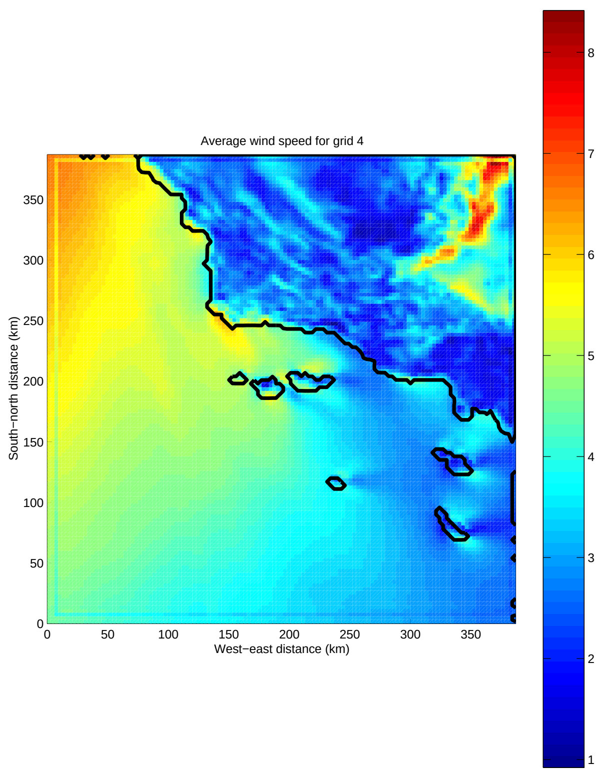

Figure 3. 10-m winds for 1-4 June 1999 with 3-km grid.

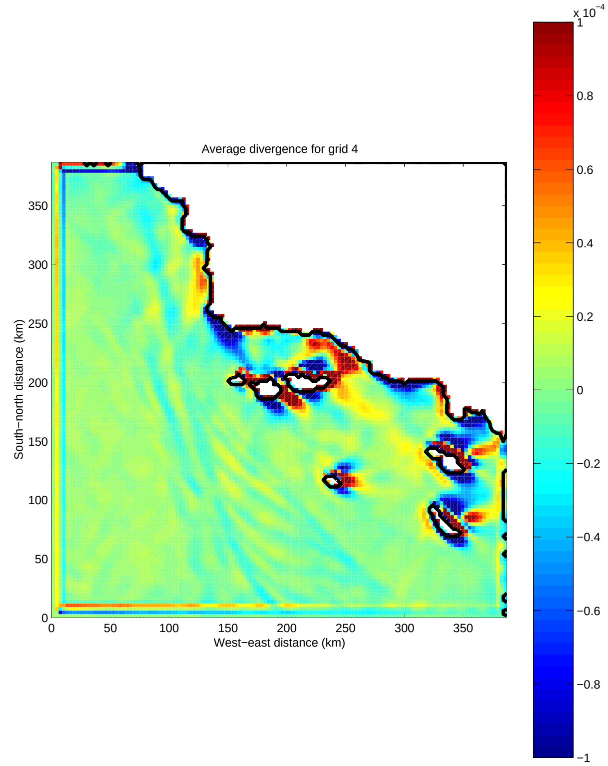

Figure 4. 10-m divergence for 1-4 June 1999 with 3-km grid.

A small compression bulge is on the immediate, upwind side of Point Conception, the largest coastal point that is near the center of the figure. The small area wind speed maximum on the tip of Point Conception and extending to the SE is an expansion fan in the western mouth of the Santa Barbara Channel. Most of the remainder of the Bight has weaker winds. In the close lee of islands, there is a "V" shaped wind maximum pointing downwind a short distance. In the center of the V is a wind minimum that extends much farther downwind.

The corresponding wind divergence field maxima & minima are much more greatly concentrated about the centers of the wind speed maxima and militia. For divergence and winds, the island disturbed lee trails can extend to the coast.

4. CLOUDS AND DIVERGENCE

Satellite detected cloud albedo is inversely related to the divergence (Koračin and Dorman 2001). The faster wind speeds in expansion fans causes the marine layer to diverge, thin and reduce the marine cloud cover. In contrast, slower wind speeds in compression bulges cause the marine layer to thicken and promotes more cloud cover. Thus, the upwind side of capes with compression bulges tend to have greatest albedo while the downwind expansion fans have the least albedo. Persistent clear areas are usually associated with the fastest marine layer speeds in an expansion fan in a lee of a cape during the warm season.

4. CONCLUSIONS

Atmospheric marine layer hydraulic effects cause important structures in the 10-m wind and wind divergence field along California and Baja California. Large compression bulges and expansion fans form about each major cape and smaller ones about smaller capes.

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