P5.11 TOPOGRAPHIC DISTORTION OF A COLD FRONT OVER THE SNAKE RIVER PLAIN AND CENTRAL IDAHO MOUNTAINS

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1. INTRODUCTION

A major roadblock to advancing our knowledge and prediction of cyclone and frontal evolution over the Intermountain West has been a lack of high spatial and temporal resolution observations. The conventional NWS/FAA/DoD surface aviation network lacks sufficient resolution to resolve many regional topographic effects, and since many aviation network observing sites are located in valley locations, large-scale airmass and circulation changes are often obscured by near-surface temperature inversions and local terrain-induced flows. In the past decade, however, the density of surface observations over the western United States has increased due to the development of meteorological networks owned and managed by a variety of federal, state, and local agencies, as well as private firms. Since 1996, data from a growing number of these networks has been gathered by MesoWest, a collection of cooperating mesonets that provide real-time observations from more than 2500 locations (http://www.met.utah.edu/mesowest).

2. CASE STUDY

MesoWest observations were used to examine the evolution of a cold front over southern and central Idaho on 3 December 1998 (Figs. 1 and 2a-e). Although relatively unperturbed upstream of central Idaho, the cold front became distorted as it was deflected and accelerated up the low-elevation Snake River Plain (SRP) where a pronounced frontal bulge developed. The speed of the cold front over the SRP was comparable to the magnitude of the postfrontal winds. A low-level jet was located directly behind the frontal bulge, oriented normal to the cold front, and appeared to be terrain channeled (Fig. 2f). A pre-frontal wind maximum was also observed. Meanwhile, the front advanced more slowly over the central Idaho mountains and southwest Montana, becoming increasingly diffuse over the former. Eventually, cold air surrounded the central Idaho mountains and the two portions of the cold front merged over eastern Idaho.

Although initially marked at Boise (BOI) by a wind shift and gradual change in temperature (Fig. 3a), the front developed the local character of a gravity current over the south-central SRP where strong temperature falls and pressure jumps were observed at Pocatello (PIH, Fig. 3b). Estimates of gravity-current speed, however, were found to be ambiguous over the central SRP and the frontal velocity over the eastern SRP was not consistent with that predicted by gravity-current theory (not shown). Thus, instead of being controlled by gravity-current dynamics, the frontal evolution over the SRP appeared to be controlled by the terrain-induced flow field, with the amplification and acceleration of the frontal bulge the result of advection by the terrain-channeled winds within the SRP.

3. CONCLUSIONS

The case study illustrates the value of high-resolution and multi-elevation MesoWest observations for advancing knowledge of frontal evolution over the western United States and improving operational surface analysis. Such observations aid in the identification of large-scale airmass and circulation changes that can be masked at low-elevation sites by boundary layer processes, valley inversions, and local and mesoscale terrain-induced wind systems. During the 3 December 1998 event, MesoWest observations illustrated the topographic distortion of a cold front by the central Idaho mountains and Snake River Plain. A paper describing this work in more detail is available at http://www.met.utah.edu/jimsteen/personal/idfront.pdf and will appear this year in *Weather and Forecasting*.

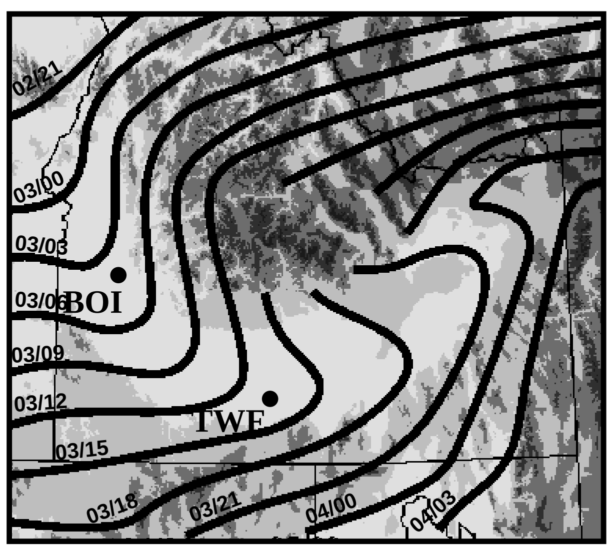

Figure 1. Isochrones of the surface cold-front position at 3-h intervals from 2100 UTC 2 Dec to 0300 UTC 4 Dec 1998.

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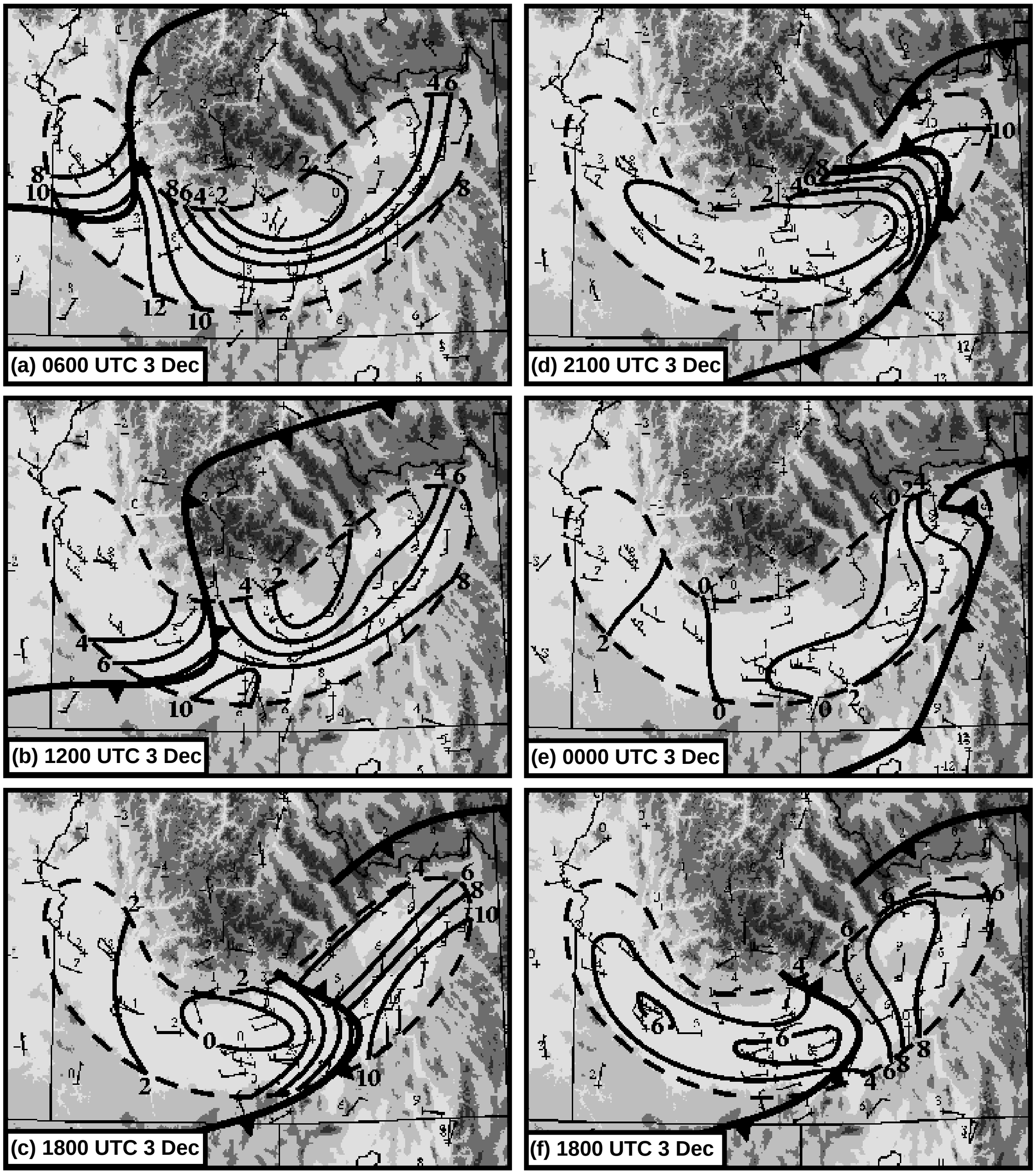

Figure 2. Frontal (conventional) and surface isotherm (every 2 C) analyses at (a) 0600 UTC 3 Dec, (b) 1200 UTC 3 Dec, (c) 1800 UTC 3 Dec, (d) 2100 UTC 3 Dec, and (e) 0000 UTC 4 Dec 1998. (f) Frontal and surface isotach (every 2 m s^{-1}) analyses at 1800 UTC 3 Dec 1998.

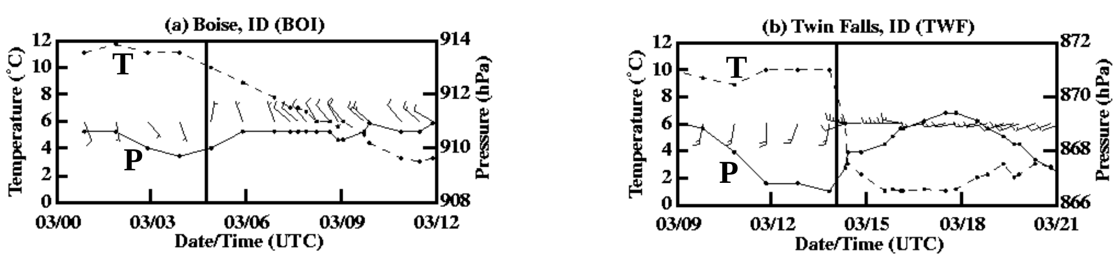

Figure 3. Meteograms from (a) Boise, ID (BOI) and (b) Twin Falls, ID (TWF). Locations depicted in Fig. 1).