

## **ANALYSIS OF COLD AIR PONDING AT THE DEVILS POSTPILE NM. METHODS AND RESULTS.**

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### **Methods**

Jessica Lundquist and others have developed an automated method for classifying cold air pooling (CAP), using digital elevation model (DEM) grids. For convenience, they use standard algorithms and code in MatLab, which will import and process DEM grids from ArcInfo. Their classification was based on percent slope, percentage, and curvature. For percentage and curvature, they used a reference radius. For convenience, they defined the radius as half the distance between peaks on opposite sides of the area of interest. However, other values for reference radii can be used. Percentage is defined as percent of elevation grid points within the reference radius lower than each grid cell. Curvature is based on elevations relative to the elevation at each grid cell within the reference radius. So cells with a positive curvature will be on peaks and ridges and those with negative curvature will be in bowls and valleys. Lundquist and others defined any point with a slope greater than 30° and/or curvature greater than zero as no CAP. For points with slope greater than 30°, CAP was further classified by the line: percentile =  $1/60 \times \text{slope} + 0.5$ . Points above the line were defined as no signal; points below the line were defined as CAP. CAP classifications were further refined by the topographic amplification factor (TAF). For TAF, consider a box through the cross section of a valley with height as the depth of the valley and width as the top width of the valley. TAF is defined as the ratio of the cross sectional area of the valley to the total area of the box. A V-shaped valley will have high TAF and a U-shaped valley, low TAF. As one moves down-valley, if TAF decreases, cold air will drain. But if TAF increases, cold air will accumulate, intensifying CAP.

### **CAP Analysis of Devils Postpile (DEPO)**

For CAP analyses, we used a DEM that covered nearly the entire watershed of the middle fork of the San Joaquin River and extended from the city of Mammoth Lakes to the east to around Iron Mountain to the west (small box in Fig. 1; the extent covering San Joaquin watershed in the Sierra Nevada is shown for reference). Four peak-to-peak or valley wall distances were selected, giving radii that ranged from 2020 to 944 m. Results for the 1289 and 944 m are shown in Fig 2. Patterns in the results are not radically different, although the smallest radius shows more fine-scaled patterns. Graph (a) shows contour intervals of elevation from the DEM. Light blue circles indicate peak or valley wall pairs used to compute the reference radii. Graph (b) shows degree slope, while (c) shows patterns in percentile (the min channel to the San Joaquin is clearly indicated); curvature is not shown. The estimated CAP classifications are on graph (d); these are numerically classified as 0-0.5 no CAP, 0.5-1.0 no signal, and 1.0-1.5 CAP\*. These show extensive potential for cold air ponding in the Middle Fork canyon, passing through DEPO. Moreover, potential CAP in the two canyons to the west of DEPO suggests that cold air drains from these into the main canyon.

01/09/2009

\*Numerical intervals are arbitrary and are intended for use in the 'temperature' style legend. These are not the classification and are not intended to indicate temperature. The classification is done to indicate the likelihood of cold air accumulation.

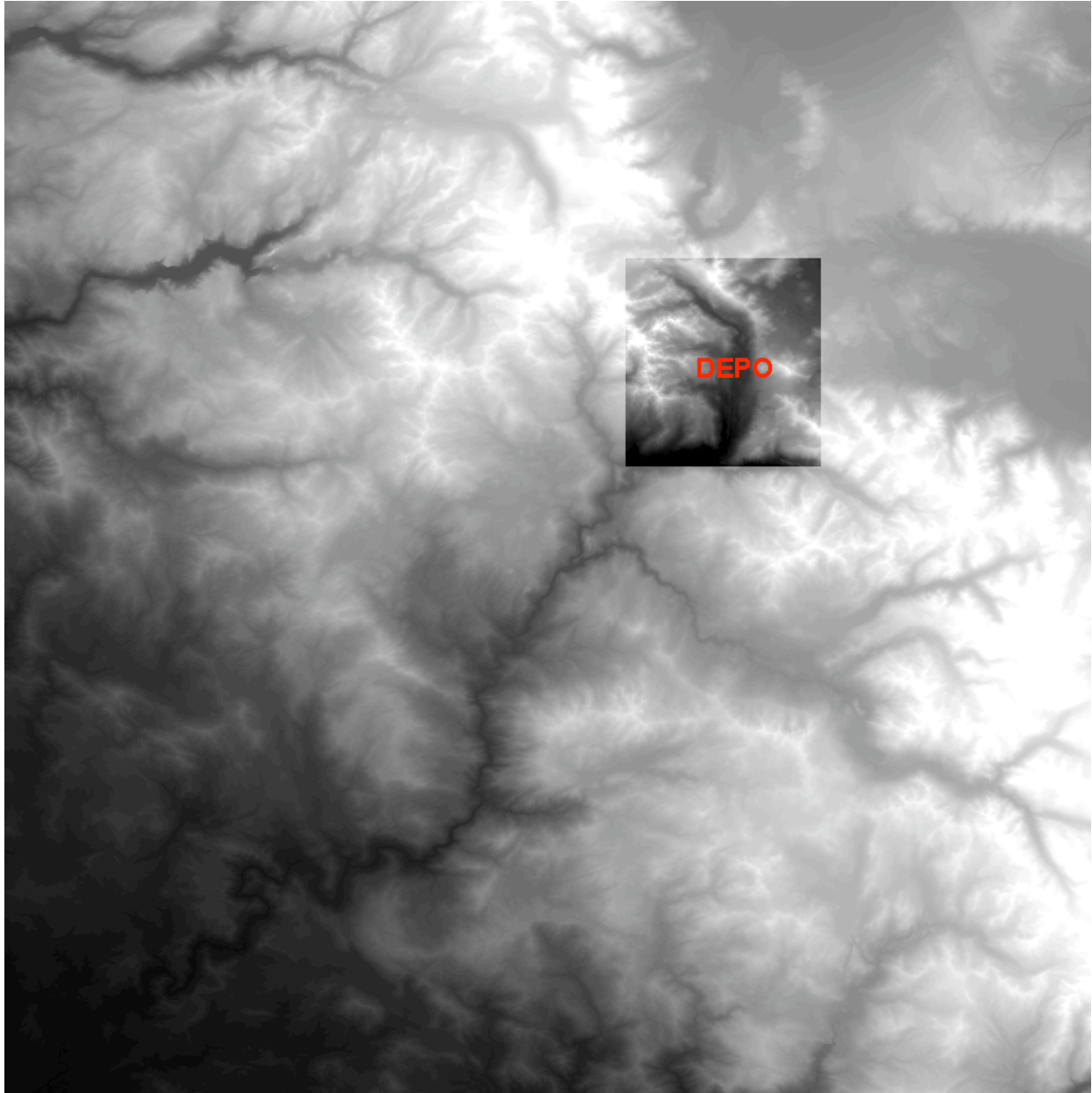
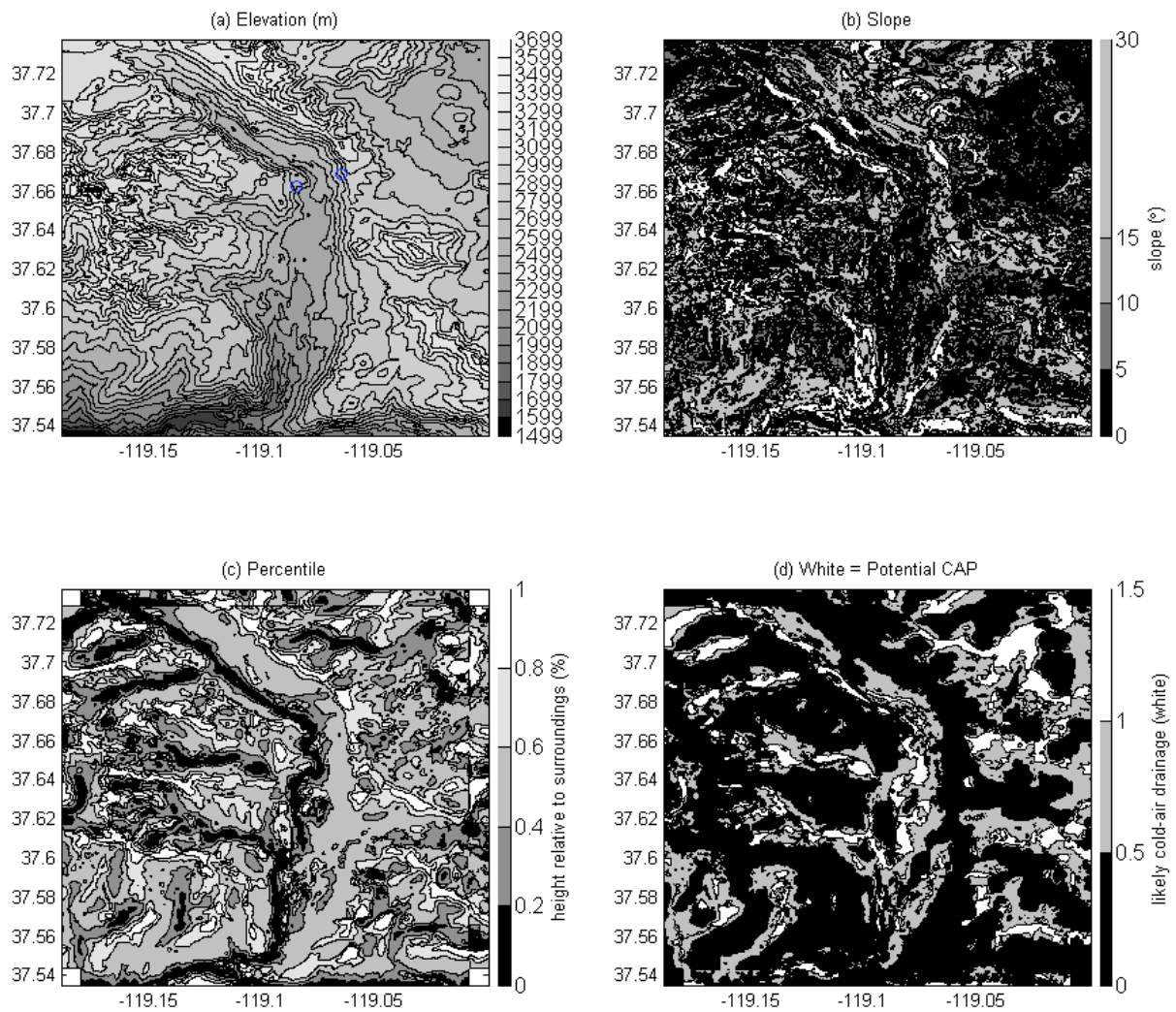


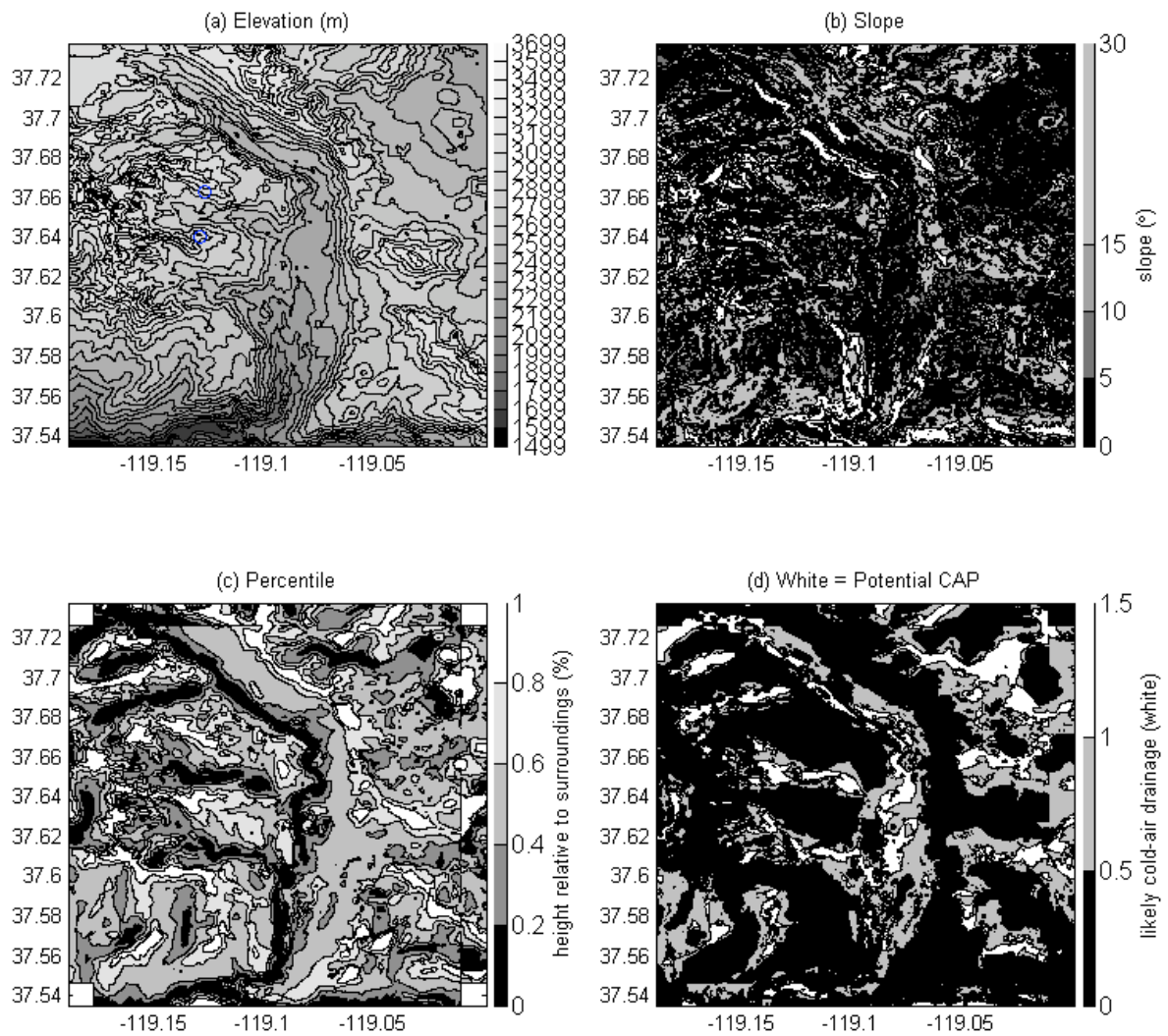
Figure 1. DEM image of the San Joaquin watershed in the Sierra Nevada. Inset image is of the DEM used for the CAP analysis of DEPO. The label is centered over the location of the headquarters complex for National Monument.

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i. 944 m raduis

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ii. 1289 m radius

Figure 2. CAP analyses results. Analyses using 944 m (i) and 1289 (ii) radii.

**Precipitation patterns in the San Joaquin River watershed in the Sierra Nevada**

Figure 3, below, shows 30 arc-sec (800 m gridded) PRISM estimates of annual precipitation (30 yr means, 1971-2000) for the region covered by Fig. 1. The PRISM estimates indicate the DEPO is in a rain shadow, flanked by ridges with high accumulation (dark blue). The estimate at DEPO is about 625 mm, that at about Mammoth Mt. is about 1325 mm, and that near Iron Mt., to the west of DEPO, 1250 mm. Maximum precipitation for this view is about 1500 mm, minimum about 320 mm.

