IC 4.3: Microclimates Exercise: The Balcones Escarpment

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Overview: The Balcones Escarpment (BE) is a tensional fault (lifted area) stretching roughly 300 linear miles in an arc from southwest of Waco to near Del Rio, TX (see Fig. 1). The coastal plains to the south and southeast of the BE have average elevations from 300 to 500 feet Mean Sea Level (MSL). The abrupt rise of the BE is between 300 and 500 feet, leading to overall elevations of 600 to 1000 feet MSL. The BE is the southern and eastern edge of the Texas Hill Country, where elevations of 1500 to 3000 feet MSL occur.

The BE affects convergence and lift of prevailing southeast flow off the Gulf of Mexico, often leading to warm season convection. In the cold season, there are three primary microclimate impacts of the BE: 1) late night and early morning fog and stratus, 2) drizzle, sometimes over sub-freezing, trapped air in river valleys, and 3) weak barrier jet flow along the I-35 corridor.

Southeasterly low level flow brings moist Gulf air to the BE, where it is lifted to the lifting condensation level (LCL) and produces fog and low stratus clouds. The fog can be dense at times (< 1/4 mile visibility), while the stratus can be low enough for minimal visual flight rules (MVFR) or instrument flight rules (IFR) restrictions, including the major airports of San Antonio International (KSAT) and Austin Bergstrom International (KAUS).

Under the right conditions of moisture advection, neutral stability, and higher wind speed for enhanced convergence, condensation will progress beyond cloud formation to the production of drizzle. The drizzle can make the steep grades and curves of Hill Country roads slick, causing an increase in auto accidents. However, if sub-freezing cold air is trapped in the west-east river valleys that exit the eastern end of the BE (e.g., Colorado, San Marcos, Guadalupe Rivers), freezing drizzle will develop and cause a significant transportation impact, prompting winter weather advisories.

Strong cold air advection behind cool season fronts can lead to a weak barrier jet along the I-35 corridor, as northeast winds hit the BE and are deflected left along I-35. These winds can mix down to the surface, and are most commonly noticed in the ASOS observations at New Braunfels Municipal Airport (KBAZ) and San Marcos Municipal Airport (KHYI).

Synoptic-scale Ingredients: Moist, low-level, southeast flow off the Gulf of Mexico is necessary for the development of stratus, fog, and drizzle. A cold frontal passage and strong northeast winds (20-30 kt) typically produce the weak barrier jet flow, with prevailing winds near 30 kt and gusts of 40-45 kt.

Diagnosis and Prognosis: The GOES IR "Fog" enhancement and monitoring of surface observations is sufficient to track and assess moisture advection from the Gulf of Mexico. Model forecasts of specific humidity, pressure, and wind on isentropic surfaces usually do a good job for timing and identification of the most likely spots for low IFR cloud ceilings, dense fog, and drizzle. Higher resolution models such as the NAM and a locally-run ARW-WRF perform better than lower resolution models such as the GFS.

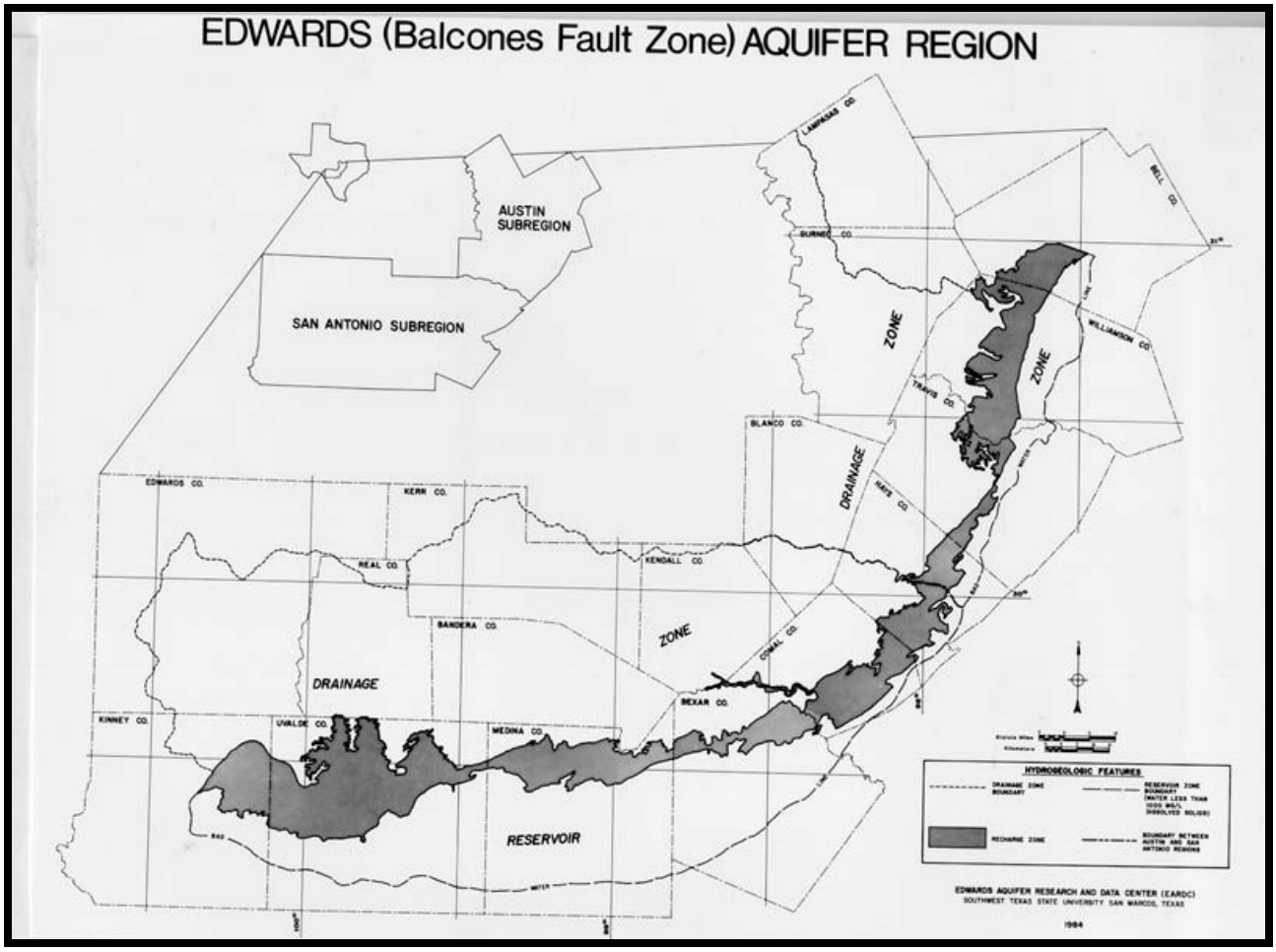

Figure 1. The Balcones Escarpment