THE PHOENIX EVENING TRANSITION: A CLIMATE PERSPECTIVE

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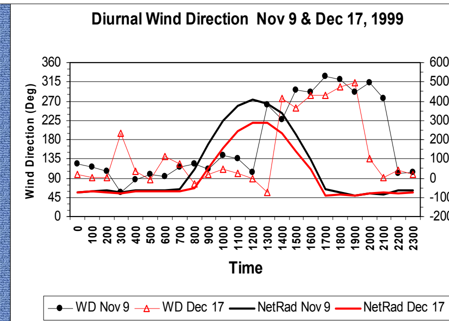
BACKGROUND AND PURPOSE

In hilly areas and climates prone to local controls, thermally-induced wind systems develop (e.g., Fernando et al, 2001 and Hunt et al, In Review). Two "transitions" occur – morning and evening – when winds reverse from downvalley to upvalley (morning) and upvalley to downvalley (evening). Climate components (and related environmental processes) are impacted by these transitions; and the unique geology/geography of the area controls the timing. Generally, flow depths at night are very shallow near the ground (ca. 0-40 m) as illustrated by the EFD group at ASU. Numerical modelers are attempting to incorporate these processes at ever increasing local scales. This poster demonstrates typical processes of the evening transition, showing results from a local field exercise around Tempe Town Lake and in the broader region of the Valley of the Sun. Very few weather sites are in river channels to observe this phenomenon. This topic is the subject of an ongoing manuscript by Brazel et al (in progress).

Tempe Town Lake Weather Station

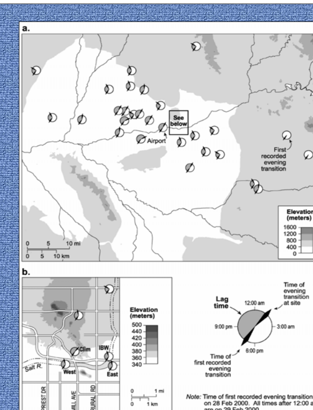
A view looking east from the west dam site of Tempe Town Lake. Automated weather station is atop a pier just above the dam and at the west end of the lake. A complete energy budget set of sensors are recording diurnal data and records are ca. two years in duration at this time.

Example of Lags of Heating/Cooling (Net Radiation) and Wind Transitions



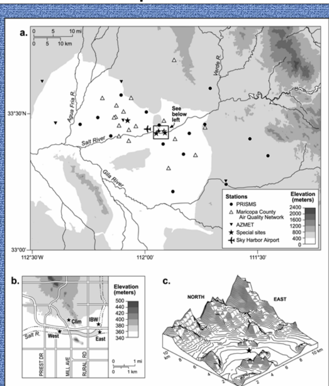
Large lags are evident in the morning and evening transition between rapid heating and cooling times and the timing of wind shifts (upvalley and downvalley) as observed at Tempe Town Lake. Due to flat extensive plain to the west of Phoenix and abrupt topography to north and east, momentum of upvalley flow lasts long into the evening.

Regional Scale Evening Transition



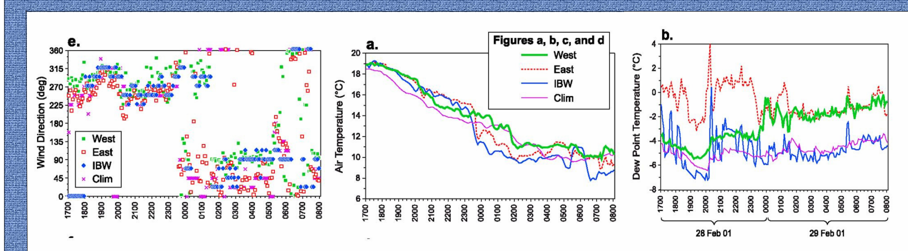
Map a. shows variation of timing in the shallow flows downvalley, compared to transitions in the upper east valley locales. Map b. shows the four sites around Tempe Town Lake. The rate of the transition change can be described crudely as a function of a site's elevation explaining about 60% of the variance in the timing of the wind shift. However, there are local boundary layer impacts from land use and exact site morphology, as learned from the Tempe Town Lake exercise (e.g., at the hilltop CLIM site – some 50 m elevation above the others nearby- evening transition lags way behind in the timing of the wind shift). Locational context in this regional picture is important to specifying the nature of this desert's evening transition. Long term data from Sky Harbor Airport does not fully represent the local variability.

Map of Wind Sites Used and Inset Map of Four Sites Sampled Around Tempe Town Lake



Four sites were sampled for a typical night (Feb. 28-29th, 2000) – WEST (west dam site), EAST (east dam site upstream of lake), IBW (inlet of Indian Bend Wash to Salt River Channel), and CLIM (weather station atop Community Services Building on a hill to the north about 50 m above channel and lake). Wind data were obtained for all sites shown on the regional map.

Variations Around and Above Tempe Town Lake



Data from the four sites are shown for wind direction, air temperature near the surface, and dew point at WEST, EAST, IBW, and CLIM. Note late wind shift transition near midnight; rapid cooling of air at IBW and EAST with drainage wind downvalley; dramatic effects on dew points, which oscillate dependent on the wind direction shifts. Large spikes early after sundown are typical of onset of strong surface inversion where moisture is "trapped" near surface under calm transitioning.

CONCLUSION

a) Evening transition processes are being modeled numerically. There is a need to understand local scale processes further.
b) The transition presets the course of cooling rates, timing of temperature and dew point variations, station separation one from another in spatial climatic variations, and significantly controls the air quality environment.
c) Unlike alpine areas, and many other sharp terrain environments, the transition is delayed well into the evening hours in winter, long after sundown, in the Phoenix area. This may be explained by the gentle sloping terrain with abrupt breaks in the terrain well to the north and east of the city.
d) CAPLTER's major weather site of the airport (used for historical assessment) must be critically analyzed further for the local effects of the kind found around Tempe Town Lake's terrain, since now the site is immediately adjacent to the Salt River's channel by the airport site.

REFERENCES

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