

METEOROLOGICAL and GEOGRAPHIC RELATIONSHIPS to WEST NILE VIRUS in the SOUTHERN PLAINS



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INTRODUCTION

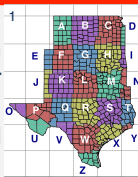
In 2012, the Southern Plains (Kansas, Oklahoma, and Texas) witnessed an unprecedented outbreak of the West Nile Virus (WNV; CDC 2012). WNV is a neuroinvasive virus that can be fatal. Mosquitoes transmit the virus. This project examined research of WNV and favorable mosquito environments that had been conducted on localized scales or in laboratories to identify relationships between weather, land use, and WNV and expand them to the Southern Plains, an under-studied region.

DATA & METHODS

•WNV data for the Southern Plains was obtained from state epidemiologists for 2002-2012 and organized by week. Meteorological data is from NCEP/NCAR and is reported in 2.5° grid spaces. Figure 1 shows the counties in each grid, with grid incidence calculated using 2010 census data.

•Paz 2006 noted a 3- to 9-week lag between an anomalous meteorological signal and a rise in infection reports. These results account for a 5-week lag.

•Crop data from the USDA was analyzed in ArcGIS 10.1.



SELECTED RESULTS

1 Irrigation linked to high incidence in western counties.

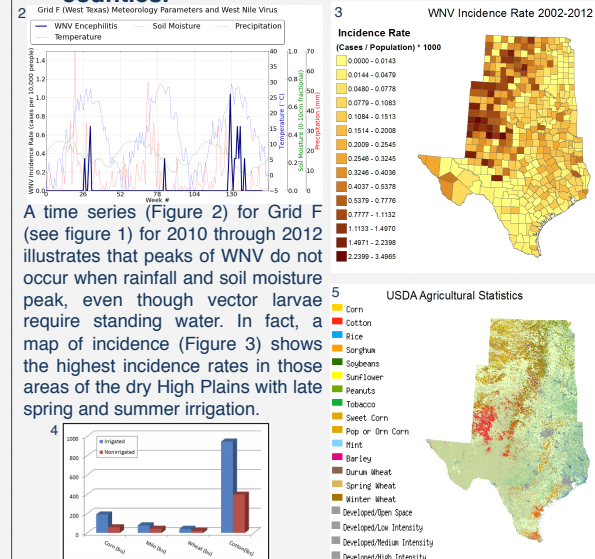
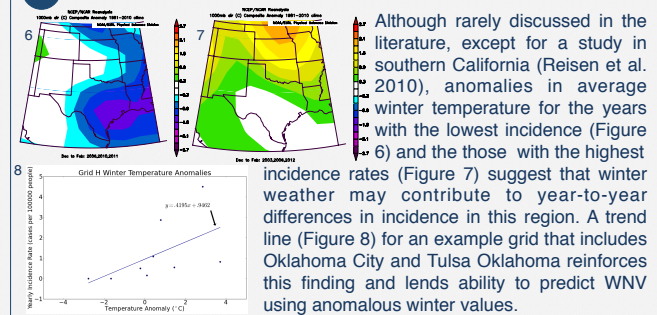


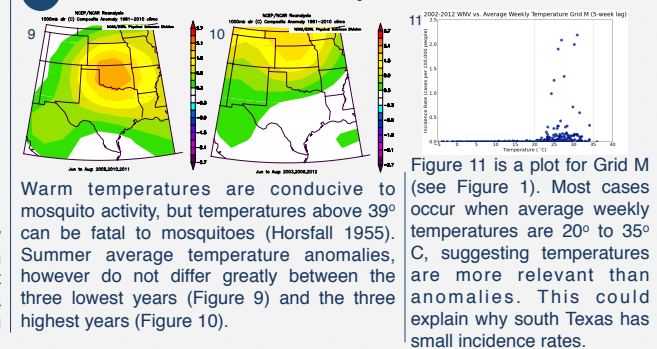
Figure 4 shows 2008-2009 crop yields taken from a study conducted by Texas A&M University (Wagner 2012) examining irrigation trends in Texas. Cotton needs heavy irrigation, and it is grown where the highest incidence rates occur (Figure 5). These findings are supported by a study in El Paso (Cardenas et al. 2011) that concluded irrigative flooding increased WNV risk.

2 Anomously cold winters decrease WNV threat.



Although rarely discussed in the literature, except for a study in southern California (Reisen et al. 2010), anomalies in average winter temperature for the years with the lowest incidence (Figure 6) and the those with the highest incidence rates (Figure 7) suggest that winter weather may contribute to year-to-year differences in incidence in this region. A trend line (Figure 8) for an example grid that includes Oklahoma City and Tulsa Oklahoma reinforces this finding and lends ability to predict WNV using anomalous winter values.

3 Influence of summer temperatures is inconclusive.



Warm temperatures are conducive to mosquito activity, but temperatures above 39° can be fatal to mosquitoes (Horsfall 1955). Summer average temperature anomalies, however do not differ greatly between the three lowest years (Figure 9) and the three highest years (Figure 10).

Figure 11 is a plot for Grid M (see Figure 1). Most cases occur when average weekly temperatures are 20° to 35° C, suggesting temperatures are more relevant than anomalies. This could explain why south Texas has small incidence rates.

SUMMARY

Heavy irrigation in the High Plains appear to increase WNV activity, while yearly meteorological variation have more influence on WNV activity in eastern Texas, Oklahoma and Kansas. Although standing water is good breeding ground for mosquitoes, rainfall is not a good predictor of WNV epidemics. Further statistical examination is needed to quantify physical relationships, but winter temperatures seem to play important role.

ACKNOWLEDGEMENTS & REFERENCES

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Figures 2, 3, 5, and 6 are provided by the NOAA/ESRL Physical Sciences Division, Boulder, Colorado from their website at <http://www.esrl.noaa.gov/psd/>.

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