Peninsular Florida Modeled Water Table Depth Arboviral Epidemic Risk Assessment

UF UNIVERSITY of FLORIDA
IFAS Research
Florida Medical Entomology Lab

Current Assessment: 07/21/2008 – Week 29 – Secondary Dry Down Phase

Modeled Water Table Depth:

MWTD has slowly increased across much of peninsular Florida with the coming of the 2008 wet season. MWTD still remains low to moderate in most areas with the shallowest depths being recorded in southwest peninsular Florida (Glades, Hendry, Collier, and Lee counties) as indicated in Figure 3. The Citrus/Hernando counties area has also reported shallow MWTDs. However, large areas of peninsula of Florida are still reporting below normal MWTD conditions for this time of year.

Arboviral Epidemic Risk:

Secondary Dry Down (SDD) Phase (Weeks 28 – 32):

MWTD profiles in eastern Martin/St. Lucie, western Sumter, eastern Citrus/Hernando, and eastern Broward/Dade counties had previously been identified as closely tracking the Arboviral Epidemic Risk Model through the IDD and IWET phases and into the SDD phase (Figure 4). Regions 2 and 3 have most closely tracked the Arboviral Epidemic Risk Model through the IDD, IWET, and SDD phase and MWTD profiles in these three regions have now deviated from the model (Figure 5). They are now classified as having *medium* **EPIDEMIC RISK** potentials ***if*** sustaining bird and mosquito populations exist. MWTD profiles for Regions 4 (Collier county) and 5 (Volusia county), have also deviated from the model on the wet and dry sides, respectively. As a result, these regions are now classified as *low risk*. Even with the substantial wetting events experienced during the IWET and SDD phases, any resulting mosquito populations likely occurred too late in the season to interact with nestling birds and initiate arboviral amplification. The widespread and extended drought early this season seriously impacted mosquito populations on a large scale. Some areas of peninsula Florida exhibited MWTD profiles of wetting and drying that closely tracked the Arboviral Epidemic Risk Model. The timing of these profiles however, resulted in the majority of peninsula Florida having *low* **EPIDEMIC RISK** potentials (Figure 4). It is not likely that any new areas will enter the parameters of the risk model during the remainder of this calendar year. For a more extensive analysis of the current arboviral risk factors please refer to the FMEL **Encephalitis Information System** at http://eis.ifas.ufl.edu/.

Seasonal Weather Forecast:

The La Niña we have experienced over the past several months is predicted to transition to a neutral El Niño-Southern Oscillation (ENSO) over the next month. A potential for increased tropical storm activity is reflected in the forecast for above normal precipitation during the next three months. The drought conditions currently reported throughout the state are predicted to abate during the summer months with ongoing summertime thunderstorm activity. ENSO is forecast to remain neutral through the fall with considerable uncertainty as to the level it will attain through the winter and spring of 2009. An active tropical storm season will help alleviate drought conditions across the state.*

The National Weather Service (NWS) Climate Prediction Center's one month outlook (Figure 8) predicts an equal chance for above, at, or below normal rainfall for peninsular Florida. The three month (August, September, and October) outlook (Figure 9) predicts above normal rainfall for peninsular Florida.

*This seasonal outlook is provided by and used with the permission of Deborah Hanley, PhD, Meteorologist, Florida Division of Forestry. Should there be any questions, please contact her at hanleyd@doacs.state.fl.us.

Historical Assessment for 2008:

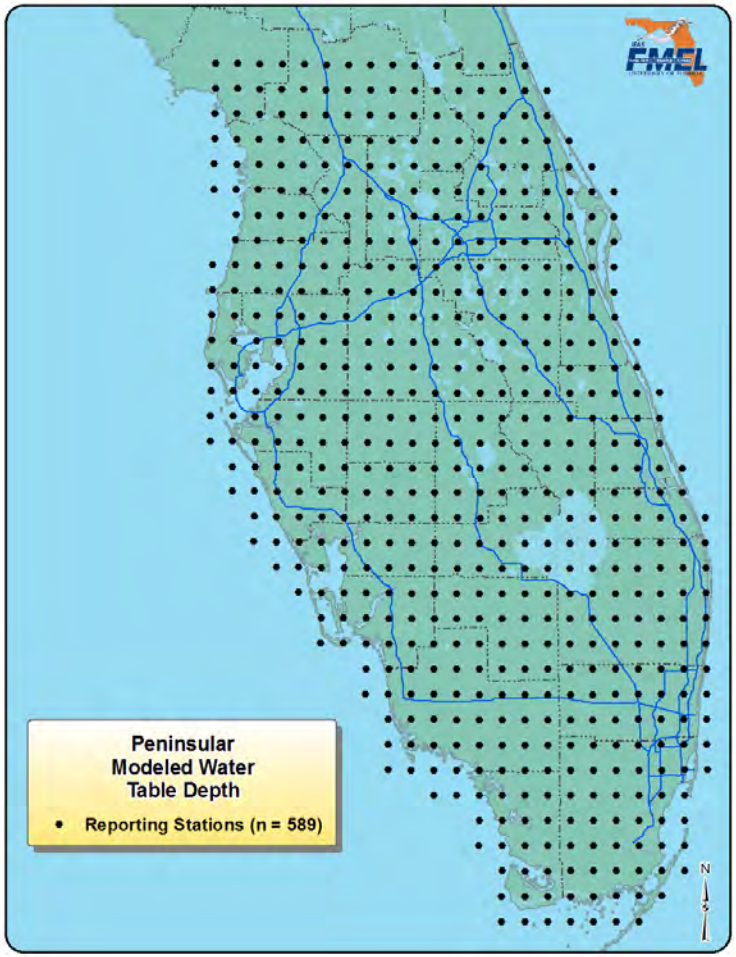
Arboviral Epidemic Risk:

Initial Dry Down (IDD) Phase (Weeks 1 – 22):

MWTD profiles in eastern Martin/St. Lucie, western Sumter, eastern Citrus/Hernando, and eastern Broward/Dade counties closely tracked the Arboviral Epidemic Risk Model through the IDD phase (Figure 4). Spatially and temporally aligned rainfall events during weeks 19 and 20 allowed the MWTD profiles in these areas to deviate slightly from the model. The profiles did, however, continue to follow the overall dry down trend of this phase. These three regions comprise an extensive area and should have been primed for high **EPIDEMIC RISK** potentials ***if*** sustaining bird and mosquito populations existed during the IDD Phase. Regions 4 and 5, Collier and Volusia counties, respectively, also continued to follow the overall dry down trend of this phase, though these regions are at a much smaller spatial scale than regions 1-3 (Figure 4). As the MWTD profiles across the entire peninsula of Florida were below normal for this phase, *Culex* populations should have been kept to a minimum on a large spatial scale. Therefore, it is unlikely that mosquito populations from surrounding areas have moved into these areas of higher risk potential.

Initial Wetting (IWET) Phase (Weeks 23 – 27):

MWTD profiles in eastern Martin/St. Lucie, western Sumter, eastern Citrus/Hernando, and eastern Broward/Dade counties closely tracked the Arboviral Epidemic Risk Model through the IDD and IWET phases (Figures 5). These three regions comprise an extensive area and may have been primed for high **EPIDEMIC RISK** potentials ***if*** sustaining bird and mosquito populations exist. Regions 4 and 5, Collier and Volusia counties respectively, also closely tracked the Arboviral Epidemic Risk Model through the IDD and IWET phases and may also have been primed for high **EPIDEMIC RISK** potentials ***if*** sustaining bird and mosquito populations exist, though these regions are at a much smaller spatial scale than regions 1,2, and 3 (Figure 4).



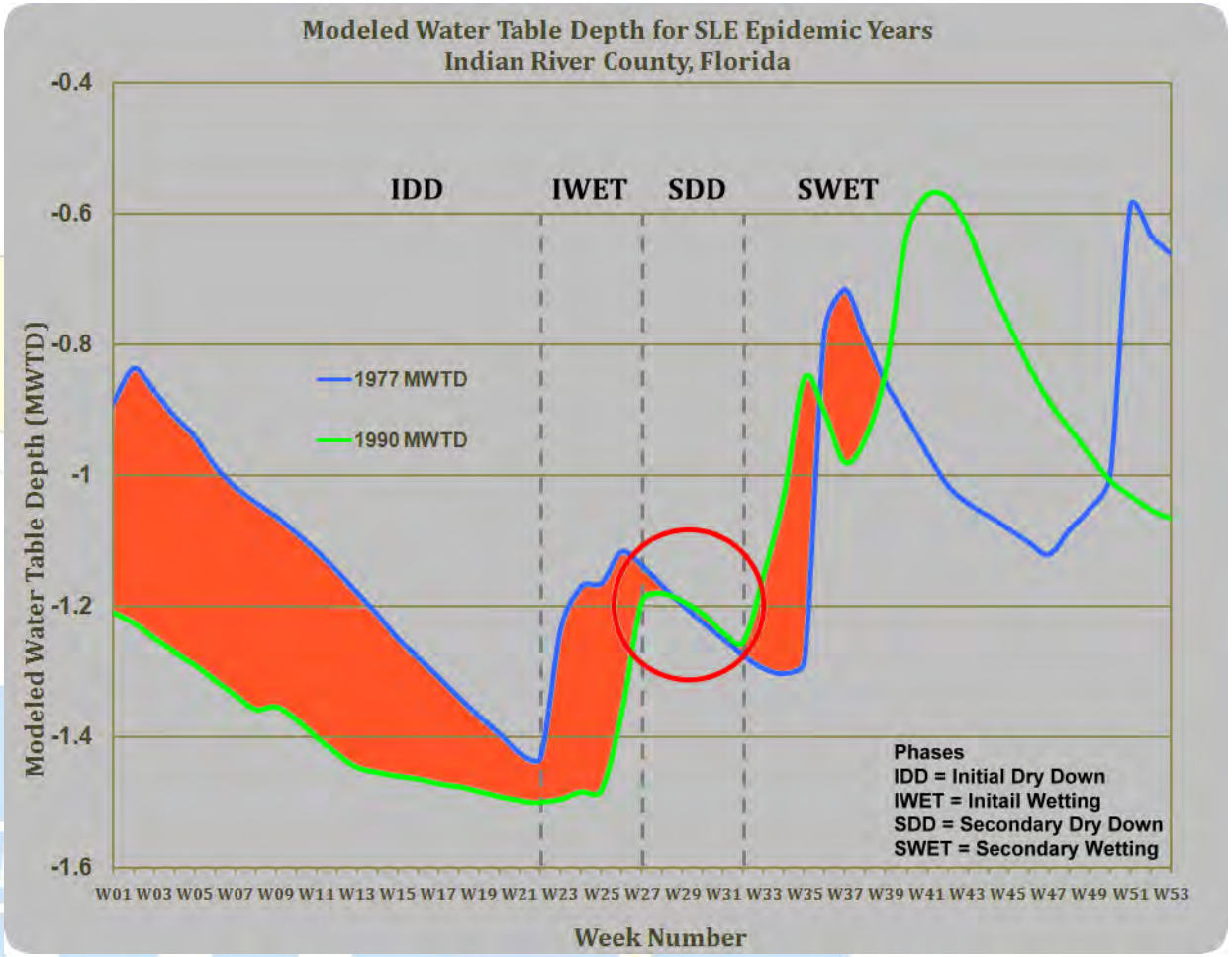


Figure 1. *Map of Peninsular Florida representing Modeled Water Table Depth calculation points located on a 0.125 degree resolution grid. A Topographically Based Hydrology (TBH) model is used to simulate variations in water table depth at the 589 sites. Mean area water table depth provides an integrated measure of near surface soil wetness conditions and are inputted into a Geographical Information System (GIS) based model to produce arboviral transmission risk maps.*

Figure 2. *Chart of weekly Modeled Water Table Depth (MWTD) values in Indian River County for SLE epidemic years 1977 and 1990. Arboviral Epidemic Risk Model values (highlighted in orange) are compared to real-time values across peninsular Florida. MWTD values falling continuously within the shaded area through the Initial Dry Down (IDD) and Initial Wetting (IWET) phases are necessary for the amplification of St Louis encephalitis (SLEV) or West Nile virus (WNV). Areas following the trends of these first two phases are considered at high risk for FOCAL arboviral transmission. The Secondary Dry Down (SDD) phase, circled in red, along with a Secondary Wetting phase, is considered critical for EPIDEMIC arboviral transmission. The last two phases provide for a second round of amplification followed by subsequent spread of the virus outside of focal amplification zones. The highlighted orange areas end at week 39 as amplification after this time is limited and any subsequent transmission risk through the remainder of the year has been determined.*

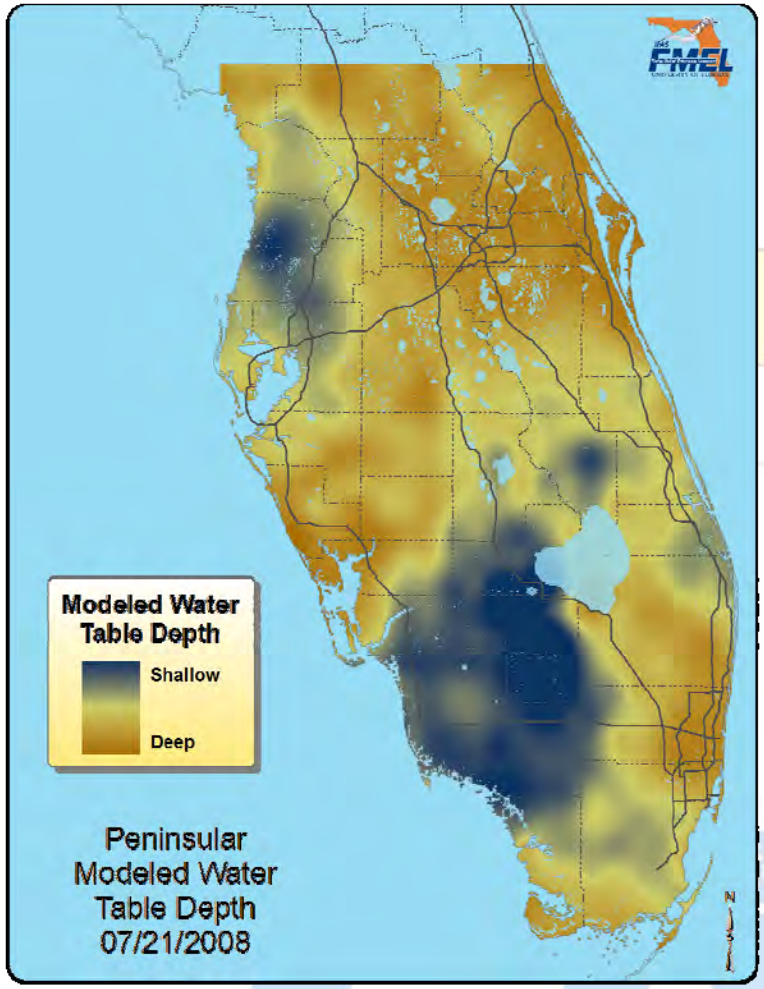


Figure 3. *Map of peninsular Florida indicating the current Modeled Water Table Depth (MWTD) situation. Areas with deeper water table depth (highlighted in orange) have less near surface water, while areas with shallow water table depth (highlighted in blue) have more near surface water. Even with the heavy spring and summer rainfall events, the majority of peninsular Florida reports below normal MWTD profiles.*

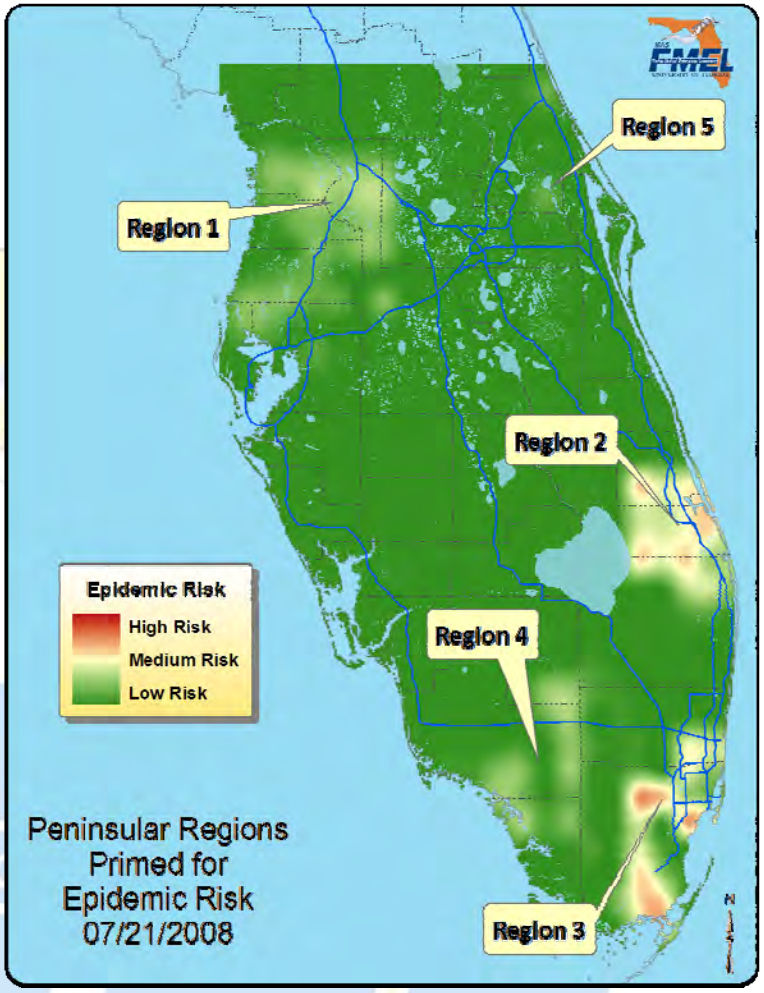


Figure 4. *Map of peninsular Florida indicating areas at high risk (highlighted in red) for arboviral amplification (SLEV, WNV). Highlighted areas indicated on the map closely followed the MWTD signature for arboviral amplification through the IDD and IWET phases (Figure 5). Focal arboviral transmission may have occurred in these areas* ***if*** *supporting bird and mosquito populations existed for arboviral amplification. It is unlikely any new areas will enter the parameters of the risk model during the remainder of this calendar year.*

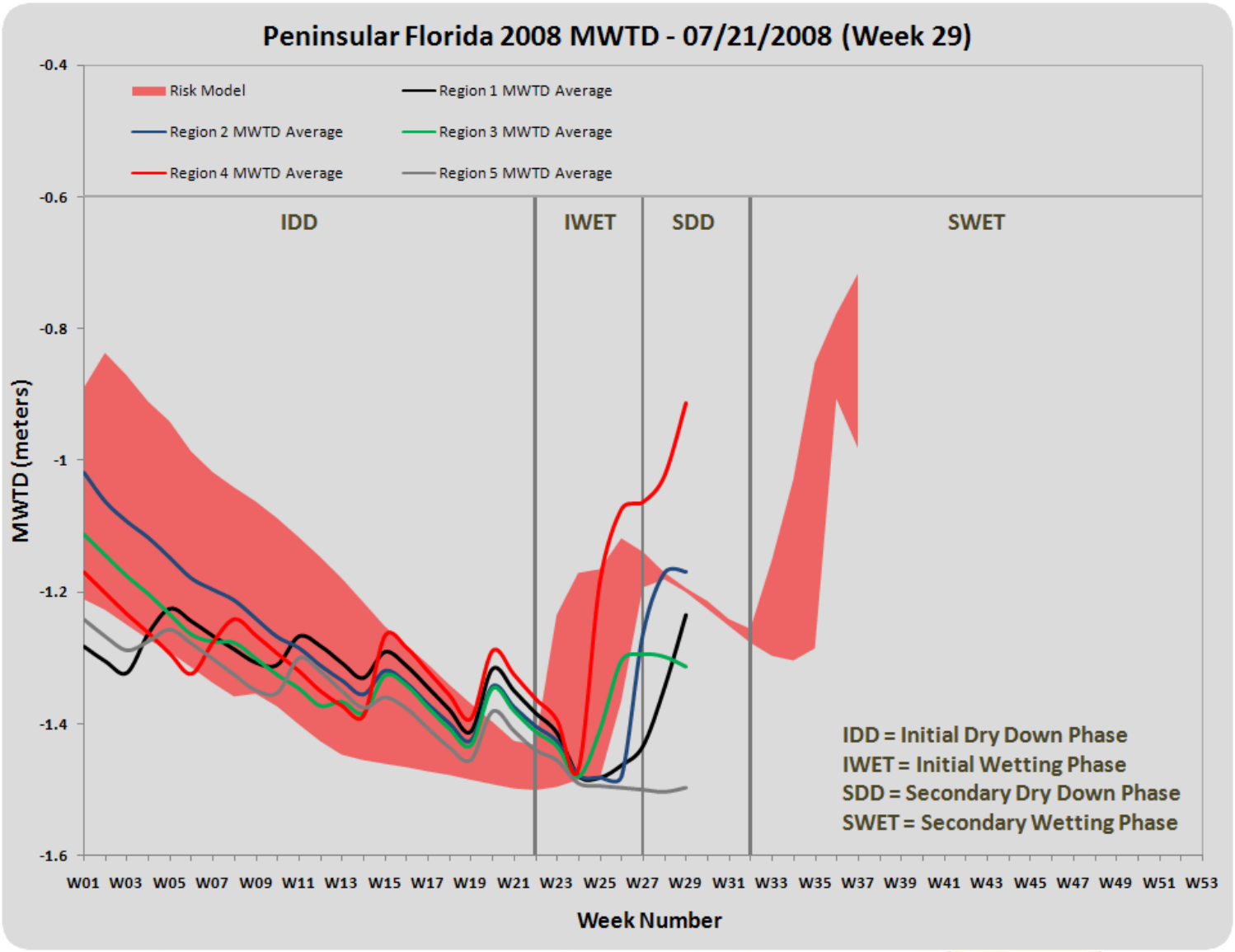
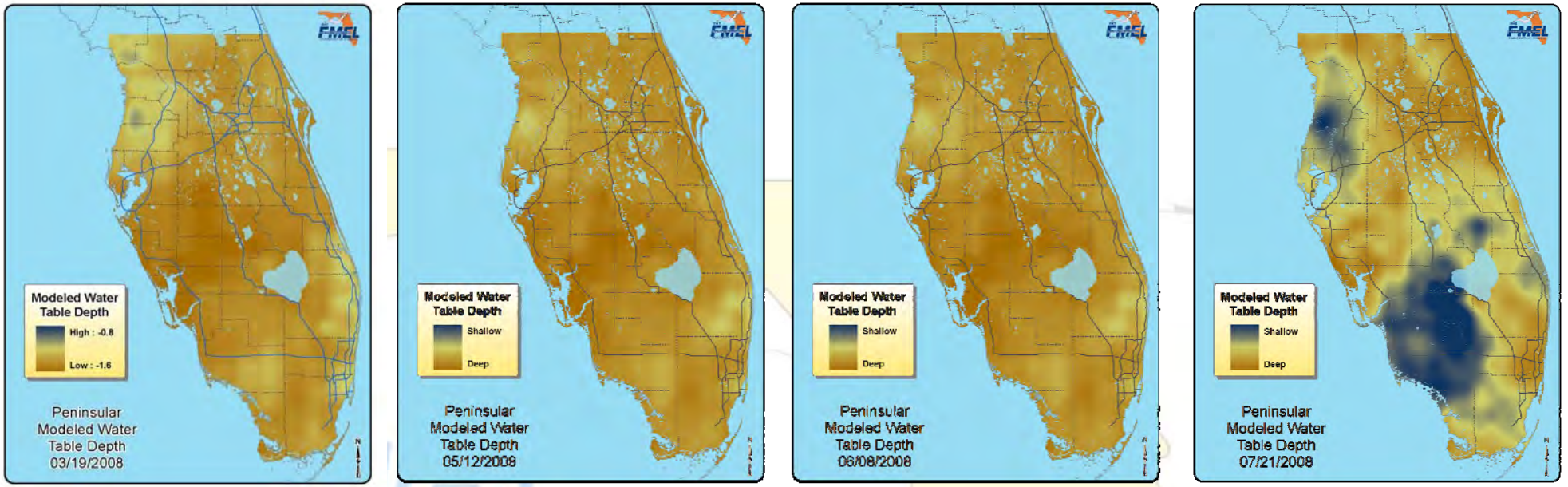
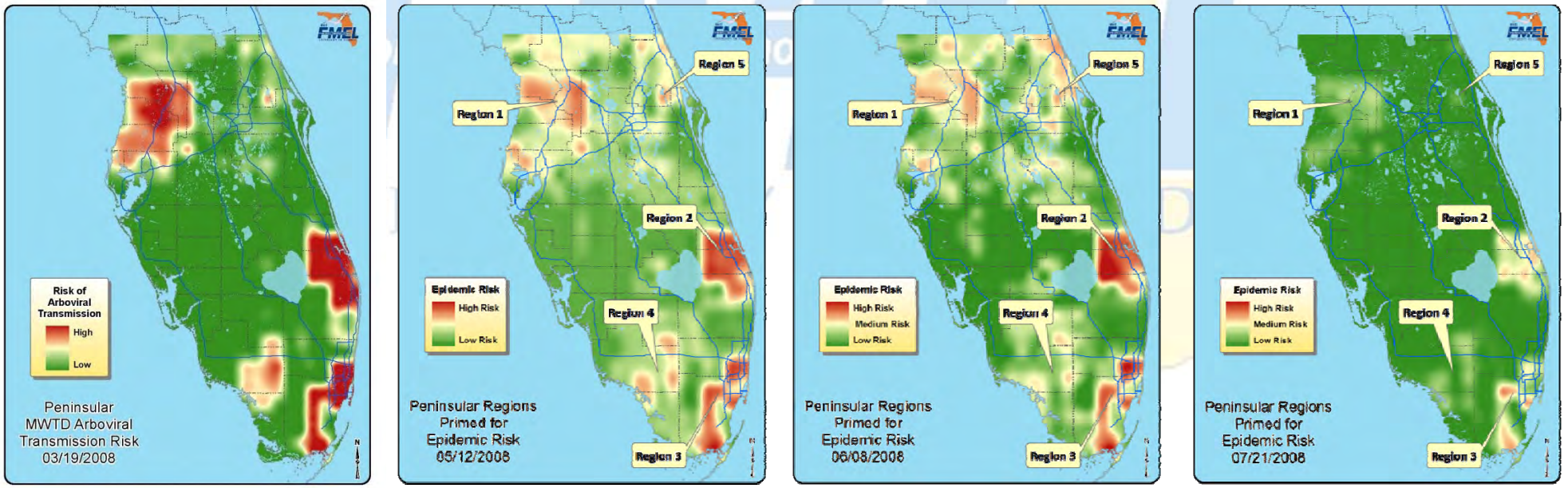
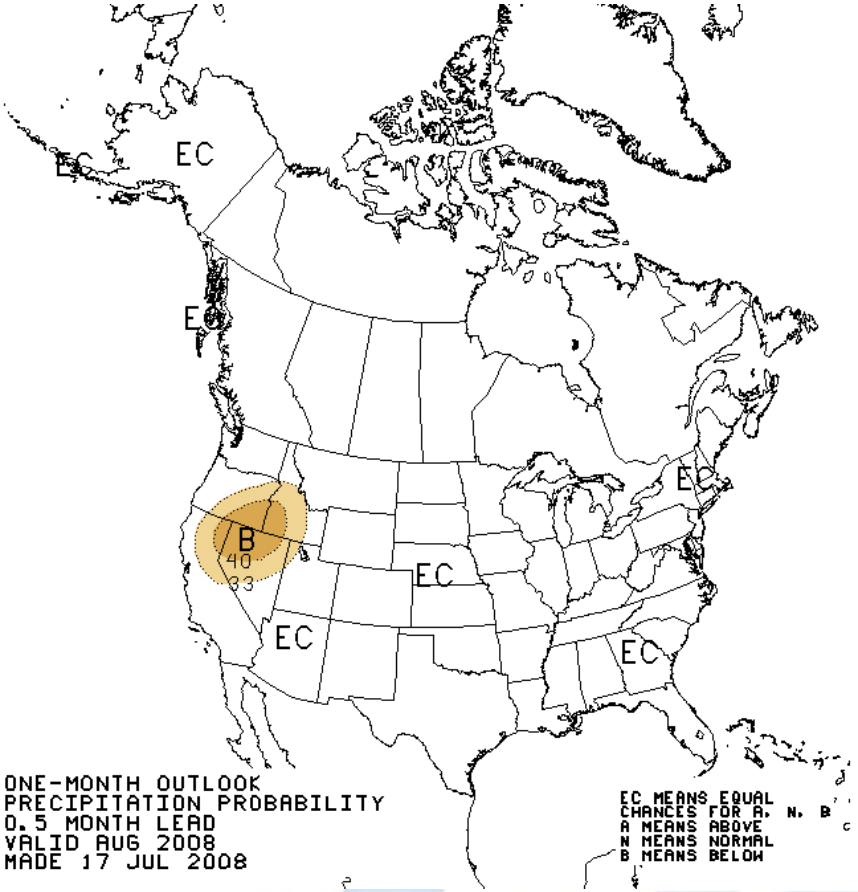


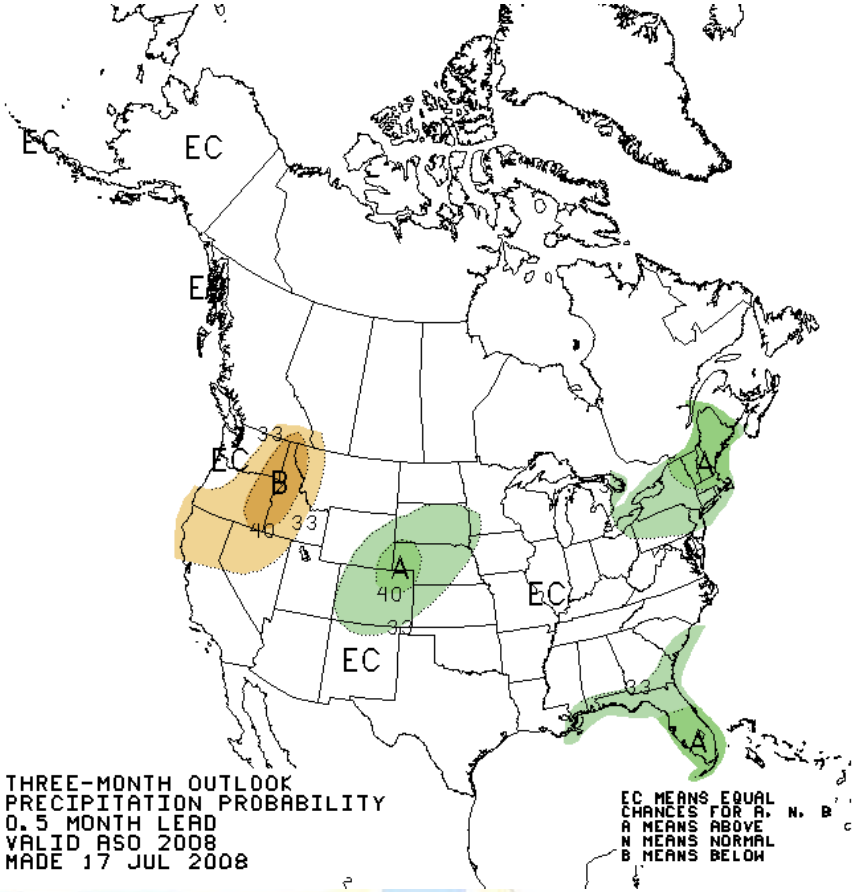
Figure 5. *Chart of averaged MWTD values for current regions of arboviral epidemic risk in peninsular Florida. The MWTD profiles charted are averaged across the sites for each region depicted in Figures 4. These regions had been identified as closely tracking the Arboviral Epidemic Risk Model (shaded in red) through the IDD and IWET phases. MWTD profiles in these five regions have now deviated from the model and are now classified as having low to medium* ***EPIDEMIC RISK*** *potentials* ***if*** *sustaining bird and mosquito populations existed (Figure 4).*



Figures 6 (above) and 7 (below). *Maps of peninsula Florida showing the historical MWTD and corresponding RISK values through 2008.*







Figures 8 and 9. *The National Weather Service (NWS) Climate Prediction Center's one month outlook (Figure 8) predicts an equal chance for above, at, or below normal rainfall for peninsular Florida. The three month (August, September, and October) outlook (Figure 9) predicts above normal rainfall for peninsular Florida.*

References

Day, J.F. 2001. Predicting St. Louis encephalitis virus epidemics: Lessons from recent, and not so recent, outbreaks. Annual Review of Entomology 46:111-38.

Day, J.F. and A.L. Lewis. 1992. An integrated approach to St. Louis encephalitis surveillance in Indian River County, Florida. Florida Journal of Public Health 4:12-16.

Day, J.F. and J. Shaman. 2007. Using hydrologic conditions to track the risk of focal and epidemic arboviral transmission in Peninsular Florida. J. Med. Entomol. (In Press).

Shaman, J. and J.F. Day. 2005. Achieving real-time operational hydrologic monitoring and forecasting of mosquito-borne disease transmission. Emerging Infectious Diseases 11:1343-1350.

Shaman, J., J.F. Day and M. Stieglitz. 2002. Drought-induced amplification of St. Louis encephalitis virus in Florida. Emerging Infectious Diseases 8:575-580.

Shaman, J., J.F. Day and M. Stieglitz. 2003. St. Louis encephalitis virus in wild birds during the 1990 south Florida epidemic: The importance of drought, wetting conditions, and the emergence of Culex nigripalpus (Diptera: Culicidae) to arboviral amplification and transmission. Journal of Medical Entomology 40:547-554.

Shaman, J., J.F. Day and M. Stieglitz. 2004. The spatial-temporal distribution of drought, wetting, and human cases of St. Louis encephalitis in south-central Florida. American Journal of Tropical Medicine and Hygiene 71:251-261.

Shaman, J., J.F. Day and M. Stieglitz. 2005. Drought-Induced amplification and epidemic transmission of West Nile Virus in south Florida. Journal of Medical Entomology 42:134-141.

Shaman, J., J.F. Day, M. Stieglitz, S. Zebiak and M. Cane. 2004. Seasonal forecast of St. Louis encephalitis virus transmission, Florida. Emerging Infectious Diseases 10:802-809.

Shaman, J., M. Stieglitz, C. Stark, S. Le Blancq and M. Cane. 2002. Predicting flood and swampwater mosquito abundances using a dynamic hydrology model. Emerging Infectious Diseases 8:6-13.

Document Authors:
Jonathan Day, Gregory Ross, Roxanne Connelly
University of Florida – IFAS – FMEL
Deborah Hanley
FDACS