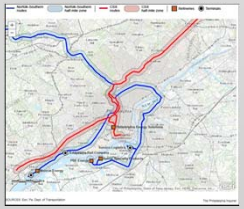

Implementation and Application of PISCES II

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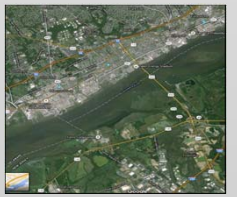


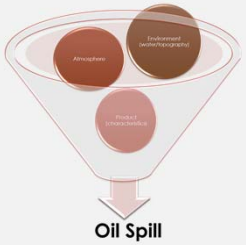
Introduction

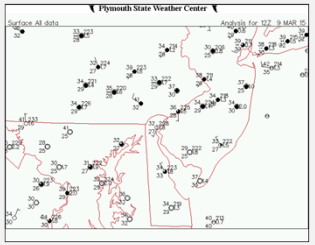
While oil products have quickly diversified over the years, response boom still remains one of the preferred methods of clean-up and spill mitigation. This has led to the need to identify new, simpler, yet effective ways to pull together expertise for the purpose of testing response boom strategies, especially in environmentally sensitive areas which may not always be accessible.

While computer simulation is not expected to replace simulations on the full, physical scale (e.g. boom deployment during a drill), the method may prove to act as a sufficient testing strategy in the time between exercises, and as more information becomes available for unconventional oils. Due to the increased interest in Bakken oil and Dilbit oil, and the overall increase of crude by rail through the region, the model runs focused on these solutions.

Materials & Methods

In order to run PISCES II you need to provide inputs to a set of variables. These inputs include: environmental characteristics, atmospheric considerations, and product chemistry and characteristics. The nexus points were chosen because of their environmental sensitivity. Water characteristics (tide, current) and shoreline characteristics come pre-downloaded in the model, as does chemistry of the oil products.



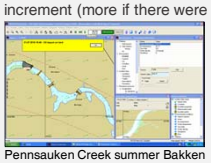


Data was provided by the USCG Sector Delaware Bay Marine Environmental Response Incident Management Team for the verification model runs of two specific spills. One on the Schuylkill River involving red-dyed diesel fuel (Jan. 2016), and the second was for the Wild Cosmos spill on the Delaware River which involved Bunker C oil (March 2015). Hour by hour atmospheric data was sourced from: vortex.Plymouth.edu/myo. These spills were chosen to be run by the model because 1)The Schuylkill River spill occurred in real-time, therefore there was ample data to test the model output with real-time findings on site, 2) The Wild Cosmos spill also had ample data and it was a unique spill which found tar balls on the shores of New Jersey; something that would prove a true test for the model to match. In all model runs, response boom strategies were provided by USCG Sector Delaware Bay Area Committee members and USCG District 5 .

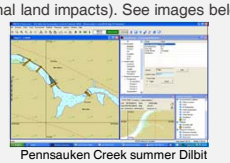
Acknowledgements: Thank you to the USCG Exercise Support Team based in Norfolk, VA and USCG Sector Delaware Bay and Area Committee for allowing the use of the PISCES II software package and providing pertinent information on spills and response strategies.

Results

The PISCES II model was applied to two (2) RR nexus points along the Delaware River and its tributaries for both Bakken and Dilbit oils. Simulations were run for a 12-24hr time frame. The assumption was made that 25,000 gallons of oil spilled into the waterway and boom was already in place in order to test the boom with a strong flow force. Each nexus point was run for both oil products in a winter climate and in a summer climate. While running the model with the response boom strategies in place (black lines), the time of impact to land was noted and snapshots were taken for approximately each 2hr increment (more if there were additional land impacts). See images below:

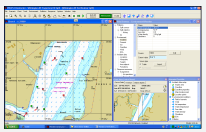


Pennsauken Creek summer Bakken scenario – 1 hour later



Pennsauken Creek summer Dilbit scenario – 12hrs later

In one case, the response boom strategy was maneuvered by researcher Erin Norris in order to test if this new strategy could slow the impact of oil to the third layer of boom, and furthermore, to test if the model truly has use in testing boom strategies. It was found that changing the angle of the boom did slow the oil flow through the third layer of boom (which was the last layer protecting the Delaware River) by approximately 30min, which is significant. During the time of study, it was decided to also run two (2) simulations to test the model's accuracy. One for The Wild Cosmos spill in March 2015 in the Port of Wilmington, and the other for a spill that was current during the study phase; a spill along the Schuylkill River near the 2400 block of Market Street in Philadelphia. Both scenarios found the model to be quite accurate according to USCG officials. For example, the model showed product moving up river toward Penns Grove, NJ which is where tar balls were found after the initial spill. Below is an image of the Bunker C from the Wild Cosmos model run breaking up in a section of the Delaware River near Penns Grove, NJ. This verification run also proved that in order to run the PISCES model as accurate as possible, a large grid spacing must be selected when defining the mapped area that is to be tested. This allows for a larger inclusion of environmental characteristics, which is especially important when running the model for 12 hours or more.



Below is a side-by-side comparison of an aerial view of the Schuylkill River after the January spill and the PISCES II model verification run from the day after the spill. The model clearly picked up on the icing in the river and the dispersion of the oil along the shoreline.

Conclusions

Despite model assumptions, it is suffice to say that in lieu of physical, real-world simulation, PISCES II could provide practical testing of response boom strategies during exercise and planning periods. The simulations appeared to match the physical and chemical aspect of what was described in findings by NOAA and LSU for Bakken oil, but certainly more information is needed about this product in order to fully be satisfied with response strategies and model solutions. In addition, more simulations may be run to gain a stronger statistical significance in the study. Overall, the research has given planners and responders new considerations when exercising response strategies.

The software package, PISCES II, requires a somewhat elevated understanding of numerical modeling and data analysis. Therefore, generating model output can be time consuming if the individual is not well-versed. It is suggested that in future research, the USCG partner with individuals well-versed in numerical modeling. Additionally, an understanding of hydrology and atmospheric science is advantageous with this model, and a lack of that knowledge may abridge model solutions. Lastly, PISCES II software retrieves its given data inputs (e.g. product chemistry, water characteristics) from a world database, of which is not fully understood. This leads to a potential lack of understanding of the model, and therefore some question to the model's accountability.

Future Considerations

As of Fall 2016 the USCG has begun to move toward OILMAP to model spills and test response boom strategies. A recent Sector Delaware Bay After Action Report recognized the importance and benefits of oil mapping software at the tactical/Sector (or Area Committee) level for regular model validation/testing of plans and strategies and recommended the funding of additional software licenses in the CG. The primary reason for this move has been that OILMAP appears to be more user friendly and less labor intensive than the PISCES II software package. Therefore, the mapping may be done on a wider basis and information may be shared more easily. Additionally, OILMAP uses the Environmental Data Server, which has a compilation of data provided by Sector Delaware Bay Area Committee Members, and the software is currently being used by several OSROs within the sector.

Further research with PISCES II and OILMAP would be beneficial to all stakeholders. Researchers hope to test OILMAP with the same verification runs that were used to test PISCES II – the Schuylkill River spill (January 2016) and the Wild Cosmos spill (March 2015). The result from the comparison of the two models in these cases would in-turn support a strong case for, or against, further use of OILMAP.

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