COMPLEX SYSTEMS, COMPUTING AND SENSORS FRONTIERS

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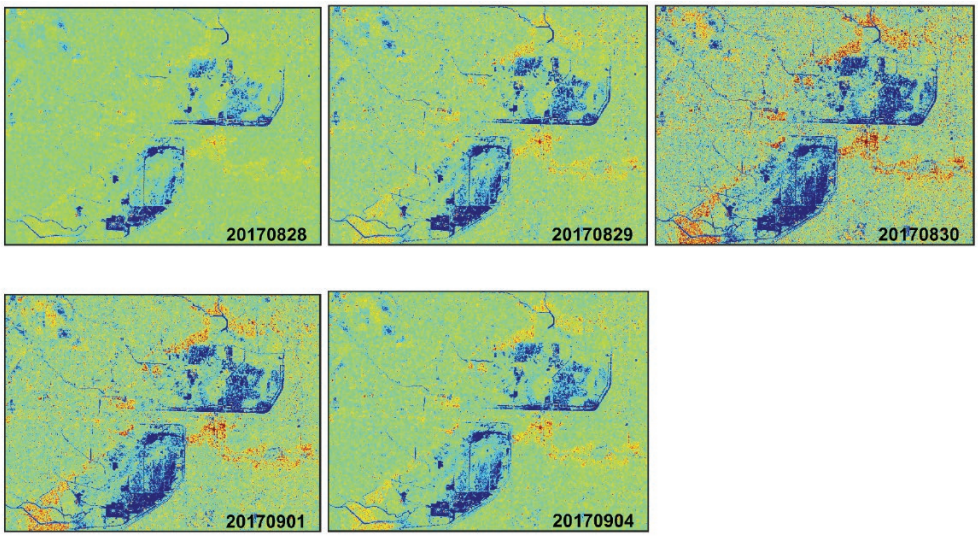
Dr. Lee's research focuses on quantifying and characterizing terrestrial water dynamics using satellite remote sensing data and modeling toward improving water resources management. He received the Cullen College of Engineering Research Excellence Award in 2016. He also received the NASA New Investigator Award in 2014. Dr. Lee has several publications highlighted as most cited articles. His recent research interests include developing innovative flood forecasting system using satellite observations. He is also interested in predicting streamflow and other hydrologic variables over poorly gauged or "geopolitically" ungauged basins using satellite observations and modeling toward sustainable water resources management and flood risk mitigation in transboundary river basins.

FLOOD FORECASTING SYSTEM RESULTS FOR HOUSTON AFTER HARVEY

As a victim of Hurricane Harvey in 2017, Dr. Lee understands firsthand that a forecasted flood extent is incredibly vital information for communities and emergency responders to reduce property damage and save lives. While flood forecasting systems typically generate streamflow or water levels forecasts, they give little indication as to spatial inundation extents. Although hydrodynamic models can transform the bulk discharge to distributed inundation extent, these models carry significant computational burden, that could affect forecast lead-time. A non-modeling approach employing a planar approximation may be less demanding because it only requires accurate topographic information and does not need to account mechanistically for backwater effects caused by infrastructure and coastal flooding.

Dr. Lee's group recently developed an innovative approach for forecasting inundation extent utilizing all-weather spaceborne radar images with historical and forecasted discharges from a rainfall-runoff model. This technique is named Forecasting Inundation Extents using Rotated empirical orthogonal function (FIER). The developed method has been demonstrated for the Mekong Basin in Southeast Asia as described in Chang et al., (2020). Dr. Lee's group is currently working on applying FIER to urban ooding using Houston as a test-bed. The images above are created Synthesized Radar (SAR)-like intensity images during Harvey using FIER. Both the blue and red colors in these images indicate inundation.



Publications

1. Du, T.L.T, H. Lee, D.D. Bui. B. Arheimer, H.-Y. Li, J. Olsson, S.E. Darby, J. Sheffield, D. Kim, E. Hwang, Streamflow prediction in "geopolitically ungauged" basins using satellite observations and regionalization at subcontinental scale, Journal of Hydrology, 588, 125016, 2020.

2. Chang, C.-H., H. Lee, D. Kim, E. Hwang, F. Hossain, F. Chishtie, S. Jayasinghe, S. Basnayake, Hindcast and forecast of daily inundation extents using satellite SAR and altimetry data with rotated empirical orthogonal function analysis: case study in Tonle Sap Lake Floodplain, Remote Sensing of Environment, 241, 111732, 2020.

3. Lee, H., T. Yuan, H. Yu, H.C. Jung, Interferometric SAR for wetland hydrology: An overview of methods, challenges, and trends, IEEE Geoscience and Remote Sensing Magazine, 8, 120-135, doi:10.1109/MGRS.2019.2958653, 2020.

4. Kim, D., H. Yu, H. Lee, E. Beighley, M. Durand, D.E. Alsdorf, E. Hwang, Ensemble learning regression for estimating river discharges using satellite altimetry data: central Congo River as a test-bed, Remote Sensing of Environment, 221, 741-755, 2019.

5. Chang, C.-H., H. Lee, F. Hossain, S. Basnayake, S. Jayasinghe, F. Chishtie, D. Saah, H. Yu, K. Sothea, D.D. Bui, A model-aided satellite altimetry based flood forecasting system for Mekong River, Environmental Modelling & Software, 112, 112-127, 2019.