BACKGROUND
Hydrologic modeling at the watershed scale requires the input of land use, topographical and meteorological data. Current watershed hydrology modeling relies on:
• Temporally non-dynamic land-cover/land-use maps,
• Topographical characterization with low-resolution data and limited geographical coverage, and
• Limited meteorological and forcings data availability.

OBJECTIVE
This project focuses on improving current hydrologic modeling approaches by using NASA products that offer the following:
• Updated/dynamic land-use/land-cover maps (MODIS, VIIRS, global coverage). MODIS landuse data is used as VIIRS proxy data.
• High-resolution topographical data (SRTM, global coverage).
• Spatial estimation potential evapo-transpiration and precipitation data (NASA-LIS).

EXPERIMENTS
Experiment I
This experiment explored the effects of swapping several topographical and land use datasets of different spatial resolution and scale in hydrological estimations of stream flow (Figure 2).

Decision Support Tools:
• Hydrological Simulation Program Fortran (HSPF)
• Soil Water Assessment Tool (SWAT)

Area of study
Jourdan River and Wolf River catchments, located in Saint Louis Bay watershed, Mississippi, constitute the area of study. Both river catchments drain approximately 202278 ha to the Mississippi gulf coast.

EXPERIMENTS
Experiment I
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Science Question:
- Is the combination of MODIS and SRTM useful for hydrological modeling?

Methodology: A factorial experiment with several different LULC and topography datasets has been performed. Twelve concurrent scenarios of topographical/LULC cases were generated for HSPF ingestion. HSPF was used to simulate streamflow hydrographs for each of the 12 cases for the Jourdan and Wolf Rivers. Simulated hydrographs were compared to measured hydrographs and the simulated-output reliability was assessed.

Landuse data: GIRAS (400 m resolution), NLCD (30 m res.), and NASA’s MODIS MOD12Q1 (1000 m res.).
Topographical data: IFSAR (5-m horizontal res.), NASA’s SRTM DTED Level 2 (30-m horizontal res.), NED (30-m), USGS-DEM (300-m).
All datasets were mosaiced, clipped, re-projected, and re-classified to meet the needs of the HSPF model.

Results: The combination of moderate resolution topographical datasets (such as SRTM, 30 m) and low resolution land use datasets (such as MODIS, 1000 m) produce good statistical fit between simulated and measured stream flow hydrographs. Model fit coefficients (R² and NS) for the MODIS-SRTM combination range between 0.73 and 0.81. (see Figure 3)
Figure 3. Results in Experiment I. Statistical fit between measured and HSPF-simulated hydrographs. NASA’s MODIS and SRTM provide good statistical fit.

Experiment II
This experiment explored the impact of using dynamic LU/LC and NASA-LIS meteorological data in hydrological simulations.

Science Questions:
- Can “Land Cover Dynamics” be used in conjunction with model-derived meteorological data to fill gaps in data for hydrologic simulation?
- In many areas where detailed land cover or meteorological stations are not available or time-series data are interrupted, what data and methods may be used to create reliable models?

Methodology: (see Figure 4).

MODIS 12Q1 land use products from 2001 up to 2004 were introduced in a calibrated HSPF model application for Wolf River watershed. Precipitation and evapotranspiration time-series from 1996 to 1997 were produced by NASA-LIS (GSFC) and introduced into a Wolf watershed HSPF application. The introduction of yearly land use information generated four different HSPF models for the Wolf River watershed. Simulated daily hydrographs at the outlet (Landon Station) were compared against measured hydrographs at the same outlet. Model fit efficiencies were evaluated for each combination of HSPF model for the Wolf River Watershed using LIS Data and the time-series.

Results:
As illustrated in the figure, hydrographs have only minor differences. Scatter-plots of observed vs. simulated daily stream flow rates are also very similar. The correlation for the 2001 and 2004 models are R=0.843 and R=0.845 respectively (corresponding to a common $R^2=0.71$) (Figure 5).

Experiment III
NASA-LIS precipitation and potential evapotranspiration data were introduced into a SWAT model application for the Wolf River watershed.

Results:
The calibration and validation of the SWAT application achieved a correlation coefficient of 0.79. This experiment showed the validity of using NASA-LIS precipitation and potential evapo-transpiration data for generating a fully calibrated watershed model without requiring weather-gage-station data.