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USING A WATERSHED MODEL TO INFORM DECISION MAKING IN SOUTHERN WISCONSIN, USA

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ABSTRACT

Large-scale hydrologic watershed models are often difficult to calibrate because of heterogeneous and dynamic land cover. Further burden on the usefulness of watershed models comes from high uncertainties in climate change models at sub-regional scales¹. However, decision makers readily accept that watershed models are suggestive rather than conclusive, and from their perspective the high uncertainties do not detract from the value of watershed models as decision-making tools². We will use storm transposition to ease the uncertainties in the effects of climate change on precipitation, using the Soil and Water Assessment Tool in the Yahara River Basin in Southern Wisconsin.

YAHARA RIVER BASIN

The basin spans about 400 square miles and is hydrologically dominated by a chain of lakes. On average the basin gets 37 inches of rain per year, and the clayey soils in the area have low saturated hydraulic conductivity. This leads to high runoff volumes into the lakes during large rain events, and flood risk is increasing due to steady conversion of open space to urban use. Lake Mendota is the largest and uppermost lake, and much of the

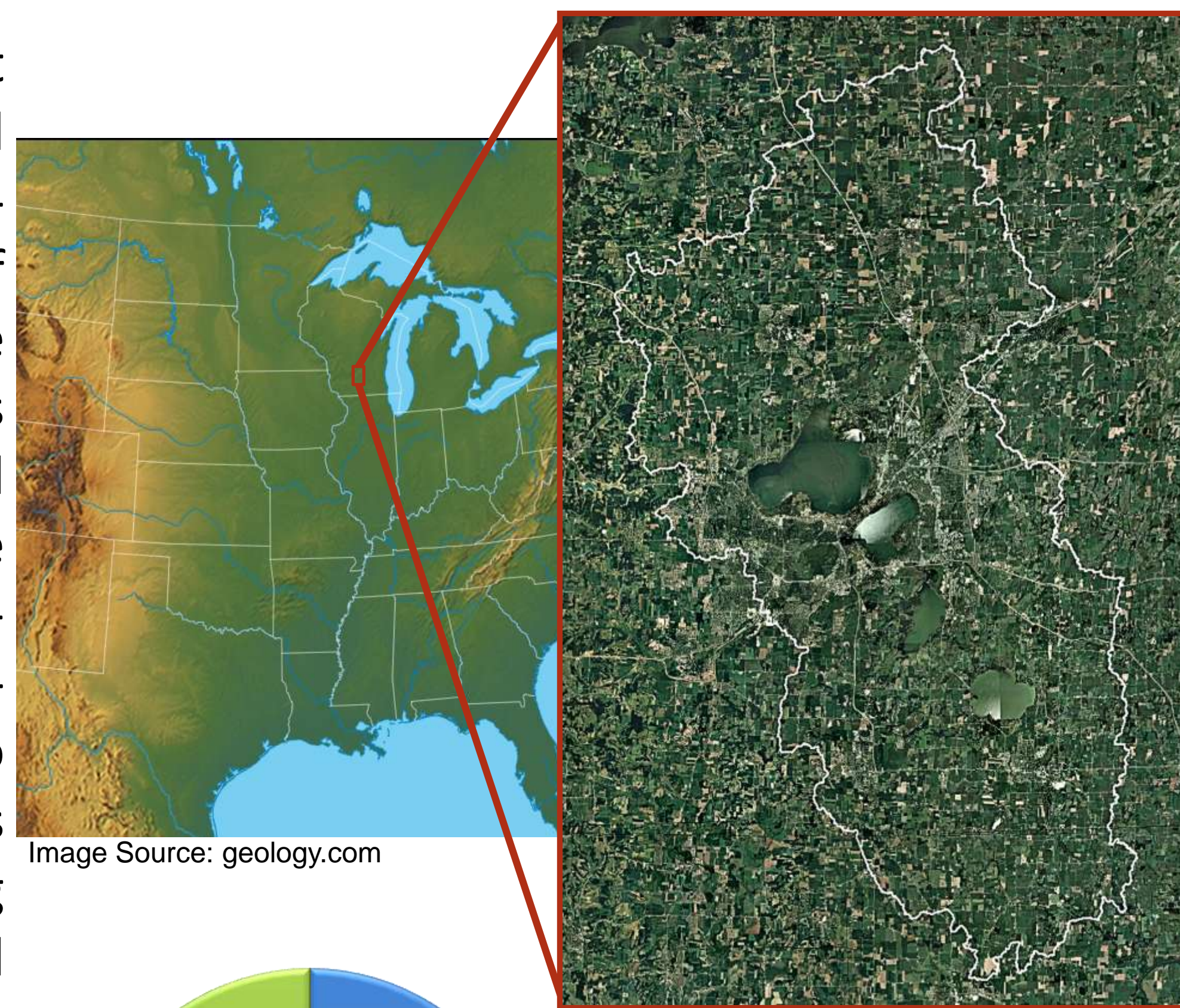
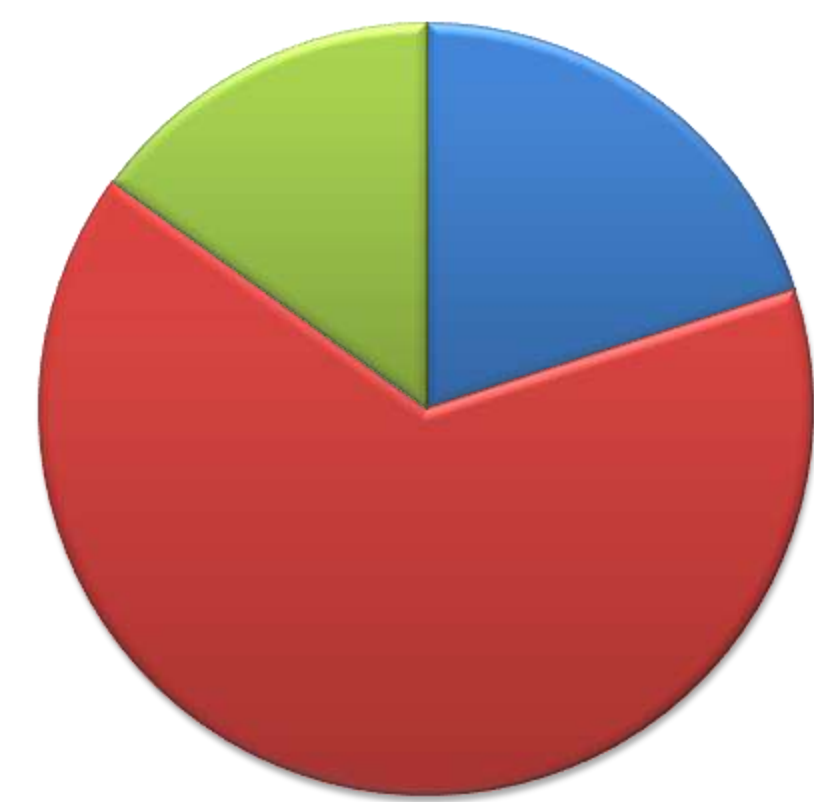


Image Source: geology.com



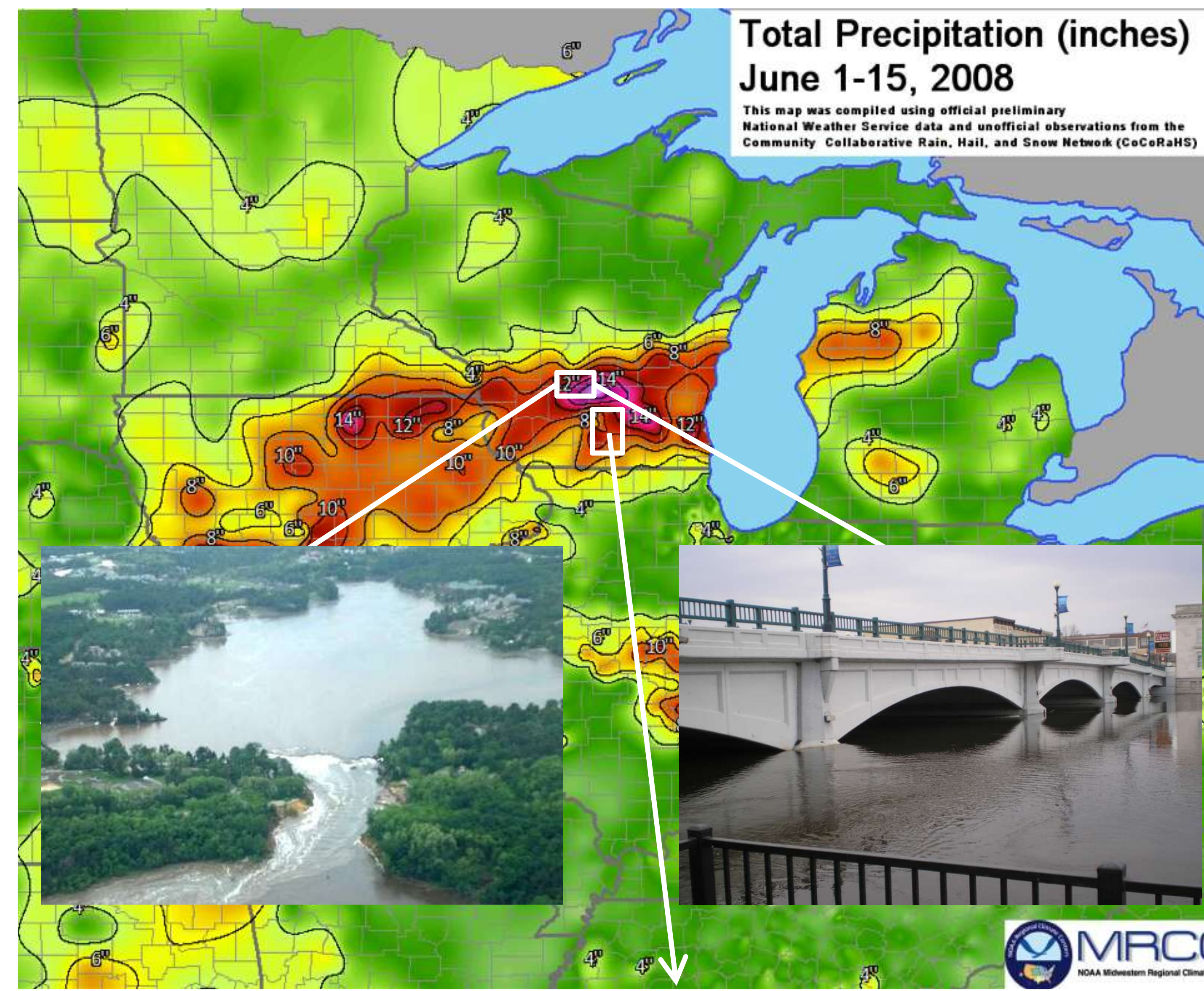
■ Urban
■ Agriculture
■ Natural

city of Madison, WI is along its shore. Flooding on Mendota would be costly, and the lake is carefully managed by a dam at its outlet. However, the low hydraulic gradient in the basin makes it difficult to pass water through the lakes during high rain events, and uncertainty due to climate change means that traditional flood frequency analyses may underestimate the magnitude of future floods.

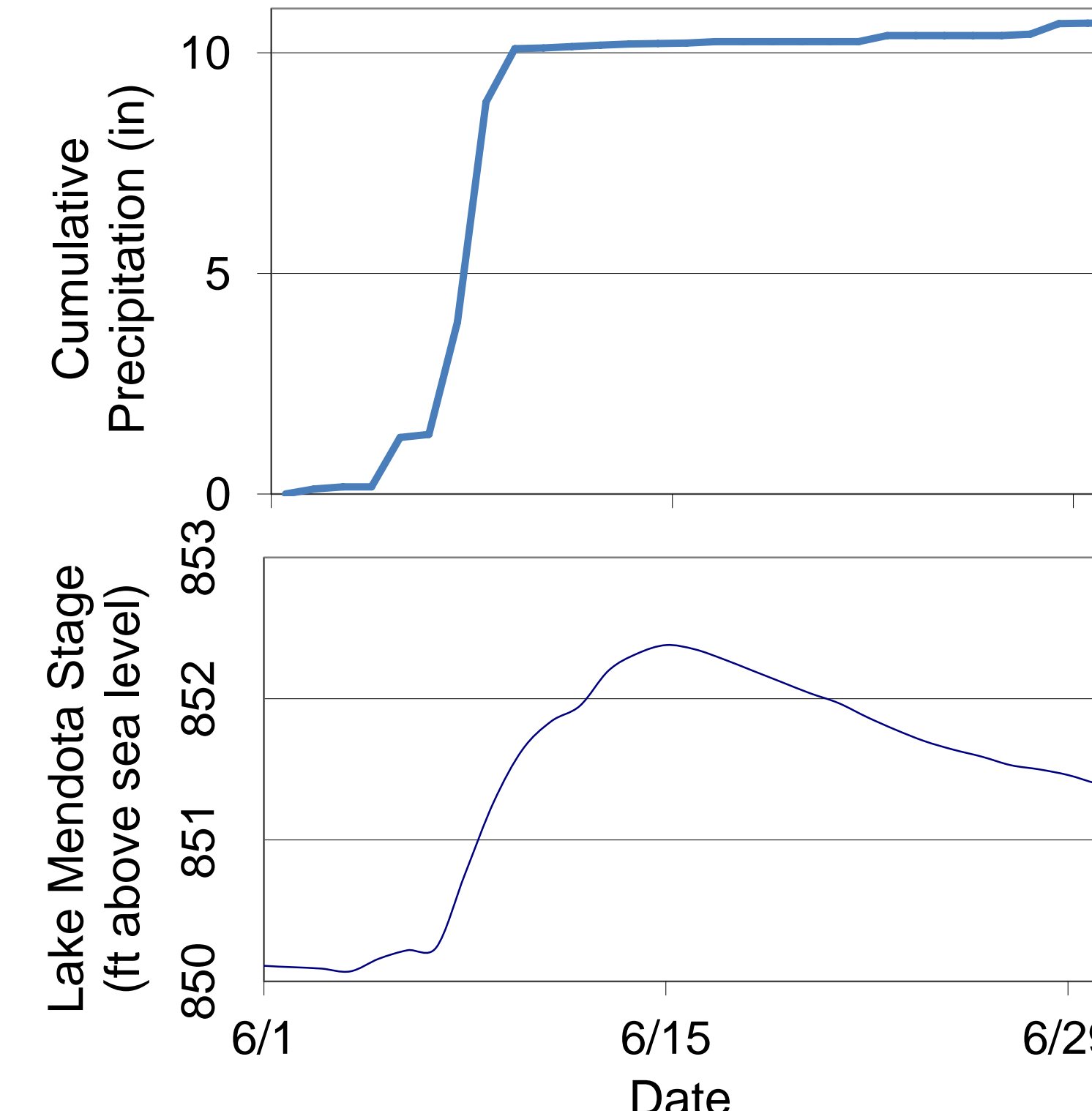


A large storm in June, 2008 brought severe flooding to the region, but the Yahara basin was spared the worst of the storm. Using NWS-NEXRAD radar data from the event we will model a scenario where the storm hits the Yahara basin more directly.

STORM TRANSPOSITION

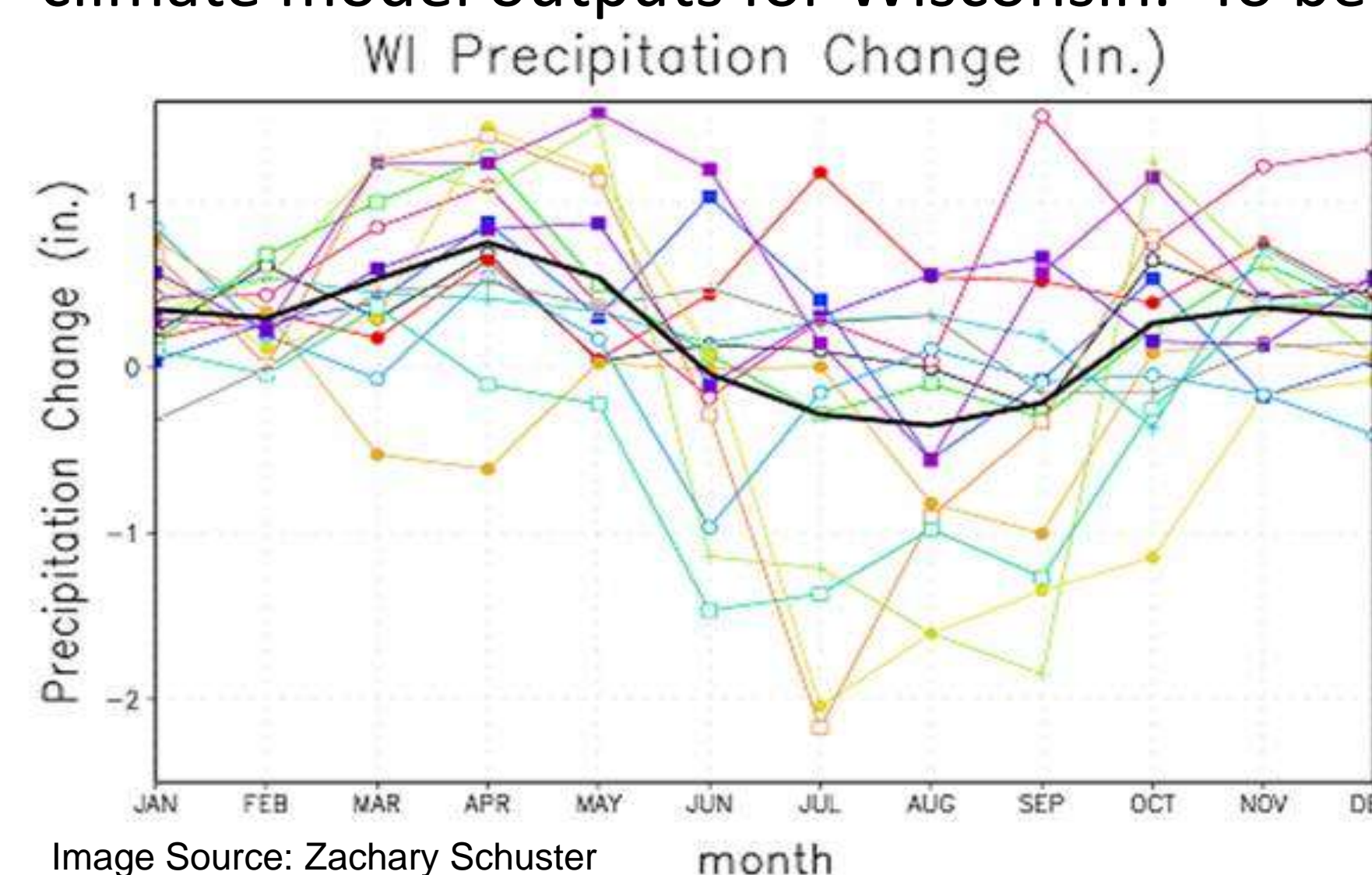


The 2008 storms brought over 14 inches of rain in less than 15 days to areas near the Yahara basin. The flood overwhelmed infrastructure throughout the mid-west; e.g. shown above is the failure and drainage of a man-made lake. The rain that the Yahara basin received caused Lake Mendota to rise two feet in a matter of days (shown at right). Magnitude estimates suggest that transposition may lead to a modeled increase of 5-6 feet in the stage of Lake Mendota due to runoff.



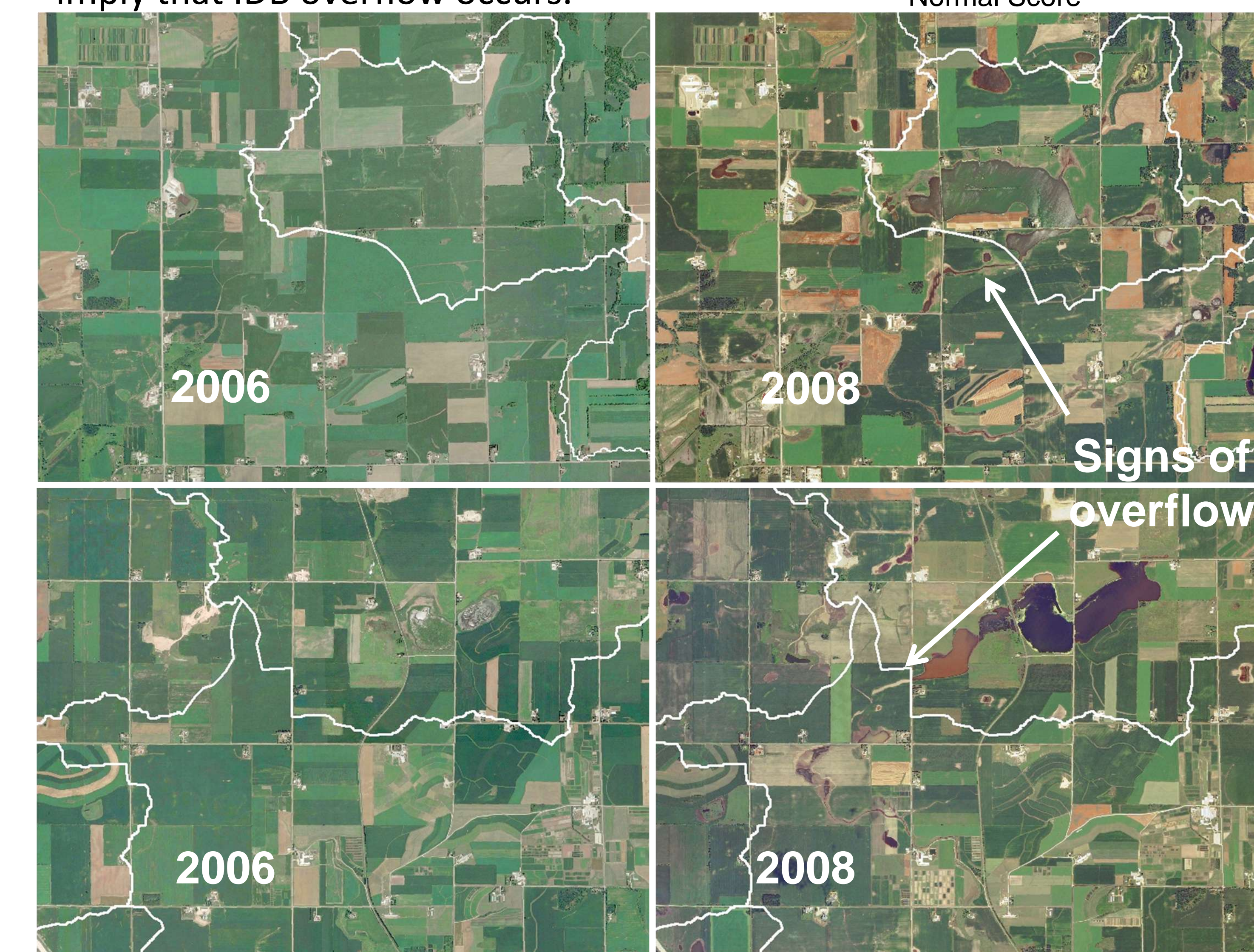
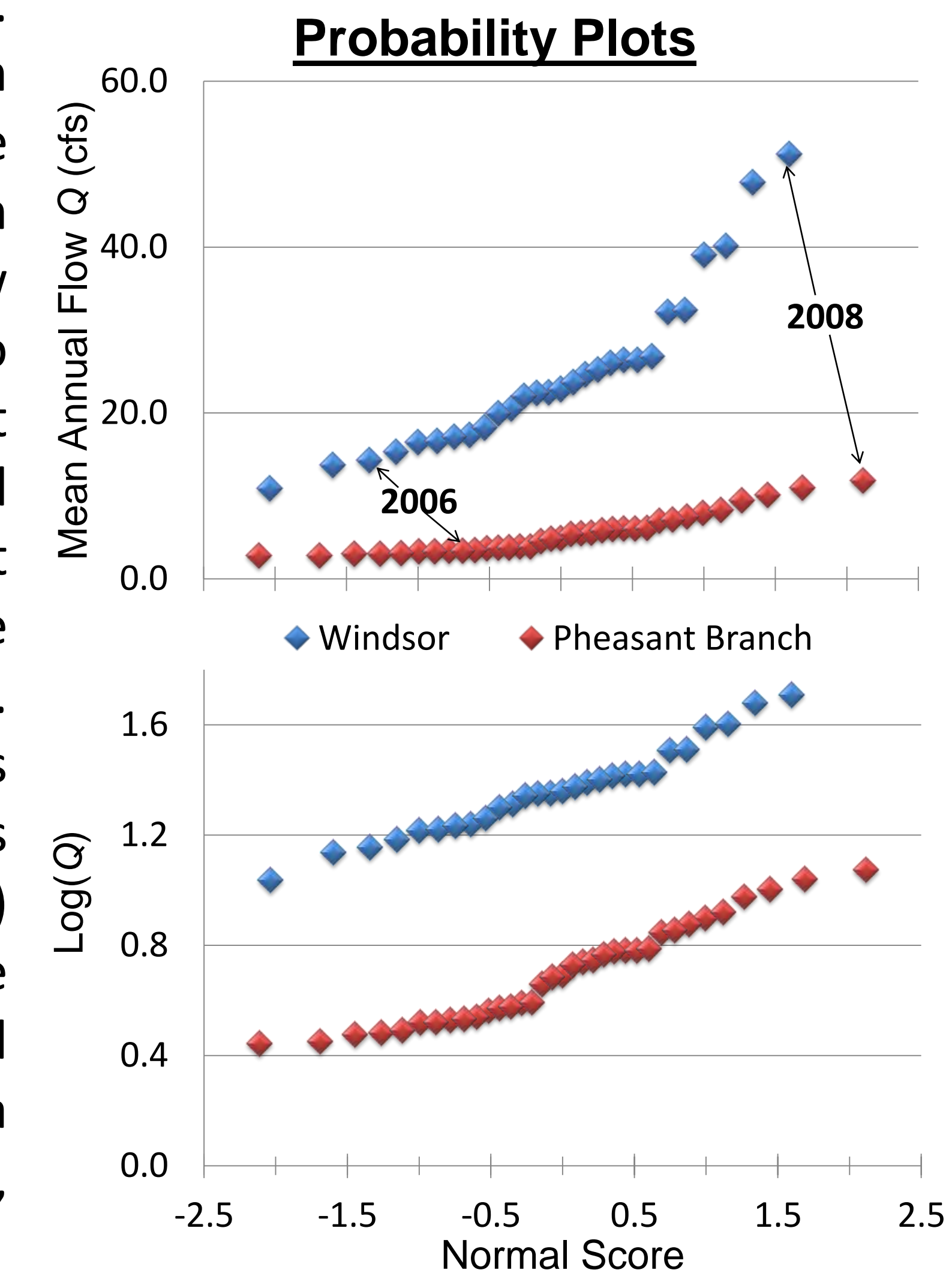
STAKEHOLDER INVOLVEMENT

We believe that using this transposed storm as hydrologic model input will enable effective communication of model results. Stakeholders are generally aware that climate change models have high uncertainties regarding sub-regional precipitation, e.g. in this ensemble of downscaled climate model outputs for Wisconsin. To better engage the stakeholders of the Yahara basin we will have regular meetings during development of the model so that they understand our methods and the model's sensitivity to our assumptions & decisions.



INTERNALLY DRAINED BASINS

In the Northern part of the Yahara basin there are many depressions that collect surface runoff, ranging in size from a few acres to many square miles. These internally drained basins (IDBs) significantly complicate modeling efforts. Generally they don't contribute runoff, but during extreme events they overflow. When doing a long-term continuous model, areas like these are often excluded, which can underestimate baseflow volumes. However, in order to include IDBs in a single-event model, reservoirs must be used at the outlets so that IDBs don't contribute runoff until they've collected enough runoff volume. Shown are aerial photos of IDBs in the Yahara basin during years that were relatively dry (2006) and relatively wet (2008). The photos, along with observed deviation of flow data from a log-normal distribution (right), imply that IDB overflow occurs.



ACKNOWLEDGEMENTS

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