Abstract Submitted
for the DFD17 Meeting of
The American Physical Society

Improving urban wind flow predictions through data assimilation[1] JORGE SOUSA, Stanford Univ, CATHERINE GORLE, Stanford University — Computational fluid dynamic is fundamentally important to several aspects in the design of sustainable and resilient urban environments. The prediction of the flow pattern for example can help to determine pedestrian wind comfort, air quality, optimal building ventilation strategies, and wind loading on buildings. However, the significant variability and uncertainty in the boundary conditions poses a challenge when interpreting results as a basis for design decisions. To improve our understanding of the uncertainties in the models and develop better predictive tools, we started a pilot field measurement campaign on Stanford University's campus combined with a detailed numerical prediction of the wind flow. The experimental data is being used to investigate the potential use of data assimilation and inverse techniques to better characterize the uncertainty in the results and improve the confidence in current wind flow predictions. We consider the incoming wind direction and magnitude as unknown parameters and perform a set of Reynolds-averaged Navier-Stokes simulations to build a polynomial chaos expansion response surface at each sensor location. We subsequently use an inverse ensemble Kalman filter to retrieve an estimate for the probabilistic density function of the inflow parameters. Once these distributions are obtained, the forward analysis is repeated to obtain predictions for the flow field in the entire urban canopy and the results are compared with the experimental data.

[1]We would like to acknowledge high-performance computing support from Yellowstone (ark:/85065/d7wd3xhc) provided by NCAR

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Date submitted: 01 Aug 2017 Electronic form version 1.4