University of California, Irvine
Statistics Seminar

Uncertainty Quantification for Remote Sensing Data

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Remote sensing data sets produced by NASA and other space agencies are a vast resource for the study of climate change and the physical processes which drive it. However, no remote sensing instrument actually observes these processes directly; the instruments collect electromagnetic spectra aggregated over two-dimensional ground footprints or three dimensional voxels, or sometimes just at a single point location. Inference on physical state based on these spectra occurs via a complex ground data processing infrastructure featuring a retrieval algorithm (so named because it retrieves latent true states from spectra) which typically provides point estimates and accompanying uncertainty or quality information. The method and the rigor by which uncertainties are derived varies by mission, and a key challenge is keeping up with the volume of data that needs to be processed. In fact,
uncertainties on remote sensing data products are not usually based on a standard, rigorous probabilistic framework.

In this talk, I will discuss our approach to uncertainty quantification for remote sensing data products for two NASA missions: the Orbiting Carbon Observatory 2 launched in

2014, and the new Surface Biology and Geology (SBG) mission slated for launch at the end of this decade. We rely on synthetic but realistic ensembles of true state vectors and their corresponding operationally-produced retrieval estimates, to learn conditional probability distributions of true states given their estimates via Gaussian mixture regression. That relationship is then applied to actual retrieved estimates to yield potentially non-Gaussian distributions of true states conditioned on their estimated values. I will present our methodology, and some result for OCO-2, and close by discussing our plans for SBG, which will provide orders-of-magnitude more data.