# WILLIAM & MARY
## DATA SCIENCE

*Spatially Adaptive Networks:*
*Architectures, Algorithms and Applications*

**HEATHER BAIER**
**DOCTOR OF PHILOSOPHY IN APPLIED SCIENCE**
**MAY 2025**
**ADVISOR: PROFESSOR DAN RUNFOLA**

SThis dissertation presents a unified framework for spatially adaptive networks that enhance deep learning performance on geospatial tasks. It includes three major contributions to the scientific literature. First, by incorporating coordinate-conditioned layers into convolutional neural networks, the GeoConv model illustrates a technique which dynamically adjusts filter weights based on local spatial context, significantly improving the extraction of heterogeneous features from satellite imagery. Second, I introduce the Spatial Imprecision Adjustment (SIA) framework, a post-processing algorithm that refines predictions by leveraging neighborhood statistics to correct errors from imprecise or offset georeferenced data. I illustrate the utility of these techniques using my third contribution, a novel technique for collecting and dataset on educational quality across the globe. The body of work in this dissertation demonstrates substantial performance gains over traditional fixed-weight models, offering a scalable solution for diverse spatial prediction challenges.