Open science: Investigating precipitation cycles in dynamically downscaled data using openly available radar data and open source software

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In order to assess infrastructure resilience to climate change in urban centers, climate model output is needed at spatial resolutions required for urban planning. This is most commonly achieved using either empirical or dynamic downscaling at present. The utility of these downscaling methods for assessments depends on having estimates of biases in the models estimate climate variables and their extremes, surface temperature and precipitation as an example, developed using historical data sets. Since precipitation is a multi-scale stochastic process direct comparison with observations is challenging and even modern data sets work at scales too coarse to capture extreme events. Gauge data requires a direct hit by a storm to see the highest rain rates, often leading to an underestimation in the 1-100 year rainfall. This is exacerbated by phenomena such as training that can cause very high gradients in accumulation.

This presentation details a long-term (multi-year) study of precipitation derived from open data from the NOAA Next-Generation Radar (NEXRAD) network. Two locations are studied; Portland, Maine, location for a pilot study conducted by the US Department of Homeland Security's on regional resilience to climate change and the Southern Great Plains of Oklahoma, home to the Department of Energy's ARM program. Both are located within 40km of a NEXRAD radar allowing retrievals of rainfall rates on the order of one kilometer using the Python-ARM Radar Toolkit (Py-ART). Both the diurnal and season cycle of precipitation is studied and compared to WRF dynamically downscaled precipitation rates. This project makes heavy use of open source community tools such as project Jupyter and the Scientific Python ecosystem to manage and process 10's of TB of data on midrange cluster infrastructure. Both the meteorological aspects and the data infrastructure and architecture will be discussed.