# Using optical flow to remove storm motion from GOES-16 image sequences to help machine learning algorithms detect convection

Yoonjin Lee[1], Jason Apke[1], Imme Ebert-Uphoff[1,2], Kyle Hilburn[1]
[1]Cooperative Institute for Research in the Atmosphere/Colorado State University (CSU)
[2]CSU Electrical and Computer Engineering

The high spatial and temporal resolution of Geostationary Operational Environmental Satellite-16 (GOES-16) data provide invaluable information for convection detection, especially over regions where ground-based radar data are limited. Features of convective clouds such as bubbling cloud tops and rapid cloud top cooling signatures are better observed from temporal image sequences rather than a static image. Recent work has demonstrated how machine learning (ML) can extract spatial features to improve decision-making tools which diagnose convection from GOES imagery. However, we hypothesize that to optimally detect convective areas with GOES, it is important to use ML techniques that can extract both the spatial and temporal features of convective clouds which are subjectively evident in image sequences. This presentation describes a convolutional neural network model that was developed for this purpose. One-minute images of channel 2 reflectance and channel 13 brightness temperature are used as inputs and trained against a gridded radar product called Multi-Radar/Multi-Sensor System (MRMS).

Results from the baseline model are comparable to the radar product, but finding spatial patterns of convective clouds that are simultaneously moving and growing is a hard task even for an advanced machine learning model. To reduce the degrees-of-freedom coming from storm motion, and to help the model to focus more on relevant spatial patterns of convective clouds during the training, optical flow motions derived from the Optical flow Code for Tracking, Atmospheric motion vector, and Nowcasting Experiments (OCTANE) developed at the Cooperative Institute for Research in the Atmosphere are used to remove cloud advection by warping the input images to the last time step. This puts the images in a common storm-relative coordinate system, and the warped images are then tested in the same ML model. Results using original images and using warped images as inputs are compared, and potential improvements coming from removing the effects of cloud advection from the input images are analyzed.