Data Science in Weather Forecasting

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Goal of this project

- Explore the feasibility of using publicly available weather data to predict the possibility of severe hail in an area in the near future(72 hours)

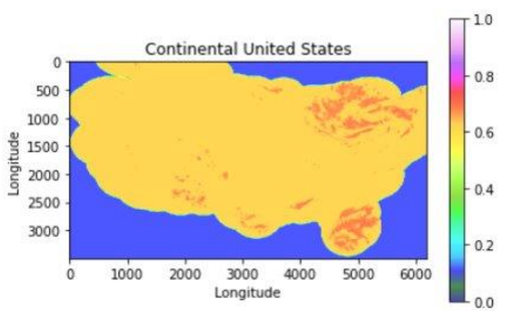
How is this important from an insurance standpoint?
Allocate resources to dealing with the aftermath of the event sooner. E.g. setup call centers, prepare enough in reserves to payout the claims from the event.

Why not go further?
The accuracy of weather predictions decrease as you try to predict farther in the future

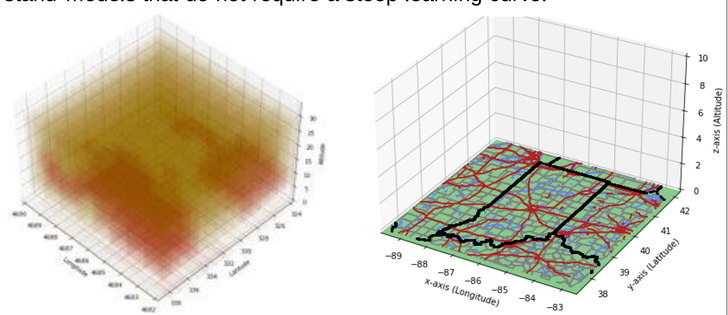
Weather Visualization

Team Goal: Convert the data into a human-readable and easy-to-understand model

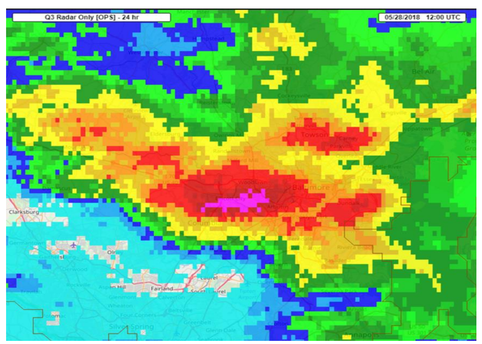
Weather prediction is a crucial element in the evaluation of risk for Nationwide Insurance. The creation of these predictions required extensive technical work, so there needs to be a way to easily interpret these results for non-technical members of the Nationwide staff. Therefore, we created easy-to-understand models that do not require a steep learning curve.



Two-Dimensional Representation
This representation creates an overview of the weather data. Applicable to small and large-scale areas around the Continental United States



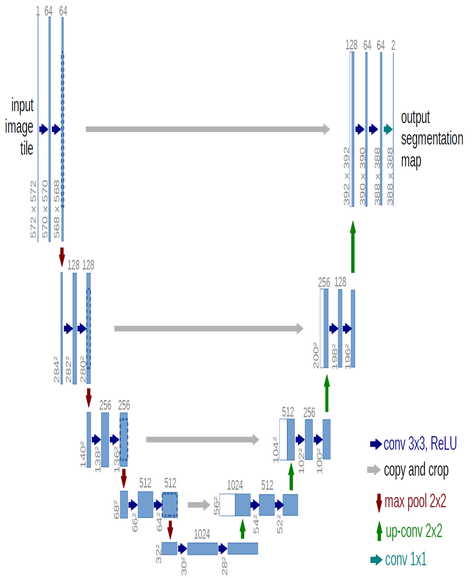
Three-Dimensional Representation
This representation creates an in-depth view of the weather data. Illustrates the differences between each altitude layer. Applicable to smaller areas within the Continental United States (counties and cities)



Data Acquisition Team

What is MRMS data?
- The Multi-Radar Multi-Sensor (MRMS) system integrates data from multiple radars and radar networks, surface observations, numerical weather prediction models, and climatology to generate seamless, high spatio-temporal resolution mosaics.

Team Goal:
- Create a script that can automatically download the weather data files and convert it into a 4D explanatory tensor with dimensions time x altitude x latitude x longitude and a 2D response tensor with dimensions latitude x longitude for the model team to use.



Weather segmentation model

Team Goal: Leverage machine learning to create a model that can take as input volumetric weather data with multiple parameters and predict severe weather events

We started with a base U-Net image segmentation model from a 2015 paper by Olaf Ronnenberger et al. A U-Net model uses convolutions to down-sample an input image and concatenation to up-sample the image for output, allowing the model to retain spatial information through the convolutions and detail through the up-sampling steps. The model also uses image augmentation to reduce the amount of training data needed to train the model.

To adapt the model to take in weather data, we changed the ingestion step so that the augmentation steps will not cause artifacts that do not normally appear when working with weather data. We also modified the down-sampling step of the model to be 3D convolutions so that the model can take in 3D data as input. The output data however would still be a 2D predictor.

Olaf Ronneberger et al., "*U-Net: Convolutional Networks for Biomedical Image Segmentation" May 2015, https://arxiv.org/abs/1505.04597*