Predicting Atlantic tropical cyclone landfalls

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April 29, 2009

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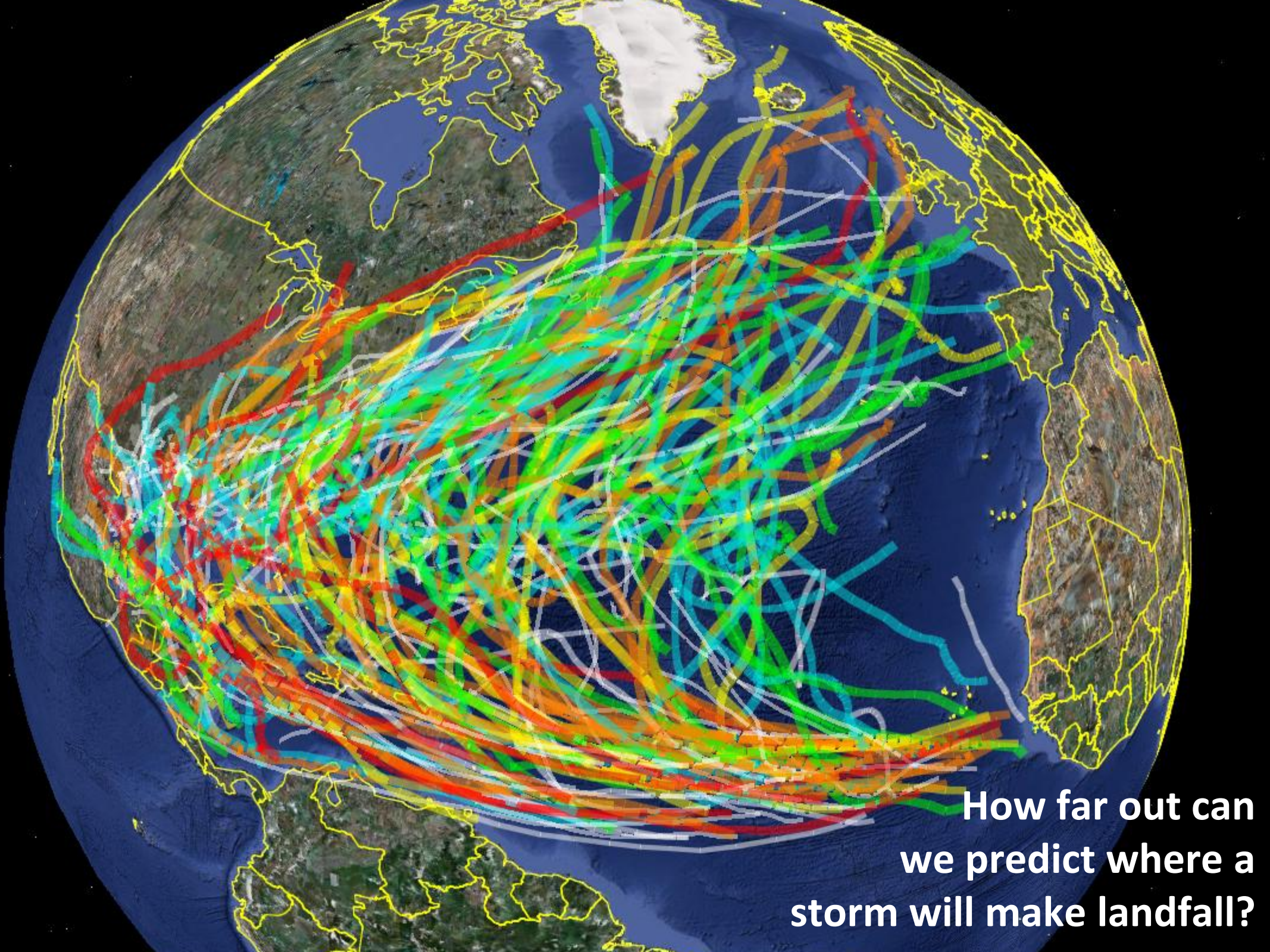
Overview

- **Introduction**
- Methodology
  - SVM vs. k-NN vs. hybrid
  - Data preparation
- Results
  - Performance
  - Observations


How far out can
we predict where a
storm will make landfall?

Datasets

- NOAA HURDAT
  - Every tropical cyclone since 1850’s
  - 6-hr interval
  - Location, intensity, direction
- NOAA North Atlantic Oscillation
  - Climate pattern controlling weather across North Atlantic
  - Monthly data

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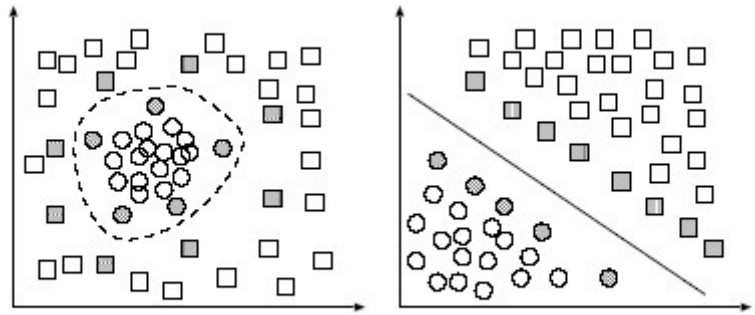
Support Vector Machine

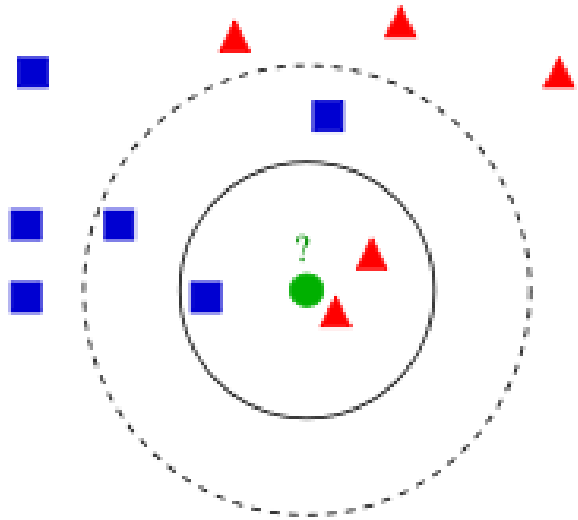
- Implementation: libSVM
  - Type: C-SVM
  - Kernel: Radial Basis Function



(a) Radial Basis Function (b) RBF mapping

- Combine subset of trackpoints into single vector
- Scale elements to [0,1]
  - Huge performance increase
- Grid search to select optimal parameters for kernel

k-Nearest Neighbors



- Distance measures
  - Euclidean
  - Mahalanobis
- Varied k
- Weighted voting
  - Counteracts positive example under-representation
  - Vote ratio 5:2

Hybrid Classifier

- Combines SVM and k-NN predictions
  - Prediction sets are independent
- *n* k-NN prediction sets are generated, weighted, and averaged to form composite prediction
- SVM prediction set is weighted (<1)
- Sum of sets is hybrid prediction

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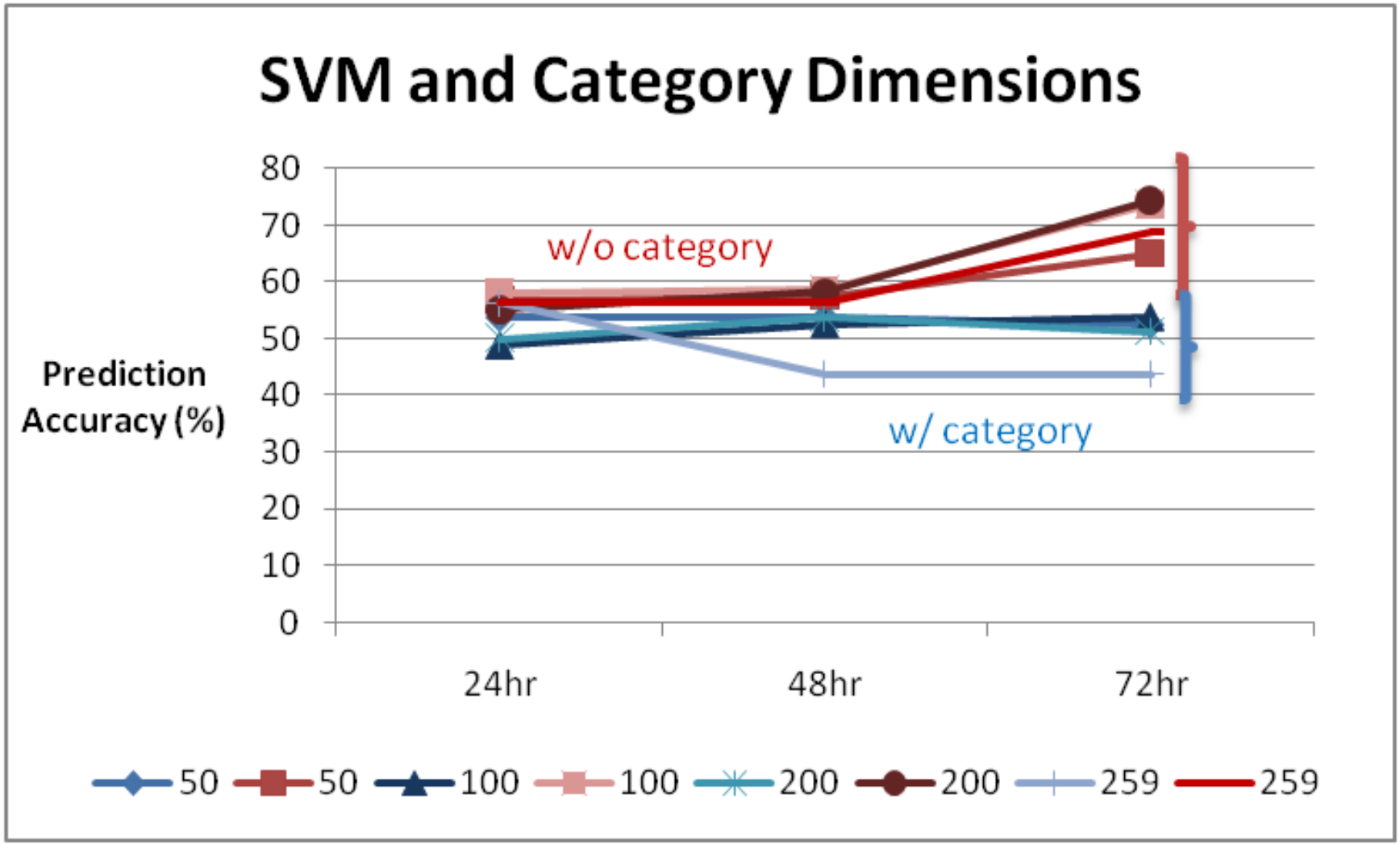
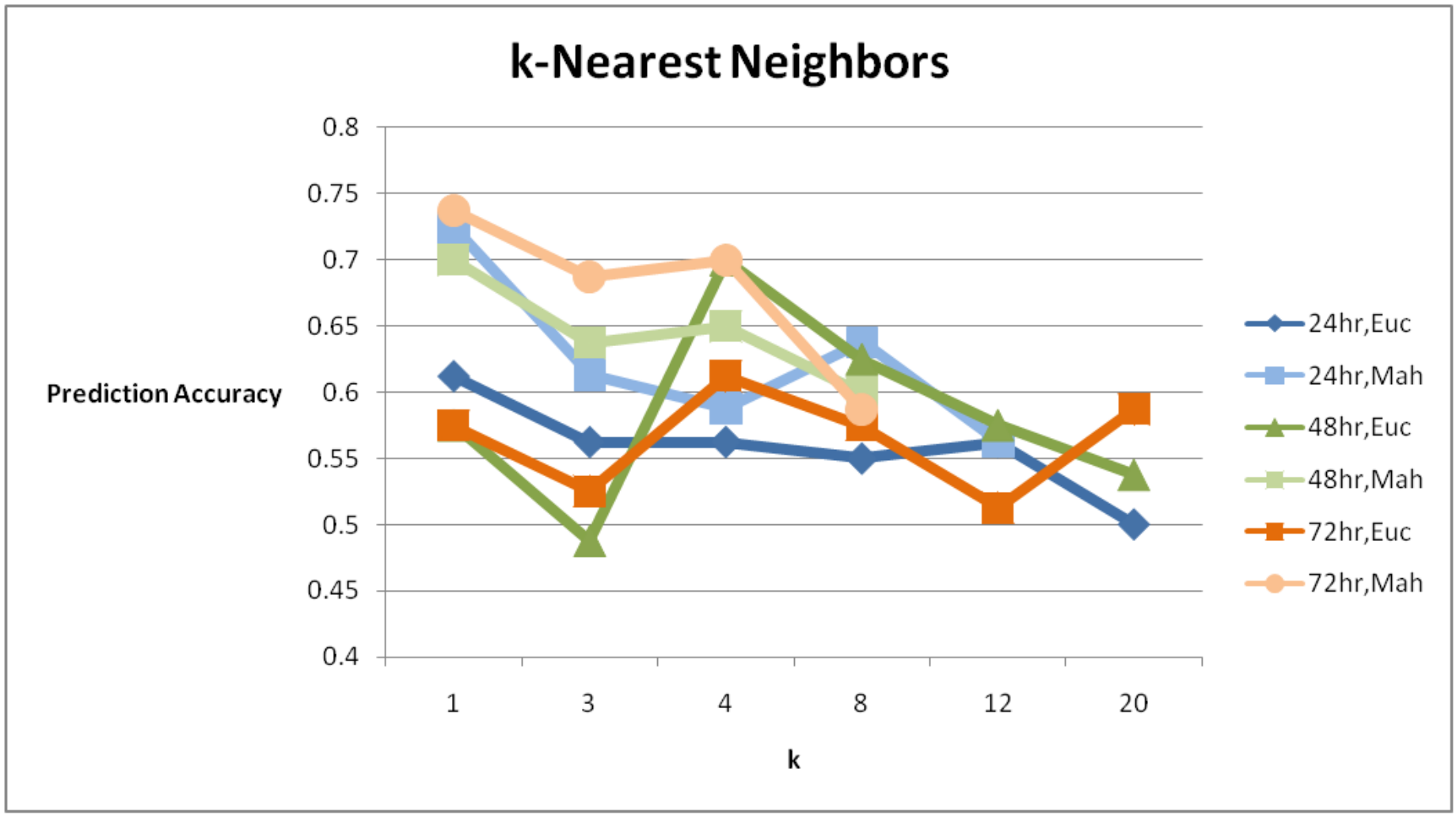
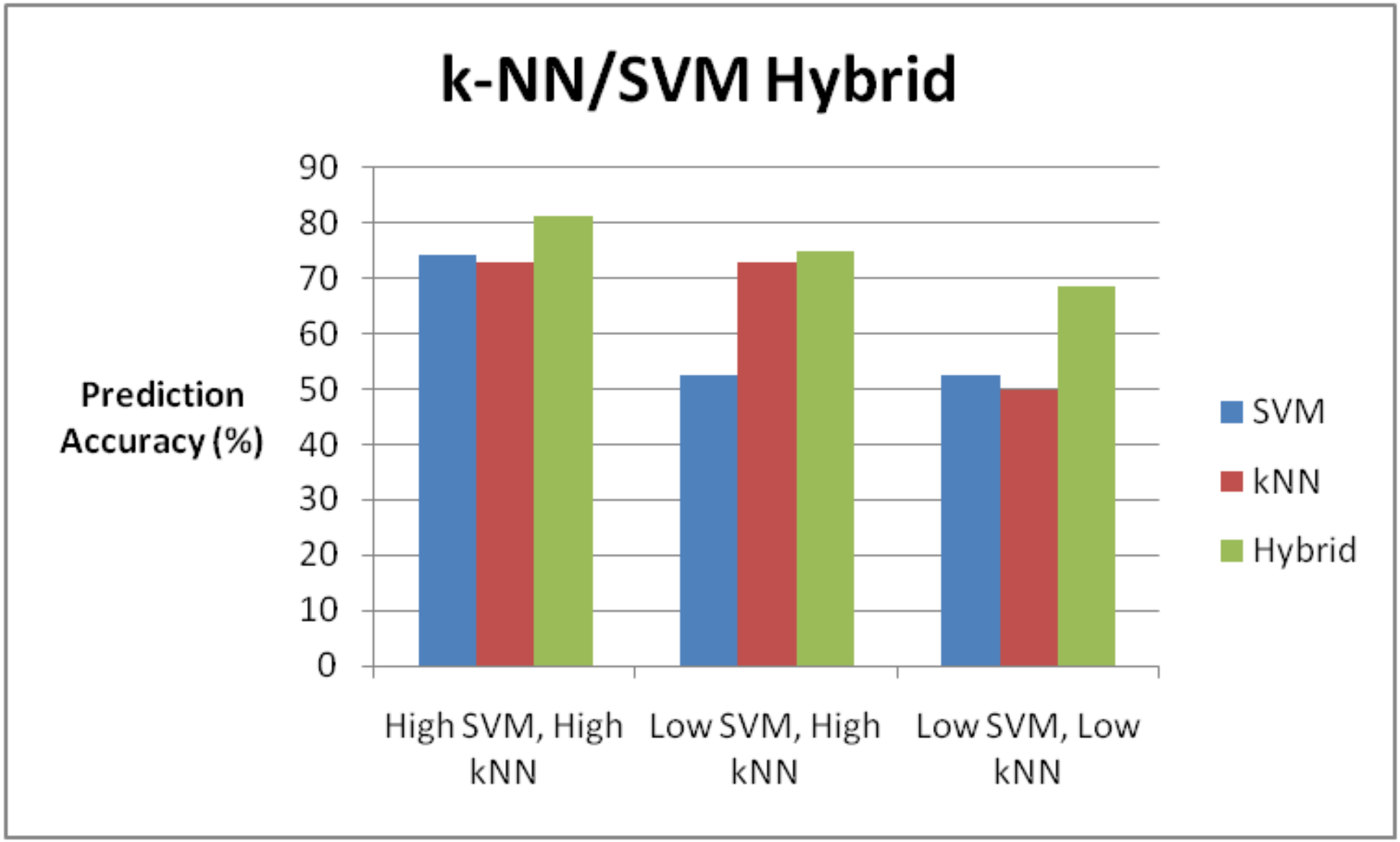
SVM Performance



k-Nearest Neighbors



Hybrid Classifier



Conclusions

- Scaled data and RBF kernel produces good consistent results
- Despite its simplicity k-NN can yield good results
- SVM and k-NN are sensitive to different aspects of the data and can produce better results when combined

- …Climate prediction is difficult with no knowledge of climate science