Predicting States Renewable Energy Production

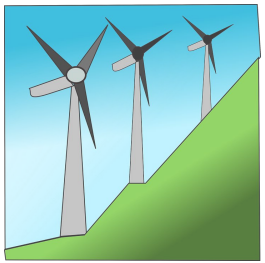
By Alex Diaz-Clark

Project Goals

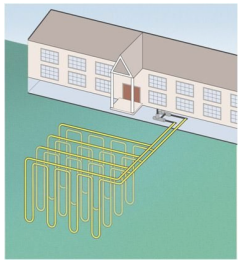
- Forecast 2020 monthly electricity generated from each renewable resource for each state based on 2001-2019 data
- Identify which states are poised to increase their portion of electricity generated from renewable resources.
- Create an interactive data dashboard for users to explore historical trends and 2020 forecasts.

The Data

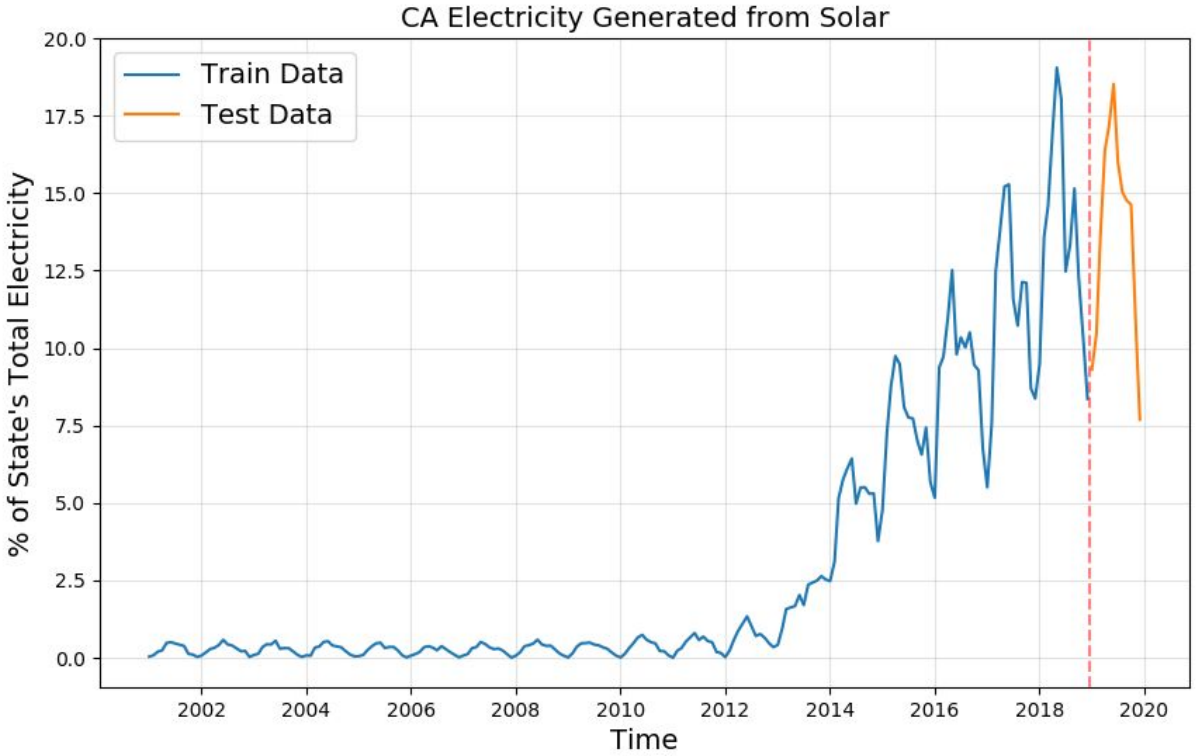
- DOE's Energy Information Administration
- Monthly time-series from 2001 to 2019: 228 periods
- Electricity generated (MWh) from all resources, including renewables
- Transformed from MWh to % of states total electricity generated
- 5 renewable energy sources x 50 states = 250 forecasts to make







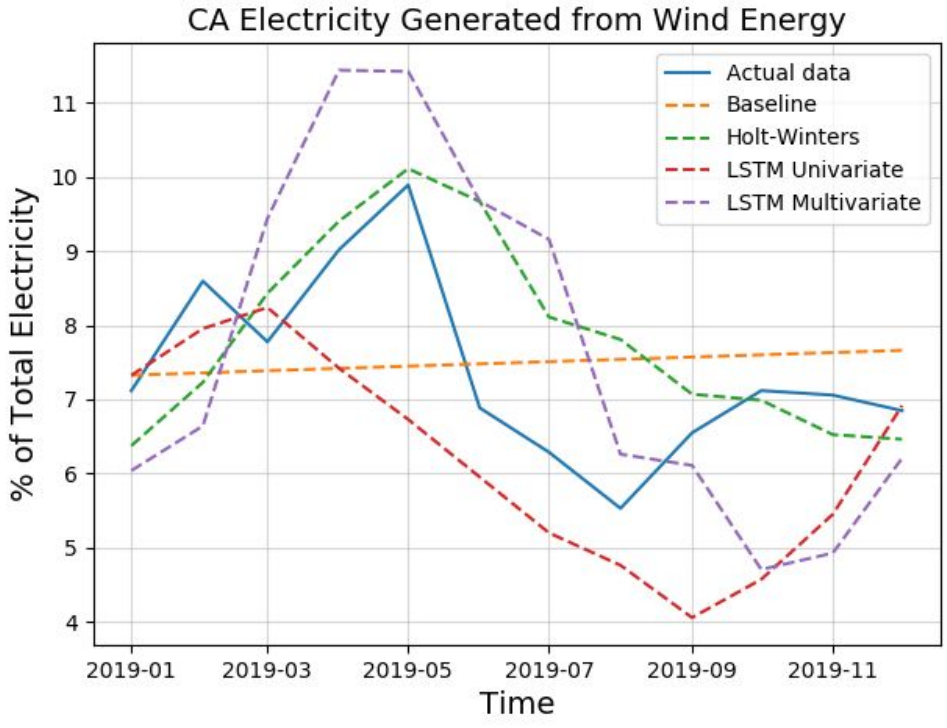
Modeling



Models used:

- Baseline: Linear regression fit to train data
- Holt-Winters method of triple exponential smoothing
- Univariate LSTM Neural Network
- Multivariate LSTM Neural Network

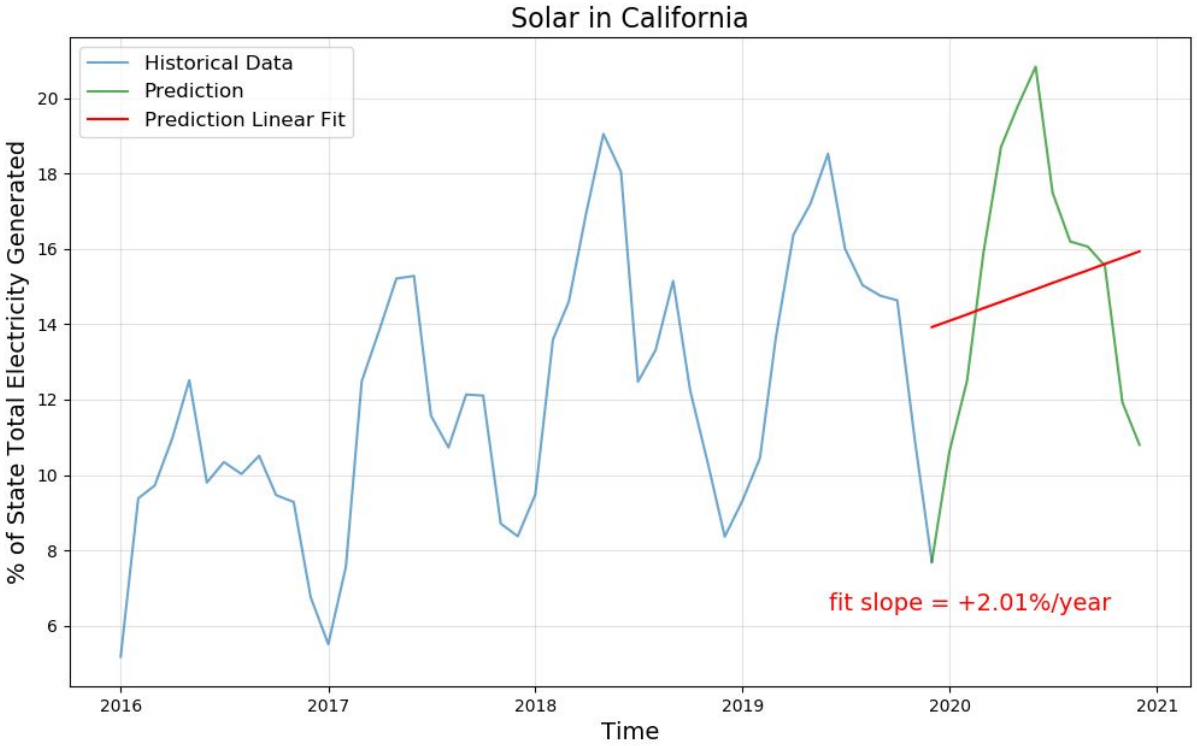
Selecting a Model



RMSE on California Test Data Predictions

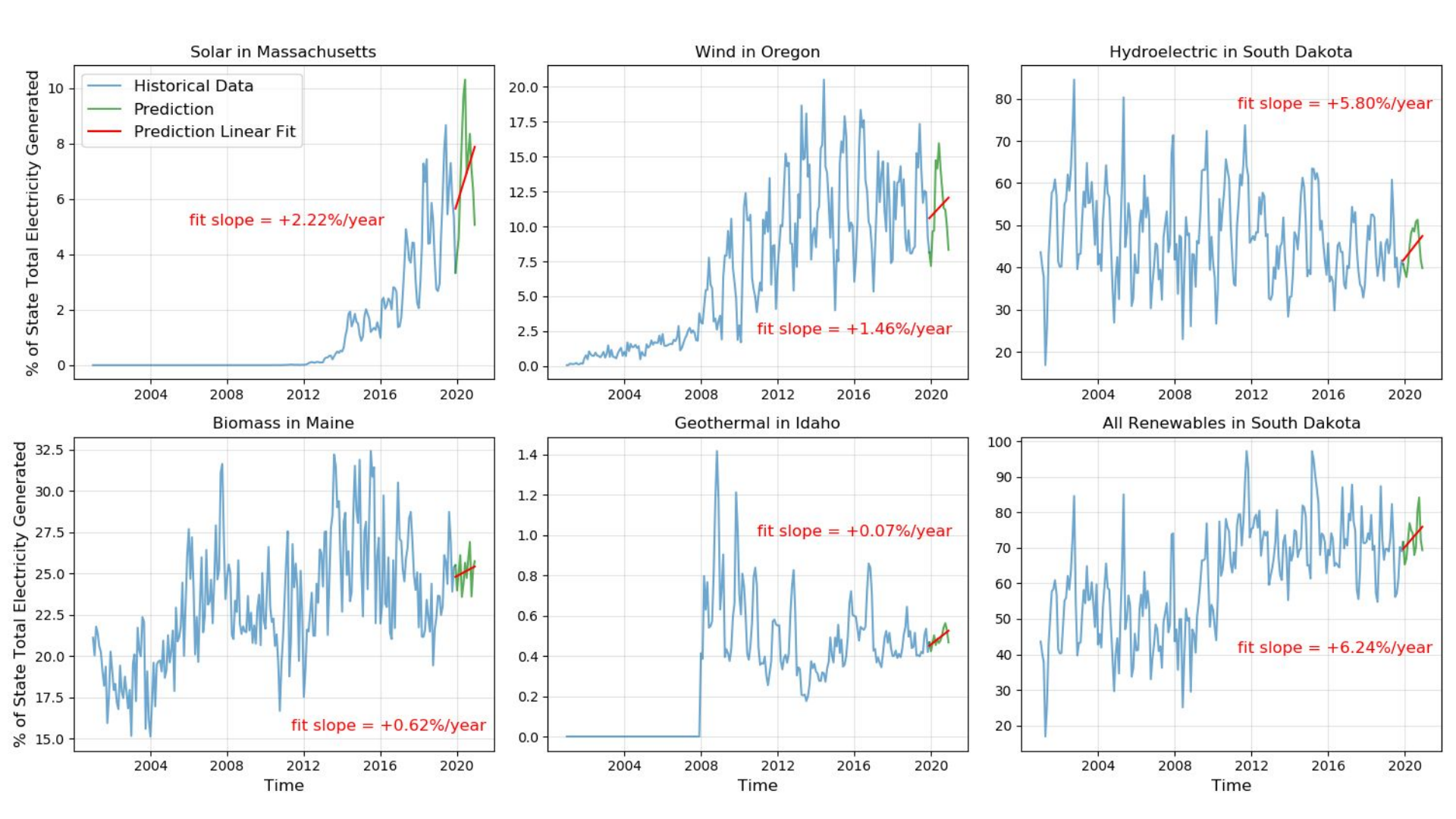
	BL	HW	LSTM Uni	LSTM Multi
Solar	0.055	0.022	0.027	0.029
Wind	0.012	0.013	0.016	0.019
Hydro	0.098	0.099	0.071	0.098
Biomass	0.0045	0.0016	0.0034	0.0044
Geothermal	0.0073	0.0085	0.0070	0.0088
Normalized Avg for CA	**1.0**	**0.79**	**0.82**	**1.05**
Normalized Avg for all forecasts	**1.0**	**0.88**	**1.05**	**1.43**

Analyzing Predictions



Identifying Leading States for 2020:

- Fit linear regression to 2020 forecast
- Find fit slope
- Compare each state's fit slopes for each renewable resource to find leaders


Solar in Massachusetts
Historical Data
Prediction
Prediction Linear Fit
fit slope = +2.22%/year
% of State Total Electricity Generated
Wind in Oregon
fit slope = +1.46%/year
Hydroelectric in South Dakota
fit slope = +5.80%/year
Biomass in Maine
fit slope = +0.62%/year
Geothermal in Idaho
fit slope = +0.07%/year
All Renewables in South Dakota
fit slope = +6.24%/year
Time

Conclusions

- For all renewables category, only 6 states with increasing forecasts; might see a 2020 dip in renewable energy for the US
- For geothermal, 46 states don’t use it, 2 states with increasing forecasts; source most likely to decrease in 2020
- 27 states with increasing forecasts for biomass: might see 2020 increase