Global Warming Analysis & Temperature Forecast

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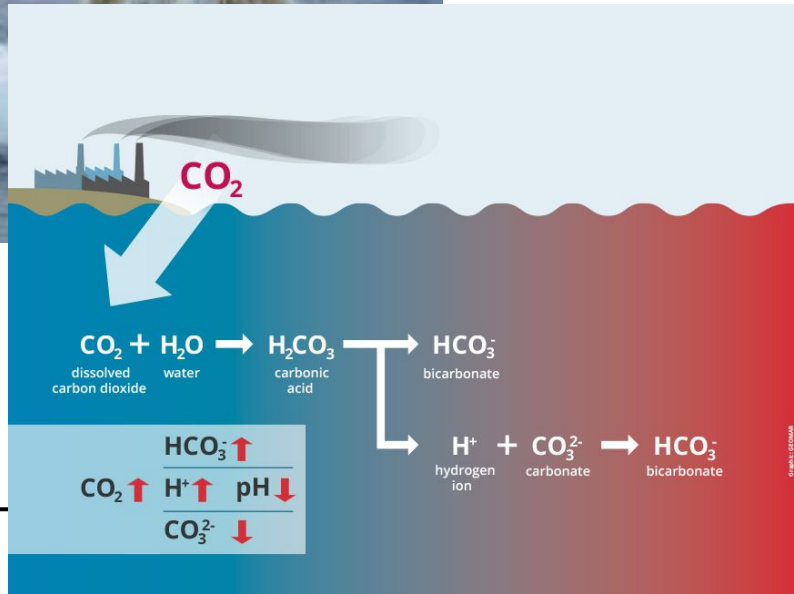
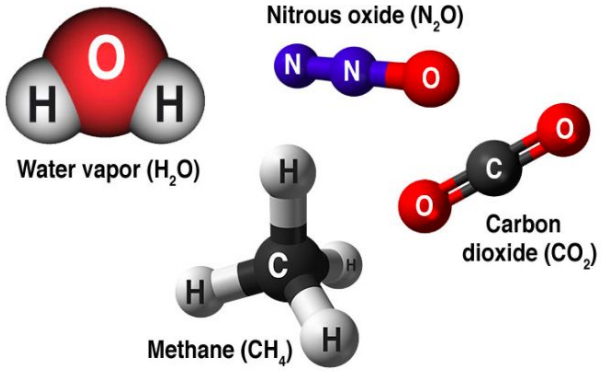
Global Warming - a global public concern

1. Global sea level rising
2. Various types of disasters, including storms, heat waves, floods, and droughts
3. Negative influence to agricultu
4. Wildlife habitat destruction / higher wildlife extinction rates
5. More acidic oceans

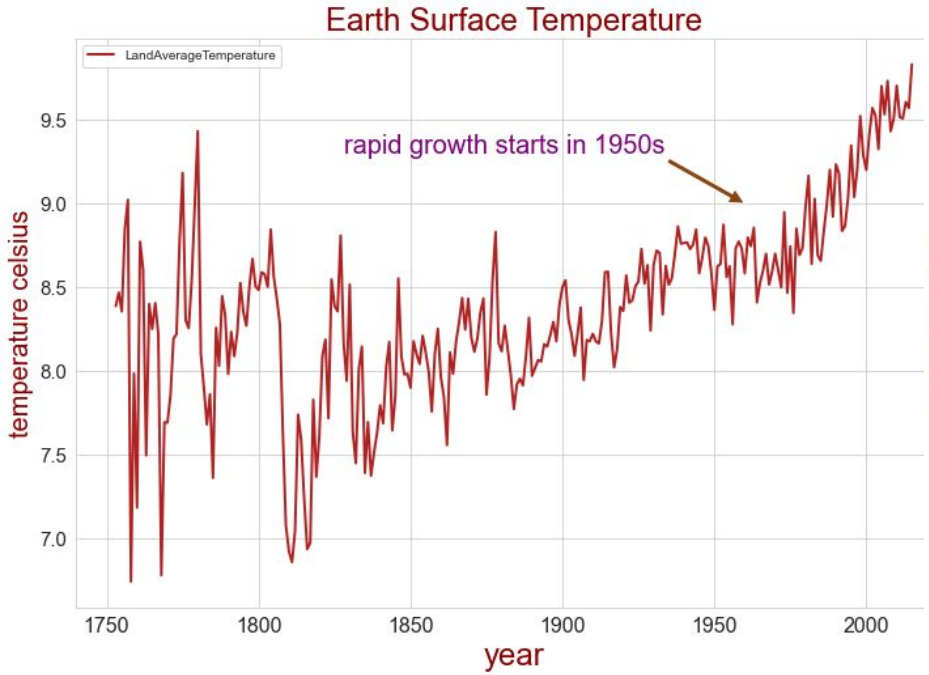


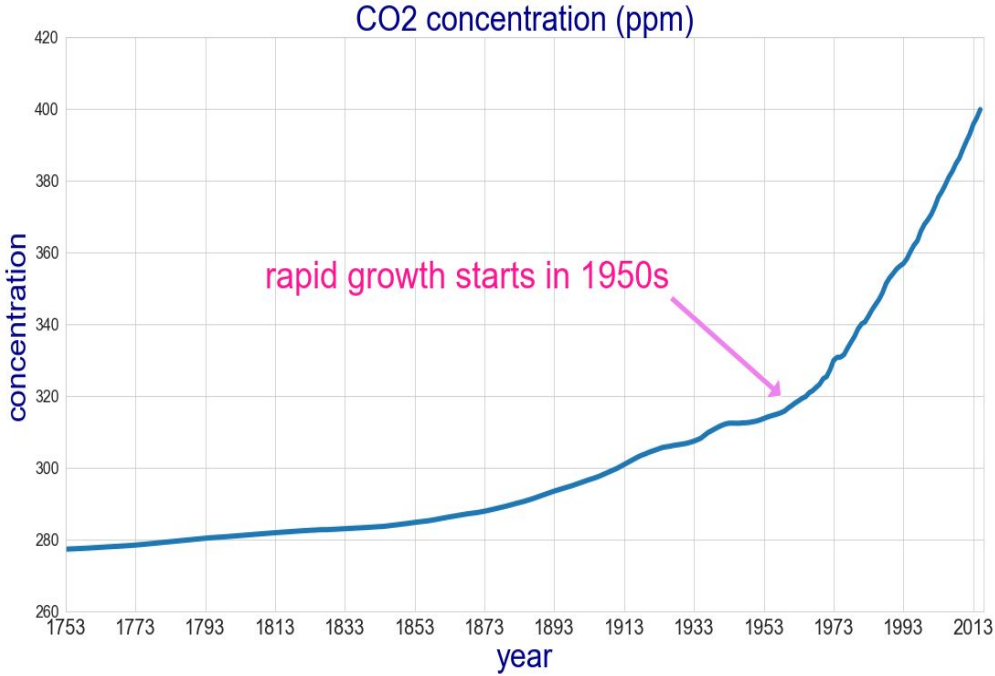
Important Factors

1. CO_2 concentration in the air
2. Other harmful gases
3. World population
4. World urban population
5. Sunspots



Earth Surface Temperature Trend & CO2

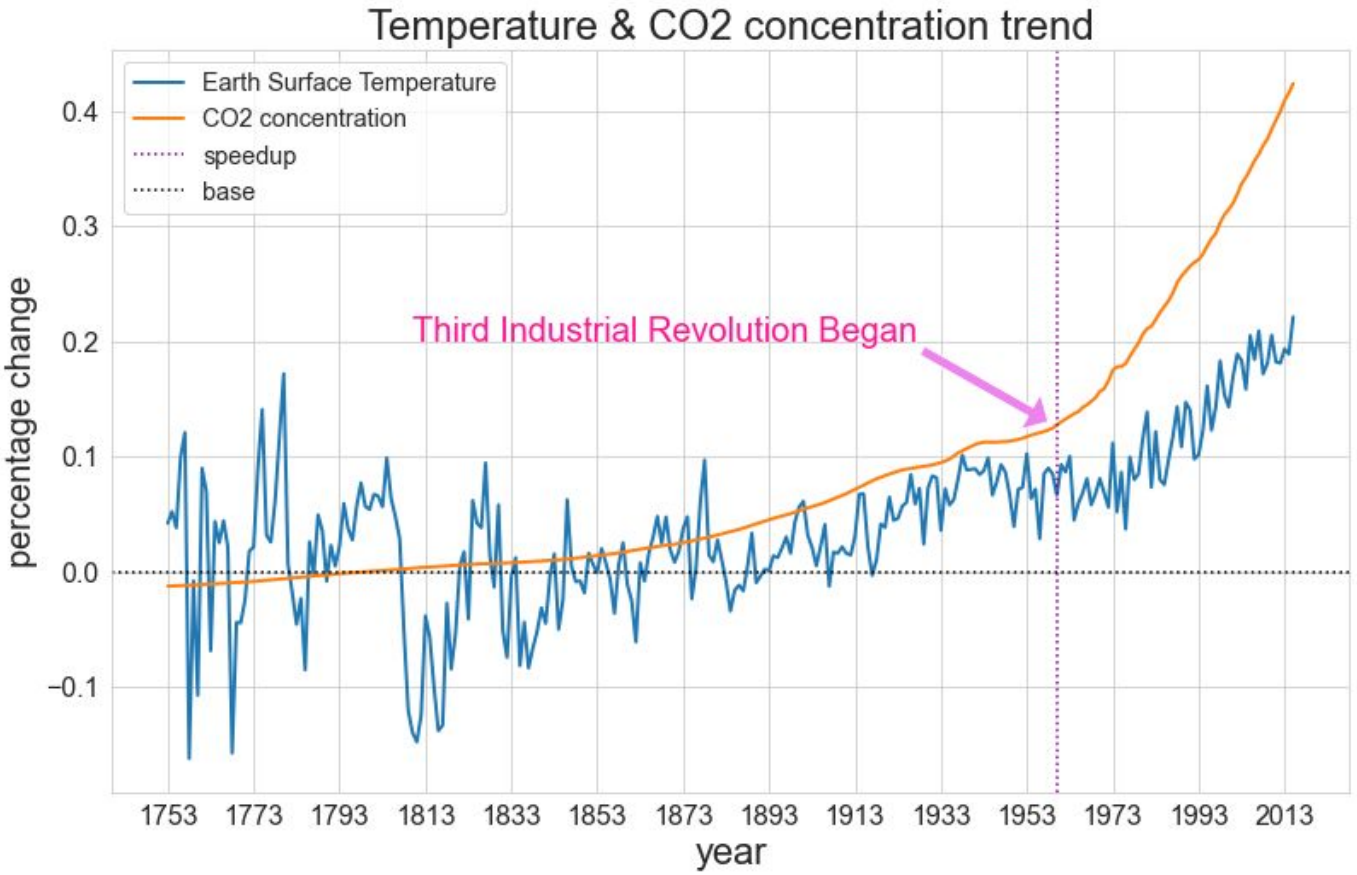




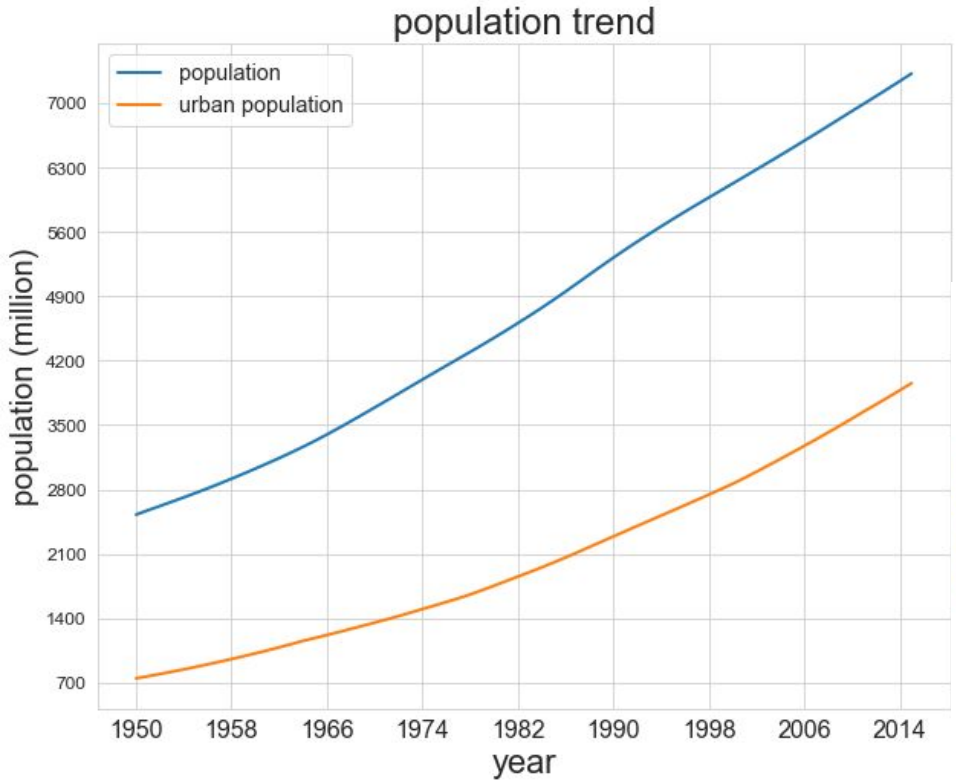
Earth Surface Temperature Trend & CO2

The rise of emerging economies (industrialization of developing countries)

The **third industrial revolution (1950s)**

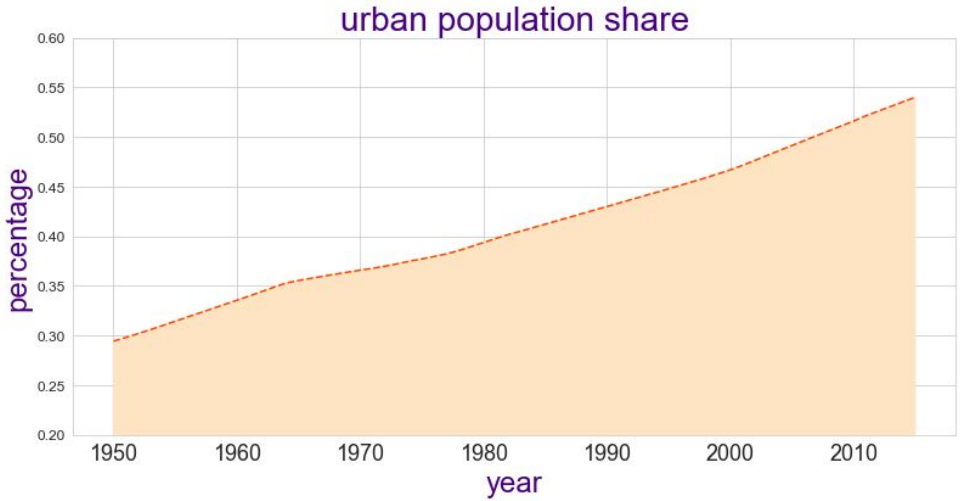


World population trend

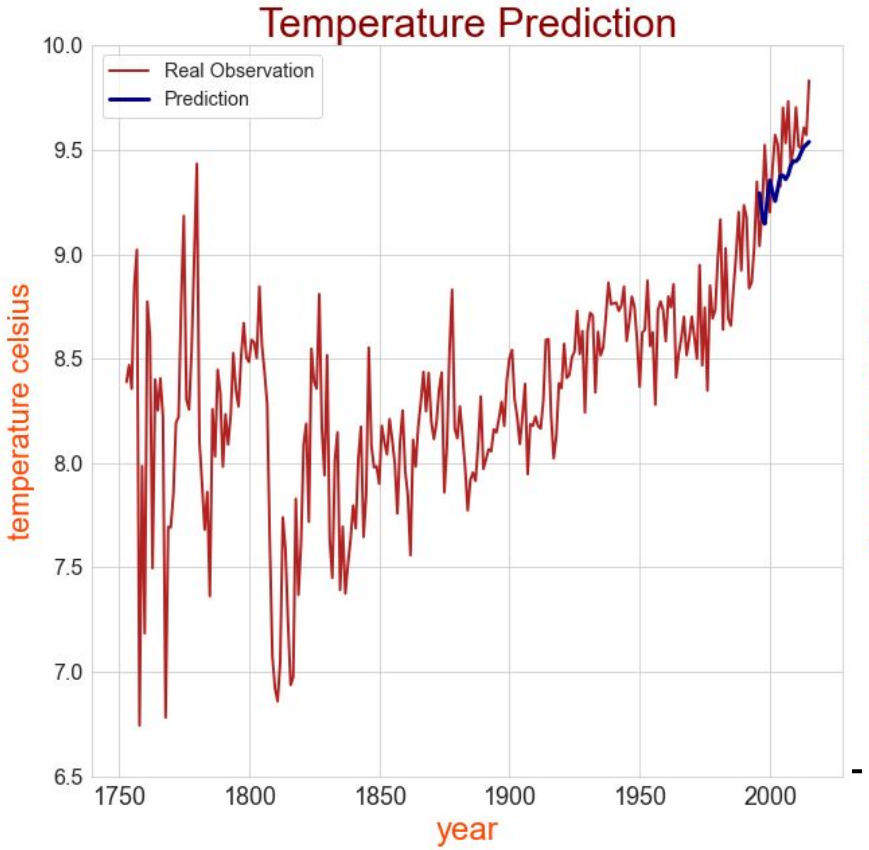


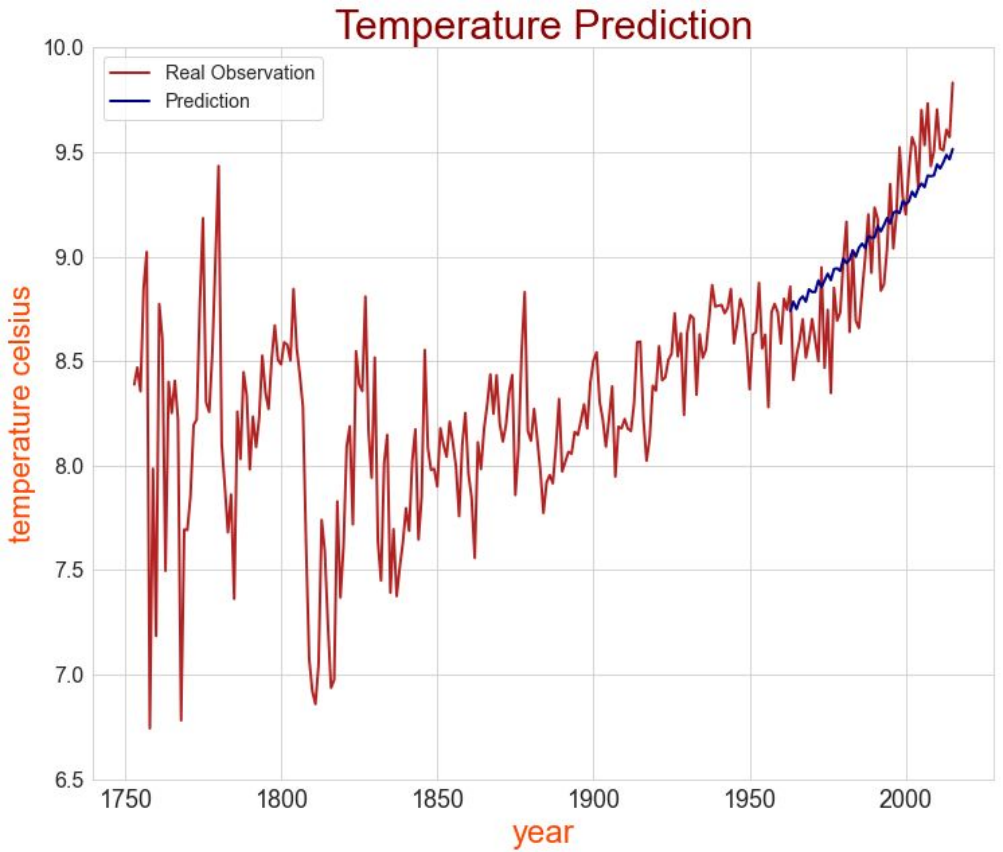
Urban population percentage doubled during the last 60 years.

Significant migration to large cities.

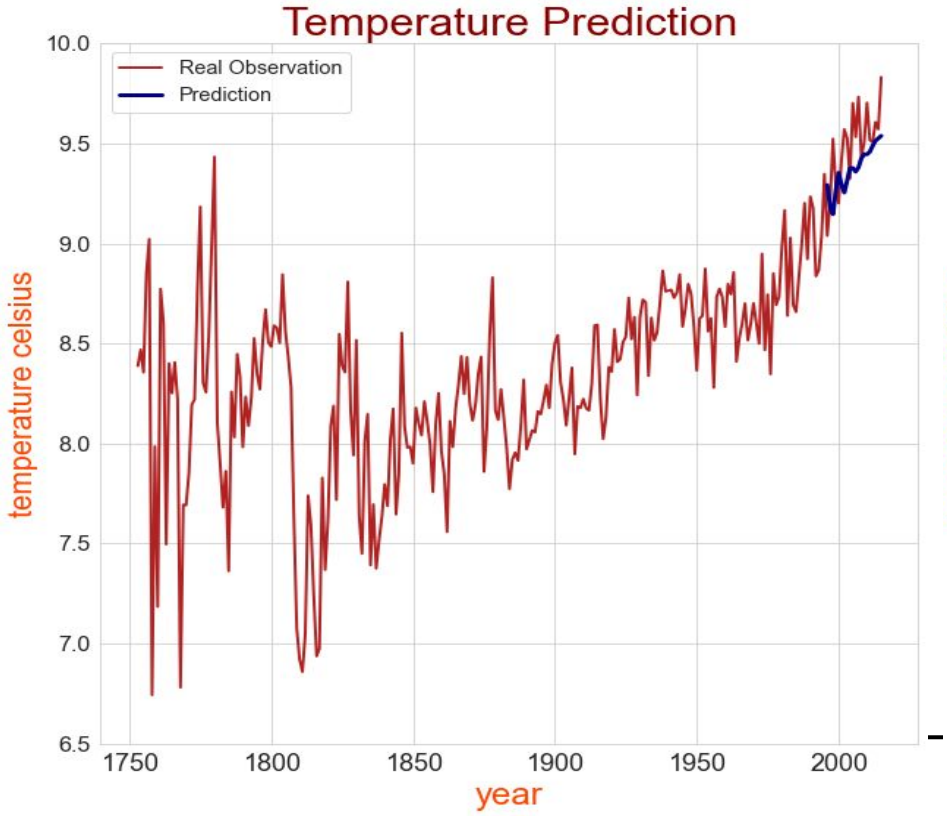


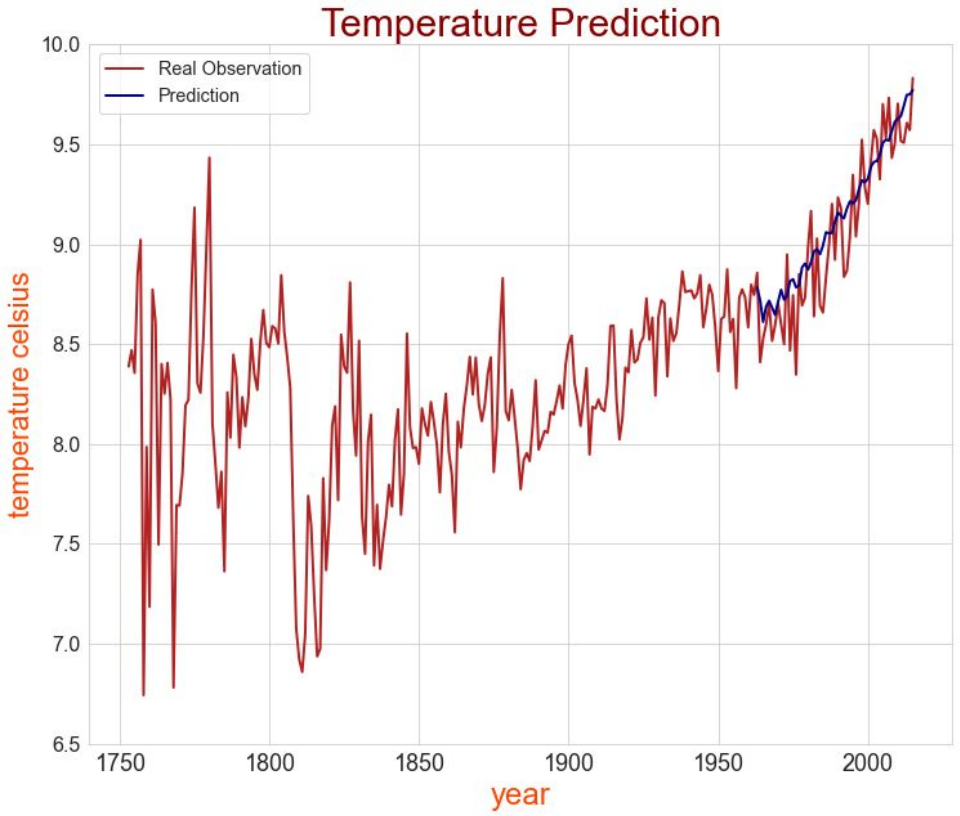
Modeling - pure time series forecast





Modeling - ARIMAX with exogenous variables



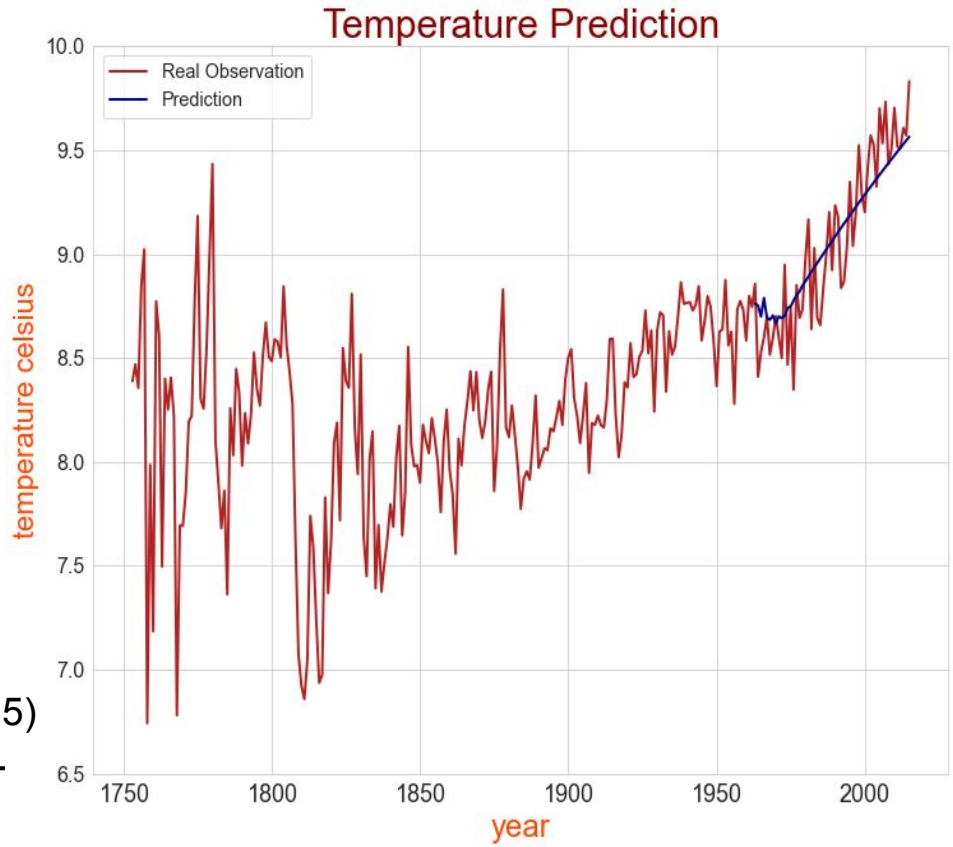


Best model results

ARIMAX(exogenous), **RMSE:0.13, MAE:0.09**
VECM(multivariates), **RMSE:0.13, MAE:0.10**
ARIMA
SARIMAX
VAR
Fbprophet

Real earth surface temperature: mean 9.58°C (2003 - 2015)

VECM model



Cointegration and Granger Causality

Cointegration	
Temperature & CO_2 Concentration	True
Temperature & World population	False
Temperature & Urban population	True

Granger Causality	
CO_2 Concentration -> Temperature	True
Temperature -> CO_2 Concentration	False

Conclusions

(1) CO2 and urban population has contributed to acceleration of global warming since the 1950s, since the third industrial revolution time.

(2). For multiple time series case, understanding the relationship between variables is important and is the foundation of choosing models.

(3). Main limitation of this project is that population data is lacking, only have population data after 1950s. People need another 100 years to fully understand how earth climate are changed by ourselves and how it affect back

Thank you!