SDG 6 CLEAN WATER AND SANITATION

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GOALS

- Target 6.1. Safe and Affordable drinking water.

  Indicator: Proportion of population using safely managed drinking water.

- Target 6.3. Improve water quality, waste water treatment and safe reuse.

  Indicator: Proportion of bodies of water with good ambient water quality.

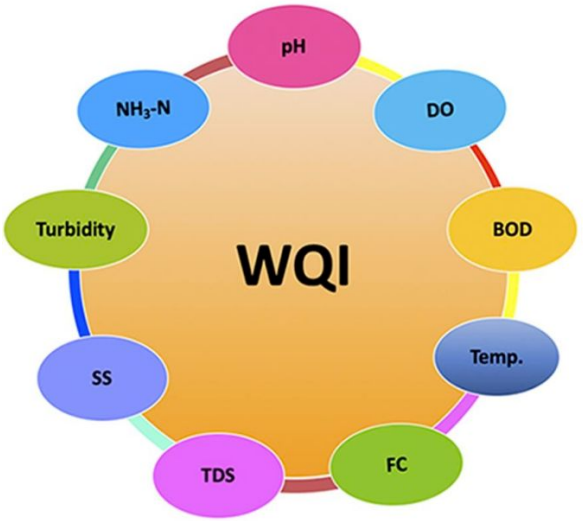
WHY BIG DATA?

- Around 20,000 stations generating tons of data every month.

Images source : https://sdgs.un.org/goals/goal6

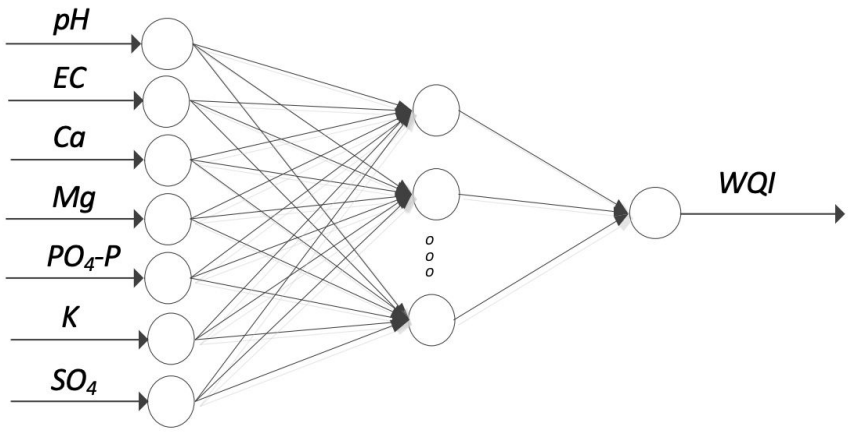
Background

"A Review Of Water Quality Index Models And Their Use For Assessing Surface Water Quality"



https://www.sciencedirect.com/science/article/pii/S1470160X20311572

"Forecasting Water Quality Index in Groundwater Using Artificial Neural Network"



https://www.mdpi.com/1996-1073/14/18/5875/pdf

"Short-term water quality variable prediction using a hybrid CNN–LSTM deep learning model"

https://link.springer.com/article/10.1007/s00477-020-01776-2

"Provide decision makers and stakeholders with quantitative information to facilitate sustainable management of ongoing and emerging environmental problems"

Data

Icons taken from: https://www.flaticon.com/

GEMStat

European Environment Agency

(Time Series Data, 14 GB)

Station ID	Location	Time	pH	BOD	Temp	TSS	Nitrate	…..
IND1002	India	11-01-1995	….	….	….	….	….	….
NOR341	Norway	12-02-1997	….	….	….	….	….	….
EGY742	Egypt	01-03-2003	…	…	…	…	…	…

Name	From	To
Europe	1941	2018
Africa	1960	2020
India	1971	2008

Table. Years of data for Europe, Africa, India

Methods

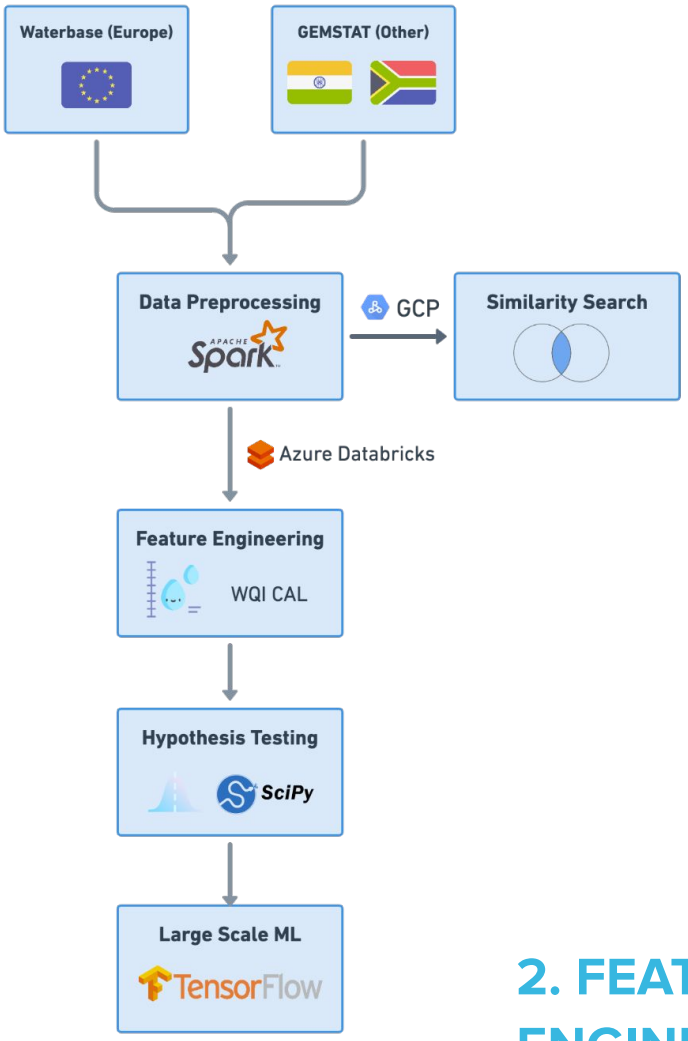
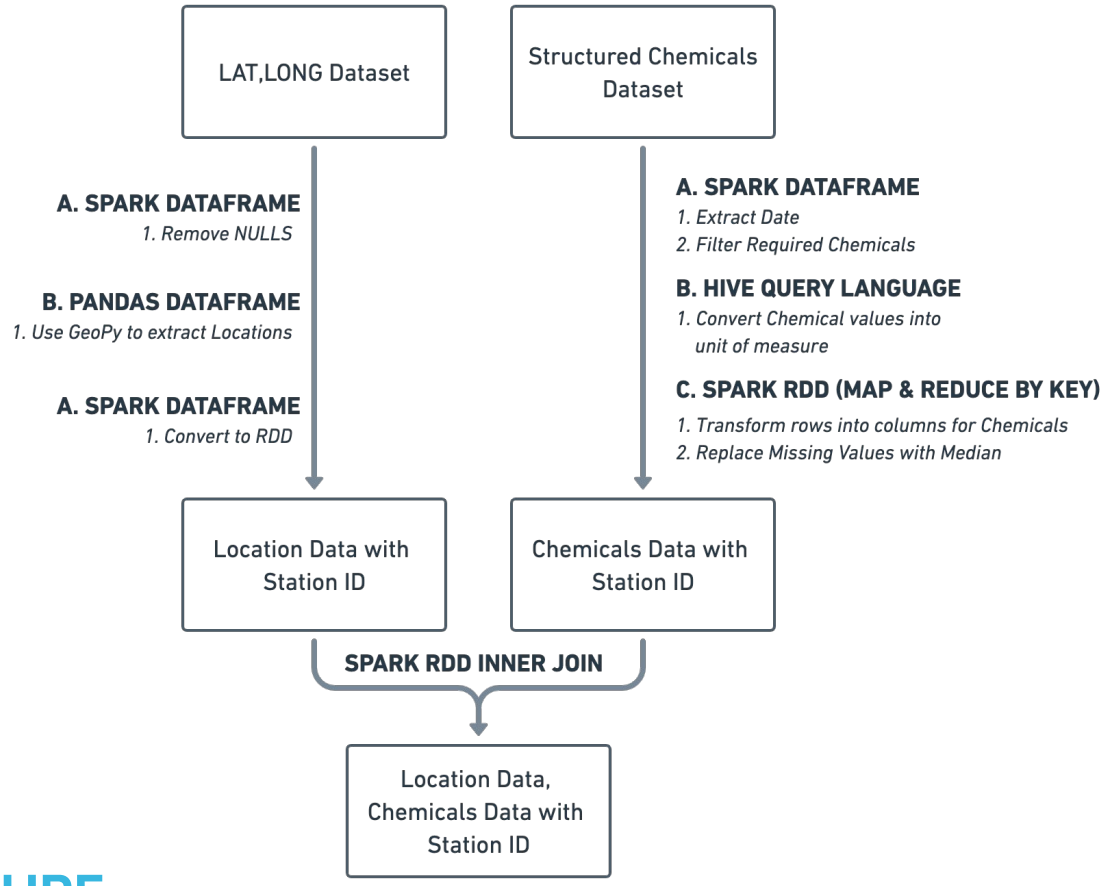


Figure. Data Pipeline

1. DATA PREPROCESSING



2. FEATURE ENGINEERING

WQI Calculation Ref : Link

WQI = TEMP * (BOD + TSS + DO + COND)

DO = Dissolved Oxygen Index
COND = Conductivity Index

Temp = water temperature index, BOD = Biological Oxygen Index, TSS = Total suspended Index

Icons taken from: https://www.flaticon.com/

Methods

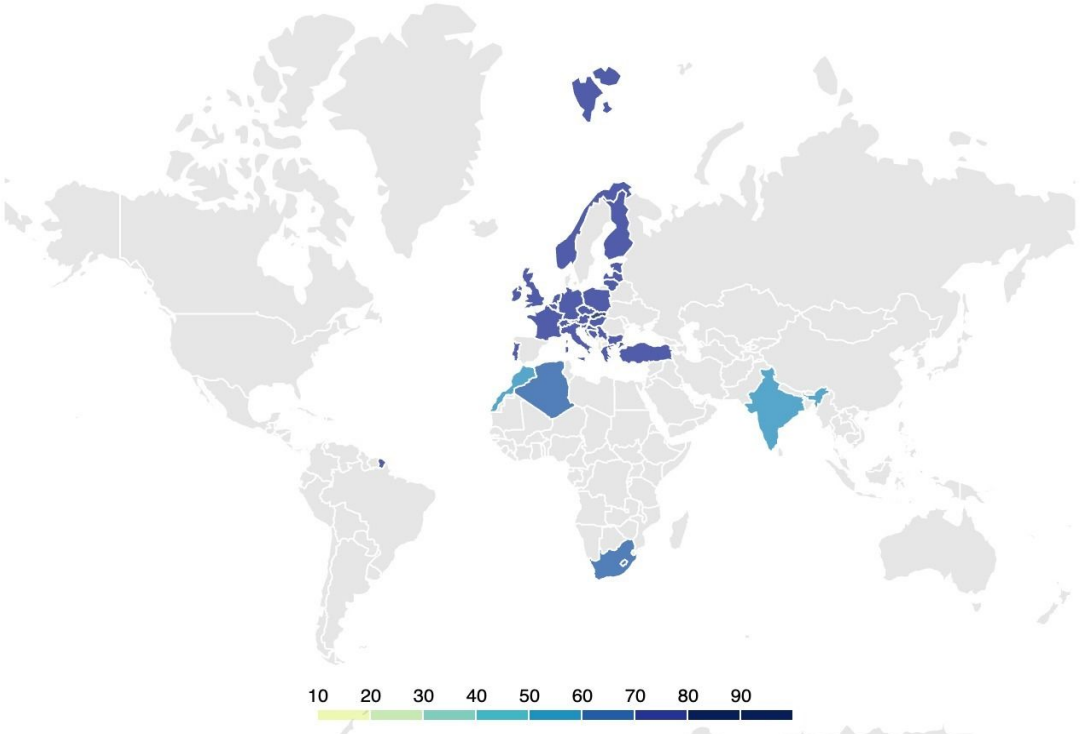


Figure. Heat Map of WQI ranges for Africa, Europe and India

3. SIMILARITY SEARCH

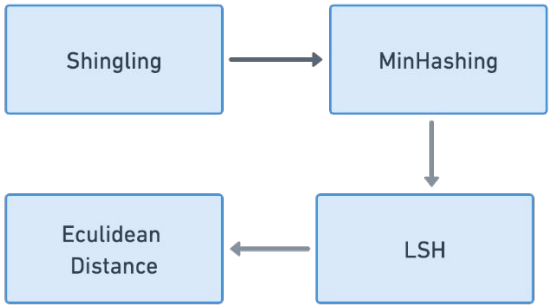


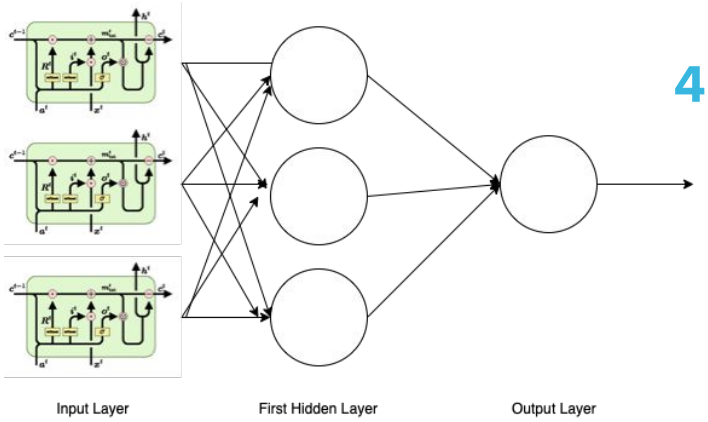
Figure. Similarity Search Pipeline

Factors

Economical: GDP, GNI
Environmental: CO2 Emissions, Air Pollution
Societal: Population, HDI, Life Expectancy
All Chemicals: pH, TSS, BOD, COND, TEMP

5. LARGE SCALE ML

LSTM Model for Time Series
Batch_Size: 16
Epochs: 50:
Input Layer: 100 LSTM Units
Hidden Layer: 50 FCN,
Output Layer: 1 FCN,
Split: 80% Train, 20% Test



4. HYPOTHESIS TESTING

WQI VS Chemicals

$$P\,Value_{Bonferroni} = P\,Value * m$$

$$(where\ m\ is\ Number\ of\ countries)$$

Evaluations / Results

Features	Cosine Similarity	P-Value	Bonferroni corrected P-Value
Iron	0.005157232	0.00011953	0.006932954
Nitrate	-0.074133163	2.9222E-10	1.69490E-08
Chloride	-0.103132809	0.00078071	0.045281067
Sodium	-0.044942523	2.6782E-10	1.55334E-08
Dissolved_oxygen	0.606046465	1.0456E-09	6.06456E-08
Water_temperature	-0.171881863	6.4731E-05	0.003754424
Total_suspended_solids	-0.006519594	7.7272E-05	0.004481761
Conductivity	0.017448662	0.00029797	0.017281976
Phosphate	0.062399443	9.9192E-05	0.005753125
pH	0.07648714	6.3983E-10	3.71104E-08
Non_ionised_ammonia	-0.099626672	0.02091294	1.2129504

Table. Hypothesis Testing Results

Bonferroni corrected P-value

- ✗ Non_ionised_ammonia > 0.05
- ✓ Others < 0.05

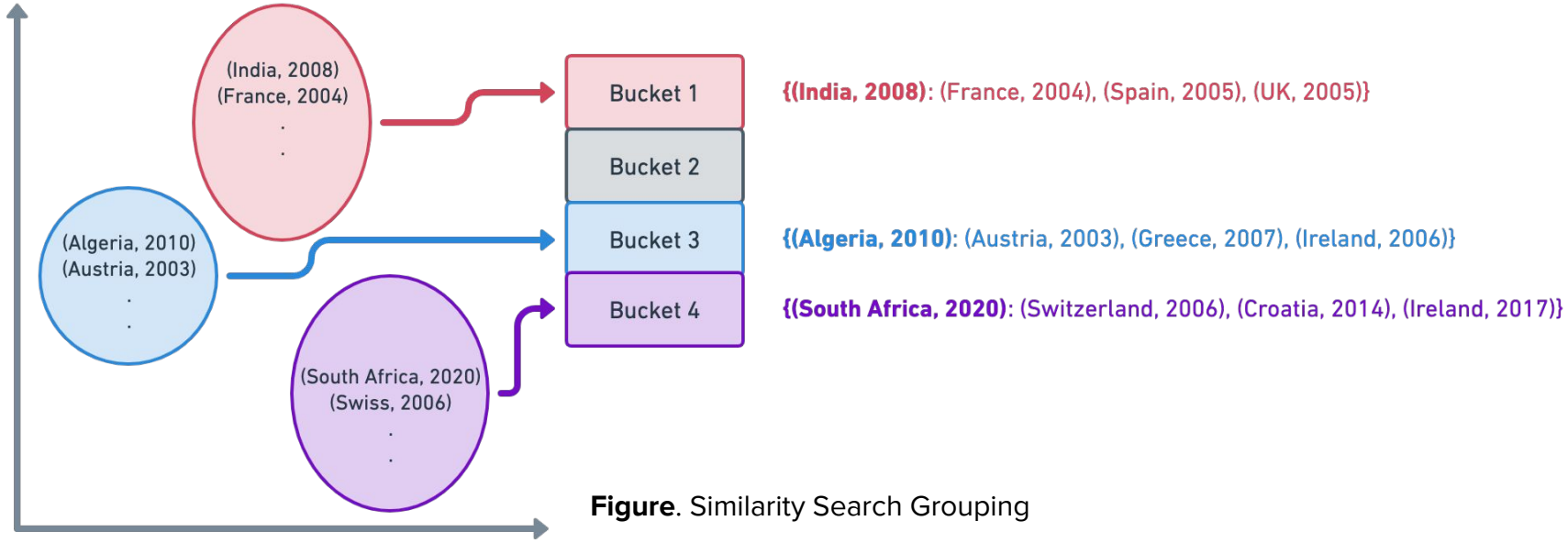
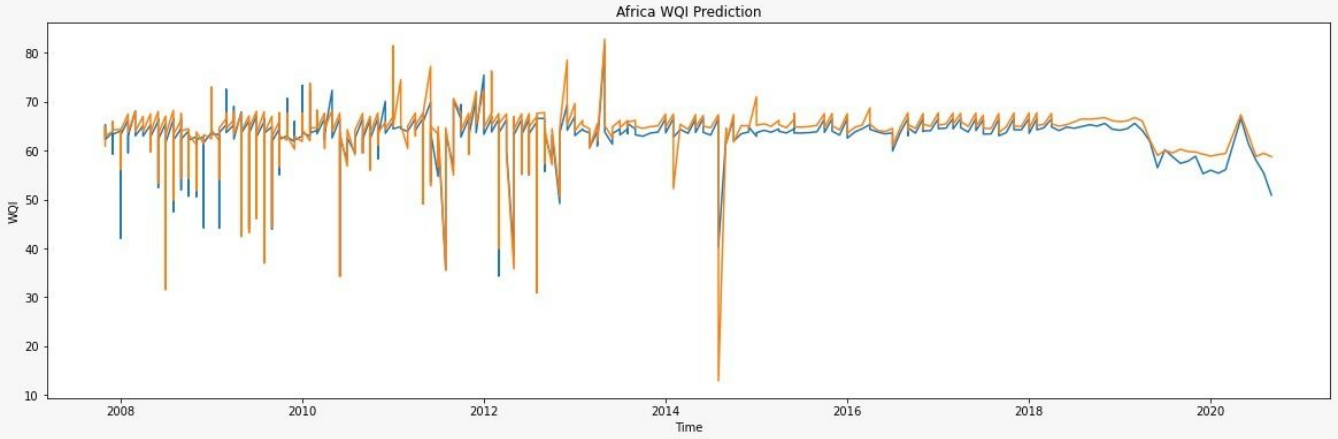


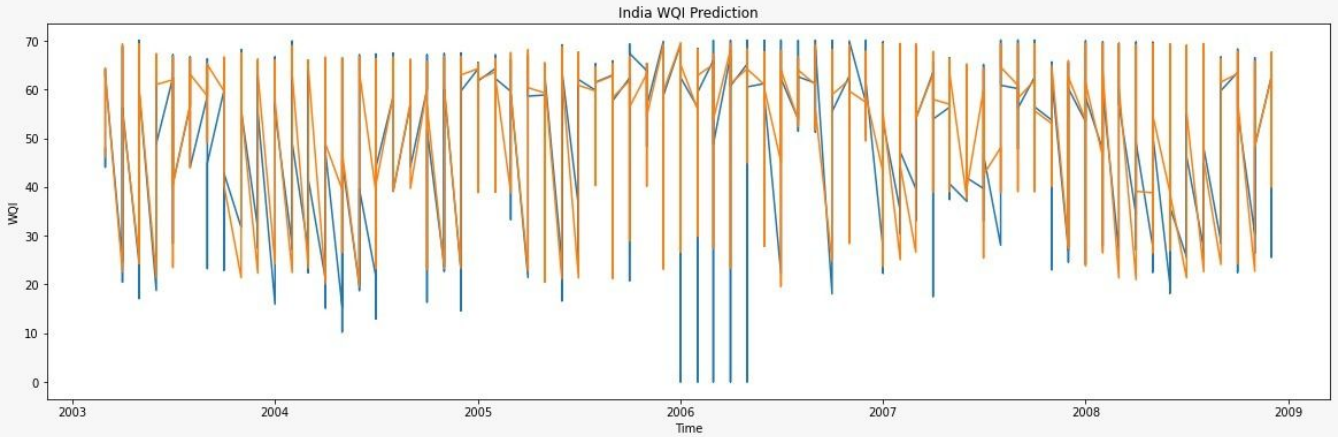
Figure. Similarity Search Grouping

Evaluations / Results



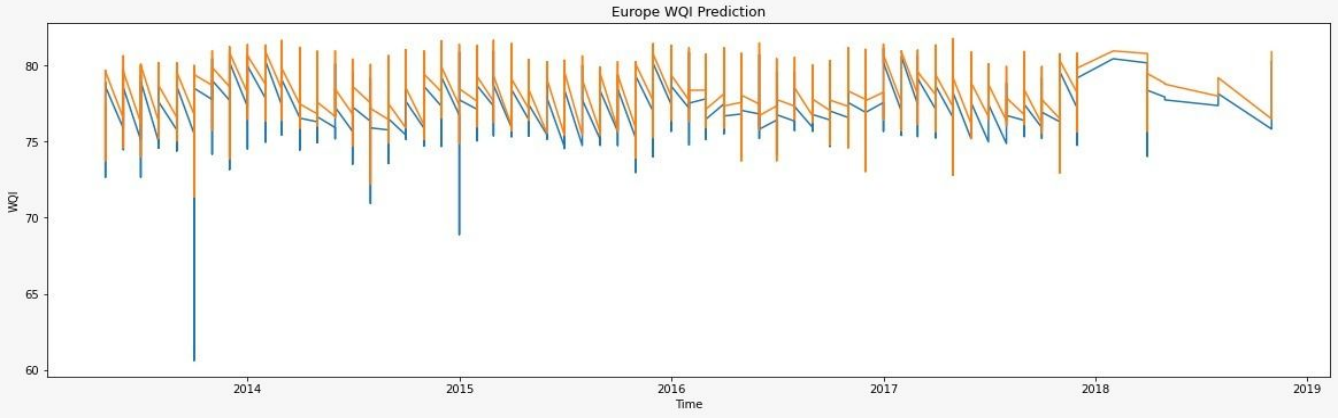
AFRICA - LSTM

Prediction (Orange) vs Original (Blue)
From 2008 to 2020
MAE: 0.84046



INDIA - LSTM

Prediction (Orange) vs Original (Blue)
From 2003 to 2009
MAE: 1.05017



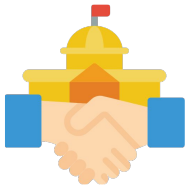
EUROPE - LSTM

Prediction (Orange) vs Original (Blue)
From 2014 to 2019
MAE: 0.88669

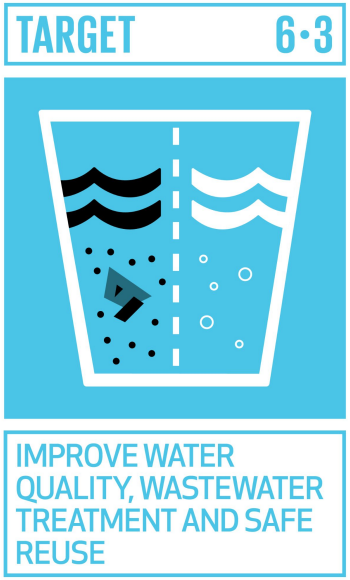
Conclusion

Efficient Water Quality Monitoring using our LSTM Model compared to conventional methods

Inform Authorities/Governing bodies to take prior action to mitigate damage to Water Quality



Inform the Government/Governing body to follow the footsteps of Developed Countries



Images taken from: https://knowsdgs.jrc.ec.europa.eu/sdg/6, Icons taken from: https://www.flaticon.com/