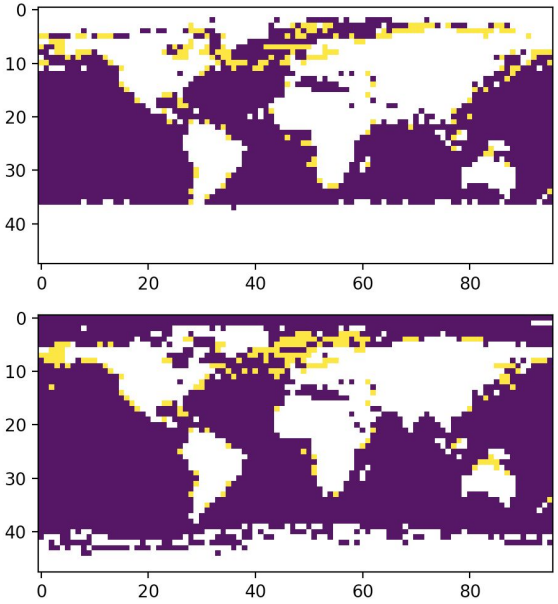
To Bloom or Not to Bloom

The Great Bloom Theory Team

NASA Space Apps Challenge

Problem - algal blooms

real



predicted

Why even bother?

- some algae release harmful toxins
- algae blooms use up lots of oxygen which results in marine life die offs
- afterwards, the decomposition of enormous amounts of bio-mass causes further environmental damage

We know the ways to prevent algal blooms...

- ultrasound
- aeration
- chemical control
- mixing

But we are yet to implement accurate prediction methods

Proposed solution

- fetch sophisticated real-time NASA satellite data which is already available
- preprocess it in sensible manner
- use it in modern machine learning models
- discover unknown patterns
- predict and apply prevention methods

...and save the day!

Data used

- NASA's Earth Observing System Data and Information System

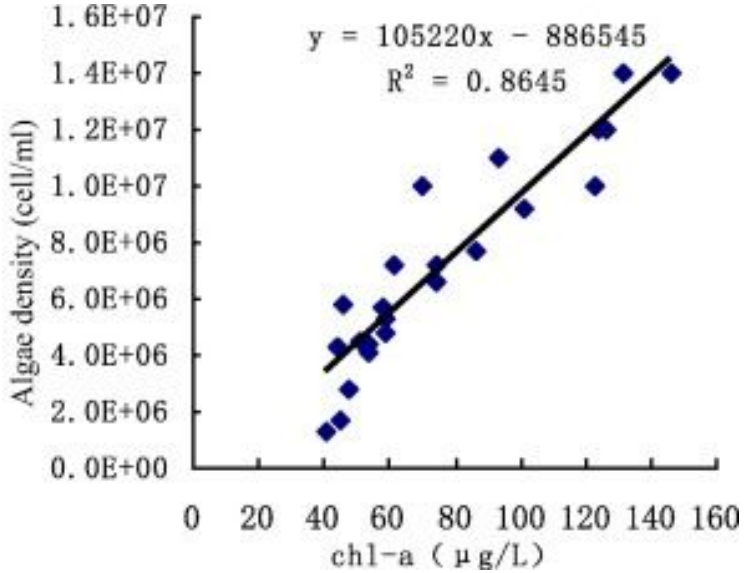
MODIS Aqua L3 - CHL, FLH, NSST, PIC, POC

OSCAR - currents

- European Centre for Medium-Range Weather Forecasts public datasets

SO, CO, SALT

Measuring algae bloom



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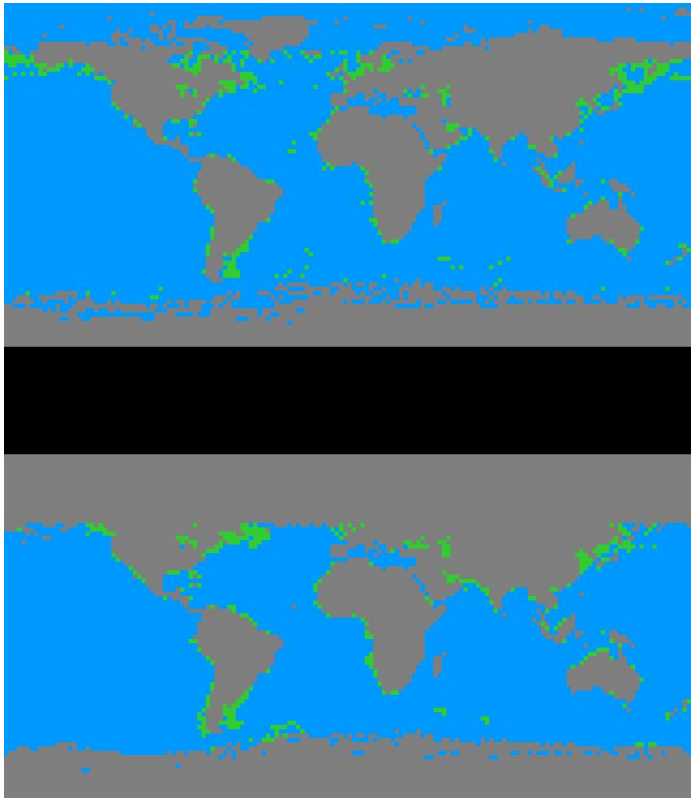
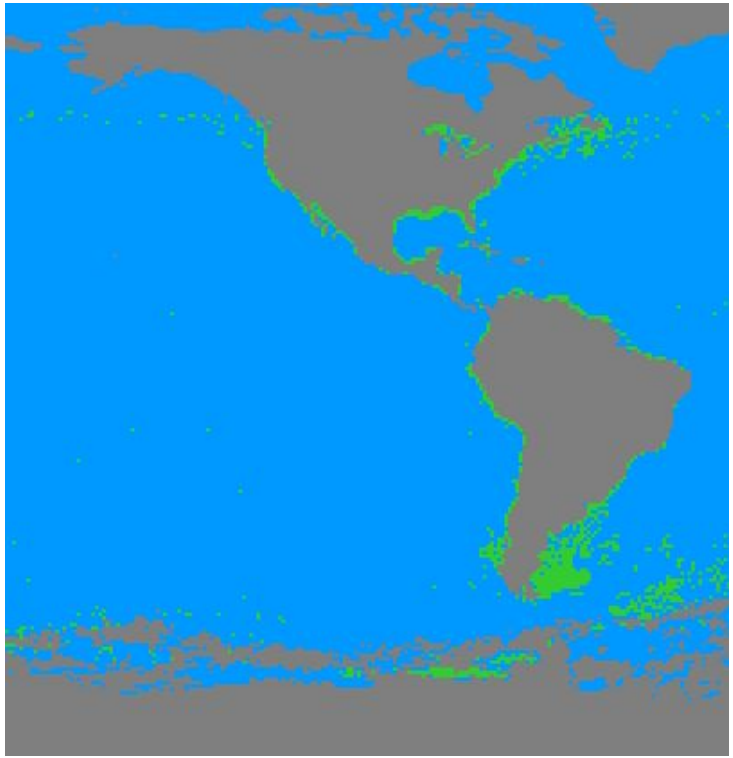


real

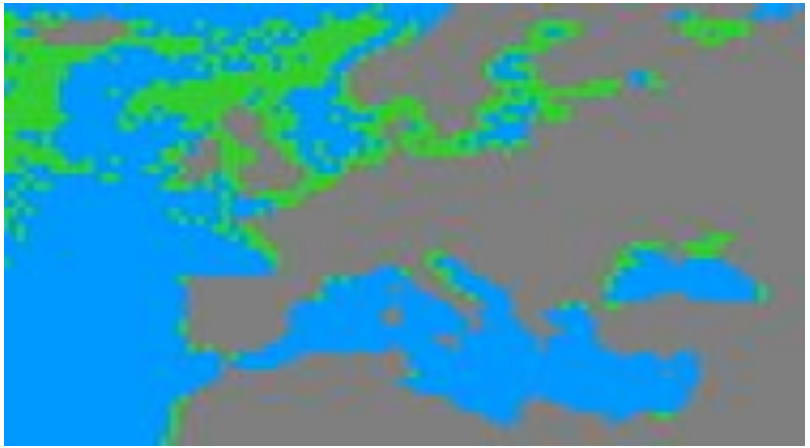
real

predicted

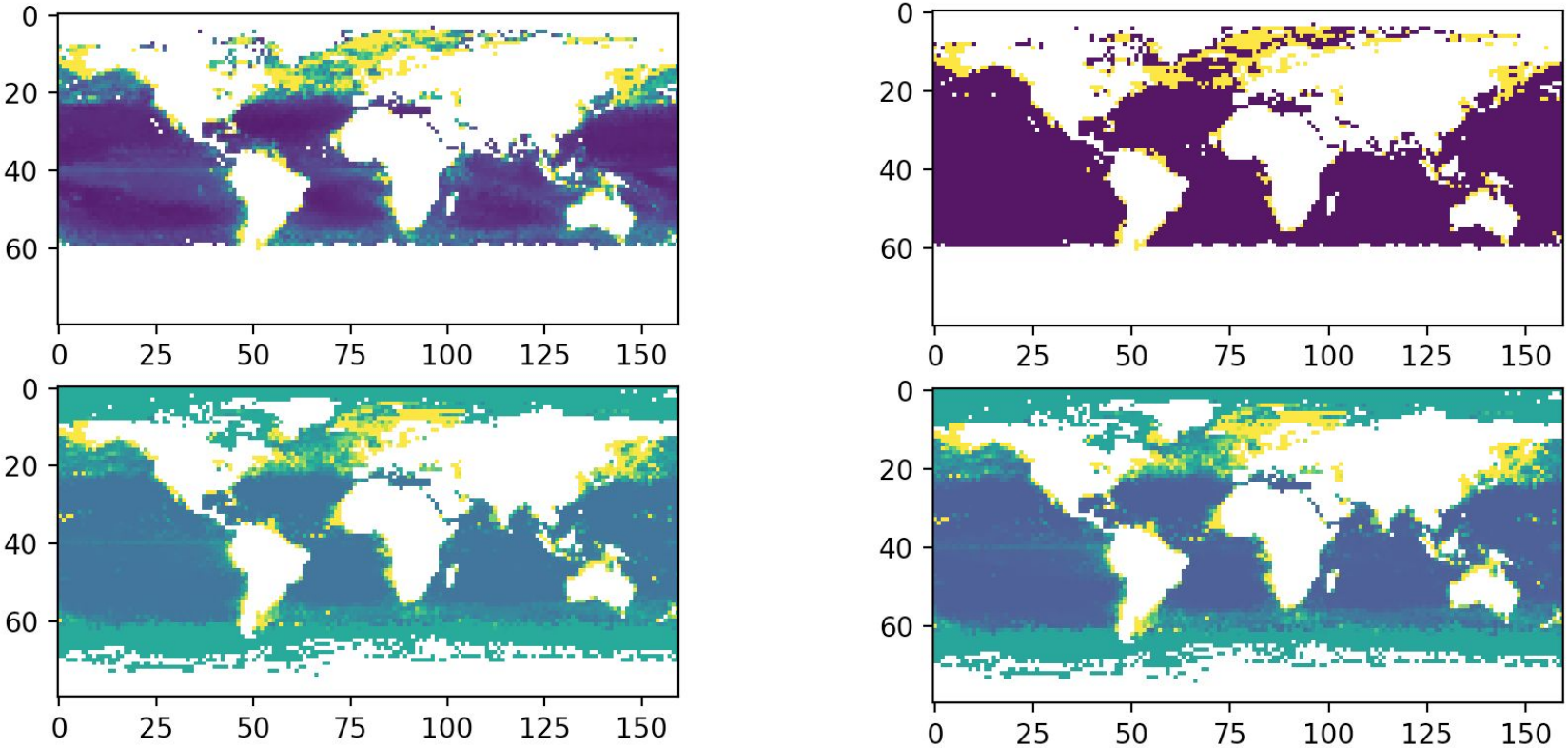


real

predicted

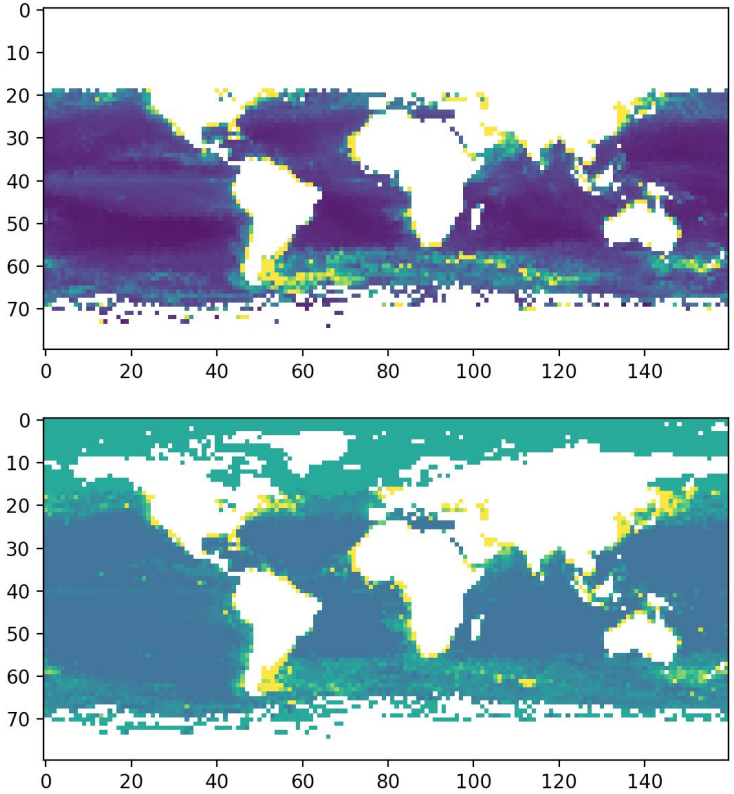


real



predicted

real



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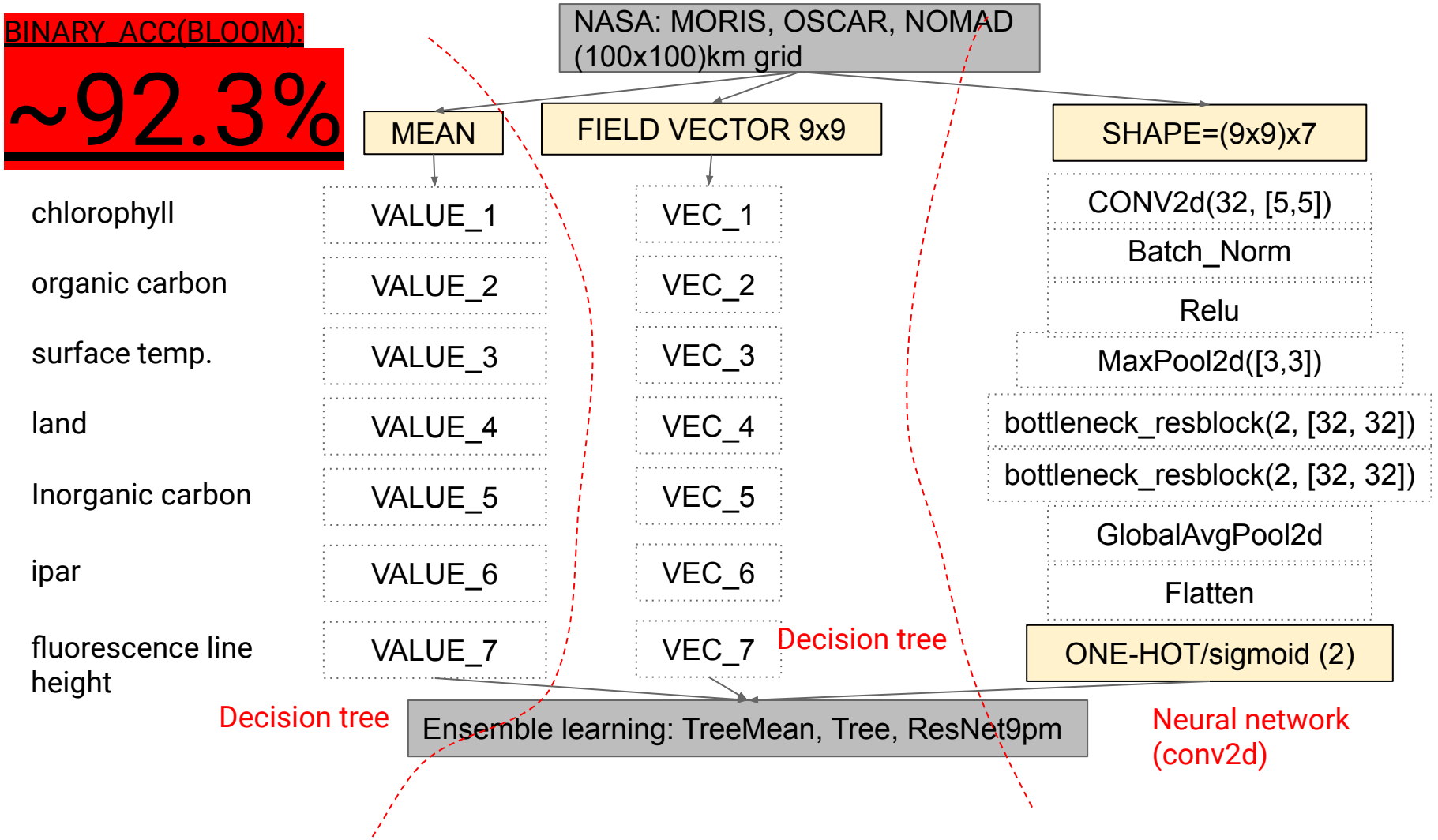
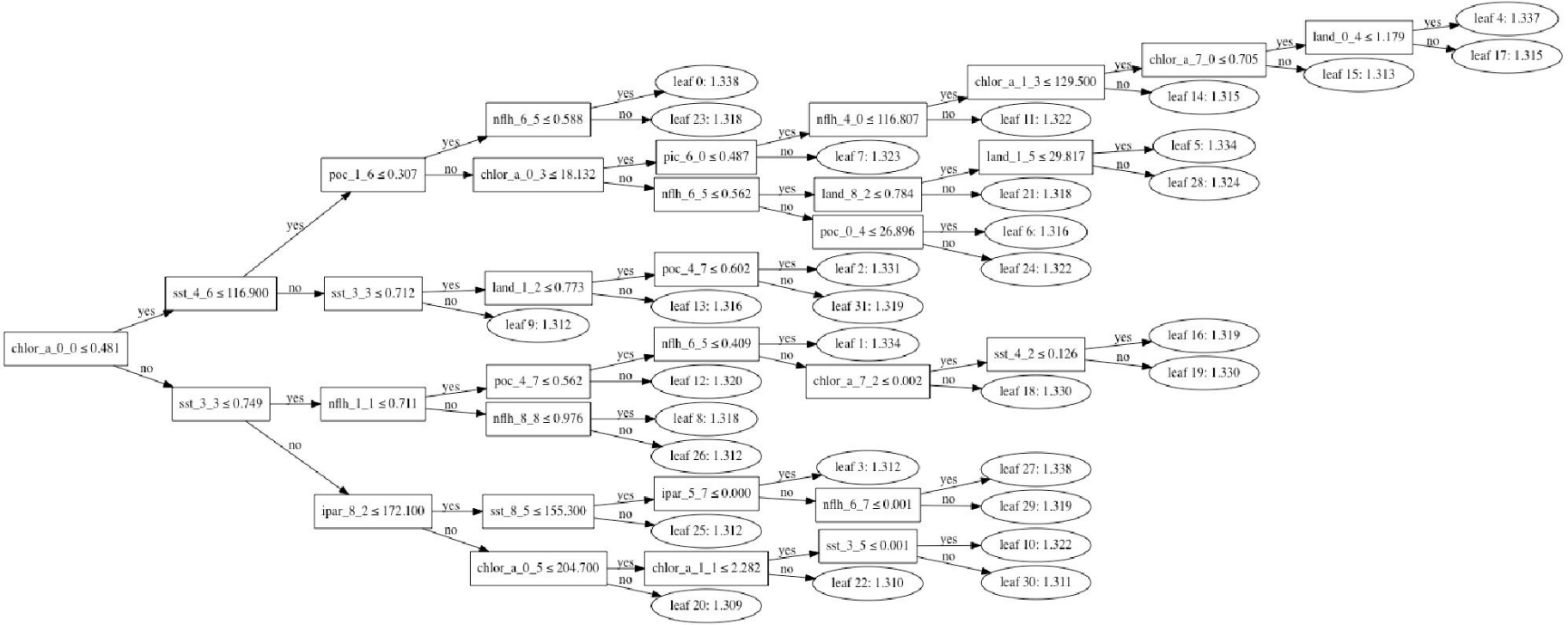

BINARY_ACC(BLOOM):
~92.3%
NASA: MORIS, OSCAR, NOMAD
(100x100)km grid
MEAN
FIELD VECTOR 9x9
SHAPE=(9x9)x7
chlorophyll
organic carbon
surface temp.
land
Inorganic carbon
ipar
fluorescence line height
VALUE_1
VALUE_2
VALUE_3
VALUE_4
VALUE_5
VALUE_6
VALUE_7
VEC_1
VEC_2
VEC_3
VEC_4
VEC_5
VEC_6
VEC_7
CONV2d(32, [5,5])
Batch_Norm
Relu
MaxPool2d([3,3])
bottleneck_resblock(2, [32, 32])
bottleneck_resblock(2, [32, 32])
GlobalAvgPool2d
Flatten
ONE-HOT/sigmoid (2)
Decision tree
Decision tree
Ensemble learning: TreeMean, Tree, ResNet9pm
Neural network
(conv2d)

Correlations discovered



Impact

- stabilization of the ecosystem and seafood markets during global warming age
- limiting health hazards

References

- Analysis of algae growth mechanism and water bloom prediction under the effect of multi-affecting factor

- Cyanobacterial Harmful Algal Blooms: State of the Science and Research Needs

- https://oceancolor.gsfc.nasa.gov/l3/

- https://apps.ecmwf.int/datasets/

- https://podaac-opendap.jpl.nasa.gov/opendap/

- https://www.ncbi.nlm.nih.gov

Thank you for your attention.

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