Remote Sensing of Global Ocean Surface Phosphate

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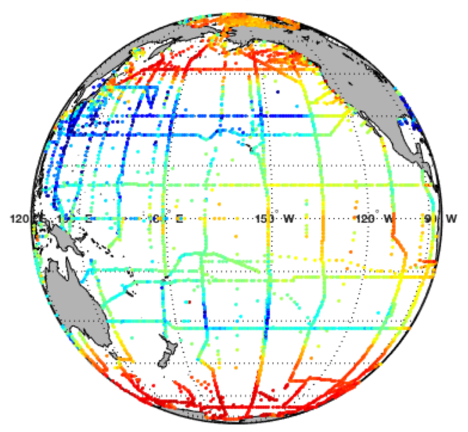
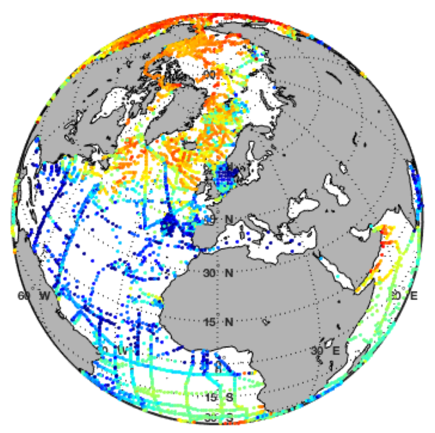
Surface Phosphate (DIP) Variation

Dissolved inorganic phosphate (DIP) is one of the major bio-limiting nutrients.

We lack either autonomous or remote sensing approaches to consistently estimate variation in DIP.





Approach: Mechanistically link axes of variation to satellite inputs

GLODAP2 PO_4 observations. High = red, Low = blue.

1st Axis, Latudinal

Physical ocean properties

- SST ,PAR, SSS

2nd Axis, Tropical upwelling

Particle optical properties

- Rrs, bb, a, chlor-a, poc, pic

Plankton size fraction

- Nano-, pico-, micro-plankton

3rd Axis, Subtropical gyres

Iron stress

- Fe stress , AOT , dust deposition

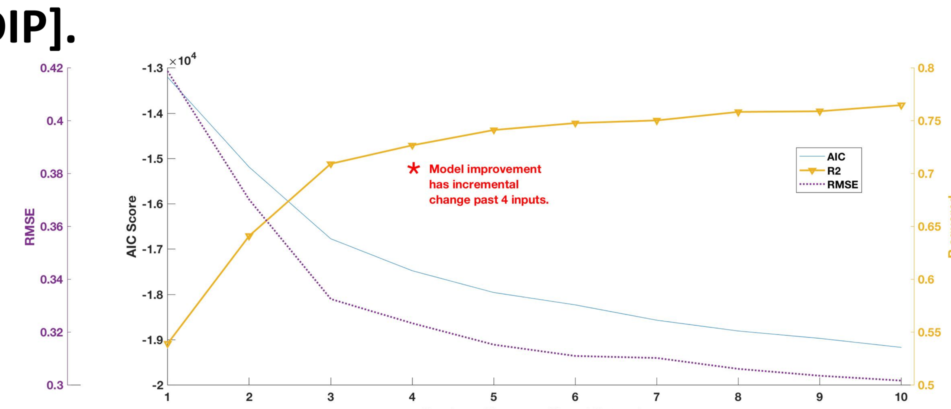
4th Axis, Polar Oceans

Upwelling indicators

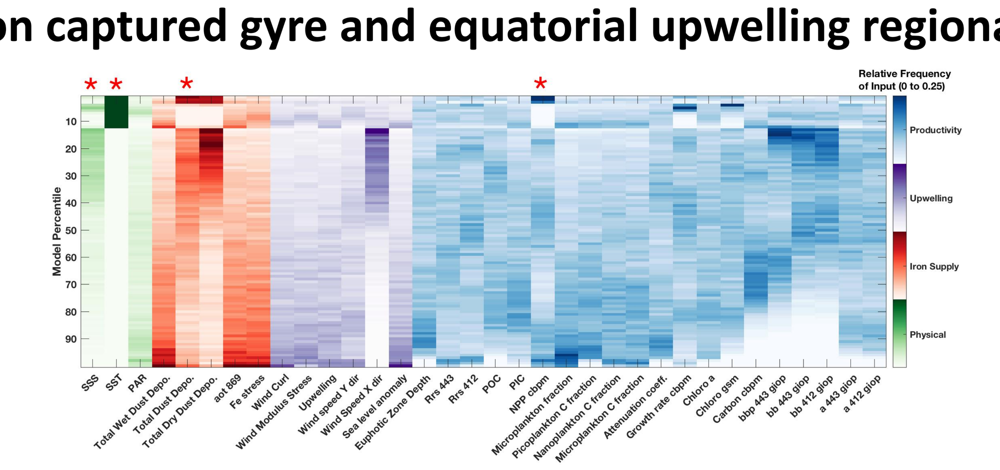
- wind stress, taux, tauy, curl,sla

Neural Network with Satellite Predictors

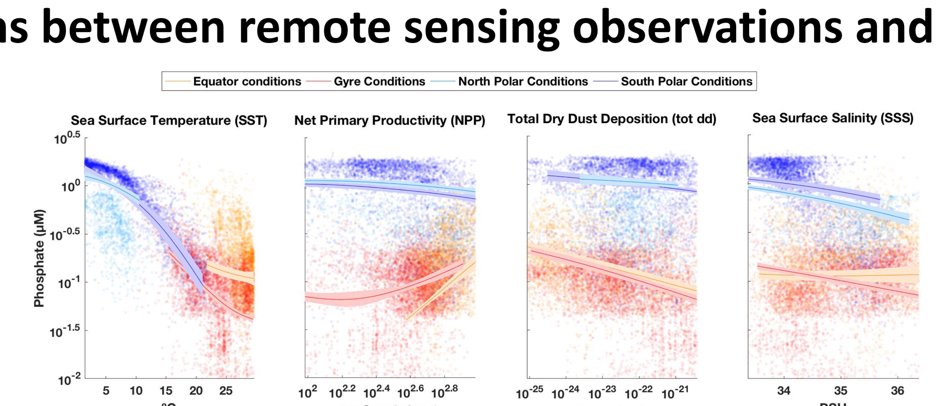
We test which combination of satellite inputs leads to the best prediction of surface [DIP].



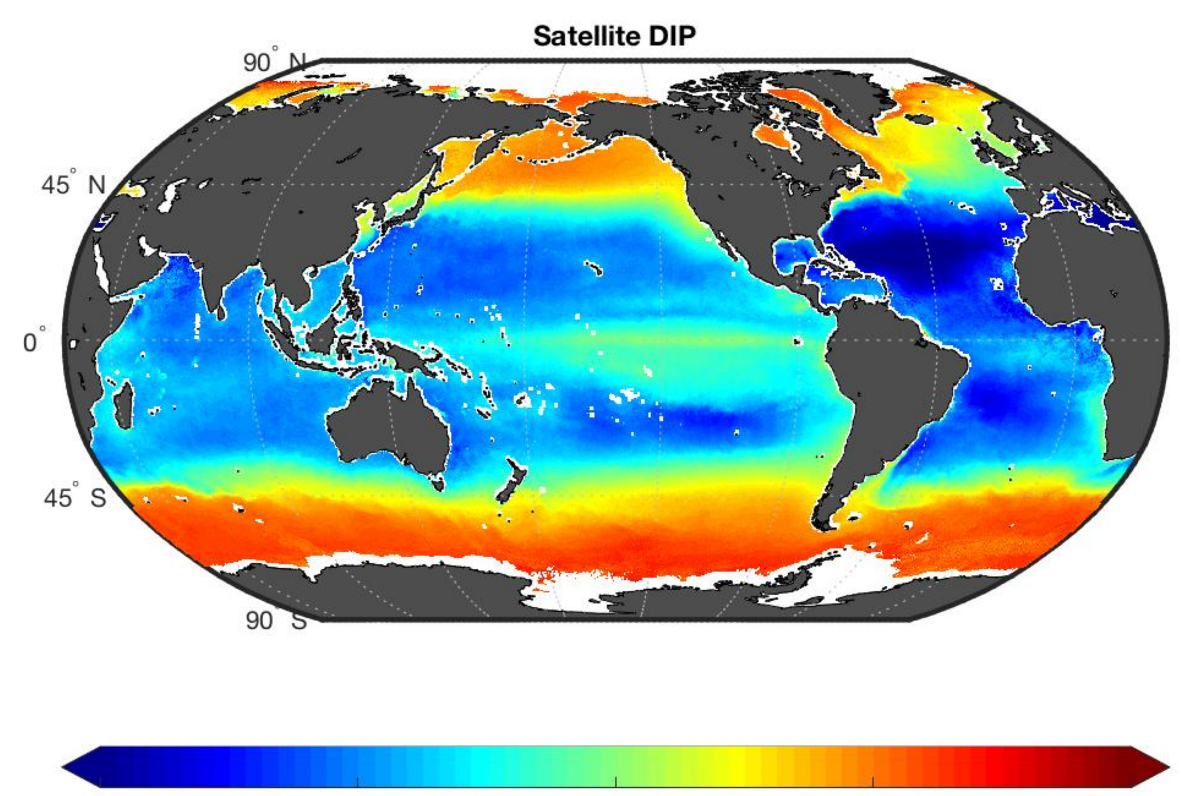
SST alone covered 55% of global variation, but networks with NPP, SSS, and Dust Deposition captured gyre and equatorial upwelling regional gradients.

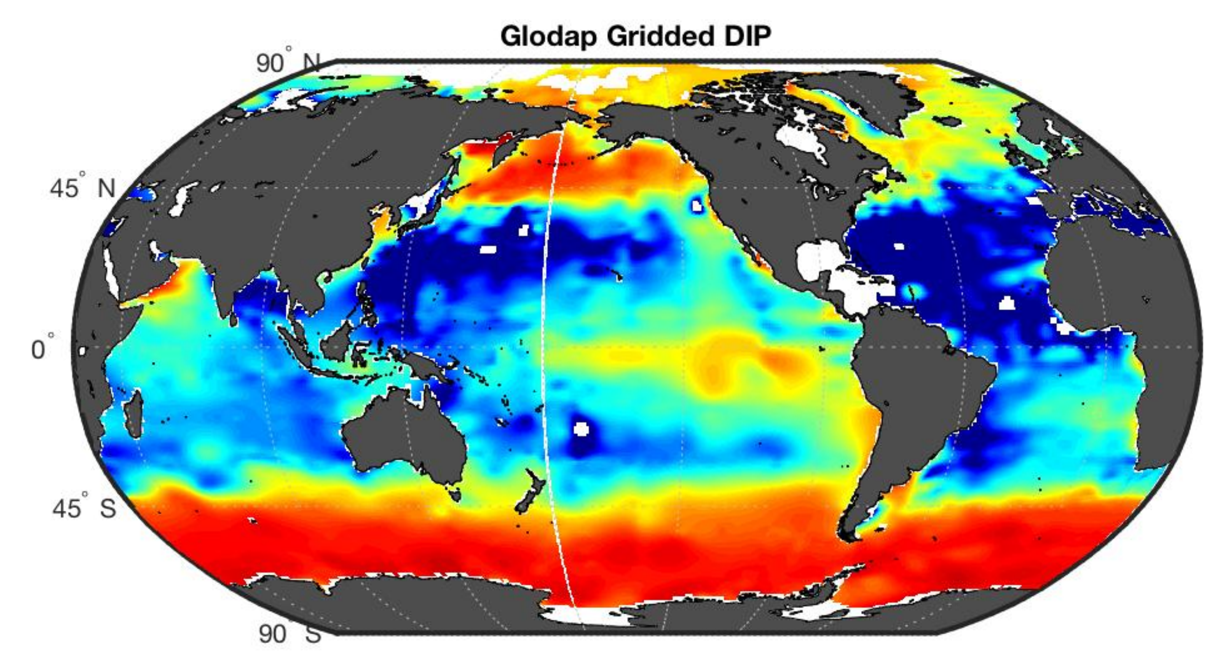


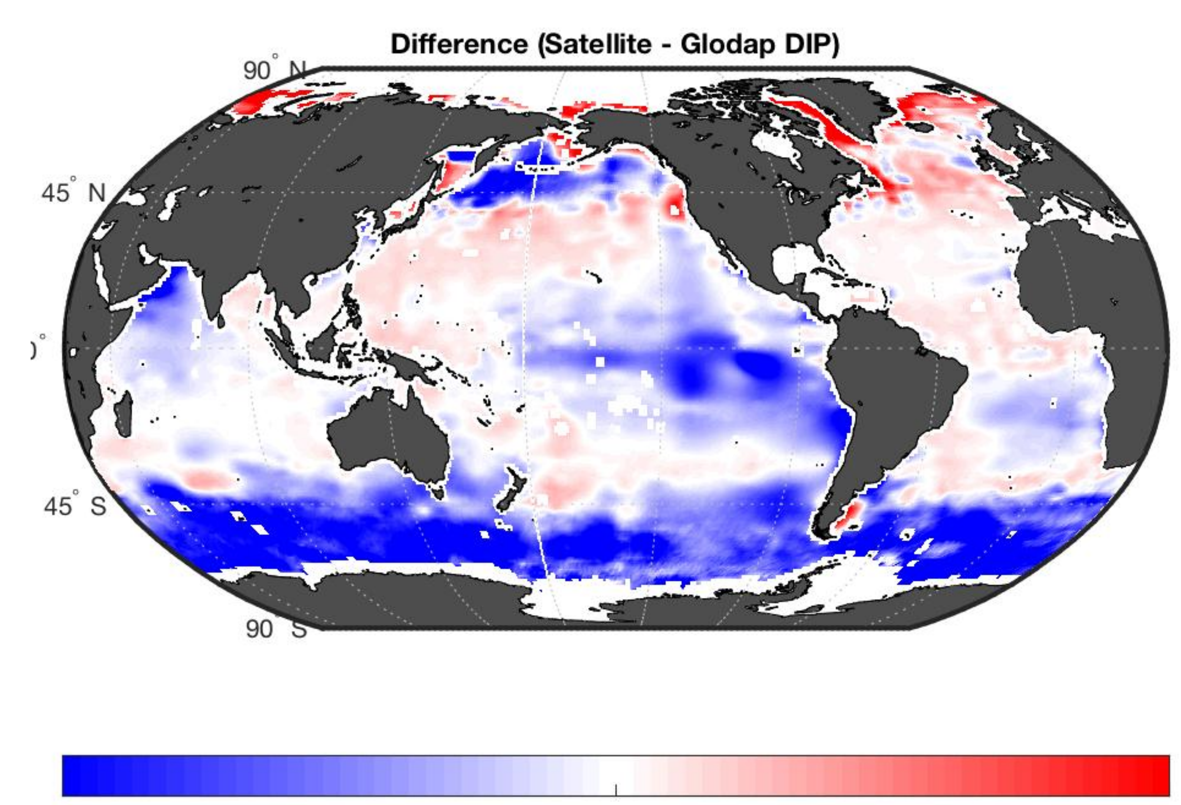
Artificial neural network models describe complex nonlinear response and interactions between remote sensing observations and [DIP].



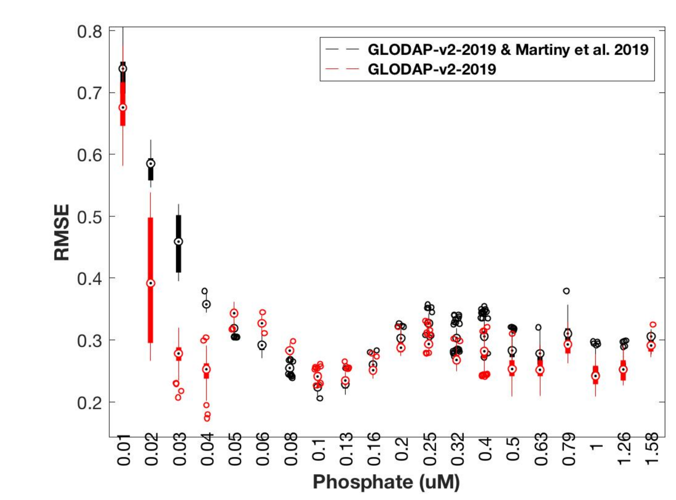
Global Distribution DIP_{sat}

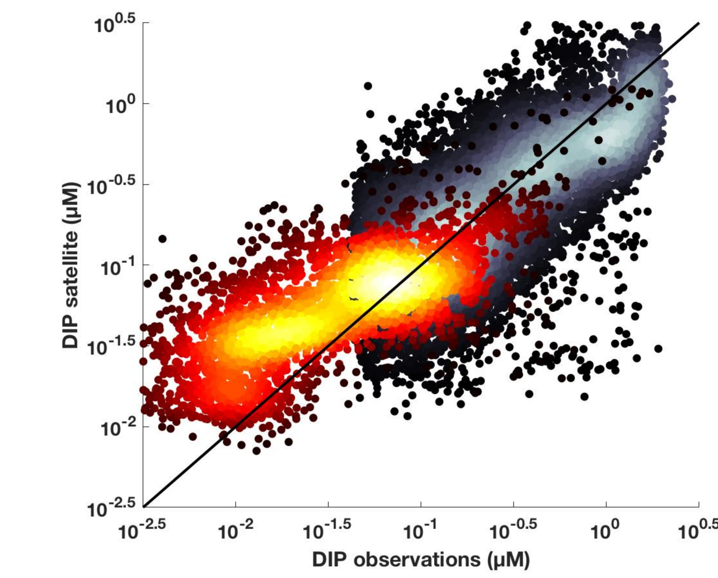






Fit to DIP Observations





Including database of high sensitivity DIP measurements improves prediction at lowest concentrations.

Conclusions

- ❑ We predict 73% of the variation in surface ocean phosphate concentration using remote sensing inputs to a neural network model.
- ❑ The response of predicted phosphate to remote sensing inputs matches our mechanistic understanding of phosphate sources and sinks.
- ❑ Sea surface salinity and dust deposition improve accuracy of low phosphate levels among subtropical gyres.
- ❑ The influence of ice melt and land induced circulation changes may not be well captured in this model.

Acknowledgements

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