

Motivation

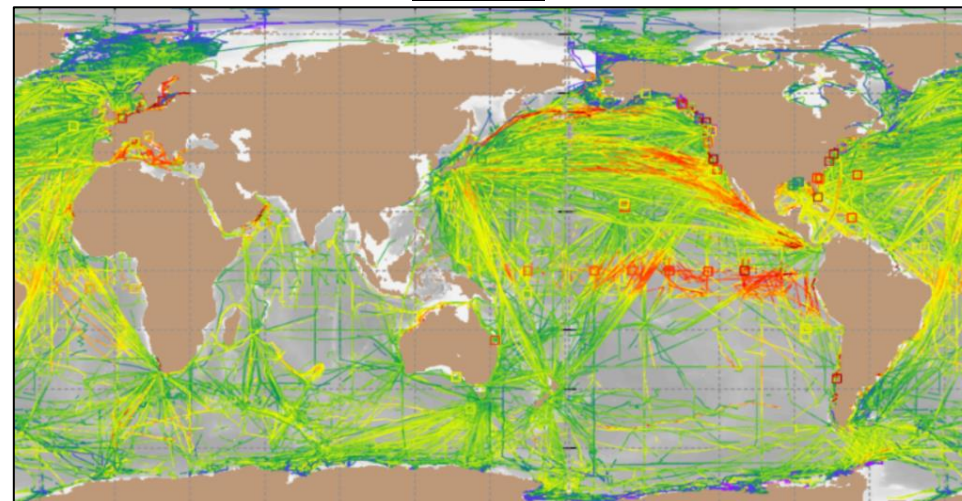
- Ocean absorbs large amounts of CO₂
- Ocean pCO₂ helps us study ocean carbon uptake
- Ocean observations have large gaps
- Machine learning can fill these gaps
- Global Carbon Budget

Objectives

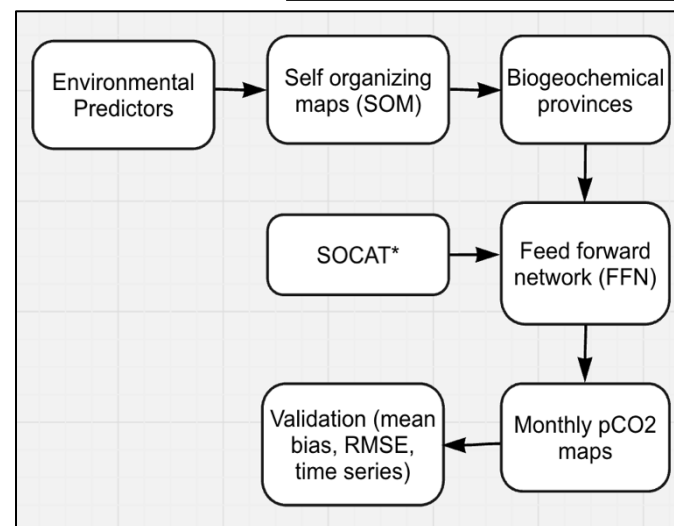
- Test the impact of data quality vs. quantity
- Compare SOM-FFN performance for two data cases
 - Case 1: High Quality, Low Quantity
 - Case 2: Low Quality, High Quantity
- Understand how observation quality affects ocean pCO₂ reconstruction

Figures

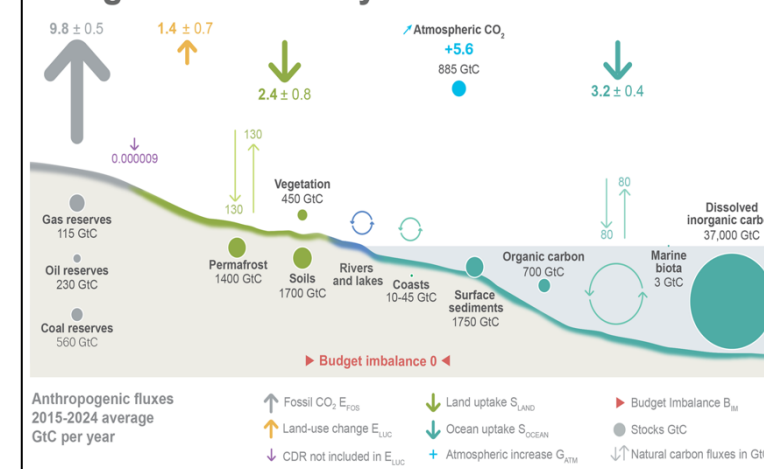
Surface ocean CO₂ from ships (NOAA, SOCAT v2024)



Global Carbon Budget 2025 - ESSD/Copernicus



The global carbon cycle



Method

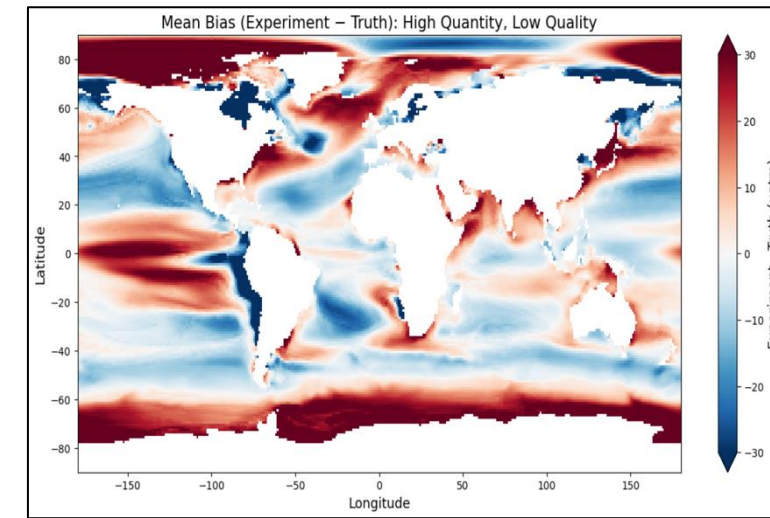
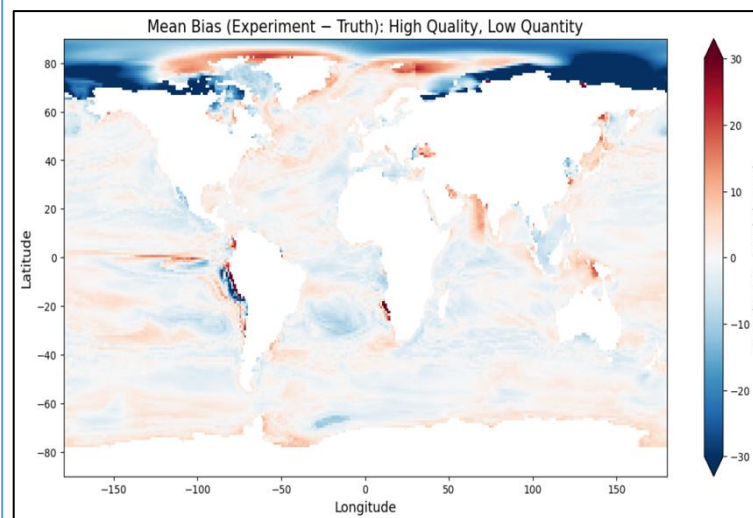
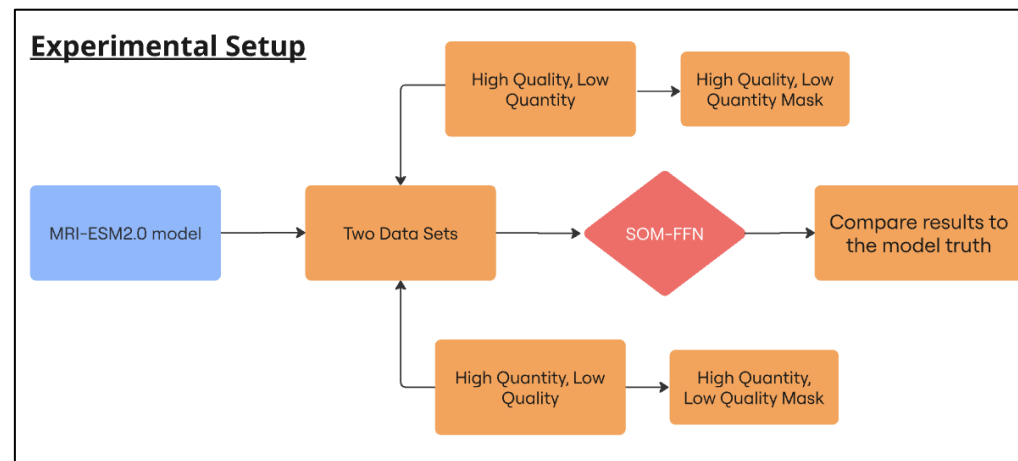
- MRI-ESM2.0 model data
 - Time Period: 1980 - 2024
 - Experiment location: Global
- Apply observation mask
- Simulate data gaps
- Run SOM-FFN for two different datasets
 - Dataset 1: High Quality, Low Quantity
 - Dataset 2: High Quantity, Low Quality
- Compare to complete model

Results: Mean Bias

- **lighter** color: closer to 0
- **brighter** color: farther from 0
- High Quality, Low Quantity: lighter color
- High Quantity, Low Quality: brighter color
- Low-quality data → larger difference

Figures

Experimental Setup



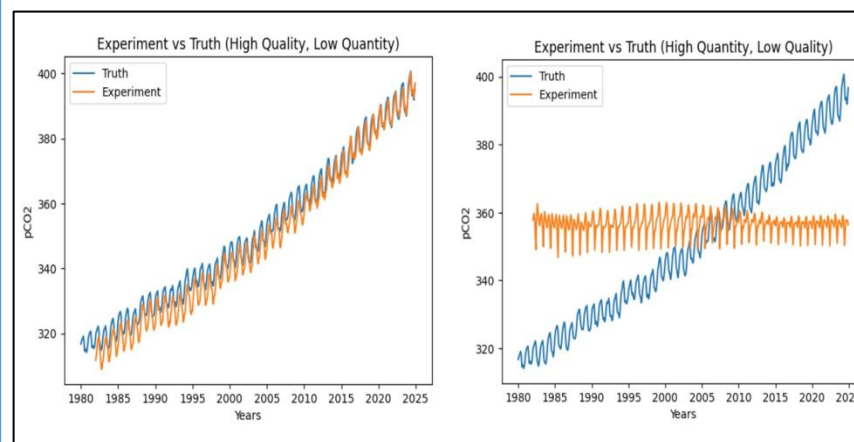
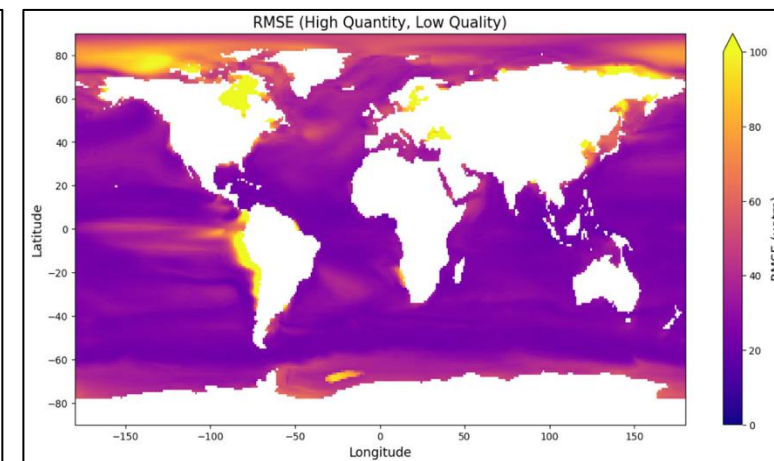
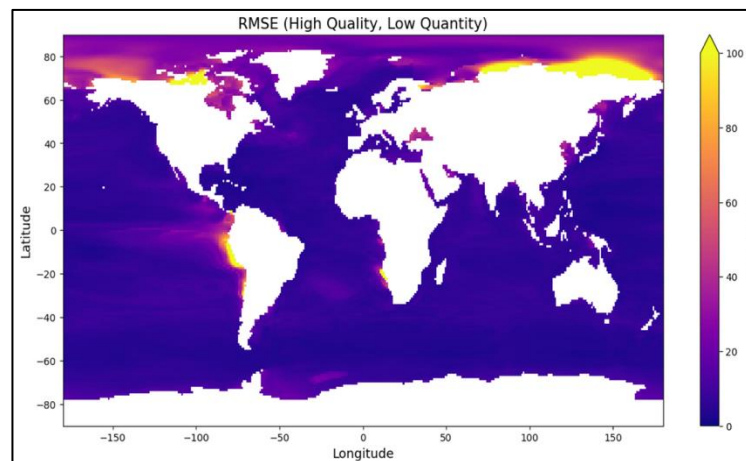
Results: RMSE & Time Series(TS)

- High Quality, Low Quantity: **lower** RMSE
- High Quantity, Low Quality: **higher** RMSE
- Higher RMSE → larger errors
- (TS) High Quality, Low Quantity: follows model's trend
- (TS) High Quantity, Low Quality: shows larger differences
 - Does not follow the same trend

Conclusions

- Higher quality data performed better
- Less data can outperform more uncertain data
- Data quality mattered more than quantity
- **Future work:**
 - Improve the low-quality data setup
 - Maintain the original pCO₂ trend
 - Try with different data masks and other ML methods

Figures



Statistic	High-Quality, Low-Quantity	High-Quantity, Low-Quantity
R ²	0.7776	0.2257
RMSE (μatm)	22.30	41.61
MAE (μatm)	9.77	29.45
Bias (μatm)	-3.03	4.52
Correlation	0.9051	0.5099