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Interpretation of Carbon Cycle with Model Analysis and expectations from Satellite Observation

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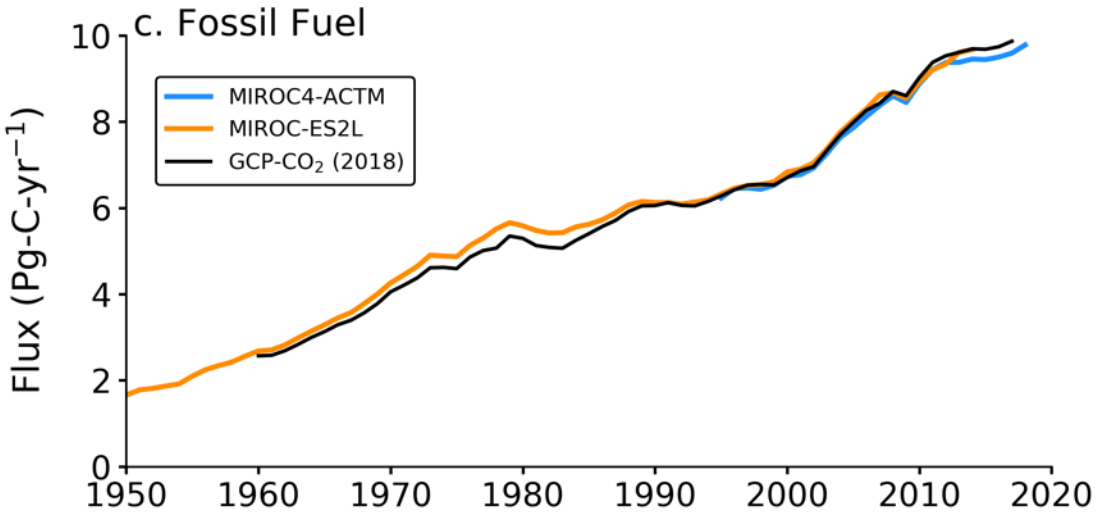
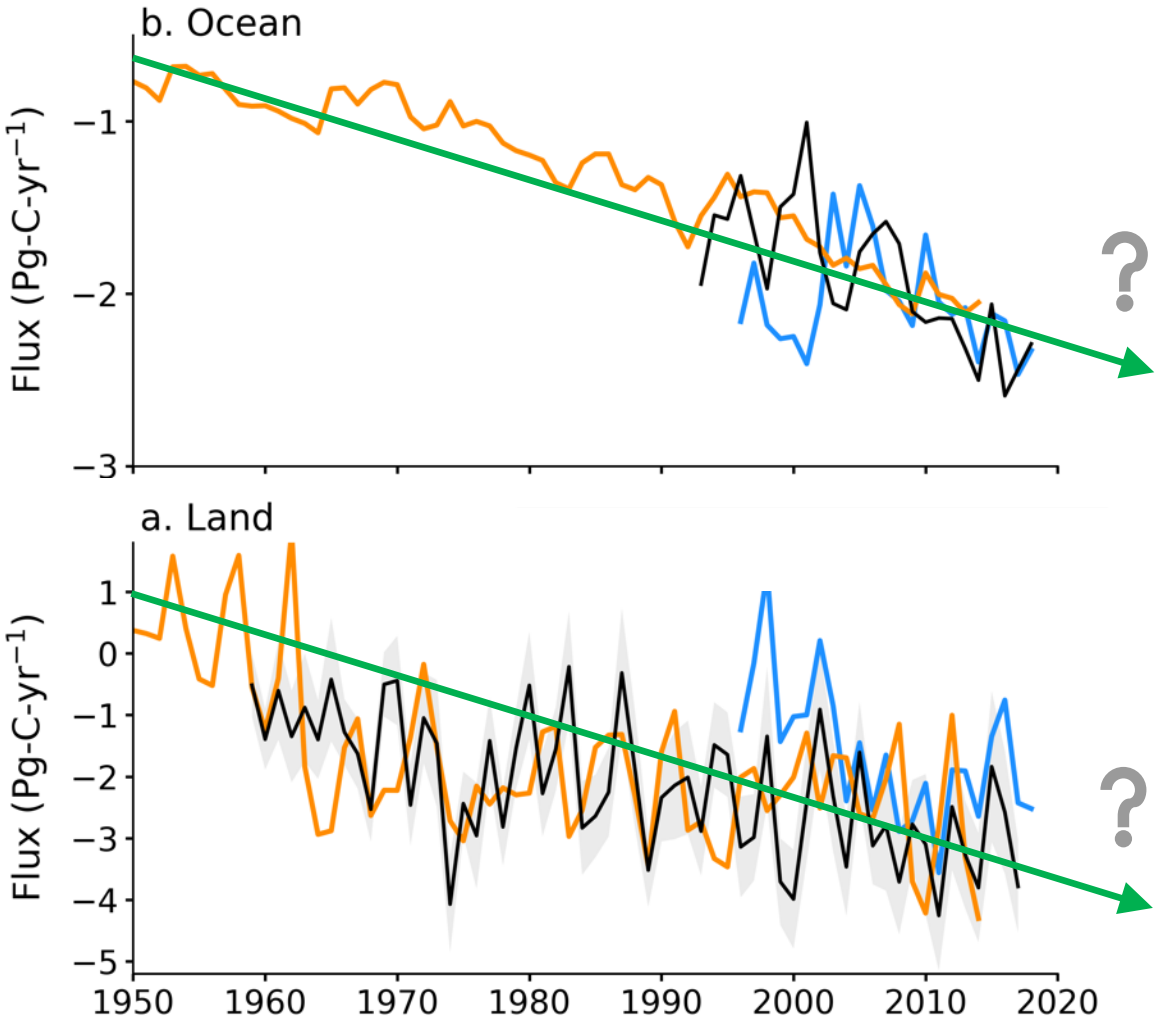
Introduction

The recent trends in global climate change is attributed mainly to an increase in carbon dioxide (CO_2) emissions due to the consumption of fossil fuels



About 50% of CO_2 emissions due to fossil fuels are removed from atmosphere by land and ocean



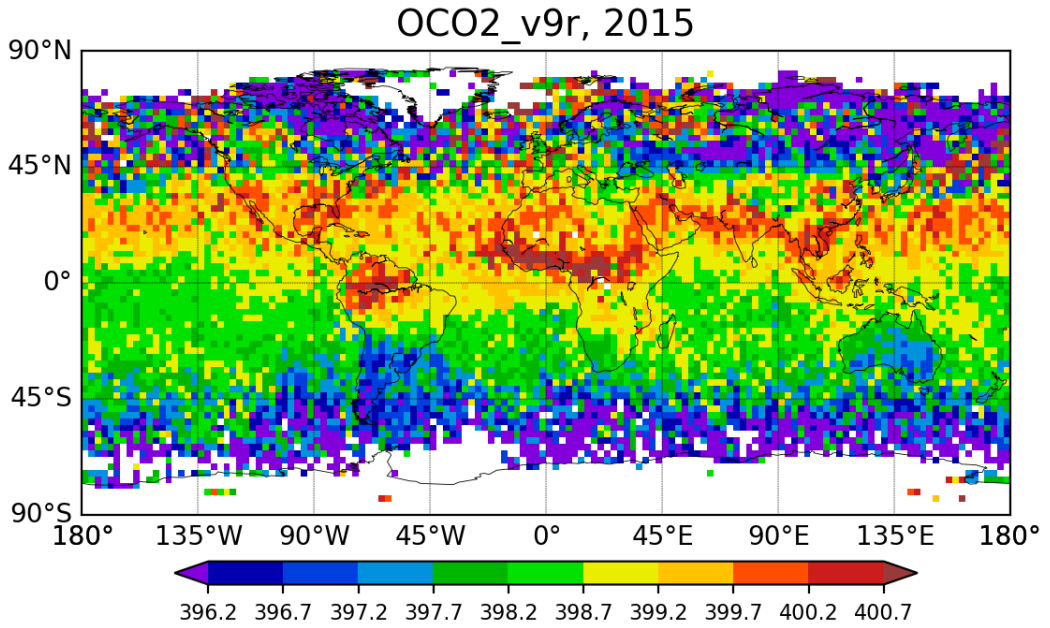
Atmospheric observations to support Paris target, by estimation of regional sources and sinks of GHGs

We use in situ data from SIO/UCSD, GMD/NOAA, JMA, NIES, CSIRO, European agencies etc.

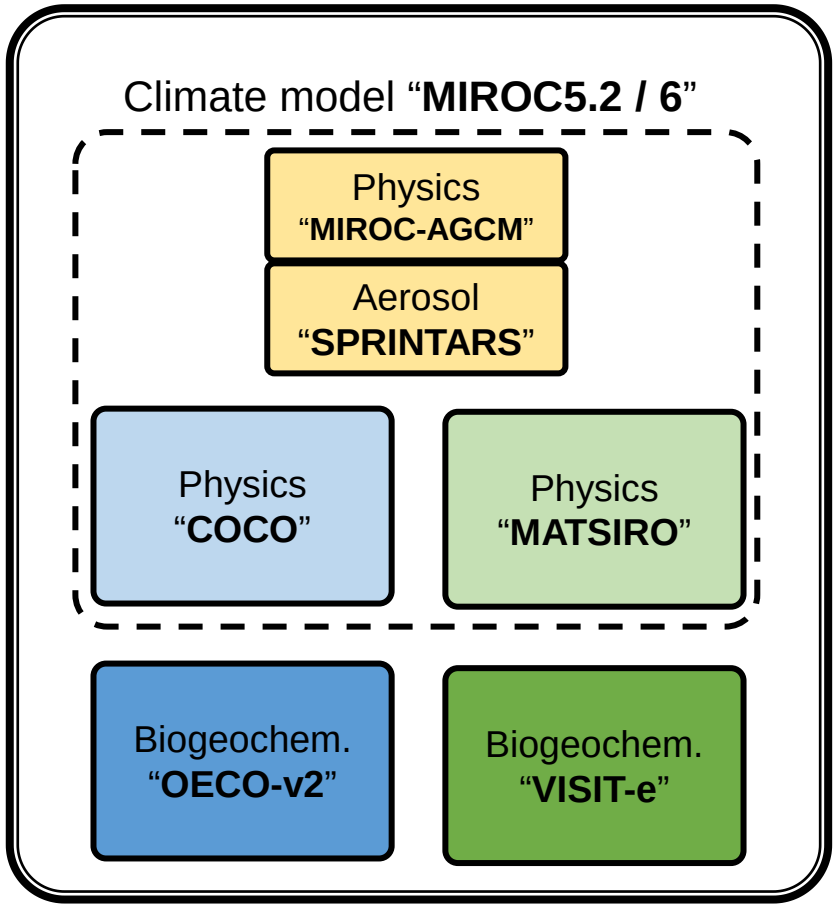
These data are at very high precision and often multispecies, helping separate anthropogenic vs natural sources at global scale, but are sparse in spatial coverage

Thanks to the large number of colleagues for sharing data freely with periodic updates (WDCGG/ObsPack)

Now we are at a new era of remote sensing measurement of greenhouse gases; GOSAT since 2009, OCO-2 since 2014, TropOMI, GOSAT-2, OCO-3 …

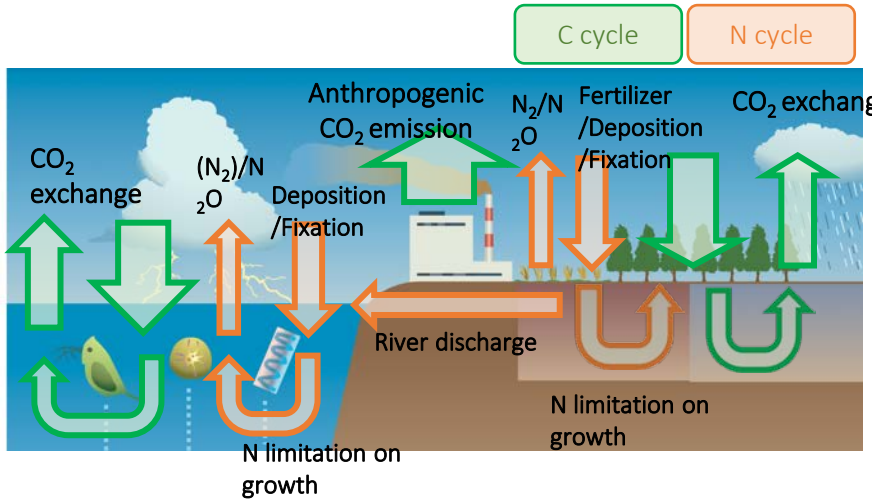


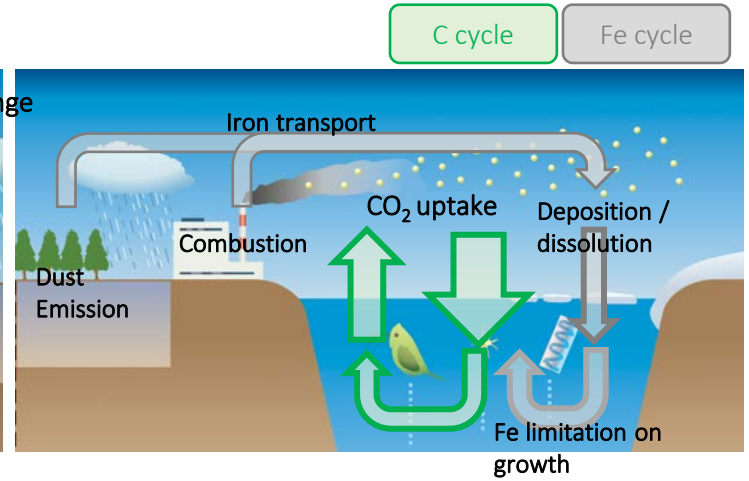
Schematic: Component models



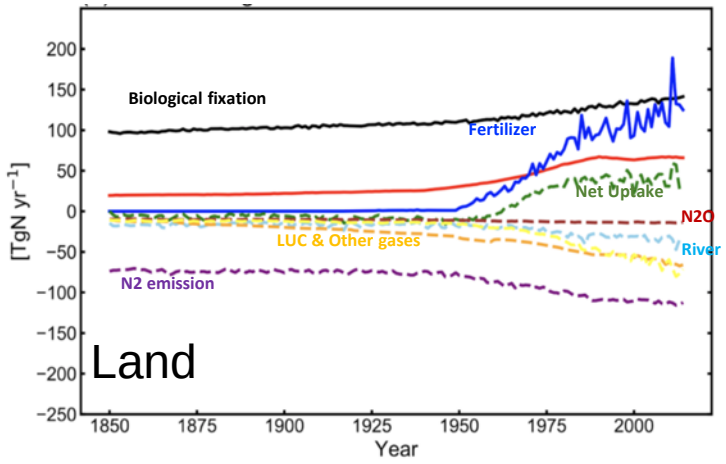
Atmosphere: About 2.8ºx2.8º, 40 layers
Ocean: About 1ºx1º. 62 layers
Land: About 2.8ºx2.8º, 6 layers

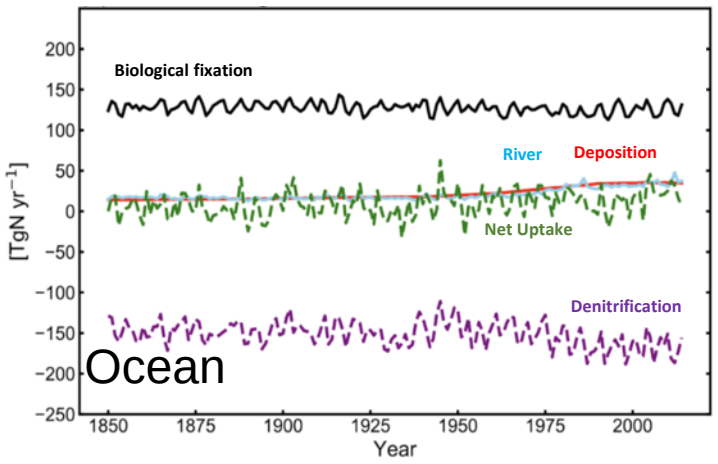
Schematic: Biogeochemical processes



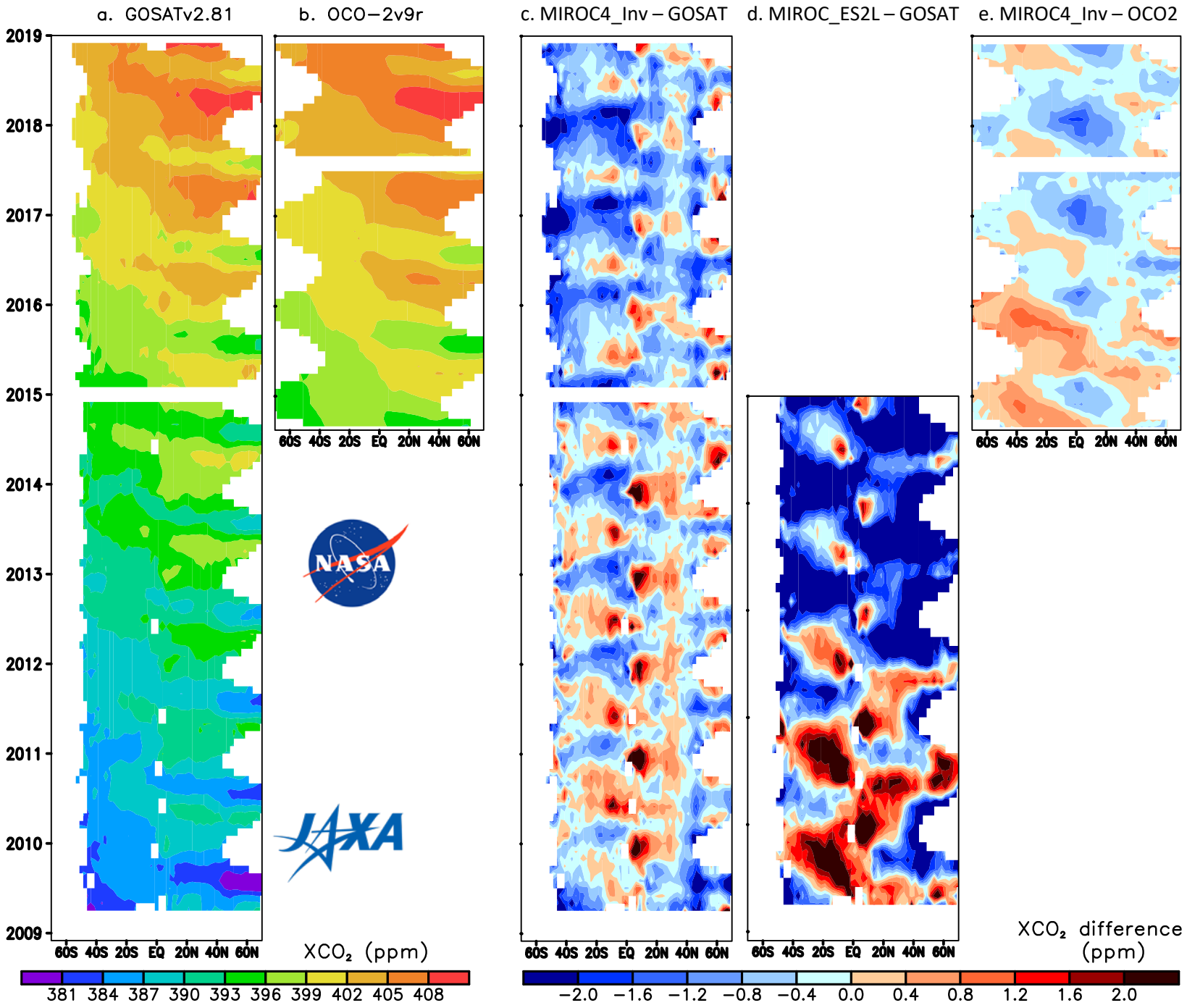


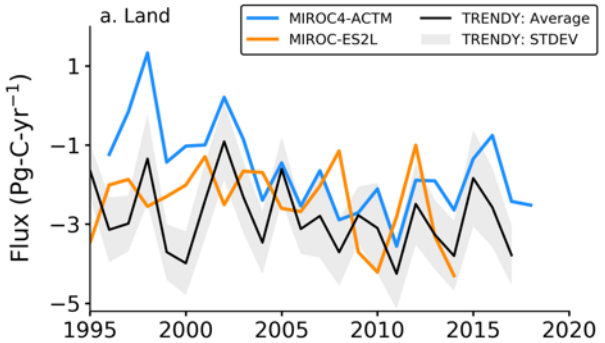
Simulated Historical Carbon and Nitrogen cycles

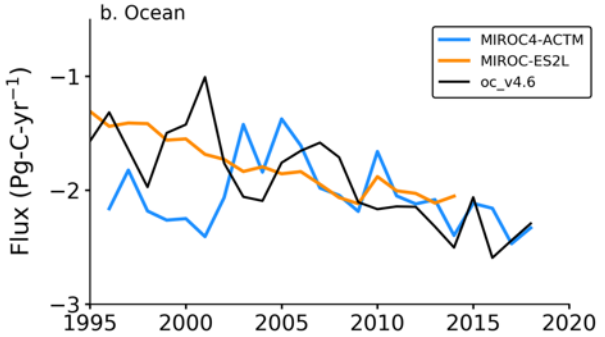


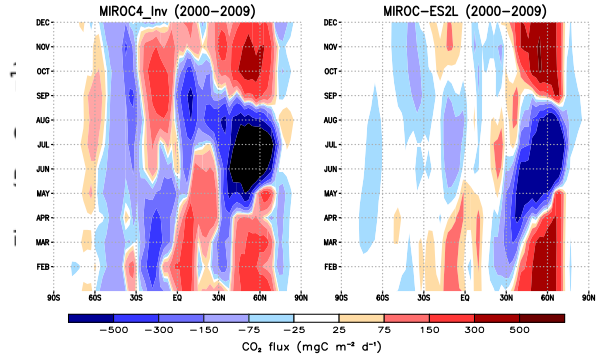


Consistency between atmospheric data and ESM fluxes

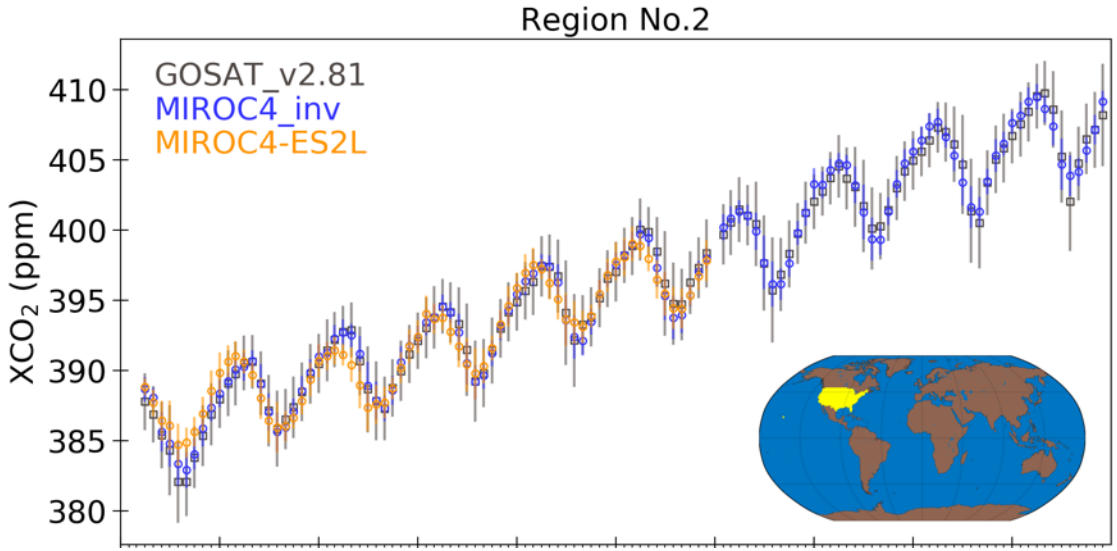


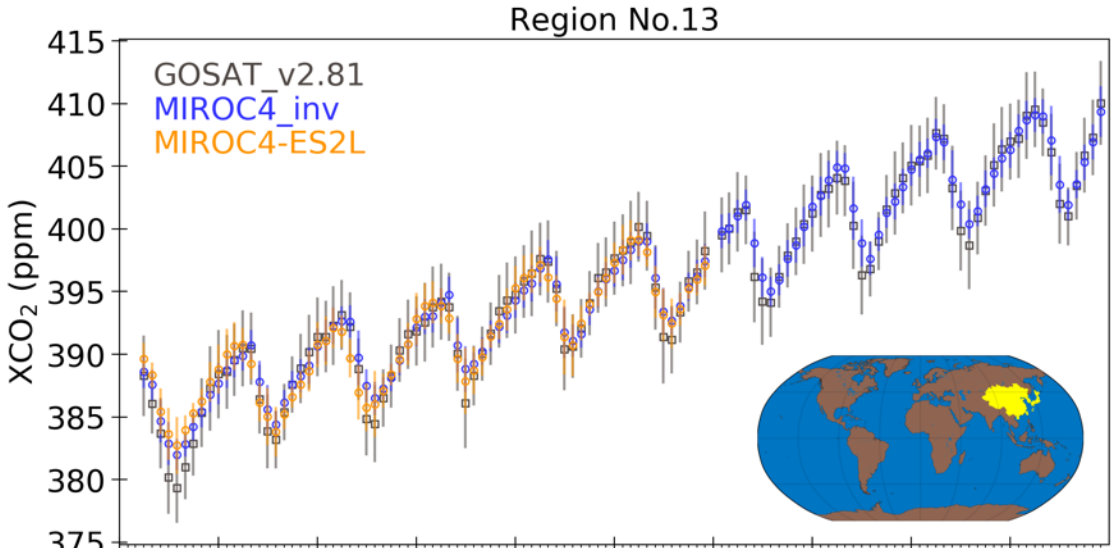


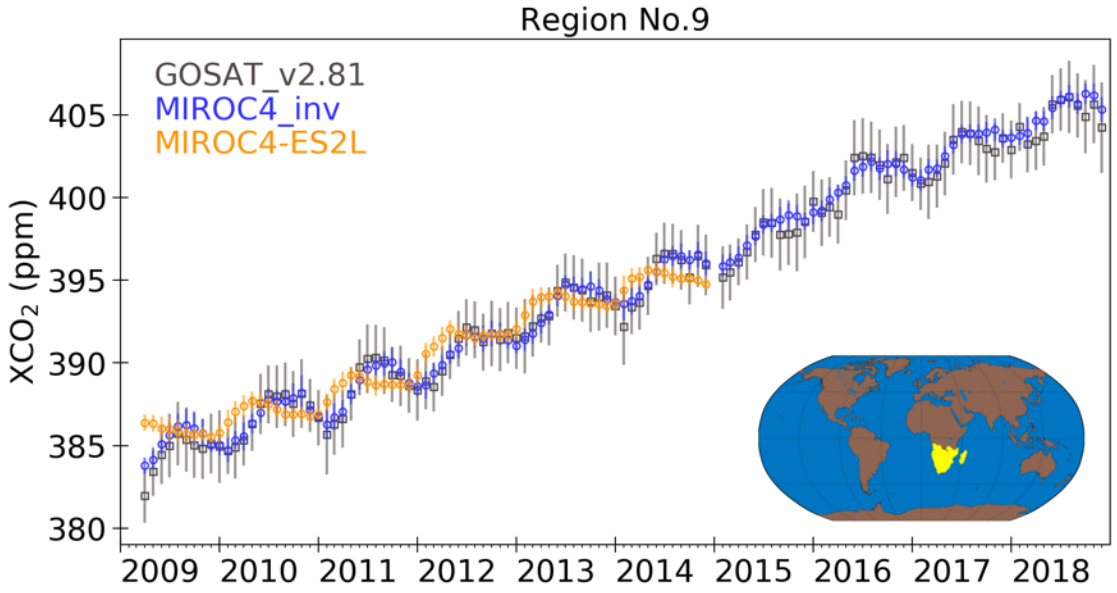


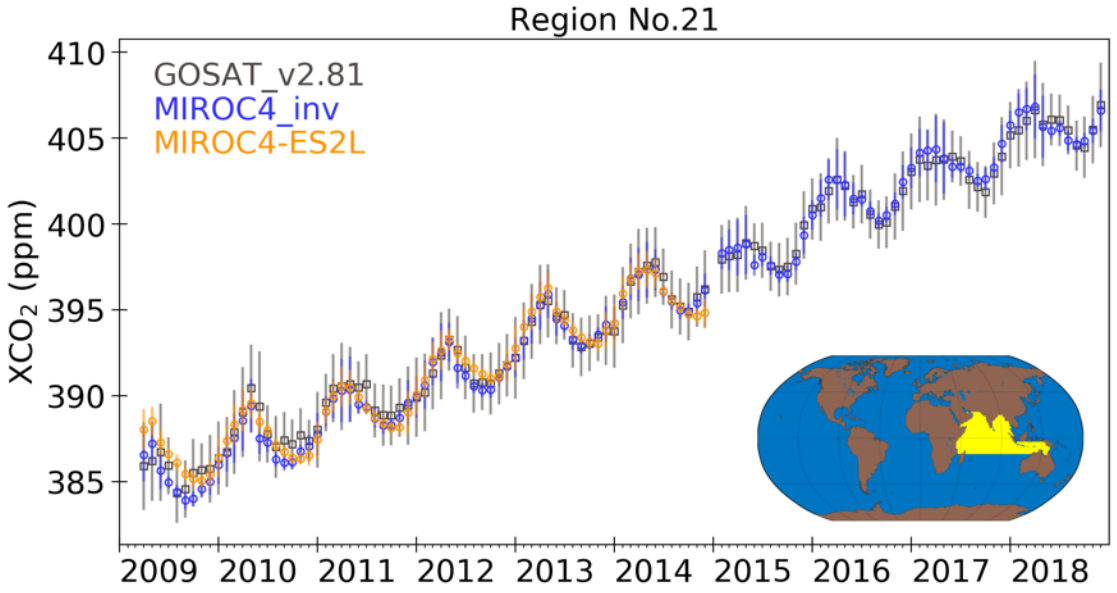


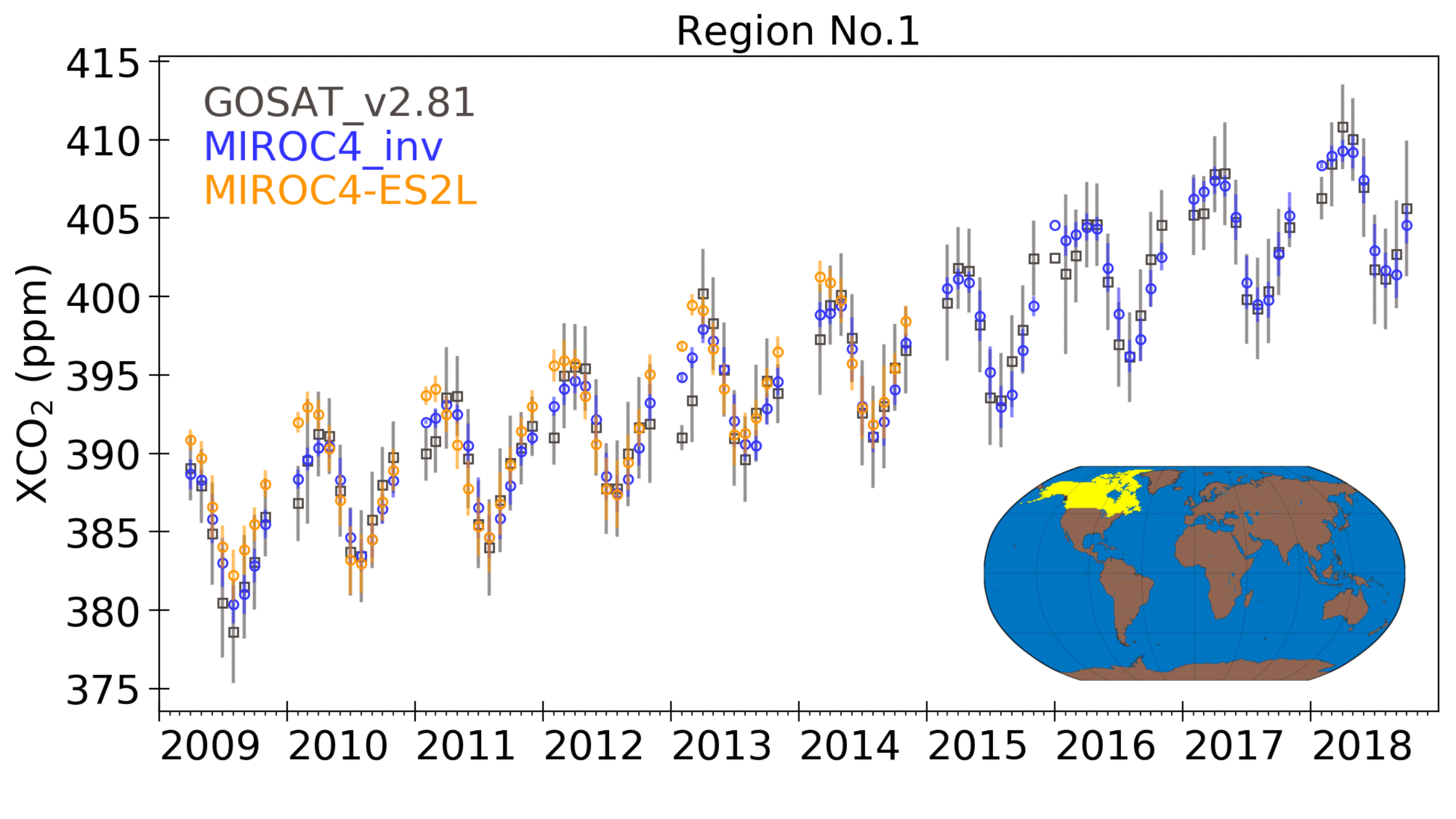
Comparison of GOSAT, MIROC4-Inversion and MIROC-ESM










Region No.1
GOSAT_v2.81
MIROC4_inv
MIROC4-ES2L
XCO2 (ppm)
415
410
405
400
395
390
385
380
375
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018

Conclusions

- We have developed an atmospheric chemistry transport model that is suitable for modelling long-lived GHGs in the Earth's atmosphere
  - JAMSTEC's global products of CO_2 (, CH_4 and N_2O) fluxes are available through the GCP's periodic update on budget assessments
  - The top-down estimations of the major GHGs budget would be generally ready for the Global Stocktake, under the Paris Agreement

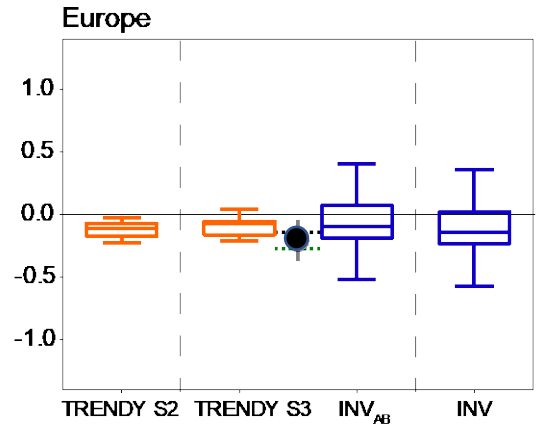
- Performance of earth system model MIROC-ES2L for simulating global and regional carbon is found to be satisfactory using using XCO_2 data and inverse model results using in situ data

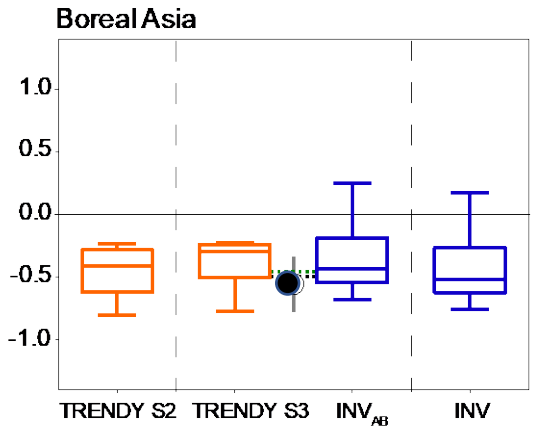
- The remote sensing XCO_2 observations are now of sufficient accuracy for improved regional carbon budgeting and process-level understanding of the carbon cycle

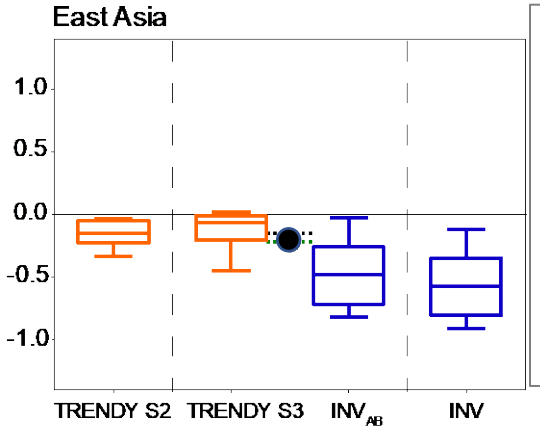
Thank you

ありがとうございました

Regional carbon budget







11 Biosphere models
8 Inversion models
RECCAP reference

Kondo, Patra, et al., GCB, 2019
GCP annual budgets (Le Quere et al., ESSD)