

## Regional estimates of CO<sub>2</sub> budget using inverse modelling for the past two decades (1996-2018)

\*Naveen Chandra<sup>1</sup>, Prabir Patra<sup>1</sup>

1. Japan Agency for Marine Earth Science and Technology

An improved understanding of the magnitude and location of the CO<sub>2</sub> sources (mainly from fossil fuel emissions) and sink (mainly from biospheric and oceanic uptake) is essential for the predictions of future climate feedback. Atmospheric inverse modelling is a powerful tool to estimate spatio-temporal variation of fluxes from an optimal fit to atmospheric CO<sub>2</sub> measurements.

Monthly CO<sub>2</sub> fluxes are estimated using a Time-Dependent Inverse (TDI) model, measurements from 30 sites across the globe and MIROC4-ACTM forward model for the period of 1996-2018. The inversion fluxes are evaluated in details using the independent CO<sub>2</sub> measurements made onboard aircraft over 74 sites across the globe. The simulations of CO<sub>2</sub> concentrations using inverted fluxes agree within 0.5 ppm at all the aircraft vertical profile sites. The long-term mean land CO<sub>2</sub> fluxes are estimated to be  $-2.2 \pm 0.5$ ,  $0.04 \pm 0.3$  and  $-0.5 \pm 0.2$  PgC yr<sup>-1</sup> in the most recent decade (2009-2018), respectively, for the northern extratropics (NET: 30-90N), tropics (TR: 30S-30N) and southern extratropics (SET: 30-90S). The ocean CO<sub>2</sub> fluxes for the same time period and regions are estimated to be  $-0.9 \pm 0.1$ ,  $0.3 \pm 0.2$  and  $-1.1 \pm 0.1$  PgC yr<sup>-1</sup>, respectively. Considering the fossil fuel emissions and land-oceanic sink, the NET and TR regions act as net sources while SET region acts as a net sink. A large fraction of the interannual variability in global CO<sub>2</sub> flux anomaly originates over the tropical land regions, induced by El-Niño southern oscillation. Sensitivity studies using different observational network suggest that the use of JAL/NIES CONTRAIL aircraft data between Japan and Australia helps us to better constrain the interannual variations in CO<sub>2</sub> fluxes over the Southeast Asia region.

Keywords: Atmospheric inversion, CO<sub>2</sub> fluxes, regional scale