

Towards operational cargo ship XCO₂, XCO, and XCH₄ measurements along the Japanese coastline

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Background

- Satellites and models provide global X_{gas} data, but need to be validated
- Sparse validation opportunities over oceans

Objective

- X_{gas} measurements onboard ships using a FTS

Instrumentation

- EM27/SUN FTS
- Custom-built solar tracker and housing by University of Heidelberg

Research vessel (RV) MIRAI cruises 2021/2022

- Deployment in the Western North Pacific Ocean
- Partly harsh environmental conditions
- Wave heights up to 10 m
- Strong winds
- MR21-1 cruise Feb. 13 – Mar. 22 2021
- MR21-6 cruise Dec. 18 2021 – Jan. 13 2022

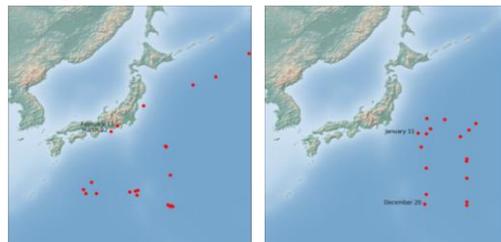


Fig. 2 and 3: MR 21-1 and MIRAI21-6 cruises. Red dots denote days with valid measurements.

MR21-1 results

- Lack of data in the first half due to rough weather conditions
- Constant offset between EM27 and CAMS data for XCO₂ & XCH₄
- XCO₂ and XCO enhancements at the end of the cruise (green box) against background (red box)
- Good agreement between EM27 and CAMS XCO₂/XCO enhancement ratio

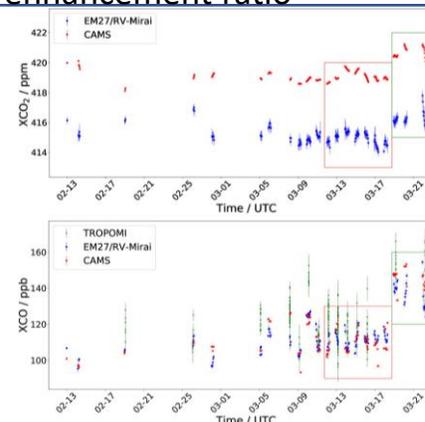


Fig. 3: XCO₂ and XCO timeseries during MR21-1.

MR21-6 results

- Software update for remote control
- One day of coincident measurements with COCCON Tsukuba (appr. 500 km distance) show good agreement

Outlook: Cargo ship deployment

- Installation in the immediate future
- Cruise duration one week
- Samples major GHG emission spots
- Remote access might be possible using an LTE router

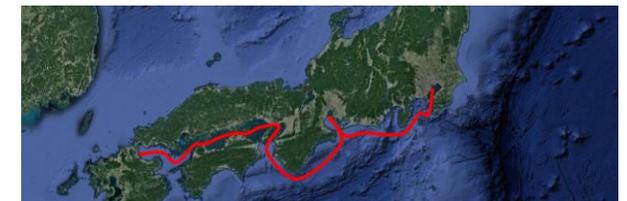


Fig. 4: Cargo ship route along the Japanese coastline.

Publications for further information

- [Knapp et al., ESSD, 2021]
- [Butz et al., FRS, 2022]



Fig. 1: Weatherproof housing and solar tracker.