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Direct oceanic emissions unlikely to account for the missing source of atmospheric carbonyl sulfide

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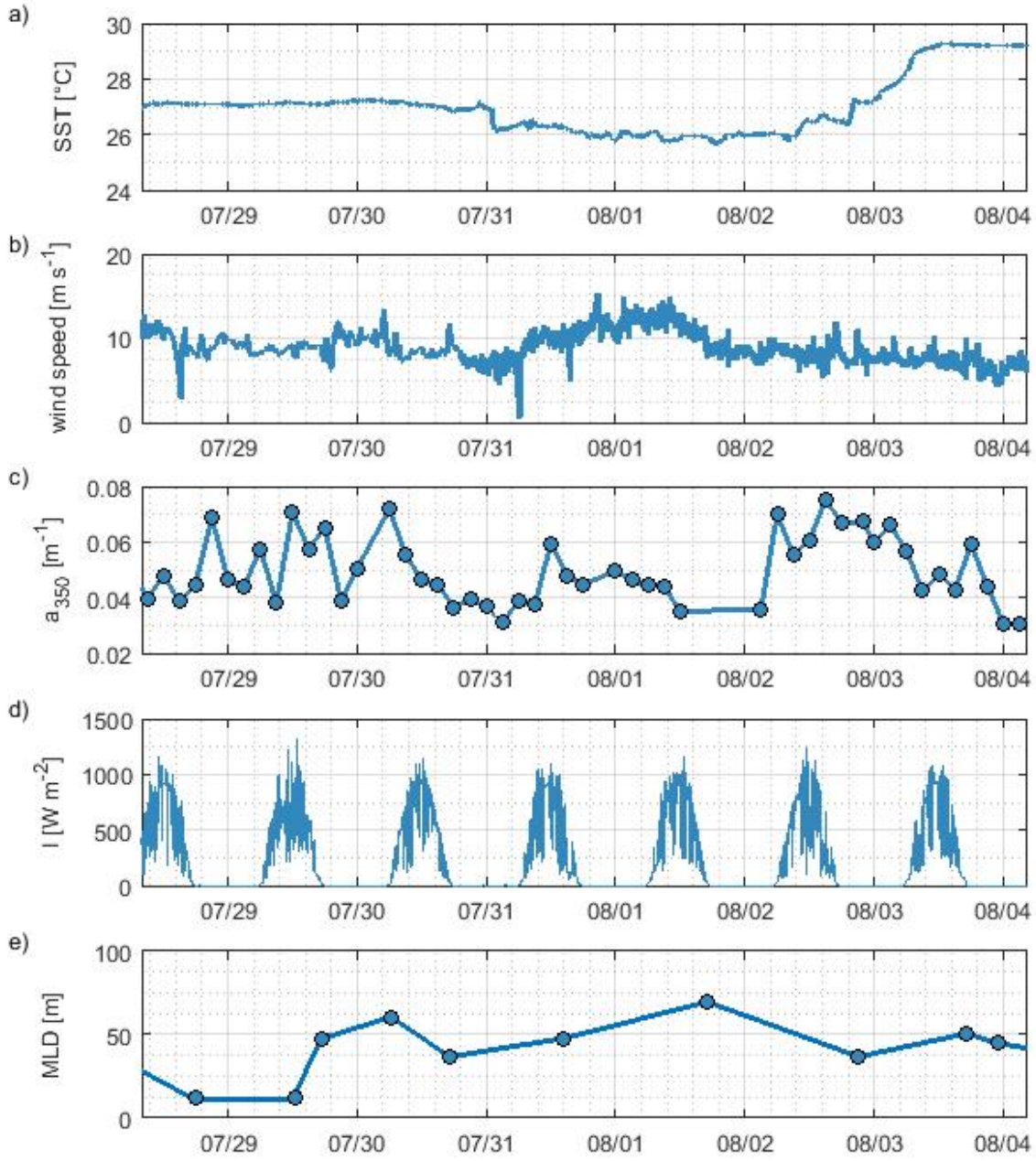
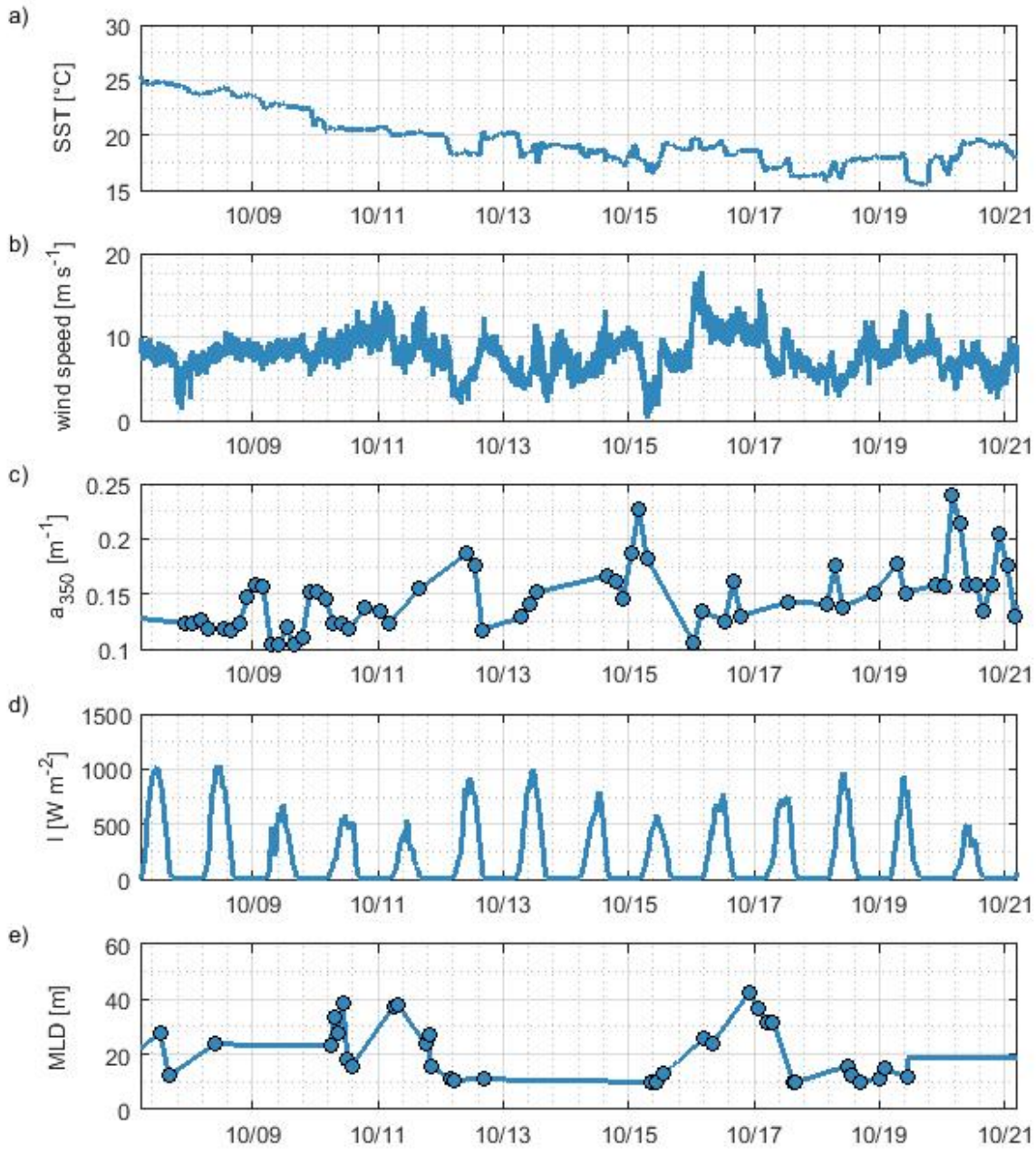
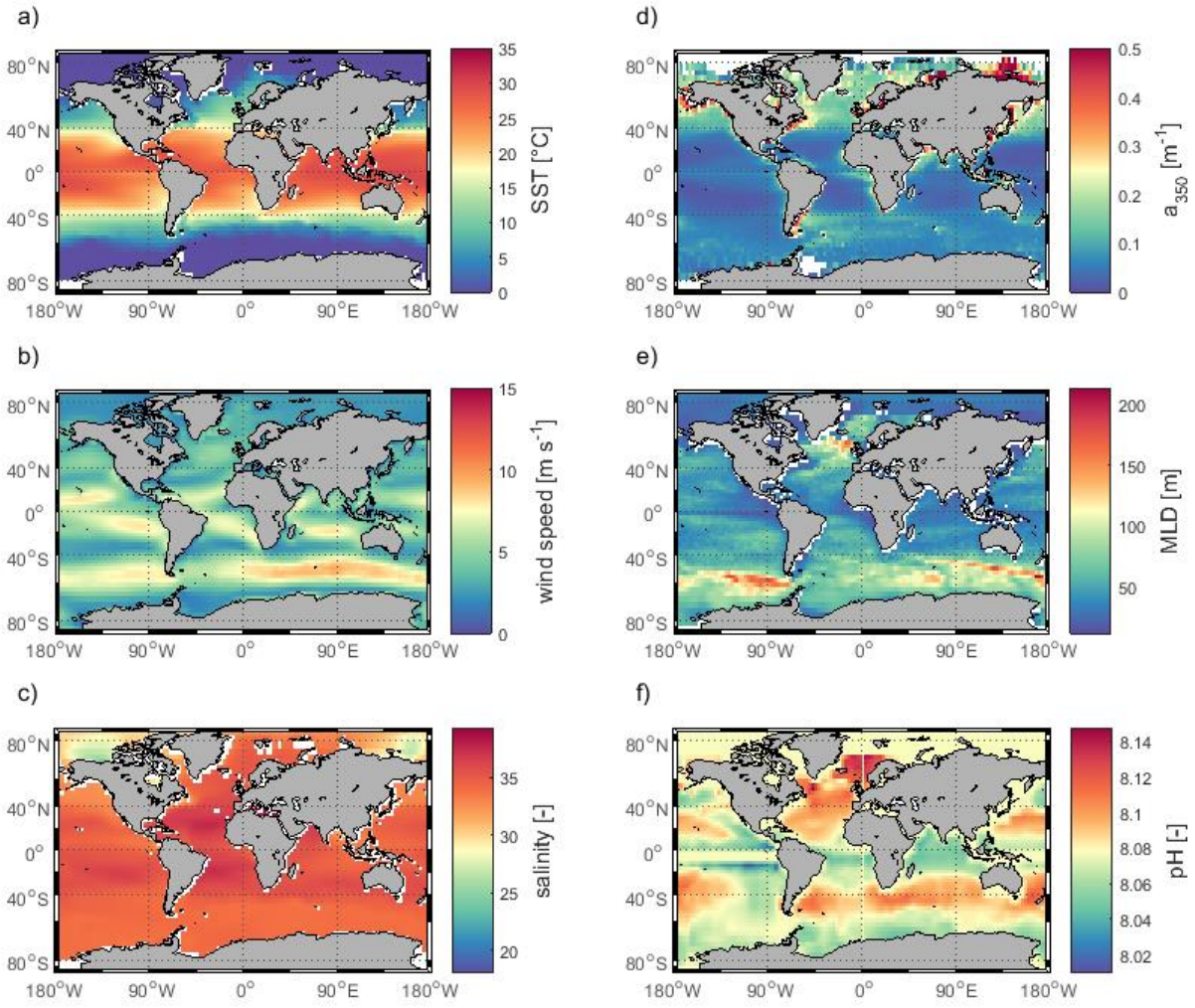
Supplementary figures



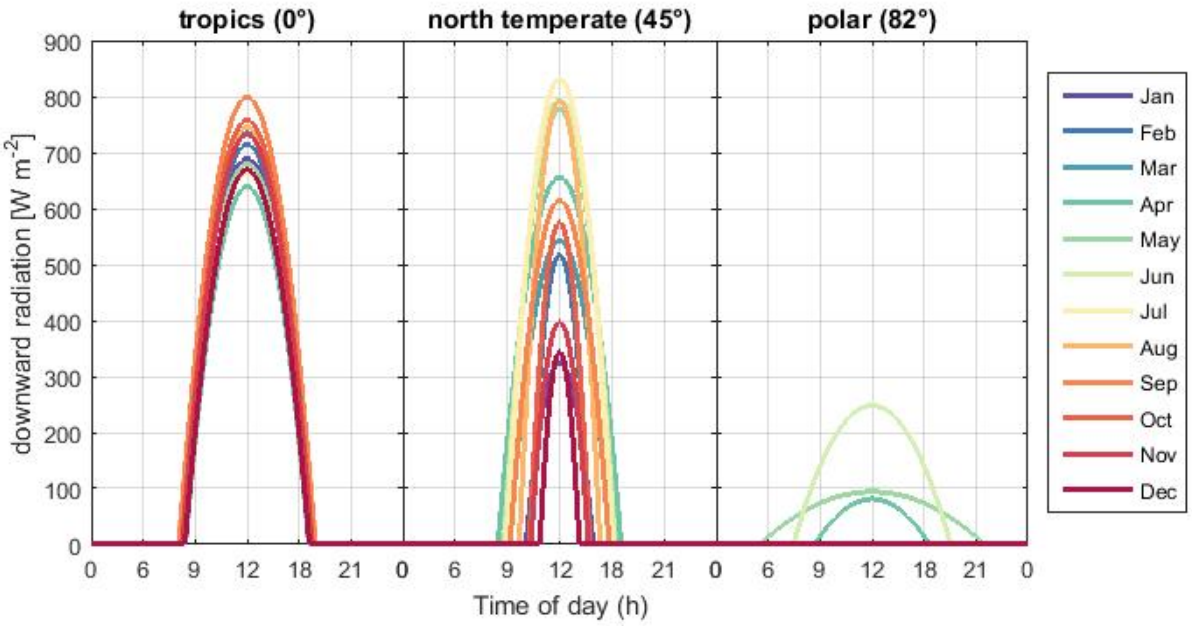
S-Fig 1: Input parameters for case study box model simulation for the OASIS cruise to the Indian Ocean for a) SST, b) wind speed corrected to 10 m height, c) absorption at 350 nm, d) global radiation, e) mixed layer depth; all measured directly onboard RV SONNE I in 2014.



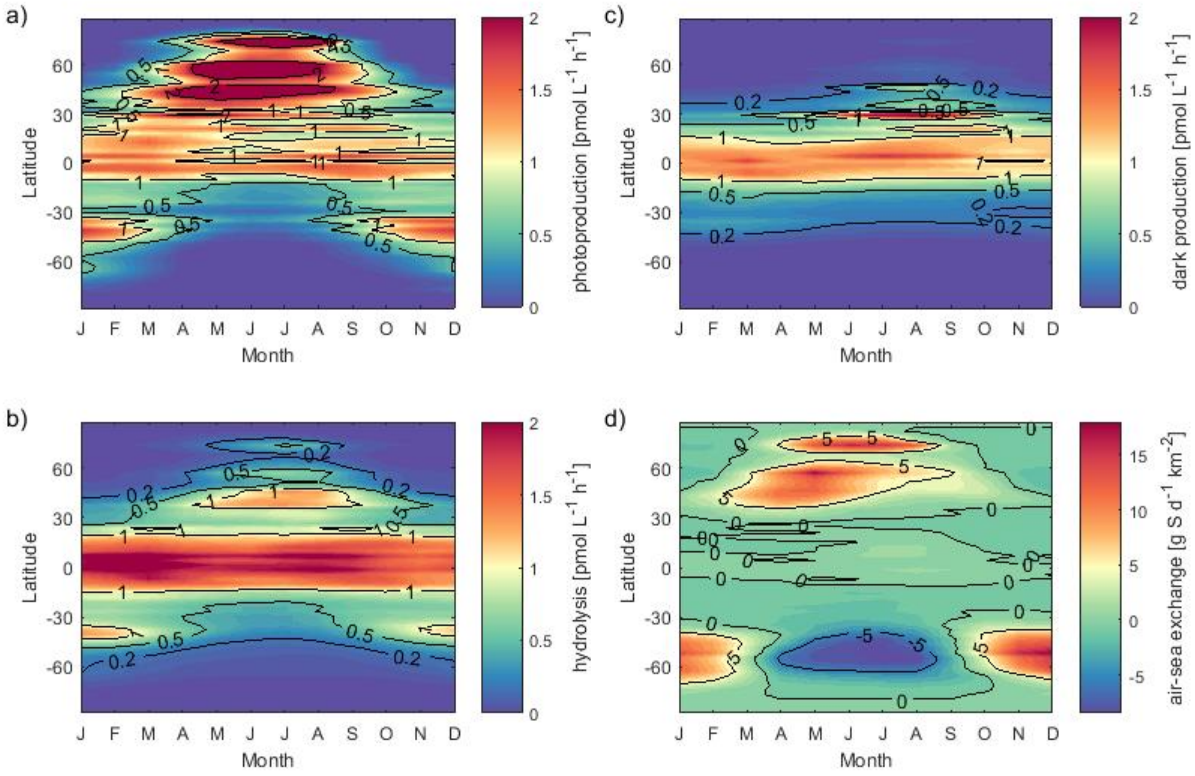
S-Fig 2: Input parameters for case study box model simulation for the ASTRA-OMZ cruise to the eastern Pacific Ocean for a) SST, b) wind speed corrected to 10 m height, c) absorption at 350 nm, d) global radiation, e) mixed layer depth; all measured directly onboard RV SONNE II in 2015.



S-Fig 3: Annual mean for input parameters of a) sea surface temperature SST, b) wind speed, c) salinity, d) absorption of CDOM at 350 nm a_{350}, e) mixed layer depth, and f) pH. Details on data sources can be found in S-Tab. 4.



S-Fig. 4: Diurnal cycles of downward radiation from the tropics, north temperate and polar regions resulting from fitting a parable to the sunshine duration and downwelling radiance from ERAInterim (Eq. 13, S-Tab. 4). Color coding refers to mean monthly diurnal cycles.



S-Fig. 5: Rates of a) photoproduction (average of the mixed layer), b) hydrolysis, c) dark production and d) air sea exchange in the mixed layer for each month and latitude from the box model simulation.

Supplementary tables

S-Tab. 1: Input parameter for the box model for the OASIS cruise (Indian Ocean). Measurements were linearly interpolated to a time grid of 2 minute resolution.

Parameter	Data source
global radiation	shipboard meteorological equipment, 10 minute mean
CDOM absorption spectrum	measured onboard, ca. 3-hour resolution, LWCC setup(Miller et al., 2002)
sea surface temperature	continuously (every minute) measured at seawater intake for underway system, Seabird MicroCat SBE41
sea surface salinity	continuously (every minute) measured at seawater intake for underway system, Seabird MicroCat SBE41
pH	calculated from dissolved inorganic carbon and alkalinity sampled at seawater intake from underway system, ca. 3-hourly resolution
wind speed	measured onboard, corrected to 10 m height, 10 minute averages
atm. volume mixing ratio of OCS	sampled onboard, ca. 3-hourly resolution, air canister samples analysed at RSMAS(Schauffler et al., 1998; de Gouw et al., 2009)
mixed layer depth	obtained from CTD profiles, using the Lorbacher(Lorbacher et al., 2006) criterion, 1-2 times per day
sea level air pressure	measured onboard, 10 minute averages

S-Tab. 2: Input parameter for the box model for the ASTRA-OMZ cruise (Pacific Ocean). Measurements were linearly interpolated to a time grid of 2 minute resolution.

Parameter	Data source
global radiation	shipboard meteorological equipment, 10 minute mean
CDOM absorption spectrum	measured onboard, ca. 3-hour resolution, LWCC setup(Miller et al., 2002)
sea surface temperature	continuously (everny minute) measured at seawater intake for underway system, Seabird MicroCat SBE41
sea surface salinity	continuously (every minute) measured at seawater intake for underway system, Seabird MicroCat SBE41
pH	mean value of 8.1 assumed (minor sensitivity to pH confirmed in sensitivity tests)
wind speed	measured onboard, corrected to 10 m height, 10 minute averages
atm. volume mixing ratio of OCS	sampled onboard, ca. 3-hourly resolution, air canister samples analysed at RSMAS(Schauffler et al., 1998; de Gouw et al., 2009)
mixed layer depth	obtained from CTD profiles, using the Lorbacher(Lorbacher et al., 2006) criterion, 0-4 times per day
sea level air pressure	measured onboard, 10 minute averages

S.-Tab 3: Input parameter for the global box model. Data was linearly interpolated to a time grid of 2 h resolution.

Parameter	Input
Global radiation	Diurnal cycle fitted to downwards radiation and sunshine duration from 2014 ERAInterim reanalysis data (ECMWF)
CDOM absorption 350 nm	MODIS Aqua satellite data "absorption due to gelbstoff and detritus 443 nm", GIOP model, corrected to 350nm assuming an exponential spectrum, climatological monthly mean 2002-2014(NASA, 2014)
sea surface temperature	ERAInterim reanalysis, climatology from 2002-2014 synoptic monthly means(Dee et al., 2011)
sea surface salinity	World Ocean Atlas climatology(Antonov et al., 2010)
pH	Takahashi climatology(Takahashi et al., 2014)
wind speed	ERAInterim reanalysis, climatology from 2002-2014 synoptic monthly means
atm. volume mixing ratio for OCS	assumed 550 ppt
mixed layer depth	MIMOC climatology(Schmidtko et al., 2013)
sea level air pressure	ERAInterim reanalysis, climatology from 2000-2014 synoptic monthly means
initial condition	8 pmol L^{-1}
spin-up until stable global mean	2 years

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