Contributions from the Peruvian upwelling to the tropospheric iodine loading above the tropical East Pacific

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INTRODUCTION

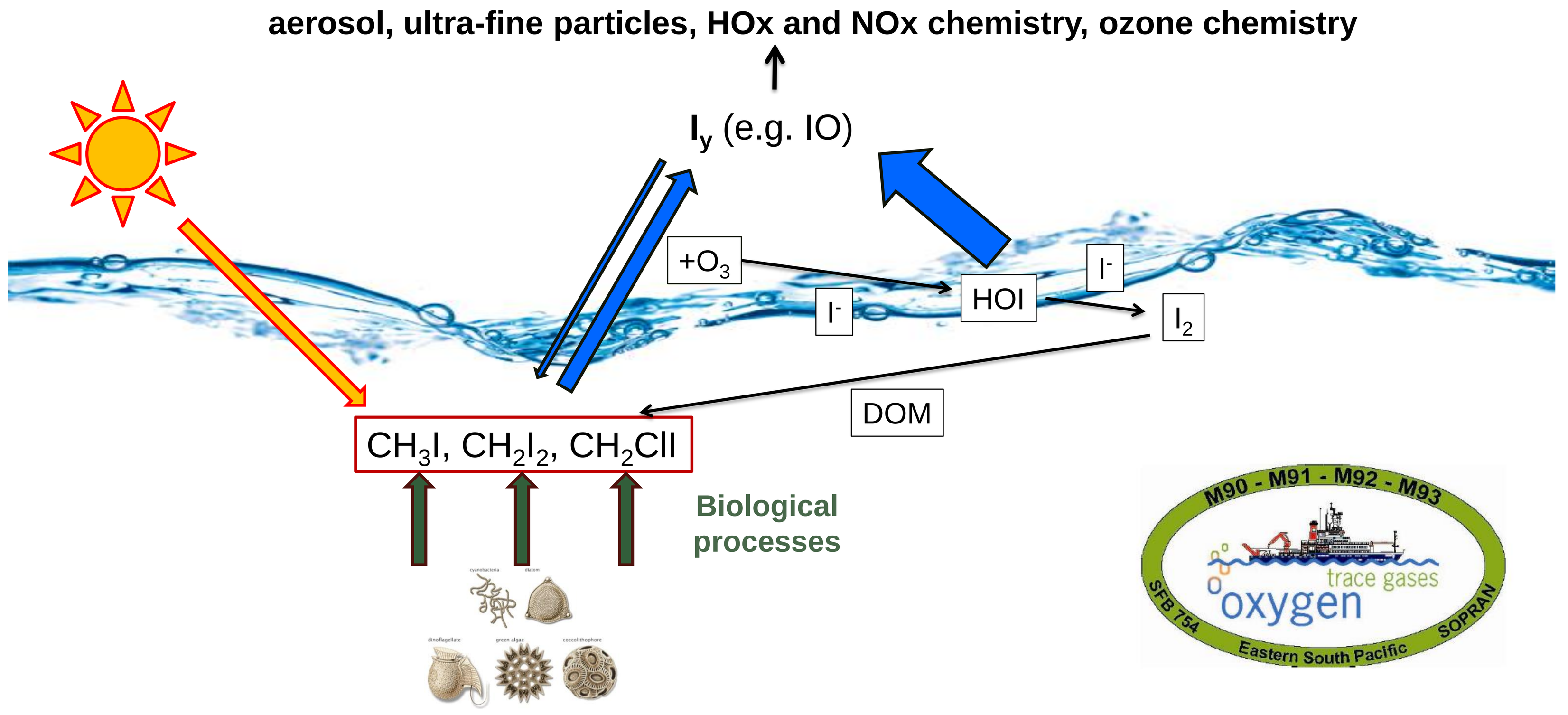


Fig. 1: Iodine in the ocean with photochemical production of CH_3I and biological production of CH_3I, CH_2I_2 and CH_2ClI contributing to the tropospheric iodine (I_y) loading, with HOI and I_2 as additrional inorganic source for I_y.

Research: How does the tropical, very biologically active Peruvian upwelling contribute to the tropospheric iodine loading of the tropical East Pacific? Which factors contribute to the regional distribution of oceanic and tropospheric CH_3I, CH_2I_2 and CH_2ClI?

CONCLUSIONS AND OUTLOOK

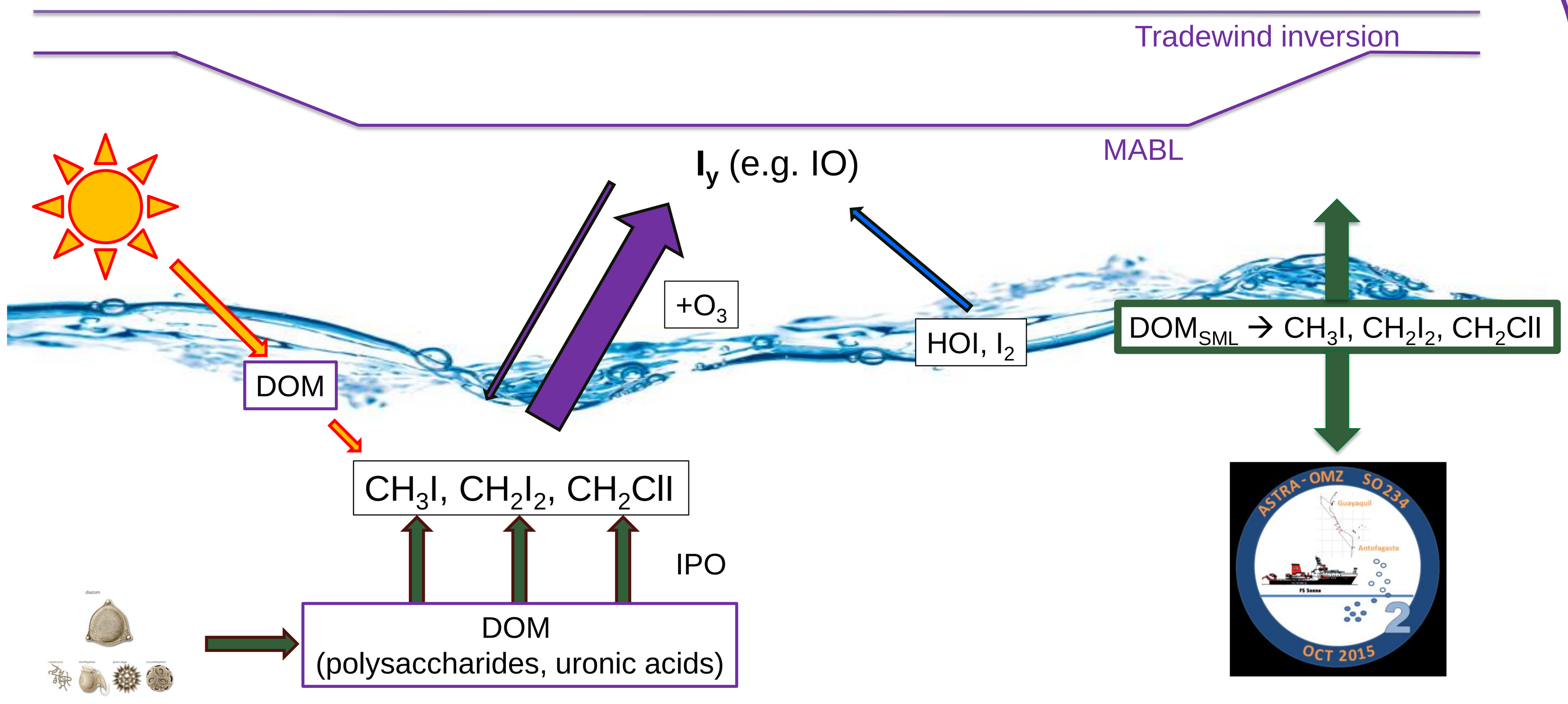
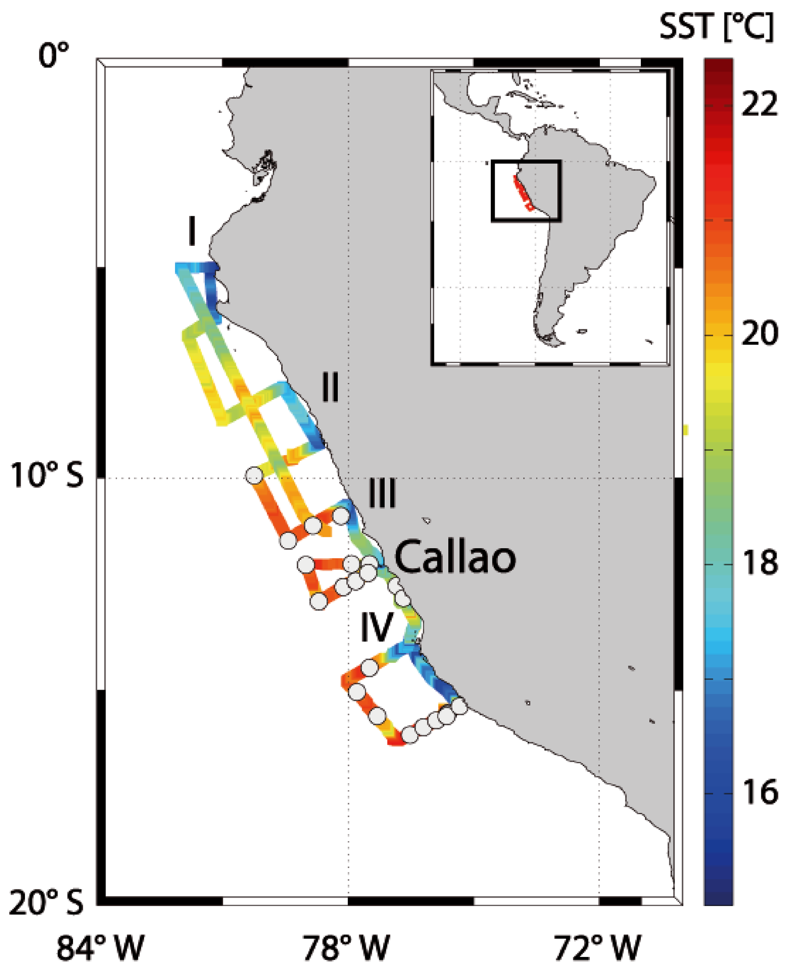


Fig. 2: Conclusions and outlook from the M91 cruise. Purple indicates conclusions, green indicates the outlook.

Outlook: **The sea surface microlayer represents a potentially very significant source for iodocarbons due to its unique DOM composition, with direct contact to the air-sea interface. This will be investigated during the ASTRA cruise to the Peruvian upwelling in October 2015.**

M91-CRUISE



RV Meteor

Fig 3: Cruise track for M91 with SST in the color coding. Four upwelling regions (roman numerals) were identified.

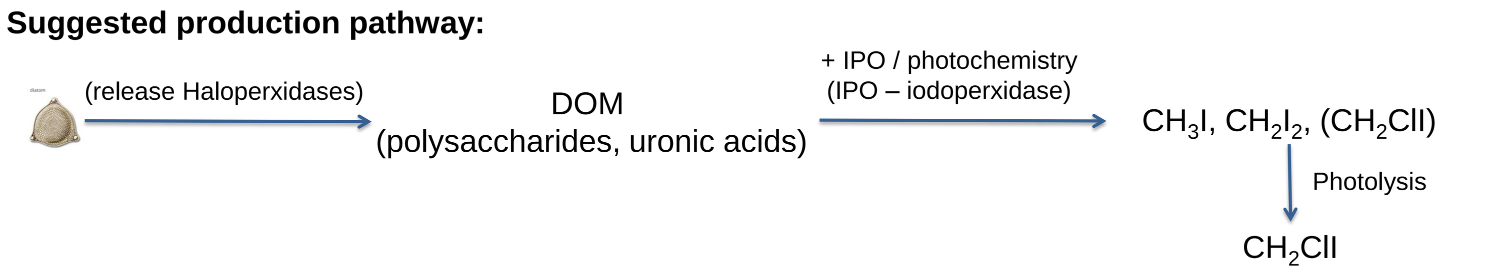
- Callao, Peru to Callao, Peru, December 1 to 26 2012
- Four upwelling regions (see Sea Surface Temperature – SST)

RELATIONSHIP TO BIOLOGICAL PARAMETERS

Spearman's rank correlation	CH_3I	CH_2ClI	CH_2I_2	$dCCHO_{ULW}$	$TUra_{ULW}$
Diatoms	0.73	0.79	0.72	0.68	0.75
$TUra_{ULW}$	0.83	0.88	0.52	0.94	
$dCCHO_{ULW}$	0.82	0.90	0.55		
CH_2I_2	0.66	0.59			
CH_2ClI	0.83				

Table 1: Spearman's rank correlation coefficients r_s of the three iodocarbons with DOM constituents in the subsurface ($dCCHO_{ULW}$ – dissolved polysaccharides, $TUra_{ULW}$ – total uronic acids) and *diatoms.*

Suggested production pathway:



The accumulation of DOM in the sea surface in regions of high iodocarbons (Fig. 3) suggests potential production of these compounds in the very surface with direct link to the air-sea interface.

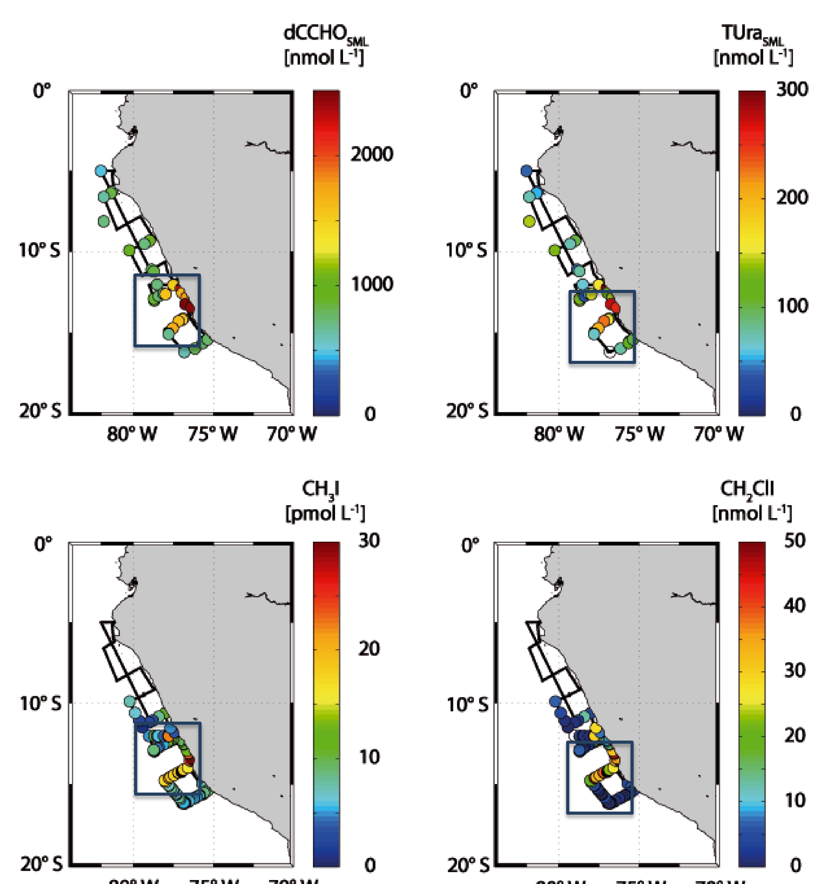


Fig. 4: dCCHO and TUra measurements directly from the microlayer (upper panel) along with measurements of CH_3I and CH_2ClI in the subsurface (around 6.8 m).

RESULTS FROM THE CRUISE

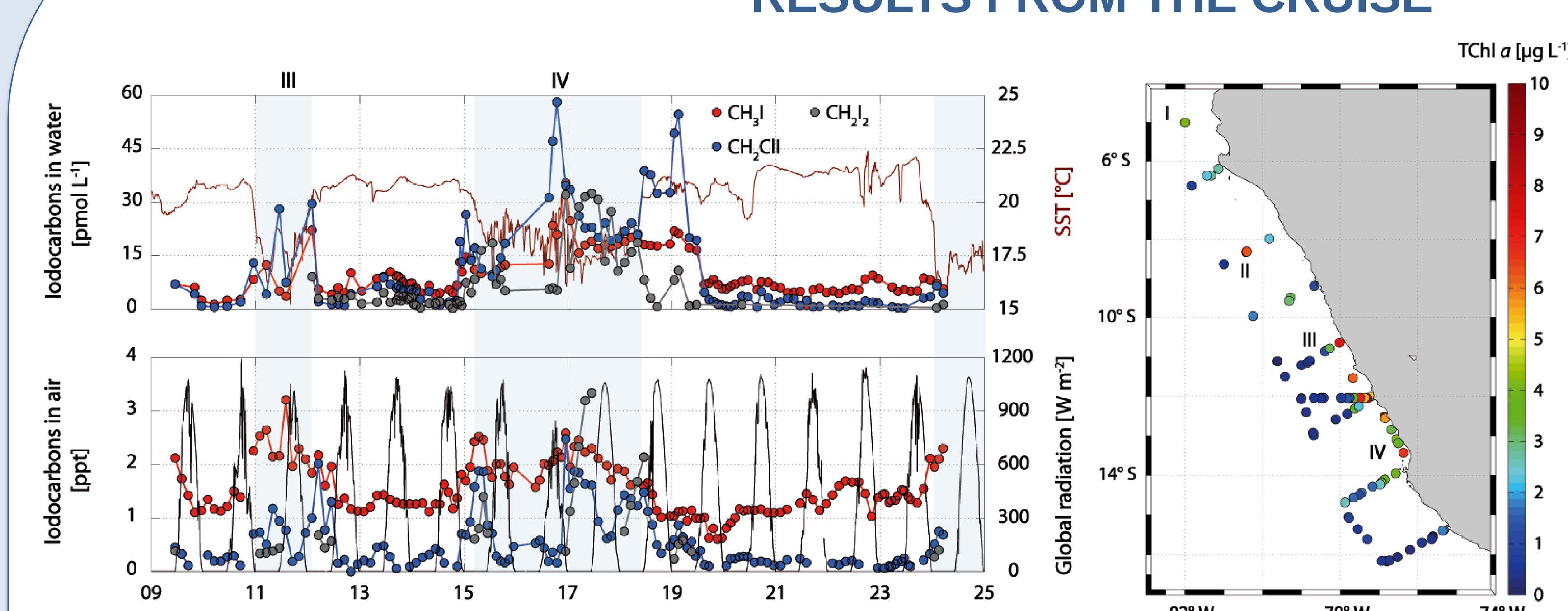


Fig. 5: Iodocarbons in sea surface water (upper panel), the lower troposphere (lower panel), along with a map of Chl *a* (see color bar).

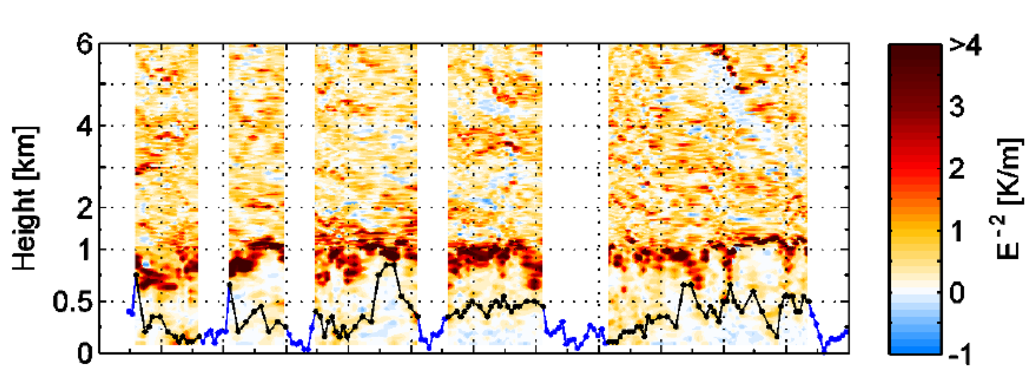


Fig. 6: Gradient of virtual temperature E^{-2} along with the height of the Marine Atmospheric Boundary Layer (MABL) (black – derived from ozone sondes, blue – derived from multiple linear regression)

- Mean (max) CH_2ClI – 10.9 (58.1) pmol L^{-1}, CH_3I – 9.8 (35.4) pmol L^{-1}, CH_2I_2 – 7.7 (32.4) pmol L^{-1} → very elevated, lead to enhanced fluxes (Fig. 7)
- Large atmospheric mixing ratios: CH_2ClI – 0.4 (2.5) ppt (lifetime: few hours), CH_3I – 1.5 (3.2) ppt (lifetime: few days), CH_2I_2 – 0.2 (3.3) ppt (lifetime: few minutes)
- Distribution of longer lived atmospheric CH_3I also strongly influenced by MABL heights (high when MABL is low, low when MABL is high) (Fig. 6)

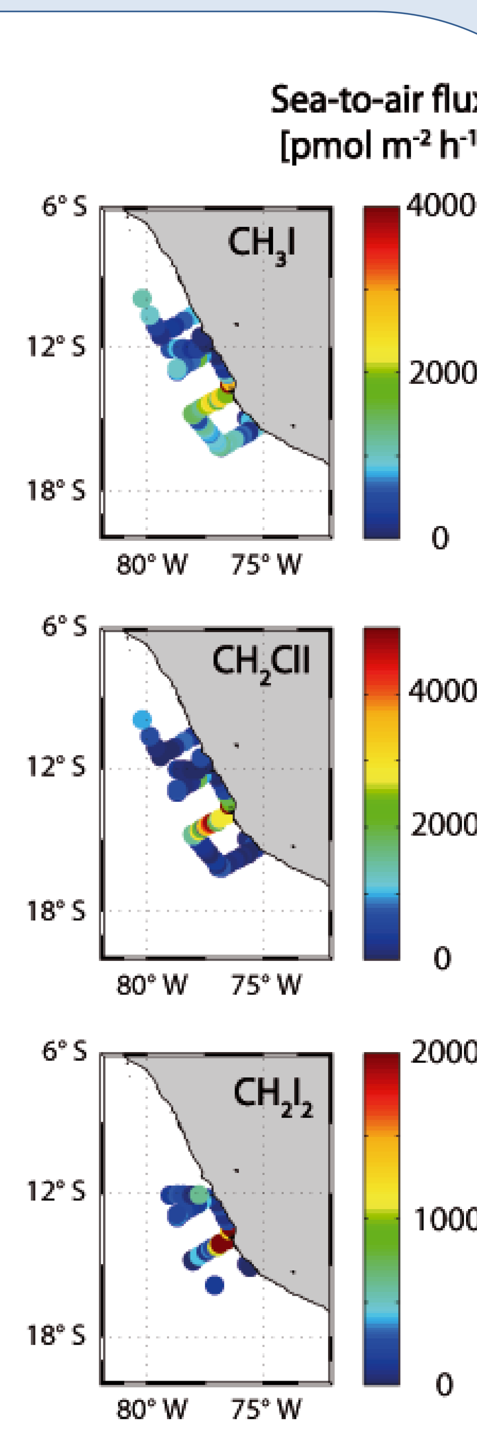


Fig. 7: Sea-to-air fluxes of iodocarbons

POSSIBLE CONTRIBUTION TO IO

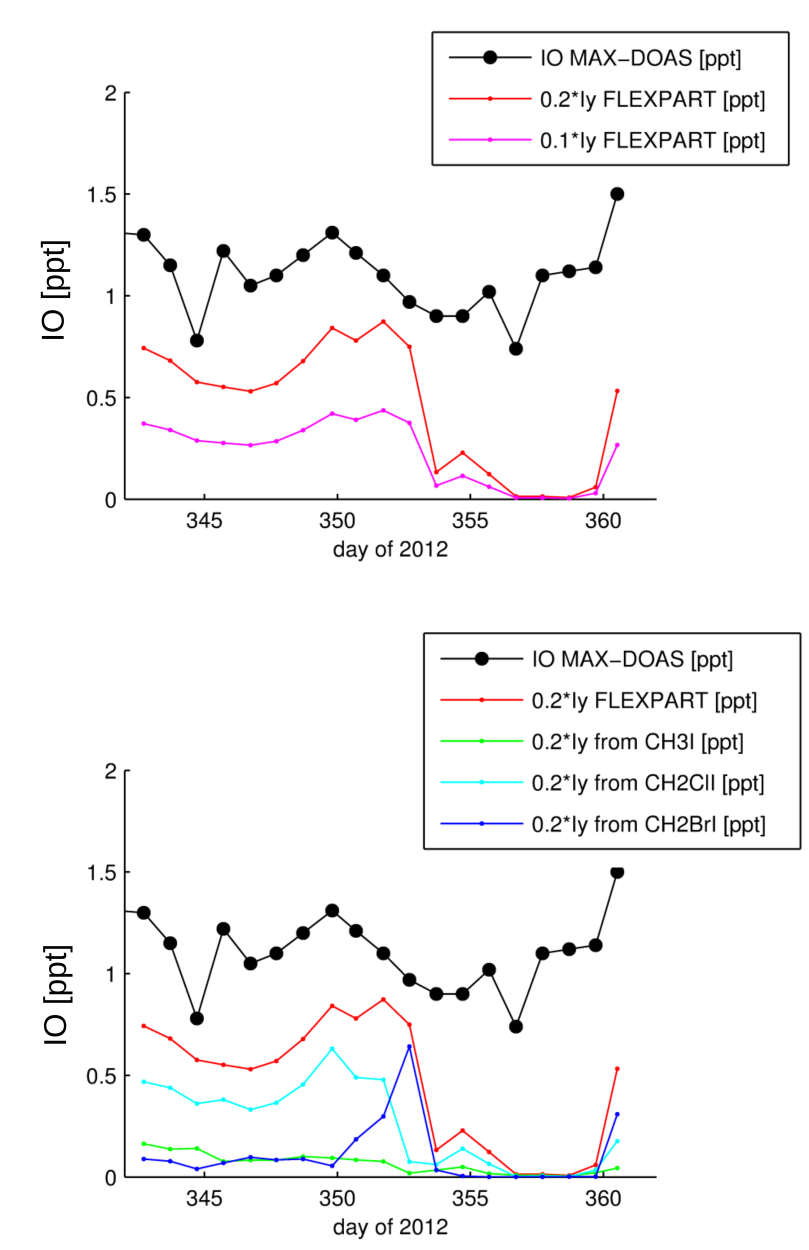


Fig. 8: Contribution of emissions of organoiodine compounds to measured iodine oxide (IO) with different fractions.

References

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