A44A-2685

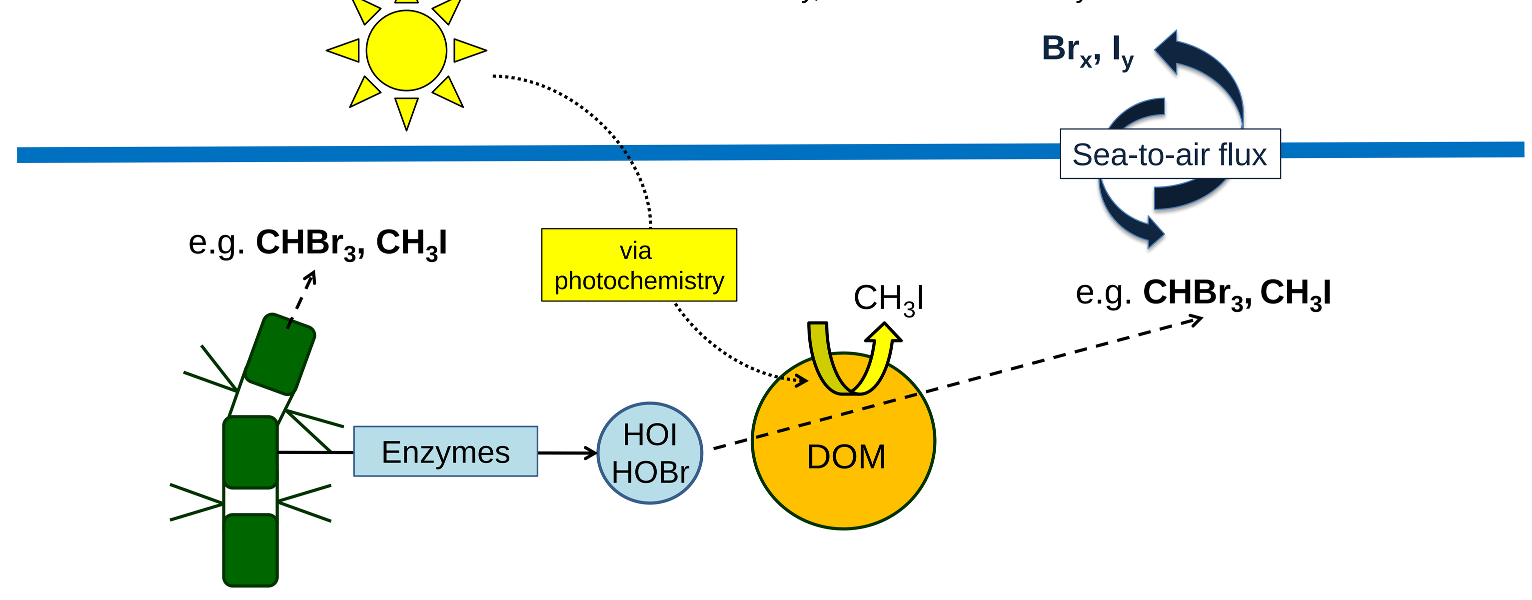
Do climate feedbacks in the tropical East Pacific impact emissions of biogenic halocarbons?

H Hepach[1*], B. Quack[1], E. Atlas[2], A. Fiehn[1], S. Tegtmeier[1], A. Bracher[3], A. Engel[1], S. Fuhlbrügge[1], and K. Krüger[4]
* hhepach@geomar.de

GEOMAR

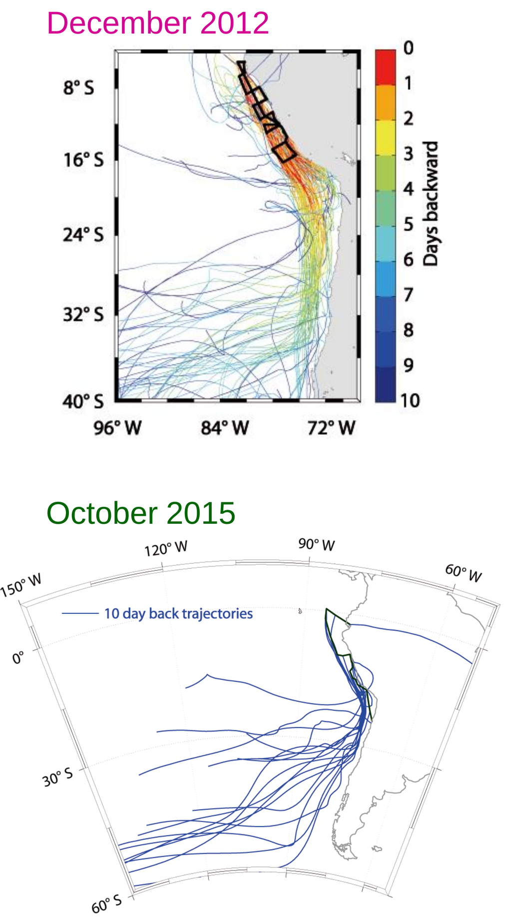
Halocarbon production

Halocarbon emissions influence atmospheric processes such as formation of aerosols, ultra-fine particles, HO_x and NO_x chemistry, and ozone chemistry.

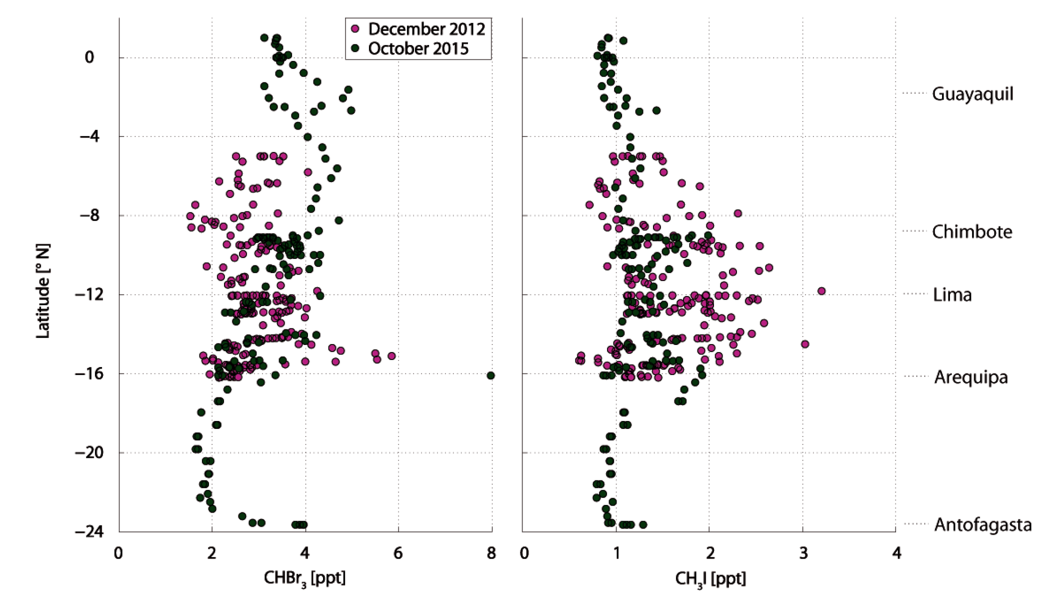


Proposed pathway of halocarbon production via dissolved organic matter (DOM) or direct emission from algae, and photoproduction of CH_3I. Chemical degradation products Br_x and I_y of halocarbon emissions take part in atmospheric chemistry.

Atmospheric halocarbons



(based on FLEXPART with ERA-Interim input)

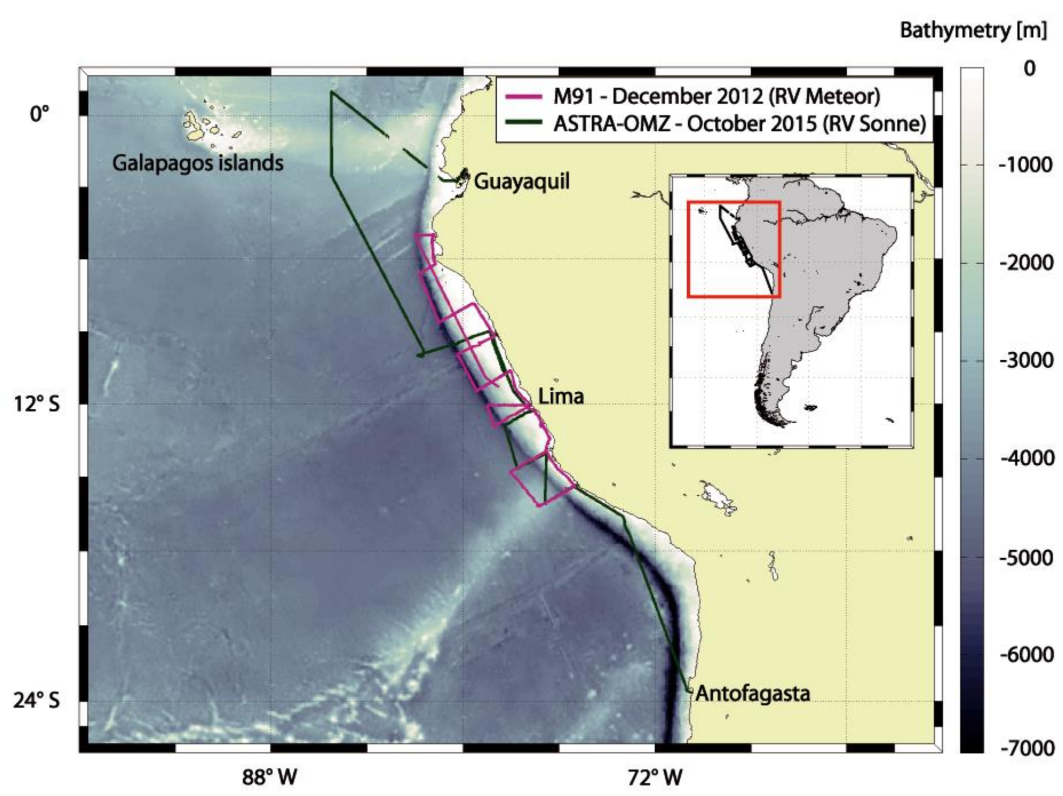


- 10 day backward trajectory analysis (left side): southwesterly winds in both cases

Mean atmospheric mixing ratios

- $CHBr_3$: 2.9 vs 3.3 ppt and CH_3I: 1.5 vs 1.2 ppt
- Difference is due to higher $CHBr_3$ and lower CH_3I sea-to-air fluxes and stability of the marine atmospheric boundary layer (MABL) (less pronounced during ASTRA-OMZ).

M91 and ASTRA-OMZ

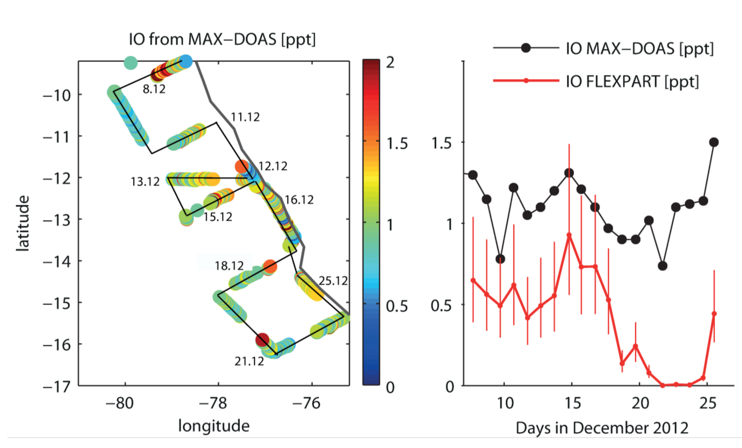


M91, RV Meteor, Lima – Lima (Peru), December 1 – 26 2012 (*ENSO neutral*)

ASTRA-OMZ, RV Sonne, Guayaquil (Ecuador) – Antofagasta (Chile), October 3 – 23 2015 (strong *El Niño*)

El Niño influenced oceanic emissions of halocarbons!

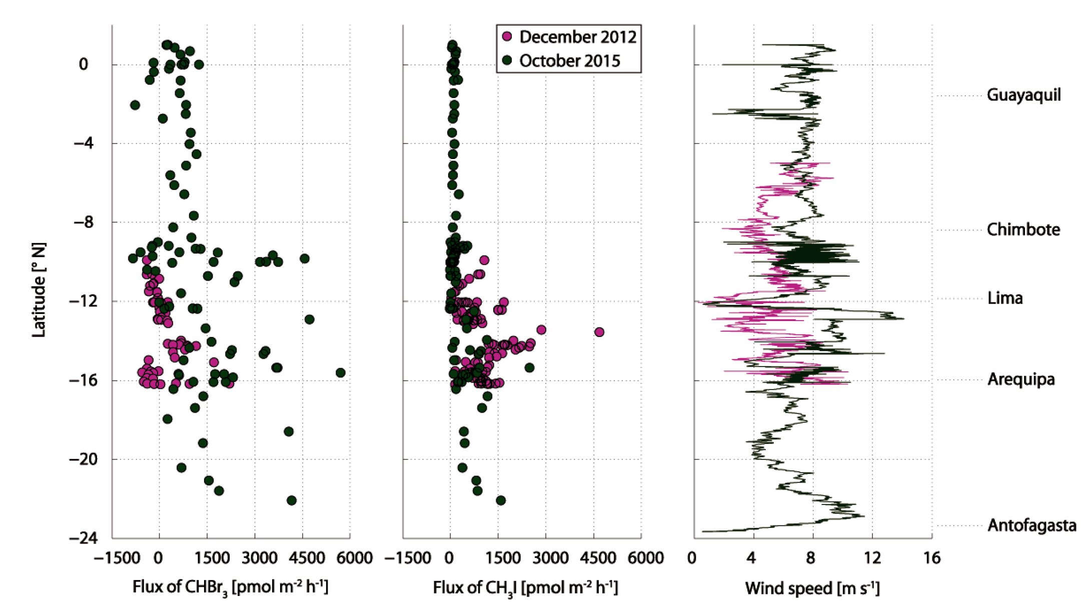
- During the ENSO neutral year 2012, higher oceanic CH_3I than $CHBr_3$ was measured, while during the El Niño year 2015 sea surface $CHBr_3$ largely exceeded lower CH_3I.
- Higher emissions of $CHBr_3$ and lower emissions of CH_3I during El Niño along with less pronounced MABL heights led to larger atmospheric $CHBr_3$ and slightly lower CH_3I in October 2015.
- High iodocarbon emissions in 2012 contributed strongly to tropospheric iodine monoxide (IO).



Open questions

- Is the neutral / El Niño difference a recuring phenomenon?
- What causes the difference in oceanic halocarbons? E.g. phytoplankton speciation and DOM composition?
- How do varying emission scenarios during different ENSO phases influence tropospheric halogen chemistry?

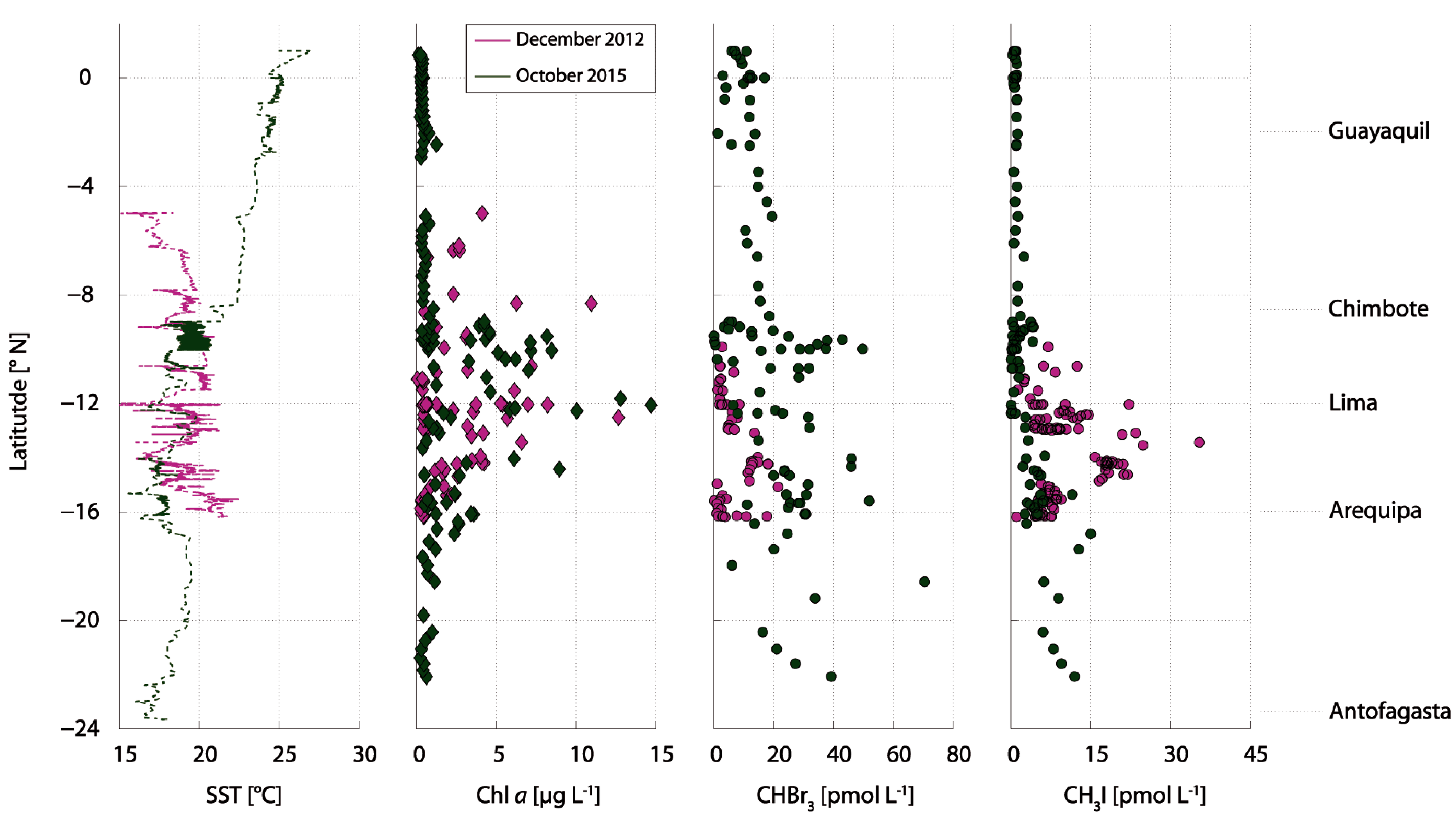
Sea-to-air fluxes



Sea-to-air fluxes for December 2012 and October 2015:

- $CHBr_3$ 131 (-550-2201), CH_3I 956 (21-4686) pmol h^{-1} m^{-2}
- $CHBr_3$ 1588 (-841-15488), CH_3I 290 (-22-2490) pmol h^{-1} m^{-2}
- October 2015 was 3.3 times lower for CH_3I and 12.1 times higher for $CHBr_3$ with moderate winds during both cruises (5.6 and 7.1 m s^{-1}, respectively).

Oceanic halocarbons



Seawater concentrations for December 2012 and October 2015 (mean (min – max)):

- $CHBr_3$ 6.5 (0.2 – 21.5), CH_3I 9.8 (1.1 – 35.4) pmol L^{-1}
- $CHBr_3$ 20.1 (0.1 – 103.0), CH_3I 2.7 (0 – 15.0) pmol L^{-1}
- October 2015 was characterized by 3 times higher $CHBr_3$ and 3.6 times lower CH_3I despite similar SST and Chl *a*.

Correlation of environmental parameters for December 2012 and October 2015 (bold numbers significant, different DOM components include uronic acids and combined high molecular weight carbohydrates):

Spearman's rank correlation	CH_3I	$CHBr_3$
SST	**-0.52 / -0.45**	**-0.29 / -0.39**
Chl *a*	**0.73** / 0.22	**0.48** / 0.13
DOM	**0.48 – 0.84**	-0.06 – 0.39
$CHBr_3$	**0.66 / 0.37**	

References
Fuhlbrügge, S., Quack, B., Atlas, E., Fiehn, A., Hepach, H. and Krüger, K.: „Meteorological constraints on oceanic halocarbons above the Peruvian Upwelling", ACPD, doi: 10.5194/acpd-15-20597-2015, 2015.
Hepach, H., Quack, B., Tegtmeier, S., Engel, A., Bracher, A., Fuhlbrügge, S., Galgani, L., Atlas, E. L., Lampel, J., Frieß, U. and Krüger, K.: „Biogenic halocarbons from the Peruvian upwelling as tropospheric halogen source", submitted to ACP, 2016.

Acknowledgements
The authors acknowledge Tom Browning for providing Chl *a* data and Gert Petrick for technical assistance with halocarbon measurements. We thank the BMBF for funding the ASTRA-OMZ and OASIS-Sonne projects.

Affiliations
1 GEOMAR Helmholtz-Zentrum für Ozeanforschung Kiel, Germany
2 Rosenstiel School of Marine and Atmospheric Science (RSMAS), University of Miami, USA
3 Alfred-Wegener-Institute (AWI) Helmholtz Center for Polar and Marine Research, Bremerhaven and Institute of Environmental Physics, University of Bremen, Germany
4 Department of Geosciences, University of Oslo, Norway

Ocean Sciences Meeting 2016, New Orleans, 21 – 26 February