

Med-Oceanor: 20 years of sun, sea-spray and studies

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Mercury in the air





Oxidised Mercury in the Marine Boundary Layer



GOS⁴M Kick-off Meeting, 2020 7-8 October

These results come from the first ever Med-Oceanor oceanographic Campaign. (Sprovieri et al., Atmos. Env., 37, S1, 63-71, 2003) Reactive Gaseous Mercury (RGM) refers to Hg(II) compounds which can be collected from the air, originally by using KCI denuders.

RGM was believed to be mostly emitted from industrial sources, and therefore this variation and link to sunlight surprised many.

Colleagues from the US-EPA were so sceptical they shipped their equipment over and came on the next Med-Oceanor campaign



Mercury in the water

On the early oceanographic cruises measurements were made taking

(Kotnik et al., Mar. Chem., 193, 8-19, 2017,





Profile distance (km)







Mercury in the water

Continuous measurement methods were developed later, which coupled with measurements of the air and sea temperature and the wind speed, allow fluxes to be calculated



Mercury flux $[ng m^{-2} h^{-1}]$

Summer / Autumn



(Nerentorp Mastromonaco et al., Mar. Chem. 193, 34-43, 2017)



Models



Time / hours from midnight 17/06/05

(Sprovieri et al., Atmos. Chem. Phys., 10, 3985–3997, 2010, Gencarelli et al., Atmos. Env., 117, 162-168, 2015)





Using models to fill in the gaps

Using chemical transport models which are validated using observations, annual deposition and evasion fields can be calculated. The Mediterranean is a net emitter of Hg to the atmosphere



4095-4109, 2014)



Total Deposition



Dry Deposition



Particulate Hg Dry Deposition



Oxidised Hg Dry Deposition



Wet Deposition









Particulate Hg Wet Deposition



Oxidised Hg Wet Deposition

Processes







(Rajar et al., Mar. Chem., 107, 89-102, 2007, Kotnik et al., Mar. Chem., 193, 8-19, 2017)





Revised budgets

Having made estimates of the various processes which add and subtract mercury compounds to the waters of the Mediterranean, it is possible, as the oceanographic campaigns continue, to assess whether changes occur as a result of the Minamata Convention

(Zagar et al., Environ. Sci. Pollut.) Res., 21, 4081 - 4094, 2014)



Total and Methylated mercury Mass Balance in the Mediterranean Sea



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surface MeHg (pg/L)

station ordered by longitude (ascending)

(Buckman et al., Ecotoxicology, 27, 1341–1352, 2018)



organism ordered by MeHg (ng/g DW) (ascending)



Mercury in the fish we eat



(Cinnirella et al., Scientific Data, 6, 205, 2019)



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37.1.1	37.1.2	37.1.3	37.2.1	37.2.2	37.3.1	37.3.2	37.4.1	37.4.2	51.1**	Total by decade	%
0	4	5	0	0	0	0	0	0	0	9	0.0
718	670	2281	1135	365	169	814	7	5	3	6167	25.2
923	1162	2010	1160	735	377	1013	8	44	19	7451	30.5
810	840	1969	581	421	214	1139	5	47	17	6043	24.7
659	315	1153	347	398	210	1077	6	5	2	4172	17.1
140	57	222	22	49	38	95	0	0	0	623	2.5
3250	3048	7640	3245	1968	1008	4138	26	101	41		
13.3	12.5	31.2	13.3	8.0	4.1	16.9	0.1	0.4	0.2		
	37.1.1 0 718 923 810 659 140 3250 13.3	37.1.1 37.1.2 0 4 0 4 718 670 923 1162 810 840 659 315 140 57 3250 3048 13.3 12.5	37.1.1 37.1.2 37.1.3 0 4 5 718 6700 2281 923 1162 2010 810 8400 1969 659 3155 1153 140 57 222 3250 3048 7640 13.3 12.5 31.2	37.1.1 37.1.2 37.1.3 37.2.1 0 4 5 0 718 6700 2281 1135 923 1162 2010 1160 810 840 1969 581 659 315 1153 347 140 57 222 22 3250 3048 7640 3245 13.3 12.5 31.2 13.3	37.1.1 37.1.2 37.1.3 37.2.1 37.2.2 0 4 5 0 0 718 6700 2281 1135 365 923 1162 2010 1160 735 810 840 1969 581 421 659 315 1153 347 398 140 57 222 22 49 3250 3048 7640 3245 1968 13.3 12.5 31.2 13.3 8.0	37.1.1 37.1.2 37.1.3 37.2.1 37.2.2 37.3.1 0 4 5 0 0 0 718 6700 2281 1135 3655 169 923 1162 2010 1160 7355 377 810 8400 1969 581 421 214 659 3155 1153 347 3988 2100 140 57 222 22 49 38 3250 3048 7640 3245 1968 1008 13.3 12.5 31.2 13.3 8.0 4.1	37.1.1 37.1.2 37.1.3 37.2.1 37.2.2 37.3.1 37.3.2 0 4 5 0 0 0 0 718 670 2281 1135 365 169 814 923 1162 2010 1160 735 377 1013 810 840 1969 581 421 214 1139 659 315 1153 347 398 210 1077 140 57 222 22 49 38 95 3250 3048 7640 3245 1968 1008 4138 13.3 12.5 31.2 13.3 8.0 4.1 16.9	37.1.1 37.1.2 37.1.3 37.2.1 37.2.2 37.3.1 37.3.2 37.4.1 0 4 5 0 0 0 0 0 0 0 718 6700 2281 1135 365 169 814 7 923 1162 2010 1160 735 377 1013 88 810 8400 1969 581 421 214 1139 55 659 315 1153 347 398 2100 1077 66 140 57 222 22 49 38 95 0 3250 3048 7640 3245 1968 1008 4138 26 13.3 12.5 31.2 13.3 8.0 4.1 16.9 0.1	37.1.1 37.1.2 37.1.3 37.2.1 37.2.2 37.3.1 37.3.2 37.4.1 37.4.2 0 4 5 0 0 0 0 0 0 0 718 6700 2281 1135 3655 1699 8144 7 5 923 1162 2010 1160 735 377 1013 8 44 810 8400 1969 581 421 2144 1139 5 47 659 3155 1153 347 398 2100 1077 6 5 140 57 222 22 49 38 95 00 0 3250 3048 7640 3245 1968 1008 4138 26 101 13.3 12.5 31.2 13.3 8.0 4.1 16.9 0.1 0.4	37.1.1 37.1.2 37.1.3 37.2.1 37.2.2 37.3.1 37.3.2 37.4.1 37.4.2 51.1** 0 4 5 0 <	Image: strain stran strain strain strain strain strain strain strain s

* This year is grouped with the 1970-1979 decade

** Not reported in the map





Mercury in the Fish We Will Eat?

Climate change and overfishing increase neurotoxicant in marine predators.

(Schartup, et al., Nature 572, 648-650, 2019)





And so leaving you with food for thought,

Thank you for your attention

