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Biogeosciences
Discussions

Interactive comment on "Factors controlling the temporal variability of mass and trace metal downward flux at 1000 m depth at the DYFAMED site (Northwestern Mediterranean Sea)" *by* L.-E. Heimbürger et al.

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Responses to Reviewer J. Scholten

Comment 1 We first want to stress that the flux values discussed by Ternon et al. (2010) are those from 200m depth, while this paper deals with 1000 m depth fluxes. Our working hypothesis (i.e., atmospheric deposition is the main source of TMs in surface waters, but does not determine marine mass fluxes, which are controlled by winter mixing and subsequent biological productivity), contradicts the statement of Ternon

et al., i.e. temporal variability of atmospheric fluxes drives the temporal variability of marine mass fluxes. This misleading interpretation of Ternon et al. may arise from hydrological data they missed to examine. We have evidence from the work of the multidisciplinary COMET research project, that the 2005-2006 200m depth flux values used in Ternon et al. are biased by strong currents. One of the target obectives of COMET is to produce reliable estimates of vertical fluxes, in an area where it is know that advection can lead to erroneous interpretation. Thorium data have been recently produced by COMET to complete our set of evidences; a paper on these aspects is in preparation. Therefore, there is no reason to "go beyond" the discussion of Ternon et al., in the present manuscript.

Comment 2 The sources of TMs at the DYFAMED site have been extensively discussed in several papers (e.g., Guerzoni et al., 1999; Migon et al., 2002; Bonnet and Guieu, 2006). The revised manuscript now provides a selection of references on the origin of TMs in surface waters. Does the trace element composition of sediment trap change over time? Certainly, both organic and atmospheric TM inputs depend on the source material and are strongly linked to atmospheric circulation. The TM/mass flux ratio is obviously dependent on the temporal variations of atmospheric deposition: the best examples are exceptional Saharan dust events that occur few days before the formation of dense water, when high crustal and low POC are transferred to depths. This can be contrasted for example to anthropogenic aerosols deposition during high biological production, resulting in high POC transfers and lower inorganic material (no accumulation: as soon as atmospheric TMs enter surface waters, they are transferred to depths). This can be extended to more cases, which subsequently translates into temporal variability as discussed by Migon et al. (2002) for Al/mass flux ratios at 200m depth at the DYFAMED site.

Comment 3 We do not have data on atmospheric deposition for the exact same period (we have aerosol data, but the extrapolation of atmospheric fluxes from aerosol data is questionable). In the revised manuscript, we provide references on the atmospheric origin of TMs in sediment traps in the NW Mediterranean. The discussion on this point is amended.

Comment 4 There is here a misunderstanding, on this point, which was probably not clear enough. Indeed, a correlation between mass and given TM fluxes is spurious, since TM fluxes (FTM) are calculated as: FTM = [TM] x FM where [TM] is the TM concentration and FM is the mass flux. This is not our point. Our argument was on the covariance simultaneously observed between all TM fluxes and mass flux. Atmospheric deposition enriched in crustal TMs (e.g., Al) and atmospheric deposition enriched in anthropogenic TMs (e.g., Pb) do not occur at the same time and exhibit different seasonal dynamics at the DYFAMED site. Nevertheless, when biological material is transferred to depths, Al and Pb are both gathered in sediment trap material. This suggests that atmospheric fluxes do not drive marine fluxes, because if they would, a Saharan dust event would yield a Al-enriched marine flux (with minimum Pb flux), and, conversely, anthropogenic events would yield a Pb-enriched marine flux (with minimum Al flux). The above statement has been re-phrased in "Results and Discussion" section as "The outstanding feature is the strong covariance simultaneously observed between the mass flux and all TM fluxes, regardless of the nature and origin of the TM".

Comment 5 This is now re-written in the revised manuscript, yet it does not affect our conclusion (the covariance between TMs and mass remains the same), i.e. high current events do not yield chemical composition changes of sediment trap material.

References cited: Bonnet, S. and Guieu, C. (2006) Atmospheric forcing on the annual iron cycle in the western Mediterranean Sea: A 1-year survey. Journal of Geophysical Research 111, C09010, doi:10.1029/2005/2005JC003213.

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Migon, C., Sandroni, V., Marty, J.C., Gasser, B. and Miquel, J.C. (2002) Transfer of atmospheric matter through the euphotic layer in the northwestern Mediterranean: seasonal pattern and driving forces. Deep-Sea Research II 49, 11, 2125-2142.

Ternon, E., Guieu, C., Loÿe-Pilot, M.D., Leblond, N., Bosc, E., Gasser, B., Miquel, J.C. and Martin, J. (2010) The impact of Saharan dust on the particulate export in the water column of the North Western Mediterranean Sea. Biogeosciences 7, 3, 809-826.

Please also note the supplement to this comment:
http://www.biogeosciences-discuss.net/7/C2285/2010/bgd-7-C2285-2010-supplement.pdf

Interactive comment on Biogeosciences Discuss., 7, 2549, 2010.

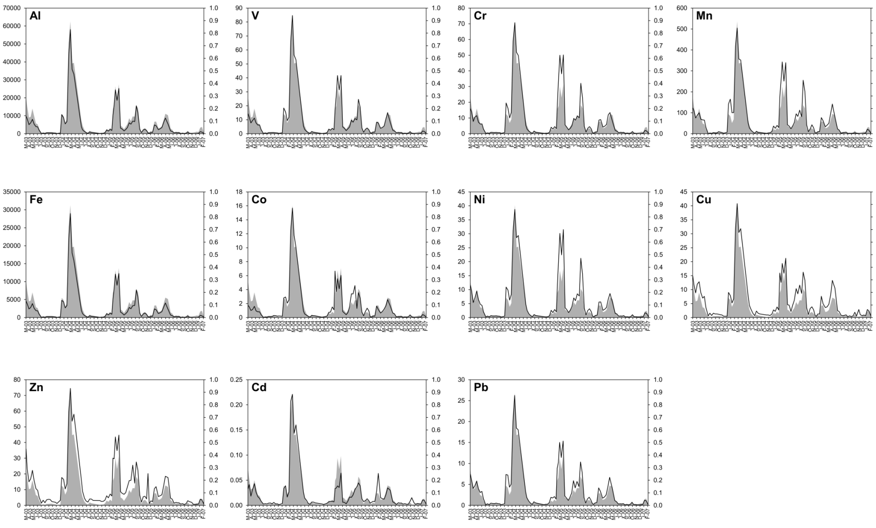

Fig. 1.