Geophysical Research Abstracts
Vol. 13, EGU2011-6314, 2011
EGU General Assembly 2011

Downwind changes in grain size of aeolian dust; examples from marine and terrestrial archives

Jan-Berend Stuut (1) and Maarten Prins (2)

(1) NIOZ - Royal Netherlands Institute for Sea Research, Den Burg, the Netherlands (jbstuut@nioz.nl) and MARUM - Center for Marine Environmental Sciences, Bremen, Germany, (2) Vrije Universiteit Amsterdam, the Netherlands

Aeolian dust in the atmosphere may have a cooling effect when small particles in the high atmosphere block incoming solar energy (e.g., Claquin et al., 2003) but it may also act as a 'greenhouse gas' when larger particles in the lower atmosphere trap energy that was reflected from the Earth's surface (e.g., Otto et al., 2007). Therefore, it is of vital importance to have a good understanding of the particle-size distribution of aeolian dust in space and time (both modern and geological time scales).

As wind is a very size-selective transport mechanism, the sediments it carries typically have a very-well sorted grain-size distribution, which gradually fines from proximal to distal deposition sites. This fact has been used in numerous paleo-environmental studies to both determine source-to-sink changes in the particle size of aeolian dust (e.g., Weltje and Prins, 2003; Holz et al., 2004; Prins and Vriend, 2007) and to quantify mass-accumulation rates of aeolian dust (e.g., Prins and Weltje 1999; Stuut et al., 2002; Prins et al., 2007; Prins and Vriend, 2007; Stuut et al., 2007; Tjallingii et al., 2008; Prins et al., 2009).

Studies on modern wind-blown particles have demonstrated that particle size of dust not only is a function of lateral but also vertical transport distance (e.g., Torres-Padron et al., 2002; Stuut et al., 2005). Nonetheless, there are still many unresolved questions related to the physical properties of wind-blown particles like e.g., the case of "giant" quartz particles found on Hawaii (Betzer et al., 1988) that can only originate from Asia but have a too large size for the distance they travelled through the atmosphere.

Here, we present examples of dust particle-size distributions from terrestrial (loess) as well as marine (deep-sea sediments) sedimentary archives and their spatial and temporal changes. With this contribution we hope to provide quantitative data for the modelling community in order to get a better grip on the role of wind-blown particles in the climate system.

Cited references

Betzer, P.R., Carder, K.L., Duce, R.A., Merrill, J.T., Tindale, N.W., Uematsu, M., Costello, D.K., Young, R.W., Feely, R.A., Breland, J.A., Bernstein, R.E., Greco, A.M., 1988. Long-range transport of giant mineral aerosol particles. Nature 336, 568.

Claquin, T., Roelandt, C., Kohfeld, K.E., Harrison, S.P., Tegen, I., C., P.I., Balkanski, Y., Bergametti, G., Hansson, M., Mahowald, N.M., Rodhe, H., Schulz, M., 2003. Radiative forcing of climate by ice-age atmospheric dust. Climate Dynamics 20, 193-202.

Holz, C., Stuut, J.-B.W., Henrich, R., 2004. Terrigenous sedimentation processes along the continental margin off NW-Africa: implications from grain-size analyses of surface sediments. Sedimentology 51, 1145-1154.

Otto, S., de Reus, M., Trautmann, T., Thomas, A., Wendisch, M., Borrmann, S., 2007. Atmospheric radiative effects of an in situ measured Saharan dust plume and the role of large particles. Atmos. Chem. Phys. 7, 4887-4903.

Prins, M.A., Weltje, G.J., 1999. End-member modeling of siliciclastic grain-size distributions: the Late Quaternary record of eolian and fluvial sediment supply to the Arabian Sea and its paleoclimatic significance., in: Harbaugh, J., Watney, L., Rankey, G., Slingerland, R., Goldstein, R., Franseen, E. (Eds.), Numerical experiments in stratigraphy: Recent advances in stratigraphic and sedimentologic computer simulations. SEPM Special Publication 62. Society for Sedimentary Geology, pp. 91-111.

Prins, M.A., Vriend, M., 2007, Glacial and interglacial eolian dust dispersal patterns across the Chinese Loess Plateau inferred from decomposed loess grain-size records. Geochemistry, Geophysics, Geosystems (G-cubed), 8, Q07Q05, doi:10.1029/2006GC001563.

Prins, M.A., Vriend, M., Nugteren, G., Vandenberghe, J., Lu, H., Zheng, H., Jan Weltje, G., 2007. Late Quaternary aeolian dust input variability on the Chinese Loess Plateau: inferences from unmixing of loess grain-size records. Quaternary Science Reviews 26, 230-242.

Prins, M.A., Zheng, H., Beets, K., Troelstra, S., Bacon, P., Kamerling, I., Wester, W., Konert, M., Huang, X., Ke, W., Vandenberghe, J., 2009. Dust supply from river floodplains: The case of the lower Huang He (Yellow River) recorded in a loess-palaeosol sequence from the Mangshan Plateau. Journal of Quaternary Science 24, 75-84.
Stuut, J.-B.W., Prins, M.A., Schneider, R.R., Weltje, G.J., Jansen, J.H.F., Postma, G., 2002. A 300-kyr record of aridity and wind strength in southwestern Africa: inferences from grain-size distributions of sediments on Walvis Ridge, SE Atlantic. Marine Geology 180, 221-233.
Stuut, J.-B.W., Zabel, M., Ratmeyer, V., Helmke, P., Schefuß, E., Lavik, G., Schneider, R.R., 2005. Provenance of present-day eolian dust collected off NW Africa. Journal of Geophysical Research 110.
Stuut, J.-B.W., Kasten, S., Lamy, F., Hebbeln, D., 2007. Sources and modes of terrigenous sediment input to the Chilean continental slope. Quaternary International 161, 67-76.
Tjallingii, R., Claussen, M., Stuut, J.-B.W., Fohlmeister, J., Jahn, A., Bickert, T., Lamy, F., Rohl, U., 2008. Coherent high- and low-latitude control of the northwest African hydrological balance. Nature Geoscience 1, 670-675.
Torres-Padrón, M.E., Gelado-Caballero, M.D., Collado-Sánchez, C., Siruela-Matos, V.F., Cardona-Castellano, P.J., Hernández-Brito, J.J., 2002. Variability of dust inputs to the CANIGO zone. Deep Sea Research Part II: Topical Studies in Oceanography 49, 3455-3464.
Weltje, G.J., Prins, M.A., 2003. Muddled or mixed? Inferring palaeoclimate from size distributions of deep-sea clastics. Sedimentary Geology 162, 39-62.