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Climate and productivity changes off Adélie Land (East Antarctica) during the Holocene: century to millennial timescales

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A 40 m-long laminated marine core, (MD03-2601, 66˚03'S and 138˚33'E, 743 m) covering the 1000-11000 years BP period, was retrieved from the Dumont d'Urville Trough off Adélie Land, East Antarctica Margin, during the MD 130-ImagesX-CADO cruise. This high resolution record allows the reconstruction of Holocene productivity and climatic changes, thus improving our understanding of the interactions between the atmospheric, oceanic, cryospheric and sea-ice climatic sub-systems in this region. However, only a good knowledge about the sedimentary conditions (export, focusing and preservation) permits to confidently document productivity and climatic changes during the Holocene. Based on this approach, we present here the first investigation of ^{230}Th-normalized biogenic flux of opal, C_{org} and N_{org} in the Antarctic sea-ice environment at centennial resolution. In parallel, a set of proxies ($\delta^{15}N_{bulk}$, diatom communities and distribution of seasonal laminations) have been used to document changes of environmental conditions as well as sea-ice cover and nutrient pools. Our study greatly improves the reconstruction of the exported productivity and provides substantial information about the relationship between climatic changes, diatom communities and productivity at the Marginal Ice Zone. We show that productivity changes are mainly related to sea ice cover and seasonality variations during the Holocene, even though other parameters (nutrient pool, oceanic current activity…) modulating phytoplankton production. At the millennial timescale, the increase of productivity along the Hypsithermal period (10 – 3.5 cal ka B.P.) is related to a decrease of sea

ice duration and an increase of seasonal contrast. At the opposite, the Neoglacial period (3.5 – 1 cal ka B.P.) show lower productivity associated to greater sea ice cover and reduced seasonality. Such Holocene trend appears to be linked to precessional insolation changes. At the sub-millennial timescale, we evidence high productivity changes that may result from the combination of external (solar activity) and internal (thermohaline and atmospheric circulation) forcing mechanisms dictating the sea ice dynamic and the nutrient input off Adélie Land. We believe that this kind of investigation provides a better understanding on the response of peri-Antarctic CO_2pump to centennial/millennial climatic changes.