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Variations of microbial activity and diversity in mesoscale eddies formed in the Eastern boundary upwelling system off West Africa

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Mesoscale eddies formed at Eastern boundary upwelling systems (EBUS) are important vehicles for nutrients and carbon to the open oligotrophic ocean that influence the biogeochemistry on relatively small spatial scales (on the order of 100 km). They impact upper-ocean chemistry and biology through a number of processes. For example, in cyclonic eddies upward nutrient supply to the euphotic zone typically results in intensified primary productivity and changes in community structure, both of which affect export fluxes of carbon to the deep ocean. Therefore, the factors that control the (sub)mesoscale dynamics of the upper ocean are essential to understanding the efficiency of the biological carbon pump. However, the governing dynamical processes are largely unknown, and so is the overall biogeochemical and ecosystem response. To investigate the horizontal and vertical variability of phytoplankton and heterotrophic bacteria within and around mesoscale eddies, we collected samples along a zonal corridor of the westward propagation of eddies between the Cape Verde Islands and Mauretania as well as from a cyclonic eddy along this transect at high spatial resolution. In the eddy, we generally observed enhanced primary production, based on ^{14}C incorporation, and heterotrophic microbial activity, based on ^{3}H leucine incorporation, compared to the surrounding waters. Similarly, microbial heterotrophic respiration rates obtained from optode□based oxygen consumption measurements during dark incubations were highest inside the eddy. However, the detailed eddy survey revealed a patchy distribution of all microbial process rates. The rates were highest in the Northern and Western periphery of the eddy where depth-integrated primary and heterotrophic production were more than three times higher than in the eddy core. The patchy distribution was also apparent from flow cytometry data, which showed higher relative abundances of larger eukaryotic phytoplankton (nanoplankton) compared to picoplankton in the most productive regions of the eddy. The higher activities were additionally accompanied by a higher relative abundance of high nucleic acid containing bacteria, which are considered the more active members of the given community compared to low nucleic acid-containing bacteria. The enhanced primary production, particularly in the Northern and Western eddy peripheries, will fuel export production particularly in these regions. To gain further insight into the organic carbon dynamics, data on the spatial distribution and the lateral and vertical fluxes of dissolved and particulate organic matter are currently underway. While our data confirm previous studies of enhanced biological activity within eddies formed in EBUS regions, it also indicates that the effect of variable phytoplankton and heterotrophic bacterial distributions and activity within an eddy leads to consequences for the spatial and temporal representativeness of measurements from only a few samples. This study thus contributes to a more comprehensive

view on the functioning of eddy dynamics and it will facilitate modelling efforts on the role that eddies play in the ocean carbon budget.