Annual recurrence of climactic microbial communities in shallow waters of the North Mediterranean

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In temperate coastal environments, wide fluctuations of biotic and abiotic factors govern microbiome dynamics. To unveil the relationship between recurrent ecological patterns and planktonic microbial communities, we analyzed a monthly-sampled 3-year time series of 16S rRNA amplicon sequencing data, alongside core environmental variables, collected at two adjacent stations in the northern Adriatic Sea. Through the multivariate exploration of our dataset, we identified three recurrent climactic communities, whose behaviour was mainly driven by changes in daily heliophany and temperature. Mixotrophs (e.g., *Ca*. Nitrosopumilus, SUP05 clade) thrived under oligotrophic, low-light conditions, whereas copiotrophs (e.g., NS4, NS5, NS9) flourished at higher temperatures and organic matter availability. The third group of communities, centered around April, was characterized by a noisier set of amplicon sequence variants (ASVs), including both copiotrophic (i.e., NS4 and NS5) and photo-auto/heterotrophic organisms (e.g., *Synechococcus* sp., *Roseobacter* clade), suggesting that the day length increase supports photoheterotrophic organisms and triggers phytoplankton blooms and the consequent organic matter load. At the interannual scale, we identified three main environmental stable states, each one exploited by a set of distinct ASVs pointing to the emergence of climactic communities according to their trophic modes. ASVs belonging to genera shared among recurring communities showed seasonal and environmental differentiation, pinpointing the need to take full advantage of the highest possible taxonomic resolution since even closely phylogenetically related ASVs may represent distinct ecotypes with different ecological roles.