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High resolution monitoring stations and big data production are two of the occurring challenges in ocean studies. To validate satellite data, make predictions on fast seawater changes and provide early warnings for maritime activities, networks of sensors producing high quality-data in real time are becoming a priority. The Internet of Underwater Things (IoUT) technology of the Green Star project at Smart Bay Santa Teresa in Lerici, Italy [SmartBay], aims to create a sensor network producing high resolution and quality data for marine ecosystem monitoring. A W-SENSE wireless sensors network provides various parameters, such as temperature, oxygen, conductivity etc. High-cost multi parametric probes such as CTD (Conductivity, Temperature and Depth) devices are also employed for IoUT sensor calibration [Raiteri(2018)]. In this paper, we investigate the daily variability of the seawater oxygen with the aim to link its temporal variations with a few environmental parameters such as solar irradiation, air and water temperature. The final goal is to forecast the oxygen content on the base of weather forecast only, once time series of a few years are acquired and tested with statistical and machine learning methods.
Since Dec. 2021, data have been acquired every 30 minutes, (see Figure - May 18-27, 2022). Here we consider the oxygen percentage (red curve), being 100% the thermodinamic value calculated at the measured water temperature and salinity. The oxygen content actually increases due to the phythoplankton production under the solar radiation. In addition, various algae progressively grow over the sensor (an effect named fouling), increasing the oxygen daily variability. To limit the fouling, the sensors are cleaned every 8-10 days, when are compared with the CTD sensor for calibration (red dot in Figure). Even with periodic cleaning, the fouling increases

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with time, especially in spring-summer due to the higher temperatures. Our first goal is then to properly decompose the signal into a daily component (the *Seasonal* one in time series analysis) and a *Trend*, taking into account long time variations, irrespective of fouling effects. We use the Seasonal-Trend decomposition using LOESS (STL), known to be robust to outliers, where the seasonal component is allowed to change over time. With this decomposition, we take daily means of a few parameters, namely the mean trend, the mean and standard deviation of the air and water temperatures, the mean solar radiation. The data of 414 days (Dec. 2021 - Apr. 2023) are then used in a random forest regressor, with the air and water temperatures, the solar irradiation and the days passed from the last cleaning as input parameters. Once properly renormalized, 90% of the data are used for train, and 10% for test, chosen randomly. We found out that the fluctuations of water and air temperatures (i.e. the standard deviation), together with the number of days from cleaning are totally irrelevant in the regression, while the solar radiation weights for about 60%, and the mean water and air temperatures for 20% each. Remarkably, the oxygen prediction are accurate within about 4 %. Future investigations will include different methods of decomposition, and analysis of the time signal with recurrent neural networks [O'Donncha(2022)].

References

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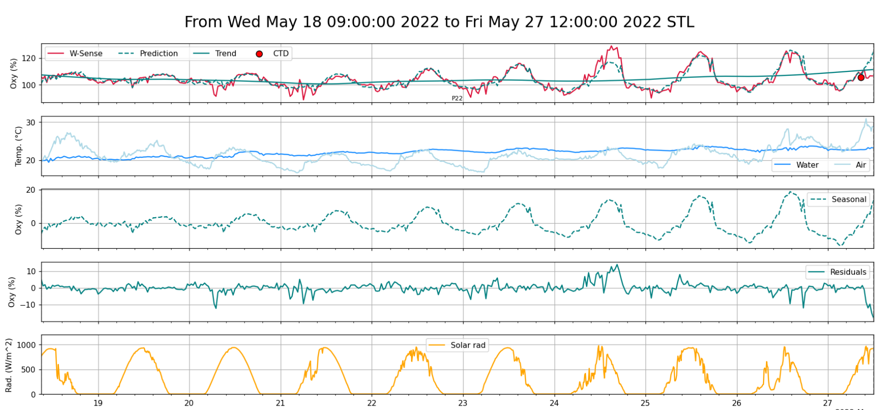

Fig. 1 Decomposition of the Oxygen content in % (red curve) with Trend (solid green line), Seasonal and Residuals. Temperatures of water and air in blue, and solar radiation in gold.