

Figure 3: A pre-processing in image edge for global front detection.

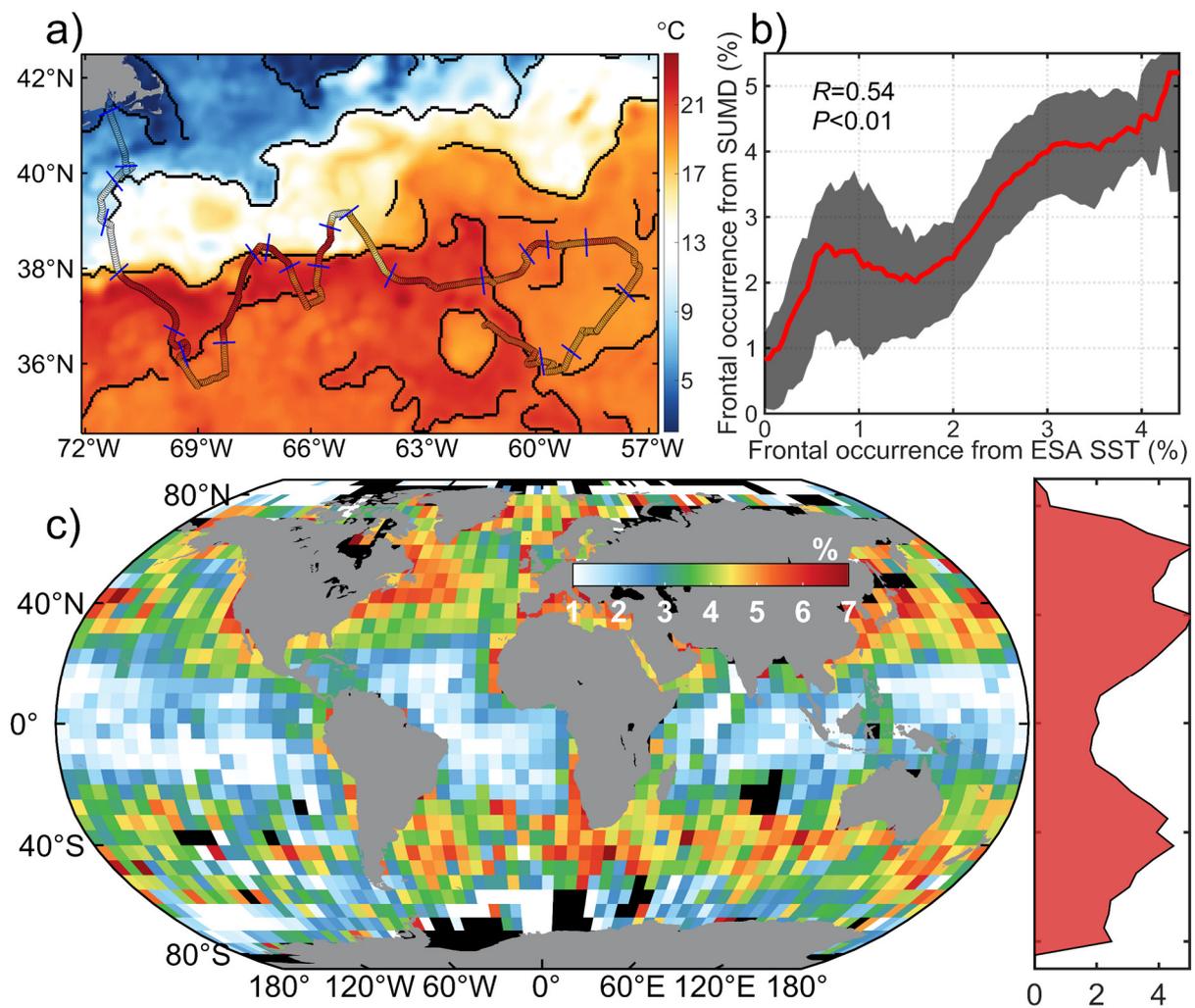


Figure 4: Ocean fronts identified from underway observations. a) An example of along-track fronts observed by Saildrone SD-1021 from January 1 to February 25, 2019. Coloured points represent underway SST observations, and blue orthogonal lines indicate the locations of detected fronts. The colours correspond to ESA SST data from February 12, 2019, while black lines represent the detected fronts. b) Comparison of global long-term frontal occurrences identified by SUMD data with those detected by ESA data on a $5^\circ \times 5^\circ$ grid. The red line represents the average values of SUMD-based frontal occurrence, while the light-grey shading denotes the 25th and 75th percentiles. c) Long-term frontal occurrence calculated from SUMD-detected fronts (1989–2023).