

Oceanographic Data Analysis using R

Week / Day	Topic	Learning Outcomes	Core Content	Key Packages
Day 1 – R Basics & Setup (4h)	• Install & configure R/RStudio • Understand R interface • Basic syntax & data types	R & RStudio setup; console, scripts, Markdown; operators; variables (numeric, char, logical)	Install & explore RStudio; run demo script; use help()	base R, tidyverse
Day 2 – Data Structures & Exploration (4h)	• Work with vectors, matrices, lists, data frames • Load & inspect data • Apply summary tools	Data structures; read CSV/Excel; str(), head(), summary(); tidy data	Load & explore CTD dataset; handle missing values; compute stats	readr, tibble, base R
Day 3 – Data Cleaning & Transformation (4h)	• Use dplyr verbs (filter, mutate, etc.) • Aggregate & summarize data • Prepare analysis-ready data	dplyr workflow; %>%; remove duplicates/outliers; derive new vars	Clean CTD data; compute density; group by depth; summarize	dpkyr, tidyr, tidyverse
Day 4 – Data Visualization (4h)	• Create plots using ggplot2 • Visualize relationships • Customize plots	ggplot2 layers & geoms; aesthetics; faceting; themes; color palettes	Plot T–S diagrams, histograms, boxplots; export figures	ggplot2, gridExtra, tidyverse
Day 5 – Oceanographic Data Import (4h)	• Understand key parameters • Read netCDF/HDF5 • Process CTD & ADCP data	Physical (T, S, ρ), biological (DO, Chl-a); netCDF/HDF5; data quality flags; sources (ERDDAP, NASA)	Import multi-format ocean data; extract surface/deep layers; handle flags	oce, ncdf4, rhdf5, stars
Day 6 – Time Series Analysis (4h)	• Create & analyze time series • Detect trends & seasonality	Time series creation; resampling; interpolation; decomposition	Build time series; fill gaps; plot multi-param trends	ts, zoo, lubridate, tseries
Day 7 – Statistics & Hypothesis Testing (4h)	• Compute descriptive stats • Perform correlation, regression, tests	Mean, SD, normality (Shapiro), correlation, t-test, ANOVA, linear models	Group-wise stats; test normality; analyze T–S–DO relationships	stats, broom, tidyverse

Day 8 – Multivariate Analysis & Classification (4h)	• Conduct PCA, clustering • Identify water masses	PCA principles; variance explained; hierarchical & k-means clustering	PCA on CTD data; biplots; classify water masses	vegan, FactoMineR, factoextra, ggplot2
Day 9 – Spatial Analysis & Mapping (4h)	• Create maps & spatial interpolations • Visualize spatial patterns	Coordinate systems; sf/raster; bathymetry; Kriging/IDW; mapping conventions	Create maps (ggOceanMaps); contour/heatmaps; water mass maps	ggOceanMaps, sf, stars, ggplot2
Day 10 – Capstone & Reproducible Research (4h)	• Integrate course concepts • Generate reproducible reports	R Markdown; documentation; workflow organization; scientific presentation	Full analysis project; R Markdown report; publication-quality outputs	rmarkdown, knitr, oce, tidyverse

Instructor: Md. Nahin Alam
 Master's Student
 Department of Oceanography
 University of Chittagong, Bangladesh
 Contact Information:
 Email: nahinalam29@gmail.com
 WhatsApp: +8801647057016