R CODE TO GENERATE DATASET

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# Radiocarbon data import

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# This script details how to import and generate

# the dataset

# Script elements

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# 1. Packages, paths and data

# 2. Import and treat radiocarbon data

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# 1. Packages

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# Install

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# install.packages("maps")

# install.packages("naniar")

# install.packages("rnaturalearth")

# install.packages("raster")

# install.packages("rcarbon")

# install.packages("rgeos")

# install.packages("rio")

# install.packages("sf")

# install.packages("spatstat")

# install.packages("tidyverse")

# install.packages("zoo")

# Library

# ---------------------------------------------------------

library(changepoint)

library(fable)

library(fabletools)

library(gridExtra)

library(gstat)

library(locfit)

library(maps)

library(naniar)

library(rnaturalearth)

library(raster)

library(rcarbon)

library(rgeos)

library(rio)

library(sf)

library(spatstat)

library(tidyverse)

library(zoo)

# Paths

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# The script currently runs with the following sub-folders:

# /data: any data that is used for the analysis

# /other\_output : other types of output

# /pop : intermediate output

# If the folders have not yet been created, the following code

# will generate these from the working directory, with the exception of

# the code file, where this and the other 6 scripts should be saved:

# dir.create("data")

# dir.create("other\_output")

# dir.create("other\_output/pop")

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# 2. Import and treat radiocarbon data

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# The following code was used to generate this dataset.

# Radiocarbon data from the following datasets:

# Balsera et al. (2015) - https://doi.org/10.1016/j.quaint.2015.06.022

# Drake et al. (2017) - https://doi.org/10.1007/s10816-016-9286-y

# McLaughlin et al. (2021) - https://doi.org/10.1098/rstb.2019.0724

# Pardo-Gordó et al. (2019) - https://doi.org/10.5334/joad.49

# and through R package c14bazAAr (Schmid et al., 2019)

# Capuzzo et al. (2014) - https://doi.org/10.2458/56.17453

# d’Errico et al. (2011) - https://doi.org/doi:10.4207/PA.2011.ART40

# Hinz et al. (2012) - https://doi.org/10.12766/jna.2012.65

# Kniesel et al. (2014) - no DOI. see http://radon-b.ufg.uni-kiel.de.

# Manning et al. (2016) - https://doi.org/10.1016/j.quascirev.2014.07.003

# Vermeersch (2020) - https://doi.org/10.1016/j.dib.2020.105793

# GTOPO30 Elevation maps from https://www.usgs.gov/centers/eros/science/usgs-eros-archive-digital-elevation-global-30-arc-second-elevation-gtopo30?qt-science\_center\_objects=0#qt-science\_center\_objects

# Save maps gt30w020n40 and gt30w020n90 in datapath

#First download and save the data from each source in csv to data path

# Import the raw data

balsera\_data\_raw <- rio::import("data/Balsera\_dataset\_v4.csv") #NB this data is available as pdf, so needs to be converted first to csv. Note, be careful with the conversion of long lats - ensure these are numeric in csv

drake\_data\_raw <- rio::import("data/Drake\_dataset.csv")

pardo\_data\_raw <- rio::import("data/Pardo\_dataset.csv")

# c14baz\_data\_raw <- c14bazAAR::get\_c14data(c("eubar", "euroevol", "radon", "radonb", "pacea", "14cpalaeolithic")) #import data and then save

# rio::export(c14baz\_data\_raw, "data/c14baz\_dataset.csv") # Saved file so that don't have to keep downloading

c14baz\_data\_raw <- rio::import("data/c14baz\_dataset.csv")

mclaughlin\_data\_raw<- rio::import("data/McLaughlin\_dataset.xlsx")

# Import elevation information

box <- raster::extent(-10, 5, 35, 45)

elevation\_map1 <- raster::raster("data/gt30w020n40.tif")

elevation\_map2 <- raster::raster("data/gt30w020n90.tif")

elevation\_map <- raster::merge(elevation\_map1, elevation\_map2) %>% #Merge maps and reduce to Iberia

 raster::crop(box)

elevation\_point <- raster::rasterToPoints(elevation\_map) # Get point elevation data for later filtering

elevations <- data.frame(elevation\_point)

colnames(elevations) = c("lon", "lat", "asl") # Rename output

# Generate owin window

iberia\_map <- maps::map("world", c("Spain(?!:)", "Portugal", "Andorra"), fill = T, resolution = 0) #Download map of Iberia

iberia\_map <- sf::st\_as\_sf(iberia\_map) #Convert to sf

iberia\_map\_25830 <- sf::st\_transform(iberia\_map, crs = 25830) #Change the crs to flat projection

iberia\_owin\_25830 <- spatstat.geom::as.owin(iberia\_map\_25830) #Generate owin

iberia\_owin\_25830\_exp <- spatstat.core::expand.owin(iberia\_owin\_25830, distance = 2000) #Expand owin to try and ensure that samples are not excluded due to coord inaccuracies

iberia\_map\_exp\_25830 <- sf::st\_as\_sf(iberia\_owin\_25830\_exp) #Convert back to sf

sf::st\_crs(iberia\_map\_exp\_25830) <- 25830 #Set crs

iberia\_map\_exp <- sf::st\_transform(iberia\_map\_exp\_25830, crs = 4258) #Change crs back to ellipsoid for raster

# Clean data/ standardise

# ---------------------------------------------------------

balsera\_data <- balsera\_data\_raw %>%

 dplyr::arrange(Date, SD, Site, `Lab #`) %>%

 dplyr::rename(c14\_age = Date, c14\_std = SD, site = Site, material = Material, longitude = Lon\_ETRS89, latitude = Lat\_ETRS89) %>%

 dplyr::mutate(lab = stringr::word(`Lab #`, 1, sep = "[:digit:]")) %>% #Set up lab numbers

 dplyr::mutate(lab = stringr::word(lab, 1, sep = "\\/")) %>% #Set up lab numbers

 dplyr::mutate(lab1 = stringr::str\_extract(`Lab #`, "\\d+\\.\*\\d\*")) %>% #Set up lab numbers

 dplyr::mutate(lab\_nr = dplyr::if\_else(is.na(lab1), "Unreported", paste0(lab, "-", lab1))) %>% #Set up lab numbers

 dplyr::mutate(lab\_nr = stringr::str\_replace\_all(lab\_nr, "\\\*", "")) %>% #Tidy up lab number code

 dplyr::mutate(lab\_nr = trimws(lab\_nr)) %>% #Tidy up lab number code

 dplyr::mutate(lab\_nr = stringr::str\_replace\_all(lab\_nr, "--", "-")) %>%

 dplyr::mutate(db\_code = paste0("b", row\_number())) %>% #Add unique item code

 dplyr::mutate(period = "") %>% #Add cultural period variable

 dplyr::mutate(source\_db = "balsera") %>%

 dplyr::mutate(longitude = as.numeric(longitude)) %>%

 dplyr::mutate(latitude = as.numeric(latitude)) %>%

 dplyr::mutate(lab\_nr = stringr::str\_replace\_all(lab\_nr, "Circe", "DSA")) %>% #Clean lab codes

 dplyr::mutate(lab\_nr = stringr::str\_replace\_all(lab\_nr, "BIRM", "Birm")) %>% #Clean lab codes

 dplyr::mutate(lab\_nr = stringr::str\_replace\_all(lab\_nr, "DHS", "DSA")) %>% #Clean lab codes

 dplyr::mutate(lab\_nr = stringr::str\_replace\_all(lab\_nr, "Gak", "GAK")) %>% #Clean lab codes

 dplyr::mutate(lab\_nr = stringr::str\_replace\_all(lab\_nr, "GaK", "GAK")) %>% #Clean lab codes

 dplyr::mutate(lab\_nr = stringr::str\_replace\_all(lab\_nr, "Gx", "GX")) %>%#Clean lab codes

 dplyr::mutate(lab\_nr = stringr::str\_replace\_all(lab\_nr, "OxAV", "OxA")) %>% #Clean lab codes

 dplyr::mutate(lab\_nr = stringr::str\_replace\_all(lab\_nr, "Rome", "R")) %>% #Clean lab codes

 dplyr::mutate(lab\_nr = stringr::str\_replace\_all(lab\_nr, "UCIAMS", "UCI")) %>% #Clean lab codes

 dplyr::mutate(lab\_nr = stringr::str\_replace\_all(lab\_nr, "UGA", "UGa")) %>% #Clean lab codes

 dplyr::mutate(lab\_nr = stringr::str\_replace\_all(lab\_nr, "UGAMS", "UGa")) %>% #Clean lab codes

 dplyr::mutate(lab\_nr = stringr::str\_replace\_all(lab\_nr, "UGaMS", "UGa")) %>% #Clean lab codes

 dplyr::mutate(lab\_nr = dplyr::if\_else(lab\_nr == "CSIC-626" & c14\_age == 4630, "CSIC-626A", lab\_nr)) %>% #Different lab nr

 dplyr::mutate(lab\_nr = dplyr::if\_else(lab\_nr == "CSIC-626" & c14\_age == 4630, "CSIC-626B", lab\_nr)) %>% #Different lab nr

 dplyr::mutate(lab\_nr = dplyr::if\_else(lab\_nr == "CSIC-637" & c14\_age == 7200, "CSIC-637R", lab\_nr)) %>% #Different lab nr

 dplyr::mutate(lab\_nr = dplyr::if\_else(lab\_nr == "I-16079" & c14\_age == 4660, "I-16079C", lab\_nr)) %>% #Different lab nr

 dplyr::mutate(lab\_nr = dplyr::if\_else(lab\_nr == "MC-1112" & c14\_age == 4700, "MC-1112B", lab\_nr)) %>% #Different lab nr

 dplyr::mutate(lab\_nr = dplyr::if\_else(lab\_nr == "OxA-2360" & c14\_age == 3946, "OxA-2360-15", lab\_nr)) %>% #Different lab nr

 dplyr::mutate(lab\_nr = dplyr::if\_else(lab\_nr == "OxA-2360" & c14\_age == 4062, "OxA-2360-23", lab\_nr)) %>% #Different lab nr

 dplyr::mutate(lab\_nr = dplyr::if\_else(lab\_nr == "OxA-2360" & c14\_age == 6399, "OxA-2360-25", lab\_nr)) %>% #Different lab nr

 dplyr::mutate(lab\_nr = dplyr::if\_else(lab\_nr == "UBAR-464" & c14\_age == 3450, "UBAR-464B", lab\_nr)) %>% #Different lab nr

 dplyr::mutate(lab\_nr = dplyr::if\_else(lab\_nr == "UBAR-464" & c14\_age == 3570, "UBAR-464A", lab\_nr)) %>% #Different lab nr

 dplyr::mutate(lab\_nr = dplyr::if\_else(lab\_nr == "UGRA-76" & c14\_age == 3890, "UGRA-76B", lab\_nr)) %>% #Different lab nr

 dplyr::mutate(lab\_nr = dplyr::if\_else(lab\_nr == "Gif-8079", "Gif-8079A", lab\_nr)) %>% #Same lab nr as another, both look correct, so adjust

 dplyr::mutate(lab\_nr = dplyr::if\_else(lab\_nr == "ICEN-76" & c14\_age == 7810, "ICEN-76A", lab\_nr)) %>% #Same lab nr as another, both look correct, so adjust

 dplyr::mutate(lab\_nr = dplyr::if\_else(lab\_nr == "GifA-99112" & c14\_age == 5480, "GifA-99113", lab\_nr)) %>% #Error in database following check

 dplyr::mutate(lab\_nr = dplyr::if\_else(lab\_nr == "GifA-99112" & c14\_age == 5580, "GifA-99114", lab\_nr)) %>% #Error in database following check

 dplyr::mutate(lab\_nr = dplyr::if\_else(lab\_nr == "GrN-7009" & c14\_age == 3980, "GrN-7008", lab\_nr)) %>% #Error in database following check

 dplyr::mutate(lab\_nr = dplyr::if\_else(lab\_nr == "ICEN-1159" & c14\_age == 4460, "ICEN-1149", lab\_nr)) %>% #Error in database following check

 dplyr::mutate(lab\_nr = dplyr::if\_else(lab\_nr == "IRPA-1062" & c14\_age == 3390, "IRPA-1063", lab\_nr)) %>% #Error in database following check

 dplyr::mutate(lab\_nr = dplyr::if\_else(lab\_nr == "KIK-3487" & c14\_age == 4715, "KIA-37691", lab\_nr)) %>% #Error in database following check

 dplyr::mutate(lab\_nr = dplyr::if\_else(lab\_nr == "Ua-35665" & c14\_age == 3830, "Ua-35655", lab\_nr)) %>% #Error in database following check

 dplyr::mutate(lab\_nr = dplyr::if\_else(lab\_nr == "Ua-37894" & c14\_age == 3480, "Ua-37895", lab\_nr)) %>% #Error in database following check

 dplyr::mutate(lab\_nr = dplyr::if\_else(lab\_nr == "Ua-40763" & c14\_age == 3681, "Ua-40761", lab\_nr)) %>% #Error in database following check

 dplyr::mutate(lab\_nr = dplyr::if\_else(lab\_nr == "Ua-4820", "Ua-4821", lab\_nr)) %>% #Error in database following check

 dplyr::mutate(c14\_std = dplyr::if\_else(lab\_nr == "GAK-8959" & c14\_age == 6480, 180L, c14\_std)) %>% #Error in database following check

 dplyr::mutate(c14\_std = dplyr::if\_else(lab\_nr == "Ua-35665" & c14\_age == 4370, 35L, c14\_std)) %>% #Error in database following check

 dplyr::mutate(c14\_std = dplyr::if\_else(lab\_nr == "UBAR-274", 50L, c14\_std)) %>% #Error in database following check

 dplyr::mutate(c14\_std = dplyr::if\_else(lab\_nr == "Wk-25162", 30L, c14\_std)) %>% #Error in database following check

 naniar::replace\_with\_na(replace = list(lab\_nr = c("KNI-200", "KNJ-115", "KNJ-117"))) %>% #Clean lab codes

 dplyr::mutate(longitude = if\_else(longitude == 1.838611111, -1.838611111, longitude)) %>% #Error in database following check

 dplyr::select(c14\_age, c14\_std, source\_db, longitude, latitude, lab\_nr, site, material, period, db\_code) %>%

 dplyr::arrange(c14\_age, c14\_std, lab\_nr, latitude, longitude, source\_db)

c14baz\_data <- c14baz\_data\_raw %>%

 dplyr::mutate(db\_code = paste0("c", row\_number())) %>% #Add unique item code

 dplyr::filter(!(is.na(lat) | is.na(lon))) %>% #Remove missing coordinate entries

 dplyr::rename(c14\_age = c14age, c14\_std = c14std, source\_db = sourcedb, lab\_nr = labnr) %>%

 dplyr::mutate(longitude = lon) %>%

 dplyr::mutate(latitude = lat) %>%

 dplyr::mutate(country = maps::map.where(x = longitude, y = latitude)) %>%

 dplyr::filter(country %in% c("Spain","Portugal", "Andorra") | is.na(country)) %>% #Filter to area, or where uncertain

 dplyr::filter(between(latitude, 36, 45)) %>%

 dplyr::filter(between(longitude, -10, 5)) %>%

 dplyr::filter(c14\_age <=20000) %>% #Limit c14 date range

 dplyr::mutate(longitude = dplyr::if\_else(lab\_nr == "Beta-297104", -4.687220, longitude)) %>% #Wrong longitude, checked

 dplyr::mutate(longitude = dplyr::if\_else(site == "Casinha Derribada", -7.863333, longitude)) %>% #Wrong longitude, checked

 dplyr::mutate(longitude = dplyr::if\_else(site == "Casinha Derribada 3", -7.863333, longitude)) %>% #Wrong longitude, checked

 dplyr::mutate(latitude = dplyr::if\_else(site == "Casinha Derribada", 40.71944, latitude)) %>% #Wrong latitude, checked

 dplyr::mutate(latitude = dplyr::if\_else(site == "Casinha Derribada 3", 40.71944, latitude)) %>% #Wrong latitude, checked

 dplyr::filter(lab\_nr != "Ly-706") %>% #In France

 dplyr::filter(site != "Montpellier Richemont") %>% #In France

 dplyr::filter(site != "La Fangade") %>% #In France

 dplyr::mutate(material = dplyr::if\_else(lab\_nr == "AA-57439", "bone / bos", material)) %>% #Duplicate code wwith Balsera, but different ste. This is correct, use material details from Balsera

 dplyr::mutate(material = dplyr::if\_else(lab\_nr == "Beta-166228", "carbon", material)) %>% #Duplicate code with Pardo, but different ste. This is correct, use material details from Pardo

 dplyr::mutate(c14\_age = dplyr::if\_else(lab\_nr == "OxA-5508", 4050L, c14\_age)) %>% #Error in database

 dplyr::mutate(c14\_std = dplyr::if\_else(lab\_nr == "OxA-5508", 60L, c14\_std)) %>% #Error in database

 dplyr::mutate(c14\_std = dplyr::if\_else(lab\_nr == "UGRA-185", 120L, c14\_std)) %>% #Error in database

 dplyr::mutate(c14\_age = dplyr::if\_else(lab\_nr == "UGRA-185", 3930L, c14\_age)) %>% #Error in database

 dplyr::mutate(lab\_nr = stringr::str\_replace\_all(lab\_nr, "\\\*", "")) %>% #Tidy up lab number code

 dplyr::mutate(lab\_nr = stringr::str\_replace\_all(lab\_nr, " ", "")) %>% #Tidy up lab number code

 dplyr::mutate(lab\_nr = stringr::str\_replace\_all(lab\_nr, "AA-8647.T.461", "AA-8647")) %>% #Clean lab codes

 dplyr::mutate(lab\_nr = stringr::str\_replace\_all(lab\_nr, "Bera", "Beta")) %>% #Clean lab codes

 dplyr::mutate(lab\_nr = stringr::str\_replace\_all(lab\_nr, "Bea", "Beta")) %>% #Clean lab codes

 dplyr::mutate(lab\_nr = stringr::str\_replace\_all(lab\_nr, "BIRM", "Birm")) %>% #Clean lab codes

 dplyr::mutate(lab\_nr = stringr::str\_replace\_all(lab\_nr, "BM-1453/I-10736", "BM-1453")) %>% #Clean lab codes

 dplyr::mutate(lab\_nr = stringr::str\_replace\_all(lab\_nr, "CAMP", "CAMS")) %>% #Clean lab codes

 dplyr::mutate(lab\_nr = stringr::str\_replace\_all(lab\_nr, "CAMS-9918/Beta-67949", "CAMS-9918")) %>% #Clean lab codes

 dplyr::mutate(lab\_nr = stringr::str\_replace\_all(lab\_nr, "Col", "COL")) %>% #Clean lab codes

 dplyr::mutate(lab\_nr = stringr::str\_replace\_all(lab\_nr, "EHT", "ETH")) %>% #Clean lab codes

 dplyr::mutate(lab\_nr = stringr::str\_replace\_all(lab\_nr, "Gak", "GAK")) %>% #Clean lab codes

 dplyr::mutate(lab\_nr = stringr::str\_replace\_all(lab\_nr, "GaK", "GAK")) %>% #Clean lab codes

 dplyr::mutate(lab\_nr = stringr::str\_replace\_all(lab\_nr, "COL2", "COL-2")) %>% #Clean lab codes

 dplyr::mutate(lab\_nr = stringr::str\_replace\_all(lab\_nr, "COL4", "COL-4")) %>% #Clean lab codes

 dplyr::mutate(lab\_nr = stringr::str\_replace\_all(lab\_nr, "GAK-6448/6460", "GAK-6448")) %>% #Clean lab codes

 dplyr::mutate(lab\_nr = stringr::str\_replace\_all(lab\_nr, "Gra", "GrA")) %>% #Clean lab codes

 dplyr::mutate(lab\_nr = stringr::str\_replace\_all(lab\_nr, "GdrA", "GrA")) %>% #Clean lab codes

 dplyr::mutate(lab\_nr = stringr::str\_replace\_all(lab\_nr, "GRN", "GrN")) %>% #Clean lab codes

 dplyr::mutate(lab\_nr = stringr::str\_replace\_all(lab\_nr, "Gx", "GX")) %>% #Clean lab codes

 dplyr::mutate(lab\_nr = stringr::str\_replace\_all(lab\_nr, "HD", "Hd")) %>% #Clean lab codes

 dplyr::mutate(lab\_nr = stringr::str\_replace\_all(lab\_nr, "Kia", "KIA")) %>% #Clean lab codes

 dplyr::mutate(lab\_nr = stringr::str\_replace\_all(lab\_nr, "Kn", "KN")) %>% #Clean lab codes

 dplyr::mutate(lab\_nr = stringr::str\_replace\_all(lab\_nr, "Lod", "LOD")) %>% #Clean lab codes

 dplyr::mutate(lab\_nr = stringr::str\_replace\_all(lab\_nr, "LYON", "Ly")) %>% #Clean lab codes

 dplyr::mutate(lab\_nr = stringr::str\_replace\_all(lab\_nr, "Lyon", "Ly")) %>% #Clean lab codes

 dplyr::mutate(lab\_nr = stringr::str\_replace\_all(lab\_nr, "Ly-49(OxA)", "Ly-49")) %>% #Clean lab codes

 dplyr::mutate(lab\_nr = stringr::str\_replace\_all(lab\_nr, "NzA", "NZA")) %>% #Clean lab codes

 dplyr::mutate(lab\_nr = stringr::str\_replace\_all(lab\_nr, "OA", "OxA")) %>% #Clean lab codes

 dplyr::mutate(lab\_nr = stringr::str\_replace\_all(lab\_nr, "Oxa", "OxA")) %>% #Clean lab codes

 dplyr::mutate(lab\_nr = stringr::str\_replace\_all(lab\_nr, "OXA", "OxA")) %>% #Clean lab codes

 dplyr::mutate(lab\_nr = stringr::str\_replace\_all(lab\_nr, "Pioz", "Poz")) %>% #Clean lab codes

 dplyr::mutate(lab\_nr = stringr::str\_replace\_all(lab\_nr, "Pz", "Poz")) %>% #Clean lab codes

 dplyr::mutate(lab\_nr = stringr::str\_replace\_all(lab\_nr, "PxA", "OxA")) %>% #Clean lab codes

 dplyr::mutate(lab\_nr = stringr::str\_replace\_all(lab\_nr, "Rome", "R")) %>% #Clean lab codes

 dplyr::mutate(lab\_nr = stringr::str\_replace\_all(lab\_nr, "Sanu", "SANU")) %>% #Clean lab codes

 dplyr::mutate(lab\_nr = stringr::str\_replace\_all(lab\_nr, "SU", "Su")) %>% #Clean lab codes

 dplyr::mutate(lab\_nr = stringr::str\_replace\_all(lab\_nr, "SuA", "SUA")) %>% #Clean lab codes

 dplyr::mutate(lab\_nr = stringr::str\_replace\_all(lab\_nr, "UGA", "UGa")) %>% #Clean lab codes

 dplyr::mutate(lab\_nr = stringr::str\_replace\_all(lab\_nr, "UGaMS", "UGa")) %>% #Clean lab codes

 dplyr::mutate(lab\_nr = stringr::str\_replace\_all(lab\_nr, "UGAMS", "UGa")) %>% #Clean lab codes

 dplyr::mutate(lab\_nr = stringr::str\_replace\_all(lab\_nr, "UGAM", "UGa")) %>% #Clean lab codes

 dplyr::mutate(lab\_nr = stringr::str\_replace\_all(lab\_nr, "WK", "Wk")) %>% #Clean lab codes

 naniar::replace\_with\_na(replace = list(lab\_nr = c("?", "No det.", "I-?", #Clean lab codes

 "8649X-404", "1Tucson", "Ariz.Univ",

 "Beta-", "Gif-?", "Hv-?",

 "Gif-A-II.4", "Gif-", "GrN-",

 "LUNK-0725", "LUNK-0762", "LUNK-0859",

 "LUNK-0860", "LUNK-0867", "LUNK-0867",

 "n/a-n/a", "Nodet.", "OxA-",

 "SMU-?", "Ua-", "Ua-CabezoJuré"))) %>%

 dplyr::select(c14\_age, c14\_std, source\_db, longitude, latitude, lab\_nr, site, material, period, db\_code) %>%

 dplyr::arrange(c14\_age, c14\_std, lab\_nr, latitude, longitude, source\_db)

drake\_data <- drake\_data\_raw %>%

 dplyr::mutate(db\_code = paste0("d", row\_number())) %>% #Add unique item code

 dplyr::mutate(source\_db = "drake") %>%

 dplyr::rename(c14\_age = "14C Year", c14\_std = Sigma, lab\_nr = Sample, site = Site, material = Material) %>%

 dplyr::mutate(longitude = Longitude) %>%

 dplyr::mutate(latitude = Latitude) %>%

 dplyr::mutate(period = "") %>%

 dplyr::mutate(lab\_nr = stringr::str\_replace\_all(lab\_nr, "\\\*", "")) %>% #Tidy up lab number code

 dplyr::mutate(lab\_nr = stringr::str\_replace\_all(lab\_nr, "=", "")) %>% #Tidy up lab number code

 dplyr::mutate(lab\_nr = trimws(lab\_nr)) %>% #Tidy up lab number code

 dplyr::mutate(lab\_nr = stringr::str\_replace\_all(lab\_nr, " ", "-")) %>% #Tidy up lab number code

 dplyr::mutate(lab\_nr = stringr::str\_replace\_all(lab\_nr, "CSIC-150B", "CSIC-150")) %>% #Based on duplicate Balsera

 dplyr::mutate(lab\_nr = stringr::str\_replace\_all(lab\_nr, "DSH", "DSA")) %>% #Clean lab codes

 dplyr::mutate(lab\_nr = stringr::str\_replace\_all(lab\_nr, "UGA", "UGa")) %>% #Clean lab codes

 dplyr::mutate(lab\_nr = stringr::str\_replace\_all(lab\_nr, "Mams", "MAMS")) %>% #Clean lab codes

 naniar::replace\_with\_na(replace = list(lab\_nr = c("0", "", "?-17697", "UNK-1"))) %>% #Clean lab codes

 dplyr::select(c14\_age, c14\_std, source\_db, longitude, latitude, lab\_nr, site, material, period, db\_code) %>%

 dplyr::arrange(c14\_age, c14\_std, lab\_nr, latitude, longitude, source\_db)

pardo\_data <- pardo\_data\_raw %>%

 dplyr::mutate(db\_code = paste0("p", row\_number())) %>% #Add unique item code

 dplyr::mutate(source\_db = "pardo") %>%

 dplyr::rename(c14\_age = "FechaBP", c14\_std = Desviación, lab\_nr = IDmuestra, site = Yacimiento, material = Material, period = "Adscripcion cronológica") %>%

 dplyr::mutate(longitude = Long) %>%

 dplyr::mutate(latitude = Lat) %>%

 dplyr::mutate(lab\_nr = stringr::str\_replace\_all(lab\_nr, "\\\*", "")) %>% #Tidy up lab number code

 dplyr::mutate(lab\_nr = trimws(lab\_nr)) %>% #Tidy up lab number code

 dplyr::mutate(c14\_age = dplyr::if\_else(db\_code == "p598", 5170L, c14\_age)) %>% #Wrong date

 dplyr::mutate(c14\_age = dplyr::if\_else(db\_code == "p319", 6220L, c14\_age)) %>% #Wrong date

 dplyr::mutate(material = dplyr::if\_else(db\_code == "p371", "Human bone", material)) %>% #Wrong material

 dplyr::mutate(lab\_nr = dplyr::if\_else(db\_code == "p538", "OxA-2360-25", lab\_nr)) %>% #Prob should be this rather than OxA-236025 in line with balsera

 dplyr::mutate(lab\_nr = dplyr::if\_else(db\_code == "p1539", "Wk-27462", lab\_nr)) %>% #Checked, wrong lab-nr for this item

 dplyr::mutate(lab\_nr = stringr::str\_replace\_all(lab\_nr, "AA-15499", "AA-16499")) %>% #Checked and should be same as Balsera 16499 (15499 not found)

 dplyr::mutate(lab\_nr = stringr::str\_replace\_all(lab\_nr, "Beta-59996", "Beta-59998")) %>% #Checked and should be same as Drake 59998 (59996 not found)

 dplyr::mutate(lab\_nr = stringr::str\_replace\_all(lab\_nr, "Beta-166232", "Beta-166231")) %>% #Checked and should be same as Drake 166231 (166232 not found)

 dplyr::mutate(lab\_nr = stringr::str\_replace\_all(lab\_nr, "Beta-89225", "Beta-89285")) %>% #Checked and should be same as Balsera 89285 (89225 not found)

 dplyr::mutate(lab\_nr = stringr::str\_replace\_all(lab\_nr, "BLN", "Bln")) %>% #Clean lab codes

 dplyr::mutate(lab\_nr = stringr::str\_replace\_all(lab\_nr, "Cams", "CAMS")) %>% #Clean lab codes

 dplyr::mutate(lab\_nr = stringr::str\_replace\_all(lab\_nr, "CCDS-1", "GAK-8950")) %>% #Based on manual checck of data with c14baz

 dplyr::mutate(lab\_nr = stringr::str\_replace\_all(lab\_nr, "Col", "COL")) %>% #Clean lab codes

 dplyr::mutate(lab\_nr = stringr::str\_replace\_all(lab\_nr, "DSH", "DSA")) %>% #Clean lab codes

 dplyr::mutate(lab\_nr = stringr::str\_replace\_all(lab\_nr, "Gak", "GAK")) %>% #Clean lab codes

 dplyr::mutate(lab\_nr = stringr::str\_replace\_all(lab\_nr, "GaK", "GAK")) %>% #Clean lab codes

 dplyr::mutate(lab\_nr = stringr::str\_replace\_all(lab\_nr, "GiF/LSM-11037", "Gif/LSM-11037")) %>% #Clean lab codes

 dplyr::mutate(lab\_nr = stringr::str\_replace\_all(lab\_nr, "Gr-15369", "GrA-15369")) %>% #Clean lab codes

 dplyr::mutate(lab\_nr = stringr::str\_replace\_all(lab\_nr, "GRN", "GrN")) %>% #Clean lab codes

 dplyr::mutate(lab\_nr = stringr::str\_replace\_all(lab\_nr, "GrN-19282", "GrN-18282")) %>% #Checked and should be same as Balsera 18282 (92 relates to record in Ireland)

 dplyr::mutate(lab\_nr = stringr::str\_replace\_all(lab\_nr, "Mams", "MAMS")) %>% #Clean lab codes

 dplyr::mutate(lab\_nr = stringr::str\_replace\_all(lab\_nr, "Oxa", "OxA")) %>% #Clean lab codes

 dplyr::mutate(lab\_nr = stringr::str\_replace\_all(lab\_nr, "UGA", "UGa")) %>% #Clean lab codes

 dplyr::mutate(lab\_nr = stringr::str\_replace\_all(lab\_nr, "UGAMS", "UGa")) %>% #Clean lab codes

 dplyr::mutate(lab\_nr = stringr::str\_replace\_all(lab\_nr, "UGAMS", "UGaMS")) %>% #Clean lab codes

 dplyr::mutate(lab\_nr = stringr::str\_replace\_all(lab\_nr, "UtC-9329", "UtC-9320")) %>% #Checked and should be same as Balsera 9320 (9329 not found)

 dplyr::mutate(c14\_std = dplyr::if\_else(db\_code == "p299", 55L, c14\_std)) %>% #Error in database

 dplyr::mutate(c14\_std = dplyr::if\_else(db\_code == "p239", 75L, c14\_std)) %>% #Error in database

 naniar::replace\_with\_na(replace = list(lab\_nr = c("rev-"))) %>% #Clean lab codes

 dplyr::mutate(longitude = dplyr::if\_else(longitude<(-1000), longitude/1000000, longitude)) %>% #Correct errors in dataset

 dplyr::mutate(latitude = dplyr::if\_else(latitude >1000, latitude/1000000, latitude)) %>% #Correct errors in dataset

 dplyr::select(c14\_age, c14\_std, source\_db, longitude, latitude, lab\_nr, site, material, period, db\_code) %>%

 dplyr::arrange(c14\_age, c14\_std, lab\_nr, latitude, longitude, source\_db)

mclaughlin\_data\_4258 <- mclaughlin\_data\_raw %>%

 dplyr::mutate(db\_code = paste0("m", row\_number())) %>% #Add unique item code

 dplyr::rename(period = Cultural.attribution) %>%

 dplyr::rename(site = Site) %>%

 dplyr::rename(lab\_nr = LabCode) %>%

 dplyr::rename(c14\_age = BP) %>%

 dplyr::rename(c14\_std = Std) %>%

 dplyr::rename(material = Sample) %>%

 dplyr::mutate(source\_db = "mclaughlin") %>%

 dplyr::mutate(longitude = UTM\_E) %>%

 dplyr::mutate(latitude = UTM\_N) %>%

 dplyr::mutate(lab\_nr = stringr::str\_replace\_all(lab\_nr, "Q-(AM85B2b)", "QAM-85B2b")) %>% #To standardise

 dplyr::mutate(lab\_nr = stringr::str\_replace\_all(lab\_nr, "ICEN-889", "ICEN-899")) %>% #Checked and should be same as Pardo 158

 dplyr::mutate(lab\_nr = stringr::str\_replace\_all(lab\_nr, "UGAMS", "UGa")) %>%

 sf::st\_as\_sf(coords = c("longitude", "latitude"), crs = 25830, agr = "constant") %>%

 sf::st\_transform(., crs = 4258)

mclaughlin\_data\_lon\_lat <- sf::st\_coordinates(mclaughlin\_data\_4258) %>%

 dplyr::as\_tibble()

mclaughlin\_data <- mclaughlin\_data\_4258 %>% #Convert to lon lat projection

 sf::st\_set\_geometry(NULL) %>%

 cbind(mclaughlin\_data\_lon\_lat) %>%

 dplyr::rename(longitude = X, latitude = Y) %>%

 dplyr::select(c14\_age, c14\_std, source\_db, longitude, latitude, lab\_nr, site, material, period, db\_code) %>%

 dplyr::arrange(c14\_age, c14\_std, lab\_nr, latitude, longitude, source\_db)

data\_order <- c("balsera",

 "pardo",

 "mclaughlin",

 "drake",

 "bird",

 "radon",

 "radonb",

 "eubar",

 "euroevol",

 "14cpalaeolithic",

 "pacea")

# Combine datasets

# ---------------------------------------------------------

# Combine data, check coordinates, search for missing labs and replace with "unknown\_#"

c14\_data <- dplyr::bind\_rows(balsera\_data, mclaughlin\_data, drake\_data, pardo\_data, c14baz\_data, .id = NULL) %>%

 dplyr::mutate(lab\_check = stringr::str\_count(lab\_nr, "\\-")) %>% #ID lab nrs without lab and nr format

 dplyr::mutate(lab\_nr = ifelse(lab\_check < 1, NA, lab\_nr)) %>% #Make incomplete lab nrs. NA

 dplyr::mutate(source\_db = factor(source\_db, levels = data\_order)) %>%

 dplyr::filter(c14\_std <= 200) %>% #Filter out SD greater than 200

 dplyr::filter(!(longitude > 2 & latitude < 41)) %>% #Remove data from Balearics

 dplyr::arrange(c14\_age, c14\_std, lab\_nr, latitude, longitude, source\_db)

c14\_data\_lon\_lat <- c14\_data %>% #Lon lats of data

 dplyr::select(longitude, latitude) %>%

 as.matrix()

c14\_elevation <- raster::extract(elevation\_map, c14\_data\_lon\_lat) # Using topo raster, extract elevations for pop data

combined\_data <- c14\_data %>%

 dplyr::mutate(elevation = c14\_elevation) %>%

 dplyr::mutate(elevation = dplyr::if\_else(is.na(elevation), 0, elevation)) %>%

 dplyr::filter(elevation <= 2000) #Limit to less than 2000m

na\_lab\_count <- sum(is.na(combined\_data$lab\_nr)) #How many samples do not have complete lab codes

unknown\_labs <- ifelse(is.na(combined\_data$lab\_nr), "unknown-", combined\_data$lab\_nr) %>% #Generate tibble with NA converted to numbered unknown no.

 dplyr::as\_tibble() %>%

 dplyr::rename(lab\_nr = value) %>%

 dplyr::mutate(unknown\_nr = row\_number()) %>%

 dplyr::mutate(lab\_nr = ifelse(lab\_nr == "unknown-", paste0("unknown-", unknown\_nr), lab\_nr))

population\_data <- combined\_data %>%

 dplyr::mutate(lab\_nr = coalesce(combined\_data$lab\_nr, unknown\_labs$lab\_nr)) %>% #Replace NA values with unknown lab values

 dplyr::arrange(c14\_age, c14\_std, lab\_nr, latitude, longitude, source\_db) %>%

 dplyr::mutate(id = row\_number())

# Make sure that period tags are included where duplicate lab nrs are in the data

period\_population\_data <- population\_data %>% #Extract period data from other potentially excluded

 dplyr::filter(period != "")

dist\_period\_population\_data <- dplyr::distinct(period\_population\_data, lab\_nr, .keep\_all = T)

no\_period\_population\_data <- population\_data %>%

 dplyr::filter(period == "") %>%

 dplyr::left\_join(dplyr::select(dist\_period\_population\_data, period, lab\_nr), by = "lab\_nr") %>%

 dplyr::mutate(period = period.y) %>%

 dplyr::select(-period.x, -period.y) %>%

 dplyr::select(c14\_age, c14\_std, source\_db, longitude, latitude, lab\_nr, site, material, period, db\_code, lab\_check, elevation, id)

pop\_data\_tag <- period\_population\_data %>%

 rbind(no\_period\_population\_data) %>%

 dplyr::arrange(c14\_age, c14\_std, lab\_nr, latitude, longitude, source\_db)

lab\_codes <- unique(sub("-.\*", "", pop\_data\_tag$lab\_nr)) %>%

 as\_tibble()

# Ensure material information isn't lost where dublicates are in the data

material\_population\_data <- pop\_data\_tag %>% #Extract material data from other potentially excluded

 naniar::replace\_with\_na(replace = list(material = c("Unreported", "Unreported / \"\"bulk sediment\"\"",

 "n.d", "Otros","", "miscellaneous", "No det.", "from level 21 ivd",

 "?", "from layer 7 rosa", "layer ?", "from -2.19m", "possibly intrusive (?)from B2-B3",

 "from layer IB", "from layer IIB", "from surface near art 188, Puenta",

 "global sample from IV", "line on panl nø 14", "from level 1c1",

 "from leel 1be", "line below a deer", "from level 1c2", "PAI B12.285, layer IV",

 ".", "from Er-1790", "from level 1c3", "e Pai F10.269, layer 4",

 "from Er-30-75", "triangular sign nr 57A", "PAI F10.269, layer 4", "from layer IV",

 "from PAI F14.296, layer 4", "from the base", "Hogar from level 8/s", "possible from level III"))) %>%

 dplyr::filter(!is.na(material))

dist\_material\_population\_data <- dplyr::distinct(material\_population\_data, lab\_nr, .keep\_all = T) #Needed otherwise duplicate lab\_nrs can end up adding rows

no\_material\_population\_data <- pop\_data\_tag %>%

 naniar::replace\_with\_na(replace = list(material = c("Unreported", "Unreported / \"\"bulk sediment\"\"",

 "n.d", "Otros","", "miscellaneous", "No det.", "from level 21 ivd",

 "?", "from layer 7 rosa", "layer ?", "from -2.19m", "possibly intrusive (?)from B2-B3",

 "from layer IB", "from layer IIB", "from surface near art 188, Puenta",

 "global sample from IV", "line on panl nø 14", "from level 1c1",

 "from leel 1be", "line below a deer", "from level 1c2", "PAI B12.285, layer IV",

 ".", "from Er-1790", "from level 1c3", "e Pai F10.269, layer 4",

 "from Er-30-75", "triangular sign nr 57A", "PAI F10.269, layer 4", "from layer IV",

 "from PAI F14.296, layer 4", "from the base", "Hogar from level 8/s", "possible from level III"))) %>%

 dplyr::filter(is.na(material)) %>%

 dplyr::left\_join(dplyr::select(dist\_material\_population\_data, material, lab\_nr), by = "lab\_nr") %>%

 dplyr::mutate(material = material.y) %>%

 dplyr::select(-material.x, -material.y) %>%

 dplyr::select(c14\_age, c14\_std, source\_db, longitude, latitude, lab\_nr, site, material, period, db\_code, lab\_check, elevation, id)

pop\_data <- material\_population\_data %>%

 rbind(no\_material\_population\_data) %>%

 dplyr::arrange(c14\_age, c14\_std, lab\_nr, latitude, longitude, source\_db)

# Test for duplicates

# ---------------------------------------------------------

# First pass: lab nr, age and error

duplicate\_testing\_lab <- vector("integer", nrow(pop\_data))

d1\_pop\_data <- pop\_data %>% #Ensure data in the right order for testing for duplicates

 dplyr::arrange(c14\_age, c14\_std, lab\_nr, latitude, longitude, source\_db)

for (i in 2:nrow(d1\_pop\_data)){#Generate vector to see whether duplicate rows based on lab\_nr

 duplicate\_testing\_lab [[i]] <- if\_else((d1\_pop\_data$lab\_nr[[i]] == d1\_pop\_data$lab\_nr[[(i-1)]]

 & d1\_pop\_data$c14\_age[[i]] == d1\_pop\_data$c14\_age[[(i-1)]]

 & d1\_pop\_data$c14\_std[[i]] == d1\_pop\_data$c14\_std[[(i-1)]])

 , 1, 0 )

}

pop\_data\_check\_dr1 <- d1\_pop\_data %>% #insert duplicates, visually check this!

 dplyr::mutate(duplicate = duplicate\_testing\_lab)

pop\_data\_dr1 <- pop\_data\_check\_dr1 %>% #Remove duplicate labs

 dplyr::filter(duplicate == 0) %>%

 dplyr::select(-duplicate) %>%

 dplyr::filter(c14\_std > 0) %>%

 dplyr::mutate(latitude2 = round(latitude, 2)) %>%

 dplyr::mutate(longitude2 = round(longitude, 2))

# 2nd pass: coordinates, age and error

duplicate\_testing\_coords <- vector("integer", nrow(pop\_data\_dr1))

d2\_pop\_data <- pop\_data\_dr1 %>% #Ensure data in the right order for testing for duplicates

 dplyr::arrange(latitude2, longitude2, c14\_age, c14\_std, lab\_nr, source\_db)

for (i in 2:nrow(d2\_pop\_data)){#Generate vector to see whether duplicate rows based on coords

 duplicate\_testing\_coords [[i]] <- if\_else((d2\_pop\_data$longitude2[[i]] == d2\_pop\_data$longitude2[[(i-1)]]

 & d2\_pop\_data$latitude2[[i]] == d2\_pop\_data$latitude2[[(i-1)]]

 & d2\_pop\_data$c14\_age[[i]] == d2\_pop\_data$c14\_age[[(i-1)]]

 & d2\_pop\_data$c14\_std[[i]] == d2\_pop\_data$c14\_std[[(i-1)]]

 & (is.na(d2\_pop\_data$lab\_check[[i]]) | is.na(d2\_pop\_data$lab\_check[[i-1]])))

 , 1, 0 )

}

pop\_data\_check\_dr2 <- d2\_pop\_data %>% #insert duplicates, visually check this!

 dplyr::mutate(duplicate = duplicate\_testing\_coords)

pop\_data\_dr2 <- pop\_data\_check\_dr2 %>% #Remove duplicate coords, etc.

 dplyr::filter(duplicate == 0) %>%

 dplyr::select(-duplicate)

# 3rd pass: error, visual check

duplicate\_testing\_error <- vector("integer", nrow(pop\_data\_dr2))

d3\_pop\_data <- pop\_data\_dr2 %>% #Ensure data in the right order for testing for duplicates

 dplyr::arrange(c14\_age, c14\_std, lab\_nr, latitude, longitude, source\_db)

for (i in 2:nrow(d3\_pop\_data)){#Generate vector to see whether duplicate rows based on std and age only

 duplicate\_testing\_error [[i]] <- if\_else((d3\_pop\_data$c14\_std[[i]] == d3\_pop\_data$c14\_std[[(i-1)]]

 & d3\_pop\_data$c14\_age[[i]] == d3\_pop\_data$c14\_age[[(i-1)]])

 , 1, 0 )

}

pop\_data\_check\_dr3 <- d3\_pop\_data %>% #insert duplicates, visually check this!

 dplyr::mutate(duplicate = duplicate\_testing\_error)

pop\_data\_dr3 <- pop\_data\_check\_dr3 %>% #Remove duplicate coords, etc.

 dplyr::filter(!(lab\_nr == "CSIC-201B" & c14\_age == 2570 & source\_db == "radon")) %>%

 dplyr::filter(!(lab\_nr == "KN-I.-201" & c14\_age == 2770 & source\_db == "radonb")) %>%

 dplyr::filter(!(lab\_nr == "IAB-110" & c14\_age == 2980 & source\_db == "eubar")) %>%

 dplyr::filter(!(lab\_nr == "Ua-2310" & c14\_age == 3000 & source\_db == "eubar")) %>%

 dplyr::filter(!(lab\_nr == "ICEN-84" & c14\_age == 3000 & source\_db == "radonb")) %>%

 dplyr::filter(!(lab\_nr == "unknown-534" & c14\_age == 3080 & source\_db == "eubar")) %>%

 dplyr::filter(!(lab\_nr == "unknown-647" & c14\_age == 3170 & source\_db == "eubar")) %>%

 dplyr::filter(!(lab\_nr == "unknown-671" & c14\_age == 3180 & source\_db == "balsera")) %>%

 dplyr::filter(!(lab\_nr == "P-4069A" & c14\_age == 3200 & source\_db == "radonb")) %>%

 dplyr::filter(!(lab\_nr == "I-7706" & c14\_age == 3230 & source\_db == "eubar")) %>%

 dplyr::filter(!(lab\_nr == "unknown-768" & c14\_age == 3245 & source\_db == "balsera")) %>%

 dplyr::filter(!(lab\_nr == "UtC-1436" & c14\_age == 3280 & source\_db == "radonb")) %>%

 dplyr::filter(!(lab\_nr == "Ua-394892" & c14\_age == 3287 & source\_db == "radonb")) %>%

 dplyr::filter(!(lab\_nr == "unknown-1032" & c14\_age == 3330 & source\_db == "balsera")) %>%

 dplyr::filter(!(lab\_nr == "unknown-1150" & c14\_age == 3365 & source\_db == "eubar")) %>%

 dplyr::filter(!(lab\_nr == "UtC-1354" & c14\_age == 3370 & source\_db == "radonb")) %>%

 dplyr::filter(!(lab\_nr == "UBAR-673" & c14\_age == 3370 & source\_db == "eubar")) %>%

 dplyr::filter(!(lab\_nr == "ICEN-11069" & c14\_age == 3470 & source\_db == "radonb")) %>%

 dplyr::filter(!(lab\_nr == "unknown-1572" & c14\_age == 3475 & source\_db == "eubar")) %>%

 dplyr::filter(!(lab\_nr == "UtC-1433" & c14\_age == 3480 & source\_db == "radonb")) %>%

 dplyr::filter(!(lab\_nr == "unknown-1625" & c14\_age == 3490 & source\_db == "balsera")) %>%

 dplyr::filter(!(lab\_nr == "ICEN-11070" & c14\_age == 3520 & source\_db == "radonb")) %>%

 dplyr::filter(!(lab\_nr == "UtC-2289" & c14\_age == 3530 & source\_db == "radonb")) %>%

 dplyr::filter(!(lab\_nr == "UtC-1437" & c14\_age == 3530 & source\_db == "radonb")) %>%

 dplyr::filter(!(lab\_nr == "Beta-91583" & c14\_age == 3570 & source\_db == "radonb")) %>%

 dplyr::filter(!(lab\_nr == "KIA-22256" & c14\_age == 3580 & source\_db == "radonb")) %>%

 dplyr::filter(!(lab\_nr == "UtC-1439" & c14\_age == 3580 & source\_db == "radonb")) %>%

 dplyr::filter(!(lab\_nr == "UBAR-661" & c14\_age == 3630 & source\_db == "radon")) %>%

 dplyr::filter(!(lab\_nr == "KIA-22257" & c14\_age == 3630 & source\_db == "radonb")) %>%

 dplyr::filter(!(lab\_nr == "ICEN-16352" & c14\_age == 3640 & source\_db == "radonb")) %>%

 dplyr::filter(!(lab\_nr == "H-2048/1458" & c14\_age == 3650 & source\_db == "radon")) %>%

 dplyr::filter(!(lab\_nr == "C-341" & c14\_age == 3680 & source\_db == "radonb")) %>%

 dplyr::filter(!(lab\_nr == "B-6331" & c14\_age == 3680 & source\_db == "radonb")) %>%

 dplyr::filter(!(lab\_nr == "ICEN-16063" & c14\_age == 3680 & source\_db == "radonb")) %>%

 dplyr::filter(!(lab\_nr == "UtC-2284" & c14\_age == 3700 & source\_db == "radonb")) %>%

 dplyr::filter(!(lab\_nr == "Ua-26013" & c14\_age == 3705 & source\_db == "radonb")) %>%

 dplyr::filter(!(lab\_nr == "UtC-2292" & c14\_age == 3720 & source\_db == "radonb")) %>%

 dplyr::filter(!(lab\_nr == "I-19306" & c14\_age == 3830 & source\_db == "radonb")) %>%

 dplyr::filter(!(lab\_nr == "I-15319" & c14\_age == 3870 & source\_db == "radonb")) %>%

 dplyr::filter(!(lab\_nr == "UBAR-297" & c14\_age == 3890 & source\_db == "radon")) %>%

 dplyr::filter(!(lab\_nr == "CSIC-30647" & c14\_age == 3900 & source\_db == "radonb")) %>%

 dplyr::filter(!(lab\_nr == "OxA-236015" & c14\_age == 3946 & source\_db == "radonb")) %>%

 dplyr::filter(!(lab\_nr == "unknown-3226" & c14\_age == 3950 & source\_db == "balsera")) %>%

 dplyr::filter(!(lab\_nr == "GrN-7007C" & c14\_age == 3950 & source\_db == "radonb")) %>%

 dplyr::filter(!(lab\_nr == "GrN-15511" & c14\_age == 3990 & source\_db == "radonb")) %>%

 dplyr::filter(!(lab\_nr == "unknown-3373" & c14\_age == 3990 & source\_db == "balsera")) %>%

 dplyr::filter(!(lab\_nr == "unknown-3405" & c14\_age == 3995 & source\_db == "balsera")) %>%

 dplyr::filter(!(lab\_nr == "Beta-125862" & c14\_age == 4000 & source\_db == "radon")) %>%

 dplyr::filter(!(lab\_nr == "ICEN-601" & c14\_age == 4010 & source\_db == "radon")) %>%

 dplyr::filter(!(lab\_nr == "UtC-2630" & c14\_age == 4040 & source\_db == "radonb")) %>%

 dplyr::filter(!(lab\_nr == "OxA-236023" & c14\_age == 4062 & source\_db == "radonb")) %>%

 dplyr::filter(!(lab\_nr == "Beta-193744" & c14\_age == 4130 & source\_db == "radon")) %>%

 dplyr::filter(!(lab\_nr == "AA-4238" & c14\_age == 4220 & source\_db == "radonb")) %>%

 dplyr::filter(!(lab\_nr == "GAK-10943" & c14\_age == 4220 & source\_db == "radon")) %>%

 dplyr::filter(!(lab\_nr == "H-2049/148" & c14\_age == 4260 & source\_db == "radon")) %>%

 dplyr::filter(!(lab\_nr == "H-204-247" & c14\_age == 4295 & source\_db == "radon")) %>%

 dplyr::filter(!(lab\_nr == "unknown-4382" & c14\_age == 4295 & source\_db == "balsera")) %>%

 dplyr::filter(!(lab\_nr == "unknown-4610" & c14\_age == 4420 & source\_db == "balsera")) %>%

 dplyr::filter(!(lab\_nr == "R-1768" & c14\_age == 4515 & source\_db == "balsera")) %>%

 dplyr::filter(!(lab\_nr == "ICEN-172" & c14\_age == 4540 & source\_db == "radon")) %>%

 dplyr::filter(!(lab\_nr == "ICEN-5506" & c14\_age == 4600 & source\_db == "radon")) %>%

 dplyr::filter(!(lab\_nr == "MC-1112B" & c14\_age == 4600 & source\_db == "radon")) %>%

 dplyr::filter(!(lab\_nr == "unknown-5169" & c14\_age == 4790 & source\_db == "balsera")) %>%

 dplyr::filter(!(lab\_nr == "Gif-4956" & c14\_age == 4800 & source\_db == "radon")) %>%

 dplyr::filter(!(lab\_nr == "Beta-242781" & c14\_age == 4890 & source\_db == "balsera")) %>%

 dplyr::filter(!(lab\_nr == "Bln-5540" & c14\_age == 4892 & source\_db == "balsera")) %>%

 dplyr::filter(!(lab\_nr == "I-15349" & c14\_age == 4920 & source\_db == "balsera")) %>%

 dplyr::filter(!(lab\_nr == "unknown-5383" & c14\_age == 4940 & source\_db == "balsera")) %>%

 dplyr::filter(!(lab\_nr == "DESCONOCIDO-17694" & c14\_age == 4950 & source\_db == "balsera")) %>%

 dplyr::filter(!(lab\_nr == "DESCONOCIDO-17693" & c14\_age == 4960 & source\_db == "balsera")) %>%

 dplyr::filter(!(lab\_nr == "unknown-5430" & c14\_age == 4965 & source\_db == "balsera")) %>%

 dplyr::filter(!(lab\_nr == "KIK/KIA-5833/40816" & c14\_age == 5000 & source\_db == "drake")) %>%

 dplyr::filter(!(lab\_nr == "unknown-5532" & c14\_age == 5010 & source\_db == "balsera")) %>%

 dplyr::filter(!(lab\_nr == "unknown-5533" & c14\_age == 5010 & source\_db == "drake")) %>%

 dplyr::filter(!(lab\_nr == "GrN-26226" & c14\_age == 5045 & source\_db == "balsera")) %>%

 dplyr::filter(!(lab\_nr == "unknown-5850" & c14\_age == 5135 & source\_db == "drake")) %>%

 dplyr::filter(!(lab\_nr == "unknown-5851" & c14\_age == 5135 & source\_db == "balsera")) %>%

 dplyr::filter(!(lab\_nr == "unknown-5932" & c14\_age == 5175 & source\_db == "drake")) %>%

 dplyr::filter(!(lab\_nr == "unknown-6009" & c14\_age == 5210 & source\_db == "drake")) %>%

 dplyr::filter(!(lab\_nr == "Beta-156686" & c14\_age == 5220 & source\_db == "drake")) %>%

 dplyr::filter(!(lab\_nr == "Beta-184182" & c14\_age == 5230 & source\_db == "balsera")) %>%

 dplyr::filter(!(lab\_nr == "KIK/KIA-4381/32340" & c14\_age == 5245 & source\_db == "drake")) %>%

 dplyr::filter(!(lab\_nr == "GifA-99113" & c14\_age == 5330 & source\_db == "pardo")) %>%

 dplyr::filter(!(lab\_nr == "unknown-6365" & c14\_age == 5380 & source\_db == "balsera")) %>%

 dplyr::filter(!(lab\_nr == "UtC-7318" & c14\_age == 5404 & source\_db == "balsera")) %>%

 dplyr::filter(!(lab\_nr == "Gif-11037" & c14\_age == 5460 & source\_db == "balsera")) %>%

 dplyr::filter(!(lab\_nr == "GrA-13624" & c14\_age == 5480 & source\_db == "balsera")) %>%

 dplyr::filter(!(lab\_nr == "Beta-166179" & c14\_age == 5630 & source\_db == "drake")) %>%

 dplyr::filter(!(lab\_nr == "KIK/KIA-5832/40815" & c14\_age == 5635 & source\_db == "drake")) %>%

 dplyr::filter(!(lab\_nr == "Ua-16205" & c14\_age == 5640 & source\_db == "drake")) %>%

 dplyr::filter(!(lab\_nr == "KIK/KIA-5860/41134" & c14\_age == 5645 & source\_db == "drake")) %>%

 dplyr::filter(!(lab\_nr == "KIK/KIA-5834/40817" & c14\_age == 5685 & source\_db == "drake")) %>%

 dplyr::filter(!(lab\_nr == "Beta-180981" & c14\_age == 5690 & source\_db == "balsera")) %>%

 dplyr::filter(!(lab\_nr == "I-17789" & c14\_age == 5700 & source\_db == "drake")) %>%

 dplyr::filter(!(lab\_nr == "unknown-6828" & c14\_age == 5710 & source\_db == "drake")) %>%

 dplyr::filter(!(lab\_nr == "GAK-15223" & c14\_age == 5710 & source\_db == "radon")) %>%

 dplyr::filter(!(lab\_nr == "KIK/KIA-5785/40878" & c14\_age == 5715 & source\_db == "drake")) %>%

 dplyr::filter(!(lab\_nr == "Wk-16148" & c14\_age == 5831 & source\_db == "drake")) %>%

 dplyr::filter(!(lab\_nr == "Ua-4821" & c14\_age == 5960 & source\_db == "drake")) %>%

 dplyr::filter(!(lab\_nr == "Q-(AM85B2b)" & c14\_age == 5990 & source\_db == "radon")) %>%

 dplyr::filter(!(lab\_nr == "UGa-7565" & c14\_age == 6120 & source\_db == "balsera")) %>%

 dplyr::filter(!(lab\_nr == "Beta-74212" & c14\_age == 6130 & source\_db == "drake")) %>%

 dplyr::filter(!(lab\_nr == "KIA-6790" & c14\_age == 6144 & source\_db == "balsera")) %>%

 dplyr::filter(!(lab\_nr == "unknown-7740" & c14\_age == 6184 & source\_db == "balsera")) %>%

 dplyr::filter(!(lab\_nr == "unknown-7741" & c14\_age == 6184 & source\_db == "drake")) %>%

 dplyr::filter(!(lab\_nr == "AA-78527" & c14\_age == 6203 & source\_db == "balsera")) %>%

 dplyr::filter(!(lab\_nr == "Beta-166182" & c14\_age == 6240 & source\_db == "drake")) %>%

 dplyr::filter(!(lab\_nr == "H-1754/1208" & c14\_age == 6265 & source\_db == "drake")) %>%

 dplyr::filter(!(lab\_nr == "Beta-22340" & c14\_age == 6270 & source\_db == "drake")) %>%

 dplyr::filter(!(lab\_nr == "unknown-7987" & c14\_age == 6270 & source\_db == "drake")) %>%

 dplyr::filter(!(lab\_nr == "CSIC-114A" & c14\_age == 6320 & source\_db == "drake")) %>%

 dplyr::filter(!(lab\_nr == "OxA-V-2392-26" & c14\_age == 6341 & source\_db == "drake")) %>%

 dplyr::filter(!(lab\_nr == "OxA-2360" & c14\_age == 6389 & source\_db == "balsera")) %>%

 dplyr::filter(!(lab\_nr == "OxA-V-2360-22" & c14\_age == 6389 & source\_db == "drake")) %>%

 dplyr::filter(!(lab\_nr == "OxA-V-2360-25" & c14\_age == 6399 & source\_db == "drake")) %>%

 dplyr::filter(!(lab\_nr == "Beta-189076" & c14\_age == 6400 & source\_db == "balsera")) %>%

 dplyr::filter(!(lab\_nr == "OxA-V-26075" & c14\_age == 6430 & source\_db == "drake")) %>%

 dplyr::filter(!(lab\_nr == "Beta-180721" & c14\_age == 6440 & source\_db == "drake")) %>%

 dplyr::filter(!(lab\_nr == "unknown-8345" & c14\_age == 6440 & source\_db == "drake")) %>%

 dplyr::filter(!(lab\_nr == "Beta-13157" & c14\_age == 6590 & source\_db == "drake")) %>%

 dplyr::filter(!(lab\_nr == "Beta-233092" & c14\_age == 6660 & source\_db == "drake")) %>%

 dplyr::filter(!(lab\_nr == "A-1" & c14\_age == 6710 & source\_db == "pardo")) %>%

 dplyr::filter(!(lab\_nr == "GrN-26400" & c14\_age == 6710 & source\_db == "balsera")) %>%

 dplyr::filter(!(lab\_nr == "Beta-74220" & c14\_age == 6730 & source\_db == "drake")) %>%

 dplyr::filter(!(lab\_nr == "unknown-8712" & c14\_age == 6760 & source\_db == "drake")) %>%

 dplyr::filter(!(lab\_nr == "unknown-8714" & c14\_age == 6760 & source\_db == "balsera")) %>%

 dplyr::filter(!(lab\_nr == "Gif-2368" & c14\_age == 6780 & source\_db == "drake")) %>%

 dplyr::filter(!(lab\_nr == "unknown-8764" & c14\_age == 6800 & source\_db == "balsera")) %>%

 dplyr::filter(!(lab\_nr == "KIA-34796" & c14\_age == 6810 & source\_db == "drake")) %>%

 dplyr::filter(!(lab\_nr == "Beta-141050" & c14\_age == 6910 & source\_db == "balsera")) %>%

 dplyr::filter(!(lab\_nr == "unknown-8936" & c14\_age == 6970 & source\_db == "drake")) %>%

 dplyr::filter(!(lab\_nr == "TO-354" & c14\_age == 6970 & source\_db == "radon")) %>%

 dplyr::filter(!(lab\_nr == "UGaMS-7196" & c14\_age == 6990 & source\_db == "drake")) %>%

 dplyr::filter(!(lab\_nr == "H-2119" & c14\_age == 7080 & source\_db == "balsera")) %>%

 dplyr::filter(!(lab\_nr == "H-2119/1546" & c14\_age == 7080 & source\_db == "drake")) %>%

 dplyr::filter(!(lab\_nr == "CSIC-637R" & c14\_age == 7200 & source\_db == "drake")) %>%

 dplyr::filter(!(lab\_nr == "Beta-171910" & c14\_age == 7280 & source\_db == "pardo")) %>%

 dplyr::filter(!(lab\_nr == "TO-11819" & c14\_age == 7300 & source\_db == "balsera")) %>%

 dplyr::filter(!(lab\_nr == "TO-11819-R" & c14\_age == 7300 & source\_db == "drake")) %>%

 dplyr::filter(!(lab\_nr == "GrA-7093" & c14\_age == 7360 & source\_db == "drake")) %>%

 dplyr::filter(!(lab\_nr == "Gif-3741" & c14\_age == 7620 & source\_db == "balsera")) %>%

 dplyr::filter(!(lab\_nr == "OxA-7495" & c14\_age == 7710 & source\_db == "balsera")) %>%

 dplyr::filter(!(lab\_nr == "GrA-22806" & c14\_age == 8250 & source\_db == "pardo")) %>%

 dplyr::filter(!(lab\_nr == "GrN-18115" & c14\_age == 9260 & source\_db == "pardo")) %>%

 dplyr::filter(!(lab\_nr == "CSIC-261" & c14\_age == 9430 & source\_db == "pacea")) %>%

 dplyr::filter(!(lab\_nr == "ICEN-92" & c14\_age == 9530 & source\_db == "radon")) %>%

 dplyr::filter(!(lab\_nr == "GrN-17785" & c14\_age == 9715 & source\_db == "14cpalaeolithic")) %>%

 dplyr::filter(!(lab\_nr == "unknown-10061" & c14\_age == 10190 & source\_db == "pacea")) %>%

 dplyr::filter(!(lab\_nr == "Gif-95617" & c14\_age == 10260 & source\_db == "pacea")) %>%

 dplyr::filter(!(lab\_nr == "UGRA-147?" & c14\_age == 12060 & source\_db == "pacea")) %>%

 dplyr::filter(!(lab\_nr == "Gif-95630" & c14\_age == 12240 & source\_db == "pacea")) %>%

 dplyr::filter(!(lab\_nr == "unknown-10478" & c14\_age == 12282 & source\_db == "14cpalaeolithic")) %>%

 dplyr::filter(!(lab\_nr == "unknown-10601" & c14\_age == 12896 & source\_db == "14cpalaeolithic")) %>%

 dplyr::filter(!(lab\_nr == "GifA-96096" & c14\_age == 13210 & source\_db == "pacea")) %>%

 dplyr::filter(!(lab\_nr == "unknown-10662" & c14\_age == 13300 & source\_db == "pacea")) %>%

 dplyr::filter(!(lab\_nr == "GifA-96139" & c14\_age == 13320 & source\_db == "pacea")) %>%

 dplyr::filter(!(lab\_nr == "GrN-17255" & c14\_age == 14020 & source\_db == "pacea")) %>%

 dplyr::filter(!(lab\_nr == "unknown-10788" & c14\_age == 14040 & source\_db == "14cpalaeolithic")) %>%

 dplyr::filter(!(lab\_nr == "GifA-91130" & c14\_age == 14250 & source\_db == "pacea")) %>%

 dplyr::select(-duplicate)

# 4th pass: same lab no but different data or se, visual check

duplicate\_testing\_error <- vector("integer", nrow(pop\_data\_dr3))

d4\_pop\_data <- pop\_data\_dr3 %>% #Ensure data in the right order for testing for duplicates

 dplyr::arrange(lab\_nr, c14\_age, c14\_std, latitude, longitude, source\_db)

for (i in 2:nrow(d4\_pop\_data)){#Generate vector to see whether duplicate rows based on coords

 duplicate\_testing\_error [[i]] <- if\_else((d4\_pop\_data$lab\_nr[[i]] == d4\_pop\_data$lab\_nr[[(i-1)]])

 , 1, 0 )

}

pop\_data\_check\_dr4 <- d4\_pop\_data %>% #insert duplicates, visually check this!

 dplyr::mutate(duplicate = duplicate\_testing\_error)

pop\_data\_dr4 <- pop\_data\_check\_dr4 %>% #Manually checked all of these duplicates

 dplyr::filter(!(lab\_nr == "AA-29648" & c14\_age == 3565 & source\_db == "pardo")) %>%

 dplyr::filter(!(lab\_nr == "AA-57439" & c14\_age == 4604 & source\_db == "balsera")) %>%

 dplyr::filter(!(lab\_nr == "AA-59519" & c14\_age == 7256 & source\_db == "drake")) %>%

 dplyr::filter(!(lab\_nr == "AA-8647" & c14\_age == 9988 & source\_db == "14cpalaeolithic")) %>%

 dplyr::filter(!(lab\_nr == "Beta-123555" & c14\_age == 3650 & source\_db == "radonb")) %>%

 dplyr::filter(!(lab\_nr == "Beta-124523" & c14\_age == 4460 & source\_db == "radon")) %>%

 dplyr::filter(!(lab\_nr == "Beta-124525" & c14\_age == 4040 & source\_db == "radon")) %>%

 dplyr::filter(!(lab\_nr == "Beta-124540" & c14\_age == 3500 & source\_db == "radonb")) %>%

 dplyr::filter(!(lab\_nr == "Beta-125110" & c14\_age == 7320 & source\_db == "balsera")) %>%

 dplyr::filter(!(lab\_nr == "Beta-126686" & c14\_age == 5460 & source\_db == "balsera")) %>%

 dplyr::filter(!(lab\_nr == "Beta-127449" & c14\_age == 7120 & source\_db == "pardo")) %>%

 dplyr::filter(!(lab\_nr == "Beta-136676" & c14\_age == 6900 & source\_db == "balsera")) %>%

 dplyr::filter(!(lab\_nr == "Beta-136677" & c14\_age == 7000 & source\_db == "balsera")) %>%

 dplyr::filter(!(lab\_nr == "Beta-142289" & c14\_age == 6510 & source\_db == "balsera")) %>%

 dplyr::filter(!(lab\_nr == "Beta-162879" & c14\_age == 17850 & source\_db == "14cpalaeolithic")) %>%

 dplyr::filter(!(lab\_nr == "Beta-164901" & c14\_age == 4540 & source\_db == "balsera")) %>%

 dplyr::filter(!(lab\_nr == "Beta-165793" & c14\_age == 6350 & source\_db == "pardo")) %>%

 dplyr::filter(!(lab\_nr == "Beta-166181" & c14\_age == 5810 & source\_db == "drake")) %>%

 dplyr::filter(!(lab\_nr == "Beta-166228" & c14\_age == 5020 & source\_db == "pardo")) %>%

 dplyr::filter(!(lab\_nr == "Beta-166229" & c14\_age == 4250 & source\_db == "balsera")) %>%

 dplyr::filter(!(lab\_nr == "Beta-166231" & c14\_age == 6010 & source\_db == "pardo")) %>%

 dplyr::filter(!(lab\_nr == "Beta-169264" & c14\_age == 4450 & source\_db == "balsera")) %>%

 dplyr::filter(!(lab\_nr == "Beta-169546" & c14\_age == 4430 & source\_db == "balsera")) %>%

 dplyr::filter(!(lab\_nr == "Beta-176897" & c14\_age == 4280 & source\_db == "balsera")) %>%

 dplyr::filter(!(lab\_nr == "Beta-179900" & c14\_age == 5980 & source\_db == "drake")) %>%

 dplyr::filter(!(lab\_nr == "Beta-180980" & c14\_age == 3869 & source\_db == "balsera")) %>%

 dplyr::filter(!(lab\_nr == "Beta-186855" & c14\_age == 3850 & source\_db == "radon")) %>%

 dplyr::filter(!(lab\_nr == "Beta-188925" & c14\_age == 3310 & source\_db == "balsera")) %>%

 dplyr::filter(!(lab\_nr == "Beta-188926" & c14\_age == 3360 & source\_db == "balsera")) %>%

 dplyr::filter(!(lab\_nr == "Beta-189075" & c14\_age == 5170 & source\_db == "pardo")) %>%

 dplyr::filter(!(lab\_nr == "Beta-191083" & c14\_age == 6850 & source\_db == "pardo")) %>%

 dplyr::filter(!(lab\_nr == "Beta-193745" & c14\_age == 4110 & source\_db == "radon")) %>%

 dplyr::filter(!(lab\_nr == "Beta-193760" & c14\_age == 7000 & source\_db == "drake")) %>%

 dplyr::filter(!(lab\_nr == "Beta-197384" & c14\_age == 6100 & source\_db == "drake")) %>%

 dplyr::filter(!(lab\_nr == "Beta-197385" & c14\_age == 6380 & source\_db == "drake")) %>%

 dplyr::filter(!(lab\_nr == "Beta-202343" & c14\_age == 5100 & source\_db == "pardo")) %>%

 dplyr::filter(!(lab\_nr == "Beta-208132" & c14\_age == 6120 & source\_db == "drake")) %>%

 dplyr::filter(!(lab\_nr == "Beta-208133" & c14\_age == 6150 & source\_db == "drake")) %>%

 dplyr::filter(!(lab\_nr == "Beta-208134" & c14\_age == 6320 & source\_db == "drake")) %>%

 dplyr::filter(!(lab\_nr == "Beta-220914" & c14\_age == 6110 & source\_db == "drake")) %>%

 dplyr::filter(!(lab\_nr == "Beta-222342" & c14\_age == 6590 & source\_db == "balsera")) %>%

 dplyr::filter(!(lab\_nr == "Beta-222444" & c14\_age == 4000 & source\_db == "radonb")) %>%

 dplyr::filter(!(lab\_nr == "Beta-223091" & c14\_age == 5880 & source\_db == "drake")) %>%

 dplyr::filter(!(lab\_nr == "Beta-225217" & c14\_age == 4710 & source\_db == "balsera")) %>%

 dplyr::filter(!(lab\_nr == "Beta-225218" & c14\_age == 5080 & source\_db == "balsera")) %>%

 dplyr::filter(!(lab\_nr == "Beta-225224" & c14\_age == 5010 & source\_db == "balsera")) %>%

 dplyr::filter(!(lab\_nr == "Beta-229791" & c14\_age == 3920 & source\_db == "balsera")) %>%

 dplyr::filter(!(lab\_nr == "Beta-231876" & c14\_age == 5890 & source\_db == "balsera")) %>%

 dplyr::filter(!(lab\_nr == "Beta-231880" & c14\_age == 6600 & source\_db == "balsera")) %>%

 dplyr::filter(!(lab\_nr == "Beta-232340" & c14\_age == 6020 & source\_db == "pardo")) %>%

 dplyr::filter(!(lab\_nr == "Beta-232341" & c14\_age == 6800 & source\_db == "pardo")) %>%

 dplyr::filter(!(lab\_nr == "Beta-232342" & c14\_age == 6780 & source\_db == "pardo")) %>%

 dplyr::filter(!(lab\_nr == "Beta-232484" & c14\_age == 5880 & source\_db == "balsera")) %>%

 dplyr::filter(!(lab\_nr == "Beta-235487" & c14\_age == 3450 & source\_db == "radon")) %>%

 dplyr::filter(!(lab\_nr == "Beta-235488" & c14\_age == 3960 & source\_db == "radon")) %>%

 dplyr::filter(!(lab\_nr == "Beta-236821" & c14\_age == 3310 & source\_db == "radonb")) %>%

 dplyr::filter(!(lab\_nr == "Beta-240897" & c14\_age == 5010 & source\_db == "drake")) %>%

 dplyr::filter(!(lab\_nr == "Beta-247406" & c14\_age == 5340 & source\_db == "drake")) %>%

 dplyr::filter(!(lab\_nr == "Beta-248523" & c14\_age == 6020 & source\_db == "balsera")) %>%

 dplyr::filter(!(lab\_nr == "Beta-250404" & c14\_age == 5000 & source\_db == "drake")) %>%

 dplyr::filter(!(lab\_nr == "Beta-252263" & c14\_age == 5120 & source\_db == "balsera")) %>%

 dplyr::filter(!(lab\_nr == "Beta-256325" & c14\_age == 3910 & source\_db == "radon")) %>%

 dplyr::filter(!(lab\_nr == "Beta-258466" & c14\_age == 3340 & source\_db == "balsera")) %>%

 dplyr::filter(!(lab\_nr == "Beta-278255" & c14\_age == 5262 & source\_db == "drake")) %>%

 dplyr::filter(!(lab\_nr == "Beta-278256" & c14\_age == 5129 & source\_db == "drake")) %>%

 dplyr::filter(!(lab\_nr == "Beta-288933" & c14\_age == 3550 & source\_db == "pardo")) %>%

 dplyr::filter(!(lab\_nr == "Beta-288934" & c14\_age == 3550 & source\_db == "pardo")) %>%

 dplyr::filter(!(lab\_nr == "Beta-288935" & c14\_age == 3550 & source\_db == "pardo")) %>%

 dplyr::filter(!(lab\_nr == "Beta-288936" & c14\_age == 3550 & source\_db == "pardo")) %>%

 dplyr::filter(!(lab\_nr == "Beta-288937" & c14\_age == 3550 & source\_db == "pardo")) %>%

 dplyr::filter(!(lab\_nr == "Beta-288938" & c14\_age == 3550 & source\_db == "pardo")) %>%

 dplyr::filter(!(lab\_nr == "Beta-288939" & c14\_age == 3550 & source\_db == "pardo")) %>%

 dplyr::filter(!(lab\_nr == "Beta-298124" & c14\_age == 6290 & source\_db == "pardo")) %>%

 dplyr::filter(!(lab\_nr == "Beta-298125" & c14\_age == 6270 & source\_db == "pardo")) %>%

 dplyr::filter(!(lab\_nr == "Beta-298126" & c14\_age == 6180 & source\_db == "pardo")) %>%

 dplyr::filter(!(lab\_nr == "Beta-299101" & c14\_age == 3430 & source\_db == "eubar")) %>%

 dplyr::filter(!(lab\_nr == "Beta-299302" & c14\_age == 3550 & source\_db == "pardo")) %>%

 dplyr::filter(!(lab\_nr == "Beta-299303" & c14\_age == 3550 & source\_db == "pardo")) %>%

 dplyr::filter(!(lab\_nr == "Beta-299307" & c14\_age == 3550 & source\_db == "pardo")) %>%

 dplyr::filter(!(lab\_nr == "Beta-299308" & c14\_age == 3550 & source\_db == "pardo")) %>%

 dplyr::filter(!(lab\_nr == "Beta-299309" & c14\_age == 3550 & source\_db == "pardo")) %>%

 dplyr::filter(!(lab\_nr == "Beta-299311" & c14\_age == 3550 & source\_db == "pardo")) %>%

 dplyr::filter(!(lab\_nr == "Beta-299312" & c14\_age == 3550 & source\_db == "pardo")) %>%

 dplyr::filter(!(lab\_nr == "Beta-301219" & c14\_age == 3550 & source\_db == "pardo")) %>%

 dplyr::filter(!(lab\_nr == "Beta-301220" & c14\_age == 3550 & source\_db == "pardo")) %>%

 dplyr::filter(!(lab\_nr == "Beta-301221" & c14\_age == 3550 & source\_db == "pardo")) %>%

 dplyr::filter(!(lab\_nr == "Beta-301222" & c14\_age == 3550 & source\_db == "pardo")) %>%

 dplyr::filter(!(lab\_nr == "Beta-301223" & c14\_age == 3550 & source\_db == "pardo")) %>%

 dplyr::filter(!(lab\_nr == "Beta-301224" & c14\_age == 3550 & source\_db == "pardo")) %>%

 dplyr::filter(!(lab\_nr == "Beta-301225" & c14\_age == 3550 & source\_db == "pardo")) %>%

 dplyr::filter(!(lab\_nr == "Beta-301226" & c14\_age == 3550 & source\_db == "pardo")) %>%

 dplyr::filter(!(lab\_nr == "Beta-307795" & c14\_age == 3550 & source\_db == "pardo")) %>%

 dplyr::filter(!(lab\_nr == "Beta-307796" & c14\_age == 3550 & source\_db == "pardo")) %>%

 dplyr::filter(!(lab\_nr == "Beta-307797" & c14\_age == 3550 & source\_db == "pardo")) %>%

 dplyr::filter(!(lab\_nr == "Beta-315717" & c14\_age == 3980 & source\_db == "balsera")) %>%

 dplyr::filter(!(lab\_nr == "Beta-321414" & c14\_age == 3550 & source\_db == "pardo")) %>%

 dplyr::filter(!(lab\_nr == "Beta-321415" & c14\_age == 3550 & source\_db == "pardo")) %>%

 dplyr::filter(!(lab\_nr == "Beta-321416" & c14\_age == 3550 & source\_db == "pardo")) %>%

 dplyr::filter(!(lab\_nr == "Beta-321418" & c14\_age == 3550 & source\_db == "pardo")) %>%

 dplyr::filter(!(lab\_nr == "Beta-321419" & c14\_age == 3550 & source\_db == "pardo")) %>%

 dplyr::filter(!(lab\_nr == "Beta-321420" & c14\_age == 3550 & source\_db == "pardo")) %>%

 dplyr::filter(!(lab\_nr == "Beta-330866" & c14\_age == 10520 & source\_db == "14cpalaeolithic")) %>%

 dplyr::filter(!(lab\_nr == "Beta-58933" & c14\_age == 8790 & source\_db == "pardo")) %>%

 dplyr::filter(!(lab\_nr == "Beta-58934" & c14\_age == 6189 & source\_db == "pardo")) %>%

 dplyr::filter(!(lab\_nr == "Beta-61490" & c14\_age == 5580 & source\_db == "pardo")) %>%

 dplyr::filter(!(lab\_nr == "Beta-61490" & c14\_age == 5880 & source\_db == "drake")) %>%

 dplyr::filter(!(lab\_nr == "Beta-64940" & c14\_age == 4100 & source\_db == "balsera")) %>%

 dplyr::filter(!(lab\_nr == "Beta-72552" & c14\_age == 5000 & source\_db == "balsera")) %>%

 dplyr::filter(!(lab\_nr == "Beta-72553" & c14\_age == 5100 & source\_db == "balsera")) %>%

 dplyr::filter(!(lab\_nr == "Beta-74311" & c14\_age == 6180 & source\_db == "balsera")) %>%

 dplyr::filter(!(lab\_nr == "Beta-74313" & c14\_age == 6130 & source\_db == "balsera")) %>%

 dplyr::filter(!(lab\_nr == "Beta-75211" & c14\_age == 3710 & source\_db == "radonb")) %>%

 dplyr::filter(!(lab\_nr == "Beta-75214" & c14\_age == 5790 & source\_db == "balsera")) %>%

 dplyr::filter(!(lab\_nr == "Beta-75214" & c14\_age == 5970 & source\_db == "drake")) %>%

 dplyr::filter(!(lab\_nr == "Beta-79492" & c14\_age == 4790 & source\_db == "balsera")) %>%

 dplyr::filter(!(lab\_nr == "Beta-80602" & c14\_age == 5320 & source\_db == "balsera")) %>%

 dplyr::filter(!(lab\_nr == "Beta-83126" & c14\_age == 4029 & source\_db == "balsera")) %>%

 dplyr::filter(!(lab\_nr == "Beta-89286" & c14\_age == 6060 & source\_db == "balsera")) %>%

 dplyr::filter(!(lab\_nr == "Beta-90884" & c14\_age == 5920 & source\_db == "balsera")) %>%

 dplyr::filter(!(lab\_nr == "Bln-5050" & c14\_age == 312 & source\_db == "radon")) %>%

 dplyr::filter(!(lab\_nr == "BM-1450" & c14\_age == 12282 & source\_db == "pacea")) %>%

 dplyr::filter(!(lab\_nr == "BM-2275R" & c14\_age == 6440 & source\_db == "radon")) %>%

 dplyr::filter(!(lab\_nr == "BM-2276r" & c14\_age == 7840 & source\_db == "radon")) %>%

 dplyr::filter(!(lab\_nr == "BM-2347" & c14\_age == 4027 & source\_db == "radonb")) %>%

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 dplyr::filter(!(lab\_nr == "Ua-36209" & c14\_age == 6085 & source\_db == "pardo")) %>%

 dplyr::filter(!(lab\_nr == "Ua-37834" & c14\_age == 6090 & source\_db == "pardo")) %>%

 dplyr::filter(!(lab\_nr == "Ua-3903" & c14\_age == 3530 & source\_db == "balsera")) %>%

 dplyr::filter(!(lab\_nr == "Ua-39481" & c14\_age == 3511 & source\_db == "balsera")) %>%

 dplyr::filter(!(lab\_nr == "Ua-39867" & c14\_age == 4415 & source\_db == "balsera")) %>%

 dplyr::filter(!(lab\_nr == "Ua-4301" & c14\_age == 15615 & source\_db == "pacea")) %>%

 dplyr::filter(!(lab\_nr == "Ua-4821" & c14\_age == 6010 & source\_db == "balsera")) %>%

 dplyr::filter(!(lab\_nr == "UBAR-100" & c14\_age == 5100 & source\_db == "balsera")) %>%

 dplyr::filter(!(lab\_nr == "UBAR-209" & c14\_age == 4860 & source\_db == "pardo")) %>%

 dplyr::filter(!(lab\_nr == "UBAR-258" & c14\_age == 2380 & source\_db == "radonb")) %>%

 dplyr::filter(!(lab\_nr == "UBAR-274" & c14\_age == 5280 & source\_db == "pardo")) %>%

 dplyr::filter(!(lab\_nr == "UBAR-671" & c14\_age == 3305 & source\_db == "balsera")) %>%

 dplyr::filter(!(lab\_nr == "UBAR-673" & c14\_age == 3360 & source\_db == "radon")) %>%

 dplyr::filter(!(lab\_nr == "UBAR-698" & c14\_age == 3590 & source\_db == "balsera")) %>%

 dplyr::filter(!(lab\_nr == "UBAR-760" & c14\_age == 6405 & source\_db == "pardo")) %>%

 dplyr::filter(!(lab\_nr == "UBAR-760" & c14\_age == 6450 & source\_db == "drake")) %>%

 dplyr::filter(!(lab\_nr == "UBAR-865" & c14\_age == 3040 & source\_db == "balsera")) %>%

 dplyr::filter(!(lab\_nr == "UGRA-103" & c14\_age == 3470 & source\_db == "balsera")) %>%

 dplyr::filter(!(lab\_nr == "UGRA-107" & c14\_age == 3190 & source\_db == "eubar")) %>%

 dplyr::filter(!(lab\_nr == "UGRA-109" & c14\_age == 3440 & source\_db == "radonb")) %>%

 dplyr::filter(!(lab\_nr == "UGRA-155" & c14\_age == 3360 & source\_db == "radonb")) %>%

 dplyr::filter(!(lab\_nr == "UGRA-155" & c14\_age == 3450 & source\_db == "balsera")) %>%

 dplyr::filter(!(lab\_nr == "UGRA-164" & c14\_age == 3921 & source\_db == "radonb")) %>%

 dplyr::filter(!(lab\_nr == "UGRA-185" & c14\_age == 3930 & source\_db == "balsera")) %>%

 dplyr::filter(!(lab\_nr == "UGRA-19" & c14\_age == 3260 & source\_db == "balsera")) %>%

 dplyr::filter(!(lab\_nr == "UGRA-254" & c14\_age == 6160 & source\_db == "radon")) %>%

 dplyr::filter(!(lab\_nr == "UGRA-260" & c14\_age == 3530 & source\_db == "radonb")) %>%

 dplyr::filter(!(lab\_nr == "UGRA-306" & c14\_age == 3480 & source\_db == "balsera")) %>%

 dplyr::filter(!(lab\_nr == "UGRA-309" & c14\_age == 3990 & source\_db == "balsera")) %>%

 dplyr::filter(!(lab\_nr == "UGRA-326" & c14\_age == 3050 & source\_db == "balsera")) %>%

 dplyr::filter(!(lab\_nr == "UGRA-327" & c14\_age == 5160 & source\_db == "drake")) %>%

 dplyr::filter(!(lab\_nr == "Wk-13682" & c14\_age == 6185 & source\_db == "balsera")) %>%

 dplyr::filter(!(lab\_nr == "Wk-13692" & c14\_age == 6712 & source\_db == "pardo")) %>%

 dplyr::filter(!(lab\_nr == "Wk-14793" & c14\_age == 6737 & source\_db == "pardo")) %>%

 dplyr::filter(!(lab\_nr == "Wk-14794" & c14\_age == 6821 & source\_db == "pardo")) %>%

 dplyr::filter(!(lab\_nr == "Wk-14797" & c14\_age == 6860 & source\_db == "balsera")) %>%

 dplyr::filter(!(lab\_nr == "Wk-14797" & c14\_age == 6862 & source\_db == "mclaughlin")) %>%

 dplyr::filter(!(lab\_nr == "Wk-27995" & c14\_age == 4739 & source\_db == "balsera")) %>%

 dplyr::filter(!(lab\_nr == "Wk-28006" & c14\_age == 4775 & source\_db == "pardo")) %>%

 dplyr::filter(!(lab\_nr == "Wk-28008" & c14\_age == 4932 & source\_db == "pardo")) %>%

 dplyr::filter(!(lab\_nr == "Wk-28010" & c14\_age == 4765 & source\_db == "pardo")) %>%

 dplyr::filter(!(lab\_nr == "Wk-28635" & c14\_age == 5441 & source\_db == "balsera")) %>%

 dplyr::filter(!(lab\_nr == "Wk-8939" & c14\_age == 8580 & source\_db == "radon")) %>%

 dplyr::filter(!(lab\_nr == "Wk-8950" & c14\_age == 8640 & source\_db == "radon")) %>%

 dplyr::filter(!(lab\_nr == "Wk-8951" & c14\_age == 8400 & source\_db == "radon")) %>%

 dplyr::filter(!(lab\_nr == "Wk-9213" & c14\_age == 7370 & source\_db == "drake")) %>%

 dplyr::filter(!(lab\_nr == "Wk-9744" & c14\_age == 5753 & source\_db == "drake")) %>%

 dplyr::select(-duplicate) %>%

 dplyr::arrange(c14\_age, c14\_std, lab\_nr, latitude, longitude, source\_db)

gen\_site\_id <- dplyr::group\_indices(pop\_data\_dr4, latitude2, longitude2) #necessary for later binning of sites in SPD, used rounded coords

pop\_data\_dr4<- pop\_data\_dr4%>%

 dplyr::mutate(site\_id = gen\_site\_id) %>%

 dplyr::filter(c14\_std>0)

cleaned\_data\_all <- pop\_data\_dr4 %>% #Filter to approx dates required

 dplyr::filter(between(c14\_age, 1000, 15000)) %>%

 dplyr::mutate(calibration\_curve = dplyr::if\_else(material %in% c("Littorina l.",

 "Malacofauna",

 "mollusc",

 "P. vulgata shell B1 (Middle Mahgdalenian)",

 "shel from level 1Cm",

 "shell",

 "Shell",

 "Shell . Obusata",

 "shell from level 1 B M",

 "shell from level 1B P",

 "Shell, Littorina littorea",

 "shell, Patella vulgata"),

 "marine20", "intcal20")) %>%

 dplyr::mutate(calibration\_curve = dplyr::if\_else(is.na(material), "intcal20", calibration\_curve))

shell\_data <- cleaned\_data\_all %>% #Lots of manual searches here for offset values

 dplyr::filter(material %in% c("Littorina l.",

 "Malacofauna",

 "mollusc",

 "P. vulgata shell B1 (Middle Mahgdalenian)",

 "shel from level 1Cm",

 "shell",

 "Shell",

 "Shell . Obusata",

 "shell from level 1 B M",

 "shell from level 1B P",

 "Shell, Littorina littorea",

 "shell, Patella vulgata")) %>%

 dplyr::left\_join(dplyr::select(mclaughlin\_data\_4258, lab\_nr, Reservior, ReserviorError), by = "lab\_nr") %>%

 dplyr::rename(reservoir\_offset = Reservior, reservoir\_std = ReserviorError) %>%

 dplyr::select(!geometry) %>%

 dplyr::mutate(offset\_source = dplyr::if\_else(!is.na(reservoir\_offset),

 "McLaughlin, T.R., Gómez-Puche, M., Cascalheira, J., Bicho, N., Fernández-López de Pablo, J., 2021. Late Glacial and Early Holocene human demographic responses to climatic and environmental change in Atlantic Iberia. Philos. Trans. R. Soc. B Biol. Sci. 376, 20190724. https://doi.org/10.1098/rstb.2019.0724",

 "")) %>%

 dplyr::mutate(reservoir\_offset = dplyr::if\_else(site == "Santa Sofia", 95, reservoir\_offset)) %>% #Mannual search

 dplyr::mutate(reservoir\_std = dplyr::if\_else(site == "Santa Sofia", 15, reservoir\_std)) %>% #Mannual search

 dplyr::mutate(offset\_source = dplyr::if\_else(site == "Santa Sofia", "Soares, A. M. M.; Arruda, A. M., 2017.Cronologia de radiocarbono para a Idade do Ferro Orientalizante no território português. Uma leitura crítica dos dados arqueométricos e arqueológicos. In Barcleó, J. A.; Bogdanovic, I.; Morell, B., eds. - IberCrono 2016 Cronometrías Para la Historia de la Península Ibérica (Chronometry for the History of the Iberian Peninsula). Actas del Congrso de Cronometrias para la Historia de la Península Ibérica, Barcelona, 17-19 de octubre 2016. Barcelona: CEUR. pp. 235-259. http://hdl.handle.net/10451/30122",

 offset\_source)) %>% #Mannual search

 dplyr::mutate(reservoir\_offset = dplyr::if\_else(site %in% c("Alcalar (settlement)", "Alcalar 7", "Alcalar Monument 7") , 69, reservoir\_offset)) %>% #Mannual search

 dplyr::mutate(reservoir\_std = dplyr::if\_else(site %in% c("Alcalar (settlement)", "Alcalar 7", "Alcalar Monument 7"), 17, reservoir\_std)) %>% #Mannual search

 dplyr::mutate(offset\_source = dplyr::if\_else(site %in% c("Alcalar (settlement)", "Alcalar 7", "Alcalar Monument 7"), "Morán H., María E. 2015. El asentamiento prehistórico de Alcalar (Portimão, Portugal): la organización del territorio y el proceso de formación de un estado prístino en el tercer milenio A.N.E. (Tesis Doctoral Inédita). Universidad de Sevilla. https://hdl.handle.net/11441/73261",

 offset\_source)) %>% #Mannual search

 dplyr::mutate(reservoir\_offset = dplyr::if\_else(site == "Castro de Chibanes" , 95, reservoir\_offset)) %>% #Mannual search

 dplyr::mutate(reservoir\_std = dplyr::if\_else(site == "Castro de Chibanes", 15, reservoir\_std)) %>% #Mannual search

 dplyr::mutate(offset\_source = dplyr::if\_else(site == "Castro de Chibanes", "Silva, C.T. and Soares, J., 2014. O Castro de Chibanes (Palmela) e o tempo social do III milénio BC na Estremadura. Setúbal Arqueológica-II Encontro de Arqueologia da Arrábida. Homenagem a AI Marques da Costa, 15, pp.105-172.http://hdl.handle.net/10451/10914",

 offset\_source)) %>% #Mannual search

 dplyr::mutate(reservoir\_offset = dplyr::if\_else(site == "Magoito" & is.na(reservoir\_offset) , 95, reservoir\_offset)) %>% #Same as McLaughlin et al. 2021

 dplyr::mutate(reservoir\_std = dplyr::if\_else(site == "Magoito" & is.na(reservoir\_std), 15, reservoir\_std)) %>% #Same as McLaughlin et al. 2021

 dplyr::mutate(offset\_source = dplyr::if\_else(site == "Magoito" & offset\_source == "", "same site as within McLaughlin et al. 2021",

 offset\_source)) %>% #Same as McLaughlin et al. 2021

 dplyr::mutate(reservoir\_offset = dplyr::if\_else(site == "La Loma" , 22, reservoir\_offset)) %>% #Mannual search

 dplyr::mutate(reservoir\_std = dplyr::if\_else(site == "La Loma", 35, reservoir\_std)) %>% #Mannual search

 dplyr::mutate(offset\_source = dplyr::if\_else(site == "La Loma", "Aranda Jiménez, G., Cámalich Massieu, M.D., Martín Socas, D., Morgado, A., Martínez-Sevilla, F., Lozano, J., Rodríguez Rodríguez, A., Mancilla Cabello, M.I. and Román Punzón, J., 2012. La Loma (Íllora, Granada). Un yacimiento de fosas del VI-IV milenios cal. BC. Consejería de Cultura Junta de Andalucía, Sevilla. ISBN: 978-84-9959-105-6",

 offset\_source)) %>% #Mannual search

 dplyr::mutate(reservoir\_offset = dplyr::if\_else(site == "Pico Ramos" , -1, reservoir\_offset)) %>% #Mannual search

 dplyr::mutate(reservoir\_std = dplyr::if\_else(site == "Pico Ramos", 42, reservoir\_std)) %>% #Mannual search

 dplyr::mutate(offset\_source = dplyr::if\_else(site == "Pico Ramos", "Zapata, L., 2017. Level 4 of the cave of Pico Ramos (Muskiz, Bizkaia): excavation, stratigraphy, chronology and materials. In: Zapata, L., (ed.) The shell midden of Pico Ramos (Muskiz, Bizkaia): Humans on the Basque coast during the 6th and 5th millennium B.C. Trrres , Bilbao , pp. 1-514. ISBN: 978-84-617-8618-3",

 offset\_source)) %>% #Mannual search

 dplyr::mutate(reservoir\_offset = dplyr::if\_else(lab\_nr %in% c("QAM-85B2b", "Wk-28050"), 140, reservoir\_offset)) %>% #Same as McLaughlin et al. 2021

 dplyr::mutate(reservoir\_std = dplyr::if\_else(lab\_nr %in% c("QAM-85B2b", "Wk-28050"), 40, reservoir\_std)) %>% #Same as McLaughlin et al. 2021

 dplyr::mutate(offset\_source = dplyr::if\_else(lab\_nr %in% c("QAM-85B2b", "Wk-28050"), "same site as within McLaughlin et al. 2021",

 offset\_source)) %>% #Same as McLaughlin et al. 2021

 dplyr::mutate(reservoir\_offset = dplyr::if\_else(lab\_nr %in% c("Wk-17029", "Wk-6075"), -116, reservoir\_offset)) %>% #Same as McLaughlin et al. 2021

 dplyr::mutate(reservoir\_std = dplyr::if\_else(lab\_nr %in% c("Wk-17029", "Wk-6075"), 40, reservoir\_std)) %>% #Same as McLaughlin et al. 2021

 dplyr::mutate(offset\_source = dplyr::if\_else(lab\_nr %in% c("Wk-17029", "Wk-6075"), "same site as within McLaughlin et al. 2021",

 offset\_source)) %>% #Same as McLaughlin et al. 2021

 dplyr::mutate(reservoir\_offset = dplyr::if\_else(lab\_nr == "ICEN-873" , 69, reservoir\_offset)) %>% #Mannual search

 dplyr::mutate(reservoir\_std = dplyr::if\_else(lab\_nr == "ICEN-873" , 17, reservoir\_std)) %>% #Mannual search

 dplyr::mutate(offset\_source = dplyr::if\_else(lab\_nr == "ICEN-873" , "Morán H., María E. 2015. El asentamiento prehistórico de Alcalar (Portimão, Portugal): la organización del territorio y el proceso de formación de un estado prístino en el tercer milenio A.N.E. (Tesis Doctoral Inédita). Universidad de Sevilla. https://hdl.handle.net/11441/73261",

 offset\_source)) %>% #Mannual search

 dplyr::mutate(reservoir\_offset = dplyr::if\_else(lab\_nr == "ICEN-645" , 69, reservoir\_offset)) %>% #same site as Morán H. and María E. 2015

 dplyr::mutate(reservoir\_std = dplyr::if\_else(lab\_nr == "ICEN-645" , 17, reservoir\_std)) %>% #same site as Morán H. and María E. 2015

 dplyr::mutate(offset\_source = dplyr::if\_else(lab\_nr == "ICEN-645" , "#same site as within Morán H. and María E. 2015 ",

 offset\_source)) %>% #same site as Morán H. and María E. 2015

 dplyr::mutate(reservoir\_offset = dplyr::if\_else(lab\_nr == "Beta-168461", -110, reservoir\_offset)) %>% #Same as McLaughlin et al. 2021

 dplyr::mutate(reservoir\_std = dplyr::if\_else(lab\_nr == "Beta-168461", 40, reservoir\_std)) %>% #Same as McLaughlin et al. 2021

 dplyr::mutate(offset\_source = dplyr::if\_else(lab\_nr == "Beta-168461", "same site as within McLaughlin et al. 2021",

 offset\_source)) %>% #Same as McLaughlin et al. 2021

 dplyr::mutate(reservoir\_offset = dplyr::if\_else(site == "Cierro" , -117, reservoir\_offset)) %>% #Mannual search

 dplyr::mutate(reservoir\_std = dplyr::if\_else(site == "Cierro", 70, reservoir\_std)) %>% #Mannual search

 dplyr::mutate(offset\_source = dplyr::if\_else(site == "Cierro", "Álvarez-Fernández, E., Bécares, J., Pardo, J.F.J., Agirre-Uribesalgo, A., Álvarez-Alonso, D., Aparicio, M.T., Barrera-Mellado, I., Carral, P., Carriol, R.P., Cubas, M. and Cueto, M., 2020. Palaeoenvironmental and chronological context of human occupations at El Cierro cave (Northern Spain) during the transition from the late Upper Pleistocene to the early Holocene. Journal of Archaeological Science: Reports, 29, p.102138. https://doi.org/10.1016/j.jasrep.2019.102138",

 offset\_source)) %>% #Mannual search

 dplyr::mutate(reservoir\_offset = dplyr::if\_else(site == "Cova Rosa" , -117, reservoir\_offset)) %>% #Mannual search

 dplyr::mutate(reservoir\_std = dplyr::if\_else(site == "Cova Rosa", 70, reservoir\_std)) %>% #Mannual search

 dplyr::mutate(offset\_source = dplyr::if\_else(site == "Cova Rosa", "Álvarez-Fernández, E., Jordá Pardo, J. F., Arias, P., Bécares, J., Martín-Jarque, S., Portero, R., Teira, L. and Douka, K. (2021) “RADIOCARBON DATES FOR THE LATE PLEISTOCENE AND EARLY HOLOCENE OCCUPATIONS OF COVA ROSA (RIBADESELLA, ASTURIAS, SPAIN),” Radiocarbon. Cambridge University Press, 63(3), pp. 1053–1072. doi: 10.1017/RDC.2021.18. https://doi.org/10.1017/RDC.2021.18",

 offset\_source)) %>% #Mannual search

 dplyr::mutate(reservoir\_offset = dplyr::if\_else(is.na(reservoir\_offset), -9999, reservoir\_offset))

rio::export(shell\_data, "other\_output/marine.xlsx") #Reference information for marine offset information

shell\_data\_sf <- shell\_data %>%

 sf::st\_as\_sf(coords = c("longitude", "latitude"), crs = 4258, agr = "constant") %>%

 dplyr::filter(reservoir\_offset > -9999)

radio\_citation <- dplyr::tribble(

 ~dataset, ~dataset\_citation,

 "14cpalaeolithic", "Vermeersch, P.M., 2020. Radiocarbon Palaeolithic Europe database: A regularly updated dataset of the radiometric data regarding the Palaeolithic of Europe, Siberia included. Data Br. 31, 105793. https://doi.org/10.1016/j.dib.2020.105793",

 "balsera", "Balsera, V., Díaz-del-Río, P., Gilman, A., Uriarte, A., Vicent, J.M., 2015. Approaching the demography of late prehistoric Iberia through summed calibrated date probability distributions (7000–2000 cal BC). Quat. Int. 386, 208–211. https://doi.org/10.1016/j.quaint.2015.06.022",

 "drake", "Drake, B.L., Blanco-González, A., Lillios, K.T., 2017. Regional Demographic Dynamics in the Neolithic Transition in Iberia: Results from Summed Calibrated Date Analysis. J. Archaeol. Method Theory 24, 796–812. https://doi.org/10.1007/s10816-016-9286-y",

 "eubar", "Capuzzo, G., Boaretto, E., Barceló, J.A., 2014. EUBAR: A Database of 14 C Measurements for the European Bronze Age. A Bayesian Analysis of 14 C-Dated Archaeological Contexts from Northern Italy and Southern France. Radiocarbon 56, 851–869. https://doi.org/10.2458/56.17453",

 "euroevol", "Manning, K., Colledge, S., Crema, E.R., Shennan, S., Timpson, A., 2016. The Cultural Evolution of Neolithic Europe. EUROEVOL Dataset 1: Sites, Phases and Radiocarbon Data. J. Open Archaeol. Data 5. https://doi.org/10.5334/joad.40",

 "mclaughlin", "McLaughlin, T.R., Gómez-Puche, M., Cascalheira, J., Bicho, N., Fernández-López de Pablo, J., 2021. Late Glacial and Early Holocene human demographic responses to climatic and environmental change in Atlantic Iberia. Philos. Trans. R. Soc. B Biol. Sci. 376, 20190724. https://doi.org/10.1098/rstb.2019.0724",

 "pacea", "d’Errico, F., Banks, W.E., Vanhaeren, M., Laroulandie, V., Langlais, M., 2011. PACEA geo-referenced radiocarbon database. PaleoAnthropology 2011, 1–12. https://doi.org/doi:10.4207/PA.2011.ART40",

 "pardo", "Pardo-Gordó, S., García Puchol, O., Bernabeu Aubán, J., Diez Castillo, A., 2019. Timing the Mesolithic-Neolithic Transition in the Iberian Peninsula: The Radiocarbon Dataset. J. Open Archaeol. Data 7. https://doi.org/10.5334/joad.49",

 "radon", "Hinz, M., Furholt, M., Müller, J., Rinne, C., Raetzel-Fabian, D., Sjögren, K.-G., Wotzka, H.-P., 2012. RADON - Radiocarbon dates online 2012. Central European database of 14C dates for the Neolithic and the Early Bronze Age. J. Neolit. Archaeol. 0. https://doi.org/10.12766/jna.2012.65",

 "radonb", "Kniesel, J., Hinz, M., Rinne, C., 2014. Radon-B. In: http://radon-b.ufg.uni-kiel.de."

)

cleaned\_data <- cleaned\_data\_all %>%

 dplyr::left\_join(dplyr::select(shell\_data, db\_code, reservoir\_offset, reservoir\_std), by = "db\_code") %>%

 dplyr::mutate(reservoir\_offset = ifelse(is.na(reservoir\_offset), 0, reservoir\_offset)) %>%

 dplyr::mutate(reservoir\_std = ifelse(is.na(reservoir\_std), 0, reservoir\_std)) %>%

 dplyr::filter(reservoir\_offset > -9999) %>%

 dplyr::mutate(reservoir\_offset = as.numeric(reservoir\_offset)) %>%

 dplyr::mutate(reservoir\_std = as.numeric(reservoir\_std)) %>%

 dplyr::mutate(period = dplyr::if\_else(period %in% c("Neolítico", #This is a bit back to front, but for the purposes of generating a file in pub, best way to go

 "Ferro I A",

 "Ferro I",

 "Ferro I B",

 "Bronze final A",

 "Bronce",

 "Antic",

 "Adlerberg Gruppe",

 "Calcolítico",

 "Spätchalkolithikum",

 "Bošáca Group",

 "Chalkolithikum spät",

 "Frühchalkolithikum",

 "Neolithic",

 "UN"), "Neolithic", NA\_character\_)) %>%

 dplyr::arrange(c14\_age, c14\_std, lab\_nr) %>%

 dplyr::rename(neolithic\_tag = period) %>%

 dplyr::rename(dataset = source\_db) %>%

 dplyr::left\_join(radio\_citation, by = "dataset")

radiocarbon\_data <- cleaned\_data %>%

 dplyr::select(c14\_age,

 c14\_std,

 longitude,

 latitude,

 lab\_nr,

 site,

 site\_id,

 material,

 neolithic\_tag,

 elevation,

 calibration\_curve,

 reservoir\_offset,

 reservoir\_std,

 dataset,

 dataset\_citation)

cleaned\_data\_sites <- length(unique(cleaned\_data$site\_id))

rio::export(radiocarbon\_data, "other\_output/pop/radiocarbon\_data.csv") #This is the clean data used for analysis