Archived Soil Incubations Project

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Notes:

- This workbook is intended to load and prepare the key data for analysis for the archive incubation project.
- in general, this is an updated version of script "./src/arc_inc_master.R"
- all code chunk options are set to "echo = FALSE"; see raw .Rmd file for data wrangling code.

CO$_2$ fluxes and soil data

1. Load flux data from air-dry + storage control samples, and convert from "wide" to "long" format so as to match other data.

2. Load flux data from air-dry + storage samples and from air-dry experiment (ctl & treatment), C & N data for all the Exploratories samples (measured in 2011), and soil mass and moisture data for all experiments.

3. Combine and summarize data in long format to calculate respiration rates and plot over time.

4. Plot of CO$_2$ fluxes over time. Note that the final measurement points for a few samples which took >18 days to reach CO$_2$ targets are excluded for display reasons. Respiration rates for those samples remained flat.

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## Warning: Removed 7 rows containing missing values (geom_path).
```
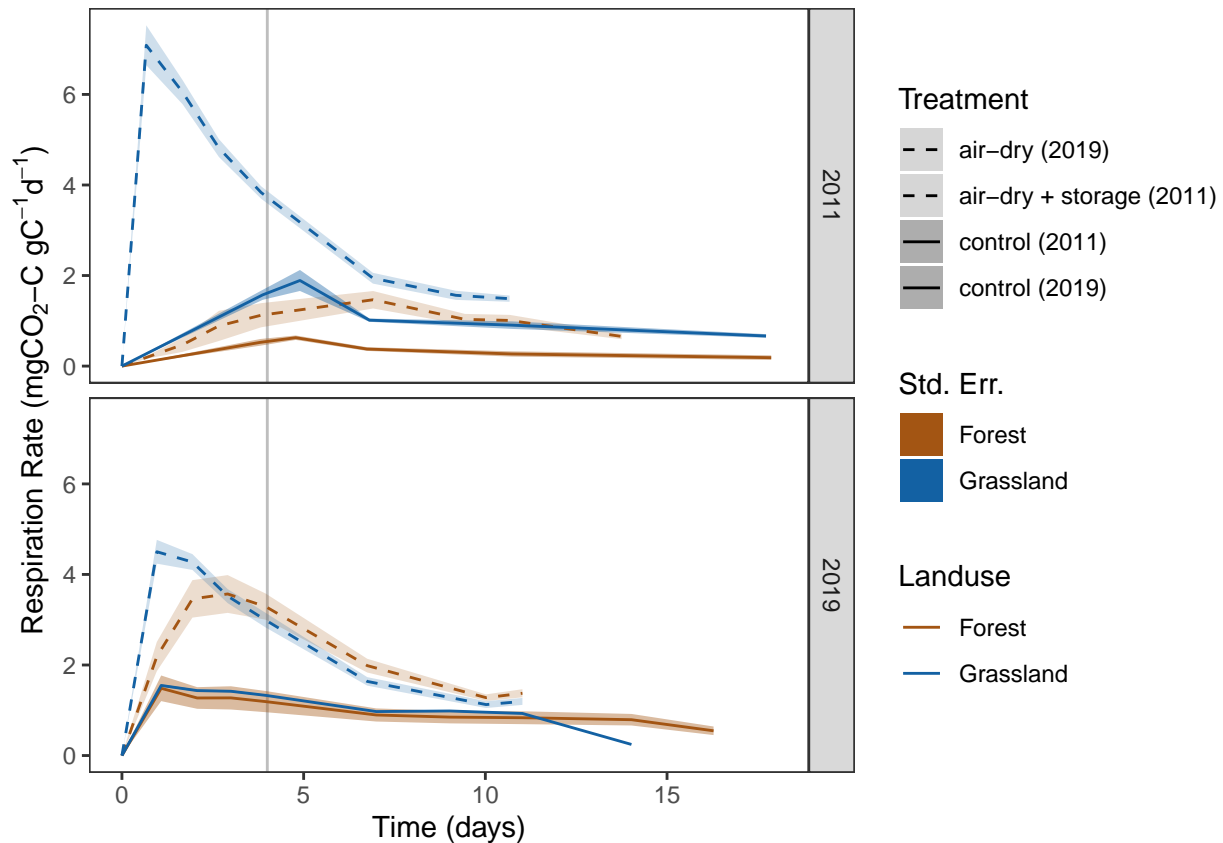
Isotope data

1. Read in isotope data from various sources. First load helper function 'read_jena_ams_results.R"

2. Next read in data from the appropriate directories in 'data/raw'.

3. Create a "tidy" style template for the data, i.e. variables in columns.

- Key variables are as follows:
  - SampleName (incorporates lab rep and treatment, e.g. "HEG10-1_dry")
  - ID (plot IDs, e.g. for "HEG10" for Exploratory samples)
  - Treatment (3 treatments: air-dry, air-dry + storage, storage duration; + controls)
  - Type (2 levels: F = forest, G = grassland)
  - Period (incubation period, 2 levels: pre = preincubation, inc = equilibrium incubation)
  - Experiment (3 levels: arc = air-dry + storage, rewet = air-dry/rewet, time = storage duration)
- Observational columns include:
  - d14c (Δ^{14}C-CO_2)
  - d13c (δ^{13}C-CO_2)
  - C_g_kg (C content)
  - dw_g (dry weight)
  - mgCO2.C_gS (mg CO_2-C respired g^{-1} soil Period^{-1})
  - time_d (days in incubation period prior to measurement)
  - h2o_grav (gravimetric water content, percent)
  - h2o_whc_field (percent of water holding capacity, field-moist)

4. Summarize observational data from timeseries data by unique IDs (SampleName).

5. Create helper functions for decay correction, converting $\Delta^{14}C$ to fraction modern, and cleaning up extraneous values in raw ^{14}C data. Archived sample $\Delta^{14}C$ data should to be corrected for decay since the year of collection. (Although the correction is very small and likely insignificant, I will do it anyway).

- decay correction formula is:

$$1000 \cdot \left((FM \cdot e^{\frac{-year_{sampled}+1950}{8267}}) - 1 \right)$$

6. Clean up ^{14}C data.

7. Combine data.

8. Count number of ^{14}C observations for checking plots.

9. Plot pre-incubation period $\Delta^{14}C$ against equilibrium respiration period $\Delta^{14}C$.

- Relative outlier point is the very negative (mean = -51.1‰) HEW22 pre-incubation control samples from the 2019 air-dry experiment.
- Data from both experiments plotted together, i.e. "treatment" = air-dry/air-dry + storage
- Pre-incubation $\Delta^{14}C$ was not measured for the 2011 control samples.
- Samples from three of the forest plots of the 2011 treatment samples failed to accumulate enough CO_2 to measure ^{14}C.

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Warning: Removed 15 rows containing missing values (geom_errorbar).

Warning: Removed 15 rows containing missing values (geom_errorbarh).
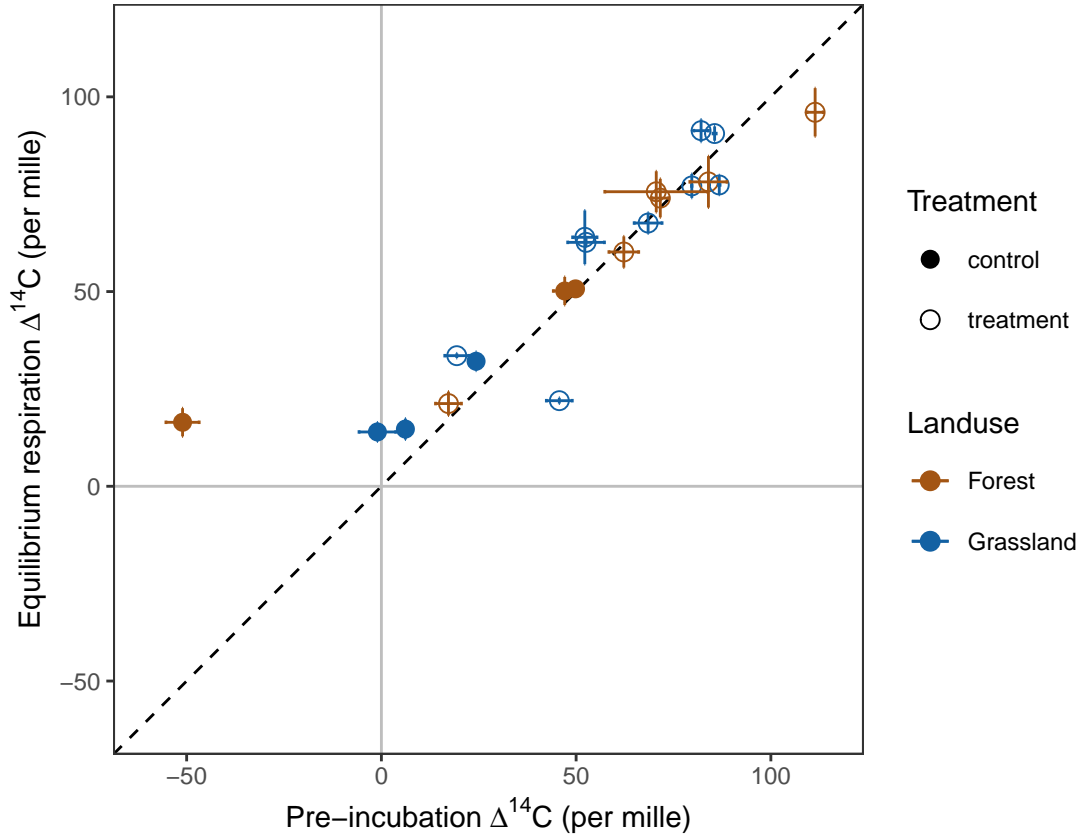
10. Plot $\Delta^{14}C$ against proportion of soil C respired by experiment, land cover, and sampling period.

- Note that data are first shown averaged by plot (Fig. 1), and then averaged by land use and treatment within sampling periods (Fig. 2)
- Pre-incubation $\Delta^{14}C$ was not measured for the 2011 control samples.
- Outlier data excluded (HEW22 control pre-incubation)

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## Warning: Removed 14 rows containing missing values (geom_point).
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## Warning: Removed 9 rows containing missing values (geom_path).
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## Warning: Removed 14 rows containing missing values (geom_errorbar).
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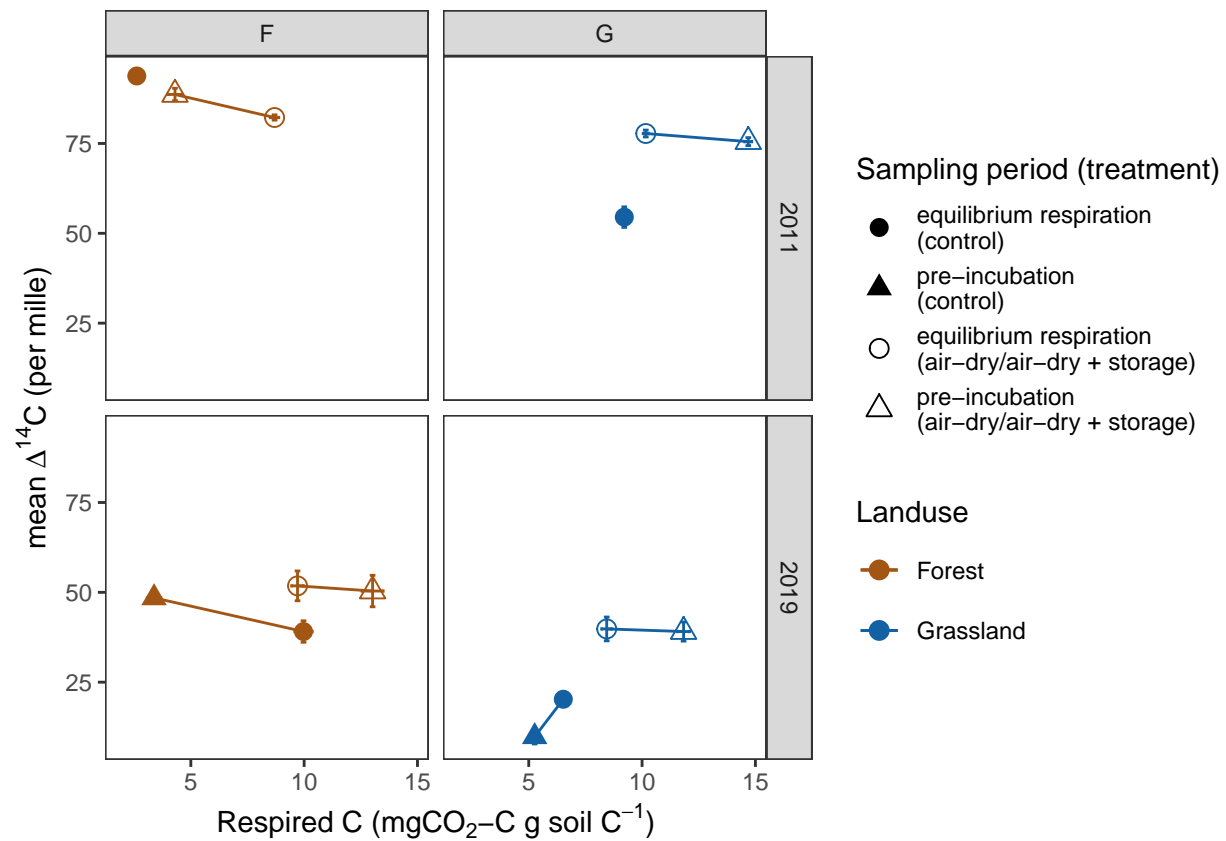
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## Warning: Removed 2 rows containing missing values (geom_point).
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## Warning: Removed 2 rows containing missing values (geom_errorbar).
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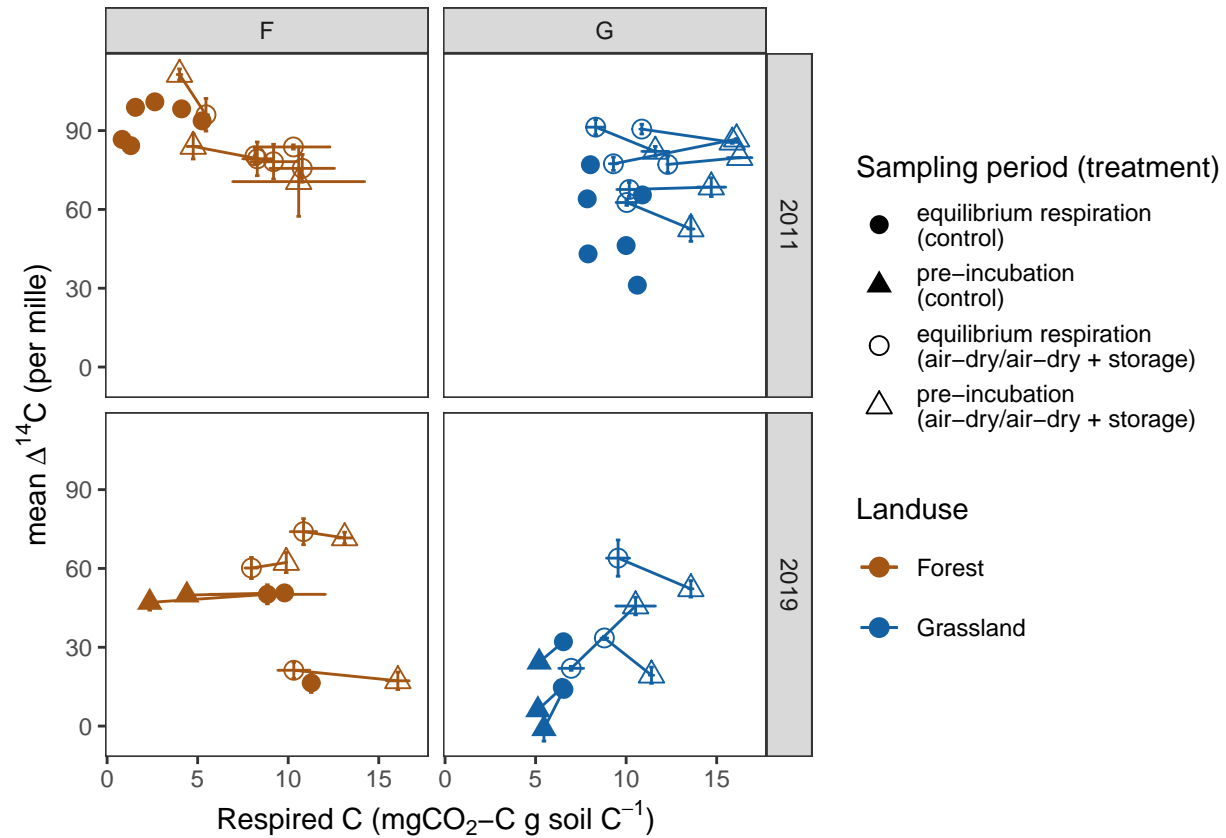
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11. Same plot as in step 10, but including outlier data.

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