Data management: visualisation and interpretation

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Stable Isotope Ecology Short Course

The isoplot: look at the variability between different sample groups

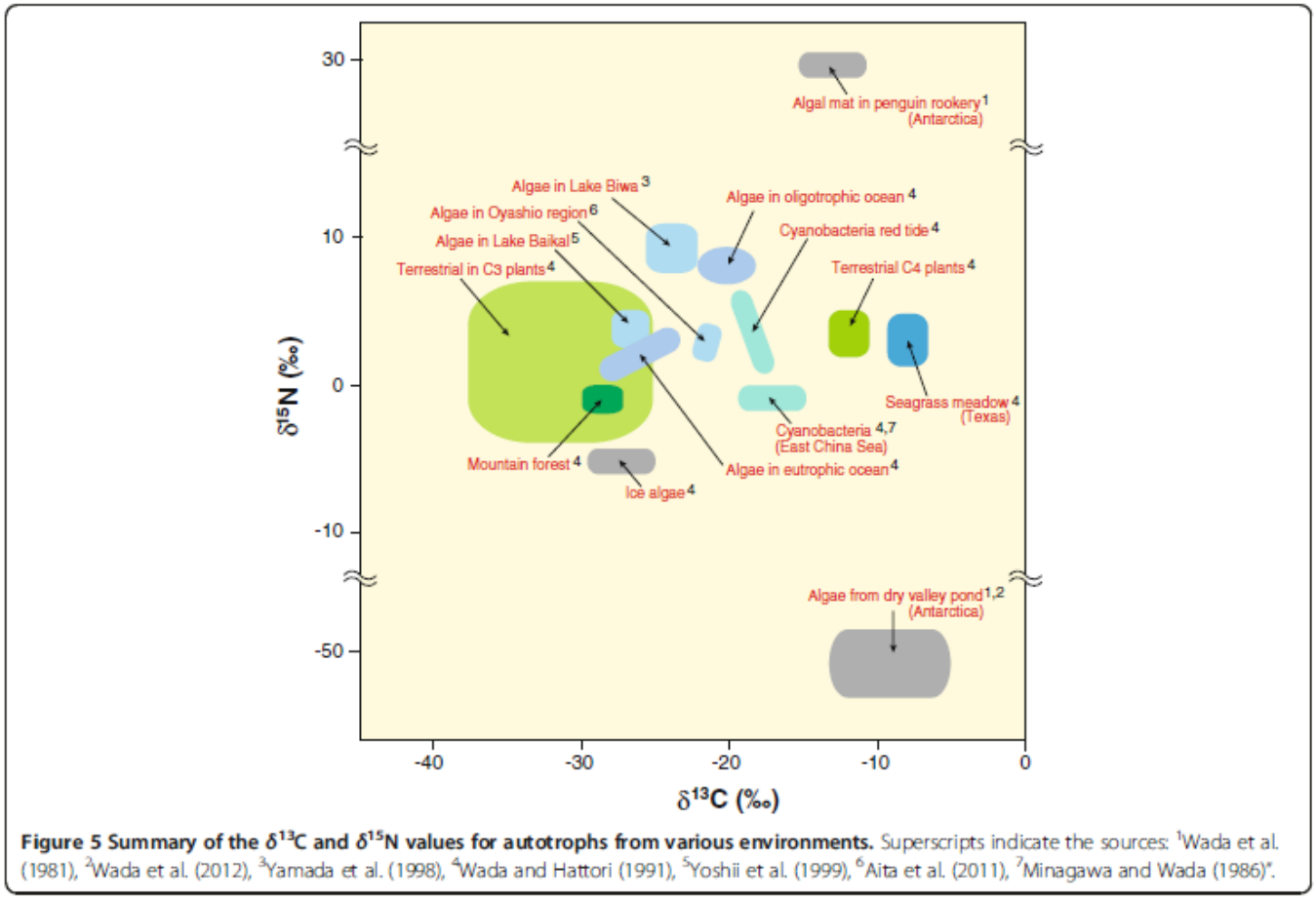
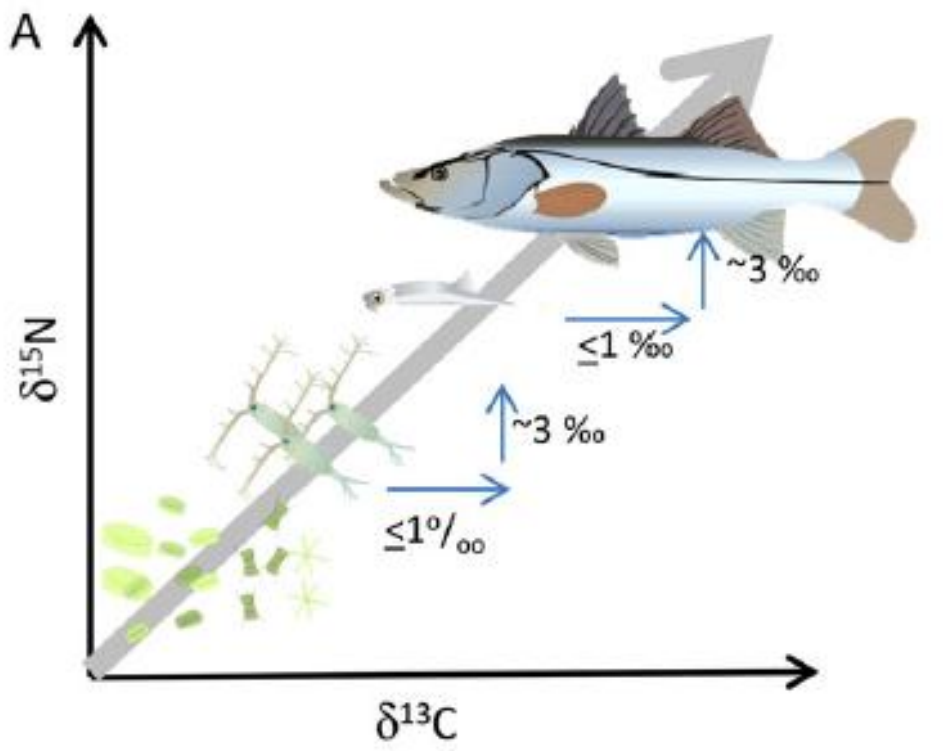


Figure 5 Summary of the $\delta^{13}C$ and $\delta^{15}N$ values for autotrophs from various environments. Superscripts indicate the sources: [1]Wada et al. (1981), [2]Wada et al. (2012), [3]Yamada et al. (1998), [4]Wada and Hattori (1991), [5]Yoshii et al. (1999), [6]Aita et al. (2011), [7]Minagawa and Wada (1986)*.

Ohkouchi et al., 2014

The isoplot: trophic interactions



Glibert at al., 2018

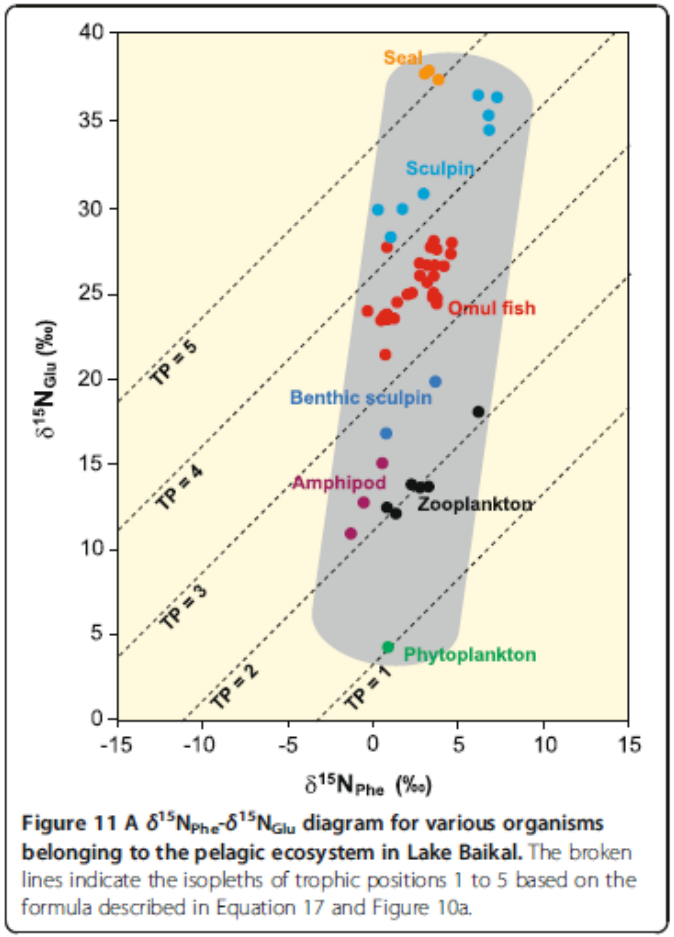
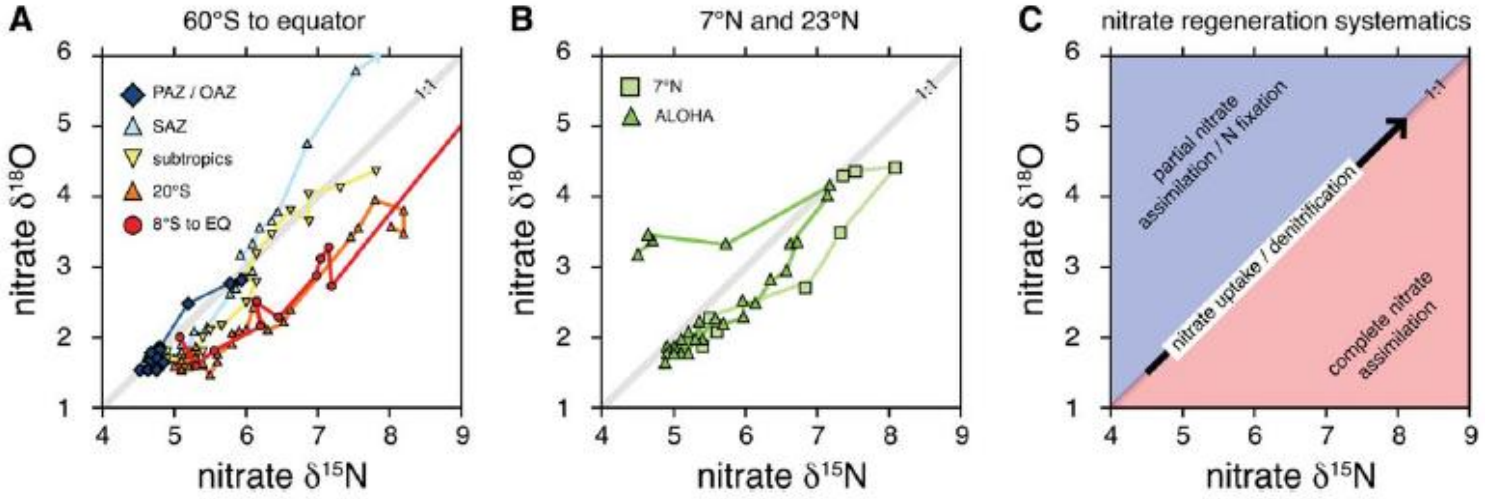


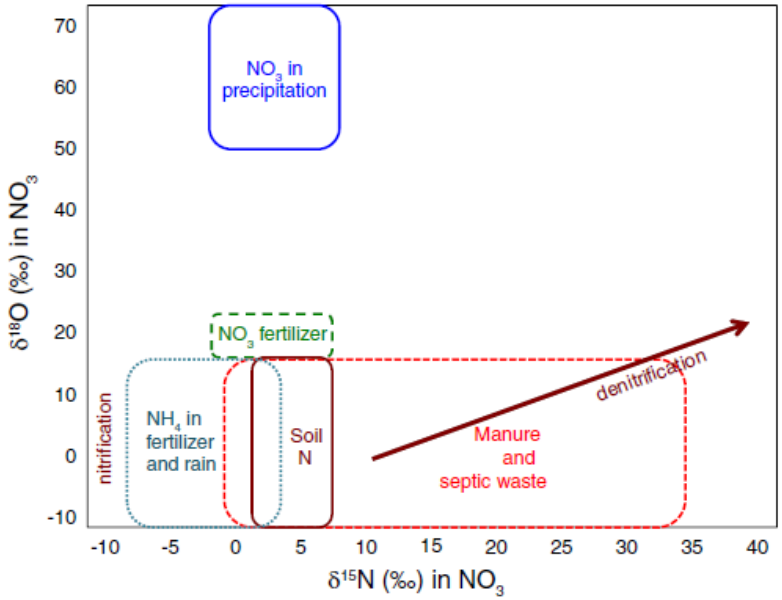
Figure 11 A $\delta^{15}N_{Phe}$-$\delta^{15}N_{Glu}$ diagram for various organisms belonging to the pelagic ecosystem in Lake Baikal. The broken lines indicate the isopleths of trophic positions 1 to 5 based on the formula described in Equation 17 and Figure 10a.

Ohkouchi et al., 2014

The isoplot: Biochemical processes

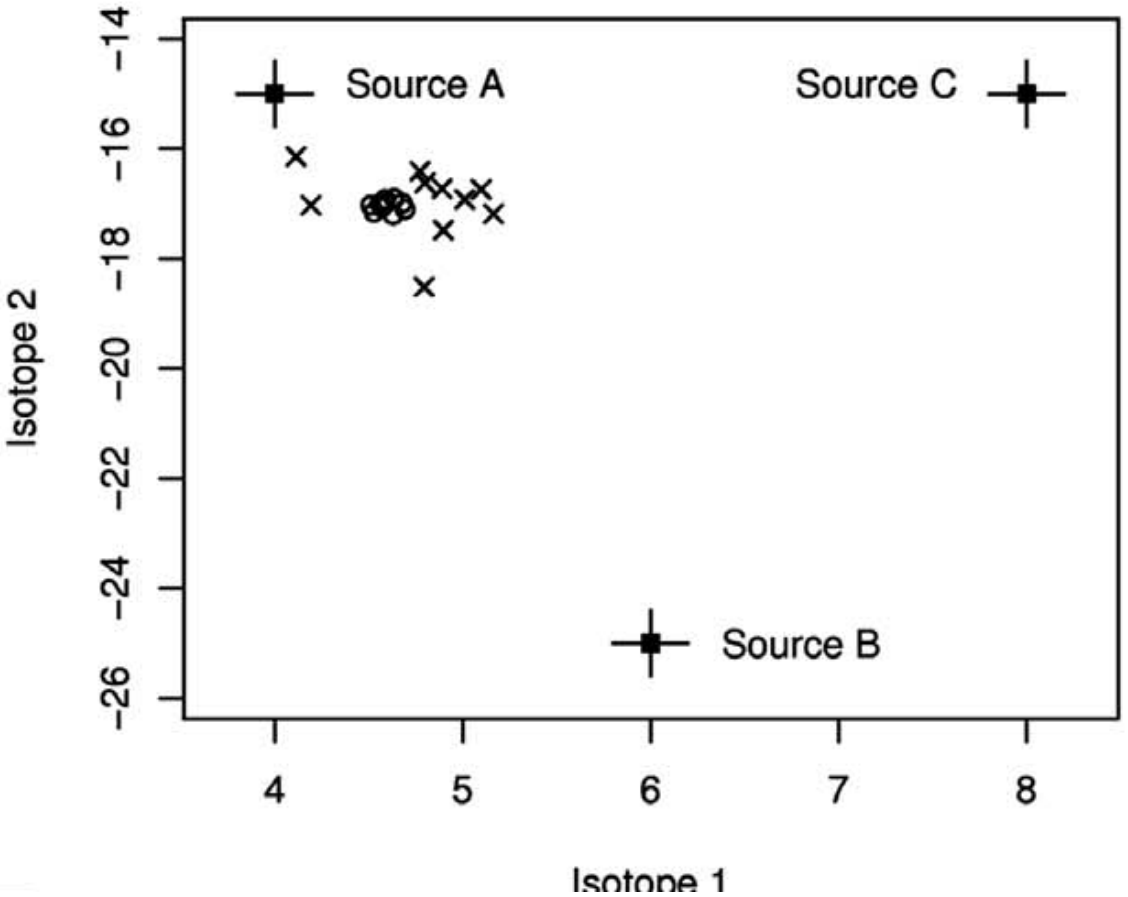


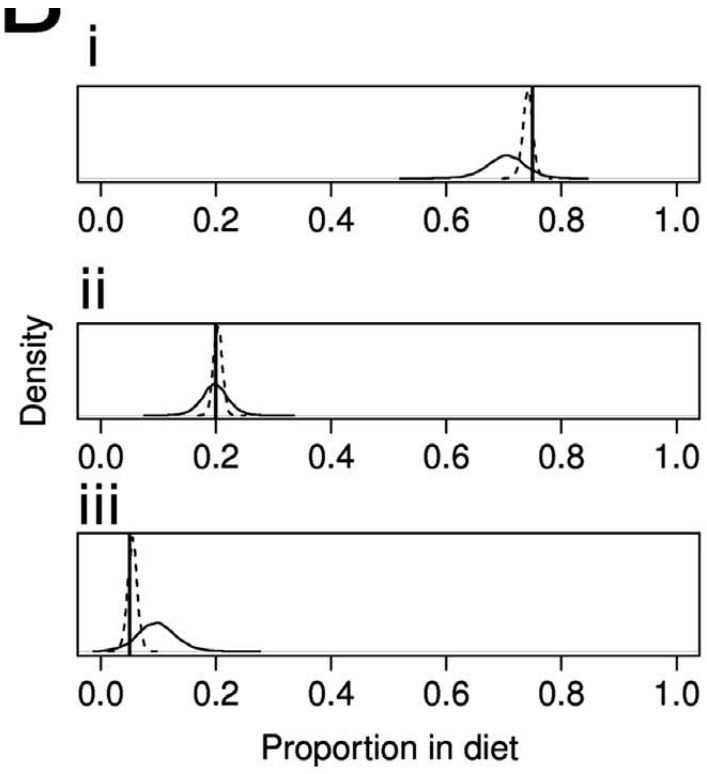
Rafter et al. 2013



Glibert at al., 2018

The isoplot: source partitioning





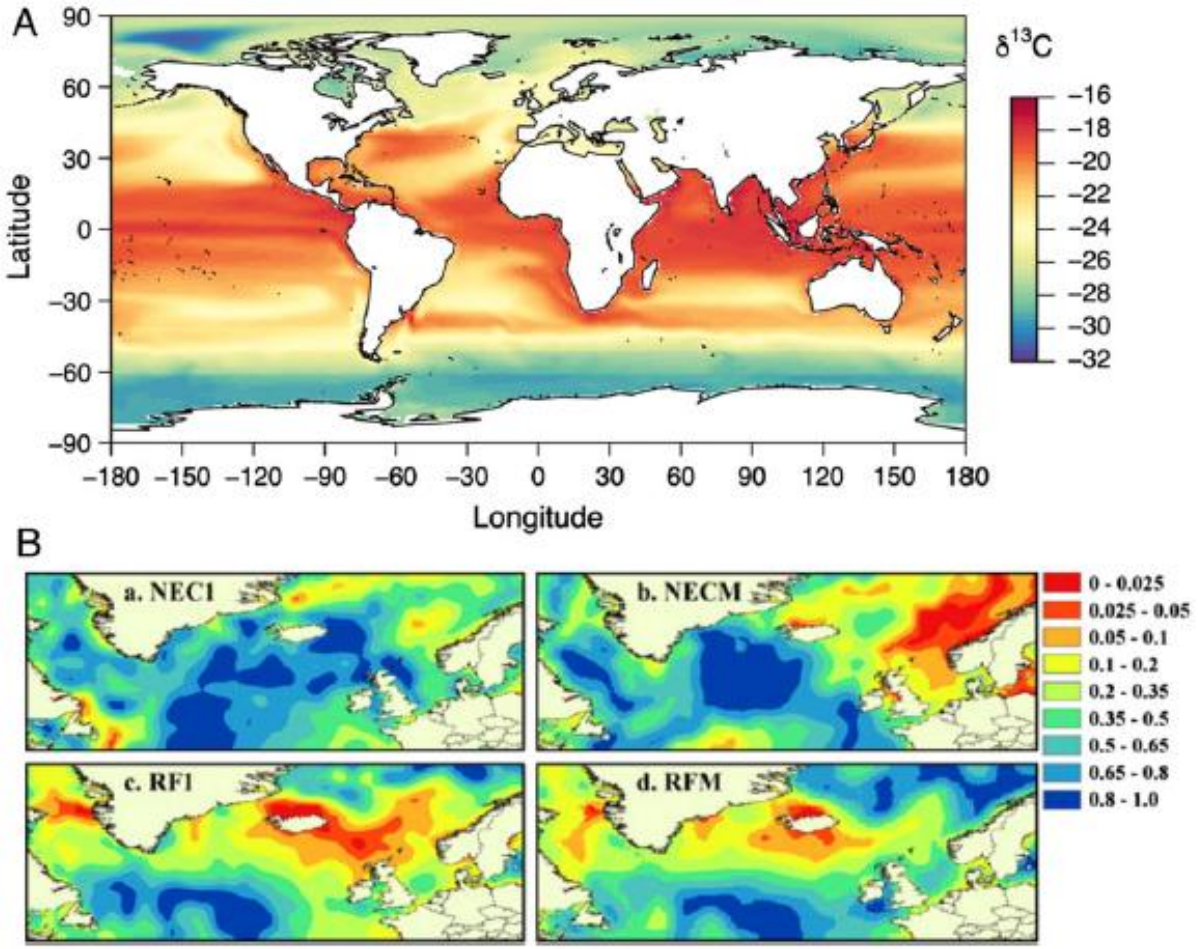
(Parnell et al., 2014)

Let’s look at some data

- Open the file: “Data_visualisation.xlsx”
- It has:
  - Nitrate N and O isotope date
  - Suspended matter C, N, S isotope data
  - Auxiliary data (site name, coordinates, depth and concentration)

- Task: make some isoplots. Which one looks most interesting?

The isoscape



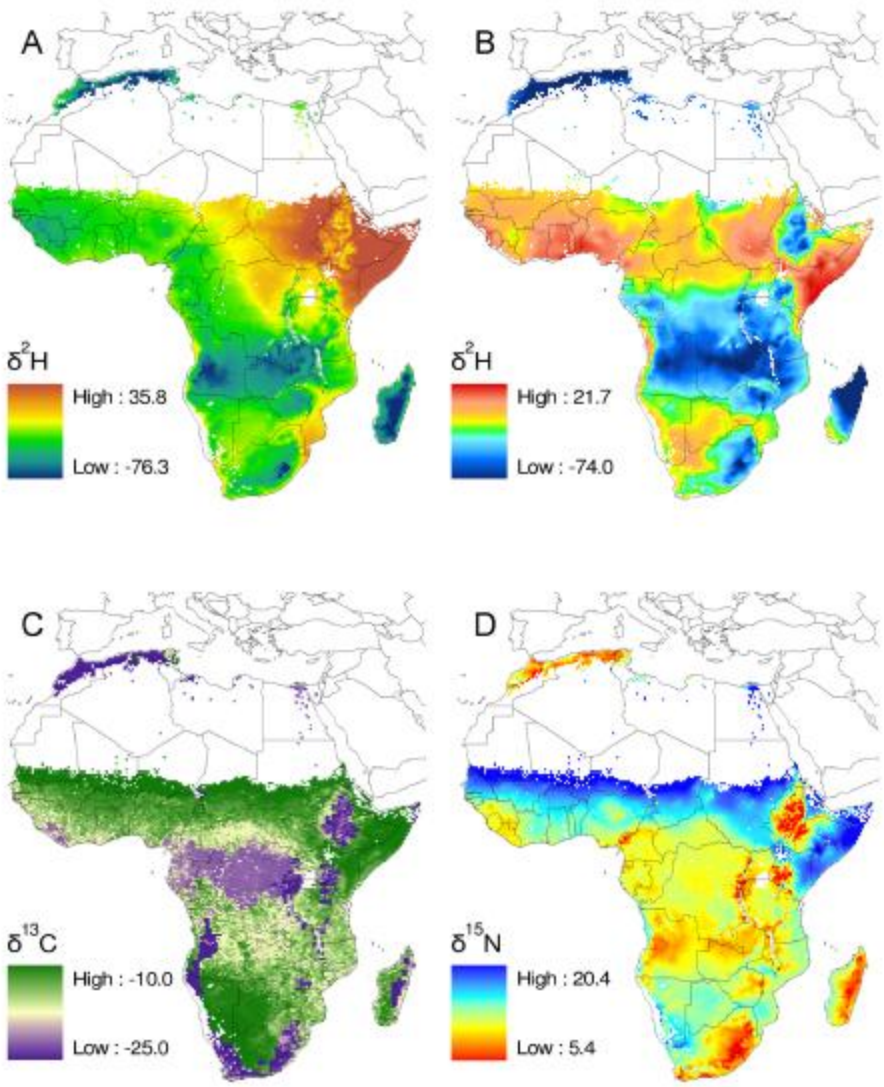
Phytoplankton $\delta^{13}C$

Proposed feeding areas for Atlantic salmon populations

Fig. 7. (**A**) Modeled annually averaged surface-water distribution of the carbon isotope composition of phytoplankton ($\delta^{13}C_{PLK}$, ‰). Annual average $\delta^{13}C_{PLK}$ values are calculated using a monthly climatology for the period 2001–2010. (**B**) Proposed feeding areas for two Atlantic salmon populations indicated by the strength of correlation between temporal records of sea surface temperature and scale collagen $\delta^{13}C$ values. Each map represents feeding areas for a specific population and cohort: (a) North East Coast 1SW, (b) North East Coast MSW, (c) River Frome 1SW, and (d) River Frome MSW. Panel **A** reproduced from Magozzi et al. 2017) and panel **B** from MacKenzie et al. (2011) under creative commons licenses.

Glibert at al., 2018

The isoscape



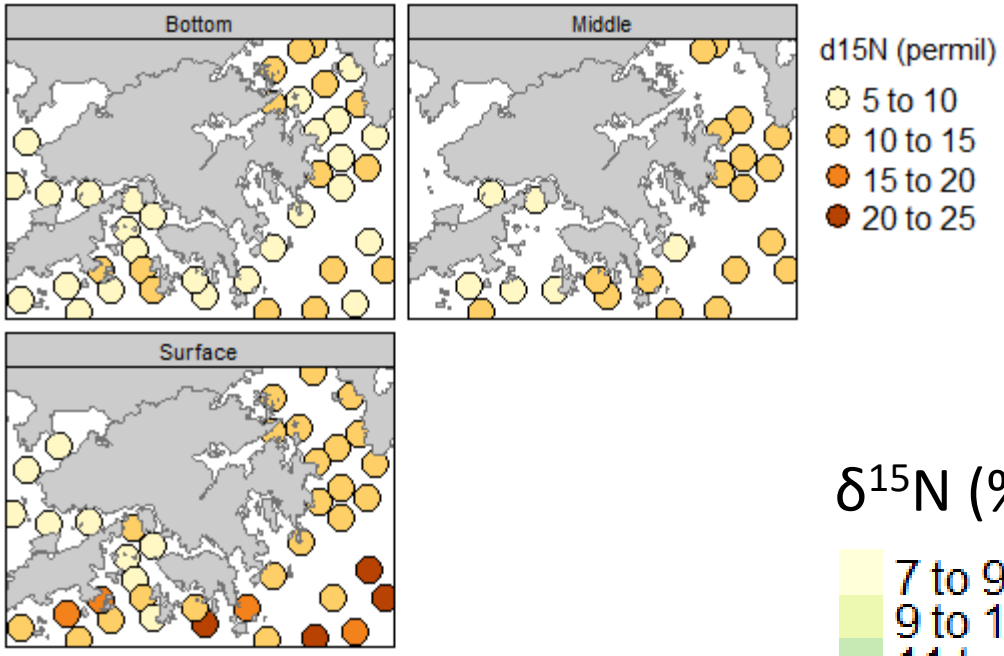
δ^2H, $\delta^{13}C$, and $\delta^{15}N$ isoscapes for feathers grown in Africa

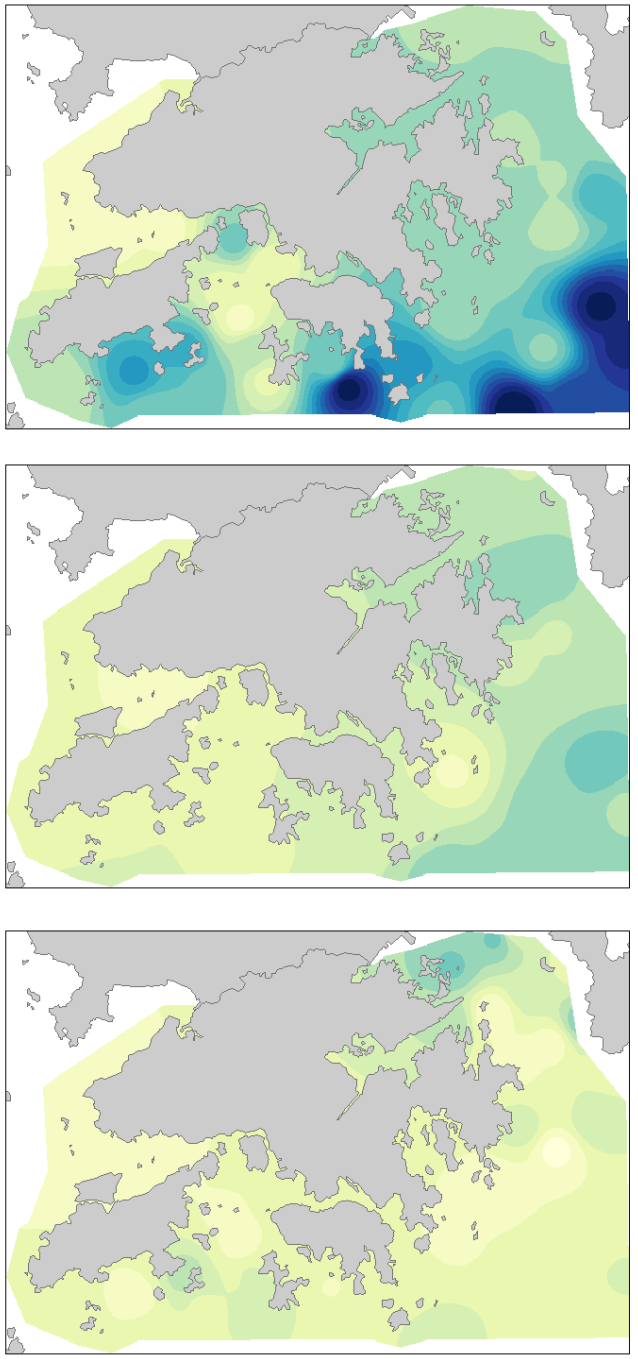
Fig. 2. d2H, d13C, and d15N isoscapes for feathers grown in Africa. Portrayed are (A) Feather d2H isoscape calibrated from amount-weighted growing-season d2H in precipitation; (B) Feather d2H isoscape calibrated from amount-weighted d2H in precipitation during the three months of highest precipitation (Dec–Feb); (C) predicted d13C in feathers calibrated from the isoscape of Still and Powell (2010) by assuming +2% discrimination from plants to feather; and (D) predicted feather d15N isoscape constructed by applying a discrimination of +4% to the isoscape of Craine et al. (2009).

Let’s look at some data

- Open the file: “Data_visualisation.xlsx”
- Unfortunately, Excel can’t color data points based on value.
- Plot the latitude (y-axis) and longitude (x-axis) to see the distribution of the samples
- Plot $\delta^{18}O$ as a function of longitude (east-west gradient)

It works better in R





Is variation due to mixing or processes?

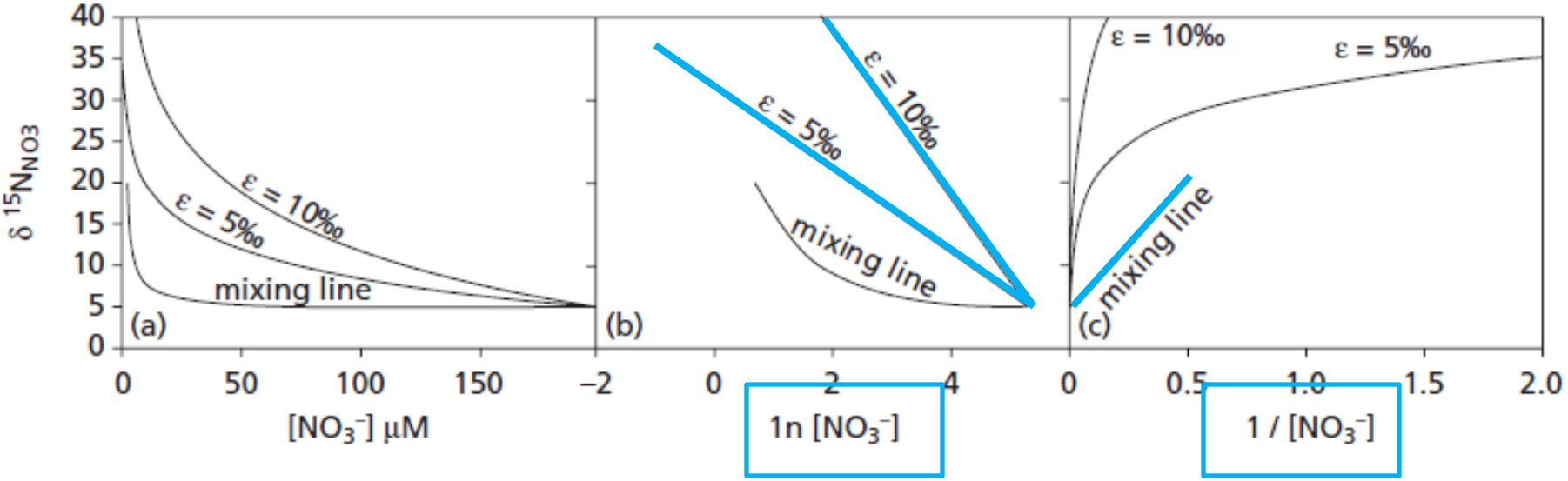
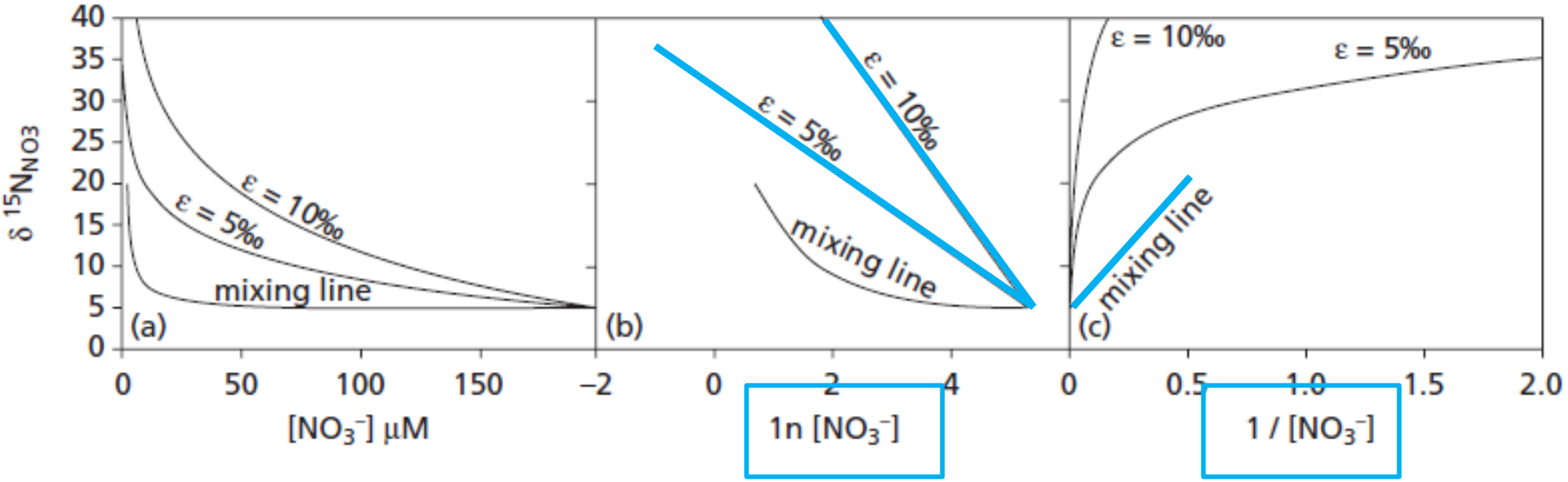


Figure 12.6 The curves on a plot of $\delta^{15}N$ vs. NO_3 (a) resulting from mixing of two sources of nitrate with different concentrations, can be distinguished from the curves resulting from denitrification with two different fractionations by plotting $\delta^{15}N$ vs. $\ln NO_3$ (b), where different denitrification fractionations yield straight lines whereas mixing yields a curve, and by plotting $\delta^{15}N$ vs. $1/NO_3$ (c), where different denitrification fractionations yield curves whereas mixing yields a straight line.

(Kendall et al. 2007)

Let's go back to the data



Calculate ln(NO_3^-) and 1/NO_3^-

Make these graphs for the dataset

Make an idealised graph which fit some of the data based on the Raigleigh equation:

$$\delta^{15}\mathrm{N}_{\mathrm{reactant}} = \delta^{15}\mathrm{N}_{\mathrm{initial}} - \varepsilon\{\ln(f)\}$$