

Spectral Casting Methods

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CBP – TMAW
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Spectral Approach:

proposed by Nagaraj Neerchal in early 1990's

rarely implemented because of computational intensity.

Basic idea:

Interpolate low frequency (lf) data

capture variability of high frequency (hf) data

create a synthetic from the filtered lf and hf data.

May need to filter overlapping frequencies from lf and hf so don't double count.

Nagaraj proposed using Fourier series for both jobs.

Fourier series:

Any sequence of data can be represented by a summation of Sin and Cos functions

$$x_t^{lt} = \bar{x}^{lt} + \sum_{k=1}^{ltn/2} \left\{ a_k^{lt} \cos(2\pi f_k^{lt} t) + b_k^{lt} \sin(2\pi f_k^{lt} t) \right\}$$

Solve for a's and b's using DFT.

Using DFT for interpolation
departs from usual use of Spectral Analysis -

Spectral Casting

Create a synthetic high frequency data set for a site with low frequency samples.

Borrows high frequency information from another site with high frequency samples.

**Low frequency site is called the Receiving Site.
High frequency site is called the Sending Site.**

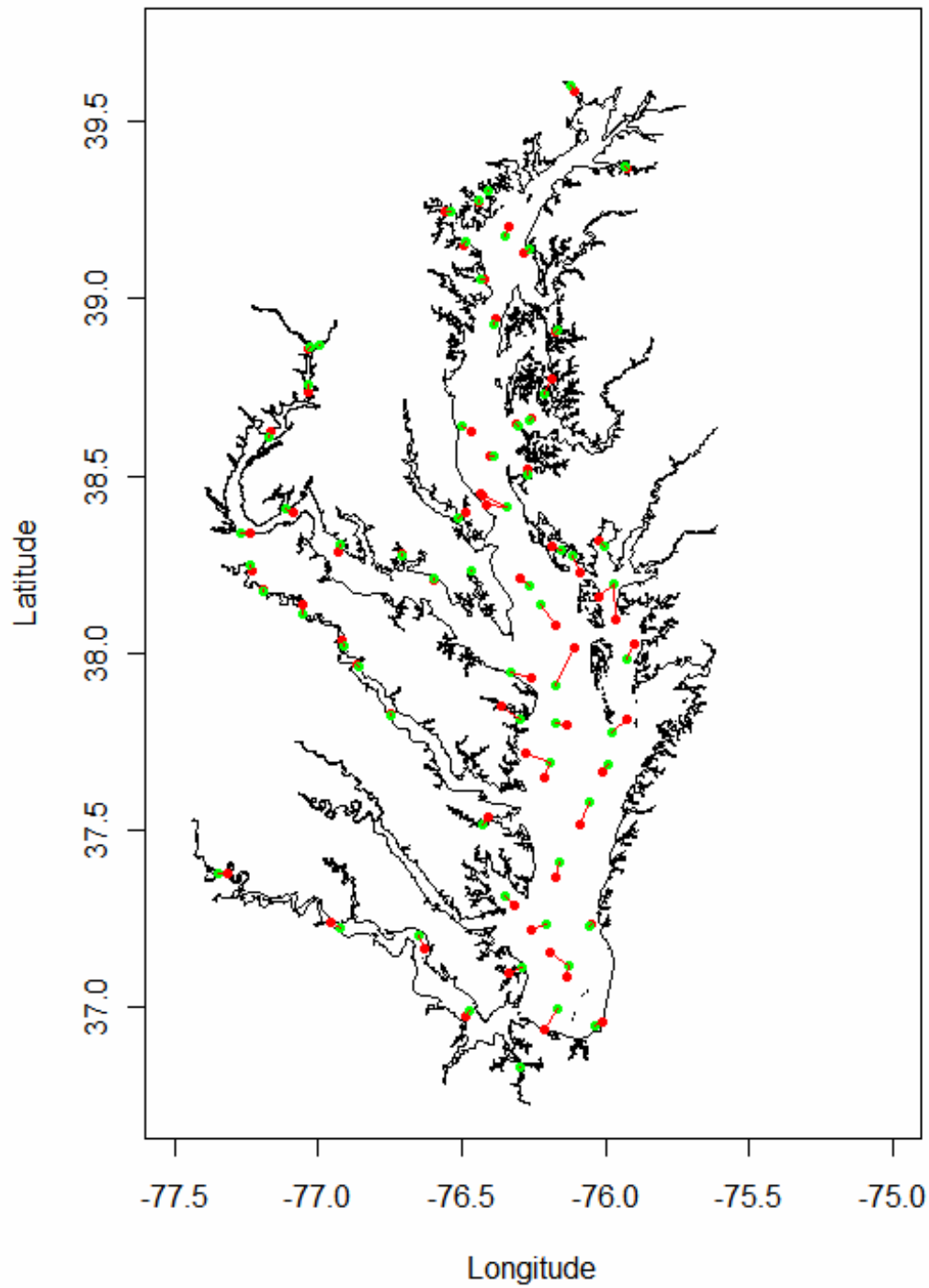
Role in Umbrella Concept.

Initial Plan

Generate Synthetic data for each Station of Fixed Station Network.

Interpolate the high frequency data over space.

Do a Cumulative Frequency Diagram assessment of the Instantaneous Mimimum criterion based on interpolated Synthetic data.



Fixed Station in Red

Bouy data in Green

How Well Does Syn Data represent Real data?

Syn data is NOT an estimate of the DO time series.

We just ask that Syn data have properties similar to a real time series. e.g. Percent of observations < 3.2. Length of time < 3.2.

Test to Answer Question -

Use two hf locations.

One for sending.

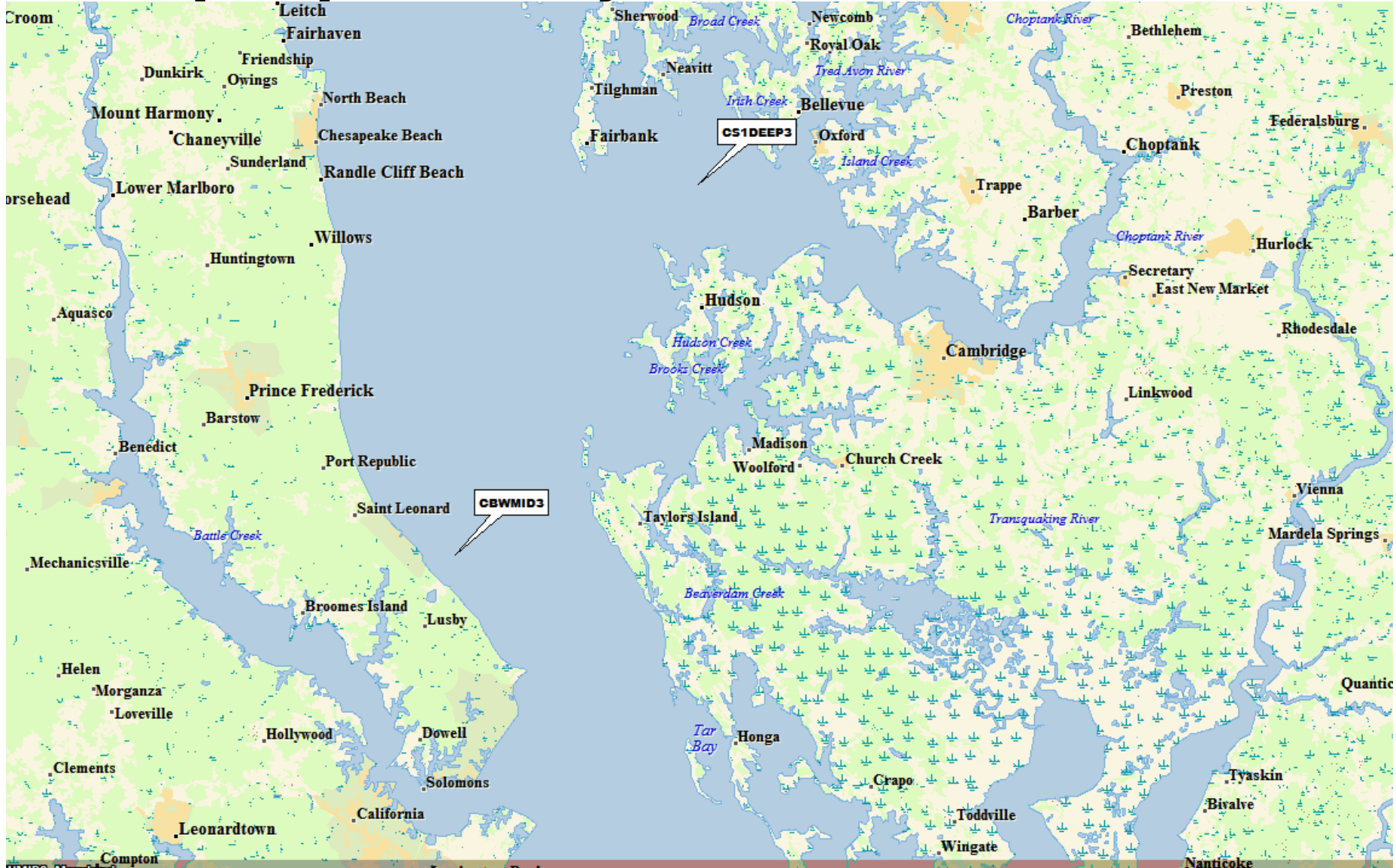
Second for receiving/validation.

Subsample receiving site at low frequency.

Do spectral cast from sending site to lf receiving data to create syn data.

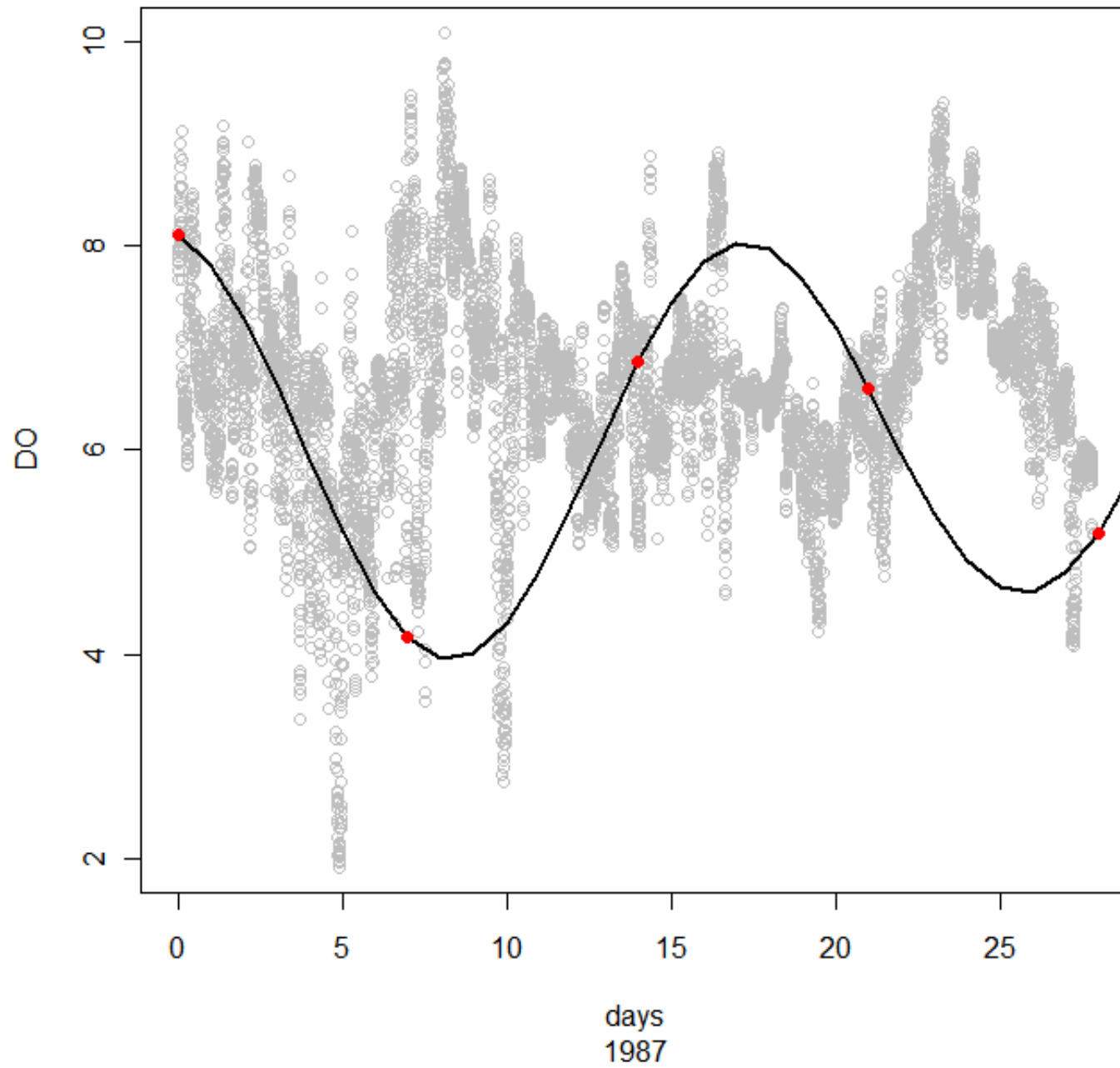
Validate by comparing syn data to original receiving hf data.

example plot of syn and real data

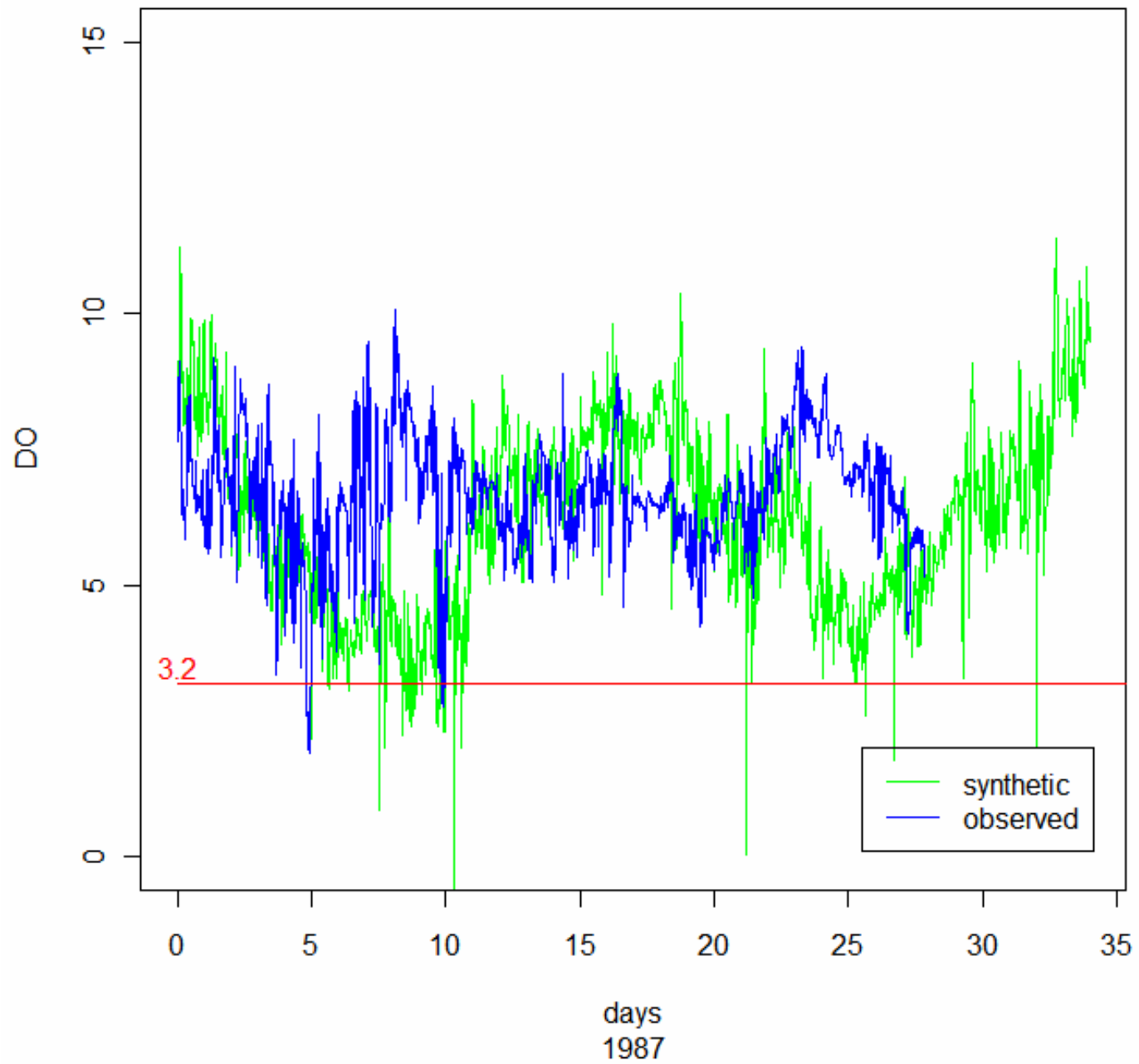


sending = CSDEEP3; receiving = CBWMID3

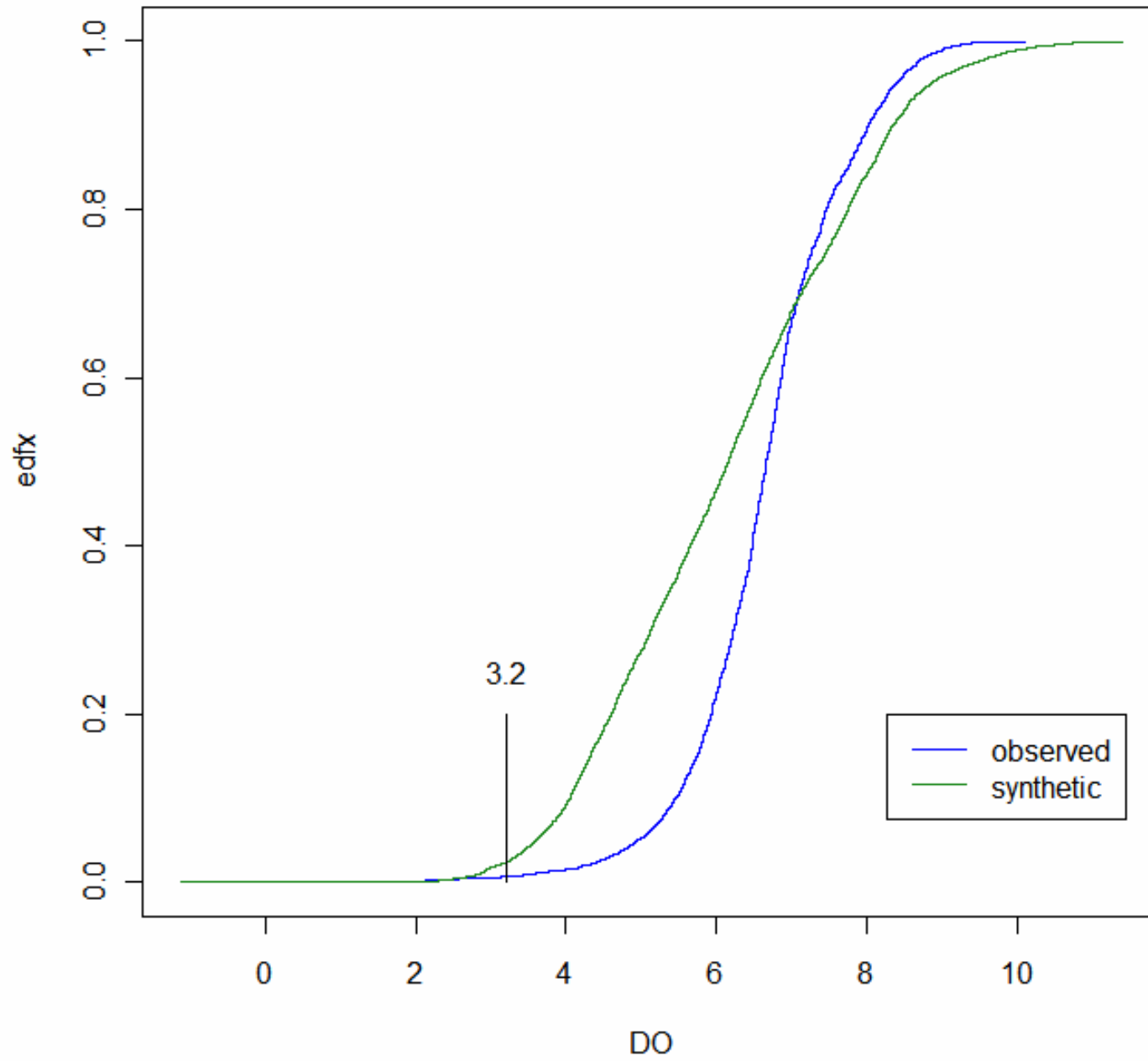
CBWMID3, 6m



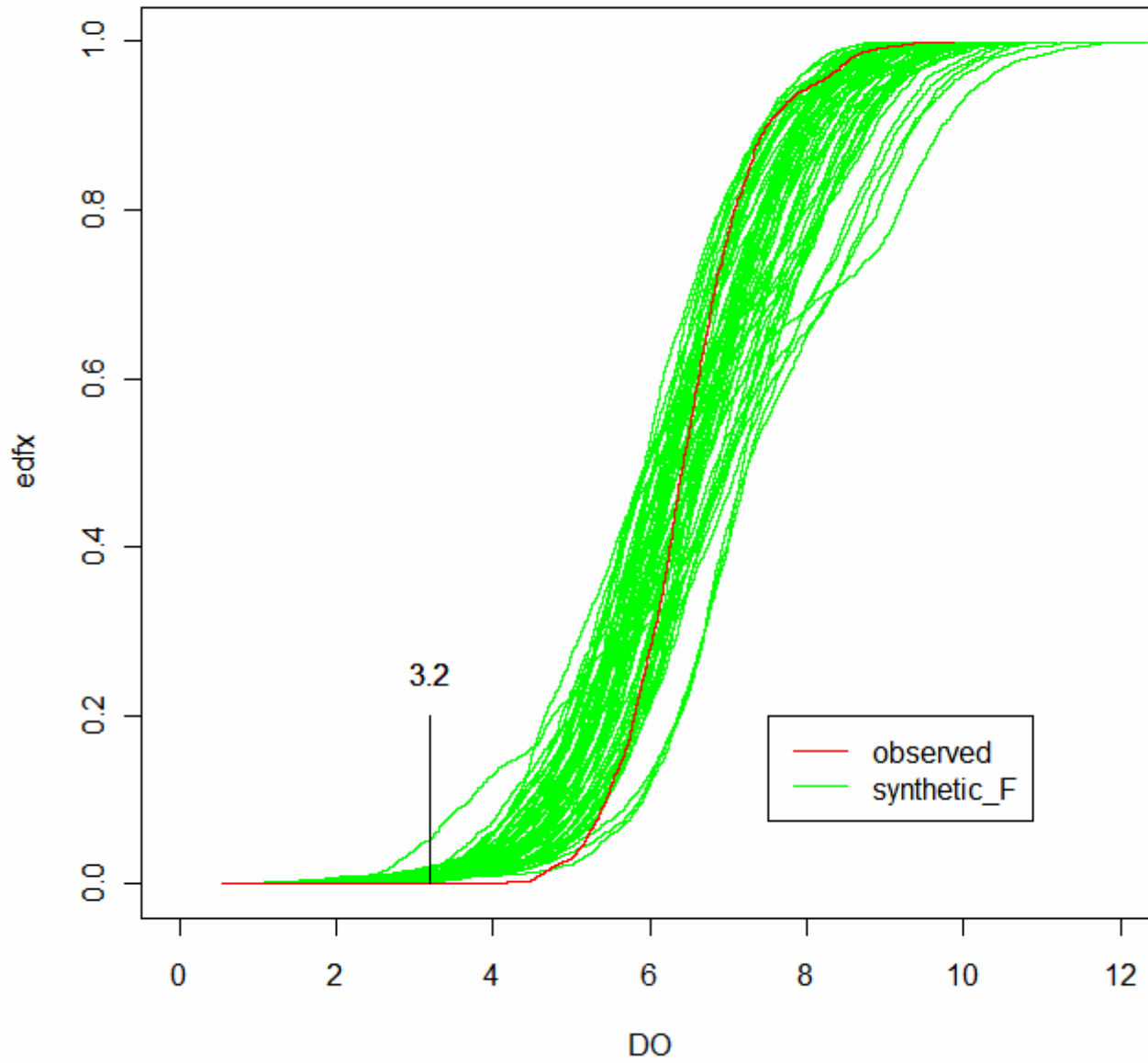
syn.CBWMID3, 6m



CS1DEEP3 -> CBWMID3

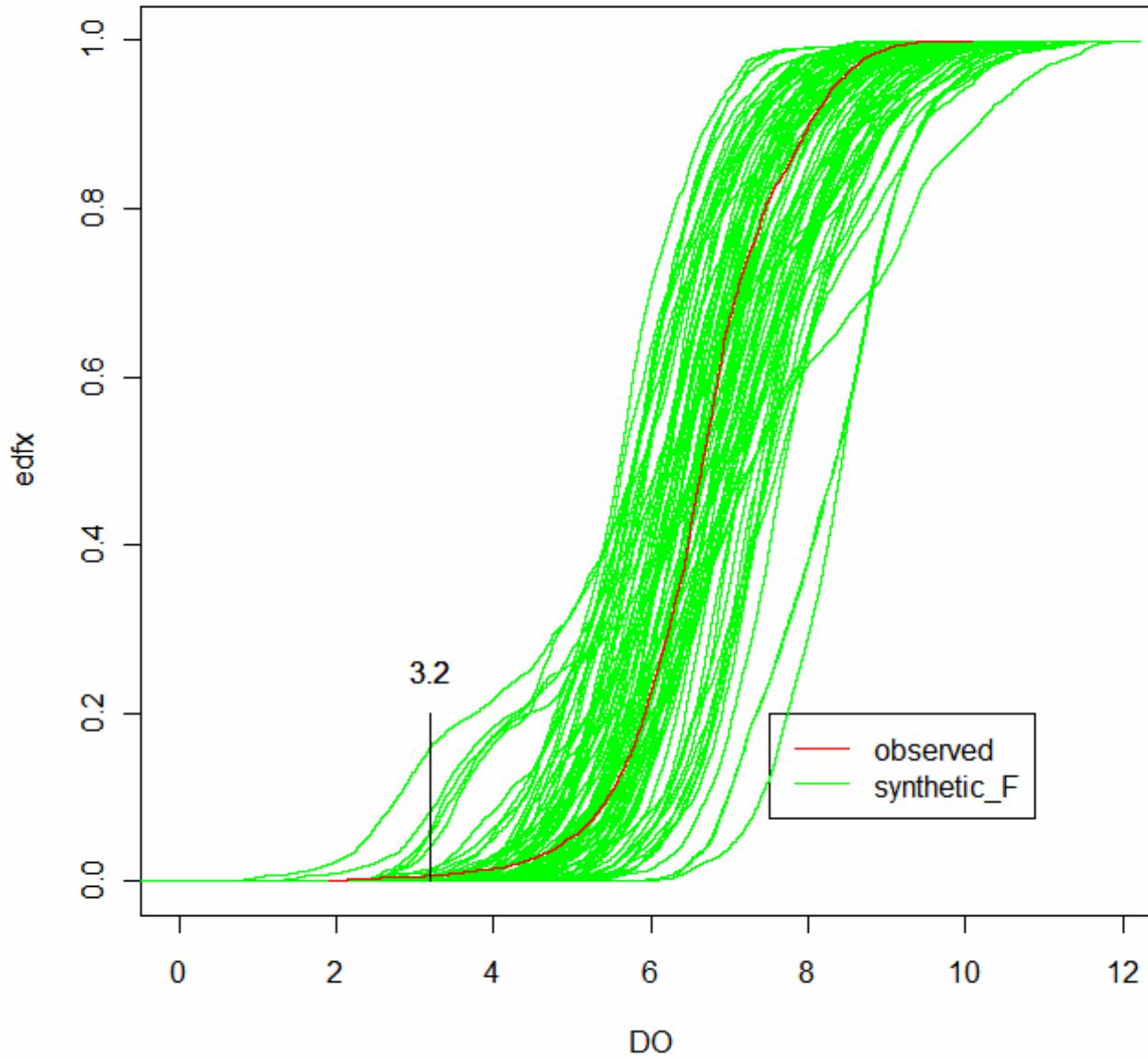


CBWMID3 -> CS1DEEP3



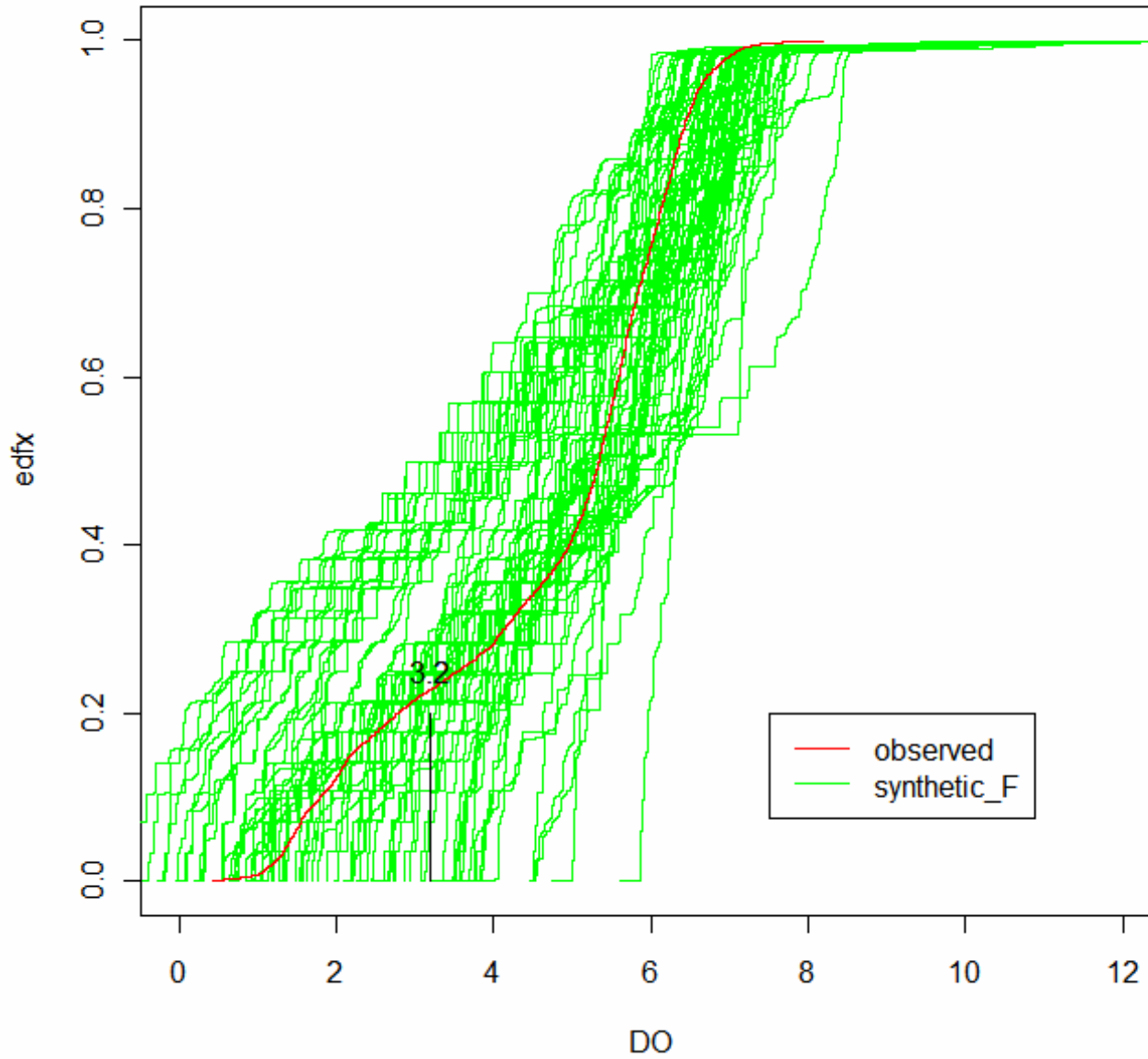
repeated LF sampling - buoy sites

CS1DEEP3 -> CBWMID3



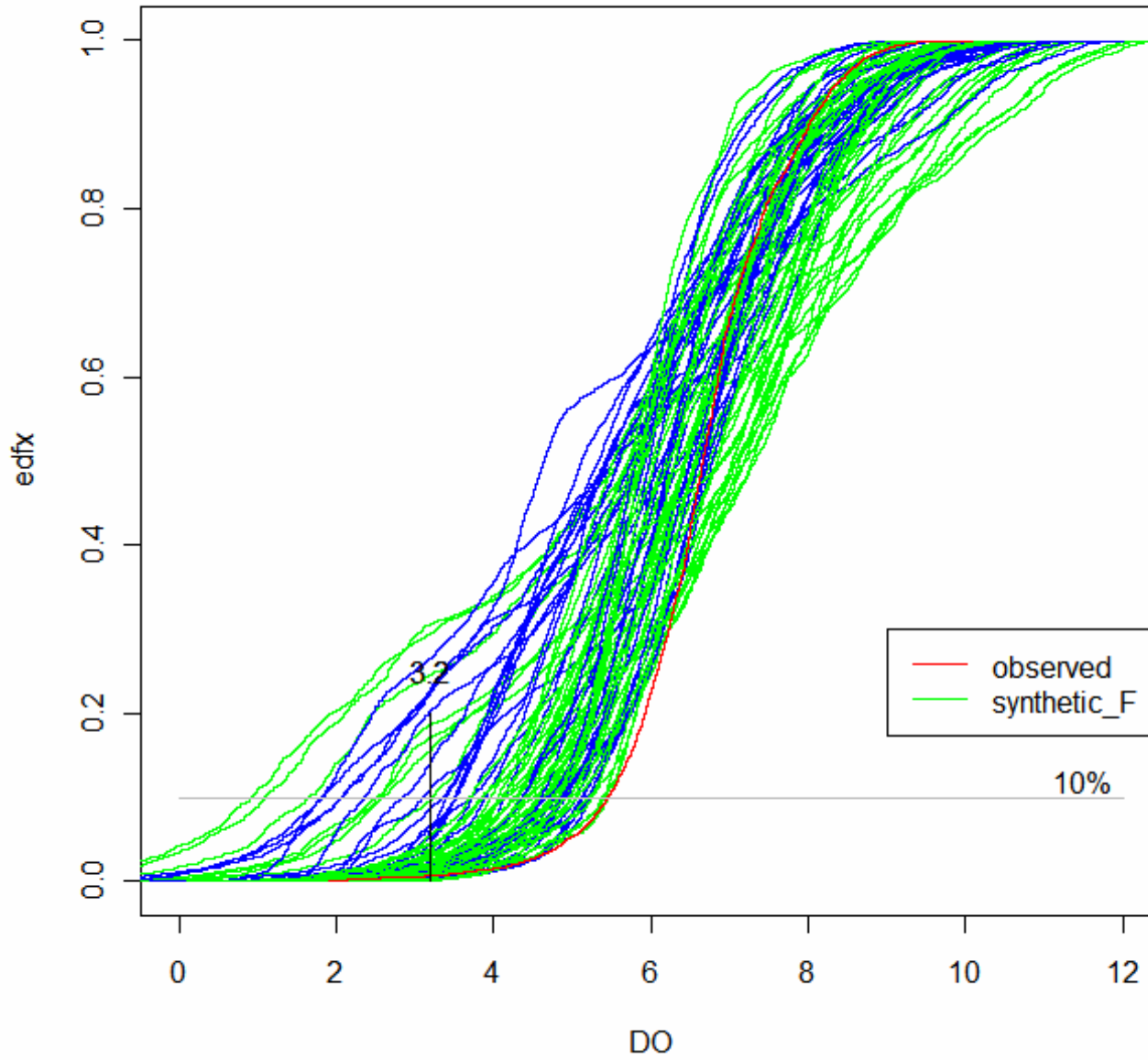
repeated LF sampling - buoy sites

CE1DEEP3 -> CE2DEEP3



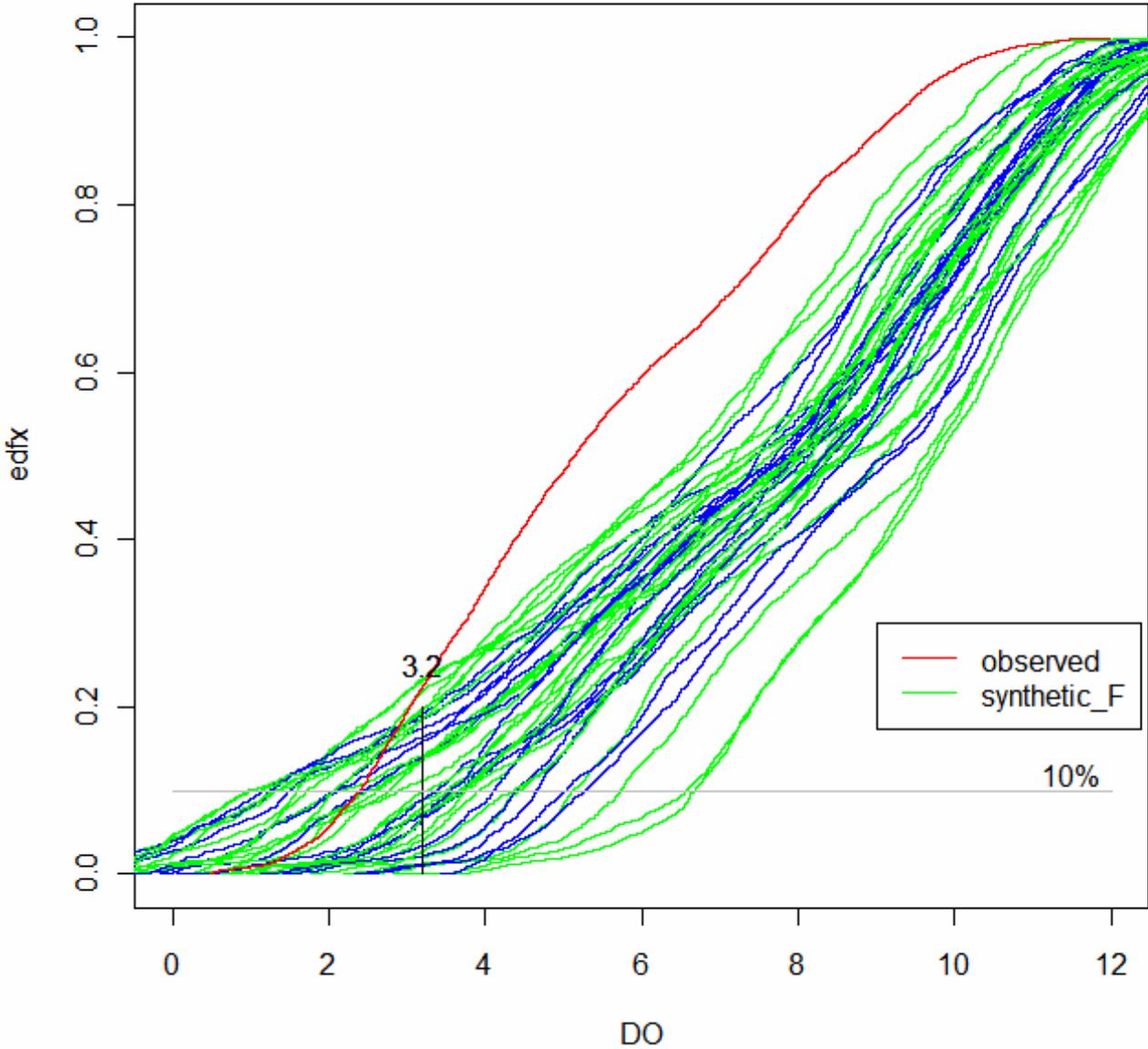
repeated LF sampling - buoy sites

CBL90 → CBWMID3

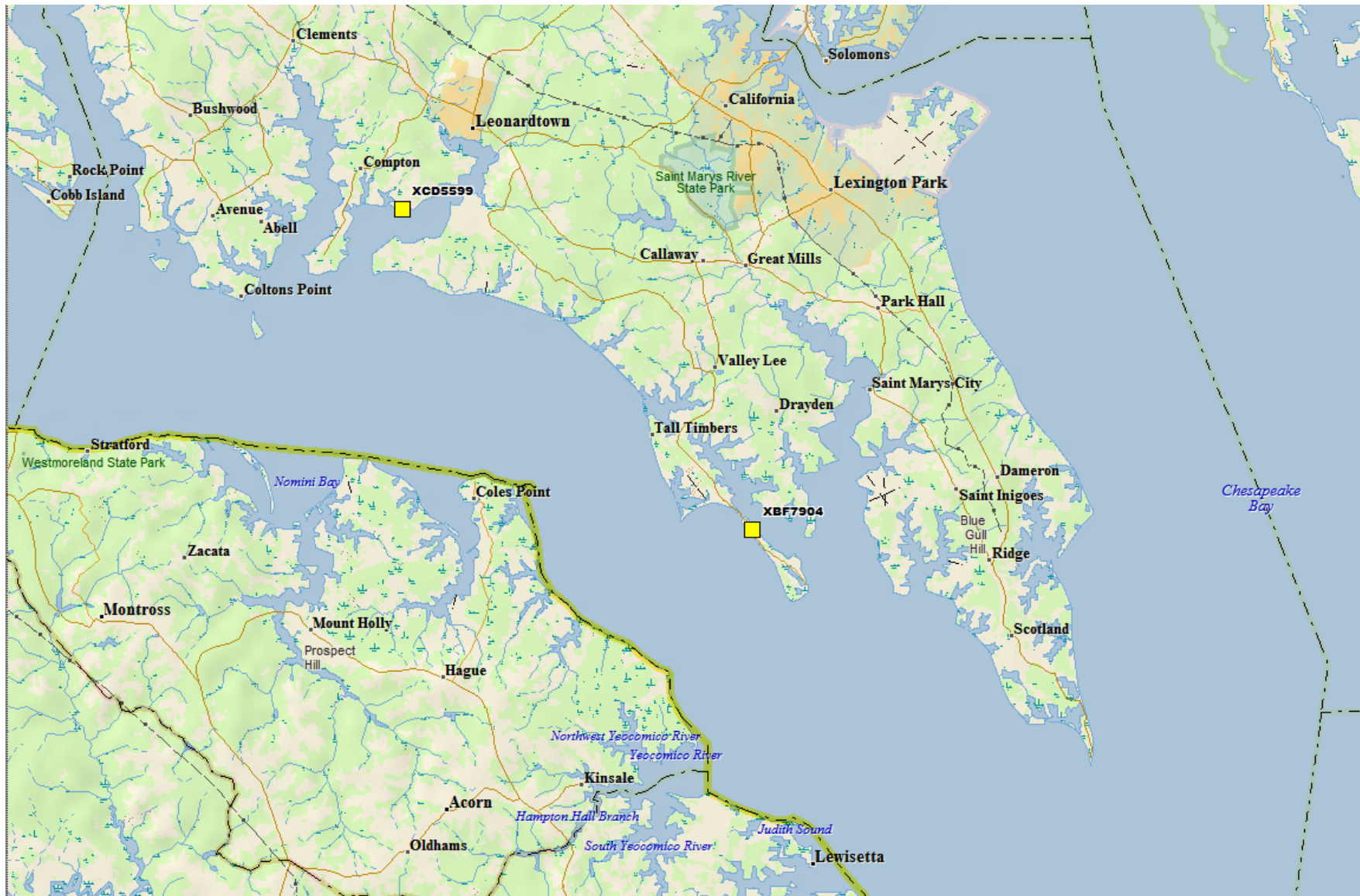


repeated LF sampling - buoy sites

CBW2M -> CBW5M

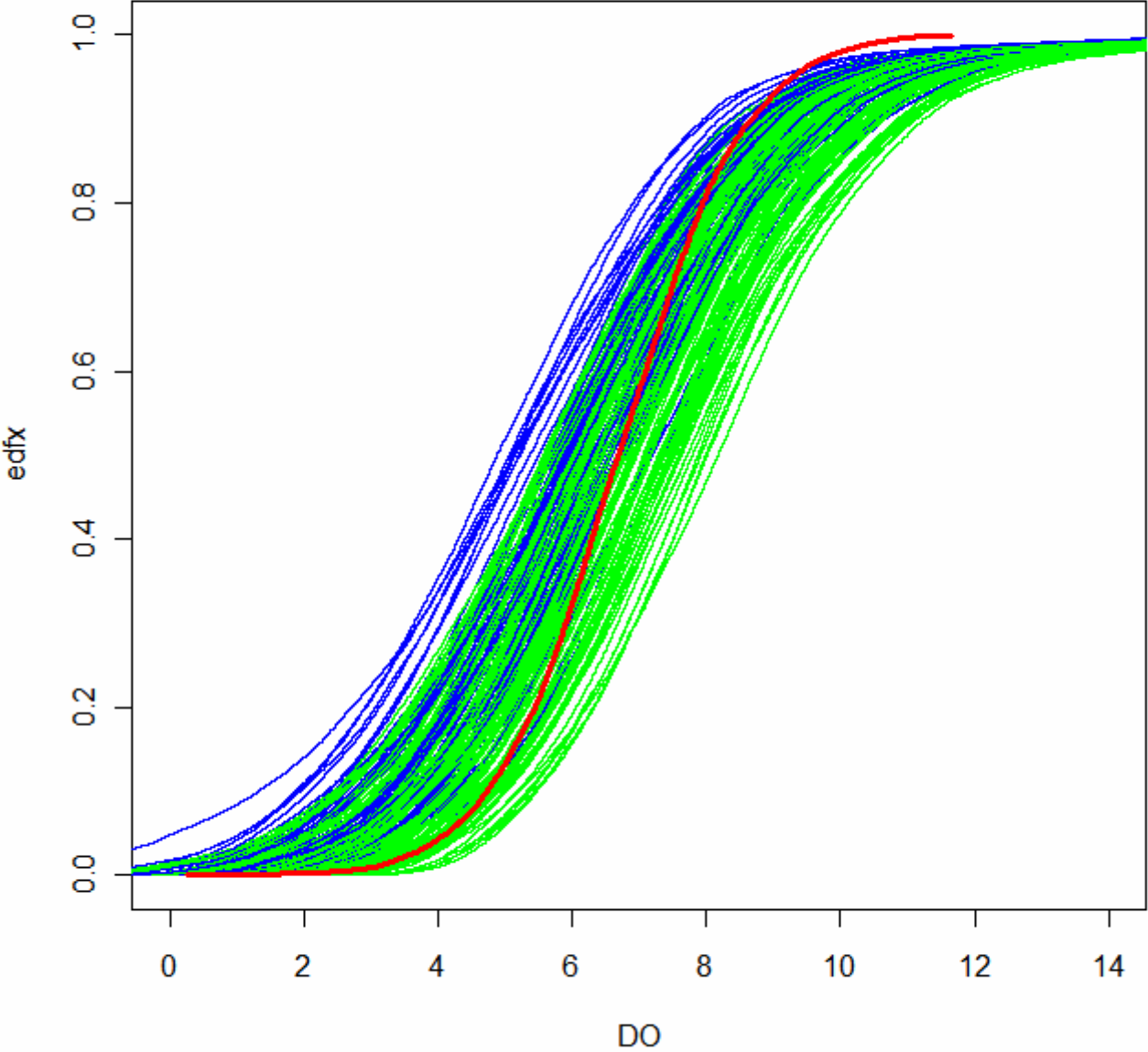


repeated LF sampling - buoy sites



repeated LF sampling - **Common**

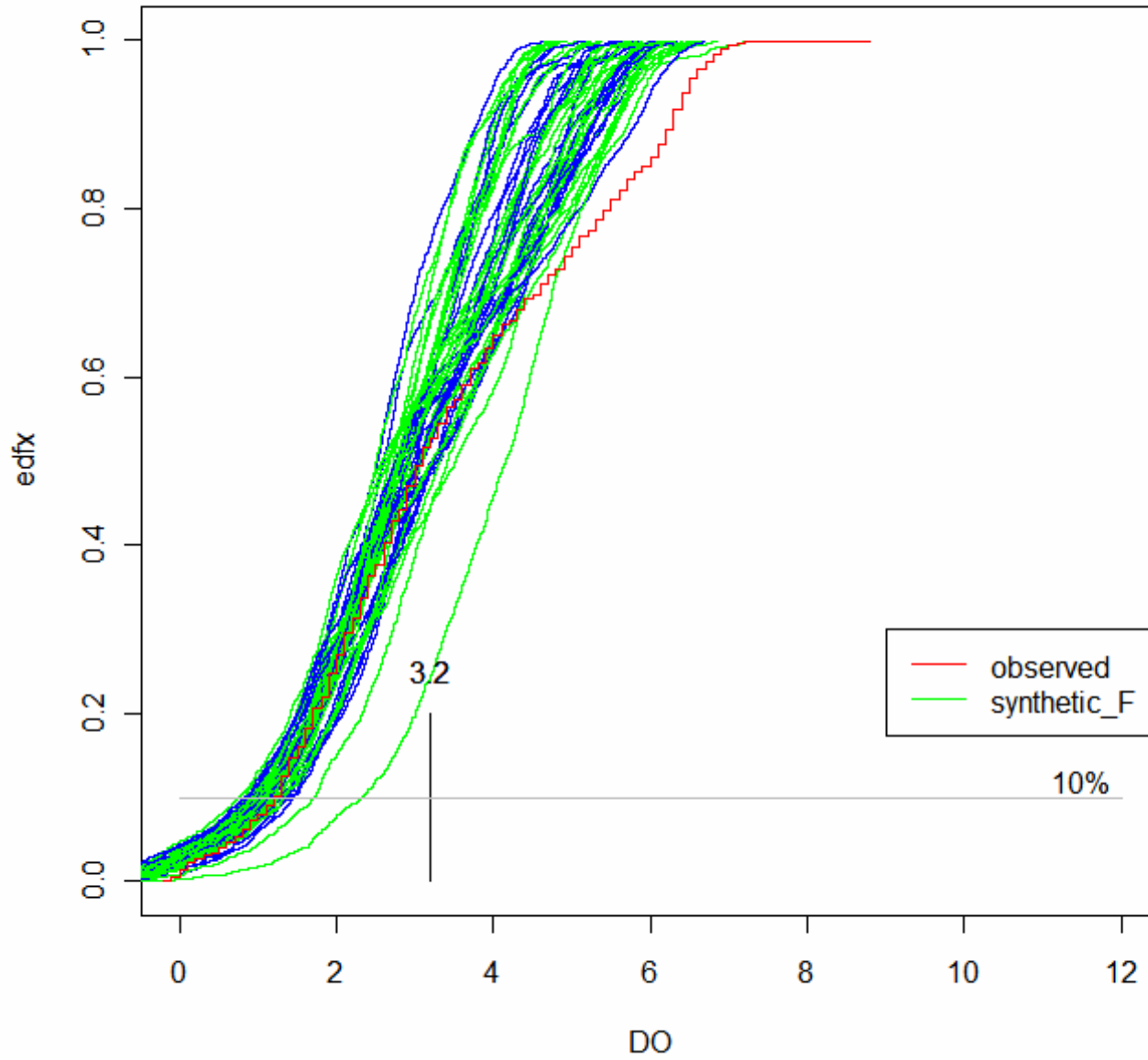
XCD5599 multiple LF samples XBF7904



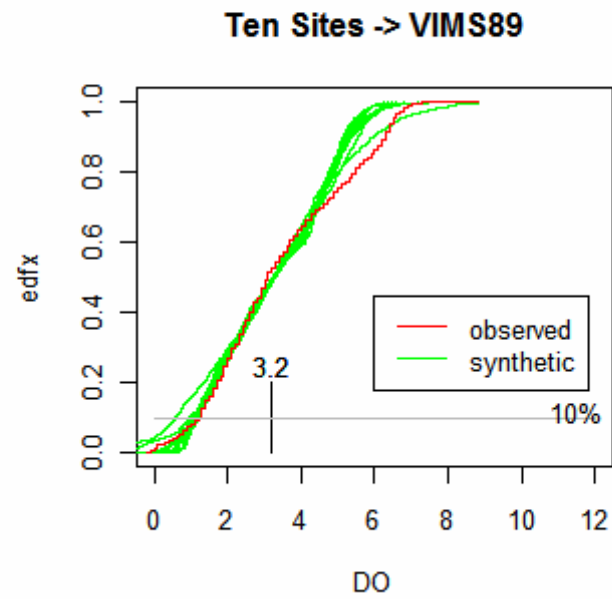
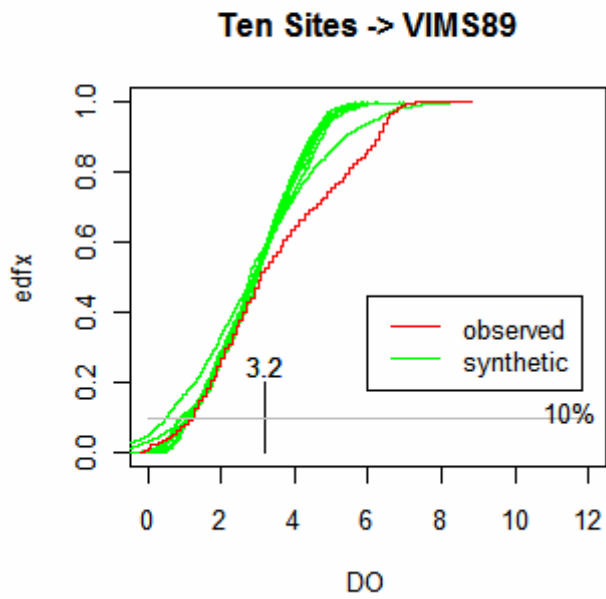
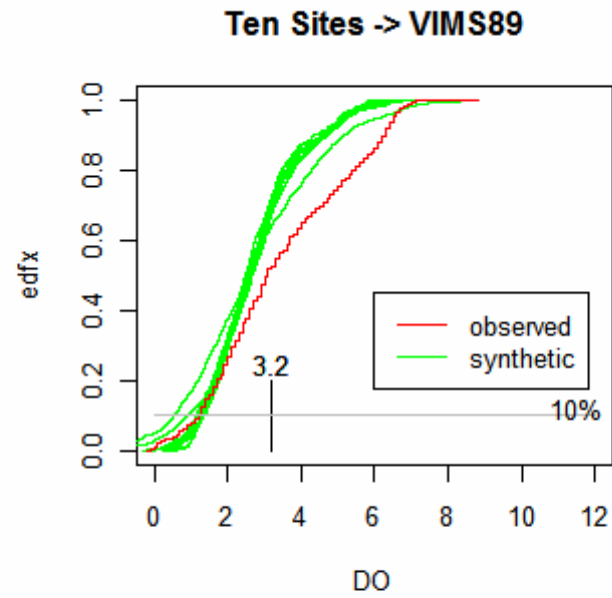
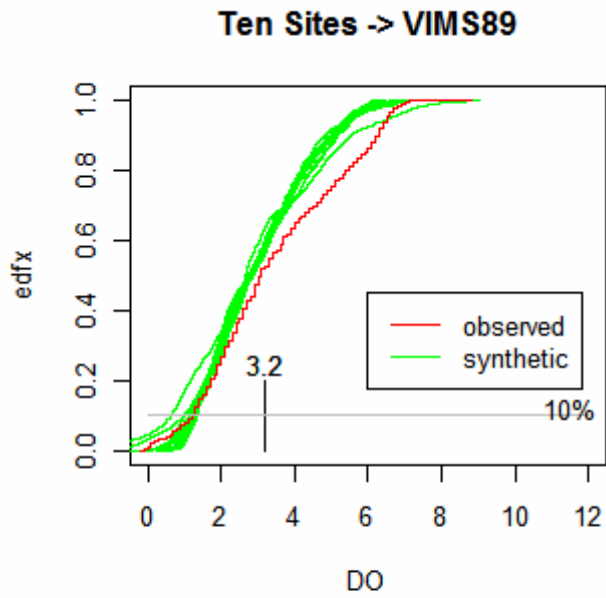
repeated LF sampling common

Casting variability
vs.
Low Frequency Sampling Variability

EMAP1013 -> VIMS89

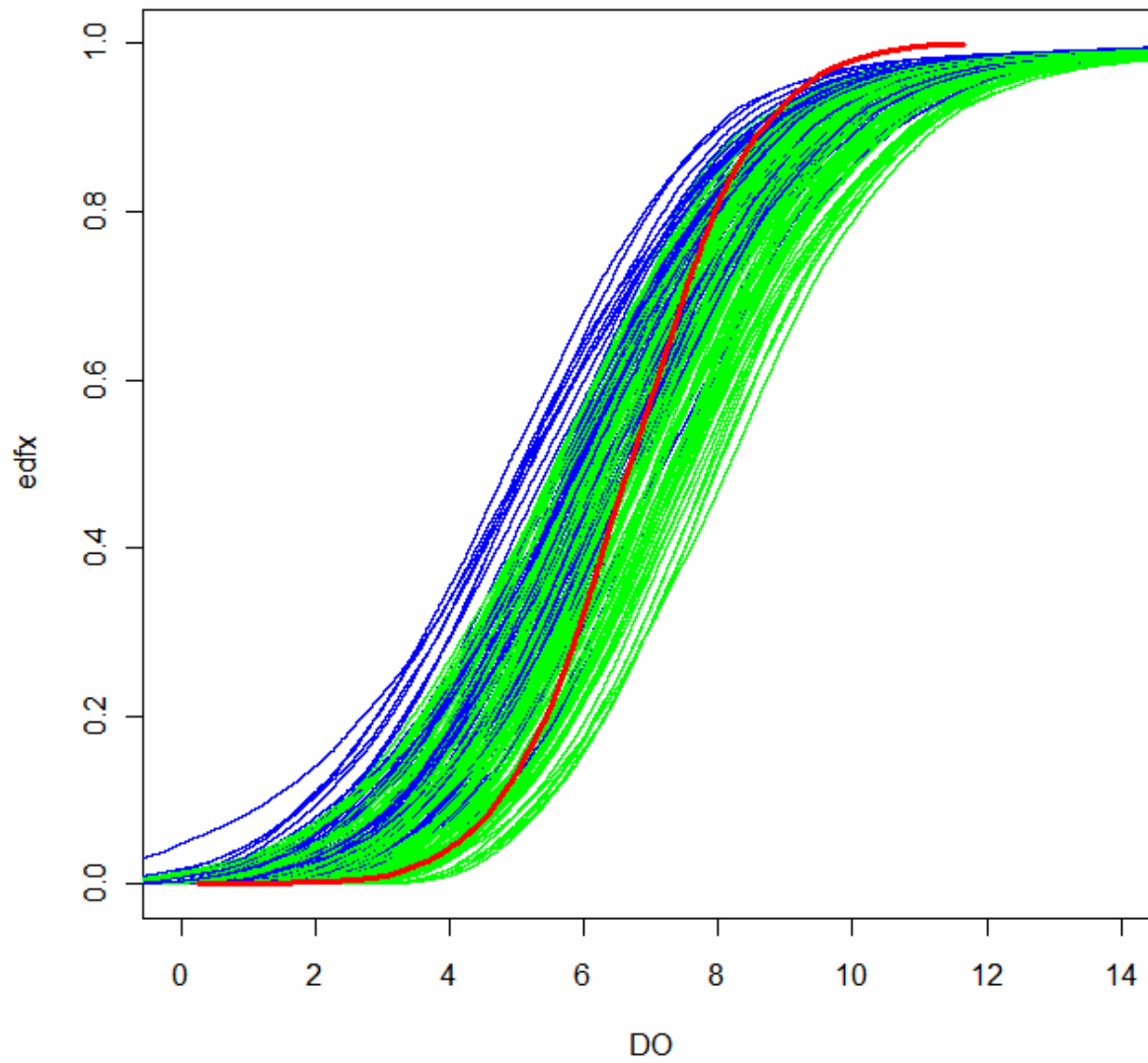


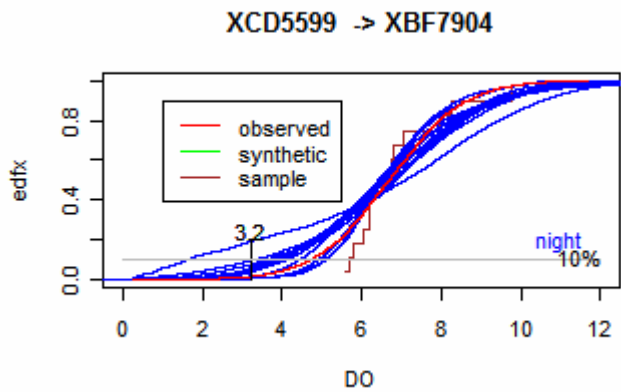
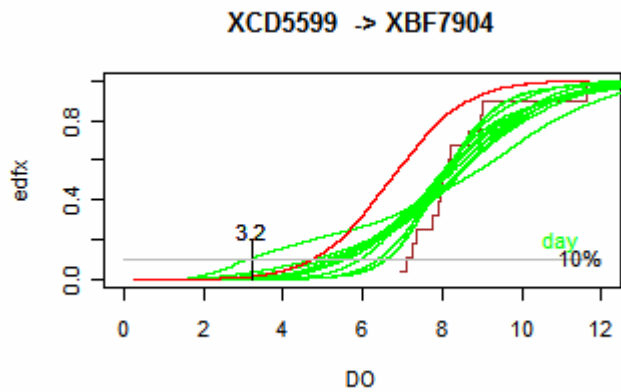
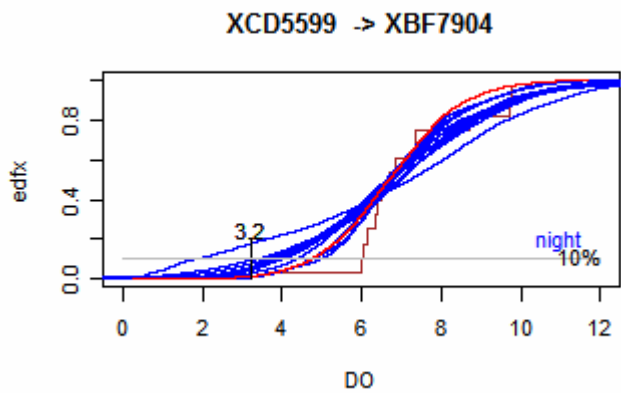
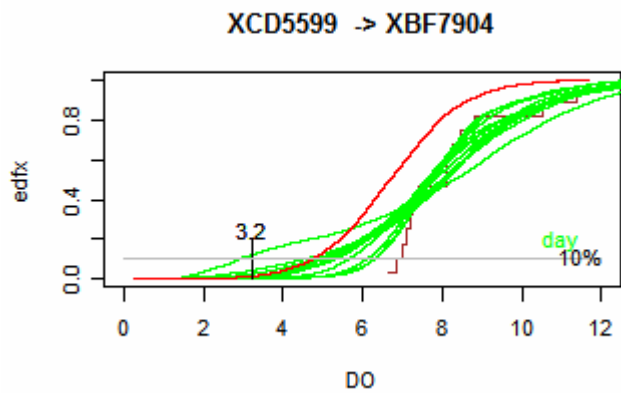
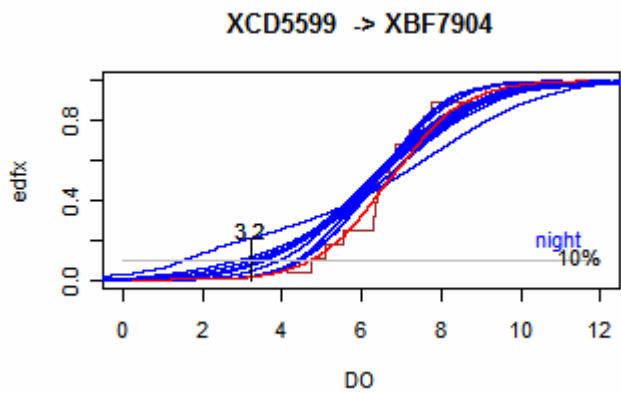
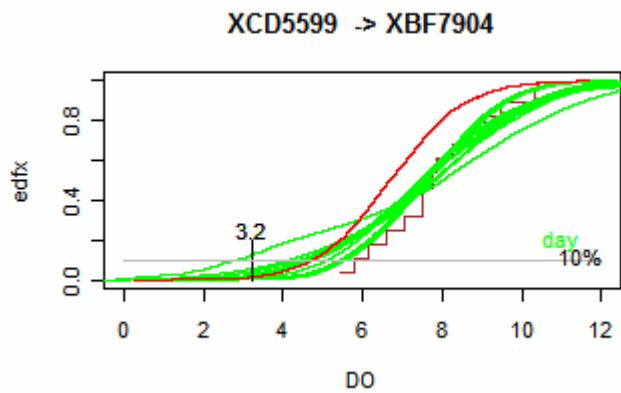
repeated LF sampling - buoy sites



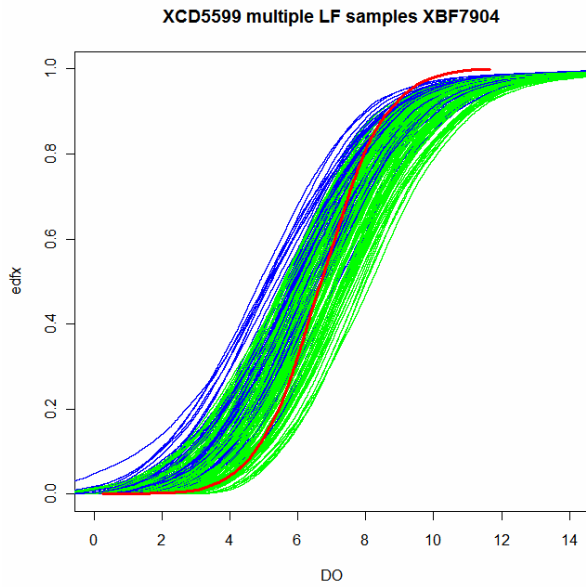
repeated casting buoy

XCD5599 multiple LF samples XBF7904

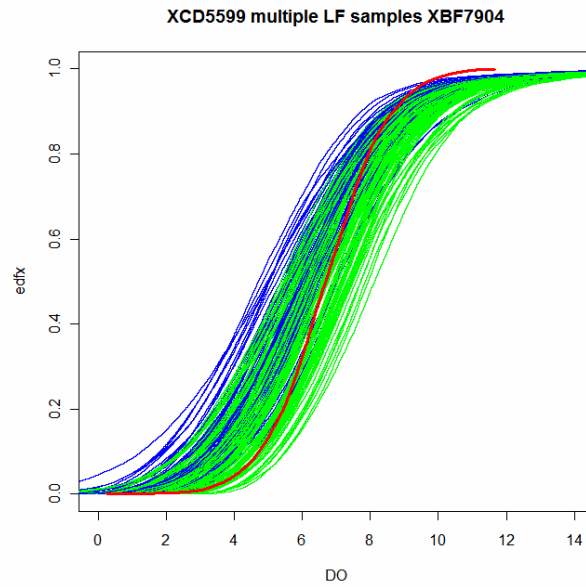




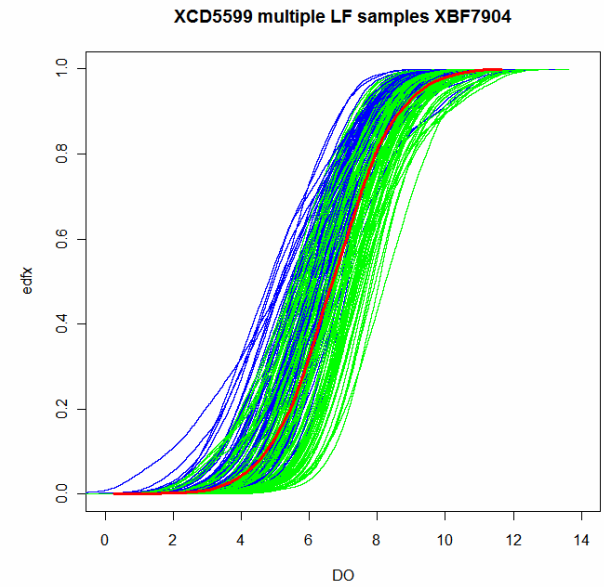
repeated casting Common



Fourier



Cubic Spline



Linear

Different If interpolation methods