Online Ecological Forecasting Resource Repository

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Key to the types of materials listed

- CM = course material (archived from past synchronous or asynchronous academic course)
- V = video (recorded lectures, video tutorials, etc.)
- R = repository (link to another collection of resources)
- M = module (short hands-on lesson)
- W = workshop (synchronous opportunity)
- T = textbook (full online textbook)
- A = article (online short text)
- NLL = NetLogo Lab (module dependent on NetLogo software)

The materials are further organized as Introductory, Intermediate, and Advanced.

Concepts

Basics of forecasting

Introductory

1. Why Forecast? V
2. Predictability First Principles V
3. Forecast Analysis Cycle V
4. NEFI 2019 Summer Course CM
5. NEFI 2020 Summer Course CM
6. Ecological Forecasting: The Science of Predicting Ecosystems V
7. Introduction To Making Forecasts From Time-Series Models in R (weecology video series) V
8. Introduction To Making Forecasts With Cross-sectional Data (weecology video series) V
9. Lecture: Pandemics CM
10. Student Research Summary: So… How Much Glacier Are We Losing? A
11. Student Research Report: Forecasting the change of sea ice extent globally A
12. Student Research Report: Team Project in Glacier Data Analysis A
13. Skype a Scientist (featuring ecological forecasting) V
14. Understanding Climate Science Course M
15. Understanding Uncertainty in Ecological Forecasts M
16. Using Ecological Forecasts to Guide Decision Making M

Intermediate

17. Oxford Bibliographies: Ecological Forecasting R
18. Using Ecological Forecasts to Guide Decision Making M
19. Introduction to Ecological Forecasting M

Advanced

20. Ecological Dynamics & Forecasting Course CM
21. Ecological Forecasting and Informatics CM

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Incorporating Traditional Ecological Knowledge

Introductory

1. Enduring Legacies: Native Case Studies M R
2. Traditional Ecological Knowledge and Conservation M

Intermediate

Advanced

Click her to return to the table of contents

Basics

Basics of R

Introductory

1. learnR4free R M
2. RStudio Cheatsheets R
3. Data wrangling, exploration, and analysis with R CM
4. Swirl R
5. Data Carpentry for Biologists CM
6. What are Rscripts (weecology video series) V
7. Saving Rscripts and Setting the Working Directory (weecology video series) V
8. What is an Rnotebook (weecology video series) V
9. Issues w character dates (weecology video series) V
10. Formatting dates (weecology video series) V
11. Importing Dates with Times (weecology video series) V
12. Using Lubridate (weecology video series) V
13. Introduction to dates and times (weecology video series) V
14. Importing dates (weecology video series) V
15. WhatisRStudio (weecology video series) V
16. Loading data for time series decomposition (weecology video series) V
17. Importing Data into a Time Series Object (weecology video series) V
18. Conducting a Moving Average in R (weecology video series) V
19. Conducting a Moving Average in R (weecology video series) V
20. Using decompose() to do a time series decomposition in R (weecology video series) V
21. Using Season Trend Decomposition using Loess (stl) in R (weecology video series) V
22. Using acf() in R to explore autocorrelation (weecology video series) V
23. Using pacf() to diagnose the time lag for autoregressive models (weecology video series) V
24. Fitting a white noise model to data (weecology video series) V
25. Fitting an ARIMA model in R (weecology video series) V
26. Fitting a seasonal ARIMA in R (weecology video series) V
27. Fitting external predictors using auto.arima() (weecology video series) V
28. Using auto.arima() in R (weecology video series) V
29. Make Beautiful Graphs in R: 5 Quick Ways to Improve ggplot2 Graphs V
30. Learn R Programming R M
31. Learn R Programming (2) R M
32. freeCodeCamp V
33. freeCodeCamp.org M CM
34. Intro to R V CM
35. Intro to Data Analysis with R V CM

36. Data Storytelling with R V CM
37. Introduction to R for Data Science CM
38. Introduction to Conditional Statements in R in weecology video series V
39. Introduction To `if` Statements In R in weecology video series V
40. Introduction To `else if` And `else` Statements In R in weecology video series V
41. Using if/else if/else Statements Inside of Functions in R in weecology video series V
42. Introduction To Nested `if` Statements in R in weecology video series V
43. Introduction to Species Distribution Modeling Using R in weecology video series V
44. Introduction to Repeating Things in R in weecology video series V
45. Introduction to Repeating Things in R: Using Vectorized Functions in weecology video series V
46. Introduction to Repeating Things in R: Apply Functions in weecology video series V
47. Introduction to Repeating Things in R: Using mapply For Functions with Multiple Vector Arguments in weecology video series V
48. Introduction to Repeating Things in R: Combining Your Own Functions With dplyr in weecology video series V
49. Introduction to Repeating Things in R: Basic For Loops in weecology video series V
50. Introduction to Repeating Things in R: Looping by Index in weecology video series V
51. Introduction to Repeating Things in R: Looping Over Multiple Objects in weecology video series V
52. Introduction to Repeating Things in R: Looping Using Functions in weecology video series V
53. Introduction to Repeating Things in R: Looping Over Files in weecology video series V
54. Cleaning Data Using tidyr: Introduction in weecology video series V
55. Cleaning Data Using tidyr: Pivoting Wide Data to be Longer in weecology video series V
56. Cleaning Data Using tidyr: Extracting Data From Within Columns in weecology video series V
57. Cleaning Data Using tidyr: Separating Data From Within A Column in weecology video series V
58. Cleaning Data Using tidyr: Combining Data From Multiple Columns in weecology video series V
59. Cleaning Data Using tidyr: Making Long Data Wide in weecology video series V
60. Cleaning Data With tidyr: Gappy And Incomplete Data in weecology video series V
61. SQL Databases For dplyr Users: Introduction in weecology video series V
62. SQL Databases For dplyr Users: Selecting Columns Using SELECT in weecology video series V
63. SQL Databases For dplyr Users: Filtering Data Using WHERE in weecology video series V
64. SQL Databases For dplyr Users: Sorting Using ORDER BY in weecology video series V
65. SQL Databases For dplyr Users: Order Of SQL Keywords in weecology video series V

66. SQL Databases For dplyr Users: Combining Tables Using JOIN in weecology video series V
67. Working With SQL Databases From R: Introduction & Connecting To Databases in weecology video series V
68. Working With SQL Databases From R: Running SQL Database Queries From R in weecology video series V
69. Working With SQL Databases From R: Querying SQL Databases Using dplyr in weecology video series V
70. Working With SQL Databases From R: Copying Data From R To A Database in weecology video series V
71. SQL Databases For dplyr Users: Grouping And Summarizing Data Using GROUP BY in weecology video series V

Intermediate

72. Climate Change Effects on Lake Temperatures M
73. Tidy Modeling with R T

Advanced

74. Ecological Dynamics & Forecasting Course CM
75. Using Phenocams and Eddy Covariance Data CM
76. Using ModisTools Data CM
77. SESYNC Decision Support Tool Short Course M CM
78. Advanced Data Mining with Weka CM

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Basics of Python

Introductory

1. RStudio Cheatsheets R
2. freeCodeCamp.org M CM
3. Intro to Python V CM
4. Data Wrangling with Pandas V CM
5. Learn to Code for Data Analysis CM

Intermediate

1. Reproducible and Collaborative Statistical Data Science CM
2. Learn to Code for Data Analysis CM
3. Introduction to Machine Learning CM
4. Deep Learning CM
5. Applied Deep Learning with TensorFlow* CM
6. Time-Series Analysis CM

Advanced

1. Advanced Data Mining with Weka CM

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Basics of Ecology

Introductory

1. TRENCH-ED M
2. EREN Curricula M
3. Earth in the Future CM V
4. Inland water chemistry: the Nordic Lake Survey 1995 CM
5. Examining Changes in Waterfowl Density and Climate Change M
6. Paleobiology CM
7. Carbon and Climate CM
8. Project Biodiversify Repository R
9. Understanding Climate Science Course M
10. Big Data and the Environment CM

Intermediate

11. Climate Change Effects on Lake Temperatures M
12. Cross-Scale Interactions M
13. Teleconnections M
14. Macro-Scale Feedbacks M
15. Lake Ice Phenology Module M
16. Lake Metabolism Module M
17. Lake Mixing Module M
18. Stream Discharge Module M
19. Water Quality Module M
20. Soil Respiration Module M
21. Nutrient Loading Module M
22. Climate Change Module M
23. How Ecology Works Video Series V

Advanced

24. Lauren Buckley's Lab Website M CM
25. Ecological Dynamics & Forecasting Course CM
26. Ecological Forecasting and Informatics CM
27. Using ModisTools Data CM

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Basics of Statistics

Introductory

1. Crash Course Statistics V
2. Introduction to Time Series Decomposition (weecology video series) V
3. Identifying the Long-term Signal in a Time Series (weecology video series) V
4. Time series decomposition: Removing the long-term signal (weecology video series) V
5. Multiplicative vs. additive time series decomposition in R (weecology video series) V
6. Using Season Trend Decomposition using Loess (stl) in R (weecology video series) V
7. Generating random time series in R (weecology video series) V
8. Introduction to exploring autocorrelation (weecology video series) V
9. Exploring autocorrelation through lag plots (weecology video series) V
10. Autoregressive vs moving average processes (weecology video series) V
11. Exploring lagged correlations between different time series (weecology video series) V
12. Bunnies: An Introduction to Logistic Growth in Discrete Time NLL
13. Cobweb Diagrams NLL
14. Cobweb Player NLL
15. Emergent Logistic Growth plus Writeup for Entire Series NLL
16. Equation based Logistic Growth NLL
17. Lorenz Attractor NLL
18. Mandelbrot Explained NLL
19. Universality in the Logistic Map: Feigenbaum's constants NLL
20. Affine Transformations NLL
21. Functions and Iterations CM
22. Introduction to Differential Equations CM
23. Introduction to Information Theory CM
24. Vector and Matrix Algebra CM
25. Game Theory I - Static Games CM
26. Game Theory II- Dynamic Games CM
27. Introduction to Computation Theory CM
28. Fractals and Scaling CM
29. Introduction to Complexity CM
30. Introduction to Dynamical Systems and Chaos CM
31. Nonlinear Dynamics: Mathematical and Computational Approaches CM
32. Nonlinear Dynamics: Mathematical and Computational Approaches (Spring 2020) CM
33. Introduction to Agent-Based Modeling (Spring 2020) CM
34. Computation in Complex Systems (Summer 2020) CM
35. Understanding Statistical Power and Significance Testing: An interactive visualization CM
36. Student Research Summary: So… How Much Glacier Are We Losing? A
37. Student Research Report: Forecasting the change of sea ice extent globally A
38. Student Research Report: Team Project in Glacier Data Analysis A

39. Intro to Data Analysis with R V CM
40. Intro to Data Analysis V CM
41. Deep Learning V CM
42. Data 8: The Foundations of Data Science CM
43. Basic Statistics CM
44. Data Science Math Skills CM
45. Data to Insight: An Introduction to Data Analysis CM
46. Introduction to Probability and Data CM

Intermediate

47. Bayesian Modeling for Socio-Environmental Data Short Course M CM
48. Reproducible and Collaborative Statistical Data Science CM
49. Time-Series Analysis CM

Advanced

50. Ordinary Differential Equations CM
51. Maximum Entropy Methods CM
52. Introduction to Renormalization CM
53. Advanced Data Mining with Weka CM

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Data Sources

Data Sources

Introductory

1. GIS in Ecology V W R
2. GIS for Biologists V M
3. Earth in the Future CM V
4. EarthLab M

Intermediate

5. Biodiversity Informatics Training Curriculum V
6. Environmental Informatics Using Research Infrastructures and their Data T
7. NEON Data Skills GitHub Repo M R

Advanced

8. Using Phenocams and Eddy Covariance Data CM
9. Using ModisTools Data CM

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Data Skills

Working with Data

Introductory

1. EREN Curricula M
2. Inland water chemistry: the Nordic Lake Survey 1995 CM
3. Baseflow Recession M
4. Examining Changes in Waterfowl Diversity and Climate Change M
5. EarthLab M
6. Remote Sensing & Climate Science M
7. Big Data and the Environment CM

Intermediate

8. Macro-Scale Feedbacks M
9. Lake Metabolism Module M
10. Lake Mixing Module M
11. Stream Discharge Module M
12. Water Quality Module M
13. Soil Respiration Module M
14. Nutrient Loading Module M
15. Climate Change Module M
16. Biogeoinformatics YouTube channel V
17. Tidy Modeling with R T
18. Environmental Informatics Using Research Infrastructures and their Data T
19. NEON Data Skills GitHub Repo M R

Advanced

20. Ecological Models and Data in R M T

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Data (manipulation, processing)

Introductory

1. Introduction to Data Visualization and Data Wrangling for R Users Group CM
2. RStudio Cheatsheets R
3. Data wrangling, exploration, and analysis with R CM
4. freeCodeCamp V
5. EarthLab M
6. Data Science Basics V CM
7. Data Wrangling with Pandas V CM
8. Intro to Data Analysis V CM
9. Data 8: The Foundations of Data Science CM
10. Data to Insight: An Introduction to Data Analysis CM
11. Cleaning Data Using tidyr: Introduction in weecology video series V
12. Cleaning Data Using tidyr: Pivoting Wide Data to be Longer in weecology video series V
13. Cleaning Data Using tidyr: Extracting Data From Within Columns in weecology video series V
14. Cleaning Data Using tidyr: Separating Data From Within A Column in weecology video series V
15. Cleaning Data Using tidyr: Combining Data From Multiple Columns in weecology video series V
16. Cleaning Data Using tidyr: Making Long Data Wide in weecology video series V
17. Cleaning Data With tidyr: Gappy And Incomplete Data in weecology video series V
18. SQL Databases For dplyr Users: Introduction in weecology video series V
19. SQL Databases For dplyr Users: Selecting Columns Using SELECT in weecology video series V
20. SQL Databases For dplyr Users: Filtering Data Using WHERE in weecology video series V
21. SQL Databases For dplyr Users: Sorting Using ORDER BY in weecology video series V
22. SQL Databases For dplyr Users: Order Of SQL Keywords in weecology video series V
23. SQL Databases For dplyr Users: Combining Tables Using JOIN in weecology video series V
24. Working With SQL Databases From R: Introduction & Connecting To Databases in weecology video series V
25. Working With SQL Databases From R: Running SQL Database Queries From R in weecology video series V
26. Working With SQL Databases From R: Querying SQL Databases Using dplyr in weecology video series V
27. Working With SQL Databases From R: Copying Data From R To A Database in weecology video series V

28. SQL Databases For dplyr Users: Grouping And Summarizing Data Using GROUP BY in weecology video series V

Intermediate

29. Data Carpentry Ecology Curriculum M W
30. Environmental Informatics Using Research Infrastructures and their Data T
31. Reproducible and Collaborative Statistical Data Science CM
32. Getting and Cleaning Data CM
33. Digital Curation 101 CM
34. Learn to Code for Data Analysis CM

Advanced

35. Ecological Forecasting and Informatics CM

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Data visualization tools

Introductory

1. Introduction to Data Visualization and Data Wrangling for R Users Group CM
2. RStudio Cheatsheets R
3. Data wrangling, exploration, and analysis with R CM
4. Inland water chemistry: the Nordic Lake Survey 1995 CM
5. Baseflow Recession M
6. Examining Changes in Waterfowl Diversity and Climate Change M
7. R Graph Data Visualization R
8. Exploring autocorrelation through lag plots (weecology video series) V
9. Evaluating Forecasts - Hindcasting & Visual Evaluation (weecology video series) V
10. Make Beautiful Graphs in R: 5 Quick Ways to Improve ggplot2 Graphs V
11. Data Storytelling with R V CM

Intermediate

12. Data Carpentry Ecology Curriculum M W
13. Lake Ice Phenology Module M
14. Nutrient Loading Module M
15. Climate Change Module M
16. Reproducible and Collaborative Statistical Data Science CM
17. Learn to Code for Data Analysis CM

Advanced

18. Using Phenocams and Eddy Covariance Data CM
19. Using ModisTools Data CM
20. SESYNC Decision Support Tool Short Course M CM

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Model Building

Statistical models

Introductory

1. Latent Variables V
2. Bayesian Hierarchical Models V
3. NEFI 2019 Summer Course CM
4. NEFI 2020 Summer Course CM
5. Baseflow Recession M
6. Examining Changes in Waterfowl Diversity and Climate Change M
7. Time series modeling: starting with white noise (weecology video series) V
8. Fitting a white noise model to data (weecology video series) V
9. Explaining the ARIMA model (weecology video series) V
10. Fitting an ARIMA model in R (weecology video series) V
11. Modeling seasonal signals in ARIMA models (weecology video series) V
12. Fitting a seasonal ARIMA in R (weecology video series) V
13. Bunnies: An Introduction to Logistic Growth in Discrete Time NLL
14. Emergent Logistic Growth plus Writeup for Entire Series NLL
15. Equation based Logistic Growth NLL
16. Simple Logistic Map NLL
17. Random Walks CM
18. Introduction to Dynamical Systems and Chaos CM
19. Lecture: Pandemics CM
20. Nonlinear Dynamics: Mathematical and Computational Approaches CM
21. Nonlinear Dynamics: Mathematical and Computational Approaches (Spring 2020) CM
22. Introduction to Agent-Based Modeling (Spring 2020) CM
23. Introduction to Species Distribution Modeling Using R in weecology video series V

Intermediate

24. Lake Ice Phenology Module M
25. Stream Discharge Module M
26. Water Quality Module M
27. Soil Respiration Module M
28. Nutrient Loading Module M
29. Spectral Seismology Module M
30. Bayesian Modeling for Socio-Environmental Data Short Course M CM
31. Biogeoinformatics YouTube channel V
32. Tidy Modeling with R T

Advanced

33. Ecological Forecasting and Informatics CM
34. Ecological Models and Data in R M T

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Mechanistic models

Introductory

1. Carbon and Climate CM

Intermediate

2. Climate Change Effects on Lake Temperatures M
3. Cross-Scale Interactions M
4. Teleconnections M
5. Macro-Scale Feedbacks M

Advanced

6. Ecological Forecasting and Informatics CM
7. Physical Processes in Ecosystems T

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State space models

Introductory

1. State Space Models V
2. NEFI 2019 Summer Course CM
3. NEFI 2020 Summer Course CM
4. Introduction to State Space Modeling in R for Forecasting and Modeling Time Series (weecology video series) V
5. Introduction to State Space Modeling in R for Forecasting and Modeling Time Series Part 2 (weecology video series) V

Intermediate

Advanced

6. Ecological Dynamics & Forecasting Course CM
7. Ecological Forecasting and Informatics CM
8. Applied Environmental Statistics CM

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Uncertainty

Introductory

1. Modeling Statistical Uncertainty V
2. Errors in Variables V
3. Uncertainty Propagation: Tradeoffs & Analytical Moments V
4. Uncertainty Propagation: Linear Tangent V
5. Uncertainty Analysis V
6. Uncertainty Propagation: Monte Carlo V
7. NEFI 2019 Summer Course CM
8. NEFI 2020 Summer Course CM
9. Examining Changes in Waterfowl Diversity and Climate Change M
10. Evaluating Forecasts - Evaluating Uncertainty Using Coverage (weecology video series) V
11. Evaluating Forecasts - Evaluating How Forecast Accuracy Changes With Forecast Horizon (weecology video series) V
12. Sensitivity to Initial Conditions NLL
13. Understanding Uncertainty in Ecological Forecasts M

Intermediate

14. Oxford Bibliographies: Ecological Forecasting R
15. Bayesian Modeling for Socio-Environmental Data Short Course M CM
16. Using Ecological Forecasts to Guide Decision Making M

Advanced

17. Ecology Dynamics & Forecasting Course CM
18. Ecological Forecasting and Informatics CM
19. Applied Environmental Statistics CM

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Forecast Cycle

Data assimilation

Introductory

1. Univariate Kalman Filter V
2. Multivariate Kalman Filter V
3. Ensemble Kalman Filter V
4. Particle Filter V
5. NEFI 2019 Summer Course CM
6. NEFI 2020 Summer Course CM

Intermediate

7. Oxford Bibliographies: Ecological Forecasting R

Advanced

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Iteration

Introductory

1. Iteration Explorer NLL

Intermediate

2. Oxford Bibliographies: Ecological Forecasting R

Advanced

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Machine learning

Introductory

1. Machine Learning V
2. NEFI 2019 Summer Course CM
3. NEFI 2020 Summer Course CM
4. Crash Course Artificial Intelligence V
5. Fundamentals of Machine Learning CM
6. Lecture: Artificial Intelligence CM
7. Intro to Machine Learning V CM

Intermediate

8. Neural Networks for Machine Learning CM
9. Practical Deep Learning for Coders CM
10. Introduction to Machine Learning CM
11. Deep Learning CM
12. Applied Deep Learning with TensorFlow* CM

Advanced

13. Advanced Machine Learning CM

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Applying Forecasts

Workflows & Open Science

Introductory

1. NEFI 2019 Summer Course CM
2. NEFI 2020 Summer Course CM
3. Intro to Git and GitHub V CM
4. Intro to Github and Git CM

Intermediate

5. Data Carpentry Ecology Curriculum M W
6. Climate Change Effects on Lake Temperatures M
7. Reproducible and Collaborative Statistical Data Science CM
8. High Performance Computing in the Cloud CM
9. Digital Curation 101 CM

Advanced

10. Ecological Forecasting and Informatics CM
11. Foundational Open Science Skills Online W

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Model assessment (frequentist and Bayesian)

Introductory

1. NEFI 2019 Summer Course CM
2. NEFI 2020 Summer Course CM
3. Baseflow Recession M
4. Evaluating Forecasts - Hindcasting & Visual Evaluation (weecology video series) V
5. Evaluating Forecasts - Quantitative Evaluation of Point Estimates (weecology video series) V
6. Evaluating Forecasts - Evaluating Uncertainty Using Coverage (weecology video series) V
7. Evaluating Forecasts - Evaluating How Forecast Accuracy Changes With Forecast Horizon (weecology video series) V

Intermediate

8. Oxford Bibliographies: Ecological Forecasting R

Advanced

9. Ecological Dynamics & Forecasting Course CM
10. Ecological Forecasting and Informatics CM
11. Applied Environmental Statistics CM

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End-users

Decision science

Introductory

1. Expert Elicitation V
2. PROACT: Intro to Environmental Decision Making V
3. PROACT: Problems & Objectives V
4. PROACT: Performance Measures V
5. PROACT: Decision Alternatives V
6. PROACT: Consequences V
7. PROACT: Trade-offs V
8. NEFI 2019 Summer Course CM
9. NEFI 2020 Summer Course CM
10. An Overview of Structured Decision Making - ALC3183 - Resources CM V
11. Using Ecological Forecasts to Guide Decision Making M

Intermediate

12. Oxford Bibliographies: Ecological Forecasting R
13. SESYNC Decision Support Tool Short Course M CM
14. Using Ecological Forecasts to Guide Decision Making M

Advanced

15. Ecological Dynamics & Forecasting Course CM
16. Ecological Forecasting and Informatics CM

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Interpreting Forecasts

Introductory

1. Betting on Climate Predictions A
2. Lecture: Pandemics CM
3. Calling Bullshit T

Intermediate

4. SESYNC Decision Support Tool Short Course M CM

Advanced

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Extras

Forecasting Textbooks

Introductory

1. Ecological Forecasting T
2. Primer of Ecology Using R T

Intermediate

3. Forecasting: Principles and Practice T
4. Spatiotemporal Statistics with R T
5. Ecological Models and Data in R T

Advanced

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Resource Repositories (external to EFI)

Introductory

1. NIMBioS Resource Library R
2. Online Teaching Activities, Courses, and Materials R
3. Conservation Bridge R
4. Teaching Issues and Experiments in Ecology Special Issue R
5. Enduring Legacies: Native Case Studies M R
6. UKCEH Case Studies M R
7. DNA to Darwin M R
8. Scientific Thinking and Integrative Reasoning Skills - Case Studies M R
9. HHMI BioInteractive M R
10. Knowledge Project R
11. National Geographic Education Resource Library R
12. Network of Conservation Educators & Practitioners Modules M R
13. EarthLab M R

Intermediate

14. Learn to Use Earth Observatories R
15. QUBES R
16. NEON Data Skills GitHub Repo M R
17. Leanpub R T
18. EDSA Video Lectures R V

Advanced

19. Coastal Carbon Training and Resources R
20. PyData YouTube Channel R V

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