

Fisheries modelling in R: the FLR (Fisheries Library in R) project

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FLR



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The FLR project

- Objectives
 - To develop a platform for quantitative work in fisheries biology, assessment and management based on R.
 - To encourage open and transparent collaboration in fisheries research.
 - To introduce new tools and procedures already in use in other fields.
 - To improve upon the quality of the scientific work carried out for fisheries management.
- Research and management applications
- The project

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The FLR project

- Objectives
- Research and management applications
 - Support for data collection and analysis of sampling design issues
 - Exploratory data analysis, data aggregation and error checking
 - Stock assessment and estimation of stock status indicators
 - Simulation testing of management scenarios
- The project

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The FLR project

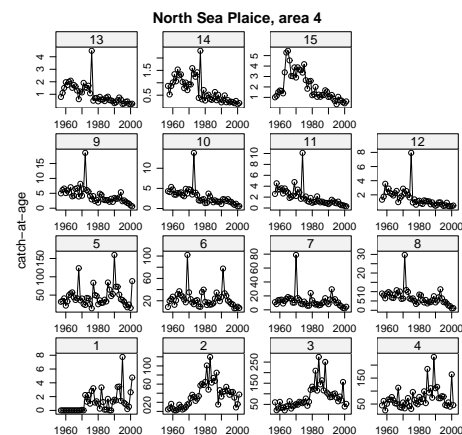
- Objectives
- Research and management applications
- The project
 - <http://flr-project.org>
 - A small team in charge of FLCore, general design and package release
 - EU-funded research projects

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The FLQuant class

- Basic “building block” of FLCore, holds most fisheries data (biological, technological, economic)
- A five dimensional array (soon to be 6D)
- Dimensions: quant, year, unit, season, area, (iter)
- Attribute: units

The FLQuant class

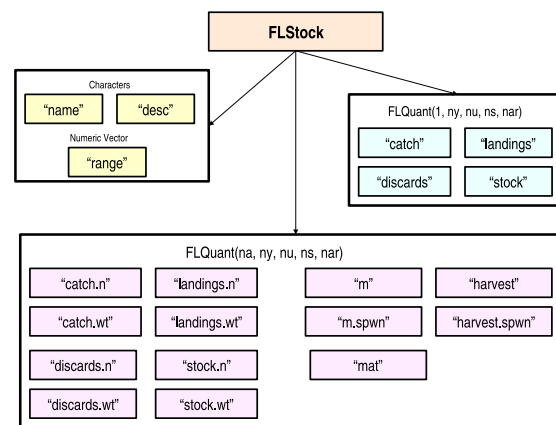


FLCore: classes

- Fully designed around S4 classes
 - Inheritance provides good extensibility (FLAssess)
 - Method overloading reduces command set for interactive use and simplifies modular development (assess)
- C++ classes
 - FLCore classes have been replicated in C++ to use with R headers
 - To help integrating legacy code and speed up slow calculations
- Accesor and replacement functions automatically generated at package compile time

FLCore: classes

- Example: FLStock



FLCore: methods

- Extensive use of lattice to deal with plots of multi-dimensional data
- Minimum set of methods required for new classes
 - show, summary, plot
 - window
- A number of new generic methods covering common operations
- Overloading of many S3 methods in R base

Other packages

- FLEDA: exploratory data analysis, lattice plots,
- FLBayes: Bayesian fisheries models, MCMC S4 class
- FLAssess + FLXSA: Stock assessment using VPA methods
- FLOE: Observation error
- FLOM: Fisheries Operating Model conditioned on age-structured assessment results
- FLEcon

Stock assessment with FLAssess

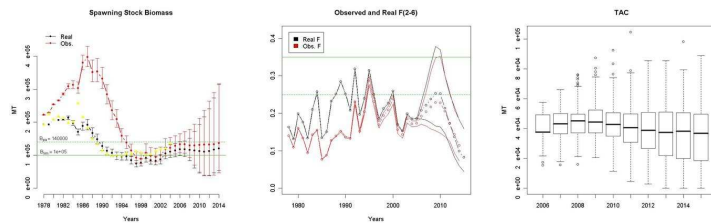
- Stock assessment is a fundamental task in fisheries science.
- Separate implementations of sometimes similar methods require and return input and output files in different formats
- Data available as FLR objects can be input to a range of assessment methods
- Output diagnostics and standard plots are available with the same syntax for different assessment models
- ICES advice system requires yearly evaluation of stock status and trends
- Exploration of data and results is limited by time constraints and the difficulty of moving data between incompatible software

Management Strategy Evaluation

- Computer simulation of stock, fishery, advice and management systems
- Exploration of uncertainties and their impact on management
- Comparison of complex models and simpler management rules under various scenarios
- Objective is the design of management procedures robust to present and future uncertainties
- Pioneered by the development of the Revised Management Procedure of the IWC
 - Operational Model of the fishery system (stock & fleet)
 - Data collection and stock assessment
 - Harvest Control Rule for management decision making
 - Interaction through Bayesian Belief Networks

Management Strategy Evaluation

- Fisheries operating models: Northern Hake (Garcia, D., Mosqueira, I.)



- Variability in SSB, F and TAC due to uncertainty in recruitment and indices of abundance

Future developments

- Increase its adoption on various fora (ICES, Tuna Commissions)
- Packages in development
 - Cluster and grid computation
 - Storage of FLR objects in SQL databases
- File format based on XML and StatDataML
- Implementation of unit testing