Modern Fisheries Science and Global Partnership

Centro de Investigaciones Pesqueras, Havana
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ICES Secretariat
& UN University

ICES
CIEM
Science for sustainable seas

ICES

- Overview of ICES
- Stock assessment and advice
- New transparent workflow
- Existing links between CIP and UN University

Statistical computing

- Software
- Assessment models
- Methods and techniques
- Current modelling trends

ICES - Overview

International Council for the Exploration of the Sea

Marine research & cooperation since 1902

20 member countries (Europe, USA, Canada)

Affiliate countries include South Africa, Australia, New Zealand, and Chile

ICES - Structure

Advice

Working Groups
Benchmarks
Peer Reviews
Final Advice
Transparent Workflow

Science

Working Groups
Ecosystem Approach
Impact on Habitat
Climate and Distribution
Surveys and Fishing Gear

Data

Submitted by Member Countries
Quality Controlled
Open and Available Online - Web Services

Other Services

Annual Science Conference
ICES Journal
Training Courses
Special Requests

ICES - Stock assessment & advice

1. Preparation work at member institutes - data analysis
2. ICES Working Group (WG) meeting - review, report, early draft advice
3. ICES Advice Drafting Group (ADG) meeting - draft advice
4. ICES Advisory Committee (ACOM) meeting - final advice

Transparent Assessment Framework (TAF)

Transparent Assessment Framework (TAF)

Should be:

- Encapsulated: entire pathway from raw data to advice in one system
- Repeatable: data preparation and assessment workflow is recorded
- Transparent: anyone can browse on the web

New framework: TAF

Make it easier to:

- Find data and results from a given assessment
- Rerun model with different data or assumptions
- Prepare and run an update assessment
- Access ICES data web services

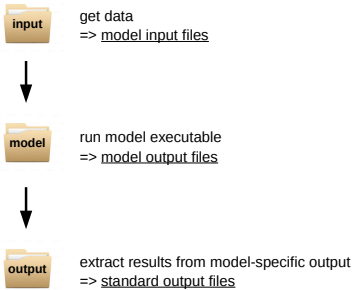
⇒ Will save time for scientific and advisory workflow

New framework: TAF

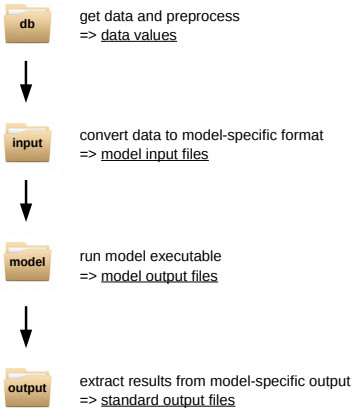
Help people to:

- See changes in model setup and data between years
- Use reproducible research to strengthen institutional memory
- Access data and results from all stocks for big-picture research

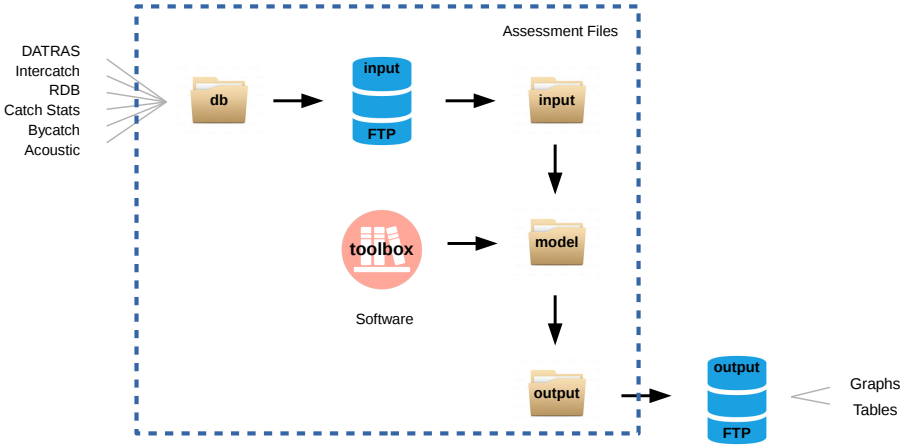
Core workflow



Preprocessing data



Data archives for input and output



R packages supporting TAF workflow

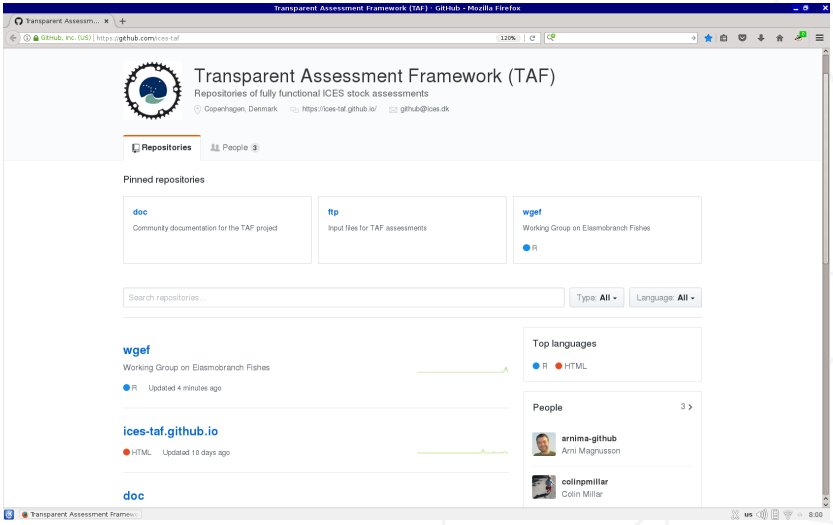
Web services

icesDatras	trawl survey database
icesSAG	stock assessment graphs
icesSD	stock database
icesVocab	reference codes

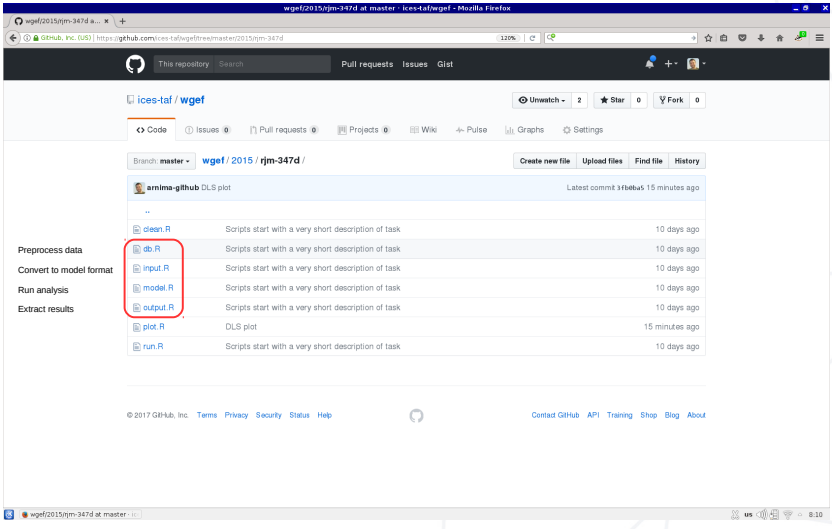
Other

icesAdvice	advisory methods
icesTAF	support functions

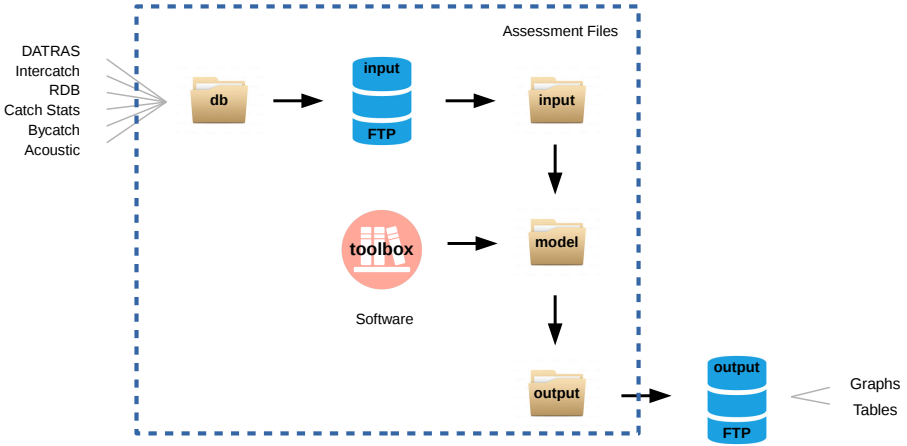
GitHub assessment repository



Assessment = R scripts



TAF overview



Web user interface

(design outline)

Open `taf.ices.dk` in a web browser

Browse (everything is open) or log in to modify/run assessments

- Stock mode — upload, edit, save, run
- Boss mode

HAWG	NWWG
● her-3a22	● cod-iceg
○ her-47d3	● sai-faro
● her-67bc	● sai-icel
● her-irls	○ smr-5614
○ ...	○ ...

Download any dataset into R using read.csv

Key benefits

- High quality science: online, peer-reviewed, reproducible
- Improved time efficiency and reduced workload on WGs
- Much more open and structured than current workflow

Follow ongoing development

taf.ices.dk

Main landing page

ices-taf.github.io

Technical overview and design comments

github.com/ices-taf

Assessments (R scripts)

github.com/ices-tools-prod

R packages

Statistical computing

Statistical computing

Software

Working environment

- R

Model development

- AD Model Builder (ADMB)
- Template Model Builder (TMB)

Methods

- Nonlinear models

  stock assessment

- Evaluating uncertainty

  delta method, bootstrap
  profile likelihood, mcmc

- Simulations

  uncertainty, test performance of methods

RStudio

File Edit Code View Plots Session Build Debug Profile Tools Help

mu.R

```
f <- function(par, data)
{
  fit <- par["mu"]
  sigma <- exp(par["logSigma"])
  -sum(dnorm(data, fit, sigma, TRUE))
}

nlminb(c(mu=0,logSigma=0), f, data=rivers)
```

Environment History

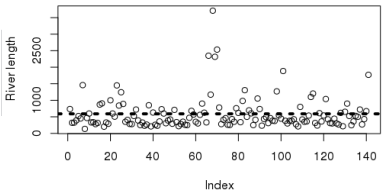
Functions

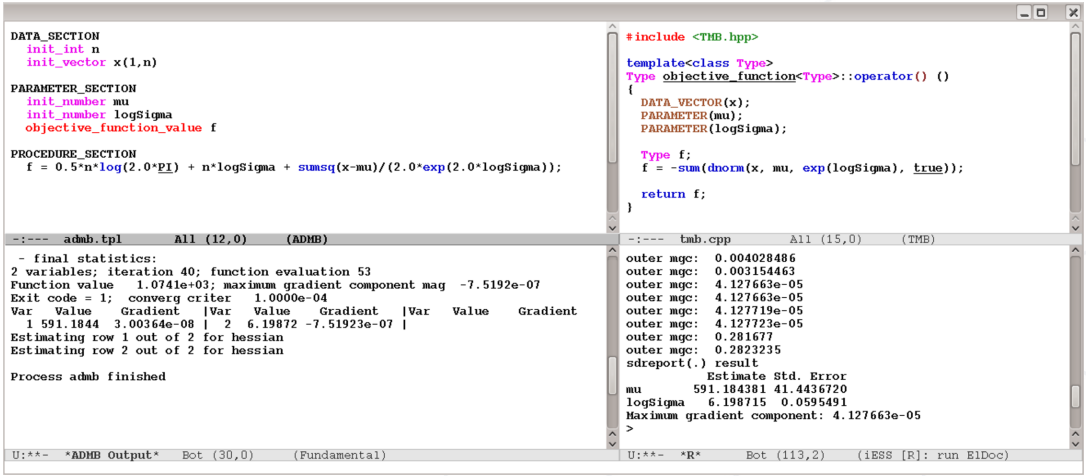
f	function (par, data)

Console ~/core/verk/admb/admin/president/youtube/

```
$par
       mu   logSigma
591.184416   6.198715

$objective
[1] 1074.089

$convergence
[1] 0

$iterations
[1] 37

$evaluations
function gradient
      38       81

$message
[1] "relative convergence (4)"
```

Files Plots Packages Help Viewer




DATA_SECTION
init_int n
init_vector x(1,n)
PARAMETER_SECTION
init_number mu
init_number logSigma
objective_function_value f
PROCEDURE_SECTION
f = 0.5*n*log(2.0*PI) + n*logSigma + sumsq(x-mu)/(2.0*exp(2.0*logSigma));
-:--- admb.tpl All (12,0) (ADMB)
#include <TMB.hpp>
template<class Type>
Type objective_function<Type>::operator() ()
{
DATA_VECTOR(x);
PARAMETER(mu);
PARAMETER(logSigma);
Type f;
f = -sum(dnorm(x, mu, exp(logSigma), true));
return f;
}
-:--- tmb.cpp All (15,0) (TMB)
- final statistics:
2 variables; iteration 40; function evaluation 53
Function value 1.0741e+03; maximum gradient component mag -7.5192e-07
Exit code = 1; converg criter 1.0000e-04
Var Value Gradient |Var Value Gradient |Var Value Gradient
1 591.1844 3.00364e-08 | 2 6.19872 -7.51923e-07 |
Estimating row 1 out of 2 for hessian
Estimating row 2 out of 2 for hessian
Process admb finished
U:**- *ADMB Output* Bot (30,0) (Fundamental)
outer mgc: 0.004028486
outer mgc: 0.003154463
outer mgc: 4.127663e-05
outer mgc: 4.127663e-05
outer mgc: 4.127719e-05
outer mgc: 4.127723e-05
outer mgc: 0.281677
outer mgc: 0.2823235
sdreport(.) result
Estimate Std. Error
mu 591.184381 41.4436720
logSigma 6.198715 0.0595491
Maximum gradient component: 4.127663e-05
>
U:**- *R* Bot (113,2) (iESS [R]: run ElDoc)

Training courses

ICES (1 week)

- Introduction to stock assessment
- Advanced stock assessment
- Introduction to the R environment
- AD Model Builder (ADMB)
- Template Model Builder (TMB)

United Nations University (6 months)

Fisheries training programme:

- Fisheries policy & planning
- Resource assessment & monitoring
- Quality management & processing
- Management of companies & technology
- Sustainable aquaculture

Summary

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ICES - assessment reviews, annual science conference, etc.

Modern workflow - fully scripted and transparent online

Statistical computing - R, AD Model Builder, Template Model Builder

CIP - capacity building and collaboration with United Nations University

Training courses - can also be organized in Havana

Thanks!

Questions?

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ICES International Council for the Exploration of the Sea

CIEM Conseil International pour l'Exploration de la Mer