# Reliability of marine ecosystem models for operational advice: How to assess skills and sensitivity

Sigrid Lehuta – Ifremer, DECOD, Nantes

Ifremer

ISIS-fish

MEXICO

*MEthods for numerical EXploration of COmplex systems*

ICES CIEM

International Council for the Exploration of the Sea

Conseil international pour l'Exploration de la Mer

# Using big models for advice… is hard!

- An example : ISIS-Fish for the évaluation of the West-Med management plan

  Stecf context : 1 week meetings, twice a year

  Tors defined by DG MARE

ISIS-fish

Hake - Gulf of Lion
Calibrated
2015-2017

Evaluation of spatial measures

# Using big models for advice… is hard!

- An example : ISIS-Fish for the évaluation of the West-Med management plan

  Stecf context : 1 week meetings, twice a year

  Tors defined by DG MARE

Scenarios clarified on say 2 (if not 3)

ISIS-fish

Hake - Gulf of Lion
Calibrated
2015-2017

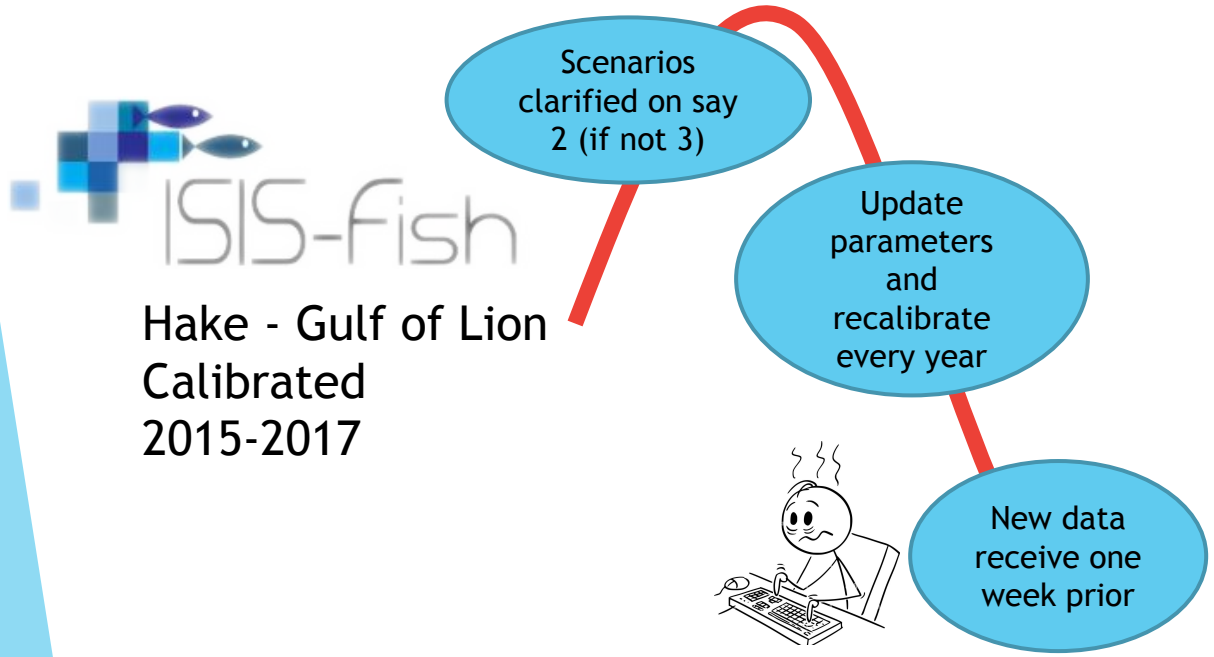
Evaluation of spatial measures

# Using big models for advice… is hard!

- An example : ISIS-Fish for the évaluation of the West-Med management plan

Stecf context : 1 week meetings, twice a year

Tors defined by DG MARE




Hake - Gulf of Lion
Calibrated
2015-2017

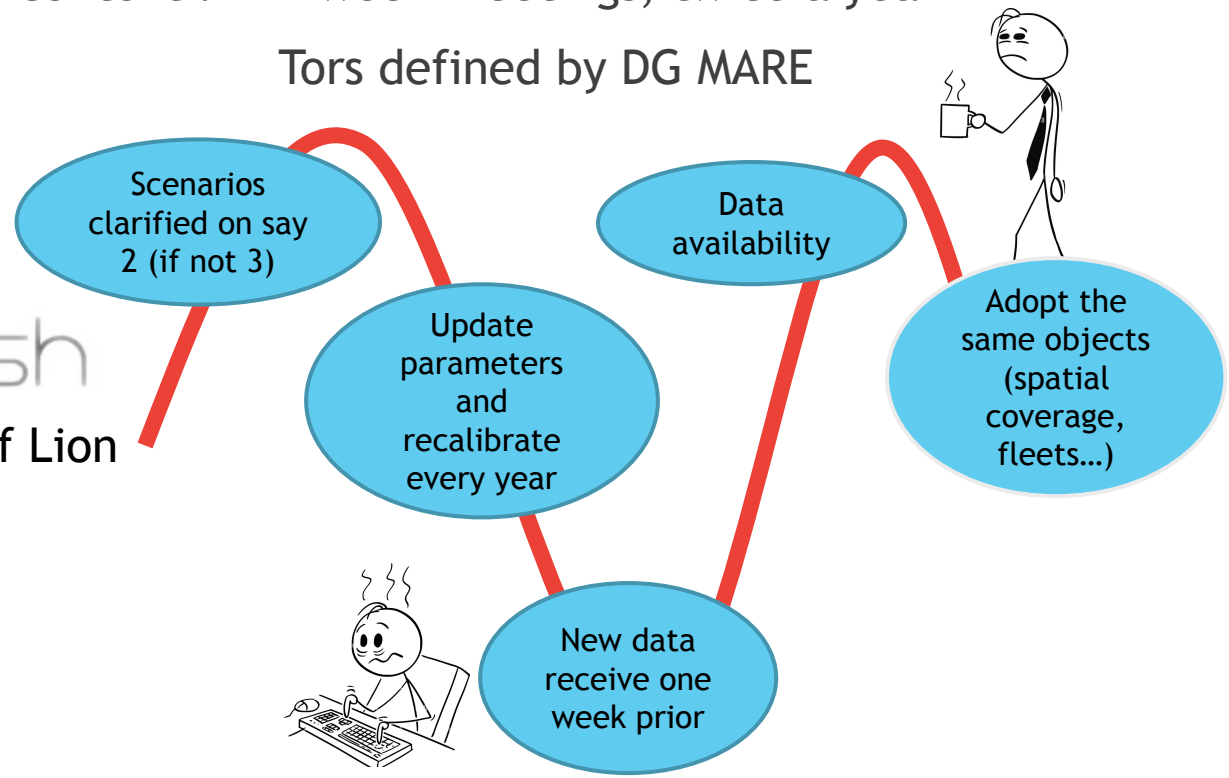
Evaluation of spatial measures

# Using big models for advice… is hard!

- An example : ISIS-Fish for the évaluation of the West-Med management plan

Stecf context : 1 week meetings, twice a year

Tors defined by DG MARE




ISIS-fish

Hake - Gulf of Lion
Calibrated
2015-2017

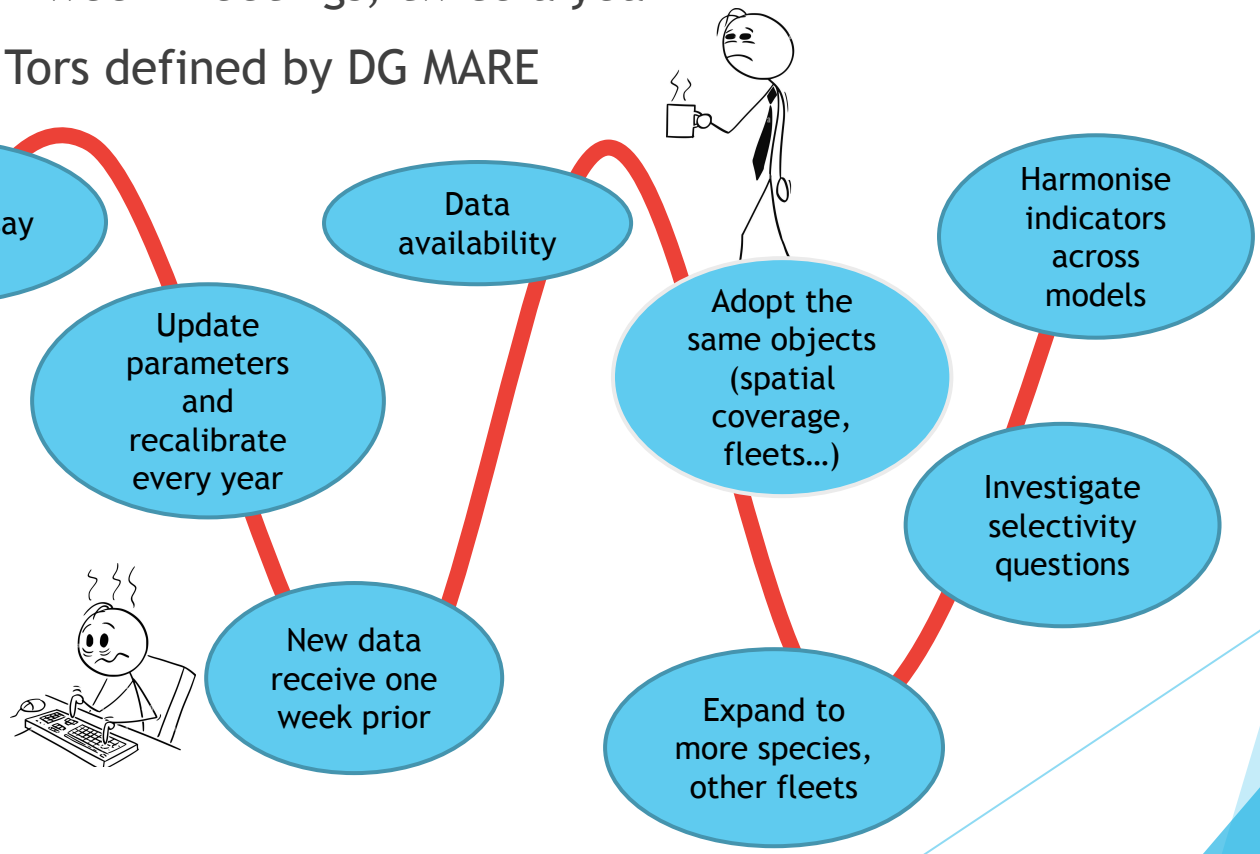
Evaluation of spatial measures

# Using big models for advice… is hard!

- An example : ISIS-Fish for the évaluation of the West-Med management plan

Stecf context : 1 week meetings, twice a year

Tors defined by DG MARE




ISIS-fish

Hake - Gulf of Lion
Calibrated
2015-2017

Evaluation of spatial measures

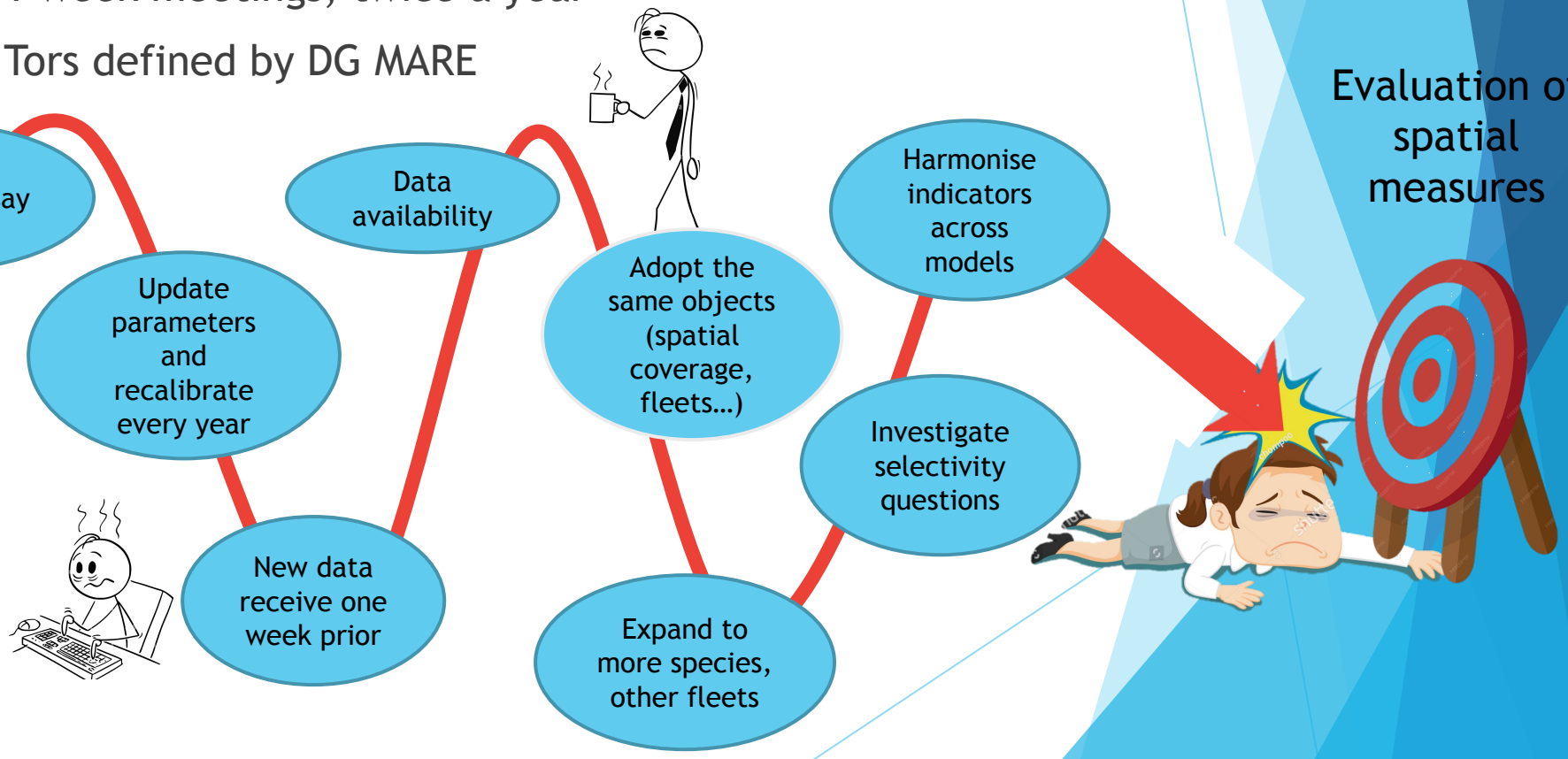
# Using big models for advice… is hard!

- An example : ISIS-Fish for the évaluation of the West-Med management plan

Stecf context : 1 week meetings, twice a year

Tors defined by DG MARE

Hake - Gulf of Lion
Calibrated
2015-2017



# Complex ecosystem models as decision support tools ?

ICES Journal of Marine Science Advance Access published January 9, 2014

ICES Journal of Marine Science

ICES CIEM

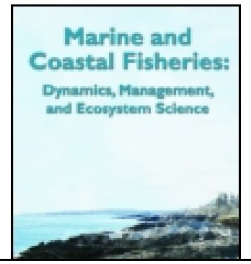
ICES Journal of Marine Science; doi:10.1093/icesjms/fst215

**Food for Thought**

**Hazard warning: model misuse ahead**

**Simulation-based management strategy evaluation: ignorance disguised as mathematics?**

Marie-Joëlle Rochet and Jake C. Rice




**Marine and Coastal Fisher Management, and Ecosyst**

Publication details, including instructions f subscription information:
http://www.tandfonline.com/loi/umcf20

**End-To-End Models for the Marine Ecosystems: Challe and Next Steps**

Marine Policy 61 (2015) 291–302

Contents lists available at ScienceDirect

Marine Policy

journal homepage: www.elsevier.com/locate/marpol

**Making modelling count - increasing the contribution of shelf-seas community and ecosystem models to policy development and management**

Kieran Hyder [a,*], Axel G. Rossberg [a], J. Icarus Allen [b], Melanie C. Austen [b], Rosa M. Barciela [c], Hayley J. Bannister [d], Paul G. Blackwell [e], Julia L. Blanchard [d,f], Michael T. Burrows [g], Emma Defriez [h], Tarquin Dorrington [i], Karen P. Edwards [j], Bernardo Garcia-Carreras [a,h],

Contents lists available at SciVerse ScienceDirect

Progress in Oceanography

journal homepage: www.elsevier.com/locate/pocean

**Dealing with uncertainty in ecosystem models: The paradox of use for living marine resource management**

J.S. Link [a,*], T.F. Ihde [b], C.J. Harvey [c], S.K. Gaichas [d], J.C. Field [e], J.K.T. Brodziak [f], H.M. Townsend [b] R.M. Peterman [g]

SCIENTIA MARINA 76(1)
March 2012, 195-201, Barcelona (Spain)
ISSN: 0214-8358
doi: 10.3989/scimar.03574.20B

**nd-to-end models for marine ecosystems: Are we on the precipice of a significant advance or just putting lipstick on a pig?**

KENNETH A. ROSE

ICES Journal of Marine Science Advance Access published September 7, 2015

ICES Journal of Marine Science

ICES CIEM

ICES Journal of Marine Science; doi:10.1093/icesjms/fsv155

**Food for Thought**

**Projecting the future state of marine ecosystems, "la grande illusion"?**

Contents lists available at ScienceDirect

Progress in Oceanography

journal homepage: www.elsevier.com/locate/pocean

**The case for marine ecosystem models of intermediate complexity**

Charles Hannah [a,*], Alain Vezina [a], Mike St. John [b]

[a] Bedford Institute of Oceanography, Fisheries and Oceans Canada, Dartmouth, NS, Canada
[b] University of Hamburg, Hamburg, Germany

Aquat. Living Resour. 29, 208 (2016)
© EDP Sciences 2016
DOI: 10.1051/alr/2016022
www.alr-journal.org

Aquatic Living Resources

**Reconciling complex system models and fisheries advice: Practical examples and leads**

Sigrid LEHUTA[1,a], Raphaël GIRARDIN[2], Stéphanie MAHÉVAS[1], Morgane TRAVERS-TROLET[2] and Youen VERMARD[1]

[1] IFREMER Ecologie et modèles pour l'halieutique, Rue de l'île d'Yeu, BP 2011, 44311 Nantes Cedex 03, France
[2] IFREMER Halieutique Manche Mer du Nord, 150 Quai Gambetta, 62200 Boulogne-sur-Mer, France

FISH and FISHERIES

FISH and FISHERIES

**On scientists' discomfort in fisheries advisory science: the example of simulation-based fisheries management-strategy evaluations**

*Sarah B M Kraak[1,2], Ciaran J Kelly[2], Edward A Codling[3] & Emer Rogan[1]*

Contents lists available at ScienceDirect

Marine Policy

journal homepage: www.elsevier.com/locate/marpol

**Building ecological-economic models and scenarios of marine resource systems: Workshop report**

# Ready to take up the challenges…
# but not alone and well armed !

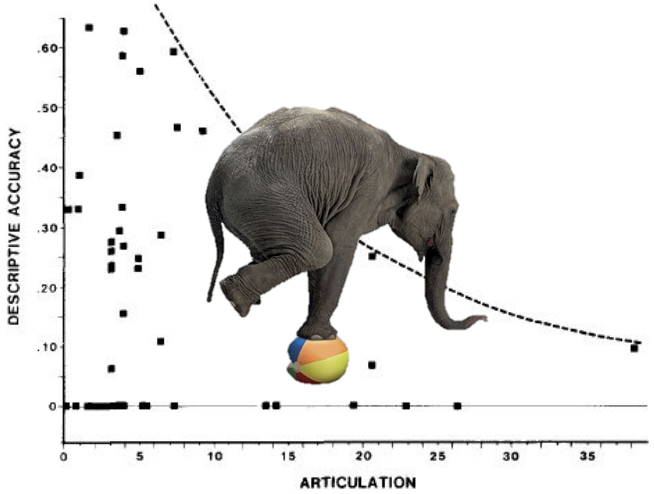



Fig. 1. Plot of articulation index vs. descriptive accuracy index for the models reviewed in this study, showing the current accuracy frontier.

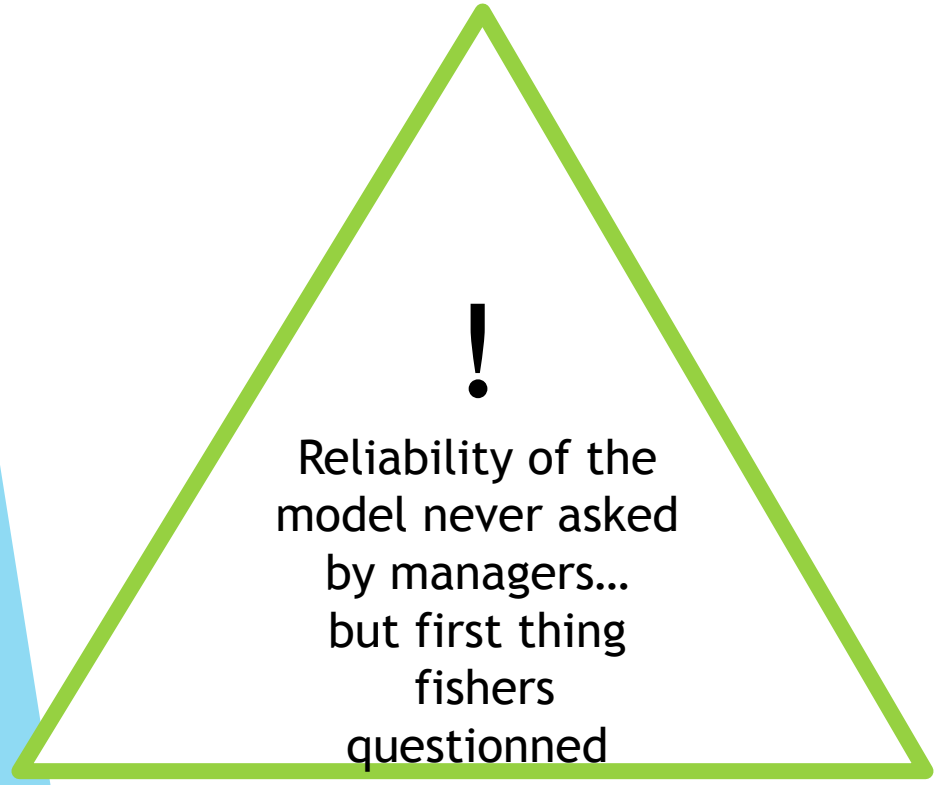
Costanza and Slar, 1985

complexity

The appropriate level of complexity is needed

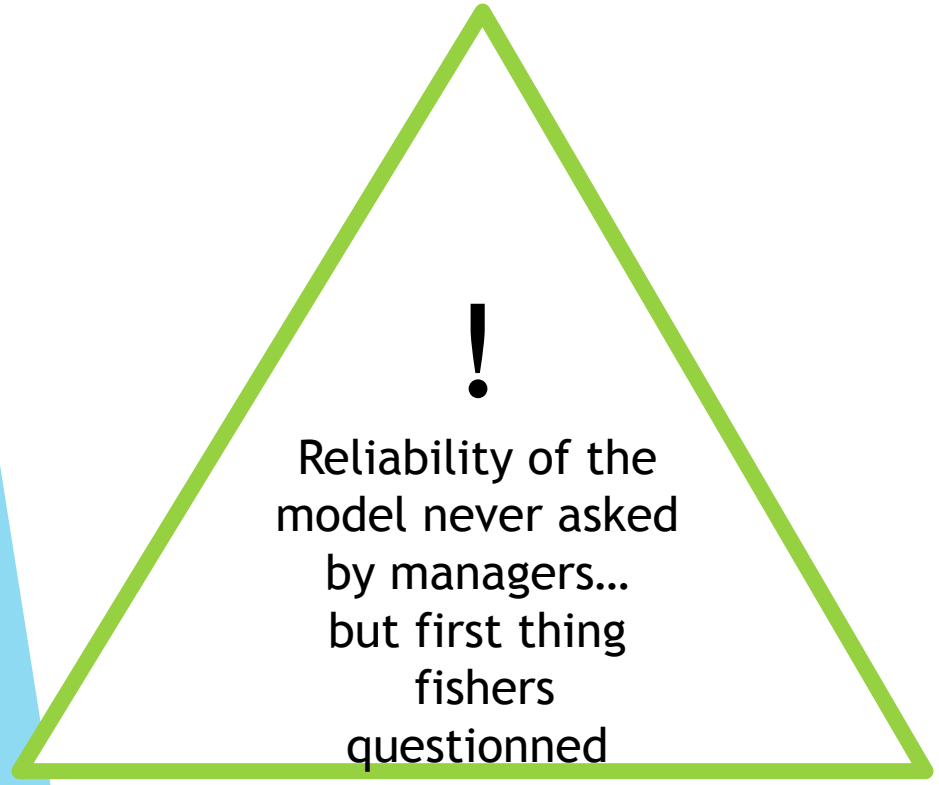
- Replicability, flexibility, automating processes
- Transparency, appropriateness, robustness
- Communication, Appropriation

# Ready to take up the challenges… but not alone and well armed !




- Replicability, flexibility, automating processes
- Transparency, appropriateness, robustness
- Communication, Appropriation

# Ready to take up the challenges…
# but not alone and well armed !




- Replicability, flexibility, automating processes
- **Transparency, appropriateness, robustness**
- Communication, Appropriation

# Best Practices for MEMs in operational advice Validation/ skill assessment/ benchmarking/ evaluation…

Journal of Marine Systems 109–110 (2013) 103–108

Contents lists available at SciVerse ScienceDirect

Journal of Marine Systems

journal homepage: www.elsevier.com/locate/jmarsys

## Construction kits or virtual worlds; Management applications of E2E models☆

John H. Steele [a,*], Kerim Aydin [b], Dian J. Gifford [c], Eileen E. Hofmann [d]

Progress in Oceanography 102 (2012) 102–114

Contents lists available at SciVerse ScienceDirect

Progress in Oceanography

journal homepage: www.elsevier.com/locate/pocean

## Report of the 2nd National Ecosystem Modeling Workshop (NEMoW II)

## Bridging the Credibility Gap - Dealing with Uncertainty in Ecosystem Models

## Dealing with uncertainty in ecosystem models: The paradox of use for living marine resource management

J.S. Link [a,*], T.F. Ihde [b], C.J. Harvey [c], S.K. Gaichas [d], J.C. Field [e], J.K.T. Brodziak [f], H.M. Townsend [b]
R.M. Peterman [g]

Food and Agriculture Organization of the United Nations

ENHANCED BY Google

English

GLOBEFISH

Information and Analysis on Markets and Trade of Fisheries and Aquaculture Products

About GLOBEFISH | Market Reports | Trade Information | Countries | Publications | News & Events | Prices | Meet the Expert

Fisheries management. 2. The ecosystem approach to fisheries. 2.1 Best practices in ecosystem modelling for informing an ecosystem approach to fisheries

Environmental Modelling and Software 128 (2020) 104697

Contents lists available at ScienceDirect

Environmental Modelling and Software

journal homepage: http://www.elsevier.com/locate/envsoft

## A system of metrics for the assessment and improvement of aquatic ecosystem models

Matthew R. Hipsey [a,b,*], Gideon Gal [c], George B. Arhonditsis [d], Cayelan C. Carey [e], J. Alex Elliott [f], Marieke A. Frassl [g], Jan H. Janse [h], Lee de Mora [i], Barbara J. Robson [j]

ScienceDirect

journal homepage: www.elsevier.com/locate/ecolmodel

## A methodology for developing simulation models of complex systems

*Craig A. Aumann**

*CW-405, Department of Biological Sciences, University of Alberta, Edmonton, Alta., Canada T6G 2E9*

# But we can't get enough!
# The need for paving the way with questions…

… that could serve as a template for reporting the exercice

… and accomodate the diversity of MEMs (~~one fits all~~)

inspired from ICES « key runs »  and  Overview Design Details (Grimm et al., 2006)

Fisheries Research 268 (2023) 106845

Contents lists available at ScienceDirect

Fisheries Research

journal homepage: www.elsevier.com/locate/fishres

Skill assessment of models relevant for the implementation of ecosystem-based fisheries management

Alexander Kempf [a,*], Michael A. Spence [b], Sigrid Lehuta [c], Vanessa Trijoulet [d], Valerio Bartolino [e], Maria Ching Villanueva [f], Sarah K. Gaichas [g]

ICES WGSAM team

Ecological Modelling 471 (2022) 110059

Contents lists available at ScienceDirect

Ecological Modelling

journal homepage: www.elsevier.com/locate/ecolmodel

A standard protocol for describing the evaluation of ecological models

Benjamin Planque [a,*], Johanna M. Aarflot [b], Lucie Buttay [a], JoLynn Carroll [c,d], Filippa Fransner [e], Cecilie Hansen [b], Bérengère Husson [b], Øystein Langangen [f], Ulf Lindstrøm [a,d], Torstein Pedersen [d], Raul Primicerio [a,d], Elliot Sivel [a,d], Morten D. Skogen [b], Evelyn Strombom [g], Leif Christian Stige [f], Øystein Varpe [h,i], Nigel G. Yoccoz [d]

Contents lists available at ScienceDirect

Fisheries Research

ELSEVIER

Skill assessment
ecosystem-based

Alexander Kempf[a,*],
Valerio Bartolino[c], M

**General questions**

What is needed for a successful delivery of the advice product?

- ☐ What is the advice question?
- ☐ Has the model the right complexity?
- ☐ Can the model deliver the output needed at the right spatial and temporal scales?
- ☐ Which are the most important outputs and metrics for the advice?

What type of model is available and which skill assessment methods are appropriate?

What real world observations are available for skill assessments?

- ☐ Are sufficient observations for important outputs in relation to t… …estion(s) available?
- ☐ Are the observations at the right spatial and temporal scale in relation to the advice question(s)?
- ☐ How certain and/or biased are the observations?

**Hindcast**

Which are the most sensitive parameters and is there room for improvement?

What is the performance of the (final) model hindcasts?

- ☐ How good is the agreement between model output and real world observations?
- ☐ How large are the estimated parameter uncertainties?
- ☐ Are there indications for major structural uncertainties (e.g. … by sensitivity analyses)?

Are the parameterization and emerging properties from the (final) model sound according to scientific knowledge?

Are there retrospective patterns?

**Forecast**

What is the predictive skill of the (final) model?

- ☐ Do predictions show expected model behavior?
- ☐ How does the model perform in cross validations?
- ☐ How large are the estimated uncertainties?
- ☐ Are there indications for major structural uncertainties (e.g, identified by sensitivity analyses)?
- ☐ How is the performance of short-, medium- and long-term forecasts?

Appropriateness
Observation availability and quality

Contents lists available at ScienceDirect

Ecological Modelling

ELSEVIER

A standard pro

Benjamin Planque[a]
Cecilie Hansen[b], B
Torstein Pedersen[d]
Leif Christian Stige

| | | # | Question |
|---|---|---|---|
| OBJECTIVES | CONTEXT AND MOTIVATIONS | 1 | What are the objectives of the model application? |
| | | 2 | Why is the model suitable to address the objectives? |
| | | 3 | What would count as successful in achieving these objectives? |
| | SPECIFIC MODEL SETUP | 4 | Are there any deviations from the original model description?<br>a In the model assumptions?<br>b In the model structure – submodels, variables, components, scales?<br>c In the model details – parameter values, functional relationships<br>d In the model forcing – initial conditions, boundary conditions, observation forcing, maps? |
| PATTERNS | SELECTED PATTERNS | 5 | Which ecological patterns are used for the model evaluation?<br>a Temporal patterns – cycles, shifts, trends, variability, autocorrelation<br>b Spatial patterns – synchrony, travelling waves, patchiness, autocorrelation<br>c Structural, functional patterns – diversity, biomass ratio, integrated production, diet, traits<br>d Other relevant patterns |
| | | 6 | Why are these patterns important/essential to address the objectives? |
| | INDEPENDENT DATA | 7 | Where do the independent data originate from? |
| | | 8 | What are the extent and resolution of the independent data? |
| | | 9 | How representative of the ecological process are the independent data? |
| | | 10 | Are there estimates of independent data accuracy, precision, bias, or uncertainty? |
| | | 11 | How are the independent data processed to represent the selected pattern? Are assumptions made to derive these patterns from the data? |
| | MODEL OUPUTS | 12 | Which model outputs are used for the evaluation? |
| | | 13 | Have the outputs been post-processed, and how? |
| | | 14 | Are there estimates of model output accuracy, precision, bias, or uncertainty? |
| | | 15 | Are additional assumptions made when deriving patterns from model outputs? |

Contents lists available at ScienceDirect

Fisheries Research

ELSEVIER

Skill assessment
ecosystem-based

Alexander Kempf[a,*],
Valerio Bartolino[e], M

**General questions**

What is needed for a successful delivery of the advice product?

- ☐ What is the advice question?
- ☐ Has the model the right complexity?
- ☐ Can the model deliver the output needed at the right spatial and temporal scales?
- ☐ Which are the most important outputs and metrics for the advice?

What type of model is available and which skill assessment methods are appropriate?

What real world observations are available for skill assessments?

- ☐ Are sufficient observations for important outputs in relation to the advice question(s) available?
- ☐ Are the observations at the right spatial and temporal scale in relation to the advice question(s)?
- ☐ How certain and/or biased are the observations?

**Hindcast**

Which are the most sensitive parameters and is there room for improvement?

What is the performance of the (final) model hindcasts?

- ☐ How good is the agreement between model output and real world observations?
- ☐ How large are the estimated parameter uncertainties?
- ☐ Are there indications for major structural uncertainties (e.g, identified by sensitivity analyses)?

Are the parameterization and emerging properties from the (final) model sound accor… scientific knowledge?

Are there retrospective patterns?

**Forecast**

What is the predictive skill of the (final) model?

- ☐ Do predictions show expected model behavior?
- ☐ How does the model perform in cross validations?
- ☐ How large are the estimated uncertainties?
- ☐ Are there indications for major structural uncertainties (e.g, identified by sensitivity analyses)?
- ☐ How is the performance of short-, medium- and long-term forecasts?

Contents lists available at ScienceDirect

Ecological Modelling

journal homepage: www.elsevier.com/locate/ecolmodel

ELSEVIER

A standard pr…

Benjamin Planque
Cecilie Hansen[b], …
Torstein Pedersen
Leif Christian Stig…

**Table 1** (*continued*)

| | | # | Question |
|---|---|---|---|
| EVALUATION | EVALUATION METHODOLOGY | 16 | Are sanity checks conducted? If so, what is the method used? If not, explain why.<br>a Which data and patterns are used for this?<br>b Does this apply to patterns that are not otherwise evaluated for this model application? |
| | | 17 | What is the methodology used to compare ecological patterns derived from independent data with patterns from the model?<br>a What is the rationale for choosing this method?<br>b How are observational and/or model output uncertainties handled?<br>c Does the methodology rely on specific assumptions?<br>d Were other methods experimented? If they didn't succeed, explain why. |
| | | 18 | Is there a threshold level (match between observed and modelled patterns) that can separate acceptable from unacceptable models? |
| | | 19 | How comparable are the patterns derived from the model and those derived from the independent data? |
| | SENSITIVITIES | 20 | Has a model sensitivity analysis been performed? If so, how? If not, explain why.<br>a on the model structure?<br>b on the model parametrization?<br>c on other aspects of the model? |
| | | 21 | Which elements are the modelled patterns most sensitive to?<br>a input parameters<br>b priors and assumptions<br>c structural elements<br>d processes |
| | | 22 | How sensitive are the modelled patterns to the choice of initial conditions, boundary conditions, spatial and temporal resolution? |
| | | 23 | How sensitive is the model evaluation to the independent data availability and uncertainty? |
| | | 24 | How much is the model evaluation constrained by computational or theoretical limits? |
| | | 25 | How does the perceived performance of the model depend on the chosen evaluation methodology? |

Model behavior

Contents lists available at ScienceDirect

Fisheries Research

ELSEVIER

Skill assessment
ecosystem-based

Alexander Kempf[a,*],
Valerio Bartolino[c], M

**General questions**

What is needed for a successful delivery of the advice product?

- ☐ What is the advice question?
- ☐ Has the model the right complexity?
- ☐ Can the model deliver the output needed at the right spatial and temporal scales?
- ☐ Which are the most important outputs and metrics for the advice?

What type of model is available and which skill assessment methods are appropriate?

What real world observations are available for skill assessments?

- ☐ Are sufficient observations for important outputs in relation to the advice question(s) available?
- ☐ Are the observations at the right spatial and temporal scale in relation to the advice question(s)?

- ☐ How good is the agreement between model output and real world observations?
- ☐ How large are the estimated parameter uncertainties?
- ☐ Are there indications for major structural uncertainties (e.g, identified by sensitivity analyses)?

Are the parameterization and emerging properties from the (final) model sound acco… scientific knowledge?

Are there retrospective patterns?

**Forecast**

What is the predictive skill of the (final) model?

- ☐ Do predictions show expected model behavior?
- ☐ How does the model perform in cross validations?
- ☐ How large are the estimated uncertainties?
- ☐ Are there indications for major structural uncertainties (e.g, identified by sensitivity analyses)?
- ☐ How is the performance of short-, medium- and long-term forecasts?

Emphasis on hindcast vs.
Forecast, technical,
Estimation models+

Contents lists available at ScienceDirect

Ecological Modelling

journal homepage: www.elsevier.com/locate/ecolmodel

ELSEVIER

A standard pr…

Benjamin Planque
Cecilie Hansen[b], I
Torstein Pedersen
Leif Christian Stig

**Table 1** (*continued*)

| | | # | Question |
|---|---|---|---|
| EVALUATION | EVALUATION METHODOLOGY | 16 | Are sanity checks conducted? If so, what is the method used? If not, explain why.<br>a Which data and patterns are used for this?<br>b Does this apply to patterns that are not otherwise evaluated for this model application? |
| | | 17 | What is the methodology used to compare ecological patterns derived from independent data with patterns from the model?<br>a What is the rationale for choosing this method?<br>b How are observational and/or model output uncertainties |
| | SENSI… | | …ns?<br>…succeed, explain<br>…and modelled<br>…otable models?<br>…model and those<br>…so, how? If not, |
| | | | a on the model structure?<br>b on the model parametrization?<br>c on other aspects of the model? |
| | | 21 | Which elements are the modelled patterns most sensitive to?<br>a input parameters<br>b priors and assumptions<br>c structural elements<br>d processes |
| | | 22 | How sensitive are the modelled patterns to the choice of initial conditions, boundary conditions, spatial and temporal resolution? |
| | | 23 | How sensitive is the model evaluation to the independent data availability and uncertainty? |
| | | 24 | How much is the model evaluation constrained by computational or theoretical limits? |
| | | 25 | How does the perceived performance of the model depend on the chosen evaluation methodology? |

Emphasis on patterns,
documentation,
sensitivity
Simulation models+

# A Practical Guide for Conducting Calibration and Decision-Making Optimisation with Complex Ecological Models

Stephanie Mahévas *, Victor Picheny, Patrick Lambert, Nicolas Dumoulin, Lauriane Rouan, Jean-Christophe Soulié, Dimo Brockhoff, Sigrid Lehuta, Rodolphe Le Riche, Robert Faivre, Hilaire Drouineau


- The same need dedicated to the calibration (fitting) phase
- The ODD of Optimisation protocole

| | | | |
|---|---|---|---|
| Pre-processing | Problem Formulation | Model | |
| | | Question | |
| | | Data | |
| | | Parameters Bounds&constrainsts | |
| | | Uncertainty (process and data) | |
| | | Initial objective function | |
| | Objective Function | building | |
| | | reshaping | |
| | | final | |
| | Exploratory Analysis | data | |
| | | Reduction dimension | |

| | | |
|---|---|---|
| Algorithm | Family | |
| | Description-Justification | |
| | Changes in the algorithm | |
| | Settings | |

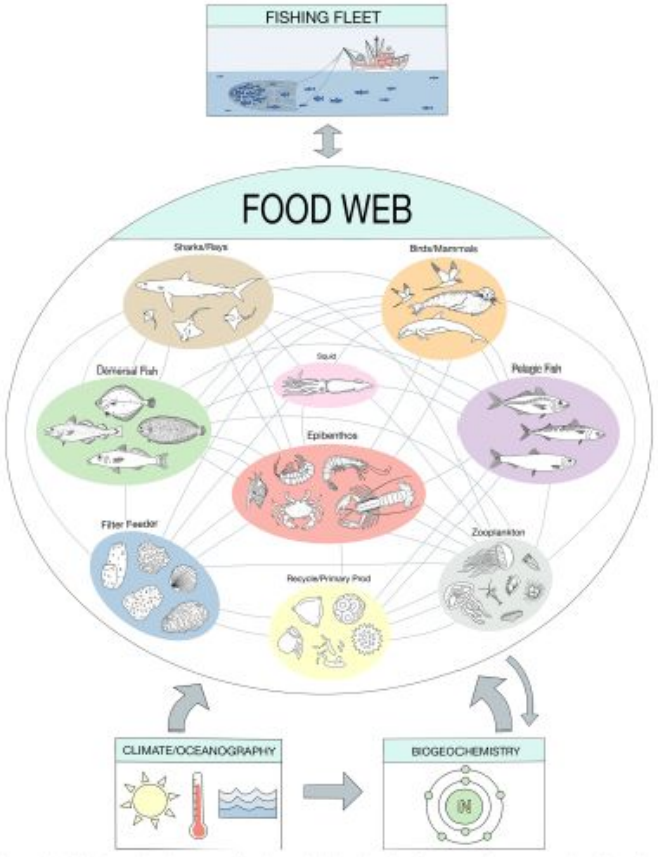
| | | |
|---|---|---|
| Algorithm | Family | |
| | Description-Justification | |
| | Changes in the algorithm | |
| | Settings | |

| | | |
|---|---|---|
| Post-processing | Convergence | |
| | Optimum properties including Identifiability | |
| | Residual analysis | |
| | Multicriteria | |

| | |
|---|---|
| Comment | Number of simulations required |
| | Duration |
| | Reached stopping criteria |
| | |

# An insightful Sensitivity analysis of an Atlantis model

- Atlantis in the Eastern English Channel




Ecological Modelling 431 (2020) 109133

Contents lists available at ScienceDirect

Ecological Modelling

journal homepage: www.elsevier.com/locate/ecolmodel

Improving confidence in complex ecosystem models: The sensitivity analysis of an Atlantis ecosystem model

Chloe Bracis[a,*], Sigrid Lehuta[b], Marie Savina-Rolland[c], Morgane Travers-Trolet[b], Raphaël Girardin[a]

- Morris method
- 4550 simulations – 90 parameters – 4h/run
- Impact on biomass (40 groups) and system stability

# An exemple of insightful Sensitivity analysis of a complex model

- Atlantis in the Eastern English Channel
- Top down control : unrealistic behavior of top predateurs

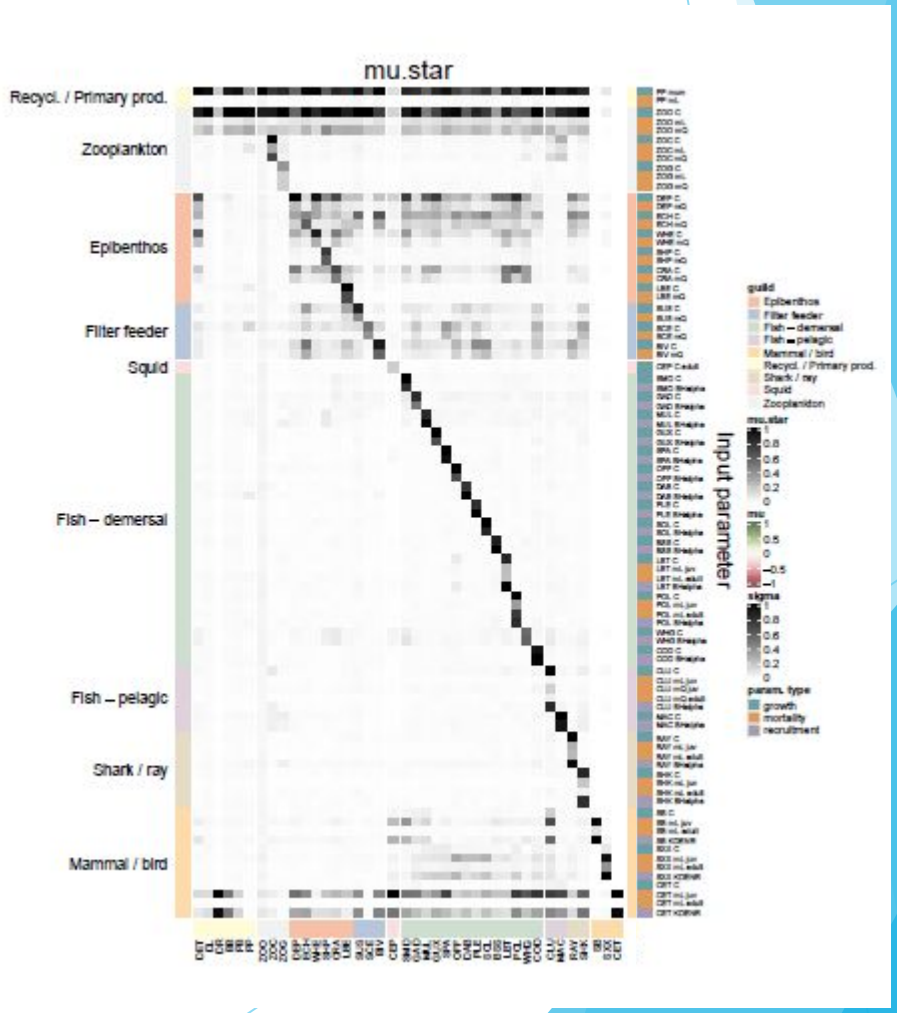
⇒ better represent competition among top predators and the effects of limited food

- Bottom-up control : growth rates of phytoplankton and zooplankton

⇒ Improve representation, coupling/inputs from NPZ models

- Strong benthopelagic coupling in the system consistent with shallow system
- Distinction betw. parameters affecting all groups vs. their own group

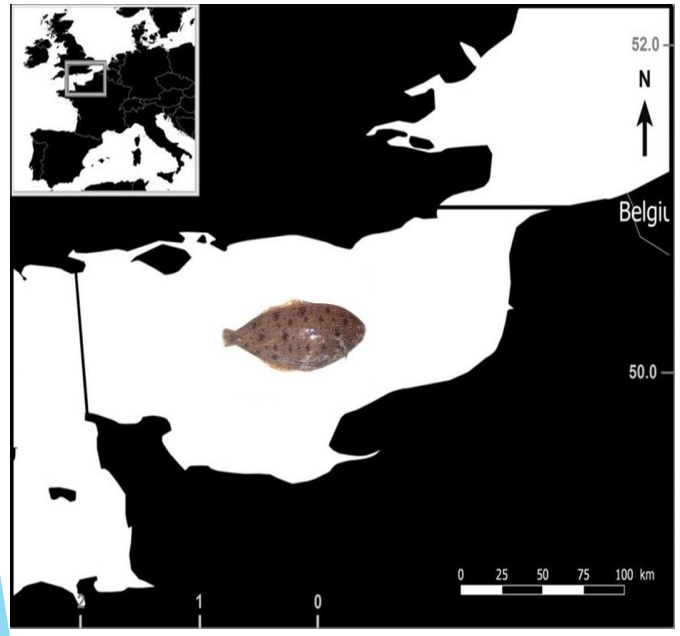
⇒ Implication for calibration



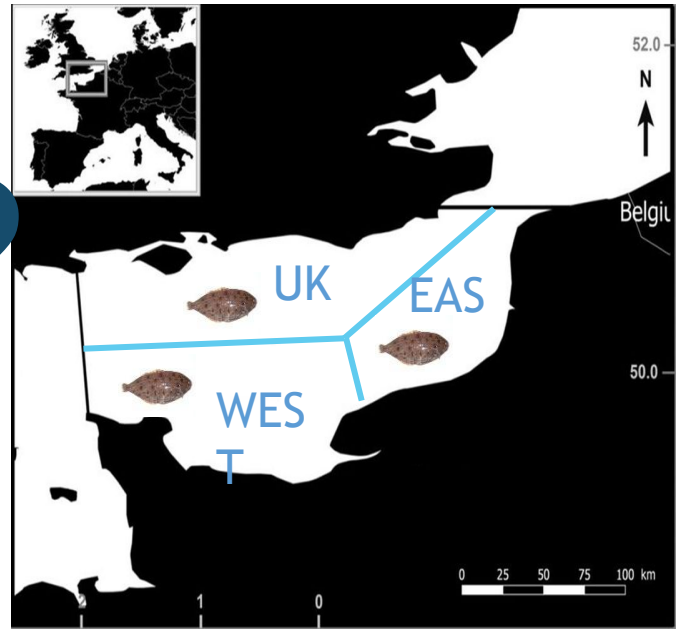
# Skill assessment for testing assumptions

- ISIS-Fish for Sole in the Eastern English Channel

(Kotthaus, 1963 ; Coggan & Dando, 1988 ; Riou et al., 2001 ; Burt & Millner, 2008 ; Rochette et al., 2012 ; Le Pape & Cognez et al., 2016 ; Du Pontavice et al., 2018)



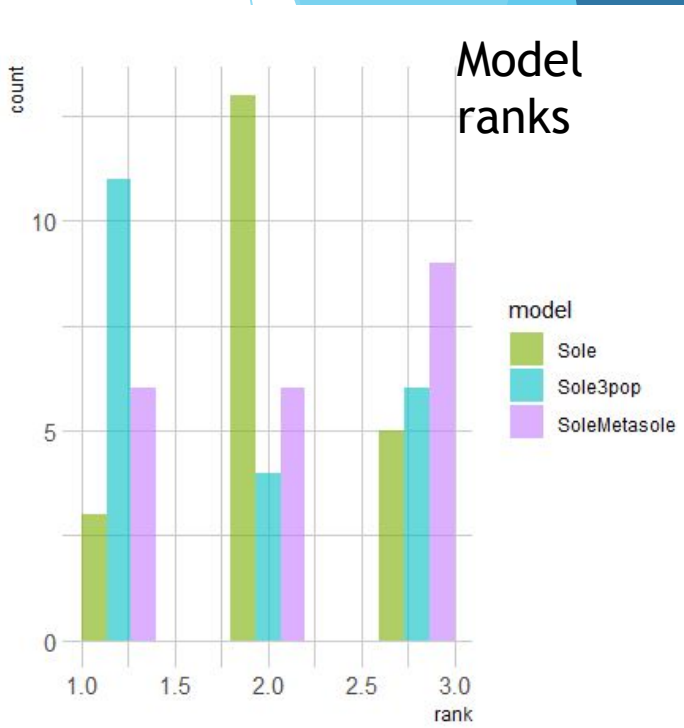

?

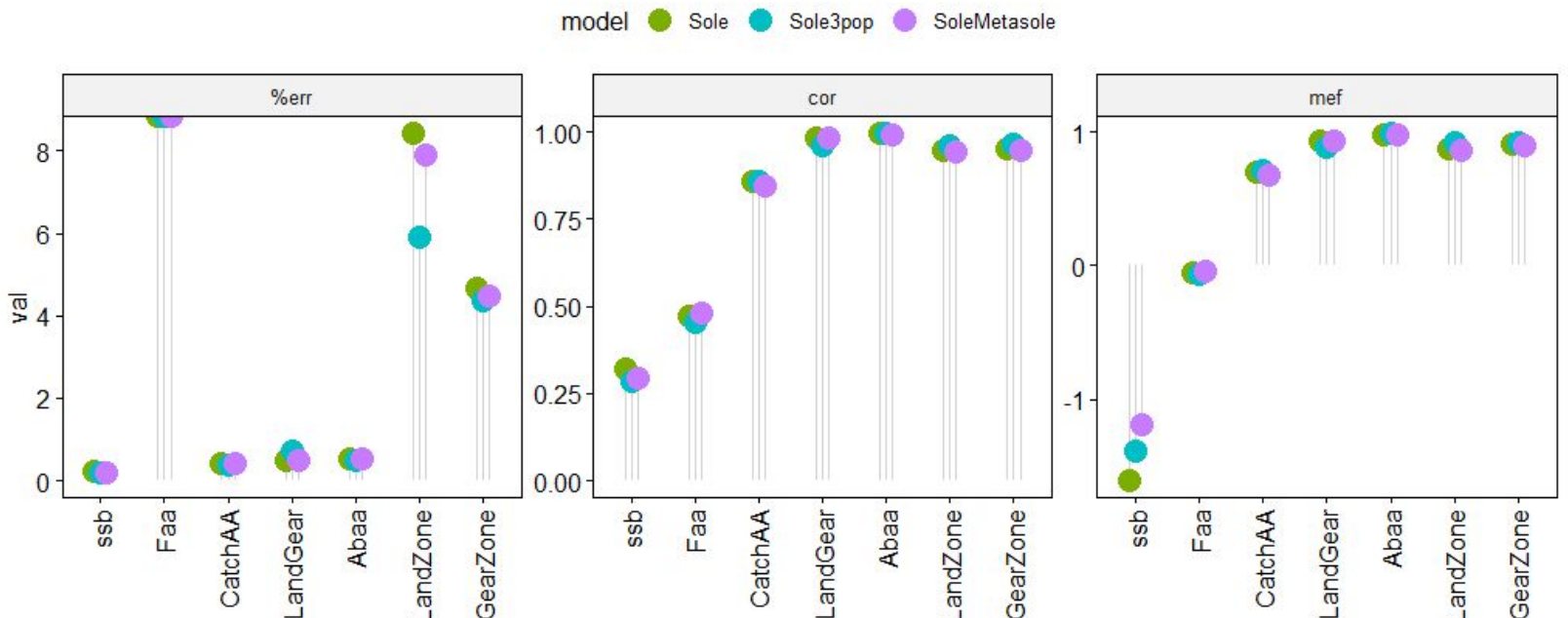



- Calibation (GA) of 3 alternative models – 11 parameters – 1h/run
- Comparative model skill assessment
- Implication for MSY estimates

# Skill assessment for testing assumptions

- ISIS-Fish for Sole in the Eastern English Channel
- More differences betw. variables than models
- Complementarity of metrics
- F and SSB less reliable than other outputs



# Combining sensitivity and skill assessment to calibrate

- Larval drift IBM for Sole in the North Sea

MARINE ECOLOGY PROGRESS SERIES
Mar Ecol Prog Ser

In press

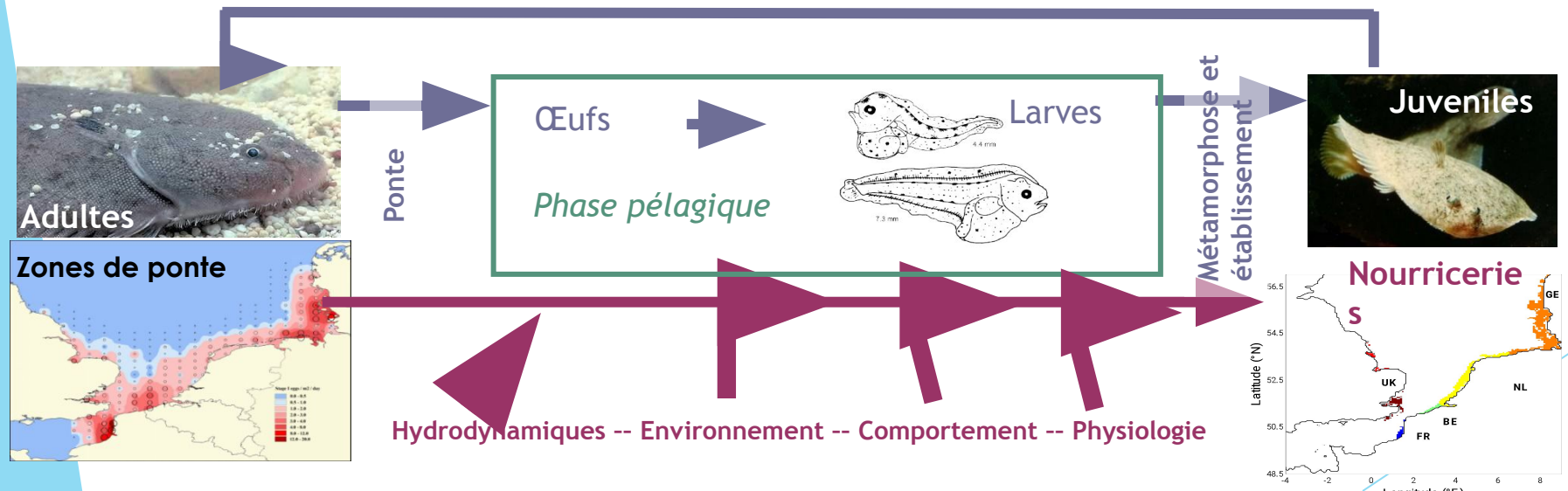
**Lessons from the calibration and sensitivity analysis of a fish larval transport model**

Léo Barbut[1,2,*], Sigrid Lehuta[3], Filip A.M. Volckaert[2], Geneviève Lacroix[1]

- 8 parameters (1 discret) - 12h/1 year run
- Observations available to assess model skills over 12 years
- Step 1 : SA (optimal design)

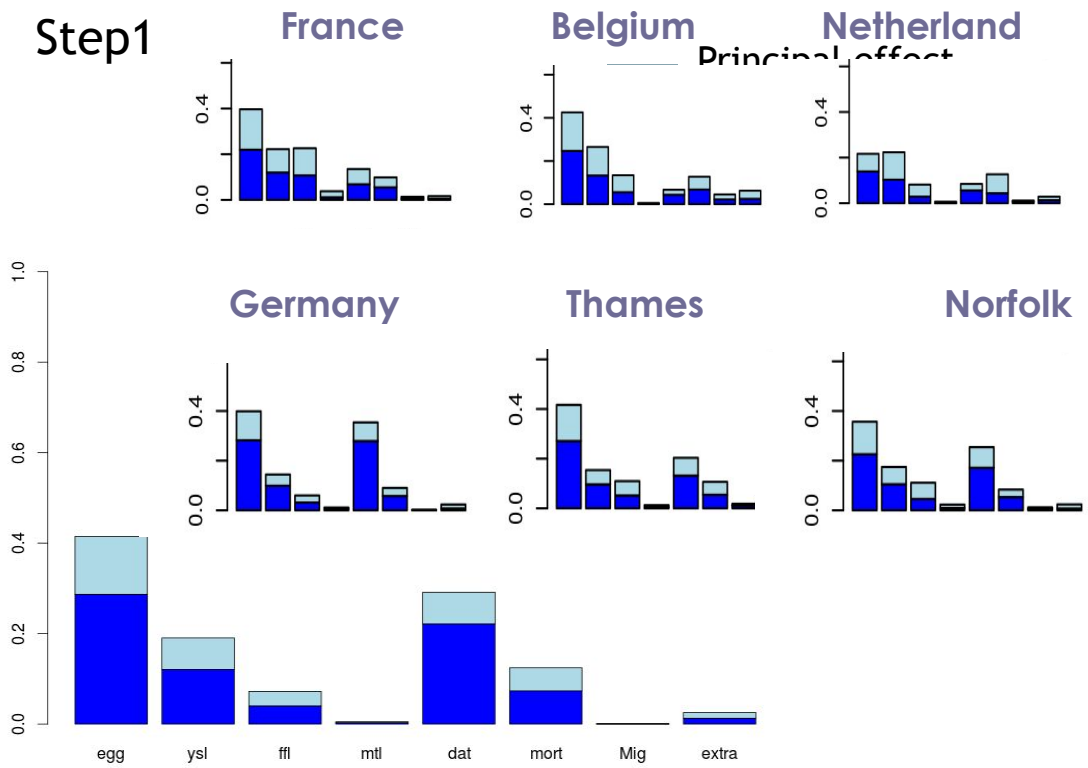
⇒ Most influent parameters

- Step 2 : MSA (full factorial design)

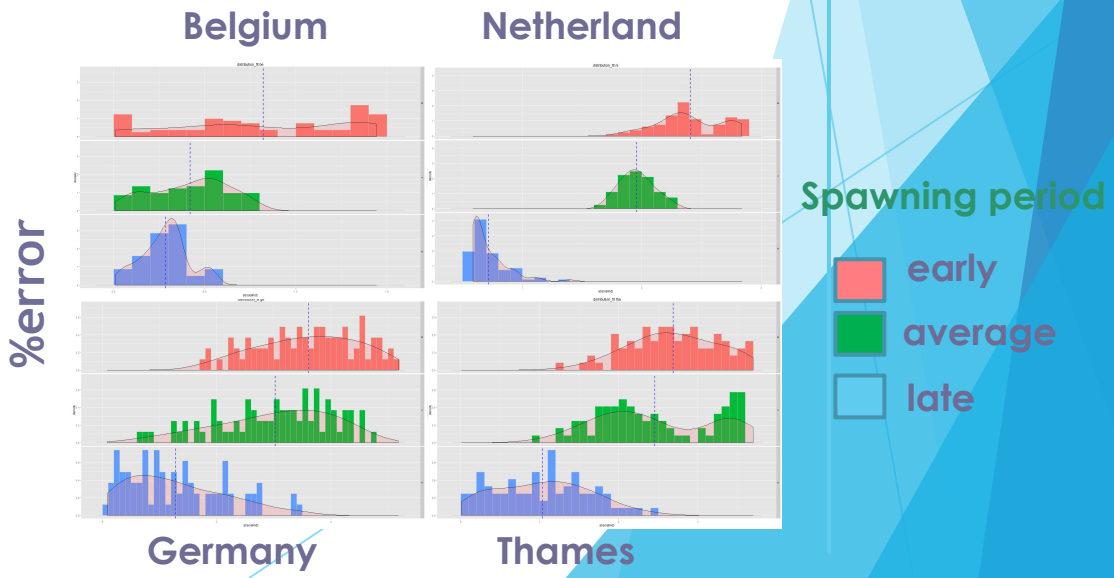


# Combining sensitivity and skill assessment to calibrate

- Larval drift IBM for Sole in the North Sea




- ⇒ Validation of model behavior
- ⇒ Identification of factors influencing recruitment success
- ⇒ Preliminary calibration over 12-years at managable cost
- Dimension reduction allows for a quantitative calibration



# Ready to take up the challenges…
# but not alone and well armed !

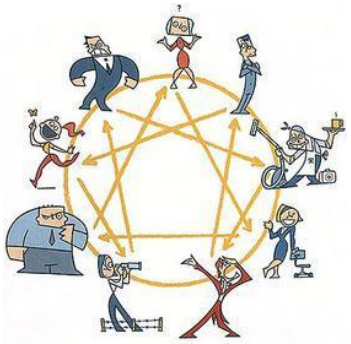
- Replicability, flexibility, automating processes

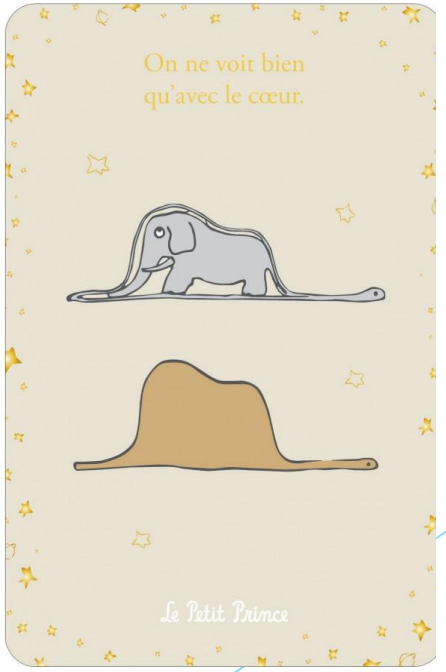

- Transparency, appropriateness, robustness
- **Communication, Appropriation**

- # Sharing commun knowledge, representations, tools, uncertainties

Objectives:

- Demystifying models, explain uncertainties
- Exchange knowledge and representations
- Learning by doing

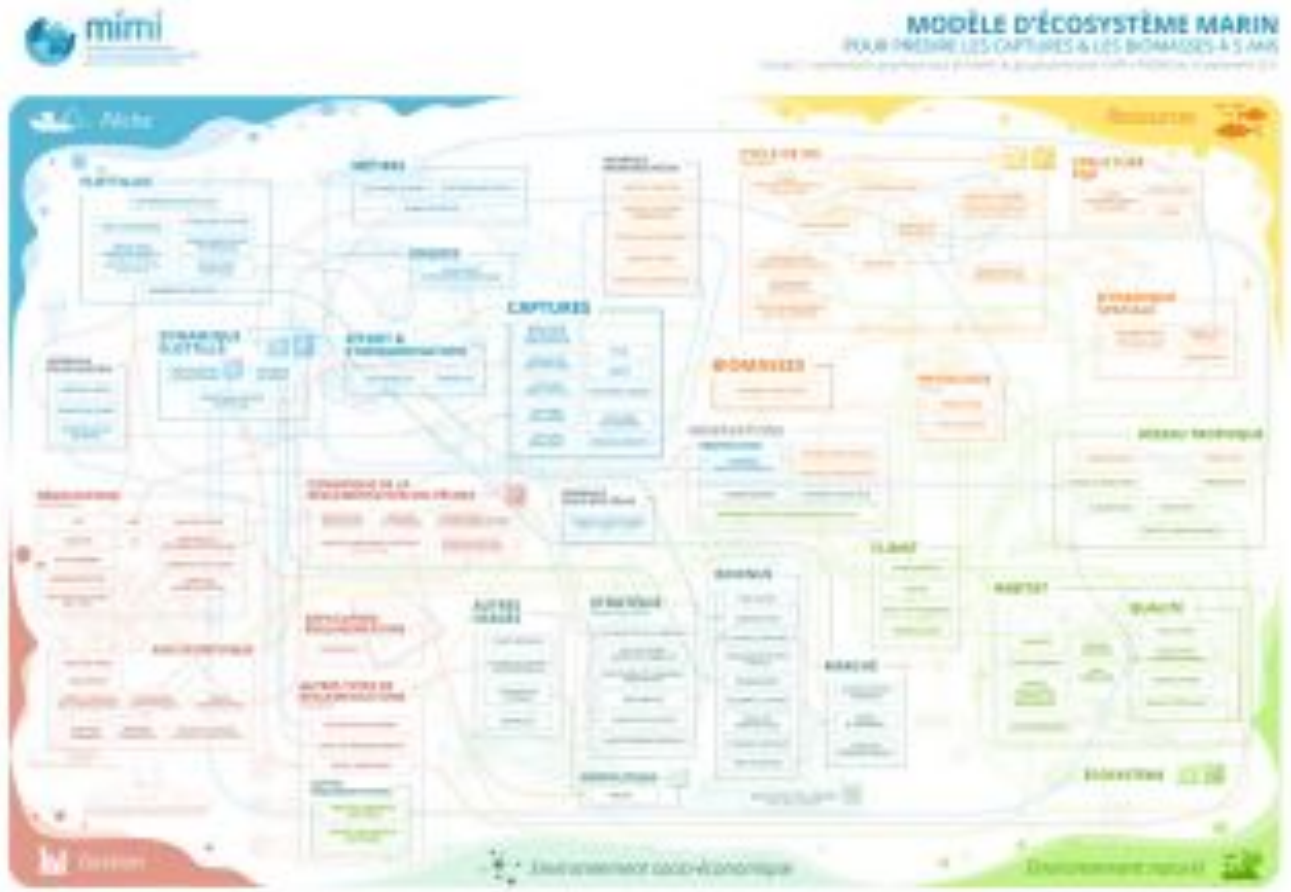




# • Sharing commun knowledge, representations, tools, uncertainties

- 2 workshops with fishers representatives
  - WK 1 : build your own model to predict biomass and catch in 5 years (25 pers.)

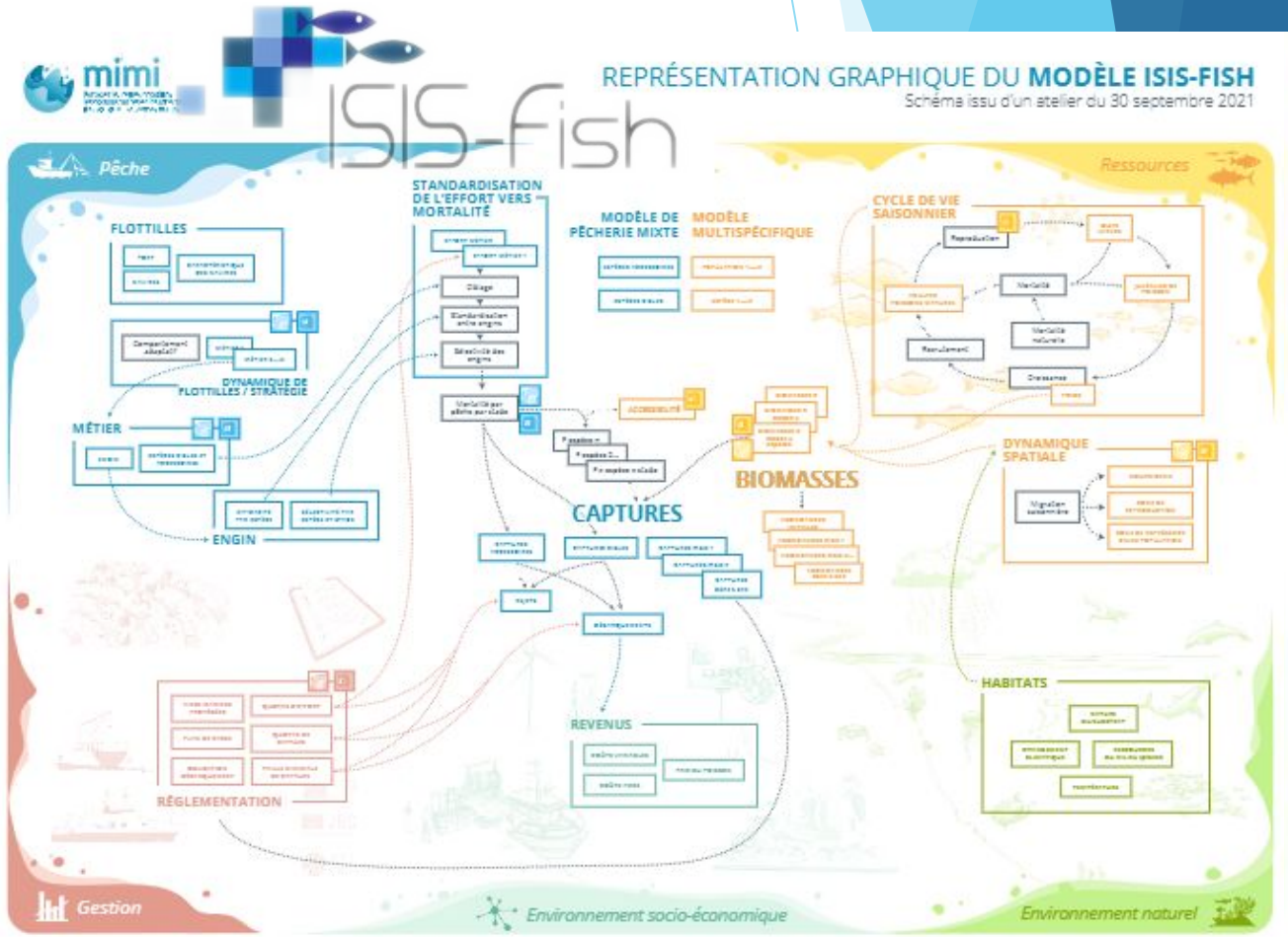
- **Conclusions**
- Highly complex models
- Unexpected uncertainties and detailed compartements



# • Sharing commun knowledge, representations, tools, uncertainties

- 2 workshops with fishers representatives
  - WK 1 : build your own model to predict biomass and catch in 5 years (25 pers.)

- **Conclusions**
- Highly complex models
- Unexpected uncertainties and detailed compartements



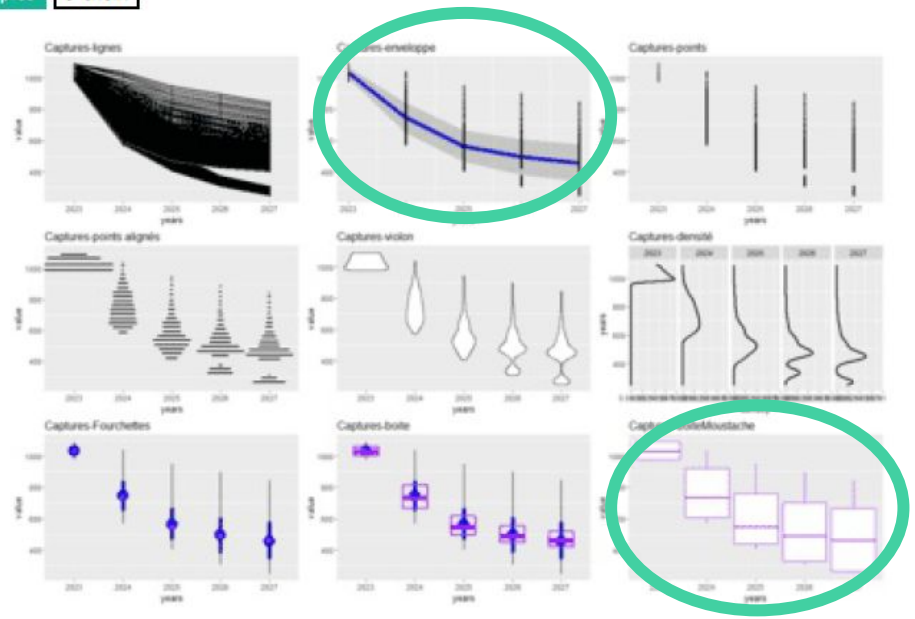
# Advice time and science time…

- Vote for your prefered representation of uncertainty

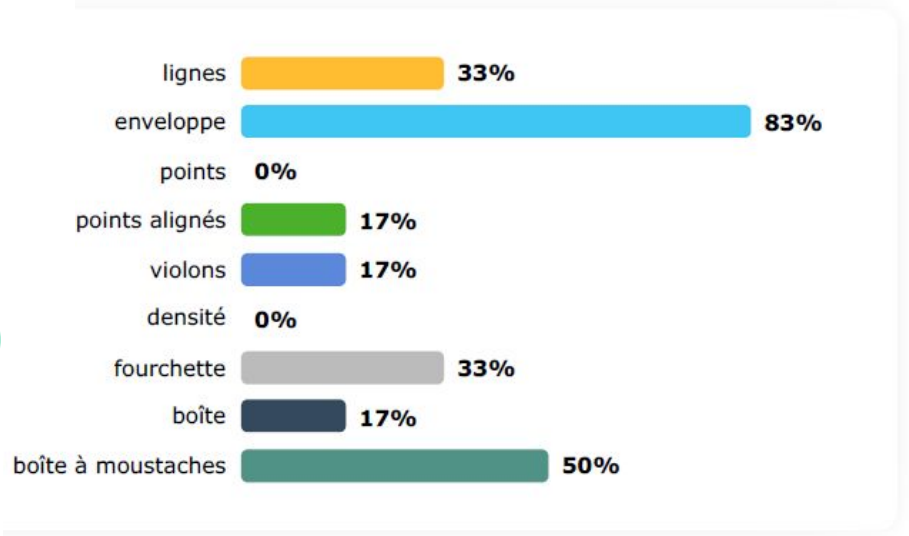
Question 1

Incertitude en sortie du modèle - Quelle(s) représentation(s) comprenez-vous le mieux ?

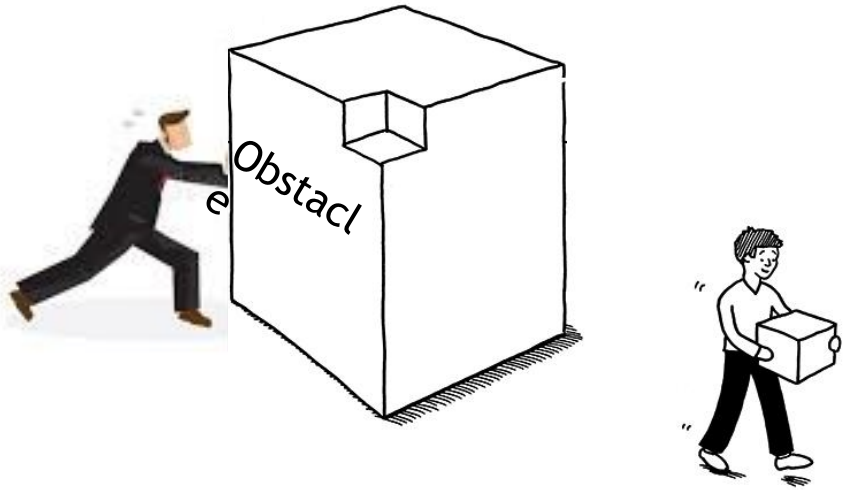
choix multiples | 9 choix




- Need for a practical guide for thr interpretation of graphs
- With fishers, make sentences !



# Tackle big challenges in small chunks…






- with appropriate tools :

  Maths, templates, common language…

- From various disciplines (IT, Social sciences, mathematics…)

- Compatibility of « Advice time » ?

# Thank you for your attention

# And applications…

Fisheries Research 143 (2013) 57–66

Geosci. Model Dev., 9, 59–76, 2016
www.geosci-model-dev.net/9/59/2016/
doi:10.5194/gmd-9-59-2016
© Author(s) 2016. CC Attribution 3.0 License.

Geoscientific Model Development
Open Access
EGU

PLOS ONE

Ecological Modelling 258 (2013) 16–32

Contents lists available at SciVerse ScienceDirect

Ecological Modelling

journal homepage: www.elsevier.com/locate/ecolmodel

ELSEVIER

Sensitivity analysis and pattern-oriented validation of TRITON, a model with alternative community states: Insights on temperate rocky reefs dynamics

Martin P. Marzloff[a,b,*], Craig R. Johnson[a], L. Rich Little[b], Jean-Christophe Soulié[c], Scott D. Ling[a], Stewart D. Frusher[a]

Journal of Marine Systems 76 (2009) 95–112

JOURNAL OF GEOPHYSICAL RESEARCH, VOL. 112, C08001, doi:10.1029/2006JC003852, 2007

## The assessment of a global marine ecosystem model on the basis o emergent properties and ecosystem function: a case study with ERSEM

L. de Mora, M. Butenschön, and J. I. Allen
Plymouth Marine Laboratory, Prospect Place, The Hoe, Plymouth, PL1 3DH, UK
*Correspondence to:* L. de Mora (ledm@pml.ac.uk)

Chinese Journal of Oceanology and Limnology

http://dx.doi.org/10.1007/s00343-016-5068-3

## Discussion of skill improvement in marine ecosystem dynamic models based on parameter optimization and skill assessment*

CrossMark

SHEN Chengcheng (沈程程)[1,2], SHI Honghua (石洪华)[2,**], LIU Yongzhi (刘永志)[3], LI Fen (李芬)[3], DING Dewen (丁德文)[2]

## Assessm… models:

Marjorie A…
Robert A.
Masahiko …
Markus Sc…

Received 31 J…

ICES Journal of Marine Science

ICES CIEM International Council for the Exploration of the Sea

ICES Journal of Marine Science (2016), 73(7), 1715–1724. doi:10.1093/icesjms/fsw047

## Quo Vadimus

## A guinea pig's tale: learning to review end-to-end marine ecosystem models for management applications

Isaac C. Kaplan[1]* and Kristin N. Marshall[2]

[1]*Northwest Fisheries Science Center, National Marine Fisheries Service, NOAA, 2725 Montlake Boulevard E., Seattle, WA 98112, USA*
[2]*University of Washington School of Aquatic and Fisheries Sciences, PO Box 355020, Seattle, WA 98195, USA*

**Corresponding author: tel: +1-206-302-2446; fax: +1-206-860-3394; e-mail: isaac.kaplan@noaa.gov*

Kaplan, I. C., and Marshall, K. N. A guinea pig's tale: learning to review end-to-end marine ecosystem models for management applications. – ICES Journal of Marine Science, 73: 1715–1724.

Downloaded from https://academic.ou…