

DEVELOPING A WEB-BASED BEST PRACTICE GUIDE FOR MULTIPLE DRIVER BIOLOGICAL MANIPULATION STUDIES



SCOR Working Group 149

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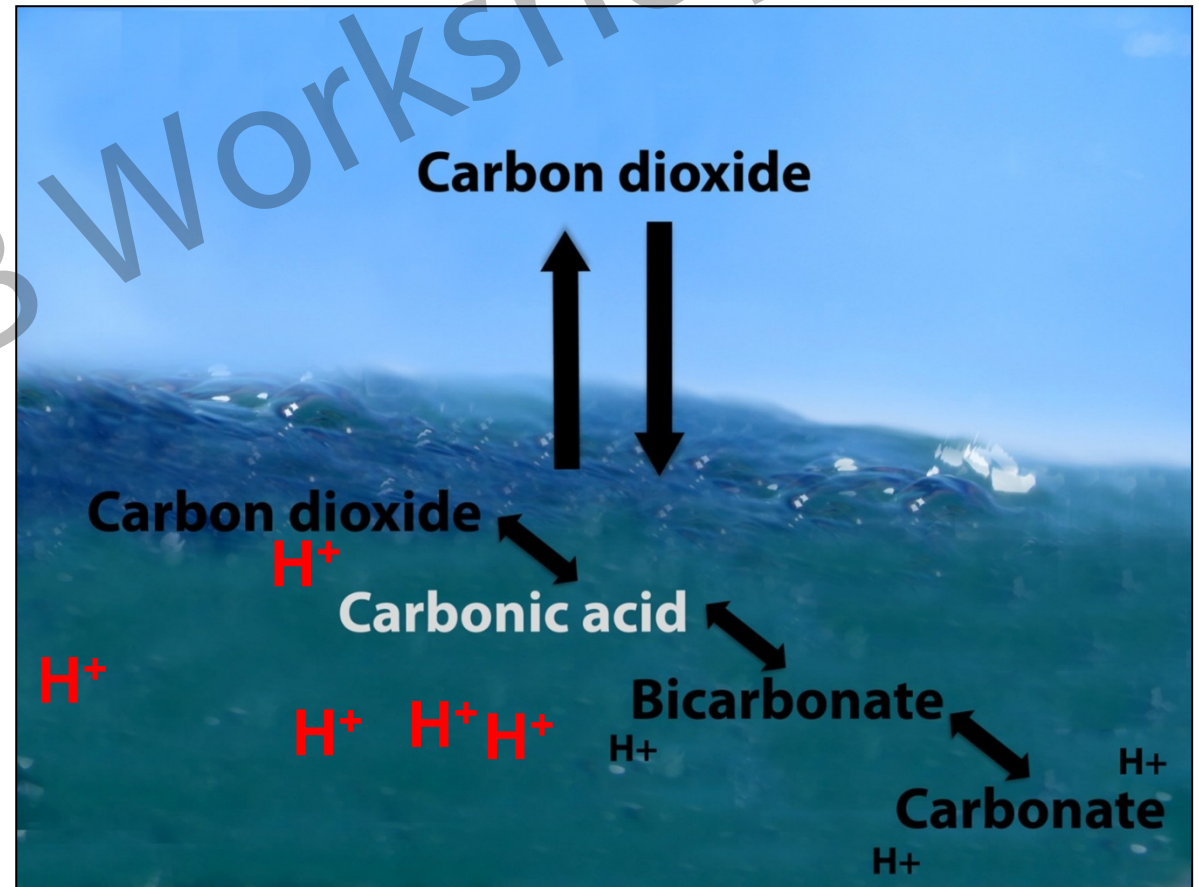
Group Web site: <https://scor149-ocean.com/>

Different experimental conditions can exert a major influence on their outcomes

Synthesis of trends from Ocean Acidification studies

Study	Strain	PIC production	POC production
Feng et al. 2008	CCMP371 ^C	↘	—
Iglesias-Rodriguez et al. 2008	NZEH _R	↗	↗
Langer et al. 2009	RCC1212 _B ^O	↗	—
	RCC1216 _R ^O	↗	—
	RCC1238 _A ^C	—	↘
	RCC1256 _A ^C	↘	↘
Riebesell et al. 2000	PLYB92/11 _A ^C	↗	↗
Sciandra et al. 2003	TW1	—	—
Shi et al. 2009	NZEH _R	↗	↗
This study	RCC1256 _A ^C	↗	—
	NZEH _R	↗	—

Different ways to manipulate carbonate chemistry



Different experimental conditions can exert a major influence on their outcomes

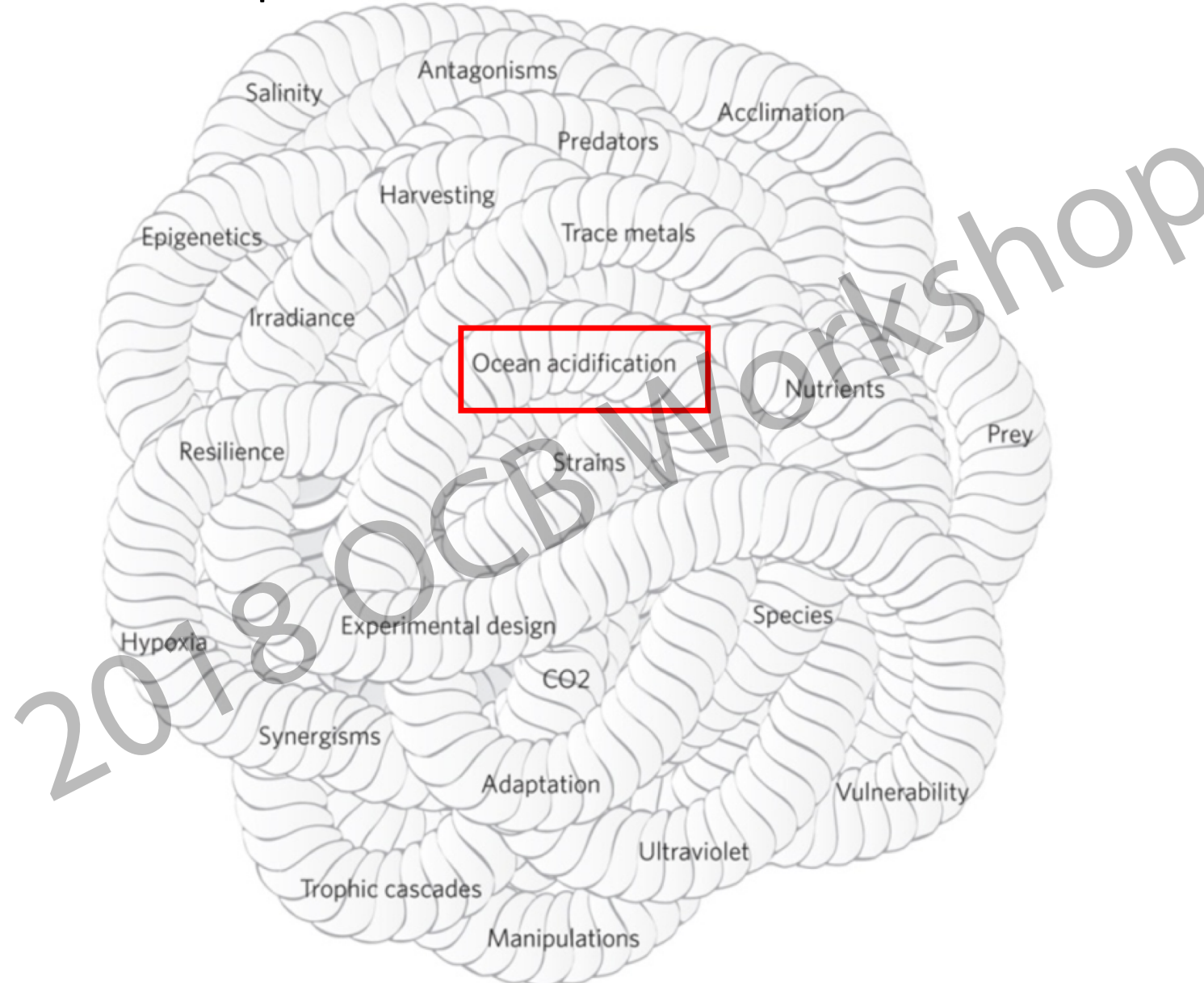


Hence the need for a Best Practices Guide (Riebesell et al. 2011)

Different outcomes
When we move beyond
Ocean Acidification

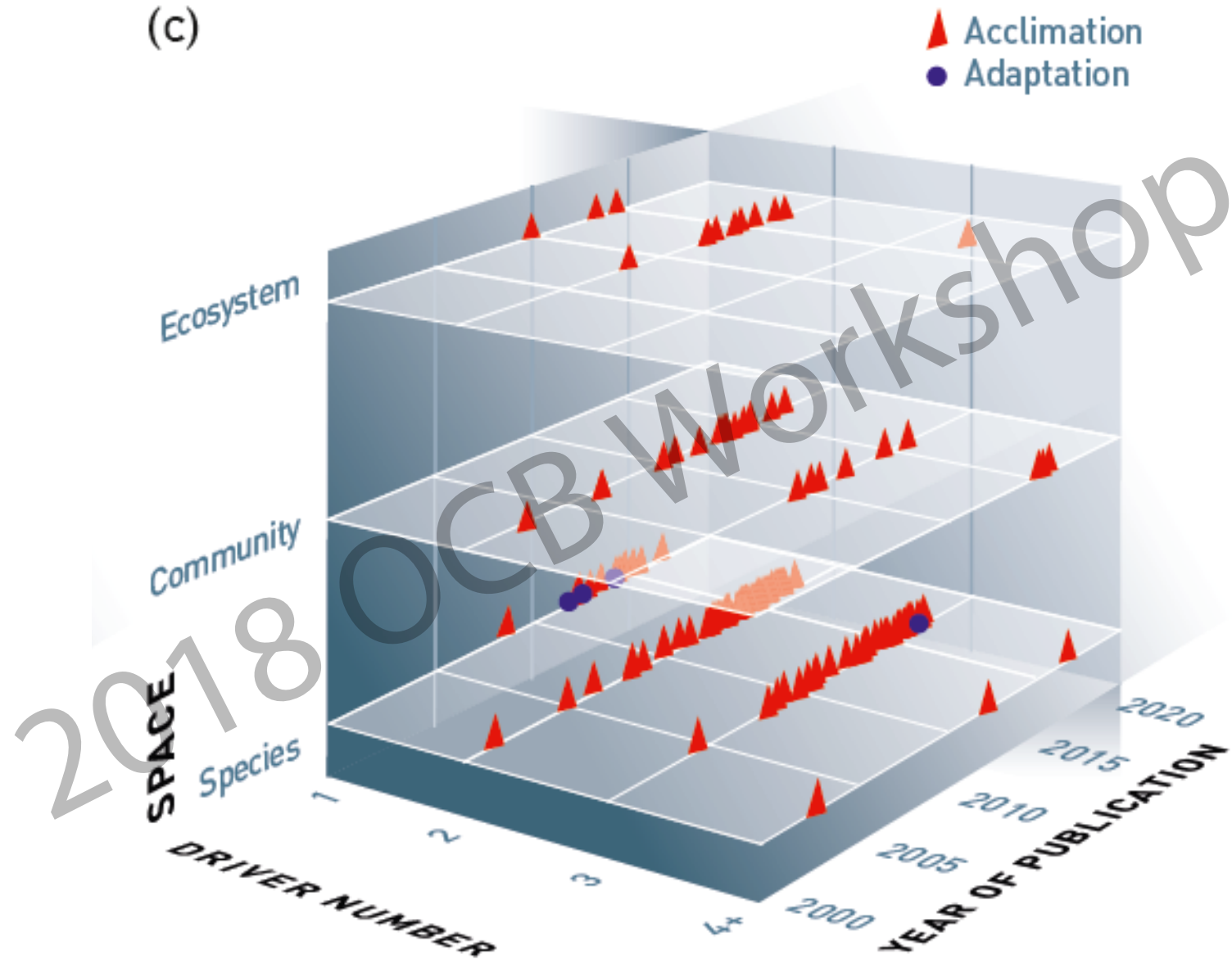


Multiple drivers - A Gordian Knot to unravel



Boyd 2013
Nature Climate Change

There has been a proliferation of multiple driver experimental studies in recent years



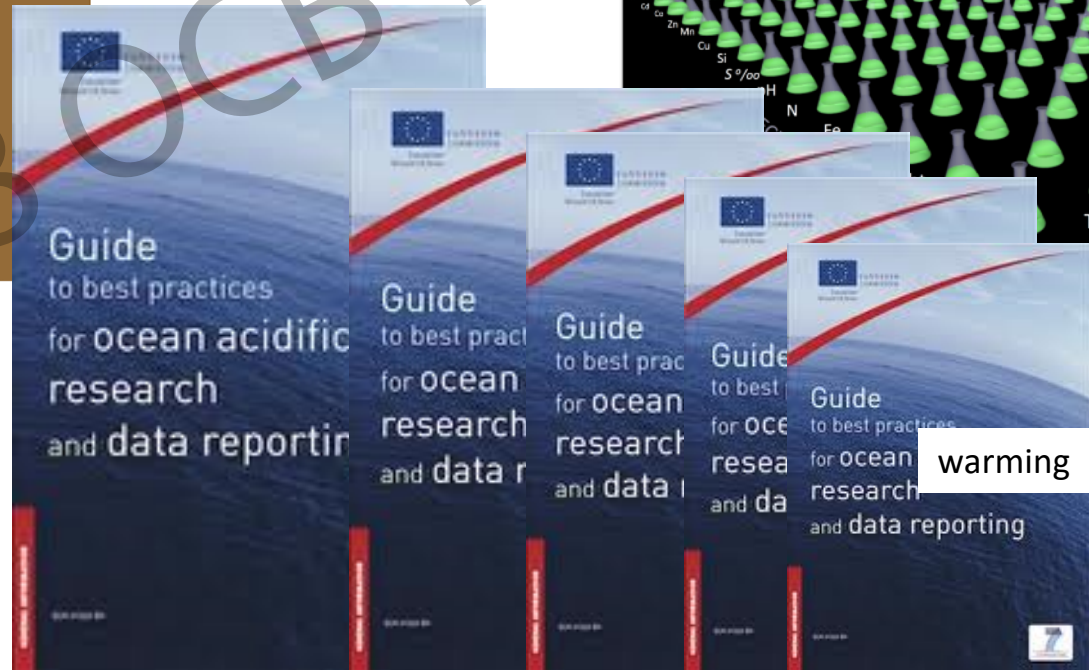
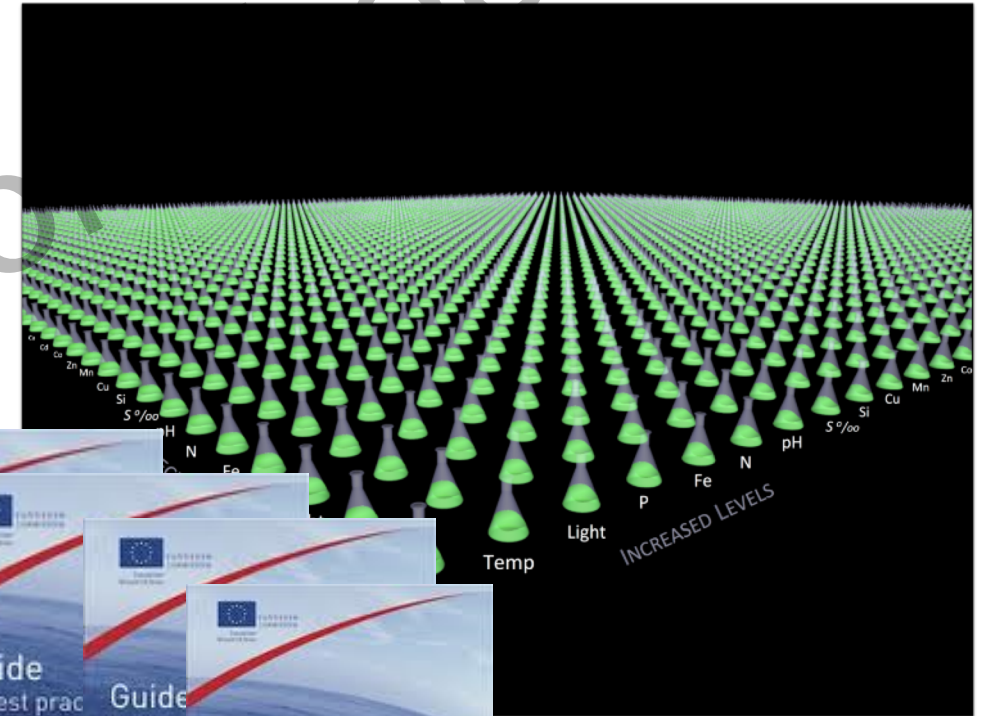
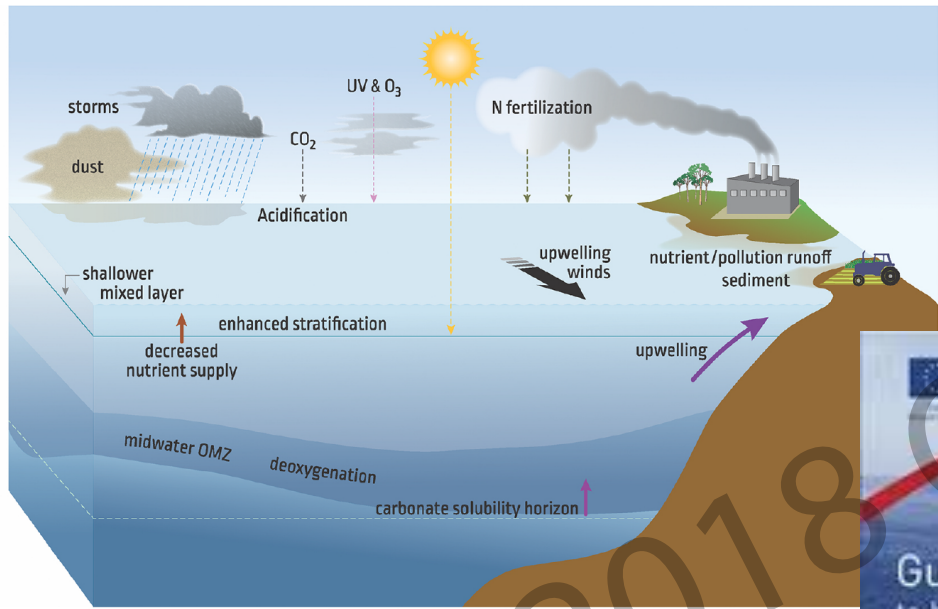
How can we reconcile:

Multiple drivers

Interactive effects between drivers

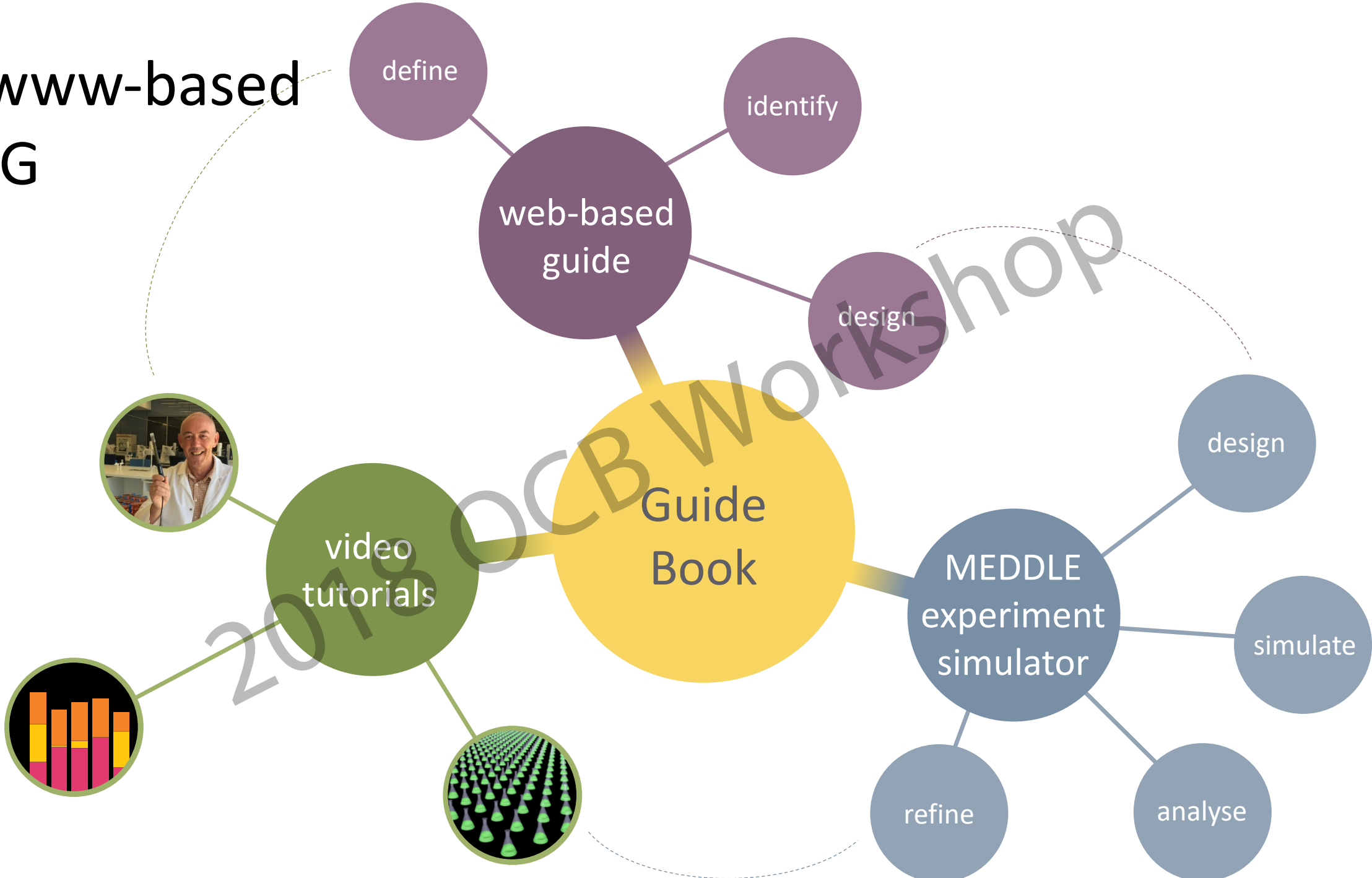
Multiple treatment levels
replication

A huge number of potential permutations

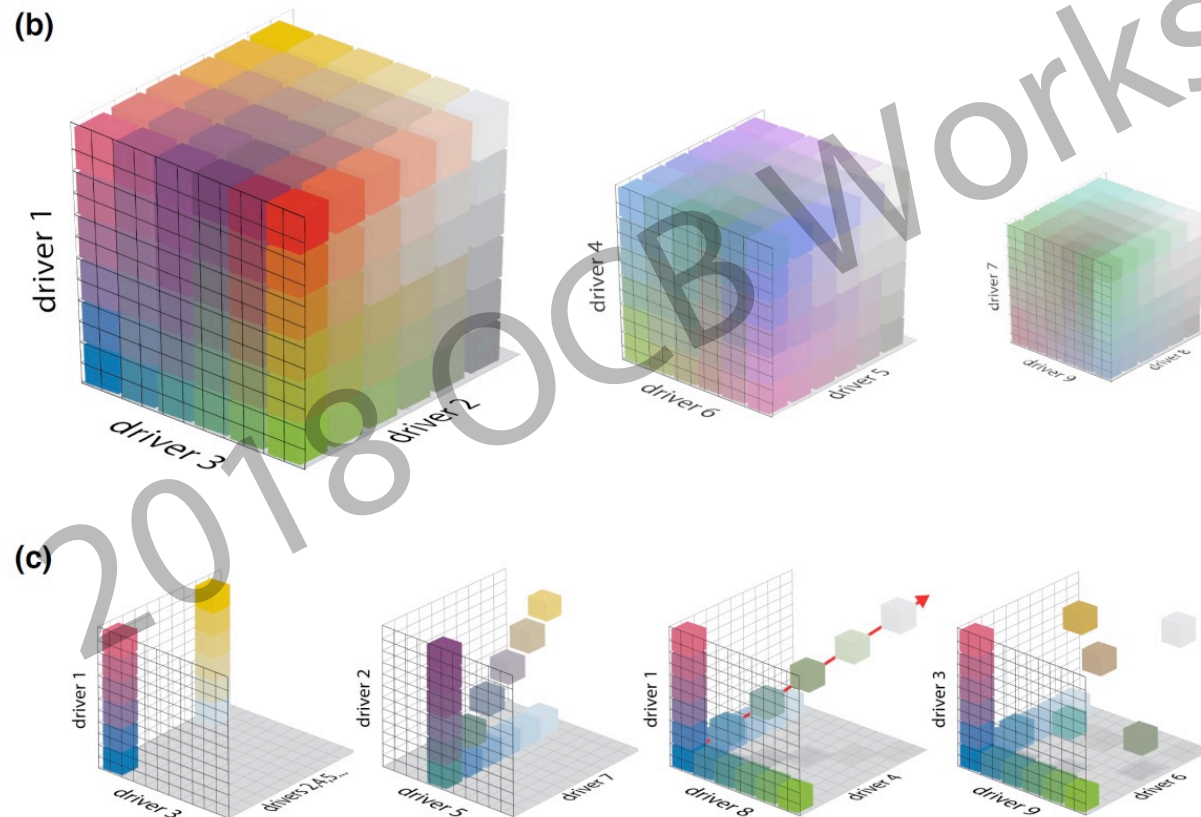


Do we need a bookshelf of BPG's
OR a Fridge magnet ??

A www-based BPG

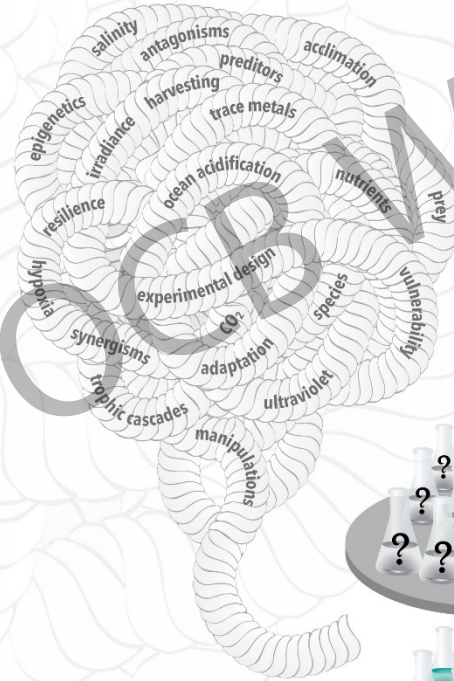


Experimental strategies to assess the biological ramifications of multiple drivers of global ocean change—A review



H A N D B O O K
to support the www-based

Guide to multiple driver experimental design for changing ocean biological systems



- Question(s)
- Inventory
- Design
- Experiment



- Improved design
- Question answered

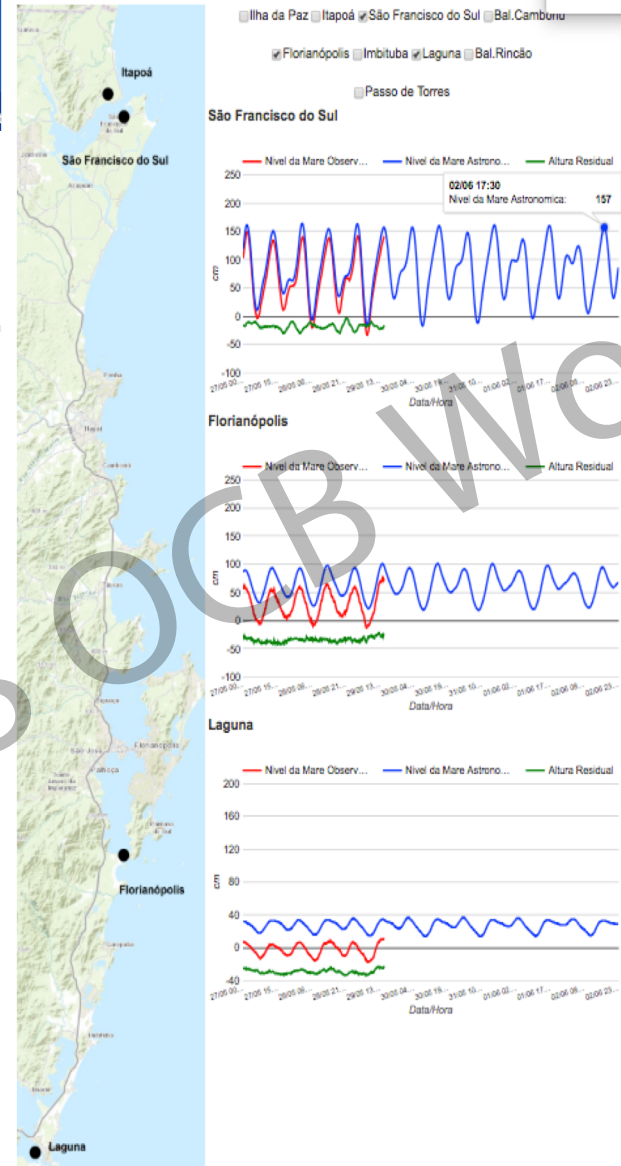
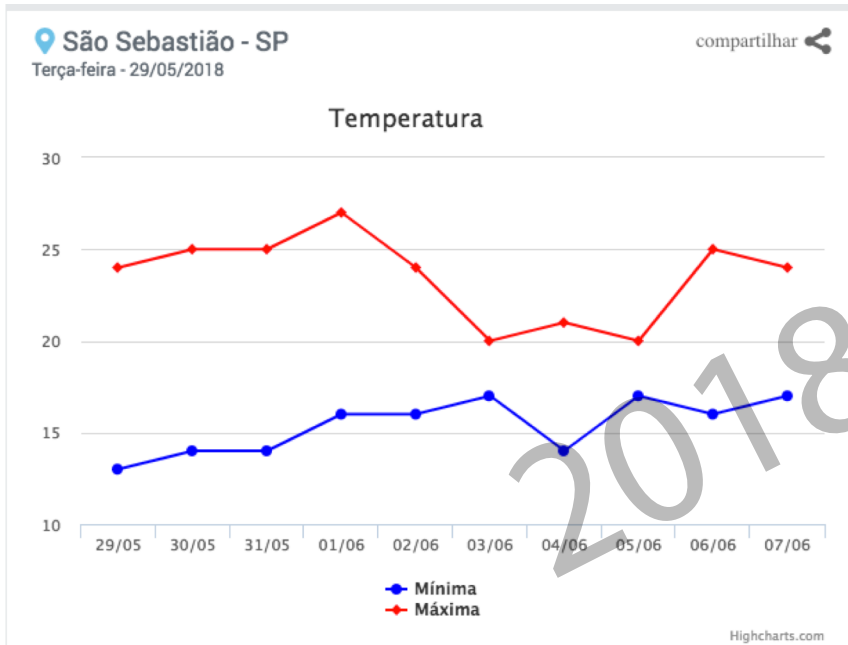
2018

Examples of data archives – selecting controls or fluctuations

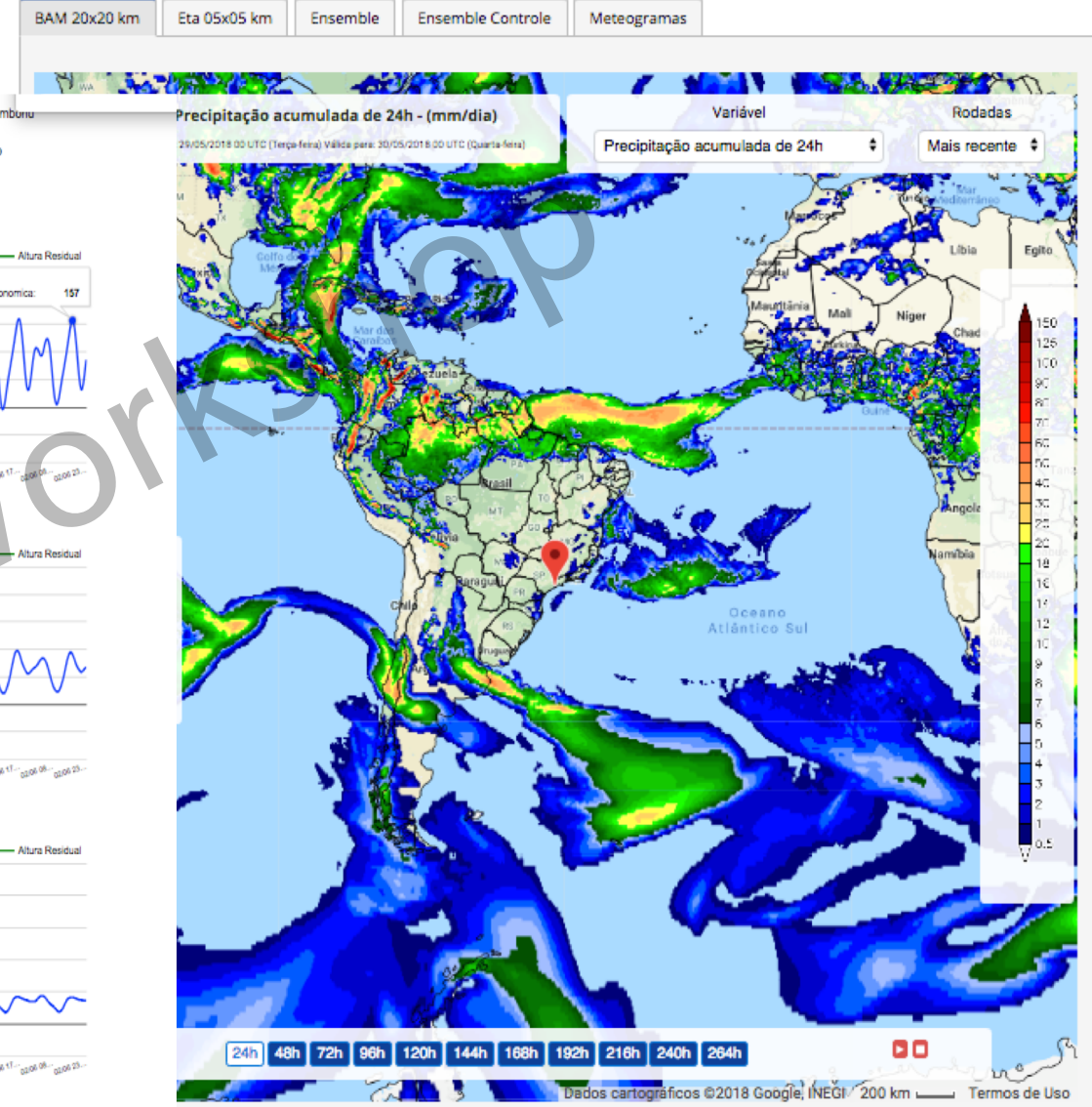
Center for Weather Forecasting and Climate Studies

NATIONAL INSTITUTE FOR SPACE RESEARCH

Weather Climate Numerical Forecasts Satellites Waves Observational Data



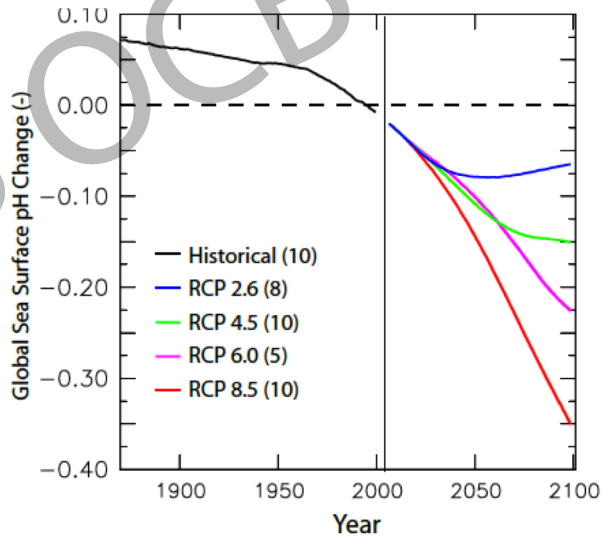
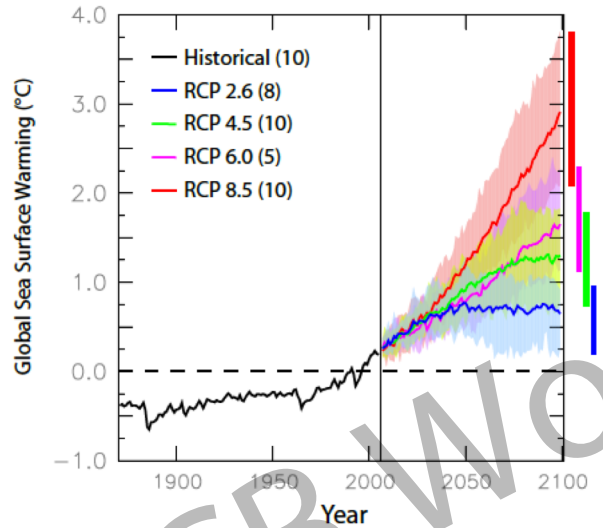
MAPAS BRASIL



Earth System Model Output Future Projections



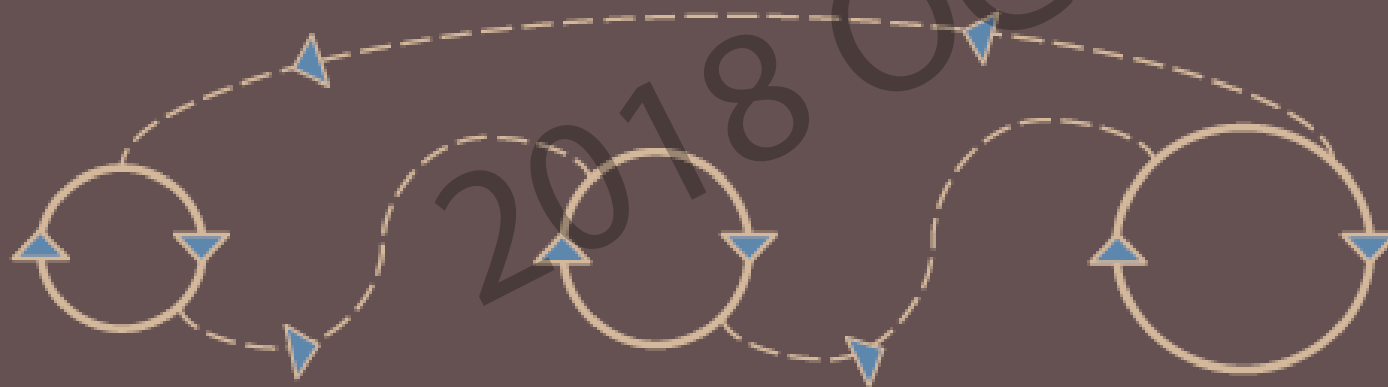
Selecting a Scenario



Step 1 Getting started &
initial guidance

Getting started: decision support tool

A three-step decision support tool to help you identify relevant drivers and design your experiment.



Broadly define the
research question

Identify responses,
drivers and designs

Detailed design: drivers,
replicates, statistics, resources

Guide:

- Identify how drivers will vary with region and season.
- Make decisions in a step-wise manner using the decision support tool.
- Select the best design for your project/question(s)/study site.

First Pass: Broadly define the research question and background

What exactly is your research question?

Be as precise as possible.

What are the objectives of your study?

Provide a comprehensive list of what you aim to achieve.

Get back to this list at the end of the planning process, and double-check whether the objectives have changed, and whether you have addressed them all.

Why is your question relevant?

And to whom?

Has anyone already tried to answer a similar research

2018 OCB Workshop

Third Pass: Quantitative aspects of the study

- **Response variables / traits of interest**

Repeat for each trait/parameter of interest

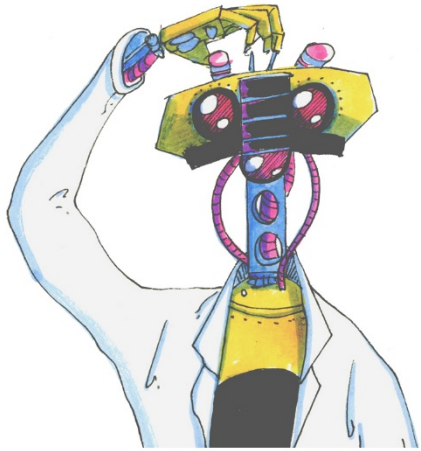
Have you chosen your treatment levels to reflect your best guess of expected response norms to the main drivers? (see Fig 2 of GCB manuscript).

Does your design allow you to determine responses to both individual and multiple drivers?

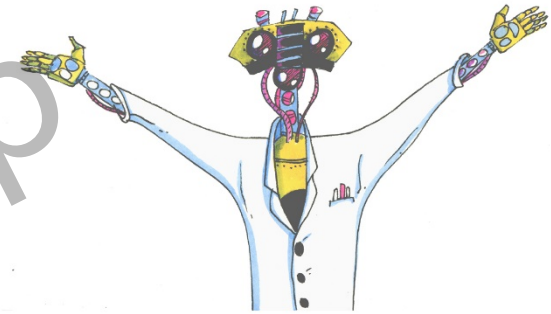
Step 2

MEDDLE - Multiple Environmental Driver Design Lab for Experiments

A virtual laboratory to:

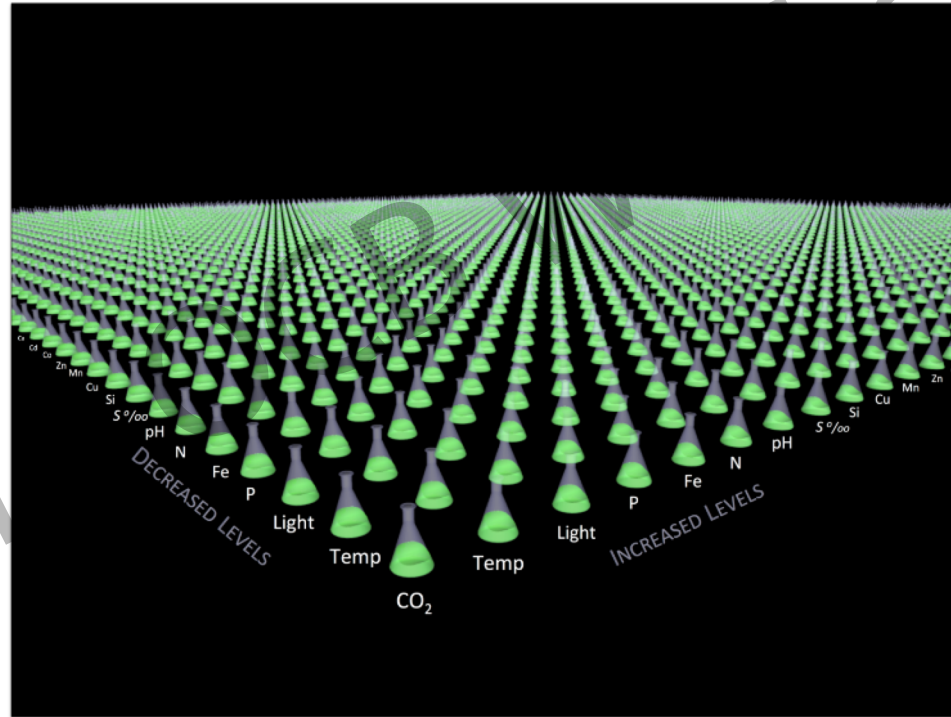


Design, simulate, analyse, refine

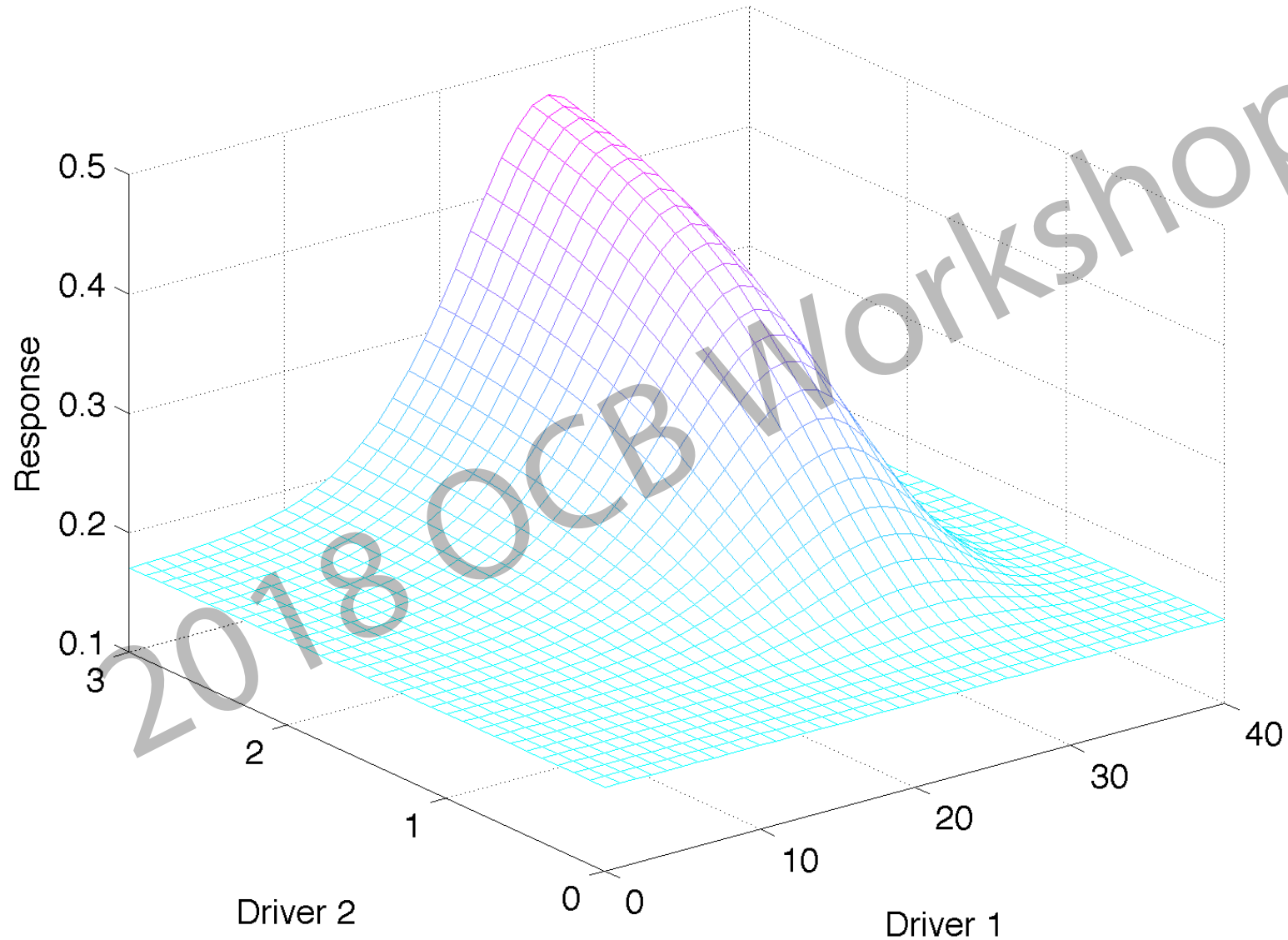


Resource Allocation
Between

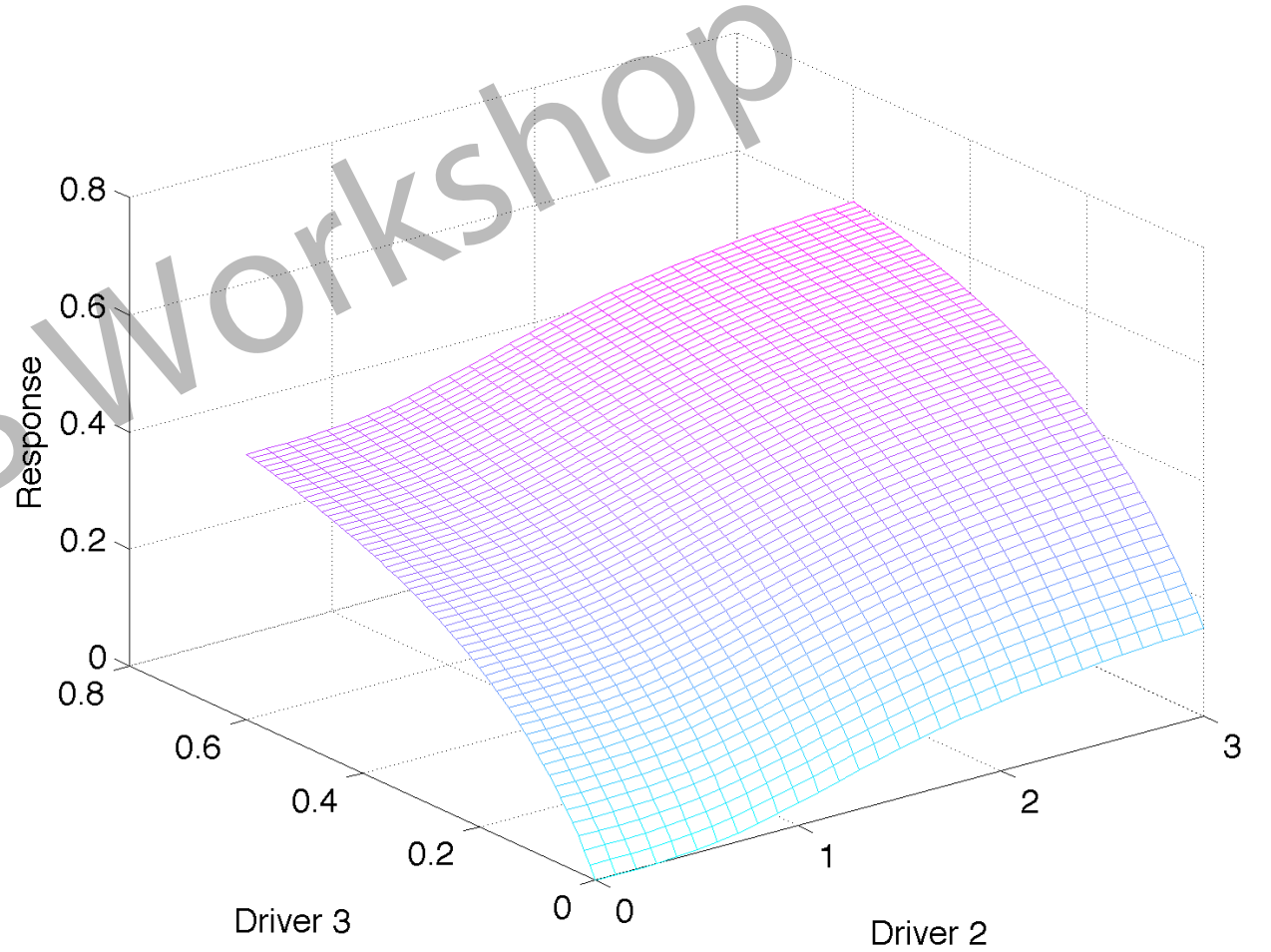
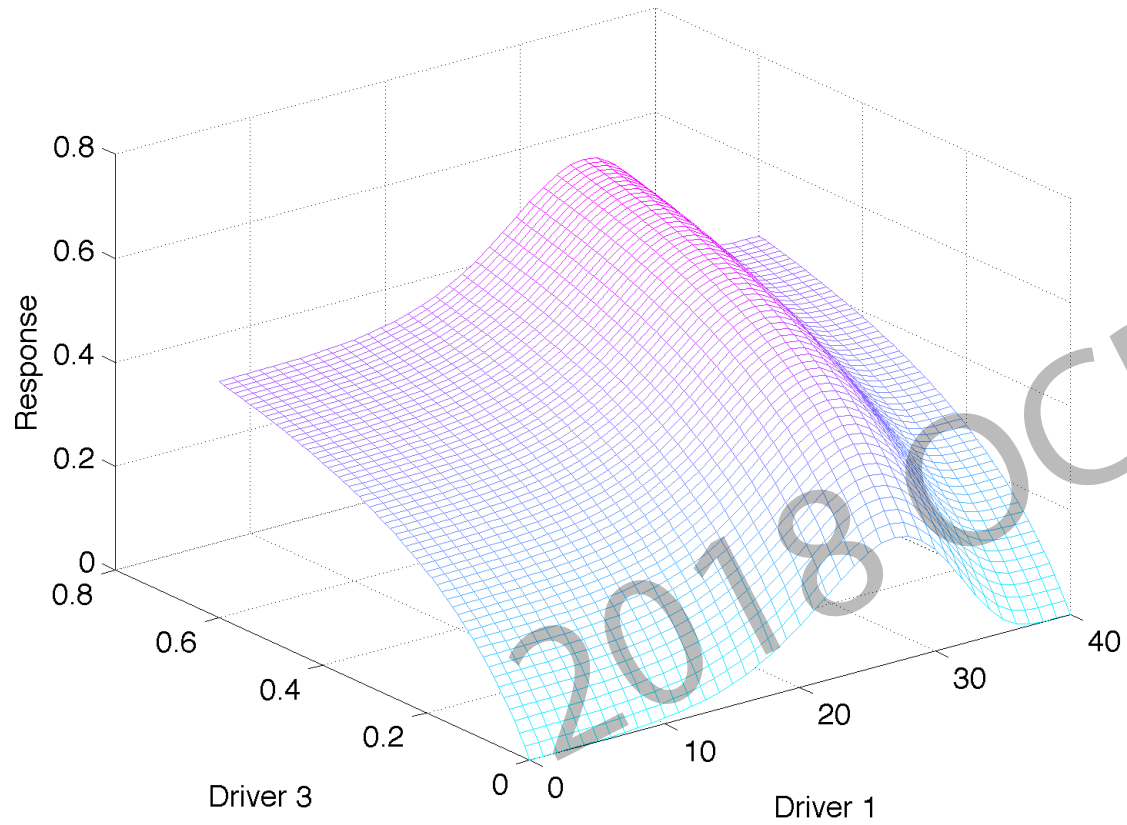
of Drivers
Treatment levels
Replication



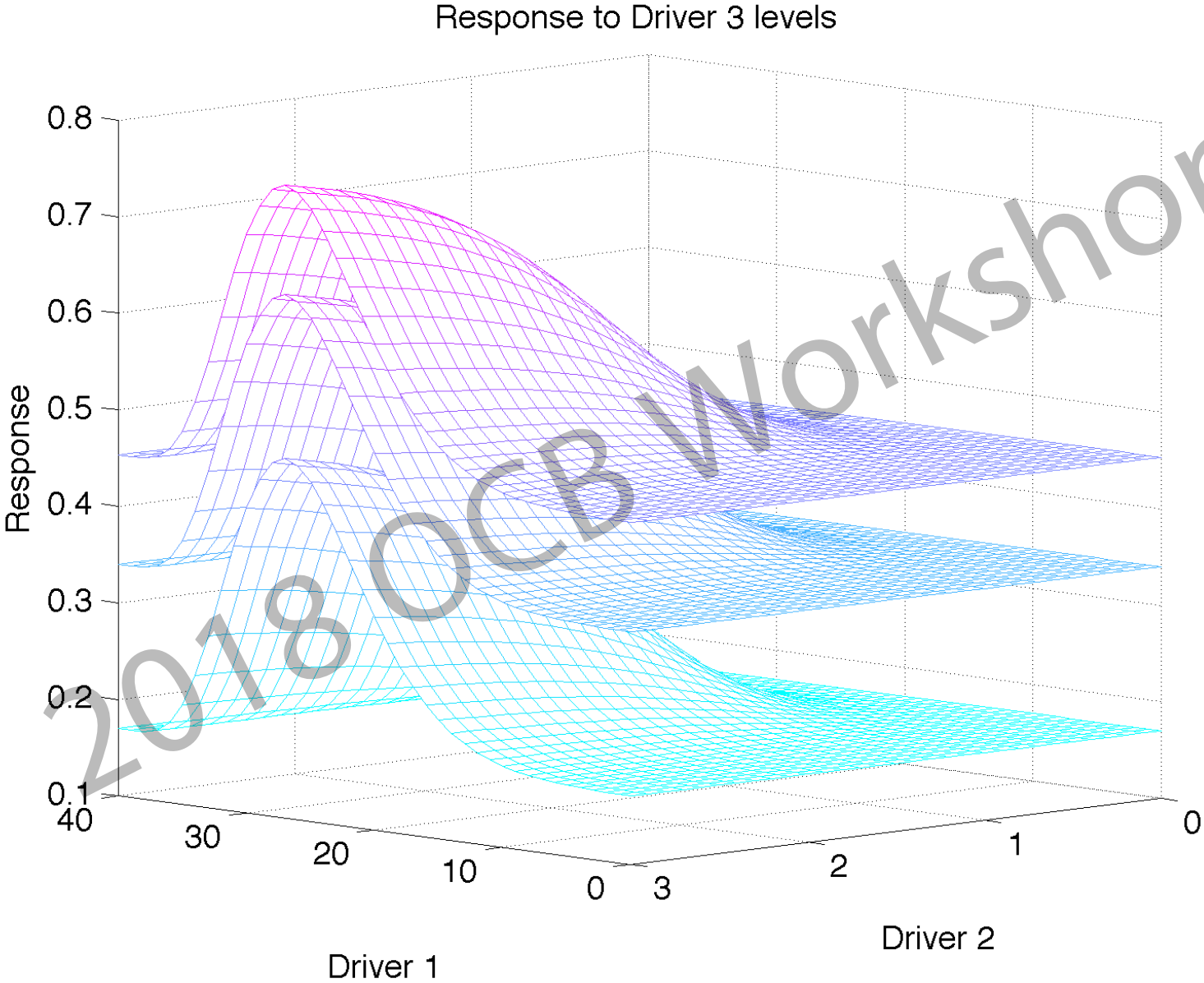
The engine of this virtual lab is a series of landscapes for three drivers



The interplay between each driver differs



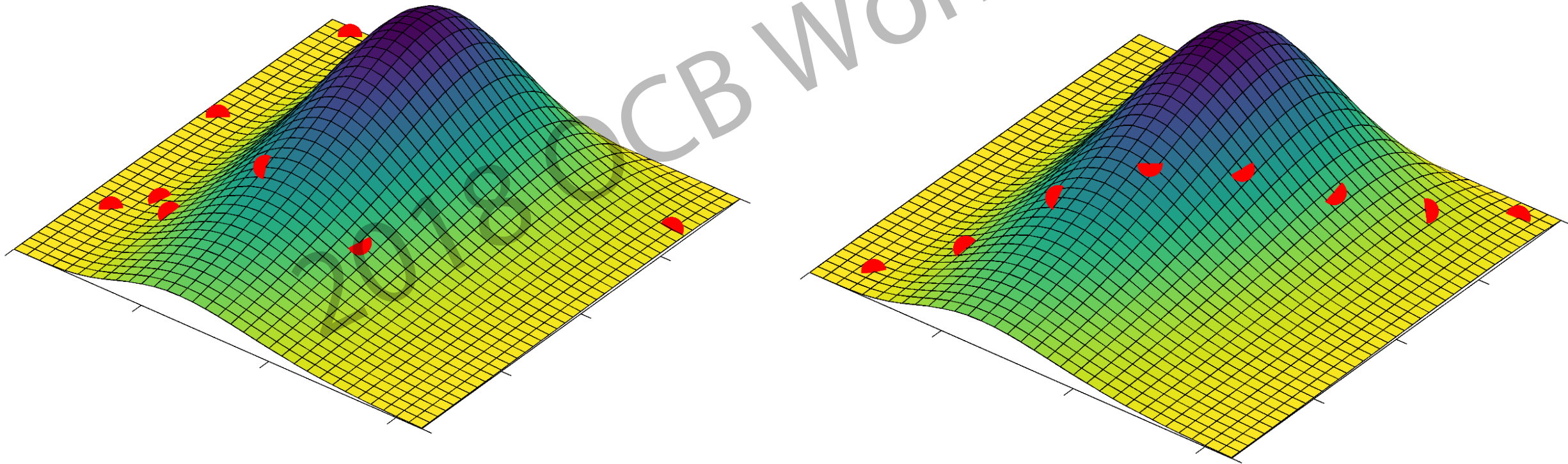
Multiple Landscapes reflect the interactive responses to three drivers



How do users of MEDDLE refine their designs???

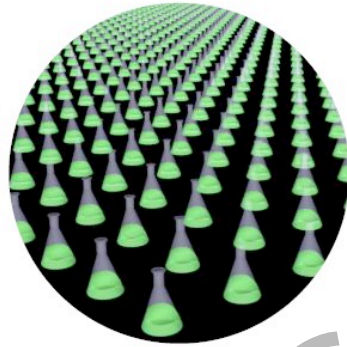
Analysis of results - how significant are your findings? Statistical tools

Visual feedback – how well did your selected drivers and treatment levels capture the landscape?



MEDDLE also has a randomisation module to ensure you can't get exactly the same results twice.

Step 3 Video tutorials



Linked video tutorials

In “Post-production”

Constructing your multi-driver inventory

Experimental Design

Bio-statistics

Micro-evolution experimental design

Fluctuating environments and design

Mesocosm studies

How not to run an experiment

Instructor Bloopers

“Story-boards prepared”

The role of meta-analyses

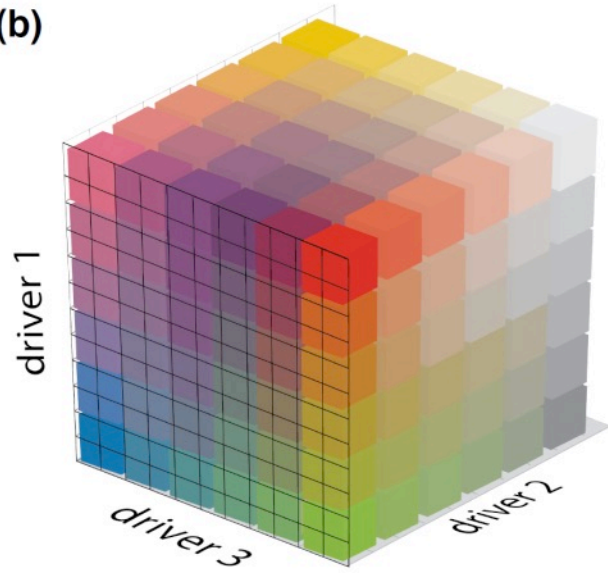
Modelling to help with experimental design

Evology - Multigenerational studies

Calibration matters

Links across the www-based BPG

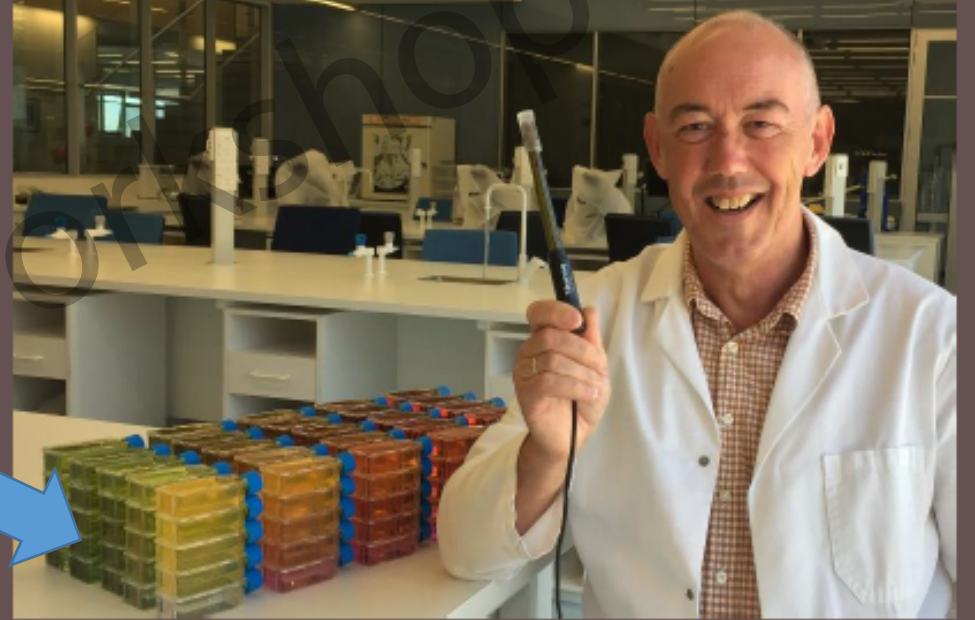
(b)



Roll out
GRS July 18
GRC July 18
IAEA early 2019
OCB newsletter and other outlets

Group Web site: <https://scor149-ocean.com>

Expert advice: online video tutorials



Short videos (2 – 10 minute) explain the most challenging aspects of multiple driver experiments. These videos complement the pdf guide and decision support tool.



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