

Visual Tools for Decision Making

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Overview

- What is visualization?
- A case study
 - Vismon - Fisheries science
- Problem abstraction
- Challenges

What is Visualization?

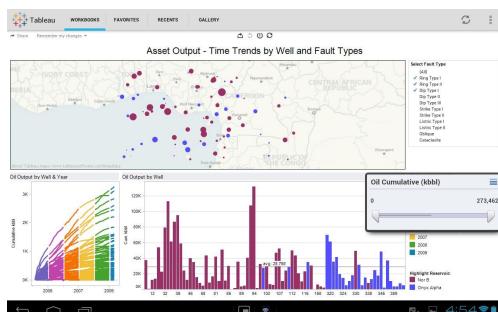
Tamara Munzner 2011:

“Computer-based visualization systems provide visual representations of datasets intended to help people carry out some task more effectively.”

What is Visualization?

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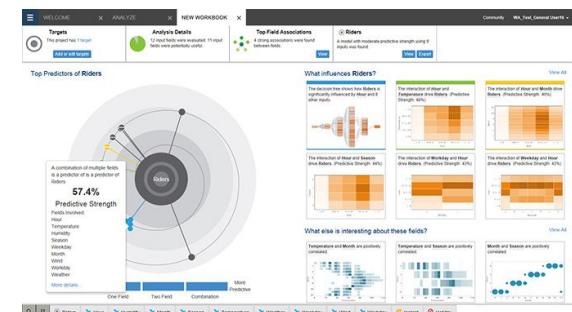
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Tableau



SAS



IBM Watson Analytics

NOT pretty images

What is Visualization?

Tamara Munzner 2011:

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	Males		Females	
Income Group	Under 65	65 or Over	Under 65	65 or Over
low income	250	200	375	550
high income	430	300	700	500

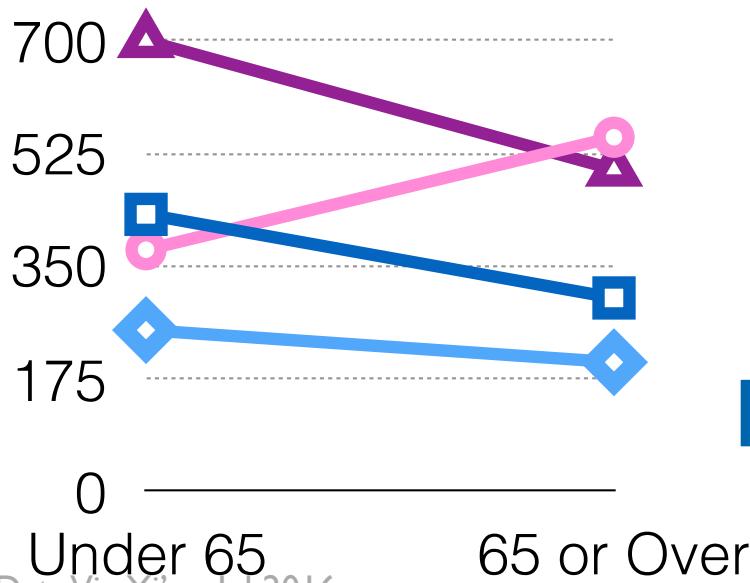
Q: Which gender or income level group shows different effects of age on blood fat levels?

What is Visualization?

Tamara Munzner 2011:

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Blood fat levels



- ◊ MALE / low income
- MALE / high income
- FEMALE / low income
- ▲ FEMALE / high income

Perception beats Cognition!

What is Visualization?

Tamara Munzner 2011:

“Computer-based visualization systems provide visual representations of datasets intended to help people carry out some task more effectively.”

not needed if fully automatic solution exists (and is trusted)

III-defined / ill-structured problems:

- no single optimal solution
- no clear objective measures

Herbert A. Simon.

The structure of ill-structured problems.
Artificial Intelligence, 4, 181-204. 1973.

Examples:

- exploratory analysis of scientific problems
- (collaborative) decision-making problems
- model building & validation

What is Visualization?

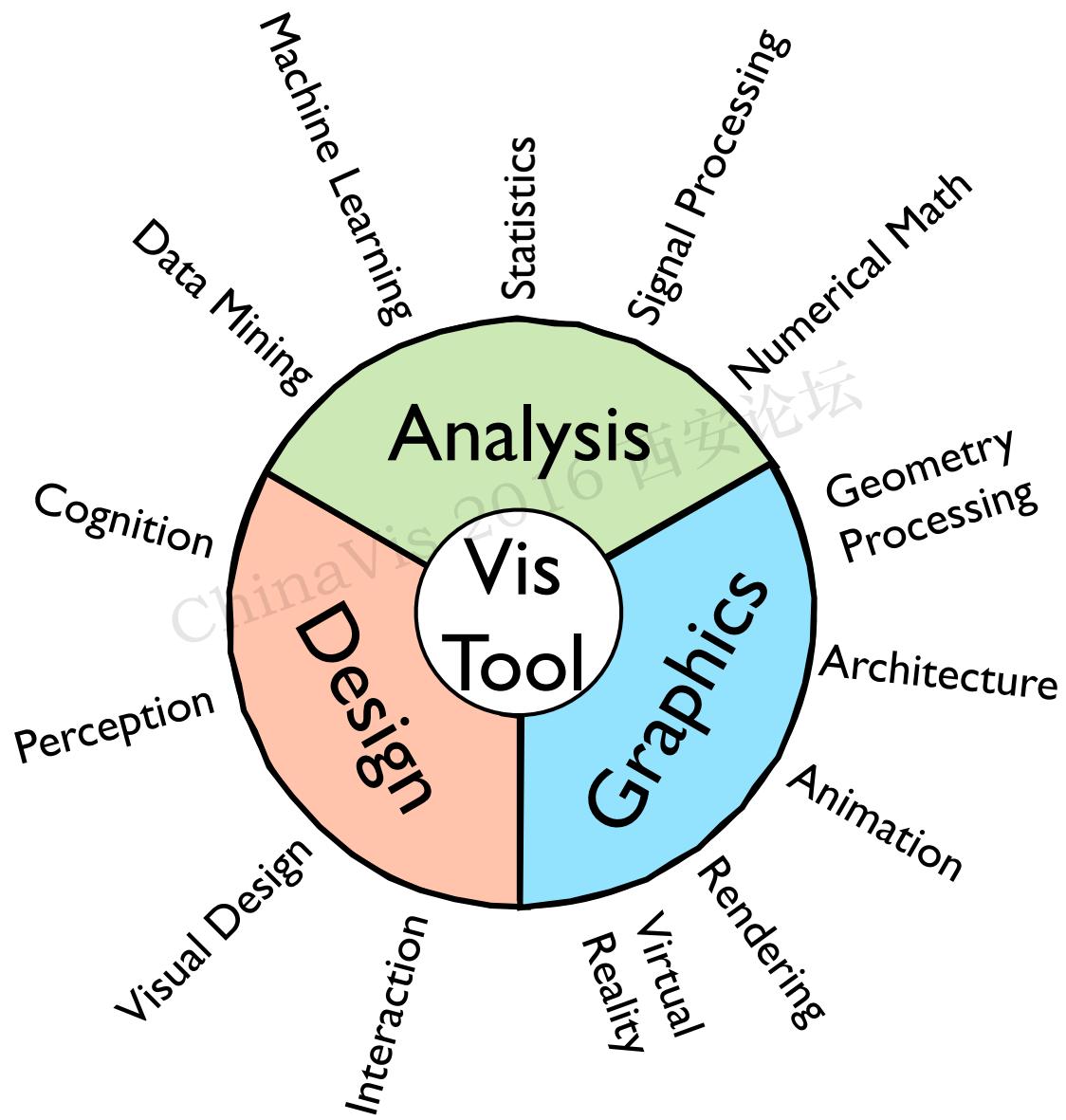
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Metrics of success:

- Novel — entirely new insights
- Faster — speed up common workflows

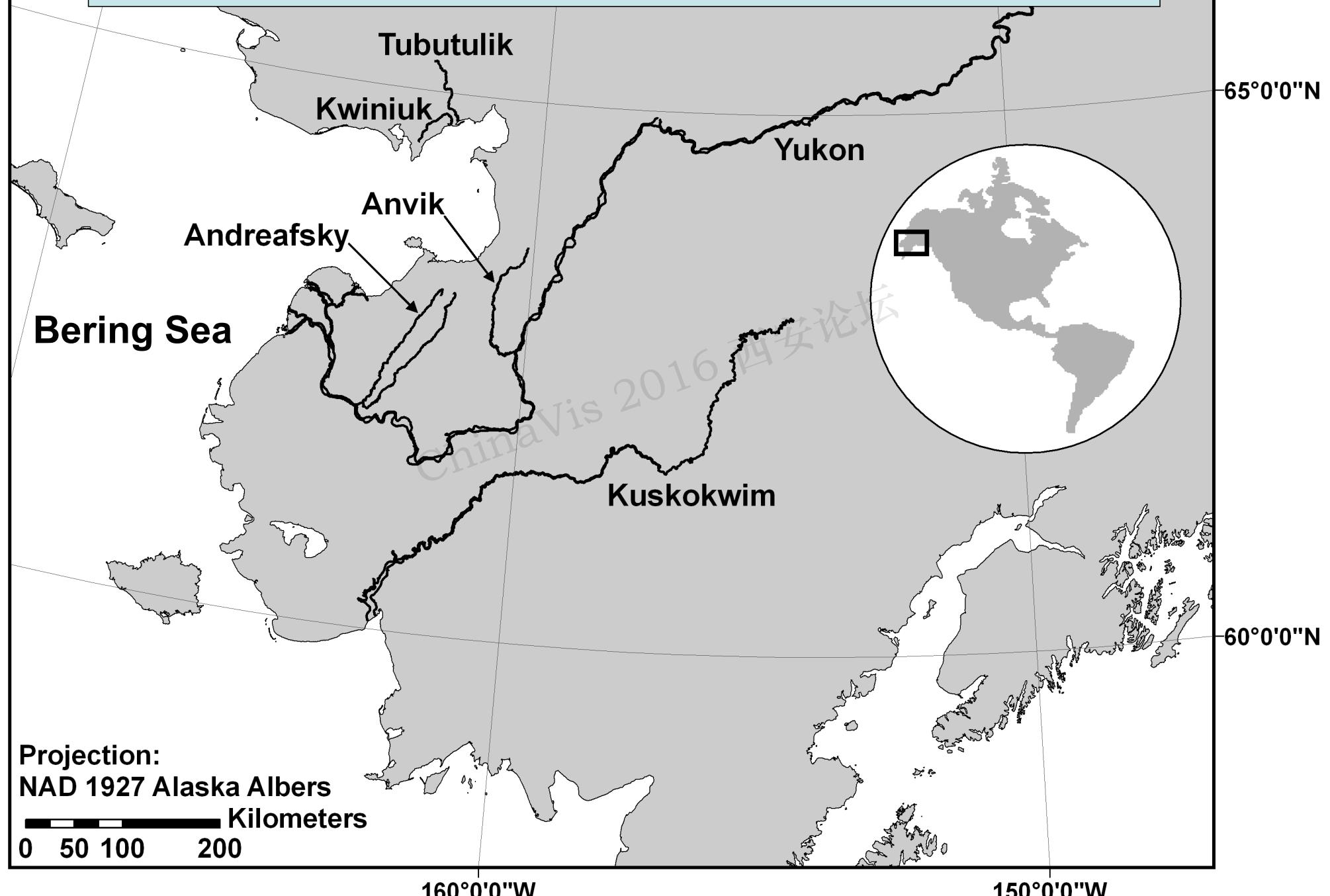
Visualization



Vismon

Fisheries science

The Arctic-Yukon-Kuskokwim (AYK) region



Roles - old days



Scientists



Managers

Goal



Scientists

Simulation worksheet

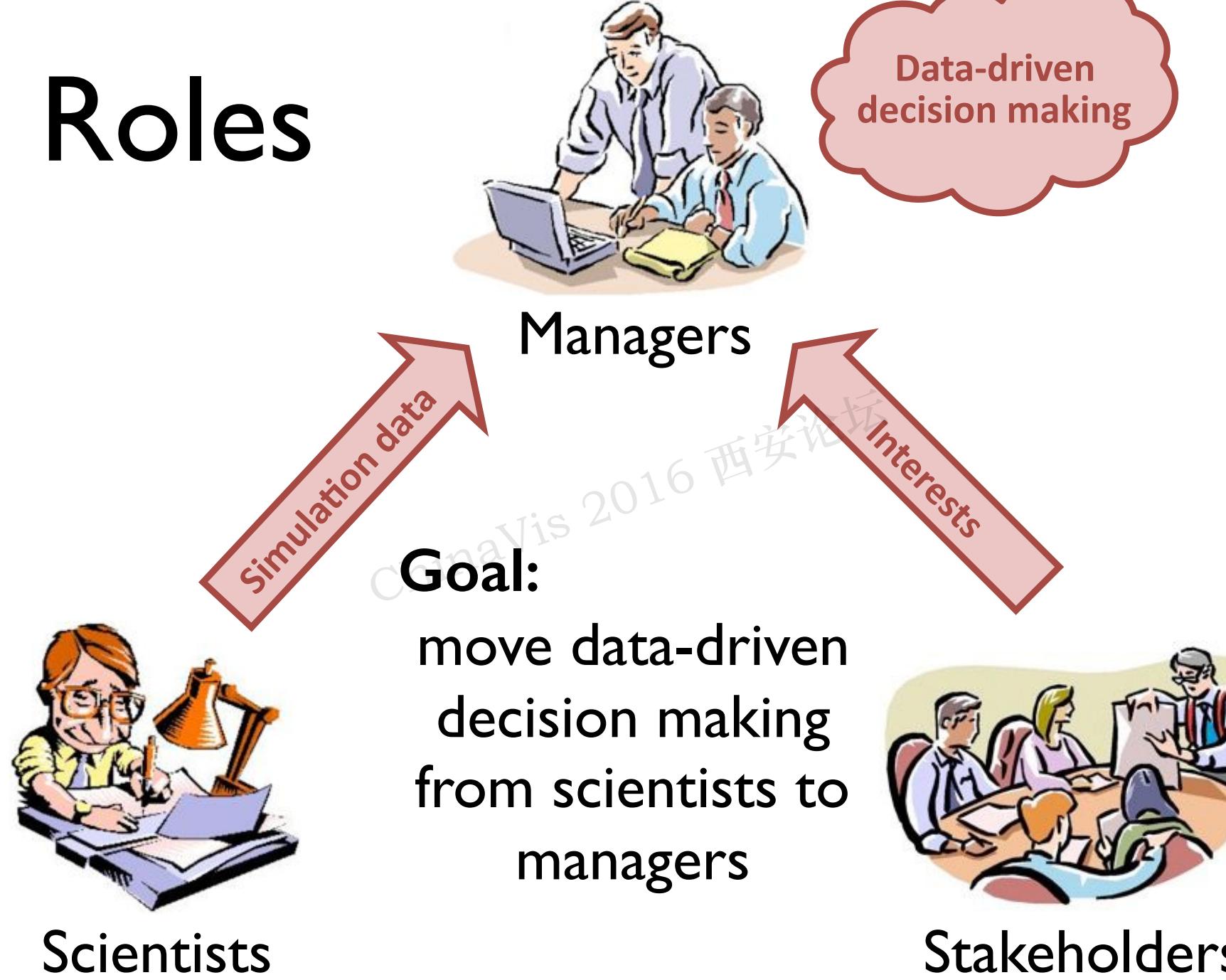


Managers

Goal:

move data-driven decision making from scientists
to managers

Roles

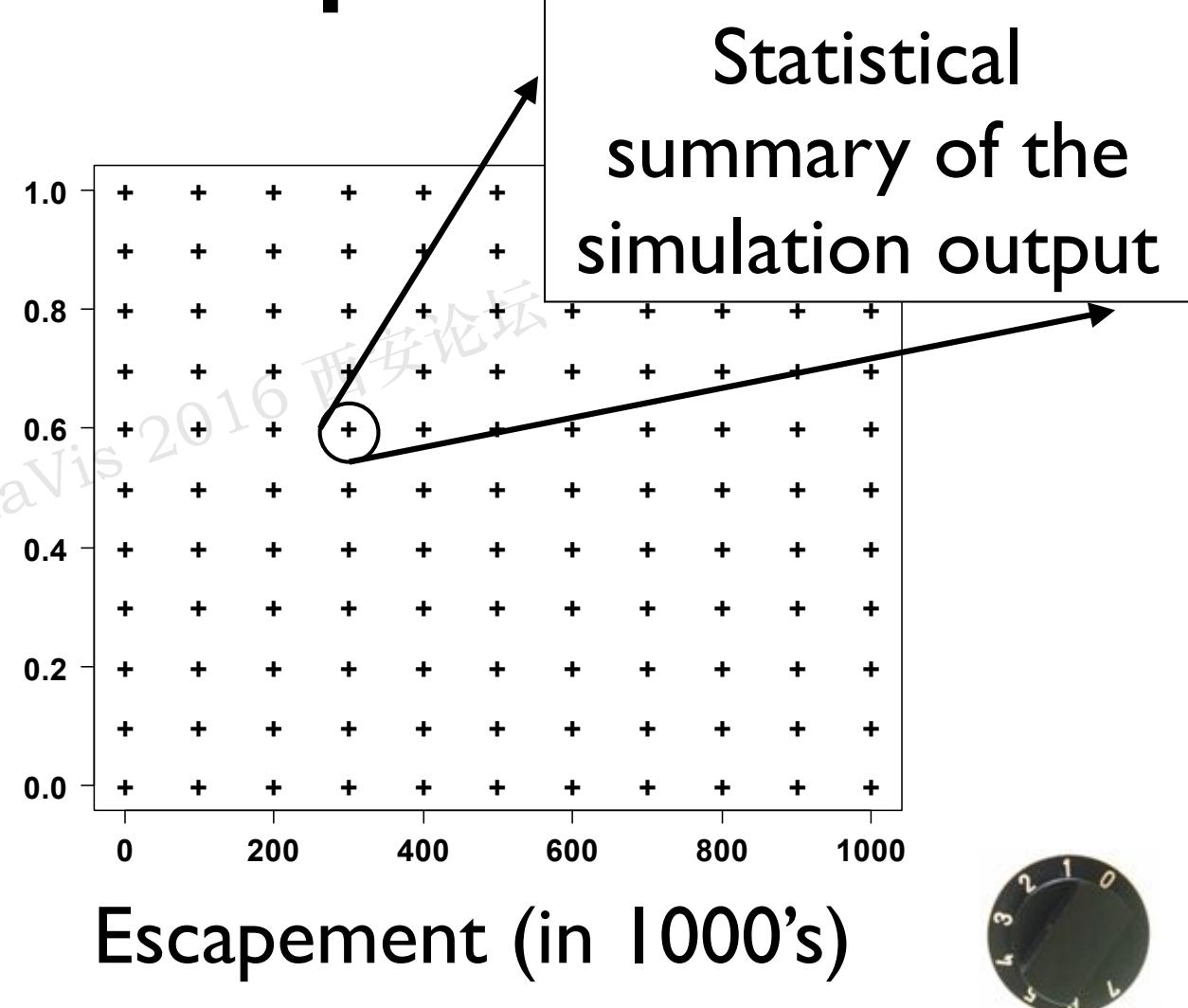


Alaskan Salmon Model



Scenario: 2 input values

Harvest rate



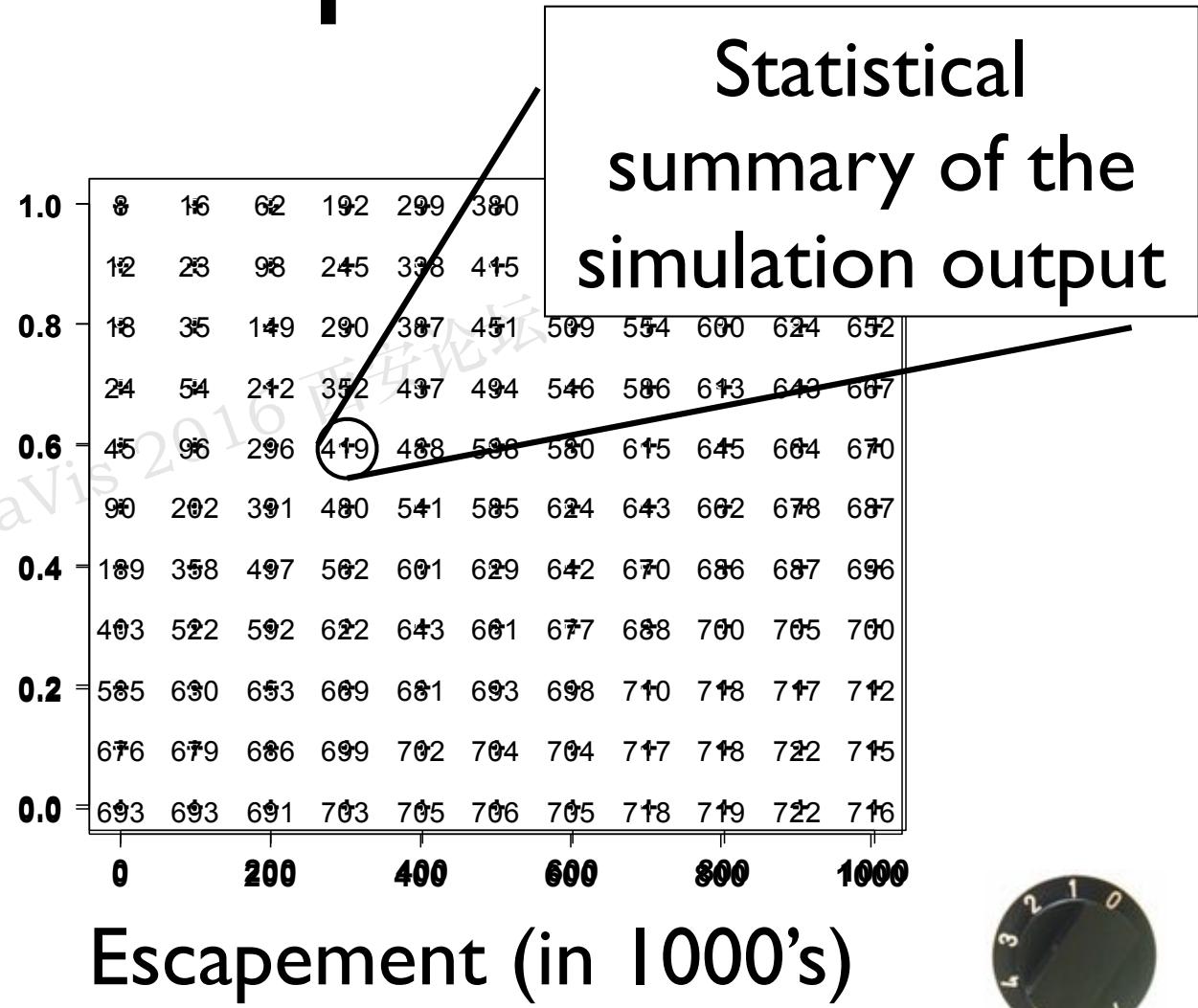
Output summarized ...

Statistical
summary of the
simulation output

- Average
- Median
- Coefficient of variation
- % of years something bad happens

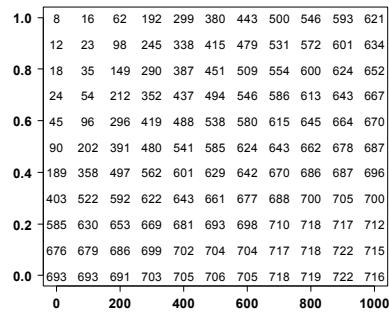
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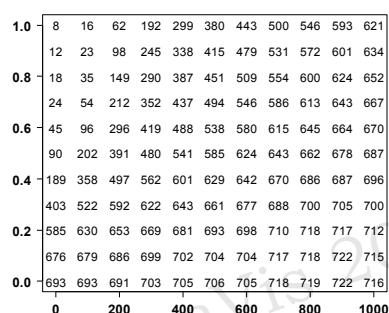


Scenario: 2 input values

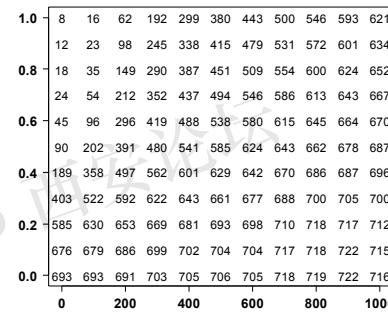
Avg



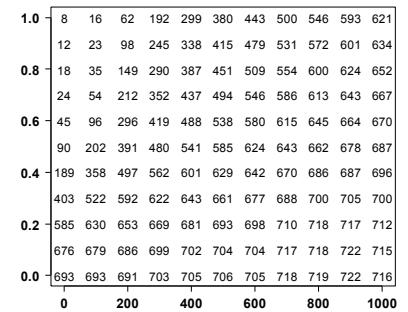
Median



CV



%



12 Outputs / Indicators

Spawners
(Escapement)

Food
(subsistence)

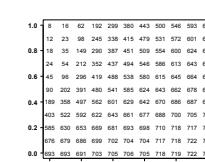
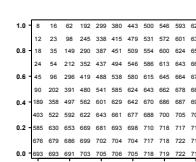
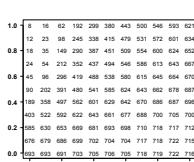
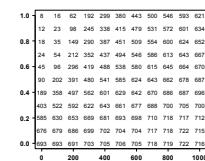
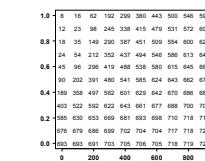
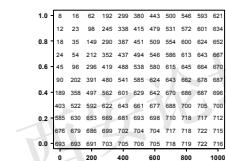
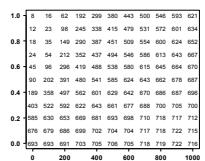
\$
(commercial)

Avg

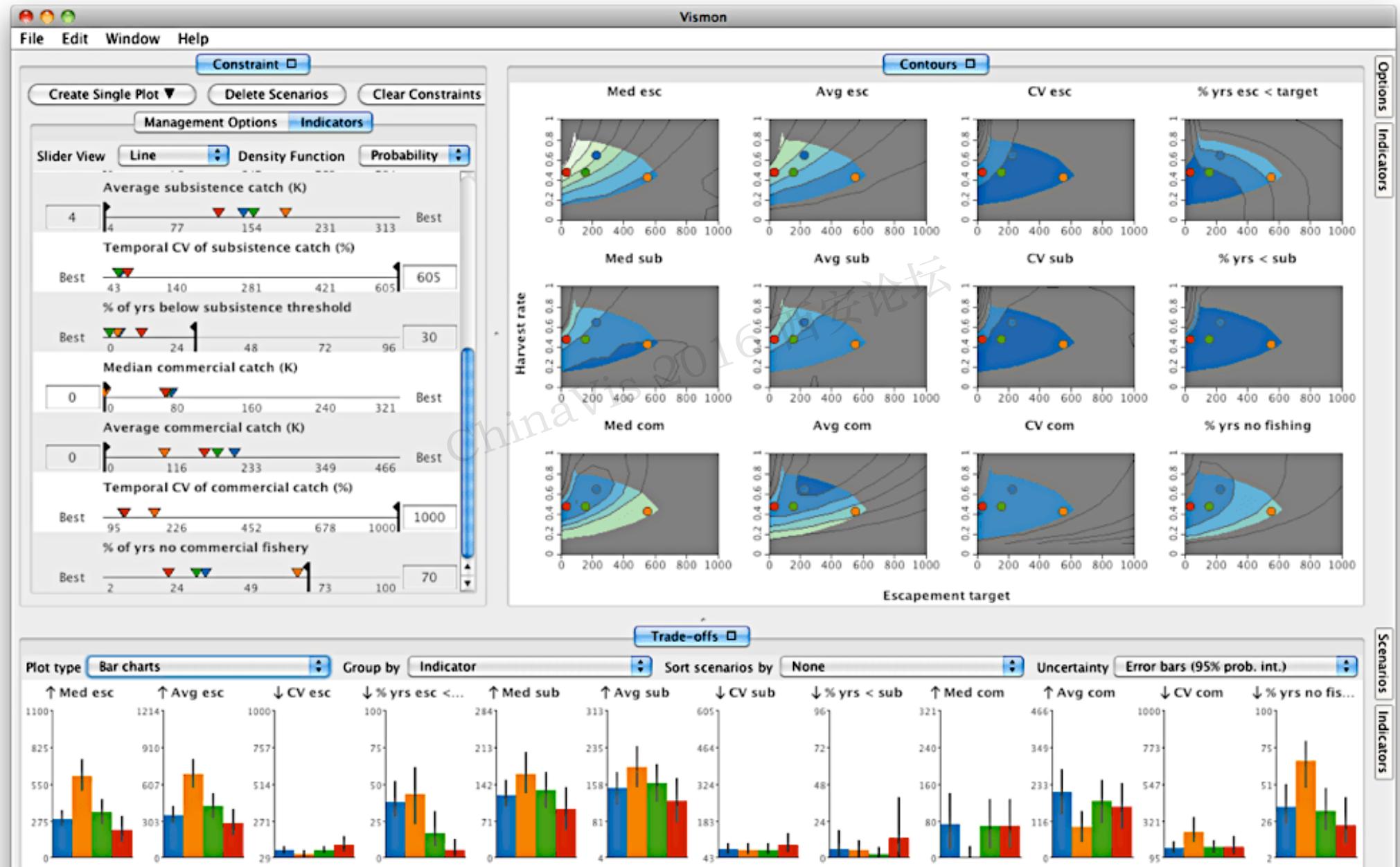
Median

CV

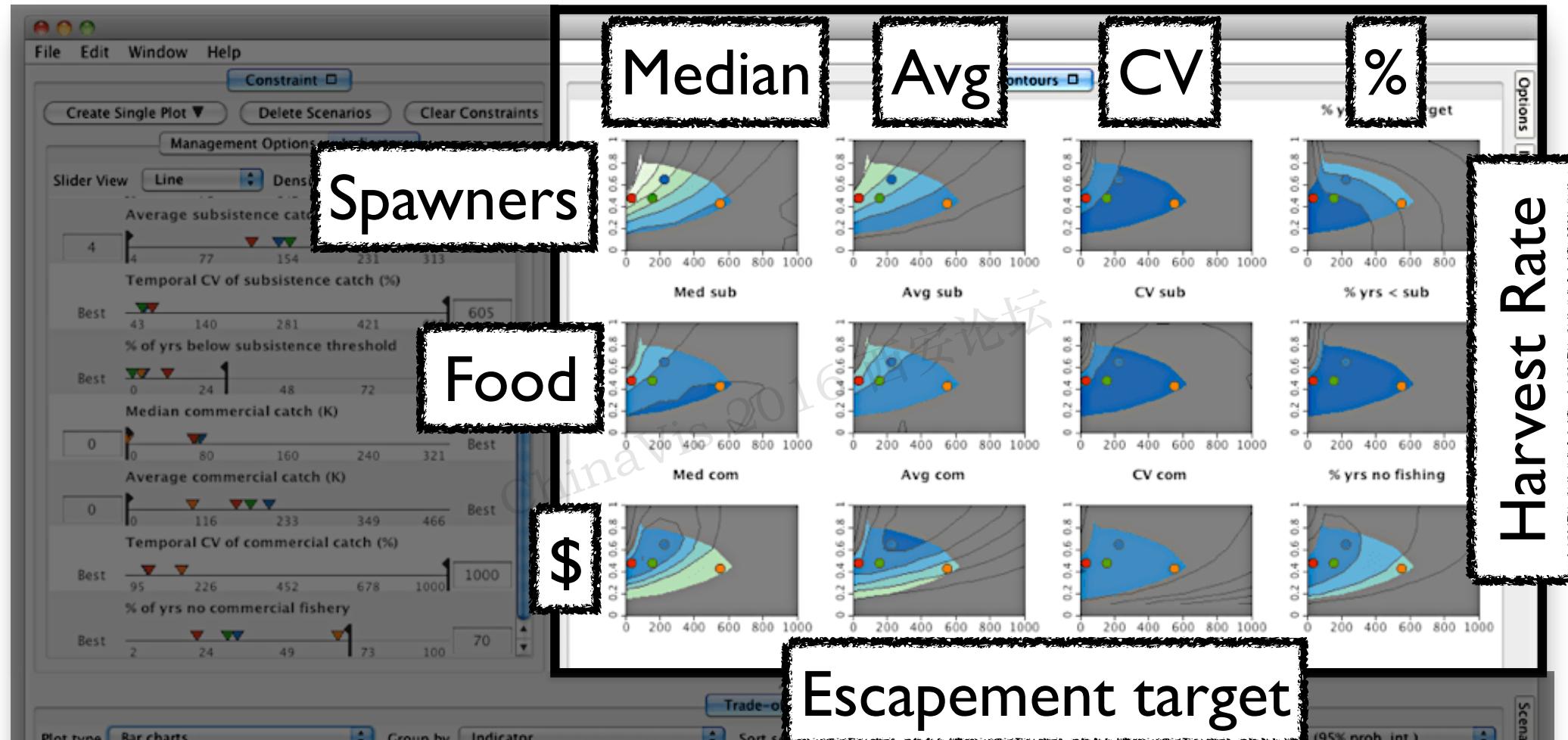
%



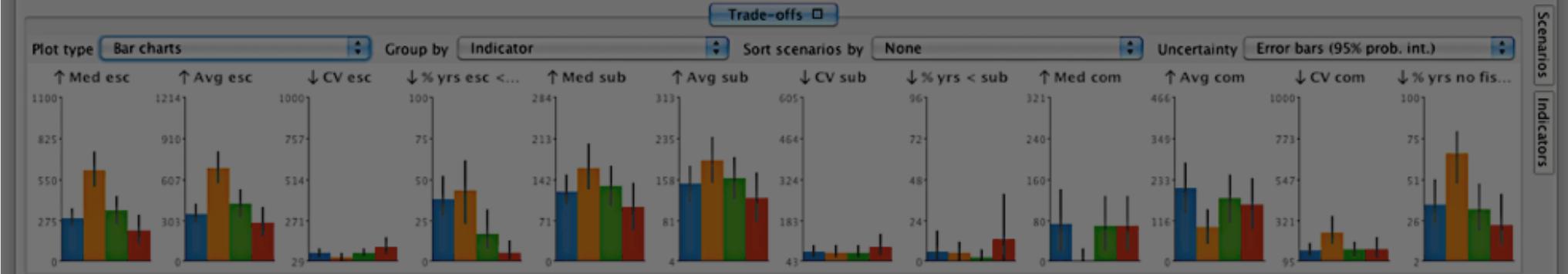
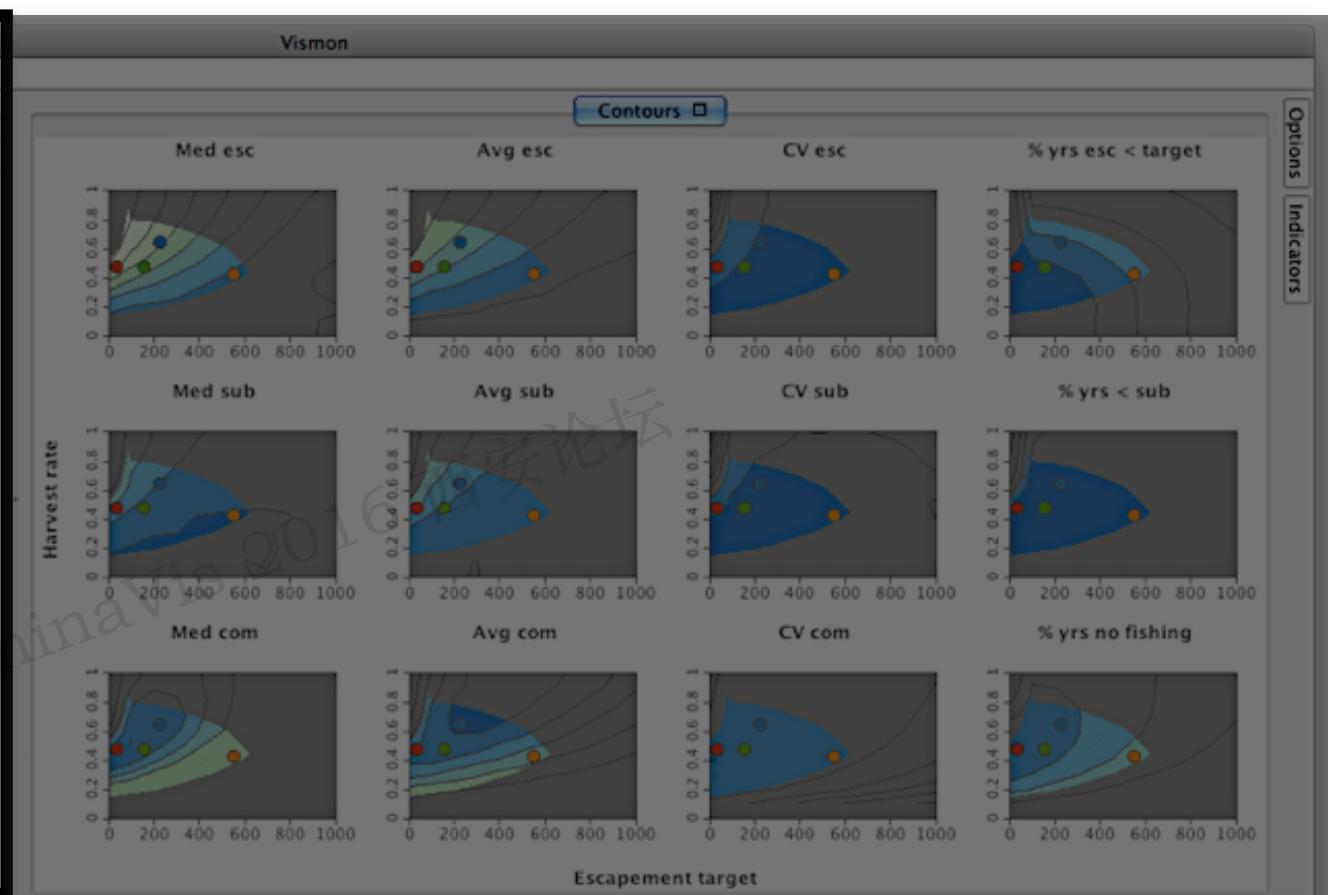
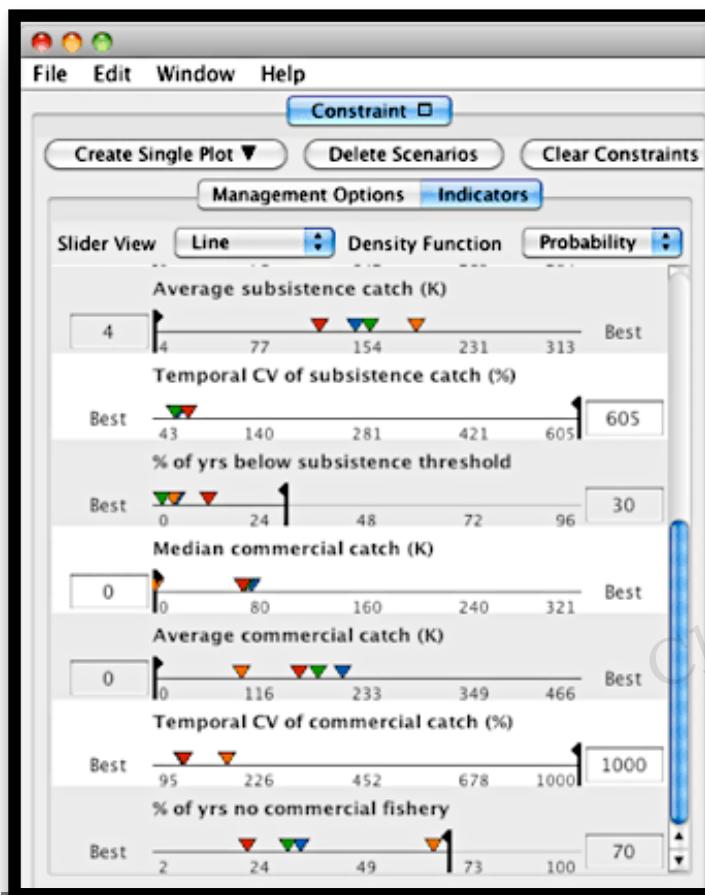
Vismon



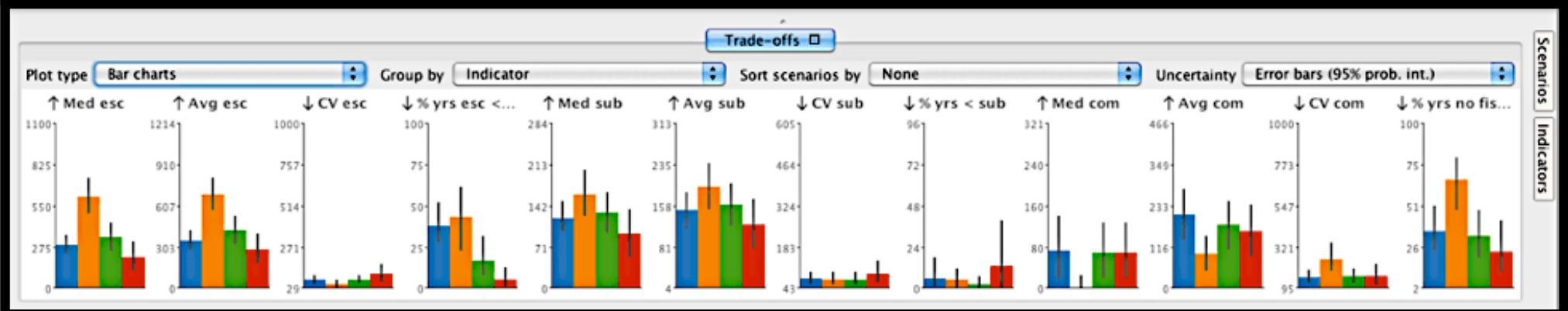
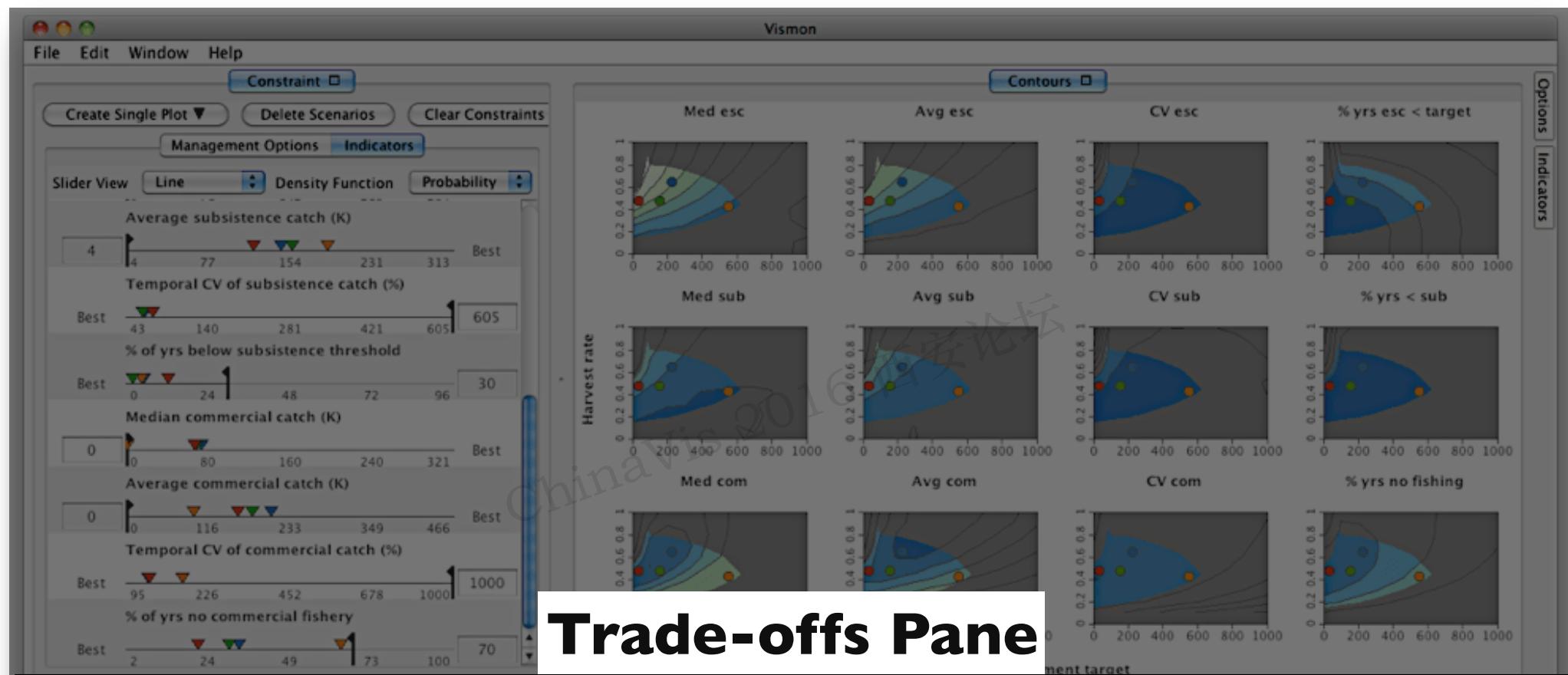
Vismon Contours Pane



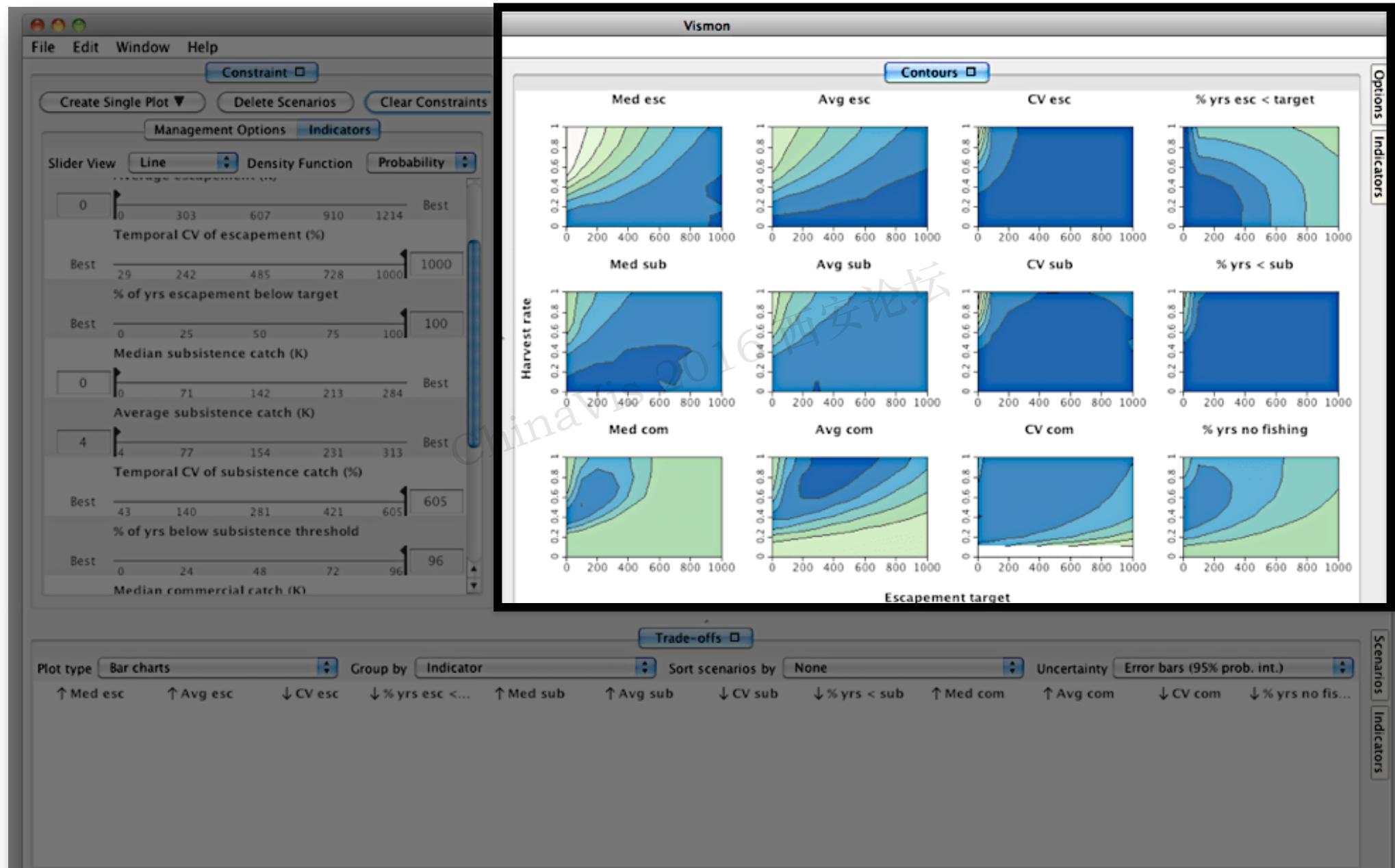
Constraint Pane Vismon



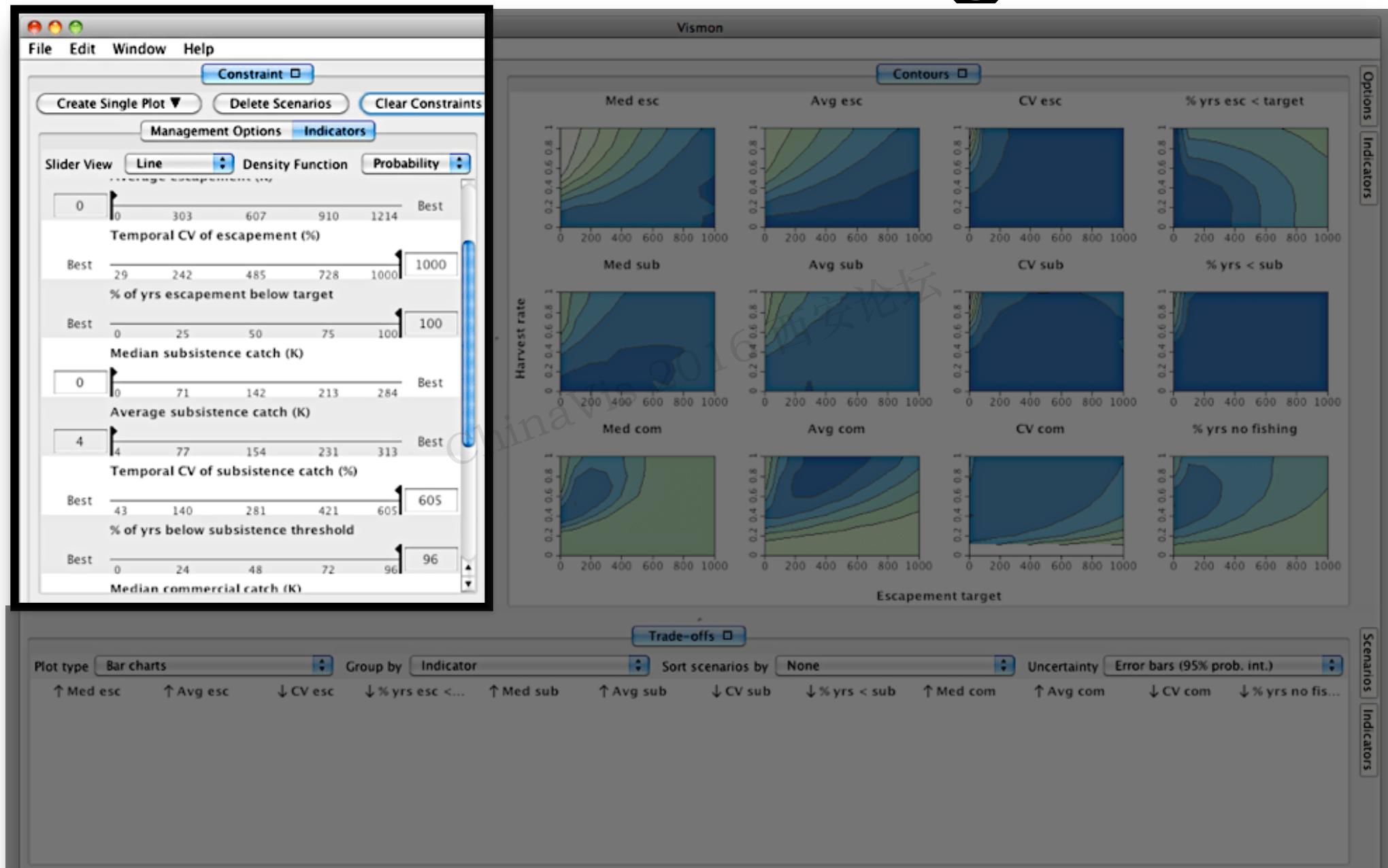
Vismon



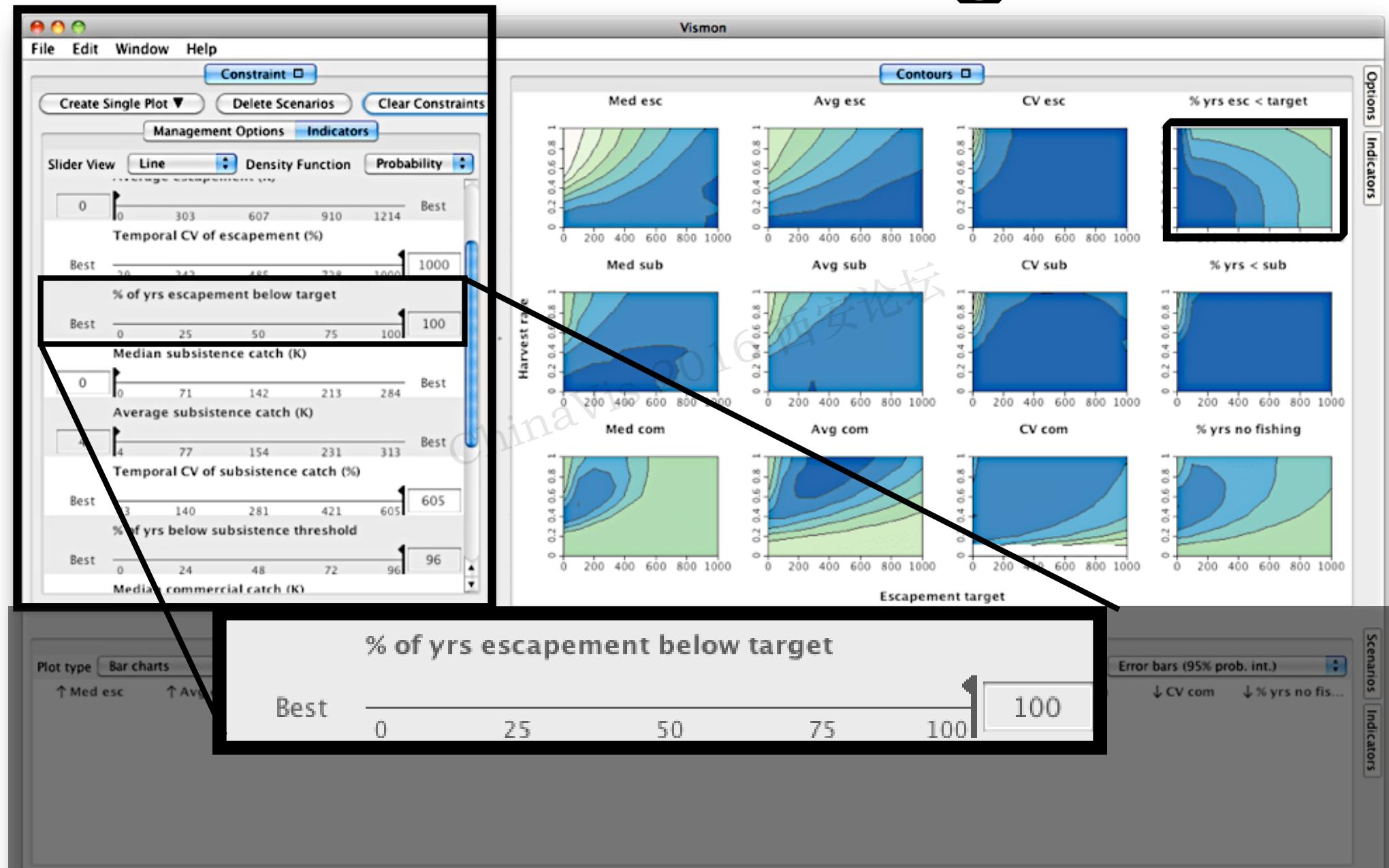
Summarization



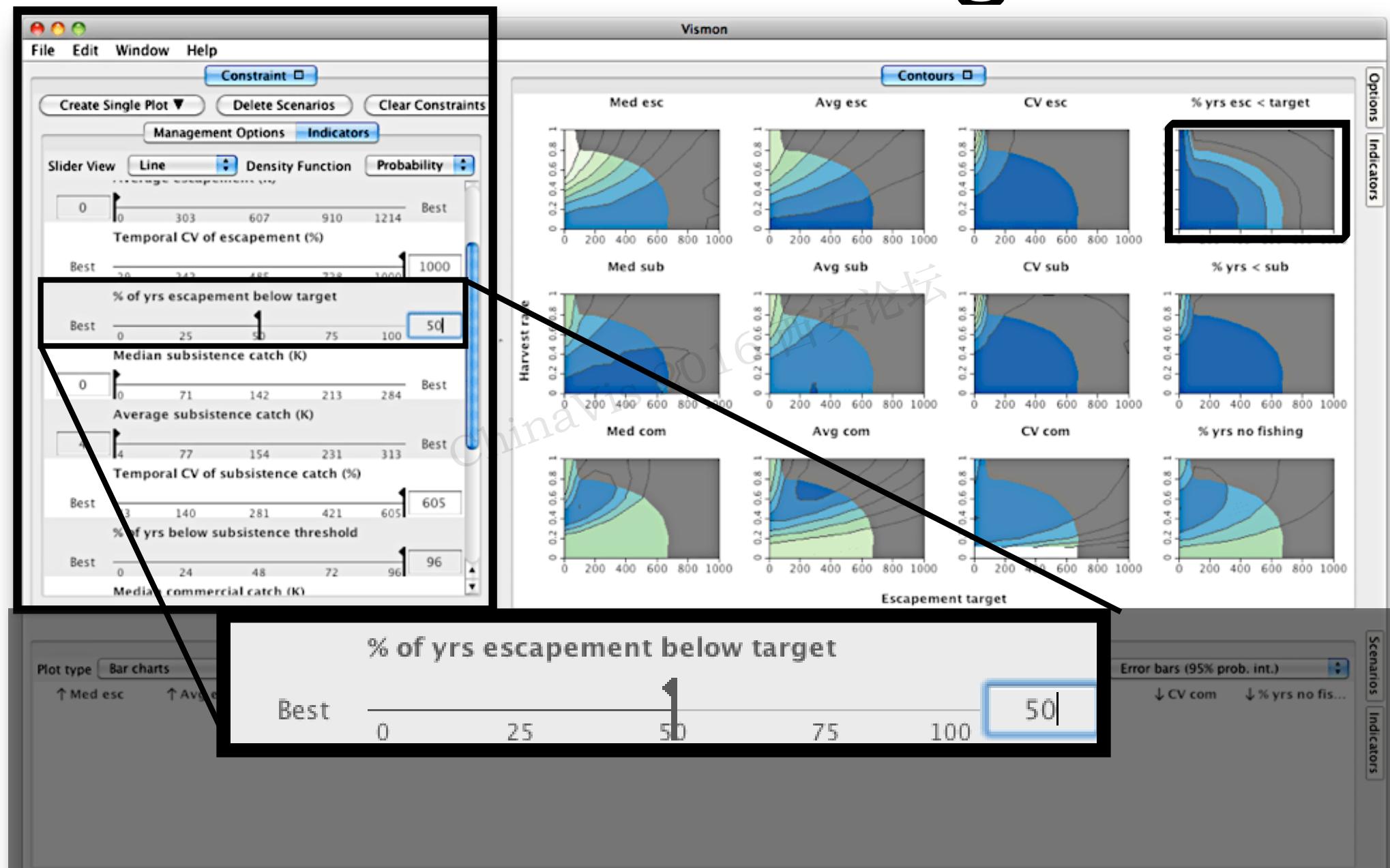
Constraining



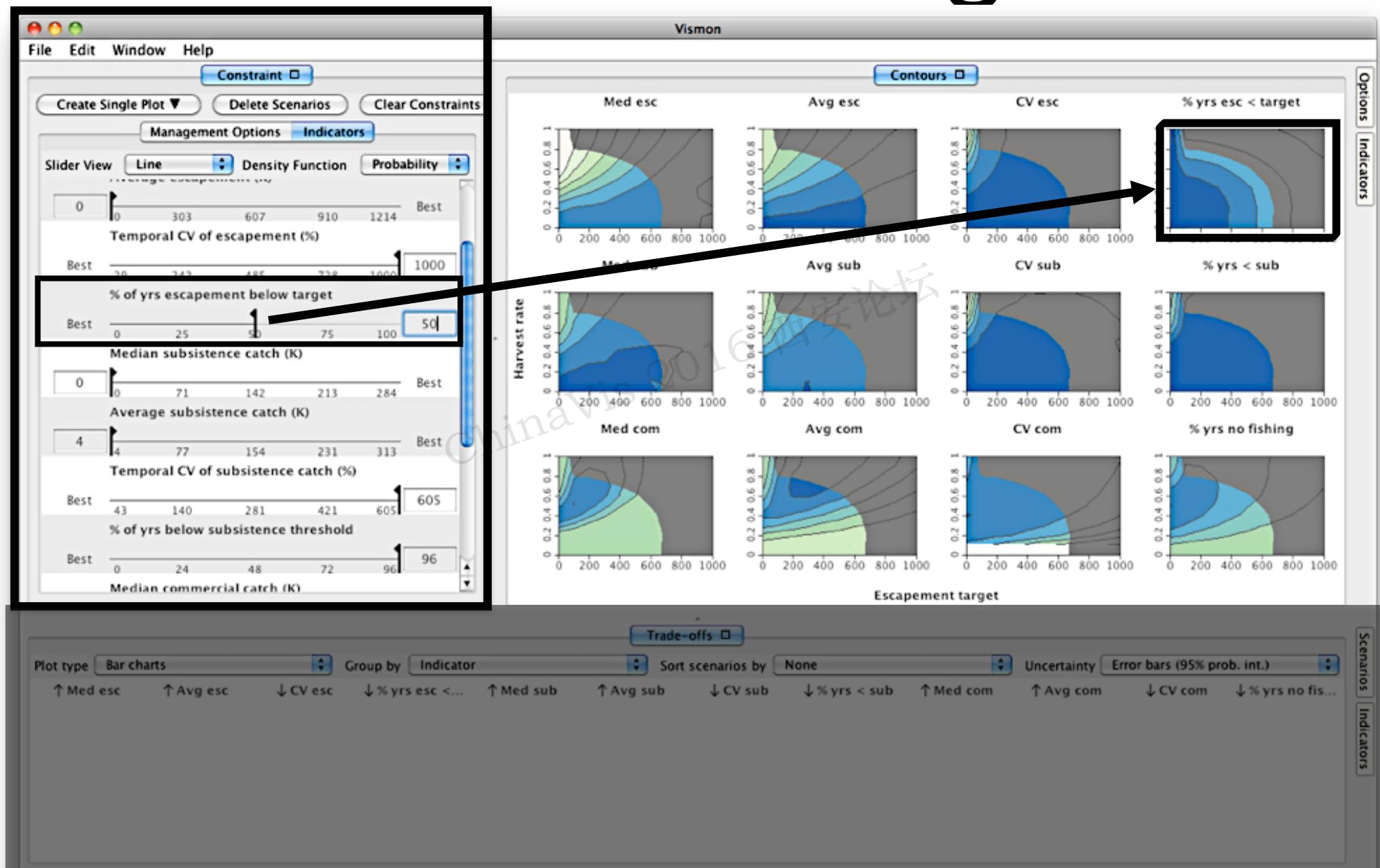
Constraining



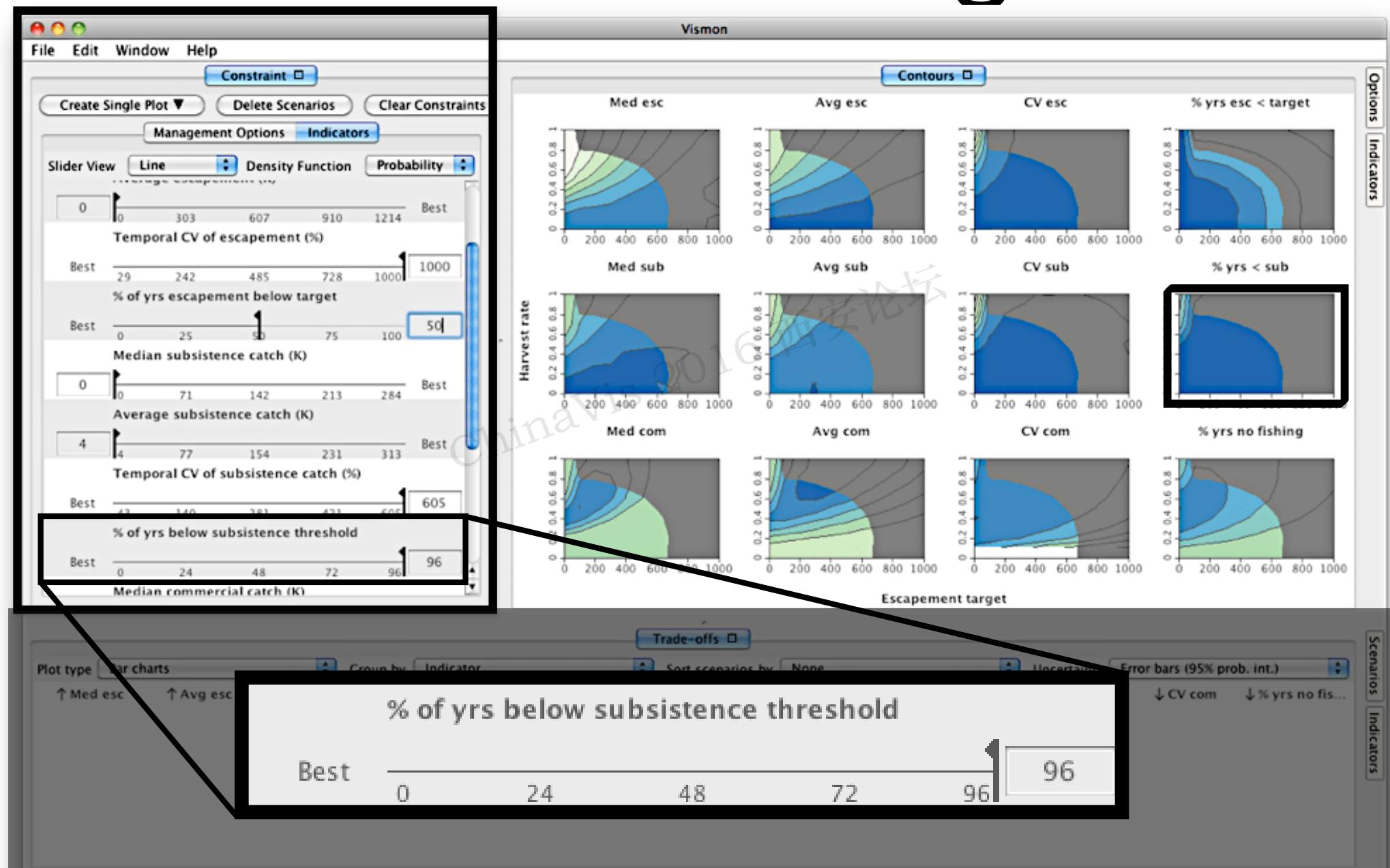
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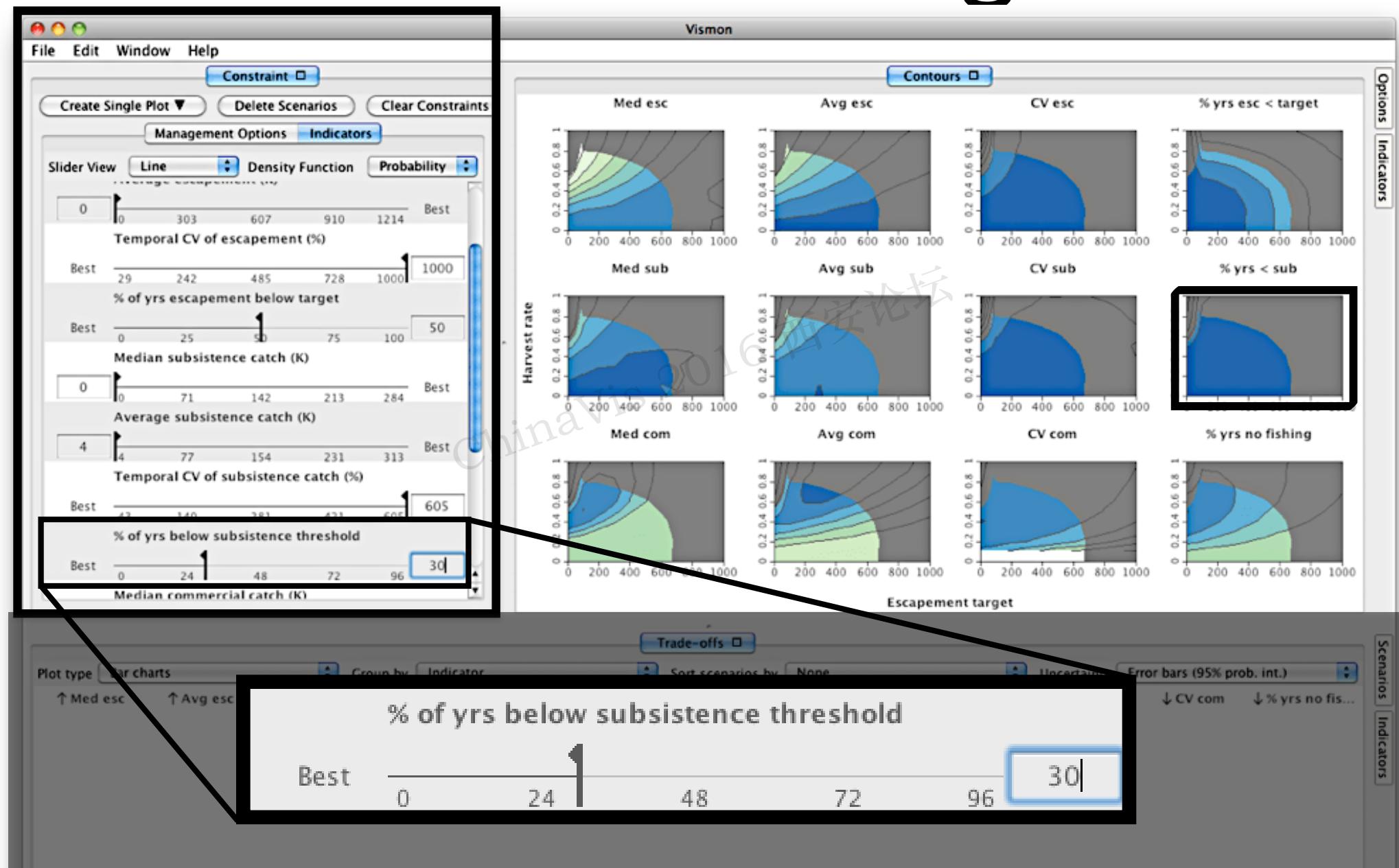
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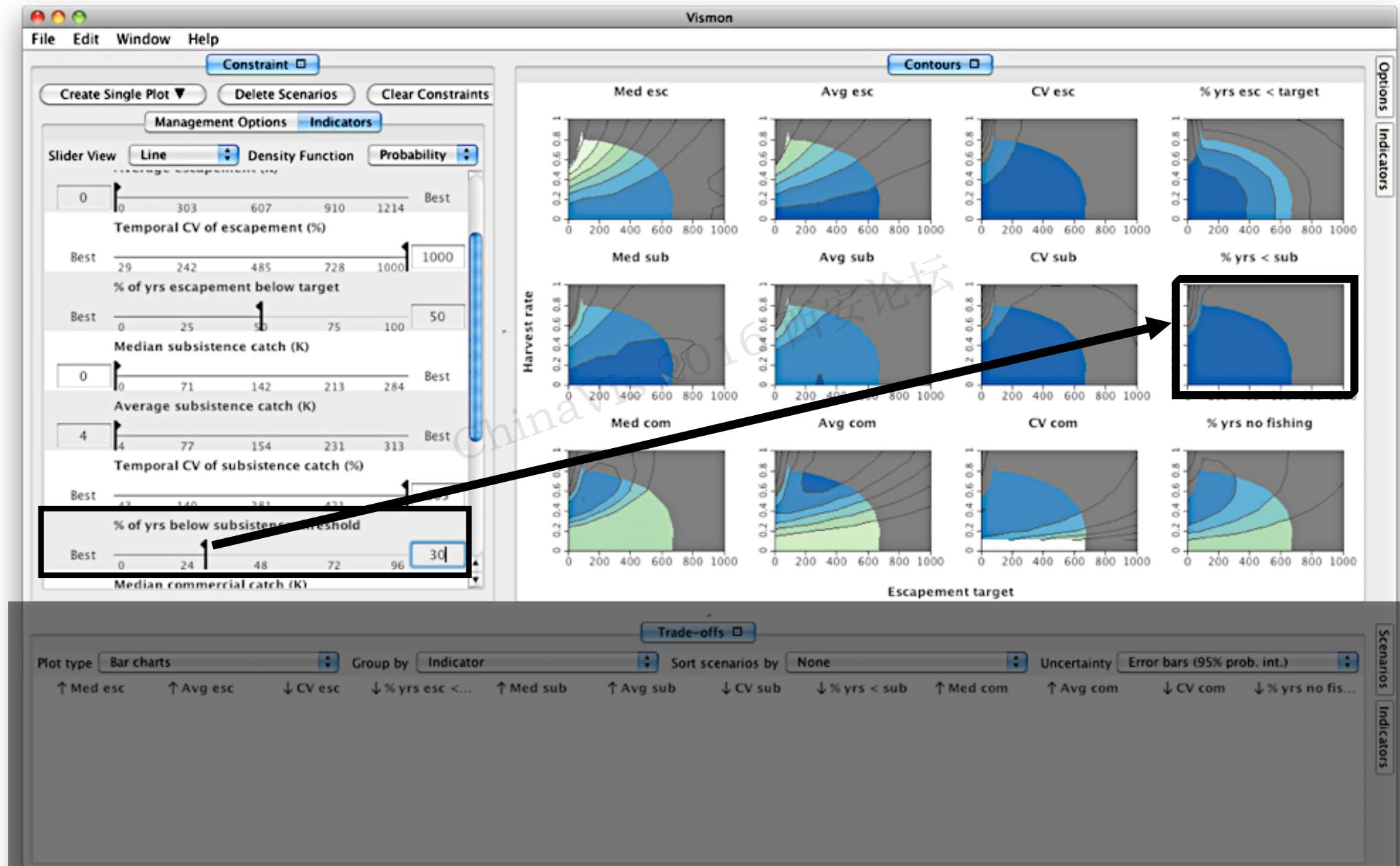
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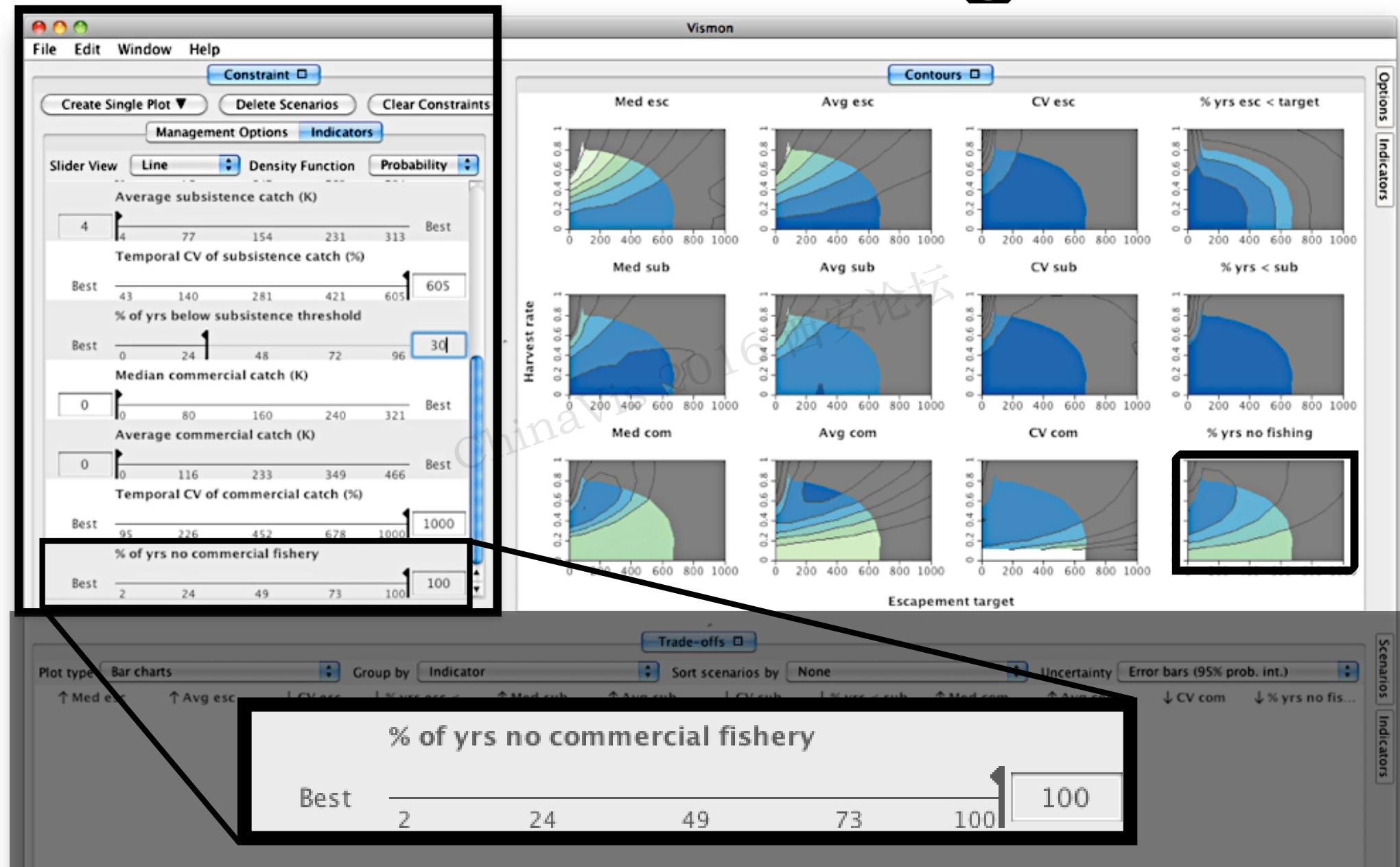
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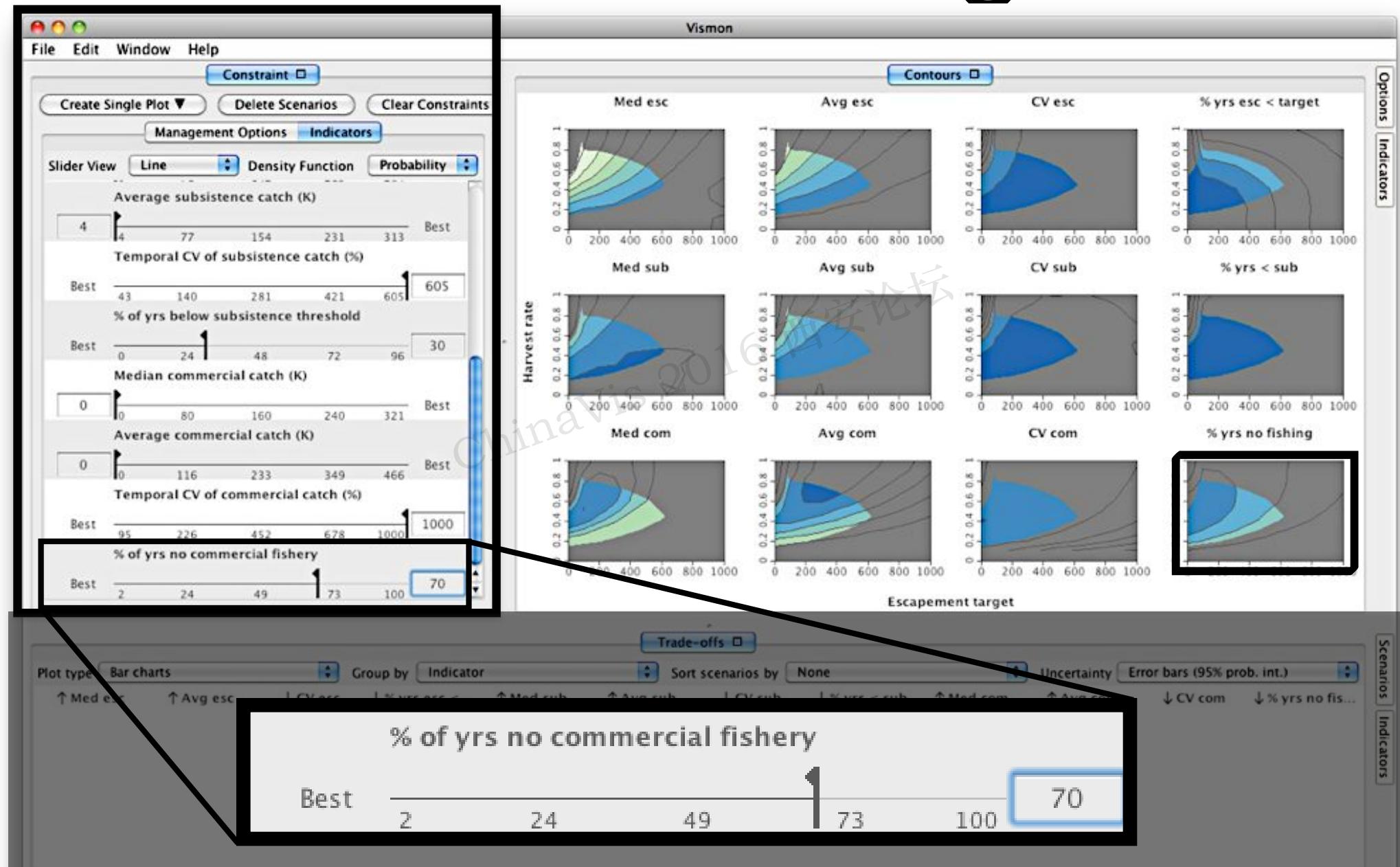
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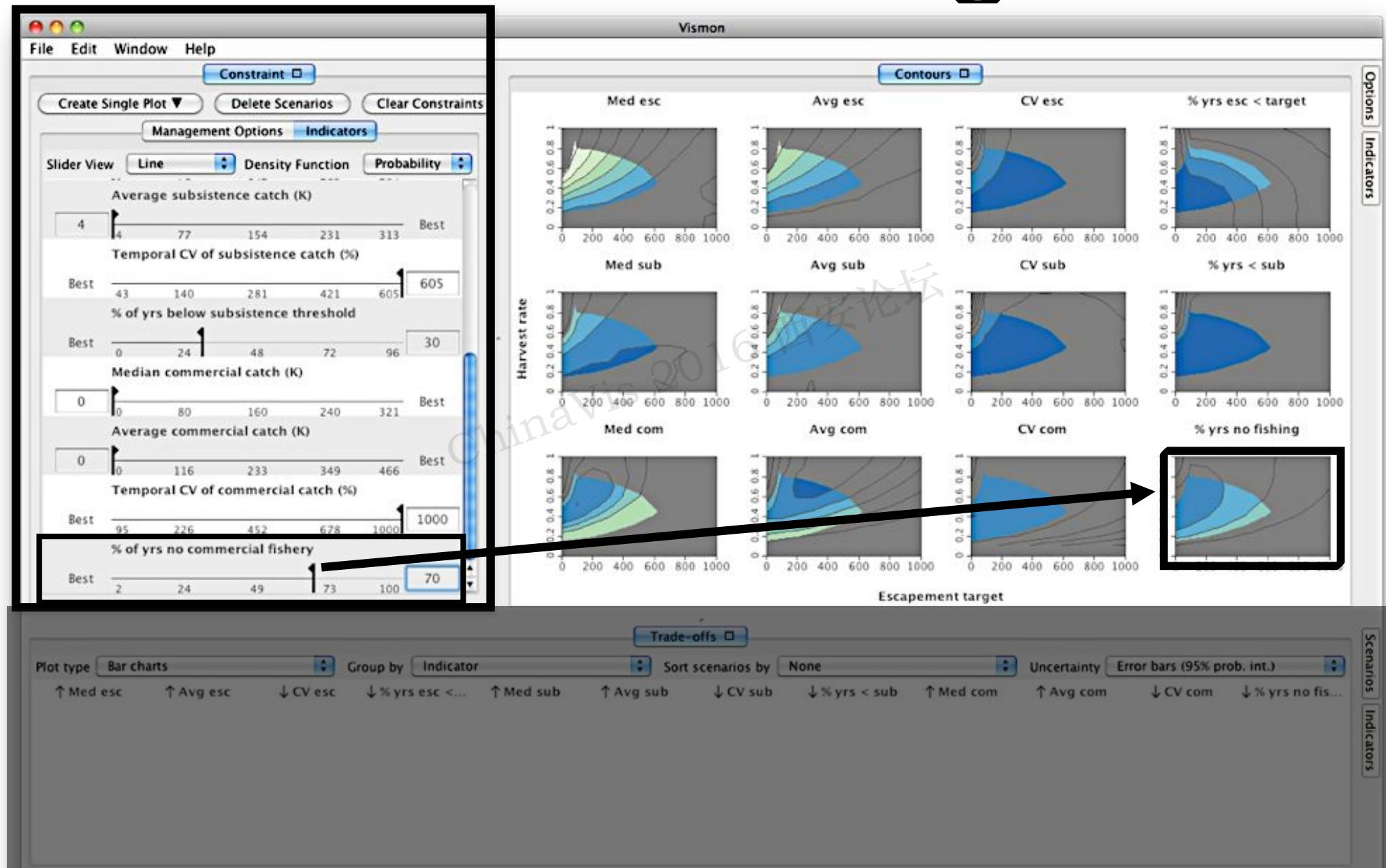
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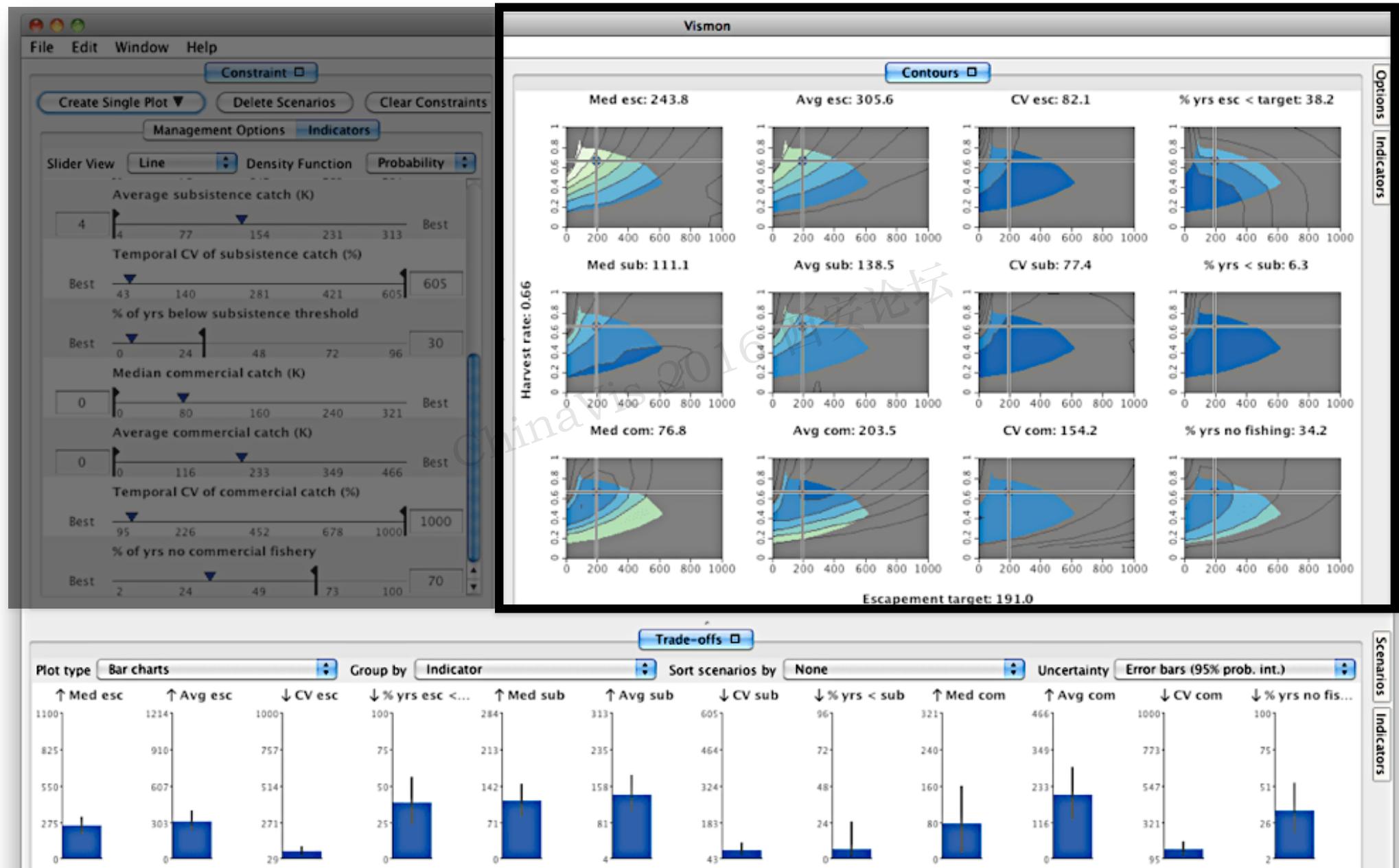
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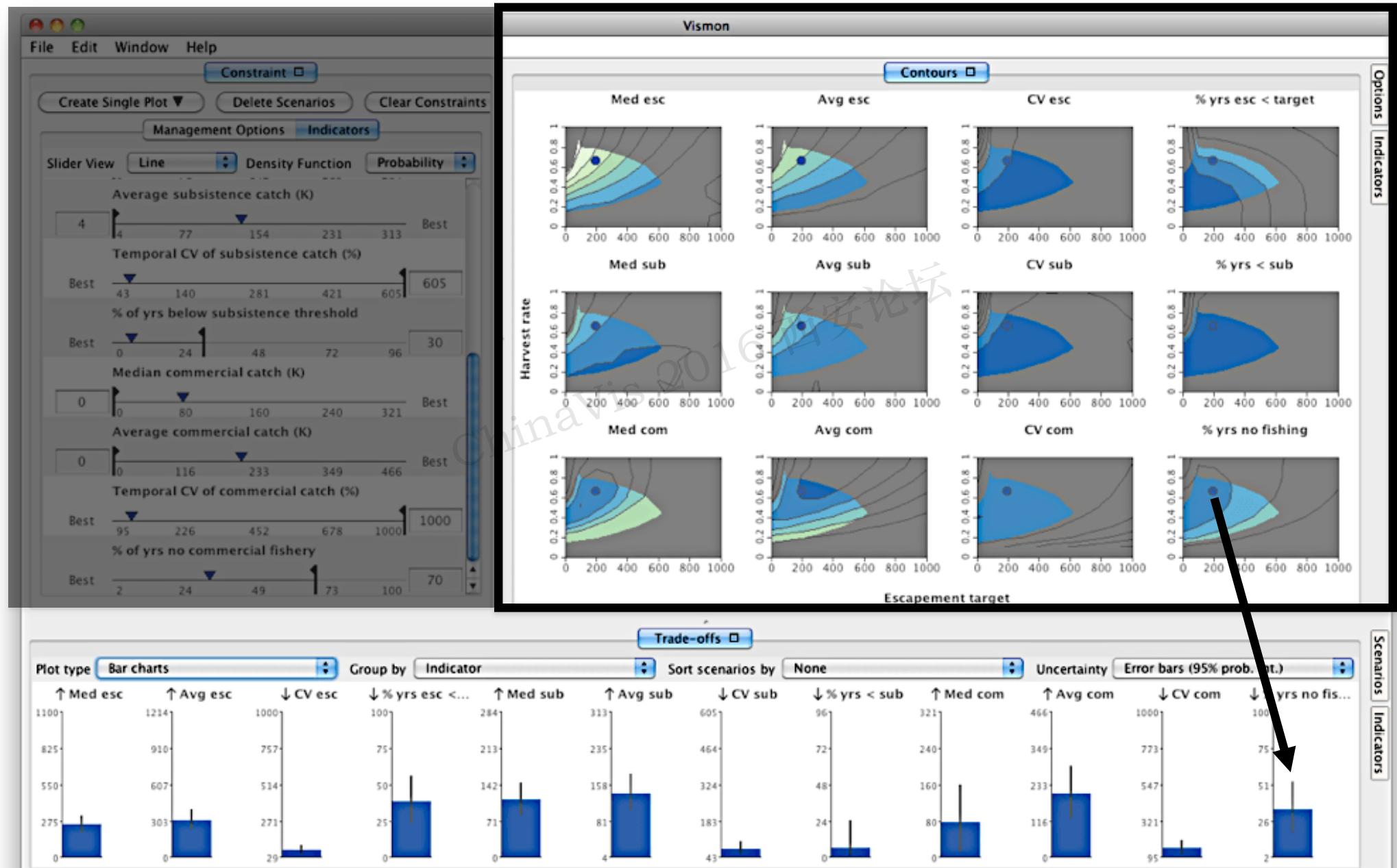
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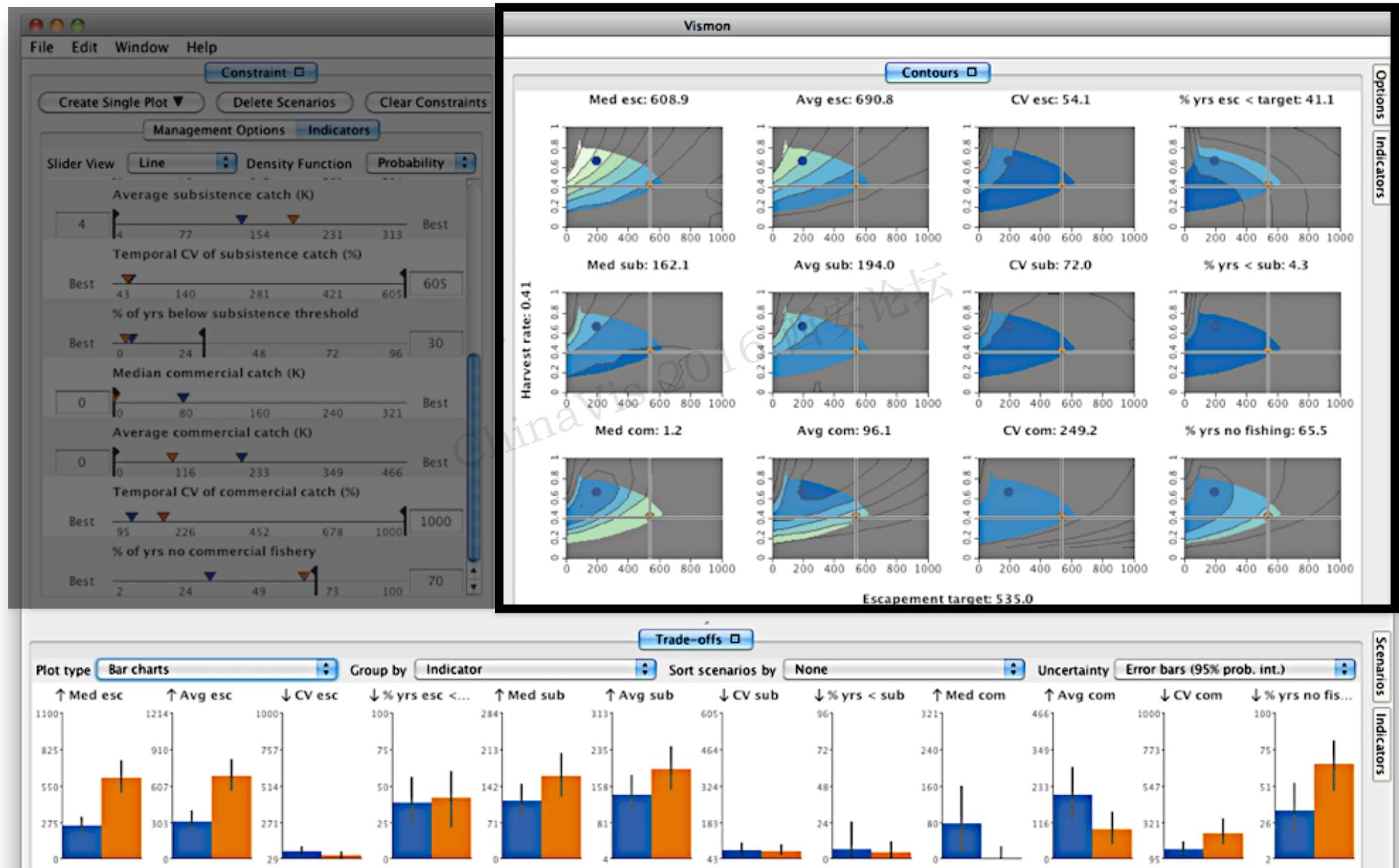
Selection



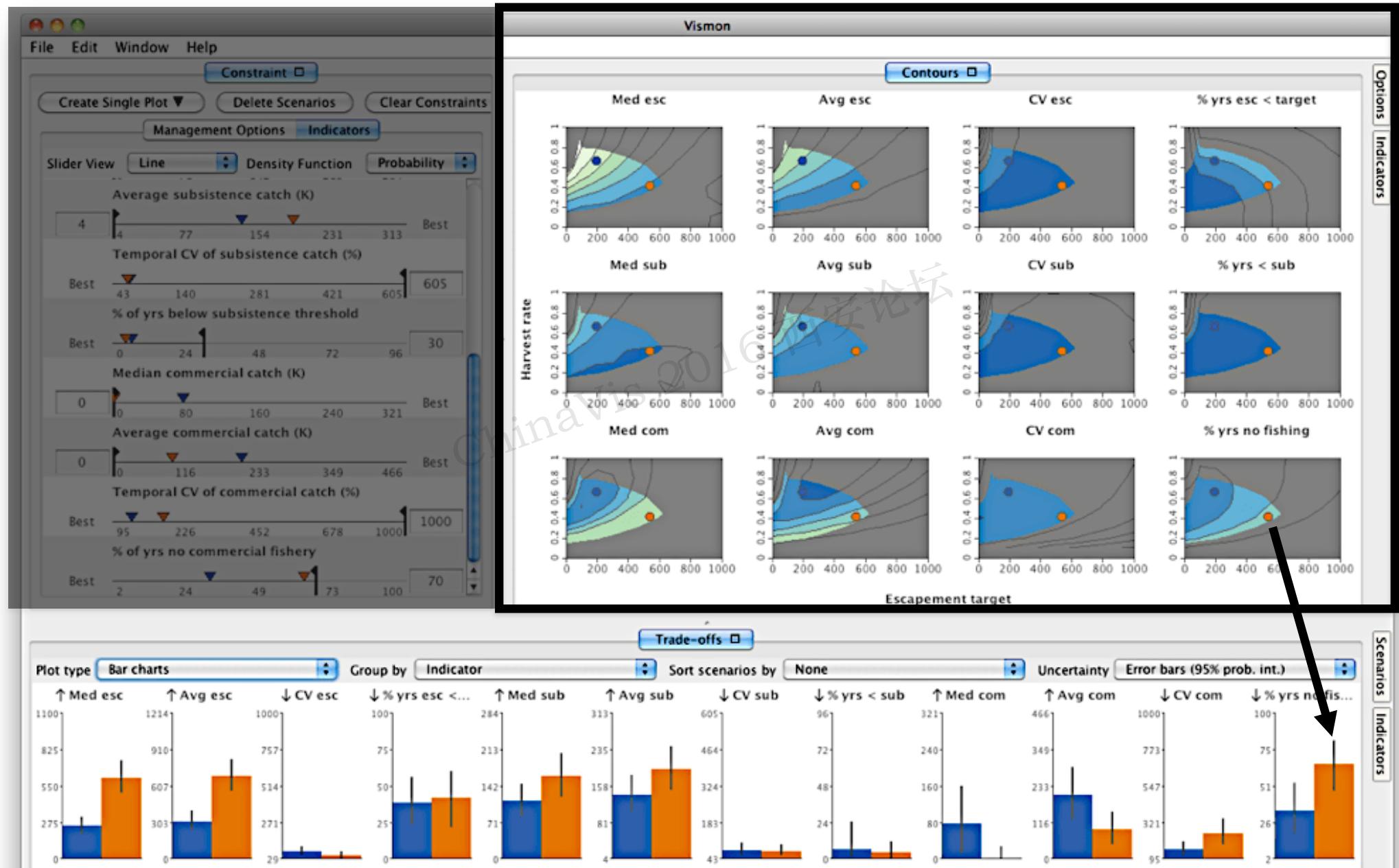
Selection



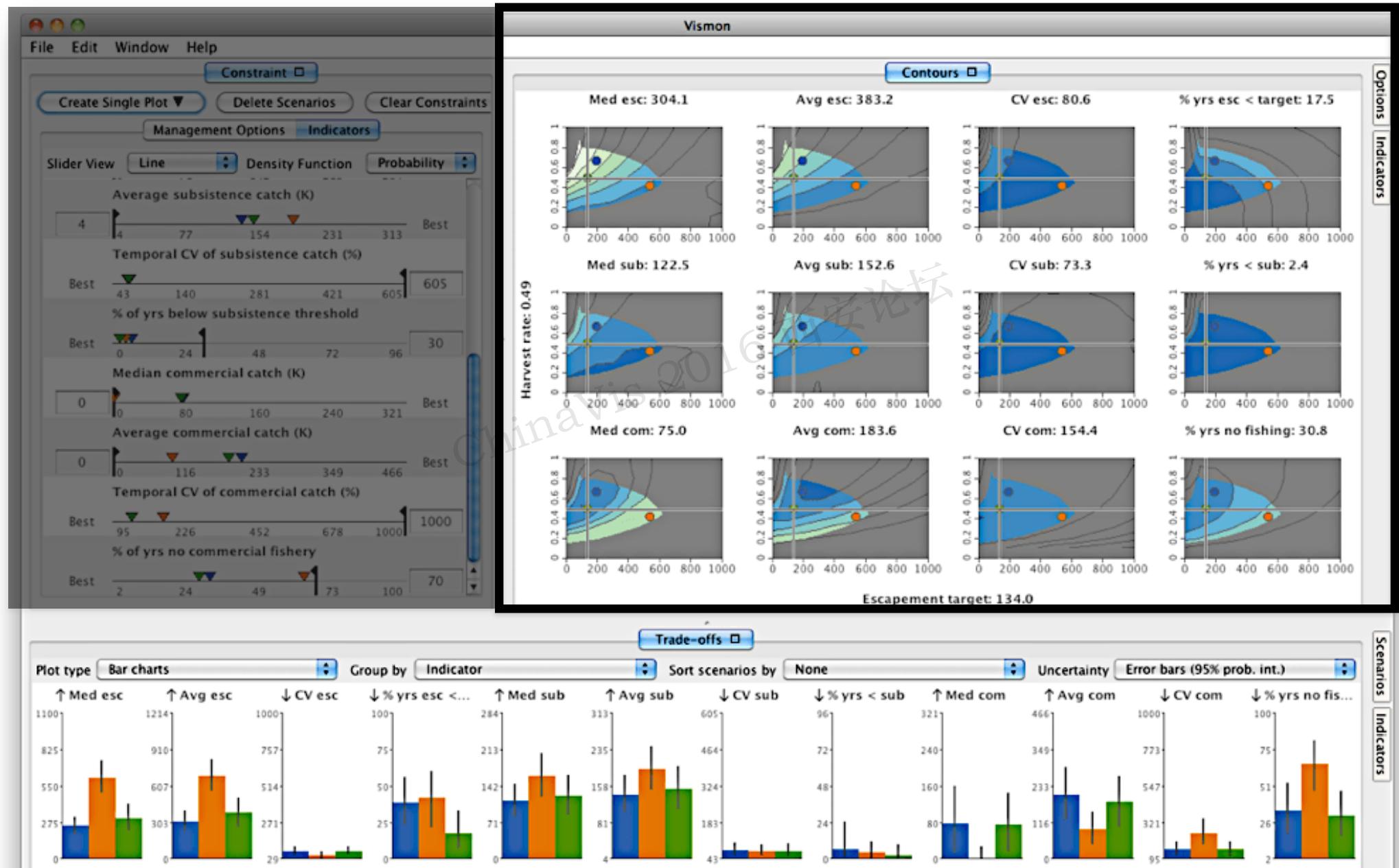
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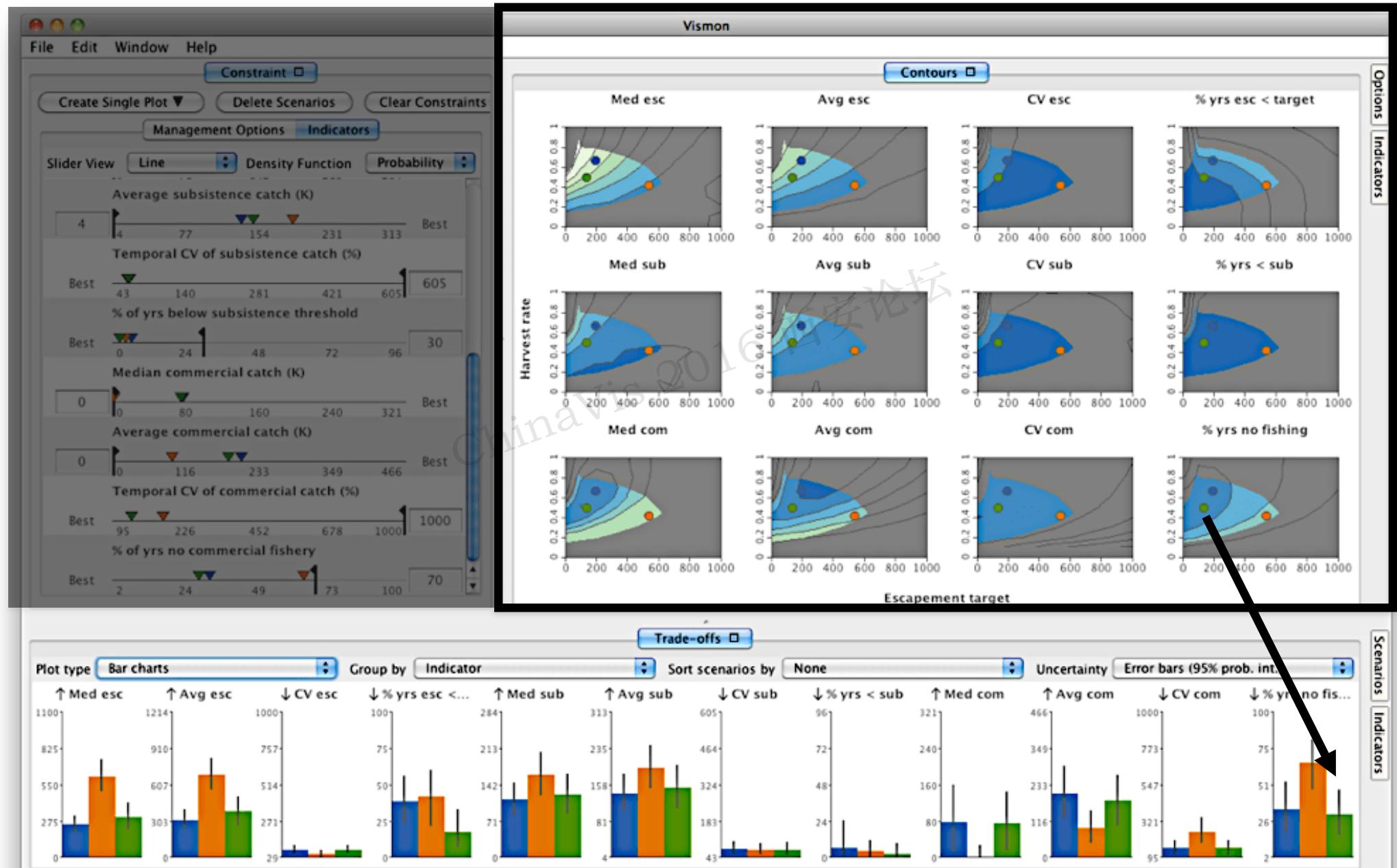
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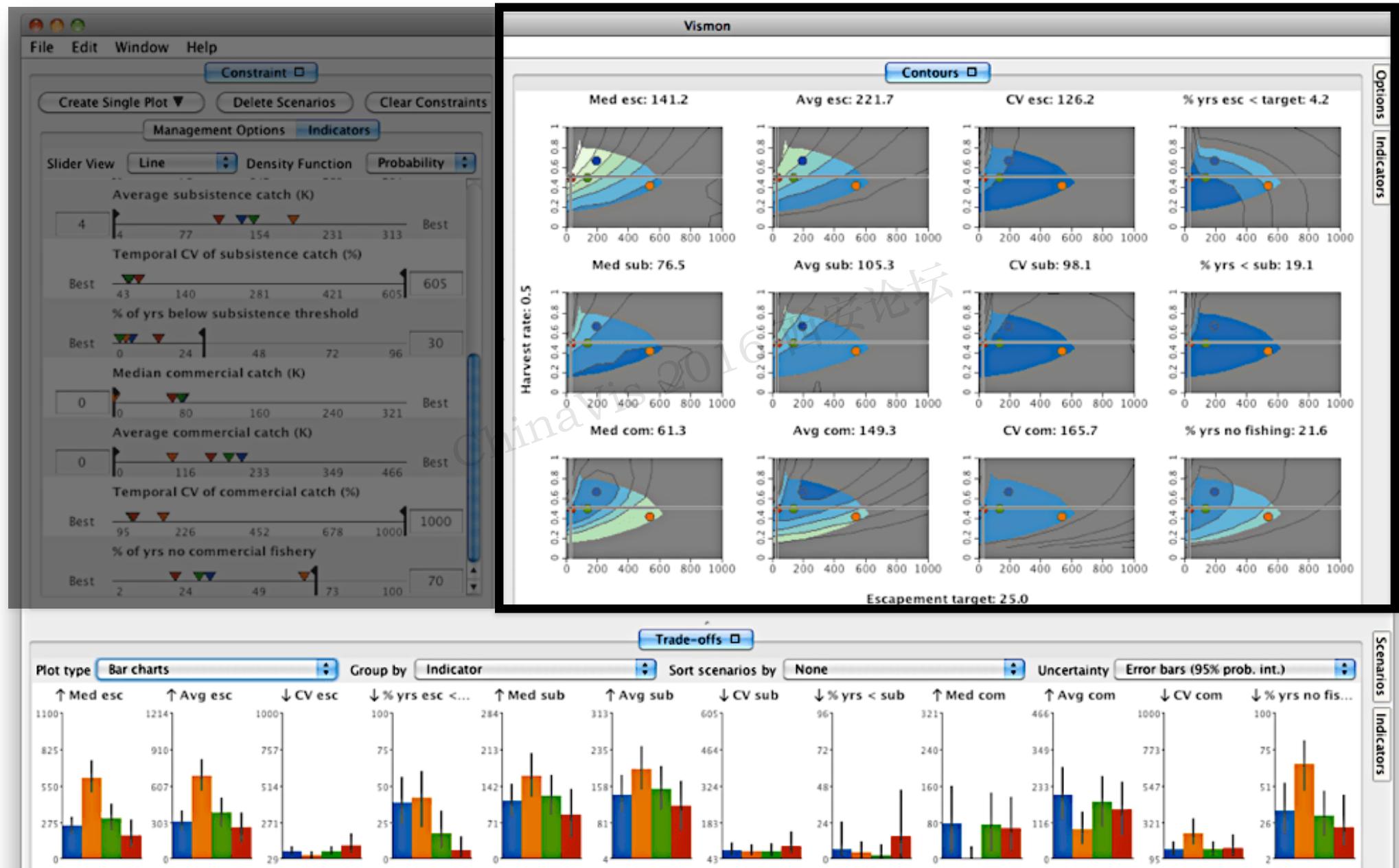
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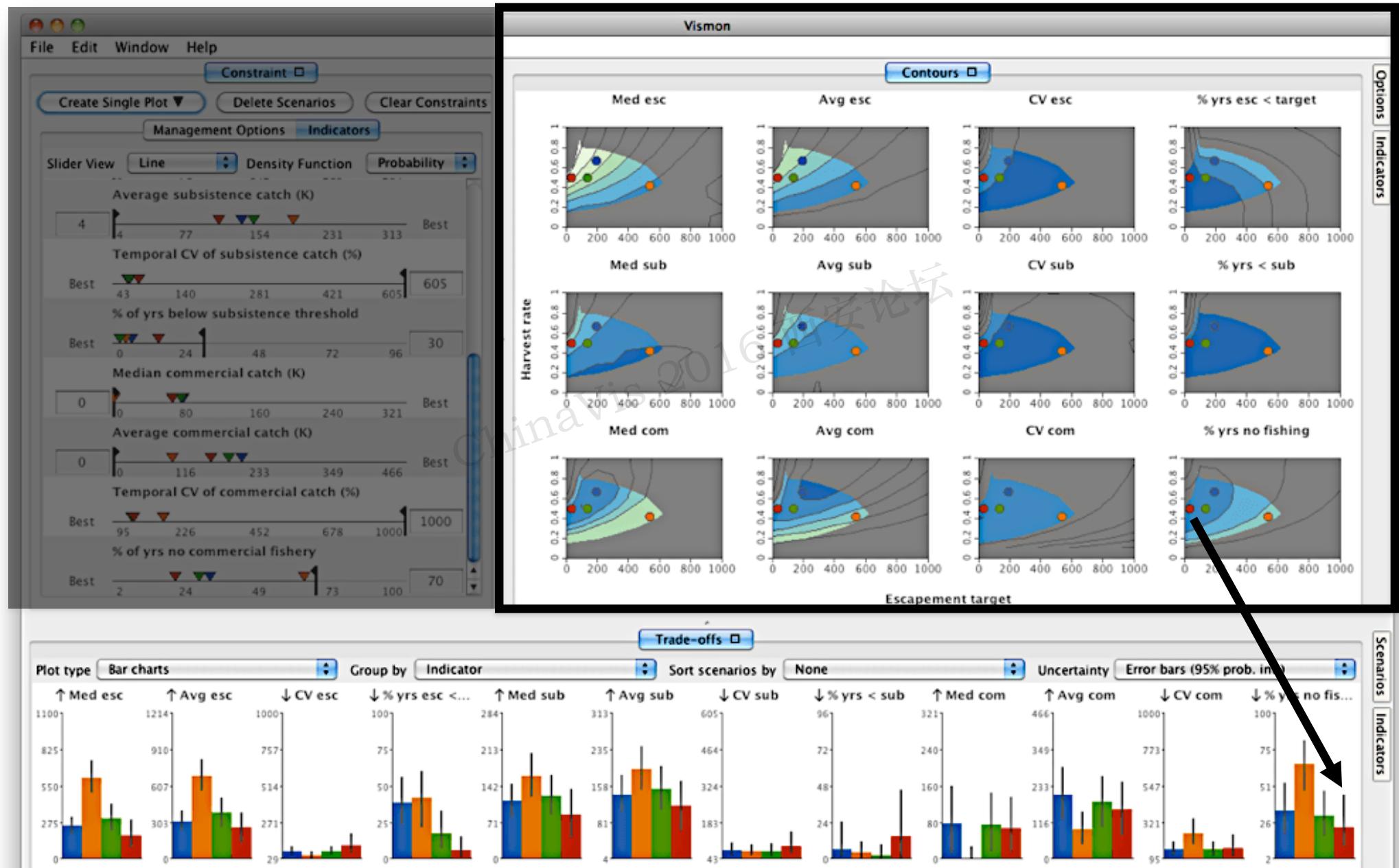
Selection



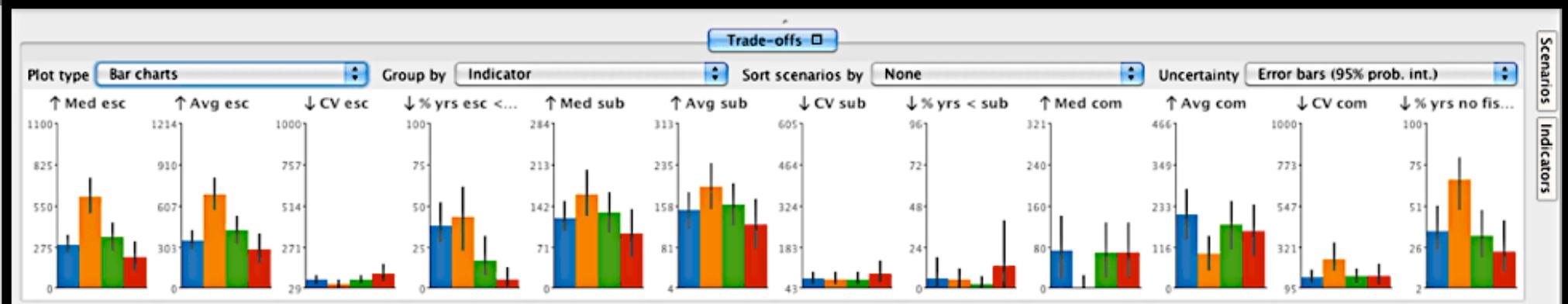
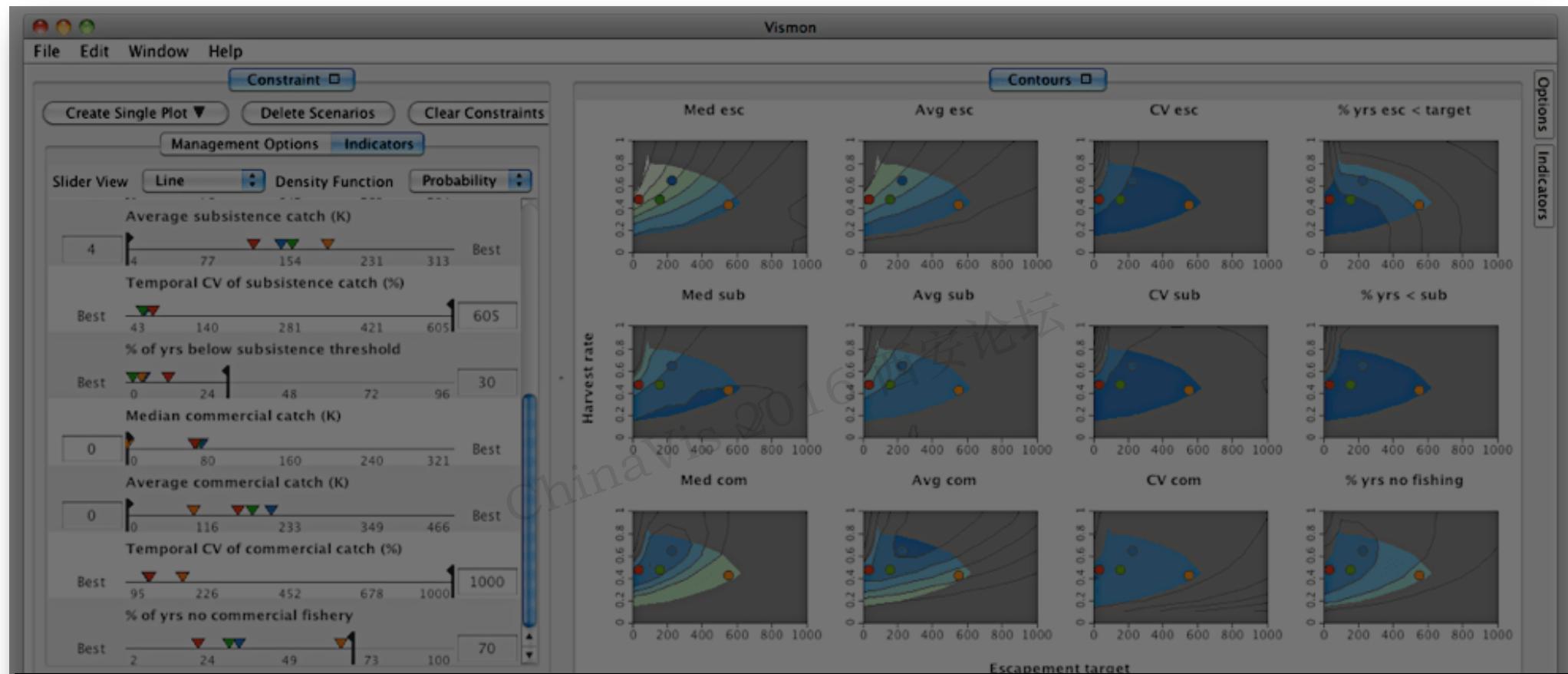
Selection



Selection



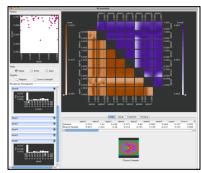
Trade-off quantification



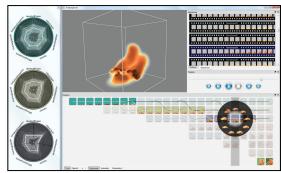
Other tools

Much recent attention in vPSA

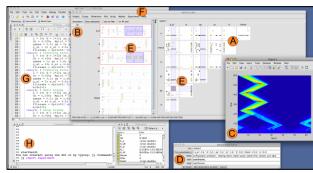
- **Image segmentation** [Torsney Weir et al. 2011]
- **Weather forecast** [Potter et al. 2009]
- **Disaster simulation** [Waser et al. 2010]
- **many more ...**



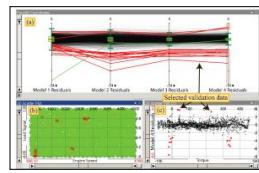
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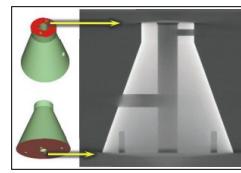
[Bruckner & Möller 2010]



[Bergner et al. 2013]

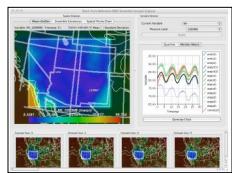


[Piringer et al. 2010]

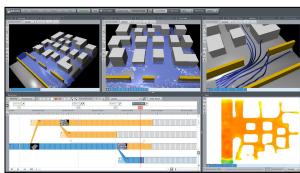


[Amirkhanov et al. 2010]

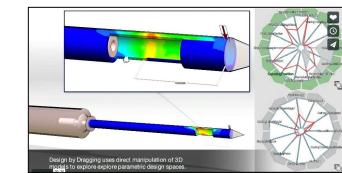
...etc. (us)



[Potter et al. 2009]



[Waser et al. 2010]



[Coffey et al. 2013]

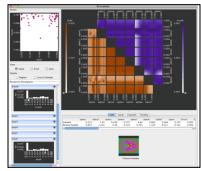


[Pretorius et al. 2011]

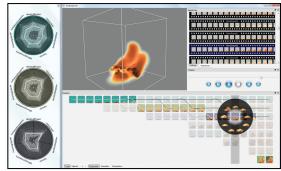
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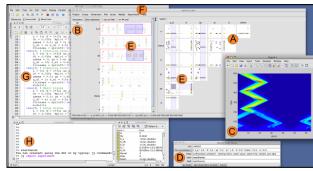
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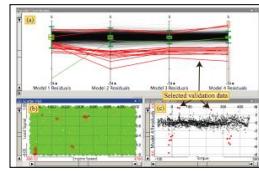
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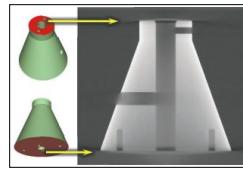
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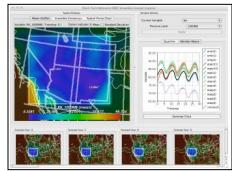


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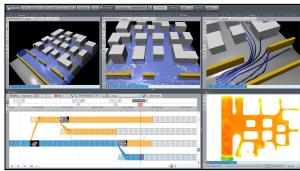


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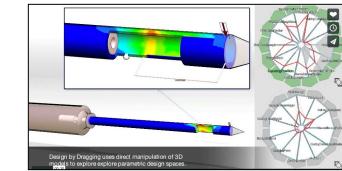
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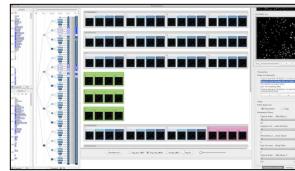
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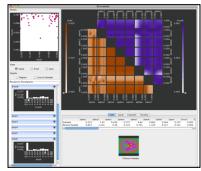


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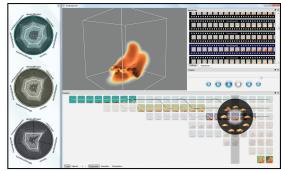
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Much recent attention in vPSA

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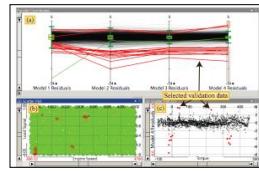
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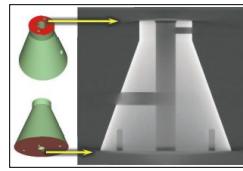
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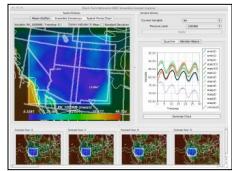


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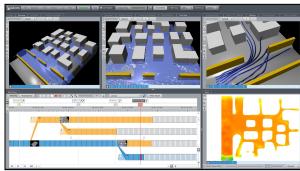


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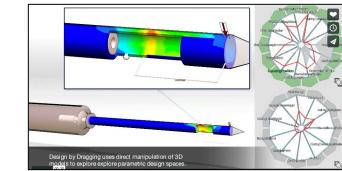
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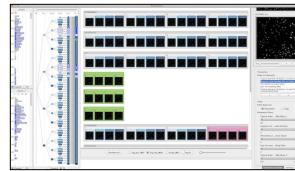
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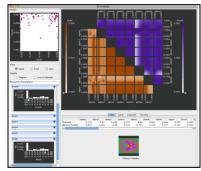


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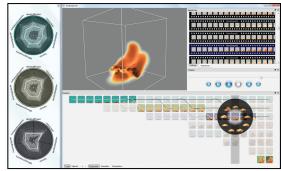
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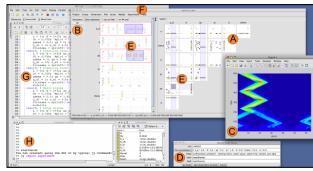
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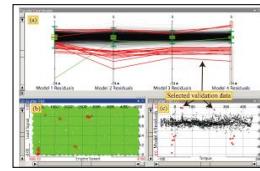
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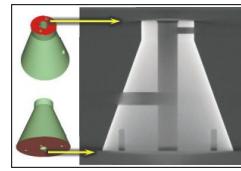
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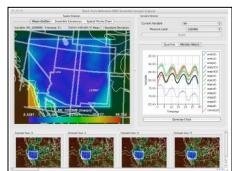


[Piringer et al. 2010]

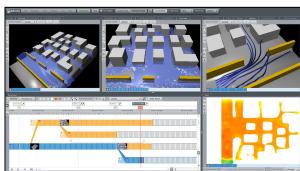


[Amirkhanov et al. 2010]

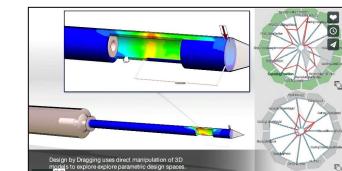
...etc. (us)



[Potter et al. 2009]



[Waser et al. 2010]



[Coffey et al. 2013]



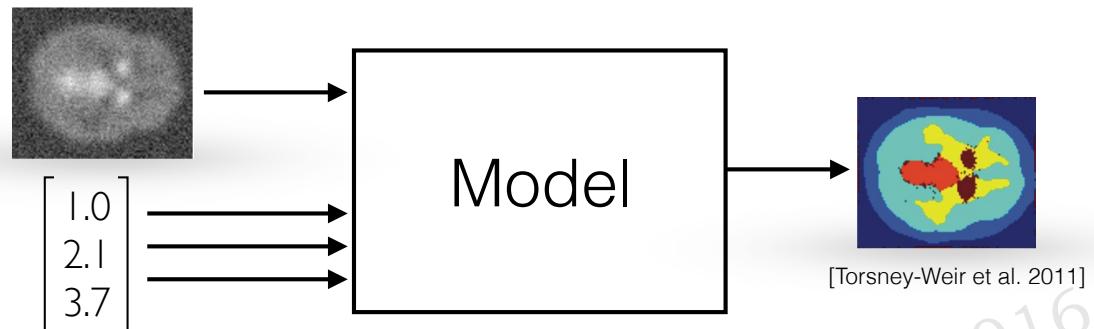
[Pretorius et al. 2011]

...etc. (others)

Overview

- What is visualization?
- A case study
 - Vismon-Fisheries science
- Problem abstraction
- Challenges

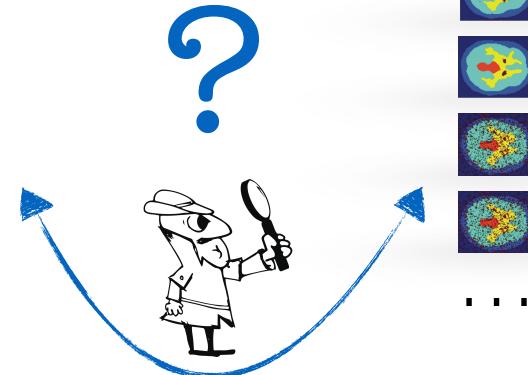
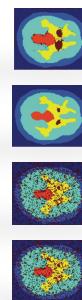
Complex objects (in 18/21 papers)



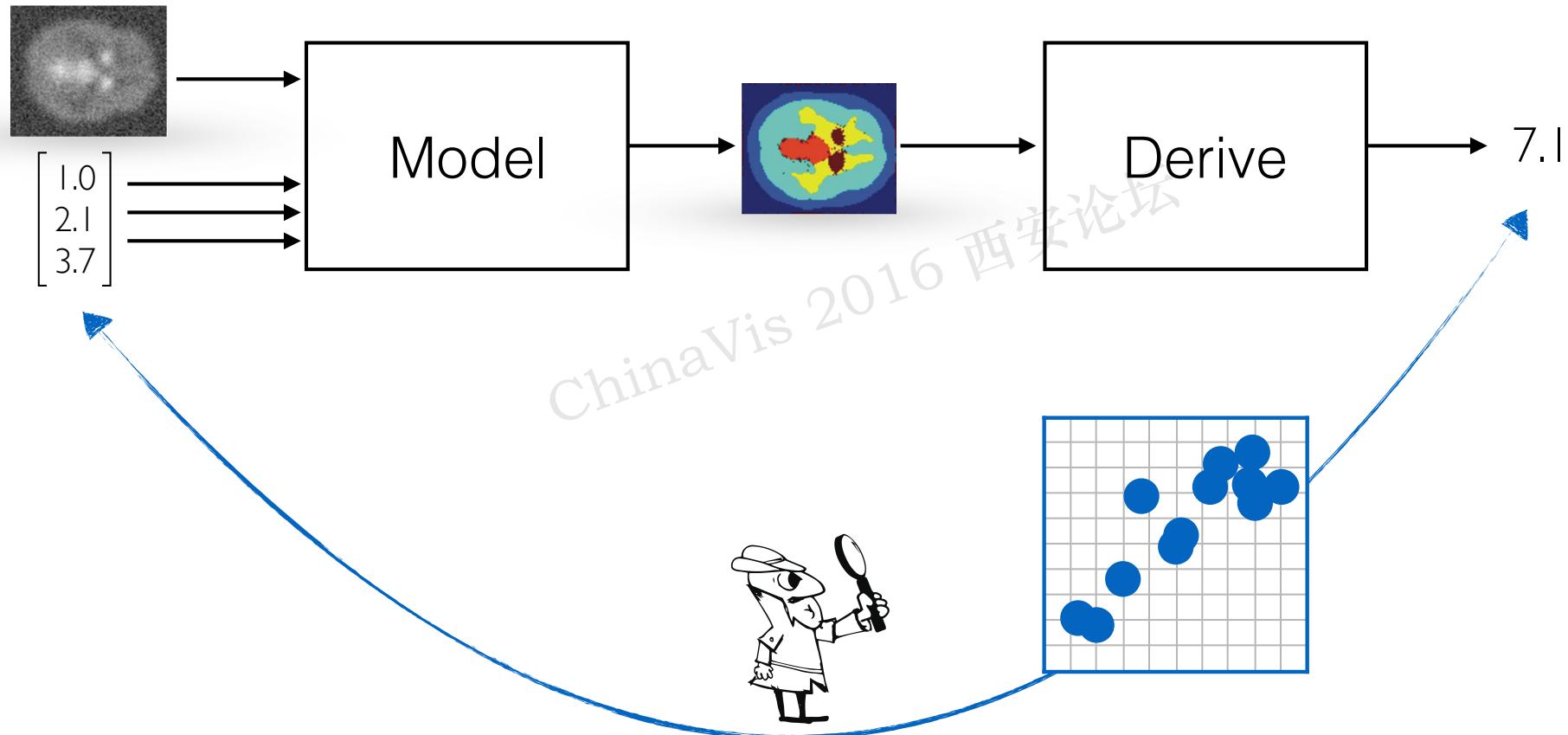
Input Parameters

	1.0	2.1	3.7
	6.3	3.3	5.2
	2.2	2.1	2.0
	1.1	5.6	7.8
...

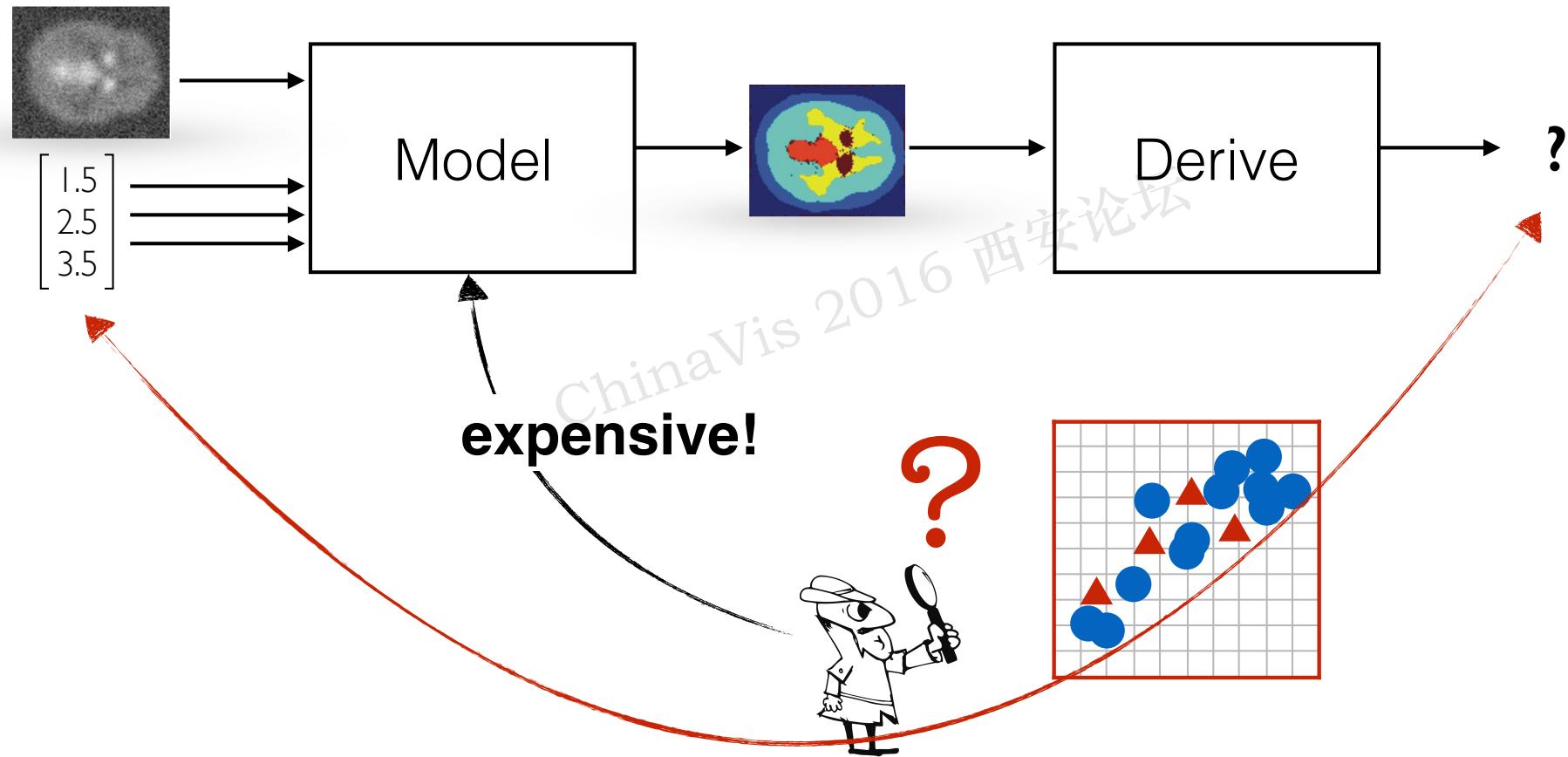
Outputs



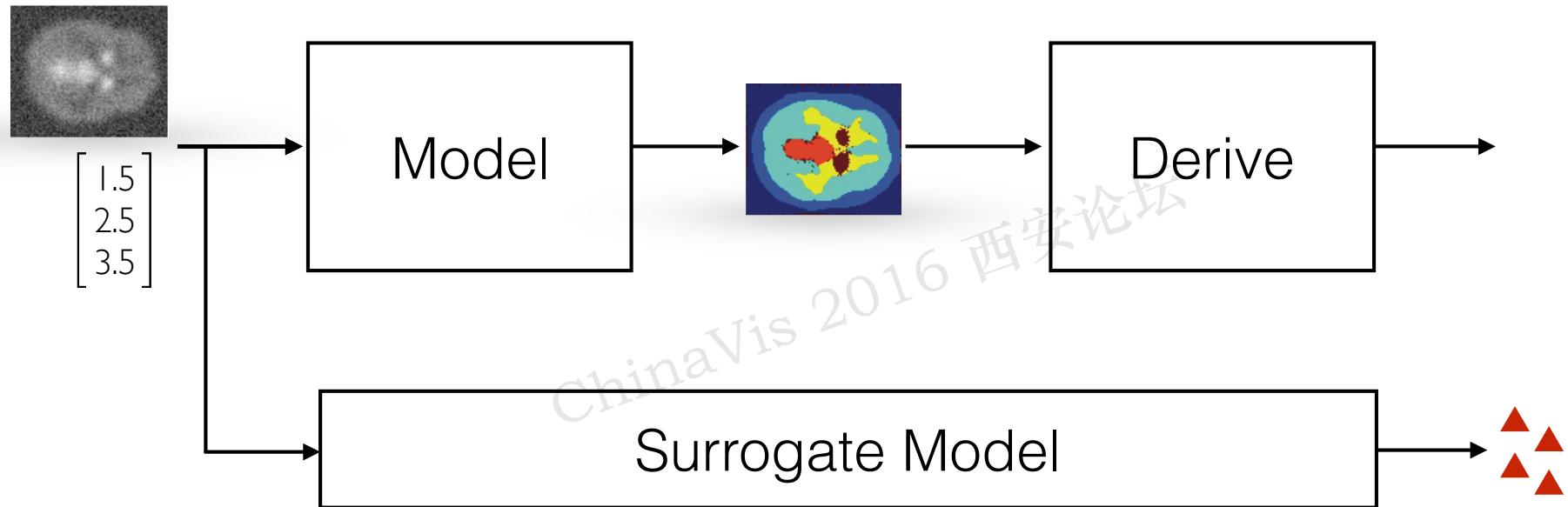
Derive objective measures



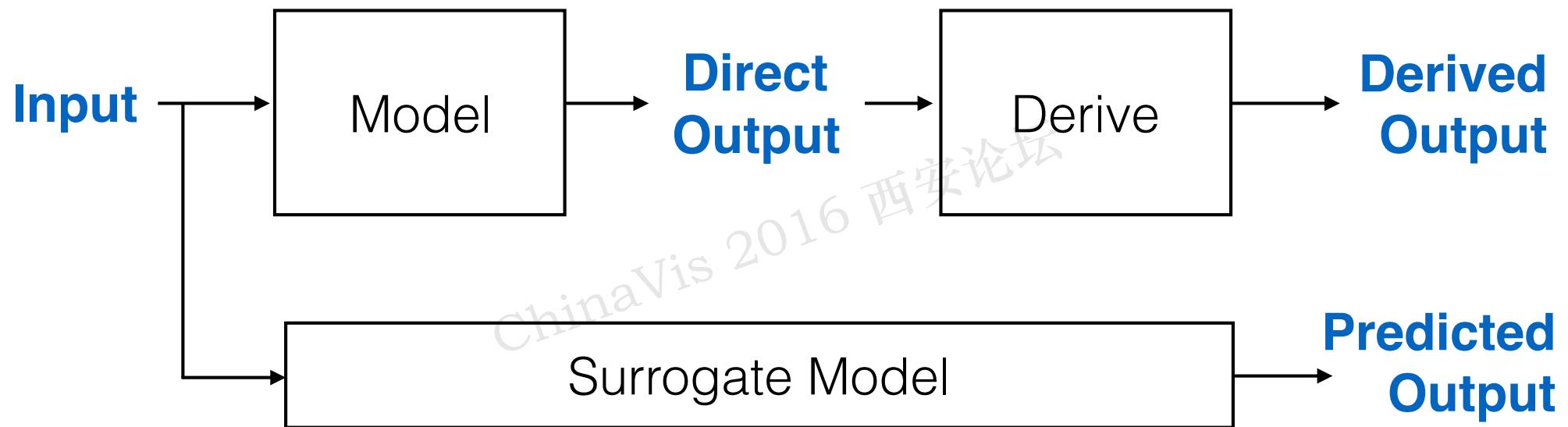
Surrogate models



Surrogate models



Data flow model



Overview

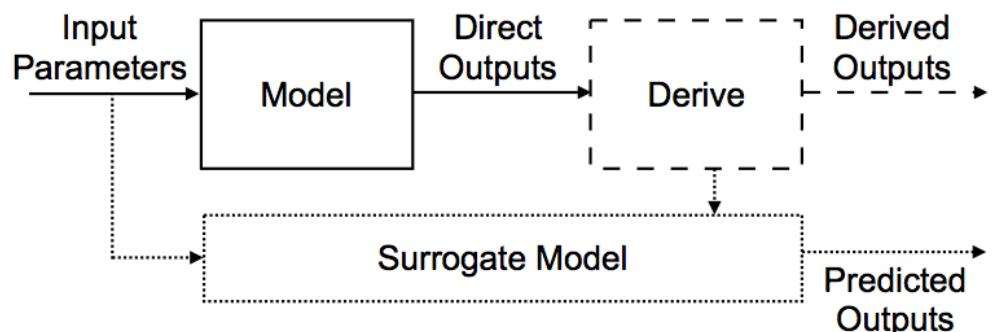
- What is visualization?
- A case study
 - Vismon-Fisheries science
- Problem abstraction
- Challenges

Research challenges

- Data Acquisition & Management
- Data Analysis
- Decision Making

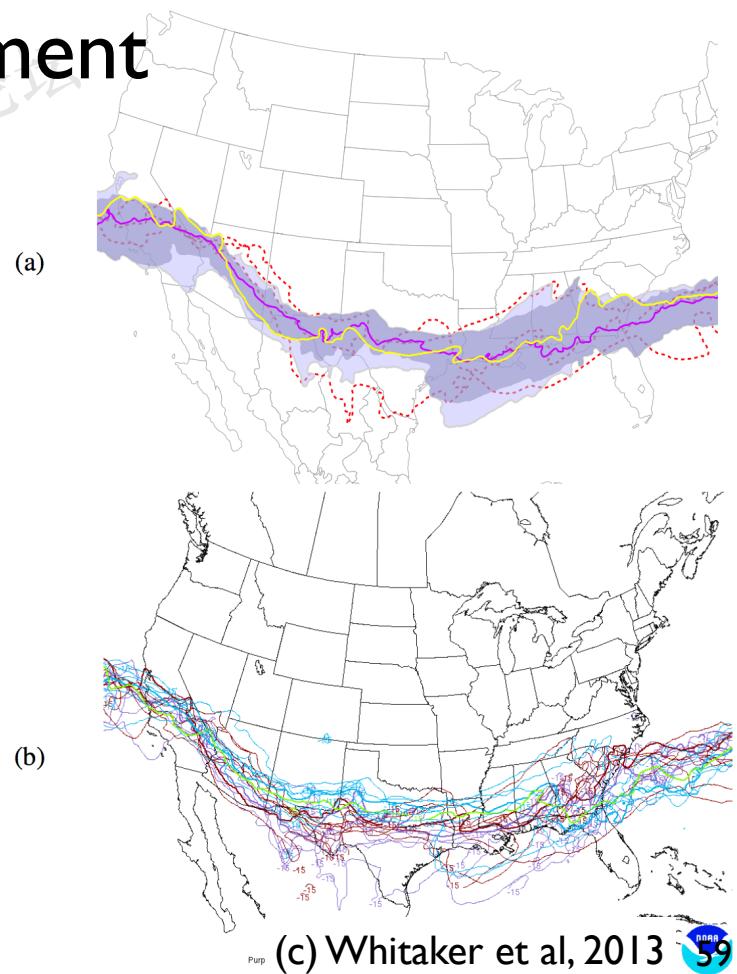
Research challenges

- Data Acquisition & Management
 - Support integrated sampling, derivation, and prediction
 - trading off computational speed (& memory) with accuracy
- Data Analysis
- Decision Making



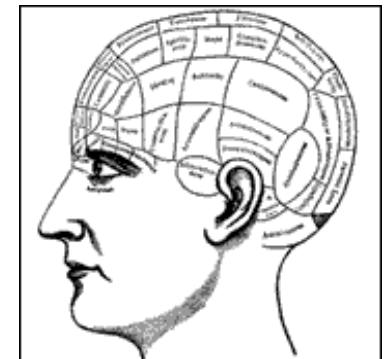
Research challenges

- Data Acquisition & Management
- Data Analysis
 - uncertainty analysis
 - sensitivity analysis
- Decision Making



Research challenges

- Data Acquisition & Management
- Data Analysis
- Decision Making
 - cognition multivariate spaces
 - trading off multiple objectives



Summary

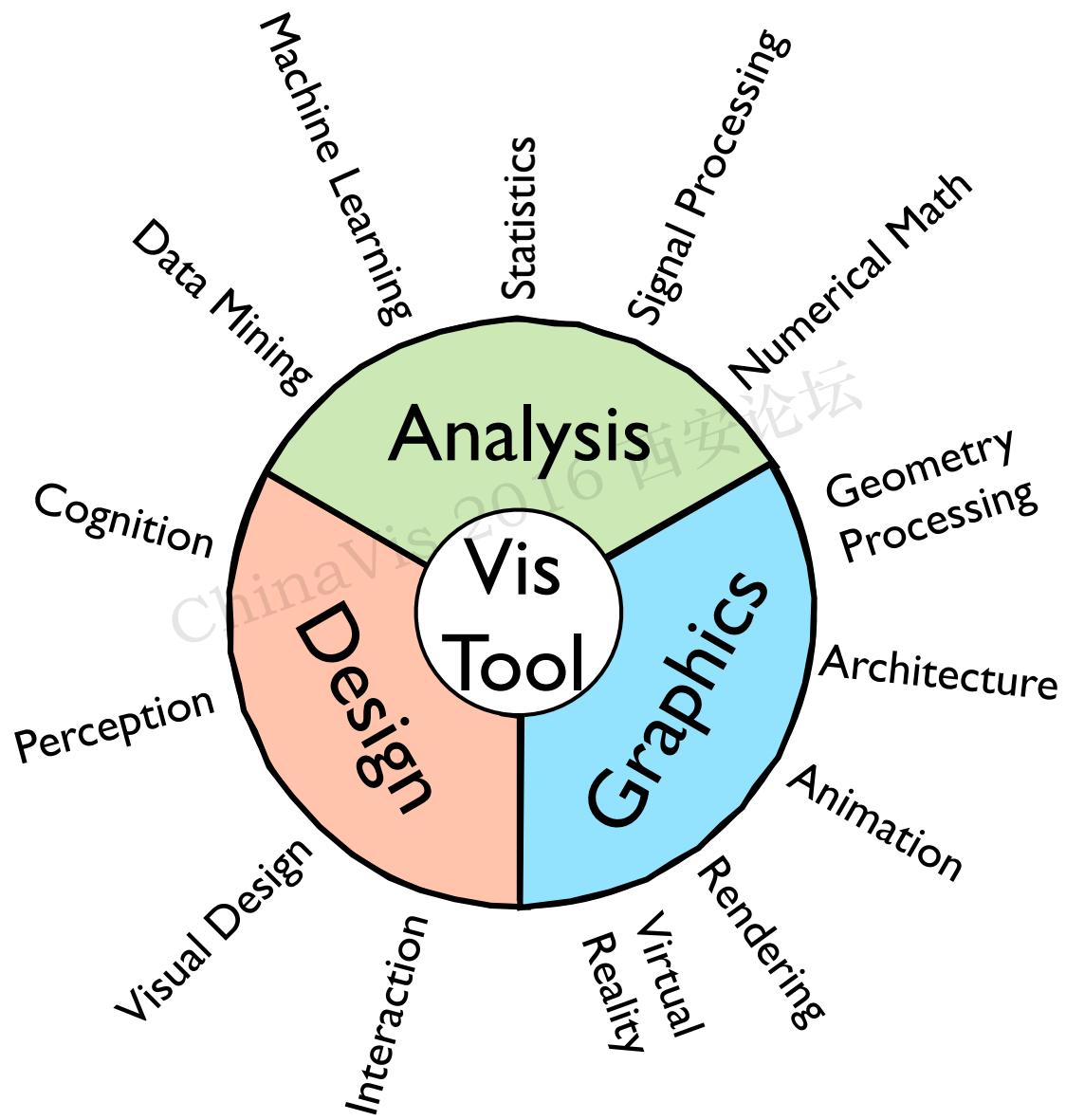
- understanding parameter space - an essential task of computational science
- visual tools—universal across domains / stimulate intuition about complex (in-out) relationships
- recognition—“*This reduced the work of days to a couple of hours.*”

What is Visualization?

Tamara Munzner 2011:

“Computer-based visualization systems provide visual representations of datasets intended to help people carry out some task more effectively.”

Visualization



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UBC



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U Victoria

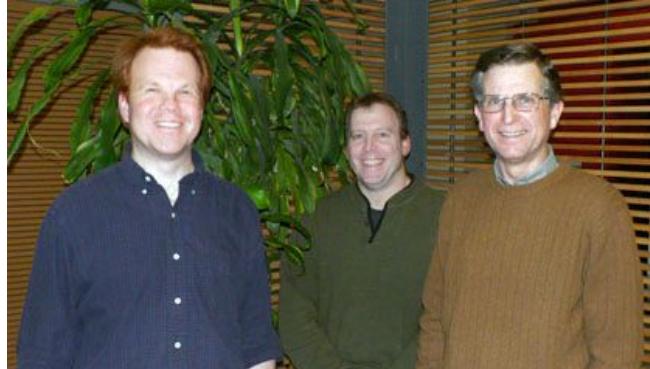


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Questions?

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