

# ECOSYSTEM SERVICE VALUATION

San Vito di Cadore, Italy

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# HIGHLIGHTS

**What** is ecosystem service valuation?

**Why** value ecosystem services?

**How** InVEST values ecosystem services?

**Expanding** beyond InVEST



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# VALUE ECOSYSTEM SERVICES

Value depends on human well-being

Tradeoffs between scarce resources

**Social Relations**

**Material Needs**

**Safety**

**Health**

**Spiritual Satisfaction**

Monetary and non-monetary valuation

# ECOSYSTEM SERVICES

BENEFITS PEOPLE OBTAIN FROM ECOSYSTEMS

## Provisioning Services

- Food
- Fresh water
- Wood and fiber
- Fuel
- ...

## Regulating Services

- Climate regulation
- Flood regulation
- Disease regulation
- Water regulation
- ...

## Cultural Services

- Aesthetic
- Spiritual
- Educational
- Recreational
- ...

## Supporting Services

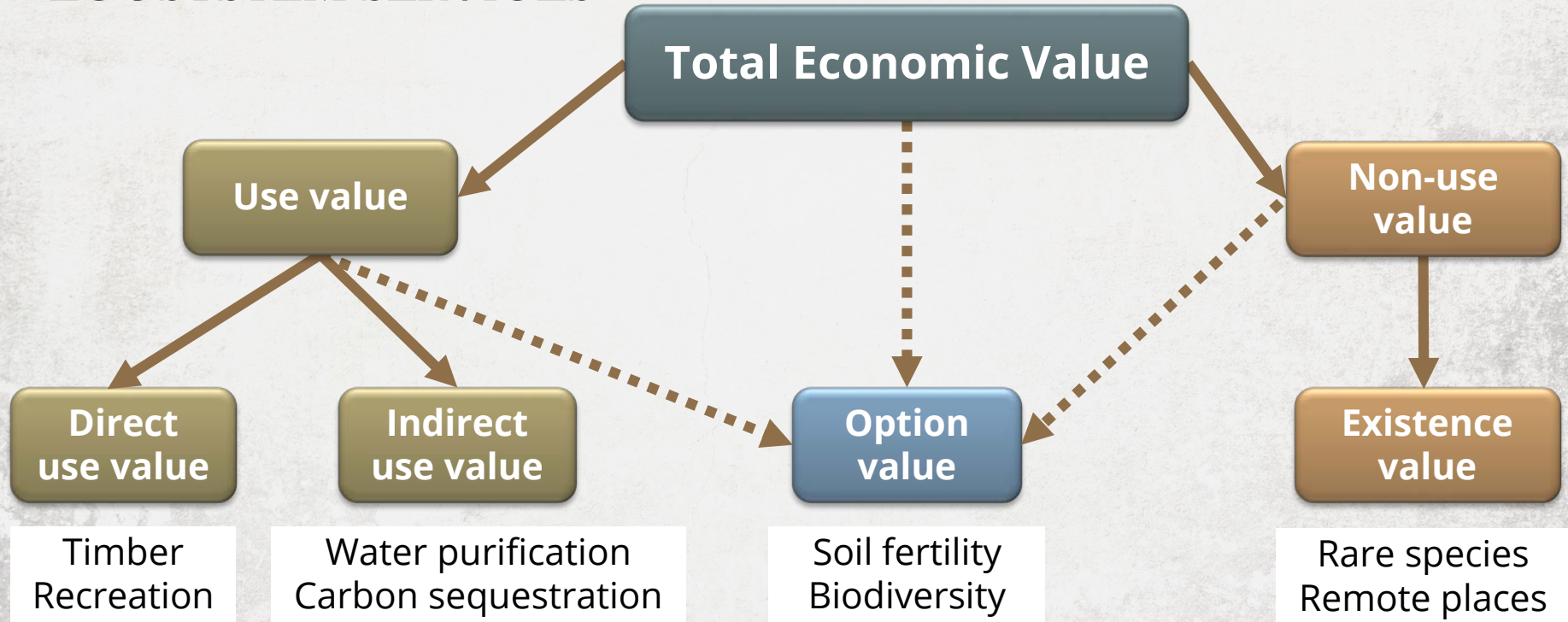
- Nutrient cycling
- Water cycling
- Soil formation
- Provision of habitat
- Primary production

Millennium Ecosystem Assessment

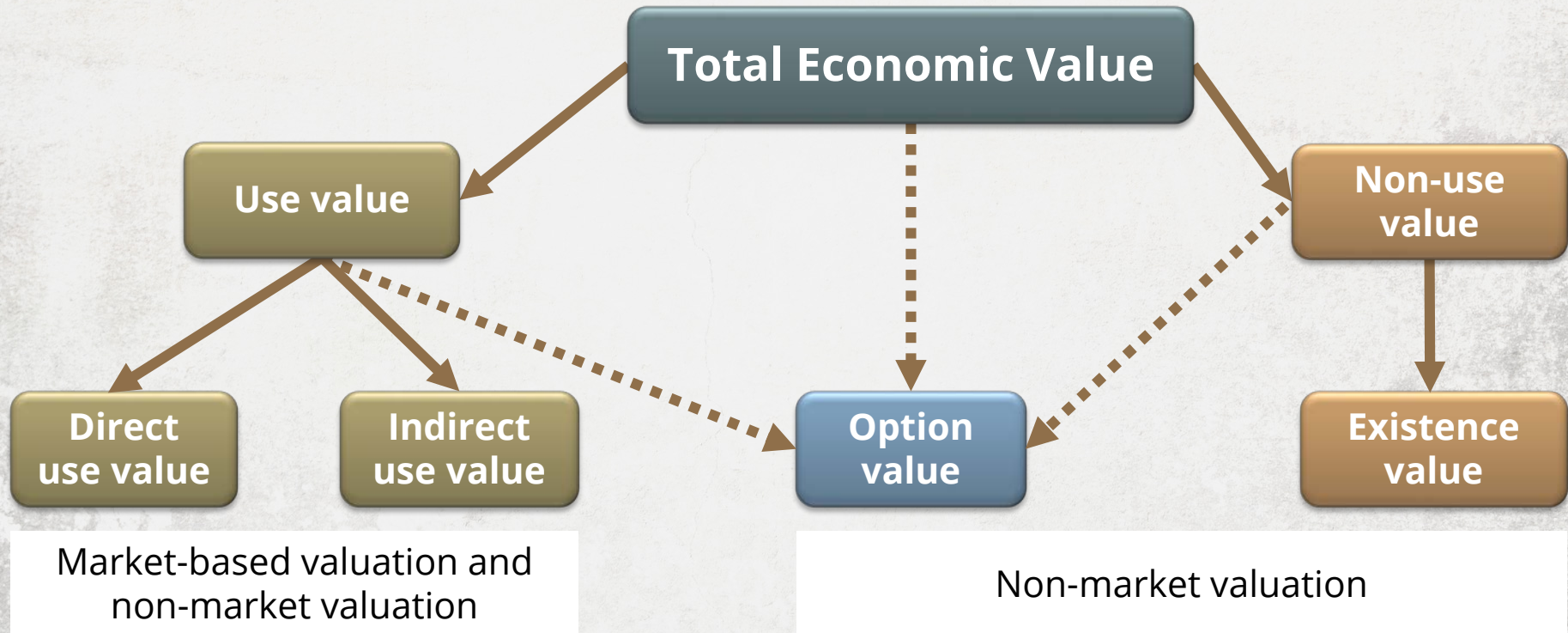


# **MONETARY VALUATION**

## **ECOSYSTEM SERVICES**



# MONETARY VALUATION



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# RESEARCH QUESTION

DETERMINE THE TOTAL BENEFITS FROM ECOSYSTEMS

Commonly  
Measured

Grazing

Timber and fuelwood

Non-market  
and other  
values

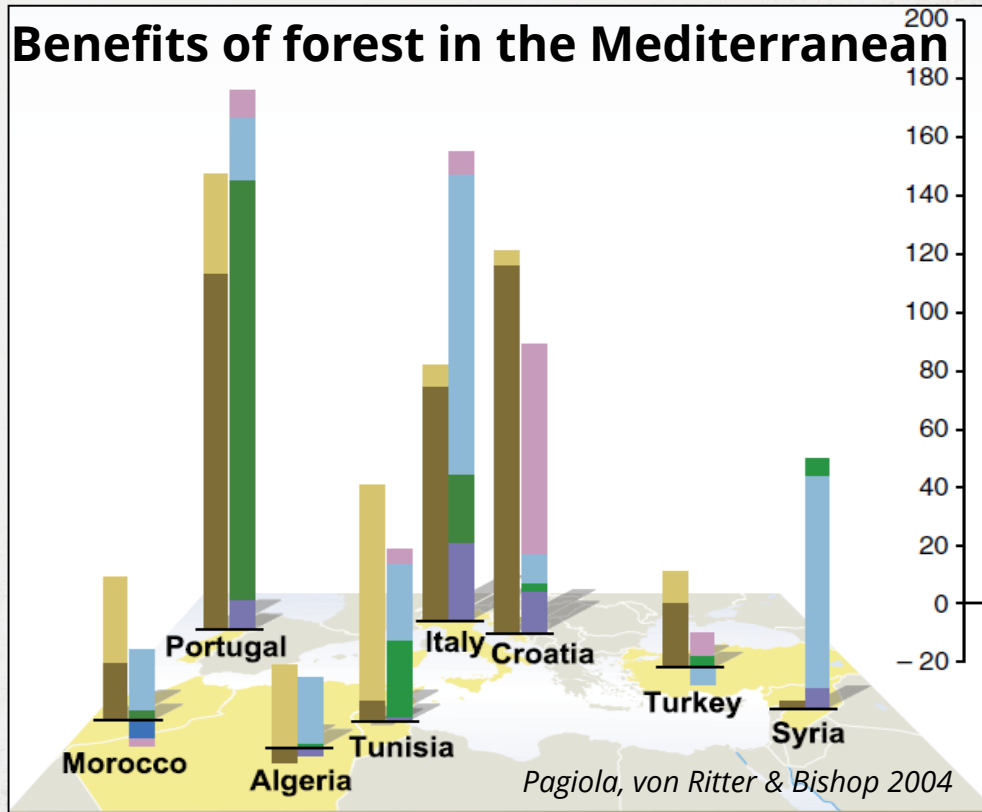
Carbon sequestration

Watershed protection

Non-timber forest products

Recreation and hunting

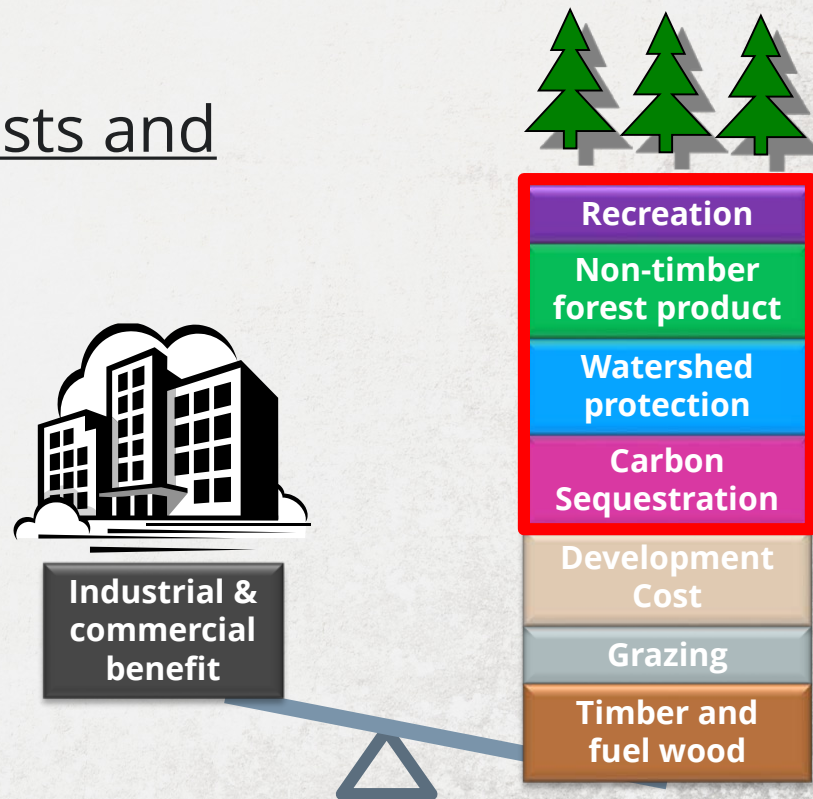
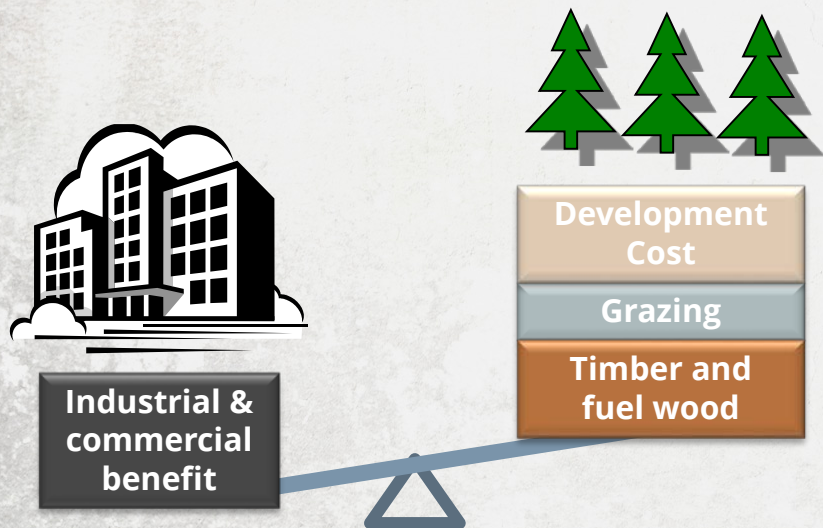
## Benefits of forest in the Mediterranean



# RESEARCH QUESTION

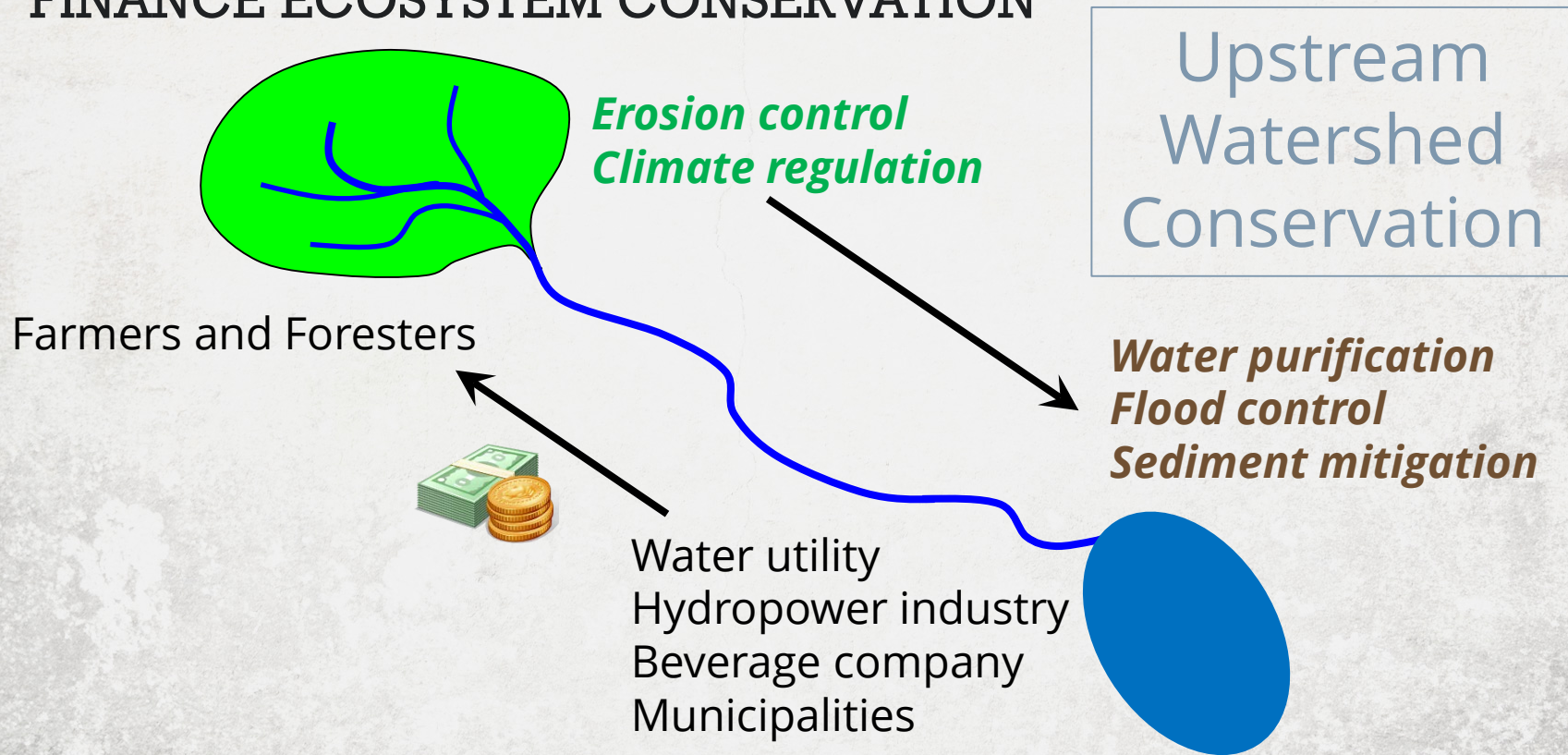
## COST BENEFIT ANALYSIS

More complete accounting of costs and benefits



# RESEARCH QUESTION

## FINANCE ECOSYSTEM CONSERVATION



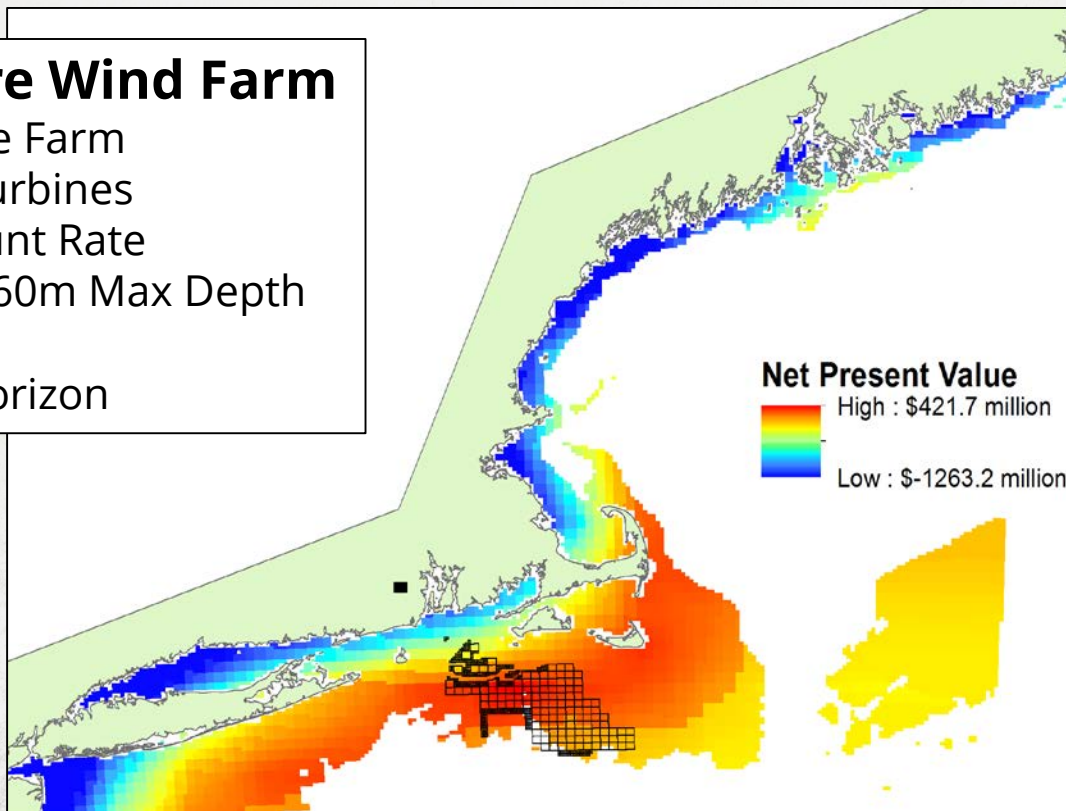


# RESEARCH QUESTION

## OPTIMAL SITING DECISIONS

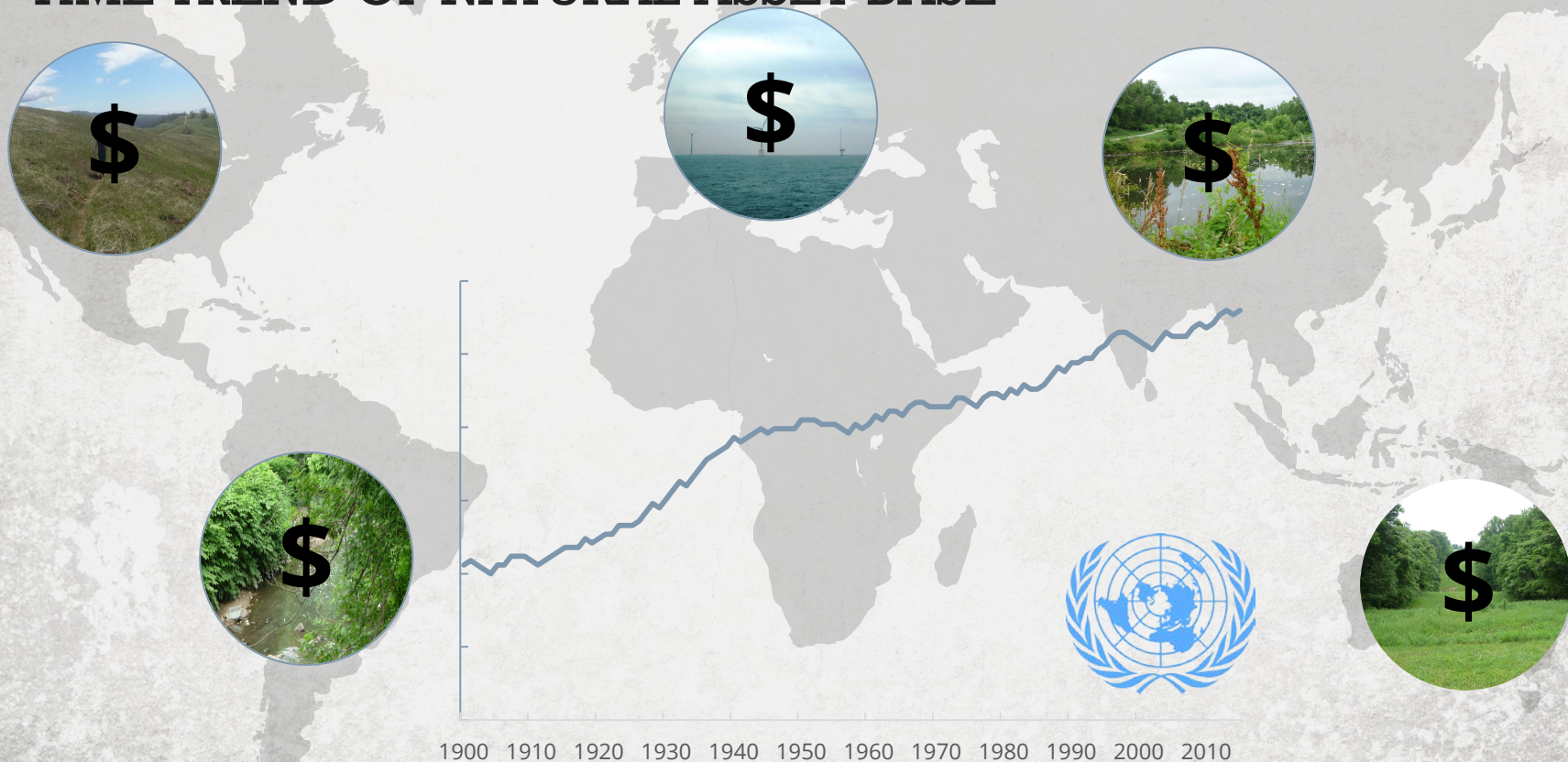
### Offshore Wind Farm

80 Turbine Farm  
3.6 MW Turbines  
7% Discount Rate  
3m Min / 60m Max Depth  
\$.18/kWh  
20 year horizon



# NATIONAL ACCOUNTING

## TIME TREND OF NATURAL ASSET BASE





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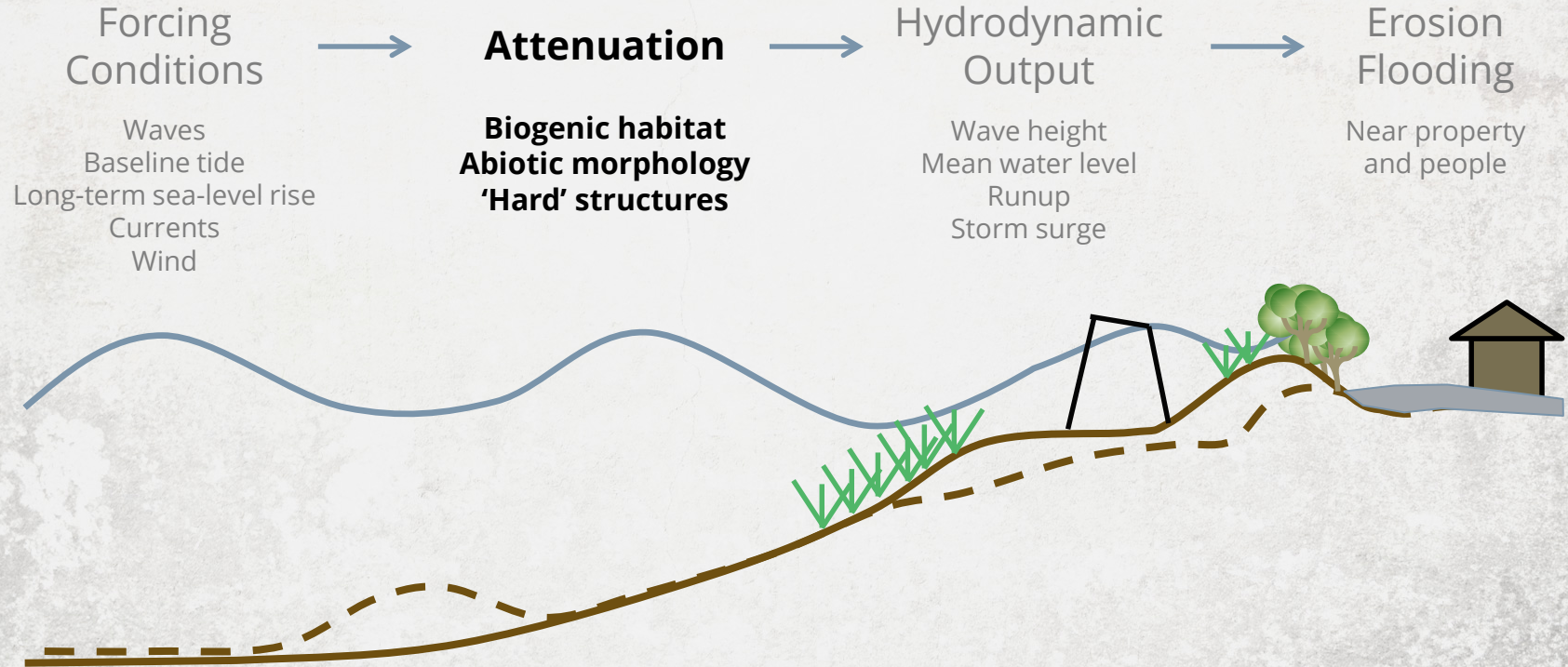
**Expanding** beyond InVEST





# PROCESS-BASED MODELS

## COASTAL PROTECTION

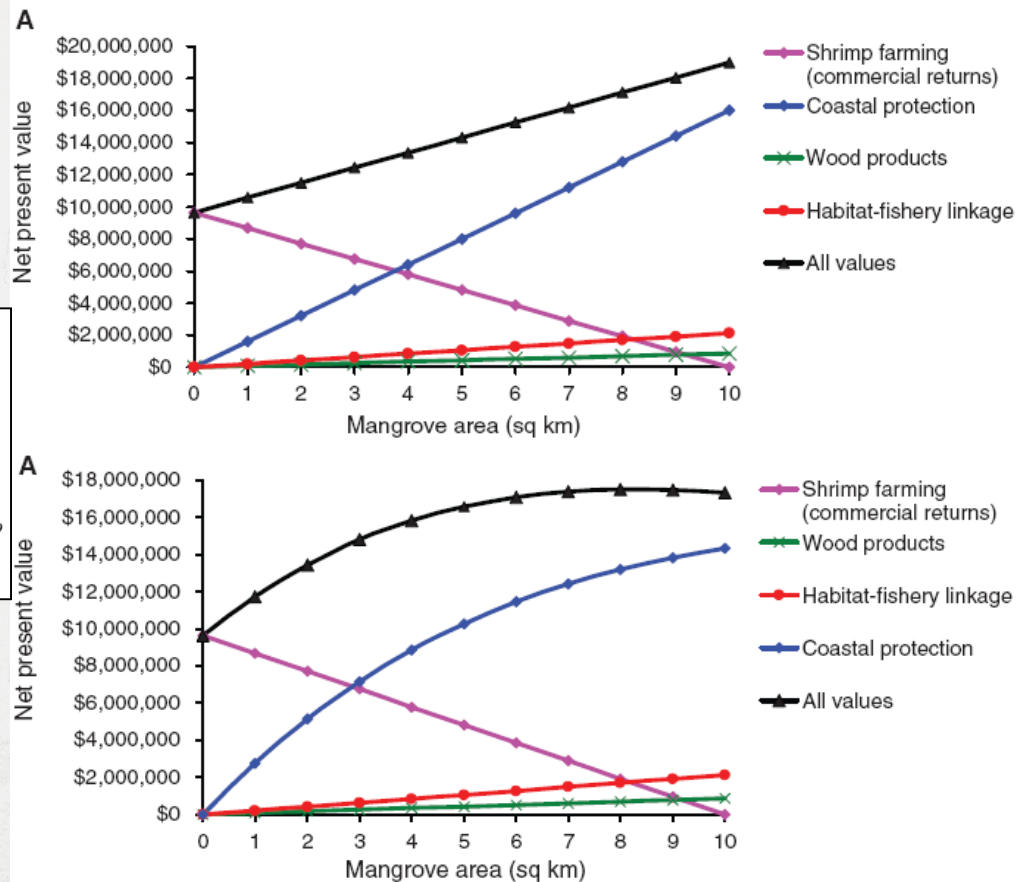


# VALUATION THEORY

## MARGINAL VALUE

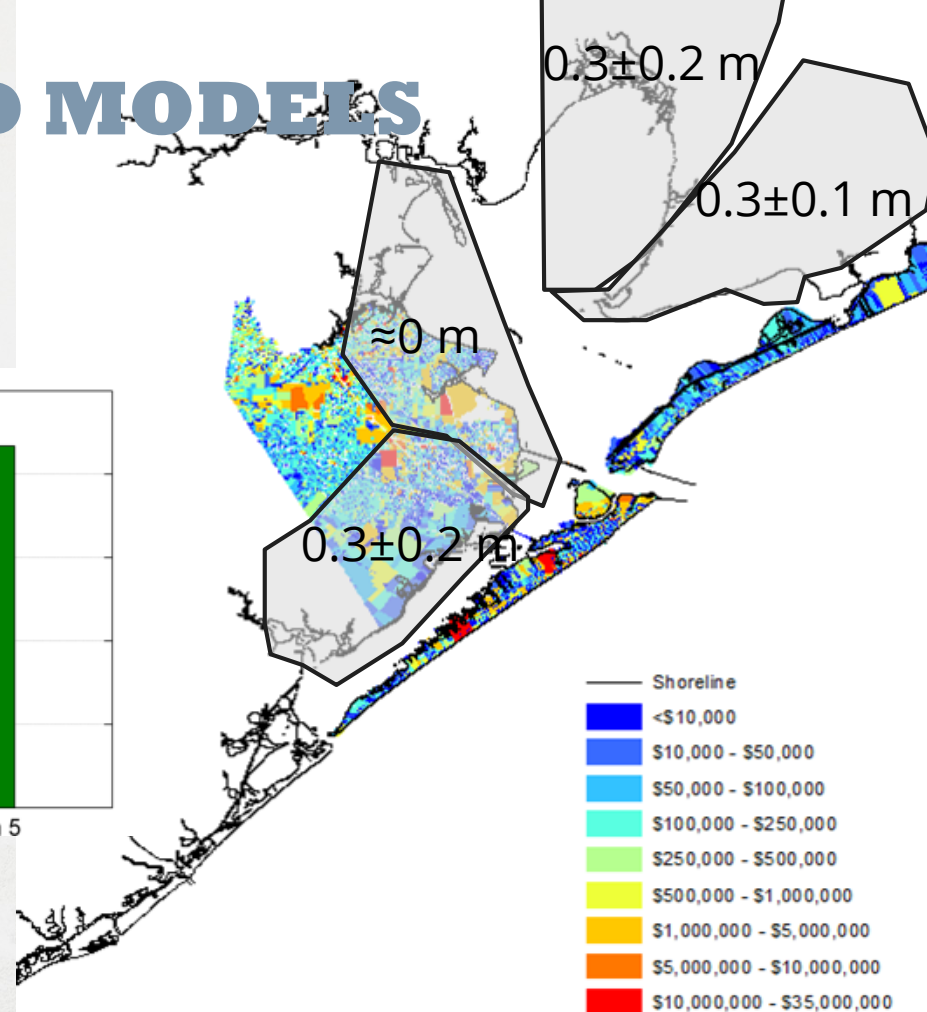
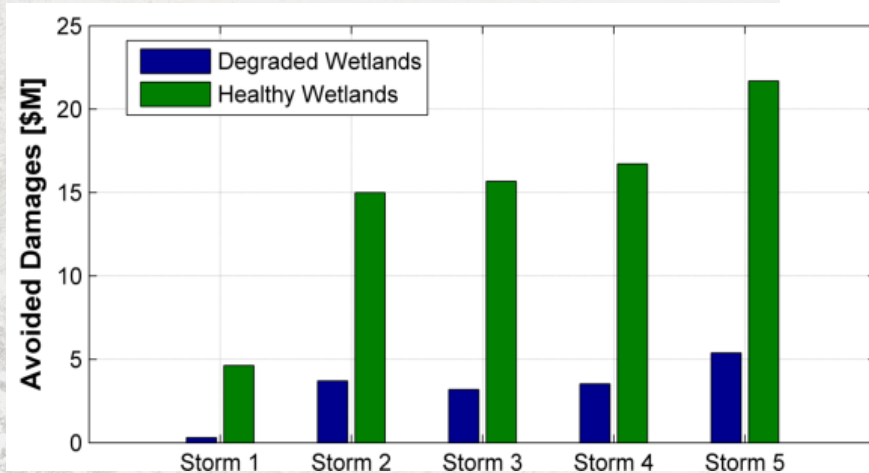
### Coastal Ecosystem–Based Management with Nonlinear Ecological Functions and Values

Edward B. Barbier,<sup>1\*</sup> Evamaria W. Koch,<sup>2</sup> Brian R. Silliman,<sup>3</sup> Sally D. Hacker,<sup>4</sup>  
Eric Wolanski,<sup>5</sup> Jurgenne Primavera,<sup>6</sup> Elise F. Granek,<sup>7</sup> Stephen Polasky,<sup>8</sup> Shankar Aswani,<sup>9</sup>  
Lori A. Cramer,<sup>10</sup> David M. Stoms,<sup>11</sup> Chris J. Kennedy,<sup>1</sup> David Bael,<sup>8</sup> Carrie V. Kappel,<sup>12</sup>  
Gerardo M. E. Perillo,<sup>13</sup> Denise J. Reed<sup>14</sup>



# PROCESS-BASED MODELS

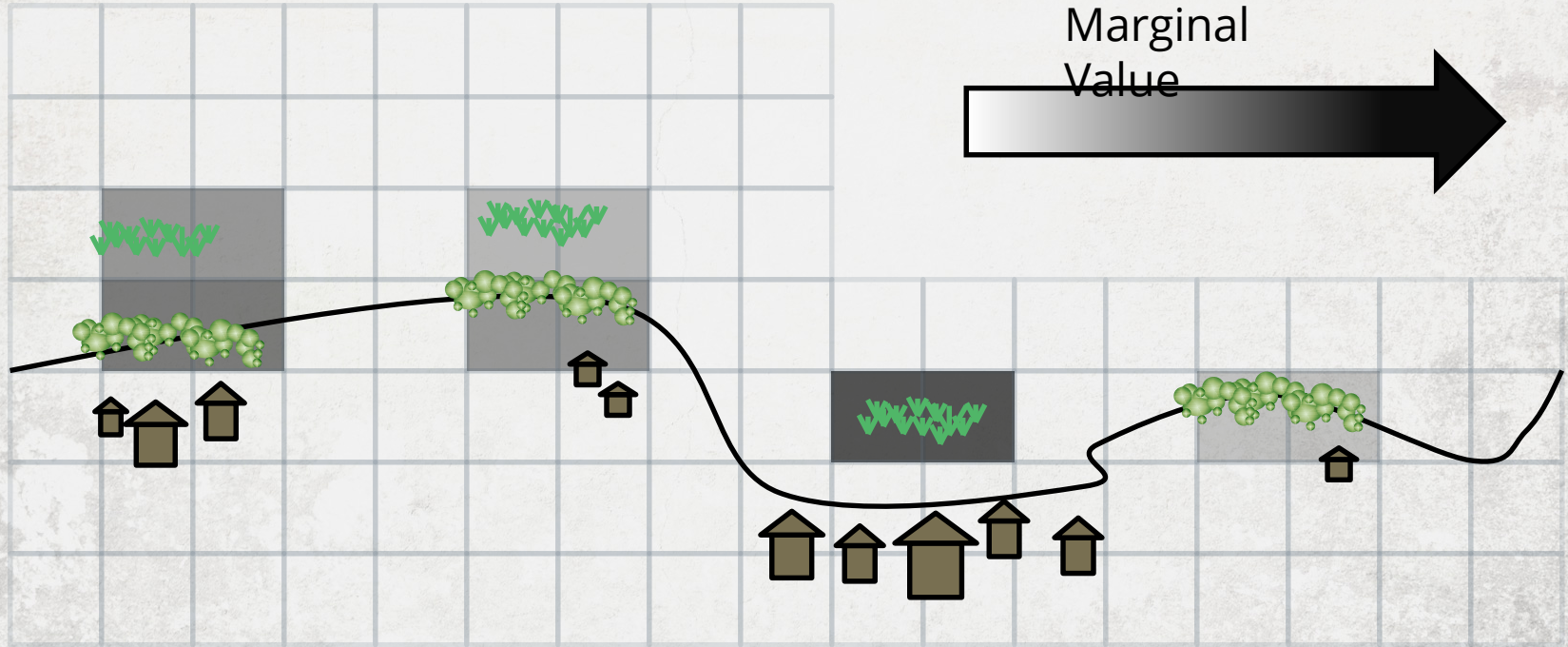
## COASTAL PROTECTION





# MARGINAL VALUE MAP

## COASTAL PROTECTION



# MONETARY VALUATION

InVEST

integrated valuation of  
environmental services  
and tradeoffs

## Market-based Valuation

Direct and indirect market

Market Price

Avoided  
Damages

Replacement  
Cost

Production  
Function

## Non-market Valuation

Surrogate market

Revealed  
Preference

Travel  
Cost

Hedonic  
Pricing

Hypothetical market

Stated  
Preference

Contingent  
Valuation

Choice  
Modeling

InVEST

integrated valuation of  
environmental services  
and tradeoffs

## Other Approaches

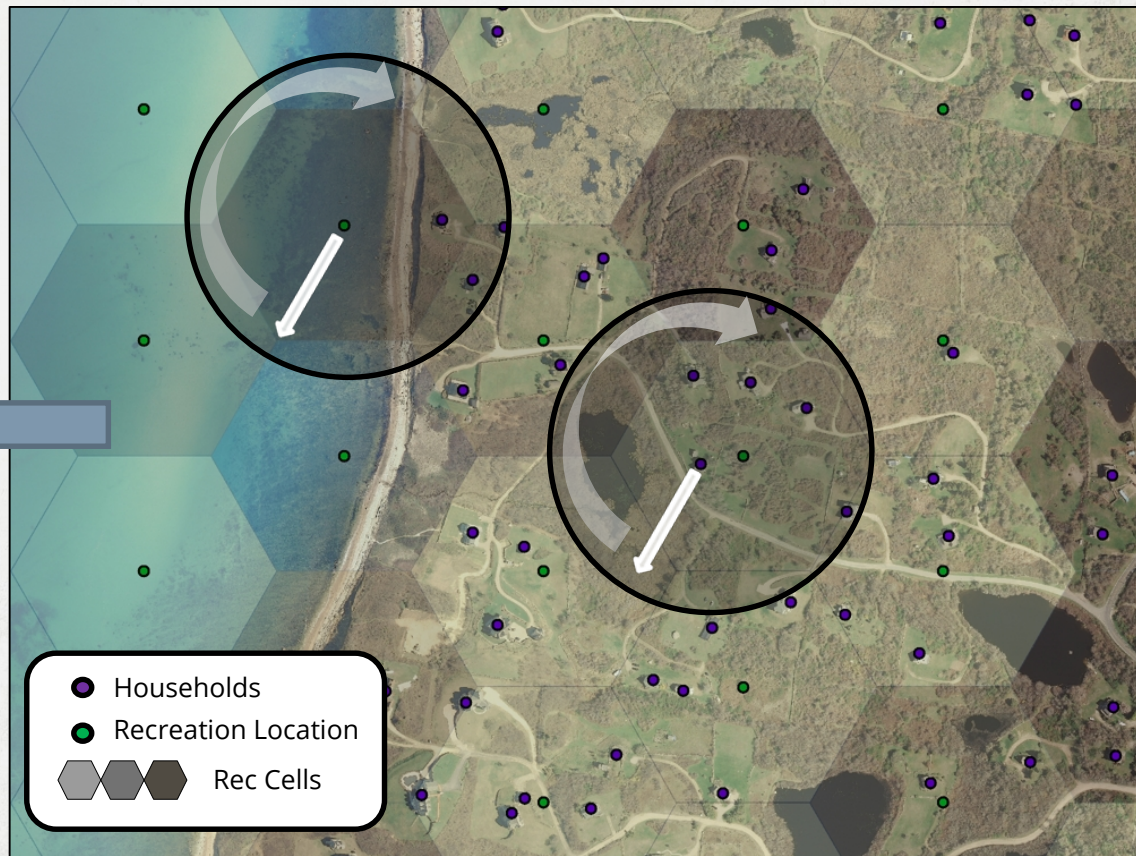
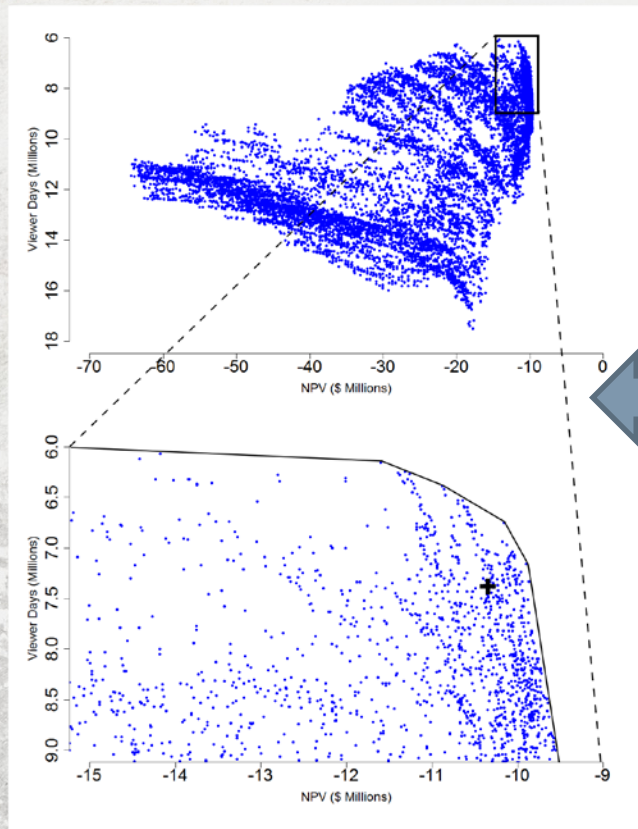
Benefit  
Transfer

Qualitative  
Metrics



# NON-MONETARY VALUE

## VIEWS AND WIND ENERGY



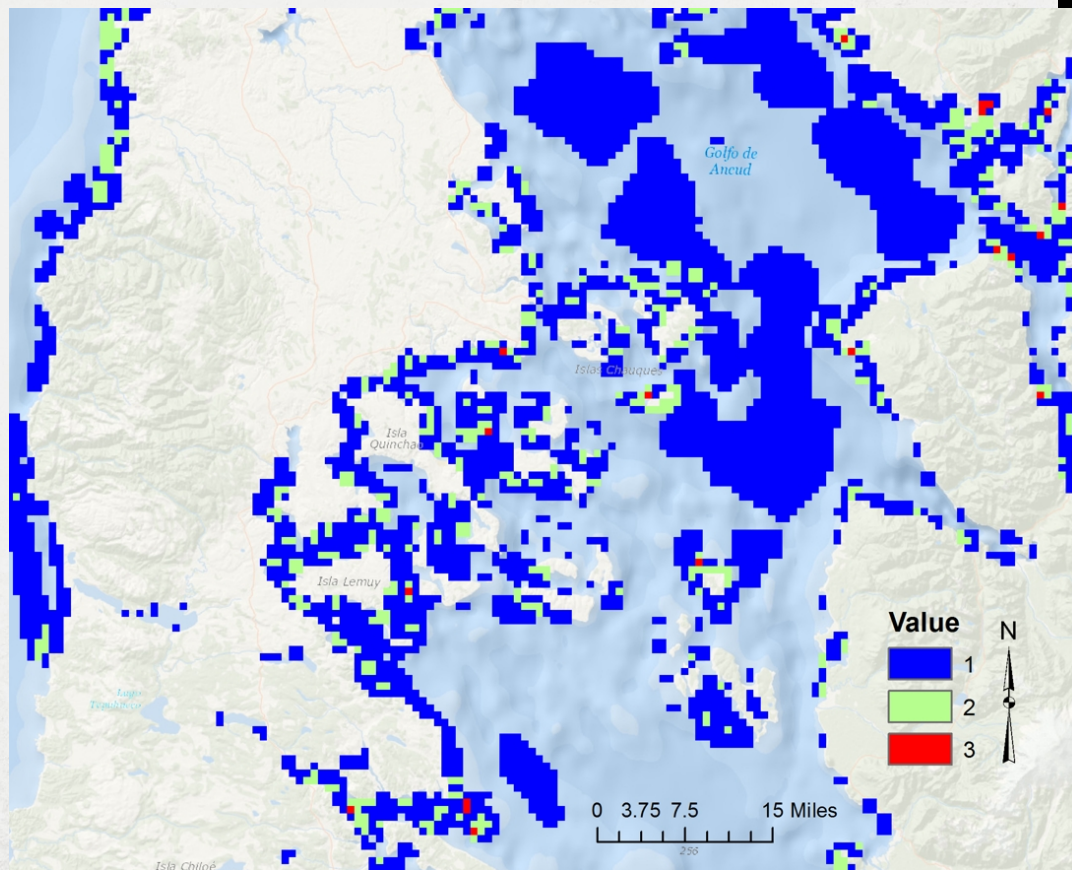


# NON-MONETARY VALUE

## INTENSITY OF USE

### Overlap Analysis tool

*Which areas are used most intensively?*



# SCENARIOS AND OPTIMIZATION



Scenario-based analysis and optimization using Python

Optimal conservation for watershed ecosystem services under a budget



Landscape-level tool for mitigating environmental losses from development



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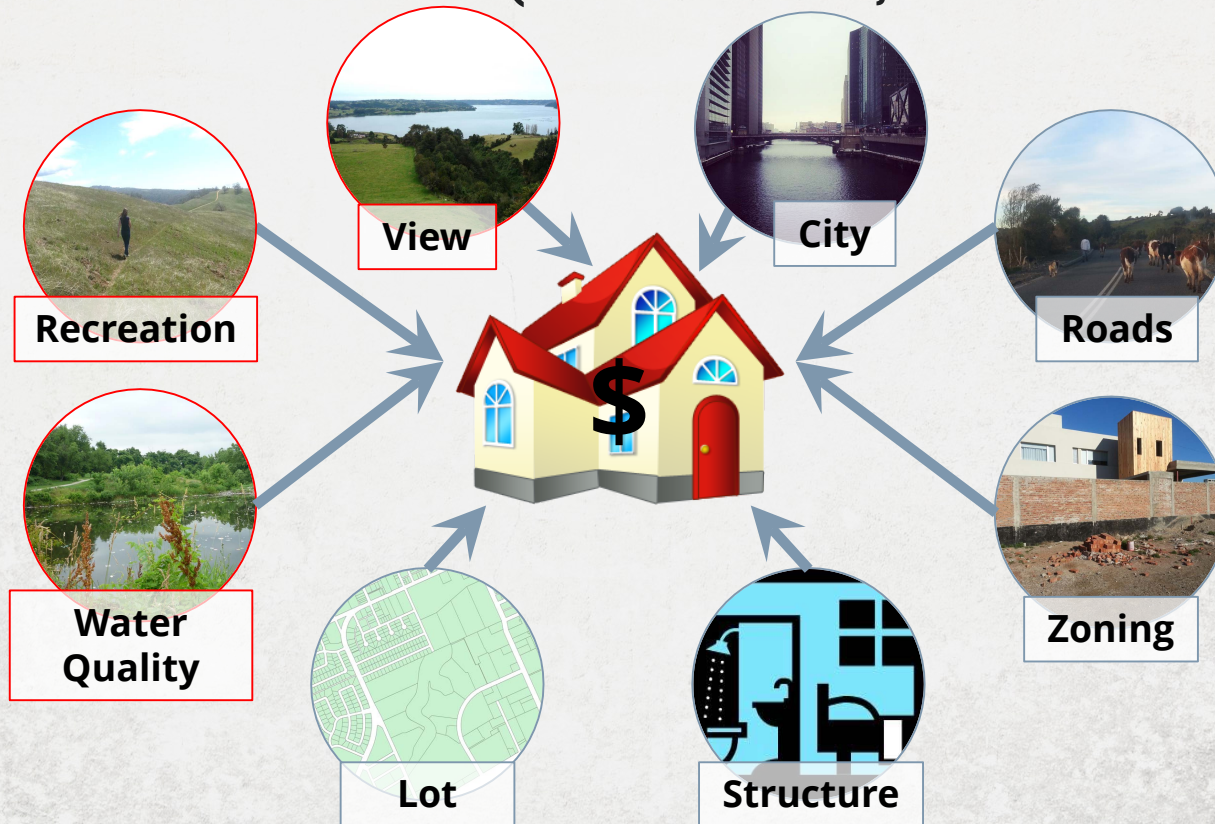
**Expanding** beyond InVEST





# HEDONIC PRICING

**LAND/PROPERTY PRICE =  $F(\text{ATTRIBUTE1}, \text{ATTRIBUTE2}, \dots)$**



# STATED PREFERENCE

## CONTINGENT VALUATION AND CHOICE MODELLING

### Contingent valuation

Ask respondents to express their willingness to pay (WTP) or willingness to accept (WTA) for changes in **ecosystem services**

### Choice modeling

Ask respondents to rank/rate/choose alternative choice sets which have different combination of price attribute and **ecosystem attributes**

InVEST

integrated valuation of  
environmental services  
and tradeoffs



# BENEFIT TRANSFER

## CONCEPTS

Benefit transfer uses values from existing studies to estimate value elsewhere

Value transfer  $\rightarrow$  \$/unit

Function transfer  $\rightarrow f(\$, \text{site or study attributes})$





# BENEFIT TRANSFER

## EXAMPLE

FEMA (Federal Emergency Management Agency)  
Mitigation Policy FP-108-024-01  
2013

### Notes

1. Service based (not bundled by land cover type)
2. Constant \$ per acre
3. Similarity of
  - a. Service
  - b. Context

*Service  
Based*

*Constant*

\$ Benefits per acre per year

	GREEN OPEN SPACE	RIPARIAN
Aesthetic Value	\$1,623	\$582
Air Quality	\$204	\$215
Biological Control	--	\$164
Climate Regulation	\$13	\$204
Erosion Control	\$65	\$11,447
Flood Reduction	--	\$4,007
Food Provisioning	--	\$609
Habitat	--	\$835
Pollination	\$290	--
Recreation	\$5,365	\$15,178
Storm Water Retention	\$293	--
Water Filtration	--	\$4,252

# THANKS!

## MODEL SUMMARY

Method	ES type	InVEST model
Market price	Provisioning Service	Fish Aquaculture Managed Timber Production Wave Energy Hydropower Production Wind energy Recreation (expenditures) Fisheries Agricultural Production Non-timber Forest Product Production
	Regulating Service	Carbon Sequestration (Marine, Terrestrial) Water for Irrigation
Avoided damages/ replacement cost	Regulating Service	Nutrient Retention Carbon Sequestration (Marine, Terrestrial) Sediment Retention Coastal Protection Storm Peak Mitigation
Non \$ Values	All	Overlap Analysis Scenic Quality Coastal Vulnerability Pollination
NA	Cultural/Supporting /Regulating Services	Biodiversity/Habitat quality and rarity Habitat risk assessment