Integrating Econometric Land Use Models with Ecological Models to Guide Coastal Management and Planning

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Camp Resources XXIV

Outline

- Motivation
  - Land Use Policies
- Framework
  - Land Use Change
  - Simulations
- Recap
- Future Directions

Flooding: Climatic and Economic Threat

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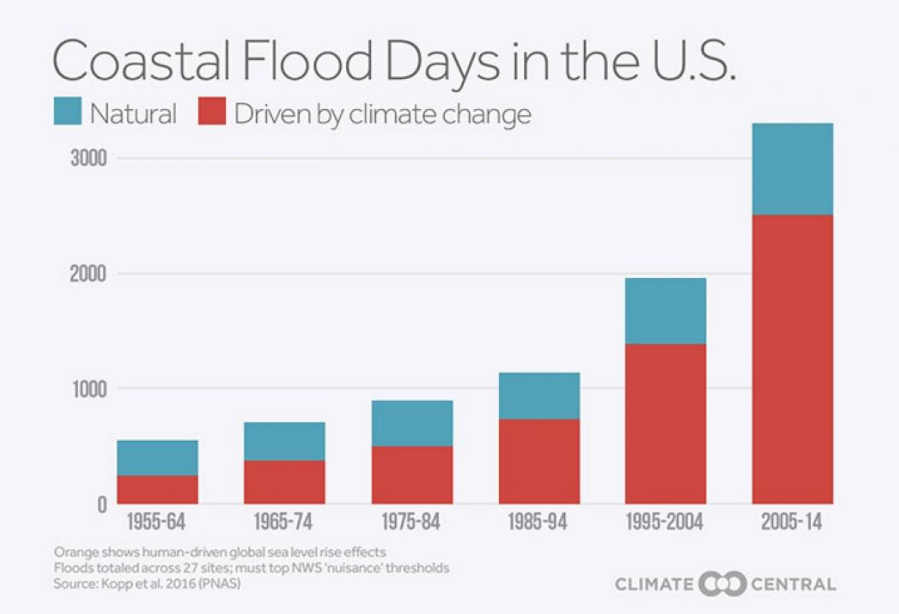
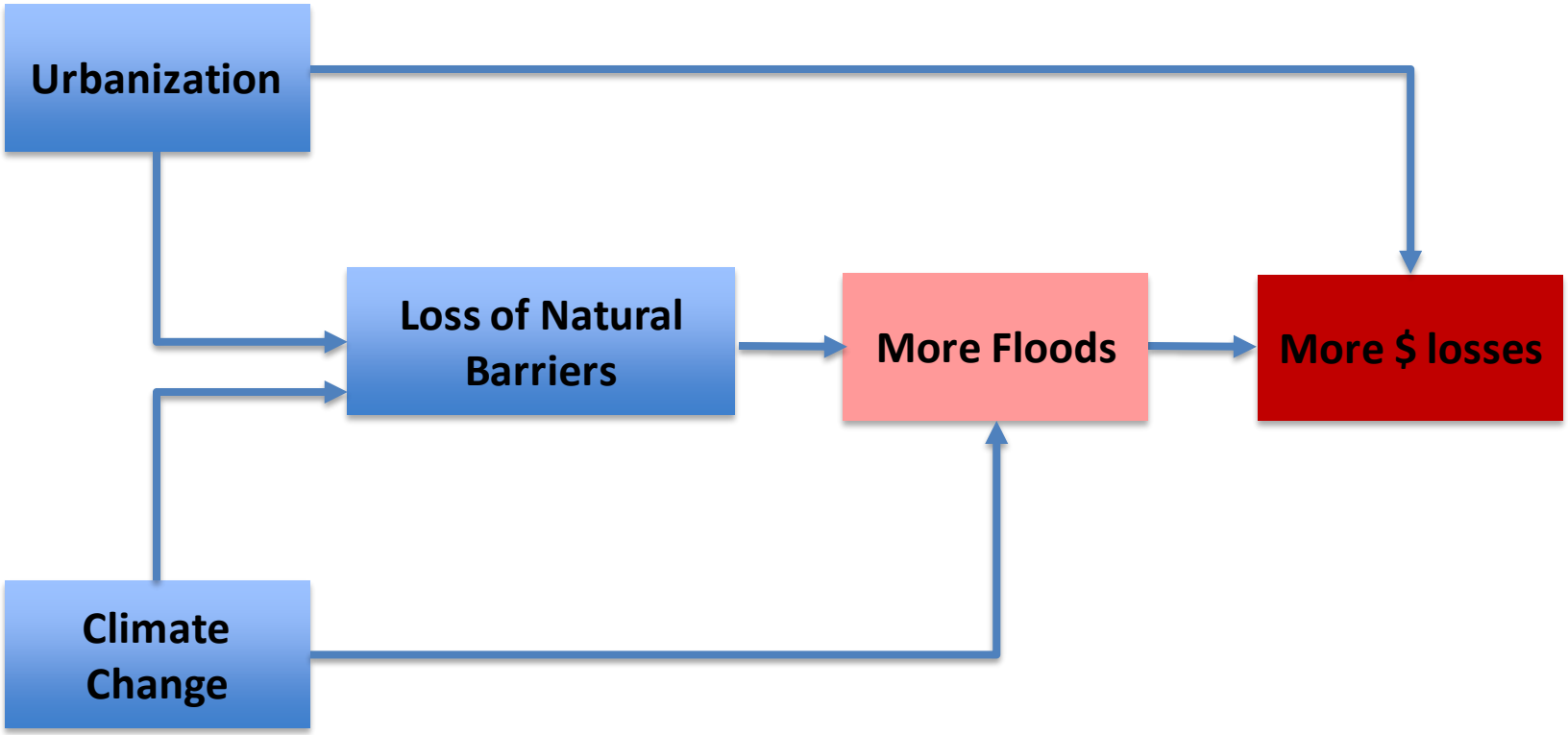


- Since 1960s, inland floods have increased 300-925%
- Since 1980, floods caused $7.96 billion/year+ 82 fatalities/year
- 39% of US HH live in shoreline coastal counties
  - 445 p/mi^2 > 105 p/mi^2

Flooding: Climatic and Economic Threat



What to Do?

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- More of the Same
- Build/Protect Natural Barriers

Land Use Policies

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- Flat development impact fee
- Impact fee that is sensitive to spatial features
- Limit on % of impervious surfaces
- Minimum % of wetland
- Minimum % of tree coverage

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General Framework

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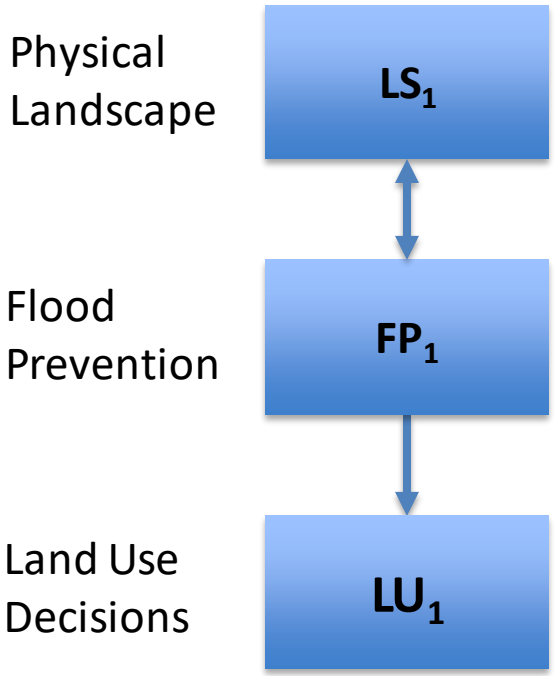

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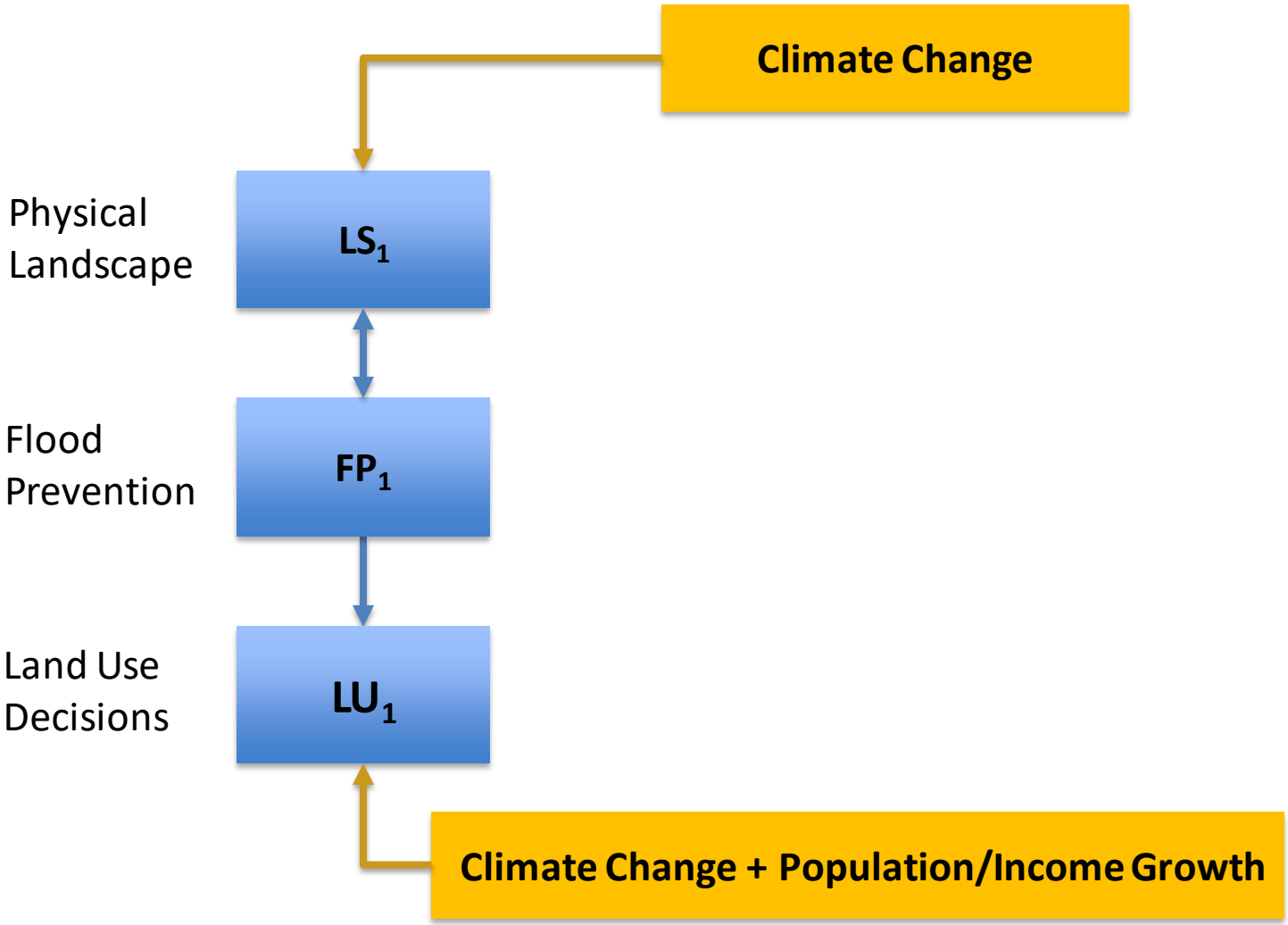

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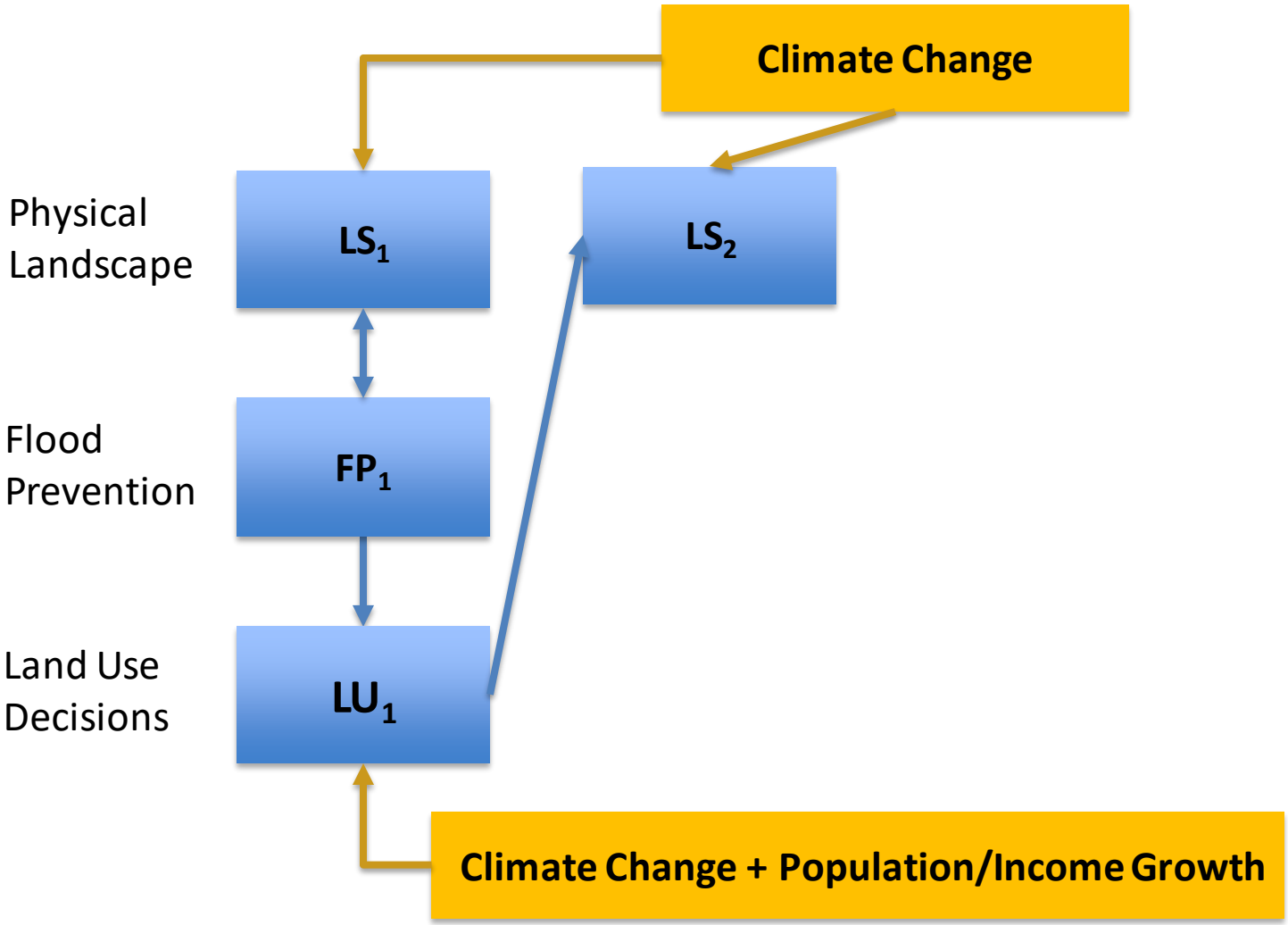

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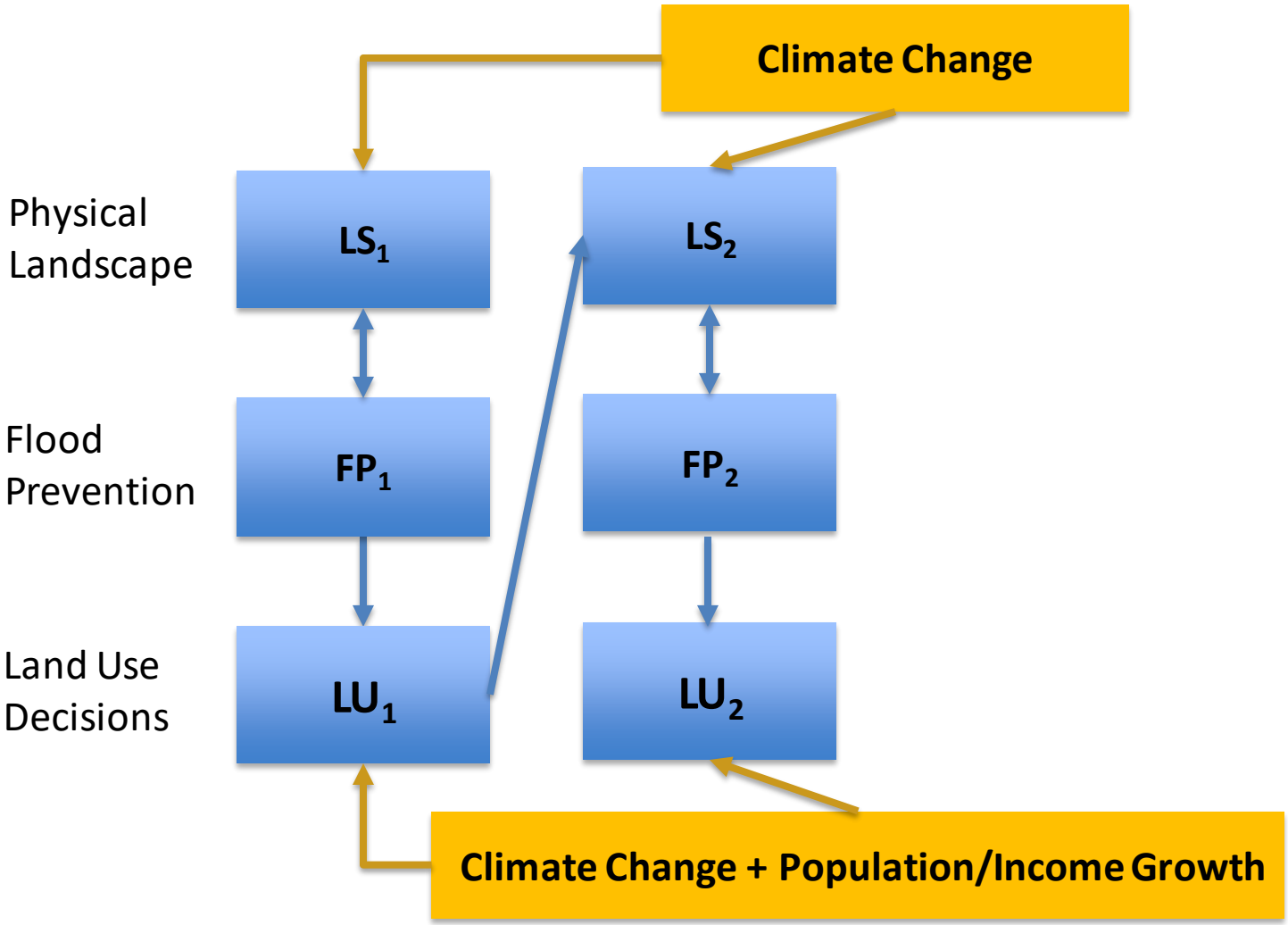

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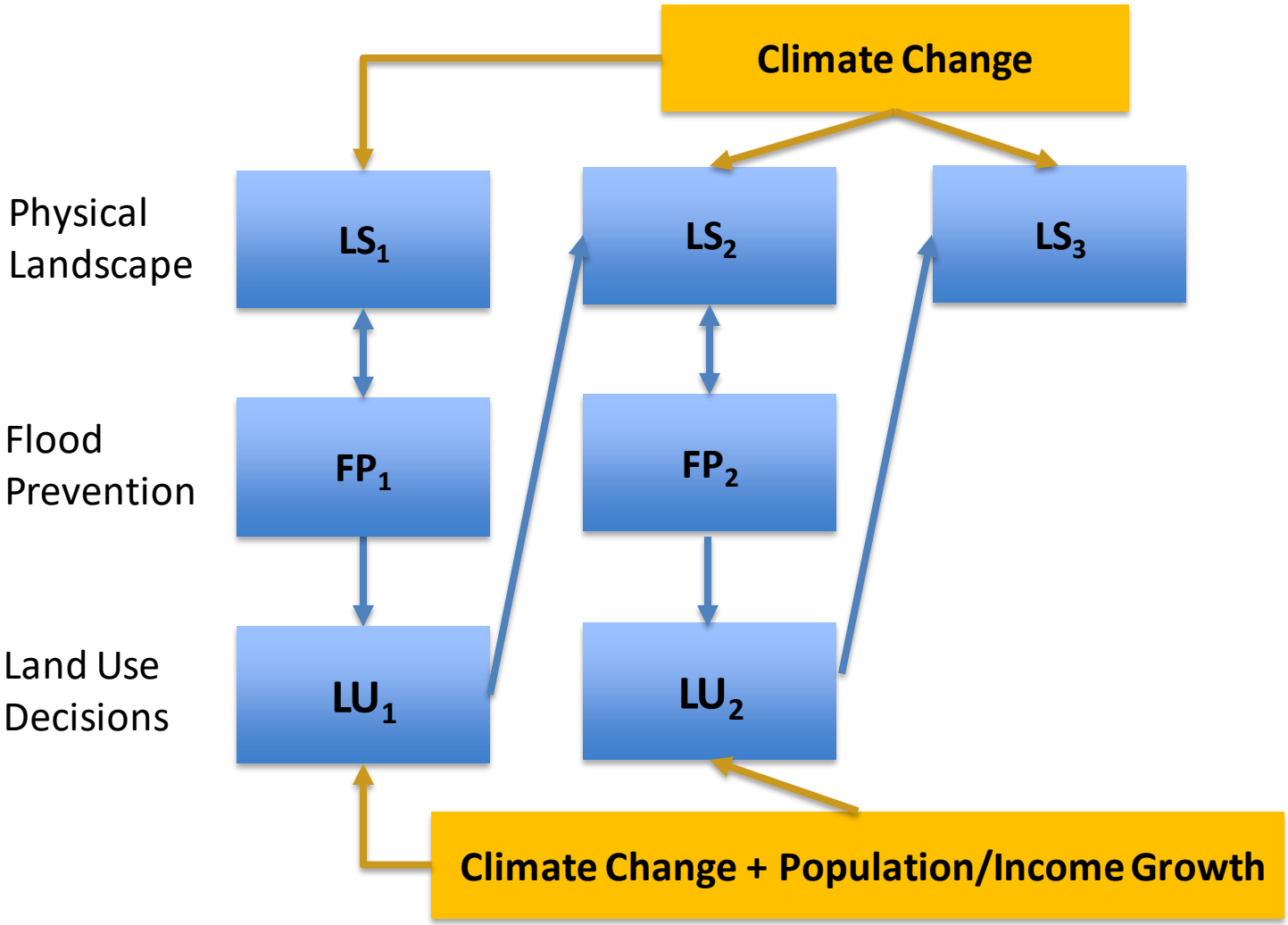

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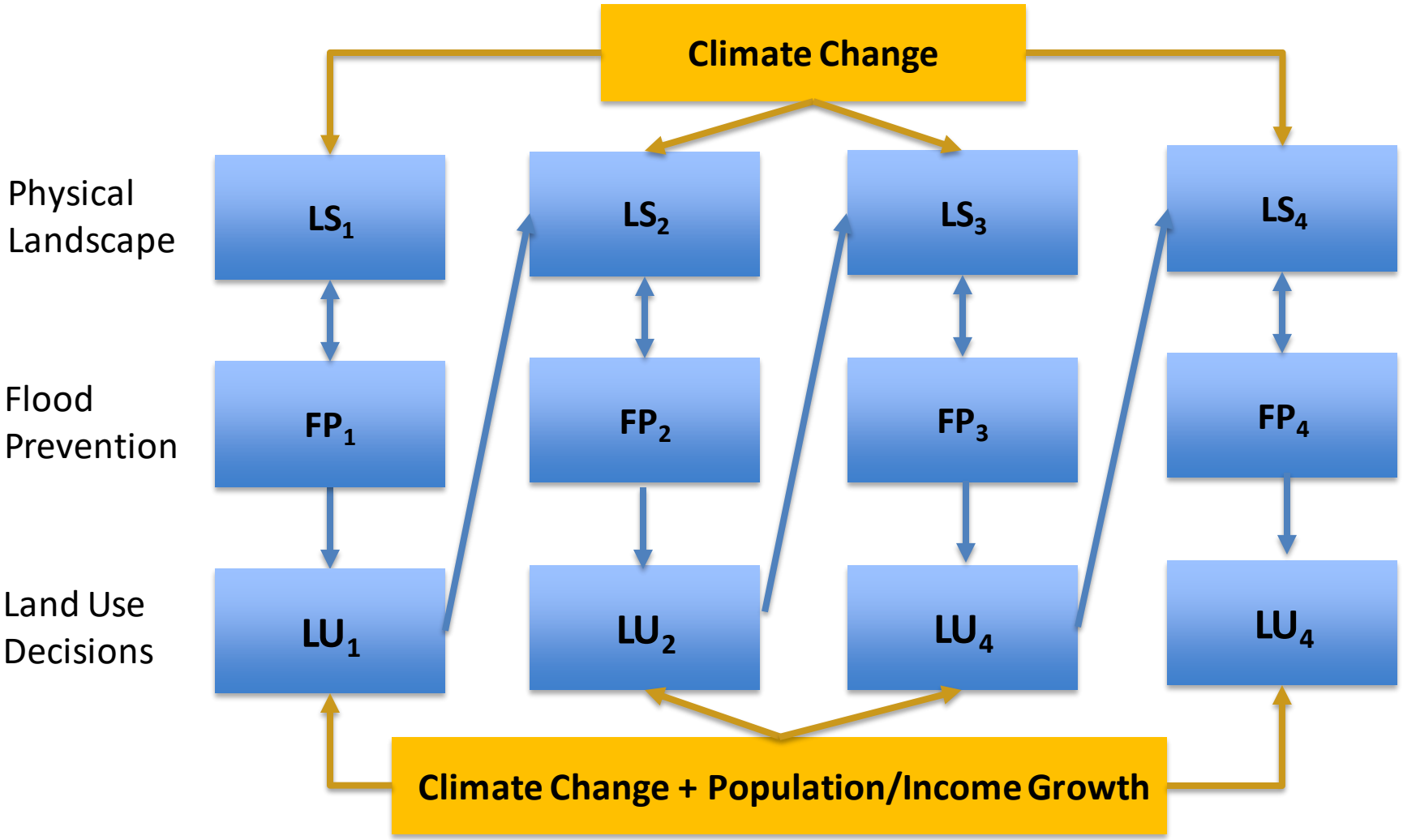

- BAU

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LS_5 * FP_5 = $Scenario_1$

- Flat development impact fee — $Scenario_2$
- Impact fee that is sensitive to spatial features — $Scenario_3$
- Limit on % of impervious surfaces — $Scenario_4$
- Minimum % of wetland — $Scenario_5$
- Minimum % of tree coverage — $Scenario_6$

- Which policy leads to lower expected damages?
- What is the spatial distribution of expected damages?

Land Use Change Model

Land Use Change Model

$$\max_{k = D, U} V^k = \sum \beta^t NB_t$$

Prob($d = 1$) = Prob($V^D > V^U$)

		t_0	
		D	U
t_1	D	1	δ
	U	0	$1 - \delta$

What are V^D and V^U?

$$\tilde{V}^D = \hat{P}^D(S, L, N, Policy_j)$$

$$\tilde{V}^U = \hat{P}^U(S, L, N, Policy_j)$$

- 2-Step approach: Bockstael,1996; Newburn,2004-2006; Bigelow,2015
- 1-Stage = Predictive hedonic price models
- 2-Stage LU Change (above)

Simulations

Newburn, 2004-2006; Lewis and Plantinga, 2007; Lewis et al., 2011; Bigelow,2015

δ_{ti} = Prob($d_{ti} = 1$) = Prob($\tilde{V}^D{}_{ti} > \tilde{V}^U{}_{ti}$); $\tilde{V}^k{}_{ti} = \hat{P}^k{}_i\,(S, L, N, Policy_j)$

∀ policies j

∀ t $\leq T$

∀ parcels i

$\widetilde{\delta_{0i}} \geq$ r(U[0,1]) → parcel i is developed in t_1

→ landscape in t_1

→ landscape in T (each i is associated with an E[damage from flooding])

→ 6 scenarios in T

Which policy leads to lower expected damages?

What is the spatial distribution of expected damages?

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Recap

- Forward-looking land management policies:
  - that are nature-centered.
- Holistic, flexible approach.
- How effective are they?

Future Directions

- Alternative policies.
- Intensity of development.
- Spatially autocorrelated error in non-linear models.
- Other policy questions.

Thanks!