

**“Politics is for the moment.
An equation, for eternity.”**

Chesapeake Bay Program's
Science and Technical Advisory
Committee
Workshop,
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Annapolis, MD

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**scientific
information**

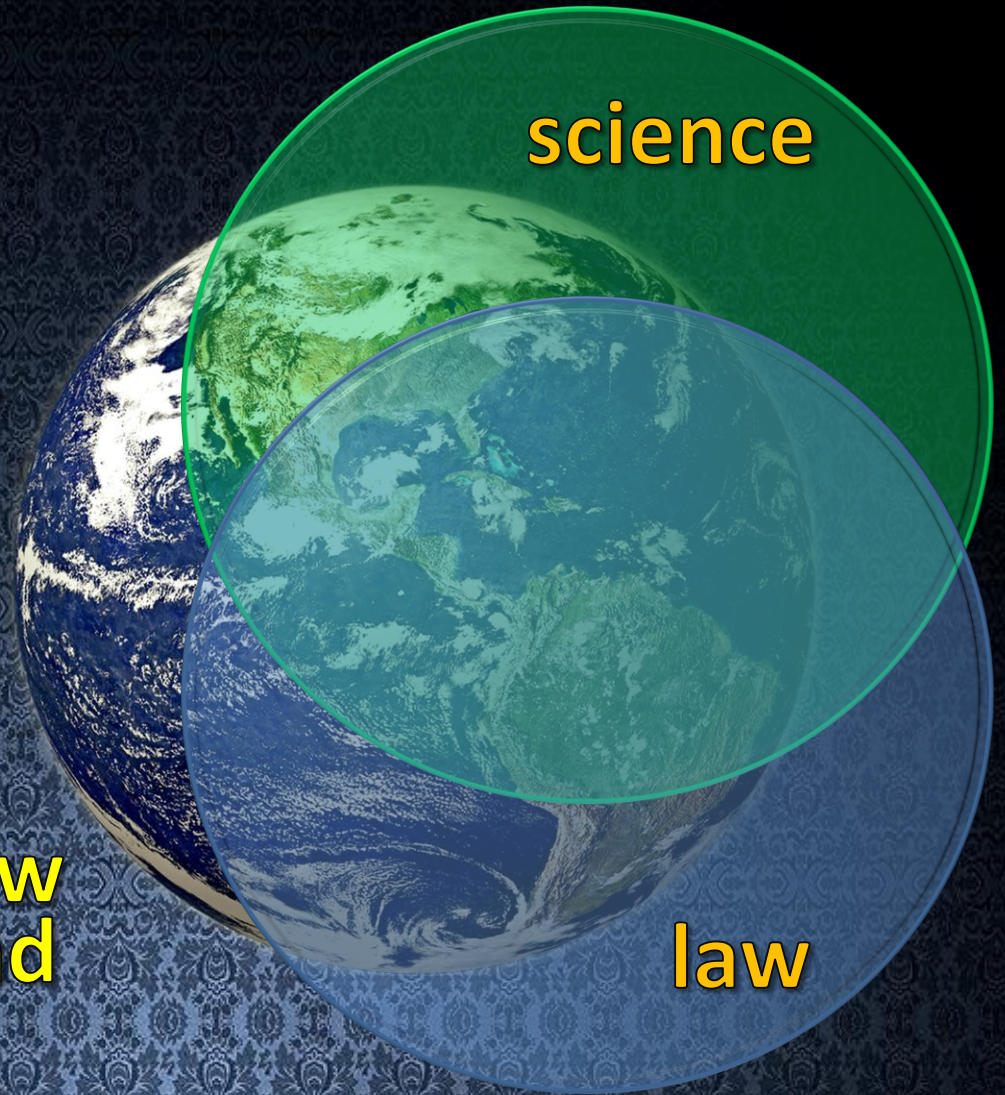
evidence

**legal rights
and
obligations**

B

Premises:

1. Known and unknown unknowns are inevitable
2. Conciliation between science and law is desirable and possible.



Jurisprudence on regulatory models

$f(\text{data}, \text{parameters})$

- If rational connection between model and reality, courts defer to Agency.

$f(\text{data}, \text{parameters})$

$f(\text{data}, \text{parameters})$

- Does difference matter?
- Are methods compatible?

data

- Work with available data, then adapt.

$f(\cdot)$

parameters

- Irrational if based on implausible assumptions.

**MA
v.
EPA**

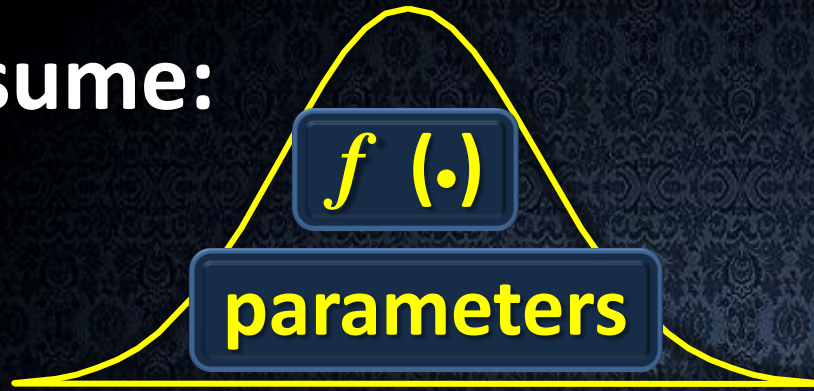
**Scientific evidence can
compel EPA to regulate CO₂**

**Petitioners can't link coastal harms back thru
web of causal factors to the fraction of global
emissions that EPA would limit.**



Defining causation

assume:



given:

data

infer:

$f(X, \theta) \rightarrow Y$



**scientific
information**

evidence

method

axiomatic v. non-axiomatic

probabilistic v. non-probabilistic

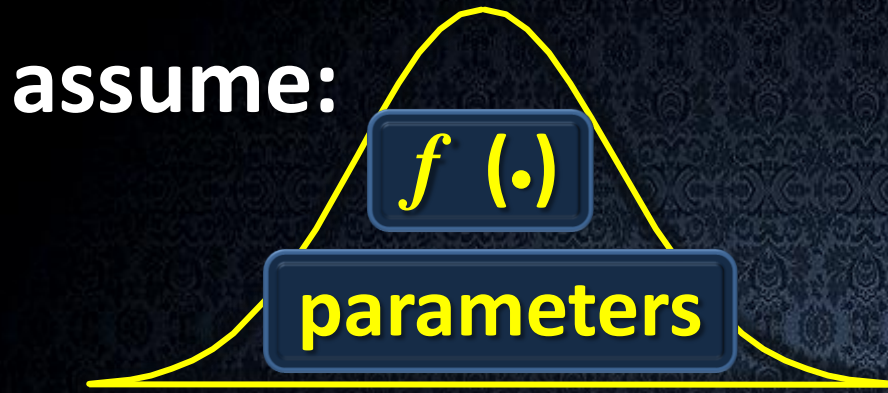
p-value

likelihood

Bayesian

Pascual, Wagner, Fisher (2013)

Defining causation



given: data

infer:

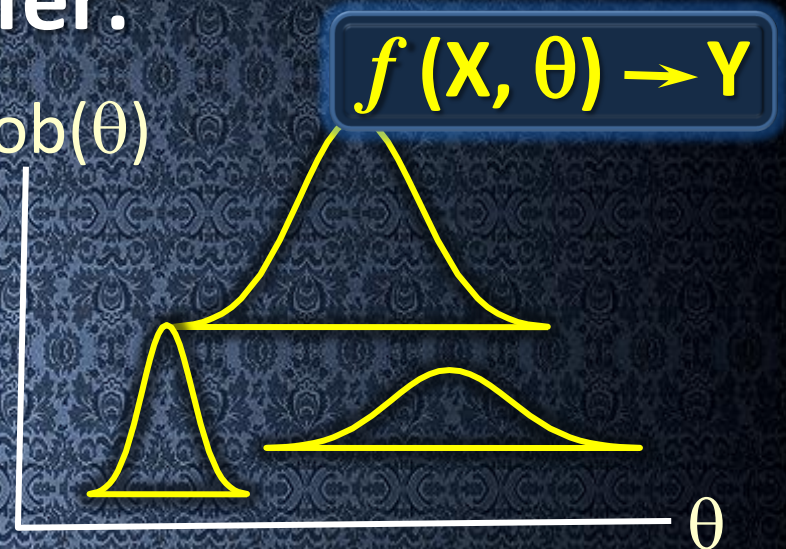
$f(X, \theta) \rightarrow Y$

assume: $f(\cdot)$

given: data

infer:

prob(θ)



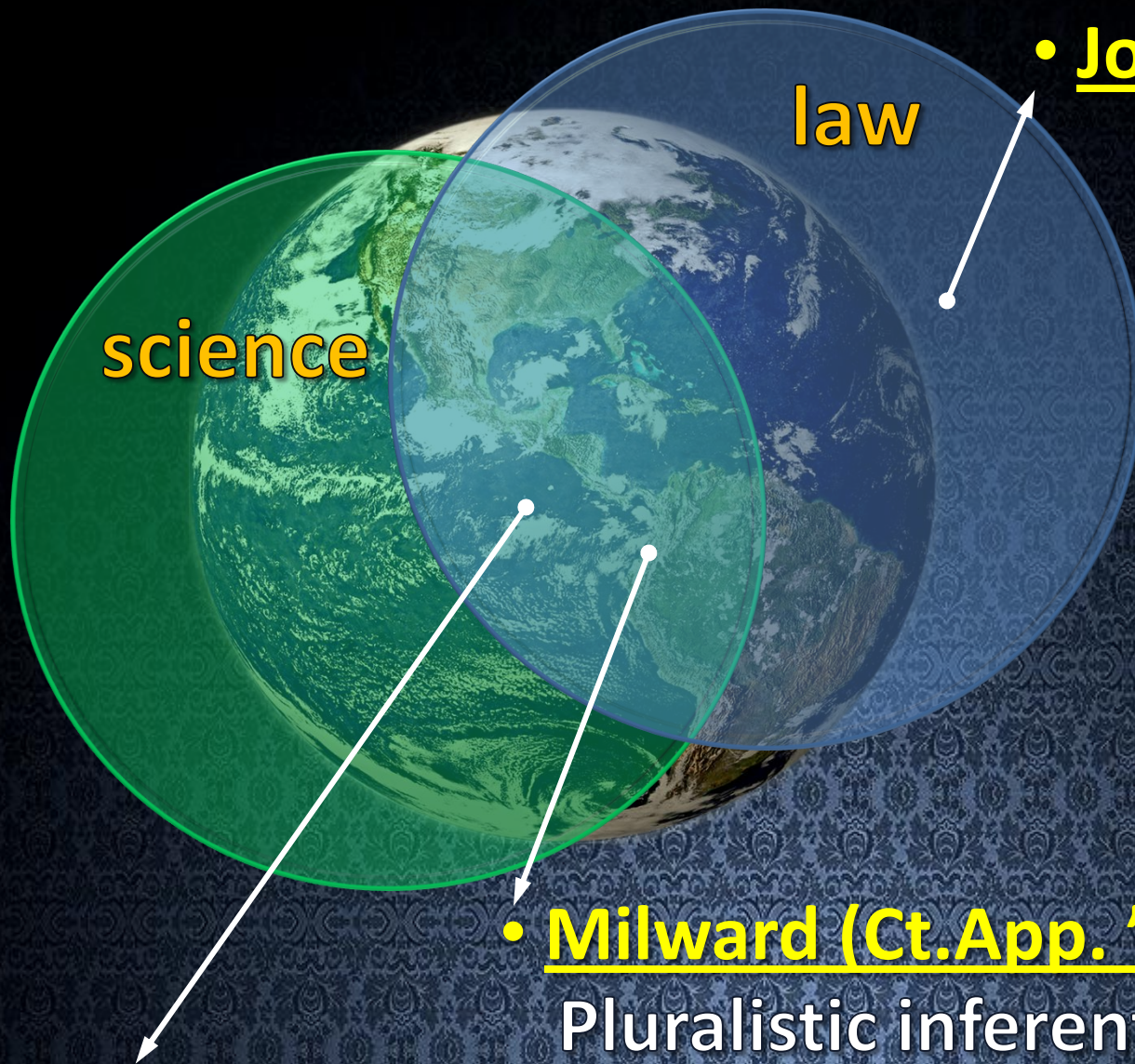
The image features a background of the Earth from space. A large green circle is overlaid on the left side of the globe. The word "science" is written in orange text above the circle. A dark blue rounded rectangle with yellow text is positioned over the center of the circle. Two white arrows originate from the bottom of this rectangle and point to two separate rounded rectangles below: a green one on the left and an orange one on the right. The background has a subtle, repeating pattern.

science

f (data, parameters)

f_1 (data, parameters)

f_2 (data, parameters)



• Joiner (S.Ct. '97)

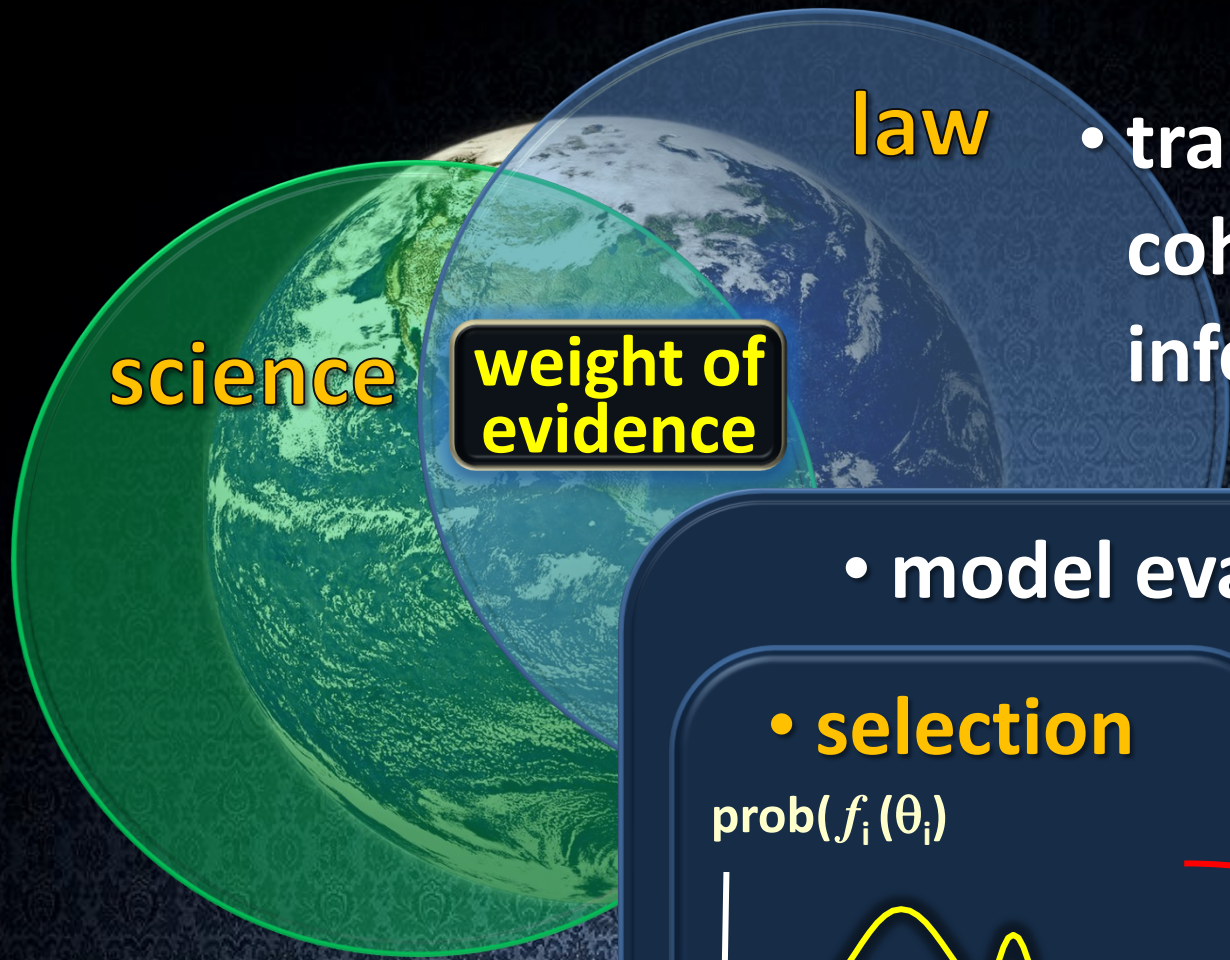
Discrete evidence, not WOE.

• Milward (Ct.App. '11)

Pluralistic inferential methods.

• Matrixx (S.Ct. '11)

Not just p-values.



science

law

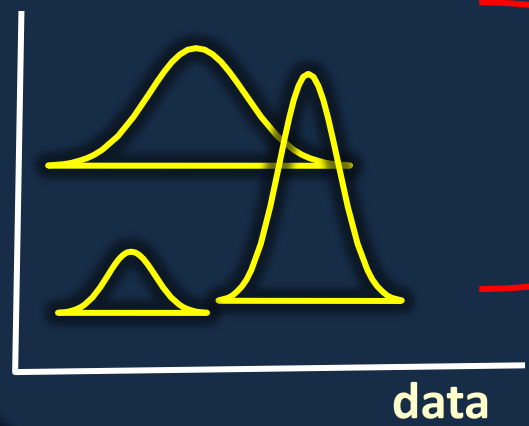
weight of evidence

- transparency + coherency of inference

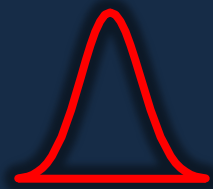
- model evaluation

- selection

$$\text{prob}(f_i | \theta_i)$$



- averaging



$$\sum \text{prob}(f_i | \text{data}) * \text{prob}(\theta | f_i, \text{data})$$

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