

# How Statisticians Can Help Climate Change Policy Makers

## ***ASA Advisory Committee on Climate Change Policy***

- ***Who:*** Statisticians with expertise in climate and environmental science
- ***Why this Committee:*** Statistics can make fundamental contributions to climate engagement of our community.
- ***What can we do:*** Support policy makers by 1) aiding in the understanding of statistical arguments, 2) advising on connections between raw information and conclusions

## ***Statistical Contributions to Climate Policy Making***

- ***Quantification at Heart of Policy Making:*** necessary to quantify the many physical factors and costs, and their likelihoods, that must be balanced:
  - costs of remediation, emission reduction, etc.,
  - costs of impacts of climate change
- ***Quantification Subject to Uncertainty,*** which must also be quantified. Consider:
  - Under “business as usual,” global average temperature will increase by 2° C by 2090; versus
  - Under “business as usual,” we are 90% confident that global average temperature will increase between 1.5° C and 2.3° C by 2090 or so.
- ***Quantification and Uncertainty to be Integrated from Many Inputs and Steps:*** For example, in the following causal chain, the uncertainty in each of the arrows must be understood and quantified using input from multiple disciplines:  
CO<sub>2</sub> → global climate → regional climate → local weather, hydrology  
→ environment → disease patterns, crop yields; etc.  
Uncertainty modeling is also needed to account for feedbacks and interactions in such chains.

## ***Role of Statisticians:***

- Aid in understanding statistical procedures
- Assessments of specific statistical analyses (quality, appropriateness, etc.)
- Provide frameworks for uncertainty management and their applications to specific climate problems
- Expertise in application of Decision Theory to decision support problems.

## ***View of Climate Change***

The ASA Board of Directors has endorsed the conclusion of IPCC Fourth Assessment.

- Warming of the climate system unequivocal
- Very likely\* caused by human activities. (\*probability > 90%)
- Most observed changes over the past 50 years are now simulated by climate models
- Natural forcings do not account for observed warming after 1970

## **Statistical Science**

- Data Analysis: model building and assessment
- Design of experiments and data collection
- Combining Information: data sources, science, and models
- Uncertainty Management: identify, model, and deal with uncertainty
- Decision making and decision support

## **Uncertainty & Uncertainty Management**

- Uncertainty
  - Information sources (models and observations) are imperfect
  - Quantification is essential
  - Uncertainty  $\neq$  Ignorance/Inaction
- Uncertainty management
  - Scientific treatment: Apply statistical and probabilistic methods
  - Uncertainties interact in complicated ways
  - Conclusions are statistical in nature
- Statistical Decision Theory: Analytical techniques to choose among alternative actions in the presence of uncertainty.
  - **Actions** (policies)
  - **Consequences** of actions depend on uncertain quantities/futures.  
“Doing nothing” is an action and has consequences
  - **Probabilities** for unknowns using science, observations, and expert opinion.
  - Identify action with smallest risk, where Risk = Expectation of Consequences

## **Example: Establishing Causation in the Presence of Uncertainty**

1. Why does the climate science community claim “human activities are causing global warming?” Such claims are based on the weight of evidence, not perfect knowledge.
  - Climate models do not need to be perfect to be informative
  - IPCC 2008 : It is likely ( $P > 0.66$ ) that the second half of the 20th century was the warmest Northern Hemisphere 50-year period in the last 1,300 years.

Even if there has been a warmer period, the weight of evidence remains strong.

Compare: Mr. Smith smoked 3 packs of cigarettes a day and never got cancer, so the claim that cigarette smoking causes cancer is false.

2. “Global warming caused Hurricane Katrina to be as severe as it was” not viewed as scientific because climate is statistical by nature. It describes typical behaviors, not specific events.

Compare: “Smoking causes heart disease” versus “Mr. Jones had a heart attack because he smoked.”