

# Risks, Abrupt Change & Climate Catastrophes

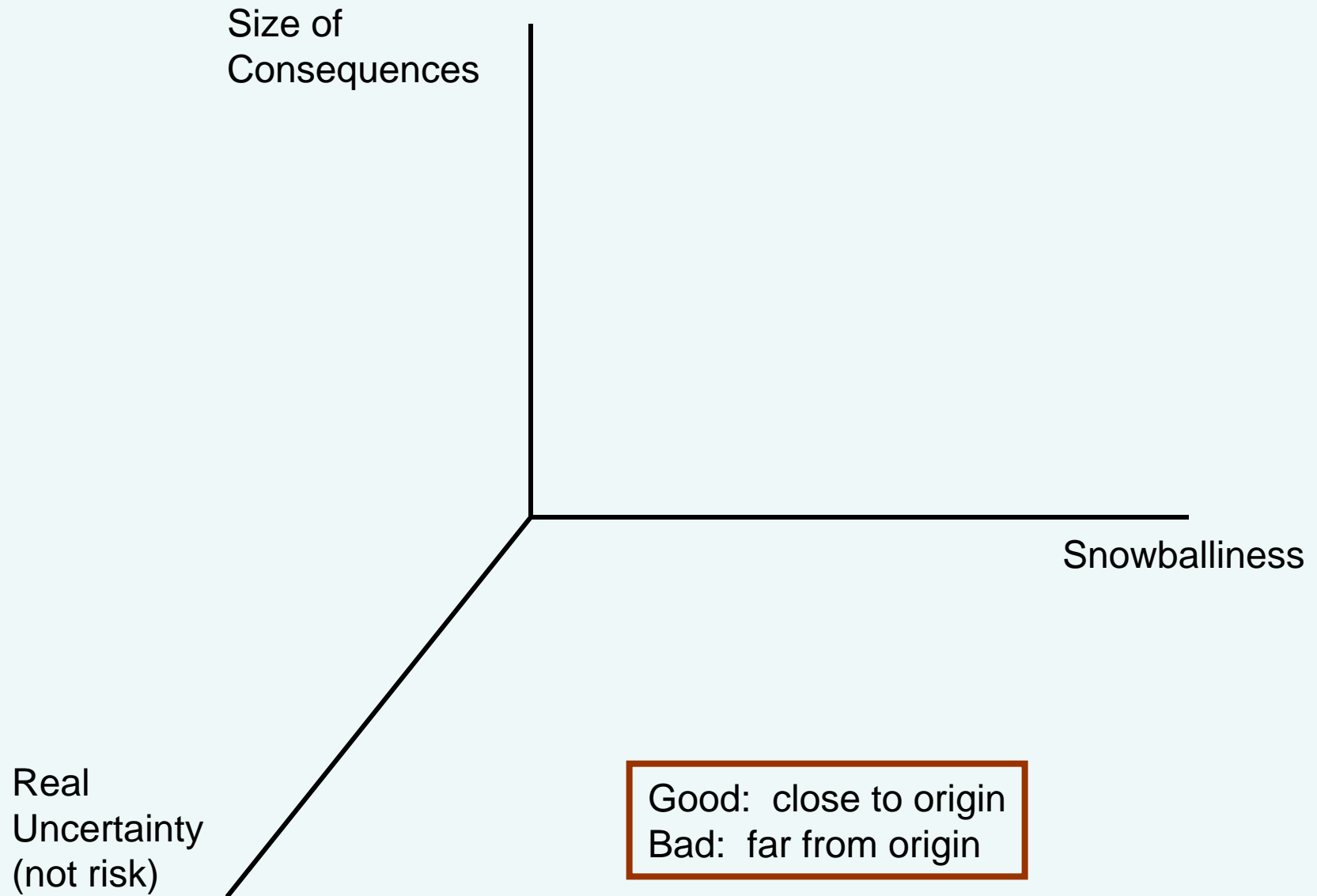


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**Presentation at [www.ckolstad.org](http://www.ckolstad.org)**

**Corporate Summit**  
**May 12, 2006**

# Just what are we talking about?

- Uncertainty vs. Risk
  - Risk – we sort of understand the probabilities (eg, hurricanes in the Gulf)
  - Uncertainty – we don't really even understand how likely or unlikely things are (eg, shut down of Gulf Stream). Most climate consequences.
- Abrupt change: regime shift, something new happens quickly, gets out of hand, snowballs – chaotic
- Catastrophe: something really big happens, though perhaps slowly, perhaps quickly (eg, sea level creeps up at 1 meter a decade, steadily)



# Just what are we talking about II?

- Physical changes
  - Gulf stream shutdown
  - Ice Sheet collapse
- Economic disruptions from small physical changes
  - Infrastructure overload
  - Financial markets collapse
  - Mass migration
- Social and Political Crises from small physical changes
  - Wars over resources (eg, Pakistan-India)

# Rumsfeld on Uncertainty

“There are known knowns: there are things we know we know. We also know there are known unknowns; that is to say we know there are some things we do not know. But there are also unknown unknowns — the ones we don't know we don't know.”

-Donald Rumsfeld, Feb 2003

- Rummy could just as well have been talking about climate change (he wasn't)

# Frank Knight's Typology

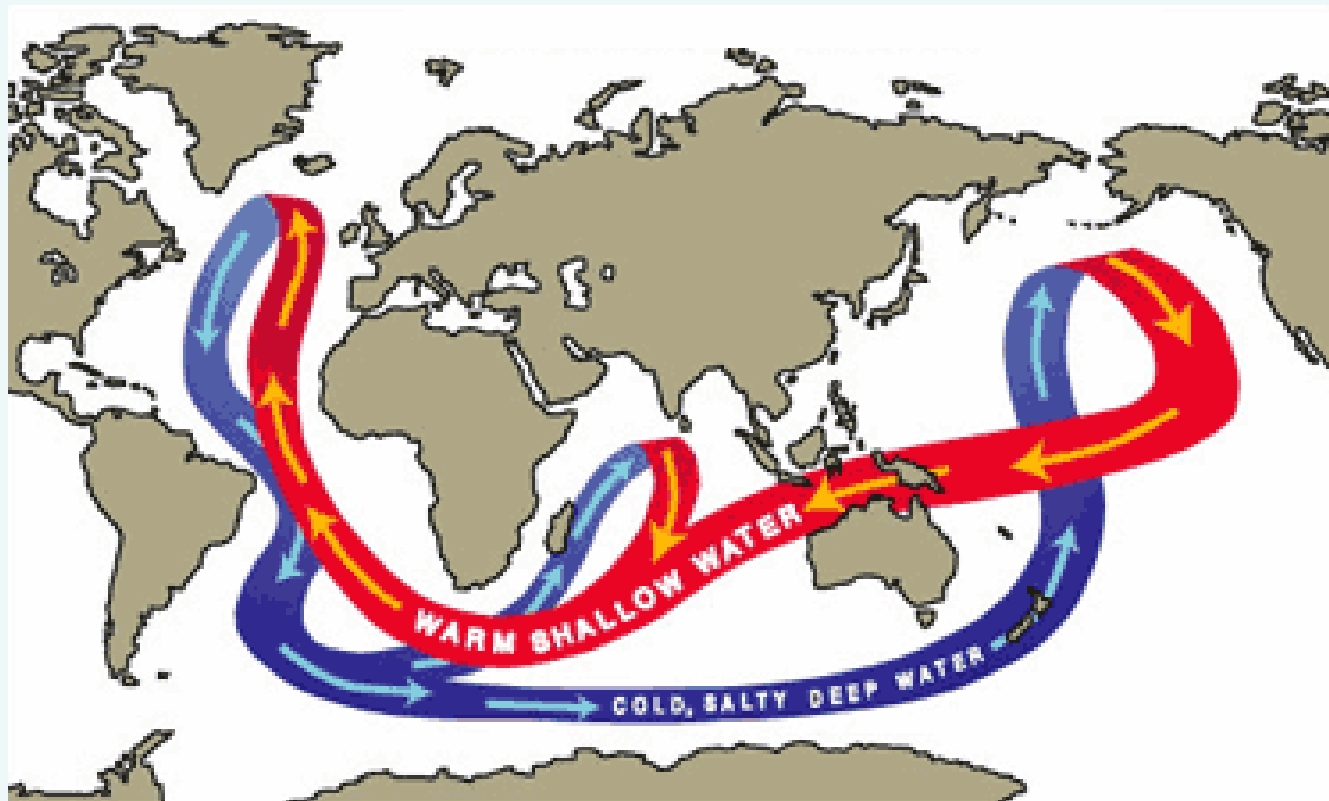
## Risk and Uncertainty in Economics

- Three kinds of probabilities (Knight, 1921)
  - Clear objective ones like the flip of a coin
  - Statistical ones like the probability of rain in September in Santa Barbara
  - Estimated ones like the probability of THC shutdown from a 3° global temperature rise (where there is no basis for statistical estimates)
- We can get a handle on the first two
- BUT, some things are just not knowable from direct statistical observation (“non-ergodic theorem”)

- Climate change: mostly the uncertainty kind of unknown
- We have a very poor grasp on how likely many events are
- We don't even have a good grasp on how severe the consequences might be

# Physical Changes

- Stability of ocean currents – freshwater input at high latitudes changes things

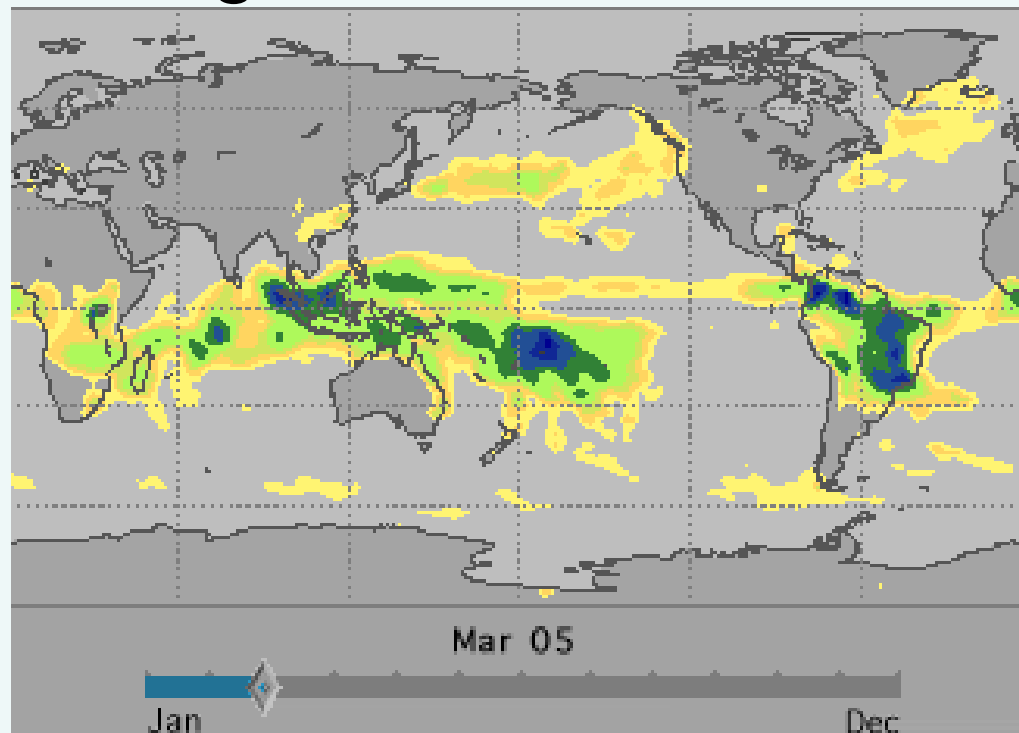


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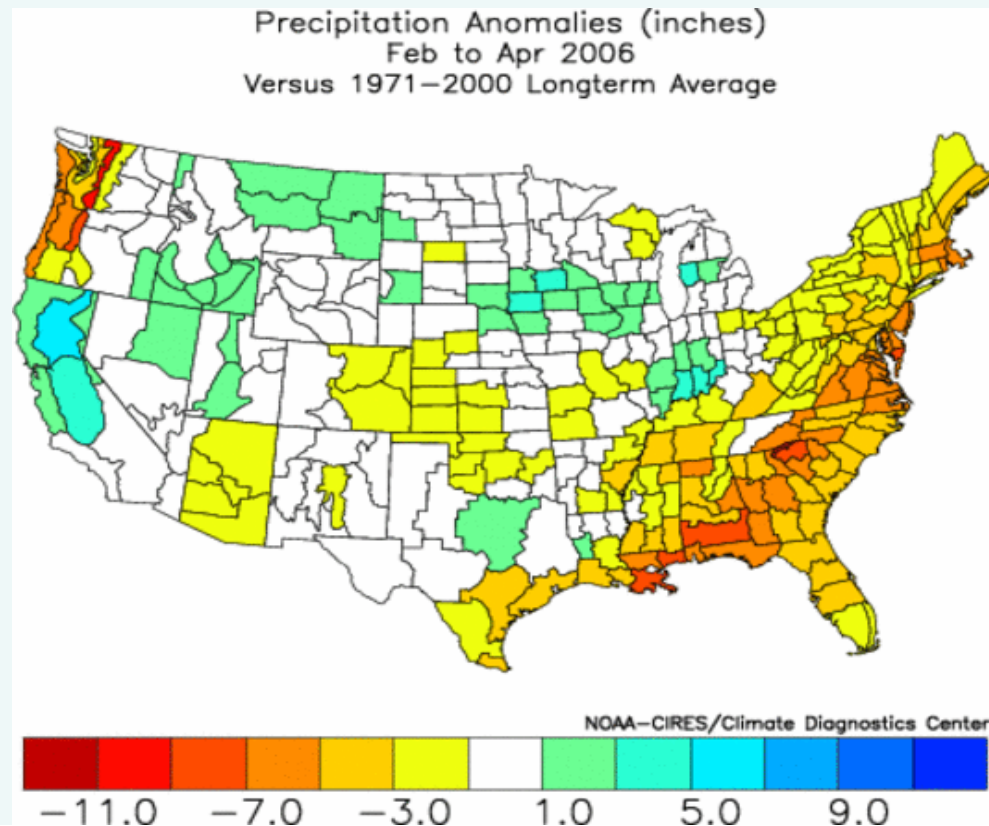
# Physical Changes

- Stability of ocean currents
- Stability of regional monsoons



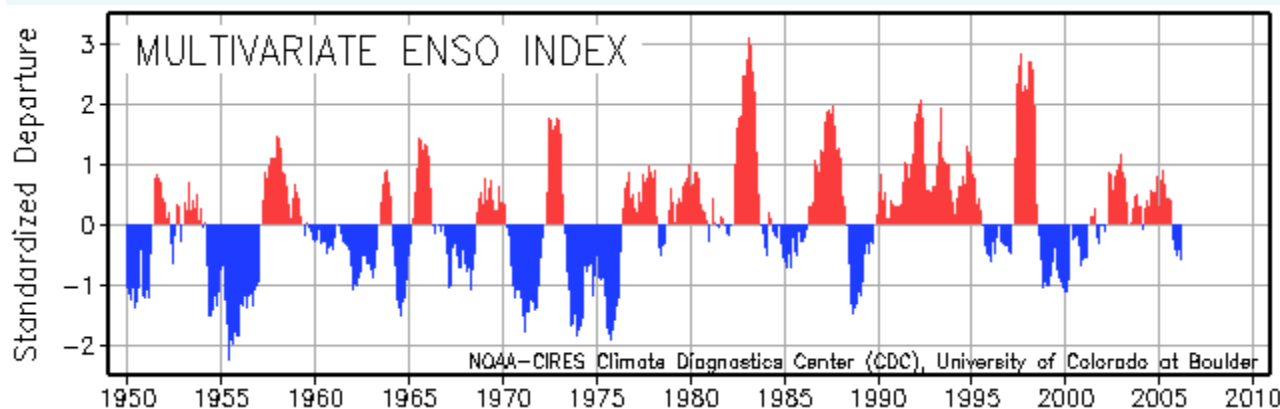
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- Stability of ocean currents
- Stability of regional monsoons
- Stability of regional precipitation regimes
- Stability of interannual climate (eg, ENSO)



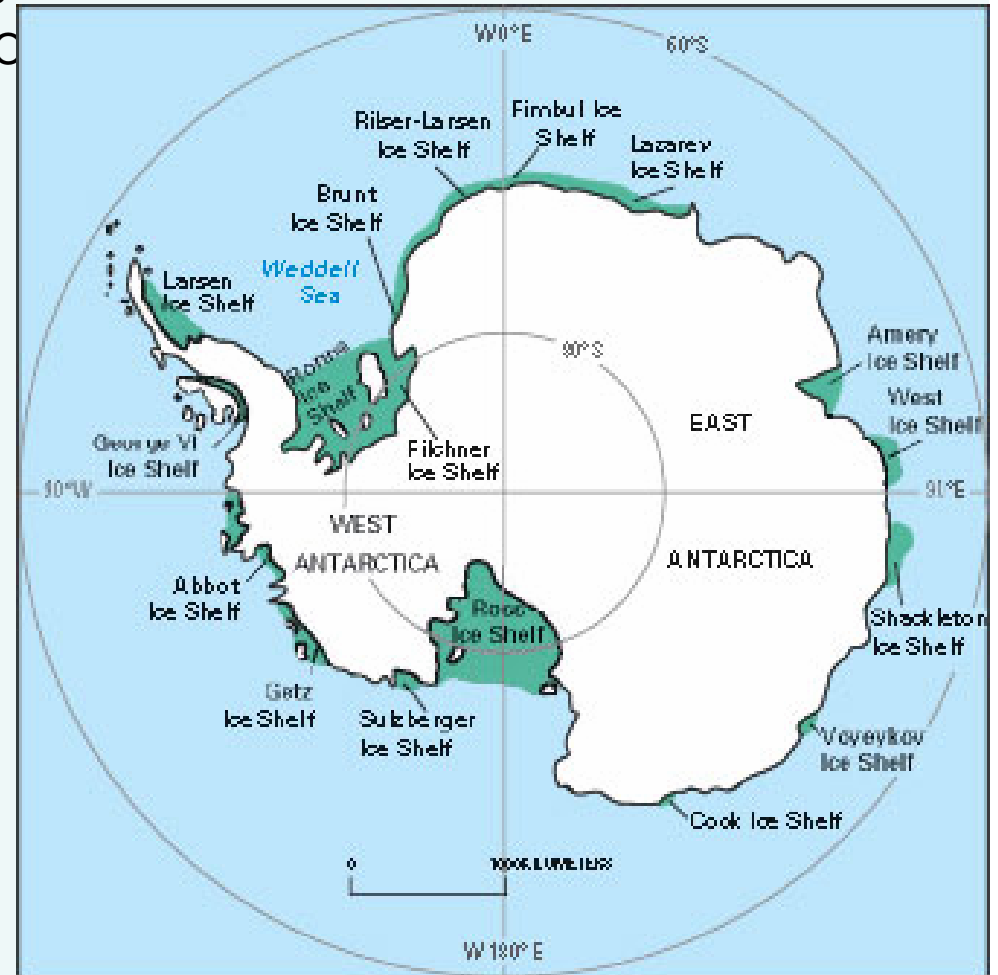
Remember Calif in  
The last big ENSO?

Source: NOAA/CIRES

# Physical Changes

- Stability of ocean currents
- Stability of regional monsoons
- Stability of regional precipitation regimes
- Stability of interannual climate (eg, ENSO)

- **Stability of major ice sheets**



West Antarctica ice sheet goes  
→ ~6m sea level rise

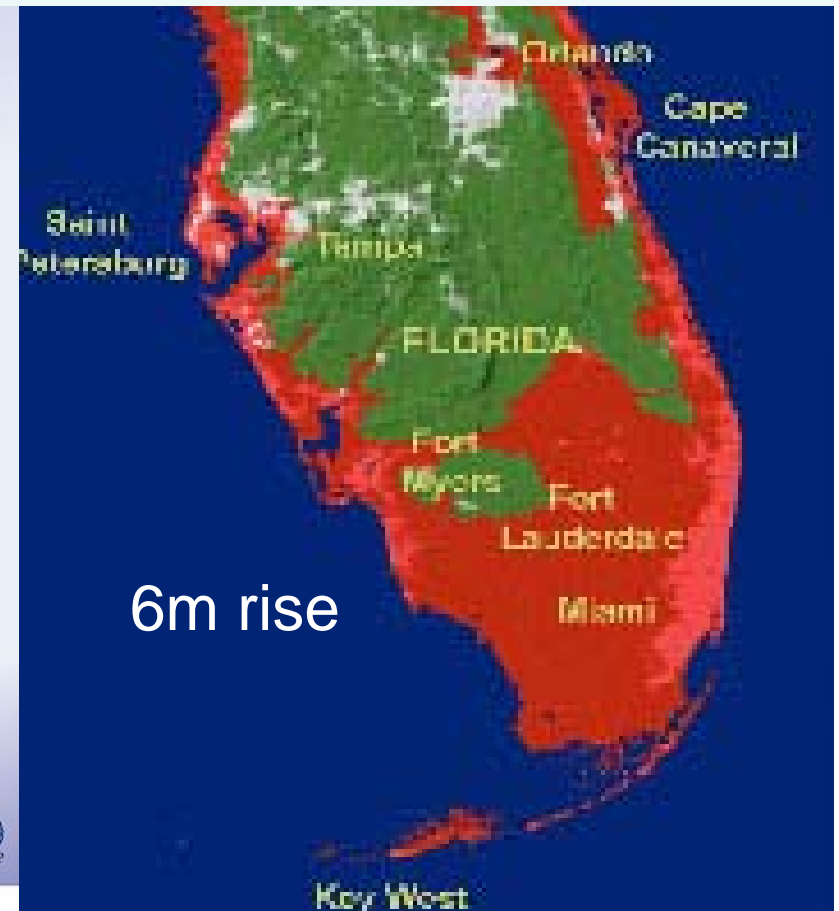
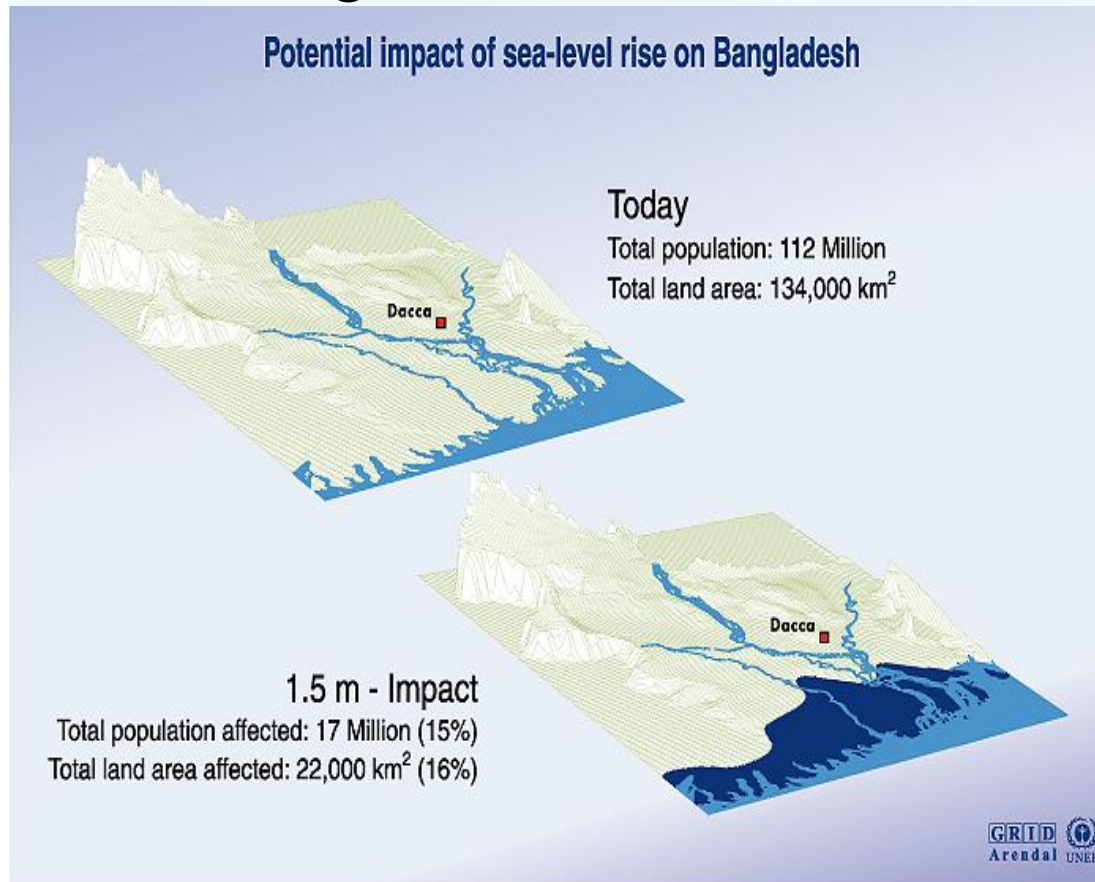
Source: USGS

# Economic Changes

Flooding uninhabited areas less economically consequential

- Flood 2/3 of low lying areas like Netherlands, Bangladesh, Florida

Source: Overpeck, UAz



# Economic Changes

- Flood 2/3 of Low Countries
- Mass migrations create large economic disruptions (Katrina small potatoes)
  - Bangladesh to India
  - Coastal US to inland
  - Netherlands to Belgium, France and Germany

# Economic Changes

- Flood 2/3 of Low Countries
- Mass migrations create large economic disruptions (Katrina small potatoes)
- Bankruptcies of insurance companies could ripple through financial system
  - Eg, China decides to call in its debt
  - Federal flood insurance program goes bankrupt
- Price of oil could skyrocket
  - \$6/gallon gas in US would cause some real estate mkts to collapse

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# Social Changes

- Wars and conflicts
  - Famine in South Asia generates war between Pakistan and India; escalates to nuclear
- Religious flare-ups

# Bottom line on climate effects

- Abrupt change the rule not the exception:
  - If physical effects are not abrupt, economic and social effects probably will be
- Forget about calculating risks
  - Calculate the historic risk of flood in the coastal area
  - Cannot “calculate” increased hurricane risk in Gulf Coast – only estimate
- Rummy: The known unknowns may be the killers

# Should we despair?

- NO
- Metaphor of driving a car on the 405
  - Take risks
  - Future unknown
  - Take precautions when we can
  - Insure when we can – hedge risks
  - Not the end of the world

# How will we see climate change: A Bang or a Whimper?

- Bang (catastrophe/abrupt change)
  - May be too late to pursue mitigation
  - Geoengineering solutions may be first choice
  - Problem will move to front of agenda
- A whimper (or...like slowly raising the temperature of a pot of water)
  - May tax the ability of social institutions to cope
  - Consequences can be just as severe

# Climate Change: What can be done?

- Mitigation
  - Slow additions to atmosphere of GHG
  - Take action to sequester carbon
  - Actions can be by government or by individuals/corp. (possibly via offsets)
- Adaptation
  - Private – individuals and firms take action to reduce vulnerability and impact from change
  - Public – infrastructure change in anticipation
- Learning
  - Invest in better understanding the problem
  - Encourage R&D into carbon saving technologies

# Climate Risk and Uncertainty: What can be done?

- Insurance markets (good for risk, not uncertainty)
  - Some risks insurable (require risk pooling)
    - Flood risk
  - Problems
    - Risks not always well known or well defined with changing climate
    - Reinsurers vulnerable
    - Market distortions an obstacle (Federal Flood Insurance, state regulation)
- Derivative markets (better for uncertainty)
  - Catastrophe bonds
    - Pay off in certain well defined states of the world
      - Eg, Pay if Category 5 hurricane hits downtown New Orleans in 2006 pays \$1
      - Market price of 20¢ with people on both sides → 20% market probability
    - Both sides of market involved
  - Risk pooling not necessary
  - Allows hedging of risk but doesn't eliminate damage from change
- Insurance and derivatives do not undo damage, only hedge risk
  - Mitigation and adaptation reduce damage

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# What to do *now*??

- Clear strategy:
  - Pursue relatively low cost options for mitigation and adaptation
  - Experience will be invaluable
  - Innovation will be induce
- Experience with past environmental problems instructive
  - Doing generates learning

# Some Research Frontiers

at Bren and elsewhere

- Understanding how to regulate better and more flexibly
- Understanding technology R&D process
- Understanding monetary damage from climate change
- Understanding adjustment costs from rapid climate change
- Understanding role of uncertainty, risk and learning in managing climate change

# Questions??