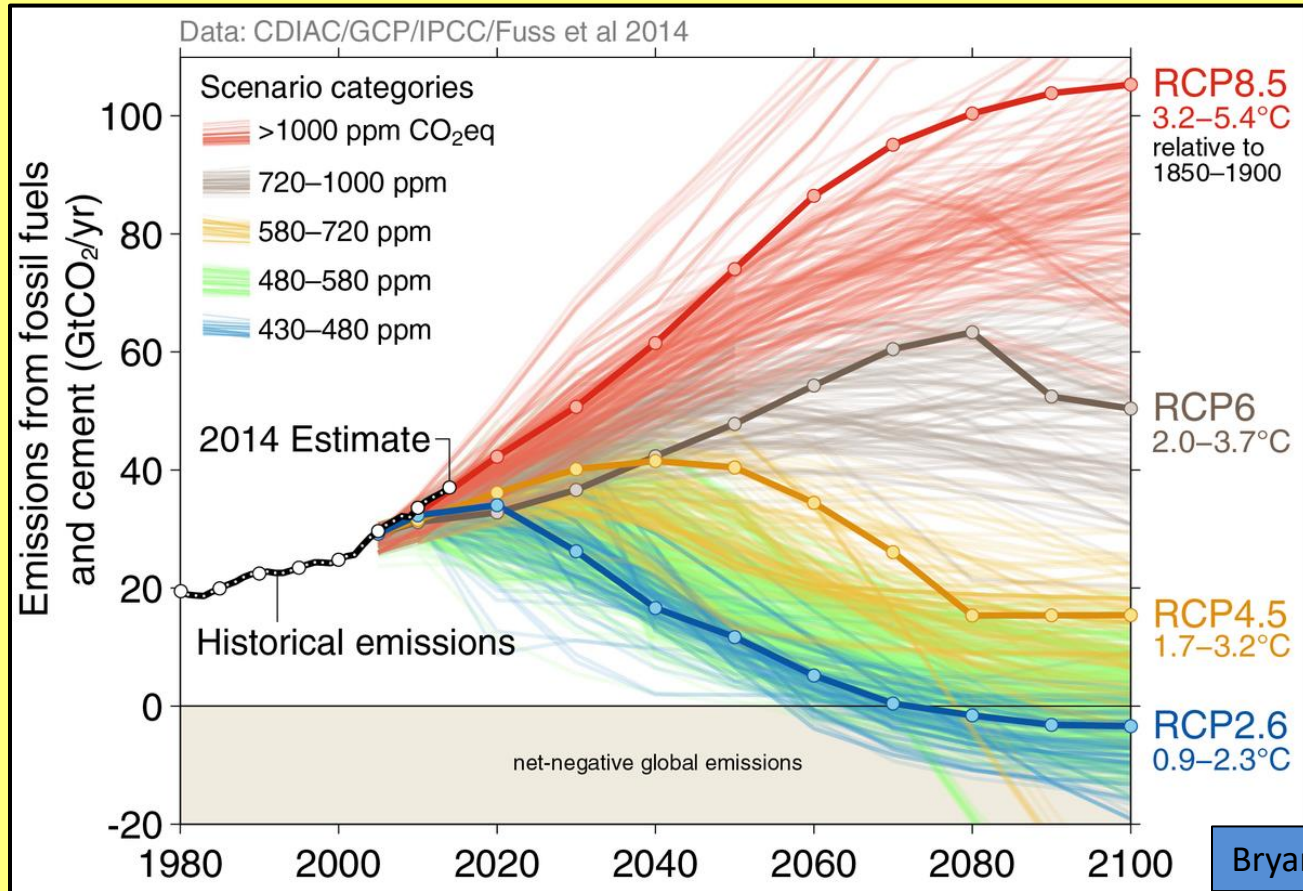


# WHAT IF: CLIMATE CHANGE ISN'T THAT SERIOUS



RELIGION  
POLITICS  
SEX.....

CLIMATE  
CHANGE!

Bryan Martindale, P.E. CFM

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# WHAT IF: CLIMATE CHANGE ISN'T THE END OF THE WORLD?

- THE COMING ICE AGE
- Y2K
- 2012
- KILLER BEES



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# WHAT IS CLIMATE CHANGE ?

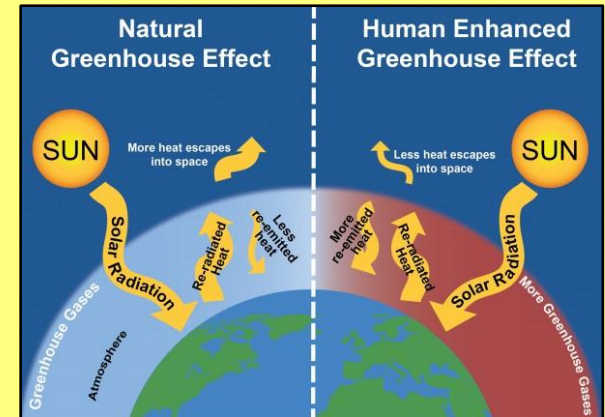
- GLOBAL COOLING OR WARMING?
- WEATHER ?
- MAN-MADE OR NATURAL ?

➔ “HUNDREDS OF DEFINITIONS”

*NASA.....Climate Change vs. Global Warming*

**Global Warming** - “long-term heating of Earth’s climate system observed since the pre-industrial period (between 1850 and 1900) **due to human activities**, primarily fossil fuel burning, which increases heat-trapping greenhouse gas levels in Earth’s atmosphere”.

**Climate Change** – many times interchanged with **Global Warming** though refers to **both human and naturally produced** warming and the effects it has on our planet. It is most commonly measured as the average increase in Earth’s global surface temperature.



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## WHAT IF: DISCUSSION TOPICS

- CLIMATE CHANGE HISTORY
- COMPLEX OR SIMPLE?
- RAINFALL – NEAR AND DEAR
- IMPACTS TO ENGINEERING
- RISKS AND COSTS





## CLIMATE CHANGE HISTORY HIGHLIGHTS

**1896**

SWEDISH  
SCIENTIST  
SVANTE  
ARRHENIUS **FIRST  
PREDICTED CO2  
COULD ALTER  
SURFACE TEMPS  
VIA  
GREENHOUSE  
EFFECT**

**1938**

BRITISH  
ENGINEER GUY  
CALLENDAR  
USED **50  
YEARS TEMP  
RECORDS TO  
CLAIM EARTH  
WAS  
WARMING**

**1961**

GEOCHEMIST  
CHARLES  
KEELING  
**PUBLISHED  
DATA  
SHOWING  
INCREASED  
CO2 LEVELS**

**1988**

**HOTTEST SUMMER ON  
RECORD AT THE  
TIME....**NASA SCIENTIST  
JAMES HANSEN  
**PROCLAIMS TO  
CONGRESS THAT HE  
WAS "99 PERCENT  
SURE" OF GLOBAL  
WARMING**

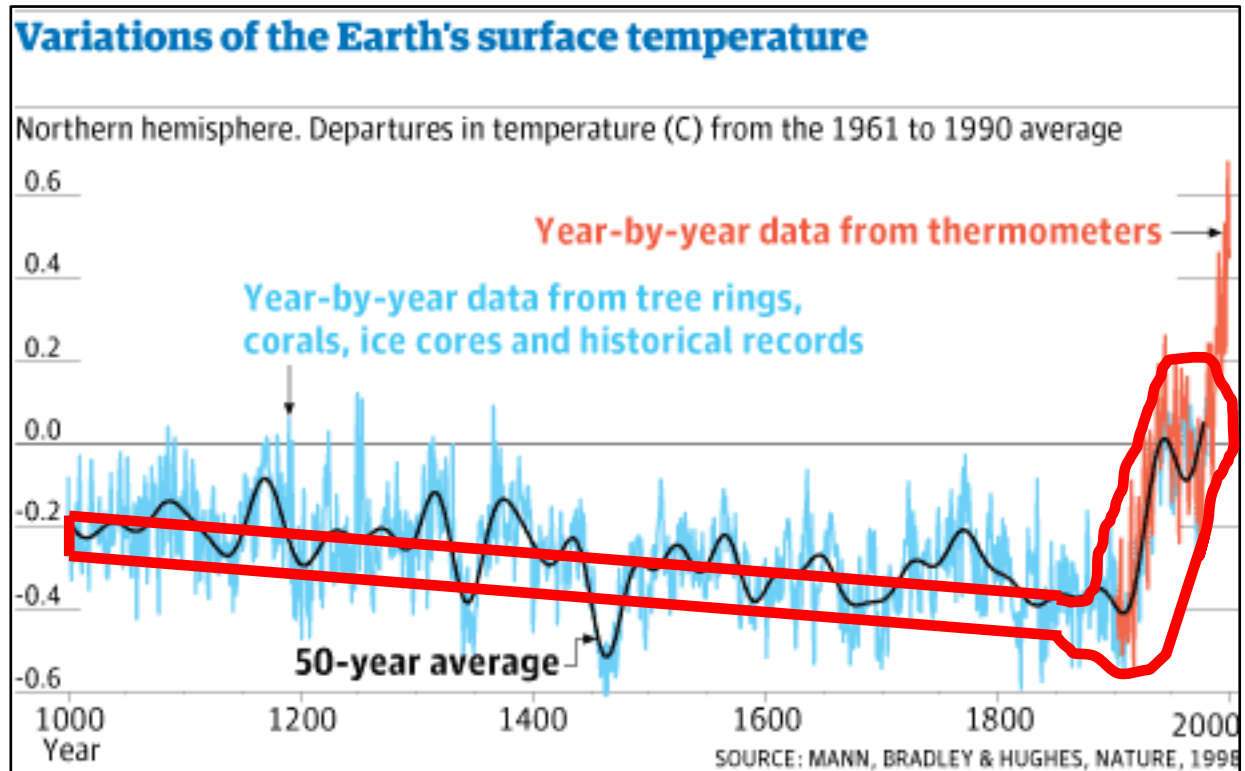
**1989**

U.N.  
INTERGOVERNMENTAL  
PANEL ON CLIMATE  
CHANGE (IPCC)  
FORMED....**OFF AND  
RUNNING**

## THE BIG MOMENT FOR CLIMATE CHANGE - THE HOCKEY STICK

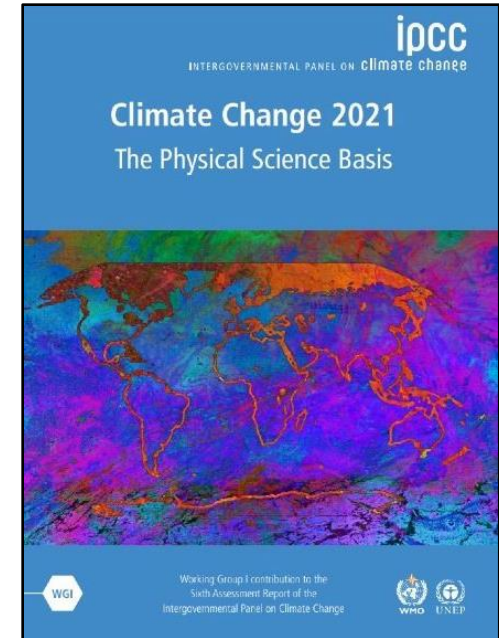
**1998**

CLIMATE  
SCIENTIST  
MICHAEL MANN  
PUBLISHES THE  
HOCKEY STICK  
GRAPH IN  
NATURE  
MAGAZINE



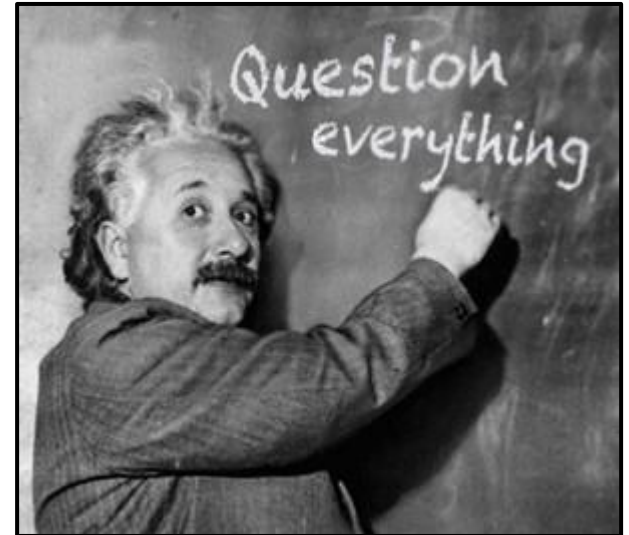
## CLIMATE “COMMUNITY” CONCLUSIONS

- SINCE 1989 - IPCC 6 ASSESSEMENT REPORTS  
MOST RECENT AUGUST 2021
  1. **ROOT CAUSE** FOR TEMP INCR MOSTLY **CO2**
  2. **“TIPPING POINT” = 2030 @ 1.5 degree C**
  3. CONTINUED HIGH EMISSIONS = **6 degree C BY 2100**  
**“CATAclySMIC”**
  4. TRANSFORMATION **CHANGES NEEDED** TO AVOID  
CATASTROPHY
  5. CLIMATE **SCIENCE IS STRONGER** THAN EVER
  6. **RECENT CHANGES ARE UNPRECEDENTED AND ARE**  
**WORLDWIDE**
  7. EVERY FRACTION OF A DEGREE INCREASE = DANGEROUS  
AND COSTLY IMPACTS



## WHAT IF:

- THE HOCKEY STICK GRAPH COULD BE DEBUNKED?!
- THE IPCC REPORTS WERE NOT SUBJECTED TO REVIEW BY OPPOSING EXPERTS
- COMPUTER MODELS USED TO PREDICT GLOBAL WARMING INTO THE FUTURE PREDICTED FAR GREATER INCREASES THAN HAVE OCCURRED OVER THE LAST 40 YEARS
- MODELS ARE BASED ON THE USE OF UNREALISTIC PARAMETRIC VALUES OR INCOMPLETE DATA SETS
- TEMPERATURE DATA SETS FOR MODELING WERE NOT NORMALIZED

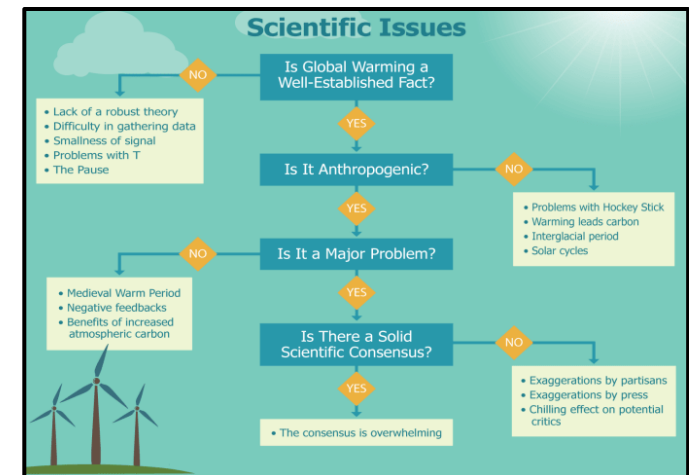




## WHAT IF:

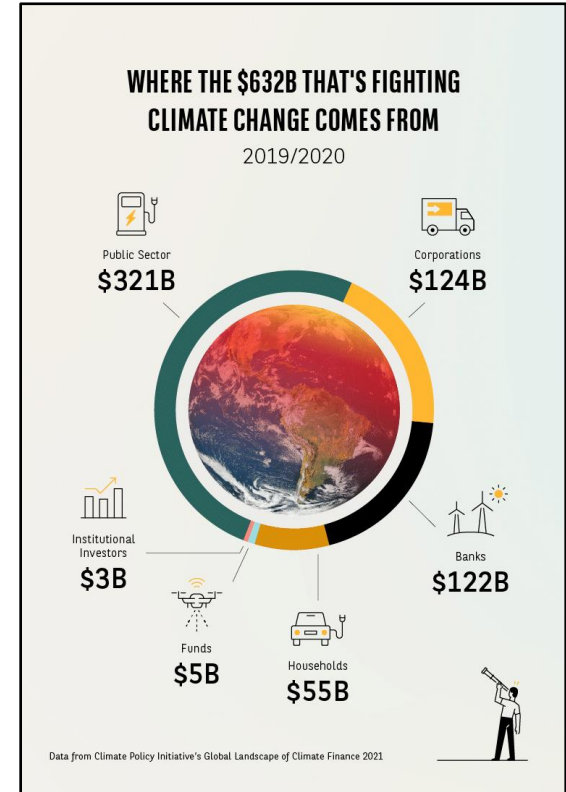
THERE ARE REPUTABLE SOURCES THAT QUESTION THE CURRENT CLIMATE MODELING CONCLUSIONS?

- **PRINCETON** PHYSICS PROFESSOR WILLIAM HAPPER
- **MIT** DISTINGUISHED SENIOR FELLOW AND METEOROLOGY PROFESSOR RICHARD LINDZEN
- **PRINCETON** PHYSICS PROFESSOR FREEMAN DYSON
- **100'S OF OTHERS WITH IMPRESSIVE CREDENTIALS**



## WHAT IF: CLIMATE CHANGE POLICY CREATES BIG BUSINESS

- \$632 BILLION IN 2020
- TO PREVENT “TIPPING POINT” - \$4 TRILLION/YEAR
- USA = \$21 TRILLION
- GERMANY = \$4 TRILLION



## CLIMATE MODELING TYPES

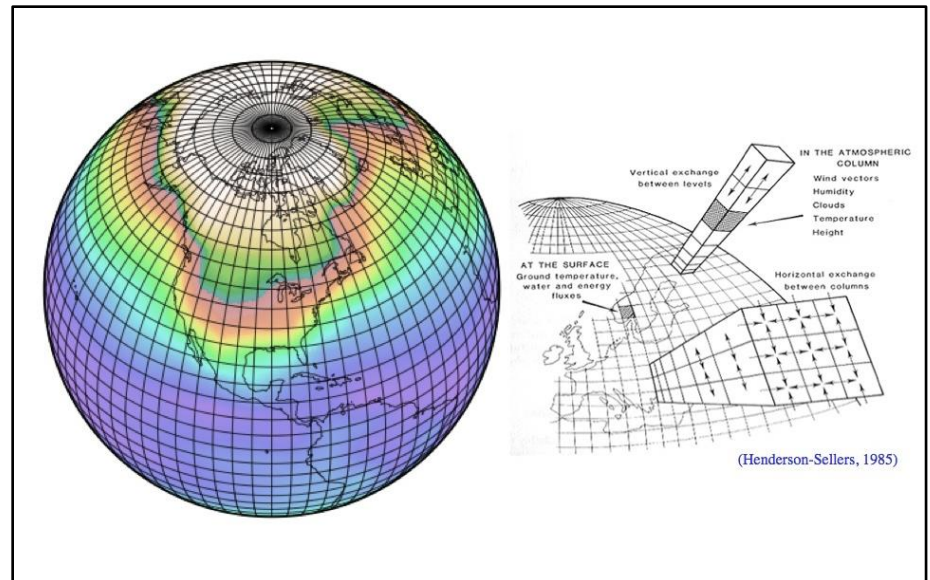
1. EARTH BALANCE MODELS
2. EARTH MODELS OF INTERMEDIATE COMPLEXITY
3. **GENERAL CIRCULATION MODELS**

### PROBABILISTIC

MODELS INFUSED WITH RECORDS OF WEATHER THAT OCCURRED UNDER **"SIMILAR PATTERNS"** IN THE PAST

### HOW ARE WE MODELING?

- MASS AND ENERGY TRANSFER
- PHYSICS, FLUID DYNAMICS AND CHEMISTRY
- 3D GRID AND TIME STEPS
- INITIAL CONDITIONS



THIS SOUND FAMILIAR !

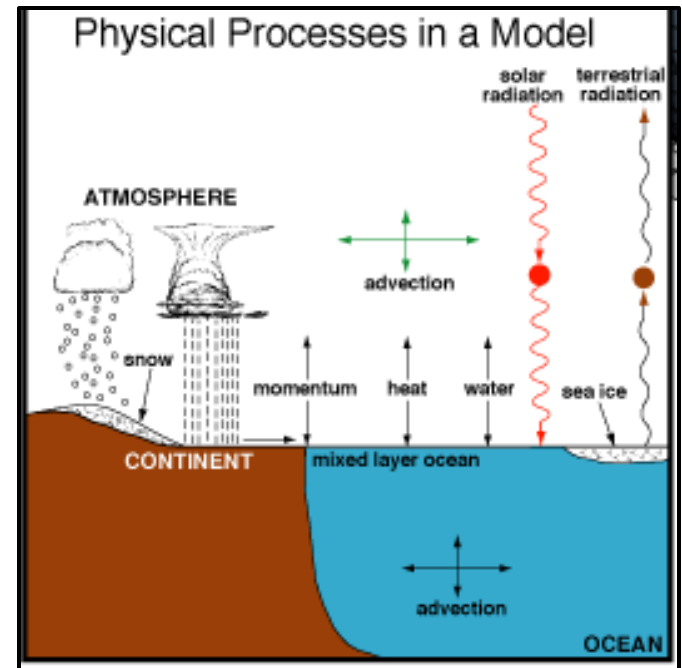
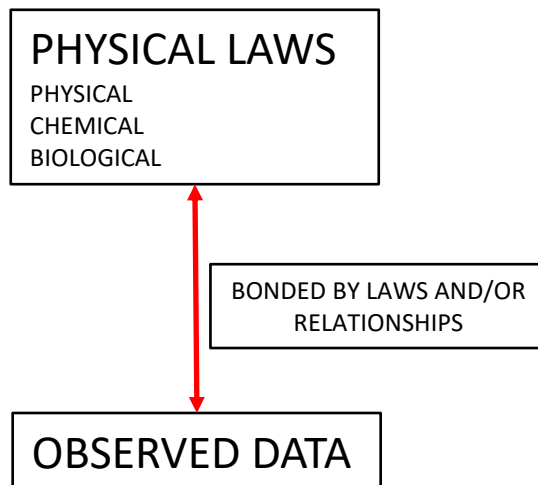
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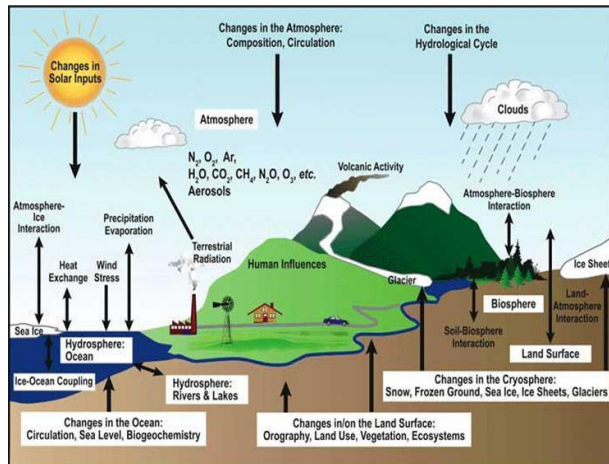
WHAT IF:  
CLIMATE CHANGE ISN'T THAT  
SERIOUS

# CLIMATE MODELS HAVE TWO MAJOR BUILDING BLOCKS

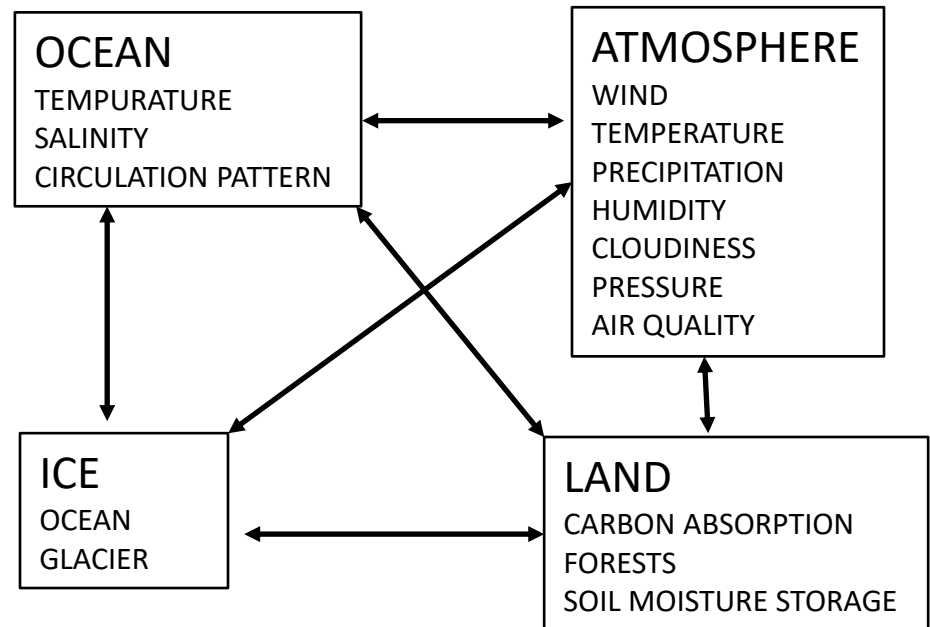


## PHYSICAL PROCESSES IN MODELING

- RADIATION FROM THE SUN
- VOLCANIC ERUPTION
- ORBITAL CHANGES
- EVAPORATION
- PHOTOSYNTHESIS



## 4 COMPONENTS OF ALL MODELS



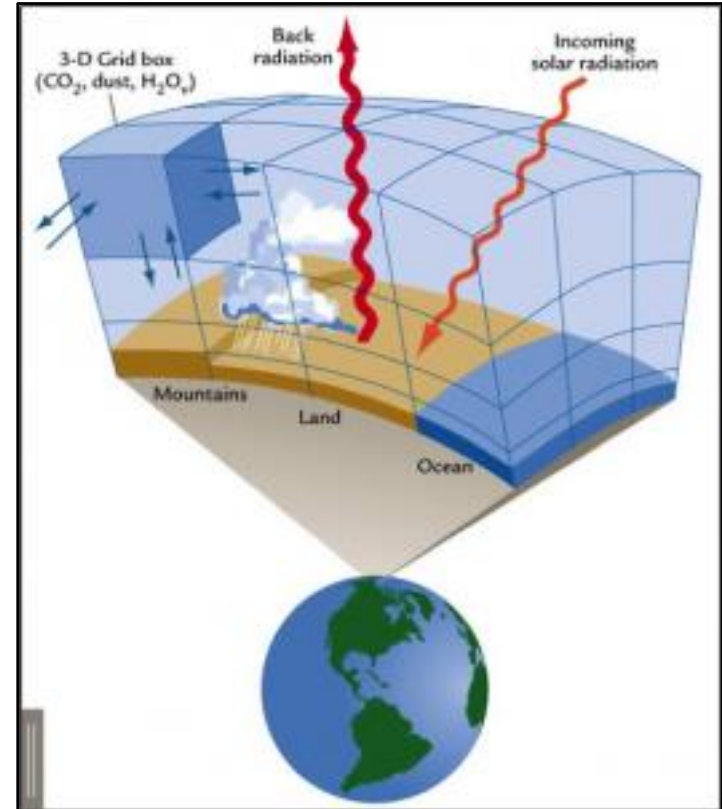


## HOW MANY MODELS?

- ~ 100 INDIVIDUAL MODELS
- 49 MODELING GROUPS
- IPCC – COUPLED MODEL INTERCOMPARISON PROJECT

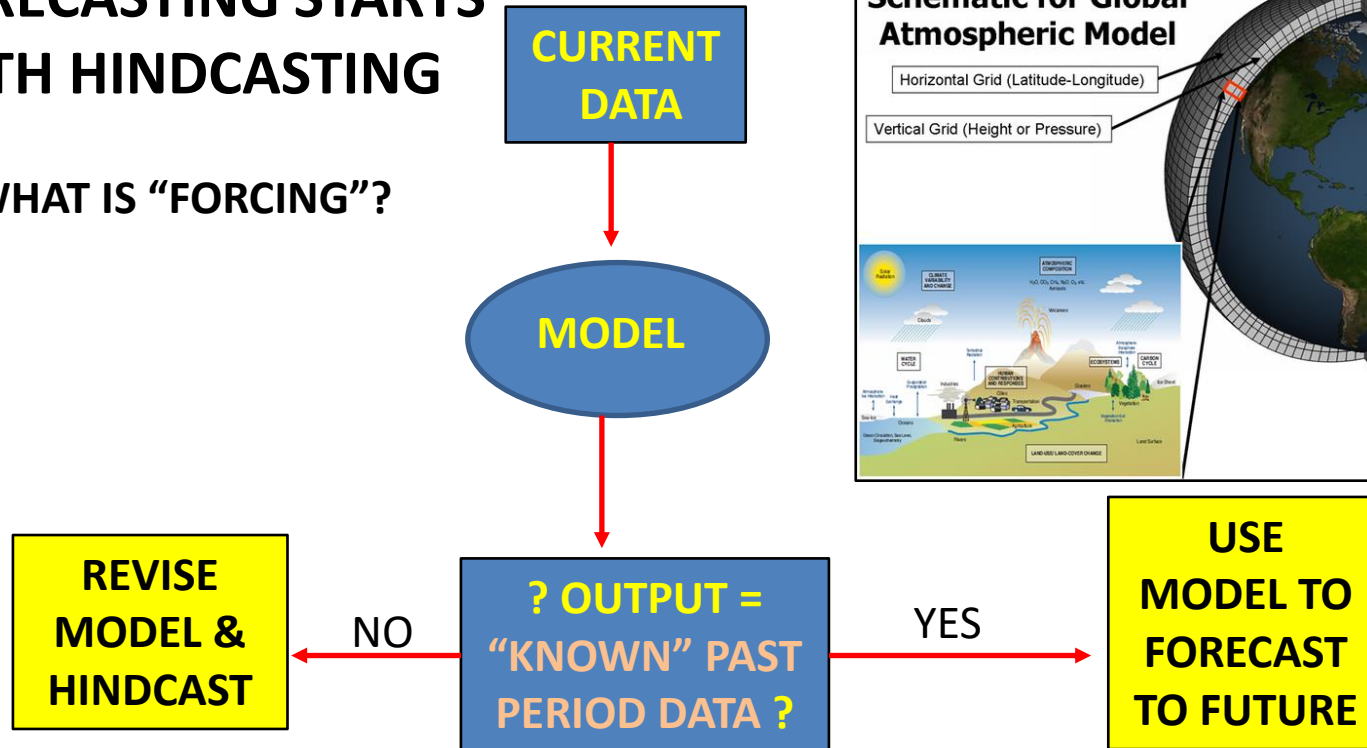
## MODELING OBSERVATIONAL DATA

- LAST 200 YEARS
- > 200 YEARS
  - ICE CORES
  - CORAL
  - TREE RINGS
  - SEA FLOOR SEDIMENT

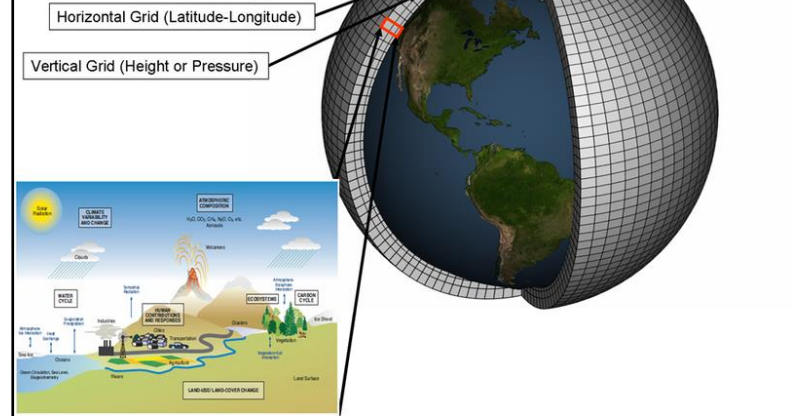


# FORECASTING STARTS WITH HINDCASTING

- WHAT IS “FORCING”?



## Schematic for Global Atmospheric Model



## **FORECASTING – DRIVING FORCES**

### **SOCIOECONOMIC WORLDWIDE CHANGES**

- **POPULATION GROWTH**
- **LAND USE – CROP YIELDS**
- **“FORCING” – RATE AND TRAJECTORY OF GREENHOUSE GASES THAT EFFECT ATMOSPHERIC CONDITIONS**



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**WHAT IF:  
CLIMATE CHANGE ISN'T THAT  
SERIOUS**

## MODELING UNCERTAINTIES & INACCURACIES

- **PARAMETRIC UNCERTAINTY**

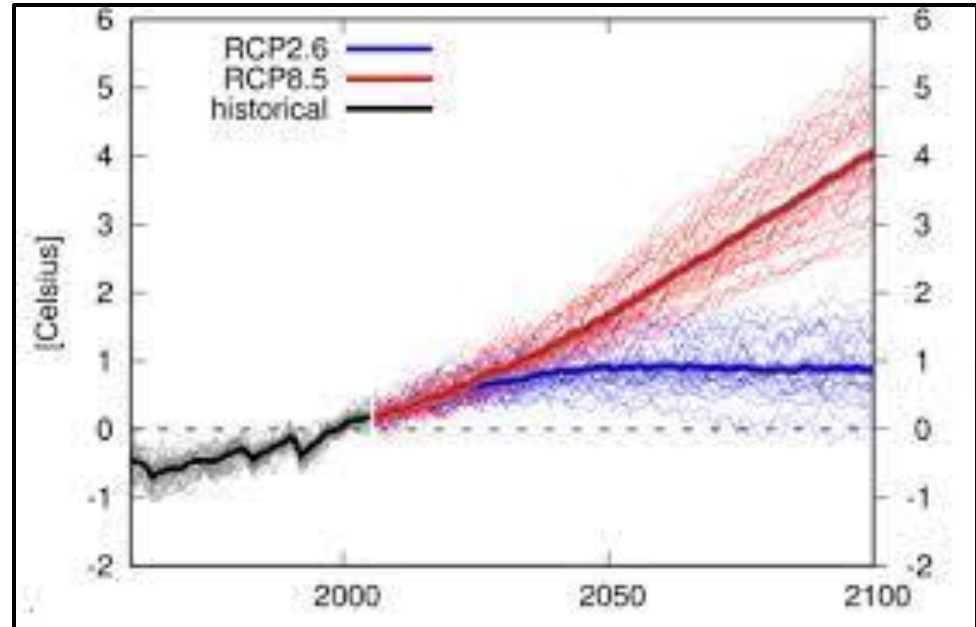
- MISSING OR BAD DATA

- (EX. ANCIENT TIMES AND/OR REMOTE AREAS)

- **STRUCTURAL UNCERTAINTY**

- RELATIONSHIP BETWEEN PARAMETERS

- (EX. HOW CLOUDS INFLUENCE AND ARE INFLUENCED BY TEMPERATURE CHANGE IS NOT COMPLETELY UNDERSTOOD)



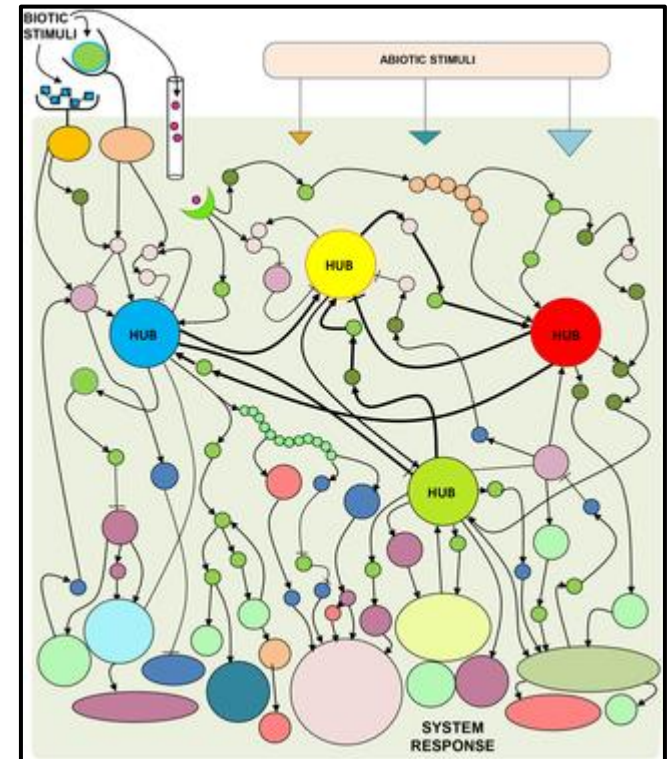
## COMPLEX OR SIMPLE ?

SO, CLIMATE MODELS ARE:

SIMPLY COMPLEX!

**WHAT IF:** MODELS WERE NOT PRESENTED  
AS SO SIMPLE?

- UNCERTAINTY IS HUGE ISSUE – MORE LATER





## CLIMATE CHANGE AND RAINFALL..... ILLINOIS STYLE!

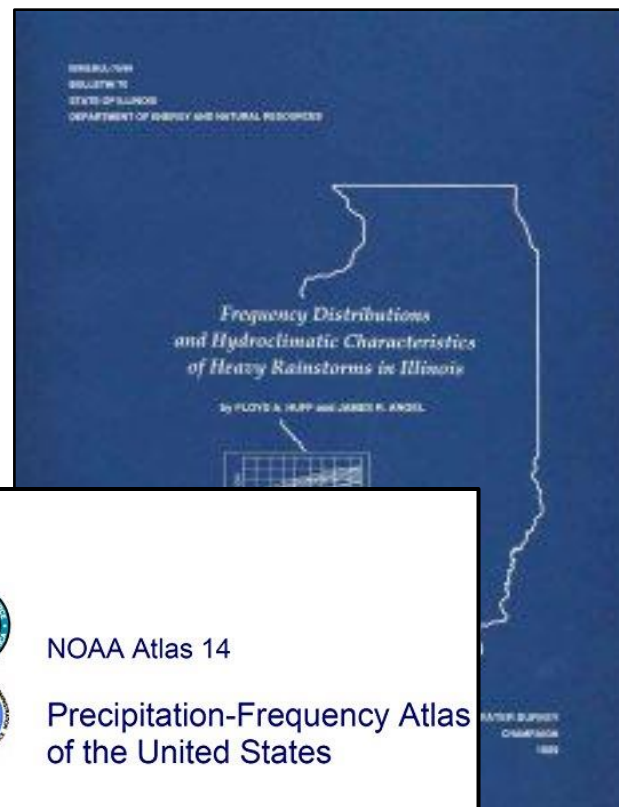
### OLD SCHOOL

#### ILLINOIS STATE WATER SURVEY

- BULLETIN 70 (1989)
- CIRCULAR 172 **DATA PERIOD 1901-1983**
- CIRCULAR 173

### NOAA

- ATLAS 14 (2006)
- PRECIP < BULLETIN 70 **DATA PERIOD 1901 – 2000**
- NOT ACCEPTED!



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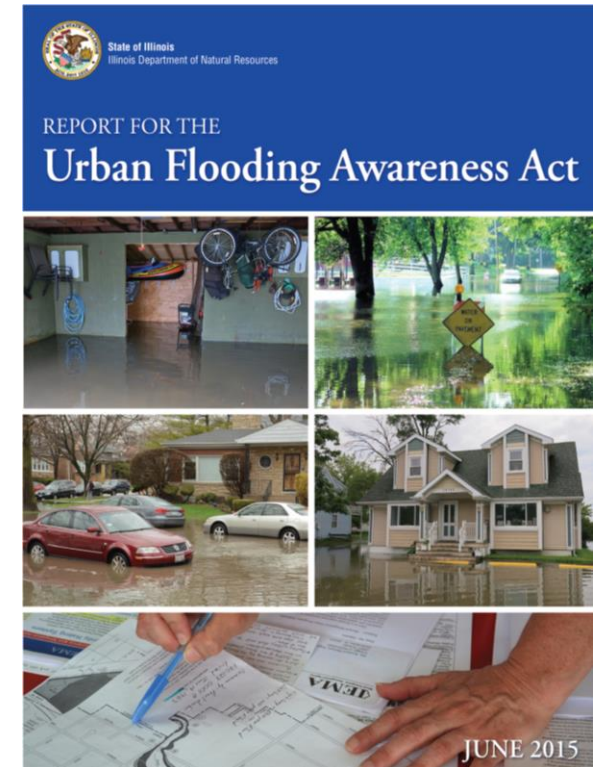
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**WHAT IF:  
CLIMATE CHANGE ISN'T THAT  
SERIOUS**

# CLIMATE CHANGE AND RAINFALL..... ILLINOIS STYLE!

## OLD SCHOOL ILLINOIS DEPARTMENT OF NATURAL RESOURCES

- URBAN FLOOD AWARENESS ACT (2015)
- DAMAGES EVALUATION **PERIOD OF DATA 2007 - 2014**
- **"SIGNIFICANT UNCERTAINTY  
IN CLIMATE PROJECTIONS"**



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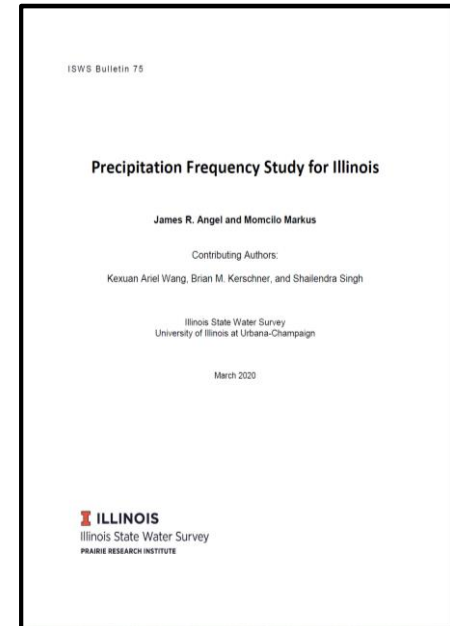
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**WHAT IF:  
CLIMATE CHANGE ISN'T THAT  
SERIOUS**

# CLIMATE CHANGE AND RAINFALL..... ILLINOIS STYLE!

## NEW GENERATION ILLINOIS STATE WATER SURVEY

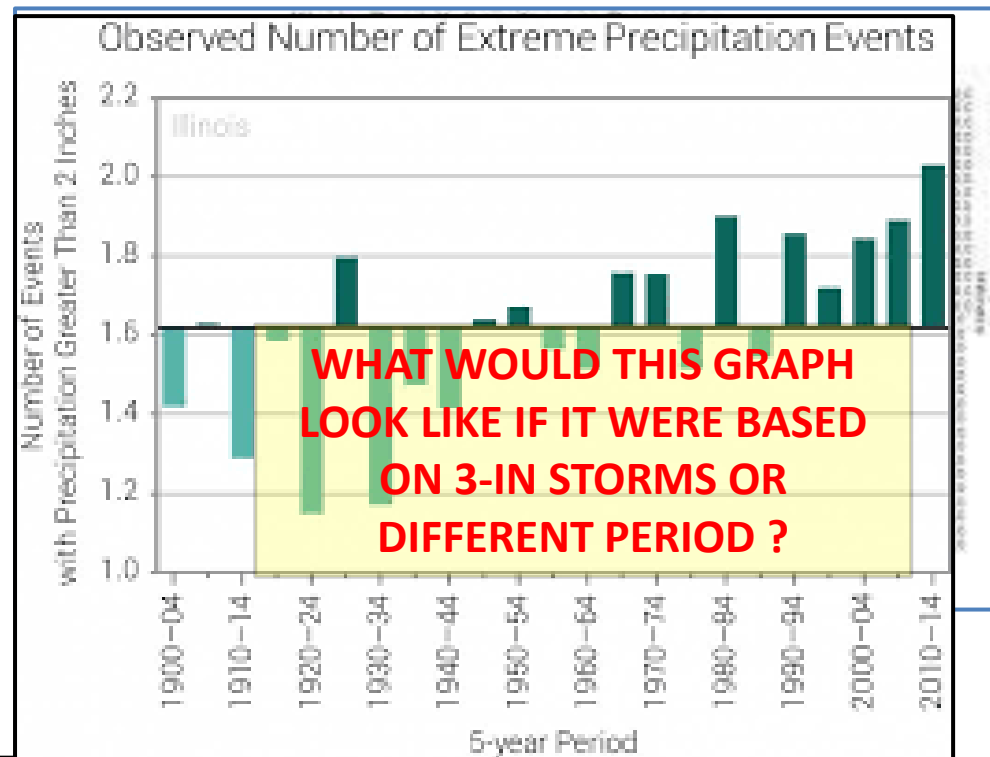
- **BULLETIN 75** **DATA PERIOD 1948 - 2017**
- **17 YEARS OF ADDITIONAL DATA**
- **“TO MINIMIZE THE POTENTIAL FOR UNDERESTIMATING THE FREQUENCY OF HEAVY PRECIPITATION EVENTS.....ONLY THE DATA FROM 1948-2017 PERIOD WERE CONSIDERED IN THE STUDY” I.E. ELIMINATION OF 40 YEARS OF DATA**
- **761 STATIONS CONSIDERED; 176 STATIONS USED**
- **NONSTATIONARITY!**



## CLIMATE CHANGE AND RAINFALL.....BULLETIN 75

### WHAT IF:

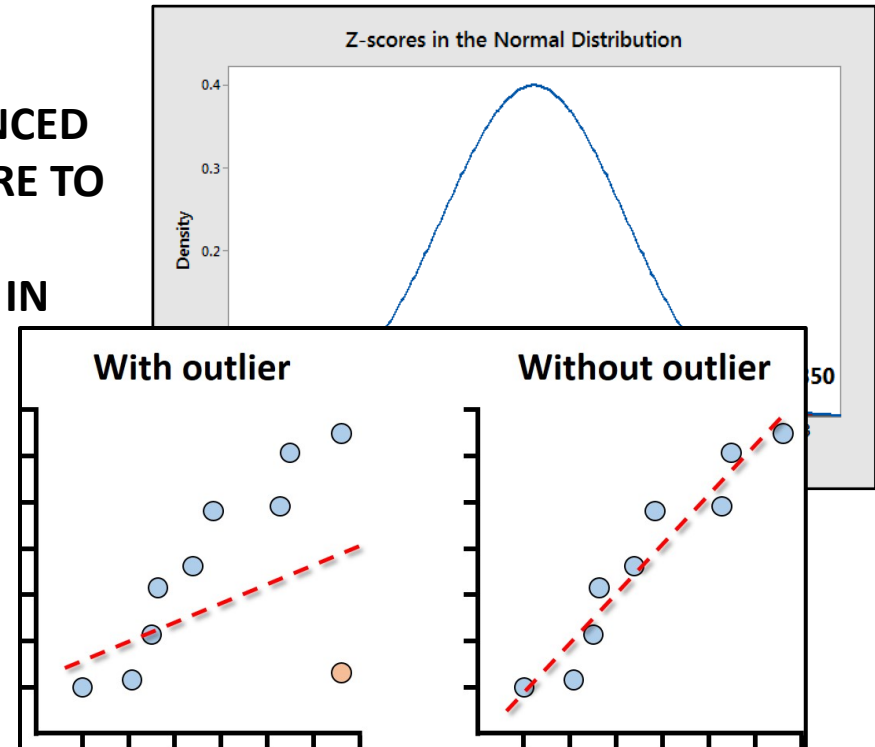
- STATEWIDE AVERAGE ANNUAL PRECIPITATION INCREASE BASED ON SAME PERIOD (1948 - 2017) AS FINAL REPORT  
(3.9% NOT 11%)
- OBSERVED NUMBER OF “EXTREME” PRECIP EVENTS - 3 INCH STORMS VS. 2 INCH STORMS



## CLIMATE CHANGE AND RAINFALL.....BULLETIN 75

### WHAT IF:

- CLIMATE CHANGE MODEL RESULTS INFLUENCED FREQUENCY ANALYSIS APPROACH (PRESSURE TO SHOW MORE RAINFALL)
- 1908 – 1948 PRECIP DATA NOT ELIMINATED IN **FINAL** ANALYSIS
- NONSTATIONARITY METHOD NOT UTILIZED
- OUTLIER TECHNIQUES WERE UTILIZED VS. NONSTATIONARITY





## CLIMATE CHANGE PREDICTIONS → INCREASED RAINFALL

### ENGINEERING IMPLICATIONS

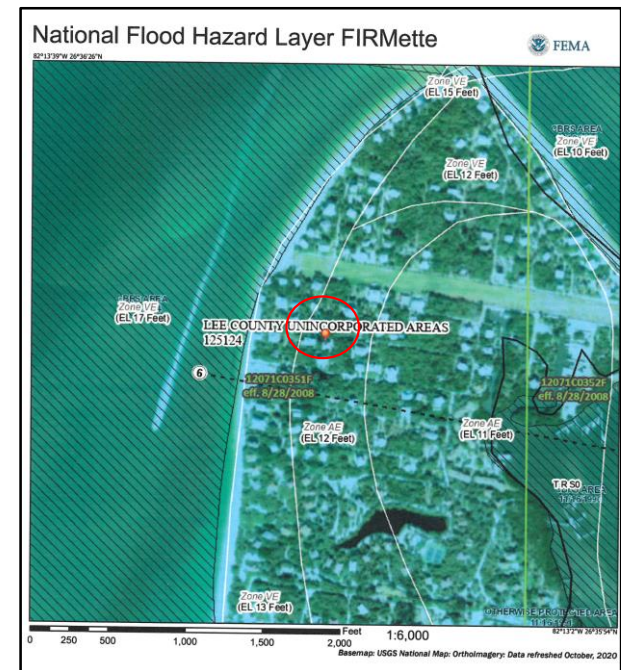
- BIGGER CULVERTS
- LARGER DETENTION BASINS (MORE PROPERTY)
- LONGER BRIDGES
- BIGGER SPILLWAYS
- HIGHER LEVEES
- LESS DEVELOPABLE AREA
- **LARGER FLOODPLAIN AND FLOODWAY DELINEATIONS**
  - **MORE AND MORE AND MORE MAP REVISIONS!**



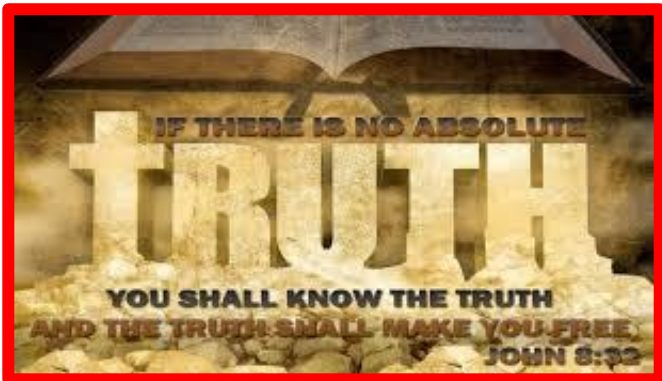
# CLIMATE CHANGE PREDICTIONS → INCREASED RAINFALL

## MAPPING IMPLICATIONS

- NEWER MAPS NEED UPDATED?
- OLDER MAPS ARE REALLY, REALLY BAD! (TP40)
- TO FINISH MAPMOD UP TO \$11 BILLION
- \$500 MILLION TO MAINTAIN
- HOW OFTEN DO MAPS NEED REVISED? FUTURE CONDITIONS
- BUDGETING
- STATE VS. FEDERAL OVERSIGHT?



# CLIMATE CHANGE PREDICTIONS ABSOLUTE TRUTH OR CERTAIN UNCERTAINTY

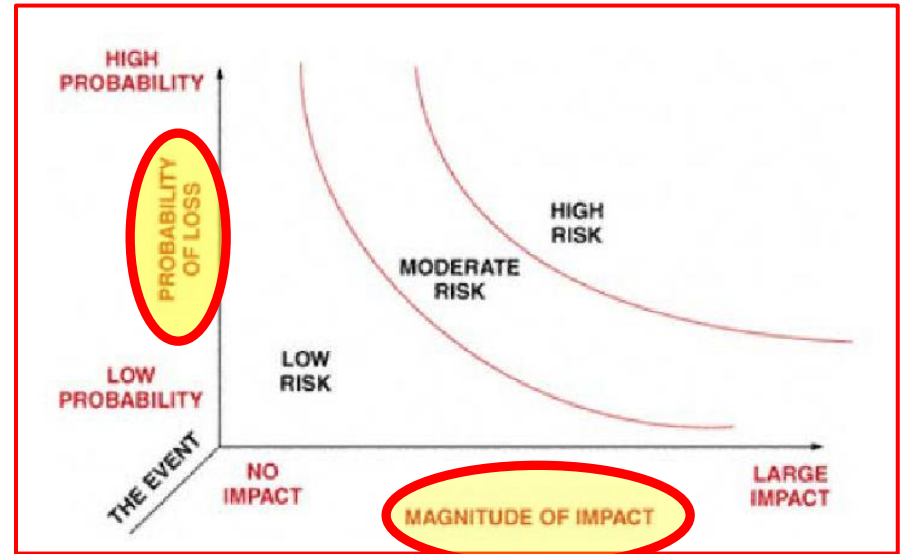


# CLIMATE CHANGE PREDICTIONS ABSOLUTE TRUTH OR CERTAIN UNCERTAINTY

## RISK INVOLVES PROBABILITY AND IMPACT

- RISK IS ALWAYS PRESENT
- **PERCEIVED RISK IS NOT ACTUAL RISK**
- RISK CAN BE MANAGED

## RISK IMPLIES UNCERTAINTY !



## **CLIMATE CHANGE PREDICTIONS ABSOLUTE TRUTH OR CERTAIN UNCERTAINTY**

**WHAT IF:  
RISKS PRESENTED TO PUBLIC OPENLY INCLUDED UNCERTAINTY**

- **CURRENT DIALOGUE IGNORES UNCERTAINTY**
  - **EX. EXTRAPOLATION OF DATA**
    - **TREE RINGS TO TEMPERATURE - REALLY, NO UNCERTAINTY**



## CLIMATE CHANGE PREDICTIONS

**IMPACTS = BIG COSTS TO FLOODPLAIN & STORMWATER PROJECTS**



## WHAT CAN WE DO?

- BIGGER BETTER BUYOUTS - LET IT RIP!
- DESIGN USING UNCERTAINTY GOING FORWARD – LOWER COSTS ?
- FACTORS OF SAFETY AND FREEBOARD - WE DO THIS ALREADY!

## WHAT IF:

**PORTION OF THE \$4 TRILLION/YEAR SPENT ON MITIGATION ?**

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**WHAT IF:  
CLIMATE CHANGE ISN'T THAT  
SERIOUS**



## WHAT IF:

- CRITICAL THINKING  
– LOST ART?
- THE “FIGURES” THEORY –  
PROFESIONAL DUTY TO  
EXPLAIN THE ENTIRE  
SITUATION
- REVIEW BY CRITICS NOT  
SUPPORTERS



**SCIENCE CAN AMUSE AND FASCINATE US ALL,  
BUT IT IS ENGINEERING THAT CHANGES THE  
WORLD**

**ISAAC ASIMOV**