



## **North American Weather & Climate Extremes Key Priorities for Assessing Uncertainties**

**What types of climate “extremes” have the greatest impacts on human society & the environment?**

***Different types of extremes:***

- Short time scale event type of phenomena (e.g., hurricanes, 100-yr flood, “exceptional heat wave”, coral bleaching event).



## What types of climate “extremes” have the greatest impacts on human society & the environment?

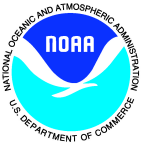
*Intermediate time scales:*

- *severe/extreme “extraordinary” drought*
- *“El Niño of the century”*
- Mother of all PDO's
- A climate feature that recurs or extends for a period longer than 2 years (but arbitrarily less than about 10yrs)

## What types of climate “extremes” have the greatest impacts on human society & the environment?

*Long time scales ( $> \sim 10$  yrs):*

- *Culture ending droughts -- e.g., Maya civilization, Anasazi cultures of the US Southwest*
- *Little Ice Age (demise of Greenland settlements)*
- *Dust Bowl of the 1930s*



# **North American Weather & Climate Extremes Key Priorities for Assessing Uncertainties**

## **Workshop on Assessing, Modeling, and Monitoring the Impacts of Extreme Climate Events**

Hamilton, Bermuda

October 13–14, 2005



## Topics

### *Do we have the right tools?*

- Assessing robust statistics for extreme event return periods.
- What can we say about extreme event frequency under global warming?

### *Are we measuring the right things?*

- What, if any, improvements in the climate monitoring system are needed to develop more accurate models and estimates of extreme event statistics?

### *Connecting extremes to societal impacts*

- What are the critical systems that will be most impacted by climate-driven extreme events?

- *Assessing robust statistics for extreme event return periods.*
- *What can we say about extreme event frequency under global warming?*

### ***Excerpted from David Stephenson***

- (short time scales) Extreme events arise by several different dynamical processes such as:
  - Fast growth caused by unstable positive feedback (e.g. baroclinic storms, tropical cyclones, convective precipitation, etc.)
  - Survival of an event into a new spatial region or time period (e.g. transition of a tropical cyclone into mid-latitudes)
  - Conjunction of several non-rare events (e.g., freak waves)

## *Intermediate Time Scales*

- Persistence of weather conditions leading to a climate extreme (e.g., drought).
- Clustering/recurrence of weather events (e.g. unusually stormy wet season).

## *Long Time Scales -- Multi-year to Multi-decadal*

- Most likely slow changes in the background state are involved. Recurrence statistics rely on stationary processes ==> Violation of stationarity assumption.

- *Paleoclimate records useful and provide the longer records with which to evaluate decadal extremes (e.g., N=30 ensemble of 30-yr averages)*

*Connecting climatic extremes to societal impacts*

- *What are the critical systems that will be most impacted by climate-driven extreme events?*
  - ✓ Heat waves and morbidity. Large forest fires.
  - ✓ Tropical cyclones: loss of life versus loss of property. River and coastal flooding. Wind storms at sea and extreme wave heights
  - ✓ Severe convective storms (tornadoes, hail storms)





## Temperature and Precipitation Extremes

Observed changes in the distribution of daily maximum and minimum temperatures *David Easterling*

Extensive summer hot and cold spells under current and possible future climatic conditions: North America and Europe *Sasha Gershunov*

Climatic extremes and their impacts: Examples from the European Alps  
*Martin Beniston*

Beyond mean climate change: What climate models tell us about future climate extremes *Claudia Tebaldi*





## Extreme Events--Weather Systems

Simulations of tropical cyclone activity using global and regional models at GFDL *Tom Knutson*

Statistical model of extreme U.S. hurricane winds *Jim Elsner*

Hurricane risk: Present and future *Kerry Emanuel*

A 21<sup>st</sup> Century extreme wave climate scenario for the North Pacific: Calibration and projection *Nick Graham*

Using environmental observations to estimate the distribution of severe thunderstorms *Harold Brooks*

Towards a European database on severe convective storm events: Results and implications for climatic trends in their occurrence, size or intensity *Nikolai Dotzek*





## *Measuring extremes by its effects*

The impact of weather and climate extremes on coral growth  
*James Crabbe*

Application of climate model simulations to estimating  
insurance loss costs *Chuck Watson*

Quantifying drought impacts and economic losses *Michael  
Hayes*

Climate, fire, and human extremes: The merging of shaping  
factors for 21st century land management *Tim Brown*

Disaster risk management in Caribbean small-island  
economies *Roger Pulwarty*



## *What can we say about climatic extremes under increasing greenhouse warming?*

- *European summer 2003 heat wave*
- *More intense synoptic events?*
- *More intense multi-year droughts/flooding?*
- *Decadal variability or climate change?*  
*(hockey sticks and other games...)*