Megadroughts in Northeastern US History – Implications for our Future?

Research Team

Peteet, D., GISS, LDEO
Kenna, T., LDEO
Sritrairat, S., LDEO
Pederson, D., LDEO
Nichols, J., GISS, LDEO
Previdi, M., LDEO
Chou, C., LDEO
Key Findings

*Droughts are rare in the NE US recent history, but sediment cores from New York marshes confirm major droughts can occur.

*Cores indicate at least three "megadroughts" have occurred in the last 6,000 years.

*The longest – detectable in cores as a thick charcoal layer, changes in pollen, foraminifera, and seed assemblages, and evidence of salt water moving up the Hudson – began around 850 C.E. and lasted about 500 years until 1350 C.E. (Medieval Warm Period, MWP).

*Shorter but possibly more intense droughts occurred 5,480 and 5,745 years ago as seen by new XRF data.

*More research needed to confirm how widespread the droughts were and why they occurred.
Cores at *sensitive* estuarine locations give signatures of marine (Ca, Cl, Br, Sr) inflow and fresh water from uplands (Ti, Rb, K, Zr) as well as hydrogen isotopes… drought means more salt water moves up estuary.

**Fresh water runoff**
- $\delta D \approx -50\%$
- salinity $\approx 0$ ppt
- Ti, Rb, K, Zr

**Marine influence**
- $\delta D \approx 0\%$
- salinity $\approx 35$ ppt
- Ca, Cl, Br, Sr

- high fresh water flux, salt front moves out to sea
- less fresh water, salt front moves upstream
Droughts are visible by *increases in marine* elements, declines in continental elements; droughts 5-6000 years ago also evident.
Pollen ➔ Vegetation ➔ Climate

**Dry, warm climate**
- pine
- charcoal
- hickory

**Cool, wetter climate**
- hemlock
- oak
- beech
Piermont North Pollen Percentage Data

Increase of pine, hickory, charcoal

Settlement 1700 AD

Pederson et al., 2005
Iona Marsh - grass, cattails (human impact increases), and charcoal in the top meter of 9-meter core
NYC Water supply sensitivity-Catskills 90% water supply

- 10 million people
- Storage capacity 1 year
  - 1961: 100% capacity
  - 1963: only 26% capacity
Conclusions and Future Research

* Hudson marshes reveal at least 3 significant droughts in past 6000 years

* Establish drought frequency & duration over past 15,000 years in Hudson Valley & Northeastern US
  - Use XRF to fill in gaps in Piermont, Iona cores - watershed
  - Use hydrogen & oxygen isotopes to further identify droughts
  - Expand to other marshes, estuaries in northeastern US
  - Link droughts to upland sediment cores from lakes

* Using climate models (statistical & GCM’s), determine drought mechanisms

* Improve drought prediction – severity, timing, extent
Past evidence of Megadroughts longer than the 1960’s drought indicates NY region needs preparation: water supplies, agriculture, erosion, social order.