

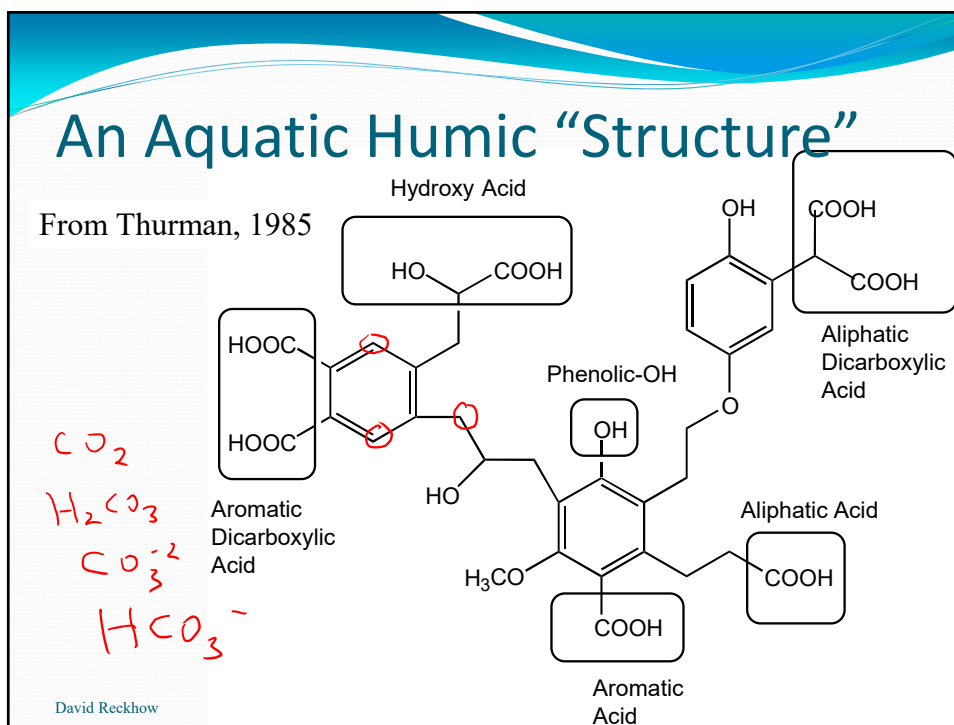
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# CEE 680: Water Chemistry

Lecture #18  
Dissolved Carbon Dioxide: Introduction  
 (Stumm & Morgan, Chapt.4)

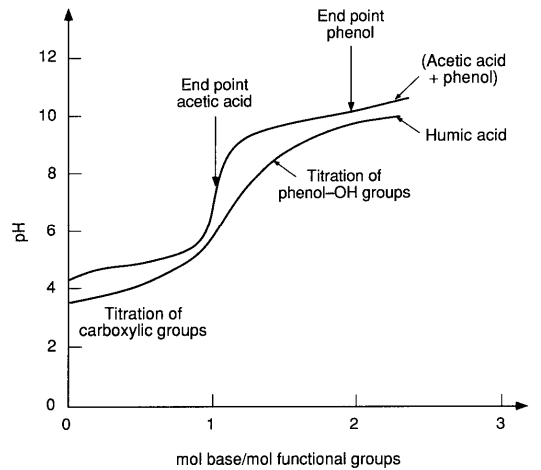
Benjamin; Chapter 5.4 & 7

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## Titration of Humics

- Model for aquatic humic substances
  - Acetic acid + phenol



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## Acid Neutralizing Capacity

- Net deficiency of protons
  - with respect to a proton reference level
    - when the reference level is  $\text{H}_2\text{CO}_3$ , the ANC=Alkalinity

$$[ANC] = \int_{f=n}^{f=x} \beta dpH$$

- conservative, not affected by T or P
- In a monoprotic system:
  - $[ANC] = [A^-] + [OH^-] - [H^+]$
  - $= C_T \alpha_1 + [OH^-] - [H^+]$

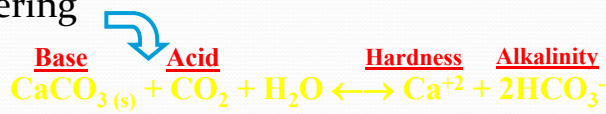
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## Dissolved Carbon Dioxide

- Importance
  - regulating pH in natural waters, also source of carbon for autotrophic organisms
- Sources
  - volcanism, combustion, respiration, weathering
- Sinks
  - photosynthesis, precipitation



## Major Forms of Carbon on Earth

Source	Mass, 10 <sup>15</sup> Kg	Percent
Geologic inorganic minerals	60,000	83%
Geologic organic minerals <sup>a</sup>	12,000	17%
Oceanic inorganics	40	0.056
Atmosphere	0.7	0.00097
All life on earth	0.6	0.00083

Ray, Table 3.3, pg. 37

## Carbon Forms: Definitions

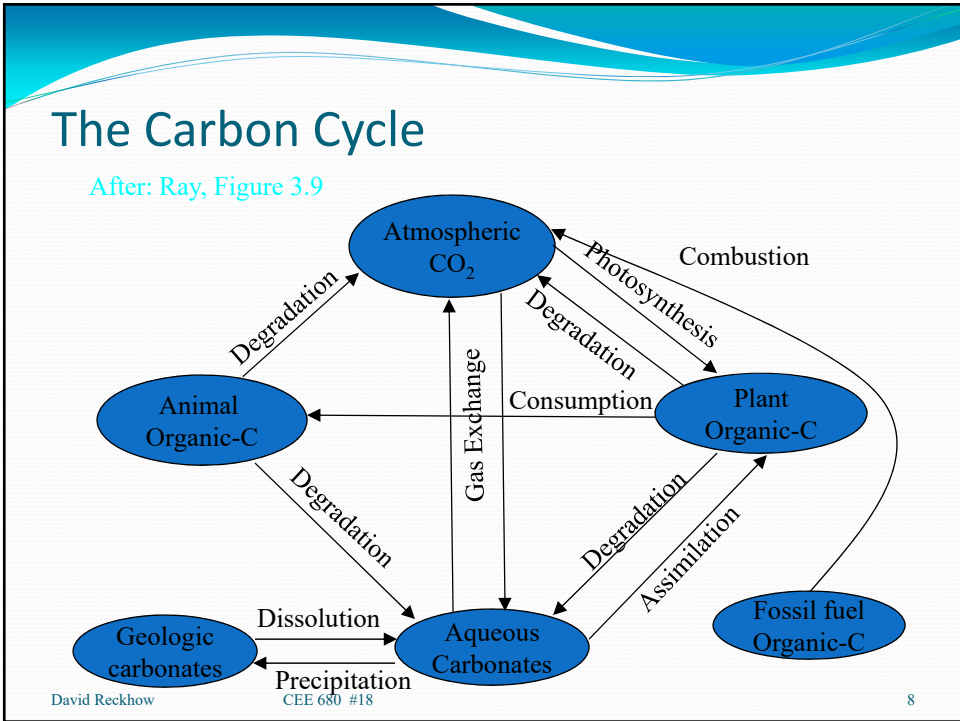
**Inorganic Carbon**

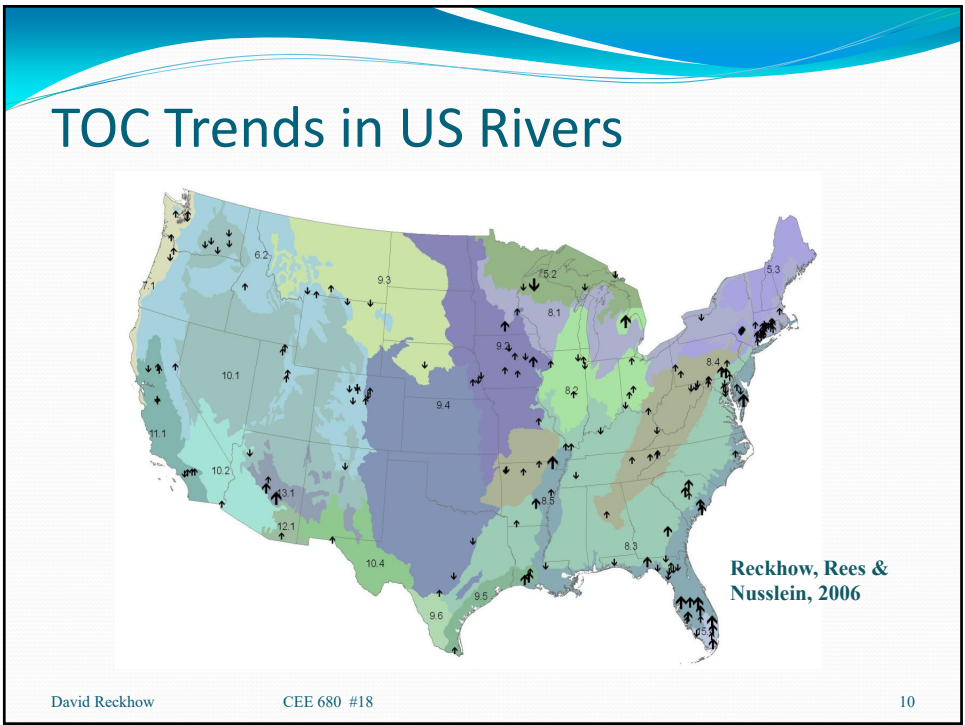
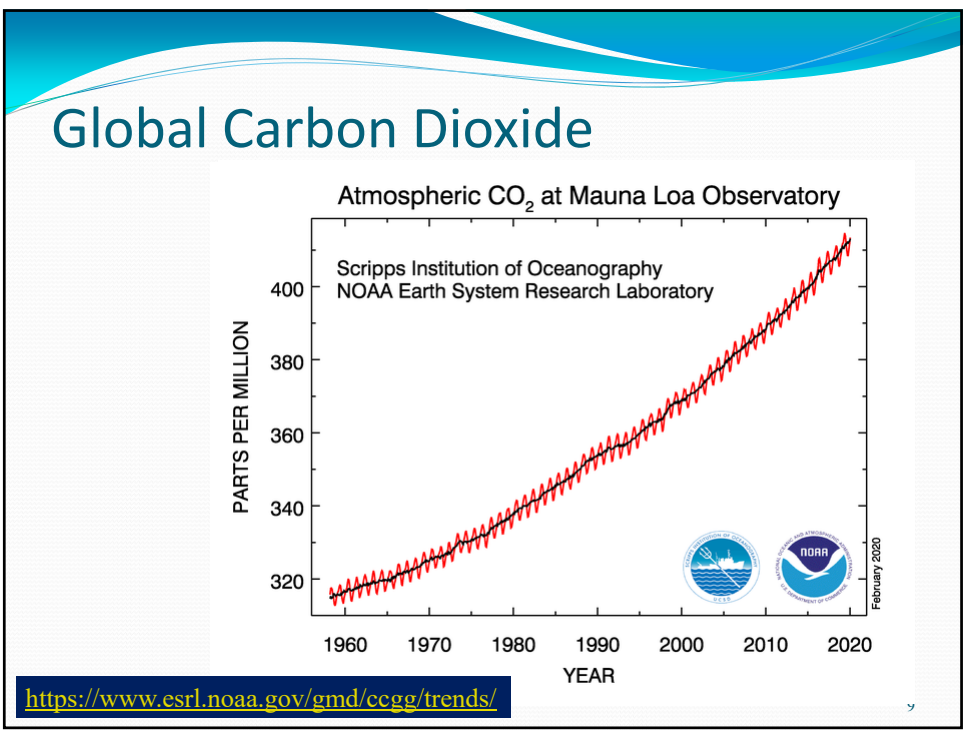
- $\text{CO}_2$  = carbon dioxide (dissolved and gas)
- $\text{H}_2\text{CO}_3$  = carbonic acid (dissolved)
- $\text{HCO}_3^-$  = bicarbonate (dissolved)
- $\text{CO}_3^{-2}$  = carbonate (dissolved)
- $\text{CaCO}_3$  = calcium carbonate (mineral)

**Organic Carbon**

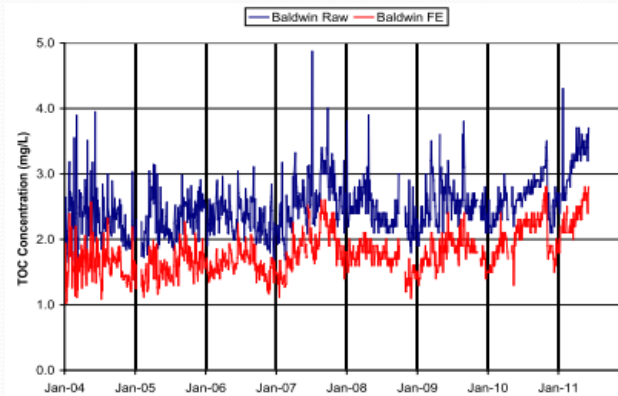
- $\text{C}_6\text{H}_{12}\text{O}_6$  = glucose (a sugar)
- $\text{CH}_3\text{COOH}$  = acetic acid (a carboxylic acid)

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## Lake Erie



Total Organic Carbon levels from 2004 to 2011 in the Western Basin of Lake Erie (Baldwin Raw) and in treated water (Baldwin FE)

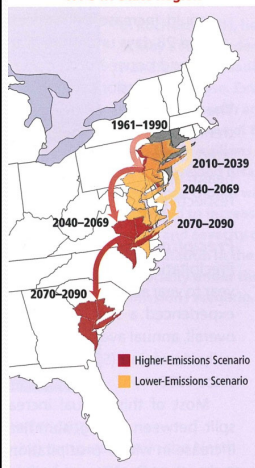
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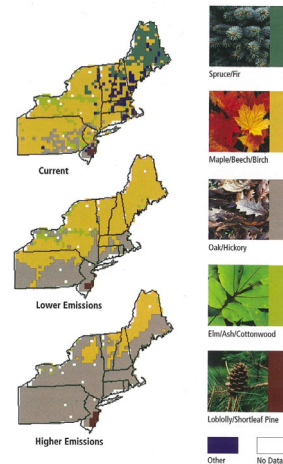
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## Tri-state Region

NYC Tri-State Region




The Northeast Climate Change Report has projected increases in temperature of 8-12°F in winter and 6-14°F in summer based on the higher emissions scenario. In general a great annual rainfall is expected, with more high flow events in winter and spring, higher intensity storms and longer annual droughts in summer. This is projected to cause a loss of spruce, fir, hemlock, maple beech and birch, and a migration to a oak/hickory forest. There may be more complete export of agriculturally-applied nutrients. The loss of hemlocks could speed up decomposition and nutrient cycling in soils, increasing nitrate runoff into streams.



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- To next lecture

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