WaterNet: Enhancing an Integrated Assessment Model (IAM)

- Enhancing Ecologic and Hydrologic Links
- Land-Use and Hydro-Ecologic Models
- Economic Adaptation to Climate Change

WaterNet Colleagues:
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Importance of Carbon-Nitrogen Interactions and Ozone on the Hydrologic Response to Climate Change

A new version of the Terrestrial Ecosystem Model (TEM-Hydro) was developed to examine the effects of carbon and nitrogen on the water cycle. To examine the effects of climate, elevated CO2, nitrogen limitation, and ozone exposure on the hydrological cycle in the eastern United States.

While the direction of future runoff changes is largely dependent upon predicted precipitation changes, the effects of elevated CO2 on ecosystem function (stomatal closure and CO2 fertilization) increase runoff by 3–7%, as compared to the effects of climate alone. Consideration of nitrogen limitation and ozone damage on photosynthesis increases runoff by a further 6–11%. Failure to consider the effects of the interactions among nitrogen, ozone, and elevated CO2 may lead to significant regional underestimates of future runoff.

Enhancing Links Between Earth and Human Systems for IAMs

EPPA-Global Land System Interactions

MIT EPPA, 16 Region, multi-sector CGE model

- GHG and other pollutants from energy and agriculture/land use
- Land use shares for crops, livestock, bioenergy, forestry

Coupled Ocean, Atmosphere

- Biogeoophysical Land Processes
  - Temperature, precipitation, solar radiation
  - CO₂, tropospheric ozone, nitrogen deposition

GTAP land data/spatial disaggregation algorithm

- Spatial data (.5° x .5°) for land use

Dynamic Terrestrial Ecosystems Model (TEM)

Crop, pasture, bioenergy, forest productivity

Gurgel et al., JP Tech.

WaterNet Team Meeting
Land Use Change for Food, Water, Energy and Hydro-Climate Consequences

Further Investigations/Actions:
- Regional/daily climate change
- Explicit crop modeling
- Irrigation (biofuel study rain-fed)
- Explicit BGC of fertilization
- Biogeophysical response/feedback
- Convey results to JP Sponsors

2050: Cellulosic Biofuel Land Area

Melillo et al. 2009 (JP Tech Report)

- 0.2 – 0.4
- 0.4 – 0.6
- 0.6 – 0.8
- 0.8 – 1.0

\[ \Delta \text{ Irrigation Deficit (\%)} \]

2030

From K. Strzepek and EACC Collaborators

\[ \begin{align*}
\text{Irrigation Deficit (\%)} &: \text{2030} \\
< -50 & : \text{Blue} \\
-50 \text{ to } -20 & : \text{Light Blue} \\
-20 \text{ to } -5 & : \text{Lighter Blue} \\
0 \text{ to } +5 & : \text{Orange} \\
+5 \text{ to } +20 & : \text{Light Orange} \\
+20 \text{ to } +50 & : \text{Red} \\
> +50 & : \text{Dark Red}
\end{align*} \]

WaterNet Team Meeting