

Ecosystem Effects Models

Doug Burns, USGS, Troy, NY

Tom Clair, Environ. Canada, NB

My Bias/Knowledge Base

- Acid precipitation – N and S
- Mercury – modeling is at earlier stage of development
- Some knowledge of N as nutrient models
- No experience with ozone or most HAPs
- No experience with CMAQ

Commonly used Models

- ILWAS – 1970s and 80s, overparameterized, not used today
- MAGIC – Jack Cosby, simple N cycle
- PnET and PnET-BGC – John Aber, Charlie Driscoll, more complex N cycle
- DAYCENT-CHEM – Jill Baron, more complex N cycle
- Mercury – WASP, SERAFM, GBMM, WARMF, others
- Nitrogen – SPARROW, process-based

Critical Loads Modeling

- Dynamic – MAGIC, pollutant load needed to reach critical value (ex – ANC = 20 ueq/L)
- Steady State – maps of area currently in excess of CLs, Eric Miller

Atmospheric Inputs

- NADP/NTN/MDN for precip. chemistry
- Precip. amount based on nearby gage
- Dry dep. from CASTNET, throughfall, others
- Dep. models have become more common in last 10 yrs. – Scott Ollinger, Jim Lynch, Kathie Weathers, Eric Miller
- Mercury estimates have high uncertainty

Generalities about Models

- Most applied to stream and small lake watersheds – focus on terrestrial processes as controls
- Most lack detailed aquatic processes
- Calibrate to stream chem. record
- Predict future stream chem under various future emissions scenarios

Key Terrestrial Processes – S and N

- Chemical weathering rate
- Soil chemistry – CEC, base saturation, sulfate adsorption
- Nitrogen – veg. uptake, soil storage, microbial cycling processes, denitrification
- Aluminum controls – gibbsite solubility
- Soil organic matter processes not well constrained – abiotic N uptake, DOC

Key Processes - Hg

- Methylation – wetlands
- Soil organic matter – processes not well known
- Demethylation and photolysis
- Gaseous exchange
- Bioaccumulation
- Immature science

Model Needs

- Terrestrial processes – aquatic effects dilemma
- Lacking models of terrestrial effects – sugar maple, red spruce
- May need aquatic processes for lakes
- Mercury models don't have high predictive accuracy – knowledge limited
- Natural disturbances – insects, ice storms, fire, climate change
- Should include Carbon