

North American Carbon Program (NACP) regional interim synthesis: Terrestrial biospheric model intercomparison

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Objective

- To evaluate the state-of-the-science in estimating the strength of the North American CO₂ sink estimated by terrestrial biosphere models (TBMs).

New Science

- Intercomparisons were done by grouping models by their photosynthetic formulation, treatment of soil carbon dynamics, and whether they considered fire disturbances and land-use change, transient CO₂ and N deposition forcing.
- TBMs predicted annual net ecosystem production (NEP) over a range from -0.7 to +1.7 PgC yr⁻¹ for prognostic models and -0.3 to +2.2 PgC yr⁻¹ for diagnostic models.
- Overall average NEP of +0.65 PgC yr⁻¹ for North America.
- Estimates of gross primary production and heterotrophic respiration for North America varied considerably 12.2 and 32.9 PgC yr⁻¹ (prognostic models) and 5.6 and 13.2 PgC yr⁻¹ (diagnostic models).

Significance

- The study revealed large variation in TBM estimates of long-term mean NEP and discrepancies in the magnitude and timing of the seasonal cycle from model structural and model driver data differences.

| | Number of models | Prognostic Models | | Number of models | Diagnostic Models | |
|---|------------------|-------------------|------|------------------|-------------------|------|
| | | (min, max) | mean | | (min, max) | mean |
| Net Ecosystem Productivity (n= 17) | | | | | | |
| North America | 9 | (-0.7,1.7) | 0.4 | 6 | (-0.3, 2.2) | 0.9 |
| Boreal NA | 10 | (-0.2, 0.7) | 0.1 | 4 | (-0.4, 0.6) | 0.1 |
| Temperate NA | 10 | (-0.5, 1.1) | 0.2 | 6 | (-0.1,1.6) | 0.7 |
| Gross Primary Productivity (n=15) | | | | | | |
| North America | 8 | (12.2, 32.9) | 20.0 | 6 | (12.2, 18.7) | 14.8 |
| Boreal NA | 9 | (2.2, 11.6) | 5.7 | 5 | (2.6, 4.4) | 3.6 |
| Temperate NA | 8 | (7.7, 21.3) | 12.3 | 6 | (8.2, 12.6) | 10.0 |
| Heterotrophic Respiration (n=13) | | | | | | |
| North America | 8 | (5.6, 13.2) | 8.2 | 2 | (7.4,8.6) | 8.2 |
| Boreal NA | 9 | (1.3,4.6) | 2.6 | 2 | (2.1,2.9) | 2.4 |
| Temperate NA | 9 | (3.4,7.5) | 4.8 | 3 | (2.4,5.6) | 4.5 |

