



**Physiological feedbacks designated on the diagram are:**

- (1) increased decomposition of soil organic matter ( $\text{CO}_2 \uparrow$ ),
- (2) vegetation productivity (NPP) response to drought stress ( $\text{CO}_2 \uparrow$ ),
- (3) methanogenesis response to increasing temperature and soil moisture ( $\text{CH}_4 \uparrow$ ),
- (4) methanogenesis response to drying ( $\text{CH}_4 \downarrow$ ),
- (5) NPP response to longer growing season ( $\text{CO}_2 \downarrow$ ),
- (6) NPP response to increased N mineralization ( $\text{CO}_2 \downarrow$ ),
- (7) NPP response to temperature increase ( $\text{CO}_2 \downarrow$ ), and
- (8) NPP response to increased atmospheric  $\text{CO}_2$  concentration ( $\text{CO}_2 \downarrow$ ).

**The structural feedbacks shown are:**

- (9) expanded distribution of tundra shrubs ( $\text{CO}_2 \downarrow$ ),
- (10) treeline advance ( $\text{CO}_2 \downarrow$ ),
- (11) forest degradation ( $\text{CO}_2 \uparrow$ ),
- (12) conversion of light to dark taiga ( $\text{CO}_2 \downarrow$ ), and
- (13) increased occurrence of fire, insects, and logging ( $\text{CO}_2 \uparrow$ ). The physical responses include
- (14) the release of inorganic carbon from permafrost thaw ( $\text{CO}_2 \uparrow$ ,  $\text{CH}_4 \uparrow$ ).

**Figure 13:** Terrestrial carbon responses and pathways to warming in the Arctic. Physical responses of snow cover and permafrost on the left are coupled with functional (physiological) and structural biotic responses on the right. Modified from McGuire et al. (2006).

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