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Modelling long-term impacts of mountain pine beetle outbreaks on merchantable biomass, ecosystem carbon, albedo, and radiative forcing

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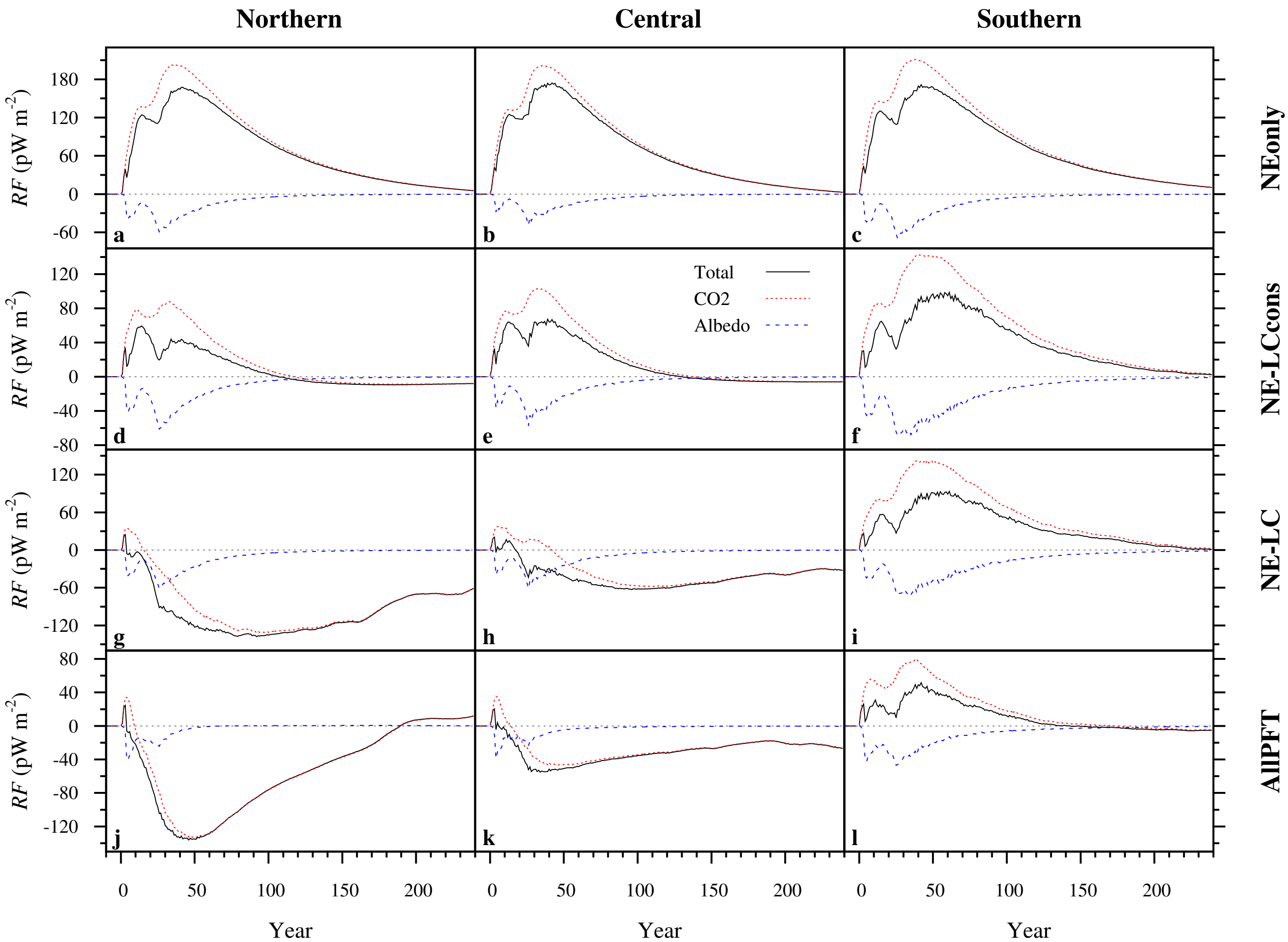

Figure S1. Transient effect of the *Peak* outbreak regime on total *RF* as well as its CO_2 and α components (all in pico-W m^{-2}, for 1-ha outbreaks) compared with the no-outbreak *Control* (the outbreak occurred on year 1). The columns correspond to the three locations (Fig. 1) and the rows to the four vegetation coexistence scenarios (Table 2); the y-axis scale differs across the four rows.

Table S1. Comparison of IBIS–MIM results for different carbon cycle variables to four empirical and one model-based studies.

Variable	This study	Previous studies
ΔC_{eco} (kg C m^{-2})		
Years 1–3	−0.16 (−0.23 to −0.12)[a]	−1.9 (−4.2 to 0.4)[1]
ΔC_{eco} (kg C m^{-2})		
Years 25–30	−0.20 (−0.58 to 0.34)[b]	−0.40[2]
ΔGPP (kg C m^{-2} yr^{-1})		
Years 1–3	−0.34 (−0.41 to −0.30)[a]	−0.04 (−0.09 to 0.01)[3]
Years 4–9	−0.24 (−0.50 to 0.01)[a]	−0.22 (−0.27 to 0.17)[3]
ΔGPP (%)		
Years 1–5	−18 (−33 to −11)[c]	−14 (−18 to −10)[4]
ΔEcosystem respiration (%)		
Years 1–5	−9 (−16 to −5)[c]	−12 (−16 to −8)[4]
ΔNEP (kg C m^{-2} yr^{-1})		
Years 1–4	−0.19 (−0.26 to −0.16)[a]; −0.23[d]	−0.13[5]
Years 5–15	−0.05 (−0.16 to 0.09)[a]; −0.15[d]	−0.23[5]
Years 16–25	−0.01 (−0.07 to 0.10)[a]; −0.07[d]	−0.13[5]
Years 26–65	0.00 (−0.04 to 0.05)[a]; −0.03[d]	−0.05[5]
Years 66–80	0.02 (−0.01 to 0.04)[a]; 0.03[d]	0.02[5]

[a]Mean value from the 12 combinations of locations and vegetation coexistence scenarios for the *Peak* outbreak regime, with the minimum and maximum values in parenthesis. [b]Same as "[a]", but for the *Medium* outbreak regime. [c]Same as "[a]", but for the *Large* outbreak regime. [d]Value from the *Peak* outbreak regime at the central location for the NEonly vegetation scenario.

[1]Morehouse et al. (2008), from their Table 3 (≥80% mortality ∼1–3 years earlier); errors were added in quadrature.

[2]Kashian et al. (2013), from their Table 4 (∼25% mortality 25–30 years earlier).

[3]Bright et al. (2013), from the >70–90% cumulative mortality of their Fig. 2 (timeseries over different stands); Year 0 corresponds to mortality of >1%.

[4]Moore et al. (2013), from their Fig. 1 (50% mortality at Year 0, 70% mortality at Year 5).

[5]Arora et al. (2016), from their Fig. S6 (estimated uncertainty of ∼0.03 kg C m^{-2} yr^{-1} for our visual retrieval of their results); ∼80% cumulative mortality over Years ∼1–10 for a NEonly-type modelling setting in a grid cell close to the central location of our study.

Table S2. Comparison of IBIS–MIM *Peak* results for $\Delta\alpha$ (unitless) to three empirical studies.

Variable	This study[a,b]	Previous studies
Mean value; Nov–Feb		
Years 4–9	0.07 (0.06 to 0.08)	0.05 (0.02 to 0.08)[1]
Years 10–14	0.09 (0.08 to 0.10)	0.07 (0.04 to 0.10)[1]
Mean value; Jun–Sep		
Years 4–9	0.009 (−0.002 to 0.013)	0.006[1]
Years 10–14	0.004 (−0.001 to 0.009)	0.006[1]
February only		
Years 1–3	0.011 (0.010 to 0.013)	0.00 (−0.04 to 0.04)[2]
Years 4–9	0.09 (0.08 to 0.10)	0.06 (−0.005 to 0.13)[2]
Mean value; Dec–Feb		
Years 1–3	0.008 (0.007 to 0.009)	−0.02[3]
Years 4–13	0.07 (0.06 to 0.08)	0.06[3]
Years 14–20	0.05 (0.04 to 0.07)	0.10[3]
Years 21–30	0.11 (0.05 to 0.14)	0.06[3]
Years 31–40	0.10 (0.03 to 0.16)	0.00[3]
Years 51–60	0.05 (0.004 to 0.11)	−0.01[3]
Mean value; Jun–Aug		
Years 1–3	0.001 (−0.001 to 0.002)	0.005[3]
Years 4–13	0.007 (−0.001 to 0.01)	0.005[3]
Years 14–20	0.003 (−0.001 to 0.006)	0.005[3]
Years 21–30	0.009 (−0.002 to 0.02)	0.005[3]
Years 31–40	0.008 (−0.002 to 0.02)	−0.005[3]
Years 51–60	0.004 (−0.001 to 0.01)	0.01[3]

[a]Mean value from the 12 combinations of locations and vegetation coexistence scenarios, with the minimum and maximum values in parenthesis. [b]Values for many months were computed as the simple mean of the monthly $\Delta\alpha$ (i.e., without weighting monhtly values with incoming solar radiation).

[1]O'Halloran et al. (2012), from the black curves and error bars of their Fig. 6 (timeseries over different stands); cumulative mortality and mortality at Year 1 not reported.

[2]Bright et al. (2013), from the >70–90% cumulative mortality of their Fig. 2 (timeseries over different stands); Year 0 corresponds to mortality of >1%.

[3]Vanderhoof et al. (2014), from the MODIS results of their Fig. 2 (stands grouped by age since mortality); cumulative mortality from <1 to 88%.

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