



Supplement of

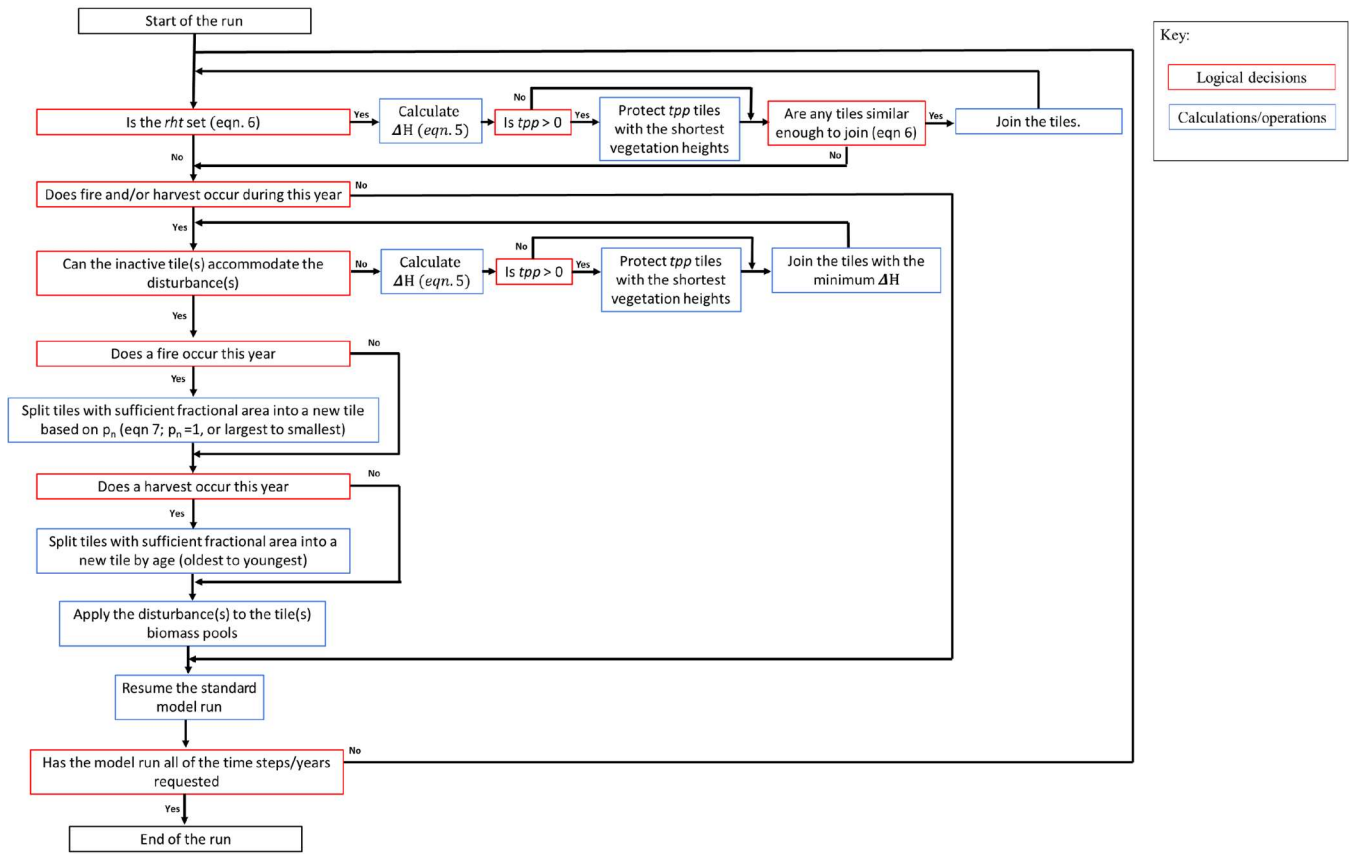
Implementing a dynamic representation of fire and harvest including subgrid-scale heterogeneity in the tile-based land surface model CLASSIC v1.45

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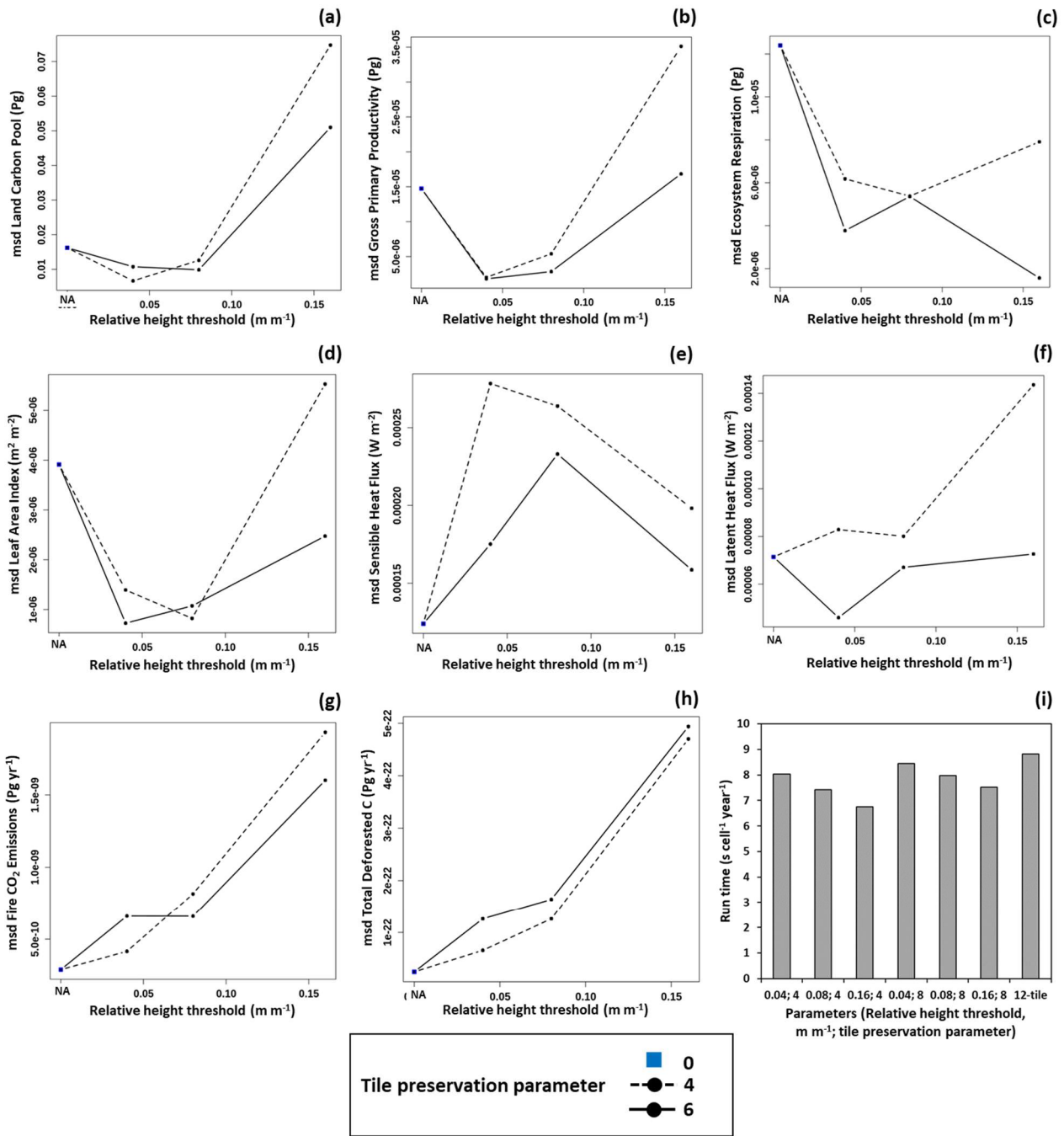
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15 **Figures**



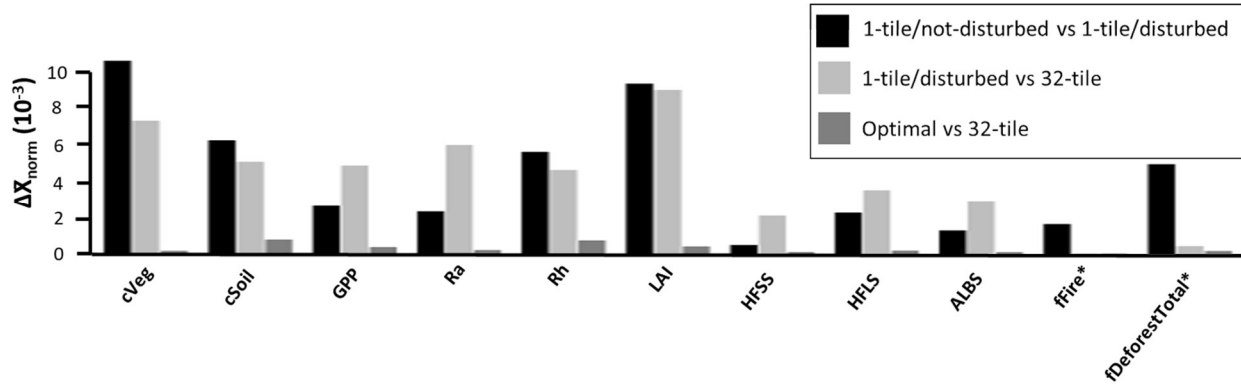
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17 **Figure S1: Logical flow chart of tile management during the model run.**



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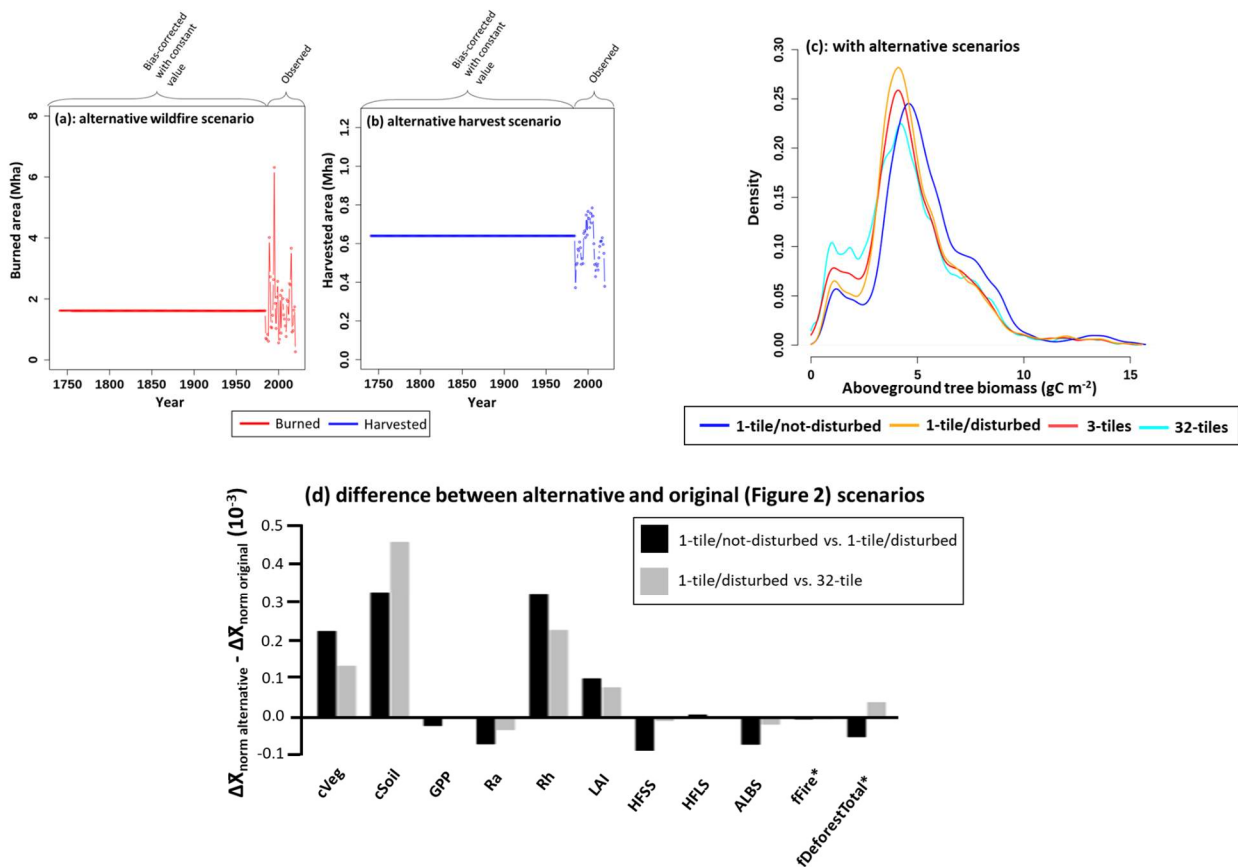
19 **Figure S2:** Plots of the total mean squared deviation (msd; 1985 – 2017; Eqn 11) for a) the land carbon pool, b) gross primary
 20 productivity (GPP), c) ecosystem respiration (ER), d) leaf area index (LAI), e) sensible heat flux (HFSS), f) latent heat flux (HFLS),
 21 g) fire emissions (fFire), and h) total deforested C (fDeforestTotal) for model runs with varying relative height thresholds (*rht*; NA,
 22 0.04 – 0.16 unitless) and tile preservation parameters (*tpp*; 0 - 6 tiles) compared against the run with the most tiles (32-tile; not
 23 shown). i) The run time for each configuration. All runs include disturbance.



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26 Figure S3: a) Plot of the normalized response metric ($\Delta\bar{X}_{norm}$; Eqn 12) for 1-tile/not-disturbed versus 1-tile/disturbed, 1-tile/disturbed
 27 versus 32-tile, and 32-tile versus optimal for vegetation carbon (cVeg), soil carbon (cSoil), gross primary productivity (GPP),
 28 autotrophic respiration (Ra), heterotrophic respiration (Rh), leaf area index (LAI), sensible heat flux (HFSS), latent heat flux
 29 (HFLS), albedo (ALBS), fire emissions (fFire) and total deforested carbon (fDeforestTotal). All runs using >1 tile include
 30 disturbance. A normalized response of zero indicates no differences between the runs. *denotes disturbance-related fluxes omitted
 31 in the 1-tile/not-disturbed model run.

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34 **Figure S4: Model runs using alternative historical harvest and fire scenarios. Plots of the alternative disturbance drivers over time.**
 35 **a) annual total burned and b) harvested area from 1740 - 2020. Observed indicates the period that uses the Landsat fire and harvest**
 36 **observations (Hermosilla et al., 2016, 2015a, b). Bias-corrected with constant values refers to the period where the inferred**
 37 **disturbance was bias-corrected using the mean of the Landsat observations. c) Weighted histogram of aboveground tree biomass**
 38 **for forested areas of Canada at the end of a selection of model runs including the 1-tile/not-disturbed run, 1-tile/disturbed,**
 39 **3-tiles, and 32-tiles. The contributions of all forested subgrid areas weighted by their fractional area within the modeled region are**
 40 **considered. d) Plot of the difference in the normalised response metric between model runs using the alternative disturbance scenario**
 41 **($\Delta\bar{X}_{norm,alternative}$) and the original disturbance scenario ($\Delta\bar{X}_{norm,original}$; Figure 2) for 1-tile/not-disturbed versus 1-tile/disturbed, 1-**
 42 **tile/disturbed versus 32-tile, for vegetation carbon (cVeg), soil carbon (cSoil), gross primary productivity (GPP), autotrophic**
 43 **respiration (Ra), heterotrophic respiration (Rh), leaf area index (LAI), sensible heat flux (HFSS), latent heat flux (HFLS), albedo**
 44 **(ALBS), fire emissions (fFire) and total deforested carbon (fDeforestTotal). All runs using >1 tile include disturbance. *denotes**
 45 **disturbance-related fluxes omitted in the 1-tile/not-disturbed model run.**