Table 1. Variables used to calculate the Γ metric. Not all variables were available for all ecosystem models. Table S2 details which variables were used for each model to calculate Γ.

Subset	Variables
Carbon fluxes	Net primary production (NPP), heterotrophic respiration (Rh), fire carbon (FC)
Stored carbon	Carbon contained in vegetation and soils (cstore)
Water fluxes	Transpiration (trans), evaporation (evap), runoff (qtot)
All	Carbon fluxes, stored carbon, water fluxes, fire frequency, soil water content (soilsat)
Vegetation structure	Composition (plant functional type, PFT)

Table 2. Variables reported by each GVM, which were then included in the calculation of Γ.

	Net Primary Product	Fire Carbon	C stocks	transpriation	Evaporation	Runoff	Soil Saturation	Dynamic Vegetation Composition
LPJmL	✓	✓	✓	✓	✓	✓	✓	✓
VISIT	✓	✓	✓	✓	✓	✓	✓	-
SDGVM	✓	✓	✓	✓	✓	✓	-	-
JULES	✓	✓	-	✓	✓	✓	✓	✓
Hybrid	✓	-	✓	✓	-	-	-	✓
ORCHIDEE	✓	-	✓	✓	✓	✓	✓	-
JeDi	✓	-	✓	✓	✓	✓	✓	-

Table 3. Combinations of GCMs, ecosystem models and RCPs used in the full model ensemble. The global mean temperature rise over the 30-year period 2070-2099 is provided for each climate run in the top row.

	HadGEM2-ES				IPSL-CM5A-LR				MIROC-ESM-CHEM			
RCP	8.5	6.0	4.5	2.6	8.5	6.0	4.5	2.6	8.5	6.0	4.5	2.6
ΔGMT_{2084} °C	4.4	2.9	2.6	1.4	4.2	2.4	2.2	1.3	4.5	2.8	2.5	1.7
LPJmL	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Hybrid	✓	✓	✓	✓	-	-	-	-	-	-	-	-
JULES	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
VISIT	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
JeDi	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
ORCHIDEE	✓	-	✓	✓	-	-	-	-	-	-	-	-
SDGVM	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Combined Γ metric

Shift from (columns) / Shift to (rows)

Shift to \ Shift from	Tropical Rainforest	Tropical Seasonal & Deciduous Forest	Temperate Broadleaved Evergreen Forest	Temperate Broadleaved Deciduous Forest	Mixed Forest	Temperate Coniferous Forest	Boreal Evergreen Forest	Boreal Deciduous Forest	Warm Woody Savanna, Woodland & Shrubland	Warm Savanna & Open Shrubland	Warm Grassland	Temperate Woody Savanna, Woodland & Shrubland	Temperate Savanna & Open Shrubland	Temperate Grassland	Arctic Tundra	Desert
Tropical Rainforest	0	0.46	0.49	0.64	0.48	0.54	0.73	0.75	0.59	0.91	0.98	0.77	0.94	0.98	0.93	0.98
Tropical Seasonal & Deciduous Forest	0.31	0	0.59	0.66	0.65	0.63	0.72	0.75	0.23	0.88	0.97	0.75	0.92	0.98	0.91	0.99
Temperate Broadleaved Evergreen Forest	0.38	0.62	0	0.14	0.05	0.11	0.48	0.65	0.49	0.78	0.93	0.6	0.85	0.95	0.88	0.96
Temperate Broadleaved Deciduous Forest	0.5	0.73	0.1	0	0.11	0.17	0.29	0.51	0.56	0.82	0.91	0.55	0.81	0.93	0.86	0.96
Mixed Forest	0.42	0.72	0.05	0.16	0	0.06	0.39	0.62	0.6	0.89	0.96	0.66	0.89	0.96	0.91	0.98
Temperate Coniferous Forest	0.5	0.72	0.11	0.26	0.06	0	0.37	0.61	0.59	0.87	0.95	0.65	0.88	0.96	0.9	0.98
Boreal Evergreen Forest	0.75	0.82	0.46	0.31	0.36	0.24	0	0.31	0.7	0.91	0.96	0.7	0.92	0.96	0.92	0.99
Boreal Deciduous Forest	0.84	0.85	0.64	0.46	0.59	0.5	0.21	0	0.8	0.93	0.89	0.62	0.8	0.92	0.73	0.95
Warm Woody Savanna, Woodland & Shrubland	0.51	0.16	0.57	0.63	0.68	0.63	0.7	0.75	0	0.55	0.85	0.61	0.79	0.87	0.82	0.99
Warm Savanna & Open Shrubland	0.73	0.62	0.68	0.72	0.78	0.72	0.74	0.83	0.26	0	0.63	0.48	0.58	0.76	0.78	0.98
Warm Grassland	0.86	0.98	0.78	0.69	0.75	0.75	0.72	0.67	0.88	0.86	0	0.7	0.55	0.17	0.58	0.68
Temperate Woody Savanna, Woodland & Shrubland	0.71	0.66	0.45	0.35	0.51	0.46	0.48	0.54	0.41	0.54	0.62	0	0.35	0.71	0.6	0.92
Temperate Savanna & Open Shrubland	0.76	0.74	0.61	0.52	0.64	0.62	0.63	0.63	0.6	0.64	0.22	0.12	0	0.48	0.54	0.85
Temperate Grassland	0.9	0.98	0.84	0.76	0.81	0.82	0.8	0.7	0.92	0.92	0.04	0.8	0.67	0	0.31	0.61
Arctic Tundra	0.91	0.97	0.81	0.71	0.78	0.73	0.66	0.45	0.91	0.86	0.63	0.66	0.57	0.57	0	0.74
Desert	0.98	1	0.98	0.97	0.97	0.97	0.97	0.96	0.99	0.98	0.44	0.95	0.87	0.41	0.8	0

Fig. 1. Table of Γ values for transitions between representative biomes. Based on results using the LPJmL model and reproduced from Ostberg et al. (2013). Note that the original state of the ecosystem is given on the upper horizontal axis, and the target ecosystem state on the left vertical axis.

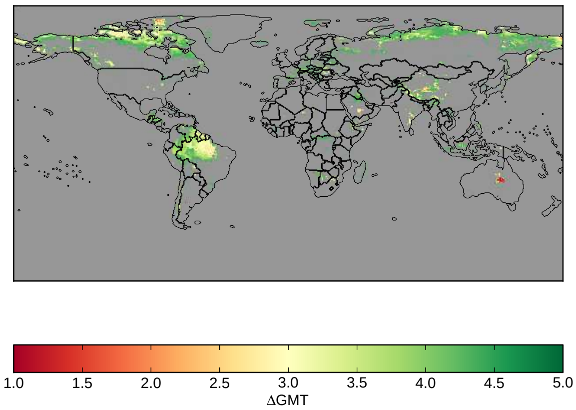

Fig. 2. Median ΔGMT at which $\Gamma = 0.3$ is first exceeded for runs with fixed atmospheric CO_2 concentration. Only HadGEM2-ES RCP 8.5 climate is used in this analysis, and only data from the LPJmL, VISIT, SDGVM and JeDi models was for these calculation. Pixels where natural vegetation covers $< 2.5\%$ of the land area are omitted from the analysis and coloured white in the maps. Pixels where less than half of the models project $\Gamma \geq 0.3$ are coloured grey. For the maximum (bottom), pixels where Γ for at least one model does not reach 0.3 are coloured grey.

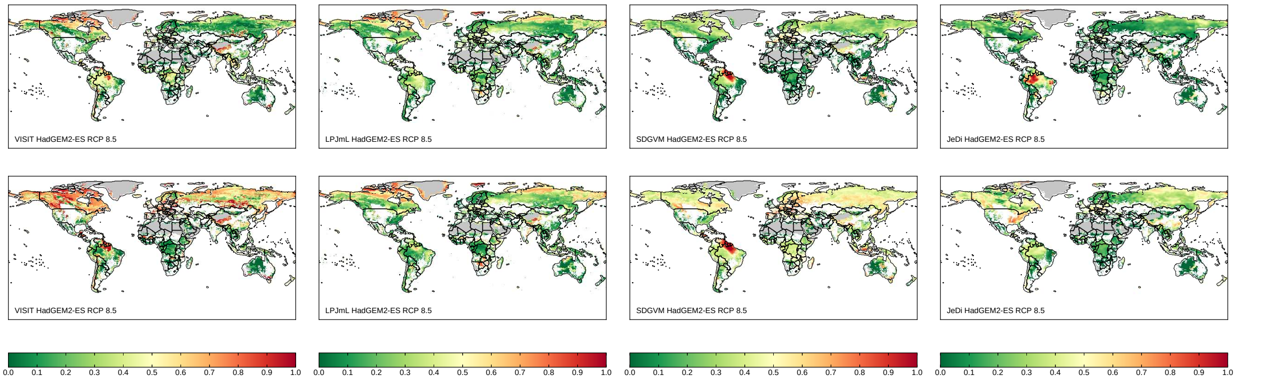

Fig. 3. Maps of Γ in 2084 for runs with fixed present-day atmospheric CO_2 concentration for the RCP 8.5 HadGEM2-ES climate data (top row). The equivalent map with time-dependent atmospheric CO_2 concentration is shown in the bottom row.

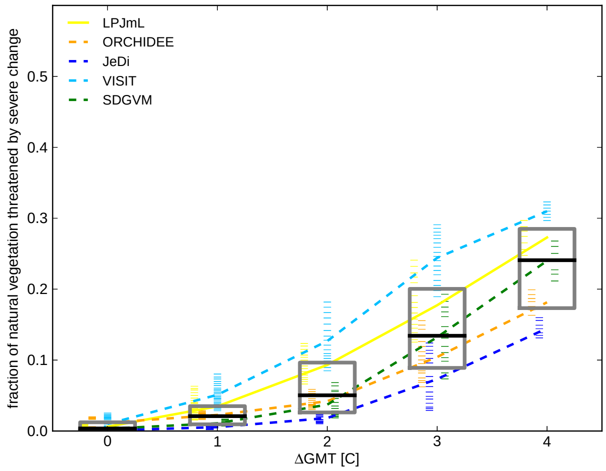

Fig. 4. Comparison of the fraction of global land surface at risk of severe ecosystem change for runs with fixed atmospheric CO_2 concentration for HadGEM2-ES RCP 8.5 climate data.

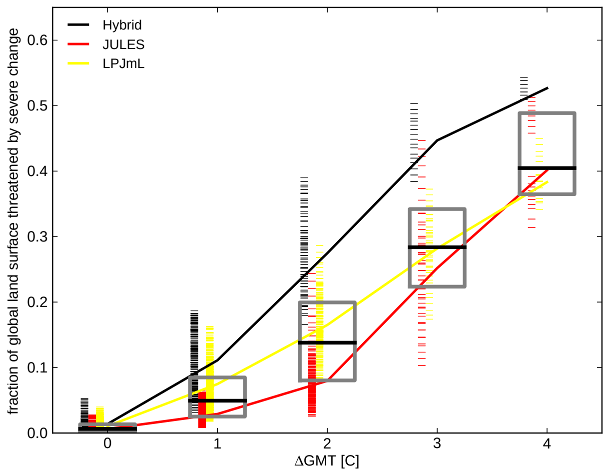

Fig. 5. Comparison of the fraction of global land surface at risk of severe ecosystem change for models with dynamic vegetation composition, but ignoring the ΔV component of the Γ metric calculation.

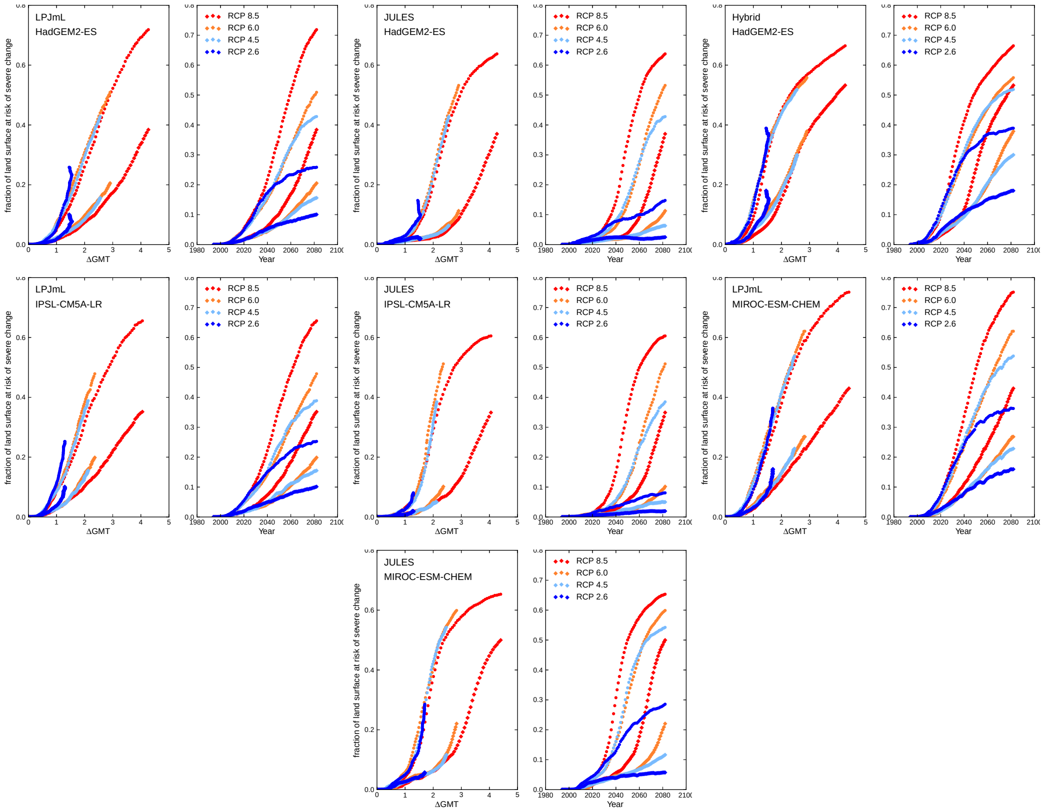

Fig. 6. The fraction of naturally vegetated land surface at risk of severe ecosystem change for models with dynamic vegetation composition, but ignoring the ΔV component of the Γ metric calculation.

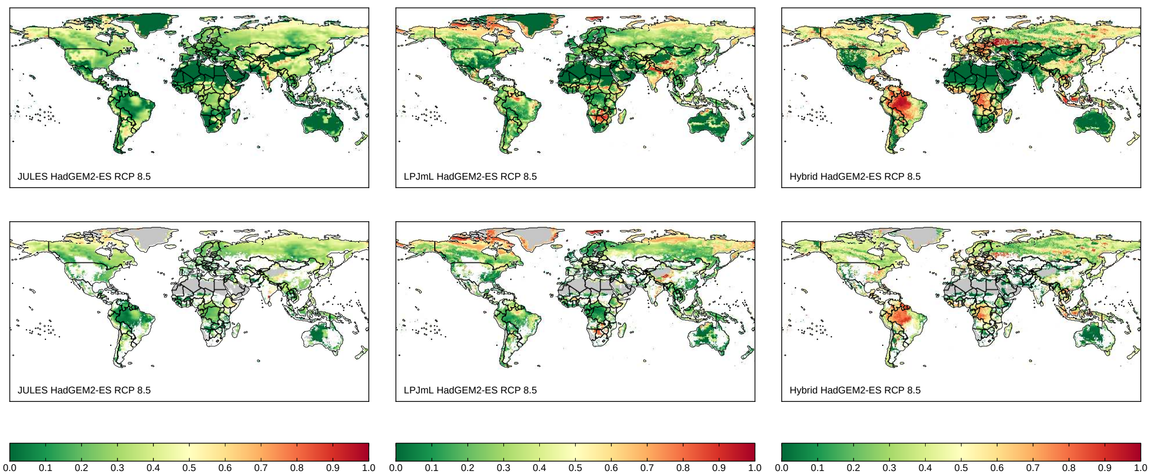

Fig. 7. Maps of Γ in 2084 calculated for models with dynamic vegetation composition, but ignoring the ΔV component (top row) of the Γ metric calculation. The equivalent maps, but with the ΔV component included in the Γ calculation are shown in the bottom row.

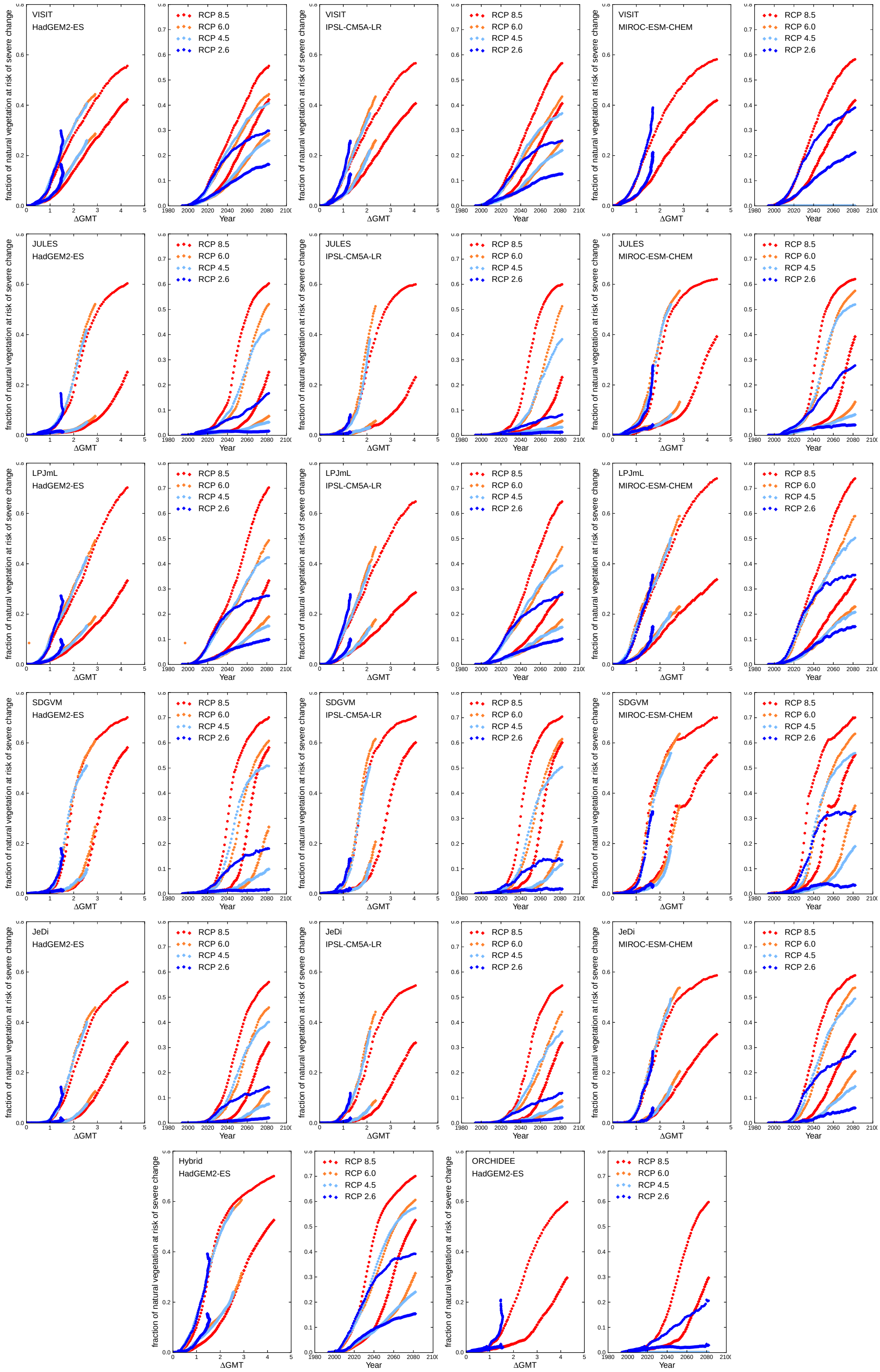

Fig. 8. Transient, globally aggregated results for all combinations of GCM, RCP and ecosystem model used in the analysis. The value shown is the fraction of global land surface subject to small and severe change (circles and diamonds respectively) plotted against ΔGMT (left panels) and time (right panels).

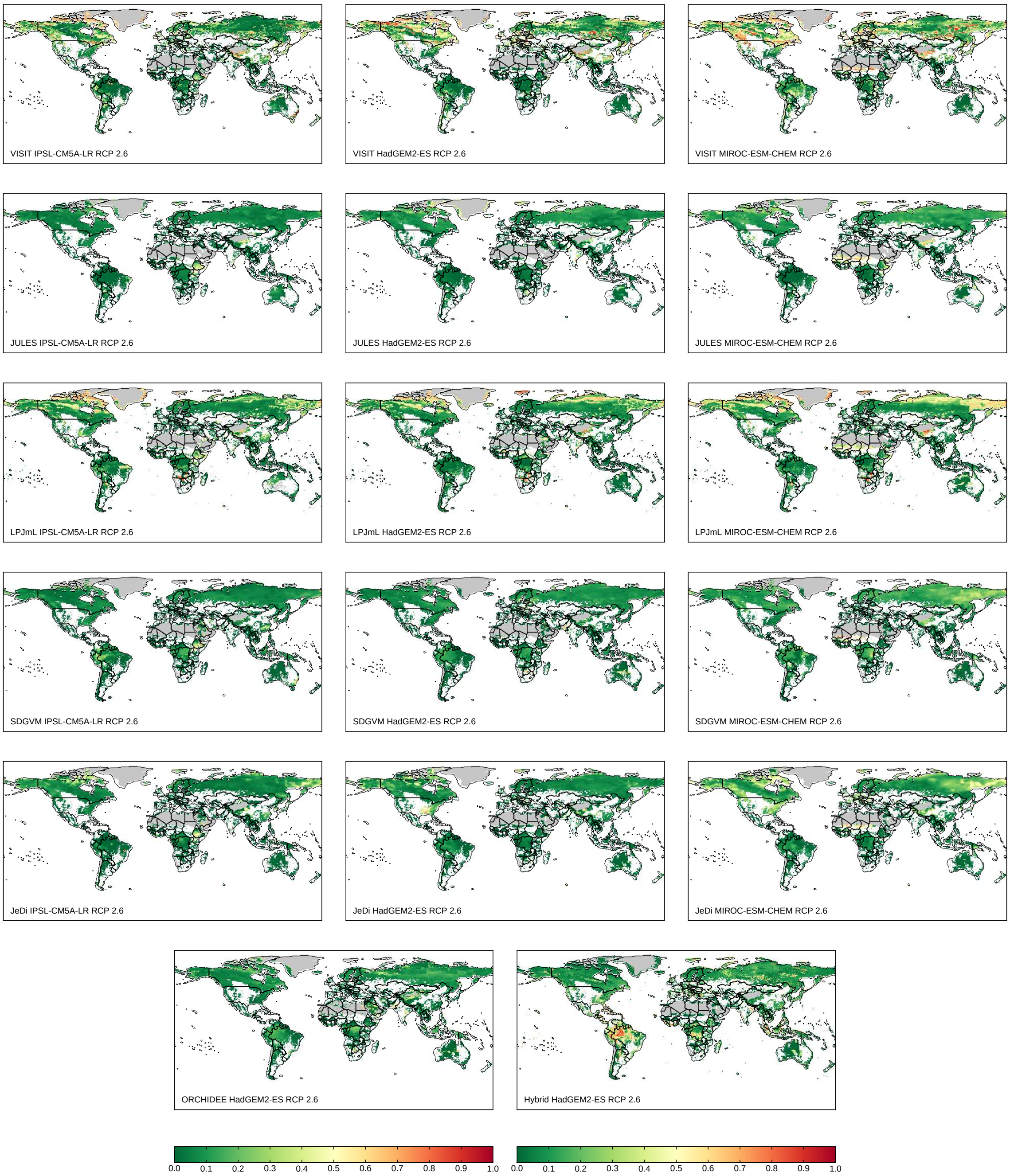

Fig. 9. Maps of Γ in 2084 for all ecosystem models and GCMs for RCP 2.6.

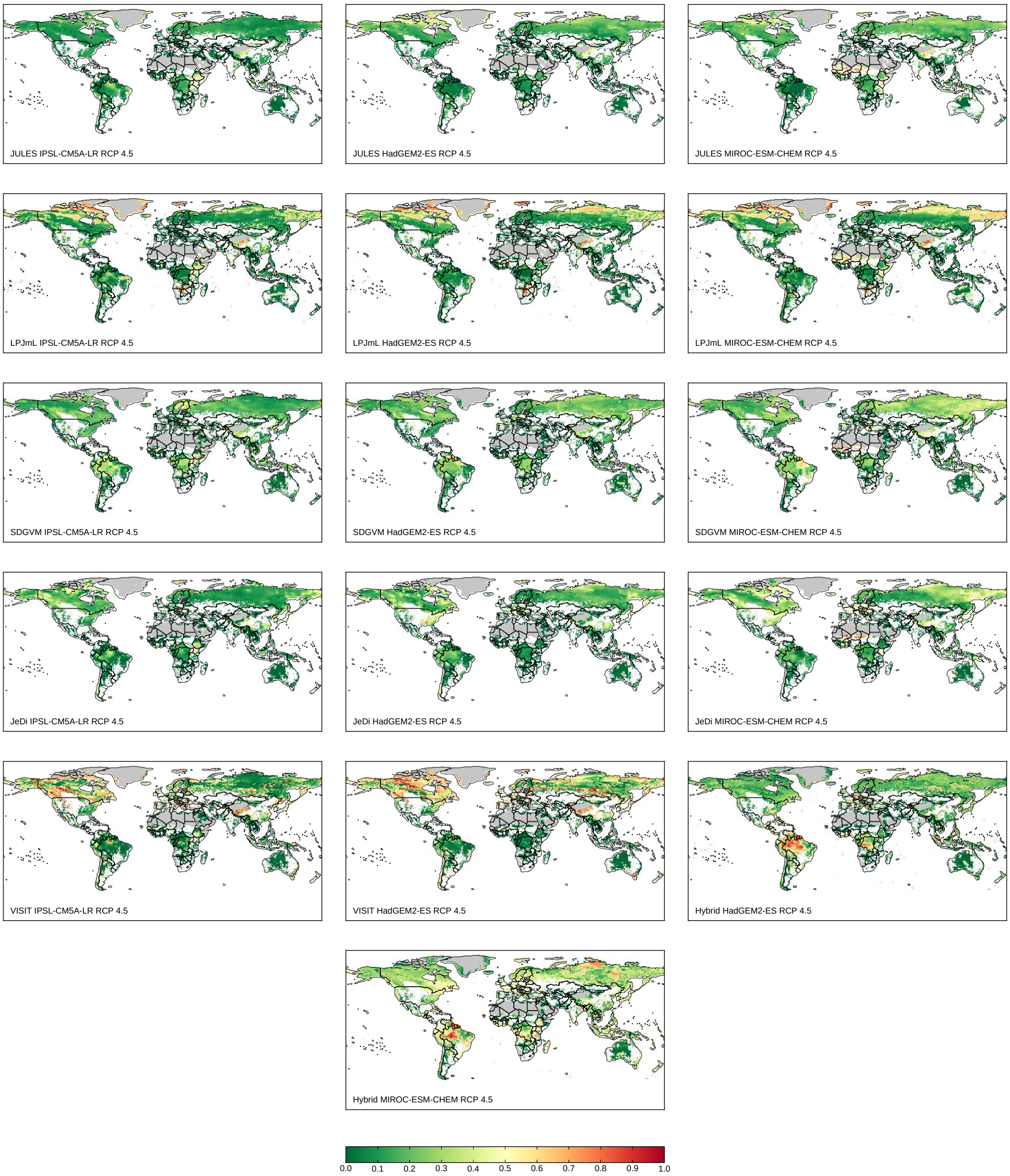

Fig. 10. Maps of Γ in 2084 for all ecosystem models and GCMs for RCP 4.5.

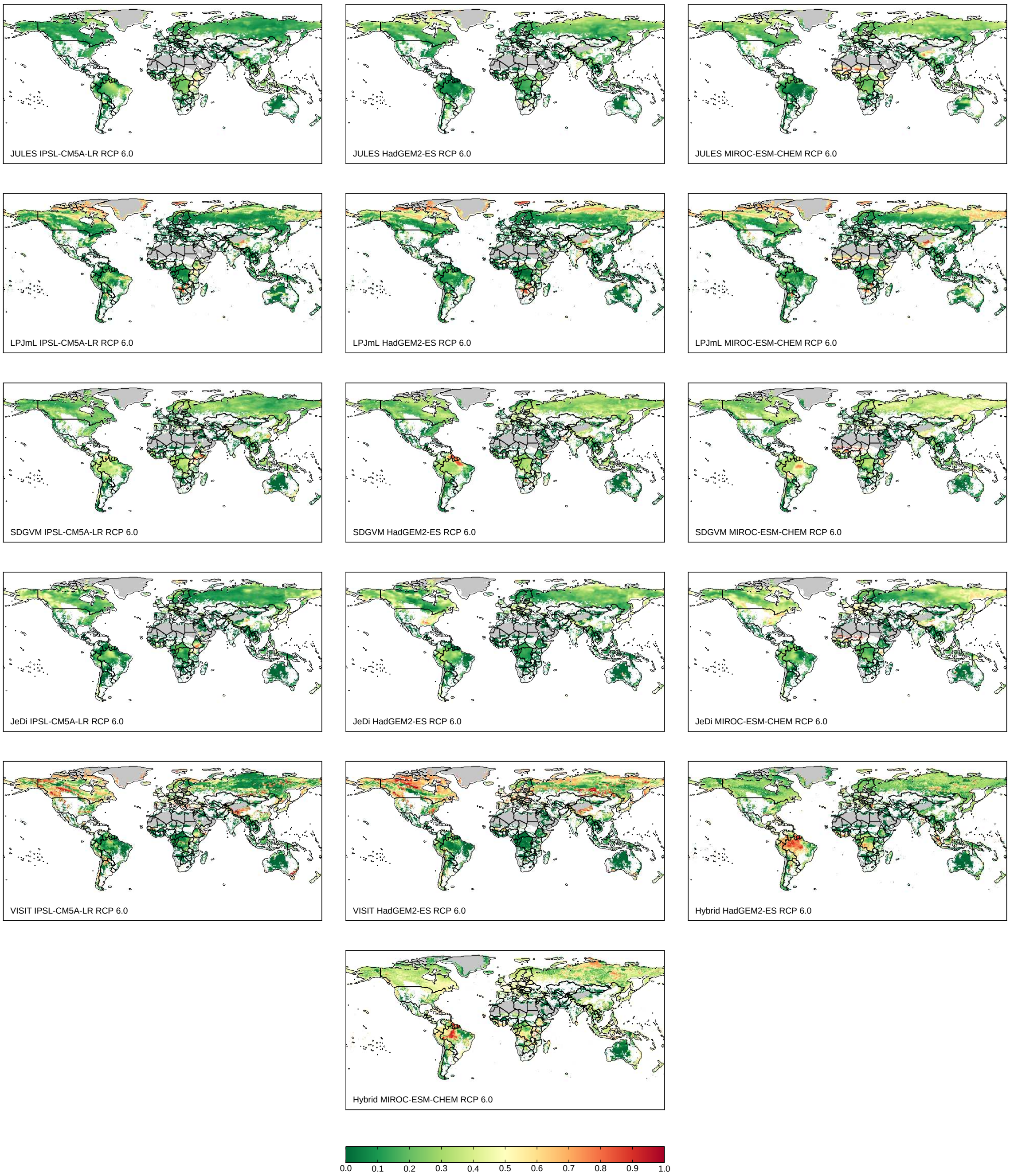

Fig. 11. Maps of Γ in 2084 for all ecosystem models and GCMs for RCP 6.0.

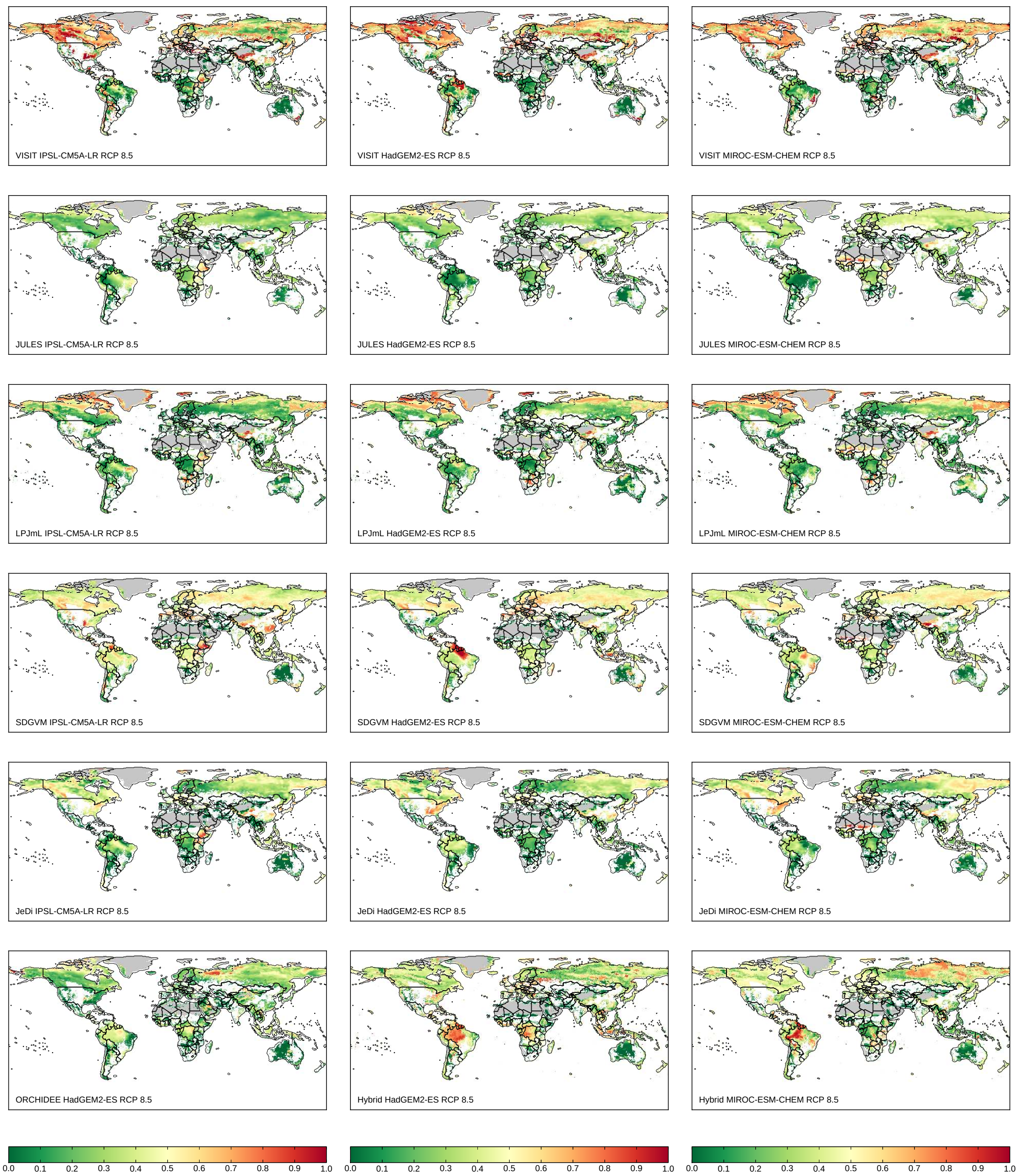

Fig. 12. Maps of Γ in 2084 for all ecosystem models and GCMs for RCP 8.5.

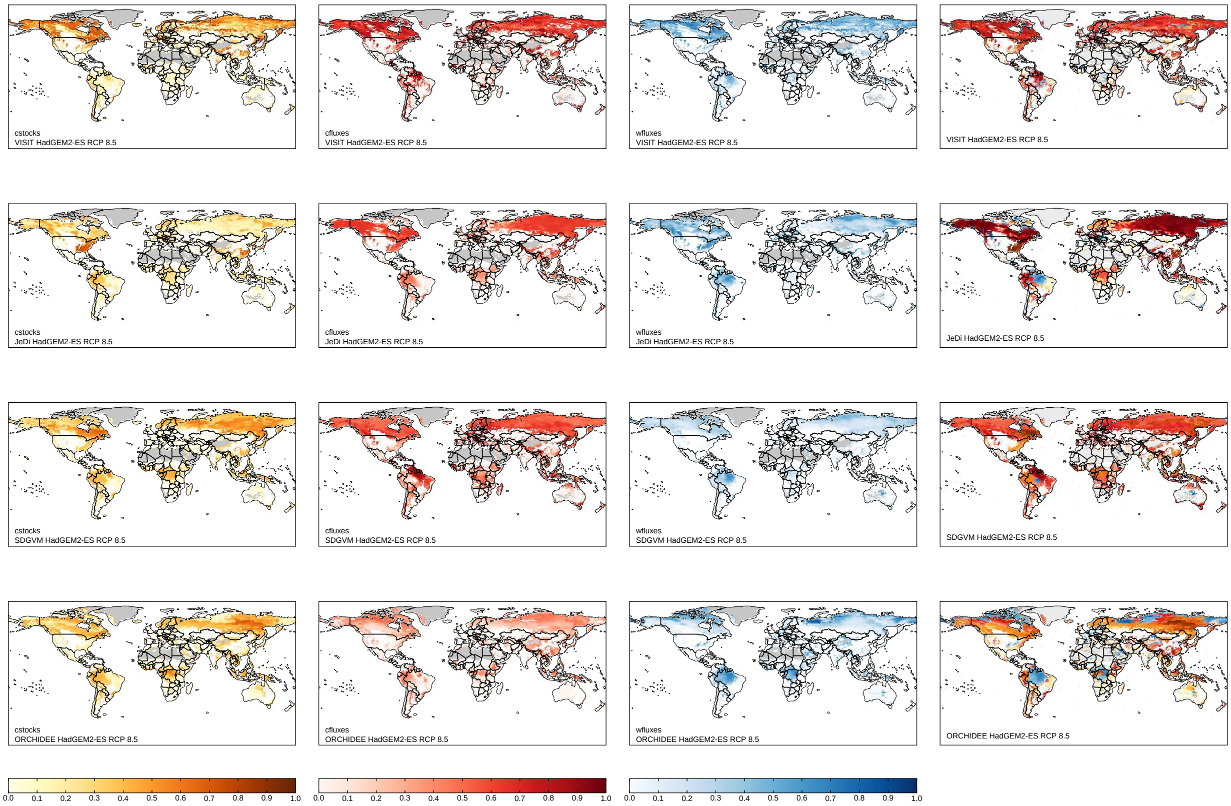

Fig. 13. Maps of the Γ components (carbon stores - browns, carbon fluxes - reds, water fluxes - blue) for ecosystem models for which dynamic vegetation composition data was not modelled or not available, for the year 2084 of the HadGEM2-ES RCP 8.5 climate data. The right-hand column plots the dominant component at each pixel.

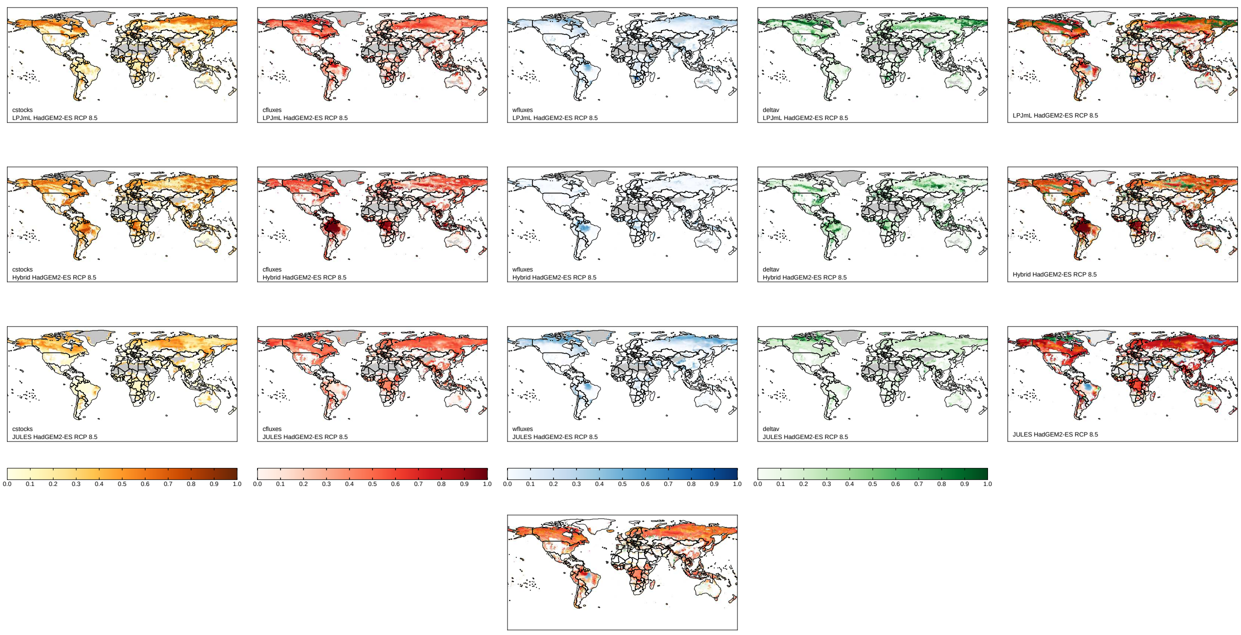

Fig. 14. Maps of the Γ components (carbon stores - browns, carbon fluxes - reds, water fluxes - blue, vegetation composition changes - green) for ecosystem models for which dynamic vegetation composition data was available, for the year 2084 of the HadGEM2-ES RCP 8.5 climate data. The right-hand column plots the dominant component at each pixel. The bottom panel shows the dominant component across the model ensemble with dynamic vegetation (calculated as the maximum of the median values across the ensemble in each component) as projected by the models for which dynamic vegetation composition data was available.

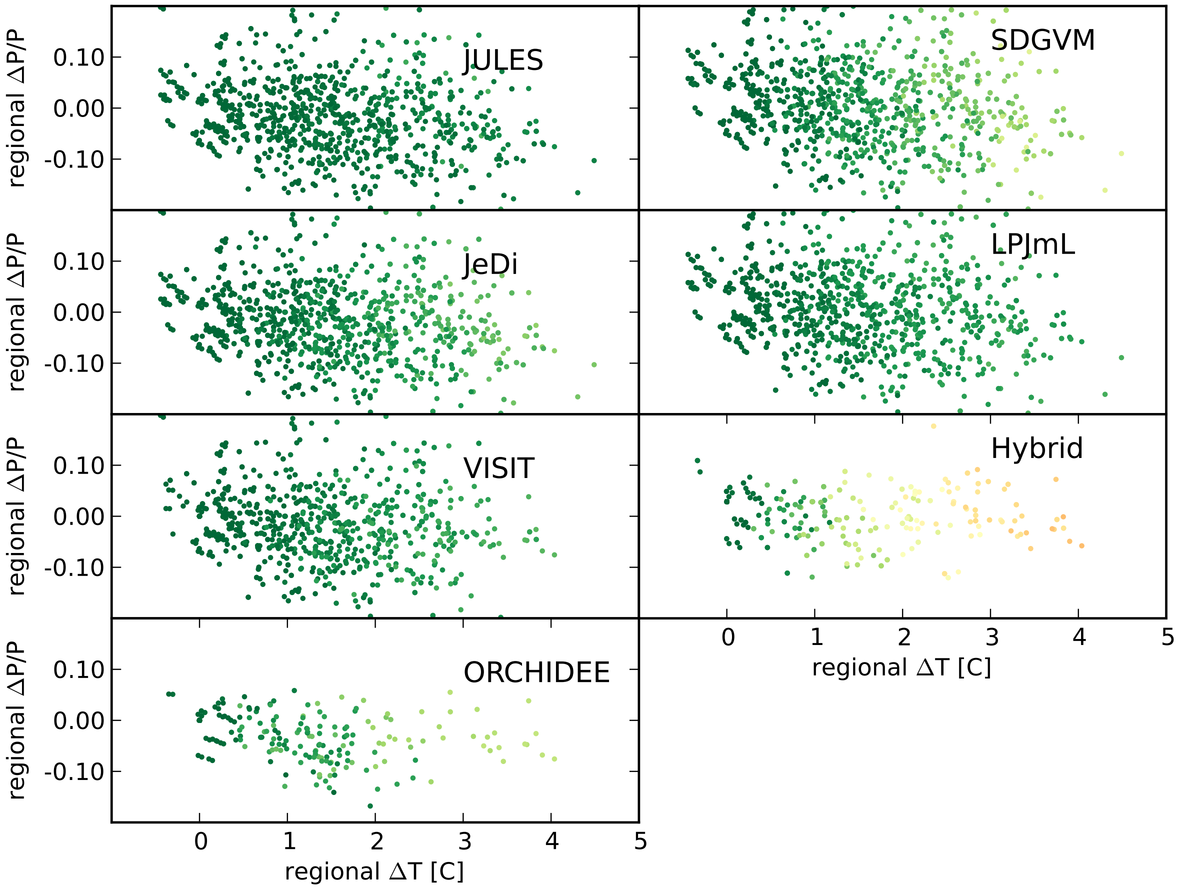

Fig. 15. Γ averaged over the Amazon forest as a function of regionally-averaged temperature and precipitation changes for all seven ecosystem models and all GCMs and RCPs. Each point results from a single year in a single climate scenario.

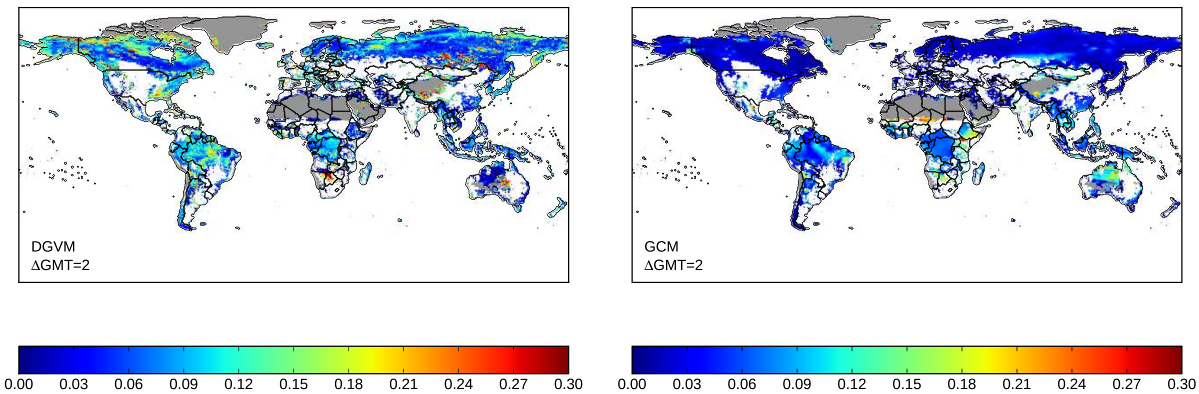

Fig. 16. Spread in Γ across ecosystem models (left) and GCMs (right) at ΔGMT$= 2^{\circ}$C using only RCP 8.5 runs

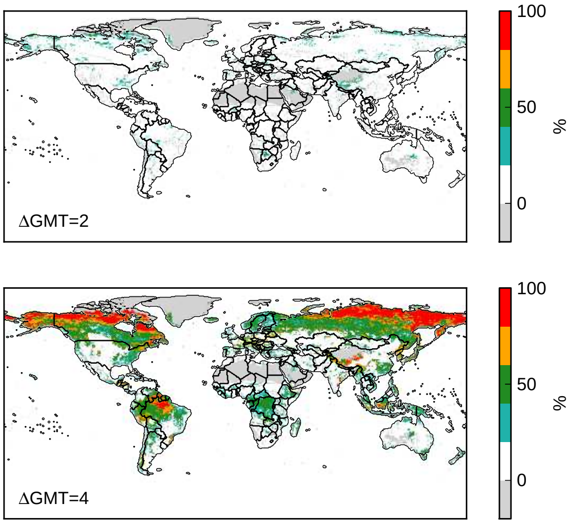

Fig. 17. The number of runs (combining ecosystem models and GCMs) that agree on severe ecosystem damage at $\Delta GMT = 2°$C (top) and $4°$C (bottom), using only RCP 8.5 runs.

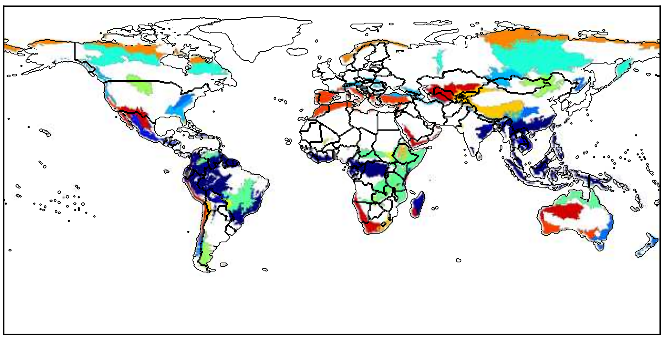

Fig. 18. The 'Global 200' global biodiversity hotpots as compiled by Olson et al. (2002). The colours have no specific meaning, other than to differentiate the regions.