Non-linear climate change impacts on crop yields may mislead stakeholders

Supporting Information

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Table S1: Species and emissions scenario simulation outputs available from each global gridded crop model utilized in this study. More details about each of these models is provided in Jägermeyr et al. (2021).

Global Gridded Crop Model	Crop Commodity				Scenario		
	Maize	Wheat	Rice	Soybean	SSP1-2.6	SSP3-7.0	SSP5-8.5
CROVER	✓	✓	✓	✓	✓	✓	✓
CYGMA1p74	✓	✓	✓	✓	✓	✓	✓
DSSAT-Pythia	✓	✓	x	x	✓	x	✓
EPIC-IIASA	✓	✓	✓	✓	✓	✓	✓
ISAM	✓	✓	✓	✓	✓	✓	✓
LandscapeDNDC	✓	✓	✓	✓	✓	✓	✓
LPJmL	✓	✓	✓	✓	✓	✓	✓
PEPIC	✓	✓	✓	✓	✓	✓	✓
pDSSAT	✓	✓	✓	✓	✓	x	✓
PROMET	✓	✓	✓	✓	✓	✓	✓
SIMPLACE-LINTULS	✓	✓	x	✓	✓	x	✓

Legend:
✓ = complete
✓ = only one season
x = not simulated

Table S2: Number of global climate models (out of 5 from ISIMIP) and scenario combinations that reach each global warming level (GWL) in a 20-year moving window prior to 2100. Darker blue shading indicates a higher percentage of all GCM/ensemble combinations are available (with a maximum of 15).

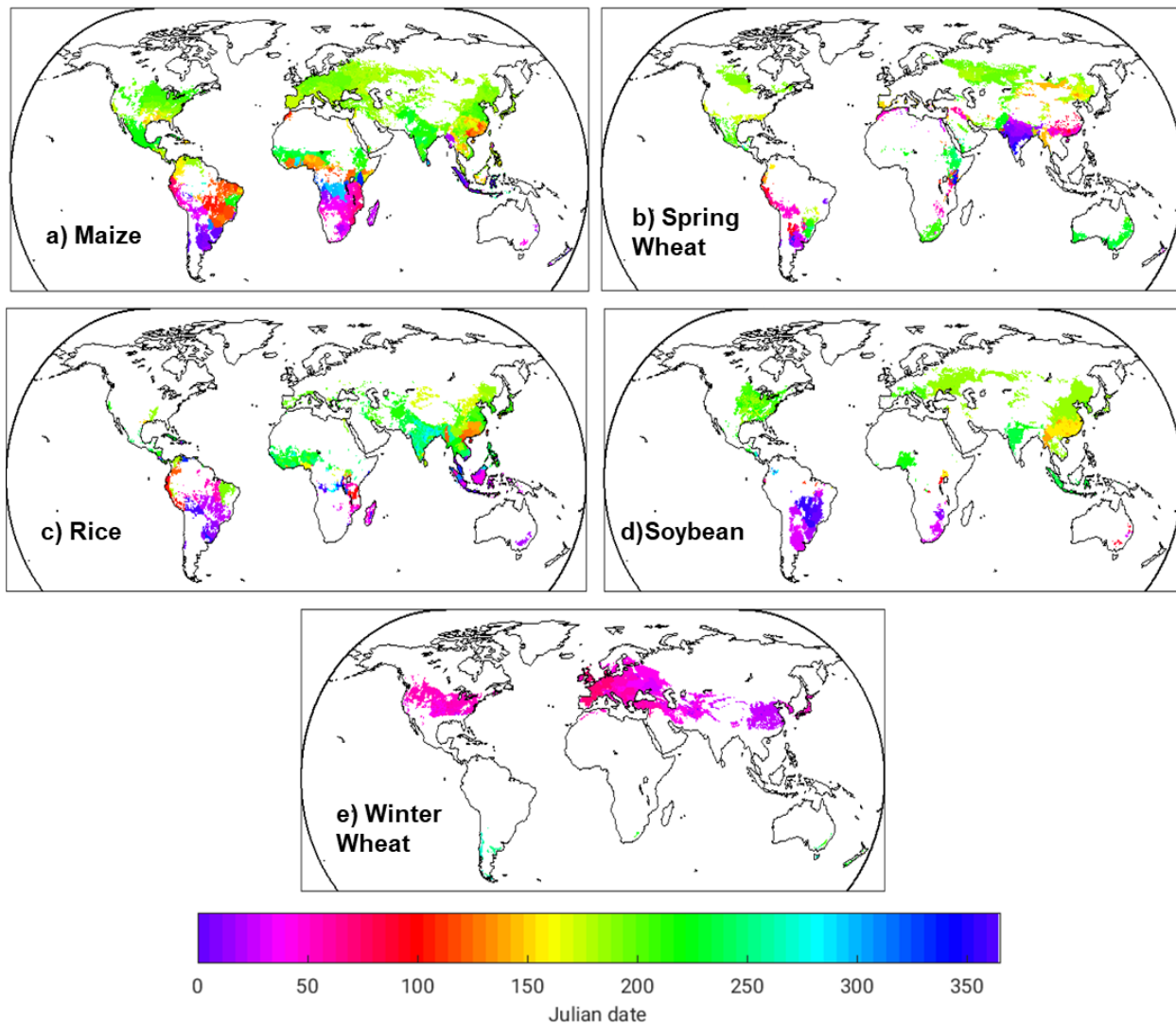| Emissions Scenario	Global Warming Level							
	0.69°C	1.0°C	1.5°C	2.0°C	2.5°C	3.0°C	3.5°C	4.0°C
SSP1-2.6	5	5	4	2	1	0	0	0
SSP3-7.0	5	5	5	5	5	5	3	2
SSP5-8.5	5	5	5	5	5	5	5	3
Total Available:	15	15	14	12	11	10	8	5

Figure S1: Central Julian day of each crop's rainfed growing season. Note that 'winter' wheat describes the system's dependence on a dormant period and vernalization rather than the specific dates of cultivation.
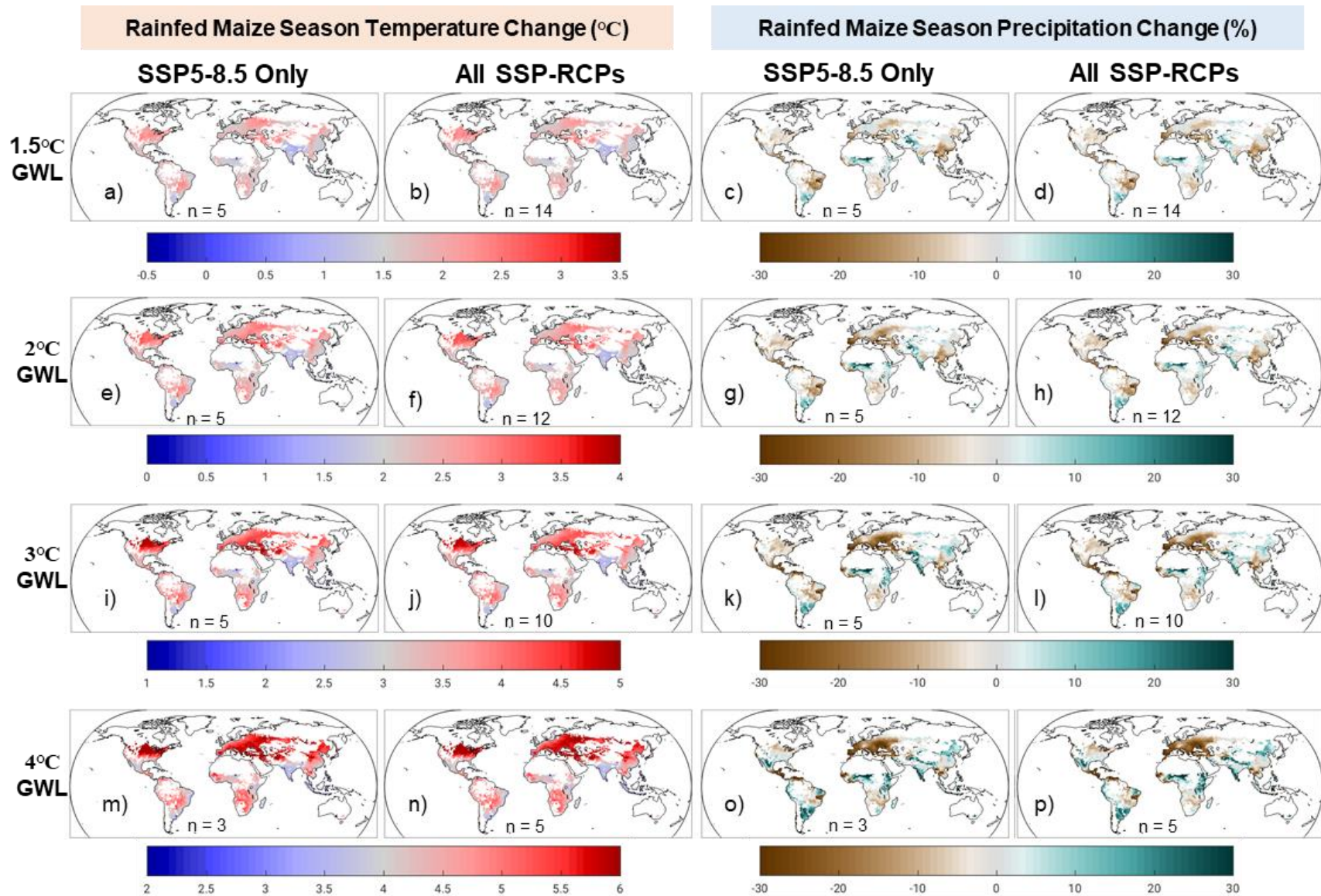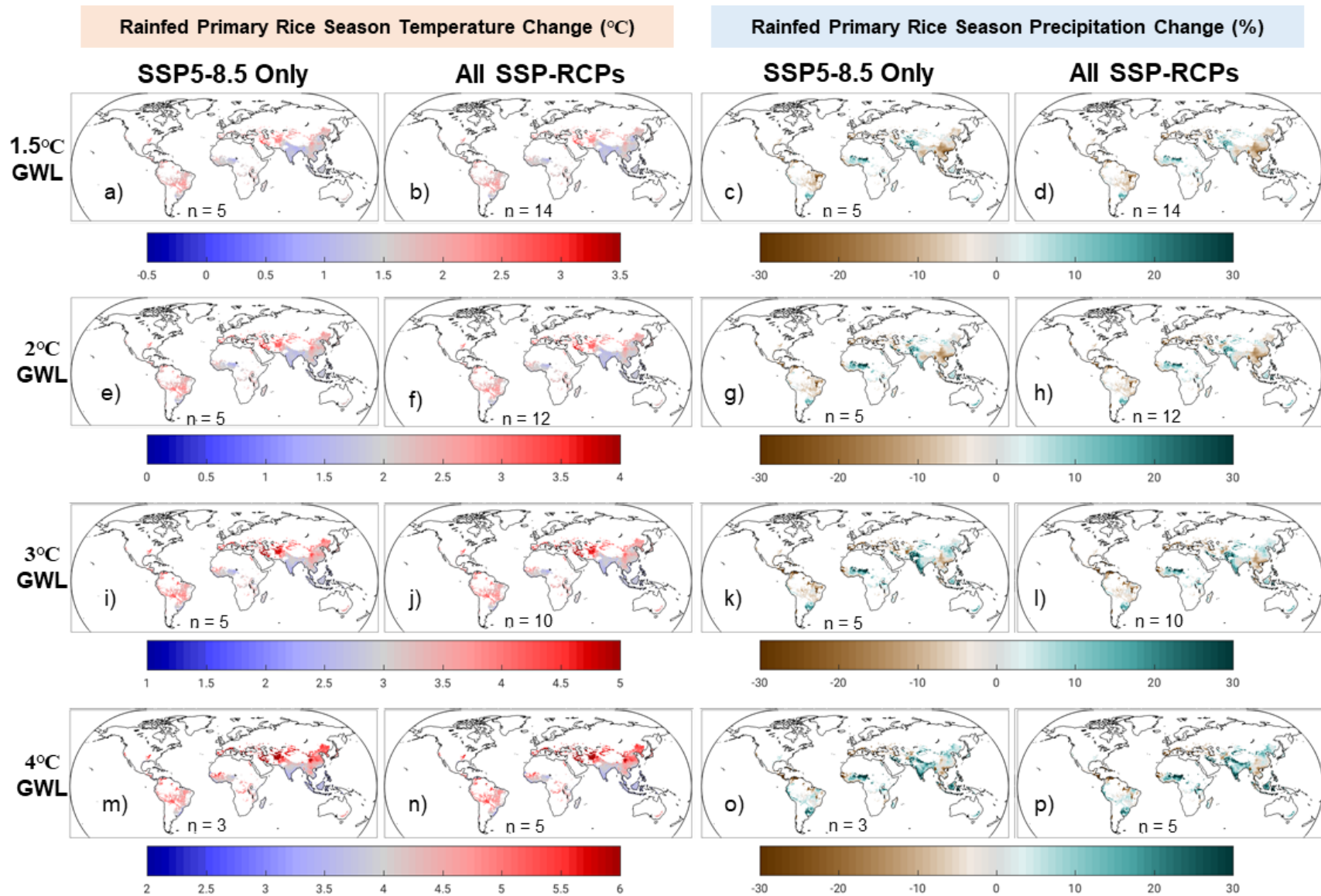
Figure S2: As in Figure 3, but local rainfed maize season temperature (°C; left) and precipitation (%; right) changes at a given GWL (compared to pre-industrial) drawn from the SSP5-8.5 scenario (1st and 3rd columns from left) and all SSP-RCP combinations (2nd and 4th columns) for all ISIMIP climate model projections that reach (a-d) 1.5°C, (e-h) 2°C, (i-l) 3°C and (m-p) 4°C GWL. n = the number of GCM/scenario combinations included in each GWL calculation.
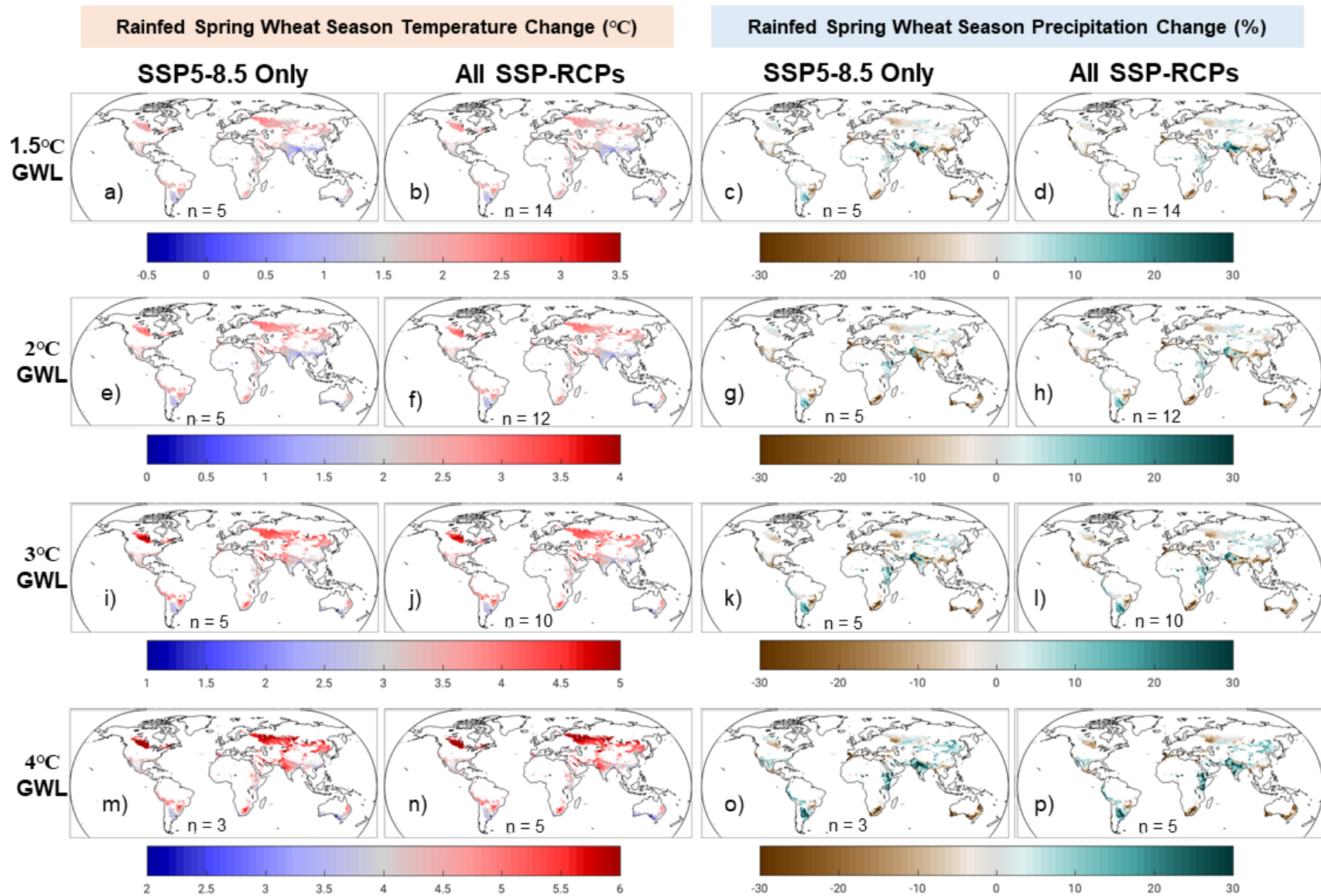
Figure S3: As in Figure 3, but local rainfed spring wheat season temperature (°C; left) and precipitation (%; right) changes at a given GWL (compared to pre-industrial) drawn from the SSP5-8.5 scenario (1st and 3rd columns from left) and all SSP-RCP combinations (2nd and 4th columns) for all ISIMIP climate model projections that reach (a-d) 1.5°C, (e-h) 2°C, (i-l) 3°C and (m-p) 4°C GWL. n = the number of GCM/scenario combinations included in each GWL calculation.
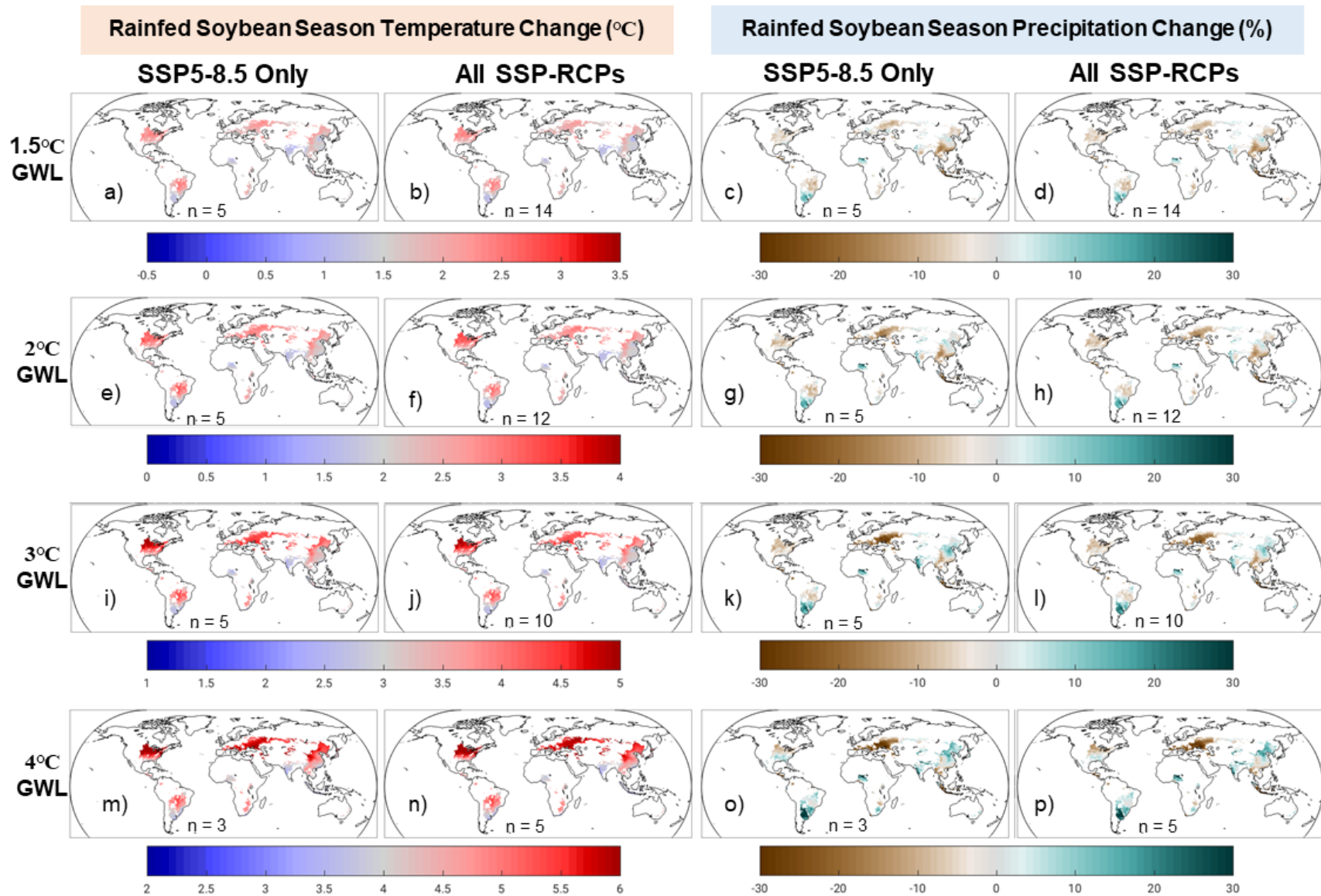
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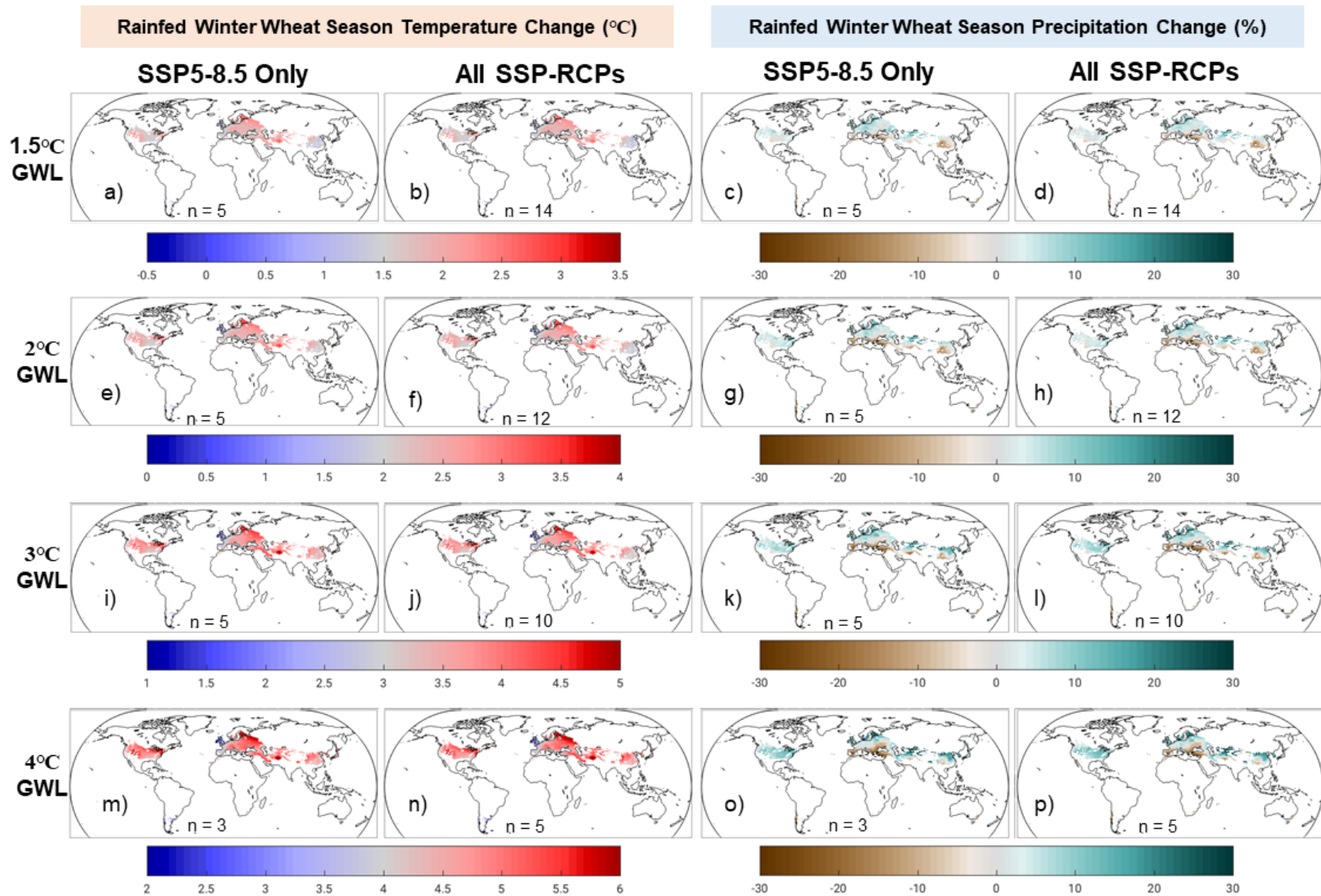
Figure S4: As in Figure 3, but local rainfed winter wheat season temperature (°C; left) and precipitation (%; right) changes at a given GWL (compared to pre-industrial) drawn from the SSP5-8.5 scenario (1st and 3rd columns from left) and all SSP-RCP combinations (2nd and 4th columns) for all ISIMIP climate model projections that reach (a-d) 1.5°C, (e-h) 2°C, (i-l) 3°C and (m-p) 4°C GWL. n = the number of GCM/scenario combinations included in each GWL calculation.
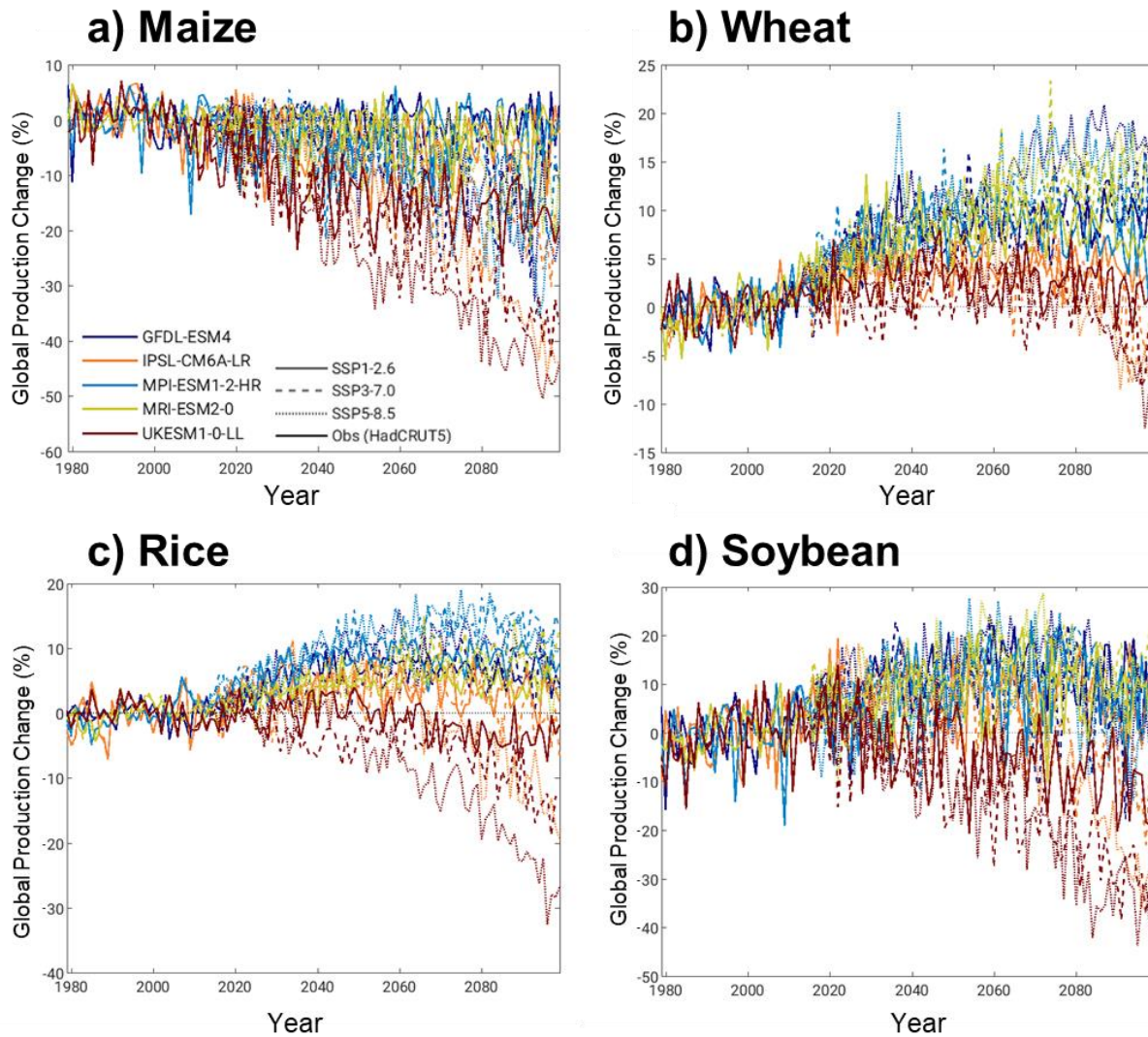
Figure S5: As in Figure 3, but local rainfed primary rice season temperature (°C; left) and precipitation (%; right) changes at a given GWL (compared to pre-industrial) drawn from the SSP5-8.5 scenario (1st and 3rd columns from left) and all SSP-RCP combinations (2nd and 4th columns) for all ISIMIP climate model projections that reach (a-d) 1.5°C, (e-h) 2°C, (i-l) 3°C and (m-p) 4°C GWL. n = the number of GCM/scenario combinations included in each GWL calculation.

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Figure S6: As in Figure 3, but local rainfed soybean season temperature (°C; left) and precipitation (%; right) changes at a given GWL (compared to pre-industrial) drawn from the SSP5-8.5 scenario (1st and 3rd columns from left) and all SSP-RCP combinations (2nd and 4th columns) for all ISIMIP climate model projections that reach (a-d) 1.5°C, (e-h) 2°C, (i-l) 3°C and (m-p) 4°C GWL. n = the number of GCM/scenario combinations included in each GWL calculation.
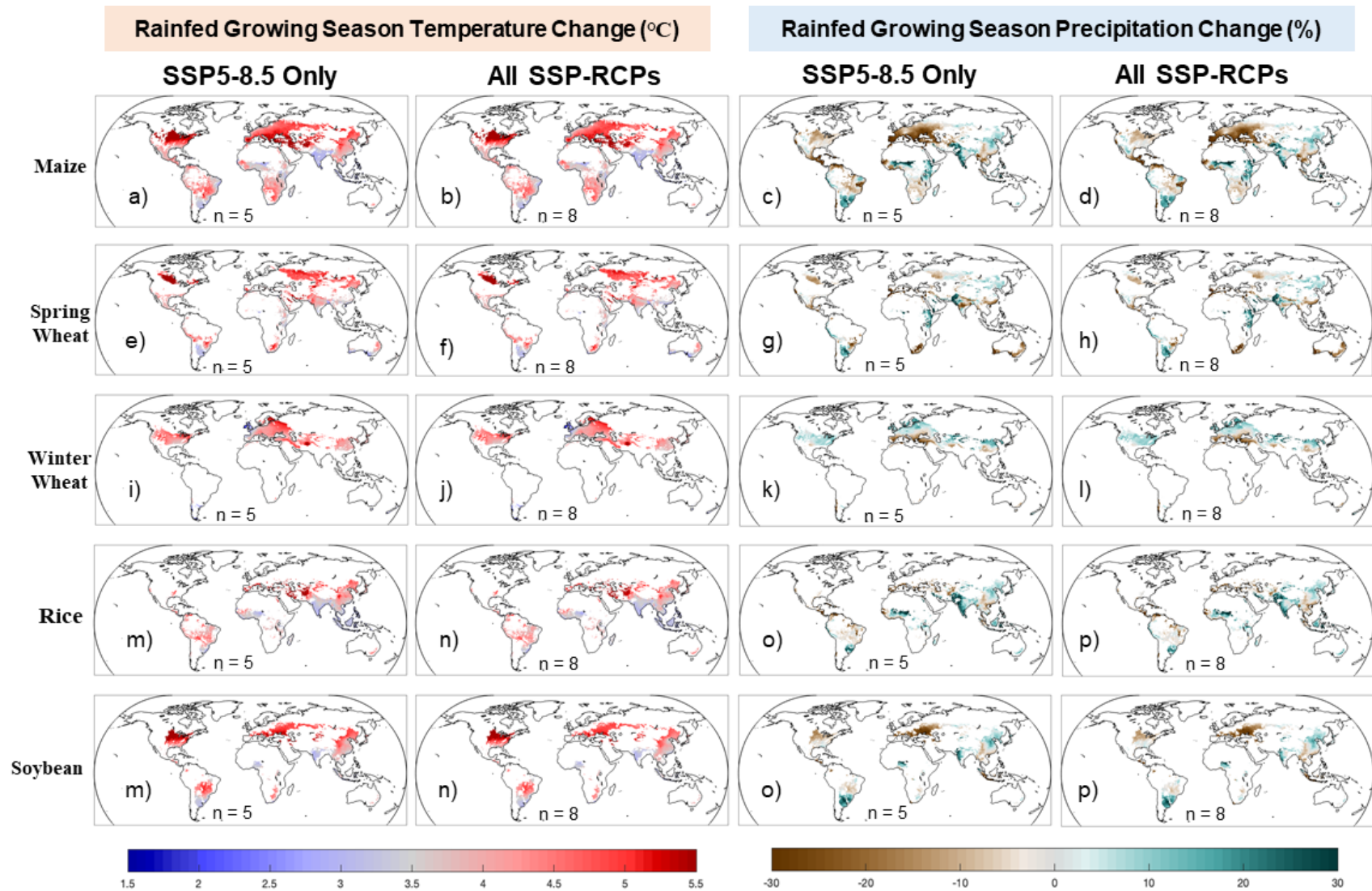
Figure S7: GGCMI crop model ensemble-mean global production change by SSP-RCP and driving GCM. Production changes are compared to the 1983-2013 period for each GCM as in Jägermeyr et al. (2021).

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Rainfed Growing Season Temperature Change (°C)

Rainfed Growing Season Precipitation Change (%)

SSP5-8.5 Only | All SSP-RCPs | SSP5-8.5 Only | All SSP-RCPs

Maize
a) n = 5 | b) n = 8 | c) n = 5 | d) n = 8

Spring Wheat
e) n = 5 | f) n = 8 | g) n = 5 | h) n = 8

Winter Wheat
i) n = 5 | j) n = 8 | k) n = 5 | l) n = 8

Rice
m) n = 5 | n) n = 8 | o) n = 5 | p) n = 8

Soybean
m) n = 5 | n) n = 8 | o) n = 5 | p) n = 8

Figure S8: As in Figures S2-S6, but local growing season temperature (°C; left) and precipitation (%; right) changes for each crop at 3.5°C GWL (compared to pre-industrial) drawn from the SSP5-8.5 scenario (1st and 3rd columns from left) and all SSP-RCP combinations (2nd and 4th columns) for all ISIMIP climate model projections that reach this GWL. Rows indicate growing season changes for each rainfed cropping system at this highest GWL that is reached by all GCMs in the SSP5-8.5 scenario.

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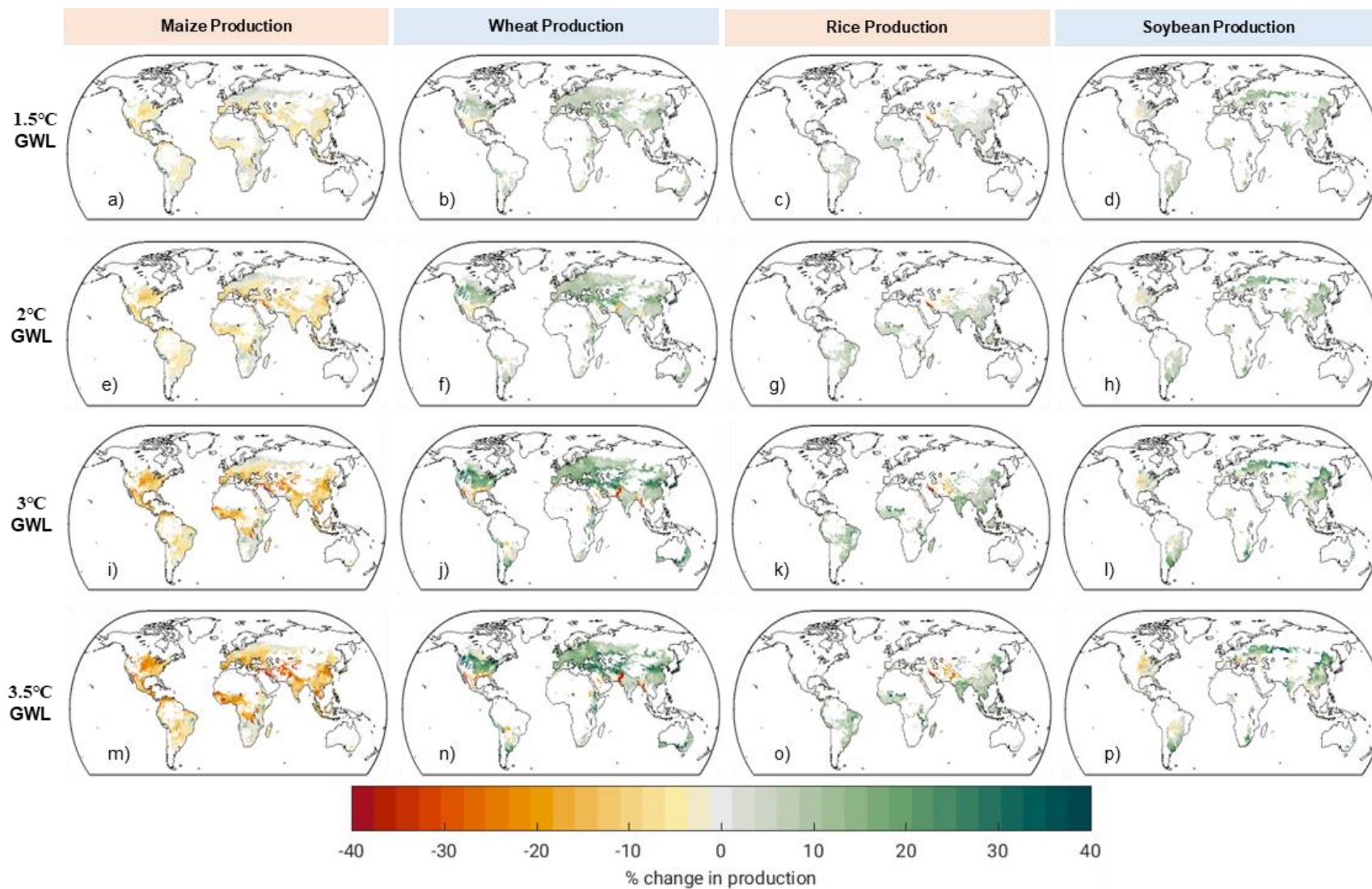
Figure S9: As in Figure 5 but using all SSP-RCP combinations. Mean production change (compared to 0.69℃ GWL) for maize, wheat, rice and soybean at GWL 1.5℃ (14 SSP-RCP/GCM combinations), 2.0℃ (12 combinations), 3℃ (10 combinations) and 3.5℃ (8 combinations). n = the number of model/scenario combinations included in each GWL calculation.
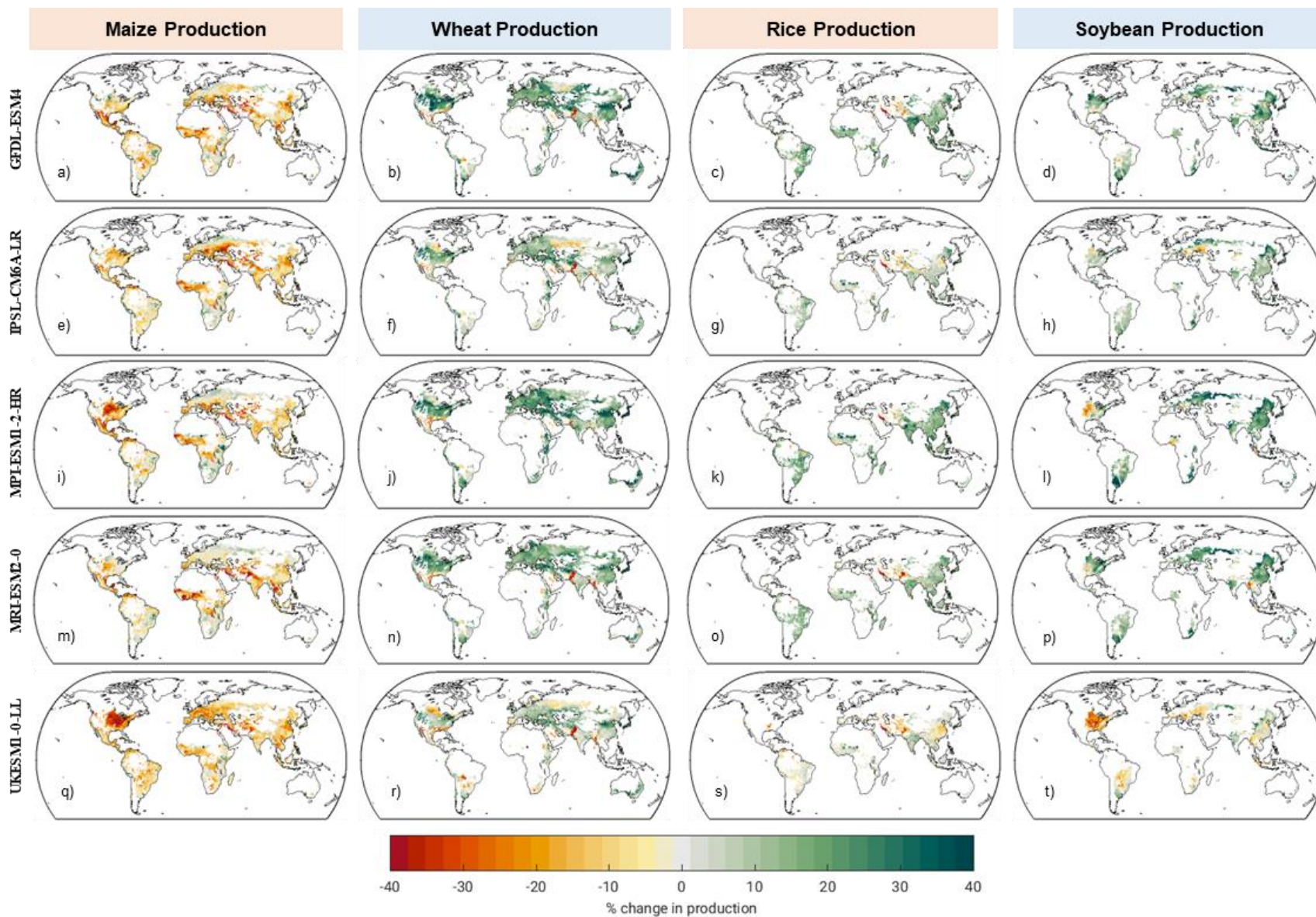
Figure S10: As in Figure 5 but showing the productivity response at the 3°C GWL for each GCM (ensemble across all GGCMs that ran that GCM). Global productivity changes for each GCM and crop species at this GWL are presented in Figure 4.