The compact Earth system model OSCAR v2.2: description and first results
Supplement

T. Gasser[1,2], **P. Ciais**[1], **O. Boucher**[3], **Y. Quilcaille**[1,2], **M. Tortora**[2], **L. Bopp**[1], **and D. Hauglustaine**[1]

[1]Laboratoire des Sciences du Climat et de l'Environnement, LSCE/IPSL, Université Paris-Saclay, CEA – CNRS – UVSQ, 91191 Gif-sur-Yvette, France
[2]Centre International de Recherche sur l'Environnement et le Développement (CIRED), CNRS – PontsParisTech – EHESS – AgroParisTech – CIRAD, 94736 Nogent-sur-Marne, France
[3]Laboratoire de Météorologie Dynamique, LMD/IPSL, CNRS – UPMC, 75252 Paris, France

Correspondence to: Thomas Gasser (tgasser@lsce.ipsl.fr)

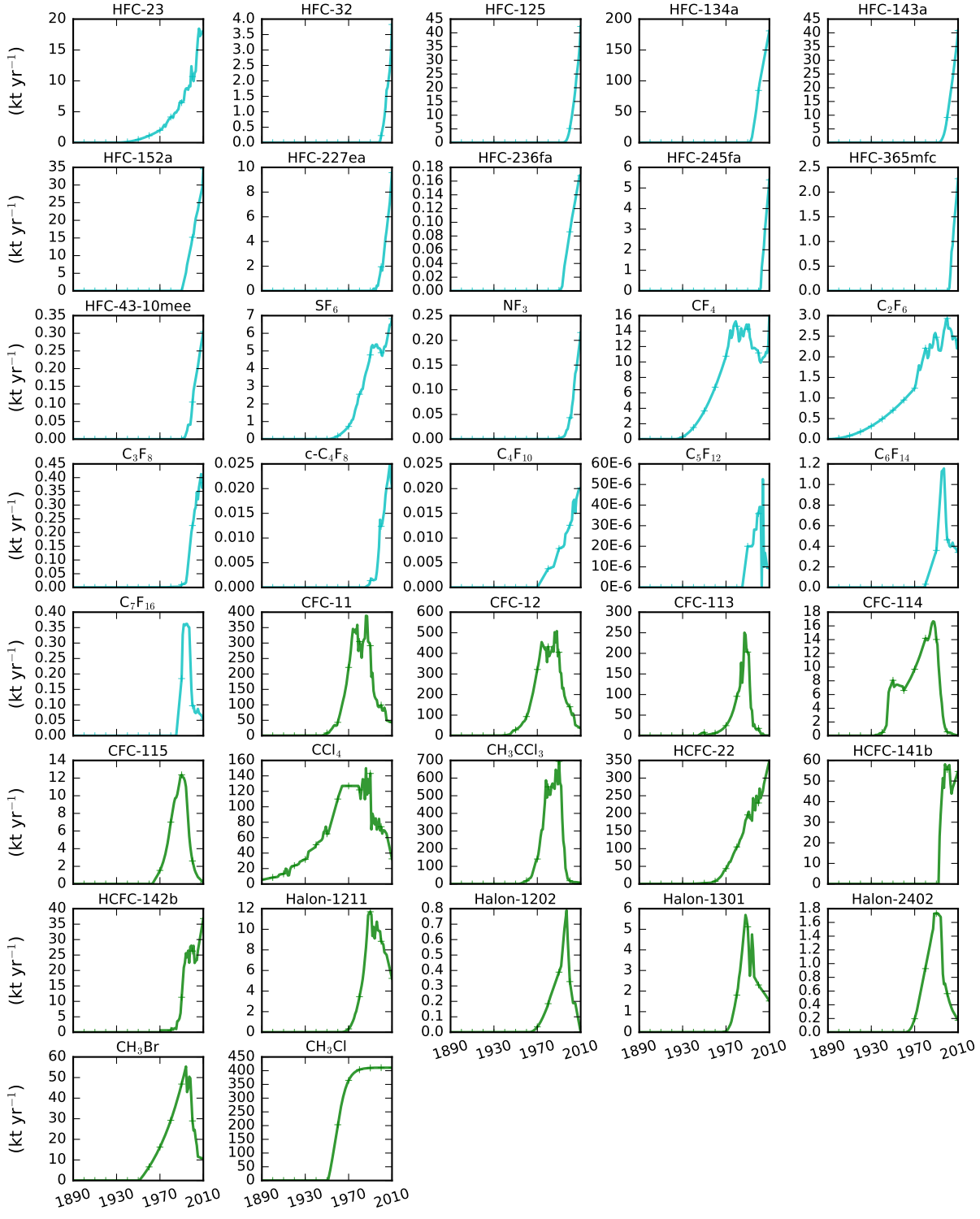

Figure S1. Time-series of the anthropogenic emissions of halogenated compounds used as inputs of OSCAR (section 2.2.1).

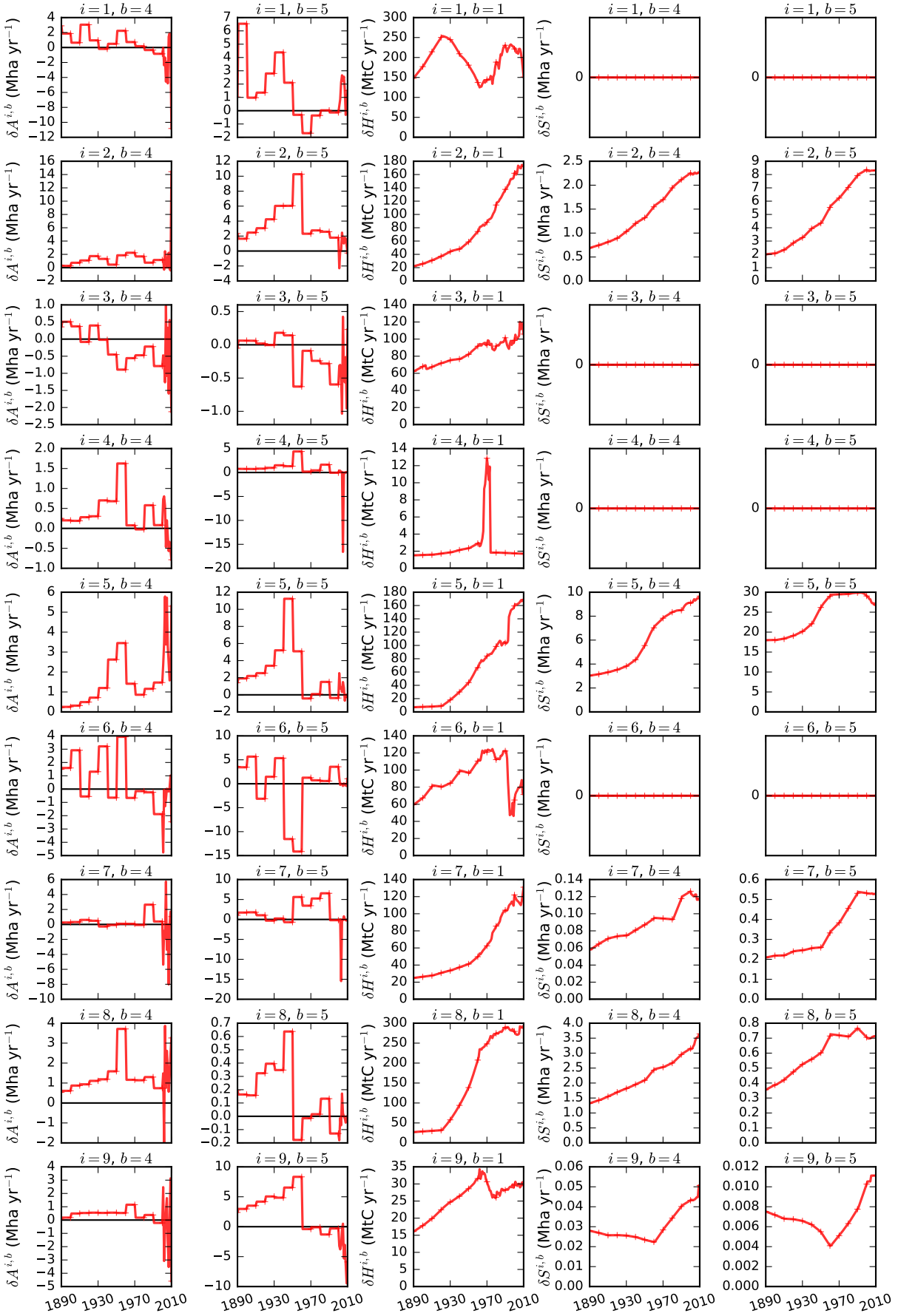

Figure S2. Time-series of the LULCC drivers used as inputs of OSCAR (section 2.2.2). The first column shows the change in cropland area; the second that in pasture area; the third shows harvest in forest; the fourth shifting cultivation for cropland; the fifth shifting cultivation for pastures. The rows correspond to the nine regions of figure S4.

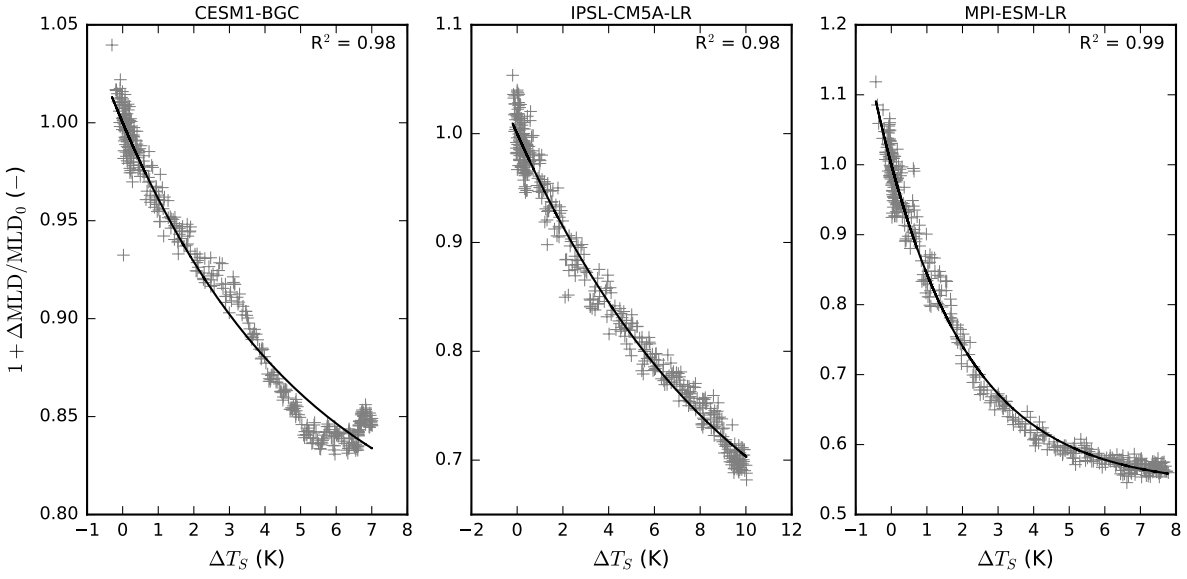

Figure S3. Fits of the parameters of the mixed layer depth of the surface ocean (section 2.3.1).

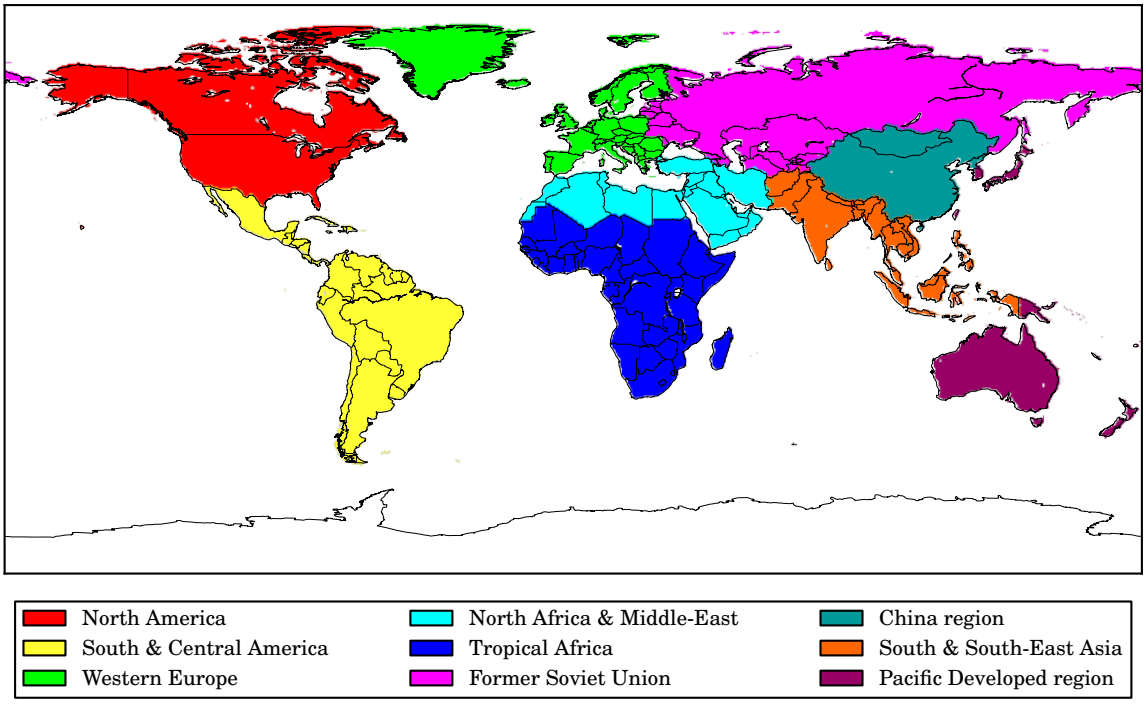

Figure S4. Biospheric regions (i.e. the i-axis defined in section 2.3.2) used in this paper: ($i = 1$) North America; ($i = 2$) South & Central America; ($i = 3$) Western Europe; ($i = 4$) North Africa & Middle-East; ($i = 5$) Tropical Africa; ($i = 6$) Former Soviet Union; ($i = 7$) China region; ($i = 8$) South & South-East Asia; ($i = 9$) Pacific Developed region.

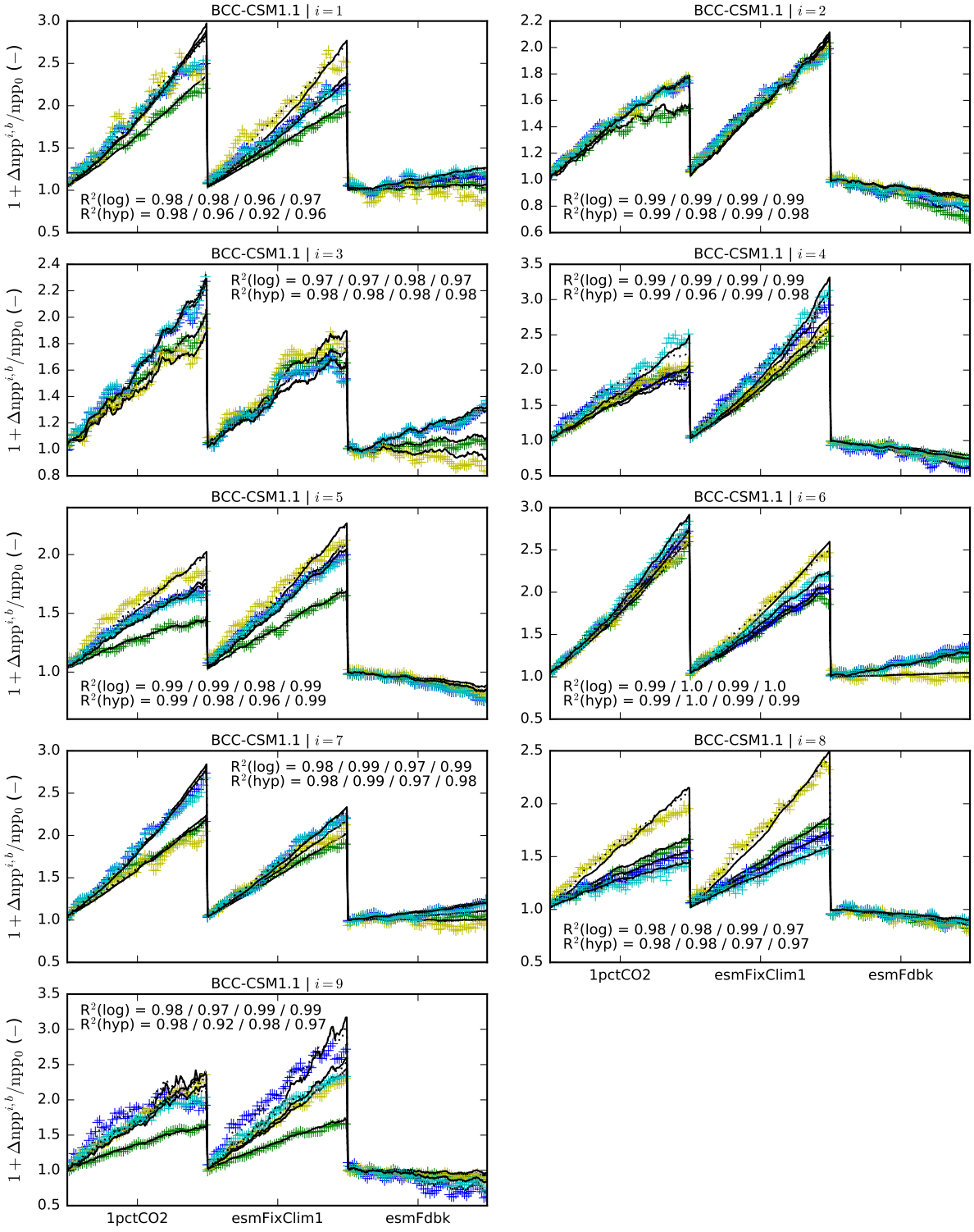

Figure S5. Fits of the parameters of the NPP response based on the "BCC-CSM1.1" model (section 2.3.2). Each panel is one of the nine regions (see figure S4), and the different colors are for the biomes: forest (green), mixed shrubland and grassland (blue), cropland (yellow), and pasture (cyan). The R^2 are given in this exact order, for the logarithmic (log) and hyperbolic (hyp) fits. Decadal running means are shown; and the fits are the dotted and plain black lines, for the logarithmic and hyperbolic formulations respectively.

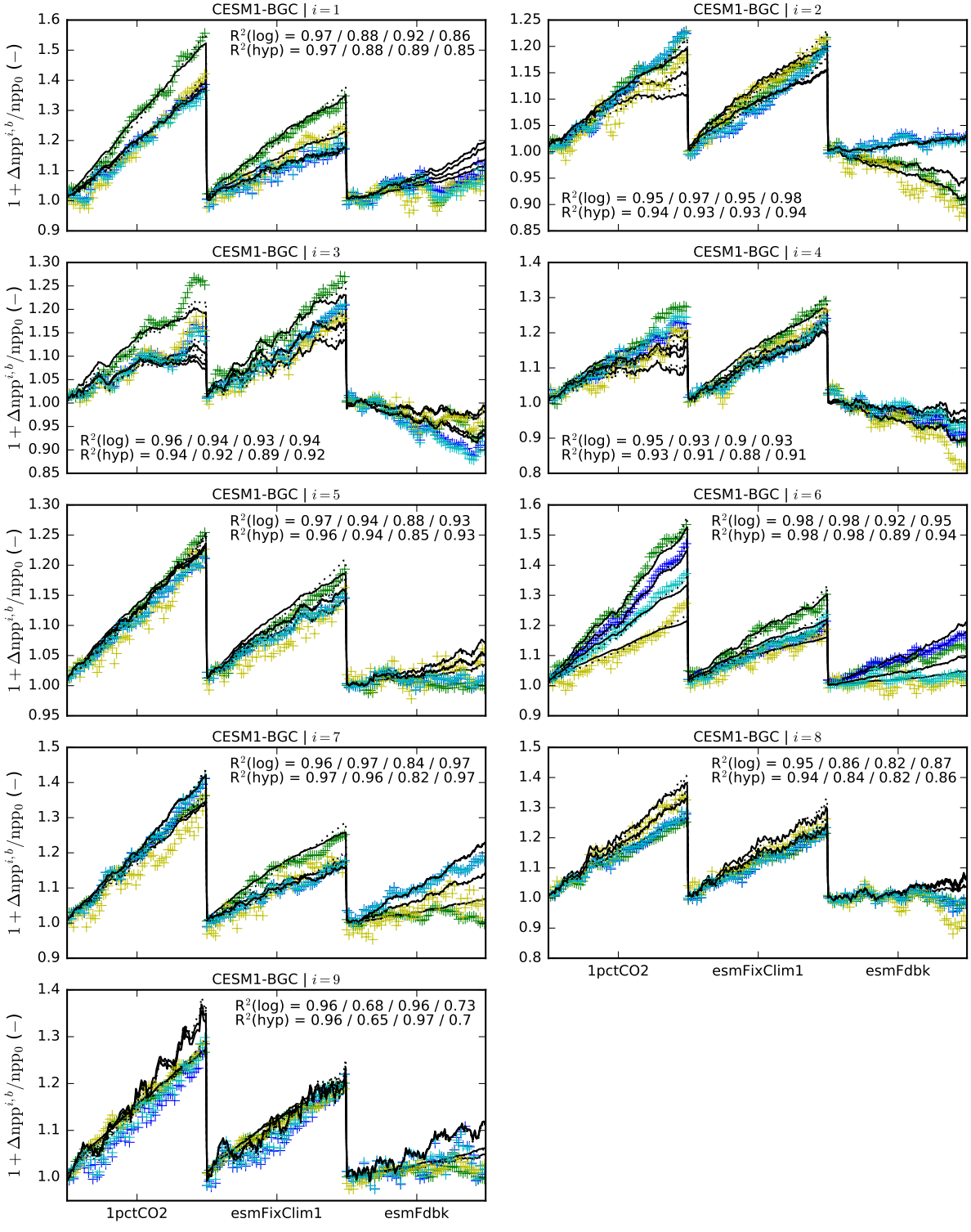

Figure S6. Same as figure S5 but for the "CESM1-BGC" model.

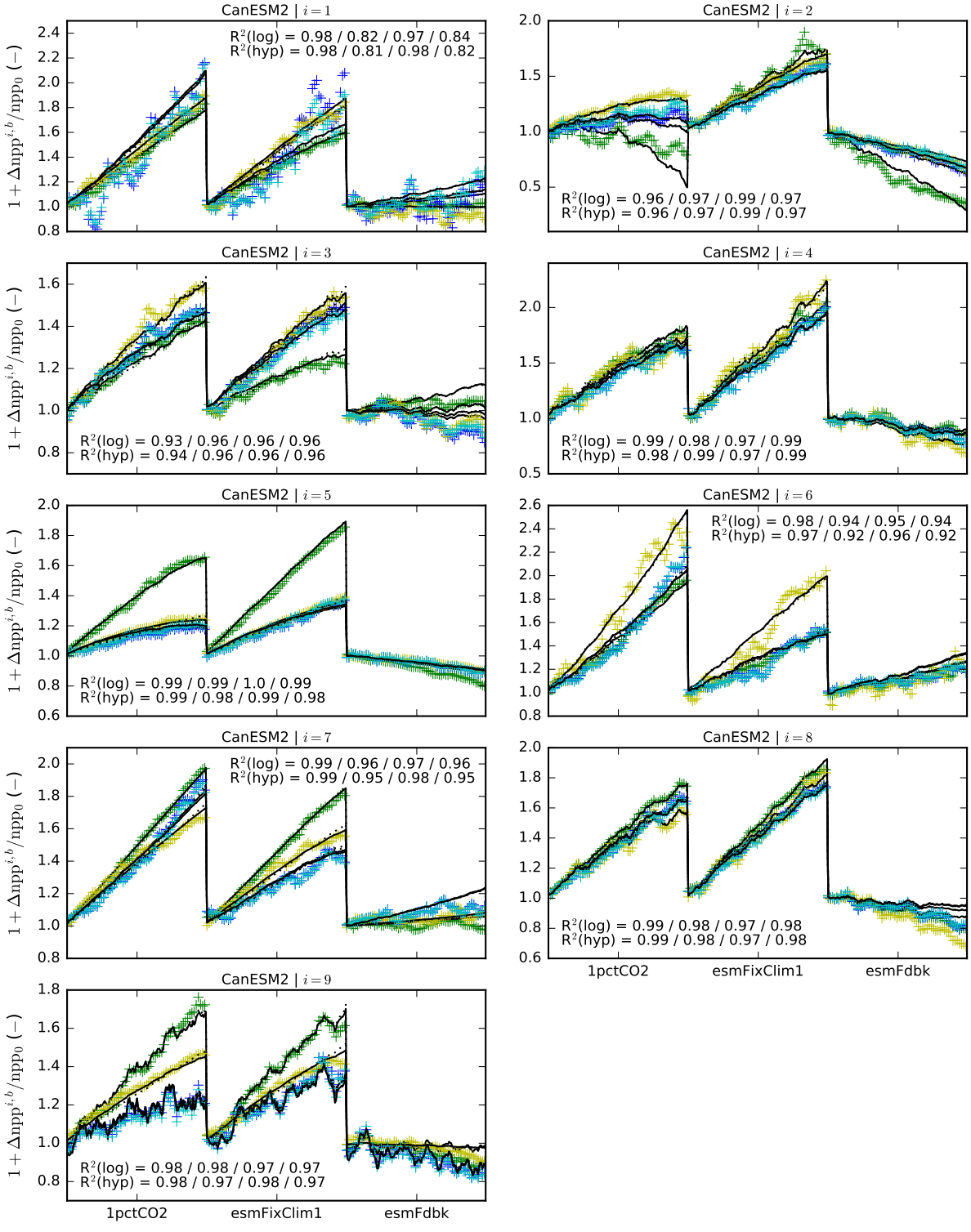

Figure S7. Same as figure S5 but for the "CanESM2" model.

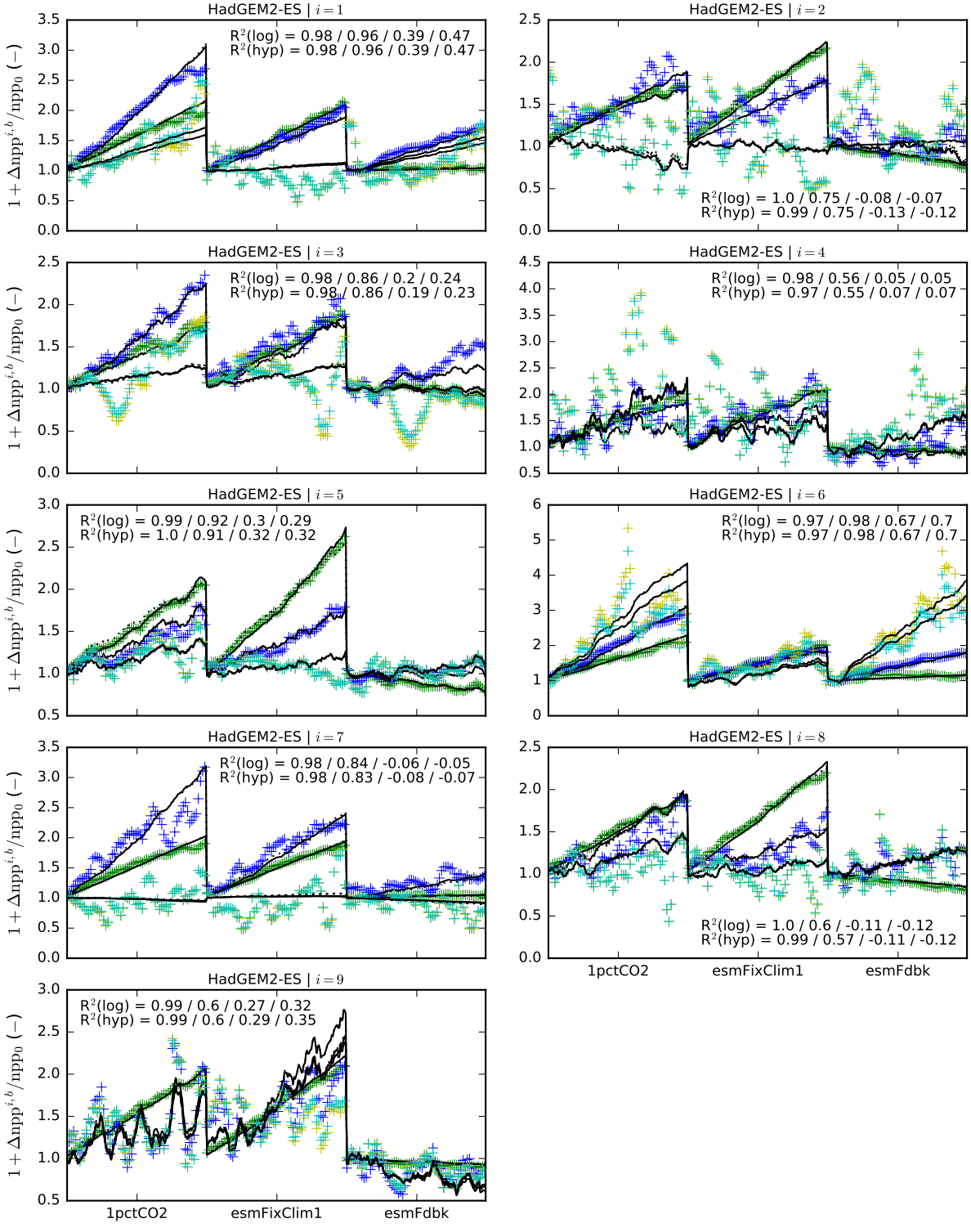

Figure S8. Same as figure S5 but for the "HadGEM2-ES" model.

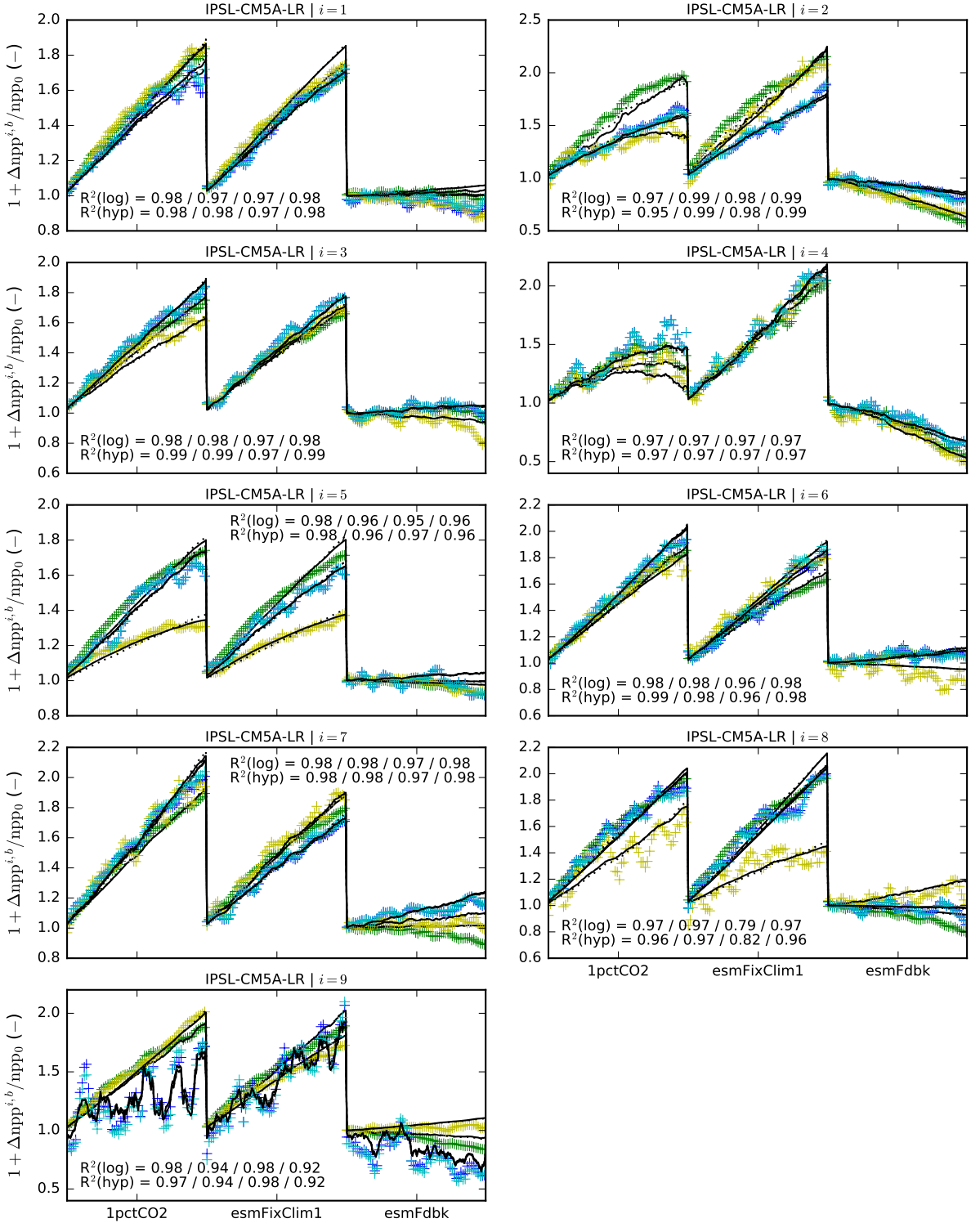

Figure S9. Same as figure S5 but for the "IPSL-CM5A-LR" model.

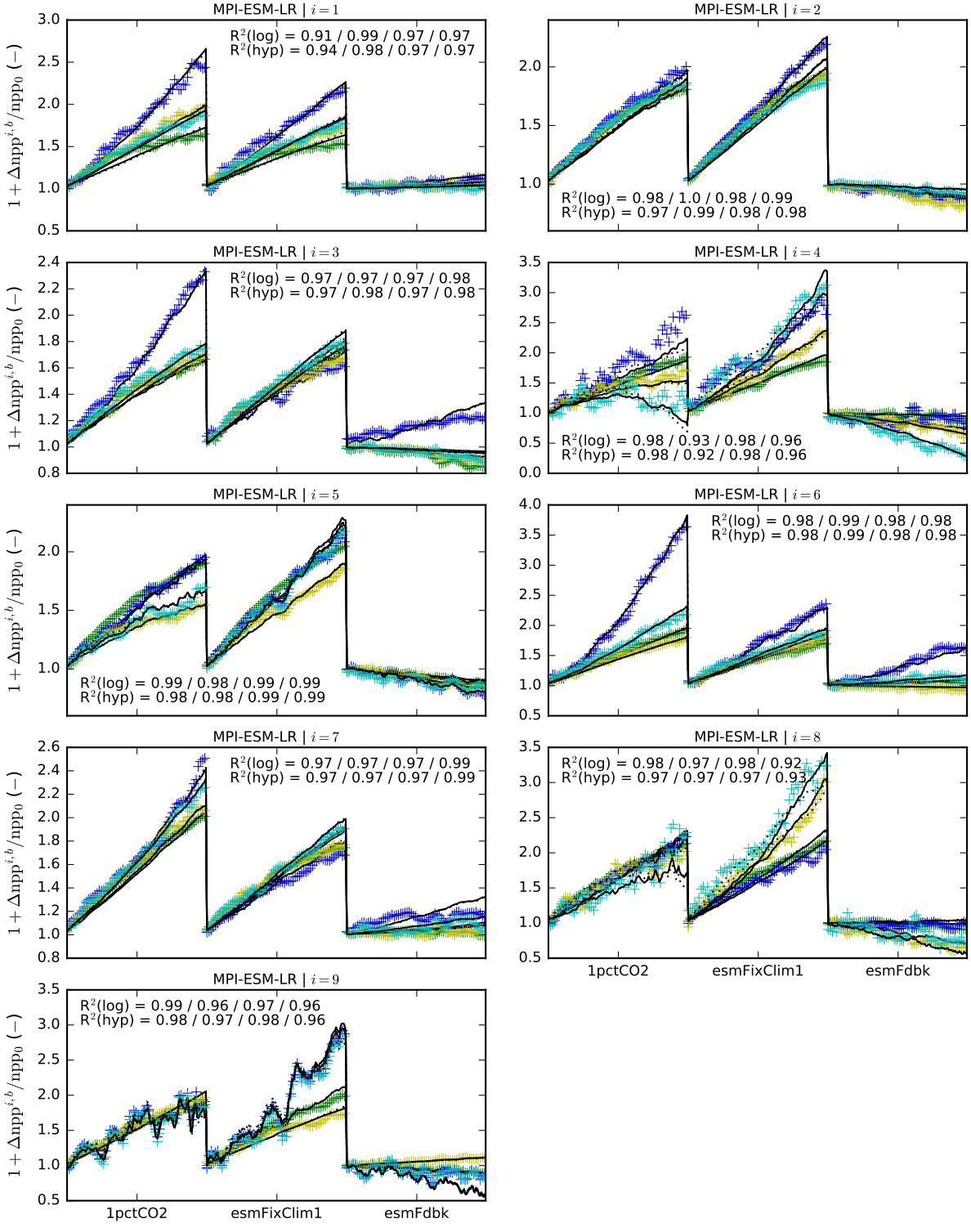

Figure S10. Same as figure S5 but for the "MPI-ESM-LR" model.

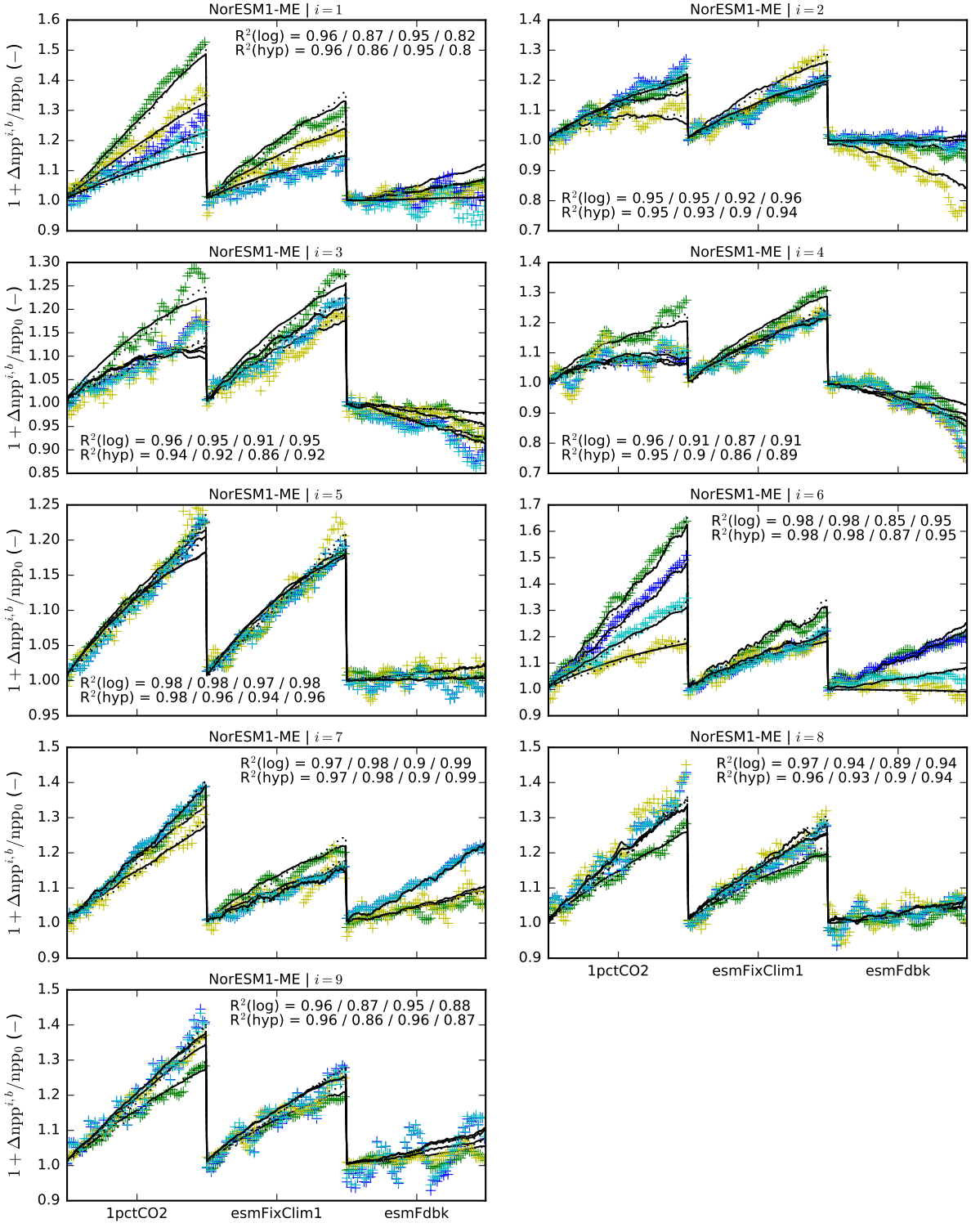

Figure S11. Same as figure S5 but for the "NorESM1-ME" model.

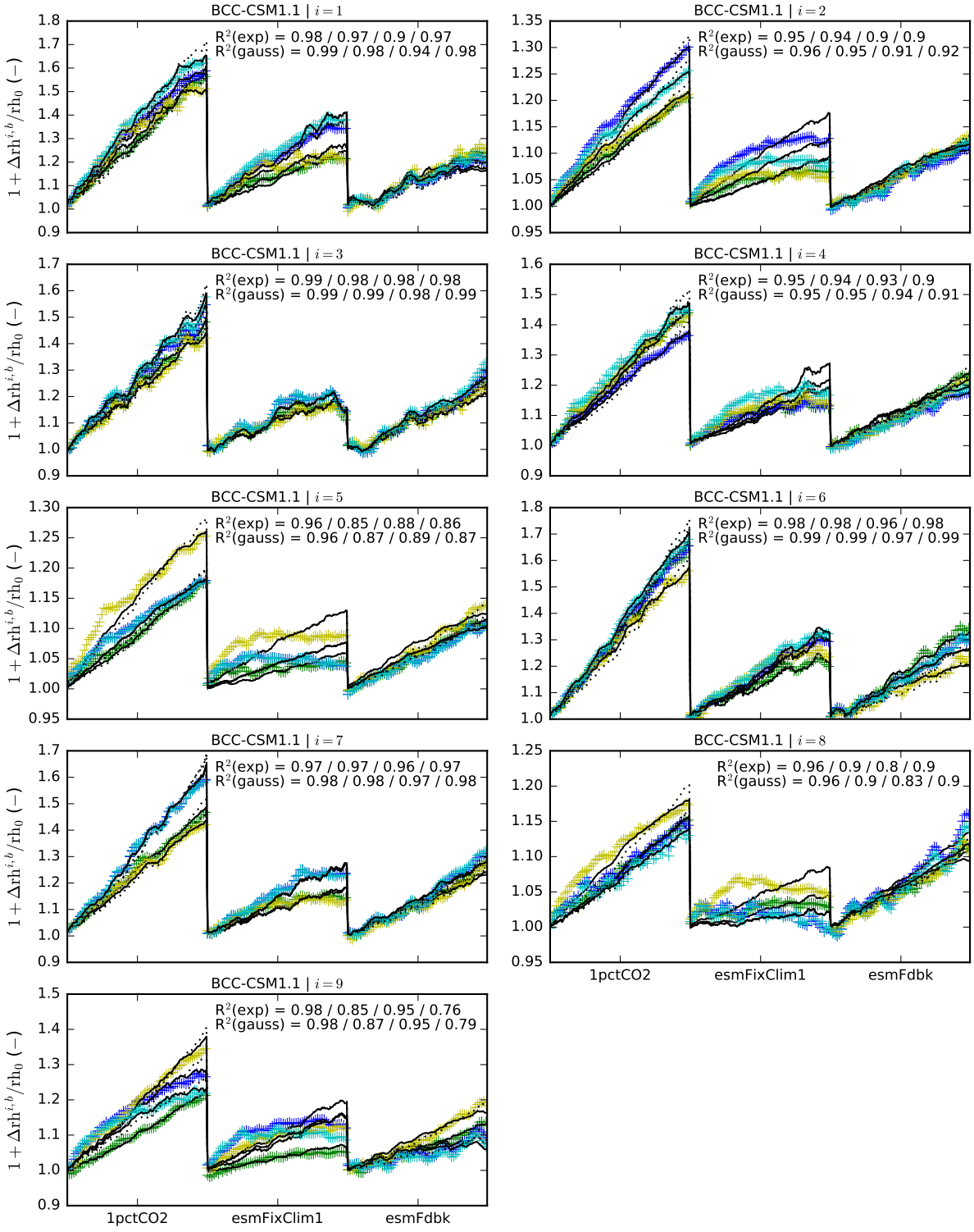

Figure S12. Fits of the parameters of the heterotrophic respiration response based on the "BCC-CSM1.1" model (section 2.3.2). Each panel is one of the nine regions (see figure S4), and the different colors are for the biomes: forest (green), mixed shrubland and grassland (blue), cropland (yellow), and pasture (cyan). The R^2 are given in this exact order, for the exponential (exp) and Gaussian (gauss) fits. Decadal running means are shown; and the fits are the dotted and plain black lines, for the exponential and Gaussian formulations respectively.

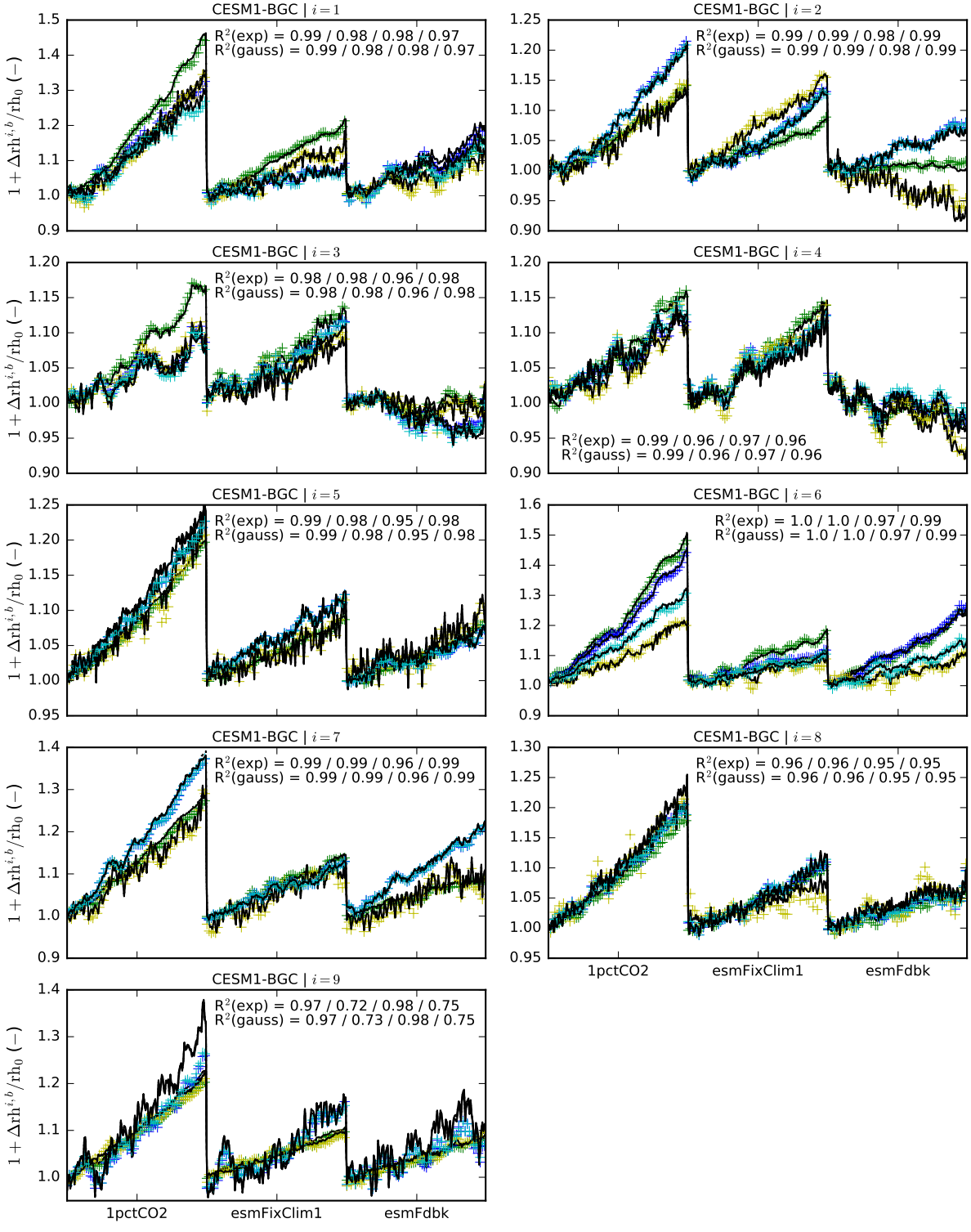

Figure S13. Same as figure S12 but for the "CESM1-BGC" model.

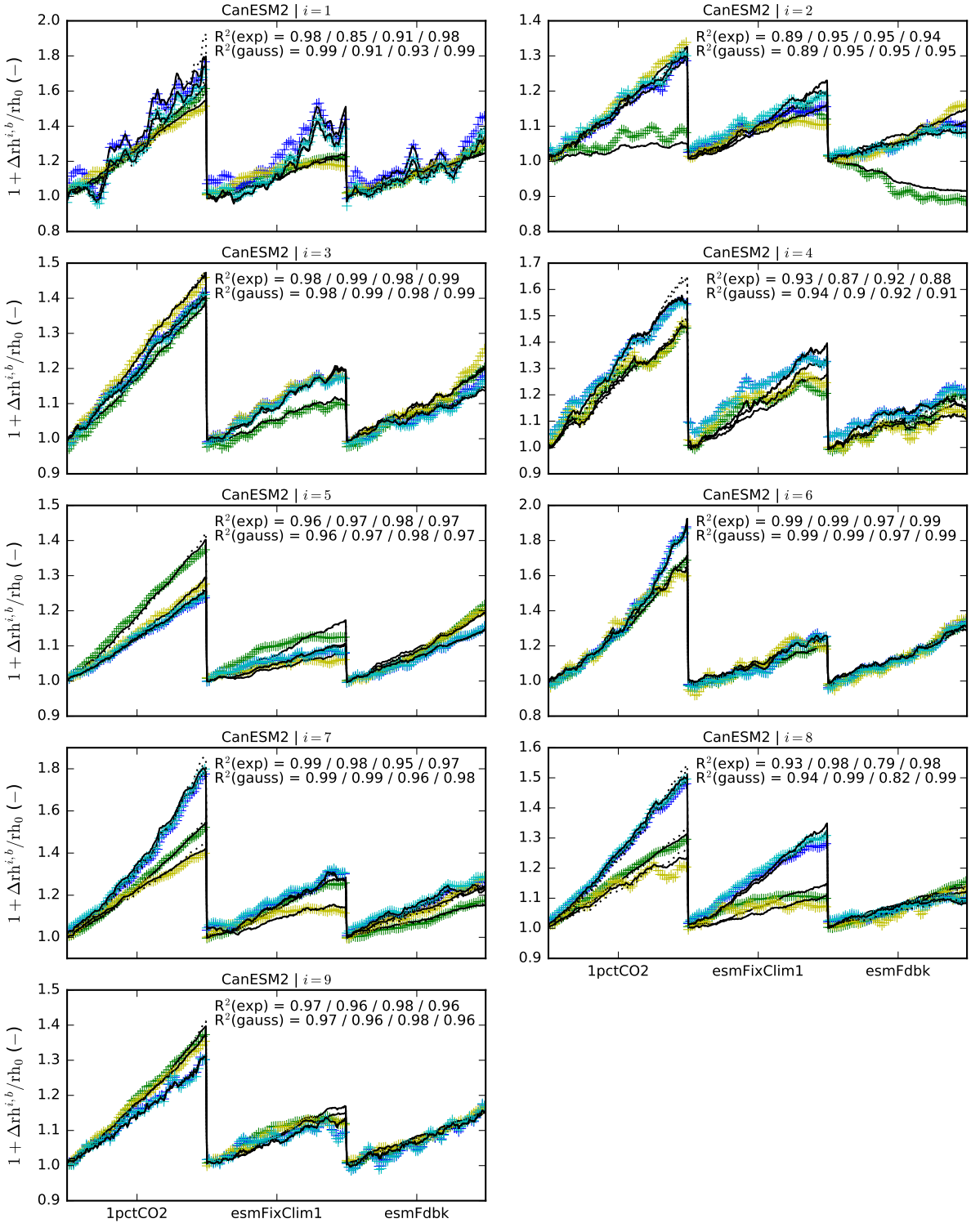

Figure S14. Same as figure S12 but for the "CanESM2" model.

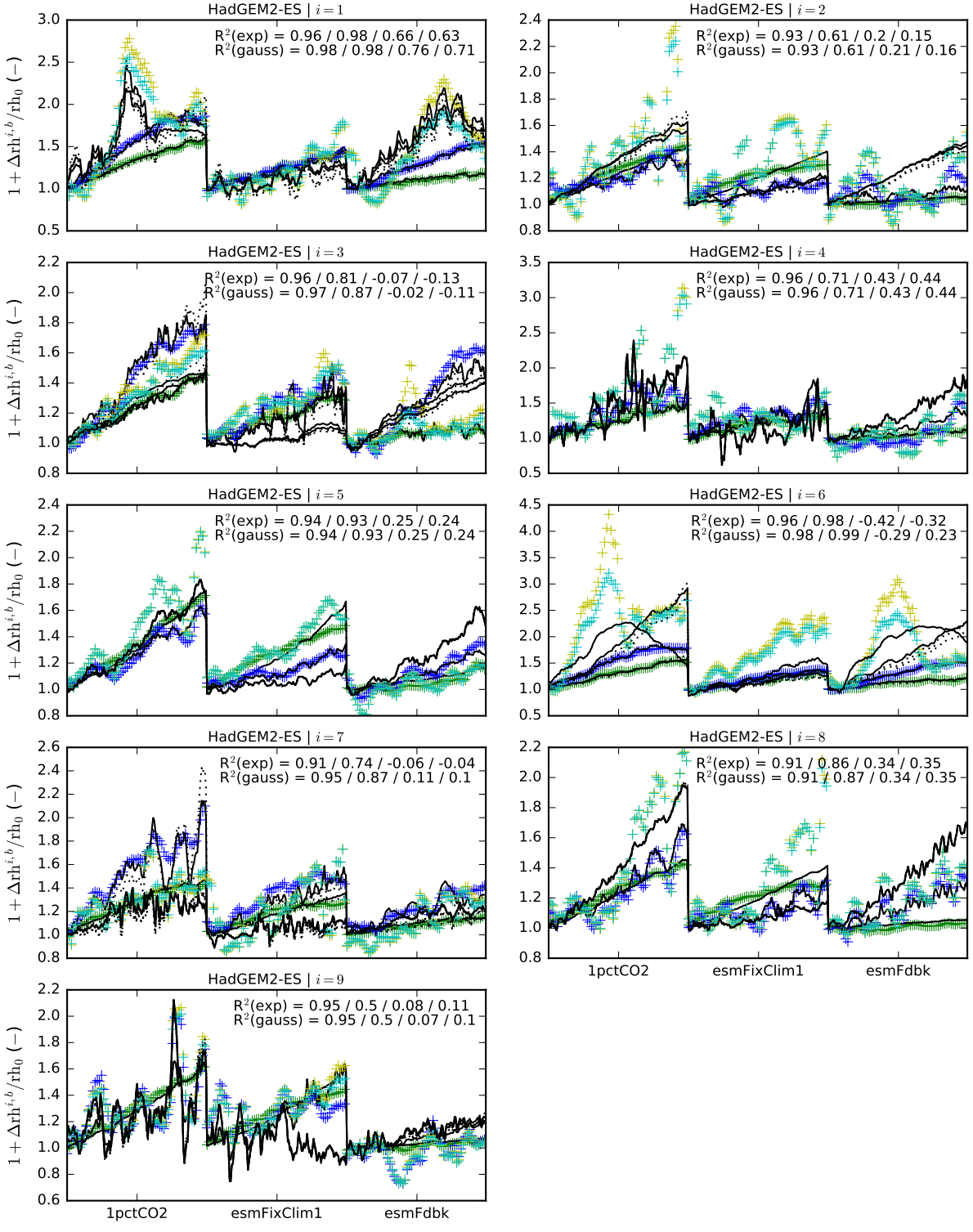

Figure S15. Same as figure S12 but for the "HadGEM2-ES" model.

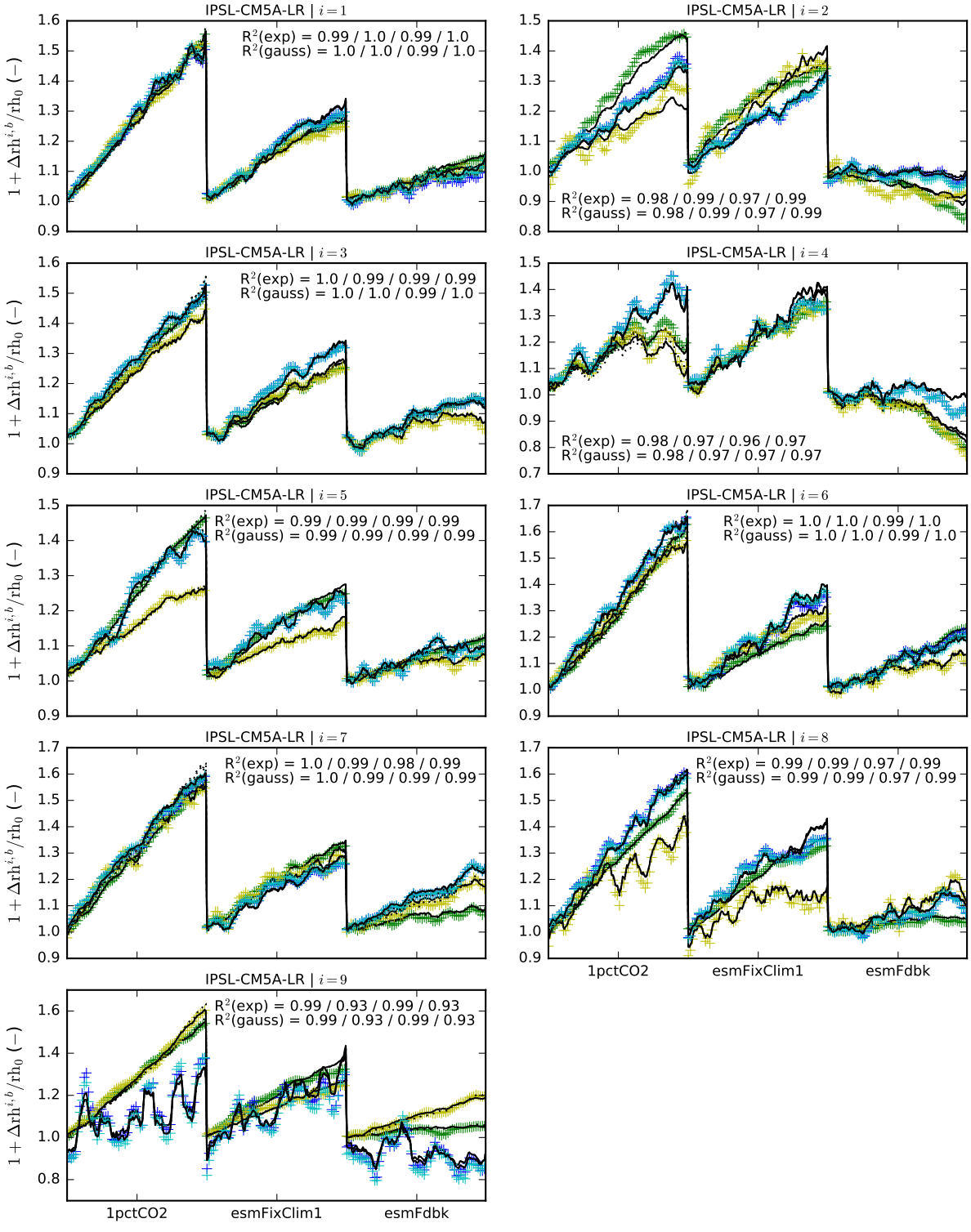

Figure S16. Same as figure S12 but for the "IPSL-CM5A-LR" model.

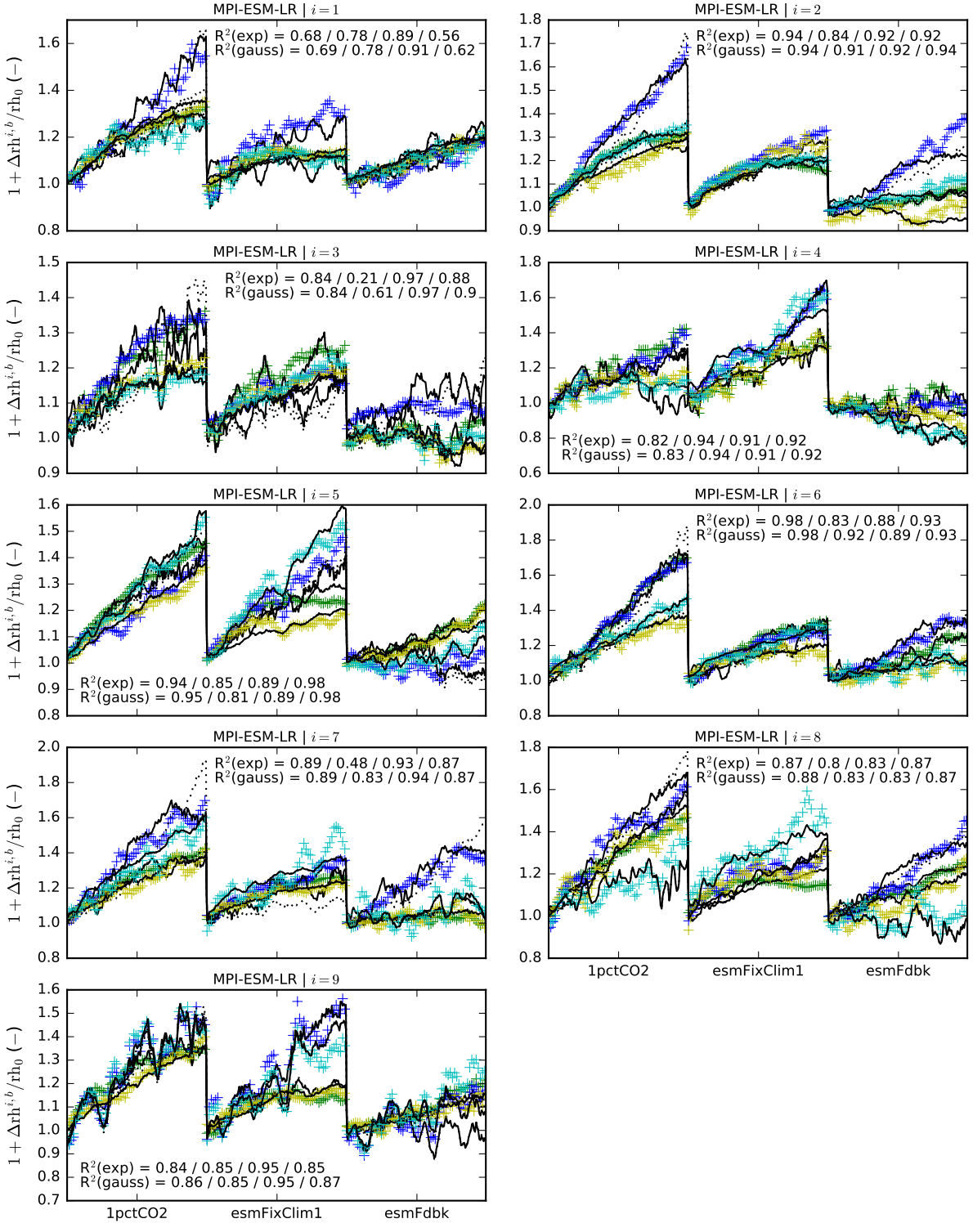

Figure S17. Same as figure S12 but for the "MPI-ESM-LR" model.

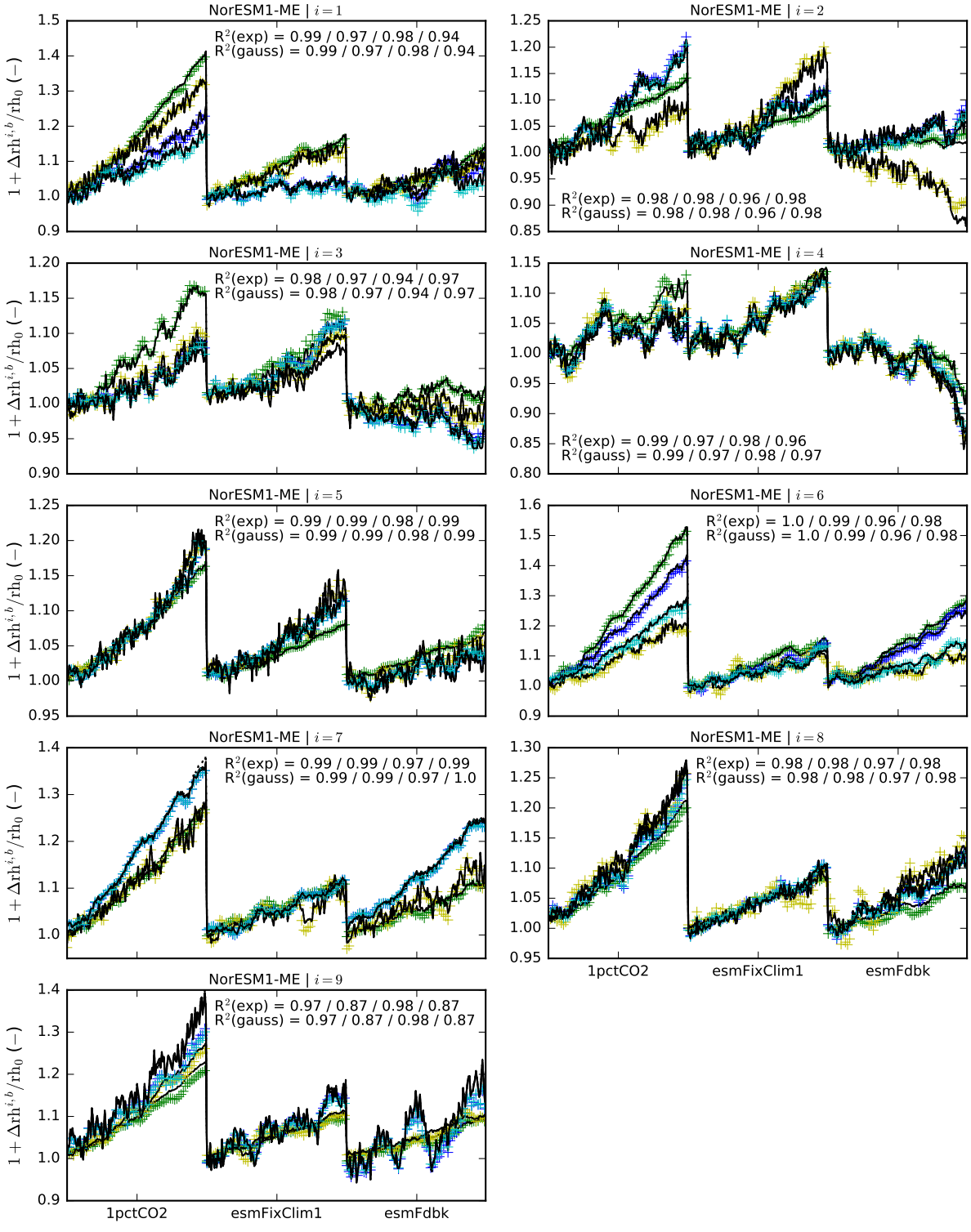

Figure S18. Same as figure S12 but for the "NorESM1-ME" model.

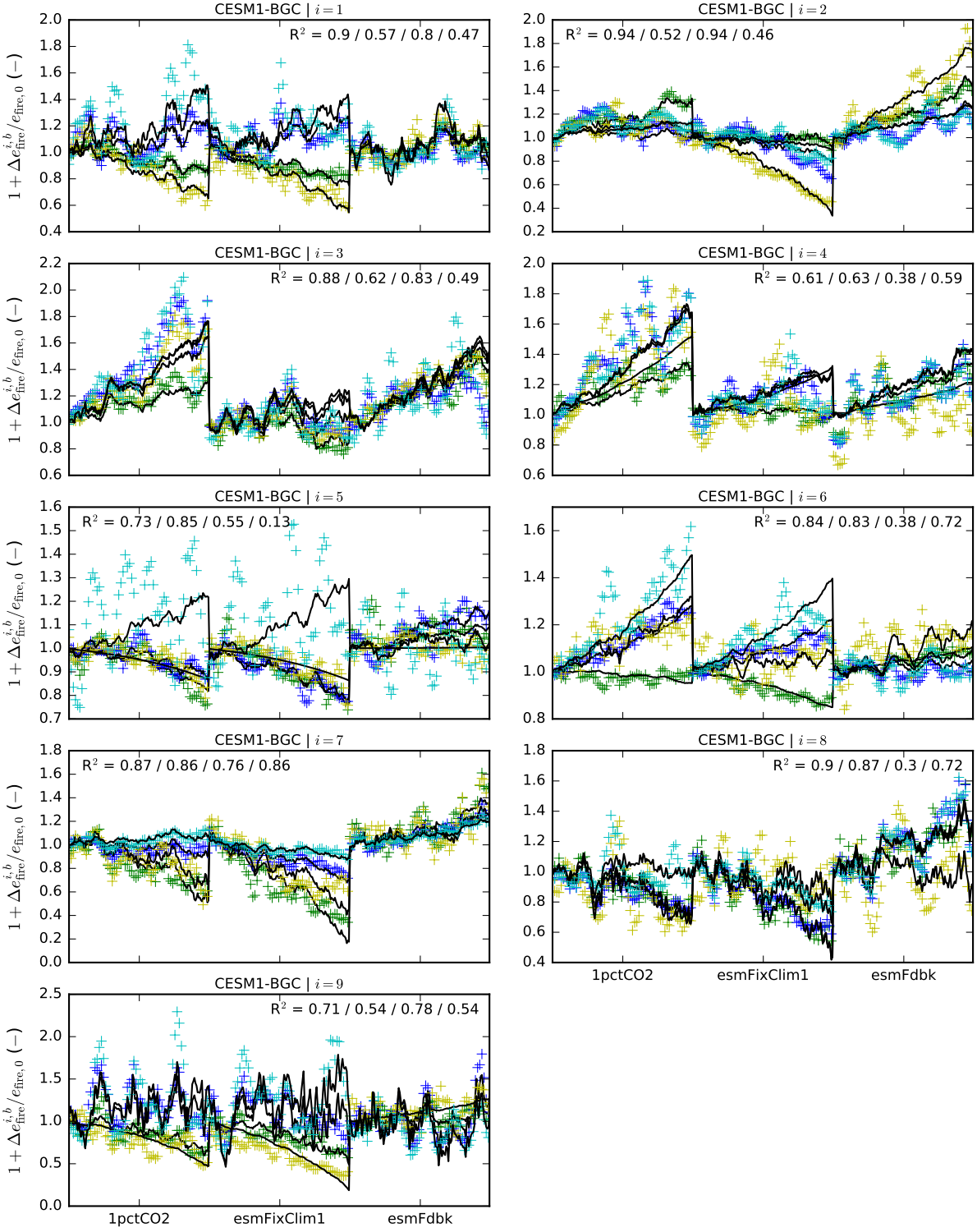

Figure S19. Fits of the parameters of the wildfire intensity response based on the "CESM1-BGC" model (section 2.3.2). Each panel is one of the nine regions (see figure S4), and the different colors are for the biomes: forest (green), mixed shrubland and grassland (blue), cropland (yellow), and pasture (cyan). The R^2 are given in this exact order. Decadal running means are shown; and the fits are the plain black lines.

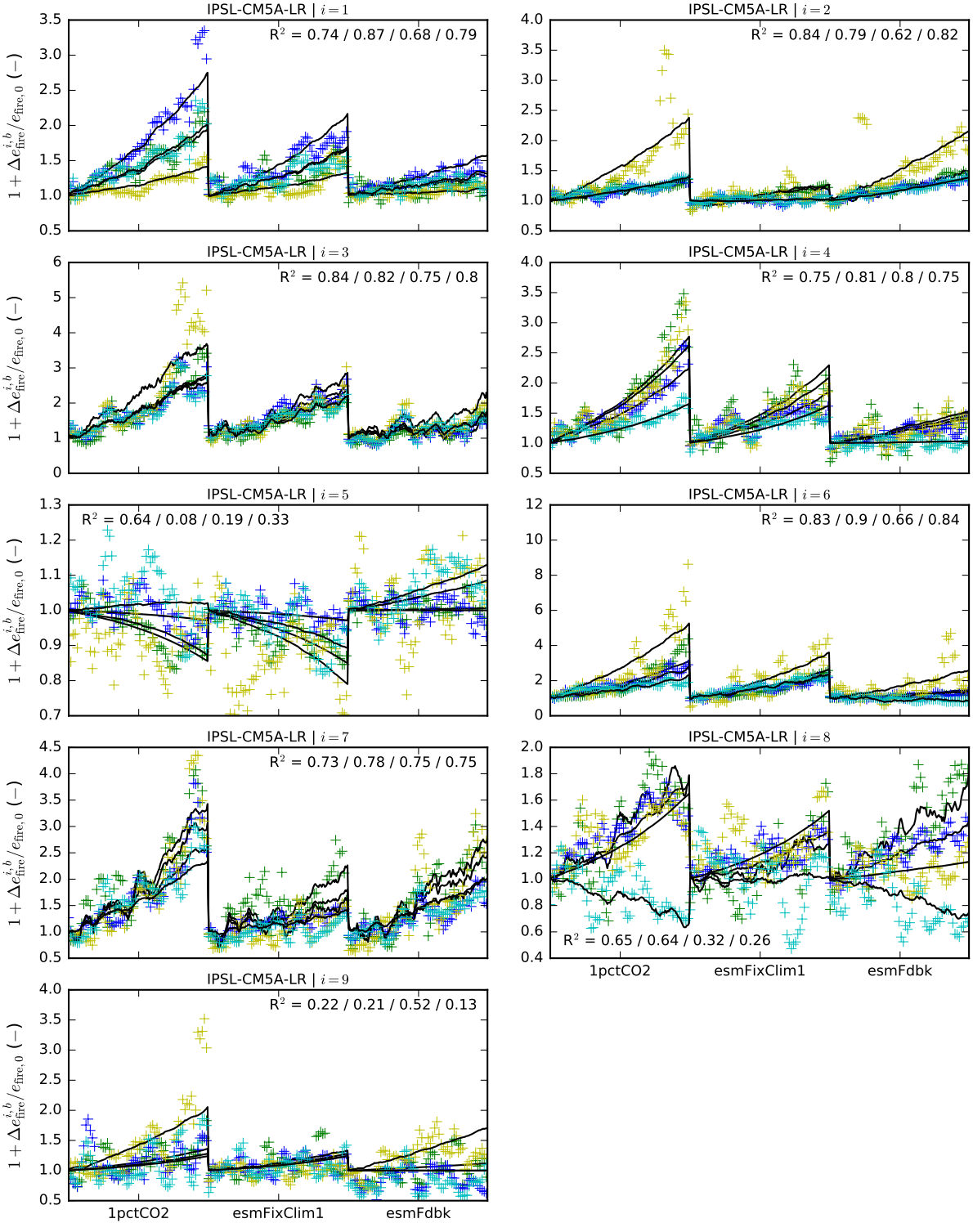

Figure S20. Same as figure S19 but for the "IPSL-CM5A-LR" model.

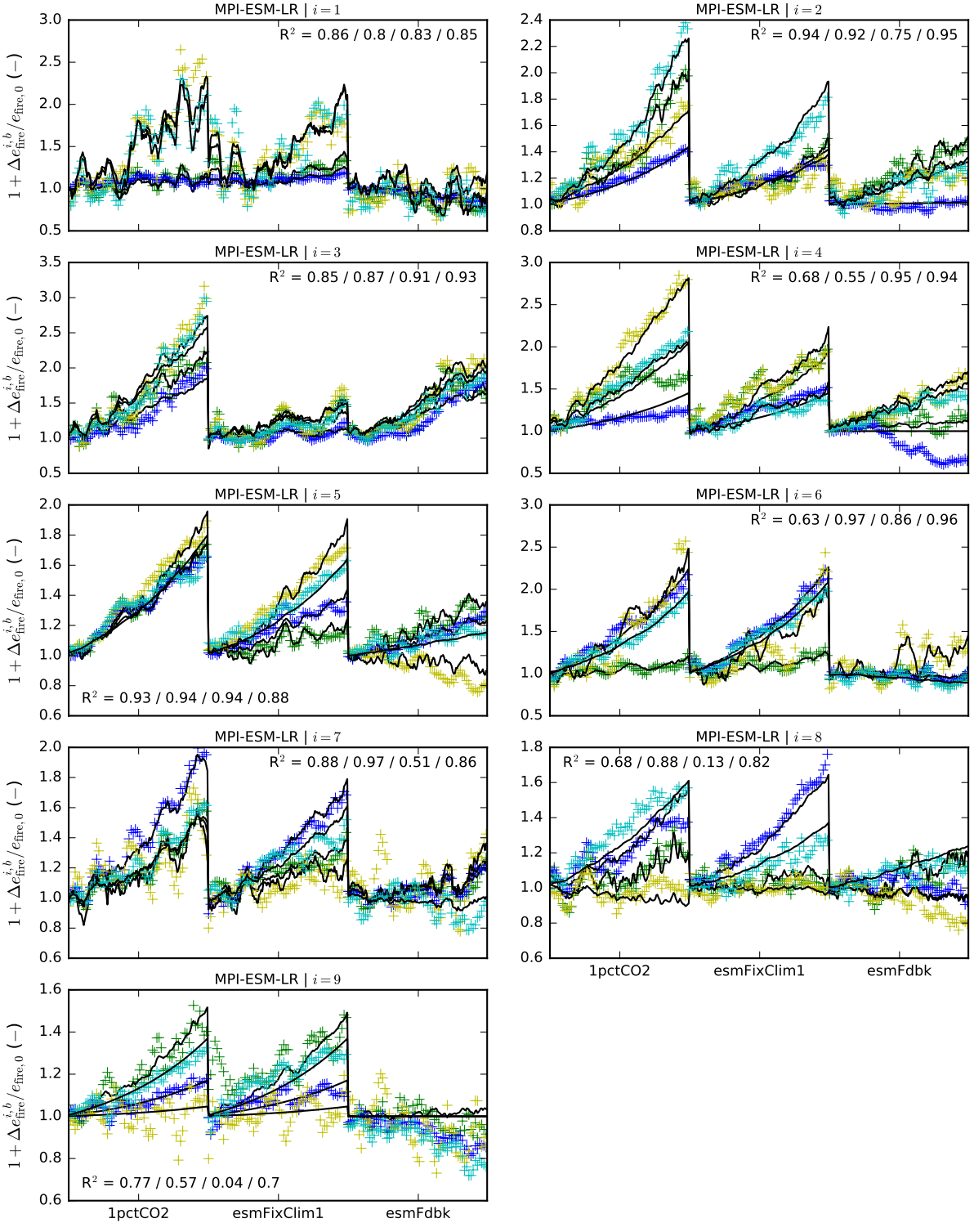

Figure S21. Same as figure S19 but for the "MPI-ESM-LR" model.

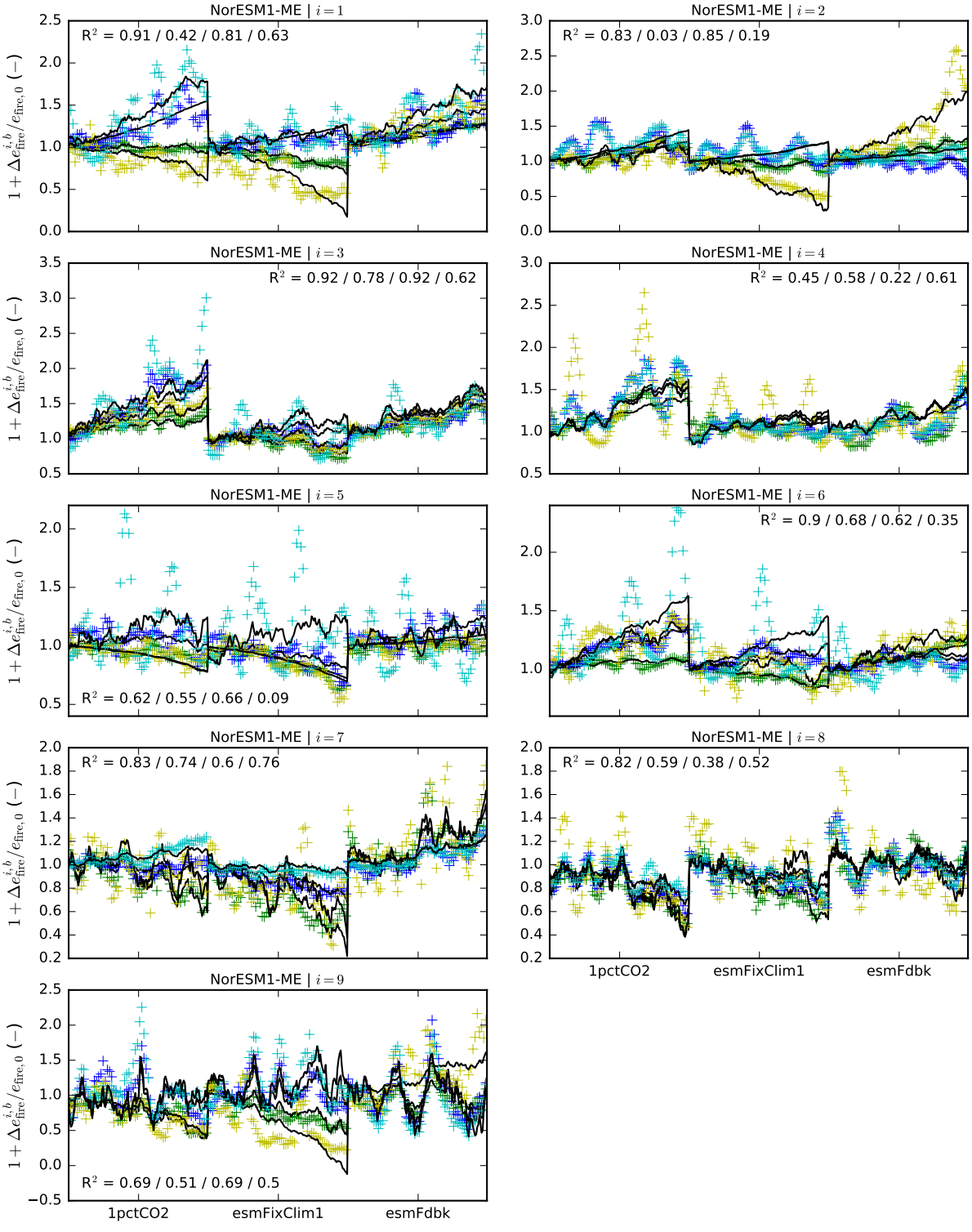

Figure S22. Same as figure S19 but for the "NorESM1-ME" model.

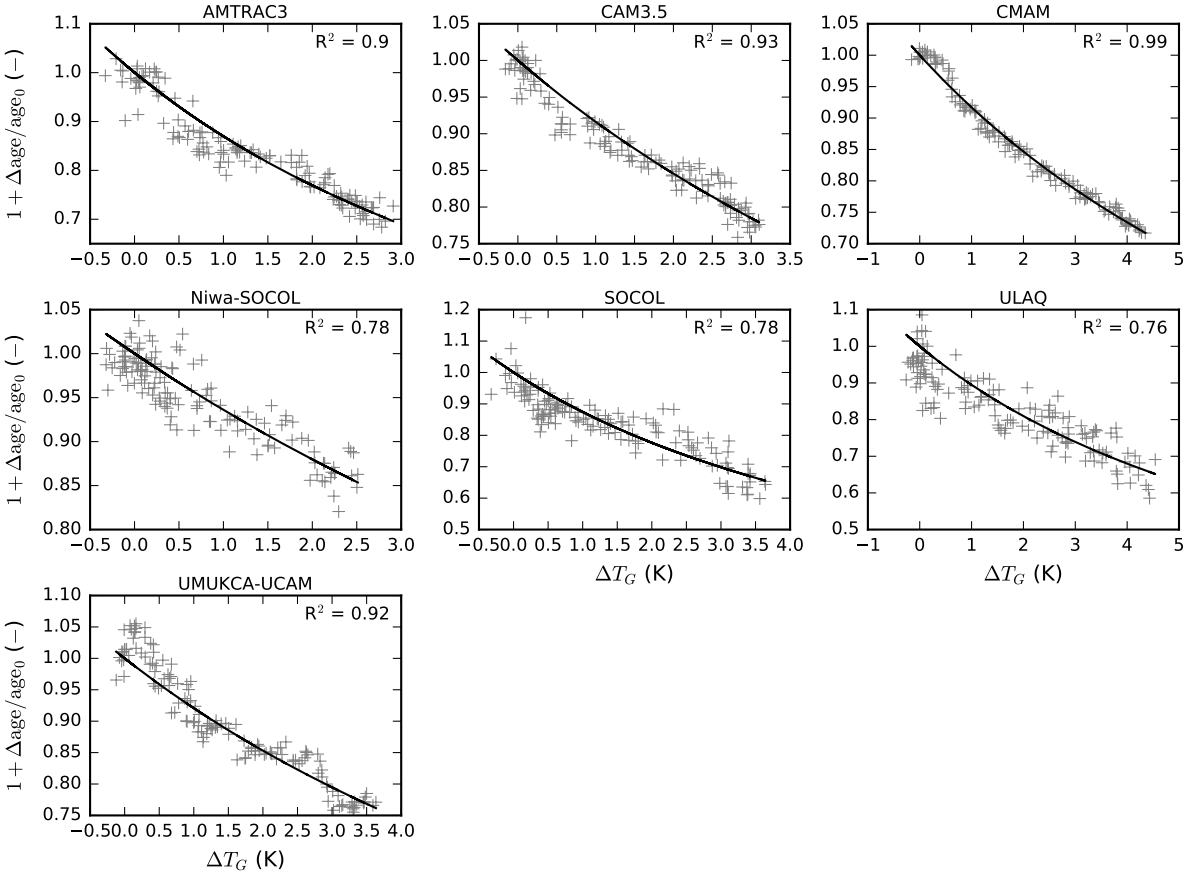

Figure S23. Fits of the parameter of the age of stratospheric air dependency on climate change (section 2.6.1).

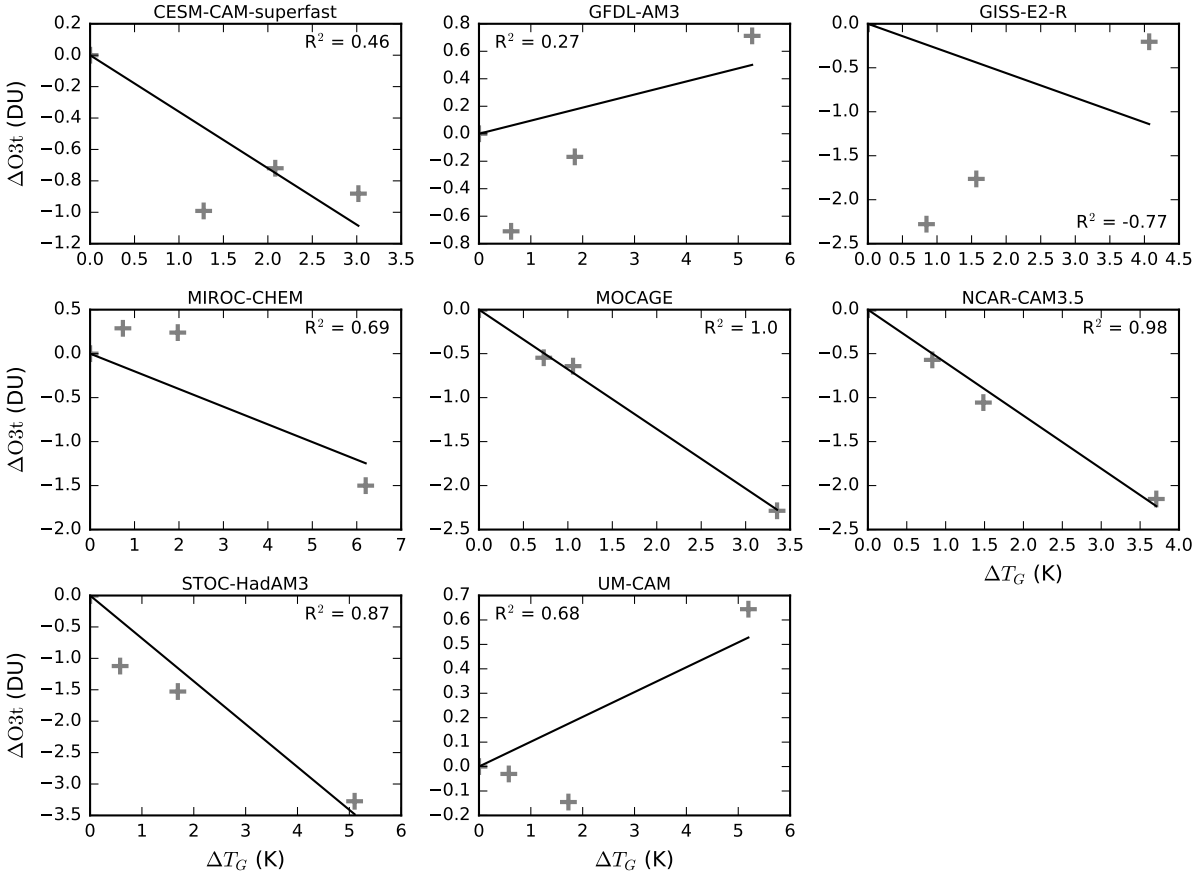

Figure S24. Fits of the parameter of the tropospheric ozone response to climate change (section 2.8.1).

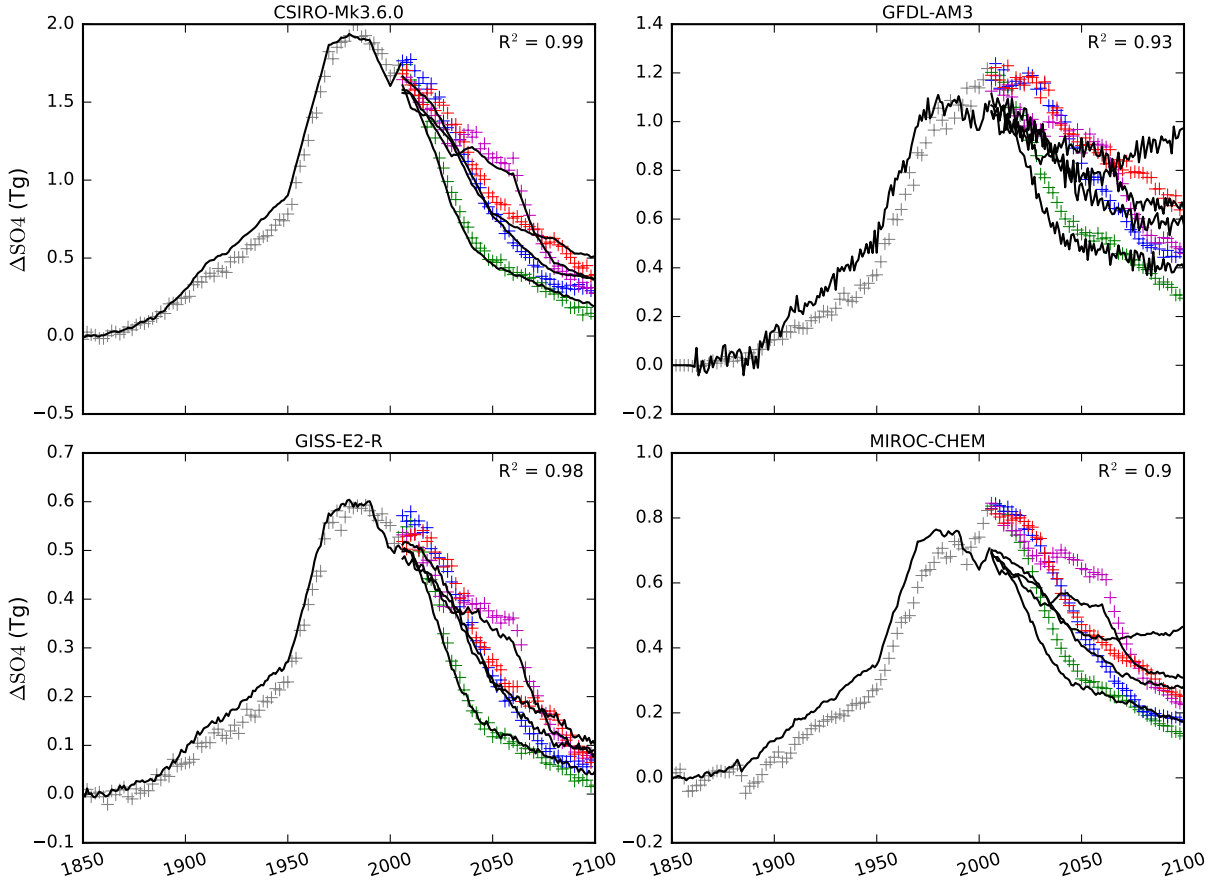

Figure S25. Fits of the parameters for the atmospheric burden of sulphated aerosols (section 2.9.1). The historical simulation from CMIP5 is in grey, while the RCP2.6 is in green, RCP4.5 in blue, RCP6.0 in magenta, and RCP8.5 in red.

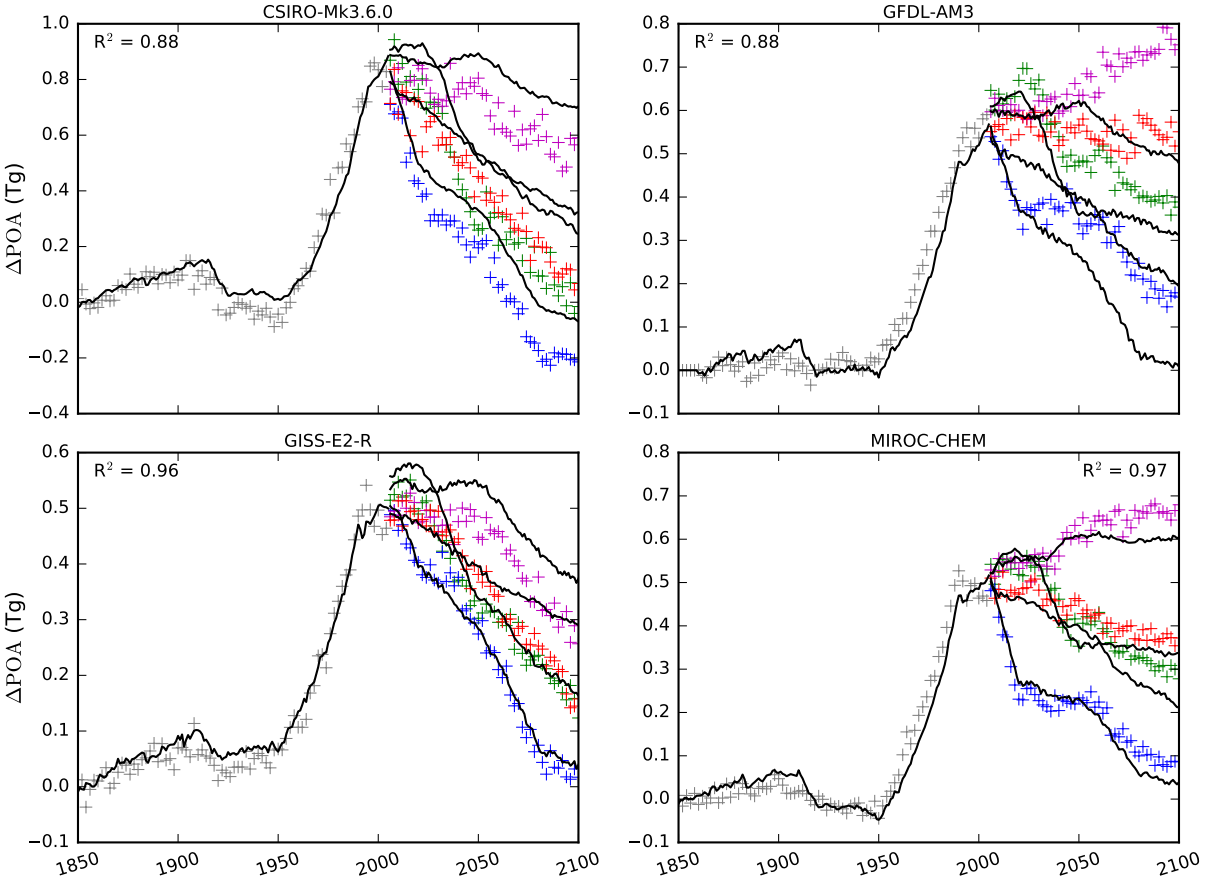

Figure S26. Same as figure S25 but for primary organic aerosols.

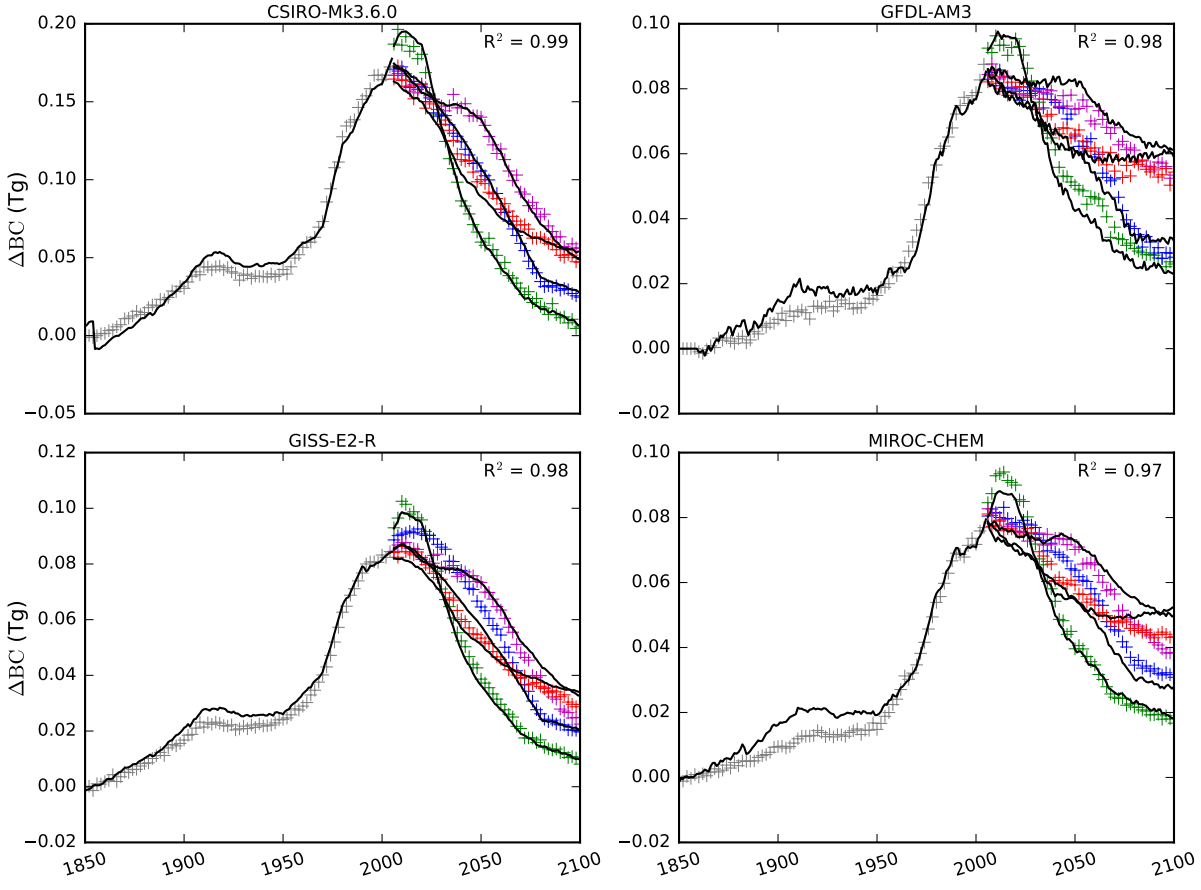

Figure S27. Same as figure S25 but for black carbon aerosols.

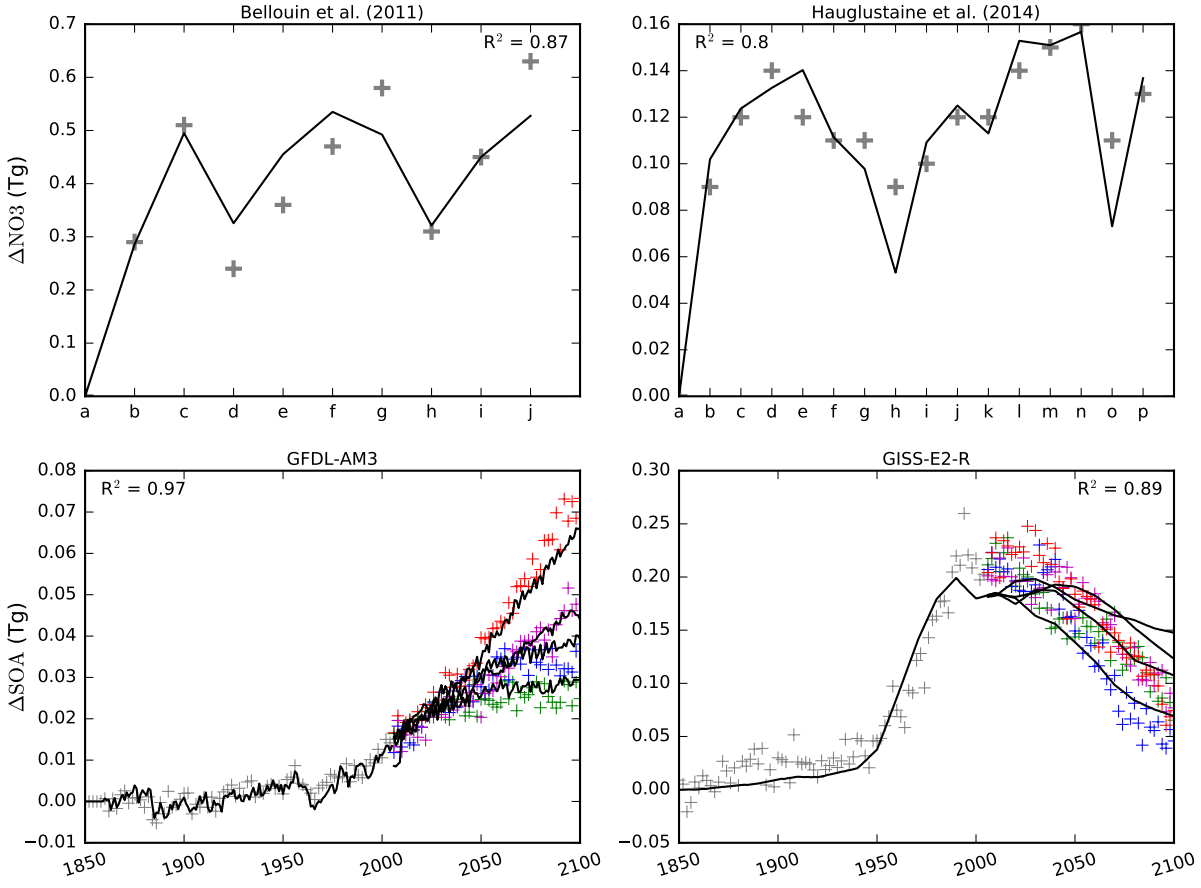

Figure S28. Same as figure S25 but for nitrated aerosols (top panels) and secondary organic aerosols (bottom panels). In the case nitrated aerosols, each letter on the *x*-axis corresponds to a simulation from the given reference.

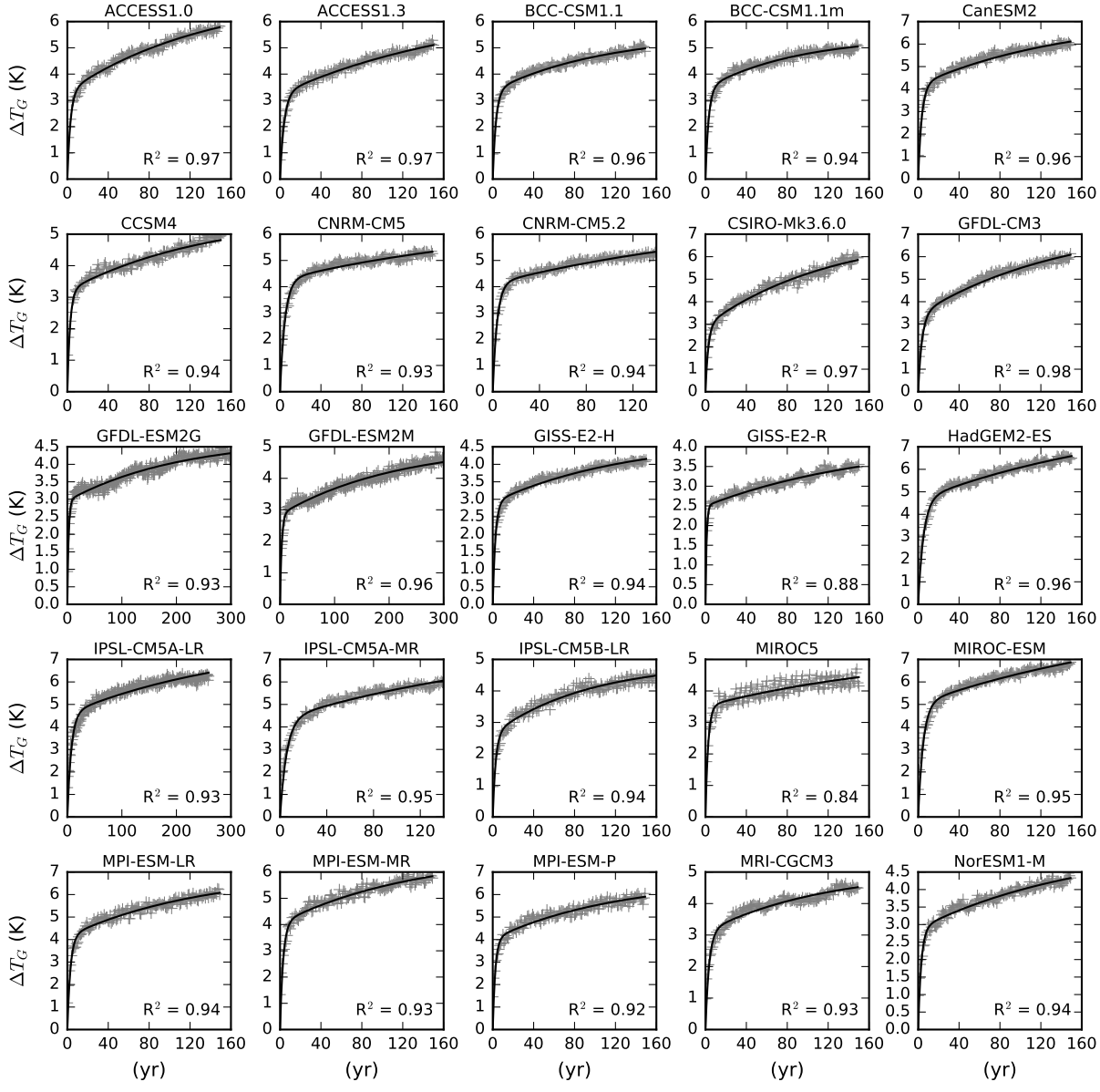

Figure S29. Fits of the parameters of the global surface temperature response (section 2.11.2).

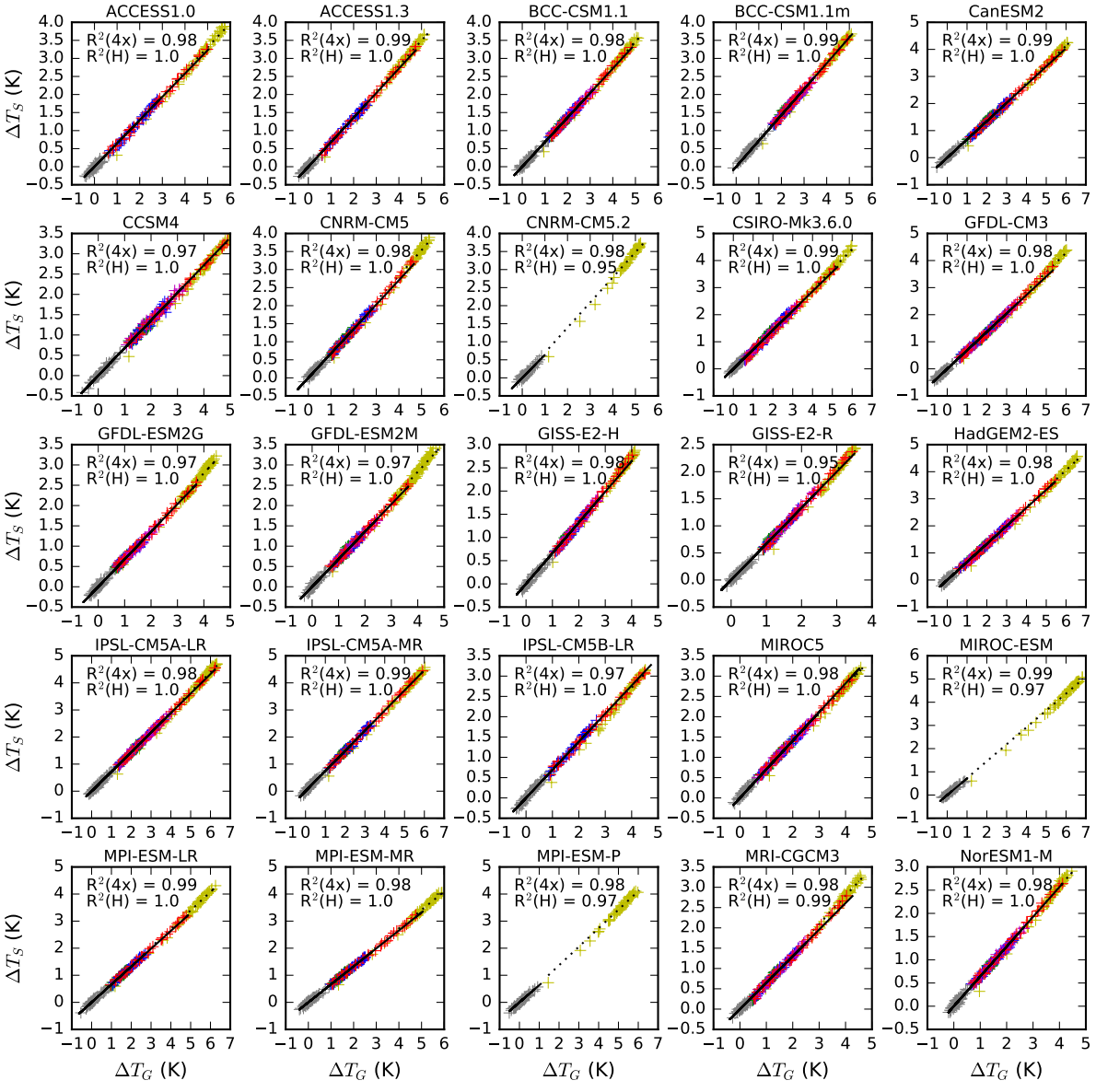

Figure S30. Fits of the parameter of the pattern scaling for sea surface temperature (section 2.11.2). The grey, green, blue, magenta and red points are from the historical, RCP2.6, RCP4.5, RCP6.0 and RCP8.5 simulations, respecitvely; the yellow ones are from the "abrupt4xCO2" simulation. The R^2 are given for fits made over the quadrupled CO_2 experiment (4x) or the combined historical and RCPs (H) – if these RCP simulations were conducted. The fits are the dotted and plain black lines, for the quadrupled CO_2 experiment and combined historical and RCPs respectively.

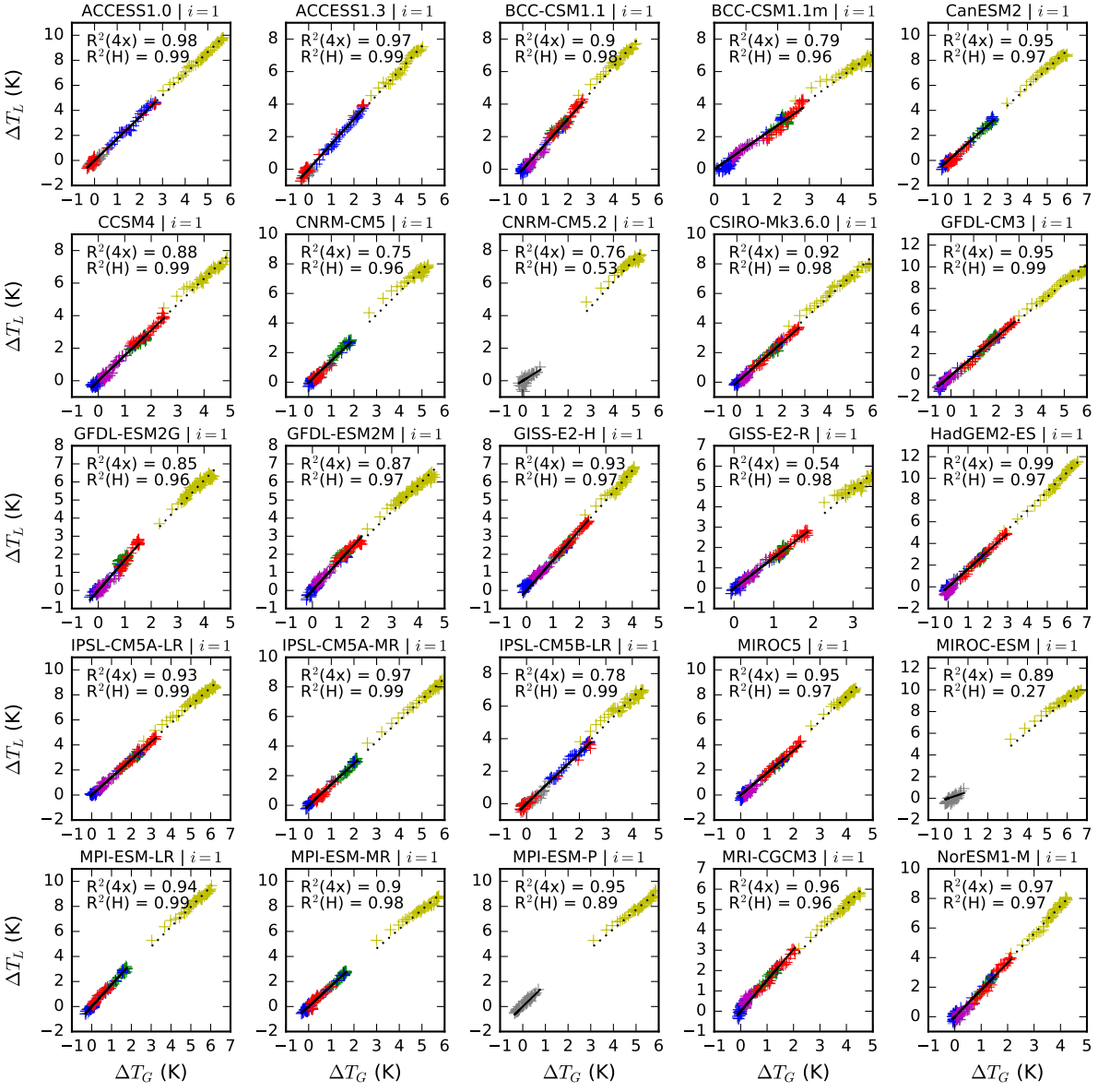

Figure S31. Same as figure S30 but for local surface temperature in region $i = 1$, and except that decadal running means are shown.

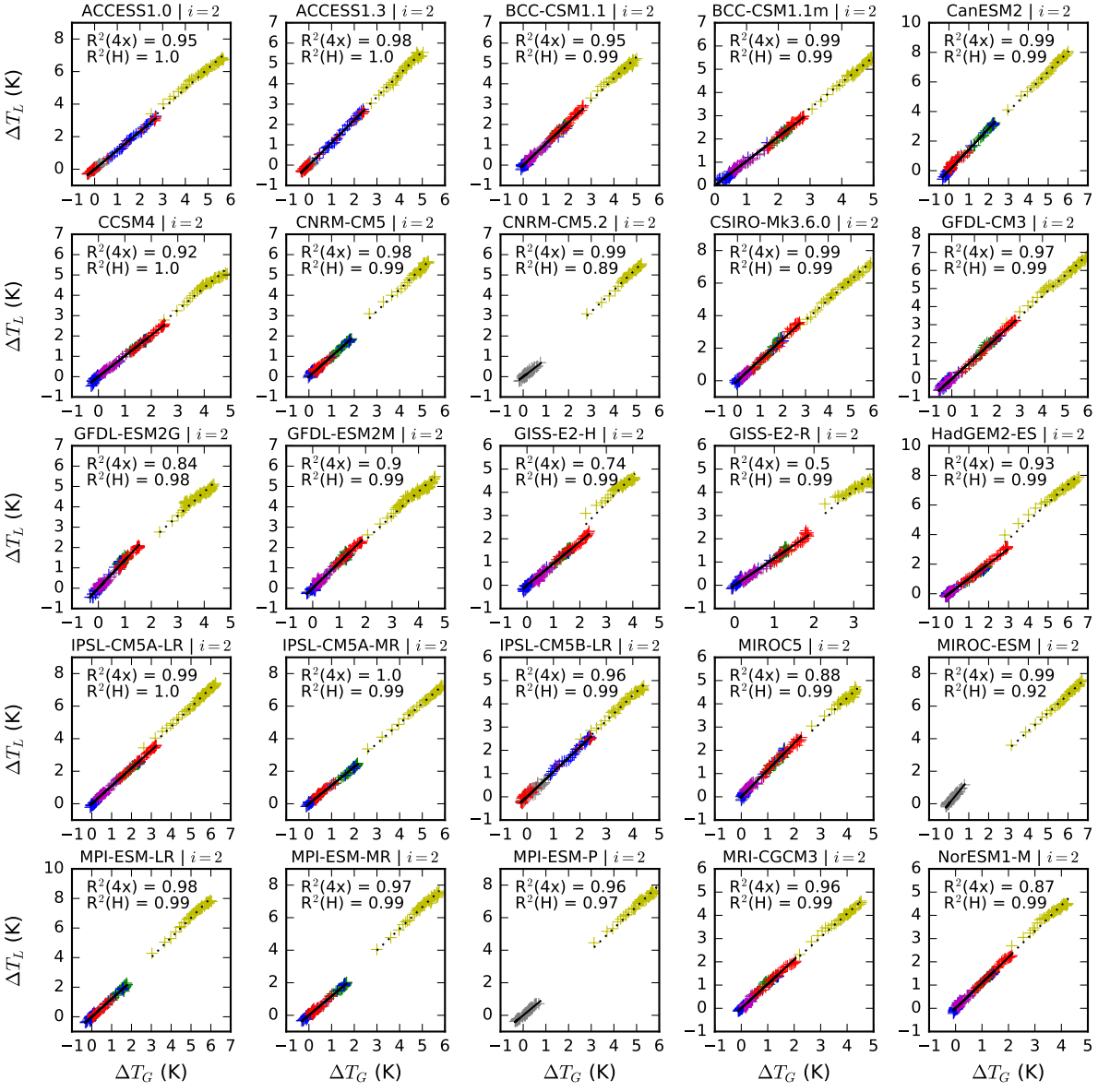

Figure S32. Same as figure S30 but for local surface temperature in region $i = 2$, and except that decadal running means are shown.

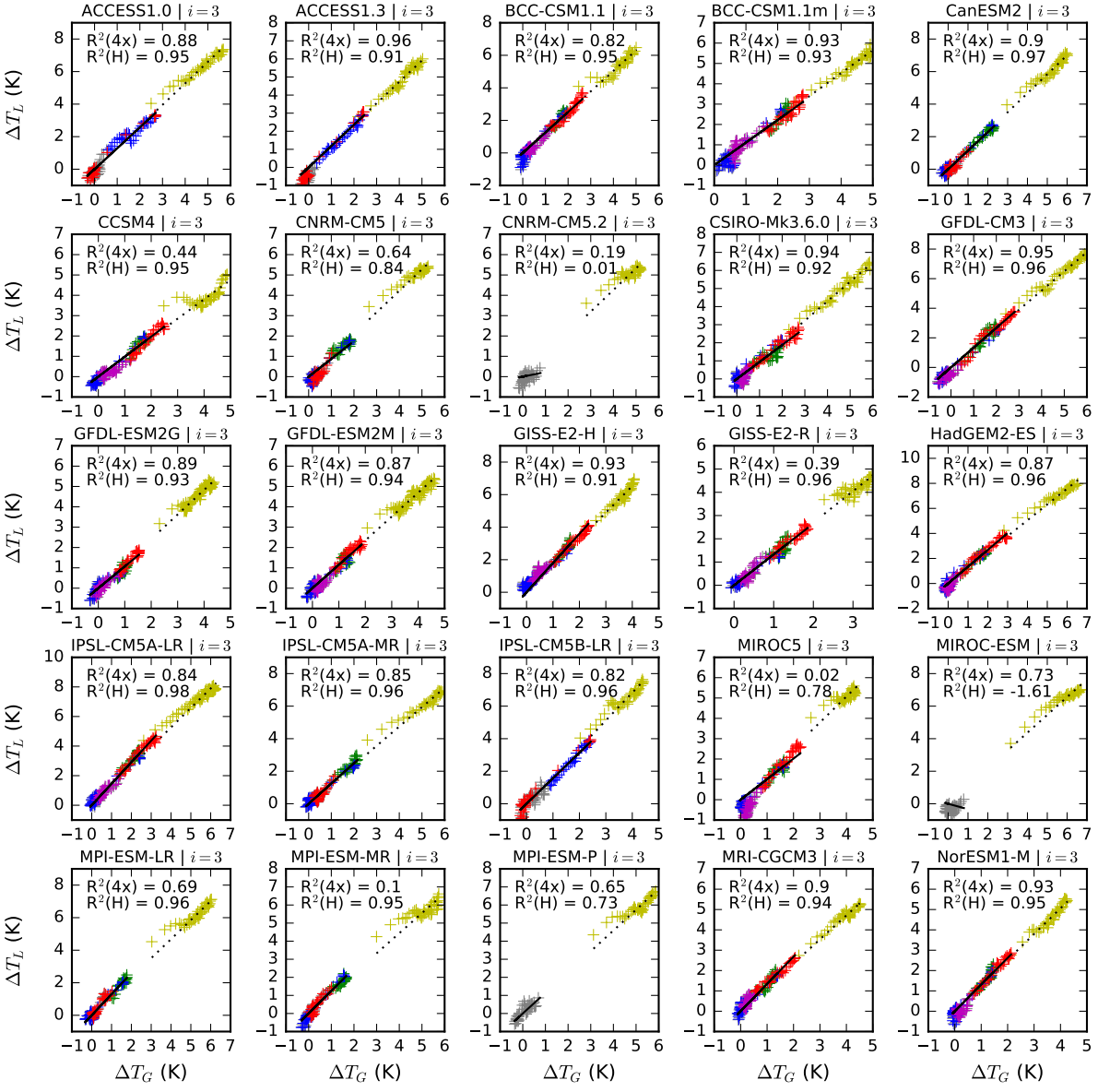

Figure S33. Same as figure S30 but for local surface temperature in region $i = 3$, and except that decadal running means are shown.

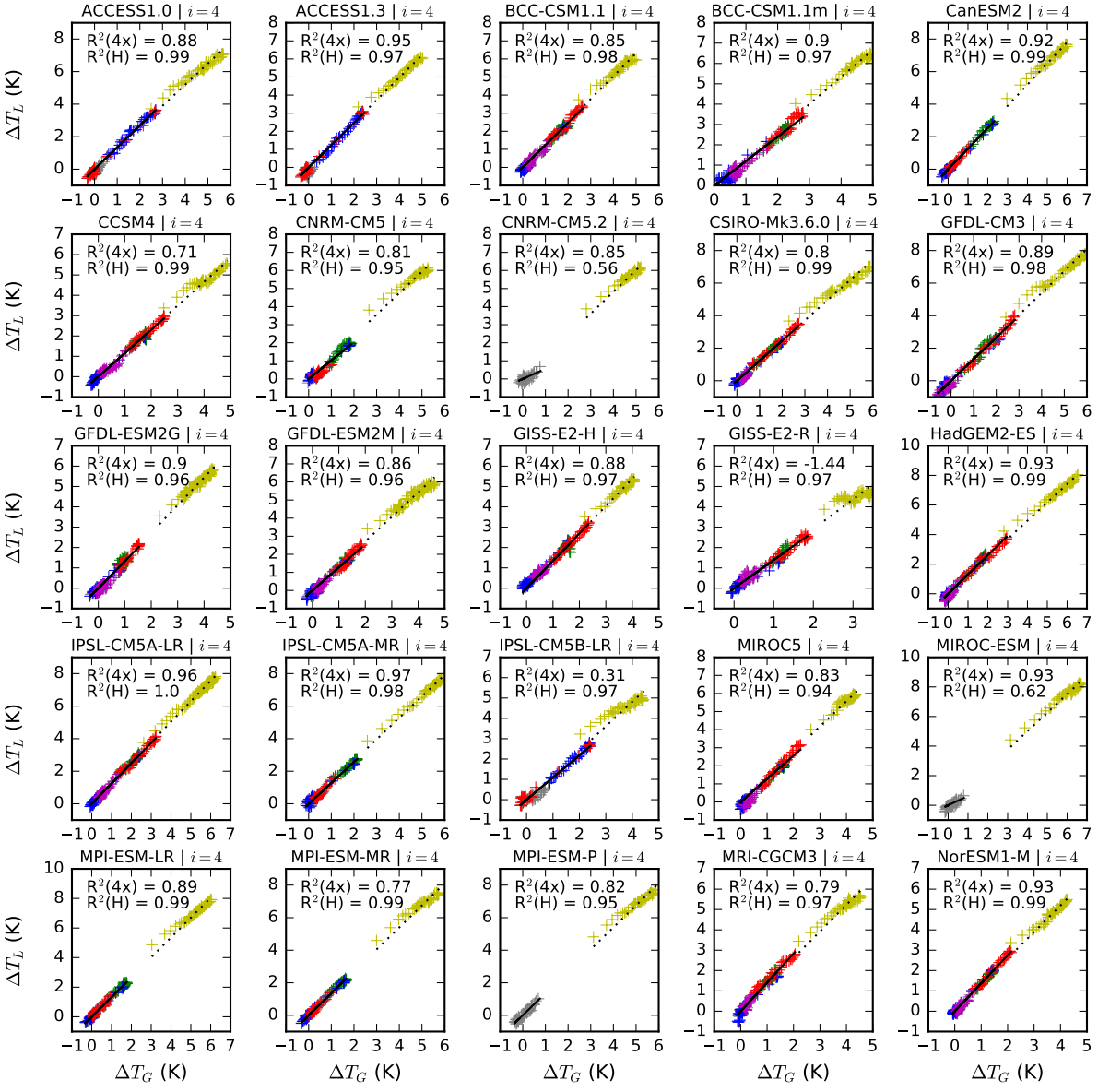

Figure S34. Same as figure S30 but for local surface temperature in region $i = 4$, and except that decadal running means are shown.

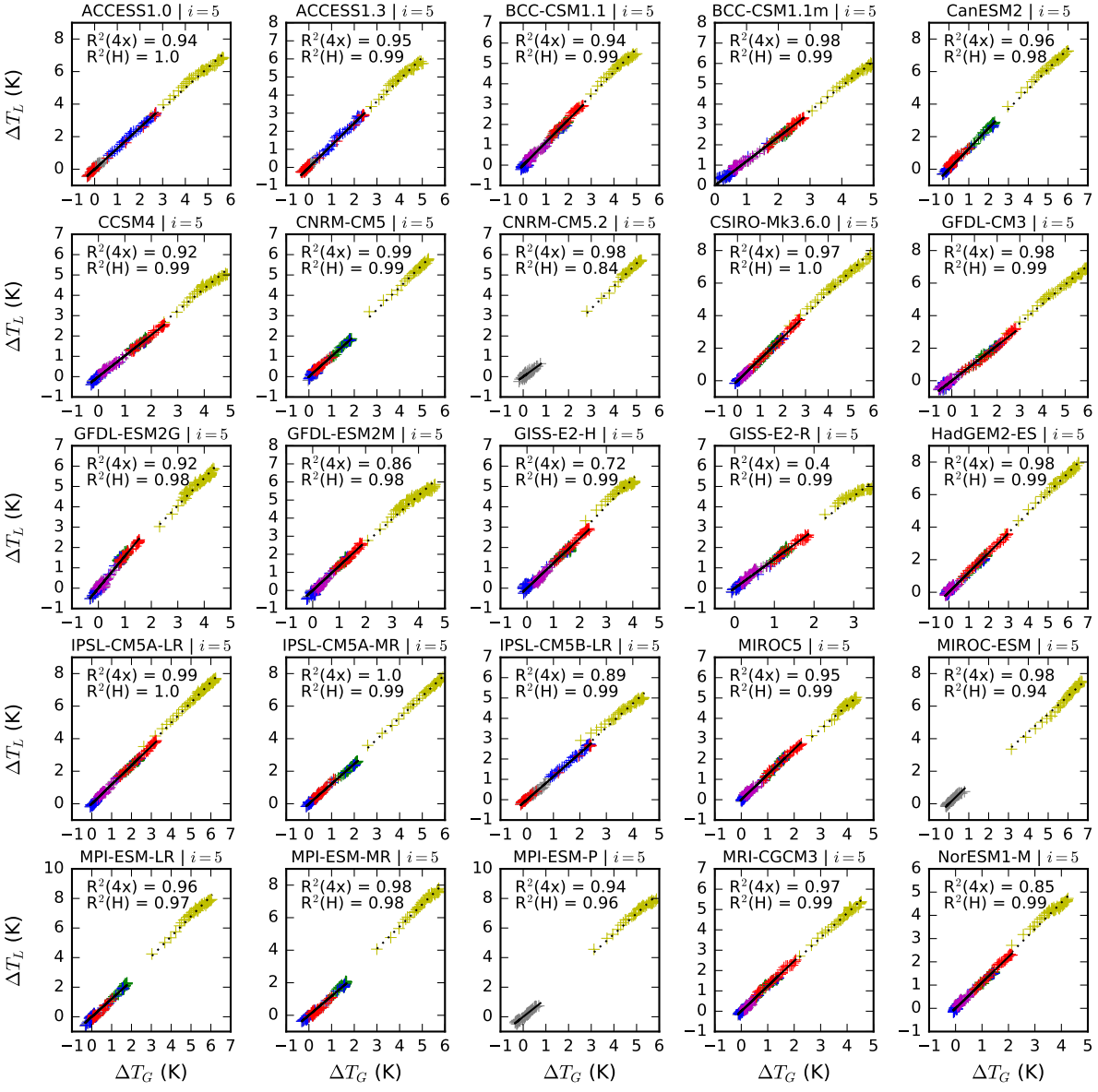

Figure S35. Same as figure S30 but for local surface temperature in region $i = 5$, and except that decadal running means are shown.

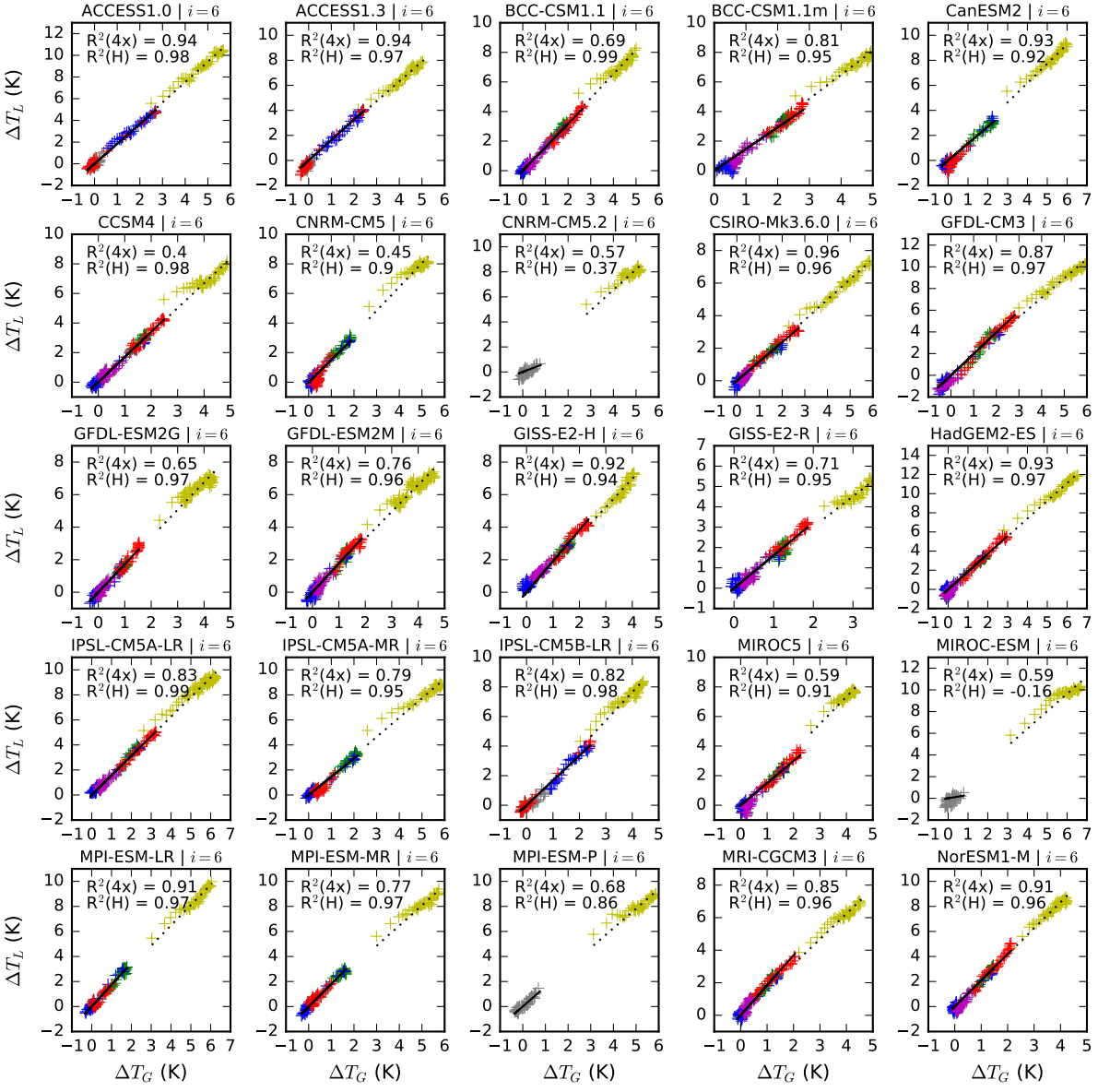

Figure S36. Same as figure S30 but for local surface temperature in region $i = 6$, and except that decadal running means are shown.

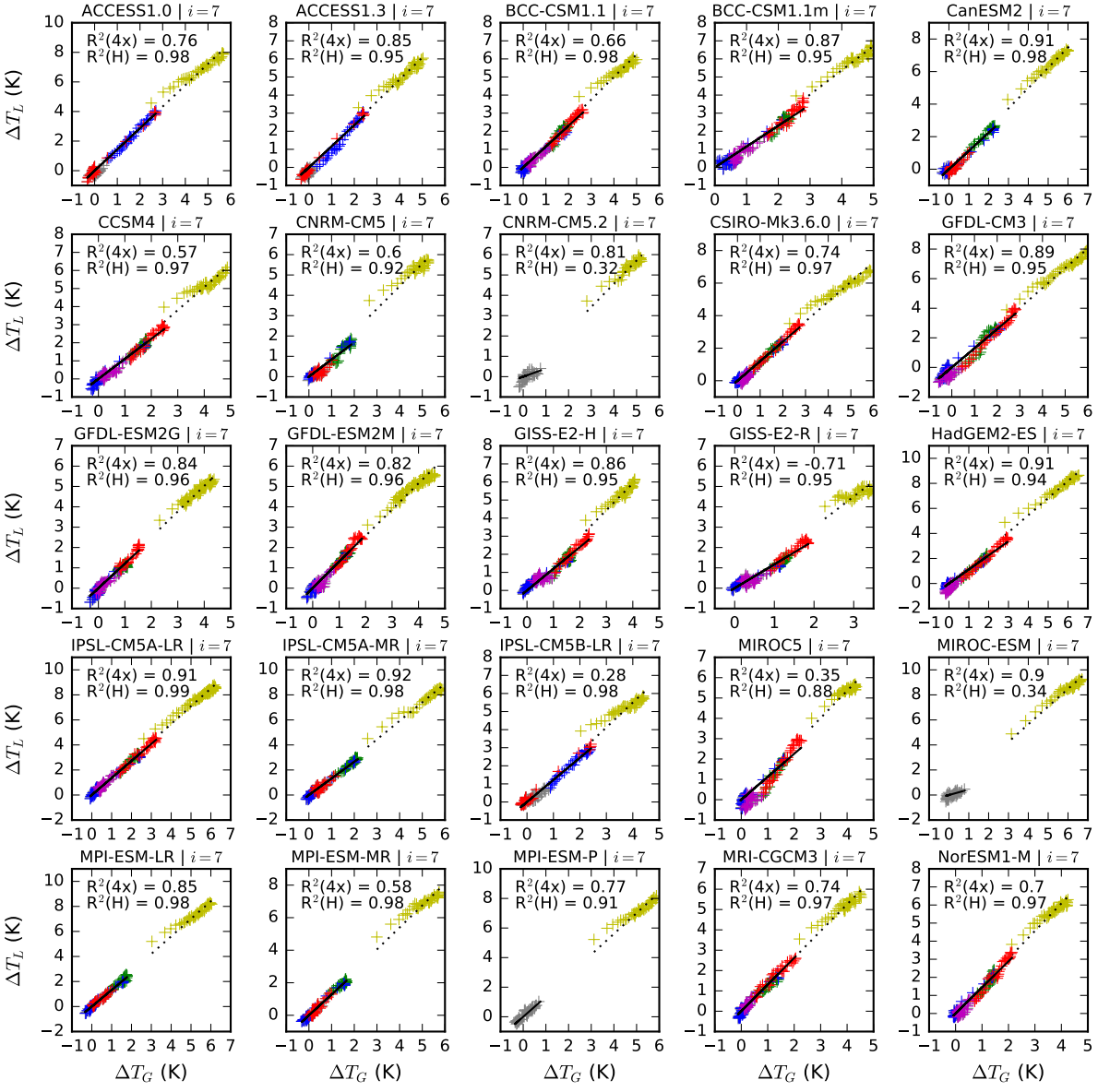

Figure S37. Same as figure S30 but for local surface temperature in region $i = 7$, and except that decadal running means are shown.

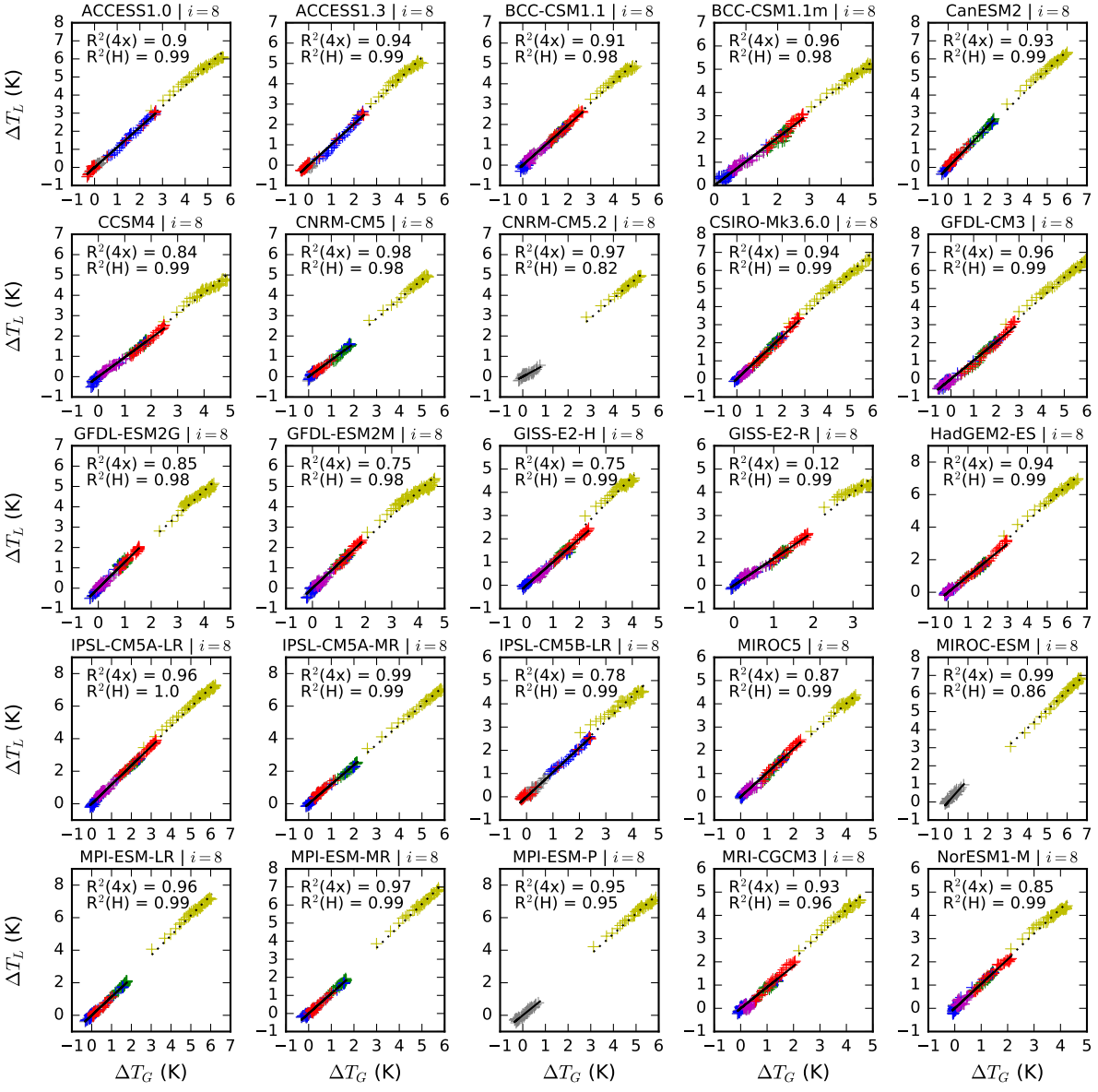

Figure S38. Same as figure S30 but for local surface temperature in region $i = 8$, and except that decadal running means are shown.

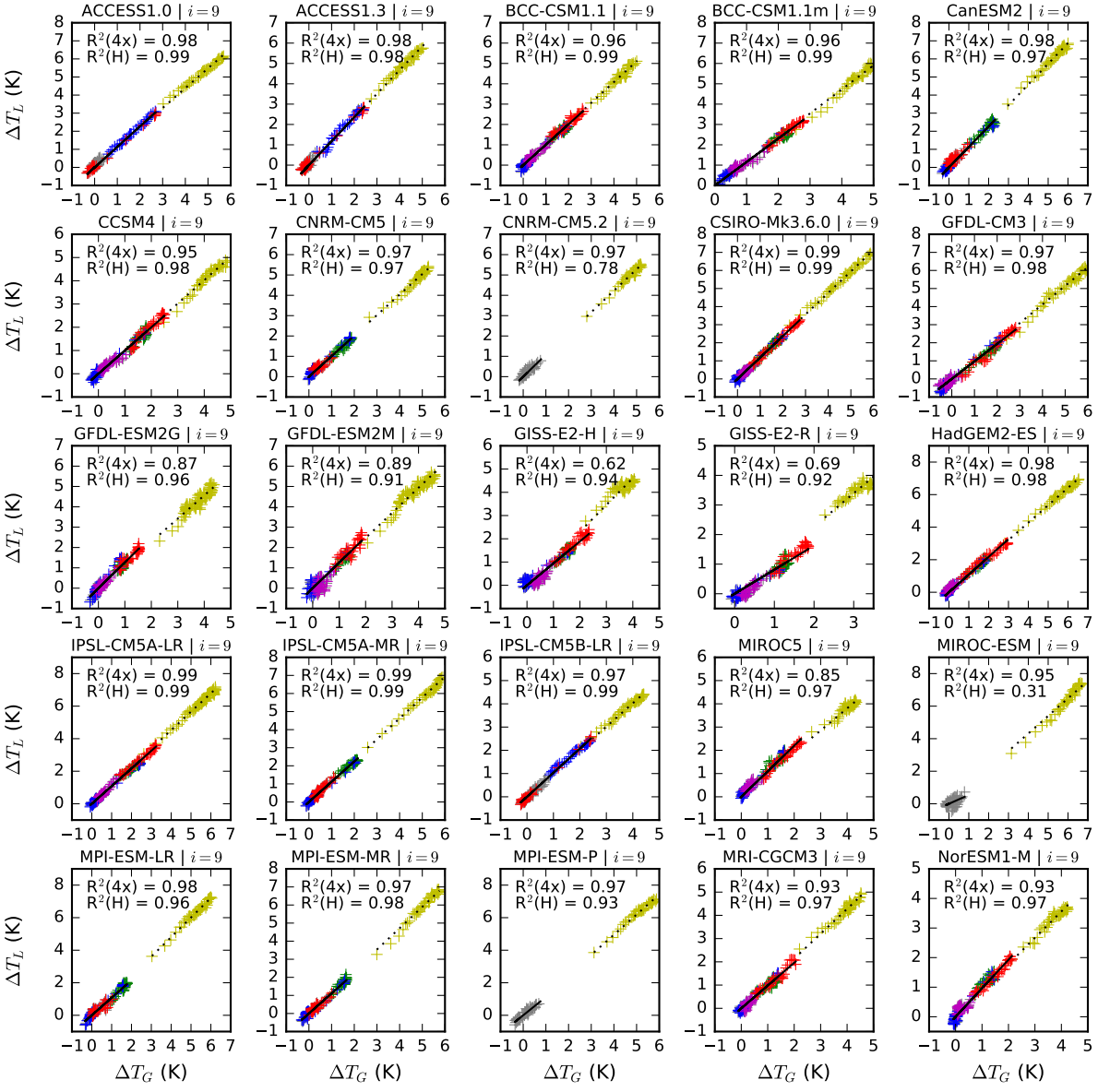

Figure S39. Same as figure S30 but for local surface temperature in region $i = 9$, and except that decadal running means are shown.

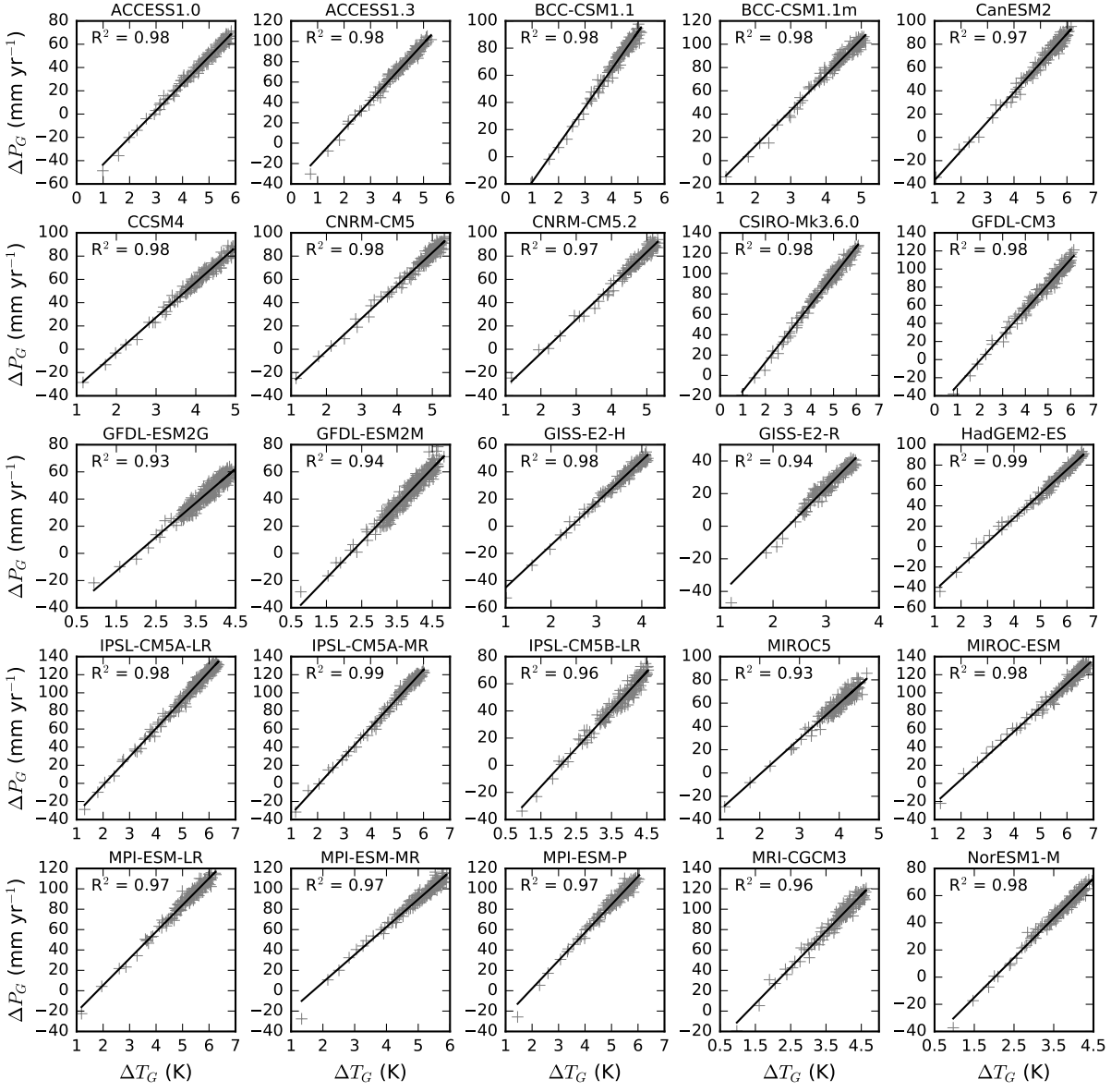

Figure S40. Fits of the parameters of the global yearly precipitations response (section 2.11.3).

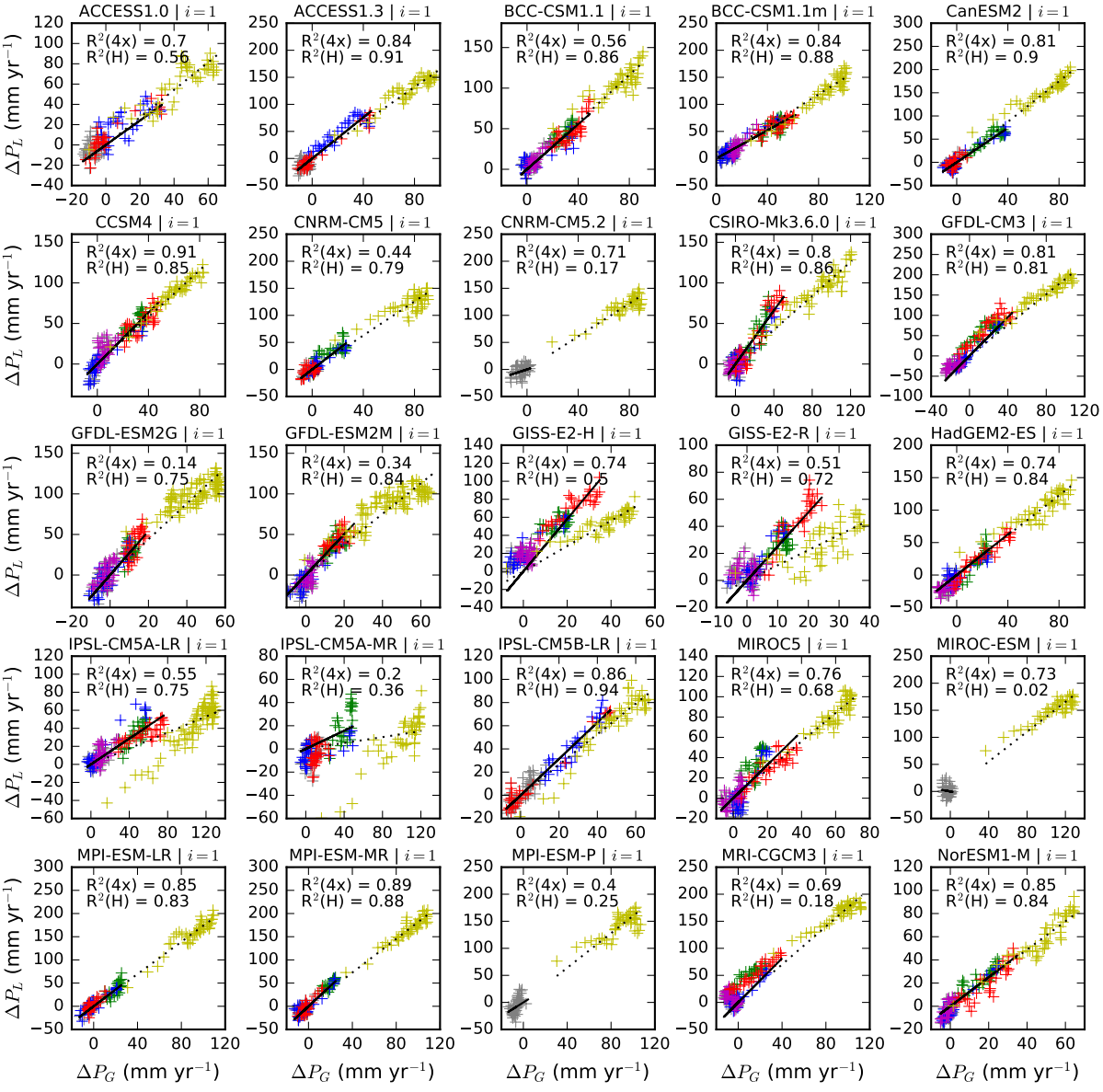

Figure S41. Fits of the parameter of the pattern scaling for local yearly precipitations (section 2.11.3). The grey, green, blue, magenta and red points are from the historical, RCP2.6, RCP4.5, RCP6.0 and RCP8.5 simulations, respecitvely; the yellow ones are from the "abrupt4xCO2" simulation. The R^2 are given for fits made over the quadrupled CO_2 experiment (4x) or the combined historical and RCPs (H) – if these RCP simulations were conducted. Decadal running means are shown; and the fits are the dotted and plain black lines, for the quadrupled CO_2 experiment and combined historical and RCPs respectively.

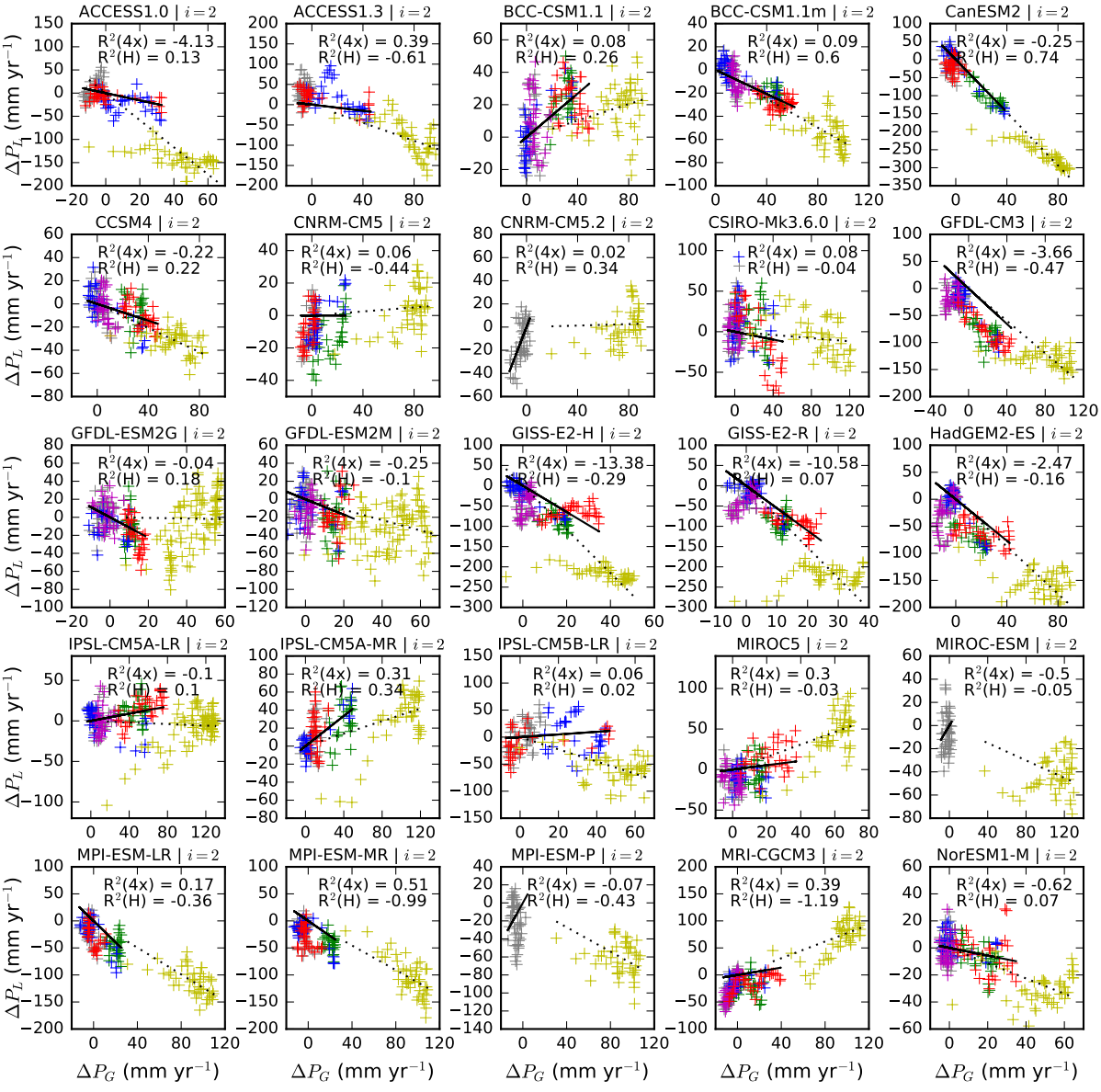

Figure S42. Same as figure S40 but for local yearly precipitations in region $i = 2$.

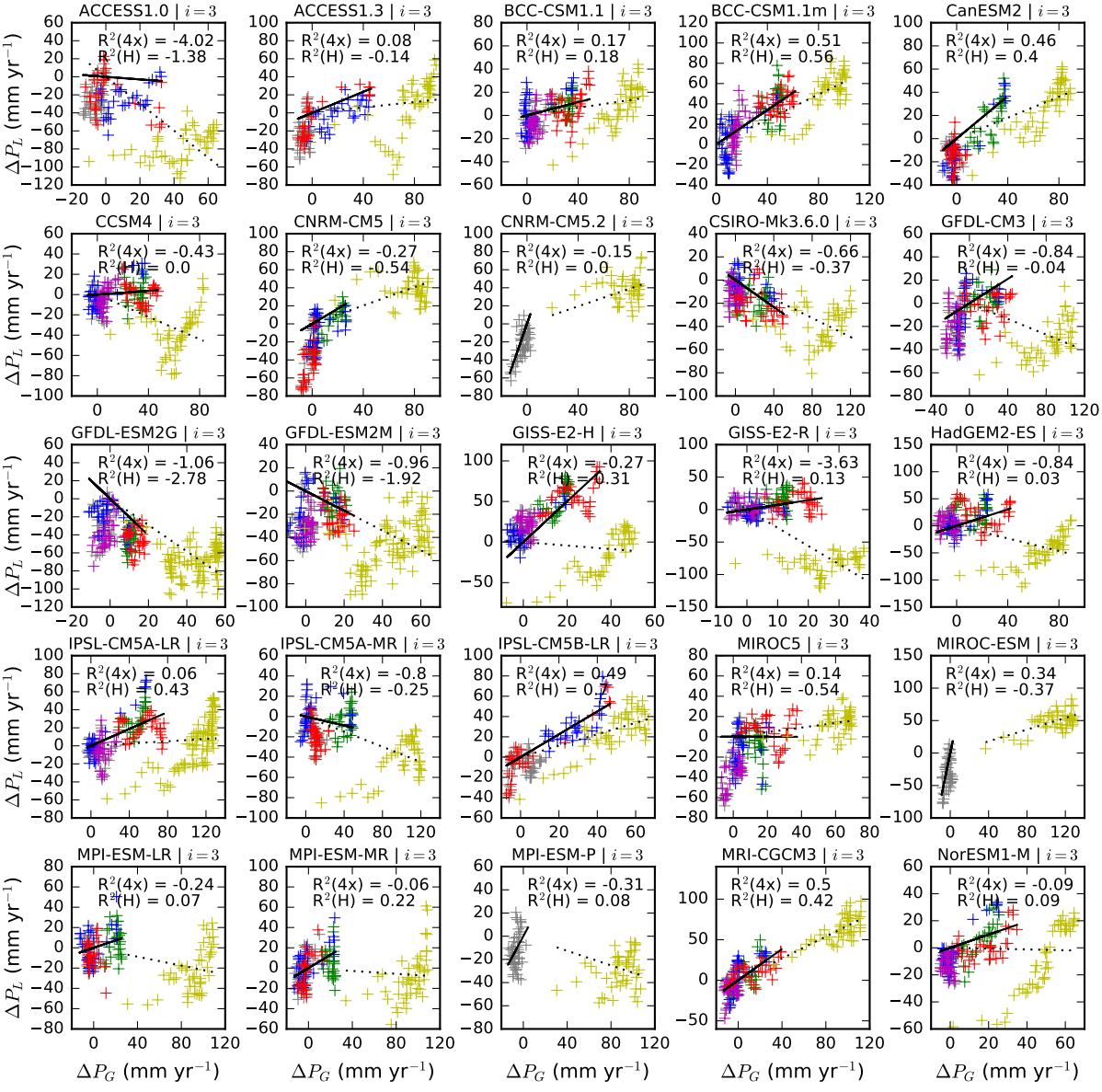

Figure S43. Same as figure S40 but for local yearly precipitations in region $i = 3$.

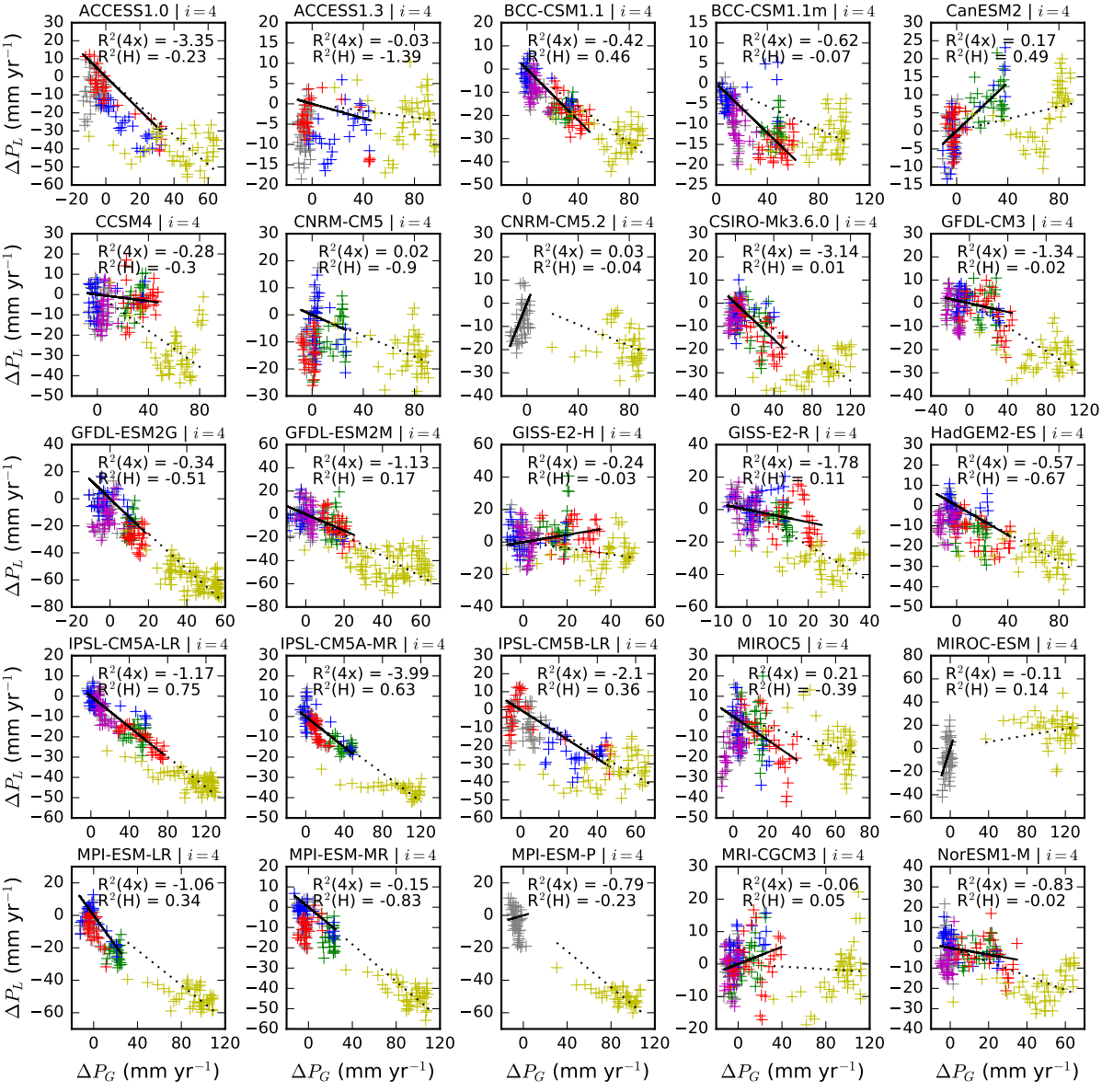

Figure S44. Same as figure S40 but for local yearly precipitations in region $i = 4$.

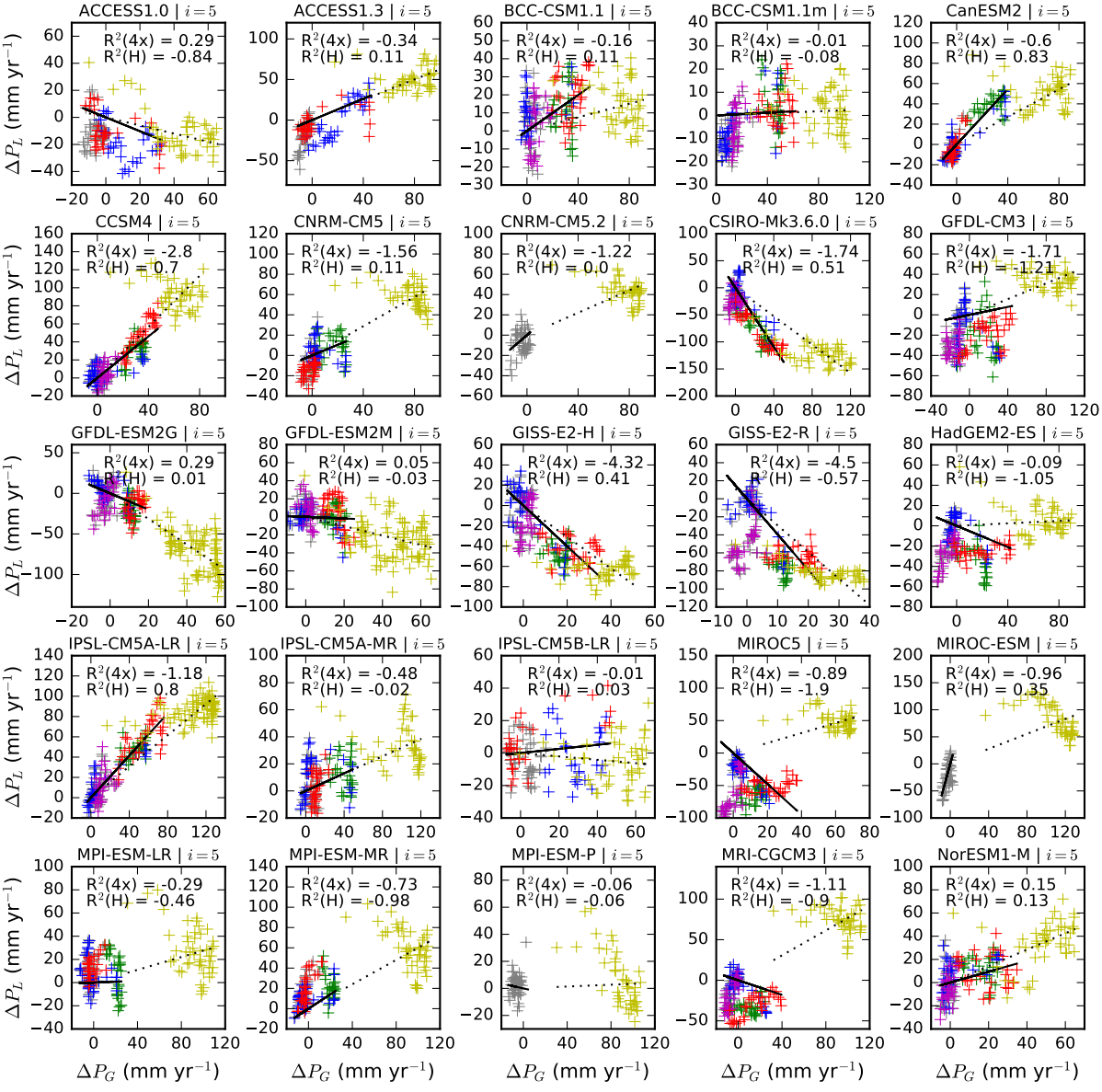

Figure S45. Same as figure S40 but for local yearly precipitations in region $i = 5$.

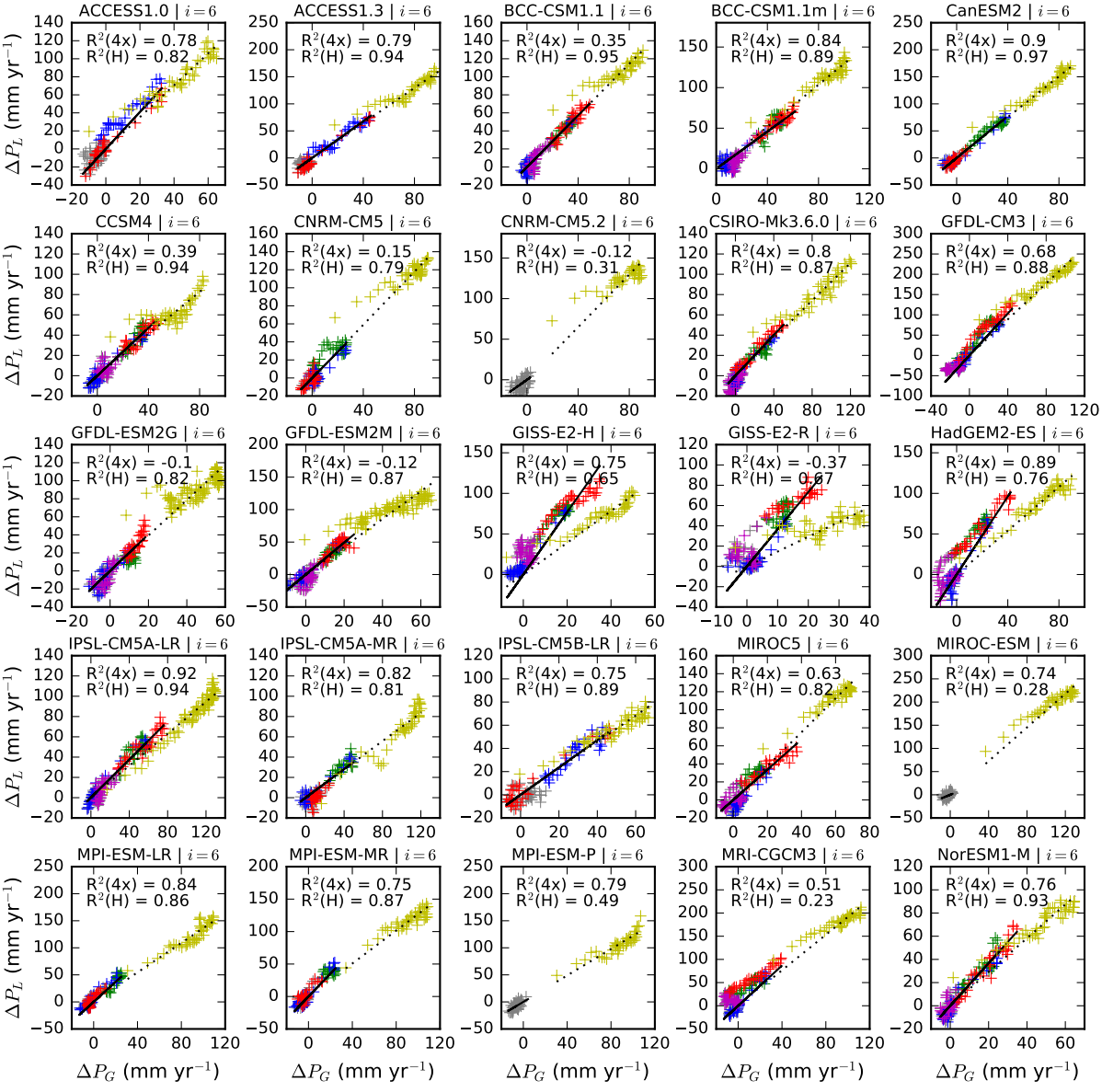

Figure S46. Same as figure S40 but for local yearly precipitations in region $i = 6$.

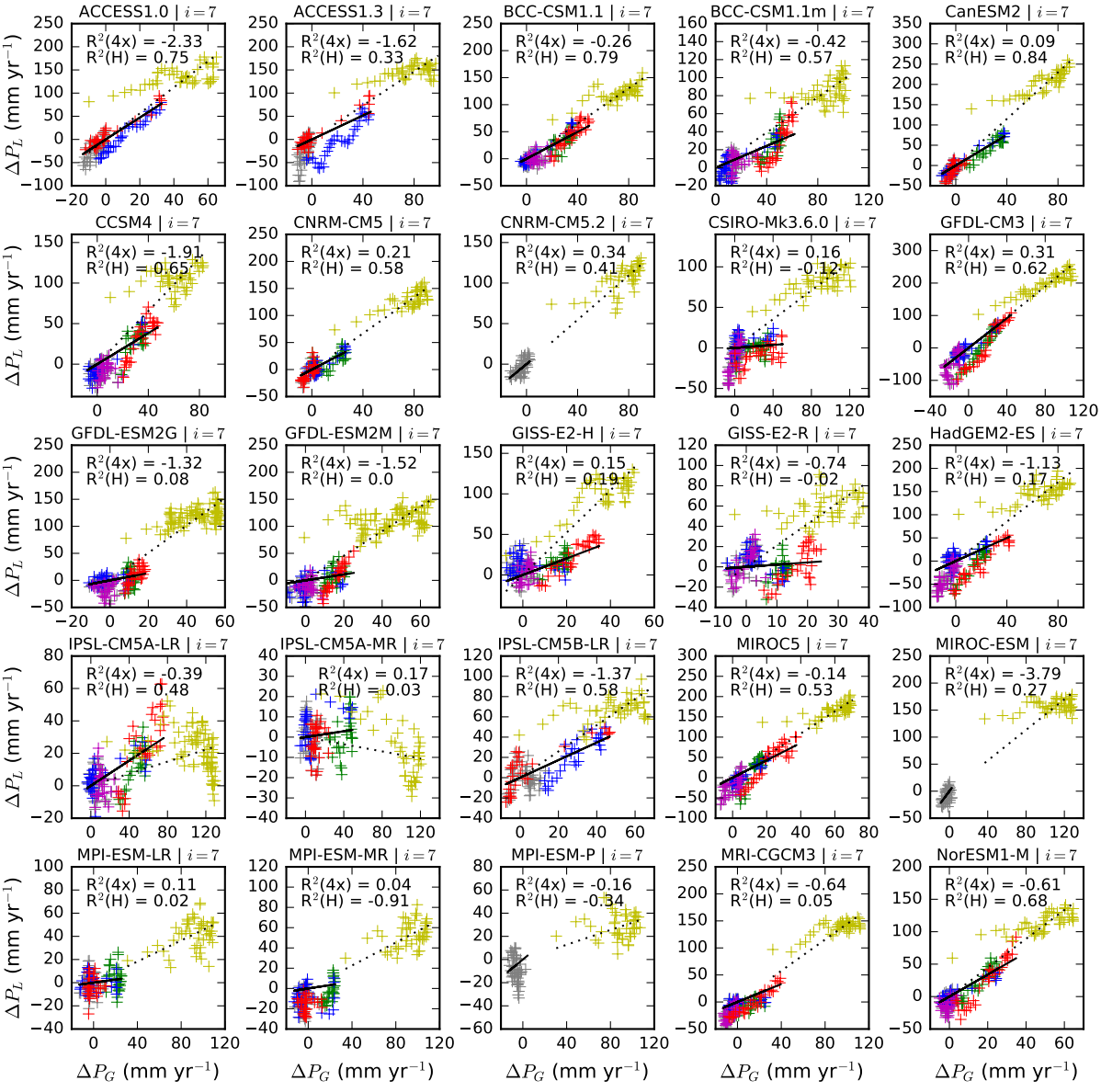

Figure S47. Same as figure S40 but for local yearly precipitations in region $i = 7$.

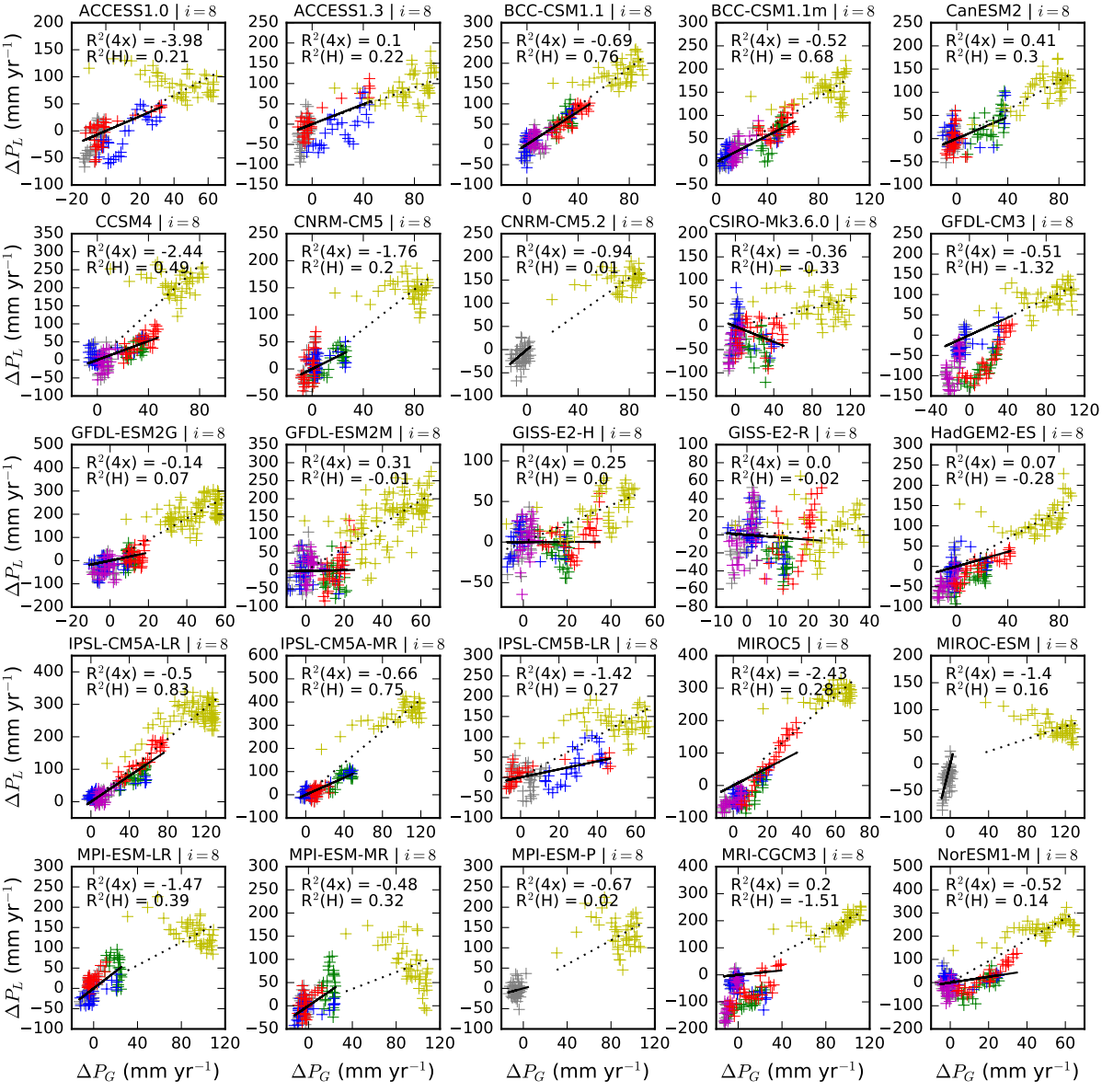

Figure S48. Same as figure S40 but for local yearly precipitations in region $i = 8$.

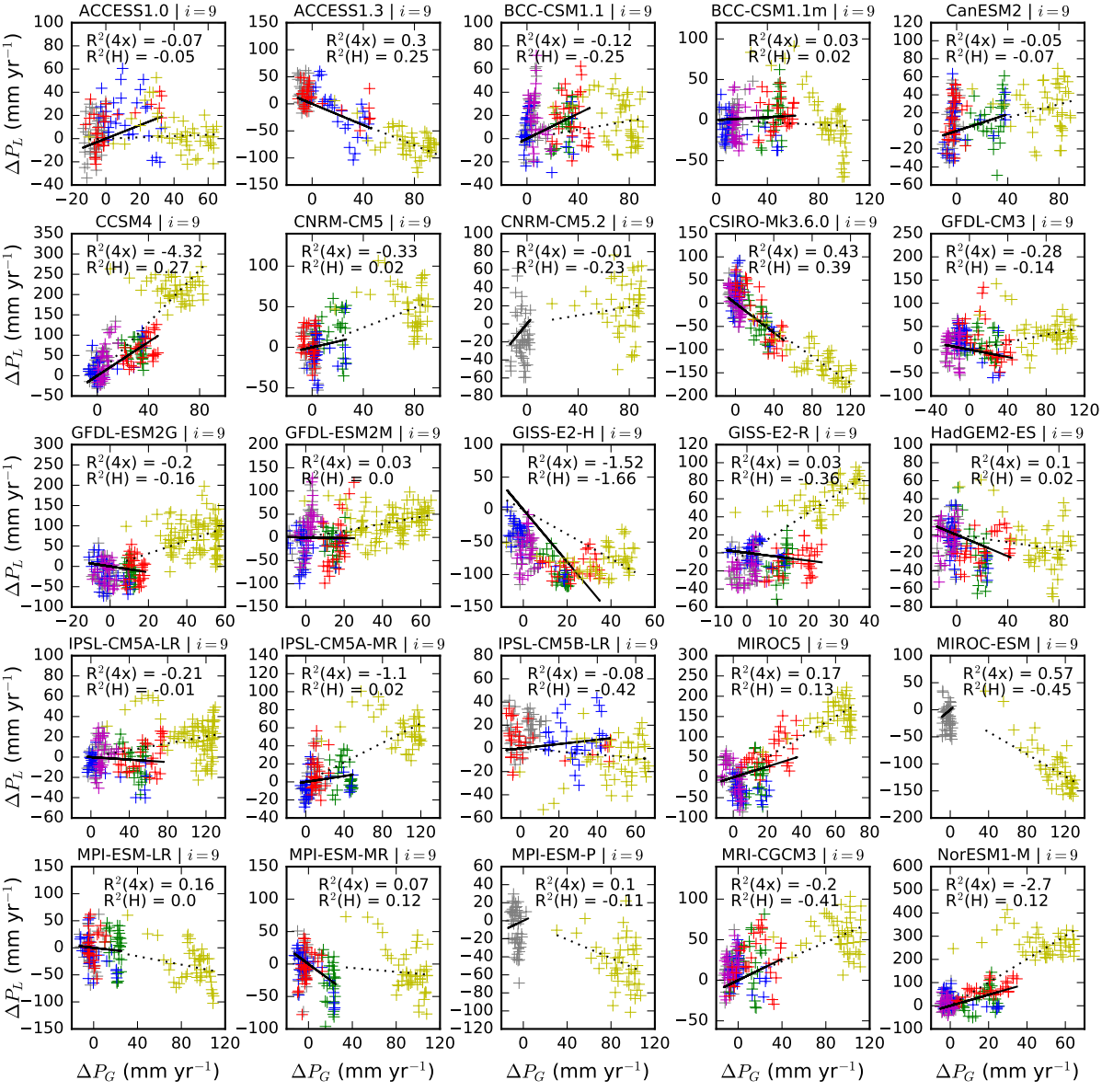

Figure S49. Same as figure S40 but for local yearly precipitations in region $i = 9$.

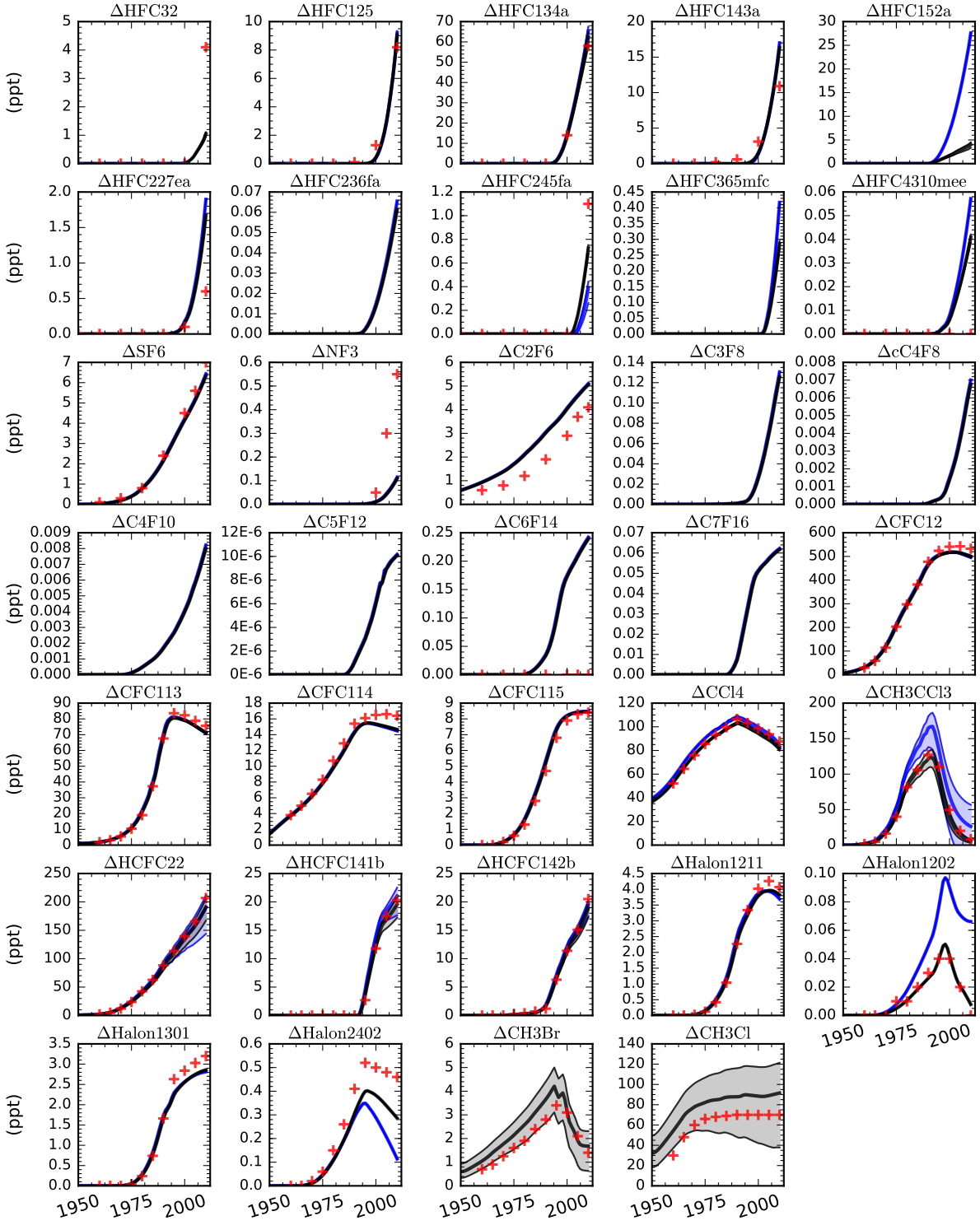

Figure S50. Results of our simulations with OSCAR, for all halogenated compounds not shown in main text; with the same format as figure 8 of main text. Reference is IPCC (2013). The reconstructed (offline) atmospheric concentrations of CH_3Br and CH_3Cl are not shown, because they go completely offtrack as methane does in this simulation.

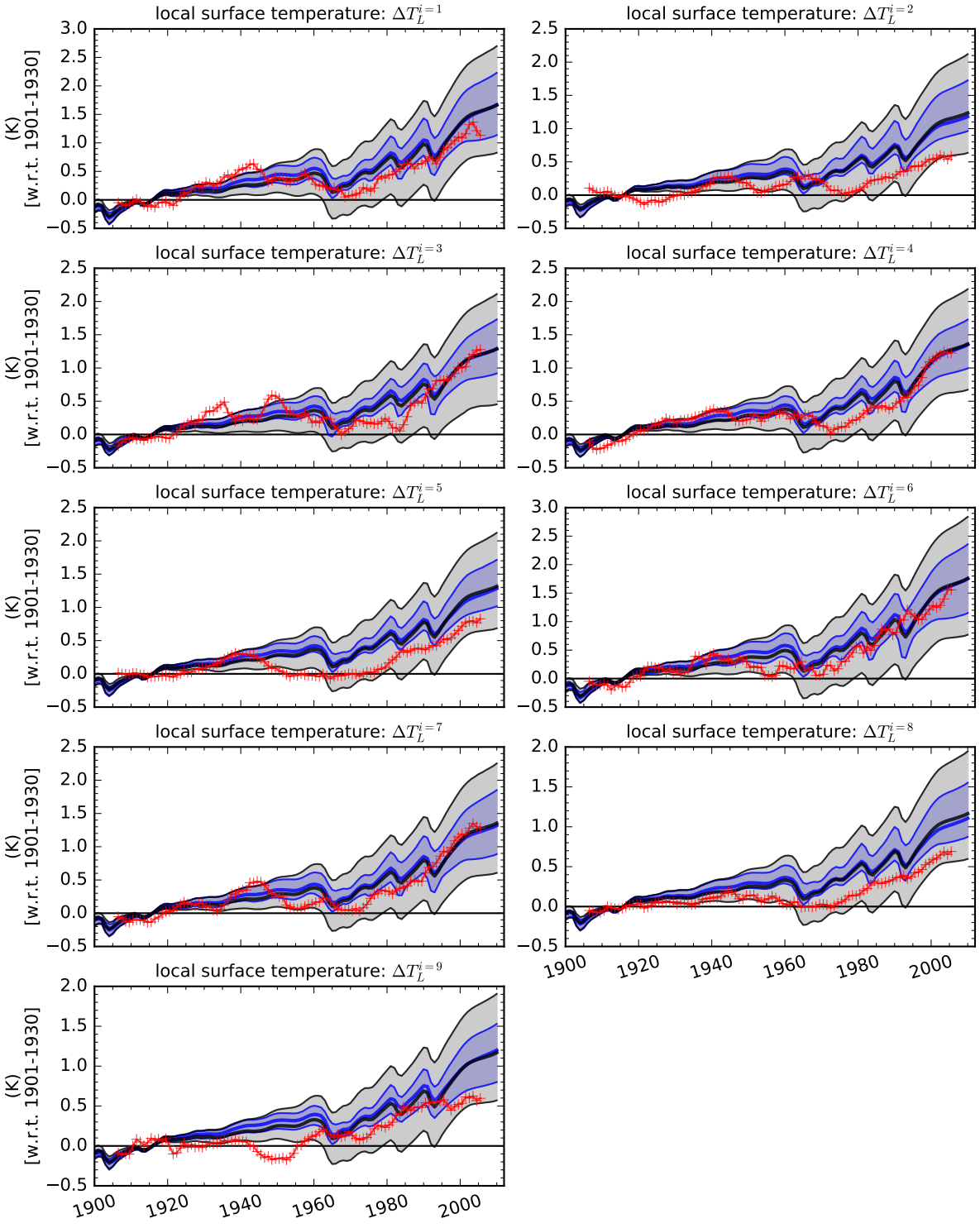

Figure S51. Results of our simulations with OSCAR, for local surface temperature; with the same format as figure 12 of main text. Reference is CRU TS3.23 (Harris et al., 2014) and it is shown as a decadal running mean.

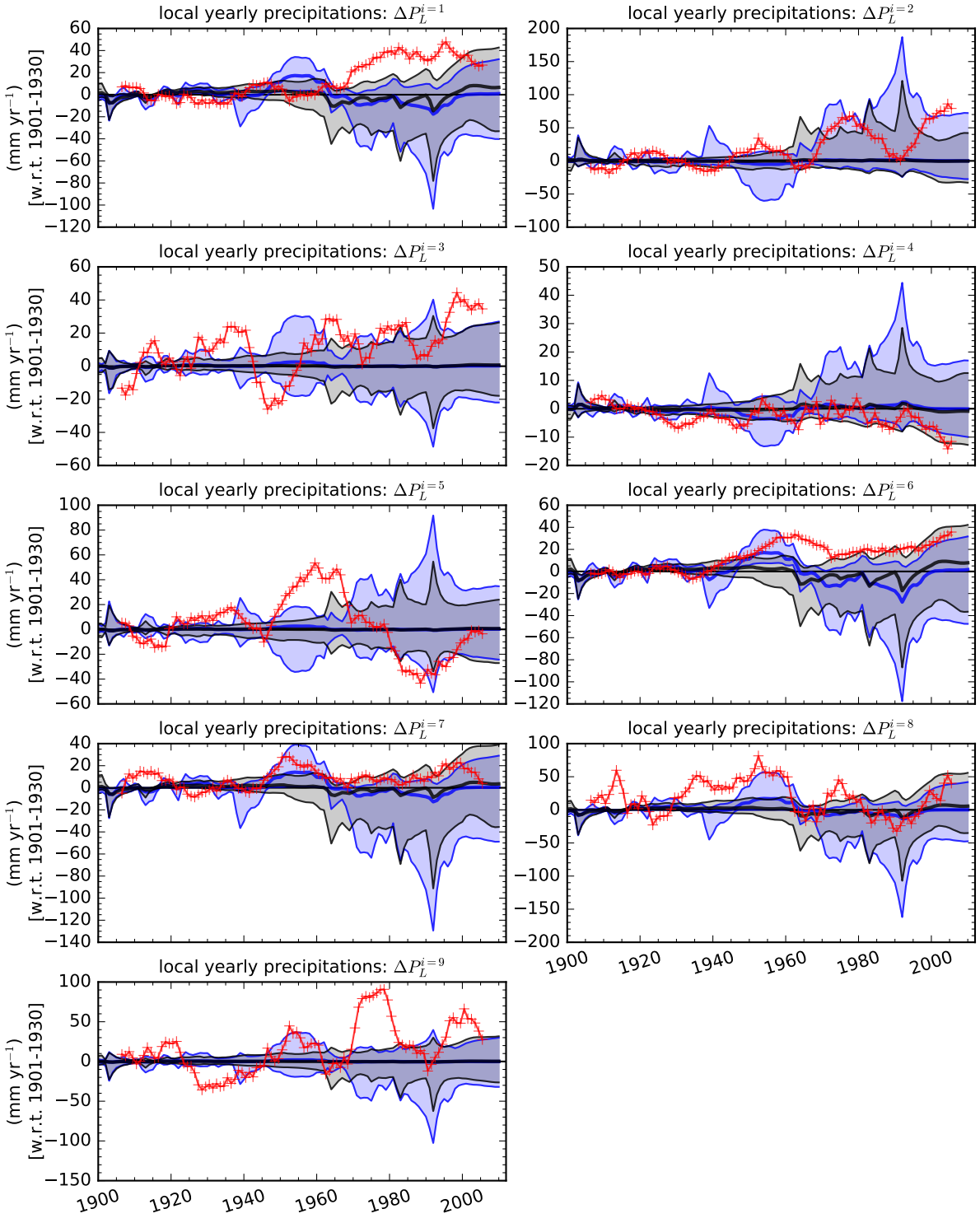

Figure S52. Same as figure S50 but for local yearly precipitations.