ETH

Eidgenössische Technische Hochschule Zürich
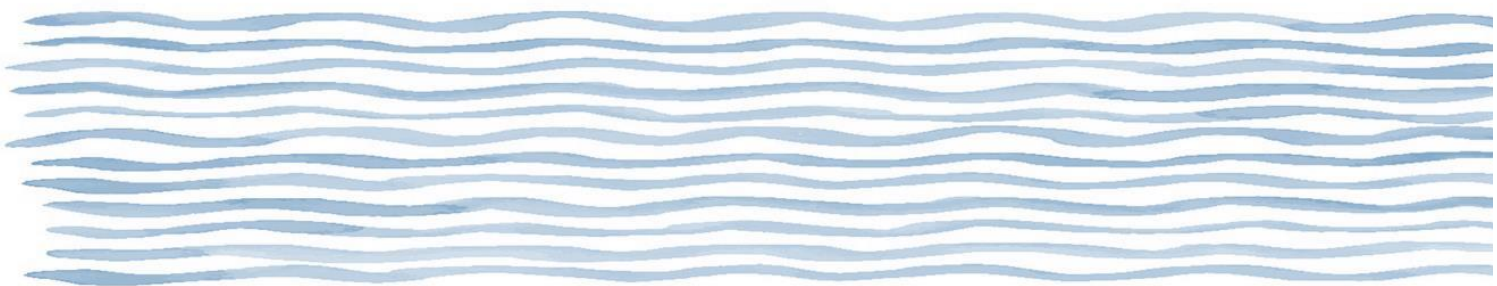Swiss Federal Institute of Technology Zurich

SOIL MOISTURE AND EVAPOTRANSPIRATION: APPENDIX

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1.1 Observational evaluation of CH2018 scenarios in the five Swiss regions
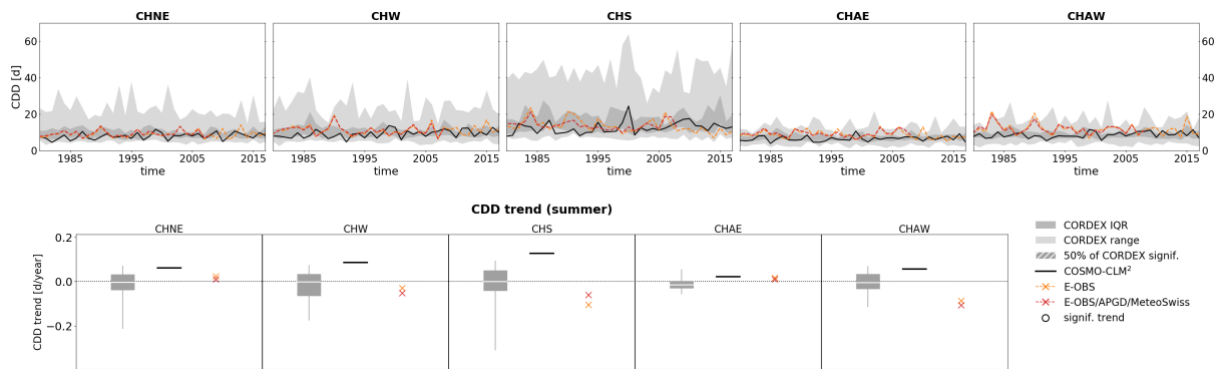

Figure A1: Historical evolution (upper panel) and historical trends (lower panel) of the maximum number of consecutive dry days (*CDD*) during summer (June, July, August) in the five Swiss regions Northeastern Switzerland (CHNE), western Switzerland (CHW), southern Switzerland (CHS), eastern Swiss Alps (CHAE), and western Swiss Alps (CHAW) during 1980–2017. The grey ranges in the upper panel indicate the evolution and spread of the CH2018 CORDEX models, the black line indicates COSMO-CLM2, and the coloured dashed lines indicate the observations. The boxplots in the lower panel indicate the distribution of the CH2018 CORDEX models (white lines indicate the median, boxes the interquartile range and whiskers the 5th and 95th percentiles). Hatching for CORDEX models indicates 50% of models having significant trend consistent with the trend in the ensemble median. Circles indicate significant trends for COSMO-CLM2 and the observations (for observational datasets it is additionally required that they span a time period of at least 15 years).
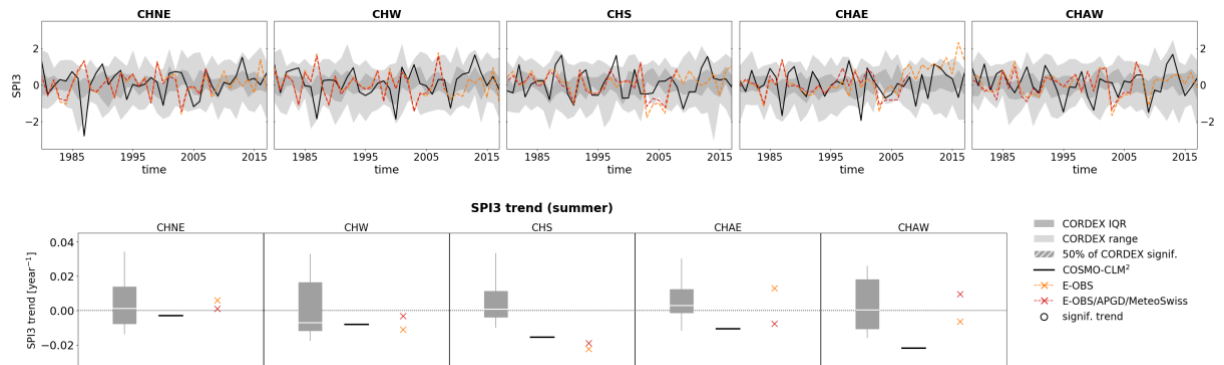

Figure A2: As in Figure A1 but for the 3-month standardized precipitation index (*SPI3*) averaged over summer.
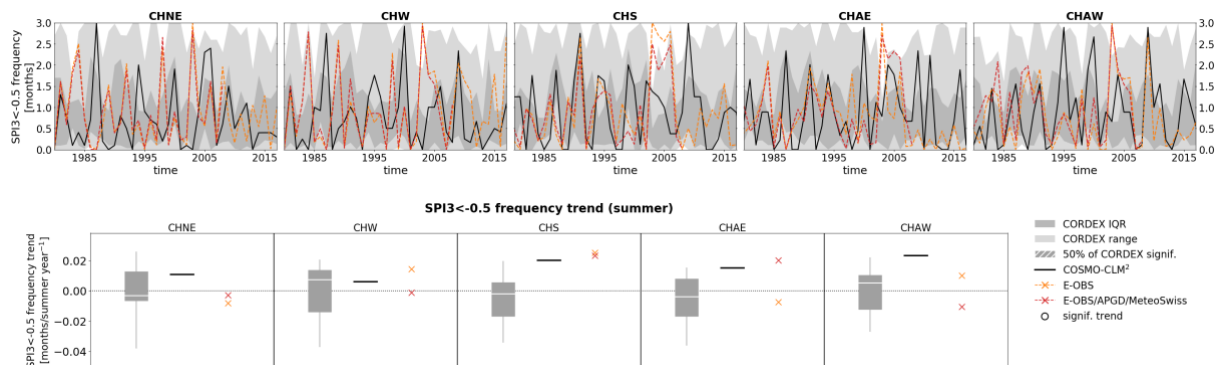

Figure A3: As in Figure A1 but for the average number of summer months, during which *SPI3* is lower than -0.5.
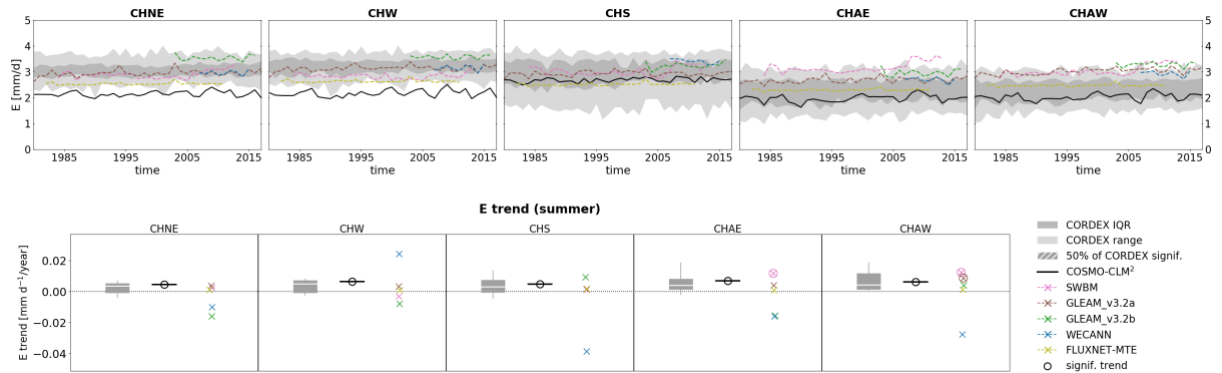
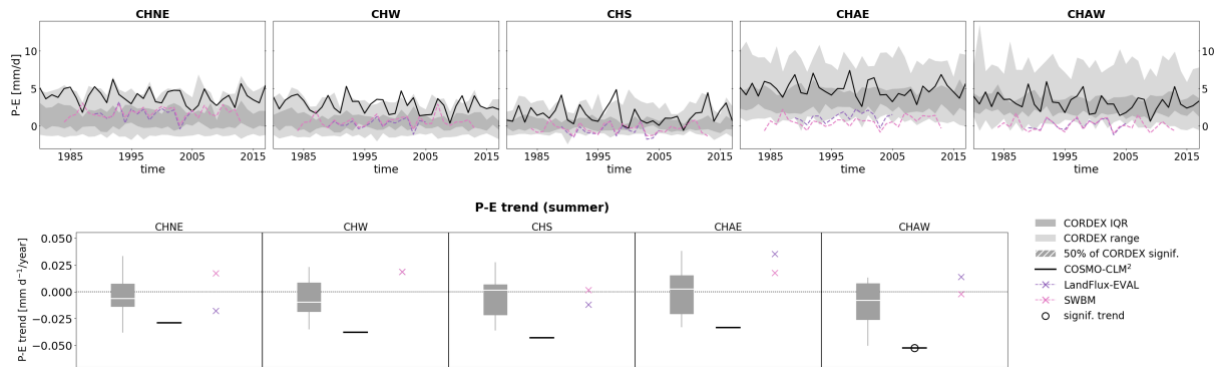Figure A4: As in Figure A1 but for summer mean evapotranspiration (*E*).

Figure A5: As Figure A1 but for summer mean of precipitation minus evapotranspiration (*P-E*).
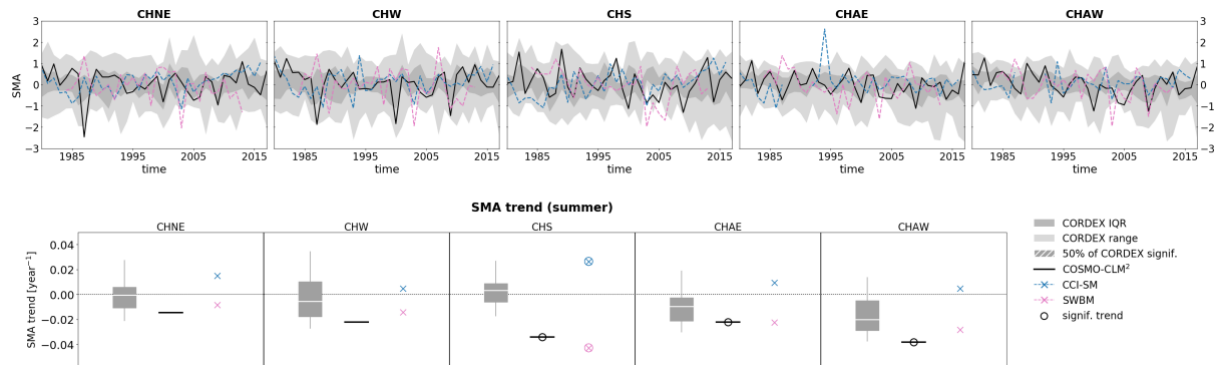

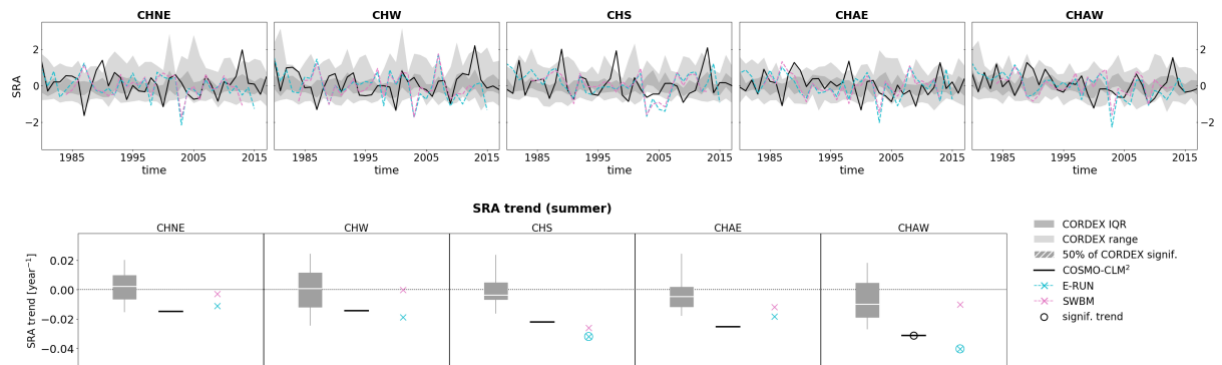Figure A6: As in Figure A1 but for summer mean soil moisture anomalies (*SMA*).

Figure A7: As in Figure A1 but for summer mean surface runoff anomalies (*SRA*).

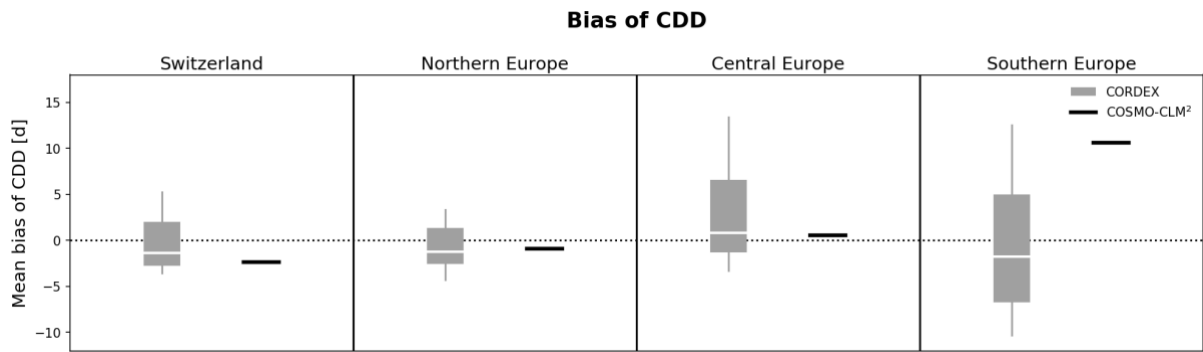## 1.2 Bias evaluation of model simulations

Bias of CDD

Figure A8: Mean bias in summer *CDD* for the CH2018 CORDEX models and COSMO-CLM2 compared to the observations. The boxplots indicate the bias distributions of the CORDEX models (white lines indicate the median, boxes the interquartile range, and whiskers the 5th and 95th percentile). Biases were calculated to each of the observational time series during the time period observations are available and averaged afterwards.
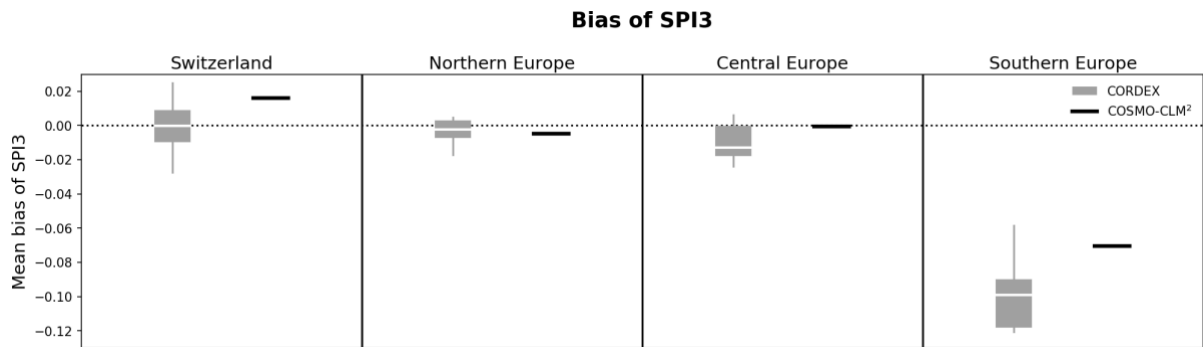
Bias of SPI3

Figure A9: As in Figure A8 but for the 3-month standardized precipitation index (*SPI3*) averaged over summer.
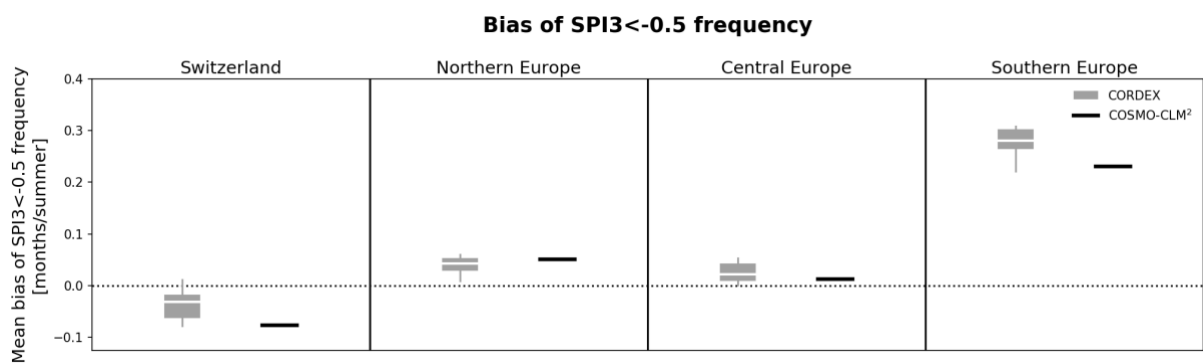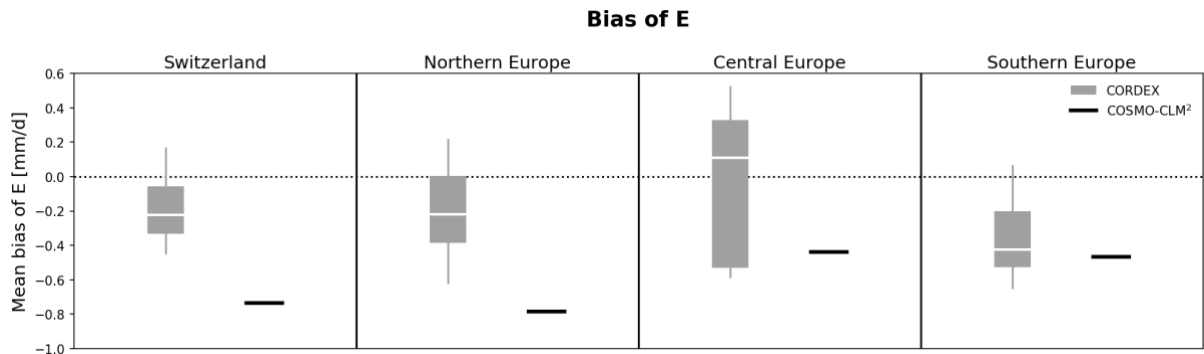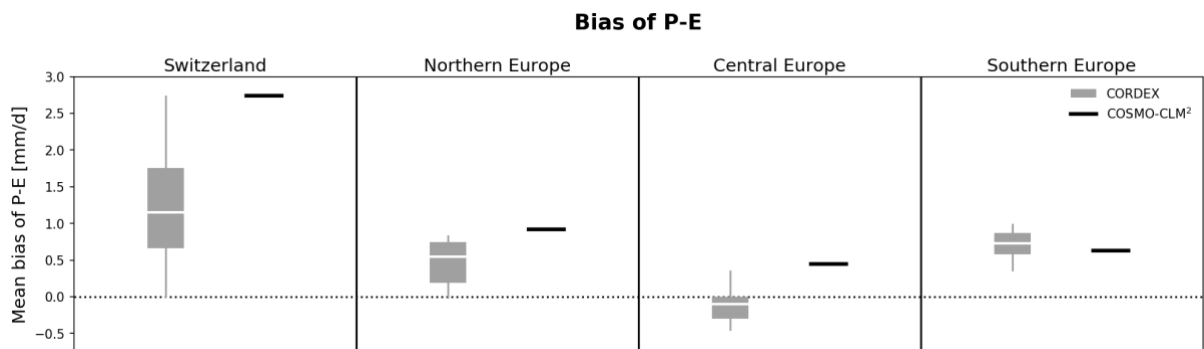
Bias of SPI3<-0.5 frequency

Figure A10: As Figure A8 but for the average number of summer months, during which *SPI3* is lower than -0.5.

Bias of E

Figure A11: As in Figure A8 but for summer mean evapotranspiration (*E*).

Bias of P-E

Figure A12: As Figure A8 but for summer mean of precipitation minus evapotranspiration (*P-E*).
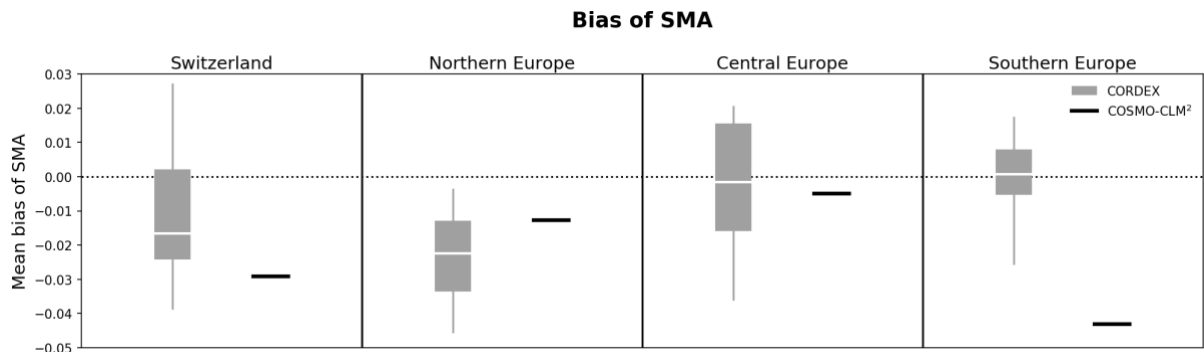
Bias of SMA

Figure A13: As in Figure A8 but for summer mean soil moisture anomalies (*SMA*).
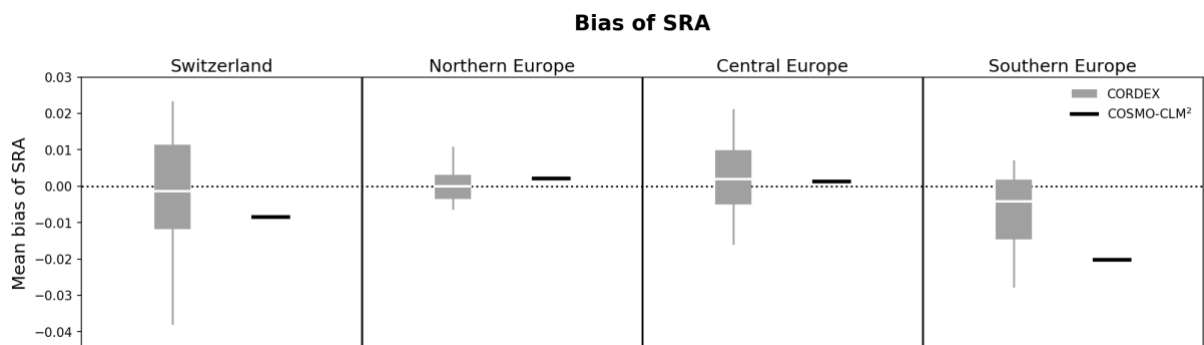
Bias of SRA

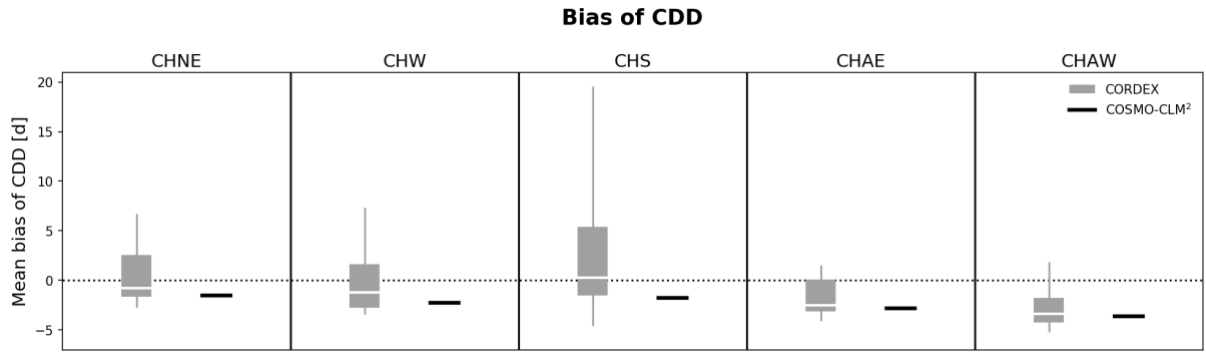**Figure A14: As in Figure A8 but for summer mean surface runoff anomalies (*SRA*).**

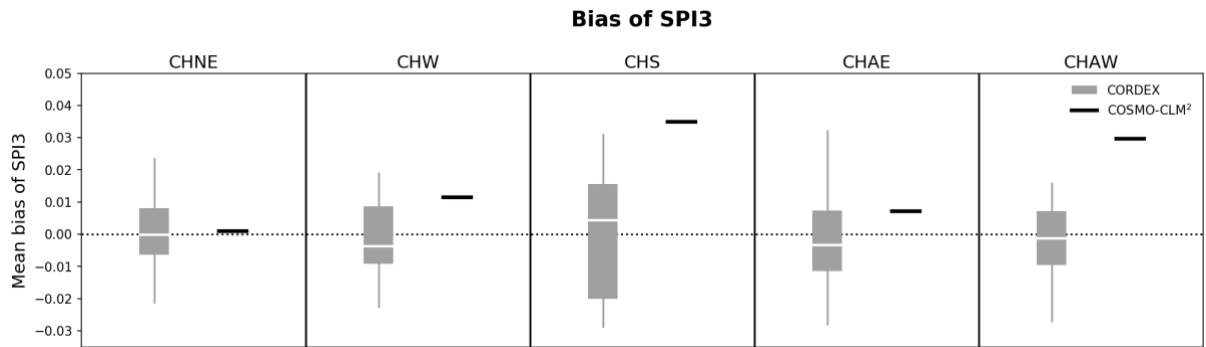**Figure A15: As in Figure A8 but for the five Swiss regions CHNE, CHW, CHS, CHAE, and CHAW.**

Figure A16: As in Figure A8 but for the 3-month standardized precipitation index (*SPI3*) in CHNE, CHW, CHS, CHAE, and CHAW, averaged over summer.
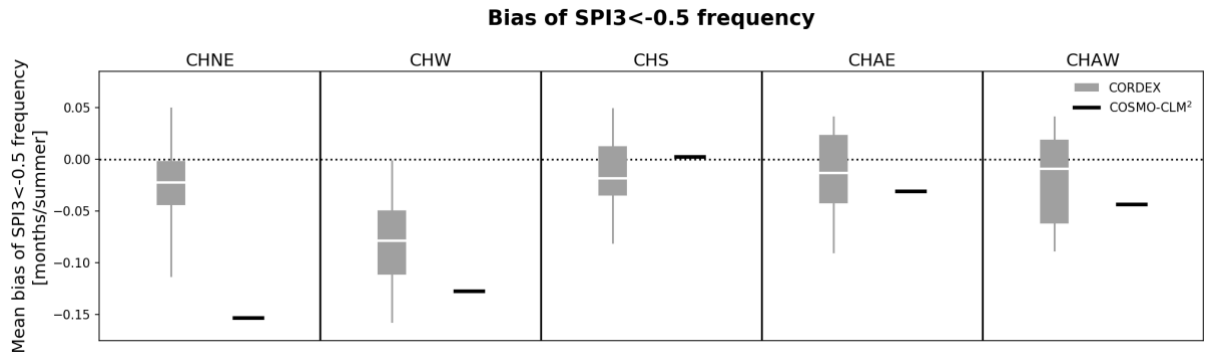

Figure A17: As Figure A8 but for the average number of summer months, during which *SPI3* is lower than -0.5 in CHNE, CHW, CHS, CHAE, and CHAW.
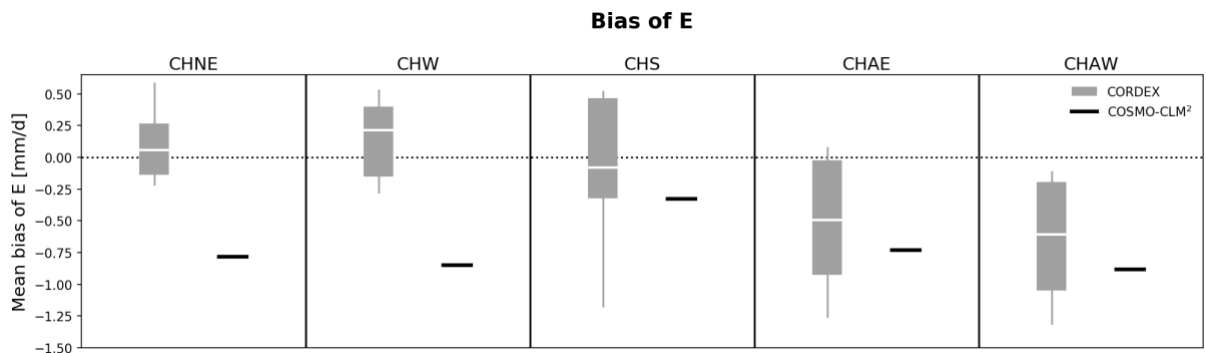

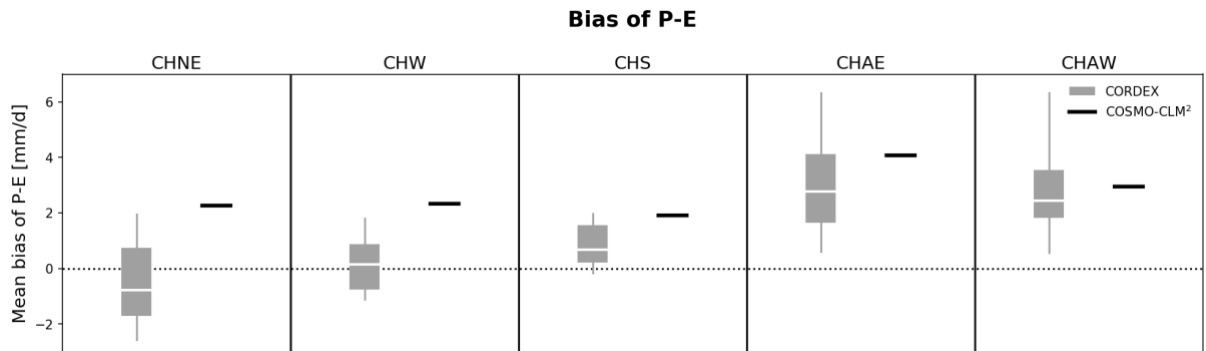**Figure A18: As in Figure A8 but for summer mean evapotranspiration (*E*) in CHNE, CHW, CHS, CHAE, and CHAW.**

Figure A19: As Figure A8 but for summer mean of precipitation minus evapotranspiration (*P-E*) in CHNE, CHW, CHS, CHAE, and CHAW.
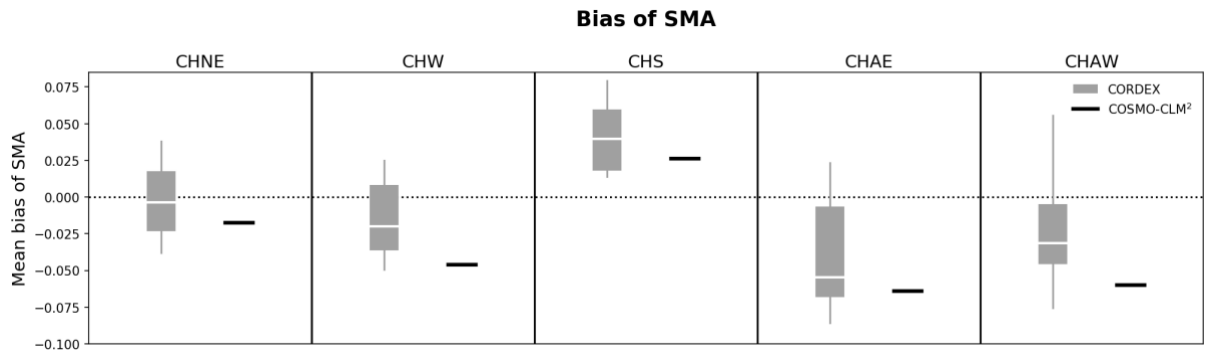

Figure A20: As in Figure A8 but for summer mean soil moisture anomalies (*SMA*) in CHNE, CHW, CHS, CHAE, and CHAW.
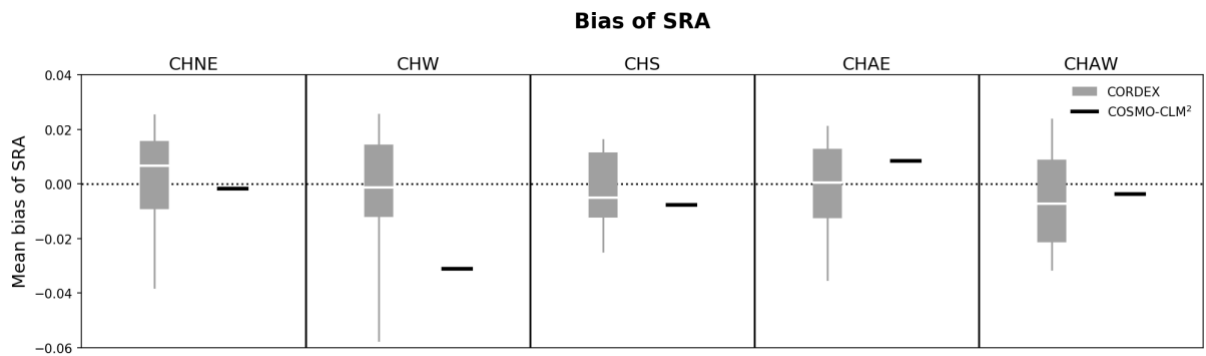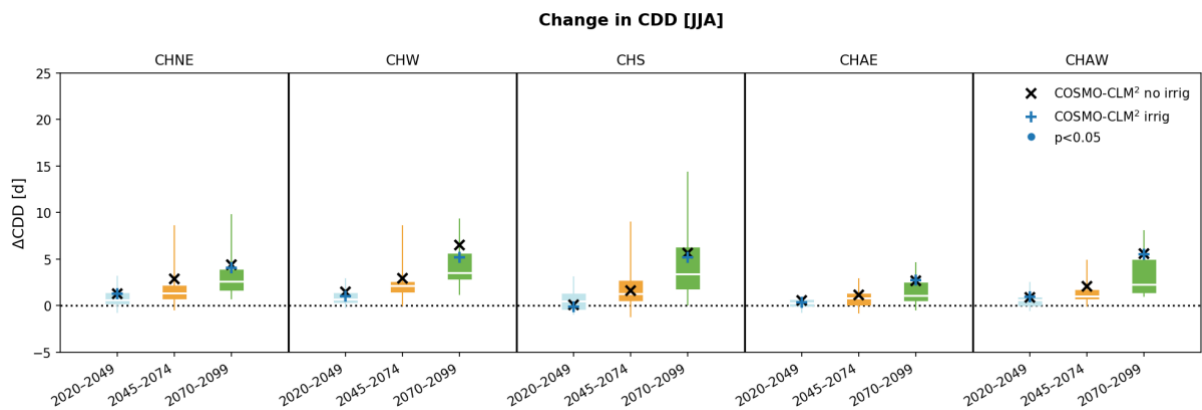

Figure A21: As in Figure A8 but for summer mean surface runoff anomalies (*SRA*) in CHNE, CHW, CHS, CHAE, and CHAW.

1.3 Future changes in the five Swiss regions

Change in CDD [JJA]

Figure A22: Future changes of the maximum number of consecutive dry days (ΔCDD) during summer (June, July, August) in the five Swiss regions Northeastern Switzerland (CHNE), western Switzerland (CHW), southern Switzerland (CHS), eastern Swiss Alps (CHAE), and western Swiss Alps (CHAW) during 2020–2049 (light blue boxplots), 2045–2074 (orange boxplots), and 2070–2099 (green boxplots) relative to the 1981–2010 reference period. Black crosses (blue plus signs) indicate the changes in COSMO-CLM₂ without (with) irrigation effects. Blue dots indicate whether the COSMO-CLM₂ irrigation simulation differs significantly from the one without irrigation. The boxplots indicate the distribution of the CH2018 CORDEX models (white lines indicate the median, boxes the interquartile range and whiskers the 5th and 95th percentiles).

Change in SPI3 [JJA]
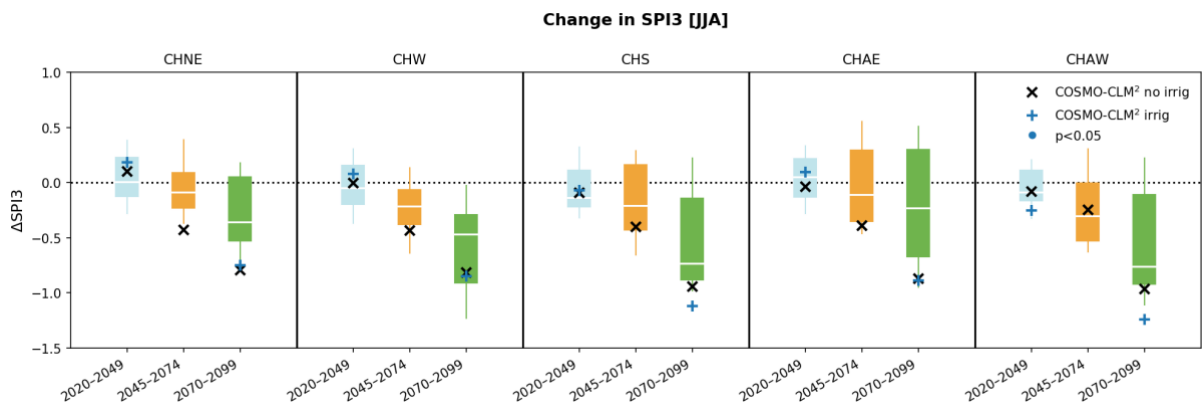
Figure A23: As in Figure A22 but for the 3-month standardized precipitation index (SPI3) averaged over summer.

Change in SPI3<-0.5 frequency in summer
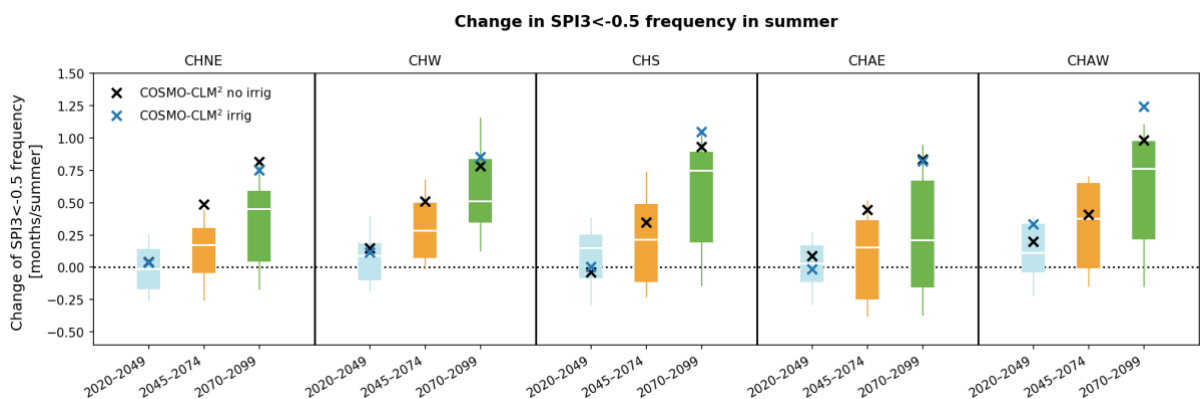
Figure A24: As in Figure A22 but for the average number of summer months, during which SPI3 is lower than -0.5.
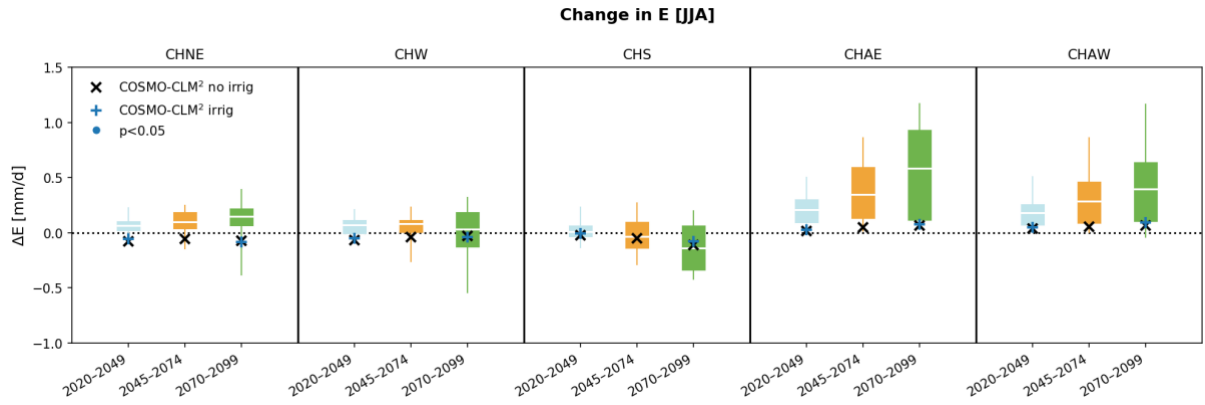
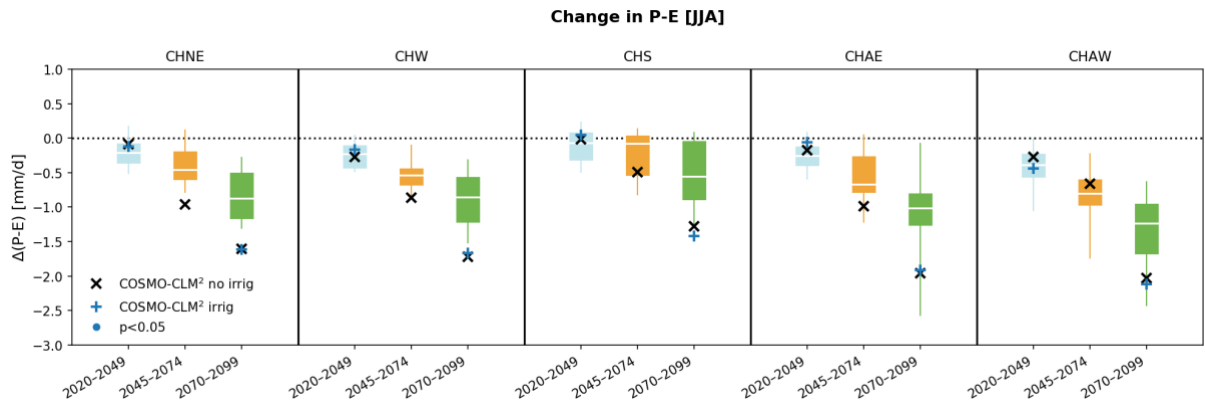**Figure A25: As in Figure A22 but for summer mean evapotranspiration (*E*).**

Figure A26: As in Figure A22 but for summer mean of precipitation minus evapotranspiration (*P-E*).
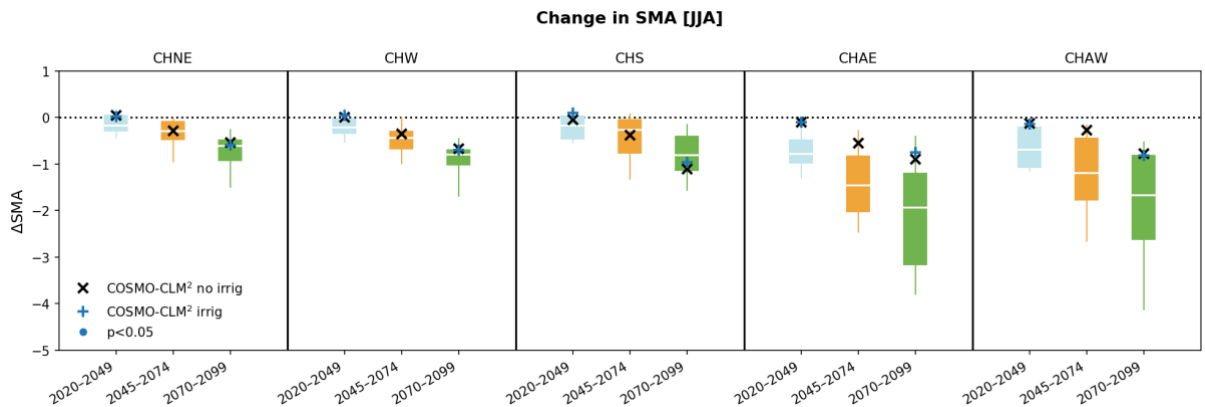

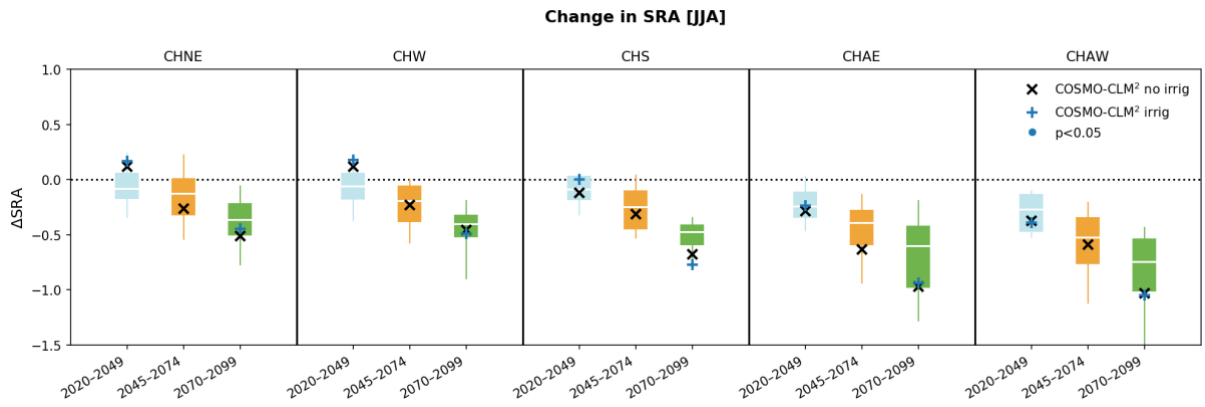**Figure A27: As in Figure A22 but for soil moisture anomalies (*SMA*).**

Figure A28: As in Figure A22 but for mean surface runoff anomalies (*SRA*).
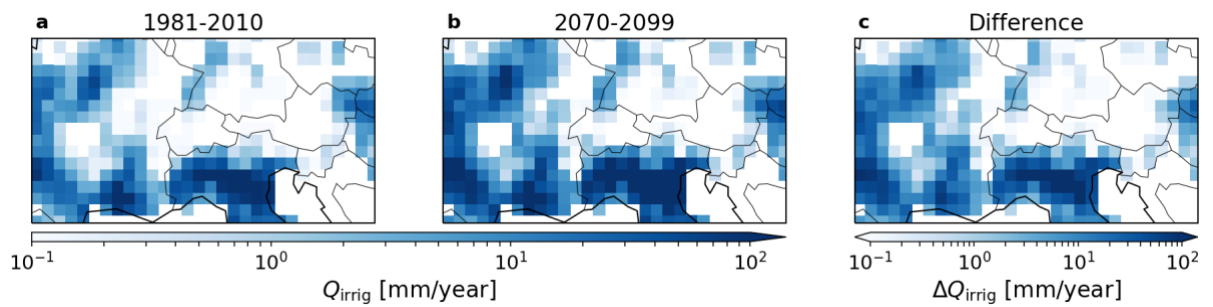

Figure A29: Yearly irrigation amount in the Alpine region in COSMO-CLM$_2$ during (a) 1981–2010 and (b) 2070–2099 and (c) the irrigation difference between the two time periods.