Multivariate stochastic bias corrections with optimal transport: supplementay materials

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References

Lorenz, E. N.: Irregularity: a fundamental property of the atmosphere, Tellus A, 36, 98–110, 1984.

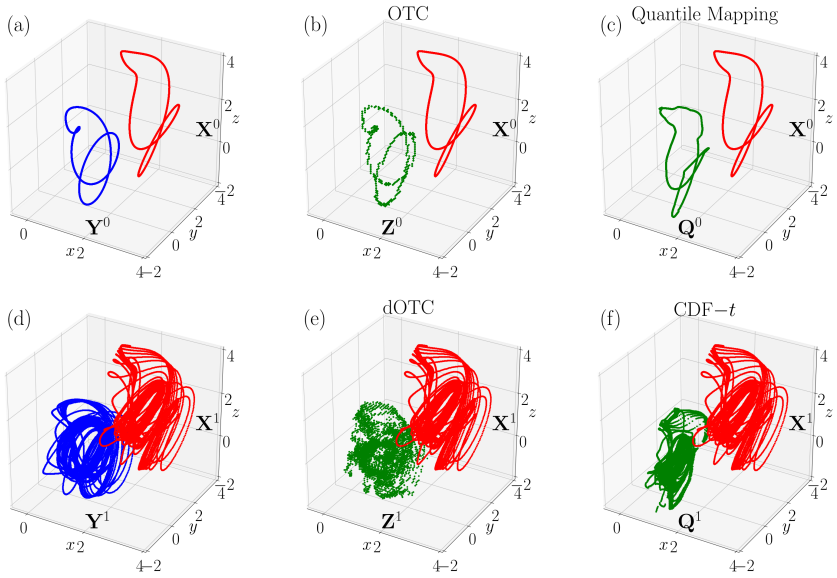

Figure 1. Random variables generated by Lorenz (1984) model, OTC and dOTC, quantile mapping and CDF-t. The method dOTC uses the standard deviation matrix instead of the Cholesky matrix. (a) Biased random variable $\mathbf{X}^0$ (red) and references $\mathbf{Y}^0$ (blue) for time period 0. (b) Biased random variable $\mathbf{X}^0$ (red) and correction $\mathbf{Z}^0$ with OTC (green). (c) Biased random variable $\mathbf{X}^0$ (red) and correction $\mathbf{Q}^0$ with quantile mapping (green). (d) Biased random variable $\mathbf{X}^1$ (red) and references $\mathbf{Y}^1$ (blue) for time period 1. (e) Biased random variable $\mathbf{X}^1$ (red) and correction $\mathbf{Z}^1$ with dOTC (green). (f) Biased random variable $\mathbf{X}^1$ (red) and correction $\mathbf{Q}^1$ with CDF-t (green).

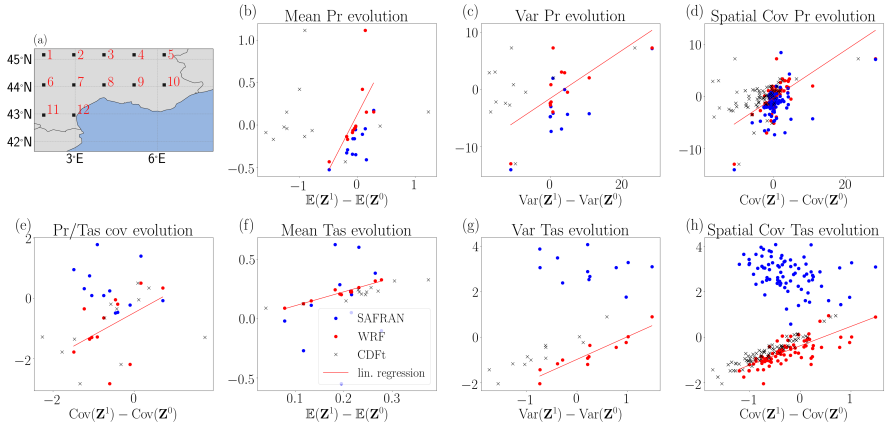

Figure 2. Evolution of correction with dOTC method during winter. (a) Map of the south east of the France. The 12 black squares are the locations where corrections are performed. (b-h) The x axis of panels a-h is the evolution of the correction with dOTC. The y axis of panels a-h is the evolution of WRF in red and the evolution of SAFRAN in blue. The red line is the linear regression between the evolution of correction and the evolution of WRF. The black cross marker are the scatter plot between the evolution of correction with CDF-t and evolution of WRF. (b) Evolution of mean precipitation, i.e. difference between the projection period and the calibration period. (c) Evolution of variance of precipitation. (d) Evolution of spatial covariance of precipitation. (e) Evolution of covariance between precipitation and temperatures. (f) Evolution of mean temperatures. (g) Evolution of variance of temperatures. (h) Evolution of spatial covariance of temperatures.

Table 1. Representation of bias correction in context of climate change.

	Present	Future
Numerical model	$\mathbf{X}^0$	$\mathbf{X}^1$
Observations	$\mathbf{Y}^0$	unknown ($\mathbf{Y}^1$)

Table 2. r-value, p-value and standard error of linear regression between evolution of correction and evolution of WRF.

	r-value	p-value	standard error
Mean evolution Pr	0.68	10^{-2}	0.45
Mean evolution Tas	0.97	10^{-7}	0.09
Variance evolution Pr	0.71	10^{-2}	0.13
Variance evolution Tas	0.93	10^{-5}	0.13
Covariance Pr/Tas evolution	0.45	$\times 10^{-1}$	0.46
Spatial covariance Pr	0.63	10^{-17}	0.04
Spatial covariance Tas	0.77	10^{-29}	0.05