Correction

EARTH, ATMOSPHERIC, AND PLANETARY SCIENCES

Correction for "Improved El Niño forecasting by cooperativity detection," by Josef Ludescher, Avi Gozolchiani, Mikhail I. Bogachev, Armin Bunde, Shlomo Havlin, and Hans Joachim Schellnhuber, which appeared in issue 29, July 16, 2013, of *Proc Natl Acad Sci USA* (110:11742–11745; first published July 1, 2013; 10.1073/pnas.1309353110).

The authors note that: "Due to a minor technical error in the calculation of the climatological average of the considered atmospheric temperatures for each calendar day, Figs. 2 and 3 appeared incorrectly. The amended figures and their legends are provided below. The main message and the interpretation of our paper remain unaffected by this correction."

"The figures in the *Supporting Information* have been exchanged accordingly. We'd like to add that for the calculation of the climatological average, the leap days have been removed, and in the prediction phase, only the data from the past up to the prediction date have been considered. In addition, we note that for calculating the link strengths $S_{ij}(t)$, not the cross-covariance function $C_{ij}^{(t)}(\tau)$ has been considered but the absolute values of the corresponding cross-correlation functions $c_{ij}^{(t)}(\tau)$. When averaging over all link strengths, we obtain the time dependent average link strength $S(t)$. In the learning phase, we compare $S(t)$ with decision thresholds above its mean to obtain the optimal threshold used in the prediction phase."

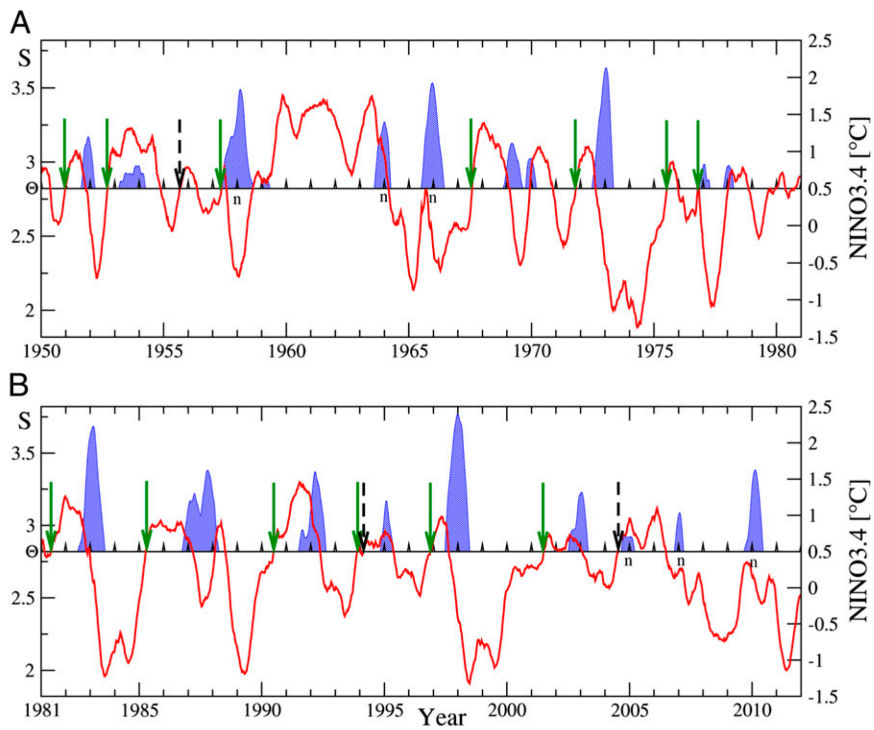

Fig. 2. The forecasting algorithm. We compare the average link strength *S*(*t*) in the climate network (red curve) with a decision threshold Θ (horizontal line, here Θ = 2.82) (left scale) with the standard NINO3.4 index (right scale), between January 1, 1950 and December 31, 2011. Only thresholds above the average of *S(t)* in the learning phase are considered. When the link strength crosses the threshold from below outside an El Niño episode, we give an alarm and predict that an El Niño episode will start in the following calendar year. The El Niño episodes (when the NINO3.4 index is above 0.5 °C for at least 5 mo) are shown by the filled blue areas. The first half of the record (*A*) is the learning phase where we optimize the decision threshold. In the second half (*B*), we use the threshold obtained in (*A*) to predict El Niño episodes. Correct predictions are marked by green arrows and false alarms by dashed arrows. The index n marks a nonpredicted El Niño episode. To resolve by eye the accurate positions of the alarms, we show in *SI Appendix,* Fig. S5, magnifications of those parts of Fig. 2 where the crossings or non-crossings are difficult to see clearly without magnification. We also show the alarms for the slightly larger threshold Θ = 2.83 (*SI Appendix,* Fig. S6), which yields the same performance in the learning phase and one more false alarm in the prediction phase. The lead time between the prediction and the beginning of the El Nino episodes is 1.01 ± 0.28 y, while the lead time to the maximal NINO3.4 value is 1.35 ± 0.47 y.

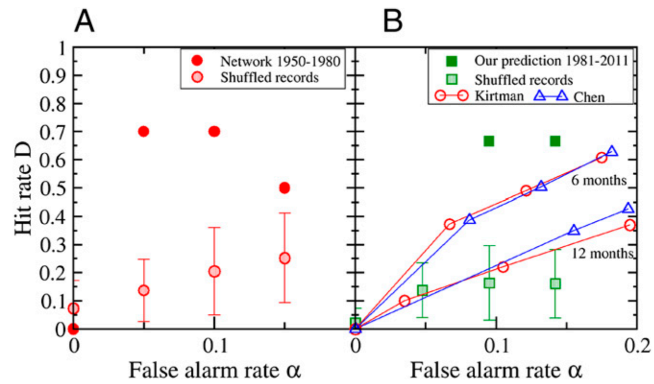

Fig. 3. The prediction accuracy [Receiver Operating Characteristic (ROC)-type analysis]. (*A*) For the four lowest false-alarm rates $\alpha = 0$, 0.05, 0.1, and 0.15, the best hit rates *D* in the learning phase (Fig. 2*A*). The best result is obtained at $\alpha = 0.05$, where $D = 0.7$ and the decision threshold Θ is between 2.815 and 2.834. The results for the randomized $S(t)$ with error bars are shown by the shaded circles. (*B*) The quality of the prediction in the second half of the record, when the above thresholds are applied. For $2.815 < \Theta \leq 2.826$, we have $D = 0.667$ at $\alpha = 0.095$, for $2.826 < \Theta \leq 2.834$, we have $D = 0.667$ at $\alpha = 0.143$. For comparison, we show also results for 6- and 12-mo forecasts based on climate models (21, 37). The shaded squares and the error bars denote the mean hit rates and their SDs for predictions based on the shuffled data.

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