The Southern Oscillation Index (SOI) is used to track and predict changes in both the El Niño-Southern Oscillation (ENSO), and the Walker Circulation (WC). During El Niño, for example, the WC weakens and the SOI tends to be negative. Climatic variations linked to changes in the WC have a profound influence on climate, ecosystems, agriculture, and societies in many parts of the world.

Here we examine changes in the SOI and air pressure across the Pacific in the observations and in numerous WCRP/CMIP3 climate model integrations for both the 20th and 21st centuries. The difference in mean sea-level air pressure (MSLP) between the eastern and western equatorial Pacific, a measure of the strength of the WC, tends to weaken during the 21st century, consistent with previous research. Here we show that this primarily arises because of an increase in MSLP in the west Pacific and not a decline in the east. We also show - in stark contrast to expectations - that the SOI actually tends to increase during the 21st century, not decrease. Under global warming MSLP tends to increase at both Darwin and Tahiti, but tends to rise more at Tahiti than at Darwin. Tahiti lies in an extensive region where MSLP tends to rise in response to global warming. Our results also indicate that the observed decline in the SOI in recent decades has been driven by natural, internally generated variability. Implications that these discoveries have for understanding recent climatic change and for seasonal prediction are discussed.