Session: C9 Poster: M91A

The impact of global warming on the Southern Oscillation Index

Scott Power[†]; Greg Kociuba
[†] Bureau of Meteorology, Australia
Leading author: s.power@bom.gov.au

The Southern Oscillation Index (SOI) - a measure of air pressure difference across the Pacific Ocean, from Tahiti in the south-east to Darwin in the west - is one of the world's most important climatic indices. The SOI is used to track and predict changes in both the El Niño - Southern Oscillation (ENSO) phenomenon, 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, extreme weather and societies in many parts of the world. Previous research has shown that (i) the WC and the SOI weakened in recent decades and that (ii) the WC in climate models tends to weaken in response to elevated atmospheric greenhouse gas concentrations. 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 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. So while the SOI is an excellent indicator of interannual variability in both the equatorial MSLP gradient and the WC, it is a highly misleading indicator of long-term equatorial changes linked 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. The externally-forced signal in the June-December SOI during 2010 is estimated to be approximately 5% of the standard deviation of variability in the SOI during the 20th century. This figure is projected to increase to 40% by the end of the 21st century under the A2 SRES scenario. The 2010 global warming signal is already a major contributor to interdecadal variability in the SOI, equal to 45% of the standard deviation of 30-yr running averages of the SOI. This figure is projected to increase to nearly 340% by the end of the 21st century. Implications that these discoveries have for understanding recent climatic change and for seasonal prediction are discussed.