



Spatiotemporal Analyses of Remotely Sensed Soil Moisture with Respect to Regional Climate Modes and Solar Activity in Australia

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Soil moisture is an important environmental variable with impact on hydrologic, meteorologic and climatologic processes as well as on agriculture and socioeconomics. The interactions between soil moisture and climatologic variables are still the object of research in various scientific disciplines. Climate and, hence, soil moisture variations are related to a number of atmospheric and oceanic periodical phenomena called climate modes. Furthermore, the impact of solar variation on the Earth's climate is still matter of dispute.

Interactions between climate variations and climate modes are particularly strong in Australia. This study explores Australia's surface soil moisture (SSM) in the period 1978-2010 with data generated during the WACMOS project. This is motivated by the very first possibility of continuous analysis of remotely sensed soil moisture variations over a period of 32 years. The WACMOS data merges passive and active microwave data and offers a sampling of 0.25 degrees in space and one day in time. The soil moisture regime of Australia is assembled and then broken down into monthly and seasonal means as well as corresponding anomalies. An Empirical Orthogonal Functions (EOF) analysis is applied to the SSM data in order to extract major variations in Australia's hydrologic conditions. The relationships of SSM anomalies and SSM EOFs with climate indices and solar activity are examined with Spearman rank correlation analysis. Strong relationships are found between Southern Oscillation Index (SOI) and SSM in eastern and northern Australia, especially during southern winter and spring season. Similar connections are detected between Southern Annular Mode Index (SAM) and SSM during summer and fall. Ocean surface temperature variations at tropical Indian and Pacific Ocean correlate with SSM patterns too, but however, to a lesser extent. Solar radio flux (F10.7) does not show significant relations to Australian SSM signals or to climate modes.

The findings agree with previous research on atmospheric and oceanic oscillations and their impact on Australia's climate. It is shown that the WACMOS data reproduces properly Australia's soil moisture conditions and enables long-term analysis of hydrologic processes.