

Seasonal Shifts in the North American Monsoon

Katrina Grantz^{1,2}, Balaji Rajagopalan^{1,3}, Martyn Clark³, and Edith Zagona²

Dept of Civil, Environmental & Architectural Engineering (CEAE), University of Colorado, Boulder, CO

Abstract. Analysis is performed on the spatio-temporal attributes of North American Monsoon System (NAMS) rainfall and streamflow in the southwestern USA. Results show a significant delay in the monsoon rainfall cycle in recent decades with a decrease in July rainfall and a corresponding increase in August and September rainfall. Relating these attributes to antecedent winter/spring land and ocean conditions leads us to propose the following hypothesis: warmer tropical Pacific sea surface temperatures (SSTs) and cooler northern Pacific SSTs in the antecedent winter/spring leads to wetter than normal conditions over the desert southwest (and drier than normal conditions over the Pacific Northwest). This enhanced antecedent wetness delays the seasonal heating of the North American continent that is necessary to establish the monsoonal land-ocean temperature gradient. The delay in seasonal warming in turn delays the monsoon initiation, thus reducing rainfall during the typical early monsoon (July) period and increasing rainfall during the later months (August and September) of the monsoon season. While early monsoon rainfall appears to be significantly modulated by antecedent winter/spring Pacific SST patterns, later monsoon rainfall seems to be driven more by near term SST conditions along the coast of California and the Gulf of California. The preliminary analysis of streamflow shows similar trends and relationships. The role of antecedent land and ocean conditions in modulating the following summer monsoon appears to be quite significant. This enhances the prospects for long-lead forecasts of monsoon rainfall over the southwestern US, which could have significant implications for water resources planning and management in this water-scarce region.

¹ Dept of Civil, Environmental & Architectural Engineering (CEAE), University of Colorado, Boulder, CO

² Center for Advanced Decision Support for Water and Environmental Systems (CADSWES)/CEAE, University of Colorado, Boulder, CO

³ CIRES, University of Colorado, Boulder, CO