

An Integrated Multisensor/Modeling Approach Addressing Climate Related Extreme Events

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Abstract : A clear distinction between weather and climate is a necessity because while they are closely related, there are still important differences. Climate change is identified when we compute the statistics of the observed changes in weather over space and time. In this work we will show how the changing climate contribute to the frequency, magnitude and extent of different extreme events using a multi sensor approach with some synergistic modeling activities. We are exploring satellite observations of dust over North Africa, Gulf Region and the Indo Gangetic basin as well as dust versus anthropogenic pollution events over the Delta region in Egypt and Seoul through remote sensing and utilize the behavior of the dust and haze on the aerosol optical properties. Dust impact on the retreat of the glaciers in the Himalayas is also presented. In this study we also focus on the identification and monitoring of a massive dust plume that blew off the western coast of Africa towards the Atlantic on October 8th, 2012 right before the development of Hurricane Sandy. There is evidence that dust aerosols played a non-trivial role in the cyclogenesis process of Sandy. Moreover, a special dust event "An American Haboob" in Arizona is discussed as it was predicted hours in advance because of the great improvement we have in numerical, land-atmosphere modeling, computing power and remote sensing of dust events. Therefore we performed a full numerical simulation to that event using the coupled atmospheric-dust model NMME-DREAM after generating a mask of the potentially dust productive regions using land cover and vegetation data obtained from satellites. Climate change also contributes to the deterioration of different marine habitats. In that regard we are also presenting some work dealing with change detection analysis of Marine Habitats over the city of Hurghada, Red Sea, Egypt. The motivation for this work came from the fact that coral reefs at Hurghada have undergone significant decline. They are damaged, displaced, polluted, stepped on, and blasted off, in addition to the effects of climate change on the reefs. One of the most pressing issues affecting reef health is mass coral bleaching that result from an interaction between human activities and climatic changes. Over another location, namely California, we have observed that it exhibits highly-variable amounts of precipitation across many timescales, from the hourly to the climate timescale. Frequently, heavy precipitation occurs, causing damage to property and life (floods, landslides, etc.). These extreme events, variability, and the lack of good, medium to long-range predictability of precipitation are already a challenge to those who manage wetlands, coastal infrastructure, agriculture and fresh water supply. Adding on to the current challenges for long-range planning is climate change issue. It is known that La Niña and El Niño affect precipitation patterns, which in turn are entwined with global climate patterns. We have studied ENSO impact on precipitation variability over different climate divisions in California. On the other hand the Nile Delta has experienced lately an increase in the underground water table as well as water logging, bogging and soil salinization. Those impacts would pose a major threat to the Delta region inheritance and existing communities. There has been an undergoing effort to address those vulnerabilities by looking into many adaptation strategies.

Keywords : remote sensing, modeling, long range transport, dust storms, North Africa, Gulf Region, India, California, climate extremes, sea level rise, coral reefs

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