

Preface

Water is the most important natural resource we possess on the planet. Too much water—floods—can cause tremendous damage by washing away roads and buildings, eroding land, and destroying crops and livestock. Floods often result in the loss of human lives, and can have huge impacts on national economies when occurring at large scales. At the other end of this spectrum are droughts. Droughts result in reduced crop yield when irrigation sources are unavailable and rainfall is the only source of water for crops.

The time scales, inception, and progress of floods and droughts are completely different. Whereas floods (specifically flash floods) can happen quickly, droughts take months and sometimes years to form. In the case of flooding, there is some advance warning in precipitation forecasts using atmospheric models. In cases of downstream floods, the flow time from the upper reaches of the catchment to the lower reaches and the outlet offers some advance lead time. In the case of droughts, the lack of precipitation coupled with high evapotranspiration is a prescription for disaster, and this could occur over long periods of months to years.

With rapid advances in computer modeling and observing systems, floods and droughts can be forecasted and assessed with greater precision today than ever before. Land surface models (especially over the entire Continental United States) can map the hydrological cycle at kilometer and sub-kilometer scales. In the case of smaller areas (not the entire Continental United States), there is even higher spatial resolution, and the only limiting factor is the availability of input data. In situ sensors are commonly automated and the data directly relayed to the Internet for many hydrological variables such as precipitation, soil moisture, surface temperature, and heat fluxes. In addition, satellite remote sensing has advanced to providing daily (or better) observations at kilometer to 10-km spatial scales.

We are at a critical juncture in studying hydrological extremes. The following features make this unique. Firstly, in recent years, floods (e.g., in China, Pakistan, Thailand, Laos, South Carolina, and Eastern China) and droughts (e.g., in California, Australia, and the Asian subcontinent) have centered on extremes involving water. Water plays an important role in the global economy and thus extreme events

can have a large economic impact that is not limited to a specific region or country. Secondly, there have been major advances in the global monitoring of precipitation and measurement of soil moisture with the launch of the Global Precipitation Measurement (GPM) mission in February 2014. This follows the Tropical Rainfall Measurement Mission [TRMM] that provided data from 1997 to 2015 for the measurement of precipitation and the Soil Moisture Active Passive (SMAP) mission in January 2015 and the Soil Moisture and Ocean Salinity (SMOS) in November 2009. These have been complemented by sensors that monitor vegetation, surface temperature, and evapotranspiration (Moderate Resolution Imaging Spectroradiometer—MODIS), and the Gravity Recovery and Climate Experiment (GRACE) that estimates changes in surface and subsurface water storage and provides a clear picture of the land surface hydrological state. Lastly, we are at the end of an El-Nino event that alters the normal hydrological cycle. Thus, this is the perfect time to focus on methods to monitor hydrological extremes and provide support to emergency management using the latest technology.

This book—*Remote Sensing of Hydrological Extremes: Droughts and Floods*—provides an overview of the current state of the science on the monitoring of droughts and floods using remote sensing. The various chapters in the book span the diversity of geographical locations and satellite sensors and analyze methods for studying these extreme events. Droughts and floods are studied in Brazil, the Congo River Basin of Africa, the Mekong River Basin, the Magdalena River Basin in Columbia, South America, and various locations in United States. New tools and analyses have been developed to map floods, and these will prove valuable for recovery and rebuilding efforts. Analyses of the dependence of land surface variables in spatial and temporal propagation help to predict droughts. Both of these analyses (floods and droughts) are of value for future land-use planning.

This book will serve as a reference for students, teachers, practicing hydrologists, agriculture scientists, engineers, and those involved in water and emergency management and in the construction and insurance industry.

Water can be a blessing or a curse. . .predictability of water in a flood and lack of water in a drought is both a scientific problem and a societal necessity.

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