

Climate change and extreme weather

Kevin Trenberth, Head

Climate Analysis Section at the National Center for Atmospheric Research, Boulder, CO

abstract

Following a discussion on the framing of how climate extremes relate to climate change, an examination will be given of a number of large impact climate extremes that occurred in 2010 and 2011. The main focus is on the Russian heat wave and the Pakistan floods, how they are related and how both are driven by natural variability, especially ENSO, and global warming from human influences. Together these resulted in very high sea surface temperatures (SSTs) in several places that played a vital role in subsequent developments. In the Northern Indian Ocean the highest SST and the highest SST anomaly for any month occurred in May 2010. The highest SSTs and SST anomalies on record also occurred in August 2010 in the Gulf of Mexico, followed by the highest SSTs on record in the Caribbean for September. SST anomalies were also highest on record north of Australia in December 2010. In all cases, these regions provided a source of unusually abundant atmospheric moisture for nearby monsoon rains and flooding in Pakistan, Colombia, and Queensland. The resulting atmospheric monsoonal circulations had a direct link to higher latitudes: from Southeast Asia to southern Russia, and from Colombia to Brazil, and helped support the persistent atmospheric “blocking” anticyclone that set the stage for the Russian heat wave and wild fires, and drought in Brazil. Strong convection in the Caribbean and tropical Atlantic in association with the record high SSTs in August and September 2010 likely also played a role in Europe via Rossby wave teleconnections. This unique combination of natural variability along with a human element from the record high SSTs played a key influential and formative role in the Russian heat wave climate event. A challenge is to replicate these aspects with climate models.