Floods negatively impact the global economy through disruptions in supply chain networks. Today’s global supply chain has achieved cost savings through reduced inventories, shortened transit cycles, and streamlined production processes. Even though the supply chain is very efficient it is still susceptible to systematic risk, a financial term used to describe a risk originating from one node of a financial network which then harms the entire financial market. For example, while a more efficient production and transportation system is more capital intensive and cost efficient, in the event of a natural disaster the entire system may collapse. The Economist reported a decrease in death rates from natural disasters, however, the economic burden increased drastically. The overall loss caused by all types of disasters in 2011 was 380 billion U.S. dollars (Fig.1). It was the largest damage in history. Despite investment in flood control, annual flood damages in adjusted dollars continue to increase in the United States as well (Fig.2). The weather-related disasters such as storms, floods, and droughts accounted for 39% of total damage of 380 billion U.S. dollars in 2011, compared to geophysical disasters’ 61% such as earthquakes and tsunamis. Yet, between 1950 – 2010, the weather-related disasters accounted for the majority (67%) of total damage of 2.1 trillion U.S. dollars (Munich Re NatService).

Thailand, for example, was economically devastated by prolonged flooding in 2011. Thai Central Bank estimated that the disruption of supply chain reduced 76% of GDP growth rate, from 4.1% expected to 1% in reality. The country accounts for approximately 40% of the world’s production of hard disk drives (HDD). Western Digital, which produces one-third of the world’s HDD, lost 45% of its shipments due to a plant closure in Thailand during the flood. HDD shipments from the industry’s five major manufacturers declined severely in the fourth quarter of 2011 to 123.3 million units, which was down 30% from 175.2 million units the quarter before. As a result, United States consumers faced an 80%-190% price increase for certain hard drive models. In addition to the hard drive industry, the automobile sector was also affected by Thailand’s flood, for instance, Japanese automakers’ operating profits drastically declined (Fig.3). Historically, floods not only impact production, but can affect transportation systems. The Mississippi River flooded in May 2011 causing a suspension of barge traffic. The New York Times estimated that the money tied up in transportation costs can be $300 million a day in for the entire river.

Neither public nor private sectors effectively mitigate the impact disasters have on the supply chain. The private sector, especially, does not properly consider natural hazards and disaster risks in their decision-making process. As a result, the private sector’s vulnerability impacts the whole economy. To increase supply chain resilience, industry leaders could produce more excessive inventory. However, it is not a simple problem. Since cost reduction is vital for firms to maintain a competitive edge, increasing inventory to ensure resiliency does not follow the current business model. Thus, the real challenge is to formulate a way to reduce vulnerability to supply chain risk while maintaining competitive advantage.

Since the issue is interdisciplinary in nature, utilizing the multidisciplinary expertise of environmental and industrial engineers will further the investigation into the impact of natural disasters on supply chain networks. The proposed study is a part of the Columbia Global Flood Initiative, and aims to analyze the supply chain system and propose optimal risk mitigation strategies without losing sight of
the company’s desire for competitiveness. Other ongoing projects within the Columbia Global Flood Initiatives involve predicting flood incidence locations from a long term climate perspective and evaluating flood risk using atmospheric dynamics. Findings from these projects will help us understand, predict and map indirect losses. Furthermore, using empirical and mathematical models, the study seeks to investigate the vital components of resilient supply chain networks that are not vulnerable to flood risk. Also, while analyzing existing insurance mechanisms of supply chain networks, the study will advance both the conceptual and technical development of innovations in insurance mechanisms.

![Fig 1: Damages of the Major Disasters in 2011](source: TOPICS GEO Natural Catastrophes 2012)

![Fig 2: Annual Flood Damages in U.S. in Billion $ adjusted to 2011](source: http://www.nws.noaa.gov/oh/hic/)}
Fig 3: Decreased Operating Profits of Japanese Major Automakers
(April - Dec 2011)

- Yen appreciation
- Thailand floods
- Japanese earthquake and tsunami