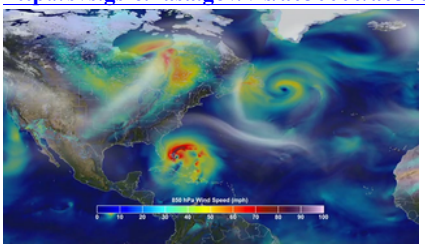
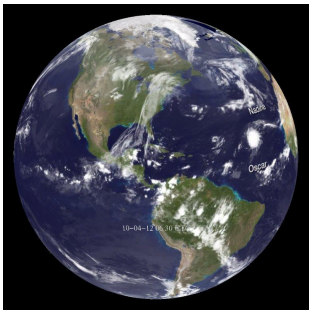
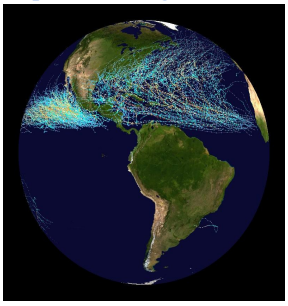
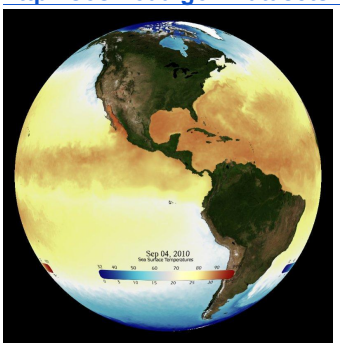
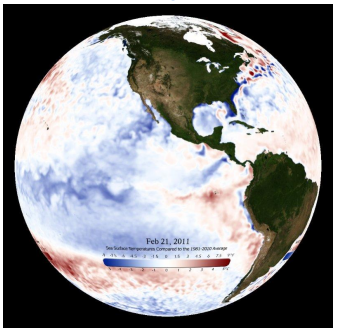
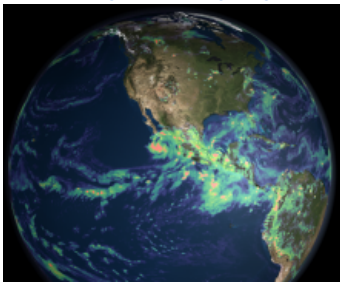
WATER FALLS DOCENT SCRIPT: EXTREME EVENTS

Key Points	Visuals
Water in just the right amount supports life. Too much or too little spells disaster. **This animation shows the clouds and wind speed associated with *Hurricane Sandy*, the deadliest and costliest hurricane to hit the United States in 2012. It moved ashore over New Jersey, flooded New York City and left a total of 286 dead and more than $60 billion worth of damage.**	**1) GEOS Hurricane Sandy** **Wind Speed over Water Vapor** **NOAA GSD, NASA GSFC** **http://svs.gsfc.nasa.gov/vis/a030000/a030000/a030019/** 
Cloud loop of the 2012 Hurricane Season illustrates where Hurricanes, Typhoons, & cyclones develop and move. They: **- originate over warm tropical or subtropical waters as clusters of thunderstorms that the Earth's rotation helps to organize around a deep low pressure center** **- have winds of at least 74 mph (64 knots)** **- devastate areas when they make landfall: in 2012, *Hurricane Isaac* struck the Gulf coast twice, costing 41 lives and more than $2 billion and causing the Mississippi River to flow backwards for 24 hours, which last happened during Hurricane Katrina in 2005**	**2) 2012 Hurricane Season** **NOAA EVL** **http://sos.noaa.gov/Datasets/dataset.php?id=372** 
Hurricane tracks from 1950-2005. Notice: **- tropical cyclones need warm water and the influence of the Earth's rotation to form** **- on the equator, the Earth's rotational force is absent, so tropical cyclones cannot form or survive on the equator** **- tropical cyclones dissipate over cool water or move poleward out of the tropics and are absorbed by midlatitude storms** **- National Hurricane Center in Miami monitors and predicts Atlantic hurricanes** **- Joint Typhoon Warning Center in Hawaii monitors and predicts Pacific typhoons** **- hurricanes are mostly absent in the South Atlantic and eastern South Pacific**	**3) Accummulative Hurricane Tracks 1950-2005** **NHC, JTWC** **http://sos.noaa.gov/Datasets/dataset.php?id=5** 

The oceans drive weather and climate and influence extreme events. **Sea-surface temperatures are used to predict extreme weather like hurricanes: recall locations with the most hurricane tracks in the last clip are where the water off the equator is warmest in the summer. Recall the absence of tracks in the South Atlantic and eastern South Pacific where water never gets as warm.** **Temperatures can also be used:** **to detect wind-driven ocean currents** **- warm, tropical water moves poleward fastest along the east coast of continents (e.g. Gulf Stream current off of the United States, Kuroshio off of Japan)** **-cool, polar water moves southward more slowly along the west coast of continents (e.g. California current)** **and to understand patterns such as El Nino**	**4) Real-Time: SST** **NOAA EVL** http://sos.noaa.gov/Datasets/dataset.php?id=197 
These sea-surface temperature anomalies are departures from the 30 year average seasonal cycle. **In the Tropical Pacific, El Nino and its opposite phase, La Nina, drive extreme weather world-wide. Scientists watch sea-surface temperature anomalies off of South America and along the equator:** **- warmer means an El Nino event** **- cooler indicates La Nina conditions** **- winds, precipitation, and sea life affected** **- global weather is affected as well** **- for North America, during El Nino winter the Pacific Northwest is warmer; the US Northeast is warmer; the Southeast is wetter. Droughts occur in Southeast Asia and India. Atlantic hurricanes are suppressed during an El Nino summer.**	**5) Real-time: SST Anomalies** **NOAA NCDC** http://sos.noaa.gov/Datasets/dataset.php?id=198 

Floods **over past 15 years, the Tropical Rainfall Measuring Mission has been giving high resolution rainfall estimates within 50 degrees of the equator. Scientists use the data to:** **- predict major rainfall events and potential flooding and landslide activity** **- study rainfall variation from year to year** **- understand how El Nino affects rain patterns worldwide** **- observe the anatomy and lifecycle of major storms, like hurricanes**	**6) Global TRMM Rainfall, Aug-Sep, 2003 NASA GSFC** http://svs.gsfc.nasa.gov/goto?2910 
Human impact of floods **- a major flood happens almost every day some place in the world, impacting people, infrastructure, and agriculture** **- September, 2013 saw catastrophic flash floods in Boulder County, Colorado caused by a slow moving front that stalled over the Rocky Mountains and drew moisture from the Pacific and Gulf of Mexico. Called a 'Biblical flood', 9 inches of rain fell in one day and more than 20 inches over one week, causing roads and bridges to wash out, property destruction and loss of life.**	**7) Human impact: Floods**  September, 2013 Boulder, Colorado Photo credit: Charley Schollaert, used with permission
Human impact of landslides **Heavy rainfall or rapid snowmelt can change the earth into a flowing river of mud, pulling anything in its path down the slope and causing loss of life. In the United States alone, landslides cost about $2B per year in destroyed homes and roads.** **- In the Phillippines, a massive landslide following a week of heavy rain killed roughly half of a 2,500 resident village and buried a school full of students.** **- Heavy rain from tropical storms or hurricanes can trigger mudslides.** ***NASA is developing a new landslide early-warning system using satellite rainfall data.***	**8) Human impact: Landslides**  California house sliding down a hill (left) and Las Colinas landslide (right) photo credit: FEMA and USGS

Droughts

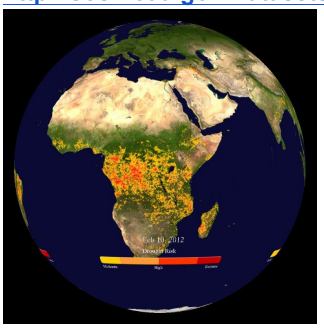
extended period of below-normal precipitation or reduction of groundwater:
- natural causes such as El Nino
- man-made causes such as over-farming, deforestation and desertification

Satellites monitor vegetation health, moisture and temperatures to identify areas that are stressed due to drought. Yellow areas indicate moderate drought conditions; red indicates extreme drought. ***Important note: drought imagery is based on the analysis of vegetation health and stress, not soil moisture. Areas of desert and snow cover are not included.***

Human impact of droughts

- stresses or ruins agriculture
- can lead to food shortages and famine
- make regions vulnerable to forest fires

9) Real-Time: Drought RiskC
NOAA
http://sos.noaa.gov/Datasets/dataset.php?id=129



Human impact: USGS gallery

Drought in Africa (left)
Dried river bed (center)
Dried fish in Texas river bed in 2011 (right)
Photo credit: USGS