Concepts of Climate Change and their Impacts

Rishiraj Dutta
Asian Disaster Preparedness Center



Learning Objectives

At the end of this module, participants will be able to

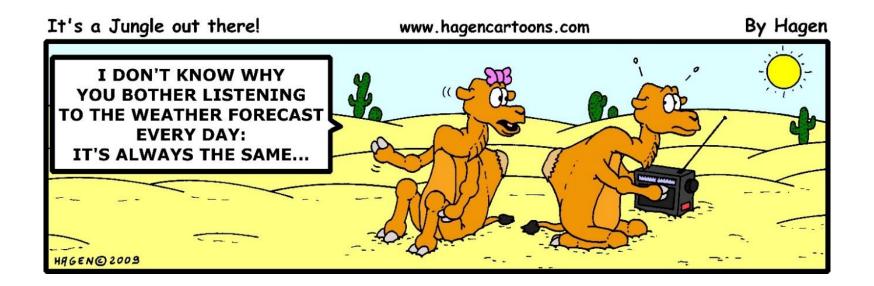
Describe the science behind climate change;

 Identify sources of natural and human-induced climate change; and

Describe the projected impacts of climate change.



Weather vs. Climate





Weather

The state of atmosphere at a given time and place measured in terms of variables that include temperature, precipitation, cloudiness, humidity, air pressure and wind.

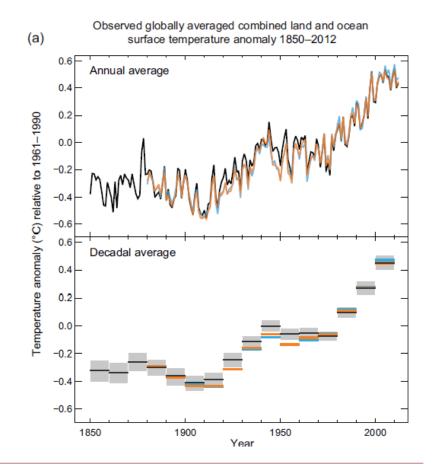
Climate

The long-term average of conditions in the atmosphere described by statistics, such as means and extremes



Climate Change

Climate Change is defined statistically significant variation in either mean state of the climate or in its variability, persisting for an extended period (typically decades or longer). Climate change may be due to natural internal processes or external forcing or to persistent anthropogenic changes in composition of the atmosphere or in land use (IPCC, 2001).







Climate Change (NOAA Definition)

Climate change is a long-term shift in the statistics of the weather (including its averages).

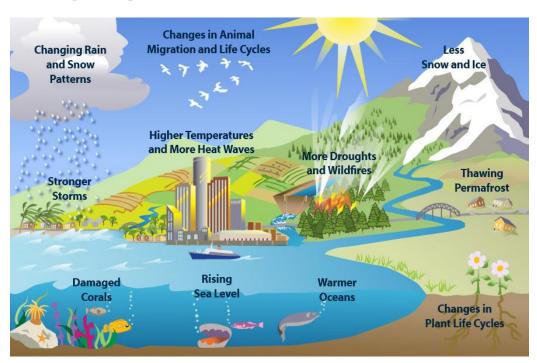
For example, it could show up as a change in climate normals (expected average values for temperature and precipitation) for a given place and time of year, from one decade to the next



Why is the Climate Changing??

Natural Variability

Climate change is a normal part of the Earth's natural variability, which is related to interactions among the atmosphere, ocean, and land, as well as changes in the amount of solar radiation reaching the earth.



US Environment Protection Agency



Human Induced Change

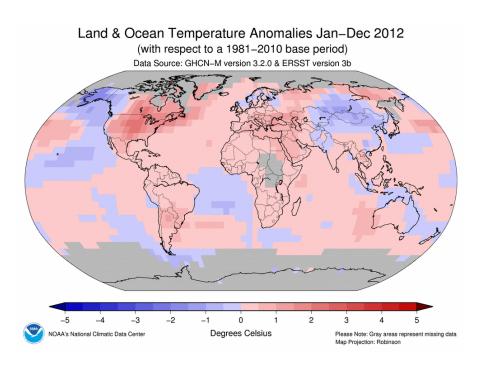
Greenhouse Gases

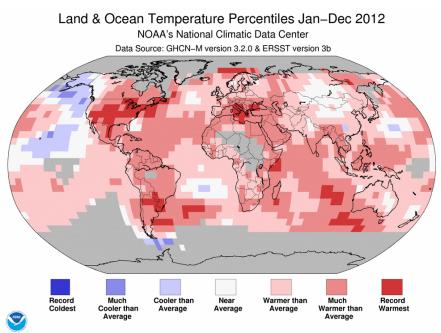
- Carbon dioxide (CO₂) and water vapor (H₂O), trap heat in the atmosphere causing a greenhouse effects
- Burning of fossil fuels, like oil, coal, and natural gas is adding CO₂ to the atmosphere.

The AR4 of the Intergovernmental Panel on Climate Change (IPCC) concludes, "that most of the observed increase in the globally averaged temperature since the mid-20th century is very likely due to the observed increase in anthropogenic greenhouse gas concentrations."



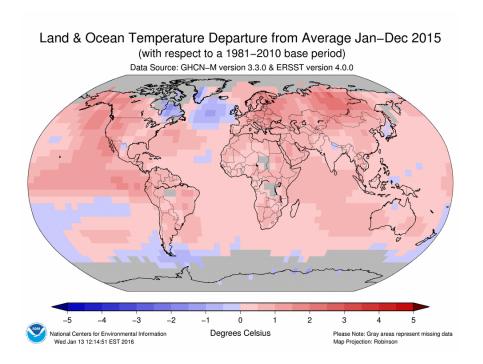
Regional Temperatures

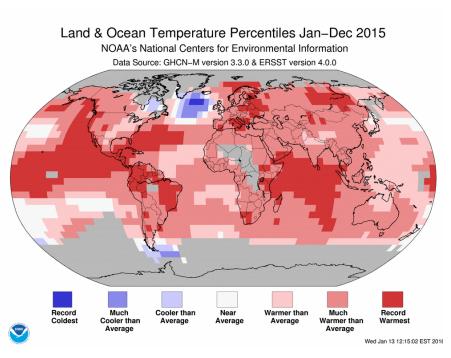






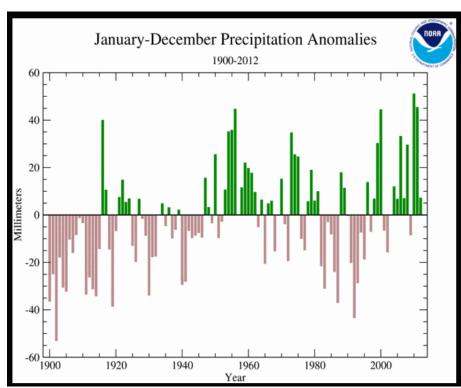
Regional Temperatures

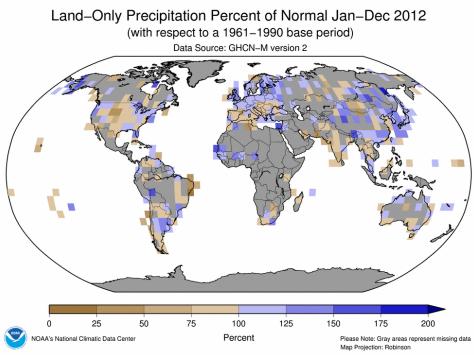






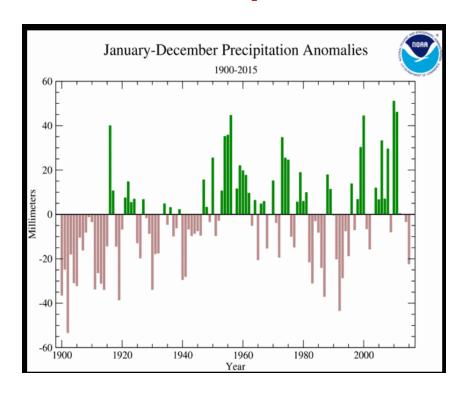
Global Precipitation

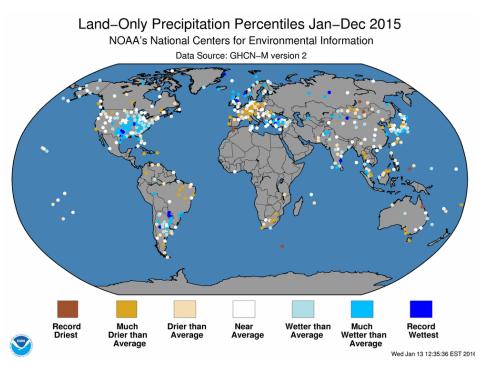






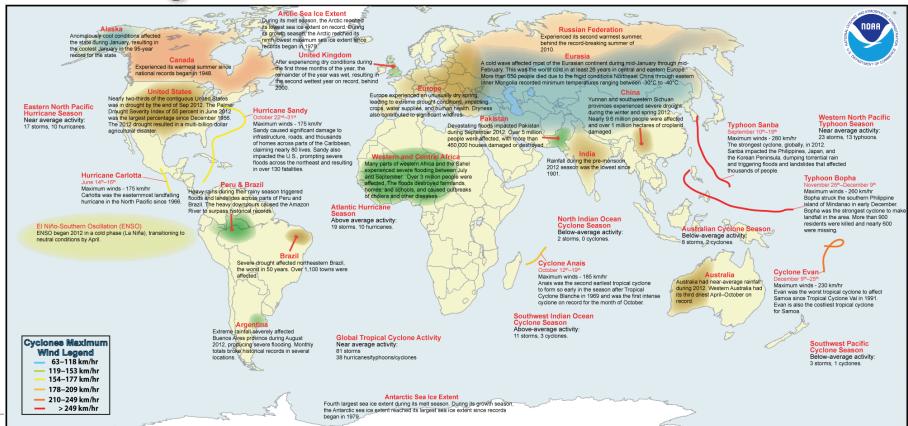
Global Precipitation







2012 Significant Climate Anomalies and Events





Selected Significant Climate Anomalies and Events in 2015

ARCTIC SEA ICE EXTENT During its growth season, the Arctic had its smallest annual ASIA maximum extent. During its melt season, the Arctic reached its Much-warmer-than-average conditions were present ALASKA fourth smallest minimum extent on record. across much of the continent. 2015 was the warmest year The year 2015 tied with 2002 as the since continental records began in 1910. Russia had its CANADA second warmest year since statewide warmest Jan-Sep since national records began in 1936. records began in 1925, behind 2014. Parts of western Canada had their warmest summer China had its warmest Jan-Oct, with Hong Kong on record. Moderate to extreme drought developed experiencing its warmest Jun-Aug period on record. across parts of western Canada due to the unusual warmth and dryness. Europe, as a whole, experienced its second warmest year on record, behind 2014, Several countries had a top 5 year: Spain (warmest), Finland (warmest), Austria (2nd), Germany (2nd), France (3rd), and The Netherlands (5th). **EASTERN NORTH PACIFIC BASIN** Heavy rain from May-Oct caused floods August 2015 A major heatwave affected India from that affected 75 million people. Provinces At the end of August, three storms—Kilo, Ignacio, and CONTIGUOUS UNITED STATES 21 May-10 June. Average temperatures in southern China experienced their Jimena—represented the first simultaneous occurrence wettest May in 40 years. over 45°C were observed, with some The contiguous U.S. had its second warmest of three major hurricanes in the basin since records locations reaching 48°C. Over 2000 (behind 2012) and third wettest year since began in 1949. fatalities were blamed on the excessive national records began in 1895. May 2015 WESTERN PACIFIC OCEAN was the wettest month of any month on **TYPHOON SEASON** Above average activity MOROCCO 28 storms, 21 typhoons ATLANTIC HURRICANE On Aug 6th, Marrakech **SEASON** received over 13 times its CYCLONE CHAPALA monthly average in one hour. Below average activity (October 28th-November 4th, 2015) 63% of normal ACE Maximum winds - 250 km/hr 11 storms, 4 hurricanes Chapala was the first hurricane-strength **EASTERN NORTH PACIFIC** storm (Category 1 in the Saffir-Simpson **AFRICA** NORTH INDIAN OCEAN **HURRICANE SEASON** scale) on record to make landfall in Yemen. CYCLONE SEASON 2015 was the second warmest Above average activity Several storm systems brought heavy precipitation year, behind 2010, since Near average activity 144% of normal ACE during March 2015, with the national average being continental records began in 5 storms, 2 cyclones 18 storms, 13 hurricanes **AUSTRALIAN CYCLONE** over three times the monthly average. This was the 1910. SEASON SOUTH WEST PACIFIC wettest March since national records began in 1941. OCEAN CYCLONE Near average activity **HURRICANE SANDRA** SEASON 9 storms, 7 cyclones **SOUTH WEST INDIAN SOUTH AFRICA** Near average activity (November 23rd-28th, 2015). OCEAN CYCLONE Jul 2014-Jun 2015 was the driest 6 storms, 2 cyclones Maximum winds - 230 km/hr SEASON season since 1991/92 and third Sandra was the latest major hurricane Near average activity driest since records began in CHILE AUSTRALIA observed in the Eastern North Pacific 13 storms, 6 cyclones 1932/33. basin since reliable records began in Experienced its fifth warmest year since Jan 2015 was the driest Jan in at least five decades. national records began in 1910. The month of October was excpetionally **SOUTH AMERICA** warm, recording the largest anomaly Much-warmer-than-average conditions for any month on record. engulfed much of the region during the Second warmest year, behind 2012, since national year, resulting in the warmest year since records began in 1961. The four warmest years on ANTARCTIC SEA ICE EXTENT continental records began in 1910. record have occurred since 2012. During its growth season, the Antarctic had its 16th largest annual maximum extent. During its melt season, the Antarctic reached its fourth largest minimum extent on record.



Climate Variability & Climate Change



What is the Climate System?

Consists of five major components:

- The atmosphere
- The hydrosphere
- The cryosphere
- Land surface
- The biosphere

The climate system continually changing due the interactions between the components as well as external factors such as volcanic eruptions solar variations and human-induced factors such as changes to the atmosphere and changes in land use. (WMO)



What is Climate Variability?

Variations in the mean state and other statistics of the climate on all temporal and spatial scales, beyond individual weather events.

- Deviations of climatic statistics over a given period of time (e.g. a month, season or year) when compared to long-term statistics for the same calendar period;
- Variability may be due to natural internal processes within the climate system (internal variability), or to variations in natural or anthropogenic external factors (external variability).



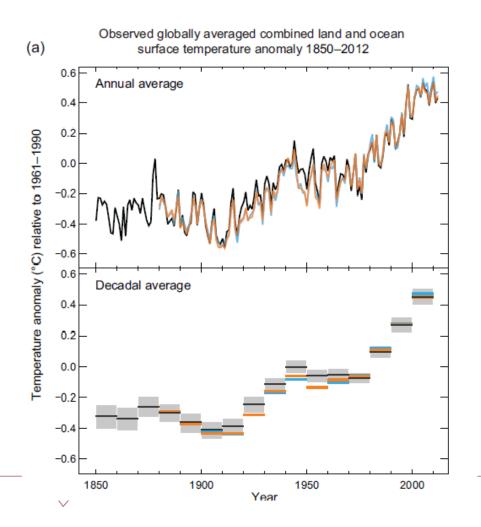
What is the difference between Climate Variability and Climate Change?

Climate variability looks at changes that occur within smaller timeframes, such as a month, a season or a year, and climate change considers changes that occur over a longer period of time, typically over decades or longer.

A key difference between climate variability and change is in persistence of "anomalous" conditions - when events that used to be rare occur more frequently, or vice-versa.

(WMO)





From IPCC Assessment Report (AR5) (2014)



Consequences of Climate Change



Present Consequences

Global climate change has already had observable effects on the environment.

- Glaciers have shrunk, ice on rivers and lakes is breaking up earlier, plant and animal ranges have shifted and trees are flowering sooner.
- Past predictions by scientists are now occurring: loss of sea ice, accelerated sea level rise and longer, more intense heat waves.

(NASA Vital Signs of the Planet)



Future Consequences

- Change will continue through this century and beyond;
- Temperatures will continue to rise;
- Variations in crop growing season;
- Changes in precipitation patterns;
- More droughts and heat waves;
- Sea level will rise 1-4 feet by 2100.

(NASA Vital Signs of the Planet)

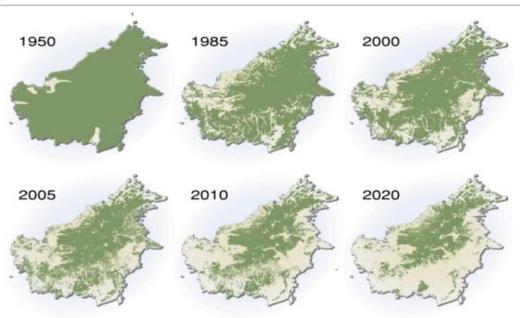


What Changes Climate



Landuse Changes

Past, Present and Future in Indonesia





Volcanic Eruptions

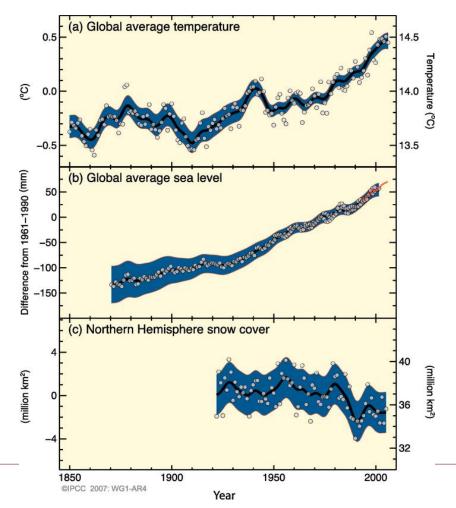


Greenhouse Gas Emissions



Observations of Climate Change



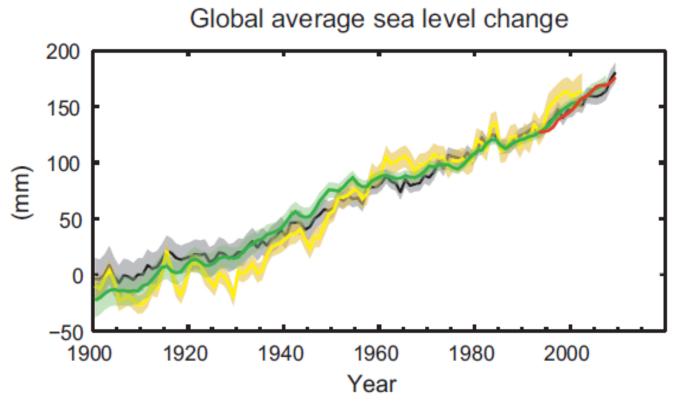


Direct Observations

CHANGES IN TEMPERATURE, SEA LEVEL AND NORTHERN HEMISPHERE SNOW COVER

Observed changes in (a) global average surface temperature, (b) global average sea level from tide gauge (blue) and satellite (red) data and (c) Northern Hemisphere snow cover for March-April. All changes are relative to corresponding averages for the period 1961–1990. Smoothed curves represent decadal average values while circles show yearly values. The shaded areas are the uncertainty intervals estimated from a comprehensive analysis of known uncertainties (a and b) and from the time series (c).





From IPCC Assessment Report (AR5) (2014)



Mount Kilimanjaro

Feb. 17, 1993



Feb. 21, 2000



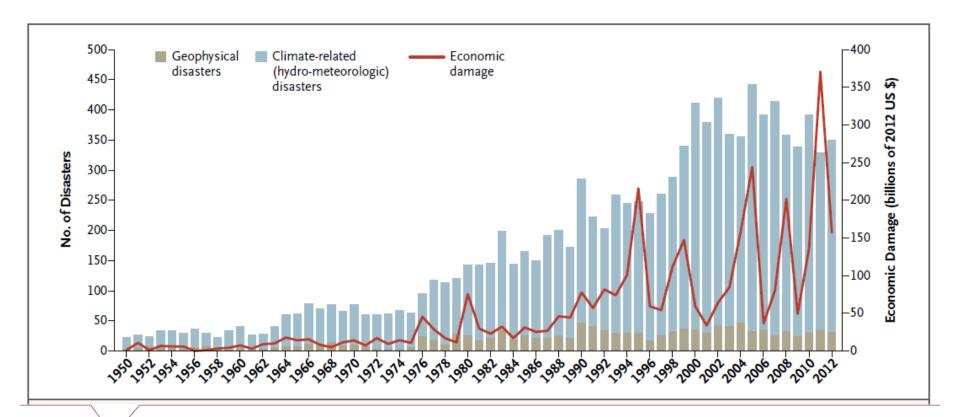
Credit: Jim Williams, NASA GSFC Scientific Visualization Studio, Landsat 7 Science Team



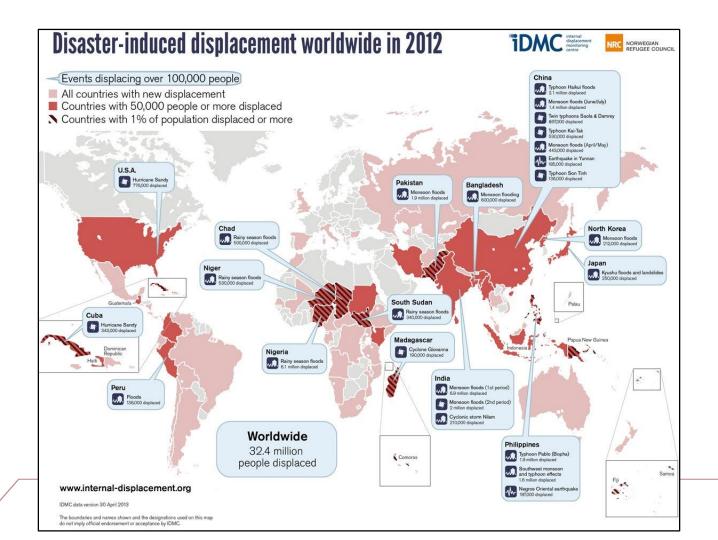




Climate related Disasters on the Increase...

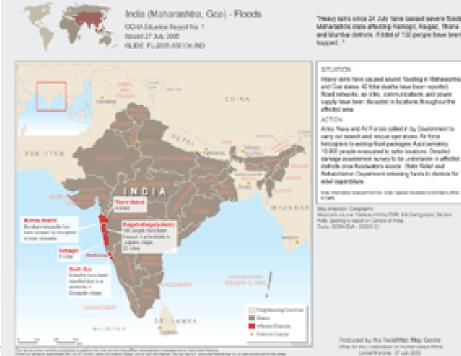








Bombay Extreme Rainfall on 26th July 2005 (944 mm - 24 hrs.)



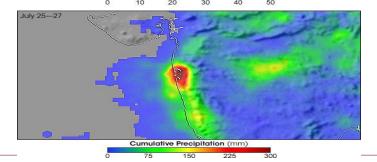
Trisser same simos 24 July have caused severe North in Maharbatos state affecting Halbogs, Raigno, Thane and Martine delivers. A total of TSC people have been

Fenery wire here caused source fooding in Michaelette. and Distriction. 40 febb strates have been reported. Road setworks, at 17ths, communications, and power supply have been disrupted to bootlers. Broughout the

Acres News and Art Forces salted in by Commonwellinparty and beautiful and resource specialisms. As there being men to wrong that puriouse. Accommons 10:000 people resourced to safer treations. Detailed between management support to be underlander in affective districts your foundations woulde. State Relational Refractioner Connectional intensity funds to discountilly

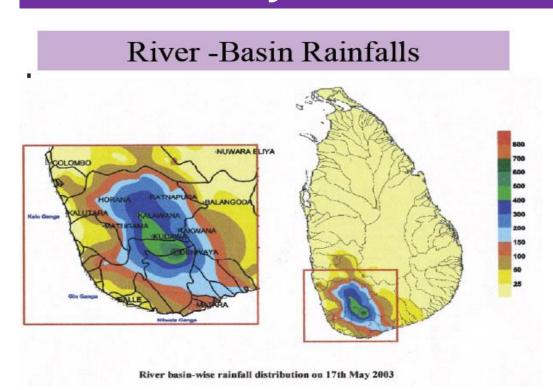
Pentured by the Relativity May Contra Other for the Commission of Productional Photo-

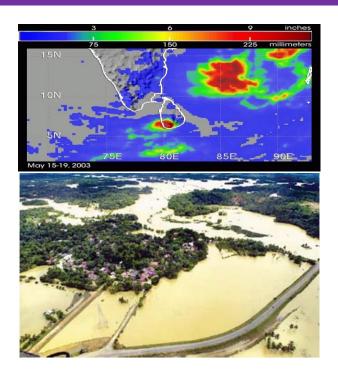






15 – 19 May 2003 Flood event in Sri Lanka







Climate Change's Devastating Effects

Impacts of Climate Change



THANK YOU FOR YOUR ATTENTION







http://www.drrprojects.net



Group: Asian Disaster Preparedness Center (@ADPCnet

