

ENVIS-IITM NEWSLETTER

Indian Institute of Tropical Meteorology, Pune Acid Rain and Atmospheric Pollution

(The project of Ministry of Environment, Forest & Climate Change, Govt. of India)

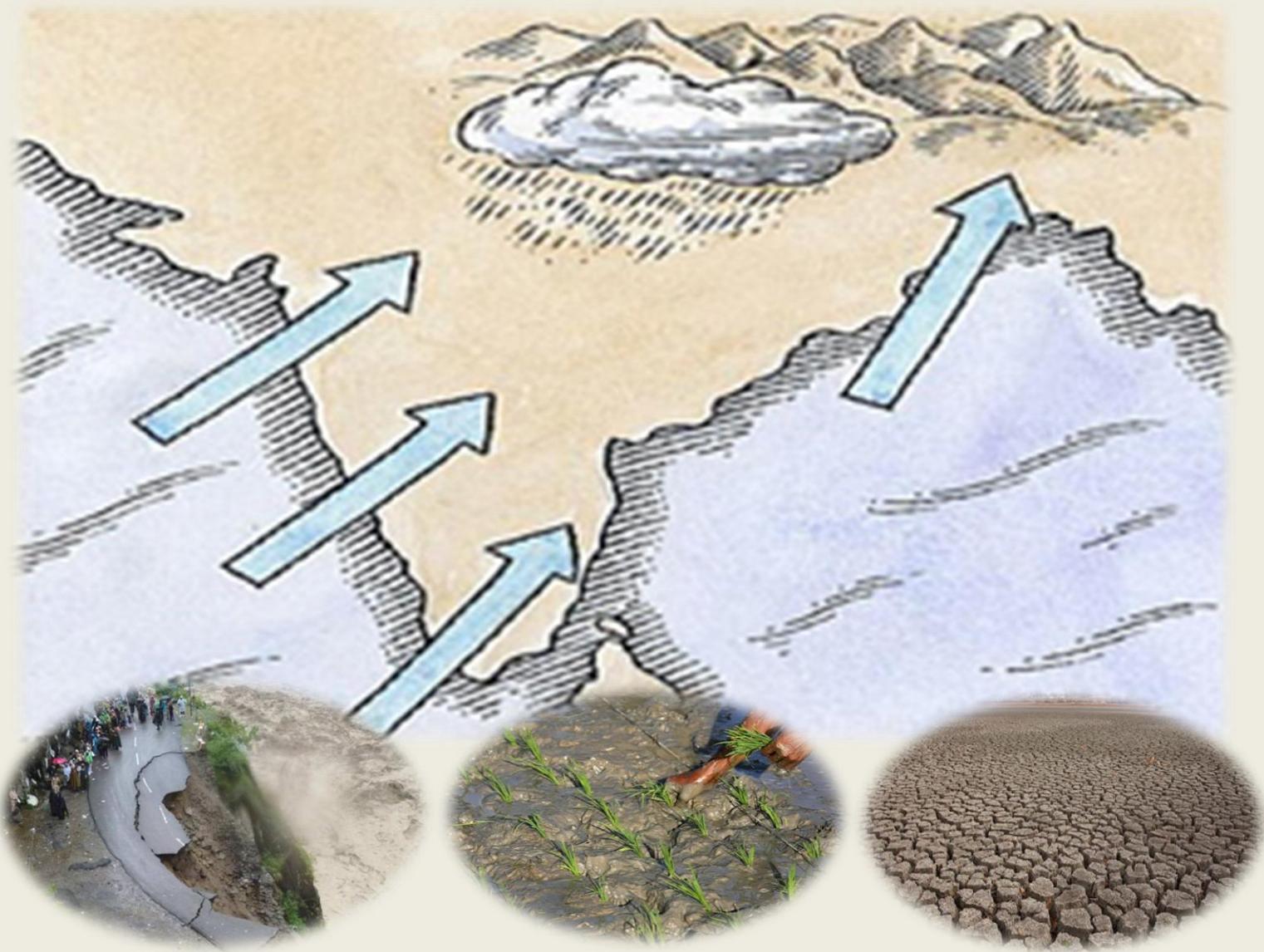


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INDIAN MONSSON AND AIR POLLUTION



EDITORIAL TEAM

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EDITORIAL

The IITM-ENVIS centre deals with Acid Rain and Atmospheric Pollution. It is well known fact that our atmosphere is being polluted to an extreme level by development, industrialization and human interference. Today many planetary and environmental problems like pollution and global warming are linked with atmospheric changes, it also affects monsoon on which entire agricultural activities and hence food security of India depends. Monsoon has profound impact on Asian culture and nearly two third population of world is relied on it. Majority of us are curious to know whether air pollution has any impact on Monsoon activity or not. This issue will provide you basic information of monsoon, its path, and also give insights on studies which show effect of air pollution on monsoon progression. We hope the content of this newsletter will help you to understand more about monsoon activity and give all of you its overview for the year 2015.

-Gufran Beig



MONSOON

Monsoon is the wind that changes with season

Monsoon is a wind regime operating at a level of 20 km from the earth's surface. It is characterised by seasonal reversal of wind direction at regular intervals. On a global scale, the monsoons are a major source of energy driving the planet's atmospheric circulation, which has huge influence on food security of the world. Monsoon conditions are found over verity of regions around the world, the prominent is the monsoon of Asia.

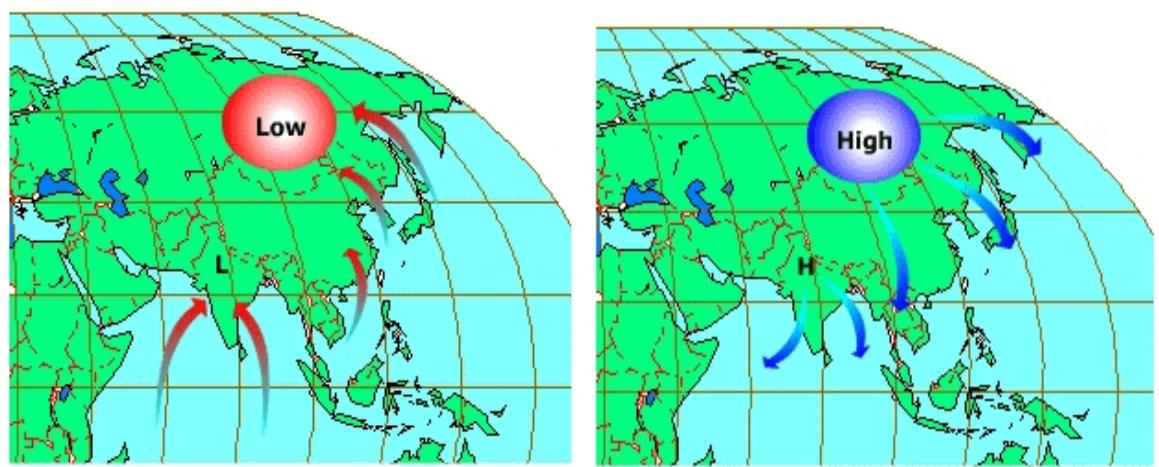
Change in direction is due to the difference in the way water and land heat.

Monsoon system over India differs considerably from that of rest of the Asia. As a consequence of high temperature over the Tropic of Cancer (which passes through centre of India) the region develops low pressure at the end of summer. The winds from high pressure water belts such as Bay of Bengal, Arabian Sea & Indian Ocean starts moving towards the low pressure belts. They shift their direction while crossing the equator and start blowing from the South West direction. The wind gets moistened while passing along these seas and causes heavy rainfall across the various places in India. During winter, winds start blowing away from northern region. They pick up moisture from Bay of Bengal (BOB) on their way which is dropped over southern parts of India.

IN INDIA

AGRICULTURAL

ACTIVITY DEPENDS
ON MONSOON RAIN



Summer

Winter

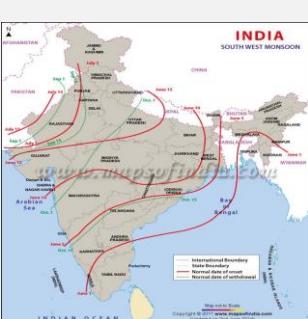
South West Monsoon (SWM)

The SWM brings rains towards the end of summer as the high pressure built in the India Ocean pushes the wind masses towards the low pressure formed on land. It's the temperature variation between the sea and the landmass- Sea air being cooler and the land being warmer. The SWM, a four month period (June- September) when massive convective thunderstorms dominate India's weather and is also the most productive wet season. The SWM arrives in 2 branches, the Bay of Bengal and the Arabian Sea branch. The latter extends toward a low pressure area over the Thar Desert and is roughly 3 times stronger than the Bay of Bengal. **Arabian Sea branch splits into 3 branches.**

- 1) One branch causes heavy orographic rain on the western slopes of the Western Ghats Mountains. It causes little rainfall east of the Western Ghats, this region is known as the rain shadow area and includes parts of Maharashtra & Karnataka.
- 2) Another branch strikes the coast North of Mumbai. Moving along Narmada & Tapi valleys they cause rainfall in extensive areas of Central India. Thereafter they enter Ganga plains and mingle with Bengal of Bay.
- 3) Third branch moves northwards through Kachchh, Saurashtra & western Rajasthan which fail to get adequate rainfall. In Punjab & Haryana it too joins the BOB branch. These 2 branches, reinforced by each other, cause rains in the Western Himalayas.

The BOB branch strikes coast of Myanmar and part of South East Bangladesh. This Branch splits into two.

- 1) One branch moves westward along the Ganga plains
- 2) Another branch moves up the Brahmaputra valley in the north & north-east causing wide spread rains. Its sub branch strikes the Garo-Khasi hills of Meghalaya. Mawsynram located on the crest of Khasi hills receives the highest rainfall. Tamil Nadu coast remains dry during this season.



Terminology used for the Southwest Monsoon activity

- i) Weak/subdued Monsoon - Rainfall less than half the normal (over the land area) Wind speed upto 12 knots (over the Sea)
- ii) Normal Monsoon - Rainfall half to less than 1½ times the normal (over the land area) 12 Wind speed is between 13 to 22 knots (over the Sea)
- iii) Active Monsoon -
 - a) Rainfall 1 ½ to 4 times the normal.
 - b) The rainfall in at least two stations should be 5 cm, if that sub-division is along the west coast and 3 cm, if it is elsewhere.
 - c) Rainfall in that sub-division should be fairly widespread to widespread. (over the land area) Wind speed is between 23 to 32 knots(over the Sea)
- iv) Vigorous Monsoon -
 - a) Rainfall more than 4 times the normal.
 - b) The rainfall in at least two stations should be 8 cm if the sub-division is along the west coast and 5 cm if it is elsewhere.
 - c) Rainfall in that sub-division should be fairly widespread or widespread. Wind speed is 33 knots and above (over the Sea)
- v) Break Monsoon - Monsoon trough shifts northwards and runs close to foot hills of Himalayas, resulting in drastic reduction in rainfall over the country outside the foot hills and southernmost Peninsula.

NORTH EAST MONSOON



North East Monsoon (NEM)

Towards the end of September, the low pressure centre in northwest begins to disintegrate and eventually shifts to the equatorial regions. The cyclonic conditions are replaced by anticyclonic ones, as a result, winds start blowing away from northern region. The wind is of land origin and so less moisture. The retreating monsoons over Bay of Bengal pick up moisture on their way which is dropped over eastern or coastal Orissa, Tamil Nadu and parts of Karnataka during October-November; this is the main season of rains over these areas.

AREAS RECEIVING NEM RAINFALL

Eastern of costal Orissa, Tamil Nadu, part of karnataka

Terminology used for the Northeast Monsoon activity

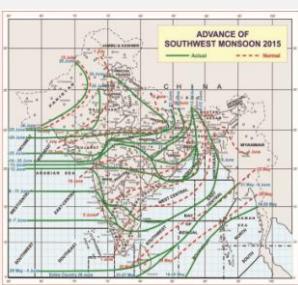
- i) Weak Monsoon: Rainfall less than half the normal.
- ii) Normal Monsoon: Rainfall is half to less than one and a half ($1\frac{1}{2}$) times the normal.
- iii) Active Monsoon :
 - a) Rainfall $1\frac{1}{2}$ to 4 times the normal.
 - b) Rainfall in atleast two stations should be 3 cm in coastal Tamil Nadu and south coastal Andhra Pradesh and 2 cm elsewhere.
 - c) Rainfall in that sub-division should be fairly widespread or widespread.
- iv) Vigorous Monsoon :
 - a) Rainfall exceeding 4 times the normal.
 - b) Rainfall in atleast two stations should be 5 cm in coastal Tamil Nadu and south coastal Andhra Pradesh and 3 cm elsewhere.
 - c) Rainfall in that sub-division should be fairly widespread or widespread.

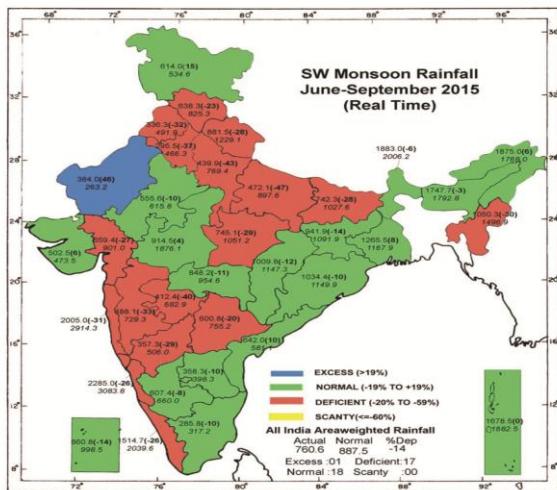
2015 Southwest Monsoon Highlights

- The season (June-September) rainfall over the country as a whole was **86%** of its long period average (LPA). Thus years 2014 & 2015 was the fourth case of two consecutive all India deficient monsoon years during the last 115 years.
- Seasonal rainfall was 83% of its LPA over Northwest India, 84% of its LPA over Central India, 85% of its LPA over south Peninsula and 92% of its LPA over Northeast (NE) India.
- Out of the total 36 meteorological subdivisions, 18 subdivisions constituting 55% of the total area of the country received normal season rainfall and 17 subdivisions (39% of the total area of the country) received deficient season rainfall. One subdivision (West Rajasthan) constituting 6% of the total area of the country received excess rainfall.
- Monthly rainfall over the country as a whole was 116% of LPA in June, 84% of LPA in July, 78% of LPA in August, and 76% of LPA in September.
- Monsoon current advanced over the Andaman Sea 4 days earlier than its normal date of 20th May. However, it set in over Kerala on 5th June, 4 days later than its normal date of 1st June and covered the entire country by 26th June, nearly 20 days earlier than its normal date of 15th July. Withdrawal of monsoon from west Rajasthan commenced on 4 th September against its normal date of 1st September.
- During the season, 2 Cyclonic Storms ('Ashobaa' and 'Kemon'), 6 monsoon depressions and 3 monsoon low pressure areas were formed as against the normal of 6 monsoon depressions and 6 monsoon low pressure areas per season.

ADVANCES OF SWM

2015





- The monsoon onset over Kerala for this year was on 5th June against the forecast of 30th May ± 4 days.
- All the operational forecasts for the 2015 southwest monsoon season rainfall over the country as a whole and that over 4 broad geographical regions were within the limits of forecast issued in June and accurate.

- The forecasts for the rainfall for the second half of the monsoon season and that for the July over the country as a whole were also within the forecast limits. However, the forecast for the August rainfall was slightly below the lower forecast limit.

Monsoon & Air Pollution

A study suggests emissions produced by human activity over the past 50 years have caused decline in the annual monsoon rainfall on which billions of people depend. In the second half of the 20th century, the levels of rain recorded during the Northern Hemisphere summer monsoon fell by as much as 10%. Scientist found that emissions of tiny air particles from man-made sources, known as anthropogenic aerosols were the cause. High levels of aerosols in the atmosphere cause heat from the sun to be reflected back into the space, lowering temperatures on the Earth's surface and reducing rainfall. Levels of aerosol emissions have soared since the 1950s with the most common sources being power stations and cars.

Increased particle emissions during or before the Asian summer monsoon are also expected to affect cloud and rainfall pattern. Smoke or dust in the air act as "seeds" on which water drops form to make clouds. The more particles in the atmosphere, the more water vapour spreads out and the longer it takes to rain. Scientists believe this will result in more extreme rainfall events as larger clouds form and release more water. But, it's uncertain how much current pollution levels will affect this.

Thus pollution from vehicles and other fossil fuel burning in South Asia is a major contributor to the increased particle pollution, causing a cooling effect on the surface. The surface cooling slows atmospheric air circulation, leading to a reduction in the summer monsoon rainfall.

AIR POLLUTION THREAT TO MONSOON



DO YOU KNOW

- **Why Tamil Nadu remains dry during South West Monsoon season?**
 - Tamil Nadu coast is situated parallel to the Bay of Bengal branch. It also lies in the rain shadow area of the Arabian Sea Branch of the South West Monsoon.
- **Why Mawsynram receives highest rainfall?**
 - Mawsynram (near Cherrapunji) is situated on the southern slopes of Khasi hills. Its average annual rainfall is 11,873 millimetres . It has a peculiar geographical location. It is flanked on all sides by the Garo, Khasi and Jaintia hills except for a gap through which the rain bearing winds enter and are forced to rise, thus yielding the heaviest rainfall. According to the Guiness Book of World Records, Mawsynram received 26,000 millimetres of rainfall in 1985.
- **How are the terms drizzle, rain, shower differentiated?**
 - a) Drizzle: Liquid precipitation in the form of water drops of very small size (by convention, with radius of water drop between 60 about 100 and 500 μm)
 - b) Rain: Liquid precipitation in the form of water drops of radius between about 500 and 2500 μm .
 - c) Shower: Solid or liquid precipitation from a vertically developed cloud. They are characterised by short duration and rapid fluctuations of intensity (by convention, with radius of water drop more than 2500 μm).
- **Hon'ble Union Minister of Agriculture Launched the Nowcast-Extreme weather alerts services to farmers on 18 June 2015, for providing localised extreme weather warnings to more than 1 crore farmers registered on MKisan Portal.**

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