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Changing monsoonal rainfall patterns over the Western Ghats

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From 1931 to 2015, the average rainfall in the northern Western Ghats has increased by 2 percent per decade while in the southern region it has decreased by 3 percent per decade.

Saturday, January 26, 2019 - 12:06

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Neha Jain

Every summer, Indian farmers eagerly await the arrival of the southwest monsoon, which comprises up to 90 per cent of the country's annual rainfall. The Western Ghats (WG), a 1600-km mountain range lying parallel to the west coast of India, are the first to experience the monsoon rains.

But the amount of rain in the region varies considerably with factors such as elevation playing a role. Now, a recent study reveals that over the past 85 years, rainfall patterns within the mountain-stretch have changed; the northern parts have become wetter while the southern region has been getting drier.



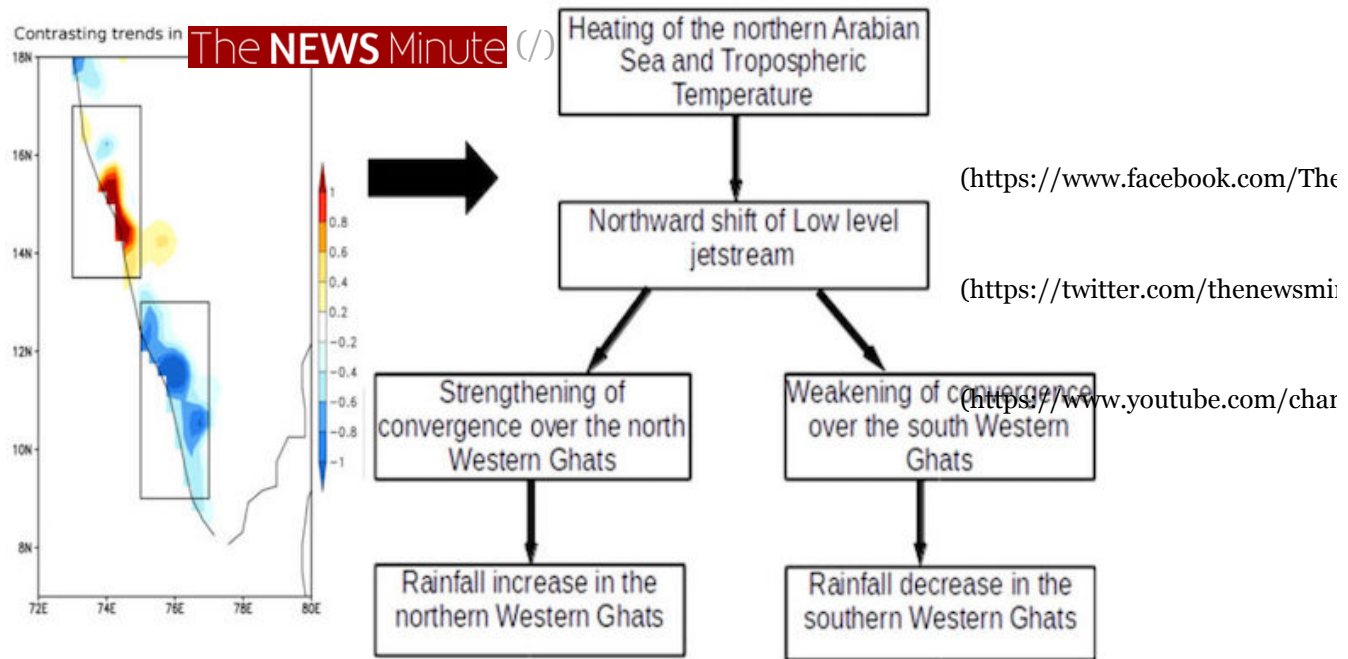
The research team attributes a southerly shift in the low-level jet stream (LLJ) — fast-moving moisture-laden westerly winds in the lower troposphere (the lowest part of our atmosphere) — triggered by a rise in the sea surface temperature over the northern Arabian Sea. The LLJ, which moves across the Arabian Sea towards the west coast of India, is one of the main sources of moisture for the southwest monsoon.

“Although the Western Ghats are getting enough rainfall (~300 cm/year) and more than 80 per cent of this rainfall is contributed by the southwest monsoon, the southern region shows a significant reduction in rainfall, which is alarming,” said Hamza Varikoden, lead author of the study, who is a scientist at the Centre for Climate Change Research (http://cccr.tropmet.res.in/home/index.jsp) in the Indian Institute of Tropical Meteorology in Pune. “The state governments concerned need to take actions for appropriate collection of rainwater in the form of micro-irrigation projects, mini-hydral projects and so on.”

To unveil regional trends in rainfall in the Western Ghats, the team examined daily gridded IMD (India Meteorological Department (http://www.imd.gov.in/Welcome%20To%20IMD/Welcome.php)) rainfall data from 1901 to 2015. And to shed light on the causes of the changes in rainfall patterns, they analysed wind and temperature data obtained from the National Centre for Environmental Prediction-National Centre for Atmospheric Research (NCEP-NCAR) from 1948 to 2015. In addition, sea surface temperature data spanning the period from 1931 to 2015 from the Hadley Centre was combined in their analysis.

Wetter north, drier south

The analysis revealed that from 1931 to 2015, the northern WG experienced an increase in average rainfall of 2 per cent per decade (+0.3 mm per day per decade) while rainfall in the southern region decreased at 3 per cent per decade (-0.39 mm per day per decade).



According to the study, rainfall in the northern part has increased while it has decreased in the south from 1931 to 2015. Photo by researchers.

These trends, the researchers point out, are restricted to the upstream flow of the low-level westerlies (winds originating from the west). When the westerlies encounter the mountainous barrier of the WG, they are forced to rise and form organised clouds in the windward side, which pour down as rain, explained Varikoden. “Any modification to these flows can significantly affect the orographic clouds and hence the rainfall pattern of the region.”

In the northern windward region, the increased wetting is notable in the low-altitude plains (elevation less than 200 m), which receive the maximum amount of rainfall. As you move south on the coastal plains, rainfall decreases, and it is also more variable.

When looking at trends in anomalous rainfall, the team noted that the southern region had excess rainfall in the past decades but deficit rainfall in the recent decades. However, the opposite trend was observed for the northern region where earlier decades had deficit rainfall and recent ones saw surplus rainfall.

Why is this happening?



According to ~~the team~~ **The NEWS Minute** (V) for the contrasting trends in average rainfall lie in a 5 degrees (550 km) northerly shift of the core of the low-level jet stream (LLJ)—high-speed westerly winds in the lower troposphere peaking at 1.5 km. [\(https://www.facebook.com/The](https://www.facebook.com/The)

“This low-level flow starts from the easterly trade winds and crosses the equator at Somali region with strong winds in order to call it as LLJ, then it moves towards north and turns towards the Indian peninsular region,” said Varikoden. [\(https://twitter.com/thenewsmin](https://twitter.com/thenewsmin) [\(https://www.youtube.com/char](https://www.youtube.com/char) Along this route, the LLJ picks up moisture from the surrounding oceans and seas, which ultimately falls as rain on the Indian landmass.

But why has the LLJ moved northward? The study points to an abnormal increase in the lower tropospheric temperature over northern continental India and rising sea surface temperatures in the northern Arabian Sea—particularly over the Oman upwelling region—in the recent decades.

“The hotter region leads to the formation of low-pressure zones. Due to these low-pressure regions, the core of the winds shows a tendency to move towards that zone. This would facilitate movement of LLJ towards north and can be attributed to the heating,” explained Varikoden.

As the core moved northward, the westerly winds over the southern WG weakened, reducing moisture transport over the region and lowering the conditions for the development of organised monsoon clouds.



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Although the Western Ghats are getting enough rainfall, the southern region shows a significant reduction in rainfall, says the research. Photo (https://commons.wikimedia.org/wiki/File:Western_ghats_monsoon_time.jpg) by Mariappan Ramachandran/Wikimedia Commons.

“The shift in LLJ is expected, but such a magnitude of shift is unexpected and the tropospheric warming over the Arabian Sea is also alarming,” said Varikoden. In a 2014 study (<https://link.springer.com/article/10.1007/s00382-014-2261-y>), another research team had reported a poleward shift of the LLJ by 1.5 to 2 degrees in latitude. The researchers think that this smaller shift could be because of the team’s shorter period of analysis

Other factors play a role

Raghu Murtugudde, a professor of atmospheric, oceanic, and earth system science at the University of Maryland (<https://www.umd.edu/>) and visiting professor at IIT Bombay (<http://www.iitb.ac.in/>) said it is interesting to look at past trends in rainfall. But he cautioned that both studies are incomplete in explaining the cause and effect.



“Rainfall is a **The NEWS Minute** (V) have feedbacks. So when rainfall has changed, claiming that it is because of the shift in the jet may not be the entire story,” he said. He explained his point with an example, “If Eurasian snow cover has a trend and that created a large scale ocean -land temperature gradient trend and that changed the rainfall, then the associated heat source changes will adjust the jet as well.”

He pointed out that the changes in temperature and the response “cannot always be separated easily in a complex coupled climate system especially when land, ocean and atmosphere are so tightly coupled.”

Essentially, the 2014 study along with this one, are “explaining that there is a consistency in the rain change and the jet change,” he said.

The relation to Kerala floods

There is still a long way to go to explain the reason for the Kerala floods earlier this summer, said Murtugudde. “There were multiple heavy rain events over Kerala and this required the jet to tilt back towards the south. Does that mean that LLJ is shifting back?” he asked. “We cannot know that for another decade since to see any trend we need to wait.”

Varikoden said that they did not analyse the recent anomalous rainfall in Kerala. “That was an extreme event and has to be studied in detail to uncover the exact reasons.”

CITATION

Varikoden., H., Revadekar, J.V., Kuttippurath, J., Babu., C.A. (2018). Contrasting trends in southwest monsoon rainfall over the Western Ghats region of India. *Climate Dynamics*, doi.org/10.1007/s00382-018-4397-7 (<https://link.springer.com/article/10.1007/s00382-018-4397-7>)

Banner image: Western Ghats. Photo (https://commons.wikimedia.org/wiki/File:Post_monsoon_climate.jpg) by Rakdept/Wikimedia Commons.



This article was originally published on Mongabay. Find the original article here



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Crime

20 Indians languish in Gulf prisons even after completing term, says VK Singh

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Experts say that the process of release and repatriation of Indian nations who complete jail sentences abroad is an uphill task.

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Saturday, February 09, 2019 - 12:40

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Twenty Indians -- four in Oman and 16 in United Arab Emirates (UAE) -- are still lodged in prisons even after completing their jail terms, Minister of State in the Ministry of External Affairs Gen VK Singh has stated



(<https://www.thenewsminute.com/article/indian-prisoners-released-1006>)

dtl/31006/QUESTION_NO461_RELEASE_OF_INDIAN_PRISONERS_FROM_MIDDLE_EAST on Thursday.

Responding to a question raised by parliamentarian V Muraleedharan in the Rajya Sabha, VK Singh said, “There are four in Oman and 16 in UAE. However, due to stringent privacy laws prevailing in many countries, the local authorities do not share information on prisoners unless the person concerned consents to the disclosure of such information,” the minister said.

“Even countries which share information do not generally provide detailed information about the persons who have been imprisoned,” he added.

According to the minister, the process of release and repatriation of Indian nationals who complete their sentences in foreign prisons is dynamic and the number keeps changing. “Our Missions and Posts abroad provide all possible consular support and humanitarian and legal assistance on a case to case basis, for completing formalities by coordinating with local immigration authorities for early deportation of the Indians who have completed their jails terms,” he said.

The support includes issue of emergency certificates, if required, and also provision of airfare on a means-tested basis in deserving cases from the Indian Community Welfare Fund (ICWF).

Bheem Reddy, a migrant rights activist in Hyderabad, said that other than just stating that there are 20 Indians languishing in jails even after completing term, they should initiate steps to release them and bring them home. “Most of the time, when we approach the ministry seeking help in freeing the jailed Indians in the Gulf countries, the response is tepid,” he noted.

Meanwhile, talking on the hassles in providing legal assistance for jailed Indians in the Gulf countries, Rafeek Ravuther, an Indian migrant rights activist, said that in the Gulf countries, lack of human and financial resources



are the two main hurdles in handling the legal cases. However, he added that “both the Indian embassies or Civil Society Organisations have enough funds or human resources to handle cases.”

“Every Indian embassy in the Gulf countries have a legal panel with empanelled lawyers. However, they are not much effective on the ground,” Rafeek alleged.

In February 2018, 62 Indians, many of whom were serving jail terms for over two decades, were released by the Oman government while Prime Minister Narendra Modi visited the Arab country.

Among the 62, five Keralites who were jailed on murder charges, were also released. Indian External Affairs Ministry, Indian Embassy in Oman and a few social workers had been following the case of jailed Indians tirelessly for the last few years.

Among the released 62, Santhosh Kumar and Shajahan, were jailed on ‘murder charges’ of two Omani security guards in 1997. The charges on the two Keralites were that they had allowed the convicts, a group of Pakistanis, to reportedly buy weapons for a robbery and murder from the Keralites’ shop in Oman. The Oman court had slapped a death sentence on the four Pakistanis involved in the case. When released in February 2018, Shajahan and Santhosh had completed 21 years in the jail.

In December 2018, the ministry had stated that “as per information available with the Ministry through our Missions/Posts, 8,445 Indian nationals are currently in jails in foreign countries.” In a document (https://www.mea.gov.in/Images/amb1/ru1607.pdf) tabled in the parliament, there are 2,224 Indians jailed in Saudi Arabia. Saudi Arabia tops the list with maximum number of Indians jailed. The UAE comes in second position with 1,606 Indians in jail and Nepal comes in third position with 1,065 Indians in jail. In Pakistan, there are 549 Indians jailed.

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