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TRMM
Tropical Rainfall Measuring Mission

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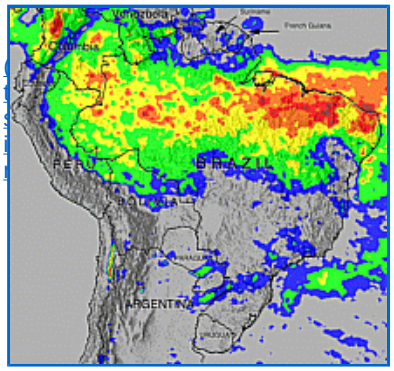
The Tropical Rainfall Measuring Mission (TRMM) is a joint mission between NASA and the Japan Aerospace Exploration Agency (JAXA) designed to monitor and study tropical rainfall.

TOP STORY

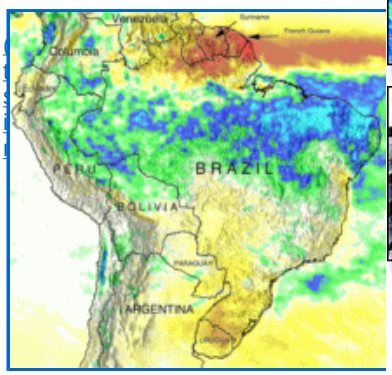
PERSISTENT HEAVY RAINS BRING FLOODING TO NORTHERN BRAZIL

Over the past several weeks, persistent heavy rains have brought severe flooding, the worst in over two decades, to parts of northeastern and northern Brazil. So far at least 40 people have died as a result of the flooding and over 300,000 have been displaced from their homes. The heavy rains began back in early April, which is actually not that unusual. Climatologically, northeastern Brazil is fairly dry; however, being located deep within the Tropics does give it a summer wet season in addition to the dry season. The typical summer rainy season ramps up in February, peaks in April and quickly falls off in May. This pattern is intimately tied to the seasonal migration of the sun via what is known as the Intertropical Convergence Zone or ITCZ. The ITCZ is manifest as a band of showers and storms that wraps around the globe near the equator. It is produced by warm, moist air rising in response to the instability generated by heating from the sun, which is maximized when the sun is located directly overhead. However, there is a time lag over oceans because it takes a while for the water to heat up. Hence, the southernmost extent of the ITCZ in northeastern Brazil occurs in April due to the close proximity of the Atlantic Ocean. Rising motion within the ITCZ induces low pressure at the surface, which results in a band of low pressure that circumnavigates the globe near the equator. This trough of low pressure draws in the trade winds from both hemispheres causing them to converge and ascend, providing moisture for the showers and storms.



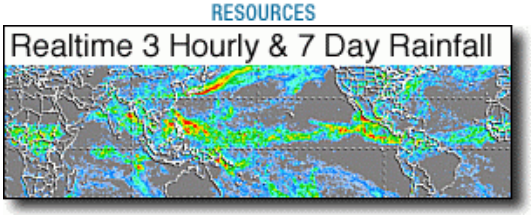
Armed with both a passive microwave sensor and a space-borne precipitation radar, the primary objective of the Tropical Rainfall Measuring Mission satellite (better known as TRMM) is to measure rainfall from space. For increased coverage, TRMM can be used to calibrate rainfall estimates from other additional satellites. The TRMM-based, near-real time Multi-satellite Precipitation Analysis (TMPA) at the NASA Goddard Space Flight Center is used to monitor rainfall over the global Tropics. TMPA rainfall totals are shown here for the 1-month period 12 April to 12 May 2009 for Brazil and the surrounding region. The single most prominent feature is the large east-west band of very heavy rain stretching from the Atlantic Ocean in the East to the northern Andes mountains of Peru, Ecuador, and Columbia in the West. This band is a direct result of the ITCZ..

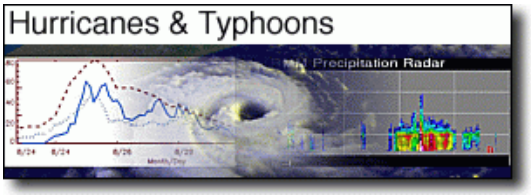
For the period, rainfall totals within this band exceed 450 mm (~18 inches, shown in orange) over much of northeastern Brazil with embedded areas of upwards of 600 mm (~24 inches, shown in red) to as high as 750 mm (~30 inches, shown in brown). Farther west over the Amazon Basin, totals are generally slightly lower but still in excess of 150 to 300 mm (~6 to 12 inches, shown in green and yellow, respectively)

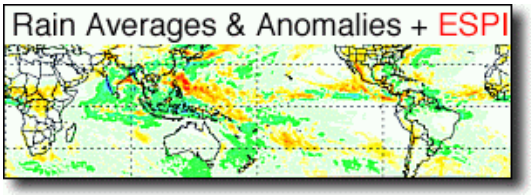


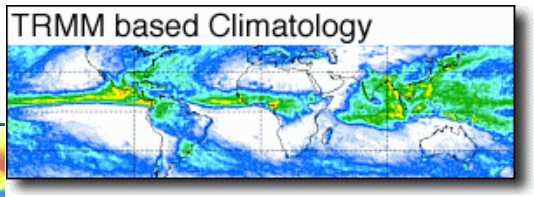
The ITCZ is a regular feature in the Tropics; what lead to the record rainfall in this situation was the movement of the ITCZ or actually the lack there of. This next image shows the rainfall in relation to the climatological average for the same period. The anomalies (or deviations from the climatological average) show well-above-normal rainfall over most of northeastern Brazil (light blue areas). Slightly- to moderately-above-normal rainfall (shown in green and dark blue, respectively) extends westward to the northern Andes such that the overall pattern is similar to that for the total rainfall shown in the previous image. The anomaly pattern, however, has an additional feature--a strong east-west band of below-normal rainfall (shown in brown) positioned immediately along the northern edge of the above-normal band.

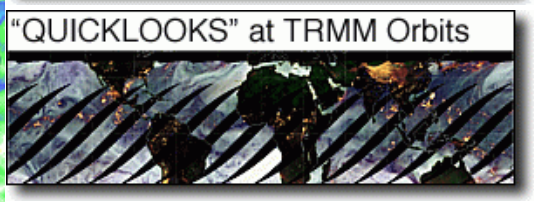
RESOURCES





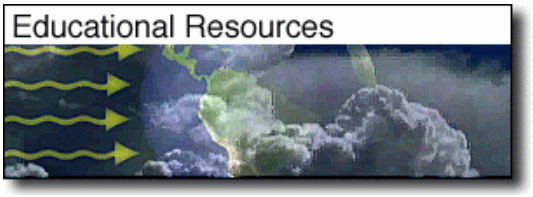






The overall anomaly pattern shows that the ITCZ remained locked over northeastern Brazil instead of migrating back northward as it would normally do over French Guiana, Suriname, and Guyana. One possible reason for this has to do with what is known as the North Atlantic Oscillation or NAO. The oscillation describes changes in the relative strengths of two semi-permanent pressure features over the North Atlantic: the Icelandic Low and the Azores High. When the index is positive, the pressure features are stronger. The NAO became strongly positive at the beginning of May, indicating that the Azores High was stronger than normal. As a result, stronger-than- normal trade winds from the northern hemisphere can flow in towards the ITCZ in the southern hemisphere. These winds not only create a surge in moisture into the ITCZ, they can impede its movement both directly and indirectly by blowing additional warm ocean surface waters southward. This is consistent with the weakly-coherent pattern of above-normal sea surface temperatures in the tropical South Atlantic at the latitude of northern Brazil becoming much more coherent and stronger starting at the very end of April.

Images by Hal Pierce(SSAI/NASA GSFC) and captions by Steve Lang (SSAI/NASA GSFC)



(July 9, 2007) ***Google Earth Downloads***

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