

TROPICS first light: How low-noise amplifier technology improves meteorology

TROPICS (Time-Resolved Observations of Precipitation structure and storm Intensity with a Constellation of Smallsats) is a NASA space mission proposed and lead by MIT Lincoln Laboratory (PI William J. Blackwell). TROPICS uses microwave sensing over the tropics regions on Earth to gather data on the storm systems in the troposphere such as hurricanes and tropical cyclones. These contain huge amount of water where microwave radiometers can detect water vapor, precipitation, and cloud ice formations. TROPICS is equipped with a 12-channel passive radiometer detecting such information from 90 to 206 GHz. TROPICS is based on a miniature satellite design, so-called CubeSats. A picture of the TROPICS CubeSat is shown in Fig. 1. The components in CubeSats do not require the extensive testing as required for traditional and much more expensive space missions. For example, the microwave/mm-wave electronics does not need full space qualification.

Low Noise Factory AB and Chalmers has jointly developed the InP HEMT MMIC technology which enables amplifiers up to 120 GHz. The 90-120 GHz LNA module (and others) have been delivered to the TROPICS radiometer. These and other amplifiers have helped to increase the resolution in weather monitoring needed to study the meteorology aimed for in the TROPICS scientific objectives.

The first TROPICS CubeSats were launched by NASA June 30th 2021, on the SpaceX transporter. In Fig. 3, the first light from TROPICS is seen capturing the evolution of hurricane Ida over Louisiana late August 2021. During 2022, NASA will launch six more TROPICS CubeSats which will enable full detection and in-depth analysis of future tropical storms.

References

<https://tropics.ll.mit.edu/CMS/tropics/Mission-Overview>

Yulung Tang, Niklas Wadefalk, Jacob Kooi, Joel Schlee, Giuseppe Moschetti, Per-Åke Nilsson, Arsalan Pourkabirian, Eunjung Cha, Silvia Tuzi, Jan Grahn, Cryogenic W-band LNA for ALMA Band 2+3 with Average Noise Temperature of 24 K, IEEE MTT-S International Microwave Symposium Digest (2017).

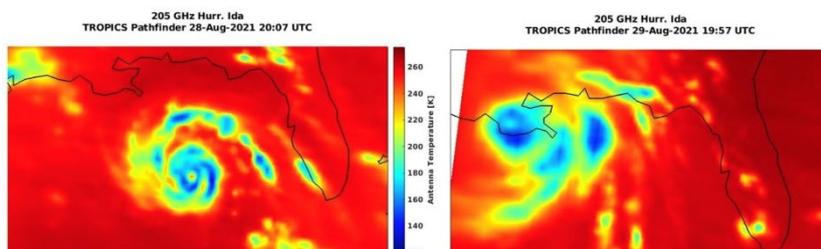
<https://directory.eoportal.org/web/eoportal/satellite-missions/content/-/article/tropics>



Tropic Pathfinder Satellite. Image credit Blue Canyon Technologies.



The LNF-LNR83-120WA delivered to TROPICS mission.



TROPICS radiometer images of hurricane Ida August 2021. Courtesy NASA and MIT Lincoln Laboratory.