SEAC^{4}RS ER-2 Microwave Temperature Profiler (MTP)

Contact Information

Instrument:
ER-2 Microwave Temperature Profiler (MTP)

Principal Investigator:
Michael J. ("MJ") Mahoney

Organization:
Jet Propulsion Laboratory
Mail Stop 169-237
4800 Oak Grove Drive
Pasadena, CA 91109-8099

Phone: (818)-354-5584
FAX: (818)-393-4619
E-mail: Michael.J.Mahoney@jpl.nasa.gov
URL: http:\\mtp.jpl.nasa.gov\

MTP located on the ER-2's right engine cheek (HDPE window just visible)

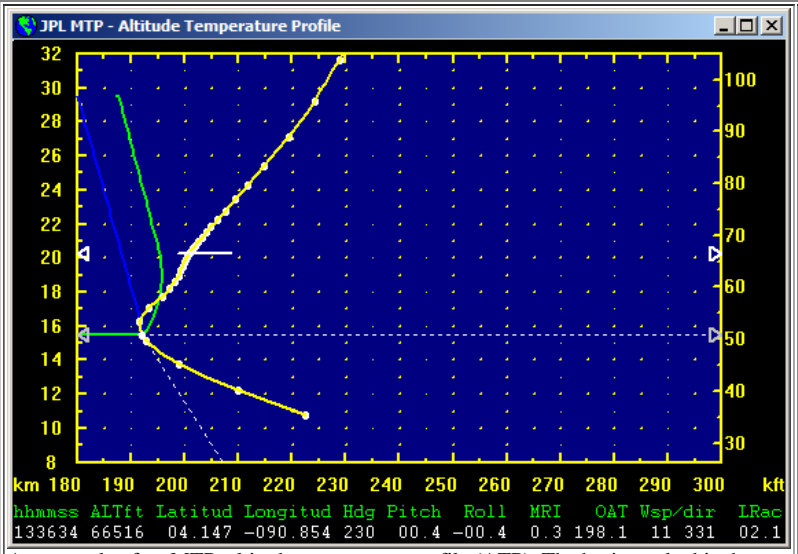
A view of the MTP fairing (left upper) on the right engine cheek of the ER-2. The Sensor Unit extends out into the fairing, and the Data Unit is mounted below it inside the engine cheek.

Principle of Operation

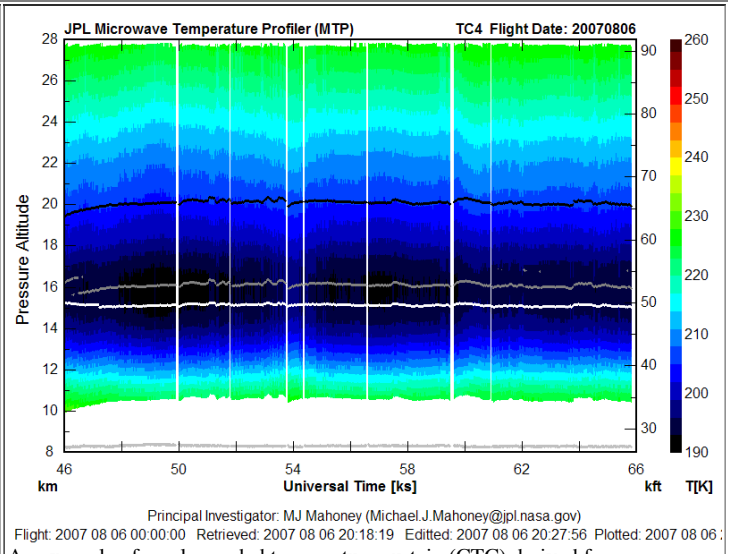
The ER2 MTP is a passive microwave radiometer, which measures the natural thermal emission from oxygen molecules in the earth's atmosphere for a selection of elevation angles between zenith and nadir. The current observing frequencies are 55.51, 56.65 and 58.80 GHz. The measured "brightness temperatures" versus elevation

angle are converted to air temperature versus altitude using a quasi-Bayesian statistical retrieval procedure. The MTP has no ITAR restrictions, has export compliance classification number EAR99/NLR.

MTP Data Products



An example of an MTP altitude temperature profile (ATP). The horizontal white bar indicates the ER-2's altitude, and the horizontal white dashed lines is the thermal tropopause altitude.



An example of a color-coded temperature curtain (CTC) derived from individual ATPs measured along the ER-2's flight track during TC4 on 2007-08-06. The black trace is the ER-2's altitude, the white trace the tropopause altitude, and the gray trace the height of the cold point.

An altitude temperature profile (ATP) is produced in this manner every 15 seconds (about 3 km) along the flight path (see above left), and these can be used to produce a color-coded temperature curtain (CTC) of the temperature field which the ER-2 has flown through (see image above right).

Because the average tropopause height is ~16 km, with a range of 14.5-17.5 km during August and September in the region that SEAC4RS aircraft will fly in, it is clear that the lapse-rate tropopause height and cold point height can only be measured by a remote sensing instrument such as the MTP. Implicit in this measurement are the height of the tropopause and the cold point (and their temperatures), which are key parameters in understanding transport through the Tropical Transition Layer (TTL), and how this affects atmospheric composition. Equally important to understanding stratosphere-troposphere exchange (STE) is being able to determine the presence of gravity waves (GWs) since they are one of the most important dynamical phenomena in the tropical atmosphere. The MTP can measure the presence of GWs by converting temperature profiles into potential temperature profiles, and then identifying levels of constant potential temperature, or isentropes -- the stream lines on which air parcels flow.

The MTP measurements can also contribute to satellite validation papers (since Aqua/AIRS and Aura/MLS/TES make temperature profile measurements), to satellite interpretation papers, and to data assimilation papers. The latter has been done for prior campaigns and has identified biases in the assimilated data.

The MTP Sensor Unit (left) and Data Unit (right).

Hardware Description

The MTP on the ER2 consists of two components: the *sensor unit* (located behind the fairing in the figure above), and the *data unit* (which controls the sensor unit and

records data from it). Both components are located on the right engine cheek. There is a small panel attached by two screws on the engine hatch that the MTP is mounted on to access data on a Flashcard in the Data Unit, and to access keyboard and monitor connectors for preflight instrument checkout.

MTP/ER2 Performance

Accuracy: Temperature accuracy is approximately 1 K within 6 km of the ER2 flight altitude,& < 2K for an 6 km region centered on the ER-2.
Response Time: Temperature profiles are obtained every 15 seconds.
Vertical Resolution: 150 m at flight level, and degrades with distance from flight level
Horizontal Resolution: 1-3 km depending on the altitude

MTP Flight Heritage

The ER-2 MTP has flown on 16 field campaigns, for 317 flights and 1675 flight hours
Collectively, MTPs have flown on 58 field campaigns, for 893 flights and 5159 flight hours

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For more information, go to the MTP Home Page (http:\\mtp.jpl.nasa.gov\ )