MEASUREMENTS OF CARBON| MONOXIDE WITH THE MOPITT IINSTRUMENT 1999-2009

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1. INTRODUCTION

The Measurements Of Pollution In The Troposphere (MOPITT) instrument was launched on the Terra spacecraft on 18th December 1999. It is now completing ten years of operation measuring carbon monoxide (CO) over the planet. These measurements have demonstrated changes of CO in both space and time and shown a planet with very large variations in concentrations depending upon events and circumstances.

2. BACKGROUND

Carbon monoxide is a common pollutant in the troposphere. Produced mainly by incomplete combustion and industrial activity, it has a concentration within the (normal) range of ~50-200ppbv throughout the troposphere. The major sink is its reaction with the hydroxyl (OH) radical. The lifetime of CO is ~20-30days in the troposphere. The fairly long lifetime and the reaction with OH makes CO an interesting chemical to measure for studies of tropospheric chemistry and pollutant transport.

Before the MOPITT instrument, there were few global measurements of carbon monoxide. The best datasets were produced by the Measurements of Air Pollution from Satellites (MAPS) instrument from the shuttle in the 1980-1995 time period. MOPITT represented the first space instrument to undertake a complete global mapping of CO over a long period of time [1].

MOPITT measures CO by monitoring the upwelling 4.7μm and 2.2-2.4μm radiation in the fundamental and first overtone vibration-rotation bands respectively. The radiation is analysed using a set of correlation cells to enhance the dynamic range of the measurement and then measured and transmitted to the ground [2]. Retrieval of the CO amount and vertical information is accomplished using a maximum-likelihood approach [3].

MOPITT was provided to NASA and the Terra spacecraft by the Canadian Space Agency under a Memorandum of Understanding between the two agencies.

3. MEASUREMENTS

In the nearly ten years of operation of the instrument, MOPITT has provided over two billion measurements of CO over the planet. It has observed a large number of singular events, such as the extensive burning in Indonesia in 2006 as a result of an El Nino and the outflow from forest fires in various parts of North America. It has established the general trend of CO over the planet: The Northern hemisphere amount peaks early in the year due to increased biological activity and meteorological effects, but the Southern hemisphere peaks later in the year due to biomass burning in both South America and Africa. However, the singular events referred to above frequently disturb this pattern and the concept of a "typical year" is elusive [4]. For this reason, it will be necessary to continue to measure CO over the planet rather than rely on models to predict the distributions.

There have been many studies involving MOPITT data and as the data record length increases, these will become more numerous. The data analysis has been continually improved, often guided by experience with the dataset. An example of this is the 2006 Indonesian event that produced CO concentrations so high that the retrieval flagged them as "unreasonable". A new version of the data processing algorithm (v4) has been produced that does not suffer from this problem [5].

4. THE MISSION

Over the ten years of the mission, the MOPITT instrument has been extremely stable. The overall system electronic and optical gains have changed minimally, well within the range of the on-board calibration systems to compensate. There have been a number of mechanism problems, some of which have proved difficult to deal with, but none has proven fatal. In 2001 half of the detector cooling system became inoperative, but sufficient redundancy existed in the instrument to compensate. As recently as 2009 changes in mechanism characteristics caused an anomaly, but again it has proven possible to modify the operating parameters to compensate. At the time of writing MOPITT is operational and heading into its eleventh year of service.

5. CONCLUSIONS

The MOPITT instrument has performed well during its ten years of operation. Much has been learned about the distribution of CO over the planet and these data have been applied to a number of scientific problems. The instrument is still producing excellent data and will continue to do so.

6. ACKNOWLEDGEMENTS

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7. REFERENCES

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