THE CLOUDSAT MISSION: STATUS AND PLANS

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1. INTRODUCTION

CloudSat will be the first spaceborne deployment of a 94-GHz cloud profiling radar. The spacecraft will be launched in April 2004 and will fly in on-orbit formation with the CALIPSO spacecraft and the EOS-Aqua spacecraft, providing a suite of measurements for cloud and aerosol studies. The mission is a partnership between NASA, the Canadian Space Agency (CSA), the US Air Force (USAF), and the US Department of Energy's Atmospheric Radiation Measurements (ARM) Program. The Principal Investigator, at Colorado State University, provides scientific leadership, and he has delegated mission management responsibility to the JPL.

2. FORMATION FLYING FOR SYNERGY WITH CALIPSO AND EOS-AQUA

By maintaining an on-orbit formation with the CALIPSO and EOS-AQUA satellites, CloudSat's mission design provides the opportunity to combine observations from the radar with observations from the other satellites to the study of clouds, aerosols and their interactions. CloudSat will maintain a formation with CALIPSO such that the CloudSat-radar footprint will always be closer than 2 km (crosstrack) to a CALIPSO-lidar footprint, and furthermore we expect that actual overlap of the footprints will occur approximately 50% of the time. The time delay between a lidar observation of a particular cloud region and the radar observation of that same region will be approximately 15 seconds. CloudSat will also maintain a formation with EOS-Aqua, approximately 60 seconds apart, with both CloudSat and CALIPSO flying near the nadir track of the Aqua-MODIS instrument swath.

CLOUDSAT SCIENCE OBJECTIVES
• Provide a quantitative evaluation of the representation of clouds and cloud processes in global atmospheric circulation models, leading to improvements in both weather forecasting and climate prediction;
• Provide a quantitative evaluation of the relationship between the vertical profiles of cloud liquid water and ice content and cloud radiative properties, including the radiative heating by clouds;
• Evaluate cloud information derived from other research and operational meteorological spacecraft;
• Improve our understanding of the indirect effect of aerosols on clouds by investigating the effect of aerosols on cloud formation;

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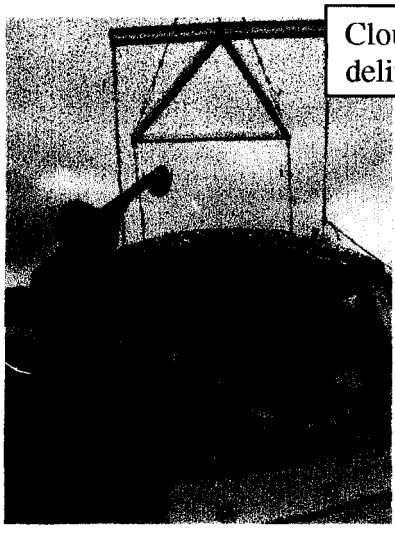
3. DATA PRODUCTS

CloudSat will produce and make available to the international scientific community several Standard Data Products . Two of the Standard Products, the cloud mask and cloud-type classification, will be produced for both radar-only and radar+lidar configurations. Other combined radar/lidar products will be produced in an experimental, research mode. Several of the Standard Products make use of MODIS radiance information as an integral part of the algorithm. The specification of Level 3 products is in process.

CLOUDSAT STANDARD DATA PRODUCTS	
Level 1B	
	Calibrated radar reflectivity data
Level 2	
	Radar-only cloud mask
	Combined radar+lidar cloud mask
	Radar-only cloud-type classification
	Radar + lidar cloud-type classification.
	Cloud optical depth as a function of altitude
	Cloud liquid water content as a function of altitude
	Cloud ice water content as a function of altitude
	Atmospheric radiative fluxes and heating rates
Level 3	
	Under discussion

4. CLOUD RADAR

Construction of the cloud radar, a partnership between NASA and the Canadian Space Agency, is underway at JPL in Pasadena, California, and at Communications & Power Industries, Inc. and COM DEVin Canada. Recently, the antenna was delivered to JPL and it has undergone far-field and near-field testing; results indicate that the antenna performance exceeds the specifications. The high-voltage power supply engineering model passed thermal vacuum test at JPL, and the flight power supply is under development. The 94-GHz Extended Interaction Klystron (EIK) engineering model passed thermal vacuum test, and the construction of the protoflight, flight and backup units is underway at CPI.



CloudSat radar primary antenna being delivered to far-field range for test

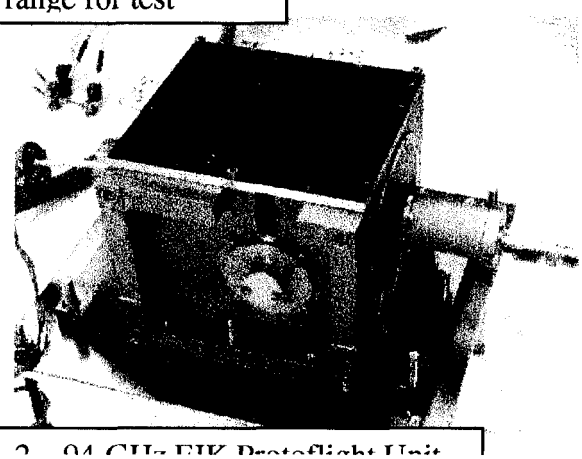


Fig. 2 – 94 GHz EIK Protoflight Unit

Integration and test of all radar subsystems will be completed in the Summer of 2003, and the radar will then be delivered to the spacecraft contractor.

The RS2000 spacecraft is under construction at Ball Aerospace in Boulder, Colorado (Fig. 3).

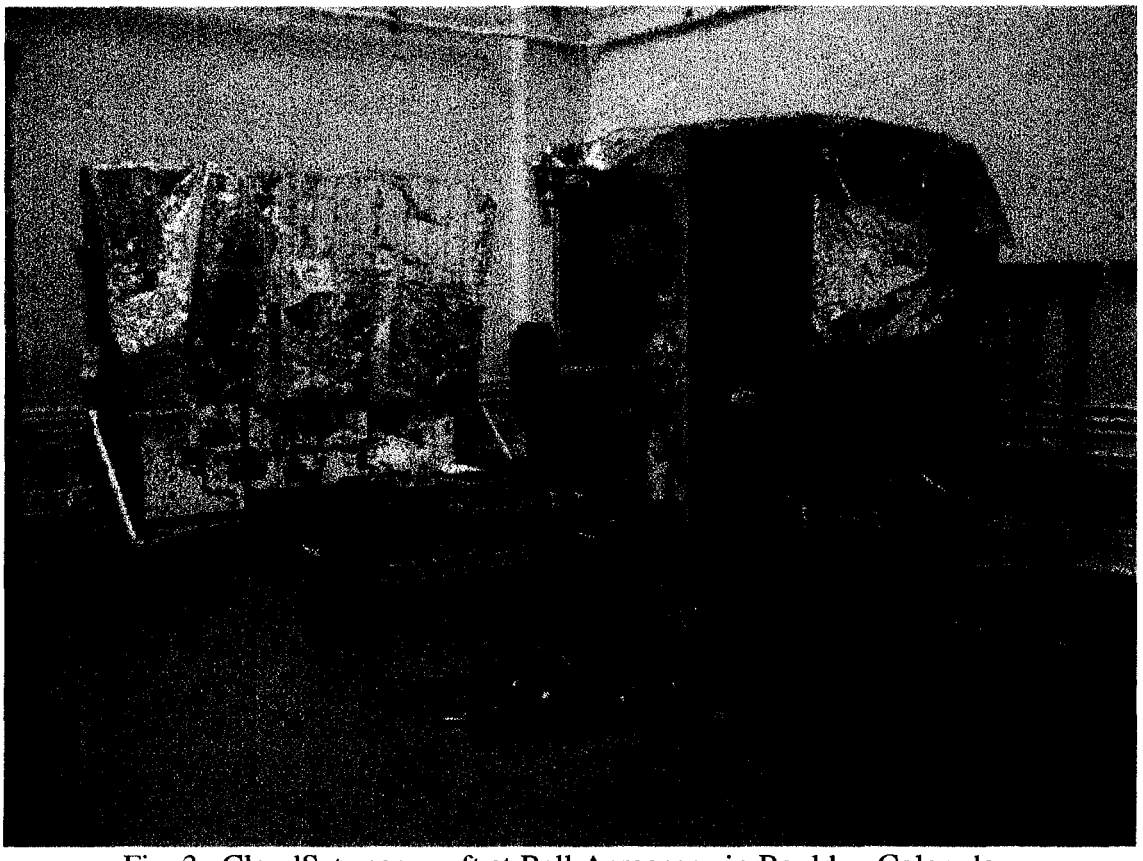


Fig. 3. CloudSat spacecraft at Ball Aerospace in Boulder, Colorado

5. SCIENCE TEAM ACTIVITIES

The CloudSat Science Team is an international partnership, with members from USA, Canada, Japan and Europe having expertise in cloud radar design and observations, cloud and radiation research, and NWP, GCM and cloud modeling. Science team members have responsibility for developing software code and documentation for CloudSat Standard Data products, for reviewing radar test and validation procedures, and for developing test data sets. The science team is beginning to plan the post-launch research and validation activities. Validation will rely heavily on the systematic measurement programs of ARM as well as systematic measurements planned for selected sites in Europe and Japan. Validation will also benefit from the aircraft radar

measurement activities of USA, Canada, Japan and Europe, from the measurement capabilities at number of universities, and from cloud field-capaign activities representing targets of opportunity planned in the coming years, including field campaigns associated with the CALIPSO and AQUA missions.

6. FURTHER INFORMATION

Further information on the CloudSat mission may be obtained from the author or by accessing the CloudSat Home Page at http://cloudsat.atmos.colostate.edu.

7. ACKNOWLEDGEMENTS

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