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Study of critical technology items for an Advanced Earth Orbiting Atmospheric Chemistry/Climate Observatory Using Cryogenic mm/Submm Receivers

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Abstract- This paper is a progress report on a NASA Earth Science Technology office task for studies of critical technology items that can greatly benefit future atmospheric chemistry and climate observations from space by microwave techniques. Present Earth observing microwave instruments use room temperature or modestly cooled receivers. Future instruments could gain a factor of 50 or more in sensitivity (a factor of 2,500 or more reduction in required measurement time) by cooling a few key components to 4 and 20 Kelvin. We are studying concepts that can enable a mm/submm wavelength instrument with the receiver front-end mixers and amplifiers cooled to 4 and 20 Kelvin by cryocoolers that appear feasible and affordable by the end of the decade. There is, potentially, a substantial savings in cryocooler development cost by coordinating with developments now underway by NASA Code S. Keeping the cryocooler power consumption to less than a few hundred Watts is essential for deployment on relatively small missions. We are developing a thermal/mechanical concept that should limit the cryocooler power consumption to 200W or less for a complement of, for example, five radiometers. Such a concept, combined with a novel azimuth scanning antenna system can provide twice-daily (day and night) full global coverage of microwave observations for atmospheric chemistry and climate from an instrument in low Earth orbit.