P5.11 **VALIDATION OF** THE AIRS/AMSU ON THE AQUA SATELLITE

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1. INTRODUCTION

The Advanced InfraRed Sounder (AIRS) was launched on May 4^{th} 2002, on the AQUA satellite. We are running a validation system in which the radiances from the satellite are matched with observations from radiosondes and other sources of truth, such as aircraft reports, and moisture values from the Global Positioning System (GPS) moisture measurements. Although special validation measurements are being made, the operational radiosondes are valuable because they are a source of data that are numerous enough to rapidly build a statistically significant sample. In addition, many stations have been used for climate studies and comparisons with those stations will provide a connection to the long-term trends that have been established.

2. APPROACH

The radiosondes are available through the Environmental Monitoring Center's (EMC) PREPQC files. These files are used because the radiosondes in them have been processed through their quality control procedures Collins (2001a, 2001b) thus eliminating the need to duplicate these procedures. The files containing the radiosondes retain information about all the changes that have been made. Not all can be saved, but we save the initial version of the radiosonde report and the final version that contains all the adjustments made by NCEP.

Two comparisons can be made. These are the radiances and the retrieved parameters such as temperature and water vapor. Both have advantages and disadvantages. The radiances have the advantage that they are the quantity being measured by the satellite. In contrast, the retrieved parameters contain errors due to the retrieval process. But the disadvantage to radiances is that they require that the complete atmospheric state be specified before they can be calculated. Their advantage is that they can be compared to measurements such as aircraft reports which are at a single level.

Radiosondes by themselves do not provide all the information necessary to calculate a radiance. A radiance calculation requires a complete specification of the atmospheric state, including the upper atmosphere, the temperature and emissivity of the radiating surface at the ground, and the concentrations of the important gases. This means that the radiosondes need to be supplemented to provide the complete information. For some parameters, the satellite measurements themselves are the most accurate source of information. Using these data means that the true error may be underestimated for some channels, but it assures that the error will not be inflated by "truth" whose uncertainty exceeds that of the satellite measurements. Trace gases are one example. Fortunately trace gases only affect limited regions of the atmosphere. In other cases, estimates can be made based on forecasts and physical models. Surface emissivity over oceans is an example. In any case our approach is to concentrate on ocean measurements first. The surface temperature will be taken from the EMC forecast and an emissivity model will be used to calculate the surface emissivity. The radiosondes will provide the water vapor and temperature measurements. The upper levels will be obtained using a regression to predict the level temperatures from the satellite measurements. Initially, channels with strong contributions from trace gases will not be used. Ozone data will be added, but not in real time. Later comparisons will be made using the forecast to account for differences in time and space. When using the forecast, there is a trade to be made between using the analysis, which is available every six hours, but contains no forecast error, and the forecast which is available at 3-hour intervals. Initially we are using the analysis.

There is also a lively discussion about the use of radiance adjustments versus adjusting the radiative transfer calculations. This discussion started with the processing of the Vertical Profile Radiometer (VTPR) (McMillin et al. 1973) and attempts were made to use the radiosonde comparisons to adjust the transmittance calculations. The problem was that there were too many degrees of freedom unless the transmittances were constrained to fit some physical model, and then the errors did not always fit the assumptions. This was resolved by fitting the radiances (Uddstrom and McMillin, 1994) by using the measurements to calculate small adjustments to be applied to the difference between calculated and observed radiances. Similar techniques are used by numerical prediction centers to remove biases between their various inputs. However with the high resolution of the current instruments, specific problems in the transmittance calculations can be more readily identified. The approach to be used for AIRS will depend on the results, but even if not used,

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the coefficients provide information about the performance of the instrument.

3. RESULTS

The Advanced Microwave Instrument (AMSU) differs from the AIRS in that the antennae is small compared to the wavelength. This means that the (Field-Of-View) FOV contains significant contributions from side lobes, some of which observe the spacecraft. This is an almost certain cause of a scan bias that is observed. In any case, the practice is to measure the scan pattern on the ground and then use it to account for contributions to a given measurement that come from space and the spacecraft. This means that it is very unlikely that the effects can be identified to the degree of accuracy required to make a totally physical correction. Measurements of the differences between observed and calculated radiances have been made, and coefficients have been generated that use the measured radiances to calculate the required adjustments. At this time, the AMSU results are preliminary. These preliminary results show that the procedure makes a significant reduction in the observed differences. Final results for AMSU and results from AIRS will be shown at the meeting.

4. ACKNOWLEDGEMENTS

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