Intercalibration of Passive Microwave Rain Rates

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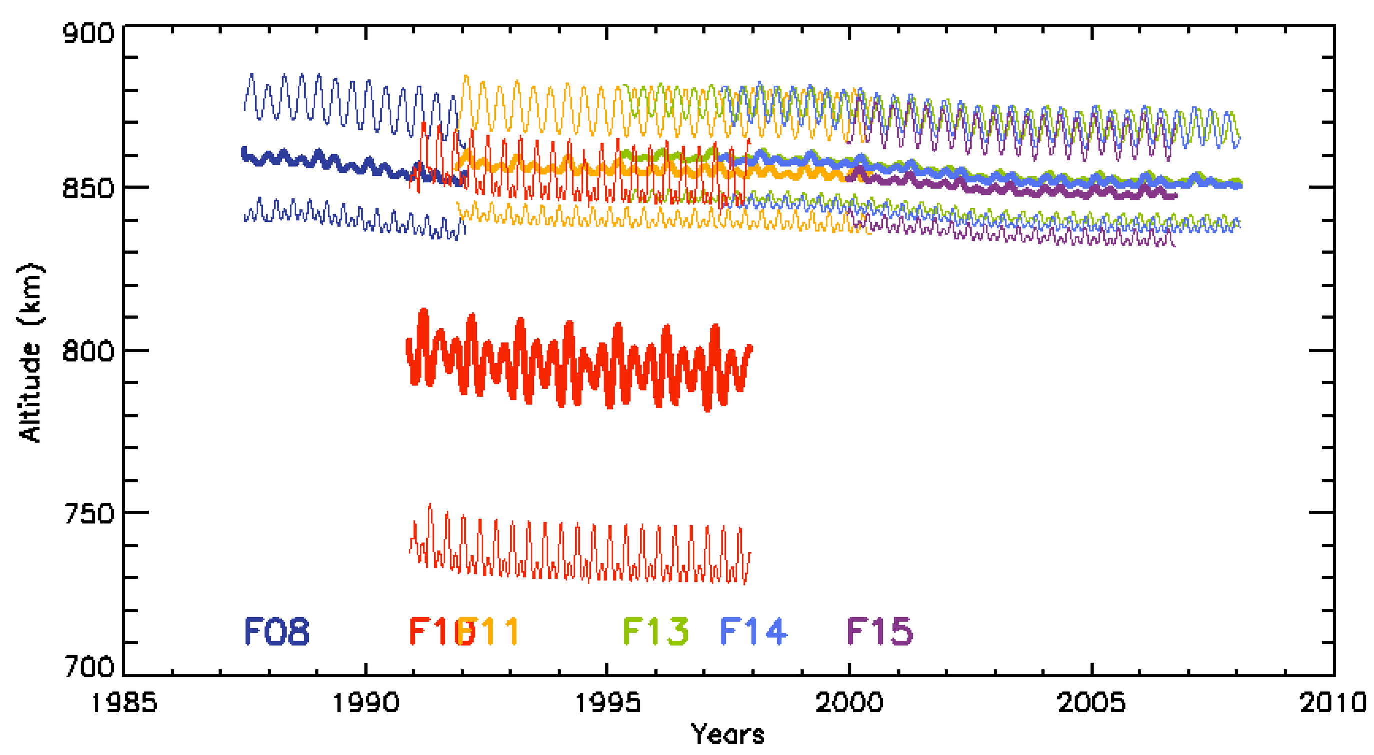
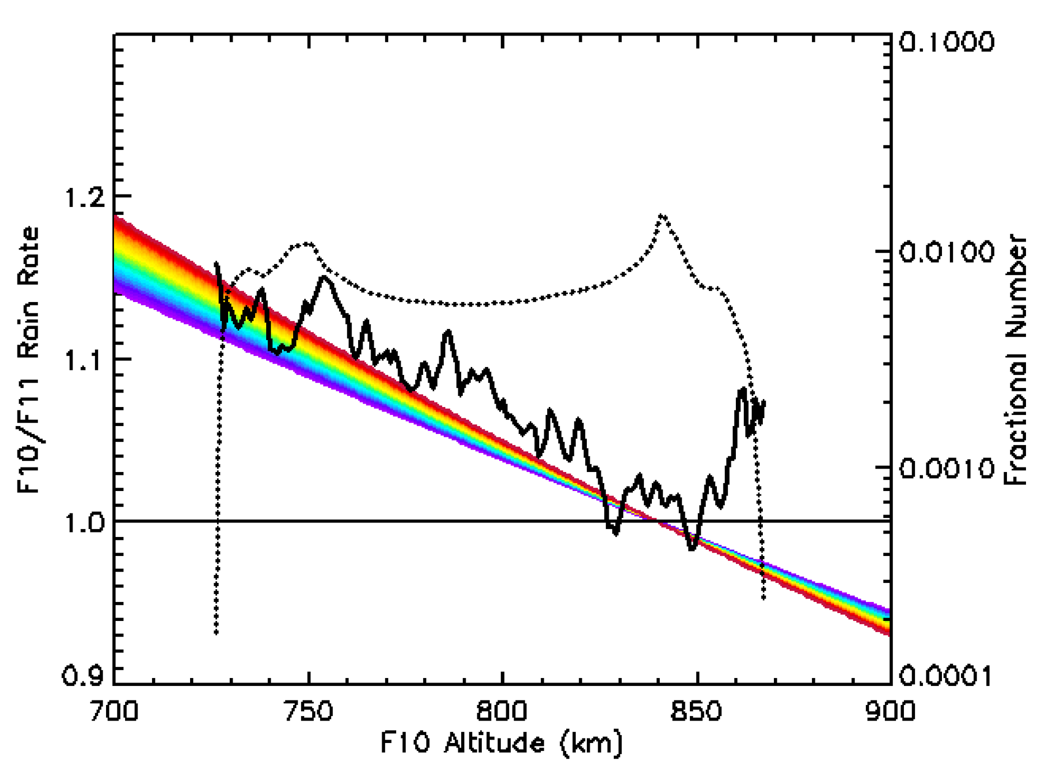
Impact of Altitude on SSM/I Rain Retrievals

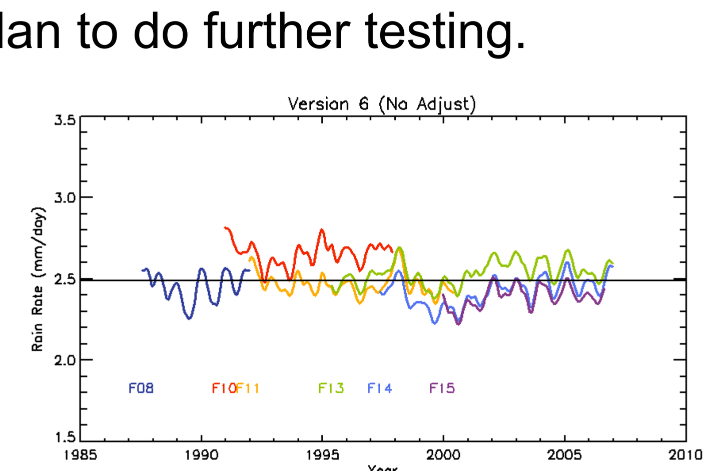
It has long been recognized that retrievals from the F10 suffer from some unique anomalies, but their exact nature has been unclear. Hilburn and Wentz (2008) suggested that F10 rain retrievals are about 10% too large. Recent work, shown below, reveal that the F10 orbit is about 50-60 km lower than the other DMSP satellites and is more elliptical. This is consistent with the higher rain retrievals because a lower altitude implies a smaller footprint which makes for larger rain rates (that is, we are overcorrecting beamfilling). The plot below shows daily average (heavy lines) and the daily minimum/maximum (thin lines) altitudes.

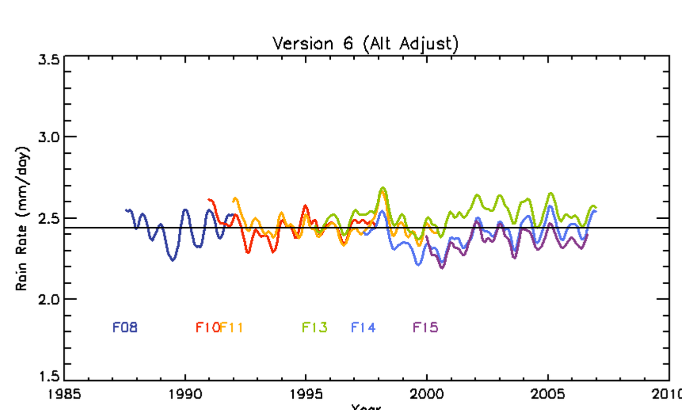


We can confirm that F10 rain biases are due to unresolved altitude issues by examining the F10 biases relative to F11 as a function of F10 altitude. In the figure below, we have plotted the ratio of the F10/F11 retrieved rain rates (solid line) as a function of the F10 altitude. The dotted line shows the fractional number of observations. These are RSS V6 SSM/I data. The rainbow colored lines show the range of theoretical prediction based on the beamfilling theory in Hilburn and Wentz (2008).



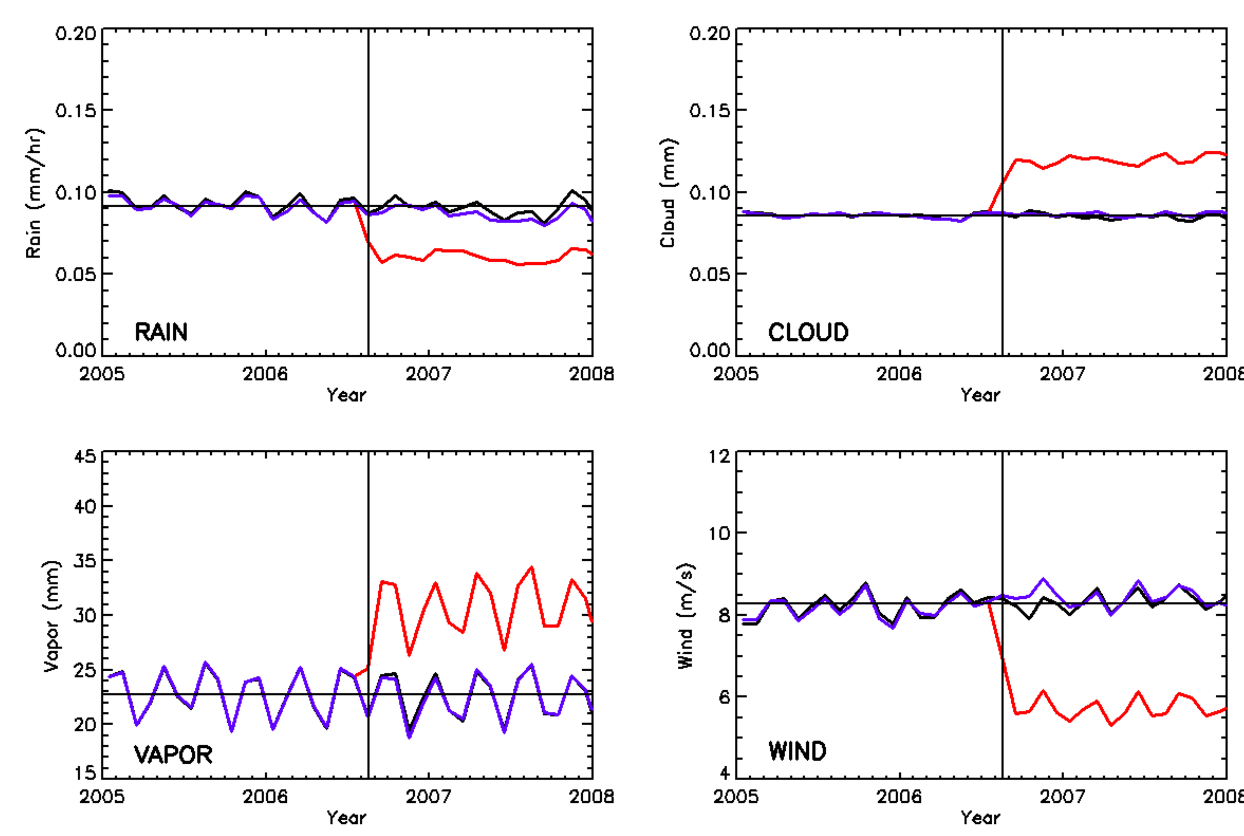
The figures below show the unadjusted SSM/I time series (left), and the time series with a simple altitude based F10 rain correction (right). F10 is the red line in both plots. The correction works well, and we plan to do further testing.



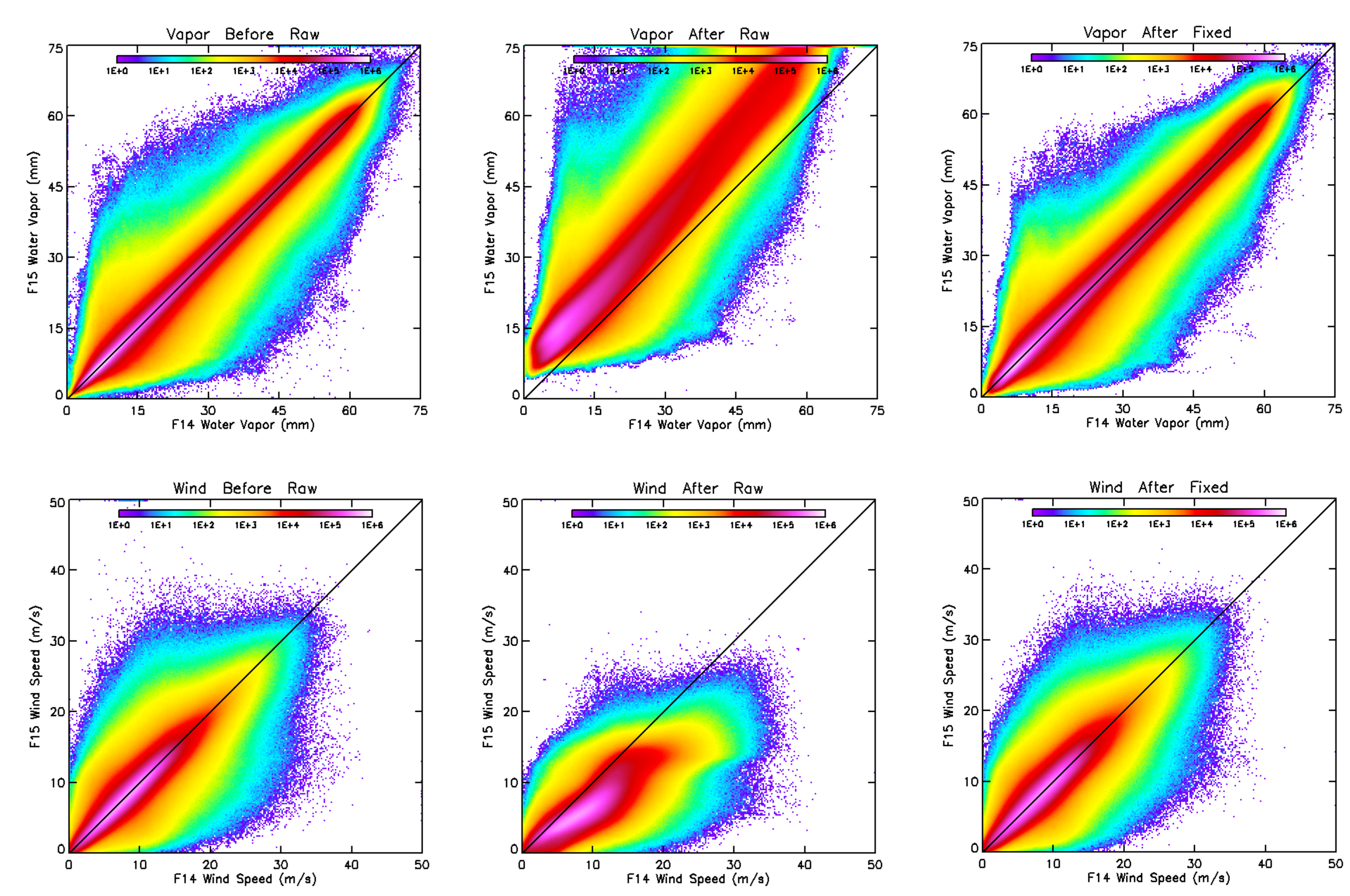


F15 RADCAL Beacon Correction

On 14-Aug-2006, a RADAR calibration beacon was activated on board the F15 DMSP satellite. The figure below shows that F15 retrievals (red line) are biased relative to F14 retrievals (black line). The biases are very large: rain is low (31%), cloud is high (42%), vapor is high (37%), and winds are low (32%). The interference appears limited to the 22 GHz vertical polarization channel, and is characterized by a mean increase of 10K that is a function of the position across the swath. We have developed a very simple tabular correction. The corrected F15 data are shown in the figure below (blue line) and are in excellent agreement with F14 (black line).



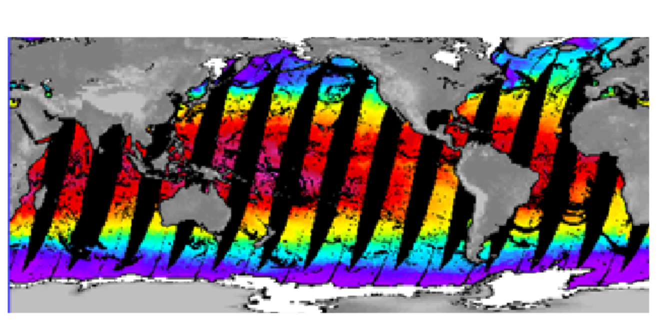
Joint histograms of F15 versus F14 (below) show the dramatic improvements. The top row shows water vapor and the bottom row shows wind speed. In both cases the correction removes a mean bias, straightens-out a systematic bias in the joint histogram, and reduces the RMS blur.

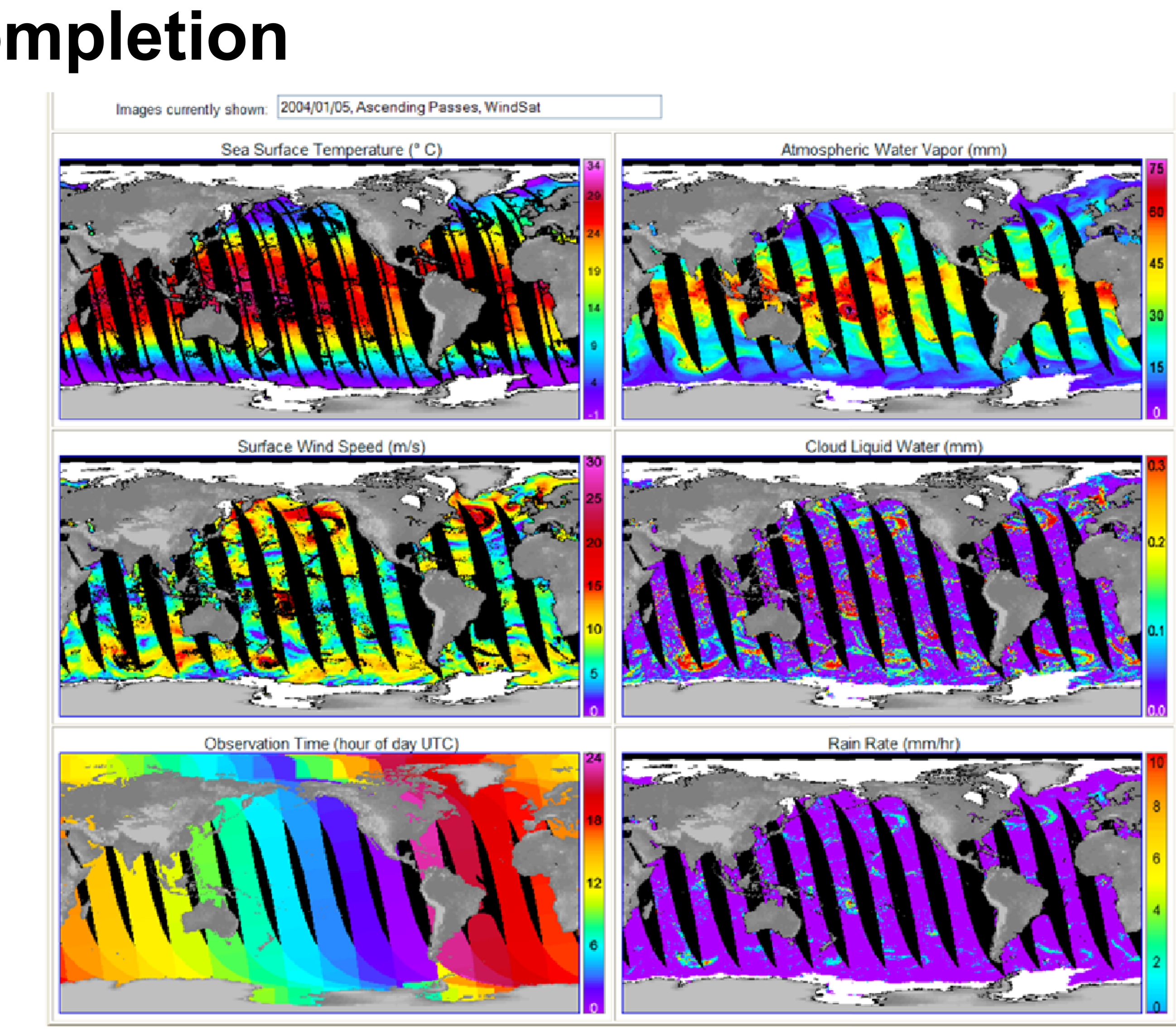


The corrected F15 data are adequate for weather applications, but we do not recommend using F15 data after 14-August-2006 for climate purposes. There is no guarantee that F15 interference will remain stable in time, and there is evidence that it may in fact depend upon the thermal environment of the F15 satellite. We will continue to monitor and study this situation.

WindSat Retrievals Are Nearing Completion

We achieve wide swaths of WindSat retrievals by using both the forward and backward swaths. For the 6.8 GHz channel, a small slit can be seen in the ascending passes due to earth's rotation, and the rotation helps close the slit for descending passes (shown to the right).





WindSat has very complicated geometry with forward and backward looks and each frequency has different locations and incidence angles. We avoid these complications by immediately placing the brightness temperatures onto a fixed 1/8th degree earth grid rather than working on a traditional swath grid.

WindSat has had the usual assortment of issues in calibration: star tracker outages and attitude misspecifications; moon, sun, earth, and RFI intrusion; pointing errors and misalignments (squinting).

We have developed an algorithm for our usual suite of products (SST, wind, vapor, cloud, and rain), and Dr. Thomas Meissner at RSS is currently developing a fully polarametric retrieval algorithm on a separate track. This algorithm development is also providing new ways to accurately retrieve wind in rain (both for WindSat and other passive microwave