1. Minutes of the previous meeting
The minutes of the 39th Experimenters’ meeting were accepted without correction.
# 2. Matters arising

<table>
<thead>
<tr>
<th>ACTION ITEM 34.6.1: DAH and SJP to check on the status of the Aberystwyth MST radar within the peace time frequency allocation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ONGOING</strong></td>
</tr>
</tbody>
</table>

DAH reported that he had been reminding Ofcom of this issue on an approximately-monthly basis. Gradual progress had been made. The last mail from Ofcom, on 11th January 2008, stated that the matter had been passed on to their legal team and that an offer of a license should be forthcoming.

<table>
<thead>
<tr>
<th>ACTION ITEM 35.4.1: SJP and ZAKO to arrange for disposal of junk items, for the renovation of the large shed, and for the installation of a car-port in place of the small shed.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>COMPLETED</strong></td>
</tr>
</tbody>
</table>

A report on the sheds will be given in Section 3b.

<table>
<thead>
<tr>
<th>ACTION ITEM 38.7.1: DAH and TO to determine, in time for the 39th Experimenters’ meeting, which documents state that upper-air input from the NERC MST Radar leads to an improvement in the weather forecasts.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SUSPENDED</strong></td>
</tr>
</tbody>
</table>

This information has proved hard to find. JN and TO reported that the MO’s continuing desire to pay for data was a sign of the radar’s importance. The value of the data had often been questioned when the MO’s operations budget was squeezed. Nevertheless MO data users had always argued strongly in favour of maintaining the funding. The launch of operational radiosondes from Aberporth had been discontinued on the basis that the Aberystwyth MST radar was providing the necessary upper air winds.

<table>
<thead>
<tr>
<th>ACTION ITEM 39.3.1: GV to send DAH copies of the University of Manchester H&amp;S documentation covering the MST Radar site by the end of July 2007.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>COMPLETED</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ACTION ITEM 39.3.2: DAH to update the RAL risk assessment for Capel Dewi - to include dangers posed by the doors to the new car port under conditions of strong winds - and to send copies to GV, DPW and TO by the end of July 2007.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>COMPLETED</strong></td>
</tr>
</tbody>
</table>

Health and Safety issues will be dealt with in more detail in Section 3a.

<table>
<thead>
<tr>
<th>ACTION ITEM 39.3.3: DAH to provide site keys and alarm codes to TO and to provide GV with keys to the instrument compound gates by September 2007.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ONGOING</strong></td>
</tr>
</tbody>
</table>

DAH reported that he still needed to collect a spare key for the site gate padlock to give to the MO.
ACTION ITEM 39.4.1: DAH to provide ZAKO, by September 2007, with a maintenance procedure for carrying out periodic inspections of all instruments at the MST Radar site.

COMPLETED

ACTION ITEM 39.4.2: GV and TO to report at the 40th Experimenters’ meeting on a NERC/MO proposal for an investigation into the usefulness of ceilometer backscatter profiles.

COMPLETED

GV has submitted a CASE studentship application to NERC for an investigation into the usefulness of data from vertical profiling instruments. The MO are the industrial partner and Catherine Gaffard (CG) will be a co-supervisor, from August 2008, if funding is awarded. The outcome of this application will be known in February 2008.

ACTION ITEM 39.5.1: GAP to report to TO any gaps in the BADC archive of Capel Dewi GPS data and TO to supply the missing data to GAP. To be completed by the time of the 40th Experimenters’ meeting.

COMPLETED

Further details are given in Section 5a.

ACTION ITEM 39.7.1: GAP to report on progress with obtaining high-resolution Aberporth radiosonde data at the 40th Experimenters’ meeting.

COMPLETED

Radiosondes are no longer launched every day from Aberporth, nor even at the same time for each day on which they are launched. Nevertheless, the data are now coming in to the BADC. JN speculated that Aberporth may be willing to launch sondes on a paid basis, subject to staff availability. Jeremy Gillham of the MO is the person to contact for further enquiries.

3. Site Report
   a) Health and Safety (H&S)

Two members of the RAL H&S team inspected the site on 12th September 2007. They found no major problems but made the following recommendations: to remove old computer chairs which were not sufficiently adjustable, to carry out Portable Appliance Testing (as most of the test labels were out of date), to replace a powder fire extinguisher with a CO\textsubscript{2} unit (as powder tends to damage electronic equipment beyond repair), to renew the contents of the first aid boxes (which were all out of date), to install an eye-wash kit, to install a chemical cupboard, to cut back vegetation from around the bungalow, to generally tidy the site and to specifically clear scrap items from behind the sheds. They advised that special training is now a pre-requisite for people working at heights, e.g. by climbing ladders. The next visit will not be before late 2009. DAH reported that he had replaced the first aid boxes and delivered an eye-wash kit on 10th October 2007. The area around the sheds had been significantly cleaned up during the process of renovating the small shed during October 2007.

When Owain Davies (OTD), from Chilbolton, visited the site on 8th - 10th October 2007, he pointed out that it was now a legal requirement to display an “It is illegal to smoke in these premises” sign on enclosed work spaces, i.e. on the bungalow and the sheds. DAH took the opportunity to create additional signs, including one describing the risks posed by the laser ceilometer. This is attached to the fence of
the instrument compound. He pointed out that such signs were particularly important for visitors who are not familiar with the site.

A query from one of the University of Aberystwyth (UofA) fire officers, in August 2007, had thrown doubt upon the status of the site’s fire alarm. Dyfed Alarms, who maintain the burglar alarm, claimed that the fire sensors were not even wired into the system. Nevertheless, ZAKO had once inadvertently summoned the Fire Brigade by burning a piece of toast in the site kitchen. A Dyfed Alarms engineer visited the site on 16th October to check the existing system and during a second visit, on 11th December 2007, he officially integrated the fire sensors. An alert will only be sent to the Fire Brigade if the burglar alarm has already been activated. This will prevent false alarms whilst the site is manned.

A concrete base for the external security camera was laid opposite the bungalow on 21st August 2007. Dyfed Alarms attempted to install the camera on the 4.5 m high mounting pole on 11th September but were unable to get a suitable picture from it. The camera had to be sent away for repairs and was re-installed on 12th December 2007. It has pan-tilt-zoom (PTZ) capabilities and Dave Wareing (DPW) has programmed a number of pre-set views into the system. Nevertheless, for the time being, the camera has been left permanently viewing the main gate. Owing to the fact that the track is higher near the gate than it is where the camera mount is located, it is not possible to view the gate area at full telephoto zoom. For legal conformity, DAH has placed a sign near the main gate which advises that images are being recorded for the purposes of crime prevention. The organisation (RAL) responsible for the system and a contact number are included. A Dyfed Alarms CCTV sign has also been displayed. Although it does not (alone) contain all of the legally-required information, it is large and highly-visible.

b) Site developments.

A new air-conditioning unit was installed in the RX room on 19th July 2007. DAH pointed out that high temperatures are the primary cause of radar interference. Consequently the RX room door should be kept closed at all times. A sign indicating this has been placed on the door.

Construction of the large shed was completed just before the time of 39th Experimenters’ meeting. It had been necessary to leave gaps between the floor and the bottom of the walls in order to conform with Environment Agency restrictions on building within a flood risk zone. This will allow water to flow through the building as opposed to being displaced by it sideways onto another property. However, it also allows rain water to blow in from the sides. In order to damp-proof the shed, a waterproofing layer has been added to the floor and polystyrene bricks have been used to plug the gaps between the walls and the floor. The bricks will float away in the event of a flood. DAH pointed out that although flooding of the site is extremely unlikely, users of the shed should evacuate if the level of the stream reaches the field. DAH stressed that there was a far more realistic risk of injury by attempting to manoeuvre the large and heavy shed doors in a strong wind. Consequently this should not be attempted. Moreover, the doors should always be bolted in place after they have been manoeuvred. HAC suggested that perhaps a wind sock could be attached to the top of the shed.

Renovation of the smaller shed was carried out during October 2007 and completed in the first week of November. This included the removal of the toilet, the wash basin and the water pipes, the provision of an outside water tap, the addition of insulation between the ceiling and roof, the repair and painting of internal walls, and the repair of window fixtures. GV would like a dedicated electrical connection to be made to this shed.

A NERC team visited the site on 12th/13th September, partially overlapping with the RAL H&S visit. The main purpose of the visit was to renew the site’s lease from the UofA beyond 2008. A further extension beyond 2010 will be considered if NERC funding for the Facility is renewed beyond that point. NERC are planning to take direct control of the site’s electricity bills whilst RAL will take over responsibility for the phone bills. These are currently paid indirectly through the UofA Institute of Mathematics.
and Physical Sciences (IMAPS).

A follow-on NERC team visited the site on 8th October 2007 in order to establish requirements for essential maintenance work: repairing some brickwork, replacing the doors on the west side of the bungalow, carrying out interior decoration, replacing the plants surrounding the bungalow with turf, replacing the main gate and adding an intercom unit, erecting a new sign post, resurfacing the track and adding a cable duct and low-energy lighting along its length. The fence surrounding the instrument compound will need to be reshaped in order to conform with changes to the legal requirements for the width of fire escape routes. The route from the TX room, past the instrument compound, needs to be increased from 1.0 to 1.2 m. DAH pointed out that a previous NERC plan for site maintenance, resulting from a visit in 2004, had resulted in no actions being taken. Consequently he had negotiated with NERC to allow him to retain control of the renovation of the small shed. As reported above, this action has been completed. NERC work is yet to start.

c) Site connections
The continuing high level of MST radar uptime is attributed to the use of Uninterrupted Power Supply (UPS) units wherever possible. These have been configured to send e-mails to DAH whenever there is a fluctuation in the input mains voltage. Although all UPS units respond simultaneously when there is a major fluctuation, such as occurred around 15:56 UT on 17th September 2007, it is more common for only one or two units to become activated at any one time. It is probable that some of the units are more sensitive than others.

The packages for the two broadband connections to site have been changed, on 18th October 2007, to allow faster upload speeds. DPW has reported a noticeable improvement in performance. DAH noted that there was an increased incidence of failed file transfers at the time of the switch-over. Nevertheless, it has been simple to apply checks for this in the transfer software.

d) Frongoch farm
IMAPS are clearing the area close to the Frongoch wind measurement tower for the installation of an astronomy dome. They would additionally like to upgrade the telephone line for broadband connectivity; it is currently only used for dial-up connections to the wind data logger. DAH has discussed with IMAPS the possibility of providing them with real time wind data, which may be used to determine whether or not it is safe to open the dome.

GV commented that the facility for launching radiosondes from Frongoch had now been lost. Despite his many attempts to speak to the UofA, he had been unable to receive any replies on this subject.

4. NERC Instrument Report

a) Surface met sensors
At the time of the last meeting on 12th July 2007, it was known that the tipping bucket rain gauge had not recorded any precipitation since 24th June 2007. This was despite the fact that the sky-camera images suggested that it had been raining. ZAKO reported finding an ants’ nest built around the tipping mechanism when he cleaned it on 17th July 2007. The unit appears to have been functioning correctly since then.

It was not possible to establish a computer connection with the data logger for the two week period 28th August - 11th September 2007. ZAKO discovered that water had somehow managed to accumulate within the logging box. Once he had dried this out, all of the outstanding data were successfully downloaded. The communication problem recurred on 18th September and the whole logging unit was sent back to Campbell Scientific for repairs and for recalibration. The unit was re-installed on 3rd October 2007.
A new humidity probe, to replace the one which failed in April 2007, was installed on 12th December 2007.

b) Surface wind sensors
The clock on the (Windows) data logging PC was reset on 3rd October 2007 after it was found to have been running 7 minutes behind actual time. Although Network Time Protocol (NTP) synchronisation had been enabled on this PC, it had not been functioning. OTD installed a more reliable NTP program the following week.

DAH drew attention to a small limitation with the way in which the minimum and maximum gust wind speeds are recorded in the NASA Ames files. They are expressed as factors relative to the mean wind speed. In order to prevent a division by zero error, the file creation software substitutes missing data values for the gust speed factors when the mean speed drops below $0.1 \text{ m s}^{-1}$. In retrospect it would have been better to record the actual, not relative, gust speeds.

c) New Vaisala surface met and wind sensors
A Vaisala WXT510 Weather Transmitter was installed approximately 15 m north of the site bungalow on 12th December 2007. It was deliberately not placed within the instrument compound since it was thought that the concrete base would lead to biases in the temperature and relative humidity measurements. It is mounted on a pole with its base being approximately 1.9 m above the ground. It samples three sets of sensors in separate cycles. A single measurement of pressure, temperature and relative humidity is made once every 60 s. These measurements are very well matched with those made by the Campbell Scientific probes, which are located approximately 50 m away. The only significant differences occur when there are sharp changes in temperature and relative humidity, e.g. during the passage of a front. The 10 minute sampling interval of the Campbell Scientific probes leads to noticeable time offsets between the transitions.

Precipitation is detected by a piezoelectric sensor, which effectively listens to the pitter-pat of rain drops and hail. It has been configured to generate messages, at 10 s intervals, only when precipitation is active. According to advice from Vaisala, the configuration should be further adjusted so that the messages report the mean rates over the preceding 60 s. Vaisala were not sure, based on the current configuration, over what period the rain rates were averaged. Nevertheless, there is good agreement with the Campbell Scientific tipping bucket rain gauge under conditions of stratiform precipitation. Under conditions of convective precipitation, as might be expected, the Vaisala sensor shows considerable variability in rain rate over the 10 minute integration period of the tipping bucket rain gauge.

The third set of sensors comprises an array of three equally-spaced ultrasonic transducers in a horizontal plane. The wind speed and direction are determined by the differences in propagation times between each pair of transducers. The sensors are sampled at $4 \text{ Hz}$ over 3 s, i.e. generating 12 separate values of speed and direction. The minimum, mean and maximum values of each of these are reported once every 60 s. DAH showed comparisons with measurements made from the Frongoch wind tower, which is located at the top of a hill 3 km to the west. There is typically a poor agreement for wind direction, which is strongly influenced at the radar site by the WSW-ENE alignment of the valley in which it is located. Consequently the winds measured by the new instrument cannot be assumed to be representative of the broader-scale low-level flow.

Since the three sets of sensors are sampled at different time steps, the data will be made available in three separate files. GV pointed out that surface met and wind data are particularly useful for undergraduate projects. Consequently they should be made available in a format which can be read by Excel, i.e. something other than netCDF.
JN commented that these instruments had been designed for large-scale deployment. He questioned whether the wind measurements from Frongoch were sufficient for the purposes of characterising localised extreme weather events. He was particularly interested in the case of 8th January 2008, when the Frongoch wind speed rose to nearly 20 m s\(^{-1}\). However, this was not sufficiently strong to uproot the trees, somewhere north of Aberystwyth, which had been reported to DAH by a mid-Walean storm chaser. JN suggested that a small network of surface wind measurement sites might provide the necessary detail to study such an event.

**d) Ceilometer**

The date field in the raw cloud base messages changed from “7” to “0” at 04:26 UT on 3rd July 2007. Thereafter the day-month information updated in a regular fashion but with incorrect values. DAH was obliged to make changes to the software which creates the NASA-Ames files in order to account for this. The problem could not be solved by power-cycling the instrument and so Vaisala sent a replacement circuit board. This was installed on 12th December 2007.

At 14:55 UT on 12th September 2007, DAH resynchronised the time of the ceilometer’s internal clock, which was found to have been slow by 2 minutes and 10 s.

The backscatter profile data continue to be logged. However, low priority is currently assigned to the job of making them available in a standard-format file. Anyone requiring the data should contact DAH.

**e) Sky-camera**

There is an approximately 24 hour gap in observations, from 11:08 on 10th September 2007 until 11:06 the following day, resulting from the power lead to the camera being accidentally disconnected.

There are a few missing images, between 16:15 and 16:19 UT on 12th September, during the time when DAH was updating the camera’s firmware. This upgrade caused a slight change in the colour bias of the images but this did appear to improve the distinction between overlapping cloud features.

Software for animating sky-camera images (together with a ready-made sample animation) is now available through the website. This was used by a 16 year old work experience student who had a one week placement with DAH during October 2007. The student systematically worked through 2 months of observation and created an event log recording instances of the following: daybreak, sunset, nightfall, mountain wave activity, Kelvin-Helmholtz instabilities, dying cumulus, cirrus, mist, rain, rainbows, contrails, counter-flows, the passage of the Moon and planets, insects, crepuscular rays and aesthetically-pleasing scenes. This event log is also available through the web site.

**f) MST Radar**

The radar operated in an unstable fashion between 09:00 and 11:45 UT on 18th July 2007. This was apparently caused by the induction on the driver valve having burnt out. The signal processing was effective at blanking the wind-profile data during this period.

The radar was out of action for several hours each day between 8th and 10th October 2007 to allow tests to be conducted using the Phase-II radar control and data acquisition system. DAH accidentally failed to restart the data flow after the first day of tests, which resulted in a 12 hour backlog of observations. The Met Office received the missing messages as soon as the problem was resolved the following morning. DAH noted that, at the time of these tests, the operational radar control and data acquisition (Linux) PC had been up for 264 days since the last reboot. The previous (WindowsNT) PC had to be rebooted on a weekly basis to prevent it from crashing.

The radar suffered a number of short periods of interference on every day between 17th and 24th of October 2007. These are only noticeable in the “Secondary Radial Chain Exists” panels of the diag-
nostic plots, which indicates that the signal processing had been successful at avoiding contamination. However, some contamination of the wind-profile data is evident on 28th October 2007. This led ZAKO to remove some superfluous T-connectors from the back of the receiver on the following day. Unfortunately he failed to notice that one of the cables had not been re-attached properly. Although the radar appeared to be functioning, according to the usual diagnostics, the acquisition system was acquiring “empty” data. DAH only spotted the problem the following morning (30th October), but was unable to make phone contact with ZAKO before he left for Spain later the same day. On the morning of the 31st October, following ZAKO’s instructions, DAH guided DPW, over the telephone, through some system checks. DPW’s use of a web-cam, which allowed DAH to monitor what he was doing, proved to be invaluable. The radar was returned to working order at 09:26 UT.

GV suggested that additional diagnostic tools were required so that problems of the type which occurred on 29th October could be spotted more quickly. DAH had been relying on Met Office quick-look plots as the primary diagnostic tool for identifying immediate problems. This had incurred a delay of several hours before a problem could be identified. JN pointed out that it was not always easy to determine whether or not an instrument was functioning correctly until a sufficient quantity of data had built up.

**ACTION ITEM 40.4.1:** DAH to improve the short time-scale MST radar diagnostic tools in time for the 41st Experimenters’ meeting.

The radar began to malfunction again at 21:45 UT on 31st October. Spectral features appear smeared out in range as though the range resolution had been reduced. DPW once again carried out checks following DAH’s telephone instructions the following morning (1st November). The radar was returned to working order shortly after 10 UT.

The radar was powered down between 13:50 and 15:50 UT on 27th November 2007 to allow MSc students, from the UofA Institute of Geography and Earth Sciences, to carry out a surveying practical on the antenna array.

The radar developed an instability at around 01:00 UT on 29th October 2007. This was apparent in the scope trace of one of the two receiver channels. DPW had helpfully left a web-cam pointing at the scope, allowing DAH to diagnose the problem remotely. DAH blocked data being sent to the Met Office at around 08:00 UT, but the radar continued to run until about 11:30 UT when DPW assisted him (remotely) to switch the receiver units off and then on again. This failed to solve the problem of the first few attempts. However, DPW eventually disconnected and then re-connected various wires from the receiver. The problem was gone when the radar was restarted at around 12:15 UT.

GV suggested that more web-cams should be installed at site, given their utility for remotely diagnosing problems. He questioned whether the instrument event log could be used to automatically blank periods of unreliable data for a program which operates over extended data periods. SJP pointed out that the log was written in an XML file, which is inherently machine-readable. However, he suspected that a data blanking flag might need to be added.

**ACTION ITEM 40.4.2:** DAH to install more strategically-positioned web-cams at the radar site as an aid to the remote diagnosis of problems.

**ACTION ITEM 40.4.3:** GV to investigate whether the instrument event log is suitable for automatically blanking periods of unreliable data and to report, to the 41st Experimenters’ meeting, what changes (if any) are necessary to make it suitable for such a purpose.

DAH submitted a manuscript on validation of the v3 signal processing scheme to the MST11 special edition of Annales Geophysicae in mid-October 2007. Anyone who is interested in a copy should e-mail him to request one. He is currently awaiting referees’ comments. DAH emphasised that, in the interests of traceability, people should quote the version of signal processing which had been used to generate the
data used in their publications.

DAH has also begun writing up a system guide. This will be used to document details about the radar which are not recorded elsewhere. These gaps in knowledge are coming to light as DAH and OTD collaborate on upgrades to the radar control and data acquisition system.

In the 12 months since ZAKO moved to part time work, there has not been a noticeable degradation in the level of radar uptime. Nevertheless, the existing valve transmitters require regular expert maintenance in order to keep them in good working order. Consequently it will be necessary to switch to modern solid state units as ZAKO spends progressively less time at site. DAH has instigated a feasibility study to determine what changes, if any, will need to be made to the existing system to allow it to operate with new transmitters. For this purpose he intends to visit the site together with OTD and Jon Eastment, from Chilbolton, in March 2008. An application for the necessary capital investment will be submitted to NERC together with the funding renewal document in just under 12 months time.

5. Guest Instrument Report
   a) UFAM mobile instruments.
   EGN reported that the boundary-layer wind-profiler (BLWP) had spent the summer at Achern, in Germany, as part of the Convective and Orographically-induced Precipitation Study (COPS). The problems with ground clutter were so great at the site that it was necessary to construct a special clutter screen from wire mesh attached to a wooden frame. This was a copy of a screen already used at Cardington, which has proved to be highly effective. Nevertheless, reflections from the tethered balloon are still a problem.

   **ACTION ITEM 40.5.1:** EGN and DPW to arrange for construction of a BLWP clutter screen at Capel Dewi in time for the atmospheric turbulence measurement campaign in March 2008.

   It turns out that the heights reported by the BLWP have been in error since a software upgrade in 2004. This meant that the data for the lowest range gates were of no value. The problem has now been corrected.

   In August 2007 the BLWP returned to Cardington, where it was operated alongside the Salford Doppler lidar. The wind directions were found to agree closely, but the speeds differed. The agreement was rather better at the higher altitudes, where the BLWP was less likely to be affected by clutter (which can force the Doppler shifts closer to zero). The day used for comparison was not ideal as the BLWP’s auto-adjustment of Nyquist velocity did not function. The BLWP has had a number of critical components replaced. It is currently at Capel Dewi, although DPW will need to carry out some work on it to make it operational.

   The lidar took part in the Leicester Air quality Measurement Project (LAMP) during August 2007. It recorded some of its best data yet, albeit only when none of the other instruments was in operation. It will be operated at Capel Dewi in March 2008 as part of the atmospheric turbulence measurement campaign.

   b) University of Manchester static instruments.
   GV reported that following the completion of HAC’s PhD work, the water vapour lidar has been temporarily decommissioned. This will allow DPW to complete work on making the system remotely-operable.

   c) The Met Office GPS water vapour receiver.
   GAP reported that he is investigating the possibility of acquiring, for the BADC, the integrated water data from all UK sites. JN reported that by the middle of 2008, the MO will be getting data from approx-
imately 150 GPS water vapour receivers across France and from a number of receivers in the Republic of Ireland. Although Germany is building a measurement network, the data from France will probably be of more use to them. In terms of thunderstorm predictions, data from upstream sites tend to be of more use than local measurements. This is less true in the British Isles, where the situation is more complex.

6. Science Presentations
a) Boundary layer ozone and aerosol profiles from Capel Dewi - HMAR
Intercomparisons between ozone concentrations measured by ozonesondes and by the UFAM lidar agree to within 3 ppbv. Intercomparisons between lidar and DOAS (Differential Optical Absorption Spectroscopy) aerosol measurements were carried out as part of LAMP (see section 5a). HMAR has been developing a correction for the fact that the lidar detector does not sit exactly within the focal plane. The position of the latter depends on the altitude from which laser signals are returned. Observations made on the clear-sky night of 31st July 2007 give a text-book example of the diurnal changes in boundary layer structure. The 1 minute resolution data show the existence of individual convective plumes. HMAR was intrigued by several small height-time regions of low ozone concentration. He speculated that these may be associated with plumes from passing trains.

b) The relationship between water vapour mixing ratio and temperature gradients - HAC
Layers of enhanced MST radar return power are often associated with large vertical gradients of water vapour measured by lidar. A study of Aberporth radiosonde data has shown that water vapour gradients and potential temperature gradients (both of which contribute to radar reflectivity) are anti-correlated, with a correlation coefficient of approximately -0.4. However, they are positively correlated under precipitation conditions, with a correlation coefficient of +0.38. Consequently, where water vapour gradients and potential temperature gradients are co-located, the radar reflectivity may either be enhanced or suppressed.

c) Limits to the accuracy of MST radar v3 winds - DAH
As part of his work on v3 wind validation, DAH looked into the self-consistency of wind components by calculating the root mean square (rms) differences between the values adjacent time steps. He found that the values were larger for single cycle data, which are separated by 4.7 minutes, than for the 30 minute average data that are sent to the Met Office. This is the opposite of what Kitchen had found (in a 1989 paper) for radiosonde profiles separated by several hours. The increase in rms values with increasing time separation between profiles was attributed to the natural variability of the atmosphere. DAH speculates that the random measurement errors dominate the variability between single cycle profiles and that consequently a small amount of time averaging is desirable. He would like to further this work by testing for an optimum level of averaging which minimises the combined effects of random measurement error (which decreases with increased averaging) and atmospheric variability (which increases with increased averaging).

d) Review of MST performance statistics 2007 - TO
The MO monitor the quality of wind-profile data in three ways. Daily monitoring identifies the quantity of the incoming data and the presence of any spurious reports. Weekly monitoring looks at root mean square differences between adjacent time steps (as described above). Monthly monitoring is based on model-observation comparison statistics. The latter indicate that there has been a decrease in reliability of Aberystwyth data over the past 12 months. Although the wind directions appear to be unaffected, the radar-derived speeds are positively biased below 300 hPa and negatively biased above. The results for July 2007 were particularly bad, with a larger than normal negative speed bias immediately around the tropopause region. This almost led to the data being internally black-listed. Surprisingly, the weekly rms values show no significant change (however, a median filter is used in generating these values, so
any spurious data points would not have been considered). There has also been a noticeable decrease in altitude coverage. DAH reported that the signal processing had not changed and that the decrease in performance coincided with the switch to the new radar control and data acquisition in February 2007 (this had been reported at the previous meeting). TO conceded that the MO monitoring was not sufficiently sensitive to narrow down the problem. JN pointed out that monitoring against model wind fields was not perfect. The model will not account for small-scale gravity waves, which give rise to significant wind speed perturbations. The model and observation wind speeds can differ by as much as 10 m s\(^{-1}\) above 200 hPa in the tropics. He suggested that the MO should consider carrying out another radiosonde validation campaign at Aberystwyth.

**ACTION ITEM 40.6.1:** DAH to determine the causes of the reduced reliability and reduced altitude coverage of MST radar wind-profile data and to take corrective action as a matter of urgency.

e) Testing and deployment of 94 GHz cloud radar - TO
The MO have recently taken delivery of their first operational prototype FMCW (Frequency Modulated Continuous Wave) cloud radar from RAL. The frequency has shifted from 78 to 94 GHz and the overall design has been improved. The sensitivity and performance are much better than those of the original instrument. Observations made on 18th January 2008 show a clear signature of a melting layer. The system can be put together and be in working order in less than an hour, making it highly mobile. It will need to be operated in parallel with other instruments in order to evaluate its performance. It will spend 4 - 6 months in Camborne before being taken to Chilbolton for calibration tests. It will the be moved to Wattisham. The MO are very pleased with this first instrument and are considering purchasing another two or three within the next few months. They would like to see Doppler capability added, even if this turns out to be not particularly useful.

f) Update on the upper-air roadmap project - JN
JN and CG were successful in securing funding for a new COST project - European Ground-Based Observations of Essential Variables for Climate and Operational Meteorology (EG-CLIMET) - which will begin in May 2008. The key aims are to further develop remote sensing for operational networks, to improve the integration of groups of systems, to design advanced assimilation techniques to handle the data, and to deploy integrated systems in test-beds. This will complement other COST actions, such as the one dealing with atmospheric water vapour. The World Meteorological Organisation (WMO) will fund some of the activities. It is known that the current observation networks do not capture mesoscale phenomena with sufficient detail to allow the data to be used to forecast small-scale high-impact weather events. The GPS network gives an example of how high spatial-resolution observations can provide the necessary level of detail in the water vapour field. The high time-resolution of wind-profile data can used to provide a spatial distribution of winds by considering the advection of weather systems. Moreover, the South Uist radar has proved to be highly robust. It survived several hours of winds in excess of 50 m s\(^{-1}\) during the storms in January 2005. The MO have been authorised to buy another BLWP, although it is not yet known where it will be stationed. The focus of this work will probably be over south-east England with Cardington and Wattisham being used as integrated test sites. JN is nevertheless keen to make use of the Aberystwyth site and instruments. If the integrated systems prove to be effective, the MO are likely to invest serious money in them. JN’s group will be joined by some new people during the forthcoming year.

7. Any Other Business
a) Forthcoming projects
CFL has recently begun a PhD project on the measurement of turbulence using wind-profiles. He has already conducted a pilot study at Camborne, during which the UFAM BLWP was operated alongside an instrumented tethered balloon. The BLWP has been returned to Capel Dewi, where it will be operated in parallel with the MST radar to coincide with overflights by the Dornier aircraft, 10 - 20 March 2008.
Radiosondes will be launched from the radar site during this campaign.

b) MSTRF funding renewal
A funding renewal application will need to be submitted to NERC within the next 12 months; the current contract expires in March 2010. This will be an appropriate opportunity to apply for capital investment for the purchase of solid-state transmitters. TO said that owing to the importance of the radar from the MO’s point of view, they should support the bid with an agreed contribution of capital investment. The anticipated cost of £300k compares favourably with the £1M required to build the South Uist radar from scratch. He added that the requirements should be established for an expected life-time of 10 years, even if NERC funding could only be guaranteed for 5 years.

ACTION ITEM 40.7.1: DAH to establish, by the time of the 41st Experimenters’ meeting, the technical and capital requirements for replacing the MST radar transmitters.

c) Miscellaneous
The next meeting is provisionally scheduled for Wednesday 16th July 2008 at the Cosener’s House.