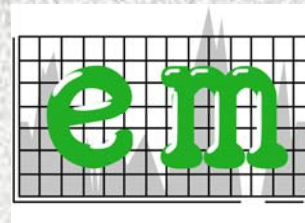


# A Heated Aerodynamic Universal Precipitation Gauge



Dutton, M. and Jenkins, T.  
Environmental Measurements Limited, Sunderland, UK

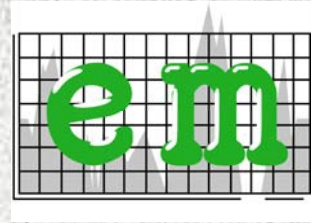
Strangeways, I.  
TerraData Limited, Wallingford, UK



# 1. Introduction

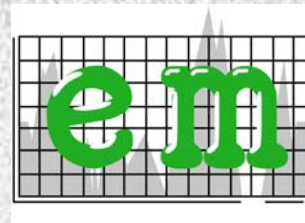
- The accurate measurement of all forms of precipitation has been a major difficulty in meteorology.
- Problems such as wind effect, evaporation losses, wetting errors and financial costs to name but a few.
- This research project and product development aims to try and address these issue.
- The following instrument development is the result of a collaboration between TerraData Ltd and Environmental Measurements Ltd.
- We have taken a proven aerodynamic rain gauge and adapted it to produce a Universal Precipitation Gauge (UPG1000) – The 1000 is the size of the collecting area in cm<sup>2</sup>.

## 2. The Wind Effect



- The effect of wind on the catch of a precipitation gauge is the largest source of error in measuring precipitation.
- The most effect way of minimising loss is by exposing the gauge at ground level (Robinson and Rodda 1969). This is not always practical.
- Where ground level exposure is not possible windshields such as those designed by Nipher and Tretyakov are sometimes used. Or the Alter screen.
- An alternative is to design the gauge to be aerodynamic in profile. This was done over a ten year period (1994-2004) by TerraData Ltd.
- This included five years of field tests, resulting in a practical, modified design.

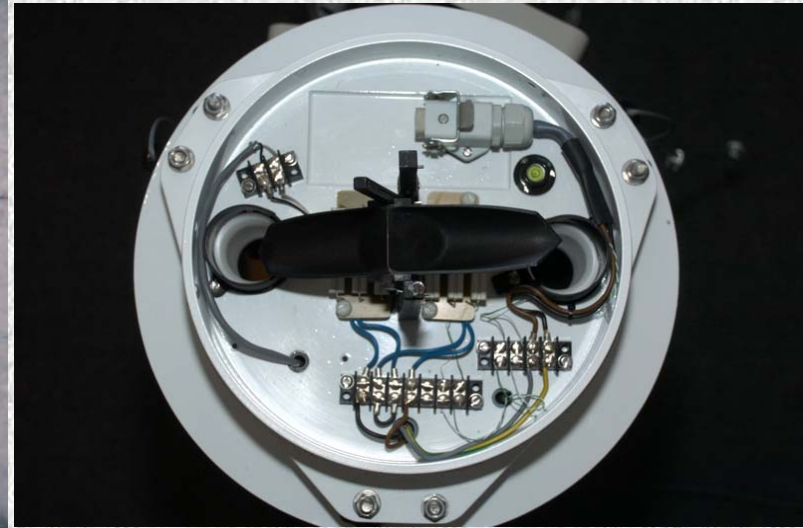




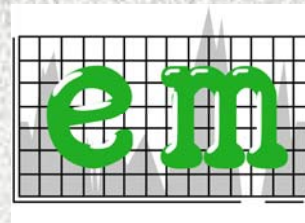
### 3. Melting of solid precipitation

- At attended sites, the solid precipitation caught by conventional rain gauges can be melted manually.
- At unattended sites, the funnel can be omitted and the solid precipitation is allowed to fall directly into an open container, which is weighed periodically with load cells.
- The alternative is to gently heat the collecting funnel. This also allows a conventional tipping bucket mechanism to measure the melted precipitation which is much cheaper.
- The simplest and most controllable method of heating an aerodynamic funnel is to use electrical heaters.
- This, of course, requires the presence of mains electric power at the site, but where this is available, electrical melting is reliable, finely-controllable and clean solution.

### 3. Melting of solid precipitation



- The heated gauge uses electrical heating pads fixed inside the funnel to melt the snow. These pads cover the entire surface of the funnel giving an even distribution of gentle heat.
- The internal tipping bucket chamber also contains separately controlled heaters to prevent icing.



### 3. Field Testing

- Two test sites have been, and are still be used to assess the performance of the UPG1000.
- One site is in the Scottish Highlands, the other at Rothera in Antarctica operated by the British Antarctic Survey (BAS).
- The Scottish trials extended over two winters 2006/7 and 2007/8.
- The Antarctic tests started in December 2007 and are ongoing.
- The data logger used at the two test sites, to collect the data and to control the heaters is the CR800 logger from Campbell Scientific.
- The number of bucket tips are logged at an interval of 15 minutes, along with the Max, Min and Average temperatures of the funnel, bucket and the data logger.

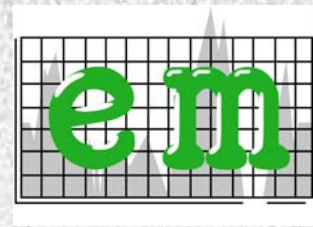
## 3a. Field Testing - Scotland

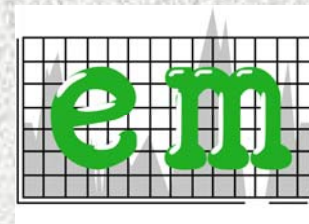
- Firstly the test carried out in Scotland were at a place called Easter Cottartown in the Cairngorm mountain range of the Scottish Highlands...



- The prototype UPG1000 was tested alongside an unheated rain gauge for comparison. A manual gauge was also operated nearby to make periodic comparative checks.

# 3a. Field Testing - Scotland

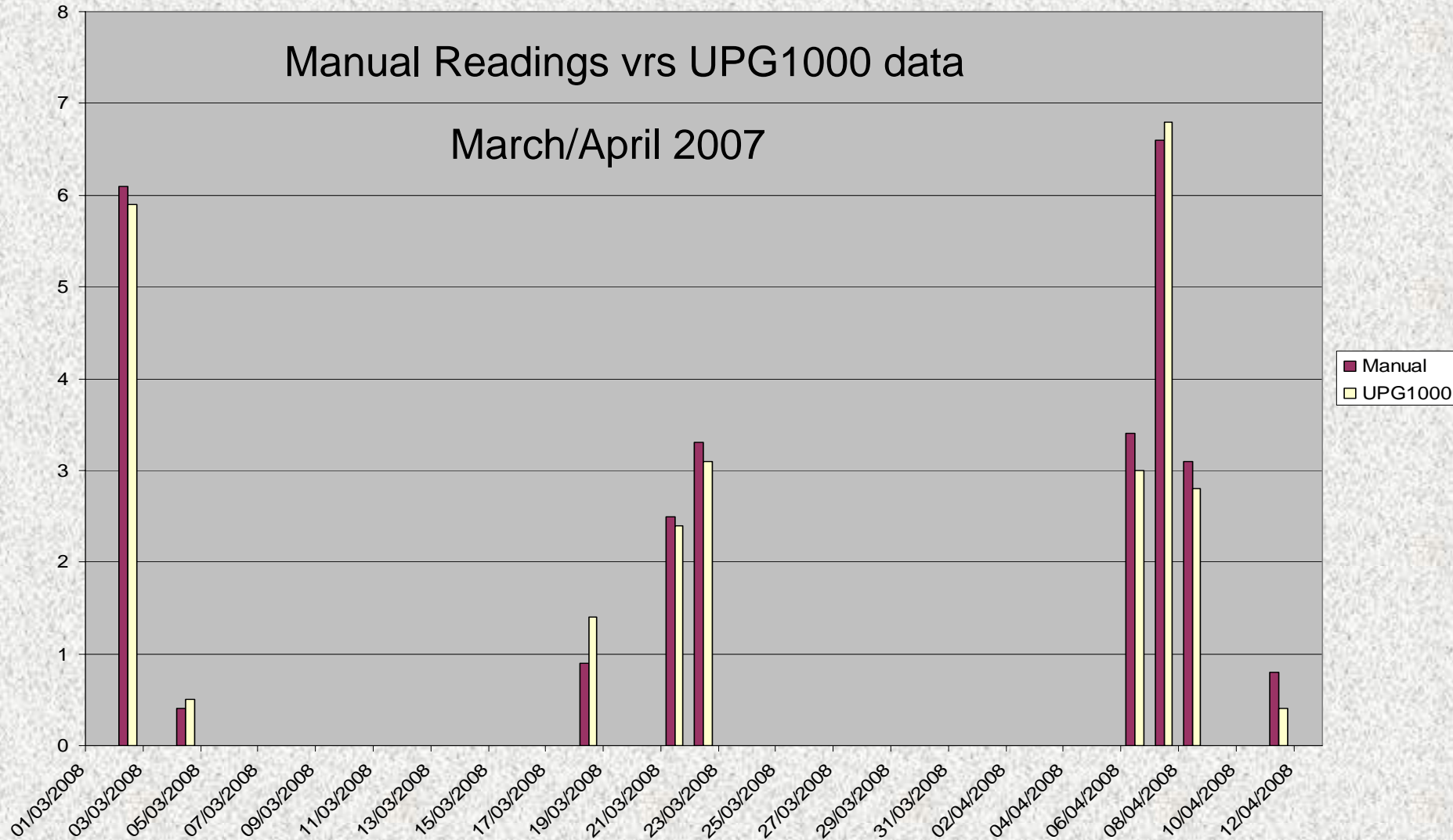




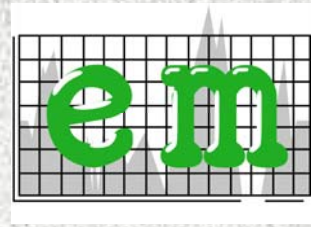
# 3a. Field Testing - Scotland

Manual Readings vrs UPG1000 data

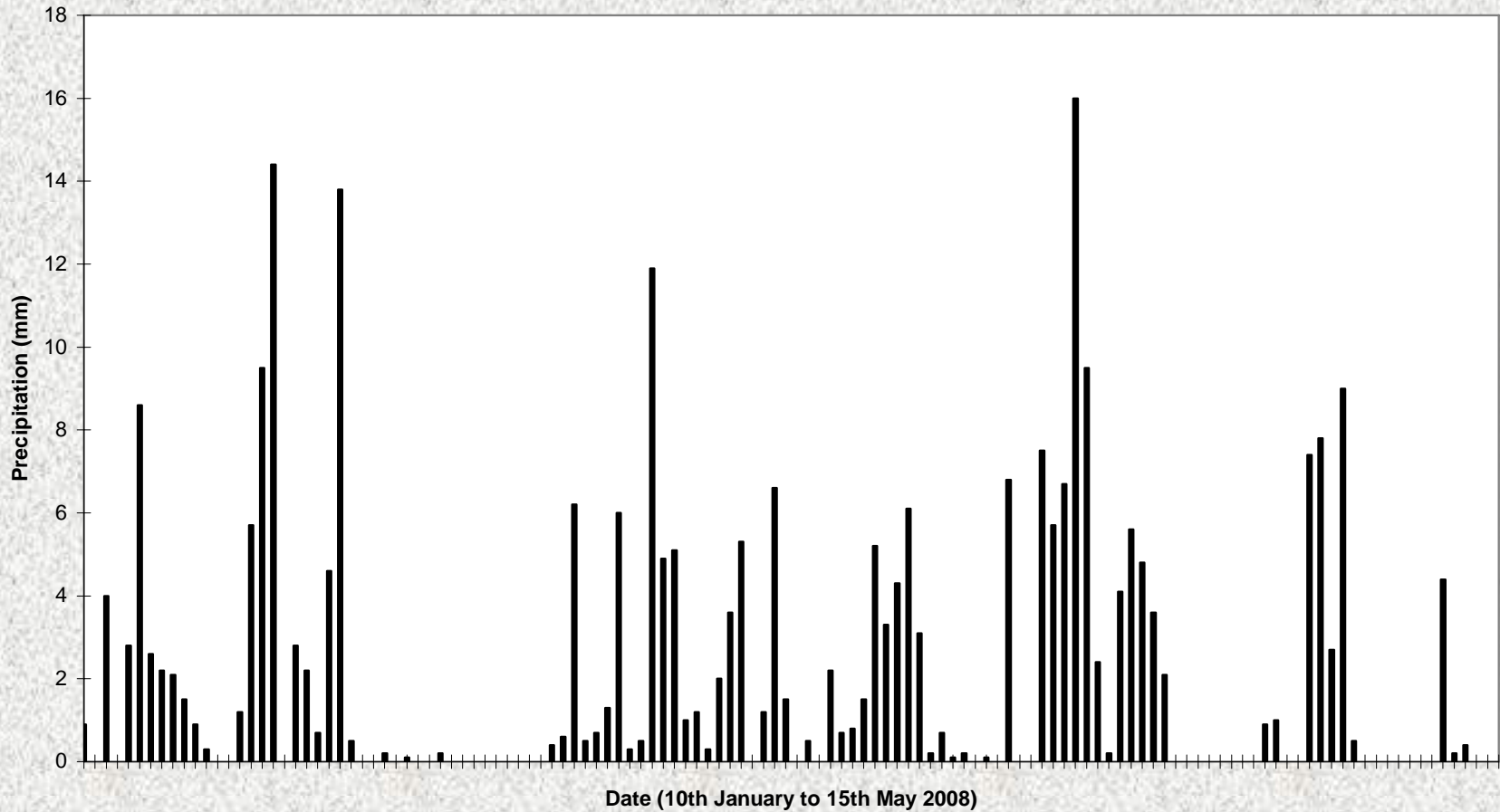
March/April 2007

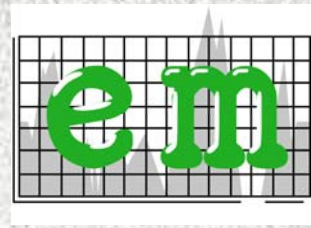


# 3a. Field Testing - Scotland



UPG1000 - Scotland Test 2008

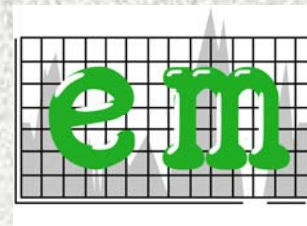


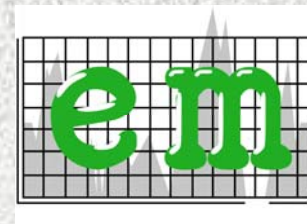


## 3b. Field Testing - Antarctica

- The Antarctic tests started in December 2007 and will continue until around December 2009.
- There is only our UPG1000 on test at the Rothera, BAS site and no manual or standard rain gauge to use as comparisons. But, there are two present weather detectors (Biral and Vaisala) close by, with which we can hopefully use for comparative purposes in the future.
- The logging interval has recently been altered to every minute and now we also log the ON/OFF time of the heaters to give us a more precise picture of the performance in very harsh, extreme conditions.

# 3b. Field Testing - Antarctica

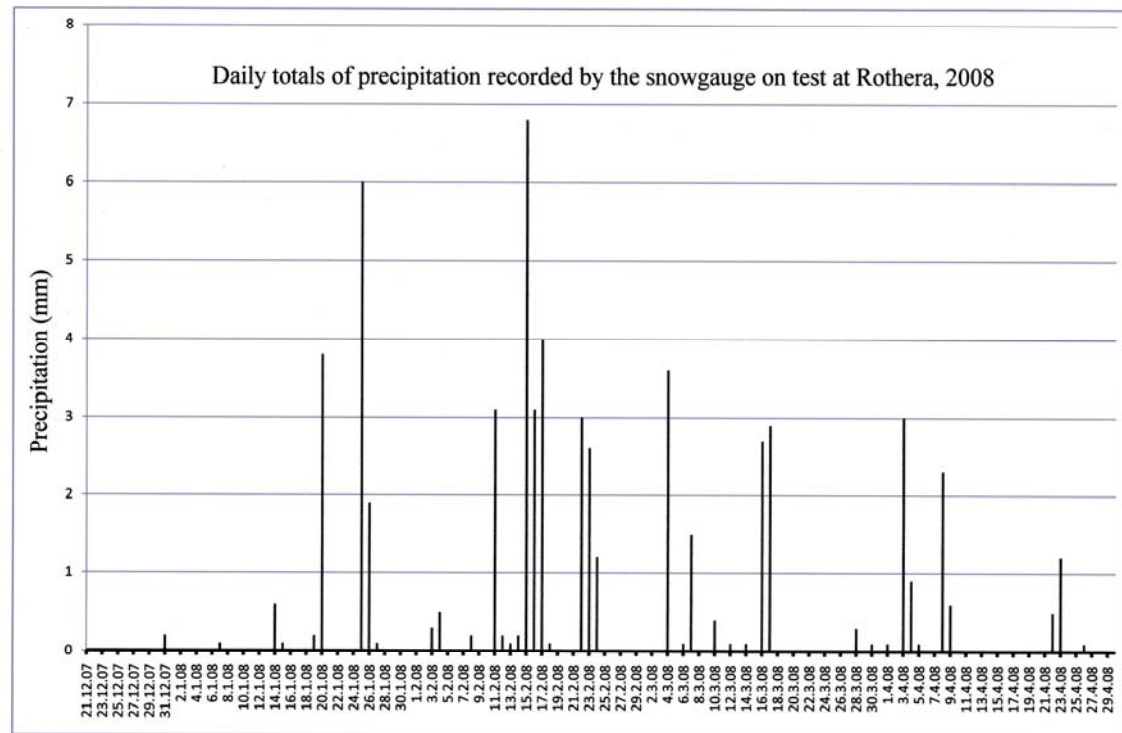


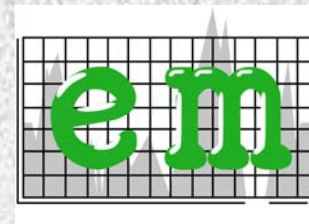


## 3b. Field Testing - Antarctica

- Data is currently being e-mailed monthly from Rothera and analysed in Wallingford, UK.

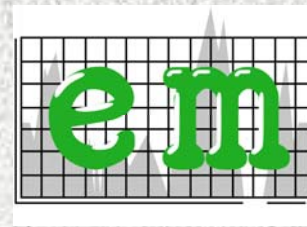
- A graph showing the daily totals of precipitation from Rothera. Dec'07 to end of April'08





## 4. Future plans and conclusions

- Provisional conclusions on this ongoing development project are that the gauges are performing well and in accordance with expectations.
- The test results from Scotland showed very close agreement between the UPG1000 and the daily manual readings.
- The results from Antarctica are very encouraging despite the low temperatures. The tests will continue for at least another 12-months and more analysis will be completed.
- **Future Plans** - We are currently looking into the possibility of sending out another gauge to Antarctica in January 2009, and we are also considering attaching more sensors and intelligence to this gauge to gather more information and also allow us to decipher between the different types of precipitation.



## 4. Contact Details and Info

- If you would like to talk more about this product please do not hesitate to contact me on Stand 138 here at the exhibition.

Or alternatively e-mail me (Mark Dutton) at:  
[mark@emltd.net](mailto:mark@emltd.net)

Thank You!