Extreme Monthly Rainfall: November 2009

Further to our note on the extreme rainfall in Cumbria on 18-20 November (Weather, 65, p14??), we now have received provisional monthly data from the Environment Agency for the two telemetered tipping-bucket gauges at Seathwaite Farm and Honister Pass, and for the monthly-read gauge at Styhead. Styhead is located very close to the wettest spot in the Lake District; the latest published Annual Average Rainfall (AAR) at the raingauge site, for 1941-70, is 3947 mm.

The November total for Seathwaite was 1024.0mm and for Honister 1017.8mm, both figures being about three times the relevant monthly average for the reference period 1941-70. The previous wettest months known on the long record at Seathwaite (rainfall records commenced here in 1844) were 899 mm in November 1861 and 889 mm in January 1928 (records 1845-1895, 1921-91).

The monthly total at Styhead, read on the morning of 1 December, was given by the Environment Agency as 1269 mm. However, on examination it became clear that the monthly gauge had previously been read on the morning of 3 November, and it is known that there had been prolonged heavy rain on both 1 and 2 November. It is therefore clear that this 1269 mm monthly total is somewhat lower than the true calendar month total.

The accepted method of assigning rainfall to individual days on occasions like this is to compare the total from the monthly gauge with the total for exactly the same period from a nearby daily gauge, calculate the ratio between the two, and use this figure to multiply the rainfall at the daily gauge for the balance of the month to achieve an estimate for any missing days at the monthly gauge. If anything, this practice will slightly underestimate the amount of rain at the higher level station during an orographically-enhanced rainfall event, as occurred on 1/2 November.

Seathwaite Farm is the nearest daily gauge, some 3km to the NNE of Styhead, and 206m lower. Between 3 November and 1 December, 908mm of rain fell at Seathwaite and 1269mm at Styhead, a ratio of 1.40. On 1/2 November, 116mm fell at Seathwaite which (using the same ratio) gives an estimated additional fall of 162mm at Styhead, lifting the probable monthly total there to 1431mm. We can repeat the operation using data from Honister, 2km further away and in a different valley, which gives an estimated monthly total at Styhead of 1451mm, and by using the long-term average Styhead:Seathwaite ratio of 1.265 which gives an estimated monthly total of 1416mm. It is therefore reasonable to propose a figure of about 1430mm for the November 2009 calendar month rainfall at Styhead.

An attempt to place this into an appropriate historical context has revealed that the widely-quoted UK rainfall record for a calendar month, 1436mm in October 1909 at Llyn Llydaw Copper Mine on the eastern flank of Snowdon, is erroneous. The page of *errata* at the beginning of the 1909 edition of *British Rainfall* requires the deletion of all previously published records in *British Rainfall* for Llyn Llydaw Intake and Llyn Llydaw Copper Mine, noting "…corrections made necessary by having accepted the records of two rain gauges of faulty construction." The gauge at the Copper Mine appears to have been installed some time in 1906, and *British Rainfall* contains two full years of records before the problem was recognised towards the end of 1909. The

annual total for 1908 there was 6028mm, compared with 3579mm at another gauge at similar altitude a few hundred metres away, a ratio of about 1.85. An examination of nearby monthly aggregates during October 1909 suggests that the error at the copper mine during this calendar month also approximated to a factor of 2. October 1909 was also not an exceptionally wet month in north Wales (*British Rainfall* 1909 pp [166-167]).

Records of other exceptionally high monthly rainfall totals are difficult to assemble, but other extremes fall well short of 1400 mm. The highest monthly totals known to us are:

1270 mm (estimated) at The Stye (gauge B) in January 1928
1250 mm at Allt Mhoille, just north of Ben Cruachan, in January 1974
1228 mm at Ben Nevis Observatory in January 1900
1181 mm at Dalness Forest, Glen Etive, in March 1990
1174 mm at Strath Cluanie, Glen Shiel, in March 1990
1153 mm at Styhead in December 1980
1124 mm at Sprinkling Tarn in September 1950
1119 mm at Loan, Glen Quoich, in January 1916
1109 mm at Ben Nevis Observatory in December 1898
1106 mm at Ben Nevis Observatory in September 1891
1092 mm at Sprinkling Tarn in October 1954
1080 mm at The Stye (gauge C) in January 1921
1067 mm at Styhead in November 1954
1061 mm at Strath Cluanie, Glen Shiel, in February 1990
1060 mm at Cruadhach, Loch Quoich, in December 1974
1041 mm at Fleetwith, above Buttermere, in October 1967
1029 mm at Styhead Tarn in September 1950
1016 mm at Cruadhach, and Coire nan Gall, above Loch Quoich, in March 1967

We therefore suggest that the Llyn Llydaw "record" for October 1909 be discarded as inaccurate, and that the more reliable assessment of 1430mm at Styhead for the calendar month of November 2009 take its place as – by some margin – the highest monthly rainfall total yet observed in the British Isles. We also suggest that, as records from this exceptionally wet spot are clearly of interest in determining the extremes of orographic rainfall, that consideration be given by the Environment Agency to supplementing the existing monthly gauge at Styhead with a tipping-bucket logger to provide hourly and daily totals.

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