Prepared by:
Douglas K. Miller

Undergraduate research students (UNC Asheville):
William Clark, Sky Taylor, Ethan Wright

Volunteer assistants (other):
Donal Elliott (Waynesville Watershed Field Manager)

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Status

Table 1: Gauge visits during the summer 2016. Comments: DD=gauge data download, MN=general gauge maintenance (cleaning, re-level), CV= clear vegetation, and BR = data logger battery replacement (if necessary).

Date	Gauges Visited	Technicians	Comments
6/4/2016	304, 307, 401, 114	Doug, Ethan, Sky	DD, MN, CV, BR
6/8/2016	1, 3, 10	Doug	DD, MN, CV, BR
6/13/2016	2, 5, 8, 106, 4	Doug, Don	DD, MN, CV, BR
6/15/2016	111, 112, 104, 105, 106*, 107, 109	Doug	DD, MN, CV, BR
6/17/2016	101, 102, 103, 110, 108	Doug, Sky	DD, MN, CV, BR
6/22/2016	305, 309, 310, 109*	Doug, William	DD, MN, CV, BR
6/29/2016	303s, 306	Doug, William	DD, MN, CV, BR
7/2/2016	311	Doug	DD, MN, CV, BR
7/9/2016	300, 301, 302, 308	Doug, Ethan	DD, MN, CV, BR

Gauge visitation in support of the Duke Great Smoky Mountain Rain Gauge Network (GSMRGN) during the summer 2016 occurred over 9 days spanning a period of six weeks from June – July 2016. Funding of the Duke GSMRGN project ended in calendar year 2015 and no visits to the gauges were scheduled in the spring 2016 due to the uncertainty of follow-on funding of the project. Since follow-on funding was officially approved in mid-May 2016, gauge visitation plans were made for June and July 2016, even though the 'official' project start date is listed as 1 July 2016. The primary purpose of the visits in the summer 2016 was [1] to perform downloads of gauge tip observations since the previous gauge visits in the autumn 2015, [2] to complete maintenance tasks, [3] to clear vegetation from the surrounding area and [4] to monitor the lithium battery voltage and replace the battery in the data logger if the voltage had dropped below 3.3V. Four technicians and volunteers (listed on the front page) made the visits and performed the required work. It is important to note that the volunteers were NOT directly involved in any of the gauge visit tasks, but were volunteering to assist with personal safety should someone get injured during a particular series of gauge visits.

The general tasks completed at **every** gauge visit consisted of (1) gauge data download from the data loggers [DD in Table 1], (2) general gauge maintenance and ML1 logger condition monitoring [MN in Table 1], (3) clearing of vegetation products (e.g., leaves) from the gauge funnel and clearing of potential gauge-blocking vegetation of the surrounding area [CV in Table 1], and (4) replacement of data logger batteries if the voltage had dropped to a significantly low level [BR in Table 1]. Specialized tasks were to re-install a gauge that had been pushed over (human? animal?) near Mt. Cammerer (g303s), replace a siphon that had become severely clogged (g105), and spray a wasp nest with insecticide (g106). Task (1) merely required a serial

port link between the field study laptop and the gauge data logger and consisted of pulling the data (often in files having raw [*.txt] and CSV formats) onto a desktop folder on the laptop, checking for completeness of the data, and comparing the data logger time and date to the actual GPS time and date (making a screen capture of the time comparison). The standard that has been chosen for this study is to maintain the clocks on Eastern Daylight Time, since most of the "warm" precipitation will be occurring during the season when EDT is in effect. Most ML1-FL data logger times have been adjusted (using "TA" command) during previous gauge visits to coincide with the EDT given by the GPS locator. Most new ML1-420 loggers installed during the summer 2013 campaign were keeping ***much*** better time than did the older generation ML1-FL loggers and only required minimal adjustment. However, the lithium battery life of the ML1-420 loggers (3 loggers had dead batteries since the previous visit in autumn 2015; g307, g001, g008) is much less predictable than the ML1-FL loggers (2 loggers had dead batteries since the previous visit in autumn 2015; g111, g311) and more frequent battery replacement appears necessary. Tasks (2) and (3) required the cleaning of debris from the funnel filter, cleaning the tipping buckets of debris (if necessary), cleaning the gauge drain ports and siphon, re-leveling the gauge if it has come unleveled, fixing or replacing the gauge mesh if it had been damaged and cutting of nearby vegetation to avoid overgrowth. No substantial vegetation overgrowth was observed at any of the gauge site locations in the summer 2016 (minor blockage; g309, g308). Task (4) consisted of replacing data logger lithium batteries if tests indicated voltage had dropped below a reasonable level (e.g., 3.3 V). Lithium batteries were replaced at gauges g001, g005 (HOBO), g008, g103, g108 (HOBO), g111, g311, g301, g302, and g300. The Hydrological Services of America (HSA) logger draws power from the laptop while connected, so it is unknown if the voltage shown during a WinComLog (HSA software) session is accurate. A multimeter test was run during the 9 July 2016 gauge visits and showed that the actual battery voltage could be lower from that indicated during a WinComLog session.

The challenges encountered during some of the gauge visits in the summer 2016 were primarily the result of the long-layover between the most recent visits at each location during the autumn 2015 gauge campaign. Most gauge sites had as much as a seven month wait between visits while the wait at one site (g#311) extended to almost one year. As a result, dead batteries, clogged drains or siphons, wasp nests, and a pushed-over gauge were some of the unusual occurrences that will be avoided in future campaigns due to the increased frequency of visits at each rain gauge location.

Details of every gauge visit along with precipitation raw and CSV files can be found via Google Drive at https://drive.google.com/a/unca.edu/file/d/0B9P8oUaRiBOwb3VfVGtTenB1ckk/view?usp=sharing_eid&ts=5759b047 which contains sub-folders for each gauge that consist of the individual data files (often having at least two different formats), pictures taken at the gauge site during the visit, screenshots of the GPS (laptop) and ML1 logger time comparison, and a MS Word document that mirrors the notes made in the field journal during the visit.

Plans for the autumn months of 2016

Table 2: Planned gauge visits during the autumn 2016. Comments: DD=gauge data download, MN=general gauge maintenance (cleaning, re-level), BR = data logger battery replacement (ALL loggers), and CA = calibration with three nozzles.

Date	Gauges Visited	Technicians	Comments
9/??/2016	1, 3	Doug, Student #1	DD, MN, BR, CA
9/??/2016	4, 10	Doug, Student #1	DD, MN, BR, CA
9/??/2016	101, 102, 103, 110	Doug, Student #1	DD, MN, BR, CA
10/??/2016	2, 5, 8	Doug, Student #1	DD, MN, BR, CA
10/??/2016	100T, 105	Doug, Student #1	DD, MN, BR, CA
10/??/2016	106, 109	Doug, Student #1	DD, MN, BR, CA
10/??/2016	111, 112, 107	Doug, Student #1, Student #2	DD, MN, BR, CA
10/??/2016	104, 108	Doug, Student #1	DD, MN, BR, CA
10/??/2016	304, 307	Doug, Student #1, Student #2	DD, MN, BR, CA
10/??/2016	303s, 306, 311	Doug, Student #1, Student #2	DD, MN, BR, CA
10/??/2016	305, 309, 310	Doug, Student #1, Student #2	DD, MN, BR, CA
11/??/2016	301, 302	Doug, Student #1, Student #2	DD, MN, BR, CA
11/??/2016	300, 308	Doug, Student #1, Student #2	DD, MN, BR, CA

Gauge visitation in support of the Duke GSMRGN during the autumn 2016 will occur over at least thirteen days spanning a period of eight weeks in September – November 2016. The primary purpose of the visits will be to download precipitation observations that were made since the previous gauge visits in June - July 2016 [DD in Table 2], perform maintenance and check if the ML1 logger times have drifted between visits and make the corresponding needed adjustments [MN in Table 2], calibrate all rain gauges [CA in Table 2], and replace all ML1 and HOBO batteries at every rain gauge location [BR in Table 2]. Calibration of the rain gauge network has not occurred since the gauge visit campaign of fall 2014.

Details of every gauge visit along with each gauge precipitation and calibration data record will be posted online and shall contain sub-folders for each gauge that consist of the individual data files (often having at least two different formats), pictures taken at the gauge site during the visit, screenshots of the GPS (laptop) and ML1 logger time comparison, and a MS Word document that mirrors the notes made in the field journal during the visit.

New undergraduate research students at UNC Asheville will be recruited as field technicians for the Duke GSMRGN project during an informational meeting to be held in the ATMS Department early in the fall 2016 semester. The current technician roster during the academic year consists of Ben House, Ethan Wright, William Clark, Bonnie Thompson, and Samuel O'Donnell. Mr. Sky Taylor will be graduating from UNC Asheville in August 2016.

Table 1: The Duke Great Smoky Mountain Rain Gauge Network is currently (valid as of 11 July 2016) comprised of 32 tipping bucket rain gauges.

Gauge #	Location	Latitude	Longitude	Altitude
RG001	Deep Gap	35°23.8' N	82°54.7' W	3794 ft.
RG002	Lickstone Bald	35°25.5' N	82°58.2' W	5680 ft.
RG003	High Top	35°23.0' N	82°54.9' W	5280 ft.
RG004	Lickstone Ridge S	35°22.0' N	82°59.4' W	6305 ft.
RG005	Deep Gap	35°24.5' N	82°57.8' W	4986 ft.
RG008	Double Spring Gap	35°22.9' N	82°58.4' W	5700 ft.
RG010	Beaty Spring Gap	35°27.3' N	82°56.8' W	4849 ft.
RG100T	Purchase Knob	35°35.1' N	83°04.3' W	4905 ft.
RG101	The Swag	35°34.5' N	83°05.2' W	4986 ft.
RG102	Hemphill Bald	35°33.8' N	83°06.2' W	5365 ft.
RG103	JR Property	35°33.2' N	83°07.0' W	5539 ft.
RG104	Cat. Ski Area	35˚33.2' N	83˚05.2' W	5208 ft.
RG105	KH Property	35°38.0' N	83°02.4' W	4412 ft
RG106	Pinnacle Ridge	35°25.9' N	83°01.7' W	3969 ft
RG107	Lookout Point	35°34.0' N	82°54.4' W	4459 ft
RG108	Utah Mountain	35°33.2' N	82°59.3' W	4188 ft
RG109	Eaglesnest Ridge	35°29.7' N	83°02.4' W	4922 ft
RG110	JH Property	35°32.8' N	83°08.8' W	5128 ft
RG111	Hurricane Ridge	35°43.7' N	82°56.8' W	4573 ft
RG112	Ore Knob	35°45.0' N	82°57.8' W	3884 ft
RG300	Camel Hump Knob	35°43.5' N	83°13.0'W	5110 ft
RG301	Mt Guyot	35°42.3'N	83°15.3'W	6570 ft
RG302	Snake Den Ridge	35°43.2'N	83°14.8'W	6104 ft

RG303s	Mt Cammerer	35°45.7’N	83°09.7’W	4887 ft
RG304	Big Cataloochee	35°40.2’N	83°10.9’W	5971 ft
RG305	Mt Sterling 1	35°41.4’N	83°07.9’W	5349 ft
RG306	Sunup Knob	35°44.7’N	83°10.2’W	5039 ft
RG307	Balsam Mountain	35°39.0’N	83°11.9’W	5327 ft
RG308	Cosby Knob	35°43.8’ N	83°10.9’W	4826 ft
RG309	Mt Sterling 2	35°40.9’N	83°09.0’W	5262 ft
RG310	Mt Sterling 3	35°42.1’N	83°07.3’W	5761 ft
RG311	Big Creek	35°45.9’N	83°08.4’W	3398 ft