GLACIERS AND CLIMATE OF THE UPPER SUSITNA BASIN, ALASKA; SUPPORTING DATA

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GLACIERS AND CLIMATE OF THE UPPER SUSITNA BASIN, ALASKA; SUPPORTING DATA

Andrew K. Bliss[1,2], Regine Hock[2], Gabriel J. Wolken[3], Erin N. Whorton[3,4], Caroline Aubry-Wake[2,5], Juliana Braun[2,6], Alessio Gusmeroli[7], William D. Harrison[2], Andrew Hoffman[2], Anna K. Liljedahl[8], and Jing Zhang[9]

ABSTRACT

As part of a study for a proposed hydropower facility, the authors conducted extensive field observations in the Upper Susitna basin, a 13,289 km^2 (5,130 mi^2) glacierized catchment in central Alaska, in 2012–2014. This comprehensive data set includes meteorological, glacier mass balance, snow cover, and soil measurements. We also include digitized snow depth data from a set of similar observations collected in the 1980s. The data will be useful for hydrological and glaciological studies, including modeling efforts. http://doi.org/10.14509/30138

INTRODUCTION

This dataset is a companion to a paper submitted to the journal *Earth Systems Science Data* (Bliss and others, unpub. data). We measured glacier mass balance and surface characteristics on the five largest glaciers in the Upper Susitna Basin to see how the glaciers have changed over recent years and estimate their contribution to the total runoff in the basin. We installed two large weather stations—one on West Fork Glacier and one adjacent to Susitna Glacier—to aid in glacier modeling. Around the rest of the basin, we installed 26 stations that measured air temperature and relative humidity, 10 of which also measured precipitation and nine of which measured soil temperature. These stations help to characterize the weather across a high elevation basin with very sparse measurements. We characterized soil profiles at nine sites to verify that they match up with mapped soil textures.

METHODS USED TO COLLECT THE DATA

The methods used to collect the data are described in detail in a paper submitted to the journal *Earth Systems Science Data* (Bliss and others, unpub. data). Briefly, we used weather stations from Campbell Scientific and Onset to collect meteorological data; ablation stakes, snow pits, and helicopter-borne radar to measure glacier mass balance; an Adirondack snow tube to

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measure snow depth; a Wingscapes time-lapse camera; and photos and field observations to establish soil types in the soil pits.

Locations described in these files were measured with GPS and should be considered accurate to within a few meters. Higher precision is not needed for any of the position data we present here.

DESCRIPTION OF THE FILES

Station locations

Station locations and elevations for the weather measurements generated or utilized in this study.

Station = Station name

File = file name of the corresponding data table for the weather stations installed for this project

Type = Station type is one of the following: Automatic weather station (AWS); HOBO installed on the glacier (HOBO glacier); HOBO installed on tundra (HOBO tundra); National Climatic Data Center (NCDC); or Susitna Watana Hydrological Data Network (SWHDN).

Latitude_deg = Latitude (degrees), NAD83 datum

Longitude_deg = Longitude (degrees), NAD83 datum

Northing_m = Northing (meters), UTM Zone 6N

Easting_m = Easting (meters), UTM Zone 6N

Elevation_m = Elevation (meters above sea level)

On-Ice and Off-Ice weather stations

Instrument readings from the Susitna Glacier "Off-Ice" weather station and the West Fork Glacier "On-Ice" weather station. The West Fork Glacier On-Ice station "floats" on the ice surface and moves down as the surface ablates. Note: "NaN" values throughout this table indicate that the measurement was not taken or was not applicable.

time = Matlab date (where day 1 = 1 January of year 0)

YYYY = Year

MM = Month

DD = Day

hh = Hour (local time)

mm = Minute

ss = Second

dayofyear = Day of year

AirTemp_C = Air temperature (degrees C)

RH_pct = Relative humidity (percent)

AirTemp2_C = Air temperature from redundant sensor (degrees C)
RH2_pct = Relative humidity from redundant sensor (percent)
SWup_W_m2 = Upward-facing (incoming) shortwave radiation (W/m^2)
SWdn_W_m2 = Downward-facing (reflected) shortwave radiation (W/m^2)
LWup_W_m2 = Upward-facing (incoming) longwave radiation (W/m^2)
LWdn_W_m2 = Downward-facing (outgoing) longwave radiation (W/m^2)
Precip_mm = Precipitation (mm)
WindDir_deg = Wind direction (degrees from North)
WindSpdMax_m_s = Wind speed maximum averaged over a 3 second interval (m/s)
WindSpd_m_s = Average wind speed (m/s)
TiltUx_deg = Tilt of the radiation sensors in the x-direction (degrees)
TiltUy_deg = Tilt of the radiation sensors in the y-direction (degrees)
BaroPr_hPa = Barometric pressure (hPa)
DistanceToSurface_m = Distance to the ice surface measured from a pole that is fixed vertically in the ice (meters)

Ice temperatures at the On-Ice station

Thermistor temperature measurements (degrees C) near the West Fork Glacier On-Ice weather station. Sensors are labeled with their height/depth relative to the ice surface at installation. These depths change over time as the surface ablates.

time = Matlab date (where day 1 = 1 January of year 0)
YYYY = Year
MM = Month
DD = Day
hh = Hour (local time)
mm = Minute
ss = Second
dayofyear = Day of the year
Snow 0.65 m = Temperature of the snowpack (degrees C)
Snow 1.15 m = Temperature of the snowpack (degrees C)
Snow 1.65 m = Temperature of the snowpack (degrees C)
Ice 0.1 m = Temperature of the ice (degrees C)
Ice 0.5 m = Temperature of the ice (degrees C)
Ice 1.0 m = Temperature of the ice (degrees C)
Ice 1.5 m = Temperature of the ice (degrees C)
Ice 2.0 m = Temperature of the ice (degrees C)
Ice 2.5 m = Temperature of the ice (degrees C)

Ice 3 m = Temperature of the ice (degrees C)
Ice 5 m = Temperature of the ice (degrees C)
Ice 6 m = Temperature of the ice (degrees C)
Ice 7 m = Temperature of the ice (degrees C)
Ice 8 m = Temperature of the ice (degrees C)
Ice 10 m = Temperature of the ice (degrees C)

Simple weather stations, including soil temperature

Readings from 26 stations installed around the basin to measure air temperature and relative humidity. A subset of these stations also measured precipitation and soil temperature.

time = Matlab date (where day 1 = 1 January of year 0)
YYYY = Year
MM = Month
DD = Day
hh = Hour (local time)
mm = Minute
ss = Second
dayofyear = Day of the year
AirTemp_C = Air temperature (degrees C)
RH_pct = Relative humidity (percent)
Precip_mm = Precipitation (mm)
SoilTempShallow_C = Shallow soil temperature (degrees C)
SoilTempDeep_C = Deep soil temperature (degrees C)

Soil temperature measurement depths

Soil temperature measurement depths (m) at nine simple weather stations.

Station = Station
Shallow_Depth_m = Depth (m) of the shallow soil temperature sensor
Deep_Depth_m = Depth (m) of deep soil temperature sensor

Mass balance (point)

Point mass balance data in water equivalence (w.e.) from earlier work (Clarke and others, 1985) and our work. Note that the year used here is the mass balance year and not calendar year. The mass balance year 2012 corresponds to winter of 2011/2012 through the end of the summer of 2012.

Station = Station
Data_Source = originator of data incorporated from historical observations
Latitude_deg = Latitude (degrees), NAD83 datum

Longitude_deg = Longitude (degrees), NAD83 datum

Elevation_m = Elevation (meters above sea level)

Year = Year

AnnualMB_mmwe = Annual mass balance (mm w.e.)

WinterMB_mmwe = Winter mass balance (mm w.e.)

SummerMB_mmwe = Summer mass balance (mm w.e.)

Mass balance (radar)

Winter mass balance data from helicopter-borne snow radar. Units are meters of snow water equivalent (SWE). For each glacier, the data were binned into 50-m elevation bands and then averaged. Standard deviation within each bin is also given.

time = Matlab date (where day 1 = 1 January of year 0)

YYYY = Year

MM = Month

DD = Day

Zone = Zone 1: West Fork Glacier; 2: Susitna Glacier; 3: East Fork Glacier; 4: Maclaren Glacier; 5: Eureka Glacier; 6: any area off the glaciers.

Elevation_m = Elevation of the bottom of the 50 m bin (meters above sea level)

SWE_m = Mean SWE in the bin (meters)

SWE_std_m = Standard deviation of SWE in the bin (meters)

Time-lapse

Time-lapse videos from the cameras near the On-Ice (West Fork Glacier) and Off-Ice (Susitna Glacier) weather stations. The images used in these videos were captured at 10 a.m. local time. The camera at the On-Ice weather station started April 18, 2013, and ran until September 5, 2013. The camera at the Off-Ice weather station started on July 17, 2013, and ran until September 26, 2013.

Snow depth

Snow depth and density measurements between 2012 and 2014.

Site = Site name

Latitude_deg = Latitude (degrees), NAD83 datum

Longitude_deg = Longitude (degrees), NAD83 datum

Elevation_m = Elevation (meters above sea level)

Year = Year

Month = Month

Day = Day

VegClass = Vegetation class: spruce forest (SPRUCE); shrub (SHRUB); rock (ROCK)

SnowDepth_mm = Snow depth (mm)

DepthSTD_mm = Standard deviation of snow depth (mm)
Density_kg_m3 = Snow density (kg/m^3)
SWE_mmwe = Snow Water Equivalent (mm w.e.)

Soil pits

Observations from soil pits.

Site = Site name
Depth_cm = Depth or depth interval of observations (cm), with a depth of 0 at the transition from living plant material above (negative depths) to soil and roots below (positive depths)
SoilHorizon = Soil horizon observed
Description = Description of the soil
Comments = Any additional comments recorded in the field

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REFERENCES

Clarke, T.S., Johnson, D., and Harrison, W.D., 1985, Glacier mass balances and runoff in the upper Susitna and Maclaren River basins, 1981-1983: University of Alaska Fairbanks Geophysical Institute Report, 51 p.