Wood River Groundwater Model Development: Options for Estimating Precipitation and Evapotranspiration - Continued

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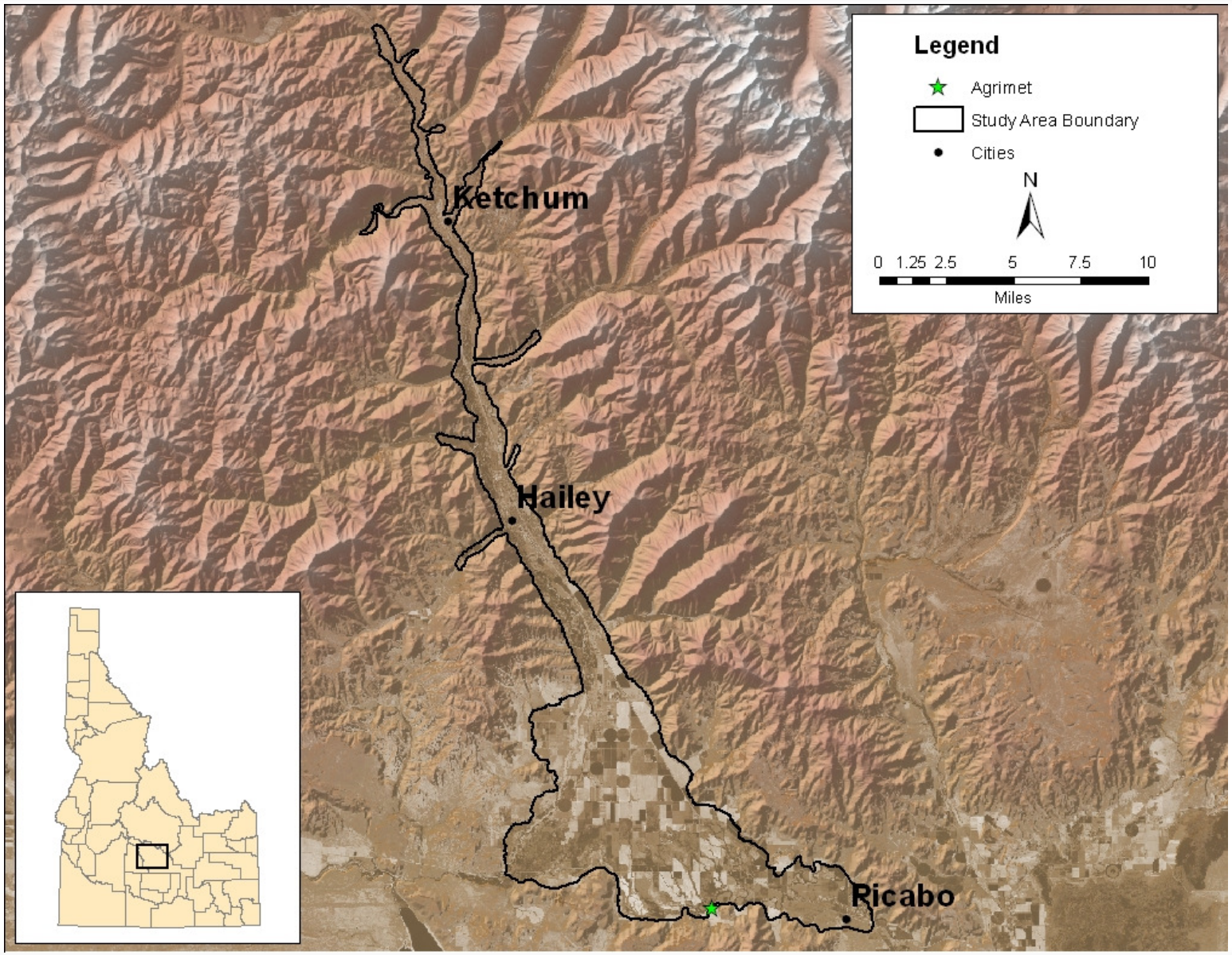
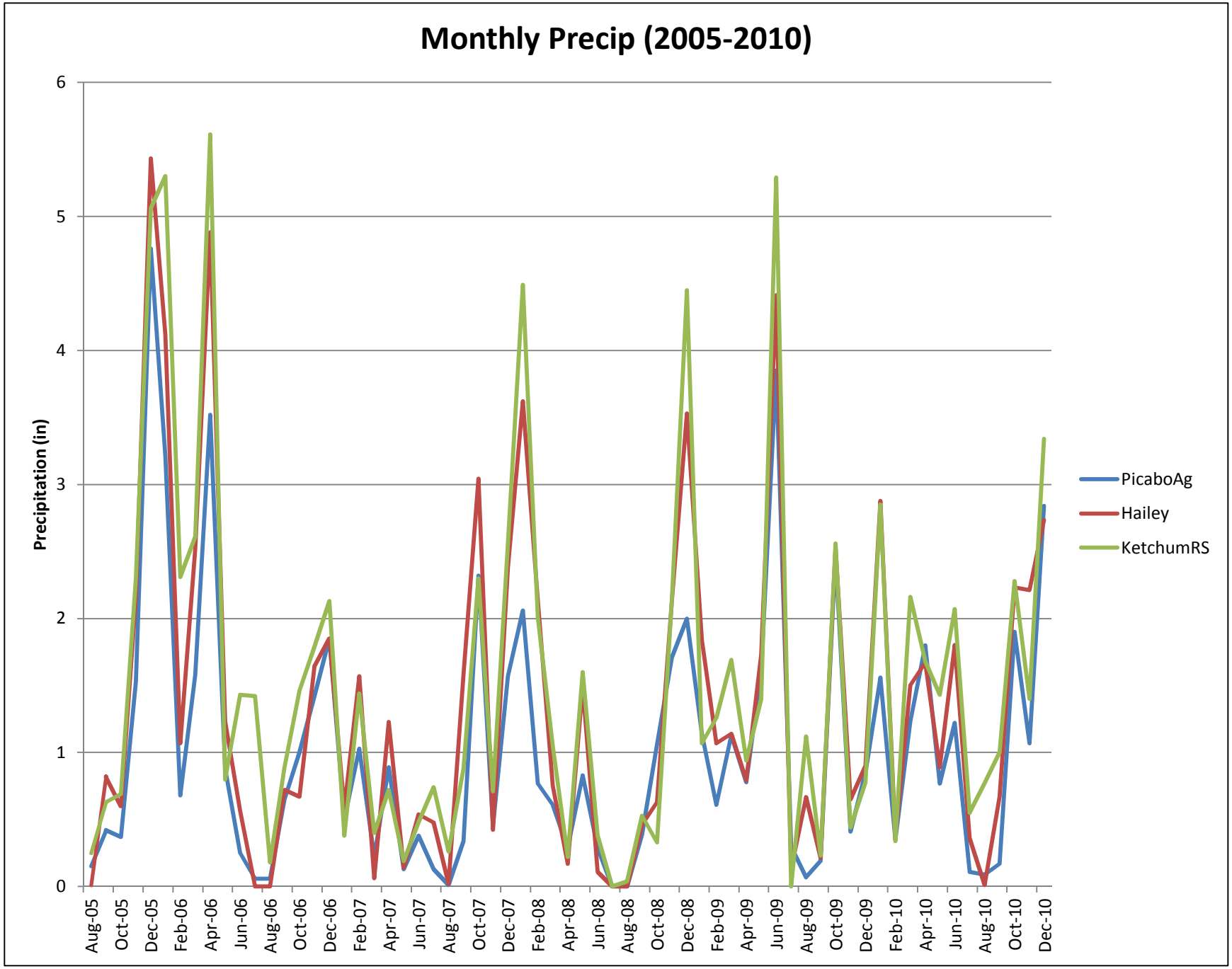
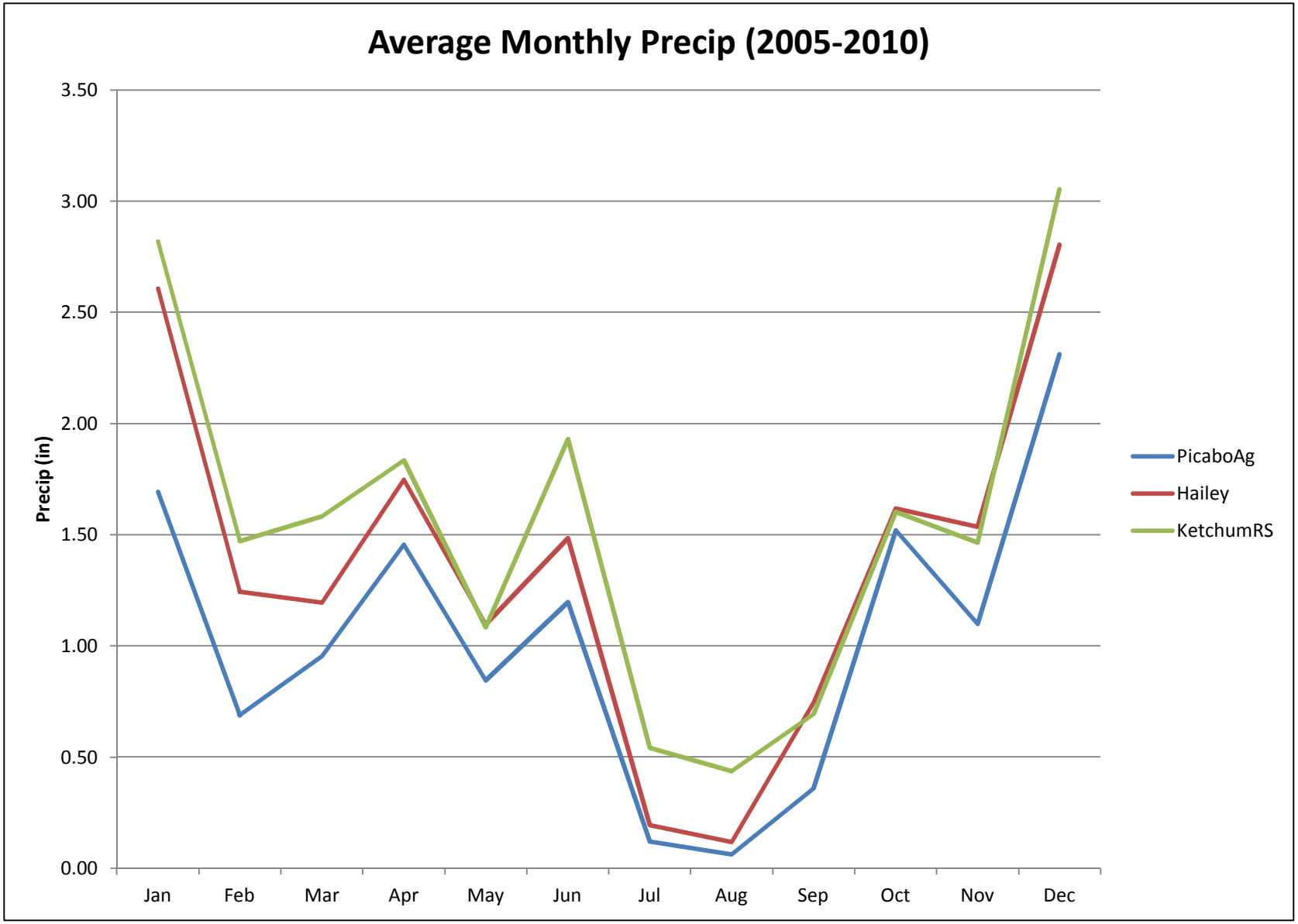
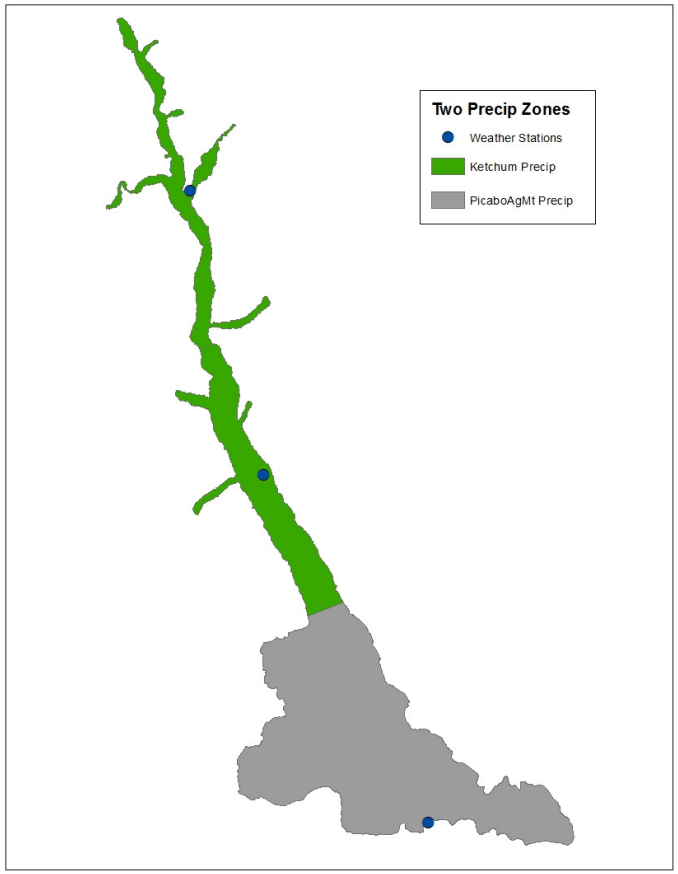
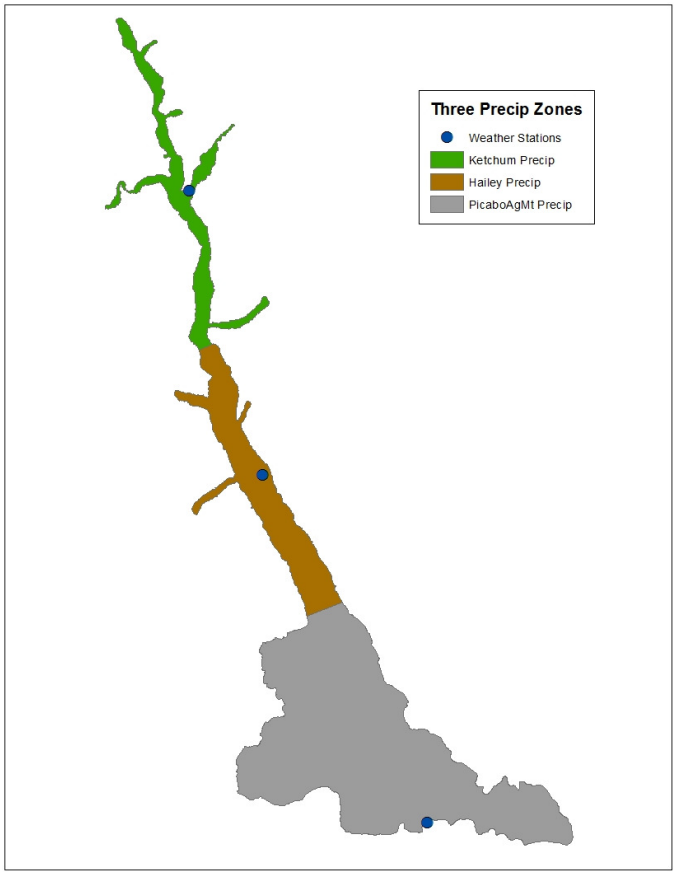

Legend
Agrimet
Study Area Boundary
Cities
N
0 1.25 2.5 5 7.5 10
Miles
Ketchum
Hailey
Ricabo

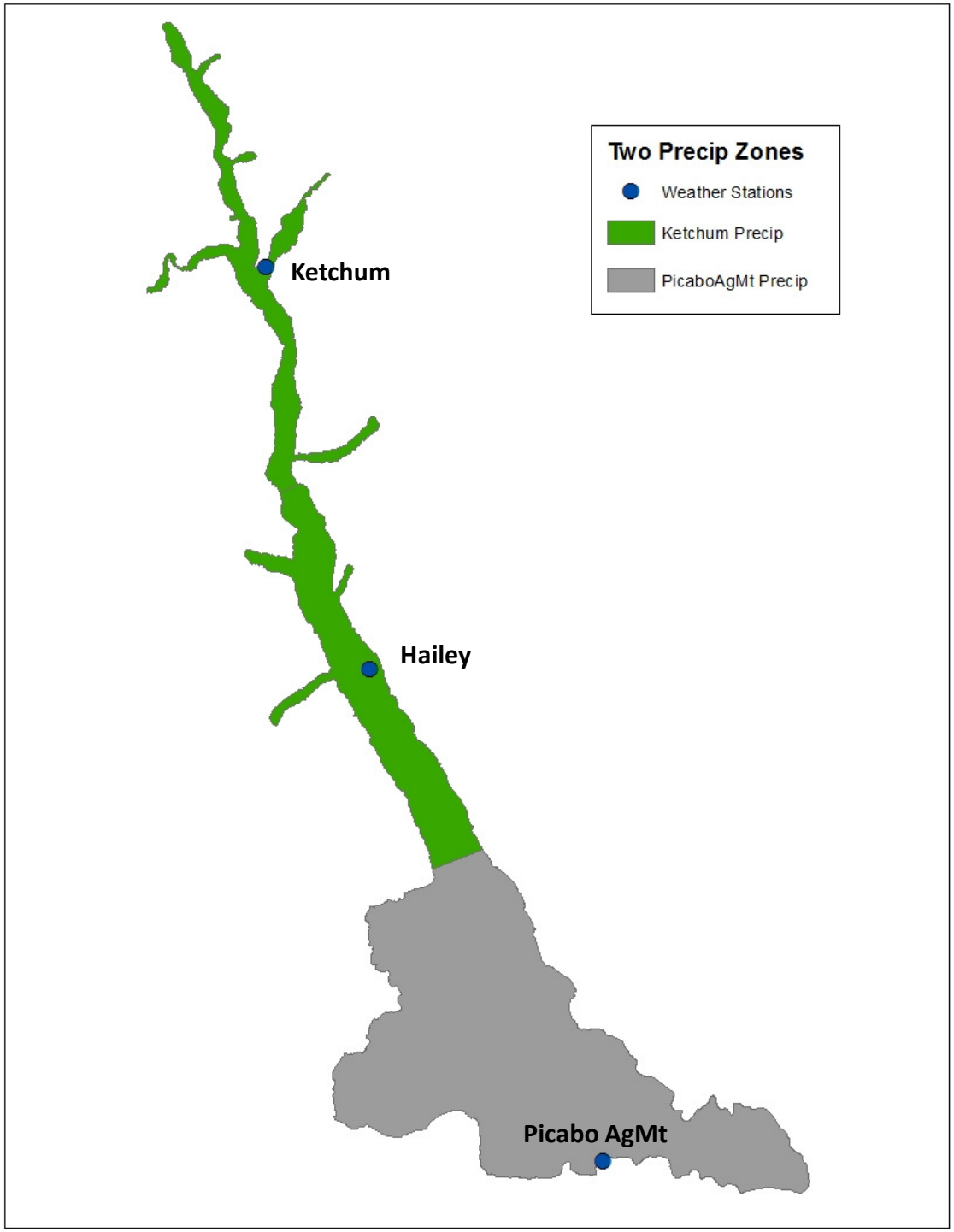

Monthly Precip (2005-2010)
Precipitation (in)
0
1
2
3
4
5
6
Aug-05
Oct-05
Dec-05
Feb-06
Apr-06
Jun-06
Aug-06
Oct-06
Dec-06
Feb-07
Apr-07
Jun-07
Aug-07
Oct-07
Dec-07
Feb-08
Apr-08
Jun-08
Aug-08
Oct-08
Dec-08
Feb-09
Apr-09
Jun-09
Aug-09
Oct-09
Dec-09
Feb-10
Apr-10
Jun-10
Aug-10
Oct-10
Dec-10
PicaboAg
Hailey
KetchumRS


Average Monthly Precip (2005-2010)
Precip (in)
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
PicaboAg
Hailey
KetchumRS

Two Zones (Ketchum, Picabo) versus Three Zones (Ketchum, Hailey, Picabo)





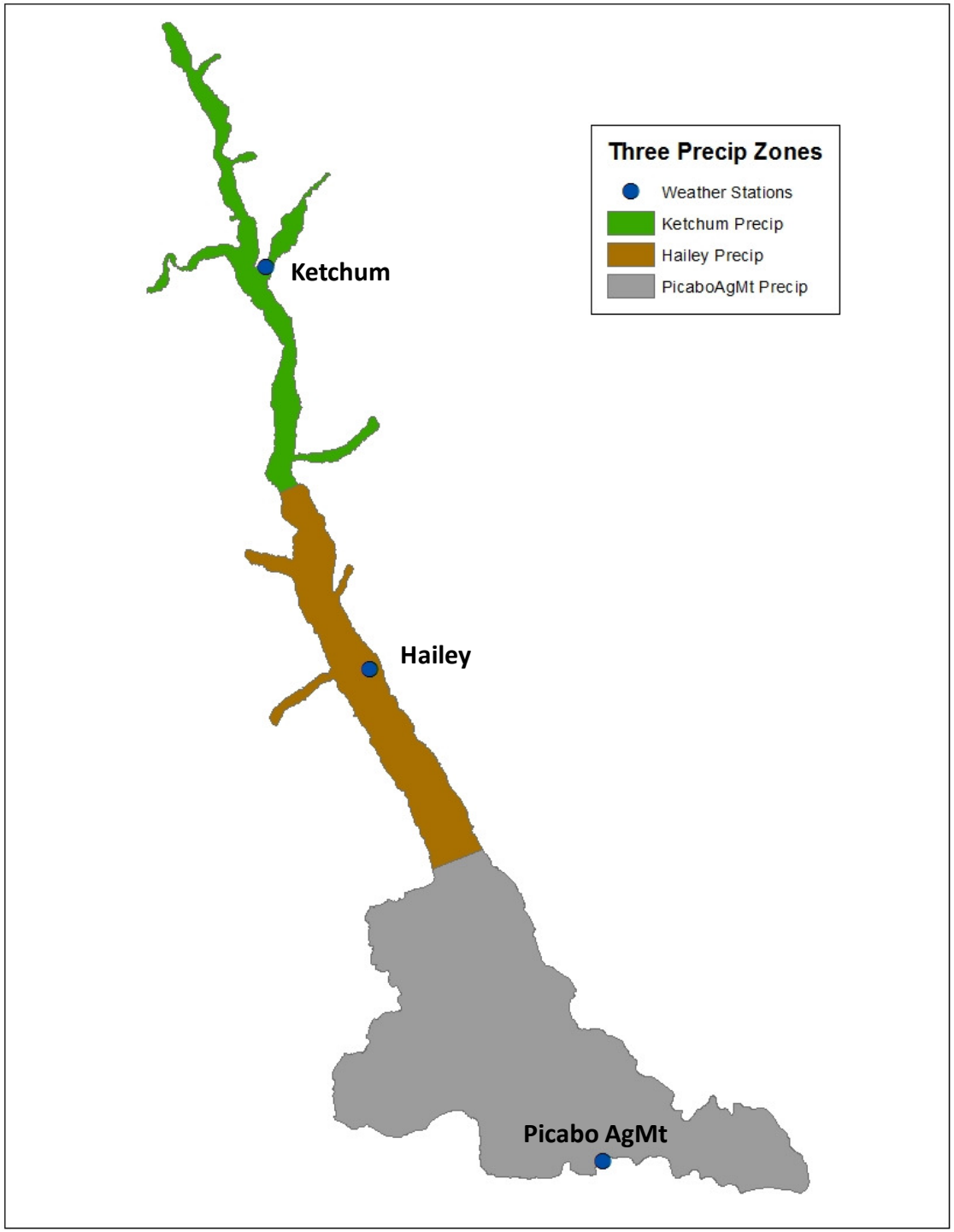


Volume of precipitation per zone and model domain – using monthly average precipitation and study area.

AVE	PicaboAg	KetchumRS	Total (AF)
Jan	5,405	3,906	9,311
Feb	2,195	2,040	4,235
Mar	3,044	2,193	5,237
Apr	4,645	2,542	7,188
May	2,693	1,503	4,195
Jun	3,822	2,675	6,497
Jul	383	751	1,134
Aug	202	605	807
Sep	1,149	961	2,110
Oct	4,850	2,222	7,072
Nov	3,504	2,031	5,535
Dec	7,375	4,232	11,608
			64,929

Ketchum Zone = 16,633 acres
Picabo Zone = 38,286 acres

Volume = Station Precipitation x Zone Area



Volume of precipitation per zone and model domain – using monthly average precipitation and study area.

AVE	PicaboAg	Hailey	KetchumRS	Total (AF)
Jan	5,405	2,168	1,563	9,135
Feb	2,195	1,034	816	4,045
Mar	3,044	993	877	4,914
Apr	4,645	1,454	1,017	7,116
May	2,693	911	601	4,205
Jun	3,822	1,235	1,070	6,127
Jul	383	161	301	844
Aug	202	98	242	542
Sep	1,149	619	384	2,152
Oct	4,850	1,345	889	7,084
Nov	3,504	1,278	812	5,594
Dec	7,375	2,332	1,693	11,400
				63,161

Ketchum Zone = 6,654 acres
Hailey Zone = 9,979 acres
Picabo Zone = 38,286 acres

Volume = Station Precipitation x Zone Area

Volume Difference Between Two and Three Zones

Two Precip Zones (ave precip 2005-2010)

AVE	PicaboAg	KetchumRS	Total (AF)
Jan	5,405	3,906	9,311
Feb	2,195	2,040	4,235
Mar	3,044	2,193	5,237
Apr	4,645	2,542	7,188
May	2,693	1,503	4,195
Jun	3,822	2,675	6,497
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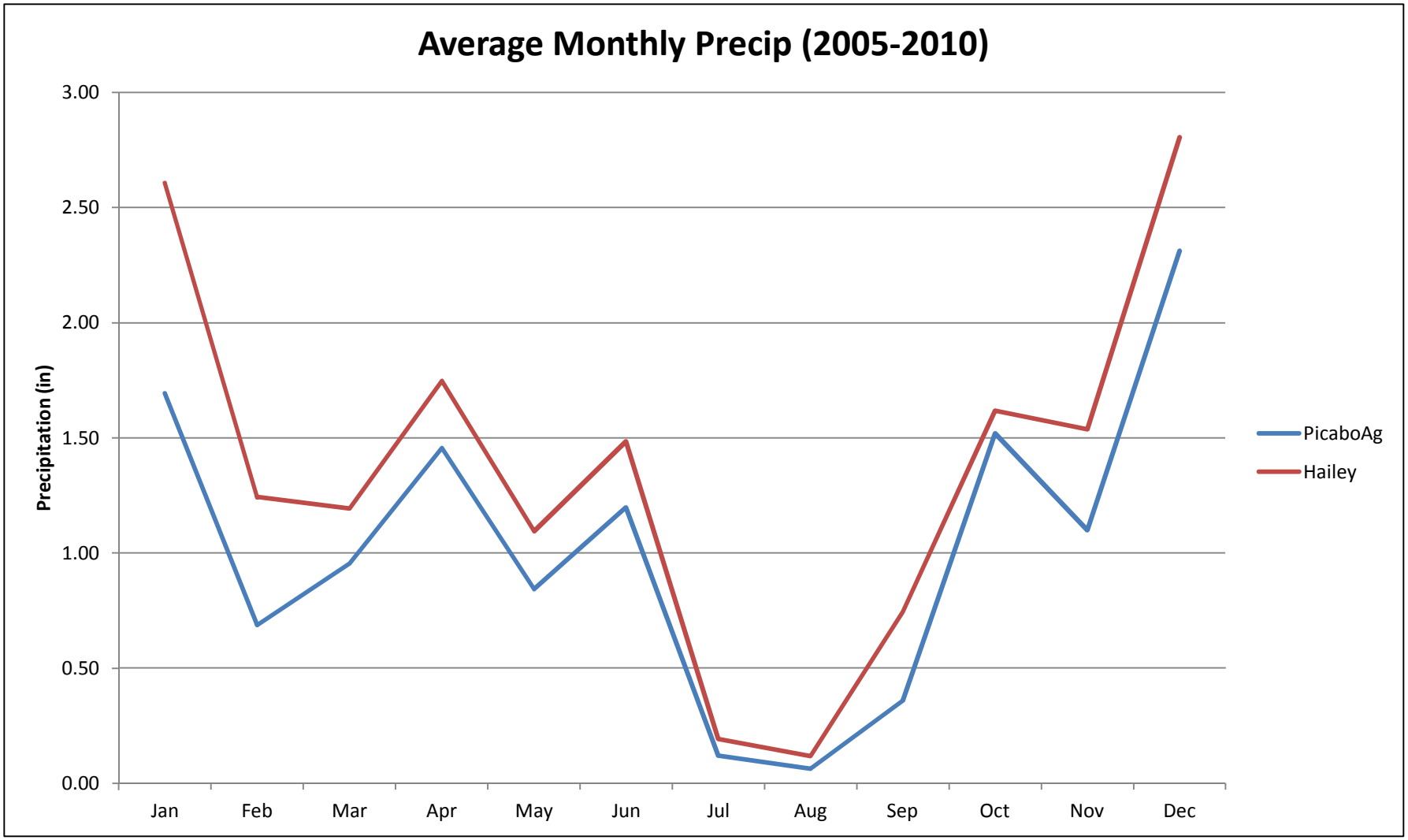
Aug	202	605	807
Sep	1,149	961	2,110
Oct	4,850	2,222	7,072
Nov	3,504	2,031	5,535
Dec	7,375	4,232	11,608
			64,929

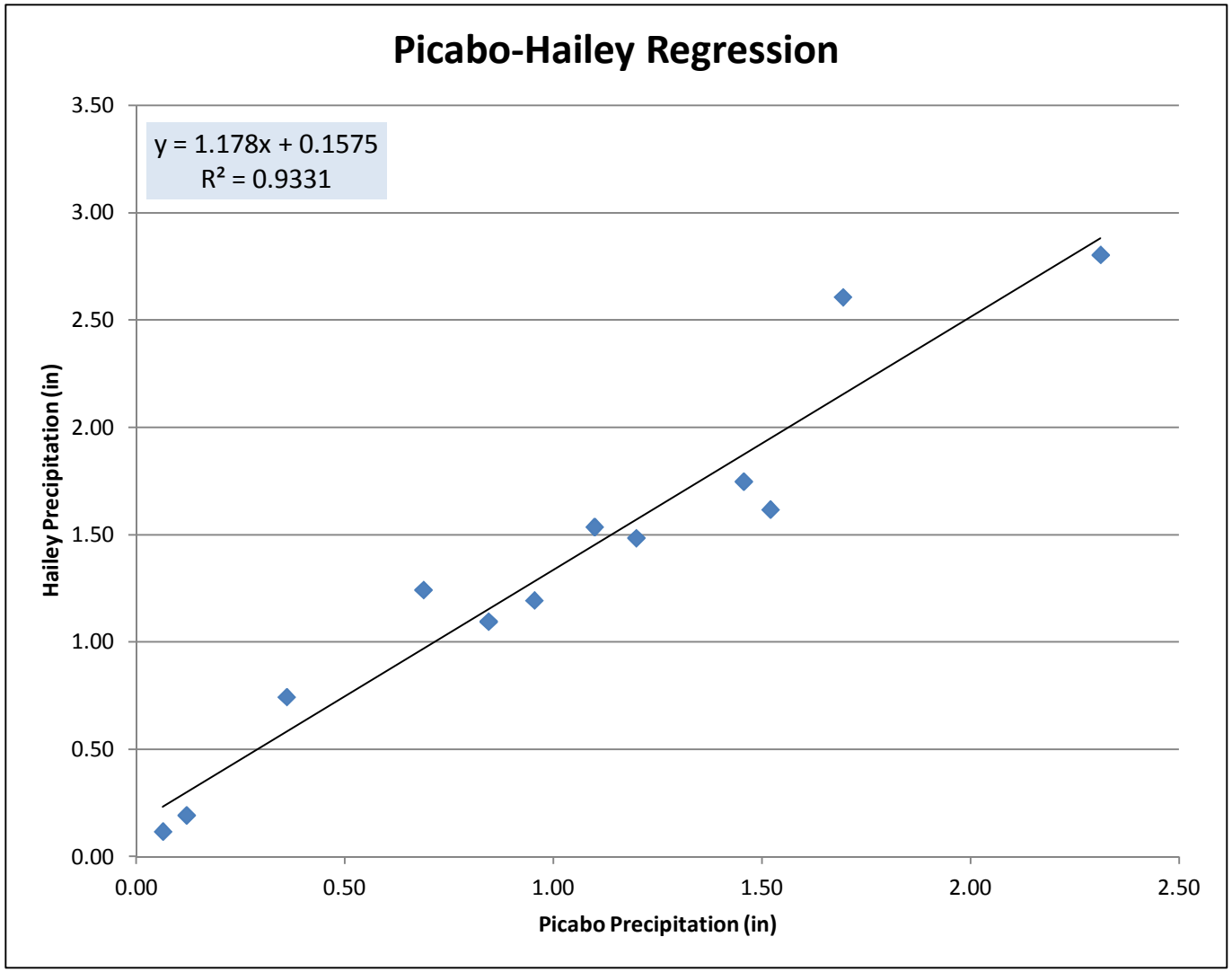
Three Precip Zones (ave precip 2005-2010)

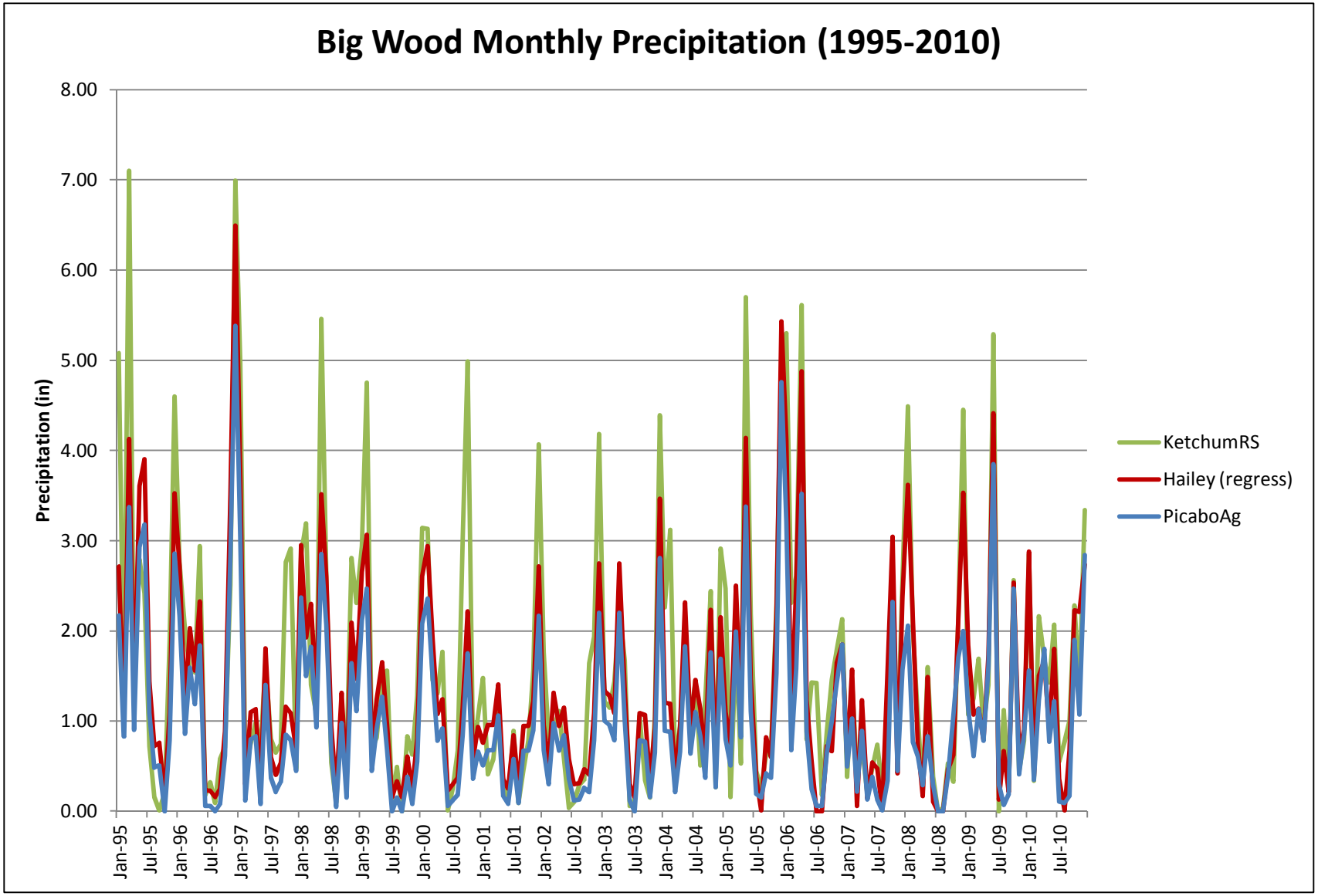
AVE	PicaboAg	Hailey	KetchumRS	Total (AF)	Diff (AF)
Jan	5,405	2,168	1,563	9,135	176
Feb	2,195	1,034	816	4,045	190
Mar	3,044	993	877	4,914	322
Apr	4,645	1,454	1,017	7,116	71
May	2,693	911	601	4,205	-10
Jun	3,822	1,235	1,070	6,127	370
Jul	383	161	301	844	290
Aug	202	98	242	542	265
Sep	1,149	619	384	2,152	-42
Oct	4,850	1,345	889	7,084	-12
Nov	3,504	1,278	812	5,594	-59
Dec	7,375	2,332	1,693	11,400	207
				63,161	**1,768**
					+2.7%

Two precipitation zones results in more precipitation because generally higher Ketchum precipitation is assigned to a larger area.

Can we use correlation between sites to generate a complete data set?




Picabo-Hailey Regression
y = 1.178x + 0.1575
R² = 0.9331
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Hailey Precipitation (in)
0.00
0.50
1.00
1.50
2.00
2.50
Picabo Precipitation (in)



Precipitation includes correlated Hailey 1995-2005 data.

Precipitation proposal

- Use Hailey data when available (2005-2010)
- Use regression to calculate Hailey data when it is not available (1995-2005)
  - 1995-2000 is warm up period
  - 2000 – 2010 is calibration period

Evapotranspiration (ET)

Estimating ET Using METRIC

- METRIC is a widely accepted method for computing ET.
- We don't (and won't) have METRIC available for all years
  - We need an estimation method for the non-METRIC years
- Previously we proposed **ET Idaho** (aka Standardized Penman-Monteith or Crop Coefficient method) for non-METRIC years and north of Bellevue Triangle

Estimating ET for non-METRIC Years

- Rick Allen says METRIC useful for entire study area
- ETIdaho crop coefficients for riparian vegetation come from METRIC
- Downside of ETIdaho is estimating crop mix
- Don’t have to estimate crop mix with METRIC
- Other option for non-METRIC year - NDVI

Normalized Difference Vegetative Index (NDVI)

- Plants adsorb solar radiation in the photosynthetic active radiation spectrum and reflect solar radiation in the near-infrared spectrum .
- Live green plants are dark in the photosynthetic active spectrum and bright in the near-infrared spectrum.
- The ratio (NIR-VIS)/(NIR+VIS) is referred to as NDVI.

Normalized Difference Vegetative Index (NDVI)

$$NDVI = \frac{\mathrm{NIR} - \mathrm{VIS}}{\mathrm{NIR} + \mathrm{VIS}}$$

- Near-infrared (NIR) and photosynthetic spectrum (VIS) are about equal i.e. both reflected snow
  - NDVI ~ 0
- Mixed sage and grass – NIR and some of VIS reflected
  - NDVI small (0.2-0.4)
- Well watered crops – NIR reflected and VIS adsorbed
  - NDVI ~ 1.0

Estimating ET Using NDVI

Use NDVI values to calculate the Crop Coefficient (Kc) using the equation:

$$Kc = 0.15 + 1.06*NDVI$$

Where: Kc = Crop coefficient, equivalent to ETrF (reference ET fraction) from METRIC.

The NDVI method is a compatible method to use in conjunction with METRIC. Like the METRIC and ET Idaho methods, the NDVI method utilizes Kc * ETr (reference ET from weather stations) to determine ET.

This is a satellite-based method, and there will be some images that are unusable due to clouds. However, there has been work done on using partial-year NDVI to interpolate between METRIC years.

http://www.idwr.idaho.gov/Browse/WaterInfo/ESPAM/ESPAM_3.0/ET_Subcommittee/METRIC_For_ESPAM3_Revision_20120330.pdf

Benefits of Using NDVI

1. Major benefit is non-reliance on both crop mix (very poor data) and the assumption of standard crop conditions.
2. The NDVI equation was developed by Dr. Allen for use in southern Idaho.
3. Consistent scale and data format for processing.
4. Quicker and easier processing. May speed up METRIC processing for applicable years.
   a. Processing NDVI for a LANDSAT image takes a matter of minutes.

Numbers, figures and analysis will be forthcoming. NDVI processing for ET in progress.

ET proposal

- Use METRIC when it is available
- Use NDVI and ETr (reference ET from weather stations) when METRIC is not available.