Breakpoints for farm field runoff

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The following is the R code used to produce a piecewise regression model:

```
> piecewise <- function(th, x, y) { #
+         X <- cbind( ifelse(x>=th, 1, 0), x, pmax(0, x-th) )
+         fit = lsfit(X, y) #actually fit the model
+
+         #Counts how many observations lie above and below the breakpoint
+         upper = as.logical( ifelse(x-th>=0, 1, 0) )
+         n_upper = sum(upper)
+         n_lower = dim(X)[1] - n_upper
+
+         #Sum of squared residuals on either side of the breakpoint
+         ssr_upper = sum( fit$resid[upper]**2 )
+         ssr_lower = sum( fit$resid[!upper]**2 )
+
+         #Return the residual standard error:
+         return( n_lower*sqrt(ssr_lower/(n_lower-2))
+             + n_upper*sqrt(ssr_upper/(n_upper-2)) ) }
```

We identify the best breakpoint by using R's optimize function to minimize the residual standard error:

```
> soil_moisture_limits = c(33, 43) #set the limits
> optimize(piecewise, soil_moisture_limits, x=data$sm, y=data$rc)$minimum
```

First, let us do the soil moisture breakpoint analysis. The breakpoints at each farm

individually, and for all farms in aggregate are:

```
Kp: 35
P: 35
Pf: 36
R: 36
S: 40

aggregate: 35
```

Now get the I30 breakpoints:

```
Kp: 0.5
P: 0.8
Pf: 0.7
R: 0.6
S: 0.9

aggregate: 0.6
```

When we put the events in bins based on their antecedent soil moisture (SM: high, medium, and low), the following are the I30 breakpoints (inches of rain per hour):

```
-Inf <= SM < 30: 1.7
30 <= SM < 35: 0.5
35 <= SM < Inf: 0.8
```

When we put the events in bins based on their antecedent soil moisture (SM: high, medium, and low), the following are the rain depth breakpoints (inches of rain):

```
-Inf <= SM < 30: 1.3
30 <= SM < 35: 0.94
35 <= SM < Inf: 0.45
```

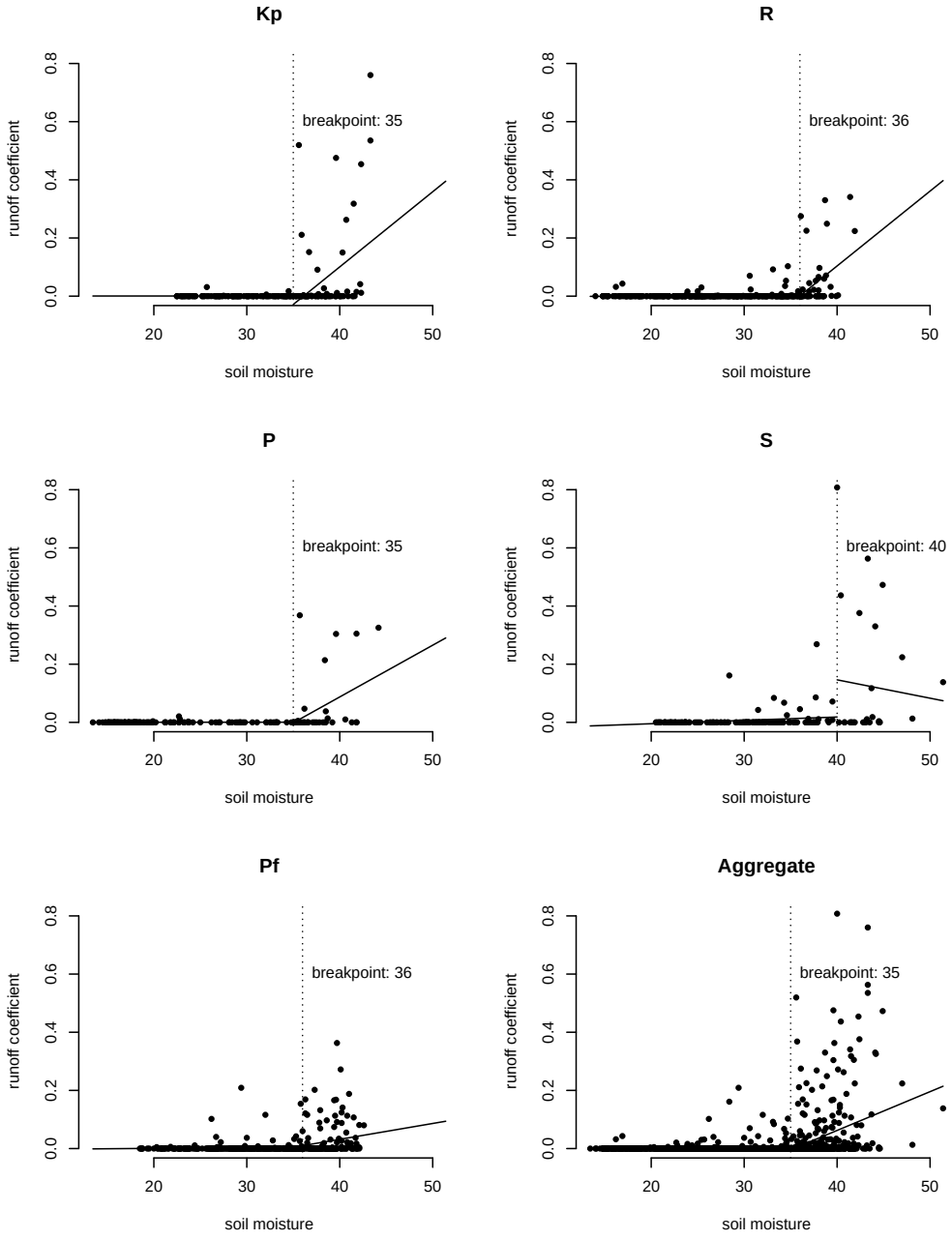

Figure 1: caption.

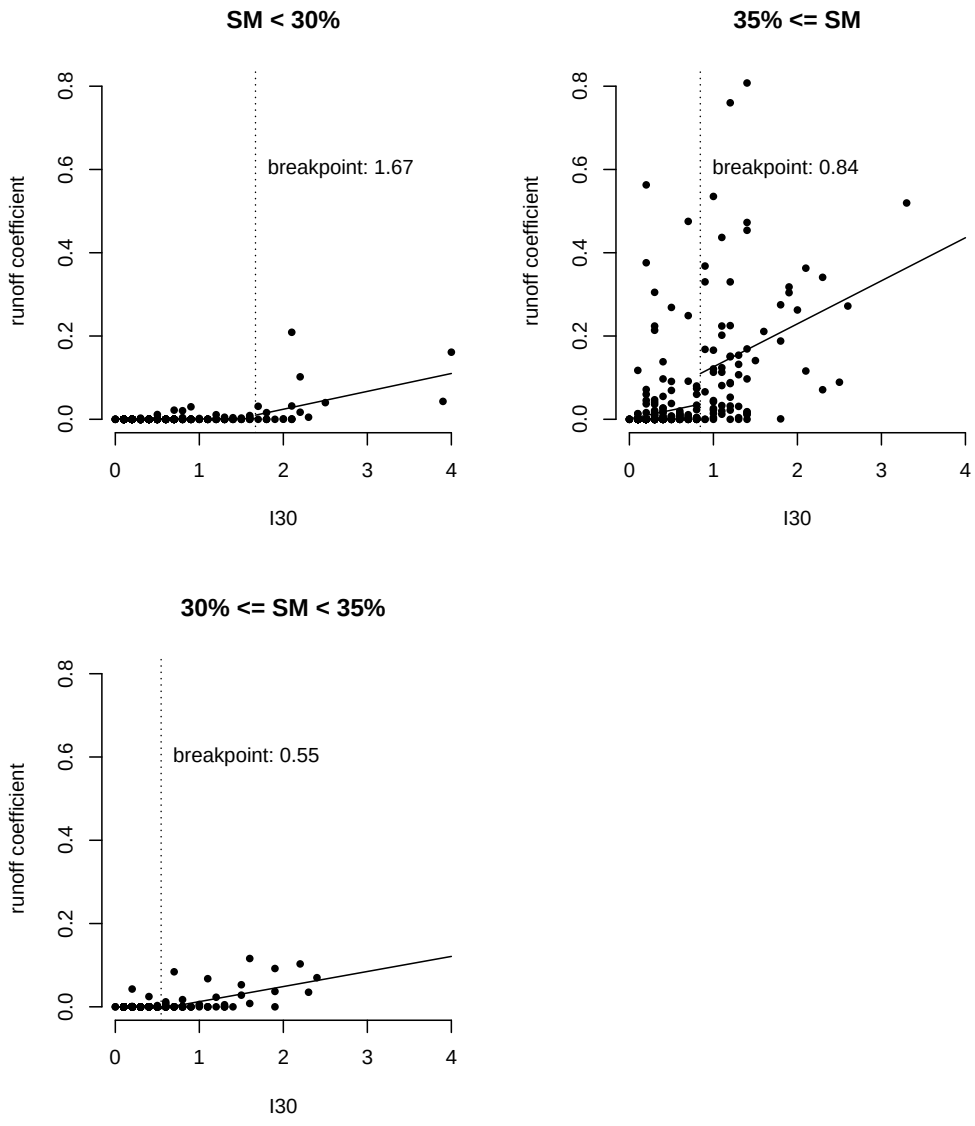

Figure 2: caption.

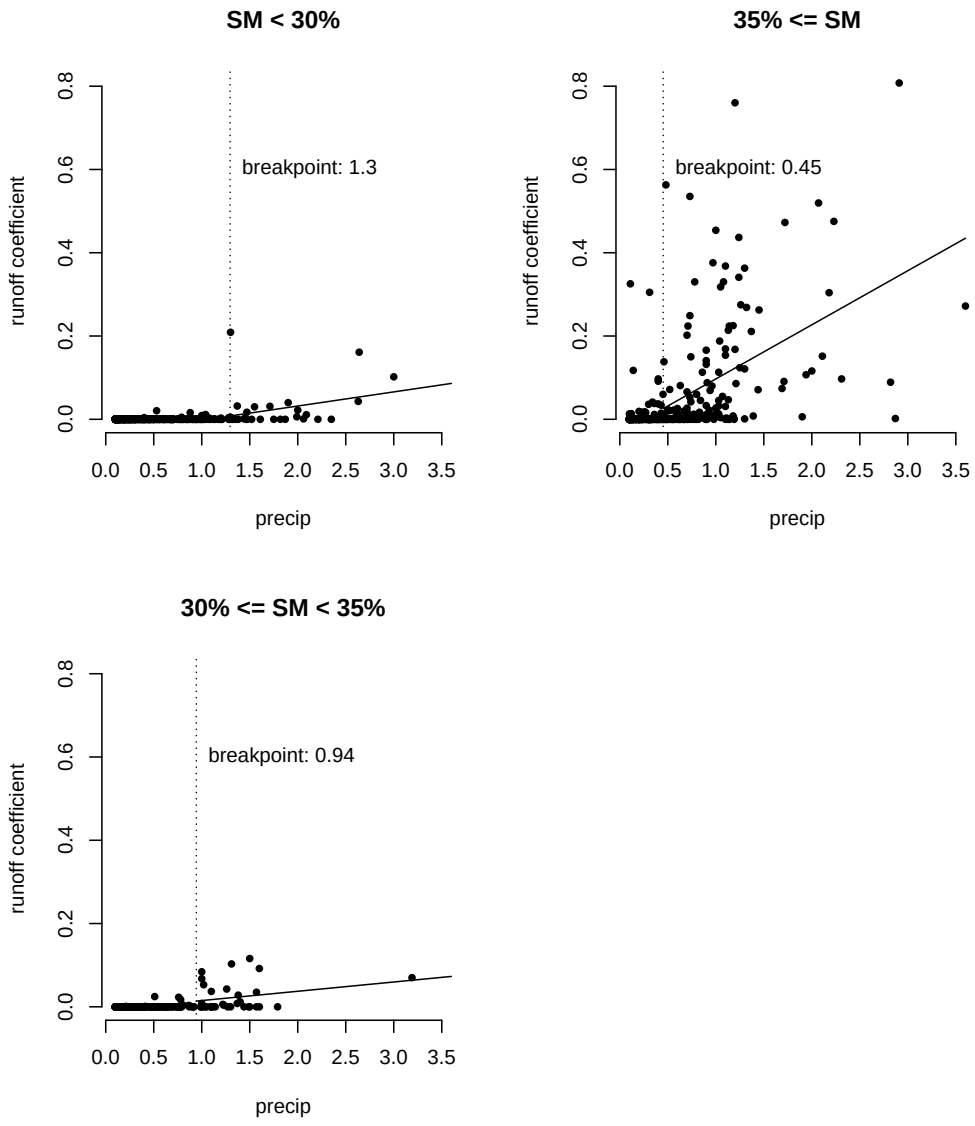

Figure 3: caption.