

Precipitation Data-Munging

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Broad questions:

What is the drought history of the Pine Ridge Reservation?
Does the drought extent differ across the study area?

Narrower questions:

What is are precipitation trends?

Analysis Steps:

1. Data read in from NOAA website
2. Data munging to check, join and remove NAs
3. Updated unit vals - originally in tenths of mm; now in mm
4. Changed daily data into monthly and annual data
5. Cross-validated monthly data
6. Created plots

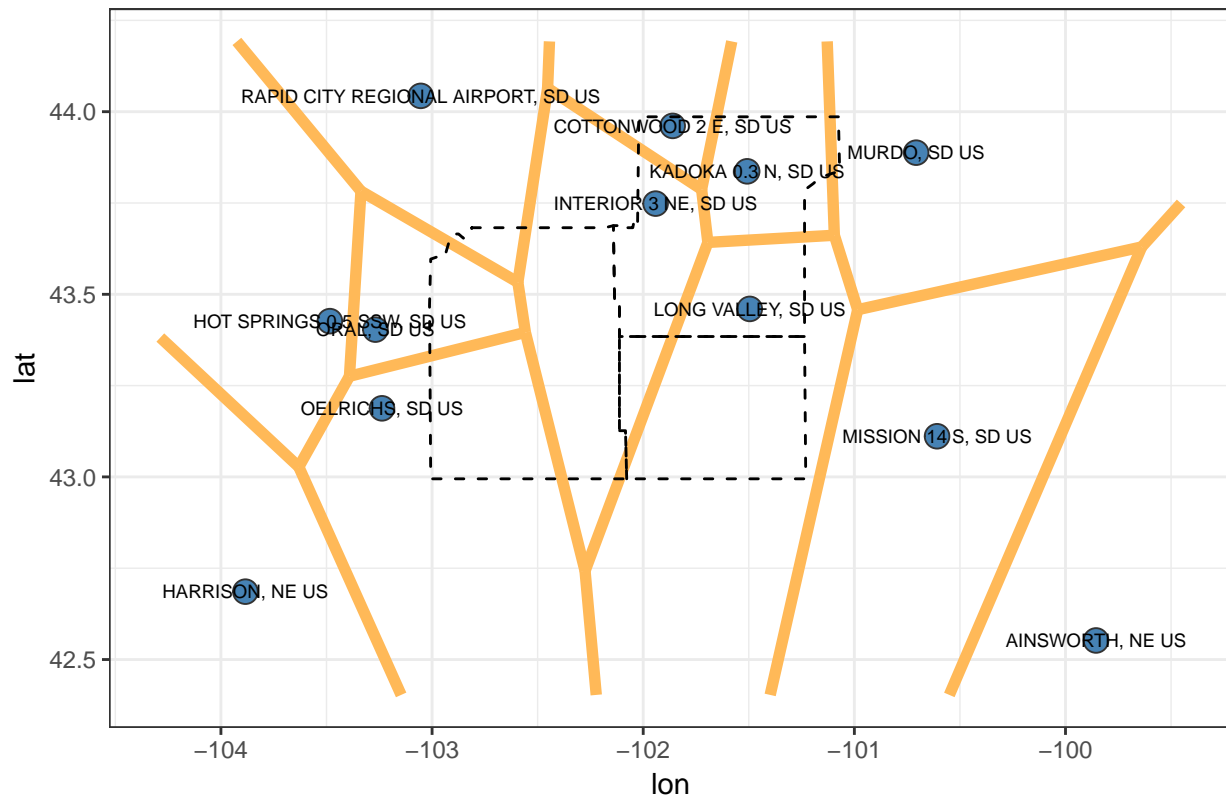
Variable naming convention:

sta precipitation station
__meta metadata
__raw the “mostly” raw dataset
__geXX data greater than or equal to year XX
__geXXmYY data greater than or equal to year XX and month YY
__ltXXmYY data less than year XX and month YY
__clean intermediate df - clean part of NA split ;-}
__dirty intermediate df - NA part of NA split ;-}
__transZ final df - after cleaning

Results:

The results generally show rainshadow effects from the Black Hills and southeast to northwest aridity trend at the annual scale. 1900s were a very wet decade for the southern Black Hills.

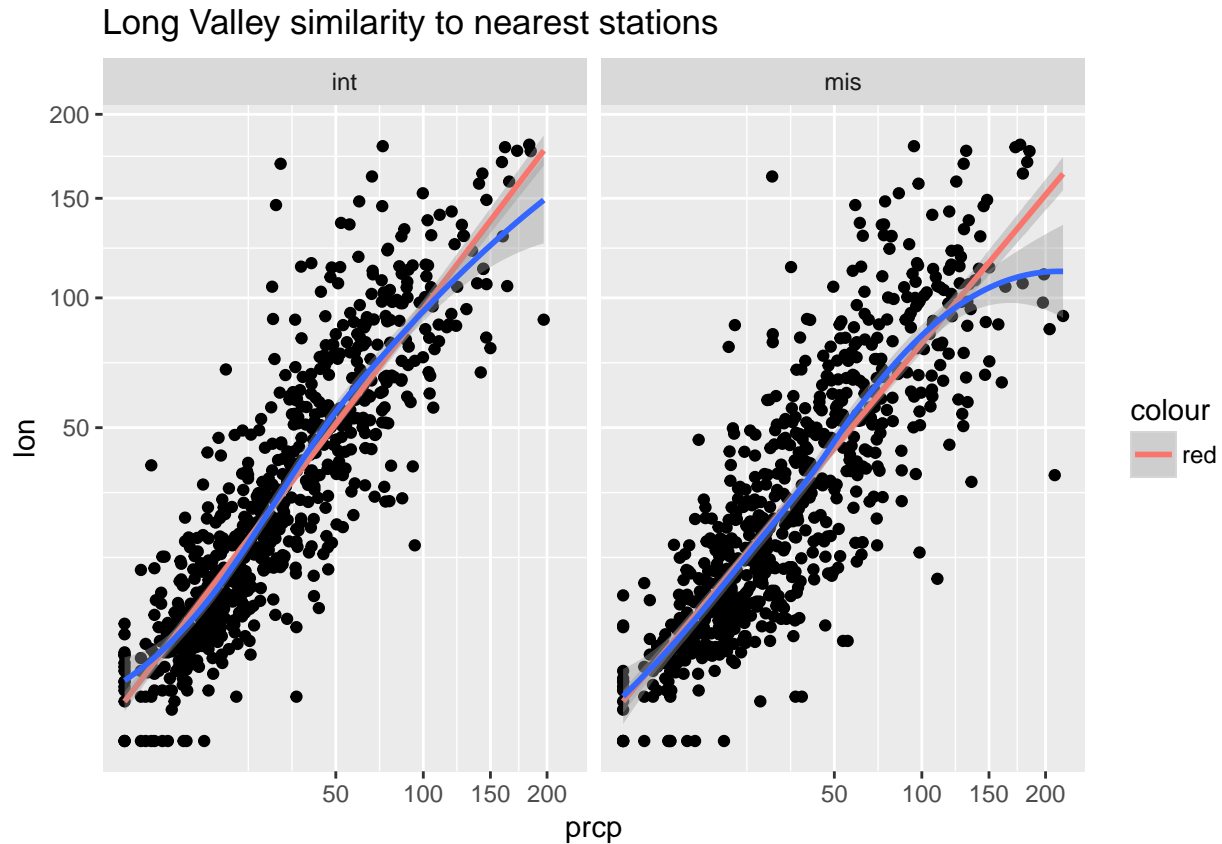
Original Theissen Polygon Map



Original Stations and reason for removal, if removed

GHCND:US1SDCS0027 HERMOSA 10.3 ESE, SD US - short record
 GHCND:USC00253615 HARRISON, NE US - outside region
 GHCND:USC00396212 OELRICHS, SD US
 GHCND:US1SDFR0001 HOT SPRINGS 0.5 SSW, SD US - close to Oelrichs
 GHCND:USC00396304 ORAL, SD US
 GHCND:USW00024090 RAPID CITY REGIONAL AIRPORT, SD US
 GHCND:USC00394184 INTERIOR 3 NE, SD US
 GHCND:USC00391972 COTTONWOOD 2 E, SD US
 GHCND:USC00394983 LONG VALLEY, SD US
 GHCND:US1SDJK0006 KADOKA 0.3 N, SD US - short period of record
 GHCND:USC00395891 MURDO, SD US - outside region
 GHCND:USC00395638 MISSION 14 S, SD US
 GHCND:USC00250050 AINSWORTH, NE US

Deciding whether to keep Long Valley



```
## # A tibble: 3 x 12
##   name r.squared adj.r.squared sigma statistic p.value df logLik
##   <chr>   <dbl>         <dbl> <dbl>    <dbl>    <dbl> <int> <dbl>
## 1 both    0.810           0.810  1.30    1532. 1.48e-259  3 -1212.
## 2 int     0.755           0.755  1.48    2218. 8.58e-222  2 -1303.
## 3 mis     0.699           0.699  1.64    1667. 2.48e-189  2 -1378.
## # ... with 4 more variables: AIC <dbl>, BIC <dbl>, deviance <dbl>,
## #   df.residual <int>
```

Fixing NA values

These are the stations that NA values were fixed NAs are caused in part by different start dates

OEL - OELRICHS 1893 - 2018 - fixed with Murdo

COT - COTTONWOOD 1909 - 2018 - fixed with Interior & Murdo

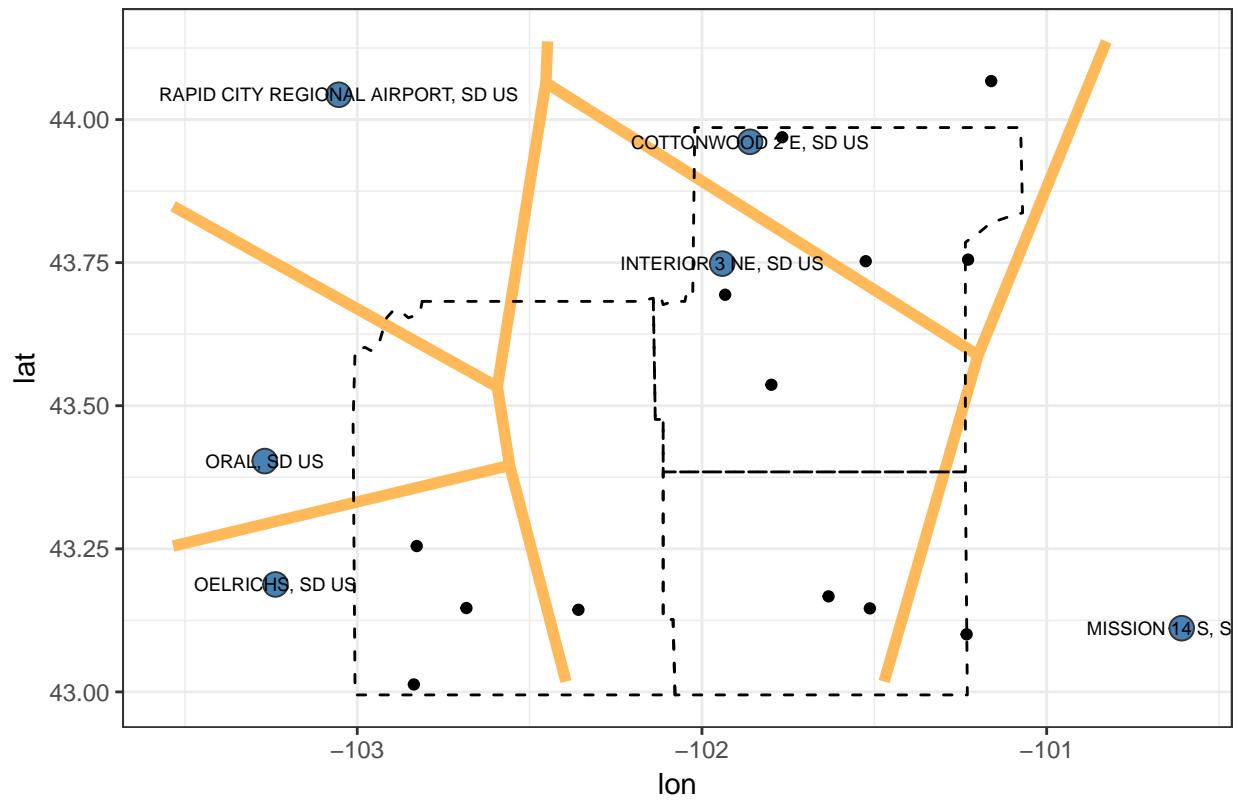
RAP - RAPID CITY 1948 - 2018 - fixed with Interior

INT - INTERIOR 1949 - 2018 - fixed with Cottonwood & Murdo

ORA - ORAL 1971 - 2018 - fixed with Oelrichs & Harrison

```
## Warning: The plyr::rename operation has created duplicates for the
## following name(s): (`fill`)
```

Final Theissen Polygon Map

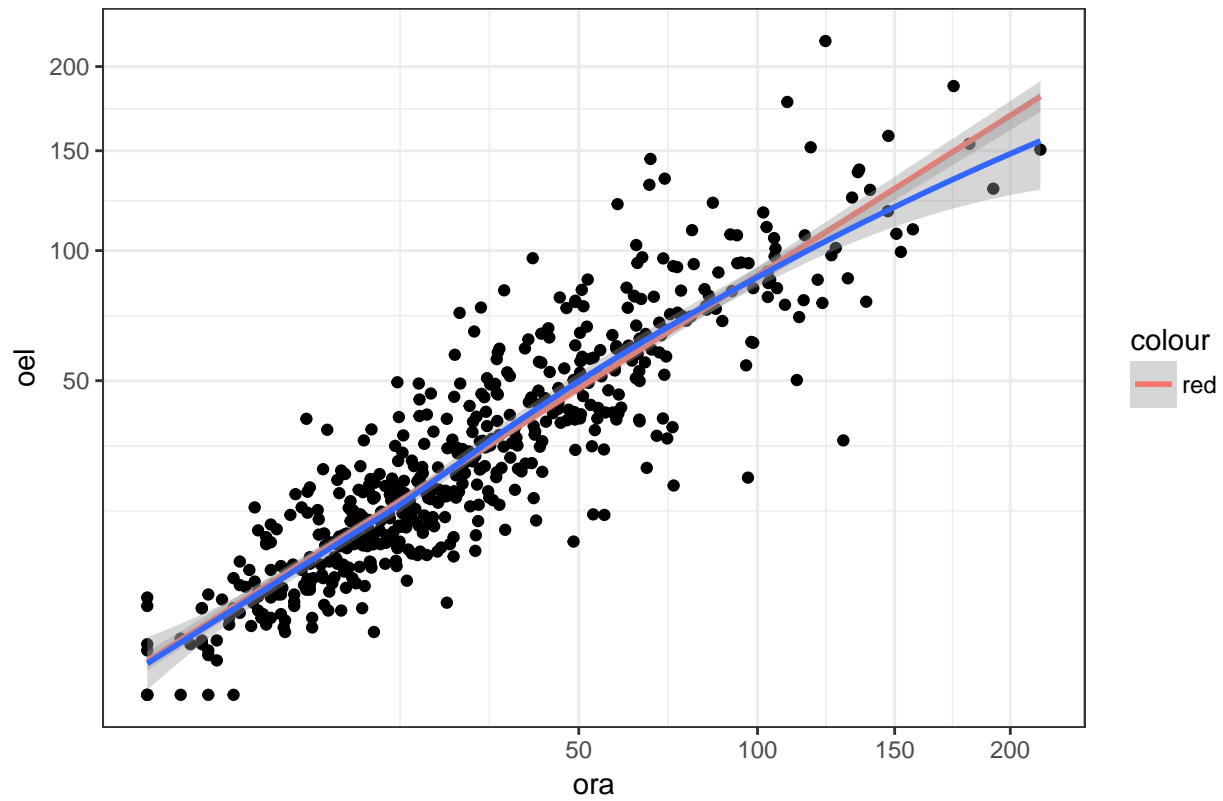


Note: Mission is kept on the map to extend the INT - COT line

Deciding to keep Oral

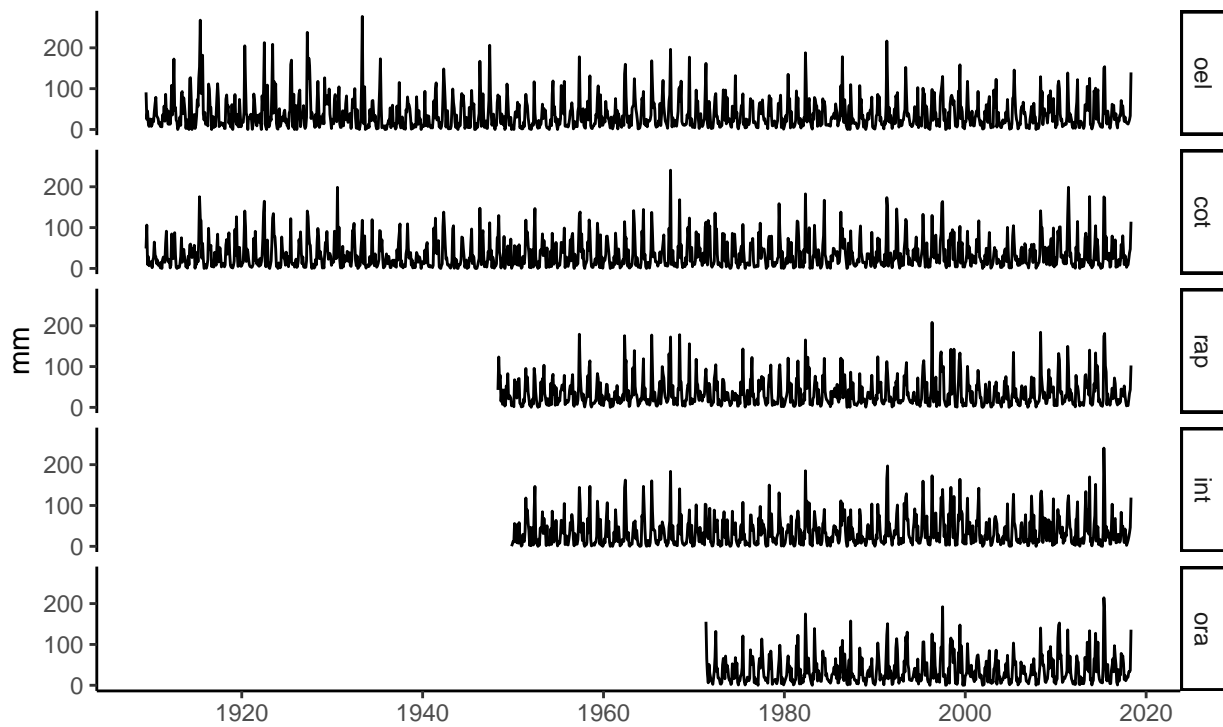
```
## `geom_smooth()` using method = 'loess'
```

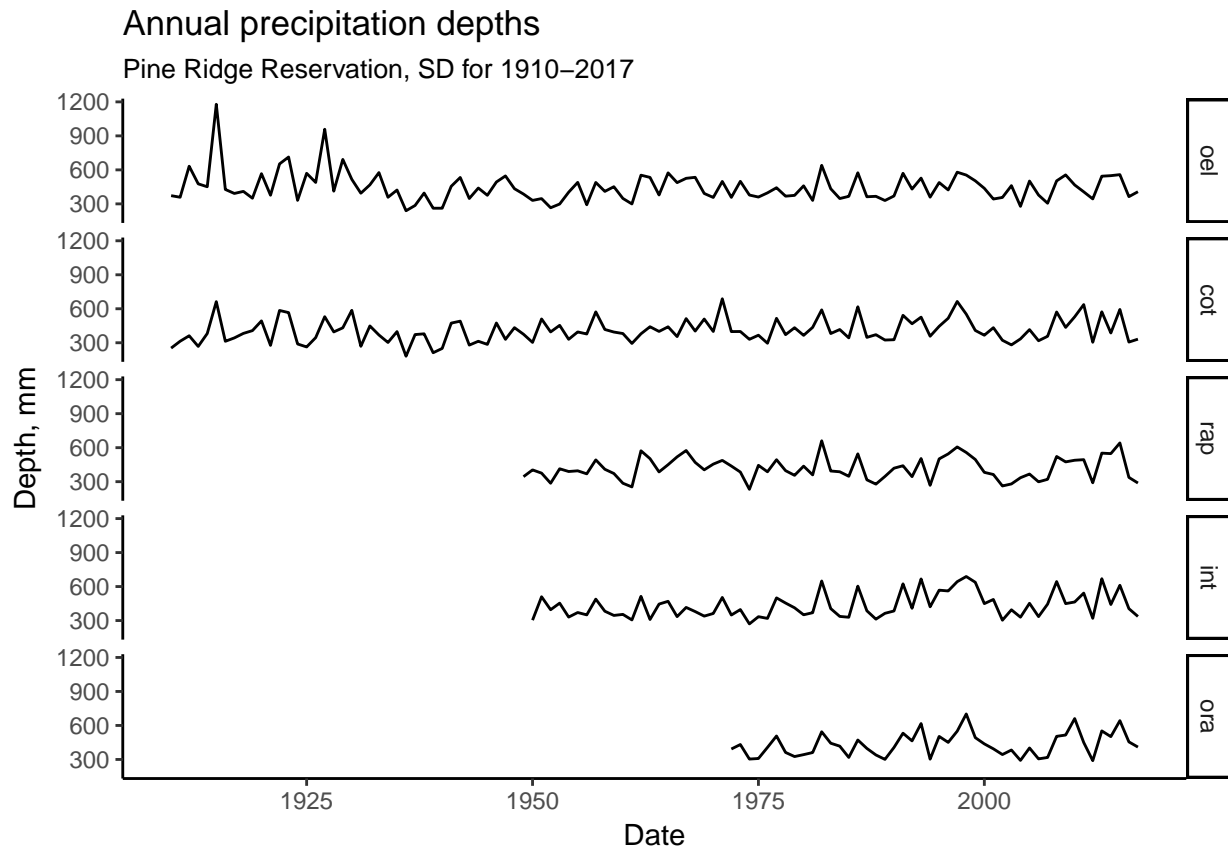
Double mass plots



Monthly precipitation depths

Pine Ridge Reservation, SD for 1909–2018





Annual Summaries

```
## # A tibble: 5 x 6
##   station mean  med   IQR  min  max
##   <fct>   <dbl> <dbl> <dbl> <dbl> <dbl>
## 1 oel     446.  422.  147.  239. 1179.
## 2 ora     431.  413.  160.  289.  701.
## 3 int     434.  405.  148.  270.  688.
## 4 rap     417.  397.  148.  232.  661.
## 5 cot     408.  390.  139.  182.  688.
```

Monthly Summaries

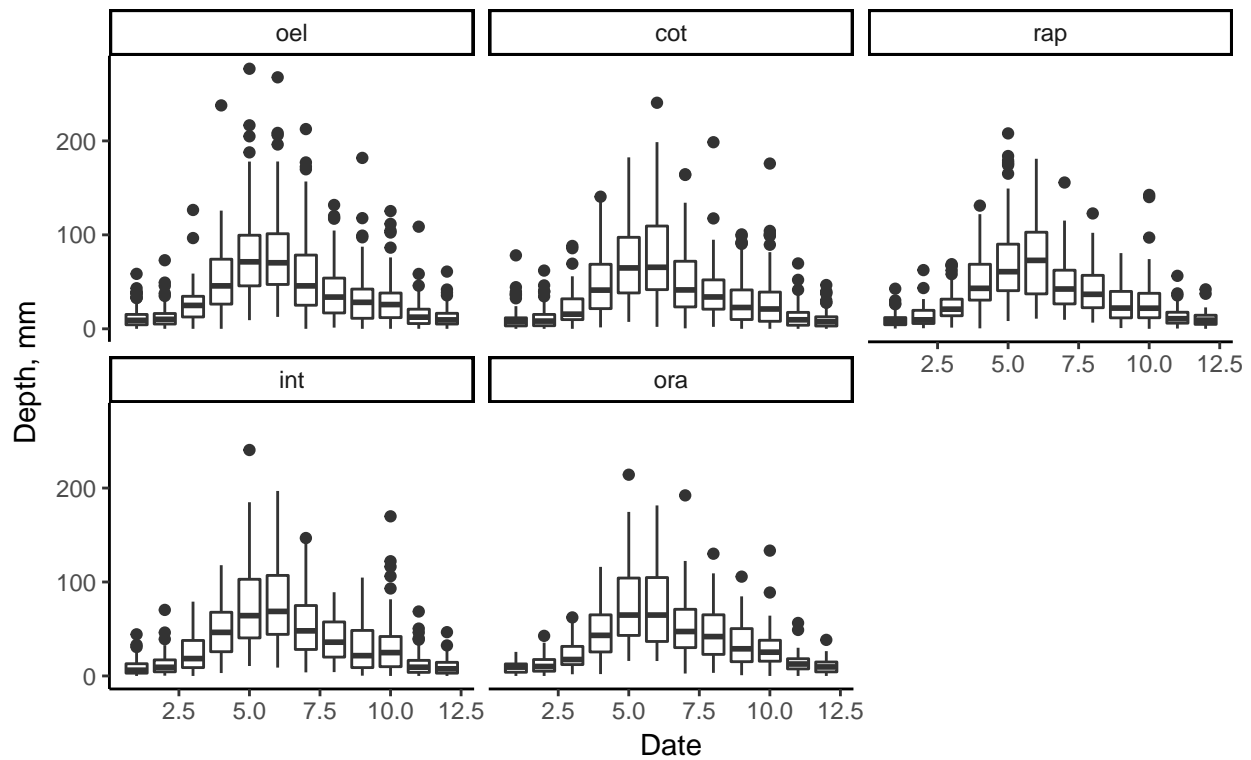
```
## # A tibble: 60 x 7
## # Groups:   station [5]
##   station month mean  med   IQR  min  max
##   <fct>   <int> <dbl> <dbl> <dbl> <dbl> <dbl>
## 1 oel       1  11.7   9    11    0  58.5
## 2 oel       2  12.6  10.1  11.2   0   73
## 3 oel       3  26.4  24.9  22    0  126.
## 4 oel       4  52.2  45.7  47.8   0  238.
## 5 oel       5  79.7  71.3  53.9   9.2 277.
## 6 oel       6  79.8  70.3  54    12.7 268.
```

```
## 7 oel      7  54.7  45.7  53.4  0  213.
## 8 oel      8  39.1  33.8  37.1  1.3 132.
## 9 oel      9  32.9  28.2  31.1  0  182.
## 10 oel     10  29.6  25.8  26.2  0  125.
## # ... with 50 more rows
```

```
## Warning: Removed 1695 rows containing non-finite values (stat_boxplot).
```

Monthly precipitation depths

Pine Ridge Reservation, SD for 1910–2017



Correlation Plots with Pearson Coefficients

