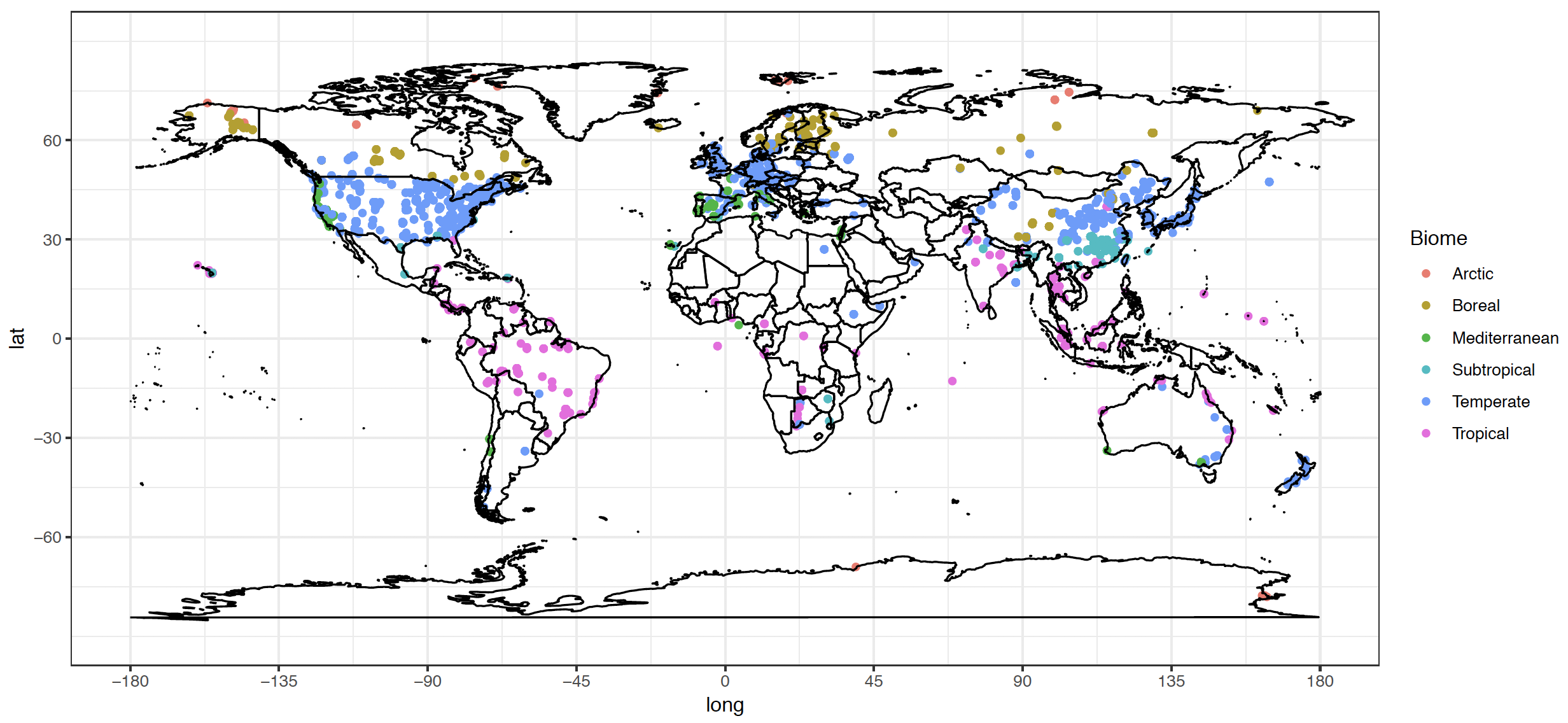
|  |
| --- |
| Title: Can soil respiration measured at mean temperature represents actual soil respiration |
| author: “Jinshi” |
| date: “March 26, 2019” |
| output: |
| html\_document: |
| df\_print: paged |
| bibliography: bibliography.ris |

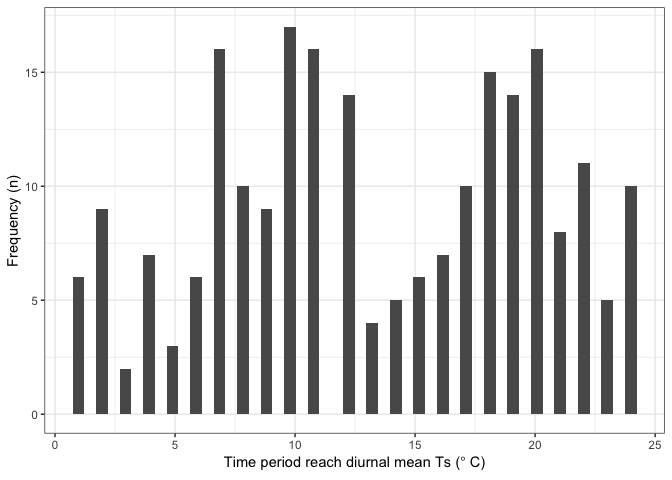
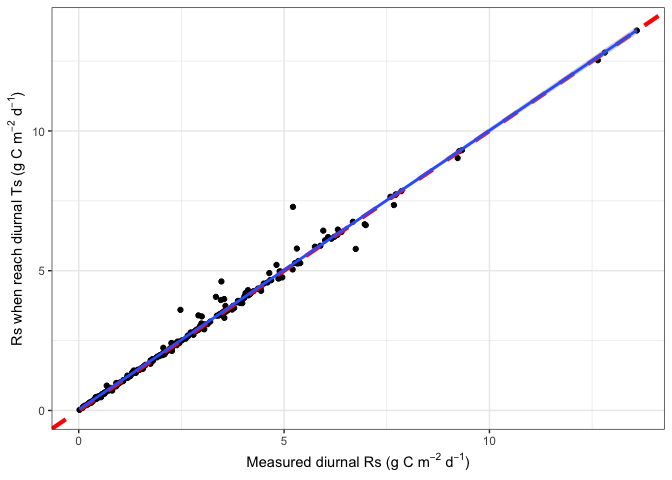
# 1. The spatial destribution of global Rs sites

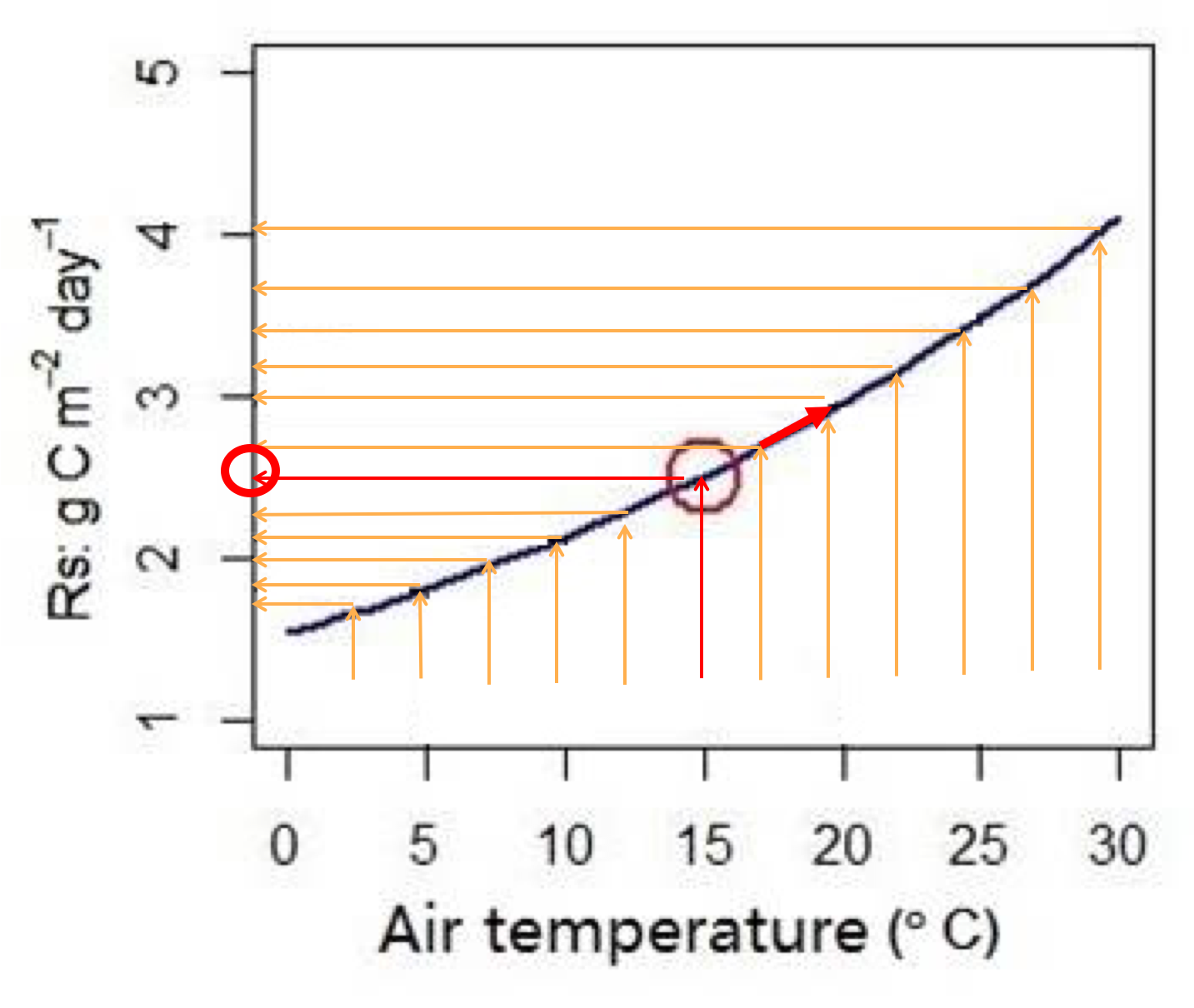
* We have much more measured Rs from the middle latitude region
* It is difficult to measure soil respiration all year around in the cold region
* Developed contries most located at Middle latitude region, thus recieved more funds to support the Rs measurements



Global spatial destribution of soil repiration sites

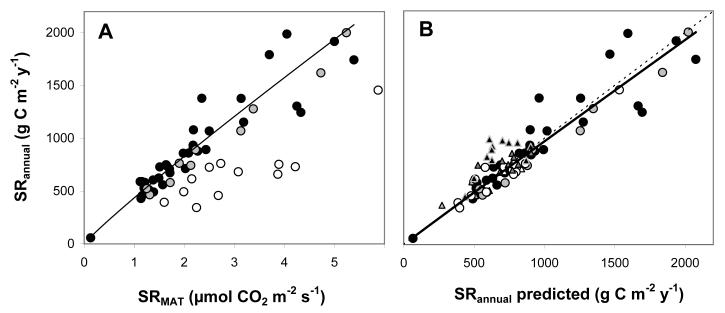
* Rs measurements from cold region is more importent, but how to increase the measurements?
* Making equipment works normal in cold condition
* Increase funds input
* Measured once per day to get daily mean





Rs measured at diurnal soil temperature

* Measure once per year to get a annual Rs mean? **Bahn’s approach** [Bahn et al. (2004) Biogeosciences]



Rs measured at mean annual soil temperature

* Rs measured at annuam mean temperature linearly related with annual Rs rate
* Rs at mean temperature: soil respiration measured at annual mean temperature / monthly mean temperature / daily mean temperature
* Rs\_annual ~ Rs\_mat (Rs\_bahn)
* Rs\_annual = 455.8 \* Rs\_mat^1.0054 (R^2 = 0.94, p<0.001)

# 2. The object of this analysis are

* Whether Rs measured at annuam mean soil temperature can represent annual Rs rate?
* Annuam mean air temperature (e.g., average of 12 monthes’ air temperature of 2000) / Mean annual air temperature (1964-2014)
* If not, when and what is the mechanism?
* Update the model?

# 3. Mthods

**Data**

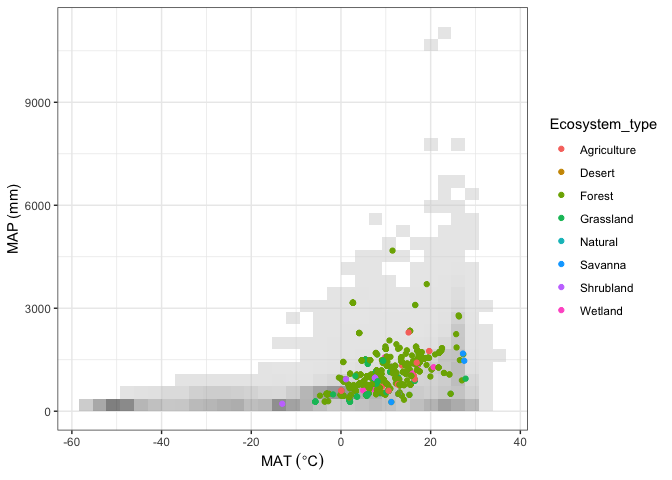
* SRDB\_V4 – Rs\_Annual
* Annual mean soil temperature (reported in the papers or can be calculated with simple assumption)
* Relationship between Rs and soil temperature (SRDB\_V4)
* Air temperature (University of Daleware global precipitation and air temperature data, 1964-2014, half degree spatial resolusion)
* 823 records from 253 studies

**Statistics**

* According the the relationship between Rs and Ts, we can estimate Rs\_mat base on the annual mean soil temperature / T\_Annual / MAT
* Using Bahn (2010, Biogeoscience model: Rs\_annual = 455.8 \* Rs\_mat^1.0054) to predict Rs\_annual based on Rs\_mat
* Comparing Rs\_annual and Rs\_annual\_bahn to evaluate the performance of Bahn model across the global

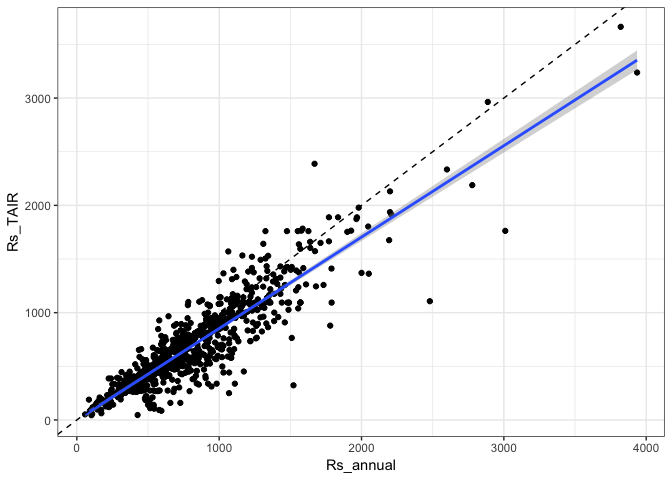
**Update Bahn’s model**

* If Bahn (2010) model does not predict Rs\_annual in all conditions
* Update Bahn (2010) model (e.g., including drought parameter, other parameters?)
* Regression tree modeling?



## 3.2 test the relationship between Rs\_annual and Rs\_mat

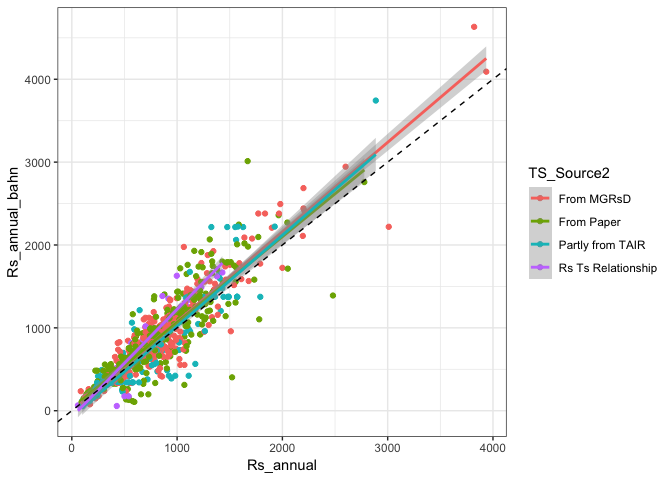
## Tue Apr 2 13:26:05 2019 -------------------+++++-------------------  
## Tue Apr 2 13:26:05 2019 Bahn relationship for these data:  
##   
## Call:  
## lm(formula = Rs\_TAIR ~ Rs\_annual, data = sdata)  
##   
## Residuals:  
## Min 1Q Median 3Q Max   
## -1006.45 -84.72 14.90 93.38 964.58   
##   
## Coefficients:  
## Estimate Std. Error t value Pr(>|t|)   
## (Intercept) 0.64266 13.67584 0.047 0.963   
## Rs\_annual 0.85184 0.01466 58.126 <2e-16 \*\*\*  
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Residual standard error: 185.1 on 821 degrees of freedom  
## Multiple R-squared: 0.8045, Adjusted R-squared: 0.8043   
## F-statistic: 3379 on 1 and 821 DF, p-value: < 2.2e-16



## [1] "test intercept=0 and slope=1"  
## [1] "p\_intercept = 0.9625, p\_slope = 0"

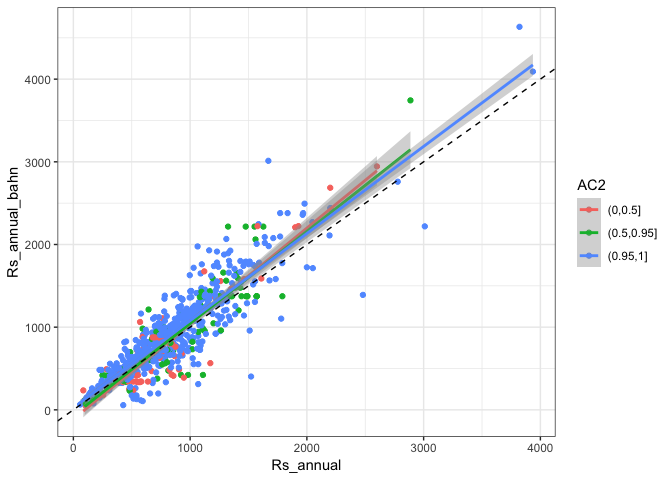
## 3.3 Ts sources (MGRsD, MGRsD\_TAIR, From paper, Rs\_Ts\_relationship)

## Saving 7 x 5 in image

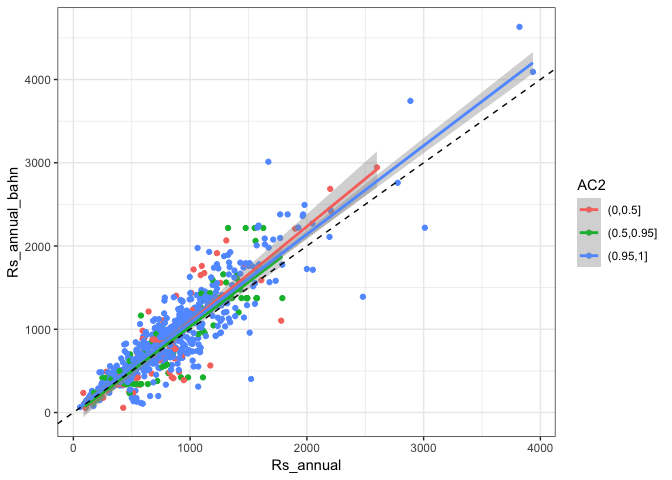


## 3.4 Annual Rs or Ts coverage effect

## Saving 7 x 5 in image



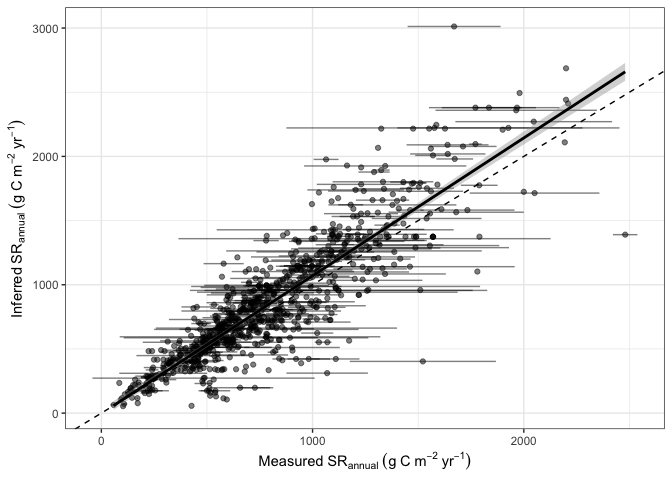
## Saving 7 x 5 in image



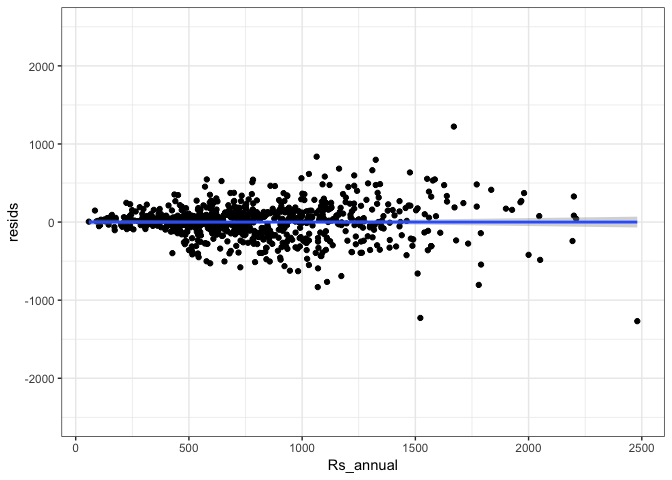
## 3.4.1 Test whether extreme high Rs values affect the regression

* Cinclusion: no

## Saving 7 x 5 in image

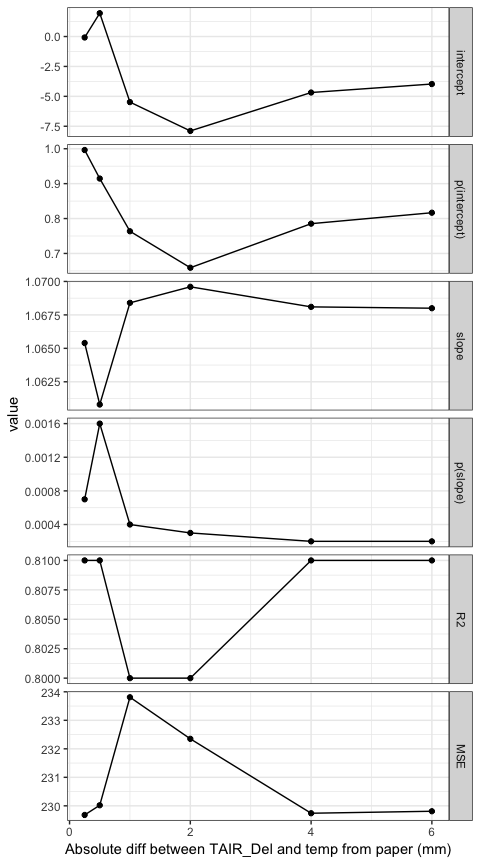


## Saving 7 x 5 in image

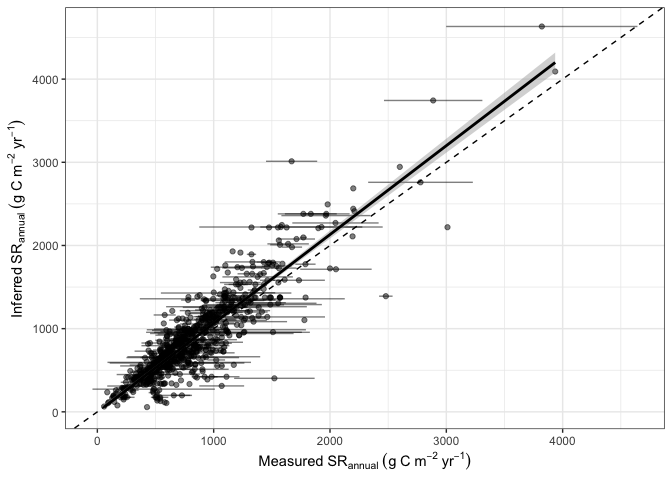


## 3.4.2 Effect of maximum allowed divergence between global climate data set and site-specific air temperature

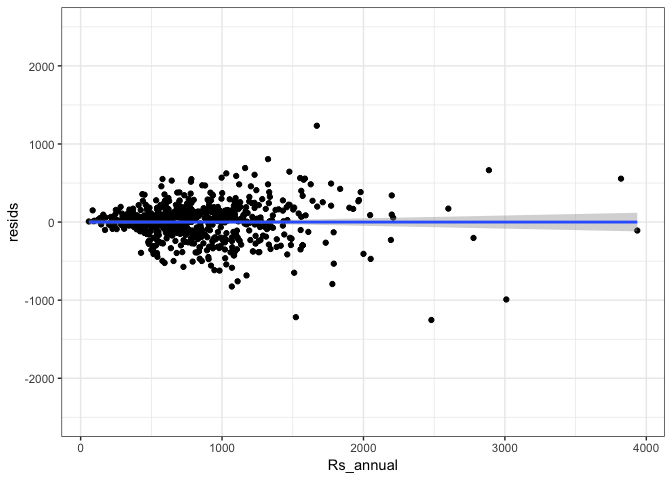
* Does TAIR\_dev and TAIR\_LT<\_dev affect the relationship – YES!!!!!
* TAIR\_LTM\_dev = with( srdb, abs( MAT\_Del - MAT ) )
* Does TAIR\_LTM\_dev () pull the slope off 1? – YES!!!!!
* TAIR\_dev <- with( srdb, abs( TAnnual\_Del - Study\_temp ) )
* Figure E. Effect of maximum allowed divergence between global climate data set and site-specific air temperature, when given. As we throw out data points with high divergence, R2 goes up (top panel) and RSE goes down (bottom, g C m-2 yr-1).



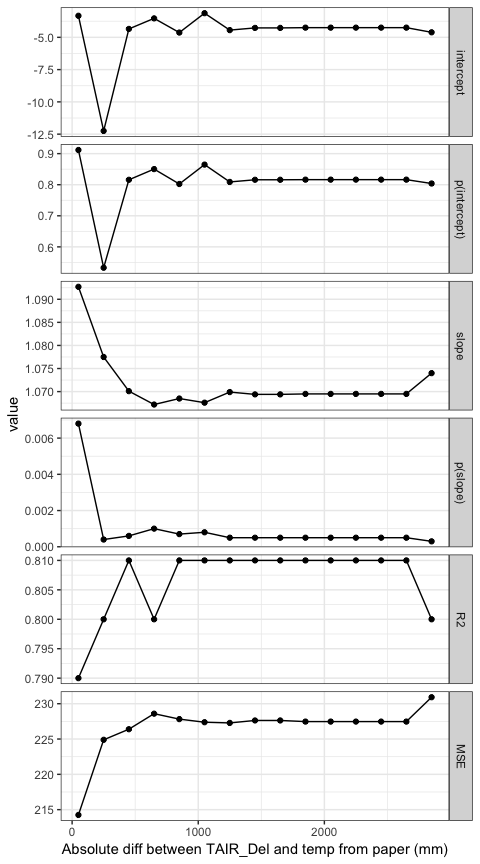
## Saving 7 x 5 in image



## Saving 7 x 5 in image



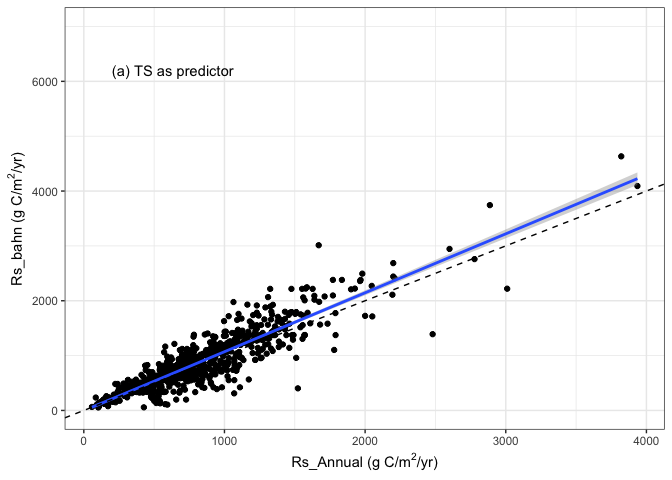
## 3.4.3 Effect of maximum allowed divergence between annual precipitation from paper and Del



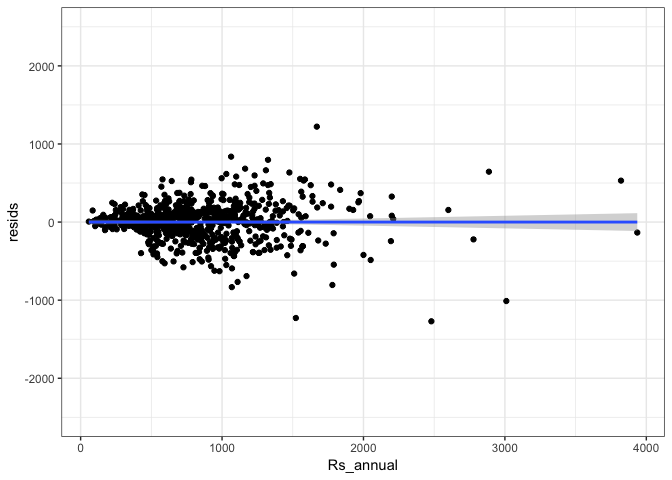
# 4. Results

## 4.1 Using Ts, TAnnual or MAT

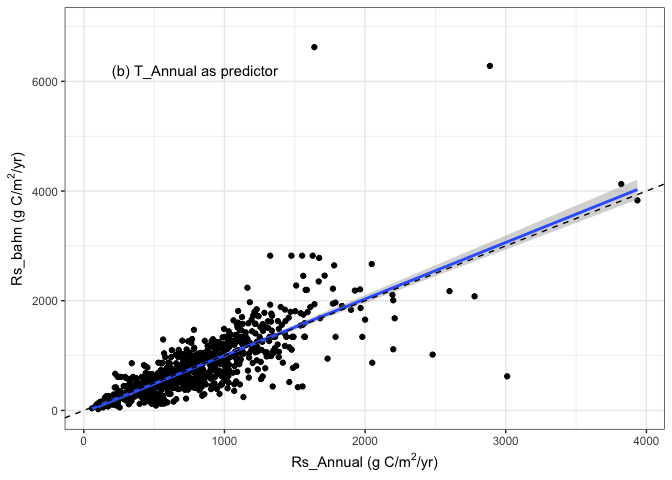
### 4.1.1 Using soil temperature



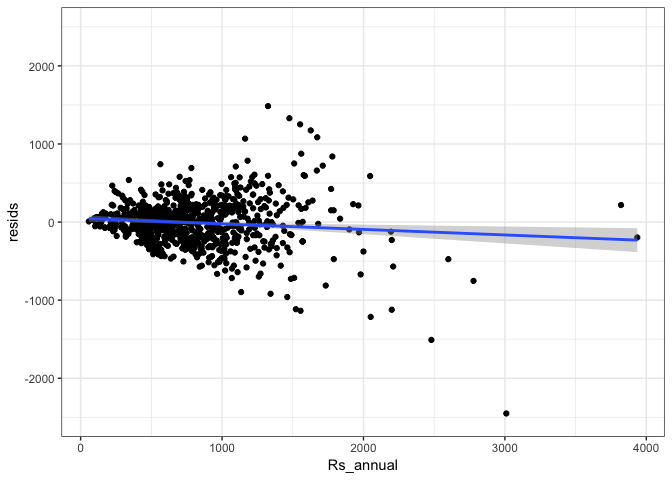
## Saving 7 x 5 in image



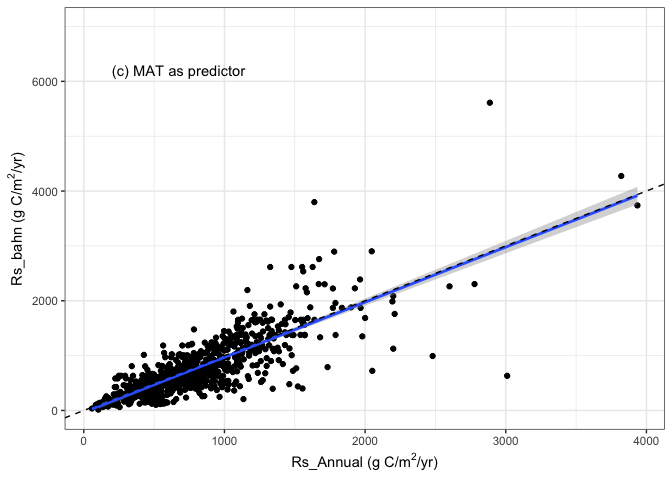
### 4.1.2 Using T\_Annual



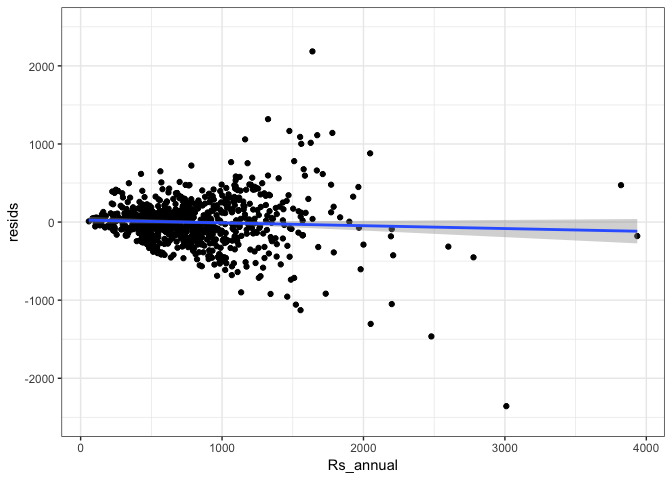
## Saving 7 x 5 in image



### 4.1.3 Using MAT



## Saving 7 x 5 in image

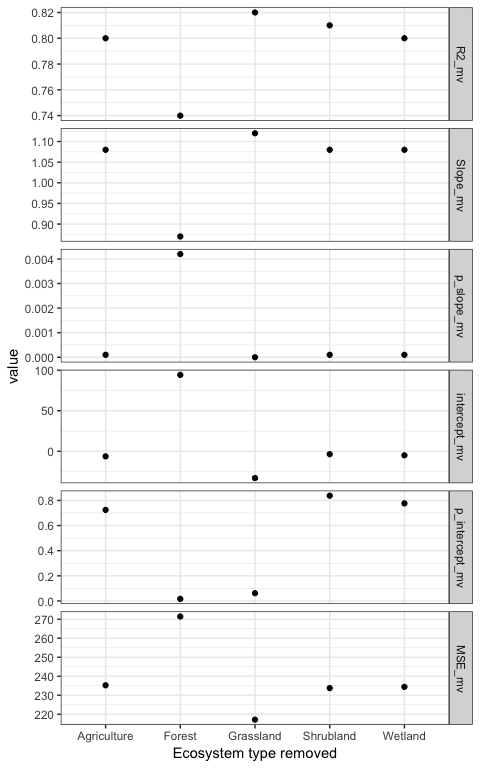


## 4.2 Analysis when Rs\_mat cannot represent Rs\_annual

## 4.2.2 Does Ecosystem\_type affects the relationship between Rs\_annual and Rs\_mat

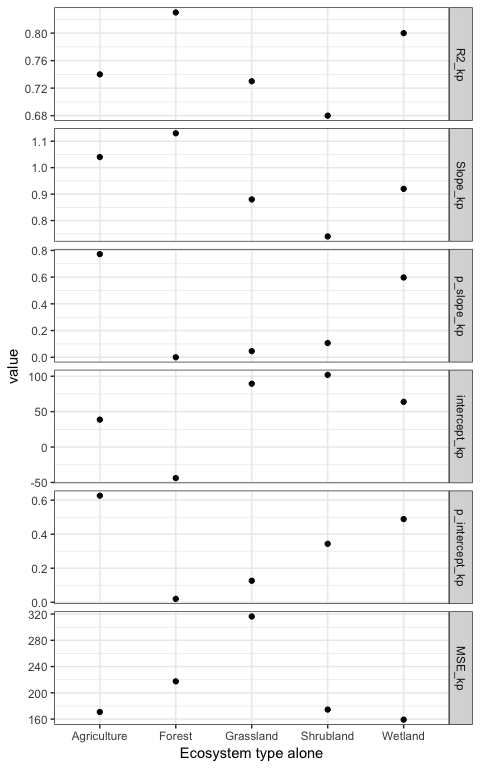
## Ecosystem R2\_mv Slope\_mv p\_slope\_mv intercept\_mv  
## Rs\_annual Agriculture 0.80 1.08 0.0001 -6.25  
## Rs\_annual1 Forest 0.74 0.87 0.0042 94.20  
## Rs\_annual2 Grassland 0.82 1.12 0.0000 -33.00  
## Rs\_annual3 Shrubland 0.81 1.08 0.0001 -3.57  
## Rs\_annual4 Wetland 0.80 1.08 0.0001 -4.97  
## p\_intercept\_mv MSE\_mv  
## Rs\_annual 0.7245 235.24  
## Rs\_annual1 0.0167 271.45  
## Rs\_annual2 0.0617 217.13  
## Rs\_annual3 0.8376 233.75  
## Rs\_annual4 0.7765 234.40

## geom\_path: Each group consists of only one observation. Do you need to  
## adjust the group aesthetic?  
## geom\_path: Each group consists of only one observation. Do you need to  
## adjust the group aesthetic?  
## geom\_path: Each group consists of only one observation. Do you need to  
## adjust the group aesthetic?  
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## adjust the group aesthetic?  
## geom\_path: Each group consists of only one observation. Do you need to  
## adjust the group aesthetic?  
## geom\_path: Each group consists of only one observation. Do you need to  
## adjust the group aesthetic?

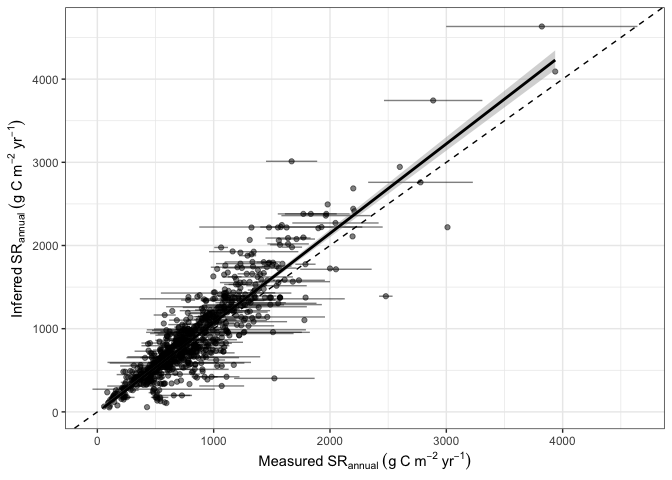


## Ecosystem R2\_kp Slope\_kp p\_slope\_kp intercept\_kp  
## Rs\_annual Agriculture 0.74 1.04 0.7725 38.73  
## Rs\_annual1 Forest 0.83 1.13 0.0000 -43.81  
## Rs\_annual2 Grassland 0.73 0.88 0.0459 89.44  
## Rs\_annual3 Shrubland 0.68 0.74 0.1066 101.92  
## Rs\_annual4 Wetland 0.80 0.92 0.5972 63.88  
## p\_intercept\_kp MSE\_kp  
## Rs\_annual 0.6262 170.87  
## Rs\_annual1 0.0199 217.52  
## Rs\_annual2 0.1264 316.26  
## Rs\_annual3 0.3434 174.53  
## Rs\_annual4 0.4887 159.16

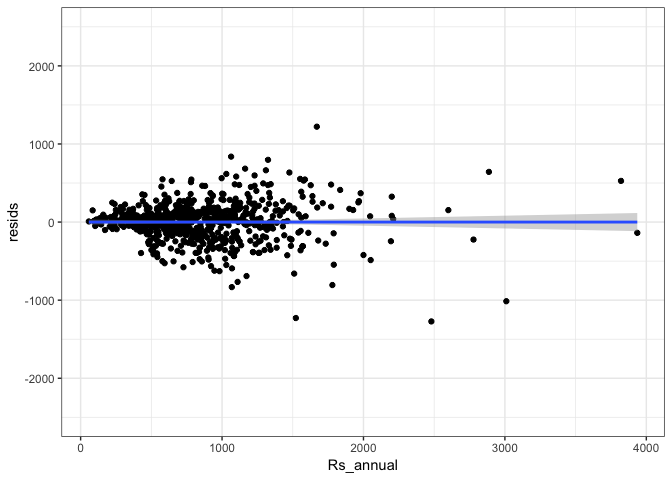
## geom\_path: Each group consists of only one observation. Do you need to  
## adjust the group aesthetic?  
## geom\_path: Each group consists of only one observation. Do you need to  
## adjust the group aesthetic?  
## geom\_path: Each group consists of only one observation. Do you need to  
## adjust the group aesthetic?  
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## adjust the group aesthetic?  
## geom\_path: Each group consists of only one observation. Do you need to  
## adjust the group aesthetic?  
## geom\_path: Each group consists of only one observation. Do you need to  
## adjust the group aesthetic?



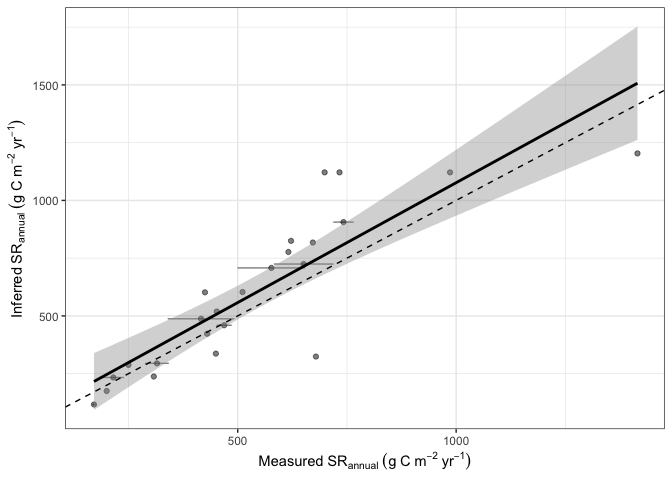
## Saving 7 x 5 in image



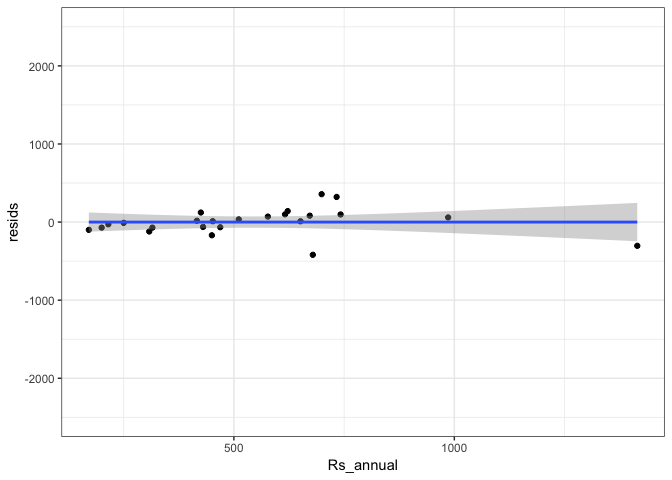
## Saving 7 x 5 in image



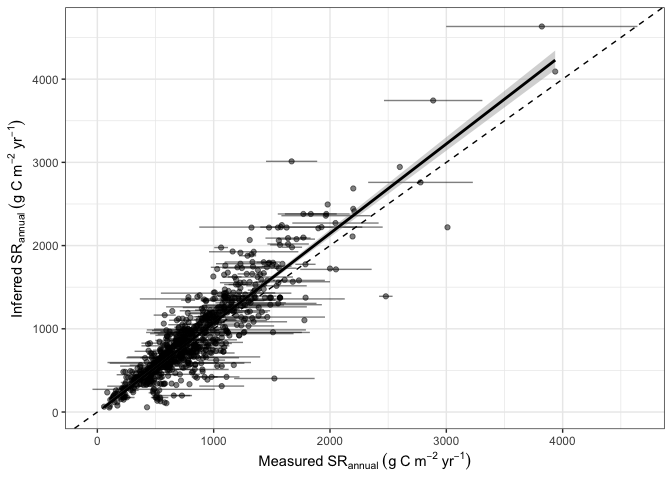
## Saving 7 x 5 in image



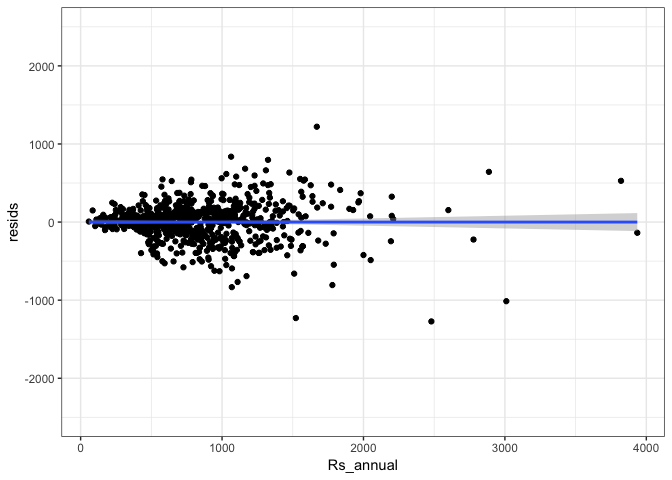
## Saving 7 x 5 in image



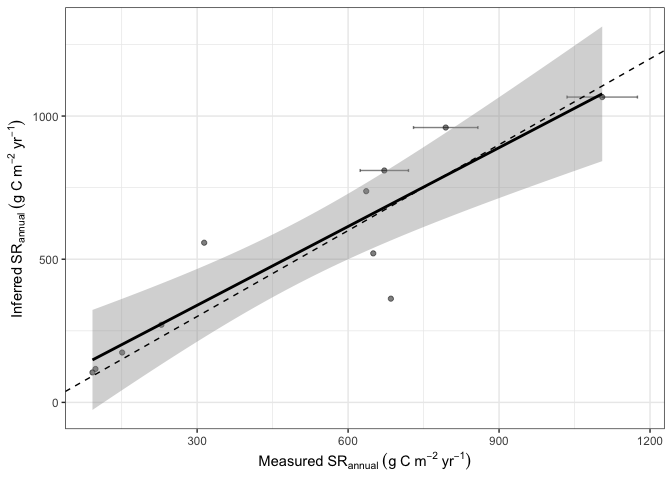
## Saving 7 x 5 in image



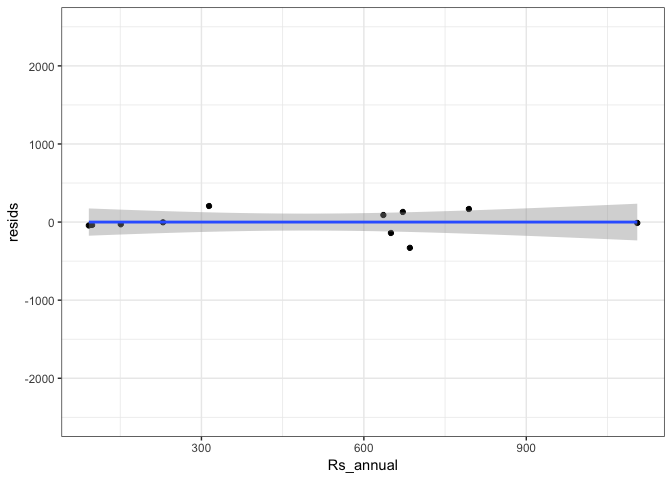
## Saving 7 x 5 in image



## Saving 7 x 5 in image

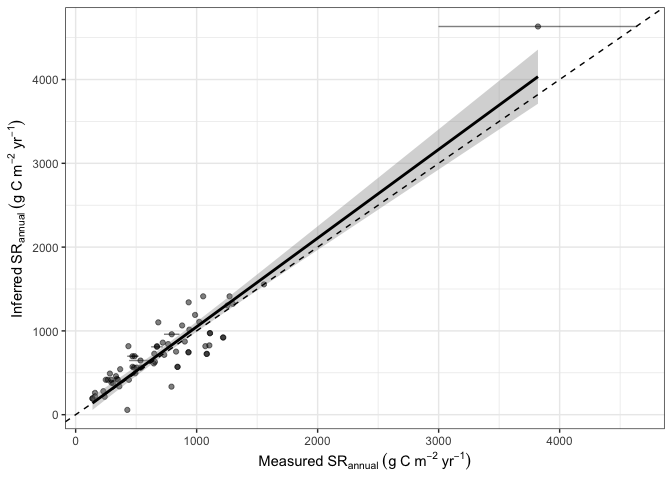


## Saving 7 x 5 in image

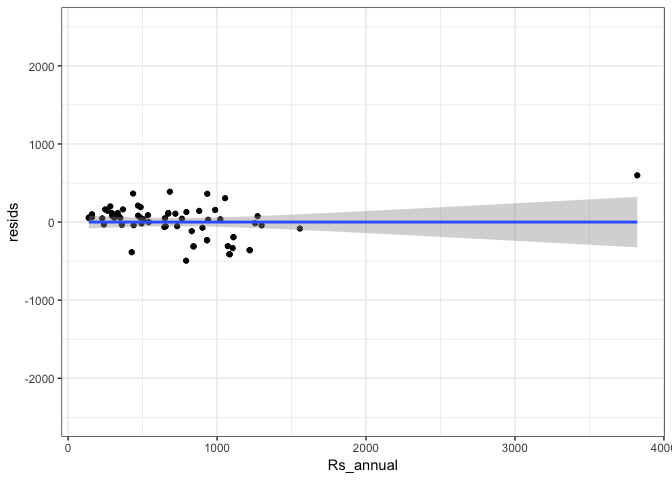


## 4.2.3 Does Meas\_method affects the relationship

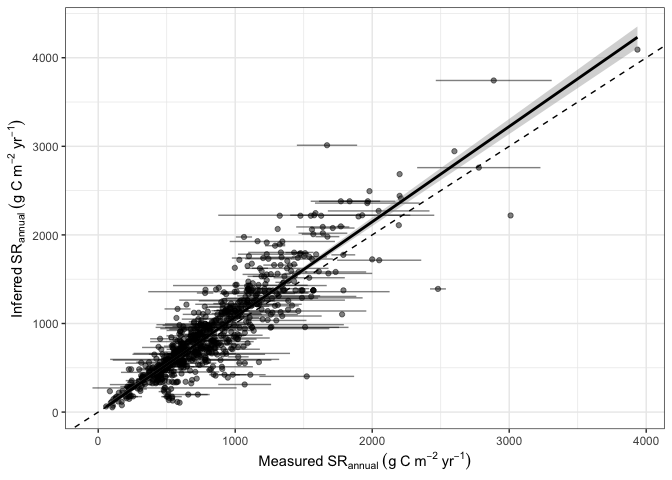
## Saving 7 x 5 in image



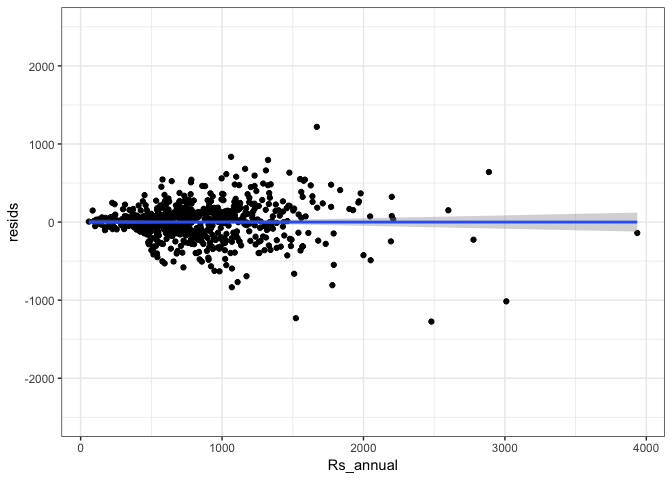
## Saving 7 x 5 in image



## Saving 7 x 5 in image

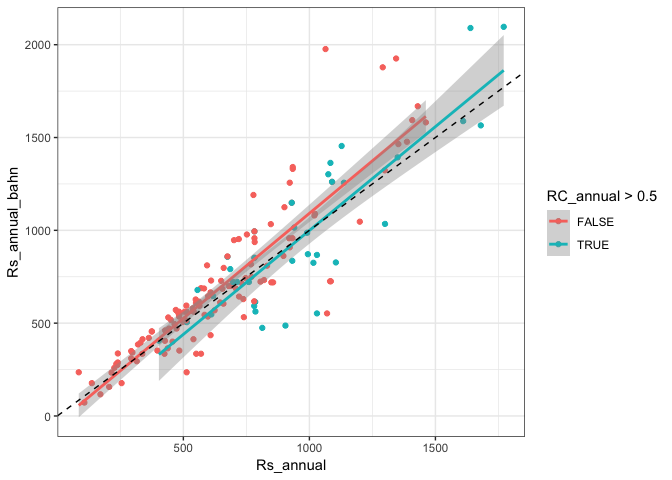


## Saving 7 x 5 in image

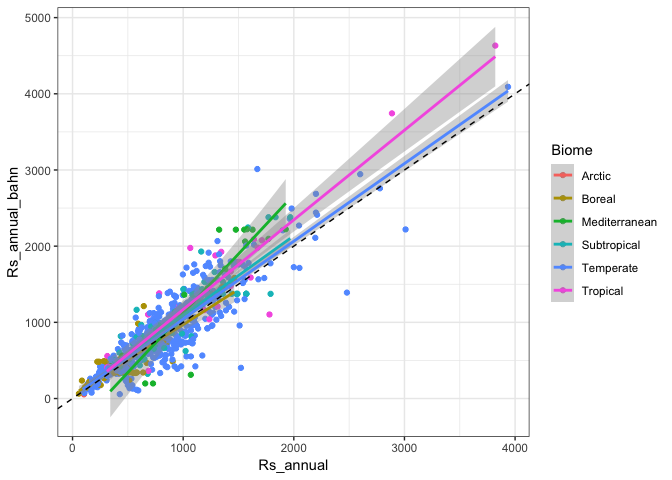


### 4.2.4 RA or RH dominated sites differ?

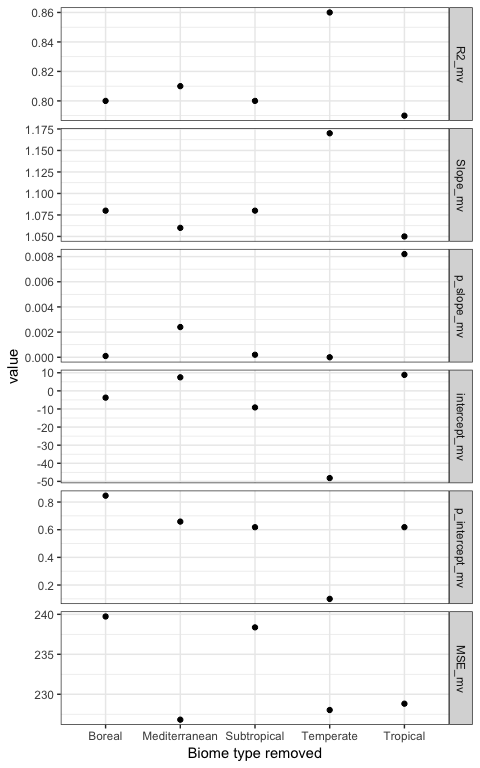
## Saving 7 x 5 in image



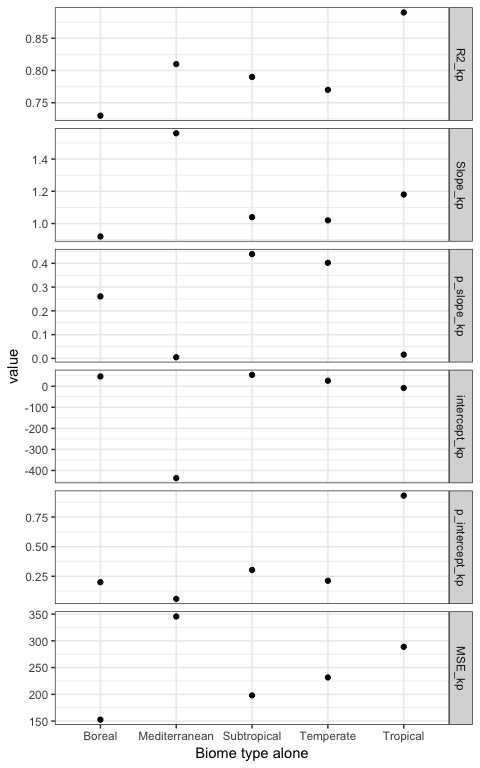
### 4.2.5 Biome effect



## geom\_path: Each group consists of only one observation. Do you need to  
## adjust the group aesthetic?  
## geom\_path: Each group consists of only one observation. Do you need to  
## adjust the group aesthetic?  
## geom\_path: Each group consists of only one observation. Do you need to  
## adjust the group aesthetic?  
## geom\_path: Each group consists of only one observation. Do you need to  
## adjust the group aesthetic?  
## geom\_path: Each group consists of only one observation. Do you need to  
## adjust the group aesthetic?  
## geom\_path: Each group consists of only one observation. Do you need to  
## adjust the group aesthetic?

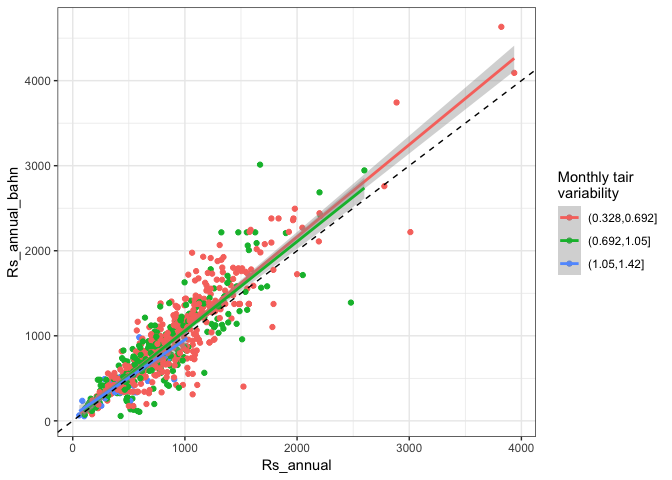


## geom\_path: Each group consists of only one observation. Do you need to  
## adjust the group aesthetic?  
## geom\_path: Each group consists of only one observation. Do you need to  
## adjust the group aesthetic?  
## geom\_path: Each group consists of only one observation. Do you need to  
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## geom\_path: Each group consists of only one observation. Do you need to  
## adjust the group aesthetic?  
## geom\_path: Each group consists of only one observation. Do you need to  
## adjust the group aesthetic?

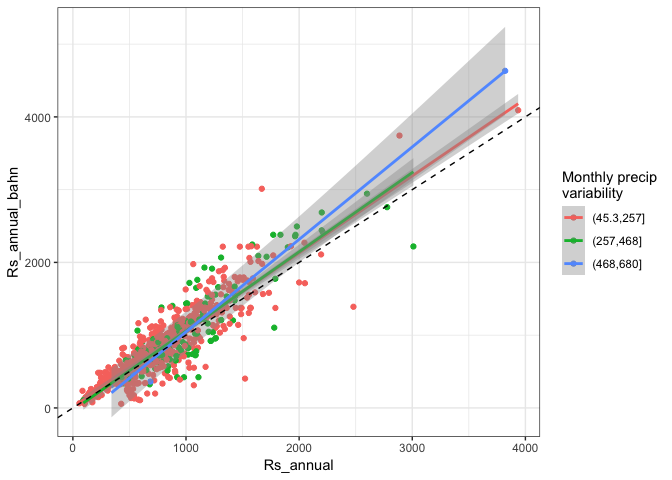


## 4.2.6 TAIR and precipitation variability affect?

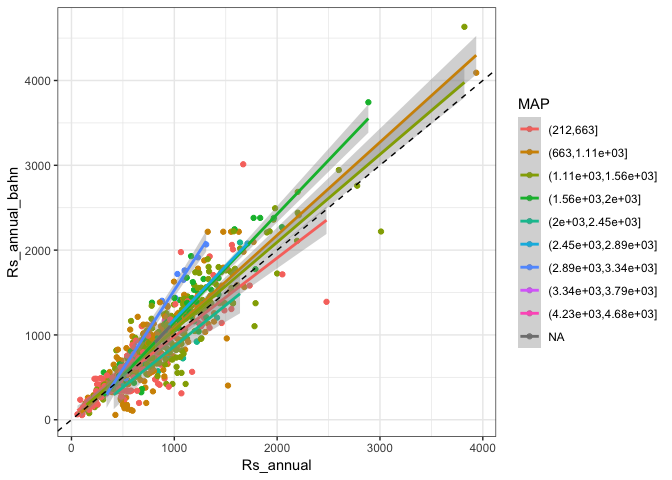
## Saving 7 x 5 in image



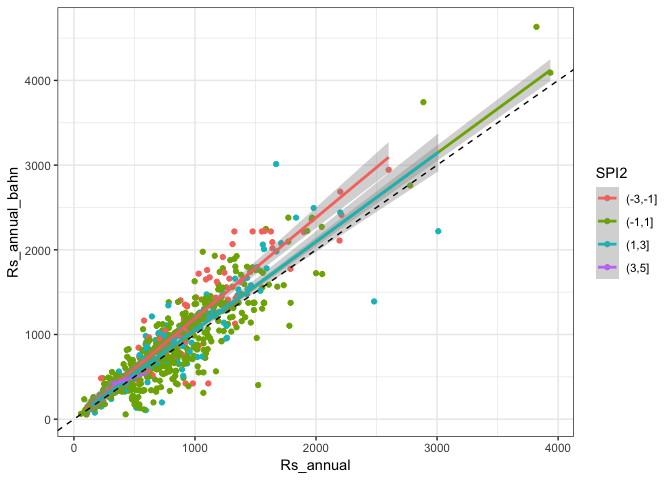
## Saving 7 x 5 in image



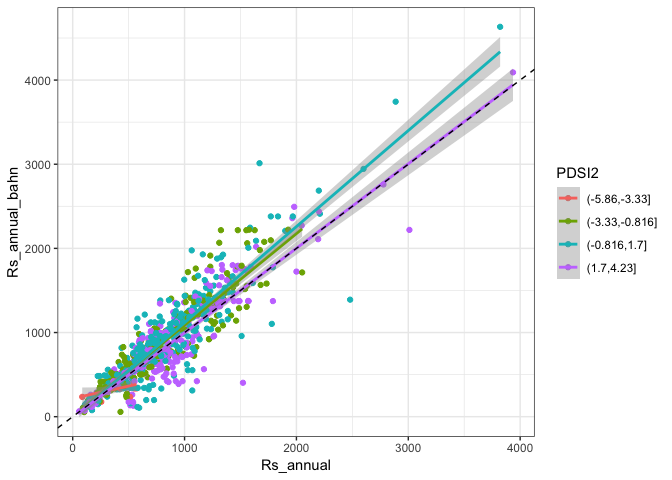
## 4.2.7 Does drought affect?



## Saving 7 x 5 in image



## Saving 7 x 5 in image



# 5. Discussion & questions

# 6. More analysis in the future

* 1 Using SD information with boosting?
* 2 Use Rs\_mat predict Rh?
* 3 Use this approach estimate global Rs
* 4 Think about application
* 5 Update bahn model with more predictors or using regression tree method?