WaterBudget\_MDV

QingQing

18/03/2021

#### Reading data

# dVol = Qin-Qout  
  
require(lubridate)

## Loading required package: lubridate

##   
## Attaching package: 'lubridate'

## The following object is masked from 'package:base':  
##   
## date

library(readr)  
require(dplyr)

## Loading required package: dplyr

##   
## Attaching package: 'dplyr'

## The following objects are masked from 'package:lubridate':  
##   
## intersect, setdiff, union

## The following objects are masked from 'package:stats':  
##   
## filter, lag

## The following objects are masked from 'package:base':  
##   
## intersect, setdiff, setequal, union

setwd("C:\\Users\\QingZ\\PhD-Qing\\GitProject\\Mark\_Dintel\_Vliet\_Project\_Shared\\Modelling\\Waterbalance")# Set the working directory  
  
#### Data preparation ####  
# WL: Water depths  
# Up: Upstream of sluice  
# Down: Downstream of sluice  
  
WL\_Down\_Vliet <- read\_csv("WL\_Down\_Vliet.csv",col\_types = cols(Datum = col\_datetime(format = "%d-%m-%Y %H:%M:%S"), Eenheid = col\_skip(),Serie = col\_skip(), X5 = col\_skip()))

## Warning: Missing column names filled in: 'X5' [5]

## Warning: 106734 parsing failures.  
## row col expected actual file  
## 1 -- 5 columns 4 columns 'WL\_Down\_Vliet.csv'  
## 2 -- 5 columns 4 columns 'WL\_Down\_Vliet.csv'  
## 3 -- 5 columns 4 columns 'WL\_Down\_Vliet.csv'  
## 4 -- 5 columns 4 columns 'WL\_Down\_Vliet.csv'  
## 5 -- 5 columns 4 columns 'WL\_Down\_Vliet.csv'  
## ... ... ......... ......... ...................  
## See problems(...) for more details.

WL\_Down\_Dintel <- read\_csv("WL\_Down\_Dintel.csv",col\_types = cols(Datum = col\_datetime(format = "%d-%m-%Y %H:%M:%S"), Eenheid = col\_skip(),Serie = col\_skip(), X5 = col\_skip()))

## Warning: Missing column names filled in: 'X5' [5]

## Warning: 143850 parsing failures.  
## row col expected actual file  
## 1 -- 5 columns 4 columns 'WL\_Down\_Dintel.csv'  
## 2 -- 5 columns 4 columns 'WL\_Down\_Dintel.csv'  
## 3 -- 5 columns 4 columns 'WL\_Down\_Dintel.csv'  
## 4 -- 5 columns 4 columns 'WL\_Down\_Dintel.csv'  
## 5 -- 5 columns 4 columns 'WL\_Down\_Dintel.csv'  
## ... ... ......... ......... ....................  
## See problems(...) for more details.

names(WL\_Down\_Vliet) <- c("Datum", "WL\_Down\_Vliet")  
names(WL\_Down\_Dintel) <- c("Datum", "WL\_Down\_Dintel")  
# Water depth measurements at downstream of Dintel and Vliet as indicator of Water depth dynamics in Volkerakmeer  
  
WL\_Up\_Vliet <- read\_csv("WL\_Up\_Vliet.csv",col\_types = cols(Datum = col\_datetime(format = "%d-%m-%Y %H:%M:%S"), Eenheid = col\_skip(),Serie = col\_skip(), X5 = col\_skip()))

## Warning: Missing column names filled in: 'X5' [5]

## Warning: 5561 parsing failures.  
## row col expected actual file  
## 1 -- 5 columns 4 columns 'WL\_Up\_Vliet.csv'  
## 2 -- 5 columns 4 columns 'WL\_Up\_Vliet.csv'  
## 3 -- 5 columns 4 columns 'WL\_Up\_Vliet.csv'  
## 4 -- 5 columns 4 columns 'WL\_Up\_Vliet.csv'  
## 5 -- 5 columns 4 columns 'WL\_Up\_Vliet.csv'  
## ... ... ......... ......... .................  
## See problems(...) for more details.

WL\_Up\_Dintel <- read\_csv("WL\_Up\_Dintel.csv",col\_types = cols(Datum = col\_datetime(format = "%d-%m-%Y %H:%M:%S"), Eenheid = col\_skip(),Serie = col\_skip(), X5 = col\_skip()))

## Warning: Missing column names filled in: 'X5' [5]

## Warning: 107055 parsing failures.  
## row col expected actual file  
## 1 -- 5 columns 4 columns 'WL\_Up\_Dintel.csv'  
## 2 -- 5 columns 4 columns 'WL\_Up\_Dintel.csv'  
## 3 -- 5 columns 4 columns 'WL\_Up\_Dintel.csv'  
## 4 -- 5 columns 4 columns 'WL\_Up\_Dintel.csv'  
## 5 -- 5 columns 4 columns 'WL\_Up\_Dintel.csv'  
## ... ... ......... ......... ..................  
## See problems(...) for more details.

names(WL\_Up\_Vliet) <- c("Datum", "WL\_Up\_Vliet")  
names(WL\_Up\_Dintel) <- c("Datum", "WL\_Up\_Dintel")  
# Water depth measurements at upstream of Dintel and Vliet as indicator of Water depth dynamics in Mark-Dintel-Vliet system  
  
# Gastel (Molenbeak) water depth measurements  
WL\_Gastel <- read\_csv("WL\_Gastel.csv",col\_types = cols(Datum = col\_datetime(format = "%d-%m-%Y %H:%M:%S"), Eenheid = col\_skip(),Serie = col\_skip(), X5 = col\_skip()))

## Warning: Missing column names filled in: 'X5' [5]

## Warning: 657340 parsing failures.  
## row col expected actual file  
## 1 -- 5 columns 4 columns 'WL\_Gastel.csv'  
## 2 -- 5 columns 4 columns 'WL\_Gastel.csv'  
## 3 -- 5 columns 4 columns 'WL\_Gastel.csv'  
## 4 -- 5 columns 4 columns 'WL\_Gastel.csv'  
## 5 -- 5 columns 4 columns 'WL\_Gastel.csv'  
## ... ... ......... ......... ...............  
## See problems(...) for more details.

names(WL\_Gastel) <- c("Datum", "WL\_Gastel")  
  
# Water level inside MDV system  
WL\_Down\_Rooskensdonk <- read\_csv("C:\\Users\\QingZ\\PhD-Qing\\GitProject\\Mark\_Dintel\_Vliet\_Project\_Shared\\Modelling\\Waterbalance\\WL\_Down\_Rooskensdonk.csv",col\_types = cols(Datum = col\_datetime(format = "%d-%m-%Y %H:%M:%S"), Eenheid = col\_skip(),Serie = col\_skip(), X5 = col\_skip()))

## Warning: Missing column names filled in: 'X5' [5]

## Warning: 96622 parsing failures.  
## row col expected actual file  
## 1 -- 5 columns 4 columns 'C:\Users\QingZ\PhD-Qing\GitProject\Mark\_Dintel\_Vliet\_Project\_Shared\Modelling\Waterbalance\WL\_Down\_Rooskensdonk.csv'  
## 2 -- 5 columns 4 columns 'C:\Users\QingZ\PhD-Qing\GitProject\Mark\_Dintel\_Vliet\_Project\_Shared\Modelling\Waterbalance\WL\_Down\_Rooskensdonk.csv'  
## 3 -- 5 columns 4 columns 'C:\Users\QingZ\PhD-Qing\GitProject\Mark\_Dintel\_Vliet\_Project\_Shared\Modelling\Waterbalance\WL\_Down\_Rooskensdonk.csv'  
## 4 -- 5 columns 4 columns 'C:\Users\QingZ\PhD-Qing\GitProject\Mark\_Dintel\_Vliet\_Project\_Shared\Modelling\Waterbalance\WL\_Down\_Rooskensdonk.csv'  
## 5 -- 5 columns 4 columns 'C:\Users\QingZ\PhD-Qing\GitProject\Mark\_Dintel\_Vliet\_Project\_Shared\Modelling\Waterbalance\WL\_Down\_Rooskensdonk.csv'  
## ... ... ......... ......... .............................................................................................................................  
## See problems(...) for more details.

names(WL\_Down\_Rooskensdonk) <- c("Datum", "WL\_Down\_Rooskensdonk")  
  
WL\_Down\_Oosterhout <- read\_csv("C:\\Users\\QingZ\\PhD-Qing\\GitProject\\Mark\_Dintel\_Vliet\_Project\_Shared\\Modelling\\Waterbalance\\WL\_Down\_Oosterhout.csv",col\_types = cols(Datum = col\_datetime(format = "%d-%m-%Y %H:%M:%S"), Eenheid = col\_skip(),Serie = col\_skip(), X5 = col\_skip()))

## Warning: Missing column names filled in: 'X5' [5]

## Warning: 107001 parsing failures.  
## row col expected actual file  
## 1 -- 5 columns 4 columns 'C:\Users\QingZ\PhD-Qing\GitProject\Mark\_Dintel\_Vliet\_Project\_Shared\Modelling\Waterbalance\WL\_Down\_Oosterhout.csv'  
## 2 -- 5 columns 4 columns 'C:\Users\QingZ\PhD-Qing\GitProject\Mark\_Dintel\_Vliet\_Project\_Shared\Modelling\Waterbalance\WL\_Down\_Oosterhout.csv'  
## 3 -- 5 columns 4 columns 'C:\Users\QingZ\PhD-Qing\GitProject\Mark\_Dintel\_Vliet\_Project\_Shared\Modelling\Waterbalance\WL\_Down\_Oosterhout.csv'  
## 4 -- 5 columns 4 columns 'C:\Users\QingZ\PhD-Qing\GitProject\Mark\_Dintel\_Vliet\_Project\_Shared\Modelling\Waterbalance\WL\_Down\_Oosterhout.csv'  
## 5 -- 5 columns 4 columns 'C:\Users\QingZ\PhD-Qing\GitProject\Mark\_Dintel\_Vliet\_Project\_Shared\Modelling\Waterbalance\WL\_Down\_Oosterhout.csv'  
## ... ... ......... ......... ...........................................................................................................................  
## See problems(...) for more details.

names(WL\_Down\_Oosterhout) <- c("Datum", "WL\_Down\_Oosterhout")  
  
WL\_Up\_Oosterhout <- read\_csv("C:\\Users\\QingZ\\PhD-Qing\\GitProject\\Mark\_Dintel\_Vliet\_Project\_Shared\\Modelling\\Waterbalance\\WL\_Up\_Oosterhout.csv",col\_types = cols(Datum = col\_datetime(format = "%d-%m-%Y %H:%M:%S"), Eenheid = col\_skip(),Serie = col\_skip(), X5 = col\_skip()))

## Warning: Missing column names filled in: 'X5' [5]

## Warning: 106789 parsing failures.  
## row col expected actual file  
## 1 -- 5 columns 4 columns 'C:\Users\QingZ\PhD-Qing\GitProject\Mark\_Dintel\_Vliet\_Project\_Shared\Modelling\Waterbalance\WL\_Up\_Oosterhout.csv'  
## 2 -- 5 columns 4 columns 'C:\Users\QingZ\PhD-Qing\GitProject\Mark\_Dintel\_Vliet\_Project\_Shared\Modelling\Waterbalance\WL\_Up\_Oosterhout.csv'  
## 3 -- 5 columns 4 columns 'C:\Users\QingZ\PhD-Qing\GitProject\Mark\_Dintel\_Vliet\_Project\_Shared\Modelling\Waterbalance\WL\_Up\_Oosterhout.csv'  
## 4 -- 5 columns 4 columns 'C:\Users\QingZ\PhD-Qing\GitProject\Mark\_Dintel\_Vliet\_Project\_Shared\Modelling\Waterbalance\WL\_Up\_Oosterhout.csv'  
## 5 -- 5 columns 4 columns 'C:\Users\QingZ\PhD-Qing\GitProject\Mark\_Dintel\_Vliet\_Project\_Shared\Modelling\Waterbalance\WL\_Up\_Oosterhout.csv'  
## ... ... ......... ......... .........................................................................................................................  
## See problems(...) for more details.

names(WL\_Up\_Oosterhout) <- c("Datum", "WL\_Up\_Oosterhout")  
  
# Inflow discharges:  
HF\_Qin\_MarkCanal <- read\_csv("HF\_Qin\_MarkCanal.csv",col\_types = cols(Datum = col\_datetime(format = "%d-%m-%Y %H:%M:%S"), Eenheid = col\_skip(),Serie = col\_skip(), X5 = col\_skip()))

## Warning: Missing column names filled in: 'X5' [5]

## Warning: 105920 parsing failures.  
## row col expected actual file  
## 1 -- 5 columns 4 columns 'HF\_Qin\_MarkCanal.csv'  
## 2 -- 5 columns 4 columns 'HF\_Qin\_MarkCanal.csv'  
## 3 -- 5 columns 4 columns 'HF\_Qin\_MarkCanal.csv'  
## 4 -- 5 columns 4 columns 'HF\_Qin\_MarkCanal.csv'  
## 5 -- 5 columns 4 columns 'HF\_Qin\_MarkCanal.csv'  
## ... ... ......... ......... ......................  
## See problems(...) for more details.

names(HF\_Qin\_MarkCanal) <- c("Datum","Qin\_MarkCanal")  
  
HF\_Qin\_Oranjeboombrug <- read\_csv("HF\_Qin\_Oranjeboombrug.csv",col\_types = cols(Datum = col\_datetime(format = "%d-%m-%Y %H:%M:%S"), Eenheid = col\_skip(),Serie = col\_skip(), X5 = col\_skip()))

## Warning: Missing column names filled in: 'X5' [5]

## Warning: 97692 parsing failures.  
## row col expected actual file  
## 1 -- 5 columns 4 columns 'HF\_Qin\_Oranjeboombrug.csv'  
## 2 -- 5 columns 4 columns 'HF\_Qin\_Oranjeboombrug.csv'  
## 3 -- 5 columns 4 columns 'HF\_Qin\_Oranjeboombrug.csv'  
## 4 -- 5 columns 4 columns 'HF\_Qin\_Oranjeboombrug.csv'  
## 5 -- 5 columns 4 columns 'HF\_Qin\_Oranjeboombrug.csv'  
## ... ... ......... ......... ...........................  
## See problems(...) for more details.

names(HF\_Qin\_Oranjeboombrug) <- c("Datum","Qin\_Oranjeboombrug")  
  
HF\_Qin\_BlauweKamer <- read\_csv("HF\_Qin\_BlauweKamer.csv",  
 col\_types = cols(Datum = col\_datetime(format = "%d-%m-%Y %H:%M:%S"), Eenheid = col\_skip(),Serie = col\_skip(), X5 = col\_skip()))

## Warning: Missing column names filled in: 'X5' [5]

## Warning: 722945 parsing failures.  
## row col expected actual file  
## 1 -- 5 columns 4 columns 'HF\_Qin\_BlauweKamer.csv'  
## 2 -- 5 columns 4 columns 'HF\_Qin\_BlauweKamer.csv'  
## 3 -- 5 columns 4 columns 'HF\_Qin\_BlauweKamer.csv'  
## 4 -- 5 columns 4 columns 'HF\_Qin\_BlauweKamer.csv'  
## 5 -- 5 columns 4 columns 'HF\_Qin\_BlauweKamer.csv'  
## ... ... ......... ......... ........................  
## See problems(...) for more details.

names(HF\_Qin\_BlauweKamer) <- c("Datum","Qin\_BlauweKamer")  
  
HF\_Qin\_Molenbeak <- read\_csv("HF\_Qin\_Molenbeak.csv",  
 col\_types = cols(Datum = col\_datetime(format = "%d-%m-%Y %H:%M:%S"), Eenheid = col\_skip(),Serie = col\_skip(), X5 = col\_skip()))

## Warning: Missing column names filled in: 'X5' [5]

## Warning: 588013 parsing failures.  
## row col expected actual file  
## 1 -- 5 columns 4 columns 'HF\_Qin\_Molenbeak.csv'  
## 2 -- 5 columns 4 columns 'HF\_Qin\_Molenbeak.csv'  
## 3 -- 5 columns 4 columns 'HF\_Qin\_Molenbeak.csv'  
## 4 -- 5 columns 4 columns 'HF\_Qin\_Molenbeak.csv'  
## 5 -- 5 columns 4 columns 'HF\_Qin\_Molenbeak.csv'  
## ... ... ......... ......... ......................  
## See problems(...) for more details.

names(HF\_Qin\_Molenbeak) <- c("Datum","Qin\_Molenbeak")  
  
# Outflow discharges:  
HF\_Qout\_Dintelsas <- read\_csv("HF\_Qout\_Dintelsas.csv",  
 col\_types = cols(Datum = col\_datetime(format = "%d-%m-%Y %H:%M:%S"), Eenheid = col\_skip(),Serie = col\_skip(), X5 = col\_skip()))

## Warning: Missing column names filled in: 'X5' [5]

## Warning: 299449 parsing failures.  
## row col expected actual file  
## 1 -- 5 columns 4 columns 'HF\_Qout\_Dintelsas.csv'  
## 2 -- 5 columns 4 columns 'HF\_Qout\_Dintelsas.csv'  
## 3 -- 5 columns 4 columns 'HF\_Qout\_Dintelsas.csv'  
## 4 -- 5 columns 4 columns 'HF\_Qout\_Dintelsas.csv'  
## 5 -- 5 columns 4 columns 'HF\_Qout\_Dintelsas.csv'  
## ... ... ......... ......... .......................  
## See problems(...) for more details.

names(HF\_Qout\_Dintelsas) <- c("Datum", "Qout\_Dintelsas")  
  
HF\_Qout\_Vliet <- read\_csv("HF\_Qout\_Vliet.csv",  
 col\_types = cols(Datum = col\_datetime(format = "%d-%m-%Y %H:%M:%S"), Eenheid = col\_skip(),Serie = col\_skip(), X5 = col\_skip()))

## Warning: Missing column names filled in: 'X5' [5]

## Warning: 315749 parsing failures.  
## row col expected actual file  
## 1 -- 5 columns 4 columns 'HF\_Qout\_Vliet.csv'  
## 2 -- 5 columns 4 columns 'HF\_Qout\_Vliet.csv'  
## 3 -- 5 columns 4 columns 'HF\_Qout\_Vliet.csv'  
## 4 -- 5 columns 4 columns 'HF\_Qout\_Vliet.csv'  
## 5 -- 5 columns 4 columns 'HF\_Qout\_Vliet.csv'  
## ... ... ......... ......... ...................  
## See problems(...) for more details.

names(HF\_Qout\_Vliet) <- c("Datum", "Qout\_Vliet")  
  
# Integrating dataset #  
sTime\_numeric <- seq(HF\_Qin\_MarkCanal$Datum[1]%>%as.numeric,HF\_Qin\_MarkCanal$Datum[length(HF\_Qin\_MarkCanal$Datum)]%>%as.numeric, by=3600) #hourly interval  
  
WaterBudget\_MDV <- data.frame(Datum = ymd\_hms("1970-01-01 00:00:00")+sTime\_numeric,WL\_Down\_Dintel=NA,WL\_Down\_Vliet=NA,WL\_Up\_Dintel=NA,WL\_Up\_Vliet=NA,WL\_Gastel=NA, WL\_Down\_Oosterhout=NA,WL\_Up\_Oosterhout=NA, WL\_Down\_Rooskensdonk=NA, Qin\_MarkCanal=NA, Qin\_BlauweKamer=NA, Qin\_Molenbeak=NA, Qin\_Oranjeboombrug=NA, Qout\_Dintelsas=NA, Qout\_Vliet=NA)  
  
WaterBudget\_MDV$WL\_Down\_Dintel <- approx(WL\_Down\_Dintel$Datum%>%as.numeric,WL\_Down\_Dintel$WL\_Down\_Dintel,xout=WaterBudget\_MDV$Datum%>%as.numeric)$y

## Warning in regularize.values(x, y, ties, missing(ties)): collapsing to  
## unique 'x' values

WaterBudget\_MDV$WL\_Down\_Vliet <- approx(WL\_Down\_Vliet$Datum%>%as.numeric,WL\_Down\_Vliet$WL\_Down\_Vliet,xout=WaterBudget\_MDV$Datum%>%as.numeric)$y

## Warning in regularize.values(x, y, ties, missing(ties)): collapsing to  
## unique 'x' values

WaterBudget\_MDV$WL\_Up\_Dintel <- approx(WL\_Up\_Dintel$Datum%>%as.numeric,WL\_Up\_Dintel$WL\_Up\_Dintel,xout=WaterBudget\_MDV$Datum%>%as.numeric)$y

## Warning in regularize.values(x, y, ties, missing(ties)): collapsing to  
## unique 'x' values

WaterBudget\_MDV$WL\_Up\_Vliet <- approx(WL\_Up\_Vliet$Datum%>%as.numeric,WL\_Up\_Vliet$WL\_Up\_Vliet,xout=WaterBudget\_MDV$Datum%>%as.numeric)$y  
WaterBudget\_MDV$WL\_Gastel <- approx(WL\_Gastel$Datum%>%as.numeric,WL\_Gastel$WL\_Gastel, xout = WaterBudget\_MDV$Datum%>%as.numeric)$y

## Warning in regularize.values(x, y, ties, missing(ties)): collapsing to  
## unique 'x' values

WaterBudget\_MDV$WL\_Up\_Oosterhout <- approx(WL\_Up\_Oosterhout$Datum%>%as.numeric,WL\_Up\_Oosterhout$WL\_Up\_Oosterhout,xout = WaterBudget\_MDV$Datum%>%as.numeric)$y

## Warning in regularize.values(x, y, ties, missing(ties)): collapsing to  
## unique 'x' values

WaterBudget\_MDV$WL\_Down\_Oosterhout <- approx(WL\_Down\_Oosterhout$Datum%>%as.numeric,WL\_Down\_Oosterhout$WL\_Down\_Oosterhout,xout = WaterBudget\_MDV$Datum%>%as.numeric)$y # inside the MDV system

## Warning in regularize.values(x, y, ties, missing(ties)): collapsing to  
## unique 'x' values

WaterBudget\_MDV$WL\_Down\_Rooskensdonk <- approx(WL\_Down\_Rooskensdonk$Datum%>%as.numeric,WL\_Down\_Rooskensdonk$WL\_Down\_Rooskensdonk,xout = WaterBudget\_MDV$Datum%>%as.numeric)$y

## Warning in regularize.values(x, y, ties, missing(ties)): collapsing to  
## unique 'x' values

### Inflows and outflows  
WaterBudget\_MDV$Qin\_MarkCanal <- approx(HF\_Qin\_MarkCanal$Datum%>%as.numeric,HF\_Qin\_MarkCanal$Qin\_MarkCanal,xout = WaterBudget\_MDV$Datum%>%as.numeric)$y

## Warning in regularize.values(x, y, ties, missing(ties)): collapsing to  
## unique 'x' values

WaterBudget\_MDV$Qin\_BlauweKamer <- approx(HF\_Qin\_MarkCanal$Datum%>%as.numeric,HF\_Qin\_MarkCanal$Qin\_MarkCanal,xout = WaterBudget\_MDV$Datum%>%as.numeric)$y

## Warning in regularize.values(x, y, ties, missing(ties)): collapsing to  
## unique 'x' values

WaterBudget\_MDV$Qin\_Molenbeak <- approx(HF\_Qin\_Molenbeak$Datum%>%as.numeric,HF\_Qin\_Molenbeak$Qin\_Molenbeak,xout = WaterBudget\_MDV$Datum%>%as.numeric)$y  
WaterBudget\_MDV$Qin\_Oranjeboombrug <- approx(HF\_Qin\_Oranjeboombrug$Datum%>%as.numeric,HF\_Qin\_Oranjeboombrug$Qin\_Oranjeboombrug,xout = WaterBudget\_MDV$Datum%>%as.numeric)$y

## Warning in regularize.values(x, y, ties, missing(ties)): collapsing to  
## unique 'x' values

WaterBudget\_MDV$Qout\_Vliet <- approx(HF\_Qout\_Vliet$Datum%>%as.numeric,HF\_Qout\_Vliet$Qout\_Vliet,xout = WaterBudget\_MDV$Datum%>%as.numeric)$y

## Warning in regularize.values(x, y, ties, missing(ties)): collapsing to  
## unique 'x' values

WaterBudget\_MDV$Qout\_Dintelsas <- approx(HF\_Qout\_Dintelsas$Datum%>%as.numeric,HF\_Qout\_Dintelsas$Qout\_Dintelsas,xout = WaterBudget\_MDV$Datum%>%as.numeric)$y

## Warning in regularize.values(x, y, ties, missing(ties)): collapsing to  
## unique 'x' values

## Calculation of discharge at Molenbeak (Gastel) by Roosendaal discharge based on catchment-discharge relationship  
HF\_Qin\_Roosendaal\_2 <- read\_csv("HF\_Qin\_Roosendaal\_2.csv",  
 col\_types = cols(Datum = col\_datetime(format = "%d-%m-%Y %H:%M:%S"), Eenheid = col\_skip(),Serie = col\_skip(), X5 = col\_skip()))

## Warning: Missing column names filled in: 'X5' [5]

## Warning: 105259 parsing failures.  
## row col expected actual file  
## 1 -- 5 columns 4 columns 'HF\_Qin\_Roosendaal\_2.csv'  
## 2 -- 5 columns 4 columns 'HF\_Qin\_Roosendaal\_2.csv'  
## 3 -- 5 columns 4 columns 'HF\_Qin\_Roosendaal\_2.csv'  
## 4 -- 5 columns 4 columns 'HF\_Qin\_Roosendaal\_2.csv'  
## 5 -- 5 columns 4 columns 'HF\_Qin\_Roosendaal\_2.csv'  
## ... ... ......... ......... .........................  
## See problems(...) for more details.

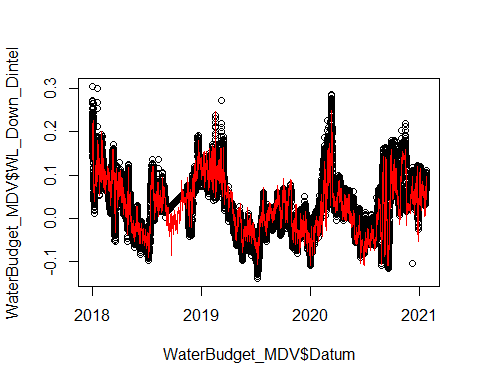
names(HF\_Qin\_Roosendaal\_2) <- c("Datum", "Qin\_Roosendaal\_2")  
  
WaterBudget\_MDV$Qin\_Roosendaal <- approx(HF\_Qin\_Roosendaal\_2$Datum%>%as.numeric, HF\_Qin\_Roosendaal\_2$Qin\_Roosendaal\_2, xout = WaterBudget\_MDV$Datum%>%as.numeric)$y

## Warning in regularize.values(x, y, ties, missing(ties)): collapsing to  
## unique 'x' values

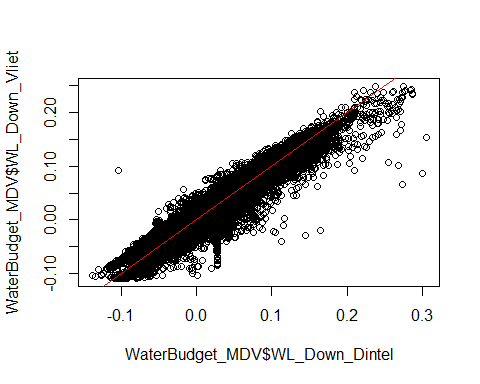
Roosendaal\_CatchmentArea <- 2277 # 1 ha = 10000 m2  
Molenbeek\_CatchmentArea <- 1709 # 1 ha = 10000 m2  
  
WaterBudget\_MDV$Qin\_Molenbeak\_Corr <- WaterBudget\_MDV$Qin\_Roosendaal/Roosendaal\_CatchmentArea\*Molenbeek\_CatchmentArea

#### Compare the measurements at Dintel and Vliet downsteram as indicator of water depth dynamics at Volkerakmeer

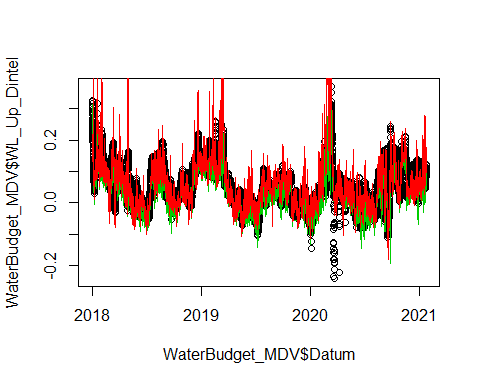
plot(WaterBudget\_MDV$Datum, WaterBudget\_MDV$WL\_Down\_Dintel)  
lines(WaterBudget\_MDV$Datum, WaterBudget\_MDV$WL\_Down\_Vliet, col=2)



plot(WaterBudget\_MDV$WL\_Down\_Dintel, WaterBudget\_MDV$WL\_Down\_Vliet)  
lines(-2:2,-2:2,col=2) # 1:1 line



#### Compare depth measurements inside MDV system  
plot(WaterBudget\_MDV$Datum, WaterBudget\_MDV$WL\_Up\_Dintel)  
lines(WaterBudget\_MDV$Datum, WaterBudget\_MDV$WL\_Up\_Vliet, col=2)  
  
lines(WaterBudget\_MDV$Datum, WaterBudget\_MDV$WL\_Gastel,col=3)  
  
lines(WaterBudget\_MDV$Datum, WaterBudget\_MDV$WL\_Down\_Oosterhout, col=2)  
  
lines(WaterBudget\_MDV$Datum, WaterBudget\_MDV$WL\_Up\_Vliet, col=2)



#### Trunc data from hourly to daily

WaterBudget\_MDV$Daily <- trunc(WaterBudget\_MDV$Datum, "days")  
WB\_MDV\_Day <- aggregate(WaterBudget\_MDV[,2:18],by=list(as.character(WaterBudget\_MDV$Daily)),mean)  
names(WB\_MDV\_Day)[1] <- "Datum"  
WB\_MDV\_Day$Datum <- ymd(WB\_MDV\_Day$Datum)  
  
#### analysis summer and the rest period separately  
WB\_MDV\_Day$period <- ifelse(month(WB\_MDV\_Day$Datum)%in%5:9,"Summer","No summer")  
WB\_MDV\_Day$period <- factor(WB\_MDV\_Day$period, levels = c("Summer","No Summer"))

#### Closing the water balance by adjusting the inflows at Gastel (Molenbeak)

Surface <- 50\*(114-0)\*40+50\*(640-114)\*50+50\*(666-640)\*100+50\*(743-666)\*40+50\*(760-743)\*26+50\*(1117-760)\*30 # m^2  
WB\_MDV\_Day$dt <- c(1, diff(as.numeric(WB\_MDV\_Day$Datum))\*86400) # seconds  
  
WB\_MDV\_Day$dV <- c(0, diff(WB\_MDV\_Day$WL\_Down\_Oosterhout)\*(50\*(114-0)\*40)+diff(WB\_MDV\_Day$WL\_Down\_Rooskensdonk)\*50\*((640-114)\*50+(666-640)\*100)+diff(WB\_MDV\_Day$WL\_Gastel)\*50\*((743-666)\*40+(760-743)\*26+(1117-760)\*30)) # m^3  
  
#### Calculting the rest discharge to close the water budget ####  
WB\_MDV\_Day$dQ <- WB\_MDV\_Day$dV/WB\_MDV\_Day$dt # m3/s  
  
#### Calculation of discharge at polders  
WB\_MDV\_Day$Q\_Polder <- WB\_MDV\_Day$dQ-(WB\_MDV\_Day$Qin\_MarkCanal+WB\_MDV\_Day$Qin\_BlauweKamer+WB\_MDV\_Day$Qin\_Oranjeboombrug+WB\_MDV\_Day$Qin\_Molenbeak\_Corr-WB\_MDV\_Day$Qout\_Dintelsas-WB\_MDV\_Day$Qout\_Vliet)  
  
mean(WB\_MDV\_Day$Q\_Polder, na.rm = T)

## [1] 4.837534

sd(WB\_MDV\_Day$Q\_Polder, na.rm = T)

## [1] 12.62892

# summer discharge  
mean(WB\_MDV\_Day$Q\_Polder[which(month(WB\_MDV\_Day$Datum)%in%c(5:9))],na.rm = T)

## [1] -3.77742

sd(WB\_MDV\_Day$Q\_Polder[which(month(WB\_MDV\_Day$Datum)%in%c(5:9))],na.rm = T)

## [1] 7.318447

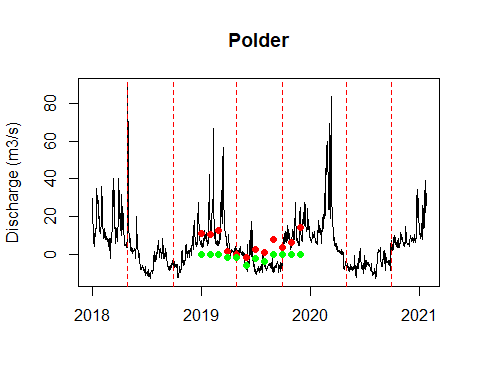
# no summer discharge  
mean(WB\_MDV\_Day$Q\_Polder[-which(month(WB\_MDV\_Day$Datum)%in%c(5:9))],na.rm = T)

## [1] 10.82884

sd(WB\_MDV\_Day$Q\_Polder[-which(month(WB\_MDV\_Day$Datum)%in%c(5:9))],na.rm = T)

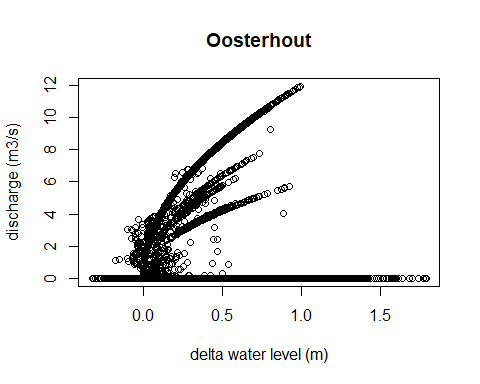
## [1] 12.07099

#### Compare it with Measurements at Molenbeak ####  
plot(WB\_MDV\_Day$Datum,WB\_MDV\_Day$Q\_Polder, type = "l", ylab="Discharge (m3/s)", xlab="", main="Polder")   
  
abline(v=ymd("2018-05-01","2018-09-30","2019-05-01","2019-09-30","2020-05-01","2020-09-30"), col="red", lty=2)  
  
# Discharge data from report  
Q\_df <- read.csv("C:\\Users\\QingZ\\PhD-Qing\\GitProject\\Mark\_Dintel\_Vliet\\Modelling\\Advection-Diffusion-Production\\Waterbalance\\Q\_df.csv")  
Q\_df$Date <- ymd("2019-01-01","2019-02-01","2019-03-01","2019-04-01","2019-05-01","2019-06-01","2019-07-01","2019-08-01","2019-09-01","2019-10-01","2019-11-01","2019-12-01")  
  
points(Q\_df$Date, Q\_df$f..Ground.water+Q\_df$g..rest.heading+Q\_df$h..PolderOut,col="red",pch=19)  
  
points(Q\_df$Date, Q\_df$h..PolderOut,col="green",pch=19)



#### Q vs delta water levels

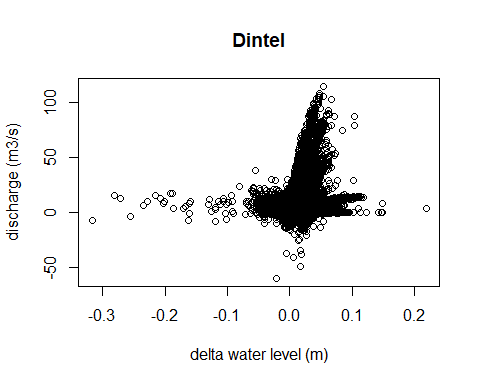
# for Oosterhout:  
plot(WaterBudget\_MDV$WL\_Up\_Oosterhout-WaterBudget\_MDV$WL\_Down\_Oosterhout,WaterBudget\_MDV$Qin\_MarkCanal, main = "Oosterhout",xlab = "delta water level (m)", ylab = "discharge (m3/s)")



summary(lm(WaterBudget\_MDV$Qin\_MarkCanal~WaterBudget\_MDV$WL\_Up\_Oosterhout-WaterBudget\_MDV$WL\_Down\_Oosterhout))

##   
## Call:  
## lm(formula = WaterBudget\_MDV$Qin\_MarkCanal ~ WaterBudget\_MDV$WL\_Up\_Oosterhout -   
## WaterBudget\_MDV$WL\_Down\_Oosterhout)  
##   
## Residuals:  
## Min 1Q Median 3Q Max   
## -4.963 -2.830 -1.841 3.228 10.745   
##   
## Coefficients:  
## Estimate Std. Error t value Pr(>|t|)   
## (Intercept) 4.11201 0.04543 90.52 <2e-16 \*\*\*  
## WaterBudget\_MDV$WL\_Up\_Oosterhout -2.64346 0.08066 -32.77 <2e-16 \*\*\*  
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Residual standard error: 3.466 on 26855 degrees of freedom  
## Multiple R-squared: 0.03846, Adjusted R-squared: 0.03842   
## F-statistic: 1074 on 1 and 26855 DF, p-value: < 2.2e-16

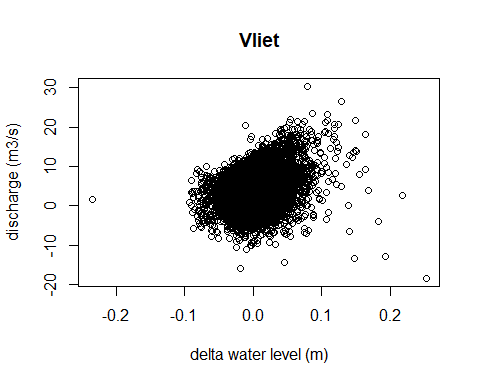
plot(WaterBudget\_MDV$WL\_Up\_Dintel-WaterBudget\_MDV$WL\_Down\_Dintel, WaterBudget\_MDV$Qout\_Dintelsas, main = "Dintel",xlab = "delta water level (m)", ylab = "discharge (m3/s)")



summary(lm(WaterBudget\_MDV$Qout\_Dintelsas~(WaterBudget\_MDV$WL\_Up\_Dintel-WaterBudget\_MDV$WL\_Down\_Dintel)))

##   
## Call:  
## lm(formula = WaterBudget\_MDV$Qout\_Dintelsas ~ (WaterBudget\_MDV$WL\_Up\_Dintel -   
## WaterBudget\_MDV$WL\_Down\_Dintel))  
##   
## Residuals:  
## Min 1Q Median 3Q Max   
## -85.738 -6.691 -1.882 4.554 84.917   
##   
## Coefficients:  
## Estimate Std. Error t value Pr(>|t|)   
## (Intercept) 6.69925 0.08917 75.13 <2e-16 \*\*\*  
## WaterBudget\_MDV$WL\_Up\_Dintel 74.57375 1.08567 68.69 <2e-16 \*\*\*  
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Residual standard error: 11.29 on 26855 degrees of freedom  
## Multiple R-squared: 0.1494, Adjusted R-squared: 0.1494   
## F-statistic: 4718 on 1 and 26855 DF, p-value: < 2.2e-16

plot(WaterBudget\_MDV$WL\_Gastel-WaterBudget\_MDV$WL\_Down\_Vliet, WaterBudget\_MDV$Qout\_Vliet, main = "Vliet",xlab = "delta water level (m)", ylab = "discharge (m3/s)")



summary(lm(WaterBudget\_MDV$Qout\_Vliet~(WaterBudget\_MDV$WL\_Gastel-WaterBudget\_MDV$WL\_Down\_Vliet)))

##   
## Call:  
## lm(formula = WaterBudget\_MDV$Qout\_Vliet ~ (WaterBudget\_MDV$WL\_Gastel -   
## WaterBudget\_MDV$WL\_Down\_Vliet))  
##   
## Residuals:  
## Min 1Q Median 3Q Max   
## -25.444 -1.992 -0.254 1.665 26.119   
##   
## Coefficients:  
## Estimate Std. Error t value Pr(>|t|)   
## (Intercept) 1.88753 0.02004 94.19 <2e-16 \*\*\*  
## WaterBudget\_MDV$WL\_Gastel 15.24660 0.29867 51.05 <2e-16 \*\*\*  
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Residual standard error: 3.104 on 26854 degrees of freedom  
## (1 observation deleted due to missingness)  
## Multiple R-squared: 0.08846, Adjusted R-squared: 0.08842   
## F-statistic: 2606 on 1 and 26854 DF, p-value: < 2.2e-16