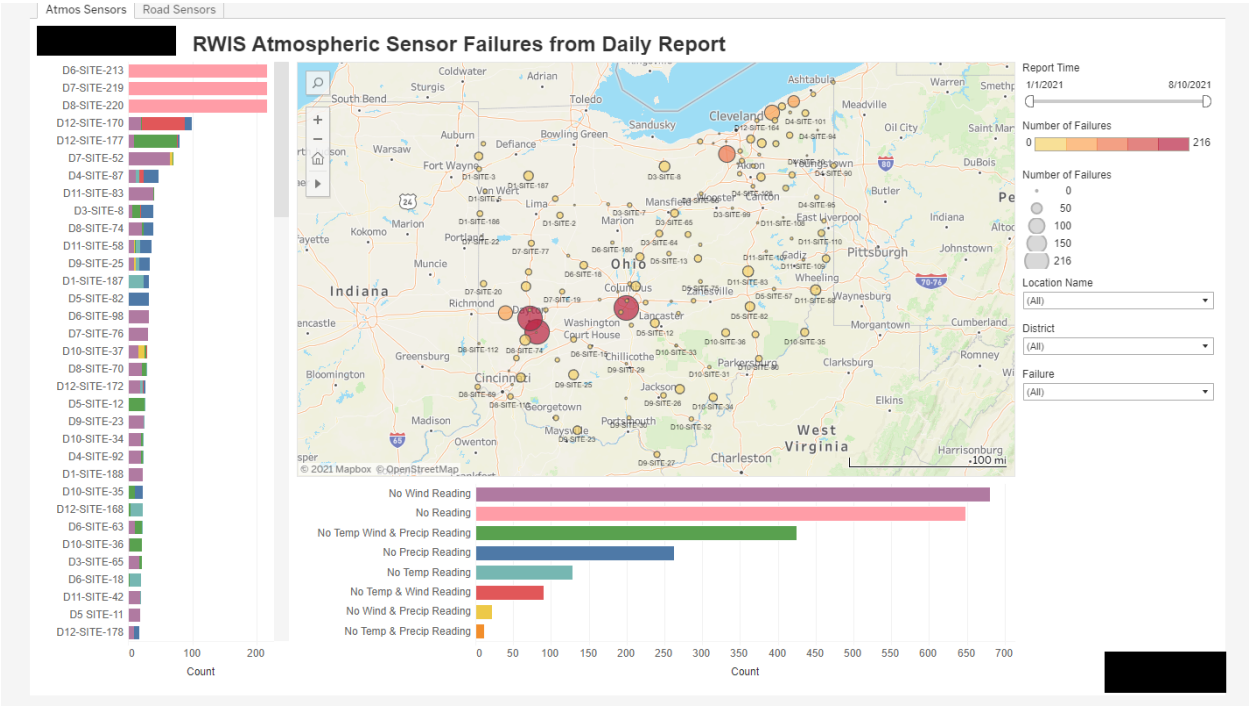
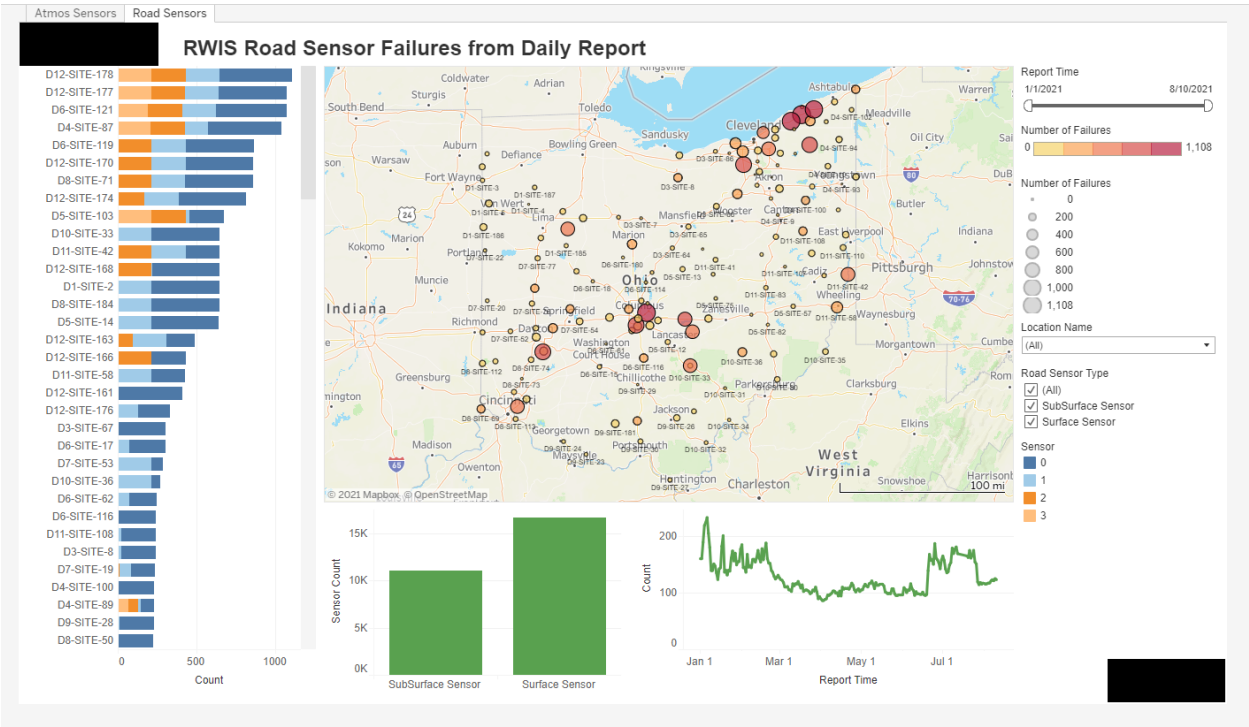
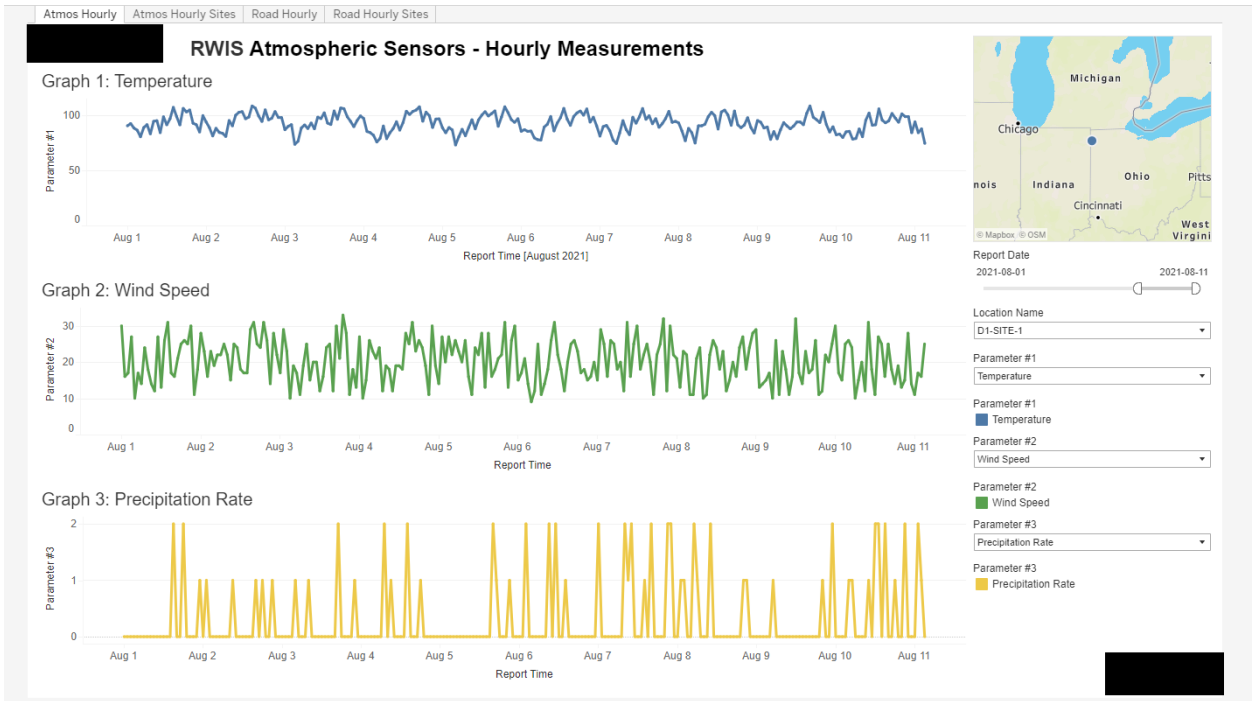
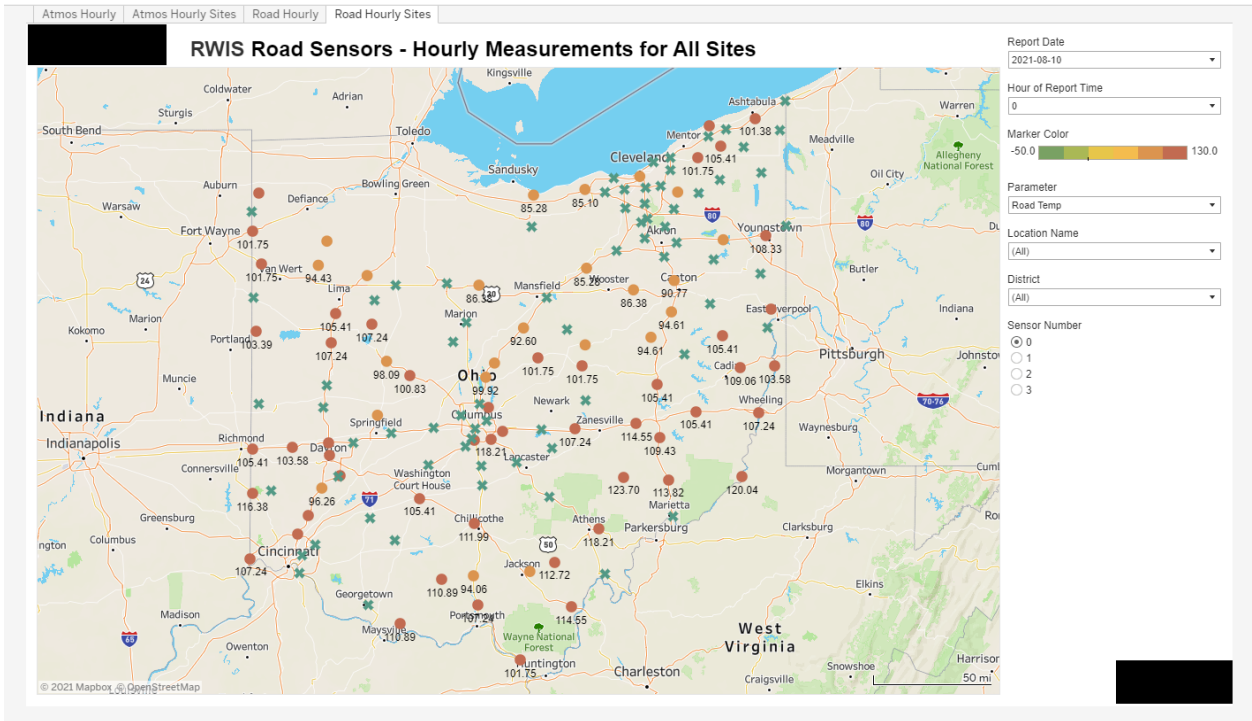
Kyle Vertin
Internship May 2021 - August 2021

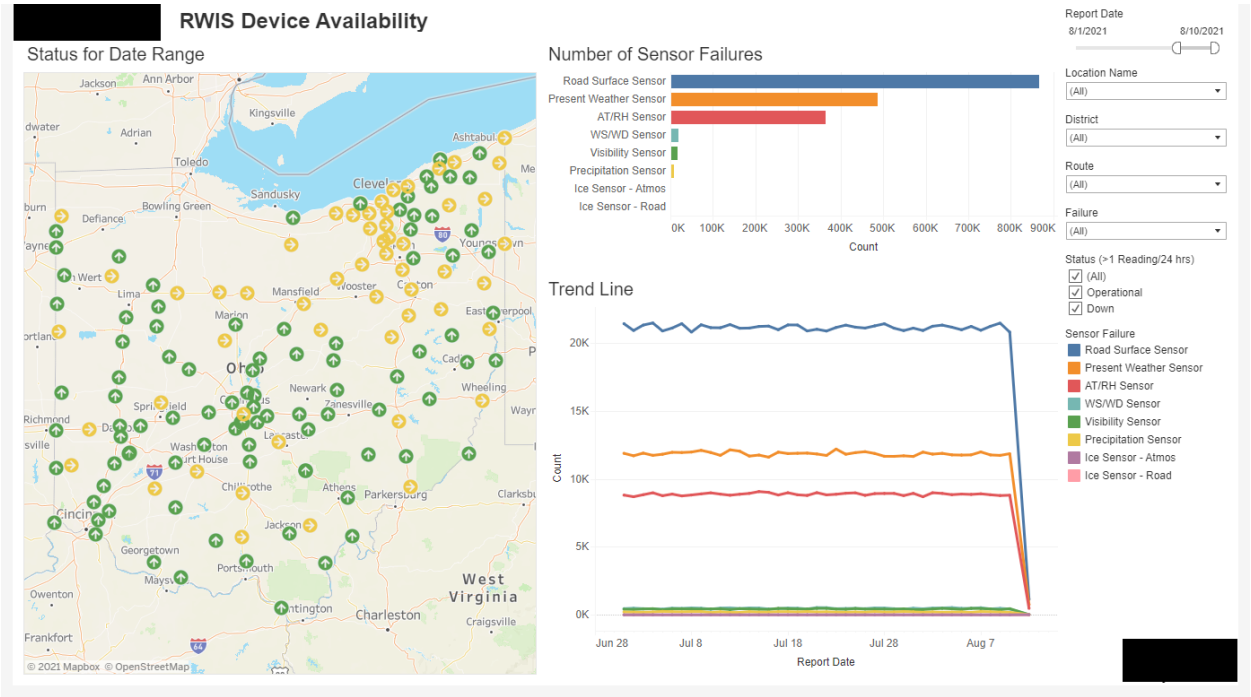
Dashboards:






Atmos Hourly
Atmos Hourly Sites
Road Hourly
Road Hourly Sites
RWIS Atmospheric Sensors - Hourly Measurements
Graph 1: Temperature
Parameter #1
Report Time [August 2021]
Graph 2: Wind Speed
Parameter #2
Report Time
Graph 3: Precipitation Rate
Parameter #3
Report Time
Aug 1
Aug 2
Aug 3
Aug 4
Aug 5
Aug 6
Aug 7
Aug 8
Aug 9
Aug 10
Aug 11
Michigan
Chicago
Indiana
Ohio
Cincinnati
Report Date
2021-08-01
2021-08-11
Location Name
D1-SITE-1
Parameter #1
Temperature
Parameter #2
Wind Speed
Parameter #3
Precipitation Rate


Atmos Hourly
Atmos Hourly Sites
Road Hourly
Road Hourly Sites
RWIS Road Sensors - Hourly Measurements for All Sites
Report Date
2021-08-10
Hour of Report Time
0
Marker Color
-50.0
130.0
Parameter
Road Temp
Location Name
(All)
District
(All)
Sensor Number
0
1
2
3
Cleveland
Pittsburgh
Cincinnati
Columbus
Indianapolis
Toledo
Akron
Youngstown
Canton
Mansfield
Dayton
Springfield
Zanesville
Parkersburg
Charleston
West Virginia
Huntington
Morgantown
Wheeling
Weirton
Marietta
Athens
Chillicothe
Lancaster
Newark
Portsmouth
Jackson
Wayne National Forest
Allegheny National Forest
© 2021 Mapbox © OpenStreetMap
50 mi



Scripts:

----------PARSE THE DAILY REPORT AND STORE IN DATABASE----------

```
library(lubridate)
library(stringr)
library(plyr)
library(dplyr)
library(openxlsx)
library(tools)

rm(list=ls())
Sys.setenv(TZ='America/New_York')

home <- "setwd('~/analytics/scripts')"
eval(parse(text = home))

# Read reference data for normalization purposes
setwd("../database")
r_failure <- read.csv("r_failure.csv", stringsAsFactors = FALSE, na.strings = c("NA",""))
r_failure <- subset(r_failure, select = c(failure_id, failure, failure_datasource))

t_location <- read.csv("t_location.csv", stringsAsFactors = FALSE, na.strings = c("NA",""))
```

```
#t_location$location <- t_location$location_number
t_location$location_number <- as.integer(gsub("^.*-", "", t_location$location_number))
t_location <- t_location[!is.na(t_location$location_number),]
t_location <- subset(t_location, select = c(location_id, location_description, location_number))

# Read the database tables that store daily report data

t_dailyatmos <- read.csv("t_dailyatmos.csv", stringsAsFactors = FALSE, na.strings = c("NA",""))
t_dailysensor <- read.csv("t_dailysensor.csv", stringsAsFactors = FALSE, na.strings =
c("NA",""))

# Denormalize

      t_dailyatmos  <- join(t_dailyatmos,
r_failure[r_failure$failure_datasource=="daily_report_atmospheric",], by = "failure_id",) %>%
            join(.,t_location, by="location_id")

      # warning if failure or location_number are not in reference tables
      if(sum(is.na(t_dailyatmos$failure)) > 0) { warning("daily_parse: The failure in t_dailyatmos
is NA") }
      if(sum(is.na(t_dailyatmos$location)) > 0) { warning("daily_parse: The location in
t_dailyatmos is NA") }

      t_dailyatmos <-  t_dailyatmos[,c("location_number", "failure", "location_description",
"report_time",
                           "dailyatmos_inserted", "dailyatmos_inserted_by", "dailyatmos_updated")]



#Denormalize t_dailysensor


      t_dailysensor  <- join(t_dailysensor,
r_failure[r_failure$failure_datasource=="daily_report_sensor",], by = "failure_id") %>%
            join(.,t_location, by="location_id")


      t_dailysensor <-  t_dailysensor[,c("location_number", "failure", "location_description",
"sensor", "sensor_name", "report_time",
                                   "dailysensor_inserted", "dailysensor_inserted_by",
"dailysensor_updated")]
```

```
# Replace all your names:  location became location, location_description became
location_description.....report_data to report_time
# Run each part of the code and change the columns name to match the schema

setwd("../input_files/daily_report")
input_files <- list.files(pattern = ".txt", all.files = TRUE)

# Rename the files with their dates

	for(file in input_files) {

		#file <- input_files[1]
		rdr <- readLines(file)
		rdr <- data.frame(x = rdr, stringsAsFactors = FALSE)

		report_time <- str_sub(rdr$x[1], 43, nchar(rdr$x[1]))
		# gsub use regex, meaning regular expressions
		report_time <- gsub("\\.", "", report_time)

		# Put in UTC format
		report_time <- date(strptime(report_time, "%m/%d/%Y", tz = ""))
		# print(report_time)

		newfile <- paste0("daily_report_", report_time, ".txt")

		if(!newfile %in% input_files) {
			file.rename(file, newfile)
		}
	}

# Check if the data for each report is already in the database

	input_files <- sort(list.files(pattern = ".txt", all.files = TRUE))
	outage_flag <- 0
	sensor_flag <- 0

for(file in input_files) {

	#file <- input_files[1]
	rdr <- readLines(file)
	rdr <- data.frame(x = rdr, stringsAsFactors = FALSE)

	report_time <- str_sub(rdr$x[1], 43, nchar(rdr$x[1]))
	# gsub use regex, meaning regular expressions
```

```
report_time <- gsub("\\.", "", report_time)

# Put in UTC format
report_time <- date(strptime(report_time, "%m/%d/%Y", tz = ""))
# print(report_time)

# Initialize
rdr$location_number <- NA
rdr$location_description <- NA
rdr$sensor <- NA
rdr$sensor_name <- NA
rdr$failure <-   NA
# Use ?strptime codes
rdr$report_time <- paste0(format(report_time, "%Y-%m-%d"), " 10:00:00")

# Remove blank lines
rdr$x <- gsub("^ *$", "", rdr$x)
rdr <- rdr[rdr$x != "",]

row.names(rdr) <- NULL

if(sum(t_dailyatmos$report_time == report_time) == 0) {

    # Flag = 1 means the records for this report are being added to the database and the
end
    outage_flag <- 1
    #Top
    start <- which(grepl("RWIS ATMOSPHERIC REPORT", rdr$x))
    end <-  which(grepl("RWIS SURFACE SENSOR REPORT", rdr$x))
    t1 <- rdr[start:(end-1),]

    t1 <- as.data.frame(t1)

    t1 <- t1[grepl("^[0-9]", t1$x),]
    t1$report_name <- "RWIS ATMOSPHERIC REPORT"

    t1$dailyatmos_inserted <- t1$report_time
    t1$dailyatmos_inserted_by <- "daily_parse"
    t1$dailyatmos_updated <- t1$report_time

    d_start <- c(1,11,71)
    d_end <- c(10,70,255)

    for(i in 1:nrow(t1)) {
```

```
            t1$location_number[i] <- substr(t1$x[i],d_start[1],d_end[1])
            t1$location_description[i] <- substr(t1$x[i],d_start[2],d_end[2])
            t1$failure[i] <- substr(t1$x[i],d_start[3],d_end[3])
        }

        t1$failure <- gsub("^.*No", "No", t1$x)
        t1$location_number <- as.integer(t1$location_number)
        t1$location_description <- gsub(" *$", "", t1$location_description)
        t1$failure <- gsub(" *$", "", t1$failure)

        t1 <- subset(t1, select = -c(x, sensor, sensor_name, report_name))

        if(nrow(t1) > 0) {
            # Column names must be identical for rbind
            t_dailyatmos <- rbind(t_dailyatmos,t1)
        }
}

if(sum(t_dailysensor$report_time == report_time) == 0) {

        sensor_flag <- 1
        # Middle
        start <- which(grepl("RWIS SURFACE SENSOR REPORT", rdr$x))
        end <-  which(grepl("RWIS SUB SENSOR REPORT", rdr$x))
        t2 <- rdr[start:(end-1),]
        t2 <- t2[grepl("^[0-9]", t2$x),]
        t2$report_name <- "RWIS SURFACE SENSOR REPORT"

        t2$dailysensor_inserted <- t2$report_time
        t2$dailysensor_inserted_by <- "daily_parse"
        t2$dailysensor_updated <- t2$report_time


        d_start <- c(1,11,71,81,131)
        d_end <- c(10,70,80,130,255)

        for(i in 1:nrow(t2)) {
            t2$location_number[i] <- substr(t2$x[i],d_start[1],d_end[1])
            t2$location_description[i] <- substr(t2$x[i],d_start[2],d_end[2])
            t2$sensor[i] <- substr(t2$x[i],d_start[3],d_end[3])
            t2$sensor_name[i] <- substr(t2$x[i],d_start[4],d_end[4])
            t2$failure[i] <- substr(t2$x[i],d_start[5],d_end[5])
        }
```

```
t2$location_number <- as.integer(t2$location_number)
t2$sensor <- as.integer(t2$sensor)
t2$location_description <- gsub(" *$", "", t2$location_description)
t2$sensor_name <- gsub(" *$", "", t2$sensor_name)
t2$failure <- gsub(" *$", "", t2$failure)

# t2 <- subset(t2, select = -c(x,location_description,report_name))

# Bottom

start <- which(grepl("RWIS SUB SENSOR REPORT", rdr$x))
end <-  nrow(rdr)
t3 <- rdr[start:end,]
t3 <- t3[grepl("^[0-9]", t3$x),]
t3$report_name <- "RWIS SURFACE SENSOR REPORT"

t3$dailysensor_inserted <- t3$report_time
t3$dailysensor_inserted_by <- "daily_parse"
t3$dailysensor_updated <- t3$report_time


d_start <- c(1,11,71,81,131)
d_end <- c(10,70,80,130,255)

for(i in 1:nrow(t3)) {
      t3$location_number[i] <- substr(t3$x[i],d_start[1],d_end[1])
      t3$location_description[i] <- substr(t3$x[i],d_start[2],d_end[2])
      t3$sensor[i] <- substr(t3$x[i],d_start[3],d_end[3])
      t3$sensor_name[i] <- substr(t3$x[i],d_start[4],d_end[4])
      t3$failure[i] <- substr(t3$x[i],d_start[5],d_end[5])
}

t3$location_number <- as.integer(t3$location_number)
t3$sensor <- as.integer(t3$sensor)
t3$location_description <- gsub(" *$", "", t3$location_description)
t3$sensor_name <- gsub(" *$", "", t3$sensor_name)
t3$failure <- gsub(" *$", "", t3$failure)


# t3 <- subset(t3, select = -c(x,location_description, report_name))

t2 <- subset(t2, select = -c(x,report_name))
t3 <- subset(t3, select = -c(x,report_name))
```

```
        if(nrow(t2) > 0 | nrow(t3) > 0 ) {
            # Column names must be identical for rbind
            t_dailysensor <- rbind(t_dailysensor, rbind(t2,t3))
    }
    }
    } # end of for loop for the files


# Normalize: Using the location, get the location_id and failure_id

    t_dailyatmos <- join(t_dailyatmos, t_location, by = "location_number") %>%
        join(., r_failure[r_failure$failure_datasource=="daily_report_atmospheric",], by =
"failure")

    # Create a warning that the failure is not in r_failure table, to prompt you to add it
    if(sum(is.na(t_dailyatmos$failure_id)) > 0) {
        warning("daily_parse: Daily outage failure is not in r_failure table, add it")
        print("daily_parse: Daily outage failure is not in r_failure table, add it")
        print(sort(unique(t_dailyatmos$failure[is.na(t_dailyatmos$failure_id)])))
    }

    # Drop the records that do not have a match in t_location (ICE sites)
    t_dailyatmos <- t_dailyatmos[!is.na(t_dailyatmos$location_id),]


    # This key needs to be assigned for the whole table for database simulation purposes only
    t_dailyatmos$dailyatmos_id <- 1:nrow(t_dailyatmos)

    # Keep the columns that were in the original database table
    t_dailyatmos <-
t_dailyatmos[,c("dailyatmos_id","location_id","failure_id","location_description", "report_time",

"dailyatmos_inserted","dailyatmos_inserted_by","dailyatmos_updated")]


    t_dailysensor <- join(t_dailysensor, t_location, by = "location_number") %>%
        join(., r_failure[r_failure$failure_datasource=="daily_report_sensor",], by = "failure")

    # Drop the records that do not have a match in t_location (ICE sites)
    t_dailysensor <- t_dailysensor[!is.na(t_dailysensor$location_id),]

    # This key needs to be assigned for the whole table for database simulation purposes only
    t_dailysensor$dailysensor_id <- 1:nrow(t_dailysensor)
```

```
	# Keep the columns that were in the original database table
	t_dailysensor <-
t_dailysensor[,c("dailysensor_id","location_id","failure_id","location_description",
"sensor","sensor_name","report_time",

"dailysensor_inserted","dailysensor_inserted_by","dailysensor_updated")]

# Write the database tables

	setwd("../../database")

	if(outage_flag == 1) {
		write.table(t_dailyatmos, "t_dailyatmos.csv", row.names = FALSE, sep=",")
	}

	if(sensor_flag == 1) {
		write.table(t_dailysensor, "t_dailysensor.csv", row.names = FALSE, sep=",")
	}
```

----------SCRIPT TO READ API DATA AND INSERT INTO DATABASE----------

```
suppressMessages(library(lubridate))
suppressMessages(library(plyr))
suppressMessages(library(dplyr))
suppressMessages(library(stringr))
suppressMessages(library(openxlsx))
suppressMessages(library(tools))
suppressMessages(library(httr))
suppressMessages(library(jsonlite))
suppressMessages(library(digest))

#suppressMessages(library(RMariaDB))
#suppressMessages(library(rsyslog))

# FIXES

# skip sites that aren't in t_location
# For sites that don't report_assign the failure "Not Reporting", this only applies to t_atmos

# Change location in the noramlization/demormalization, get rid of r_site_crossref.csv
```

```
# Some sites can be missing from the API query - how to handle?

# API Information

	#Some sample requests using this API key are below.  The top request is for sensorpheric observations for station OH001.  The bottom request is for surface observations for station OH001.

	# WeatherSentry API
# https://api.com/random/random/exampletext/

# How to HTTP in R
# https://medium.com/@traffordDataLab/querying-apis-in-r-39029b73d5f1`


#path <- "https://api.com/random/random/exampletext/"

# atmospheric
# path <- "https://api.com/random/random/exampletext/"

# Sensors
#path <- "https://api.com/random/random/exampletext/"

	# API Connection info
	#myquery$failure_code
	#myquery$request

rm(list = ls())
options(max.print=10000)
options(digits=6)
Sys.setenv(TZ='America/New_York')

# Staging

	# OPTIONS FOR TESTING
	# These options are for testing and are not going to be in the production code
	# Option 1: Make input database tables t_atmos, t_atmos_item, t_sesnor, t_sensor_item
	# blank with header only if empty_tables == 1, leave as-is if == 0
	empty_tables <- 0
	# Option 2: Use simulated report_time dates if simulation == 1, do not simulate if simulation == 0
	simulation <- 1
```

```
	tday <- Sys.time()
	attr(tday,"tzone") <- "America/Denver"
	tdayf2 <- format(tday, "%y%m%d_%H%M%S")
	attr(tday,"tzone") <- "UTC"
	tdayf <- format(tday, "%Y-%m-%d %H:%M:%S")


	# Choose one type of query, and one site.  Site is "OH001" in the URL.
	home <- "setwd('~/analytics/scripts')"
	eval(parse(text = home))

	# Read reference data for normalization purposes
	setwd("../database")
	site_cref <- read.csv("r_site_crossref.csv", stringsAsFactors = FALSE, na.strings =
c("NA",""))
	setwd("../input_files")

	setwd("../database")

	t_location <- read.csv("t_location.csv", stringsAsFactors = FALSE, na.strings = c("NA",""))
	t_location <- subset(t_location, select = c(location_id, ws_location_name,
ws_location_number))

	r_failure <- read.csv("r_failure.csv", stringsAsFactors = FALSE, na.strings = c("NA",""))
	r_failure <- subset(r_failure, select = c(failure_id, failure, failure_datasource))

	# Read the database tables that store the WeatherSentry data
	t_atmos <- read.csv("t_atmos.csv", stringsAsFactors = FALSE, na.strings = c("NA",""))
	t_atmos_item <- read.csv("t_atmos_item.csv", stringsAsFactors = FALSE, na.strings =
c("NA",""))
	t_sensor <- read.csv("t_sensor.csv", stringsAsFactors = FALSE, na.strings = c("NA",""))
	t_sensor_item <- read.csv("t_sensor_item.csv", stringsAsFactors = FALSE, na.strings =
c("NA",""))

	# Option for testing
	if(empty_tables == 1) {
		t_atmos <- t_atmos[0,]
		t_atmos_item <- t_atmos_item[0,]
		t_sensor <- t_sensor[0,]
		t_sensor_item <- t_sensor_item[0,]
	}

	# Options for testing - simulate the report_time
	# This applies only to data already in t_atmos and t_sensor
```

```
	# Scramble up the dates
	if(simulation == 1 & nrow(t_atmos) > 0) {
		# Date simulation is going to go in the ws_collect script
		adt <- as.POSIXct(paste0(date(tdayf), "06:00:00"))
		attr(adt,"tzone") <- "UTC"
		for(k in 1:30) {
			adt <- c(adt, adt[1] - days(k))
		}
		adt <- format(adt,"%Y-%m-%d %H:%M:%S")
		t_atmos$report_time <- sample(adt, nrow(t_atmos),replace = TRUE)
		t_sensor$report_time <- sample(adt, nrow(t_sensor),replace = TRUE)
	}

# Denormalize the historical data

	# t_atmos  <- join(t_atmos, t_location, by="location_id")

	atmos_cols <-
c("location_id","atmos_item_set_id","report_time","temperature","dew_point","relative_humidity",
"wind_speed","wind_direction","wind_gust",

"visibility","precipitation_rate","atmos_inserted","atmos_inserted_by","atmos_updated")

	t_atmos <- t_atmos[,atmos_cols]

	atmos_item_cols <- c("atmos_item_set_id","failure_id","count","atmos_item_inserted",
			"atmos_item_inserted_by","atmos_item_updated")

	t_atmos_item <- t_atmos_item[,atmos_item_cols]




# Get Atmospheric Measurements from WS API query for t_atmos

	# df has all data for all sites
	atmos <- NULL
	# failure has failure data for all sites
	failure <- NULL
	# StationId
	i <- 0

	for(j in 1:250) {
		i <- i + 1
```

```
        print(i)

        # Skip if the site is not in t_location
        if(i %in% t_location$ws_location_number) {

        a <- str_pad(as.character(i), 3, "left", pad = "0")
        path <- paste0("https://api.dtn.com/weather/stations/OH", a,
"/atmospheric-observations?hours=1&units=us&precision=1&apikey=aGwSJ1OWuhLifG28IznmrYYQcdtEnIpS")
        myquery <-  GET(url = path)
        output <- httr::content(myquery, as = "text")
        z <- fromJSON(output)

        if("stationId" %in% names(z)) {  # If true this is a DTS site that is reporting

            # Process the qcFailures list, if there is even one failure over past hour include it
            if("qcFailures" %in% names(z) & sum(!is.na(z$qcFailures)) > 0) {
                temp <- bind_rows(z$qcFailures)
                temp$StationId <- paste0("OH",a)

                # Assemble a dataframe of all values in case we want to analyze
                if(is.null(failure)){
                    failure <- temp
                }else {
                    failure <- rbind(failure, temp)
                }
            }

            # Extract from embedded dataframe
            z$precipitation_rate <- z$precipitation$rate

            keepcols <- c("stationId",
                          #"latitude",
                          #"longitude",
                          "utcTime",
                          "temperature",
                          "dewPoint",
                          #"wetBulbTemp",
                          "relativeHumidity",
                          "windSpeed",
                          "windDirection",
                          "windGust",
                          "visibility",
                          "precipitation_rate"
```

```
                        #"pressureSeaLevel"
                )

                z <- z[nrow(z), keepcols]

                if(is.null(atmos)){
                        atmos <- z
                        report_time <- as.POSIXct(strptime(z$utcTime[nrow(z)],
"%Y-%m-%dT%H:%M:%SZ"), tz = "UTC")
                        print(paste0("Time of the WeatherSentry API Query in UTC = ",
report_time))
                }
                else {
                        atmos <- bind_rows(atmos, z)
                }
        }else {
                # The DTS site is not reporting
                temp <- data.frame(attribute = "Not Reporting", arrayIndex = NA, causes = "",
                                StationId = paste0("OH",a))
                if(is.null(failure)){
                        failure <- temp
                }else {
                        failure <- rbind(failure, temp)
                }
        } # Go to the next site
        } # Skip the site if it is not in t_location, it is not a site in DTS PFP project
    } # end for loop

    # The key for joining to t_atmos_item, use 0 if no failures by default, and set key below for
sites with failures
    atmos$atmos_item_set_id <- 0
    atmos <- subset(atmos, select = -c(utcTime))
    report_time <- format(report_time,"%Y-%m-%d %H:%M:%S")

    atmos$report_time <- report_time
    atmos$atmos_inserted <- tdayf
    atmos$atmos_inserted_by <- "ws_collect"
    atmos$atmos_updated <- tdayf

    names(atmos) <- c(
        "ws_location_name",
        "temperature",
        "dew_point",
        "relative_humidity",
```

```
            "wind_speed",
            "wind_direction",
            "wind_gust",
            "visibility",
            "precipitation_rate",
            "atmos_item_set_id",
            "report_time",
            "atmos_inserted",
            "atmos_inserted_by",
            "atmos_updated"
      )

# Get Atmospheric Failures from WS API query for t_atmos_item

      # Here are the types of failures we are recording
      sort(unique(failure$attribute))
      # We want these in our df
      failure_all_col <- c("temperature","windSpeed","windDirection","windGusts",
"wetBulbTemp",
                           "dewPoint","precipitation.accumulation.6H","precipitation.accumulation.24H",
                           "precipitation.precipDetected","precipitation.rate","relativeHumidity",
"visibility",
                           "precipitation.accumulation.1H","precipitation.accumulation.3H",
                           "precipitation.accumulation.12H", "Not Reporting")

      # Warn if we are missing a failure
      if(sum(!failure$attribute %in% failure_all_col) > 0) {
            print("Need to add a failure attribute to the df data frame: ")
            print(unique(failure$attribute[!failure$attribute %in% failure_all_col]))
      }

      failure <- failure[failure$attribute %in% failure_all_col,c("attribute","StationId")]

      # Aggregate the failure data so we can get it into df
      failure$num <- 1
      fagg <- aggregate(num ~ attribute + StationId, data = failure, sum)
      fagg$attribute <- gsub("\\.","_",fagg$attribute)

      # Names in schema
      names(fagg) <- c("failure","ws_location_name","count")
      fagg$atmos_item_set_id <- 0
      fagg$atmos_item_inserted <- tdayf
      fagg$atmos_item_inserted_by <- "ws_collect"
      fagg$atmos_item_updated <- tdayf
```

```
	# Find the index in t_atmos
	if(nrow(t_atmos) == 0) {
		index <- 0
	}else {
		index <- max(t_atmos$atmos_item_set_id)
	}

	sites <- unique(atmos$ws_location_name)

	# Assign the key to link the tables
	for(i in sites) {
		# for(j in c(0,1,2,3)) would need another loop for sensors here
		# Check if there is a failure for the location_name
		if(i %in% fagg$ws_location_name) {
			index <- index + 1
			atmos$atmos_item_set_id[atmos$ws_location_name == i] <- index
			fagg$atmos_item_set_id[fagg$ws_location_name == i] <- index
		}
	}




	atmos <- join(atmos, t_location, by = "ws_location_name")
	atmos <- atmos[,atmos_cols]

	t_atmos <- rbind(t_atmos, atmos)

	# This key needs to be assigned for the whole table for database simulation purposes only
	t_atmos$atmos_id <- 1:nrow(t_atmos)
	t_atmos <- t_atmos[,c("atmos_id",atmos_cols)]

	write.table(t_atmos, "t_atmos.csv", row.names = FALSE, sep=",")

# Normalize failure_id for fagg

	fagg <- join(fagg, r_failure, by="failure")
	fagg <- fagg[,atmos_item_cols]

	t_atmos_item <- rbind(t_atmos_item, fagg)

	# This key needs to be assigned for the whole table for database simulation purposes only
```

```
t_atmos_item$atmos_item_id <- 1:nrow(t_atmos_item)
t_atmos_item <- t_atmos_item[,c("atmos_item_id",atmos_item_cols)]

write.table(t_atmos_item, "t_atmos_item.csv", row.names = FALSE, sep=",")
```

NOW DO THE SAME THING FOR THE PAVEMENT SENSOR DATA - AND COMBINE IN THE SAME DATAFRAME "ws".

JOIN THE API ATMOS DATA TO API ROAD SESNOR DATA AND THEN TO site_cref and webdata

########PAVEMENT SENSORS

```
# Denormalize

# t_sensor  <- join(t_sensor, t_location, by="location_id")

sensor_cols <- c("location_id","sensor_item_set_id","report_time","sensor_number",
                 "sensor_name",
                 "road_temp",
                 "bridge_temp",
                 "freeze_temp",
                 "pavement_sensor_obs_error",
                 "subsurface_temperature",
                 "sensor_inserted","sensor_inserted_by","sensor_updated")

t_sensor <- t_sensor[,sensor_cols]

sensor_item_cols <- c("sensor_item_set_id","failure_id","count","sensor_item_inserted",
                      "sensor_item_inserted_by","sensor_item_updated")

t_sensor_item <- t_sensor_item[,sensor_item_cols]
```

# df has all data for all sites
sensor <- NULL
# failure has failure data for all sites
failure <- NULL
# StationId

```
i <- 0

      for(j in 1:25) {
            i <- i + 1
            print(i)

            # Skip if the site is not in t_location
            if(i %in% t_location$ws_location_number) {

            a <- str_pad(as.character(i), 3, "left", pad = "0")
            path <- paste0("https://api.dtn.com/weather/stations/OH", a,
"/pavement-observations?hours=1&units=us&precision=1&apikey=aGwSJ1OWuhLifG28IznmrY
YQcdtEnIpS")

            myquery <-  GET(url = path)
            output <- httr::content(myquery, as = "text")
            z2 <- fromJSON(output)

            if("stationId" %in% names(z2)) {

                  # Process the qcFailures list, if there is even one failure over past hour include it
                  if("qcFailures" %in% names(z2) & sum(!is.na(z2$qcFailures)) > 0) {

                        temp <- NULL

                        for(k in 1:nrow(z2)) {
                              if(is.null(z2$qcFailures[[k]]$attribute)) {
                                    fail <- data.frame(attribute = NA,
                                                StationId = paste0("OH",a),
                                                sensorId = z2$sensorId[k], stringsAsFactors =
FALSE)
                              }else {
                                    fail <- data.frame(attribute = z2$qcFailures[[k]]$attribute,
                                                StationId = paste0("OH",a),
                                                sensorId = z2$sensorId[k], stringsAsFactors =
FALSE)
                              }
                              if(is.null(temp)) {
                                    temp <- fail
                              }else {
                                    temp <- rbind(temp,fail)
                              }

                        }
```

```
                # Assemble a dataframe of all values in case we want to analyze
                if(is.null(failure)){
                        failure <- temp
                }else {
                        failure <- rbind(failure, temp)
                }
        }

        if("subsurfaceTemps" %in% names(z2) & sum(!is.na(z2$subsurfaceTemps)) > 0
) {

                sstemp <- NULL

                for(x in 1:nrow(z2)) {
                        if(is.null(z2$subsurfaceTemps[[x]]$temperature)) {
                                ssvec <- NA
                        }else {
                                # For sites that are erroneously returning two temps for one
sensor
                                # take the first one (example "OH098")
                                if(length(z2$subsurfaceTemps[[x]]$temperature) > 1) {
                                        print(paste0("WS API has returned more than 1 temperature
per sensor: OH", a))
                                }
                                ssvec <- z2$subsurfaceTemps[[x]]$temperature[1]
                        }
                        if(is.null(sstemp)) {
                                sstemp <- ssvec
                        }else {
                                sstemp <- c(sstemp, ssvec)
                        }
                }
                z2$subsurfaceTemps <- sstemp
        } else {
                z2$subsurfaceTemps <- NA
        }

        z2 <- z2[z2$utcTime == max(z2$utcTime),
                        c("stationId",
                        #"latitude",
                        #"longitude",
                        "utcTime",
```

```
                                #"precipitation" this is an embedded dataframe may need to
process later
                                "sensorId",
                                "sensorName",
                                #"surfaceCondition",
                                #"mobileFriction",
                                "roadTemp",
                                "bridgeTemp",
                                "freezeTemp",
                                #"chemicalPercent",
                                #"chemicalFactor",
                                #"waterLevel",
                                #"icePercent",
                                #"conductivity",
                                #"salinity",
                                "subsurfaceTemps", # We may need to add this back in later
                                "pavementSensorObservationError"
                    )]

                    if(is.null(sensor)){
                        sensor <- z2
                        report_time <- as.POSIXct(strptime(z2$utcTime[nrow(z2)],
"%Y-%m-%dT%H:%M:%SZ"), tz = "UTC")
                        attr(report_time,"tzone") <- "America/New_York"
                        print(paste0("Time of the WeatherSentry API Query in Eastern Time = ",
report_time))
                    }
                    else {
                        sensor <- bind_rows(sensor, z2)
                    }
                } # Go to the next site
                } # Skip the site if it is not in t_location, it is not a site in DTS PFP project
        } # for loop

# The key for joining to t_sensor_item, use 0 if no failures by default, and set key below for sites
with failures

        sensor$sensor_item_set_id <- 0
        sensor <- subset(sensor, select = -c(utcTime))
        report_time <- format(report_time,"%Y-%m-%d %H:%M:%S")

        sensor$report_time <- report_time
        sensor$sensor_inserted <- tdayf
        sensor$sensor_inserted_by <- "ws_collect"
```

```
    sensor$sensor_updated <- tdayf

    names(sensor) <- c(
        "ws_location_name",
        "sensor_number",
        "sensor_name",
        #"surface_condition",
        #"mobile_friction",
        "road_temp",
        "bridge_temp",
        "freeze_temp",
        "subsurface_temperature",
        "pavement_sensor_obs_error",
        "sensor_item_set_id",
        "report_time",
        "sensor_inserted",
        "sensor_inserted_by",
        "sensor_updated"
    )


# Here are the types of failures we are recording
    sort(unique(failure$attribute))
    # We want these in our df2
    failure_all_col <- c("salinity", "subSurfaceTemps", "surfaceCondition", "surfaceTemp")

# Remove causes and columns we wont use
    if(sum(!failure$attribute %in% failure_all_col) > 0) {
        print("Need to add a failure attribute to the df2 data frame: ")
        print(unique(failure$attribute[!failure$attribute %in% failure_all_col]))
    }

    failure <- failure[failure$attribute %in% failure_all_col,c("attribute","StationId", "sensorId")]

    # Aggregate the failure data so we can get it into df
    failure$num <- 1
    fagg <- aggregate(num ~ attribute + StationId, data = failure, sum)
    fagg$attribute <- gsub("\\.","_",fagg$attribute)

    # Names in schema
    names(fagg) <- c("failure","ws_location_name","count")
    fagg$sensor_item_set_id <- 0
    fagg$sensor_item_inserted <- tdayf
    fagg$sensor_item_inserted_by <- "ws_collect"
```

```
fagg$sensor_item_updated <- tdayf

# Find the index in t_sensor
if(nrow(t_sensor) == 0) {
	index <- 0
}else {
	index <- max(t_sensor$sensor_item_set_id)
}

sites <- unique(sensor$ws_location_name)

# Assign the key to link the tables
for(i in sites) {
	# for(j in c(0,1,2,3)) would need another loop for sensors here
	# Check if there is a failure for the location_name
	if(i %in% fagg$ws_location_name) {
		index <- index + 1
		sensor$sensor_item_set_id[sensor$ws_location_name == i] <- index
		fagg$sensor_item_set_id[fagg$ws_location_name == i] <- index
	}
}



#using location_id and ws_location_name for normalization and denormalization
#Get the t_sensor and t_sensor_item tables updating first, with normalization and denormalization
#Test by sourcing the script multiple times to confirm data are being added to the tables each time it is run
#Once it is fully working, weâ ™ll meet to discuss t_sensor/t_sensor_item and how it will differ for storing sensor data for the site.

sensor <- join(sensor, t_location, by = "ws_location_name")
sensor <- sensor[,sensor_cols]

t_sensor <- rbind(t_sensor, sensor)

# This key needs to be assigned for the whole table for database simulation purposes only
t_sensor$sensor_id <- 1:nrow(t_sensor)
t_sensor <- t_sensor[,c("sensor_id",sensor_cols)]

write.table(t_sensor, "t_sensor.csv", row.names = FALSE, sep=",")

# Normalize failure_id for fagg
```

```
fagg <- join(fagg, r_failure, by="failure")
fagg <- fagg[,sensor_item_cols]

t_sensor_item <- rbind(t_sensor_item, fagg)

# This key needs to be assigned for the whole table for database simulation purposes only
t_sensor_item$sensor_item_id <- 1:nrow(t_sensor_item)
t_sensor_item <- t_sensor_item[,c("sensor_item_id",sensor_item_cols)]

write.table(t_sensor_item, "t_sensor_item.csv", row.names = FALSE, sep=",")
```

-----SCRIPT TO READ API DATA AND INSERT INTO DATABASE WITH AGGREGATIONS----

```
suppressMessages(library(lubridate))
suppressMessages(library(plyr))
suppressMessages(library(dplyr))
suppressMessages(library(stringr))
suppressMessages(library(openxlsx))
suppressMessages(library(tools))
suppressMessages(library(httr))
suppressMessages(library(jsonlite))
suppressMessages(library(digest))

#suppressMessages(library(RMariaDB))
#suppressMessages(library(rsyslog))

# FIXES

# Change location in the noramlization/demormalization, get rid of r_site_crossref.csv
# Some sites can be missing from the API query - how to handle?

# API Information

#Some sample requests using this API key are below.  The top request is for sensorpheric observations for station OH001.  The bottom request is for surface observations for station OH001.

# WeatherSentry API
# https://api.com/random/random/exampletext/

# How to HTTP in R
```

```
# https://medium.com/@traffordDataLab/querying-apis-in-r-39029b73d5f1`


#path <- "https://api.com/random/random/exampletext/"

# atmospheric
# path <- "https://api.com/random/random/exampletext/"

# Sensors
#path <- "https://api.com/random/random/exampletext/"

# API Connection info
#myquery$failure_code
#myquery$request

rm(list = ls())
options(max.print=10000)
options(digits=6)
Sys.setenv(TZ='America/New_York')

# Staging

    home <- "setwd('~/analytics/scripts')"
    eval(parse(text = home))

    # Specify the retention days for data in t_atmos and t_sensor tables and their item tables
    retention_days <- 10

    tday <- Sys.time()
    attr(tday,"tzone") <- "America/Denver"
    tdayf2 <- format(tday, "%y%m%d_%H%M%S")
    attr(tday,"tzone") <- "UTC"
    tdayf <- format(tday, "%Y-%m-%d %H:%M:%S")

# Read reference data for normalization purposes
setwd("../database")
site_cref <- read.csv("r_site_crossref.csv", stringsAsFactors = FALSE, na.strings = c("NA",""))
setwd("../input_files")

setwd("../database")

# Read the database tables that store the WeatherSentry data

t_atmos <- read.csv("t_atmos.csv", stringsAsFactors = FALSE, na.strings = c("NA",""))
```

```
t_atmos_item <- read.csv("t_atmos_item.csv", stringsAsFactors = FALSE, na.strings =
c("NA",""))
t_sensor <- read.csv("t_sensor.csv", stringsAsFactors = FALSE, na.strings = c("NA",""))
t_sensor_item <- read.csv("t_sensor_item.csv", stringsAsFactors = FALSE, na.strings =
c("NA",""))

t_availability <- read.csv("t_availability.csv", stringsAsFactors = FALSE, na.strings = c("NA",""))

r_failure <- read.csv("r_failure.csv", stringsAsFactors = FALSE, na.strings = c("NA",""))
unneeded <-
c("precipitation_accumulation_3H","precipitation_accumulation_6H","precipitation_accumulation
_12H",
            "salinity","surfaceCondition")
r_failure <- r_failure[!r_failure$failure %in% unneeded,]
r_failure_atmos <- r_failure$failure_id[r_failure$failure_datasource == "api_atmospheric"]
r_failure_sensor <- r_failure$failure_id[r_failure$failure_datasource == "api_sensor"]

t_location <- read.csv("t_location.csv", stringsAsFactors = FALSE, na.strings = c("NA",""))
t_location_vec <- t_location$location_id[t_location$active == 1]

t_asset <- read.csv("t_asset.csv", stringsAsFactors = FALSE, na.strings = c("NA",""))
t_asset <- t_asset[,c("asset_status_id","location_id")]

# Make this just availability_cols


# Consolidate this to a single table t_availability and remove unused statements



t_availability_cols <- c("location_id",
              "failure_id",
              "asset_status_id",
              "report_date",
              "count",
              "availability_inserted",
              "availability_inserted_by",
              "availability_updated")

t_availability <- t_availability[,t_availability_cols]


#
# Determine if date(t_atmos$report_time) %in% t_availability$report_date
```

```
# If it is in, there is nothing to do.

    alldates <- as.character(unique(date(t_atmos$report_time)))
    newdates <- alldates[!alldates %in% t_availability$report_date]

    #atmos

    if(length(newdates) > 0) {

        t_atmos <- t_atmos[as.character(date(t_atmos$report_time)) %in% newdates, ]

        # Convert report_time time zone to Eastern before availabilityregation (convert string
to as.POSIXct(), then use attr() to change tz to Eastern)
        #Give some new name:
        t_atmos_item <- join(t_atmos, t_atmos_item, by = "atmos_item_set_id")

        t_atmos_item$report_time <-  as.POSIXct(t_atmos_item$report_time, tz = "UTC")
        attr(t_atmos_item$report_time, "tzone") <- "America/New_York"

        t_atmos_item$report_date <- date(t_atmos_item$report_time)

        #as.Date(t_atmos_item$report_time, tz = "EST", format = "%Y-%m-%d-%h")
        #format = "%Y-%m-%d-%h-%m-%s"

        aagg <- aggregate(count ~ location_id + failure_id + report_date, t_atmos_item, sum)

        aagg$report_date <- format(aagg$report_date, "%Y-%m-%d")

        df <- expand.grid(location_id = t_location_vec, failure_id = r_failure_atmos,
report_date = newdates)

        aagg <- join(df, aagg, by = c("location_id", "failure_id", "report_date"))
        aagg$count[is.na(aagg$count)] <- 0

        # Assign the current asset_status_id START HERE - APPLY THIS TO SENSOR

        aagg <- join(aagg, t_asset, by = "location_id")

        aagg$availability_inserted <- tdayf
        aagg$availability_inserted_by <- "ws_aggregate"
        aagg$availability_updated <- tdayf
        names(aagg)[names(aagg) == "count"] <- "count"

        aagg <- aagg[,t_availability_cols]
```

```
        # now check that you match the schema exactly before doing rbind (t_availability)
        t_availability <- rbind(t_availability, aagg)
    }


#sensor

    # Determine if date(t_sensor$report_time) %in% t_availability$report_date
    # If it is in, there is nothing to do.

    # Can't do this because newdates already added to t_availability above
    #alldates <- unique(date(t_sensor$report_time))
    #newdates <- alldates[!alldates %in% t_availability$report_date]

    if(length(newdates) > 0) {




        #t_sensor <- t_sensor[as.character(date(t_sensor$report_time)) %in% newdates, ]

        # Convert report_time time zone to Eastern before aggregation (convert string to
as.POSIXct(), then use attr() to change tz to Eastern)
        #Give some new name:
        t_sensor_item <- join(t_sensor, t_sensor_item, by = "sensor_item_set_id")

        t_sensor_item$report_time <-  as.POSIXct(t_sensor_item$report_time, tz = "UTC")
        attr(t_sensor_item$report_time, "tzone") <- "America/New_York"

        t_sensor_item$report_date <- date(t_sensor_item$report_time)

        #as.Date(t_sensor_item$report_time, tz = "EST", format = "%Y-%m-%d-%h")
        #format = "%Y-%m-%d-%h-%m-%s"

        sagg <- aggregate(count ~ location_id + failure_id + report_date, t_sensor_item, sum)

        sagg$report_date <- format(sagg$report_date, "%Y-%m-%d")

        df <- expand.grid(location_id = t_location_vec, failure_id = r_failure_sensor,
report_date = newdates)

        sagg <- join(df, sagg, by=c("location_id", "failure_id", "report_date"))
        sagg$count[is.na(sagg$count)] <- 0
```

```
            sagg <- join(sagg, t_asset, by = "location_id")

            sagg$availability_inserted <- tdayf
            sagg$availability_inserted_by <- "ws_aggregate"
            sagg$availability_updated <- tdayf
            names(sagg)[names(sagg) == "count"] <- "count"

            sagg <- sagg[,t_availability_cols]

            # now check that you match the schema exactly before doing rbind (t_availability)
            t_availability <- rbind(t_availability, sagg)
}

      # Assign key and get columns in the right order before writing to database
      t_availability$availability_id <- 1:nrow(t_availability)
      t_availability_cols <- c("availability_id",t_availability_cols)
      t_availability <- t_availability[,t_availability_cols]

      t_availability$availability_id <- 1:nrow(t_availability)
      t_availability <- t_availability[,c("availability_id",t_availability_cols)]

      write.table(t_availability, "t_availability.csv", row.names = FALSE, sep=",")  # Do this after
t_sensor


# Next: Delete records in t_atmos and t_atmos_item that are older than "retention_days"

      # Hints
      # You need to determine atmos_item_set_id keys that are older than the retention_days
and
      # delete from t_atmos_item table using the keys
      # Find retention_cutoff_datetime <- tdayf - days(retention_days)

      # delete_keys  <- t_atmos$atmos_item_set_id[t_atmos$report_time <
retention_cutoff_datetime]
      # t_atmos_item <- t_atmos_item[!t_atmos_item$atmos_item_set_id %in% delete_keys]
      # Do the same thing for t_sensor and t_sensor_item

      # Read the database tables that store the WeatherSentry data
      # Need to read again becuase tables changed per above
      t_atmos <- read.csv("t_atmos.csv", stringsAsFactors = FALSE, na.strings = c("NA",""))
```

```
    t_atmos_item <- read.csv("t_atmos_item.csv", stringsAsFactors = FALSE, na.strings =
c("NA",""))
    t_sensor <- read.csv("t_sensor.csv", stringsAsFactors = FALSE, na.strings = c("NA",""))
    t_sensor_item <- read.csv("t_sensor_item.csv", stringsAsFactors = FALSE, na.strings =
c("NA",""))

    retention <- Sys.Date() - 10

    retain_keys  <- t_atmos$atmos_item_set_id[date(t_atmos$report_time) >= retention &
t_atmos$atmos_item_set_id != 0]
    t_atmos <- t_atmos[date(t_atmos$report_time) >= retention, ]
    t_atmos_item <- t_atmos_item[t_atmos_item$atmos_item_set_id %in% retain_keys,]

    retain_keys  <- t_sensor$sensor_item_set_id[date(t_sensor$report_time) >= retention &
t_sensor$sensor_item_set_id != 0]
    t_sensor <- t_sensor[date(t_sensor$report_time) >= retention, ]
    t_sensor_item <- t_sensor_item[t_sensor_item$sensor_item_set_id %in% retain_keys,]
```