# climateVelocity

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We create a box (Quebec plus buffer)

```r
bbox <- data.frame("xmin" = -1631298.5, "xmax" = 1183769.6, "ymax" =  3202287.0,"ymin" = -945173.4 )
srs.cube <- "EPSG:6623"
```

**Mean temperature in 1981**

```r
cube <-
  load_cube(stac_path = "https://io.biodiversite-quebec.ca/stac/",
            limit = NULL,
            collections = c("chelsa-monthly"),
            use.obs = F,
            bbox = bbox,
            buffer.box = 0,
          # layers = c("bio1"),
            variable = "tas",
            srs.cube = srs.cube,
            t0 = "1981-01-01",
            t1 = "1981-12-01",
            spatial.res = 1000, # in meters
            temporal.res = "P1Y",
            aggregation = "mean",
            resampling = "near")
```

```
## Warning in gdalcubes::stac_image_collection(it_obj$features, asset_names =
## layers, : STAC asset with name 'tas_01_1981' does not include eo:bands metadata
## and will be considered as a single band source

## Warning in gdalcubes::stac_image_collection(it_obj$features, asset_names =
## layers, : STAC asset with name 'tas_02_1981' does not include eo:bands metadata
## and will be considered as a single band source

## Warning in gdalcubes::stac_image_collection(it_obj$features, asset_names =
## layers, : STAC asset with name 'tas_03_1981' does not include eo:bands metadata
## and will be considered as a single band source

## Warning in gdalcubes::stac_image_collection(it_obj$features, asset_names =
## layers, : STAC asset with name 'tas_04_1981' does not include eo:bands metadata
## and will be considered as a single band source
```

```
## Warning in gdalcubes::stac_image_collection(it_obj$features, asset_names =
## layers, : STAC asset with name 'tas_05_1981' does not include eo:bands metadata
## and will be considered as a single band source

## Warning in gdalcubes::stac_image_collection(it_obj$features, asset_names =
## layers, : STAC asset with name 'tas_06_1981' does not include eo:bands metadata
## and will be considered as a single band source

## Warning in gdalcubes::stac_image_collection(it_obj$features, asset_names =
## layers, : STAC asset with name 'tas_07_1981' does not include eo:bands metadata
## and will be considered as a single band source

## Warning in gdalcubes::stac_image_collection(it_obj$features, asset_names =
## layers, : STAC asset with name 'tas_08_1981' does not include eo:bands metadata
## and will be considered as a single band source

## Warning in gdalcubes::stac_image_collection(it_obj$features, asset_names =
## layers, : STAC asset with name 'tas_09_1981' does not include eo:bands metadata
## and will be considered as a single band source

## Warning in gdalcubes::stac_image_collection(it_obj$features, asset_names =
## layers, : STAC asset with name 'tas_10_1981' does not include eo:bands metadata
## and will be considered as a single band source

## Warning in gdalcubes::stac_image_collection(it_obj$features, asset_names =
## layers, : STAC asset with name 'tas_11_1981' does not include eo:bands metadata
## and will be considered as a single band source

## Warning in gdalcubes::stac_image_collection(it_obj$features, asset_names =
## layers, : STAC asset with name 'tas_12_1981' does not include eo:bands metadata
## and will be considered as a single band source

## Warning in gdalcubes::stac_image_collection(it_obj$features, asset_names =
## layers, : STAC asset with name 'tasmax_01_1981' does not include eo:bands
## metadata and will be considered as a single band source

## Warning in gdalcubes::stac_image_collection(it_obj$features, asset_names =
## layers, : STAC asset with name 'tasmax_02_1981' does not include eo:bands
## metadata and will be considered as a single band source

## Warning in gdalcubes::stac_image_collection(it_obj$features, asset_names =
## layers, : STAC asset with name 'tasmax_03_1981' does not include eo:bands
## metadata and will be considered as a single band source

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## layers, : STAC asset with name 'tasmax_04_1981' does not include eo:bands
## metadata and will be considered as a single band source

## Warning in gdalcubes::stac_image_collection(it_obj$features, asset_names =
## layers, : STAC asset with name 'tasmax_05_1981' does not include eo:bands
## metadata and will be considered as a single band source
```

```
## Warning in gdalcubes::stac_image_collection(it_obj$features, asset_names =
## layers, : STAC asset with name 'tasmax_06_1981' does not include eo:bands
## metadata and will be considered as a single band source

## Warning in gdalcubes::stac_image_collection(it_obj$features, asset_names =
## layers, : STAC asset with name 'tasmax_07_1981' does not include eo:bands
## metadata and will be considered as a single band source

## Warning in gdalcubes::stac_image_collection(it_obj$features, asset_names =
## layers, : STAC asset with name 'tasmax_08_1981' does not include eo:bands
## metadata and will be considered as a single band source

## Warning in gdalcubes::stac_image_collection(it_obj$features, asset_names =
## layers, : STAC asset with name 'tasmax_09_1981' does not include eo:bands
## metadata and will be considered as a single band source

## Warning in gdalcubes::stac_image_collection(it_obj$features, asset_names =
## layers, : STAC asset with name 'tasmax_10_1981' does not include eo:bands
## metadata and will be considered as a single band source

## Warning in gdalcubes::stac_image_collection(it_obj$features, asset_names =
## layers, : STAC asset with name 'tasmax_11_1981' does not include eo:bands
## metadata and will be considered as a single band source

## Warning in gdalcubes::stac_image_collection(it_obj$features, asset_names =
## layers, : STAC asset with name 'tasmax_12_1981' does not include eo:bands
## metadata and will be considered as a single band source

## Warning in gdalcubes::stac_image_collection(it_obj$features, asset_names =
## layers, : STAC asset with name 'tasmin_01_1981' does not include eo:bands
## metadata and will be considered as a single band source

## Warning in gdalcubes::stac_image_collection(it_obj$features, asset_names =
## layers, : STAC asset with name 'tasmin_02_1981' does not include eo:bands
## metadata and will be considered as a single band source

## Warning in gdalcubes::stac_image_collection(it_obj$features, asset_names =
## layers, : STAC asset with name 'tasmin_03_1981' does not include eo:bands
## metadata and will be considered as a single band source

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## layers, : STAC asset with name 'tasmin_04_1981' does not include eo:bands
## metadata and will be considered as a single band source

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## layers, : STAC asset with name 'tasmin_05_1981' does not include eo:bands
## metadata and will be considered as a single band source

## Warning in gdalcubes::stac_image_collection(it_obj$features, asset_names =
## layers, : STAC asset with name 'tasmin_06_1981' does not include eo:bands
## metadata and will be considered as a single band source
```

```
sum_bands <-  paste(names(cube), collapse="+")
mean_bands <- sprintf("(%s)/%i", sum_bands, length(names(cube)))
cube_bands <-  select_bands(cube, bands =  names(cube))
tmean_cube <- apply_pixel(cube_bands, mean_bands, names = "mean_tmean")
tmean_cube_1981 <- cube_to_raster(tmean_cube, format = "terra")
```

```
## Warning in CPL_read_gdal(as.character(x), as.character(options),
## as.character(driver), : GDAL Message 1: Recode from UTF-8 to CP_ACP failed with
## the error: "Invalid argument".

## Warning in CPL_read_gdal(as.character(x), as.character(options),
## as.character(driver), : GDAL Message 1: Recode from UTF-8 to CP_ACP failed with
## the error: "Invalid argument".
```

**Mean temperature in 2019**

```
cube <-
  load_cube(stac_path = "https://io.biodiversite-quebec.ca/stac/",
            limit = 5000,
            collections = c("chelsa-monthly"),
            use.obs = F,
            bbox = bbox,
            buffer.box = 0,
          #  layers = c("bio1"),
            variable = "tas",
            srs.cube = srs.cube,
            t0 = "2019-01-01",
            t1 = "2019-12-01",
            spatial.res = 1000, # in meters
            temporal.res = "P1Y",
            aggregation = "mean",
            resampling = "near")
sum_bands <-  paste(names(cube), collapse="+")
mean_bands <- sprintf("(%s)/%i", sum_bands, length(names(cube)))
cube_bands <-  select_bands(cube, bands =  names(cube))
tmean_cube <- apply_pixel(cube_bands, mean_bands, names = "mean_tmean")
tmean_cube_2019 <- cube_to_raster(tmean_cube, format = "terra")
```

**Local climate velocity**

```
tmean_cube_2019 <- (tmean_cube_2019 / 10) - 273.15
tmean_cube_1981 <- (tmean_cube_1981 / 10) - 273.15
c_velocity <-
  climate_velocity(
    raster::raster(tmean_cube_1981),
    raster::raster(tmean_cube_2019),
    time_span = 2019 - 1981,
    type = "local",
    opt = "slope",
```

```
    units = "meters",
    neighbors = 8
  )

c_velocity <- terra::rast(c_velocity)
plot(c_velocity)
```