Re: [EXTERNAL] RE: build/start TAT-C

Ravindra, Vinay (ARC-SG)[Bay Area Environmental Research Institute] <vinay.ravindra@nasa.gov>
Tue 9/15/2020 4:45 PM
To: Paul Grogan <pgrogan@stevens.edu>; Nag, Sreeja (ARC-AFO)[Bay Area Environmental Research Institute] <sreeja.nag@nasa.gov>

Hi Paul,

Thanks for the feedback. I think the behaviour of the results with closely repeating ground track for a polar-orbit is consistent with the error in the date input to the ECI to lat/lon conversion. Perhaps the jDate was erroneously at a fixed value in the iteration loop implying in effect the rotation of Earth is not being modeled. (The latitude thus changes while longitude is nearly the same, but not the same because it is not 90 deg inclination orbit.)

I think your fix is correct. The bug is in the GMAT part of the code. Line 455, `prop->Propagate (*orbitDate);` which is supposed to propagate (and also update the corresponding state elements) the satellite tied with the `prop` object (Line 363). It appears though that **only** the six Cartesian states X,Y,Z,VX,VY,VZ of the satellite are being updated in the `Spacecraft` class (and hence the `sat` object) and the **time is not** updated.

See:

1. https://gitlab.tatc-git.net/tat-c/tat-c/-/blob/new_folder_structure/modules/orbits/oc/src/Propagator.cpp (Line 256)
2. https://gitlab.tatc-git.net/tat-c/tat-c/-/blob/new_folder_structure/modules/orbits/oc/src/Spacecraft.cpp (Line 527, the function variable 't' should perhaps be used to update Spacecraft class variable `orbitEpoch`)

We did not come across the same problem in Dshield since we do not use the ECI to lat/lon conversion functionality. I am surprised about that error since I remember Gabe showing some nice heat-map plots of coverage, revisits etc which spanned the entire globe. Perhaps it crept in at a later stage of the project.

Best,
Vinay

From: Paul Grogan <pgrogan@stevens.edu>
Sent: Tuesday, September 15, 2020 2:55 PM
To: Ravindra, Vinay (ARC-SG)[Bay Area Environmental Research Institute] <vinay.ravindra@nasa.gov>; Nag, Sreeja (ARC-AFO)[Bay Area Environmental Research Institute] <sreeja.nag@nasa.gov>
Subject: RE: [EXTERNAL] RE: build/start TAT-C

Greetings Vinay,

Thanks for your thoughts on this one.

I replaced line 477 below with “Spherical” rather than “Elliptical” but get substantially the same results with close to a repeating ground track.

Inspecting the source, code, I was suspicious that the satellite date may not be updating correctly.

I replaced jDate with propTime on line 477 and am now getting reasonable results. Do you have any way to confirm is this is actually a bug?

As this is in the orbits module, it may also be a bug in your codebase.

Cheers,

Paul Grogan

From: Ravindra, Vinay (ARC-SG)[Bay Area Environmental Research Institute] <vinay.ravindra@nasa.gov>
Sent: Tuesday, September 8, 2020 4:44 PM
To: Paul Grogan <pgrogan@stevens.edu>; Nag, Sreeja (ARC-AFO)[Bay Area Environmental Research Institute] <sreeja.nag@nasa.gov>
Subject: Re: [EXTERNAL] RE: build/start TAT-C

Hi Paul,

Looking at the data, there appears to be an error in the conversion from the ECI to the lat, lon coordinates. The Keplerian elements look fine, and also the ECI Cartesian coordinates.

Could you try by replacing 'Ellipsoid' with 'Spherical' in the following line?
https://gitlab.tatc-git.net/tat-c/tat-c/-/blob/new_folder_structure/modules/orbits/rm/src/OrbitPropagator.cpp#L477

In Dshield we are currently using the GMAT part of TATC, and not the rm. And actually I was under the impression we were using spherical Earth shape in TATC while calculating the coordinates (i.e. geocentric lat, lon).
https://gitlab.tatc-git.net/tat-c/tat-c/-/issues/4

Best,
Vinay

From: Paul Grogan <pgrogan@stevens.edu>
Sent: Friday, September 4, 2020 11:16 AM
To: Ravindra, Vinay (ARC-SG)[Bay Area Environmental Research Institute] <vinay.ravindra@nasa.gov>; Nag, Sreeja (ARC-AFO)[Bay Area Environmental Research Institute] <sreeja.nag@nasa.gov>
Subject: RE: [EXTERNAL] RE: build/start TAT-C

Hi Vinay,

Thanks for taking a look – attached is Rhae Sung’s obs file (zipped).

Cheers,

Paul

From: Ravindra, Vinay (ARC-SG)[Bay Area Environmental Research Institute] <vinay.ravindra@nasa.gov>
Sent: Friday, September 4, 2020 1:54 PM
To: Paul Grogan <pgrogan@stevens.edu>; Nag, Sreeja (ARC-AFO)[Bay Area Environmental Research Institute] <sreeja.nag@nasa.gov>
Subject: Re: [EXTERNAL] RE: build/start TAT-C

Hi Paul,

The conversion to ECEF before computing the lat, lons seem OK as seen here:
https://gitlab.tatc-git.net/tat-c/tat-c/-/blob/new_folder_structure/modules/orbits/rm/src/OrbitPropagator.cpp#L477

It seems that for some reason the longitude value is set to 0 always (it appears to pass through the Prime meridian). The latitude values seem to be changing.

Could you check in the raw data output? Also varying the Dates of the mission, and the duration may help to narrow down the cause. There maybe some error in the translation of the duration (P0Y0M91D) to a C++ float type variable.

Best,
Vinay

From: Paul Grogan <pgrogan@stevens.edu>
Sent: Thursday, September 3, 2020 3:09 PM
To: Nag, Sreeja (ARC-AFO)[Bay Area Environmental Research Institute] <sreeja.nag@nasa.gov>
Cc: Ravindra, Vinay (ARC-SG)[Bay Area Environmental Research Institute] <vinay.ravindra@nasa.gov>
Subject: FW: [EXTERNAL] RE: build/start TAT-C

Greetings Sreeja,

Hoping you may have some insight, I forget who was working on the orbit module but only know I am not C++ literate.

Rhae Sung has identified that the geodetic (lat/lon) outputs in the obs file do not show proper ground track propagation. My guess would be there is an error that is using the inertial, rather than earth fixed, Cartesian coordinates to compute the geodetic positions in the obs file output. There does not seem to be problems with the other revisit statistics.

If you have some time, could you take a look? His mission.json file is attached.

Thanks,

Paul Grogan

From: Kim, Rhae Sung (GSFC-617.0)[UNIVERSITIES SPACE RESEARCH ASSOCIATION] <rhaesung.kim@nasa.gov>
Sent: Thursday, September 3, 2020 5:28 PM
To: Paul Grogan <pgrogan@stevens.edu>
Subject: Re: [EXTERNAL] RE: build/start TAT-C

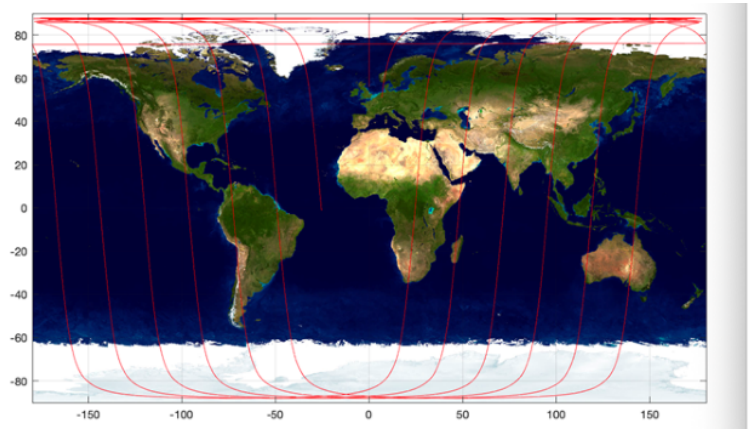
Hello Paul,

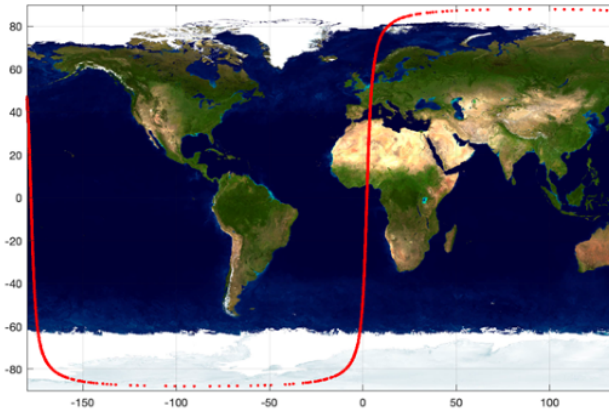
Many thanks for helping this out despite your busy schedule. This works fine now in my side.

When plotting lat, lon data from results, It looks like TAT-C simulates single orbital trace for 91 day period (see attached comparison image, left panel from CVIS and right panel from TAT-C).

1. For getting similar trajectory from CVIS simulation, what should I consider to change in the JASON document?
2. 'Nominal duration' in TAT-C means the revisit time? How do I set the revisit time in the TAT-C? I tried to input 91days here, which is the revisit time of ICESat-2.

Thanks so much in advance,
Rhae Sung





From: Paul Grogan <pgrogan@stevens.edu>
Date: Thursday, September 3, 2020 at 12:38
To: "Kim, Rhae Sung (GSFC-617.0)[UNIVERSITIES SPACE RESEARCH ASSOCIATION]" <rhaesung.kim@nasa.gov>
Subject: RE: [EXTERNAL] RE: build/start TAT-C

Greetings Rhae Sung,

Hope all is well. I normally would like to be able to respond quicker but this has been a challenging week with the start of our new "distance learning" courses as a part of our COVID-19 response plan.

I was able to inspect your mission.json file and, after some digging, there is a simple solution:

The designSpace.spaceSegment.constellationType key should set to "DELTA_HOMOGENEOUS" instead of "EXISTING". Long story short, the EXISTING constellation type requires all satellites be pre-defined inside the constellation rather than being generated by TAT-C to match a constellation pattern. However, TAT-C does not seem to process missions that have no "new" generated constellations (the tradespace size is interpreted as 0). So, to get around this issue, you can have TAT-C generate a constellation with 1 satellite matching your specification. The DELTA_HOMOGENEOUS type with size 1 will arrange the satellite in the expected orbit.

I have attached a prettified JSON document with this change. It runs from the TAT-C "Raw JSON" upload option (takes about 3-4 minutes on my machine).

Cheers,

Paul Grogan

From: Kim, Rhae Sung (GSFC-617.0)[UNIVERSITIES SPACE RESEARCH ASSOCIATION] <rhaesung.kim@nasa.gov>
Sent: Thursday, August 27, 2020 10:09 AM

To: Paul Grogan <pgrogan@stevens.edu>
Subject: Re: [EXTERNAL] RE: build/start TAT-C

Hello Paul,

I have played around with CVIS and it worked great. Thanks!

I am trying to do something similar in TAT-C by customizing the "mission.json" (please see attached, I was trying to use Keplerian elements), but it looks like TAT-C failed to generate "arch-X" directory and "summary.csv" is empty ☹ Did I miss something here?

Please let me know if I miss something or "mission.jon" needs to be corrected.

Thanks,
Rhae Sung

From: Paul Grogan <pgrogan@stevens.edu>
Date: Monday, August 17, 2020 at 09:59
To: "Kim, Rhae Sung (GSFC-617.0)[UNIVERSITIES SPACE RESEARCH ASSOCIATION]" <rhaesung.kim@nasa.gov>
Subject: RE: [EXTERNAL] RE: build/start TAT-C

Greetings Rhae Sung,

You are correct that the obs_X.csv file reports trajectory information which is informed by the orbit section of the input. You can generate a range of orbital specifications using the "Simple" interface by modifying:

- Constellation size (affects plane phasing)
- Orbital planes
- Orbital altitude
- Orbital inclination

This interface does not provide some of the more advanced features like sun-synchronous orbits, for example, where the "correct" inclination varies by altitude. Those would have to be added by customizing the "mission.json" and using the "Raw JSON" interface.

You are right there are a lot of fields in the JSON document. We have a schema defined here https://tatckb.org/schema.html that gives documentation.

The satellite template does not have an impact on the orbital propagation (just cost, etc.).

The columns Lat[deg] and Lon[deg] report the geodetic coordinates in WGS84 and Time[s] is the relative time from the start of the mission.

Alternatively, my group built a related tool at https://cvis.code-lab.org/ that does essentially the same thing but outside of the tradespace exploration framework of TAT-C and provides better visualization of trajectories. You can enter TLE from Celestrak or another source or use Keplerian elements and view elements and download as CSV or JSON. I know others like Bart Forman have used it to generate ground tracks.

Cheers,

Paul

From: Kim, Rhae Sung (GSFC-617.0)[UNIVERSITIES SPACE RESEARCH ASSOCIATION] <rhaesung.kim@nasa.gov>
Sent: Friday, August 14, 2020 2:11 PM
To: Paul Grogan <pgrogan@stevens.edu>
Subject: Re: [EXTERNAL] RE: build/start TAT-C

Hello Paul,

I have played around with TAT-C and tried to generate a simple ground trajectory data from, for example, ICESat-2 satellite simulation.

Some questions:

1. For this process, can I simply use the "simple" request mode and set the satellite template as a "default"? Or do I have to edit "mission.json" file?
2. If I need to upload new "mission.json" file, what parameters should I consider to edit? I am not familiar with every single parameter in this file ☹
3. I guess I can plot/generate the ground trajectory data from 'obs_X.csv (lat, long, time), right? If not, please correct me.

Thanks,
Rhae Sung

From: Paul Grogan <pgrogan@stevens.edu>
Date: Thursday, July 30, 2020 at 18:13
To: "Kim, Rhae Sung (GSFC-617.0)[UNIVERSITIES SPACE RESEARCH ASSOCIATION]" <rhaesung.kim@nasa.gov>
Subject: RE: [EXTERNAL] RE: build/start TAT-C

Greetings Rhae Sung,

Chad was working with Docker for our NOS Testbed project, but some of the concepts translate to TAT-C.

It looks like your project is working as expected. Unfortunately we do not have a good user's guide for the overall project at this time. I have a draft version of the final report attached that may be of some assistance. There is also some documentation for the lower-level modules contributed by their respective authors but it won't be much help at the top level.

After running, you should see some new files put into your user directory. These are the lower-level data that generate some of the output visualizations at http://localhost/data .

The front-end at http://localhost gives a subset of options for creating a tradespace request. For example, you can adjust some of the parameters to generate more architectures (for example, look at constellation sizes between 1 and 2 satellites, you will see more results generated). There are more options that are not exposed for the simple interface. One of the files that gets written to your output folder is mission.json … you can edit this manually (helps to "pretty-print" the JSON in a text editor) and upload in the "Raw JSON" option for the front-end interface. There is some documentation about the syntax that comprise this document on the TAT-C knowledge base, https://tatckb.org/ but I acknowledge this is still a pretty tall pull at this time without better support.

I am in the early phases of defining a new major version of TAT-C that builds on some of the lessons learned from this version. We would expect to have a new release available next year that improves usability.

Cheers,

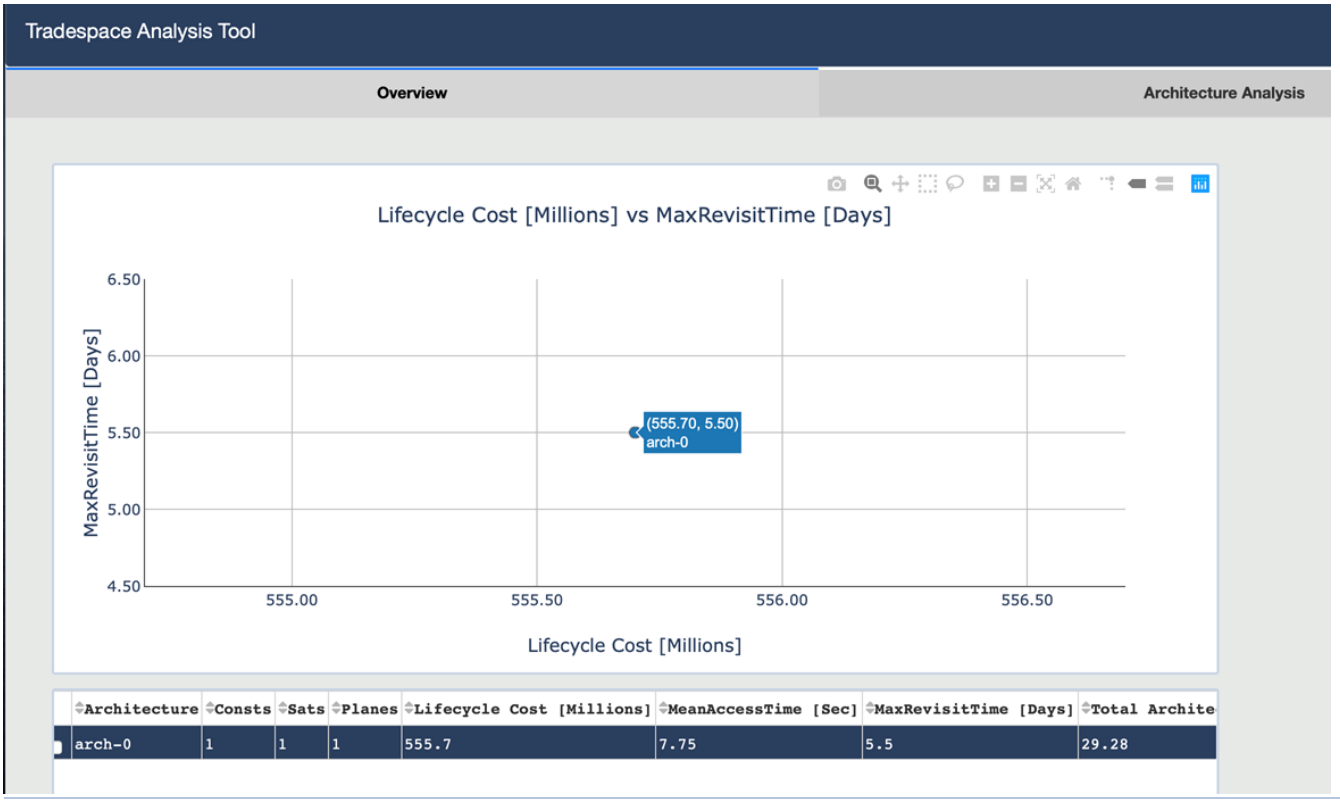
Paul

From: Kim, Rhae Sung (GSFC-617.0)[UNIVERSITIES SPACE RESEARCH ASSOCIATION] <rhaesung.kim@nasa.gov>
Sent: Thursday, July 30, 2020 5:55 PM
To: Paul Grogan <pgrogan@stevens.edu>
Subject: Re: [EXTERNAL] RE: build/start TAT-C

Thanks, Paul! I will reach out to Chad to hear his experience about using VPN with TAT-C.

When I run the default case, I can see the attached result page.
Do you think it is working properly? Or, should I try to rerun 'docker-compose up' without VPN?
BTW, do you have any documents (like a 'user guide') I can start with?

Best,
Rhae Sung



From: Paul Grogan <pgrogan@stevens.edu>
Date: Thursday, July 30, 2020 at 17:25
To: "Kim, Rhae Sung (GSFC-617.0)[UNIVERSITIES SPACE RESEARCH ASSOCIATION]" <rhaesung.kim@nasa.gov>
Subject: RE: [EXTERNAL] RE: build/start TAT-C

Greetings Rhae Sung,

I have actually heard of some issues from others regarding the NASA VPN interfering with Docker. It takes a strong position on restricting network connections.

Chad Frost (Frost, Chad R. {Chad} (ARC-R) <chad@nasa.gov>) had made some progress to figure out how to have them play better together … I don't have much experience though.

If you are seeing the TAT-C interface at http://localhost you can try running the default case (just hit execute). It takes about 10 seconds to run on my desktop (will show FINEST: Took XXX sec in console when done). You may have to refresh the http://localhost/data page to show the results when it is done (it polls for new results only every so often).

Cheers,

Paul Grogan

From: Kim, Rhae Sung (GSFC-617.0)[UNIVERSITIES SPACE RESEARCH ASSOCIATION] <rhaesung.kim@nasa.gov>
Sent: Thursday, July 30, 2020 5:16 PM
To: Paul Grogan <pgrogan@stevens.edu>
Subject: Re: [EXTERNAL] RE: build/start TAT-C

Paul,

Thanks for the quick response. I can see the TAT-C browser-based interface when I go to http://localhost, but not sure this is working or not.

1. I am on Mac and using the Docker Desktop.
2. Below is the output from when I first try running 'docker-compose up'.

I remember after getting this output, it took few hours to have the improper HTTP request message.
Do you think using the NASA VPN on NASA laptop matter?

Best,
Rhae Sung

^CGracefully stopping... (press Ctrl+C again to force)

```
Stopping tatc020_tat-c_1 ... done
Stopping tatc020_redis_1 ... done
gs617-creek:tatc020 rkim3$ docker-compose down
Removing tatc020_tat-c_1 ... done
Removing tatc020_redis_1 ... done
Removing network tatc020_default
gs617-creek:tatc020 rkim3$ docker-compose up
Creating network "tatc020_default" with the default driver
Creating tatc020_tat-c_1 ... done
Creating tatc020_redis_1 ... done
Attaching to tatc020_redis_1, tatc020_tat-c_1
redis_1  | 1:C 30 Jul 2020 20:59:57.940 # oO0OoO0OoO0Oo Redis is starting oO0OoO0OoO0Oo
redis_1  | 1:C 30 Jul 2020 20:59:57.940 # Redis version=5.0.3, bits=64, commit=00000000, modified=0, pid=1, just started
redis_1  | 1:C 30 Jul 2020 20:59:57.940 # Configuration loaded
redis_1  | 1:M 30 Jul 2020 20:59:57.941 * Running mode=standalone, port=6379.
redis_1  | 1:M 30 Jul 2020 20:59:57.941 # WARNING: The TCP backlog setting of 511 cannot be enforced because /proc/sys/net/core/somaxconn is set to the lower value of 128.
redis_1  | 1:M 30 Jul 2020 20:59:57.941 # Server initialized
redis_1  | 1:M 30 Jul 2020 20:59:57.942 # WARNING you have Transparent Huge Pages (THP) support enabled in your kernel. This will create latency and memory usage issues with Redis. To fix this issue run the command 'echo never >
/sys/kernel/mm/transparent_hugepage/enabled' as root, and add it to your /etc/rc.local in order to retain the setting after a reboot. Redis must be restarted after THP is disabled.
redis_1  | 1:M 30 Jul 2020 20:59:57.942 # <ReJSON> JSON data type for Redis v1.0.4 [encver 0]
redis_1  | 1:M 30 Jul 2020 20:59:57.942 * Module 'ReJSON' loaded from /usr/lib/redis/modules/rejson.so
redis_1  | 1:M 30 Jul 2020 20:59:57.942 * Ready to accept connections
tat-c_1  | Running on http://0.0.0.0:80/data/
tat-c_1  | Debugger PIN: 105-497-720
tat-c_1  | * Serving Flask app "app" (lazy loading)
tat-c_1  | * Environment: production
tat-c_1  |   WARNING: This is a development server. Do not use it in a production deployment.
tat-c_1  |   Use a production WSGI server instead.
tat-c_1  | * Debug mode: on
tat-c_1  | Running on http://0.0.0.0:80/data/
tat-c_1  | Debugger PIN: 156-873-463
```

From: Paul Grogan <pgrogan@stevens.edu>
Date: Thursday, July 30, 2020 at 16:28
To: "Kim, Rhae Sung (GSFC-617.0)[UNIVERSITIES SPACE RESEARCH ASSOCIATION]" <rhaesung.kim@nasa.gov>
Subject: [EXTERNAL] RE: build/start TAT-C

Greetings Rhae Sung,

Sorry to hear you are stuck! Hope I can help.

It looks like TAT-C is running from your command trace below and the .env file looks fine, but it seems to be having some problems communicating with the internal web server. (If you open a browser, what happens if you go to http://localhost ?).

Are you on Mac or Linux? If you are on Mac, are you using Docker Desktop (only available for newer hardware) or Docker Toolbox (required for older hardware)?

Could you send me the output from when you first try running `docker-compose up` ? To get back to that step, you can CTRL+C to kill the process and enter `docker-compose down` to bring down this stack.

I have not seen the messages before that show on your trace – it seems that there are improper HTTP requests being issued? I believe 172.18.0.1 is a private IP address. I know that Docker Toolbox has to do some trickery with private IP addresses to work on old hardware.

Cheers,

Paul

From: Kim, Rhae Sung (GSFC-617.0)[UNIVERSITIES SPACE RESEARCH ASSOCIATION] <rhaesung.kim@nasa.gov>
Sent: Thursday, July 30, 2020 10:36 AM
To: Paul Grogan <pgrogan@stevens.edu>
Subject: build/start TAT-C

Dear Paul,

I am trying to build/run the public TAT-C release and I'm stuck on doing the "Docker Compose".
Please first accept my apologies- I am new to Docker and seeing the below screen for almost a half day. Do you expect this long?

```
tat-c_1  | Rendering Main Page
tat-c_1  | Rendering Main Page
tat-c_1  | Rendering Main Page
tat-c_1  | Rendering Main Page
tat-c_1  | Rendering Main Page172.18.0.1 - - [30/Jul/2020 00:58:14] code 505, message Invalid HTTP version (2.0)
tat-c_1  | 172.18.0.1 - - [30/Jul/2020 00:58:25] code 400, message Bad request syntax ("\x16\x03\x01\x02\x00\x01\x00\x01ü\x03\x03þ\x06:¬ßW<ð\
x90Uæ\x8aÁýH¯C@±9/\x04NÇÅ°TwàÓ3²\x00\x00ÌÀ,À0\x00£\x00\x9fÌ®Ì¯Ì²Ã¯Â\xadÀ£À\x9fÀ]ÅaÀWÀS\x00§À+À/\x00C\x00\x9eÀ®Ã¬ÀcÀ\x9eÀ\\À`ÀVÀR\x00¦À$À(\x00
k\x00jÀsÀw\x00ÃÀ\x00Ã\x00m\x00ÅÀ#À'\x00g\x00@ÀrÀv\x00%\x00%\x00l\x00¿À")
tat-c_1  | 172.18.0.1 - - [30/Jul/2020 00:58:53] code 400, message Bad HTTP/0.9 request type ('\x16\x03\x01\x00£\x01\x00\x00\x9f\x03\x01ÎÆ°ÅH
è\xad¾Þd\x93?\x01®VEÉ')
tat-c_1  |
tat-c_1  | Rendering Main Page
tat-c_1  | Rendering Main Page
tat-c_1  | Rendering Main Page
tat-c_1  | Rendering Main Page
```

I am not sure if I define below variables correctly in '.env' file. I created a token from Mapbox and copied in '.env' file.

MAPBOX=pk.eyJ1IjoicmhhZXN1bmciLCJhIjoiY2tkN3NiYXFkMDAzbTJ3bzZnbmM5cTM5ZSJ9.154DLK5g-jjgkphjUssozw
TATC_DATA=/Users/rkim3/Documents/Projects/OSSE/TAT_C/Data

Thanks in advance,
Rhae Sung