CIVE580C3 - Term Project Scope

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Contents

Overview

The Surface Water and Ocean Topography (SWOT) mission [1] was launched by NASA in December of 2022. This means there is now a full two years worth of data (2023 and 2024) that can be viewed and analyzed. My proposed term project will acquire and process SWOT River Discharge Estimates for the Colorado River basin and compare them against USGS stream gauge data.

Proposed Project Scope

A basic analysis of the SWOT River Discharge Estimates will include:

- Evaluating how well SWOT discharge estimates match USGS stream gauge data across different reaches using statistical measures (e.g., bias, RMSE)
- Assessing how temporal and spatial discrepancies vary with factors such as river width and season
- Comparing the uncertainty in SWOT estimates to those from USGS gauges
- Examining how the temporal sparsity of SWOT data influences its ability to capture hydrologic extremes

Since discharge estimates are not yet available via Hydrocron [2], this effort alone may prove challenging and time consuming. However, time permitting, I would also like to incorporate some more hydrologic science into my analysis. This could include analyses such as:

- Investigating what other river morphological characteristics might be influencing the accuracy of SWOT river discharge estimates
- Assessing where and how the increased spatial resolution of the SWOT data might fill in gaps in our understanding of the dynamics of the Colorado River and its tributaries

Schedule of Tasks

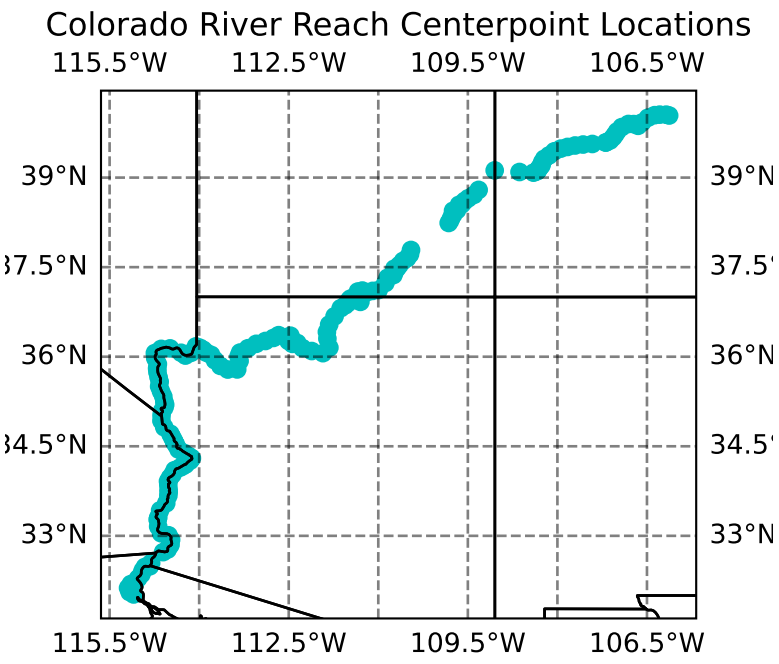
As alluded to above, since the SWOT River Discharge Estimates have not yet been widely used, it is difficult to say how easy it will be to accomplish what I've outlined here. Any difficulty in acquiring and/or processing these data might shift my schedule, and I may not get to the optional tasks.

Week	Task
Week 1 (Mar 3 - Mar 9)	Define project scope, refine research questions, set up computational environment, download sample data through the Sword of Science API (for proof of concept).
Week 2 (Mar 10 - Mar 16)	Project on pause (I'll be out of the country).
Week 3 (Mar 17 - Mar 23)	Acquire SWOT River Discharge Estimates and USGS stream gauge data for the Colorado River basin. Preprocess and clean SWOT and USGS discharge data, ensuring time and spatial alignment.
Week 4 (Mar 24 - Mar 30)	Perform initial comparison of SWOT vs. USGS discharge using statistical measures (bias, RMSE).
Week 5 (Mar 31 - Apr 6)	Analyze spatial and temporal discrepancies based on river width, season, and other factors.
Week 6 (Apr 7 - Apr 13)	Investigate how SWOT's temporal sparsity affects the capture of hydrologic extremes.
Week 7 (Apr 14 - Apr 20)	Optional: Incorporate additional hydrologic science analyses (e.g., morphology influences, spatial resolution benefits).
Week 8 (Apr 21 - Apr 27)	Finalize results, create visualizations, and draft initial report.
Week 9 (Apr 28 - May 4)	Revise and refine report, prepare final presentation (if required).
Week 10 (May 5 - May 11)	Submit final term project and present findings.

Proof of Concept

Through the Sword of Science API, I have been able to download and plot SWOT river discharge estimates, so this looks promising.

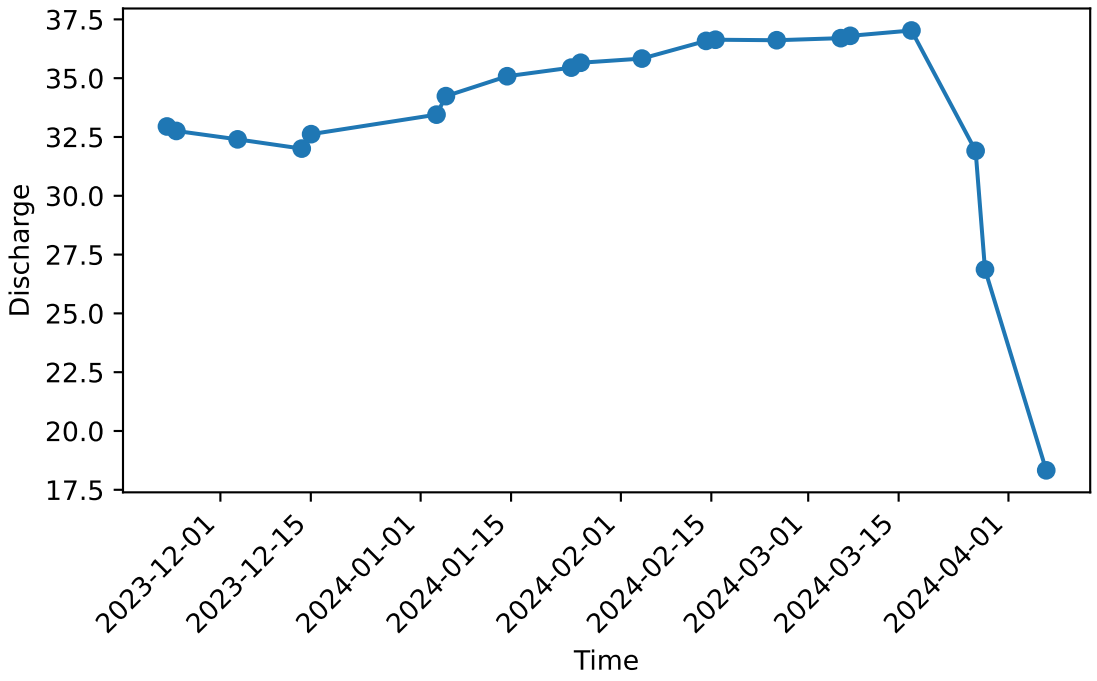
```
# Plot the location of the river
fig = plt.figure(figsize=(4,4))

# Add map elements gridlines
ax = plt.axes(projection=ccrs.PlateCarree())
ax.coastlines()
ax.add_feature(cfeature.STATES, edgecolor='black')

gl = ax.gridlines(crs=ccrs.PlateCarree(), linewidth=1, color='black', alpha=0.5, linestyle='--',
↪  draw_labels=True)
gl.xlabels_top = False
gl.ylabels_left = True
gl.ylabels_right=False
gl.xlines = True

gl.xformatter = LONGITUDE_FORMATTER
gl.yformatter = LATITUDE_FORMATTER

# Plot the river reach centerpoint locations
ax.scatter(reach_lon[idx], y=reach_lat[idx], color='c')

# Add the title
plt.title(f'{RIVER_NAME} Reach Centerpoint Locations')

plt.show()
```



```python
# Plot Discharge for the River Reach Identifier

# Convert time strings to datetime objects
time_dt = [datetime.datetime.strptime(t, '%Y-%m-%dT%H:%M:%S') for t in time_str]

# Set up plot
fig, ax1 = plt.subplots(figsize=(6.5,4))

# Plot data using datetime objects
ax1.scatter(time_dt, discharge_algo_q)
ax1.plot(time_dt, discharge_algo_q)

# Format date ticks correctly
ax1.xaxis.set_major_locator(mdates.AutoDateLocator())
ax1.xaxis.set_major_formatter(mdates.DateFormatter('%Y-%m-%d'))  # Format as YYYY-MM-DD

plt.xticks(rotation=45, ha='right')  # Rotate and align labels correctly
```

```
## (array([19692., 19706., 19723., 19737., 19754., 19768., 19783., 19797.,
##         19814.]), [Text(19692.0, 0, '2023-12-01'), Text(19706.0, 0, '2023-12-15'), Text(19723.0, 0, '
```

```python
plt.subplots_adjust(bottom=0.25)  # Prevent label cutoff

plt.xlabel('Time')
plt.ylabel('Discharge')
plt.suptitle(f"Discharge Timeseries from {DISCHARGE_ALGORITHM.upper()} for {RIVER_NAME} (Reach ID:
↪  {reach_id})")

plt.show()
```



References

[1] Biancamaria S, Lettenmaier DP, Pavelsky TM. The SWOT Mission and Its Capabilities for Land Hydrology. Surveys in Geophysics. 2016;37(2):307–337. https://doi.org/10.1007/s10712-015-9346-y. doi:10.1007/s10712-015-9346-y

[2] Nickles C, Tang V, McDonald V, Gomez Gonzalez V, Byrne J, Garde J, Oaida Taglialatela CM, Greguska FR, Tarpinian N, Vannan S. Increasing data accessibility and utility for NASA PO.DAAC hydrology observations. 2023;2023:IN31E–07. https://ui.adsabs.harvard.edu/abs/2023AGUFMIN31E..07N