Global land surface water observations from space: What will SWOT see?

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ABSTRACT

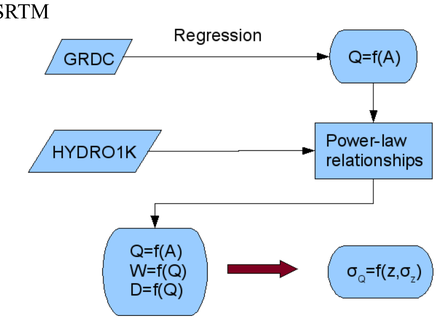
SWOT will provide global estimates of river discharge derived from river heights and slopes. The instrument will measure water surface levels with a vertical accuracy on the order of centimeters when averaged over an area on the order of 1 km² SWOT-derived slopes over reach lengths from 1 to 10 km will be accurate on the order of microradians. Both measured quantities depend to some degree on river widths; hence, a question arises as to where there is sufficient width to support an assimilation approach to retrieving discharge. In order to estimate which water bodies meet these width criteria, we need a reasonable approximation of what is actually on the ground. Unfortunately, datasets of river width and depth are only available on a local basis. As a first cut effort, we applied well-known geomorphic relationships to estimate these river properties on a global scale. Mean annual flood discharge was approximated from drainage area for each HYDRO1K stream. Widths and discharge values were then obtained from the estimated mean annual flood discharge. From this information, in combination with proposed orbital tracks and mission specifications, we generated maps of which streams should be observable from SWOT given various width and discharge thresholds. Statistics regarding the predicted observable river discharge and channel morphology, as well as number of visits per repeat cycle, are also presented .

1 Motivation

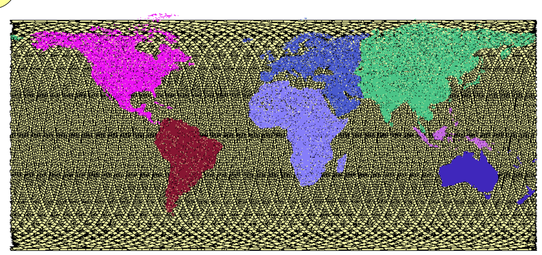
- Obvious question on what rivers will SWOT be able to "see"
  - *What are their characteristics*?
  - *How many times will they be observed per orbit cycle*?
- What are the expected errors in discharge estimation?
  - *How far upstream the drainage network can we estimate discharge with reasonable accuracy*?

2 Experimental Design

- HYDRO1K
  - Topographically derived dataset based on GTOPO30 (stream lines etc)
- GRDC
  - Mean monthly discharge (3,035 stations globally)
- HYDROSHEDS
  - Hydrologically conditioned dataset based on 3-arcsec SRTM

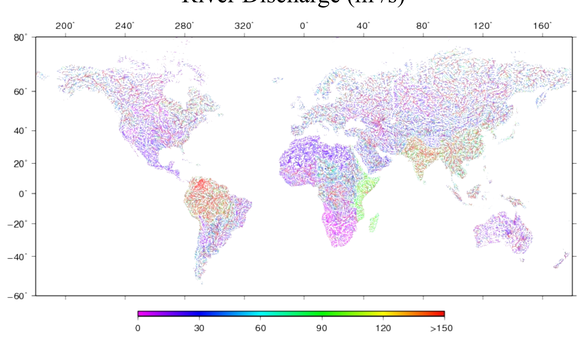


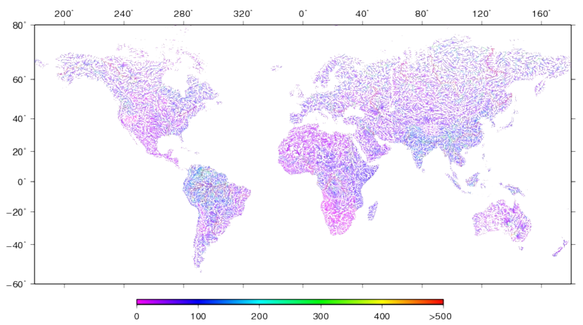
3 SWOT Orbital Coverage

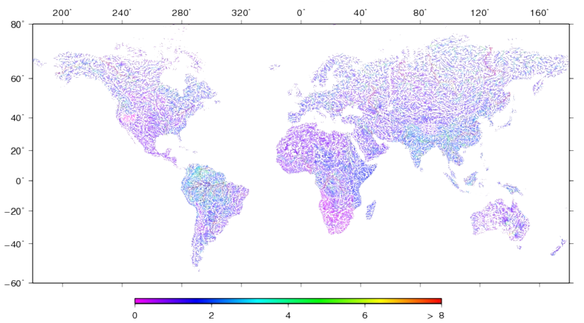


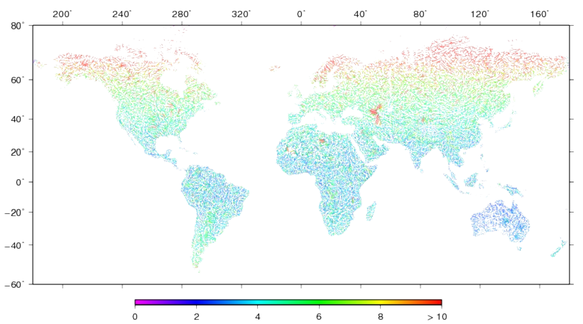
- 22-day repeat cycle
- 78 degree inclination
- Australia from HYDROSHEDS

4 Global maps of river characteristics

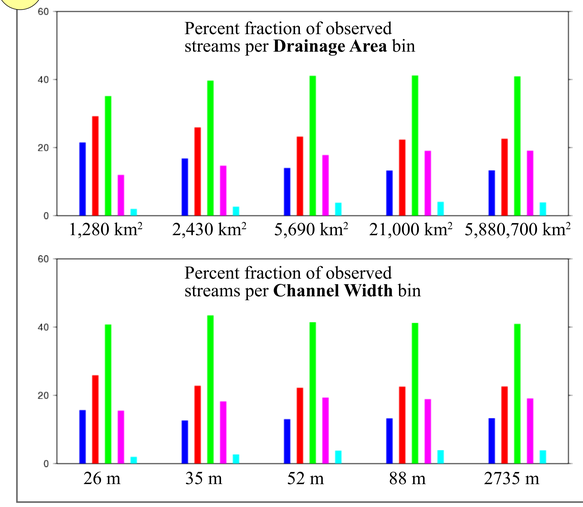


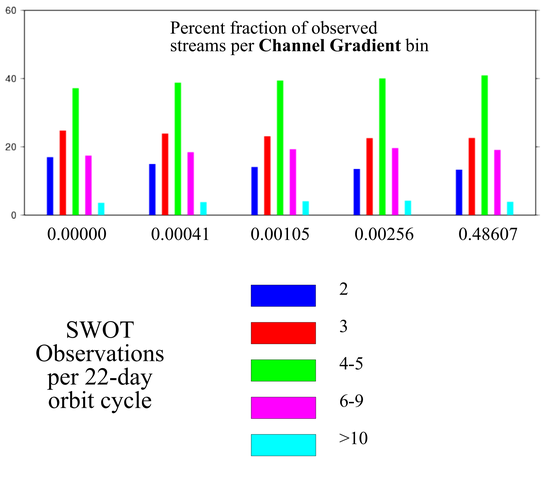




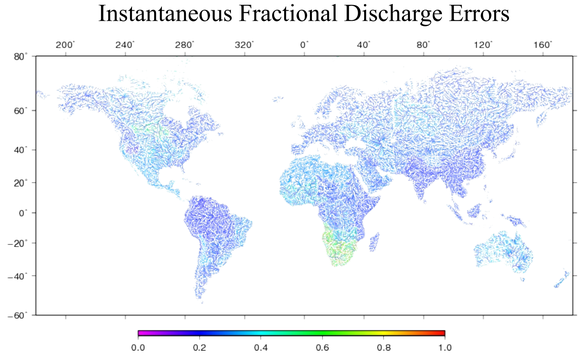


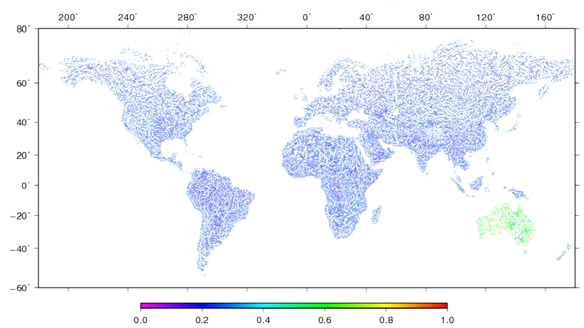
5 How many times will rivers be observed and what are their characteristics?

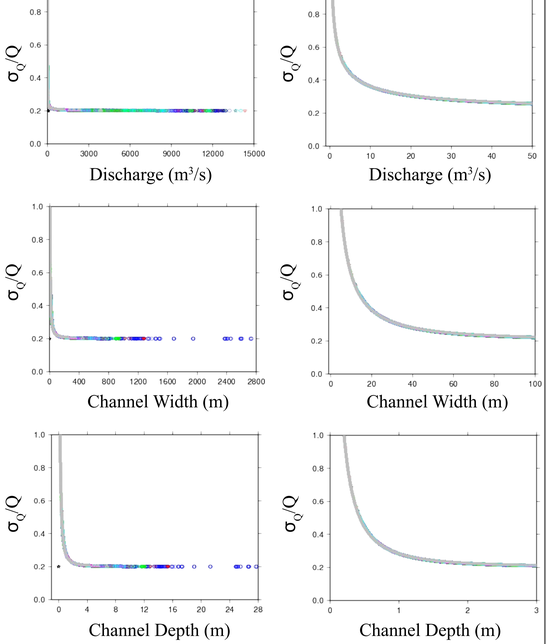




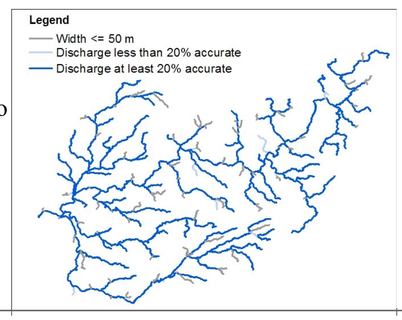
6 Maps of river discharge errors & river characteristics

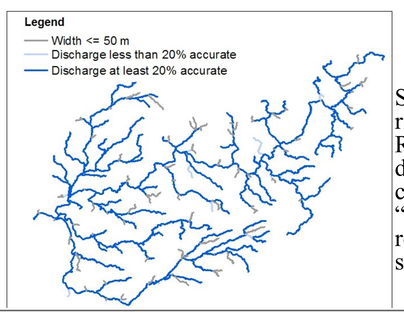






SWOT-observed rivers in the Ohio River basin with discharge errors being calculated from best-fit regression on in-situ data





SWOT-observed rivers in the Ohio River basin with discharge errors calculated from "worst-case" regression on in-situ data