National Aeronautics and Space Administration

Postdoc Research

Yukon River Temperature patterns from 2003 -2020

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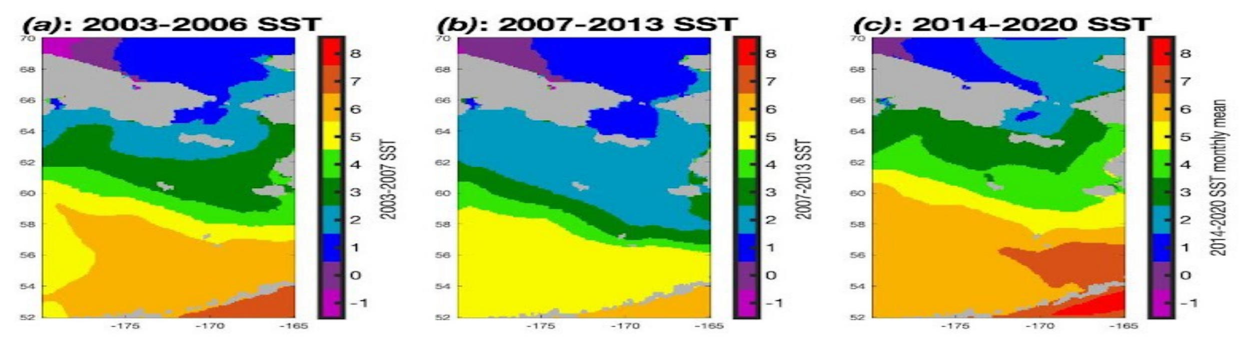
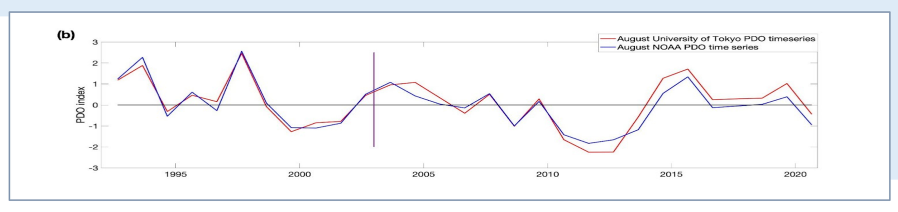
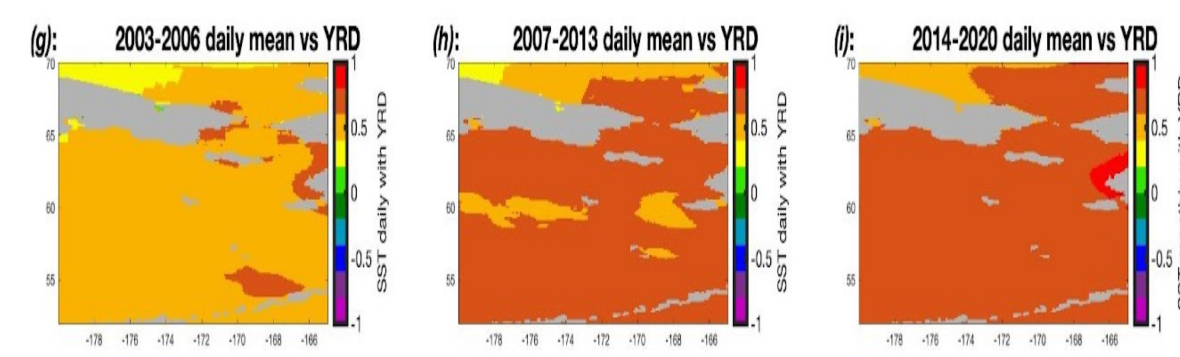
Background Years with warm sea surface temperature causes earlier river flux (shifting from the springtime to the winter) and may also decrease discharge [1]. This has implications for biodiversity. For example, it has been reported that a reduction in August freshwater river flux could reduce the spawning capability of Chinook salmon. Additional factors such as reduced wintertime ice days and an increased number of fall floods might reduce productivity as well



(a): Monthly mean GHRSST-MWIR SST 2003–2006, (b): Monthly mean GHRSST-MWIR SST 2007-2013, (c): Monthly mean GHRSST-MWIR SST 2014-2020, (d): Monthly mean ECCO-Fekete SST 1992–1998.

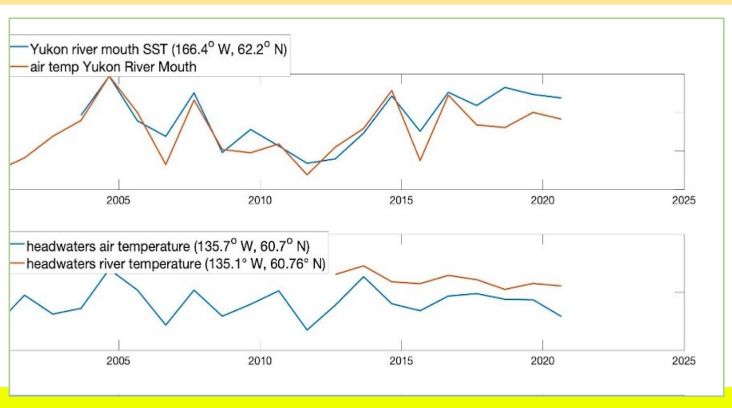


August SST index values from the University of Tokyo from 1992 (red) and NOAA (blue) through 2020. The year 2003 is marked with a vertical line (purple) to separate the current study years to potentially lengthened study years in future experiments.



(g):,(h):,(i): panels: daily GHRSST-MWIR vs. daily, R.D.

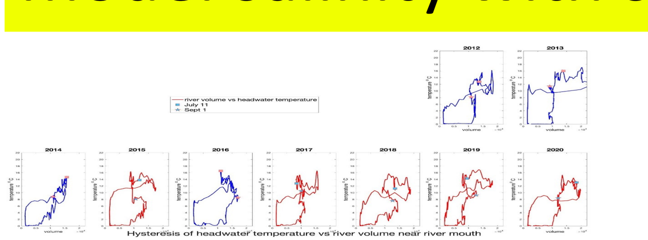
Objectives We tested whether the published sea surface temperature (SST) indexes in August (taken from 2 datasets; University of Tokyo [3] and NOAA [4]), are related to the August SST at the Yukon river mouth in the Gulf of Alaska using the GHRSST-MWIR satellite remote sensing dataset from 2003 - 2020 [2;3;4;5]. We also compared these values to air temperature at the river mouth, air temperature at the river headwaters, water vapor, precipitation (MERRA-2), volumetric river discharge (ArcGro-YR).



August temperature time series (MERRA-2): (a): Air temperature at YRM with Yukon SST (166.4° W, 62.2° N), (r value = 0.85) (b): Headwaters air temperature (135.7° W, 60.7° N) with headwaters river temperature (135.1° W, 60.76° N), r value = 0.71

The de-coupling of August SST from air temperature at the river mouth from 2017-2020 suggests that surface processes alone (such as increased discharge) may be responsible for this change in pattern. Only the most lenient of regime shift thresholds (from 0-0.64°C) indicates a positive temperature shift at the river mouth in the years 2017, 2019, 2020.

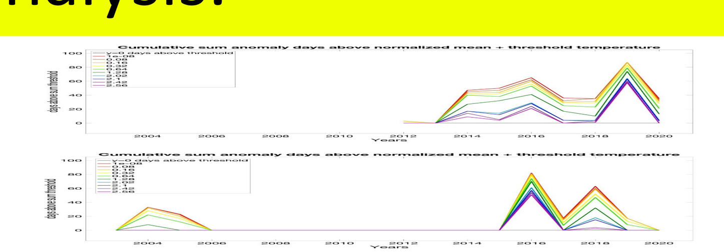
Approach and Results We performed a positive cumulative sum regime shift test on the VonFinster headwaters temperature dataset, 60.76° N, 135.1° W [6]) and the GHRSST-MWIR SST time series[5] at the river mouth in the Norton Sound to test the consistency of changes in river temperature at the Yukon river mouth and at the Yukon headwaters. We compared these values to Yukon river volume from the ArcGro-YR in situ dataset and the NASA ECCO model salinity with standardized August temperature time series and Principal component analysis.



Late summer headwaters flux also increases on or following September 1, in years 2015-2019 during warm-SST indexes. This increased discharge suggests a neutralizing or dampening effect on SST at the river mouth later in the year and a possible further risk of river discharge events.

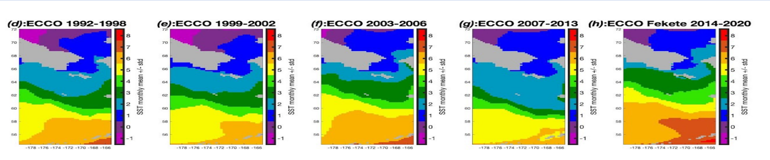
(a): headwaters temperature regime shift.

(b): GHRSST-MWIR regime shift.



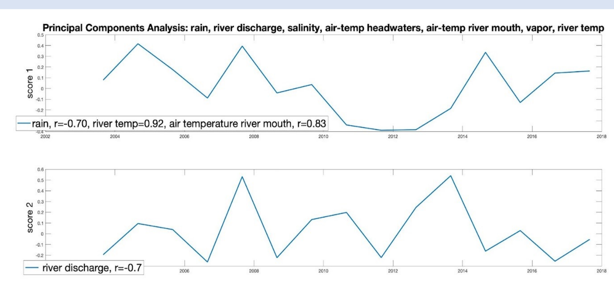
A possible lag is revealed between the start and end of the river: A study of relative wind direction and wind strength over this timeframe is warranted verify this possibility of eastward warming.

Significance of Results/Benefits to NASA/JPL changes in Yukon river discharge have implications for the NASA mission of biodiversity. Mapping decadal scale occurrences is important to the future forecasting of extreme events in the Gulf of Alaska; we showcase in this paper the benefits of a remote sensing dataset in a hard to reach area.



PCA right, shows that air temp closely follows river temp; river discharge (score 2) is up in low temperature years (score 1)

(e): Monthly mean ECCO-Fekete SST 1999–2002, (f): Monthly mean ECCO-Fekete SST 2003–2006
(g): Monthly mean ECCO-Fekete SST 2007–2013, (h): Monthly mean ECCO-Fekete SST 2014–2020.



First two scores of Principal Components Analysis on August time series from 2003-2017: river mouth SST, air temp, vapor, rainfall, ECCO salinity headwaters air temp.
(a): Score 1, with correlation r-values with SST at the river mouth, MERRA-2 air temperature at the river mouth.
(b): Score 2 with correlation r-values with river discharge.

Future Work Future experiments will illustrate the versatility of the NASA inverse model ECCO, with an improved river discharge and data back to 1992. SWOT data, newly published this fall, will allow us to test steric height with river discharge.

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In prep to *Remote Sensing*: **Comparison of GHRSST SST analysis with Yukon River discharge; how does river discharge influence sea surface temperature in the Gulf of Alaska?**

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