Carton
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Monthly continental discharge data set 1980-2019

1. Introduction

Here I discuss construction of a global 0.5°x0.5° uniformly gridded monthly continental discharge data set spanning the 40-year period 1/1980 – 12/2019. Dai and Trenberth (2002) estimate that roughly half of all discharge is accounted for by the 921 largest rivers and the remainder is contributed by other, mainly ungauged, sources. When corrected for the ungauged discharge they estimate the global annual discharge to be 1.18±0.02Sv ($1Sv = 1x10^6 m^3/s$), with peak discharge occurring in June. For our updated data set, assuming that the Dai and Trenberth global number is correct, approximately 46% of the total discharge must be from ungauged sources.

Among the ocean basins the Atlantic is the largest contributor to global discharge at a rate of 0.608Sv. More than half of this, 0.336Sv, is from a combination of three tropical rivers: the Amazon, Congo, and Orinoco. The Pacific basin has the next largest annual rate of discharge (0.288Sv), while the Indian and Arctic basins have annual rates of discharge of 0.144Sv and 0.116Sv respectively. Dai and Trenberth (2002) also estimate the fraction of total ungauged discharge for each basin (their Table 3). In their examination the Indian sector has the largest fraction of ungauged rivers (the amount ungauged exceeds the amount gauged!)

2. Data and methods

The primary source for this data set is the set of 925 monthly gauged river discharge estimates developed by, and described in a series of papers by Dai and Trenberth (most recently: Dai, 2017). Their data is based on gauging stations which may lie at some distance from the river mouth. To correct for this they provide an inflation factor for each river. The early part of our period of interest shows an annual maximum transport of approximately $1.2x10^6 m^3/s$ (**Fig. 1** orange curve). The amount of missing data increases dramatically with time so that in the past decade the maximum annual global discharge has been cut in half. To correct for this artificial trend we compute a monthly climatology at each station based on the full 40-year period and use that monthly climatology to fill in any missing months (**Fig. 1** blue curve).

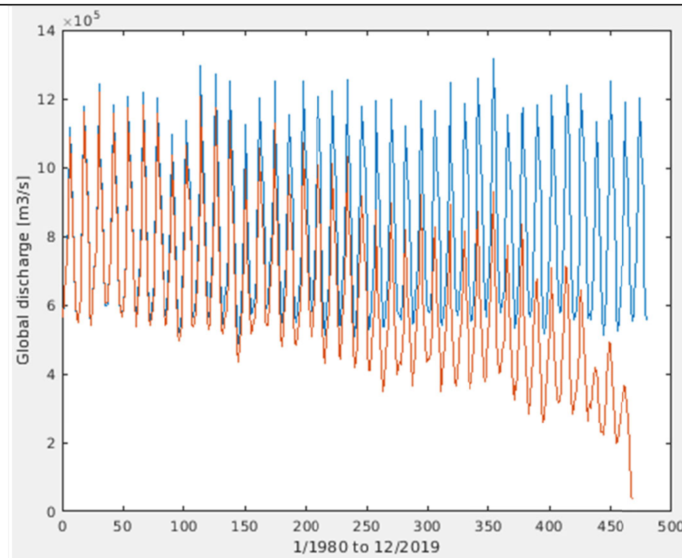
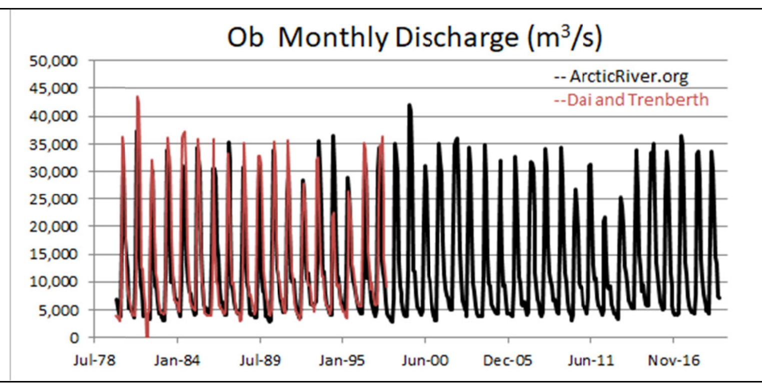


Figure 1. Global monthly discharge based on the Dai and Trenberth set of 925 gauged rivers (Dai, 2017). Orange curve shows monthly sum of discharges without any infilling of missing values, while the blue curve shows monthly discharge when missing values are filled in with the 40-year monthly climatology. Dai and Trenberth (2002) provide an estimate of the time mean global average of $1.18 \times 10^6 m^3/s$, which looks about right. Notice that despite the claims of updating the actual amount of discharge data declines from the 1980s on.

Of particular interest the discharge that enters the Arctic Ocean because of its contribution to Arctic nearsurface stratification and ice formation. Two thirds of the discharge into the Arctic Ocean, about $6 \times 10^4 m^3/s$, comes from the six Eurasian rivers (Yenisey, Lena, Ob', Pechora, Kolyma, and Severnaya Dvina) whose catchment areas are roughly 50% larger than the the Arctic Ocean itself (*Peterson et al., 2002*). Most discharge occurs after the ice breakup in May to November. An examination of the Dai and Trenberth data set shows that these rivers in particular are in need of updating (**Fig. 2**). To address this problem we have replaced the Dai and Trenberth monthly discharge time series for these six rivers with data obtained from the Great Arctic Rivers Observatory (arcticgreatrivers.org, *Shiklomanov et al., 2020*).



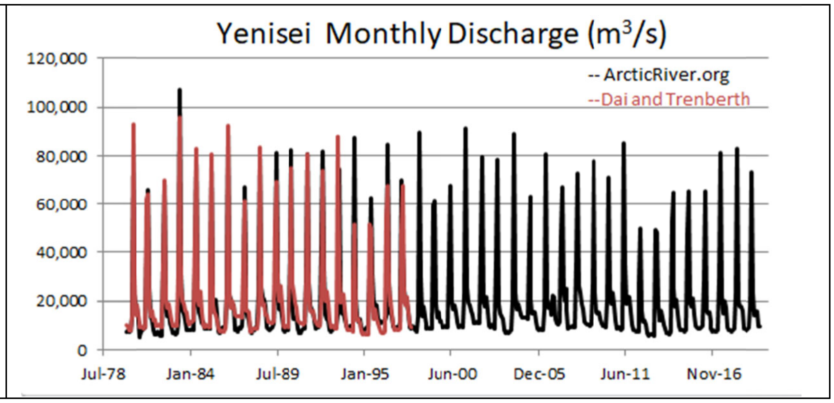


Figure 2 Comparison of monthly discharge from two of the six great Eurasian rivers: Ob and Yenisei, as they appear in Dai and Trenberth (*Dai, 2017*; red) and the ArcticGreatRivers data set (*Shiklomanov et al., 2020*; black).

The Dai and Trenberth data set does not include Greenland discharge. Here we include Greenland discharge from Mankoff et al (2019), a record which begins in 1987 (**Figure 3**). Note the increase in discharge in the early 2000s which seems to coincide with the availability of gravity data from the GRACE satellite mission (launched in 2002). A funny minimum in discharge occurs in February, 2016. I did not go back and check the source of this.

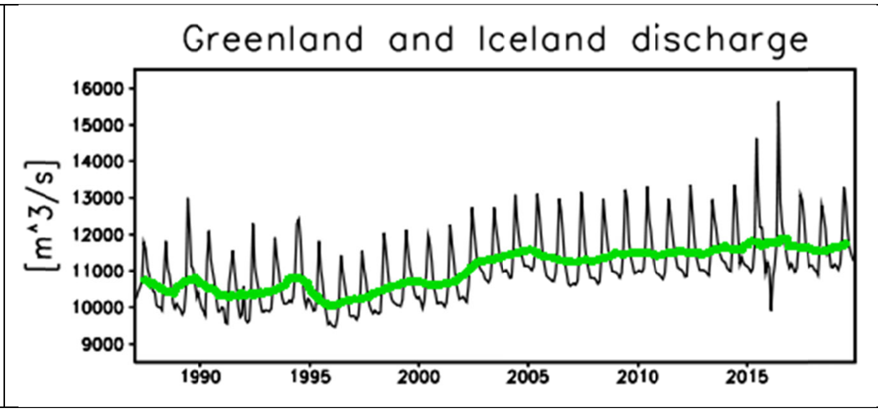


Figure 3 Discharge in a domain, [60-84N, 78W-10W], which includes both Greenland and Iceland. Greenland discharge (beginning 1987) is provided by Mankoff et al. (2019).

2.1 Correction for ungauged discharge

As pointed out in the Introduction, much of the continental discharge is ungauged. We initially followed Dai and Trenberth (2002) who follow, in turn Fekete et al. (2000), and inflate the gauged river estimates using the basin-dependent inflation factors listed in Dai and Trenberth **Table 3** except for the Arctic, where we use the inflation factor of 30% suggested by Shiklomanov et al. (2020). This initial calculation provided a global, time average estimate of 1.08Sv. To bring the global estimate closer to the Dai and Trenberth (2002) estimate of 1.18±0.02Sv quoted in and mentioned in the *Introduction* we have inflated the inflation factors by an additional 6%, finally bringing our total to 1.14Sv (**Figure 4**).

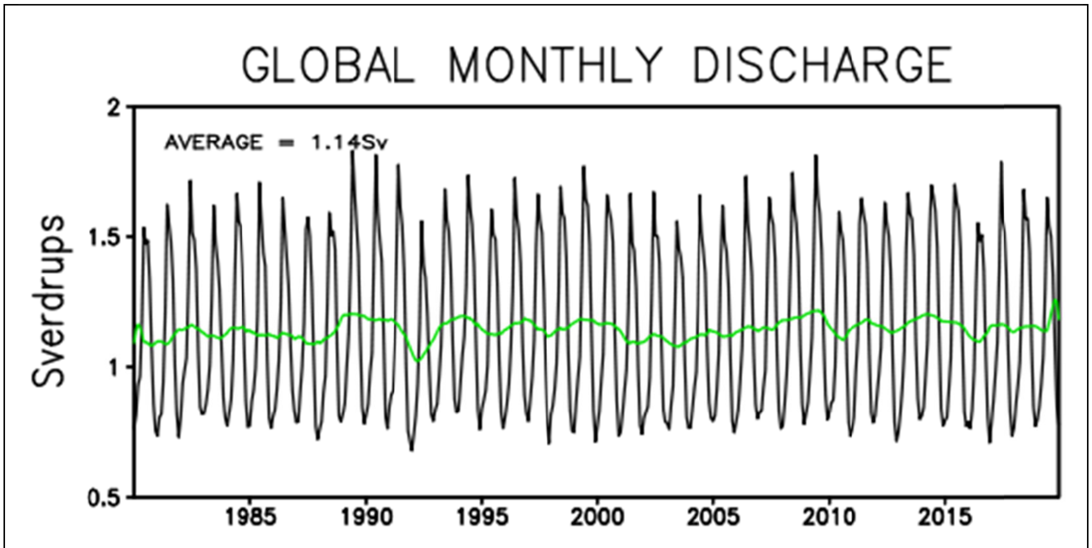


Figure 4 Global monthly discharge after correction for ungauged discharge (running 12mo average is superimposed in green).

3. Results

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References

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