Supporting Material for

ERA5-based database of Atmospheric Rivers over Himalaya

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**S1: Trends in AR frequency**

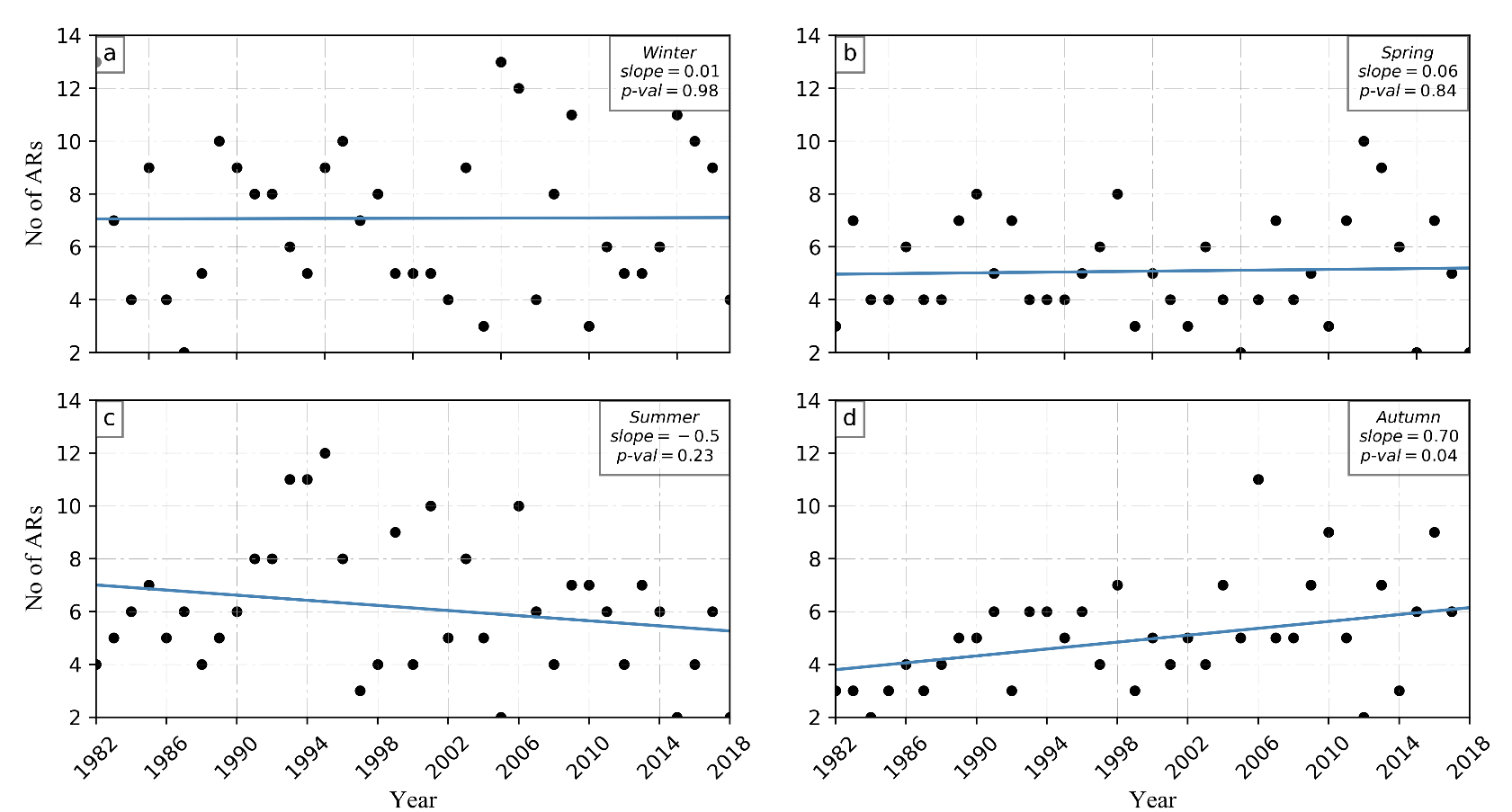


Figure S1: Long term seasonal trend of AR frequency at southern front of the Himalayas for (a) winter (December–February) (b) spring (March–May) (c) summer (June–August) and (d) autumn (September–November) from 1982 to 2018 (years 1980-1981 were not included in this analysis as mostly cyclones were present in these years). The blue colored line shows the trend (slope is taken per decade).

**S2: ARs and AR related precipitation for Indus Basin.**

This section shows the top 3 to 8 ARs (top 2 are shown in the main manuscript) identified in BinA and BinB in the Indus Basin. The ARs in Figure S2 (A) were identified on 2nd February 1989 (B) 2nd March 1998 (C) 6th March 1983(D) 15th February 2017 (E) 25th December 2015 and (F) 15th January 1990. (Left panel) The ARs in (A) and (B) are classified under category 4 with maximum IVT ofand respectively; (C), (D), (E) and (F) are under category 3 with maximum IVT of.,, and respectively. These AR have duration of at least 3 days. These ARs confined their track mostly in the northern Arabian Sea and countries of Iran, Pakistan and Afghanistan. (Right panels) The precipitation observations, taken from Indian Meteorological Department (IMD), are shown in Figure S2:(a1) to (f1) which shows the precipitation on the next day after the AR was identified and (a2) to (f2) shows the precipitation on the second or third day after the AR was identified.

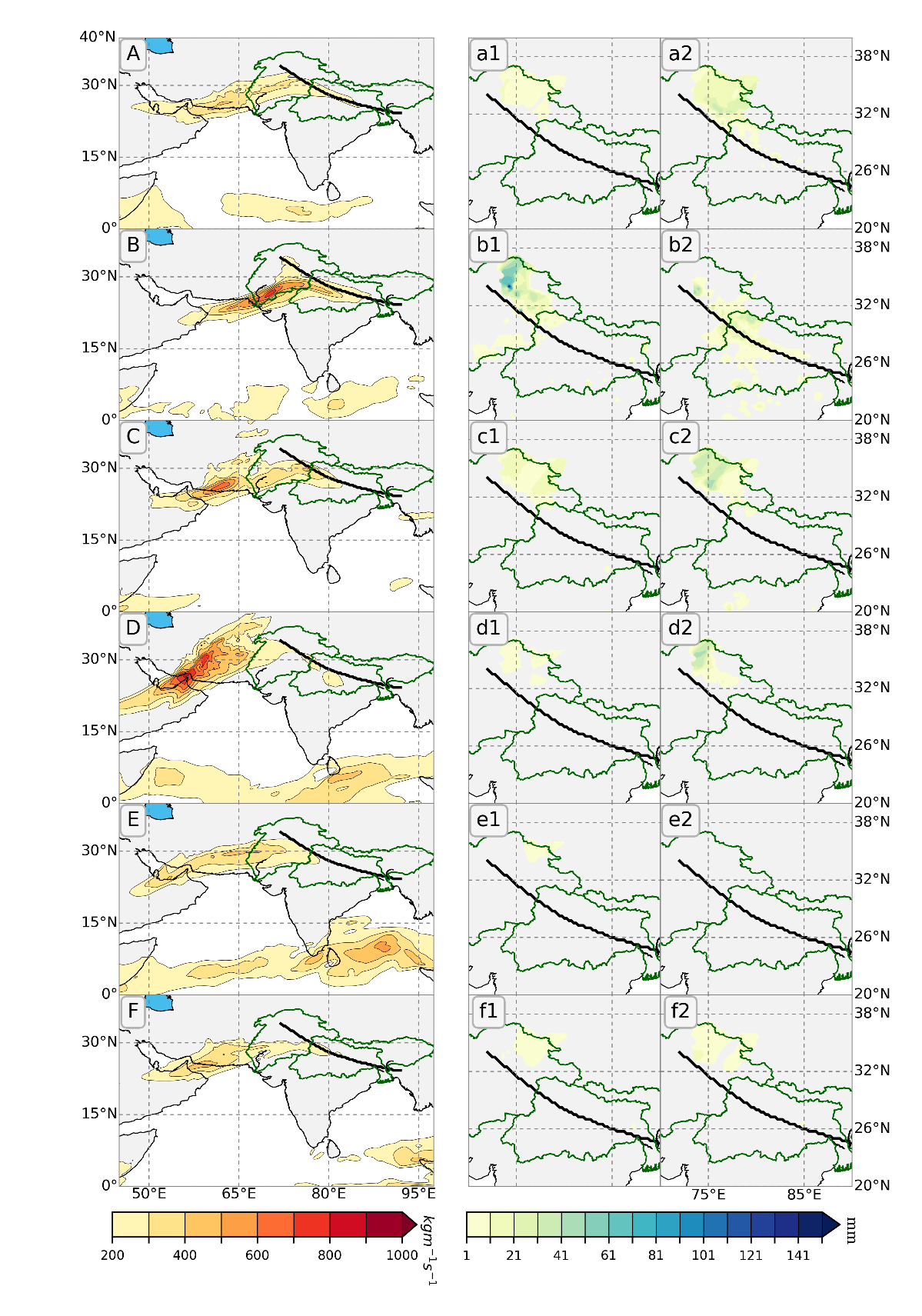


Figure S2: The top 3 – 8 ARs (in ) taken from the database which are identified in the Indus basin (BinA and BinB) during winter and spring seasons (left: panels (A)-(F)) and precipitation (in milli meters ‘mm’) (right) observed one day (panels a1: f1) and second/third day (panels a2: f2) after the AR day.

**S3: ARs and AR related precipitation for Ganga Basin.**

This section shows the top 3 to 8 ARs (top 2 are shown in the main manuscript) identified for BinC and BinD in the Ganga Basin. The ARs in Figure S3 (A) 25th July 1995, (B) 24th May 2000, (C) 3rd October 2013 and (D) 29th September 2001, (E) 23re January 1992 and (F) 12 February 2005. (Left panel) ARs in (A), (B), (C) and (D) are under category 5 with maximum IVT of , , and respectively. ARs in (E) and (F) are under category 4 with maximum IVT of. and respectively. All these AR also have duration of at least 3 days. (Right panel) Figure S2 (a1) to (f1) shows precipitation observed one day after the AR was identified and (a2) to (f2) shows the precipitation on the second/third day after the AR was identified.

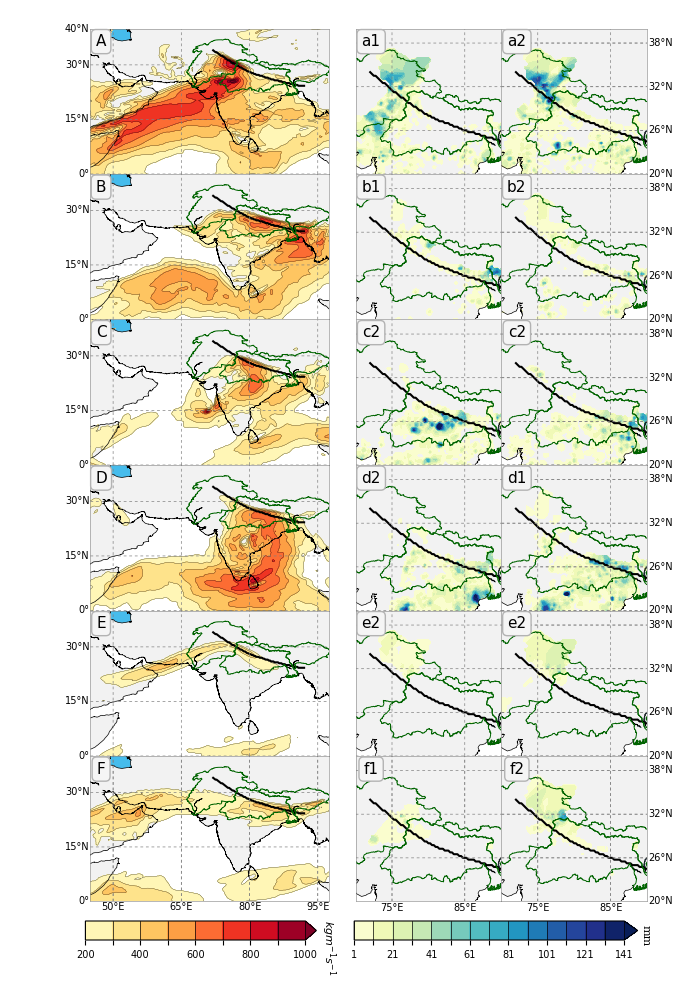


Figure S3: Same as Figure S2 but for Ganga Basin.