We would like to thank the reviewers for the thorough reading of the manuscript and the valuable remarks that helped us to improve the manuscript. We have revised the manuscript carefully according to the reviewer's comments, and have incorporated the suggestions into the revised manuscript.

The notes below provide a point-by-point response to each comment from the referees. The texts with blue font are the reviewer's original comments, the texts with black font are authors' responses.

1. From the figures in the MS, the mountain glacier regions are included. I do not mean the glacier-melting-induced floods. I do not see the results in these regions, the detection of floods in these regions should be shown to reviewers.

Response： We thank reviewer's suggestions. We used global glacier outline data from the Randolph Glacier Inventory (RGI). This dataset can be used to estimate glacier volumes, rates of elevation change at regional and global scales, and the response of the cryosphere to climate forcing. The dataset is updated annually in shapefile format. We used it in this paper to locate global glaciers (Arendt et al., 2017).

In the range of 60°S—60°N, there are 10 glacier regions and 163 flood events recorded based on DFO database (Figure 1). 142 flood events were identified and 21 flood events were not detected, with a POD of 0.87. The capacity of flood detection is close to the global POD (0.81). The results showed that GRACE also has good potential in identifying precipitation-induced floods in glaciers regions. Of these 21 flood events, 4 flood events could not be identified due to missing months in GRACE data. 8 flood events had a maximum daily precipitation of less than 40 mm according to the DFO-recorded time period and spatial location (minimum: 8.44 mm, maximum: 36.56 mm) and GRACE could not identify the weaker signal. The remaining 9 flood events could not be identified due to GRACE itself failing to identify flood conditions.

We further selected the GRACE grid covering the glacier regions and analyzed the characteristics of the extracted flood days. Figure 2 showed the 10 detailed glacier regions and the corresponding selected GRACE grids which covered the main glacier areas. Figure 3 showed the results of the extracted flood days related to the grid of each region. In general, the number of flood days in the glacier regions was relatively small, and mostly concentrated within 50 days from Apr. 1st, 2002 to Aug 31st, 2016, while the glaciers in the South Island of New Zealand and the glacier regions in the east of southern Asia were exceeded 100 days. The South Island of New Zealand where mountain glaciers are located experiences a hyper-maritime climate, and the west coast of the South Island receives the most precipitation, with annual precipitation >12 m (Anderson et al., 2010). Glacier regions in the east of south Asia are mainly located in the Himalayas, where normal climatic fluctuations become rather quick in the Himalayan sectors due to topography and the southwest Indian Ocean monsoon. It would occur cloud bursts, high winds, snowstorms, etc., further caused quick floods

(Nandargi and Dhar, 2011).

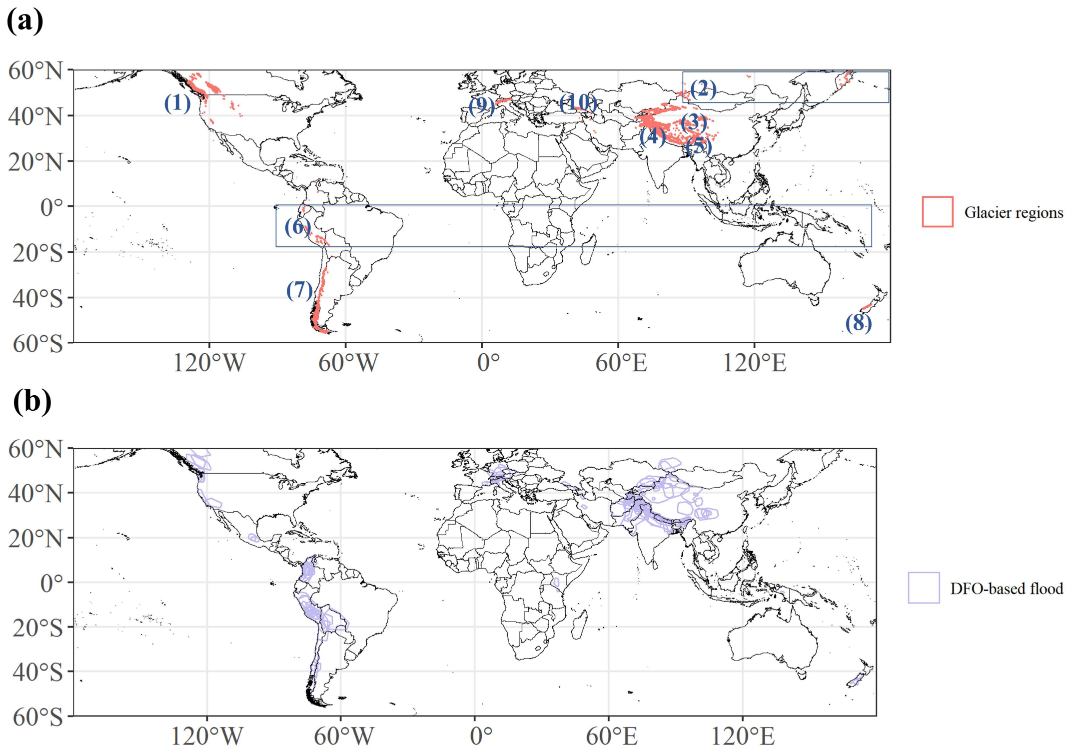
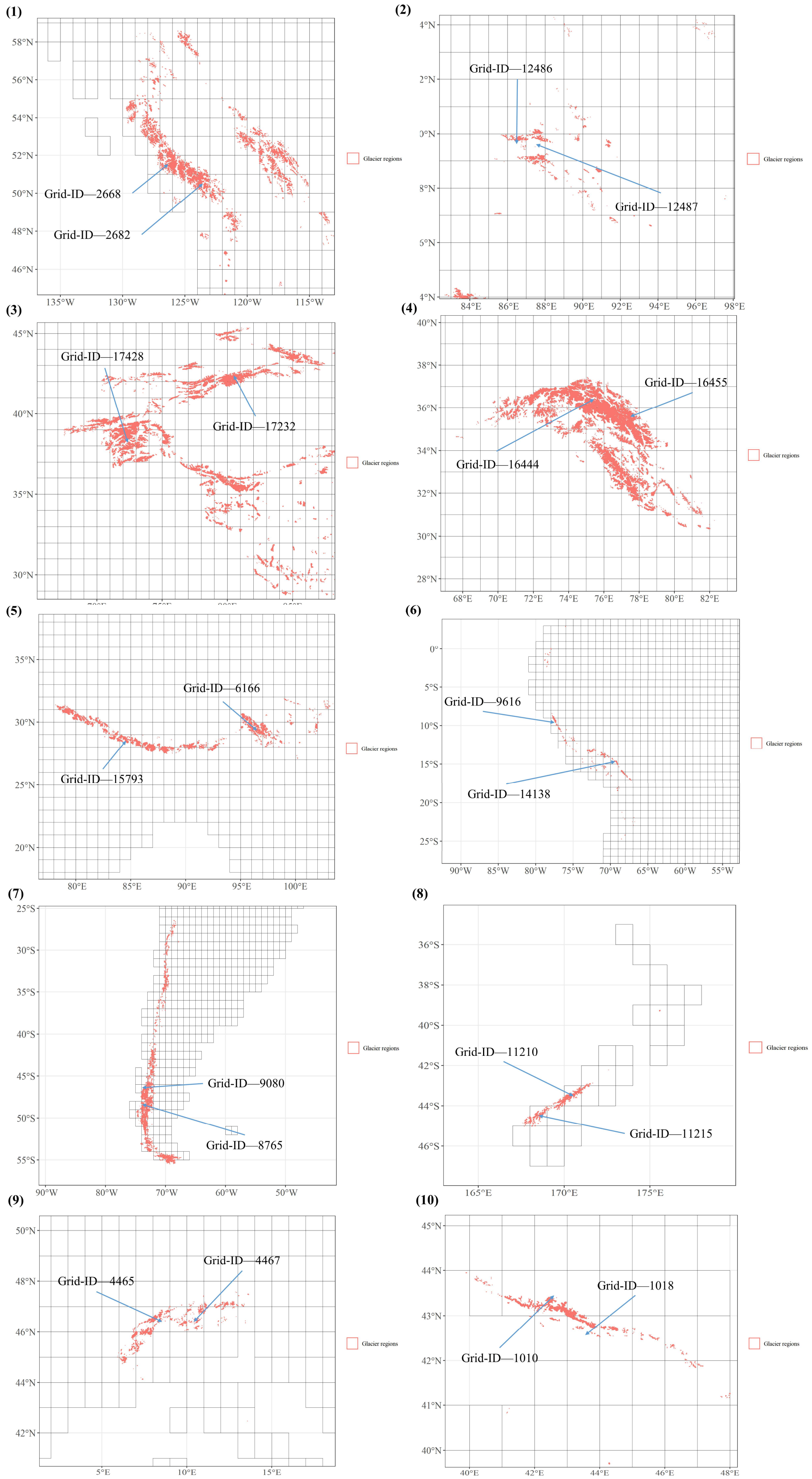


Figure 1 Global glacier distribution (a) and corresponding DFO-based flood events (b). (1) glacier regions in the western Canada and US; (2) glacier regions in north Asia; (3) glacier regions in central Asia; (4) glacier regions in the west of south Asia; (5) glacier regions in the east of south Asia; (6) glacier regions in the low latitudes; (7) glacier regions in the southern Andes; (8) glacier regions in the New Zealand; (9) glacier regions in the central Europe; (10) glacier regions in the middle east of Caucasus.



(1)
58°N
56°N
54°N
52°N
50°N
48°N
46°N
135°W
130°W
125°W
120°W
115°W
Grid-ID—2668
Grid-ID—2682
Glacier regions
(2)
Grid-ID—12486
Grid-ID—12487
84°E
86°E
88°E
90°E
92°E
94°E
96°E
98°E
Glacier regions
(3)
45°N
40°N
35°N
30°N
Grid-ID—17428
Grid-ID—17232
Glacier regions
(4)
40°N
38°N
36°N
34°N
32°N
30°N
28°N
68°E
70°E
72°E
74°E
76°E
78°E
80°E
82°E
Grid-ID—16455
Grid-ID—16444
Glacier regions
(5)
35°N
30°N
25°N
20°N
80°E
85°E
90°E
95°E
100°E
Grid-ID—6166
Grid-ID—15793
Glacier regions
(6)
0°
5°S
10°S
15°S
20°S
25°S
90°W
85°W
80°W
75°W
70°W
65°W
60°W
55°W
Grid-ID—9616
Grid-ID—14138
Glacier regions
(7)
25°S
30°S
35°S
40°S
45°S
50°S
55°S
90°W
80°W
70°W
60°W
50°W
Grid-ID—9080
Grid-ID—8765
Glacier regions
(8)
36°S
38°S
40°S
42°S
44°S
46°S
165°E
170°E
175°E
Grid-ID—11210
Grid-ID—11215
Glacier regions
(9)
50°N
48°N
46°N
44°N
42°N
5°E
10°E
15°E
Grid-ID—4465
Grid-ID—4467
Glacier regions
(10)
45°N
44°N
43°N
42°N
41°N
40°N
40°E
42°E
44°E
46°E
48°E
Grid-ID—1018
Grid-ID—1010
Glacier regions

Figure 2 Ten glacier regions during the 60°S—60°N latitudes. two representative GRACE grid points in each region were selected to analyze the flood of the temporal detection. This was corresponding to the time series in Figure 3. (1) glacier regions in the western Canada and US; (2) glacier regions in north Asia; (3) glacier regions in central Asia; (4) glacier regions in the west of south Asia; (5) glacier regions in the east of south Asia; (6) glacier regions in the low latitudes; (7) glacier regions in the southern Andes; (8) glacier regions in the New Zealand; (9) glacier regions in the central Europe; (10) glacier regions in the middle east of Caucasus.

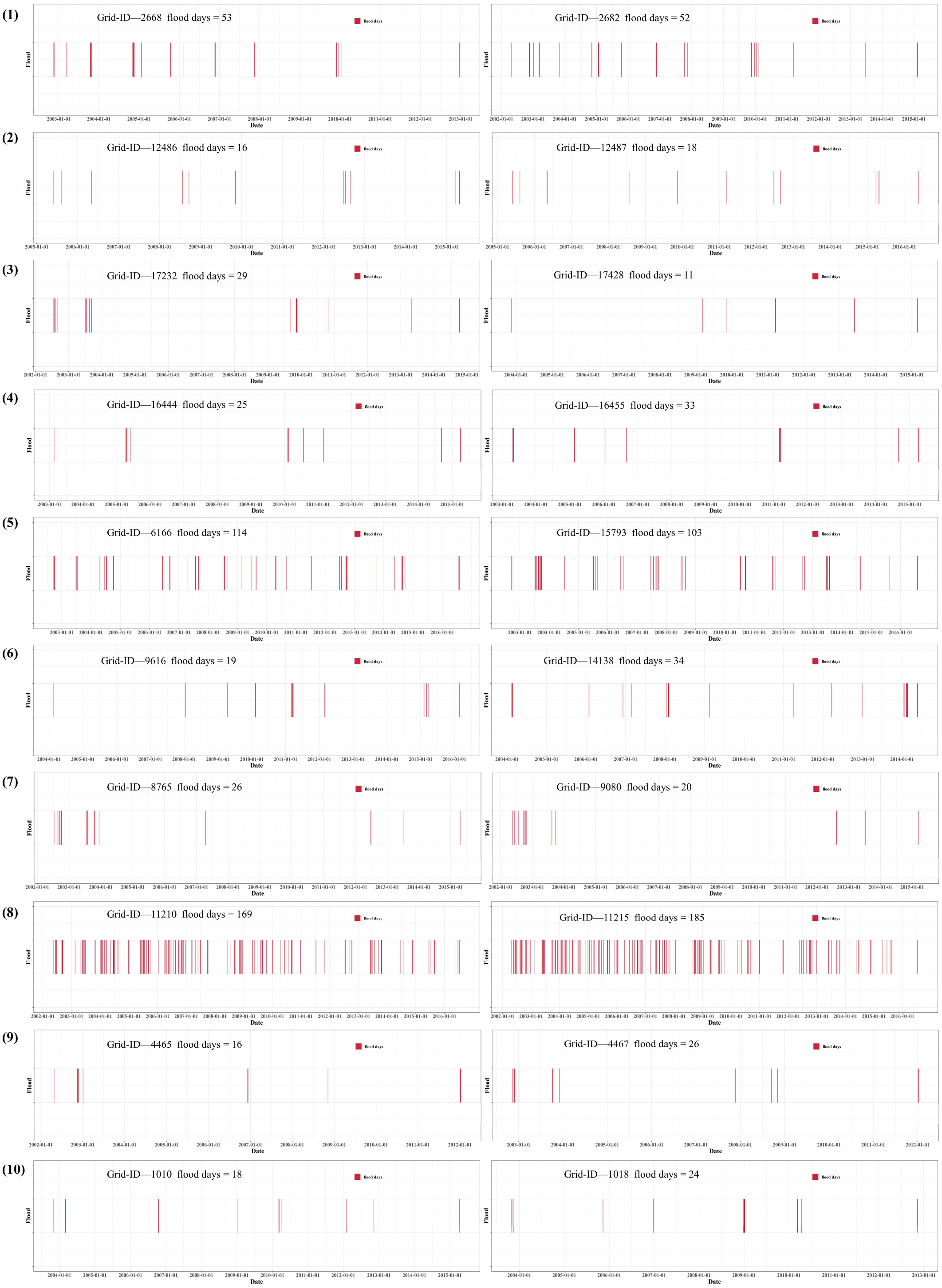
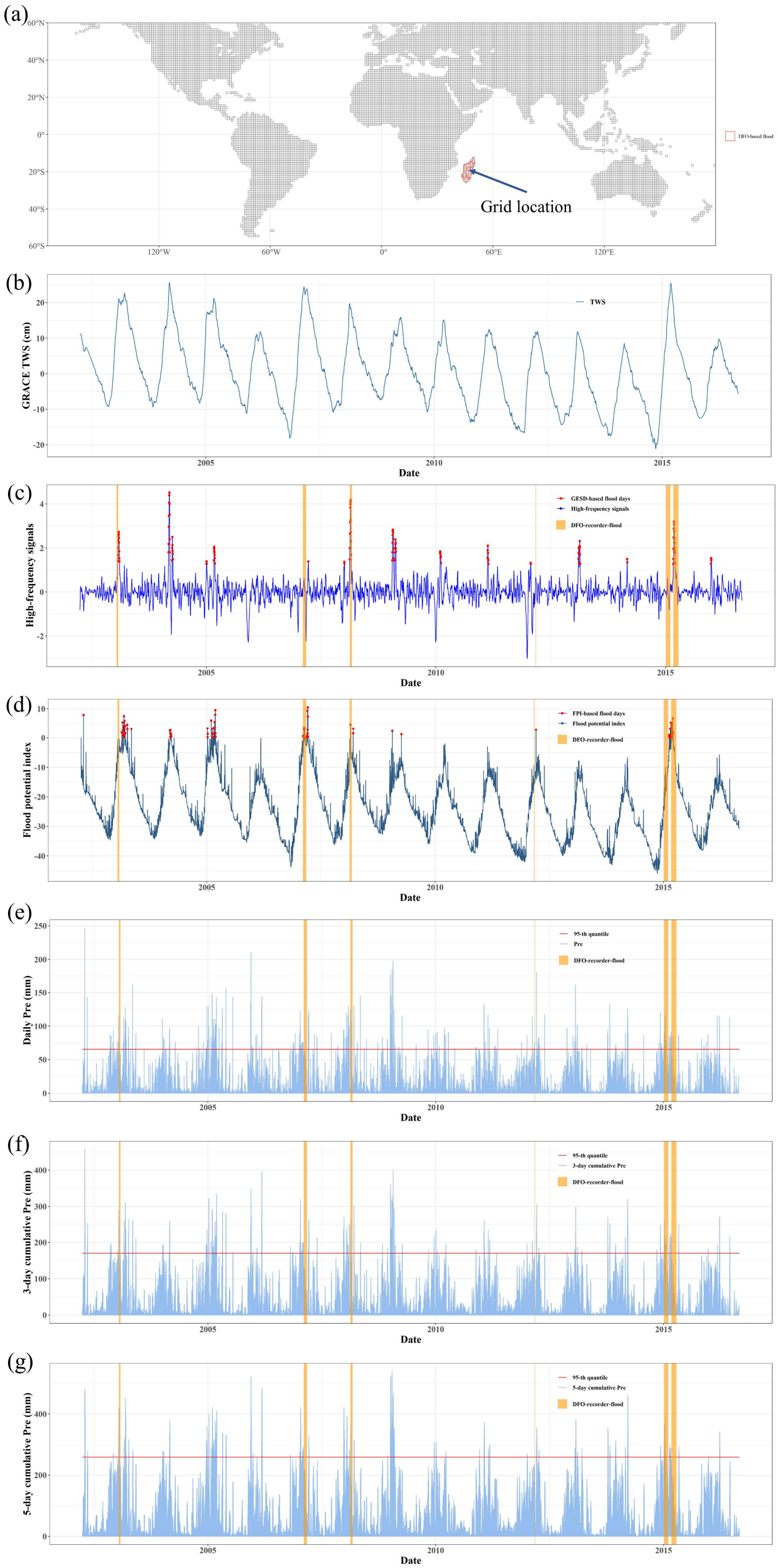


Figure 3 Flood detection results for different glacier regions.(specific regions are consistent with Figure-2.)

2. In Figure 1 in your response, you should also show the location of the grid.

Response: We thank reviewer's suggestions. We have shown the location of the grid.



(a)
60°N
40°N
20°N
0°
20°S
40°S
60°S
120°W
60°W
0°
60°E
120°E
DFO-based flood
Grid location
(b)
GRACE TWS (cm)
TWS
Date
(c)
High-frequency signals
GESD-based flood days
High-frequency signals
DFO-recorder-flood
Date
(d)
Flood potential index
FPI-based flood days
Flood potential index
DFO-recorder-flood
Date
(e)
Daily Pre (mm)
95-th quantile
Pre
DFO-recorder-flood
Date
(f)
3-day cumulative Pre (mm)
95-th quantile
3-day cumulative Pre
DFO-recorder-flood
Date
(g)
5-day cumulative Pre (mm)
95-th quantile
5-day cumulative Pre
DFO-recorder-flood
Date

Figure 4 Schematic diagram of the intermediate variable time series processing for flood extraction based on GRACE and extreme precipitation for a randomly selected grid from Apr. 1st, 2002 to Aug. 31st, 2016. (a) randomly selected grid for flood detection; (b) GRACE TWS times series; (c) high-frequency signals time series derived from GRACE and flood days extraction based on GESD; (d) flood days extraction based on flood potential index time series; (e) daily precipitation time series and extreme precipitation days based on 95-th quantile; (f) 3-day cumulative precipitation time series and extreme precipitation days based on 95-th quantile; (g) 5-day cumulative precipitation time series and extreme precipitation days based on 95-th quantile.

References:

Anderson, Brian, Mackintosh, Andrew, Stumm, Dorothea, George, Laurel, Kerr, Tim, Winter-Billington, Alexandra, and Fitzsimons, Sean: Climate sensitivity of a high-precipitation glacier in New Zealand, Journal of Glaciology, 56, 114-128, 2010.

Arendt, A, Bliss, A, Bolch, T, Cogley, JG, Gardner, A, Hagen, J-O, Hock, R, Huss, M, Kaser, G, and Kienholz, C: Randolph Glacier inventory–A dataset of Global glacier outlines: Version 6.0: Technical report, Global land ice measurements from space, 2017.

Nandargi, S and Dhar, ON: Extreme rainfall events over the Himalayas between 1871 and 2007, Hydrological Sciences Journal, 56, 930-945, 2011.