Answer to the Anonymous Referee #1 comments

Dear Referee

We highly appreciate your comments and suggestions adding valuable inputs to improve our manuscript. Based on your insightful guidance, we revised our paper and made respective minor changes. We hope our revision meet your approval.

Comment: Authors must indicate the meaning of the acronyms used in the manuscript (e.g., page 3 AOGCM and RCM)

Response: In the revision, we indicate these acronyms as Atmosphere-Ocean Global Circulation Models (AOGCM) and Regional Climate Models (RCM) on page 3 of the paper. We checked all other acronyms and hope all are explained now.

Comment: A uniform way to reference figures must be used (Fig or Figure)

Response: We have gone through the paper and included reference to figures as (Figure)

Comment: Figure 1 has very low quality. It would also be advisable to provide coordinates or/and additional localization map. This map is difficult to interpret. Authors should explain that it represents the political-administrative division of the country together with the 5 locations of study

Response: We produced a new, high quality figure showing the main mudflow regions and administrative divisions respectively. We included mudflow locations for the 2005-2014 period to highlight the different regions.

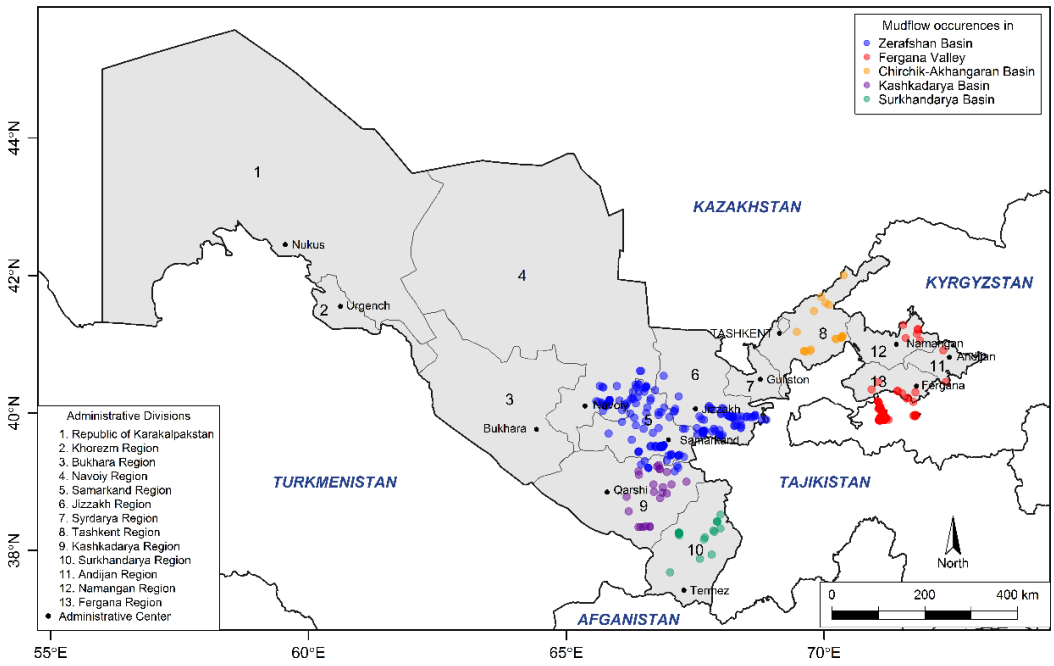

Figure 1. Mudflow occurrences for the years 2005-2014 in areas with high probability of mudflow passage in Uzbekistan: Zerafshan Basin (blue dots) in central part of the country; Fergana Valley (red dots) in the east; Chirchik-Akhangaran Basin (orange) in the north-east; Surkhandarya (green) and Kashkadarya (violet) rivers' basins in the south of Uzbekistan. Map also represents political administrative divisions and administrative centers/cities of the country. Map does not include inland water resources.

Comment: Figure 3 should indicate the average monthly temperature.

Response: Figure 3 actually indicates the average monthly temperature (black curve line) and precipitation (grey bars) in original version, however we have changed the colour to increase visibility.

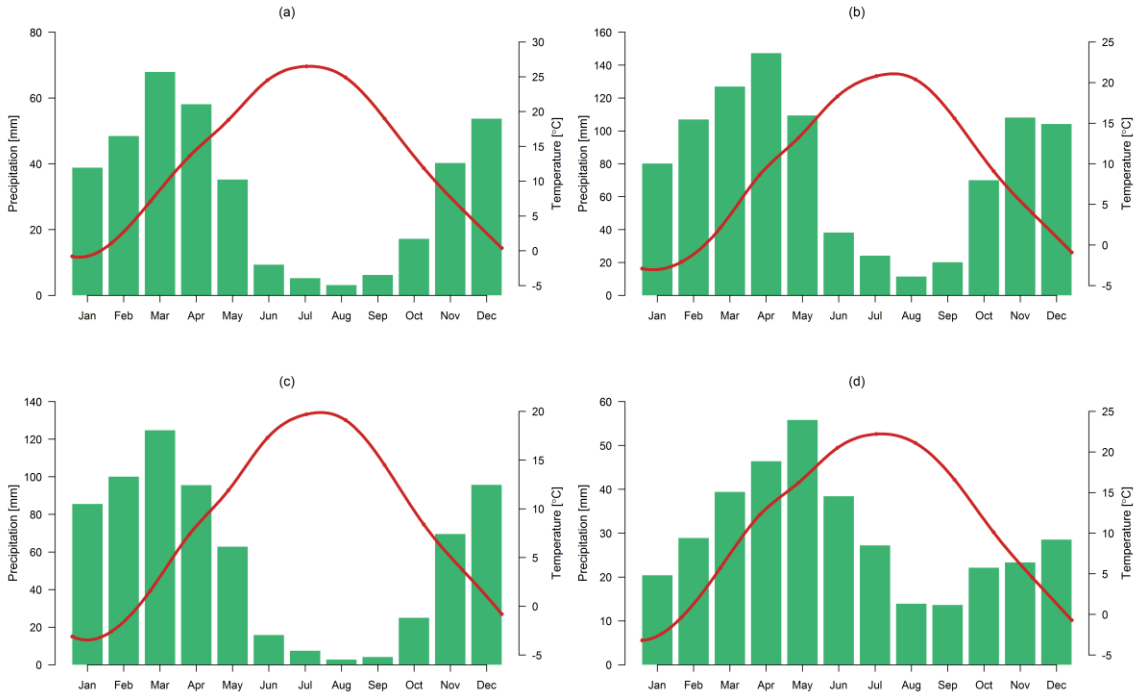

Figure 3. The 30-year means (1984-2013) of monthly temperature (°C, red line) and precipitation (mm, green bars) in four selected stations namely Gallyaral in Zerafshan Basin (a), Chimgan in Chirchik-Akhangaran Basin (b), Mingchukur representing Kashkadarya and Surkhandarya Basins (c) and Sokh in Fergana Valley (d) with high occurrences of mudflow in Uzbekistan. Graphs have different scales

Comment: Authors should consider the possibility of reducing the number of figures and tables (e.g., figure 4 and table 1 can be removed).

Response: We followed this recommendation and removed Figure 4 and moved Table 1 into the Appendix.

Comment: Figure 7 should indicate for latitude/longitude the symbol of degrees and North and East.

Response: Figure 7 was presented as originally published. However, we produced a figure based on the reference material and added information about the nature of the flow.

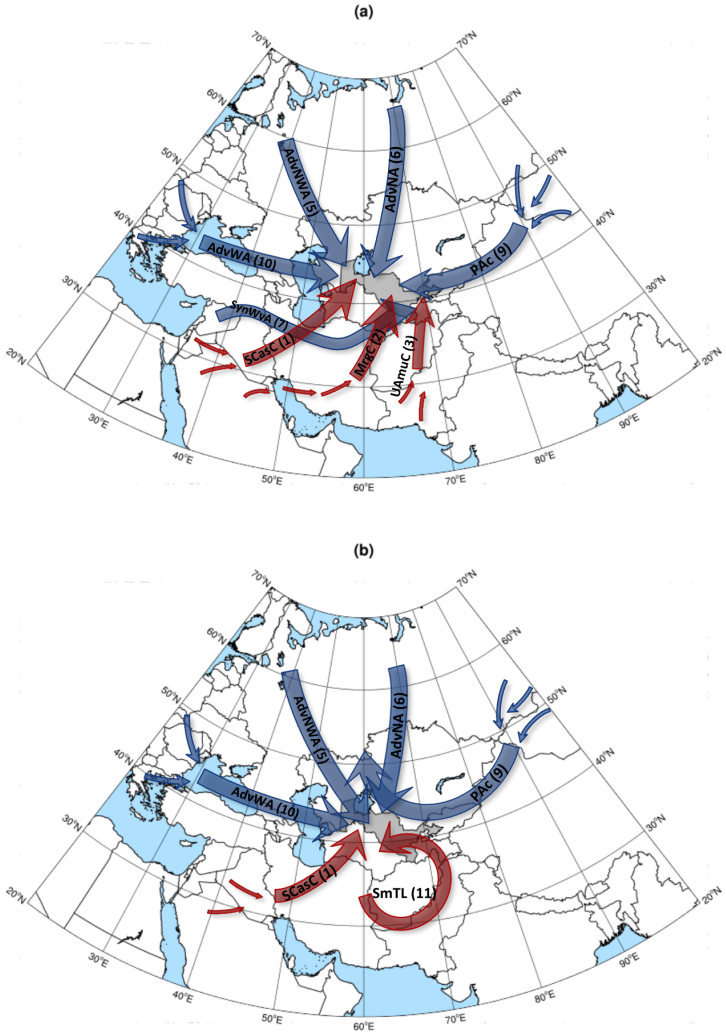

Figure 7. Scheme of synoptic weather types in Central Asia and Uzbekistan during the cold (a) and warm seasons (b) of the year (after Inagamova et al., 2002). Blue and red cursors indicate relatively cold and warm air trajectories approaching to the investigation area (grey background). Abbreviations and numbers of each weather type explained in Table 1 of Appendices.

Comment: In the caption for Figure 9 the reference to subfigures a and c is missing.

Response: Many thanks. Corrected.

Comment: It is difficult to interpret graphs 8 and 9 with numbers of SWT, and then its link to table A1 (annex). I advise the authors to use abbreviations that allow to easily remember the synoptic weather types instead of numbers.

Response: We are appreciative of this comment. However, in the original work to SWT each weather type is given as a number code. We would like to conserve this. Nevertheless, we added abbreviations in order to indicate the respective weather class in the revised version.

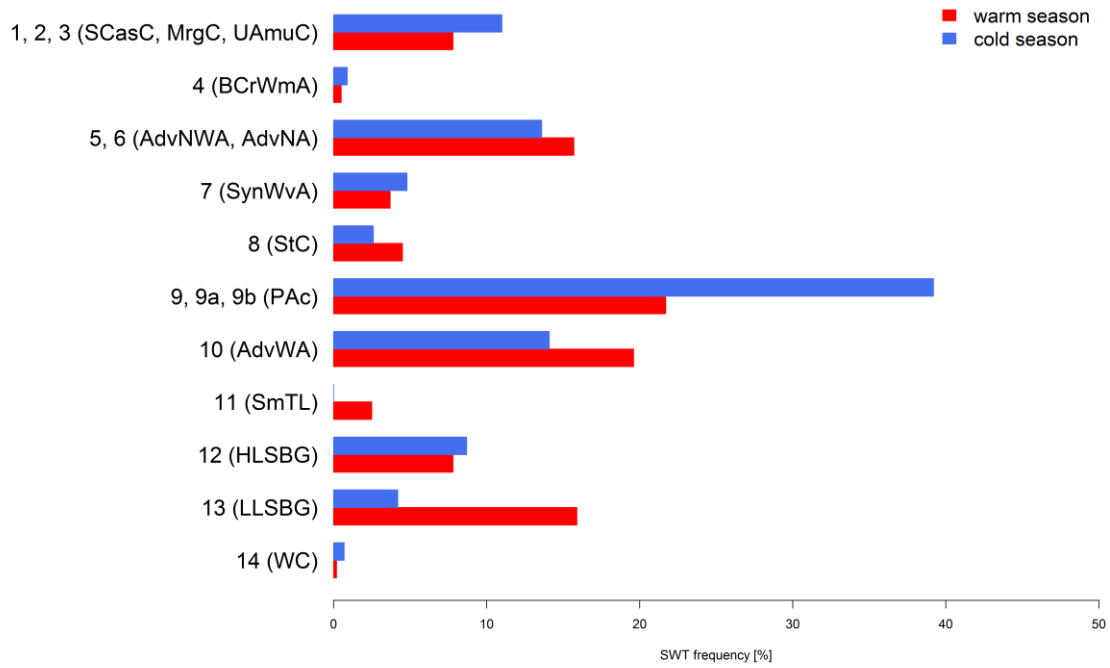

Figure 8. Frequency distributions of daily synoptic weather types by Bugayev's classification during the cold (Sep-Feb) and warm (Mar-Aug) seasons in the period of 1935-2014 y. Definitions of SWT can be seen in Table 1 in appendices section.

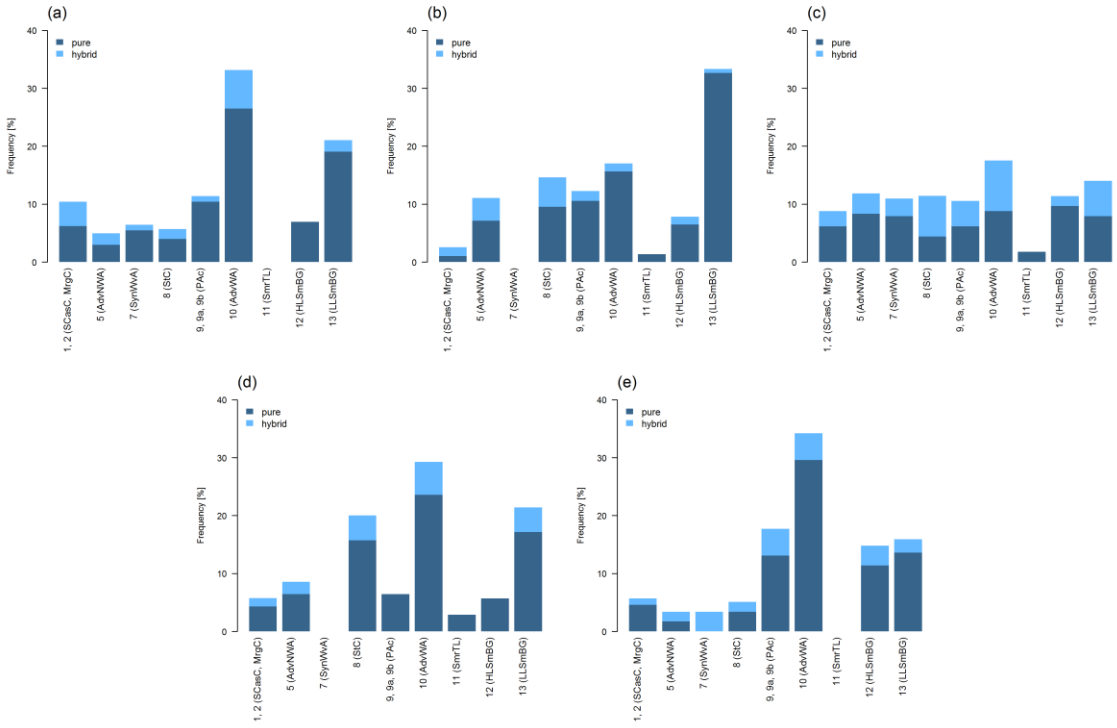

Figure 9. Frequency of mudflows under the synoptic weather types (SWT) over Uzbekistan during 1984-2013 (March-August): a) Zerafshan Basin (101 days); b) Fergana Valley (147 days); c) Chirchik-Akhangaran Rivers Basin (57 days); d) Kashkadarya Basin (35 days); e) Surkhandarya Basin (44 days). Definitions of SWT can be seen in Table 1 in appendices section.

Table 1. Synoptic weather types (SWT) of Central Asia and general weather characteristics over the region and in Uzbekistan. SWT 1-9, 9a and 10-11 was classified by Bugayev et al. (1957); types 9b and 12-15 were added later by the researchers of the Hydrometeorological Scientific Institute in Uzbekistan.

Group	Code	Synoptic Weather Type (SWT)	Source region	Air mass	Characteristics
Group A Cyclones from south and south-west	1	South Caspian Cyclone (**SCasC**)	Southern part of Caspian Sea, east of Mediterranean Sea, Mesopotamia, Northern part of Arabian Peninsula	tropical	rising temperature in the warm sector of the cyclone in winter, heavy precipitation especially in mountain areas, strong winds, dust storms along the desert areas
	2	Murgab Cyclone (**MrgC**)	Cyclone forms as a wave in Iraq, Mesopotamia, Iran and approaches to the Southern part of Turkmenistan, Murghab and Tejen Rivers' basins	tropical, continental (temperate zones)	mild and wet in the warm sector of the cyclone, strong winds, heavy precipitation, thunderstorms in spring, floods in the rivers, sometimes radiation fog
	3	Upper-Amudarya Cyclone (**UAmuC**)	Afghanistan, West Pakistan, Persian Gulf	tropical	warm air flow, cloudy; precipitation may be observed in the territory of Tajikistan; strong winds in the mountain areas, sometimes fog
	4	Broad carrying the warm air (**BCrWmA**)	South-westerly and southerly flows in the troposphere approach to the Southern part of European Russia, Western Kazakhstan and Central Asia	tropical, continental (temperate zones)	warm, clear, dry weather condition with light winds
Group B Advection of cold airflow from north and north-west	5	Advection of cold north-westerly air flow (**AdvNWA**)	South-eastern part of European Russia, Western Kazakhstan and Ustyurt	arctic (Siberian sector), continental (temperate zones)	mainly cold in winter with cloudiness, precipitation and strong winds; in summer cool weather, precipitation depends on the orography and convection process; frosts in spring and autumn
	6	Advection of cold northerly air flow (**AdvNA**)	Ural, Western Siberia, Kazakhstan	arctic (Greenland and the North Sea), continental (temperate zones)	very cold, sometimes severe weather with winds, little precipitation and fog in winter season; thundery and rainfall in summer in the mountain areas; frost in early spring and late autumn
	7	Synoptic wave activity on a cold front (**SynWvA**)	Eastern Mediterranean, Middle East	Mediterranean, Atlantic (subtropical)	mostly the weather is wet with changeable temperature, sleet showers, winds, occasionally thundery in spring
	8	Stationary Cyclone over the Central Asia (**StC**)	Regeneration of western or south-western cyclones	Mediterranean, Atlantic, tropical	sleet in cold period; in summer cool and heavy rainfall especially in south-eastern mountain areas, thundery, slight winds
	10	Advection of westerly air flow (**AdvWA**)	Central and Southern Europe (westerly moist) European Russia and Ukraine (westerly cold)	Atlantic and continental (temperate zones), sometimes arctic	cool, strong winds, precipitation in cold period; in spring and early summer the weather is wet giving most rain, temperature falling, dust storms, thundery
	15	Diving Cyclone (**DC**)	Norwegian Sea, Barents Sea, Kara Sea	arctic	precipitation, strong winds
Group C Anticyclonic weather	9	Periphery of anticyclone (**PAc**) — South-western periphery of Anticyclone (**SWPAc**)	Siberian High	arctic	in general, it is clear and mostly dry with slight winds; radiation fog in the piedmont and mountain areas in the first phase of the synoptic type, cloudiness and precipitation might be observed in eastern mountain areas of Central Asia
	9a	Periphery of anticyclone (**PAc**) — South-eastern periphery of Anticyclone (**SEPAc**)	Stationary anticyclone over the Ustyurt, lower Volga or western Kazakhstan (part of Siberian High)	arctic	clear, cold, frost and mist on the plain surface, sometimes precipitation in mountain areas in cold period; in summer, it is cool and slight winds
	9b	Periphery of anticyclone (**PAc**) — Southern periphery of Anticyclone (**SPAc**)	Siberian High extends to the eastern regions 50-55º N in which Central Asia is on its southern periphery	arctic	mostly this synoptic weather type is cold and dry with foggy days in winter phase; in summer the weather is cool and clear
	11	Summer thermal low (**SmTL**)	Non frontal low pressure area over southwest of Central Asia	tropical dry	clear, dry, very hot, haze, winds, dust storms
	12	High level of small barometric gradient (**HLSBG**)	The area of high pressure over the Central Asia which units the Siberian High and the anticyclone over the European Russia	mostly arctic	generally cold, dry and clear weather with light winds; in cold periods it is foggy and little precipitation in south-eastern regions
	13	Low level of small barometric gradient (**LLSBG**)	Low-pressure area over the Central Asia which aligns in meridional orientation	moderate zones	in most parts of Central Asia there are dry and warm weather conditions; in winter the weather is mostly foggy with slight precipitation; in summer convective clouds and heavy rainfall may be observed in local areas
Group D Mid-latitude cyclone	14	Western Cyclone (**WC**)	Cyclone tracks from the Mediterranean Sea, sometimes from Northern Africa to the Black Sea or Middle East then reaches to the Central Asia through the Caspian Sea	Mediterranean	strong winds, dust storm in the desert area, precipitation especially in mountain areas

Comment: Figure 10 has errors in it. The grey backgrounds in 10a and 10b don't indicate anything, so they should be removed. Moreover, it's advisable to show the area of study with a grey background. In fig. 10c the measurement unit (m) should be indicated for the orography

Response: Many thanks for this point. Grey background in Figures 10a and 10b was changed to a blue colour to indicate inland water resources. Investigation area was filled in grey background. Orography unit (m) in Figure 10c was added.

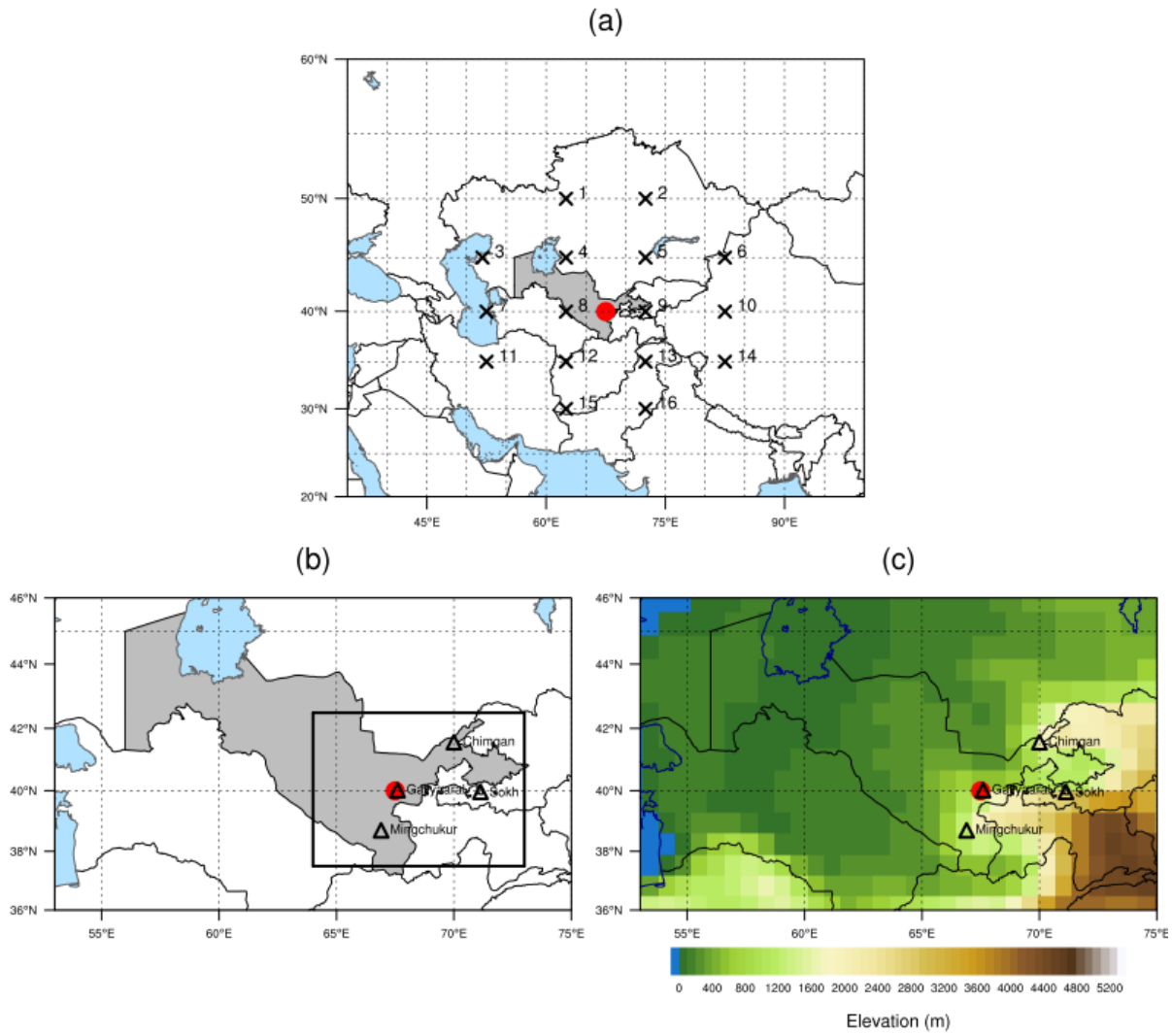

Figure 10. a) Location of the study domain together with the 16 grid points and central grid point (40N-67.5E, red circle) used in the automated weather circulation type; **b)** Investigation area shown in rectangle and location of selected stations (black triangles) around the central grid point 40.0 N-67.5 E (red circle) of CWT objective method. Stations: Gallyaral (40.02 N-67.60 E), Chimgan (41.57 N-70.00 E), Sokh (39.97 N-71.13 E) and Mingchukur (38.70N – 66.90 E); **c)** ERA-Interim orography map and the location of central grid point (red circle) together with representative four stations (black triangles).

Comment: Authors should include in the text references to figures 10b, A1 and to table A2.

Response: Done.

Comment: Figure 14 has a misleading description. It is not entirely clear what graphs represent.

Response: Many thanks for the comment and for suggesting this improvement. We revised Figure14 adding more precisely figure caption and we also proposed to make minor correction to the figure which is detailed in the explanation.

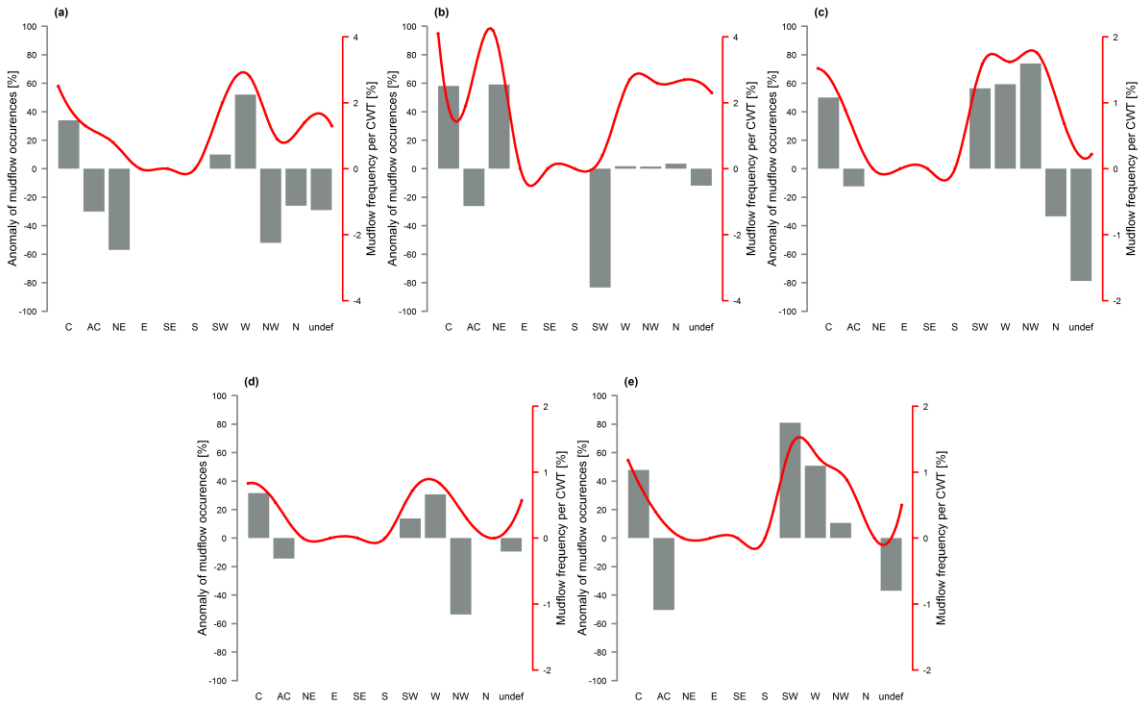

Figure 14. Anomaly of mudflow days per CWT class (grey bars, grey axis, %) and CWT classes for mudflow days (red line, red axis, %) for the March-August period between 1984 and 2013 in five regions: a) Zerafshan Basin (101 days); b) Fergana Valley (147 days); c) Chirchik-Akhangaran Rivers Basin (57 days); d) Kashkadarya Basin (35 days); e) Surkhandarya Basin (44 days). Figure has different scales.

Explanation of the Figure 14.

Red line is CWT for mudflow days: 1018 days from total 5520 climatological CWT days in warm season associated with cyclonic circulation over Zerafshan Basin and only 25 days or 2.5 % from total cyclonic days (red line and red scale) resulted mudflow occurrences in Zerafshan (Figure 14a). Similarly mudflow anomalies or values compared to the average occurrence of mudflows (1.8% or 101 days out of 5520) in this region increased nearly 35% on cyclonic days (grey bar and grey scales). However, frequency of anticyclonic days shows 1.3 % (13 anticyclonic mudflow days out of 1012 anticyclonic totals) and decreases more than 20% compared to the average mudflow occurrences. During the investigation period E, SE and S classifications highly unlikely resulted mudflow events in Zerafshan subsequently representing missing values in figure.