

Formatted	... [1]
Deleted:	
Formatted	... [2]
Deleted:	
Formatted	... [3]
Deleted:	
Formatted	... [4]
Deleted: Zaria Ireon Cast (zaria.cast)	
Formatted	... [5]
Deleted:	
Formatted	... [6]
Formatted	... [7]
Formatted	... [8]
Deleted:	
Formatted	... [9]
Deleted: the	
Deleted:	
Formatted	... [10]
Formatted	... [11]
Deleted: as rain	
Formatted	... [12]
Deleted: the extreme south	
Formatted	... [13]
Deleted: Annual precipitation	
Formatted	... [14]
Deleted:	
Formatted	... [15]
Deleted:	
Formatted	... [16]
Deleted: as rain	
Formatted	... [17]
Deleted:	
Formatted	... [18]
Deleted:	
Formatted	... [19]
Deleted: rainfall	
Formatted	... [20]
Deleted: rainfall	
Deleted: all seasons	
Formatted	... [21]
Formatted	... [22]
Deleted:	
Formatted	... [23]
Deleted:	
Formatted	... [24]
Deleted: , which has numerous causes,	
Deleted:	
Formatted	... [25]
Formatted	... [26]
Deleted:	
Formatted	... [27]
Deleted:	
Formatted	... [28]
Deleted: Duo	
Formatted	... [29]
Deleted:	
Formatted	... [30]
Deleted: ARC,	
Formatted	... [31]

1 Seasonal Characteristics and Trends in Precipitation

2 Partitioning in the Arctic

3 Zaria Ireon Cast¹, Mark C. Serreze¹, Elizabeth N. Cassano¹, Andrew P. Barrett¹,

4 ¹Cooperative Institute for Research in Environmental Sciences, National Snow and Ice Data Center, University of
5 Colorado, Boulder CO, 80301, United States of America

6 Correspondence to: [Elizabeth Cassano \(Elizabeth.cassano@colorado.edu\)](mailto:Elizabeth.cassano@colorado.edu)

7
8 **Abstract.** Driven by growing impacts of changing precipitation amounts and phase on the Arctic's natural and built
9 environment, we examine seasonal patterns and trends in Arctic precipitation and partitioning between its liquid and
10 solid forms. Use is made of data from ERA5 reanalysis, Automated Surface Observing System stations over land,
11 and a climatology based on present weather reports over the Arctic Ocean. In the Atlantic sector of the Arctic, most
12 precipitation falls [in liquid form](#) in all seasons in [its southern limits](#), but snowfall is high over its northern parts,
13 [Precipitation](#) over the dry central Arctic Ocean and terrestrial polar deserts almost always falls as snow. Even during
14 the summer, typically 50% of precipitation over the central Arctic Ocean falls as snow. Over land, [nearly all summer](#)
15 precipitation falls [in liquid form](#), except in the Canadian Arctic Archipelago where summer snowfall is still
16 common. Annual precipitation has increased since 1979, primarily in the Barents Sea sector, accompanied by
17 generally downward trends in snowfall and, hence, upward trends in liquid precipitation. Across much of the Arctic,
18 [the liquid](#) to total precipitation ratio has increased only in summer [and autumn](#), while in the Atlantic sector, the
19 [liquid](#) to total precipitation ratio has increased in [fall and winter](#).

21 1 Introduction

22
23 Arctic surface air temperatures are increasing more rapidly than for the globe as a whole (Rantanen et al., 2022),
24 This Arctic Amplification of warming is associated with changing precipitation patterns. Historically, most of the
25 annual precipitation in the Arctic (apart from the warm Atlantic sector) has fallen [as snow](#). However, as the Arctic
26 warms, one expects both an increase in total precipitation (due to more atmospheric water vapor and a stronger
27 poleward moisture flux convergence), a shift towards more rainfall, and larger precipitation events (e.g., [Dou et al.,](#)
28 2022; [McCrystall et al.,](#) 2021). Indeed, annual precipitation for the Arctic, viewed as a whole now appears to have a
29 detectable upward trend ([Moon et al.,](#) 2024).

30
31 This paper focuses on the seasonal and spatial variability of Arctic precipitation, its phase ([liquid versus snowfall](#)),
32 [and how precipitation totals and its phase are changing](#). It makes primary use of ERA5 variables of total
33 precipitation, snowfall, and liquid precipitation ([calculated as total precipitation minus snowfall](#)) over the period
34 1979-2023. Additional data sources, used primarily for validation of ERA5, include Automated Surface Observing
35 System (ASOS) reports of precipitation phase over land, an early climatological analysis of precipitation phase on
36 the Arctic Ocean from present weather reports (Clark et al., 1996; Serreze et al., 1996) and published studies of

105 ERA5 precipitation. This paper represents a contribution to the Arctic Rain on Snow (AROSS) study, part of the
106 National Science Foundation Navigating the New Arctic (NNA) Initiative. AROSS focuses on understanding
107 impacts of rain on snow (ROS) and extreme precipitation events on the Arctic natural and built environment, with a
108 special focus on reindeer herding practices (Serreze et al., 2021). A consequence of ROS events is that rainfall,
109 when followed by a temperature drop, can result in the formation of hard, icy crusts. Impacts can be immediate
110 (such as on travel), evolve or accumulate. There have been recorded events of starvation-induced die-offs of tens of
111 thousands of reindeer, caribou, and musk oxen. Voveris and Serreze (2023) describe the meteorology behind some
112 of these ROS events and point out that even a small precipitation event can have large consequences. Thus, a greater
113 understanding of how Arctic precipitation is changing will inform how these events may also be changing, by either
114 a reduction in snowpack or increasing rain events.

115
116 The present study addresses the following question: What are the present-day seasonal and spatial patterns of
117 precipitation and partitioning (liquid versus snowfall) across the Arctic, and how have these patterns changed over
118 the study period in response to the warming Arctic climate?

119 2 Data Sources

120 2.1 ERA5 Reanalysis

121
122 Atmospheric reanalyses are widely used in the research community (Zhao et al. 2010). The European Centre for
123 Medium-Range Weather Forecast (ECMWF) Reanalysis version 5 (ERA5) (Hersbach et al., 2020) employs four-
124 dimensional variational data assimilation (4D-Var) (Rabier, 2005). Observations assimilated into the ERA5 system
125 include surface data, radiosonde profiles, ship-based measurements, aircraft reports and satellite data. Precipitation
126 is generally not assimilated. While ERA5 extends back to 1950, we use data from 1979 to 2023. The availability of
127 satellite observations from 1979 onward significantly improves estimates of precipitation and atmospheric
128 conditions in the Arctic (Xiong et al., 2022). As with any reanalysis, one must be aware that the assimilation
129 database has changed over time (Hersbach et al., 2020) which can introduce biases, especially in earlier records with
130 fewer observational constraints (Simmons et al., 2021).

131
132 We use monthly data at 31 km horizontal resolution of total precipitation, snowfall, and turbulent latent heat fluxes.
133 Total precipitation represents the accumulation of all forms of precipitation. Liquid precipitation is obtained by
134 subtracting snowfall from total precipitation. Along with rainfall, this may also include sleet and freezing rain. After
135 a forecast is generated, ERA5 applies a post-processing step to adjust precipitation fields based on available surface
136 observations. However, these observations are not incorporated into the model during the assimilation phase. As a
137 result, ERA5 precipitation estimates are primarily influenced by the model's internal physics and parameterizations
138 (Hersbach et al., 2020). Accuracy of precipitation fields in ERA5 hence depends largely on the model's ability to
139 simulate precipitation processes effectively (Bromwich et al., 2016). The determination of precipitation phase in
140
141

- Deleted:
- Formatted ... [38]
- Deleted:
- Formatted ... [39]
- Deleted:
- Formatted ... [40]
- Deleted:
- Formatted ... [41]
- Deleted:) or
- Deleted:
- Formatted ... [42]
- Formatted ... [43]
- Deleted:
- Formatted ... [44]
- Deleted:
- Formatted ... [45]
- Deleted:
- Deleted:
- Formatted ... [46]
- Formatted ... [47]
- Deleted:
- Formatted ... [48]
- Deleted:
- Formatted ... [49]
- Formatted ... [50]
- Deleted:
- Deleted:
- Formatted ... [51]
- Deleted:
- Formatted ... [52]
- Formatted ... [53]
- Deleted:
- Formatted ... [54]
- Deleted:
- Formatted ... [55]
- Deleted:
- Formatted ... [56]
- Deleted:
- Formatted ... [57]
- Deleted:
- Formatted ... [58]
- Deleted: 6-hourly
- Formatted ... [59]
- Deleted: liquid precipitation, rainfall, and
- Formatted ... [60]
- Deleted: .
- Deleted:
- Formatted ... [61]
- Formatted ... [62]
- Deleted:
- Formatted ... [63]
- Deleted:
- Formatted ... [64]
- Deleted:
- Formatted ... [65]
- Deleted: ERA-5
- Formatted ... [66]
- Deleted: Herbach
- Formatted ... [67]

204 ERA5 is based on a combination of near-surface air temperature, atmospheric moisture, and model-based
205 calculations within the forecast system. Wet bulb temperature is a key factor in the determination. In some cases,
206 mixed-phase precipitation may occur within a small temperature range with temperatures just above freezing
207 (Hersbach et al., 2020; Xiong et al., 2022).

209 While ERA5 is known to have a warm bias over sea ice, ERA5 is considered one of the most reliable reanalysis
210 datasets for Arctic precipitation (Graham et al., 2019) and performs well in capturing precipitation phase (Xiong et
211 al. 2022). Loeb et al. (2022) concludes that ERA5 effectively captures the spatial distribution and frequency of
212 precipitation events in the eastern Canadian Arctic and Greenland. Serreze et al. (2022) show that ERA5
213 successfully represents broad precipitation trends and seasonal variations over the Canadian Arctic. Barrett et al.
214 (2020) compared precipitation estimates from six atmospheric reanalyses (NASA MERRA, NASA MERRA2,
215 NOAA CFSR/CFSv2, ECMWF ERA-Interim, ECMWF ERA5, and JMAO JRA55) against records from the
216 Russian North Pole series of drifting camps over the central Arctic Ocean. They find that the time series of annual
217 precipitation over the central Arctic Ocean correlates well between all reanalyses, and that all of the reanalyses
218 capture the basic spatial and seasonal patterns of Arctic precipitation. All reanalyses are prone to a problem of
219 spurious drizzle over the Arctic Ocean, with daily amounts less than 1 mm/day. However, Barrett et al. (2020), show
220 (from comparisons with data from the North Pole drifting stations) that a 1 mm cutoff used in many past studies
221 misses a significant amount of precipitation. As part of the present study, we compare ERA5 depictions of
222 precipitation partitioning against the ASOS database and an Arctic Ocean climatology described in more detail
223 below.

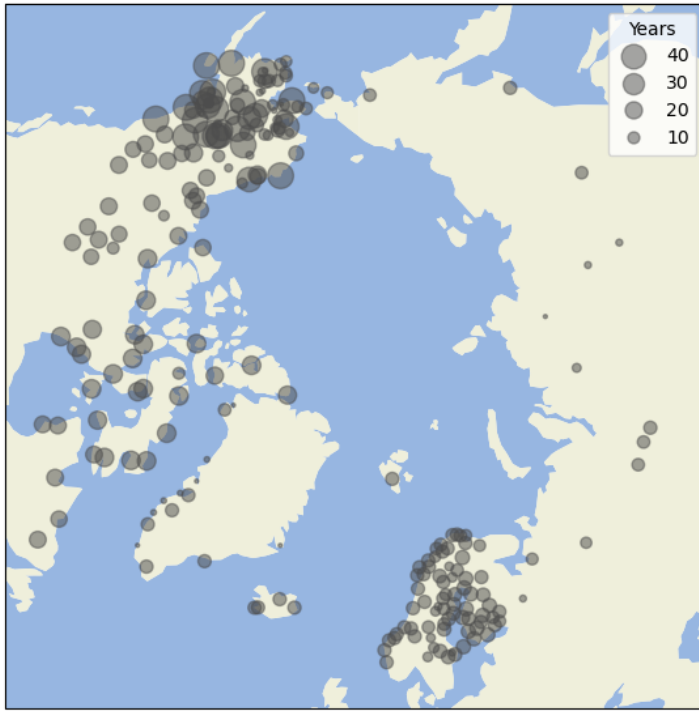
224 2.2 ASOS Database

227 As part of the AROSS project, a database of Arctic precipitation phase was compiled using reports from stations in
228 the Automated Surface Observing System (ASOS) networks of the United States, Canada, Greenland, Iceland,
229 Norway, Sweden, Finland and Russia. The database has records from 244 stations. Records used here span the
230 period 1979 to 2023.

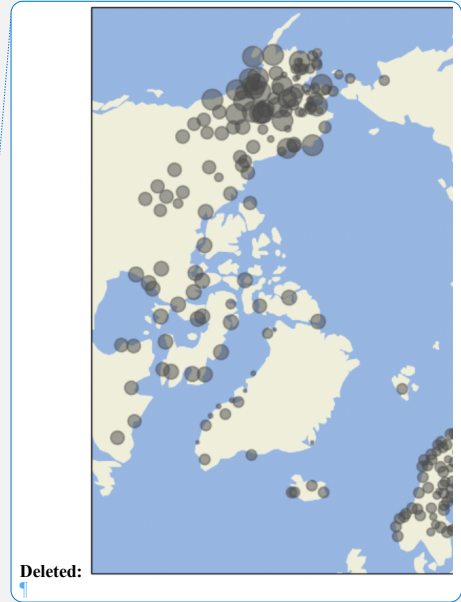
232 Precipitation type codes in reports are used to identify rain, freezing rain and solid precipitation. These codes are,
233 based on automated precipitation type sensors. Manual observations may be used to override automated reports,
234 when human observers are on station and when precipitation type reports are deemed erroneous. Reports were
235 quality controlled to ensure logical consistency between near-surface air and dew point temperatures and reported
236 precipitation type. For example, records with freezing or solid rain reports but with air temperature of 20°C or
237 higher were discarded. At the finest temporal resolution reported (minutes to an hour), rain events were reported
238 765610 times. Freezing rain was reported 18174 times. For the present study, data were resampled to an hourly
239 frequency. If a given precipitation type was reported during an hour reporting period, that hour was assigned the
240 precipitation type. Hours could be assigned multiple precipitation types if different precipitation types occurred

- Deleted:
- Formatted ... [69]
- Deleted:
- Formatted ... [70]
- Deleted:
- Formatted ... [71]
- Deleted:
- Formatted ... [72]
- Formatted ... [73]
- Formatted ... [74]
- Deleted:
- Formatted ... [75]
- Deleted:
- Formatted ... [76]
- Deleted:
- Formatted ... [77]
- Deleted:
- Formatted ... [78]
- Deleted:
- Deleted: depict that the majority
- Formatted ... [79]
- Formatted ... [80]
- Deleted: total annual precipitation
- Deleted: central
- Deleted: comes from small events,
- Formatted ... [81]
- Formatted ... [82]
- Formatted ... [83]
- Deleted:
- Formatted ... [84]
- Formatted ... [85]
- Deleted:
- Formatted ... [86]
- Formatted ... [87]
- Deleted: the
- Deleted:
- Formatted ... [88]
- Formatted ... [89]
- Formatted ... [90]
- Deleted:
- Formatted ... [91]
- Deleted:
- Formatted ... [92]
- Deleted:
- Formatted ... [93]
- Deleted:
- Formatted ... [94]
- Deleted: ,
- Formatted ... [95]
- Deleted:
- Formatted ... [96]
- Deleted:
- Formatted ... [97]
- Deleted: was
- Formatted ... [98]
- Deleted:
- Deleted:
- Formatted ... [99]
- Formatted ... [100]

295 within that hour. For example, if precipitation type transitioned from rain, to freezing rain, to snow in an hour, that
 296 hour would be assigned rain, freezing rain and solid precipitation. **Figure 1** shows the number of complete years of
 297 data for the period 1979 to 2023 for ASOS sites in the database. A complete year is defined as a year in which at
 298 least one hour has precipitation of any phase. A heatmap of the number of hours with liquid precipitation in each
 299 month for the 1979 to 2023 period organized by country is shown in **Figure 2**.



- Formatted: Font: 10 pt
- Deleted: The spatial distribution of ASOS sites with
- Deleted: numbers
- Formatted: Font: 10 pt
- Formatted: Font: 10 pt
- Deleted: as proportional circles
- Deleted: shown in **Figure 1**.
- Formatted: Font: 10 pt
- Deleted: events through the database
- Formatted: Font: 10 pt, Not Bold
- Formatted: Font: 10 pt
- Formatted: Font: 10 pt
- Formatted: Font: 10 pt, Not Bold
- Formatted: Font: 10 pt

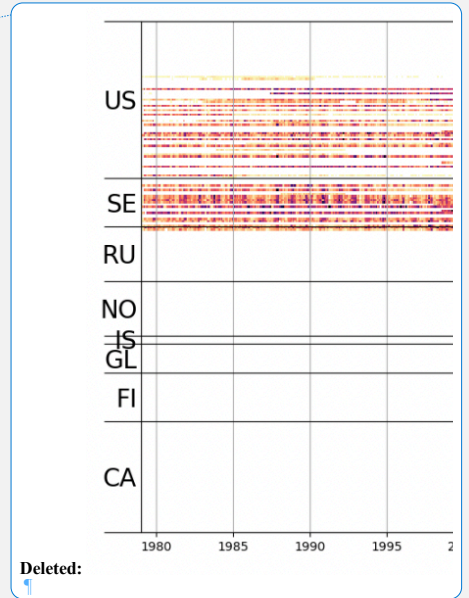
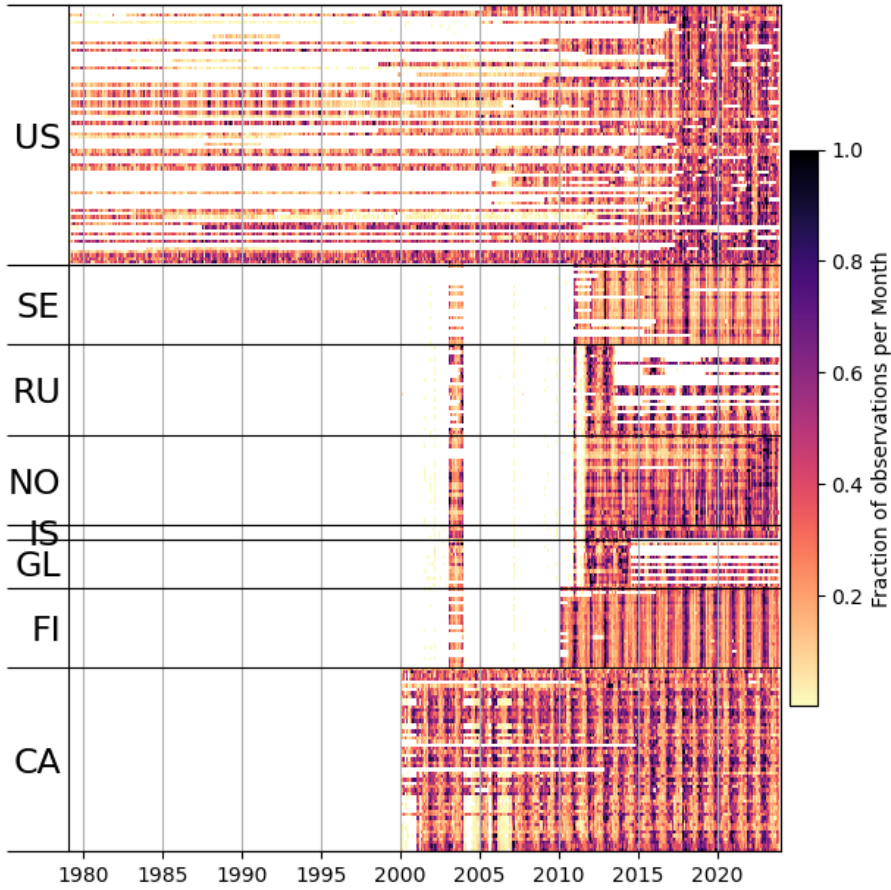


Deleted:

300
 301 **Figure 1: Number of complete years with data shown as proportional circles for ASOS stations. A complete**
 302 **year is defined as having at least one precipitation event of any phase reported in all twelve months.**

- Deleted:
- Formatted: Font: 10 pt
- Formatted: Font: 10 pt, Not Bold

811



812

813 **Figure 2: Heatmap of liquid precipitation events by month for the 1979 to 2023 from the ASOS database.**
 814 **Colors represent the hours in each month in the 1979 to 2023 period that a station reported liquid**
 815 **precipitation. Reports are organized vertically by country, and latitude. Country codes are US United States,**
 816 **SE Sweden, RU Russia, NO Norway, IS Iceland, GL Greenland, FI Finland, CA Canada. Latitude is in**
 817 **ascending order for each country grouping.**

818

819 **2.3 ICOADS Study**

820

- Deleted: rain
- Deleted: 2000
- Deleted: 2020.
- Formatted: Font: 10 pt
- Formatted: Font: 10 pt
- Formatted: Font: 10 pt
- Deleted:
- Deleted: :
- Formatted: Font: 10 pt
- Formatted: Font: 10 pt
- Formatted: Font: 10 pt
- Deleted:
- Formatted: Font: 10 pt
- Formatted: Font: 10 pt, Not Bold
- Formatted: Font: 10 pt
- Deleted:
- Formatted: Font: 10 pt, Bold
- Deleted: Clark

331 [Direct measurements of precipitation are particularly sparse over the Arctic Ocean. However, Serreze et al. \(1996\)](#)
332 [as part of a NSIDC Special Report, provide figures for each month](#) of precipitation phase and intensity over the
333 [Arctic Ocean based on present weather codes included within the Integrated Comprehensive Ocean-Atmosphere](#)
334 [Data Set \(ICOADS\). Clark et al. \(1996\) use these data in a study of Arctic Ocean climate characteristics.](#) Over the
335 central Arctic Ocean, most of the observations are from the Russian North Pole series of camps. These camps were
336 deployed on ice floes or tabular icebergs to gather oceanographic and meteorological data. The record examined
337 spans the period of 1950-1995. [For the NSIDC special report and Serreze and Barry \(2014\), observations](#) were
338 interpolated into a coarse grid array covering the Arctic Ocean for January and July. Precipitation frequency is the
339 percent of all reports for which any precipitation was observed. Frequency is also given for reports of “medium” and
340 “heavy” precipitation, [the designation being up to the observer and hence somewhat subjective.](#) Phase is based on
341 the percentage of all ICOADS reports for which liquid or solid precipitation was observed. While these data are
342 from an old study and the climate has changed since then, they still provide valuable information on precipitation
343 characteristics that, along with the ASOS database, can be compared to ERA5. [Because of past inattention to data](#)
344 [preservation we do not have the digital records - only the figures.](#)

3 Climatological Patterns

3.1 Annual

350 We look first at long-term (1979-2023) [mean annual totals](#) of total precipitation, snowfall, liquid precipitation and
351 [the liquid/total precipitation ratio](#) from ERA5 (Figure 3). As is well known, total precipitation is highest in the
352 North Atlantic sector, particularly in [the Greenland, Norwegian and Barents Seas \(top left panel\)](#). This reflects the
353 frequent passage of extratropical cyclones and within-region cyclogenesis associated with the North Atlantic
354 cyclone track (e.g., Serreze et al., 1993). As discussed shortly, cold-season evaporation rates are also very high in
355 this region. Locally, orographic uplift, such as that occurs along the southeast coast of Greenland, enhances
356 precipitation (Serreze et al., 1997; Tsukernik et al., 2007). Precipitation is much lower over the central Arctic Ocean
357 and Canadian Arctic Archipelago, the latter region classified as polar desert (Serreze and Barry, 2014). Note the
358 especially low precipitation over the high elevation [Greenland Ice Sheet](#).

360 Snowfall is low over the central Arctic Ocean and polar desert regions (Figure 3, upper right panel). Snowfall is in
361 turn greatest in the northern North Atlantic sector where total precipitation is high. While the Atlantic sector is the
362 warmest part of the Arctic, reflecting the lack of a sea ice cover and the influence of the warm North Atlantic Drift
363 current, temperatures over its northern portion are still generally cold enough in the lower troposphere (according to
364 ERA5) for most precipitation to fall as snow. There is much less snowfall in the southern part of this sector,
365 reflecting, of course, a higher incidence of [liquid precipitation](#) off the coast of northern Norway.

366 It follows that the highest [liquid](#) to total precipitation ratios are in the North Atlantic sector (Figure 3, lower right
367 [panel](#)). By contrast, the central Arctic Ocean and the Greenland Ice Sheet have the lowest [liquid](#) to total precipitation

- Formatted [101]
- Deleted:) published a paper highly relevant to the p [102]
- Formatted [103]
- Deleted:
- Formatted [104]
- Deleted:
- Formatted [105]
- Deleted:
- Formatted [106]
- Deleted:
- Formatted [107]
- Deleted:
- Formatted [108]
- Deleted: used by Clark et al. (1996)
- Formatted [109]
- Deleted: Observations
- Formatted [110]
- Deleted:
- Formatted [111]
- Deleted: .
- Formatted [112]
- Deleted:
- Formatted [113]
- Formatted [114]
- Deleted:
- Formatted [115]
- Formatted [116]
- Formatted [117]
- Deleted: means (
- Formatted [118]
- Deleted:)
- Formatted [119]
- Deleted:
- Formatted [120]
- Deleted: the
- Deleted: .
- Formatted [121]
- Formatted [122]
- Deleted:
- Formatted [123]
- Deleted: . As
- Formatted [124]
- Deleted:
- Formatted [125]
- Deleted:
- Formatted [126]
- Deleted:
- Deleted:
- Formatted [127]
- Formatted [128]
- Deleted: .
- Formatted [129]
- Deleted:
- Formatted [130]
- Deleted:
- Formatted [131]
- Deleted:
- Formatted [132]
- Deleted:

447 ratios. Over most of the central Arctic Ocean, 20-25% of annual precipitation falls as rain [\(Figure 3, lower left](#)
448 [panel\)](#).

449
450 Over the central part of the Greenland ice sheet, liquid precipitation is extremely rare. However, in August 2021,
451 [Summit Station](#) located at the highest point of the ice sheet, (3,216 meters above sea level), experienced its first
452 recorded rainfall event (European Space Agency, 2021). [According to the National Snow and Ice Data Center](#)
453 [\(NSIDC\)](#), this was the first known instance of rainfall at Summit Station. Warm air intrusions in 2012 and 2019,
454 resulted in brief surface melting, but temperatures were not high enough for rainfall to occur [in those years](#)
455 [\(Hermann et al., 2020; Tedesco and Fettweis, 2020\)](#).

456

Formatted: Font: 10 pt

Deleted:

Deleted:

Formatted: Font: 10 pt

Deleted:

Deleted:

Formatted: Font: 10 pt

Formatted: Font: 10 pt

Deleted:

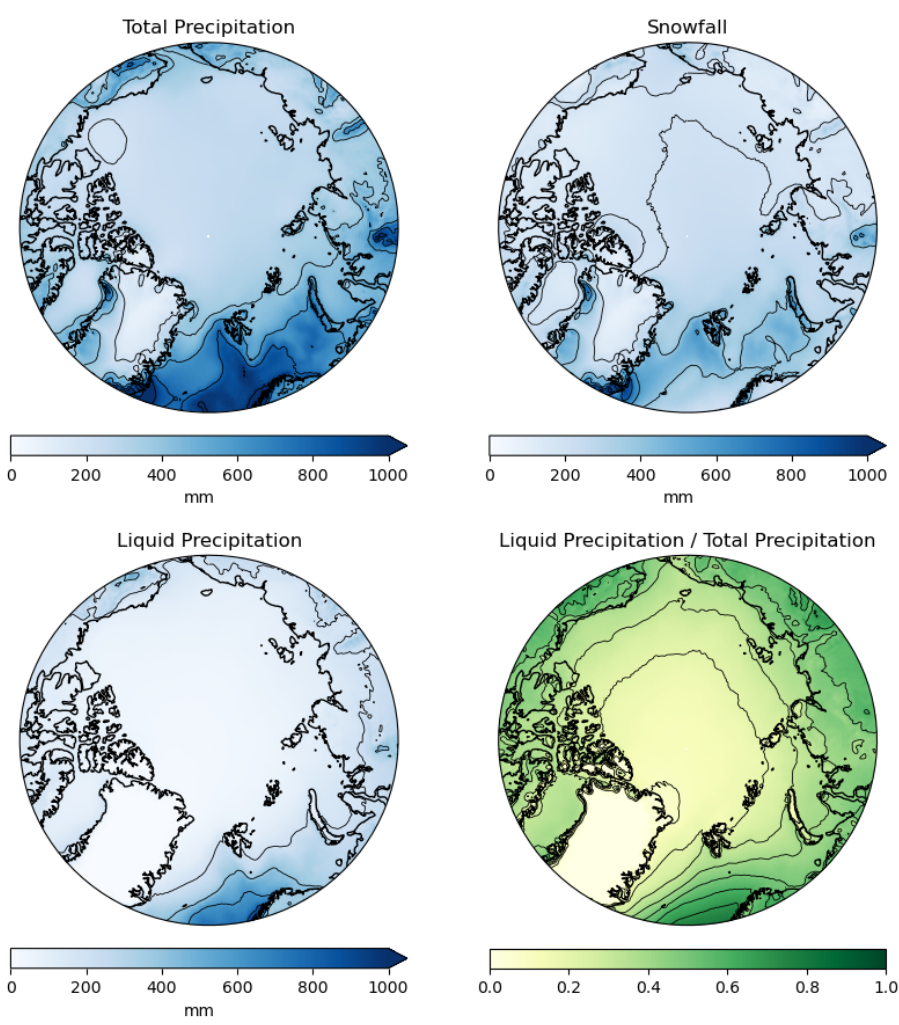
Formatted: Font: 10 pt

Deleted: .

Formatted: Font: 10 pt

Formatted: Font: 10 pt

Deleted: ¶ ... [140]



468
469
470
471
472
473
474
475

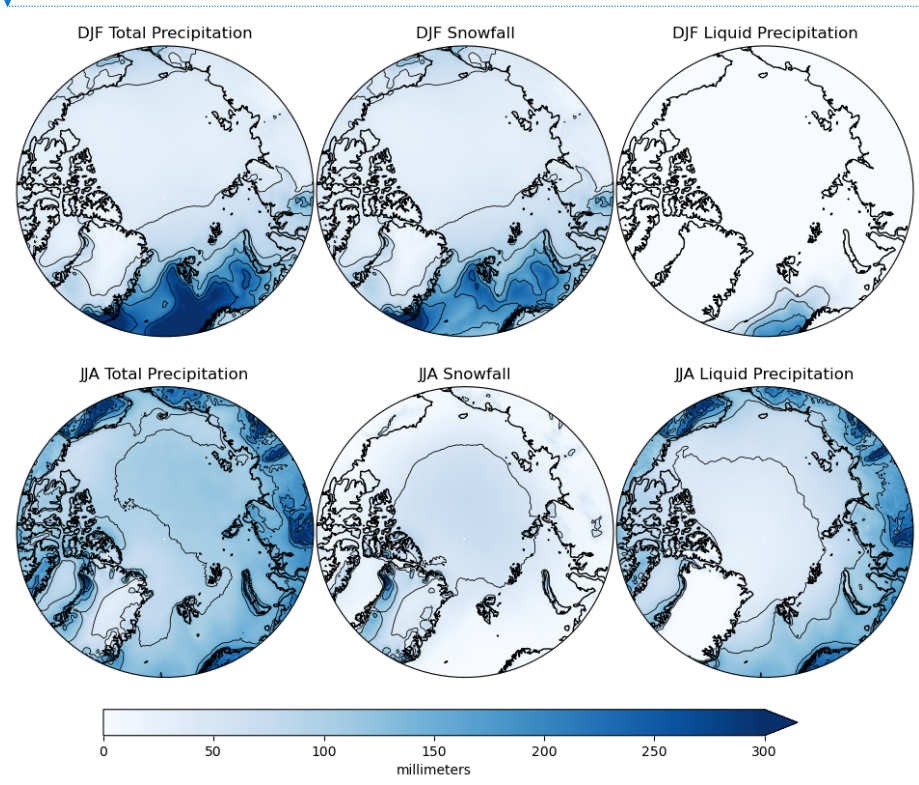
Figure 3: Spatial distribution of average annual totals (1973-2023) of total precipitation, snowfall, liquid precipitation and the liquid/total precipitation ratio, from ERA5. Black contours are drawn on the figures for ease of viewing and occur every 200mm for the total precipitation, snowfall, and liquid precipitation and every 0.1 for the liquid/total precipitation plot in the lower right panel.

- Formatted: Font: 10 pt
- Formatted: Font: 10 pt
- Formatted: Font: 10 pt
- Deleted: .
- Formatted: Font: 10 pt, Not Bold
- Formatted: Font: 10 pt
- Deleted:
- Formatted: Font: 10 pt, Bold

3.2 Seasonality

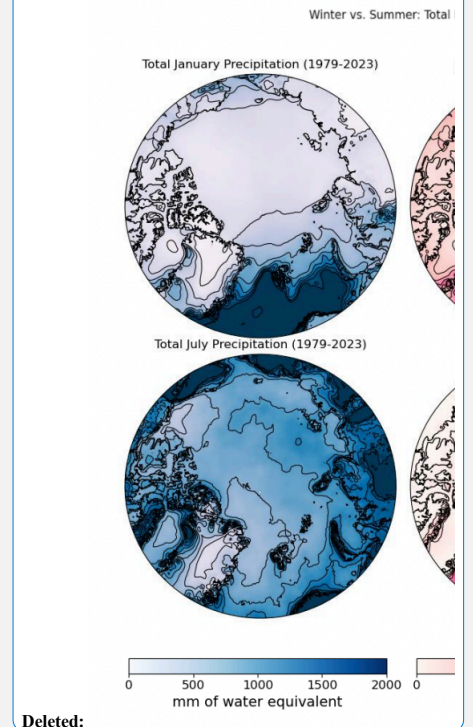
478
479
480
481
482
483
484
485
486
487
488
489
490

Attention now turns to seasonality, looking first at contrasts between winter (December, January, February (DJF)) and summer (June, July, and August (JJA)) of precipitation, snowfall and liquid precipitation (Figure 4). Winter precipitation is particularly low over the central Arctic Ocean and most land areas, reflecting low temperatures (hence little atmospheric moisture) and distance from Atlantic moisture sources. The much higher winter precipitation over the North Atlantic sector clearly stands out. The North Atlantic cyclone track is most active at this time. Cyclones are passing over open ocean and can pick up ample moisture. Average winter latent heat fluxes over the ice-free Atlantic sector as depicted in ERA5 are on the order of 80 Wm^{-2} , or even higher, compared to much lower values over the ice-covered central Arctic Ocean and land areas (Figure 5). Olafsson and Okland (1994) describe how Arctic air masses moving over these warm Atlantic sector waters develop convective boundary layers that enhance precipitation.



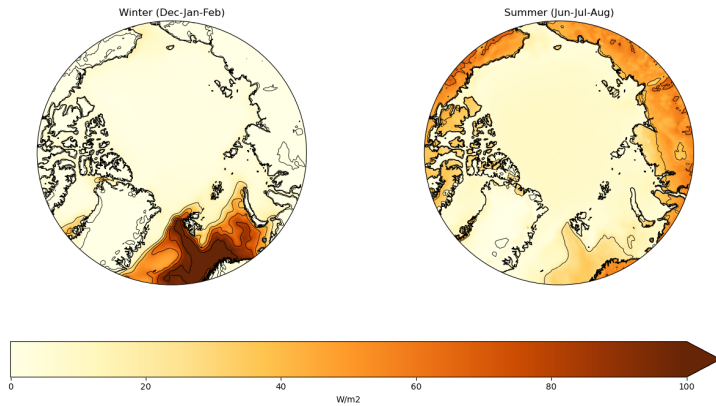
491

Deleted: DJF)
Formatted: Font: 10 pt
Formatted: ... [141]
Deleted:)
Deleted:
Formatted: Font: 10 pt
Formatted: Font: 10 pt
Deleted:
Formatted: Font: 10 pt
Deleted:
Formatted: Font: 10 pt
Deleted:
Formatted: Font: 10 pt
Deleted: , and cyclones
Deleted:
Formatted: Font: 10 pt
Formatted: Font: 10 pt
Deleted:
Formatted: ... [142]
Deleted:
Formatted: Font: 10 pt
Deleted:
Formatted: Font: 10 pt



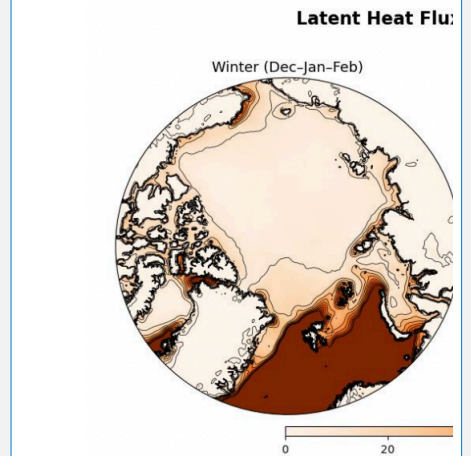
Deleted:

516 **Figure 4: Average seasonal totals of total precipitation, snowfall, and liquid precipitation for winter**
 517 **(December, January, February (DJF); top) and summer (June, July, August (JJA); bottom) from ERA5**
 518 **(1979–2023).**



520 **Figure 5: Average latent heat fluxes for winter (left) and summer (right), 1979-2023, from ERA5. These are**
 521 **created by using monthly averages of hourly data.**

- Deleted: Climatology
- Deleted:
- Deleted: Winter (
- Formatted ... [143]
- Formatted ... [144]
- Formatted ... [145]
- Deleted: Summer (
- Formatted ... [146]
- Formatted ... [147]
- Deleted:)
- Formatted ... [148]



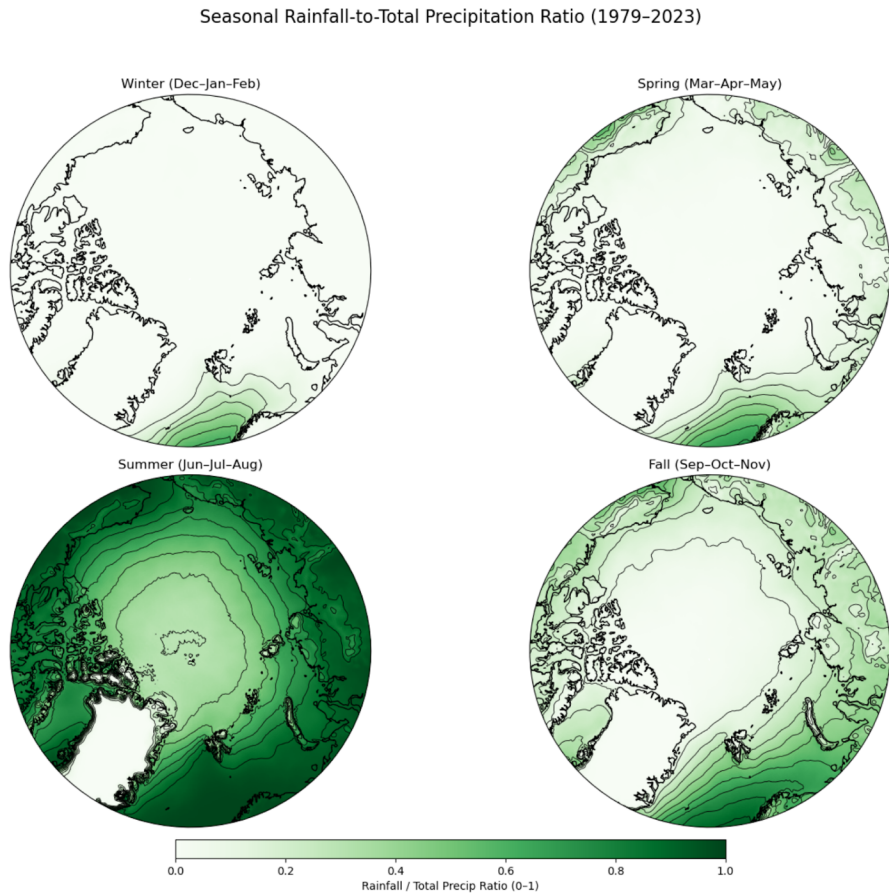
- Deleted: ... [149]
- Deleted: .
- Formatted ... [150]
- Formatted ... [151]
- Deleted:
- Formatted ... [152]
- Deleted: in general
- Deleted:
- Formatted ... [153]
- Formatted ... [154]
- Formatted ... [155]
- Deleted: both an increase in cyclone frequency and ... [156]
- Formatted ... [157]
- Deleted: over land
- Deleted: support the higher precipitation amounts (... [159]
- Formatted ... [158]
- Formatted ... [160]
- Deleted:
- Formatted ... [161]
- Deleted:
- Formatted ... [162]
- Deleted:
- Formatted ... [163]
- Deleted:
- Formatted ... [164]
- Deleted: et al.,
- Deleted:
- Formatted ... [165]
- Formatted ... [166]
- Deleted:
- Formatted ... [167]
- Deleted:
- Formatted ... [168]

524 Precipitation over the North Atlantic sector is much lower in the summer. **Figure 5** shows Atlantic sector latent heat
 525 fluxes are **much** lower, and the North Atlantic cyclone track and associated Icelandic Low are also much weaker at
 526 this time (Serreze et al., 1997). Summer precipitation is at its seasonal maximum over **most** land areas, reflecting **the**
 527 **seasonal maximum atmospheric moisture due to higher temperatures, surface heating fostering strong** latent heat
 528 fluxes **and, in some** areas, **convective activity, along with increased cyclone activity**. The summer precipitation peak
 529 over the central Arctic Ocean reflects the seasonal peak in atmospheric water vapor, and a summer/early autumn
 530 maximum in cyclone activity. These systems move into the area from the Atlantic and Eurasia, and some form over
 531 the Arctic Ocean **itself** (Serreze and Barrett, 2008). Note that summertime latent heat fluxes are small over the
 532 Arctic Ocean due to the **melting sea ice cover, limiting saturation vapor pressure and the vertical vapor gradient**
 533 (Serreze **and Barry**, 2014).

534
 535 As is clear from **Figure 4**, there are prominent contrasts between winter and summer in snowfall and liquid
 536 precipitation. The amount of snowfall is a function of both precipitation amount and temperature, which bears on
 537 whether precipitation is in liquid or solid form. For example, over the central Arctic Ocean, the low winter snowfall
 538 is primarily a function of low precipitation, while over the land areas in summer, the low snowfall (close to zero in

590 some areas) is due to temperature. Over much of the North Atlantic sector, high winter precipitation leads to ample
591 snowfall.

592



593

594

595

596 **Figure 6: Average seasonal distribution of the liquid-to-total precipitation ratio from ERA5, 1979 to 2023.**

597

598 With such controls in mind, attention turns to **Figure 6**, the liquid to total precipitation ratio for each season. During

599 winter, (upper left panel), liquid precipitation is a large fraction of total precipitation only in the very southernmost

600 regions of the North Atlantic. This is consistent with observations that even Bergen, Norway, lying at about 60°N

Deleted:
Formatted: Font: 10 pt
Formatted: Font: 10 pt
Deleted: 9
... [170]

Deleted: The
Deleted: rainfall
Deleted:
Formatted: Font: 10 pt
Formatted: Font: 10 pt
Formatted: Font: 10 pt
Formatted: Font: 10 pt
Formatted: Font: 10 pt
Deleted: rainfall
Deleted:
Formatted: Font: 10 pt
Formatted: Font: 10 pt
Deleted: ,
Formatted: Font: 10 pt
Deleted:
Formatted: Font: 10 pt

614 along the west coast of Norway, seldom sees snowfall in winter. This is due to the North Atlantic Drift Current,
615 which results in high air temperature relative to latitude. While winter rainfall fractions are shown as near zero over
616 most land areas and the Arctic Ocean, it is known that occasional warm air intrusions can allow for brief wintertime
617 rain or freezing rain events over the central Arctic Ocean. In recent years, there have been extreme cases of
618 wintertime warming. On February 2, 2025, temperatures near the North Pole reached the melting point, more than
619 20°C above average (The Guardian, 2025).

620
621 During spring (Figure 6, upper right panel), the liquid precipitation fraction increases over land areas. However,
622 snowfall is still by far the dominant precipitation type over much of the Arctic Ocean away from land areas and the
623 Atlantic sector. The highest ratios of course occur during the summer (lower left panel). Over the Atlantic sector,
624 essentially all summer precipitation falls as liquid precipitation. Liquid precipitation is also dominant over land
625 areas, the obvious exception being the high, cold Greenland ice sheet. Note, however, that over the central Arctic
626 Ocean, about half of all summer precipitation still falls as snow according to ERA5.

627
628 As summer fades to autumn, the liquid precipitation fraction decreases as temperatures fall (Figure 6, lower right
629 panel). However, early autumn (September) still shows high liquid precipitation fractions over the northern North
630 Atlantic (not shown). This area remains ice-free year-round, and temperatures remain high for the latitude. By
631 contrast, the seasonal shift from liquid precipitation to snowfall is prominent over the ice-covered central Arctic
632 Ocean where autumn temperatures sharply drop.

633 3.3 Comparisons with ICOADS Records

634
635 The Serreze et al. (1996) study, based on the ICOADS data base over the period 1950-1995, while certainly dated,
636 provides valuable independent estimates of precipitation phase as well as intensity over the Arctic Ocean and North
637 Atlantic sector. Figure 7 and Figure 8 show the key results for January and July reproduced from that study. The
638 ICOADS data (as with the ASOS data described below) are expressed as the percent of all precipitation observations,
639 in liquid or solid form, the percent of all observations in which precipitation occurred and (for ICOADS) when the
640 precipitation was coded as moderate to heavy. While this differs from the ERA5 analysis which shows the ratio
641 between liquid and total precipitation, results from the two studies are still comparable. As far as we are aware, there
642 is no specific threshold regarding what qualifies as moderate to heavy precipitation in the ICOADS reports - the
643 designation depends on the manual observer.

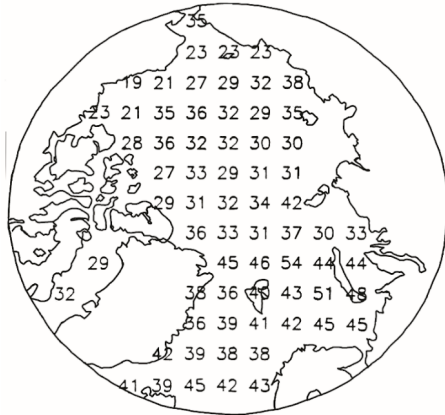
644
645 The ICOADS records from 1950-1995 show 95% - 99% of all January precipitation events over the central Arctic
646 Ocean falling as snow. This broadly corresponds to a liquid to total precipitation ratio of 0.01 to 0.05 in ERA5 data,
647 which shows an overwhelming dominance of solid precipitation during winter, even in today's warmer climate. The
648 ICOADS maps for December and February are very similar to those for January. The January maps can hence be
649 viewed as representative for winter as a whole. As mentioned earlier, there have been some recent rainfall events

- Deleted:
- Deleted: ,
- Deleted: .
- Formatted ... [171]
- Formatted ... [172]
- Deleted:
- Formatted ... [173]
- Formatted ... [174]
- Deleted: harking back to previous discussion,
- Deleted:
- Formatted ... [175]
- Formatted ... [176]
- Deleted:
- Formatted ... [177]
- Deleted:
- Formatted ... [178]
- Deleted: ,
- Deleted: rainfall
- Formatted ... [179]
- Formatted ... [180]
- Deleted:
- Formatted ... [181]
- Deleted:
- Deleted: .
- Formatted ... [182]
- Formatted ... [183]
- Deleted: rain. Rainfall
- Formatted ... [184]
- Deleted: rainfall
- Deleted: .
- Formatted ... [185]
- Formatted ... [186]
- Deleted:
- Formatted ... [187]
- Deleted: rainfall
- Formatted ... [188]
- Deleted: phase shifts
- Formatted ... [189]
- Deleted: are more prominent due to the lower
- Formatted ... [190]
- Deleted: associated with both increasing latitude and
- Formatted ... [192]
- Deleted:
- Formatted ... [193]
- Formatted ... [194]
- Deleted: Clark
- Formatted ... [195]
- Deleted:
- Deleted:
- Formatted ... [196]
- Formatted ... [197]
- Deleted:
- Formatted ... [198]
- Deleted:
- Formatted ... [199]
- Deleted:
- Formatted ... [200]
- Deleted:
- Formatted ... [201]

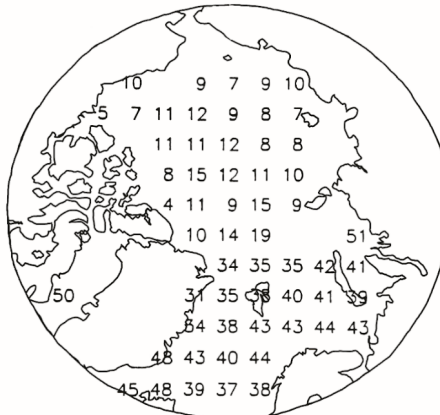
718 over the central Arctic Ocean in winter, associated with intrusions of warm moist air originating in the Atlantic. It is
 719 of interest, however, that even in the older ICOADS records, there were still occasional liquid precipitation events in
 720 winter. Consistent with the much higher precipitation totals over the northern North Atlantic shown in ERA5 and
 721 other studies, the ICOADS records show this region as having a much higher frequency of moderate to heavy
 722 precipitation as compared to the central Arctic Ocean, where most precipitation events are small. Hence, in
 723 summary, in at least a qualitative sense, winter results from ERA5 are consistent with the spatial patterns from the
 724 ICOADS record.

Deleted:
 Formatted: Font: 10 pt
 Deleted:
 Formatted: Font: 10 pt
 Deleted:
 Deleted:
 Deleted:
 Formatted: Font: 10 pt
 Formatted: Font: 10 pt
 Deleted:
 Formatted: Font: 10 pt
 Formatted: Font: 10 pt
 Deleted: 11

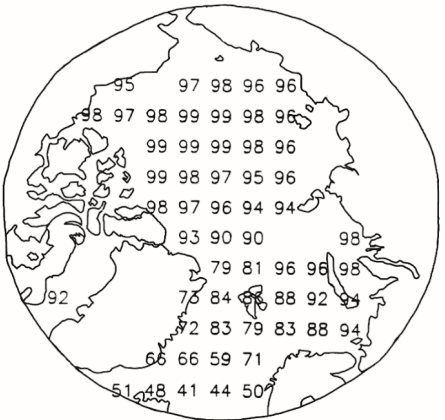
Jan: precipitation freq.



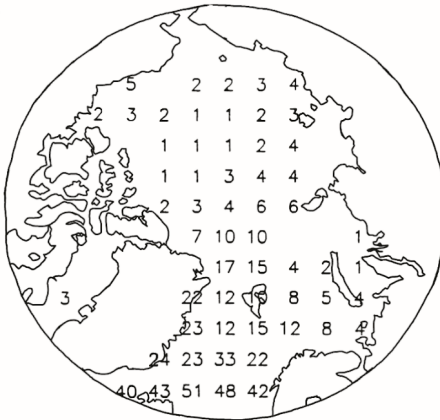
Jan: freq. moderate to heavy precipitation



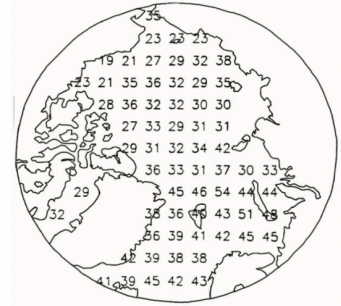
Jan: freq. solid precipitation



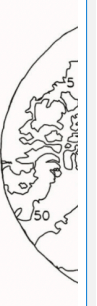
Jan: freq. liquid precipitation



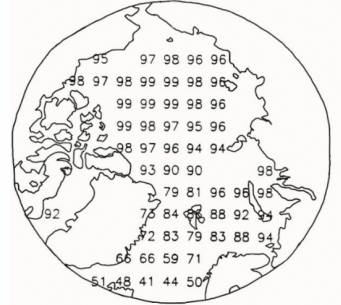
Jan: precipitation freq.



Jan: freq



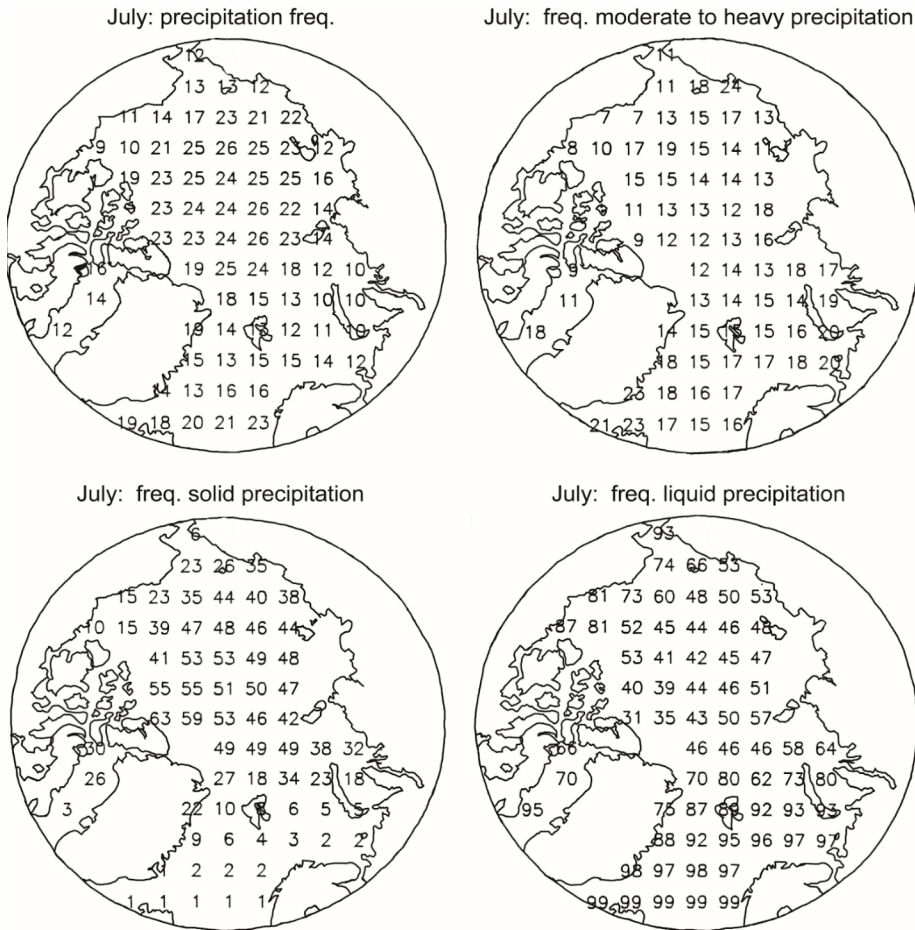
Jan: freq. solid precipitation



Ja



735 **Figure 7: Distribution of precipitation phase (liquid and solid), precipitation frequency and the frequency of**
 736 **moderate to heavy precipitation over the Arctic Ocean for January, based on JCOADS data, reproduced**
 737 **from Serreze et al. (1996).**



738 **Figure 8: Seasonal distribution of precipitation phase (liquid and solid), precipitation frequency and the**
 739 **frequency of moderate to heavy precipitation over the Arctic Ocean for July, based on JCOADS data,**
 740 **reproduced from Serreze et al. (1996).**

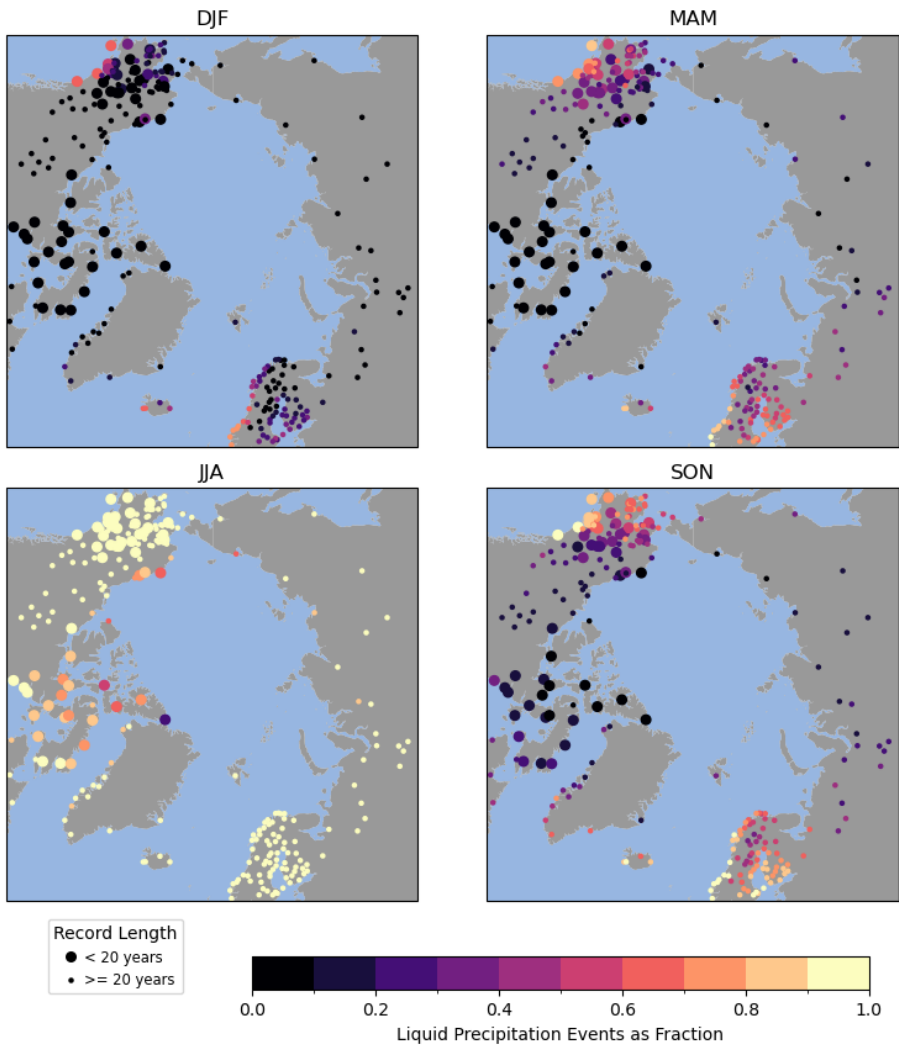
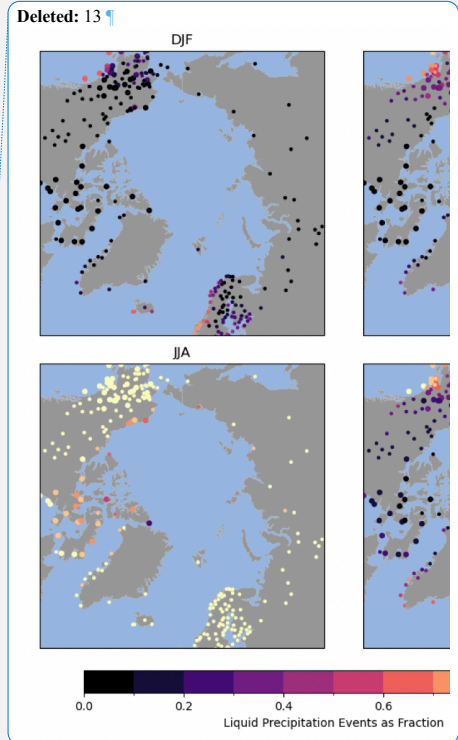
741 For July (Figure 8), the JCOADS records depict approximately 40% - 60% of precipitation events over the central
 742 Arctic Ocean as snow, and only infrequent snowfall over the northern North Atlantic, in overall agreement with the
 743 Arctic Ocean as snow, and only infrequent snowfall over the northern North Atlantic, in overall agreement with the
 744 Arctic Ocean as snow, and only infrequent snowfall over the northern North Atlantic, in overall agreement with the

- Deleted: Seasonal distribution
- Formatted: Font: 10 pt
- Formatted ... [205]
- Deleted: COADS
- Formatted: Font: 10 pt
- Deleted: Clark
- Formatted ... [206]
- July: precipitation freq.
- July: freq. moderate to heavy precipitation
- July: freq. solid precipitation
- July: freq. liquid precipitation
- Deleted: ... [207]
- Formatted ... [208]
- Deleted: COADS
- Formatted ... [209]
- Deleted: Clark
- Formatted: Font: 10 pt
- Deleted:
- Deleted: Used to validate ERA-5 precipitation phase.
- Formatted: Font: 10 pt
- Formatted: Font: 10 pt, Not Bold
- Formatted: Font: 10 pt
- Deleted: depicts
- Deleted:
- Formatted ... [210]
- Formatted: Font: 10 pt
- Deleted: representing
- Deleted:
- Formatted: Font: 10 pt
- Formatted: Font: 10 pt
- Formatted: Font: 10 pt

772 ERA5 summer results. [The August ICOADS map is similar to that for July, while the map for June shows a lower](#)
 773 [fraction of events as liquid \(20-25%\). All of the summer months show the seasonal](#) reduction over the North Atlantic
 774 sector in the frequency of moderate to heavy precipitation, consistent with the lower amounts of summer
 775 precipitation here shown in ERA5 due to the [weaker north Atlantic cyclone track. An updated analysis of the](#)
 776 [ICOADS records would be highly valuable for better validating ERA5.](#)

Deleted: Note also the
 Formatted: Font: 10 pt

Deleted:
 Formatted: Font: 10 pt
 Formatted: Font: 10 pt



777

782 **Figure 9: Number of hours with liquid precipitation expressed as a fraction of the total number of hours with**
783 **any type of precipitation for climatological seasons from the ASOS database. Large symbols represent**
784 **stations with more than 20 years of data for the 1979 to 2023 period. Small symbols are for stations with**
785 **shorter records.**

787 3.4 Comparisons with ASOS Records

789 **Figure 9** shows the number of hours with a report of liquid precipitation expressed as a fraction of the total number
790 of hours with either liquid or solid precipitation reported by season for stations in the ASOS database. This is
791 essentially equivalent to the liquid to solid precipitation ratios just examined. The winter results are qualitatively
792 consistent with results from ERA5 liquid/total precipitation ratios. The ASOS database shows that few events are
793 liquid in winter, the exceptions being sites in extreme southern Alaska and along the Norwegian coast. The pattern
794 for spring is similar, except sites in southern Alaska and the Norwegian coast are more numerous and the liquid
795 fractions are higher. In the summer months, liquid precipitation is the majority almost everywhere, the exception
796 being over the Canadian Arctic Archipelago, where snow events can still be common. Autumn marks the transition
797 back to the winter pattern, as decreasing temperatures reduce the fraction of liquid precipitation.

799 From an analysis of Ku-Band Quikscat radar data over November through February from 2000-2009 (Bartsch et al.
800 2010, Bartsch 2010a:b), Scandinavia and northwestern Russia emerge as “hotspots” for rain on snow events (in
801 some places up to 12 events per year). This is consistent with the fairly high frequency of liquid precipitation events
802 in this area from the ASOS data for winter, spring and autumn, and is also clear when we look at the correspondence
803 between rain events in the ASOS database and the occurrence of snow on the ground (not shown). It is unfortunate
804 that few ASOS records are available over much of central and eastern Russia, but the few stations that do exist point
805 to a low frequency of rain events in the cold season, consistent with the QuikScat analysis indicating one or zero
806 ROS events per year in this area characterized by a highly continental climate.

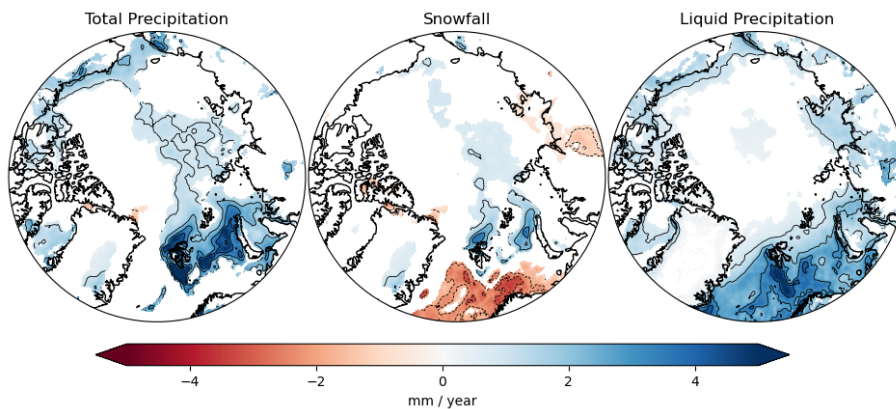
808 An event of particular note occurred 8-10 November, 2013 over the Yamal Peninsula of Russia as well as
809 neighboring coastal regions east of the area of highest ROS frequency seen in the Quikscat analysis. This event is
810 described by Forbes et al. (2016), who note that several other Yamal events have been recorded in recent years.
811 After the 2016 event, ice covered an area of approximately 27,000 km² and completely blocked reindeer from
812 foraging, leading to the death of 61,000 animals between November 2013 and June 2014.

814 4 Trends

816 4.1 Precipitation

- Formatted [211]
- Deleted:
- Formatted [212]
- Deleted: AROSS
- Formatted [213]
- Deleted:
- Formatted [214]
- Formatted [215]
- Formatted [216]
- Deleted: 14
- Formatted [217]
- Formatted [218]
- Formatted [219]
- Deleted: AROSS
- Deleted:
- Formatted [220]
- Formatted [221]
- Deleted: Stations with more than 20 years of record [222]
- Formatted [223]
- Deleted:
- Formatted [224]
- Deleted: rainfall
- Formatted [225]
- Deleted: AROSS
- Formatted [226]
- Deleted:
- Formatted [227]
- Deleted:
- Formatted [228]
- Deleted:
- Formatted [229]
- Deleted: rainfall.
- Formatted [230]
- Deleted: 2010a, 2010b
- Deleted: et al., 2010
- Deleted:
- Formatted [231]
- Formatted [232]
- Formatted [233]
- Deleted:
- Formatted [234]
- Deleted:
- Formatted [235]
- Deleted:
- Formatted [236]
- Deleted:
- Formatted [237]
- Deleted:
- Formatted [238]
- Formatted [239]
- Deleted: 8-10 November, 2013
- Formatted [240]
- Deleted:
- Formatted [241]
- Deleted:
- Formatted [242]
- Deleted:
- Formatted [243]
- Deleted:

877 As the Arctic warms, one expects more rain events, and while this implies more ROS events, a caveat is that the
 878 snow-covered season will shorten, therefore rain will increasingly fall on bare ground. Climate models are in near
 879 universal agreement that Arctic precipitation will increase (McCrystal et al., 2021), driven by rising atmospheric
 880 moisture availability, which enhances precipitation as warming temperatures allow for greater evaporation, a greater
 881 moisture holding capacity of the atmosphere, and hence a poleward moisture transport. There is emerging evidence
 882 that, at least assessed for the Arctic region as a whole, Arctic precipitation is indeed increasing (Walsh et al., 2023).



883
 884 **Figure 10: Linear trends in annual total precipitation, snowfall, and liquid precipitation from 1979 to 2023**
 885 **from ERA5. Only trends that are statistically significant at the 95% confidence level are shown by colors.**

886 **Figure 10** shows linear trends in annual precipitation, snowfall and liquid precipitation over the period 1979-2023.
 887 Of particular note are the statistically significant increases over the Barents and Kara Seas Sea and around and north
 888 of the Svalbard archipelago, locally 3-4 mm per year. It hence seems that the conclusion that increased Arctic
 889 precipitation, considered for the region as a whole (Walsh et al., 2023), is largely due to increases in this area.
 890 In explanation, this is the one area of the Arctic that has experienced substantial reductions in winter sea ice extent,
 891 linked to a stronger inflow of warm and salty Atlantic water (Lien et al. 2017). This warm Atlantic water, underlying
 892 very cold air, can result in large latent heat fluxes to the atmosphere and unstable low level boundary layers,
 893 favoring increased precipitation. Digging into this further, the increase in winter precipitation as depicted by ERA5
 894 in the Barents and Kara Seas appears to be in part convective precipitation. Analysis of the full-length ERA5 record
 895 indicates, based on linear trends, statistically significant 4-5% increases since 1950 in the ratio between convective
 896 and total precipitation in this area (not shown), with smaller increases in autumn and spring. Convective-type
 897 precipitation is known to occur in winter in the Norwegian Sea where warm water underlies cold air, fostering high
 898 evapotranspiration and unstable boundary layers (Olafsson and Okland, 1994), and it appears that such wintertime
 899 convective precipitation is now moving into higher latitudes as winter sea ice retreats.

900
 901

Deleted: [247]
 Formatted [248]
 Deleted: McCrystal
 Deleted:
 Formatted [249]
 Deleted:
 Formatted [250]
 Deleted:
 Formatted [251]
 Deleted: ¶ [252]
 Formatted [253]
 Deleted:
 Deleted:
 Formatted [254]
 Formatted [255]
 Formatted [256]
 Deleted:
 Formatted [257]
 Formatted [258]
 Formatted [259]
 Formatted [260]
 Deleted:
 Deleted: .
 Formatted [261]
 Formatted [262]
 Formatted [263]
 Formatted [264]
 Deleted:
 Formatted [265]
 Formatted [266]
 Deleted: ¶ [267]
 Formatted [268]
 Formatted [269]
 Formatted [270]
 Formatted [271]
 Formatted [272]
 Formatted [273]
 Formatted [274]
 Formatted [275]
 Formatted [276]
 Formatted [277]

Annual snowfall has fairly pronounced downward trends only over the warm Atlantic side of the Arctic, but largely south of the area with the largest precipitation trends. Liquid precipitation by contrast has widespread positive annual trends over most of the North Atlantic sector pointing to the warming conditions.

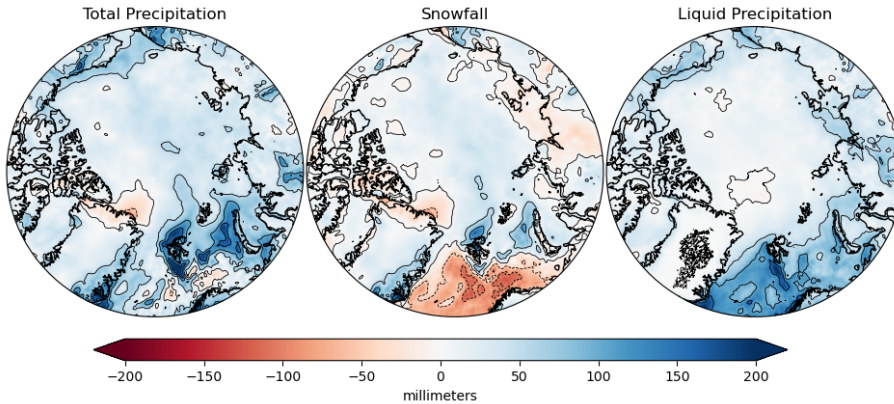


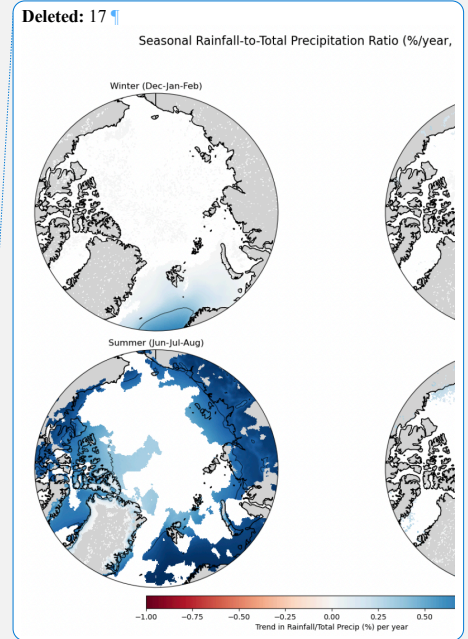
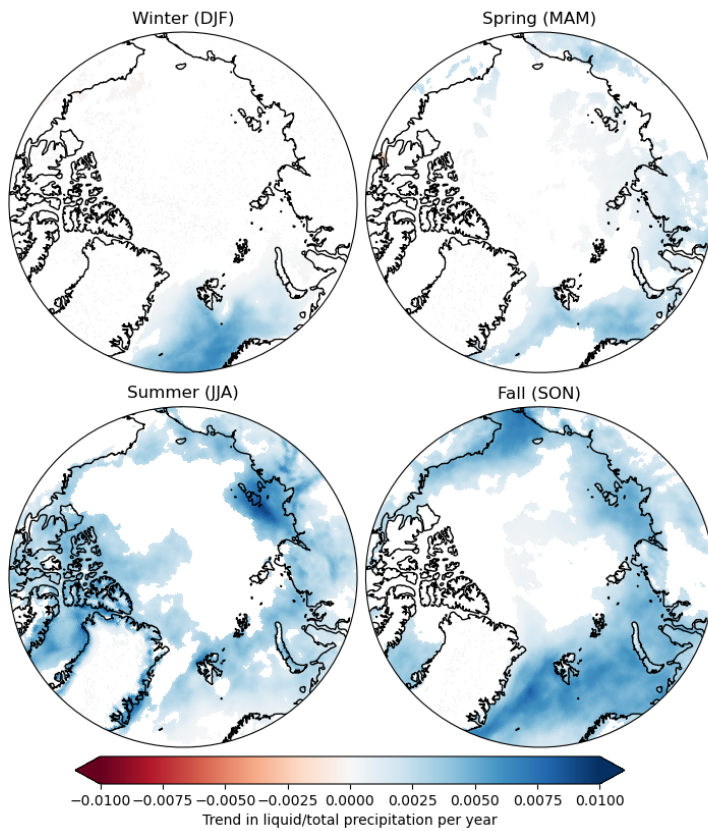
Figure 11: The difference in annual total precipitation (left), snowfall (middle), and liquid precipitation (right) between the recent period (2014–2023) and an earlier baseline period (1979–1988) from ERA5.

As linear trends can sometimes be misleading, Figure 11 shows the difference in annual total precipitation, snowfall and liquid precipitation between the first (1979–1988) and last (2014–2023) decades of the study period. The overall conclusion is that the decadal differences largely follow changes shown in the trends. The larger amount of liquid precipitation over the north Atlantic sector is particularly striking. While the spatial pattern of trends in liquid precipitation (Figure 10) is similar to the pattern of decadal differences shown in Figure 11, the latter suggests more recent increases in liquid precipitation and decadal variability over land areas not captured in linear trends. Note in turn the large differences in snowfall over the Atlantic sector, locally 100 mm lower in the most recent decade, paired with more liquid precipitation.

4.2 Liquid to Total Precipitation Ratio

Seasonal trends in the liquid to total precipitation ratio follow in Figure 12. Statistically significant positive trends are fairly widespread in summer and especially autumn, but there are large areas over the Arctic Ocean where no significant trends are present in the summer season. Even in summer, trends over the Greenland Ice Sheet are essentially zero. Statistically significant positive trends in winter and spring are largely limited to the North Atlantic sector. Phrased differently, away from the Atlantic sector, it has yet to warm sufficiently to see a change in the ratio over much of the Arctic except during summer and autumn, and even in summer, ratios over large areas of the ocean are essentially unchanged. Winter precipitation has increased over the Atlantic sector, but then the increase in the liquid precipitation fraction dominates, yielding an upward trend in the winter liquid to total precipitation ratio.

- Formatted [278]
- Deleted: these are spotty in spatial extent as are
- Formatted [279]
- Deleted: local increases poleward of Svalbard.
- Formatted [280]
- Deleted:
- Formatted [281]
- Deleted: and Barents Sea
- Formatted [282]
- Deleted:
- Formatted [283]
- Deleted:
- Formatted [284]
- Deleted: 16 [285]
- Formatted [286]
- Deleted: 2013
- Formatted [287]
- Deleted:
- Formatted [288]
- Deleted: 1989).
- Formatted [289]
- Formatted [290]
- Formatted [291]
- Formatted [292]
- Deleted: 1989
- Formatted [293]
- Deleted: 2013
- Formatted [294]
- Deleted:
- Formatted [295]
- Deleted:
- Formatted [296]
- Deleted:
- Deleted: nevertheless
- Formatted [297]
- Formatted [298]
- Deleted:
- Deleted: .
- Formatted [299]
- Formatted [300]
- Deleted: Positive trends are less widespread in autumn.
- Deleted: apparent only in
- Deleted:
- Formatted [301]
- Formatted [302]
- Formatted [303]
- Deleted:
- Formatted [304]
- Deleted:
- Deleted: and while locally, there are increases in snowfall,
- Formatted [305]
- Formatted [306]
- Deleted:
- Deleted: rainfall
- Deleted:
- Formatted [307]
- Formatted [308]
- Formatted [309]



1019
1020
1021
1022
1023
1024
1025
1026
1027
1028
1029

Figure 12: Seasonal trends in liquid to total precipitation ratios (1979–2023) from ERA5. Only trends that are statistically significant at the 95% confidence level are shown by colors.

- Deleted: rainfall
- Deleted:).
- Formatted: Font: 10 pt
- Formatted: Font: 10 pt
- Formatted: Font: 10 pt
- Formatted: Font: 10 pt
- Deleted:
- Deleted:
- Formatted: Font: 10 pt
- Formatted: Font: 10 pt, Not Bold

1036
1037
1038
1039
1040
1041
1042
1043
1044
1045
1046
1047
1048
1049
1050
1051
1052
1053
1054
1055
1056
1057
1058
1059
1060
1061
1062
1063
1064
1065
1066
1067
1068
1069
1070
1071
1072

5 Synthesis and Discussion

What are the present-day seasonal and spatial patterns of precipitation partitioning (liquid versus snowfall) across the Arctic, and how have these patterns changed through the warming Arctic climate?

To address this question, it was first necessary to ask: Is ERA5 up to the task of providing sufficiently reliable estimates of precipitation and its phase? Prior validation studies, as well as the work presented here based on the ASOS and ICOADS climatologies, argue that the answer is a qualified yes. While uncertainty remains, ERA5 has demonstrated consistency with the ICOADS records and the ASOS records (the AROSS database) in capturing precipitation phase. The study by Edel et al. (2020), based on CloudSat data, provides further supporting evidence, at least in a qualitative sense, showing that on an annual basis, the frequency of solid precipitation is greater than 70% over the Arctic Ocean, 95% over Greenland, with mixed precipitation (50% solid) over the North Atlantic. However, this study was limited to a four year period (January 2007 to December 2010) and CloudSat provides no coverage poleward of about 80°N.

The general agreement between data sources is important given that the Arctic's surface station network is sparse and insufficient for capturing spatial precipitation patterns (Thoman et al. 2023). Therefore, reanalysis data remain the best tool for evaluating large-scale precipitation patterns (including phase) and trends across the region. However, this must be viewed with the caveats that the available observations for validation either cover a different time period than the reanalyses or do not provide full spatial coverage. Time coincident data is wanted. While further analysis of the AROSS database is warranted, this data set unfortunately provides no coverage over the Arctic Ocean for which to assess either seasonal patterns or trends in precipitation partitioning. Similarly, while for the Arctic as a whole, both the gauge network and ERA5 show that precipitation in the Arctic is increasing, the gauge network is insufficient to make meaningful comparisons with the spatial patterns of ERA5 trends. Yet another issue to be aware of is the known warm bias in surface air temperatures over the sea ice cover in ERA5 (Tian et al. 2024), which, especially if affecting a deeper part of the atmosphere, could influence precipitation phase.

This said, analysis of the ERA5 data records over the period 1979-2023 reveals a complex picture of a seasonally varying and evolving hydrological regime. Over most of the study region, annual precipitation falls mainly as snow, the clear exception being the Atlantic sector where temperatures are fairly high, reflecting the ice-free conditions. During summer, roughly half of precipitation still falls as snow, surprisingly similar to snowfall fractions based on ICOADS records for 1950-1999 when the Arctic was cooler. Analysis of the ERA5 data shows an increase in annual precipitation, primarily in the Norwegian, Barents and Kara Seas. Reports that precipitation increases for the Arctic, viewed as a whole, in line with climate model predictions, must be tempered by recognition of these strong regional expressions of change. At least some of these regional increases likely have a convective component linked to winter sea ice loss. Apart from the north Atlantic sector, the liquid-to-total precipitation ratio has appreciably

- Formatted: Font: 10 pt
- Deleted:
- Formatted: Font: 10 pt, Not Bold
- Formatted: Font: 10 pt
- Deleted:
- Deleted:
- Formatted: Font: 10 pt
- Formatted: Font: 10 pt
- Deleted:
- Deleted:
- Formatted: Font: 10 pt
- Formatted: Font: 10 pt
- Formatted: Font: 10 pt
- Deleted:
- Deleted: independent datasets
- Formatted: Font: 10 pt
- Formatted: Font: 10 pt
- Deleted: changes and trends. This
- Deleted:
- Formatted: Font: 10 pt
- Formatted: Font: 10 pt
- Deleted: ARC, 2023). Therefore, reanalysis data remains the best tool for evaluating large-scale precipitation pat(... [310]
- Formatted: Font: 10 pt
- Deleted: Analysis
- Formatted: Font: 10 pt
- Deleted:
- Formatted: Font: 10 pt
- Deleted:
- Formatted: Font: 10 pt
- Deleted:
- Formatted: Font: 10 pt
- Deleted:
- Deleted:
- Formatted: Font: 10 pt
- Deleted:
- Formatted: Font: 10 pt
- Deleted:
- Formatted: Font: 10 pt
- Deleted: rainfall
- Formatted: Font: 10 pt
- Formatted: Font: 10 pt

1096 increased across much of the Arctic only during summer. Increases outside of the northern North Atlantic sector in,
 1097 other seasons are much more limited.

1098

1099 With continuing warming, we can expect a more pronounced change in the ratios, which even in the absence of
 1100 changing precipitation amounts raises the concerns about cascading effects of rain on snow events on Arctic ecology,
 1101 and the built environment. A key issue in this regard is that as the climate warms, the length of the snow-covered,
 1102 season will decrease, implying an increase in rain on bare ground. A next step is to make further use of the database,
 1103 compiled from the ASOS sites to provide comprehensive assessment of changes in rain on snow events.

1104

1105 **Author Contributions:** ZIC and MCS planned the campaign; ZIC, APB and ENC created the figures; ZIC,
 1106 MCS, ENC, and APB analyzed the data; ZIC, ENC, and MCS wrote the manuscript draft; ZIC, MCS, ENC,
 1107 and APB reviewed and edited the manuscript.

1108

1109 **Data availability:** The ERA5 data were obtained from the Copernicus Climate Data Store (CDS):
 1110 <https://cds.climate.copernicus.eu/>. The data from the ASOS database are available here: doi:10.18739/A2VT1GR83.

1111

1112 **Acknowledgements:** This study was supported by NSF Grant NNA 1928230. The authors thank two anonymous
 1113 reviewers for their valuable insights and suggestions.

1114

1115 **References**

1116

1117 Barrett, A. P., Stroeve, J. C., and Serreze, M. C.; Arctic Ocean precipitation from atmospheric reanalyses and
 1118 comparisons with North Pole drifting station records, *J. Geophys. Res. Oceans*, 125, e2019JC015415,
 1119 <https://doi.org/10.1029/2019JC015415>, 2020.

1120

1121 Bartsch, A.: Spring snowmelt and midwinter thaw and refreeze north of 60°N based on SeaWinds QuikSCAT 2000–
 1122 2009, PANGAEA, <https://doi.org/10.1594/PANGAEA.834198>, 2010a.

1123

1124 Bartsch, A.: Ten years of SeaWinds on QuikSCAT for snow applications, *Remote Sens.*, 2, 1142–1156,
 1125 <https://doi.org/10.3390/rs2041142>, 2010b.

1126

1127 Bartsch, A., Kumpula, T., Forbes, B. C., and Stammler, F.; Detection of snow surface thawing and refreezing in the
 1128 Eurasian Arctic with QuikSCAT: implications for reindeer herding, *Ecol. Appl.*, 20, 2346–2358, 2010.

1129

1130 Bromwich, D. H., Wilson, A. B., Bai, L. S., Moore, J. A., Bauer, P., Brown, D., et al.; Arctic system reanalysis
 1131 version 2, *J. Climate*, 29(9), 3537–3560, 2016.

1132

- Deleted:
- Formatted ... [311]
- Deleted:
- Deleted:
- Formatted ... [312]
- Deleted:
- Formatted ... [313]
- Deleted:
- Formatted ... [314]
- Formatted ... [315]
- Deleted: ¶
- Formatted ... [316]
- Formatted ... [317]
- Formatted ... [318]
- Formatted ... [319]
- Formatted ... [320]
- Formatted ... [321]
- Formatted ... [322]
- Formatted ... [323]
- Formatted ... [324]
- Deleted:
- Formatted ... [325]
- Formatted ... [326]
- Formatted ... [327]
- Formatted ... [328]
- Formatted ... [329]
- Formatted ... [330]
- Deleted: . (2020):
- Deleted:
- Formatted ... [331]
- Formatted ... [332]
- Deleted: <https://doi.org/10.1029/2019JC015415>.
- Formatted ... [333]
- Moved (insertion) [1]
- Formatted ... [334]
- Formatted ... [335]
- Deleted: . (2010a):
- Deleted:
- Formatted ... [336]
- Formatted ... [337]
- Deleted: .
- Formatted ... [338]
- Moved up [1]: ¶
- Formatted ... [339]
- Formatted ... [340]
- Formatted ... [341]
- Deleted: . (2016):
- Deleted:
- Formatted ... [342]
- Formatted ... [343]
- Deleted: .
- Formatted ... [344]
- Deleted: ¶
- Formatted ... [345]
- Formatted ... [346]

1257 Clark, M. P., Serreze, M. C., and Barry, R. G.: Characteristics of Arctic Ocean climate based on COADS data,
1258 1980–1991, *Geophys. Res. Lett.*, 23, 1953–1956, 1996.

1259

1260 Dou, T. F., Pan, S. F., Bintanja, R., and Xiao, C. D.: More frequent, intense, and extensive rainfall events in a
1261 strongly warming Arctic, *Earth's Future*, 10, e2021EF002378, <https://doi.org/10.1029/2021EF002378>, 2022.

1262

1263 [Edel, L., Claud, C., Genthon, C., Palermé, C., Wood, N., L'Ecuyer, T., and Bromwich, D.: Arctic Snowfall from
1264 CloudSat Observations and Reanalyses, *J. Climate*, 33, 2093–2109. <https://doi.org/10.1175/jcli-d-19-0105.1>, 2020.](#)

1265

1266 [European Space Agency: Historic Greenland Ice Sheet rainfall unravelled](#), Retrieved from:
1267 https://www.esa.int/Applications/Observing_the_Earth/FutureEO/Historic_Greenland_ice_sheet_rainfall_unravelled
1268 , 2021.

1269

1270 Forbes, B. C., Kumpula, T., Meschtyb, N., [Laptander, R., Macias-Eauria, M., Zetterberg, P., Verdonen, M., Skarin,
1271 A., Kim, K.-Y., Boisvert, L.N., Stroeve, J.C., and Bartsch, A.](#): Sea ice, rain-on-snow and tundra reindeer nomadism
1272 in Arctic Russia, *Biol. Lett.*, 12, <https://doi.org/10.1098/rsbl.2016.0466>, 2016.

1273

1274 Graham, R. M., Rinke, A., and Maturilli, M.: Evaluation of Arctic precipitation from global atmospheric reanalyses,
1275 *J. Climate*, 32(20), 6945–6963, <https://doi.org/10.1175/JCLI-D-18-0643.1>, 2019.

1276

1277 [Hersbach, H., Bell, B., Berrisford, P., Hirahara, S., Horánvi, A., Muñoz-Sabater, J., Nicolas, J., Peubey, C., Radu,
1278 R., Schepers, D., Simmons, A., Soci, C., Abdalla, S., Abellan, X., Balsamo, G., Bechtold, P., Biavati, G., Bidlot, J.,
1279 Bonavita, M., De Chiara, G., Dahlgren, P., Dee, D., Diamantakis, M., Dragani, R., Flemming, J., Forbes, R.,
1280 Fuentes, M., Geer, A., Haimberger, L., Healy, S., Hogan, R.J., Hólm, E., Janisková, M., Keeley, S., Laloyaux, P.,
1281 Lopez, P., Lupu, C., Radnoti, G., de Rosnay, P., Rozum, I., Vamborg, F., Villaume, S., Thépaut, J.-N.: The ERA5
1282 global reanalysis, *Q. J. R. Meteorol. Soc.*, 146, 1999–2049, <https://doi.org/10.1002/qj.3803>, 2020.](#)

1283

1284 [Hermann, M., Papritz, L., and Wernli, H. A Lagrangian analysis of the dynamical and thermodynamic drivers of
1285 large-scale Greenland melt events during 1979–2017, *Wea. Clim. Dyn.*, 1, 497–518, \[https://doi.org/10.5194/wcd-1-
1286 497-2020\]\(https://doi.org/10.5194/wcd-1-497-2020\), 2020.](#)

1287

1288 Lien, V. S., Schlichthol, P., Skagseth, Ø., and Vikebø, F. B.: Wind-driven Atlantic water flow as a direct mode for
1289 reduced Barents Sea ice cover, *J. Climate*, 30, 803–812, <https://doi.org/10.1175/JCLI-D-16-0025.1>, 2017.

1290

1291 Loeb, N. A., Crawford, A., Stroeve, J. C., and Hanesiak, J.: Extreme precipitation in the eastern Canadian Arctic and
1292 Greenland: An evaluation of atmospheric reanalyses, *Front. Environ. Sci.*, 10,
1293 <https://doi.org/10.3389/fenvs.2022.866929>, 2022.

- Deleted: . (1996):
- Deleted:
- Formatted ... [347]
- Formatted ... [348]
- Deleted: .
- Formatted ... [349]
- Deleted: ¶
- Formatted ... [350]
- Formatted ... [351]
- Formatted ... [352]
- Deleted: . (2022):
- Deleted:
- Formatted ... [353]
- Formatted ... [354]
- Deleted: <https://doi.org/10.1029/2021EF002378>.
- Formatted ... [355]
- Formatted ... [356]
- Deleted: et al. (2016):
- Formatted ... [357]
- Deleted: 12, <https://doi.org/10.1096/rsbl2016.0466>.
- Formatted ... [358]
- Deleted: ¶
- Formatted ... [359]
- Formatted ... [360]
- Deleted: . (2019):
- Deleted:
- Formatted ... [361]
- Formatted ... [362]
- Deleted: <https://doi.org/10.1175/JCLI-D-18-0643.1>.
- Formatted ... [363]
- Moved (insertion) [4] ... [364]
- Moved (insertion) [10]
- Formatted ... [365]
- Formatted ... [366]
- Deleted: Hersbach, H., Bell, B., Berrisford, P., et al ... [367]
- Deleted: Working Group I to
- Deleted: Sixth Assessment Report of the IPCC, Cat ... [370]
- Deleted: Holland, M. M. (2020): Extremes become ... [372]
- Formatted ... [368]
- Formatted ... [369]
- Formatted ... [371]
- Deleted: *Change*, 10(12), 1108–1115
- Deleted: 1038/s41558-020-0892-z.
- Formatted ... [373]
- Formatted ... [374]
- Formatted ... [375]
- Deleted: . (2017):
- Deleted:
- Formatted ... [376]
- Formatted ... [377]
- Deleted: <https://doi.org/10.1175/JCLI-D-16-0025.1>.
- Formatted ... [378]
- Deleted: . (2022):
- Formatted ... [379]
- Deleted: *Sci.*, 10,
- Formatted ... [380]

1387

1388 McCrystall, M. R., Stroeve, J. C., Serreze, M., Forbes, B. C., and Screen, J. A.; New climate models reveal faster

1389 and larger increases in Arctic precipitation than previously projected, *Nat. Commun.*

1390 <https://doi.org/10.1038/s41467-021-27031-y>, 2021.

1391

1392 Moon, T.A., M.L. Druckenmiller, and R.L. Thoman, eds.: *Arctic Report Card 2024*. [https://doi.org/10.25923/b7c7-](https://doi.org/10.25923/b7c7-6431)

1393 [6431](https://doi.org/10.25923/b7c7-6431), 2024.

1394

1395 Olafsson, H., and Okland, E.; Precipitation from convective boundary layers in Arctic air masses, *Tellus A*, 46(4),

1396 4–13, <https://doi.org/10.3402/tellusa.v46i1.15422>, 1994.

1397

1398 Rabier, F.; Overview of global data assimilation developments in numerical weather-prediction centres, *Q. J. R.*

1399 *Meteorol. Soc.*, 131, 3215–3233, <https://doi.org/10.1256/qj.05.129>, 2005.

1400

1401 Rantanen, M., Karpechko, A. Y., Lipponen, A., Nordling, K., Hyvärinen, O., Ruosteenoja, K., Vihma, T., and

1402 Laaksonen, A.; The Arctic has warmed nearly four times faster than the globe since 1979, *Commun. Earth Environ.*,

1403 3, 168, <https://doi.org/10.1038/s43247-022-00498-3>, 2022.

1404

1405 Serreze, M.C., and Barrett, A.P.: The summer cyclone maximum over the central Arctic Ocean, *J. Clim.*, 21, 1048-

1406 1065, <https://doi.org/10.1175/2007JCL11810.1>, 2008.

1407

1408 Serreze, M. C., and Barry, R. G.; *The Arctic Climate System*, 2nd ed., Cambridge University Press, 2014.

1409

1410 Serreze, M.C., Box, J.E., Barry, R.G. and Walsh, J.E.: Characteristics of Arctic synoptic activity, 1952-1989, *Met.*

1411 *Atmos. Phys.*, 1, 147-164, 1993.

1412

1413 Serreze, M.C., Maslanik, J.A., and Key, J.R.: Atmospheric and Sea Ice Characteristics of the Arctic Ocean and the

1414 SHEBA Field Region in the Beaufort Sea, NSIDC Special Report -

1415 4, https://nsidc.org/sites/default/files/nsidc_special_report_4.pdf, 1996.

1416

1417 Serreze, M. C., Carse, F., Barry, R. G., and Rogers, J. C.; Icelandic Low cyclone activity: Climatological features,

1418 linkages with the NAO, and relationships with recent changes in the Northern Hemisphere circulation, *J. Climate*,

1419 10, 453–464, 1997.

1420

1421 Serreze, M. C., Gustavson, J., Barrett, A. P., Druckenmiller, M. L., Fox, S., Voveris, J., Stroeve, J., Sheffield, B.,

1422 Forbes, B. C., Rasmus, S., Laptander, R., Brook, M., Brubaker, M., Temte, J., McCrystall, M. R., and Bartsch, A.;

Deleted: https://doi.org/10.3389/fenvs.2022.866929
Formatted ... [381]
Deleted: . (2021):
Deleted:
Formatted ... [382]
Formatted ... [383]
Deleted: https://doi.org/10.1038/s41467-021-27031-y .
Formatted ... [384]
Deleted: Dutra, E., Agusti-Panareda, A., et al. (202)
Deleted: . <i>Lett.</i> , 31(13), L13302, ... [386]
Formatted ... [385]
Formatted ... [387]
Formatted ... [389]
Deleted: . (1994):
Deleted:
Formatted ... [390]
Formatted ... [391]
Deleted: https://doi.org/10.3402/tellusa.v46i1.15422 .
Formatted ... [392]
Deleted: ¶
Deleted: E., Wang, M., Walsh, J. E., and Stroeve, J. (... [394]
Deleted: . (2005):
Deleted: 445
Formatted ... [393]
Formatted ... [395]
Formatted ... [396]
Formatted ... [397]
Deleted: https://doi.org/10.1256/qj.05.129 .
Formatted ... [398]
Deleted: et al. (2022):
Formatted ... [399]
Deleted: 3, 168, https://doi.org/10.1038/s43247-022 ... [400]
Formatted ... [401]
Deleted: Richter-Menge, J., Druckenmiller, M. L., (... [403]
Formatted ... [402]
Formatted ... [404]
Formatted ... [405]
Deleted: . (2014):
Deleted: .
Formatted ... [406]
Formatted ... [407]
Formatted ... [408]
Deleted: Serreze, M. C., Barrett, A. P., Slater, A. G. (... [409]
Formatted ... [410]
Deleted: . (1997):
Deleted:
Formatted ... [411]
Formatted ... [412]
Deleted: 465
Formatted ... [413]
Deleted: .
Formatted ... [414]
Deleted:
Formatted ... [415]
Deleted:
Deleted: (2021):
Formatted ... [416]
Formatted ... [417]

1597 Arctic rain-on-snow events: Bridging observations to understand environmental and livelihood impacts, *Environ.*
1598 *Res. Lett.*, 16, <https://doi.org/10.1088/1748-9326/ac269b>, 2021.

1599

1600 Serreze, M. C., Voveris, J., Barrett, A. P., Fox, S., Blanken, P. D., and Crawford, A., Characteristics of extreme
1601 daily precipitation events over the Canadian Arctic, *Int. J. Climatol.*, <https://doi.org/10.1002/joc.7907>, 2022.

1602

1603 Simmons, A. J., Hersbach, H., Dee, D. P., Berrisford, P., and Poli, P., Low-frequency variability and trends in
1604 surface air temperature and precipitation analyses of the ECMWF ERA5 reanalysis, *Q. J. R. Meteorol. Soc.*
1605 147(739), 3076–3100, <https://doi.org/10.1002/qj.4121>, 2021.

1606

1607 Tedesco, M., and Fettweis, X.: Unprecedented atmospheric conditions (1948-2019) drive the 2019 exceptional
1608 melting season over the Greenland ice sheet, *The Cryosphere*, 14, 1209-1223, [https://doi.org/10.5194/tc-14-1209-](https://doi.org/10.5194/tc-14-1209-2020)
1609 [2020](https://doi.org/10.5194/tc-14-1209-2020), 2020.

1610

1611 *The Guardian*, Temperatures at North Pole 20 °C above average and beyond ice melting point, *The Guardian*,
1612 [https://www.theguardian.com/environment/2025/feb/04/temperatures-at-north-pole-20c-above-average-and-beyond-](https://www.theguardian.com/environment/2025/feb/04/temperatures-at-north-pole-20c-above-average-and-beyond-ice-melting-point)
1613 [ice-melting-point](https://www.theguardian.com/environment/2025/feb/04/temperatures-at-north-pole-20c-above-average-and-beyond-ice-melting-point), 2025.

1614

1615 Thoman, R.L., Moon, T.A., and Drukenmiller, M.L., Eds.: Arctic report card 2023, [https://doi.org/10.25923/5vfa-](https://doi.org/10.25923/5vfa-k694)
1616 [k694](https://doi.org/10.25923/5vfa-k694), 2023.

1617

1618 Tian, T., Yang, S., Hoyer, J.L., Nielsen-Englyst, P., Singha, S.: Cooler Arctic surface temperatures simulated by
1619 climate models are closer to satellite-based data than the ERA5 reanalysis, *Commun Earth Environ.*, 5.,
1620 <https://doi.org/10.1038/s43247-024-01276-z>, 2024.

1621

1622 Tsukernik, M., Kindig, D.N. and Serreze M.C.: Characteristics of winter cyclone activity in the northern North
1623 Atlantic: Insights from observations and regional modeling, *J. Geophys. Res.*, 112, D03101,
1624 <https://doi.org/10.1029/2006JD007184>, 2007.

1625

1626 Voveris, J., and M. Serreze: A tale of two events: Arctic rain-on-snow meteorological drivers, *Ann. Glaciol.*, 64,
1627 194-205, <https://doi.org/10.1017/aog.2023.25>, 2023.

1628

1629 Walsh, J. E., Bigalke, S., McAfee, S. A., Lader, R., Serreze, M. C., and Ballinger, T. J.: Precipitation, in: NOAA
1630 Arctic Report Card 2023, <https://doi.org/10.25923/hcm7-az41>, 2023.

1631

1632 Xiong, W., Tang, G., Wang, T., Ma, Z., and Wan, W.: Evaluation of IMERG and ERA5 precipitation-phase
1633 partitioning on the global scale, *Water*, 14(7), 1122, <https://doi.org/10.3390/w14071122>, 2022.

Deleted:

Formatted ... [418]

Deleted: <https://doi.org/10.1088/1748-9326/ac269b>.

Formatted ... [419]

Deleted: . (2022):

Deleted:

Formatted ... [420]

Formatted ... [421]

Deleted: <https://doi.org/10.1002/joc.7907>.

Formatted ... [422]

Deleted: ¶

Formatted ... [423]

Formatted ... [424]

Deleted: . (2021):

Deleted:

Formatted ... [425]

Formatted ... [426]

Deleted:

Formatted ... [427]

Deleted: <https://doi.org/10.1002/qj.4121>.

Formatted ... [428]

Deleted: Spiridonov, V., and Ćurić, M. (2021): Wea... [429]

Deleted: (2025, February 4):

Formatted ... [430]

Formatted ... [431]

Formatted ... [432]

Deleted: *The Guardian*,

Formatted ... [433]

Formatted ... [434]

Deleted: , M. C. (2023):

Deleted: ,

Deleted: 485

Deleted: <https://doi.org/10.1017/aog.2023.25>.

Formatted ... [435]

Formatted ... [436]

Formatted ... [437]

Formatted ... [438]

Formatted ... [439]

Deleted: . (2023):

Deleted:

Formatted ... [440]

Formatted ... [441]

Deleted: <https://doi.org/10.25923/hcm7-az41>.

Formatted ... [442]

Deleted: ¶

Formatted ... [443]

Formatted ... [444]

Deleted: . (2022):

Deleted:

Formatted ... [445]

Formatted ... [446]

Deleted: <https://doi.org/10.3390/w14071122>.

Formatted ... [447]

1716

1717 Zhao, T., Fu, C., Ke, Z., and Guo, W.: Global atmosphere reanalysis datasets: Current status and recent advances,

1718 *Adv. Earth Sci.*, 25(3), 241, [2010](#).

Deleted: . (2010):

Deleted:

Formatted: Font: 10 pt

Formatted: Font: 10 pt

Deleted: . ¶

¶
Zhou, Y., Wu, B., and Wei, J. (2021): Assessing the performance of ERA5 precipitation in the Arctic using in situ gauge data from drifting ice stations, *J. Geophys. Res. Atmos.*, 126(12), e2020JD034545, ¶
<https://doi.org/10.1029/2020JD034545>. ¶

¶

¶

Formatted: Font: 10 pt

Page 1: [1] Formatted	Revised	2/13/26 11:10:00 AM
-----------------------	---------	---------------------

Font: 10 pt

Page 1: [1] Formatted	Revised	2/13/26 11:10:00 AM
-----------------------	---------	---------------------

Font: 10 pt

Page 1: [1] Formatted	Revised	2/13/26 11:10:00 AM
-----------------------	---------	---------------------

Font: 10 pt

Page 1: [2] Formatted	Revised	2/13/26 11:10:00 AM
-----------------------	---------	---------------------

Font: 10 pt

Page 1: [3] Formatted	Revised	2/13/26 11:10:00 AM
-----------------------	---------	---------------------

Font: 10 pt

Page 1: [4] Formatted	Revised	2/13/26 11:10:00 AM
-----------------------	---------	---------------------

Font: 10 pt

Page 1: [5] Formatted	Revised	2/13/26 11:10:00 AM
-----------------------	---------	---------------------

Font: 10 pt

Page 1: [6] Formatted	Revised	2/13/26 11:10:00 AM
-----------------------	---------	---------------------

Font: 10 pt

Page 1: [7] Formatted	Revised	2/13/26 11:10:00 AM
-----------------------	---------	---------------------

Font: 10 pt, Not Bold

Page 1: [8] Formatted	Revised	2/13/26 11:10:00 AM
-----------------------	---------	---------------------

Font: 10 pt

Page 1: [8] Formatted	Revised	2/13/26 11:10:00 AM
-----------------------	---------	---------------------

Font: 10 pt

Page 1: [8] Formatted	Revised	2/13/26 11:10:00 AM
-----------------------	---------	---------------------

Font: 10 pt

Page 1: [9] Formatted	Revised	2/13/26 11:10:00 AM
-----------------------	---------	---------------------

Font: 10 pt

Page 1: [10] Formatted	Revised	2/13/26 11:10:00 AM
------------------------	---------	---------------------

Font: 10 pt

Page 1: [11] Formatted	Revised	2/13/26 11:10:00 AM
------------------------	---------	---------------------

Font: 10 pt

Page 1: [12] Formatted	Revised	2/13/26 11:10:00 AM
------------------------	---------	---------------------

Font: 10 pt

Page 1: [13] Formatted	Revised	2/13/26 11:10:00 AM
------------------------	---------	---------------------

Font: 10 pt

Page 1: [14] Formatted	Revised	2/13/26 11:10:00 AM
------------------------	---------	---------------------

Font: 10 pt

Page 1: [15] Formatted	Revised	2/13/26 11:10:00 AM
------------------------	---------	---------------------

Font: 10 pt

Page 1: [16] Formatted	Revised	2/13/26 11:10:00 AM
------------------------	---------	---------------------

Font: 10 pt

Page 1: [17] Formatted	Revised	2/13/26 11:10:00 AM
------------------------	---------	---------------------

Font: 10 pt

Page 1: [18] Formatted	Revised	2/13/26 11:10:00 AM
------------------------	---------	---------------------

Font: 10 pt

Page 1: [19] Formatted	Revised	2/13/26 11:10:00 AM
------------------------	---------	---------------------

Font: 10 pt

Page 1: [20] Formatted	Revised	2/13/26 11:10:00 AM
------------------------	---------	---------------------

Font: 10 pt

Page 1: [20] Formatted	Revised	2/13/26 11:10:00 AM
------------------------	---------	---------------------

Font: 10 pt

Page 1: [21] Formatted	Revised	2/13/26 11:10:00 AM
------------------------	---------	---------------------

Font: 10 pt

Page 1: [22] Formatted	Revised	2/13/26 11:10:00 AM
------------------------	---------	---------------------

Font: 10 pt

Page 1: [23] Formatted	Revised	2/13/26 11:10:00 AM
------------------------	---------	---------------------

Font: 10 pt

Page 1: [24] Formatted	Revised	2/13/26 11:10:00 AM
------------------------	---------	---------------------

Font: 10 pt

Page 1: [25] Formatted	Revised	2/13/26 11:10:00 AM
------------------------	---------	---------------------

Font: 10 pt

Page 1: [26] Formatted	Revised	2/13/26 11:10:00 AM
------------------------	---------	---------------------

Font: 10 pt

Page 1: [27] Formatted	Revised	2/13/26 11:10:00 AM
------------------------	---------	---------------------

Font: 10 pt

Page 1: [28] Formatted	Revised	2/13/26 11:10:00 AM
------------------------	---------	---------------------

Font: 10 pt

Page 1: [29] Formatted	Revised	2/13/26 11:10:00 AM
------------------------	---------	---------------------

Font: 10 pt

Page 1: [30] Formatted	Revised	2/13/26 11:10:00 AM
------------------------	---------	---------------------

Font: 10 pt

Page 1: [31] Formatted	Revised	2/13/26 11:10:00 AM
------------------------	---------	---------------------

Font: 10 pt

Page 1: [32] Formatted	Revised	2/13/26 11:10:00 AM
------------------------	---------	---------------------

Font: 10 pt

Page 1: [33] Formatted	Revised	2/13/26 11:10:00 AM
------------------------	---------	---------------------

Font: 10 pt

Page 1: [34] Formatted	Revised	2/13/26 11:10:00 AM
------------------------	---------	---------------------

Font: 10 pt

Page 1: [34] Formatted	Revised	2/13/26 11:10:00 AM
------------------------	---------	---------------------

Font: 10 pt

Page 1: [35] Formatted	Revised	2/13/26 11:10:00 AM
-------------------------------	----------------	----------------------------

Font: 10 pt

Page 1: [36] Formatted	Revised	2/13/26 11:10:00 AM
-------------------------------	----------------	----------------------------

Font: 10 pt

Page 1: [37] Formatted	Revised	2/13/26 11:10:00 AM
-------------------------------	----------------	----------------------------

Font: 10 pt

Page 2: [38] Formatted	Revised	2/13/26 11:10:00 AM
-------------------------------	----------------	----------------------------

Font: 10 pt

Page 2: [39] Formatted	Revised	2/13/26 11:10:00 AM
-------------------------------	----------------	----------------------------

Font: 10 pt

Page 2: [40] Formatted	Revised	2/13/26 11:10:00 AM
-------------------------------	----------------	----------------------------

Font: 10 pt

Page 2: [41] Formatted	Revised	2/13/26 11:10:00 AM
-------------------------------	----------------	----------------------------

Font: 10 pt

Page 2: [42] Formatted	Revised	2/13/26 11:10:00 AM
-------------------------------	----------------	----------------------------

Font: 10 pt

Page 2: [43] Formatted	Revised	2/13/26 11:10:00 AM
-------------------------------	----------------	----------------------------

Font: 10 pt

Page 2: [44] Formatted	Revised	2/13/26 11:10:00 AM
-------------------------------	----------------	----------------------------

Font: 10 pt

Page 2: [45] Formatted	Revised	2/13/26 11:10:00 AM
-------------------------------	----------------	----------------------------

Font: 10 pt

Page 2: [45] Formatted	Revised	2/13/26 11:10:00 AM
-------------------------------	----------------	----------------------------

Font: 10 pt

Page 2: [46] Formatted	Revised	2/13/26 11:10:00 AM
-------------------------------	----------------	----------------------------

Font: 10 pt

Page 2: [47] Formatted	Revised	2/13/26 11:10:00 AM
-------------------------------	----------------	----------------------------

Font: 10 pt

Page 2: [48] Formatted	Revised	2/13/26 11:10:00 AM
------------------------	---------	---------------------

Font: 10 pt, Bold

Page 2: [49] Formatted	Revised	2/13/26 11:10:00 AM
------------------------	---------	---------------------

Font: 10 pt

Page 2: [50] Formatted	Revised	2/13/26 11:10:00 AM
------------------------	---------	---------------------

Font: 10 pt

Page 2: [51] Formatted	Revised	2/13/26 11:10:00 AM
------------------------	---------	---------------------

Font: 10 pt

Page 2: [52] Formatted	Revised	2/13/26 11:10:00 AM
------------------------	---------	---------------------

Font: 10 pt

Page 2: [53] Formatted	Revised	2/13/26 11:10:00 AM
------------------------	---------	---------------------

Font: 10 pt

Page 2: [53] Formatted	Revised	2/13/26 11:10:00 AM
------------------------	---------	---------------------

Font: 10 pt

Page 2: [54] Formatted	Revised	2/13/26 11:10:00 AM
------------------------	---------	---------------------

Font: 10 pt

Page 2: [55] Formatted	Revised	2/13/26 11:10:00 AM
------------------------	---------	---------------------

Font: 10 pt

Page 2: [56] Formatted	Revised	2/13/26 11:10:00 AM
------------------------	---------	---------------------

Font: 10 pt

Page 2: [57] Formatted	Revised	2/13/26 11:10:00 AM
------------------------	---------	---------------------

Font: 10 pt

Page 2: [58] Formatted	Revised	2/13/26 11:10:00 AM
------------------------	---------	---------------------

Font: 10 pt

Page 2: [59] Formatted	Revised	2/13/26 11:10:00 AM
------------------------	---------	---------------------

Font: 10 pt

Page 2: [60] Formatted	Revised	2/13/26 11:10:00 AM
------------------------	---------	---------------------

Font: 10 pt

Page 2: [61] Formatted	Revised	2/13/26 11:10:00 AM
------------------------	---------	---------------------

Font: 10 pt

Page 2: [62] Formatted	Revised	2/13/26 11:10:00 AM
------------------------	---------	---------------------

Font: 10 pt

Page 2: [63] Formatted	Revised	2/13/26 11:10:00 AM
------------------------	---------	---------------------

Font: 10 pt

Page 2: [64] Formatted	Revised	2/13/26 11:10:00 AM
------------------------	---------	---------------------

Font: 10 pt

Page 2: [65] Formatted	Revised	2/13/26 11:10:00 AM
------------------------	---------	---------------------

Font: 10 pt

Page 2: [66] Formatted	Revised	2/13/26 11:10:00 AM
------------------------	---------	---------------------

Font: 10 pt

Page 2: [67] Formatted	Revised	2/13/26 11:10:00 AM
------------------------	---------	---------------------

Font: 10 pt

Page 2: [68] Formatted	Revised	2/13/26 11:10:00 AM
------------------------	---------	---------------------

Font: 10 pt

Page 3: [69] Formatted	Revised	2/13/26 11:10:00 AM
------------------------	---------	---------------------

Font: 10 pt

Page 3: [70] Formatted	Revised	2/13/26 11:10:00 AM
------------------------	---------	---------------------

Font: 10 pt

Page 3: [71] Formatted	Revised	2/13/26 11:10:00 AM
------------------------	---------	---------------------

Font: 10 pt

Page 3: [72] Formatted	Revised	2/13/26 11:10:00 AM
------------------------	---------	---------------------

Font: 10 pt

Page 3: [73] Formatted	Revised	2/13/26 11:10:00 AM
-------------------------------	----------------	----------------------------

Font: 10 pt

Page 3: [74] Formatted	Revised	2/13/26 11:10:00 AM
-------------------------------	----------------	----------------------------

Font: 10 pt

Page 3: [75] Formatted	Revised	2/13/26 11:10:00 AM
-------------------------------	----------------	----------------------------

Font: 10 pt

Page 3: [75] Formatted	Revised	2/13/26 11:10:00 AM
-------------------------------	----------------	----------------------------

Font: 10 pt

Page 3: [76] Formatted	Revised	2/13/26 11:10:00 AM
-------------------------------	----------------	----------------------------

Font: 10 pt

Page 3: [77] Formatted	Revised	2/13/26 11:10:00 AM
-------------------------------	----------------	----------------------------

Font: 10 pt

Page 3: [78] Formatted	Revised	2/13/26 11:10:00 AM
-------------------------------	----------------	----------------------------

Font: 10 pt

Page 3: [79] Formatted	Revised	2/13/26 11:10:00 AM
-------------------------------	----------------	----------------------------

Font: 10 pt

Page 3: [80] Formatted	Revised	2/13/26 11:10:00 AM
-------------------------------	----------------	----------------------------

Font: 10 pt

Page 3: [81] Formatted	Revised	2/13/26 11:10:00 AM
-------------------------------	----------------	----------------------------

Font: 10 pt

Page 3: [82] Formatted	Revised	2/13/26 11:10:00 AM
-------------------------------	----------------	----------------------------

Font: 10 pt

Page 3: [83] Formatted	Revised	2/13/26 11:10:00 AM
-------------------------------	----------------	----------------------------

Font: 10 pt

Page 3: [83] Formatted	Revised	2/13/26 11:10:00 AM
-------------------------------	----------------	----------------------------

Font: 10 pt

Page 3: [84] Formatted	Revised	2/13/26 11:10:00 AM
-------------------------------	----------------	----------------------------

Font: 10 pt

Page 3: [84] Formatted	Revised	2/13/26 11:10:00 AM
------------------------	---------	---------------------

Font: 10 pt

Page 3: [85] Formatted	Revised	2/13/26 11:10:00 AM
------------------------	---------	---------------------

Font: 10 pt, Not Bold

Page 3: [86] Formatted	Revised	2/13/26 11:10:00 AM
------------------------	---------	---------------------

Font: 10 pt

Page 3: [87] Formatted	Revised	2/13/26 11:10:00 AM
------------------------	---------	---------------------

Font: 10 pt, Bold

Page 3: [88] Formatted	Revised	2/13/26 11:10:00 AM
------------------------	---------	---------------------

Font: 10 pt

Page 3: [89] Formatted	Revised	2/13/26 11:10:00 AM
------------------------	---------	---------------------

Font: 10 pt

Page 3: [90] Formatted	Revised	2/13/26 11:10:00 AM
------------------------	---------	---------------------

Font: 10 pt

Page 3: [91] Formatted	Revised	2/13/26 11:10:00 AM
------------------------	---------	---------------------

Font: 10 pt

Page 3: [92] Formatted	Revised	2/13/26 11:10:00 AM
------------------------	---------	---------------------

Font: 10 pt

Page 3: [93] Formatted	Revised	2/13/26 11:10:00 AM
------------------------	---------	---------------------

Font: 10 pt

Page 3: [94] Formatted	Revised	2/13/26 11:10:00 AM
------------------------	---------	---------------------

Font: 10 pt

Page 3: [95] Formatted	Revised	2/13/26 11:10:00 AM
------------------------	---------	---------------------

Font: 10 pt

Page 3: [96] Formatted	Revised	2/13/26 11:10:00 AM
------------------------	---------	---------------------

Font: 10 pt

Page 3: [97] Formatted	Revised	2/13/26 11:10:00 AM
------------------------	---------	---------------------

Font: 10 pt

Page 3: [98] Formatted	Revised	2/13/26 11:10:00 AM
------------------------	---------	---------------------

Font: 10 pt

Page 3: [99] Formatted	Revised	2/13/26 11:10:00 AM
------------------------	---------	---------------------

Font: 10 pt

Page 3: [100] Formatted	Revised	2/13/26 11:10:00 AM
-------------------------	---------	---------------------

Font: 10 pt

Page 3: [100] Formatted	Revised	2/13/26 11:10:00 AM
-------------------------	---------	---------------------

Font: 10 pt

Page 6: [101] Formatted	Revised	2/13/26 11:10:00 AM
-------------------------	---------	---------------------

Font: 10 pt

Page 6: [102] Deleted	Revised	2/13/26 11:10:00 AM
-----------------------	---------	---------------------

▼

Page 6: [103] Formatted	Revised	2/13/26 11:10:00 AM
-------------------------	---------	---------------------

Font: 10 pt

Page 6: [104] Formatted	Revised	2/13/26 11:10:00 AM
-------------------------	---------	---------------------

Font: 10 pt

Page 6: [105] Formatted	Revised	2/13/26 11:10:00 AM
-------------------------	---------	---------------------

Font: 10 pt

Page 6: [105] Formatted	Revised	2/13/26 11:10:00 AM
-------------------------	---------	---------------------

Font: 10 pt

Page 6: [106] Formatted	Revised	2/13/26 11:10:00 AM
-------------------------	---------	---------------------

Font: 10 pt

Page 6: [107] Formatted	Revised	2/13/26 11:10:00 AM
-------------------------	---------	---------------------

Font: 10 pt

Page 6: [108] Formatted	Revised	2/13/26 11:10:00 AM
-------------------------	---------	---------------------

Font: 10 pt

Page 6: [109] Formatted	Revised	2/13/26 11:10:00 AM
-------------------------	---------	---------------------

Font: 10 pt

Page 6: [110] Formatted	Revised	2/13/26 11:10:00 AM
-------------------------	---------	---------------------

Font: 10 pt

Page 6: [111] Formatted	Revised	2/13/26 11:10:00 AM
-------------------------	---------	---------------------

Font: 10 pt

Page 6: [112] Formatted	Revised	2/13/26 11:10:00 AM
-------------------------	---------	---------------------

Font: 10 pt

Page 6: [113] Formatted	Revised	2/13/26 11:10:00 AM
-------------------------	---------	---------------------

Font: 10 pt

Page 6: [114] Formatted	Revised	2/13/26 11:10:00 AM
-------------------------	---------	---------------------

Font: 10 pt

Page 6: [115] Formatted	Revised	2/13/26 11:10:00 AM
-------------------------	---------	---------------------

Font: 10 pt, Bold

Page 6: [116] Formatted	Revised	2/13/26 11:10:00 AM
-------------------------	---------	---------------------

Font: 10 pt

Page 6: [116] Formatted	Revised	2/13/26 11:10:00 AM
-------------------------	---------	---------------------

Font: 10 pt

Page 6: [117] Formatted	Revised	2/13/26 11:10:00 AM
-------------------------	---------	---------------------

Font: 10 pt

Page 6: [117] Formatted	Revised	2/13/26 11:10:00 AM
-------------------------	---------	---------------------

Font: 10 pt

Page 6: [118] Formatted	Revised	2/13/26 11:10:00 AM
-------------------------	---------	---------------------

Font: 10 pt

Page 6: [119] Formatted	Revised	2/13/26 11:10:00 AM
-------------------------	---------	---------------------

Font: 10 pt

Page 6: [120] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------------	----------------	----------------------------

Font: 10 pt

Page 6: [120] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------------	----------------	----------------------------

Font: 10 pt

Page 6: [121] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------------	----------------	----------------------------

Font: 10 pt

Page 6: [122] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------------	----------------	----------------------------

Font: 10 pt

Page 6: [123] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------------	----------------	----------------------------

Font: 10 pt

Page 6: [124] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------------	----------------	----------------------------

Font: 10 pt

Page 6: [125] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------------	----------------	----------------------------

Font: 10 pt

Page 6: [126] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------------	----------------	----------------------------

Font: 10 pt

Page 6: [127] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------------	----------------	----------------------------

Font: 10 pt

Page 6: [128] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------------	----------------	----------------------------

Font: 10 pt

Page 6: [129] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------------	----------------	----------------------------

Font: 10 pt

Page 6: [130] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------------	----------------	----------------------------

Font: 10 pt

Page 6: [131] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------------	----------------	----------------------------

Font: 10 pt

Page 6: [132] Formatted	Revised	2/13/26 11:10:00 AM
-------------------------	---------	---------------------

Font: 10 pt

Page 6: [132] Formatted	Revised	2/13/26 11:10:00 AM
-------------------------	---------	---------------------

Font: 10 pt

Page 6: [133] Formatted	Revised	2/13/26 11:10:00 AM
-------------------------	---------	---------------------

Font: 10 pt

Page 6: [134] Formatted	Revised	2/13/26 11:10:00 AM
-------------------------	---------	---------------------

Font: 10 pt

Page 6: [135] Formatted	Revised	2/13/26 11:10:00 AM
-------------------------	---------	---------------------

Font: 10 pt

Page 6: [136] Formatted	Revised	2/13/26 11:10:00 AM
-------------------------	---------	---------------------

Font: 10 pt

Page 6: [137] Formatted	Revised	2/13/26 11:10:00 AM
-------------------------	---------	---------------------

Font: 10 pt

Page 6: [138] Formatted	Revised	2/13/26 11:10:00 AM
-------------------------	---------	---------------------

Font: 10 pt

Page 6: [139] Formatted	Revised	2/13/26 11:10:00 AM
-------------------------	---------	---------------------

Font: 10 pt

Page 7: [140] Deleted	Revised	2/13/26 11:10:00 AM
-----------------------	---------	---------------------

▼

Page 9: [141] Formatted	Revised	2/13/26 11:10:00 AM
-------------------------	---------	---------------------

Font: 10 pt

Page 9: [141] Formatted	Revised	2/13/26 11:10:00 AM
-------------------------	---------	---------------------

Font: 10 pt

Page 9: [142] Formatted	Revised	2/13/26 11:10:00 AM
-------------------------	---------	---------------------

Font: 10 pt

Page 9: [142] Formatted	Revised	2/13/26 11:10:00 AM
-------------------------	---------	---------------------

Font: 10 pt

Page 9: [142] Formatted	Revised	2/13/26 11:10:00 AM
-------------------------	---------	---------------------

Font: 10 pt

Page 10: [143] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 10: [144] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 10: [145] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 10: [146] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 10: [147] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 10: [148] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 10: [149] Deleted	Revised	2/13/26 11:10:00 AM
------------------------	---------	---------------------

Page 10: [150] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 10: [150] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 10: [151] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 10: [152] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt, Bold

Page 10: [152] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt, Bold

Page 10: [153] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 10: [154] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 10: [155] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 10: [155] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 10: [156] Deleted	Revised	2/13/26 11:10:00 AM
------------------------	---------	---------------------

▼

Page 10: [157] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 10: [158] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 10: [159] Deleted	Revised	2/13/26 11:10:00 AM
------------------------	---------	---------------------

▼

Page 10: [160] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 10: [161] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 10: [162] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 10: [163] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 10: [164] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 10: [165] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 10: [166] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 10: [167] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt, Bold

Page 10: [167] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt, Bold

Page 10: [168] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 10: [169] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 11: [170] Deleted	Revised	2/13/26 11:10:00 AM
------------------------	---------	---------------------

▼

Page 12: [171] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 12: [171] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 12: [172] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 12: [173] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 12: [174] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 12: [175] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 12: [176] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 12: [177] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 12: [178] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 12: [179] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 12: [180] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 12: [181] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 12: [182] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 12: [183] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 12: [184] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 12: [184] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 12: [184] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 12: [185] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 12: [186] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 12: [186] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 12: [187] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 12: [188] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 12: [188] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 12: [189] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 12: [189] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 12: [190] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 12: [191] Deleted	Revised	2/13/26 11:10:00 AM
------------------------	---------	---------------------

▼

Page 12: [192] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 12: [193] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt, Bold

Page 12: [194] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 12: [195] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 12: [196] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 12: [197] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 12: [197] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 12: [197] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 12: [198] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 12: [199] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 12: [200] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 12: [200] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 12: [201] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 12: [202] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 12: [203] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 12: [204] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 14: [205] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 14: [205] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 14: [205] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 14: [206] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 14: [206] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 14: [206] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 14: [207] Deleted	Revised	2/13/26 11:10:00 AM
------------------------	---------	---------------------

▼

Page 14: [208] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 14: [208] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 14: [208] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 14: [208] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 14: [209] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 14: [209] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 14: [210] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt, Bold

Page 14: [210] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt, Bold

Page 16: [211] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 16: [212] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 16: [213] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 16: [214] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 16: [214] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 16: [215] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 16: [216] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt, Bold

Page 16: [217] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Left

Page 16: [218] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 16: [219] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt, Not Bold

Page 16: [219] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt, Not Bold

Page 16: [220] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 16: [221] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 16: [222] Deleted	Revised	2/13/26 11:10:00 AM
------------------------	---------	---------------------

▼

Page 16: [223] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 16: [224] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 16: [225] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 16: [226] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 16: [227] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 16: [227] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 16: [228] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 16: [229] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 16: [230] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 16: [231] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 16: [232] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 16: [233] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 16: [234] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 16: [235] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 16: [236] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 16: [237] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 16: [238] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 16: [239] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 16: [240] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 16: [241] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 16: [241] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 16: [241] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 16: [241] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 16: [241] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 16: [242] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 16: [242] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 16: [242] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 16: [243] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt, Bold

Page 16: [244] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 16: [245] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt, Bold

Page 16: [246] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 17: [247] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 17: [248] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 17: [249] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 17: [250] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 17: [251] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 17: [252] Deleted	Revised	2/13/26 11:10:00 AM
------------------------	---------	---------------------

▼

Page 17: [253] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 17: [254] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 17: [255] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 17: [256] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt, Bold

Page 17: [257] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 17: [258] Formatted	Revised	2/13/26 11:10:00 AM
---------------------------------	----------------	----------------------------

Font: 10 pt, Not Bold

Page 17: [259] Formatted	Revised	2/13/26 11:10:00 AM
---------------------------------	----------------	----------------------------

Font: 10 pt

Page 17: [260] Formatted	Revised	2/13/26 11:10:00 AM
---------------------------------	----------------	----------------------------

Font: 10 pt

Page 17: [261] Formatted	Revised	2/13/26 11:10:00 AM
---------------------------------	----------------	----------------------------

Font: 10 pt

Page 17: [262] Formatted	Revised	2/13/26 11:10:00 AM
---------------------------------	----------------	----------------------------

Font: 10 pt

Page 17: [263] Formatted	Revised	2/13/26 11:10:00 AM
---------------------------------	----------------	----------------------------

Font: 10 pt

Page 17: [264] Formatted	Revised	2/13/26 11:10:00 AM
---------------------------------	----------------	----------------------------

Font: 10 pt

Page 17: [265] Formatted	Revised	2/13/26 11:10:00 AM
---------------------------------	----------------	----------------------------

Font: 10 pt

Page 17: [266] Formatted	Revised	2/13/26 11:10:00 AM
---------------------------------	----------------	----------------------------

Font: 10 pt

Page 17: [267] Formatted	Revised	2/13/26 11:10:00 AM
---------------------------------	----------------	----------------------------

Font: 10 pt

Page 17: [268] Formatted	Revised	2/13/26 11:10:00 AM
---------------------------------	----------------	----------------------------

Font: 10 pt

Page 17: [269] Formatted	Revised	2/13/26 11:10:00 AM
---------------------------------	----------------	----------------------------

Font: 10 pt

Page 17: [270] Formatted	Revised	2/13/26 11:10:00 AM
---------------------------------	----------------	----------------------------

Font: 10 pt

Page 17: [271] Formatted	Revised	2/13/26 11:10:00 AM
---------------------------------	----------------	----------------------------

Font: 10 pt

Page 17: [272] Formatted	Revised	2/13/26 11:10:00 AM
---------------------------------	----------------	----------------------------

Font: 10 pt

Page 17: [273] Formatted	Revised	2/13/26 11:10:00 AM
---------------------------------	----------------	----------------------------

Font: 10 pt

Page 17: [274] Formatted	Revised	2/13/26 11:10:00 AM
---------------------------------	----------------	----------------------------

Font: 10 pt

Page 17: [275] Formatted	Revised	2/13/26 11:10:00 AM
---------------------------------	----------------	----------------------------

Font: 10 pt

Page 17: [276] Formatted	Revised	2/13/26 11:10:00 AM
---------------------------------	----------------	----------------------------

Font: 10 pt

Page 17: [277] Formatted	Revised	2/13/26 11:10:00 AM
---------------------------------	----------------	----------------------------

Font: 10 pt

Page 18: [278] Formatted	Revised	2/13/26 11:10:00 AM
---------------------------------	----------------	----------------------------

Font: 10 pt

Page 18: [279] Formatted	Revised	2/13/26 11:10:00 AM
---------------------------------	----------------	----------------------------

Font: 10 pt

Page 18: [280] Formatted	Revised	2/13/26 11:10:00 AM
---------------------------------	----------------	----------------------------

Font: 10 pt

Page 18: [281] Formatted	Revised	2/13/26 11:10:00 AM
---------------------------------	----------------	----------------------------

Font: 10 pt

Page 18: [281] Formatted	Revised	2/13/26 11:10:00 AM
---------------------------------	----------------	----------------------------

Font: 10 pt

Page 18: [282] Formatted	Revised	2/13/26 11:10:00 AM
---------------------------------	----------------	----------------------------

Font: 10 pt

Page 18: [283] Formatted	Revised	2/13/26 11:10:00 AM
---------------------------------	----------------	----------------------------

Font: 10 pt

Page 18: [284] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 18: [285] Deleted	Revised	2/13/26 11:10:00 AM
------------------------	---------	---------------------

Page 18: [286] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 18: [286] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 18: [286] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 18: [287] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 18: [288] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 18: [289] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 18: [289] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 18: [290] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 18: [291] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Left

Page 18: [292] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 18: [293] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 18: [294] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 18: [294] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 18: [295] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 18: [295] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 18: [296] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 18: [297] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 18: [297] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 18: [298] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 18: [299] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 18: [300] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 18: [301] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 18: [302] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 18: [303] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 18: [304] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 18: [304] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 18: [305] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 18: [306] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 18: [307] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 18: [308] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 18: [309] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 20: [310] Deleted	Revised	2/13/26 11:10:00 AM
------------------------	---------	---------------------

▼

Page 21: [311] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 21: [312] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 21: [313] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 21: [314] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 21: [315] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 21: [316] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 21: [316] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 21: [317] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 21: [318] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 21: [319] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 21: [320] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 21: [321] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 21: [322] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 21: [323] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt, Bold

Page 21: [324] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 21: [325] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt, Not Bold

Page 21: [326] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt, Bold

Page 21: [327] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 21: [328] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Left

Page 21: [329] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt, Bold

Page 21: [330] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 21: [331] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 21: [332] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 21: [332] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 21: [332] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 21: [333] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 21: [334] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 21: [335] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 21: [336] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 21: [337] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 21: [337] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 21: [337] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 21: [338] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 21: [339] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 21: [340] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 21: [341] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 21: [342] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 21: [343] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 21: [343] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 21: [343] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 21: [344] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 21: [345] Deleted	Revised	2/13/26 11:10:00 AM
------------------------	---------	---------------------

▼

Page 21: [346] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 22: [347] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 22: [348] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 22: [348] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 22: [348] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 22: [349] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 22: [350] Deleted	Revised	2/13/26 11:10:00 AM
------------------------	---------	---------------------

▼

Page 22: [351] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt, Not Italic

Page 22: [352] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 22: [353] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 22: [354] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 22: [354] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 22: [354] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 22: [355] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 22: [356] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 22: [357] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 22: [357] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 22: [357] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 22: [358] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 22: [359] Deleted	Revised	2/13/26 11:10:00 AM
------------------------	---------	---------------------

Page 22: [360] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 22: [361] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 22: [362] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 22: [362] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 22: [362] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 22: [363] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 22: [364] Moved from page 21 (Move #4)	Revised	2/13/26 11:10:00 AM
---	---------	---------------------

[Hersbach, H.](#)

Page 22: [364] Moved from page 21 (Move #4)	Revised	2/13/26 11:10:00 AM
---	---------	---------------------

[Hersbach, H.](#)

Page 22: [364] Moved from page 21 (Move #4)	Revised	2/13/26 11:10:00 AM
---	---------	---------------------

[Hersbach, H.](#)

Page 22: [365] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 22: [366] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 22: [366] Formatted Revised 2/13/26 11:10:00 AM

Font: 10 pt

Page 22: [367] Deleted Revised 2/13/26 11:10:00 AM

▼

Page 22: [368] Formatted Revised 2/13/26 11:10:00 AM

Font: 10 pt

Page 22: [369] Formatted Revised 2/13/26 11:10:00 AM

Font: 10 pt

Page 22: [370] Deleted Revised 2/13/26 11:10:00 AM

▼

Page 22: [371] Formatted Revised 2/13/26 11:10:00 AM

Font: 10 pt

Page 22: [372] Deleted Revised 2/13/26 11:10:00 AM

▼

Page 22: [373] Formatted Revised 2/13/26 11:10:00 AM

Font: 10 pt, Not Italic

Page 22: [374] Formatted Revised 2/13/26 11:10:00 AM

Font: 10 pt

Page 22: [374] Formatted Revised 2/13/26 11:10:00 AM

Font: 10 pt

Page 22: [375] Formatted Revised 2/13/26 11:10:00 AM

Font: 10 pt

Page 22: [376] Formatted Revised 2/13/26 11:10:00 AM

Font: 10 pt

Page 22: [377] Formatted Revised 2/13/26 11:10:00 AM

Font: 10 pt

Page 22: [377] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 22: [377] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 22: [378] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 22: [379] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 22: [379] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 22: [380] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 23: [381] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 23: [382] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 23: [383] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 23: [383] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 23: [383] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 23: [384] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 23: [385] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 23: [386] Deleted	Revised	2/13/26 11:10:00 AM
------------------------	---------	---------------------

▼

Page 23: [387] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt, Not Italic

Page 23: [388] Deleted	Revised	2/13/26 11:10:00 AM
------------------------	---------	---------------------

▼

Page 23: [389] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 23: [390] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 23: [390] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 23: [390] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 23: [391] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 23: [392] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 23: [393] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 23: [394] Deleted	Revised	2/13/26 11:10:00 AM
------------------------	---------	---------------------

▼

Page 23: [395] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 23: [396] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 23: [396] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 23: [397] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 23: [397] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 23: [397] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 23: [398] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 23: [399] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 23: [399] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 23: [399] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 23: [400] Deleted	Revised	2/13/26 11:10:00 AM
------------------------	---------	---------------------

▼

Page 23: [401] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 23: [402] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt, Not Italic

Page 23: [403] Deleted	Revised	2/13/26 11:10:00 AM
------------------------	---------	---------------------

▼

Page 23: [404] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 23: [405] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 23: [406] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 23: [407] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 23: [408] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 23: [409] Deleted	Revised	2/13/26 11:10:00 AM
------------------------	---------	---------------------

Page 23: [410] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 23: [411] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 23: [412] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 23: [412] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 23: [413] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 23: [413] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 23: [413] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 23: [414] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 23: [415] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 23: [416] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 23: [417] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 24: [418] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 24: [419] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 24: [420] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 24: [421] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 24: [421] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 24: [421] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 24: [422] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 24: [423] Deleted	Revised	2/13/26 11:10:00 AM
------------------------	---------	---------------------

Page 24: [424] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 24: [425] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 24: [426] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 24: [426] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 24: [426] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 24: [427] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 24: [428] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 24: [429] Deleted	Revised	2/13/26 11:10:00 AM
------------------------	---------	---------------------

▼

Page 24: [430] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 24: [431] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 24: [432] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 24: [432] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 24: [433] Deleted	Revised	2/13/26 11:10:00 AM
------------------------	---------	---------------------

▼

Page 24: [434] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 24: [435] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 24: [436] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 24: [437] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 24: [437] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 24: [438] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 24: [438] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 24: [438] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 24: [439] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 24: [440] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 24: [441] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 24: [441] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 24: [441] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 24: [442] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 24: [443] Deleted	Revised	2/13/26 11:10:00 AM
------------------------	---------	---------------------

Page 24: [444] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 24: [445] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 24: [446] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Page 24: [446] Formatted	Revised	2/13/26 11:10:00 AM
--------------------------	---------	---------------------

Font: 10 pt

Font: 10 pt

Font: 10 pt