



Global Cryosphere – Past, Present and Future

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First, an overview of the Earth's cryosphere - all forms of snow and ice, both terrestrial and marine – snow cover, glaciers, ice sheets, lake and river ice, permafrost, sea ice, and icebergs – is presented. In recent years, studies have shown that the Earth is undergoing potentially rapid changes in all cryospheric components, including Arctic sea ice shrinkage, mountain glacier recession, thawing permafrost, diminishing snow cover, and accelerated melting of the Greenland ice sheet. This has significant implications for global climate, hydrology, water resources, and global sea level. Physical evidences of changes observed in the cryosphere are: (a) Duration of ice cover of rivers and lakes in high latitudes of N. H. decreased by about two weeks over the 20th Century; (b) Significant retreat of glaciers world wide during the 20th Century; (c) Thinning of Arctic sea-ice extent and thickness by about 40% in late summer in recent decades, with the minimum sea ice concentration mapped by the SSM/I sensor of NASA in 2007; (d) Snow cover decreased in area by about 10% since global observations by satellites began in the late 1960s, in various places of the Northern Hemisphere; (e) In North America, snow water equivalent decreased by about 10mm since observations by passive microwave sensors began in the late 1970s; (f) Degradations of permafrost have been detected in some parts of the polar and sub-polar regions, and (g) The total 20th Century global average sea level rise was about 0.17m, likely due to decline in glaciers, snow, ice sheets, and losses from Greenland and Antarctica ice. Next, projected changes to the Cryosphere: northern hemisphere snow cover, avalanches, land ice, permafrost, freshwater ice, and sea ice changes, are presented.