

## **World on the Edge - Climate Data - Ice Melt and Sea Level Rise**

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This is part of a supporting dataset for Lester R. Brown, **World On the Edge: How to Prevent Environmental and Economic Collapse** (New York: W.W. Norton & Company, 2010). For more information and a free download of the book, see Earth Policy Institute on-line at [www.earth-policy.org](http://www.earth-policy.org).

### Major Ice Disintegration and Calving Events, 1995-2010

Date*	Name	Area (Weight)	Location	Notes
January 1995	Larsen A Ice Shelf	1,500 km <sup>2</sup>	Antarctic Peninsula, West Antarctica	The ice shelf rapidly disintegrated into icebergs, indicating "a new style of ice shelf response to pronounced climate warming." Disintegration is thought to start with warm summers' creating meltponds on the ice shelf surface which drain through cracks to the shelf base. Larsen A had been acting as a buttress to the inland glaciers that fed it; after disintegration, the speeds of those glaciers increased 2-3 times.
March 2000	Ross Ice Shelf	11,007 km <sup>2</sup>	Ross Sea, East Antarctica	Iceberg B-15, one of the largest ever observed, broke off of the Ross Ice Shelf near Roosevelt Island, obstructing pack ice movement out to sea and blocking sunlight from the marine ecosystem.
31 January - 5 March 2002	Larsen B	3,250 km <sup>2</sup> (720 billion tons)	Antarctic Peninsula, West Antarctica	The Northern portion of 400-year old Larsen B disintegrated over a span of 35 days, marking the "largest single disintegration event in 30 years of ice shelf monitoring." The break-up led to a speeding up of the inland glaciers that fed it, "showing that much of Antarctica's ice is vulnerable if its other ice shelves break up."
11 March 2002	Thwaites Glacier	5,538 km <sup>2</sup>	Pine Island Bay, Amundsen Sea, West Antarctica	Iceberg B-22 broke off from the Thwaites Glacier Tongue. Both the Thwaites Glacier and neighboring Pine Island Glacier have sped up and thinned over the past few decades as they are being melted by warm water from below. They have been called the "weak underbelly of West Antarctica."
5 May 2002	Ross Ice Shelf	560 km <sup>2</sup>	Ross Sea, East Antarctica	Iceberg C-18 calved off of the Ross Ice Shelf.
February - July 2008	Wilkins Ice Shelf		Antarctic Peninsula, West Antarctica	The Wilkins Ice Shelf underwent three periods of significant disintegration: in February-March, May, and June-July. The latter two were particularly notable because they occurred in winter.
22 July - 29 August 2008	Ellesmere Coast	214 km <sup>2</sup>	Ellesmere Island, Canada	The five ice shelves in the Canadian Arctic, Serson, Petersen, Milne, Ward Hunt, and Markham, collectively lost 214 km <sup>2</sup> of ice. The Ellesmere Coast ice shelves were discovered in the early 1900s and, at the time, were thousands of square miles in area and 20-40 meters thick. Now, there are only "tiny fragments" remaining.
12 April 2009	Wilkins Ice Bridge, Wilkins Ice Shelf		Antarctic Peninsula, West Antarctica	The sequential disintegrations on the Wilkins Ice Shelf in 2008 left a narrow "bridge" of ice connecting the main part of the ice shelf to Charcot Island and surrounding ice. In April, this ice bridge gave way, opening a passage for the previously detached pieces to flow out to sea and leaving the southern portion of the shelf more vulnerable to disintegration.
January 12-13, 2010	Ronne-Filchner Ice Shelf	> 3,140 km <sup>2</sup>	Weddell Sea, West Antarctica	An area larger than the state of Rhode Island broke off of the sea ice bridge between the Ronne-Filchner Ice Shelf and the A-23A iceberg in this routine event.
February 12 or 13, 2010	Mertz Glacier	3,042 km <sup>2</sup> (700-800 billion tons)	George V Coast, East Antarctica	The B-09B iceberg, which was 94km x 39 km in size, collided with the Mertz Glacier tongue, causing it to break away from the rest of the glacier and form a new iceberg. The ice tongue had formerly helped keep a section of the ocean ice-free, creating an ice-free area ("polynya") that was a crucial wildlife feeding site.
July 6-7, 2010	Jakobshavn Isbrae Glacier		Southwest Greenland	The Jakobshavn Glacier, which is one of the principal outlets via which the Greenland Ice sheet drains to the sea, retreated by 1.5 kilometers in just 2 days. Jakobshavn, which has been retreating for decades, is the fastest flowing glacier in the world, and its speed is accelerating: it flowed by 7 km/yr in 2001 and by 15 km/yr in 2010.
August 5, 2010	Petermann Glacier	251 km <sup>2</sup>	Northwest Greenland	About one-quarter of the 70-kilometer ice tongue of the Petermann Glacier, the longest floating ice tongue in the Northern Hemisphere, broke off. This iceberg, four times the size of Manhattan and "up to half the height of the Empire State building," was the largest calved in the Arctic since 1962.

\* Note: Dates may indicate the date of observation and not necessarily the date of the ice break-up event.

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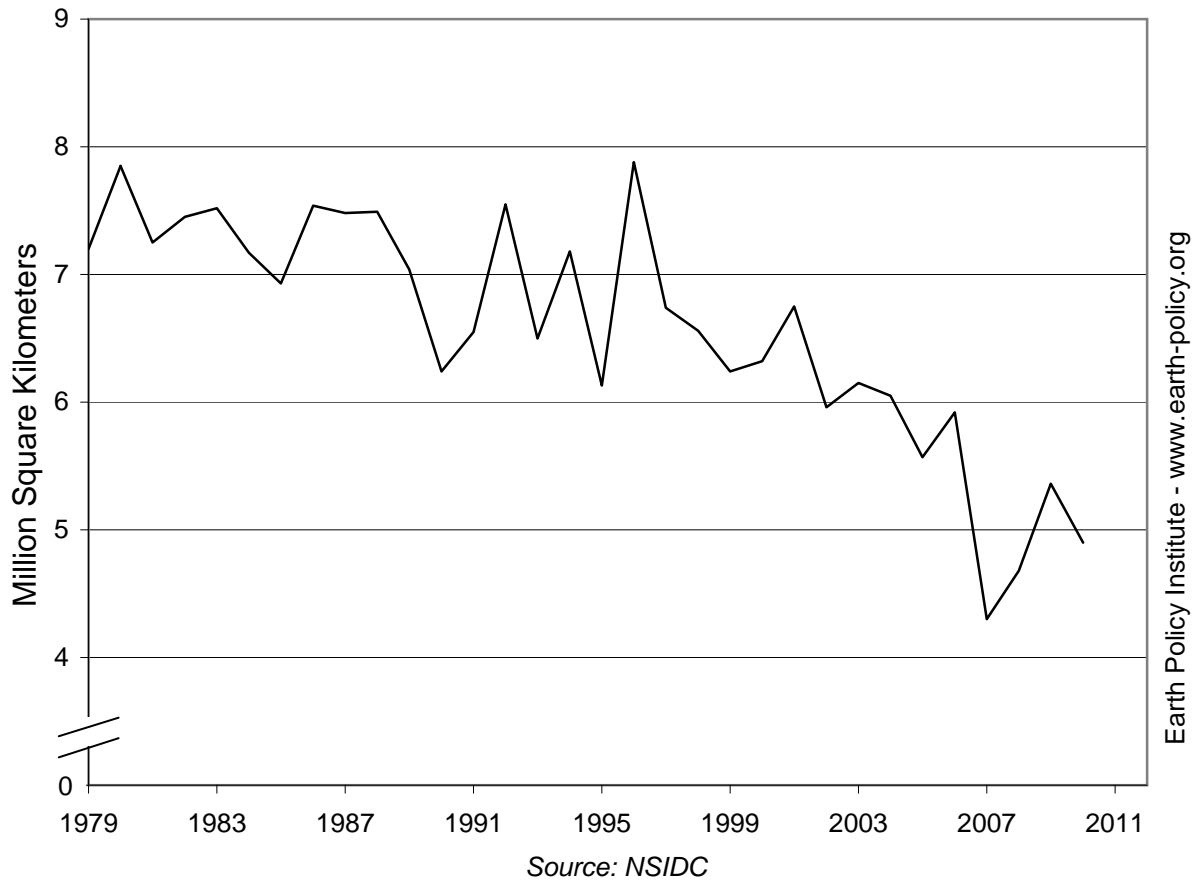
### September and Annual Average Arctic Sea Ice Extent, 1979-2010

Year	Sea Ice Extent, September	Sea Ice Extent, Annual Average
Million Square Kilometers		
1979	7.2	12.5
1980	7.9	12.5
1981	7.3	12.3
1982	7.5	12.7
1983	7.5	12.5
1984	7.2	12.1
1985	6.9	12.2
1986	7.5	12.4
1987	7.5	12.0
1988	7.5	12.1
1989	7.0	12.1
1990	6.2	11.9
1991	6.6	11.9
1992	7.6	12.2
1993	6.5	12.1
1994	7.2	12.2
1995	6.1	11.6
1996	7.9	11.9
1997	6.7	11.8
1998	6.6	11.9
1999	6.2	11.9
2000	6.3	11.7
2001	6.8	11.8
2002	6.0	11.6
2003	6.2	11.6
2004	6.1	11.4
2005	5.6	11.1
2006	5.9	11.0
2007	4.3	10.7
2008	4.7	11.2
2009	5.4	11.2
2010	4.9	

Source: F. Fetterer, K. Knowles, W. Meier, and M. Savoie, "Sea Ice Index," at [nsidc.org/data/g02135.html](http://nsidc.org/data/g02135.html) (Boulder, CO: National Snow and Ice Data Center (NSIDC)), viewed 16 December 2010.

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# September Arctic Sea Ice Extent, 1979-2010



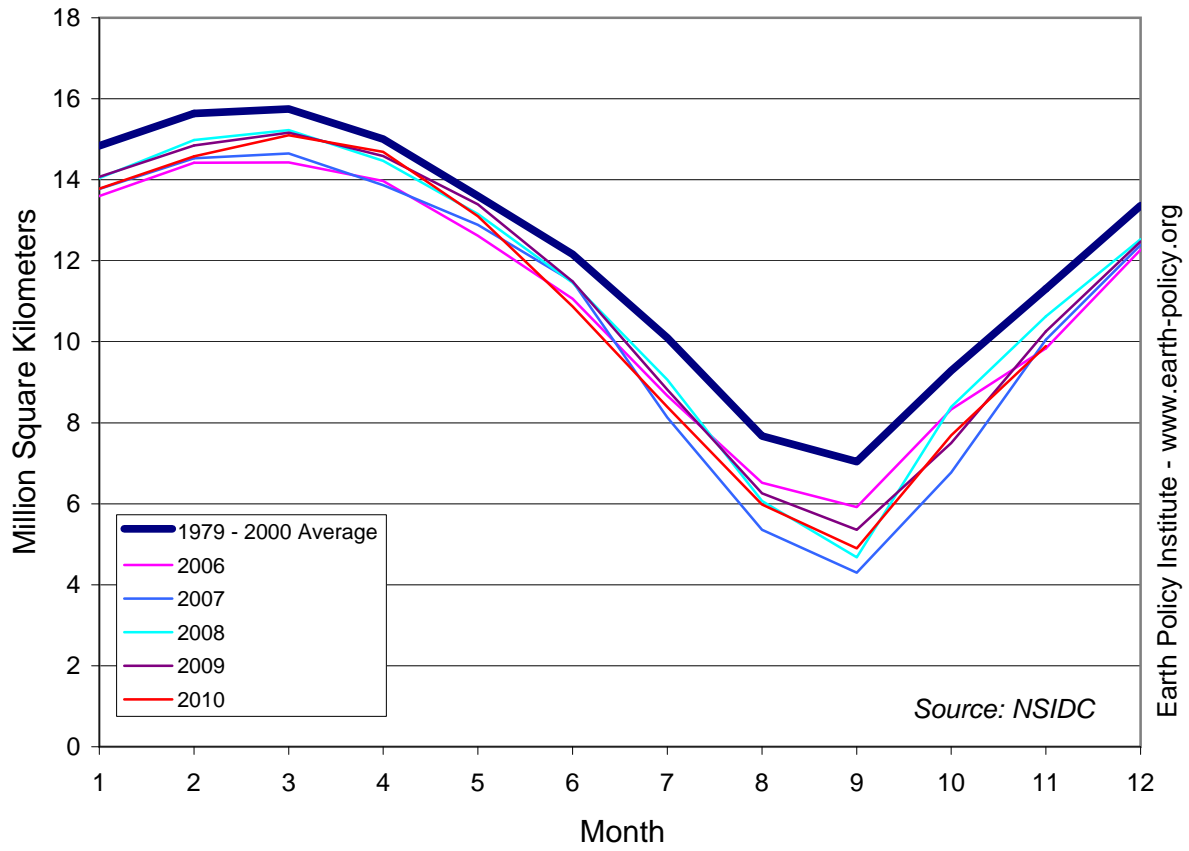
### Arctic Sea Ice Extent by Month, 2006-2010, Compared with the 1979-2000 Average

Month	1979-2000 Average	2006	2007	2008	2009	2010
Million Square Kilometers						
January	14.8	13.6	13.8	14.0	14.1	13.8
February	15.6	14.4	14.5	15.0	14.9	14.6
March	15.7	14.4	14.7	15.2	15.2	15.1
April	15.0	14.0	13.9	14.5	14.6	14.7
May	13.6	12.6	12.9	13.2	13.4	13.1
June	12.2	11.1	11.5	11.5	11.5	10.9
July	10.1	8.7	8.1	9.1	8.8	8.4
August	7.7	6.5	5.4	6.1	6.3	6.0
September	7.0	5.9	4.3	4.7	5.4	4.9
October	9.3	8.3	6.8	8.4	7.5	7.7
November	11.3	9.8	10.1	10.6	10.3	9.9
December	13.4	12.3	12.4	12.5	12.5	

Source: F. Fetterer, K. Knowles, W. Meier, and M. Savoie, "Sea Ice Index," at [nsidc.org/data/g02135.html](http://nsidc.org/data/g02135.html) (Boulder, CO: National Snow and Ice Data Center (NSIDC)), viewed 16 December 2010.

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# Arctic Sea Ice Extent by Month, 2006-2010, Compared with the 1979-2000 Average



### Effects of 1 to 5 Meters of Sea Level Rise on Populations and Land Area around the World

Region	Sea Level Rise	Population Directly Affected		Area Inundated		Urban Area Inundated		Agricultural Area Inundated	
	Meters	Millions	Percent	Square Kilometers	Percent	Square Kilometers	Percent	Square Kilometers	Percent
Latin America & Caribbean	1	2.9	0.6	64,632	0.3	3,080	0.6	16,104	0.3
	2	4.7	0.9	101,736	0.5	5,212	1.0	29,514	0.6
	3	7.2	1.5	149,183	0.8	8,090	1.6	47,003	1.0
	4	10.3	2.1	193,786	1.0	11,614	2.3	66,330	1.4
	5	13.5	2.7	234,117	1.2	15,294	3.0	85,959	1.8
Middle East and North Africa	1	8.3	3.2	24,654	0.3	3,679	1.9	4,086	1.2
	2	10.9	4.2	33,864	0.3	5,037	2.7	6,031	1.7
	3	13.7	5.3	43,727	0.4	6,529	3.4	8,007	2.3
	4	16.5	6.3	53,615	0.5	7,951	4.2	9,819	2.8
	5	19.4	7.5	63,120	0.6	9,384	4.9	11,451	3.2
Sub-Saharan Africa	1	2.1	0.5	18,641	0.1	430	0.4	1,646	0.0
	2	3.7	0.8	28,083	0.2	742	0.7	3,404	0.1
	3	4.3	0.9	42,645	0.3	1,268	1.2	6,595	0.2
	4	8.5	1.8	59,661	0.4	1,853	1.7	11,231	0.3
	5	11.0	2.4	77,253	0.5	2,449	2.2	16,145	0.4
East Asia	1	37.2	2.0	74,020	0.5	6,648	1.7	45,393	0.8
	2	60.2	3.2	119,370	0.8	11,127	2.9	78,347	1.4
	3	90.0	4.8	178,177	1.3	17,596	4.5	121,728	2.2
	4	126.2	6.7	248,970	1.8	25,725	6.6	174,076	3.2
	5	162.4	8.6	325,089	2.3	34,896	9.0	229,185	4.2
South Asia	1	5.9	0.5	12,362	0.3	809	0.3	3,442	0.1
	2	10.2	0.8	21,983	0.5	1,379	0.6	6,951	0.2
	3	17.8	1.4	35,696	0.9	2,311	1.0	13,501	0.5
	4	22.1	1.7	52,207	1.2	3,599	1.5	23,716	0.8
	5	39.5	3.0	69,225	1.7	5,117	2.1	35,190	1.2
World	1	56.3	1.3	194,309	0.3	14,646	1.0	70,671	0.4
	2	89.6	2.0	305,036	0.5	23,497	1.6	124,247	0.7
	3	133.0	3.0	449,428	0.7	35,794	2.5	196,834	1.1
	4	183.5	4.2	608,239	1.0	50,742	3.5	285,172	1.6
	5	245.9	5.6	768,804	1.2	67,140	4.7	377,930	2.1

Notes: These data are for 84 coastal developing countries; low-lying island nations, which are among those nations most affected by rising seas, are not included in this study. Population and GDP data are from 2000. The data presented here are conservative; they likely underestimate the magnitude of impacts because coastal populations have increased over the last decade and because the analysis does not take into account changes in storm surges as a result of sea level rise. Methodology of study from which these data are taken consisted of overlaying population and area data onto inundation zones with GIS software. Inundation zones were determined through analysis of coastline and elevation data and exclude low-lying areas that are not contiguous with the coast.

Source: Susmita Dasgupta et al., *The Impact of Sea Level Rise on Developing Countries: A Comparative Analysis* (Washington, DC: World Bank, February 2007).

### Effects of 10 Meter Rise in Sea Level on Populations and Land Area around the World

Region	Population and Land Area in Low Elevation Coastal Zone				Share of Population and Land Area in Low Elevation Coastal Zone			
	Total Population	Urban Population	Total Land Area	Urban Land Area	Share of Population	Share of Urban Population	Share of Land Area	Share of Urban Land Area
	Million People		Thousand Square Kilometers		Percent		Percent	
Africa	56	31	191	15	7	12	1	7
Asia	466	238	881	113	13	18	3	12
Europe	50	40	490	56	7	8	2	7
Latin America	29	23	397	33	6	7	2	7
Australia and New Zealand	3	3	131	6	13	13	2	13
North America	24	21	553	52	8	8	3	6
Small Island States	6	4	58	5	13	13	16	13
<b>World</b>	<b>634</b>	<b>360</b>	<b>2,700</b>	<b>279</b>	<b>10</b>	<b>13</b>	<b>2</b>	<b>8</b>

Note: "Low Elevation Coastal Zone" is defined as the "contiguous area along the coast that is less than 10 meters above sea level."

Source: Gordon McGranahan, Deborah Balk, and Bridget Anderson, "The Rising Tide: Assessing the Risks of Climate Change and Human Settlements in Low Elevation Coastal Zones," *Environment and Urbanization*, vol. 16, no. 1 (2007), pp. 17-37.