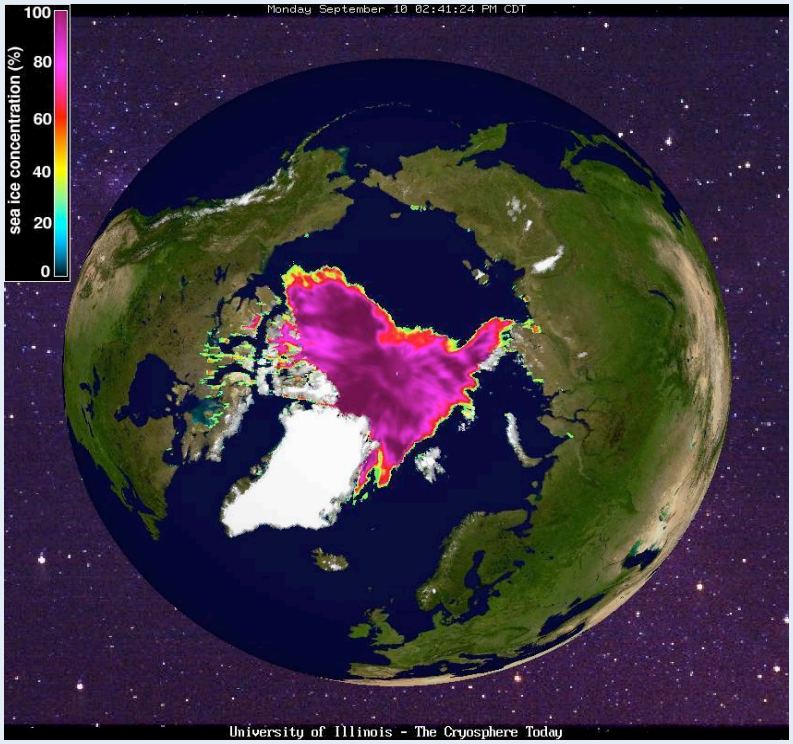
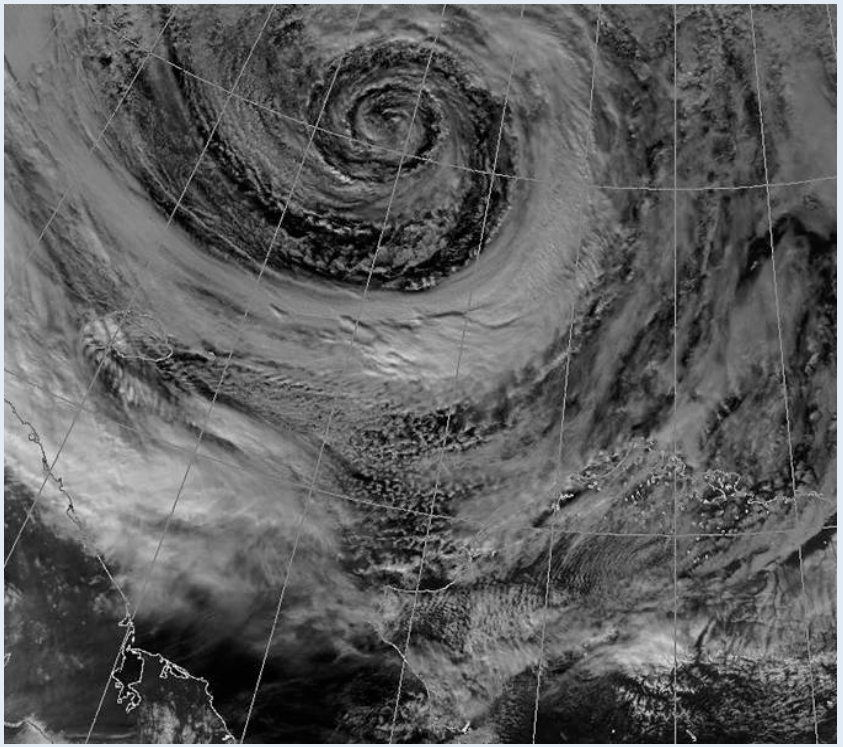
The Intersection of Sea Ice Retreat and Trends of Storms

John Walsh[1] and William Chapman[2]

[1]International Arctic Research Center, University of Alaska, Fairbanks
[2]University of Illinois, Urbana





Rates of coastal erosion and flooding are increasing in Alaska

[from U.S. Army Core of Engineers]

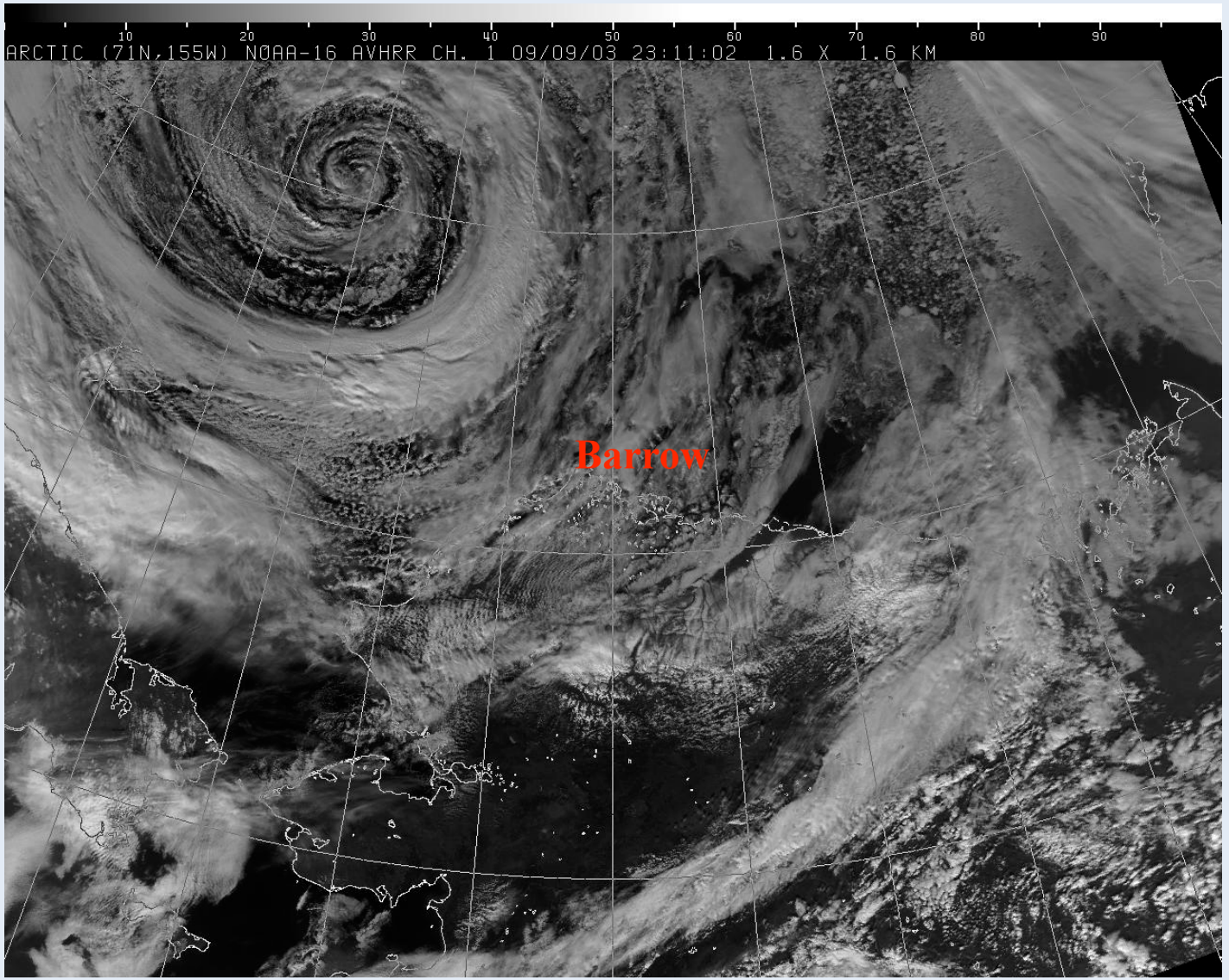
Projected Coastal Erosion at Newtok, Alaska (USACE, 2006)

Coastal Storm Activity Undermines Foundations in Western Alaska (USACE,

Several factors affect Arctic coastal vulnerability:

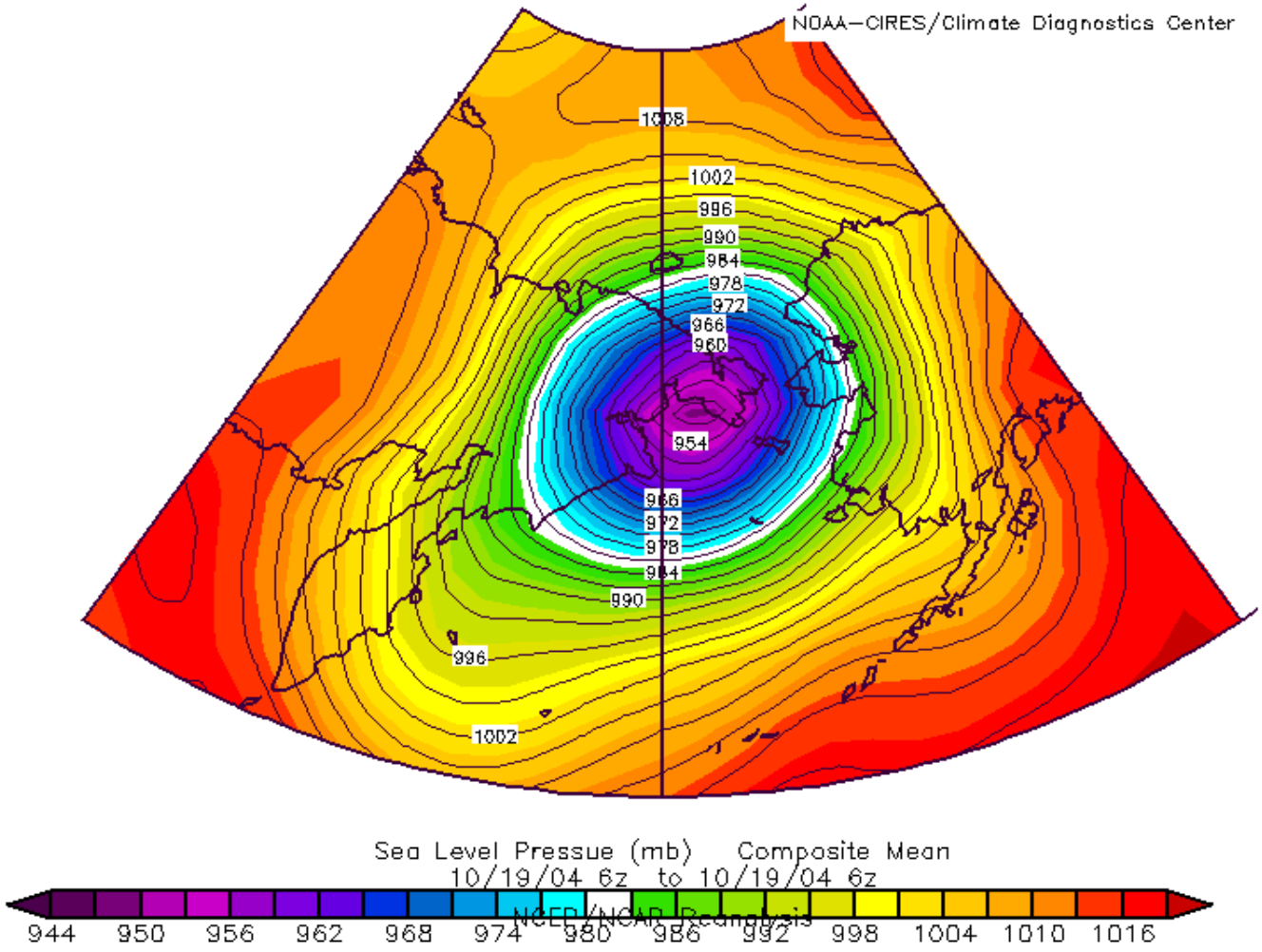
- **Frequency and intensity of storms**
- **Sea ice coverage in offshore waters**
- **Sea level**

Intense Arctic cyclone affecting Alaskan coast



Extreme event: 941 mb cyclone,

flooding of Nome, AK on 19 Oct 2004

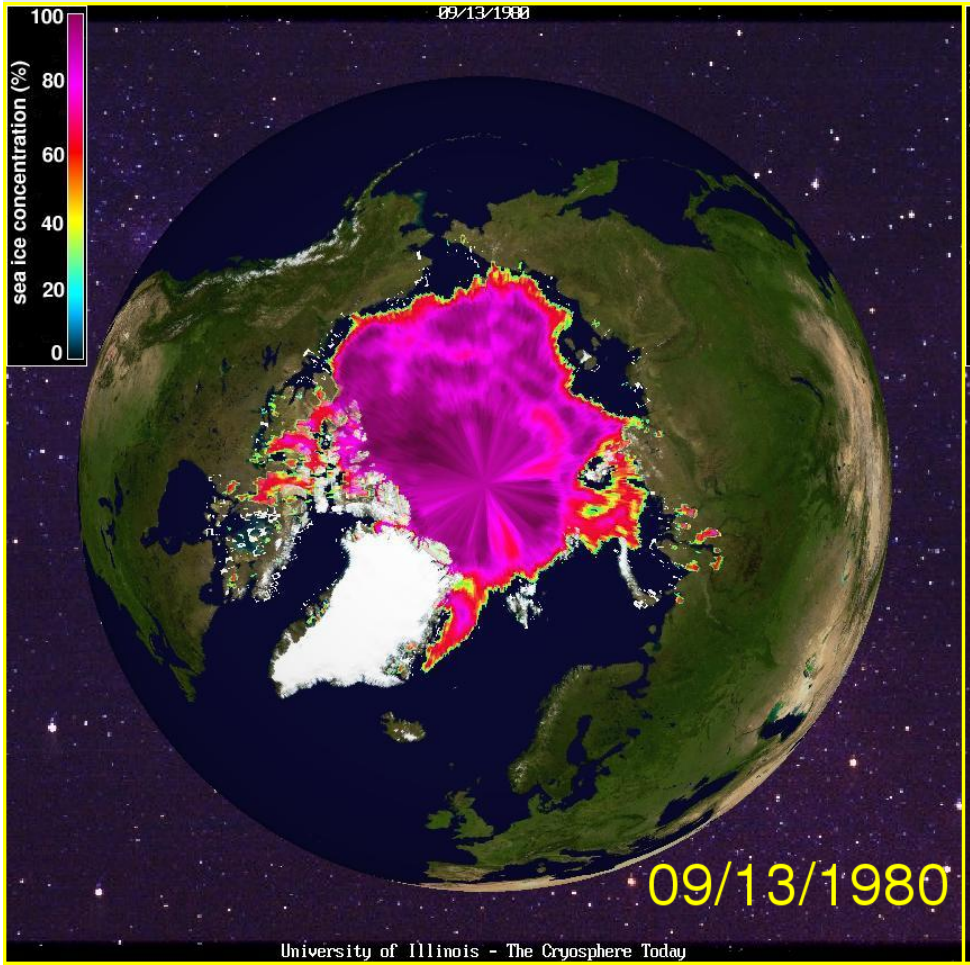


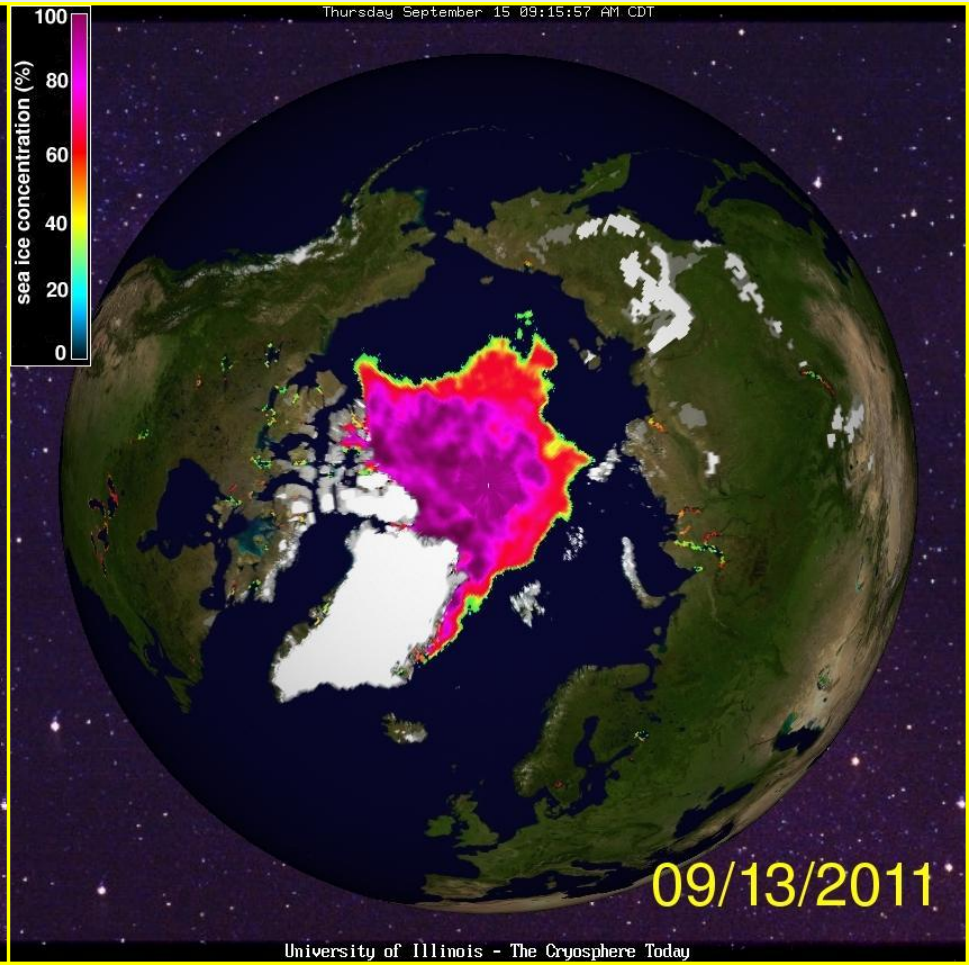
Front Street, Nome (photo by J. Steiger, WSO Nome)

Arctic sea ice concentrations

Sep. 13, 1980

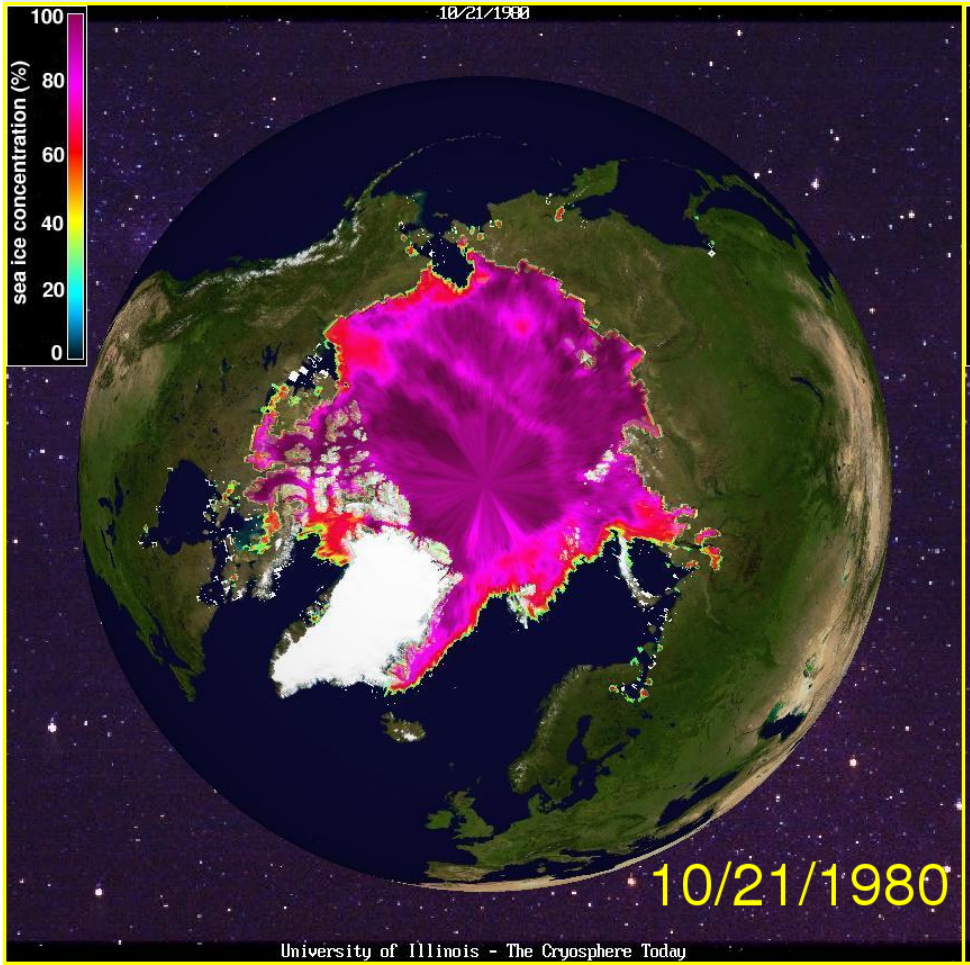
Sep. 13, 2011



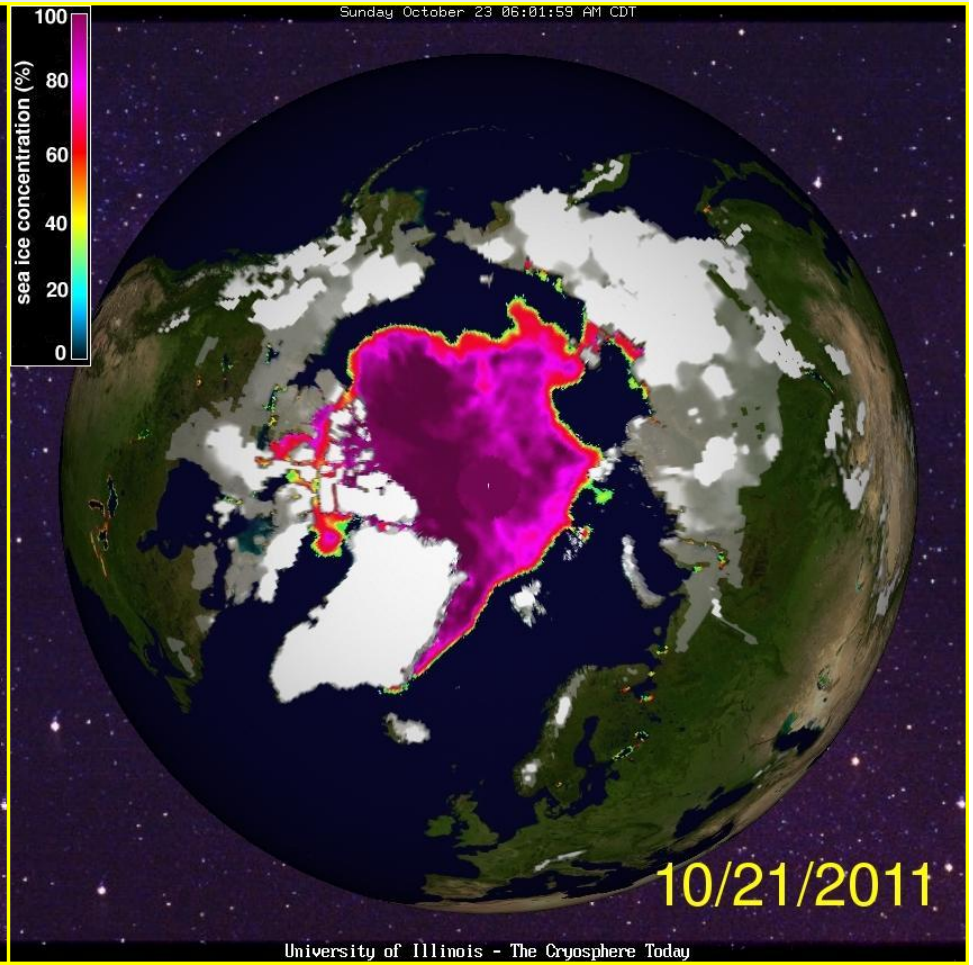


Arctic sea ice concentrations

Oct. 21, 1980



Oct. 21, 2011



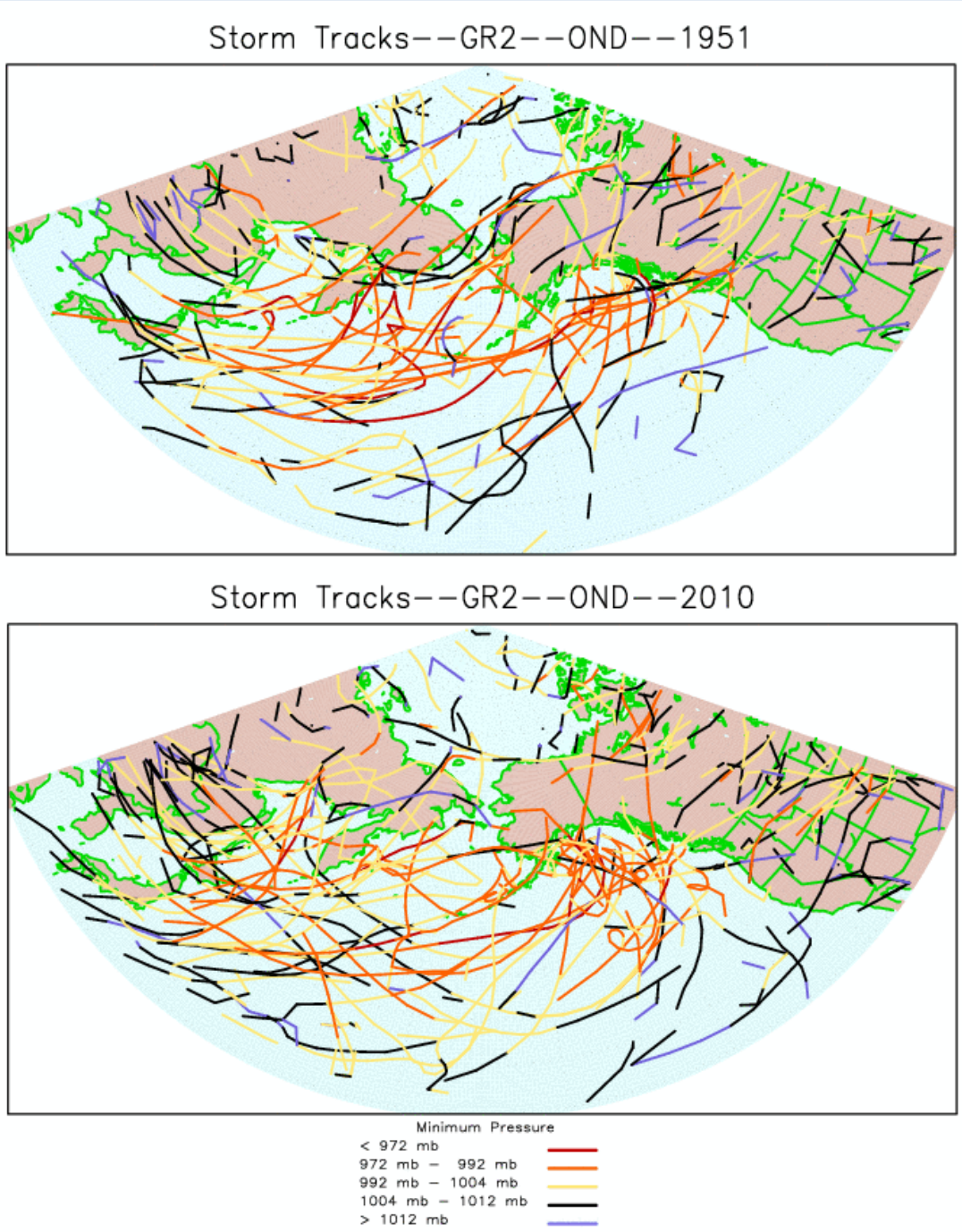
Why the recent increase in coastal flooding and erosion?

Hypothesis 1: Storminess has increased

Hypothesis 2: Coastal sea ice has decreased

Database on storms (cyclones) affecting Alaska

- **Global database of cyclone tracks compiled by Climate Prediction Center, National Centers for Environmental Prediction (J. Gottschalk)**
- **Based on NCEP/NCAR reanalysis, 1948-present**
- **6-hourly time increments**
- **Locations and central pressures of all low-pressure centers; tracking algorithm connects successive positions of storms**



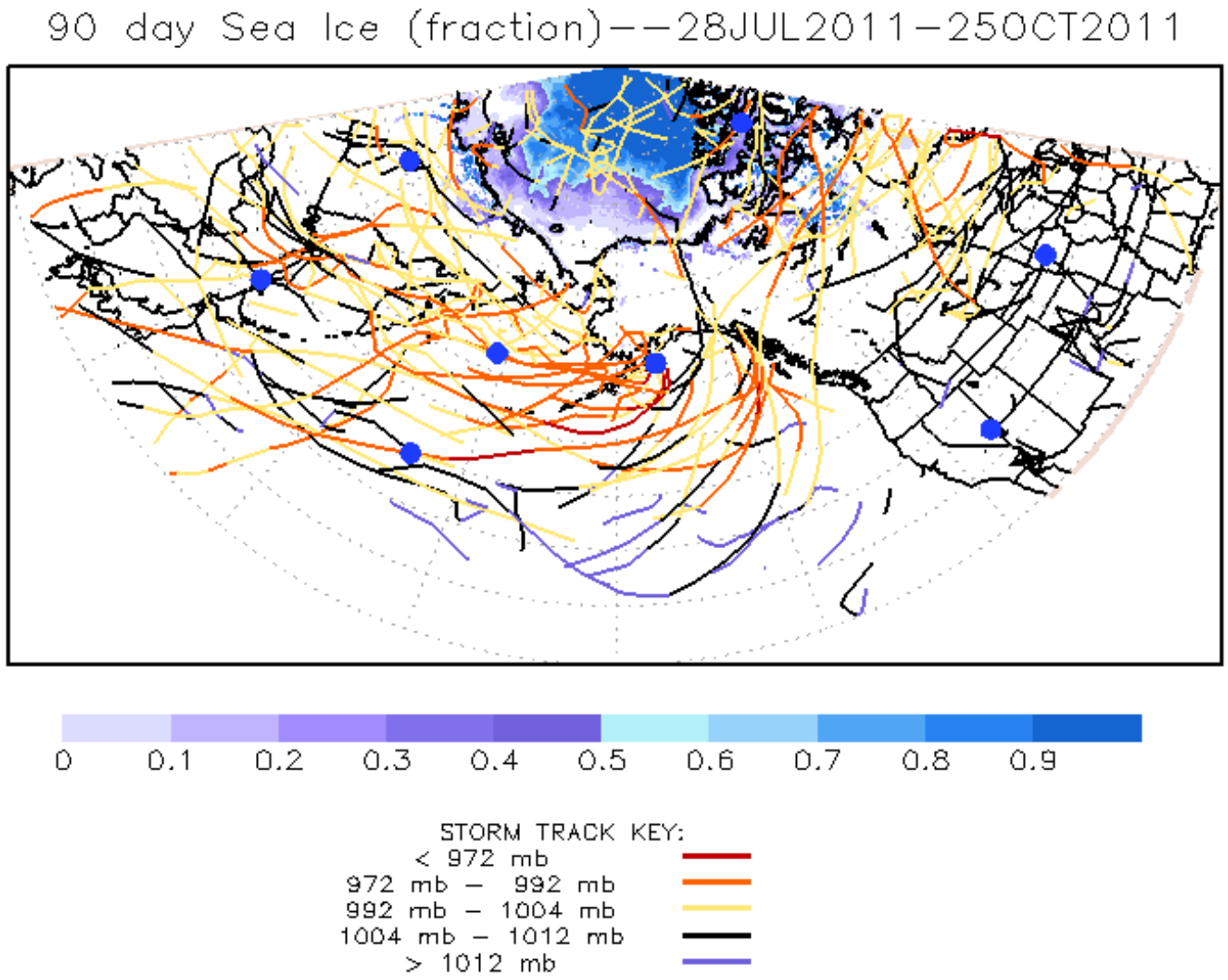
Oct-Dec 1951

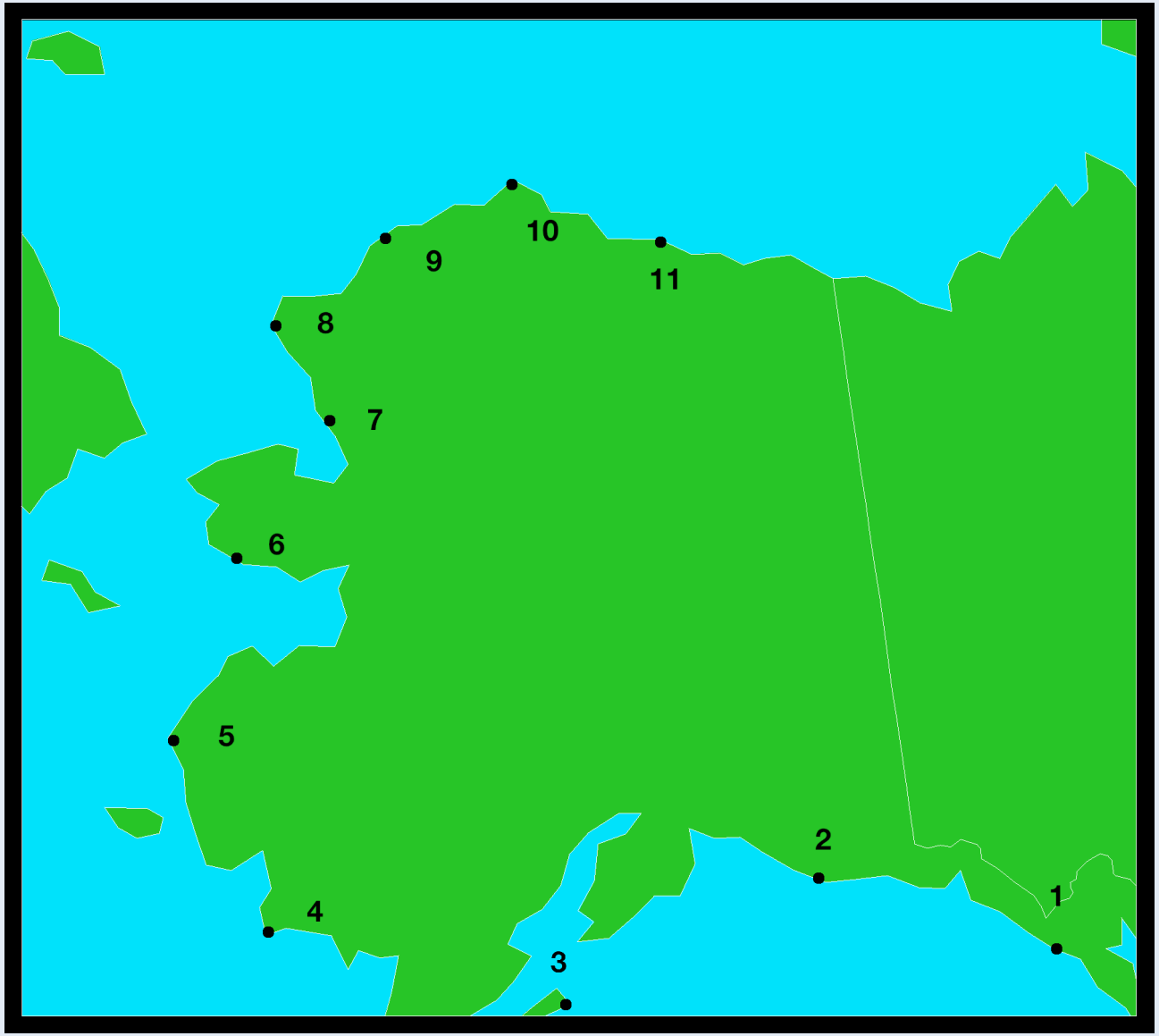
Storm tracks: examples

Oct-Dec 2010

Most recent 90-day storm tracks and sea ice coverage

[Jul 28 – Oct 25, 2011]





For each of eleven Alaskan coastal points:

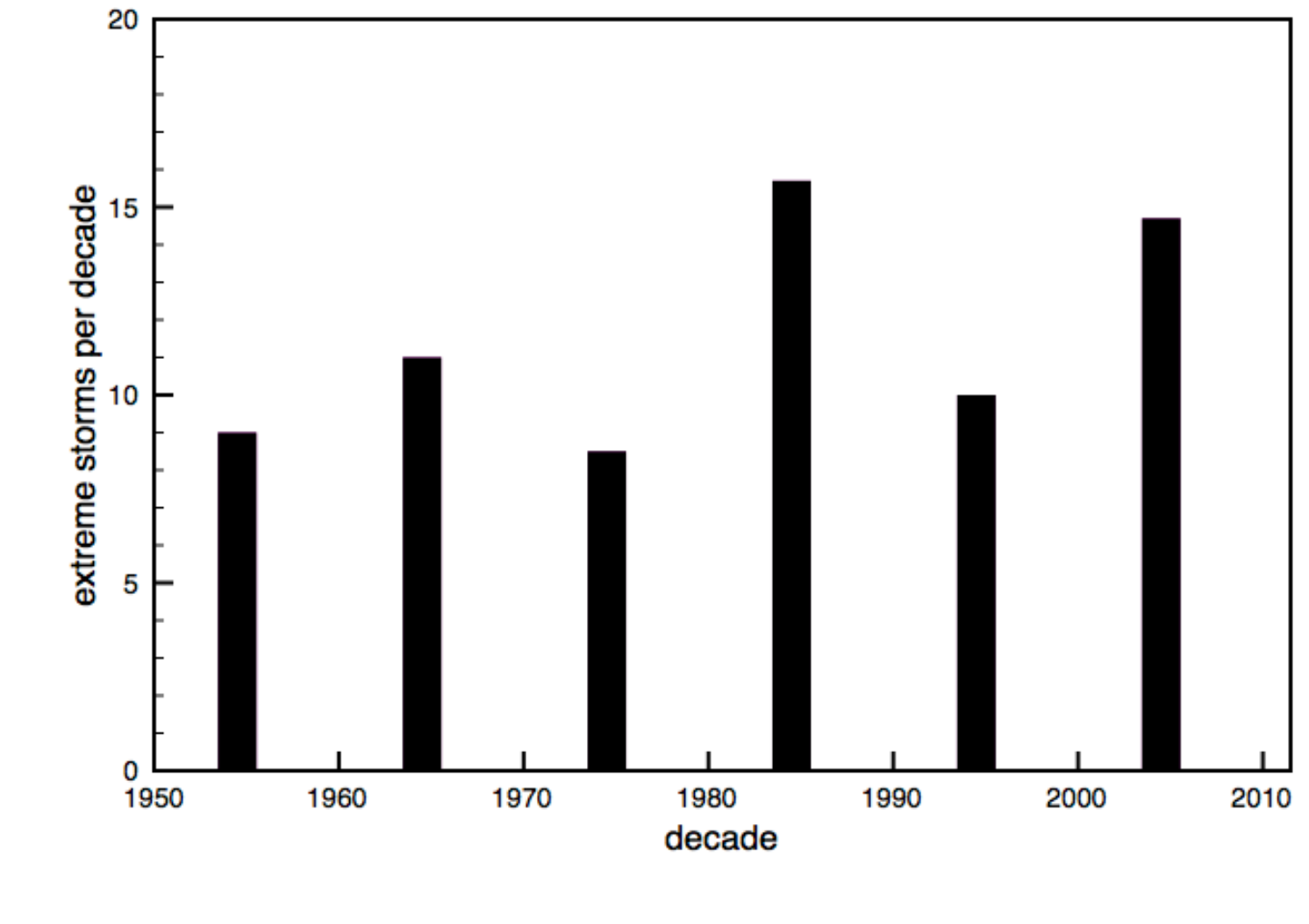
all storms within 250 miles identified

- **For each location, most intense 10% of all storms in each season were selected as the sample for analysis**

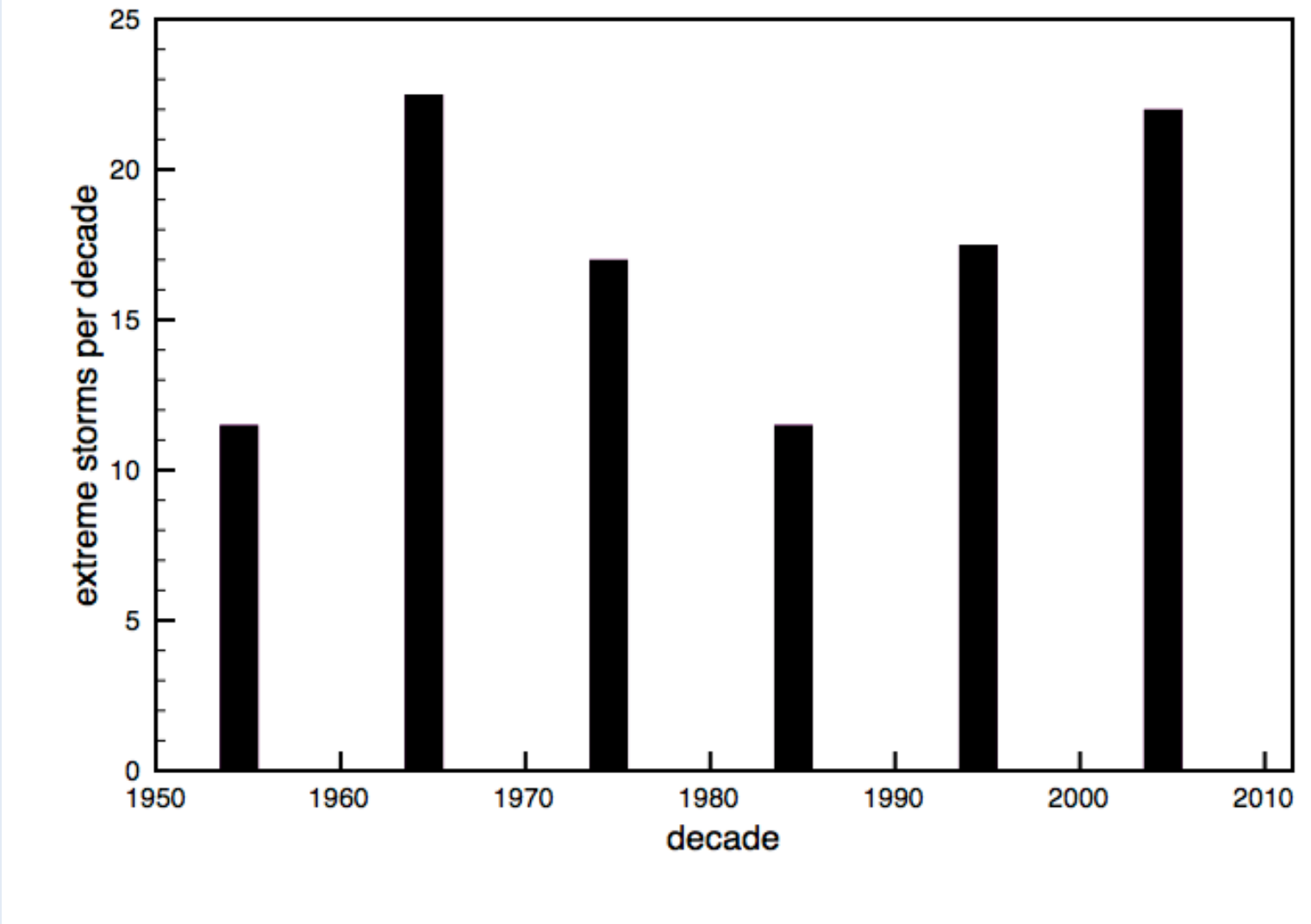
- **Storms were grouped into two categories:**

  1) **at least 100 km of open water immediately offshore**
  2) **less than 100 km “ “ “ “**

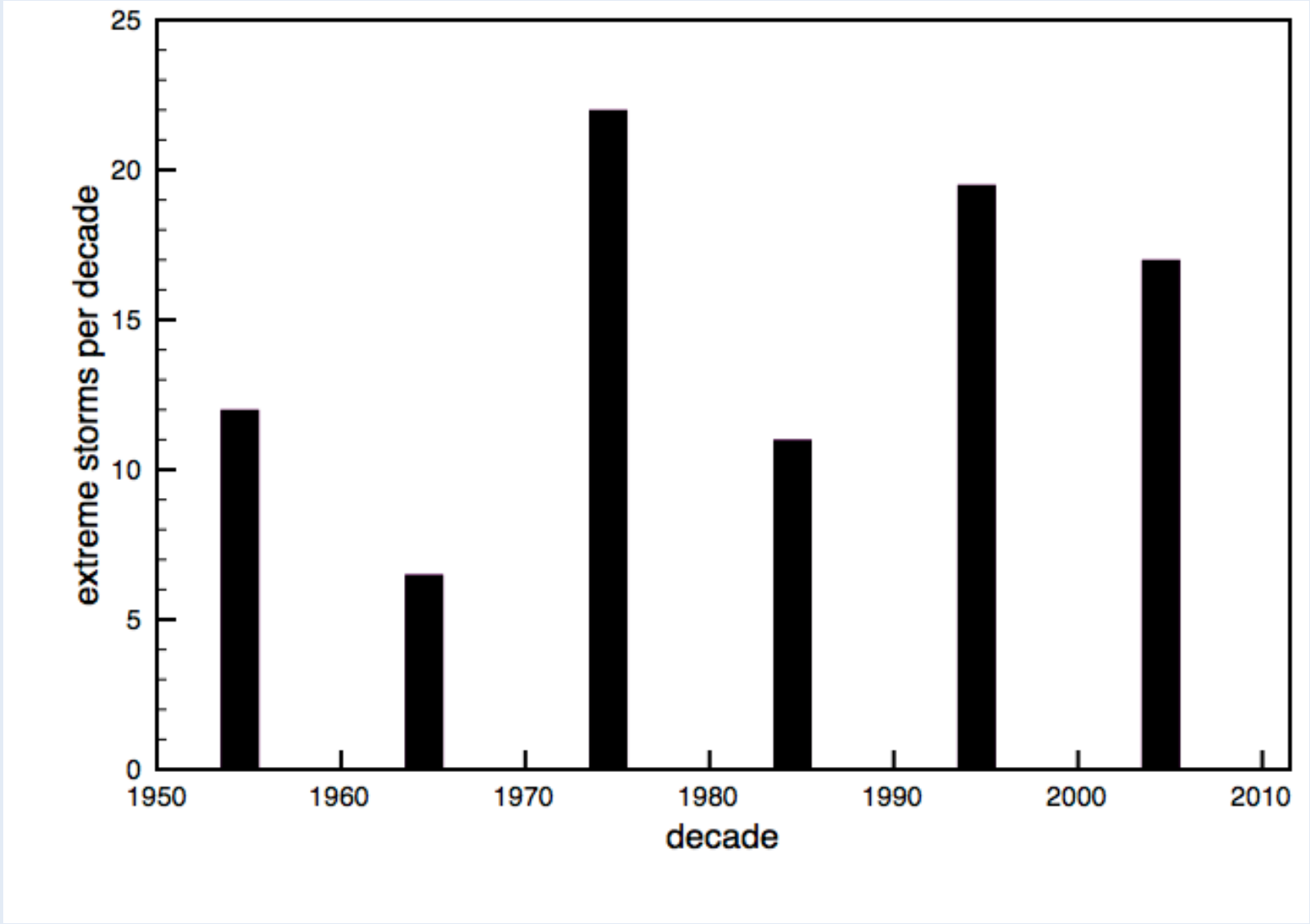
Autumn storm events by decade, northern Alaskan coast



Autumn storm events by decade, NW Alaskan coast



Winter storm events by decade, SW Alaskan coast



Trends of extreme storms by location and season

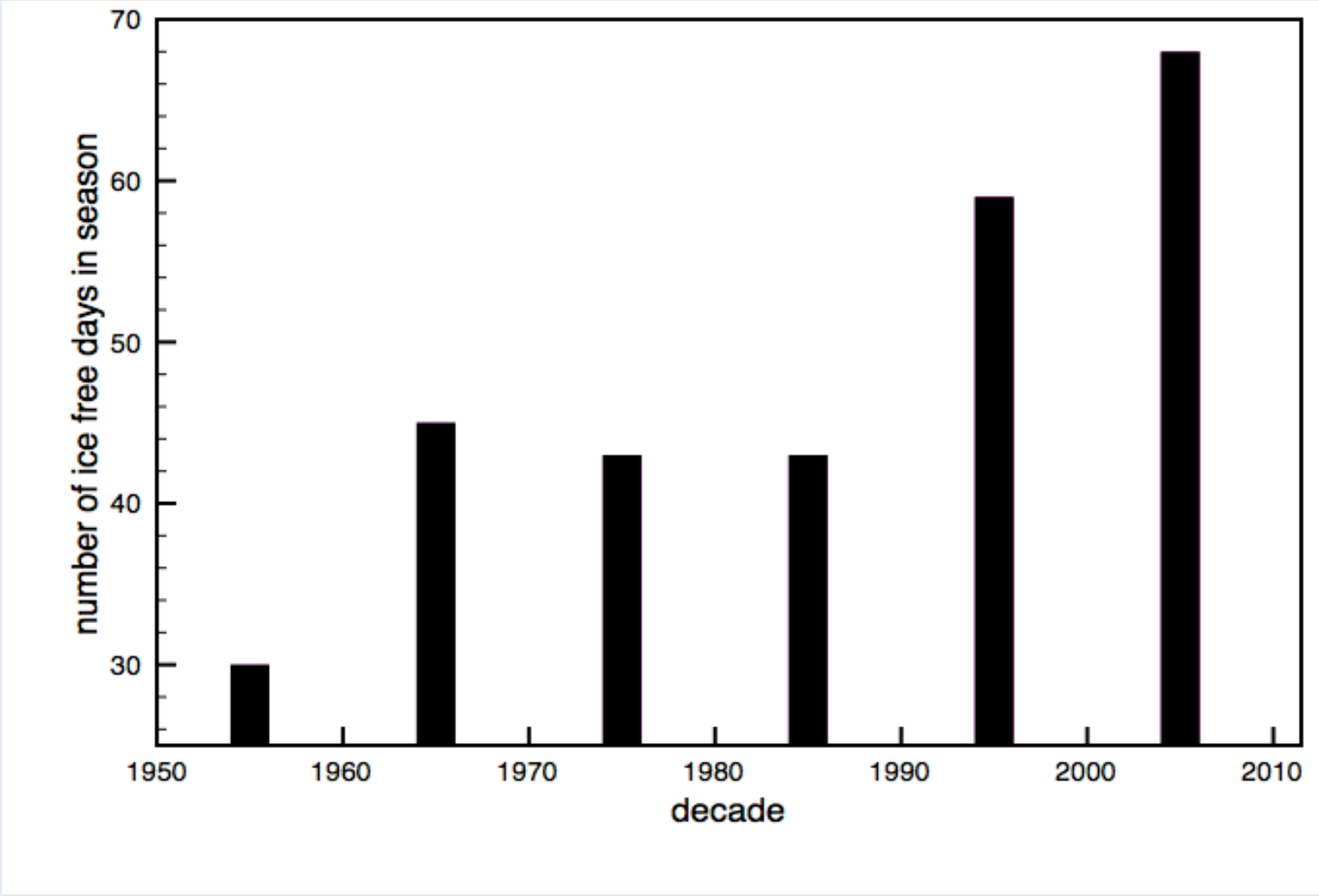
	DJF	MAM	JJA	SON	ANN
1	1.5571	-0.4735	-0.6435	0.8652	1.3054
2	0.5485	1.8005	-1.0303	-0.6085	0.7102
3	1.7472	-0.8602	-0.3084	-0.6568	-0.0784
4	1.2820	0.3968	-0.0734	**-3.5560**	-1.9505
5	1.1570	0.5535	0.1384	-2.1689	-0.3201
6	0.8202	-0.1700	-0.4701	1.4037	1.5838
7	0.6769	-0.4751	**-2.0089**	0.2534	-1.5538
8	0.0017	-0.3151	**-1.4337**	0.8669	-0.8802
9	0.3484	-0.1967	-0.3218	0.0167	-0.1534
10	0.4184	0.3984	-0.3201	1.0036	1.5004
11	**0.8302**	0.6418	-0.0167	0.5068	**1.9622**

-- increases at all locations in winter

-- northward shift in autumn

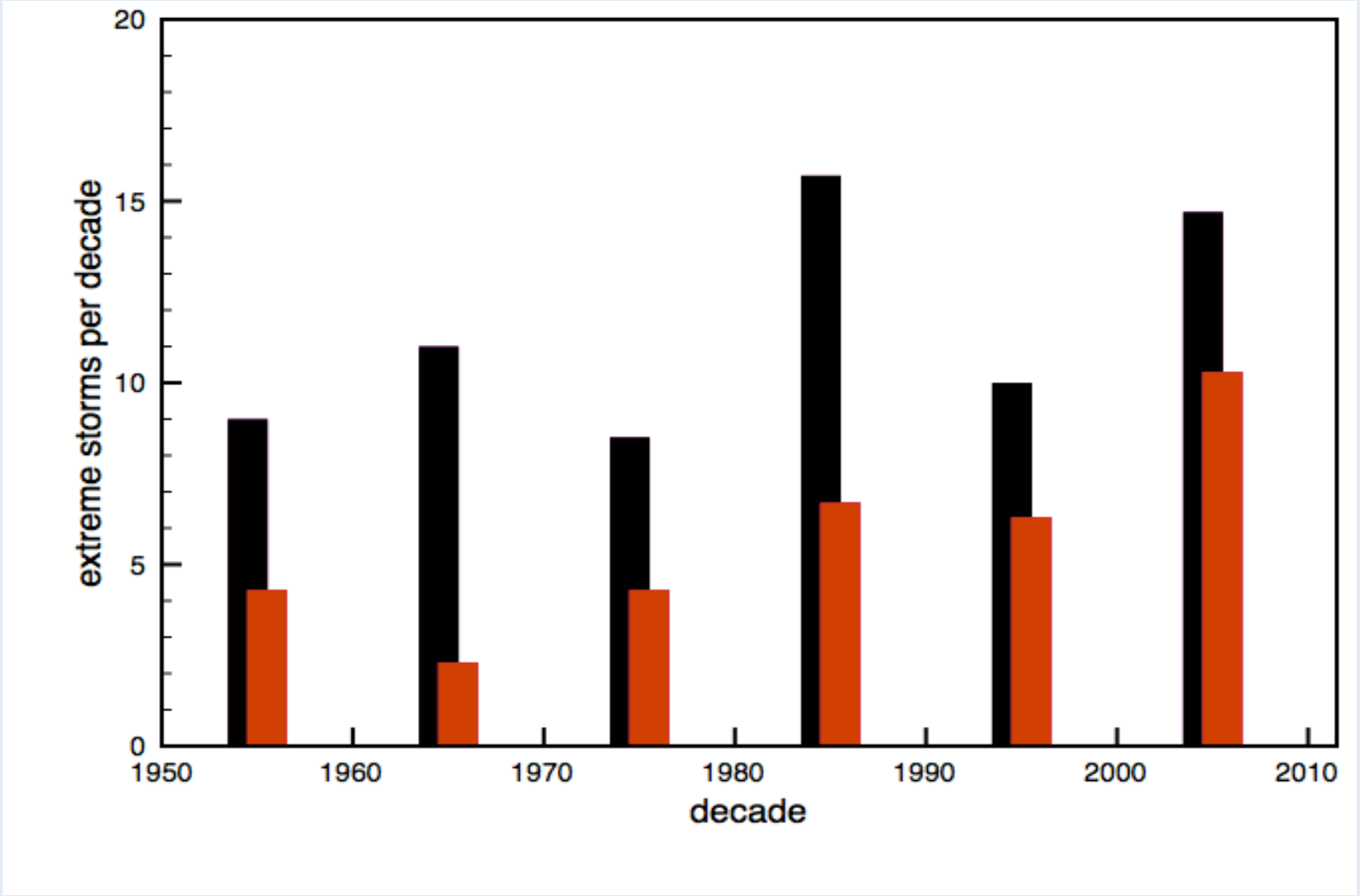
(generally <u>not</u> statistically significant)

Decadal mean # of ice-free days in autumn: North coast



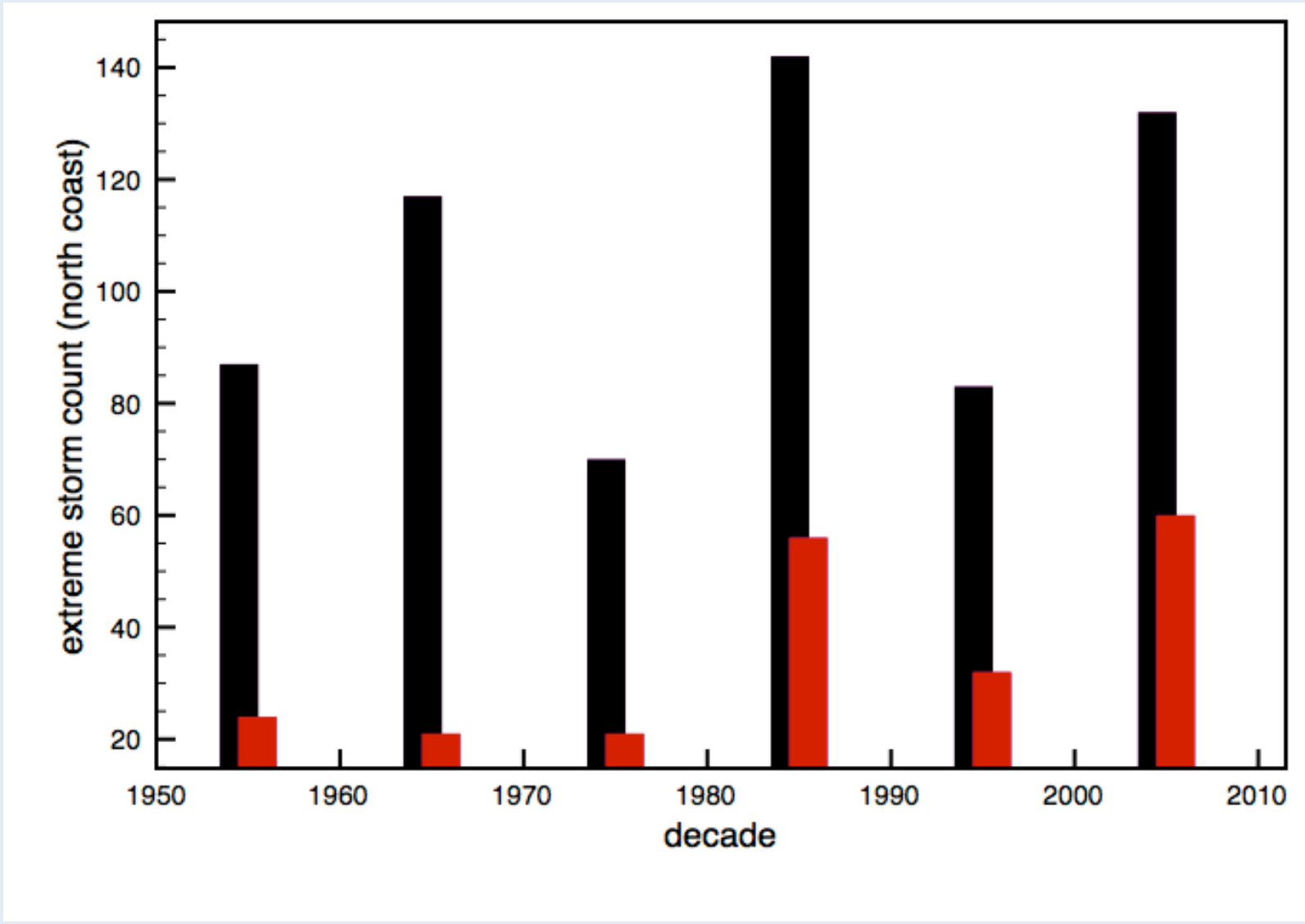
Autumn storm events by decade, northern Alaskan coast

[red = open water]

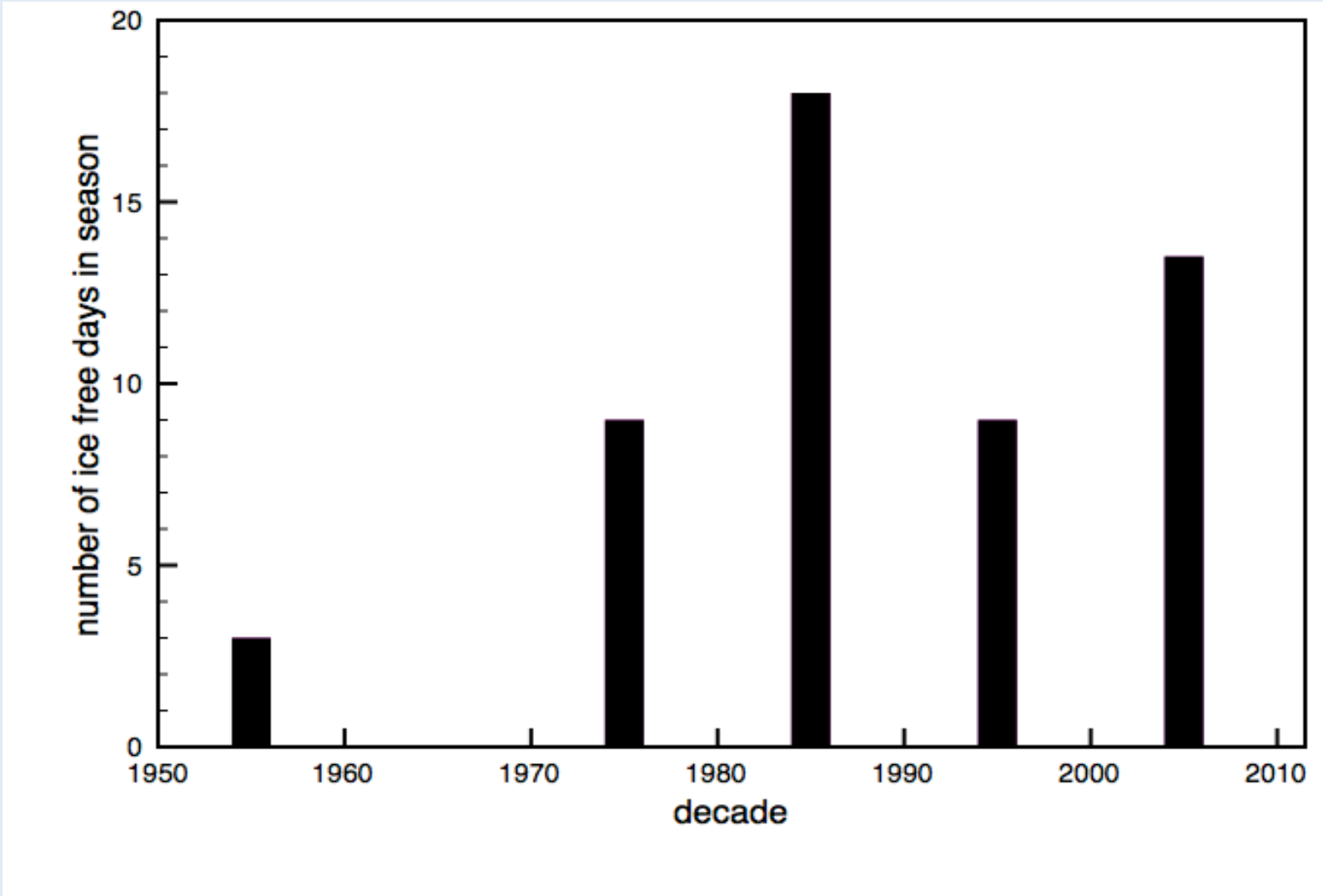


Storm events *(all seasons)* by decade, northern Alaska

[red = open water]

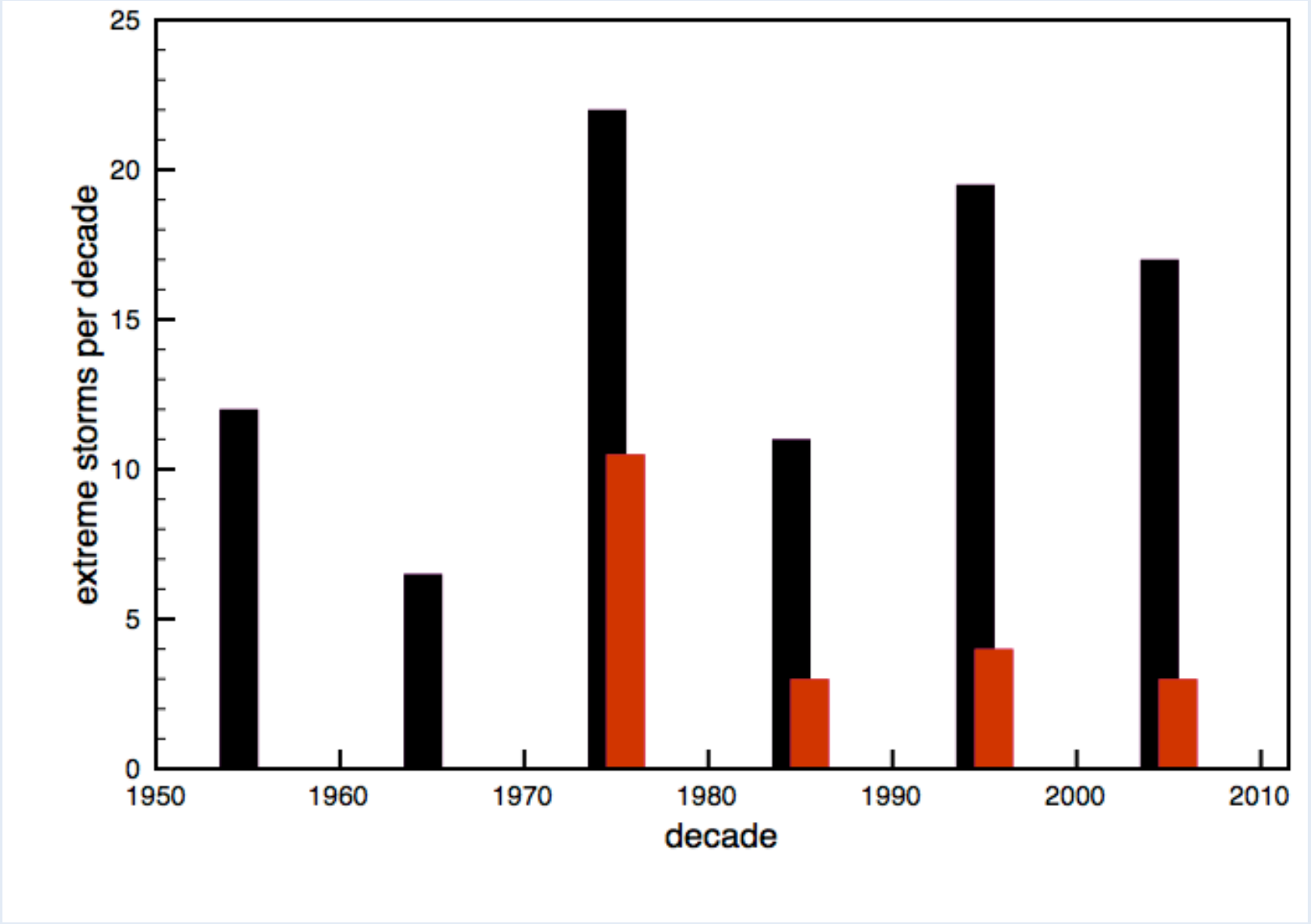


Decadal mean # of ice-free days in winter: SW coast



Winter storm events by decade, SW coast

[red = open water]



Conclusions

- **Frequency of intense storms in Alaskan coastal waters shows modest changes, but statistical significance is marginal**
  - **-- increase in winter at all locations**
  - **-- northward shift in autumn**

- **Length of the open water season has increased, especially along the northern and NW coasts**

- **Increase of coastal erosion and flooding is mainly a consequence of changes in sea ice**