Yearly storm counts at Nome, Alaska
Extreme event: 941 mb cyclone, flooding of Nome, AK on 19 Oct 2004
Intense Arctic cyclone affecting northern Alaskan coast
Yearly storm counts at Barrow, Alaska
Projected change in winter sea level pressure: 2070-2090
lower pressure ⇒ more storms? Plausible
Projected change of sea level (16 models), 2080-2099, due to ocean density and circulation changes
Spring ice edge has moved northward onto the Bering Sea shelf
Monthly averaged SST measured at Savoonga on St. Lawrence Island

Shifts in center of distribution for 45 taxa in SE Bering Sea, 1982-2006

Snow crab

Rate similar to North Sea (Perry et al. 2005)
2-3 times faster than terrestrial mean (Parmesan and Yohe 2003)
Projected changes of Arctic sea ice (ACIA, 2005)
IPCC (2007) model projections:

sea ice in Alaska/Bering sector
Ice edge vs. shelf edge: 1979-1989 vs. 2050

Currently the shelf break is largely ice covered in summer.

But by 2050 the ice edge retreats well beyond the shelf break.

What would be the impact on shelf-basin exchange and new production - for example, on shelf-break upwelling?
Mean of upwelling-directed NCEP wind-stress in 1998:

Red arrows indicate mean of upwelling-directed wind-stress.

Yellow arrows indicate the onshore Ekman (i.e. bottom boundary layer) transport.

From this, and from offshore nutrient distributions, the flux of nitrate onto the shelf is calculated.
A circulation ‘cell’ forms with upwelling at the coast and downwelling at the ice edge. Only shelf water circulates if the shelf-break is ice-covered.

Continued retreat of summer ice cover exposes more and more of the shelf-break for longer periods of time to upwelling favorable winds.

Upwelling depth increases as slope waters become ice-free. Salty, nutrient-rich water can now cross the whole shelf in a thin bottom boundary layer.

From: Carmack & Chapman, GRL, 2003
Projected increase in total nitrate flux onto shelves due to upwelling:

The bars show increase in nitrate flux across each shelf break. Values are the onshore Ekman transport multiplied by the maximum nitrate in the water column.

The increase is not uniform. Some shelves experience greater upwelling than others, particularly the Beaufort.
IMPACTS OF A WARMING ARCTIC

Possible Changes in Fish Distribution
Conclusions

- Despite strong winter warming, winter sea ice north of Alaska shows less evidence of change than summer ice.

- Storminess shows signs of increase in N and W Alaskan coastal seas; vulnerability ↑ as open water season length ↑

- Ecosystem shifts have been detected in seas west of Alaska; shifts projected for waters north of Alaska.

- Projected changes: thinner winter sea ice ⇒ more dynamically active sea ice during winter?