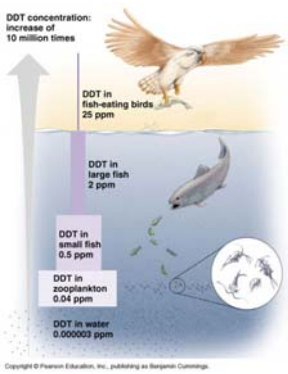
Bioaccumulation of DDT, PCBs, Hg, and other toxins



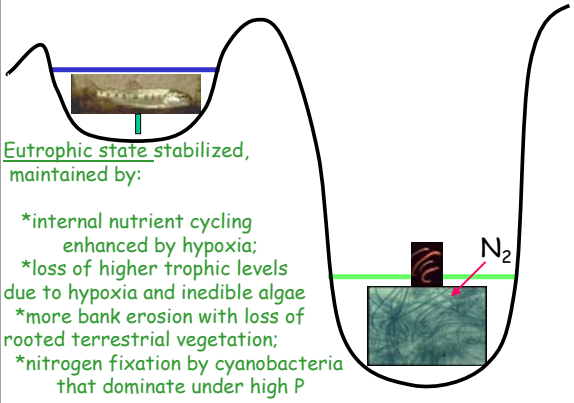
Campbell, p. 1218

Clear water state:

Green water, eutrophic state:

stabilized or maintained by:

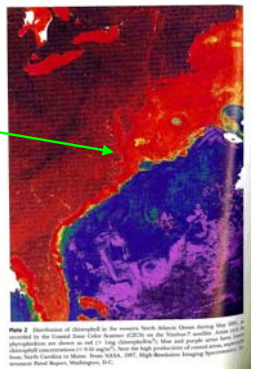
*nutrient sequestration in long-lived top predators;
*upslope vectoring of nutrients by mobile scavengers and predators (salmonids, birds, bats, bears);
*terrestrial vegetative cover;
*frequent scour and flushing that maintain edible taxa at lower trophic levels



Eutrophic state stabilized, maintained by:

*internal nutrient cycling enhanced by hypoxia;
*loss of higher trophic levels due to hypoxia and inedible algae
*more bank erosion with loss of rooted terrestrial vegetation;
*nitrogen fixation by cyanobacteria that dominate under high P

Coastal Zone Color Scanner Nimbus-7 satellite



Pfiesteria piscicida, N.C.

Sewage and volatilized NH_3 from industrial pig farms

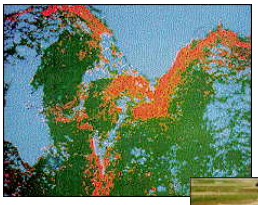
Burkholder and Glasgow 1997

Dinoflagellate

Agricultural subsidies with global impacts- Robt Jefferies, Snow geese numbers increasing due to drop in hunting, and agricultural subsidies across the U.S.

Scaling issue—if floodplain area too small, and subsidized by agricultural imports by waterfowl—eutrophication. How large (or flushed) must it be?

Snowgeese (and cranes) in Bosque del Apache reserve, NM—Post et al. 1998—avian cholera and botulism



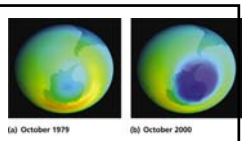
LaPerouse Bay, East Shore Hudson Bay (Jefferies 1999)

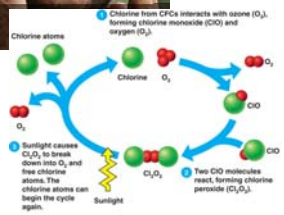
Blue-water
Green-graminoid vegetation
Red—had veg in 1973, mudflat in 1993)

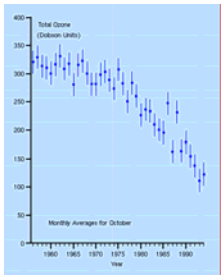
Canadian Arctic– irreversible fdbks as goose grubbing converts marsh to salinized mudflat….

http://itsb.ucsf.edu/~vcr/sk03GeorgeBushSrEfudex.gif

Skin cancer, Cataracts, Amphibian eggs, Phytoplankton (!)







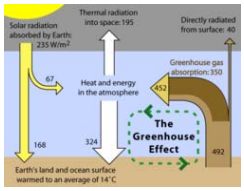
Spahini et al. Science 2005

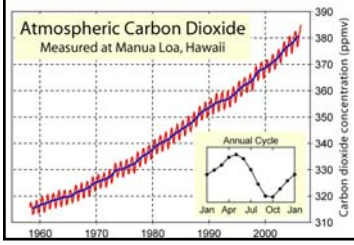
Vostok (Antarctic) ice core archived climate and atmospheric composition over past four glacial cycles over past 420 Kyr.

New Antarctic Core spans 8 cycles, (4 more than previously available) over past 740 Kyr.

This ice is about 491,0000 years old

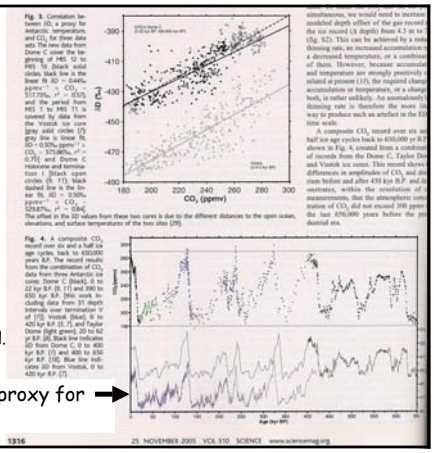
The concentration of CO2 in air today is higher than it has been in the last 650,000 years, and probably since it has been in the last 50 my.





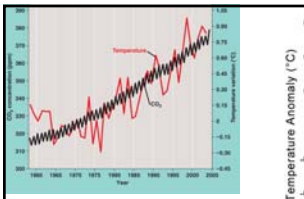
	CO_2 (ppm)
Before 1850	274
1958 (Keeling)	316
2005	370
2075 (est.)	540

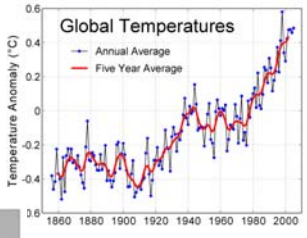
CO2 concentration and isotopic temperature proxies in ice cores are strongly correlated

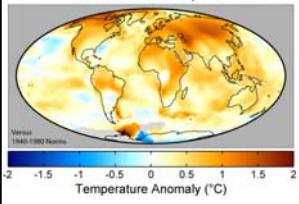


Siegenthaler et al. 2005

δ deuterium proxy for temperature







1995-2004 vs 1940-1980

	CO_2 (ppm)
Before 1850	274
1958 (Keeling)	316
2005	370
2075 (est.)	540

Positive fdbks destabilizing Earth's response to global warming:

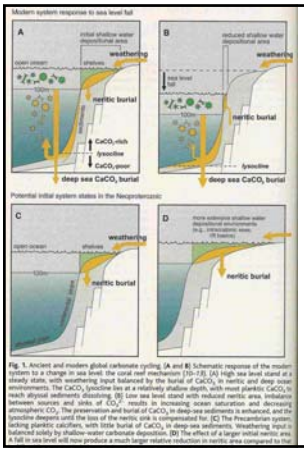
* "The clathrate surprise": Methane clathrates on the ocean floor release more methane (the clathrate gun hypothesis).

* Oxidation of ancient carbon stored in arctic ecosystems with melt of permafrost terrestrial ecosystems, leading to an increase of atmospheric CO2 levels

* Higher albedo of sea ice and seasonal snow cover. Darker earth and sea surfaces absorb more sunlight, leading to further warming.

*Moulins, deep holes in continental glaciers, allow melt water to lubricate base, accelerating slippage of ice shelfs off continents (e.g. Greenland) into the ocean.

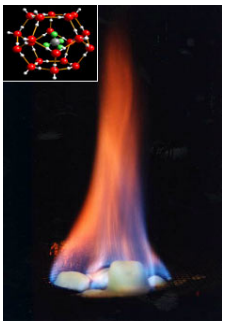
*Acidification of the ocean--elevating CO2 concentration will lower ocean pH, interfering with the ability of ocean biota to produce calcium carbonate. E. Colbert, New Yorker Nov. 20 2006, pp. 67-76.

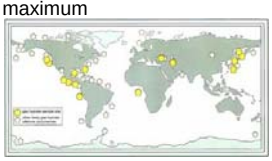


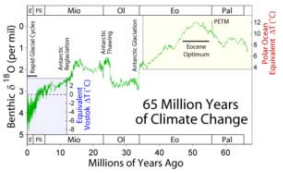
THE WEATHER MAKERS
How Man Is Changing the Climate and What It Means for Life on Earth.
By Tim Flannery.
Illustrated. 357 pp. Atlantic Monthly Press.

FIELD NOTES FROM A CATASTROPHE
Man, Nature, and Climate Change.
By Elizabeth Kolbert.
Illustrated. 210 pp. Bloomsbury.

Methane clathrate degassing--hypothesis for Paleocen-Eocene thermal maximum







http://en.wikipedia.org/wiki/Methane_clathrate

Evidence of global warming

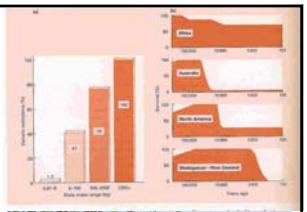
- Glacier shrinkage on mountains around the globe
- Satellite, balloon measurements show lower atmosphere is warming at similar rate to surface
- Permafrost melting in Arctic
- Acceleration of Greenland deglaciation due to moulins
- Warming of upper layers of the ocean

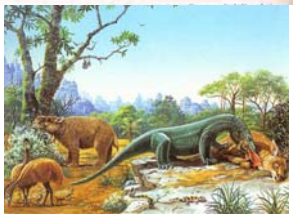
Elizabeth Colbert, New Yorker series on global warming

http://www.newyorker.com/fact/content/?050425fa_fact3

Human roles in the Pleistocene (Flannery*, Zimov et al.)

- 25-15 K y bp: last ice age began (how rapidly? Over a century? Decades?)
- Ice covered latitudes north of Wales, New England, Washington state
- Sea level fell 160 m, land bridges exposed
- Ice age grip loosened about 15 K y bp, physical world like today's by 9 K bp.
- HUGE worldwide megafaunal extinctions—lost 75% of taxa in N. and S. America, 45% in Europe. Why?





* books: The Future Eaters; The Weather Makers

Four hypotheses

- Climate change (prevailing view until recently)
- Human predation (Pleistocene overkill (Paul Martin))
- Climate stressed megafauna, and humans finished them off
- *Humans killed megafauna, and ecosystem feedbacks changed climate (not generally accepted....)*

Observations

•Last ice age only most recent of 17 that have gripped the Earth over the past 2 million years, and it was not the most severe. Why did megafaunal extinctions occur primarily in this one?

•The last ice age was roughly contemporaneous (25-15 ky bp) over the entire globe. Why were the timings of extinction so different on different continents?

-N. America 10-12 ky bp lost 75 % of its megaherbivores

-Australia 35K bp lost Diprotodon, giant 2 ton wombat

-New Zealand lost 12 spp of giant Moas less than 1 ky bp!

Zimov, Chapin's—Pleistocene Park

12 ky bp, vegetation changed across all of Beringia from steppe grass to mossy tundra. Assumed this due to climate change, but no record of this in ocean sediment or ice cores.

Zimov et al. hypothesize overkill of megafauna by Pleistocene hunters.

Siberian ponies pastured downslope from grass refuges on hills extend steppe grasses over tundra…trampling and grazing kills moss.

Moss tundra is a good insulator, so permafrost shallow, soils waterlogged and hypoxic. Grasses dry up soils, support more productivity and floral diversity, and might change (decrease?) runoff to the Arctic Ocean.

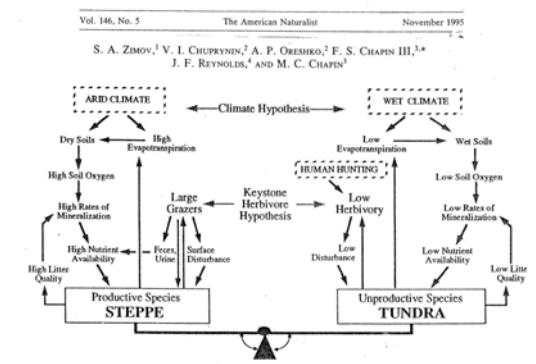
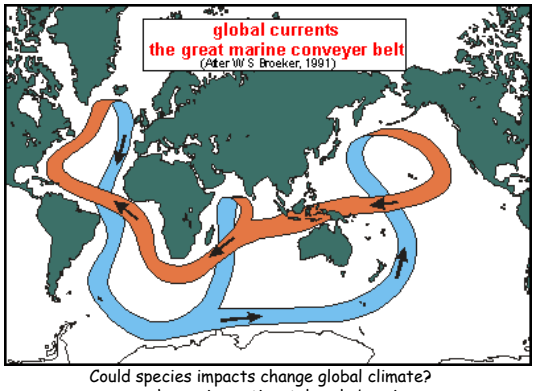


Fig. 1.—Interactions among climatic, vegetation, and soil processes leading to either tundra or steppe. The balance between tundra and steppe can be shifted by changes in either of two independent variables (shown in dashed boxes): climate (climatic hypothesis) or human hunting, which alters the abundance of large grazers (keystone-herbivore hypothesis). This figure follows the scheme presented in Schlesinger et al. (1990).

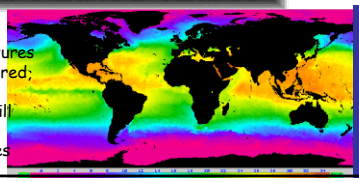
Alternative (stable?) States…tipping point – hunting?



Could species impacts change global climate?
change in continental scale burning,
or freshwater runoff from Beringia?

Evidence of global warming (K. Cuffey)
- Glacier shrinkage on mountains around the globe
- Permafrost melting in Arctic
- Satellite, balloon measurements show lower atmosphere is warming at similar rate to surface
- Warming of upper layers of the ocean

Sea temperatures > 26.5 h (red; orange, yellow) will sustain hurricanes



http://www.newyorker.com/fact/content/?050425fa_fact3
http://www.newyorker.com/fact/content/?050502fa_fact3
http://www.newyorker.com/fact/content/?050509fa_fact3

Bayou, Mangroves, Ecosystem Services

4 miles forested wetlands removes 80 feet of storm surge….