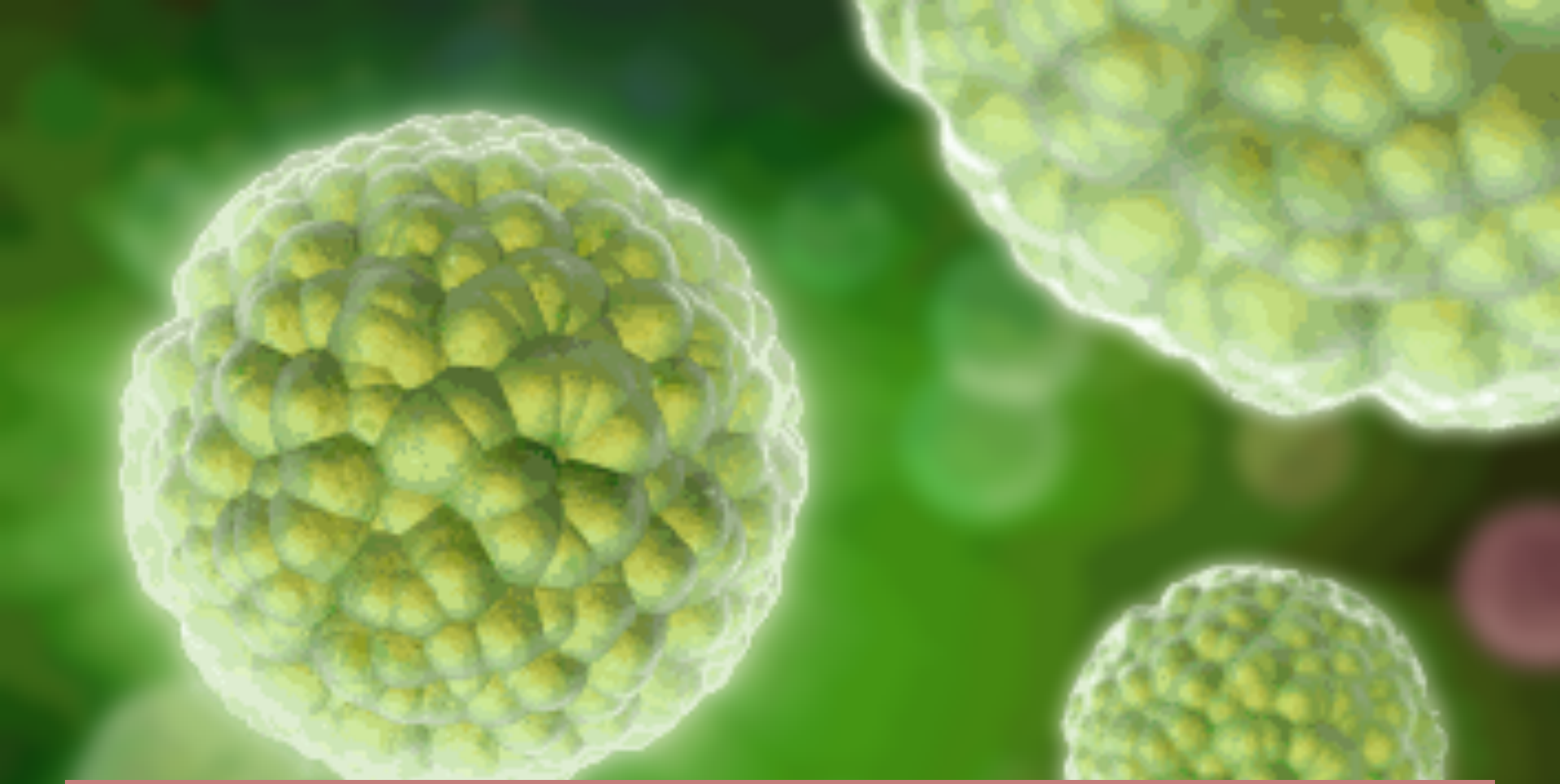


# Environmental Impacts

Okala Practitioner **Chapter 13**

# Environmental impacts

A single product can create many different kinds of environmental damage. Environmental impacts are typically grouped into three general groups: ecological damage, human health damage and resource depletion.

Although some impacts create both ecological damage and human health damage, they are categorized according to their primary impact group.

## Environmental Impact Categories

| Ecological damage | Human health damage | Resource depletion |
|---|---|---|
| Global warming | Smog & air pollutants | Fossil fuel |
| Ozone depletion | Carcinogens | Fresh water |
| Acid rain | Health damaging substances | Minerals |
| Water eutrophication | | Topsoil |
| Habitat alteration | | |
| Ecotoxicity | | |

Hurricane Sandy covering the Eastern seaboard of the US, 2012

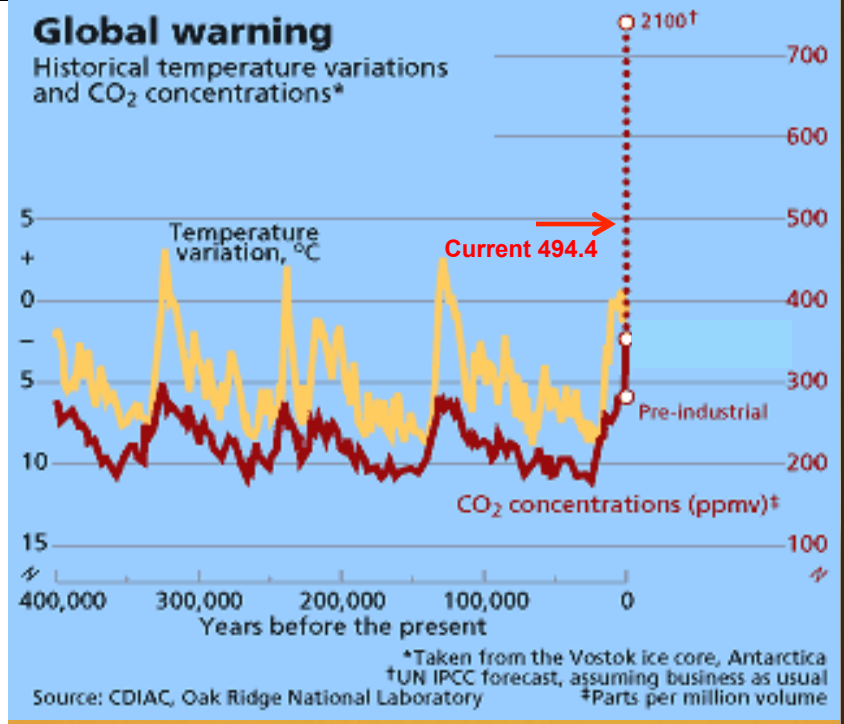
## Ecological Damage:

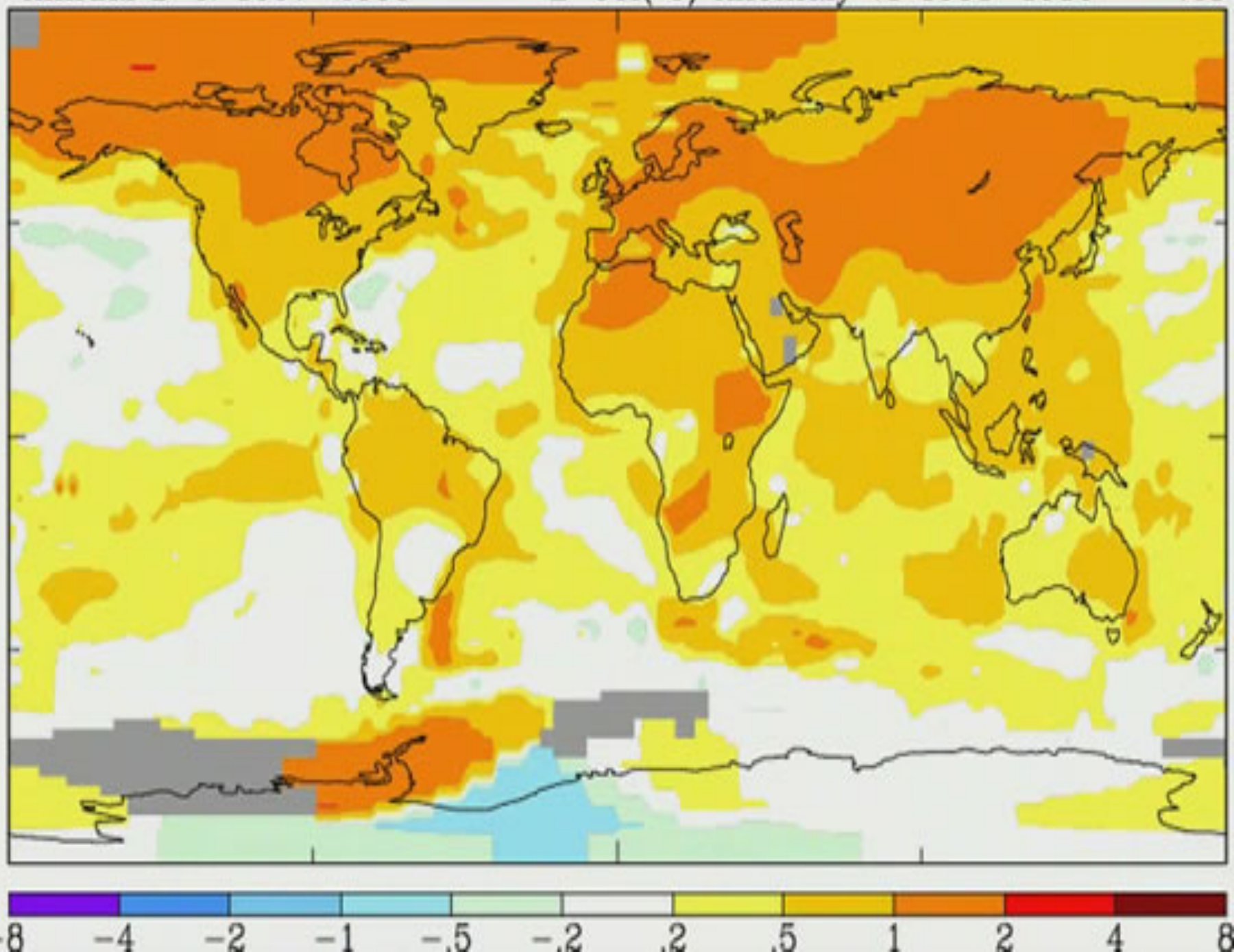
# Global Warming

Global warming (also known as climate change) results from the addition of gases to the atmosphere from the burning fossil fuels, agriculture and industrial practices that raise the temperature of the Earth's atmosphere. The rising temperature increases the following:

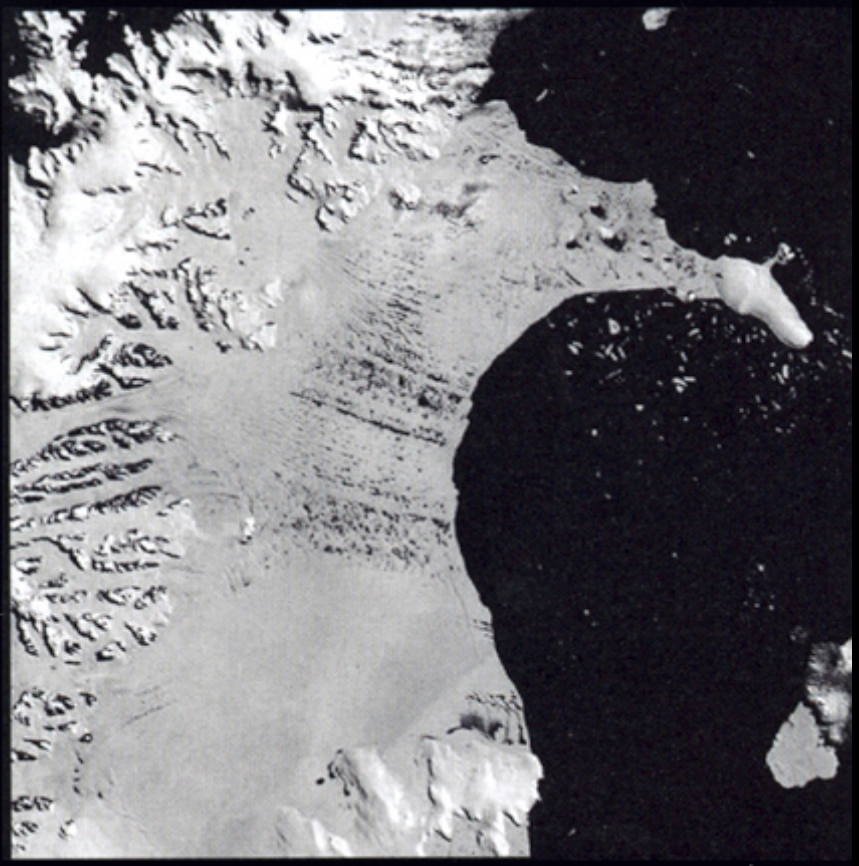
- incidence and intensity of storms
- desertification
- range of tropical diseases
- melting glaciers and polar ice caps
- changes in marine ecologies
- ocean current changes

Unit of measure: **$CO_2$ equivalent**

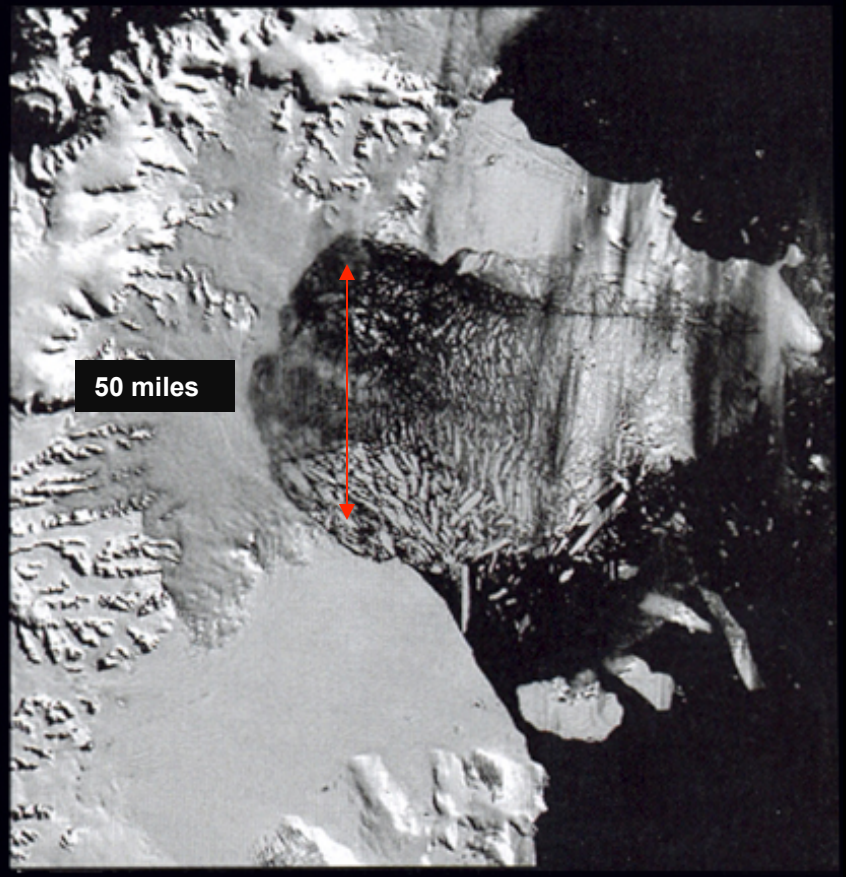




Annual D-N 1997-2006
L-OTI(°C) Anomaly vs 1951-1980
.48
-8
-4
-2
-1
-.5
-.2
.2
.5
1
2
4
8

SATELLITE IMAGE OF
THE LARSEN-B ICE SHELF,
JANUARY 31, 2002

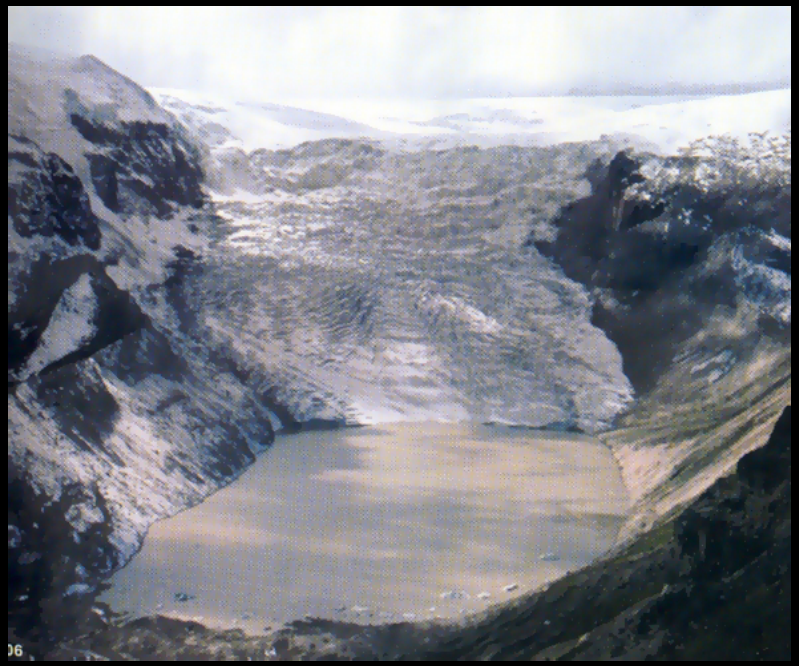


SATELLITE IMAGE OF
THE LARSEN-B ICE SHELF,
JANUARY 31, 2002




MARCH 5, 2002


Peruvian glacier 1978

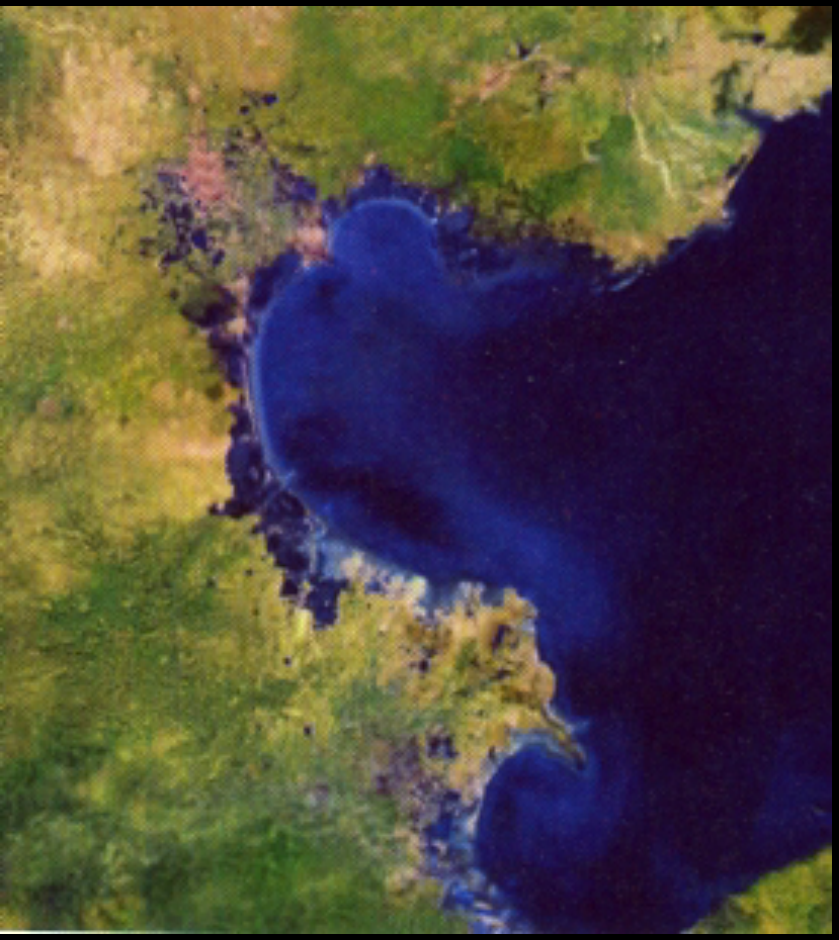
Peruvian glacier 1978

2006

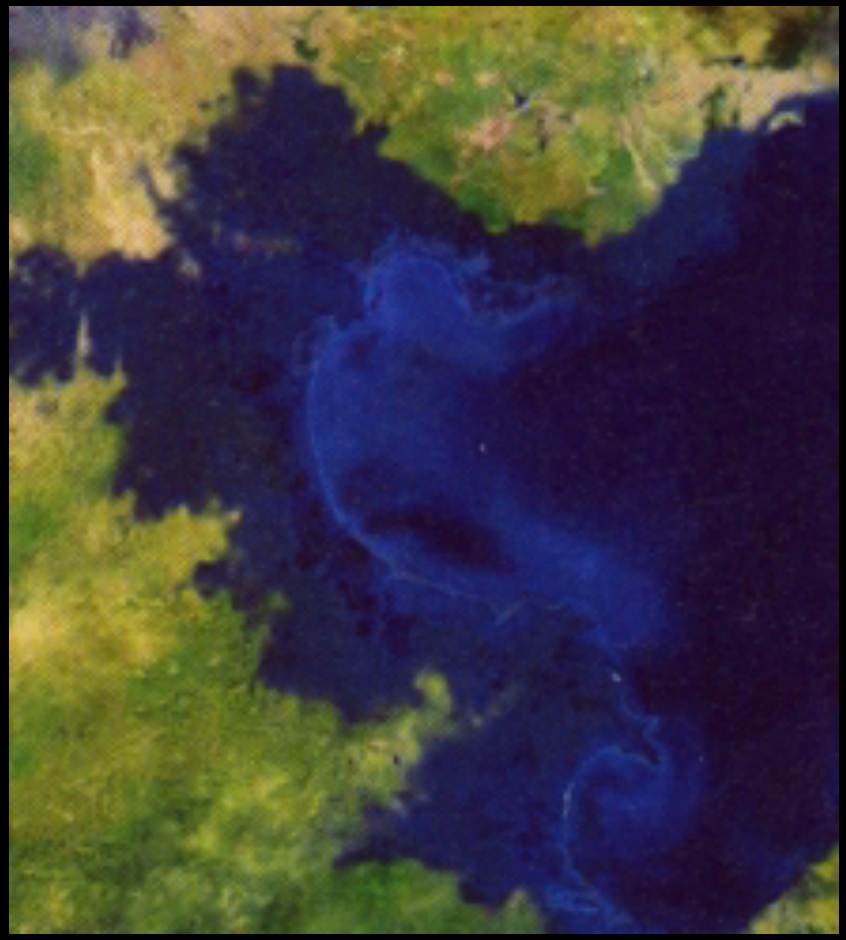
Glaciers all over the planet are shrinking at a rate never seen in modern history.

Florida now

with  30 foot ocean rise



Bay of China now



with  30 foot ocean rise

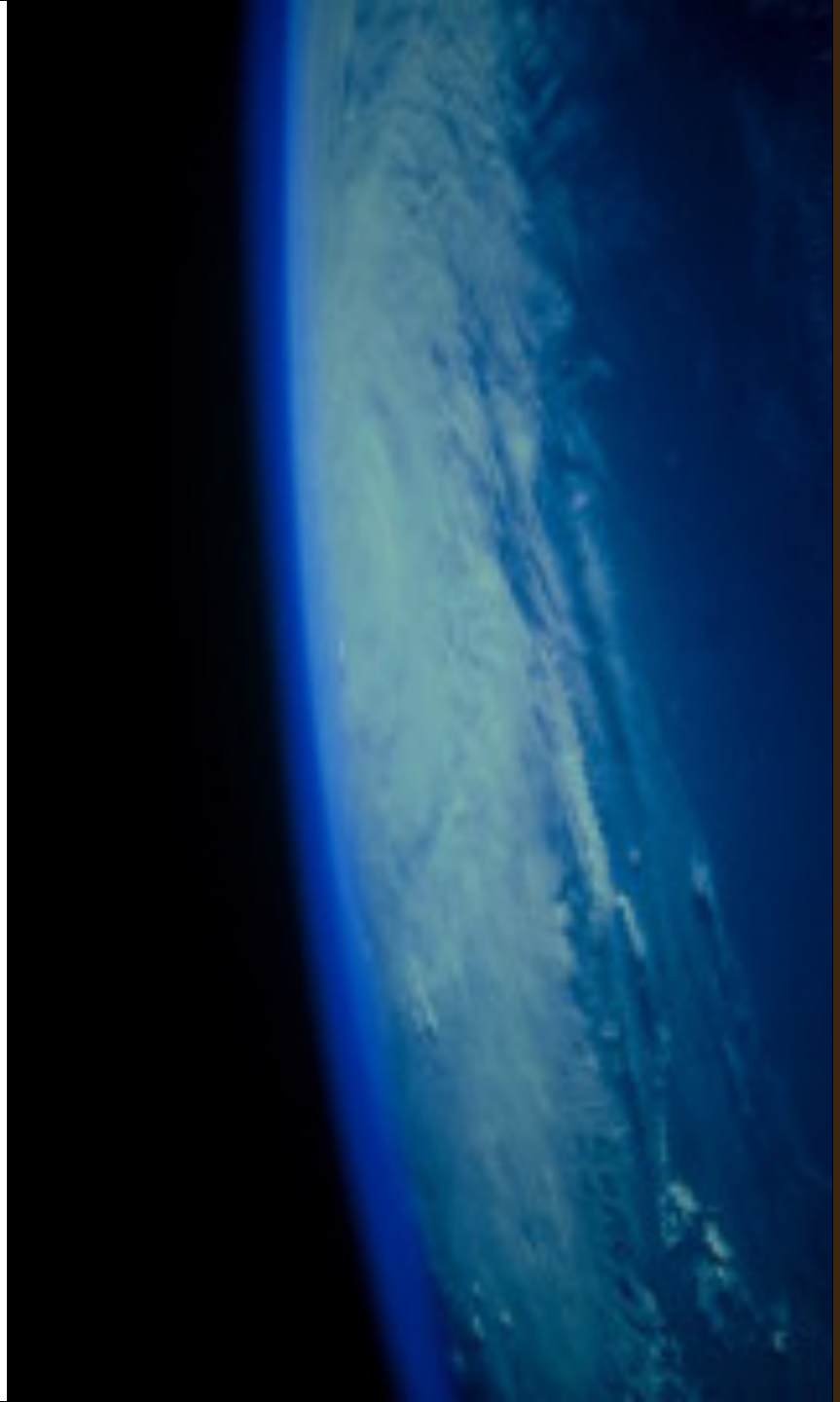
## Ecological Damage:

# Ozone Depletion

Stratospheric ozone layer depletion is caused by emissions of chlorinated fluorocarbons (CFCs) such as Freon and related compounds. Ozone ($O_3$) in the upper atmosphere is destroyed, creating "ozone holes“ above the North and South Poles.

Ozone loss increases the amount of ultraviolet (UV) light falling on the Earth, increasing cancers and cataracts in animals and humans. UV light also reduces the productivity of plants, affects marine algae and affects the biota in high latitudes. The 1992 Montreal Protocol banned use of forty-two ozone depleting chemicals internationally.

Unit of measure:
**CFC-11 equivalent**



## Ecological Damage:

# Acid Rain

Acid rain (acid precipitation or acidification) is caused by the release of acidic gases, primarily from burning fossil fuels.

The acids dissolve aluminum and other metals from soils to the level at which they become toxic to plants and to aquatic organisms. Acidification inhibits the ability of oceanic shellfish to build their shells. Acidic rain dissolves cement and minerals in the built environment.

Unit of measure:
**Sulfur dioxide ($SO_2$) equivalent**

## Ecological Damage:

# Water Eutrophication

Eutrophication is caused by the addition of excess nutrients to water leading to reduction of available oxygen in fresh and salt water.

Nitrogen and phosphorous compounds from municipal wastewater and agriculture pollute surface waters. This results in algal blooms that lower the quantity of dissolved oxygen.

Eutrophication removes the oxygen from the water, killing fish and other aquatic organisms.

Unit of measure:
**Phosphate ($PO_4$) equivalent** for fresh water
**Nitrogen (N) equivalent** for seawater

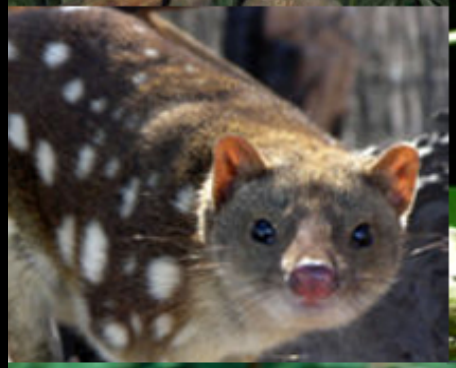
# Ecological Damage:
# Habitat Alteration

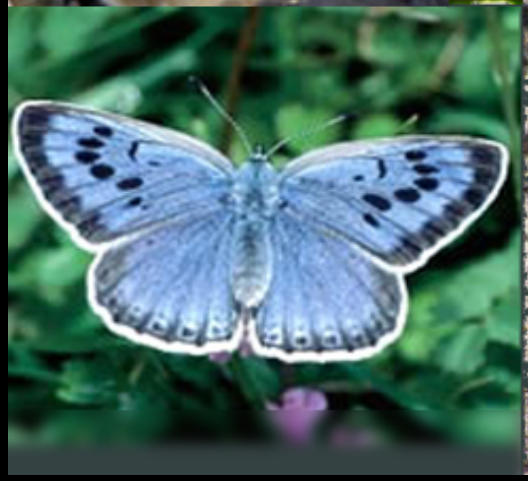
Habitat alteration (also referred to as land use) is the physical modification or destruction of natural habitats.

Ecosystems are destroyed to provide for agriculture, roads and urban growth. Habitat alteration is the primary cause of the loss of biodiversity on the planet.

Unit of measure:
**Threatened & endangered species count (T&E)** or **Area of land transformed** between two classes



## Ecological Damage:

# Ecotoxicity

Ecotoxicity is the effect of toxic substances on plants, animals and other biota in the natural environment.

The range of possible effects is large and methods of assessing these impacts are still developing. Some methods use data from tests on specific indicator species, and others extrapolate impacts on plant populations.

Ecotoxicity can be divided into the subcategories of terrestrial ecotoxicity, freshwater ecotoxicity and marine ecotoxicity.

Unit of measure:
**herbicide 2,4-D** (2,4-Dichlorophenoxyacetic acid) **equivalent, comparative toxic units,** or **triethylene glycol equivalent**

## Human health Damage:

# Photochemical Smog & Air Pollutants

Photochemical smog is caused by the emission of nitrogen oxides and volatile organic compounds (VOC's) that generate ground level ozone ($O_3$) in the presence of sunlight. Other air pollutants (referred to as "criteria air pollutants" by the U.S. E.P.A.) include dust particles and sulfur dioxide ($SO_2$).

Smog and air pollutants increase the incidence of asthma in humans and reduce the photosynthetic capacity of plants.

Unit of measure for smog:
**Non-methane volatile organic compounds (NMVOC's), nitrous oxide ($NO_x$) equivalent, or ground level ozone ($O_3$)**
Unit of measure for respiratory health:
**Particulate matter (PM) of a specified size**

## Human Health Damage:

# Health Damaging Substances

Non-cancer causing substances can include skin irritants, growth inhibitors, and hormone disrupting chemicals (endocrine disruptors).

Potential toxic effects can include transient irritation, physical or mental disability, inhibition of physical or mental development, temporary or permanent disability and/or death.

Unit of measure:
**herbicide 2,4-D** (2,4-Dichlorophenoxyacetic acid) **equivalent, comparative toxic units (CTUh) , or toluene ($C_7H_8$) equivalent**

## Human Health Damage:

# Carcinogens

Carcinogens are cancer causing substances that can cause permanent disability and/or death. Mutagens are substances that can cause genetic mutation. Most carcinogenic substances are also mutagenic. Teratogens are substances that cause defects in developing babies in the womb.

Unit of measure for carcinogens:
**Benzene ($C_6H_6$) equivalent, vinyl chloride ($C_2H_3Cl$) equivalent, or comparative toxic units (CTUh)**
Unit of measure for ionizing radiation:
**Becquerels Carbon 14 (Bq C-14) equivalent or kilograms Uranium 235 equivalent**

## Resource Depletion:

# Fossil Fuel Depletion

Current consumption rates for fossil fuels (including oil, natural gas and various types of coal) convert the fuels into carbon dioxide ($CO_2$) at a rate millions of times faster than nature can replenish the fuel reservoirs.

Unit of measure:
**Joules of surplus energy**

## Resource Depletion:

# Mineral Depletion

Metal ores are converted into metal alloys that are eventually oxidized or dispersed as waste that is often not recycled.

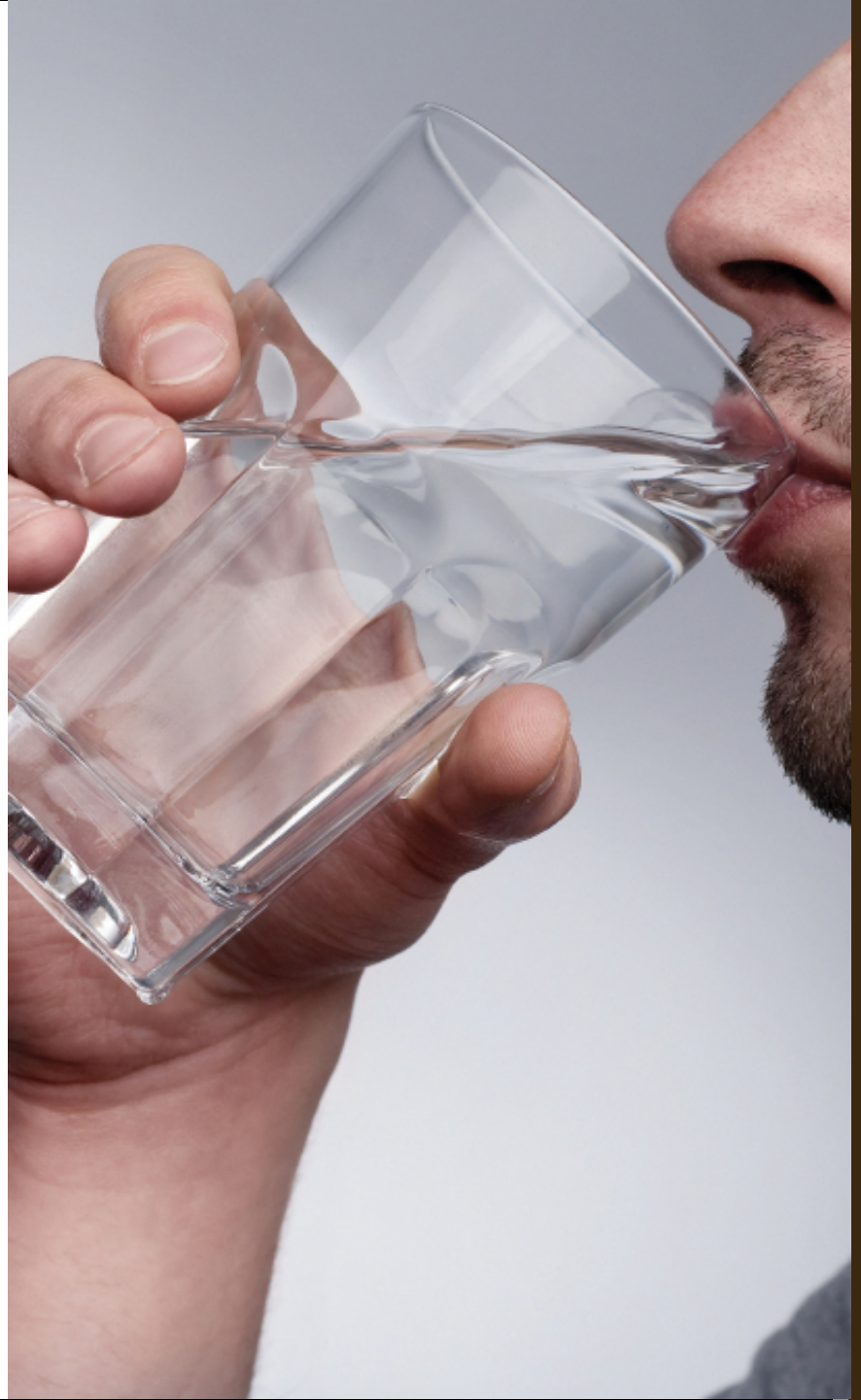
Unit of measure:
**Joules of surplus energy**

## Resource Depletion:

# Fresh Water Depletion

Consumption of fresh surface water or fresh groundwater converts them into forms that are typically not recoverable. Access to clean potable water is a growing international problem**.**

Unit of measure:
**Water scarcity adjusted amount**



## Resource Depletion:

# Topsoil Depletion

Agriculture can erode topsoil at a rate faster than it is replenished by natural and anthropogenic processes.

Unit of measure:
**Soil organic material (SOM)**

# Environmental Impact Categories

| Ecological damage | Human health damage | Resource depletion |
|---|---|---|
| Global warming | Smog & air pollutants | Fossil fuel |
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| Ecotoxicity | | |

Some people consider human health to be more important than ecological health.

Others consider human health to be diametrically opposed to ecological health.

Some people think that resource depletion is an economic problem, and not a direct environmental impact.

## Environmental Impact Categories

| Ecological damage | Human health damage | Resource depletion |
|---|---|---|
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# Discussion:

What do you think is more important:

Ecological health, Human health or Resource depletion?

Why?

# Environmental Impact Categories

| Ecological damage | Human health damage | Resource depletion |
|---|---|---|
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Many companies think they should define their own priorities about which environmental impacts they want to address.

Other companies think that impact standards make it easier for companies and designers to decide upon and implement improvements.

## Environmental Impact Categories

| Ecological damage | Human health damage | Resource depletion |
| --- | --- | --- |
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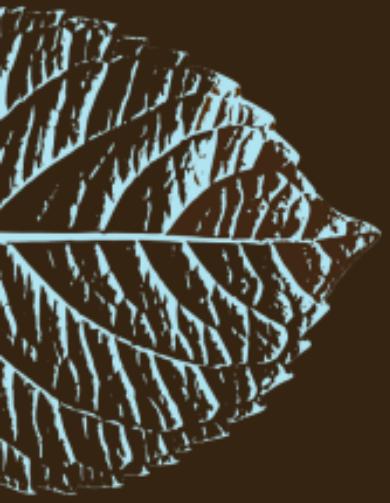
| Ecotoxicity | | |

# Discussion:

Imagine that humans have survived until the year 3000, and you are living then. Looking back on the millennium between now and 3000, which specific environmental impacts do you think humans should have been the most active in controlling or stopping?



# Okala Practitioner

## Integrating Ecological Design

This presentation is part of an educational presentation series that supports teaching from the *Okala Practitioner* guide.

*Okala Practitioner* and these presentations were created by the Okala Team to disseminate fact-based knowledge about ecological design to the design disciplines and business.

Unless provided in the presentations, Information sources are found in the *Okala Practitioner* guide.

The Okala Team: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The Okala Team initiated the collaboration with the US EPA and the Industrial Designers Society of America (IDSA) in 2003. The team developed Okala Practitioner with support from Autodesk, IBM, Eastman Chemical and the IDSA Ecodesign Section.

*Okala Practitioner* is available through amazon.com.

More information and the free Okala Ecodesign Strategy App are found at Okala.net.