Ministry of Natural Resources

Ontario

Our Climate is Changing,
...Our forests will change
...What about us?

Gary Nielsen
Climate Change Project Coordinator
Ontario Ministry of Natural Resources


CAUTION
THIS SIGN HAS
SHARP EDGES
DO NOT TOUCH THE EDGES OF THIS SIGN
ALSO, THE BRIDGE IS OUT AHEAD

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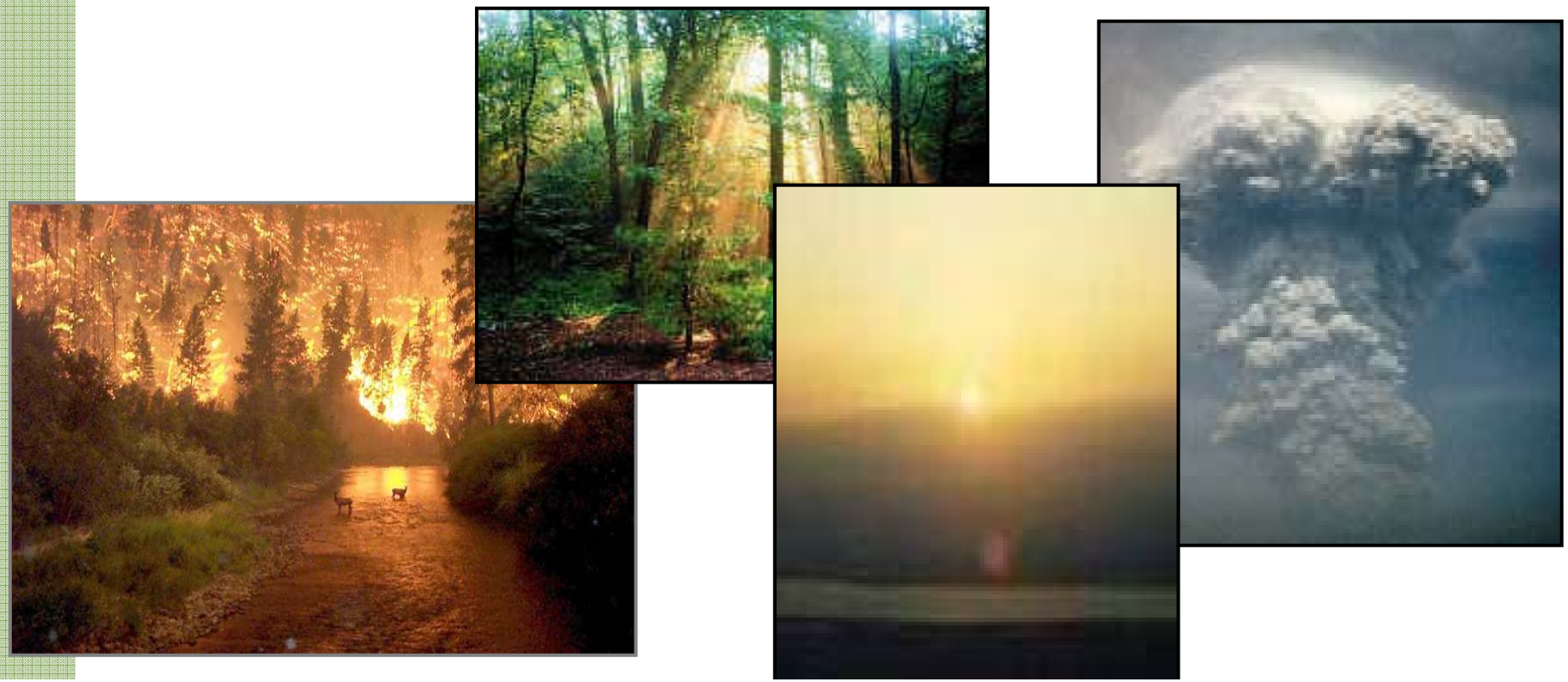
Ontario

Community Forest Mangers
2009 Annual Meeting
October 27, 2009

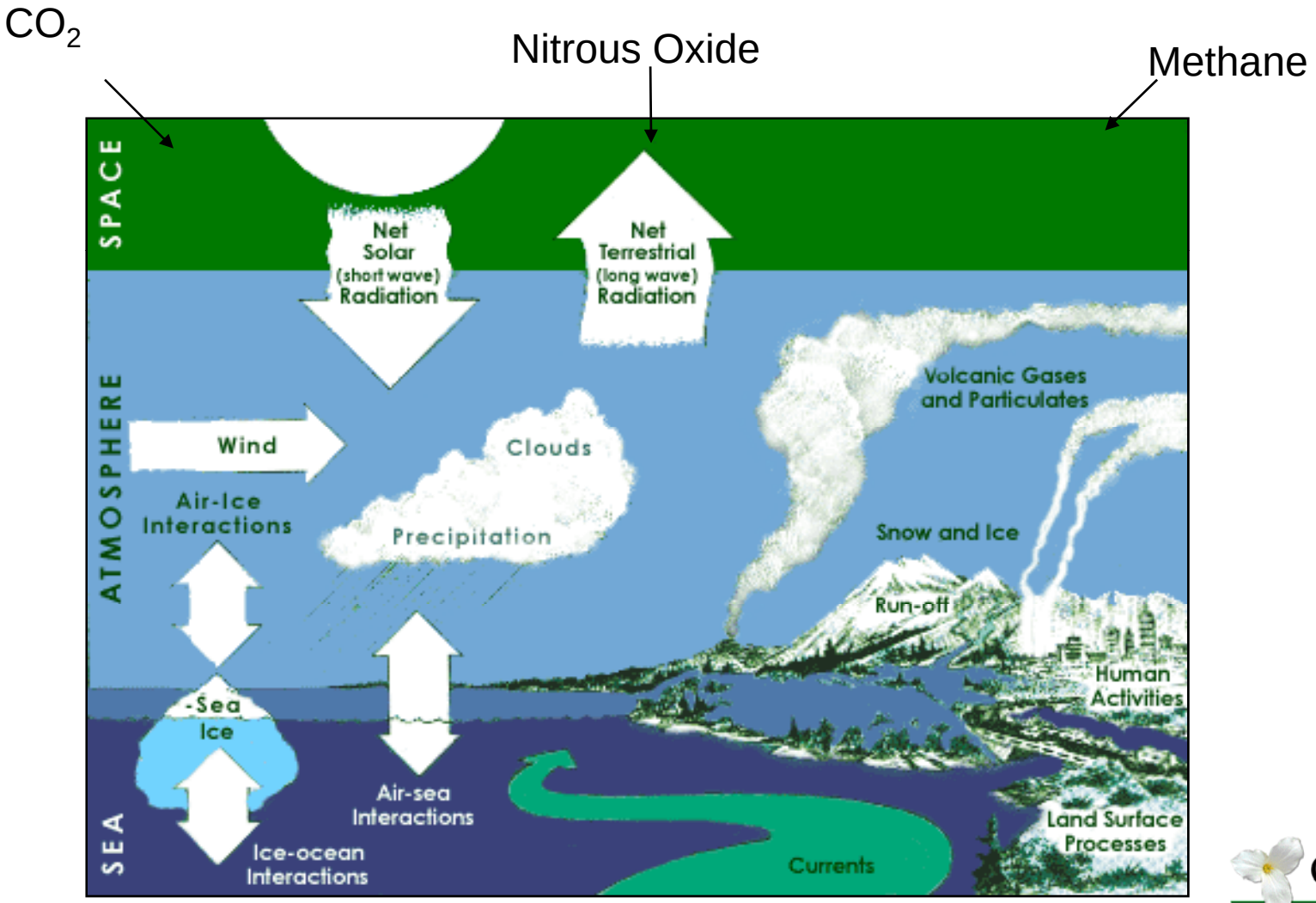
- **Climate Change 101 – A Primer**
- **Impact on Ecosystems**
- **Implications for Forestry and Forest Management**
- **Afforestation in Southern Ontario**
- **Cap and Trade and Carbon Offsets**
- **Recommendations for Forest Mangers**

What is Climate change?

The United Nations Framework Convention on Climate Change defines climate change as: “a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods”.



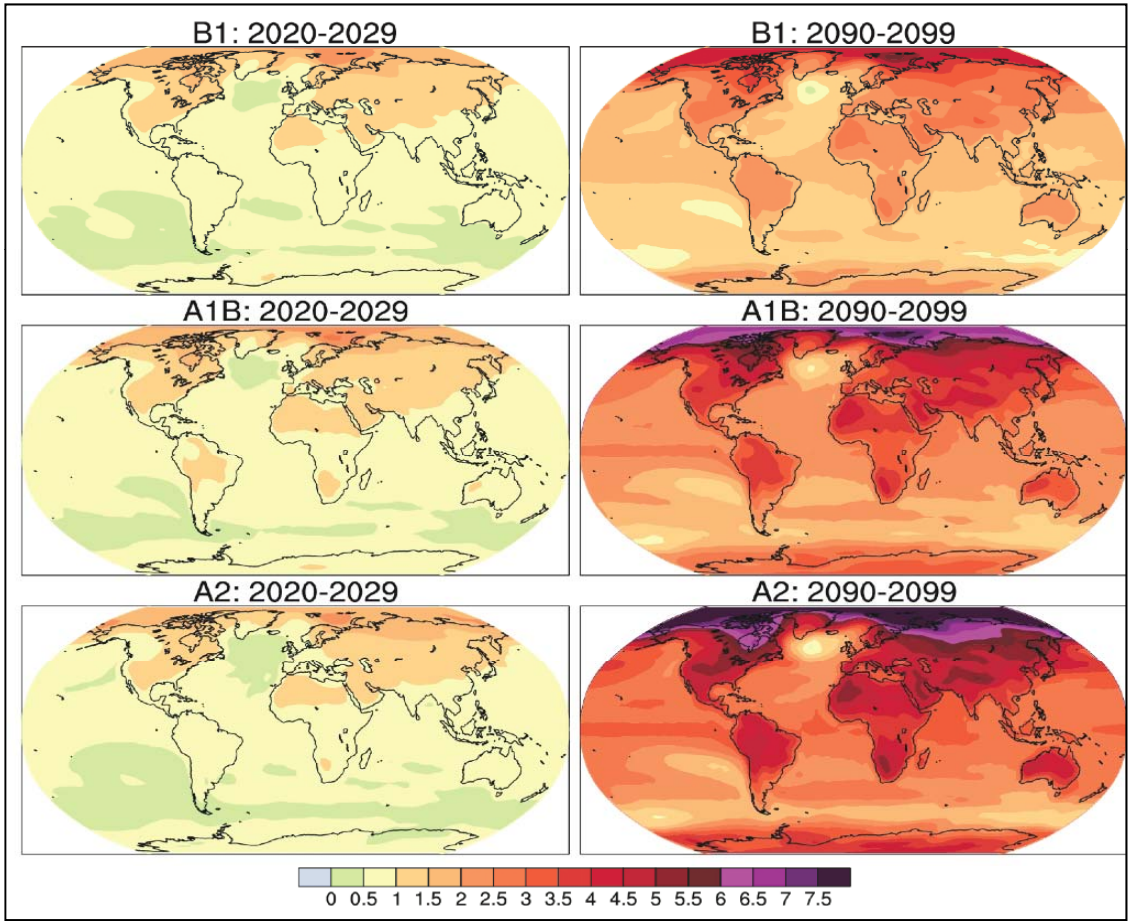
Understanding Climate Change



"Warming of the climate system is unequivocal…"

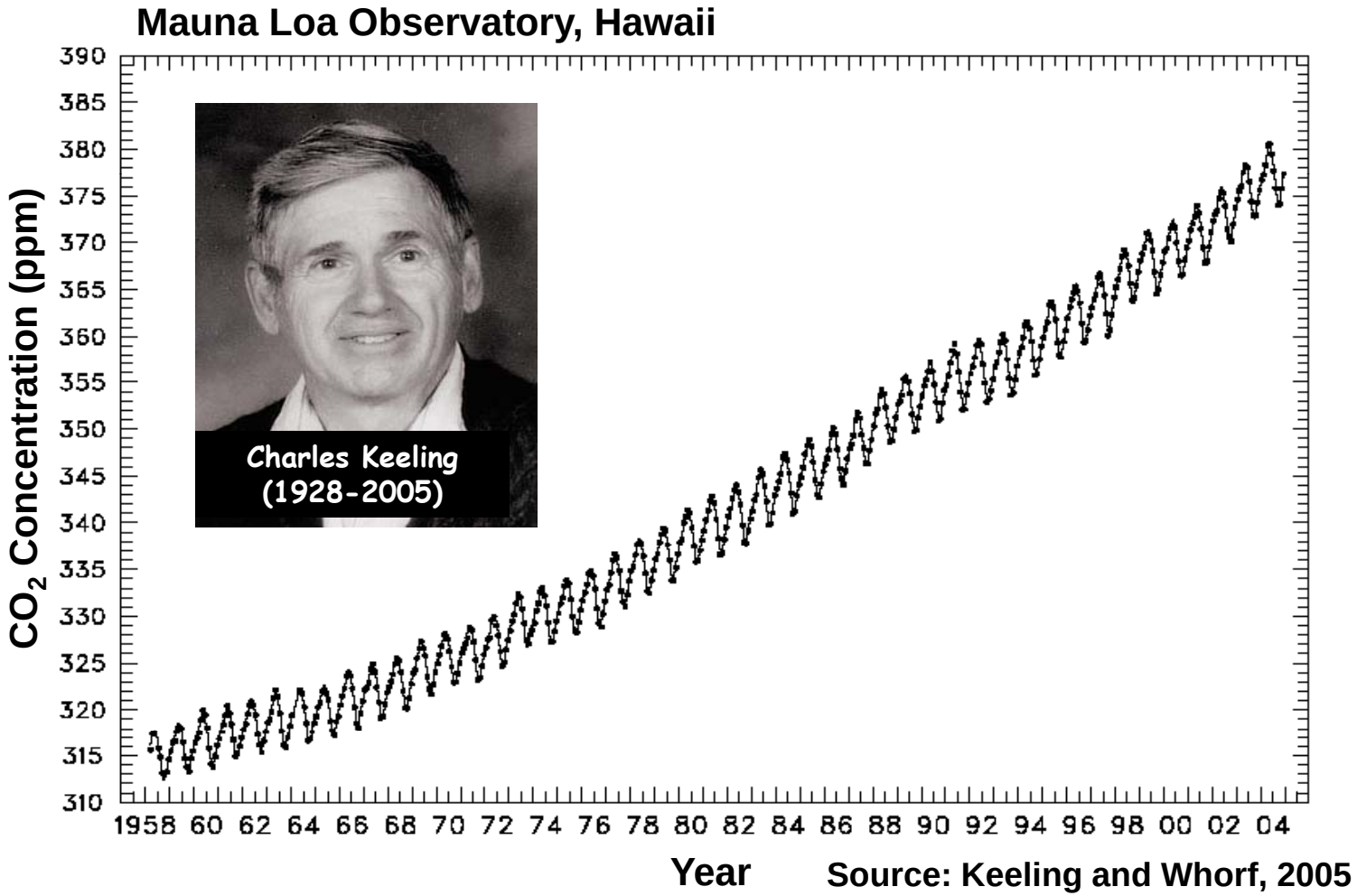
IPCC (2007):

- Human actions are changing earth's climate
- Current policies & development practices will cause continued GHG growth over next few decades, unless significant reductions are made
- 2°C (~450ppm) temperature rise will lead to major ecosystems disturbances;
- 2°C - 4.5°C (~550ppm) will have even greater impacts
- 20-30% of species at increased risk of extinction if increases exceed 1.5-2.5°C and 40-70% at temperatures exceeding 3.5°C

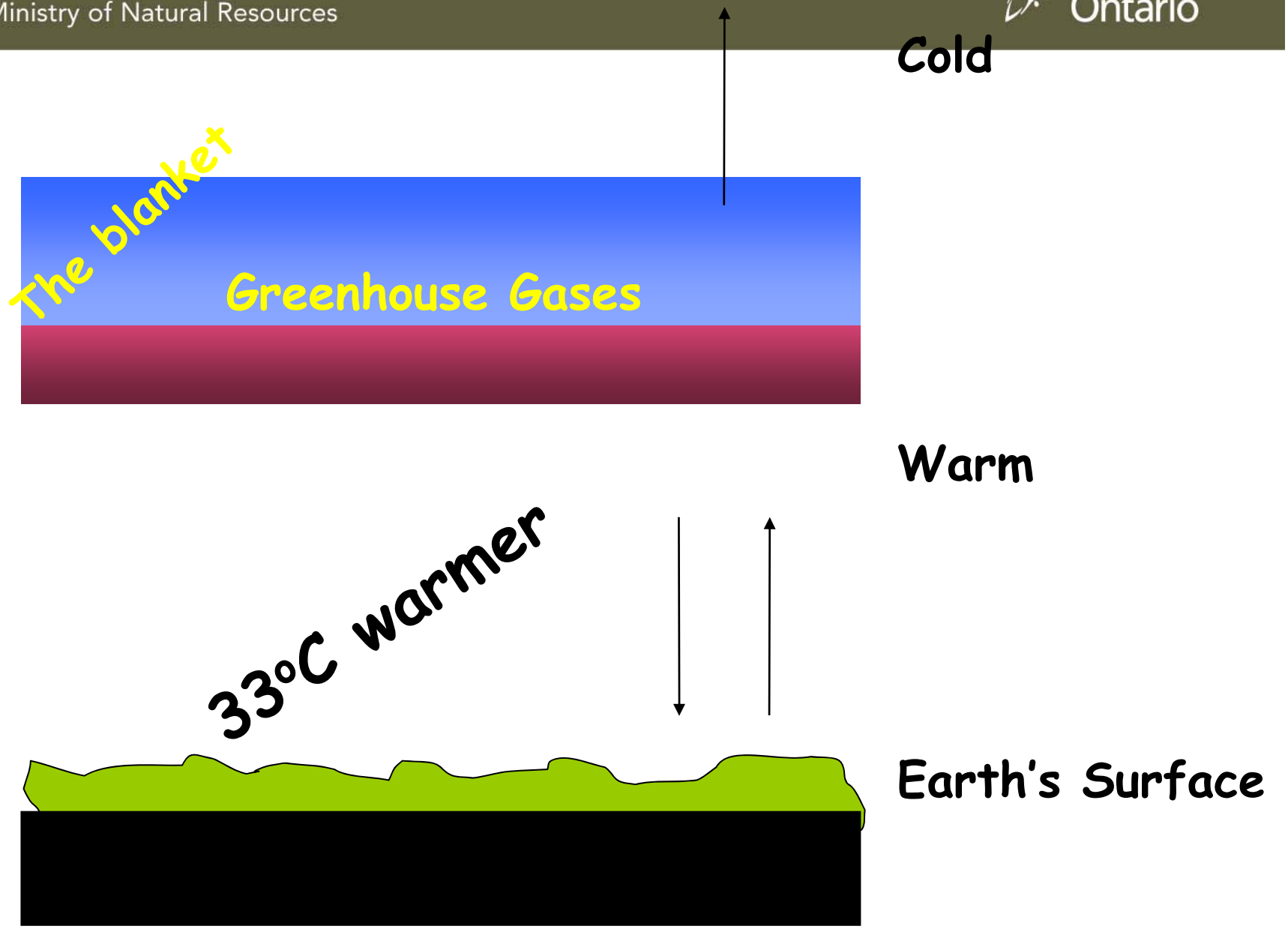


IPCC, WGI 2007

Increase in Atmospheric CO_2 Concentration

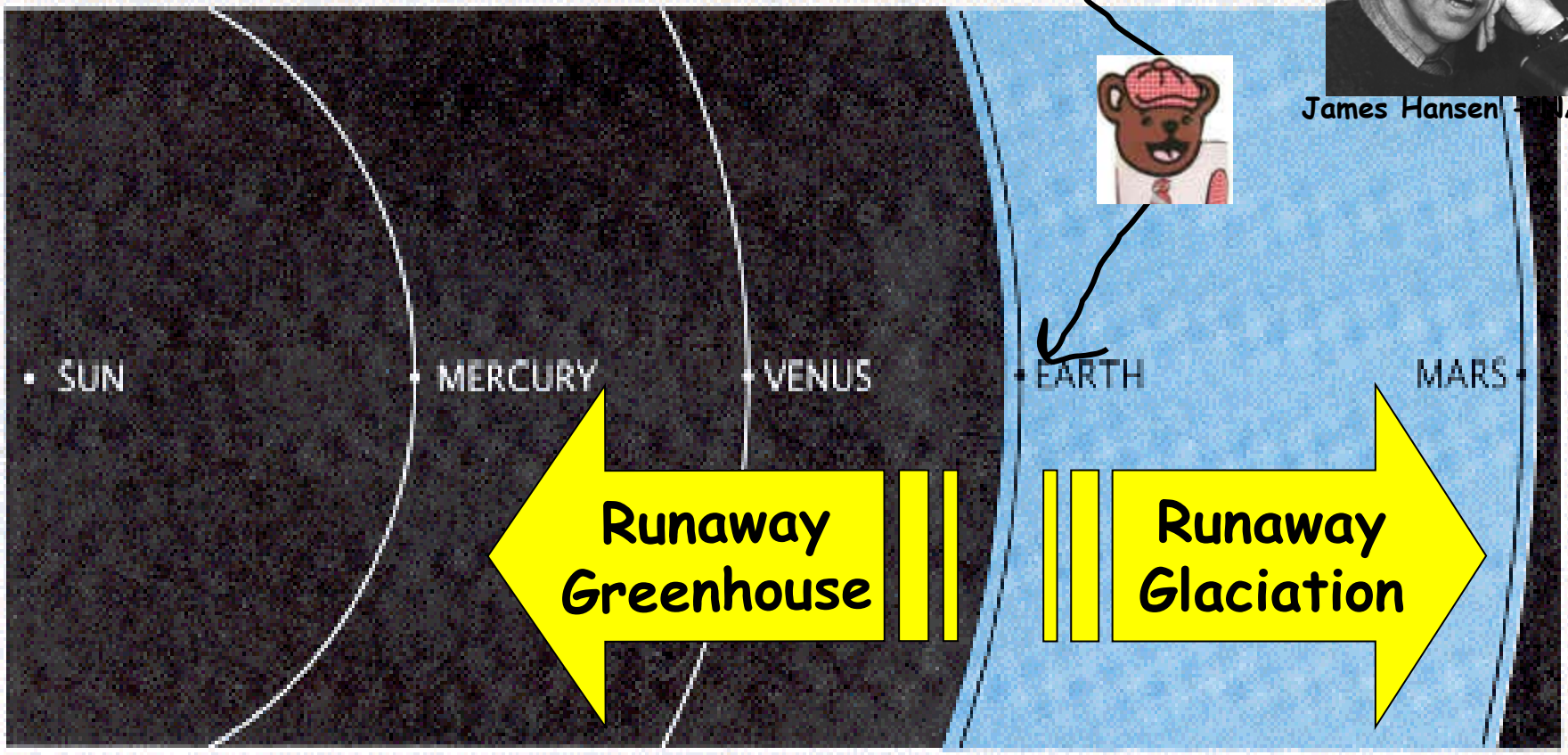


Source: Keeling and Whorf, 2005

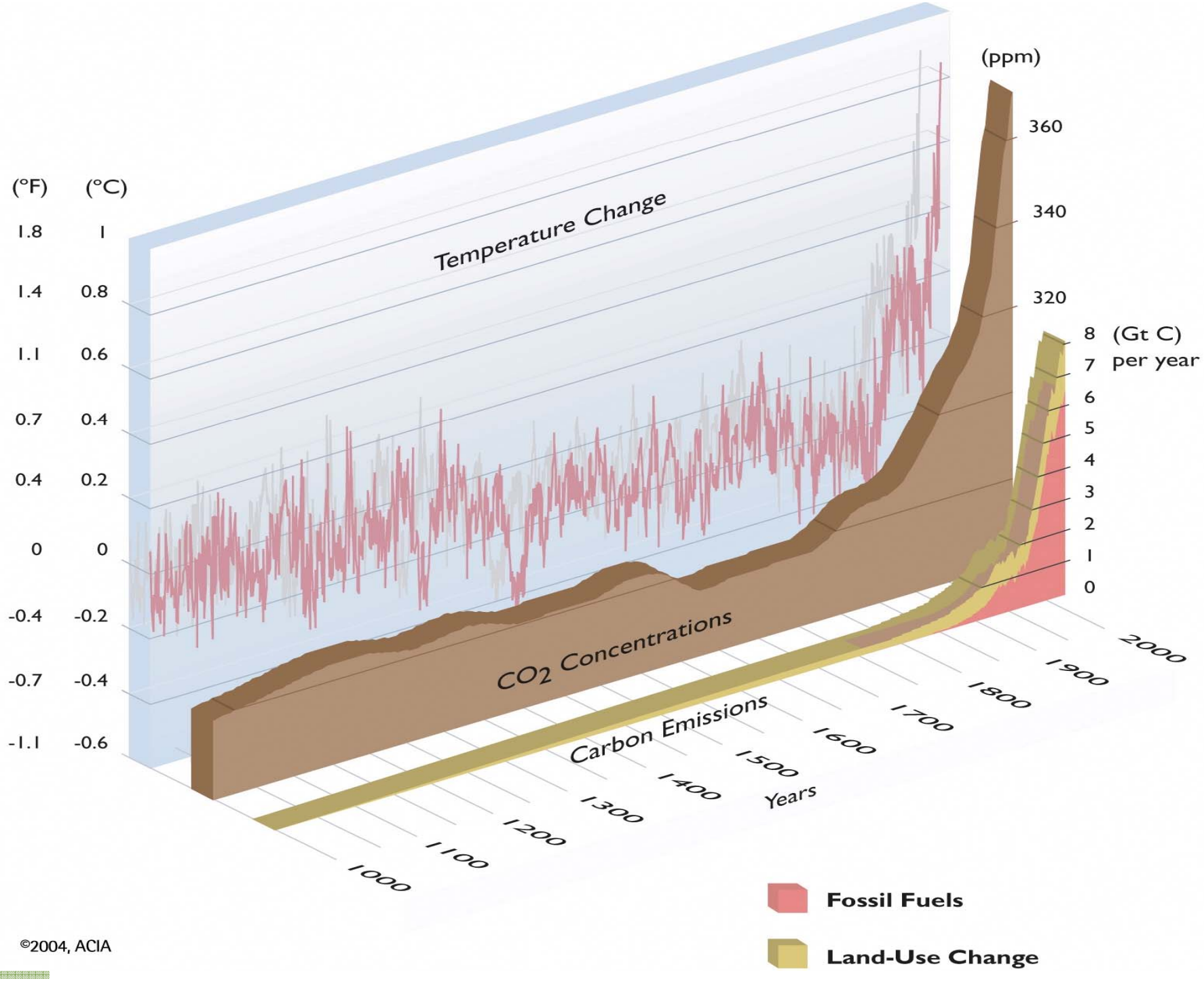

Cold
The blanket
Greenhouse Gases
Warm
33°C warmer
Earth's Surface

Habitable Zone

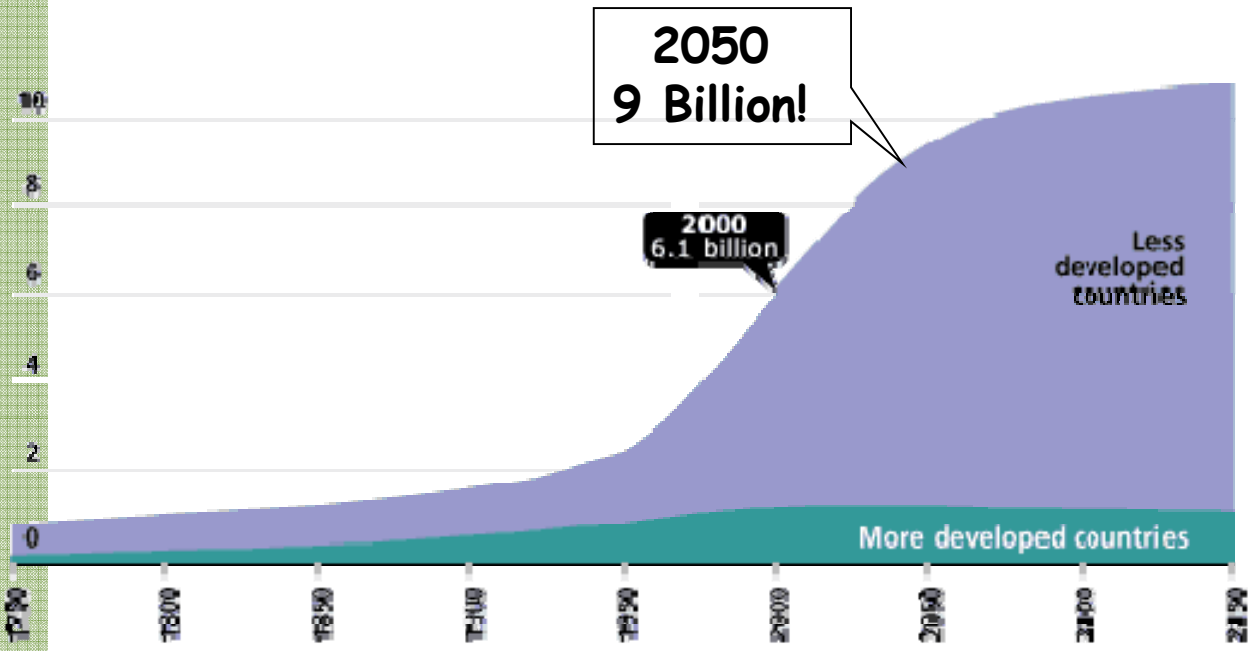
James Hansen - NASA



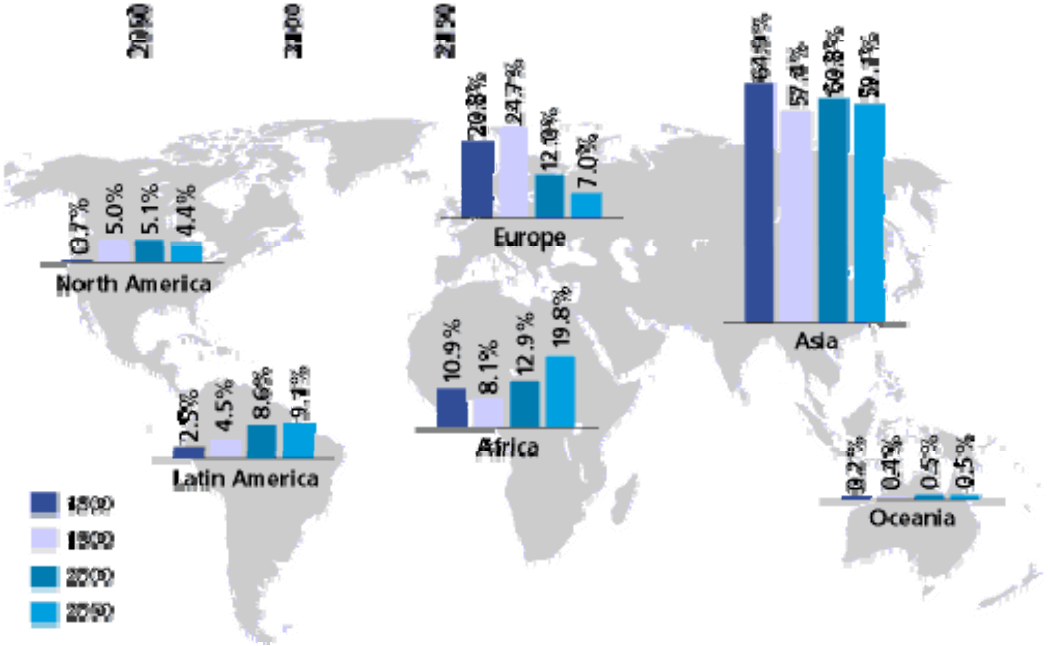
(Source: Kasting et al., 1988)


(°F)
(°C)
1.8
1
1.4
0.8
1.1
0.6
0.7
0.4
0.4
0.2
0
0
-0.4
-0.2
-0.7
-0.4
-1.1
-0.6
Temperature Change
(ppm)
360
340
320
CO2 Concentrations
8
7
6
5
4
3
2
1
0
(Gt C)
per year
Carbon Emissions
1000
1100
1200
1300
1400
1500
1600
1700
1800
1900
2000
Years
Fossil Fuels
Land-Use Change

Human Population Growth in Billions 1750-2150

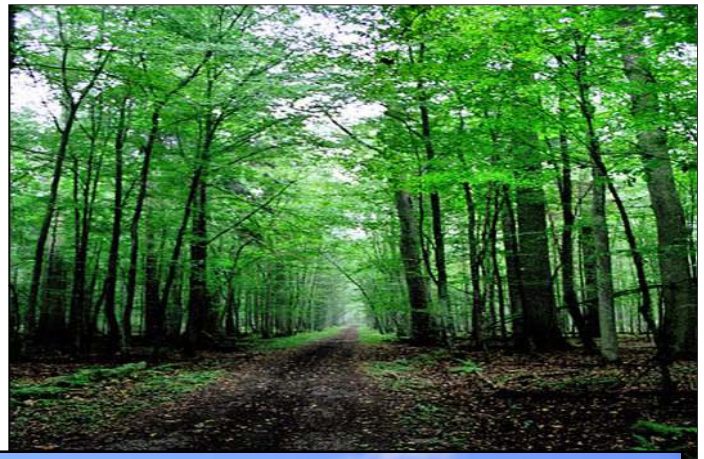


Human Population Distribution 1800-2050



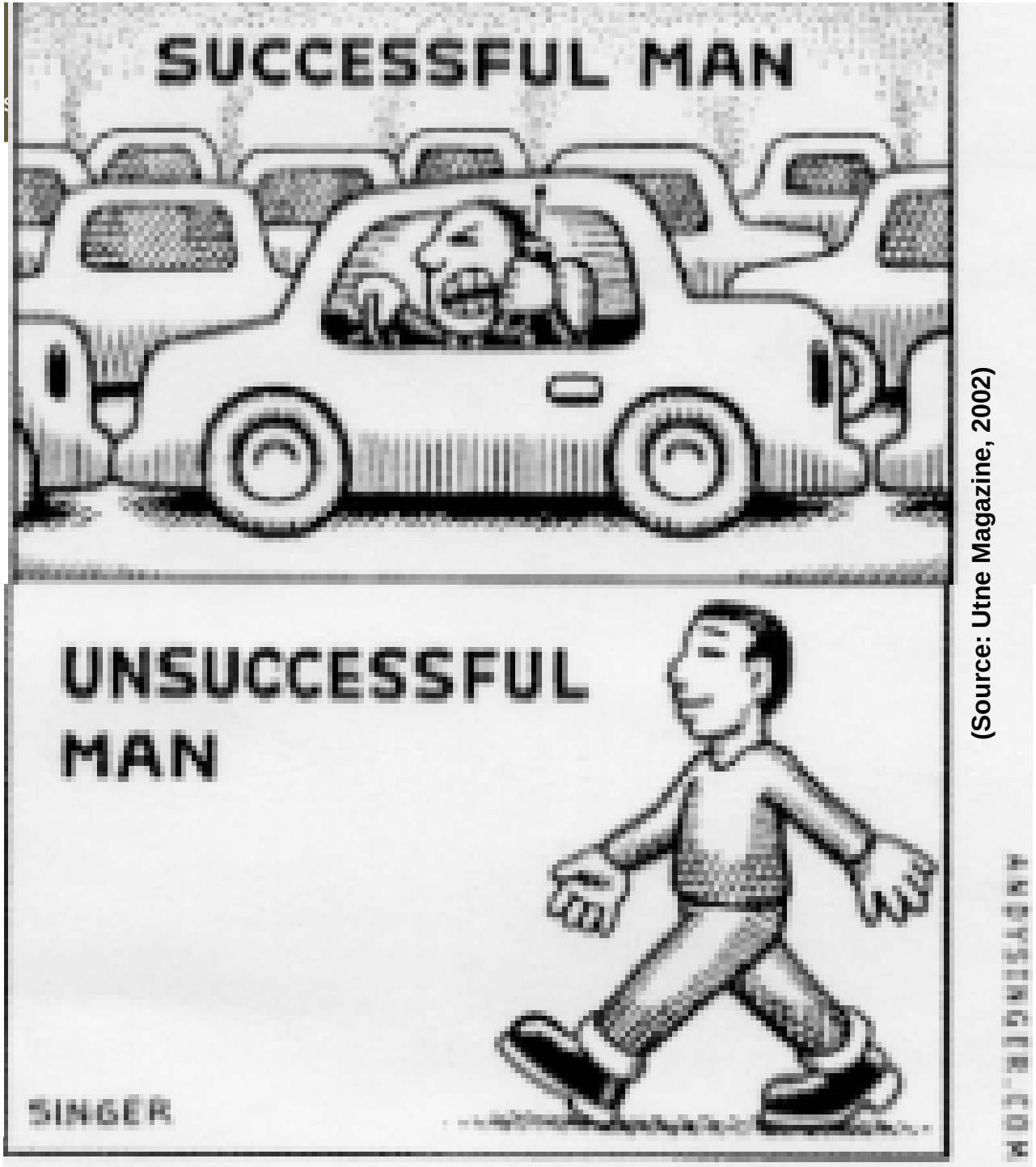
The Solution

- Reduce fossil fuel combustion (fuel switching, renewable energy)
- Energy efficiency
- Store GHGs underground (Carbon Capture and Storage)
- Remove Carbon Dioxide (CO_2) by biological sequestration (tree planting, forest management)



We don't really know how people will behave during the next 100 years

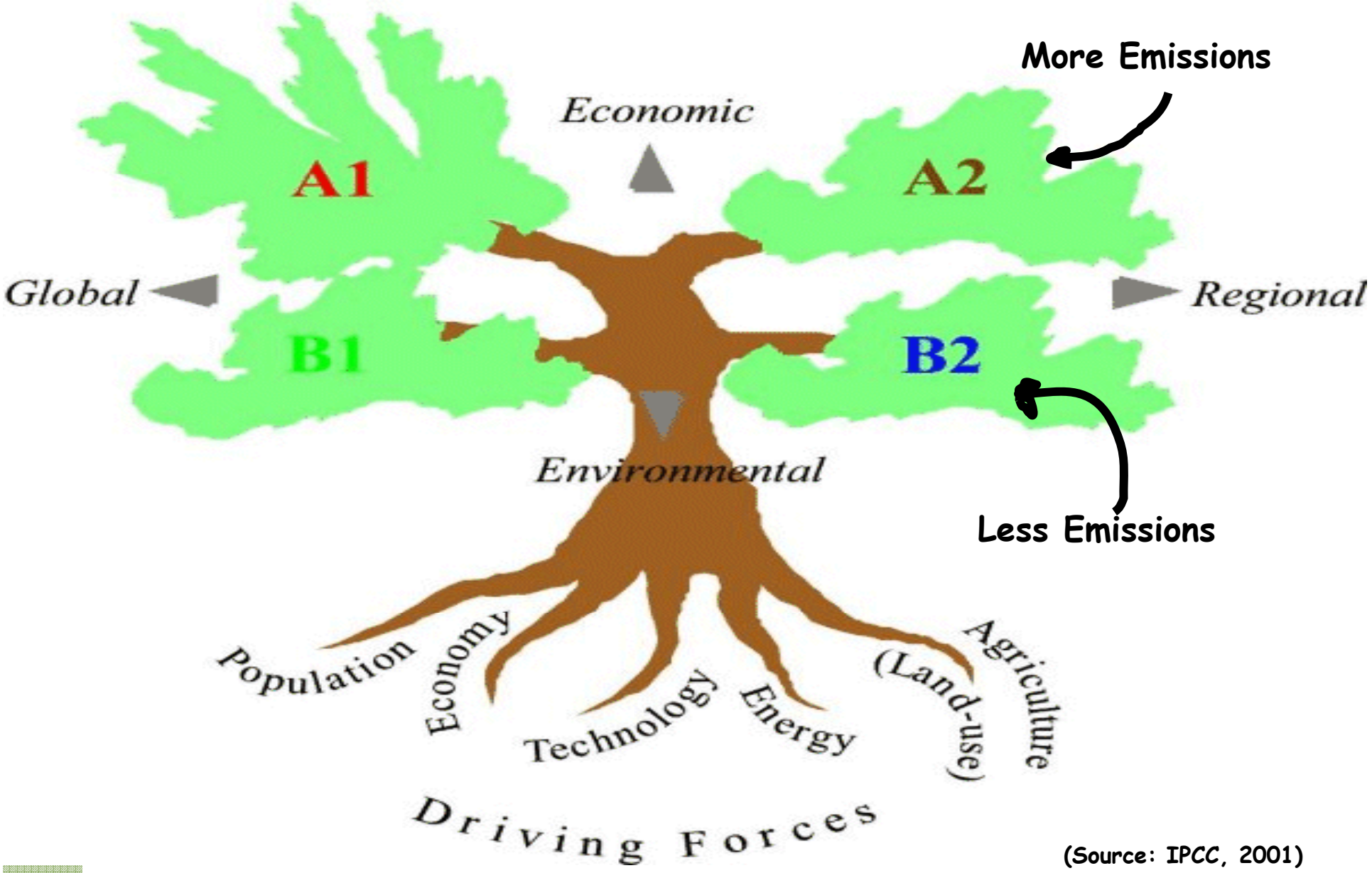
~2-6°C



(Source: Utne Magazine, 2002)

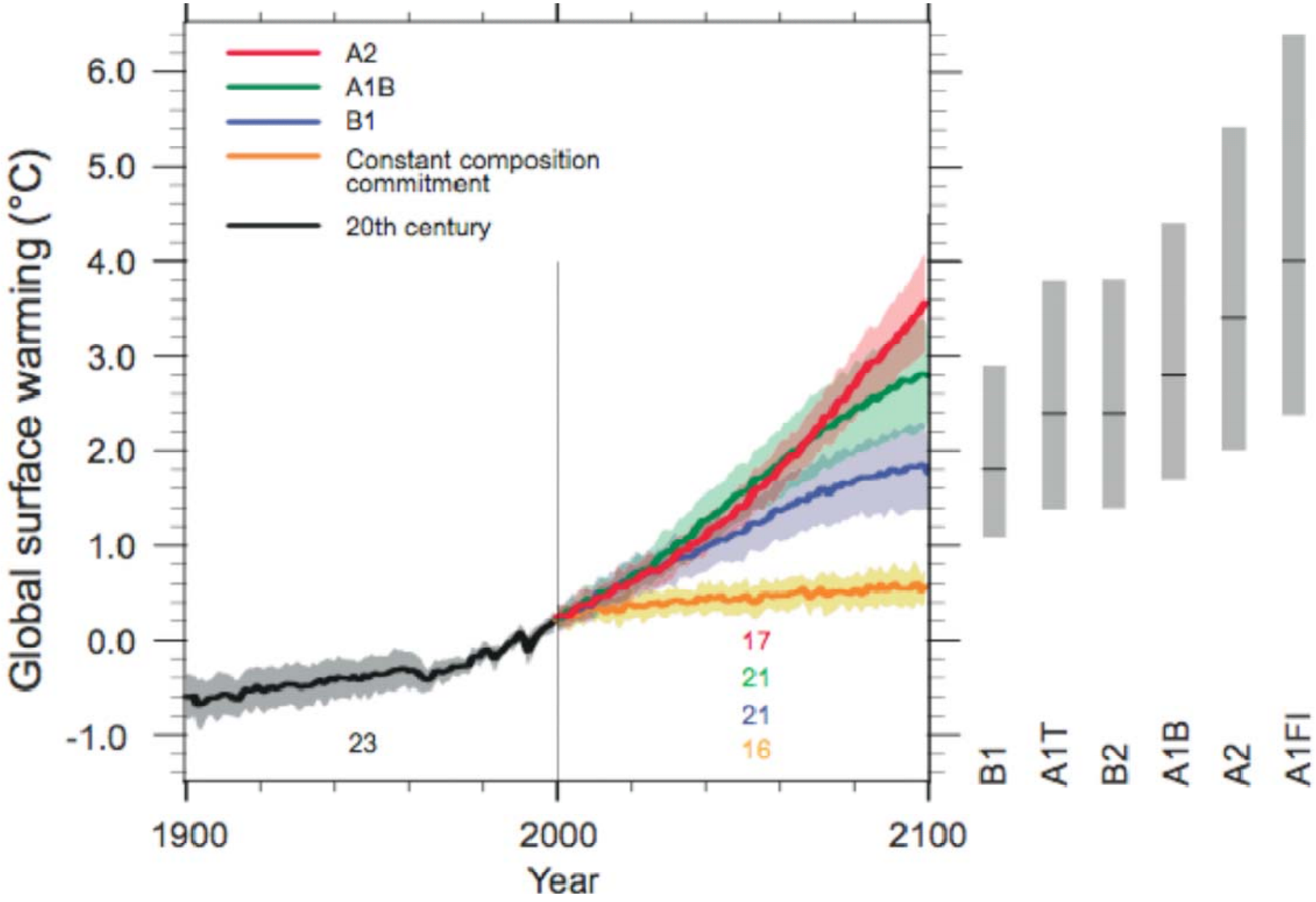
SRES Scenarios

[there are 40 scenarios]

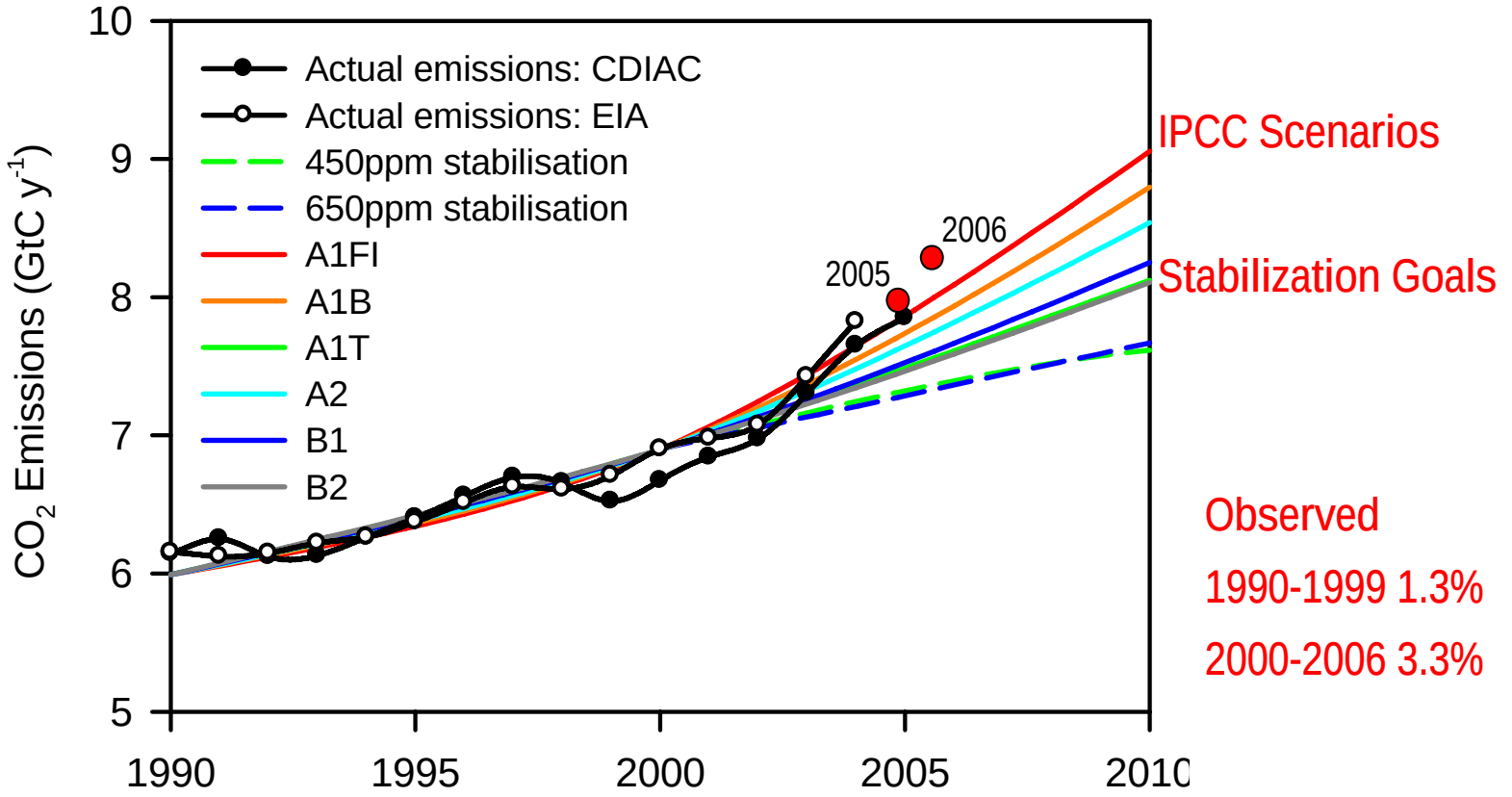


(Source: IPCC, 2001)

Multi-model Global Averages of Warming (Relative to 1980-1999): Selected Scenarios



2000-2006 emissions growth rate exceeds all IPCC scenarios

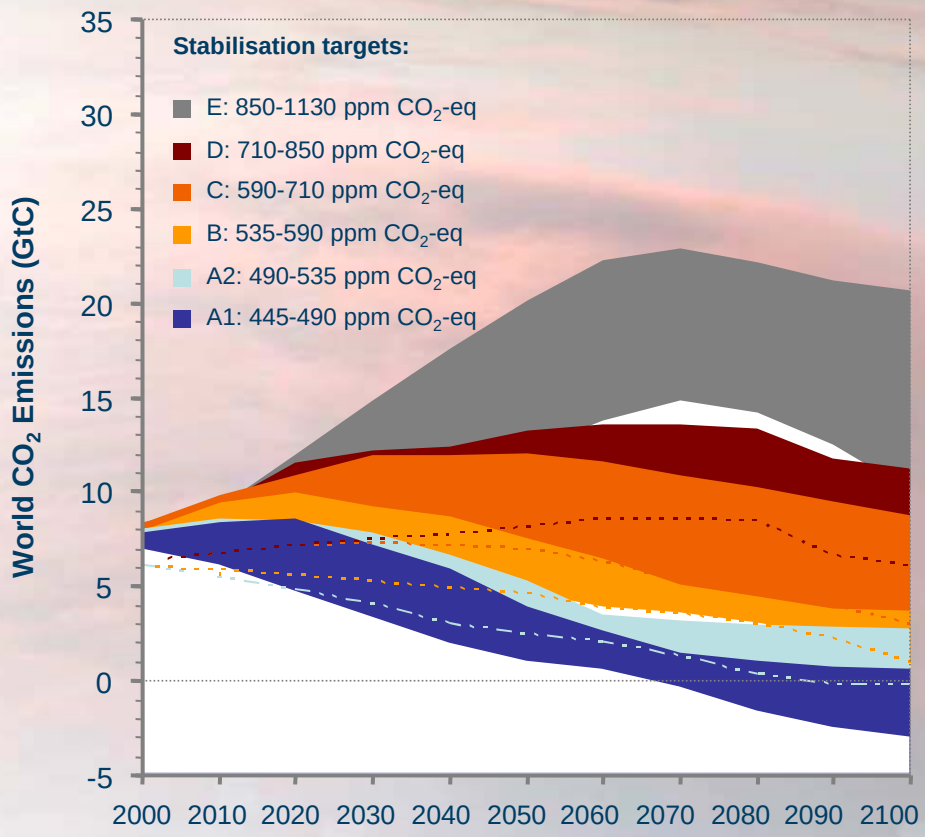


Raupach et al. 2007, PNAS

The lower the stabilization level, the earlier global CO_2 emissions have to peak

IPCC
Intergovernmental Panel on Climate Change

- The lower the target stabilisation level limit, the earlier global emissions have to peak.
- Limiting increase to 3.2 – 4°C requires emissions to peak within the next 55 years.
- Limiting increase to 2.8 – 3.2°C requires global emissions to peak within 25 years.
- Limiting global mean temperature increases to 2 – 2.4°C above pre-industrial levels requires global emissions to peak within 15 years and then fall to about 50 to 85% of current levels by 2050.

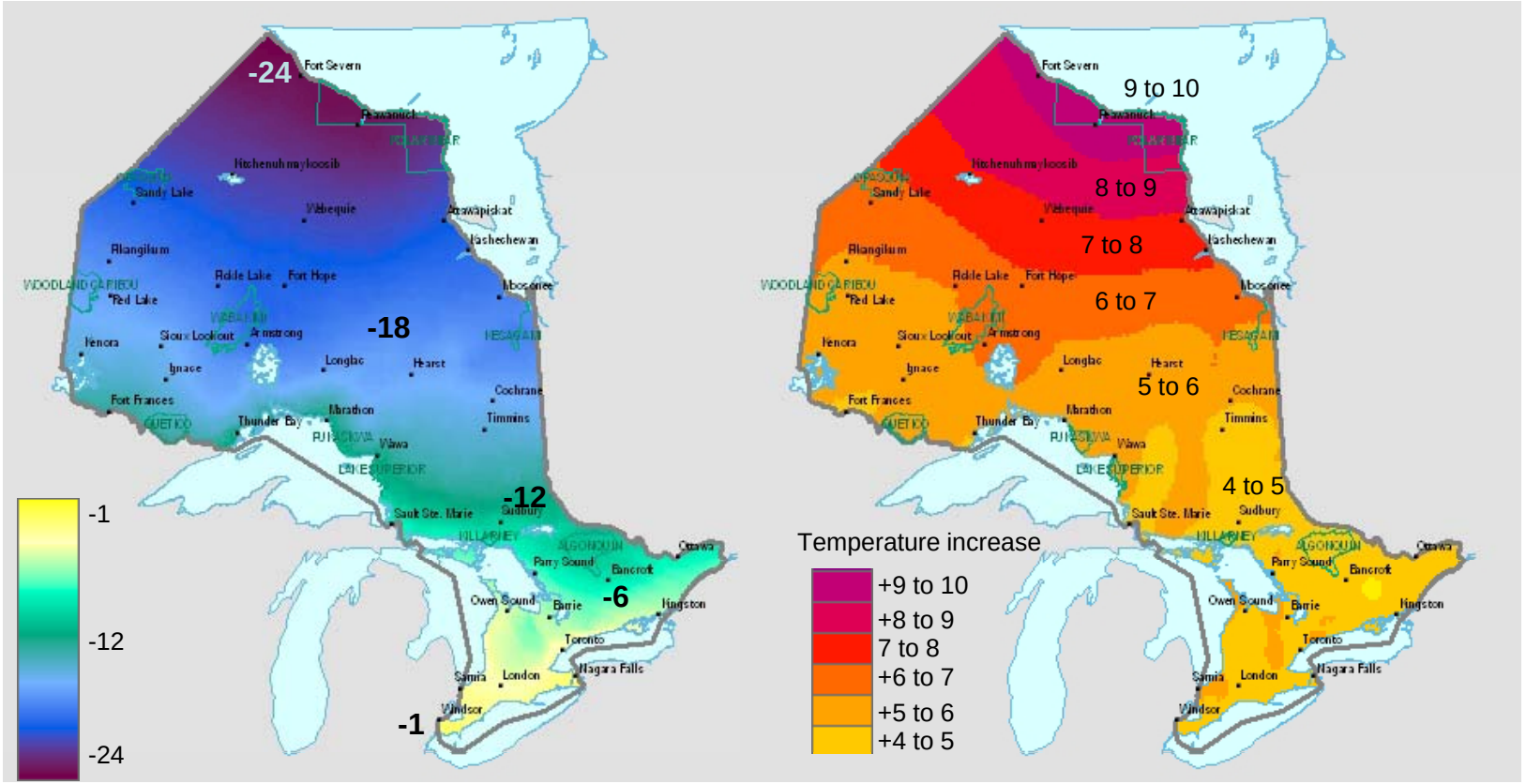


Multigas and CO_2 only studies combined

Winter temperature

Temperature 1971-2000

Change by 2071-2100

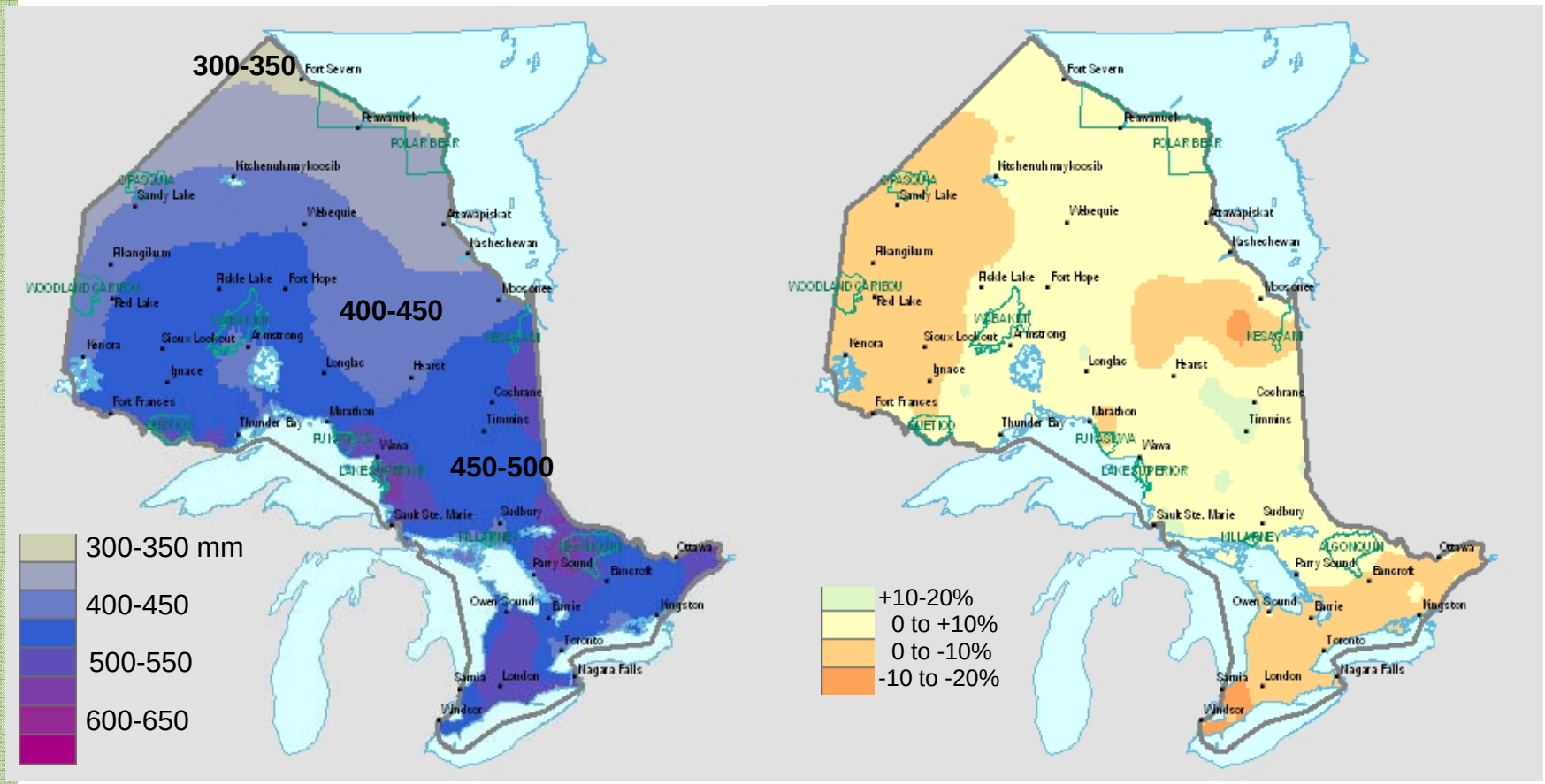


Average winter temperature, CGCM2, A2 scenario

Total warm season precipitation

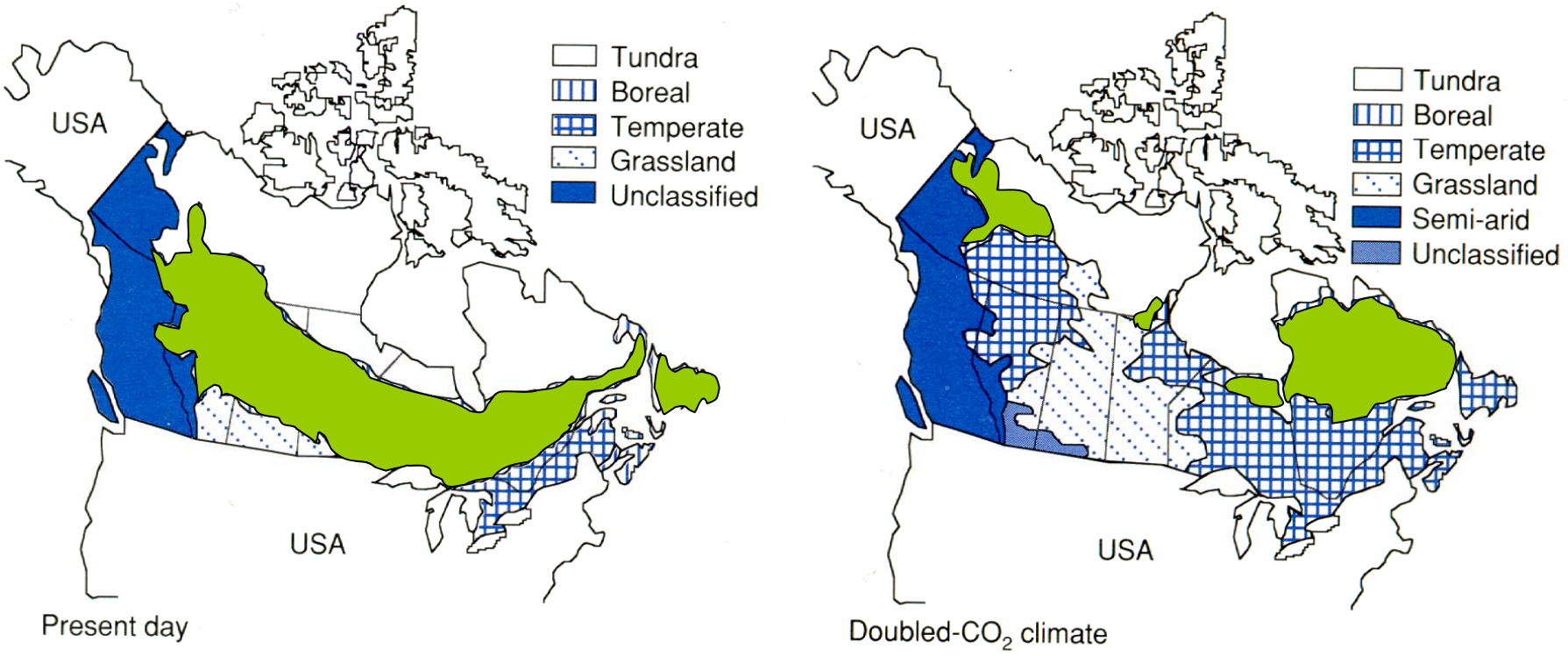
Precipitation 1971-2000

Change (%) by 2071-2100



Precipitation April-September, CGCM2, A2 scenario

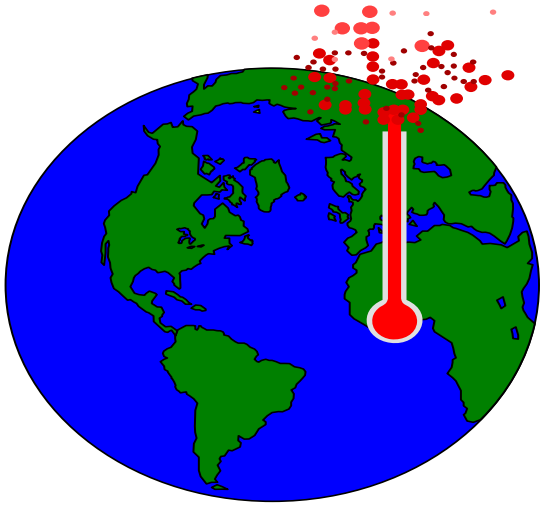
Species 'Climatic Range' Will Change



SOURCE: Rizzo 1990.

Future Climate Change and Impacts in Ontario

"Climate Change will significantly affect species (including humans), ecosystems, and most aspects of our society, including human health, the infrastructure we depend on for transportation, employment, clean water, energy production and distribution, agriculture and forestry" (IPCC,2001)

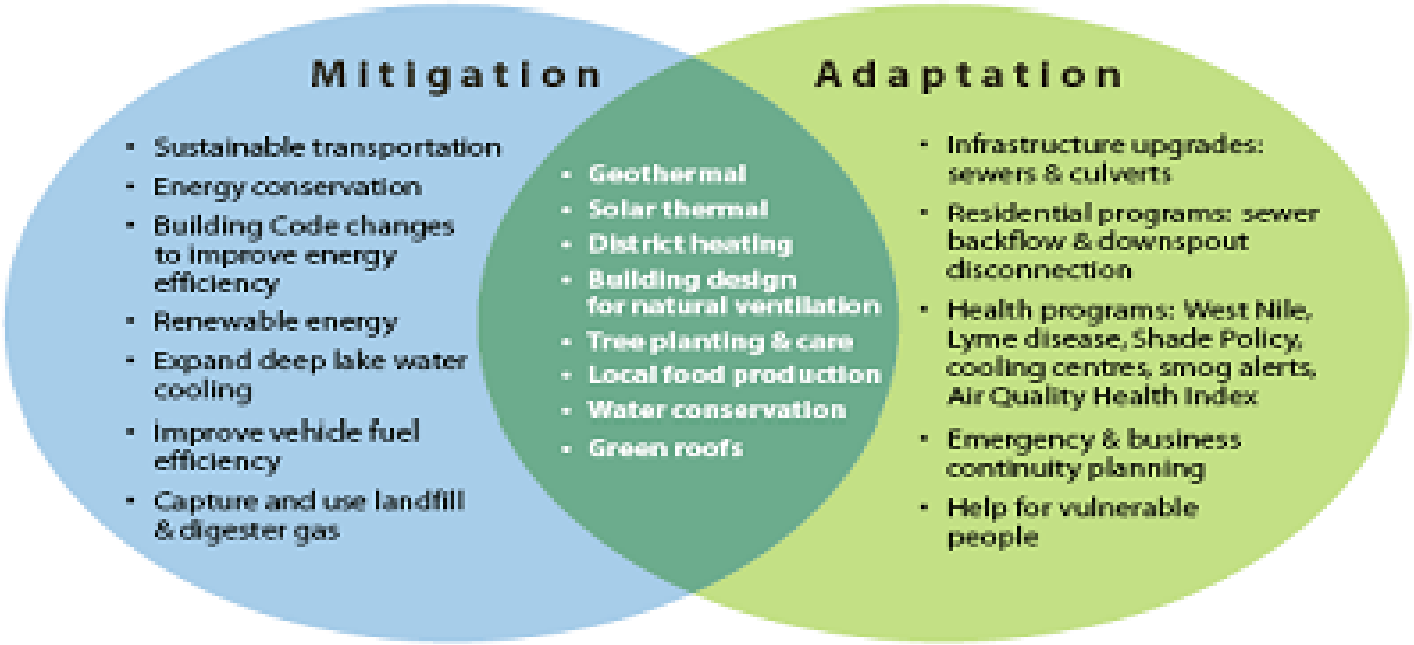


Contrary to popular belief, the impacts are projected to be widespread and not confined to the environmental sector

Climate Change and Our Built Infrastructure

- Frequency and/or intensity of weather extremes could increase
- Structural design criteria changed for new buildings
- Retrofit/redesign old buildings to withstand new extremes
- Less heating with warmer winters
- More cooling in summer with increased number of hot days
- Potential reduction in hydroelectric power generation
- Shift to alternative energy forms

Climate Change Adaptation Context



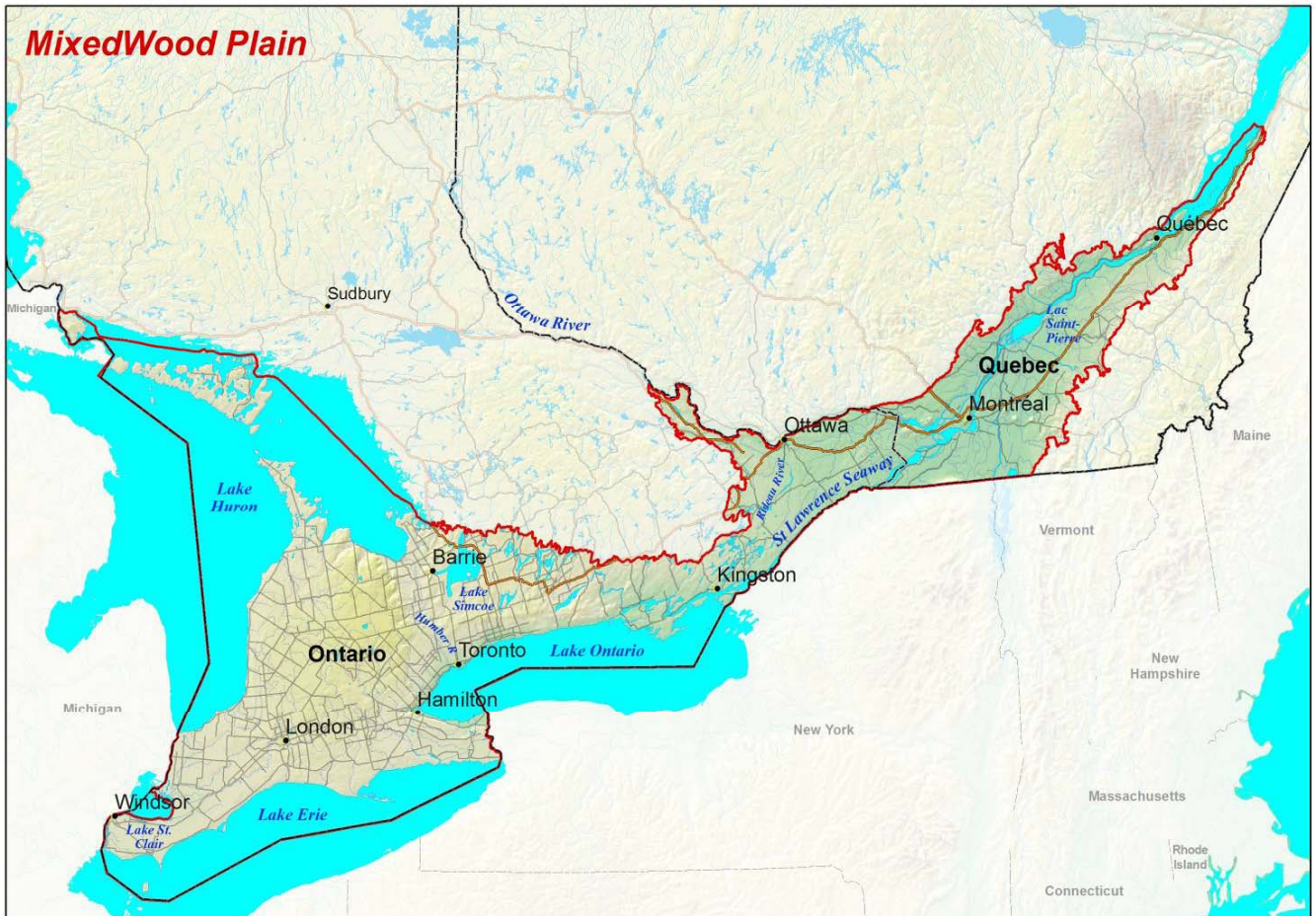
Mitigation: The globally responsible thing to do. Actions that reduce the emissions that contribute to climate change.

Adaptation: The locally responsible thing to do. Actions that minimize or prevent the negative impacts of climate change.


Biodiversity -- Species & Habitat Protection
Tourism & Recreation
Enforcement
Parks and Protected Areas
Algonquin
PROVINCIAL PARK
Alternative Energy
Land Management
Education & Extension
Solutions
Forest Management
Fire Management
Emergency Measures
Research
Water Management

Impacts of Climate Change on Ecosystems

Mixed Wood Plain Ecozone Ecosystem Status and Trends Report

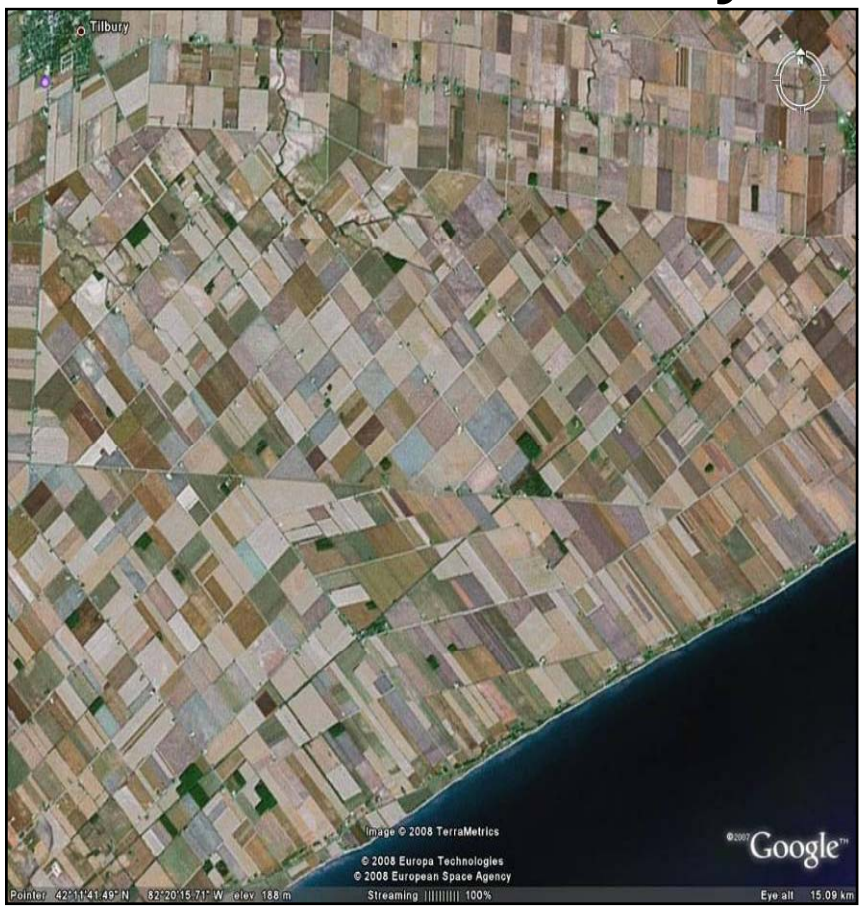


Ecosystem Structure – Key Findings

Google Earth Image of highly fragmented landscape near Ridgetown Ontario.

- The ecozone is highly fragmented
- The pattern of fragmentation is associated with physiography (rocky, steep, or shallow soiled areas have more natural vegetation remaining)
- Fragmentation is at a level that ecosystem functions may be being lost (ex: pollination)

Cumulative Human Impacts/Stewardship Key Findings



Landscape near Tilbury Ontario – Google Earth

Habitat Change Stress:

- Net loss of habitat –decrease in amount of natural area
- Loss of connectivity between habitat causing genetic isolation and localized extinctions
- Habitat deterioration from pollution and human use
- Urban areas have tripled, fewer sparsely populated areas, much more semi-urban land, with much of the land being converted from agriculture to urban use.
- Increases in farm size, overall decrease in amount of “farmland” but more land as “cropland” (intense management)
- The projected human population grow of 30% by 2031 will put huge stresses on the ecosystem and will likely only partly be mitigated through good community planning.

Global Change will have multiple interacting impacts on natural systems

:

Changes in productivity

- CO_2 fertilization
- Higher temperature
- N mineralization
- Longer growing seasons
- Changes in water balance (drought)

Migration of plant species (north and up)

Increased area burned by forest fires

Changes in insect dynamics

- Range expansions
- Life cycle changes
- Invasives

The rate of change is unprecedented

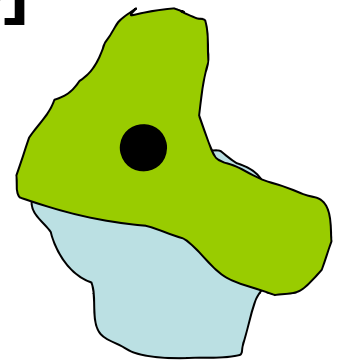
- species may not be able to adapt or migrate rapidly enough to keep pace with the change
- loss of wetlands and lower stream/lake levels
- threatened wildlife/fish habitat
- potential species extinctions
- increased invasive/alien species
- insect and disease outbreaks
- cumulative effect will be that ecosystems and biodiversity are stressed and threatened

Ecosystem Integrity will be challenged

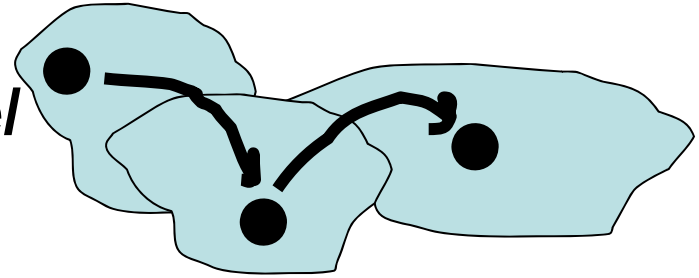
- Northward movement of the climate envelop of site districts character predicted +/- 3 km/year
- Tree species ability to migrate typically < 1 km/yr
- Habitats will change in unknown ways
- Reaction to changing climate will be species specific
- Adaptable species will be those that are mobile, able to tolerate wide ranges, high reproductive rate, not located primarily at the northern of southern limit of traditional range
- Less adaptable species will be those in fragmented or isolated habitats, low mobility, lack of genetic diversity, already at risk
- Disturbance vectors of invasive species, insects, disease and severe weather will play a role

Organism Response to Rapid Climate Change [Adapt, Move, or Die]

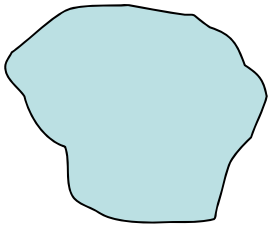
Adaptation/Micro-evolution

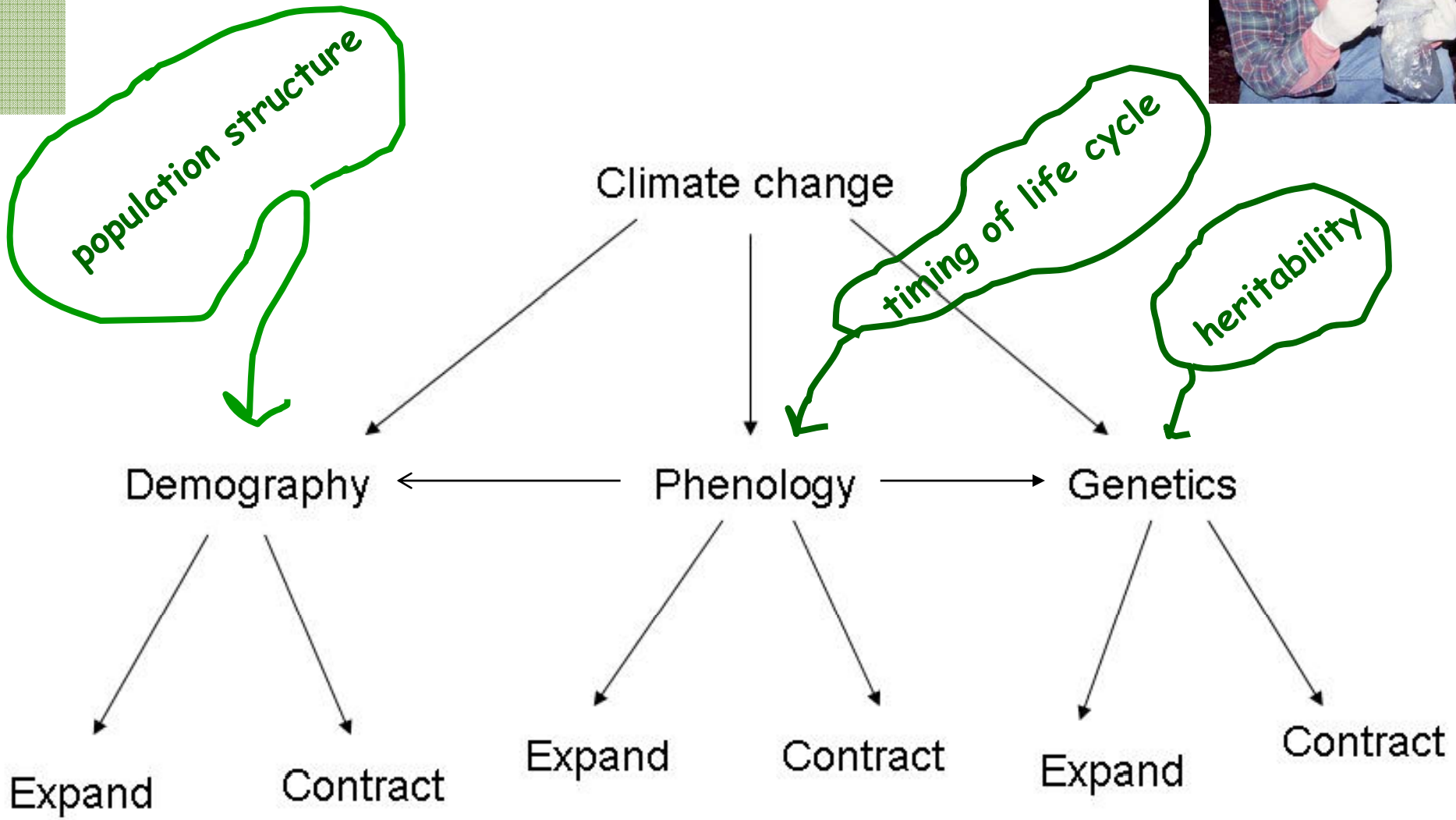


Home Range Change/ Migration



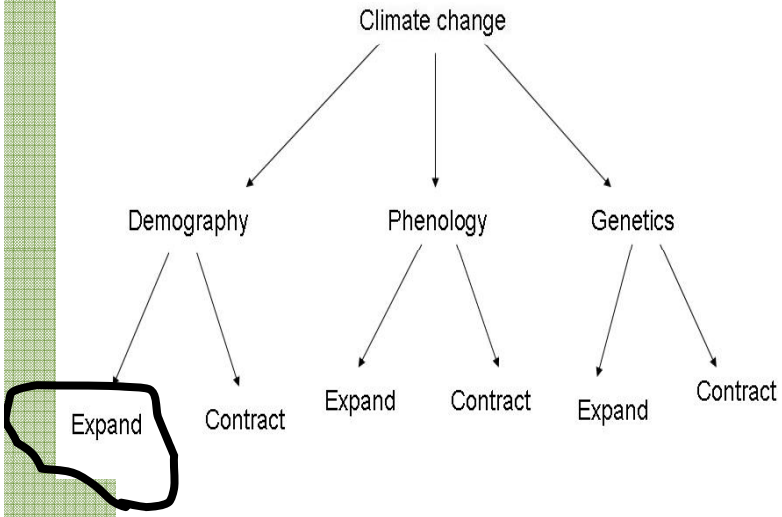
Extirpation/Extinction

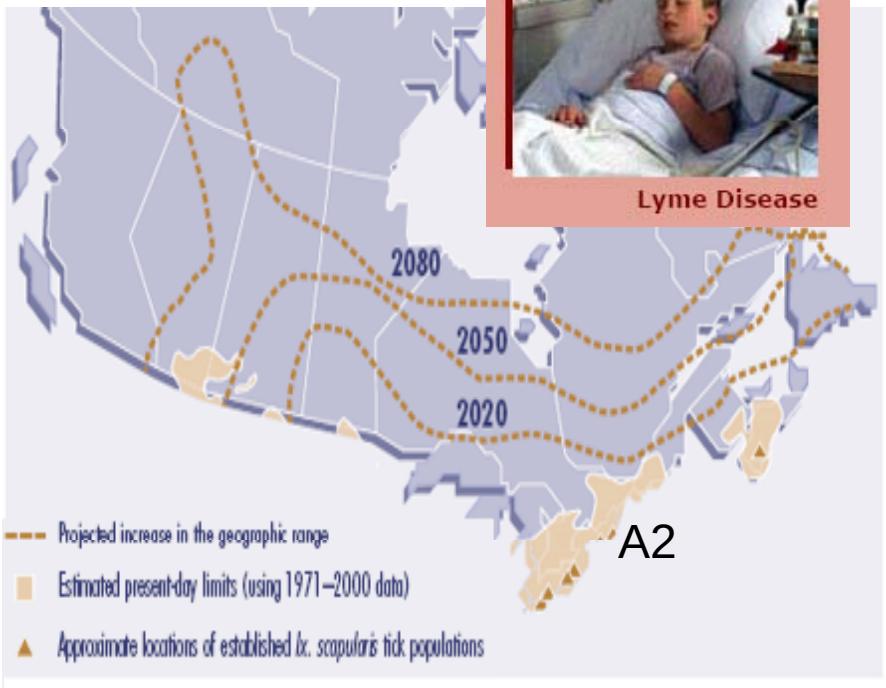




[Varrin et al., 2007]

Demography – expansion
Black-legged tick





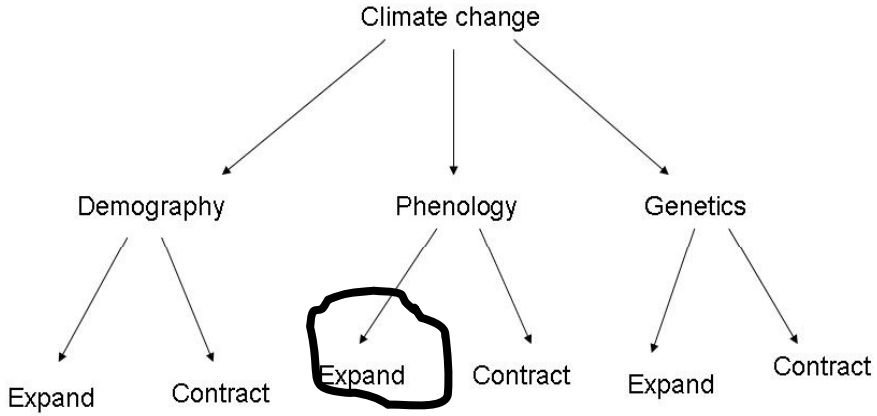
Known and potential effects

Ixodes scapularis is the vector for the causative agent of Lyme Disease in humans

Increased adult survivorship in winter leads to range expansion at northern boundary

Adapted from Ogden et al. 2006 Internat. J. Parasitol. 36: 63-70.

Phenology – expansion
Eastern bluebird



Known and potential effects

Eastern Bluebird is now migrating and breeding earlier due to warmer winters (Butler 2003, Torti and Dunn 2005)

May even begin to over-winter in some areas of Ontario where average January temperature does not fall below -6.7°C

Potential to expand number of broods produced in one breeding season, leading to range expansion

[Varrin et al., 2007]

Current Impacts on Canada's Forests

- Observed impacts already occurring
  - Increasing length of growing season 12 days between 1981-1999
  - Mean Spring thaw date 13 days earlier 1988-2001
  - Tree lines expanding upward in elevation
  - 2001-203 drought event of unprecedented length and extent
  - Increased fire incidence
  - Mountain pine beetle infestation in BC interior
  - Increasing severity of disturbance nation wide

Future Impacts on Canada's Forests

- Driven largely by increased disturbance, fire, drought, insects, and abnormally warm winters the following trends are forecasted
  - Forest land losses where moisture is limiting
  - Forest land gains where temperature is limiting
  - Change in proportion of non regenerated land
  - Change in species composition
  - Change in yield
  - New species introductions
  - Changes in structure and age class distribution
  - Increase in volume of salvage wood

Forest Sector Impacts

- uncertainty reigns but some things are known:
  - Current forest management tends to be prescriptive and deterministic and based on past historic patterns providing guidance to the future – relying on current practices of this nature will invite failure
  - Investments in forestry are long term and irreversible - Timber supply and productivity impacts will vary regionally and understanding probabilities and being able to monitor change is key
  - Current measures of sustainability will all be impacted (CCFM criteria)

Forestry/Carbon and Bio-energy

- In a carbon-constrained world, every sector of society will be expected to contribute to climate mitigation activities.
- Forest sector well positioned: forests sequester carbon and provide timber, fibre and energy.
- Forest products store carbon, and provide material to substitute high-emission products (steel, concrete, plastics).
- Forest biomass provides bioenergy – widely used already in forest industry.


Canada has wood!

Using more wood is a good thing to do!

Old forests hold more carbon but storage rates decline as growth slows

Young forests hold less carbon but absorb a lot to grow quickly

For overall health, some old forests have to die and be replaced by young vigorous forests, just like humans

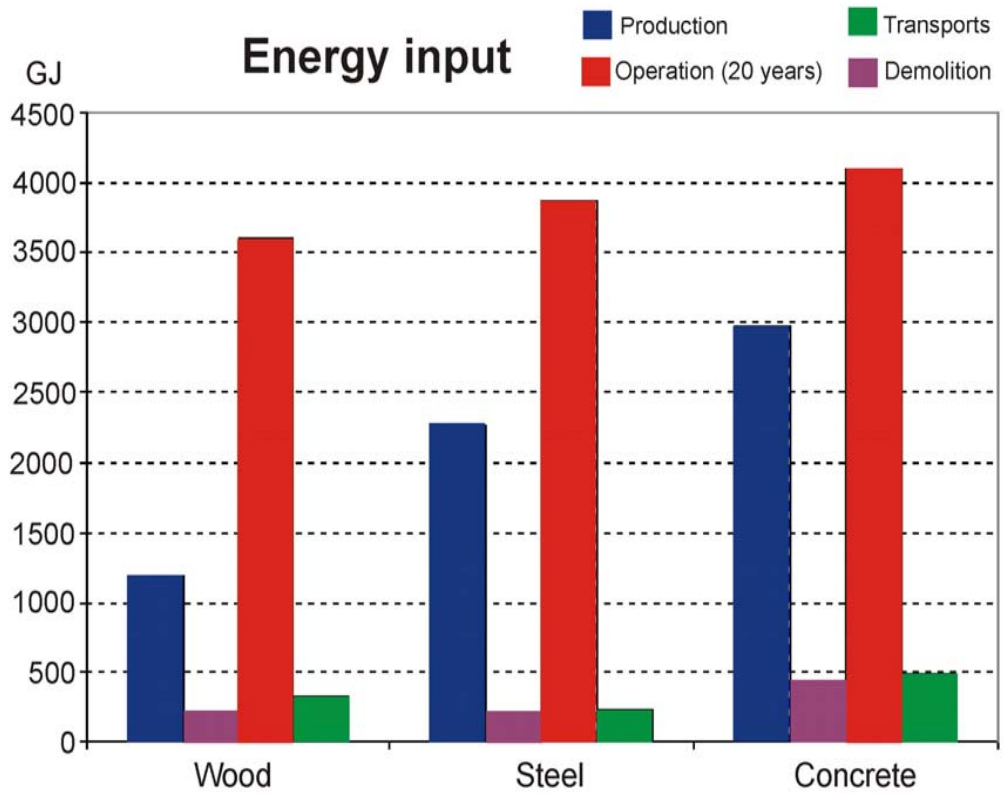
Nature does this using fire and other natural disturbance, which release CO2

Or it is done by harvest, capturing CO2 in forest products

Both result in new forests, but fire releases more CO2, while wood products store carbon for the long-term

[Source: S. Colombo]

Reduced emissions by using wood products – life-cycle assessment



From Scharai-Rad and Welling 2002, FAO.

Comparison of wood, steel, and concrete buildings of the same 1000 m² floor area.

Total energy input:
Wood: 5328 GJ
Steel: 6577 GJ
Concrete: 8003 GJ

Large amounts of CO_2 are released as concrete cures.

Using wood for energy after demolition would make the use of wood yet a better option.

Wood products – Long term carbon storage

Wood product type	Half-life of wood products (years)
Single-family homes	80-100
Multi-family homes	70
Mobile homes	20
Non-residential construction	67
Pallets	6
Furniture	30
Paper	1-6

Half-life is the time when half the carbon in a wood product placed in a particular use is no longer in use (based on Skog and Nicholson 2000)

Carbon storage in landfills

Landfill management: Waste dumped in landfills is periodically sealed with a layer of compacted soil or other impermeable material, allowing little oxygen to enter.

Decomposition:

- ✓ **Very slow.**
- ✓ **On average only a small portion (23%) of a wood product ever decomposes.**

Future waste management are likely to have more diversion of wood products and landfill methane capture for energy generation.

Summary

- ✓ **Managed forest in Ontario – C sinks:**

  Ontario's managed forests are projected to be a carbon sink in the 21st century

- ✓ **Wood products – Significant C sink:**

  Carbon storage in wood products and in landfills projected to increase significantly in 21st century

- ✓ **Reduced emissions:**

  Substitute wood products for other energy-intensive construction materials reduces carbon emissions

- ✓ **Avoided emissions:**

  Burning wood to generate energy offsets the use of fossil fuels

Sustainably managed forests contribute to mitigating climate change

In the long term, a sustainable forest management strategy aimed at maintaining or increasing forest carbon stocks, while producing an annual sustained yield of timber, fibre, or energy from the forest, will generate the largest sustained mitigation benefit.

(IPCC 2007. Climate Change 2007: Mitigation)

Ontario's Forest and Tree Species Vulnerabilities

- Increased fire incidence particularly in the NW including extreme years when fire in unmanageable
- Increased impact of insect pests spruce budworm, tent caterpillar, EAB, Gypsy Moth
- Expansion of tree species at the northern limit of their range
- Increase proportion of disturbance dependant species
- increased drought in the south will favour Red maple , Oak, White Pine over Sugar maple Hemlock in dry areas although overall Sugar maple has the greatest potential for range expansion northward
- Rate of change will prohibit a smooth transition of hardwoods into south boreal regions

Vulnerabilities Cont'd

- Shorter winter harvest seasons
- Reduced frozen ground period will require adjustments (better roads, low impact tire technology)
- Salvage opportunities will form a larger component of harvesting operations
- Nature based tourism to increase
- Snow and ice related activity to decrease
- Urban forests also face accumulation of stressors

Climate Change and Northern Communities

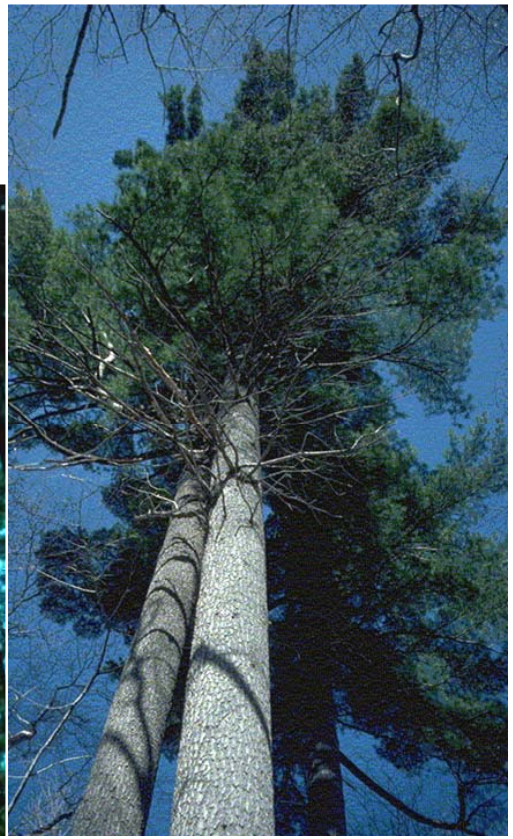
[Source: S. Colombo, 2006]

climate change may create an increase in the frequency of extreme events

2002 Halfway Lake Tornado

Afforestation in Southern Ontario

… a value added solution to many of our problems



Ontario's Afforestation history

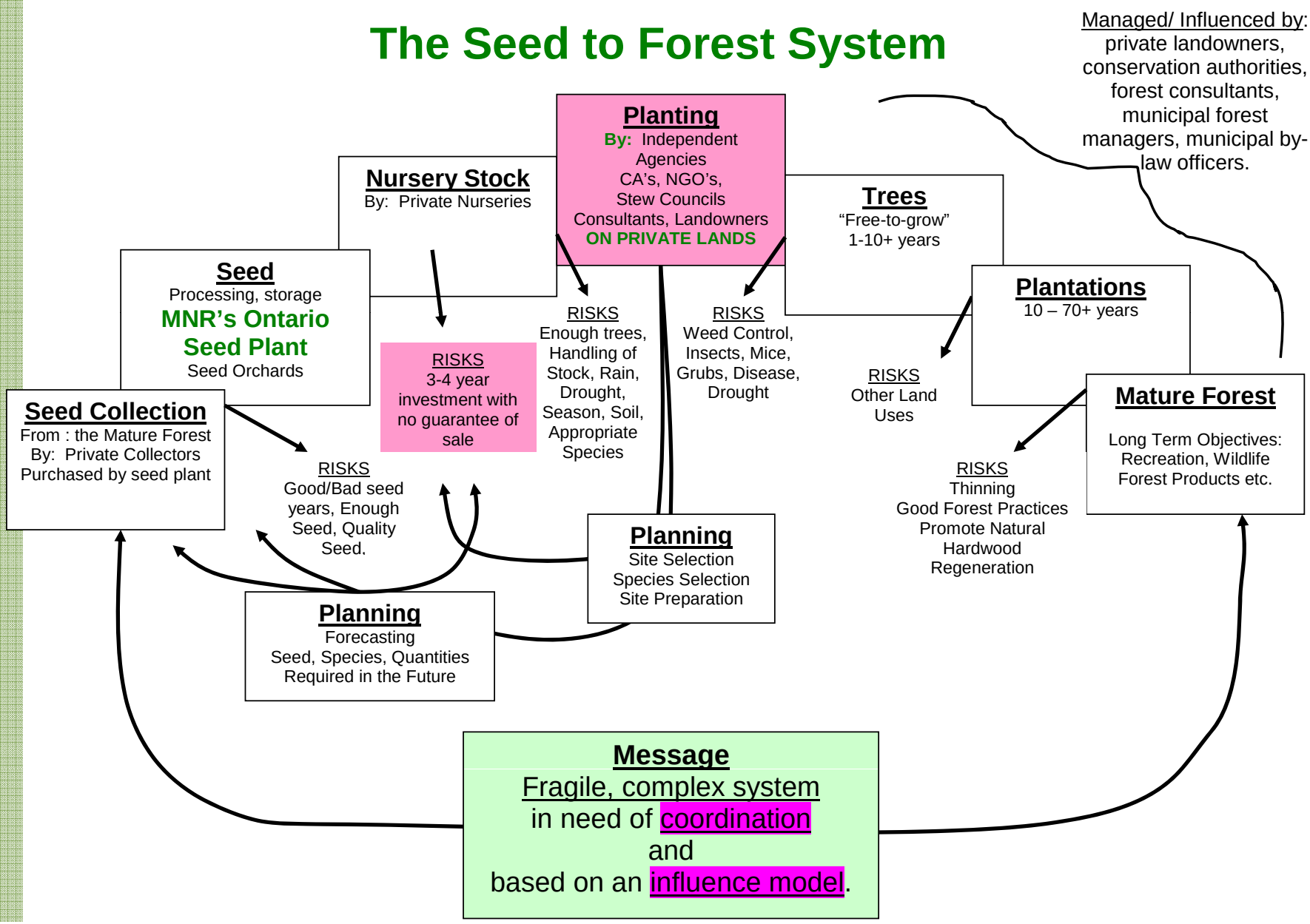
- Agreement Forests 1921-1998 130,000 ha
- WIA agreements 1966-1993 100,000 ha
- Provincial Nursery Production – 1 billion trees
- Extensive local landowner contact and education
- Science and Research - silviculture to tree improvement
- mid 80's – Ontario planted 10 to 18 million trees per year
- Landscape Restoration ~ Biodiversity Conservation ~ Economic Gain
- Results can be seen from space

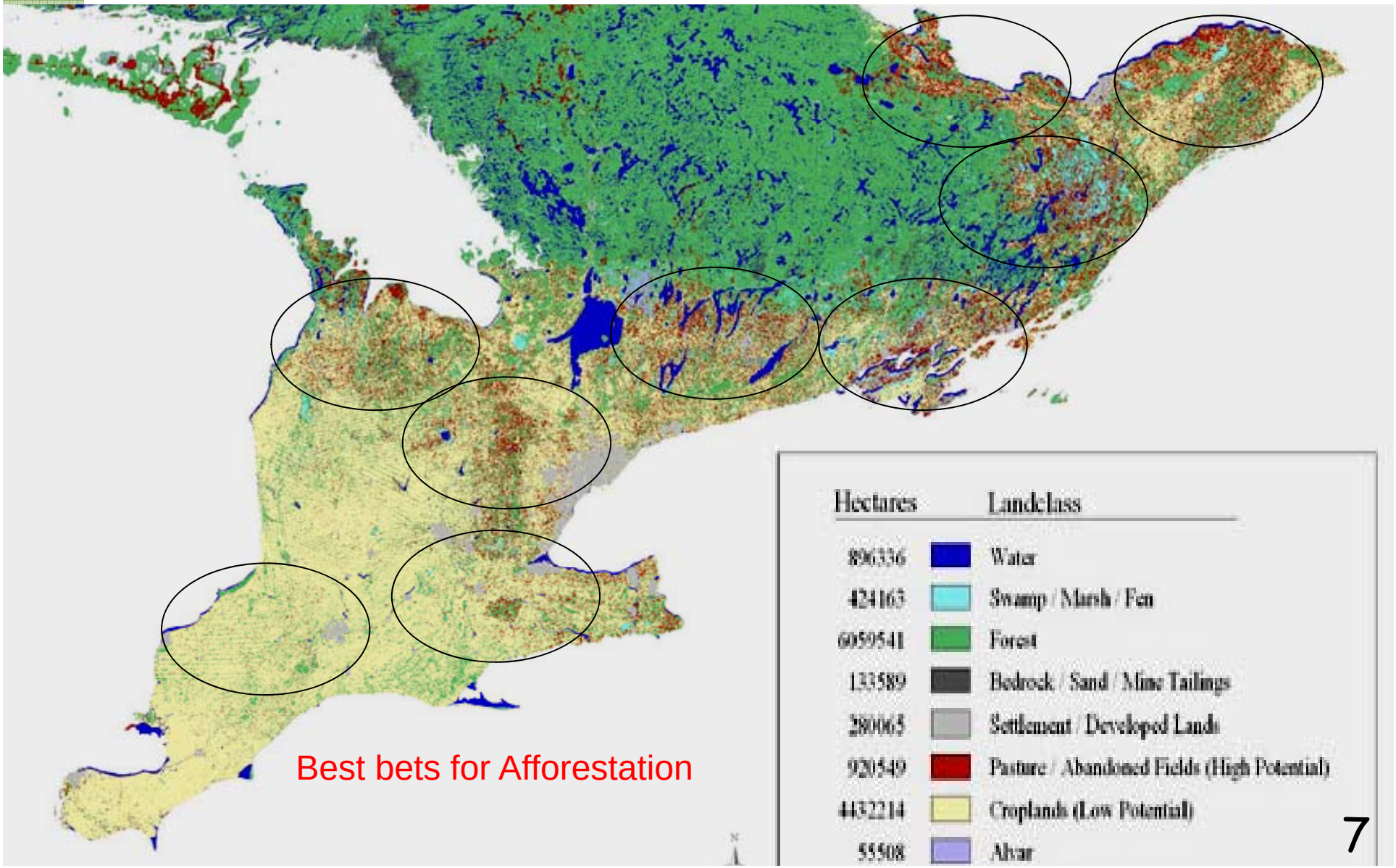
Private Land Forestry 1995-2005

A decade of reduced activity

- 1 to 3 million trees/year, due to
  - seed and stock supply and quality
  - higher private sector costs
  - short term funding for planting but not program infrastructure
- survival & growth results uncertain
- loss of expertise, infrastructure and capacity
- Some services to private landowners were maintained
  - MFTIP – an incentive to maintain, not reforest
  - FGCA – native species and seed source promotion, training
  - Ontario Tree Seed Plant - collection, processing, storage, training
  - Conservation Authorities extension and planting programs
  - Ontario Stewardship – some local planting

The Seed to Forest System




Hectares
Landclass
896336
Water
424163
Swamp / Marsh / Fen
6059541
Forest
133589
Bedrock / Sand / Mine Tailings
280065
Settlement / Developed Lands
920549
Pasture / Abandoned Fields (High Potential)
4432214
Croplands (Low Potential)
55508
Alvar
Best bets for Afforestation

50 Million Tree Program

- Ontario has committed to plant 50 million trees by 2020 as part of UN challenge to plant a billion trees worldwide (2M/yr initially, 5M/yr by 2013)
- Trees Ontario is the delivery partner
- The 50 MTP is an enabling program designed to assist conservation organizations to deliver a tree planting program to their client landowners
- Trees Ontario works through local Planting Delivery Agents (Conservation Authorities, Stewardship Councils and Contractors) to make local arrangements for tree planting
- PDA's are contracted to Trees Ontario to work with in program guidelines and get subsidized up to 1.25/tree
- Landowners pay .15/tree and sign an agreement to manage the trees for at least 15 years
- Sites must be a minimum of 2 ha, use native species best suited to the site and have a management plan

Urban Greening Initiative

- Ontario has committed to Greening our Cities and Towns
- Evergreen is the delivery partner
- Through the agreement with the MNR, Evergreen is facilitating the planting of 100,000 native trees and shrubs in 2008 and 2009.
- These trees will be planted in parks, school grounds, campuses and other publicly accessible green spaces and will help clean Ontario's air and water, provide shade and wind protection, and provide wildlife habitat.
- This program will provide funds to public agencies, institutional landowners and community organizations undertaking volunteer-driven tree planting projects in 2009. Grants awarded will range from $5,000 to $15,000.
- This partnership enables Evergreen to introduce an expanded range of tree-planting events, how-to resources, and educational workshops while offering new funding opportunities to Ontario municipalities, community groups, schools and others.
- Guidelines and application forms are available from the Evergreen website

Sustainablity depends on a mosaic of landuse that includes approximatley 35 % forest cover in most southern Ontario landscapes

Cap and trade – How does it work?

- Total emissions levels for industry are capped at a maximum allowable level that declines over time

- Total emissions allowed under cap are divided into 'allowances' that are distributed to emitters
  - By auction and some distributed at no charge
  - Scarcity of allowances creates a price for carbon based on supply and demand

- To comply, emitters need to have enough allowances or other equivalent credits to be within capped level through:
  - In house reductions through efficiencies (e.g. changes to production process)
  - Trading within cap and trade system where they can purchase:
    - allowances from auction
    - allowances from other regulated emitters with surplus allowances to sell
    - Offset credits from carbon reducing activities from non-regulated sectors
  - Other compliance opportunities (e.g. credit for early action)

What industries are typically in scope?

- **Large-emitters tend to be capped first:**
  - Electricity-generating
  - Petroleum Refineries
  - Chemical
  - Pulp and Paper
  - Upstream oil and gas
  - Aluminium
  - Cement
  - Iron and Steel
- **Phasing-in may occur for more challenging/complex sectors**
  - Transportation? Aviation?
- **Other sectors may not be capped but can still make reductions through offsets**
  - Agriculture? Forestry?

Ontario's approach to cap and trade

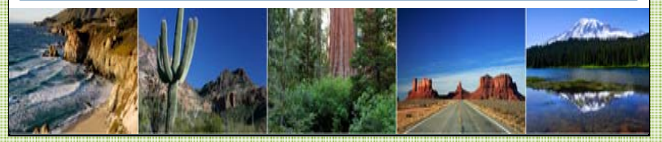
Go Green
Ontario's Action Plan
On Climate Change

- Ontario developing provincial system for 2012
- Within context of MOU with Quebec and role in WCI

TURNING THE CORNER
An action plan to reduce greenhouse gases and air pollution

- Canada developing federal system for 2010 but timing uncertainty
- Ontario plans to seek equivalency and work collaboratively

Western Climate Initiative



- 11 states and provinces developing a regional cap and trade system for 2012
- Ontario an active and lead member
- U.S. may use as model for components of federal system

Carbon Offsets

- Either a reduction in GHG emissions or carbon removal from the atmosphere, e.g. planting trees on previously cleared land
- Provides lower-cost compliance alternative
  - Encourages emission reductions beyond regulated industry
- Under cap and Trade, a regulated offsets system will be established to use standardized protocols, tracking registries
  - Considered more rigorous than voluntary market which is already active but lacks oversight, widely accepted standards, potential for double-selling, less transparency
- Offset system design being developed determining % use for compliance, types of projects and sectors in scope

Ontario's approach to offsets

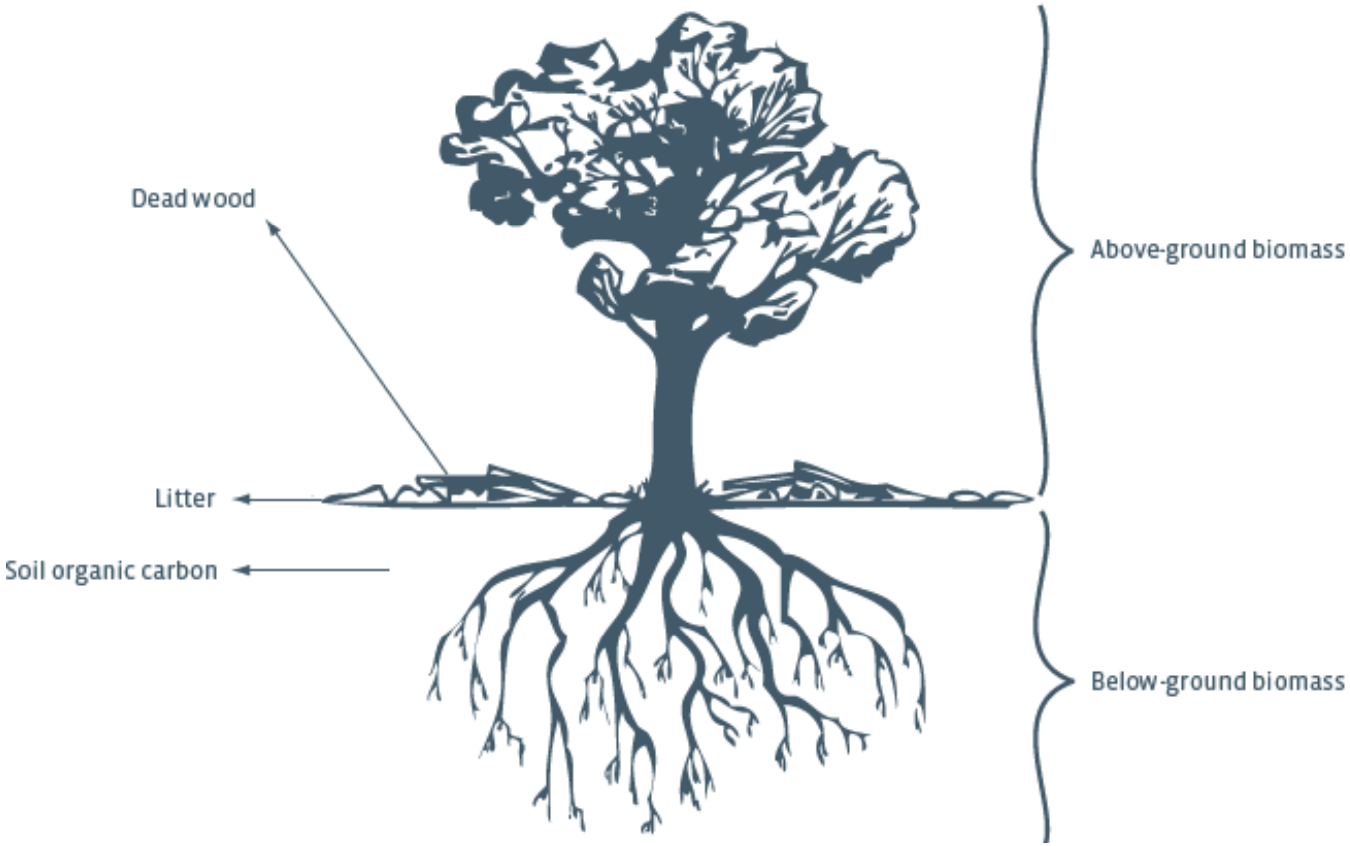
- MNR - Input on forest and land-based offsets
  1. Afforestation
     - *increases carbon storage through tree planting on non-forested lands*
  2. Forest management
     - *increases removals, reduce emissions, reduce risk of emissions through variety of activities*
  3. Avoided conversion of forests/conservation?
     - *avoids emissions via conservation of existing carbon stocks through protection of forests that are threatened by permanent conversion*
  4. Wetland restoration? Wetland conservation? Tall grass prairie restoration?

- MNR and opportunities to stimulate offsets in pre-compliance period
  - Examining protocols and guidance to give to project developers
  - Adapting draft afforestation protocol
  - Policy discussions on forest carbon management in relation to offsets
  - Draft CCFM forest management protocol framework

Carbon Offsets through Afforestation

Carbon Pools

- 5 main pools - Living trees and their roots are the biggest pool and are easy to measure



Afforestation Carbon Offset Credits

Removal of CO_2 from the atmosphere through creation of <u>new</u> forests that sequester and hold CO_2

- Planting trees on land that had no trees on it on Dec 31 1989
- Can be any cleared land but usually marginal/sub-marginal agricultural land

Basis for carbon offsets is growth in volume of trees

- Trees are approximately 50% water and 50 % solid matter
- Of the solid matter approximately 50% is carbon
- $1m^3$ of dry wood weighs ~500 kg which yields 250 kg of carbon
- To create 250 kg of carbon the tree extracts ~1 tonne of CO_{2e} from the atmosphere
- For hip pocket calculations $1m^3$ new wood = 1 carbon offset

Carbon Offset Credits and Afforestation

Private land projects are relatively small

- A 1 ha plantation will produce ~5.7 tonnes of offsets each year
- 1 tradable unit of offsets will be 10,000 tonnes of CO2e
- It will take ~1750 ha to produce 1 tradable unit of carbon offsets each year

Group approach may be necessary

- Provide technical services for management, measurement, verification, carbon offset aggregation and sales
- Average plantation size of 3 ha – 600 landowners required in a block to enter the market

A Forest Carbon Quantification Protocol will be required

- A ‘standard’ or ‘procedure’ that lays out how a project management team must establish and manage a forest carbon project in order to produce offsets that can be verified and sold

Carbon Credits and Afforestation Carbon Offsets

Additional Considerations

1. **Costs**
   - Measurement/Verification
   - Implementation
   - Administration
   - Subsidies
2. **Landowner Interest**
3. **Marketability**

2 Markets for Offsets

Compliance Market:

Cap-and-trade

- Emitters to reduce emissions to comply with targets
- Offsets produced and traded in conformity with a gov't approved protocol
- Will bring higher prices (~$20/t)
- Not yet in operation (2010-2012)

Voluntary Market

- Unregulated
- Based on a desire to do good (Corporate Social Responsibility)
- Protocols are not "approved by regulators"
- Irregular prices, some questionable products being sold.
- Now operating

Recommendations for the Forestry Sector

1. Actively promote Forest Management as an important part of our sustainable future
   - Managed Forests sequester carbon and provide timber, fiber and energy and a host of environmental goods and services
   - Forest products store carbon, and provide renewable material to substitute for high-emission products (steel, concrete, plastics).
   - Forest biomass provides bio-energy

2. Reduce uncertainty

- Enhance the capacity to undertake integrated assessment of vulnerabilities and various scales
- Increase resources for science, research, modeling and increase the capacity to monitor impacts

3. Review current policy, planning and forest management approaches for their ability to achieve social objectives under climate change

- growth and yield forecasts
- Timber supply analysis
- Reforestation options
- Protection planning (fire smart principles)
- modify sustainable forest management objectives

4. Embed principles of risk management and adaptive management in forest management planning

- Historical expectations and reactions to treatments may not apply
- Increased probability of disturbance will impact timber supply determinations
- Portfolio diversification; always wise may be imperative
- Contingency planning for unanticipated events
- Flexibility in decision making and management processes will enhance organizational resiliency

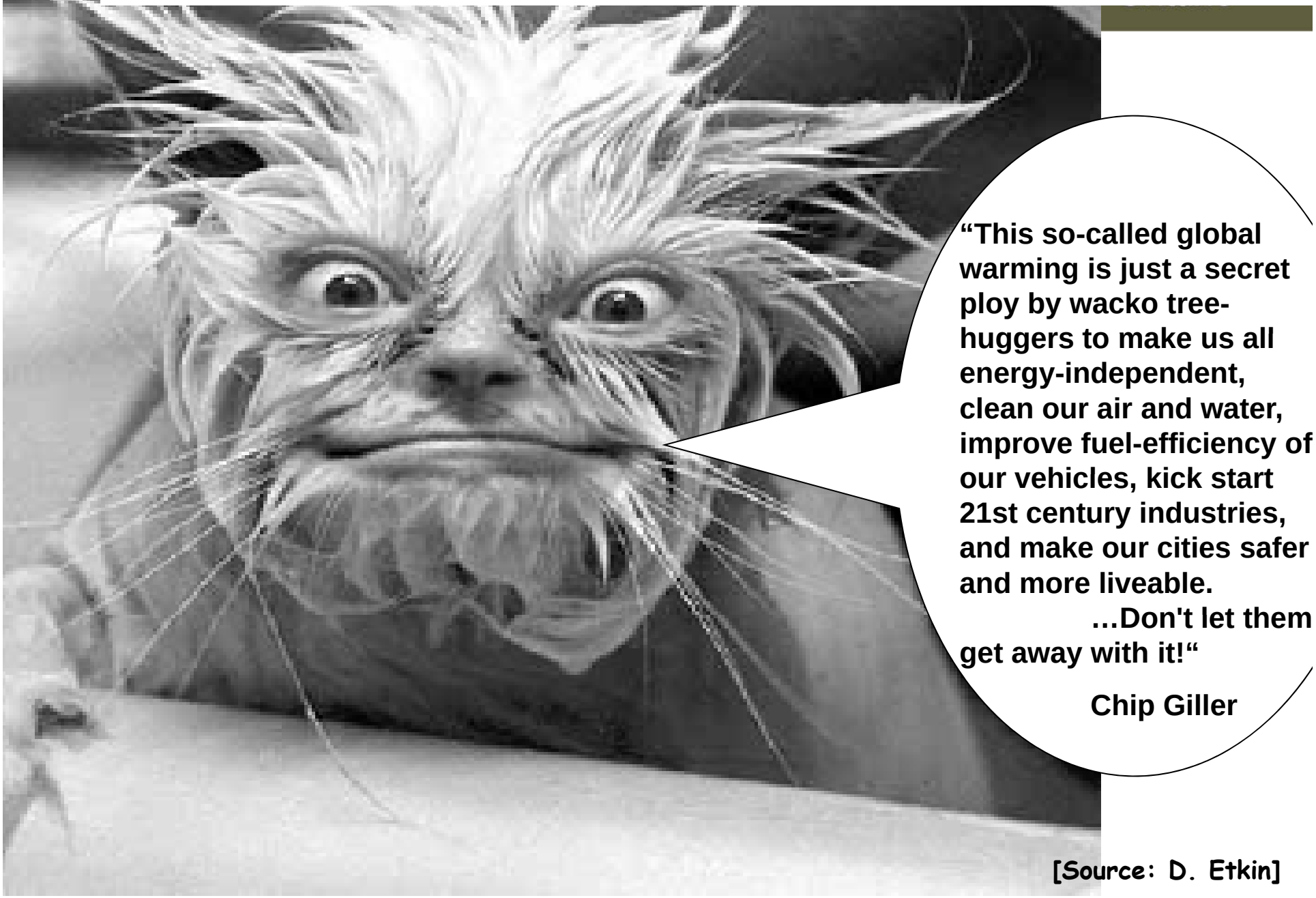
5. Improve communications, networking and information sharing

- Breaking down silos
- Building social capital and trust
- Networked organizations capable of cooperation and adaptive management will survive
- Isolated, rigid, traditional hierarchies will struggle

Recommendations for other aspects of work and life

- Every natural and social system will respond to climate change in a unique way.
- Human health will be an issue.
- Every sector will need to plan for a range impacts with a range of solutions and adaptation strategies that suit their unique situations.
- The concept/ideal/target of sustainability will change.
- Adaptive management, robust public-government partnerships, new thinking will be required
- A commitment to civic duty and participation is critical.

Now you know that Tree Planting is one of the best answers to the challenge of Climate Change …but of course there is always another view!



[Source: D. Etkin]

Summary

- Climate Change is likely the biggest challenge humanity has ever faced
- It is real, it is serious
- Significant changes to our social, economic and environmental systems are happening already and this will accelerate in the coming years
- The people in this room cannot solve the problem of fossil fuel emissions and energy use but we can play a significant role in “Adaptation” and “Enhancing the Resiliency” of our environment to the coming challenges.
- We need to get started!



Thank You !

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