

# Shorter lived climate forcers: Agriculture Sector and Land Clearing for Livestock

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# URGENCY

*“... global temperatures cannot now be stopped from rising by 4°C ”*

(Tyndall Centre for Climate Change Research, 2010)

## **Tipping points**

- Ice sheets melting
- Permafrost melting

## **Food Security**

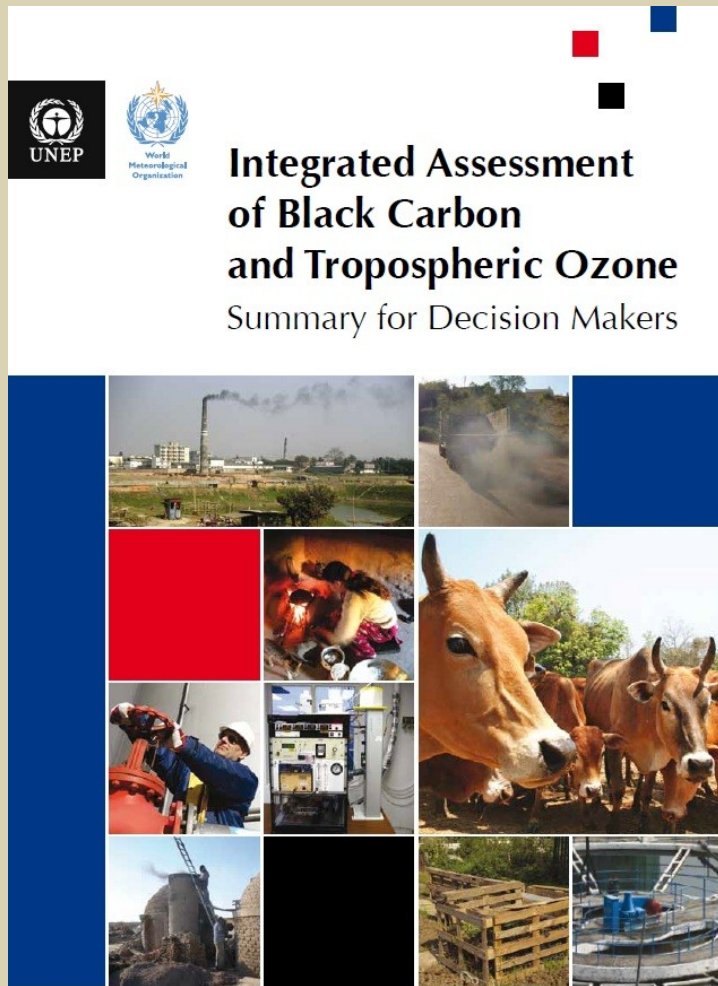
## **Water Security**

## **Climate refugees**

## **Health**

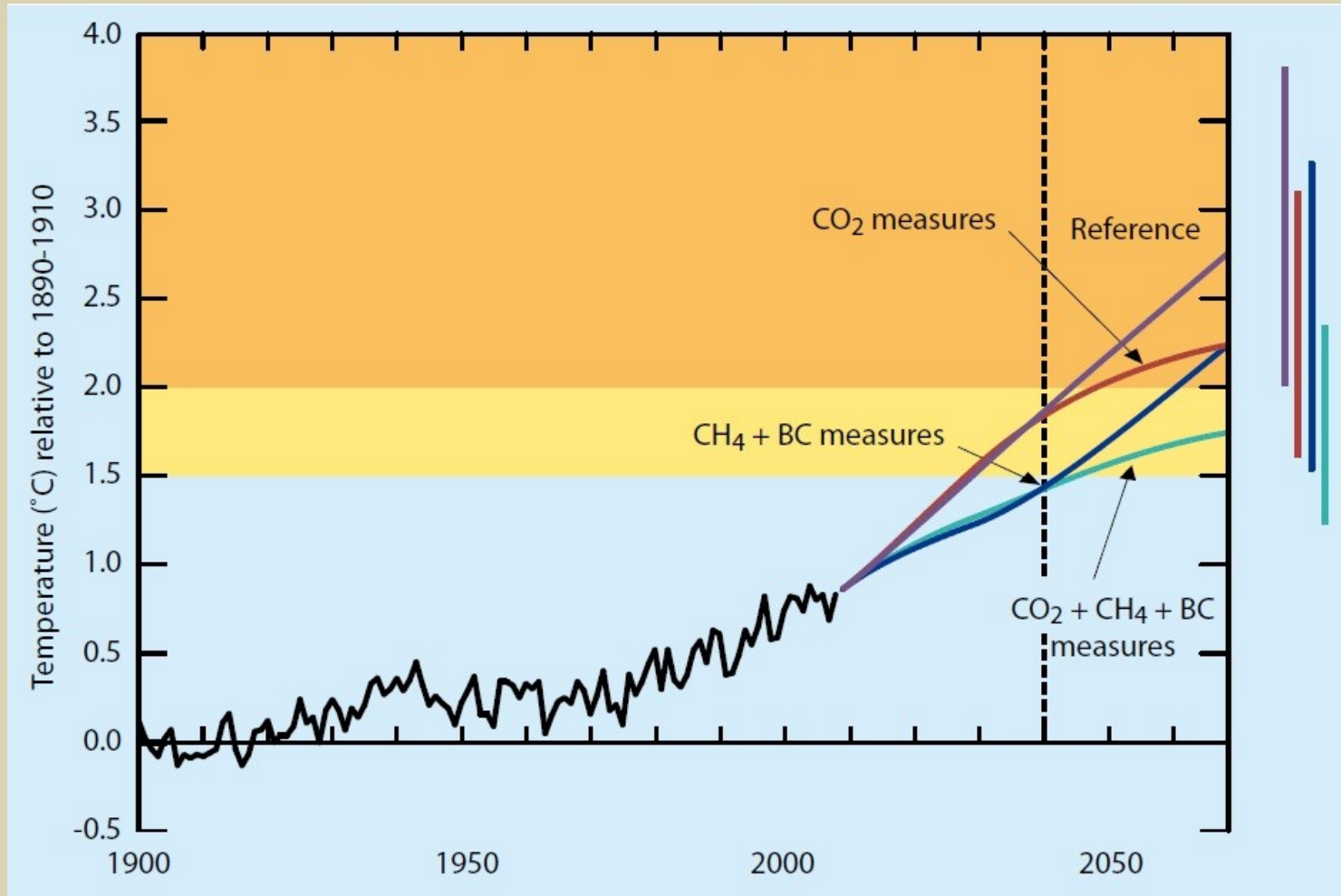
## **Catastrophic Climate Change**

# UNEP / WMO Report



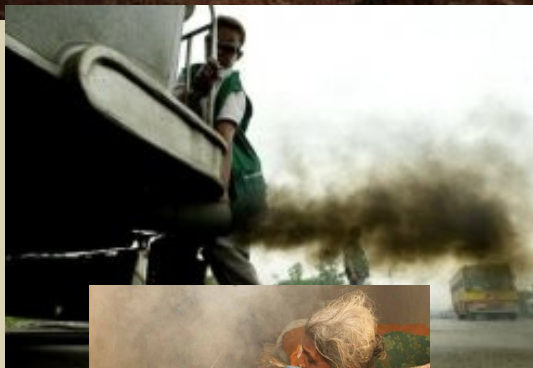
- 2011 report by 300 scientists
- UNFCCC goal of 2°C cannot be achieved with CO<sub>2</sub> reduction alone
- Black carbon, methane and trop. ozone hold the key

# Shorter-lived climate forcers



Source: Figure 3 of UNEP / WMO report on Black Carbon and Tropospheric Ozone, 2011  
(UNEP & WMO, 2011)

# Shorter-lived climate forcers



**Black Carbon**

**GWP<sub>20</sub> of BC : 1600**

(International Council on Clean Transportation, 2009)



**Methane (CH<sub>4</sub>)**

**GWP<sub>20</sub> of CH<sub>4</sub> : 72**

(IPCC 4<sup>th</sup> Assessment Report Climate Change 2007: The Physical Science Basis)

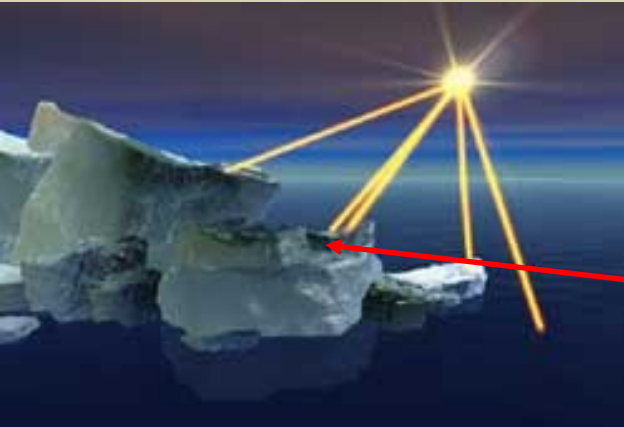


**Ground Level Ozone (O<sub>3</sub>)**

**Warming: 20% of that of CO<sub>2</sub>**

(Wallack & Ramanathan, 2009)

# Black Carbon



## BC warming impact two ways:

1. Through airborne particles absorbing light and warming the atmosphere
2. Particles deposited on ice surface generate heat and cause accelerated ice melt

**Mitigation initiatives to date:** cook stoves, diesel exhaust filters

## Large reduction in BC

### *Address open burning of agricultural lands*

- Over 42% of global BC emissions attributed to burning of forests and savanna. (Bond, 2007)
- 70% of world's agricultural lands used for livestock (UNFAO, 2006b)

## Ice Masses

BC responsible for 30% of Arctic warming. (Schindell & Faluvegi, 2009)

Other regions affected the Himalayas, the Swiss Alps & Antarctica

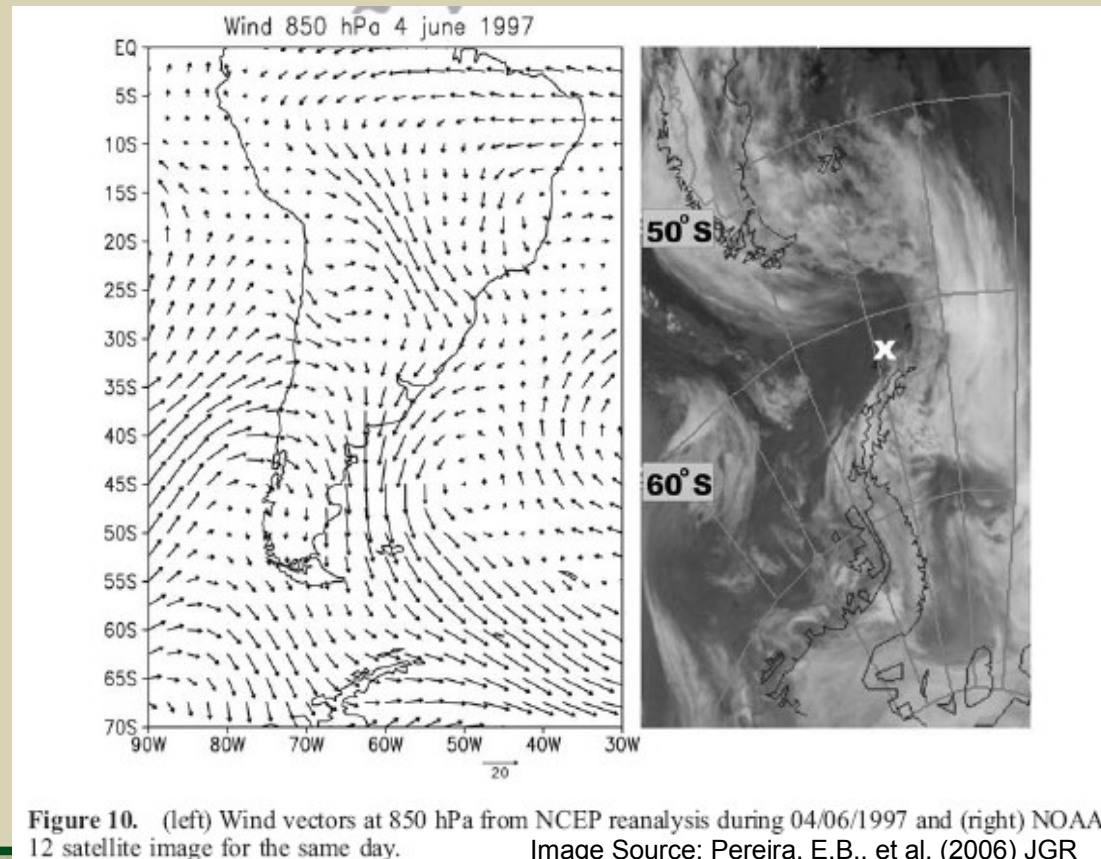
# Black Carbon in Antarctica

*“... the northern Antarctic Peninsula **warming faster than virtually any place on Earth.**”*

(Yale Environment 360, Nov 2010)

## From Brazilian Study:

- 50% of BC in Antarctica Peninsula attributed to burning biomass in South America (The Amazon, “Cerrado”, & the Coastal Atlantic Forest) (Evangelista et al, 2006)



**‘Cattle are responsible for about 80% of all deforestation’** in the Amazon region  
(Chomitz & Thomas, 2001)

# Black Carbon in Antarctica

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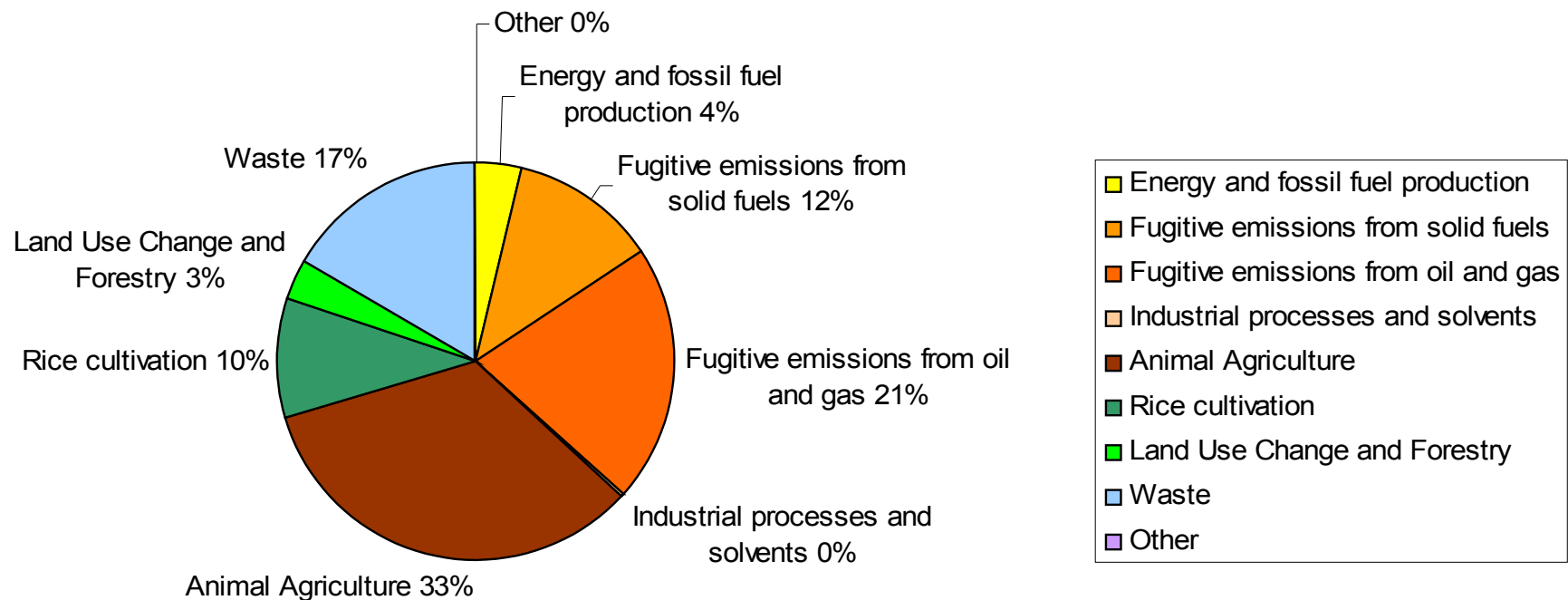


**40 to 60% of Black Carbon in  
the Antarctic Peninsula  
attributable to livestock rearing**

Image Source: NASA Goddard Space Flight Center/University of Washington/US Geological Survey

# Methane - global sources

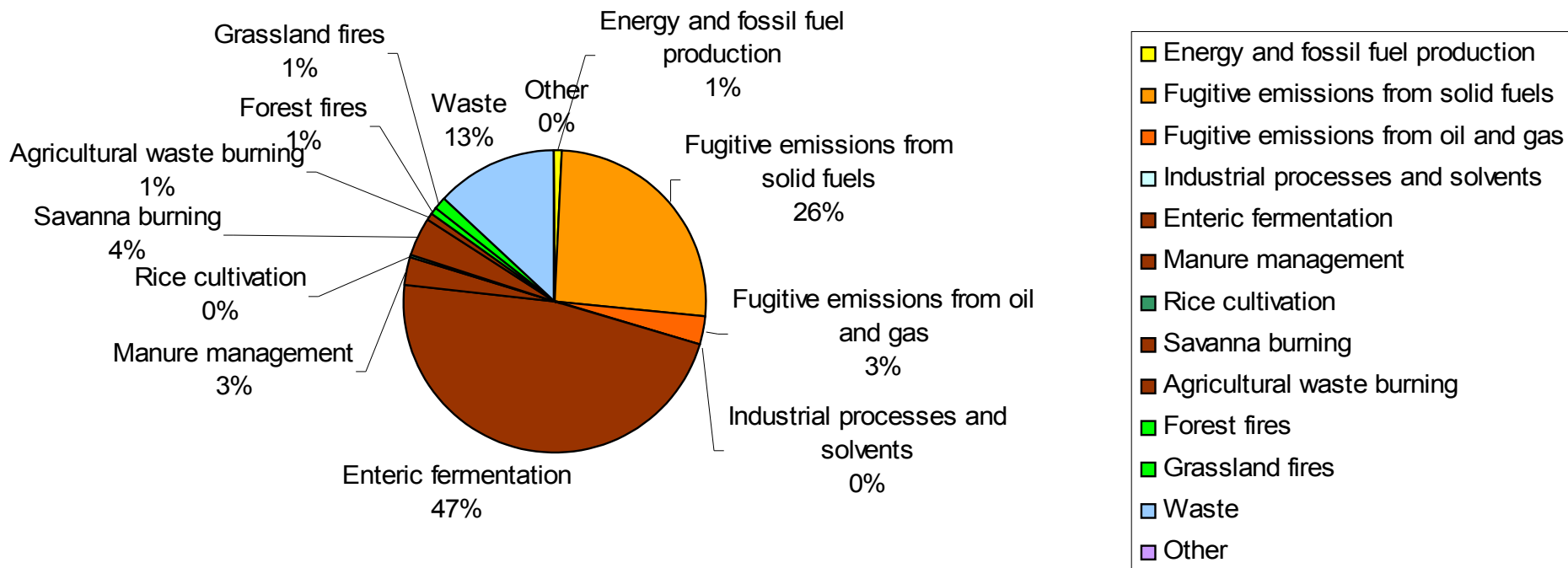
Global Anthropogenic Methane Emissions 2005



Source: European Commission, Joint Research Centre (JRC)/Netherlands Environmental Assessment Agency (PBL). Emission Database for Global Atmospheric Research (EDGAR), release version 4.1. <http://edgar.jrc.ec.europa.eu>, 2010

# Australia's Methane sources

Australia's CH<sub>4</sub> Emissions 2005



Source: European Commission, Joint Research Centre (JRC)/Netherlands Environmental Assessment Agency (PBL). Emission Database for Global Atmospheric Research (EDGAR), release version 4.1. <http://edgar.jrc.ec.europa.eu>, 2010

# Tropospheric Ozone

Tropospheric ozone – from interaction of sunlight with hydrocarbons (methane, VOCs) and nitrogen oxides

O<sub>3</sub> warming 20% of CO<sub>2</sub> (Wallack & Ramanathan 2009)

O<sub>3</sub> pollutant most powerful at reducing crop yield (UNEP & WMO, 2011)

O<sub>3</sub> best controlled by lowering methane emissions (Wallack & Ramanathan 2009), (Harvard University, the Argonne National Laboratory, and EPA (USA), 2002)



Ozone injury to yellow-popular



Ozone injury to milkweed

USFS

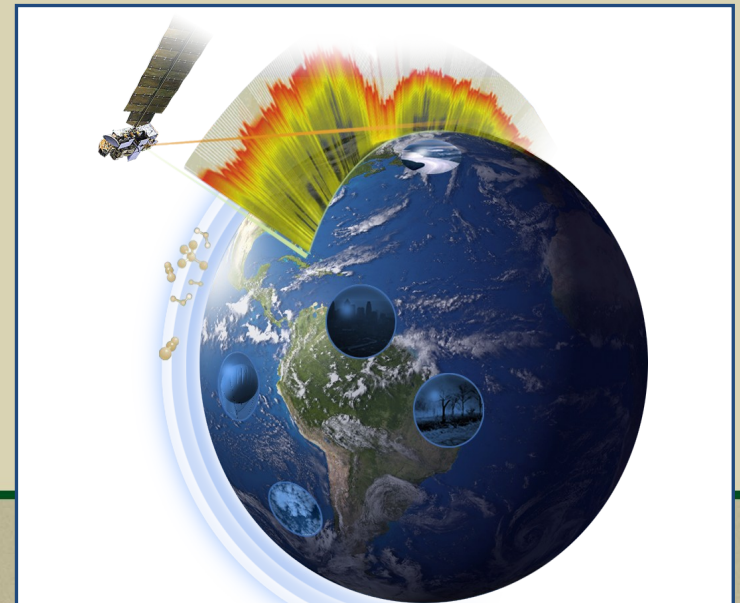
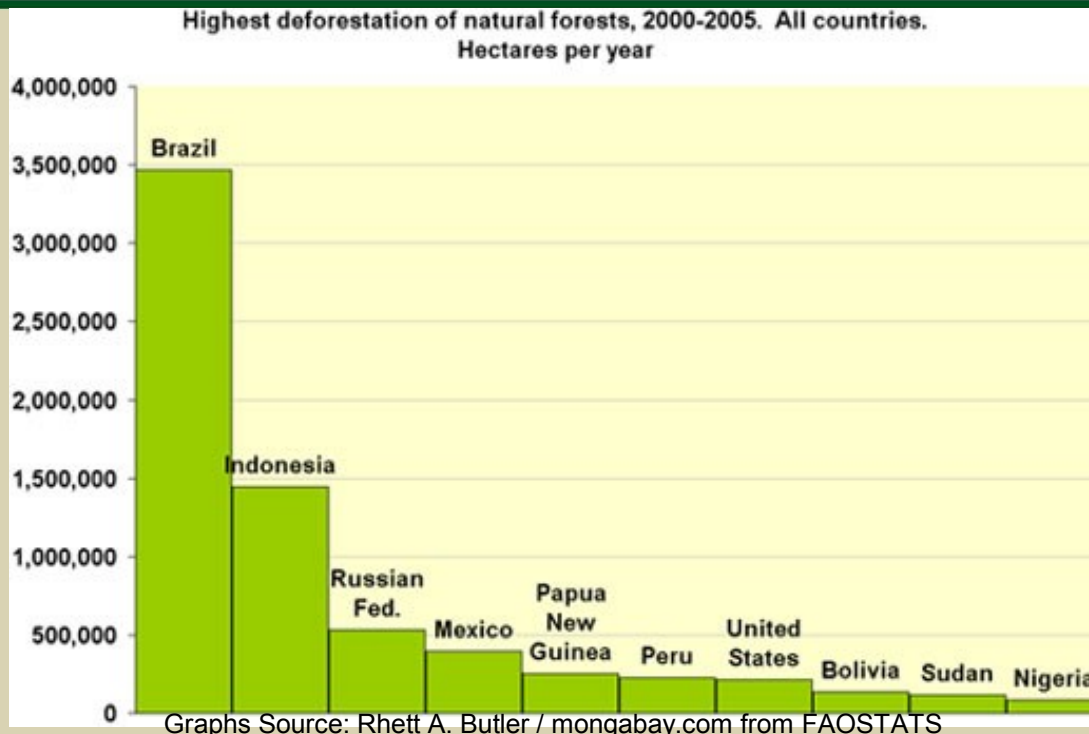


Image Source: NASA - Tropospheric Emission Spectrometer

# Deforestation



## Deforestation:

- 13 million Ha/year, (360x360km/year) (UNFAO, 2006a)
- 60-80% for animal agriculture (UNFAO, 2006a; McAlpine et al., 2009)
- releases 1.47 billion tons CO<sub>2</sub>/year (Houghton et al 2009)
- Produces 25-30% of global GHGs (UNFAO, 2006)
- large soil carbon loss from deforestation and grazing pressure (Lal, 2004)

# Reforestation





***... draw-down at least a decade of CO<sub>2</sub> emissions.***

(Fisher et al., 2007; Lal, 2004).



***10 year Acacia regrowth in arid tropics***



***5 year Rainforest regrowth in Queensland wet tropics***

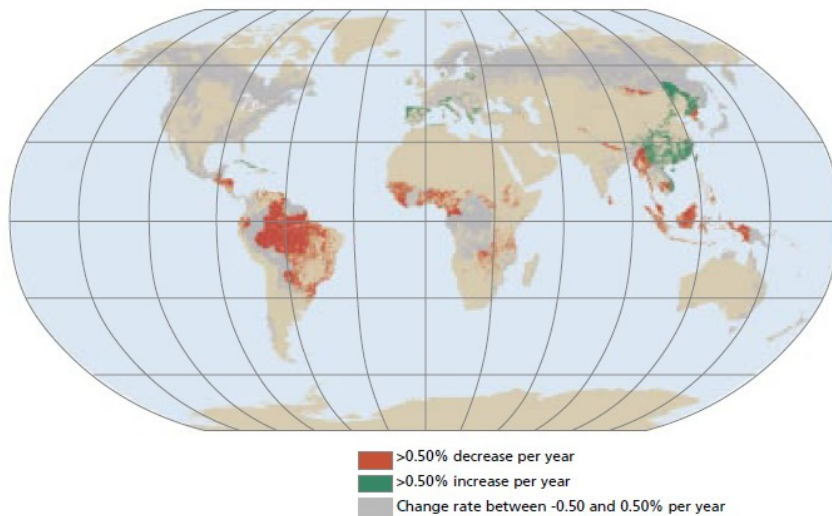
\* Opportunity to convert a major emission source into a major sink, particularly in the tropics and sub-tropics through natural re-growth

- 70% of global agricultural land is used for livestock (30% of the earth's land surface) (UNFAO, 2006b)

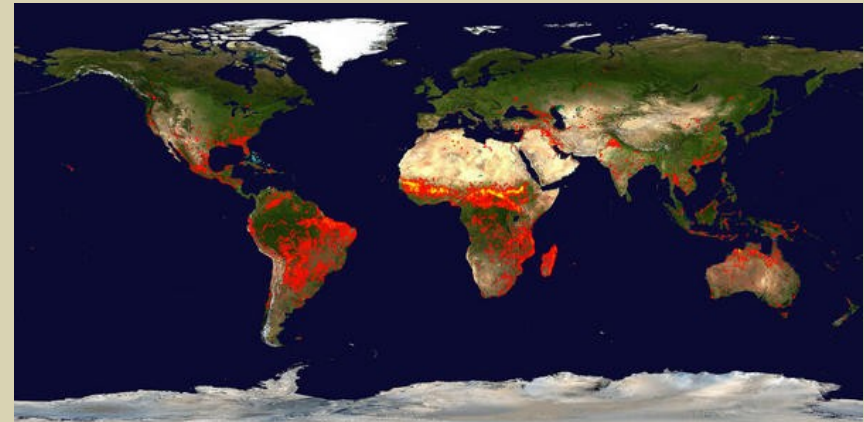
# Deforestation and Fire

- Tropical and sub-tropical fires closely match deforestation patterns
- Fire retards tree re-growth & encourages pasture growth

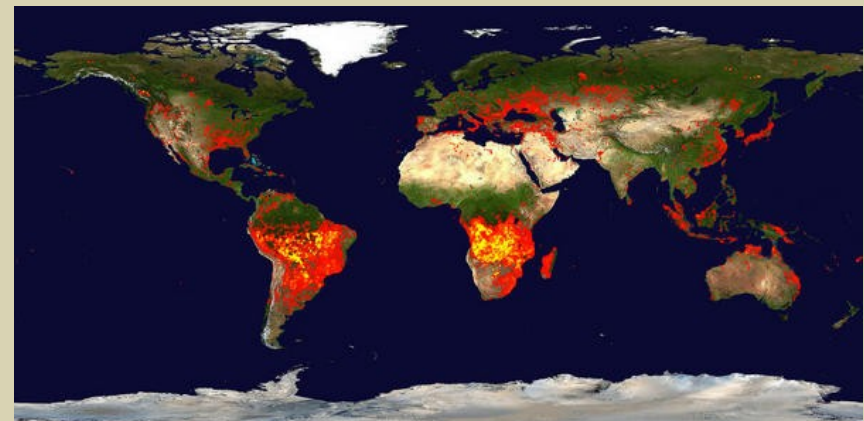
FIGURE 5  
Countries with large net changes in forest area 2000–2005



Deforestation 2000-2005



MODIS fire map 19/08/2010 to 28/08/2010



MODIS fire map 17/11/2010 to 26/11/2010

# Deforestation and Fire

- 80-90% of fires are deliberately lit (Lauk & Erb 2009)
- Anthropogenic fires release ~ 15% of global CO<sub>2</sub> emissions  
(van der Werf et al 2009)



# Population pressure?

## Livestock dominate global population pressure

- 1.4 billion cattle raised, 51.5 billion chickens, 2.6 billion ducks, 1.1 billion rabbits, 1.3 billion pigs, 1.1 billion sheep, 868 million goats, etc... (FAOSTAT, 2009)
- Humanity consumes **12%** of Net Primary Production (NPP), **Livestock consume 58%**
- Livestock provide humanity **17%** of our calorie intake (fish 1%)
- Livestock outweigh wildlife 8:1
- Livestock consumes 6 times megafauna use



*UNEP 2010: “A substantial reduction of [climate & environmental] impacts would only be possible with a **substantial worldwide diet change, away from animal products.**”*

## Livestock agriculture contributes:

- 40-60% of the BC particles in Antarctic Peninsula
- Largest methane source (indirectly largest trop. ozone driver)
- 65% of nitrous oxide emissions (UNFAO, 2006b)
- 60-80% of deforestation
- ~ 80% of open fires (CO<sub>2</sub>, methane, BC)
- Large proportion of soil carbon loss (Lal, 2004)

## Potential gains:

- up to 70% of agricultural land freed for reforestation and soil carbon capture
- Sea level - Slow down rate of ice melt
- Decrease in biodiversity loss, land degradation, soil salinity, deforestation, cleaner water systems etc. (Wedderburn-Bisshop & Pavlidis, 2010)
- Healthier people, cleaner air
- Abatement costs minimised:
  - low-meat diet 50% mitigation costs saving
  - no-meat diet 70% mitigation cost saving
  - animal free diet 80% mitigation cost saving (Stehfest, E., et al, 2009)

# Policy measures

- Halt “perverse” (UNEP 2010) subsidies on livestock production
- Promote plant-based alternatives
- Protect and restore regrowth forests in grazing lands and reduce anthropogenic open burning
- Fund alternative land uses, eg tree carbon sequestration, organic farming



*Window of opportunity  
- it's not too late*

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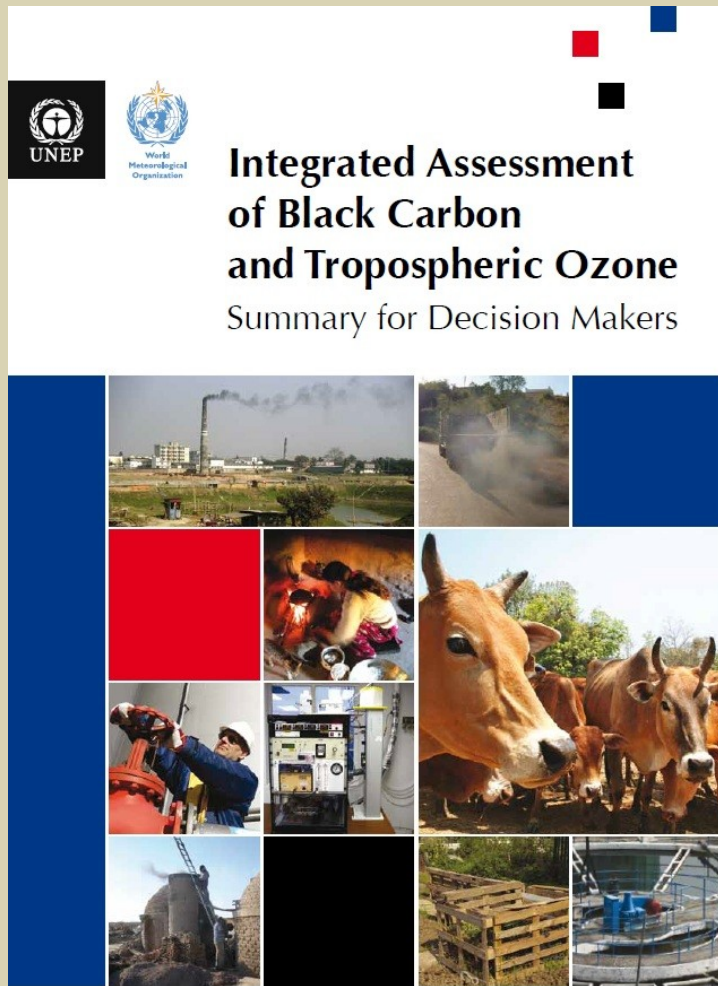
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Additional Slide ....

# UNEP / WMO Report



*“Both near-term and long-term strategies are essential to protect climate.*

*Reductions in near-term warming can be achieved by control of the short-lived climate forcers whereas carbon dioxide emission reductions, beginning now, are required to limit long-term climate change. Implementing both reduction strategies is needed to improve the chances of keeping the Earth’s global mean temperature increase to within the UNFCCC 2°C target.”* (UNEP & WMO, 2011, p.3)