

# Acid Deposition

ESS 2018



# Learning Objectives

I will be able to...

**Outline the formation of acid deposition(s)**

**Describe the effects of acid deposition on the environment and societies**

**Evaluate management strategies to reduce and eliminate acid deposition**

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# Acid deposition is serious because it...

can wipe  
out food  
webs in  
hours...

## Critical pH Levels for Aquatic Organisms

Animal	Critical pH Level
Snails	6
Clams	6
Bass	5.5
Crayfish	5.5
Mayfly	5.5
Trout	5
Salamanders	5
Perch	4.5
Frogs	4



and ecosystems in a few  
years.

# Acid Deposition

Summarise the formation of acid deposition and effects on forests and toxicity from:

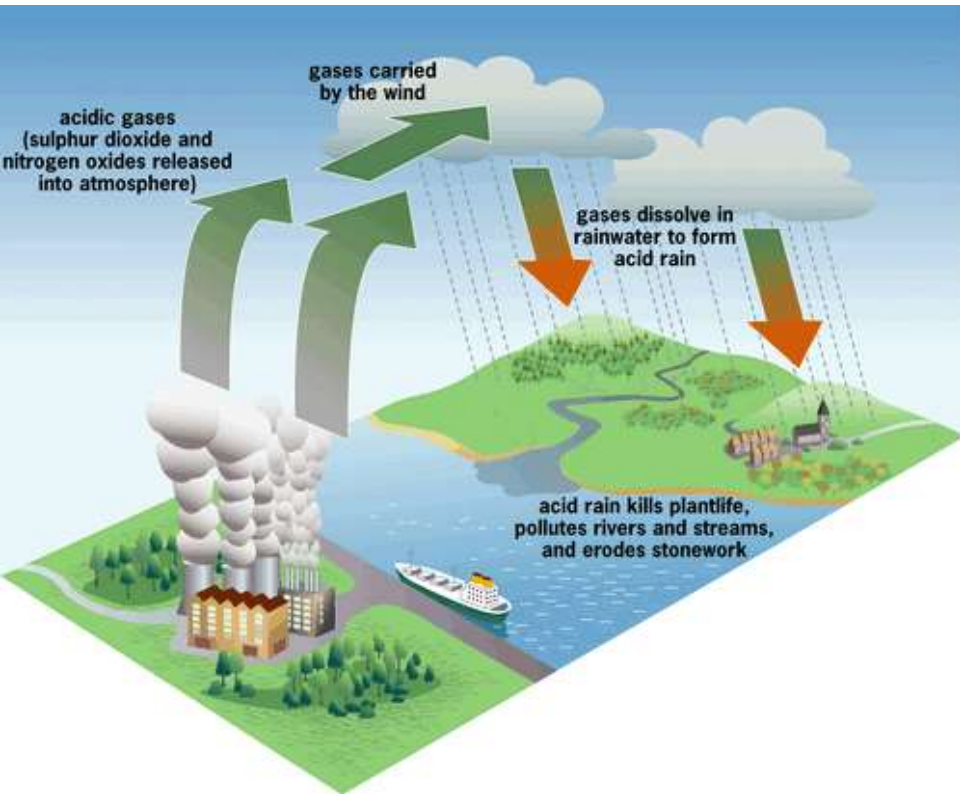
1. <https://www.youtube.com/watch?v=lWFXhKyzmZo>

2. Textbook pg 292-296

<https://www.youtube.com/watch?v=lWFXhKyzmZo>

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# Regional Effects of Acid Deposition



- What are the ethical arguments around acid deposition?
- What are the key challenges to managing acid deposition?

# Regional Effects of Acid Deposition

Acidic compounds travel only a few thousand kilometres at most

⇒ Regional rather than local or global focus

## **Dry deposition**

= close to source

= primary pollutants

=  $\text{SO}_2$ ,  $\text{SO}_3$ ,  $\text{NO}_x$

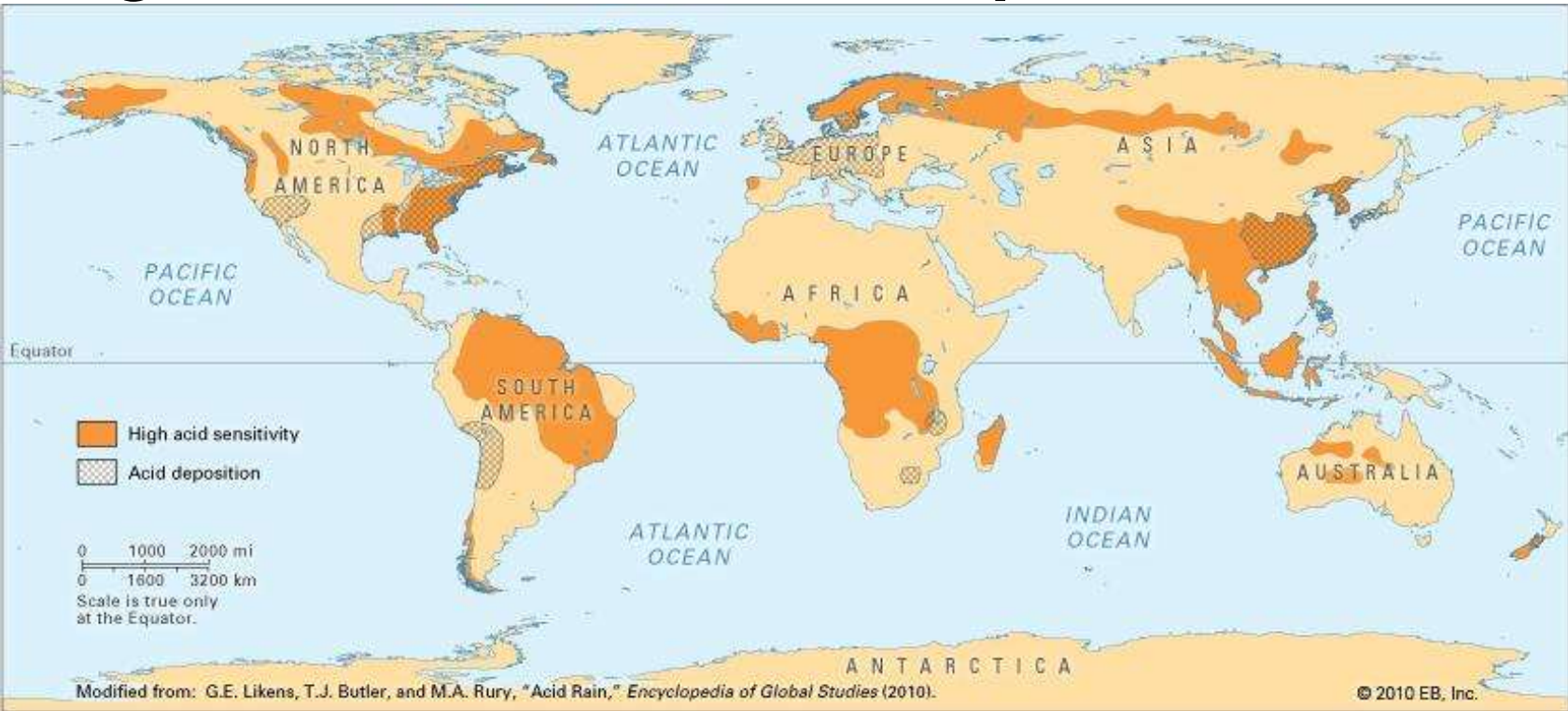
## **Wet deposition**

= further from source

= secondary pollutants

=  $\text{H}_2\text{SO}_3$ ,  $\text{H}_2\text{SO}_4$ ,  $\text{HNO}_3$

# Regional Effects of Acid Deposition



- Which regions of the world should be prioritised for intervention?
- What might make such interventions difficult to achieve?

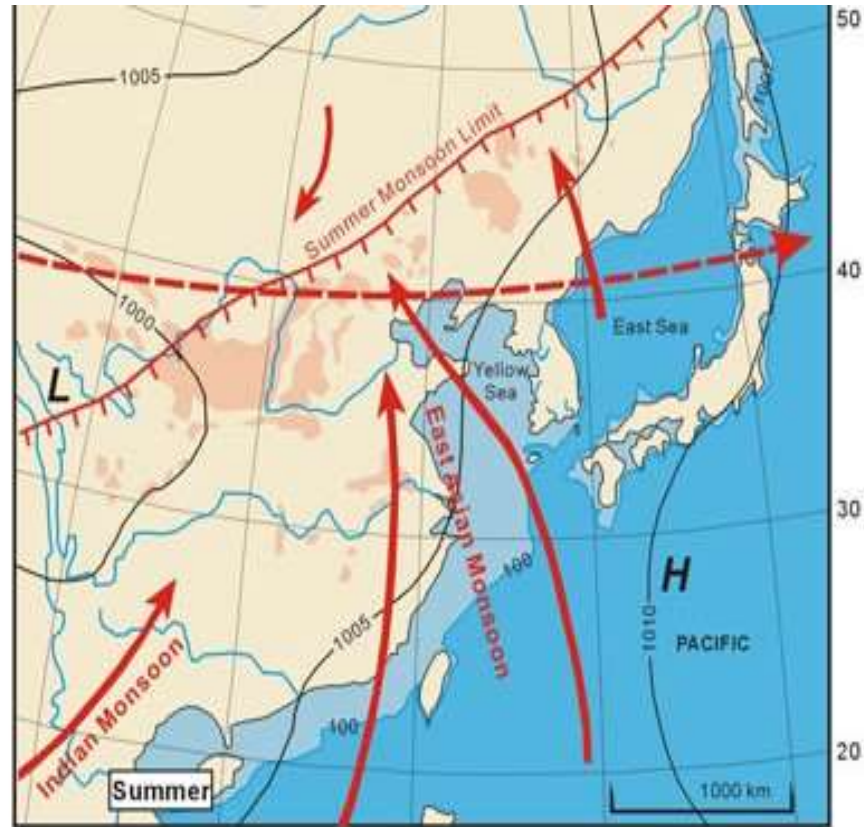
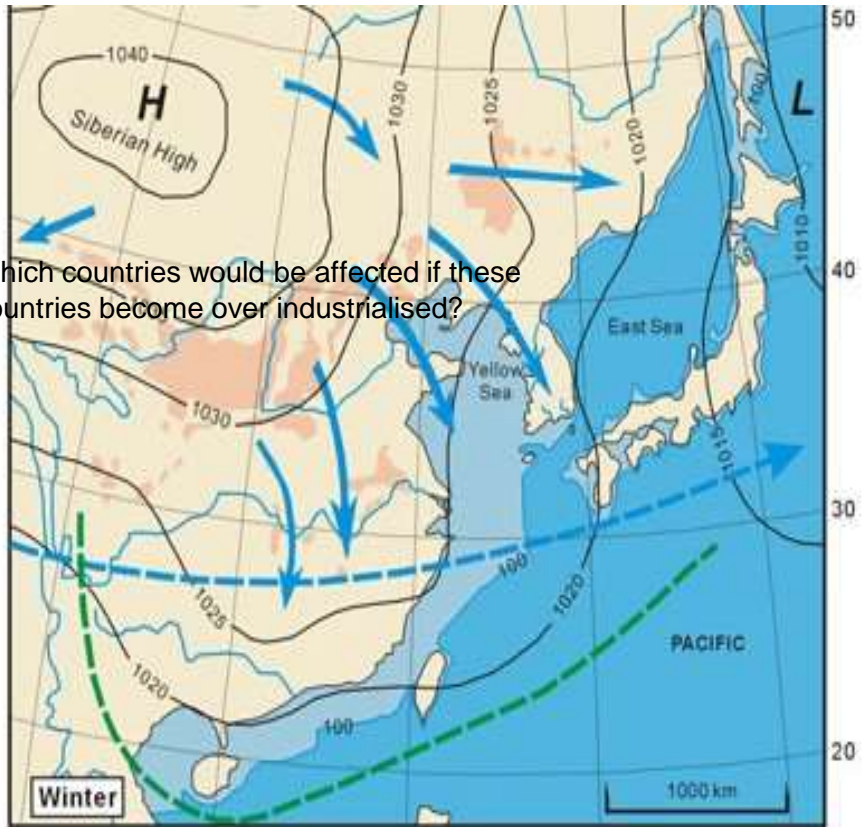


# Prevailing Winds- why are they important?









Which countries would be affected if these countries become over industrialised?

- 1025 — Mean sea-level pressure (hPa)
- —> —> — mean location of jet stream (winter/summer)
- > —> —> —> — dominant vectors of surface winds (winter/summer)
- — — — — average southern limit of cold surges (winter)
- 100 — present 100 m isobath
- — — — — loess distribution in China

# Pollution Management Strategies for Acid Deposition: Catalytic converters

## Regulating/Reducing (Level 2)

1. Metal powders (platinum, rhodium and/or palladium) help convert:

- >  $\text{NO}_x$  to  $\text{N}_2$
- > CO and hydrocarbons ( $\text{H}_x\text{C}_y$ ) to  $\text{CO}_2$

2. Sensors and computer controls the amount of fuel injected:

- > more fuel fully burnt reduces pollutants



# Pollution Management Strategies for Acid Deposition: Issues with catalytic converters

1. Needs high temperature... Cold start = max pollution
  - > Position closer to engine → heats up faster
  - > Very high temperature destroys it → place under passenger seat
  - > Preheat converter → most batteries need at least a few minutes
2. Do not work well on  $\text{NO}_x$  in diesel engines
  - > cooler than petrol engines
  - > inject carbamide (urea) in exhaust → reacts  $\text{NO}_x$  to  $\text{N}_2$  and  $\text{H}_2\text{O}$
3. Expense and efficiency
  - > Gold is cheaper and can improve removal by 40%

# Pollution Management Strategies for Acid Deposition: International Agreements (Europe)

- 1979, United Nations Economic Commission for Europe (UNECE), Convention on Long-Range Transboundary Pollution.
- 1985, most UNECE members, ratified Protocol on the Reduction of Sulphur Emissions.

- SO<sub>2</sub> emissions cut by 30% (from 1980 levels) by 1993.

Achieved!...

- UK exceeded SO<sub>2</sub> and NO<sub>x</sub> targets...

- new gas-fired power stations (which have lower emissions) replacing coal fired power stations

- Flue gas desulphurisation equipment to coal-fired power stations

# Pollution Management Strategies for Acid Deposition: International Agreements (Europe)

- 1999, UNECE, Convention on Long Range Transboundary Air Pollution, EU and 25 countries.
  - The Gothenburg Protocol “Abate Acidification, Eutrophication and Ground-level Ozone”
  - Cut emissions of SO<sub>2</sub>, NO<sub>x</sub>, VOCs and NH<sub>3</sub>
  - Country-by-country emission ceilings to be achieved by the year 2010
  - SO<sub>2</sub> reduced by 63%
  - NO<sub>x</sub> reduced by 41%
  - VOC reduced by 40%
  - NH<sub>3</sub> reduced by 17%