Radiative Forcing in the AR5

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Climate Change

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Radiative Forcing

\[ \uparrow \]

Atmospheric Concentrations

\[ \uparrow \]

Emissions

\[ \uparrow \]

Human Activities
What is Radiative Forcing?

• Change in energy flux caused by natural or anthropogenic drivers of climate change (in W m\(^{-2}\))

• Positive ➔ near-surface warming

• Puts various drivers on common scale, indicates magnitude of impact
What is Radiative Forcing?

- Includes rapid adjustments (e.g. cloud formation on aerosols)

- Stratospheric temperature adjustment included in TAR & AR4 RF; additional adjustments included in Effective RF (ERF)

- Effective RF used for aerosols & well-mixed greenhouse gases
Changes since AR4

- Greenhouse gases continue to increase rapidly
  - Uncertainty ranges increased as now accounting for rapid adjustments to forcing

- Best estimate of net aerosol cooling reduced
Time evolution

- Except volcanic, changes gradual
- Anthro faster since ~1970, CO₂ largest every decade since 1960s
- Time-averaged natural forcing small
From Concentrations to Emissions
Climate Change

↑

Radiative Forcing

↑

Atmospheric Concentrations

↑

Emissions

↑

Human Activities

← for Scientists

← for Policy Makers

Totals from Concentrations or Emissions Identical
From Concentration to Emissions

- Methane
- Carbon monoxide
- Nitrogen oxides
- Volatile organics

Emissions

Concentrations
- Methane
- Stratospheric water
- Ozone
- CO₂

- Both perspectives in AR4, both in AR5
### Radiative Forcing by Drivers (W m⁻²)

<table>
<thead>
<tr>
<th>Aerosols and Precursors</th>
<th>Natural</th>
<th>Total Anthropogenic Radiative Forcing since 1750</th>
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<tbody>
<tr>
<td><strong>Cloud Adjustments due to Aerosols</strong></td>
<td></td>
<td>2011: 2.29 [1.13 to 3.33]</td>
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<td>1980: 1.25 [0.64 to 1.86]</td>
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<td>1950: 0.57 [0.29 to 0.85]</td>
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</tbody>
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**Emitted Compound**
- CH₄
- CO₂
- H₂Ostr
- O₃
- CH₄
- O₃
- CFCs
- HCFCs

**Resulting Atmospheric Drivers and Responses**

**Level of Confidence**
- H / M
- VL / L
- M
- H
- H
- M