Atmospheric measurements of Ozone Depleting Substances (ODSs) at ESRL...

*WHAT:* Measuring ODS abundances, distributions, and changes:
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- On global to regional spatial scales:
- to address international and national issues
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On many different time-scales:  
- **years-decades**  
  *observing*  
  *long-term changes*
- **days-months**  
  *targeted*  
  *field studies*

*Sampling air by train*  
*Sampling air from snow firn*  
*Sampling from high-altitude aircraft*
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With custom instrumentation or flasks on multiple platforms:

*e.g.*, surface sites, aircraft, balloons, towers, trains, automobiles, ships
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With custom instrumentation
  
or flasks on multiple platforms:
  
e.g., surface sites, aircraft,
  balloons, towers, trains, automobiles,
  ships

**In combination with others** (NASA, Universities, international partners, others)
Why measure ozone-depleting substances at ESRL?

To understand fundamental atmospheric processes and properties:
* Hydroxyl radical abundance and variability (ODS lifetimes)
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Quantifying human contributions and their changes
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Summarizing trends for all ODSs: Effective Equivalent Chlorine (EECI)

Global EECI
$[\text{Cl} + (\text{Br} \times 60)] f$
Down 11% from peak!!
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The Ozone-Depleting Gas Index

Year (sample date + 3)
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Quantifying human contributions and their changes
Quantifying natural influences

CH$_3$Br in the Southern Hemisphere

<table>
<thead>
<tr>
<th>YEAR</th>
<th>CH$_3$Br in the Southern Hemisphere (ppt)</th>
</tr>
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<tbody>
<tr>
<td>1900</td>
<td>0</td>
</tr>
<tr>
<td>1920</td>
<td>2</td>
</tr>
<tr>
<td>1940</td>
<td>4</td>
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<tr>
<td>1960</td>
<td>6</td>
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<td>1980</td>
<td>8</td>
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<tr>
<td>2000</td>
<td>10</td>
</tr>
<tr>
<td>2020</td>
<td>2</td>
</tr>
</tbody>
</table>

From ICE (UC Irvine)  From FIRN (NOAA)  Ongoing Obs (NOAA)
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To provide policy-relevant information:
→ Guiding ozone layer recovery (Montreal Protocol)
   The Ozone Depleting Gas Index
→ Quantifying the contributions of ODSs to Radiative Forcing (AGGI)
→ Through participation in national and international assessment reports
Concerns for the future: Guiding the recovery of the Ozone Layer...

*Will ODSs decrease/change as expected?*

What influence will *unregulated* production and emission have? HCFC use in developing countries (until 2013)…

Lifetimes (OH, strat-trop exchange)

Emissions (CH$_3$Cl and CH$_3$Br, Very Short-Lived Substances)

Continued studies at ESRL will allow us to follow these issues and regularly update policy makers
Production and use of HCFCs is NOT limited in developing countries until 2013...

How high by 2013?

(UNEP data tables, 2008)
Continued measurements allow us to monitor progress and identify any unexpected developments...
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Concerns for the future:
Guiding the recovery of the Ozone Layer…

*Will ODSs decrease/change as expected?*
What influence will unregulated production and emission have?
HCFC use in developing countries (until 2013)…
CH$_3$Br for non-regulated quarantine & pre-shipment uses…
Emissions from foams, refrigerators, AC units (banks)…

*How will natural fluxes change?*
What will be the influence of climate change?
Lifetimes (OH, strat-trop exchange)
Emissions (CH$_3$Cl and CH$_3$Br, Very Short-Lived Substances)
Summary of ESRL Activities Related to Ozone-Depleting Substances

• The study of ODSs at ESRL
  – Monitoring long-term atmospheric changes
  – Investigating regional/specific issues
  – Understanding observed changes
  – Enhancing predictive capability
  – Communicating results
    ➔ Guiding the recovery of the ozone layer
    ➔ Improving our understanding of the atmosphere