World Meteorological Organization Global Ozone Research and Monitoring Project—Report No. 58



SCIEN A Path Towards More Useful CFC Scenarios **Ozor** John Daniel (NOAA, CSD) and Lucy Carpenter (University of York) CCI 4 CH 3CCI 3 100 ppt HCFC-22 HCFC-141b 150 100 ppt CHAPTER 6 SCENARIOS AND INFORMATION FOR POLICYMAKERS HCFC-142b halon-1211 Lead Authors td 20 L.J. Carpenter J.S. Daniel Coauthors E.L. Fleming halon-1301 CH 3Br T. Hanaoka A.B. Ravishankara td 2 M.N. Ross Approximate Natural Level S. Tilmes T.J. Wallington D.J. Wuebbles Year Year Contributors

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OUTLINE

- **OZONE** 1. Uses of ozone assessment scenarios
 - 2. Main requirements for developing Chapter 6 scenarios
 - 3. Key questions regarding interpreting CFC-11 growth rates
 - 4. Needs for a successful path forward for CFC-11









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SCIENTIFIC ASSES





Year	CFC-11	CFC-12	CFC-113	CFC-114	CFC-115	CCI ₄
7	246.2	539.8	77.7	16.3	8.4	91.5
8	244.1	537.6	76.9	16.3	8.4	90.3
9	242.2	535.5	76.1	16.4	8.4	89.1
0	240.4	532.8	75.7	16.3	8.4	87.9
1	238.4	530.2	75.0	16.3	8.4	86.7
2	236.4	527.7	74.4	16.1	8.4	85.5
3	234.4	524.8	73.7	16.1	8.4	84.5
4	232.9	521.9	73.0	16.1	8.4	83.3
5	231.7	519.1	72.4	16.0	8.5	82.3
6	230.3	515.9	71.7	16.0	8.5	81.1
7	229.2	512.6	71.2	16.0	8.5	79.9
8	227.0	507.6	70.4	15.9	8.5	78.8
9	224.8	502.6	69.7	15.8	8.5	77.8
0	222.5	497.7	68.9	15.8	8.5	76.7
1	220.1	492.9	68.2	15.7	8.5	75.6
2	217.6	488.1	67.4	15.6	8.5	74.5
3	215.1	483.3	66.7	15.5	8.5	73.4
4	212.5	478.6	66.0	15.5	8.5	72.3
5	209.9	473.9	65.3	15.4	8.5	71.2
0	196.4	451.2	61.9	15.0	8.5	65.9
5	182.6	429.7	58.6	14.6	8.5	60.7
0	168.9	409.1	55.6	14.2	8.4	55.8
5	155.7	389.5	52.7	13.9	8.4	51.1
0	143.1	370.9	49.9	13.5	8.3	46.7
5	131.2	353.2	47.3	13.2	8.2	42.6
0	120.0	336.3	44.8	12.8	8.2	38.8
5	109.7	320.2	42.5	12.5	8.1	35.2
0	100.1	304.9	40.3	12.2	8.0	31.9
5	91.3	290.3	38.1	11.8	8.0	28.9
0	83.2	276.4	36.1	11.5	7.9	26.1
5	75.7	263.2	34.3	11.2	7.8	23.6
0	68.9	250.6	32.5	10.9	7.7	21.3
5	62.7	238.6	30.8	10.6	7.7	19.2
0	57.0	227.2	29.2	10.4	7.6	17.2

Information Used to Develop Scenarios of Future ODS concentrations in Assessment?

Future production (consistent with Protocol) Bank sizes (bottom-up, recent) Bank release rate (inferred) Global lifetime



From WMO, 2018, Chapter 6 (Figure 6-2)

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LETTER

https://doi.org/10.1038/s41586-018-0106-2



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CFC-11 Emissions Assumed in WMO, 2018 Scenario





Alternative Scenario: Continue CFC-11 emissions at 67 Gg/yr indefinitely

Delays EESC return by 7, 20 years

No excess emission of CFC-12

From WMO, 2018, Chapter 6 (Figure 6-2)



Alternative Scenario: Continue CFC-11 emissions at 67 Gg/yr indefinitely

Delays EESC return by 7, 20 years



Scenario assumptions determine these values

From WMO, 2018, Chapter 6 (Figure 6-2)

No excess emission of CFC-12

Issue	Potential Cause	Associated Questions	Outlook	
	Dynamical Changes	Consistent with other trace gases? Consistent with reanalyses? Variability vs. trend	No unexpected future emissions Consistent with full MP compliance	
Excess "Emissions"		<u>What is Wrong?</u> Size of Bank Bank Release Rate Atmospheric Observations	Highly constrained future emissions Consistent with full MP compliance	
	New Production	Immediate Release?	Smaller future commitment to ozone impact Non-compliance with MP Larger future commitment to ozone impact	

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Could Dynamical Changes Have Affected the CFC-11 Growth Rate?



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Excess "Emissions"		<u>What is Wrong?</u> Size of Bank Bank Release Rate Atmospheric Observations	Highly constrained future emissions Consistent with full MP compliance	
		Immediate Release?	Faster response to policy action; smaller impact on ozone Non-compliance with MP Slower response to policy action; larger impact on ozone	

Issue	Potential Cause	Associated Questions	Outlook	
	Dynamical Changes	Consistent with other trace gases?	No unexpected future emissions	
	15 5 6 min 15 5 min 16 min 16 min 17 min 18 min 19 min	Consistent with reanalyses?	Consistent with full	
	Part <th< td=""><td>Variability vs. trend</td><td>MP compliance</td></th<>	Variability vs. trend	MP compliance	
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CONCLUSIONS

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- 1. Improved confidence in emissions estimated from observations
- 2. Revised bottom-up banks



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- 3. Understanding of how much of the new production is going into atmosphere vs. applications
- 4. Are we confident the emissions and production has been fully identified? Are unexpected emissions coming from multiple areas?5. The CFC-12 question...



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