

# War Climate Study - TWX

R. E. Batzel

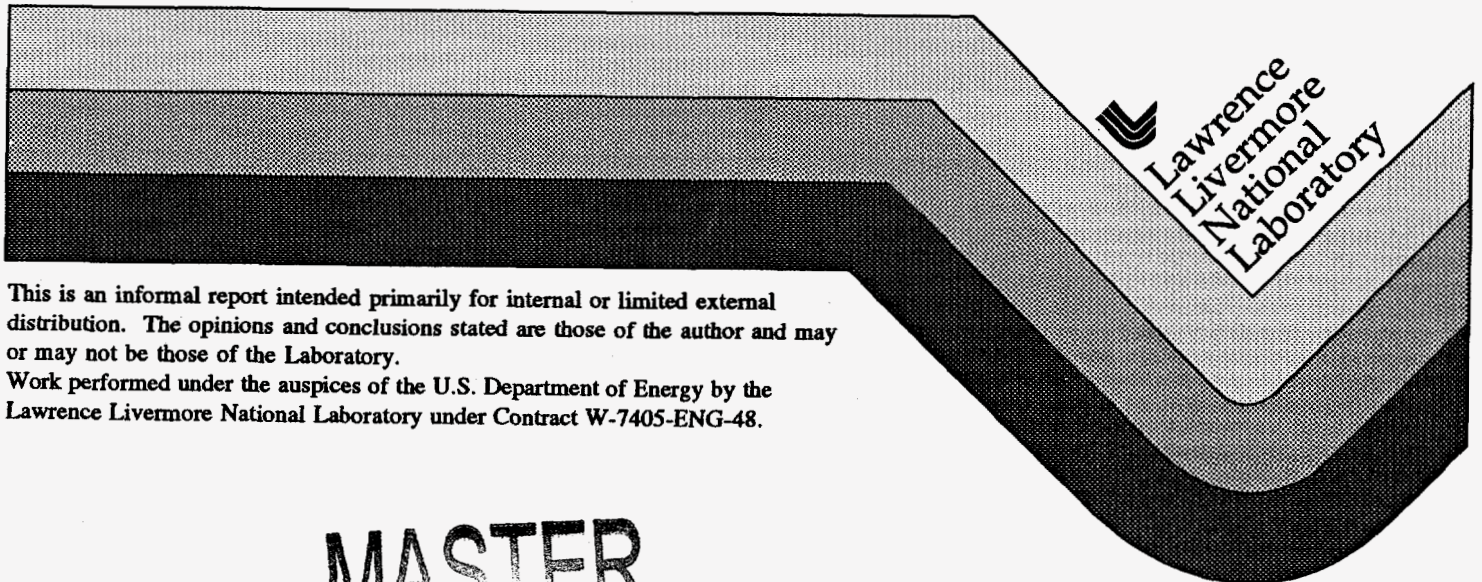
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May 2, 1974



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Work performed under the auspices of the U.S. Department of Energy by the Lawrence Livermore National Laboratory under Contract W-7405-ENG-48.

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SUBJECT CLN WAR CLIMATE STUDY

REFERENCE CLN TWX FM POOR TO BATZEL, DATED APRIL 18, 1974

OUR COMMENTS ARE AS FOLLOWS CLN 1) WE HAVE DRAFTED A PRESS  
RELEASE HAVING A DIFFERENT TONE FROM THE "STRAWMAN" YOU SENT  
US, AND THIS APPEARS AT THE END OF THIS MESSAGE. WE HAVE ATTEMPTED  
TO PUT THE MATTER INTO SOMEWHAT TRUER PERSPECTIVE, ELIMINATE  
UNQUALIFIED SPECTACULAR STATEMENTS, PROVIDE A BIT MORE UNDERSTANDING  
AND LESS SPECULATION, AND RETAIN CREDIBILITY FOR THE COMMISSION.  
2) YOUR PROPOSED STATEMENT SOLICITING INTERAGENCY COORDINATION  
COULD BE REWRITTEN WITH INFORMATION IN OUR DRAFT PRESS RELEASE.

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PAGE 2 RHEGLLL 1889 [REDACTED]

3) WE SUGGEST THE FOLLOWING ADDITIONAL REFERENCES TO YOUR BIBLIOGRAPHY CLN A) CHANG, J S AND W H DUEWER, "ON THE POSSIBLE EFFECT OF NO SUB X INJECTION IN THE STRATOSPHERE DUE TO PAST ATMOSPHERIC NUCLEAR WEAPONS TESTS," AIAA/AMS INTERNATIONAL CONFERENCE ON THE ENVIRONMENTAL IMPACT OF AEROSPACE OPERATIONS IN THE HIGH ATMOSPHERE, DENVER, COLORADO, JUNE 11-13, 1973 (AIAA PAPER 73-538). (ALSO AVAILABLE AS UCRL-74480.) B) JOHNSTON, H, G WHITTEN AND J BIRKS, "EFFECTS OF NUCLEAR EXPLOSIONS ON STRATOSPHERIC NITRIC OXIDE AND OZONE," J GEOPHYS. RES. 78 (27), 6107-6135, 1973. C) GILMORE, F "THE PRODUCTION OF NITROGEN OXIDES BY LOW ALTITUDE NUCLEAR EXPLOSIONS," R AND D ASSOCIATES (PREPRINT), JULY, 1973. 4) REGARDING YOUR REQUEST FOR AN LLL PREVIEW OF RESULTS WE ANTICIPATE FROM OUR STRATEGIC WAR CLIMATE STUDY, WE THINK THE BEST THING TO DO IS TO REFER YOU TO OUR CONFIDENTIAL DOCUMENT NO. ASG-74-4, SCOPE OF WORK ON THE POTENTIAL CLIMATIC IMPLICATIONS OF STRATEGIC WAR, APRIL 11, 1974. WE BELIEVE THIS STATES THE PROBLEM AS WELL AS IT IS PRESENTLY UNDERSTOOD, AND MORE DEFINITIVE STATEMENTS REQUIRE FURTHER RESEARCH AS OUTLINED IN ASG-74-4. WE WOULD LIKE TO BE MORE RESPONSIVE, BUT HOPE YOU WILL APPRECIATE OUR PROBLEM. 5) HOWEVER THE FINAL RELEASE IS WORDED, IT SEEMS LIKELY TO PROMPT

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PRESS INQUIRIES AND CONSIDERABLE ATTENTION. WE BELIEVE IT WOULD BE USEFUL IF ADVANCE ARRANGEMENTS ARE MADE TO HAVE QUALIFIED SCIENTISTS AVAILABLE TO HELP PROVIDE ANSWERS. OUR SUGGESTED APPROACH IF A PRESS RELEASE IS MADE IS AS FOLLOWS CLN

NEW COMPUTER CALCULATIONS BY ATOMIC ENERGY COMMISSION SCIENTISTS SUGGEST THE POSSIBILITY THAT THE DEVASTATION CAUSED BY LARGE-SCALE NUCLEAR WARFARE WITH MEGATON-YIELD WEAPONS MIGHT BE FOLLOWED BY SERIOUS DEPLETION OF THE OZONE LAYER THAT SHIELDS THE EARTH FROM THE SUN'S ULTRAVIOLET RADIATION.

GIVEN THE PRESENT INCOMPLETE UNDERSTANDING OF THE INTRICATE BEHAVIOR OF THE ATMOSPHERE, IT IS NOT CERTAIN THAT THE EFFECTS WOULD OCCUR OR, IF THEY DID, JUST HOW LARGE THEY ACTUALLY WOULD BE. BUT PRELIMINARY CALCULATIONS BY ADMITTEDLY INCOMPLETE COMPUTER MODELS INDICATE THAT AN OZONE LAYER DEPLETION OF UP TO 50 PER CENT MIGHT OCCUR WITHIN A FEW MONTHS AND EXTEND OVER A PERIOD OF YEARS AFTER A NUCLEAR EXCHANGE WITH THE LARGER WEAPONS.

THE DIRECT DAMAGE FROM NUCLEAR WEAPONS WOULD ARISE FROM BLAST, HEAT, RADIATION AND FALLOUT. THE TENTATIVE NEW DATA SUGGEST LONGER TERM, INDIRECT CONSEQUENCES ON A SCALE NOT REFLECTED IN

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**EARLIER ASSESSMENTS.**

THE PRELIMINARY ESTIMATE HAS CAUSED THE COMMISSION TO DIRECT AN INTENSIFIED STUDY OF THE OZONE DEPLETION QUESTION AND OF OTHER POTENTIAL GLOBAL CLIMATIC EFFECTS OF LARGE-SCALE NUCLEAR WARFARE.

IN PARALLEL, THE U S ARMS CONTROL AND DISARMAMENT AGENCY (ACDA) HAS ASKED THE NATIONAL ACADEMY OF SCIENCES TO CONDUCT A STUDY OF THE LONG-TERM WORLD-WIDE EFFECTS ON THE ENVIRONMENT AND ECOLOGY OF LARGE-SCALE NUCLEAR WEAPONS EXCHANGES. DATA FROM THE AEC PROGRAM WILL BE MADE AVAILABLE TO THE NATIONAL ACADEMY OF SCIENCES FOR ITS INDEPENDENT STUDY.

THE RECENT CALCULATIONS EMERGED IN THE COURSE OF RESEARCH BY ATOMIC ENERGY COMMISSION SCIENTISTS ON ONE ASPECT OF THE BROAD STUDY, STARTED TWO YEARS AGO BY THE U S DEPARTMENT OF TRANSPORTATION, OF THE POSSIBLE DEPLETION OF THE OZONE IF FLEETS OF SUPERSONIC TRANSPORTS BEGIN ROUTINE OPERATIONS IN THE STRATOSPHERE.

ONE PROPOSED MECHANISM OF OZONE DESTRUCTION IS THROUGH ITS CHEMICAL REACTION WITH NITROGEN OXIDES, WHICH EXIST NATURALLY BUT WHICH ARE ALSO PRODUCED IN THE EXHAUSTS OF JET AIRCRAFT. THE OZONE LIES PRIMARILY IN A SHELL AROUND THE EARTH AT ALTITUDES FROM

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ABOUT 10 TO 25 MILES, WHICH IS IN THE LOWER STRATOSPHERE, BECAUSE THE OZONE LAYER HELPS REGULATE THE AMOUNT OF THE SUN'S ULTRAVIOLET RADIATION REACHING THE EARTH, IT WAS PROPOSED THAT ITS PARTIAL DESTRUCTION COULD INCREASE MAN'S EXPOSURE TO ULTRAVIOLET RADIATION AND PERHAPS HAVE OTHER GLOBAL CLIMATIC EFFECTS.

SINCE THE INTRICATE PHYSICAL AND CHEMICAL MECHANISMS GOVERNING THE BEHAVIOR OF THE OZONE WERE NOT ADEQUATELY UNDERSTOOD, AND THE ACTUAL EFFECTS COULD NOT BE ACCURATELY PREDICTED, THE DEPARTMENT OF TRANSPORTATION LAUNCHED ITS BROAD CLIMATIC IMPACT ASSESSMENT PROGRAM (CIAP) SOME TWO YEARS AGO.

ONE PART OF THIS STUDY - COMPUTER MODELING OF THE ATMOSPHERE TO IDENTIFY POTENTIAL SURFACE ATMOSPHERE CHANGES - WAS UNDERTAKEN BY ATOMIC ENERGY COMMISSION SCIENTISTS HAVING LONG EXPERIENCE AND SIGNIFICANT RESOURCES PERTINENT TO THIS PROBLEM.

IN THEIR COMPUTER MODELING PROGRAM FOR CIAP, AEC SCIENTISTS USED GENERALLY ACCEPTED ESTIMATES THAT, GIVEN CONTINUOUS INJECTION OF NITROGEN OXIDES AT A RATE CONSISTENT WITH PRESENT ENGINE TECHNOLOGY AND A FLEET SIZE ESTIMATED FOR 1990, SOME 1.3 MILLION TONS PER YEAR OF NITROGEN OXIDES WOULD BE DEPOSITED IN THE STRATOSPHERE. AEC SCIENTISTS ESTIMATED THAT THIS AMOUNT OF

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PAGE 6 RHEGLLL1889 [REDACTED]

DEPOSITION WOULD CAUSE THE GLOBAL AVERAGE OZONE LAYER TO REACH A STEADY STATE LEVEL ABOUT 10 PER CENT BELOW NORMAL. THE RESULT WOULD BE AN INCREASE IN AVERAGE ULTRAVIOLET LIGHT EXPOSURE TO AN INDIVIDUAL OF ABOUT 20 PERCENT. THIS WOULD COMPARE TO HIS MOVING FROM HIS PRESENT RESIDENCE TO AN ALTITUDE SOME 7,000 FEET HIGHER.

AT ABOUT THE SAME TIME THE DOT STUDY WAS STARTING, TWO SCIENTISTS IN AN INSTITUTE FOR DEFENSE ANALYSIS SUMMER STUDY APPROACHED THE OZONE QUESTION FROM ANOTHER DIRECTION. THEY WERE AWARE THAT NUCLEAR EXPLOSIONS IN THE EARTH'S ATMOSPHERE GENERATE LARGE QUANTITIES OF NITROGEN OXIDES (ABOUT 5000 TONS PER MEGATON). THE SCIENTISTS REASONED THAT IF THE OZONE DEPLETION PREDICTIONS WERE VALID, THE ATMOSPHERIC NUCLEAR WEAPONS TESTS CONDUCTED BETWEEN 1957 AND 1963 MIGHT HAVE SHOWN AN EFFECT. IN THESE TESTS PRIOR TO THE LIMITED TEST BAN TREATY OF 1963, SOME 300 MEGATONS OF NUCLEAR WEAPONS WERE TESTED.

THIS WORK REFOCUSED THE ATTENTION OF AEC AND OTHER SCIENTISTS ON THE POTENTIAL ROLE OF NUCLEAR WEAPONS. IN PARTICULAR, COMMISSION SCIENTISTS APPLIED SOME OF THE MOST UP-TO-DATE COMPUTER SIMULATIONS TO THE PROBLEM.

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WHEN THEY "INJECTED" 300 MEGATONS INTO THEIR ATMOSPHERIC  
LODEL SIMULATION IN A MANNER COMPARABLE TO ACTUAL INJECTION  
DURING THE TESTS, THE RESULTS INDICATED THAT THE TESTS MIGHT  
HAVE CAUSED AN ESTIMATED ANNUAL AVERAGE OZONE DEPLETION OF ABOUT  
TWO PER CENT OVER THE PERIOD 1956-66. THE PEAK YEAR WAS POSSIBLY  
1962, WITH AN ESTIMATED MAXIMUM FOUR PER CENT DEPLETION.

HOWEVER, SINCE THE EFFECT EXPECTED IS RELATIVELY SMALL AND  
THE DAY TO DAY VARIATIONS IN THE OZONE ARE QUITE LARGE, SCIENTISTS  
WHO HAVE ANALYZED THE FRAGMENTARY DATA FROM METEOROLOGICAL  
OBSERVATIONS MADE DURING THE SUBSEQUENT TO THE ATMOSPHERIC TESTS

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HAVE BEEN UNABLE TO DETERMINE CONCLUSIVELY IF THERE WAS ANY EFFECT ON THE OZONE LAYER.

FOLLOWING STUDY OF THE ATMOSPHERIC WEAPONS TESTS DATA, THE AEC SCIENTISTS EXTENDED THEIR COMPUTER SIMULATIONS TO INCLUDE NITROGEN OXIDE INJECTION INTO THE STRATOSPHERE IN QUANTITIES THAT MIGHT RESULT FROM A MAJOR STRATEGIC NUCLEAR EXCHANGE OF SEVERAL THOUSANDS OF MEGATONS.

THIS WORK RESULTED IN THE PRELIMINARY ESTIMATE OF UP TO A 50 PER CENT OZONE DEPLETION OVER A PERIOD OF YEARS FOLLOWING A NUCLEAR EXCHANGE.

CURRENT STUDIES INDICATE THAT HIGH YIELD SURFACE NUCLEAR EXPLOSIONS (5 TO 20 MEGATONS) WOULD RESULT IN MAXIMUM EFFECT OF NITROGEN OXIDES ON THE OZONE LAYER. THE REASONS FOR THIS ARE THAT A YIELD SMALLER THAN 5 MEGATONS DOES NOT PROVIDE ENOUGH ENERGY TO CARRY THE POLLUTANTS UP INTO THE OZONE LAYER, WHILE A YIELD LARGER THAN ABOUT 20 MEGATONS WILL CARRY THE POLLUTANTS ABOVE THE OZONE LAYER.

COMPUTER SIMULATION OF THE RESULTING EFFECT ON ULTRAVIOLET RADIATION REACHING THE SURFACE AFTER 50 PER CENT DEPLETION INDICATES THAT AT SOME WAVE LENGTHS TRANSMISSION MIGHT BE INCREASED

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BY FACTORS OF UP TO 1000. UNDER THESE CONDITIONS, HOWEVER, THE RESULTING INTEGRATED ERYTHEMAL (SKIN-REDDENING) DOSE MIGHT INCREASE BY ABOVE A FACTOR OF 2 OR 3.

AN INCREASE BY A FACTOR OF TWO IN A TYPICAL MID-LATITUDE EXPOSURE IS APPROXIMATELY EQUIVALENT TO THE INCREASE EXPERIENCED BY ASCENDING 10 MILES ABOVE THE SURFACE OR MOVING 1000 MILES CLOSER TO THE EQUATOR.

LIKE THE QUESTION OF OZONE DEPLETION, THE EFFECTS OF INCREASES IN ULTRAVIOLET RADIATION ARE ONLY BEGINNING TO BE UNDERSTOOD. THE DEPARTMENT OF TRANSPORTATION IS SPONSORING STUDIES TO ASSESS THE BIOSPHERIC CONSEQUENCES OF UP TO A 20 PER CENT INCREASE IN ULTRAVIOLET RADIATION. THESE INCLUDE, POTENTIALLY, SKIN REDDENING, INCREASED INCIDENCE OF SKIN CANCER, REDUCED CROP PRODUCTION, AND DISRUPTION OF MARINE AND INSECT LIFE. LESS IS KNOWN ABOUT GREATER EXTREMES IN MODIFICATION OF ULTRAVIOLET RADIATION.

SST'S AND NUCLEAR EXPLOSIONS ARE NOT THE ONLY MEANS OF INJECTING POTENTIALLY IMPORTANT CHEMICAL SPECIES INTO THE STRATOSPHERE. STUDIES INDICATE THAT CHLORINE, EXHAUSTED IN THE USE OF MOST SOLID FUEL ROCKET PROPELLANTS, MAY TAKE PART IN A CATALYTIC OZONE DESTRUCTION CYCLE SIMILAR TO THAT OF THE NITROGEN OXIDES. IN

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ADDITION, METALLIC OXIDES MAY PLAY A DAMPING ROLE ON THE CYCLE. IT CAN BE SEEN, THEN, IN THE EVENT OF A CONCENTRATED EMPLOYMENT OF MISSILES IN A NUCLEAR WAR, THAT A NUMBER OF ADDITIONAL FACTORS MIGHT AFFECT THE OZONE, SUCH AS CHLORINE IN MISSILE EXHAUST, DEBRIS FROM REENTRY VEHICLES AND ROCKET STAGE BURN-UP.

WHILE ATTENTION HAS BEEN FOCUSED ON THE OZONE-ULTRA-VIOLET RADIATION PROBLEM, THERE IS A SECOND IMPORTANT RELATED CLIMATIC PROBLEM CLN THE POSSIBLE INTERFERENCE WITH THE TRANSMISSION OF SOLAR AND INFRARED RADIATION WHICH ULTIMATELY CONTROLS THE WEATHER AND CLIMATE AT THE SURFACE OF THE EARTH.

SUCH HYPOTHESIZED CLIMATIC CHANGES MIGHT BE CAUSED PARTLY BY OZONE DEPLETION, WHICH CAN LET THROUGH MORE HEAT AND INCREASE AVERAGE SURFACE TEMPERATURES. HOWEVER, PROBABLY MORE IMPORTANT WOULD BE CHANGES TO COOLER TEMPERATURES, WHICH COULD BE CAUSED BY THE GENERATION OF LARGE, WIDELY DISPERSED DUST AND DEBRIS, THAT CAN SCREEN OUT PART OF THE SOLAR RADIATION. NATURAL EVENTS SUCH AS MAJOR VOLCANIC EXPLOSIONS ARE BELIEVED TO HAVE INITIATED COOLER PERIODS IN THE EARTH'S CLIMATE LASTING SEVERAL YEARS. THE AEC STUDY WILL CONSIDER WHETHER IN A NUCLEAR EXCHANGE THE DISTRIBUTION OF DUST AND DEBRIS MIGHT BE SUFFICIENT

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TO CAUSE A SIMILAR COOLING EFFECT.

EITHER KIND OF CHANGE - TO WARMER OR COOLER - COULD CONCEIVABLY AFFECT AGRICULTURAL PRODUCTION, ESPECIALLY IN MARGINAL AGRICULTURAL AREAS.

AMONG GENERAL INSIGHTS THAT ARE EMERGING FROM THESE STUDIES TWO ARE OUTSTANDING. FIRST, IT APPEARS THAT THE GLOBAL CLIMATE MAY BE MORE SENSITIVE TO DISTURBANCES BY MAN'S ACTIVITIES THAN HAD BEEN PREVIOUSLY THOUGHT. SECOND, IF A NATION LAUNCHED A LARGE NUCLEAR ATTACK ON ANOTHER WITH WEAPONS HAVING MULTI-MEGATON YIELDS, PRELIMINARY INDICATIONS ARE THAT WORLD-WIDE SIDE EFFECTS MIGHT ULTIMATELY HAVE SERIOUS CONSEQUENCES FOR ALL NATIONS, INCLUDING THE ATTACKER, APART FROM ANY NUCLEAR RETALIATION.

TO BETTER UNDERSTAND THE NEW QUESTIONS THAT HAVE BEEN RAISED IN THIS PRELIMINARY WORK, THE AEC HAS INCREASED ITS PROGRAM OF CLIMATE RESEARCH. THE PURPOSES INCLUDE CLN 1) DEVELOPMENT OF A DETAILED INVENTORY OF THE CHEMICAL SPECIES, DUST AND OTHER MATERIALS INJECTED BY NUCLEAR EXPLOSIONS, MISSILE EXHAUST, AND ROCKET DEBRIS BASED ON THE PERTINENT CHARACTERISTICS OF SPECIFIC NUCLEAR WEAPONS SYSTEMS SCLN 2) NUMERICAL SIMULATION OF THE STRATOSPHERIC CHEMISTRY AND TRANSPORT AS A MEANS OF ASSESSING OZONE DEPLETION SCLN

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3) NUMERICAL SIMULATION OF MECHANISMS GOVERNING SURFACE CLIMATE  
TO ASSESS EFFECTS OF ALTERATIONS OF THE SOLAR AND THERMAL RADIATION  
BALANCE. THE STUDIES WILL BE COORDINATED WITH OTHER AGENCIES TO  
ASSESS THE BIOSPHERIC CONSEQUENCES OF POTENTIAL MODIFICATIONS.

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