

CO₂-CLIMATE MODELING

ALLEGARI

24, 1982

Harold:

July 21

RWC set up the following meeting
with Exxon Corp. re CO₂ on Aug. 24
from 9:00 a.m. to 12:00.

HNW, RWC, Callegari, Flannery
Sci & Tech.

Eckelman, Werthamer, Natkin and
Schumacher

Exxon Public Affairs

A. Wollord, Environmental Contact
for Public Affairs, John McCurry,
ERE Contact, Jim Meredith, their
boss

Jim Riley, Marv Glaser -- will ask
if they'd like to attend.

mgm

TOPICS TO BE DISCUSSED

- CO₂-GREENHOUSE EFFECT

- CORPORATE RESEARCH CLIMATE MODELING
 - RESULTS
 - PUBLICATION AND PRESENTATION PLANS

BASIS FOR THE CO₂ GREENHOUSE EFFECT

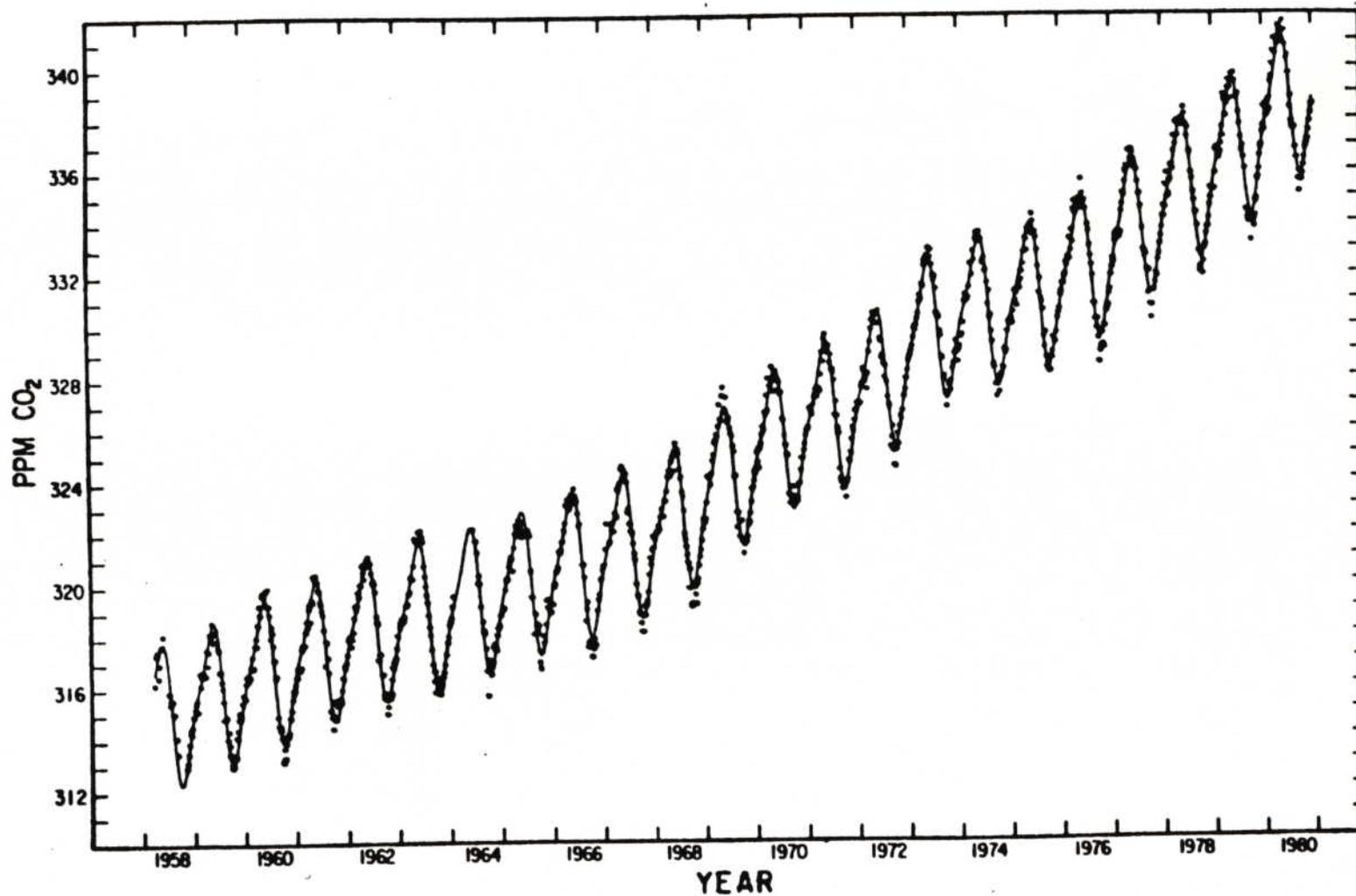
- EARTH RECEIVES VISIBLE, ULTRAVIOLET AND INFRARED RADIATION FROM THE SUN
 - SOME REFLECTED INTO SPACE
 - SOME ABSORBED BY ATMOSPHERE
 - SOME ABSORBED BY EARTH'S SURFACE

- EARTH RERADIATES ABSORBED ENERGY AS INFRARED RADIATION
 - CO₂ AND OTHER MOLECULES ABSORB PART OF INFRARED RADIATION
 - THIS ABSORBED ENERGY WARMS THE ATMOSPHERE

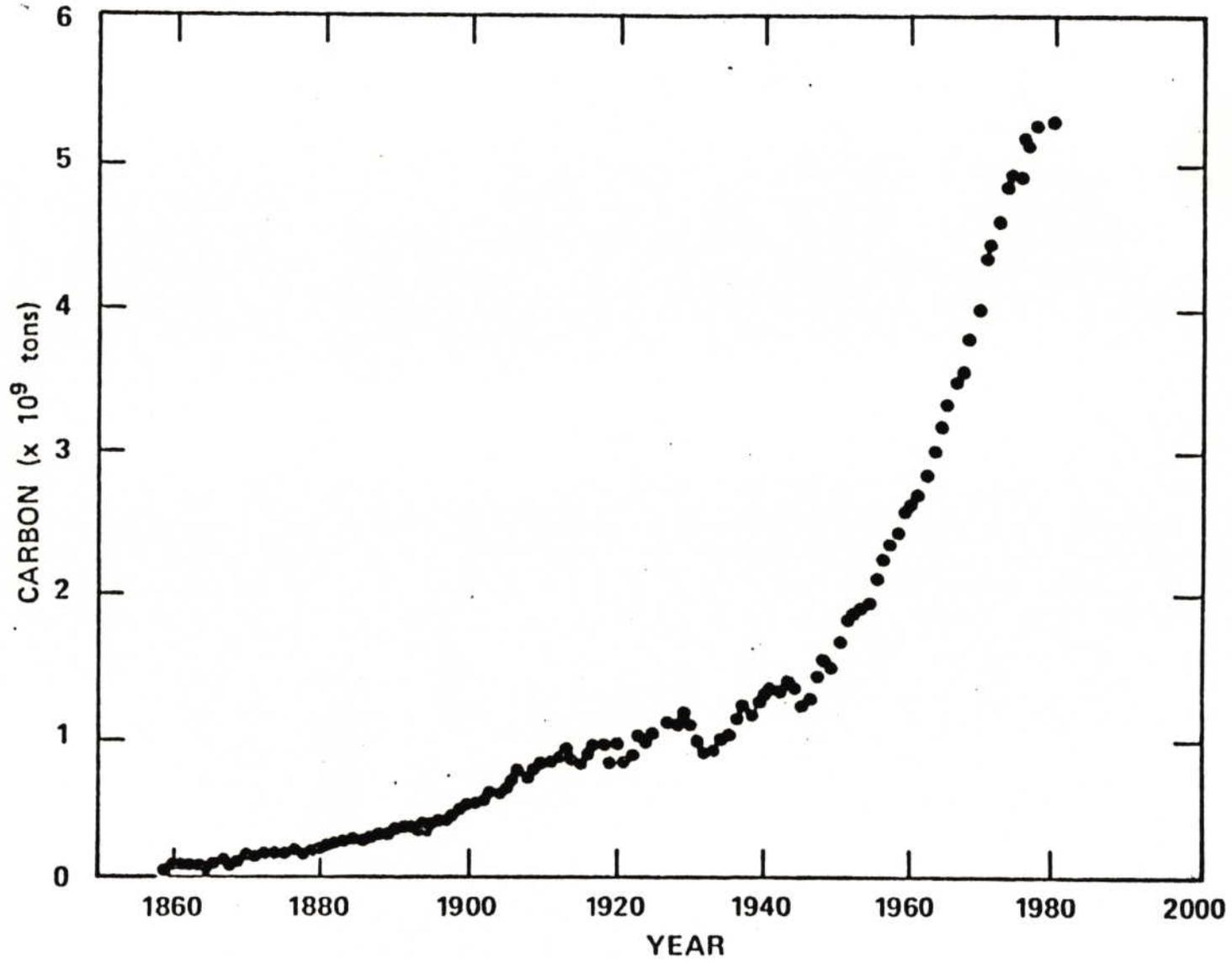
- THEREFORE HIGHER CO₂ CONCENTRATIONS WOULD WARM THE LOWER ATMOSPHERE

- WARMING COULD INDUCE MAJOR CHANGES IN CLIMATE
 - TEMPERATURE
 - RAINFALL PATTERNS
 - COASTAL SEA LEVELS

CONCENTRATION OF ATMOSPHERIC CO₂ AT MAUNA LOA OBSERVATORY, HAWAII

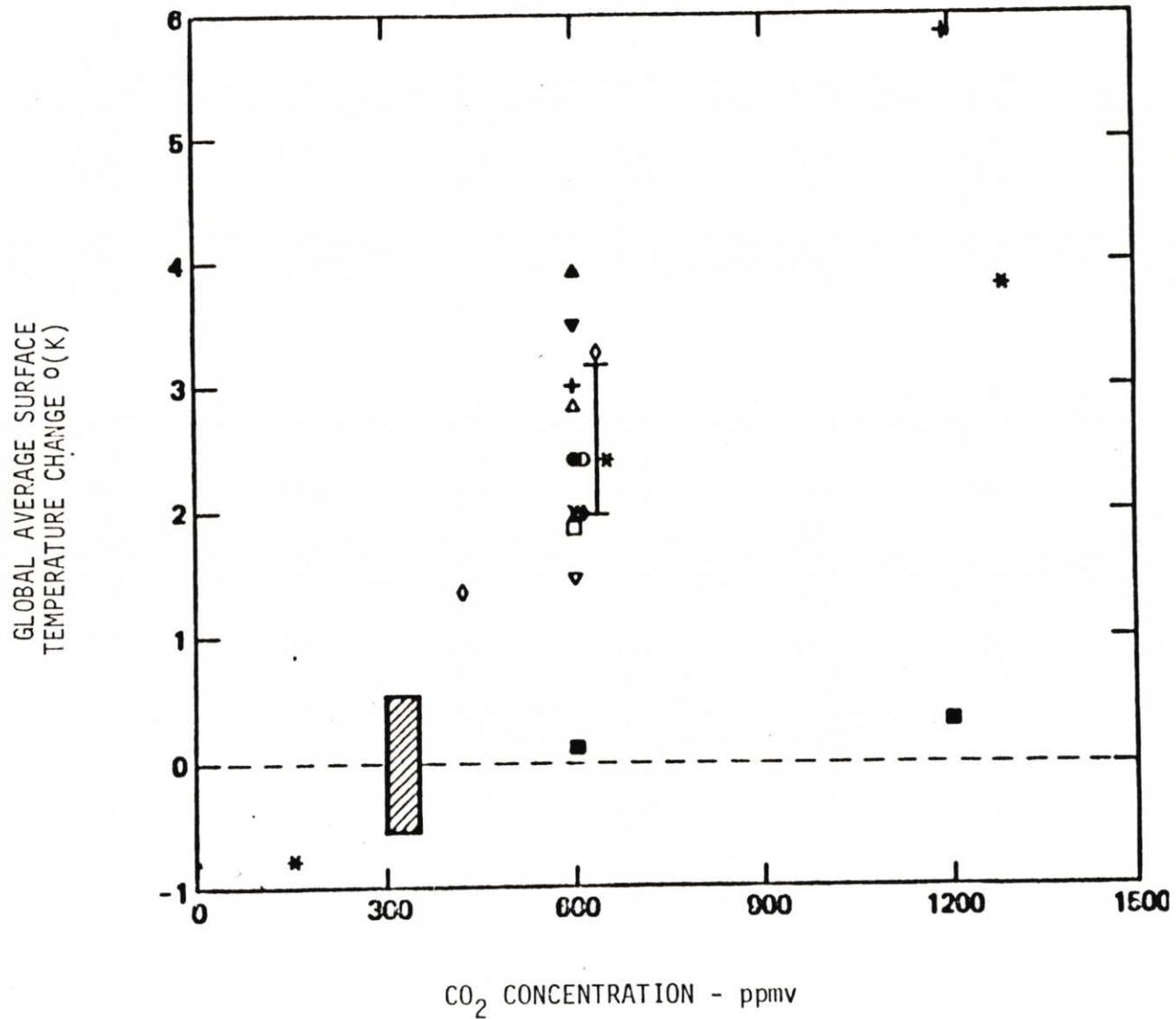


INDUSTRIAL CO₂ PRODUCTION

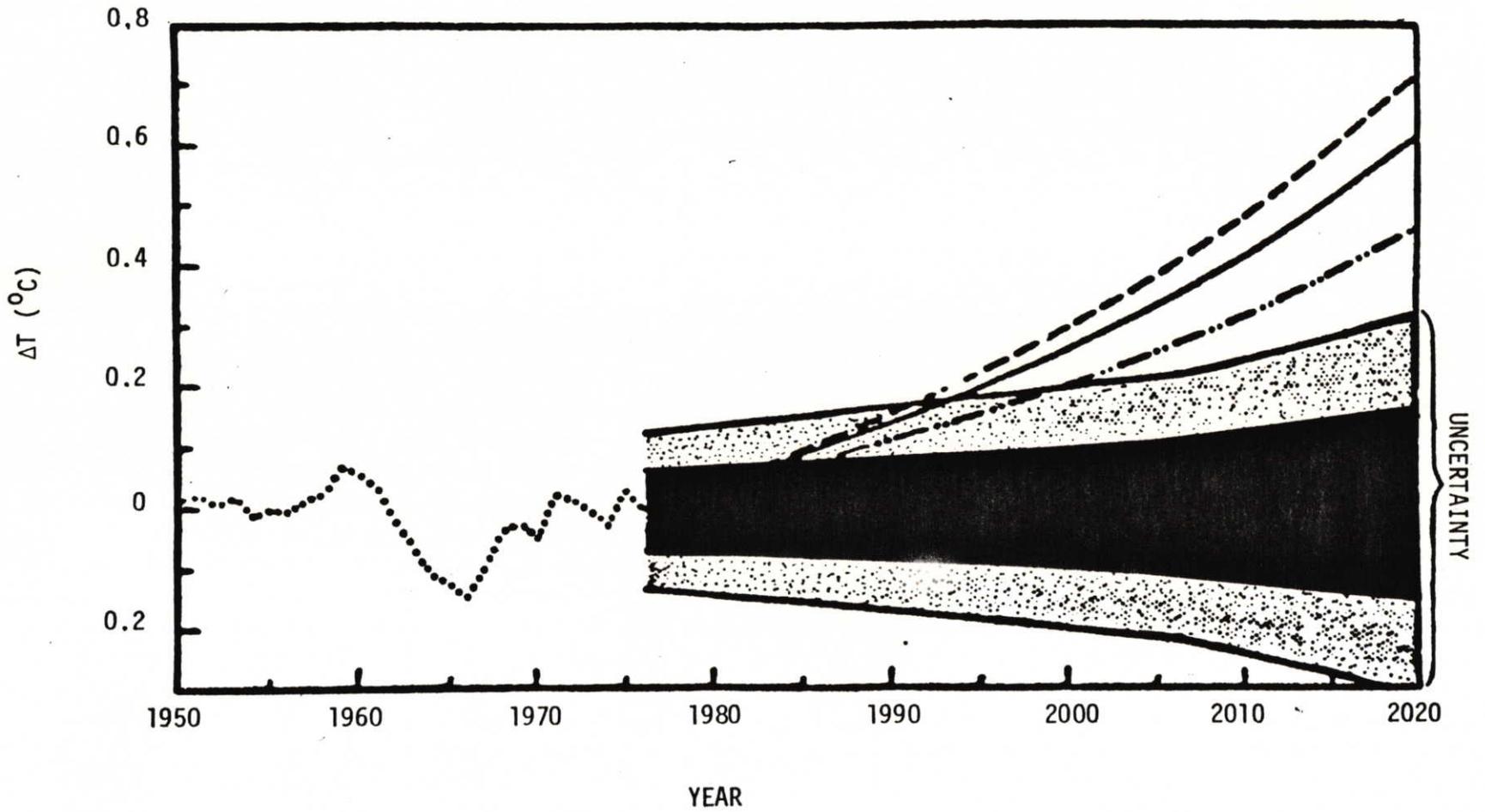


CLIMATE MODEL CONSENSUS

- ESTIMATES OF THE CHANGE IN GLOBAL AVERAGE SURFACE TEMPERATURE DUE TO VARIOUS CHANGES IN CO₂ CONCENTRATION
 - SHADING SHOWS PRESENT RANGE OF NATURAL FLUCTUATIONS



FIRST EFFECTS PREDICTED BY YEAR 2000



VALIDITY OF CLIMATE MODELS IS NOT ESTABLISHED

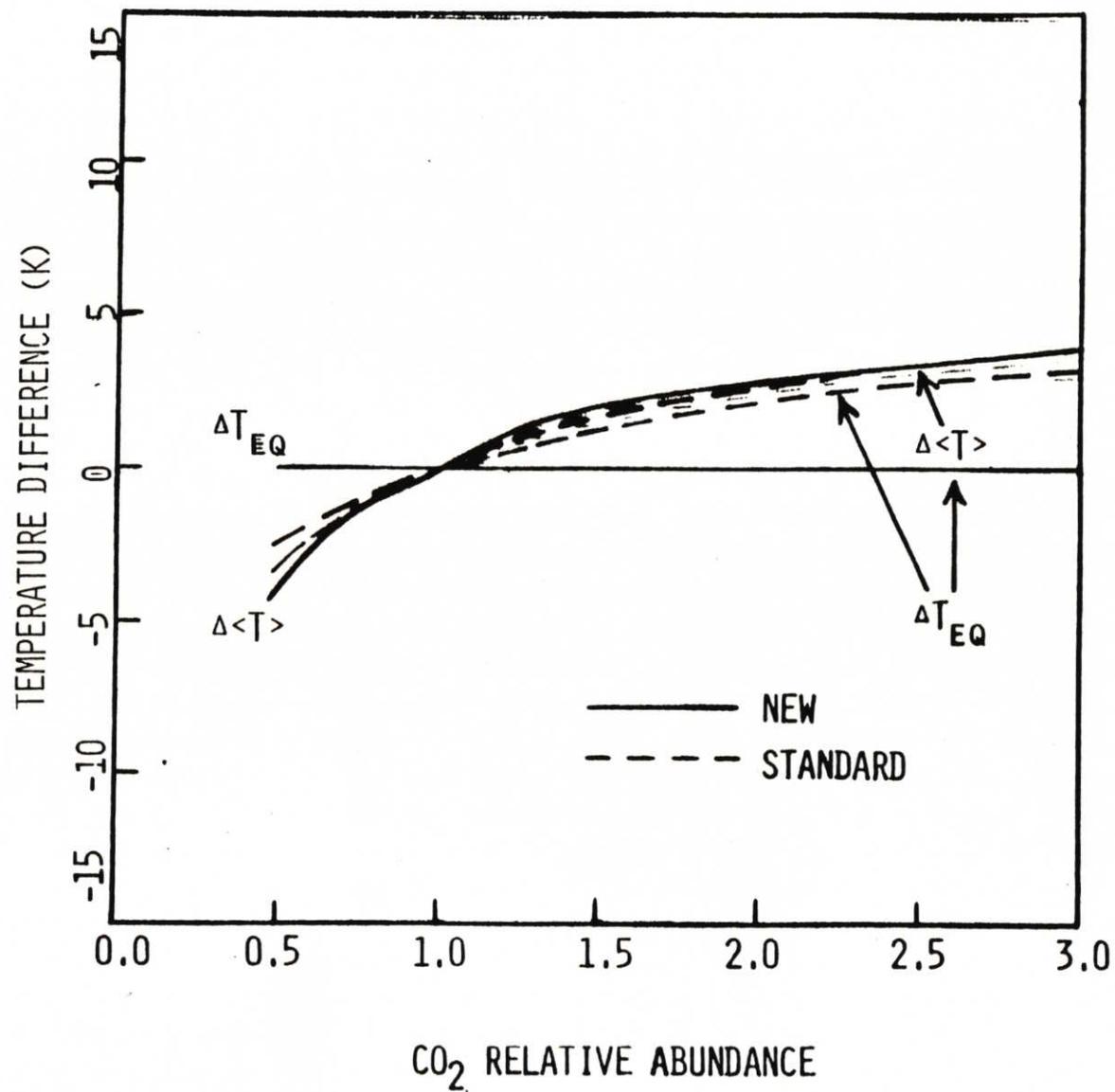
- COMPLEXITY OF CLIMATE SYSTEM REQUIRES MANY APPROXIMATIONS AND PARAMETERIZATIONS
- GEOLOGICAL AND HISTORICAL CLIMATE DATA ARE INADEQUATE FOR VALIDATION OF MODELS
- PREDICTIONS OF MODELS ARE UNVERIFIED
- RECENT CONTROVERSY OVER PREDICTION BY R. NEWELL (MIT) OF MUCH SMALLER CO₂ INDUCED WARMING
 - EVAPORATIVE BUFFERING MECHANISM TO EXPLAIN OBSERVED LACK OF TEMPERATURE VARIATION IN EQUATORIAL REGIONS
 - PROPOSED THAT THIS MECHANISM WOULD LIMIT CO₂ INDUCED GLOBAL TEMPERATURE RISE

CLIMATE MODELING AT CR

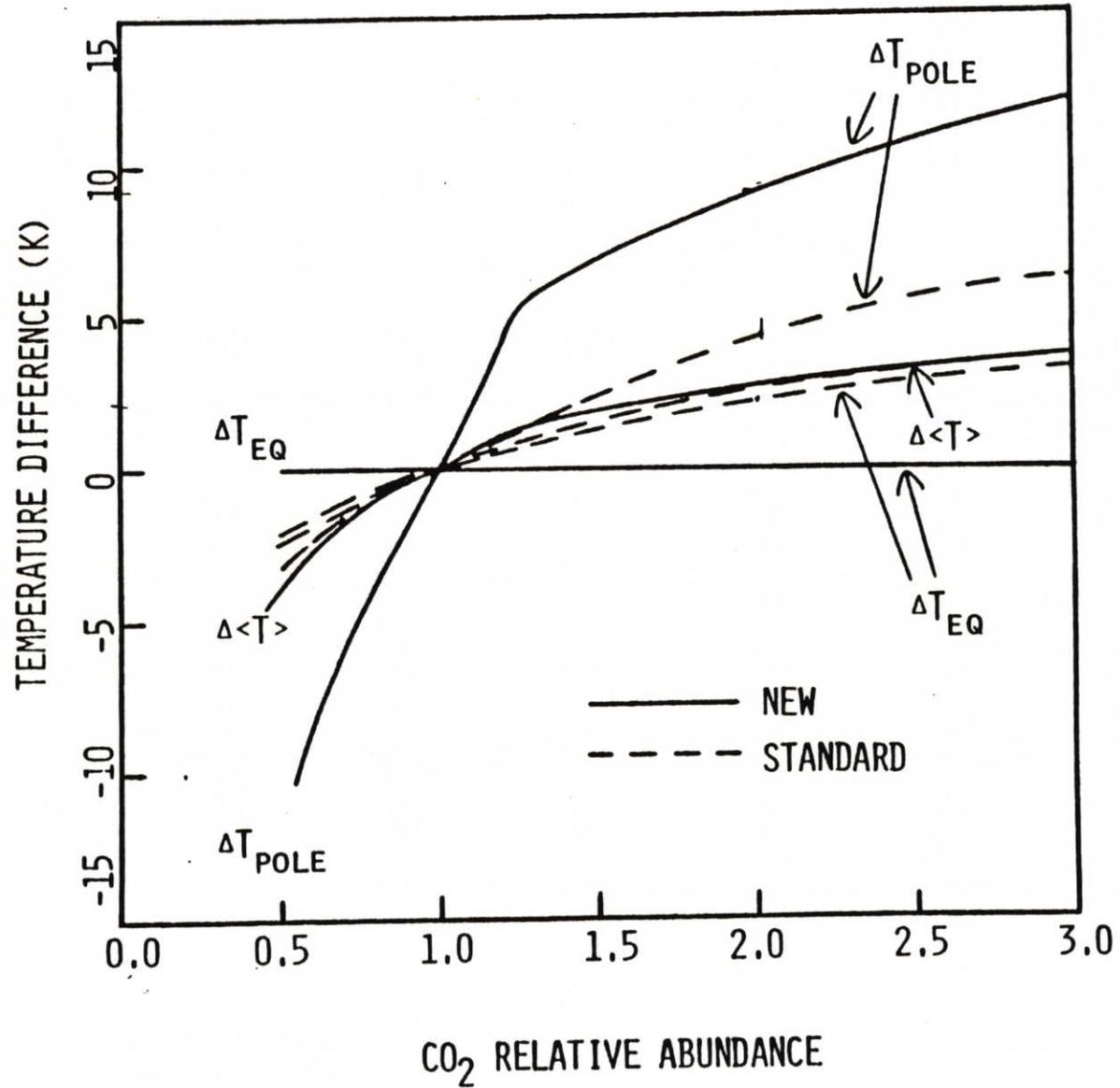
- RESEARCH HAS FOCUSED ON GLOBAL CLIMATIC EFFECTS OF EVAPORATIVE COOLING IN THE EQUATORIAL REGIONS
 - EVAPORATIVE MECHANISM OF NEWELL HAS BEEN INCORPORATED INTO A CLIMATE MODEL

- TEMPERATURE CHANGES DUE TO VARIATIONS OF SOLAR INSOLATION AND ATMOSPHERIC CO₂ CONCENTRATIONS ARE STUDIED

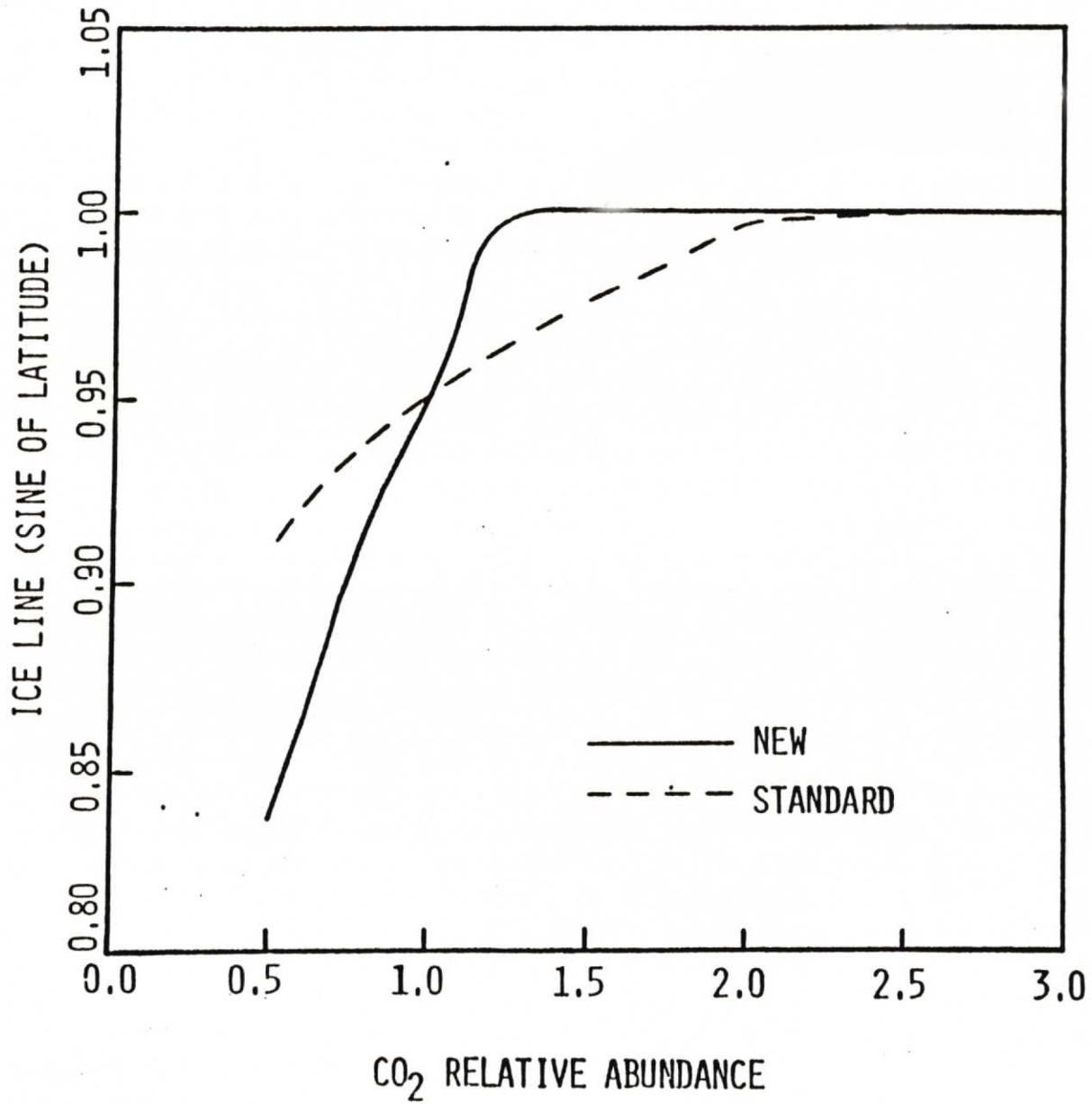
CO₂ INDUCED CHANGES FROM CURRENT CLIMATE



CO₂ INDUCED CHANGES FROM CURRENT CLIMATE



ICE LINE LOCATION



CONCLUSIONS

- EQUATORIAL EVAPORATIVE COOLING IS AN IMPORTANT FACTOR IN THE EARTH'S CLIMATE

- CONSEQUENCES OF NEWELL'S MECHANISM ARE CONSISTENT WITH THE MODELING COMMUNITY CONSENSUS
 - MODEL PREDICTS ESSENTIALLY THE SAME AVERAGE TEMPERATURE CHANGE
 - DECREASED WARMING PROPOSED BY NEWELL NOT FOUND
 - EQUATORIAL BUFFERING IMPLIES INCREASED POLAR WARMING

PUBLICATIONS AND PRESENTATIONS

- PLAN TO SUBMIT TWO MANUSCRIPTS
 - GENERAL ASPECTS OF MODEL TO BE SUBMITTED TO JOURNAL OF GEOPHYSICAL RESEARCH
 - SPECIFIC APPLICATIONS TO CO₂ PROBLEM TO BE SUBMITTED LATER

- PLAN TO PRESENT WORK AT
 - DOE SPONSORED CO₂-CLIMATE MEETING IN SEPTEMBER
 - EWING SYMPOSIUM (LAMONT-DOHERTY-EXXON FOUNDATION SUPPORTED) IN OCTOBER

- WORK IS A COLLABORATION WITH PROFESSOR M. I. HOFFERT - NEW YORK UNIVERSITY.

QUESTIONS & ANSWERS

Q. Is it Exxon's position that warming will take place?

A. Current work is a model study aimed at studying the effect of evaporative buffering in equatorial oceans on climate. The model is illustrative rather than fully predictive. Predictions are subject to approximations and simplifications used to derive the model.

Q. Is the work a refutation of Newell?

A. Model elaborates on work of Newell and incorporates his evaporative constraint in overall energy balance model. Our predictions reconcile Newell's mechanism and modeling consensus. They disagree with CO₂-related conclusions of Newell and Idso.

Q. When will effects take place?

A. Not treated in present (equilibrium) model.

Q. Why is Exxon doing this work?

A. In order to gain capability for critical evaluation of developments in a field which could impact on future energy policy.

