Roy Poats

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THE FIRST SESSION OF THE WORKING GROUP VIII ON THE INFLUENCE OF ENVIRONMENTAL CHANGES ON CLIMATE

10 - 21 June 1974
Leningrad

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REPORT OF THE FIRST MEETING OF WORKING GROUP VIII (INFLUENCE OF ENVIRONMENT CHANGE ON CLIMATE) - FOR IMPLEMENTATION OF THE AGREEMENT BETWEEN THE UNITED STATES OF AMERICA AND THE UNION OF SOVIET SOCIALIST REPUBLICS ON COOPERATION IN THE PROTECTION OF THE ENVIRONMENT

1. INTRODUCTION

1.1 The first meeting of Working Group VIII was held in Leningrad on June 10-21, 1974, as agreed to at the November 16, 1973 meeting of the Joint Committee. The participants in this meeting from both the U.S. and the USSR are listed in Appendix A. Plenary sessions were held on June 10-12 and June 19-21. Details of the agenda, including subjects and authors of formal presentations, are given in Appendix B.

During the period June 13-18, members of the American delegation visited Soviet institutions and observatories in Moscow, Novosibirsk, Kiev, Crimea and the northern Caucasus. There were also visits to a number of institutions in Leningrad during the first period of the meeting. The institutions visited by the American delegation are listed in Appendix B.

1.2. Working Group VIII, by decision of the Joint Committee, is divided into three projects. To facilitate discussion, the projects have been organized into six subgroups as follows:

Project 1. Joint studies of the effects of changes in the heat balance of the atmosphere on climate.
- a. Subgroup 1 - The influence of changes of solar activity on the climate.
- b. Subgroup 2 - Modelling of the climate.
- c. Subgroup 3 - Assessment of past climates on the basis of the analysis of natural objects and data.

Project 2. Joint studies of the effects of pollution of the atmosphere on climate.
- a. Subgroup 4 - Monitoring atmospheric constituents and assessment of their effects on climate.
- b. Subgroup 5 - The effect of pollution of the upper levels of the atmosphere on climate.

Project 3 (also Subgroup 6). Joint studies of the meteorology and air-sea interaction of polar regions in both hemispheres as they affect the climate of the planet.

There were discussions concerning the need to recommend the reorganization of this Working Group to the Joint Commission. Important considerations for the organization of the Working Group are achieving sufficient disciplinary homogeneity within each project to permit successful collaboration and the recognition of the relationship of this Working Group to other groups established under this and other bilateral and international agreements.

For the latter reason, the work of the Subgroup on polar studies is specifically concerned with problems of climate and not with the broad spectrum of all polar investigations. On the other hand there are aspects of air-sea investigations without which full understanding of the environmental influences on climate cannot be adequately treated.

At the same time, the studies of solar activity on climatic variations use different types of data and analysis and are broader in scope than the work of the other subgroups of Project 1.

For these reasons a recommendation is made to the Joint Committee for reorganizing Working Group VIII. It is realized that this recommendation impacts the interface between the efforts under this bilateral agreement and that on the Study of the World Oceans. It is therefore anticipated that action on this recommendation would require communication between the Joint Committees under the two Agreements.

The following revised structure of Working Group VIII is recommended:

Section 1. Joint studies of the effects of changes of the heat balance of the atmosphere on climate.

a. Subgroup 1 - Modelling of climate.

b. Subgroup 2 - Assessment of past changes of the climate on the basis of analysis of natural objects and data.

c. Subgroup 3 - Interactions of the atmosphere with polar regions and the oceans as they effect climate.

Section 2. Joint studies of the effects of pollution of the atmosphere on climate.

Section 3. Subgroup 6 - The influence of changes of solar activity on the climate.

2. PROPOSED COOPERATIVE ACTIVITIES

This section of the report will list all the proposals for cooperative scientific experiments that have been developed during the meeting. Not all of these can, or should be initiated now. Section 3 will list those projects which we will try to start in 1975.

PROJECT 1. JOINT STUDIES OF THE EFFECTS OF CHANGES IN THE HEAT BALANCE OF THE ATMOSPHERE ON CLIMATE

2.1 Subgroup 1. The influence of changes of solar activity on the climate

2.1.1. Scientific cooperation

Joint experiments should be conducted to test the validity of possible mechanisms of solar activity influences on atmospheric circulation and climatic changes. The following are recommended:

a) Highly accurate determinations (at least 0.1% of the mean) of variations in the integral solar radiation flux at different levels of solar activity, both over the whole range of wave length and in separate bands (including infrared, visible and ultraviolet ranges). Provision should be made in the future for scanning of the solar disc.

b) Synoptic observations of particles entering into the upper atmosphere for energies from 10^2 - 10^9 eV.

c) Synoptic global observations of infra-red radiation from the upper atmosphere, especially for the intervals of enhanced magnetospheric activity.

d) Analysis of observations of concentrations and distributions of ozone, CO_2 and H_2O in relation to the various measures of solar activity. More extensive observations of these parameters, especially at high levels, are required.

e) Experimental study of global interaction between the magnetosphere, ionosphere, stratosphere and troposphere for different levels of solar, interplanetary and geomagnetic activity.

f) The study of possible changes in the velocity of the Earth's rotation as influenced by solar flares (Danjon's effect).

g) Further analysis of changes of atmospheric circulation as have been suggested to be related to solar activity.

h) The analysis of the variations of temperature and pressure fields in the upper and lower atmosphere during solar disturbances.

i) Complex global investigations of the nature of sharp breakings of the atmospheric circulations in connection with solar activity for the purpose of studying the reasons for climatic changes.

j) The study of global conditions of formation of droughts in different parts of the world in connection with solar activity.

Initial experiments on measurements of the solar constant, particle flux and infrared radiation will be carried out in the US and USSR. At a later date, when cooperative experiments whould be undertaken, Working Group 8 will refer such proposals through the Joint Commission on the Environment to the appropriate US - USSR organization to handle space experiments.

2.1.2 Data exchange

Data on solar, interplanetary, magnetospheric, ionospheric and meteorological observations should be exchanged on

a regular basis. Specially prepared lists of times of occurrence of particular features such as solar structures, sector boundaries, large geomagnetic activity and ionospheric activity should also be exchanged. Exchanges should use existing channels, namely the World Data Centers (A in Boulder, USA; B in Moscow, USSR), which should be encouraged to compile special catalogs of data useful in solar-climate studies.

The lists of solar-geophysical data for collaborative investigations should be prepared in the nearest future and should be approved by both sides.

2.1.3 Actions proposed

a) The exchange of visits between USA and USSR. The duration of the exchange visits should be from several days or several months to one year. Longer visits are considered most important and should include both established scientists, and young scientists. At important meetings on the subject of solar-atmospheric relations in one country it is deemed desirable to invite representatives from the other side.

b) The compilation world-wide mailing list of active workers in the field. The mailing list would receive a newsletter and photocopies of any material submitted. This activity should be coordinated with the ICSU/SCOSTEP Panel on this subject.

c) The determination of the indices of solar and geophysical activities which are to be the most adequate ones when analysing and forecasting solar-atmospheric effects.

d) The working group strongly recommends the development of short and long-term solar activity forecasting methods.

2.2. Subgroup 2. Modelling of the Climate

2.2.1 Scientific cooperation

At present a number of climate theory models are availab-

le which can be used to study climate variability. Using these models, the first preliminary results have been obtained in the assessment of the role of individual physical processes in climate formation and its possible natural changes and variations due to anthropogenic factors.

Some of these results indicate high sensitivity of the current climate to small variations of climate-forming factors. It suggests the possibility of large-scale anthropogenic variations which requires the rapid development of more precise and more reliable methods to assess the mechanisms of climate changes.

In connection with existing and planned activity related to climatic modelling in the USA and USSR, the following general areas for collaboration may be considered:

a) The intercomparison of existing US and USSR climatic models is needed to assess their simulation properties.

b) The construction of new numerical models of the interactive atmosphere-hydrosphere-cryosphere system (including the stratosphere) are required. In developing numerical models of a climate theory, special attention should be paid to parameterization of the physical processes which may critically influence climate changes, including the most important feedbacks between the elements of the meteorological regime (for example, the non-conservative physical, chemical and biological changes of atmospheric constituents such as CO_2, O_3 and aerosols).

c) In order to provide consistency in interpretation of results obtained with different climatic models, analysis techniques should be agreed upon. The specific proposals should be considered at the next group meeting.

d) It is of importance to develop and use agreed upon distribution models for aerosol concentration, moisture, CO_2, ozone and other constituents.

e) The properties of the climatic models and the limits of their applicability may differ depending on the methods used for parameterization of physical processes in the atmosphere and the number of the feedbacks incorporated. It is necessary, therefore, to formulate the models compatibly to the requirements and to evaluate the limits of model applicability with respect to concrete problems.

f) Consideration should be given to the possible design, performance, analysis and interpretation of numerical experiments requested by other subgroups in order to assess the role of specific external (man-made) factors effecting the climate.

2.2.2. Data Exchange

Bearing in mind that all the current theories of climate are approximate, it is necessary to check these theories against empirical material before applying the models to calculations of future climatic conditions. For this purpose, short-term seasonal or interannual observations of meteorological elements are needed as well as the data on contemporary climate variations and on climate change in the geological past. The specification of new observational requirements are also needed.

2.2.3 Actions Proposed

A joint symposium on climatic modelling may be convened in Uzbekistan, USSR in 1976.

The United States delegation would like to issue invitations to Soviet scientists to visit the following U.S. institutions for periods of 6 to 12 months. The invitation is offered to the indicated scientist or a colleague to be agreed on by both countries.

a) To come to the Geophysical Fluid Dynamics Laboratory, National Oceanic and Atmospheric Administration, Environmental Research Laboratories in Princeton, N.J. (one or two of the visits to take place in 1975).

Professor M.I.Budyko - Climate sensitivity and stability
Professor K.Ya.Kondratiev - Radiation effects of aerosols
Academician G.I.Marchuk - Numerical integration methods
Professor S.S.Zilitinkevich - Coupled ocean-atmosphere models

b) To come to the National Center for Atmospheric Research Boulder, Colorado.

Dr. A.F.Treshnikov - Effects of sea-ice
Academician G.I.Marchuk - adjoint methods applied to climatic variations

c) To come to the University of Washington (Seattle, Washington)

Dr. A.F.Treshnikov - Modelling of ice dynamics

d) To come to Stanford University, California

Academician Mustel - Problems of solar activity and climate

2.3 Subgroup 3. Assessment of past climates on the basis of the analysis of natural objects and data

2.3.1. Scientific Cooperation

A. Century program (0 - 100 years before present)

This will focus on climatic changes in the period of modern instrumental data, including aerological data for the past 20 or 30 years, and will attempt to document the most recent trends of climate together with environmental changes which may have causal connections with such trends.

a) Exchange of data, as raw (unsmoothed) time series:

(i) Indices of atmospheric circulation intensity and patterns in the Northern Hemisphere.
- Update of Dzerdzeevskii circulation-type epoch data by the Institute of Geography, Moscow; (Ya. L. Rauner, suggested cooperating scientist).
- Updated series of coefficients of empirical orthogonal functions of monthly mean

sea-level pressure (by NOAA Environmental Data Service, Washington, D.C.; J.M.Mitchell, jr., suggested cooperating scientist).

(ii) Regional and hemispheric-scale average values of monthly average climatic parameters in Northern Hemisphere.

- Climatological surface air temperature in the form of digitized grid-point values on I IBM-compatible magnetic tape for the period 1881 to at least 1960 together with related publications (by Main Geophysical Observatory, Leningrad; Ye.P.Borisenkov, suggested cooperating scientist)
- Updated series (since 1958) of hemispheric circulation statistics, including zonal and meridional wind indices, free-air temperature, geopotential height, specific humidity, kinetic energy, fluxes of heat and momentum (by NOAA/CFDL, Princeton,N.J.; A.Oort, suggested cooperating scientist).
- Complete digitized "World Weather Records" temperature, precipitation and pressure data, by stations, on magnetic tape for the period from beginning of record at each station to at least 1960 together with related publications (by NOAA Environmental Data Service, Washington D.C.; J.M.Mitchell, jr. suggested cooperating scientist).

(iii) Exchange climatological data concerning the energy balance of the earth-atmosphere system and its geographical distribution. The USSR side would contribute surface-based data on the components of heat balance. The US side would contribute satellite-based data on the planetary heat balance, including cloudiness.

(iv) Oceanologic indices of seasonal and year-to-year variations of conditions in the North Atlantic Ocean.

- Measures of geographical distribution of ocean-surface temperature and heat content of mixed-layer of ocean (by Institute of Oceanology, Moscow; V.G.Kort, suggested cooperating scientist).
- Data on oceanic conditions, including monthly average surface temperatures and their variations over a period of many years, for all available locations in the ocean (by NOAA Environmental Data Service, Washington, D.C.; J.M.Mitchell, Jr., suggested cooperating scientist).

b) Millenium Program (0 - 1,000 years before present)
This will document in greater detail the course of global climate change in earlier centuries, thus lending perspective to the course of climate in the 20th century in the context of historical events including the "Little Ice Age".

c) Ice-age History Program (0-30,000 years before present, and older)
This will help improve the understanding of the extremes of climate, and of the nature of the transitions of climate, both within and following a major glacial event on earth; and to clarify the geographical pattern of conditions and events during each phase of the glaciation and deglaciation, as needed to evaluate the accuracy of climate simulation models.

2.3.2 Exchange of Data

a) Tree-ring widths
- un-normalized ring-width series from replicated trees in each of 11 or 12 subpolar sites in USSR, from the Finland border eastward to the Kamchatka Peninsula (by the Lithuanian Academy of Sciences,

Kaunas, Dr. Bitvinskas, suggested cooperating scientist; and by the Botanical Institute, Leningrad, Dr. Lovelius, suggested cooperating scientist).

- Ring-width series and detailed information concerning transfer functions relating ring-width series to climate, for any or all of the more than 49 available sites in North America as desired (by University of Arizona, Tucson; H.C.Fritts, suggested cooperating scientist).

b) Exchange paleoclimatographic data acquired according to the plans approved at the Paleoclimatographic Conference described in 2.3.3.

2.3.3 Action Proposed.

a) Conference on paleoclimatography: a technical conference to be held approximately June, 1975; to be organized to accomplish the specific objectives listed below, and to include as many of the cooperating scientists listed below as possible, in addition to other scientists.

Country	Institution	Suggested Participants
USSR	Institute of Geography, Moscow	M.I.Neustadt,N.S.Chebotareva, M.G.Grossvald, V.P.Gruchuk, A.A.Velichko, N.A.Khotinsky
USSR	Institute of Geology, Moscow	K.N.Nikiforova, N.V.Kind, R.E.Giterman, E.Korenova, M.A.Pavzner
USSR	All-Union Geological Institute (VSEGEI) Leningrad	I.I.Krasnov
USSR	Institute of Geology, Novosibirsk	V.N.Saks
USSR	Institute of Geology, Murmansk	S.A.Strelkov
US	Lamont-Doherty Geological Observatory, New-York	W.S.Broecker, N.Opdyke

US	University of Wisconsin	J.Kutzbach
US	Brown University, Providence, Rhode Island	T.Webb, J.Imbrie
US	University of Minnesota	H.Wright
US	Yale University, New Haven, Connecticut	M.Davis
US	US Geological Survey	D.Adam, E.Leopold
US	University of Maine	G.Denton
US	Ohio State University	T.Hughes
US	University of Washington	S.Porter

The objectives of the Conference are as follows:

- To plan for the exchange of data on C-14 dated ice-sheet moraines from as many locations as possible in the U.S. and USSR (especially Siberia).
- To plan for the exchange of historical palynological data (samples, pollen counts, C-14 dates, and pollen diagrams) from C-14 dated stratigraphic sections located as widely as possible in the U.S. and USSR including areas well south of areas covered by glacial ice during the Quaternary.
- To plan for the exchange of modern pollen data (samples, pollen counts, geographic locations) from sites distributed as widely as possible in the U.S. and USSR
- To exchange statistical transfer-function techniques designed to extract rainfall and seasonal temperature estimates from fossil pollen data.
- To assess the C-14 dating facilities needed to accomplish the first and second objectives in the U.S. and USSR, and to make appropriate recommendations to insure the needed support.
- To formulate a research plan for acquiring continuous stratigraphic sections (both pollen diagrams from lake cores and soil sequences) covering all or significant

portions of the Brunhes Magnetic Epoch (the past 690.000 years) in the U.S. and USSR at a number of widely-distributed sites.

b) Conference on paleoclimatic modelling: a technical conference to be held in the U.S. in June 1976 or thereabouts, designed to exchange results of experiments simulating selected past climates.

(i) U.S. scientists will present results of numerical experiments aimed at simulating ice-age climates at the last glacial maximum using general circulation models (NCAR, Boulder, Colorado; J.Williams, W.Washington, and R.G.Barry, suggested cooperating scientists. National Science Foundation's IDOE/CLIMAP Project Scientists and other institutions as appropriate)

(ii) USSR scientists will present results of climate-modelling experiments carried on by the Institute of Geography, Moscow (I.P.Gerasimov, suggested cooperating scientist) and by the Main Geophysical Observatory, Leningrad (M.I. Budyko, suggested cooperating scientist).In addition, information on ice-age climate in the oceans will be presented by the scientific staff of the Institute of Oceanology, Moscow (A.Lysitsin, suggested cooperating scientist) and other institutions as appropriate.

c) Exchange of scientific personnel.
Each country shall have the right to arrange for working visits of up to a total of 6 man-months duration per year by up to 3 scientists. Soviet institutions open to visitation shall include the Institutes of Geography, Geology, and Oceanology in Moscow, the All-Union Geological Research Institute in Leningrad and in Novosibirsk, and the Siberian Branch of the USSR Academy of Sciences in Novosibirsk. U.S. institutions open to visitation shall include those listed under 2.3.3. above.

PROJECT 2. JOINT STUDIES OF THE EFFECTS OF POLLUTION OF THE ATMOSPHERE ON CLIMATE

2.4. Subgroup 4. Monitoring atmospheric constituents and assessment of their effects on climate

2.4.1. Scientific cooperation

a) At present, the USA has 4 baseline stations and 10 regional stations with 2 additional baseline stations planned for the future. The USSR has 1 baseline station and 5 regional stations. It is desirable to enlarge the network of stations and to expand their geographical location. The respective networks should be expanded as soon as feasible and largely completed by 1980.

b) Both countries will provide for the accomplishment of measurements within the WMO program (aerosol chemistry based on the study of the atmospheric turbidity, rain chemistry and CO_2). Additional measurements beyond these minimum requirements are also being made others are planned.

c) Both countries should develop methods of measurement and systems of calibration for carbon dioxide, ozone, and atmospheric turbidity (and other optical properties) at the baseline stations and exchange the experience gained and the data from such work.

(i) The US would provide a surface ozone measuring system for operation at a USSR remote Observatory. The exchange would be phased as follows:

1974 - one electrochemical concentration cell system

1975-76 - one chemiluminescence (ethylene reaction) system.
One precision ozone generator.

(ii) The USSR would provide one system for the measurement of total ozone (perhaps of the M81 type) in 1974 or 1975 to be operated in parallel with a Dobson spectrophotometer at a US stations

(iii) Each instrument will be supplied with its maintenance and operating instructions

(iv) A scientist knowledgeable in the system operation will accompany the system to the proposed operational location and provide instructions and training in its operation.

d) Joint mathematical modelling of the life-cycles and of the effects of carbon dioxide, ozone, aerosols and other important pollution on atmospheric radiation for their incorporation in global climate models. Exchange of model results to enable mutual improvement.

e) Bearing in mind that atmospheric aerosols is one of the possible factors that may affect climate, it is advisable to carry out an agreed program of investigation of the spatial concentration field, microstructure, chemical composition and optical properties of the aerosol. The first projects in this area will be:

(i) The development and design of a field experiment to be conducted in a non-urban location of the USSR. The experiment would incorporate an angular integrating nephelometer to measure the scattering properties at the ground. Other instruments to measure aerosol optical properties at this site may be provided by the US and the USSR to aid in the determination of the radiative and other properties of particles. The chief focus is the massive particle production by industrial Europe after it has had the opportunity for chemical and physical changes. Prof.Charlson (USA) and Prof.Rosenberg (USSR) should coordinate the planning of this experiment.

(ii) To develop proposals on conducting surface measurements of aerosols using lidars (together with supporting measurements, aircraft and balloons) by the next meeting of the Working Group.

2.4.2. Data Exchange

Site documentation and data exchange should be organized to permit the cooperating scientists to better analyze global pollution. Data should also be exchanged from each baseline station. (The requirements for these exchanges were furnished to US and USSR Working Group members in June 1974).

2.4.3. Actions Proposed

a) To ask the Working Group on Space Meteorology (Co-chairmen are Dr. Johnson and Dr. Alexandrov) to develop suggestions on space remote sensing of the minor gaseous and aerosol components of the atmosphere, measurements of the spectral solar constants, and investigations of the radiative properties of the earth-atmosphere system, with the data obtained to be presented to Working Group 8 for projecting the climate changes.

b) A meeting of specialists on atmospheric optics and aerosols should be held. This group would study the role of relative and absolute humidity and the molecular chemical composition of the processes which influence the variability of the physical and optical properties of sub-micrometer particles in the air. Prof. Charlson (USA) and Prof. K. Kondratiev, Prof. Rosenberg (USSR) should prepare plans for this meeting. It is desirable for this meeting to be held in connection with the IUGG meeting in Grenoble, France, in August, 1975.

c) A US scientist will be invited to come to the Main Geophysical Observatory of the Hydrometeorological Service in Leningrad to work on problems of measuring minor constituents in the atmosphere.

d) In order to improve our understanding of techniques for measuring minor constituents in the atmosphere in very clean air, the US would like to invite a Soviet scientist to work at the Mauna Loa Baseline Station for a period of 1-3 months. The Soviet scientist would bring with him USSR instruments to measure ozone and atmospheric aerosols and turbidity. These instruments would be used alongside US instruments for a comparative study of these measurements and other measurements made regularly at Mauna Loa. Arrangements for this meeting would be made by Mr. Pack.

2.5 Subgroup 5. The effect of pollution of the upper levels of the atmosphere

2.5.1 Scientific Cooperation

a) Collaboration is proposed between the University of Leningrad and the University of Wyoming in joint balloon experiments for the in situ measurement of stratospheric aerosols, O_3, H_2O and ions. A detailed description is given in Appendix C.

b) It is proposed that measurements of stratospheric constituents, such as NO_x, OH, H_2O (vapor) content, UV radiation and aerosols be conducted using USSR and U.S. instruments on board the TU-144 and other aircraft.
A detailed description of the U.S. proposal is given in Appendix D.

2.5.2 Data Exchange

There should be an exchange of results of investigations of the quantitative assessment of possible environmental effects of SST exhaust, and especially the effects on climate. There should be an exchange of proposals on methods and means of detecting these effects and of possibilities for minimizing them.

2.5.3 Actions Proposed

a) Investigations should be conducted on the best available methods and instruments in U.S. and USSR for ground-based measurements of UV fluxes at the network of stations in both countries.

b) The visit of USSR scientists who can report progress on these experiments and data exchanges is invited to Boston, Massachusetts and Washington, D.C. in the period 4 to 12 February 1975, including attendance at the Fourth CIAP Conference (Boston, Massachusetts) during 4 to 7 February 1975.

c) A joint symposium on ecosystem response to climatic changes should be held in Leningrad in 1976

d) Arrangements should be made to exchange data on anticipated production of the TU-144 and other USSR civilian stratospheric vehicles in the future and comparable US data (fleet size as a function of time).

e) Arrangements should be made to exchange data and models of crop and ecosystem productivity dependence on temperature, precipitation, sunlight and solar UV-B flux, including agroclimatology of corn, wheat, rice, cotton, soybeans, sorghum and table vegetables, as well as sensitivity of crop and ecosystem yield to change in climatic variables.

f) Arrangements should be made to exchange data on the epidemiology of skin cancer in the USSR and U.S. This includes new cases per 10,000 of each age group per year, in various locations over latitudes 40°-70°, by age and skin type.

g) Arrangements should be made to exchange data on rate coefficients of chemical gas and aerosol reactions in the stratosphere, such as:

(i) O_3-NO_x-H_2O

(ii) (SO_2 + NH_3 + H_2O) - aerosol

h) Arrangements should be made to exchange data of laboratory measurements of infrared spectra useful for determination of number densities of trace gas species in stratosphere.

i) Arrangements should be made to exchange ozone, NO_x, water vapor, and aerosol data collected by commercial aircraft along transcontinental routes

j) Arrangements should be made to exchange data on emission characteristics of TU-144 and U.S. high-flying planes in the stratospheric environment, including:

(i) Emission constituents measured.

(ii) Procedures and instruments for measurements, including location of probes.

(iii) Engine environment conditions (sea-level or stratospheric temperatures and pressures).

(iv) Flight profile (fixed-altitude or climb-cruise).

PROJECT 3. JOINT STUDIES OF THE METEOROLOGY AND AIR-SEA INTERACTION OF POLAR REGIONS IN BOTH HEMISPHERES AS THEY AFFECT THE CLIMATE OF THE PLANET

2.6. Subgroup 6. Joint Studies of the Meteorology and Air-Sea Interaction of Polar Regions in both Hemispheres as they Affect the Climate of the Planet

2.6.1. Scientific Cooperation

Considering the special problems of the polar regions in the studies of climatic variations under Working group VIII it was decided to continue the work of the sub-group concerned with the problem of "Polar region effect on the climate", and the following specific recommendations were proposed:

a) To develop plans for a series of investigations on the problem of the interaction of the atmosphere and the ocean, directing primary attention to:
   (i) theoretical and experimental investigations of energy exchange in the Antarctic Ocean and in the "centers of interaction" in the North Atlantic and North Pacific;
   (ii) mathematical modelling of processes of interaction between the atmosphere and ocean;

b) To conduct numerical experiments evaluating the influence of polar regions on the climate of the planet:
   (i) to evaluate the role of the polar front and meridional wave processes (in the atmosphere);
   (ii) to reconstruct past climates using data from the isotope analysis of glacier cores obtained in Antarctica and Greenland;
   (iii) to evaluate the role of the ice cover in climate variation.

2.6.2. Data Exchange

To organize the exchange of polar information including:
   (i) meteorological data from drifting automatic stations in the Arctic;

(ii) hydrometeorological data from jointly-worked polygons in the northern parts of the Atlantic and Pacific Oceans;

(iii) meteorological forecasts in the Antarctic;

(iv) published articles and monographs.

2.6.3. Actions Proposed

To organize working visits of specialists beginning during the second half of 1974, with specialists in numerical modelling of ice dynamics between the University of Washington and the Arctic and Antarctic Research Institute, and working visits between ships participating in oceanographic studies in Drake Passage in 1975.

3. SPECIFIC TECHNICAL PROPOSALS FOR 1975

3.1. The next two-week meeting of Working Group VIII should be held in Princeton, USA, in October 1975.

About 14 Soviet scientists representing different subgroups may participate in the meeting. The number of American scientists can be enlarged.

During the meeting of the Working Group, visits to the scientific centers of Washington, Boulder, Los Angeles, Seattle and to a baseline station should be provided. These places and institutions should be specified.

During the Working Group VIII meeting, special 2-3 day symposia should be held on the Scientific problems involved. The joint publication of the materials of the symposia in Russian (USSR) and in English (USA) should be envisaged.

3.2. For preparation of the above meeting and discussions of the status results and co-ordination of the joint programs, a visit of 1-2 Soviet experts to the USA (Washington-Princeton-Boulder) should be planned in April 1975 for a period of 5-7 days, and a visit of 1-2 American experts to Moscow and Leningrad in June -July 1975 for the same period.

3.3. In order to develop a more complete understanding of the work that should be carried out in the future in several areas of study of climatic change we propose that several small groups (6 to 8 people) of experts hold meetings during the next year. These small meetings of experts would formulate more specific programs of work to be carried out in the future by Working Group VIII.

We recommend that the following meetings of experts be held during the next year if funding is available.

A) Meeting of Experts on Atmospheric Optics and Aerosols

This group would study the role of relative and absolute humadity and the molecular chemical composition of the processes which influence the variability of the physical and optical properties of sub-micrometer particles in the air. This group would include the following scientists:

Prof.R.I.Charlson (co-chairman)	University of Washington
Prof.K.T.Whitby	University of Minnesota
Dr.R.F.Pueschel	NOAA,Boulder,Colorado
Prof.G.V.Rosenberg(co-chairman)	IFA, Moscow
Prof.Fuks	Karpov Institute of Physical Chemistry,Moscow
Dr.L.S.Ivlev	State University of Leningrad

A few other scientists of equally outstanding ability could be added or exchanged with scientists on this list. Prof.Charlson and Prof.Rosenberg should organize this meeting. It might be held in connection with the IUGG meeting in Grenoble France in August 1975.

B) Meeting of Experts on Solar Activity and Climatic Variations

This group would study how to implement the work outlined in Section 2.1. Prof.Wilcox and Academician Mustel should organize the meeting which should be held in connection with the joint meeting of the American Meteorological Society and American Astronomical Society in Denver Colorado in January 1975.

C) Meeting of Experts on Forecasting Solar Disturbances

This group should study work to forecast solar disturbances and their effects on the earth. Dr.Hess should organize the meeting which should be held in the USSR possibly at IZMIRAN in 1975.

D) Meeting of Experts to Prepare Data Base of the Recent Climate

This group would recommend how the data base discussed in Section 2.2.2 should be structured, the parameters to ve included, their resolution in space and time, the level of processing of the data and their statistical treatment. The group would also recommend how such a data base should be compiled and an appropriate division of responsibility with due recognition of the need for full international cooperation to achieve global data sets and the role of GARP in compiling global data sets in connection with GARP experiments.

The group would also recommend procedures and formats for the full exchange of all data and analyses that comprise the data base for the present climate.

A meeting of 6 to 8 specialists will be organized in the United States within the next 12 months. Dr.Oort will organize the meeting.

E) Meeting of Experts on Quaternary Glaciation

This group would study the distributions and changes of ice and climatic zones in the USSR during the recent upper-quaternary glaciations. Prof.Imbrie would help organize the meeting which should be held in the USSR during 1975.

3.4. Long Duration Working Visits of Scientists

It is desirable to have scientists from each country visit the other country for periods of 6 to 12 months to work on problems connected with climatic variation.

3.4.1 The U.S.would like to issue invitations to Soviet scientists to visit the following U.S. institutions for 6 to 12 month period.

(a) To come to the Geophysical Fluid Dynamics Laboratory of NOAA in Princeton, New Jersey: (1) to study climate sensitivity and stability; (2) to work on radiation effects of particulates; (3) and to study numerical integration methods.

(b) To come to the National Center for Atmospheric Research in Boulder, Colorado to study adjoint methods of climatic perturbation and to study effects of sea ice on climate.

(c) To come to the University of Washington in Seattle to study models of ice dynamics.

(d) To come to Stanford University to study the analysis of variations of temperature and pressure fields in the upper and lower atmosphere during solar disturbances.

The USSR would like to issue invitations to U.S. scientists to visit the following USSR institutions for 6 to 12 months periods.

(a) To come to the Computing Center of the Siberian Branch of the Academy of Sciences to study numerical modelling of climate.

(b) To come to the Main Geophysical Observatory of the Hydrometeorological Service in Leningrad to work on problems of measuring minor constituents in the atmosphere.

(c) To come to the Arctic and Antarctic Research Institute in Leningrad to work on problems of polar areas as they effect climate.

(d) To come to the Hydrometeorological Center in Moscow to work on problems of climate prediction and documentation.

3.4.2. For the purpose of expediting the exchange of climatic data, a scientist from the USSR should visit the US National Climatic Center in Asheville, N.C. At this time lists of available climatic data and information will be exchanged on magnetic tape formats. The Soviet scientist will bring an example of a tape prepared in the USSR and will be supplied with an example of a tape prepared in the U.S. This visit would probably last one month and would be carried out during the next year.

3.4.3. In order to improve our understanding of techniques for measuring minor constituents in the atmosphere in very clean air, the U.S.would like to invite a Soviet scientist to work at the Mauna Loa Baseline Station for a period of 1-3 months. The Soviet scientist would bring with him USSR instruments to measure ozone and atmospheric aerosols and turbidity. These instruments would be used alongside US instruments for a comparative study of these subjects and other measurements made regularly at Mauna Loa. Arrangements for this meeting would be made by Mr.Pack.

Proposed invitations for working visits of American specialists to the Soviet Union and working visits of Soviet specialists to the United States will be decided upon by the project leaders and the directors of the institutes involved. Formal invitations for visits of Soviet specialists to the United States should be directed to the Main Administration of the Hydrometeorological Service of the USSR. Invitations to U.S.specialists should be sent directly to the specialist and his organization. A copy of all invitations should also be sent to the co-chairman of Working Group VIII.

3.5. Scientific objectives of a joint marine expedition should be developed in 1974. The general purpose of this expedition would be to determine the concentration of the minor impurities in the atmosphere and near the ocean-atmosphere boundary in various regions of the ocean. The expedition may be carried out in 1976 or 1977. The program of the expedition and its joint equipping should be discussed during the Soviet-American meetings in April and June 1975 (USA-USSR) and agreed on finally during the Working Group VIII meeting in October 1975.

3.6. Proposals for scientific collaboration in 1975 of Subgroup I on Solar Activity:

- Plan a study of global interaction between the magnetosphere, ionosphere, stratosphere and troposphere for different levels of solar, interplanetary and geomagnetic activity.

- Exchange analyses of variations of temperature and pressure fields in the upper and lower atmosphere during solar disturbances.
- Exchange of information in the analytic procedures and the result of studies of global conditions of drought in various parts of the world in connection with solar activity.
  These studies should be coordinated by Academician Mustel and Prof.Wilcox.

3.7. Subgroup 3 on Documentation of Past Changes of Climate will attempt to carry out the following studies during 1975:

- The exchange of data as given in 2.3.1 and 2.3.2.

3.8. Subgroup 4 on Monitoring will attempt to carry out the following studies during 1975:

- Exchange of instrumentation as discussed in 2.4.1.c
- Develop and design a field experiment to be carried out in the USSR on optical properties of aerosols as discussed in 2.4.1e.
- Develop a proposal for an experiment on surface measurements of aerosols as discussed in 2.4.1.e.

3.9. Subgroup 5 on the Effect of Pollution of the Upper Levels of the Atmosphere on Climate will attempt to carry out the following studies during 1975:

- Implementation of the University of Wyoming and Leningrad University cooperative research program. (See Appendix C).
- The direct discussion with TU-144 or other aircraft test authorities of the possibility of measurements of trace gases, such as NO_x, H_2O, OH content, UV radiation and aerosols using USSR and U.S.instruments on board the TU-144 or other aircraft. (See Appendix D).
- Exchange the results of investigations of the quantitative assesment of possible environmental effects of SST exhaust, and especially the effects on climate.

Exchange of proposals on methods and means of detecting these effects and of the possibilities of minimizing them.

- To begin the investigations of the best available methods and instruments of groundbased measurements of UV fluxes at the network stations in both countries.
- To begin the exchange of data on infrared molecular spectra of radiation obtained in laboratories.
- To begin arrangements to exchange ozone, NO_x, water vapour and aerosol data collected by commercial aircraft along the transcontinental routes.
- To plan for a symposium on eco-systems response to climatic changes to be held in Leningrad in first half of 1976.

3.10. Subgroup 6 on Polar Studies will attempt to carry out the following program in 1975:

To organize an exchange of polar information including:

- meteorological data from manned and automatic drifting stations in the Arctic
- hydrometeorological data from jointly-worked polygons in the northern parts of the Atlantic and Pacific Oceans
- meteorological forecasts in the Antarctic
- published articles and monographs.

This work should be planned and coordinated by Mr. Fletcher and Dr.Treshnikov.

The United States delegation would like to thank their Soviet hosts for their outstanding hospitality and the excellent arrangements that were made for this meeting.

It was agreed in order to expedite matters that the English version of this Report of the First Meeting of Working Group VIII would be the official version of the Report. Russian translations will be made at a later time.

We are both pleased to sign this Report and look forward to active cooperation in the future to help understand problems of climatic variation.

Signed in Leningrad 22 June 1974

Dr.Borisenkov Co-chairman
Director
A.I.Voeikov Main Geophysical
Observatory

Dr.Hess Co-chairman
Director
NOAA/Environmental Research
Laboratories

Ротапринт ГГО.22.06.74.3.97.

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5.	Mr.J.O.FLETCHER	National Science Foundation
6.	Dr.A.J.GROBECKER	CIAP/Department of Transportation
7.	Prof.J.IMBRIE	Department of Geological Sciences, Brown University
8.	Dr.C.E.LEITH	National Center for Atmospheric Research
9.	Dr.J.M.MITCHELL	NOAA/Environmental Data Services
10.	Dr.S.M.OLENICOFF	National Science Foundation
11.	Mr.D.H.PACK	NOAA/Air Resources Laboratory
12.	Mrs.F.SETTLE	NOAA/Environment Research Laboratories
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26. Mr.Yu.E.KAZAKOV	Chief Administration of the Hydrometeorological Service of the USSR, Moscow
27. Dr.G.M.KREKOV	Institute of Atmospheric Optics, Tomsk
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38. Dr.V.D.STEPANENKO	Voeikov Main Geophysical Observatory, Leningrad
39. Dr.A.F.TRESHNIKOV	Arctic and Antarctic Research Institute, Leningrad
40. Dr.R.F.USMANOV	Hydrometeorological Centre, Moscow
41. Dr.O.B.VASILIEV	Leningrad State University,Leningrad
42. Dr.K.Ya.VINNIKOV	Voeikov Main Geophysical Observatory, Leningrad
43. Prof.M.I.YUDIN	Voeikov Main Geophysical Observatory, Leningrad

PROGRAM OF WORKING GROUP VIII

MEETING AND VISITS TO LENINGRAD INSTITUTIONS

The first stage of the Working Group VIII meeting
(Leningrad, 10-12 June 1974)

Monday, 10 June

9.30 - 10.30 Registration of participants.
10.30 Opening Session.
Address by Prof. E.P. Borisenkov
Address by Dr. W.N. Hess

Problem 1 : The influence of the changes of solar activity on the climate.

11.15 Presentation by Acad. E.R. Mustel
Presentation by Dr. J.Wilcox
14.30 Discussion

Problem 2 : Modelling of the climate.

15.00 Presentation by Dr. J. Smagorinsky
16.15 Presentation by Acad. M.I. Budyko
17.15 Discussion

Tuesday, 11 June

Problem 3 : Studies of the past climate.

10.00 Presentation by Dr. K.Ya. Vinnikov
11.15 Presentation by Dr. J.M. Mitchell
12.15 Discussion
14.30 - 18.00 Visits to Institutions:
- Leningrad A.A.Zhdanov State University
- Arctic and Antarctic Research Institute
- Pulkovo Astronomical Observatory
- A.I. Voyeykov Main Geophysical Observatory

PROGRAM OF VISIT TO MOSCOW AND TOUR OF THE COUNTRY

On 13 to 18 June the American delegation accompanied by Soviet scientists went on tours of the country to visit various scientific institutions.

Wednesday, 12 June

23.55 All members of the american delegation leave for Moscow by the train "Krasnaya Strela".

Thursday, 13 June

08.40 Arrival in Moscow and settling in the hotel.

Visits to institutions:

- Chief Administration of the Hydrometeorological Service of the USSR
- Hydrometeorological Center of the USSR
- Geological Institute
- Institute of Civil Aviation

Friday, 14 June

Visits to institutions:

- Oceanology Institute, Ac. Sci. USSR
- Institute of Atmospheric Physics, Ac. Sci. USSR
- Computing Center, Ac. Sci. USSR
- Geography Institute, Ac. Sci. USSR
- Ministry of the Aviation Industry

Saturday, 15 June

The delegation leaves, by groups, for Novosibirsk, the Crimea, the North-Caucasian Department of Hydrometeorological Service, and Kiev.

Tuesday, 18 June

Return to Leningrad

Wednesday, 12 June

Problem 4 : Global monitoring of the atmosphere.

10.00	Presentation by Dr. L. Machta
	Presentation by Dr. D.H. Pack
11.15	Presentation by Dr. A.A. Buznikov
	Presentation by Prof. M.E. Berlyand
12.15	Discussion
14.30	Visits to Institutions:

- Leningrad Department of Oceanology Institute Ac. Sci. USSR
- Komarov Botanical Institute, Ac.Sci. USSR
- All-Union Geological Institute
- Institute of Zoology, Ac.Sci. USSR

13 - 18 June

Tour of the country of the american delegation.

The second stage of the Working Group VIII meeting (Leningrad, 19-21 June 1974)

Wednesday, 19 June

Problem 5 : Upper atmosphere pollution and its influence on the climate.

10.00	Presentation by Dr. A.J.Grobecker
11.00	Presentation by I.L.Karol
12.15	Discussion
14.30-18.00	Meetings of national delegations

Thursday, 20 June

10.00-13.00	Meetings of sub-groups on the problems
14.30-18.00	Meetings of sub-groups on the problems

Friday, 21 June

10.00-13.00	Meetings of sub-groups on the problems
14.30-18.00	Signing of working documents and closing session

Detail Description of University of Wyoming and University of Leningrad Cooperative Research Program for the Measurement of Aerosols, O_3, H_2O, and Ions.

Background

As part of the U.S.CIAP program, University of Wyoming scientists have in 1972, 1973 and 1974 made balloon-launched in situ measurements of O_3, H_2O, aerosols, temperature and winds over a range of latitudes from Antarctica to Alaska.

Proposal

It is proposed that the scientists of the University of Leningrad and the University of Wyoming collaborate in joint balloon experiments for in situ measurement of stratospheric aerosols, O_3? H_2O and ions, to determine size, configuration and chemical composition, permitting estimation of indices of refraction.

Preferred location for USSR-launched balloons is at several points in the European part of the USSR. Payloads launched are limited to 100 kg or less.

Telemetry services at their station are provided with standard radiosonde transmitters. USSR balloon launches are three in numbers, over a period not to exceed four (4) weeks.

The University of Leningrad measurements include the following:

(a) Determination of aerosols by balloon-borne impactor, of particle radius $0.25 < r < 10$ microns, on continuous profile over altitude range $0 < z < 30$ km.

(b) Determination of aerosols by aircraft-borne impactors, filters over altitude range ($0 < z < 8$ km).

(c) Measurement of integrated flux of direct solar radiation.

(d) Measurement of downward and upward fluxes of integrated radiation (over 2π) in the visible region of the spectrum.

MEASUREMENT OF NO_X, OH, H_2O (VAPOR), ULTRA VIOLET RADIATION AND AEROSOLS, USING USSR AND U S INSTRUMENTS ON BOARD A TU-144 AIRCRAFT

Background

High-flying aircraft capable of carrying instruments and/or scientists to altitudes of 18 to 20 km offer advantage in measuring constituent distributions in the stratosphere. Spectrometers flown in the Concorde in 1973 have yielded significant knowledge about the composition of the lower stratosphere. Two instruments have been used in CIAP to measure NO_x. They are the Jet Propulsion Laboratory (JPL) interference I.R.spectrometer, which senses the absorption of solar radiation, and the University of Denver spectrometer, which senses the emissions from molecules.

The JPL interferometer was installed in both the French (001) and British Concordes (002). For operation of the JPL interferometer, the presence of the U.S. scientist during the installation and flight is required.

The University of Denver spectrometer determines also O_3, H_2O, NO_2, and also the hydrocarbons of the engine exhaust of the test engines during flight. For operation of the University of Denver spectrometer, the presence of a U.S.scientist during the installation and flight is required.

A laser resonance fluorescence instrument, currently being tested by the University of Maryland, is designed to measure the ambient OH in the lower stratosphere. For operation of the University of Maryland laser, the presence of a U.S.scientist during the installation and flight is required.

The Environmental Research Laboratory (NOAA) used an I.R. radiometer to determine the total column of water vapor above the aircraft and also to determine the in situ value of water vapor. No operator for the IR radiometer is required during flight.

Two instruments have been developed to measure spectra of ultraviolet solar radiation in the range of 200-400 km. One was developed by the NASA Goddard Space Laboratory, and the other by Parametric Co. No operator for the UV instrument is required during flight.

The University of California at Los Angeles has developed a polarimeter for the determination of Stoke's parameters from which the index of refraction of aerosols may be determined. No operator for the UCLA instrument is required during flight.

The University of Wyoming has developed a two-length extinction by which vertical profiles of aerosols and water vapor may be determined over an altitude range of the vehicle. No operator for this University of Wyoming extraction instrument is required during flight.

Proposal

It is proposed that one or more of the following U.S. experiments be considered using the TU-144 aircraft as the test vehicle.

(a) The simultaneous measurement of the ambient concentration of gases (NO_4, H_2O) and the intensity of ultra violet incident radiation, using the JPL and/or the University of Denver spectrometers and the Parametric Co. (or NASA Goddard) U.V.instrument.

(b) The determination of O_3, H_2O, NO_x, and hydrocarbons in the TU-144 engine exhaust during flight.

(c) The separate measurement of OH concentration by means of the University of Maryland instrument.

It is an objective of the research program that similar or different experiments by USSR investigators be accomplished on the same flight carrying U.S. experiments.

Logistic Arrangements

(a) U.S.instruments will be furnished for a mutually agreed period of time by the U.S.Department of Transportation.

(b) Travel expenses by U.S.experimenters incurred within the

USSR will be defrayed by the USSR.

(c) Instruments will be installed in the TU-144 test vehicles by the USSR. Preliminary descriptions of instruments and installation requirements will be furnished to the USSR prior to September 1974 by the U.S.Department of Transportation (CIAP).

(d) Salary and expense of travel to and from the USSR can be defrayed by the U.S.Department of Transportation.

(e) USSR instruments will be furnished by the USSR experimenters.

(f) Travel and expenses of USSR experimenters incurred in the USA will be defrayed by US Department of Transportation (CIAP).

(g) All original data, as well as results of analysis,will be available to the U.S. and USSR experimenters by prompt exchanges. Preprints of publications will be furnished by each group publishing results to the other experimenters, to the U.S.Department of Transportation (CIAP) and to the Main Geophysical Observatory, Leningrad.