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Computing Facility Invites User Input on New "Front End" System

An NCAR Computing Facility working group has made recommendations on the design of a "front end" system that is to be part of the facility's augmentation of computing capability, and facility manager G. Stuart Patterson invites university users to obtain the working group report and comment on it.

Many users of the Computing Facility have followed the progress of the overall plan to augment computing capability in preparation for the First GARP Global Experiment (FGGE) in 1978-79 and other large-scale experimental efforts expected to result in a heavy computing load through the 1980s. The *NCAR Newsletter* brings readers up to date on the progress of the plan from time to time. "At every stage," Patterson says, "we need to take into account the comments and opinions of the user community on specific aspects of the plan."

The new "front end" system proposed by the working group is a major element in the plan, which is based on the acquisition of a number of interrelated hardware components, including a mass storage device and a fifth-generation computer. The front end will provide a sophisticated interface between users and the mass storage system, the Control Data 7600, and the fifth-generation computer.

The working group was formed last November; membership was drawn from a number of Computing Facility sections: systems, applications, and university liaison. Their mission was to study possible configurations for a front end and to report to Patterson and facility management. Their report was issued on 10 March.

The group recommended acquisition of a "distributed" front end rather than the centralized system originally envisioned. A distributed system would comprise a number of satellite computers, each capable of supporting up to 30 terminals, which would communicate with the batch-processing main frames via a "switching" machine that would be transparent to the users. While all the satellites would communicate with the switching machine using the same protocol, individual ones could be internally configured in various ways to accord with the needs of different user groups.

One satellite is already in existence——the ModComp II computer that provides a front end for the Remote Job Entry (RJE) system. RJE now serves about 35 terminals at university and government laboratories across the country.

"The working group saw several advantages to a distributed system," Patterson says. "It should be cost-effective, because it would take advantage of new directions being taken within the computer industry itself and because it could expand flexibly to meet new and different user needs. The group pointed out that their recommendation represents an orientation away from a card-and-paper environment towards a more flexible and powerful terminal environment. Scientists will be able to create and edit programs on their terminals, and they'll be able to take a selective look at their output. Some terminals will have graphics capabilities of one sort or another, which should further enhance the scientists' power."

University users will, of course, still be able to visit NCAR or use RJE as many do now, but a distributed front end might enable users with appropriate equipment to interact with a satellite computer located at the NCAR Computing Facility. Some users might wish to install their own satellite computers using the same protocol at their campuses.

To obtain copies of the working group report, call Patterson at NCAR ext. 520 or write to him at the NCAR address.

Mass Storage System Delivered

The first increment of the NCAR Computing Facility's new mass storage system was delivered to NCAR in early March. The system is part of the overall plan to augment computing capability in preparation for the heavy demands of the 1980s (see previous story).

The system is one of a number of new hardware components that are central to the augmentation plan. Computing Facility manager G. Stuart Patterson notes that a contract for a fifth-generation computer is scheduled to be awarded by 1 June 1976. A machine room addition at the NCAR Mesa Laboratory is planned to house the new equipment, and increases in systems, operations, and applications personnel are planned to provide full support for the augmentation. An invitation for bids for construction of the addition will go out at the end of April, and ground-breaking is scheduled for early this summer.

The acquisition of the hardware is planned to take place in several phases, and the goal is to complete two phases of acquisition for the mass storage system and the front end system in time for FGGE.

The mass storage system is an Ampex TeraBit Memory (TBM) system; since its delivery Ampex programmers and engineers have been working with Computing Facility personnel to put the system on line. The TBM uses videotape-width magnetic tape; the equivalent of 200 full nine-track, 1,600 bpi tapes can be stored on one TBM tape. The initial storage capacity will be 180 billion bits, 18 times the capacity of the present disk system, which has been serving the storage function. The equipment now in place includes two dual-transport TBM tape modules, two transport drivers, a data channel, a channel interface to the Control Data 7600, and a storage control processor, which is a Digital Equipment Corporation PDP 11/35 with two disks whose function is to catalogue the data volumes stored on the TBM tapes and to control the overall system. Patterson expects formal acceptance of the TBM by this fall.

The next phase planned is the acquisition of more tape transport modules and interfaces to the new front end and the fifth-generation computer. By the start of FGGE in fiscal 1978, 600 billion bits should be available; the system can expand to two trillion bits.

For more information on the mass storage system or the augmentation plan for the Computing Facility, call Patterson at NCAR ext. 520 or write to him at the NCAR address.

NCAR's mailing address for correspondence with all staff members is:

P.O. Box 3000
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To reach NCAR via FTS, dial 8, then 322-5 plus the extension; NCAR's FTS switchboard number is 322-5151. Extensions that can only be reached through the switchboard are given in *Newsletter* articles. From commercial telephones, call (303) 494-5151 and ask the switchboard operator for the extension, which is given with the name of the NCAR contact.

RAF Advisory Panel to Meet in November

The Advisory Panel for the NCAR Research Aviation Facility (RAF) will meet in Boulder on 4 - 5 November 1976 to consider requests for NCAR aircraft to be used in research programs and to make recommendations to the director of the Atmospheric Technology Division (ATD) and RAF management on aircraft allocations. Requests for research time on any of NCAR's four aircraft should be submitted to Harry Vaughan, manager of RAF, by 1 September in order to be considered at the November meeting.

The panel will be helping to plan for research flights to be made between 1 February 1977 and 31 October 1977, except in the case of the long-range Electra. Requests for use of the Electra at any time before 1 May 1978 should be submitted to Vaughan for consideration at the November meeting; the longer lead time is required in order to organize joint use of the aircraft by combinations of investigators, making every flight hour as useful as possible.

Investigators making proposals to NSF that include NCAR flight support should state their NCAR aircraft requirements in their proposals to NSF and should also send copies to RAF together with a formal NCAR flight support request. Proposals for flight support that are not part of NSF programs should be submitted with sufficient scientific justification to enable a comparison with NSF-supported programs to be made.

The RAF Advisory Panel is composed of atmospheric scientists from universities, government agencies, and NCAR. The panel meets twice each year, in the spring and fall, to consider the scheduling of NCAR aircraft. The panel's last meeting was 18 - 19 March; it was attended by panel members Robert Cunningham (Air Force Cambridge Research Laboratories, Bedford, Massachusetts), Peter Sinclair (Colorado State University), James Telford (Desert Research Institute, University of Nevada), Dennis Thomson (Pennsylvania State University), and NCAR scientists James Fankhauser (National Hail Research Experiment), Gerald Grams (Upper Atmosphere Project), and Edwin Danielsen (Aerosol Project).

NCAR's fleet of research aircraft includes two twin-engine Beech Queen Airs, which provide basic thermodynamic measurements and flight-level wind data and which can accommodate user-supplied instrumentation. They fly at altitudes up to 7,500 m above sea level. One is instrumented with a gust probe and inertial navigation system to measure all three components of air velocity. A third aircraft, a twin-engine Sabreliner jet, provides similar measurement capabilities at altitudes up to 14,000 m above sea level.

Finally, a four-engine turbo-prop Lockheed Electra is capable of making a variety of atmospheric dynamics, cloud physics, and radiation measurements. It has an inertial navigation system and gust probe for measurement of turbulent fluxes, and it is suitable for long-range research flights at altitudes up to 8,000 m above sea level. It can accommodate a variety of user-supplied instrumentation.

For complete information on the NCAR research aircraft and for information on submission of flight requests, investigators should call RAF program manager Alfred Rodi at NCAR ext. 78 - 34 (via the NCAR switchboard) or write to him at the NCAR address.

Computer Movies of Atmospheric Simulations Are Available

Four 16 mm computer-drawn color movies showing results of numerical simulation of the earth's atmosphere are available at cost to interested teachers and researchers. The simulations were made with the NCAR general circulation model (GCM) to provide graphic demonstrations of the development and movement of atmospheric systems, and the movies may also be useful for educational purposes. Their titles are

- *Baroclinic Instability*
- *Simulation of January and July with a Six-Layer Model*
- *Tropical Circulations: Western Pacific, GATE, and West Africa*
- *Seasonal Simulation of Indian Monsoon: February through July* (in the area from eastern Africa to the western Pacific).

Each movie is accompanied by a short written description. The films were produced by staff from the NCAR Computing Facility under the direction of Warren Washington, head of the NCAR GCM Coordination and Operations Group.

Each film runs about 5 min and may be purchased for $25. A composite of the four films, running about 15 min, may be purchased for $70. Requests for the films should be sent to Fred Walden of the NCAR Computing Facility at the NCAR address (checks should be made payable to NCAR). The written descriptions alone may be obtained from Washington by calling him at NCAR ext. 674 or writing to him at the NCAR address.

LIMS to Operate on Nimbus G

Data from a satellite-borne infrared monitor of the upper atmosphere will be available to university and other researchers after the flight of Nimbus G, a NASA satellite scheduled for launch in late 1978. The instrument is called the Limb Infrared Monitor of the Stratosphere (LIMS), and represents an experiment shared by NCAR, NASA, university, and government scientists.

The LIMS is an instrument similar to the Limb Radiance Inversion Radiometer (LRIR), which operated on the satellite Nimbus 6 from June 1975 to January 1976, gathering the first simultaneous global temperature, ozone, and water vapor distributions with excellent vertical resolution. In addition to measuring those variables, the LIMS data sets will provide the first global information on distributions of nitric acid and nitrogen dioxide, which are believed to be part of the chain that catalyzes most of the ozone destruction in the stratosphere. The LIMS sensors will operate in six spectral regions: 6.2 μm (nitrogen dioxide), 6.8 μm (water vapor), 9.6 μm (ozone), 11.3 μm (nitric acid), and 2 channels at 15 μm (carbon dioxide, yielding the temperature profiles). The sensors will be cooled by a two-step cryogenic cooler similar to the LRIR cooler; the instrument lifetime, which is limited by the outgassing of the coolant, is planned to be seven months, with the sensors in use approximately 75% of the time.

The LIMS will scan the atmosphere tangentially to the earth's surface (limb scanning) rather than looking directly downward, a technique which has high inherent vertical resolution, practically no background radiation problem, and a large opacity in the region scanned——there is about 60 times more emitting gas along a grazing scan path than along a vertical satellite-to-surface path.

John Gille, leader of NCAR's Upper Atmosphere Project, and James Russell III of NASA/Langley Research Center, Hampton, Virginia, are sensor co-scientists for the experiment and coordinators of the activities of the LIMS experiment team. Scientists on this team are Roland Drayson, University of Michigan; Herbert Fischer, University of Munich, Germany; André Girard, Office Nationale d'Etudes et de Recherches Aérospatiales, Chatillons-sous-Bâgneux, France; John Harries, National Physical Laboratory, Teddington, Middlesex, United Kingdom; Frederick House, Drexel University; Conway Leovy, University of Washington; Walter Planet, National Oceanic and Atmospheric Administration, Suitland, Maryland; and Ellis Remsberg, NASA/Langley. The experiment team will guide the LIMS through launch and oversee the data reduction and validation.

(Continued on page 5.)

SESAME Bulletin

This, the second *SESAME Bulletin*, is produced jointly by staff members of the National Oceanic and Atmospheric Administration (NOAA) and NCAR to inform the scientific community of planning activities for the proposed Severe Environmental Storms and Mesoscale Experiment (SESAME). The first *SESAME Bulletin* appeared in the June 1975 *NCAR Newsletter* (Vol. 2, No. 6).

SESAME Planning Progresses

SESAME is proposed to be a six-year field experiment and numerical modeling project, with the first year of field effort planned to begin in 1978. The experiment's purpose is to provide a better foundation for severe storm forecasts by gaining greater understanding of storm behavior as a function of the environment and of the interactions between internal storm dynamics and boundary-layer and mesoscale processes.

Workshops

Since the first *SESAME Bulletin* appeared last June, three workshops have been held to prepare draft plans for proposed SESAME subexperiments. The first, a boundary-layer workshop, was hosted last November by NOAA's Environmental Research Laboratories (ERL) in Boulder, Colorado. Forty scientists took part, about half of them from universities and NCAR, and the remainder from government laboratories.

A smaller group also met in November to discuss the investigation of interactions between gravity waves and severe storms. The third workshop dealt with the convective storm scale and was held in March at the National Severe Storms Laboratory in Norman, Oklahoma.

In addition, John Wallace of the University of Washington has consulted with scientists at NASA and NOAA's National Environmental Satellite Service to evaluate the probable usefulness of satellite data for SESAME and for mesoscale meteorology in general.

SESAME Project Plan

Wallace and the three workshop groups will contribute reports for inclusion in a project development plan for SESAME. The plan, which will replace the preliminary draft plan issued by NOAA in 1974, should be ready for distribution by midsummer. A significant role in SESAME research is foreseen for university scientists, and NCAR scientists and facility groups also expect to participate.

Overseeing the scientific planning activities are Douglas Lilly of NCAR (who is also a consultant to NOAA) and Stanley Barnes and Joseph Golden, both of ERL. Lilly notes that as planning gains momentum, the experiment is attracting interest from many sectors of the atmospheric science community; so far, about 200 scientists have been involved in various aspects of planning for SESAME. In addition, the planning group has benefited from suggestions made by panels on short-range forecasting and severe storms of the National Academy of Sciences Committee on Atmospheric Science.

Field Schedule

The new SESAME draft plan will propose a pilot experiment and systems test in 1978 and a regional-scale experiment in 1979, to be followed by full-scale field experiments in the early 1980s.

The 1978 pilot experiment will measure the fields of mass and moisture convergence throughout a mesoscale area of approximately 1,000 km^2. Dense instrumentation will provide a multiplicity of measurements in both convectively active and quiescent environments. Systems will probably include aircraft, laser anemometers, acoustic sounders, FM-CW radar, pulsed doppler radar for tracking chaff, microwave sounders, tethered-balloon sounders, an automated ground mesoscale network, and two sounding systems of a new design.

The boundary-layer workshop has suggested an additional subexperiment to study diurnal variations in the depth of the planetary boundary layer in the southern plains and the effects of perturbations caused by small mountains, such as those in southwestern Oklahoma. Balloons and aircraft would be the chief observational tools.

The regional-scale experiment is planned for the spring of 1979. About 20 of the balloon-borne sounding systems described in this *Bulletin* (see separate story) will be distributed over a large area in the Midwest, effectively doubling the areal resolution of the U.S. upper air sounding net. The sonde systems will be activated during periods when major outbreaks of severe storms are predicted, and the data will be used for testing regional-scale experimental prediction models under development at several universities, in NOAA's weather research and operational branches, and at NCAR.

The field periods in the early 1980s will be multiscale experiments designed along the lines specified in the original draft project development plan. Information derived from the 1978 experiment will be used to optimize the mesoscale surface and sounding nets.

Details of the experiments and subexperiments will appear in the new project development plan, and more detailed scheduling and plans will be announced as they become available.

Individual Contributions Encouraged

NSF has followed the progress of SESAME planning and has expressed strong interest in the experiment's goals. In a January letter to NSF, Lilly outlined a number of areas of research suitable for individual contributions to SESAME planning and experimental design; more topics should emerge in coming months as planning continues. Lilly said that several scientists have already expressed interest in pursuing some of the subjects listed in the first *SESAME Bulletin*. The latest list includes:

- *Boundary-layer physics and climatology*. Topics recommended by the boundary-layer workshop for analysis before the full-scale SESAME observational program are tests of microbarograph networks for monitoring gravity waves; analysis of existing data on the high Great Plains boundary layer west of the dry line; local studies of the structure of the growing mixed layer; investigation of the climatology of low-level divergence over the Great Plains; and numerical modeling of mesoscale inhomogeneous boundary layers.

- *Severe storm statistics and climatology*. Available radar data would be suitable for statistical evaluations of the practical importance of severe storm classifications. For example, the relative contributions of different storm types (e.g., quasi-steady-state supercells, multicells, and squall lines) to annual rainfall, tornadoes, and damaging hail should be determined. The planners hope that many useful studies in this area could be carried out by graduate students.

- *Satellite observation studies*. SESAME will profit from a knowledge of the response of developing convective storms to radiative or dynamic forcing from pre-existing cloud environments. Important issues are the extent to which such responses occur reliably or are subordinate to larger scale forcing; what the comparative amounts of low, middle, and high clouds are over the central Great Plains on mornings before severe storms; and what

relationships exist among cloud types and groupings, various meteorological variables, and land topography.

- *Experimental design*. Techniques must be derived for deployment of the balloonsonde network to meet the needs of regional-scale modelers for model initialization and verification and definition of the three-dimensional mesoscale environment around the storm-scale network. Formal design methods can also help to specify the optimal placement of surface net stations, multiple doppler radars, and other measurement systems.

- *Instrumentation development and testing*. Topics of special interest at the moment are operational problems and safety limits for tethered balloons and for remote piloted vehicles (small drone aircraft), both considered potentially valuable tools for boundary-layer observations during SESAME.

- *Numerical model development and testing*. Numerical modeling is at the core of SESAME as a theoretical method and a potential forecast tool. According to the modeling group of the boundary-layer workshop, many types of modeling experiments are needed before the major field experiments, to define required data densities and accuracies for model initialization. Some of those needed are observational simulation experiments, determination of model sensitivity to various parameters in the models, tests of various initialization schemes (together with research to determine how to use nonconventional satellite and aircraft data), and techniques for using mesoscale models during field experiments to help predict the location and timing of storm development.

University scientists and their graduate students may contact Lilly or Barnes for further information about these topics or to discuss other aspects of SESAME plans and goals. Both can be reached at NOAA/ERL, Boulder, Colorado 80302. Lilly's NOAA telephone number is 303 - 499 - 1000, ext. 6449 (FTS 323 - 6449), and his NCAR extension is 491. Barnes' telephone number is 303 - 499 - 1000, ext. 6234 (FTS 323 - 6234).

Inquiries to NSF concerning grant applications for SESAME-related research may be made to Dr. H. Frank Eden, Program Director, Meteorology Program, Atmospheric Research Section, National Science Foundation, 1800 G Street NW, Washington, D.C. 20550. Eden's telephone number (FTS and commercial) is 202 - 632 - 4190.

New Sonde System Enters Test Stage

A prototype of a new balloon-borne sounding system that uses doppler techniques for balloon tracking will be ready for flight testing this summer at Wallops Station, Virginia. The test is part of the Severe Environmental Storms and Mesoscale Experiment's (SESAME) program to evaluate the doppler system, which is designed to track balloons more accurately than conventional radiotheodolites and to provide automatic data processing in a one-person operation.

The need for a network of at least 20 wind-finding sonde systems was identified early in SESAME planning; after studying technical requirements, the National Oceanic and Atmospheric Administration (NOAA) chose a doppler tracking system as the most promising option. The first *SESAME Bulletin* outlined technical requirements and operational principles of the system.

Control Data Corporation is developing the ground tracking and data-handling system under contract to NOAA; partial contract funding is supplied by NCAR and the Bureau of Reclamation. Michael Exner of NCAR's Global Atmospheric Measurements Program (GAMP) is assisting SESAME planners in specifying technical requirements. GAMP is also designing and building the sonde units and will analyze hardware performance following the prototype test at Wallops.

The test will compare the system's wind measurements with wind data derived from accurate radar tracking of the balloons. A computer terminal at Wallops will communicate with a 7600 computer at the Control Data Corporation in Minneapolis to test the real-time data-processing capability of the system.

Control Data Corporation will follow the flight tests with data reduction and data comparisons, reporting final results in the fall. The SESAME project planners will then determine the feasibility of the system for the SESAME field experiments and for similar operational and research applications. Scientists interested in learning more details about the system's development and potential applications should consult the articles by V. E. Lally and R. M. Passi (*Monthly Weather Review*, vol. 103, no. 1, January 1975, pp. 21 - 26) and by K. S. Gage and W. H. Jasperson (*Bulletin of the American Meteorological Society*, vol. 55, no. 9, September 1974, pp. 1107 - 1114).

Much information can be derived from the high-resolution maps of stratospheric composition and temperature distribution that will result. The geostrophic component of the wind will be obtainable up to a level of 1 mb (~48 km), for example, through integration of the temperature profiles and use of the thermal wind equation. Information on the diurnal, seasonal, and latitudinal variation of ozone will be of particular interest. The data are also expected to illuminate the phenomenon of sudden stratospheric warmings.

The experiment team will be responsible for the reduction and validation of the data. Immediately upon validation, the data will be placed in public archives at NCAR, NASA/Goddard Space Flight Center, and perhaps at other data centers as well. The data reduction is now planned to take place at NCAR, where the LRIR data are being reduced. The raw data will be edited, calibrated, and inverted for the vertical distributions of the five measured variables from approximately 10 to 60 km in altitude; maps of global distributions can then be made for various levels. The data will be archived on computer tapes in three forms:

- *Radiance Archival Tapes (RAT)*. These will contain all useful limb radiance observations for the entire mission.

- *Profile Archival Tapes (PAT)*. Profiles will be selected from RAT tapes with a spatial frequency of about 200 km along the scan track. The profiles will then be inverted to provide distribution of temperature and mixing ratios of ozone, nitrogen dioxide, water vapor, and nitric acid on a standard grid of points spaced vertically about 1.5 km apart. In addition to the radiances and inverted quantities on the grid, the tapes will provide the same parameters interpolated to standard pressure levels plus thicknesses between pressure surfaces and cloud location information.

- *Map Archival Tapes (MAT)*. Data on PAT and other upper atmosphere data available for the same times of observation will be combined to produce objective analyses of temperature and concentration fields interpolated in time and space.

In addition, climatological summaries of meridional cross sections of all parameters and mapped data will be archived.

Further information on the LIMS is available from Gille at NCAR ext. 351 or the NCAR address, or from Russell at NASA/Langley, 804 - 827 - 3551 (FTS 928 - 3551). Russell's address is Atmospheric Management Section, Mail Stop 494, NASA/Langley Research Center, Hampton, Virginia 23665.

Four New Technical Publications Are Available

An *Atlas of Computed Infrared Atmospheric Absorption Spectra*, compiled by Thomas Kyle of NCAR (Upper Atmosphere Project) and Ahron Goldman of the University of Denver, has been published as NCAR Technical Note TN/STR - 112. The calculations are for vertical paths through the atmosphere above altitudes of 4, 14, 30, 40, 45, and 54 km, with spectral resolutions of 0.1, 5.0, and 20.0 cm^{-1}, for the spectral region from 1 to 2,600 cm^{-1}. Computed spectra have been used extensively in analyzing observed atmospheric infrared and microwave emission and absorption spectra and in studying the feasibility of remote sensing of atmospheric trace constituents by infrared and microwave spectroscopy. The atlas was suggested by Rainer Weiss of the Massachusetts Institute of Technology to answer the need for an atlas with a long wave-number interval and a large altitude range.

An *Atlas of the Global Distribution of Total Ozone, July 1957 - June 1967* has been compiled by Julius London of the Department of Astro-Geophysics, University of Colorado; Rumen Bojkov of the World Meteorological Organization; Samuel Oltmans of the National Oceanic and Atmospheric Administration; and Jean Kelley of NCAR (GATE Project). A joint production of the Department of Astro-Geophysics of the University of Colorado and NCAR, the document has been published as NCAR Technical Note TN-113+STR. The ozone atlas provides meteorologists, chemists, and biologists with information on global ozone distribution and its variations. The ten-year period covered begins when the number of ozone observing stations increased as part of the International Geophysical Year.

Estimation of Spatial Covariances from the Mid-Ocean Dynamics Experiment by James McWilliams of the NCAR Oceanography Project and W. Brechner Owens of The Johns Hopkins University has been published as NCAR Technical Note TN-115+STR. The publication is a report of a statistical analysis of mesoscale eddy observations taken during the Mid-Ocean Dynamics Experiment; support for the study was provided by the International Decade of Ocean Exploration office of NSF.

Approximate Methods of Calculating Transmission by Bands of Spectral Lines by Clive Rodgers of Oxford University has been published as NCAR Technical Note TN-116+IA. It describes approximations that have been found useful in calculating the transmission of molecular gases in planetary atmospheres, for use in energy balance studies and in interpretation of remote soundings; the approximations make use of band models and empirical models in preference to exact but time-consuming line-by-line methods. Several techniques are described for dealing with transmission through atmospheric paths inhomogeneous in the distribution of temperature, pressure, and concentration of absorbing species.

The new Technical Notes are available to interested university researchers. Call or write Janis Romancik, NCAR Publications Office, NCAR ext. 281, to obtain copies.