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Scientific and Logistic Objectives and Achievements of 22nd Indian Antarctic Expedition

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Atmospheric Sciences

INDIAN INSTITUTE OF GEOMAGNETISM

Objectives

1. To identify global signature in the atmospheric electrical parameters and distinguish atmospheric, ionospheric and magnetospheric signatures.
2. To identify polar cap signals in the high latitude measurements and to evaluate the electrical response of the atmosphere to magnetospheric influences
3. To ascertain influences of solar magnetic sector boundary crossing and understand the underlying physical mechanisms.
4. To find out the statistical occurrence of storms and substorms with intensification of auroral electrojet currents.
5. To workout a phenomenological relationship between the strength of a storm with the strength of the strength/occurrence frequency of the substorms
6. To identify global signature in the atmospheric electrical parameters and distinguish atmospheric, ionospheric and magnetospheric signatures
7. To identify polar caps signals in the high latitude measurements and to evaluate the electrical response of the atmosphere to magnetospheric influences.
8. To ascertain influences of solar magnetic sector boundary crossing.
9. To study the decline in Total Magnetic Field 'F' observed over the last few decades in southern hemisphere, especially over Antarctic continent

10. To setup 5-10 semi-permanent stations in the vicinity of Maitri station, to measure crustal dis placement and to estimate the strain field.
11. To study the effect of intense atmospheric disturbances on the repetability of base-lines.
12. To monitor ionospheric TEC, scintillation and tropospheric water vapour content.
13. To monitor the Glacier movement and to study the ice-self dynamics.

Achievements

1. A highly sensitive Digital Magnetometer was procured this year for the study of Storm-substorm relationship. The data collected from Maitri will be compared with the data from Indian Observatories for this study. The new magnetometer has a sensitivity of 0.1 nT compared to 1 nT of the old operating Fluxgate Magnetometer setup. The data is collected in digital mode on a dedicated hard disk and flash cards, which can be downloaded on any PC through a USB port. The main sensor was buried after installing a specially made wooden sensor hut to minimize the temperature variation in the sensor. The data was downloaded and compared with the old setup and found highly satisfactory. 95% good data was collected in 1 sec, 1 min., and hourly average sampling.
2. A Proton Precession Magnetometer was operated round the year to monitor Total Magnetic Field F at Maitri.
3. A 30 MHz Riometer was continued to operate at Maitri throughout the year to collect data on Cosmic Radio Noise Absorption. The Riometer operated at high latitudes also provides information on Field Aligned Currents (FAC), which is a mechanism for injection of solar wind charged particles into magnetosphere.
4. The experiment to measure the atmospheric electrical parameters in connection with the Global electric circuit continued to operate using a long wire antenna. The data collected will be used to identify and distinguish atmospheric, ionospheric and magnetospheric signatures. The electric field mill was commissioned to get data on atmospheric electric fields. Effects of local meteorological conditions on the measured electrical parameters and the magnetospheric contributions to the

ionospheric potential and the global electric circuit will be studied in detail.

5. 20 GPS sites were setup in Schirmarchar Oasis and its surrounding Nunateks for measuring the intra plate crustal deformation and estimating the crustal strain field. These sites will be occupied in the coming 3-5 years (summer periods) on a regular basis. The data was collected from each site for 3-4 days. This is a collaborative program carried out between IIG and GSI, Antarctic Div., Faridabad.
6. The ionosphere is the ionized part of the upper atmosphere between 70 and 1000 km altitude. Ionospheric electron content introduces delay in GPS signal propagation. Irregularities in the ionosphere region can scatter trans-ionospheric radio signals producing fluctuations in both amplitude and phase and GPS cycle slips. The data collected from the Maitri site will also be used for monitoring ionospheric Total Electron Content (TEC), scintillation and tropospheric water vapour content studies. The scientists of Barkatullah University are collaborating with IIG for this study.
7. 21 GPS sites (platforms) were setup on the Polar Glacier ice to study the movement of the Glacier. The data was collected from each site for more than 24 hours and will be occupied in the coming 3-5 years (summer periods). This is a collaborative program carried out between IIG and GSI, Antarctic Div., Faridabad.

IMD

Objectives

The following were the main tasks of IMD for the meteorological programme for 22nd Antarctic Expedition:

1. Continuation of ongoing programme at Maitri for preparing climatology of the area and for providing weather services for the Expedition:
2. Continuous recording of various surface meteorological parameters including synoptic hours observations. Also real time transmission of main synop message (4 times a day) over GTS for use.
3. Radiation observations, both at the surface and in the upper atmosphere.
4. Regular stratospheric ozone measurements.

Achievements

During 22nd Indian Antarctic Scientific Expedition, in addition to synoptic weather observations and continuous records of various meteorological parameters, measurements of total atmospheric ozone (along with sulphur di oxide, nitrogen di oxide and damaging ultra violet radiation), surface ozone and vertical profile of ozone (taking Ozone Sonde ascents) have been undertaken to study the Ozone Hole phenomena. For study of radiation budget Radiometer Sonde ascents have also been taken. The synoptic observations have also been taken during the cruise.

NPL

Objectives

NPL is working in the area of Atmospheric Sciences, specifically the radiation measurements (UV radiation), green house gas measurements (Ozone measurements) and the planetary boundary layer (PBL). The PBL interacts with almost all the components of Antarctic Eco-system (ice-air ocean-biological system), which in-turn is linked to the global system. Therefore, the program for the 22nd Indian Scientific Expedition falls under the banner of Global Change (monitoring of Green house gases and radiation) it was planed to continue the program which NPL restarted in 21 st Expedition: Accordingly NPL proposed to carry out following experiments during the 22nd Expedition:

1 Gas Chromatography, using flame ionisation detector and CO using IR analyser
2. UV Biometer, UV spectro-radiometer and UV - Photometer
3. Sun - Photometer for Ozone & water vapour measurements.

Achievements

1. Measurement of surface air concentration of methane and carbon dioxide has been carried out using Automated Gas Chromatograph at Indian research Station, Maitri (70°.44'S, 11°.45'E), Antarctica during 21s1 and 22nd Indian Scientific Expedition to Antarctica. Very small day-to-day variation of surface CH_4 concentration was observed during observational period. The mean CH_4 concentration for sixteen-month period (February 2003 to June 2004) was found out to be 1.70 ppm. The averaged CO, concentrations were found out to be 368.32 ppm and 369.51 ppm in the year 2002 and 2003 respectively. The values of CO, observed over Maitri are comparable to present Global CO, values.

2. Observations of carbon monoxide have been made using IR CO analyzer at Maitri (70°.44'S, 11^0.45'E), Antarctica during 22nd Indian Scientific Expedition. A diurnal cycle was systematically observed during clear sky condition. The CO concentration was observed higher in daytime sunlight period however; during cloudy day diurnal variation was absent. It has been observed that the CO concentration increases with increase of solar elevation and decline of CO concentration correlated with the drop of the solar radiation.
3. Total Water Vapour Column has been measured at Maitri (70° 45' S, 11° 44'E), Antarctica using Microtop Sun-photometer during 22^{nd} Indian Scientific Expedition to Antarctica. The annual mean water vapor was found out to be 0.45 cm in the year 2003. Columnar water vapour has been observed maximum in the month of January during observational period. Day-to-day variation of water vapour and surface temperature showed positive correlation suggesting that day-to day variation of water vapour is highly related to local meteorological conditions.
4. Total column ozone has been measured using Microtop Sun photometer at Maitri (70° 45'S, 11° 44'E), Antarctica, during 21^{st} and 22^{nd} Indian Scientific Expedition to Antarctica. A Comparison of TOC at Maitri over Schirmacher region of east Antarctica has been made to understand the behavior of ozone hole in relation with stratospheric temperature. The observation showed relationship between the stratospheric temperature and TOC. The minimum values of TOC of about 185 DU and 126 DU were observed in the year 2002 and 2003 respectively during ozone hole period. The ozone hole values (less than 220 DU) during ozone hole period at Maitri was found out to be 20.7 % and 62.7 % in the year 2002 and 2003 respectively. Temporary sudden rise in TOC before the recovery period were also observed in both the years.

BARKATULLA UNIVERSITY

Objectives

The study of VLF propagation acquires its importance because of its ability to allow atmospheric scientific community to understand the electron density variation in 500 - 1200 km region derived from the dispersion

characteristics of simultaneously 9bserved whistlers at different suitable stations as well as the effect of solar wind - magnetospheric interaction on the propagation of whistlers along the field aligned irregularities. In XVII Indian Antarctic Expedition 1997 - 98 whistler recording has been done with the analog system. Data analysis is going on related to the whistler phenomena, details of the theory has also been developed on basis of non-linear wave - wave interaction. During 22nd IAE B. U. has following scientific objectives :

1. Installation of triangular Loop Antenna (TLA) System for Direction Finding of Whistler.
2. Continues Routine Recording of Very Low Frequency (VLF) Signals from the output of TLA.
3. Detection and identification of VLF seismo-electromagnetic signals.
4. Study of Scintillations and Total Electron Content (TEC) with the help of GPS receivers.

Achievements

Under the above-proposed project, recording of VLF (Very Low frequency) signals in digital and analog modes was carried out. Completed the routine recording of VLF phenomena with the help of T-type Antenna. Installed the Triangular Loop Antenna (TLA), and the data was recorded. According to our proposed work we had two major experiments to be carried out. In the first part, the routine recording of VLF Phenomena experiment with the help of T-type Antenna was carried out. The routine recording with some modifications in T-type antenna for recording of the VLF was carried out which will facilitate the large database to confirm some of the VLF phenomena. Also installed Direction Finder at Maitri. This is a Triangular Loop Antenna covering an area of 144 m^2 One TLA was in E-W direction whereas another one was in N-S direction. This will provide polarization study, which relates with path of whistler.

To detect and identify the seismo-electromagnetic VLF signals; borehole study was carried out at about 50 m depth at GSI borehole site. The studies of electromagnetic signals at very low frequencies and ultra low frequencies suggest that they may contain precursor signals that precede the occurrence of disturbance at shallow depth. This was the first attempt made from our side to detect seismo electromagnetic VLF signals.

Earth Sciences, Glaciology & Global Change

CWPRS

Crustal evolution and tectonic activity of Antarctica has drawn the attention of the scientists and research workers because of it's significant impact over global geology. Geologists, geophysicists and meteorologists are continuously working to reveal the structural, petrological, geochemical and glaciological features of this continent Ground Penetrating Radar (GPR) can be used in thin ice cover areas (ice sheet thickness < 10m). Accordingly the **objectives** of the study were:

1. Determination of thickness of the ice and identification of the rock topography time and cost effectively. This will significantly help to plan different surveys over thin ice covered areas. Further, the thickness of ice" .. cover to rock once known will ensure that the ice coring machines do not get damaged by encountering the hard rock.
2. Resistivty mapping of ice covered rock surfaces. The maps can be interpreted in terms of lithology and will help to identify the important geological features to interpret the other available data.
3. Structural details of the important geological features, i.e., shear zones, folds, faults, etc. can be obtained by this survey.

Achievements

Ground Penetrating Radar (GPR) survey has been carried out at Schirmacher Oasis and Dakshin Gangotri located in Queen Maud Land, East Antarctica, during 22nd Indian Antarctic Summer Expedition, 2002-2003.

The survey broadly focused on the following studies: i) detection of a buried hanger and its entrance shaft under the shelf ice at Dakshin Gangotri, ii) mapping of different internal features of ice structure and bedrock topography below the ice cover along 4 km traverse on the continental glaciers in the southern margin of Schirmacher Oasis, at Shivaling and Veteheia, hi) study of subsurface internal layers of ice structures and crevasses along 2.5 km profile in the vicinity of Tallaksenvarden nunatek and iv) study of the lakebed and evaluation of thickness of ice over three lakes located at Schirmacher Oasis near Maitri station.

Results of the survey using 250 MHz antenna have revealed that the entrance shaft of the buried hangar is situated at latitude 70° 04'27.7" S and

longitude 12°00′37.9*' E, which was further confirmed by excavation. The survey also has identified the internal layers within the shelf ice which possibly represent a particular snow depositional environment and ambient meteorological condition.

The rock is found to be dipping from 30° to 40° at southern part of Schirmacher oasis, western part of Veteheia and northern part of Shivaling whereas dip varies from 10° to 30° at the eastern part of Veteheia. A small peak has also been mapped at a depth of 16 m between Shivaling and Veteheia.

The glacier at the south of Schirmacher oasis, near Veteheia, shows polythermal nature. An anomalously hot regime has been identified between Veteheia and Shivalinga, where several warm ice zones, melt water pockets and water channels have been mapped below the ice. This high-resolution survey also identified different type of ices and glaciological features which will help in modeling and forecasting the health of the glaciers.

The internal layers of firn and ice at the northern side of Tallaksenvarden nunatek have been found to have varying dips and their depositional patterns are different in different directions. Ice to firn interfaces and the crevasses have also been mapped in this area. The study showed that the thickness of ice cover of the lakes vary between 1.5 m and 3.5 m and the maximum depth of bedrock ranged from 3.3 m to 8.6 m. Permafrost studies have been carried out over vehicle path near Maitri station. The study revealed that the depth of permafrost in the area varied from 0.5 m to 1.5 m.

NGRI

Objectives

It was proposed to study the seismotectonics and geodynamical processes between India and Antarctica , by recording seismic activity in and around Antarctica. The collocation of both GPS and Seismic stations working at the same site simultaneously would yield a comprehensive picture on Indian Plate Kinematics.

The establishment of the seismic station with high-resolution digital short-period and Broad Band seismograph system and analog seismic recorder to monitor the seismicity in and around Antarctica. Also monitoring of teleseismic activity as well as the mid oceanic ridges in the Indian Ocean Region.

Achievements

The Broad Band Seismological Observatory has recorded high quality seismic data during 22nd Indian Antarctic Expedition. 289 earthquakes are recorded. Simultaneously good GPS data also has been recorded.

JALNA COLLEGE

Objectives

Microwave remote sensing is the technique of gathering information about objects at far away distances. Satellite images of the earth surface/ sea surface/ snow cover are formed by measuring the microwave energy scattered by the ground, sea surface or snow cover back to the sensors. The energy scattered by the surface depends on the physical factors such as dielectric' constant of materials. Also to measure sea surface temperature and salinity the emissivity of the sea surface must be. known accurately, which in turn depends upon the dielectric properties of sea water. The emissivity snow cover and soil surface also depends on their dielectric properties. Thus the knowledge of dielectric constant of sea water, soil and snow is useful for the inteipretation of remote sensing data of oceans, ground and ice surfaces using satellites, radars and microwave radiometers.

The study of microwave dielectric properties of sea waters, ice and soil is therefore important from the point of view of their practical applications in oceanography, glaciology and geology.

As the major work of microwave remote sensing is carried out at C-band. It is proposed to make dielectric measurements of various water and ice samples in the surrounding areas of Maitri and Dakshin Gangotri the study of dielectric properties of geophysical materials mentioned above will be undertaken at 5 GHz frequency using an automated C-band microwave bench setup already available.

Achievements

The dielectric constant and dielectric loss are measured using C-band microwave bench setup at 5 GHz frequency. The emissivity of most of the ice samples is very high. The ice sample containing soil shows comparatively less emissivity. The dielectric constant of Antarctic soils (5 - 6) in some what higher than the same for average Indian soil (3 - 4).

GSI

Objectives

GSI had proposed following tasks.

1. Extending regional geological mapping westward - thereby covering a region lying between Longitudes 500'E and 5040'E.
2. Thematic mapping of 300 sq. km. area in the Gruber mountains.
3. Monitoring all the peripheral points on the snout of Dakshin Gangotri glacier, as well as nine line-km long Ice Cap margin of the Western Schirmacher Range to record the net annual movement of the continental ice.
4. Observation of the existing network of stakes to find out the net accumulation /ablation during the present polar cycle. It was also proposed to replace the stakes in the network, which are buried or likely to be buried in the coming one year.
5. Continuation of recording icebergs in the Southern. Ocean both during the onward and return voyage would be continued to compare with the trends in the previous years.
6. Regional monitoring of shelf and polar ice margins.
7. Continuation of Geomorphological mapping of western Schumacher
8. Traverse mapping for tracing a fluvial regime in the eastern part of Schirmacher.
9. Traverse mapping for neotectonic studies in NNE-SS W of Dakshin Gangotri glacier snout and along the 'long lake', trending almost E-W, north of Trishul hill in Schirmacher range.
10. Liminological studies in collaboration with BSIP.

Achievements

1. Geological mapping in Muhlig-Hofmann area was earned out by taking 46 drop points from the helicopters. At each drop point, the helicopter was shut down and short foot traverses were taken for mapping and sampling. The area mostly comprises granites and charnockites, intruded by some mafic dykes. An area of about 1000 sq km has been mapped and about 110 rock samples have been collected for lab studies.
2. The 19 peripheral points marked in 1996 at the Dakshin Gangotri glacier snout in Schirmacher range have been recorded in February. All these points display steady recession of the glacier. Further,

18 points marked all along the western margin of the ice cap in Schirmacher range have also been monitored in detail. Most of these points also confirm the retreat of the glacier.

3. It was found that parking of vehicles and tankers in the vi"inity of the old stakes-network at Dakshin Gangotri ice shelf has buried or distorted most of the stakes. A new network of 16 stakes has been installed about 2 km away from the present area, in the upwind direction. The stakes are about 140 m apart, covering an area of about 560 m X 560 m. For the first time, GPS readings of all the stakes have also been recorded; which would be useful not only in accumulation studies but also in understanding the ice dynamics on the shelf.
4. Iceberg monitoring was carried out during the onward voyage. The first iceberg was sighted at 55° 43' south latitude. Distribution pattern of the icebergs would also be observed during the return voyage.
5. Mapping of various geomorphological elements were carried out in central and western part of Schirmacher range. The dominant units include Filsenmeer (Block Field), U-shaped Valleys, Roche Moutainees, Stepped Topography, Hanging Valleys and Recessional Morainic Plains. The direction of Glacial Striations at many locations have also been recorded to delineate the movement pattern of the Continental Ice Sheet over the Schirmacher Oasis in the geological past.
6. The occurrence of unusual concentration of pebbles having very high degree of roundness and sphericity was studied in detail. Samples of various litho-types of pebbles and the finer matrix have been collected for sedimentological analysis to find out the depositional history. A sample for TL-dating has also been collected.
7. In collaboration with the EG team, GPS markers have been installed at 20 locations on the ice cap south of Schirmacher range. There are two lines of these markers, making a general grid pattern to delineate the movement direction, speed and neotectonic distortions in the study area. Detailed benchmark observations have collected at these points for comparison with the data next year.
8. From recessional moraines and terraces of lake L-68, a total of 9 samples have been collected for dating the geological events. The lab studies would be very useful for quantifying the geological history of Schirmacher range.

9. Two sediment cores have been raised from the lake bottom of Priyadarshini lake, which are of 35 and 50 cm length, respectively. These cores would be utilised for detailed sedimentological and palynological studies. Also, by hydrochemical sampling work, 28 lakes have been covered from westernmost part to central Schirmacher. A total of 32 water samples have been collected for various physico-chemical parameters including pH, TDS, EC, major anions and cat ions and the heavy metal concentration.
10. The new upgraded version of the ice core-drilling machine was transported with all the accessories to a field site near Tallaksenvarden nunatak. This site was selected in the 20th expedition and a detailed GPR-profile was given by the Wadia Institute of Himalayan Geology. Two members of the GSI team camped at this site from 11th February to 11th March 2003. The machine was assembled at this site and a test borehole was completed. It is put on record that the machine does not work during the day-time because there is no shelter and the barrels get heated up by the sunlight. Thus, the whole work had to be carried out during the night hours and almost every night there were strong katabatic winds with heavy snowdrift. The entire work has been completed standing out in the open on the ice sheet, with wind-chill temperatures ranging between -45° to -50° Celsius. A total ice core of 62.19 meters has been generated; out of which 50.75 meters is for isotope studies at the NCAOR and the remaining is for TL-dating of ice samples at the PRL-Ahmedabad. This entire core has been transported to the freezers of the ship. The Control Panel for the Winch operations of the machine is mal-functioning and it is being taken back to the NCAOE for repairs.The machine could not be transported to the mountain glaciers, as the required logistics could not be diverted from convoys to drilling work.
11. With the help of the GPR brought by the scientist from CWPRS, the buried Dakshin Gangotri Hanger building was located. The ice core generated during the 15lh expedition, which is more than 160 meters long, has been found to be perfectly preserved. As per the instructions of the NCAOR, after departure from the summer camp, this core would be recovered for transportation to India in frozen condition.

NHO

The following tasks were proposed during the expedition.

1. Coast lining /delineation of the extent of ice shelf in the . A,reas notundertaken in earlier expeditions.
2. Reconfirm, the quality of data collected during earlier expeditions by random selection in the previous areas worked so as to check repeatability of the data gathered.
3. Collection of bathymetric data in fresh areas for eventual publication of a nautical chart.
4. Collection of physical oceanographic data in the area of survey.

Achievements

1. 200 Nautical Miles of sounding was completed.
2. 120 Nautical Miles of ice shelf was delineated.
3. Oceanographic and Meteorological data was collected.
4. Sound Velocity and Current observation were undertaken at various locations.
5. About 600 Nautical Miles of Passage Sounding was undertaken.
6. The valuable data of Antarctica Region was collected for inclusion in sailing direction.
7. The team gained valuable experience in operation of various survey equipments/systems in Polar Areas.
8. Data collected during previous expeditions was validated by the data collected during this expedition.

Biology & Environmental Conservation

ZSI

The Zoological Survey of India had proposed following tasks.

1. A continuing proramme i.e. the study of Moss inhabiting invertebrate fauna and Nematode Fauna from schimacher oasis.
2. Ultra structural studies of hairs of Mammal.
3. Studies on eco-ethological interpretation - simulation experiments using modefs such as 'avain predators on the Antarctic avifauna.
4. Studies on the population dynamics of avian fauna in the queen's maud land in Schirmacher Oasis.
5. Studies on the behaviour of birds, recapture and bird banding which were released during earlier expeditions by the ZSI scientists.

6. Study of. feeding habits of Collembola and Mites in relationship to cold tolerance.

Achievements

Extensive surveys were earned out in almost all the lakes and land mass at Schirmacher Oasis. Soil samples and moss turf have been collected from different locations and some of them have been extracted with the Tullgren Funnel in the field. The extracted materials have been sorted out. Lichens and algae from rocky areas have been collected to study the nematode population. Feathers of Snow Petrel, Penguin and South Polar Skua have been collected from different locations to study the trace elemental analysis. Behaviour of Skua along with chick has been studied and detail vediography on behaviour of Skua and its chick has been made. During the voyage from 40°S to Antarctica, observation on birds and mammals were carried out. A good number of birds and one mammal were sighted with the help of binocular. A total number of 15 species of birds and one species of mammal have been recorded. Their zoo geography, distribution also have been recorded.

NBRI

Lichens are the major component of Antarctic terrestrial flora (160 species) among algae (300 species) and bryophytes (99 species). They are found luxuriantly growing on rocks, boulders, moraine and decaying cushions of moss (Bryum) tufts in ice free area. Because of their high degree of adaptation to the harsh climatic condition they are most 'interesting group of organisms, both for taxonomic and ecological studies. Accordingly National Botanical Research Institute (NBRI), Lucknow proposes to take up following scientific tasks during 22nd IAE.

To study the distribution and diversity of lichen in Schirmacher Oasis and different mountain chains of Queen Maud Land Area by using quadrate method.

Determine the heavy metal and gaseous pollutants accumulation in. lichens of'the region and around 'Maitri' research station, compare the results with the earlier measurements taken during XI and XVII expeditions, with a view to:

Prepare a complete inventory of lichen species growing in Queen Maud Land Area.

Quantification of the lichen diversity data.

Using lichens as tool for bio-monitoring of environmental changes, and Estimating heavy metals and gaseous pollutants as indicators of man made pollution.

Achievements

A total of 32 points in Schirmacher Oasis and 7 nunataks (including Shivaling and Vettiyya) are surveyed for lichens. About 200 lichen specimens were collected. The morphology of the specimens was observed under the stereo microscope and genus level identification in carried out. The lichens were very irregularly/randomly distributed in the Oasis, near lakes, on rocks and dried water lets on hillocks. Hence the quadrate method could not been applied here. Also, in the sites far from 'Maitri' time was insufficient to carry out quadrate study. However, the data collected in the present study is sufficient to make qualitative interpretation and to fulfil the other objectives. A suitable statistical method will be applied for quantification of the data. The mountain chains (Wohlthat) in the Queen Maud Land area could not be approached because of unavailability of space in the sortie.

Heavy metal accumulation study:

The lichen *{Umbilicaria decussata)* collected from Vettiyya nunatak is transplanted near the generator hut and few thallii are removed from there at regular intervals of 3 days. The lichen samples were also collected from the sites where in XI and XVII IAE are collected for heavy metal accumulation study and to check the difference in the accumulation.

Apart from the lichens, moss samples were collected for studying trapped modern pollen spore load. The superficial and sub soil samples were collected along with the lichen samples to correlate the lichen richness with soil nutrients. Three permanent lichen sites were marked in the Vettiyya nunatak for monitoring growth rate and change in the lichen community. The type of substratum, ecological notes and association of different lichens were noted down during the collection. The specimens were dried and preserved in the paper packets. Only few specimens will be carried personally to India and remaining once are back-loaded to ship in wooden box.

Compared to the earlier two expeditions (XI and XVII) by the same organization, in the present one more area is explored for the lichens (far eastern and western part of the oasis, five nunataks). Few more objectives are included (pollen spore load study, soil nutrient analysis, permanent plot, and lichen transplant study). More number of new taxa is expected to add to the exciting list.

VJTI

Objectives

Veer Mata Jijabai Technological Institute (VJTI), proposed to carry out the following scientific activities.

1. water analysis on various samples approximately 20-25 (all routine environmental parameters e.g. PHONE NO:, D.O., Sulphates, Chlorides, Nitrates.
2. waste Water on various samples approximately 20-25 gall routine environmental parameters e.g. PH, D.O., Sulphates, BOD, COD, Chlorides, Nitrates).
3. Performance analysis of the treatment units used for water and waste water.
4. Determination of mercury in the selected environmental matrices and some bioindicators such as fish etc and speciation of mercury in environmental matrices.

Achievements

Water samples collected from various locations in and around Maitri and from lakes were characterized for various parameters like physical, inorganic and organic parameters. These include pH, temperature, conductivity, turbidity, alkalinity, total hardness, chloride, sulphate, nitrate, nitrite, dissolved oxygen, chemical oxygen demand (COD), biological oxygen demand (BOD), some heavy metals.

Noise levels at various places at different time were also recorded during the study.

Engineering and Communication

DEAL

DEAL had proposed following scientific test during 22nd IAE

1. Better HF/VHF Antenna
2. VHF Communication
3. "INMARSAT B High Speed (64/128 KBPS) Data & Video Option

New Service to Introduce

1. Video Conferencing
2. High speed data, INMARSAT B Terminal
3. HF High Speed Data with Frequency Management

Presently only HF voice service is provided and with plain vanilla HF transceiver. The situation can be highly upgraded by using Adaptive HF communication set already commercially available for many years. This set can automatically set up the links with best available frequency at that time. And with the best channel available and with advanced modem high-speed error free data can be transferred in HF band. In the XXI expedition this was tried with encouraging results and it is expected to continue in the XXII expedition.

New Experimentation

HF Adaptive Communication

It is felt that to improve the present HF communication and to provide HF data service, HF Adaptive communication system may be installed at Maitri. DEAL has experience on such system made by CO DAN, Australia that is proved to be a good system. Surely this would have improved the performance of HF communication, an important regular/stand by communication.

Achievements

1. The following experiments were carriedout with the HF Adaptive Communication system (CODAN) :-
   - PC Based Data Communication at the rate of 9600 Baud Rate
   - ALE (Automatic Link Establishment) operation
   - Scan Table Creation
   - Page Call
   - Binary file transfer
2. Made the VHF Repeater functional located at Vetahia hill. The antenna cables were rectified and the batteries were replaced.
3. Installed HF/VHF communication system on the ship "Magdalena Oldendroff'and made the HF/VHF Communication operational from Ship to Maitribase. Frequency used for HF are 4515, 51275 and 6110 MHz.
4. Provided HF communication from Kallak hill to Maitri base.
5. New Motorola VHF Repeater Station has been installed at Vetahia Ml.
6. Provided full VHF communication support during the Convoy Operation. For this purpose installed VHF Transceivers/Hand held transceivers with charger in the five vehicles.

7. Communication was maintained throughout the expedition by wintering members.

Human Physiology & Medicine

AIIMS

All India Institute of Medical Sciences, New Delhi proposed to study of higher mental functions in relation to stress and behaviour in expedition members with following objectives:

1. Impact of exposure to extreme cold and limited social interactions on higher mental and memory functions in expedition members.
2. Effects of duration of stay on higher mental and memory functions in expedition members.

Achievements

This programme did not take place, as members failed to participate in the expedition.

Logistic Objectives

The following Logistics Tasks were assigned to the XXII Indian Antarctic Expedition Team.

1. Up-keep of Maitri Station.
2. Maintenance of Generators and power supply system, Central Heating System, Water Supply System.
3. Convoy operation and Maintenance of Vehicles/Cranes/Bull-Dozers.
4. Cargo handline at shelf.
5. Logistic support for establishing and winding-up Field Camps.
6. Installation of fire-alarm system and maintenance of all types of fire extinguishers.
7. Environmental tasks of Up-keep and. restoration of the natural habitat of Maitri and its surroundings.

Achievements

1. Cargo handling at India Bay

As the Shelf at the India bay was declared unsafe for loading/unloading operations, the cargo was supposed to be unloaded at the new site selected.

But the fast ice at the new site did not break till 04 Mar' 03 and sea started freezing. There was a danger of the ship getting trapped in frozen sea. Because of the emergency, the complete cargo operations were carried out at India bay. The team worked day and night continuously for eight days, unloaded the complete cargo and simultaneously shifted it to DG. It needs to be highlighted that in second week of Apr'03, about 400m length of shelf at India Bay broke and Russians lost 200 barrels of their aviation fuel. But because of better foresight and good planning of Army Team, we did not suffer any loss of men and matrial.

2. Successful completion of convoys

All the convoys before the start of winter were completed in record time i.e. before the end of Apr' 03. All the containers and required fuel were brought to the station during this time. This reflects the standard of maintenance of vehs and the high morale of the team.

3. Fitting Engine to a 125 K V A generator

One 125 KV A Generator was off the road since two expeditions because of unserviceable engine. New engine was fitted and the Generator was made serviceable.

4. Generator Servicing

With good team work and coordination, team was able to achieve 100% serviceability state of generators. Total 7 generators were overhauled, one new alternator was fitted and all the generators were handed over to the next team in serviceable condition.

5. Replacement PB 330 cabin

Driver's cabin of one of the PB 330 was badly damaged during the previous expeditions. The complete driver's cabin and the accessories were replaced by this team.

6. Maintenance and repairs for Pisten Bully vehicles, Cranes and Trailers

Most of the Pisten bully vehicles are old and their reliability had reduced. Maintenance and major repairs of most of these vehicles was carried out by this team to enhance the life and reliability of these vehicles.

7. Retrieval of equipment at DG

All the eqpt in DG i.e. cranes, containers and tankers had gone 80% inside the snow during the last one year due to continuous blizzards and snow accumulation. The complete eqpt was retrieved by the team during their fifth convoy in the month of **Oct'** 03.

8. Renovation of living module and its sledge

The living module 'Banjara' was painted from outside. The Towing hook of the sledge of Banjara was broken and its hinges were completely worn out. With the help of Russian welder, the towing hook was welded and new hinges fitted thus enhancing the life of sledge for another few years.

9. Renovation of Convoy Generator Module

The generator module which was used for convoys was mounted on a sledge. The sledge was quite old and its skies had broken. Since no new sledge was available, this team designed a sledge using a pair of good speed skies available and an old strong platform available at Maitri. With the help of Russian welder this sledge was made. Module has also been repaired and painted.

10. Retrieval of fuel at Dozer point

Approximately 15 KL of fuel was retrieved from barrels buried at Dozer point & shifted to main Fuel dump at Maitri.

11. Retrieval of sledge from Dozer point

A sledge which was buried under snow was retrieved from Dozer point by the Army team. Now this sledge is being used for carrying another living module 'Sankalp'.

12. Cleaning of complete internal heating system at Maitri

The complete internal heating system at Maitri was cleaned, all the water inside the boilers, heating tanks, pipelines and radiators was flushed out and they were cleaned. Since new radiators were not available, some of the unserviceable radiators were repaired and fitted in the rooms where radiators were not available. Cleaning of hot and cold water storage tanks was also carried out.

13. Boiler servicing

All the boilers were serviced, repaired wherever required and made functional. Water coil of one of the boilers was damaged. A new water coil was fitted after making some modifications for its proper setting in boiler. Three water pumping motors were replaced in boiler room. One motor was overhauled and put in use.

14. Logistic and transport support to foreign visitors who had visited to witness Total Solar Eclipse

Complete logistic and transport support was provided to amateur astronomers, scientists and Japanese TV channel NHK for the transportation of their equipment and personals to the various sites for viewing Solar Eclipse on 23-24 November 2003.

15. Logistic support to Indian Scientific team durine Solar Eclipse

Complete logistic support was provided to Indian Scientific team, which had specially come to Antarctica to conduct experiments during Solar Eclipse.

16. Cleaning of new fuel dump

The new fuel dump created by the members of XXI logistic team was not fully operational as lot of snow has accumulated inside the storage tanks. This team cleaned all the tanks, fitted adapters in all the tanks and made the fuel dump completely operational.

17. Installation of new fuel line

The generators in 'Surya' complex had fuel tanks with 40 ltrs of capacity. So refueling was required to be done several times in a day. Two **new** fuel lines were laid for these generators and they were connected directly to 10 Kl tank thus reducing the fatigue of refuelling the tanks several times daily.

18. Dozer servicing

All the three dozers were repaired and made serviceable.

19. Flooring of kitchen and boiler room

The floor of kitchen and boiler room had become quite old and dirty. The old sheet has been removed and new flooring has been done by the Army team.

New Experiments in the XXII IAE

- GPR studies to map thickness of ice and rock topography - CWPRS
- Monitoring of CO at Maitri - NPL
- Studies of dielectric properties of Antarctic geophysical materials at C-Band' microwave frequencies - Jalana College
- Environmental impact assessment studies and monitoring of mercury in the environmental matrix and some bio-indicators - V JTI

Scientific Experiments in the XXII IAE with International Linkages

1. Tele seismic studies of Antarctica continent by NGRI (International program on Antarctic Seismic Networking of SCAR).
2. Monitoring of icebergs by GSI (International ship observations of Antarctic icebergs coordinated by Norwegian Polar Institute).
3. Planetary Geodetic studies by NGRI (Geodetic Infrastructure in Antarctica [GIANT] of SCAR).
4. Bathymetric survey for preparing hydrographic charts by NHO(Antarctic Hydrographic Charting of International Hydrographic Organisation).
5. Measurement of geomagnetic field currents in Antarctica by IIG (Antarctic Geomagnetic Networking [AGONET] of SCAR).
6. VLF whistler monitoring by Barkatullah University jointly with IIG (VLF monitoring network in Antarctica of SCAR)
7. Climatological database generation by EVID (Contributing to Antarctic weather forecasting by WMO).