USA, Australia and China collaborate over Pacific Ocean

San Francisco

A RESEARCH programme deemed to be one of the biggest and most sophisticated studies ever assembled to probe the dynamics of storm systems and their influence on upper atmosphere chemistry has just been launched.

The world's highest, coldest thunderstorms, which billow into the stratosphere every January and February above the tropical Arafura Sea north of Australia and the neighbouring Indonesian archipelago, may be the key to a vexing meteorological problem: how gases move between the upper and lower atmosphere.

A US National Aeronautics and Space Administration (NASA) ER-2 jet at an altitude of 20 km will test a novel hypothesis proposed about five years ago that these tropical storms in this restricted portion of the globe throw large volumes of lower atmosphere to higher levels and simultaneously preserve the extraordinarily low humidity of the lower stratosphere. The aircraft test is part of a US$10 million NASA project called Stratosphere–Troposphere Exchange Project (STEP). If the theory is supported, the warm seas northeast of Australia may contain the prime meteorological channel through which the bulk of atmospheric contaminants, including industrial discharges such as ozone-destroying fluorocarbon products, reach the stratosphere. Reginald Newell, professor of meteorology at Massachusetts Institute of Technology and an adviser to the programme, has called the area a "stratospheric fountain".

The single-engined ER-2, a research version of the US Air Force TR-1 high-altitude reconnaissance jet derived in turn from the famed Lockheed U-2 spy planes, left the NASA Ames Research Center in California on 8 January on a flight to Darwin via Hawaii and Guam. Its 1400-kg package of 16 instruments in the fuselage and two under-wing pods is the heaviest science payload the aircraft has ever carried.

Waiting at an Australian Air Force Base near Darwin to begin a month-long assault on large tropical storm buildups is a multinational research team for STEP. The project, five years in the making, is coordinated with two other studies, the Australian Monsoon Experiment (AMEX) and the Equatorial Mesoscale Experiment (EMEX). Participating agencies include NASA, the US National Oceanic and Atmospheric Administration (NOAA), the Australian Bureau of Meteorology, and several university-based groups. In addition, the crew of a research vessel from the People's Republic of China will help, launching radiosonde balloons and carrying a US-supplied weather radar to track storm systems for the combined effort.

While the sailplane-like ER-2 flies above, and into, the anvil-shaped tops of massive storms at 60,000 feet and above, other American and Australian aircraft will inspect lower altitudes. The measurements from the Chinese ship will augment a network of a dozen radiosonde and six radar sites along northern Australia.

NASA aims to sort out the precise nature of an atmospheric transport system known as the Walker Circulation, a convective cell with predominantly east–west orientation. STEP will examine the western end of the Walker Circulation as it gathers moist, warm low-level air flowing from near the coast of Mexico, lifting it up over the Western Pacific to feed dry, cold winds blowing back to the east.

Conventional wisdom has it that tropical thunderstorms flatten out at 50,000 feet or so. "We've seen them to 60,000 feet here, and radar suggests they go even higher," according to NASA meteorologist, Edwin Danielsen.

It is an issue only direct measurement can settle. The ER-2's pilots will fly above and into the cloud sheets swept outward of thunderstorm tops, giving them their characteristic anvil shapes as stormclouds overshoot points of equilibrium, flatten out, and extend downwind. The high-altitude cloud decks, rapidly losing heat to the dark sky above, and absorbing radiant heat from the sea, should become vigorously convective. As the NASA team sees it, they will become heat engines, pumping tropospheric air up, while condensing water into ice that falls back down.

Ozone, photochemical nitrogen compounds, and cosmogenic isotopes such as beryllium-7 and phosphorus-32 characteristic of the upper stratosphere, will be compared to aerosols, water vapour and water ice, carbon monoxide and radon daughters swept up in the tropopause. Temperature, wind speeds and pressure will all be carefully charted.

The project offers another big bonus. Pending approval of Chilean authorities to use an airfield at the southern tip of South America, NASA and NOAA officials plan to send the plane over Antarctica in August and September. This is when the height of the recently reported annual south polar ozone depletion is expected to occur (*Nature* **300**, 686; 1982). The Antarctic mission may uncover the role of man-made pollutants, delivered to the upper atmosphere through such mechanisms as the western Pacific stratospheric fountain, in piercing the hole in the ozone.

Charles Petit

Italy's nuclear forum is postponed

London

A CONFERENCE billed to "decide the future" of nuclear power in Italy has been postponed, throwing the Italian nuclear lobby into confusion.

Prime Minister Bettino Craxi's Socialist–Christian Democrat coalition government has equivocated on nuclear energy in public, but privately is said to back the country's recent "energy plan" to build two or three pressurized-water reactors (PWRs, Italy's first). The conference plan was supposed to be the political solution. To help satisfy public opinion, the government was (and in principle still is) to hold an open, three-day parliamentary conference covering all aspects of nuclear power, particularly safety. This was due to take place next week; but it always seemed to be a dangerous balancing act destined to receive a great deal of media attention, but with no clear powers of decision, so the postponement is perhaps unsurprising.

The Chernobyl accident last year caused an uproar in Italy. Although the country was only slightly exposed to fall-out from the explosion of the Ukrainian reactor, Italian politicians (who may soon face an election, were careful to listen to public complaints, and one after another of Italy's many political parties pledged itself against nuclear power. By late last year there was a political lobby large enough to pose a serious threat to the country's fledgling nuclear power programme.

Not only are the plans uncertain for new PWRs in Italy, but also for existing reactors and those under construction. Only four per cent of Italian electric power is nuclear-generated. (Italy is dependent upon foreign imports for some 80 per cent of its energy, making it one of the highest import dependences in Europe.) Two boiling-water reactors are in an advanced state of construction at Montalto di Castro (between Rome and Pisa), and work has begun on three PWRs sited east of Turin in the Piedmont, east of Milan in Lombardy, and south of Rome. Allowing for the decommissioning of older reactors, this would take Italy to around 25,000 million kWh per year of nuclear generating capacity by 1995, which would still amount to only 10 per cent of the country's requirements for electricity by that date, according to the Italian nuclear and alternative energy agency ENEA. The strategy, according to the president of ENEA, Professor Umberto Colombo, is to "hold the position" until renewable and fusion energy becomes available, although, he