FUNDING FOR THIS PROGRAM IS PROVIDED BY...

[ HORN HONKS ]

Narrator: AIR POLLUTION -- WE CAN'T ALWAYS SEE IT, BUT ITS EFFECTS CAN BE DEADLY.

TO FIND WAYS TO REDUCE ITS IMPACT WE NEED TO KNOW EXACTLY WHAT POLLUTANTS ARE Emitted AND HOW THEY CHANGE AS THEY TRAVEL THROUGH THE ATMOSPHERE. AT THIS POINT, WE PRIMARILY HAVE SULFATE PARTICLES. USING CUTTING-EDGE INSTRUMENTS AERODYNE RESEARCH CAN DETECT TINY CONCENTRATIONS OF POLLUTANTS IN REAL TIME TRACKING THEM BACK TO THEIR SOURCES AND SHOWING HOW THEY EVOLVE HOUR BY HOUR UNDER THE EFFECTS OF SUNLIGHT AND WEATHER.
IN MEXICO CITY
LUISA MOLINA IS LEADING A
GROUP OF OVER 450 SCIENTISTS
IN THE MOST COMPREHENSIVE
STUDY EVER CONDUCTED
OF ONE CITY’S AIR EMISSIONS.
SAMPLING ITS PLUME OF
POLLUTANTS FROM CRADLE TO
GRAVE
THE TEAM HOPES TO LEARN HOW
THE CITY’S POLLUTION
AFFECTS THE SURROUNDING
REGIONS AND EVEN THE GLOBAL
CLIMATE.
TODAY, THE RAPID INCREASE OF
POPULATION AND
INDUSTRIALIZATION
IS CAUSING INCREASING
CONCERNS ABOUT AIR
POLLUTION.

BOTH RESEARCHERS HOPE TO
DISCOVER
WHAT’S CAUSING THE MOST
DAMAGE
AND FIND WAYS TO REDUCE THE
HUMAN AND GLOBAL IMPACT.

[ HORN HONKS ]
Kolb: ONE OF THE REAL FACTS
THAT WE ALL HAVE TO DEAL WITH
IS THAT PEOPLE MAKE POLLUTION
AND AS THE POPULATION OF THE EARTH GROWS
UNLESS WE'RE VERY CLEVER AND WORK VERY HARD
THE LEVELS OF POLLUTION WE ALL HAVE TO LIVE WITH
WILL GROW ALONG WITH IT.
WE HAVE TO UNDERSTAND WHICH POLLUTANTS ARE THE ONES THAT WE MUST CONTROL
AND WE HAVE TO COME UP WITH EITHER CHANGES IN OUR TECHNOLOGY OR CHANGES IN OUR LIFESTYLES WHICH REDUCE THE HEAVY POLLUTION BURDENS THAT WE EMIT INTO THE ATMOSPHERE.

Narrator: CHARLES KOLB IS PRESIDENT OF AERODYNE RESEARCH
A COMPANY THAT SPECIALIZES IN STUDYING AIR POLLUTION AND DESIGNING INSTRUMENTS TO HELP MEASURE IT.

A NEW AEROSOL MASSSPEC BODY.

Kolb: OUR AIR-POLLUTION RESEARCH FOCUSES ON WHAT'S EMITTED BY VARIOUS POLLUTION SOURCES -- CARS, TRUCKS, PLANES,
FACTORIES, AND MANY OTHER SOURCES --
AND TO UNDERSTAND HOW THEY CHANGE THE ATMOSPHERE
AND HOW THAT CHANGED ATMOSPHERE TURNS AROUND AND IMPACTS PEOPLE AND THE CLIMATE AND THE ECOSYSTEMS THAT WE WANT TO PRESERVE.

Narrator: AIR POLLUTANTS EXIST AS HARMFUL GASES OR AS AEROSOLS. AEROSOLS ARE MICROSCOPIC SOLID OR LIQUID PARTICLES SUSPENDED IN THE AIR AND THESE POLLUTANTS CAN HAVE DEADLY EFFECTS.

Kolb: MOST OF US CAN ONLY SURVIVE A MINUTE OR SO WITHOUT A FRESH BREATH OF AIR AND IF THE AIR CONTAINS SUBSTANCES WHICH ARE GOING TO REALLY HURT YOUR HEALTH YOU'D HATE TO THINK THAT YOU'RE SHORTENING YOUR LIFE WITH EVERY BREATH OF AIR YOU TAKE.

Narrator: THE WORST
AIR-POLLUTION DISASTER ON RECORD OCCURRED IN LONDON IN DECEMBER OF 1952.

AT THIS TIME, LONDONERS STILL CONSUMED LOTS OF COAL WHICH LED TO LARGE AMOUNTS OF POLLUTANTS IN THE AIR INCLUDING BLACK CARBON, OR SOOT PARTICLES AND SULFUR DIOXIDE.

AND THIS TOXIC MIX TURNED FATAL. Kolb: THE PARTICLE LOADING GOT SO HEAVY DURING ONE EPISODE THAT THE SO-CALLED KILLER FOGS ACTUALLY KILLED MANY THOUSANDS OF PEOPLE OVER ABOUT A WEEK AND A HALF.

Narrator: THANKS TO REGULATIONS TO REDUCE THESE POLLUTANTS EVENTS LIKE THIS ARE RARE TODAY. HOWEVER, PUBLIC HEALTH OFFICIAL S ESTIMATE THAT 70,000 AMERICANS DIE PREMATURELY EACH YEAR
DUE TO AIR POLLUTION.

IN ORDER TO MONITOR THESE POLLUTANTS KOLB AND HIS TEAM AT AERODYNE RESEARCH DEVELOPED A SERIES OF REVOLUTIONARY LABORATORY-GRADE INSTRUMENTS THAT COULD BE DEPLOYED FROM A MOBILE VAN.

Kolb: WE'VE DEVELOPED SOME VERY CAPABLE AND VERY FAST RESEARCH INSTRUMENTS THAT CAN BE DEPLOYED IN THE ATMOSPHERE AND MEASURE RIGHT AWAY WHAT'S THERE.

Narrator: TRADITIONALLY SAMPLES HAD TO BE BROUGHT BACK TO THE LAB TO BE ANALYZED BUT WITH THE MOBILE VAN, MEASUREMENTS ARE INSTANTANEOUS. THE BENEFIT OF USING REAL-TIME INSTRUMENTATION IS THAT IT MAXIMIZES THE SCIENTIFIC IMPACT
THAT WE'RE ABLE TO HAVE WHEN WE'RE OUT IN THE FIELD. IT LOOKS LIKE WE'RE PICKING UP A GOOD SULFATE PLUME.

Kolb: THE MOBILE LAB IS EQUIPPED WITH INSTRUMENTS THAT CAN MEASURE EVERY SECOND OR SO. IF YOU'RE CHARACTERIZING AN EMISSIONS SOURCE AND ITS EMISSIONS ARE CHANGING SECOND BY SECOND AS A VEHICLE MIGHT AS IT STOPS AND STARTS OR ACCELERATES OR GOES UP A HILL THEN IF YOU DON'T MEASURE SECOND BY SECOND YOU WON'T GET THE RIGHT ANSWER.

NITRATES? YEAH, I SEE SOME NITRATES.

Narrator: ONE KEY INSTRUMENT IS AERODYNE'S AEROSOL MASS SPECTROMETER WHICH MEASURES THE TINY SUSPENDED PARTICLES IN THE ATMOSPHERE. WHAT'S REALLY SPECIAL ABOUT IT IS THAT USUALLY WHEN YOU'RE LOOKING AT PARTICLES
YOU JUST KNOW SORT OF HOW MANY PARTICLES ARE IN YOUR SAMPLE. BUT WHAT THE AMS IS CAPABLE OF DOING IS TELLING YOU WHAT THE CHEMICAL SPECIES OF EACH OF THOSE PARTICLES IS. YOU CAN SAY, "OH, YOU KNOW, THERE'S 1,000 PARTICLES IN THIS CUBIC CENTIMETER OF AIR," ROUGHLY THIS BIG, BUT YOU CAN ALSO SAY "OH, A CERTAIN FRACTION OF THEM ARE SULFATE "A CERTAIN FRACTION OF THEM ARE SOME SORT OF ORGANIC A CERTAIN FRACTION OF THEM ARE NITRATE," ET CETERA, ET CETERA. AND SO THAT GIVES YOU A MUCH STRONGER CAPABILITY BECAUSE IT TURNS OUT THAT THE WAY THESE PARTICLES INTERACT WITH THE ENVIRONMENT, FOR INSTANCE HOW THEY MIGHT OR MIGHT NOT AFFECT GLOBAL WARMING DEPENDS UPON THEIR COMPOSITION. AND HOW THEY MIGHT AFFECT OR
MIGHT NOT AFFECT HUMAN HEALTH DEPENDS ON THEIR COMPOSITION AS WELL AS THEIR SIZE.

Herndon: IF YOU'RE CONCERNED ABOUT THE HEALTH IMPACTS YOU'RE MOST CONCERNED ABOUT THE SIZE OF PARTICLES THAT ARE SUFFICIENTLY SMALL SO THAT THEY GO INTO YOUR LUNGS DEEP INTO YOUR LUNGS, ALONG WITH THE GAS FLOW. AND IN THAT CASE YOU COULD ACTUALLY BE INTRODUCING SOME THINGS INTO YOUR BODY, INTO YOUR BLOODSTREAM, QUICKLY THAT HAVE NO BUSINESS BEING THERE.

Narrator: PARTICLES LESS THAN 10 MICROMETERS IN DIAMETER JUST A FRACTION OF THE WIDTH OF A HUMAN HAIR CAN LODGE DEEP INTO THE LUNGS.

THOSE SMALLER THAN 2.5 MICROMETERS CLASSIFIED AS "FINE PARTICLES,"
HAVE BEEN LINKED TO THE MOST SERIOUS HEALTH PROBLEMS. Kolb: IT CAN LEAD TO A NUMBER OF MEDICAL COMPLICATIONS INCLUDING NOT JUST LUNG DISEASE -- EMPHYSEMA, ASTHMA, POSSIBLY LUNG CANCER -- BUT CAN ALSO PUT A VERY HIGH STRAIN ON YOUR HEART AND CAN LEAD TO HEART ATTACKS.

Narrator: AERODYNE MEASURES BOTH THE HAZARDOUS PARTICLES AND THE POLLUTANT GASES BEING EMITTED FROM VARIOUS SOURCES. YOU'D THINK YOU'D SEE SOME SULFATE, BUT I DON'T KNOW. Kolb: WE WANT TO USE OUR MOBILE LABORATORY TO UNDERSTAND POLLUTANTS THAT ARE DIRECTLY EMITTED INTO THE ATMOSPHERE. WE CALL THOSE "PRIMARY POLLUTANTS." WITH A MOBILE LABORATORY YOU CAN ACTUALLY MAP OUT THE DISTRIBUTION OF THE AIR POLLUTANTS
SO THAT YOU HAVE A MUCH BETTER PICTURE OF HOW THE POLLUTANTS ARE DISPERSED AROUND, SAY, A CITY, OR AROUND A FACTORY COMPLEX. IN ADDITION, YOU CAN LOCATE SOURCES OF POLLUTANTS BECAUSE YOU CAN SEE A CONCENTRATION IN A PLUME AND YOU CAN THEN USE THE MOBILE LABORATORY TO ACTUALLY FOLLOW THE PLUME BACK TO THE SOURCE.

Narrator: VEHICLE EMISSIONS ARE ONE OF THE SOURCES OF PRIMARY POLLUTANTS TRACKED BY AERODYNE. WHILE THE EMISSIONS FROM AN INDIVIDUAL CAR ARE RELATIVELY LOW COMPARED WITH FACTORIES IN MANY CITIES, THE MILLIONS OF VEHICLES ON THE ROAD ADD UP TO BE THE MOST SERIOUS THREAT TO CLEAN AIR.

VEHICLE EXHAUST POLLUTANTS INCLUDE AEROSOLS AND THESE GASES...
USING THEIR TRACE-GAS DETECTOR THE AERODYNE TEAM CAN MONITOR THESE POLLUTANT GASES EVEN AT VERY LOW LEVELS. BUT THESE POLLUTANTS, BY THEMSELVES ARE NOT THE ONLY CONCERN. SOME PRIMARY POLLUTANTS, SUCH AS NOx BECOME EVEN MORE DANGEROUS WHEN THEY BEGIN A COMPLEX CHEMICAL REACTION AFTER BEING EXPOSED TO SUNLIGHT.

SECOND BIG JOB WITH THE MOBILE LAB IS TO GO OUT AND ACTUALLY THEN SEE WHAT HAPPENS TO THOSE PRIMARY POLLUTANTS AS THEY COOK IN THE ATMOSPHERE. THIS CHEMISTRY CAN CREATE WHAT WE CALL "SECONDARY POLLUTANTS." IT CAN CHEMICALLY CHANGE THE POLLUTANTS THAT WERE Emitted INTO THE ATMOSPHERE
INTO DIFFERENT AND SOMETIMES MORE DANGEROUS CHEMICALS.

Narrator: ONE SECONDARY POLLUTANT THAT CONCERNS SCIENTISTS IS OZONE. OZONE IS A GAS MADE UP OF 3 OXYGEN MOLECULES AND IT CAN HAVE BOTH GOOD AND BAD EFFECTS DEPENDING ON WHERE IT'S LOCATED. THE STRATOSPHERIC OZONE LAYER PROTECTS THE EARTH FROM HARMFUL ULTRAVIOLET RAYS BUT GROUND-LEVEL OZONE, IN THE TROPOSPHERE IS HIGHLY REACTIVE AND CAN CAUSE IRRITATION OF THE RESPIRATORY SYSTEM PERMANENTLY SCARRING LUNG TISSUE. Kolb: OZONE IS A VERY POWERFUL OXIDANT. IT CAN KIND OF BLEACH THE CELLS IN YOUR BODY AND CAN CREATE A LOT OF SERIOUS PROBLEMS BOTH TO PEOPLE, TO OTHER ANIMALS, AND TO PLANTS.
Narrator: THE MAIN PRECURSORS IN CREATING OZONE ARE NITROGEN OXIDES Emitted FROM VEHICLES AND OTHER COMBUSTION SOURCES AND HYDROCARBONS, THE RESULT OF COMBUSTION OTHER INDUSTRIAL PROCESSES, AND VEGETATION. WHEN THESE POLLUTANTS INTERACT IN THE PRESENCE OF SUNLIGHT THEY PRODUCE GROUND-LEVEL OZONE. SUNLIGHT CAUSES NITROGEN DIOXIDE, NO2 TO SEPARATE INTO NITRIC OXIDE, "NO," AND AN OXYGEN ATOM. THE OXYGEN ATOM ADDS TO NATURALLY OCCURRING MOLECULAR OXYGEN, OR O2 TO CREATE OZONE. BUT THIS IS JUST THE FIRST STEP IN A CHAIN REACTION OF OZONE PRODUCTION. THE REMAINING NITRIC OXIDE REACTS WITH UNSTABLE MOLECULES THAT ARE PRODUCTS OF HYDROCARBONS OXIDIZING IN THE ATMOSPHERE RECREATING NITROGEN DIOXIDE
CAUSING A VICIOUS CYCLE OF OZONE PRODUCTION.
Kolb: SO OZONE GETS FORMED AS A SECONDARY POLLUTANT. IT'S NOT EMITTED DIRECTLY AND IT'S IMPORTANT TO UNDERSTAND NOT ONLY HOW MUCH OZONE IS IN THE ATMOSPHERE BUT HOW MUCH OF ITS PRECURSOR CHEMICALS ARE THERE SO WE CAN PREDICT WHAT THE OZONE WILL LOOK LIKE AS THE WIND BLOWS THAT CHEMICAL MIXTURE ACROSS THE COUNTRYSIDE.

Narrator: AERODYNE'S VAN HAS BEEN DEPLOYED ALL OVER NORTH AMERICA TO HELP ENGINEERS AND PLANNERS IDENTIFY THE BEST STRATEGIES TO REDUCE POLLUTANTS FROM INDUSTRIES AND TRANSPORTATION SYSTEMS. Kolb: WE'VE WORKED WITH THE METROPOLITAN TRANSIT AUTHORITY IN NEW YORK CITY THAT RUNS ABOUT A THIRD OF
THE CITY'S BUSES TO DETERMINE WHICH TYPES OF BUSES EMIT WHAT KINDS OF POLLUTANTS. SO ONE CAN TAKE THE MOBILE LAB AND FOLLOW THE BUSES AS THEY GO ABOUT THEIR ROUTES IN THE CITY. AND AS THEY STOP AND START, TAKE ON PASSENGERS ACCELERATE, SLOW DOWN ONE CAN SEE HOW BOTH THE PARTICLE POLLUTANTS AND THE GASEOUS POLLUTANTS THEY EMIT CHANGE. THEN YOU CAN TAKE THE SAME TYPE OF BUS AND PUT SOME EMISSION-CONTROL TECHNOLOGY ON IT -- MAYBE A TRAP THAT TRAPS AND BURNS THE PARTICLES -- AND YOU CAN SEE WHAT EFFECT THAT HAS ON THE PARTICLE EMISSIONS AND ALSO WHAT EFFECT IT HAS ON THE GASEOUS EMISSIONS.

Narrator: WHEN KOLB'S TEAM TESTED THESE BUSES THEY FOUND SOME UNEXPECTED
RESULTS.
Kolb: THE DIESEL BUSES WITH PARTICLE TRAPS DID, INDEED, EMIT ONLY ABOUT A QUARTER OF THE PARTICLES THAT NORMAL DIESEL BUSES EMITTED BUT THEY DID EMIT A LARGE AMOUNT OF NITROGEN DIOXIDE WHICH IS, AGAIN, A GAS THAT IS A TOXIC AIR POLLUTANT. SO YOU HAVE TO BE CAREFUL WHEN YOU'RE TRYING TO SOLVE ONE POLLUTION PROBLEM THAT YOU DON'T CREATE A SECOND POLLUTION PROBLEM WHICH MAY BE AS SERIOUS AS THE FIRST ONE.

Narrator: IN EUROPE AND THE UNITED STATES POLICIES HAVE BEEN PUT IN PLACE TO REDUCE AIR POLLUTION. THE CLEAN AIR ACT OF 1970, WHICH SET LIMITS ON CONCENTRATIONS OF CERTAIN POLLUTANTS ALONG WITH SUBSEQUENT PROGRAMS HAS SIGNIFICANTLY IMPROVED AIR QUALITY.
Kolb: SINCE 1970, WE'VE HAD FAIRLY STRICT LAWS WHICH HAVE HELPED STOP THE INCREASE IN BAD AIR-POLLUTION EPISODES AND, IN FACT, IN MOST CITIES HAVE DECREASED THEM. BUT IN CITIES WITH RAPID GROWTH AND WITH CHALLENGING CLIMATES -- CLIMATES THAT CAN LEAD TO A LOT OF CHEMISTRY IN THE AIR AND A LOT OF SECONDARY POLLUTION FORMATION THERE ARE CERTAINLY STILL BIG CHALLENGES LEFT.

Narrator: DEVELOPING INNOVATIVE WAYS TO MEASURE PRIMARY AND SECONDARY POLLUTANTS IS A NECESSARY FIRST STEP IN CREATING EFFECTIVE STRATEGIES FOR PROTECTING HUMAN HEALTH.

BUT MEASURING THE LOCAL AIR POLLUTION FROM CARS AND FACTORIES IS JUST ONE PIECE OF THE PUZZLE.

ATMOSPHERIC CIRCULATION
CARRIES POLLUTANT STREAMS FAR BEYOND THE METROPOLITAN AREAS WHERE THEY ARE CREATED CAUSING REGIONAL AND EVEN GLOBAL EFFECTS. AND SO THE POLLUTIONS THAT ARE CREATED IN THE LARGE MEGACITIES IN CHINA CAN DELIVER VERY HIGH LEVELS OF POLLUTANTS ALL ACROSS THE UNITED STATES JUST AS THE POLLUTION THAT'S CREATED IN THE MIDWEST AND THE EASTERN PART OF THE UNITED STATES REACHES ALL THE WAY TO EUROPE. IT ONLY TAKES ABOUT TWO WEEKS FOR AIR TO GO ALL THE WAY AROUND THE WORLD.

Narrator: AND SOME POLLUTANTS SUCH AS AEROSOLS AND GREENHOUSE GASES LIKE CARBON DIOXIDE AND OZONE EVEN AFFECT THE GLOBAL CLIMATE. SO WE DON'T HAVE THE LUXURY OF THINKING
THAT IT'S OTHER PEOPLE'S AIR-POLLUTION PROBLEMS OTHER PEOPLE'S CLIMATE PROBLEMS. IF THEY'RE HAVING PROBLEMS WE'RE GOING TO HAVE PROBLEMS, TOO.

Narrator: AND ONE OF THE BIGGEST EMERGING THREATS TO THE GLOBAL ENVIRONMENT IS INCREASED AIR POLLUTION FROM MEGACITIES. A MEGACITY IS DEFINED AS HAVING 10 MILLION OR MORE INHABITANTS. CURRENTLY, THERE ARE OVER 20 MEGACITIES WORLDWIDE AND THAT NUMBER CONTINUES TO GROW AT AN ALARMING RATE. HUNDREDS OF MILLIONS OF PEOPLE CURRENTLY LIVE IN THESE CITIES AND IT IS PROJECTED THAT BY THE MIDDLE OF THE CENTURY THIS NUMBER WILL BE MULTIPLIED MANY TIMES OVER WITH 60% OF THE WORLD'S POPULATION LIVING IN URBAN AREAS.

THIS RAPID GROWTH
MEANS AN EVER-RISING TOLL TO HUMAN HEALTH UNLESS WE GAIN A BETTER UNDERSTANDING OF THE LIFE CYCLE OF AIR POLLUTANTS.

AND THAT'S EXACTLY WHAT'S BEING DONE IN MEXICO CITY FOR THE MILAGRO PROJECT THE LARGEST COORDINATED STUDY EVER CONDUCTED OF MEGACITY AIR POLLUTION. 1, 2, 3.

LUISA MOLINA IS THE PROJECT COORDINATOR AND ONE OF THE LEAD SCIENTISTS ON THIS EFFORT. Molina: "MILAGRO" STANDS FOR "MEGACITY INITIATIVE LOCAL AND GLOBAL RESEARCH OBSERVATIONS."

AND WE WERE VERY, VERY PLEASED THAT WE WERE ABLE TO FIND AN ACRONYM, MILAGRO THAT NOT ONLY FIT THE THEMES OF OUR MEASUREMENT CAMPAIGN BUT IT ALSO MEANS "MIRACLE" IN SPANISH.
Narrator: IN MARCH 2006
MOLINA GATHERED AN
INTERNATIONAL TEAM OF MORE
THAN 450 SCIENTISTS
TO INVESTIGATE THE EFFECTS OF
LOCAL POLLUTION IN MEXICO CITY
ON THE SURROUNDING REGIONS
AND THE GLOBAL ATMOSPHERE.

THE SCIENTISTS REPRESENT
OVER 50 ACADEMIC AND
RESEARCH INSTITUTIONS
FROM MEXICO, EUROPE, AND THE
UNITED STATES
INCLUDING NASA, THE
DEPARTMENT OF ENERGY
AND THE NATIONAL SCIENCE
FOUNDATION.

MEXICO CITY IS AN IDEAL
LOCATION FOR MILAGRO’S
MEGACITY RESEARCH.

SURROUNDED ON THREE SIDES
BY MOUNTAINS
POLLUTANTS BECOME TRAPPED
WITHIN THE CITY.
Molina: THERE ARE MANY
REASONS FOR SELECTING
MEXICO CITY.
FIRST OF ALL, MEXICO CITY IS
ONE OF THE LARGEST
MEGACITIES. IT HAS ABOUT 20 MILLION PEOPLE. IT IS IN A TROPICAL LATITUDE SO IT'S REPRESENTATIVE OF MANY OF THE FUTURE MEGACITIES WHICH WILL BE IN ASIA, IN AFRICA. MEXICO CITY IS AT A HIGH ALTITUDE AND THE SOLAR RADIATION IS VERY STRONG AND THE PHOTOCHEMISTRY, IT IS VERY REACTIVE. AND OF COURSE, WHAT WE HOPE IS THAT WHAT WE LEARN FROM MEXICO CITY IT WILL PROVIDE INSIGHT FOR US SO THAT WE CAN USE THAT INSIGHT AND UNDERSTANDING AND APPLY IT TO OTHER FUTURE MEGACITIES.

Narrator: WHILE MANY PREVIOUS STUDIES REVEALED A GREAT DEAL ABOUT POLLUTION WITHIN MEXICO CITY WHAT HAPPENED TO THE POLLUTION AFTER IT LEFT THE CITY AND WHAT ITS EFFECTS WERE ON THE REGION AND THE GLOBE HAD NEVER BEEN
SYSTEMATICALLY STUDIED UNTIL MILAGRO.
SO YOU HAVE ALL THIS POLLUTION COMING OUT FROM BURNING OF FOSSIL FUELS, FROM CARS, FROM INDUSTRY. AND SO THE POLLUTANTS THAT EMITTED LOCALLY THE LOCAL EFFECTS WOULD BE ON THE HEALTH OF THE POPULATION AND ON THE AIR QUALITY. BUT THEN THEY COULD ALSO -- THE REGIONAL IMPACT WHICH WOULD AFFECT THE ECOSYSTEM. AND THEN, ALSO, THERE'S THE GLOBAL IMPACT THAT WOULD AFFECT THE CLIMATE. SO THIS IS VERY SERIOUS.

Narrator: 24 HOURS A DAY FOR 30 DAYS THE MILAGRO TEAM COLLECTED DATA USING AIRPLANES, RADARS, WEATHER BALLOONS AND DOZENS OF SCIENTIFIC INSTRUMENTS. I BROUGHT HERE TO MEXICO CITY AN INSTRUMENT WHICH I CALL
THE DIFFERENTIAL SUPERSATURATION SEPARATOR. OUR INSTRUMENT IS CALLED A LONG-PATH DIFFERENTIAL OPTICAL ABSORPTION SPECTROMETER. PHOTOELECTRIC AEROSOL SENSOR. A PROTON TRANSFER MASS SPECTROMETER. THIS IS WHAT WE CALL A CAPS PROBE, WHICH STANDS FOR "CLOUD AEROSOL AND PRECIPITATION SPECTRA" PROBE. WHAT IT MEASURES IS AEROSOL PARTICLES WHICH ARE THE VERY FINE PARTICLES IN THE AIR. AS WE FLY, IT'S IN FRONT OF THE PLANE BECAUSE THERE WOULD BE ENGINE EXHAUST IF IT WAS FURTHER BACK SO IT SEES THE AIR FIRST. AEROSOL AIR COMES THROUGH THIS PROBE AND WHAT IS DETECTED IS THE SIZE OF THE PARTICLES.

BY SIMULTANEOUSLY AND COLLABORATIVELY GATHERING THEIR DATA
THE SCIENTISTS WILL HAVE BETTER INFORMATION TO CREATE NEW MODELS FOR PREDICTING THE TRANSPORT OF POLLUTION OVER WIDE GEOGRAPHIC AREAS.

Molina: THE OBJECTIVE OF THIS STUDY, OF MILAGRO IS TO FOLLOW THE PLUMES AND FIND OUT WHERE AND HOW AND WHEN THE PLUMES ARE TRANSPORTED TO OTHER REGIONS. AND SO IT IS VERY IMPORTANT FOR US NOT ONLY JUST TO LOOK AT ONE SITE BUT TO LOOK AT VARIOUS SITES.

Narrator: TO STUDY THE MOVEMENT OF PLUMES THE RESEARCHERS HAVE THREE MAIN FIXED GROUND SITES -- "T0," LOCATED IN THE CENTER OF THE CITY AND T1 AND T2, TWO POINTS NORTH OF THE CITY WHERE THE PREVAILING WINDS ARE EXPECTED TO CARRY THE PLUMES.

AT THESE SITES, RESEARCH
TEAMS MEASURE TRACE GASES, AEROSOL CONCENTRATIONS, AND SOLAR-RADIATION LEVELS AS WELL AS METEOROLOGICAL DATA.

Molina: WE HAVE TO MEASURE THE PRESSURE
WE MEASURE THE TEMPERATURE
WE MEASURE THE RELATIVE HUMIDITY
AND THE WIND SPEED -- THE WIND DIRECTION.
THESE ALL AFFECT THE TRANSPORT OF THE POLLUTANTS.

Narrator: THE AERODYNE TEAM TRAVELED TO MEXICO CITY AS PART OF THE MILAGRO CAMPAIGN.
TO HELP MONITOR THE PLUME THEY SET UP THEIR MOBILE LAB IN A UNIQUE, ELEVATED LOCATION BETWEEN T0 AND T1, CALLED PICO DE TRES PADRES.
WE'RE ABOUT A THOUSAND METERS ABOVE EACH OF THESE TWO SITES.
SO WE HAVE AN OPPORTUNITY AT THIS LOCATION TO ACTUALLY LOOK AT THE LOFTED PLUME THAT'S COMING TO US.
IN THE MORNING
THIS LOCATION HAS RELATIVELY
CLEAN AIR
SINCE IT IS ABOVE THE
BOUNDARY LAYER
A LAYER NEAR THE GROUND
THAT DOES NOT MIX WELL WITH
THE ATMOSPHERE ABOVE.
THIS LAYER TRAPS THE
POLLUTION BELOW
IN THE BASIN OF MEXICO CITY.
BUT AS THE SUN HEATS THE
EARTH, THE BOUNDARY LAYER
RISES.

BUT WHAT WE'RE
OBSERVING RIGHT NOW --
WE'RE ABOVE THE MIXING
HEIGHT.
ALL OF THE POLLUTION AND
EMISSIONS THAT ARE TAKING
PLACE
ARE NOT ABLE TO MIX UP AND
COME UP TO THIS LOCATION.
WHAT HAPPENS IS THAT THE SUN
COMES UP
AND BEGINS TO HEAT THE
SURFACE OF THE EARTH.
AND JUST LIKE PUTTING A PAN OF
BOILING WATER ONTO THE STOVE
IT BEGINS TO MIX AND BOIL,
MOVING THE AIR UPWARD,
UPWARD.
AND SO IT MIXES UP AND UP AND UP.
AND WE'RE LOCATED UP HERE AT THIS LOCATION
AND SUDDENLY WE BEGIN TO SEE MUCH OF THE CITY POLLUTION
AND EMISSIONS COMING TO US BUT IT'S A BIT LATER THAN WHEN
THE SUN COMES UP.
WE'RE SEEING INCREASES IN CARBON MONOXIDE
CARBON DIOXIDE, AND NOx.

Narrator: AS THE SUN PEAKS AND CONTINUES THROUGH THE AFTERNOON
THE POLLUTANTS CHEMICALLY CHANGE AS THEY REACT IN THE ATMOSPHERE.
Herndon: WHAT WE OBSERVED AT T0 WE SAW A MIXTURE OF PRIMARY AND SECONDARY POLLUTANT SPECIES.
UP HERE, THE CHARACTER OF JUST ABOUT EVERYTHING WE HAVE SEEN INDICATES THAT IT'S VERY SECONDARY, VERY PROCESSED.
SO, FROM THAT POINT OF VIEW WE HAVE AN OPPORTUNITY TO
LOOK AT THE FIRST STEPS AS THE PLUME IS MOVING DOWNWIND AS TO WHAT IS HAPPENING WHAT CHANGES ARE TAKING PLACE IN THE COMPOSITION OF THOSE EMISSIONS.

Narrator: IN ADDITION TO GROUND SITES RESEARCHERS ALSO MEASURED POLLUTANTS FROM AIRPLANES AND SATELLITES TO CORROBORATE THEIR DATA AND TO HELP TRACK THE PLUME. Molina: IT IS VERY IMPORTANT FOR US TO DO AN INTEGRATED MEASUREMENT. IN ORDER FOR YOU TO LOOK AT THE OUTFLOW NOT ONLY DO YOU NEED A GROUND BASE BUT YOU ALSO NEED TO HAVE A LARGER COVERAGE SO THE AIRPLANE IS VERY ESSENTIAL. AND THEN THE SATELLITE OBSERVATION PROVIDE EVEN LARGER INTO SPACE.
WE WANTED TO USE DIFFERENT TECHNIQUES THAT COMPLEMENT EACH OTHER SO IT'S VERY IMPORTANT FOR US TO HAVE COMPLIMENTARY MEASUREMENTS. IT'S IMPORTANT FOR US TO HAVE INTERCOMPARISON. IN FACT, SOME OF THE MEASUREMENTS DURING THE CAMPAIGN WERE DESIGNED EXACTLY FOR THAT PURPOSE.

Narrator: LONG-TERM, MILAGRO WILL LEAD TO BETTER MODELS OF HOW EMISSIONS ARE TRANSPORTED AND TRANSFORMED HELPING COUNTRIES MANAGE AND IMPROVE AIR QUALITY.

DISTANCES
EVEN ACROSS CONTINENTS.

BUT IT WILL BE MANY YEARS
BEFORE MOLINA AND HER TEAM
HAVE DEFINITIVE RESULTS.
Molina: MILAGRO -- RIGHT NOW WE
ONLY FINISH THE FIRST PHASE
ONE
THE MEASUREMENT, THE
OBSERVATION STAGE.
AND THEN THE NEXT PHASE IS
NOW WE ARE IN THE PROCESS
OF DOING THE DATA ANALYSIS
SO WE HAVE ALL OF THIS TONS
AND TONS OF DATA.
THEN ALL THIS INFORMATION ARE
NOW FIT INTO MODELS.
THEN WE ARE GOING TO PRESENT
THE RESULTS
TO THE MEXICAN GOVERNMENT.

Narrator: WHILE THE MEXICAN
GOVERNMENT
HAS RECENTLY MADE STRIDES IN
REDUCING EMISSIONS
WITH STRICTER REGULATION
POLICIES AND CLEANER FUEL
MEXICO CITY IS JUST ONE OF A
GROWING NUMBER OF
MEGACITIES.
Molina: WE HOPE THAT BY
STUDYING MEXICO CITY
USE THIS AS A CASE STUDY
THEN WE CAN FIND OUT HOW
WOULD THE FUTURE MEGACITIES
THAT ARE COMING UP
HOW WOULD THEY INFLUENCE
THE ATMOSPHERIC
COMPOSITIONS
ON A LARGE REGIONAL-GLOBAL
SCALE.

Kolb: IF WE DON'T CONTROL THE
CHANGES WE MAKE TO THE
ATMOSPHERE
THE ATMOSPHERE MAY BEGIN TO
CONTROL
HOW MANY OF US ARE LEFT ON
THE PLANET.
SO IT'S VITAL THAT WE
UNDERSTAND
WHAT HAPPENS TO THE
POLLUTANTS WE EMIT
AND WE UNDERSTAND HOW TO
BETTER CONTROL THEM
SO THE PLANET CAN CONTINUE
TO BE A HABITABLE PLACE
FOR BOTH PEOPLE AND THE REST
OF THE CREATURES WE SHARE IT
WITH.