UK Distributors

enviro technology services

Services Division

Commercial Division

Aerospace Instruments Division

SIGMA SPACE CORPORATION – Excellence in Aerospace Technology

Established in 1998, Sigma Space Corporation provides its customers with **pioneering aerospace technology solutions**. We produce next-generation **lidar**, laser ranging, attitude determination, spectroscopy, and radiometry instrumentation for remote sensing and defense applications. From research and operational forecasts to national security, our instruments consistently demonstrate **unparalleled performance**.

Sigma Space also offers **advanced science and engineering services** to private and government clients, including NASA and DOD. Supporting these efforts is our world-class staff of engineers, technicians, and scientists.

MICRO PULSE LIDAR

A versatile tool for atmospheric observations and weather forecasting

Micro Pulse Lidar (MPL) is a sophisticated laser remote sensing system that provides **continuous**, **unattended monitoring of the profiles and optical properties of clouds and aerosols** in the atmosphere.

Based on the same principle as radar, MPL transmits laser pulses that scatter (reflect) off particles in the atmosphere. MPL then measures the intensity of backscattered light using **photon-counting detectors**, and transforms the signal into **atmospheric information in real time**.

Sigma Space has been manufacturing MPL systems since 2004 under license from **NASA***. Standard MPL systems are deployed in the NASA global lidar network (MPLNET) and the U.S. Department of Energy Atmospheric Radiation Measurement (DOE ARM) program. **MiniMPL** is a Sigma Space innovation **that takes lidar technology to a new level of portability, power efficiency, and cost effectiveness**, while maintaining an exceptional signal-to-noise ratio.

PRODUCTS

Accurate, reliable, and easy to use

KEY BENEFITS

- **High-resolution aerosol profiling**
- **Optically robust, resistant to misalignments**
- **Low-maintenance, optimized laser**
- **Eye safe (ANSI Class II)**
- **Continuous, autonomous data collection**
- **Operational in minutes**

MPL **MiniMPL**

* Licensed from the National Aeronautics and Space Administration under U.S. Patent No. 5,241,315.

PRODUCT LINE

Fast field deployment solutions

Sigma Space manufactures two versions of Micro Pulse Lidar: **MPL**, designed for automated observation of aerosols and clouds up to 25 kilometers, and **MiniMPL**, optimized for near-range atmospheric observation (up to 15 kilometers). Both feature durable coaxial transceiver design and sensitive single-photon detection.

MiniMPL is the first lidar on the market that has all the electronics integrated with the optics in one box. **Smaller than a carry-on suitcase and weighing only 12 kilograms**, a single operator can easily manage the instrument. With an attractive price tag, MiniMPL is readily deployable for fixed sites or field campaigns.

		MPL	MiniMPL
Performance	range resolution	5/15/30/75 m (software programmable)	5/15/30/75 m (software programmable)
	minimum range	100 m	100 m
	accumulation time	1 sec–15 min	1 sec–15 min
	detection range	up to 25 km	up to 15 km
	polarization	optional	standard
	scanning	optional	optional
Optics	laser wavelength	532 nm	532 nm
	laser pulse energy	6–10 µJ @ 2500 Hz	3–4 µJ @ 4000 Hz
	eye safety	ANSI Z136.1 2000, IEC 60825	ANSI Z136.1 2000, IEC 60825
	receiver diameter	178 mm	80 mm
	pump laser diode	fiber coupled, user replaceable	long life diode: 10,000 hrs
	detector	fiber coupled, user replaceable	fiber coupled, user replaceable
Dimensions	size (mm)	318 x 356 x 953	318 x 216 x 495
	weight (portability)	24 + 4 kg (2 persons)	12 kg (1 person)
Data	operating system	Windows XP / Vista / 7	Windows XP / Vista / 7
	computer interface	USB	USB
	data transfer	LAN Ethernet	LAN Ethernet
Environment	temperature	operating -10 to 40° C with NEMA 4 enclosure	operating -10 to 40° C with NEMA 4 enclosure
	humidity	operating 0–100% with NEMA 4 enclosure	operating 0–100% with NEMA 4 enclosure
Power	supply	100/240 V AC 50-60 Hz	100/240 V AC 50-60 Hz
	consumption	500 W	100 W

POWERFUL FEATURES

POLARIZATION

See the details

With the Polarization Control Package (optional for MPL, standard for MiniMPL), MPLs can differentiate between spherical and non-spherical aerosols—such as water droplets and ash—giving users **a comprehensive picture of what's in the sky**. To do this, MPL transmits light with a specific polarization state. Spherical droplets backscatter light without changing its polarization (**co-polarized signal**), while asymmetrical ice and ash particles depolarize part of the backscatter (**cross-polarized signal**). MPL detects and displays both signals.

SCANNER

A wide view of the sky

MPL and MiniMPL can perform customized scans with the **Two-Axis Scanner Option—resulting in real-time 3-D images**. Track sources and sinks of aerosols with ease. Gain valuable insight into pollution transport and changes over time. Whatever the application, our two-axis scanner offers the ultimate view.

SOFTWARE

Easy and automated

SigmaMPL software is a **powerful and versatile** package for instrument control, real-time data processing, data archiving, playback functions, and many automated data analysis algorithms. **Easy to use** without prior training and included free with all MPL and MiniMPL instruments.

Scan here for more information: MPL software video overview on YouTube

TRANSFORM DATA INTO **REAL-TIME INFORMATION**

Easy data access and networking

MPL and MiniMPL instruments can be seamlessly integrated into networks, enabling customers to **operate MPLs and view instrument data remotely**—key for decision makers who need **real-time access to all the lidars in their network**.

Capabilities include

- Live lidar data streaming
- Real-time views of data from instrument clusters
- Powerful graphics output that can visualize aerosol, cloud, and ash concentration and movement across multiple MPL systems
- Location of individual lidars pinpointed with GPS
- Overlays with local weather station or regional weather maps available
- Customizable to work with existing network architecture

WHO CAN BENEFIT FROM MPL TECHNOLOGY?

Meteorologists – to enhance weather and air quality forecasts

Atmospheric and environmental researchers and regulators – to improve models and emissions estimates by determining the extent of manmade and natural aerosols and measuring PBL height and trends

Airports and air traffic controllers – to optimize aviation safety through enhanced cloud and volcanic ash profiling

Wind farm planners – to help improve wind pattern forecasts for site evaluation and management

DISPLAY & CONTROL

How MPLs display data

MPLs measure aerosol type, structure, and layers, and display these characteristics in two basic kinds of plots:

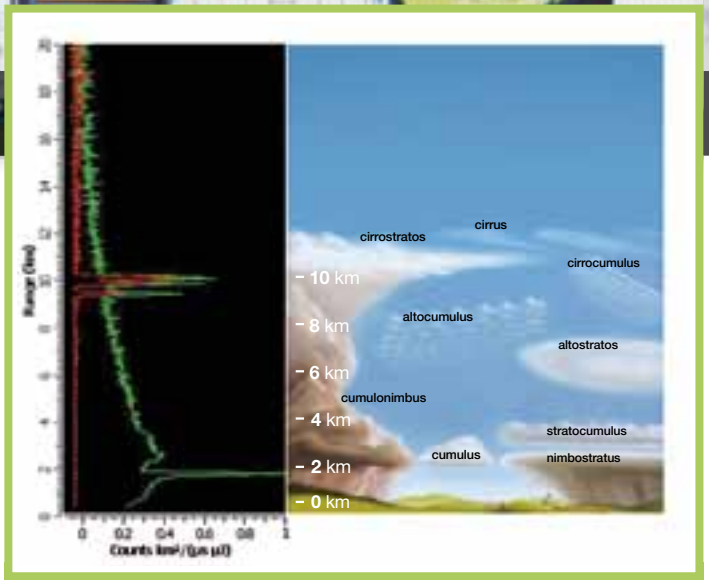
Vertical aerosol profile

A snapshot of atmospheric aerosols that depicts backscatter intensity versus distance (range). MPLs typically generate a profile every 30 seconds with a 30-meter range resolution (both parameters adjustable). Profile features include

- **Peaks** – correspond to aerosol or cloud layers.
- **Green trace** – represents **co-polarized backscatter**, returned by both spherical particles (liquid droplets), and asymmetric particles (ash and ice).
- **Red trace** – represents **cross-polarized backscatter**, returned only by asymmetric particles.

Time sequence plot

As seen on the following pages, these pseudo-color plots **show temporal and spatial trends in aerosol and cloud structure** and provide information on developing weather fronts. Backscatter (NRB) intensity is represented on a color scale. Data are updated in real time as acquired by the MPL.



Vertical aerosol profile of clouds produced by MiniMPL, and cloud diagram. At left is a 30-second averaged profile of normalized relative backscatter (NRB) intensity, indicating a thin water cloud near 2 kilometers (green peak), and multiple layers of clouds containing both water and ice in the 9–10 kilometer range (green and red peaks). A cloud diagram is shown on the right for illustration purposes.

MEASURE **CLOUD STRUCTURE, PHASE,** AND **LAYERS**

Comprehensive cloud profiles, from surface to stratosphere

MPL systems collect the **detailed, real-time cloud data** needed for industry-leading forecasts, accurate weather models, and optimal air traffic support.

Determine cloud extent and structure

MPL's vertically resolved, ground-based measurements complement satellite images by providing detailed information about **cloud height, extent, and structure**. These properties are key to forecasting because they are directly related to atmospheric processes below and within the clouds. What's more, using **cloud height** (pressure level), **optical thickness,** and **signal depolarization**, SigmaMPL software **quickly and accurately classifies cloud types and structures**, such as stratocumulus or cirrus.

Identify cloud phase

Using polarization data, MPL systems can determine whether clouds contain liquid, ice, or both. MPL software includes algorithms to mark other important features as well, including the planetary boundary layer, cloud base, cloud peaks, and top of the aerosol layer.

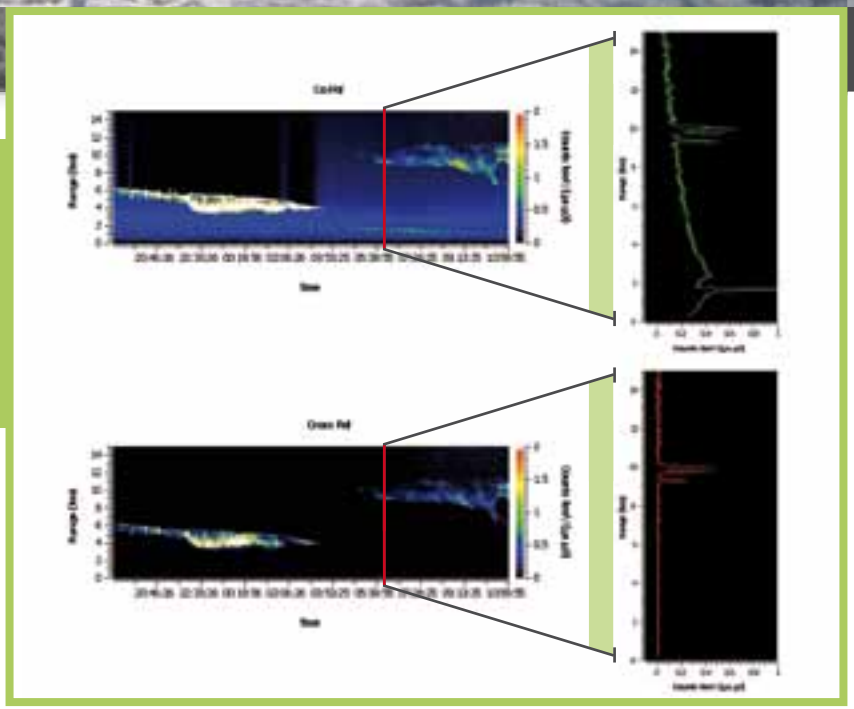
Simultaneously map multiple cloud layers

Together with boundary layer trends, this information can be used to forecast frontal passages.

BEYOND FORECASTING

In addition to improving weather models, MPL cloud profiles provide **detailed information to air traffic control** for pilots operating under visual flight rules (VFR) or instrument flight rules (IFR) near airports—**enhancing aviation safety**.

CLOUDS



MiniMPL aerosol profiles of clouds and time sequence data taken over 16 hours, Lanham, MD. The 30-second averaged profiles on the right correspond to the time indicated by the red markers on the time sequence plots. The profiles show a thin water cloud near 2 kilometers, and multiple layers of clouds containing water and ice between 9 and 10 kilometers. To the left, time sequence plots of 30-second averaged profiles illustrate cloud evolution. For example, over the first 8 hours of data collection, a layer of clouds descends from 6 kilometers and evolves into multiple layers between 2 and 5 kilometers.

MONITOR **AEROSOLS** AND THE **PLANETARY BOUNDARY LAYER** (PBL)

Effective aerosol tracking

With their **accurate measurements of aerosol structure**, MPL systems are versatile tools **for air quality forecasting**:

- Track aerosol transport and mixing into surface layers of air.
- Observe plumes from major events such as forest fires, dust storms, and volcanic eruptions.
- Trace gas-phase pollutants via their associated aerosols.

Fast, reliable, high-resolution PBL measurements

Since aerosols accumulate in the PBL—the layer of the atmosphere closest to Earth's surface—MPLs are ideally suited for PBL profiling across applications.

Get a clear forecast

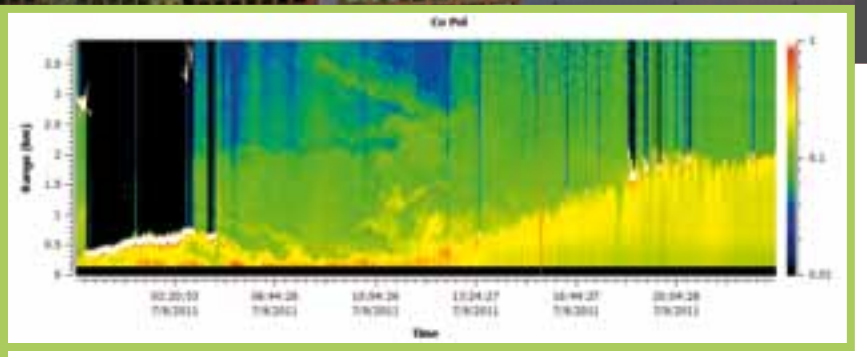
Solar heating of the planet's surface readily warms the air in the PBL—driving the weather. As a result, measuring PBL height and approximate volume **enhances weather prediction models**.

Improve emissions estimates

CO_2 and other greenhouse gases (GHGs) from surface sources collect in the PBL, and PBL height is needed to calculate top-down emissions estimates. Climate scientists can therefore use **PBL data** to **refine GHG inventories.**

Optimize wind energy measurements

PBL height affects the **vertical profile of near-surface wind speeds** and the amount of **energy available for wind turbines**, making PBL measurements useful input to wind power meteorological forecasts for planning and management.



MiniMPL PBL data, NASA DISCOVER-AQ, Edgewood, MD. This NRB time sequence of 30-second averaged profiles shows optically thick low clouds at night, indicated by high backscatter intensity near 0.5–1 kilometers between 0:00–04:00 hours UTC (local time is UTC minus 5). Then the cloud clears to reveal the prior day's residual PBL height with advection and entrainment at PBL top (green signal level near 2 kilometers). Then at 11:00 hours UTC rising daytime PBL is observed as the rising yellow signal level on the right side of the plot. Also detected are turbulent mixing features in the lower morning PBL and dynamics along the rising PBL edge showcasing the MiniMPL's excellent signal-to-noise ratio and sensitivity.

THE **RIGHT TOOL** FOR THE JOB

For PBL measurement, MPL and MiniMPL leave ceilometers in the dust, giving customers

- **Superior signal-to-noise ratio** - enough sensitivity to see PBL top through low cloud decks.
- **Fast, high-resolution reports of PBL structure**—no extended averaging periods or spatial filtering required
- **Reliable PBL measurements** from day to night and from hazy summer months to clear winter conditions

OBSERVE **VOLCANIC ASH**

Measure ash concentration in seconds to maximize aviation safety

In 2010 and 2011, volcanic eruptions in Iceland, Japan, and Chile spread volcanic ash across the globe. Commercial aviation ground to a halt as ash particles threatened aircraft engines. In 2010, lidar networks such as EARLINET were able to observe and characterize the volcanic ash—establishing lidar's utility for determining when planes could safely return to the air.

Leading the industry

Sigma Space first demonstrated MPL's volcanic ash detection capabilities in Japan following the Shinmoedake eruption in January 2011. MPL was again deployed in Argentina in January 2012, following the eruption of the Chilean volcano Puyehue—marking the world's **first operational use of real-time lidar ash data at an airport for aviation safety**.

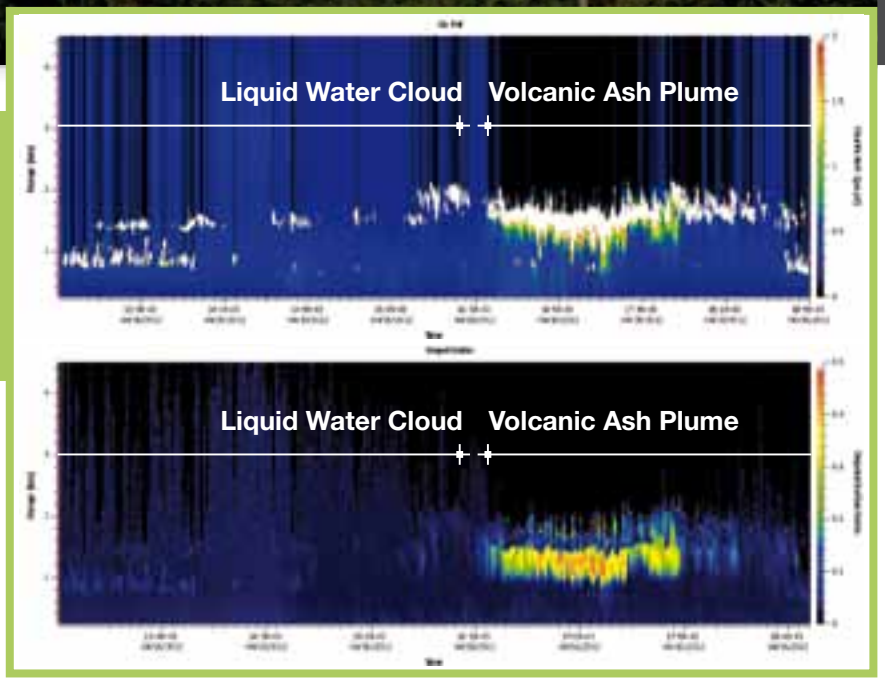
Effective ash detection technology

Clouds and fog contain spherical liquid droplets, which have a low depolarization ratio. **Volcanic ash particles** are asymmetrical, and **have a high depolarization ratio**, which is **readily detected by MPL systems** due their dual polarization channels.

CERTAINTY COUNTS

With so much riding on their decisions, **airports need the best information science and technology can provide**. Combining sensitive volcanic ash detection with continuous, worry-free operation, **MPLs are the clear choice for determining when it's safe to fly**.

VOLCANOES



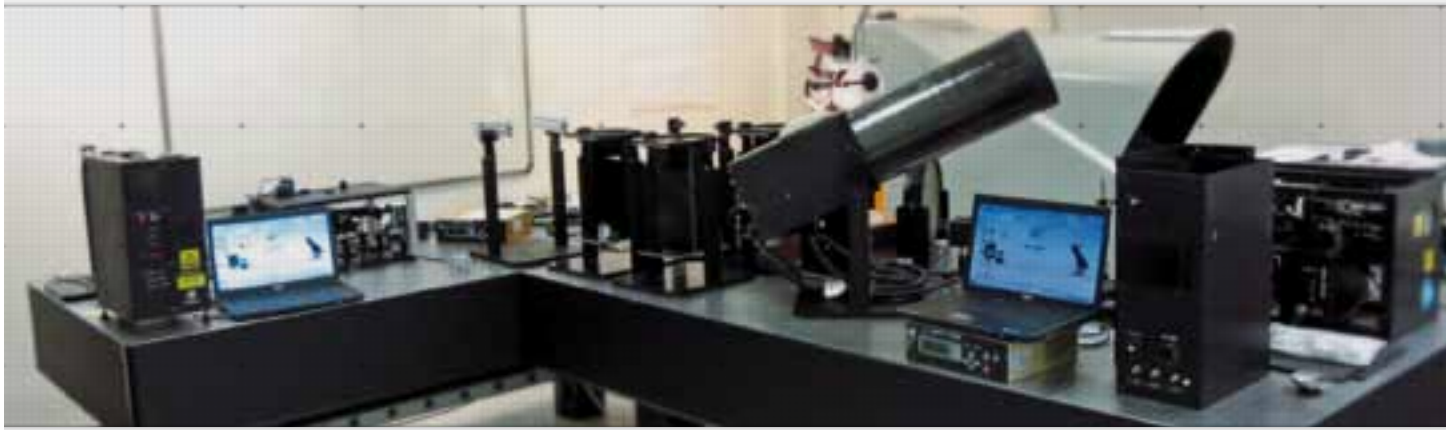
MPL data, Bariloche Airport, Argentina. On the right are two MPL time sequence plots. The top one shows the co-polarized backscatter and the bottom one shows the ratio of the cross- and co-polarized backscatter, known as the depolarization ratio. The large depolarization ratio indicates the presence of volcanic ash (asymmetrical particles)—and gives the vertical distribution of volcanic ash above the airport. These lidar measurements are proportional to the amount of volcanic ash at a given height.

MPL Applications

- Vertical aerosol distribution and trends
- Cloud structure and phase
- Air pollution monitoring
- Plume and dust tracking
- Planetary boundary layer
- Volcanic ash observation

Examples of MPL Customers

- National Aeronautics and Space Agency (NASA), USA
- United States Department of Energy (DOE), USA
- NOAA/National Weather Service, USA
- University of New Hampshire, USA
- Scripps Institution of Oceanography, California, USA
- Naval Research Laboratory, USA
- Universitat Politècnica de Catalunya, Barcelona, Spain
- Instituto Nacional de Técnica Aeroespacial, Madrid, Spain
- China Meteorological Administration, China
- Beijing Meteorological Bureau, China
- Lanzhou University, China
- Hong Kong University of Science and Technology, China
- Indian Space Research Organization (ISRO), India
- National Institute of Polar Research, Tokyo, Japan
- International Civil Aviation Organization



Scan here to learn more

UK Distributors

enviro technology services

info@et.co.uk

Tel: +44 (0) 1453 733200

Registered Office: Kingfisher Business Park, London Road, Stroud, Gloucestershire, GL5 2BY, UK.

Registered in England No. 1726773

www.et.co.uk