Enhanced atmospheric observation capacity of the Seneca III airborne platform

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CNR OGS

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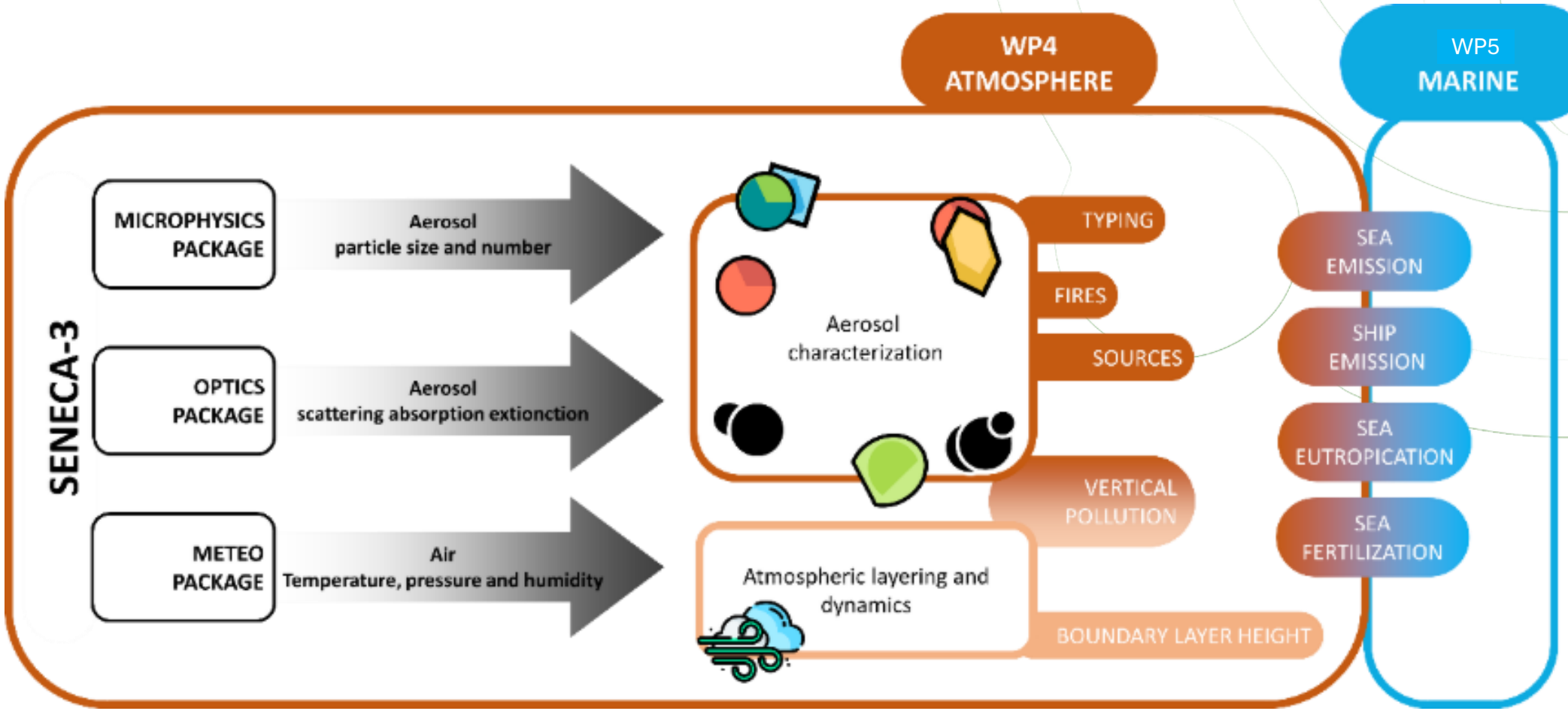
Scientific relevance of airborne observations in the Mediterranean

- **Mediterranean Basin = climate-change hotspot**
  - +1.5 °C vs. pre-industrial (≈ +35 % above global mean rise)
- **Key aerosol classes influencing radiative budget**
  - Mineral dust - Biomass-burning smoke – Marine and biogenic aerosol - Urban/industrial

- **Goal**
  - Understand, quantify, and predict climate impacts of Mediterranean aerosol anomalies
- **Platform**
  - Piper Seneca 3 with advanced aerosol instruments
  - Prior Italian campaigns: limited (balloons, zeppelins, IAGOS transits) → poor temporal coverage
- **Benefits**
  - High-precision in-situ measurements (3D observations)
  - Better knowledge of aerosol properties and their effect on Mediterranean climate
- **Focus**
  - Mid and upper troposphere processes, poorly known and misrepresented in climate models

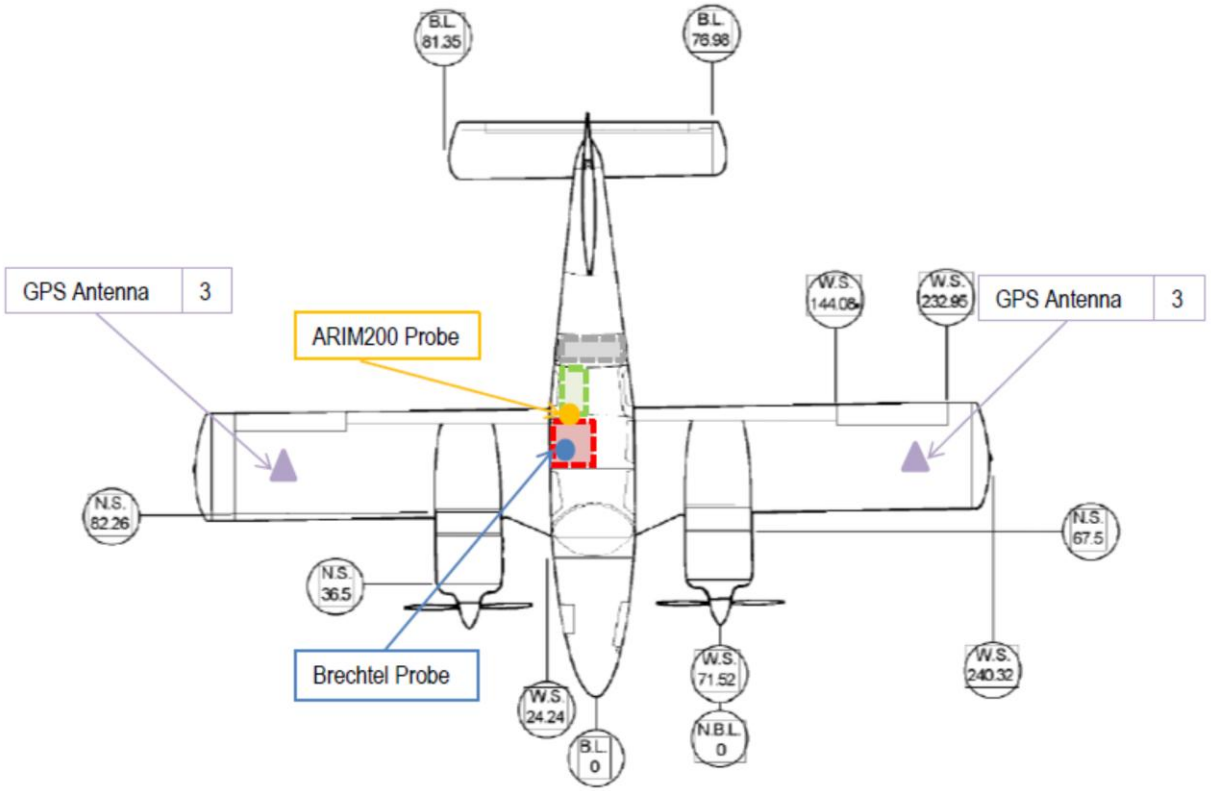
AIRBORNE measurements within ITINERIS



PIPER SENECA III

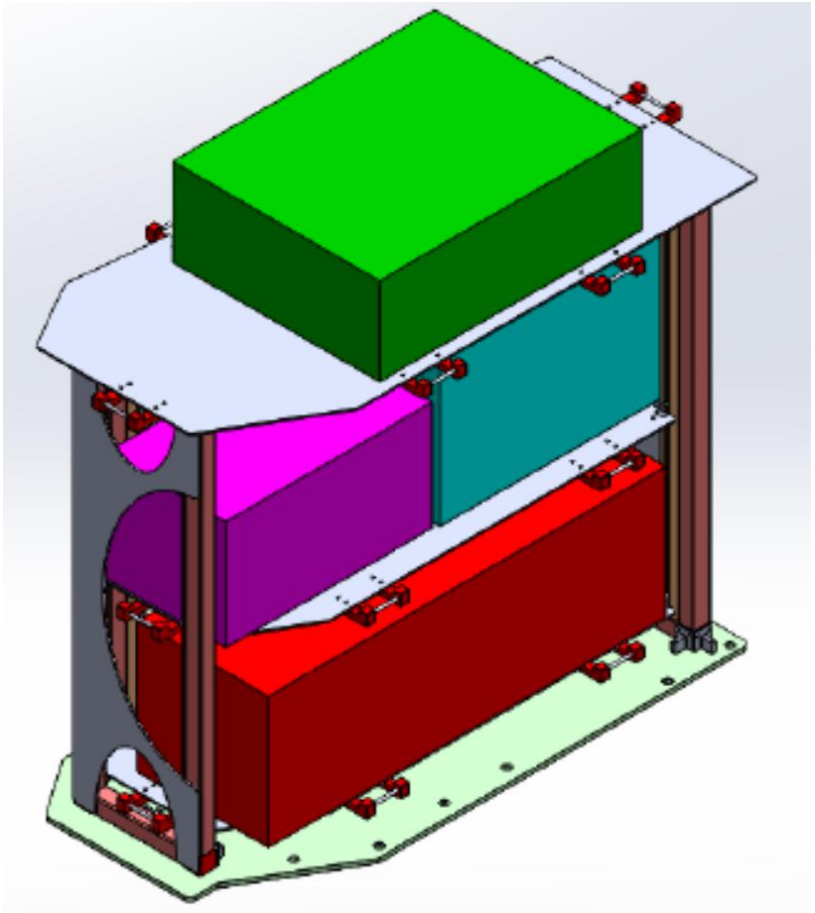
Cruise Speed	*188 kts*
Stall Speed (dirty)	*61 kts*
Gross Weight	*2165 kg*
Empty Weight	*1457 kg*
Range	*870 nmi (1611 Km)*
Service Ceiling	*25000 ft*
Seats	*6*

Sampling System



The Brechtel ISO-1200 isokinetic inlet (delivery due Q4 2024) guarantees representative transmission from < 10 nm to 4 µm across 40–90 m s^{-1} true-air-speed. An ISO-90 bend and SP025 splitter distribute flow to cabin racks.

Instruments



Three aluminum racks, certified for airborne operations, have been installed to host the scientific instrumentation

Meteorological package

Aventech AIMMS-30 probe delivers 50 Hz wind vectors, turbulence, T, P, RH and true air speed, enabling eddy-covariance aerosol flux calculations.

Microphysics package

Instrument	Size/Range	Output
TSI WCPC 3789	2 nm – 3 µm	CN concentration
TSI FMPS 3091	5.6 – 560 nm	1 Hz size dist. (32 bins)
TSI APS 3321	0.5 – 20 µm	PM mass & counts
TOPAS OPC LAP-323	0.25 – 32 µm	Optical size dist.

Optical package

- Magee AE33 aethalometer provides black carbon concentration and wavelength-dependent aerosol absorption coefficient
- Ecotech Aurora 3000 nephelometer obtains the aerosol scattering coefficient at 450/525/635 nm

Combining these two instruments the single-scattering albedo will be calculated.

Ongoing Activities

DELIVERY AND COMMISSIONING TESTS

All tenders have been finalized, all the equipment has been delivered and tested.

CERTIFICATION

The certification pathway has been defined, and an application for Major Change was submitted to EASA in May 2025, paving the way for full approval and flight testing beyond the project's timeframe.

ENHANCING ITALY'S AIRBORNE RESEARCH CAPACITY

- This work represents a substantial step forward in reinforcing Italy's capacity to contribute high-resolution, vertically resolved aerosol observations to the European airborne research infrastructure.
- The observation capacity could be extended to gas and cloud components in the future.
- The collaboration between CNR-ISAC and OGS ensures continuity towards operational deployment and scientific exploitation in international campaigns.

THANKS!

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