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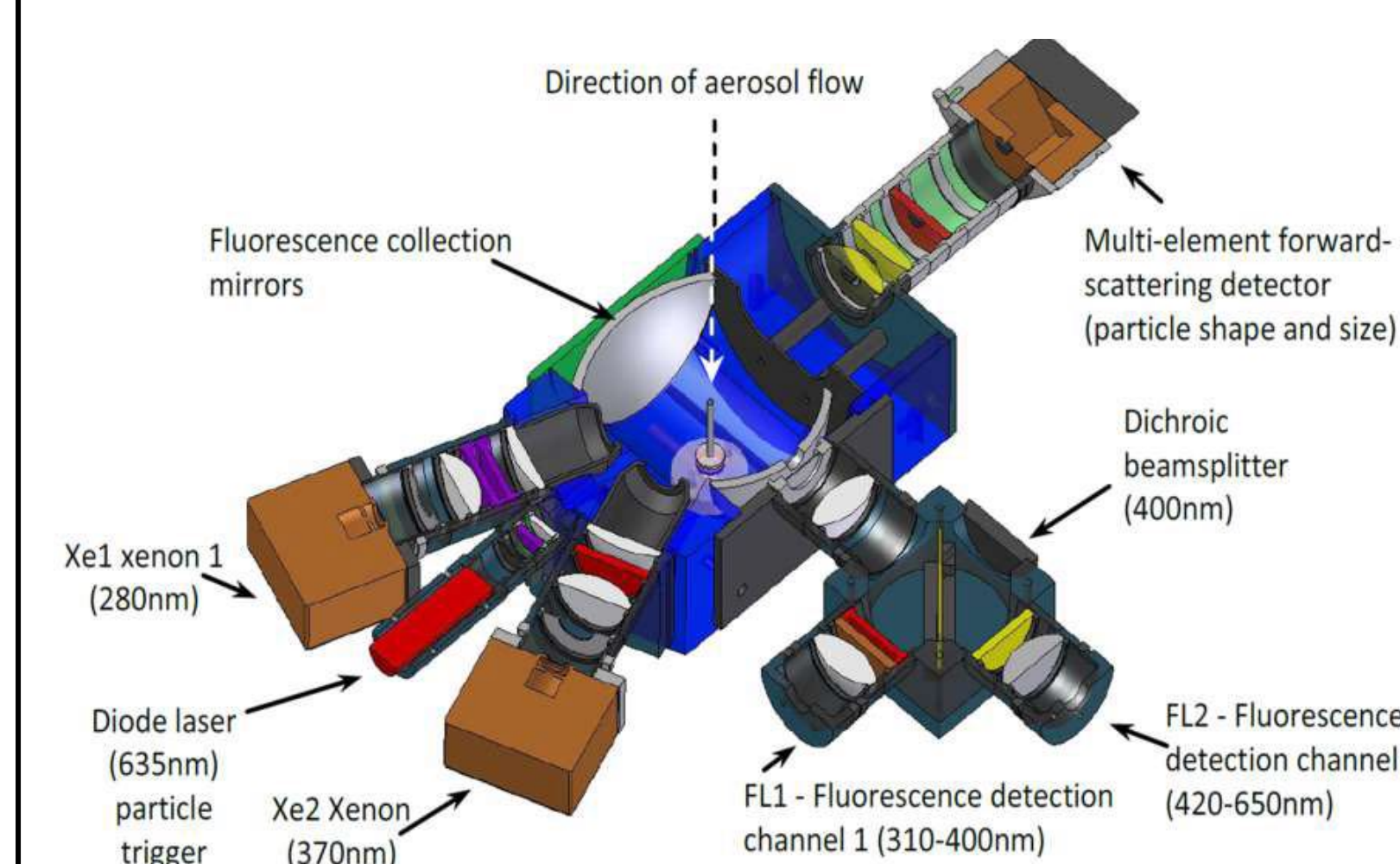
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Introduction

Sea spray aerosol particles originate from bubble bursting at the sea surface, a region that is enriched by biological particles and biogenic compounds. The aerosolization of these compounds might be an important source of ice nucleating particles (INPs) in the remote Southern Ocean (SO) boundary layer. Relatively low INP concentrations might be the reason for the persistence of supercooled liquid clouds observed in the SO. In this presentation we give an overview of the Waveband Integrated Bioaerosol Sensor (WIBS4) data collected during the Measurements of Aerosols, Radiation, and Clouds over the Southern Ocean (MARCUS) project in November 2017 to March 2018. The statistical analysis of the deduced Fluorescent Biological Aerosol Particles (FBAP) number concentrations and size distributions of the SO boundary layer is presented and is compared with results of the INP analysis of concurrently sampled aerosol filters.

Methods

The Waveband Integrated Bioaerosol Sensor Mk. 4 (WIBS4) detects bioaerosol particles based on fluorescence measurements in three excitation/emission wavebands, on a single particle basis.



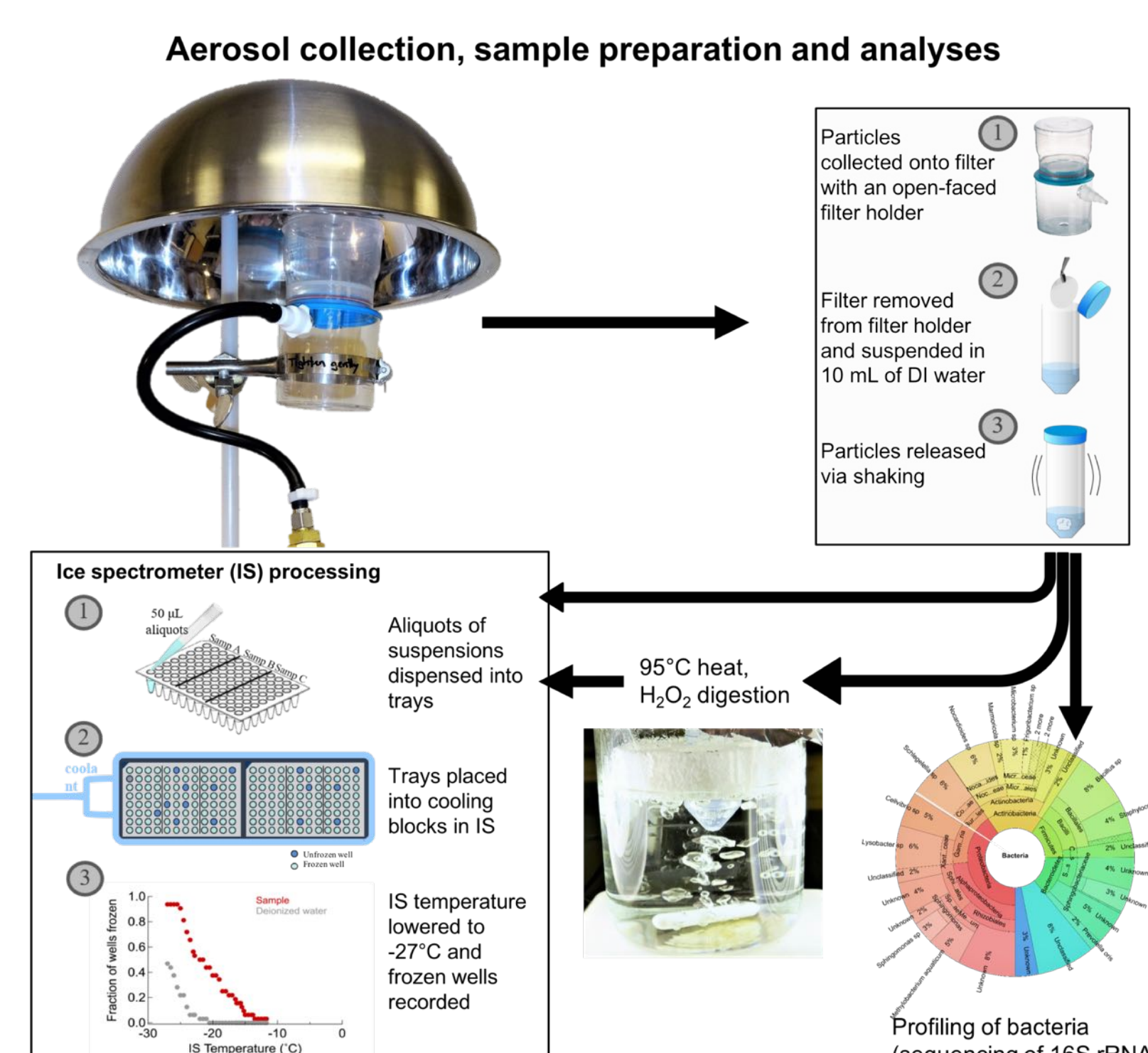
KIT Waveband Integrated Bioaerosol Spectrometer (WIBS4):

- Single particle detection of optical diameter, fluorescence, and shape.
- Fluorescence is measured in three excitation/emission band: F1 ($\lambda_{ex}=280\text{nm}$, $\lambda_{em}=310\text{-}400\text{nm}$), F2 ($\lambda_{ex}=280\text{nm}$, $\lambda_{em}=420\text{-}650\text{nm}$), F3 ($\lambda_{ex}=370\text{nm}$, $\lambda_{em}=420\text{-}650\text{nm}$)
- Biological particle discrimination by combining F1&F3 → Fluorescing Biological Aerosol Particles (FBAP)

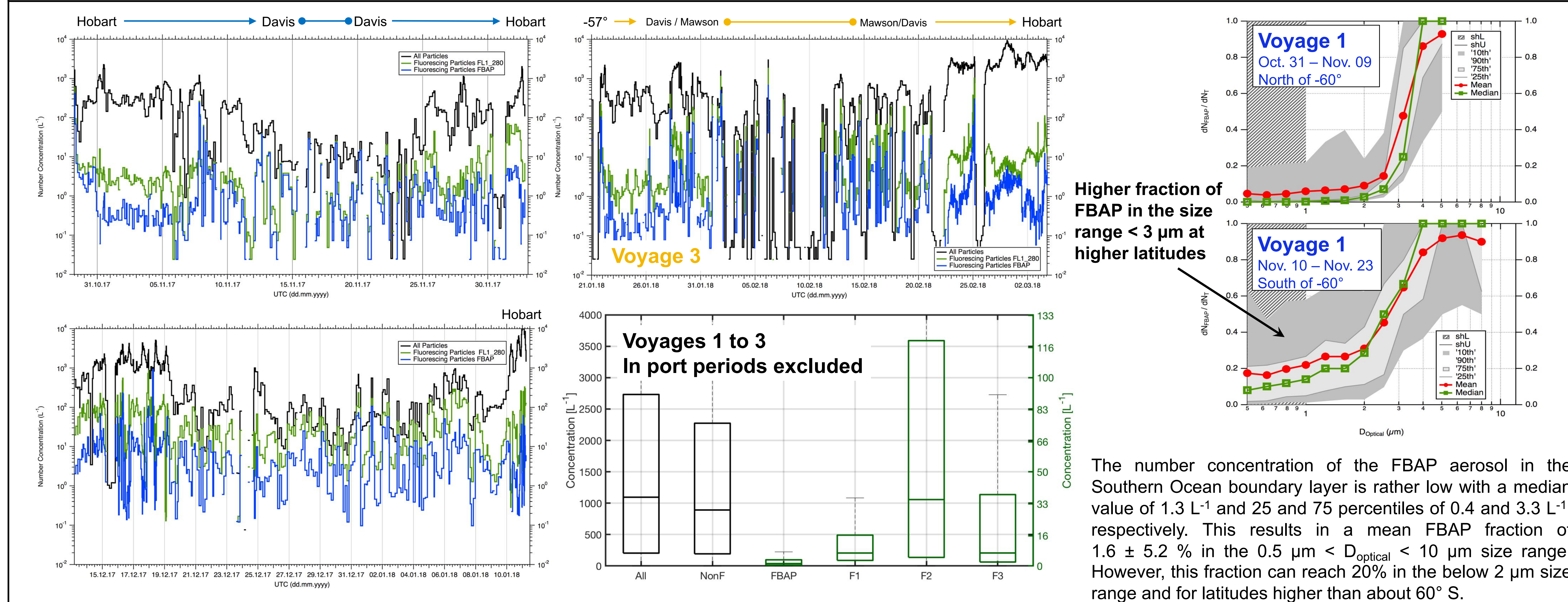
Aerosol particles were collected over 24/48 h periods on filters for off-line preparation and processing with the CSU Ice Spectrometer (IS). INP concentrations were determined in the immersion freezing mode for the -15°C to -27°C temperature range.

CSU Ice Spectrometer:

- Filter collections and particle suspension preparation
- Immersion freezing temperature spectra
- Temperature and H_2O_2 digestion treatments
- DNA sequencing
- Determine contributions of microbial INPs versus mineral/soil dust versus organic INPs



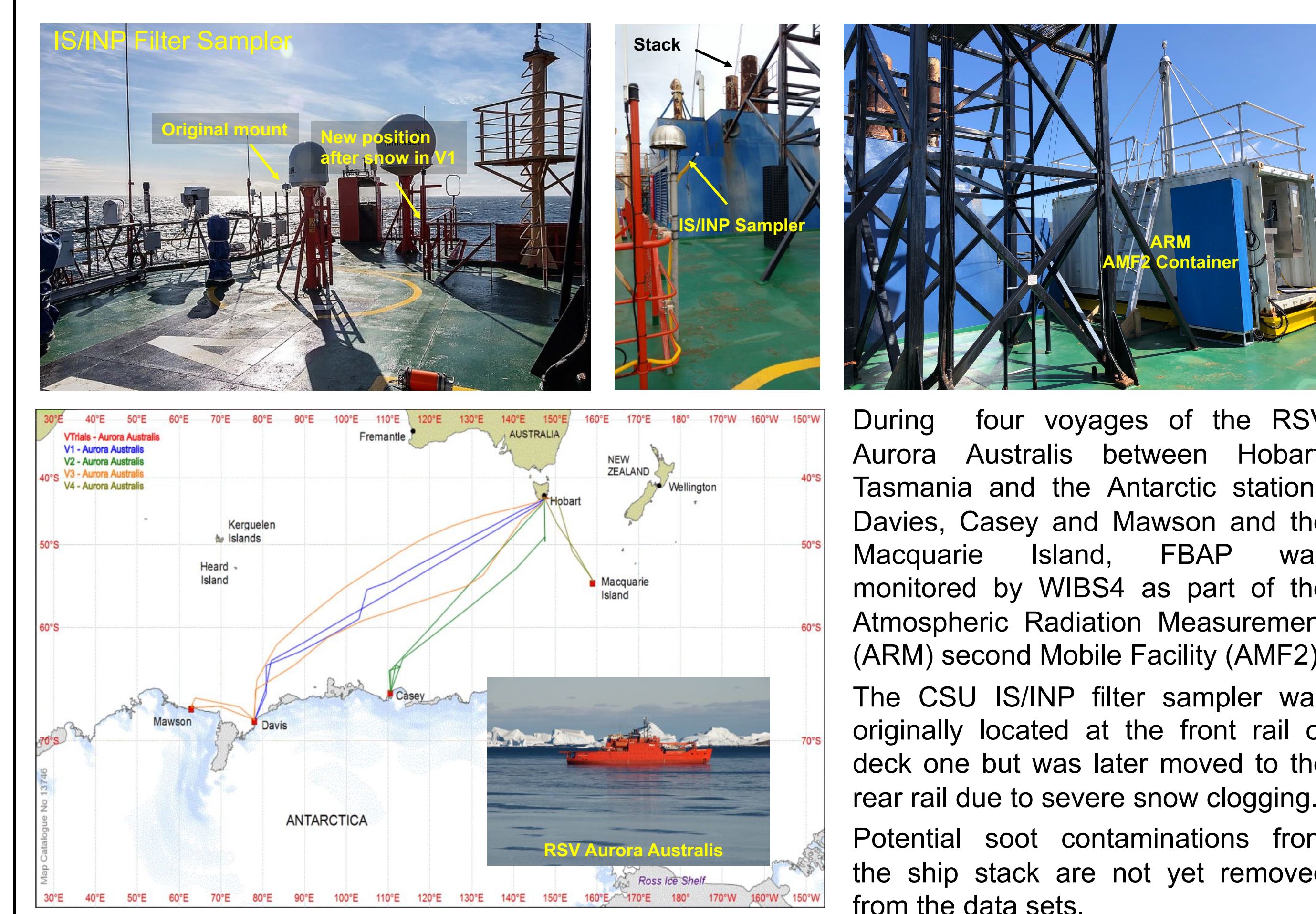
WIBS Total and FBAP Number Concentrations and Number Fractions ($0.5 \mu\text{m} < D_{\text{optical}} < 10 \mu\text{m}$)



Higher fraction of FBAP in the size range $< 3 \mu\text{m}$ at higher latitudes

The number concentration of the FBAP aerosol in the Southern Ocean boundary layer is rather low with a median value of 1.3 L^{-1} and 25 and 75 percentiles of 0.4 and 3.3 L^{-1} , respectively. This results in a mean FBAP fraction of $1.6 \pm 5.2 \%$ in the $0.5 \mu\text{m} < D_{\text{optical}} < 10 \mu\text{m}$ size range. However, this fraction can reach 20% in the below $2 \mu\text{m}$ size range and for latitudes higher than about 60°S .

The MARCUS Field Campaign



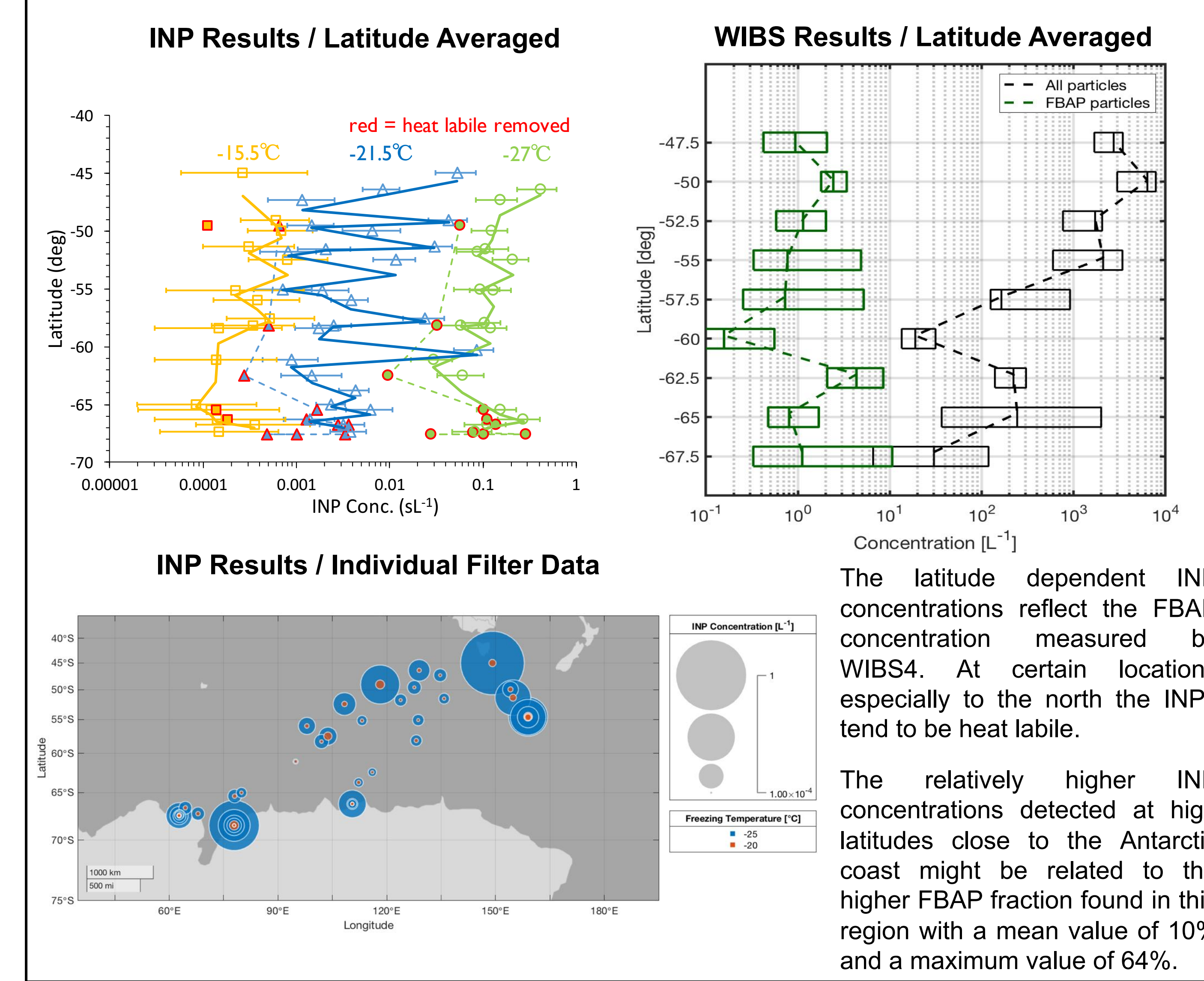
During four voyages of the RSV Aurora Australis between Hobart, Tasmania and the Antarctic stations Davies, Casey and Mawson and the Macquarie Island, FBAP was monitored by WIBS4 as part of the Atmospheric Radiation Measurement (ARM) second Mobile Facility (AMF2). The CSU IS/INP filter sampler was originally located at the front rail of the deck one but was later moved to the rear rail due to severe snow clogging. Potential soot contaminations from the ship stack are not yet removed from the data sets.

Acknowledgements

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Comparison with INP Concentrations



The latitude dependent INP concentrations reflect the FBAP concentration measured by WIBS4. At certain locations especially to the north the INPs tend to be heat labile.

The relatively higher INP concentrations detected at high latitudes close to the Antarctic coast might be related to the higher FBAP fraction found in this region with a mean value of 10% and a maximum value of 64%.