Post-Doctoral Research Associate – Southern Ocean bio-optics and satellite ocean colour (PDRA#1)

Faculty: Science and Engineering
School: Earth and Planetary Sciences
Location: Curtin University, Bentley Campus, Bentley (Perth), WA 6102
Academic Level: A or B, depending on profile
Supervisor: Prof. David Antoine
Co-supervisors: Prof. Pete Strutton and Prof. Philip Boyd (University of Tasmania; UTas)
Start: as soon as practicable, ideally first semester 2022.
Duration: two years

Position summary, overall research questions:
The proposed project aims at further improving our understanding of bio-optical properties and relationships in the Southern Ocean based on field observations, which is needed to subsequently improve interpretation of satellite ocean colour observations in this Ocean. The other aim is to explore new capabilities from the upcoming NASA hyperspectral PACE mission (https://pace.gsfc.nasa.gov). In essence, the goal is to better derive information on phytoplankton biomass and community composition from satellite ocean colour remote sensing in this remote, yet critically important oceanic region, and ultimately assess long-term changes in this critical compartment of the ocean carbon cycle and of marine food webs.

Context:
This position is part of the ARC Australian Centre for Excellence in Antarctic Science (ACEAS), a national-scale, University-led, international centre focused on helping the world community prepare for climate risks emerging from East Antarctica and the Southern Ocean by integrating knowledge of the ocean, atmosphere, cryosphere and ecosystems, and their interplay. ACEAS will grow to support the activities of around 150 researchers, administrative staff, and students, with exciting opportunities to collaborate across disciplinary and institutional boundaries.
The successful candidate will contribute to ACEAS Program 1 — Circum Antarctic and East Antarctica, which addresses the overarching question: "How can shifts in carbon, heat and moisture transport in the Antarctic and Southern Ocean system be better constrained to improve projections of future climate and sea level changes?" with connection to Program 3 – Sub-regional and Regional Antarctic Margin which addresses the overarching question " What is the risk of ice mass loss from key subglacial basins over the next decades to centuries, and what are the consequences for the local oceans and ecosystems?".
Further information on ACEAS is available at http://antarctic.org.au/

The work:
As a PDRA, you can steer the research in a preferred direction, in agreement with your supervisor. We expect the activity to contribute to the following main topics/activities:

- Analyse field bio-optical and biogeochemical data in connection with other field data sets and satellite ocean colour observations, in search of bio-optical relationships.
  - The available field datasets of bio-optical and biogeochemical properties are from the "Antarctic Circumpolar Expedition" (ACE; December 2016 – March 2017; https://spi-ace-expedition.ch) and the SOLACE research voyage (December 2020 / January 2021; lead P. Boyd, Utas). Other field datasets are also accessible through our international network of collaborators, and through publicly available datasets such as the BGC-Argo network. Satellite data sets are all available publicly, e.g., from NASA or ESA archives.
  - The field data sets include radiometry measurements, inherent optical properties (absorption and backscattering), chlorophyll fluorescence, phytoplankton pigments and absorption, cytometry data, particle size distributions, Fast repetition rate fluorescence data, particulate organic carbon.
- Explore the potential of hyperspectral measurements from PACE for mapping of phytoplankton functional groups in the Southern Ocean (field data plus radiative transfer modelling).

The research activity also implies:

- Communicating results through presentations and peer-review publications.
- Interacting with, and possibly contributing to supervision of, a PhD student working under the same project.
- Interacting with your peers within ACEAS.

Selection criteria:

- PhD or equivalent qualification in a relevant area (e.g., satellite ocean colour remote sensing, field bio-optics and biogeochemistry, phytoplankton productivity).
- Evidence of independent research work, including publications in peer-reviewed high-rank scientific journals.
- Excellent skills in processing and analysing field bio-optical data sets and possibly also satellite remote sensing data sets.
- Excellent oral and written communication skills.
- Demonstrated ability to work collaboratively in a research team covering multiple disciplines and achieve collective as well as individual outcomes.
- Demonstrated programming skills in a Unix/Linux environment (e.g., use of shell scripts, Fortran, Python, R or Matlab programming).

Other desirable criteria:

- Knowledge and practice of radiative transfer in the ocean.
- Understanding and analysis of hyperspectral radiometry (field and satellite).
- Willingness and ability to travel interstate and overseas.

PhD Scholarship offer – Long-term changes of phytoplankton in the Southern Ocean (PhD#1)

Faculty: Science and Engineering
School: Earth and Planetary Sciences
Location: Curtin University, Bentley Campus, Bentley (Perth), WA 6102
Supervisor: Prof. David Antoine
Co-supervisors: Prof. Pete Strutton (University of Tasmania, UTas, Hobart) and A/Prof. Alex Sen Gupta (University of New South Wales, UNSW, Sydney)
Start: as soon as practicable, ideally first semester 2022.

Project summary:
The proposed PhD project which is supported by a PhD stipend from Curtin University will use multi-decadal records of satellite observations in search of decadal signals and their connection with Southern Ocean dynamics and large-scale climate drivers (like El Nino/La Nina). Such analyses are necessary to ultimately understand long-term changes in the ecosystem of this key yet remote ocean.
>20-year records of satellite-derived physical parameters (sea-surface temperature, wind speed and sea-surface height) and biological parameters (phytoplankton chlorophyll concentration) are available at the scale of the entire Southern Ocean. These parameters plus outputs of ocean models will be analysed in search of temporal signals and relationships, using statistical and/or machine learning techniques. This information will be used to assess the impact of various scenarios of change in the physical environment on future changes of phytoplankton.
All satellite data sets are publicly available from ESA or NASA archives. Model outputs can be sourced from public data bases and from this project partners.
The activity is part of programs #1 and #3 of the ARC Australian Centre for Excellence in Antarctic Science (ACEAS; see below) which will provide a $5,000 pa top-up scholarship to the selected candidate.

Context:
This PhD project is affiliated with the ARC Australian Centre for Excellence in Antarctic Science (ACEAS), a national-scale, University-led, international centre focused on helping the world community prepare for climate risks emerging from East Antarctica and the Southern Ocean by integrating knowledge of the ocean, atmosphere, cryosphere and ecosystems, and their interplay. ACEAS will grow to support the activities of around 150 researchers, administrative staff, and students, with exciting opportunities to collaborate across disciplinary and institutional boundaries. Further information on ACEAS is available at: https://antarctic.org.au

Selection criteria:
- Honours / Master's degree or equivalent qualification in a relevant area (e.g., satellite ocean colour remote sensing, physical or biogeochemical oceanography, coupled physical-biogeochemical ocean modelling)
- Evidence of emerging independent research work, for example, a thesis with an associated peer-reviewed publication or draft manuscript.
- Excellent skills in processing and analysing satellite remote sensing data sets
- Experience in machine learning techniques
- Excellent oral and written communication skills
- Demonstrated programming skills in a Unix/Linux environment (e.g., use of shell scripts, Fortran, Python, R or Matlab programming)
- Some evidence of capability to collaboratively work within a research team

Other desirable criteria:
- Willingness and ability to travel interstate and overseas.

Post-Doctoral Research Associate – Indian Ocean bio-optics and satellite ocean colour (PDRA#2)

Faculty: Science and Engineering
School: Earth and Planetary Sciences
Location: Curtin University, Bentley Campus, Bentley (Perth), WA 6102
Supervisor: Prof. David Antoine
Start: as soon as practicable, ideally first semester 2022.

The Remote Sensing and Satellite Research Group (RSSRG) of Curtin University, Perth, Western Australia, invites applicants for a Post-doctoral Research Associate (PDRA) position in bio-optics and satellite ocean colour remote sensing.

The project: this PDRA position is supported by a new ARC-funded "discovery project" that the RSSRG has been awarded (project lead: Prof David Antoine). The project is called "Why ocean deserts matter: Phytoplankton carbon and productivity in oligotrophic waters of the Indian Ocean". The general goal of the project is to reassess the contribution of ocean deserts to the global carbon budget, through better quantification of phytoplankton carbon biomass and associated productivity from satellite ocean colour observations, focusing on the Indian Ocean, which is among the least sampled and therefore least understood regions of the World Ocean.

The project is essentially based on analysis of a data set that was collected in 2019 during a multidisciplinary 1-month research voyage in the Eastern Indian Ocean (http://rssrg.org/our-research/the-110e-line-research.html), and which includes inherent and apparent optical properties (IOPs and AOPs), phytoplankton pigments, primary productivity and a number of other parameters describing the phytoplankton population.

One objective is to investigate relationships among IOPs, AOPs, chlorophyll, phytoplankton carbon, particulate organic carbon, and information on particle characteristics to improve retrieval of phytoplankton carbon from satellite ocean colour (this part of the project is in collaboration with Prof Michael Behrenfeld, OSU). Another objective is to improve modelling of the optical particulate backscattering from phytoplankton and particle state variables in a coupled physical-biogeochemical model (this part of the project is in collaboration with Dr Mark Baird, CSIRO).

Specifically, the PDRA would work on the relationships between particle characteristics (e.g., concentrations and types of particles, size distributions, pigments), optical properties, and measures of phytoplankton carbon and productivity. Under the guidance of the project lead and collaborators, the PDRA will progressively gain intellectual ownership of the research and freedom to adjust its direction.

Expected qualifications: Candidates must have completed a PhD in a discipline sufficiently close to what this project is addressing. Strong expertise in marine bio-optics and satellite ocean colour (OCR) is essential. Proficiency in geophysical data processing (in-situ and satellite) is also essential, as well as experience in the development of algorithms for the retrieval of water properties from OCR. Experience with field bio-optics can be a significant advantage.

Start date: As soon as practicable for the applicant and, in case the applicant is from outside Australia, in accordance with the Covid19 pandemic situation and associated regulations that the Australian Government has put in place for visitors from abroad.

Duration: 2.5 years

7th December 2021

PhD Scholarship offer –
Phytoplankton Primary Productivity in the Indian Ocean (PhD#2)

Faculty: Science and Engineering
School: Earth and Planetary Sciences
Location: Curtin University, Bentley Campus, Bentley (Perth), WA 6102
Supervisor: Prof. David Antoine
Start: as soon as practicable, ideally first semester 2022.

Context:
The scholarship is provided by Curtin University in support to an Australian Research Council (ARC) "discovery project" that Prof David Antoine has been awarded. The project is called "*Why ocean deserts matter: Phytoplankton carbon and productivity in oligotrophic waters of the Indian Ocean*". The general goal of the project is to reassess the contribution of ocean deserts to the global carbon budget, through better quantification of phytoplankton carbon biomass and associated productivity from satellite ocean colour observations, focusing on the Indian Ocean, which is among the least sampled and therefore least understood regions of the World Ocean.
Collaborators on this project are Prof Michael Behrenfeld (Oregon State University) and Dr Mark Baird (CSIRO, Hobart).
The project will analyse a data set that we collected in 2019 during a multidisciplinary 1-month research voyage in the Eastern Indian Ocean (http://rssrg.org/our-research/the-110e-line-research.html), and which includes inherent and apparent optical properties (IOPs and AOPs), phytoplankton pigments, primary productivity and several other parameters describing the phytoplankton population.

Project summary:
The project will derive phytoplankton primary production (NPP) from satellite primary productivity models of different kinds and compare these estimates to field determinations and outputs of a coupled Biogeochemical (BGC) model. The aims are to:
1- evaluate NPP from various "satellite primary productivity models" (Chl-, absorption- and Carbon-based) using field NPP determinations and outputs of the BGC model,
2- Apply such models to the entire Indian Ocean using historical and current satellite observations to propose renewed estimates of the dynamics of phytoplankton biomass and NPP in this key ocean, and
3- Combine these NPP estimates to the voyage data to investigate the export to NPP ratio.
The parameters of the Production (P) vs. Irradiance (E) curve (initial slope and maximum rate) were determined during the voyage from P vs. E short-term incubation experiments. These parameters, combined to phytoplankton pigments, IOPs and AOPs will provide all information that chl-, absorption-, or carbon-based satellite models use (e.g., the Morel and Antoine JGR1996 model, the Vertically Generalised Production Model (VGPM), the Carbon-Based Production Model (CBPM), and the Carbon, Absorption, and Fluorescence Euphotic-resolving (CAFE) model). The CSIRO optical-biogeochemical model also provides estimates of primary production and remote-sensing reflectance. Thus the same comparison of field observations and remotely-sensed NPP can be undertaken with the model. Export estimates from the voyage measurements will be compared to in-situ and satellite NPP estimates to determine the efficiency of the biological carbon pump.
From these comparisons, we expect to learn about uncertainties in the different approaches in the specific case of oligo- to mesotrophic environments. This would be also the preliminary step before selecting the most appropriate model(s) to be applied at the scale of the Indian Ocean.

Selection criteria:
- Honours / Master's degree or equivalent qualification in a relevant area (e.g., satellite ocean colour remote sensing, modelling of phytoplankton primary productivity, physical or biogeochemical oceanography, coupled physical-biogeochemical ocean modelling)
- Evidence of emerging independent research work, for example, a thesis with an associated peer-reviewed publication or draft manuscript.
- Excellent skills in processing and analysing satellite remote sensing data sets
- Excellent oral and written communication skills
- Demonstrated programming skills in a Unix/Linux environment (e.g., use of shell scripts, Fortran, Python, R or Matlab programming)
- Some evidence of capability to collaboratively work within a research team

Other desirable criteria:

- Willingness and ability to travel interstate and overseas.