

# SOOS

SOUTHERN OCEAN OBSERVING SYSTEM

## **PLANNING WORKSHOP:**

# **IMPLEMENTATION OF A SOUTHERN OCEAN OBSERVING SYSTEM**

10 - 12 June 2015

Institute for Marine and Antarctic Studies,  
University of Tasmania Waterfront Building  
20 Castray Esplanade  
Hobart, Tasmania, Australia

# WORKSHOP SPONSORS

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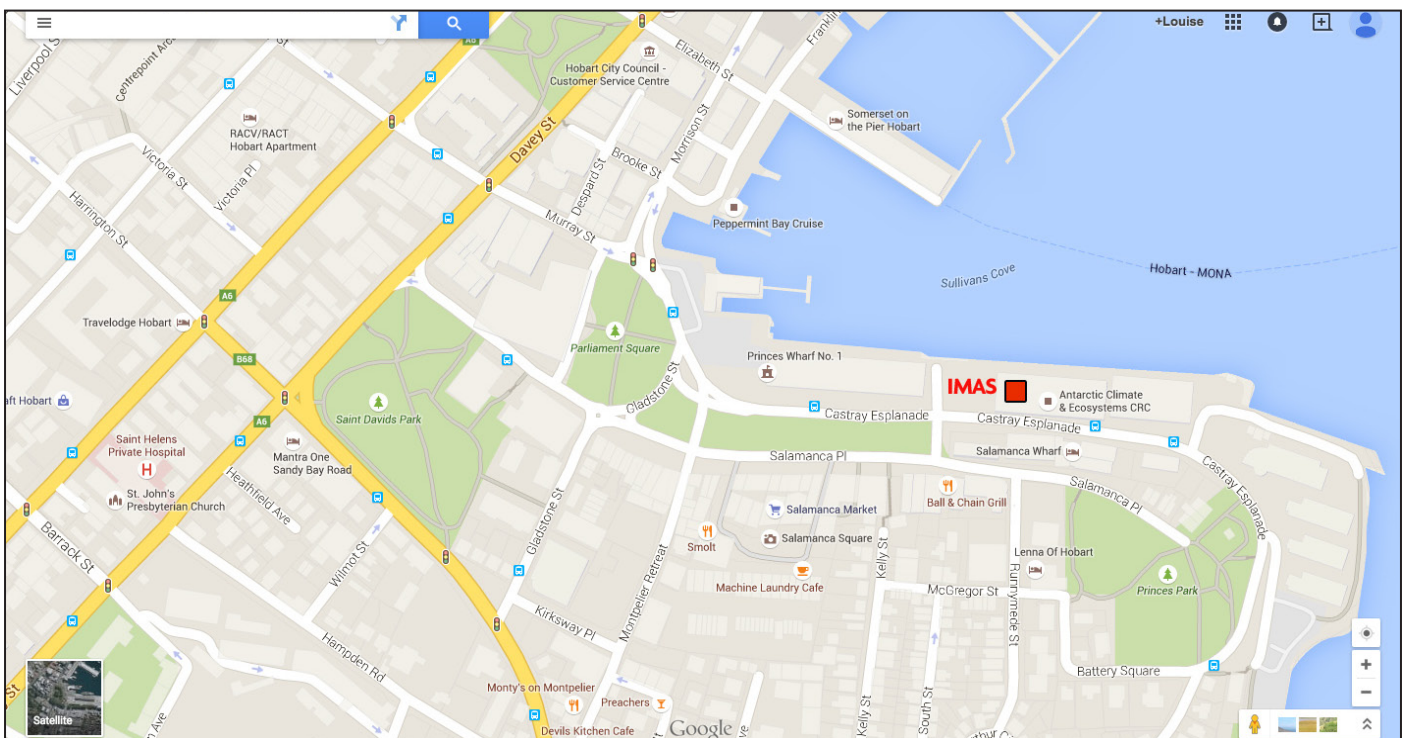
## Information for Arrival in Hobart Airport

Hobart airport is about 15km from the city centre and is serviced by taxi, shuttle bus ([www.airporter-hobart.com.au/](http://www.airporter-hobart.com.au/)), bus ([www.tasredline.com.au/index.php/airport-shuttles/](http://www.tasredline.com.au/index.php/airport-shuttles/)), or you can hire (<http://hobartairport.com.au/to-from/car-rentals/>) a vehicle from there. The taxi fare to the city is approximately Au\$55. Shuttle buses provide door-to-door service (Hobart city) for a fare of AU\$ 17(ow)/30(rt), and are timed to connect with all incoming and outgoing flights. Pre-bookings are not required for taxis or buses.

If driving in Hobart, please remember to drive on the left hand side of the road, and to drive in a clockwise direction around roundabouts.

## Venue

The workshop is being hosted by the Institute for Marine and Antarctic Studies at the University of Tasmania's Waterfront Building (20 Castray Esplanade, Battery Point). The Workshop will take place on the ground floor in the Aurora Lecture Theatre. All morning and afternoon teas, and lunches are provided.



# WORKSHOP PROGRAM

## WEDNESDAY 10<sup>TH</sup> JUNE

17:30 - 19:00	Public Forum <i>Convenor: Oscar Schofield</i>	IMAS Aurora Theatrette
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17:00	<b>Registration (IMAS Foyer)</b>
17:30 - 17:40	<b>Welcome</b> <i>His Excellency The Hon. Sir Guy Green (AC, KBE, CVO, Australia)</i>
17:40 - 17:45	<b>Welcome from the Hobart Antarctic Community</b> <i>John Brennan (Chair, Tasmanian Polar Network)</i>
17:45 - 18:00	<b>The Southern Ocean Observing System</b> <i>SOOS Co-Chair Prof. Anna Wahlin (Uni Gothenburg, Sweden)</i>
18:00 - 18:15	<b>Assessing ecosystem change in the Southern Ocean</b> <i>Dr. Jessica Melbourne-Thomas (ACE-CRC, Australia)</i>
18:15 - 18:30	<b>Observing the impact of the ocean on the Antarctic Ice Sheet</b> <i>Dr. Keith Nicholls (British Antarctic Survey, UK)</i>
18:30 - 18:45	<b>Five years of KOPRI Amundsen Project - what we found and where to go</b> <i>Dr. SangHoon Lee (Korean Polar Research Institute, Korea)</i>
18:45 - 19:00	<b>Observing new time and space scales using fleets of ocean gliders</b> <i>Dr. Sebastiaan Swart (CSIR, South Africa)</i>

19:00 - 20:30	Welcome Reception	IMAS Foyer
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19:00 - 20:30	Welcome drinks and finger food
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## THURSDAY 11<sup>TH</sup> JUNE

08:30 - 10:30	Session 1: SOOS <i>Convenor: Oscar Schofield</i>	IMAS Aurora Theatrette
08:30	<b>Registration</b>	
09:00 - 09:30	<b>IMAS, Antarctic Gateway and SOOS: Welcome presentation</b> <i>Dr. Richard Coleman (IMAS, Australia)</i>	
09:30 - 10:30	<b>The SOOS 5-Year Strategic Plan and role of Regional Working Groups</b> <i>Prof. Anna Wahlin (Uni Gothenburg, Sweden)</i>	
10:30 - 11:00	Morning Tea	
11:00 - 12:30	Session 2: Essential Ocean Variables <i>Convenor: Anna Wahlin</i>	IMAS Aurora Theatrette
11:00 - 11:30	<b>Southern Ocean Essential Variables: Candidates and the way forward</b> <i>Dr. Sebastiaan Swart (CSIR, South Africa)</i>	
11:30 - 12:00	<b>Developing and evaluating ecosystem Essential Ocean Variables</b> <i>Dr. Andrew Constable (AAD, Australia)</i>	
11:00 - 12:30	<b>Prioritising sampling requirements for Essential Variables</b> <i>Dr. Matthew Mazloff (Scripps, USA)</i>	
12:30 - 13:30	Lunch	
13:30 - 15:00	Session 3: Enhancing Capabilities <i>Convenor: Sebastiaan Swart</i>	IMAS Aurora Theatrette
13:30 - 14:00	<b>Primary field capabilities: current and imminent</b> <i>Prof. Oscar Schofield</i>	
13:30 - 14:00	<b>A focus on new Circumpolar activities:</b> <b>1) Southern Ocean Carbon and Climate Observations and Modeling</b> <i>Dr. Joellen Russell (Uni Arizona, USA)</i> <b>2) Network for collection of knowledge on melt of Antarctic Ice Shelves</b> <i>Dr. Keith Nicholls (BAS, UK)</i> <b>3) Status and outlook for ice-capable Argo in the Southern Ocean</b> <i>Dr. Susan Wijffels (CSIRO, Australia)</i>	
14:00 - 14:30	<b>Preserving the States of the Southern Ocean for the next Generation</b> <i>Steve Diggs (CCHDO, USA)</i>	
14:30 - 15:00	Afternoon Tea	
15:00 - 16:30	Session 4: Regional Working Groups <i>Convenor: Andrew Constable</i>	IMAS Aurora Theatrette
15:00 - 16:30	<b>Discussion: Development of Regional Working Groups</b>	

## FRIDAY 12<sup>TH</sup> JUNE

09:00 - 17:00	Session 5: Working Group Development <i>Convenor: Anna Wahlin, Oscar Schofield</i>	IMAS Aurora Theatrette
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09:00 - 09:30	<b>Recap of Working Group discusson</b>
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*Anna Wahlin*

09:30 - 10:30	<b>Working Group breakout session: Membership, terms of reference, capabilities, existing/planned activities, priority observation gaps</b>
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*Oscar Schofield*

10:30 -11:00	Morning Tea
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11:00 - 12:30	<b>Working Group breakout session...</b> <i>continued</i>
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12:30 -13:30	Lunch
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13:30 - 14:30	<b>Plenary discussion on Working Group progress</b>
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*Andrew Constable*

14:30 - 15:30	<b>Flagship Field Projects: Plenary and breakout</b>
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*Oscar Schofield*

15:30 -16:00	Afternoon Tea
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16:00 - 16:30	<b>Flagship Field Projects: Summary</b>
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*Oscar Schofield*

16:30 - 17:00	<b>Future plans, close of workshop</b>
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*Anna Wahlin*



# ABSTRACTS

## PUBLIC FORUM

### **The Southern Ocean Observing System**

*SOOS Co-Chair Prof. Anna Wahlin (Uni Gothenburg, Sweden)*

The Southern Ocean is one of Earth's key climatological hot spots. A major part of the deep water in all the world's oceans is formed here, and the coastal regions of Antarctica are outlets for glaciers that originate in the Antarctic Ice Sheet, containing about 85% of the ice on Earth. The Southern Ocean is changing; it is warming more rapidly, and to greater depth, than the global ocean average. The floating glaciers along the coast are melting at an accelerating rate and the upper layers have freshened while widespread warming of the Antarctic Bottom Water has been observed. Sea-ice extent is showing strong regional trends, and the uptake of CO<sub>2</sub> by the ocean is changing the chemical balance, with unknown impacts on the food web. Improved understanding of the links between Southern Ocean processes, global climate, biogeochemical cycles and marine productivity is needed to inform an effective response to the challenges of climate change, sea-level rise, ocean acidification and the sustainable use of marine resources. To achieve this enhanced understanding, sustained multi-disciplinary observations are essential. SOOS is an international initiative that aims to facilitate the collection and delivery of essential observations on variability and change of Southern Ocean systems to all international stakeholders, through design, advocacy, and implementation of cost-effective observing and data delivery systems. This presentation will provide an overview of SOOS objectives of the next 5 years.

### **Assessing ecosystem change in the Southern Ocean**

*Dr. Jessica Melbourne-Thomas (ACE-CRC, Australia)*

Southern Ocean ecosystems are significant on a global scale. They support biogeochemical cycling and carbon uptake, as well as important fisheries for Antarctic krill and finfish. These ecosystems are changing and will continue to change in the future as climate change and ocean acidification modify ocean habitats. An important challenge is to provide robust assessments of ecosystem change to support effective and timely management responses. This presentation provides an overview of current work at the Antarctic Climate & Ecosystems CRC and the Australian Antarctic Division to assess the past, current and potential future ecosystem states in the Indian Sector of the Southern Ocean. This research will contribute to the design of a cost-effective observing system to detect and attribute ecosystem change.

### **Observing the impact of the ocean on the Antarctic Ice Sheet**

*Dr. Keith Nicholls (British Antarctic Survey, UK)*

Ice drains from the Antarctic Ice Sheet, via fast-flowing ice streams, into floating ice shelves that both melt at their base and calve icebergs into the ocean. We now know that reducing the extent of ice shelves causes ice streams to accelerate and drain more ice into the ocean, thereby raising sea level. To predict how ice shelves will respond to changes in ocean climate we need to run numerical models, which themselves need observations to improve and to validate them. An excellent diagnostic for such models is the rate at which ice shelves are melting at their base. An even better one is how the rate of ice-shelf melting changes in response to the ocean's seasonality. I will discuss evidence of recent change in Antarctic ice shelves, the challenge of making the measurements necessary for prediction of future change, and a SOOS-endorsed programme, NECKLACE, to meet that challenge using a circumpolar network of novel ice-sounding radars.

## **Five years of KOPRI Amundsen Project - what we found and where to go**

*Dr. SangHoon Lee (Korean Polar Research Institute, Korea)*

The Western Antarctic draws our special attention in recent years, because of the rapid temperature rise. The Amundsen Sea is located at the center of the region, experiencing a record-high loss of ice. KOPRI Amundsen Project is to understand why and how the Western Antarctic warms up, and how the ecosystem and biogeochemical cycles react. Diverse groups for interdisciplinary research from domestic universities as well as foreign organizations participate the program. We have conducted three field expeditions since 2010, and anticipate the 4th in the 2015/2016 season. We plan to expand the study area to the Antarctic Circumpolar Current area to north, and deeper into southwestern corner of the Amundsen Sea, with the reinforcement from international collaborators. This project is the very first and model case of KOPRI's commitment to the Earth observatory international network for long-term monitoring in the Southern Ocean. Included in the presentation is a sampler of the major scientific findings and the future directions.

## **Observing new time and space scales using fleets of ocean gliders: An overview of the Southern Ocean Seasonal Cycle Experiments**

*Dr. Sebastiaan Swart (CSIR, South Africa)*

The Southern Ocean is a region rich in terms of fine scale and high frequency dynamics of the surface ocean as well as the enhanced forcing of the atmosphere (storms) on the upper ocean. The current observational challenge therefore lies in resolving both seasonal to sub-seasonal temporal scales in parallel with fine scale (submesoscale) dynamical processes occurring between the atmospheric and oceanic domains. Recent Sub-Antarctic seasonal-scale (~6 month) profiling and surface wave glider deployments are uncovering the dominant space and time scale variability in both upper ocean physics and biogeochemistry. Resolving these scales are crucial to understanding the sensitivity of the Southern Ocean to climate change

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## **IMPLEMENTATION WORKSHOP**

### **Antarctic Gateway Partnership – Opportunities for SOOS**

*Dr. Richard Coleman (IMAS, Australia)*

The Australian Research Council (ARC) has provided \$24M over 3 years (2015-17) for a new research initiative to facilitate scientific collaboration between the University of Tasmania (UTAS), CSIRO and the Australian Antarctic Division (AAD) through the ARC's Special Research Initiatives (SRI) scheme. The ARC SRI will increase the capacity for collaborative research across a variety of projects covering the physical, chemical, atmospheric, cryospheric and biosciences. The Gateway Partnership will allow better remote sensing and mapping capabilities, and improve international partnerships which provide observations of land, sea and ice in the Antarctic. SOOS provides an excellent platform to coordinate some of these research activities.



## **SOOS Implementation: The 5-Year Strategic Plan and role of Regional Working Groups**

*Prof. Anna Wahlin (Uni Gothenburg, Sweden)*

SOOS recently developed the 5-Year Strategic plan to better articulate the activities and products required for us to achieve our vision of facilitating sustained delivery of observations on dynamics and change of the Southern Ocean system. This presentation will give an overview of the Strategic Plan, and outline the implementation structure that has been developed to enhance capabilities and collaborative effort.

## **Essential Ocean Variables for the Southern Ocean: Candidates and the way forward**

*Dr. Sebastiaan Swart (CSIR, South Africa)*

A key objective of SOOS is the design of a multidisciplinary and sustainable observing system. Given the scale of the Southern Ocean, and the costs and logistical demands associated with making observations, we simply cannot observe all parameters. We need to select those parameters, or Essential Ocean Variables (EOVs) that will provide us with the information needed to detect, track and attribute (either directly or using models) change in the physical, biogeochemical and biological systems of the Southern Ocean. Identification of the EOVs required to provide this information is a difficult task, and must also take into account the feasibility of observing each EOV, and the technology or observing platform required to take the measurement. The Integrated Framework for Sustained Ocean Observing has developed a process through which candidate EOVs can be prioritised, using a “Stages of Readiness” concept. A number of communities have already utilised the framework to develop EOVs for global ocean climate, biogeochemistry and biology. This presentation will provide an overview of the global Framework, highlight some key examples of EOVs developed by other communities, and will then look at the work ahead of us, the SOOS community, in defining EOVs for the Southern Ocean.

## **Developing and evaluating ecosystem Essential Ocean Variables**

*Dr. Andrew Constable (AAD, Australia)*

Recent discussions in the IPCC and the Antarctic Treaty System have shown the great importance to policy makers for measuring change in Southern Ocean ecosystems but that there are many gaps in our current knowledge. A capability for measuring dynamics and change in these ecosystems is being developed in Theme 6 of the Southern Ocean Observing System. This talk will describe the significant progress being made by the Southern Ocean ecological community in identifying important ecosystem variables required for underpinning science and management; these variables are known as ecosystem Essential Ocean Variables from the Framework for Ocean Observing. It will detail the process for identifying candidate variables and show how modelling and field work will be used to make choices as to which variables need to be monitored routinely and how often and where they need to be monitored for being most effective.

## **Prioritising sampling requirements for Essential Southern Ocean Variables**

*Dr. Matthew Mazloff (Scripps, USA)*

SOOS is aiming to develop an observing system that provides the base-level information required to address scientific and societal challenges. The first step is to develop a list of candidates for Essential Ocean Variables (EOVs). Then we must prioritize the sampling strategies for these EOVs. Priority is informed through analysis of the spatiotemporal correlation and cross correlation of EOVs. This talk will focus on how the existing observational infrastructure must be augmented to reach the SOOS goal.

## **Dawn in the age of robotic oceanography**

*Prof. Oscar Schofield (Rutgers Uni, USA)*

Improving our understanding of the ocean is essential, as many observations suggest significant change is occurring. These changes reflect both natural cycles and, increasingly, human activity. Regional and global scale changes include altered physical (temperature, salinity, sea level height), chemical (oxygen, pH, nutrients) and biological properties (fishing). Oceanographers have historically collected data from ships during cruises of limited duration. The next revolution in oceanographic sampling was the advent of satellite oceanography, which now routinely provides estimates of surface temperature, salinity, sea surface height, salinity and phytoplankton biomass. While powerful, these approaches are incapable of probing the ocean interior. Filling in our understanding of the ocean interior is now being met with ocean moorings, autonomous profilers, propeller-driven and buoyancy-driven robots. These growing networks of distributed sensors are now providing three-dimensional views of the ocean over time. These networks are increasingly being used to inform numerical models to provide accurate synoptic realisations of the physics, chemistry, and biology of the ocean. This talk will review this evolution and look forward at the new mode of doing oceanography.

## **The Southern Ocean Carbon and Climate Observations and Modeling Program (SOCCOM): Plans and Progress**

*Dr. Joellen Russell (Uni Arizona, USA)*

SOCCOM is a new 6-year observational and modeling research program focused on the role of the Southern Ocean in the anthropogenic carbon budget, ocean biogeochemistry, and climate change. The operational goal of SOCCOM is to deploy nearly 200 Argo-compatible biogeochemical (BGC) profiling floats equipped with pH, oxygen, nitrate and bio-optical sensors throughout the Southern Ocean waters south of 30°S. These climate-ready BGC-floats are calibrated at the time of deployment by high accuracy biogeochemical measurements, and they will operate year around, including in ice-covered waters. The data from the BGC-floats will be assimilated by a Southern Ocean State Estimate (SOSE) model that incorporates biogeochemical processes, and then this gridded SOSE output will be used to constrain high-resolution coupled atmosphere-ocean model simulations designed to both increase our understanding of Southern Ocean processes and to reduce the uncertainty of projections of the future trajectory of the Earth's carbon, climate and biogeochemistry

## **NECKLACE: Progress, plans and processes**

*Dr. Keith Nicholls (BAS, UK)*

NECKLACE (NEtwork for the Collection of Knowledge on meLting of Antarctic iCe shelves) is a SOOS-endorsed programme to install instruments on all major (and many minor) Antarctic ice shelves to acquire time-series observations of ocean-driven melting. The instrument is a ground-based, phase-coherent radar (ApRES), capable of operating unattended for extended periods. I will briefly describe the instrument itself, the process of instrument deployment and recovery, costs, and possible models for participation. More than a dozen instruments have now been deployed on six different ice shelves, covering a broad range of glaciological and oceanographic regimes, with four year-long records recovered last season. I will give a flavour of some of the data that have been acquired. I will describe future plans, which include deployments on an additional eight ice shelves.

## **Status and outlook for ice-capable Argo in the Southern Ocean**

*Dr. Susan Wijffels (CSIRO, Australia)*

This presentation will provide a review of the current status of under-ice floats with some example float data highlighted and some priorities/considerations for future deployments.

## **Preserving the States of the Southern Ocean for the next Generation: SOOS Data Management**

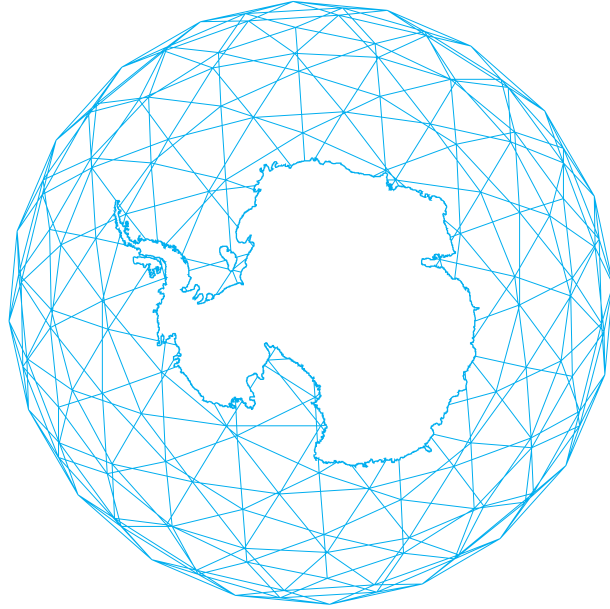
*Steve Diggs (CCHDO, USA)*

Observations in an area as remote as the Southern Ocean are costly and the pace of changes at high latitudes demand a robust and flexible data management system that leverages off of existing facilities and incorporates these in a structure that will adapt to the evolving needs of the research community. The task of protecting these valuable data is our responsibility, so come and learn how you can use this system today, and influence what it will become in the decades to come.

# PARTICIPANTS

Name	Position	Organization	Country
Ackley, A/Prof Stephen	Research Assoc Prof	Univ Texas San Antonio (UTSA)	United States
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