

**Call for Proposals under the IMOS (EIF) Five Year Strategy:
Enhancement or extension of IMOS – July 2009 to June 2013**

**Extend and enhance the Australian Mooring Network sub facility,
Lucinda Jetty Coastal Observatory**

Prepared on 29 October 2009

Proposals should be submitted by 30 October 2009 to:

Tim Moltmann, IMOS Director, University of Tasmania

email: tim.moltmann@imos.org.au

Overview:

Proposed Infrastructure Investment:	Sustained Enhanced Ocean Colour Observations – Legacy data sets- Present and Future
IMOS Facility:	Satellite Remote Sensing
Operating Institution:	CSIRO Land & Water
Facility Leader (for this Proposal):	Dr. Vittorio E. Brando Environmental Earth Observation Group, CSIRO Land & Water GPO Box 1666 Canberra ACT 2601 AUSTRALIA Phone: 02.62465716 Mob: 0418656084 vittorio.brand@csiro.au
Other(s) key people involved:	Dekker, Schroeder, Park, Cherukuru, Daniel, CLW Canberra Keen, Hawdon, CLW Townsville Mitchell, Campbell, CMAR Canberra Clementson, Matear, CMAR Hobart Lynch, Fearn, CUT, Perth
Collaborating Institutions:	CSIRO Land & Water, CSIRO Marine and Atmospheric Research, Curtin University of Technology,

List of attachments:

- Letter from senior person in Operating Institution, confirming that the proposed infrastructure can be developed and operated within that institution
- Resume of Facility Leader
- Letters received from Collaborating Institutions, detailing their support to the Proposal, and indicative level of co-investment

Nature of Investment:

This proposed investment comprises five components focussing on acquiring systematic bio-optical measurements and the use of these bio-optical measurements to ensure delivery of National Ocean Colour products with a characterised uncertainty specific to the Australian context (i.e. continental shelf and surrounding oceans). The five budgets will be presented separately. The five components are:

Acquire bio-optical measurements

- A. **Extend** – Extend from mid 2010 to mid 2013 the existing IMOS optical observatory - Lucinda Jetty Coastal Observatory (to translate top of atmosphere radiance to at water reflectance to light absorption and light backscattering to concentrations of algal pigments, coloured dissolved organic matter, particulate matter and attenuation of light). Also providing this data stream to international space agencies in return for access to their long term highest resolution ocean colour data (USA, Europe, India, China, Japan etc...)
- B. **Enhance: “next generation” at LJCO** - Enhance optical observations to enable validation of “next generation” ocean colour data products at the existing IMOS optical observatory - Lucinda Jetty Coastal Observatory from late 2010 to mid 2013
- C. **Enhance: bio-optics at NRS** - Enhance bio-optical observations at the NRS moorings to ensure national consistent Ocean Colour Calibration and Validation from late 2010 to mid 2013 [*The proposal for this activity was submitted through as a ANMN subfacility*]

Use of the bio-optical measurements to ensure delivery of National Ocean Colour products with a characterized uncertainty

- D. **Enhance: bio-optical data base of Australian Waters** – Establish a QA&QC-ed Australian Database of bio-geochemical and bio-optical data to enable the assessment of the accuracy of Ocean Colour products for Australian waters and to be used for parameterisation of regional algorithms as well as for tuning global algorithms
- E. **Enhance: Parameterization and Validation of the National Ocean Colour products** – Provide regionally validated ocean colour products of gridded satellite data through AO-DAAC with a metadata, a user-guide and with characterized uncertainty for Australian waters from late 2010 to mid 2013.

The proposal objectives are to provide bio-optical observations from Australian waters (A, B, C, D) to enable the delivery of these Ocean Colour satellite data products with a characterized uncertainty (E). The satellite derived ocean data products (algal pigments-specifically chlorophyll, coloured dissolved organic matter, particulate matter, vertical attenuation of light, primary productivity, phytoplankton functional types etc...) will be delivered to the marine and climate science community by the Satellite Remote Sensing Facility through AO-DAAC/eMII.

The bio-optical observations acquired by this subfacility will form the basis of a seamless transition for the marine and climate science community from SeaWiFS/ MODIS/MERIS (i.e. the current generation, Table 1) to OCM-2/VIIRS/NPOESS/Sentinel-3 (the “next generation”, Table 2) of ocean colour instruments. The result will be consistent & coherent time series of validated ocean colour products as Environmental Data Records contributing to the national backbone of sustained in situ (NRS) and ocean colour (SRS) observations.

In addition to assessing the accuracy of ocean colour data products, different users may analyse the bio-optical observations (A,B,C,D) for particle and phytoplankton dynamics (e.g. assessing diurnal to seasonal variability), modelling of underwater light climate for primary production, identifying optical proxies for biogeochemical properties, etc.

Implementation Strategy:

Summary

Acquire bio-optical measurements

- A. **Extend** – Maintain the existing IMOS Lucinda Jetty Coastal Observatory until June 2013. The site will be maintained on a weekly cycle, by two staff members driving on site and performing hot-swaps of underwater instruments. A contingency for replacement of part of the current optical instruments and hardware will be budgeted for, otherwise all costs relate to servicing the instruments.
- B. **Enhance: “next generation” at LJCO** - Enhance the optical observations carried out at the existing IMOS optical observatory - Lucinda Jetty Coastal Observatory to be able to validate “next generation” ocean colour data products. Continuous measurements of hyperspectral water leaving radiances will enable calibration of the new generation satellite imaging spectrometers by all the international space agencies (see Table 1, Table 2). In addition to the standard ocean colour products this will enable in situ characterizations of phytoplankton functional types, particle size distribution, and particle composition making possible the validation of such products from the next generation satellites launched from October 2009 onwards.
- C. **Enhance: bio-optics at NRS** - Augment the bio-optical observations currently performed at the National Reference Stations moorings by measuring CDOM fluorescence and scattering at BLUE & GREEN bands, complementing the Chlorophyll fluorescence and RED scattering measurement acquired with the WQMs at each NRS mooring
[The proposal for this activity was submitted through as a ANMN subfacility].

Use of the bio-optical measurements to ensure delivery of Australia Ocean Colour products with a characterized uncertainty

- D. **Enhance: Establish a bio-optical data base of Australian Waters** – By harvesting all bio-geochemical and bio-optical data from all the IMOS data streams (ANMN, NRS, ANFOG) and from legacy databases (e.g SFRSME, Great Barrier Reef Long Tem Monitoring Program, Aquafin CRC, Port Hacking transect, research cruises in the southern ocean) it will be possible to establish an Australian Database of bio-geochemical and bio-optical data. This database will be used to assess accuracy of Satellite ocean colour products for current and forthcoming satellite missions for the Australian Waters. The match-up dataset is essential to assess ocean colour products in the Australian region (e.g. chlorophyll a concentrations, phytoplankton species composition and primary production). Such a data set is crucial to quantify the uncertainty in the ocean colour products in our region. Further, it is essential to assessing new ocean colour data products generated for the Australian region. The contribution of such a database to international space agencies will ensure that the accuracy of global algorithm developed for future sensors will increase for Australian waters as bias towards Northern Hemisphere observation will be reduced.
- E. **Enhance: Parameterization and Validation of the National Ocean Colour products** - Some regional "improved" ocean colour products for the Australian region based on the inherent optical properties of the water are currently being delivered through AODAAC. The match-up data set proposed in item D will be essential to assess the uncertainty in these regional as well as the global products and to ensure a seamless transition between the products derived from the current generation of sensors (SeaWiFS/ MODIS/MERIS, see Table 1) to the next generation (see Table 2).
Exploiting historical data could also provide additional data products. An example is Primary Productivity (PP), pigment data and phytoplankton species identification for which a large archive of data is available for the Southern Ocean. The data archive has not been explicitly used in previous PP algorithms and by exploiting this data archive we would improve the PP estimates in the Australian Sector of the Southern Ocean and to assess and improve detection of phytoplankton functional types from space.

The activities of this proposals, if funded, could be developed into sub-facilities.

Objectives

Ocean Colour provides a unique and essential mean of monitoring biological processes in the waters around Australia due to the intrinsic link between biological and physical processes. A key flaw of the existing ocean colour products is the lack of a thorough assessment of their representativeness of the in situ ocean observations. Currently there four global products delivered by NASA and two delivered by ESA for the retrieval of Chlorophyll-a concentration (including GlobColour), but no estimate of accuracy is currently available for these Ocean Colour products for the open ocean, the shelf and coastal waters in the Australian sector except for the Great Barrier Reef where the global algorithms have been proven to be prone to large errors (Qin et al, 2007).

The bio-optical observations acquired at LJCO and the NRS moorings will form the basis for a seamless transition from the "current generation" (SeaWiFS/ MODIS/MERIS , Table 1) to the "next generation" (OCM-2/VIIRS/NPOESS/Sentinel-3, Table 2) of ocean colour instruments. This will enable the creation of consistent & coherent long term time series of validated ocean colour products with a characterized uncertainty for the Australian Ocean waters that can be used in investigating the impact of climate variability and change on phytoplankton composition.

The match-up analysis (E) will be carried out on historical and continuing satellite imagery for NASA's MODIS AQUA & TERRA, SeaWiFS and ESA's MERIS and for newly launched sensors: OCM-2 and HICO (see Table 1). In terms of future sensors, LJCO will be also part of the international Cal/Val effort for NPP/VIIRS and the Sentinel-3 OLCI (see Table 2).

The assessment of accuracies for satellite ocean colour products will be run at different levels:

- Water leaving radiance (or reflectance): using SEAPRISM and C-OSPREY data acquired at LJCO we will assess the accuracy of the Atmospheric correction algorithms for Australian conditions.
- Inherent Optical properties: using instruments data collected with ACs+BB9 (at LJCO), with the WQM+ECOTriplets (at the NRS moorings and on the ANFOG gliders) we will assess the accuracy of the algorithms for the retrieval of optical properties from Ocean Colour data (i.e. absorption and scattering, apportioned to Phytoplankton, Coloured Dissolve organic matter and non-algal particulate matter)
- Concentrations of optically active substances: using the direct sampling of chlorophyll, coloured dissolved organic matter and particulate matter we will assess the accuracy of ocean colour algorithms for the retrieval of such biogeochemical quantities.
- Next generation products using the in situ characterizations of primary production, phytoplankton functional types, particle size distribution, and particle composition.

The provision of the data stream acquired at LJCO (A,B) and at NRS moorings (C) as well as the bio-optical data base of Australian Waters (D) to international space agencies will also enable the participation in the global Calibration and Validation effort for each forthcoming mission, with a Principal Investigator status for members of the Australian Ocean Colour Community.

This PI status will ensure acquisition of imagery from the satellite sensors in the early stages of commissioning, participation to international meetings where the overall accuracy of the sensor is assessed, and possibly solution to adjust the performance are adopted. As an example, the PI status of Dr Dekker with ESA for MERIS, and the subsequent Cal/Val effort, ensured the acquisition of MERIS imagery at full resolution for Australian waters that would not have been acquired otherwise.

Several space agencies and earth observation programs have shown significant interest to work on the LJCO data stream for the calibration and validation of current and upcoming sensors.

- ESA issued a formal letter of support and image acquisition. The GlobColour project team expressed interest of using LJCO data as part their assessment of accuracy for Australia's continental shelf in ESA's CoastColour project.

- the HICO team will be imaging the site for calibration and evaluation from September 2009 onwards.
- the OCM-2 team at ISRO will be imaging the site for calibration/validation from October/November 2009 onwards
- the VIIRS team at Northrop Grumman, NASA, and Naval Research Laboratory included the LJCO data stream as one the 12 global VIIRS Cal/Val sites.

The atmospheric data acquired at LJCO will also be used for validation of the detailed PAR, UV and total solar radiation data products over the Great Barrier Reef produced by the subfacility proposed by Skiving and Nunez (“Measurement and mapping of solar radiation in the Great Barrier Reef region”)

In addition to validation of ocean colour data products, different users may analyse the bio-optical observations for particle and phytoplankton dynamics or shifts (e.g. assessing diurnal to seasonal to yearly to one decade of variability).

Table 1: Current Satellite Sensors for which the assessment of accuracy is planned.

Sensor	Agency	Satellite	Launch date	Swath (km)	Resolution (m)	Bands	Spectral range	orbit
SeaWiFS	NASA	OrbView-2	1 Aug. 1997	2806	1100	8	402-885	Polar
MODIS-Terra	NASA	Terra	18 Dec. 1999	2330	1000	36	405-14,385	Polar
MODIS-Aqua	NASA	Aqua	4-May-02	2330	1000	36	405-14,385	Polar
MERIS	ESA	ENVISAT	1 Mar. 2002	1150	300/1200	15	412-1050	Polar
OCM-2	ISRO	Oceansat-2	23 Sep. 2009	1420	360/4000	8	400 - 900	Polar
HICO - Hyperspectral Imager for the Coastal Ocean	ONR & DOD Space Test Programme	JEM-EF on Int. Space Stn.	18 Sep. 2009	50 km (selected coastal scenes)	100	124	380 - 1000	51.6o, 15.8 orbits p/d

Table 2: Forthcoming Satellite Sensors for which the assessment of accuracy is planned.

Sensor	Agency	Satellite	Launch date	Swath (km)	Resolution (m)	Bands	Spectral range	Orbit
VIIRS	NOAA / IPO(USA)	NPP	Early 2011	3000	370 / 740	22	402 - 11,800	Polar
HSI	DLR (Germany)	EnMAP	2012	30	30	~200	420 - 2450	Polar
OLCI	ESA	GMES-Sentinel 3A	late 2012	1265	260	21	390 - 1040	Polar
VIIRS	NOAA / IPO(USA)	NPOESS C-1	~2013	3000	370 / 740	22	402 - 11,800	Polar

List of major activities – including major party(s) involved, duration, start, finish
List of major equipment to be purchased / developed

A Extend – Maintain the existing IMOS optical observatory - Lucinda Jetty Coastal Observatory until June 2013

The Lucinda Jetty Coastal Observatory (LJCO, Figure 1) is located at the end of a 5.8 km long Lucinda Jetty (18.52 S, 146.39 E, Figure 2) in the coastal waters of Great Barrier Reef World Heritage Area close to the Herbert River Estuary and the Hinchinbrook Channel. LJCO was established with NCRIS funding to provide valuable data in coastal waters to unravel the inaccuracies in remotely-sensed satellite ocean colour products due to the optical complexity in coastal waters and the overlying atmosphere.

The Lucinda Jetty Coastal Observatory generates two different data streams: above water measurements of the water radiance and in water measurement of the optical properties. An autonomous above-water radiometer (CIMEL-SeaPRISM, CSIRO's in-kind contribution to this sub-facility) performs marine radiometric measurements for determining water leaving radiances and aerosol optical properties. An in situ instrument package representing the state-of the art of underwater optical instruments (WETLabs ACS, BB9, WQM) is deployed to characterize the inherent optical properties of these complex coastal waters.



Figure 1 Lucinda Jetty Coastal Observatory



Figure 2 Lucinda Jetty (.52 S, 146.39 E) in the coastal waters of Great Barrier Reef World Heritage Area close to the Herbert River Estuary and the Hinchinbrook Channel.

CLW ongoing: The Lucinda Jetty Coastal Observatory will be maintained on a weekly cycle by two staff members based in CSIRO's Townsville laboratories. The two staff members (Rex Keen and Aaron Howden) will drive on site and then perform hot-swaps of underwater instruments and clean up the optics of the CIMEL SEAPRISM and Satlantic Hyper-OCR. After every trip all instruments will be cleaned, serviced (and if possible calibrated). The raw data-stream is currently automatically uploaded from the Linux Server and PC installed on site to CSIRO's data storage in Canberra. Data will be pre-processed and QA/QCed automatically and then uploaded to eMII for distribution to the community.

A contingency for replacement of part of the current optical instruments and hardware was budgeted for of 150 K\$ over FY 2011 & 2012 otherwise all costs relate to servicing and calibrating the instruments. Some of the instruments are calibrated in CSIRO's Townsville laboratories after every trip, while some will be shipped to the manufacturers for factory calibration and instrument upgrades (30K\$ per year for calibration and upgrades +10 K\$ per freight).

The operating budget includes 10k\$ per year for travel to site and for attendance of IMOS meetings by key staff

Key Staff:

- Vittorio Brando, CLW – Sub Facility leader
- Paul Daniel, Rex Keen, Aaron Howden, CLW

		2009/10	2010/11	2011/12	2012/13	Total
NCRIS/EIF Funding (Note 2)		(NCRIS/EIF)	(NCRIS/EIF)	(EIF)	(EIF)	(NCRIS+EIF)
Capital	(insert description)	111,481	0	80,000	70,000	261,481
Salaries	0.2 FTE in FY 2009/10 &2010/11	17,000	17,000			34,000
Salaries	0.8 FTE in FY 2011/12 &2012/13			96,000	101,000	197,000
Operating	travel to site and to attend meetings	4,000	4,000	10,000	10,000	28,000
Operating	instruments factory calibration (including freight)			40,000	40,000	80,000
NCRIS/EIF Funding Total		132,481	21,000	226,000	221,000	600,481
Cash Co-investment (Note 3)		2009/10	2010/11	2011/12	2012/13	Total
Cash Co-investment Total		0	0	0	0	0
In-kind Co-investment (Note 3)		2009/10	2010/11	2011/12	2012/13	Total
CSIRO	salary overheads for 0.8 FTE, highly likely			87,000	91,000	178,000
CSIRO	salary overheads for 0.2 FTE, highly likely	15,500	15,500			31,000
CSIRO	salary 0.6 FTE fully inkind confirmed	97,500				97,500
CSIRO	salary 0.6 FTE fully inkind, likely		97,500			97,500
CSIRO	CIMEL SEAPRISM	63,000				63,000
In-kind Co-investment Total		176,000	113,000	87,000	91,000	467,000
TOTAL Resources		308,481	134,000	313,000	312,000	1,067,481

B Enhance: “next generation” at LJCO - Enhance the optical observations carried out at the existing IMOS optical observatory - Lucinda Jetty Coastal Observatory to be able to validate “next generation” ocean colour data products.

late 2010- mid 2011 –

A CIMEL SEAPRISM that measure water leaving radiances and reflectances at nine fixed wavelength will be acquired to reduce the downtime for calibration of the unit currently installed on-site as CSIRO’s co-investment to the facility. SEAPRISM needs to be calibrated by NASA every year and calibration lasts more up to three months.

To be able to assess accuracies for the new generation satellite imaging spectrometers by all the international space agencies (see Table 1, Table 2): the CIMEL SEAPRISM will be coupled with a C-OSPNEY. The C-OSPNEY was purposely designed by Biospherical Instrument Inc. for the long-term calibration and validation of the next generation of Ocean Colour sensors under the specifications of NASA’s Ocean Biology and Biogeochemistry Calibration and Validation Office.

CIMEL data will be uploaded to the AERONET-OC web server at NASA for direct access from the global community.

CLW late 2010- mid 2012 - Acquisition and deployment of 2 FRRF (Fast Repetitive rate Fluorometers), 2 PhytoPAM or BBE, 2 LISST (laser diffraction particle sizer) to enable continuous in situ characterizations of primary production, phytoplankton functional types, particle size distribution, particle composition. This will make possible the validation of such products from the next generation satellites to be launched from 2010 onwards.

This request of Capital (400k\$) has a lower priority and should be considered for mid to long term funding, if not awarded in this current round.

CLW mid 2010- mid 2013 - R&D before deployment of new instruments, setup of QA/QC procedures and upload of Data Streams to EMII. The instruments will require factory calibration (20k\$ factory calibration +10 k\$ freight costs each year).

The operating budget will include 30 k\$ travel to site for non Townsville based staff for R&D of new instruments, attendance of 3 national meetings per year and 2 international meetings per year

Key Staff:

- Vittorio Brando, CLW – Sub Facility leader
- Paul Daniel, Rex Keen, Young Je Park, Thomas Schroder, Nagur Cherukuru, CLW
- Ross Mitchell, Susan Campbell, Lesley Clementson, CMAR
- Merv Lynch- Peter Fearn CUT

		2010/11	2011/12	2012/13	Total
EIF Funding (Note 2)		(EIF)	(EIF)	(EIF)	(EIF)
Capital	instrumentation: CIMEL SEAPRISM	75,000			75,000
Capital	instrumentation: C-OSPREY	275,000			275,000
Capital	instrumentation: LISST, FRRF, PhytoPAM	200,000	200,000		400,000
Salaries	0.8 FTE: R&D before deployment of new instruments, setup of QA/QC procedures and upload of Data Streams to eMII	91,500	96,000	101,000	288,500
Operating	travel to site and to attend meetings	30,000	30,000	30,000	
Operating	instruments factory calibration (including freight)		30,000	30,000	60,000
	EIF Funding Total	321,500	356,000	161,000	748,500
Cash Co-investment (Note 3)		2010/11	2011/12	2012/13	Total
(enter Organisation)	(insert description, including likelihood)				0
	Cash Co-investment Total	0	0	0	0
In-kind Co-investment (Note 3)		2010/11	2011/12	2012/13	Total
CSIRO/CUT	labour overheads, highly likely	83,000	87,000	91,000	261,000
	In-kind Co-investment Total	83,000	87,000	91,000	261,000
	TOTAL Resources	404,500	443,000	252,000	1,009,500

D Enhance: Establish a bio-optical data base of Australian Waters

CLW/CMAR/CUT Mid 2010-mid2013

By harvesting all bio-geochemical and bio-optical data from all the IMOS data streams (ANMN, NRS, ANFOG) and from legacy databases (e..g SFRSME, Great Barrier Reef Long Tem Monitoring Program, Aquafin CRC, Port Hacking transect, research cruises in the southern oceans) it will be possible to establish an Australian Database of bio-geochemical and bio-optical data.

This database will be used to assess accuracy of Satellite ocean colour products for current and forthcoming satellite missions for the Australian Waters. The match-up dataset is essential to quantify the uncertainty in the ocean colour products in our region. Further, it is essential to assessing new ocean colour data products generated for the Australian region (e.g. phytoplankton species composition and primary production).

The contribution of such a database to international space agencies will ensure that the accuracy of global algorithm developed for future sensors will increase for Australian waters as well as providing Australia access to the highest resolution ocean colour data from (USA, Europe, India, China, Japan etc...)

The database will contain bio-optical data (i.e. HPLC, Chlorophyll by spectrophotometric methods, full spectral absorptions, TSS) and optical data (Vertical attenuation, water leaving radiance, reflectances, Atmospheric Optical Depth). Its structure will be compliant to the specifications of calibration/validation databases already in place at the international space agencies (e.g NOMAD, SEABASS, ESA-GlobColour, ESA-CoastColour)

CMAR staff (Lesley Clementson and Leanne Wilkes) have experience in delivering bio-optical data to space agencies. The CUT group, through WAMSI, IMOS, WASTAC, iVEC and eMII have extensive experience and expertise in data mining, archiving and management. They will integrate current operations to include mining legacy bio-geochemical and bio-optical data sets, as well as establish data pathways for current and planned instrument deployments and other measurement programmes.

The database will be contributed every six months to the calibration/validation databases already in place at the international space agencies

Key Staff:

- Lesley Clementson, CMAR, subfacility leader
- Arnold Dekker, Vittorio Brando, Thomas Schroder, Nagur Cherukuru, CLW
- Merv Lynch- Peter Fearn CUT
- Leanne Wilkes CMAR data center, 0.1 FTE fully in kind

		2010/11	2011/12	2012/13	Total
NCRIS/EIF Funding (Note 2)		(EIF)	(EIF)	(EIF)	(EIF)
Salaries	1.0 FTE Database of biogeochemical and bio-optical	114,000	120,000	124,000	358,000
Operating	attend meetings	10,000	10,000	10,000	30,000
NCRIS/EIF Funding Total		124,000	130,000	134,000	388,000
Cash Co-investment (Note 3)		2010/11	2011/12	2012/13	Total
Cash Co-investment Total		0	0	0	0
In-kind Co-investment (Note 3)		2010/11	2011/12	2012/13	Total
CSIRO/CUT	1.0 FTE labour overheads, highly likely	104,000	108,000	114,000	326,000
CSIRO	0.1FTE salary +labour overheads	22,000	23,000	24,000	69,000
In-kind Co-investment Total		126,000	131,000	138,000	395,000
TOTAL Resources		250,000	261,000	272,000	783,000

E Enhance: Parameterization and Validation of the National Ocean Colour products

Enable delivery through AoDAAC/eMII of global, improved and additional ocean colour data products for the Australian region with characterize uncertainty for Australian waters.

CLW/CMAR/CUT Mid 2010-mid 2013

Matchup analysis;

A match-up analysis will be carried out on historical and continuing satellite imagery for NASA's MODIS AQUA & TERRA, SeaWiFS and ESA's MERIS and for newly launched sensors: OCM-2 and HICO (see Table 1), and the forthcoming VIIRS and Sentinel-3 OLCI (see Table 2). The match-up data set proposed in item D will be essential to assess the uncertainty of regional as well as the global products.

The assessment of accuracies for satellite ocean colour products will be run at different levels:

- Water leaving radiance (or reflectance) and Atmospheric Optical Thickness: using SEAPRISM and C-OSPREY data acquired at LJCO we will characterize the accuracy of the Atmospheric correction algorithms for Australian conditions.
- Inherent Optical properties: using instruments data collected with ACs+BB9 (at LJCO+ legacy data), with the WQM+ECOTriplets (at the NRS moorings and on the ANFOG gliders) we will assess the accuracy of the algorithms for the retrieval of optical properties from Ocean colour data (i.e. absorption and scattering, apportioned to Phytoplankton, Coloured Dissolve organic matter and non-algal particulate matter)
- Concentrations of optically active substances: using the direct sampling of chlorophyll, coloured dissolved organic matter and particulate matter (IMOS + legacy data) we will assess the accuracy of ocean colour algorithms for the retrieval of such biogeochemical quantities.
- Next generation products using the in situ characterizations of primary productions, phytoplankton functional types, particle size distribution, and particle composition.

This activity will ensure a seamless transition between the products derived from the current generation of sensors (SeaWiFS/ MODIS/MERIS) to the next generation, enabling the delivery of National Ocean Colour products through AO-DAAC/eMII with a characterized uncertainty for Australian waters. This would raise this status of ocean colour satellite data to Environmental Data Records.

CLW/CMAR/CUT Mid 2010-mid 2013

Provide improved and additional ocean colour data products for the Australian region.

Some regional "improved" ocean colour products for the Australian region based on the inherent optical properties of the water are currently being delivered through AODAAC for the optically complex of Great Barrier Reef and Tasmanian continental shelf. These algorithms couple a physics-based atmospheric correction and in water bio-optics inversion that can deal with optical complex waters with varying optical properties.

These algorithms have been accepted as suitable for the GBR Marine Monitoring Programme providing information on chlorophyll (indicator for eutrophication and part of carbon budget-primary productivity), algal blooms, coloured dissolved organic matter (inverse tracer of salinity, freshwater influence on continental shelf waters, part of carbon pool, light availability variable), non-algal particulate matter (sediment budget, water type, light availability, part of carbon pool), vertical attenuation of light (well-defined physical variable for light availability calculations from which turbidity and transparency can be calculated).

These additional Ocean Colour products will be delivered to the marine and climate community through AO-DAAC/eMII with a characterized uncertainty for Australian waters

The implementation of algorithm regionalization will be staged addressing the Nodes science needs in consultation with the wider oceanographic community.

CLW/CMAR/CUT Mid 2010-mid 2013

Parameterize and implement a Primary Productivity Algorithm for the Australian Sector of Southern Ocean and for the Continental Shelf

An example is A large archive of data is available for the Southern Ocean for Primary Productivity observations. The data archive has not been explicitly used in previous PP algorithms and by exploiting this data archive we would improve the PP estimates in the Australian Sector of the Southern Ocean. A second effort would be to use all the pigment data and phytoplankton species identification to assess and improve detection of phytoplankton functional types from space using existing published methods. A European effort call PHYSAT is already providing global phytoplankton species composition products, and the assessment and improvement of these products in the Australian region would be useful to investigating the impact of climate variability and change on phytoplankton composition.

These additional Ocean Colour products will be delivered to the marine and climate community through AO-DAAC/eMII with a characterized uncertainty for Australian waters

The operating budget will include 40 k\$ for attendance of national and international meetings to present the results and engage with the national and international community to ensure uptake of the validated products.

Key Staff:

- Arnold Dekker, CLW – Sub Facility leader
- Vittorio Brando, Thomas Schroder, Nagur Cherukuru, CLW
- Richard Matear, Ocean Colour Scientist (to be hired), CMAR
- Merv Lynch, Peter Fearn CUT

NCRIS/EIF Funding (Note 2)		(EIF)	(EIF)	(EIF)	(EIF)
Salaries	0.5 FTE Matchup analysis	57,000	60,000	63,000	180,000
Salaries	1.0 FTE Primary Production Southern Ocean and Continental Shelf	114,000	120,000	126,000	360,000
Salaries	0.5 FTE implementation algorithm for continental shelf	57,000	60,000	63,000	180,000
Operating	attend meetings	40,000	40,000	40,000	120,000
	NCRIS/EIF Funding Total	268,000	280,000	292,000	840,000
Cash Co-investment (Note 3)		2010/11	2011/12	2012/13	Total
	Cash Co-investment Total	0	0	0	0
In-kind Co-investment (Note 3)		2010/11	2011/12	2012/13	Total
CSIRO/CUT	2.5 FTE labour overheads, highly likely	207,000	218,000	228,000	653,000
	In-kind Co-investment Total	207,000	218,000	228,000	653,000
	TOTAL Resources	475,000	498,000	520,000	1,493,000

Access, pricing regimes:

- How will data access be provided?
 - Data Acquired at LJCO will be uploaded on eMII in near real time after passing automatic QA/QC procedures. Some data streams will need “expert” QA/QC procedure and hence will be uploaded in a delayed mode (in the order of few weeks) .
 - CIMEL data will be uploaded to the AERONET-OC web server at NASA for direct access from the global community.
 - The bio-optical data base of Australian Waters will be served to the Australian community thorough eMII. The database will be contributed every six months to the calibration/validation databases already in place at the international space agencies. (e.g NOMAD, SEABASS, ESA-GlobColour, ESA-CoastColour)
 - Ocean Colour products will be distributed through AO-DAAC/eMII.

- How will data and products be managed?
 - Optical data will be QA/QC-ed with state-of the art optical procedures and then uploaded to eMII for distribution.
 - Ocean Colour products will be implemented within the SRS facility and distributed through AO-DAAC/eMII.

- What are the dependencies on external / other facilities (national and international)?
 - Dependence on laboratory analysis on samples collected at NRS mooring and QA/QC-ed by ANMN facility.
 - Dependence on international space agencies for date of forthcoming launches and for status of current satellites
 - Dependence of data custodians timely delivery of legacy bio-optical data for the establishment of the bio-optical data base of Australian Waters

- Collaborative structures for allocation of priorities
 - The roll-out of out of new bio-optical instruments at LJCO (if awarded) will be planned with the members of the proposed Bio-optical working group
 - The implementation of algorithm regionalization will be staged addressing the Nodes science needs in consultation with the wider oceanographic community

Governance

- Performance indicators
 - Successful rollout of instruments at LJCO with instruments ordered by mid/late 2010 and deployed by early/mid 2011.
 - Timely delivery of QC-ed data to eMII for distribution
 - Delivery of bio-optical data base of Australian Waters to the calibration/validation databases already in place at the international space agencies starting in mid 2011 and continuing every six months
 - Delivery of regionally validated ocean colour products of gridded satellite data through AO-DAAC with a metadata, a user-guide and with characterized uncertainty for Australian waters meeting the Nodes science needs.

- Describe key risks and risk management strategies

Risk 1 – Project management of sub-facilities

Delivery of infrastructure and management of projects require considerable FTE. During the first two years of NCRIS funding there was a mismatch between expectations and delivery.

There are no position descriptions of either facility or sub-facility leadership roles. As IMOS is designed to be on-going this lack of explicitness increases the risk of project failure following staff turn-over particularly at a facility leadership level.

Mitigation strategy 1 – Project management of sub-facilities

The management overhead of sub-facility leaders was made explicit. The budget of the sub-facilities in this proposal (A+B, D, E) provides costed support of 0.2 FTE (for each of A+B, D, E) to account for expected sub-facility management work load.

Risk 2 – Operational vs research infrastructure

There is a risk that near real time data streaming will produce the perception that the facility is an operational rather than research infrastructure. Operational infrastructure guarantees continuous service provision, which demands significantly more resources.

Mitigation strategy 2 – Operational vs. Research infrastructure

LJCO will ask eMii to produce a disclaimer that all distributed data streams are research infrastructure with explanations of the limitations of this funding model.

Risk 3 – Loss of gear

There are some risks although small, of instrument failure at Lucinda Jetty due to tropical cyclones or major storm, or fishing or boating interactions.

Mitigation strategy 3a A plan will be put in place to respond to TC alerts and dismount the instruments from the roof on the observatory and take out of the water the underwater instruments. Damages due to other storms or human interactions might involve factory repair and recalibration with some loss of data. Usually repairs can be accomplished in one to two months, during which the undamaged instrument sets would be used to limit the data loss.

Mitigation strategy 3b A communication plan for the local community will be implemented to reduce the likelihood of fishing or boating interactions with the instrumentation on the Jetty.

- For existing Facilities, respond to any issues raised in the 2008 IMOS Review

TABLE: Observations required by the Nodes in relation to this Facility

Facility	Observations required by the Node			
	NCRIS Funded (already allocated to Jun11) (see Appendix 1 of the Guidelines)	EIF first \$8M funded (already allocated to Jun10)	Extension of existing facility infrastructure out to 2013.	Enhancements of existing Facilities / new infrastructure required 2010-2013
Bluewater & Climate	<p>“Other ocean colour satellites are available from the Europe, India, and China but general Australian access to the data is not available. Through the Lucinda Jetty calibration site, CLW has negotiated access to the European satellite data and is trying to make similar arrangements with the Indians and Chinese. As long as the NASA ocean colour satellites are working access to other satellite data is not crucial. However, the NASA satellites are expected to fail soon with a high probability that there will be a gap in their ocean colour dataset. With this scenario continued access to ocean colour data is not guaranteed. “</p>			<p>“need to ensure IMOS in situ optical measurements inform algorithm development and global products” “Improve global ocean colour products by partnering internationally: -Ensure existing and new offshore in situ optical and BGC/ecosystem data sets are appropriately assembled, QC'd and provided to international groups performing satellite cal/val e.g. GlobColour and SeaDAS. -ensure calibration of offshore instruments so that they are of use in the above effort” “IMOS could help coordinate the collection of new match up data for this task by helping to standardize the collected data and ensure consistent calibration of the sensors used. Finally, the collection of match-up data to assess the ocean colour products is difficult to obtain because much of the in situ data can not be matched to a satellite pass because of clouds. To more efficiently</p>

Facility	Observations required by the Node			
	NCRIS Funded (already allocated to Jun11) (see Appendix 1 of the Guidelines)	EIF first \$8M funded (already allocated to Jun10)	Extension of existing facility infrastructure out to 2013.	Enhancements of existing Facilities / new infrastructure required 2010-2013
				<p>generate match-up data, one should use existing platforms like the gliders and national reference moorings for collecting such data”</p> <p>“For the collection of data to help calibrate and validate the ocean colour products (match-up dataset) the Australian effort has been quite ad hoc with many different groups collecting and holding such data but with no national coordination. To ensure an effective use of the data, a national match-up database should be assembled. “</p>
WAIMOS				
GBROOS				
NSW-IMOS				<p>“NSW-IMOS aims to detect trends in patterns and drivers of primary productivity throughout coastal waters, especially those associated with climate variability using SRS and a proposed bio-optics capability. Satellite remote sensing assists</p>

Facility	Observations required by the Node			
	NCRIS Funded (already allocated to Jun11)	EIF first \$8M funded (already allocated to Jun10)	Extension of existing facility infrastructure out to 2013.	Enhancements of existing Facilities / new infrastructure required 2010-2013
	(see Appendix 1 of the Guidelines)			<p>investigation of zones potentially affected by suspended sediments such as stormwater plumes emanating from estuaries. In order to achieve this it is necessary to provide reliable estimates of chlorophyll and TSS for NSW coastal waters from existing and historic satellite ocean colour data by:</p> <ul style="list-style-type: none"> • Validating contemporary ocean colour derived estimates of chlorophyll, CDOM and TSS against direct IMOS observations from the gliders' eco-triplet sensor. • Developing NSW specific optical inversion algorithms for near shore, optically complex (Type 2) coastal waters. SIMS is particularly interested in ocean colour imagery and local algorithms for coastal NSW (Pritchard <i>et al.</i>)."

Facility	Observations required by the Node			
	NCRIS Funded (already allocated to Jun11) (see Appendix 1 of the Guidelines)	EIF first \$8M funded (already allocated to Jun10)	Extension of existing facility infrastructure out to 2013.	Enhancements of existing Facilities / new infrastructure required 2010-2013
SAIMOS				
TASIMOS				<p>“It is therefore essential that the node has access to ocean colour products which separate CDOM and phytoplankton pigments”</p> <p>“SRS to support ocean colour users by providing an objective evaluation of and guide to available global products”</p> <p>“Trial products for CDOM, pigment and particulates for the Tasmanian region are available for one year through the AODAAC, and the node would like to see those extended forward and backward in time”</p> <p>“TasIMOS is in a particularly strong position to undertake the development of techniques for assimilation of ocean colour products into regional biogeochemical models. For these purposes, we’d prefer access to single pass data, at 1 km resolution, with robust cloud flagging.”</p> <p>“The IMOS in-situ mooring and glider data, and satellite data, will provide critical input to</p>

Facility	Observations required by the Node			
	NCRIS Funded (already allocated to Jun11)	EIF first \$8M funded (already allocated to Jun10)	Extension of existing facility infrastructure out to 2013.	Enhancements of existing Facilities / new infrastructure required 2010-2013
	(see Appendix 1 of the Guidelines)			model data assimilation for the Tasmanian shelf and slope and adjacent seas”