

Western Australian IMOS Node: Summary of Reviewers comments

In response to the Federal Budget requirement for enhanced monitoring in the Southern Ocean and increase coverage in northern Australian waters, the Bluewater and Climate and Western Australian Node Science and Implementation Plans (NSIPs) have been subjected to international peer review. The IMOS office contacted ten reviewers and seven responded to say that they were willing to review the node proposals. This is testament to the level of interest in IMOS activities internationally, as a leader in Southern Hemisphere ocean observations. Reviewers were chosen on the basis of their expertise in;

- Organisation of major ocean observing activities.
- Understanding of Australasian ocean climate.
- Understanding of broad scale ocean variability
- Focus on the Southern Ocean
- Linking Broadscale to regional/boundary current variability.
- Focus on the Indonesian Throughflow/Indian Ocean.
- Focus on boundary current systems (Leeuwin is a unique Eastern Boundary current)
- Linking physics to biology.
- Ocean current/shelf interactions

Each node plan had five reviews, with three reviewers looking at both plans and two other reviewers looking at one plan and a further two reviewers looking at the other plan. This approach was designed to handle the breadth and depth of IMOS.

The reviewers were asked to determine whether or not:

- Science questions posed by the Nodes are relevant and appropriate given the context for sustained ocean observing in Australia, and the state of the science globally.
- The observations being provided to the Nodes by the Facilities are, in combination, likely to address the science questions being posed.

In general, the reviews were brief, bar reviewer 5, who provided some extensive comment on specific areas. While the reviewers applauded the multi-disciplinary nature of the plan, they expressed general concerns in three areas i.e. (1) whether some of the observations proposed are sustained or exploratory, (2) whether the plan is in fact two separate Node plans, and (3) whether the observations proposed are adequately linked to the research questions posed;

Reviewer 1 questioned which aspects of the proposed observing plan were sustained and which were exploratory, suggesting that the design of the *sustained* observing system in the region is not yet mature; Reviewer 1 went on to recommend a national planning process for the coastal ocean

Reviewer 1: *“Pre-IMOS sustained ocean observations were very limited in the western Australia. A thoughtful expansion as carried out under IMOS and continuing in the next 5 year period will prove to be of great value both for basic science and societal objectives. My comments below should not be taken as critical of the overall concept and plan, but merely suggesting that the plan is not yet fully mature and needs further consideration and revision.*

An important aspect of the plan that is unclear is the relationship between the proposed observations and what is intended as a long-term observing system. Are they one and the same? Are some of the observations exploratory? Are some intended to aid in the design of the long-term observing system? A lot is yet to be done to arrive at the design of long-term ocean observations for this region, and I hope that process is in the mind of the WAIMOS planners. I would view the coming 5-year period as one of designing the long-term observing system rather than of installing it.”

Two of the reviewers identified that the plan was actually two plans, and one of the reviewers saw this as a serious problem. Secondly, three out of five of the reviewers concluded that it was not clear how the observations proposed would help to answer the

science questions posed. This makes it extremely difficult to prioritise the observations requested.

Reviewer 2 went on to suggest that no enhancements to the regional observations are approved without a significant re-write, and reviewer 5 also recommended significant revisions:

Reviewer 2: *"The proposal is a long document outlining the node science and implementation plans. I was surprised to find more or less two separate discussions and proposals under one common NODE, the north-west Australian Waters and the south-west Australian Waters. This made it more difficult to read and evaluate the proposal, and even the structure under the four given headings was chosen differently between the two subregions. I would like to flag this right upfront as a serious concern that needs addressing. Either IMOS decides to break the node in to two, or it ensures proper integration. But the current proposal is an unacceptable compromise.....*

... On the basis of what is written here I would strongly urge the funders to support ongoing activities, but at the same time demand for a much more convincing and integrated observing strategy. I find it unacceptable that I have to read two plans in one."

Reviewer 5: *"Proposal format is apparently defined by a template that WAIMOS was instructed to follow. I did not care for the structure, mainly because there was no presentation of the actual observing system to be deployed until page 60 or so. I wish the authors had chosen to use the introduction to provide a more detailed summary, it would have made it much easier to follow the rationale of the rest of the proposal. The proposal itself is rather sloppy, there are a lot of grammar and syntax errors throughout, the description of the physical regimes are not entirely consistent, figure references are wrong in a number of places, many place names are not shown in the graphics and the subsections are mis-numbered in places. The presentation is therefore less clear than it could be, and if the document is to be shared publicly the authors should be asked to carefully revise it beforehand.*

..... Overall I'd rate the proposal a good - there is ample solid material included, the questions posed are fundamental and worthy of significant investment, and the observing system proposed is a prudent balance between what is desired and what is possible given budgetary and logistical constraints. It does not convey a sense of the build out plan that will be necessary to tackle many of the research topics, or how this initial effort factors into a grander scheme."

Regarding the specific responses to the questions set;

1) *Whether the Science questions posed by the Nodes are relevant and appropriate given the context for sustained ocean observing in Australia, and the state of the science globally.*

In general, reviewers approved of the balance of the science questions posed, and applauded the multi-disciplinary nature, and socio-economic context. It was noted that the questioning in some areas were more developed than others.

Reviewer 2: *"The scientific background begins with a good description of the large scale context for the Northern Section. BUT are there no common issues for both regions that would have warranted a joint discussion? However, I was surprised that issues like increase in CO2 uptake and ocean acidification were not prominently mentioned, also I would have expected some mention of sea level rise (maybe not relevant) or changes in the terrestrial input (nitrification, loss of oxygen, maybe both not relevant?)."*

Reviewer 3: *"As a summary, this is an impressive effort to develop a comprehensive regional observing system. The science questions posed are fully relevant and*

appropriate. Socio economics context is a strong driver.... The research questioning is somehow less developed for the SW Australian part; I believe this was already done in the first WAIMOS document. I did not find materials to estimate if WAIMOS fulfilled the proposed objectives (i.e. p. 52), but maybe this was done in earlier reviews."

Reviewer 4: "I found the proposal well-written with a clear presentation of the background knowledge, research questions and outreach of the proposed measurements. Those are relevant to broad scale climate and variability, continental slope, shelf and coastal processes."

Reviewer 5: "Overall, the general themes (forecasting, biodiversity and productivity and managing and planning for human use) were appropriate to the regional program and to the present state of the observing system. The specific research topics were best developed for the forecasting theme, less so for the biodiversity and productivity, and mixed for human use..... To be more positive, the proposal is delightfully multi-disciplinary and the authors are to be commended for the breadth of information they have assembled and condensed. I'm impressed that the basic themes include a strong biological component and applaud the use of passive acoustics and tagging for monitoring.

Some more specific concerns I would voice are the lack of discussion about the setting and observing along the southern shore of Australia; about the connection to the bluewater, climate and other regional nodes;"

2) The extent to which the observations being proposed will, in combination address the science questions being posed.

As mentioned above, the general concern here is that while a comprehensive list of science questions, it is not clear how the observing system proposed relates to these questions. 3 out of 4 of the reviewers agreed on this point.

Reviewer 2: "I think from my point of view the plan is very weak in this aspect. While at the high level end of the plan the overarching issue are spelled out and from my perspective seem very convincing, the issue of how those translate to a sustained observing system has not been addressed in a systematic way. This is very hard to do and I would not expect a full and 'correct' answer. But at the minimum a framework for that process should be established and described. As it stands one could say this is a collection of nice ideas for a specific task, but their joint resolving and describing power has not been assessed or presented."

Reviewer 3: "The proposed plan makes sense. It is not clear, however, how the different data sets will be integrated together and will answer science and societal questions. An integrating framework through physical, biogeochemical and ecosystem coastal modeling seems to be lacking (or is not described)."

Reviewer 4: "The observations will provide essential measurements to better understand the natural variability, long term changes, and improved physical, biogeochemical and ecological modeling."

Reviewer 5: "A general concern is that the connection between the scientific/societal needs (as stated in the research themes and subthemes) and the observing system was not terribly well spelled out. I find the motivation (in terms of scientific themes) to be expressed as long-term views, with little accounting for the necessary build-up of capabilities that this 5-year development and implementation plan addresses. The result is a disconnection between the perceived goal and the requirements to meet the goal and what is possible/feasible in the near-term to move towards satisfying that goal...."

... [Some specific concerns are] about some of the observing efforts (CO2, sediment traps) that appear in the observing system description but are never mentioned (and thus justified) earlier."

Reviewer 1 went on to question the human resources required for the proposed observing system, the demands of overseeing and running such a system and the demands on the time of the Node Leader:

Reviewer 1: *" Human resources. It appears questionable whether there is or will be in the next few years enough technical expertise to initiate and(possibly) sustain all of the proposed observations. Although the proposal does not address this issue directly, it gives some reason for concern, e.g. final sentence on p 56. The hiring of new technical staff is a necessary but not a sufficient step; the training and supervision of such staff is a major and important function in the observing system. Who are the observational/ instrumentation experts among the WAIMOS team who will carry this responsibility?*

University partnerships. This reviewer is a university professor and accepts that university-based scientists play a strong role in sustained ocean observations. Nevertheless, ocean observations and especially sustained ocean observations go against the grain of university evaluation and rewards systems. Is this an issue for WAIMOS? For a national program one might expect to see CMAR playing a stronger integrative role in developing the observing system."

1. Introduction

Reviewer 5: *" OK, though the field plan associated with Figure 1 could be more clear. What is new, what is not? Presumably red exists, white does not, but it is never stated. Nor is the red dot at NW Cape mentioned. How will new lines be instrumented? The Arafura line is said to be moorings - the same is true of others? Good rationale, though terse."*

2. Socio-economic context

Reviewer 2: *" I found it difficult to digest section 2 on the socioeconomic context, because it read to me like a collection of stakeholder statements and not a well synthesized and structured high level discussion on relevance. For example I support the five categories on page 7, but then they are not filled with more meat in the context of the WAIMOS discussion. It is maybe not an essential part of the proposal, but one that might need attention for the next round.*

Section 2.2.1 read in many places more like a research agenda, than something in support of the socioeconomic context.

Section 2.2.2 has excellent element and maybe could be seen as the intro to section 3. While section 2.2.3 for the South-West regions does address more the socio economic context."

Reviewer 3: *" The socio-economics aspects (characterization of biodiversity, regional management, ecosystem based management, design criteria for offshore structures) are well covered and the critical importance of observations is emphasized."*

Reviewer 5: *" Socio-economic context - not sure why a bullet is used in the first section, odd to just have one. I realize the point here is that there are restrictions on the use of the funds. But should be presented another way."*

Section 2.1: seems rather standard; don't see a clear connection between the observations to be collected and the opportunities and challenges identified. A clearer connection would help justify the existence and continued funding of IMOS.

It needn't be exhaustive but some description of the observations that will improve national security, conserve biodiversity, etc would be helpful. The list of quotes emphasizes the issues the region is facing but again fails to relate specific observing needed to address these issues.

Section 2.2.1 - just what I was looking for. The ATS section is good though a bit scattered in the 2nd to last paragraph. Lots of justification for observing, not so much on what

observing is needed. Ocean Research Priorities section - lapsing into acronyms that are not spelled out (MODIS, NMR, CARS-type, etc). Understanding of Arafura Sea section - bluelink needs to be defined. Some issues with grammar. Need Torres Strait on a map somewhere. End of the section: good summary of socio-economic topics to be addressed, but would be best if these came earlier, then provide the details.

Section 2.2.2 - subsection A is good, specific, to the point; subsection B is less so (cross-shelf water flow? effects of tidal dynamics on marine habitats?), and could be more specific. The two topics I've picked on are quite complex and obviously WAIMOS isn't going to address all aspects, be more specific about what can be achieved in these broad areas; subsection C - could point out economic advantage of re-using the information collected to support A and B in C; the tide-induced bottom-stress seems not to fit - isn't it likely to be highly variable in space and time and beyond the resolution of the WAIMOS infrastructure?

Section 2.2.3 - brief, and assumes familiarity with existing programs. Does not parallel the other sections very well. Of limited help in placing the existing system in the same context."

3. Scientific Background:

Reviewer 2: "In general I thought the structure of discussion for each issue was helpful, although no indication of readiness and or costs (cost effectiveness) to tackle the issue was given.

Section 3.2 for the South Western Water was structured quite differently with a good and somewhat detailed description of the science issues. I was surprised to find that biogeochemistry was only discussed in the context of nutrients and Chla. Are there no higher trophic level issues of interest?

Section 3.2.7 (labeled wrongly as 3.2.3) addresses the science questions. Interesting that ENSO was mentioned as the first point including its impact on the north-western region, but was not directly picked up from the previous section (indirectly yes, because the link is in some parts through the ITF but not only). I liked the response to the mid term review (section 3.2.8)."

Reviewer 3: "There is a good review of the scientific background that covers a wide range of topics. For the northern region, twelve science challenges are identified for three different (interlinked) themes (ocean and atmospheric weather forecasting, biodiversity conservation and ocean productivity, managing and planning for human use). For each scientific challenge, research objectives, activities and outputs and key research personnel are identified. For the southwest region where research programs are considered much more mature, the research questions are quite specific for the two themes (ocean and climate forecasting, including continental shelf processes, biodiversity conservation and ocean productivity)."

Reviewer 5: "Overall, the general themes (forecasting, biodiversity and productivity and managing and planning for human use) were appropriate to the regional program and to the present state of the observing system. The specific research topics were best developed for the forecasting theme, less so for the biodiversity and productivity, and mixed for human use...."

For some of the themes the topic was too broad (e.g. B-3, cross-shelf water flows) and others were too specific (e.g. C-3, bottom stress) relative to what can reasonably be accomplished with the observing assets discussed. Obviously with only a few transects spaced 100s of kms apart only certain cross-shelf exchange processes can be investigated. And with regard to bottom stress, only barotropic dynamics are to be considered, so quantifying the barotropic tidal dynamics would be a better statement of the research question. But the general attention to characterizing the long-shore flow environment, its variability and the biological consequences came through clearly and is an appropriate target for an initial deployment effort. I strongly suggest that Section 8 be copied in the

front sections of the proposal It is the clearest statement of science to be accomplished in the 5-year period."

Specific comments are:

"Leeuwin Current section: the presentation about the LC is confusing, mainly because the introductory material (section 1) portrays it as extending from at least the east Timor Sea, whereas Figure 2 and the text discuss its origins as being in the western Timor Sea. Figure 2 also contains much more detail than is presented in the text, and is not terribly consistent with the verbal description (e.g. eastern flow at 15S turning southward to form the LC). Third sentence should be revised to say the LC is the only poleward flowing EBC IN SUBTROPIC LATITUDES - a big point. Plenty exist in the northern hemisphere but at higher latitudes. The text is a bit sloppy in places (e.g. should be recruitment in many fisheries, not many of the fisheries recruitments; and the last sentence in each of the last 2 paragraphs are nearly identical).

Holloway Current section: should be some mention of its connection to/role in the origins of the LC. Have very different depictions of the current structure in Figs 1 and 2. Does the LC exist offshore of the HC? Or is the HC the origins of the LC?

Ocean drivers section: OK. Good to identify connections to Indian Ocean programs.

3.1.2 - region context -

tide regime, 2nd paragraph: poor grammar, makes it hard to read (about tidal fronts). Figure 5b - presume these are the depth-averaged tidal current ellipses?

Internal tides - impressive figures and important to note, but will they be observed?

Wind driven circulation - little context for what is said here. Reference to Fig 6 is made, yet the figure caption points out tidal fronts, not wind-driven upwelling.

Biological environment: lots of information here, and demonstrates the diversity of life and the scarcity of information known about its variability and controls on its abundance. Grammar is poor at times in this section, and in places there may be missing text (e.g. coral reef paragraph on p27 that suddenly turns into a discussion of sea grasses).

Section 3.1.3 - this format of presentation is not very helpful, many of the lists require specialized knowledge (e.g. government policies and programs) or are of limited value as presented (e.g. IMOS data streams and infrastructure). In Challenge A-1 suggest replacing tidal elevation and sea level elevation - the long-term pressure gradients are of as much or more interest than the tidal elevation changes.

Note that the A challenges listed are not the same as those listed in section 2.2.2, and throughout the verbal description that goes with a given sub-challenge is not consistent.

B-1: goes from water quality initially to water temperature under research objectives. Which is it?

B-2: despite the title of the section being larval and genetic exchange there does not appear to be any observing element to measure larvae or determine their genetics. The title needs to reflect that WAIMOS is CONTRIBUTING to the challenge by providing circulation information, not measuring the biology directly. Subtle but important distinction.

B-3: some recognition of how these depth-dependent processes (at least in some cases) will be observed would be helpful.

B-4: after listing a number of internal processes (front, internal tides, boundary layer dynamics) the research objective is listed as barotropic modeling, which has limited ability to address the stated challenges. Need to be consistent.

B-5: ambitious but sounds good. B-6 seems very similar - could these two be combined?

C-2: so is this nested modeling within BlueLink? Any coupling? Sustained and operational? Chance to discuss connection to bluewater/climate but not here at present.

Table 2: shouldn't box priority 1/C-2 be checked? And priority 5/B-6?

3.2.4 - nice, informed discussion of nutrient dynamics.

3.2.5, 3.2.6 - nice overview of understanding of more local phenomena and their role in structure the physical and biological environments.

It would be nice to see the questions posed for the SW Australian part of WAIMOS to be set up better by structured discussion in the preceding section. Could even envision ending a background section with 'outstanding issues' that need to be addressed. As now presented the connection is weak and these challenges appear a bit out of thin air.

End of section 3: I still don't have a clear understanding of what is being proposed. Obviously some locations will be instrumented but with what and how has not been stated. Given I'm 55 pages into the proposal that isn't helpful. Desperately needs a summary of some sort up front to give it away.

No significant discussion of oceanographic conditions east of Cape Leeuwin."

5. What observations does the Node require during 2009-2013, and how will they address the research questions?

Reviewer 1: "Long time-series. All of the proposed long time-series likely have value, but not equal value or equal cost-effectiveness. And, not all valuable oceanographic observations should be made into long time-series. Some elements of the plan appear to be relatively costly in relation to their information content, and unlikely to be sustained, including the many AUV transects and the use of ADCP on NRS moorings. The initiation of long time-series carries responsibility and obligation that should not be taken on lightly. Analogous to point 1 above, it's critical to avoid having the sustained observing system be the sum of all time-series observations carried out or envisioned by the participants."

Reviewer 2: "Table 4 gives a helpful overview. In general this is more of a work in progress where excellent parts of a complete observing system exists that should be maintained and seen in a larger scale and more integrated context. And the structure of the document makes it somewhat difficult to assess the prospect of success. But in some parts there is evidence for a more system based thinking while in others it sounds more like a collection of efforts justified by local challenges with a somewhat diffuse strategy of how they will make a difference for the larger scale issue..."

Reviewer 3: "Observations required by the northern and north west Australian water Node are then analyzed for the different science challenges (a given observation system addresses, however, many scientific challenges as the objective should be to design a "core" system that serves several scientific objectives)..."

.....The proposed observations make sense but it is difficult to figure out how priorities were defined. There is also no discussion on the specific requirements of physical and biogeochemical coastal models and how the IMOS data sets will be used in conjunction with modeling and data assimilation systems. Coastal stations and inputs from rivers do not seem to be well covered in the proposal.....It is also difficult to figure out how the

new observing systems will be set up. Will there be enough qualified personnel to make sure that good data are delivered in a timely fashion?"

Reviewer 4: "The proposed observations are ambitious and multi-disciplinary and relevant to society needs. The research questioning is somehow less developed for the SW Australian part; I believe this was already done in the first WAIMOS document. I did not find materials to estimate if WAIMOS fulfilled the proposed objectives (i.e. p. 52), but maybe this was done in earlier reviews."

Reviewer 5: "The proposed observing system enhancements were reasonably clear but as stated about the linkage between research topic and infrastructure could be improved. - That said, deployment of ADCPs, vertical arrays to measure scalars (temperature, salinity, fluorescence, etc), gliders, and passive acoustics is consistent with practices in other parts of the globe and should provide a valuable starting point for the observing system. The deployments will also provide a valuable lesson in how difficult maintenance will really be for the more remote locations."

Specifics include:

Page 67: CO2 measurements - first mention of this, should have been called for earlier. Same with sediment traps. Need to be specific that AUV surveys are to map benthic populations.

Long-term monitoring of E. Radiata - seems like an almost verbatim repeat of last paragraph in last section."

Comments on specific elements:

HF Radar

Reviewer 2: "it is not clear to me what will be gained from the HF radar system. I am sure they are very helpful for port and ship operations, and they might be able to detect some local changes in the flow. But should I interpret this activity as a template for many regions? Or is this a shared resource between the port operators and environmental observing system?"

Reviewer 3: "Is there also a specific reason why HF radars are not considered for the Northern region?"

Gliders

Reviewer 2: "One could also ask questions about the glider work. I was impressed by the results from the SLOCUM deployment, but my immediate reaction was that there is little correlation between surveys, i.e. one wants more. But then the plan proposed to use Seagliders on a zig-zag along the coast, where no single section would be repeated. How will these data make a difference to the science issue?"

Reviewer 1: "As one example, consider the proposed Seaglider surveys of Fig 25. The plan is spatially extensive, but with 3-monthly repetition would be temporally aliased. I'd support this as an exploratory effort but probably not as a plan for the next 20 years. Long-term observations would need to focus on key locations (unless the glider program is greatly increased) and higher frequency sampling. Moreover, glider technology, while now nearly mature, requires a very high level of technical support, and the Seaglider is the most technically sophisticated of the designs. I would hope that deepwater gliders can be maintained in Australia, and that may not prove feasible with the Seaglider. So in other words there are substantial remaining issues to be worked out with both the science and the technology. Nevertheless, gliders promise to be an exceptionally valuable tool in coastal and coastal-to-blue water environments, and investment in solving the remaining issues is highly justified."

AUV

Reviewer 4: *" Coral Reefs, and more generally the benthic community are under high threat by acidification, global warming and local anthropogenic pressures. They are not addressed here, but it is proposed to follow marine animals. The proposed observation of the physical parameters and CO2 will help documenting this. However, I would highly recommend an associated program (which may already exist) dealing with at least the Coral Reefs health, if not the whole benthic ecosystem."*

6. Implementation Plan - July 2009 to June 2013

Reviewer 5: *" Section 6.1 - Why PIES on the ITF line? By whom? Why on the shelf? Looks shallow enough for ADCPs. Presume again this is a connection to bluewater/climate but failed to be stated*

7. Describe how data provided by IMOS will be taken up and used by the Node

Reviewer 3: *" There is a long list of research organizations and universities that is given in section 7 but it is not clear to me how they will be involved in the scientific analysis of data from this node."*

Reviewer 5: *" It was clear that circulation modeling will be an integral part of the observing effort in NWA but exactly what will be done wasn't clearly spelled out. This omission may be due to funding constraints (can the funds only go toward infrastructure, and modeling is not considered infrastructure?) but a simple list of modeling components to be utilized would be helpful."*

8. Describe what impact the IMOS observations will have regionally, nationally and globally:

Section 8 - should appear a LOT earlier