REPORT ON THE ENVIRONMENTAL DATA LIBRARY WORKSHOP

April 22-23, 2010

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Version: V0.8

Date: 28th June, 2010

Revision History

Version	Date	Author(s)	Change description
0.1	14/5/2010	P. Flemons	Initial draft – Insert & re-draft personal workshop notes
0.2	17/5/2010	L. Belbin	Re-wrote and re-formatted.
0.3	18/5/2010	P. Flemons	Reviewed, added some text, references and tables, expanded acronyms
0.4	31/5/2010	P. Flemons	Added text based on JE's comments
0.5	4/6/10	P. Flemons	Added text based on JS's comments
0.6	6/6/2010	L. Belbin	Final review/edit
0.7	28/6/2010	L. Belbin	Remove personal contact details from text and tables, revise and update text, pagination and headings, attendees table
0.8	29/6/2010	L. Belbin	Incorporated Krisen's comments
1.0			

Table of Contents

Workshop Attendees

Person	Institution	Interests / Workshop Expectations
Alex Held	CSIRO Marine and Atmospheric Research	Remote sensing
Anna Potter	Geoscience Australia	Marine geoscience
Edward King	CSIRO Marine and Atmospheric Research	Remote sensing
Edward King	CSIRO Marine and Atmospheric Research	Satellite remote sensing
Jane Elith	University of Melbourne	Ecological modelling
Janet Stein	Fenner School of Environment and Society, ANU	Ecological modelling focussed on riverine ecosystems
Jeff Tranter	DEWHA	Ecosystem management
John Wilford	Geoscience Australia	Radiometrics
Kristen Williams	CSIRO Sustainable Ecosystems	Ecological modelling
Lee Belbin	ALA Team Leader	Team Leader, Geospatial Data Management, Atlas of Living Australia (host)
Lucy Randall	Bureau of Rural Sciences	Vegetation modelling
Miles Nichols	ALA Data Manager	Coordinating access to all data held through the ALA
Paul Flemons	Australian Museum	Data management and biodiversity informatics, building web-based data access applications.
Peter Wilson	CSIRO Land and Water	National soil information
Roland Pitcher	CSIRO Marine and Atmospheric Research	Marine community modelling

Introduction

The Atlas of Living Australia integrates a wide range of biological data. Significant value can be added to these data by integrating environmental data such as temperature and rainfall or contextual data such as land-use or land-cover.

A significant aspect of the ALA's spatial portal is a Spatial Analysis Toolkit. A workshop was held December 3-4 to identify a suite of analytical methods that could be effective for this toolkit. Many the methods recommended required environmental data. A wide range of environmental and contextual data would also be useful as basemaps; providing insight into the distribution of biological observations.

This (second) workshop gathered a group with acknowledged Australian expertise in the generation and use of terrestrial, marine and limnetic environmental data. We aimed to identify environmental and contextual layers that would be useful in better understanding Australia's biodiversity. We also wanted to identify and resolve issues that relate to the building of a National Environmental Data Library.

The idea of a National Environmental Data Library (henceforth called the Library) is not new. Henry Nix proposed an Australian Environmental GIS (AEGIS) in 1986. More recently, a National Environmental Information System (NEIS) has been proposed, and in the 2010 budget, a National Plan for Environmental Information (NPEI) was established.

We were also aware that the National Centre for Ecological Analysis and Synthesis (NCEAS) is currently running a project titled "Choosing (and making available) the right environmental layers for modelling how the environment controls the distribution and abundance of organisms." Jane Elith represented that project at this workshop.

The time indeed seems ripe to seed a library of environmental and contextual data that will help scientists, policy makers, environmental managers and the public to better understand and protect Australia's living environment.

Lee Belbin
May 2010

Workshop Aims

The workshop set out to-

- Establish **priorities** for environmental and contextual layers for a National Environmental Data Library
- Develop a draft **classification** of layers
- Decide on a base **resolution**, as necessary
- Determine core **metadata** for priority layers
- Identify data **formats** that should be used for the library

Data Selection Criteria

In addressing the first aim of the workshop, we needed to consider the criteria to be used when deciding which layers to gather for the National Environmental Data Library. For example, on what basis do we include or exclude data from the library? The following were considered relevant to the task-

- ✓ Relevant to the distribution of organisms (the ALA's imperative)
- ✓ Utility as a basemap
- ✓ Availability (currently exists and is available to use)
- ✓ Quality and consistency. There was an acknowledged trade-off between utility in terms of quality and consistency, and availability.
- ✓ Resolution. Should we aim for a consistent resolution? Ideally yes, but currently impractical. Acknowledged implication for analysis and depends on availability.
- ✓ Coverage. At this time, national coverages take priority over regional and local coverages. Regional and local coverages are expected to rise in priority in 2011 and 2012. Choice of regional coverage would depend on consistency and availability across a wide range of environmental layers.
- ✓ Currency. Recent data takes priority over historical data, although historical data are recognized as potentially valuable for temporal studies.
- ✓ Licensing. ALA data is based on a Creative Commons licence. Priority will be given to 'open data' over data requiring a licence fee, except where such data are considered vital to ALA and/or client requirements.

General Issues

Licensing and Intellectual Property

Datasets will have some form of license agreement required for their use by third parties. This is manageable when the organisation providing the data owns the Intellectual Property (IP) of the data. In some cases, an aggregator may have integrated data from multiple sources into a more effective form. Unless a specific agreement exists however, people seeking access to the data will have to negotiate with each of the contributing agencies. For example soil data held by NSW agencies can only be distributed through the NSW state portal.

The ALA does not at this time intend to deliver any complete environmental and contextual datasets from the library to clients. This is the role of the National Plan for Environmental Information (NPEI: http://www.environment.gov.au/npei/index.html) or NEIS. The ALA model is to provide environmental and contextual data *sampled at the locations where biological observations held by the ALA have been made*. This strategy provides for the ready download of integrated datasets and should hopefully simplify licensing arrangements.

Data Resolution

Ideally, data layers in the Library should be available at a range of consistent scales (e.g., 10m, 100m, 250m, 1km, 5km) dependent upon the information content of the underlying source data. Consistency of resolution would enable multiple data layers to be directly used in any analysis. In the same way, wherever possible, it would be hoped that the gridded/raster data could be registered from the same origin.

The scale and consistency of data layers has a considerable bearing on what modelled distributions can be used for. Consistency of scale across layers is important for the extrapolation of a model into geographic space to create a distribution model, as is consistency of scale of source data for the veracity of the derived models. Fine scale data is necessary for the development of models of a scale applicable to local and regional planning purposes.

At this time, it is however highly unlikely that all the data proposed at this workshop could be brought onto a consistent grid without significant processing and potential introduction of unwanted artefacts. The ALA is not in a position to address these issues: It does not have the mandate, the expertise or the time. Existing data aggregations where spatial standards have been applied and the processing well documented will be of particular value in the first instance.

A consistent resolution grid for national coverages is however a goal with significant merit. It is therefore a hope that projects such as the NPEI or NEIS can address this in the near future. Meanwhile, the Library will bring together layers subject to the Selection Criteria, regardless of resolution, scale, origin, precision or accuracy. It is up to the clients to view the associated metadata and the use to which the data will be put through the ALA spatial portal, and make decisions accordingly.

It is acknowledged that some of the methods in the Spatial Analysis Toolkit may require data at a consistent grid resolution. If this is a strong requirement for priority methods, then standard sampling techniques will be used to provide a solution ‘on-the-fly’.

Data Sampling

As noted above, the model used for the Library within the context of the ALA is to only allow for sampling at locations of biological observations. This will be a limitation for modellers wanting to predict distributions of species across the continents or within regions, using their own modelling methods. We envisage that the NPEI or NEIS would be intending to address this limitation. Bandwidth will likely remain an issue for many users for much of the environmental data, for access to environmental layers for online modelling and for downloading.

This data model may create a disconnect between the creation of a distribution model using the sampled data and the ability to apply that model for extrapolation purposes. The ALA will provide species distribution modelling tools (e.g., Maxent and Generalised Dissimilarity Modelling) of limited functionality which will have a set of environmental layers providing clients with the ability to quickly and easily create relatively simple distribution models. This is seen as an important means of offering non expert users a means of understanding what can be achieved with the data and an entree into the world of distribution modelling. However the ALA does not see its primary role as a provider of modelling capability, instead focussing on making integrated data accessible to a broad audience.

Data Format

Getting all proposed data layers into one format and one projection is a massive undertaking that is crucial to any of the data analysis goals. It is anticipated that data would be stored as NetCDF (network Common Data Form) files on ARCS (Australian Research Collaboration Services) and be indexed using the THREDDS (Thematic Real time Environmental Distributed Data Services) catalogue.

The ALA may also store the data in a form that permits rapid access for analytical purposes. This format has yet to be fully determined, but will be clearly announced when determined. The ALA will wherever possible develop web service access to analyses and data that are deemed of high utility/significance.

Categorical Data and Look-Up Tables

Many of the categorical layers such as lithology, soils etc are not, in their original categorical state, easily usable in modelling and other analysis applications. The main problem for species modelling is that most of these layers have many categories, requiring at least one estimated parameter per category. This places too high a demand on scarce biological data. A mapping of categories to a continuous data format using a look up table will enable effective data to be supplied for analysis.

Metadata

It is essential that complete metadata be available for all acquired layers. In order to assess their priority (see the selection criteria) for acquisition and to create a metadata record for the data in the Library, we should have at least the following data fields supplied (in decreasing order of importance):

- Metadata URL
- Description
- Organisation/point of contact
- Resolution
- Units
- Category classification
- Mapping accuracy
- Parameter uncertainty

Automation of Data Updates

The ALA would like to simplify and where possible automate the provision of data to the library by custodians. The ALA also recognizes the need to log usage and make that data available to custodians.

The Future Role of This Group

It was recognized that there was an on-going need for a group like those attending this workshop to provide on-going management and advice on the Library. This expertise is also expected to be valuable for the NPEI and NEIS projects. The makeup, process and mechanisms for this group were not fully identified at the workshop, but the need for such a group was endorsed.

Workshop participants were already signed up to the ALA-Google Group and it was therefore expedient for the moment, to use this group to discuss ongoing Library-related issues-

- Composition of a management group
- Developing a management structure and processes
- Disseminating information about new data
- Refine criteria for data evaluation and apply to proposed data
- Discussing data formats, resolution and processing
- Metadata standards, adequacy and consistency
- References for papers of relevance to the Library
- Analytical techniques related to the use of Library data
- Feedback on utility of the library
- Identify priorities for data custodians
- Liaison and migrations to NPIE and NEIS

Species and Geography

There are two ways that the spatial portal will integrate biological, environmental and contextual data. The two basic requirements from user needs analyses are

1. Where does species X occur? The outcome is points on a map.
2. What species occurs in this area? In this case, area can be defined in a number ways and the ALA will need to be able to handle most-
    a. Bounding box (minimum bounding rectangle)
    b. User-defined polygon
    c. Point and radius (with point defined on map or by latitude/longitude or street address)
    d. Predefined unique polygon (e.g., a catchment, State/Territory, IBRA region)
    e. A polygon class (e.g., land-use or vegetation class). This usually implies more than one polygon.
    f. A suite of polygons that are defined by an environmental envelope.

The ALA has set up a gazetteer web service that will enable the location of named features including polygon classes.

Data Model

A distributed data model has been the standard as the data resided with the custodians in a form that suited their in-house applications. Data could be exposed in a form that could be harvested and integrated. For small volumes of data (e.g., metadata), this approach can work well. The downside is that infrastructure is replicated and that changes to data need to be mirrored and indexed. With larger data volumes, a distributed approach is less appealing.

The *National Collaborative Research Infrastructure Strategy* (NCRIS) provides hosting mechanisms through ARCS and ANDS. Wherever possible, the ALA will use this infrastructure to host biological and environmental data. It is likely that a replicated-centralized strategy will be used. Data will ideally be located near the clients with greatest needs.

The Data

This section provides a general overview of the data identified during the workshop as applicable to the ALA's brief for the Library. There was also some broad ranging but incomplete discussion (due to time constraints) around what makes a good predictor and the relevant merits of proximal versus distal predictors. Rather than attempt to cover this discussion here please refer to the reference list at the end of this section for literature that deals with these issues.

Marine Data

A useful starting point is the CSIRO Atlas of Regional Seas data (CARS) that is publically available at (http://www.cmar.csiro.au/cars/). These data contain worldwide estimates of the following variables in the three dimensions of latitude, longitude and depth

- Temperature
- Salinity
- Oxygen
- Nitrate
- Silicate
- Phosphate

There are seasonal predictions for the above, standard deviation, min and max and some measures of seasonal harmonics. These are climatological averages on a 0.01degree grid, but the underlying data are not that dense.

Geoscience layers that could be provided include-

- Bathymetry
- Topography
- Geomorphology – classified geomorphology, e.g., slope shelf abyssal plain etc – based on DEM (Digital Elevation Model) plus local research – polygonal
- Sediments
- % Carbonate
- Grain size fractions – sand, mud, gravel

Seabed stress – influenced by storms – at 0.1 degrees and shallower than 10m – from hindcast wind wave may be available. We appear to need something that separates tidal stress from annual wind regime (which gives orbital velocity at seabed), from storms.

Satellite Derived Marine Data

It is recognized that the utility of satellite-based remote sensing data will substantially increase in significance over time. Satellite data is a key source for deriving a range of marine variables including some of those mentioned above in the CARS. The following issues were discussed-

- Chlorophyll
- K490 – light attenuation at 490nm (indicates the turbidity of the water column - how visible light in the blue to green region of the spectrum penetrates within the water column)
- Estimated benthic irradiance
- Sea surface temperature. IMOS(Integrated Marine Observing System) SST (Sea Surface temperature) activity happening inside the Bureau of Meteorology (BoM) – world's best practice, updated every day and going back to 1990 by using archives. Area: all EEZ (Exclusive Economic Zone), down to Antarctica. Full resolution from their receiving stations at 1km resolution with composites every 14 days. These are put into a mosaic and remapped into a geographic projection and are the recommended product. They are experimenting with an hourly SST as well.
- Ocean colour ~ biology of ocean and optical water quality. Surrogates for NPP (Net Primary Productivity) and highly correlated with turbidity.
- Geoscience Australia is doing some high resolution bathymetry mapping from remote sensing.

The Australian Oceans Distributed Active Archive Centre (AO-DAAC) has remote sensed data that can be requested for any area. The DAAC locates the data and joins it into a product. The DAAC uses ARCS infrastructure, NetCDF and THREDDS standards.

Marine Data Wish List

- Exposure to incident wave energy. Marine CERF (Commonwealth Environment Research Facilities) Hub
- Wind
- Net Primary Productivity (NPP) – a MODIS derived product from SST, chlorophyll and K490. Annual and seasonal data available.
- From NPP: organic carbon deposited to seabed
- From NCEAS project: Ph, thermocline depth, Carbon / organic C composition of sediments and substrate consolidation ("penetrometer") – i.e., measure of softness of sediment
- Local means and upwelling could be obtained through a monthly mean of Ocean Colour and give an indication of unusual or extreme events that might determine species distributions.
- BioClim layers for the Marine environment – this could potentially be done using Moderate Resolution Imaging Spectroradiometer (MODIS) data.

Limnetic Environment Data

- 9 second (~250m) DEM – stream segments (approximately 1:250K map scale). Attributes calculated at 3 spatial scales – link, immediate sub-catchment, entire upper catchment. Also the catchments are hierarchical with drainage intelligent coding based on the Pfafstetter system. Numerous attributes calculated (climate, catchment and valley morphology, substrate, catchment water balance, vegetation, indicators of disturbance). Janet Stein has the data organized as lookup tables that join to the stream network segments and associated catchments through a shared segment identifier. Note: Tasmania and Victoria have some more detailed information available - at a map scale of 1:25,000.
- Janet has calculated a monthly time series of runoff estimates for the period 1970 to 2008. Summary statistics (e.g. mean, maximum, percentiles, measures of variability etc.) were calculated from the full time series and for a 30 year period 1971 to 2000 for each stream segment. For northern Australia Janet has also calculated "wateryness" (how many water features in area such as lakes, rivers, water holes, springs etc).
- Baseline NPP using audit data (Janet suggests there could be better data available)
- Disturbance indicators – e.g., proportion of catchment used for various activities such as urban, mining etc. These figures are based on 2009 land-use data
- Human population density in sub-catchments and catchments
- River disturbance indicators based on Janet's work on the wild rivers projects.
- GeoFabric – Australian Hydrological Geospatial Fabric (AHGF) from the Bureau of Meteorology (BoM) to use 1 sec SRTM (Shuttle Radar topography Mission) DEM. This will replace the 9 second DEM derived catchment boundaries, stream networks etc after the second half of 2011 . Note: the SRTM data are quite different to the interpolated 9 sec DEM – the latter is pre-European; the SRTM shows quarries etc – i.e., it's the human impacted elevation.
- Little consistent, continent-wide environmental information is available for other aquatic systems (wetlands, lakes , groundwater dependent/ karst systems). This is a major gap

Terrestrial Climate Data

- Compiling or generating the best available environmental layers and processing these (applying spatial standards) for use in biodiversity models (such as GDM), covering most of the major known environmental drivers of distributional patterns in terrestrial biodiversity (factors related to climate, terrain, substrate, disturbance, biotic habitat type and structure). Currently 1km resolution data, Australia-wide.
- Jenny Kesterven and Mike Hutchinson are working on extremes including frosts, consecutive days over x degrees, etc.
- Terrain-corrected radiation needed
- Humidity. Wet and dry bulb to get monthly humidity and VPD (Vapour Pressure Deficit). Kristen has been calculating relative humidity as it is useful for estimating atmospheric moisture stress in a proximal way for terrestrial biodiversity modelling.

- Janet: Can produce useful summaries from time series of year to year variation. How much does rainfall vary year to year? This is not standard package data. Fenner School now has relevant data but has not processed it.
- Kristen also looked at seasonality of rainfall. Instead of continuous quarters which is used in BIOCLIM, fixed consecutive months were used (e.g., Nov-Dec-Jan rainfall etc) and expressed as a ratio of summer to winter rainfall, applied as a factor.
- Kristen: Has applied a simple tipping-bucket water balance model which combines spatial variation in soils with climate (rainfall, evaporation). Can also apply a similar model in GROWEST. Preference is to use a model that is spatially distributed and multi-layered (wish list).
- Kristen: Rates of change in climate – the amount of change in one month's rainfall and temperate to the next gives change towards wetter/drier and colder/hotter seasons. I.e., is the plant preparing to grow or survive? This picks up autumn and spring effect for temperature and rainfall, e.g., flush of growth, preparation for winter. This is a useful additional climatic effect and is akin to terrain roughness.
- Snow cover / depth – a wish list item.
- Kristen's work was for DEWHA (Department of the Environment Water and Heritage) applied at 1km – Janet's data was a base and to this was added the above mentioned factors. Future work aims to develop/apply, for example -
    - Thermal sums over the day (gets around problem of growing degree days and choosing thresholds etc). Integrated with day length.
    - Topographic adjustment of solar radiation (SRAD application) with implications for adjusted estimates of temperature and evaporation.

Bureau of Rural Science Contextual Data

- Nationally responsible for land use data – including modelled data. Degrees of intervention – relatively natural through to intensive use (various classifications).
    - Catchment scale is polygon data that is updated by the States, is consistent and accurate.
    - National scale data is modelled based on NOAA (National Oceanic and Atmospheric Administration) AVHRR (Advanced Very High Resolution Radiometer) data at 1km resolution ("spread" model).
    - Potentially can go down to commodities with groupings such as horticulture.
- National forest inventory: latest is 2008 and they are done every 5 years. States do the mapping and BRS (Bureau of Resource Sciences) integrates it into a single product.
- Vegetation assets, states and transitions (VAST). Originally done nationally by Richard Thackway; a combination of NVIS (National Vegetation Information System) data and land use data.
- Land Cover, with Geoscience Australia is based on MODIS vegetation index – an unsupervised classification using sampled vegetation data to calibrate it. 250m resolution.
- Integrated vegetation – for cover classes to be used for modelling purposes.
- Some problems in national consistency due to poor data from some states.

- Rainfall reliability - Greg Laughlan's rainfall reliability wizard. 1km resolution.
- Multi Criteria Analysis System data sets – DAFF (Department of Agriculture, Fisheries and Forestry) and ERIN (Environmental Resources Information Network) wanted the spatial data. Lucy integrated it and put it into Multi-Criteria Analysis Shell for Spatial Decision Support (MCAS-S). Booklet and CD with data (National resources mapping toolkit); data can be downloaded from web. MCAS-S can be used for example to identify where to plant trees in the landscape.

Soil Data

Australian Soils Resource Information System (ASRIS) is a compilation of State and Federal soil data. It is built mostly on a historical mapping classification.

The atlas of Australian soils is based on ASRIS with derived expert character attribution tables. Polygon dataset at 1:2million.

Late 1990's audit 1 collected and collated soil point data. These were used in multi criteria analyses to derive a set of surfaces for the east coast and some areas of western Australia.

ASRIS1+ Southwest Western Australia, agricultural areas of South Australia, bits of Victoria and Tasmania, New South Wales, Queensland are complete and Northern Territory has good coverage. Data is in a single database and managed at CSIRO. Data used to be downloadable but licensing issues have stopped that. The work is not currently funded. It is collaborative and we have to keep all the partners happy. The product can be used in agreed ways only. Limitations vary from State to State. For example, NSW want to provide the data and Victoria is limited to using 3rd party providers. A project such as the ALA may be able to setup specific use agreements but would have to do so with each state. This is going to be a common problem for any national scope projects wanting an integrated dataset.

There is now a draft set of interpreted products of area weighted averages at 250m scale with the national committee of soil and terrain. They hope to make it available by the end of 2010.

Another factor influencing soil data availability is the consortium for the global soil map. They have 6 priority measures using a continuous spline for estimating to depth plus an estimate of uncertainty. This would be 90m resolution map. There is however still considerable negotiation about what exactly needs to be supplied. There is a 5-10 year time horizon for the completion of this work.

We are currently trying to find out what different user communities want. The project is moving from descriptive phase into temporal flux soil parameter phase. They are starting to use remote sensed data but products only look at the top 2mm. Airborne radiometrics are delivering more information.

Note: There is a good web site in the states where soils data can be queried and a product delivered for the type of data required by the user (PW: URL?)

Satellite imagery

Australian remote sensing work and data has been fragmented. A number of Australian

agencies have replicated work with slightly different parameters. AusCover intends to bring much of this work together.

The Distributed Access Archive Centre (DAAC) will be freely distributing derived products via the AusCover portal, not raw satellite data. The resolution is usually coarse 1 to 5km; sometimes with time series e.g., MODIS data. These are called essential climate variables by climate community. Soil surface characteristics and coastal areas are of special interest.

The MODIS data are ready and available through ARCS and CSIRO underway with BoM so that BoM data are visible via AusCover. Water division of BoM are the most advanced in terms of how data are managed and made available. Water balance modelling is of high interest.

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Appendix: Identified Data Layers

Table 1: Terrestrial Data

Layer	Contact
Terrestrial - Existing	
Australian Bathymetry and Topography Grid (250m)	Geoscience Australia
9sec DEM	Fenner School, ANU
Solar Radiation topographically corrected by DEM?	CSIRO Land and Water
Bioclim layers - Janet	Fenner School, ANU
Vapour Pressure Deficit	CSIRO Sustainable Ecosystems
Relative humidity	CSIRO Sustainable Ecosystems
Rates of change in max and min temp and in rainfall (climatic roughness)	CSIRO Sustainable Ecosystems
DEWHA layers by Kristen for GDM (1km now - aiming for 250m)(including substrate, climate, terrain)	CSIRO Sustainable Ecosystems
Land cover layers (including NVIS and other veg data)	Bureau of Rural Sciences
Terrain - list of terrain variables developed or compiled by Janet	Fenner School, ANU
Net Primary Productivity (DCC - Forest productivity index)	Bureau of Rural Sciences
AWAP - Australian Water Availability Project	CSIRO Marine and Atmospheric Research
Grazing pressure	Bureau of Rural Sciences
Ferals data	Bureau of Rural Sciences
Threat map of Australia	Department of Environment, Water and Heritage
Soils - Northcott (now)	CSIRO Land and Water
Soils - ASRIS collated National layer (end of year)	CSIRO Land and Water
Geochemical map of Australia - new	Geoscience Australia
Geology - 1/1 million map	Geoscience Australia
weathering	Geoscience Australia

radiometrics	Geoscience Australia
inherent fertility index	Department of Environment, Water and Heritage
Geological age	CSIRO Sustainable Ecosystems
Geodata topo 250k	Geoscience Australia
Wish list	
Potential layers - summaries of year to year variations in monthly and rainfall	Fenner School, ANU
Snow cover	Fenner School, ANU
Quantitative values for lithology that are ecologically/hydrologically meaningful	Fenner School, ANU CSIRO Sustainable Ecosystems
fire compiled from states (from MODIS)	CSIRO AUSCOVER

Table 2: Marine Data

Layer	Contact
Marine - Existing	
CARS layers(e.g., temp & salinity: see Roland's List worksheet)	CSIRO Marine and Atmospheric Research
Australian Bathymetry and Topographic Grid- DEM include bathymetry, topography slope and aspect,	Geoscience Australia
Exposure to incident energy - energy regime	CSIRO Marine and Atmospheric Research
Sediment parameters, % carbonate, sand, mud, gravel,	CSIRO Marine and Atmospheric Research
Geomorphology - expert panel derived	Geoscience Australia
Satellite derived - climate annual averages and seasonality/ range, chlorophyll a, K490,	CSIRO Marine and Atmospheric Research
Estimated benthic irradiance	
Net Primary Productivity products, sea surface temperature , chlorophyll a	CSIRO Marine and Atmospheric Research
Expected organic carbon exported to seabed	
GEOMAX - includes circulation wind etc., pulls out sea floor stress, ran for 1990's,	CSIRO Marine and Atmospheric Research
land Pitcher provided a list of layers post workshop which can be accessed through	

Roland or Lee Belbin	
Wish list	
Combine NCEAS list with a few from Roland	University of Melbourne
Marine Canyons - mapping in train	Geoscience Australia
Roland's Wish list:	CSIRO Marine and Atmospheric Research
Better bathymetry source underlying the DEM, some locations are very sparse and there are some gaps. Ultimately, LADS and/or swathe coverage everywhere to get fine scale topography, reef vs. sedimentary etc…	
Better source underlying CARS…higher density of CTD casts. Adding AIMS data would be a good start.	
Seabed stress: the Geoscience Australia GEOMACS model stress data that the CERF is using is only 0.1 degree res, does not cover shallower than 20m or deeper than 200m. It also combines tide and wind stress, including storm & cyclones but only for the 10 year period of the 1990s. What we really need is bed stress at 0.01 degree resolution, separately due tides, geostrophic currents, mean monthly wind, and for cyclones and storm events for the entire recorded history of these events…to generate a climatology for stress due to tides, to currents, to winds, and to events – for depths from 0 to abyssal. This would also provide energy exposure for shallow marine habitats where wind wave energy is a major structuring force.	Geoscience Australia
Cloud cover: e.g., number of cloud free days each month per pixel…maybe better still, predicted surface irradiance that takes cloud cover etc into account.	
Satellite radar rainfall	
Frequency/probability of fronts and cold/warm core eddies derived from SST and or ocean-colour data	
Sediment carbon/organic carbon content. C/N ratio.	
Mineralogy of sediments.	
Something about sediment softness that could be measured by a penetrometer, I think Ana would probably know the proper names for the variable I mean.	

Table 3: Other Layers

Layer	Contact
Limnetic - existing	
Janet Steins LUT's (Janet provided a spreadsheet of these post workshop – contact Janet or Lee Belbin for access to the spreadsheet)	Fenner School, ANU
BOM Point contextual (gauging stations etc)	Bureau of Meteorology
National Catchment boundaries	Fenner School, ANU Geoscience Australia
AusHydro	Geoscience Australia
Wishlist	
Environmental attribution for other aquatic systems (e.g. lakes, wetlands, groundwater dependent systems)	
Satellite - Existing	
Sea Surface Temp	CSIRO Marine and Atmospheric Research
LAI	CSIRO Marine and Atmospheric Research
MODIS (NDVI) - composite	CSIRO Marine and Atmospheric Research
NOAA AVHRR NDVI 5km - (historical pre feb 2000)	CSIRO Marine and Atmospheric Research
Satellite – Wish list	
Ocean Colour derivatives (chlor A, K	CSIRO Marine and Atmospheric Research
Radar	CSIRO Marine and Atmospheric Research
Fire	CSIRO Marine and Atmospheric Research
(FPAR) Fraction of Photosynthetically active radiation	CSIRO Marine and Atmospheric Research
Other Climate - Existing	
Extreme climatic events	Fenner School, ANU