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Moving Virtual Research Environments from high maintenance Stovepipes to Multi-purpose Sustainable Service-oriented Science Platforms

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The researcher of today is likely to be part of a team distributed over multiple sites that will access data from an external repository and then process the data on a public or private cloud or even on a large centralised supercomputer. They are increasingly likely to use a mixture of their own code, third party software and libraries, or even access global community codes. These components will be connected into a Virtual Research Environments (VREs) that will enable members of the research team who are not co-located to actively work together at various scales to share data, models, tools, software, workflows, best practices, infrastructures, etc. Many VRE's are built in isolation: designed to meet a specific research program with components tightly coupled and not capable of being repurposed for other use cases - they are becoming 'stovepipes'. The limited number of users of some VREs also means that the cost of maintenance per researcher can be unacceptably high.

The alternative is to develop service-oriented Science Platforms that enable multiple communities to develop specialised solutions for specific research programs. The platforms can offer access to data, software tools and processing infrastructures (cloud, supercomputers) through globally distributed, interconnected modules.

In Australia, the Virtual Geophysics Laboratory (VGL) was initially built to enable a specific set of researchers in government agencies access to specific data sets and a limited number of tools, that is now rapidly evolving into a multi-purpose Earth science platform with access to an increased variety of data, a broader range of tools, users from more sectors and a diversity of computational infrastructures. The expansion has been relatively easy, because of the architecture whereby data, tools and compute resources are loosely coupled via interfaces that are built on international standards and accessed as services wherever possible. In recent years, investments in discoverability and accessibility of data via online services in Australia mean that data resources can be easily added to the virtual environments as and when required.

Another key to increasing to reusability and uptake of the VRE is the capability to capturing workflows so that they can be reused and repurposed both within and beyond the community that that defined the original use case. Unfortunately, Software-as-a-Service in the research sector is not yet mature. In response, we developed a Scientific Software solutions Center (SSSC) that enables researchers to discover, deploy and then share computational codes, code snippets or processes both in a human and machine-readable manner.

Growth has come not only from within the Earth science community but from the Australian Virtual Laboratory community which is building VREs for a diversity of communities such as astronomy, genomics, environment, humanities, climate etc. Components such as access control, provenance, visualisation, accounting etc. are common to all scientific domains and sharing of these across multiple domains reduces costs, but more importantly increases the ability to undertake interdisciplinary science. These efforts are transitioning VREs to more sustainable Service-oriented Science Platforms that can be delivered in an agile, adaptable manner for broader community interests.