SedEdu: developing and testing a suite of computer-based interactive educational activities for introductory sedimentology and stratigraphy courses

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SedEdu

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Abstract

SedEdu is a suite of computer-based interactive educational activities for introductory sedimentology and stratigraphy courses; it is free, cross-platform Python, and open-source.

SedEdu is comprised of "modules" which are coupled with "activities" that guide students through a concept, incrementally introducing components of the subject, and testing for understanding and retention throughout the activity.

rivers2stratigraphy is one module that illustrates the concept of the construction of fluvial stratigraphy through a laterally migrating river that leaves behind a channel-sand body after avulsion.

Students can modulate system properties like water discharge, subsidence rate, and avulsion timescale, and observe changes in the developed stratigraphic record.

We are particularly seeking advice/feedback on: 1) how to get **SedEdu** into classrooms, 2) how to design tests of the active learning approach, and 3) collaborators on the project.

SedEdu modular framework

SedEdu is modular: modules are developed and maintained by individuals, and are only collated into the framework during the program building phase.

Anyone can contribute a module with little work!

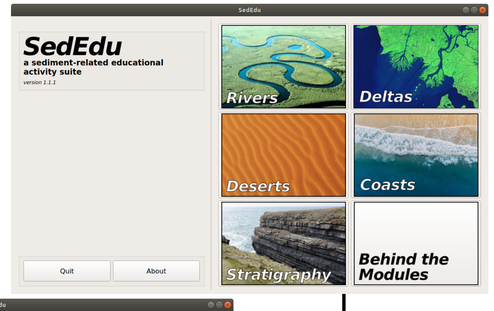
SedEdu
- organizational structure
- easily launched
- displays module metadata
- handles locating and launching activites
- Python

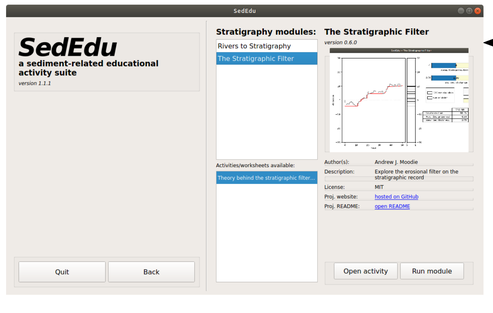
rivers2stratigraphy
- independent module code
- module activity docs
- `about.json` file

`git submodule add`

Modules are managed as `git submodules`, making updating seamless and intuitive.

In the interface, clicking on a "category" button on the main menu will take you to that category page, where you will see the available modules and associated activities in lists.





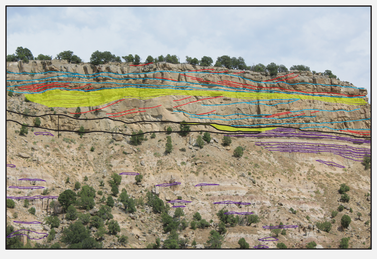
Getting started

```
conda install -c sededu rivers2stratigraphy
```
or
```
pip3 install pyqt5 rivers2stratigraphy
```

and then

```
import rivers2stratigraphy
rivers2stratigraphy.run()
```

Teaching with rivers2stratigraphy

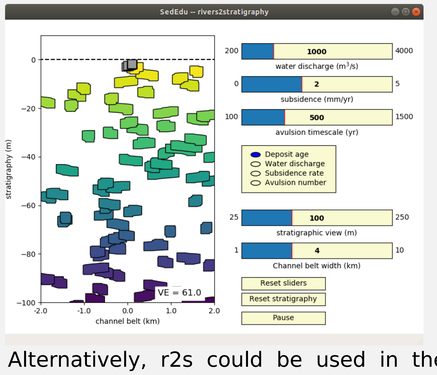


A traditional lab to teach aspects of alluvial architecture might ask students to:

1) interpret an outcrop photograph

2) draw conclusions about: channel stacking, sand body thickness, cross-cutting relationships.

For example the above outcrop shows small isolated channels in the lower section (purple) and a highly amalgamated channel rich body in the upper section (yellow), which may be interpreted in a variety of ways. For example, the change could be related to subsidence, avulsion, sediment supply, climate change, and/or basin geometry change.



The interactive r2s module allows students to modulate the river characteristics and see the resultant stratigraphy in real time.

This type of active learning is powerful when coupled with traditional laboratory activities. For example, the students may be asked to demonstrate that their interpretation of the above outcrop is valid, using r2s.

Alternatively, r2s could be used in the classroom prior to the lab, as students are introduced to the concept of basin subsidence, sediment reworking, and construction of alluvial stratigraphy.

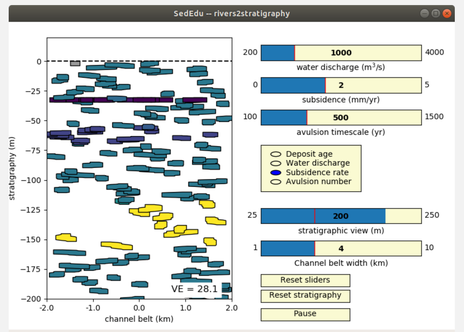
Further, the activity can be quantitatively engaged by exploring controls necessary to reproduce field observations and calculating statistics on an r2s output as though it were a real outcrop.

Examples: rivers2stratigraphy

Subsidence controls

The rate of subsidence in a basin strongly controls alluvial architecture.

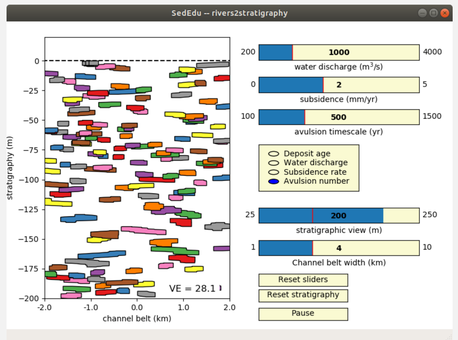
In the experiment at right, subsidence was increased from 2 mm/yr (background, light blue) to 5 mm/yr (yellow); with faster basin subsidence rates, channels become less concentrated.



Later, brief reductions in subsidence are less perceptible (dark blue = 1 mm/yr, purple = 0 mm/yr), unless they last long enough to produce a laterally continuous sand body (overlapping channels).

Hypothetical question for students: which subsidence signal is more likely to be preserved and measurable in exposed outcrop across the present land surface?

Avulsion controls



Alluvial architecture is signficantly affected by the location of new channel development during avulsion.

This process is uniformly-random in the module (each channel cycle has a unique color); as a result, more frequent avulsions (f_A) cause more connected and concentrated channels.

In the experiment above, the avulsion timescale ($T_A = 1/f_A$) was increased from 500 yr (background) to 1500 yr, then back to the background scale, then reduced to 100 yr, and finally back to the background timescale.

Contributing to SedEdu

SedEdu is free, cross-platform, and open-source and is hosted on GitHub at:

```
-- https://github.com/sededu/sededu
-- https://github.com/sededu/rivers2stratigraphy
```

The **SedEdu** project needs contributions from the community to be successful. However, there are many different ways you can contribute! You do not even need to write code to contribute to **SedEdu**. Some opportunities for contributions are listed below (in no particular order):

-- write (code) a standalone interactive module
-- write an activity for an existing module
-- write (code) features and bug fixes for modules
-- write (code) features and bug fixes for **SedEdu**
-- write documentation for **SedEdu**

Join us!!