Hypothesis Array Salinity

Does providing a hypothesis array help students make meaning from an unfamiliar data set?

The exploration of large professionally collected data sets is important in the practice of geoscience. However, being able to visualize and interpret such data sets can be difficult for students, especially when the data represent a 3D volume. It is a pedagogical challenge to scaffold students' data exploration without giving them step-by-step instructions. One promising approach, investigated in this study, is to provide students with a *hypothesis array*.

A hypothesis array provides a range of candidate hypotheses which students can potentially use to organize their data exploration, much as multiple working hypotheses can help direct expert's exploration of new data. Hypothesis arrays are distinct from multiple choice questions, in that the alternative response options are designed to guide student's thinking rather than assess their understanding. Hypothesis arrays may scaffold students' attempts to organize their observations, by laying out the pertinent dimensions along which observations could profitably be considered (Kastens, Agrawal, &Liben, 2009).

Twenty-six undergraduates enrolled in an introductory environmental science course, with some exposure to earth data and estuarine processes, participated in the current study. Students were asked to describe and interpret visualizations of Mediterranean salinity data while thinking aloud in response to guiding questions and being eye-tracked.
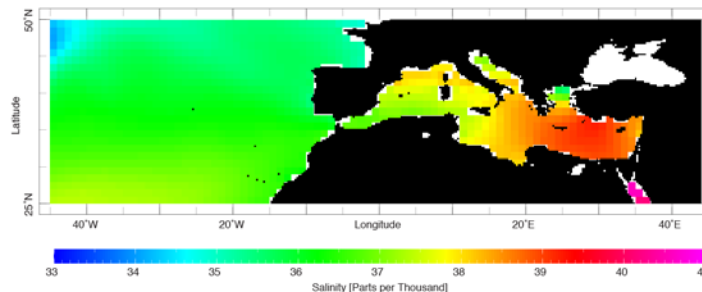

Figure 1.Map of salinity data from the Mediterranean. All students saw this image.

In a two-dimensional interpretation task, students were asked to interpret the process that led to the elevated salinity and E/W salinity gradient of the Mediterranean. For this task, students are required to make observations from the data provided in map of salinity data from the Mediterranean (Figure 1), and are not provided with any interpretive aids. Then, half of the students wereprovided with a verbal hypothesis array, outlining four possible interpretations, and asked to pick the correct interpretation.
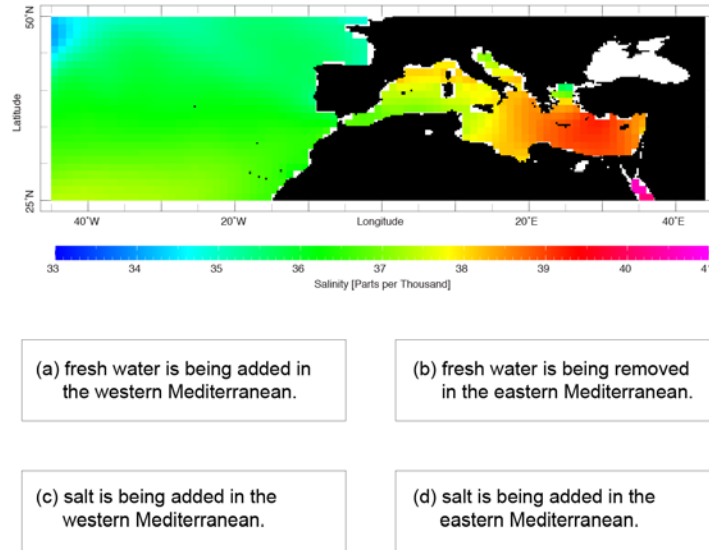
Figure 2.Map of salinity data from the Mediterranean with a verbal hypothesis array. The verbal hypothesis array outlines four potential interpretations of the E/W salinity gradient. Only half of the students saw this image.

The next section of the study examined students ability to detect and interpret the salt tongue west of Gibraltar. This task is a three-dimensional task, requiring students to coordinate information from the salinity map, pictorial hypothesis array options, and three vertical data profiles. Students were initially provided with just a pictorial hypothesis array outlining four possible interpretations of how the water is flowing into or out of the Mediterranean. Students were asked to identify the correct interpretation; however, the data provided in the hypothesis array and the map, even taken together, are insufficient to complete this task; further information is required.
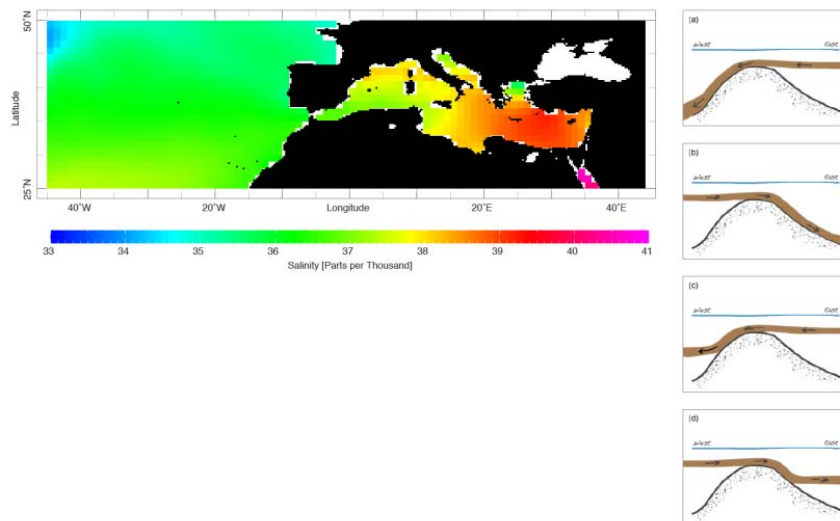

Figure 3.Map of salinity data from the Mediterranean with a pictorial hypothesis array. The pictorial hypothesis array outlines four potential interpretations of the salt tongue west of Gibraltar. All students saw this image.

Students are then provided enough information to complete this task. Students are successively presently three vertical data profiles of the water column west of Gibraltar. Students were asked to examine the three vertical data profiles and re-evaluate their initial interpretation of the pictorial hypothesis array. For those students who had initially chosen an incorrect response option from the pictorial hypothesis array, this item also examined students' willingness to change their hypothesis in the face of conflicting data.
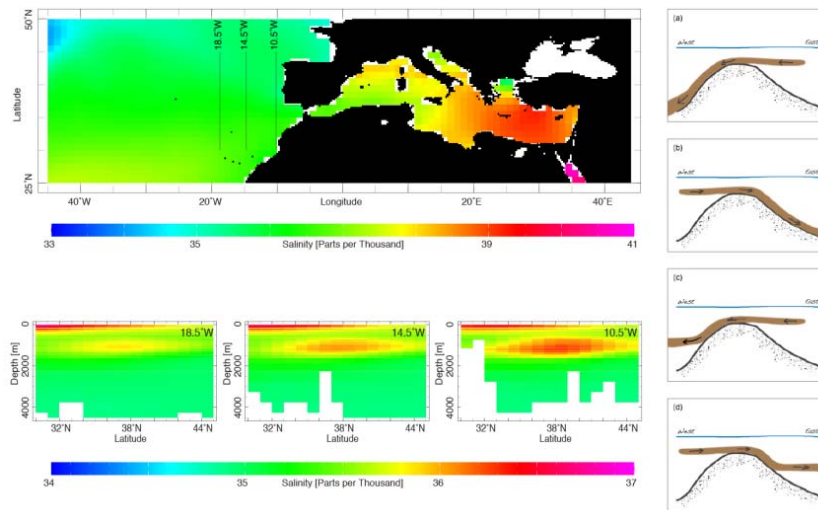

Figure 4.Map of salinity data from the Mediterranean with a pictorial hypothesis array and three vertical data profiles. All students saw this image.