GEOSPATIAL ANALYSIS FOR THE SELECTION OF ZONES UNDERGROUND STORAGE IN COLOMBIA: SINÚ-SAN JACINTO BASIN CASE ⋆

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Abstract: These instructions give you guidelines for preparing papers for IFAC technical meetings. Please use this document as a template to prepare your manuscript. For submission guidelines, follow instructions on paper submission system as well as the event website.

Keywords: Underground Storage, CO2, Sinu San Jacinto Basin, geospatial analysis

1. INTRODUCTION

In recent years, the imperative to address climate change has necessitated intensified efforts to mitigate greenhouse gas emissions. Carbon capture and storage (CCS) has emerged as a promising strategy, involving the capture and subsurface storage of carbon dioxide (CO2) emissions from industrial processes. However, successful CCS implementation critically hinges upon the identification of optimal zones for underground CO2 storage.

This study focuses on the Sinú-San Jacinto basin and aims to employ geospatial analysis techniques to select a suitable exploration zone for underground CO2 storage. Three key factors will be considered for informed decision-making: proximity to major CO2-emitting cities, the presence of mud volcanoes, and data availability encompassing well data, 2D seismic lines, and 3D seismic data.

Proximity to major CO2-emitting cities within the Sinú-San Jacinto basin constitutes the first factor for evaluation. Selecting a storage zone in close proximity to these urban areas minimizes costs and complexities associated with CO2 transport. Additionally, such proximity presents a more effective solution for reducing carbon footprints in these specific regions.

The presence of mud volcanoes in the Sinú-San Jacinto basin constitutes the second significant factor. These volcanoes, characterized by the emission of natural gases and hot mud, provide indicators of geological activity and subsurface structural variations. Evaluating their presence enhances our understanding of stability and CO2 retention capacities within the selected zone.

Finally, data availability encompassing geospatial data, existing well data, 2D seismic lines, and 3D seismic data in the Sinú-San Jacinto basin represents a crucial factor for analysis. These data sources provide valuable insights into the area's geology, subsurface characteristics, and technical feasibility of underground CO2 storage. Their integration enables comprehensive and precise assessments of potential exploration zones.

By integrating these three factors within the geospatial analysis framework, this study aims to identify an optimal exploration zone in the Sinú-San Jacinto basin that satisfies requirements related to proximity to major CO2-emitting cities, accounts for mud volcano presence, and leverages available data, including well data, 2D seismic lines, and 3D seismic data.

Ultimately, this project aims to provide evidence-based recommendations for stakeholders involved in the implementation of carbon capture and storage technologies within the Sinú-San Jacinto basin. By selecting a suitable zone for underground CO2 storage, this research endeavors to contribute to greenhouse gas emission mitigation efforts and advance towards a more sustainable and climate-resilient future.

2. METODOLOGY

Next we see a few subsections.

2.1 Review Stage

For submission guidelines, follow instructions on paper submission system as well as the event website.

Note that conferences impose strict page limits, so it will be better for you to prepare your initial submission in the camera ready layout so that you will have a good estimate for the paper length. Additionally, the effort required for final submission will be minimal.

2.2 Equations

Some words might be appropriate describing equation (1), if we had but time and space enough.

⋆ Sponsor and financial support acknowledgment goes here. Paper titles should be written in uppercase and lowercase letters, not all uppercase.

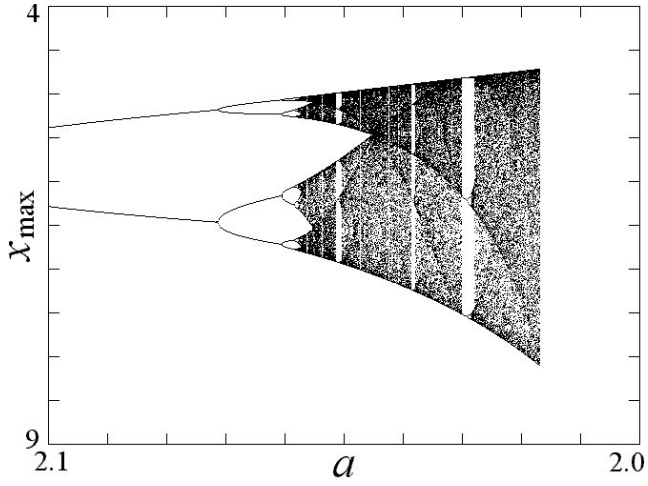

Fig. 1. Bifurcation: Plot of local maxima of x with damping a decreasing

$$\frac{\partial F}{\partial t} = D\frac{\partial^2 F}{\partial x^2}. \tag{1}$$

See Able (1956), Able et al. (1954), Keohane (1958) and Powers (1985).

Example. This equation goes far beyond the celebrated theorem ascribed to the great Pythagoras by his followers.

Theorem 1. The square of the length of the hypotenuse of a right triangle equals the sum of the squares of the lengths of the other two sides.

Proof. The square of the length of the hypotenuse of a right triangle equals the sum of the squares of the lengths of the other two sides.

Of course LaTeX manages equations through built-in macros. You may wish to use the `amstex` package for enhanced math capabilities.

2.3 Figures

To insert figures, use the `graphicx` package. Although other graphics packages can also be used, `graphicx` is simpler to use. See Fig. 1 for an example.

Figures must be centered, and have a caption at the bottom.

2.4 Tables

Tables must be centered and have a caption above them, numbered with Arabic numerals. See table 1 for an example.

Table 1. Margin settings

Page	Top	Bottom	Left/Right
First	3.5	2.5	1.5
Rest	2.5	2.5	1.5

2.5 Final Stage

Authors are expected to mind the margins diligently. Papers need to be stamped with event data and paginated for inclusion in the proceedings. If your manuscript bleeds into margins, you will be required to resubmit and delay the proceedings preparation in the process.

Page margins. See table 1 for the page margins specification. All dimensions are in *centimeters*.

2.6 PDF Creation

All fonts must be embedded/subsetted in the PDF file. Use one of the following tools to produce a good quality PDF file:

PDFLaTeX is a special version of LaTeX by Han The Thanh which produces PDF output directly using Type-1 fonts instead of the standard `dvi` file. It accepts figures in JPEG, PNG, and PDF formats, but not PostScript. Encapsulated PostScript figures can be converted to PDF with the `epstopdf` tool or with Adobe Acrobat Distiller.

Generating PDF from PostScript is the classical way of producing PDF files from LaTeX. The steps are:

(1) Produce a `dvi` file by running `latex` twice.
(2) Produce a PostScript (`ps`) file with `dvips`.
(3) Produce a PDF file with `ps2pdf` or Adobe Acrobat Distiller.

2.7 Copyright Form

IFAC will put in place an electronic copyright transfer system in due course. Please *do not* send copyright forms by mail or fax. More information on this will be made available on IFAC website.

3. RESULTS

Use SI as primary units. Other units may be used as secondary units (in parentheses). This applies to papers in data storage. For example, write "15 Gb/cm^2 (100 Gb/in^2)". An exception is when English units are used as identifiers in trade, such as "3.5 in disk drive". Avoid combining SI and other units, such as current in amperes and magnetic field in oersteds. This often leads to confusion because equations do not balance dimensionally. If you must use mixed units, clearly state the units for each quantity in an equation. The SI unit for magnetic field strength **H** is A/m. However, if you wish to use units of T, either refer to magnetic flux density **B** or magnetic field strength symbolized as μ_0 **H**. Use the center dot to separate compound units, e.g., "A $\cdot$ m^2".

4. DISCUSSION

4.1 Figures and Tables

Figure axis labels are often a source of confusion. Use words rather than symbols. As an example, write the quantity "Magnetization", or "Magnetization M", not just "M". Put units in parentheses. Do not label axes only with units. For example, write "Magnetization (A/m)" or "Magnetization (Am^{-1})", not just "A/m". Do not label axes with a ratio of quantities and units. For example, write "Temperature (K)", not "Temperature/K".

Multipliers can be especially confusing. Write "Magnetization (kA/m)" or "Magnetization (10^3A/m)". Do not write "Magnetization (A/m) × 1000" because the reader would not know whether the axis label means 16000 A/m or 0.016 A/m.

4.2 References

Use Harvard style references (see at the end of this document). With LaTeX, you can process an external bibliography database using `bibtex`, [1] or insert it directly into the reference section. Footnotes should be avoided as far as possible. Please note that the references at the end of this document are in the preferred referencing style. Papers that have not been published should be cited as "unpublished". Capitalize only the first word in a paper title, except for proper nouns and element symbols.

4.3 Abbreviations and Acronyms

Define abbreviations and acronyms the first time they are used in the text, even after they have already been defined in the abstract. Abbreviations such as IFAC, SI, ac, and dc do not have to be defined. Abbreviations that incorporate periods should not have spaces: write "C.N.R.S.", not "C. N. R. S." Do not use abbreviations in the title unless they are unavoidable (for example, "IFAC" in the title of this article).

4.4 Equations

Number equations consecutively with equation numbers in parentheses flush with the right margin, as in (1). To make your equations more compact, you may use the solidus (/), the exp function, or appropriate exponents. Use parentheses to avoid ambiguities in denominators. Punctuate equations when they are part of a sentence, as in

$$\int_0^{r_2} F(r,\varphi) dr d\varphi = [\sigma r_2/(2\mu_0)] \cdot \int_0^{\inf} exp(-\lambda|z_j - z_i|)\lambda^{-1} J_1(\lambda r_2) J_0(\lambda r_i) d\lambda \tag{2}$$

Be sure that the symbols in your equation have been defined before the equation appears or immediately following. Italicize symbols (T might refer to temperature, but T is the unit tesla). Refer to "(1)", not "Eq. (1)" or "equation (1)", except at the beginning of a sentence: "Equation (1) is ...".

4.5 Other Recommendations

Use one space after periods and colons. Hyphenate complex modifiers: "zero-field-cooled magnetization". Avoid dangling participles, such as, "Using (1), the potential was calculated" (it is not clear who or what used (1)). Write instead: "The potential was calculated by using (1)", or "Using (1), we calculated the potential".

[1] In this case you will also need the `ifacconf.bst` file, which is part of the `ifaconf` package.

A parenthetical statement at the end of a sentence is punctuated outside of the closing parenthesis (like this). (A parenthetical sentence is punctuated within the parentheses.) Avoid contractions; for example, write "do not" instead of "don' t". The serial comma is preferred: "A, B, and C" instead of "A, B and C".

5. CONCLUSION

A conclusion section is not required. Although a conclusion may review the main points of the paper, do not replicate the abstract as the conclusion. A conclusion might elaborate on the importance of the work or suggest applications and extensions.

ACKNOWLEDGEMENTS

Place acknowledgments here.

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Appendix A. A SUMMARY OF LATIN GRAMMAR

Appendix B. SOME LATIN VOCABULARY