Universidade Federal do Paraná
Programa de Pós-Graduação em Geologia

GEOL7048: Tópicos Especiais em Geologia Exploratória II

Métodos semiquantitativos

Saulo P. Oliveira

Departamento de Matemática, Universidade Federal do Paraná

UFPR
UNIVERSIDADE FEDERAL DO PARANÁ

Aula 17

- Transformada Signum

Motivação

Anomalia magnética de um dique vertical no polo:

$$M(x) = M(x, z=0) = A\left(\tan^{-1}\frac{x+a}{h} - \tan^{-1}\frac{x-a}{h}\right)$$

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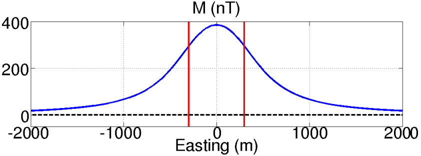

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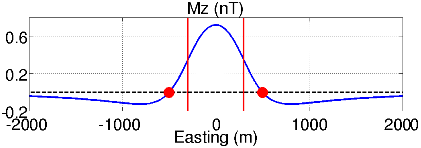

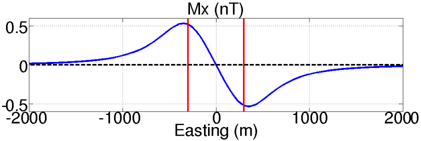

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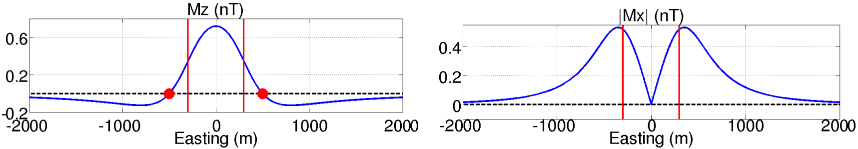

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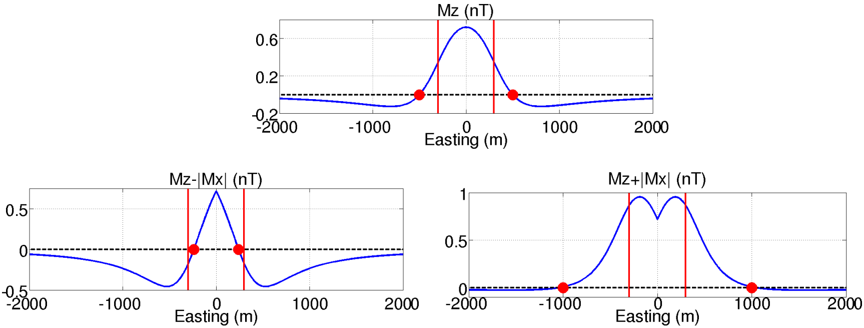

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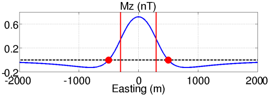
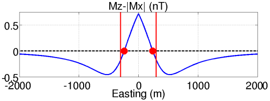
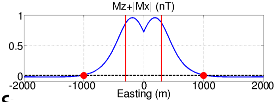


$$M_z(x_v) = \frac{\partial M}{\partial z}(x_v) = 0 \Longrightarrow x_v = \pm\sqrt{a^2+h^2}$$



$$M_z(x_{vh-}) - |M_x(x_{vh-})| = 0$$
$$\Longrightarrow x_{vh-} = \pm(h - \sqrt{a^2+2h^2})$$



S

$$M_z(x_{vh+}) + |M_x(x_{vh-})| = 0$$
$$\Longrightarrow x_{vh+} = \pm(h + \sqrt{a^2+2h^2})$$

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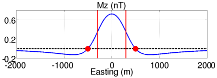
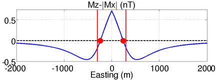


$$x_v = \pm\sqrt{a^2 + h^2}$$



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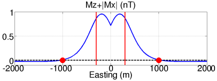

$$x_{vh+} = \pm(h + \sqrt{a^2 + 2h^2})$$

Resolvendo para a profundidade (h) e a meia-largura (a):

$$h = \frac{x_v^2 - x_{vh_-}^2}{2x_{vh_-}} \qquad a = \sqrt{x_v^2 - h^2}$$

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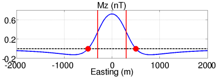

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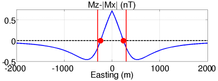

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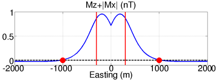

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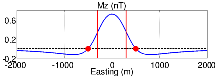

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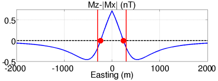

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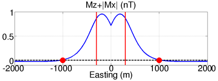

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Como encontrar x_v, x_{vh_+} e x_{vh_-} ?

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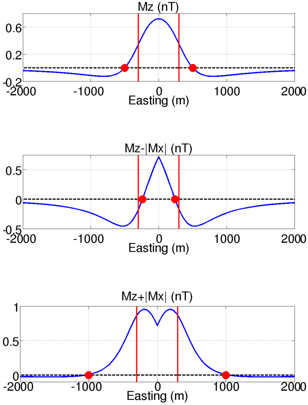
Signum transform

$$ST[f](x) = \begin{cases} \dfrac{f(x)}{|f(x)|}, & f(x) \neq 0, \\ 1, & f(x) = 0 \end{cases}$$



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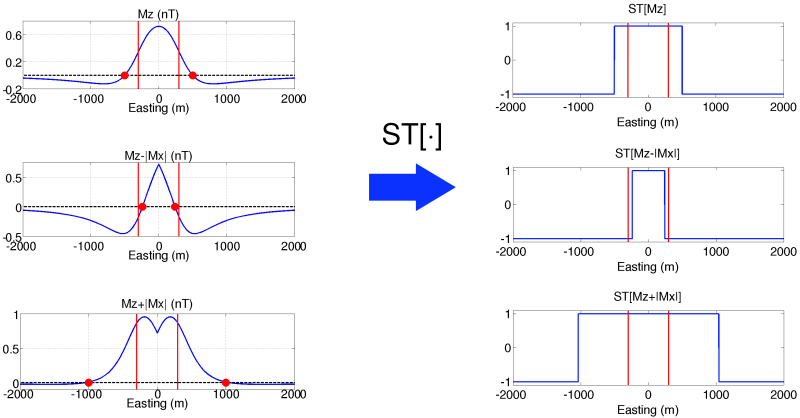
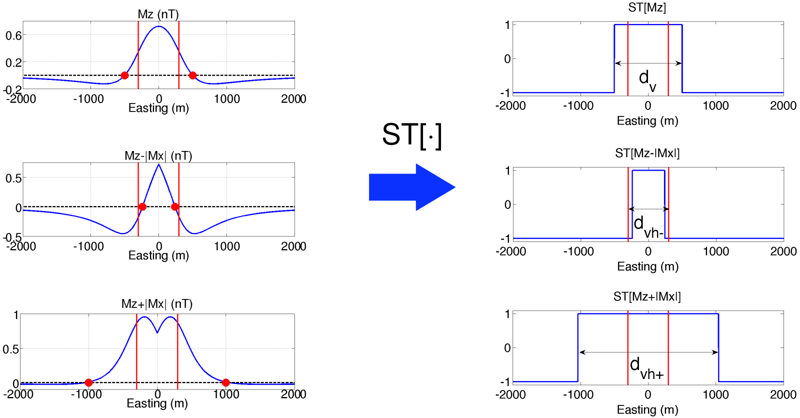
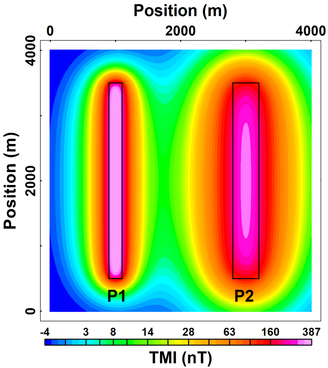


Signum transform

$$d_v = x_v^+ - x_v^-,\qquad \begin{cases} d_{vh-} = x_{vh-}^+ - x_{vh-}^- \\ d_{vh+} = x_{vh+}^+ - x_{vh+}^- \end{cases}$$



Extensão para 2D



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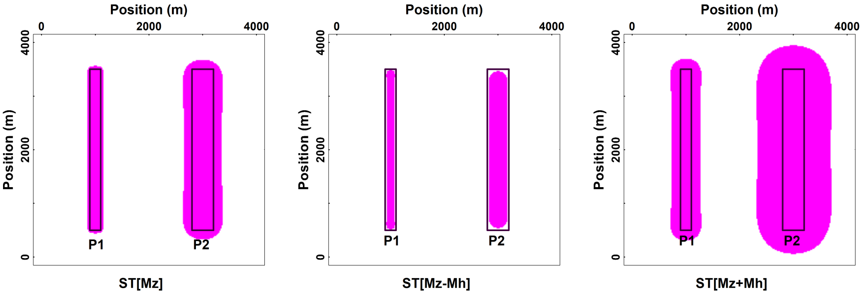

$$M_x \longleftrightarrow M_h, \qquad M_h = \text{GHT}$$

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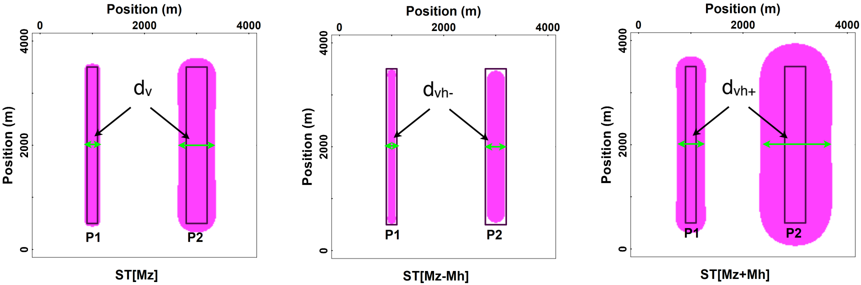

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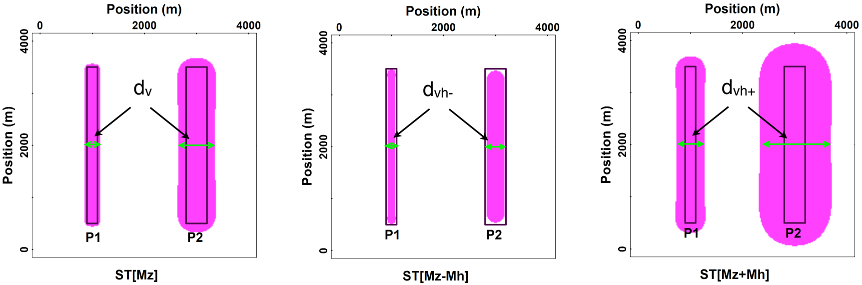

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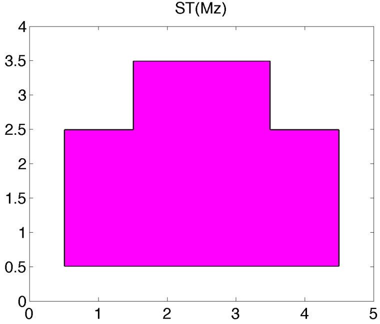
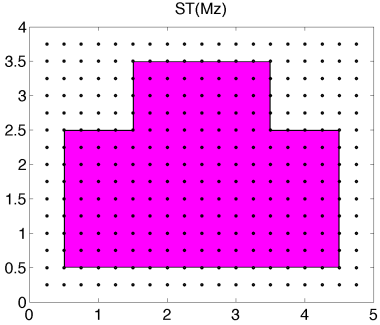
Algoritmo

Var. de entrada: S=ST$[M_z]$



Algoritmo

Var. de entrada: S=ST[M_z] e um grid G



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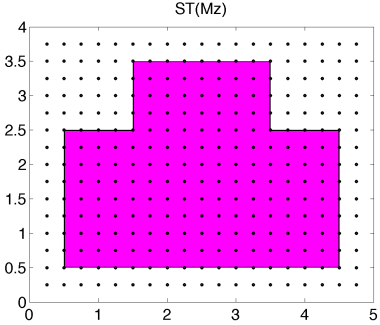

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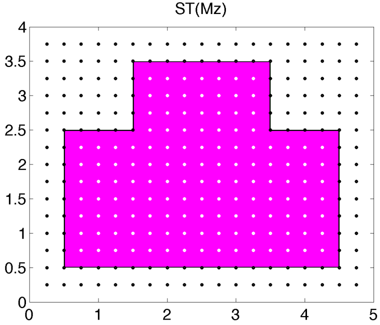

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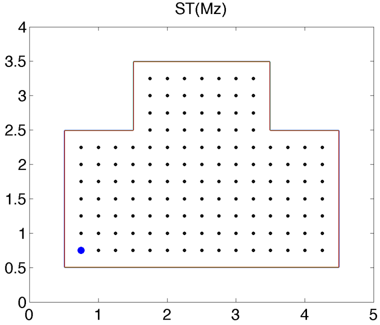

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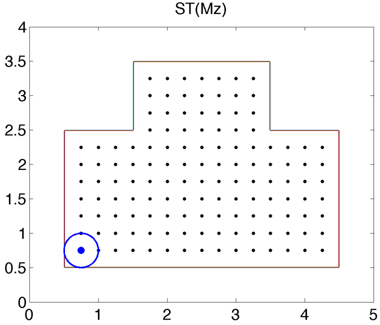

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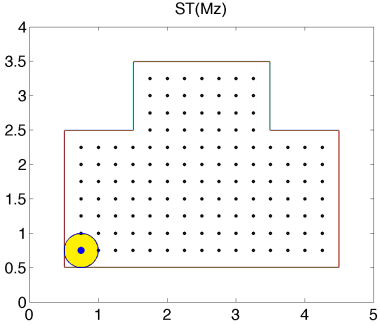

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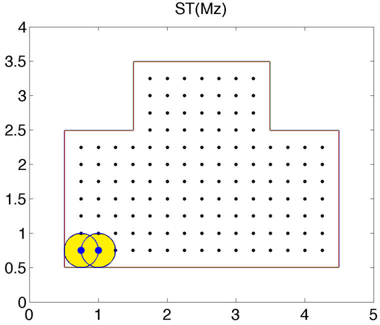

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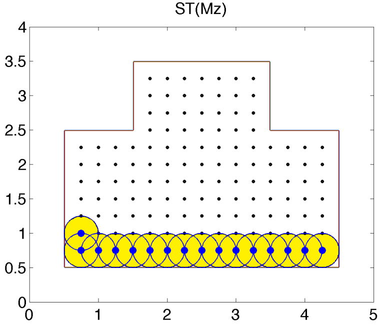

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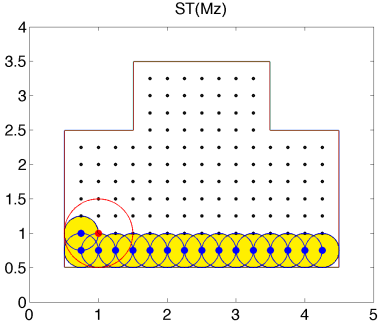

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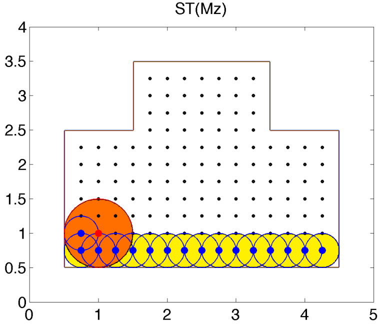

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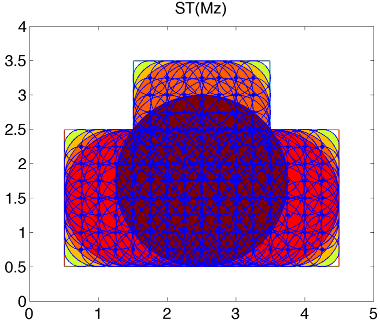

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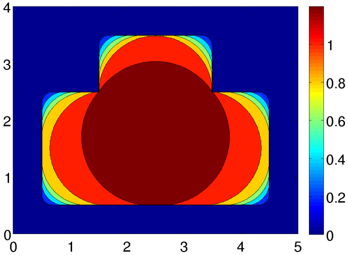
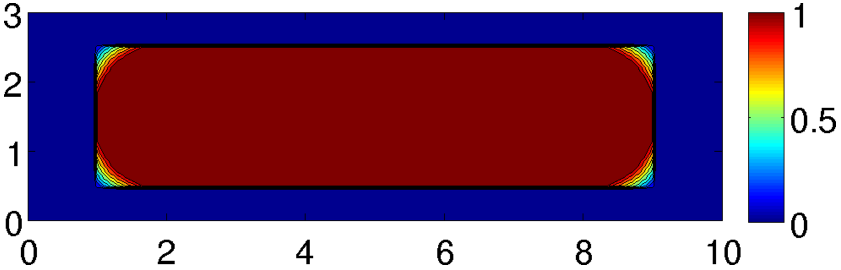
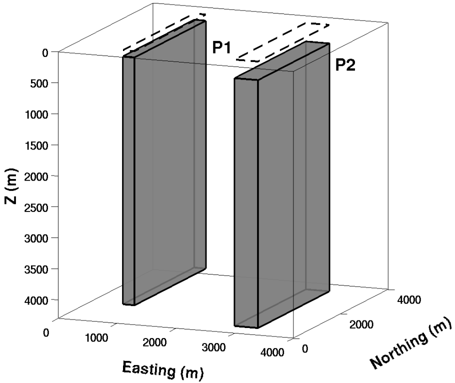


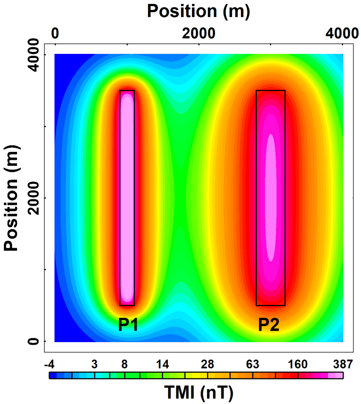
Algoritmo

Em corpos quase 1D, o algoritmo retorna $x_v \approx$ const



Exemplos (dados sintéticos)



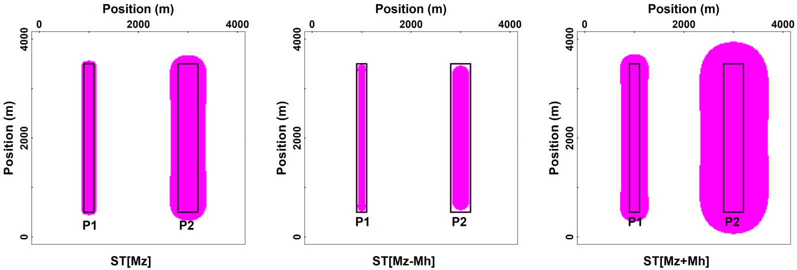


P1: $h = 100m,\ a = 200m,\ L_y = 3000m,\ L_z = 4000m$

P2: $h = 300m,\ a = 400m,\ L_y = 3000m,\ L_z = 4000m$

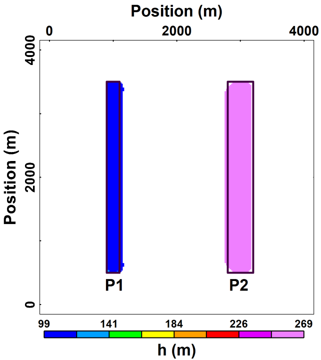
Exemplos (dados sintéticos)

Transformadas Signum:



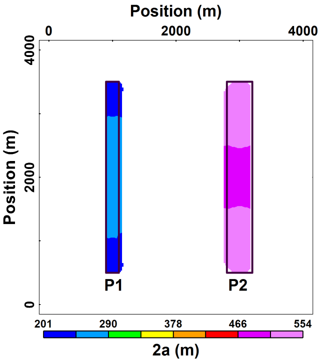
Exemplos (dados sintéticos) • • •

Prof.



$$h = \frac{x_{vh_+} - x_{vh_-}}{2}$$

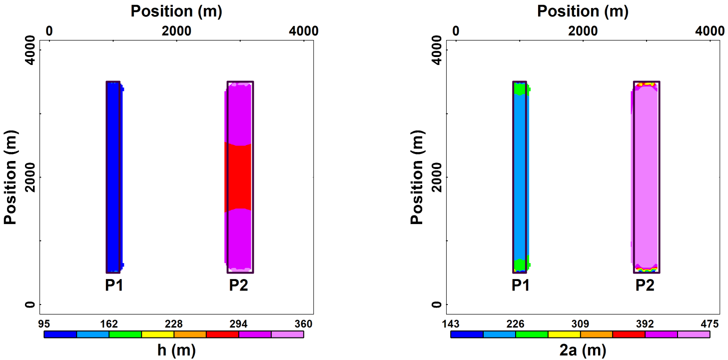
1/2 larg:



$$a = \sqrt{x_v^2 - h^2}$$

Exemplos (dados sintéticos) • • •

Prof. 1/2 larg:

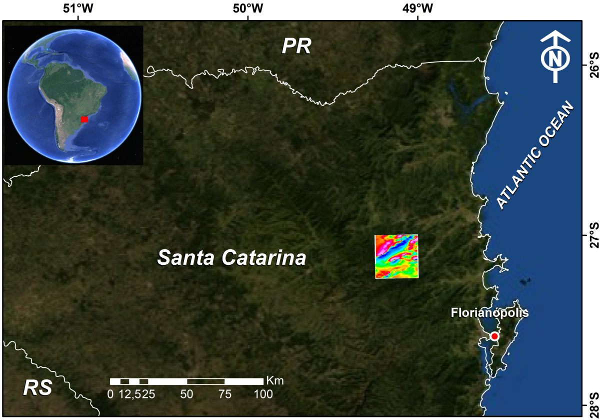


$$h = \frac{x_v^2 - x_{vh_-}^2}{2x_{vh_-}}$$

$$a = \sqrt{x_v^2 - h^2}$$

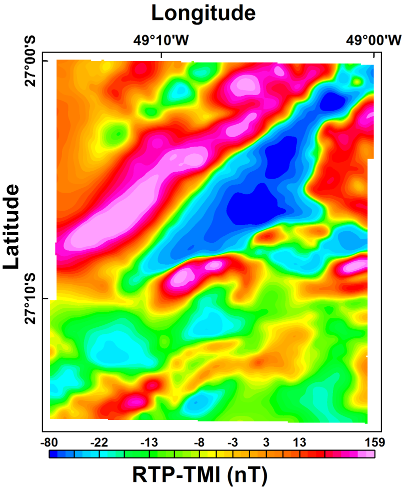
Exemplos (dados reais)

Localização:



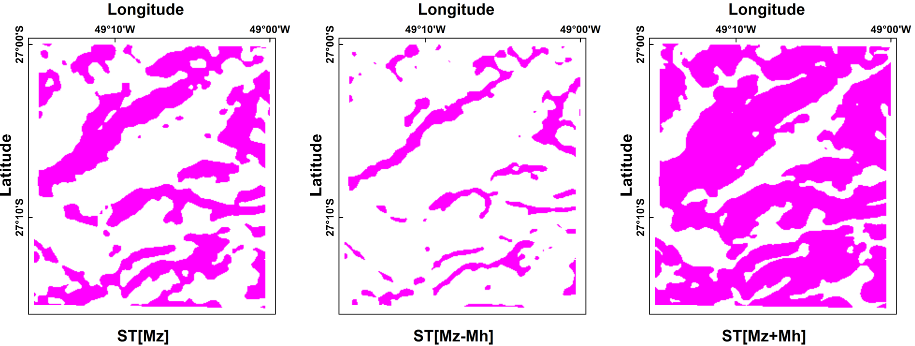
Exemplos (dados reais)

Anomalia magnética (reduzida ao polo, upward continued / 500m):



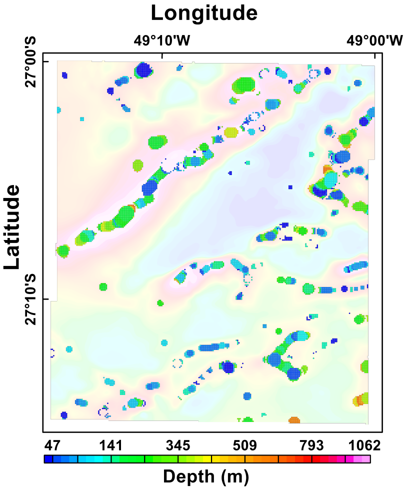
Exemplos (dados reais)

Transformadas Signum:

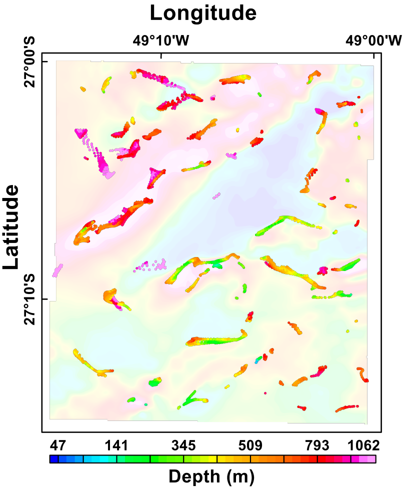


Exemplos (dados reais)

Prof. (ST)



Prof. (Euler)



Exemplos (dados reais)

Meia-largura: