

POLYTECHNIQUE
MONTREAL

WORLD-CLASS
ENGINEERING



MPS Simulation Using ERGO Database

Phase # 1: Unconditional 2D Models

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Contents

- Introduction
- Training Images (Channels, Carbonates, Fractures)
- Unconditional 2D simulations
- Simulations Using Rotation and Affinity
- Validations
- Conclusions

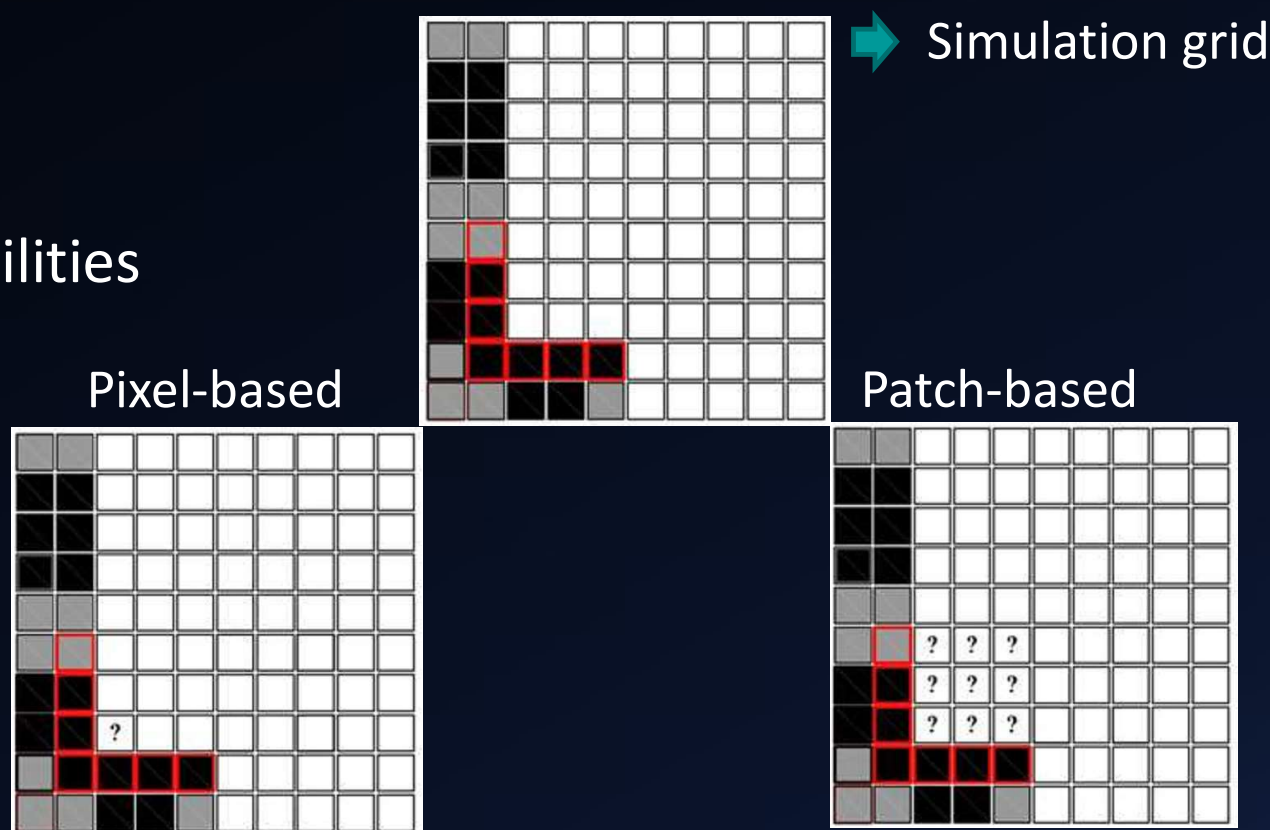
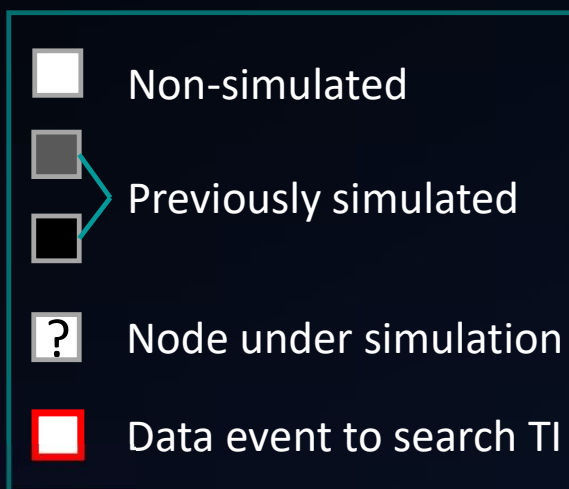


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Patch-based multiple-point geostatistics

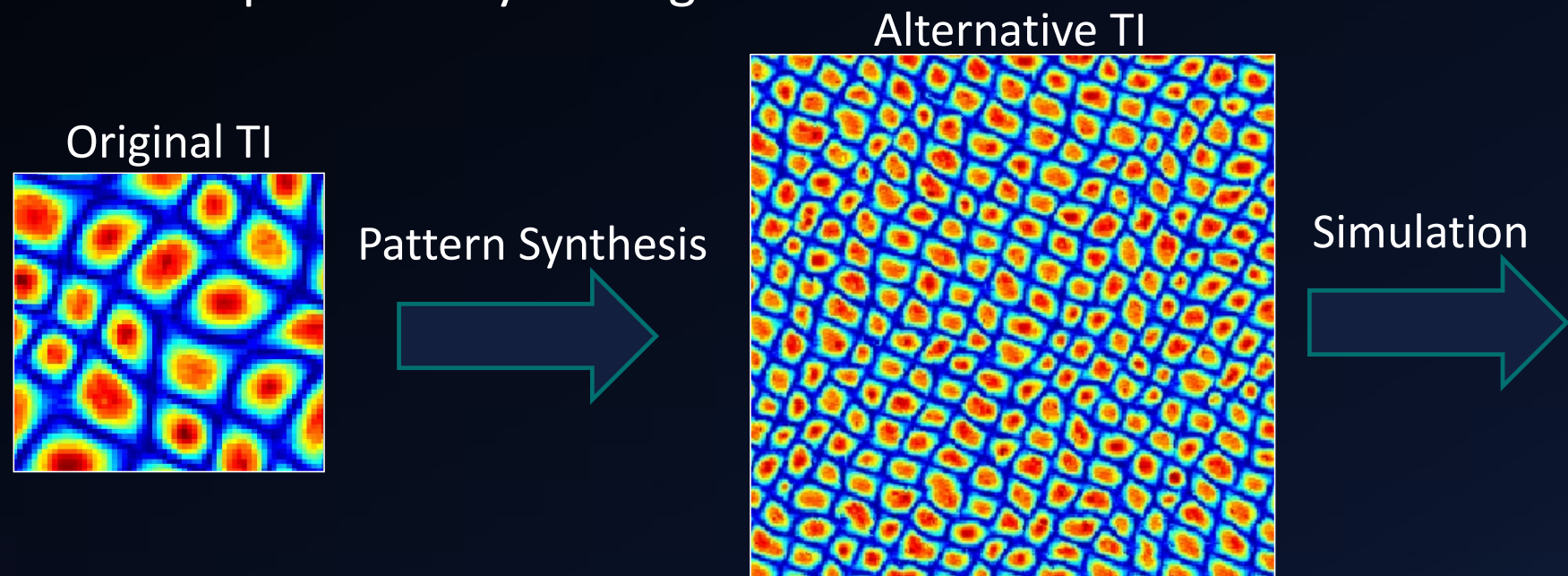
- Better continuity
- Less CPU
- Less conditioning flexibilities





Alternative Training Images (ATIs)

- Should not be a mere copy
- Should keep its fidelity to Original TI





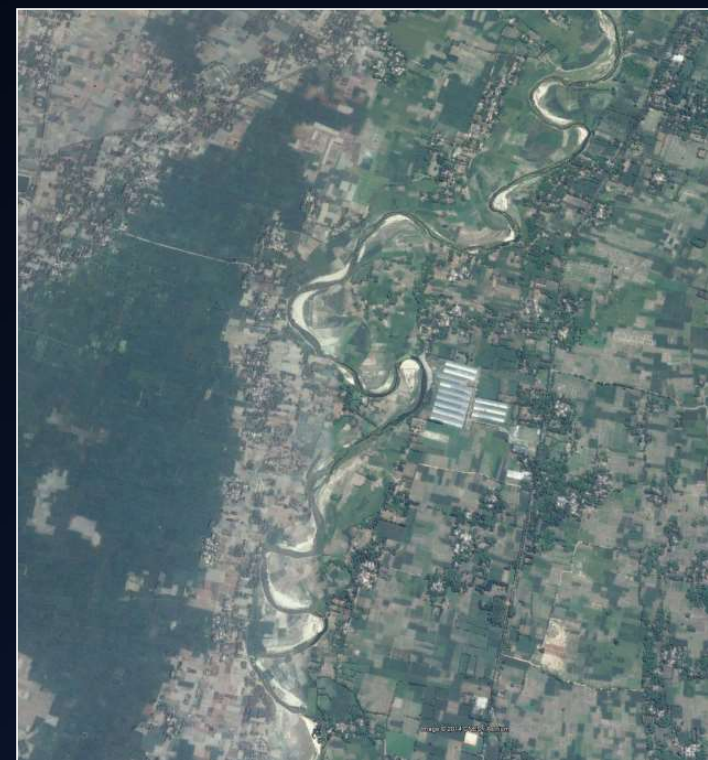
- Introduction
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TI1&2

Schooner Cays Carbonates, Bahamas



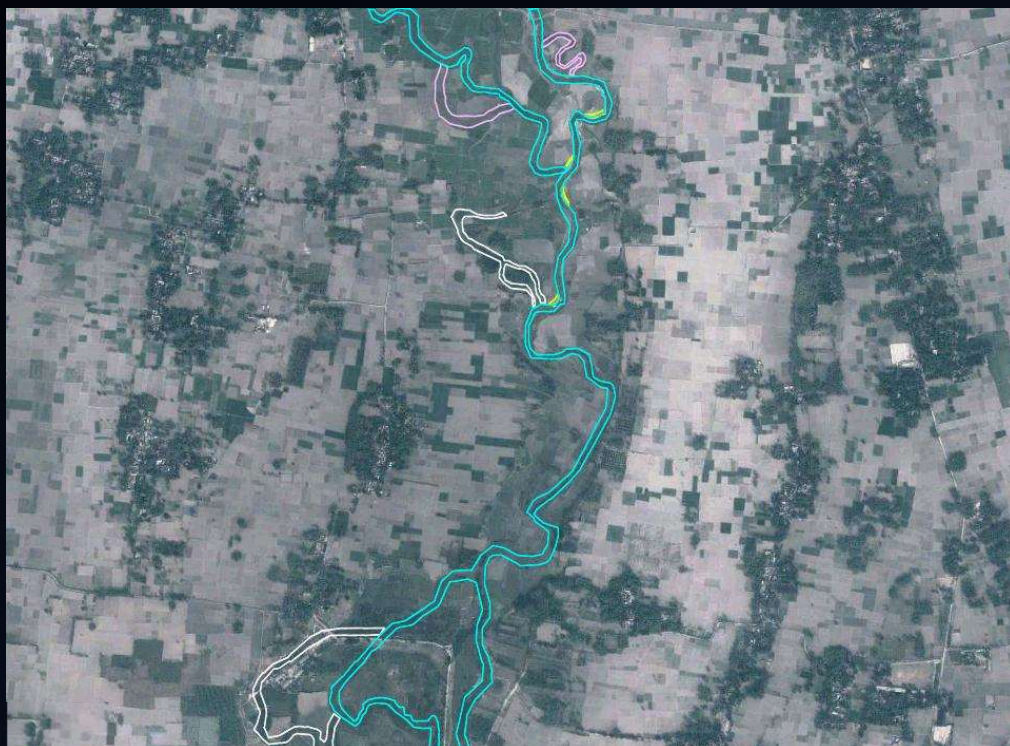
Tista Fan, Bangladesh





TI#3&4

Curvilinear Channel

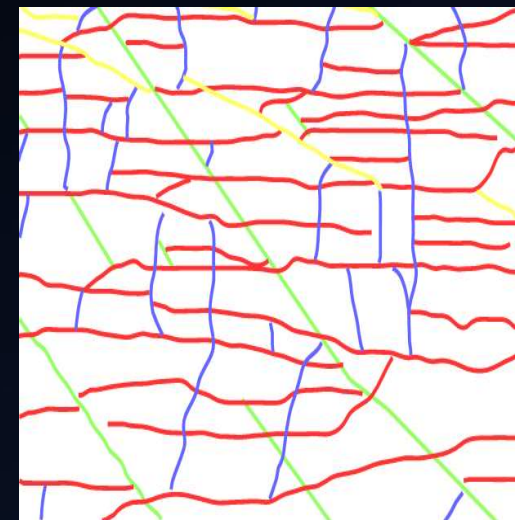
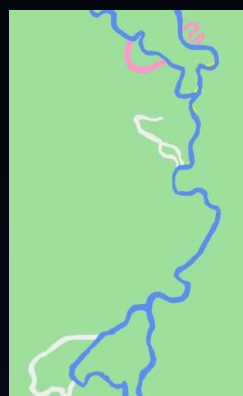


Fractures





Coded TIs

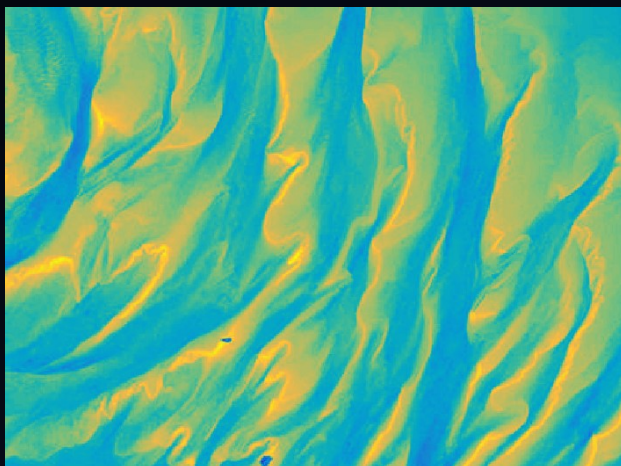




- Introduction
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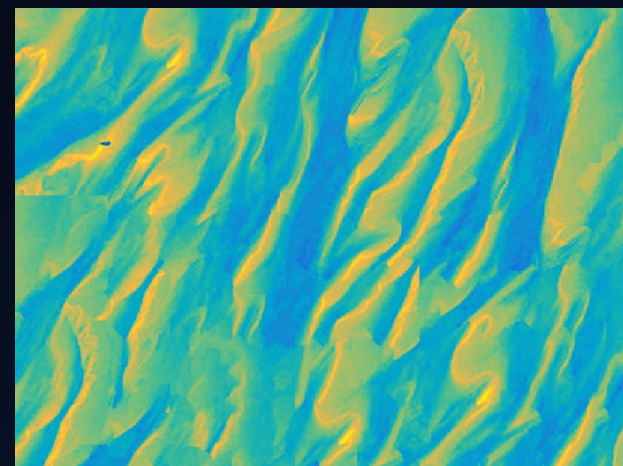
TI#1, Simulation Using Continuous Data

Training Image



500x700

Simulation



500x700



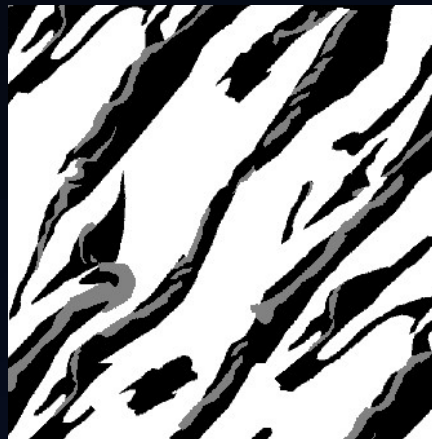
TI#1, Sample Simulation

Training Image



800x800

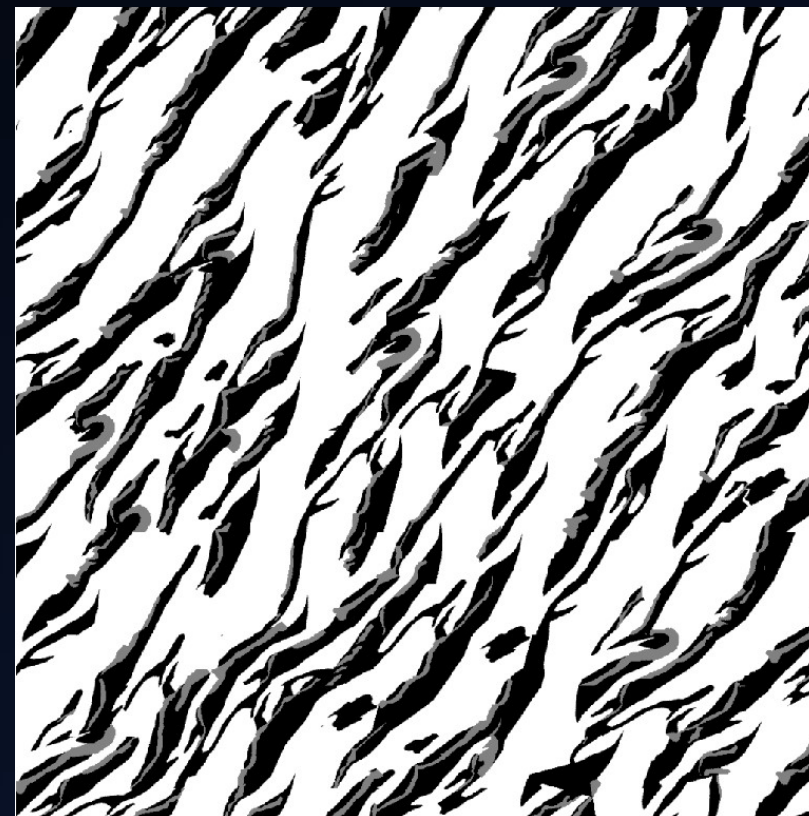
Simulation



800x800



Simulation



2000x2000

TI#2-Sample Simulations-SNESIM Model

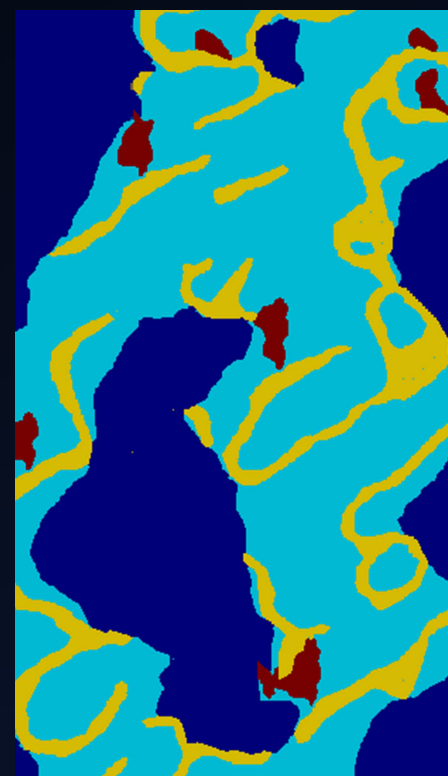
Training Image



600x350



Simulation



600x350



TI#2-Sample Simulations-Our Model

Training Image



600x350

Simulation



600x350



TI#3, Sample Simulations

Training Image



370x200



Simulation#1



370x200

Simulation#2



Simulation#3





TI#4, Simulation Using Continuous Data

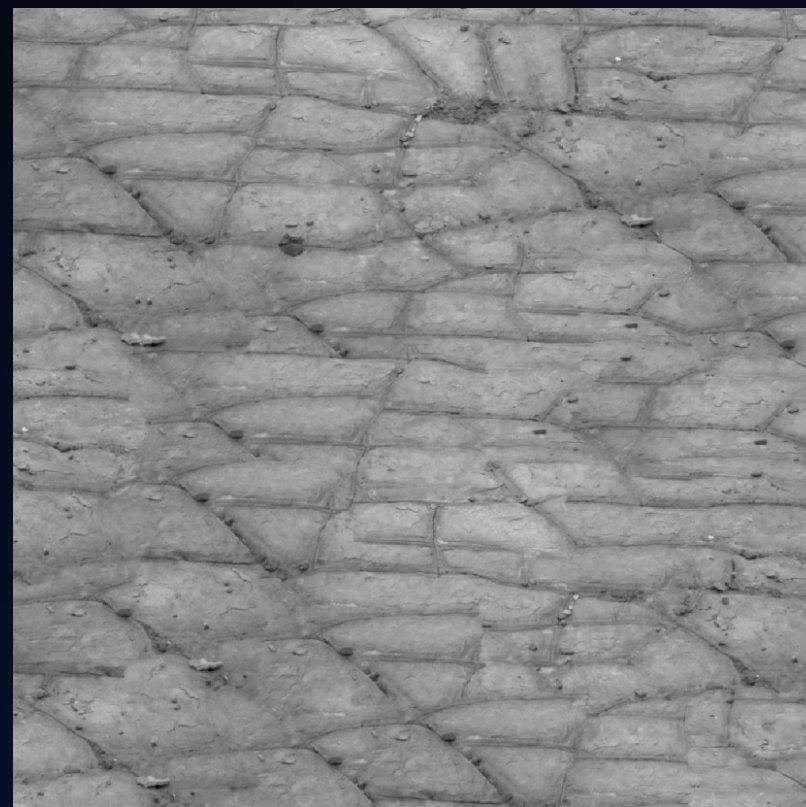
Training Image



800x800



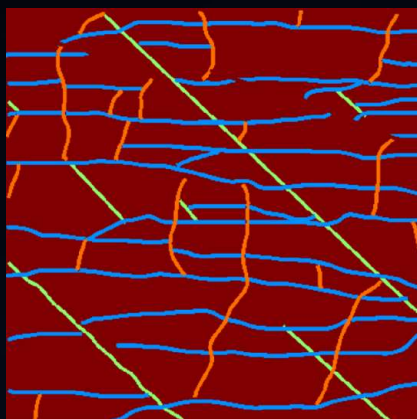
Simulation



1500x1500

TI#4, Sample Simulation

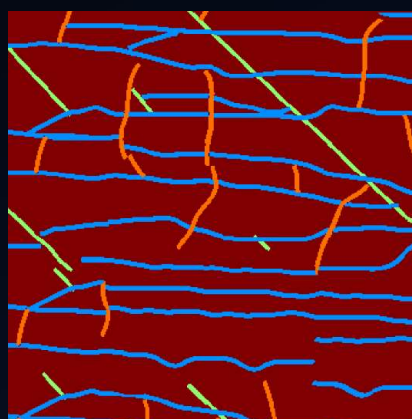
Training Image



400x600

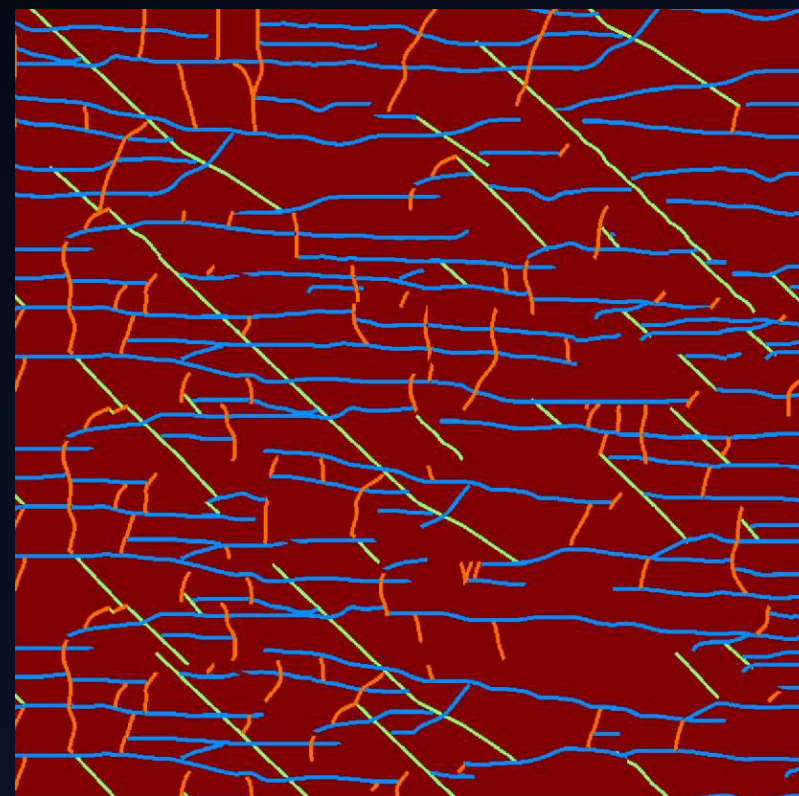


Simulation



400x600

Simulation



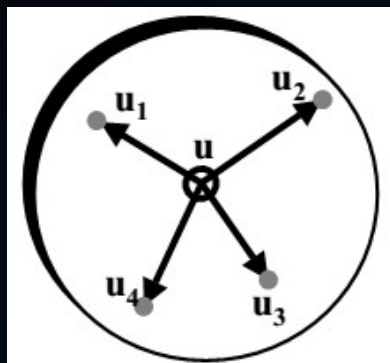
800x800



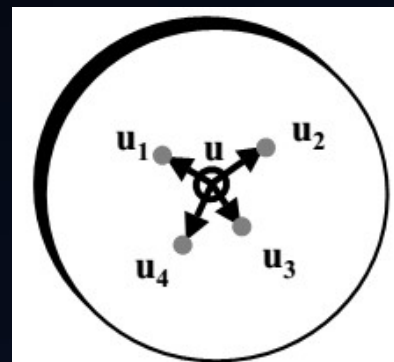
- Introduction
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Rotation and Affinity

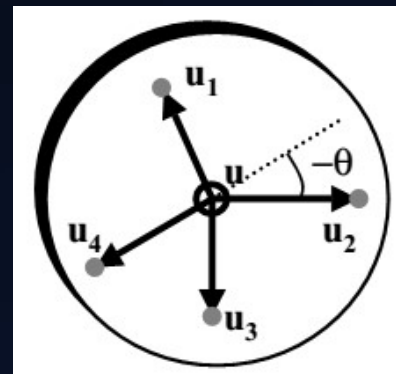
Original Data event



Affined Data event



Rotated Data event

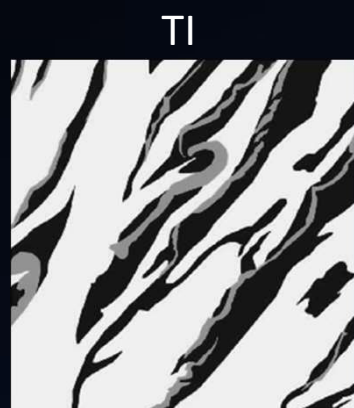


From Caers and Zhang, 2004



Secondary Variables, Rotation

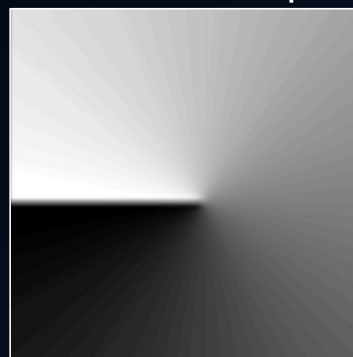
One sample simulation



400x400



Rotation Map



1600x1600

not shown in scale



+180°

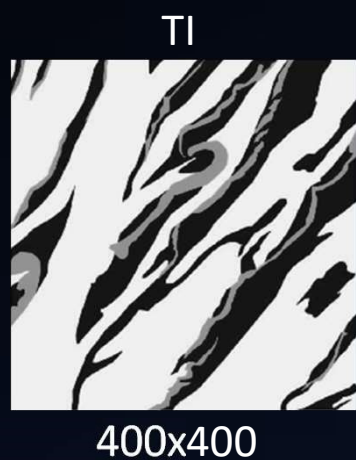
-180°



1600x1600

Secondary Variables, Affinity

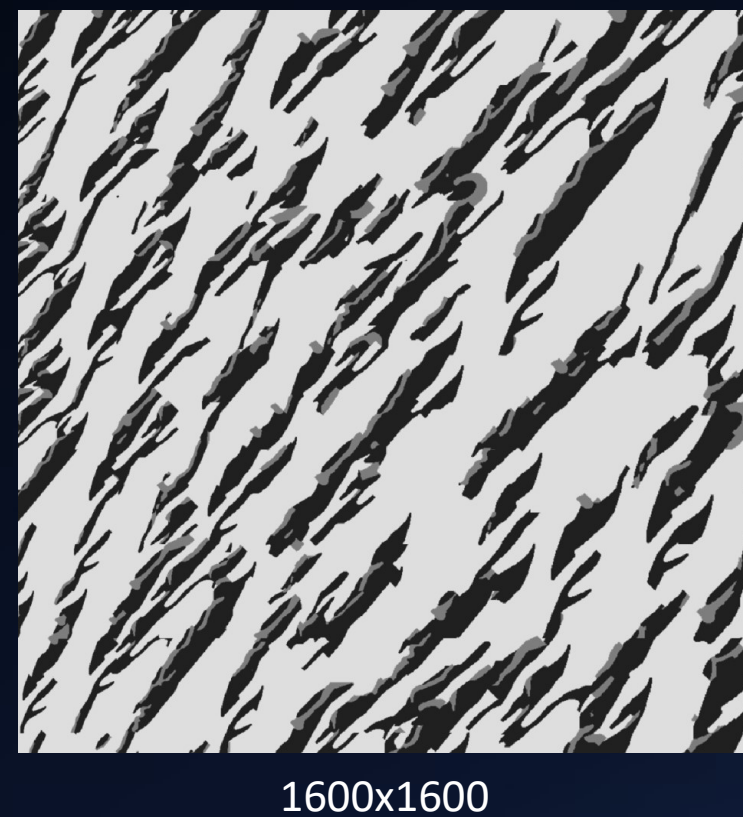
One sample simulation



+



=





Secondary Variables, Affinity & Rotation

TI



400x400

One sample simulation



Affinity Map

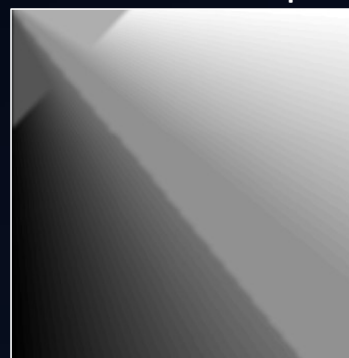


1600x1600



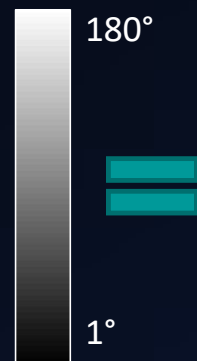
+

Rotation Map



1600x1600

not shown in scale



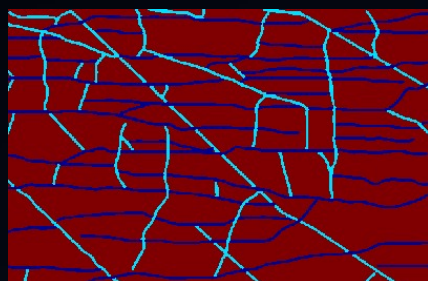
=

1600x1600



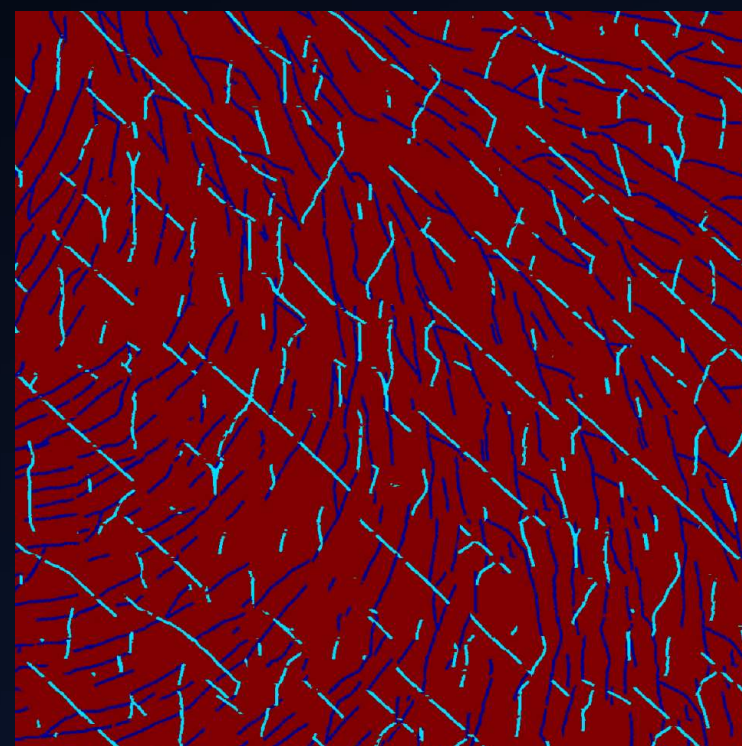
Secondary Variables, Rotation

Tl



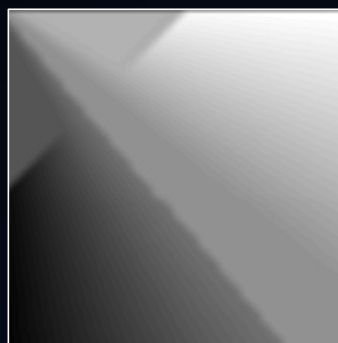
400x400

One sample simulation



1600x1600

Rotation Map F#1



1600x1600

180°

1°



Rotation Map F#2



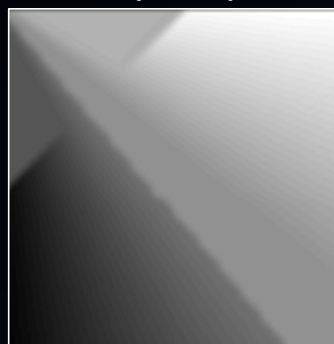
1600x1600

not shown in scale



Secondary Variables, Rotation

Affinity Map F#1

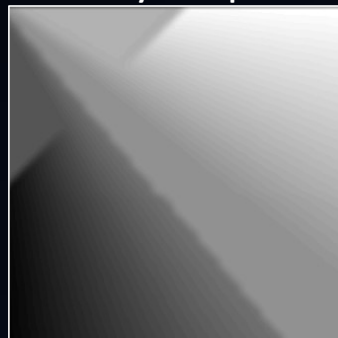


180

1



Affinity Map F#2

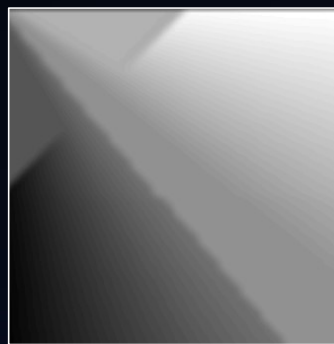


2x

1x



Rotation Map F#1



180°

1°



Rotation Map F#2

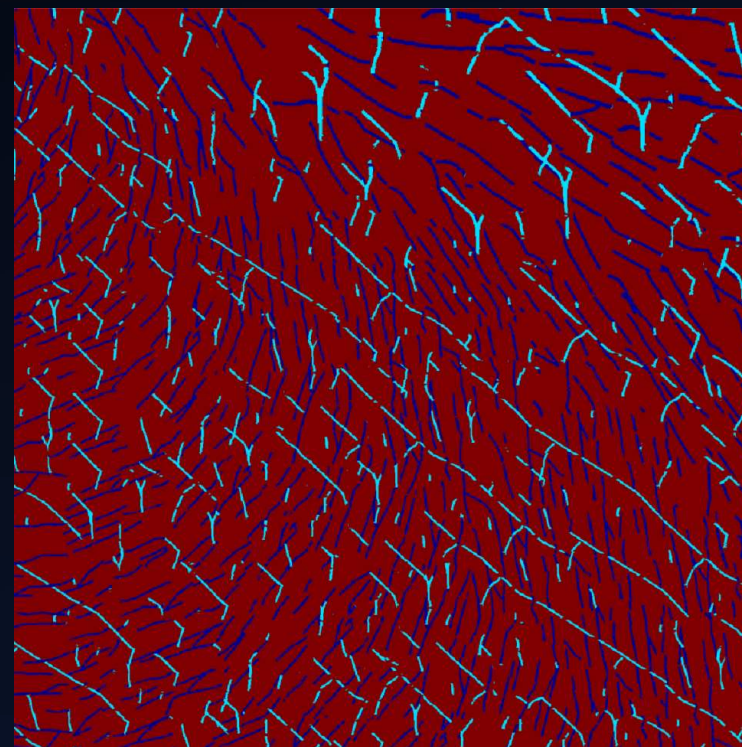


1500x1500

1500x1500

not shown in scale

One sample simulation



1500x1500



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- **Validation**
- Conclusions



Validation

Transition Probability in Simulation vs. TI

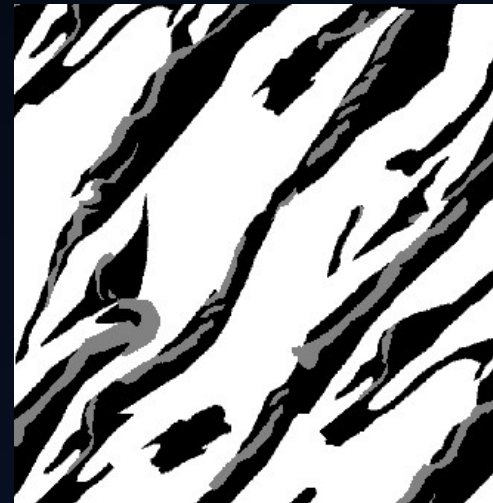


Validation, TI#1

TI#1



Simulation



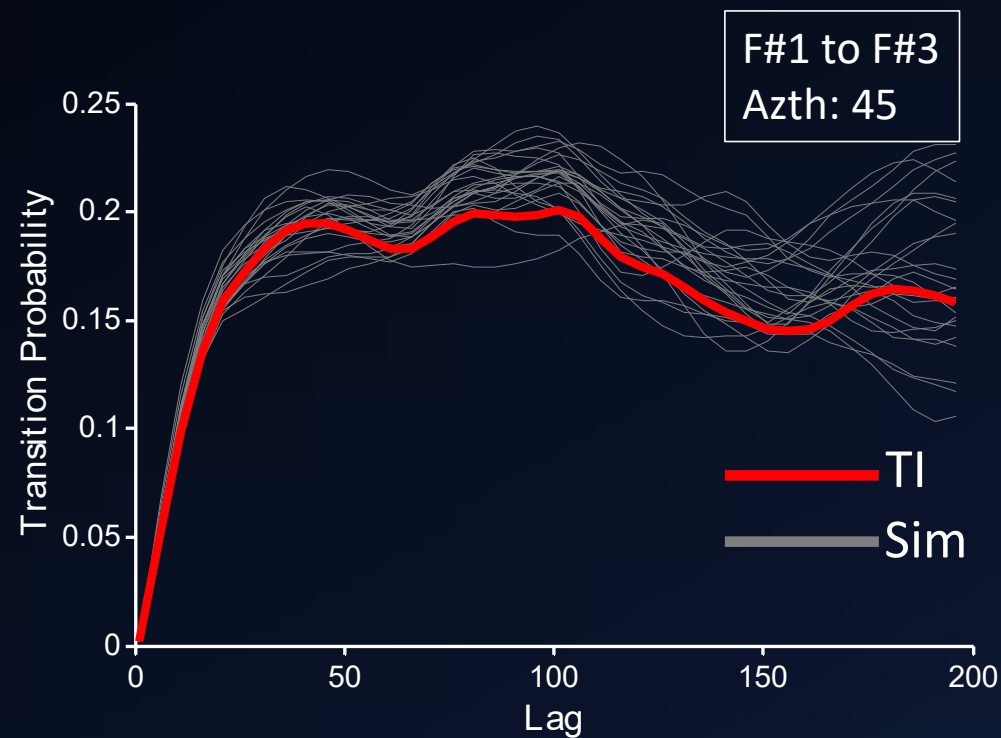
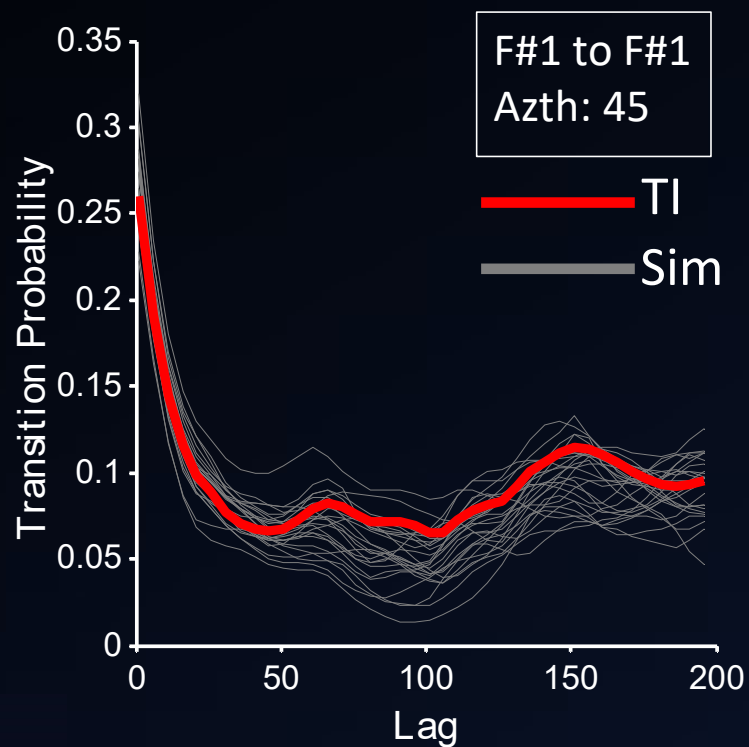
F#1

F#2

F#3

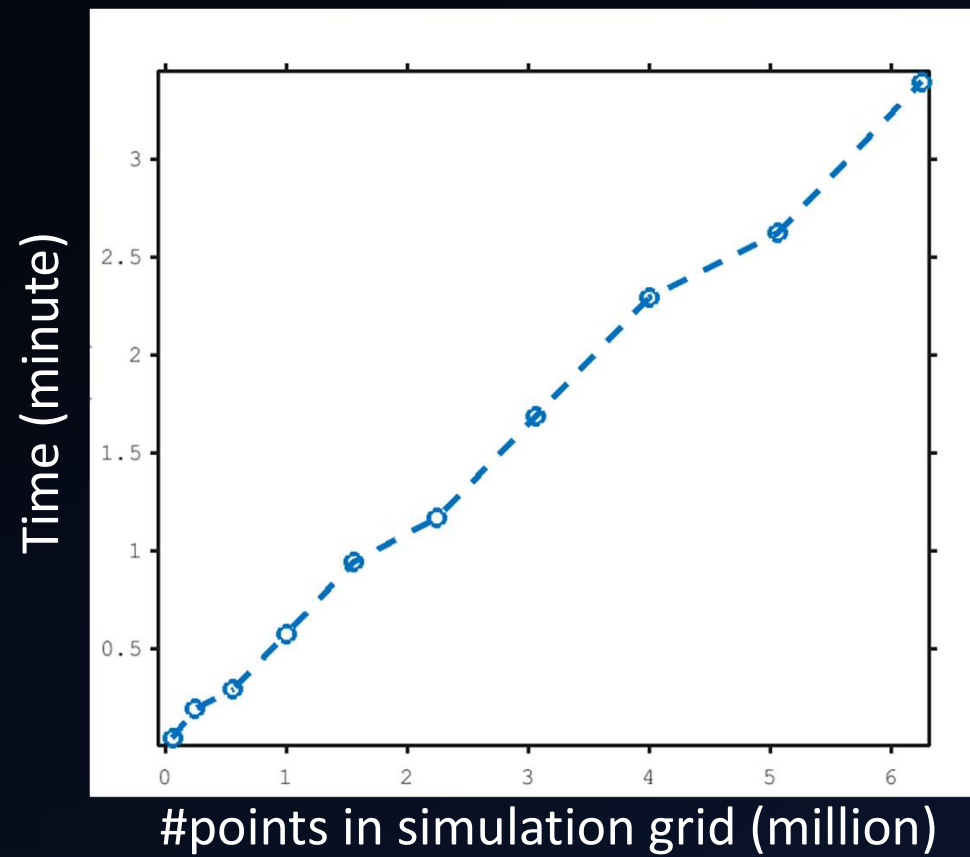


Validation, TI#1





CPU Time



#points in TI: 0.35 million



Conclusions

- Reproduction of texture and structure as in TI
- Simulations using limited databases
- Computational Efficiency
- Simulations using both continuous and categorical data

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THANKS

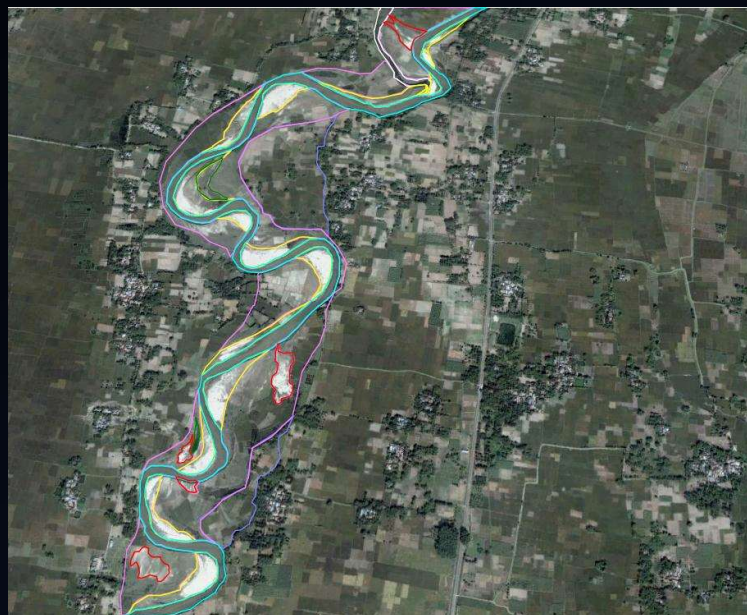
The image features a dark blue background with several teal-colored lines. On the left side, there are three parallel lines that form a corner shape, extending from the top left towards the center. On the right side, there are three parallel lines that form a diagonal shape, extending from the bottom right towards the center. The word "EXTRAS" is written in white, uppercase letters in the lower-left quadrant of the image.

EXTRAS

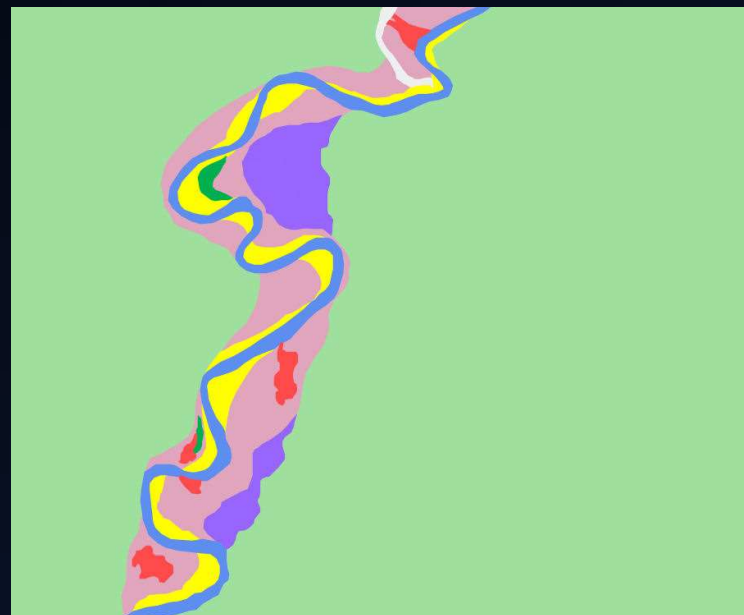


TI#2

Interpreted Image



Training Image



TI#1, Multi-Facies, Sample Simulations

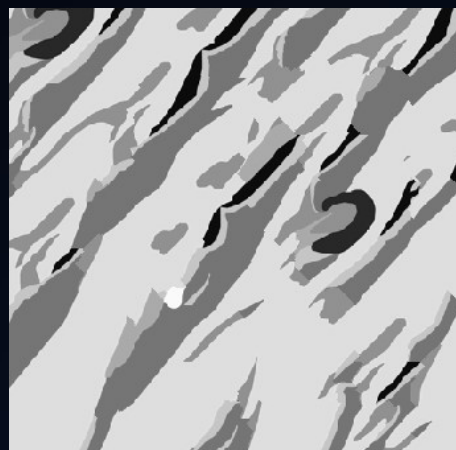
Training Image



400x400

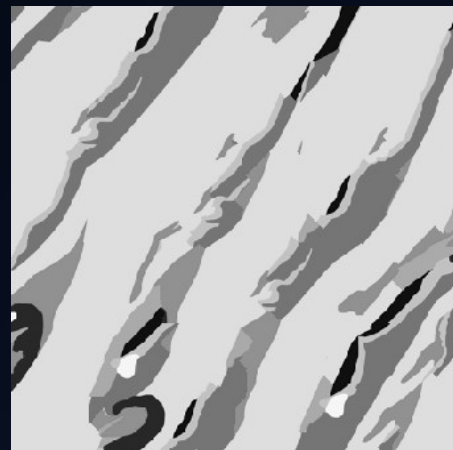


Simulation#1

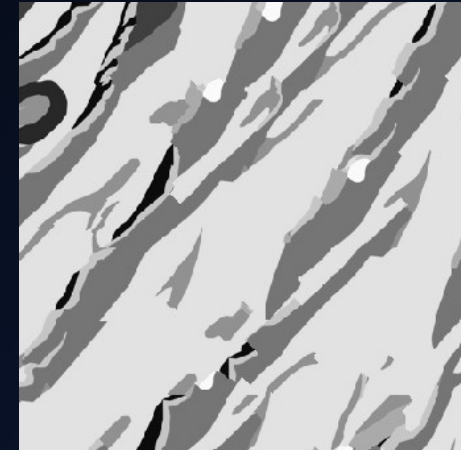


400x400

Simulation#2



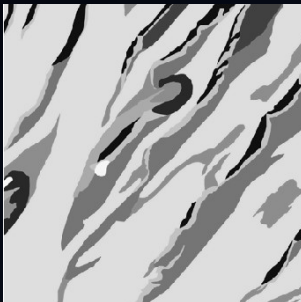
Simulation#3





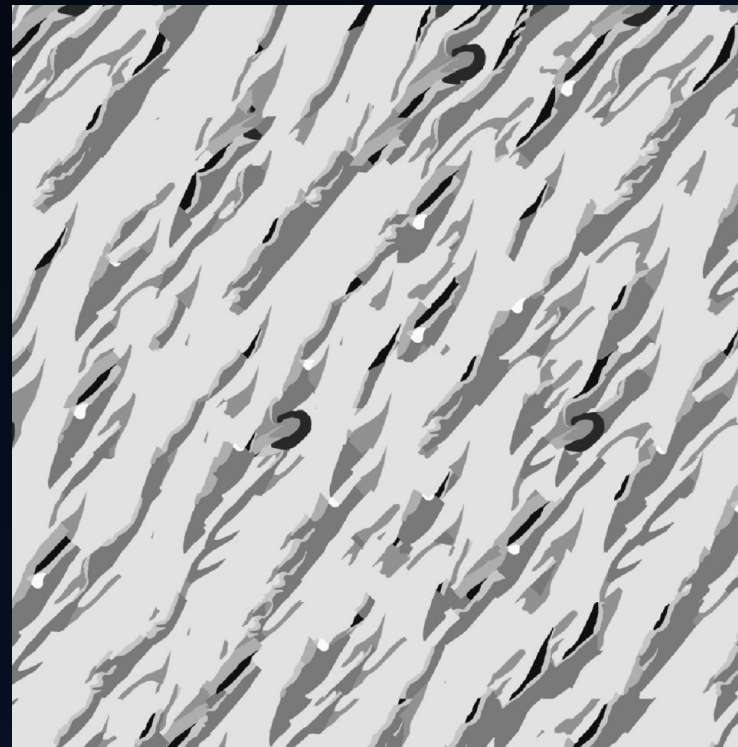
TI#1, Multi-Facies, Sample Simulation, Large Grid

Training Image



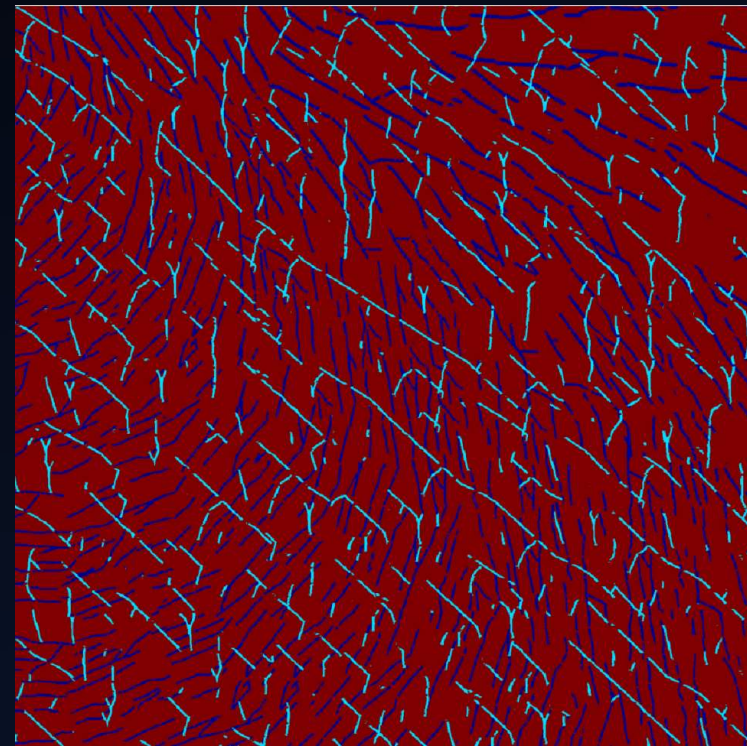
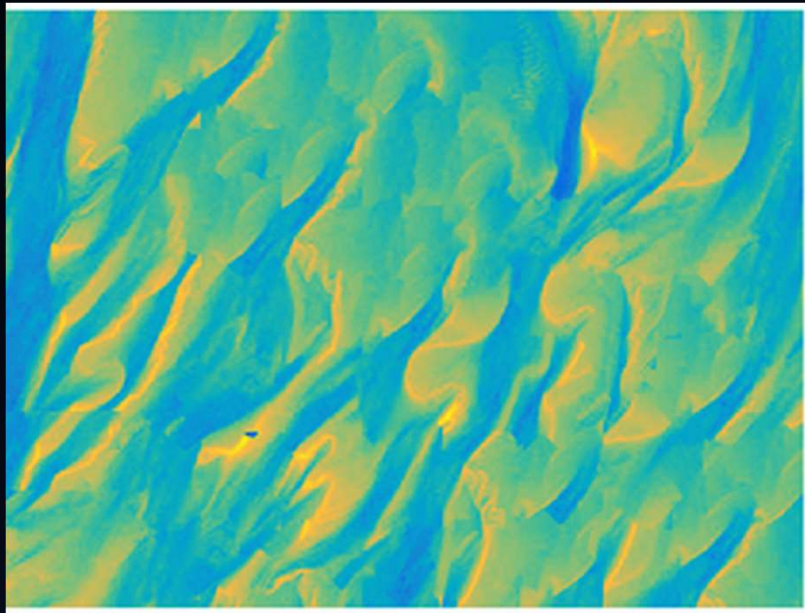
400x400

Simulation



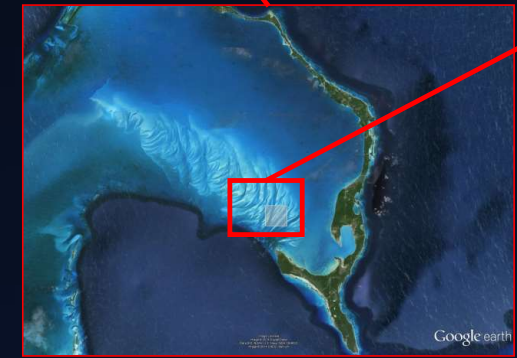
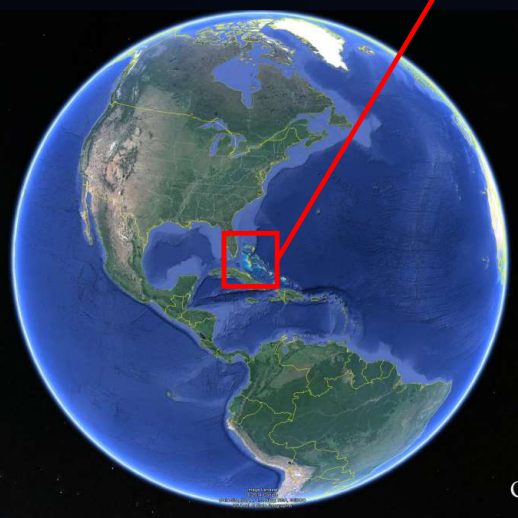
1000x1000

TI#1&4, Extra Simulations



TI#1

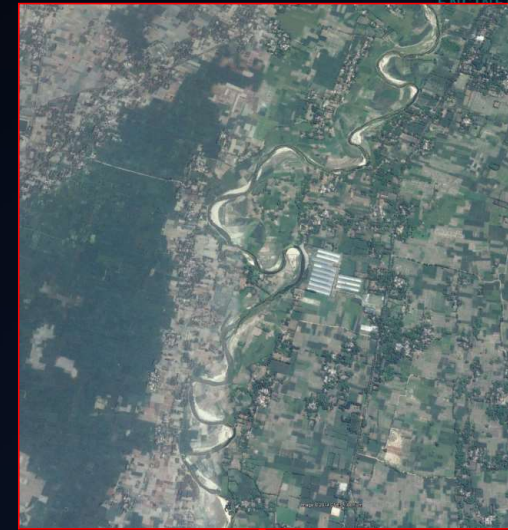
Reference Image



TI#2



Reference Image

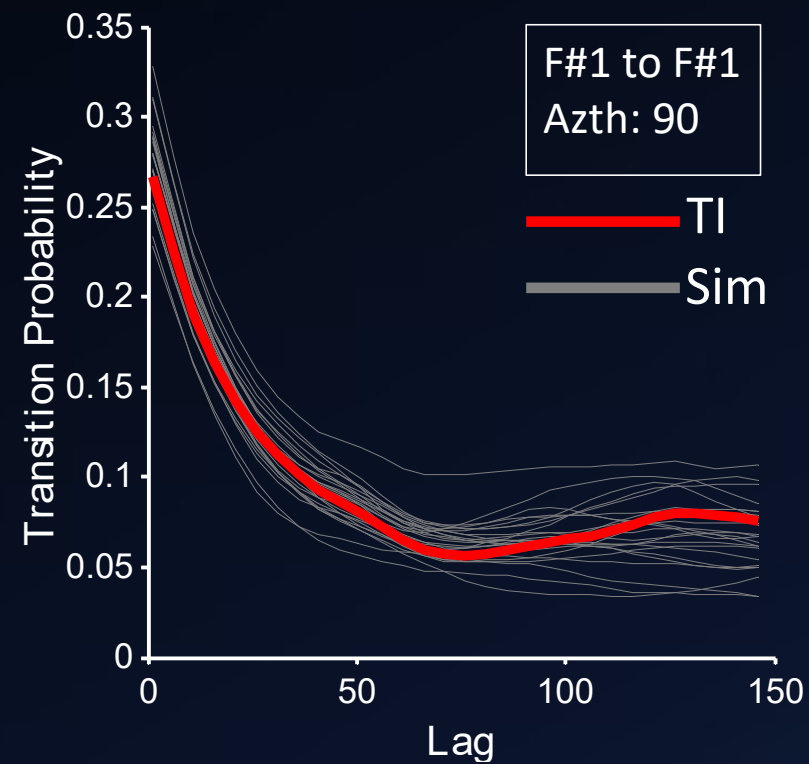
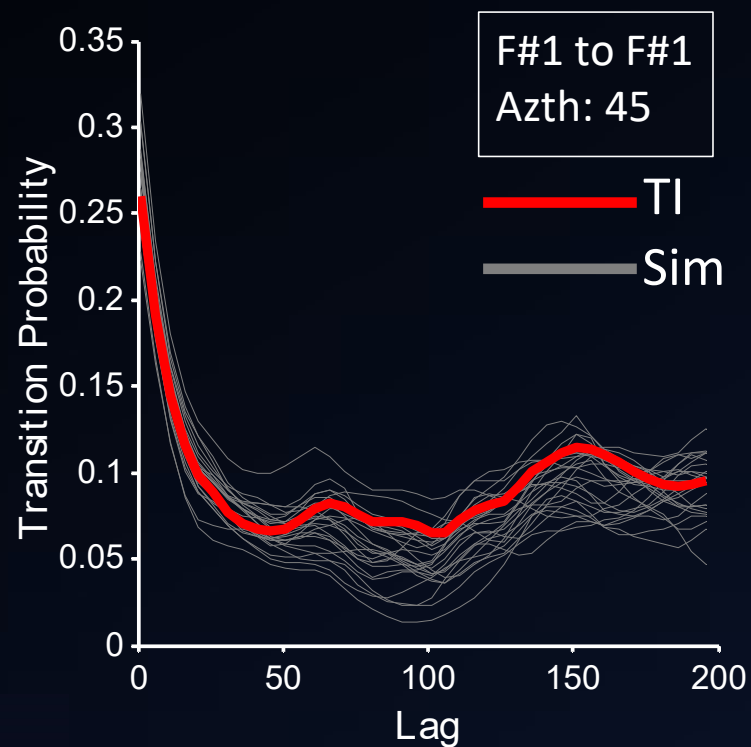


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Validation, TI#1





Validation, TI#1

