geoconvention
Virtual Event 2021
September 13 - 15

Impact of Plurigaussian Parameter Options on Model Facies Transition Statistics

David Garner, TerraMod Consulting
R. Mohan Srivastava, TriStar Gold
Jeffrey Yarus, Retired
Jean-Marc Chautru, Geovariances

Abstract

The plurigaussian simulation (PGS) method is increasingly being used by practitioners to control the relationships of modeled facies, especially in studies where users want to control transition probabilities between facies. Facies transitions are calculated in wells as part of the statistical inference to set up the PGS workflow. From the transition tables a rule set is selected to define the truncations in the bi-Gaussian model. A variogram model is associated with each truncation set to govern the behavior of the transitions. Local facies proportions influence the probability of a facies transitioning into another. The interaction of combining the truncation rule set, variograms and proportions results in a complex 3D facies model intended to honour the transition table. The following experiment illustrates the relative importance of the main steps on the ability to honour the original transition statistics by checking the model outputs. The end goal is for the PGS practitioner to be able to improve the facies transitions in geomodels.

Using 17 wells with four facies each in one stratigraphic zone, a facies transition table is computed for reference. Use of facies proportions are compared for three main approaches: 1) apply a global vertical proportion curve (VPC); 2) combine the 2D mapped proportions from wells over the zones with the global VPC using conditional independence; 3) apply a coarse grid to define sparse local VPC's from nearby wells followed by kriging proportions along model k-layers. Five initial truncation rule sets are defined and compared. The transition statistics table is interpreted to have a distinct two transition set (bi-Gaussian) behavior with one facies (f2) having no contacts with 2 others (f1 and f3). This allows the experiment to proceed with useful options. An ordered truncated Gaussian rule is used for a brief illustration of the basic method followed by four bi-Gaussian sets, two of which are a rotation of the truncation rules mask. Note variograms are swapped for the rotated sets. The rotation is to aid the illustration of the unique impact of the use of a non-zero correlation between the two underlying Gaussian random functions in each case. Variogram models for select cases are defined with one structure each and then with two structures. Transition statistics are calculated for all of the cases and summarized to help understand the impact of these significant parameters,

workflow steps and interactions using the PGS method. Given the growth in use of the plurigaussian facies simulations, this practical comparative study helps give users a better understanding of the effect of the main PGS parameters, and provides guidance on how to make good use of the PGS parameters in order to better control the facies transition statistics in PGS realizations.

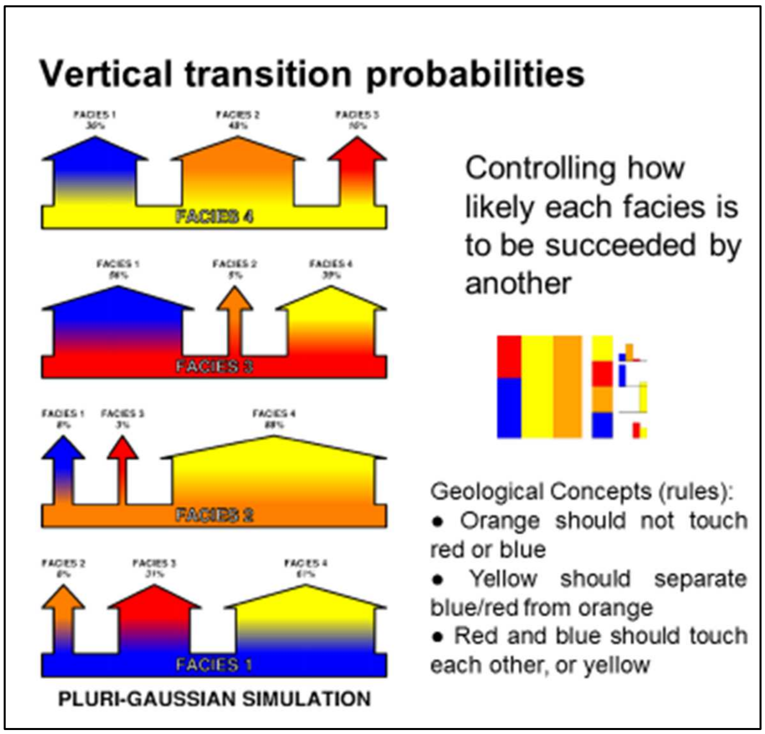

Figure 1. A slide that shows a graphical summary of vertical transition probabilities. The PGS approach directly gets the benefit of this information because this is an input to that workflow. Transition probabilities are a significant measure of continuity.

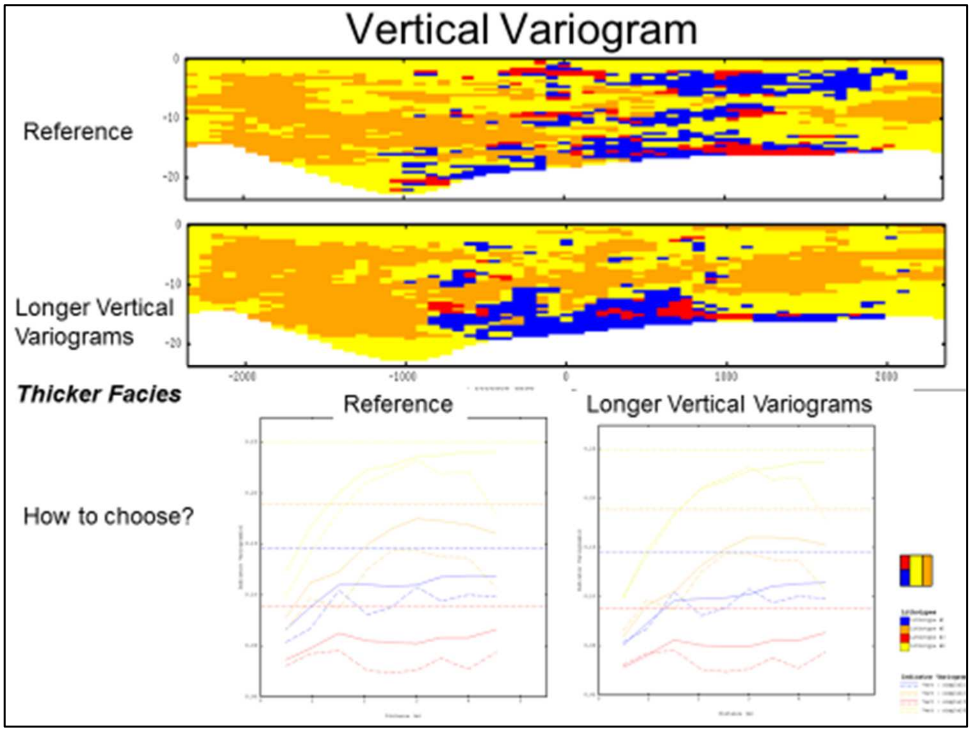

Figure 2. Choice of vertical variogram range based on fitting data has ambiguity. Honouring transition statistics in wells is an underutilized way to check model behavior and to optimize these parameters.

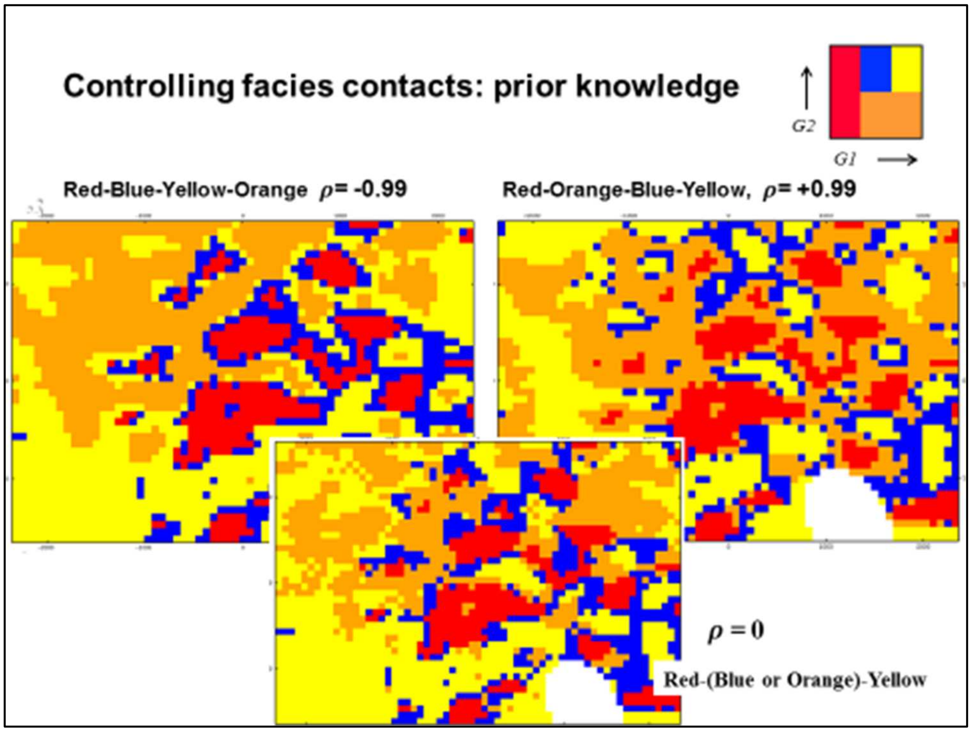

Figure 3. This example illustrates an extreme limit of geological patterns through use of the correlation of facies contacts. Based on geological understanding, controls can be imposed and numerically checked against facies stacking patterns in wells. Useful metrics (MSE, KLD) are to be discussed to help rank and choose key parameters to improve geological model verisimilitude.