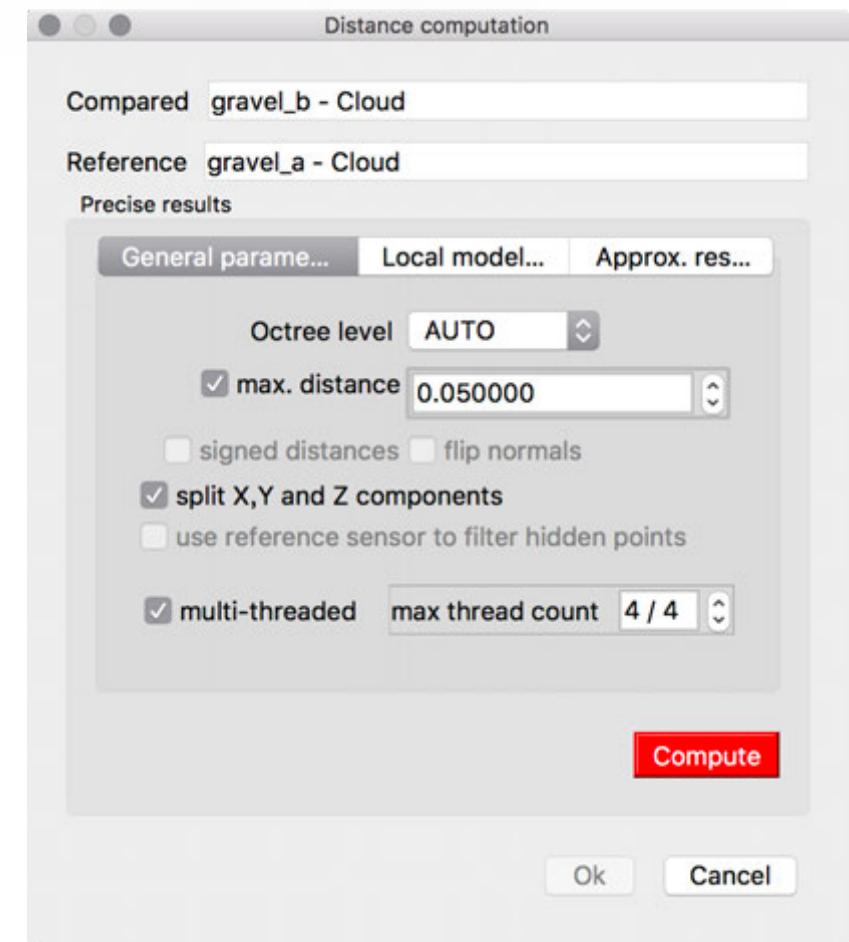
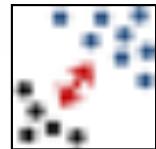


# 距離計算

LEVEL 03  
distances

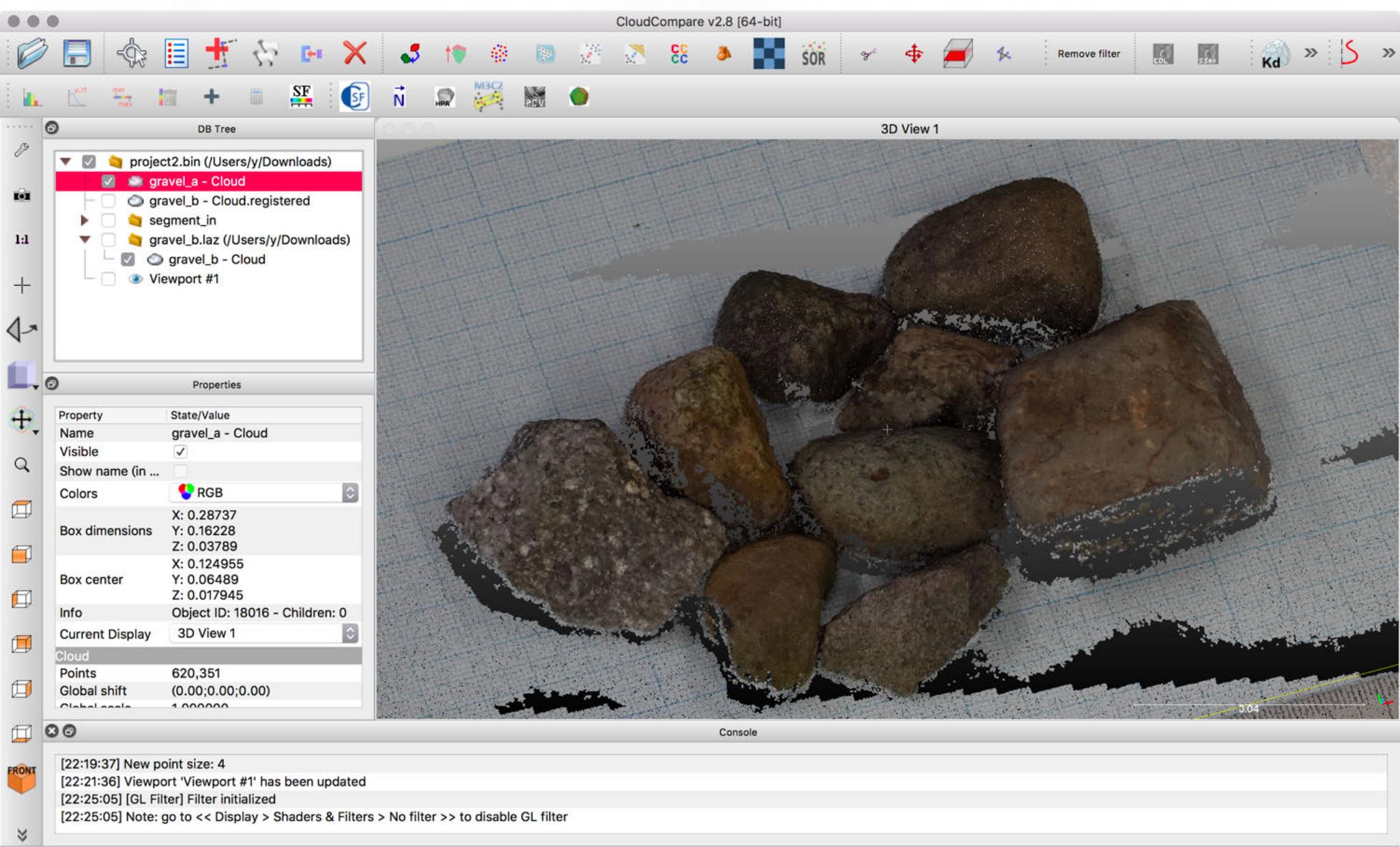
# 点群間距離 cloud-to-cloud distances

- 二つの点群を選択 (Shift+クリック)
  - Tools > Distances > Cloud/Cloud Dist.
- gravel\_aを基準 (Reference) に ←Swap
- パラメータ設定
  - max. distance = 0.05 m
  - split X, Y, and Z components: YES
  - → « Compute »
    - > OK



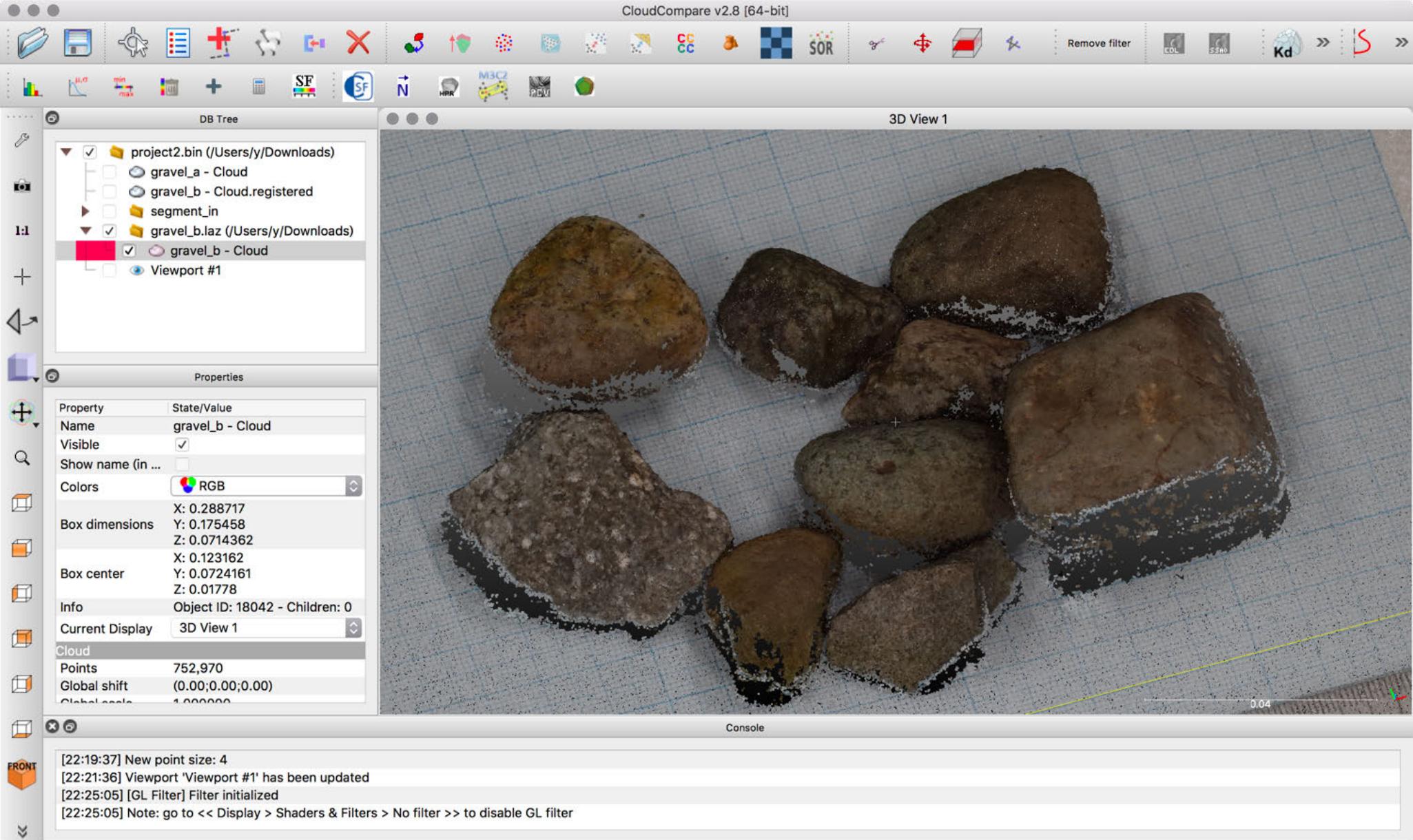
# 点群間距離

# cloud-to-cloud distances



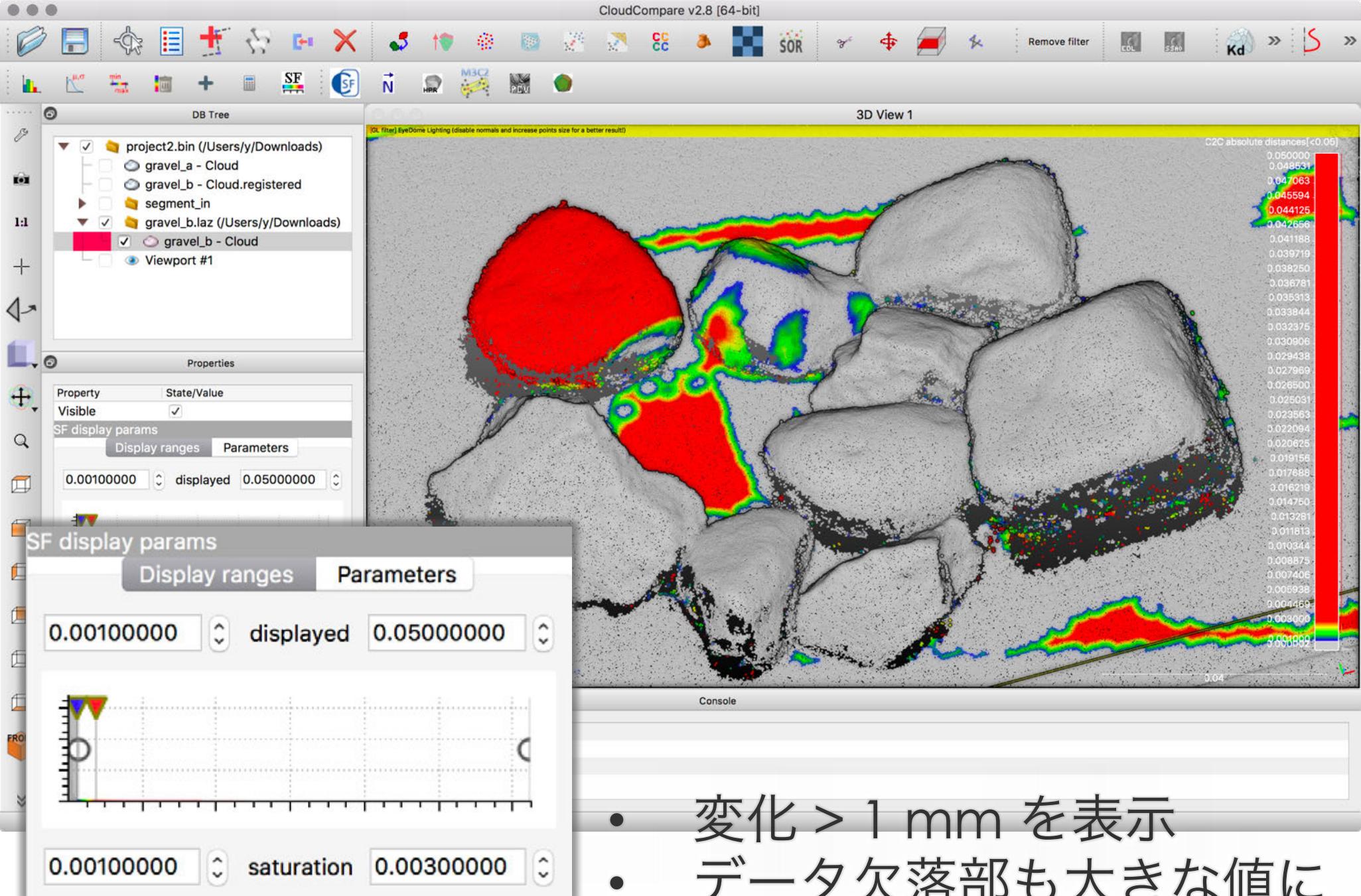
# 点群間距離

# cloud-to-cloud distances



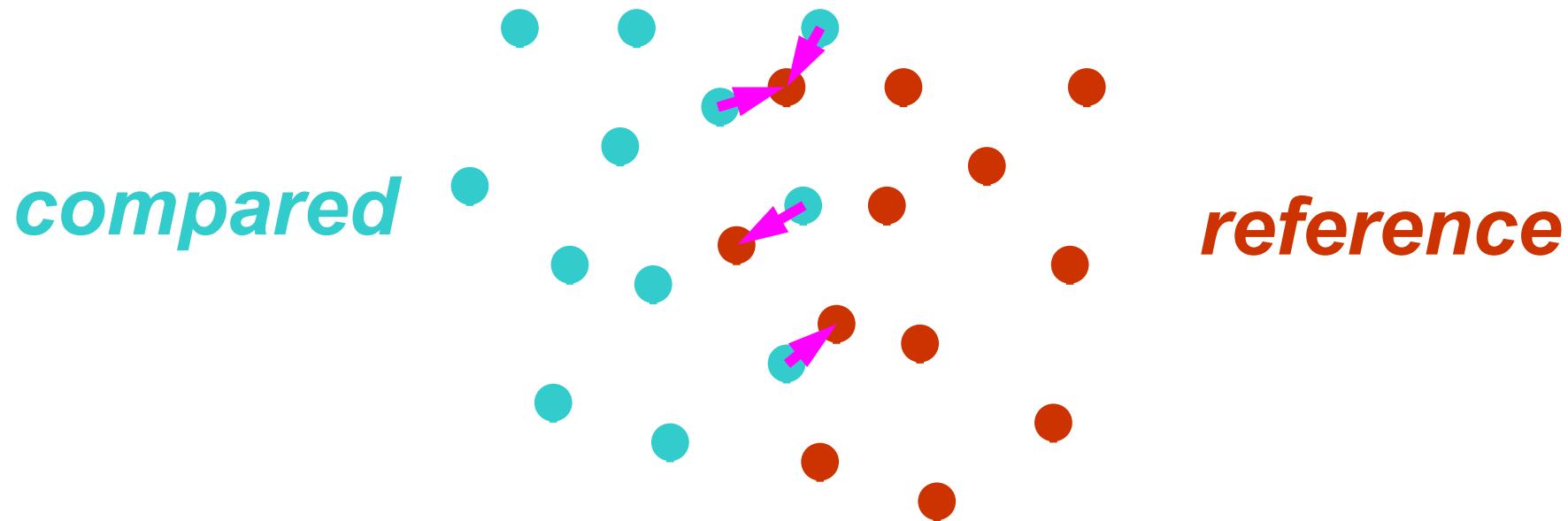
# 点群間距離

# cloud-to-cloud distances



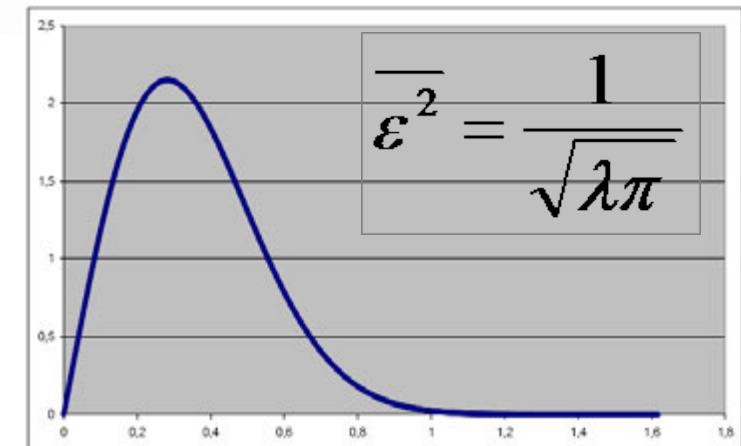
# 点群間距離の算出方法 C2C distance

- ・ デフォルトでは、比較される点群の各点について、基準点群の最近隣の点までの距離が算出される
  - 対称的ではない
  - = 基準と比較を入れ替えると結果も若干異なる



# C2C distances のコンセプト

- 基準となる点群が充分に高密度であれば、比較点群で算出される最近隣の点との距離は、実際の距離に近くなる
- 理論：TLSによる点群はポアソン分布に従う
  - 誤差は点群密度に依存する
- 基準点群は高密度である必要がある
- 基準点群は比較点群の領域を充分にカバーする必要がある



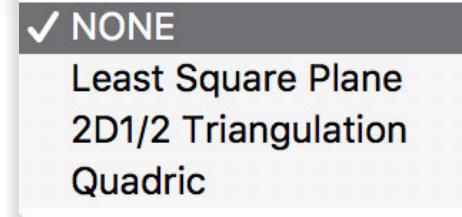
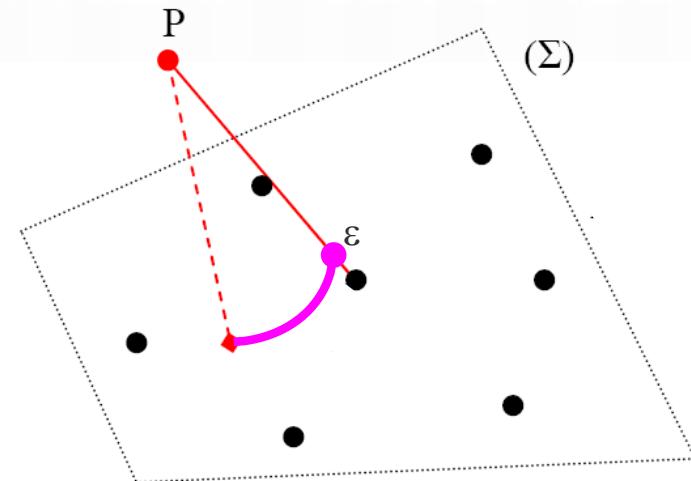
N.N. distances in a random  
Poisson process

(Girardeau-Montaut, 2016)

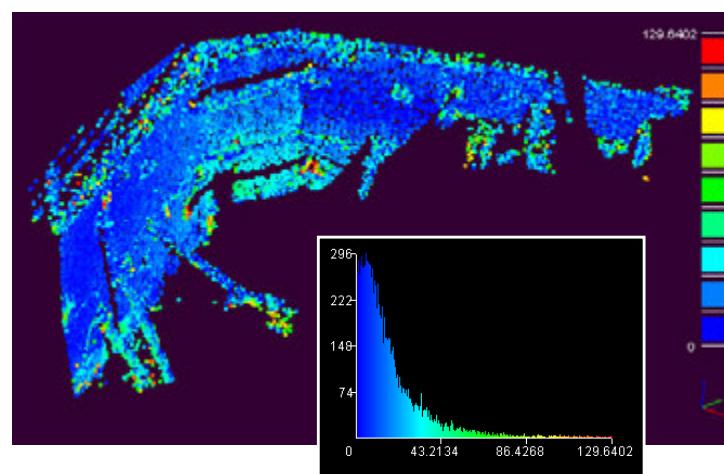
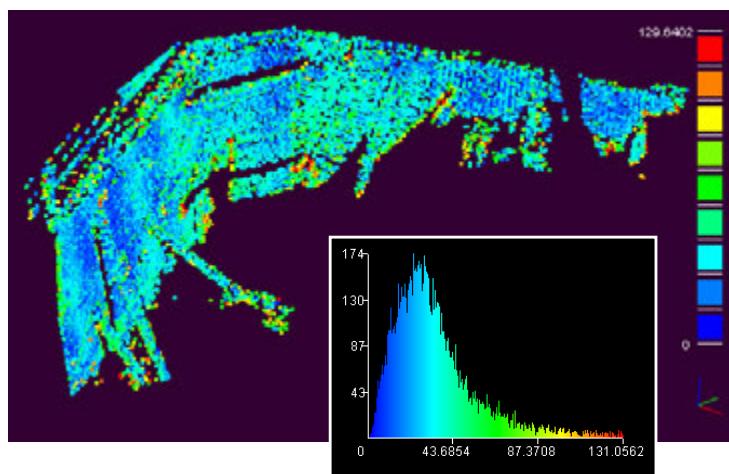
# 基準点群が高密度でない場合は？

- “Local modeling”

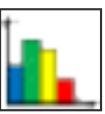
基準点群を補間（補完）するモデルを生成



(Girardeau-Montaut, 2016)

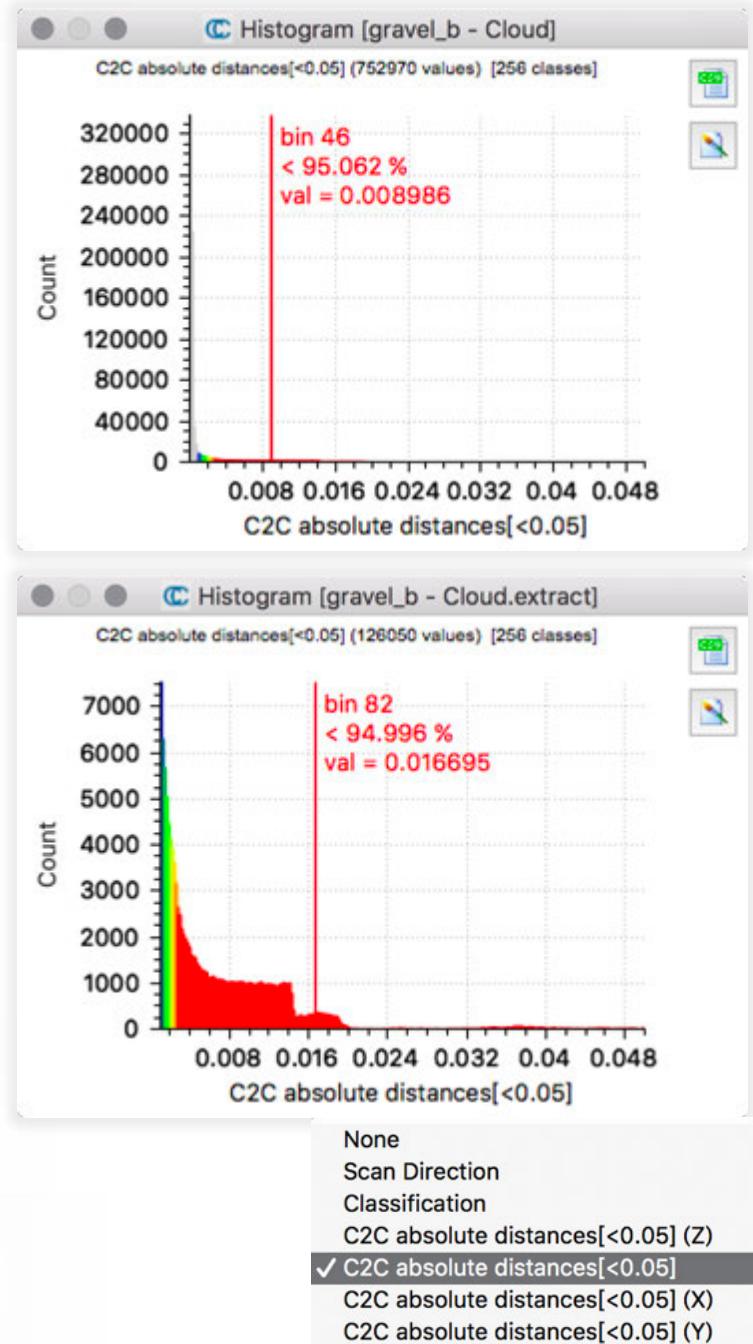


Local modelling  
(2 to 5X slower)

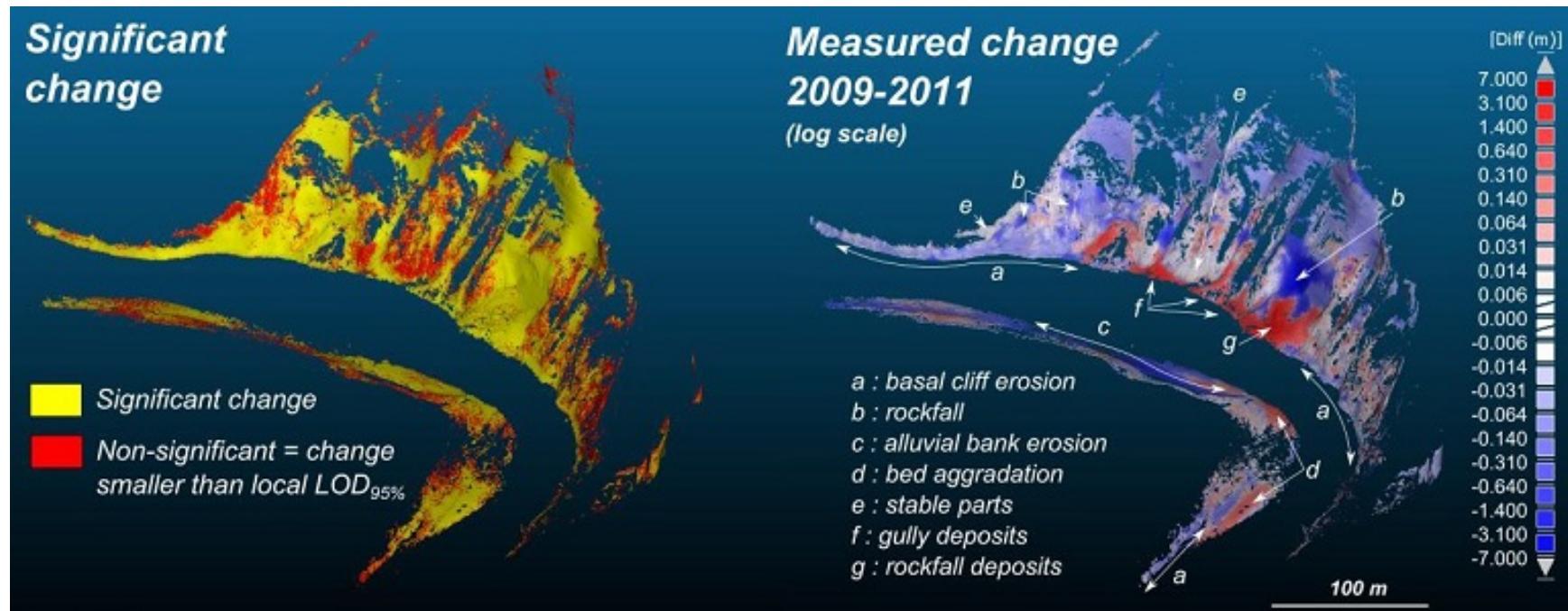
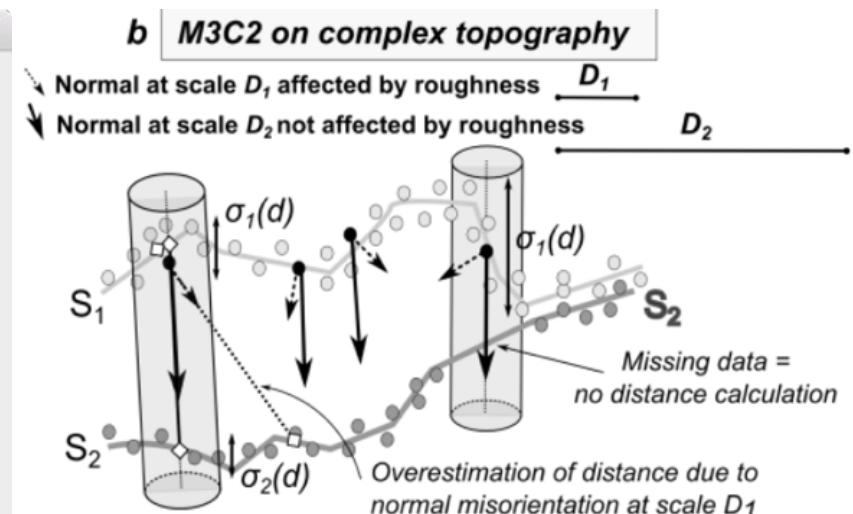
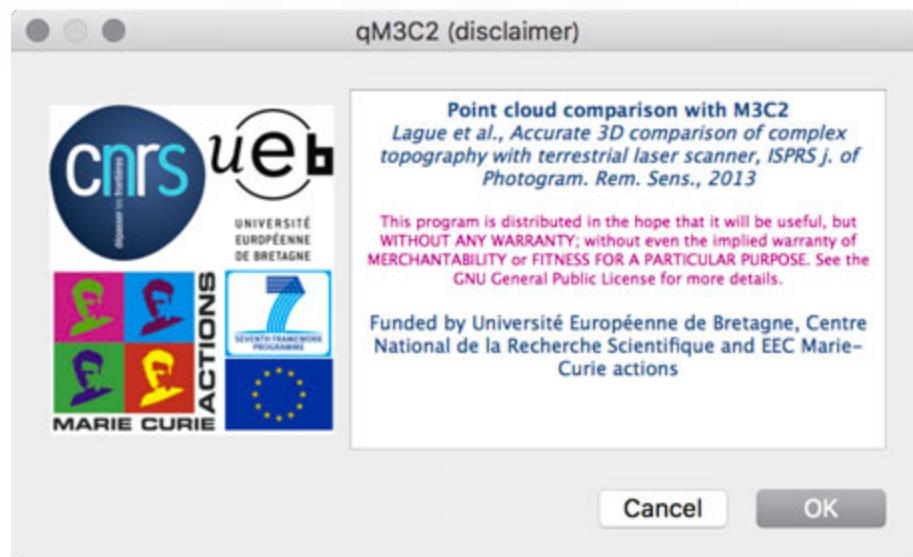


# 距離のヒストグラム表示

- `gravel_b`を選択、  
ヒストグラムを表示
  - Edit > Scalar fields  
> Show histogram
  - →<1 mm の値に集中
- 余分な値を除外
  - Edit > Scalar fields  
> Filter by value
    - [0.001 0.05] >> Export
- 出力した点群で  
SFのヒストグラムを表示
  - プロパティのカラースケールで  
色変更可能
  - X, Y, Z各方向の値 (Split有効時)



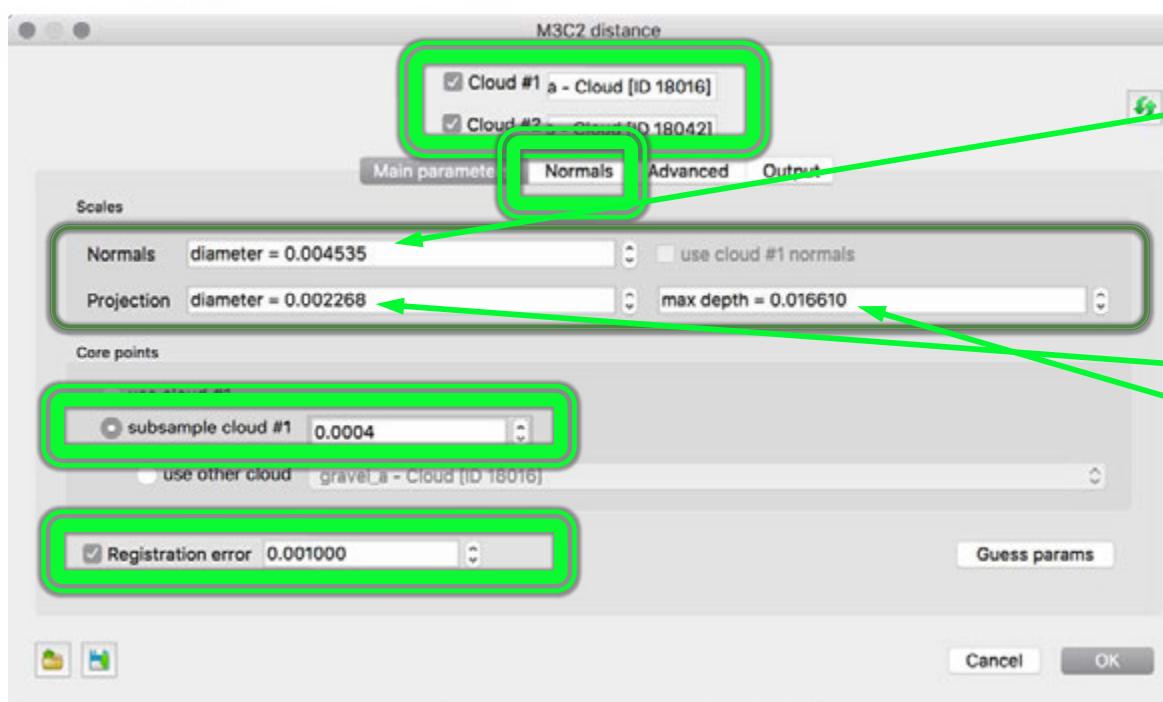
# M3C2 プラグイン



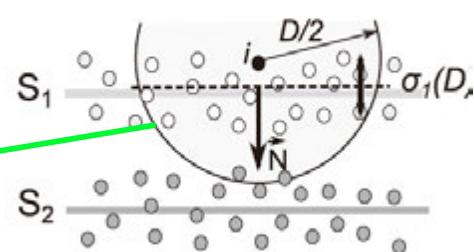
Lague, D., Brodus, N. and Leroux, J., Accurate 3D comparison of complex topography with terrestrial laser scanner: application to the Rangitikei canyon (N-Z), 2013, *ISPRS journal of Photogrammetry and Remote Sensing*

# M3C2距離

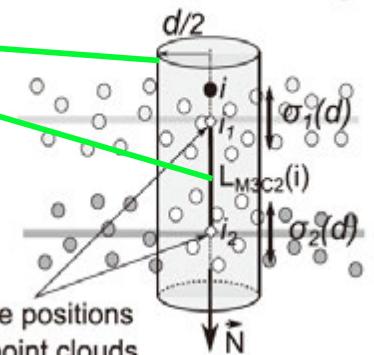
- 二つの点群を選択 (Shift+クリック)
  - Plugins > M3C2 distance
- パラメータ設定
  - Cloud #1: gravel\_a, Cloud #1: gravel\_b
  - “Guess params”
  - subsample cloud #1: 0.0004 (= 0.4 mm)
  - Registration error: 0.001 (= 1 mm)
  - Normals: default



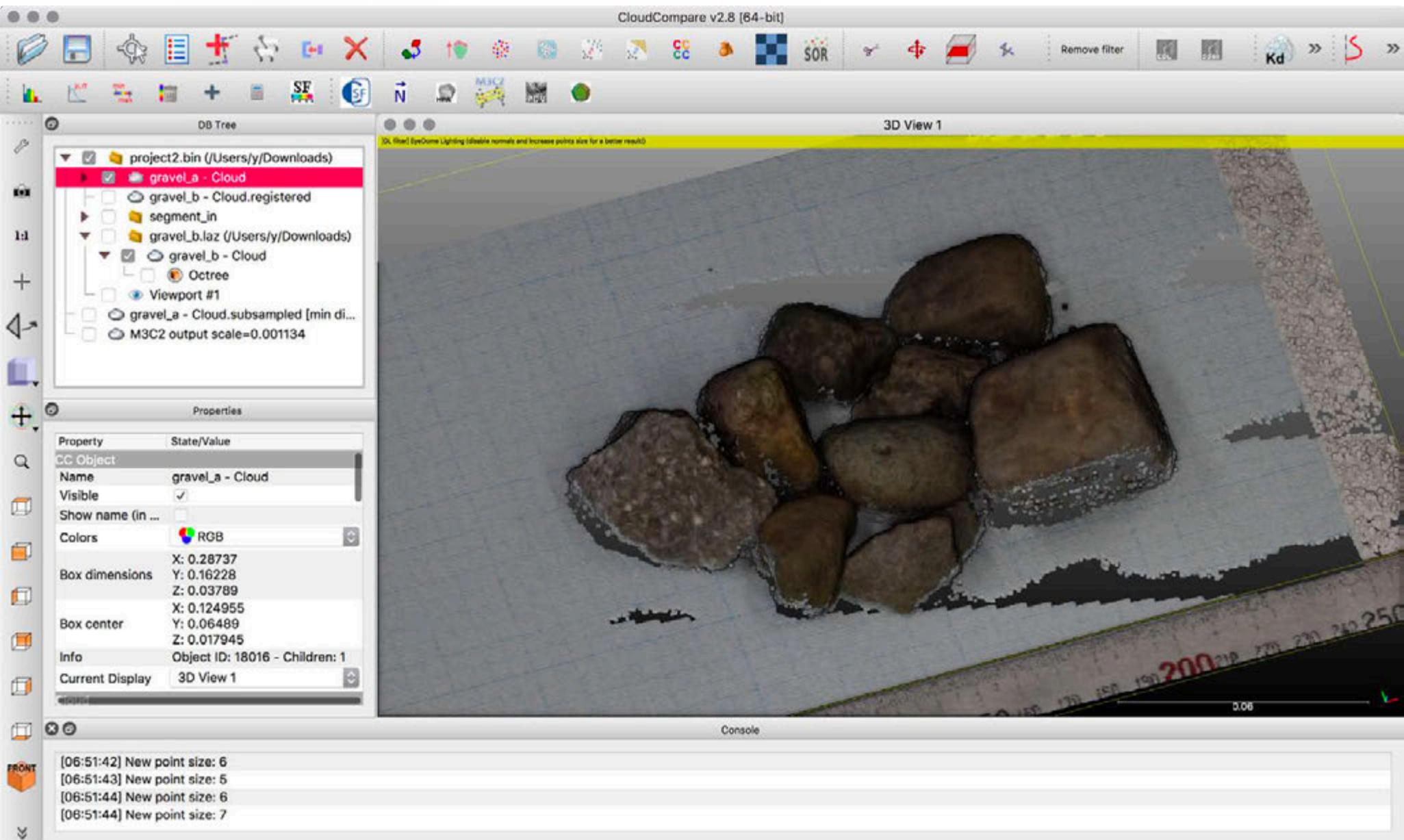
Step 1 : Calculation of normal  $\vec{N}$  at a scale  $D$  around the core point  $i$ .



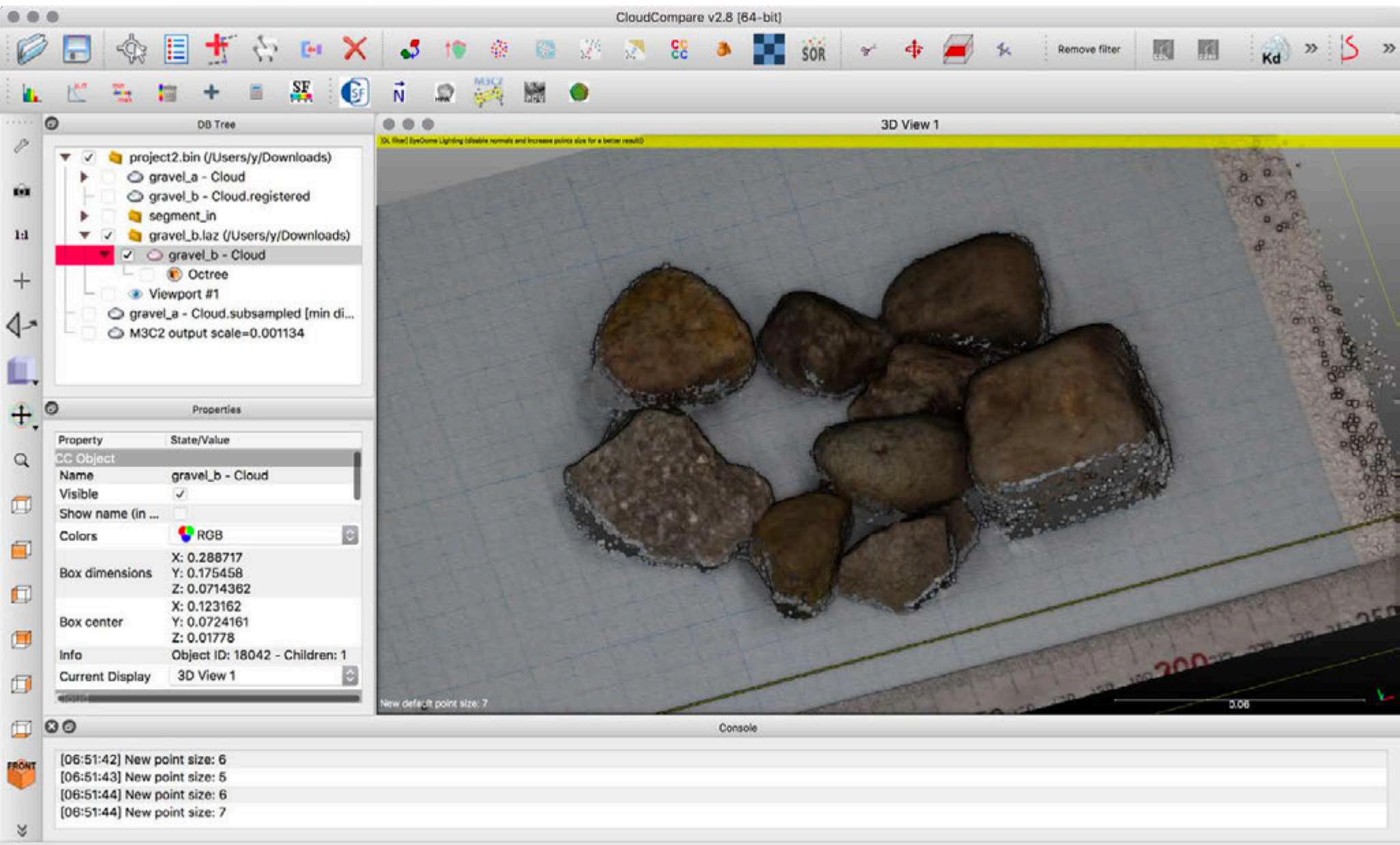
Step 2 : Average distance between the two clouds measured at a scale  $d$  along  $N$



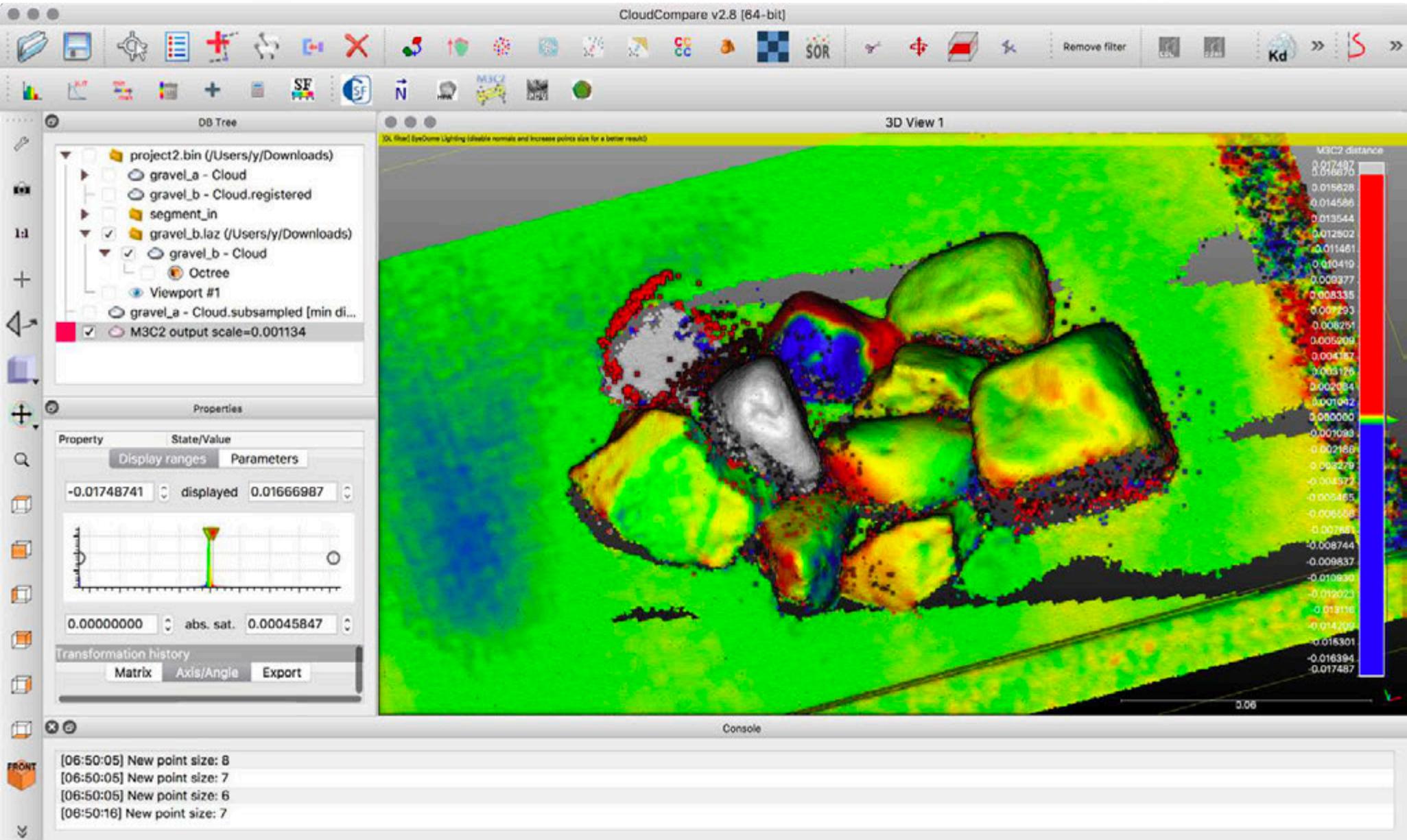
# M3C2距離 gravel\_a



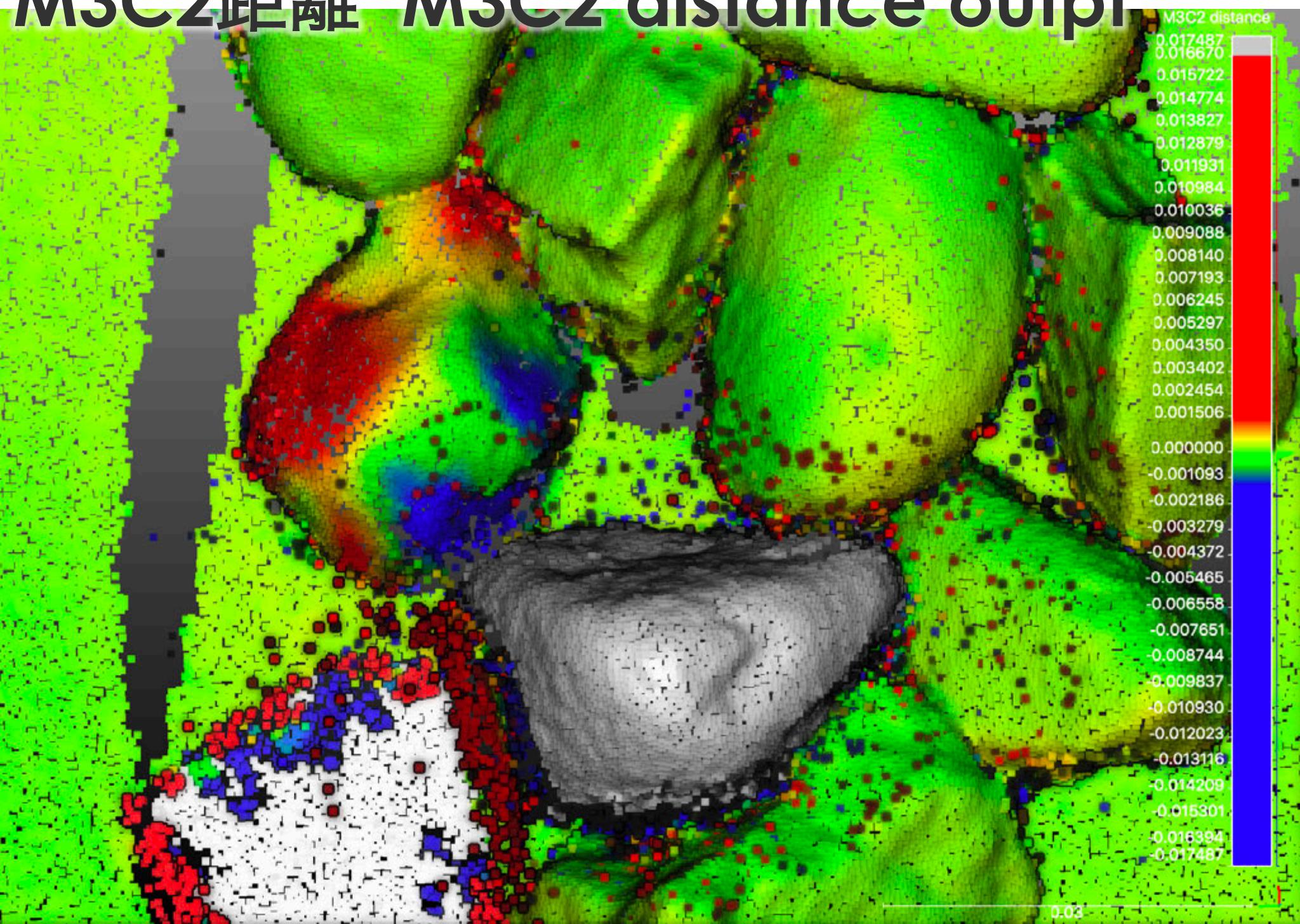
# M3C2距離 gravel\_b



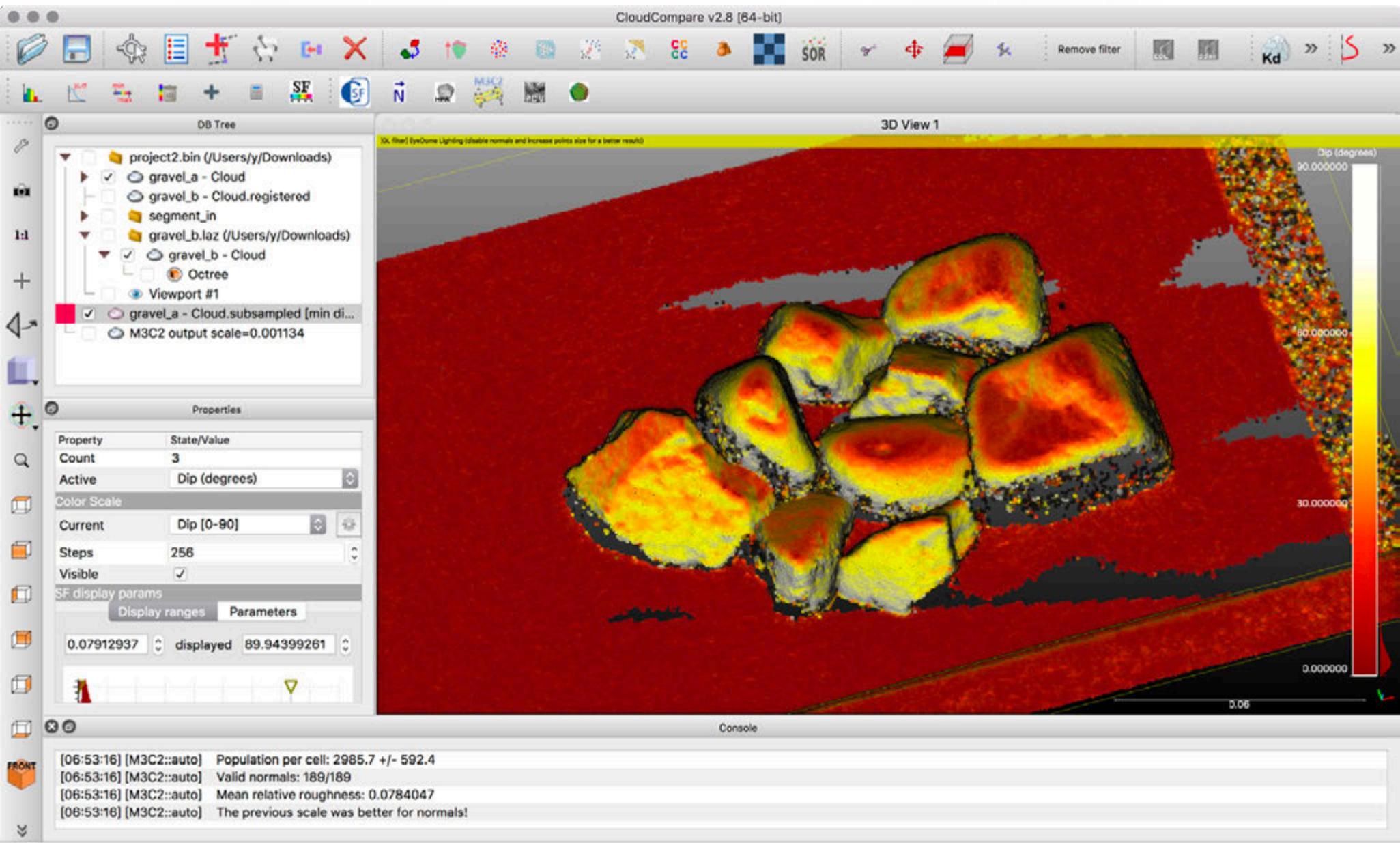
# M3C2距離 M3C2 distance output



# M3C2距離 M3C2 distance output



# M3C2距離 normal dip [0-90°]



# M3C2距離 normal dip direction [0-360°]

