# Figures of DSAM experiments

Xin HUANG

2017.4.14

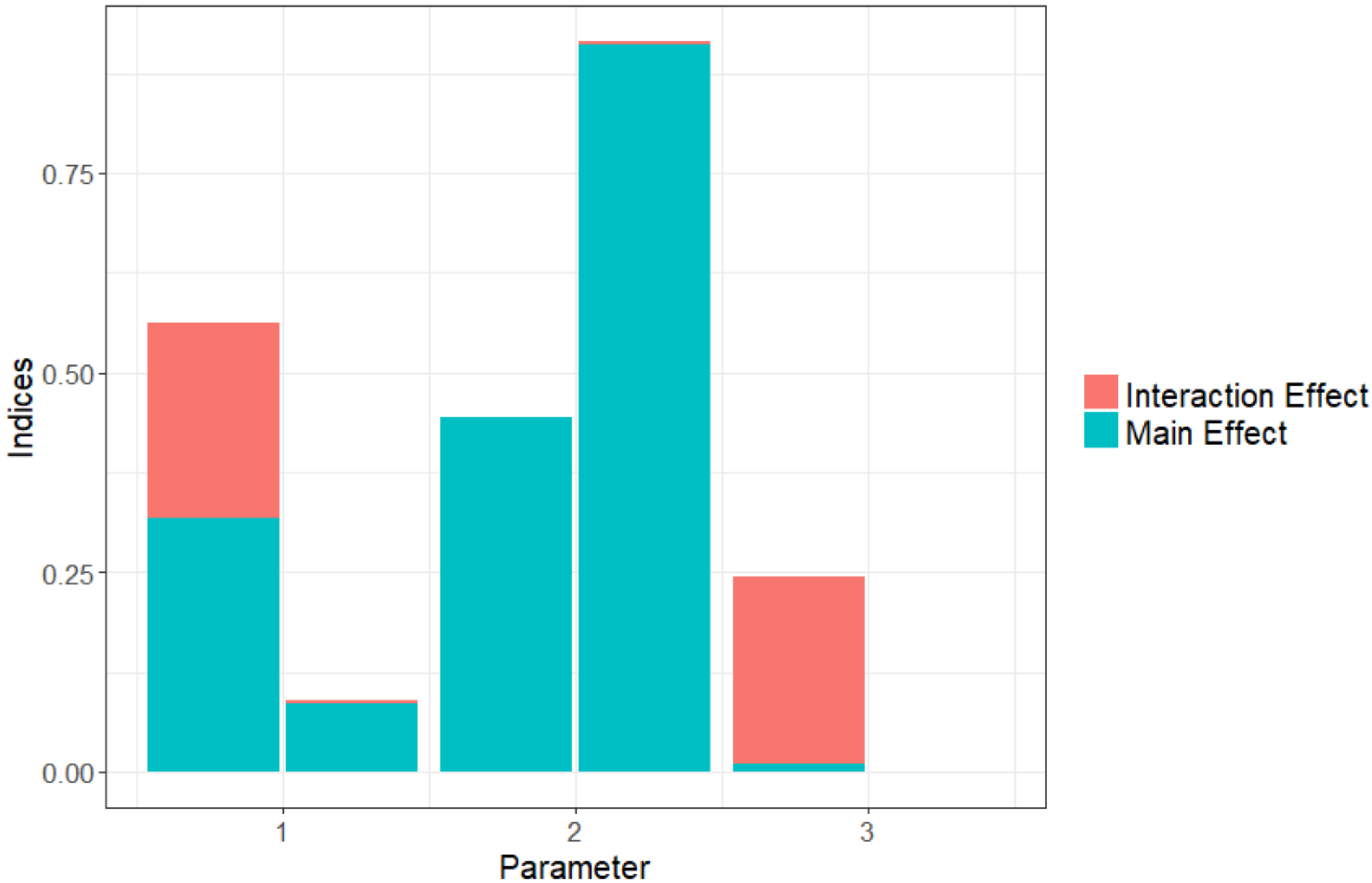



**Fig1: Ishigami Function**

$$Y = g(X_1, X_2, X_3) = \sin(X_1) + a\sin^2(X_2) + bX_3^4\sin(X_1)$$

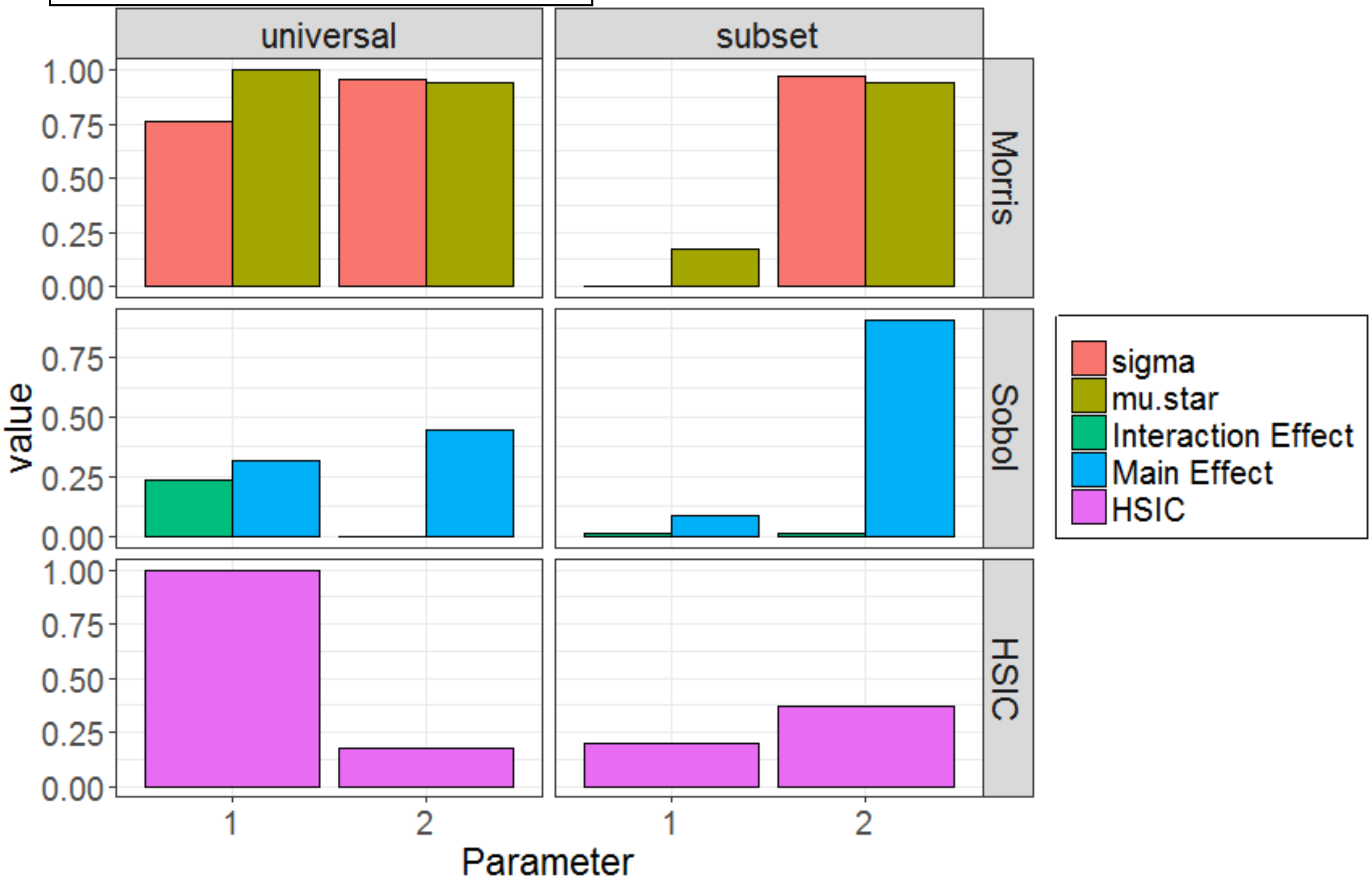



**Fig2a: Ishigami Function**

$$f(\mathbf{x}) = \prod_{i=1}^{d} \frac{|4x_i - 2| + a_i}{1 + a_i}, \text{ where}$$

$$a_i = \frac{i-2}{2}, \text{ for all } i = 1, \ldots, d$$

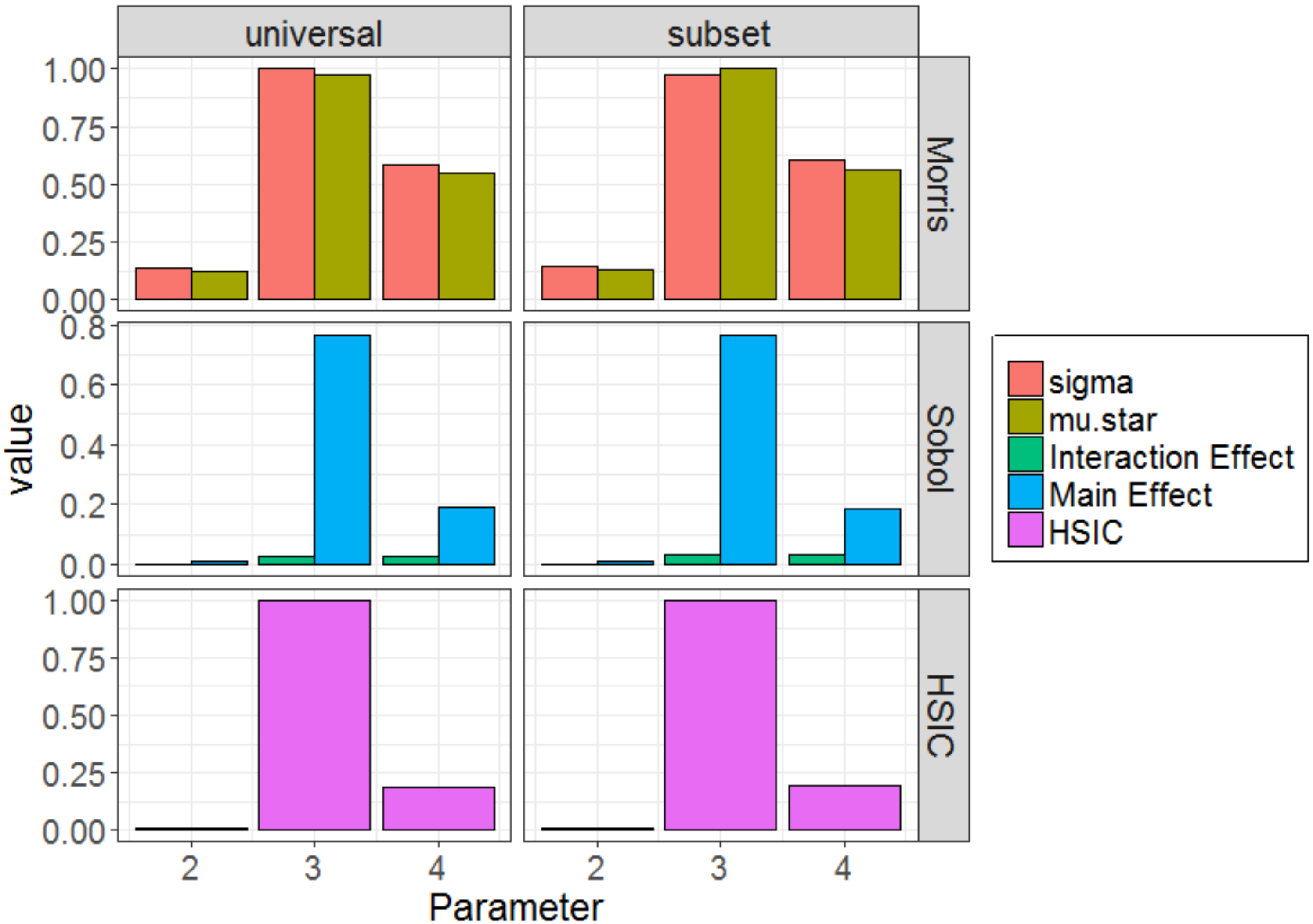



**Fig2b: GFunction**

$$f(\mathbf{x}) = \sum_{i=1}^{d} (-1)^i \prod_{j=1}^{i} x_j$$

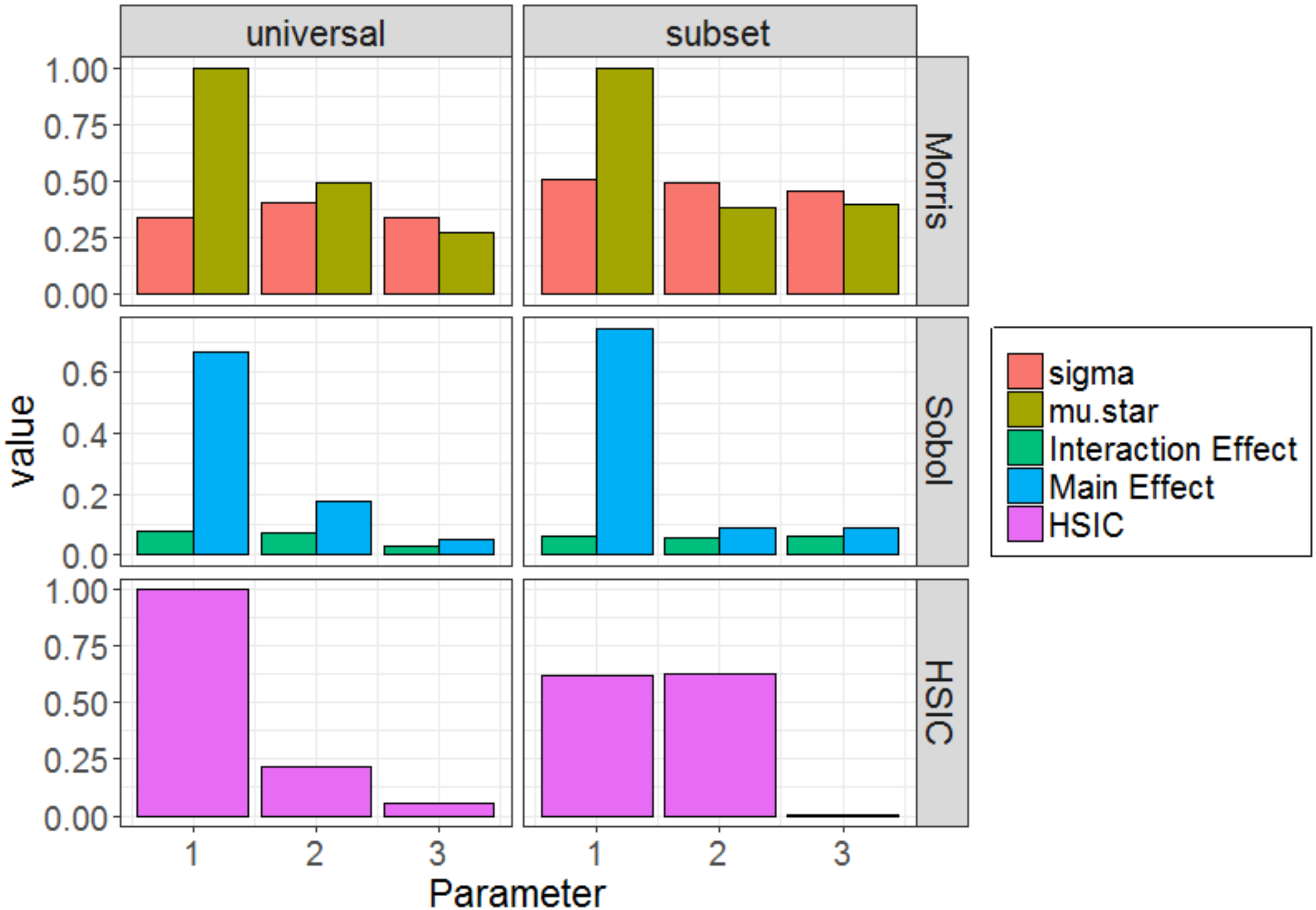



**Fig2c: Bratley function**

$$f(\mathbf{x}) = \mathbf{a_1}^T\mathbf{x} + \mathbf{a_2}^T \sin(\mathbf{x}) + \mathbf{a_3}^T \cos(\mathbf{x}) + \mathbf{x}^T\mathbf{M}\mathbf{x}$$

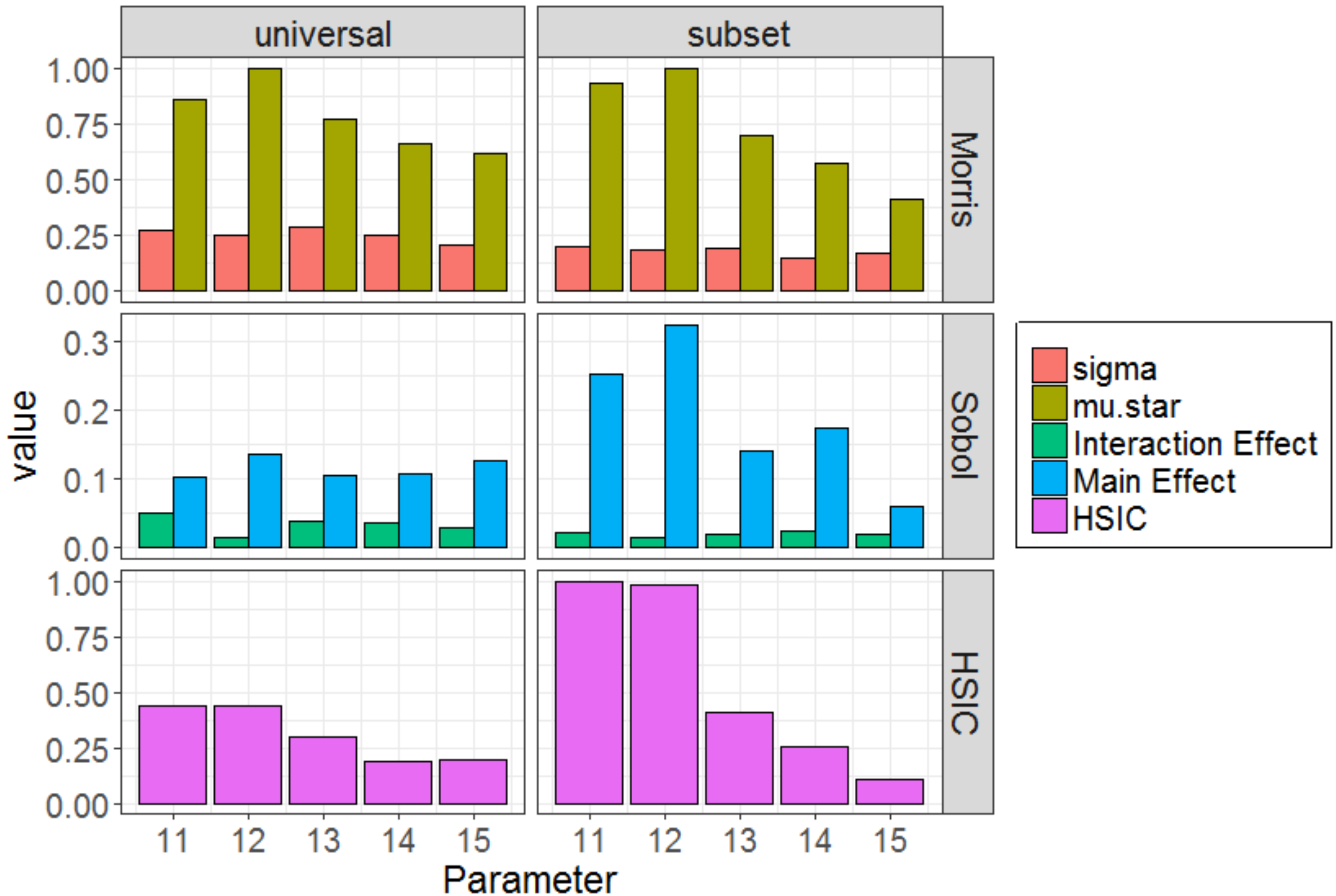



**Fig2d : Oakley Function**

$$f(\mathbf{x}) = \exp\left[\sum_{i=1}^{d} b_i x_i\right] - I_d + c_0, \text{ where}$$

$$I_d = \prod_{i=1}^{d} \frac{\exp(b_i) - 1}{b_i}$$

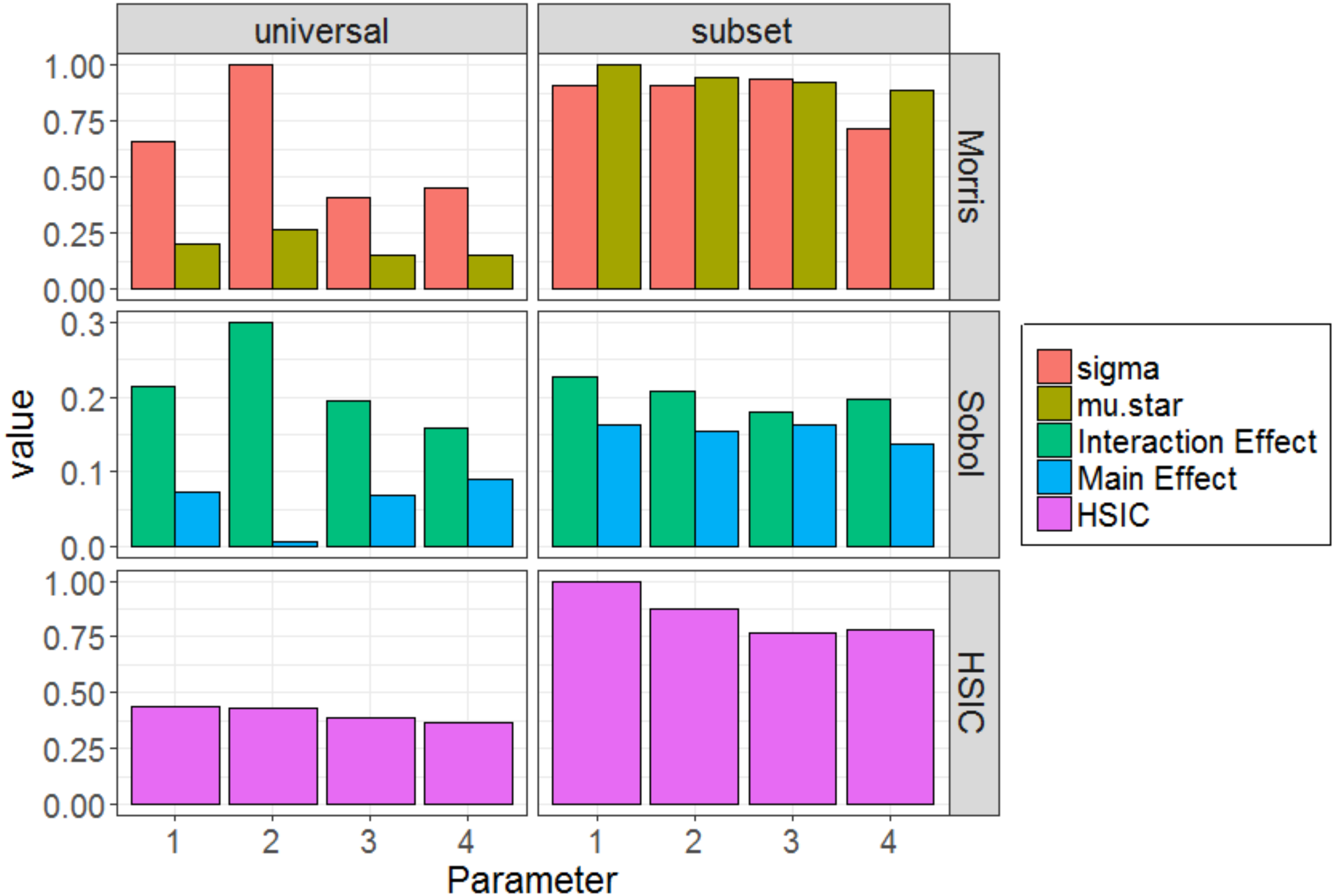



**Fig2e: Sobol&Lev function**

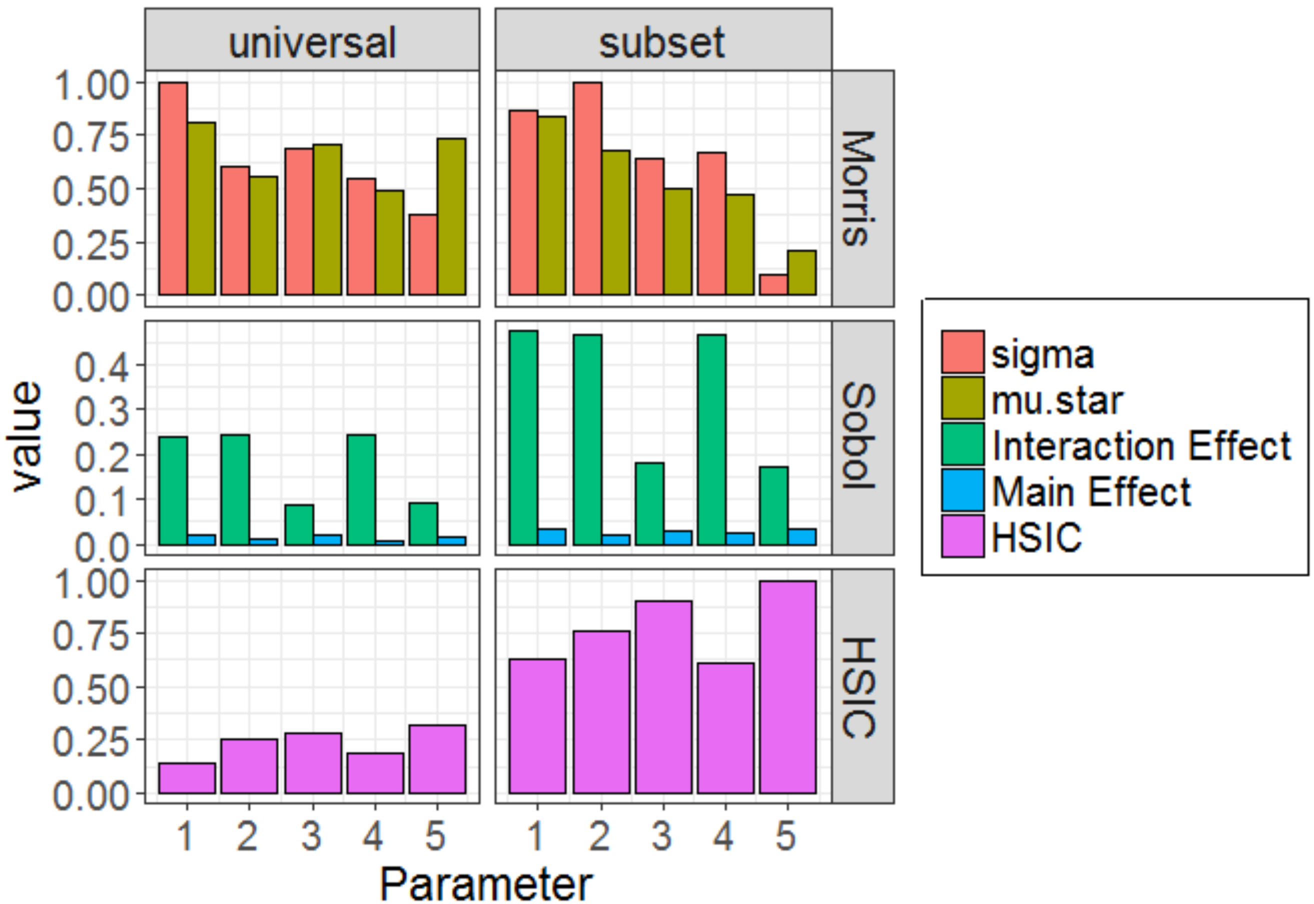
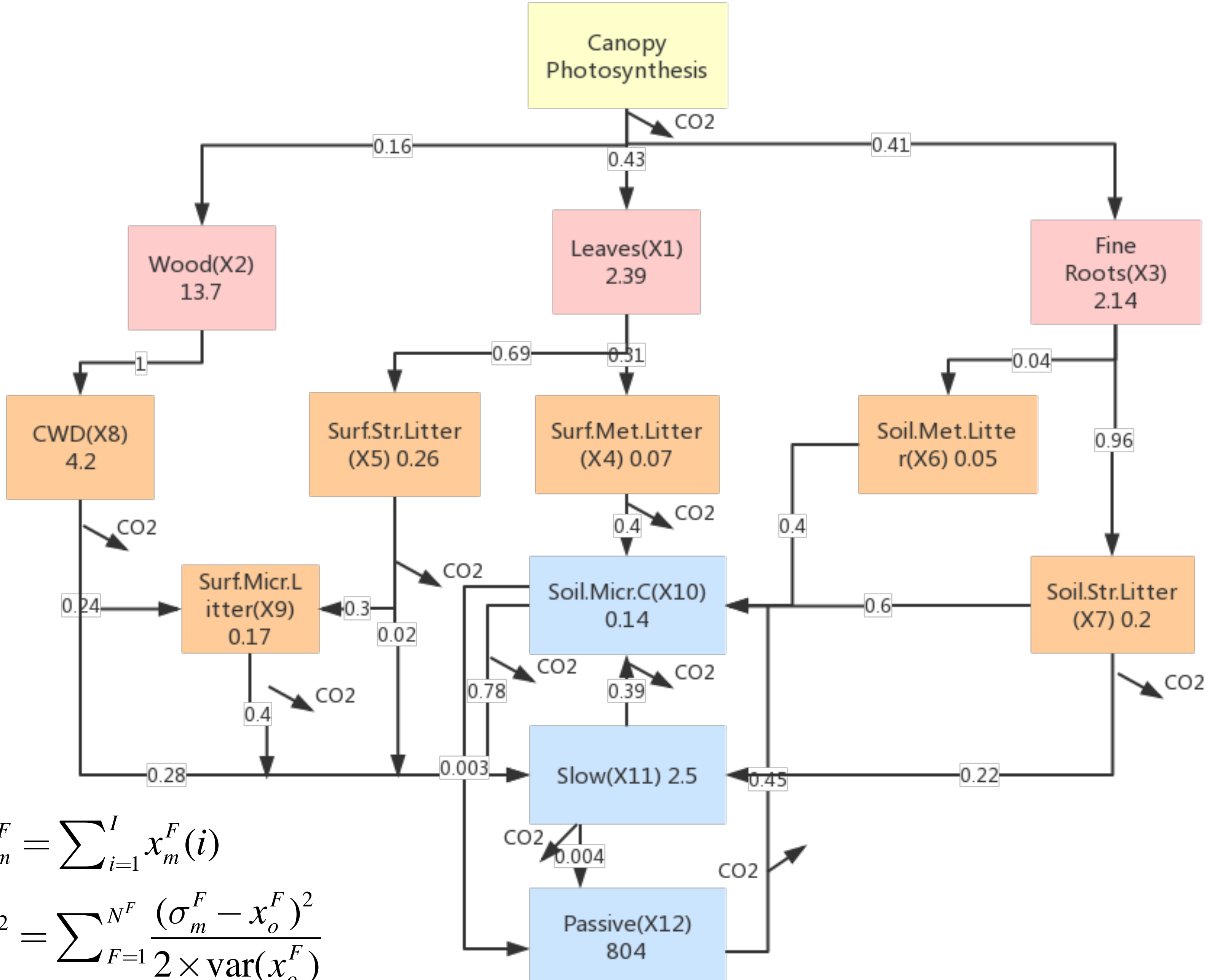



**Fig2f: Morris function**




$$\sigma_m^F = \sum_{i=1}^{I} x_m^F(i)$$

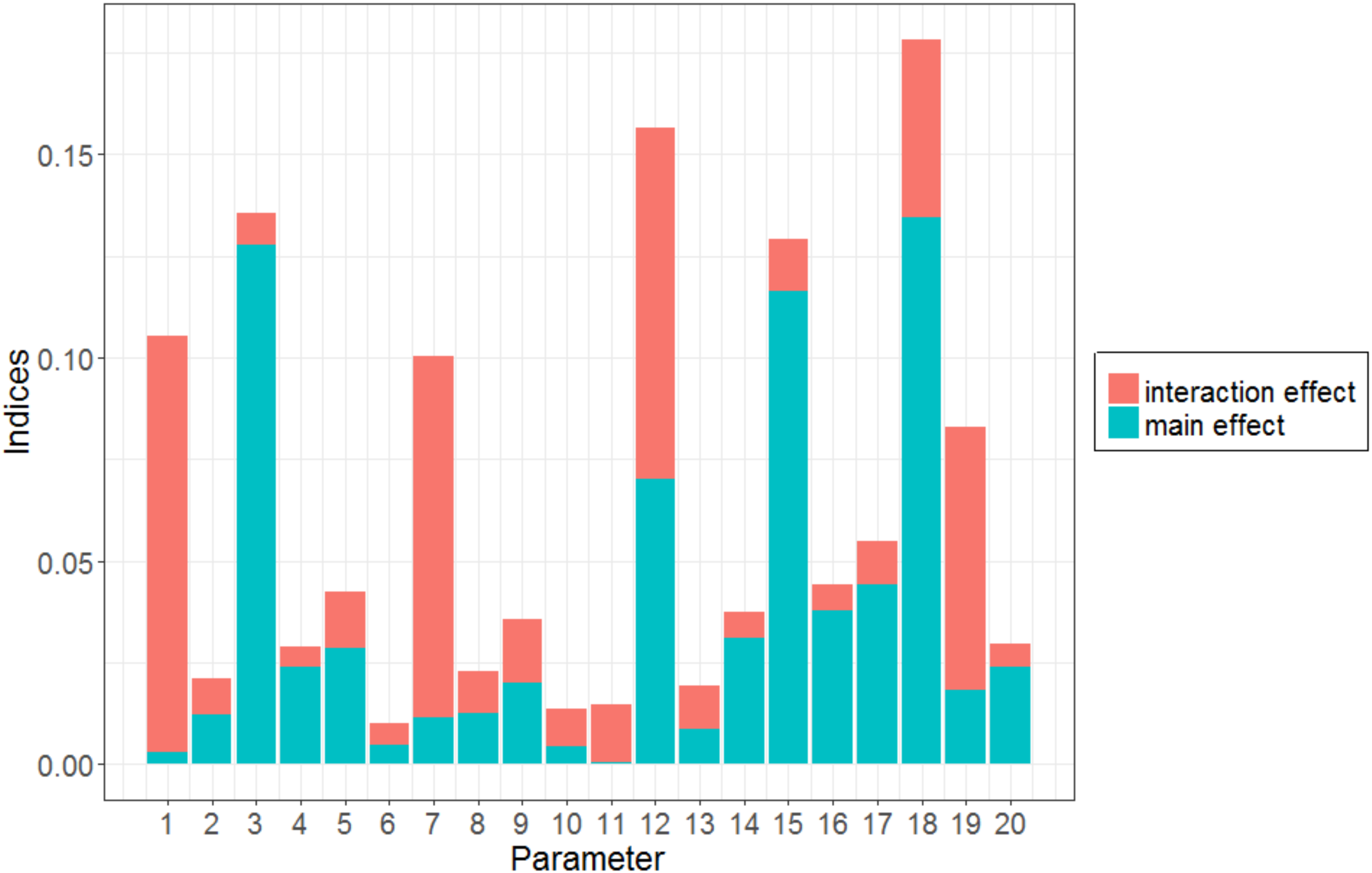
$$\chi^2 = \sum_{F=1}^{N^F} \frac{(\sigma_m^F - x_o^F)^2}{2 \times \mathrm{var}(x_o^F)}$$

**Fig3:CLM-CASA**

| ID | Description | Min | Max | Default Value |
|---|---|---|---|---|
| 1 | Clay effect on C partitioning from slow pool to passive pool | 0 | 0.7 | 0.00405 |
| 2 | C partitioning from slow to passive pool if no clay | 0 | 0.02 | 0.0135 |
| 3 | Exit rate from slow pool, (years 1) | 0.1 | 0.5 | 0.2 |
| 4 | Exit rate from passive pool, (years 1) | 0.001 | 0.005 | 0.0045 |
| 5 | C partitioning from slow to soil microbial pool if no clay | 0.3 | 0.7 | 0.44865 |
| 6 | Combined effect of sand and clay on C partitioning from soil microbial pool | 0 | 0.1 | 0.02176 |
| 7 | C partitioning from soil microbial pool to slow pool if no sand or clay | 0.019 | 0.75 | 0.16949 |
| 8 | Sand effect on C partitioning from soil microbial to slow pool | 0 | 1 | 0.67796 |
| 9 | Clay effect on C partitioning from soil microbial pool | 0 | 0.03 | 0.00544 |
| 10 | Sand effect on C partitioning from soil microbial to passive pool | 0 | 0.03 | 0.00204 |
| 11 | C partitioning from soil microbial to passive pool if no sand or clay | 0.0001 | 0.0008 | 0.00051 |
| 12 | Temperature sensitivity of C decomposition | 1 | 3 | 2 |
| 13 | Lignin effect on partitioning from surface structural litter to surface microbial litter | 0 | 0.7 | 0.4 |
| 14 | Lignin effect on partitioning from surface structural litter to soil slow pool | 0 | 0.8 | 0.7 |
| 15 | Lignin effect on partitioning from soil structural litter to soil microbial pool | 0 | 0.9 | 0.45 |
| 16 | Lignin effect on partitioning from soil structural litter to soil slow pool | 0 | 0.9 | 0.7 |
| 17 | Partitioning from surface structural to surface microbial pool if no lignin in surface structural litter | 0.35 | 2.3 | 0.4 |
| 18 | Partitioning from soil structural to soil microbial pool if no lignin in soil structural litter | 0.4 | 0.7 | 0.45 |
| 19 | Labile C fraction effect on C partitioning from roots to soil metabolic litter | 0 | 0.7 | 0.2 |
| 20 | Labile C fraction effect on C partitioning from leaves to surface metabolic litter | 0 | 1.0001 | 1 |

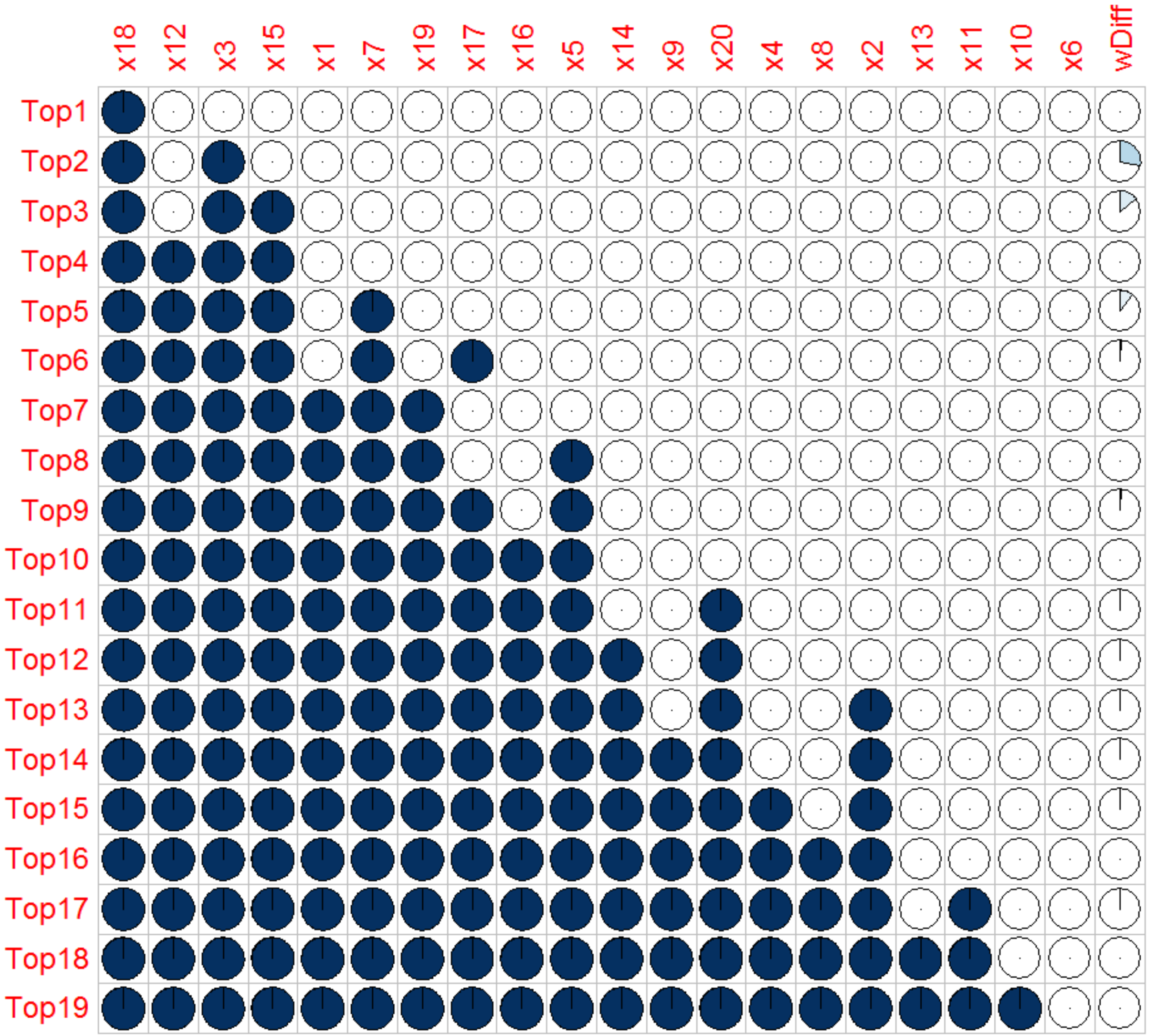
| Parameter | Description | Min | Default | Max |
|---|---|---|---|---|
| rhminh | Threshold relative humidity for stratiform high clouds | 0.65 | 0.8 | 0.85 |
| rhminl | Threshold relative humidity for stratiform low clouds | 0.8 | 0.8975 | 0.99 |
| alfa | Maximum cloud downdraft mass flux fraction | 0.05 | 0.1 | 0.6 |
| c0_lnd | *Deep* convection precipitation efficiency over land | 0.001 | 0.0059 | 0.01 |
| c0_ocn | *Deep* convection precipitation efficiency over ocean | 0.001 | 0.045 | 0.1 |
| dmpdz | Parcel fractional mass entrainment rate | -0.002 | -0.001 | -0.0002 |
| ke | Evaporation efficiency of precipitation | 5E-07 | 0.000003 | 0.00001 |
| tau | Time scale for consumption rate deep CAPE | 1800 | 3600 | 28800 |
| ai | Fall speed parameter for cloud ice | 350 | 700 | 1400 |
| as | Fall speed parameter for snow | 5.86 | 11.72 | 23.44 |
| cdnl | Lower bound on droplet number | 0 | 0 | 10000000 |
| dcs | Autoconversion size threshold for ice to snow | 0.0001 | 0.0004 | 0.0005 |
| Eii | Collection efficiency aggregation ice | 0.001 | 0.1 | 1 |
| qcvar | Inverse relative variance of sub-grid cloud water | 0.5 | 2 | 5 |
| a2l | Moist entrainment enhancement parameter | 10 | 30 | 50 |
| criqc | Maximum updraft condensate | 0.5e-3 | 0.7e-3 | 1.5e-3 |
| kevp | Evaporative efficiency | 0.000001 | 0.000002 | 0.00002 |
| rkm | Updraft lateral mixing efficiency | 8 | 14 | 16 |
| rpn | Penetrative updraft entrainment efficiency | 1 | 10->5 | 10 |

| Variables |
| --- |
| Zonal wind at 200 mbar pressure surface |
| Zonal wind at 850 mbar pressure surface |
| Meridional wind at 200 mbar pressure surface |
| Meridional wind at 850 mbar pressure surface |
| Total (convective and large-scale) precipitation rate (liq + ice) |
| Specific Humidity at 850 mbar pressure surface |
| Temperature at 850 mbar pressure surface |
| Temperature at 200 mbar pressure surface |
| Net longwave flux at top of model |
| Net solar flux at top of model |
| Net longwave flux at surface |
| Net solar flux at surface |
| Vertically-integrated high cloud |
| Vertically-integrated low cloud |
| Vertically-integrated mid-level cloud |
| Vertically-integrated total cloud |
| Surface pressure |
| Total grid-box cloud liquid water path |



Indices
0.00
0.05
0.10
0.15
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
Parameter
interaction effect
main effect


**Fig4: Sobol**



x18
x12
x3
x15
x1
x7
x19
x17
x16
x5
x14
x9
x20
x4
x8
x2
x13
x11
x10
x6
wDiff
Top1
Top2
Top3
Top4
Top5
Top6
Top7
Top8
Top9
Top10
Top11
Top12
Top13
Top14
Top15
Top16
Top17
Top18
Top19


**Fig5: DSAM**

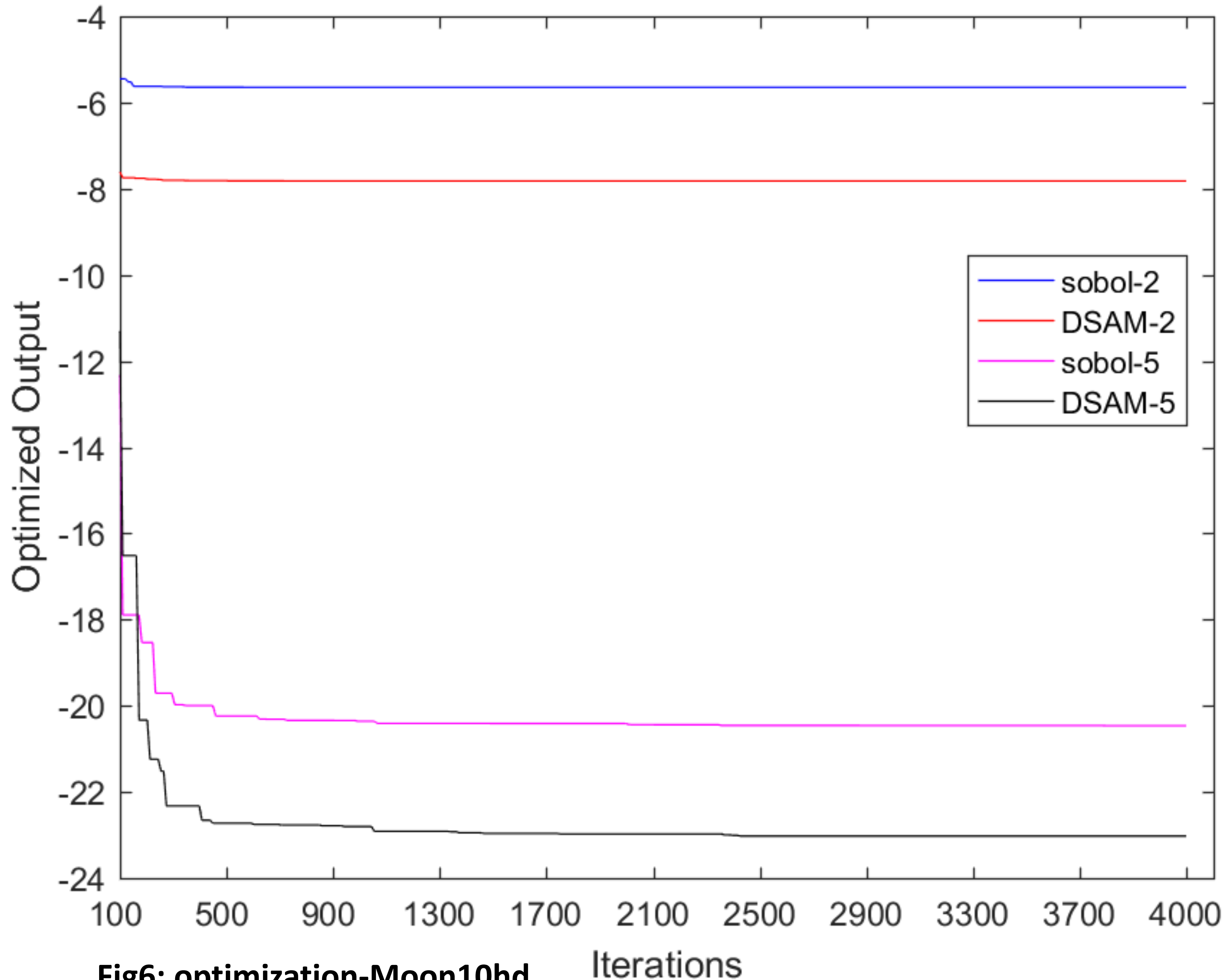



**Fig6: optimization-Moon10hd**

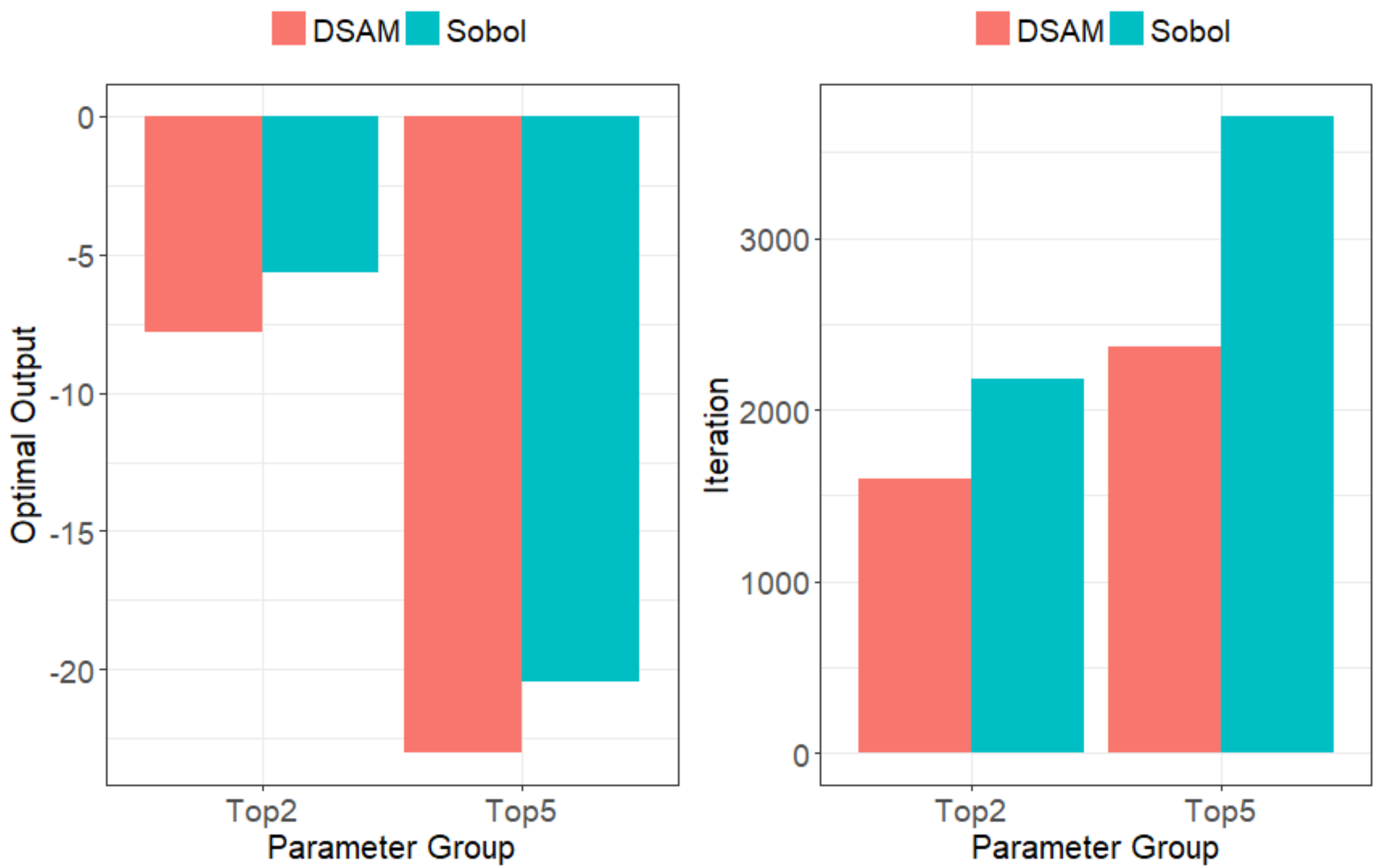



**Fig7: the optimal value and iterations**

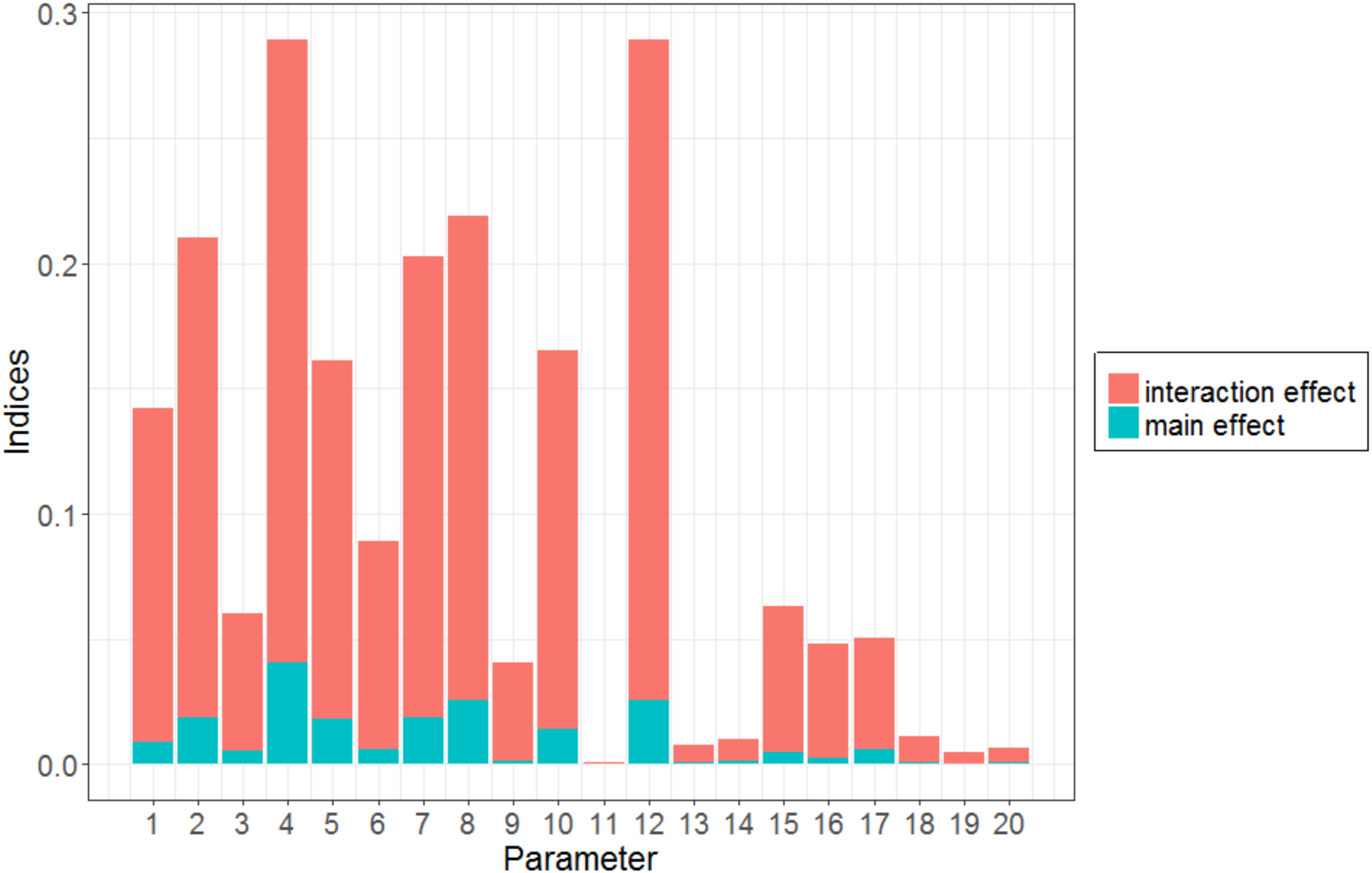



**Fig8: Sobol'-CLM-CASA'**

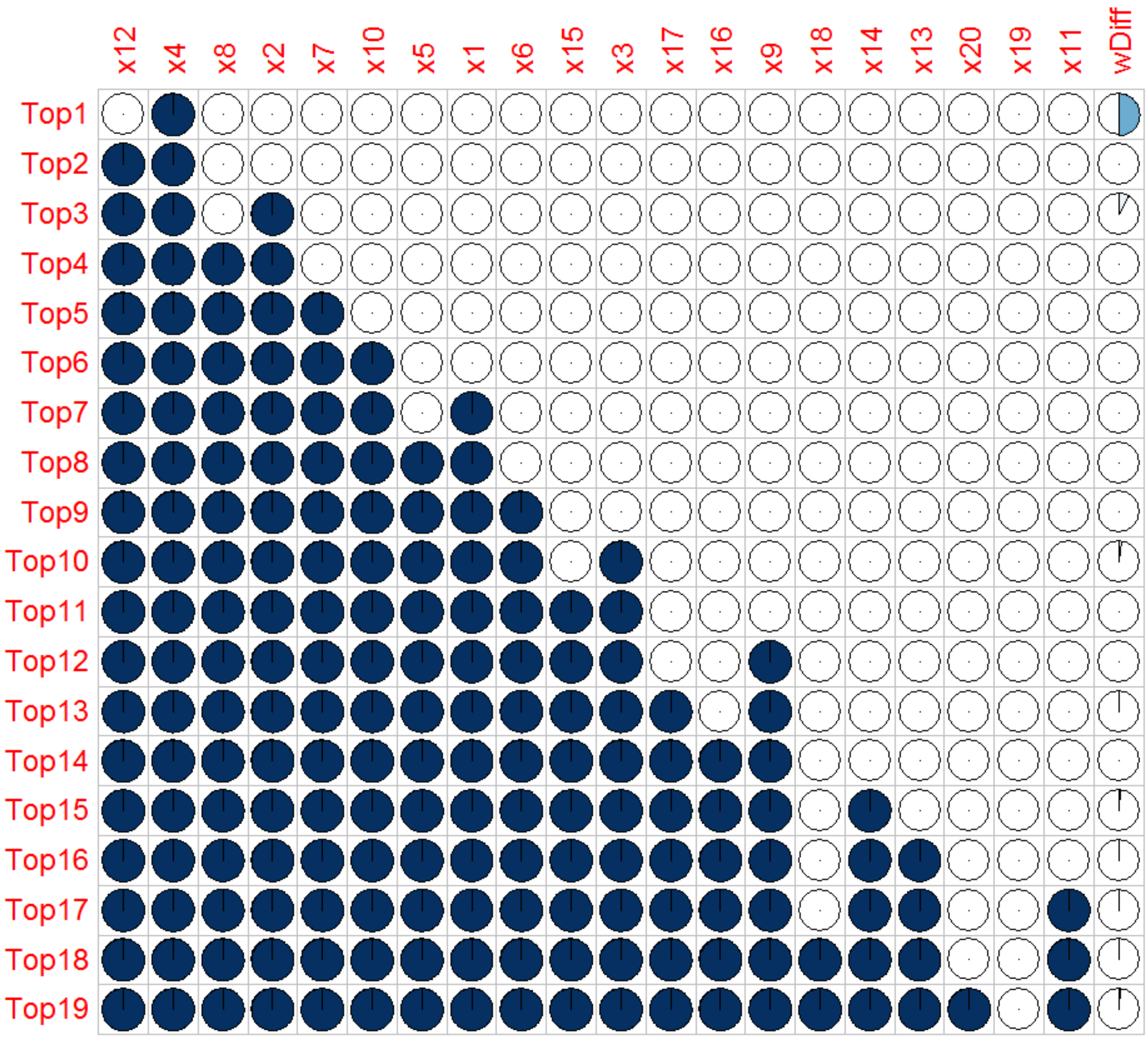



**Fig9: DSAM: CLM-CASA'**

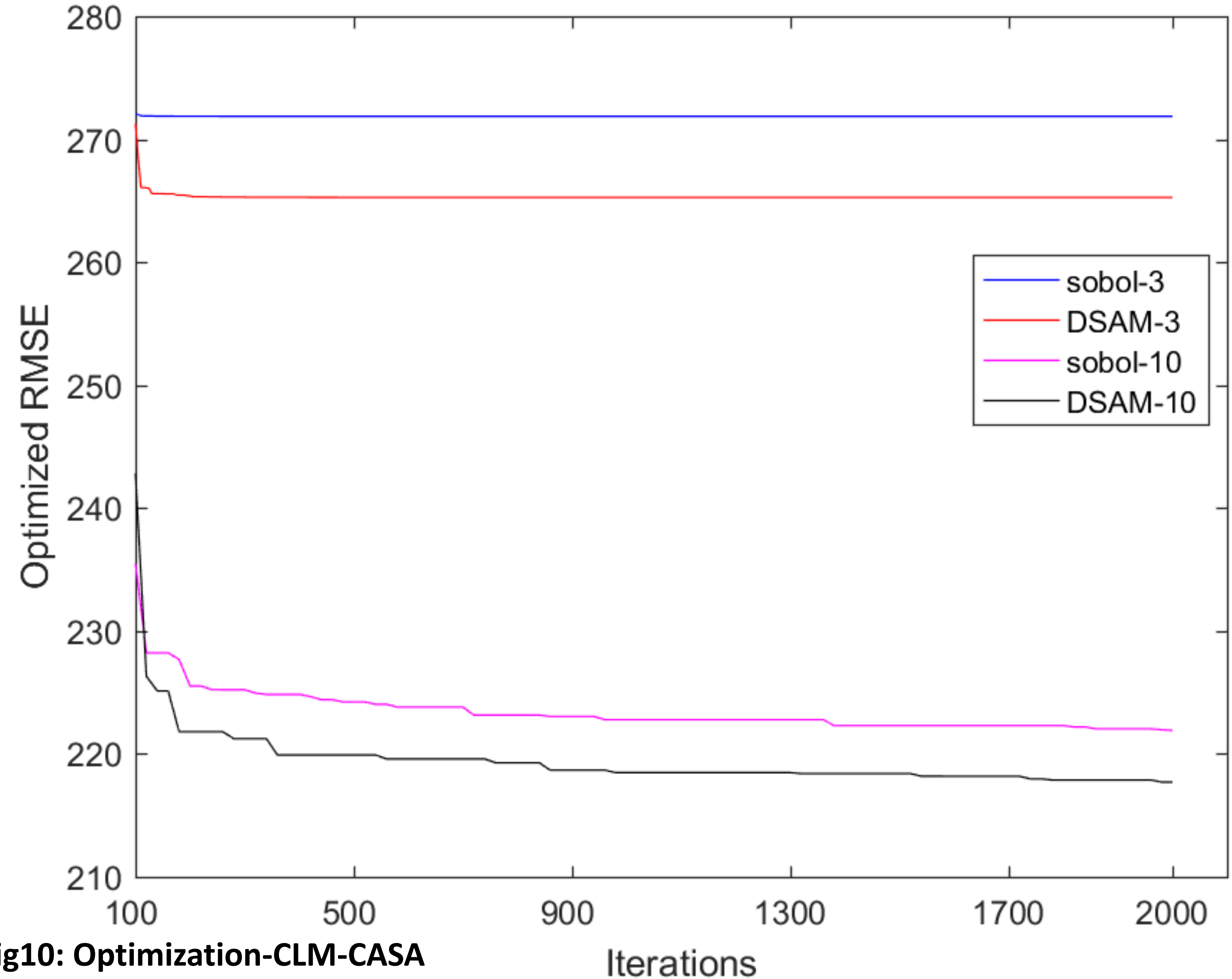



**Fig10: Optimization-CLM-CASA**

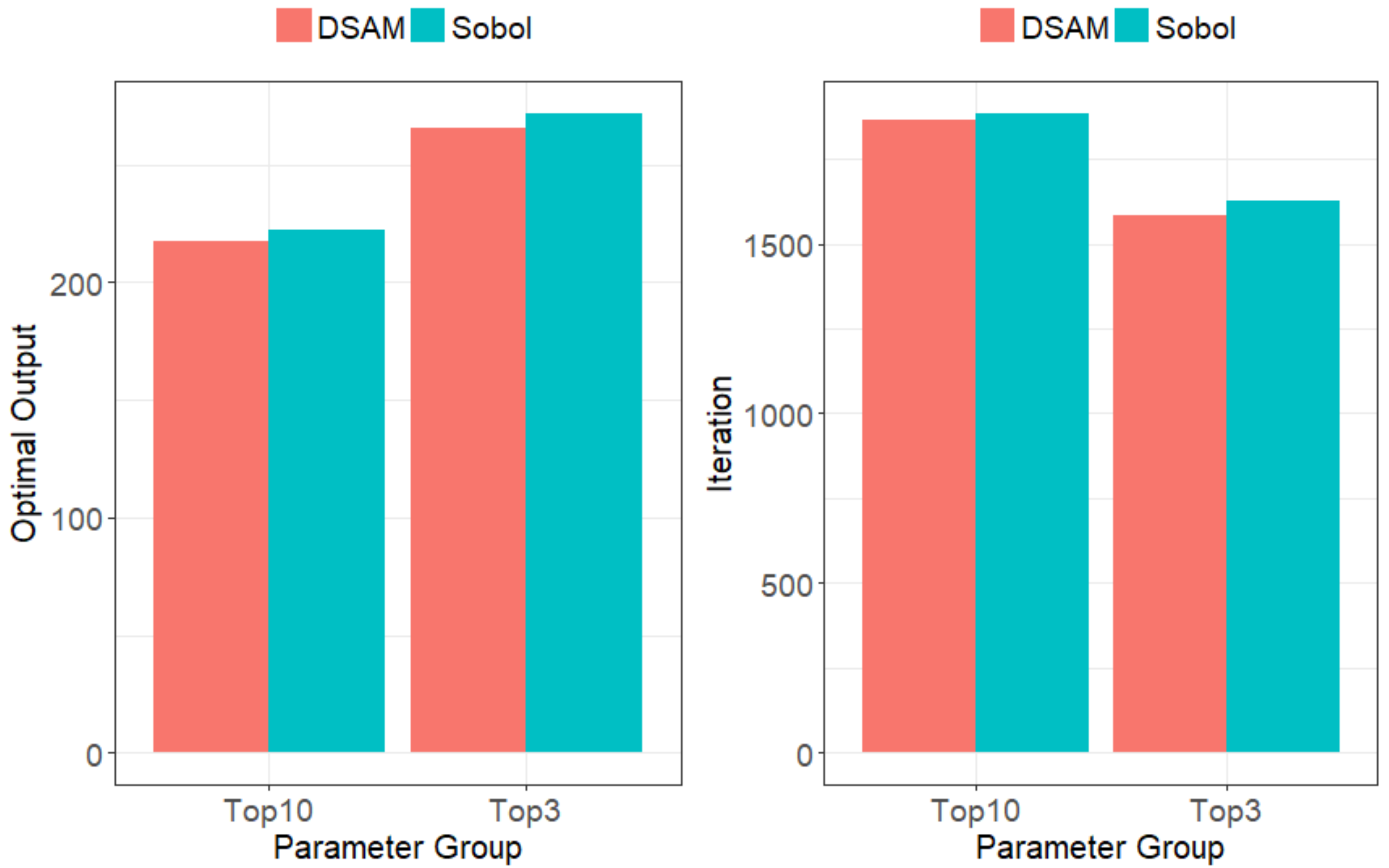



**Fig11: Optimal value and iterations**

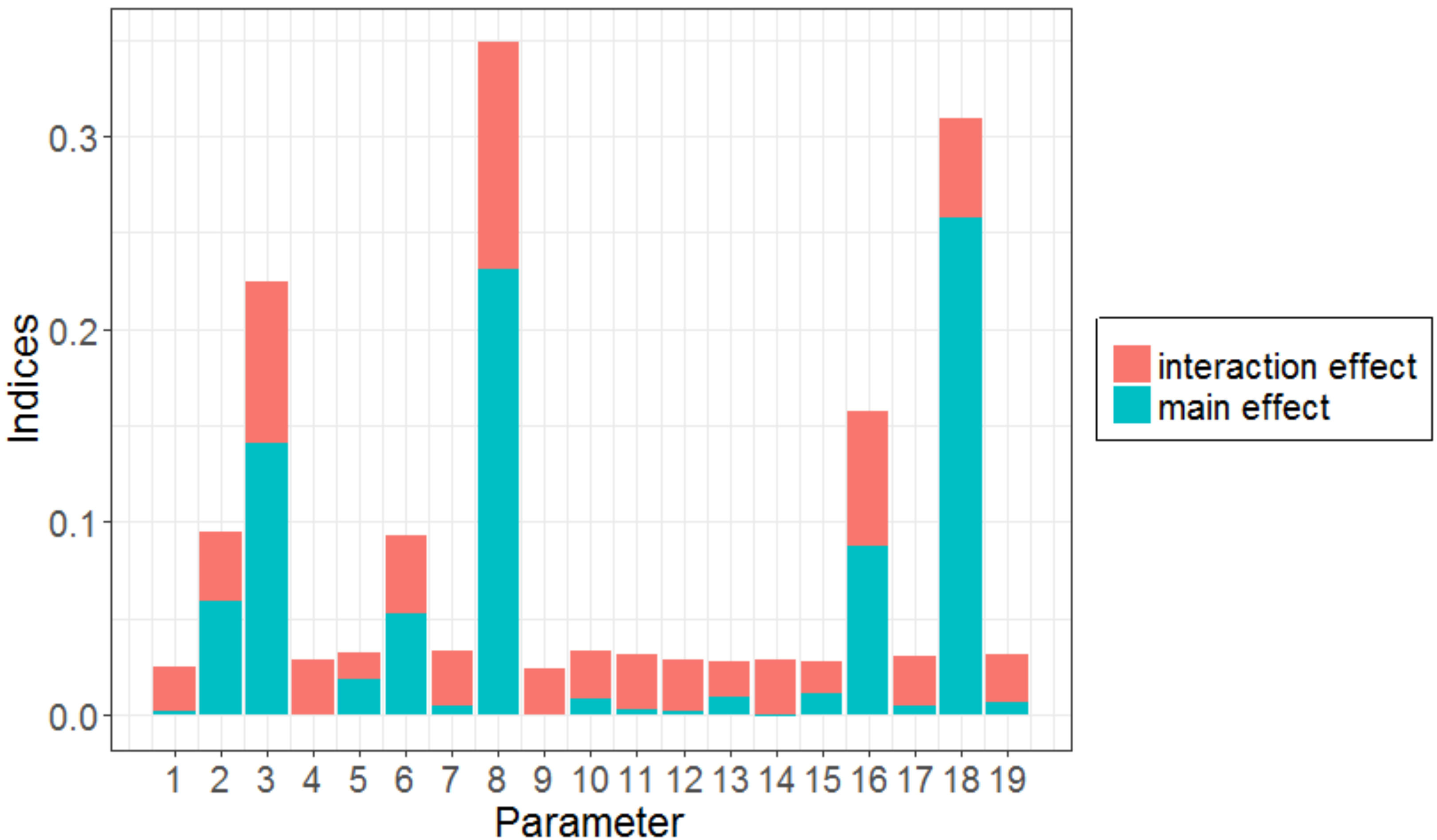



**Fig12: Sobol'-SCAM**

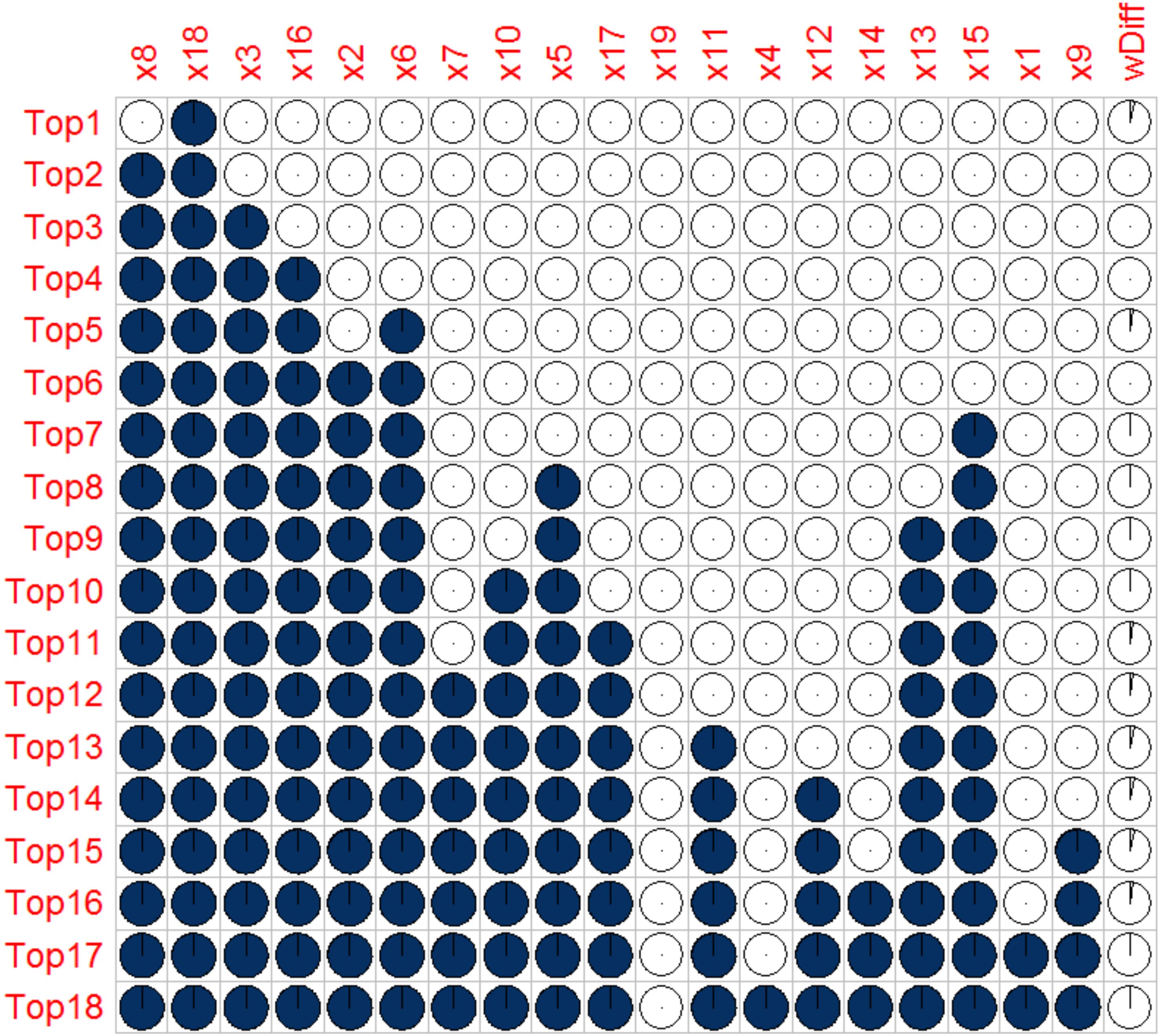



**Fig13: DSAM-SCAM**

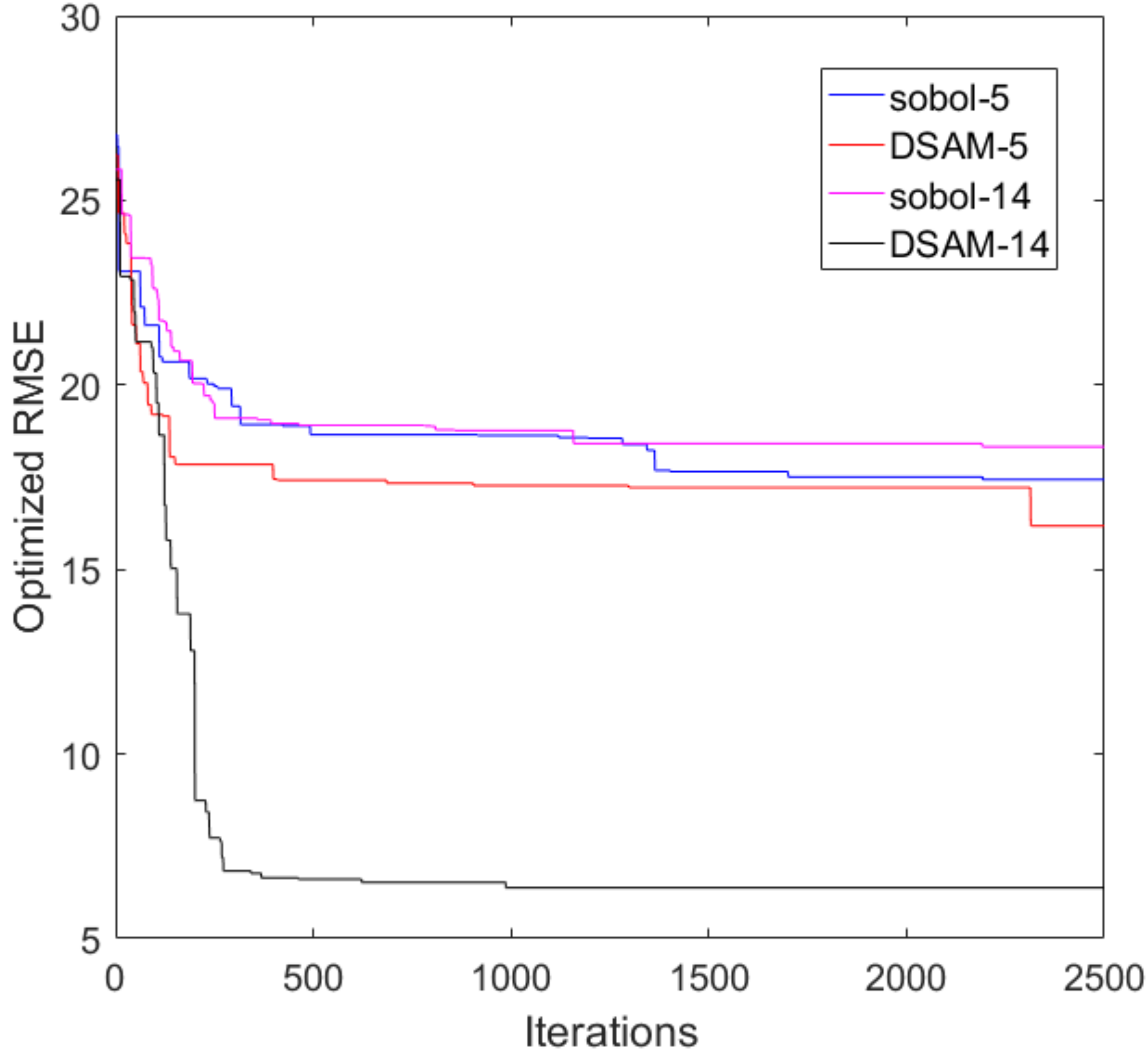



**Fig14: Optimization of Top5,14 sensitive parameters**

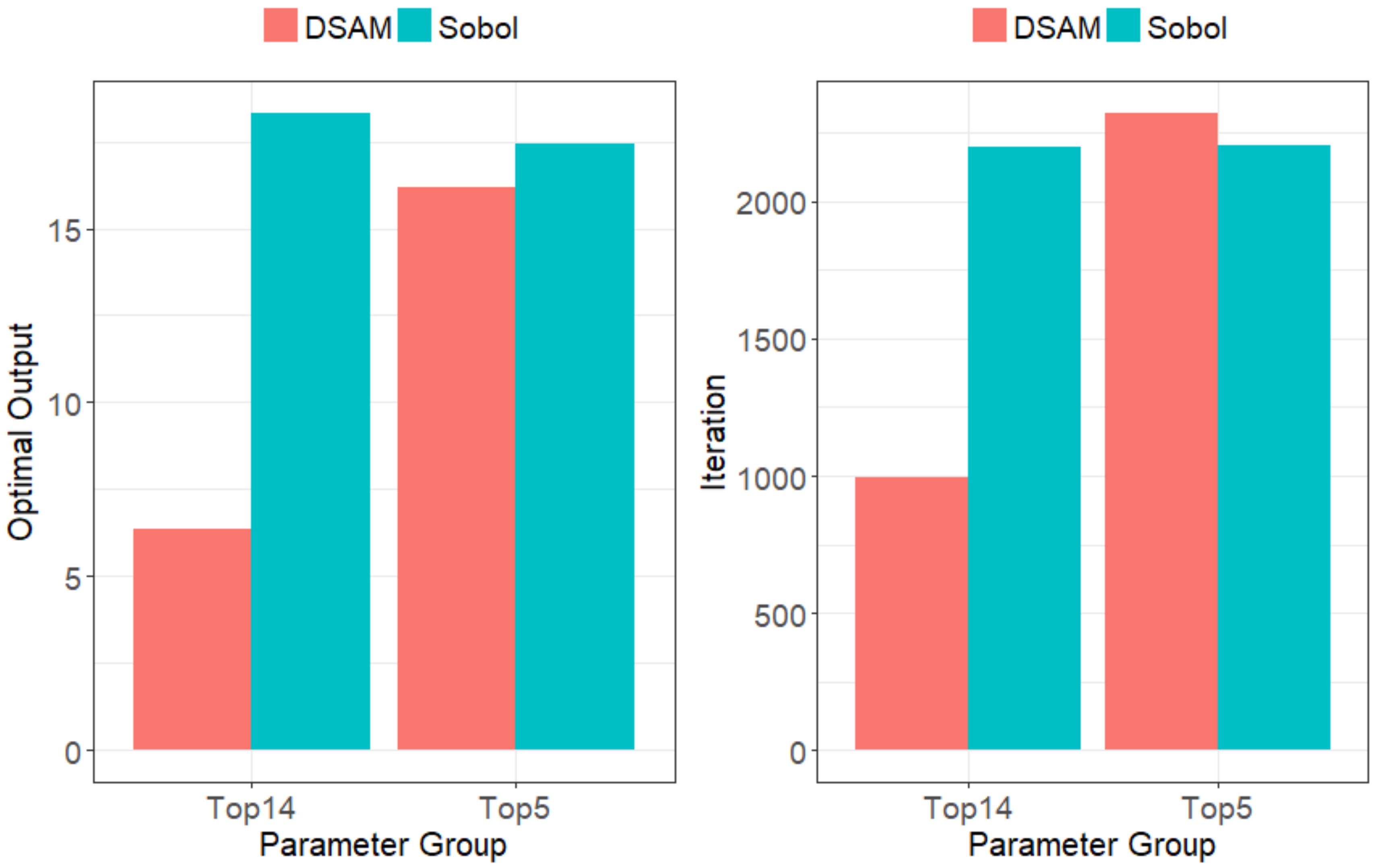



**Fig15: Optimal value and iterations**

# Additional Materials

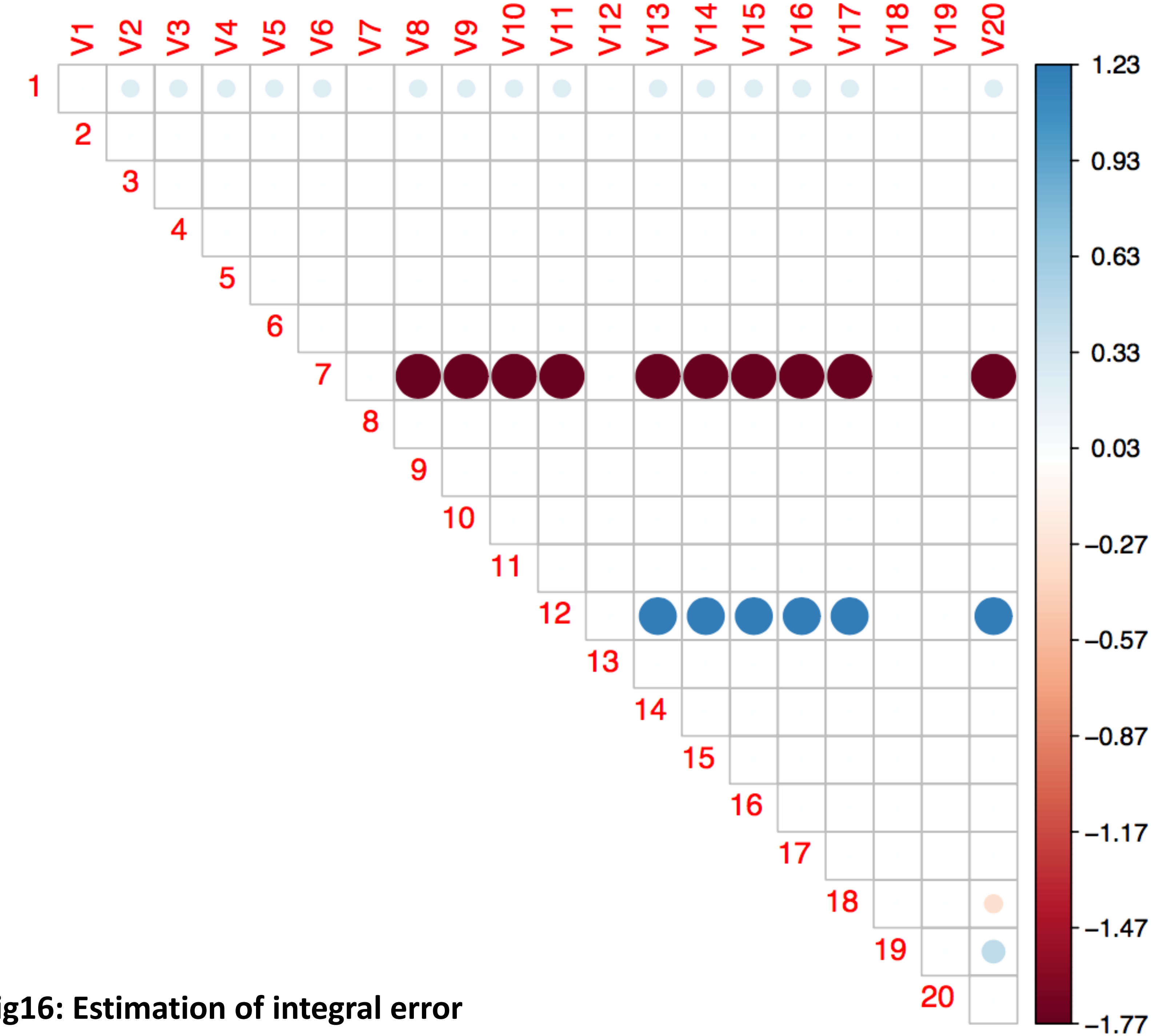



**Fig16: Estimation of integral error**

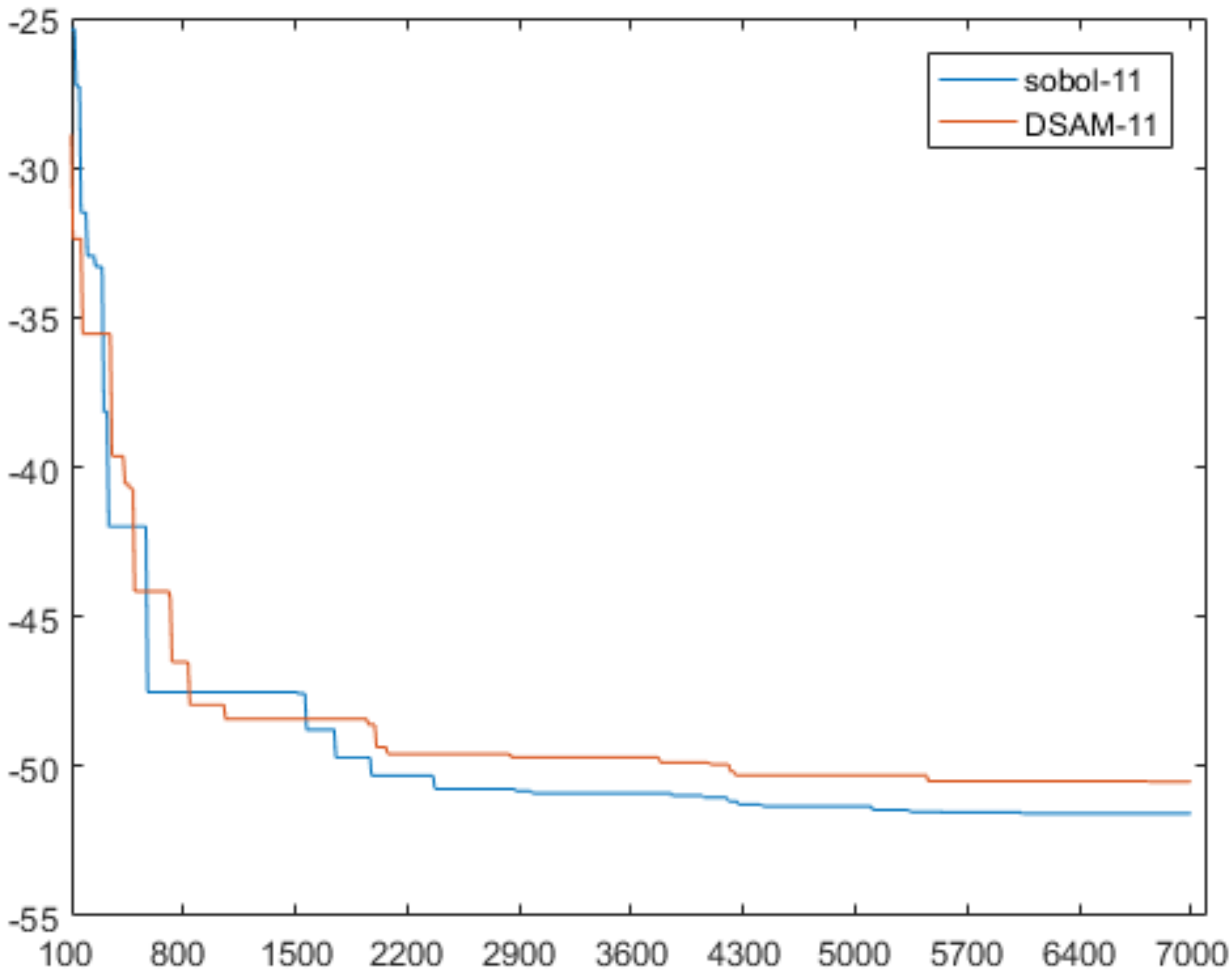



**Fig17: valid selection because of integral error**

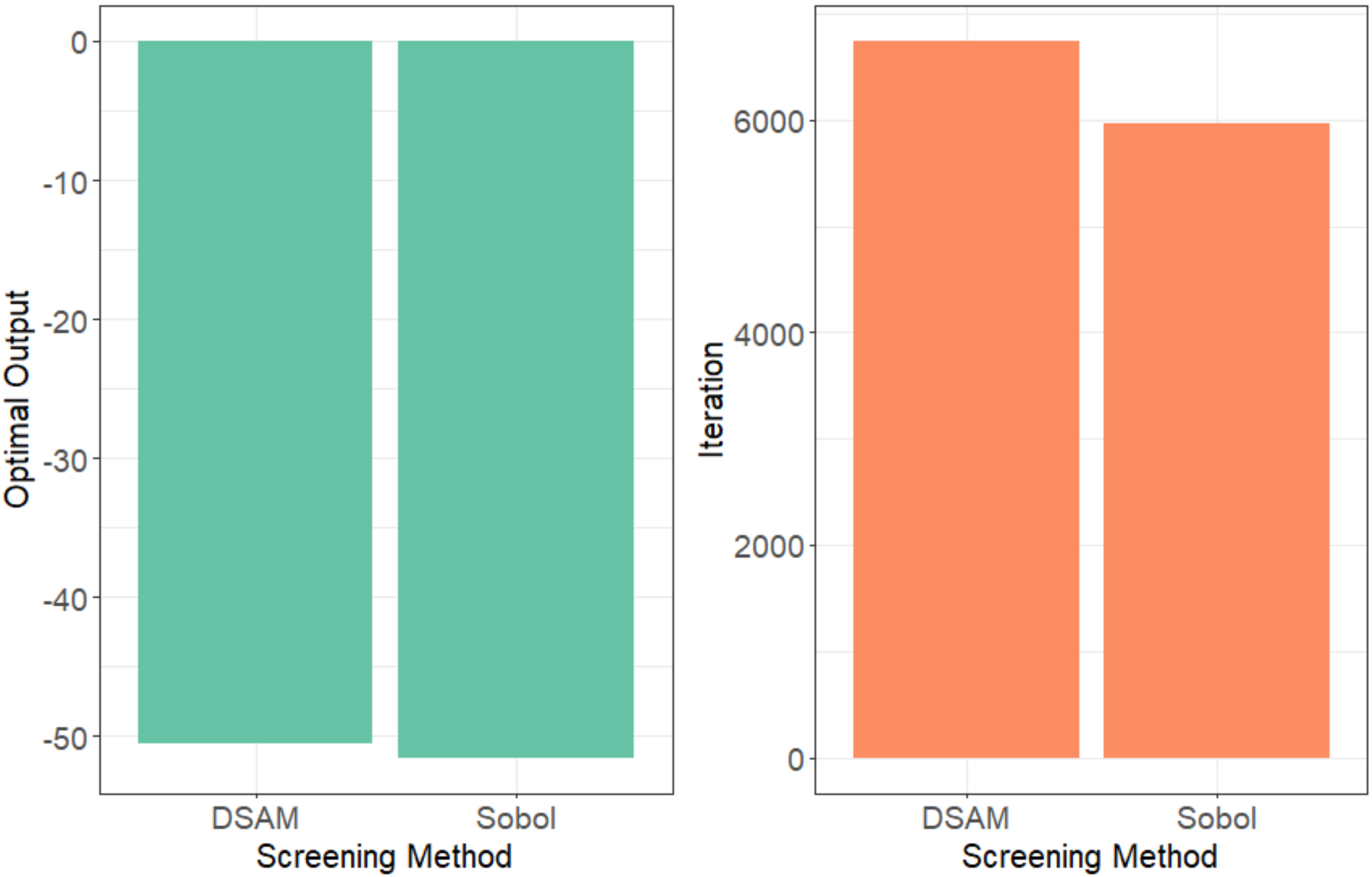



**Fig18: Optimal value and iterations**