

Data: $\mathbf{B}, \mathcal{H}(), \mathbf{H}, \mathbf{R}, o$, etc.

Input: x^g, q^a : present guess/analysis in different grid spaces

Input: $\hat{x}^s := x^g - \mathbf{L}^{-1}q^b$, x -increment

Input: $\hat{y}^s := \mathbf{B}\hat{x}^s$, y -increment

1 $d^{\hat{x}} = 0$.

2 $d^{\hat{y}} = 0$.

3 $\hat{x} = 0$.

4 $\hat{f} = 0$.

5 **do** $i = 1, \dots$

6 $g^{\hat{x}} = \mathbf{H}^T \mathbf{R}^{-1}(\mathcal{H}(x^g + \hat{x}) - o)$

7 $g^{\hat{y}} = \mathbf{B}g^{\hat{x}}$

8 $g^{\hat{x}} = \hat{y}^s + g^{\hat{x}}$

9 $g^{\hat{y}} = \hat{x}^s + g^{\hat{y}}$

10 $\hat{f} = g^{\hat{y}} - \hat{f}$

11 $\beta = \hat{f}^T g^{\hat{y}} / \hat{f}^T d^{\hat{x}}; \hat{f} = g^{\hat{y}}$

12 $d^{\hat{x}} = -g^{\hat{y}} + \beta d^{\hat{x}}$

13 $d^{\hat{y}} = -g^{\hat{x}} + \beta d^{\hat{y}}$

14 minimize $J(\hat{x} + \alpha d^{\hat{x}})$ for α

15 $\hat{x} = \hat{x} + \alpha d^{\hat{x}}$

16 $\hat{x}^s = \hat{x}^s + \alpha d^{\hat{x}}$

17 $\hat{y}^s = \hat{y}^s + \alpha d^{\hat{y}}$

18 **enddo**

19 $q^a = q^a + \mathbf{L}\hat{x}$

Result: $\hat{x}^s, \hat{y}^s, q^a$