STEP 1

Control vector

$x =$ (x_1 … x_N)

Isotopic signature $\delta^{13}C$ 1 | Source of CH_4 1

Source of $^{12}CH_4$ 1

Source of $^{13}CH_4$ 1

Isotopic signature $\delta^{13}C$ N | Source of CH_4 N

Source of $^{12}CH_4$ N

Source of $^{13}CH_4$ N

Other inputs

Total source of $^{12}CH_4$

Total source of $^{13}CH_4$

LMDz *Forward* model

Simulated $^{12}CH_4$

Simulated $^{13}CH_4$

$\mathcal{H}(x)$

Simulated CH_4

Simulated $\delta^{13}C$

Observed CH_4

Observed $\delta^{13}C$

Observation vector

$= y^0$

STEP 2

Observation operator $\mathcal{H}(x)$

$\delta y = \mathcal{H}(x) - y^0$

New x

Minimization process

$\nabla J(x)$

$J(x)$

STEP 4

$\delta y^* = \mathbf{R}^{-1}(\mathcal{H}(x) - y^0)$

STEP 3

Adjoint forcings vector

$= \delta y^*$

δy^*_1 … δy^*_p

Adjoint forcings CH_4

Adjoint forcings $\delta^{13}C$

Adjoint forcings $^{12}CH_4$

Adjoint forcings $^{13}CH_4$

LMDz *Adjoint* model

Other inputs

Sensbility to source of $^{12}CH_4$

Sensbility to source of $^{13}CH_4$

Sensibility to source of $^{12}CH_4$ 1

Sensibility to source of $^{13}CH_4$ 1

Sensibility to isotopic signature $\delta^{13}C$ 1 | Sensibility to source of CH_4 1

Sensibility to source of $^{12}CH_4$ N

Sensibility to source of $^{13}CH_4$ N

Sensibility to isotopic signature $\delta^{13}C$ N | Sensibility to source of CH_4 N

$\mathcal{H}^*(\delta y^*)$

Adjoint operator $\mathcal{H}^*(\delta y^*)$