BENCH

(Bayesian EstimatioN of CHange)

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MIML
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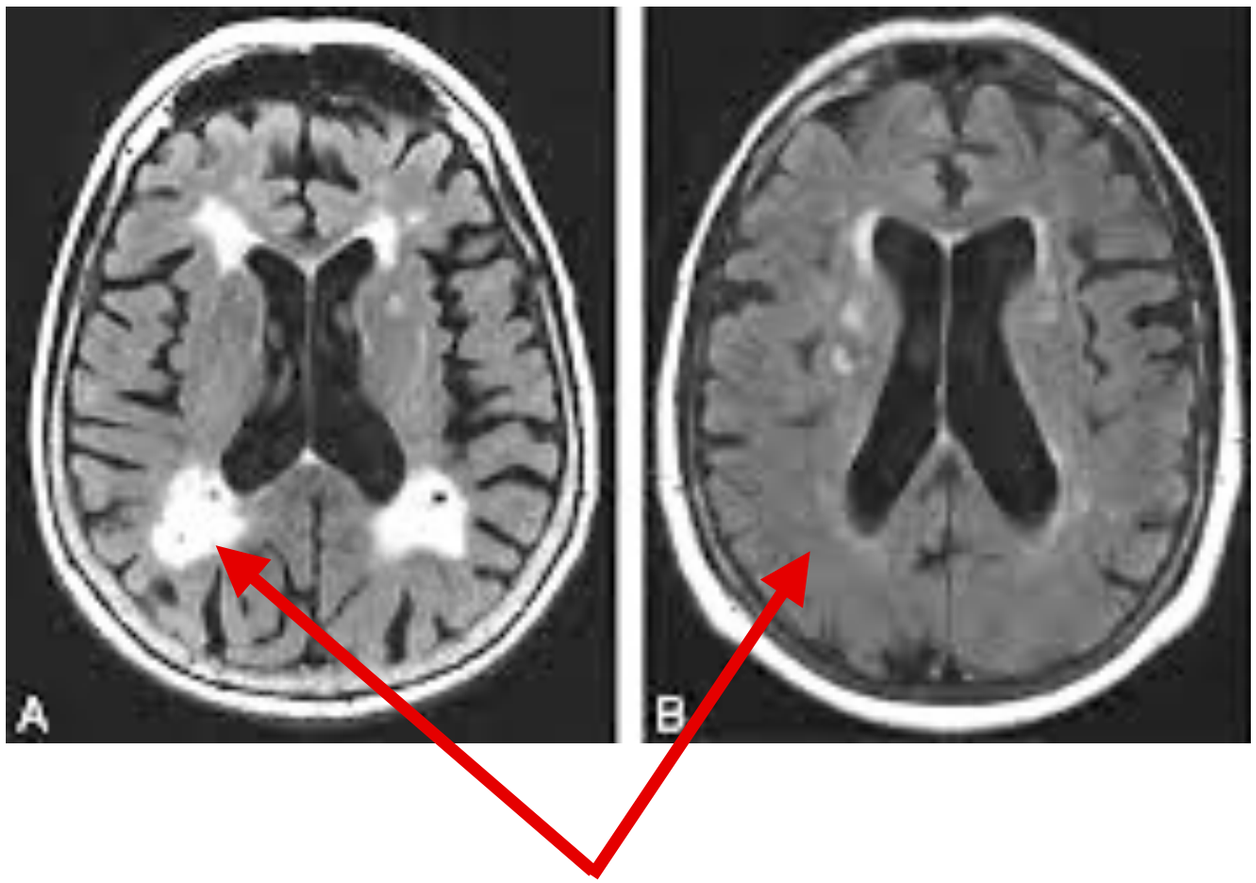


What microstructural parameter can explain the observed change in white matter hyperintensities?

* Image from: Debette S, Markus H S. The clinical importance of white matter hyperintensities on brain magnetic resonance imaging: systematic review and meta-analysis *BMJ* 2010; 341 :c3666 doi:10.1136/bmj.c3666

Microstructural Parameters

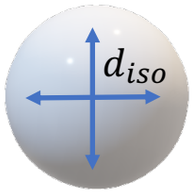
Biophysical Model

Model Inversion

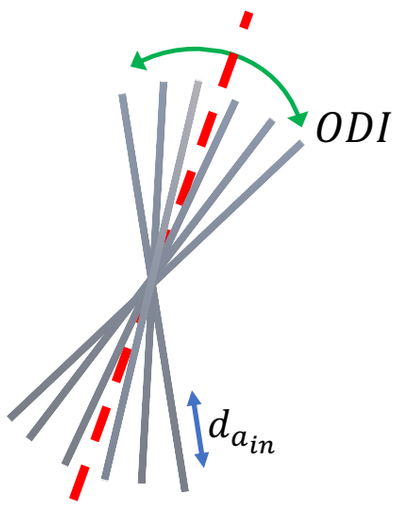
Diffusion Data

Standard Model

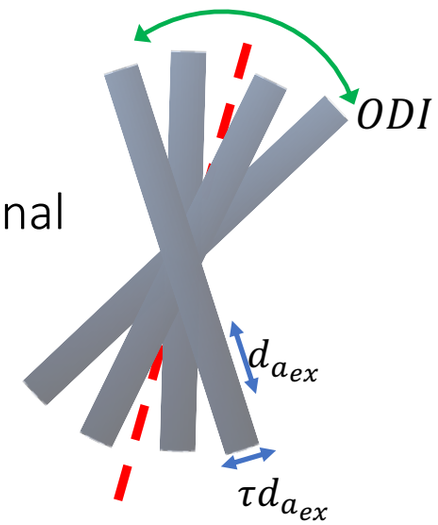
Isotropic



Intra-axonal



Extra-axonal



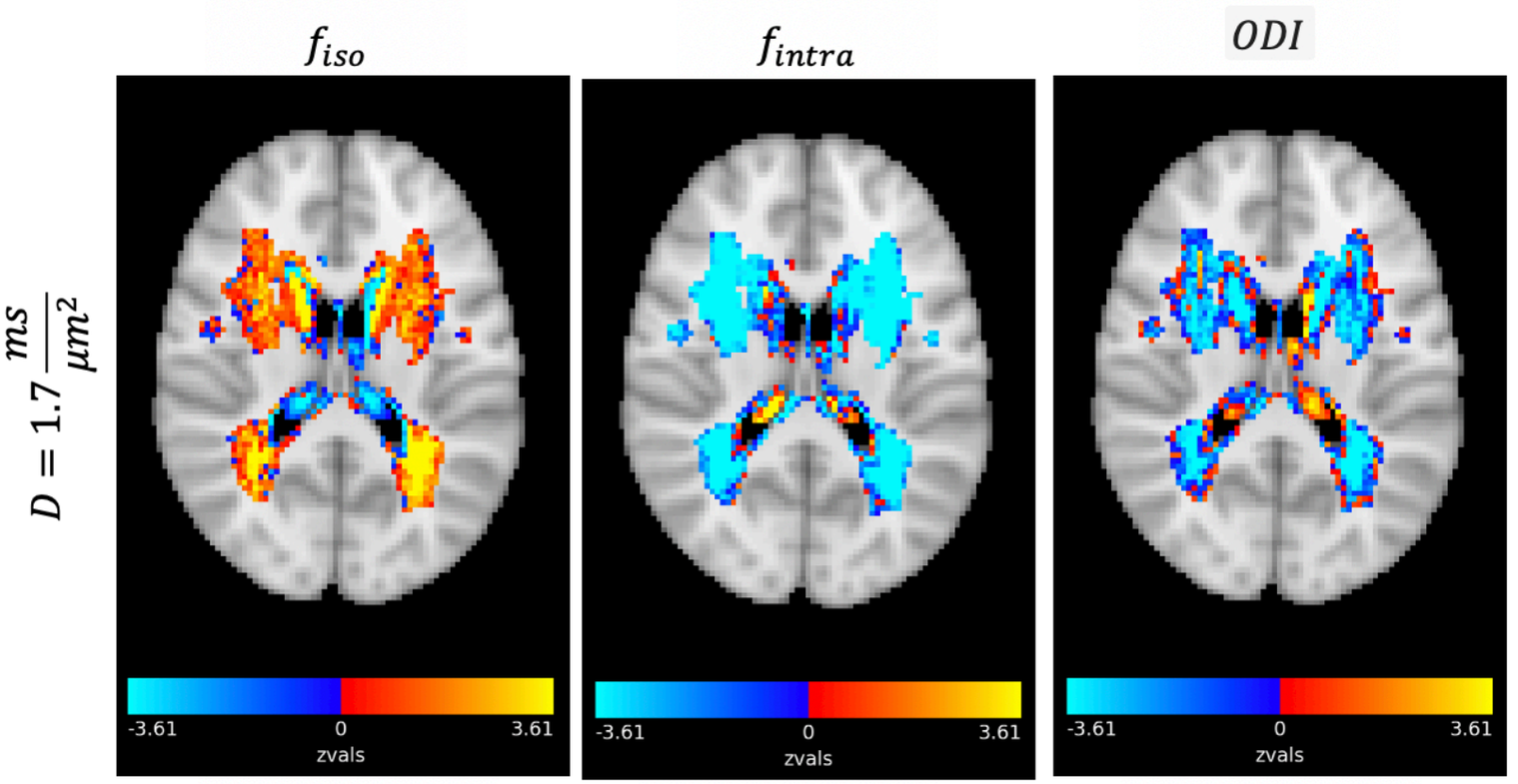
Parameter	Description
s_{iso}	**Signal fraction** for isotropic diffusion
s_{in}	**Signal fraction** of intra-cellular water
s_{ex}	**Signal fraction** of isotropic water
ODI	Fiber Orientation **dispersion** index
d_{iso}	Isotropic **diffusivity**
$d_{a_{in}}$	Intra axonal parallel **diffusivity**
$d_{a_{ex}}$	Extra axonal parallel **diffusivity**
τ	Extra axonal **diffusivity** ratio (tortuosity)

Fixed

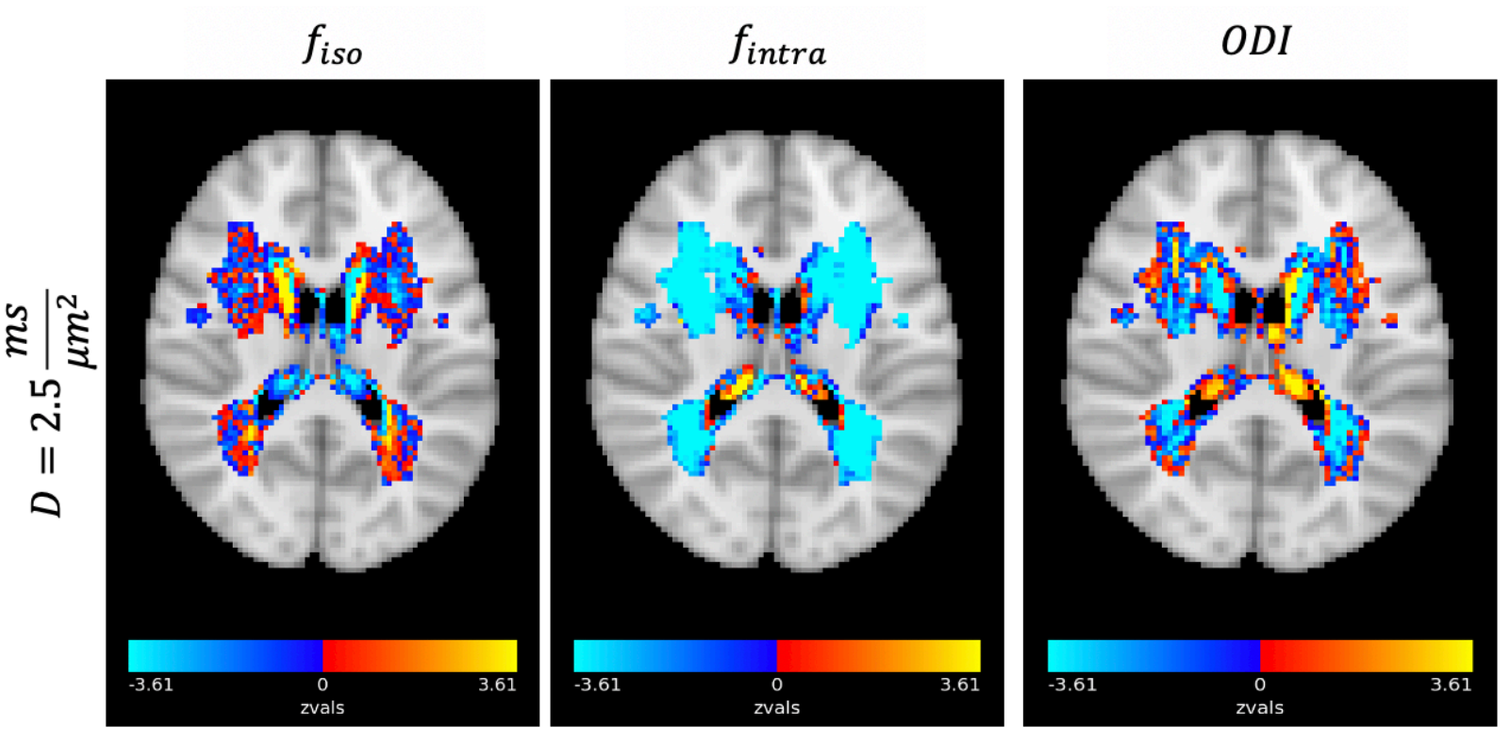
Zhang, Hui, et al. "**NODDI**: practical in vivo neurite orientation dispersion and density imaging of the human brain." *Neuroimage* 61.4 (2012): 1000-1016.

Results from NODDI

1. Free water has increased.
2. Ratio of inside to outside cellular space is decreased.
3. Fibres are less dispersed in the majority of voxels.



1. Free water has decreased.
2. Ratio of inside to outside cellular space is decreased.
3. Fibres are more dispersed in some voxels.

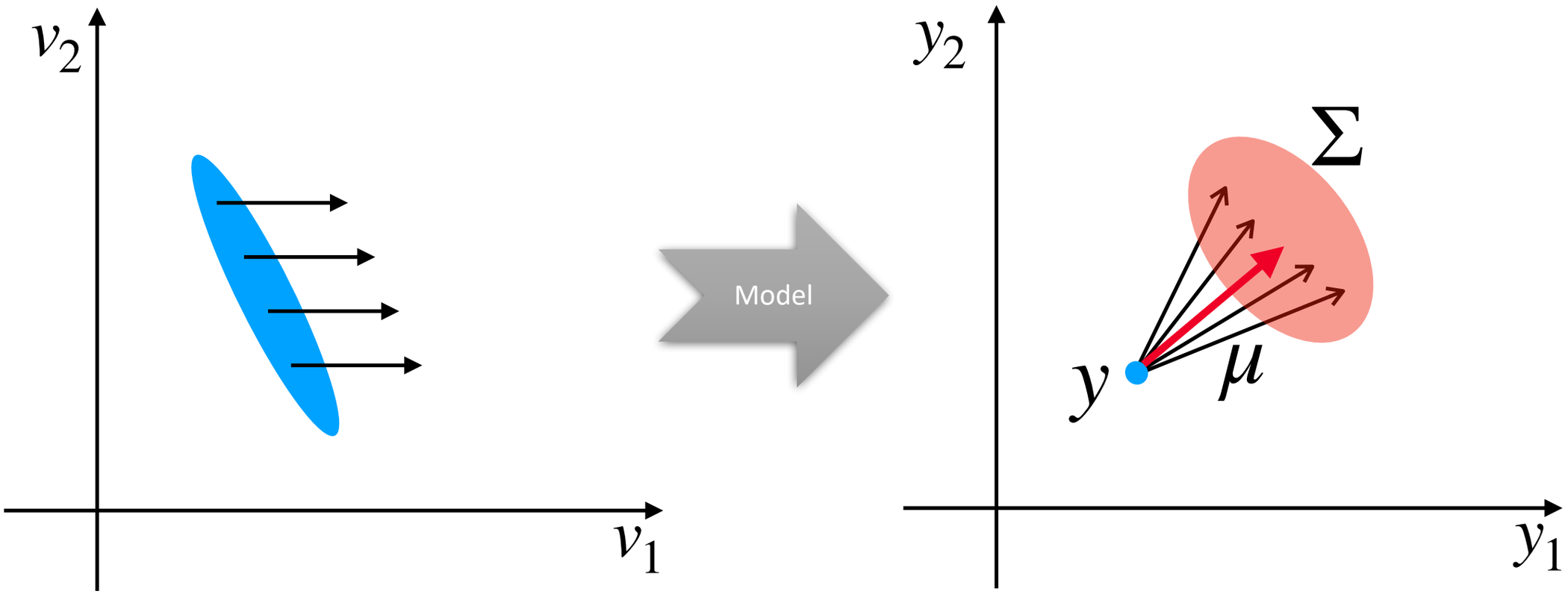


Can we avoid parameter fitting and still infer the change?

Simpler question:

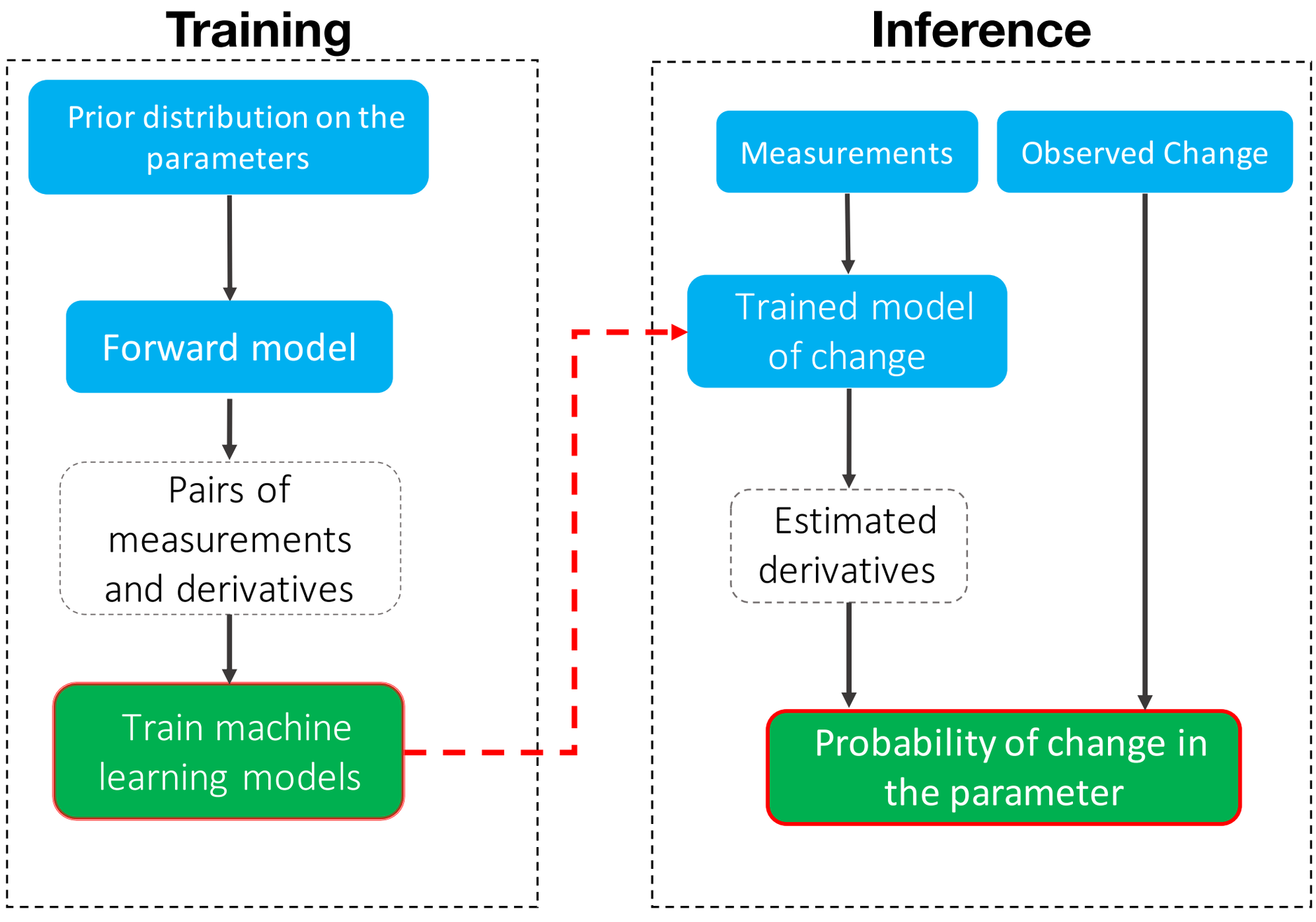
Which parameter has changed?

Change model



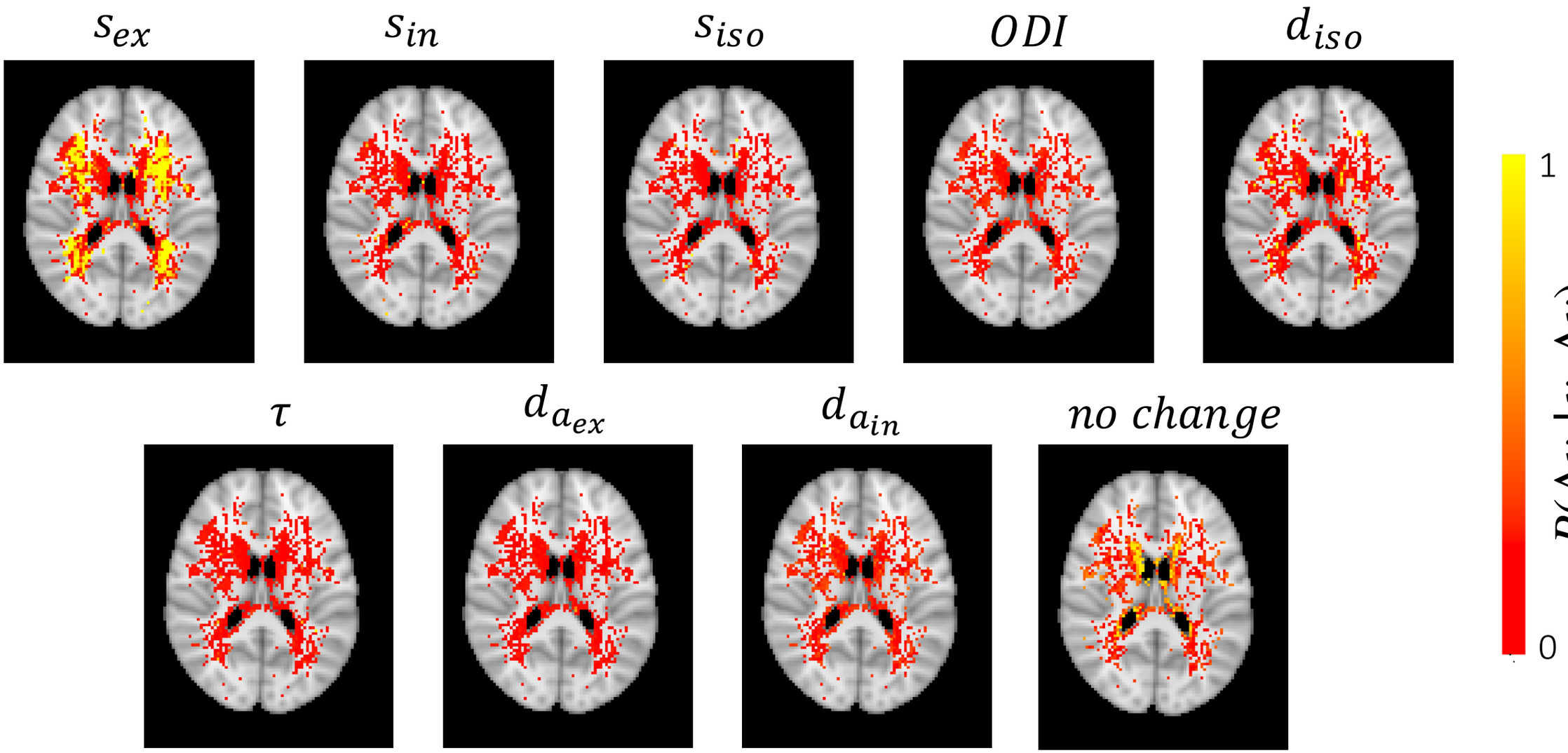
$$\frac{\partial y}{\partial v_i} \sim N(\mu(y), \Sigma(y))$$

BENCH Pipeline



BENCH applied to White matter hyperintensities

Posterior probability of change in each parameter



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New Results

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doi: https://doi.org/10.1101/2021.09.09.459626

This article is a preprint and has not been certified by peer review [what does this mean?].

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