Field Inversion & Machine learning (FIML)

Datasets \( Y_1, Y_2, \ldots, Y_n \)

Field Inversion

\[
\frac{DQ}{Dt} = R(Q) + \delta^j(x) : \min_{\delta^j(x)} ||Y^j - Y^j(Q)||
\]

Information Spatial discrepancy

Machine Learning

Knowledge Functional discrepancy

Embedding

Prediction: Injection into solver

\[
\frac{DQ}{Dt} = R(Q) + \hat{\delta}(f(Q))
\]

\[
\delta^1(x), \delta^2(x), \ldots, \delta^n(x)
\]

\[
\hat{\delta}(f(Q))
\]
Field Inversion & Machine learning (FIML)

Original system
\[ \frac{DQ}{Dt} = R(Q). \]

Datasets
\[ \gamma_1, \gamma_2, ..., \gamma_n \]

Field inversion
\[ \gamma_i \rightarrow \delta^i(x) \]

Model corrections (spatial)
\[ \delta^1(x), \delta^2(x), ..., \delta^n(x) \]

Machine learning
\[ \delta^1(x), \delta^2(x), ..., \delta^n(x), Q \rightarrow \hat{\delta}(f(Q)) \]

Model features
\[ f(Q) \]

Model corrections (functional)
\[ \hat{\delta}(f(Q)) \]

Data-augmented system
\[ \frac{DQ}{Dt} = R(Q) + \hat{\delta}(f(Q)) \]