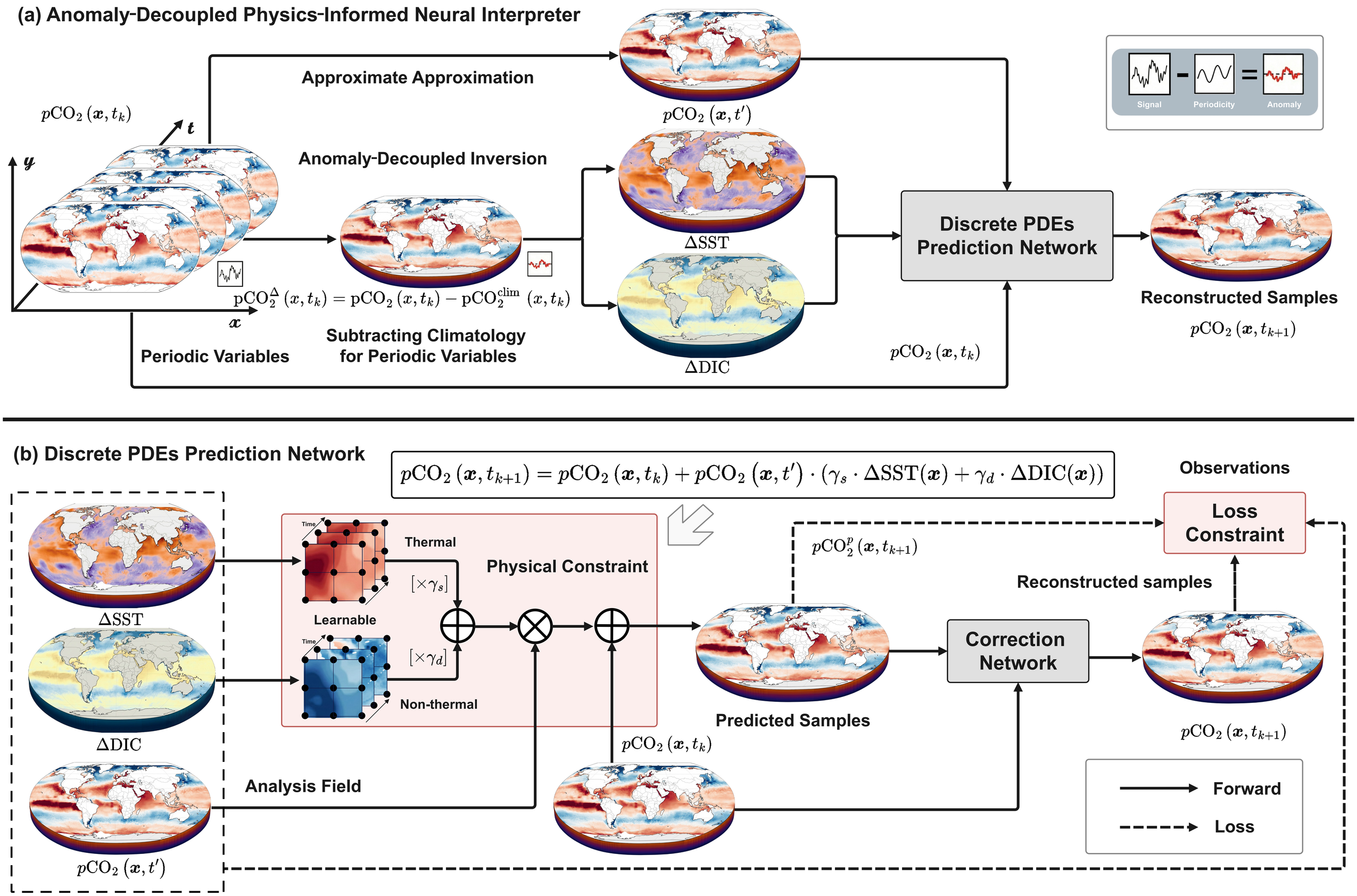
(a) Anomaly-Decoupled Physics-Informed Neural Interpreter
Approximate Approximation
$pCO_2(\boldsymbol{x}, t_k)$
t
y
x
Anomaly-Decoupled Inversion
$pCO_2(\boldsymbol{x}, t')$
ΔSST
ΔDIC
$pCO_2^{\Delta}(x, t_k) = pCO_2(x, t_k) - pCO_2^{clim}(x, t_k)$
Periodic Variables
Subtracting Climatology for Periodic Variables
Discrete PDEs Prediction Network
$pCO_2(\boldsymbol{x}, t_k)$
Signal
Periodicity
Anomaly
Reconstructed Samples
$pCO_2(\boldsymbol{x}, t_{k+1})$
(b) Discrete PDEs Prediction Network
$pCO_2(\boldsymbol{x}, t_{k+1}) = pCO_2(\boldsymbol{x}, t_k) + pCO_2(\boldsymbol{x}, t') \cdot (\gamma_s \cdot \Delta SST(\boldsymbol{x}) + \gamma_d \cdot \Delta DIC(\boldsymbol{x}))$
Observations
Loss Constraint
ΔSST
ΔDIC
$pCO_2(\boldsymbol{x}, t')$
Time
Thermal
Learnable
Non-thermal
$[\times \gamma_s]$
$[\times \gamma_d]$
Physical Constraint
$pCO_2^p(\boldsymbol{x}, t_{k+1})$
Reconstructed samples
Correction Network
Predicted Samples
$pCO_2(\boldsymbol{x}, t_k)$
$pCO_2(\boldsymbol{x}, t_{k+1})$
Analysis Field
Forward
Loss