

# Filling the Ocean's Gaps: a Self-Supervised Neural Network for Argo Profiles Data Augmentation

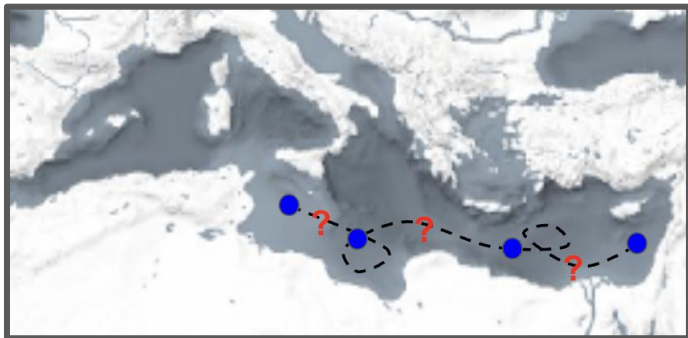
T. Tonelli (OGS, Units), L. Manzoni, G.Cossarini



AI-TT Workshop, April 13 2026, Montreal

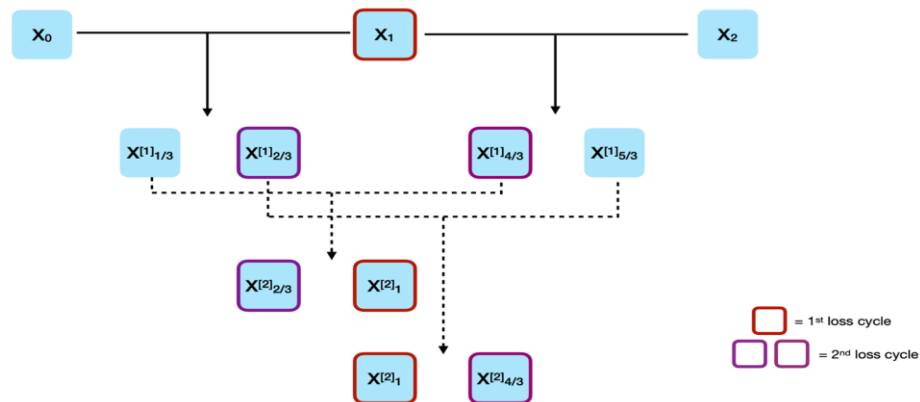
# Self-Supervised 1D-Unet for Argo Profiles Data Augmentation

- Expanding the volume and quality of observations is essential to support the growing range of Argo-driven applications.
- **1D-UNet**: generates augmented profiles by interpolating existing ones
- **Self-Supervised Learning technique**: the network learns directly from the input data without manual labels.



## Self-Supervised Learning: the Dual Cycle Interpolation

- **Key idea**: given the profiles  $x_0$  and  $x_1$ , the network predicts profiles at intermediate time steps  $x_{1/3}$  and  $x_{2/3}$  → profiles in intermediate points along the float trajectory
- **Dual cycle**:  $x_1$  predictions should match the original  $x_1$  data (red blocks comparison); intermediate profiles computed multiple times throughout the cycle should remain consistent (purple blocks comparison)



# Results and future works

- Predicted profiles are compared to real Argo-float measurements to evaluate reconstruction accuracy for chlorophyll (CHLA) and nitrate (NITRATE)
- Increase the volume of Argo float data → improving the coverage, in particular for biogeochemical variables

