

A spatial multi-mode CNN to better reconstruct and interpret ocean color time series in the global ocean

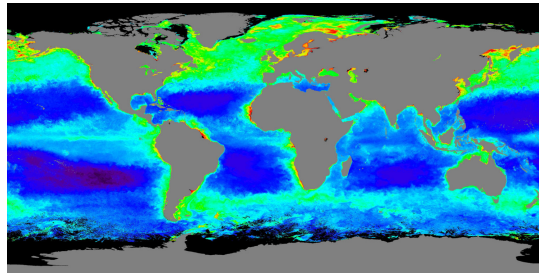
Joana Roussillon¹, Jean Littaye¹, Ronan Fablet², Lucas Drumetz², Thomas Gorgues¹,
and Elodie Martinez¹

¹Laboratoire d'Océanographie Physique et Spatiale, CNRS/IFREMER/IRD/UBO, Institut Universitaire Européen de la Mer,
Plouzané, France (joana.roussillon@etudiant.univ-brest.fr)

²IMT Atlantique, UMR CNRS LabSTICC, Technopole Brest Iroise, 29239 Brest, France

EGU General Assembly 2022
23–27 May 2022

Context



Physical Observations (T° , Currents, ...)



Chlorophyll (Chl) Satellite data



1970

1980

1990

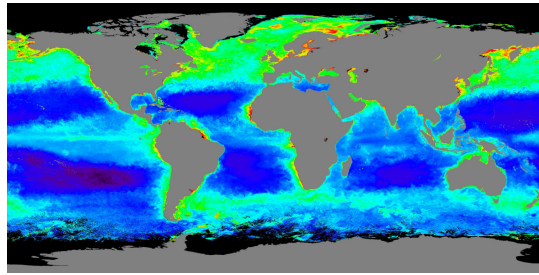
2000

2010

2022



Context



Physical Observations (T° , Currents, ...)



Chlorophyll (Chl) Satellite data



1970

1980

1990

2000

2010

2022



Physical model outputs

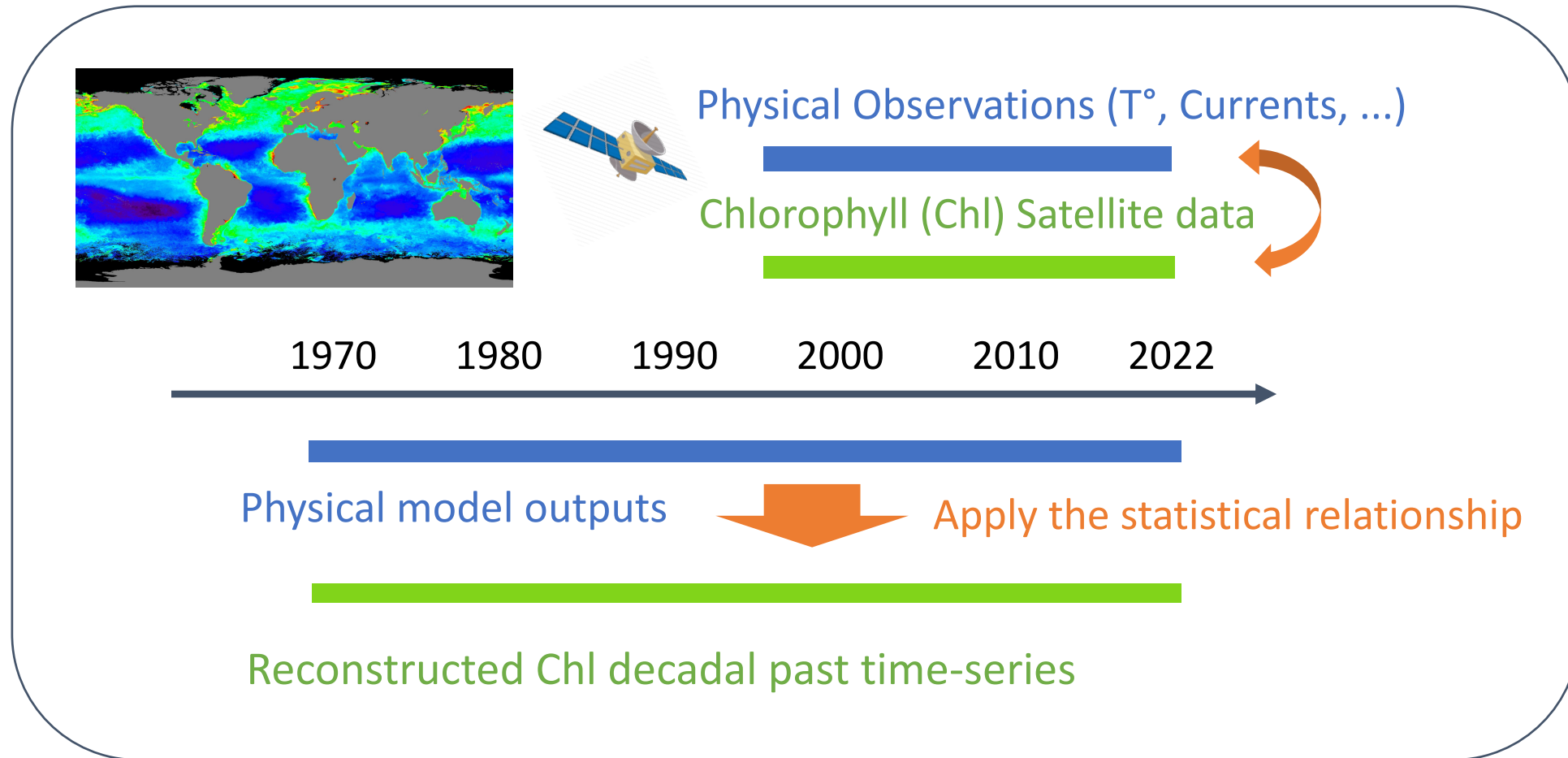


Apply the statistical relationship



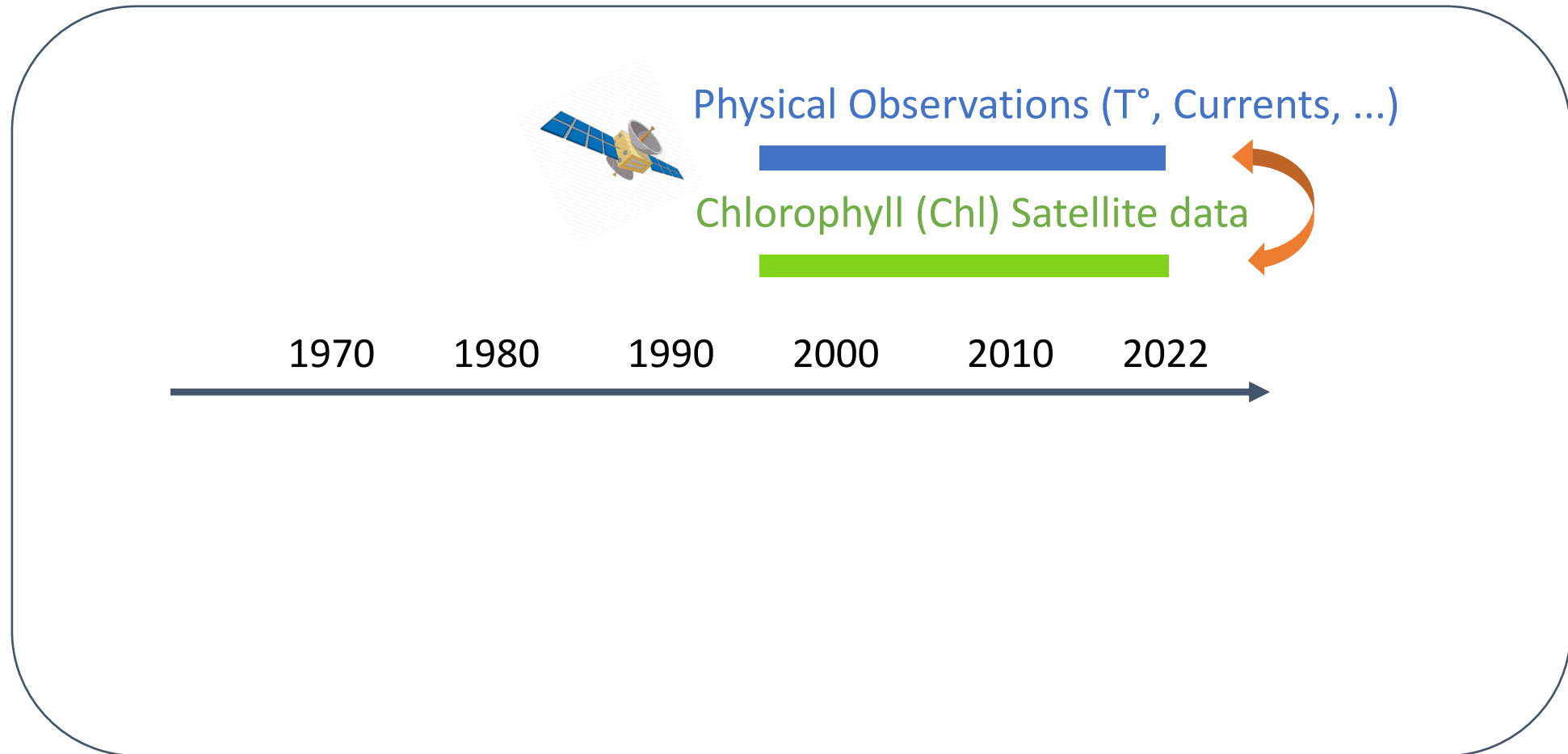
Reconstructed Chl decadal past time-series

Context



Dealing with regional specificities while extracting informations about underlying physical processes ?

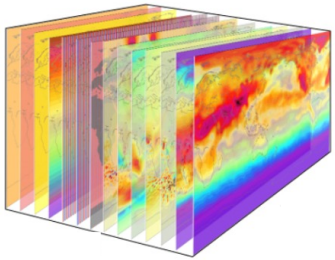
Context



Data & Method

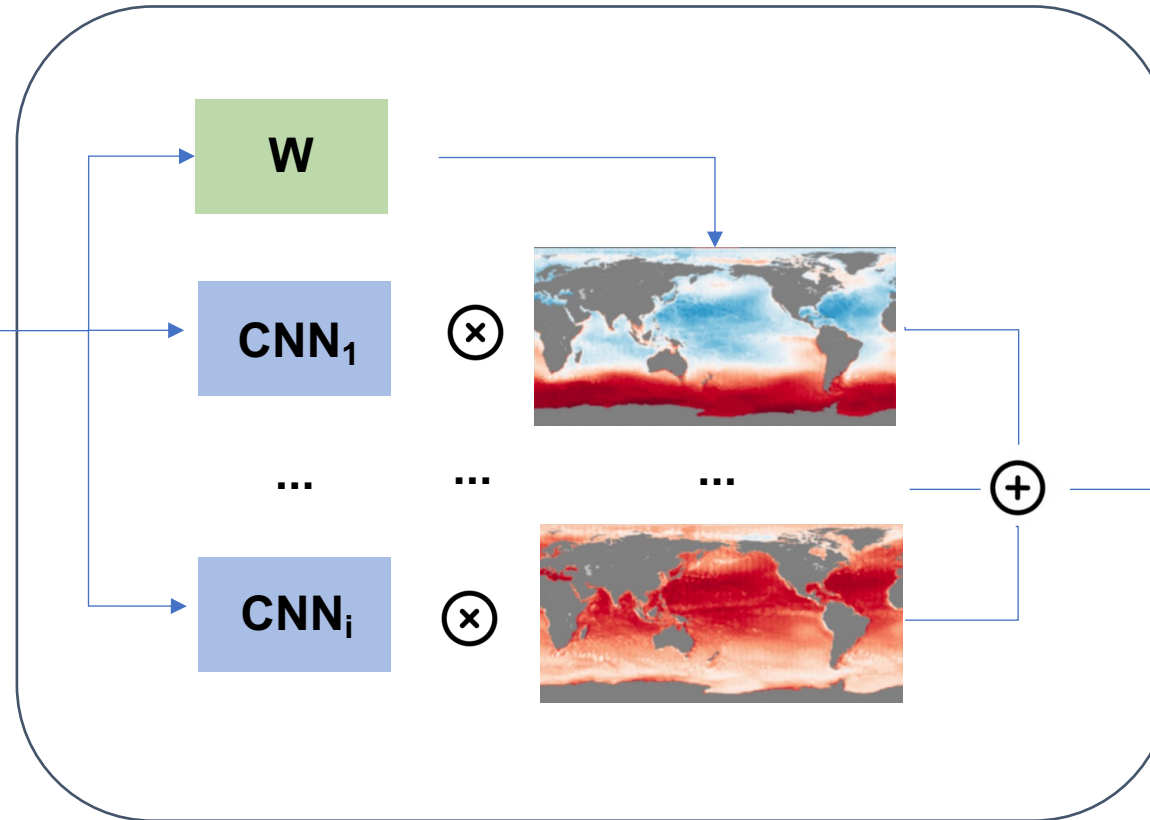
Predictors

Monthly $1^\circ \times 1^\circ$
satellite observations

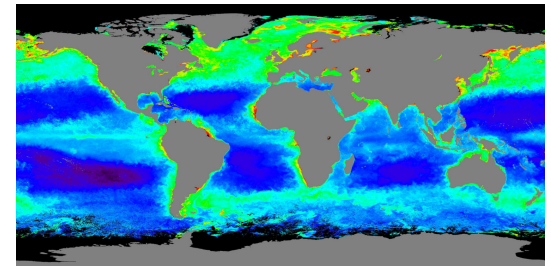


Sea Surface Temperature
Sea Level Anomaly
Short-Wave Radiations
Winds
Currents
...

Multi-Mode CNN



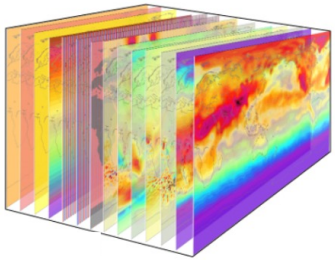
Reconstructed Chl



Data & Method

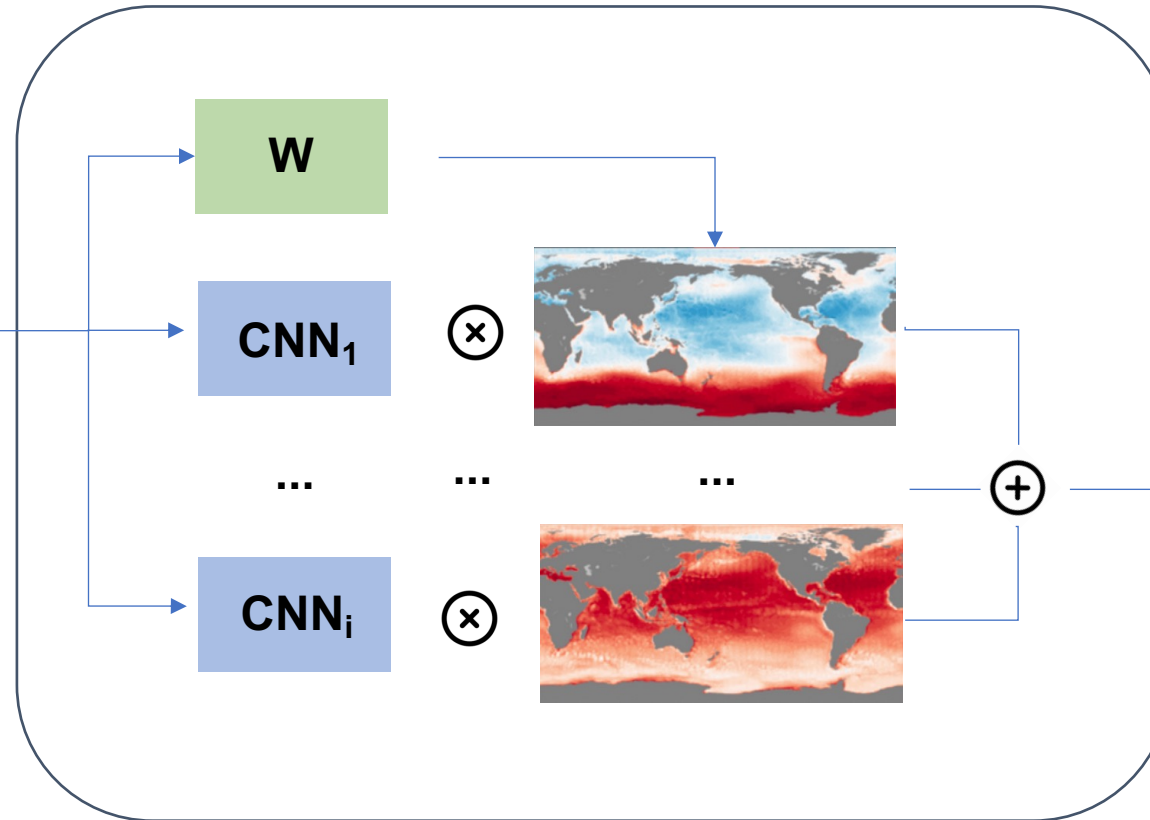
Predictors

Monthly $1^\circ \times 1^\circ$
satellite observations

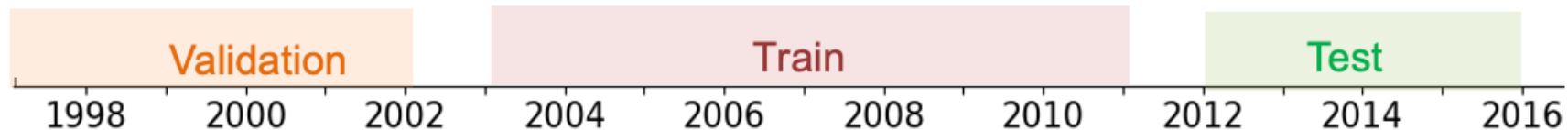
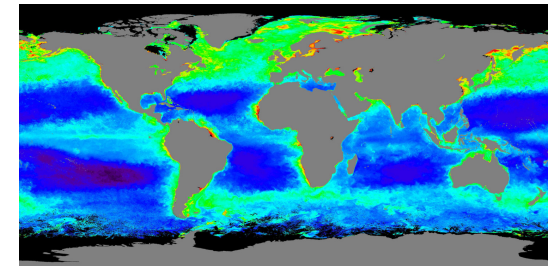


Sea Surface Temperature
Sea Level Anomaly
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Multi-Mode CNN

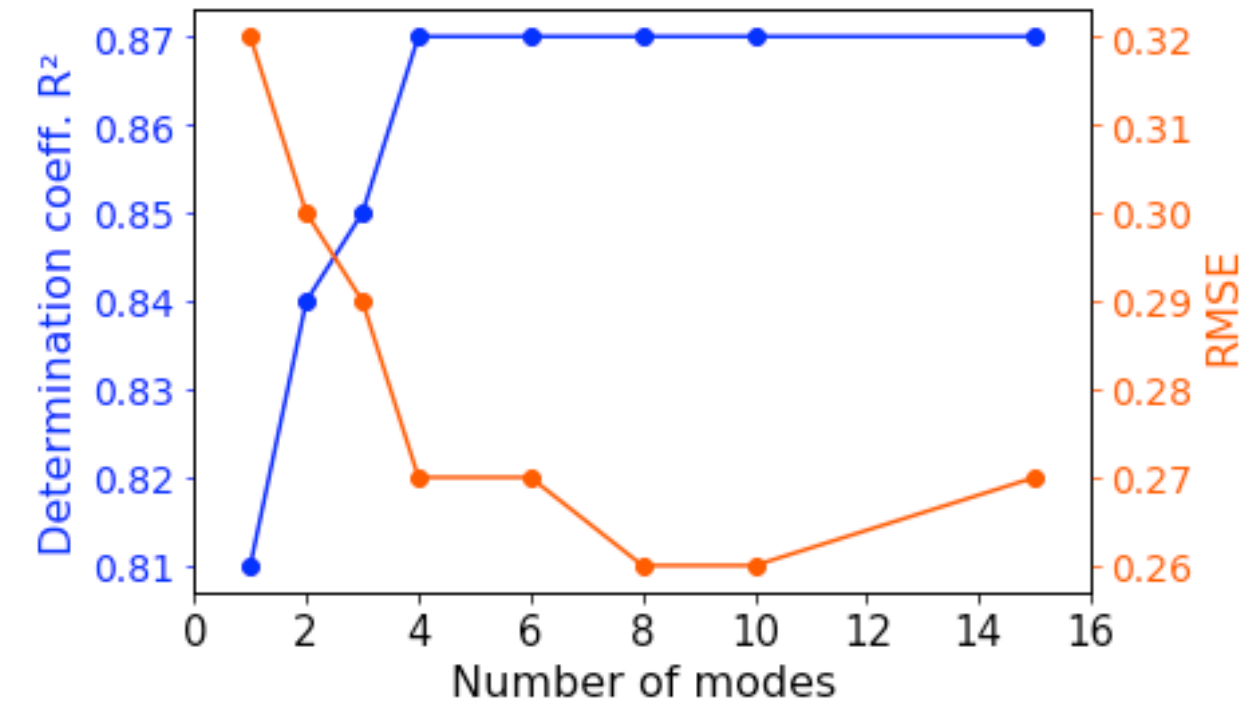


Reconstructed Chl



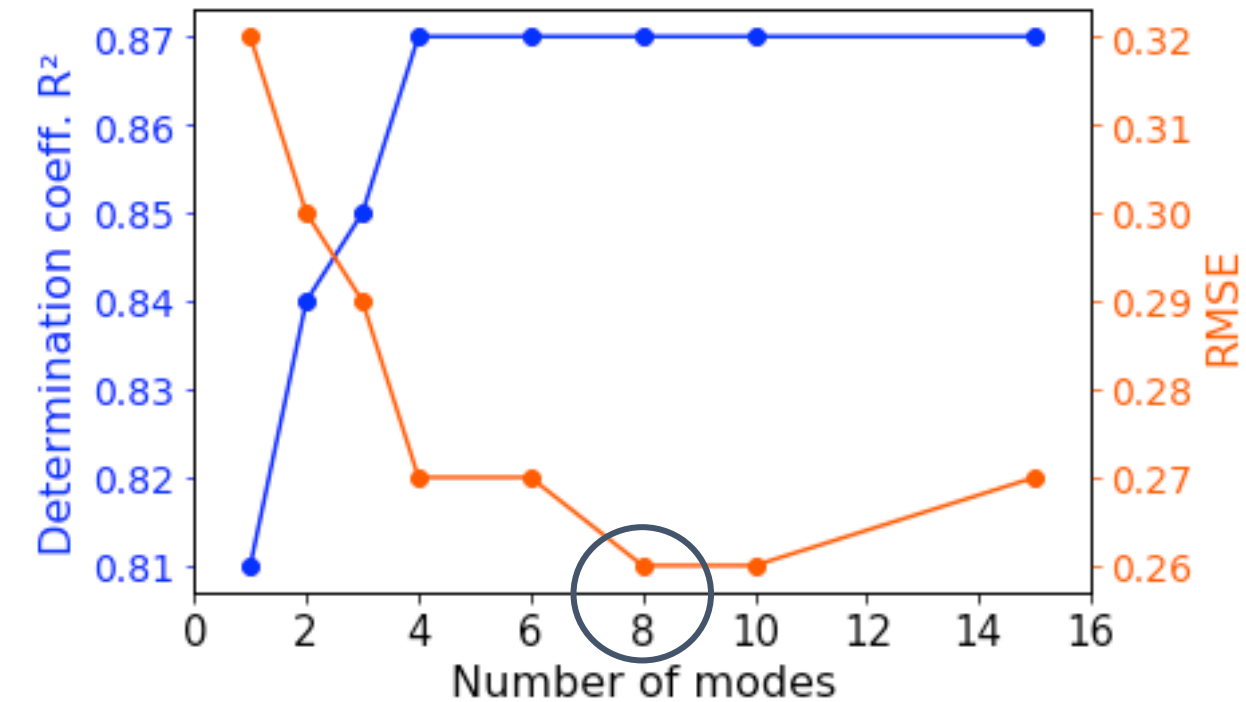
Results

- Adding spatial multimodalities improves the model performance



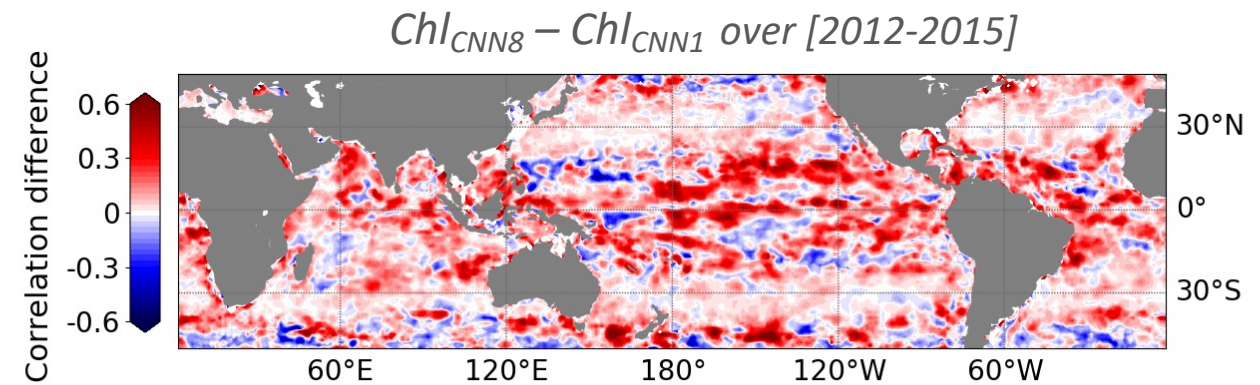
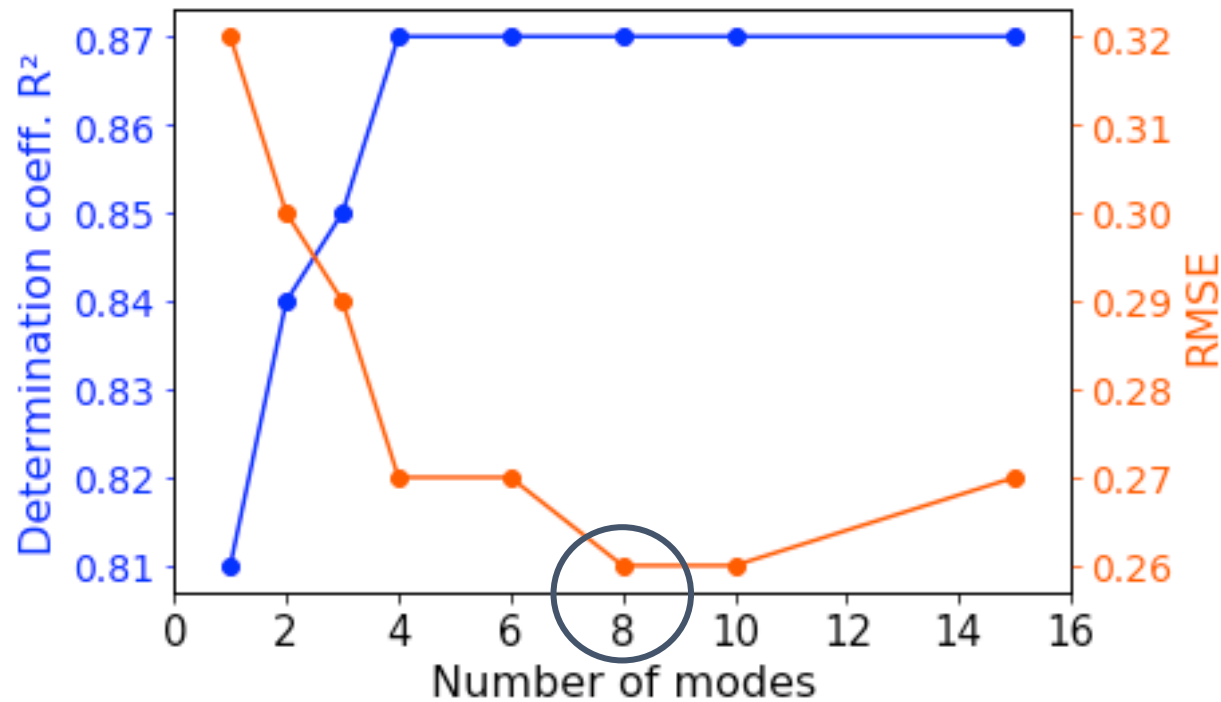
Results

- Adding spatial multimodalities improves the model performance



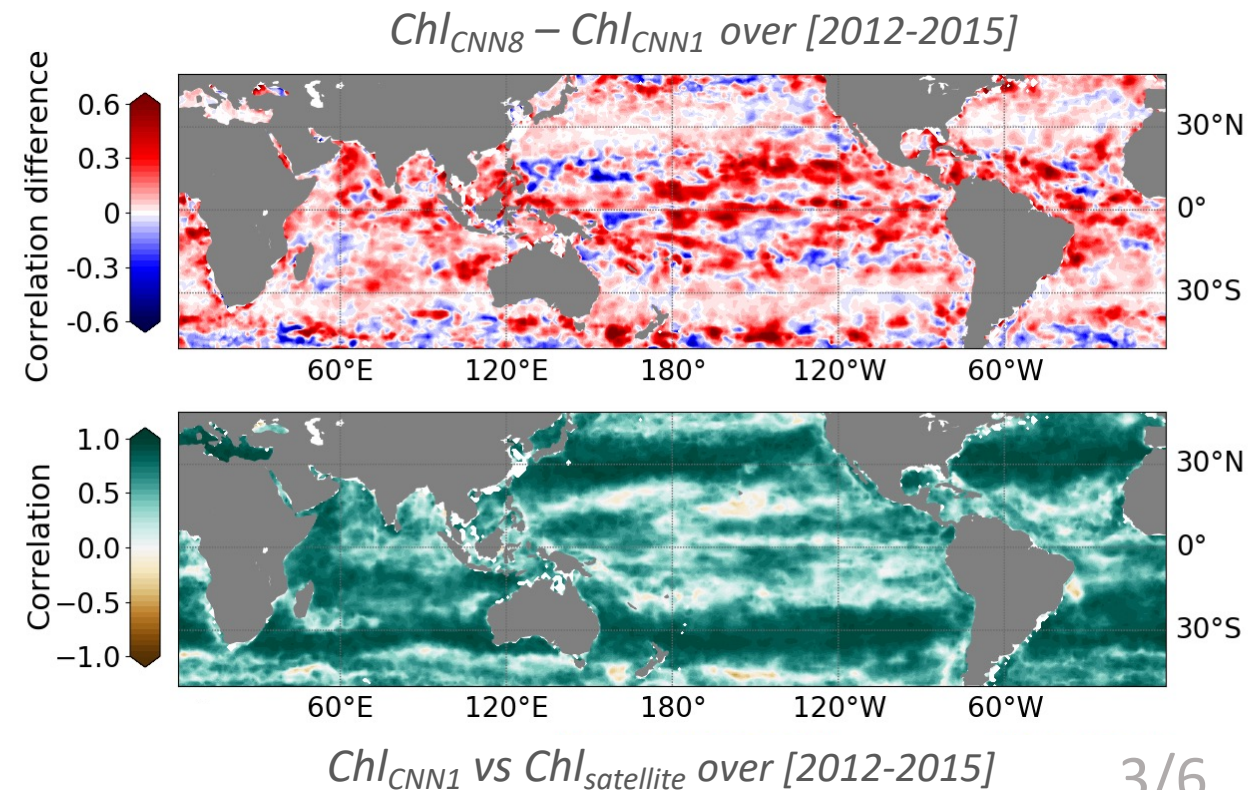
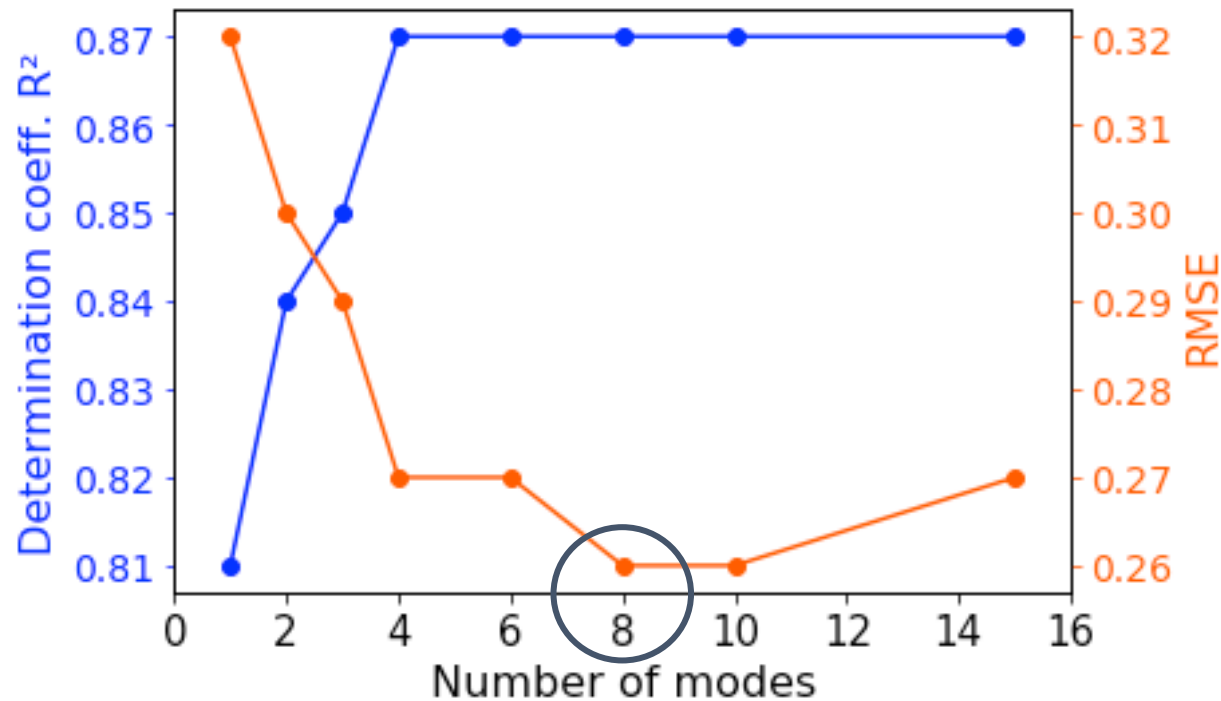
Results

- Adding spatial multimodalities improves the model performance



Results

- Adding spatial multimodalities improves the model performance
- Better improvements in area that were previously well not reconstructed



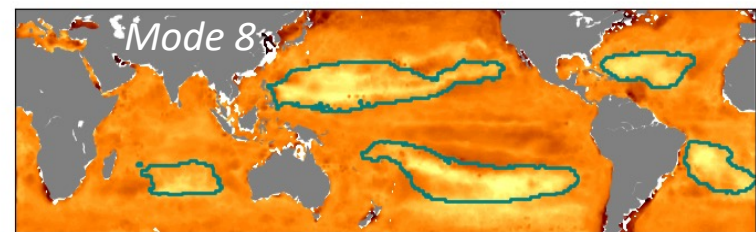
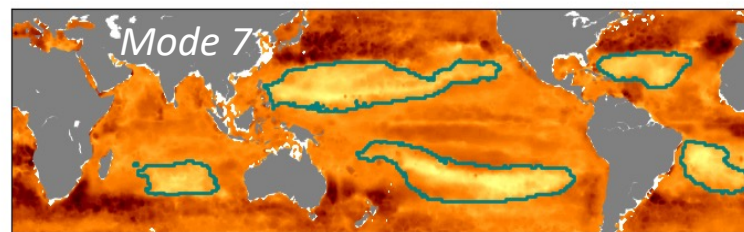
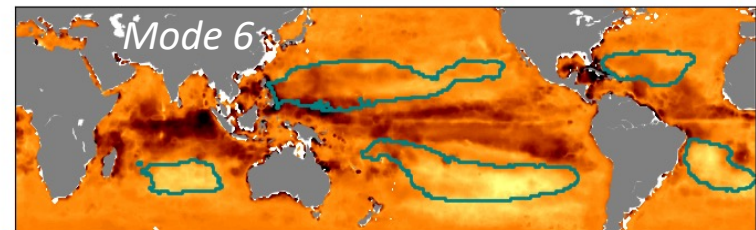
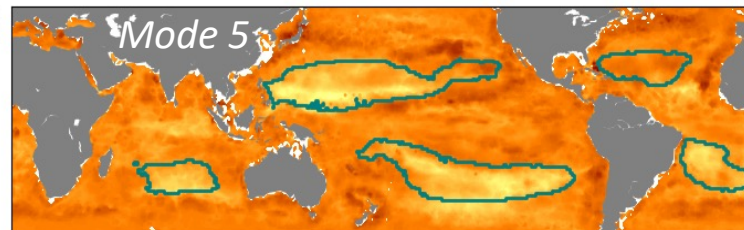
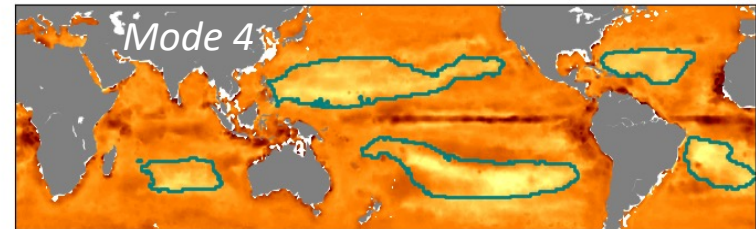
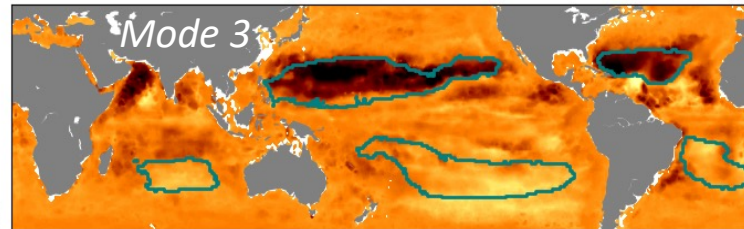
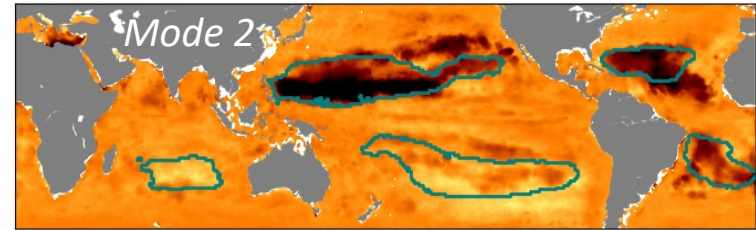
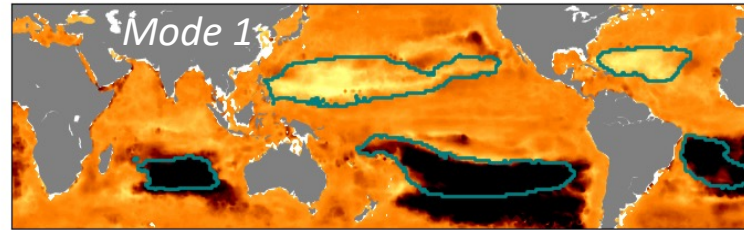
Results

*% of variance
explained by
each mode*

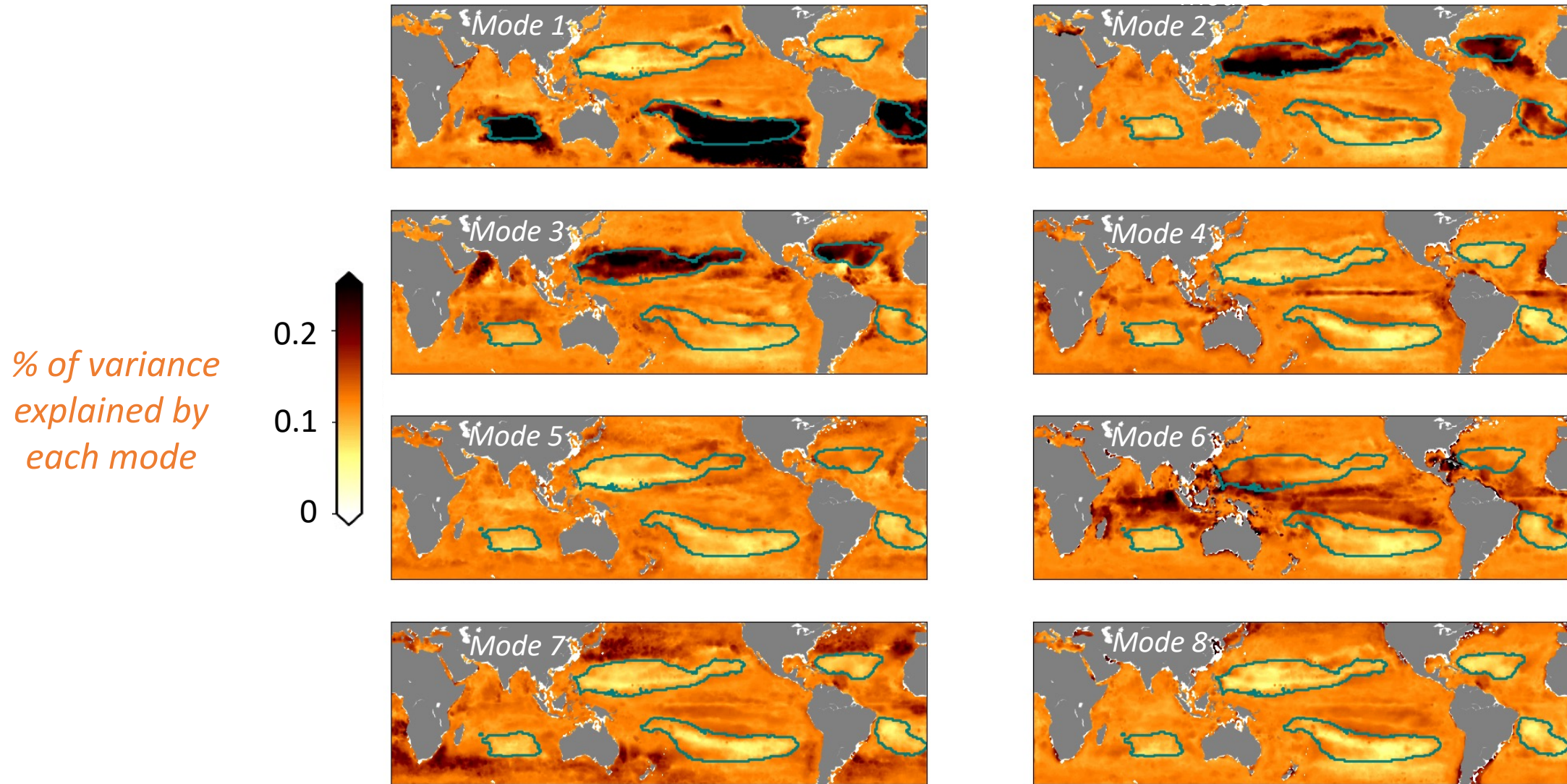
0.2

0.1

0

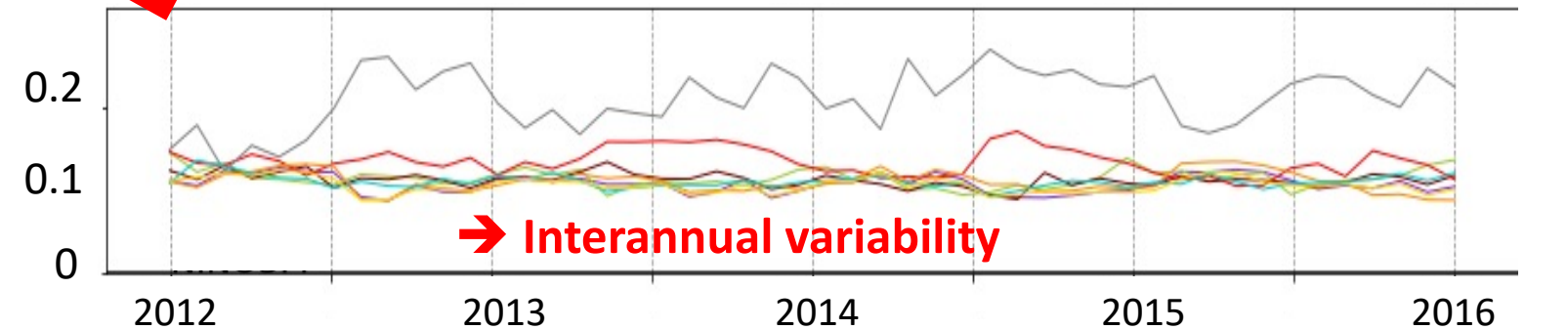
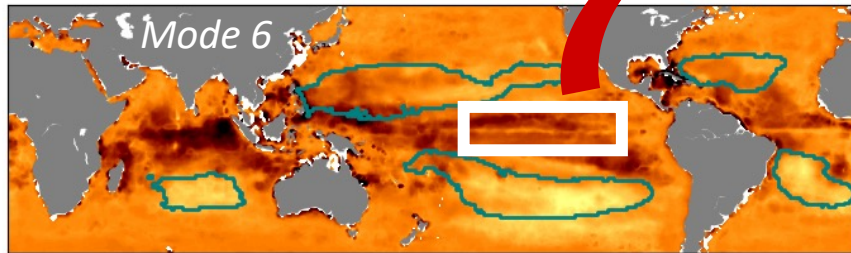
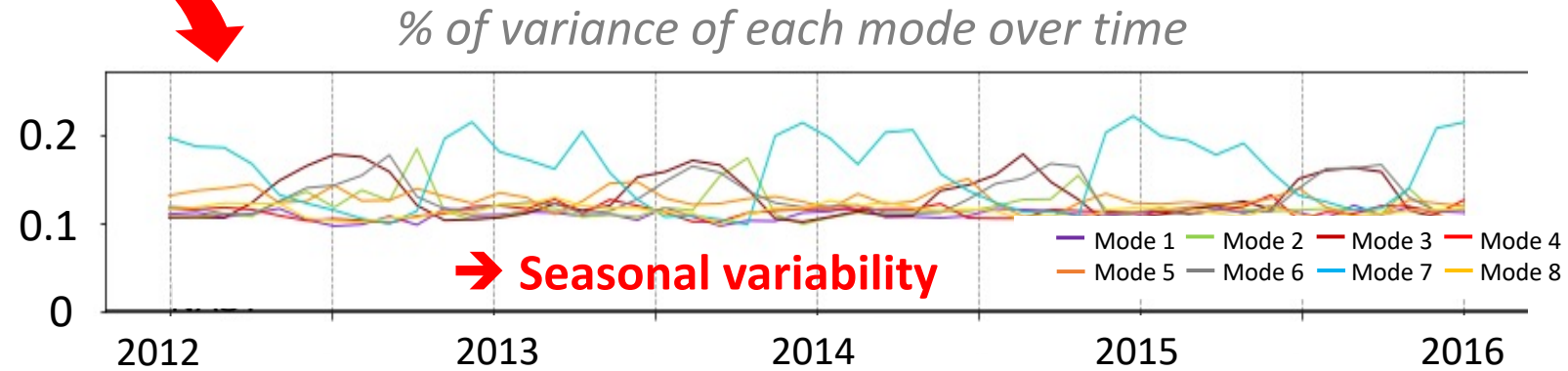
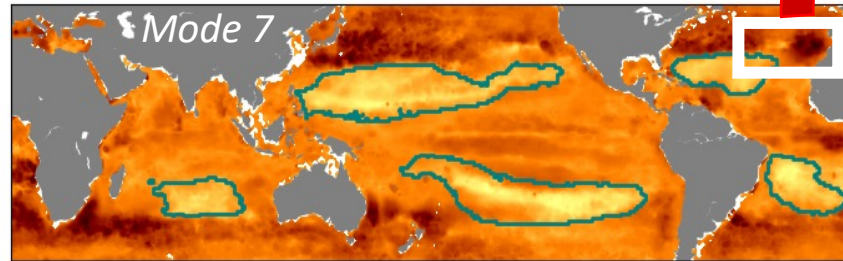


Results



Coherent patterns emerge

Results



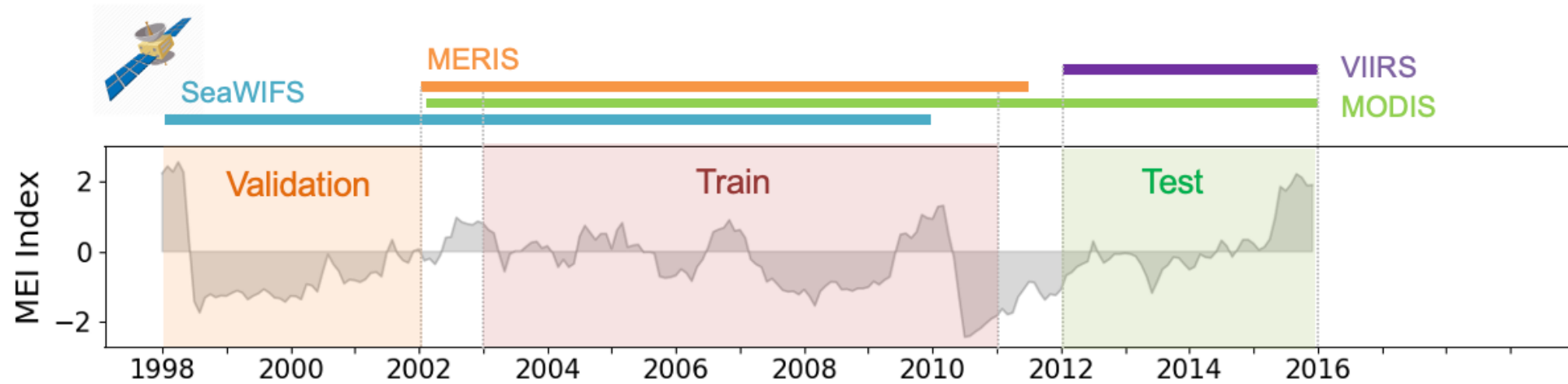
Space-time-varying modes
associated with different physics-driven responses

Conclusion & Perspectives

- Introducing spatial multi-modalities improves **performance** and **interpretability**
- Perspectives :
 - Investigating the predictors' relative importance of each mode
 - Change input predictors : finer spatial resolution ?
 - Investigating past reconstruction

Thank you for your attention !

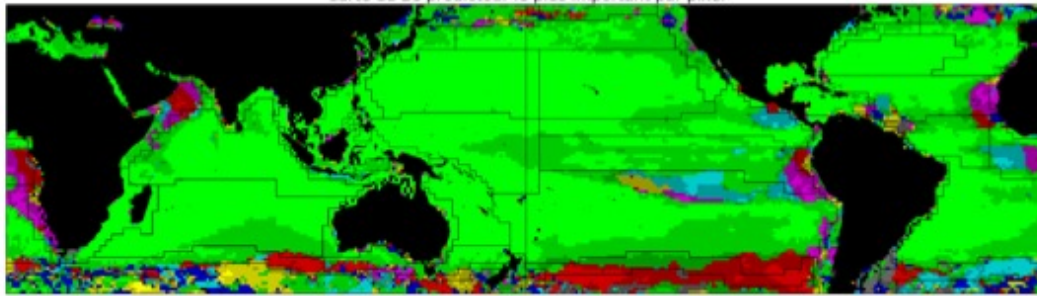
Appendix



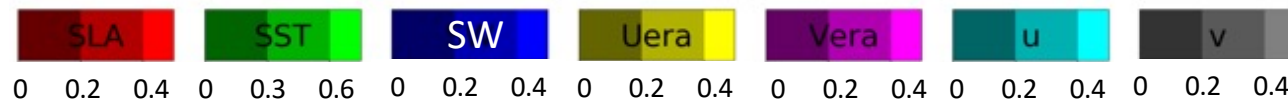
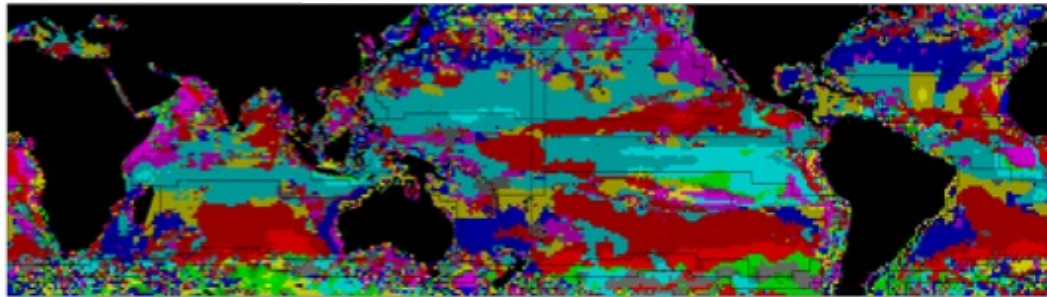
Model		Number of filters
CNN		9:16:32:64:128
MM-CNN	W	9:16:32
	CNN _i	9 : 16:32:64:128

Appendix

1st predictor



2nd most important predictor



SST distribution over modes

