Colocation Day 1 BOG ESO4clima

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ESO4clima objectives

- **ITT**

  Interfacing the climate observations and modelling communities within the ESA CLIMATE SPACE programme

- **Goals of project**

  Enhancing the community software ESMValTool in time for CMIP7

  (1) Improved framework to address observational characteristics and uncertainties in model evaluation.

  (2) Technical evolutions needed to be able to efficiently handle the expected large volumes of high-resolution model and observational data.

- **Timeframe**

  2 years (July 2025 – June 2027)

- **Connections**

  CMUG, CMIP7 REF (CMIP7 task team on model benchmarking), CCI teams (in particular cloud, SST, LST, watervapour, ozone)

Skeleton overview of the approach

ESA clima

Exploiting Satellite Observations for climate model analysis

Project aims

Enhancing the community software ESMValTool in time for CMIP7.

(1) Increase the informativeness of results and efficiency of the tool;
(2) make usage of observational data in the context of ESM evaluation and analysis more attractive and more visible to the climate community;
(3) enable fuller exploitation of the potential of ESA CCI and CCI+ data for this application.

- Improving the comparability of satellite observations and climate models with ML
- Extending ESMValTool for improved support of regional models
- Enhanced support for satellite data with new data concepts in ESMValTool
- Capability and capacity development

ECVs being used

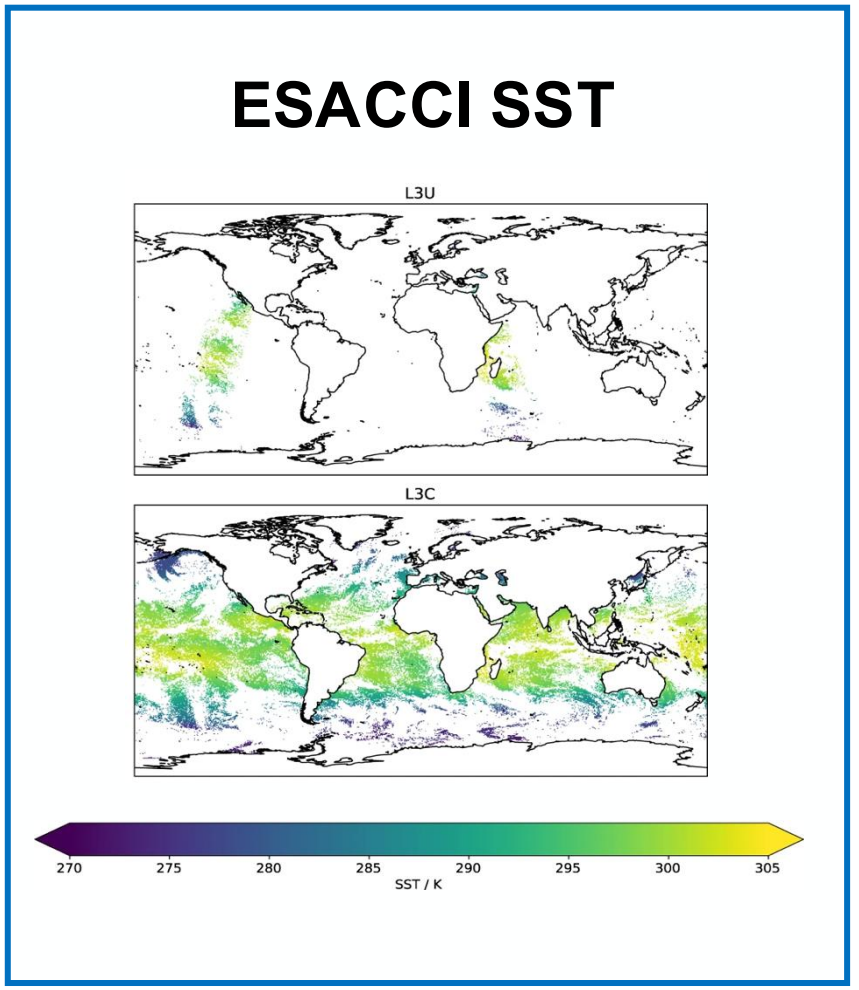
- **ECVs used**

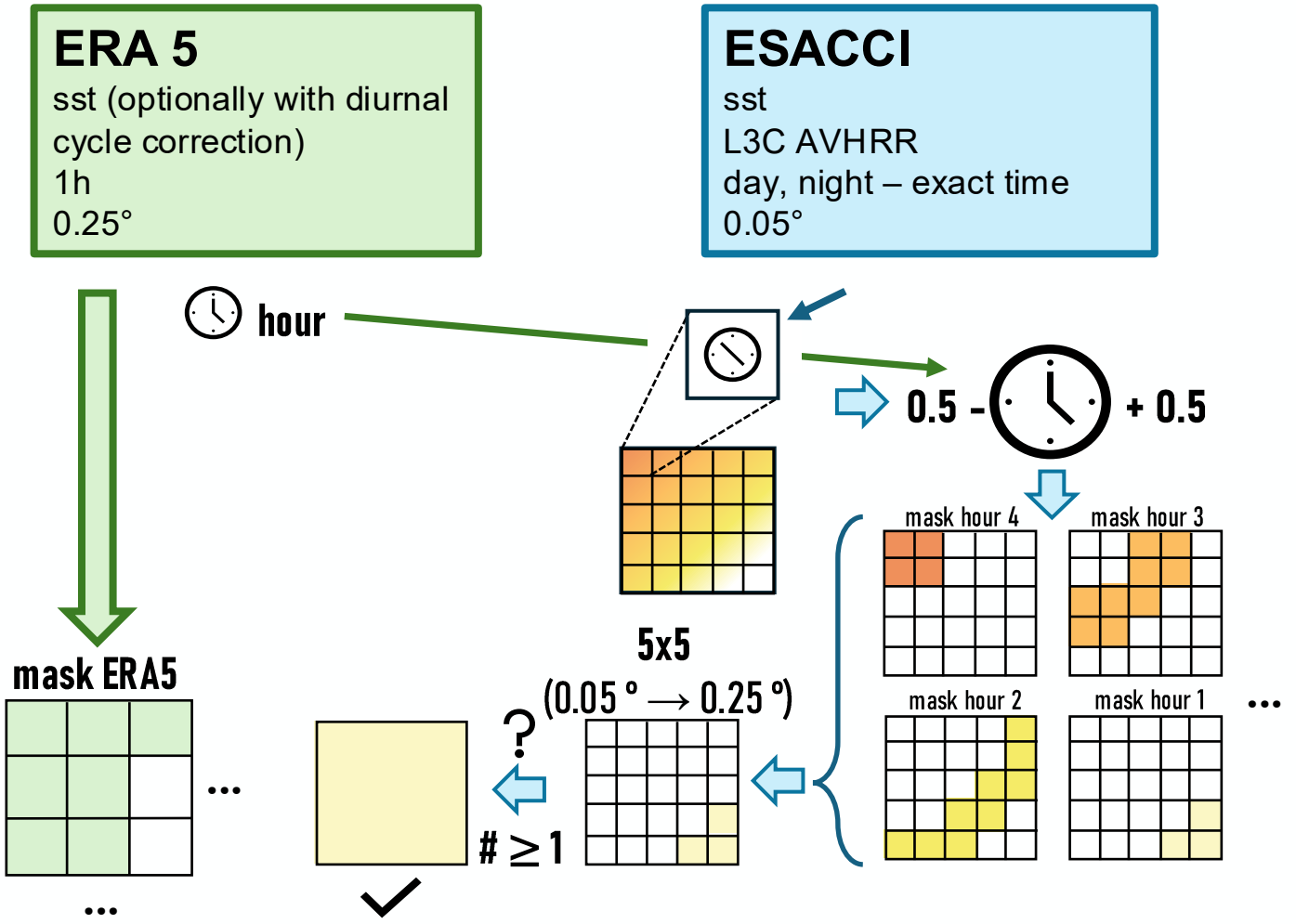
  SST, watervapour, LST

- **Why they were chosen**
  - Different Earth system components: ocean, atmosphere, land
  - Continue exploratory work on usage of uncertainty information for LST in CMUG
- **Strengths and weaknesses**
  - Strengths
    - Generally mature products, good documentation
    - SST: information on diurnal cycle can be extracted w/o having to use L2 data
    - SST+LST: guidelines for using uncertainty information
  - Weaknesses
    - No time stamp for individual grid cells in LST and watervapour
    - Partially missing: lower-resolution products (e.g. 0.5˚x0.5˚)
- **Wish list for how to improve the ECVs**
  - Information on diurnal cycle (e.g. time stamps, aggregations by hour of day)
  - Estimates for error correlation lengths (spatial and temporal)
  - More “merged” products

Results & relevance to the CCI community

- **Overview of preliminary results relevant to the CCI community**





Results & relevance to the CCI community

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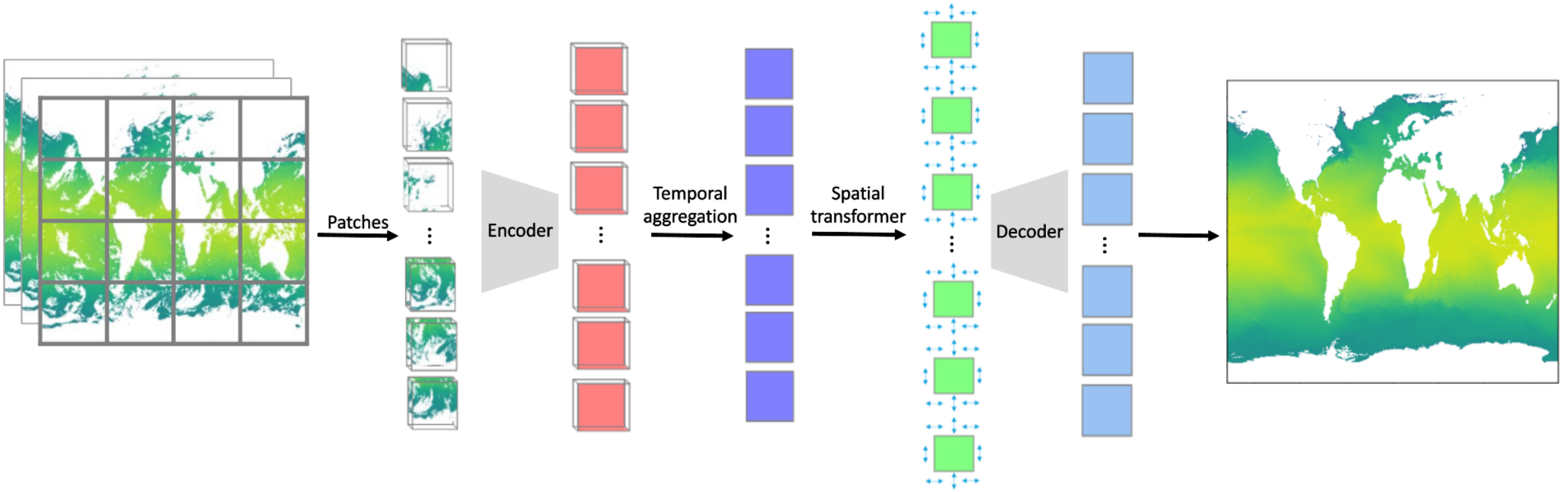
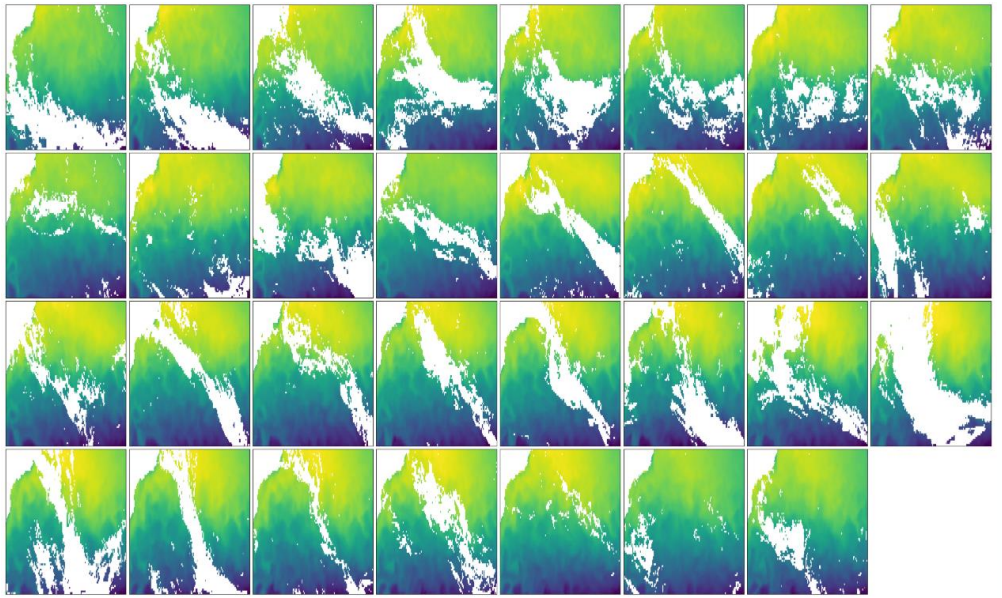
Method: A machine learning method based on Video Masked Autoencoders (MAE)



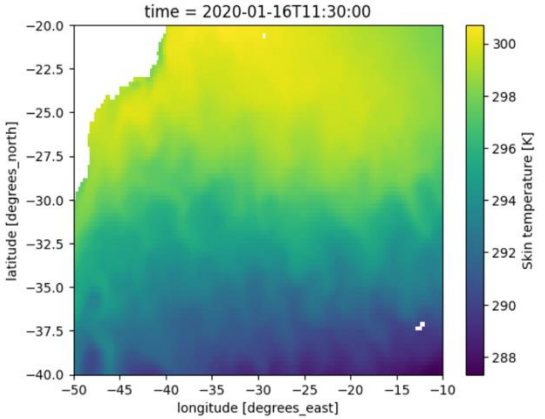
Results & relevance to the CCI community

- **Overview of preliminary results relevant to the CCI community**

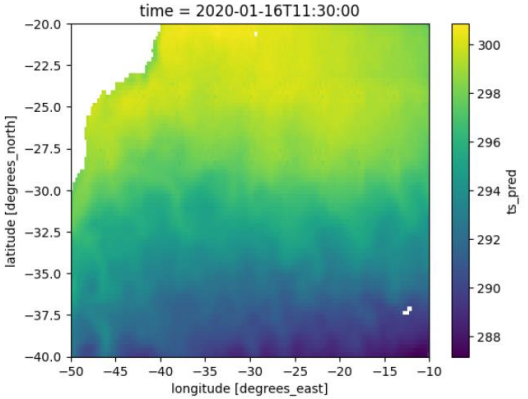
  Initial prototyping results: training set



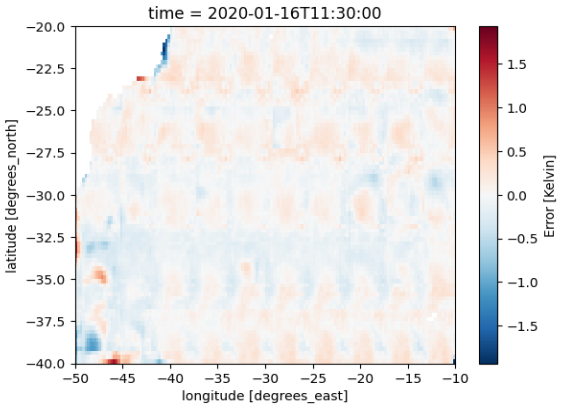
Daily SST (input)



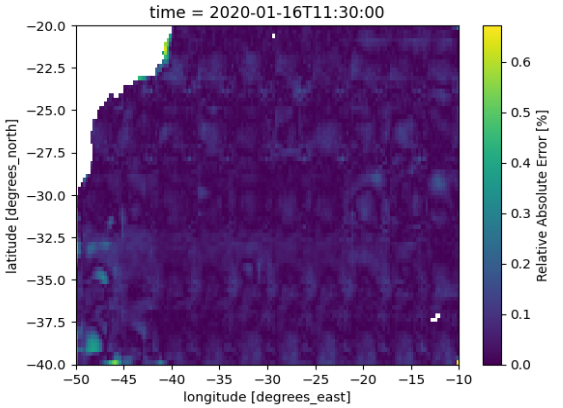
Monthly SST (target)



Monthly SST (prediction)



Error (K) =
target – prediction



Relative Absolute Error (%) =
(| target – prediction | / target) * 100

Results & relevance to the CCI community

- **Recent publications**

  Swaminathan, R., Beadling, B., Beucher, R., Blockley, E., Brands, S., Hassler, B., Hegedűs, D., Hoffman, F., Lee, J., Lewis, J., Lu, J., Malinina, E., Medeiros, B., Scoccimarro, E., Tjiputra, J., Turner, B., Watson-Parris, D., Observational Data for next generation Climate Model Evaluation: Requirements, Considerations and Best Practices. 2025. Submitted to BAMS (accepted).