EGU2020-5583: Evaluation of the University of Victoria Earth System Climate Model version 2.10 (UVic ESCM 2.10)

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UVic ESCM
(Weaver et al., 2001)

- Earth system model of intermediate complexity (EMIC)
- horizontal resolution: 3.6° longitude x 1.8° latitude
- spun-up following CMIP6 protocol

Energy moisture balance model
(Fanning and Weaver, 1996; Weaver et al., 2001, Eby et al., 2013)

- 2 dimensional
- prescribed cloud map and wind fields with thermodynamic feedback

Sea ice model
(Bitz et al., 2001; Hunke and Dukowicz, 1997)

- thermodynamic-dynamic scheme
- elastic visco-plastic rheology

Ocean general circulation model
(Pacanowski, 1995)

- Modular Ocean Model Version 2
- tidal mixing scheme
- updated air-sea gas exchange

Ocean biogeochemistry
(Keller et al., 2012)

- organic and inorganic carbon

Marine sediment model (Archer, 1996)

Dynamic vegetation model
(Meissner et al., 2003 & 2012)

- 5 plant functional types

Land surface model
(Avis et al., 2011; MacDougall et al., 2012)

- 14 subsurface levels
- top 8 layers are hydrologically active
- multi-layer representation of soil carbon

Permafrost carbon model
(MacDougall & Knutti 2016)

- diffusion based scheme

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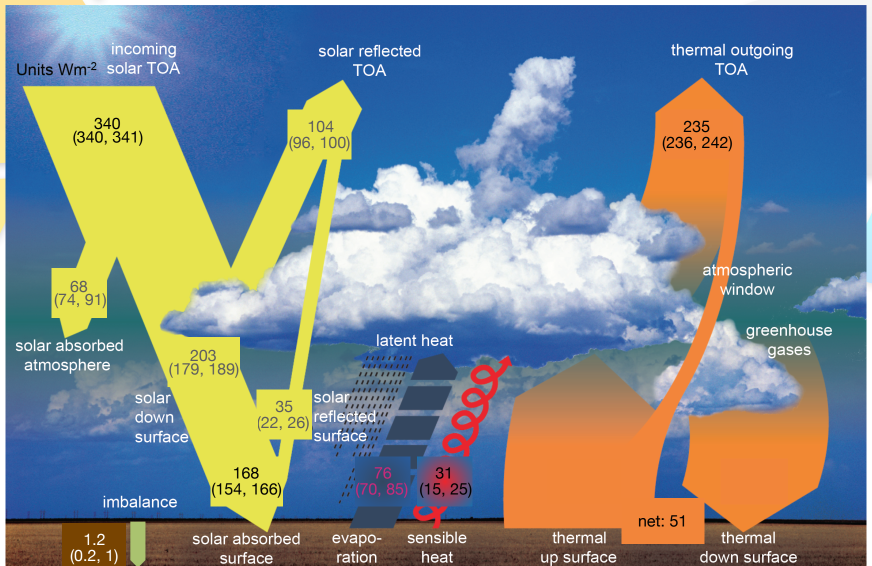
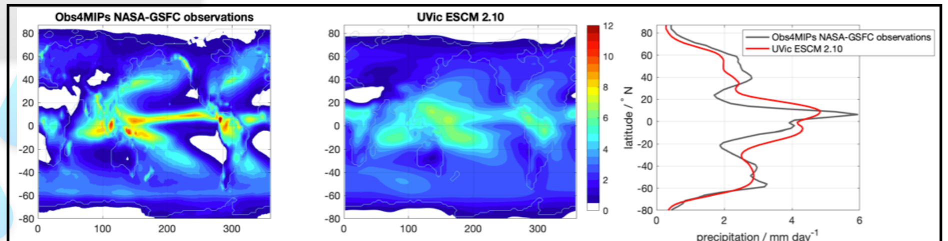


Schematic diagram of the global mean energy balance of the UVic ESCM 2.10 adapted from Wild et al., 2013. Magnitudes of the globally averaged energy balance components, black numbers indicate estimates directly taken from the model output, grey numbers have been derived by calculations given albedo values from the model, and the latent heat was calculated using the evaporation estimates from the model assuming a conversion factor of 2,260 kJ/kg. Uncertainty ranges are taken from (Wild et al., 2013), representing present day climate conditions at the beginning of the 21th century. Units Wm-2.



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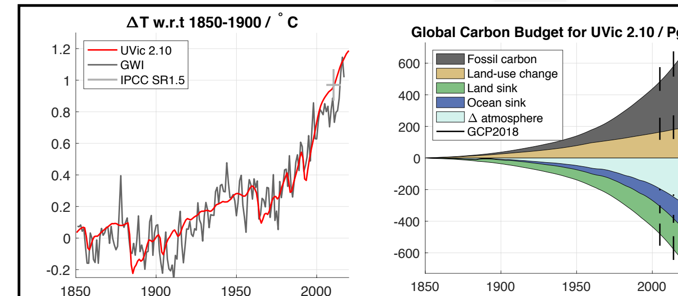

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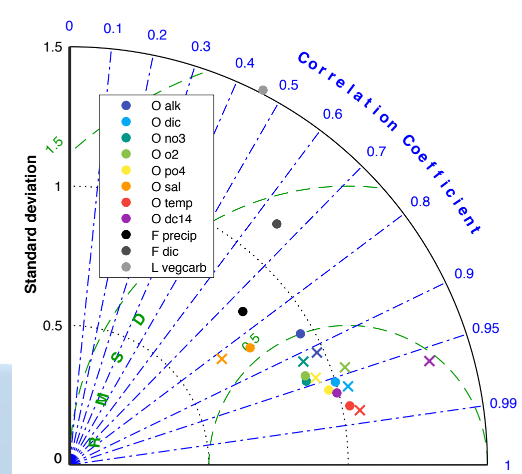

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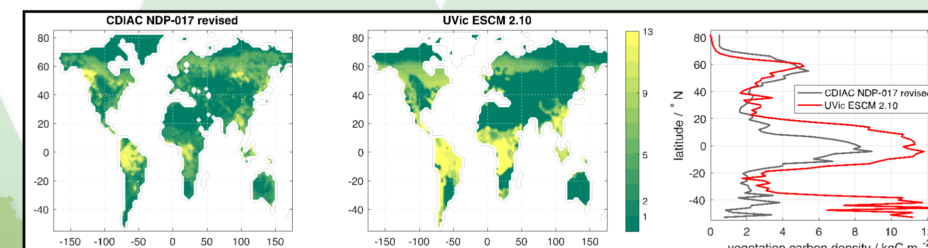

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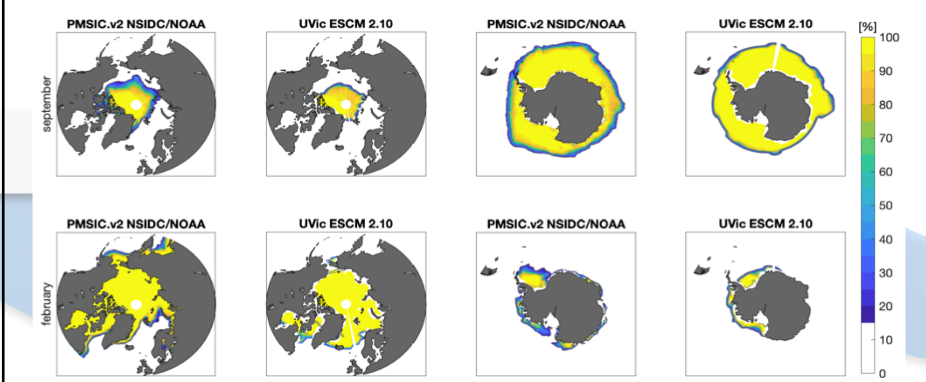

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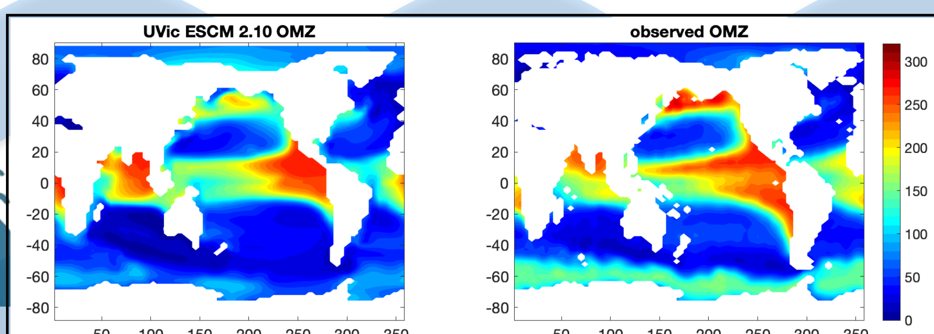

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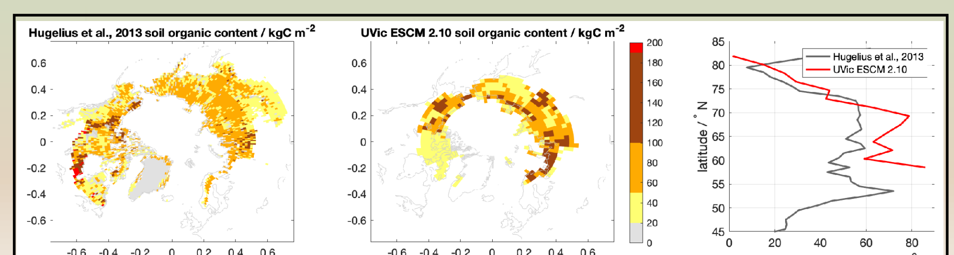

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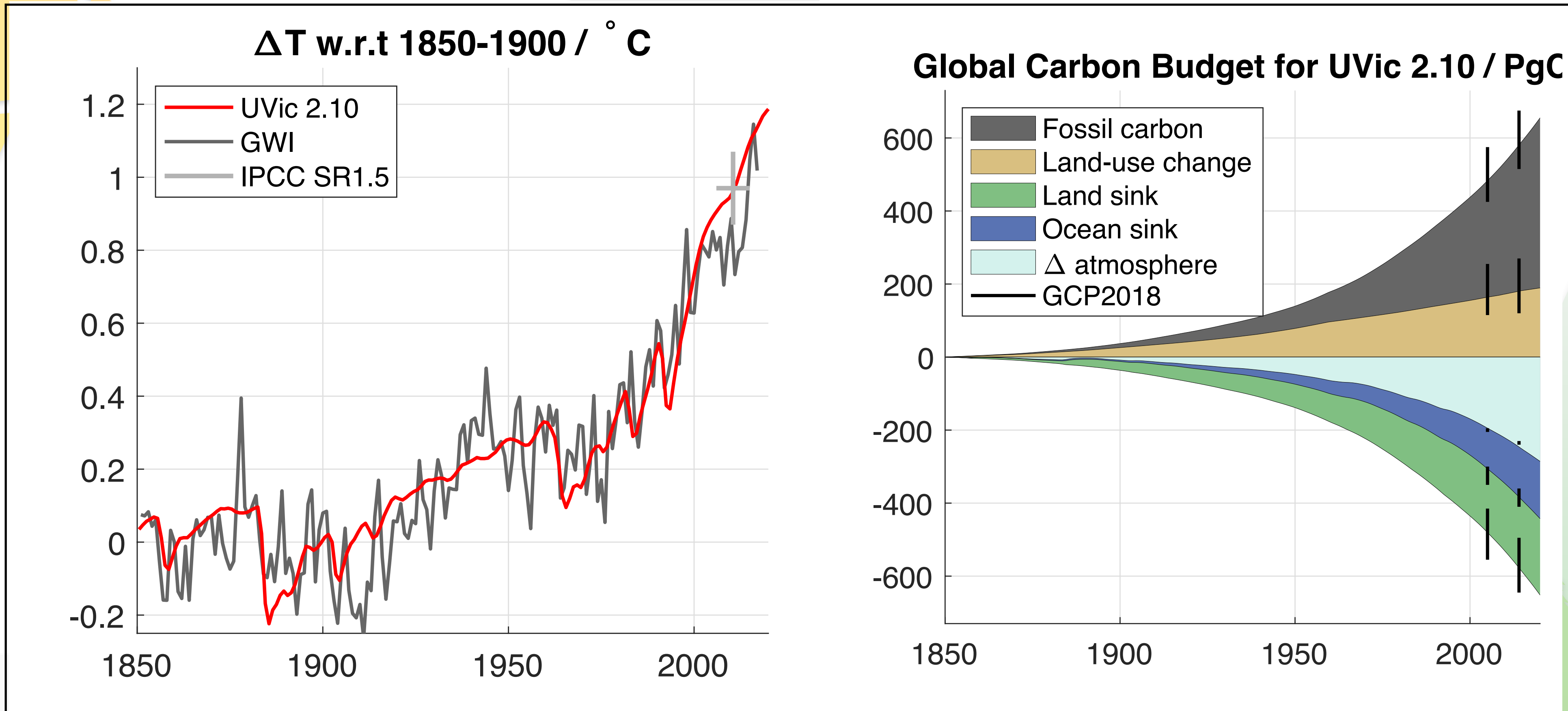

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➡ the model is able to reproduce historical mean temperature change and carbon cycle dynamics well

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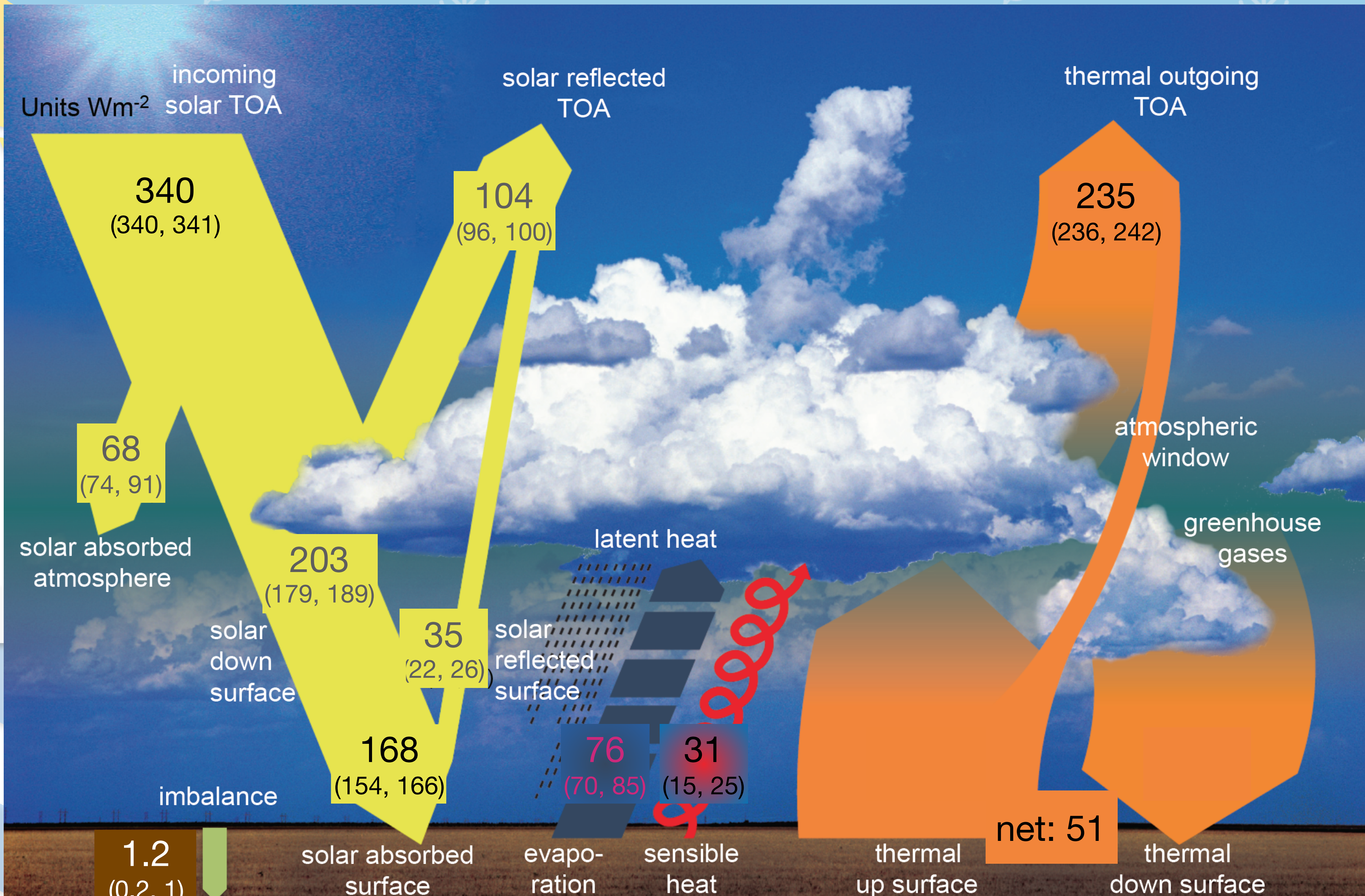

➡ the simulated values of the radiation balance are mostly within the range of uncertainty

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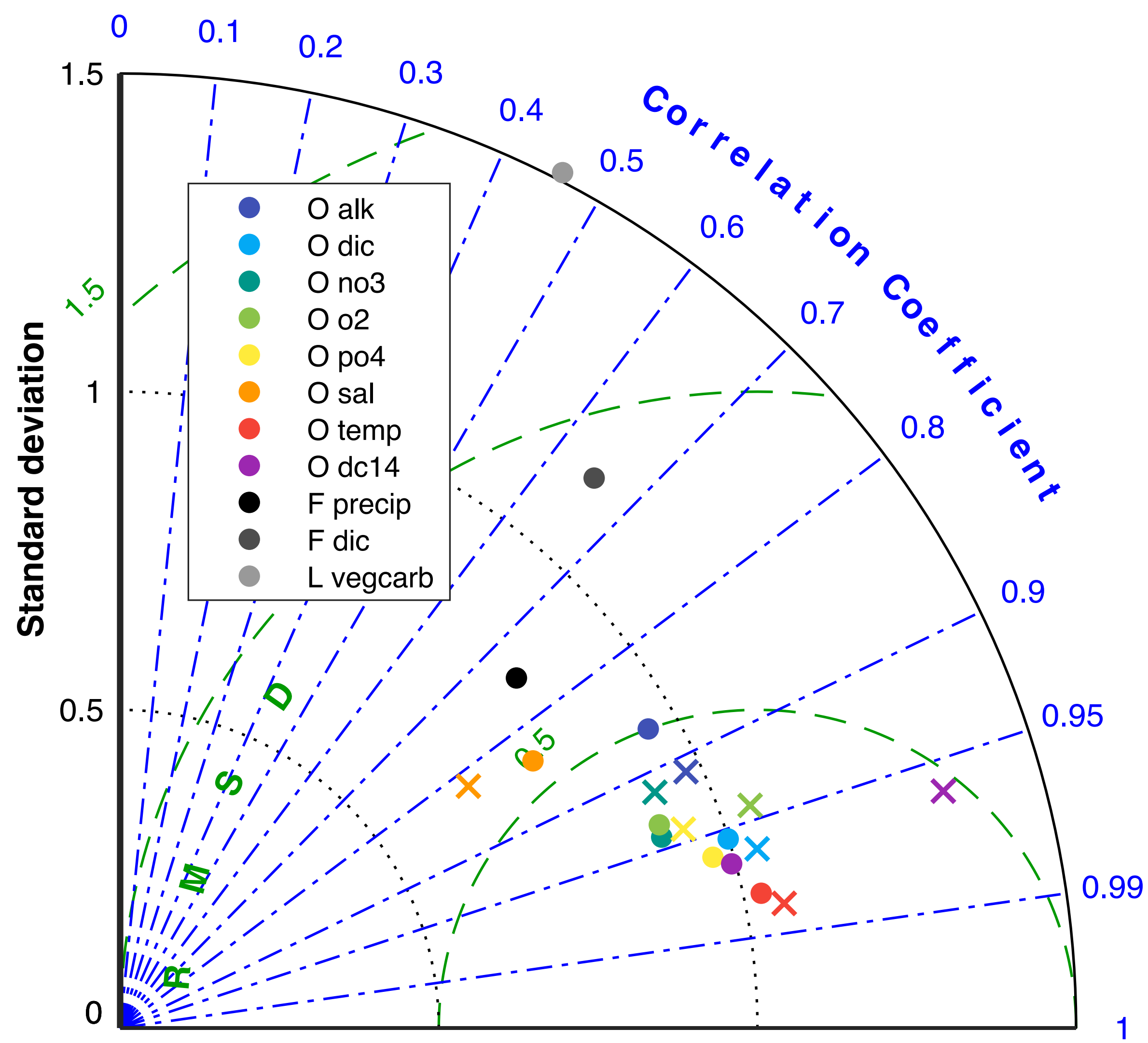

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- ➡ the models performance compared to previous versions has improved for most ocean variables
- ➡ most notable exception is alkalinity

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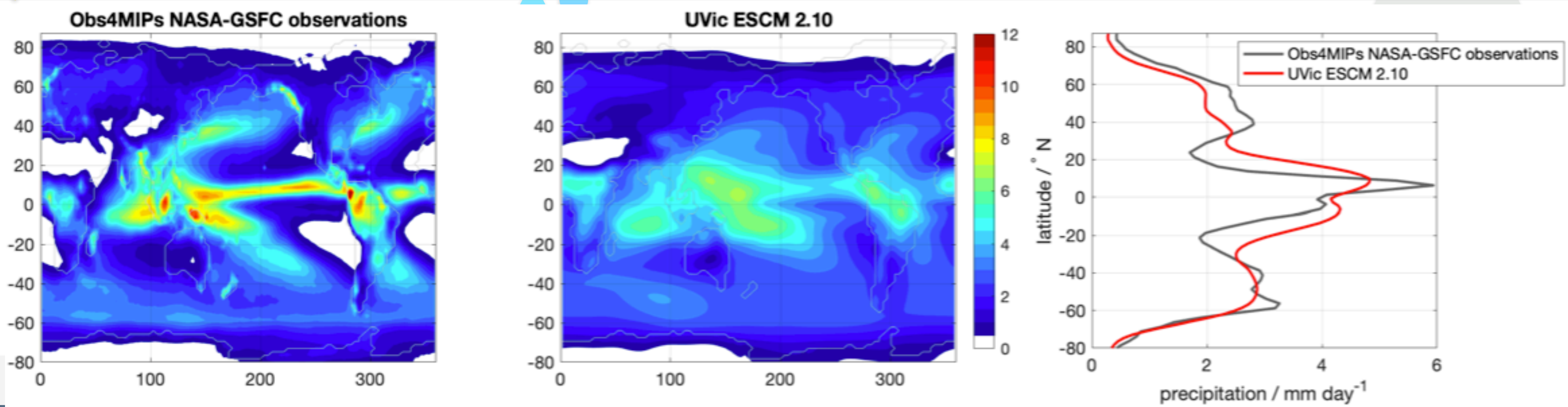

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➡ the model is able to reproduce the overall structure of precipitation patterns without simulation any extreme values

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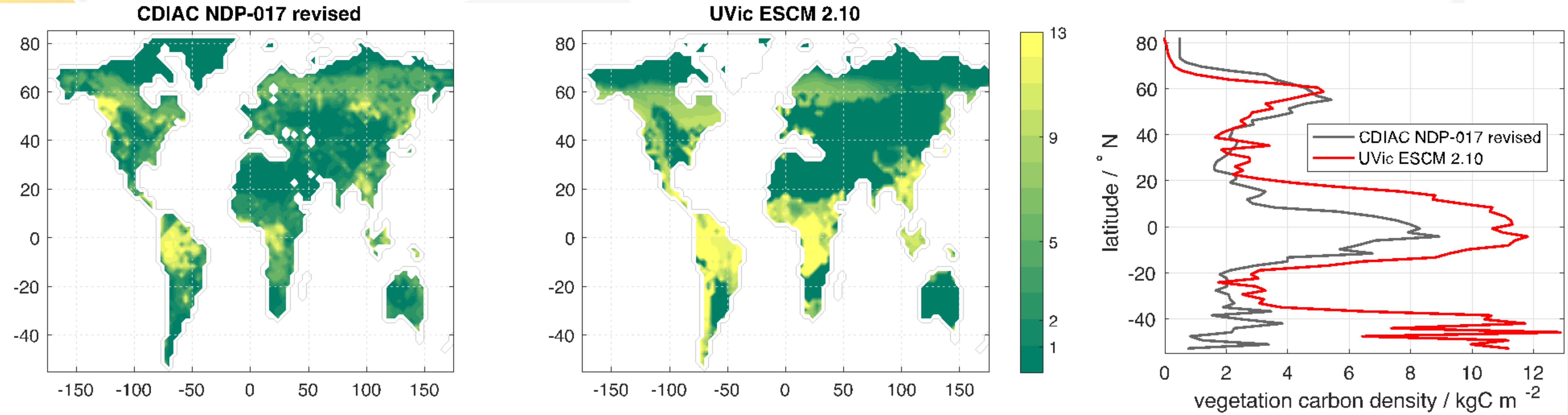

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➡ tropical vegetation carbon density values experience a positive bias

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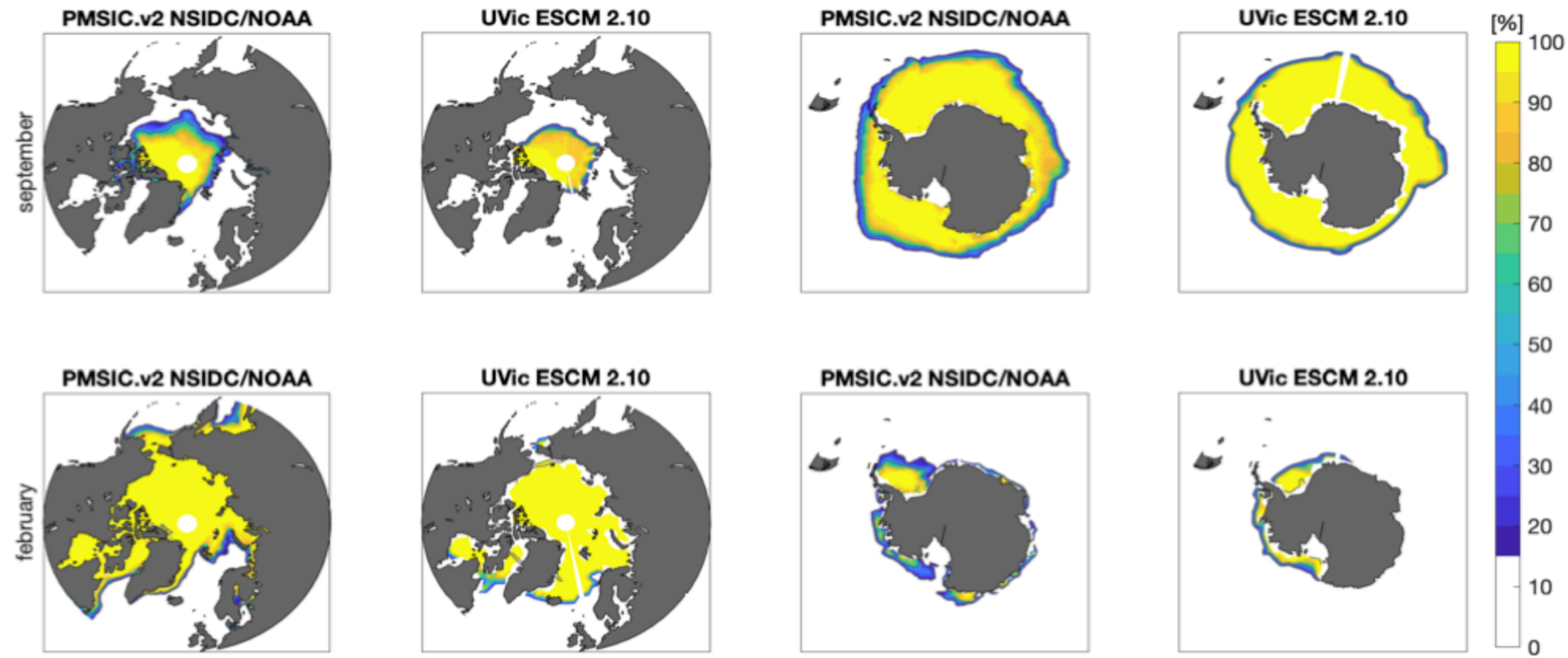

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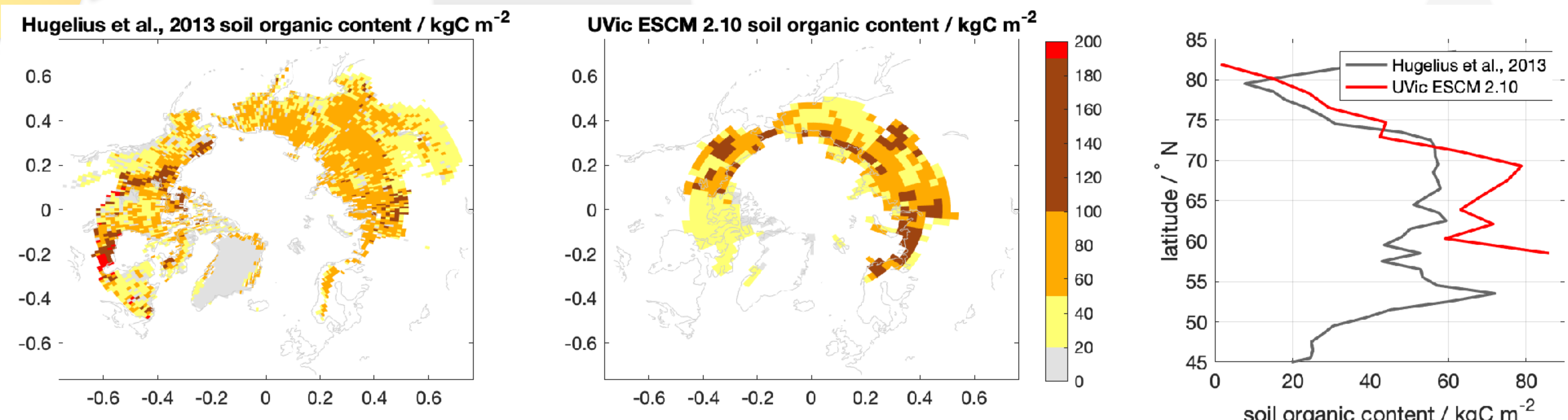

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➡ the model is able to reproduce the order of magnitude of soil organic carbon content in permafrost affected soils

➡ regional biases remain high

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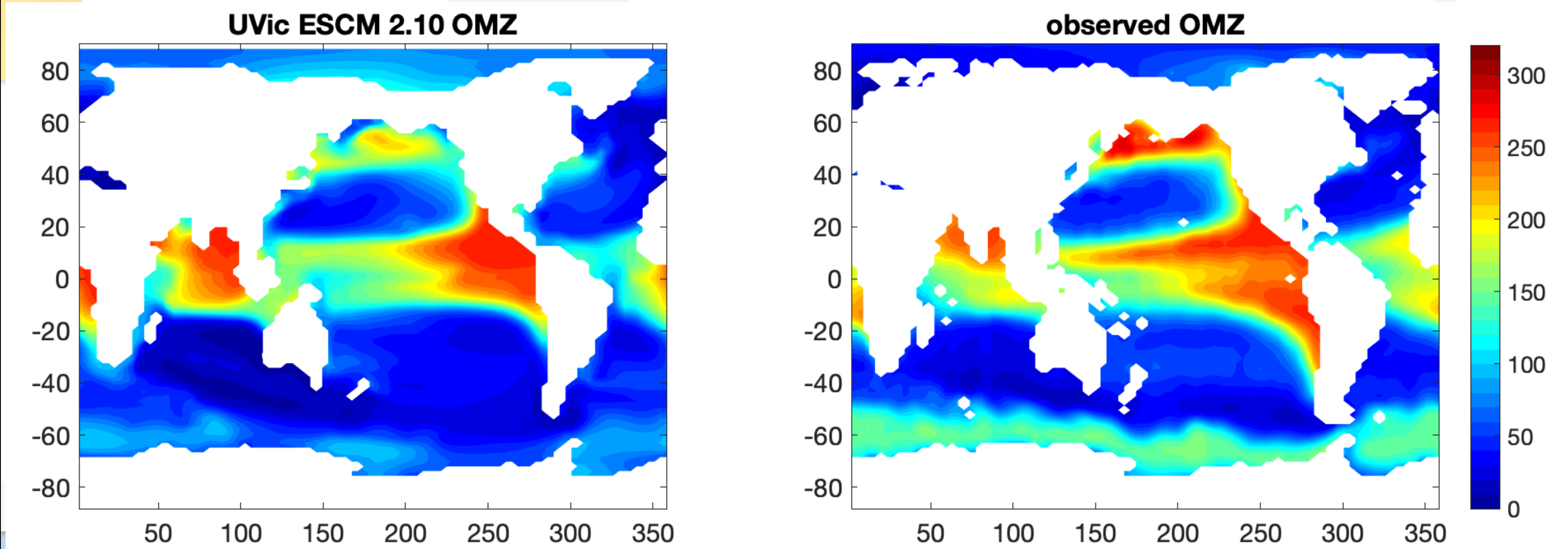

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➡ the overall representation of oxygen minimum zones (OMZs) in the model has been improved

➡ but now there is a bias in the Southern Ocean oxygen concentrations

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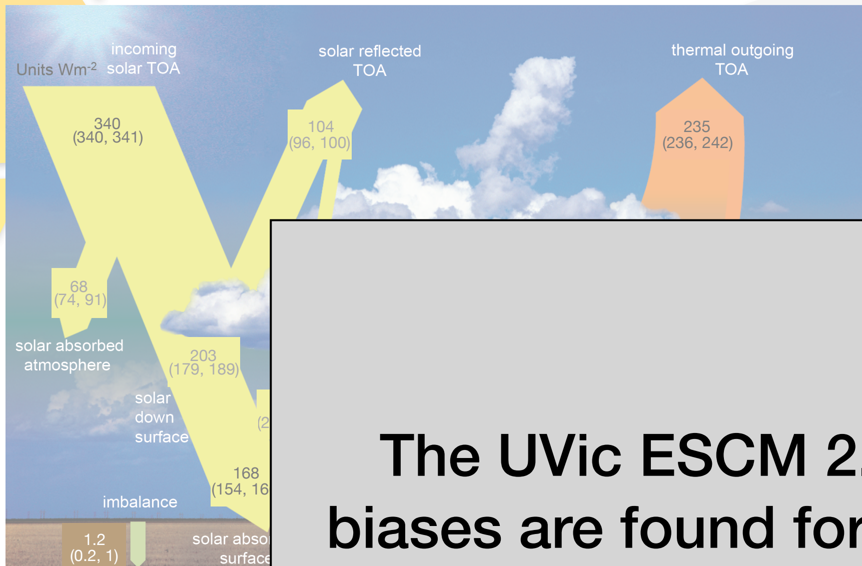

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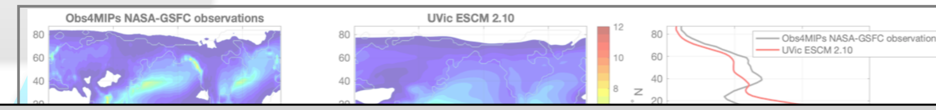

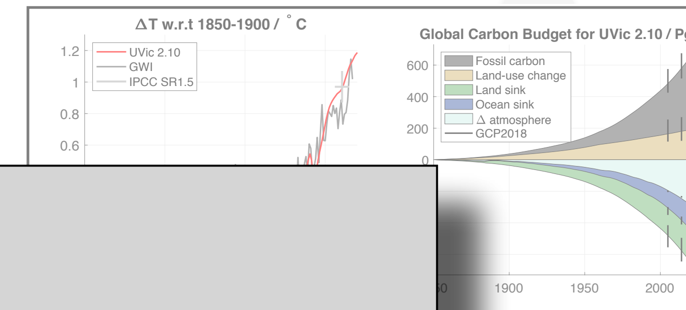

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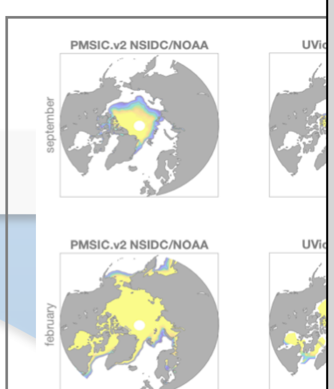

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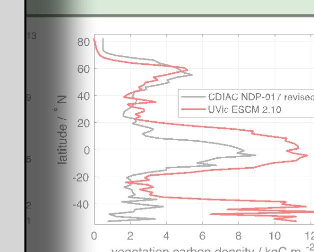
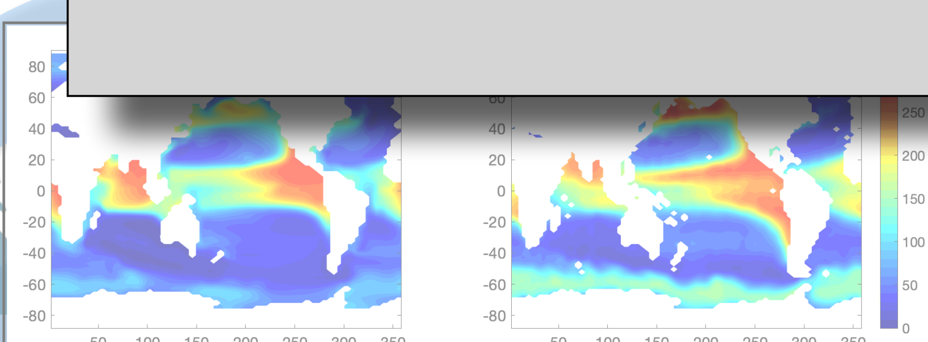


…m the revised CDIAC NDP-017 dataset …and zonally averaged values as a function

The UVic ESCM 2.10 performs well in in many respects. The biggest biases are found for tropical vegetation carbon and the Southern Ocean oxygen concentration.
Continuous efforts from the UVic ESCM community will hopefully provide a solution for some of these biases.

For more details please have a look at the corresponding publication:
https://www.geosci-model-dev-discuss.net/gmd-2019-373/



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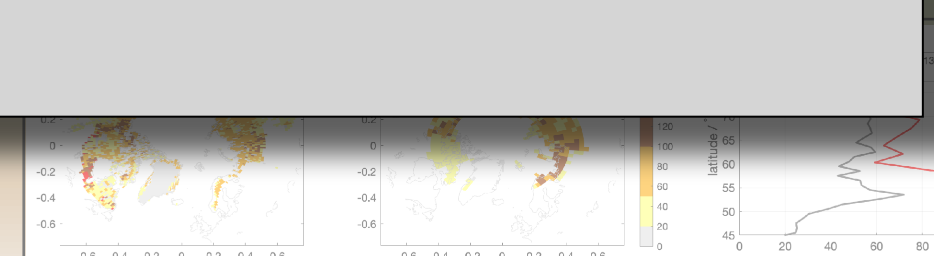

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