05/05/20

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OESCHGER CENTRE CLIMATE CHANGE RESEARCH

Time of emergence of anthropogenic deoxygenation and warming in the thermocline

Is deoxygenation detectable before warming?

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Observed deoxygenation

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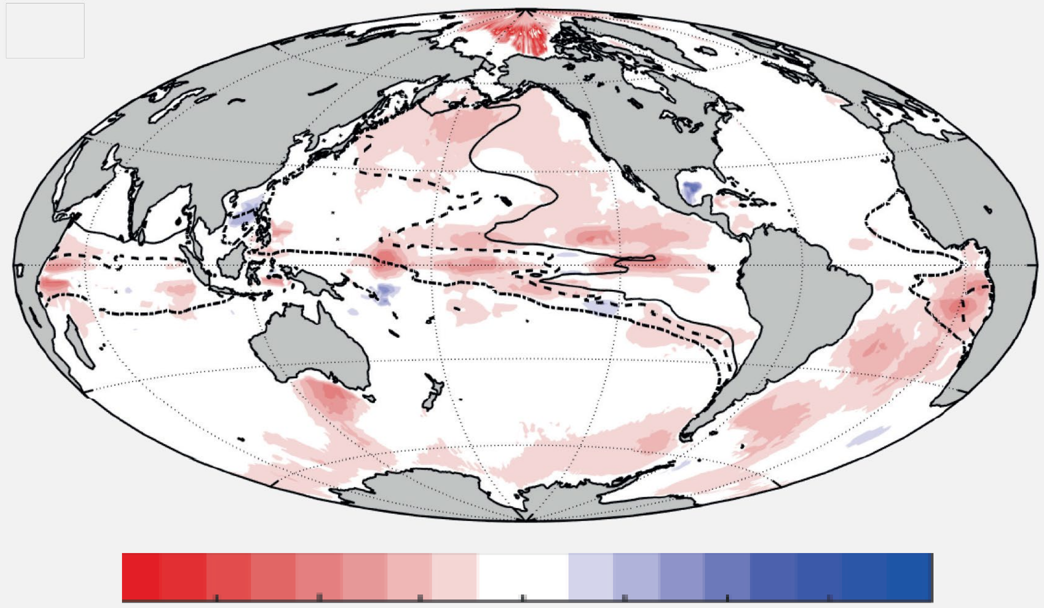
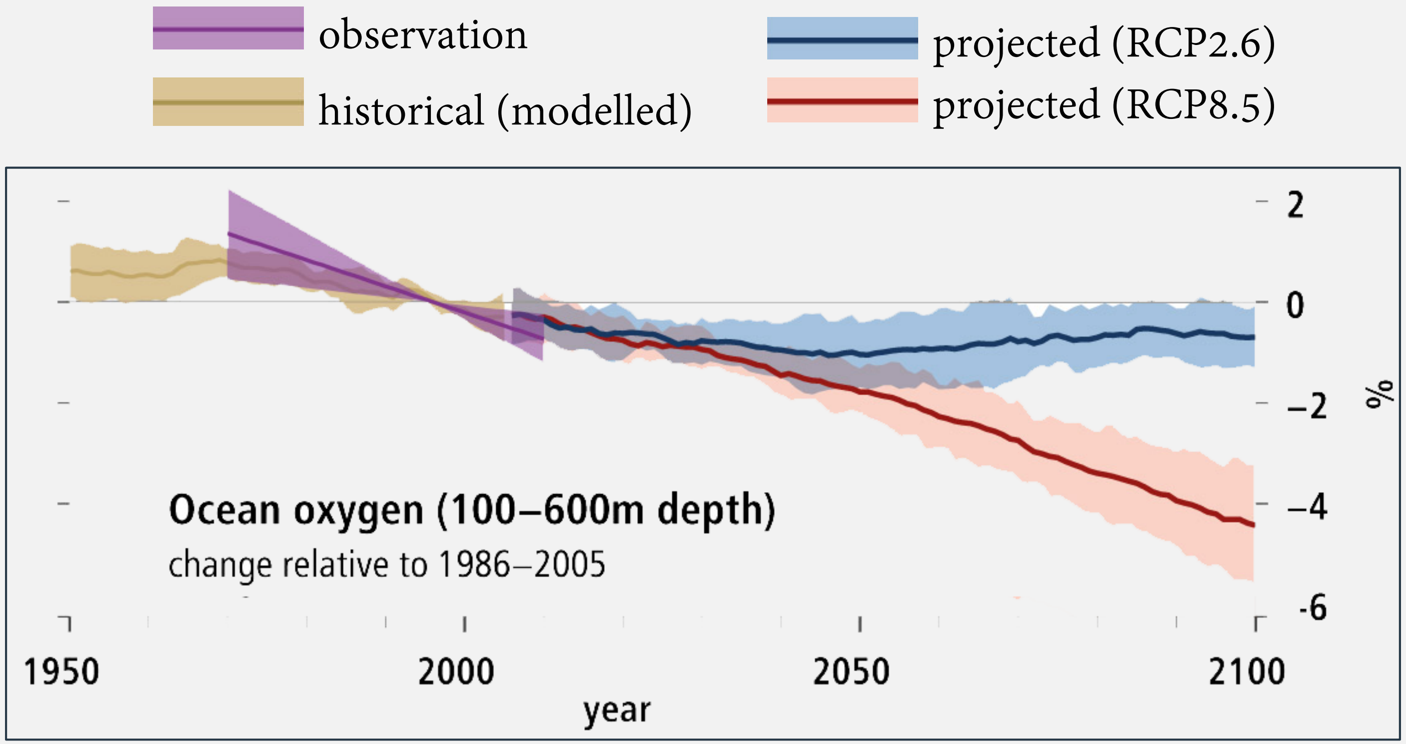
Trend of O_2 (since 1960)
[mmol m^{-3} per decade]



Schmidtko et al., 2017



IPCC, 2019

Time of Emergence - concept

$$\boldsymbol{signal \geq \alpha * noise}$$

Time of Emergence - concept

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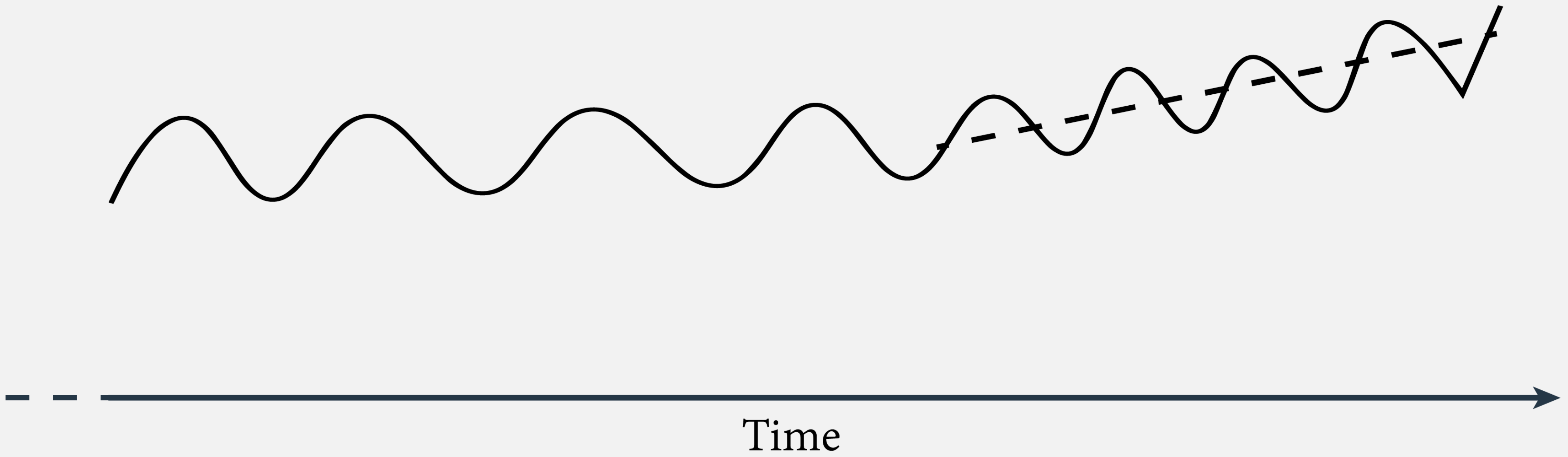
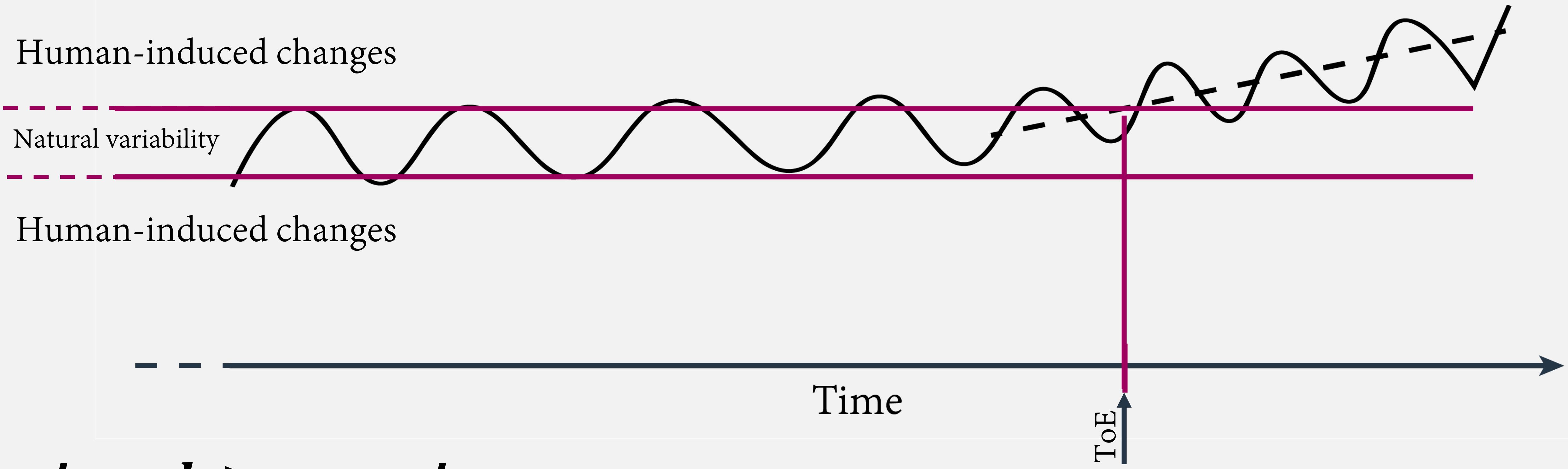


$$\boldsymbol{signal \geq \alpha * noise}$$

Time of Emergence - concept



$$\boldsymbol{signal} \geq \alpha * \boldsymbol{noise}$$

Multi-model analysis

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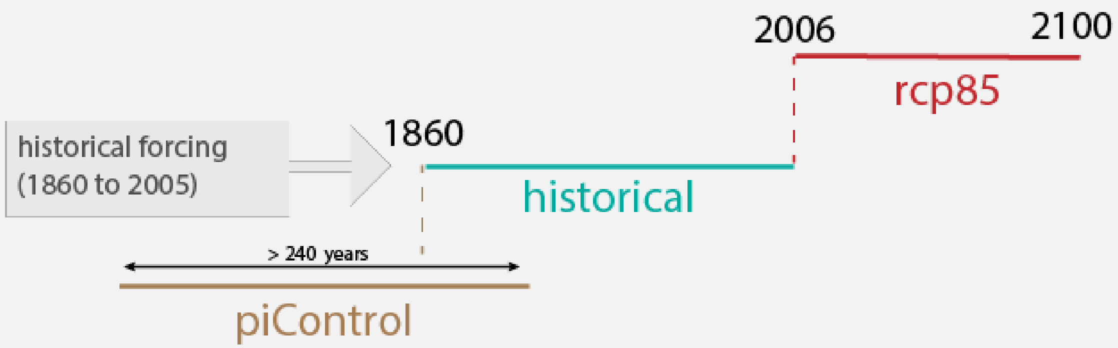
8 model configurations from the CMIP5 dataset



+

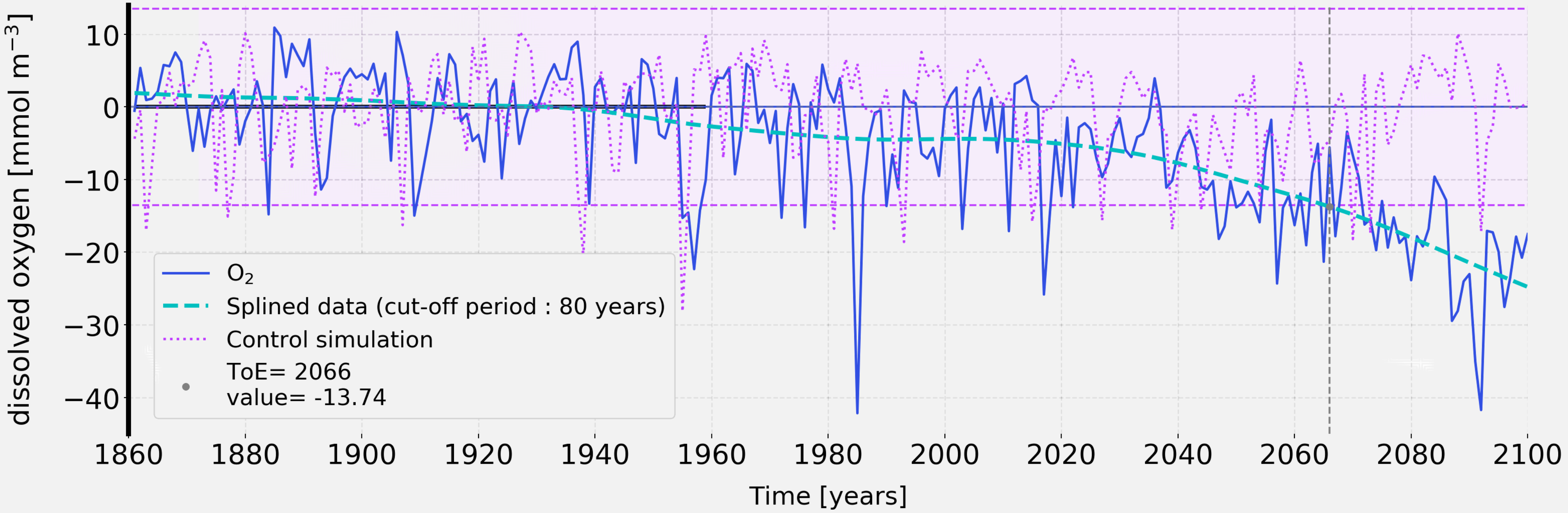
"in-house" CESM1.0 simulation

ToE – definition for this study

Noise: internal variability

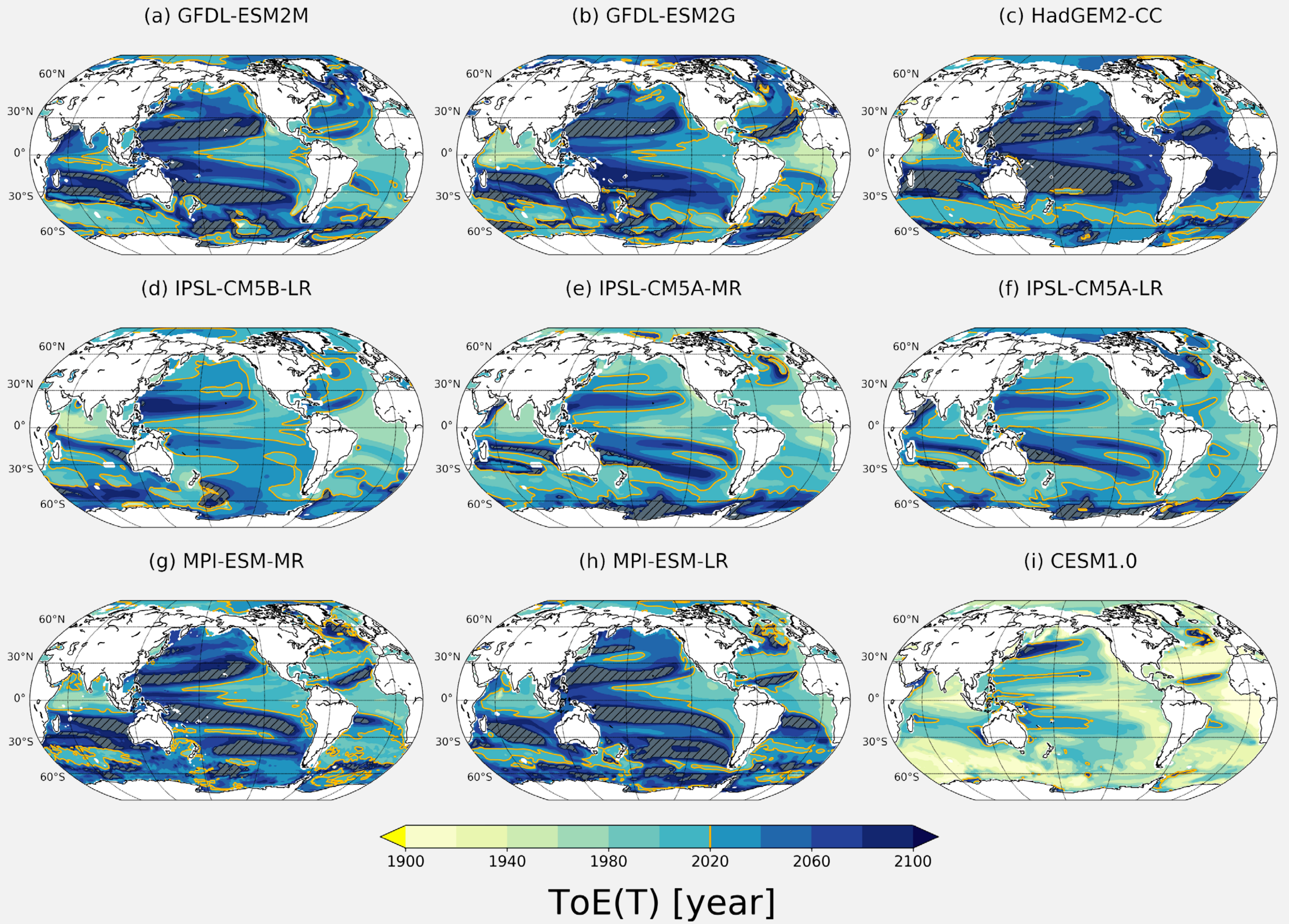
$\alpha = 2$

Signal : low-frequency filter

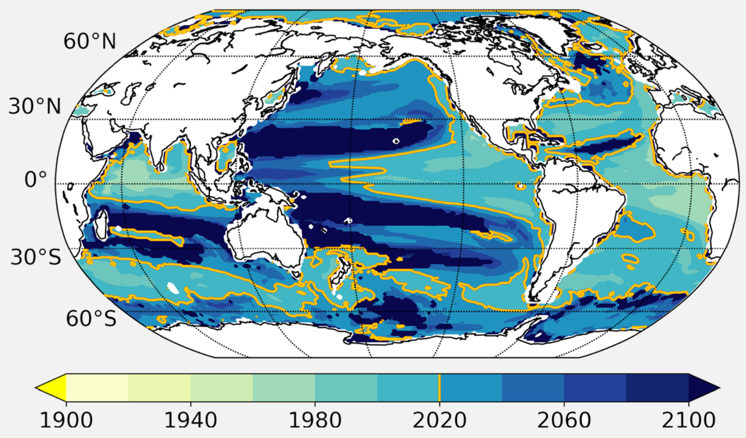


(Hameau et al., 2020)

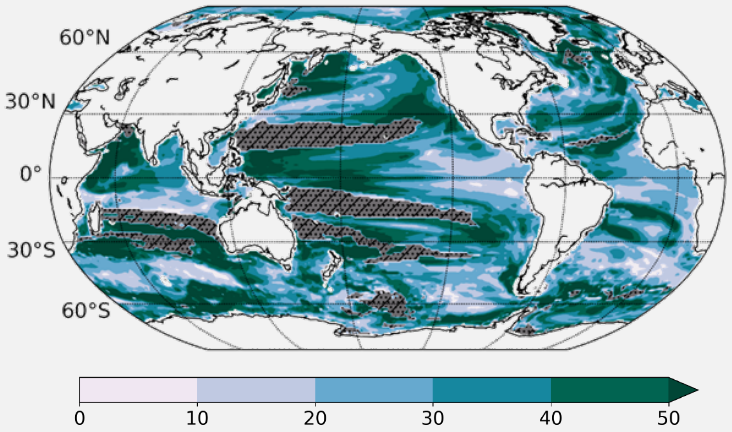
ToE(T)



Multi-model median of ToE [years]



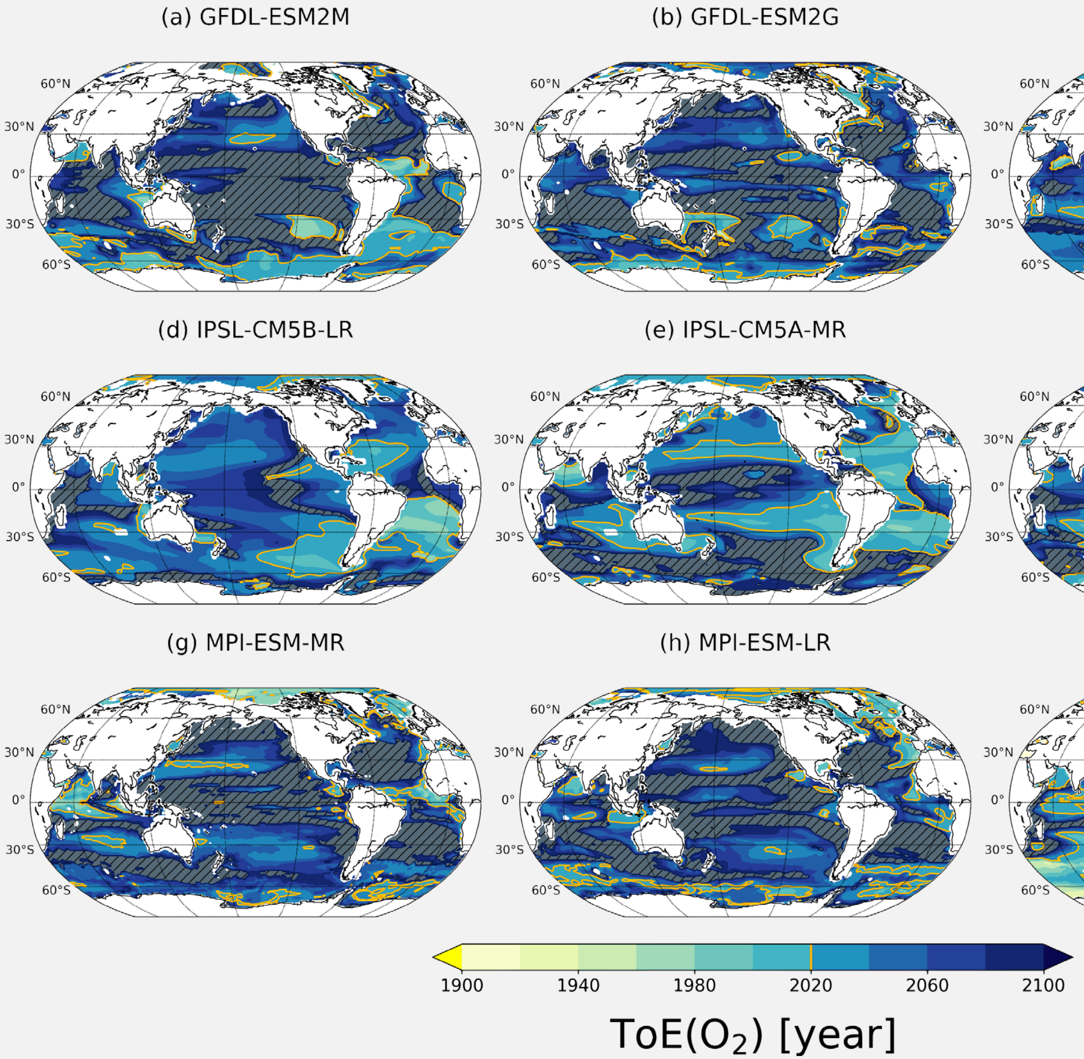
Multi-model spread of ToE [years]



(Hameau et al., 2020)

Introduction | Method | Results | Conclusion

ToE(O_2)



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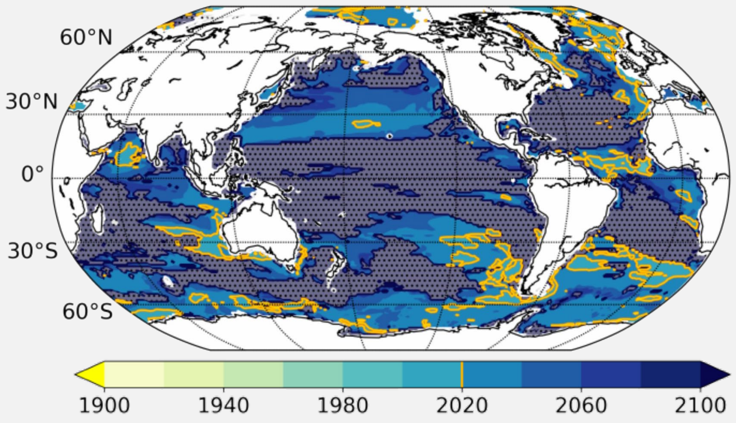
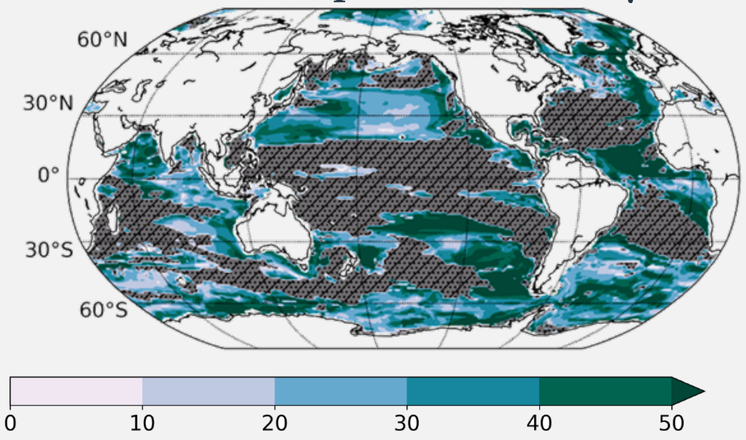
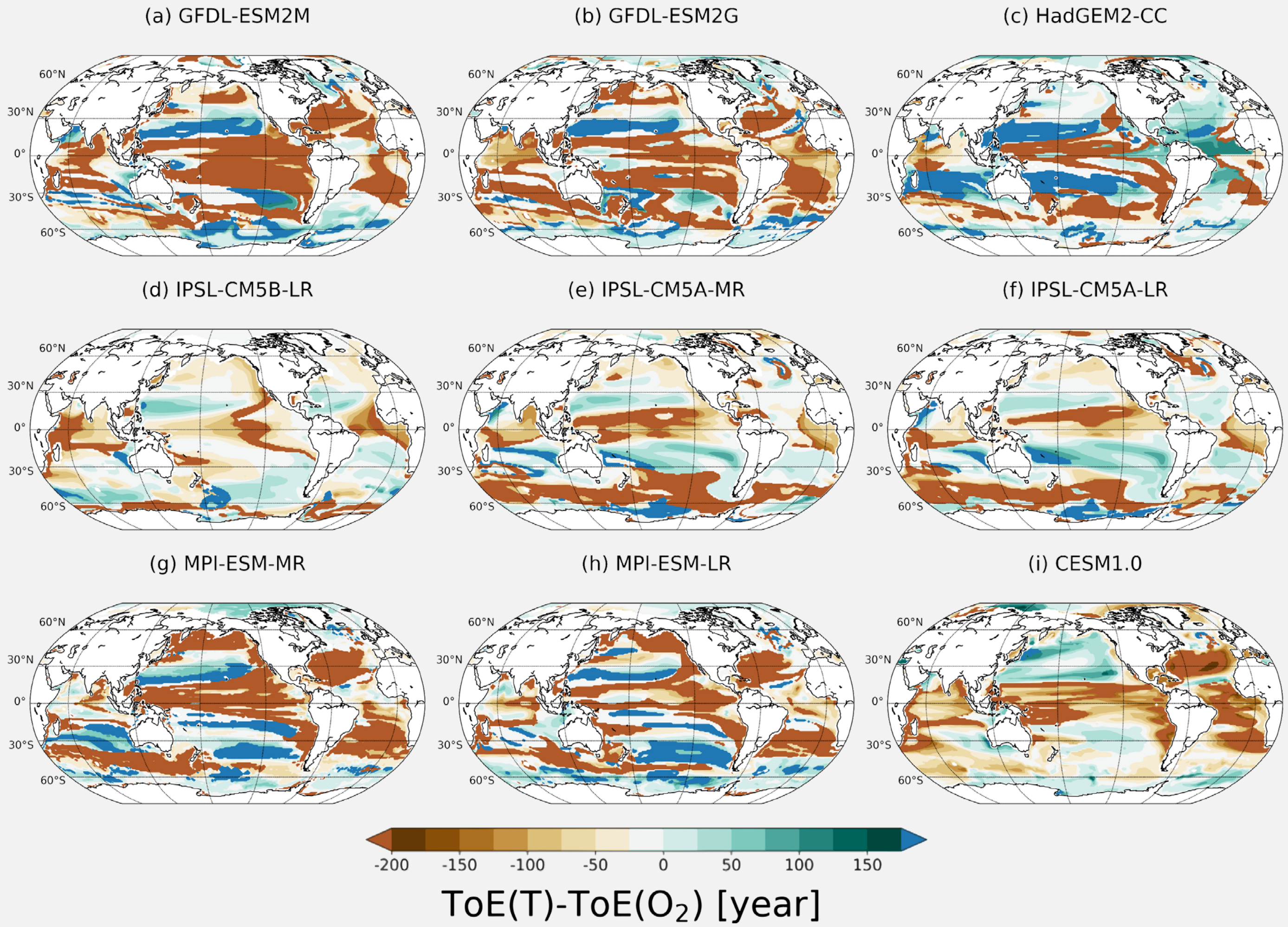


Multi-model spread of ToE [years]



(Hameau et al., 2020)

ΔToE = ToE(T)-ToE(O_2)



(Hameau et al., 2020)

ΔToE = ToE(T)-ToE(O_2)

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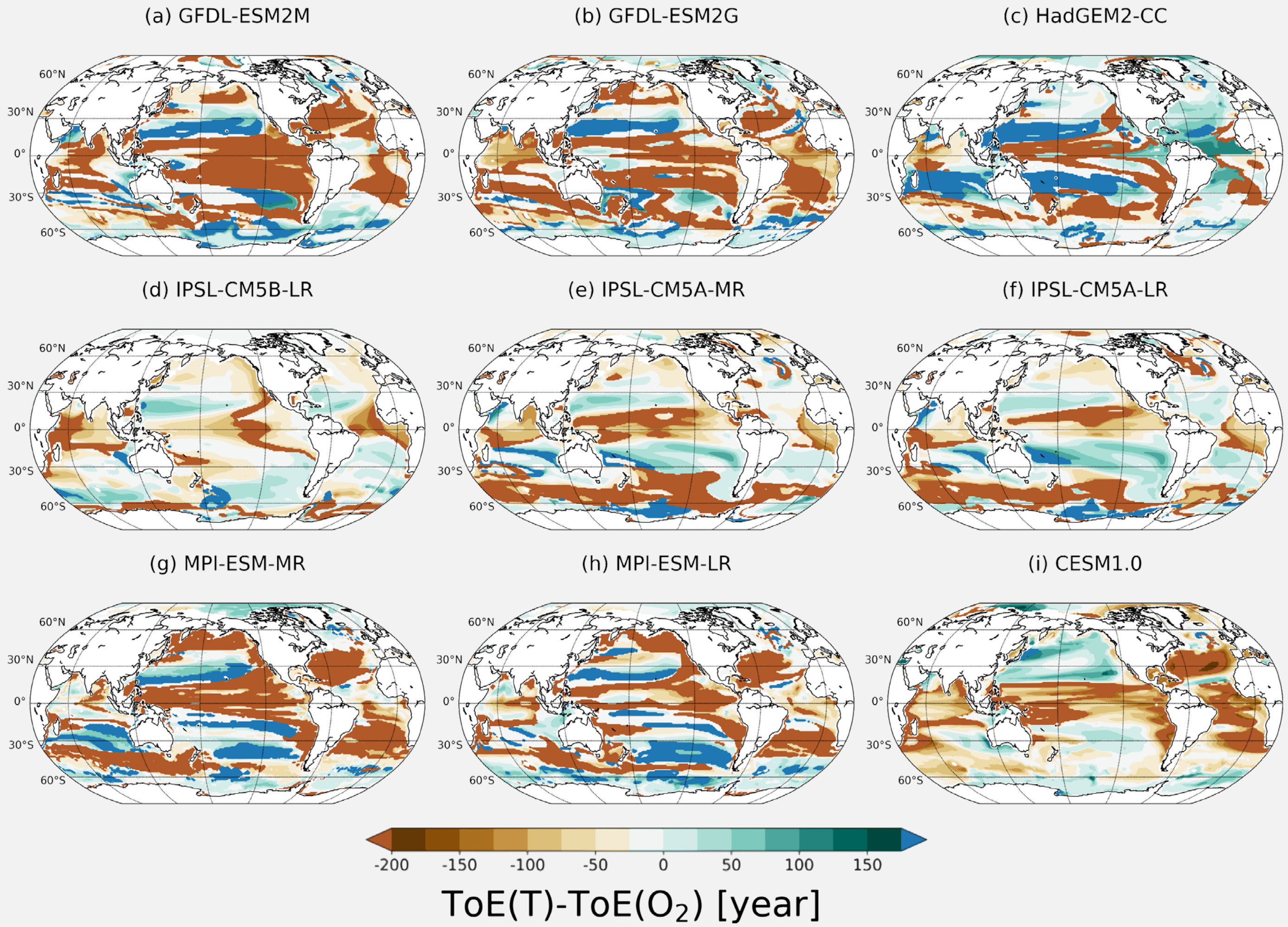
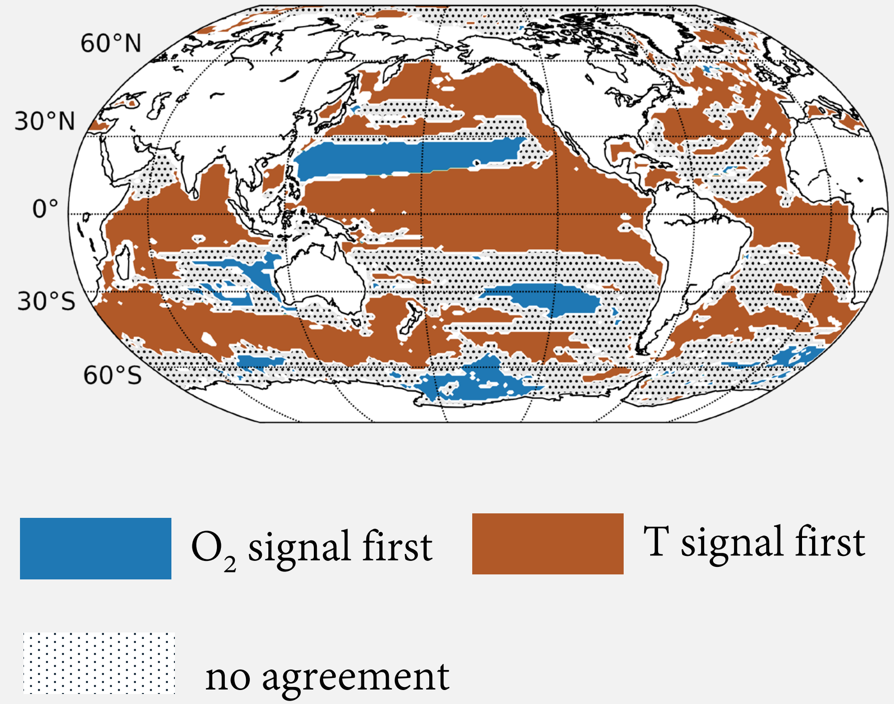
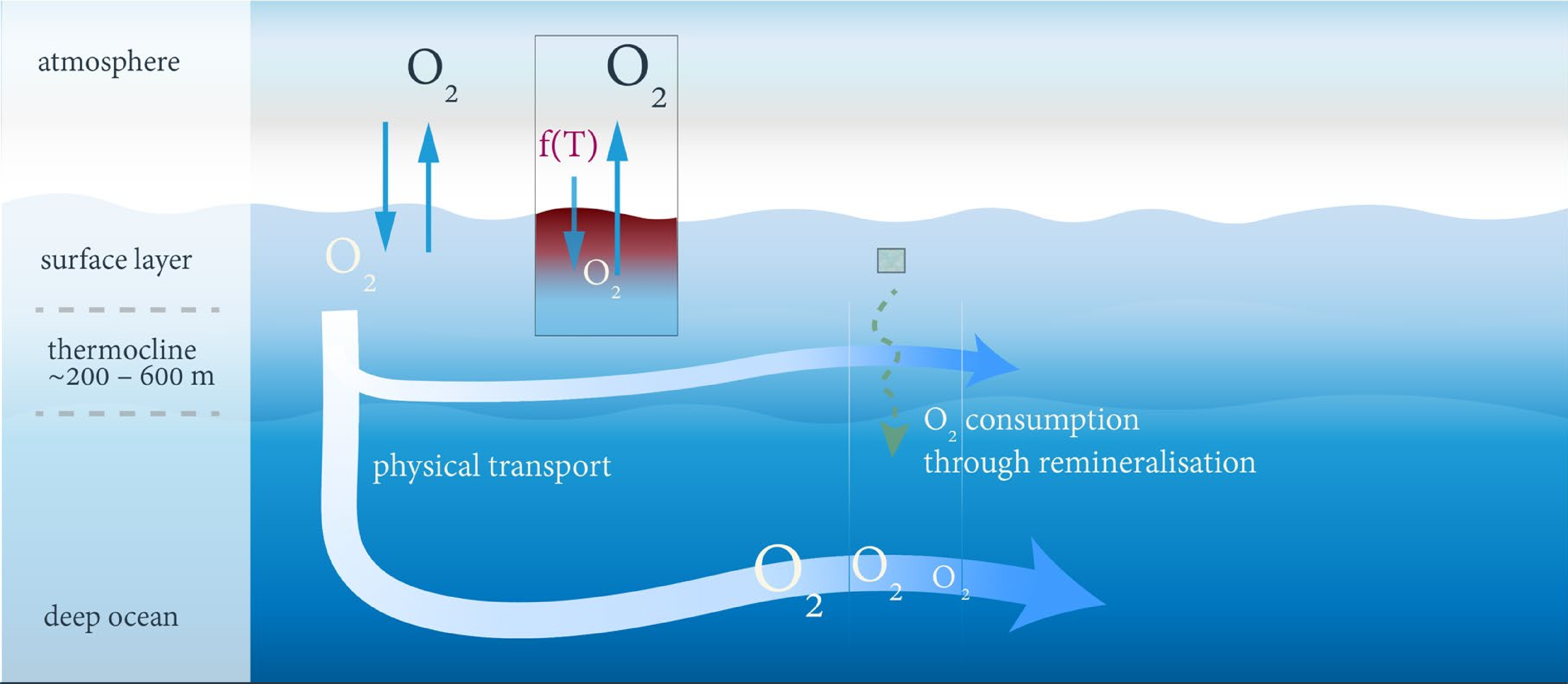


Summary map showing the regions where ΔO_2 emerge before ΔT (blue) for at least 7 out of 9 models



(Hameau et al., 2020)

Oxygen distribution is driven by physical and biogeochemical processes



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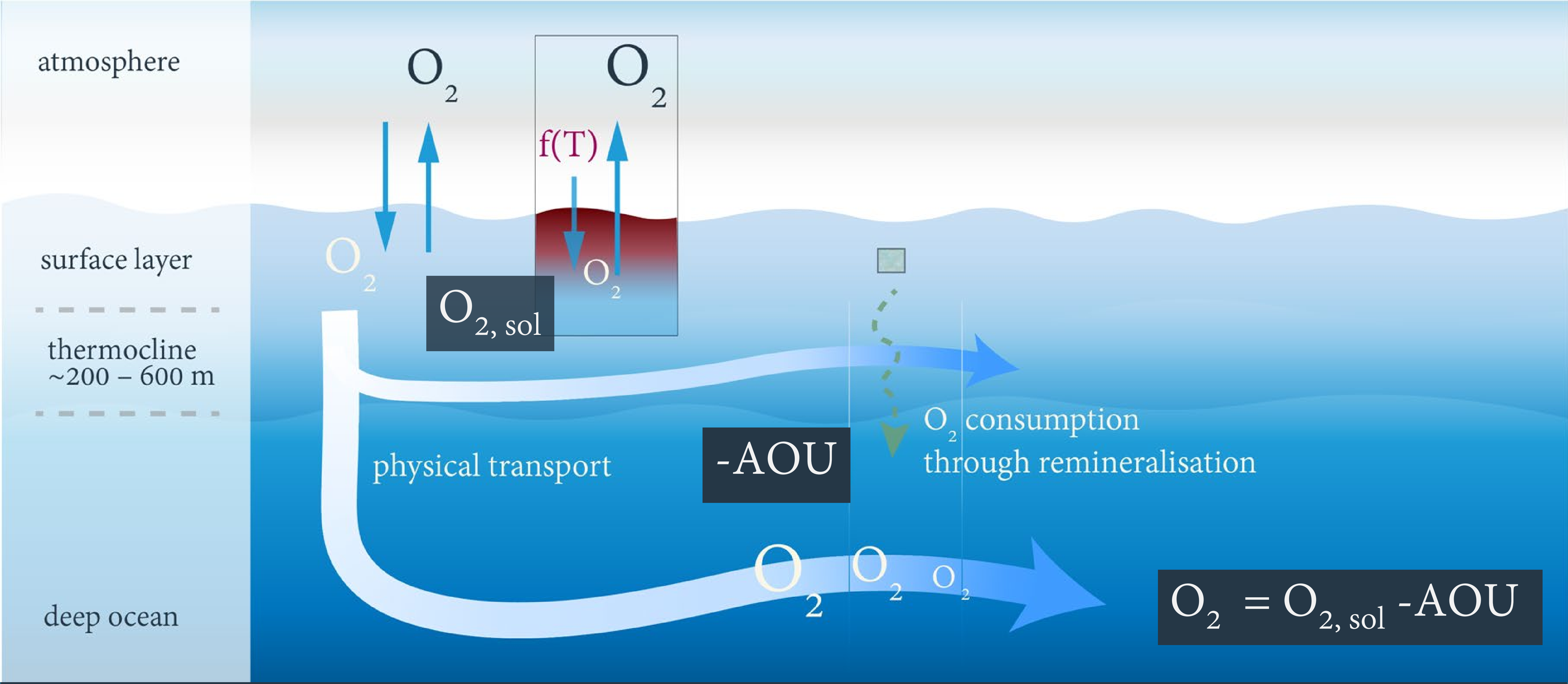

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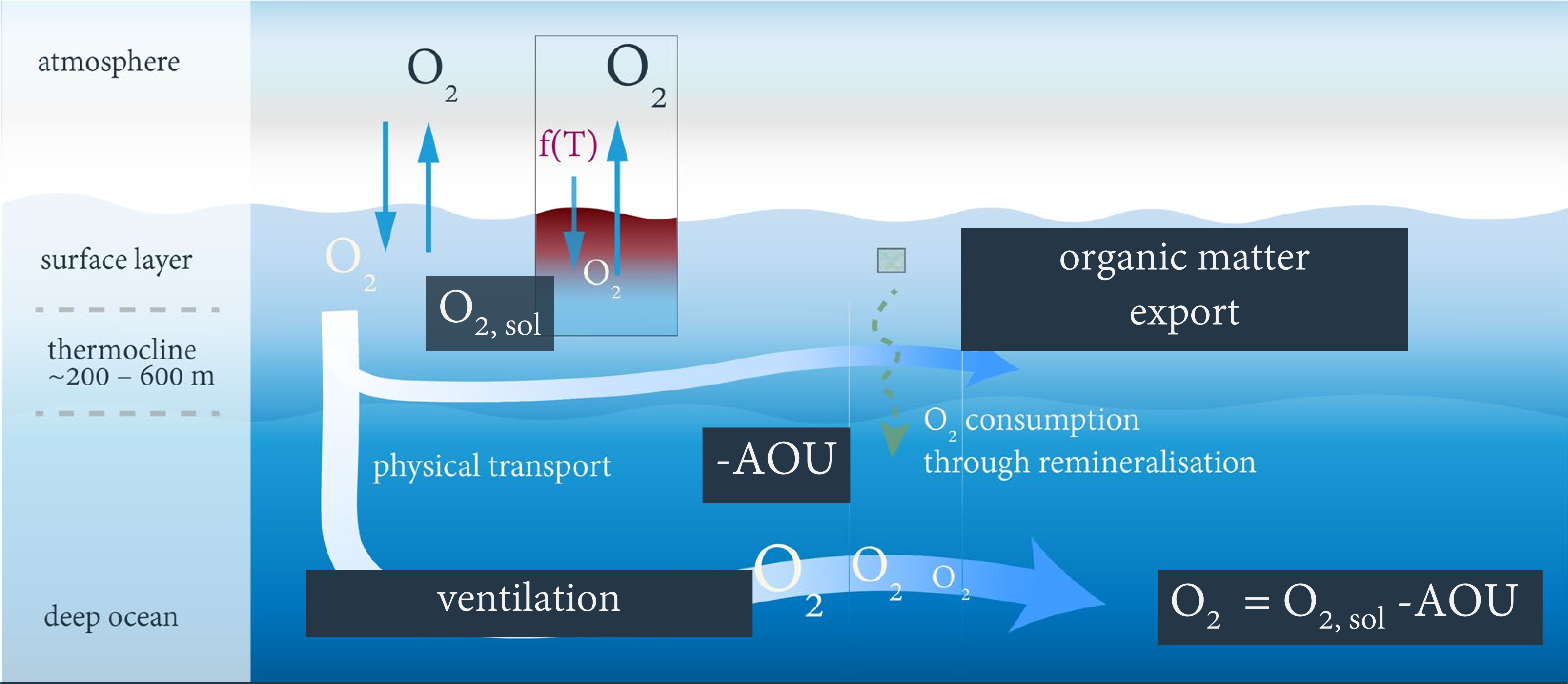

Ventilation as main driver of early emergence of ΔO_2

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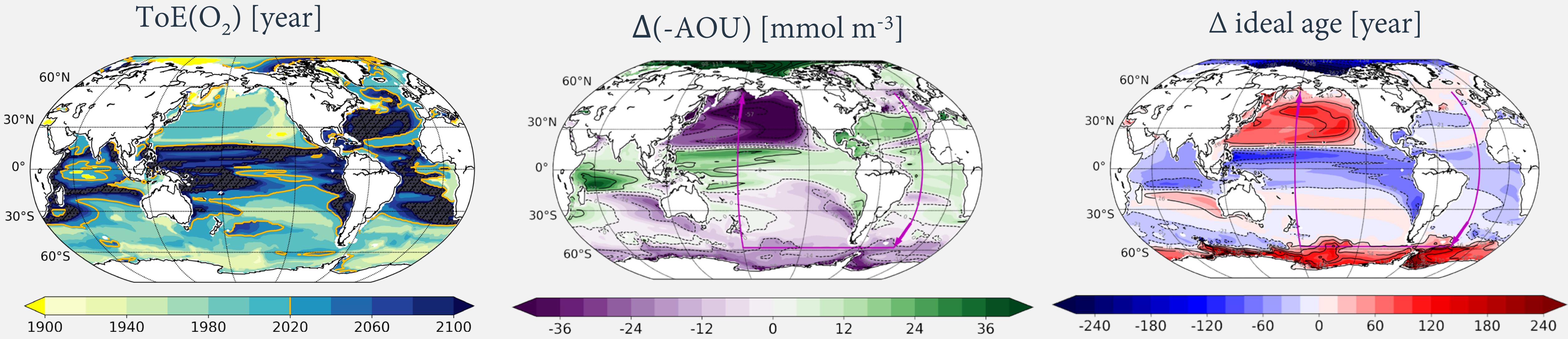
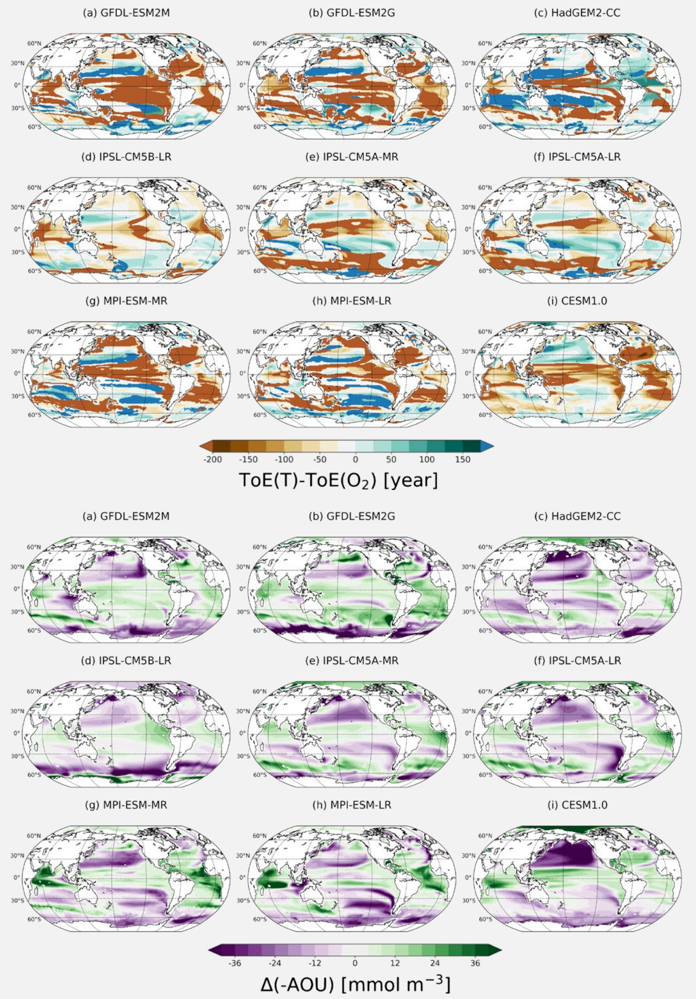
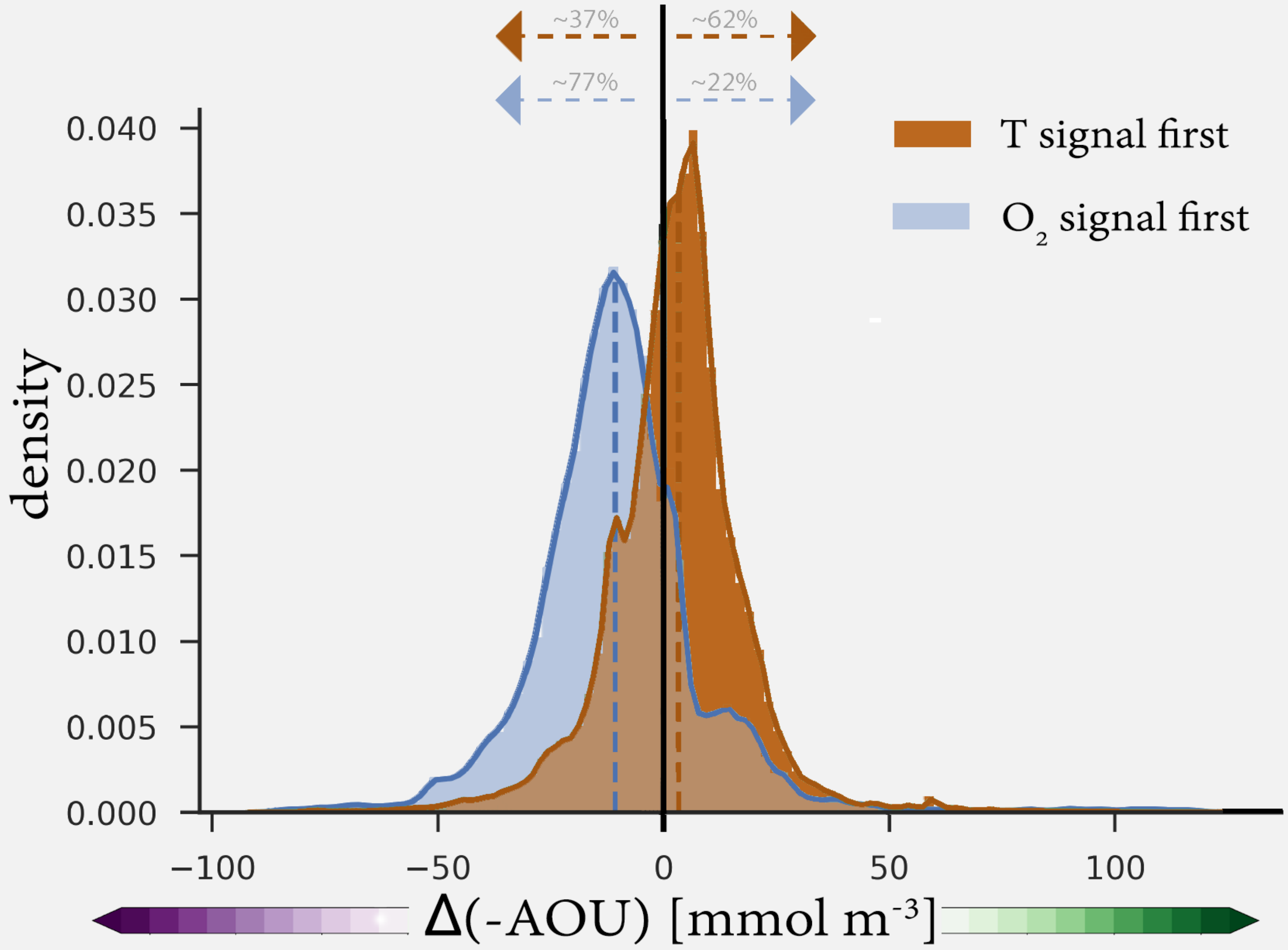


- Slower ventilation intensifies Apparent Oxygen Utilisation leading to strong O_2 depletion

(Hameau et al., 2020)

ΔToE vs Δ(-AOU)





(Hameau et al., 2020)

Conclusions

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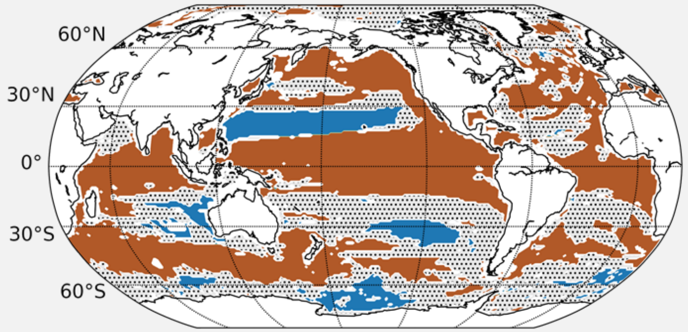
- **17%** of the global thermocline show anthropogenic **deoxygenation detectable prior to warming**

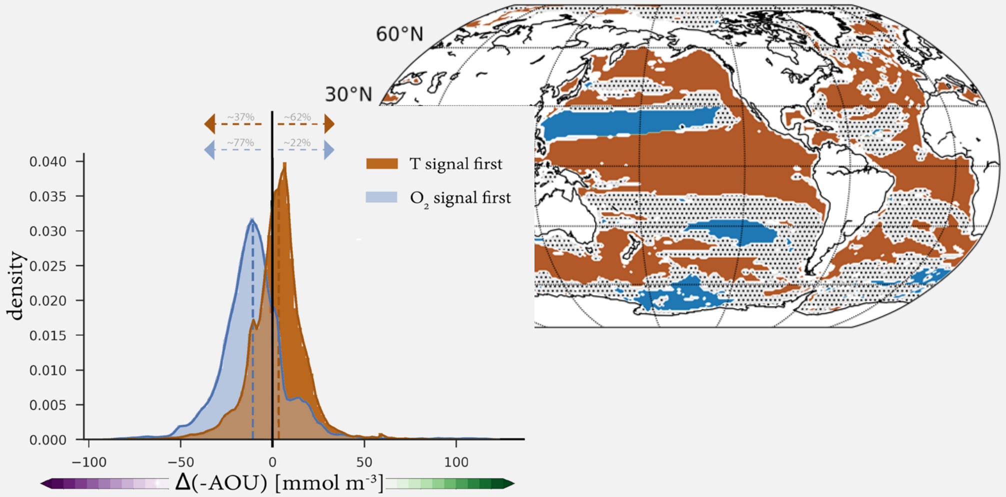


(Hameau et al., 2020)

Conclusions

- **17%** of the global thermocline show anthropogenic **deoxygenation detectable prior to warming**

- The **earlier O_2 changes** are primarily driven by **intensified O_2 consumptions** which are mostly induced by a **reduced ventilation**



(Hameau et al., 2020)

Conclusions

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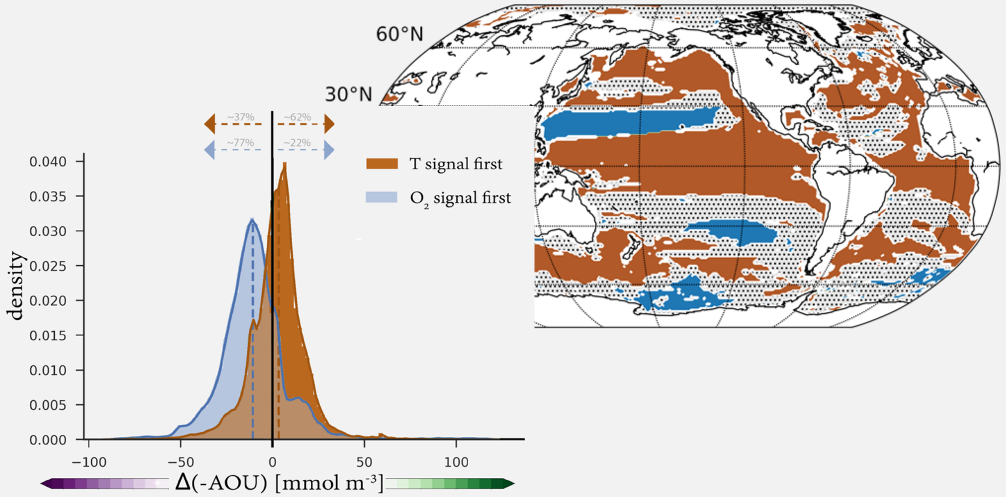
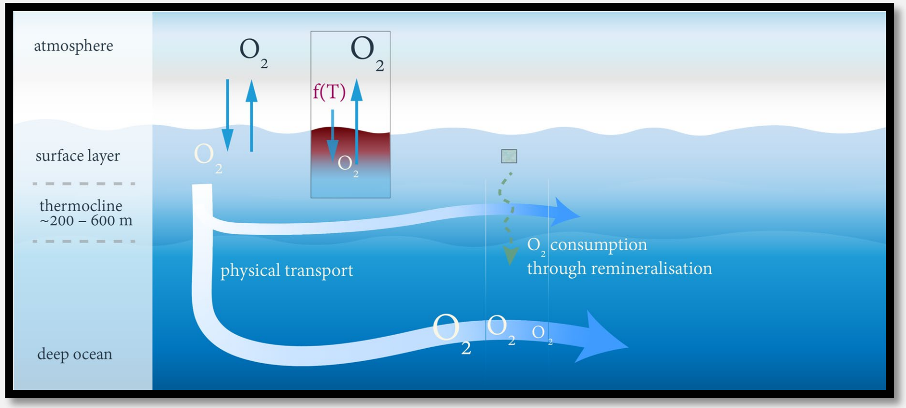
- The **earlier O_2 changes** are primarily driven by **intensified O_2 consumptions** which are mostly induced by a **reduced ventilation**

- Slower ventilation leads to a **reduction of O_2 supply** from rich surface waters to the thermocline and **delays** the propagation of the **warming signal**





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