A 3D-model inversion of methyl chloroform to constrain the atmospheric oxidative capacity

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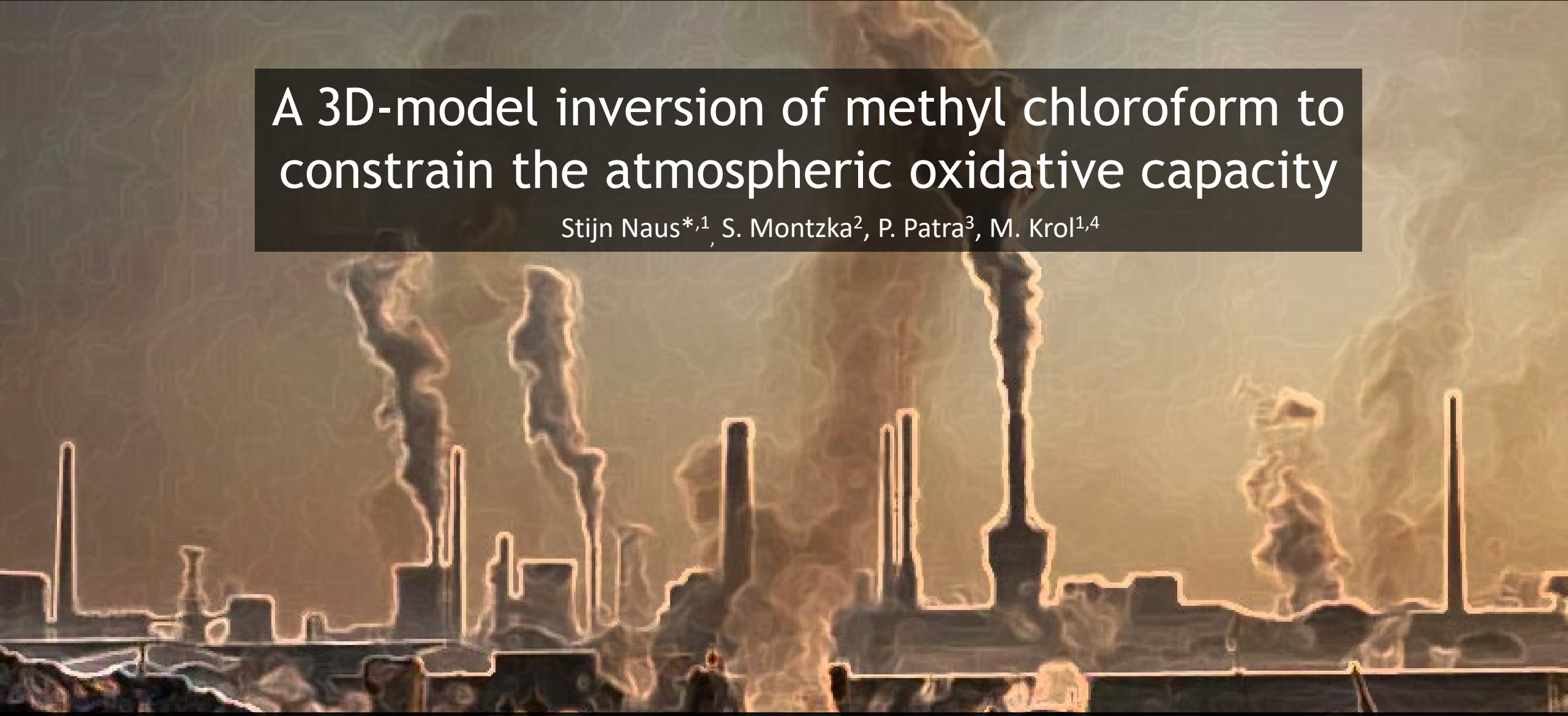

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The problem of OH

- OH removes many pollutants (CO, CH_4, NO_x ...)
- Short-lived, variable, low abundance make direct measurements difficult

Solution: Estimate OH indirectly through its effects on other tracers

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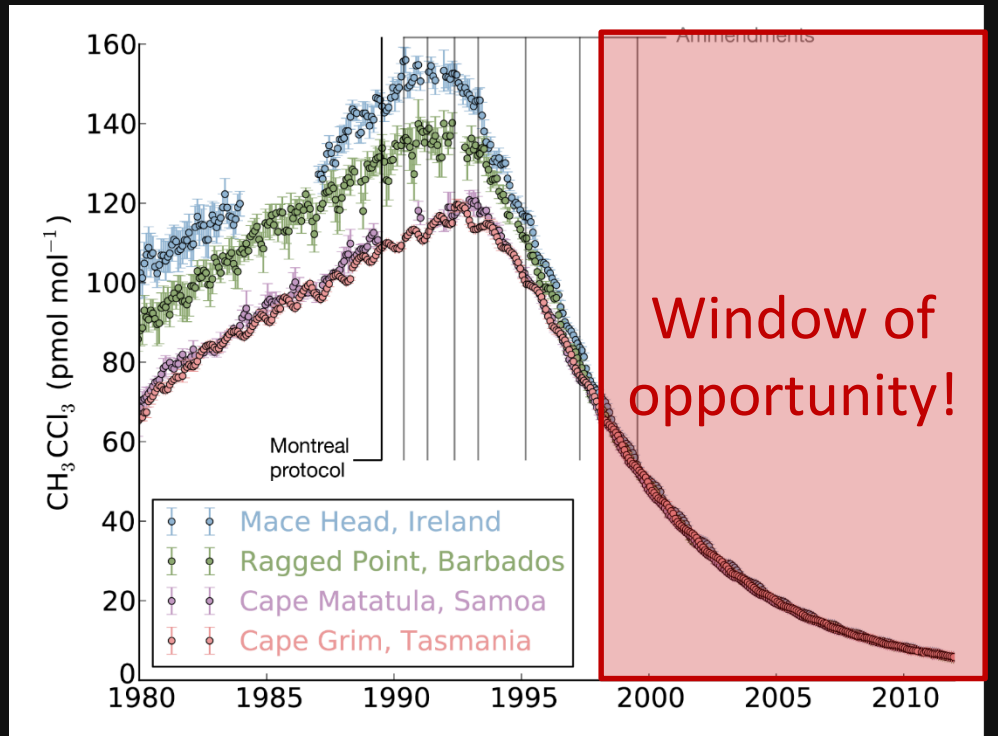
Ideal tracer: Methyl chloroform (MCF)



Set-up of the 3D model inversion in TM5-4DVAR

TM5 setup

- 6 x 4 degrees horizontal resolution
- 1998 – 2018

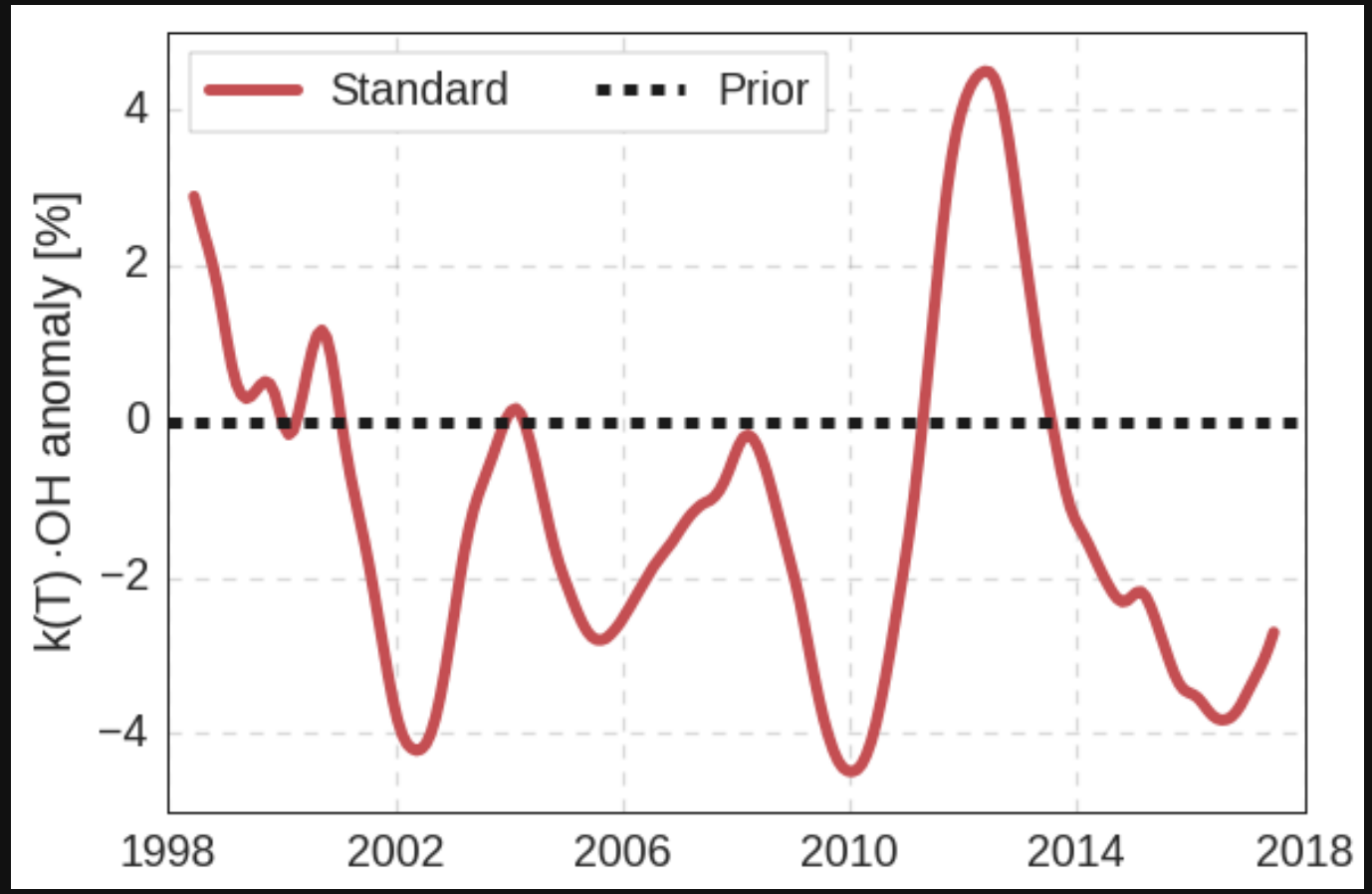
Standard prior:

1. TransCom emissions before 2008, after 2008 emissions optimized in a one box model
2. Spivakovsky OH x 0.92

Inversion:

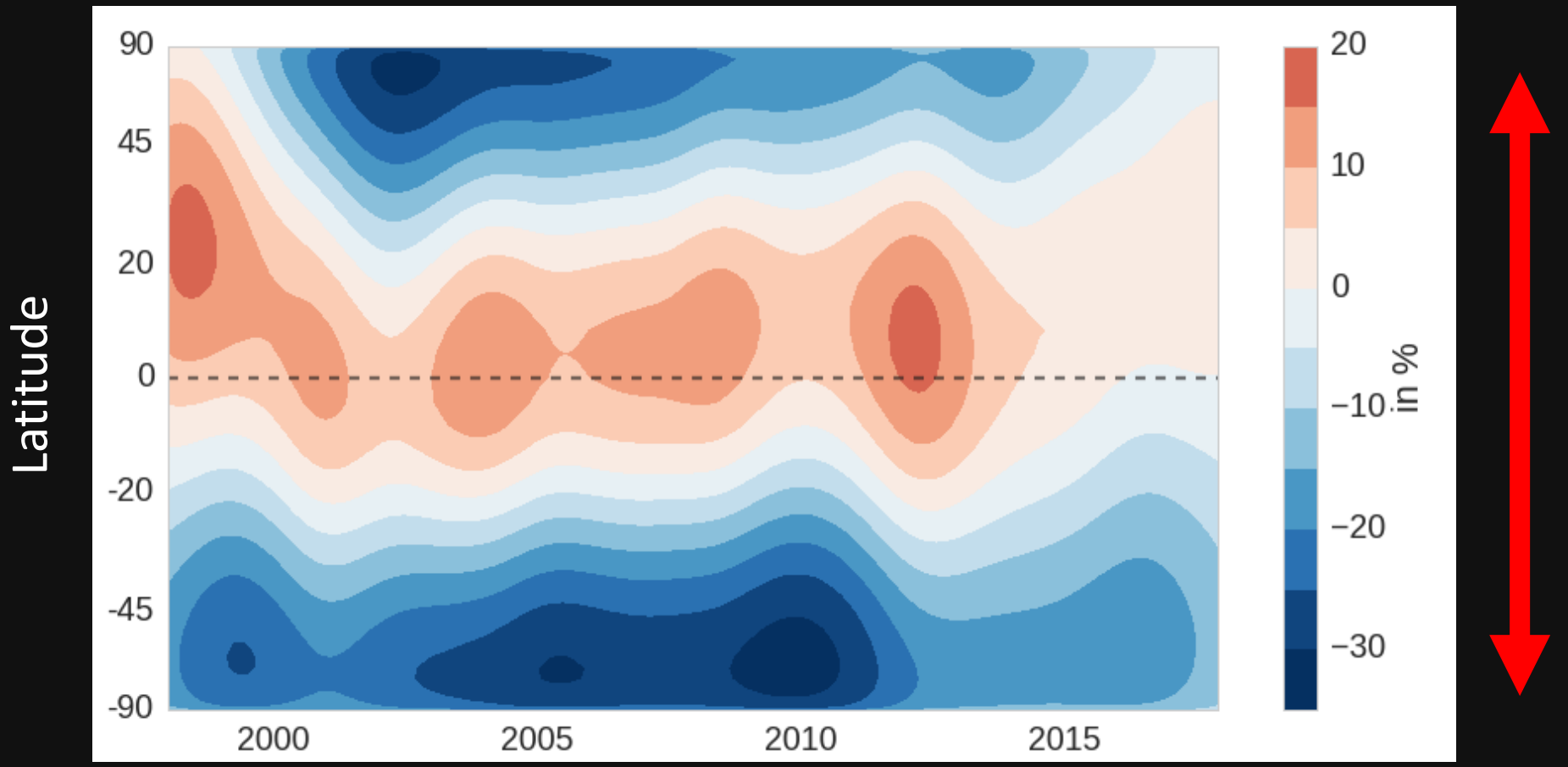
1. Optimize MCF emissions with large correlation lengths
2. Optimize OH 45 highly correlated zones

Variations in global total oxidation

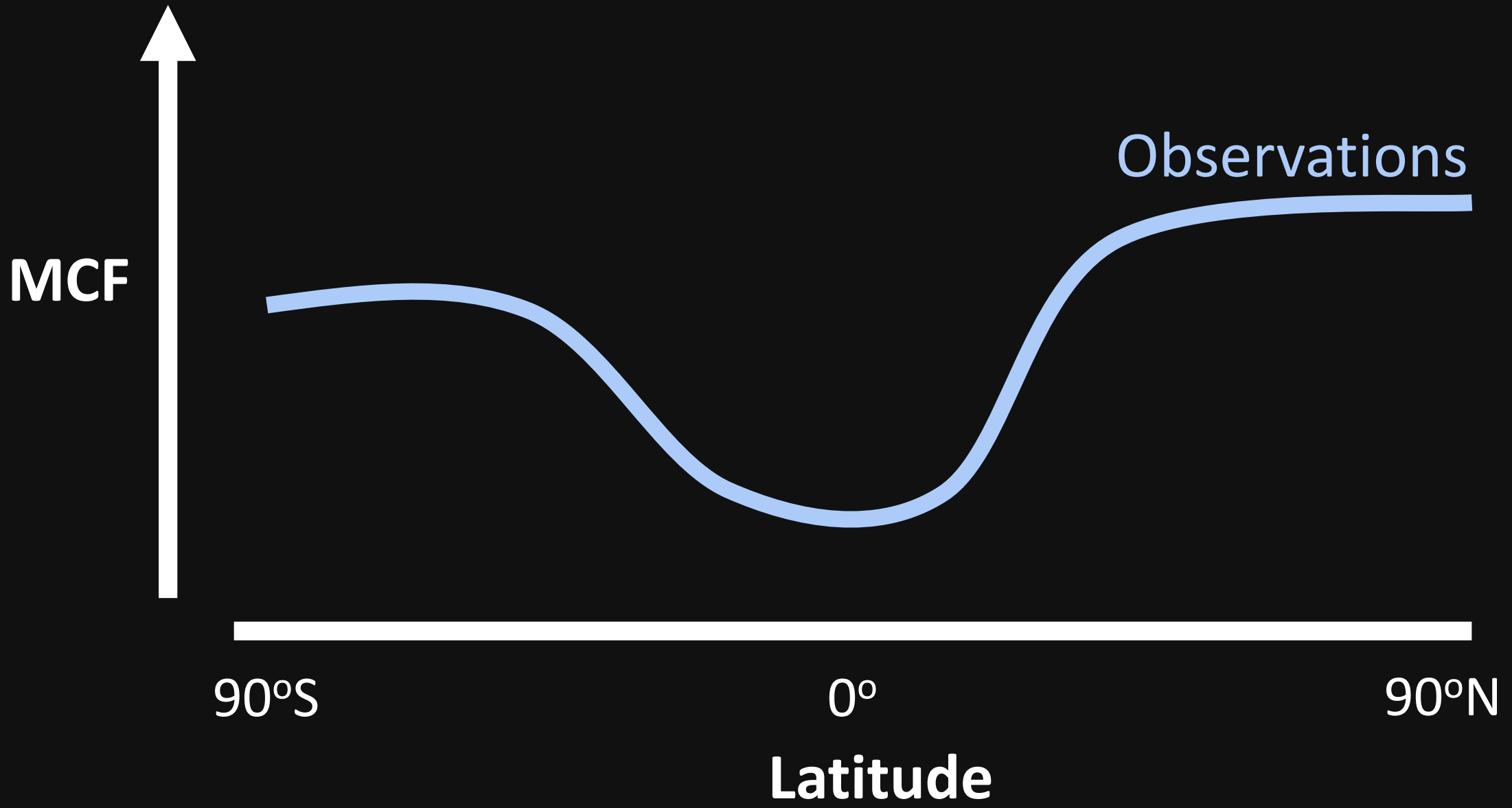


1. Interannual variations of a few %
2. No significant trend

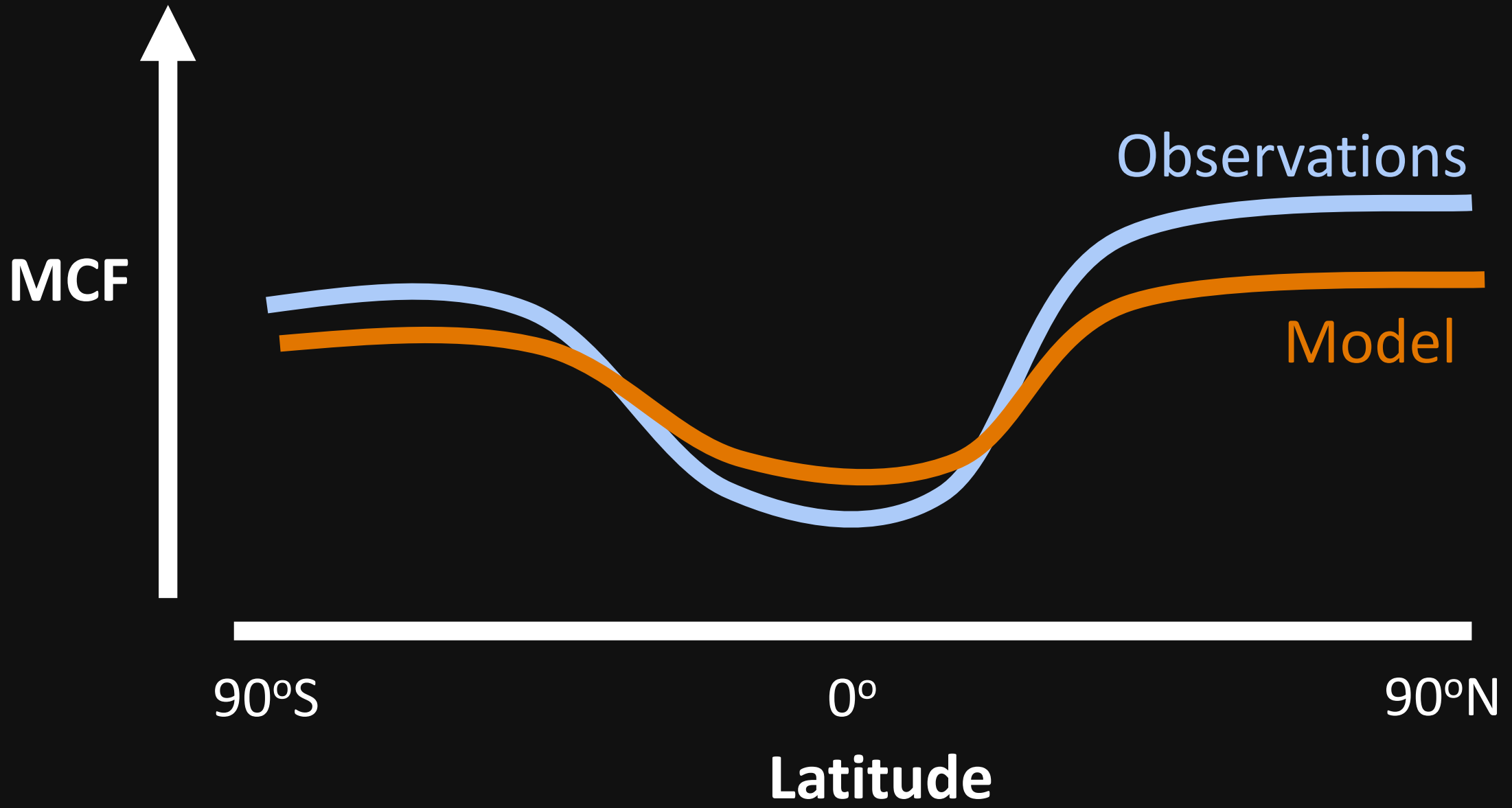
Hovmöller plot of latitudinal adjustments in OH



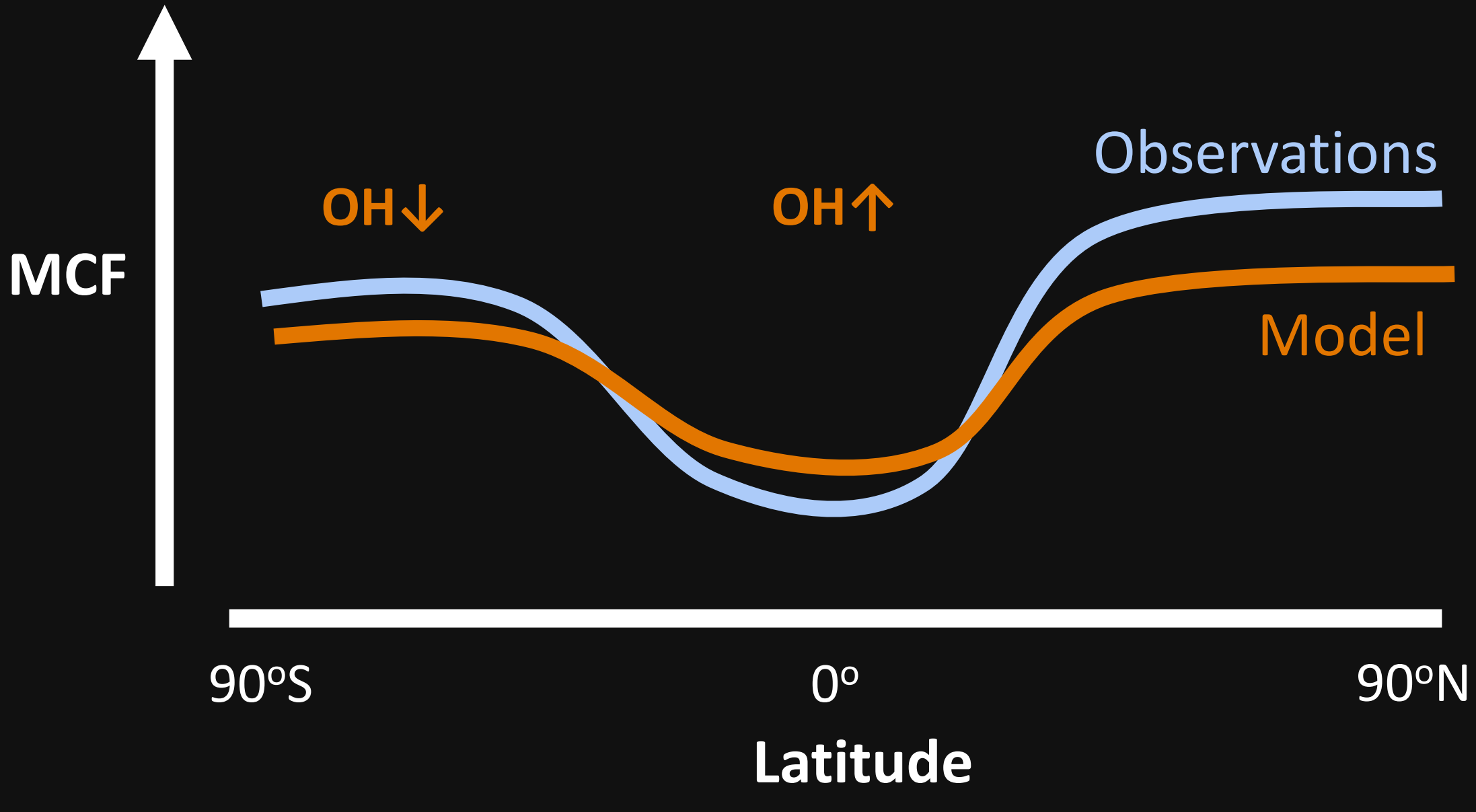
Tropical minimum of MCF



Tropical minimum of MCF



Tropical minimum of MCF

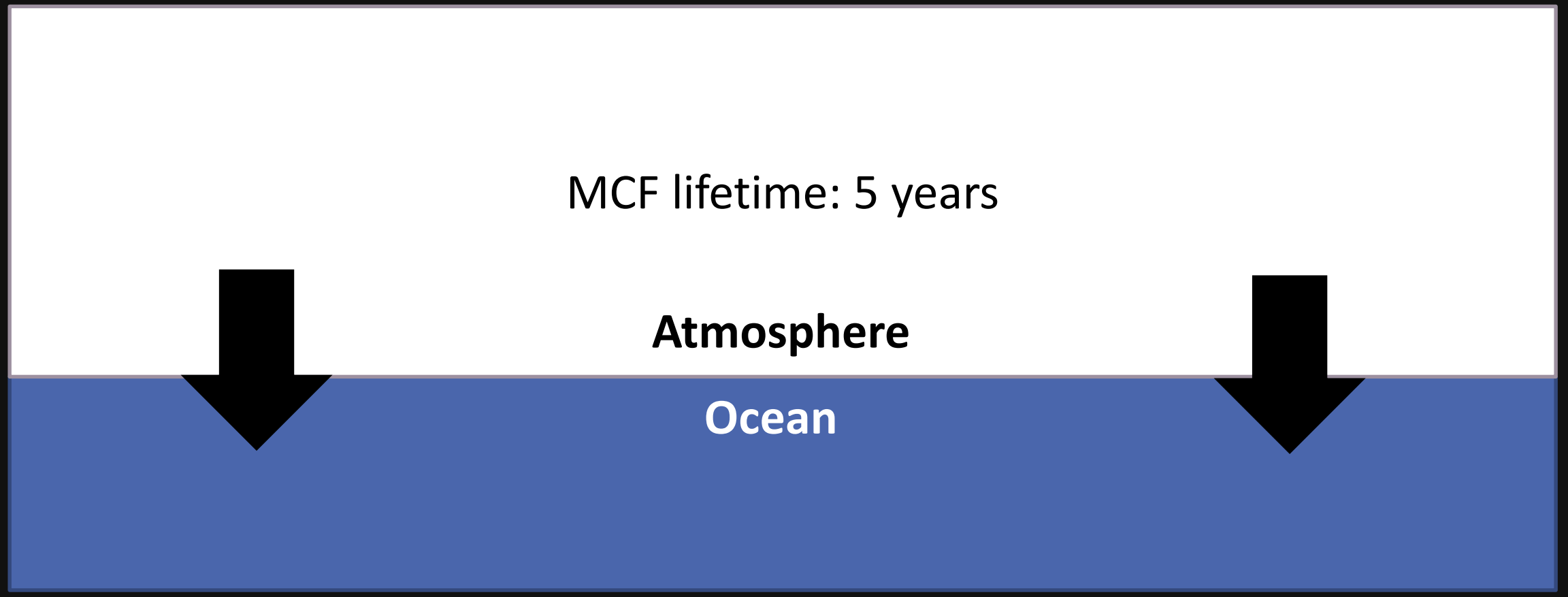


Alternative explanation:

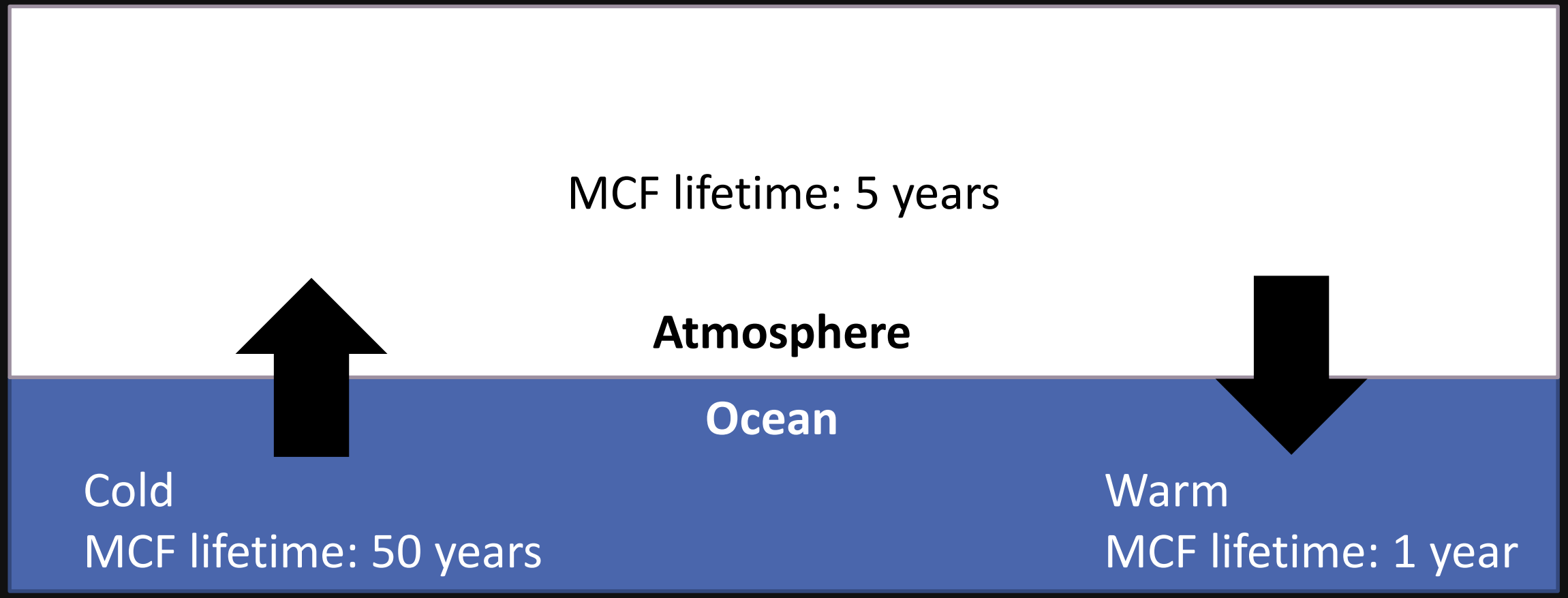
Changes in ocean-atmosphere exchange of MCF

First-order ocean sink

Key assumption: Hydrolysis is fast



Oceanic release of buffered MCF (Wennberg et al., 2004)



Result: Tropical minimum deepens!

Summary

1. We’ve derived a 1998-2018 timeseries of OH variations from MCF
2. Typically small (few %) interannual OH variations with no trend
3. Possible role for oceanic release of MCF to reduce intrahemispheric biases of MCF
4. MCF still valuable as tracer for OH, but especially a trend in OH would be difficult to derive