

Decoding **Hosing** and **Heating** Roles in a **Warming** Climate

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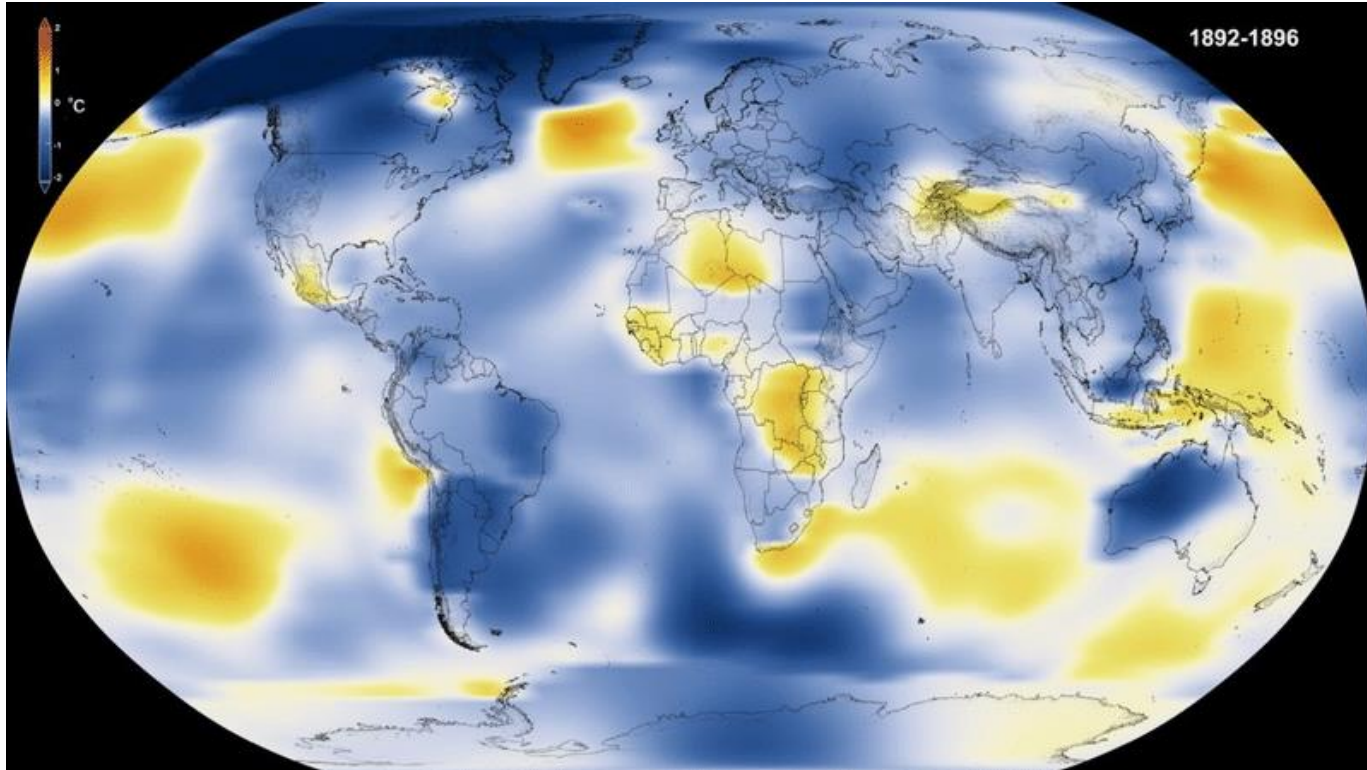
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A Warming Climate



NASA/GSFC/Scientific Visualization Studio

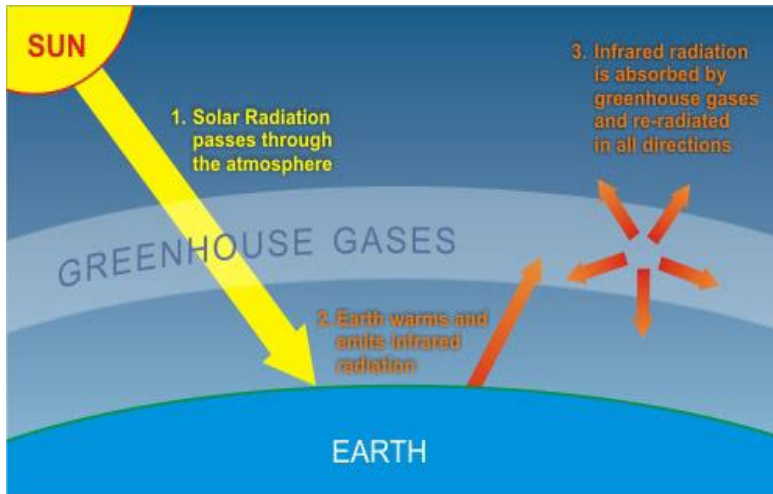
<https://www.giss.nasa.gov/research/news/20170118/2016gistempupdateblack.gif>

A Warming Climate

Resulting

Heating

Hosing



Decoding **Hosing** and **Heating** Roles in a **Warming Climate**

Water Role – A Fundamental

Lapse Rate



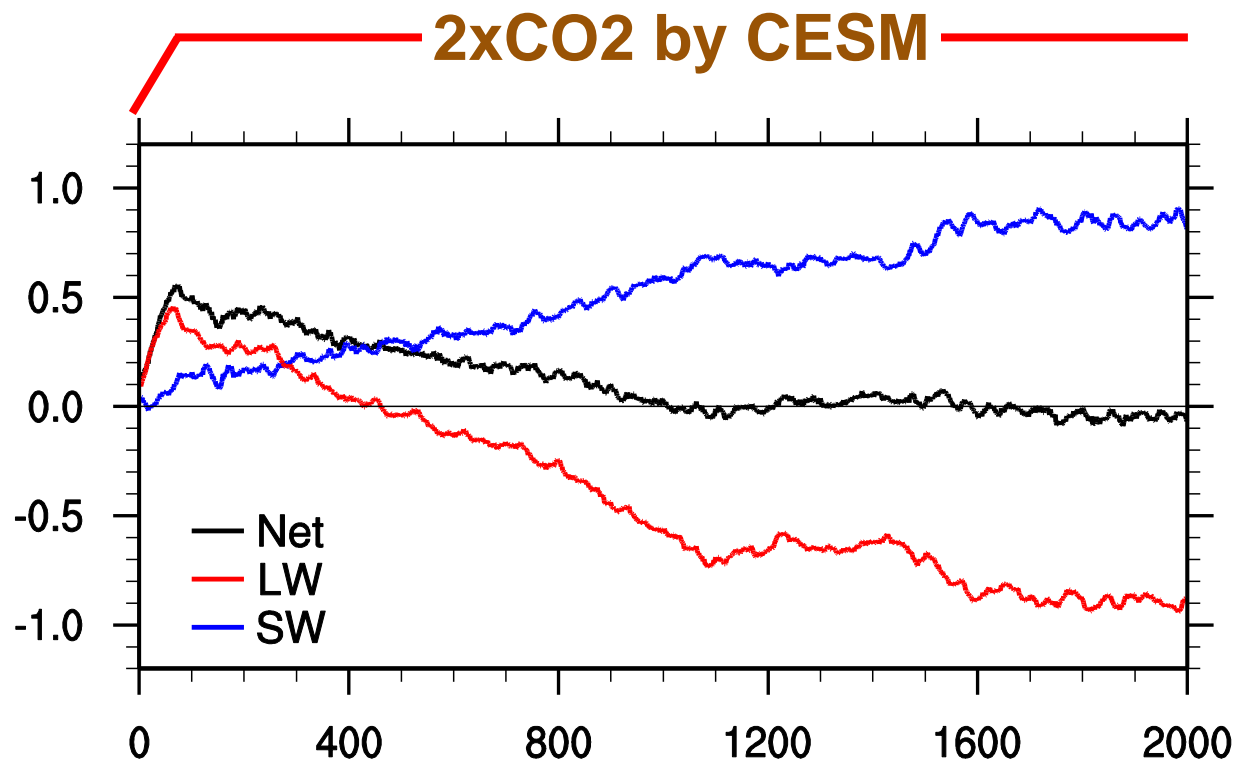
Dry Air: $\Gamma_d = g/c_p = 9.8 \text{ }^\circ\text{C/km}$

Wet Air: $\Gamma_w = \dots\dots = 6-7 \text{ }^\circ\text{C/km}$

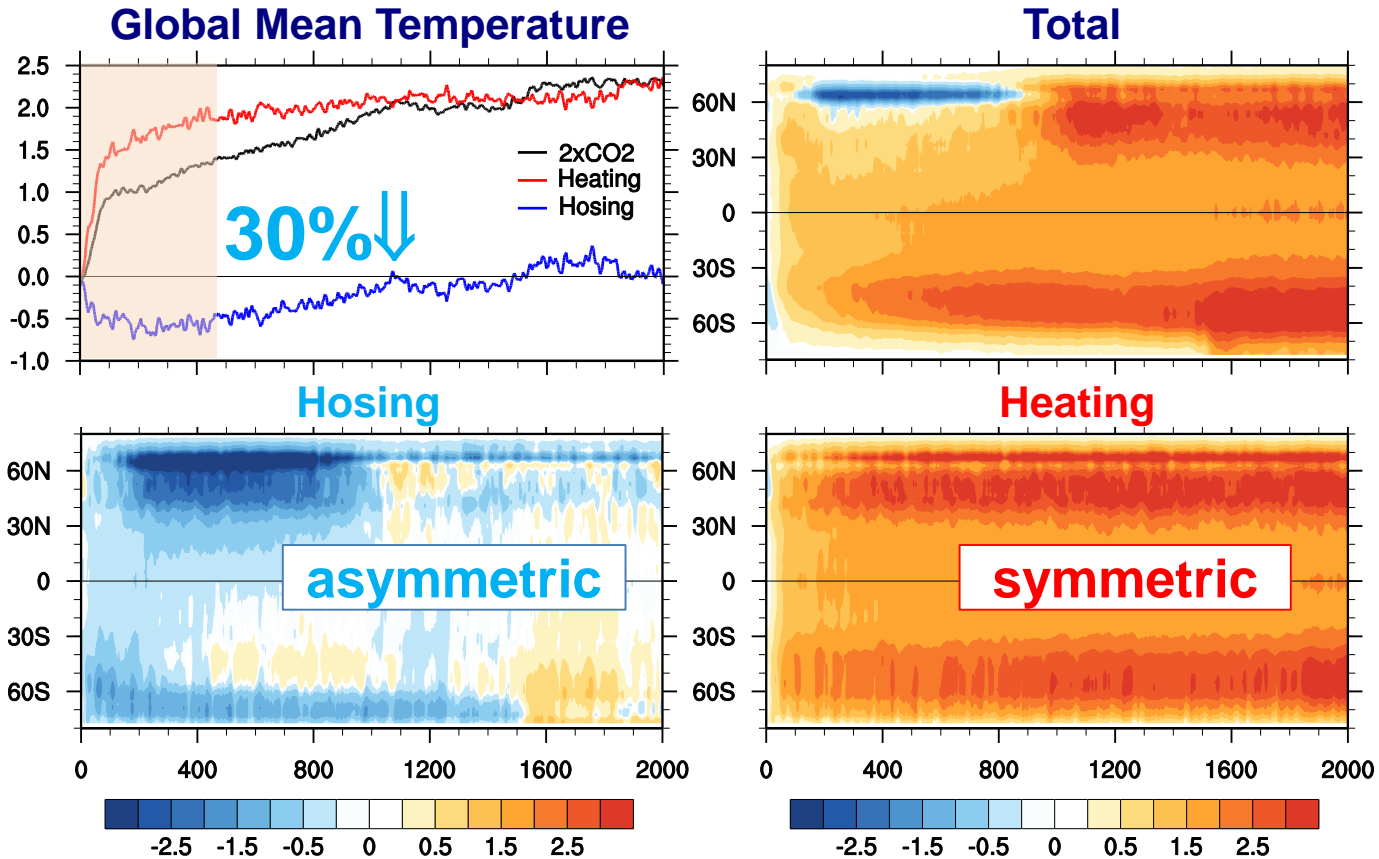


30%

TOA Flux Change in a Warming Climate



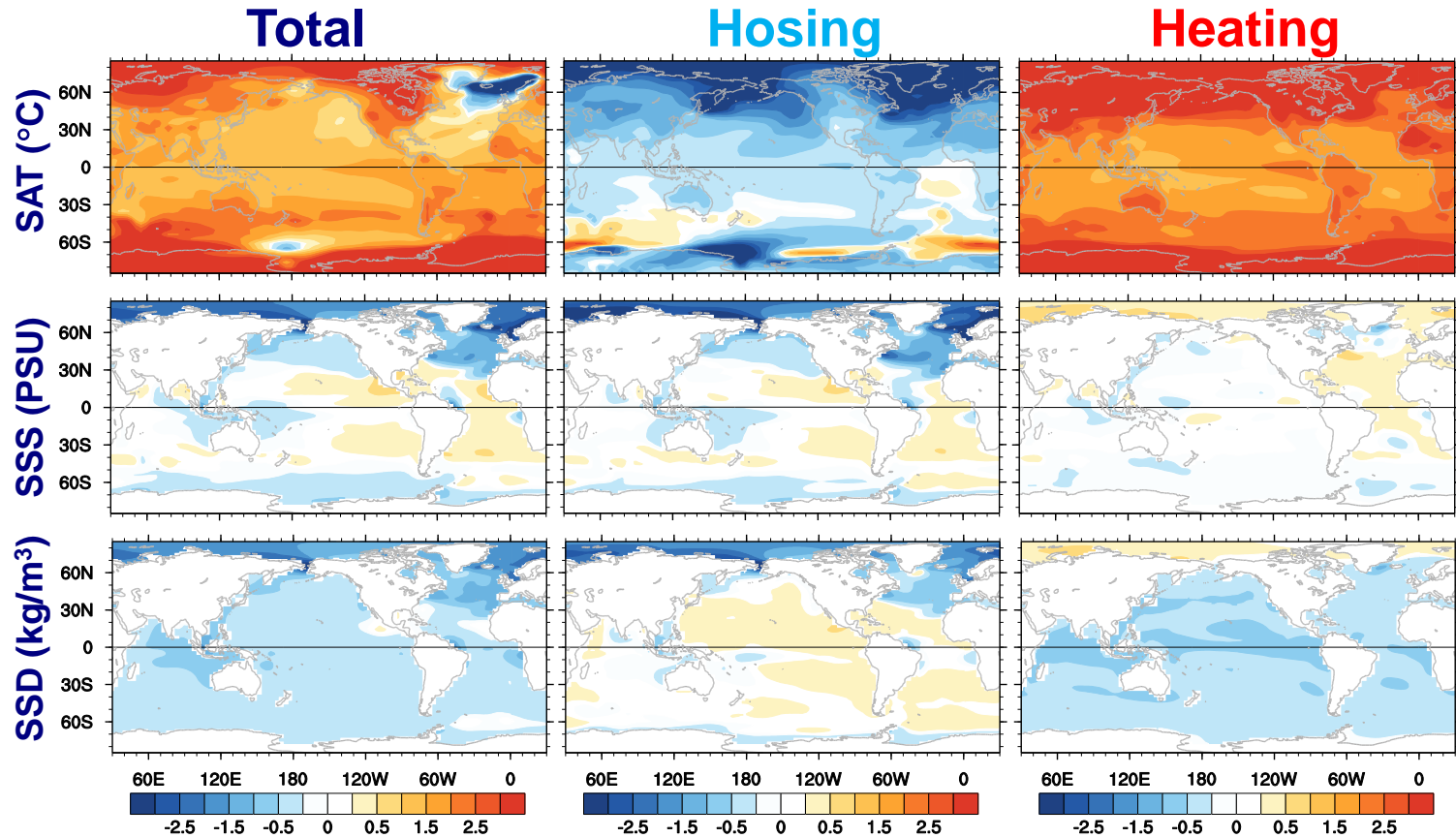
Global Temperature Evolution



Stage I

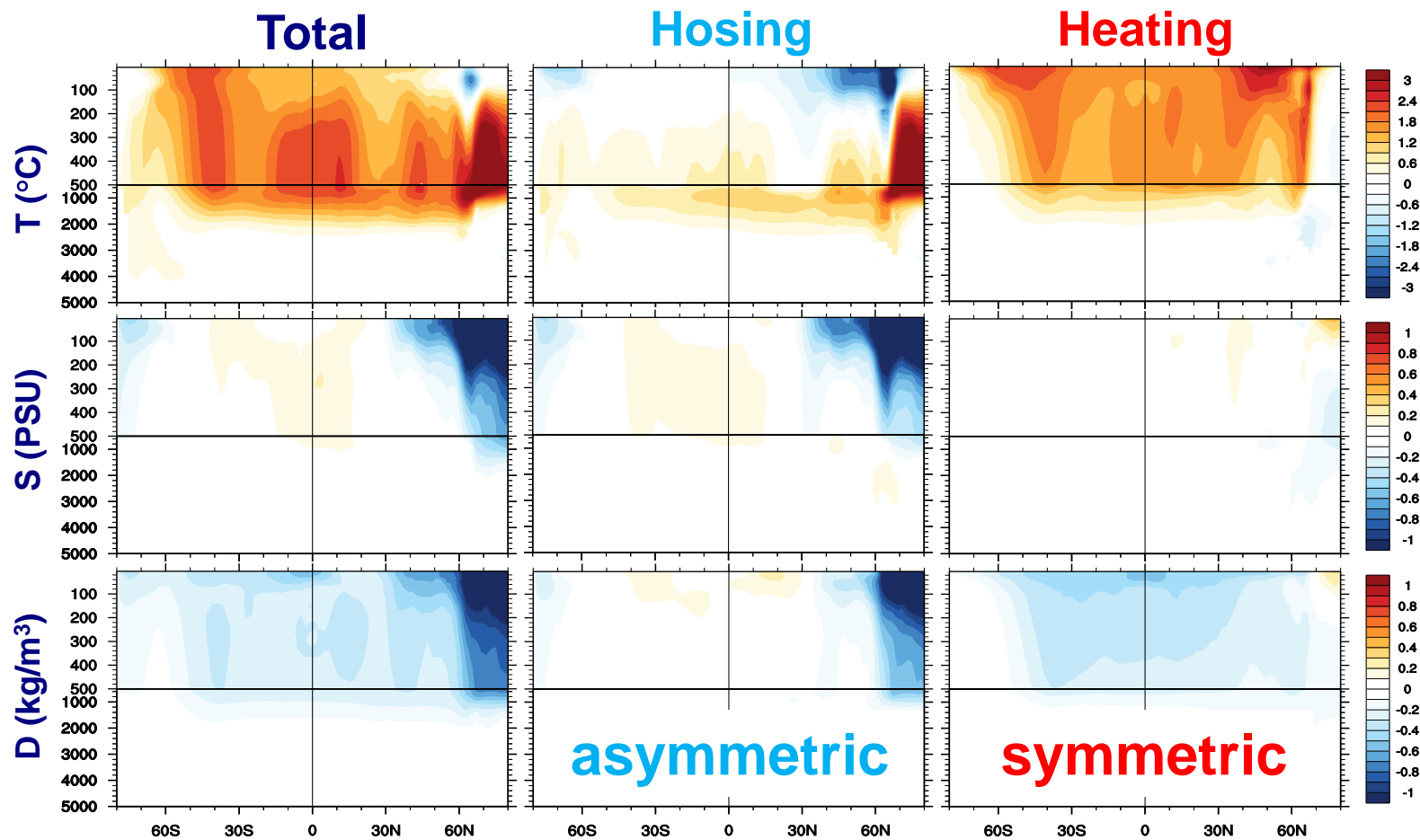
in Global Warming

Surface Changes

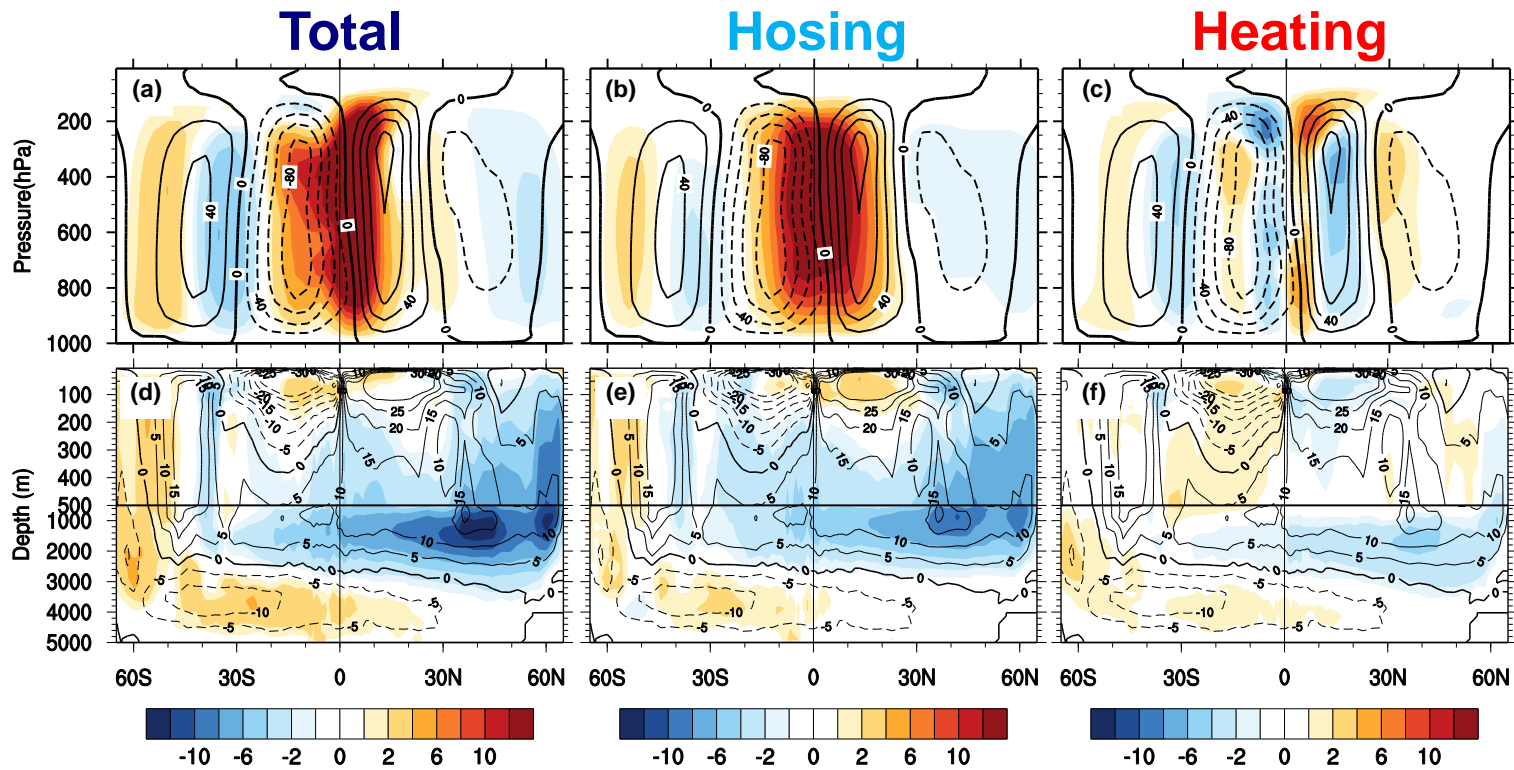


**Freshwater results in cooling and freshening,
asymmetric change**

Ocean Changes



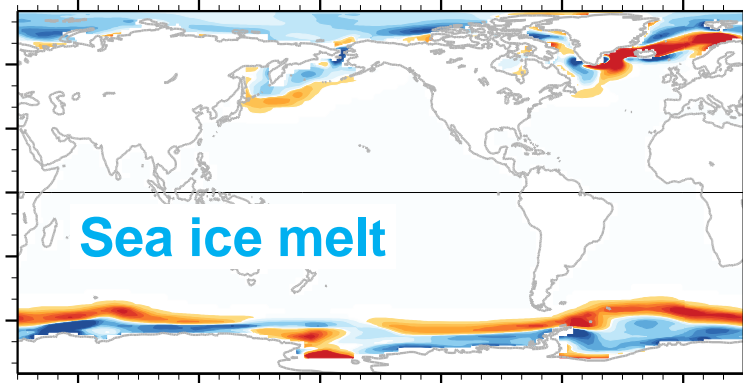
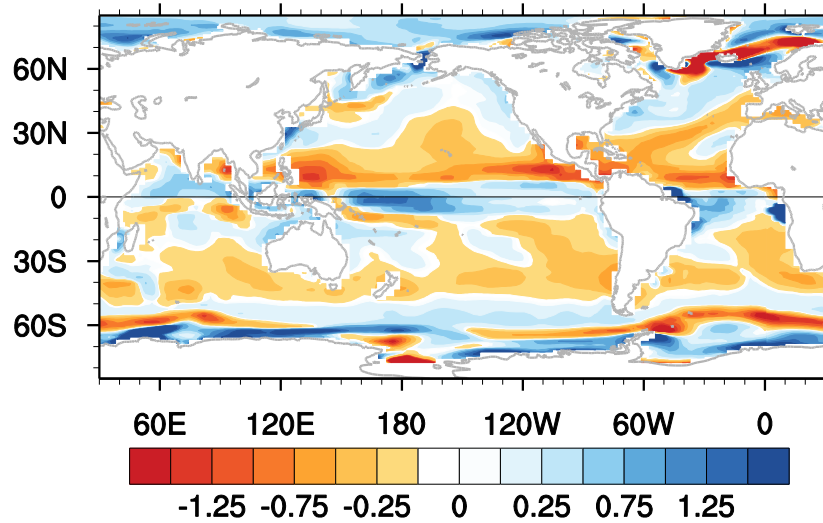
Atmosphere-Ocean MOCs



Hosing: HC and AMOC changes;
Heating: nearly unchanged

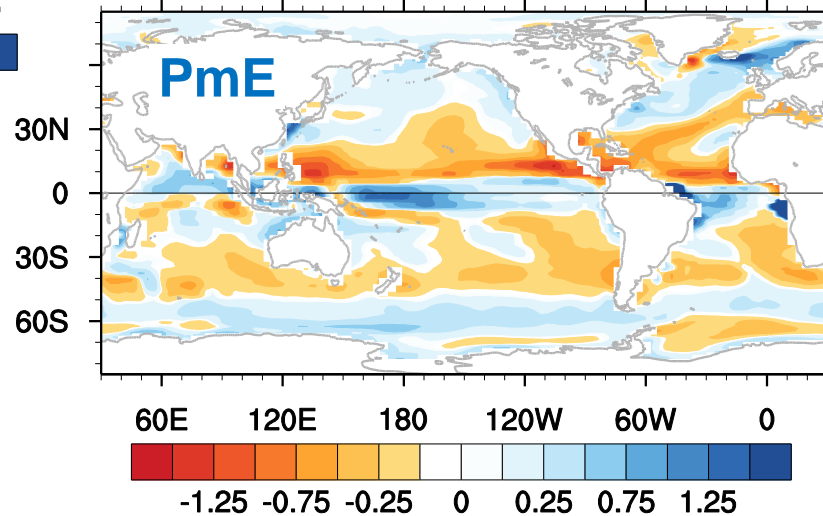
Fresh Water Change

Total



Sea ice melt

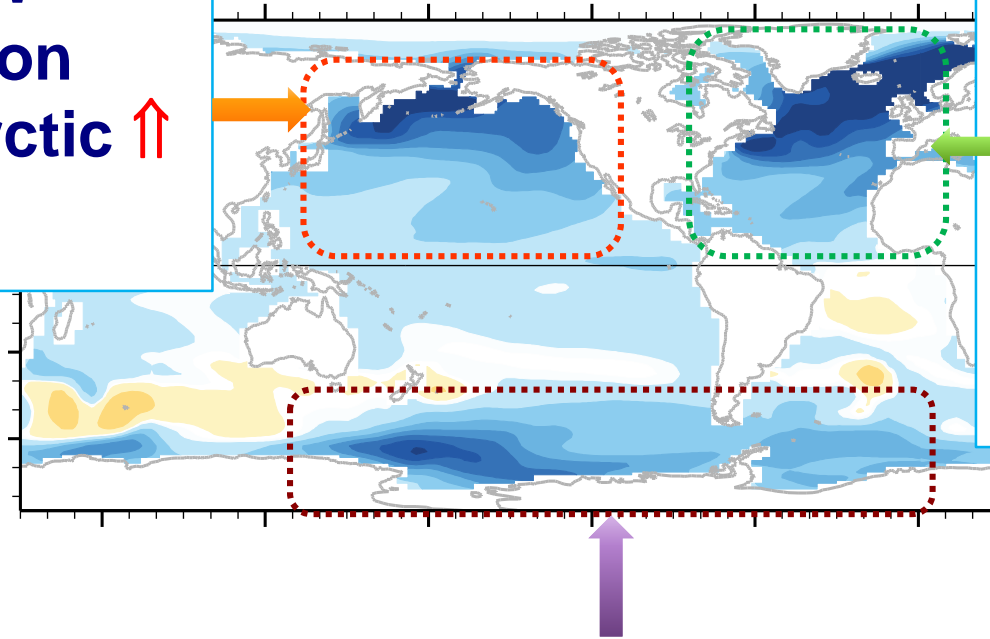
More Freshwater go to Ocean due to sea-ice melting and PmE



PmE

Mechanism of Hosing Cooling

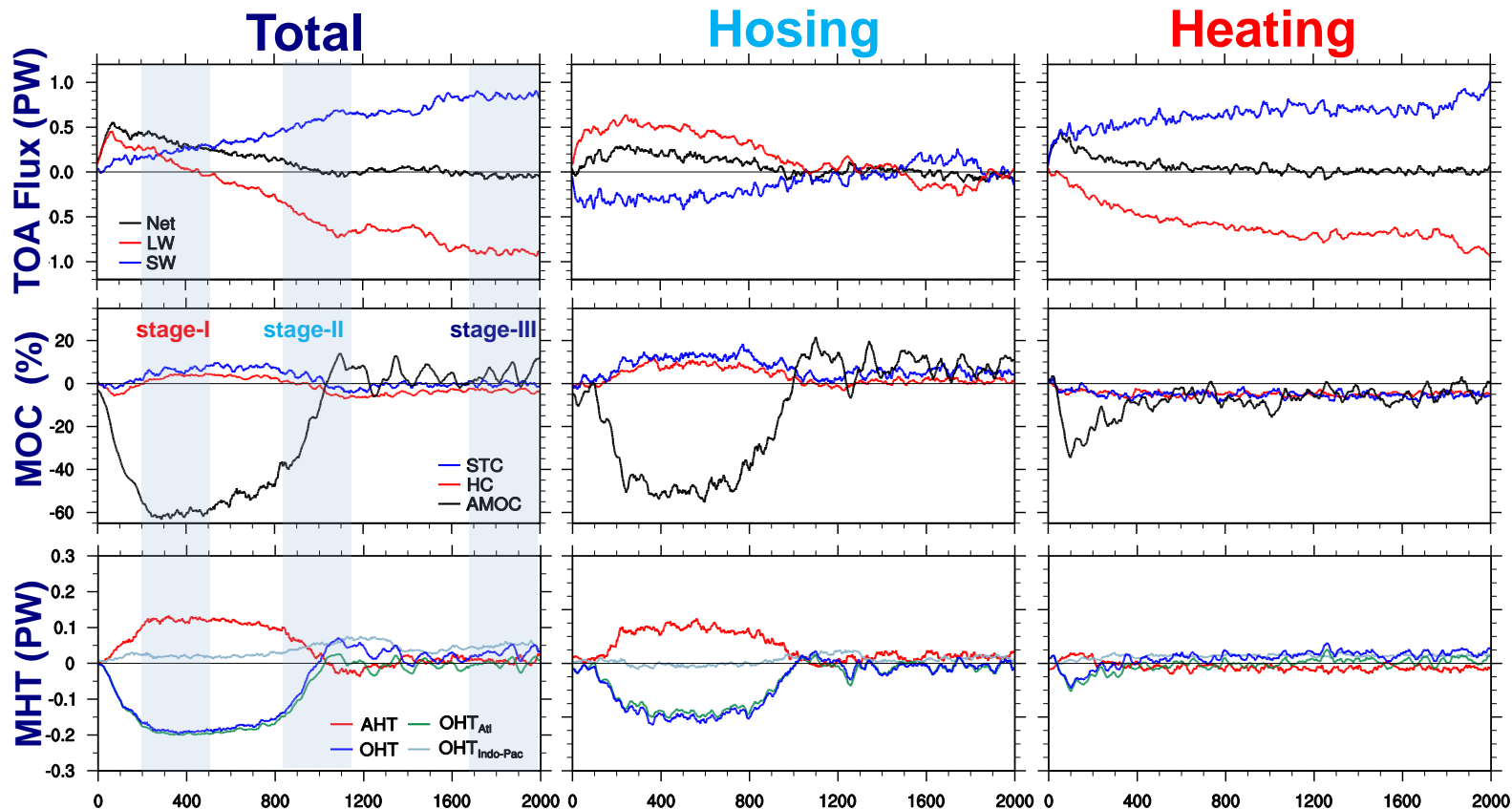
- Cold FW advection from Arctic ↑
- SAT ↓



- Freshwater ↑
→ SSS ↓
→ AMOC ↓
- Cold water advection from Arctic ↑

- Sea-ice melting ↑ → Northward Ekman flow ↑ → Ekman pumping ↑

Evolution of MOCs and MHTs



Summary and Discussion

- ◇ **Hosing: 30% cooling**
 - ◇ Asymmetric changes
 - ◇ Arctic sea ice melting
 - ◇ AMOC ↓ and HC ↑
 - ◇ Baroclinic change in ocean T
- ◇ **Heating: symmetric**
 - ◇ Barotropic change in ocean T
 - ◇ Into the deep ocean
- ◇ More studies on different stages



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Thanks