An Assessment of Global Ocean Thermal Energy Conversion (OTEC) Resources under Broad Geographical Constraints

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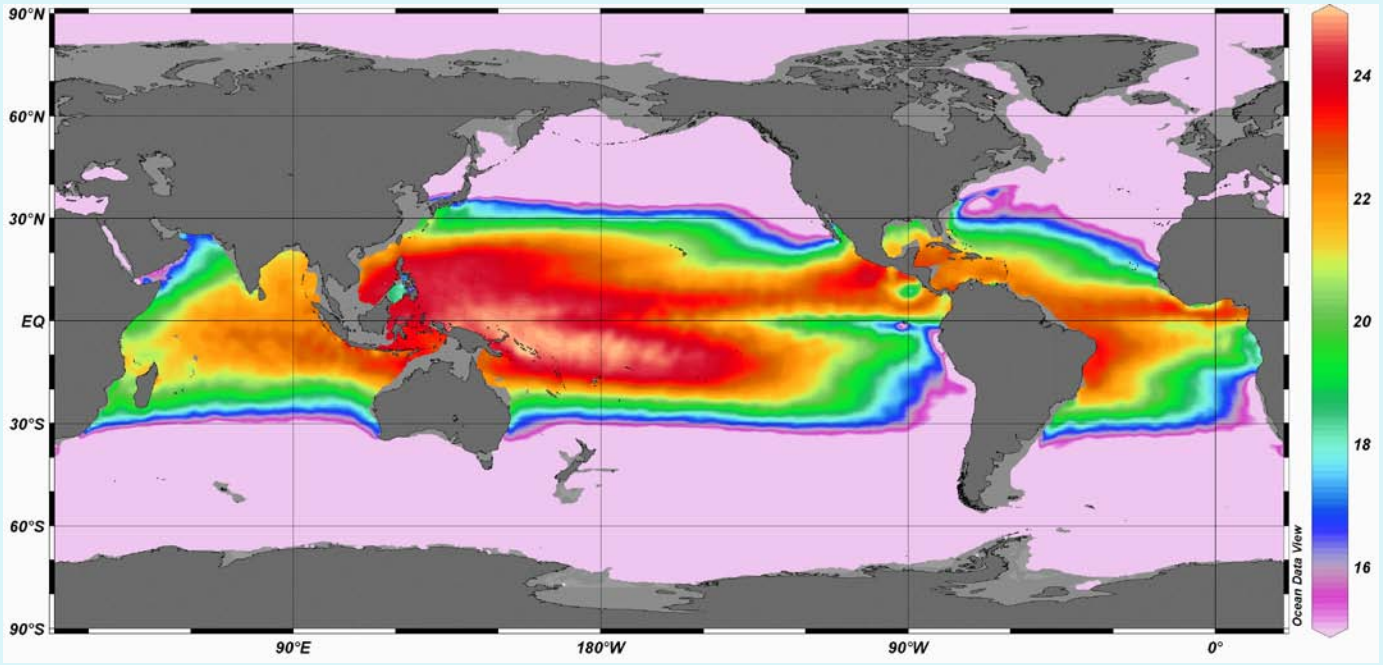
WORLDWIDE OTEC RESOURCE

Temperature difference between 20 m and 1000 m depths

(Nihous, G.C., **2**, 043104, *JRSE*, 2010; from NODC WOA05 database)



$\Delta T > 18$, OTEC RESOURCE

Is Degradation of Resource Possible?

1D studies* indicate Maximum OTEC Power

*G.C. Nihous, *J. Energy Resources Technology* **129,** 10-17, (2007)

NUMERICAL MODELING OF OTEC

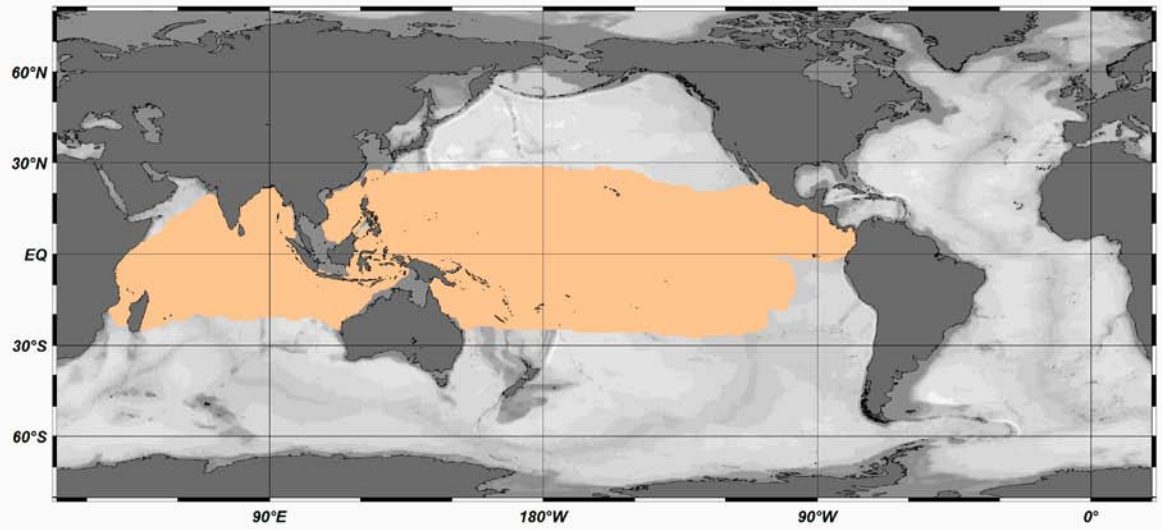
MITGCM

4 Degree* and 1 Degree ** Grids (Global)

Maximum OTEC Power, Environmental effects : cooling/warming surface layers, warming of deep layers, Increase in THC strength

1) Global 2) E
4) Only Atlantic
Pacific Ocean

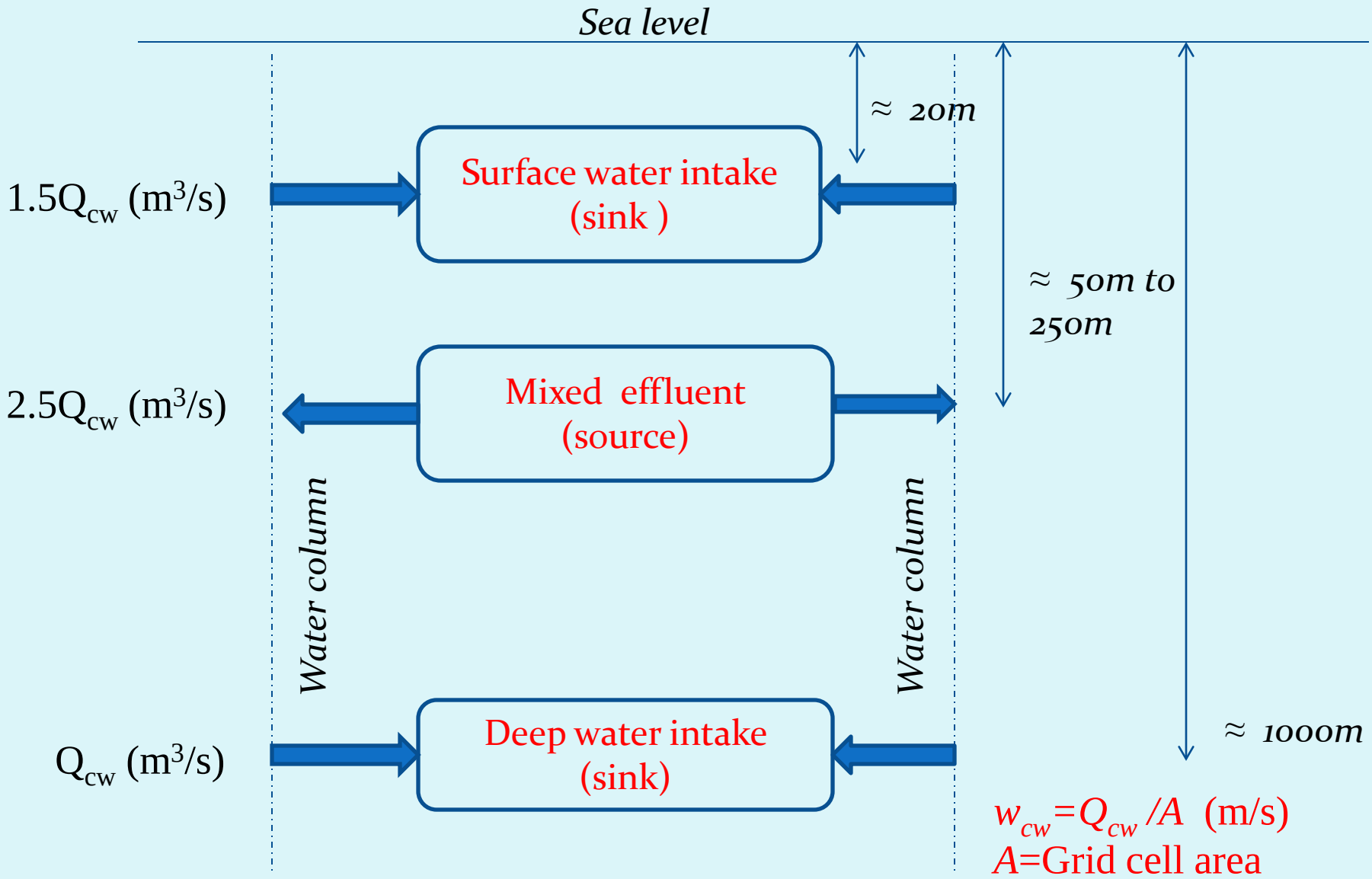
Indo-Pacific



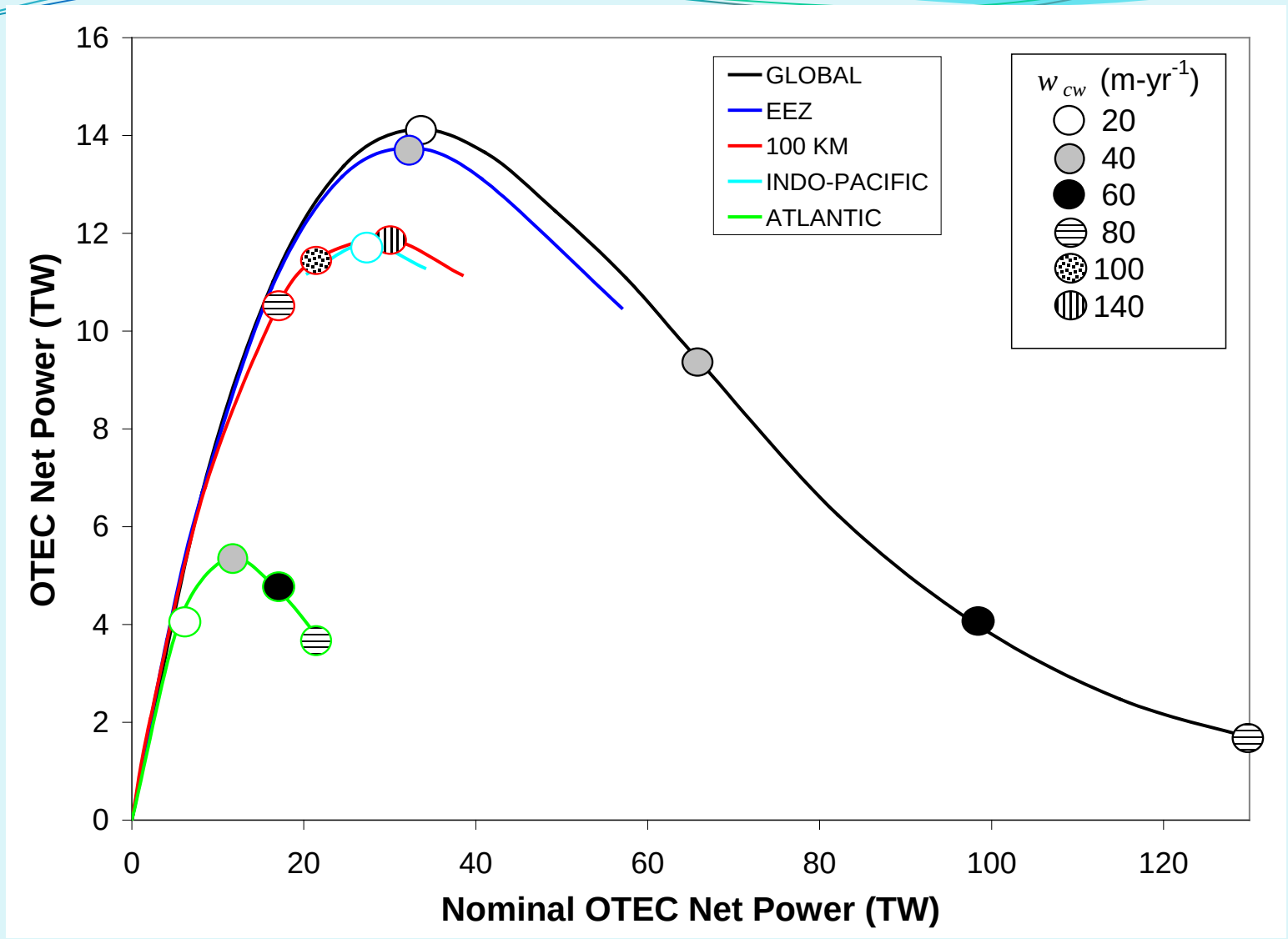
* Rajagopalan and Nihous, *Renewable Energy*, **50**, 532-540 (2013)

** Rajagopalan and Nihous, *J. Energy Resour. Technol.,* **135** (2013)

OTEC MODELING PROTOCOL



YEARLY AVERAGED OTEC POWER



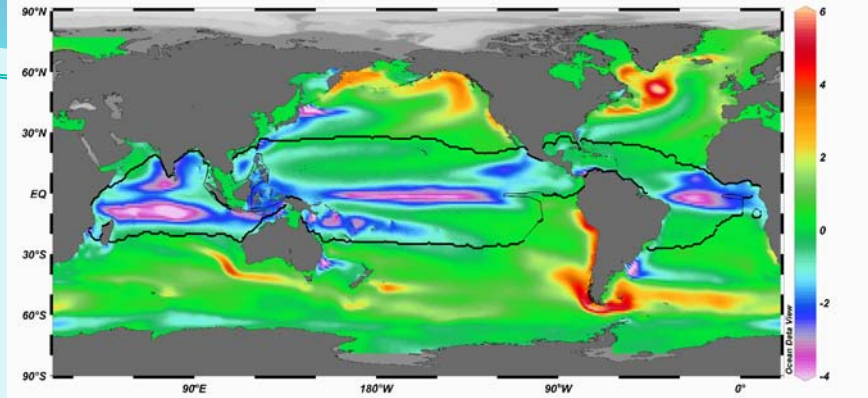
Nominal OTEC Power: $f\,(Q_{cw}, \Delta T_0)$; ΔT_0 is initial value

Actual OTEC Power: $f\,(Q_{cw}, \Delta T)$; ΔT is asymptotic value

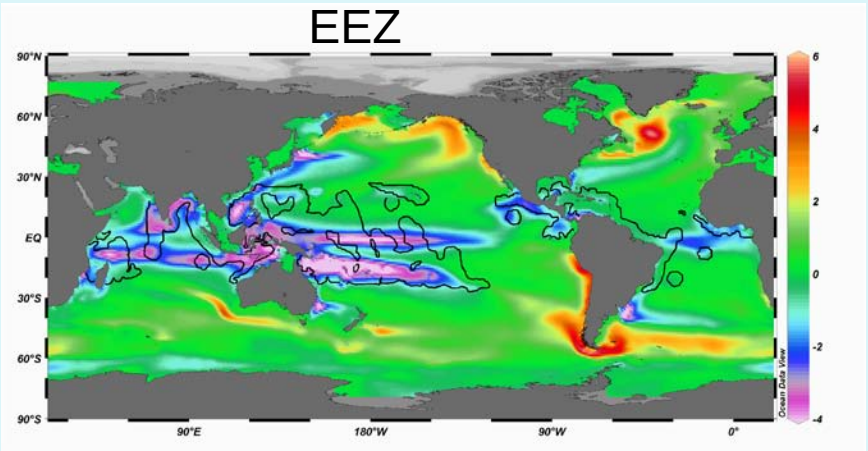
ENVIRONMENTAL EFFECTS

Temperature Change in Surface Layers (50m) at Maximum Power

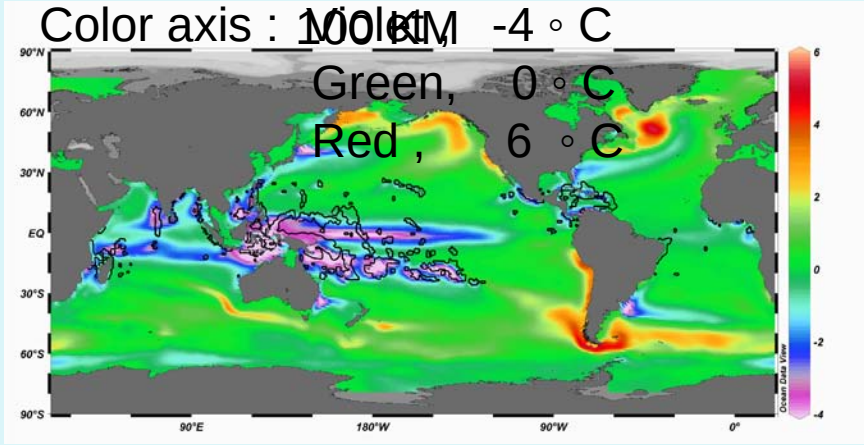
GLOBAL



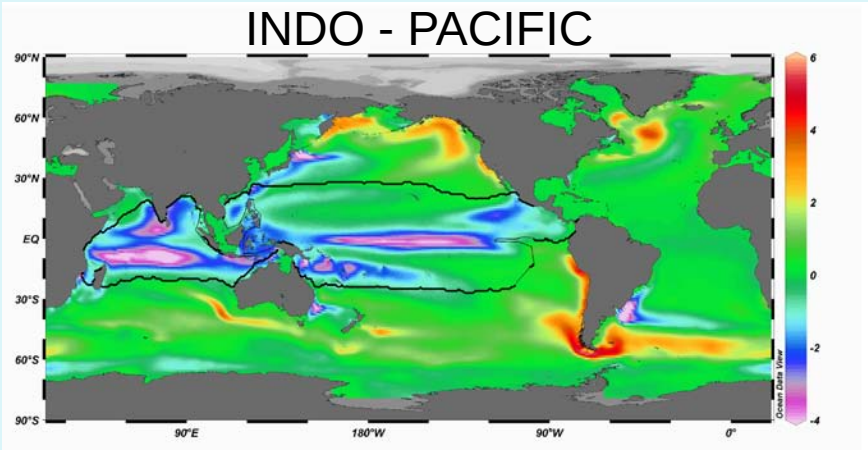
EEZ



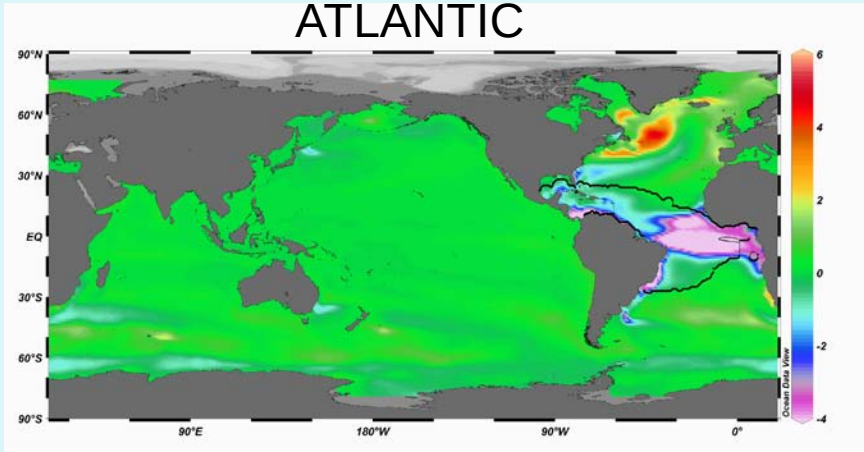
Color axis : Violet, -4 ◦ C
Green, 0 ◦ C
Red , 6 ◦ C



INDO - PACIFIC

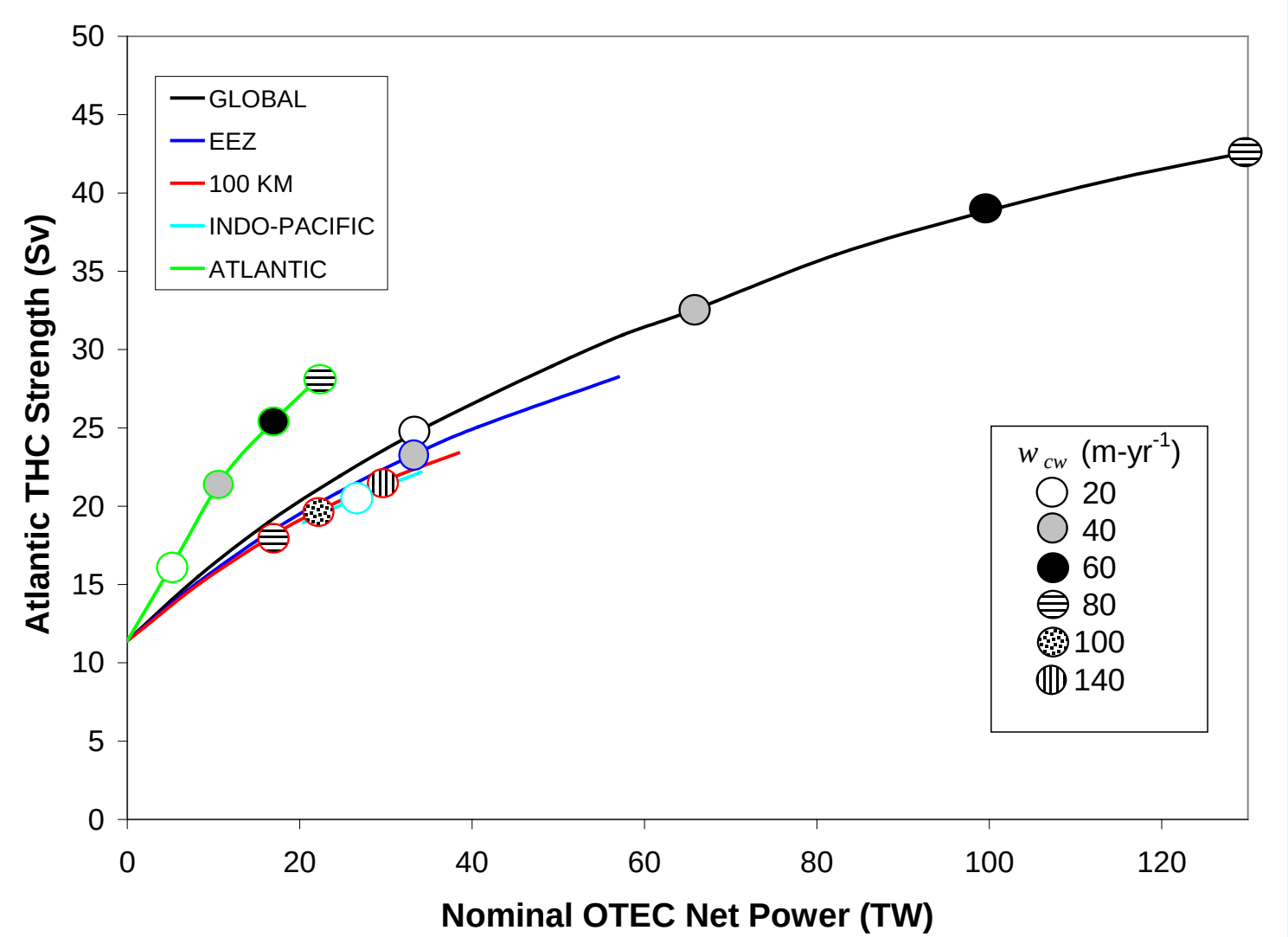


ATLANTIC



ENVIRONMENTAL EFFECTS

Strength of THC



Upper Northward Flow @ 26ºN in Atlantic Ocean

CONCLUSIONS

- Large-scale OTEC operations were assessed under broad geographical restrictions with MITgcm. A maximum power of 14TW was predicted for the Global case
- Cold seawater flow intensity at maximum power ≈ 5 Sv/TW (5 $m^3/s/MW$)
- OTEC net power (area) density at maximum power *generally* scales as inverse of area of implementation.
- Environmental effects: temperature changes in surface layers and in the ocean interior, boost of the THC.

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Thank you, Questions?