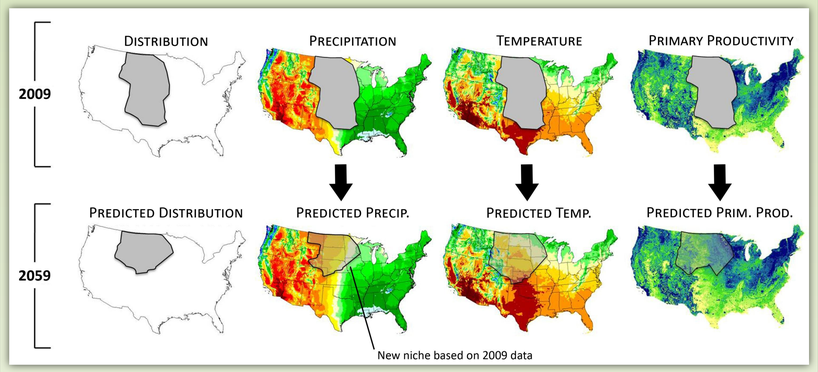
metabolism, temperature and the life histories of the future

santiago salinas[1], jorge velasquez-tibata[2], stephan b. munch[1]

[1] school of marine and atmospheric sciences, [2] dept. of ecology and evolution, stony brook university

current species distribution modeling under climate change



→ ignores phenotypic plasticity (the ability of an organism, whether it wants to or not, to change its phenotype in response to changes in the environment).

→ also, it is seldom noted that only a small fraction of species' distributions will change over contemporary timescales (parmesan et al. 1999) – most spp. will remain where they are.

→ management efforts take place within relatively small portions of a species range, so including plasticity in climate change modeling is of vital importance.

life histories in 50 yrs (plastic changes)

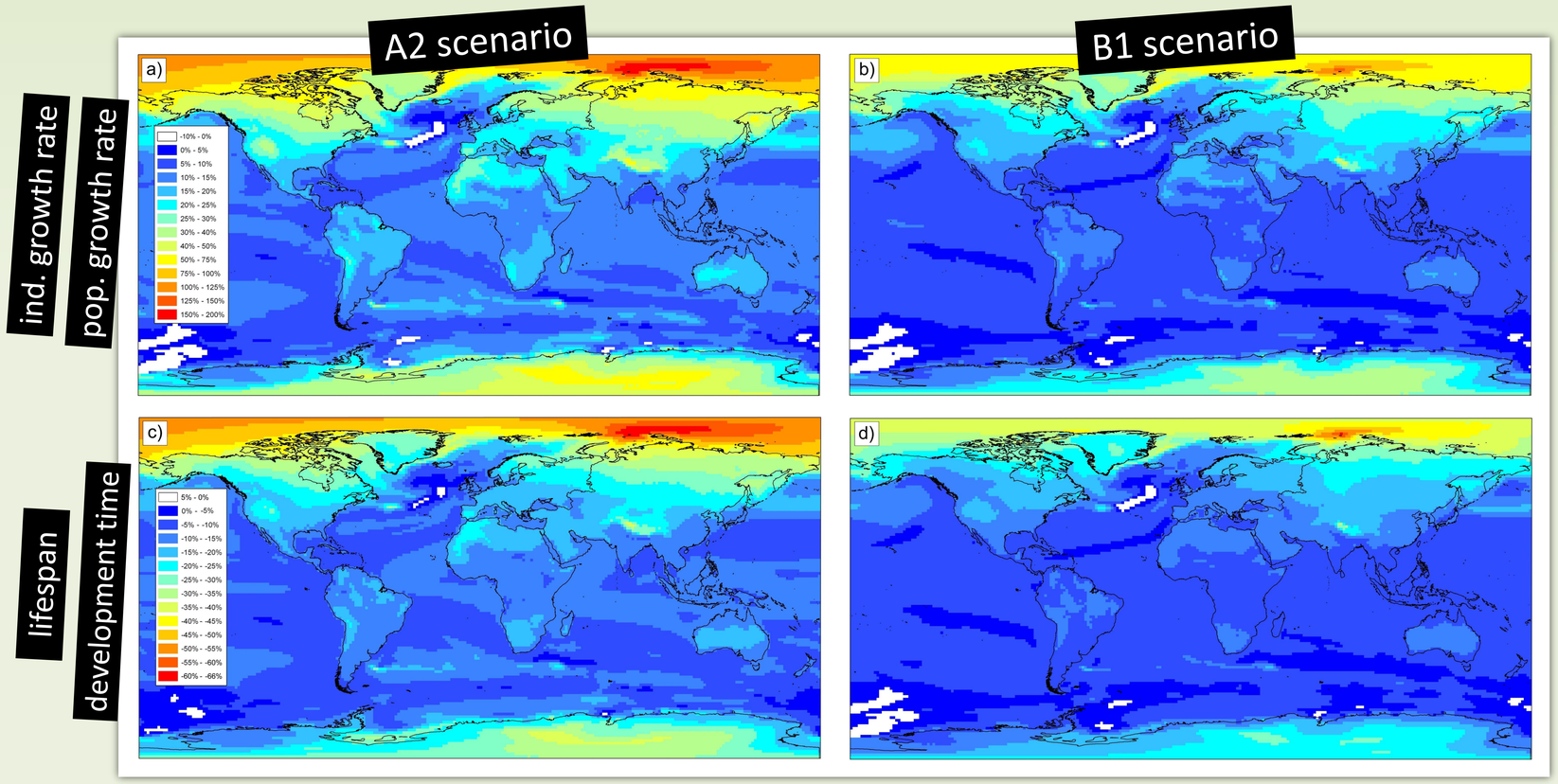
→ we estimate local, plastic changes in population dynamics and life history traits of ectotherms driven by climate change over the next 50 years. we use the metabolic theory of ecology (MTE; brown et al. 2004) to achieve this.

→ under the MTE, the effect of temperature on biological rates is described by boltzmann's factor: $e^{-\frac{E}{kT}}$
[E: activation energy (0.63; brown et al. 2004), k: boltzmann's constant (8.62×10^{-5} eV/K), T is temperature in kelvin.]
analogously, biological times scale as the inverse of boltzmann's factor.

→ we calculated % changes in ind. and pop. growth rates, development time, and lifespan using 50-year temperature predictions of the IPCC.

→ *biological rates*: individual growth rate, population growth rate. *biological times*: development time, lifespan. all these traits can be accurately described within species with the MTE (munch and salinas 2009, unpublished analyses).

→ we used two sets of temperatures, arising from different assumptions of future emissions scenarios: a more conservative set (scenario B1) and a more extreme one (scenario A2).



conclusions

→ in most parts of the world, climate change will speed the pace of life among ectotherms.

→ management and recovery plans need to account for climate-driven life history changes.

references

brown et al. 2004. *ecology* 85:1771-1789.
munch and salinas. 2009. *pnas* 106:13860-13864.
parmesan et al. 1999. *nature* 399:579-583.