

The IPRC Regional Ocean-Atmosphere Model (IROAM): Eastern tropical Pacific coupled climate, biases, and sensitivities

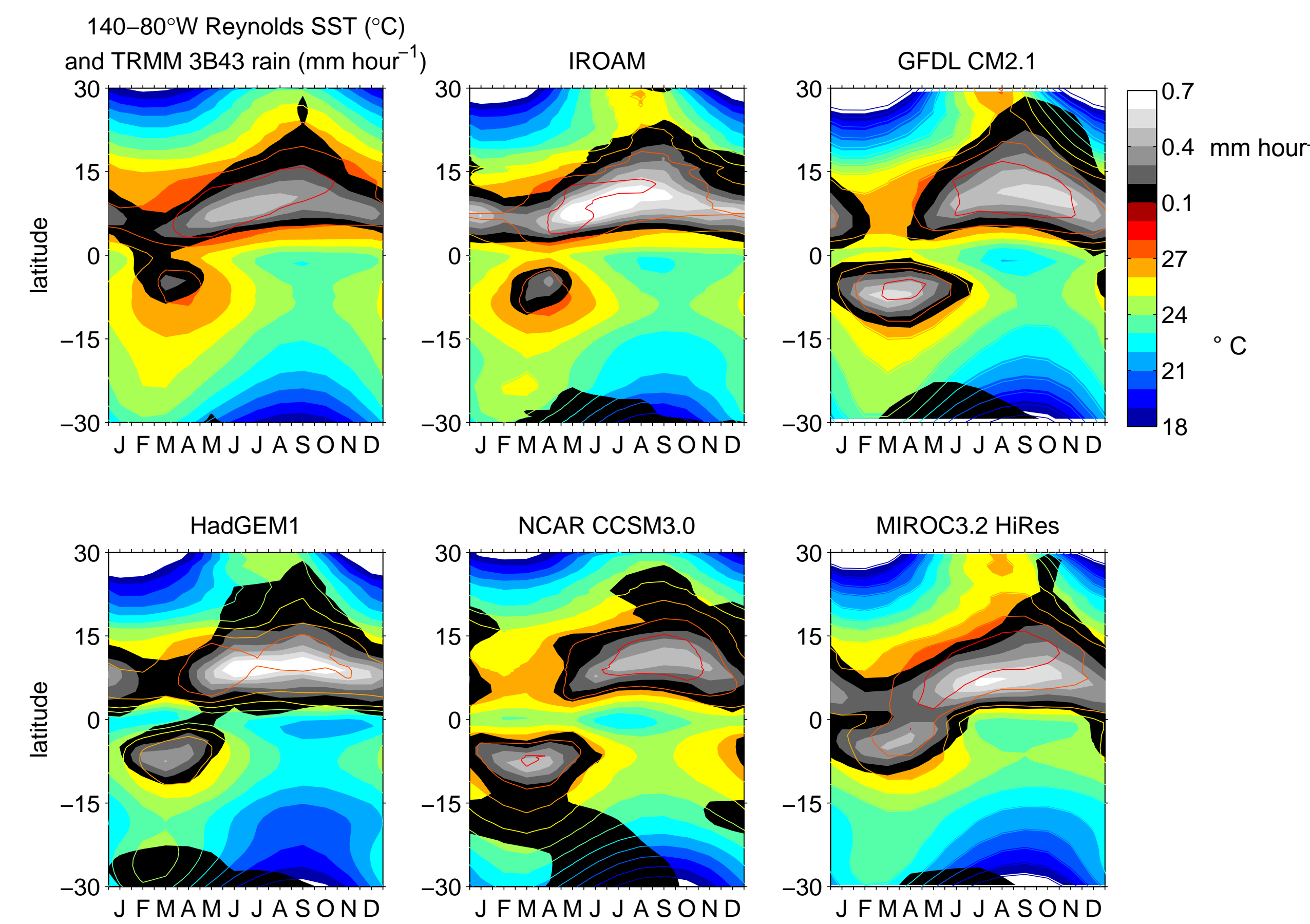
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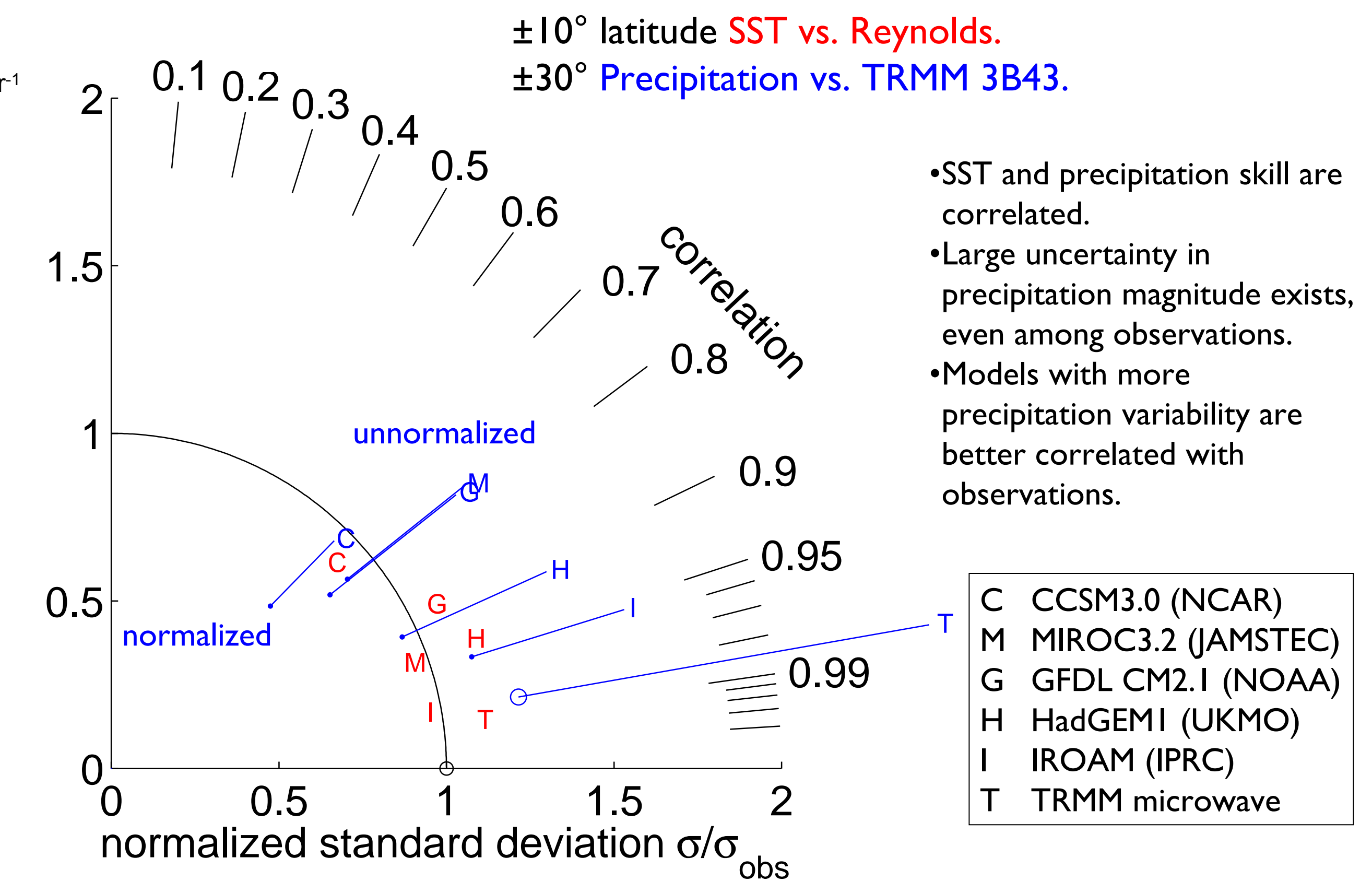
Summary

- A coupled regional ocean-atmosphere model (IROAM) simulates the spatial and seasonal variation of SST, clouds, circulation, and precipitation of the eastern Pacific.
- Simulations are compared with global models.
- Experiments test the effect of parameterizations on the coupled system.
- The shallow cumulus convection parameterization affects low clouds, SST, precipitation, and the seasonal cycle of the Hadley cell.

Eastern Pacific seasonal cycle of IROAM and CGCMs



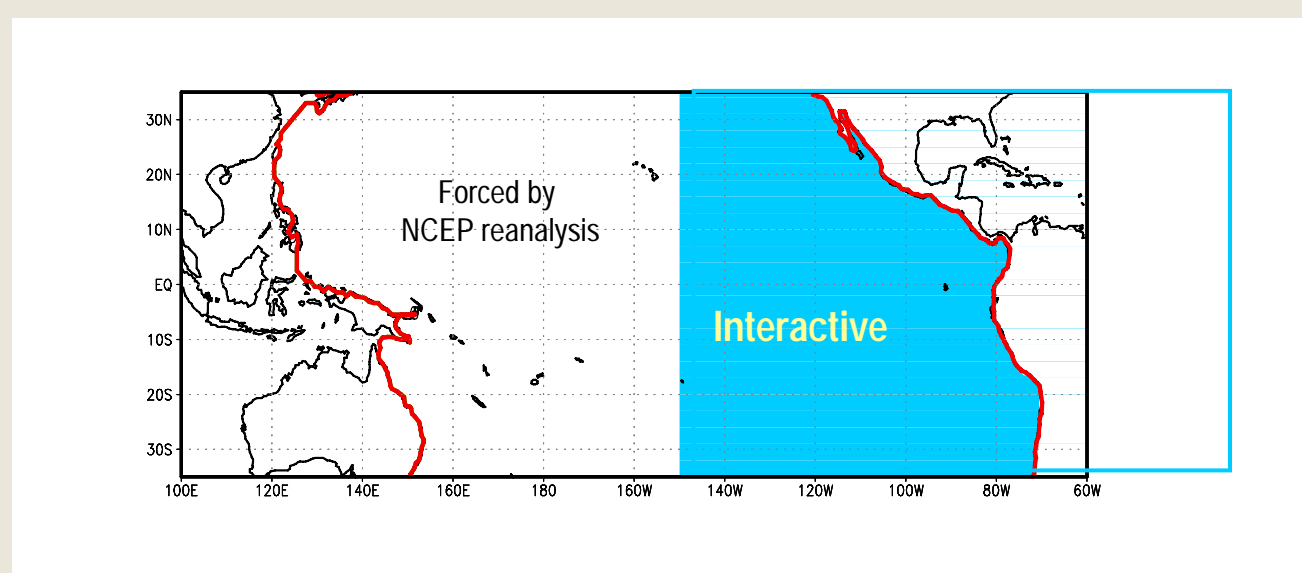
Monthly-latitude pattern correlation of SST and precipitation to observations



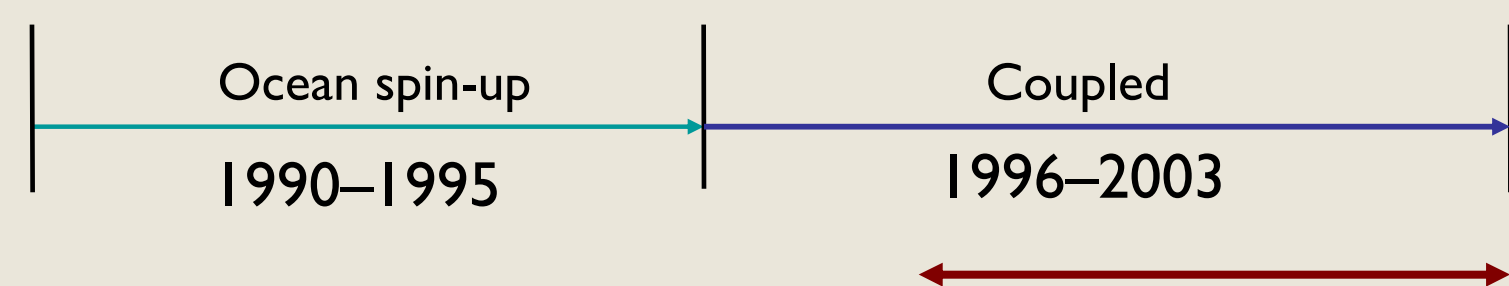
IROAM

Atmosphere: IPRC-RAM
0.5°×0.5°, L 28

GFDL Modular Ocean Model 2
0.5°×0.5°, L 30



- Reynolds SST is supplied to the RAM over the Atlantic Ocean.
- NCEP reanalysis provides the surface flux boundary condition for the MOM2 over the western Pacific, and the lateral conditions for the RAM.
- The IROAM is run on the Earth Simulator supercomputer in Yokohama, Japan, supported by JAMSTEC.



The ocean is spun up for 6 years before coupling to the atmosphere. Averages are over 1998-2003.

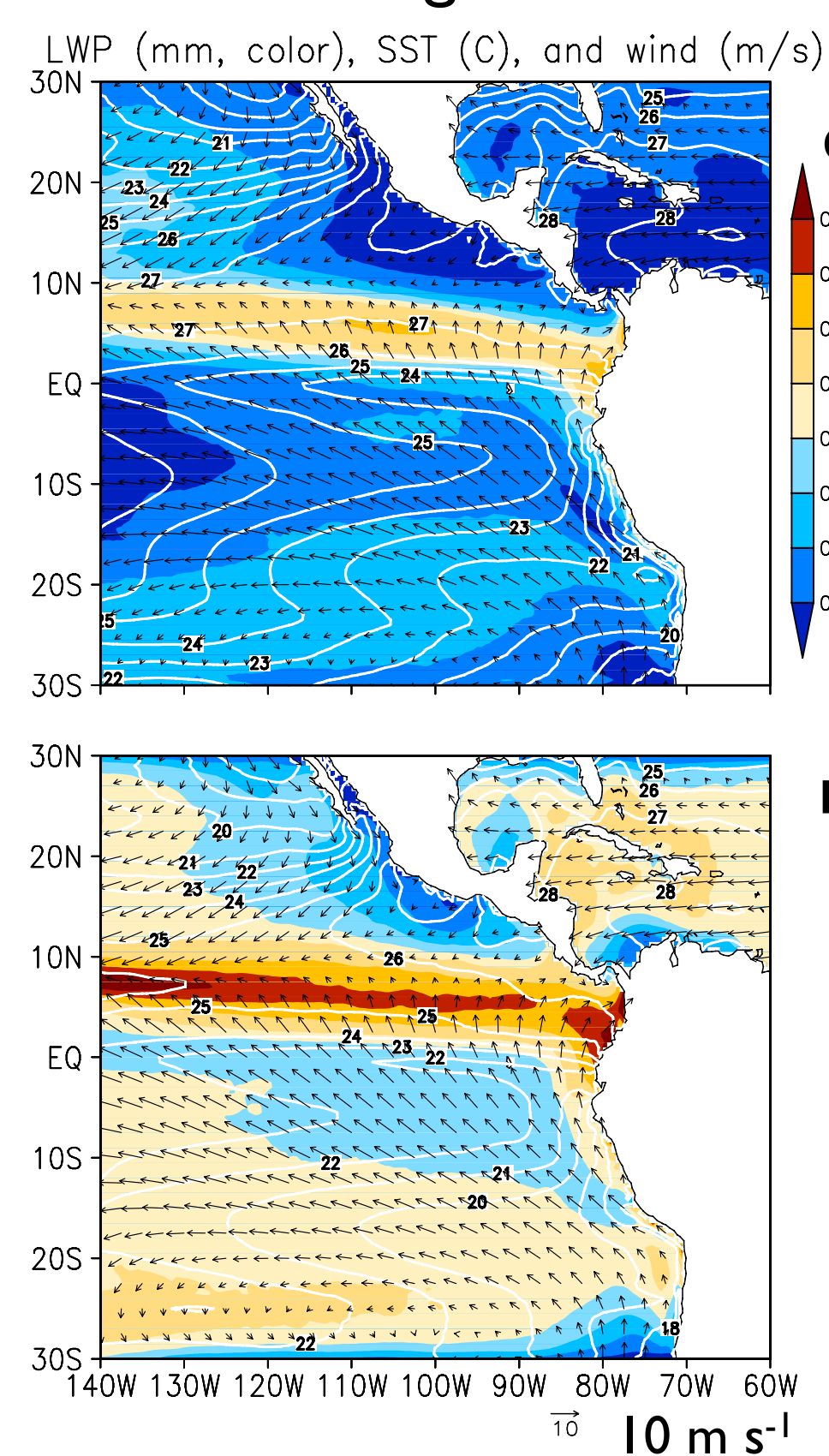
Effect of shallow cumulus convection on the eastern Pacific

Shallow cumulus convection vents moisture from the planetary boundary layer and entrains dry air in, reducing low clouds.

A simulation is performed with no shallow cumulus convection (noSC).

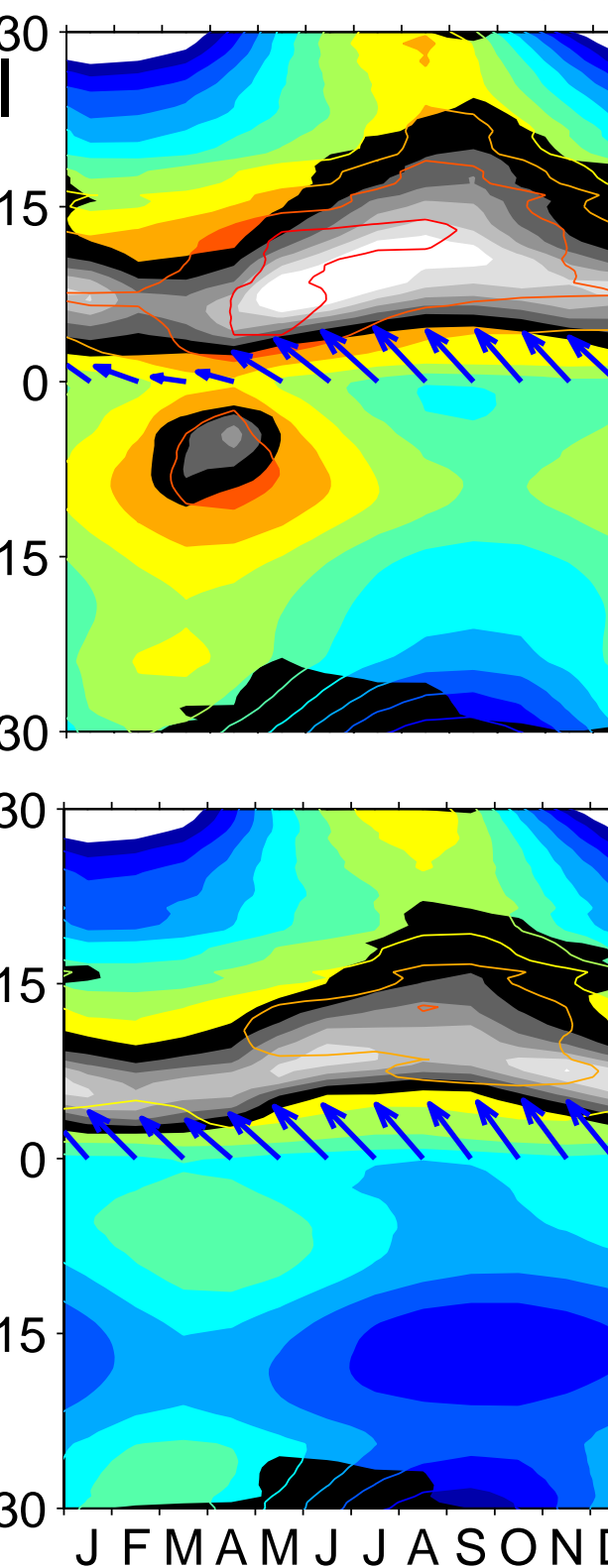
In noSC low clouds and surface solar cloud radiative forcing (CRF) are enhanced, cooling the SST.

Annual average



Overall increase in LWP in noSC.

Seasonal cycle of 80-140° W cloud fraction, SST, and wind



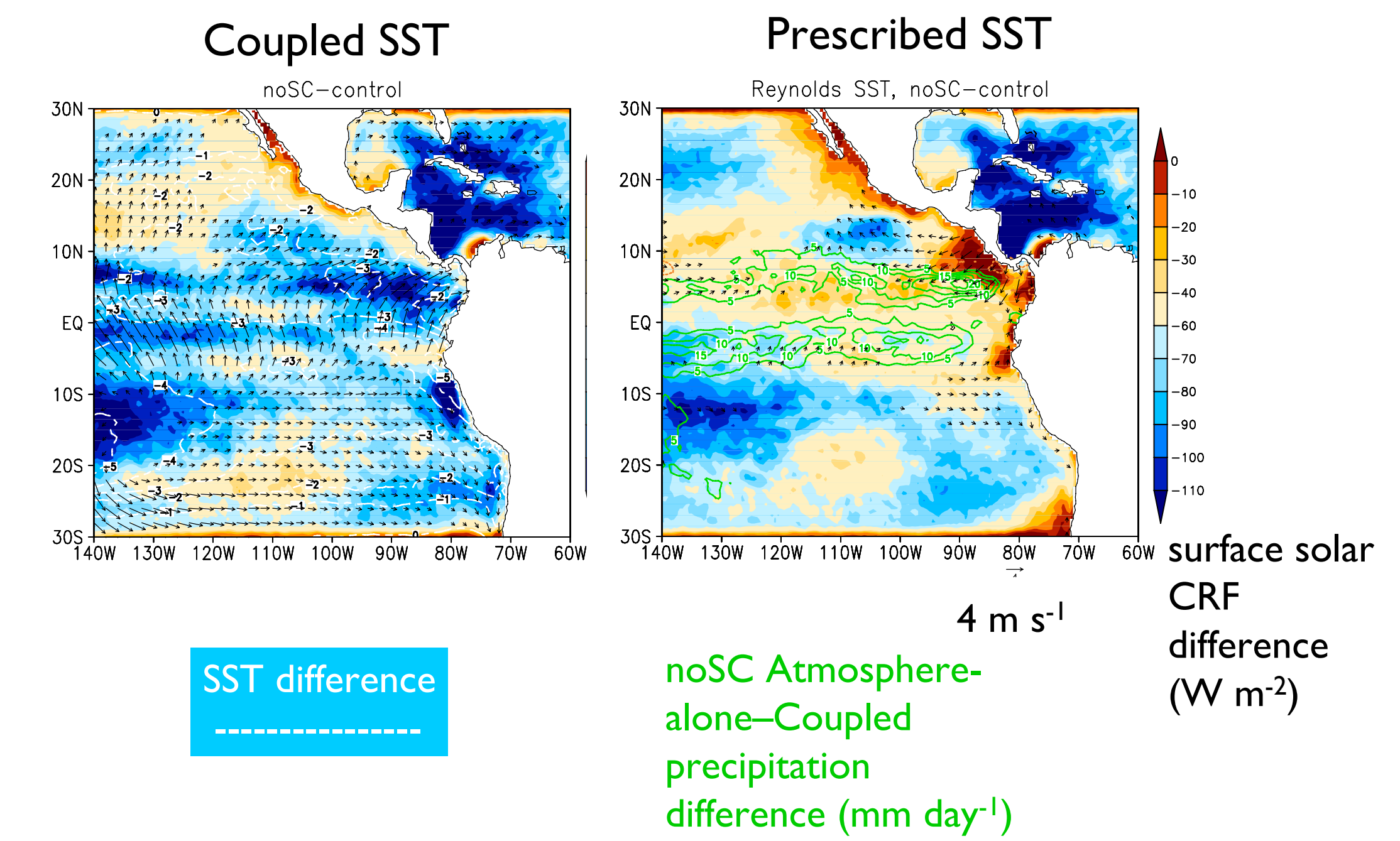
Equatorial southwesterlies and northern ITCZ become year-round.
Equatorial SST seasonal cycle is reduced to 2° C.

IROAM control

IROAM simulates the seasonal cycle of equatorial wind and SST (4° C).

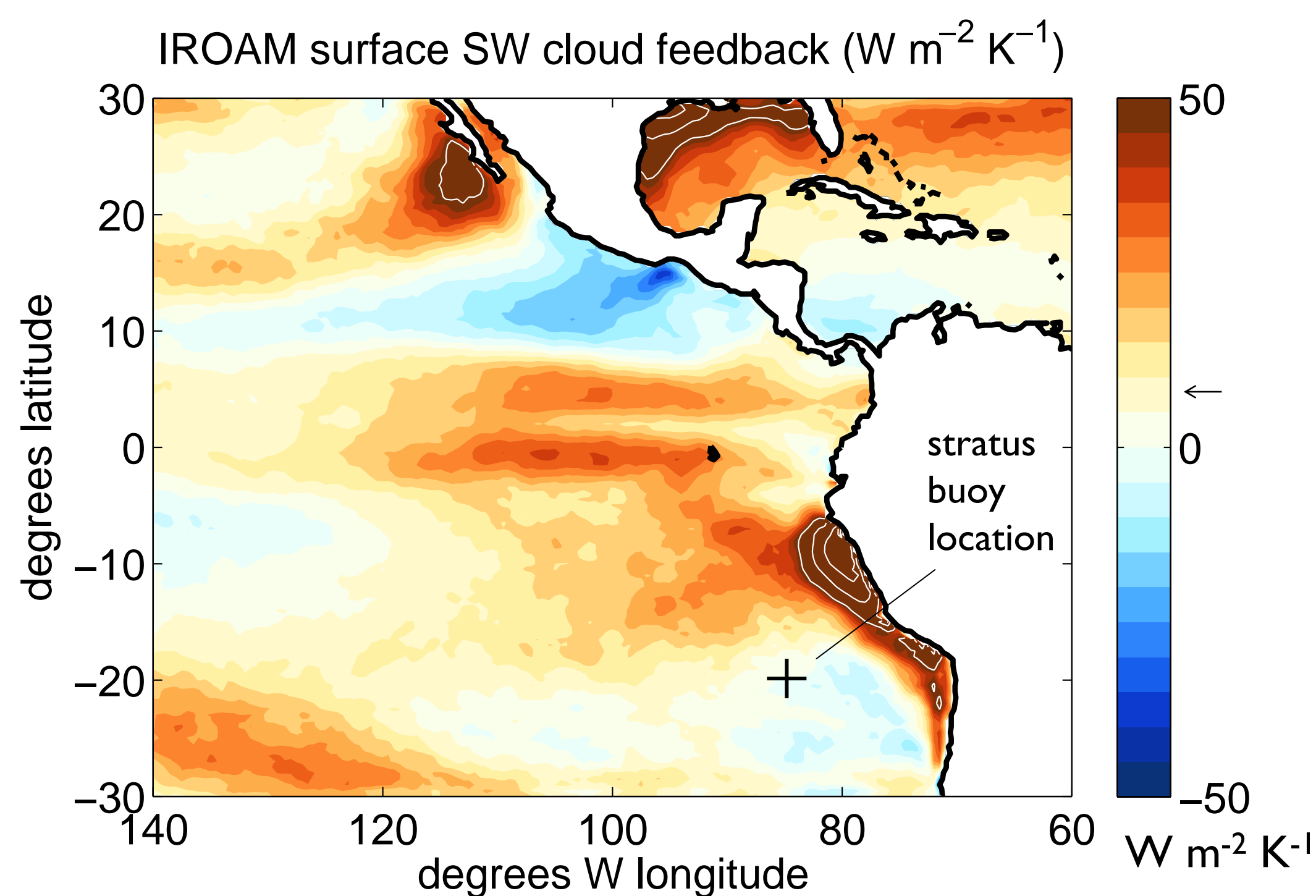
noSC
• 2-4° cooler.
• Southern ITCZ (April) is destroyed.

Role of coupled SST in April circulation



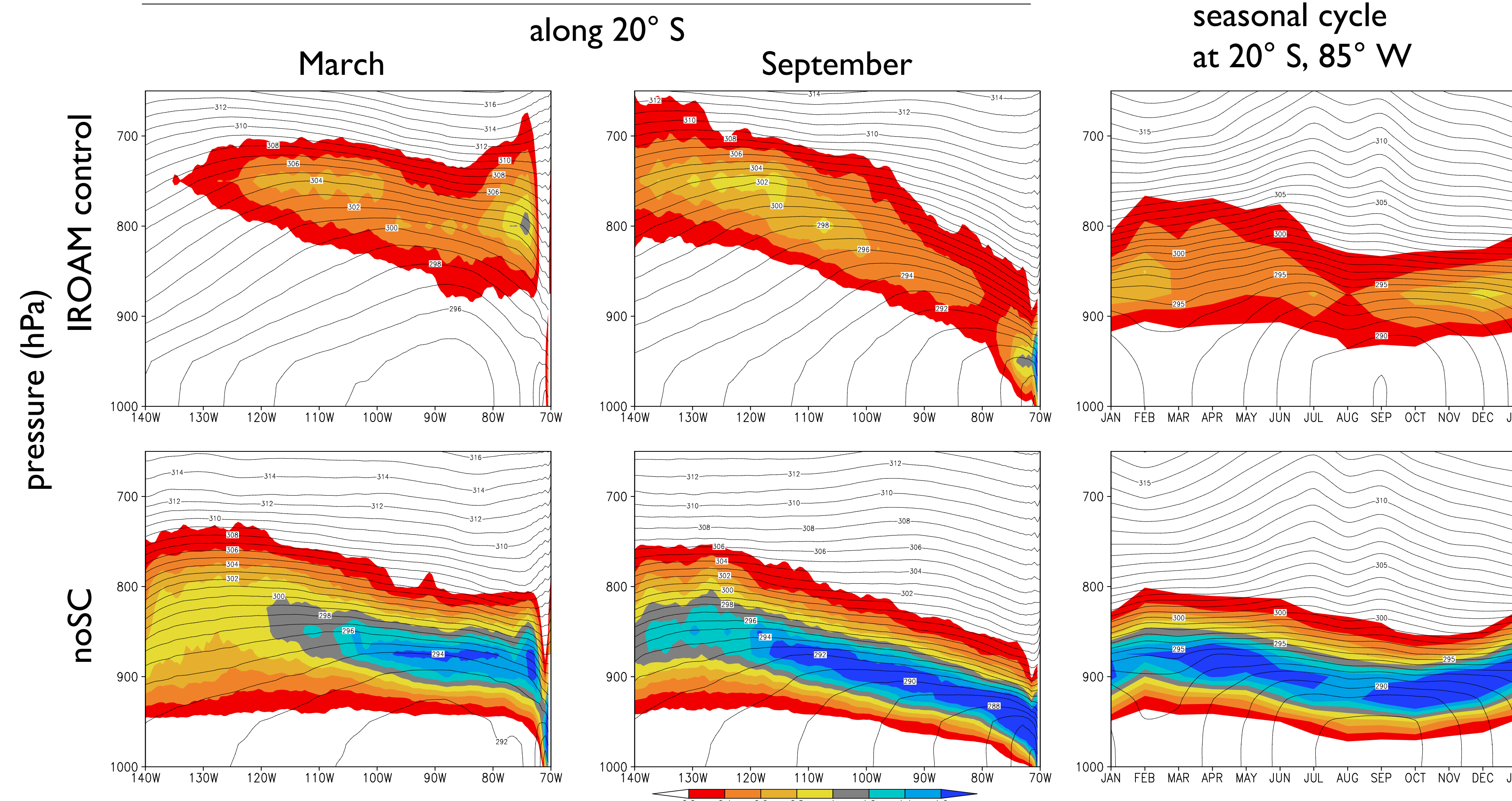
With prescribed SST the surface solar cooling due to noSC is half that of the coupled run within 10° of the equator. April atmospheric circulation becomes meridionally asymmetric. Southerly winds across the equator extinguish the double-ITCZ.

Cloud feedback on eastern Pacific SST

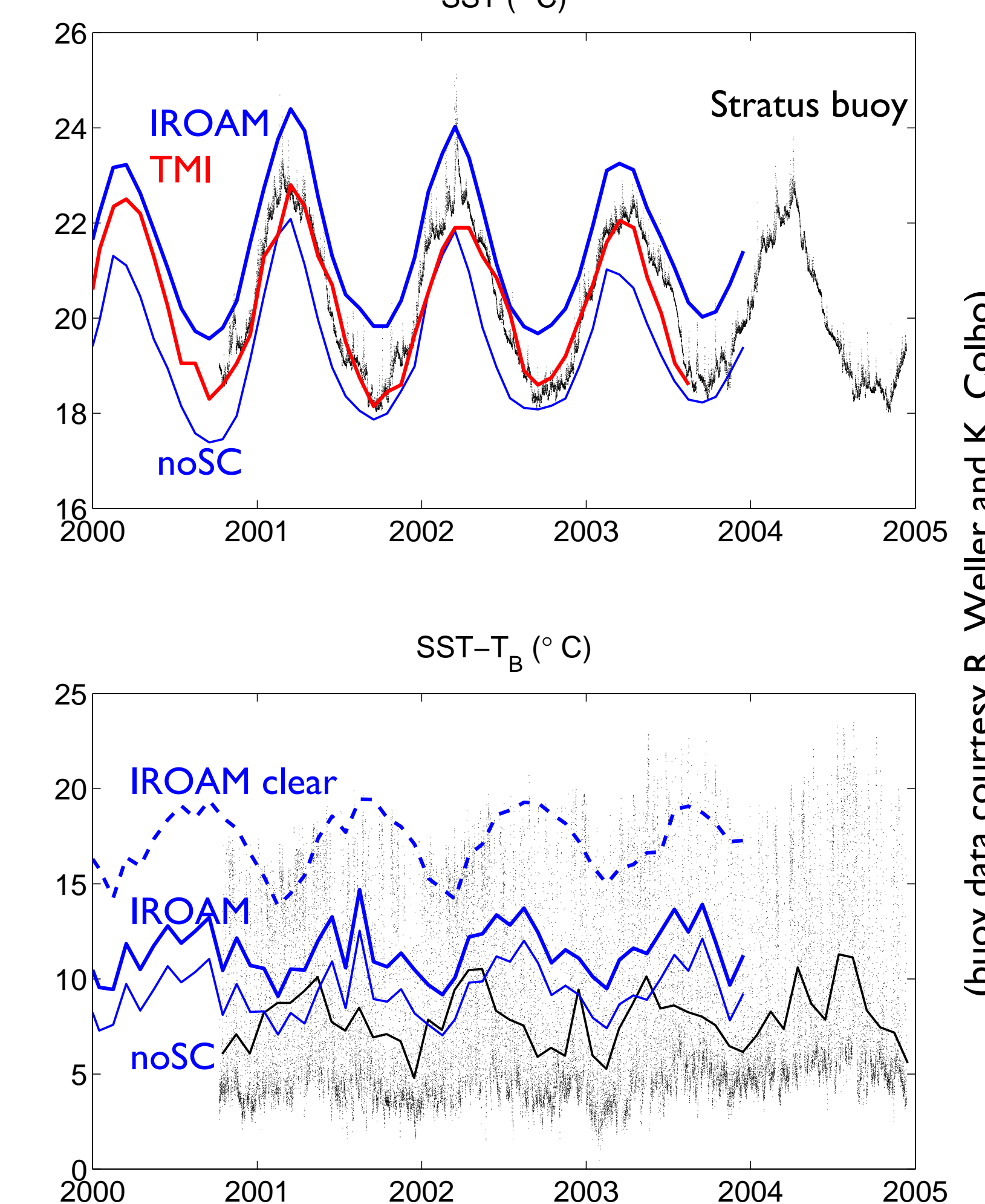


buoy full-sky SW feedback = 7.6 W m⁻² K⁻¹

Vertical structure of clouds (g kg⁻¹) and potential temperature (K)



IROAM, TMI, and WHOI Stratus Buoy (85° W, 20° S) SST (° C)



(buoy data courtesy R. Weller and K. Colbo)