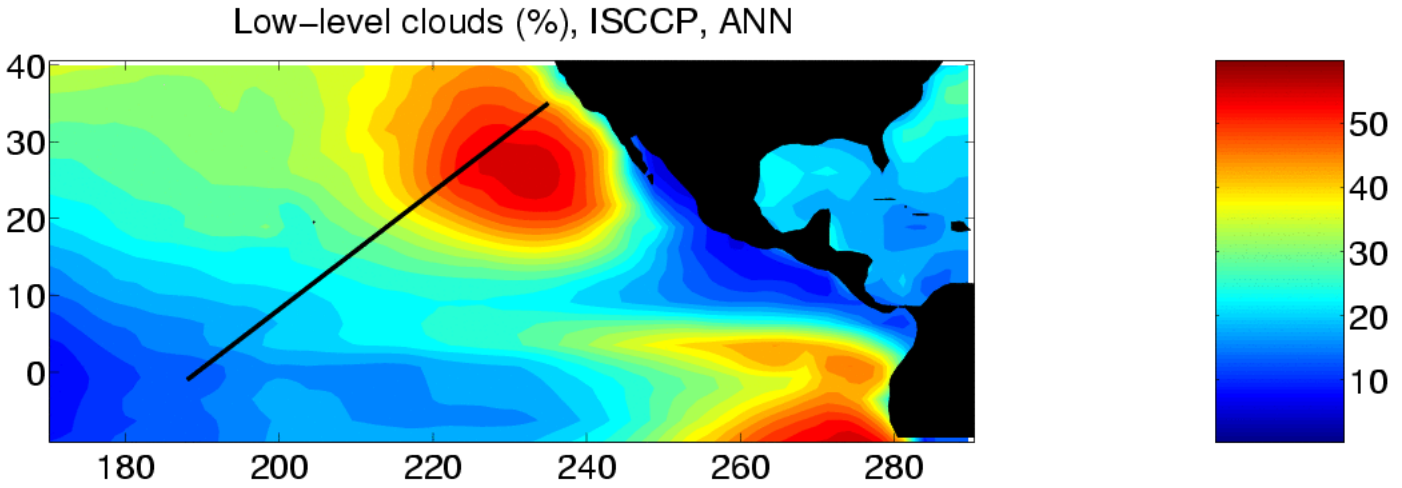
Sc-Cu transition CPT

Goal: Improve the representation of the cloudy boundary layer in NCEP GFS and CAM5 with a focus on the subtropical stratocumulus to cumulus (Sc-Cu) transition



NOAA CPO funded, 1 August 2010 - 31 July 2013

(with additional internal JPL and DOE funds)

Motivations

- Operational GFS/CFS has struggled with insufficient subtropical Sc; NCEP just introduced new shallow Cu and PBL schemes to operational GFS to address this problem.
- GFS/CFS needs to update its suite of climate bias metrics and use them more rigorously for model evaluation.
- Moist physical parameterization suite has been inadequately tested in controlled single-column settings.
- Interaction of aerosol and subtropical PBL cloud in CAM5 is inadequately understood, and transport of aerosols and cloud droplet concentration are not optimally handled.
- New EDMF turbulence and Dual-MF shallow Cu schemes developed at ECMWF provide a promising theoretical foundation for parameterization improvement in both models.

CPT Lead PI: Joao Teixeira (JPL)

NCEP

Hua-Lu Pan (PI): GFS/CFS moist physics development

Jongil Han (res sci): Shallow Cu and cloudy PBL parameterization

Ruiyu Sun (res sci): GFS/CFS runs and evaluation.

NCAR

Sungsu Park (PI): CAM5 turbulence/Cu/microphysics development

Cecile Hannay (res sci): CAM5 climate/forecast mode model runs and diagnostics

JPL

Joao Teixeira (PI): EDMF, CPT spokesman, outreach

Marcin Witek (postdoc) : EDMF implementation in GFS

U. Washington

Chris Bretherton (PI): NCEP and NCAR parameterization development

Jennifer Fletcher (grad student): NCEP SCM testing/improvement - GCSS cases

Peter Blossey (res sci): LES of GCSS Sc-Cu and other cases in support of SCM

UCLA

Roberto Mechoso (PI): Sc-Cu impact on ENSO, ocean coupling

Heng Xiao (postdoc: 50% at NCEP): " " "

LLNL (external funding)

Steve Klein (PI): PDF-based cloud parameterization for CAM5

Peter Caldwell (res sci): " "

CPT Main Tasks

a) Better climate diagnostics for NCEP

b) GCSS Sc-Cu cases with SCAM5 and GFS SCMs, and LES

c) CAM5 and GFS simulations of VOCA cloud assessment, with aerosol-cloud interaction focus for CAM5

a) Development/testing of PDF cloud schemes in NCAR, NCEP

b) Development/testing of EDMF approach in NCAR, NCEP

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Siebesma & Teixeira, 2000

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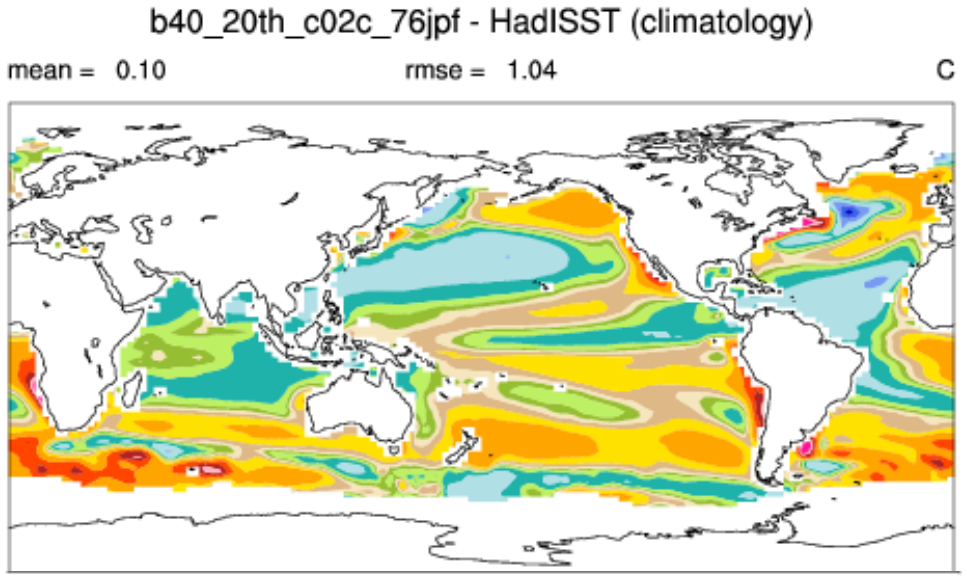
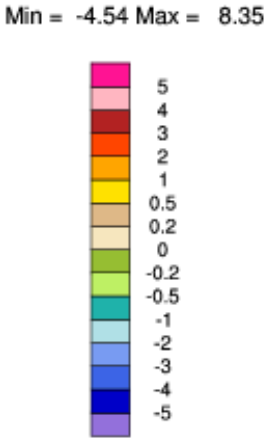
Comparison of NCAR CESM1 and NCEP GFS

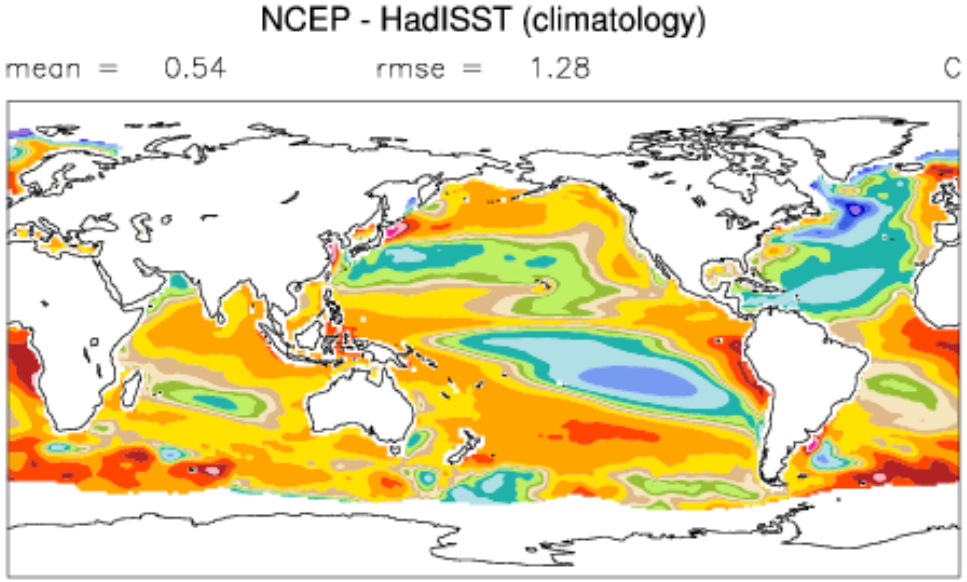
Model	NCAR CESM1	NCEP GFS
Atmosphere	CAM5 (2x2.5, L30)	GFS (T126 L64)
Boundary Layer Turbulence	Bretherton-Park (09) UW Moist Turbulence	Han and Pan (11)
Shallow Convection	Park-Bretherton (09) UW Shallow Convection	Han and Pan (11)
Deep Convection	Zhang-McFarlane Neale et al.(08) Richter-Rasch (08)	Han and Pan (11)
Cloud Macrophysics	Park-Bretherton-Rasch (10) UW Cloud Macrophysics	Zhao and Carr (97)
Stratiform Microphysics	Morrison and Gettelman (08) *Double Moment*	Zhao and Carr (97)
Radiation / Optics	RRTMG Iacono et al.(08) / Mitchell (08)	RRTM
Aerosols	Modal Aerosol Model (MAM) Liu & Ghan (2009)	Climatology
Dynamics	Finite Volume	Spectral
Ocean	POP2.2	MOM4
Land	CLM4	NOAH
Sea Ice	CICE	MOM4

Sea Surface Temperature Bias



CAM5





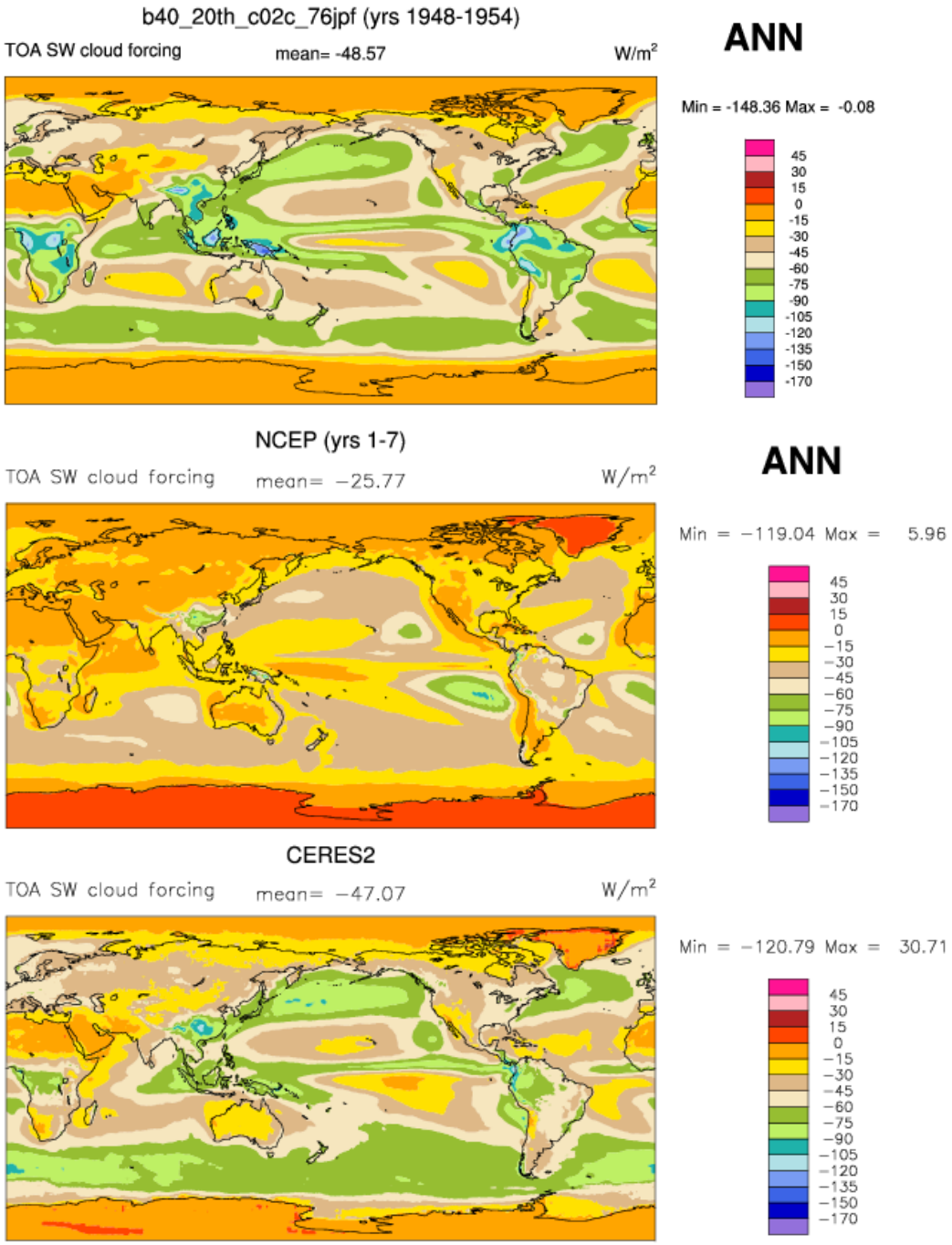
Coupled GFS, yr 1-7

AMWG metrics (Xiao, Park)

Overall C-GFS skill score 1.19 vs. 1.04 CESM1 (1=CAM4)

NCEP better only on SLP, land surface temperature

Reveal huge low bias in GFS cloud forcings and 9 W/m2 TOA imbalance.



SCAM5 and LES simulations of GCSS Sc-Cu case (Park, Blossey)