

Exploring the Southern Ocean short-wave anomaly using an across scales approach

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SFC SW down bias





45N 45S 90S 0 90E 180 90W

GA3.0



GA2.0





Compositing





AMSR water vapor path (NA)



















SWtoa



















CERES MODIS

(courtesy Rich Allen)

Boundary layer types

I. Stable boundary layer, possibly with non-turbulent cloud (no cumulus, no decoupled Sc, stable surface layer)



II. Stratocumulus over a stable surface layer (no cumulus, decoupled Sc, stable surface layer)



III. Single mixed layer, possibly cloud-topped (no cumulus, no decoupled Sc, unstable surface layer)





V. Decoupled stratocumulus over cumulus (cumulus, decoupled Sc, unstable surface layer)



VI. Cumulus-capped layer (cumulus, no decoupled Sc, unstable surface layer)



Convective or shear-driven?

- If there is sufficient wind shear that the local BL depth (height where Ri>Ri_{crit}) exceeds the top of the parcel ascent:
 - Set cumulus=false
 - Non-local scheme continues only to mix to the LCL
- Motivated by cold air outbreak work:
 - Trigger when z_h(Ri) > 0.5(zh_{par}+z_{lcl}): enough shear to disrupt cumulus formation. Diagnose well-mixed layer to zh_{par}, ie completely undo cumulus diagnosis (becomes BL III)



DIAFJ Atmos low cloud amount At 13Z on 31/ 1/2010, from 05Z on 31/ 1/2010





DIAFV Atmos low cloud amount At 13Z on 31/ 1/2010, from 05Z on 31/ 1/2010





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Cntrl



mod. BI MODIS

















SW bias and SST warm bias

•Too little and too optically thin 'stratocumulus' (or closely spaced cumulus) and 'mid-top cloud' in the cold air behind cold fronts

•The **light rain package** has produced **more mid-level cloud** in the frontal zone and thickened (to some extent) low cloud in the cold air. Both of these improve the SW flux.

•Brightening of cloud in cold air outbreaks would help (not be easy to do this without adversely affecting transition cloud in the sub-tropics)

•Change to the boundary layer diagnosis of shear-dominated BLs implemented by A. Lock seems to pick cold air outbreak regions successfully (changing cumulus diagnoses to shear-dominated) and successfully increases cloud fraction and reflected SW in CONSTRAIN 1.5km case study => Test in global model.



Questions?









ISCCP cloud and SW bias GA2.0

Hadley Centre

90N

45N -

A

45S

90S

0













Met Office Hadley Centre



GA3.0



ISCCP cloud and SW bias







