The Pre-VOCA Model Assessment

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with help from
participating modeling groups,
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Southeast Pacific Climate - A Modeling Challenge

World’s most persistent subtropical low cloud regime.

The Southeast Pacific Climate System

SST, clouds poorly simulated by GCMs

Cloud-aerosol interaction

MODIS cloud droplet conc.
**PreVOCA**

**GOAL:** Assess the forecast skill and biases of global/regional model simulations of SE Pacific boundary-layer clouds and aerosols on diurnal and longer timescales.

**WHAT?** Daily hindcasts for October 2006 over the SE Pacific.

**WHY?** Learn how to optimally use REx, satellite and cruise data for model assessment and improvement.

**WHO?** 14 modeling groups using regional and global models, including climate models run in forecast mode.

**WHEN?** Data submission is complete; analysis in progress, journal submission early 2009.

[www.atmos.washington.edu/~robwood/PreVOCA/index.html](http://www.atmos.washington.edu/~robwood/PreVOCA/index.html)
<table>
<thead>
<tr>
<th>Model</th>
<th>Levels</th>
<th>Resolution [km] (inner domain)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NRL COAMPS</td>
<td>42</td>
<td>81 (27)</td>
</tr>
<tr>
<td>COLA RSM</td>
<td>28</td>
<td>50</td>
</tr>
<tr>
<td>IPRC Reg_CM (IRAM)</td>
<td>28</td>
<td>~25</td>
</tr>
<tr>
<td>LMDZ</td>
<td>38</td>
<td>50</td>
</tr>
<tr>
<td>PNNL (WRF-Chem)</td>
<td>44</td>
<td>45 (15)</td>
</tr>
<tr>
<td>UCLA (WRF)</td>
<td>34</td>
<td>45 (15)</td>
</tr>
<tr>
<td>U. Chile (WRF)</td>
<td>43</td>
<td>45</td>
</tr>
<tr>
<td>ECMWF oper. 3-12h forecast</td>
<td>91</td>
<td>~25</td>
</tr>
<tr>
<td>ECMWF 5-day forecast</td>
<td>91</td>
<td>~40</td>
</tr>
<tr>
<td>ECMWF coupled fcst ensemble</td>
<td>62</td>
<td>~125</td>
</tr>
<tr>
<td>GMAO GEOS-5 DAS</td>
<td>72</td>
<td>~56</td>
</tr>
<tr>
<td>JMA 24-30h forecast</td>
<td>60</td>
<td>~60</td>
</tr>
<tr>
<td>NCEP oper. 12-36h forecast</td>
<td>64</td>
<td>~38</td>
</tr>
<tr>
<td>UKMO oper. 12-36h forecast</td>
<td>50</td>
<td>~40</td>
</tr>
<tr>
<td>NCAR CAM3.5/6</td>
<td>26/30</td>
<td>250</td>
</tr>
<tr>
<td>GFDL</td>
<td>24</td>
<td>250</td>
</tr>
</tbody>
</table>
## PreVOCA observational data

<table>
<thead>
<tr>
<th>Dataset</th>
<th>Parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISCCP FD</td>
<td>Radiative fluxes at surface, TOA</td>
</tr>
<tr>
<td>TMI</td>
<td>LWP, WVP</td>
</tr>
<tr>
<td>AMSR</td>
<td>LWP, WVP</td>
</tr>
<tr>
<td>MODIS</td>
<td>Cloud fraction, optical depth, droplet size, cloud-top height</td>
</tr>
<tr>
<td>NOAA ESRL Stratus Cruises</td>
<td>Temperature, moisture soundings, surface fluxes, drizzle properties, aerosols</td>
</tr>
<tr>
<td>QuikSCAT</td>
<td>Ocean surface winds</td>
</tr>
<tr>
<td>NCEP Reanalysis</td>
<td>Vertical velocity</td>
</tr>
<tr>
<td>CALIPSO</td>
<td>Cloud top height</td>
</tr>
<tr>
<td>COSMIC</td>
<td>Temperature soundings</td>
</tr>
<tr>
<td>CloudSat</td>
<td>Drizzle properties</td>
</tr>
</tbody>
</table>
Analysis

PreVOCA analysis focus:
Cloud/PBL structure and their dynamical setting.

Shown here: Monthly mean
Also analyzed: Diurnal cycle, subsidence waves
Soon: Synoptic variability
Oct 2006 10 m vector wind (m s$^{-1}$) - models agree fairly well
Omega at 850 hPa (Pa s\(^{-1}\)) - also not too bad
Liquid Water Path (g m$^{-2}$)

- TMI Observed
- COAMPS
- IPRC
- ECMWF OPER
- GFDL
20S 85W sounding comparisons

Regional

Global forecast

Climate

θ

q_v
Mean Boundary Layer Depth Along 20S
C130 RF03 (21 Oct 2008) - ‘typical’

Sloped inversion: 1000m (70W) -1600m (85W), solid Sc
UKMO global forecast model performance

...does a creditable job at representing the Sc.
Conclusions from PreVOCA

• Much scatter in PBL/Sc properties, esp. among the regional models: an issue for aerosol-cloud interaction?
• UKMO and ECMWF models perform best overall, correctly capturing most geographic variations in PBL depth/structure and cloud cover.
• Sharpness of inversion challenges even the highest-resolution models.
• Cloud variability and aerosol feedbacks are cutting-edge challenges to the best global and regional models.
• VOCALS SE Pacific datasets are wonderful tools for assessing and improving cloud and aerosol simulations.
From PreVOCA to VOCA...

• VOCA: Similar protocol to preVOCA using REx observations from 15 Oct -15 Nov 2008

• More focus on chemical transport, aerosol concentrations and $r_{\text{eff}}$ vs. in-situ and CALIPSO data.

• We will send out a detailed protocol early this year. All modeling groups are welcome (with or without chemical transport modeling capability).
Extra Slides
VOCALS

The VAMOS Ocean-Cloud-Atmosphere-Land Study

- A multiyear study of boundary layer cloud, aerosol, and upper ocean heat/constituent transport
- Annual instrumented cruises in austral spring (starting with EPIC 2001 stratocumulus cruise).
- Regional Experiment (REx) in Oct.-Nov. 2008, including 4 aircraft based in northern Chile, two ships, coastal site: PI: Rob Wood (UW).
- Satellite data analysis of cloud properties
- Atmosphere and ocean modeling (LES to global).
Data from REx for Model Assessment

- ~35 days of Ron Brown ship observations near 20S (cloud radar, scanning 5 cm radar, lidar, sondes, surface met/fluxes, aerosols, sulfur chemistry, oceanography)
- Numerous night/day flights sampling 20S along 70-85W (aerosols, chemistry, cloud radar, dropsondes).
Great cloud radar, microphysics, aerosol data

RF03

Courtesy Dave Leon

RF03 outbound PCASP and cloud droplet concentration

PCASP

Altitude (feet)

0 2000 4000 6000 8000 10000

Longitude

-86 -84 -82 -80 -78 -76 -74 -72 -70

PCASP

Nd

dBZ

0 100 200 300 400 500

-28 -16 -4 8 20

0 2000 4000 6000 8000 10000