The Pre-VOCA Model Assessment: Results and Plans for the Next Phase

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with help from
participating modeling groups
Overview

• PreVOCA experiment background
• Summary of earlier results – October averages
• The diurnal cycle at the stratus buoy
• Modelling synoptic changes
• The next phase of the modeling experiment
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.

Method: Compare model hindcasts for October 2006 over the SE Pacific. Operational/Global models run daily forecasts. Regional models typically run a month-long simulation continuously forced at domain boundaries.

Website:
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>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>
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<tr>
<td>ECMWF 5-day forecast</td>
<td>91</td>
<td>~40</td>
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<tr>
<td>ECMWF coupled fcst ensemble</td>
<td>62</td>
<td>~125</td>
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<tr>
<td>GMAO GEOS-5 DAS</td>
<td>72</td>
<td>~56</td>
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<td>JMA 24-30h forecast</td>
<td>60</td>
<td>~60</td>
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<tr>
<td>NCEP oper. 12-36h forecast</td>
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<td>~38</td>
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<tr>
<td>UKMO oper. 12-36h forecast</td>
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<td>~40</td>
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<tr>
<td>LMDZ</td>
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<td>50</td>
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<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>
Oct 2006 Low cloud fraction

- MODIS Cldfrac
- ECMWF OPER
- IPRC
- PNNL 2P D1
- CAM 3.5
- GFDL

Latitude

Longitude

3.6 UW

Color bar:

0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1

-100 -80
-100 -80
Summary of Comparison of October 2006 Means

• Model winds agree well with QuikSCAT and with each other.
• Model mean subsidence agrees fairly well.
• Much scatter in PBL/Sc properties such as boundary layer depth and cloud fraction, especially among the regional models.
• UKMO and ECMWF models perform best overall, correctly capturing most geographic variations in PBL depth/structure and cloud cover.
LWP Diurnal Cycle at 20S 85W

![Graph showing LWP diurnal cycle at 20S 85W with various model fits and observations.](image)
Low cloud diurnal cycle at 20S 85W

Ship-based Visual Observations
Evolution of clouds along 20°S
October 2006

**MODIS**

- **Total Cloud Fraction**
- **Cloud-top Height [m]**
- **Low Cloud Fraction**
- **BL Depth [m]**
- **θ at 700 hPa [K]**

**Time**

- ECMWF Operational Model

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Zuidema et al. (2009)
BL Depth at 20S 85W

MODIS
Zuidema et al. (2009)
Low Cloud at 20S 85W

operational

regional

climate

MODIS
Further Conclusions from PreVOCA

- Diurnal cycle of LWP has similar phase but weaker amplitude than observed at buoy.
- Diurnal cycle of cloud fraction is overestimated in some models.
- Diurnal upsidence wave similar to Garreaud and Munoz (2004) is present in most models.
- Mid-month BL deepening is captured qualitatively in most models, but cloud changes vary widely among models.
- Paper to be submitted to JGR…
The next phase...

• VOCA: Similar protocol to preVOCA using REx observations from 15 Oct - 15 Nov 2008
• Specify or parameterize emissions of various aerosol and gas species in a standard protocol.
• Compare aerosol and gas concentrations to in-situ measurements, testing modelling of transport, diffusion and deposition.
• Compare cloud-top effective radius with satellite.
• Assess modeling of aerosol processing by clouds.
• To be discussed on Tuesday afternoon…
Extra Slides
Model Upsidence Wave

Diurnal $\omega_{850hPa}$ [Pa s$^{-1}$] at 20S

- NCEP
- ECMWF OPER
- IPRC
- PNNL 2P D1
- CAM 3.5
- GFDL
Climate Models
20S 85W

![Graphs showing specific humidity and potential temperature across different models.]](image)
Operational Models
20S 85W
Mean Boundary Layer Depth Along 20S

Oct 2006 20S

Model Range
Model 25-75 pctile
Model Mean
COSMIC
CALIPSO
MODIS
ESRL

Boundary Layer Depth, m

Longitude
Modeled ‘Upsidence’ Wave
November 14-28 2001