Pre-VOCALS Model Assessment (PreVOCA)

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GOAL: Critically assess the ability of global and regional atmospheric, oceanic, and chemical transport models to simulate and predict synoptically-varying clouds, meteorology, ocean circulation and aerosols in the southeast Pacific (SEP) subtropical stratocumulus regime for a month in the southern spring season. All participating models must be run in some form of weather forecast mode.

WHY? VOCALS is predicated on the need to 1) reduce the systematic biases of atmosphere-ocean GCMs in the SEP, 2) improve understanding and simulation of aerosol-cloud-drizzle interactions in the marine PBL, and 3) improve understanding and simulation of ocean budgets of heat and salinity in the SEP. Therefore we need to assess the performance of model simulations of the atmosphere-ocean-aerosol in the region. In addition, the sampling strategy during the VOCALS Regional Experiment (REx) in October 2008 will critically depend on the weather conditions and hence on the regional forecasts for the region , Therefore we need to assess the models' ability to predict typical patterns of synoptic scale variability over the region where VOCALS Rex will take place.

SEP? The SEP contains the world's most persistent subtropical stratocumulus region. The meteorology is simpler than the more-studied northeast Pacific due to the low latitudes and the flow channeling by the high Andes. There is a persistent aerosol contrast between the coasts of Northern Chile and Peru, polluted by sulfate from copper smelters and other industrial activity, and the pristine flow offshore where biogenic and salt aerosol may dominate. In the clean offshore air large POCS (patches of open cells) regularly form within the solid stratocumulus sheet and last for days, possibly maintained by feedbacks between drizzle and aerosol scavenging. New satellite instruments and algorithms are giving a much more integrated view of oceanic clouds that we have had before, turning the SEP from a data void into a feast of new observations. These are supplemented in the SEP by research-grade buoy measurements and limited research cruise data. Lastly, the VOCALS-REx field experiment in Oct.-Nov. 2008 will take many detailed in-situ measurements in the SEP.

SIMULATED PERIOD: Oct. 2006. This is the SEP stratocumulus maximum, has POCs, includes a week of in-situ data (soundings, ship remote sensing, and aerosols) from a buoy maintenance cruise. 4xdaily outputs (see below)

WHEN? Submissions to Rob Wood (robwood@atmos.washington.edu) by Jan. 31, 2007

WHO? Model outputs will be archived at the University of Washington and will be analyzed by Wood, Bretherton and Mechoso. The UW and UCLA groups will each share the procurement and assembly of the various satellite datasets.

COMPARISON DATASETS:

Reanalysis products from NCEP and ECMWF
GOES (3-hourly cloud-top T, 11-3.7 micron nighttime brightness temperature difference)
MODIS (cloud effective radius, liquid water path, cloud cover, aerosol optical depth)
ISCCP (TOA shortwave and longwave cloud forcing, optical depth PDF)
AMSR-E (SST, WVP, LWP)
SSMI (water vapor path)
Quikscat (surface winds)
CloudSat (drizzle)
CALIPSO (MBL depth, aerosol optical thickness)
WHOI stratus buoy - surface flux/met obs.
Ron Brown ship – surface obs, sondes, near-surface aerosol size spectrum, cloud remote sensing for 15 Oct-6 Nov 2006.
Operational [Re]analyses – sea-level pressure patterns, free-trop. winds, etc.
AIRS (free tropospheric moisture)
COSMIC/GPS (boundary layer depth)

NOTE: PreVOCA is a pilot study, not a rigorous intercomparison. You may submit your favorite forecast/analysis model output and/or satellite observational dataset. This might be the analysis from a data-assimilating global model, a short-range (<36 hour) forecast based on a model initialization of your choice, output from a free-running regional model continuously forced by reanalysis fields at the boundary, etc. However, we do request a standardized set of outputs and if the results merit, we do hope to publish them. We intend to do more tighly controlled assessments for that period that takes best advantage of the REX dataset based on lessons learned from our first assessment.

MODEL OUTPUT RESOLUTION: To enable convenient comparison of models and observations, all models are requested to interpolate outputs to the same horizontal grid and resolution. Since our emphasis is on regional and larger scales, use a 1x1 degree grid, centered on lat gridpoints ranging from -40 to 0 degrees (40-0 S) and lon ranging from -110 to -70 degrees (110-70 W). All output should be at 3 hour time resolution, either averaged over 00-03 UTC, 03-06 UTC, etc., or instantaneous at 0130, 0430, etc. This allows good comparison with GEOS and MODIS/A-Train data. Output field dimensions should be lon by lat by height (if applicable) by time, giving a 41 x 41 x nz x 248 dimensional dataset. Use your native model vertical grid.

REQUESTED MODEL OUTPUT: Each model should submit a brief MS Word or plain text **documentation file** and a **netcdf output file**. The 1D outputs document your output grid, the 2Dxtime outputs will be used for most of the satellite comparison and comparison with the WHOI stratus buoy at 20S, 85W. The 3D outputs will be used for constructing mean cross sections along 20 W, examining the correlation of leading modes of wind variability with the PBL structure, and looking at aerosol distributions above the boundary-layer top.

The **documentation file** should include:

D1) the name and email address of the contributor
D2) the official version number and model name
D3) literature reference for your model (if available) plus any major changes made since that reference.
D4) Forecast/analysis approach used to make model output fields
D5) Horizontal model resolution
D6) Number of model vertical levels and corresponding values of sigma.
D7) Timestep
D8) PBL scheme type (e.g. nonlocal surface-forced K-profile, moist TKE, etc.) as you would summarize it in the table of a paper.
D9) Microphysics scheme type
D10) Cloud fraction scheme type
D11) Aerosol scheme type
D12) What form, if any, of aerosol-cloud interaction is included?

The **output file**, in netcdf format, should include

1D fields:
- time [days] since 00Z 1 Oct. 2006
- lat [deg N]
- lon [deg E]
- sigma [0-1] of each model vertical level, averaged over all horizontal gridpoints and times given in the output fill (sigma = p/ps).

2D fields (lon x lat x time):
- TS [K] surface radiative skin temperature (= SST over ocean for most models)
- ZS [m] surface height (may be less than zero over ocean due to spectral ringing)
- land fraction [0-1]
- SLP [Pa] - validate against Quikscat/reanalyses
- T (10 m) [K] – compare vs. stratus buoy at 20S 85W
- q (10 m) [kg/kg] specific humidity – compare vs. stratus buoy at 20S 85W
- u (10 m) [m/s] – compare vs. Quikscat and reanalyses
- v (10 m)
- u (850 hPa) - compare vs. reanalyses
- v (850 hPa)
- w (850 hPa)
- SHF
- LHF
- Surface momentum fluxes in x and y directions
- LWUPTOA, SWUPTOA [W/m2] TOA radiative fluxes. – compare vs. ISCCP
- LWDNSFC, SWDNSFC - compare vs. ISCCP and at buoy
- WVP - compare vs. SSMI/TMI
- LWP - compare vs. TMI/AMSR
- CLDLOW - low cloud fraction lcf below 800 hPa – compare vs. ISCCP?
- PRECT [kg H20/(m2-s)] surface precipitation.
- AOD [0-1] Aerosol optical depth

For the remaining three fields, we assume the layers are numbered from the top, so k = 1 is the top level. We let LWPica(k) be the integrated grid-box liquid water path including and above layer k. Use only liquid to exclude ice cloud. Define a cloud weighting function cwf(k) = lcf*ncwf(k), k = 1,…nz, where ncwf(k) = exp(-K*LWPica(k-1)) – exp(-K*LWPica(k)) and LWPica(k) is the integrated grid-box liquid water path above and including layer k. Here K = 156/lcf in units of m^2/kg. We let the surface cloud weighting function cwf(nz+1) = 1 – (cwf(1)…+cwf(nz)).

TCLDTOP [K] low cloud IR brightness temperature proxy

TBBCLD = cwf(nz+1)*Ts + sum k = 1 to nz of cwf(k)*T(k)

ZCLDTOP [m] low cloud height proxy

ZCLDTOP = (sum k = 1 to nz of cwf(k)*z(k))/ (1 – cwf(nz+1))

REFFTOP [um] effective radius proxy

REFFTOP = (sum k = 1 to nz of cwf(k)*reff(k))/ (1 – cwf(nz+1))

NDTOP [/cm3] cloud droplet concentration

NDTOP = (sum k = 1 to nz of cwf(k)*ND(k))/ (1 – cwf(nz+1))

3D Fields:

T
qv
ql+qi,
cf
reff
u, v, w

Aerosol masses:

SO_4/HSO_4, BC, OC, Seasalt

Aerosol precursor mass mixing ratios:

DMS [atmospheric], MSA, SO_2, H_2SO_4, DMS [ocean], organics?

Oxidants and oxidant related:

H_2O_2, O_3, OH

Anticipated participants

NCAR CAM (Rasch/Breth)
NASA GMAO (Bacmeister)
GFDL (Ramaswamy)
ECMWF (Koehler)
NCEP GFS (Pan)
iROAM (Y. Wang)
U. Chile WRF (Garreaud)
COAMPS (S. Wang)
MMF (Khairoutdinov)
PNNL (Fast)
Other modeling groups are welcome.