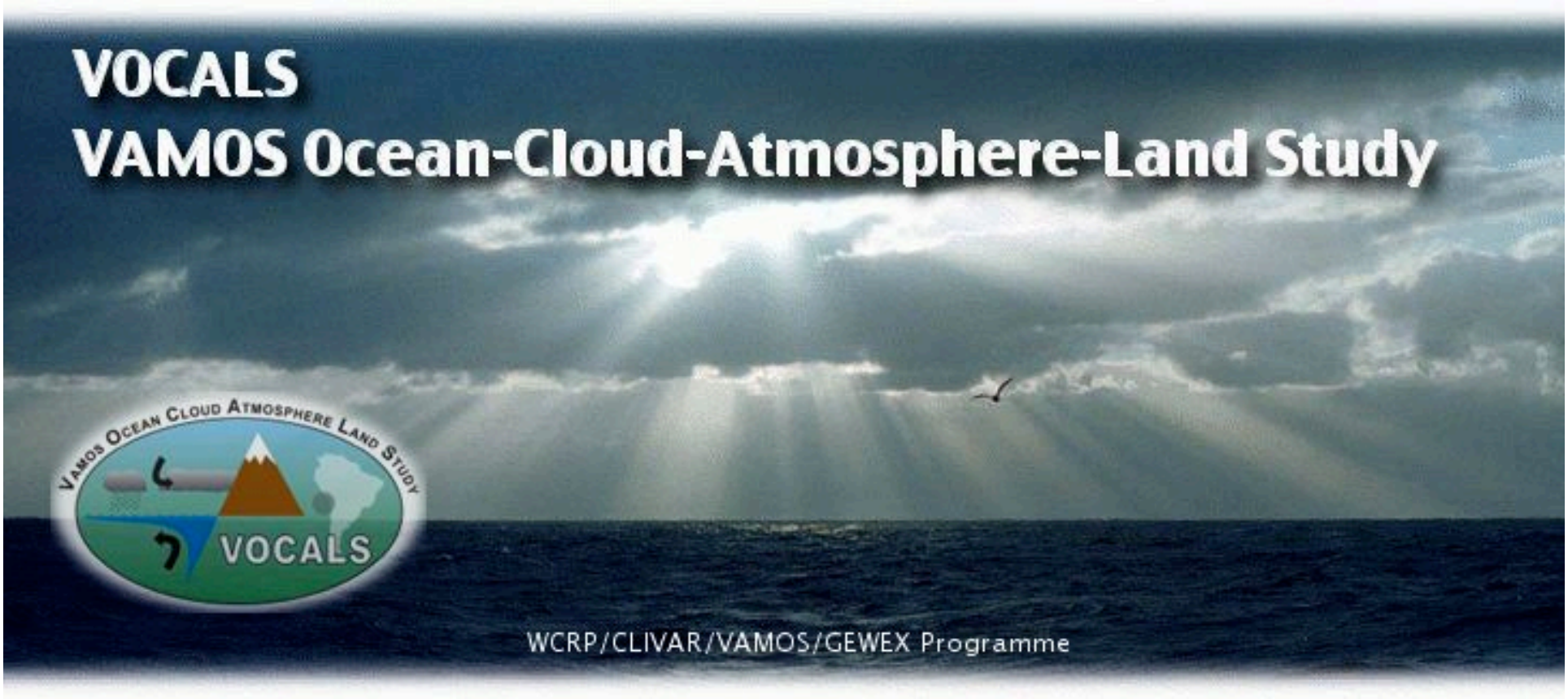
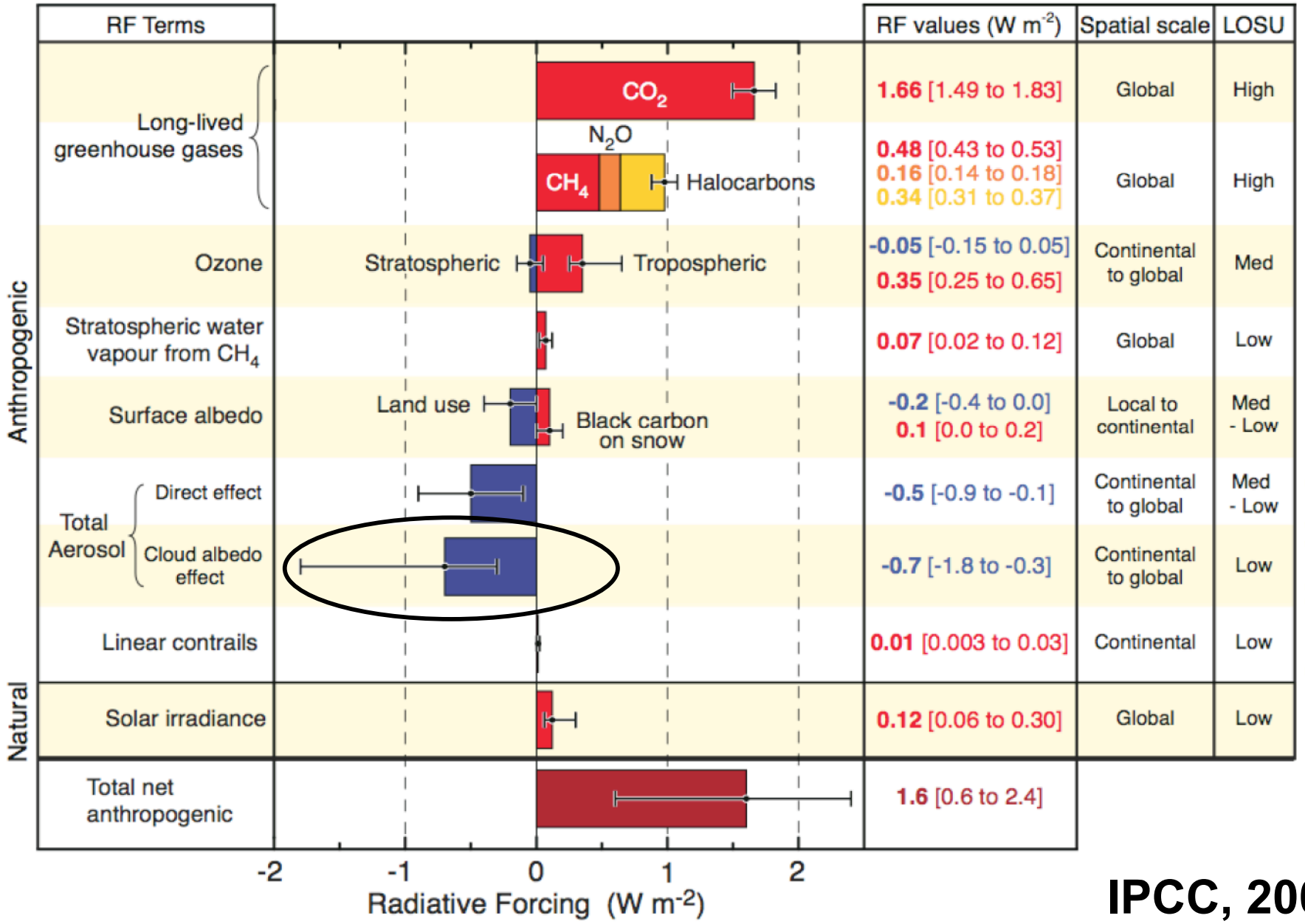
VOCALS Cloud-Drizzle-Aerosol Theme



- Understanding and modeling aerosol indirect effects
- Is drizzle important to Sc synoptic variability and climatology?

Radiative Forcing Components



IPCC, 2007

AEROSOL-CLOUD-PRECIPITATION HYPOTHESES				
#	**Hypothesis (means NOT PROVEN!)**	**Obs**	**Models**	**Model Teams**
1A	**Variability in the physicochemical properties of aerosols** has a measurable impact upon the formation of **drizzle** in stratocumulus clouds over the SEP.	C-130, RHB, Twin Otter, G-1,	LES WRF Chem GCMs	**Wood/Bretherton** **Feingold** **Cotton/Carrio** **PNNL**
1B	**Precipitation is a necessary condition** for the formation and maintenance of **pockets of open cells** (POCs) within stratocumulus clouds.	C-130, RHB	LES COAMPS	**Feingold** **Wood/Bretherton** **NRL, Wang**
1C	**The small effective radii** measured from space over the SEP are primarily controlled by **anthropogenic**, rather than **natural**, aerosol production, and entrainment of polluted air from the lower free-troposphere is an important source of cloud condensation nuclei.	C-130, RHB, G-1, Twin Otter, A-Train, Land site	WRF Chem CTMs Parcel Model GCMs	**Gallardo/Cordova** **Donner/Golaz** **Rasch** **Wood/Zaveri** **PNNL**
1D	**Depletion of aerosols by coalescence scavenging** is necessary for the maintenance of POCs.	C-130, A-Train	Parcel model LES GCMs	**Feingold** **PNNL** **Donner/Golaz**

VOCALS Cloud-Aerosol-Drizzle Modeling

Goal: Using the SEP as a testbed for better simulation of boundary-layer cloud processes and aerosol-cloud interaction, including the relative roles of natural and anthropogenic aerosol sources and their impact on cloud optical properties (coverage, thickness, and droplet size).

Modeling Themes

1. Chemical and aerosol transport modeling

2. Improving parameterizations of boundary layer clouds

3. LES of aerosol-drizzle-cloud interaction and POCs

C3: Diagnostic studies of the SEP regional climate system (coupled patterns of variability)

1. Chemical and aerosol transport modeling

Regional and global atmospheric models will be used to test our understanding of natural and anthropogenic aerosol sources in this region and understand what determines aerosol and cloud droplet concentrations and their variability over the SEP.

Models will be tested by comparing aerosol concentrations in and above the boundary layer, and satellite retrievals and REx observations of aerosol and cloud microphysical parameters.

2. Improving parameterizations of boundary layer clouds

REx and satellite observations of SEP cloud and boundary-layer properties will be used to improve the representation of boundary-layer clouds in participating AGCMs and RAMs, including parameterizations of turbulence, aerosol scavenging, cloud fraction and cloud microphysical (drizzle) processes, and turbulence, building on results from the EPIC stratocumulus cruise.

Single-column modeling based on REx will be an important analysis tool.

3. LES of aerosol-drizzle-cloud interaction and POCs

LES models will be used to investigate the physical processes involved in the formation and maintenance of pockets of open cells (POCs) and compare with VOCALS observations.

Particular modeling foci will be:

- The simulation of POC formation, aerosol budgets, and mesoscale circulations at the edges of POCs,
- Comparing POC and non-POC regions.

Some modeling groups are interested in comparing the Lagrangian evolution of cloud microphysics and aerosol in ‘clean’ regions susceptible to POC development with ‘dirty’ regions near the coast. This would require some dedicated ‘dirty Lagrangian’ flights.

C3. Diagnostic studies of SEP coupled patterns of variability

RAMs, ROMs and ROAMs will be used to investigate the coupling between the atmosphere, ocean and land in the SEP region, including model skill in simulating the strong diurnal cycle and its forcing, as well as dominant coupled patterns of SEP cloud-topped boundary-layer, wind, SST (upwelling), and aerosol variability on day-to-week timescales.

Pre-VOCALS model assessment (PreVOCA)

GOAL: To critically assess the ability of global/regional atmospheric models (atmospheric, chemical transport….) to simulate salient synoptically-varying characteristics of clouds, winds and aerosol in the VOCALS region.

WHAT? Short range 4xdaily VOCALS-region forecasts or model analyses of boundary layer structure, winds, clouds, aerosols if possible. PreVOCA pilot: Oct. 2006 (using PACS cruise and satellite data). Model output due end of 2007. RExA: In 2009, we'll refine and repeat (with tighter control) using REx period and obs.

WHY? Learn more about model biases. Understand how to better synthesize model output with REx data. Supports modeling themes 1, 2, C3.

Data sources

Satellites:

- GOES (diurnal cloud-top T)
- MODIS (clouds, microphysics)
- Quikscat (surface winds)
- AMSR (WVP, cloud LWP)
- CloudSat/CALIPSO (drizzle, MBL depth, aerosol scattering…)
- TRMM (TMI SST)

WHOI stratus buoy (surface flux/met obs).

PreVOCA: 2006 PACS cruise data

RExA: Ship met+aerosols+clouds, C-130 20S transect flights

Who?

- 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)