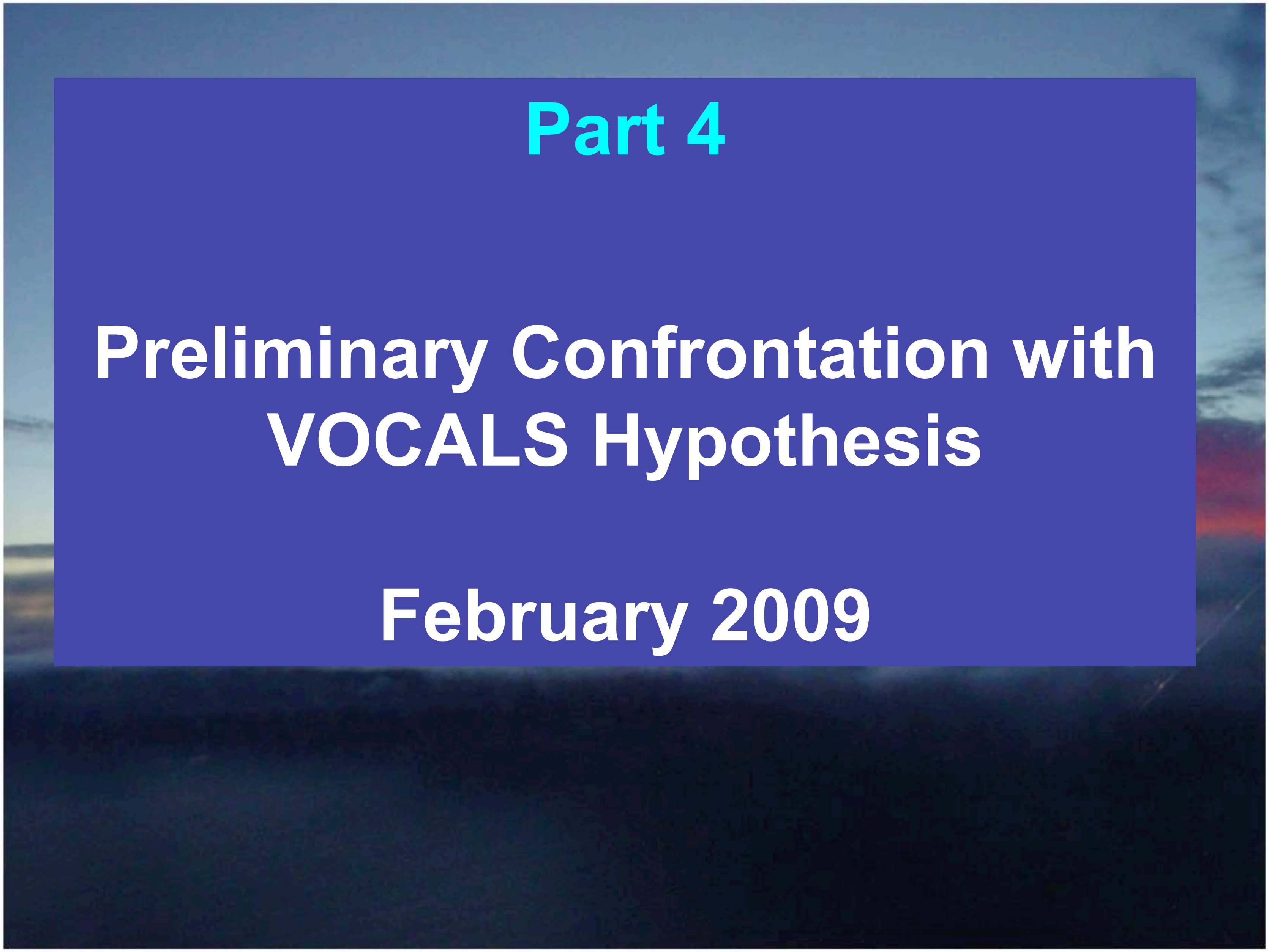
Part 4
Preliminary Confrontation with VOCALS Hypothesis
February 2009

Preliminary Confrontation of VOCALS Hypotheses with Rex Observations

Aerosol-Cloud-Precipitation Hypothesis #1: Variability in the physicochemical properties of aerosols has a measurable impact upon the formation of drizzle in stratocumulus clouds over the SEP

Synthesis: REx and recent CloudSat observations support this hypothesis. In areas with higher accumulation mode aerosol concentrations (or, alternatively higher droplet concentrations), stratocumulus clouds of a given liquid water path (LWP) drizzle less. However, LWP is also a critical control on drizzle.

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Aerosol-Cloud-Precipitation Hypothesis #2: Precipitation is a necessary condition for the formation and maintenance of pockets of open cells (POCs) within stratocumulus clouds.

Synthesis: All POCs sampled in REx contained drizzling cells, but the surrounding overcast stratocumulus commonly also supported some drizzle. Thus drizzle seems necessary, but not sufficient, to cause transition of closed-cell convection into a POC.

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Aerosol-Cloud-Precipitation Hypothesis #3: 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 (CCN).

Synthesis: Measured cloud droplet concentrations were closely correlated with those of accumulation mode aerosol particles. Such aerosols mainly seemed to derive from pollution injected into the boundary layer at the coast, but entrainment of thin tongues of high SO_2 (and other mainly gaseous pollutants) far offshore may also promote the growth of Aitken mode aerosol particles to CCN size.

Atmospheric DMS concentrations were not strongly elevated near the coastal upwelling zone. Atmospheric photochemical destruction of DMS, however, seemed to be the dominant source of new sulfate far offshore, dominating SO_2 entrainment from the free troposphere in some cases.

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Aerosol-Cloud-Precipitation Hypothesis #4: Depletion of aerosols by coalescence scavenging is necessary for the maintenance of POCs.

Synthesis: All POCs exhibited much lower CCN concentrations than in the surrounding regions, and air exiting from their cloudly updrafts was often observed to be nearly entirely cleansed of all condensation nuclei of any size.

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Coupled Ocean-Atmosphere-Land Hypothesis #1: Oceanic mesoscale eddies play a major role in the transport of heat and fresh water from coastally upwelled water to regions further offshore.

Synthesis: Oceanic mesoscale eddies were surveyed. Work with very high resolution coupled GCMs supports this hypothesis. Detailed comparisons of observations and simulations are under way.

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Coupled Ocean-Atmosphere-Land Hypothesis #2: By changing the physical and chemical properties of the upper ocean, upwelling has a systematic and noticeable effect on aerosol precursor gases and the aerosol size distribution over the SEP.

Synthesis: DMS concentrations were not strongly elevated near the coastal upwelling zone. However, photochemical destruction of DMS seemed to be dominant source of new sulfate far offshore, dominating SO_2 entrainment from the free troposphere. Analysis of oceanic photochemical DMS destruction observations is under way.

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Coupled Ocean-Atmosphere-Land Hypothesis #3: The diurnal subsidence wave ("upsidence wave") originating in northern Chile/southern Peru has an impact upon the diurnal cycle of clouds that is well-represented in numerical models.

Synthesis: A detailed examination of ship radiosondes and preVOCA/VOCA model output is under way.

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Coupled Ocean-Atmosphere-Land Hypothesis #4: The entrainment of cool fresh intermediate water from below the surface layer during mixing associated with energetic near-inertial oscillations generated by transients in the magnitude of the trade winds is an important process to maintain heat and salt balance of the surface layer of the ocean in the SEP.

Synthesis: No progress reported so far.