2. Evolution of the 5-day forecasts

We initialize CAM every 6 hours with the ECMWF analyses for the period October 11-22, 2001. For each initialization, we run the model for 5 days obtaining an ensemble of forecasts with various features. However, individual forecasts can be grouped into 2 typical behaviors: either CAM maintains the PBL or the PBL collapses. To illustrate this, we examine 2 typical forecasts starting on October 16 at 0UT (PBL maintained) and October 20 at 0UT (PBL collapsed).

Forecast of the PBL and cloud layer
The 2 versions of the model CAM3 and CAM3-UW show similarities. In both models, the PBL collapses (maintains) for the Oct 16 (Oct 20) initialization. When the PBL collapses, the model becomes very moist near the surface. There are differences between the 2 versions of the model:
- CAM3 produces an unrealistically thick layer of clouds that sometimes extends to the surface. CAM3 produces some ‘empty’ clouds (clouds with very low or no liquid water content).
- CAM3-UW clouds are more realistic and by on a single level. CAM3-UW better represents the diurnal cycle of the PBL due to the entrainment of dry air at the top of the PBL. When the PBL collapses, the cloud fraction and cloud water in CAM3-UW go to zero.

Forecast framework
In the CAPT protocol, we realistically initialize CAM with analyses and we then run the model in forecast mode to determine the drift from the analyses and/or available field data. This method allows us to diagnose model parameterization deficiencies.

3. Moisture budgets

We have made a detailed analysis of the budget terms of temperature, moisture and cloud water. As an illustration, we consider the terms of the moisture budget. The moisture equation can be written as:
\[ \frac{\partial q}{\partial t} = - \nabla \cdot \mathbf{V} q + \frac{\partial}{\partial z} \frac{\partial q}{\partial z} + PAR \]

where TOT is the total tendency, \( \nabla \cdot \mathbf{V} \) is the advection term (sum of the horizontal and vertical advection) and PAR represents the subgrid scale parameterization term. We separate the parameterization term into its components:

- **PAR** = **PBL** + **SHALLOW** + **CLDWAT** + **DEEP**

  - **PBL** is the moisture tendency due to the PBL scheme.
  - **SHALLOW** is the tendency coming from the shallow convection including the evaporation of shallow convective precipitation.
  - **CLDWAT** is the tendency coming from the prognostic cloud water scheme, which includes the conversion between vapor and condensate in the stratus cloud and the evaporation of falling precipitation and cloud water sedimentation.
  - **DEEP** is the deep convection tendency (not active for the EPIC column).

October 16 initialization (PBL maintained)
In CAM3 and CAM3-UW, the advection term dries the PBL of the PBL while the parameterization term moistens it. The 2 models show similar patterns for these 2 terms. However, separating the parameterization term into its components reveals that the mechanism for moistening the PBL is different between the 2 models. CAM3 and CAM3-UW go to zero.

October 20 initialization (PBL collapses)
When the PBL collapses, the scheme turns off in CAM3 and the PBL scheme weakens in CAM3-UW.