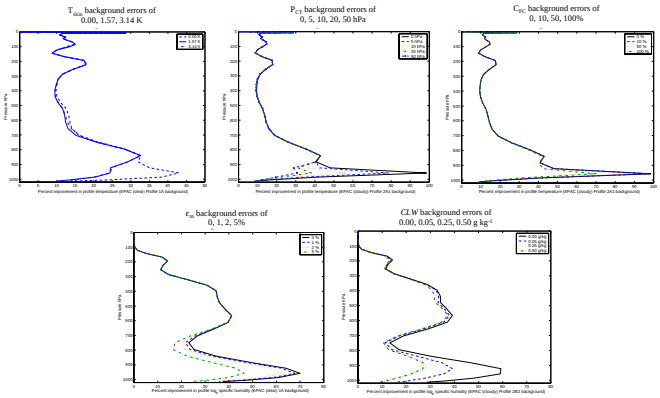
Retrieval Error Sensitivity

- P calculated with respect to surface and cloud errors in $\mathbf{B}_C$



Key Results

Near-surface profile T retrieval can be improved by prior knowledge of T_{skin}

HIR/3 surface channels (e.g., Ch 8) provides T_{CT} information

Profile T retrieval is very sensitive to P_{CT} and C_{FC} error

AMSU-B Ch 2 (150 GHz) provides majority of low-level q information

q retrieval is very sensitive to ε_m and *CLW* error

Part II: 1DVAR RETRIEVAL STUDY

NRL 1DVAR Non-Linear Minimization Equation

$$\mathbf{x}_{i+1} = \mathbf{x}_i + \mathbf{B}\mathbf{H}_i^T [\mathbf{H}_i \mathbf{B}\mathbf{H}_i^T + \mathbf{R}]^{-1} [\mathbf{y}^o - \mathrm{H}(\mathbf{x}_i) + \mathbf{H}_i \mathbf{x}_i - \mathbf{H}_i \mathbf{x}^b]$$

Simulated 1DVAR Retrievals

- Simulated ATOVS observations ($\mathbf{y}^o_s$) and simulated background state vectors ($\mathbf{x}^b$) ($N = 1000$)
  - "True" profile $\mathbf{x}^t$ is set of representative EPAC $\mathbf{x}^b$

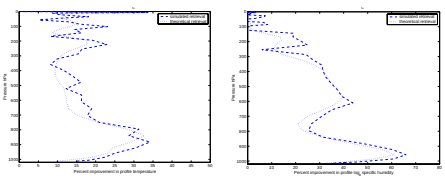
$$\mathbf{x}^b = \mathbf{x}^t + \sum_j \gamma_j \sqrt{\lambda_j}\, \mathbf{B}_j^* \qquad \mathbf{y}_s^o = H(\mathbf{x}^t) + \sum_j \gamma_j \sqrt{\lambda_j}\, \mathbf{R}_j^*$$

  - P compared for error statistics of converged solutions (σ_r^2) versus theoretically derived values ($\mathbf{S}_I$)

$$\sigma_r = \left[\left\langle (\mathbf{x} - \mathbf{x}^t)^2 \right\rangle - \mu^2 \right]^{1/2} \qquad \mathbf{S}_I = \mathbf{B} - \mathbf{B}\mathbf{H}_i^T \left[\mathbf{H}_i \mathbf{B}\mathbf{H}_i^T + \mathbf{R} \right]^{-1} \mathbf{H}_i \mathbf{B}$$

Key Result

Good agreement between theoretical and iterated solution



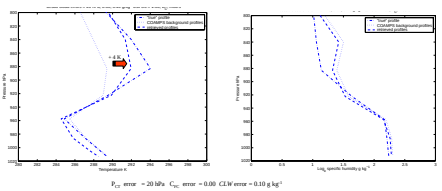
- Simulated ATOVS observations and DYCOMS II COAMPS™ short-term forecast fields
  - IR and MW channels included
  - VT 0900Z 11 July 2001
  - Collocated ECMWF profile as $\mathbf{x}^t$
  - COAMPS™ 9-hr forecast fields as $\mathbf{x}^b$ ($N = 660$)

Key Results

Satellite-derived information adjusted profile T and $\log_e q$ retrieval toward designated true profile.

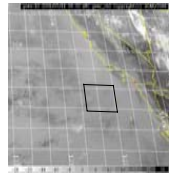
4 K change in profile T above P_{CT}

$\log_e q$ profile adjusted toward "truth"



1DVAR Retrievals

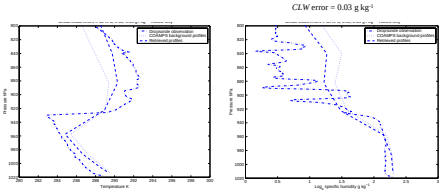
- ATOVS observations and DYCOMS II COAMPS™ short-term forecast fields
  - MW channels only
    AMSU-A and B observations from NOAA-16
    Averaged over inner model domain
    No bias corrections applied
  - VT 0900Z 11 July 2001
  - COAMPS™ 9-hr forecast fields as $\mathbf{x}^b$ ($N = 660$)
  - Retrievals compared with collocated dropsonde observation



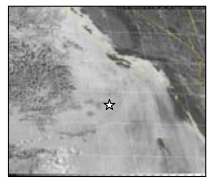
Key Results

Satellite-derived information adjusted profile T and $\log_e q$ retrieval toward observed in-situ values.

Quality of q retrieval is highly dependent upon prior knowledge of *CLW*.



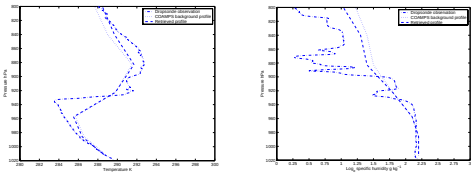
- ATOVS observations and COAMPS™ / NAVDAS forecast system
  - MW channels only
    AMSU-A and B observations from NOAA-16
    Bias corrected (AMSU-A)
  - 18 km, single nested domain corresponding to the DYCOMS II outer area
  - Real data model simulation
  - 6-hr forecast field VT 12Z 11 July 01
  - 4, 550 "successful" retrievals
  - Comparison with collocated dropsonde and NESDIS retrieval



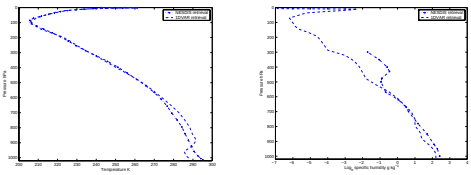
Key Results

Satellite-derived information adjusted profile T and $\log_e q$ retrieval toward observed in-situ values.

Smaller adjustment:
- model run closer to truth
- bias corrected observations



- 1DVAR retrieval versus NESDIS Retrieval



Key Results

Collocated NESDIS retrieval lacks MABL structure.

1DVAR retrieval with COAMPS™ background is better choice for data assimilation.

Summary

Analyses of information content and theoretical retrieval performance showed that, when treated optimally, significant humidity and temperature information can be derived from ATOVS retrievals within the clear and cloudy sky summertime EPAC environment.

The 1DVAR results are consistent with the theoretical information content study and indicate that these satellite observations can provide information that, when used in concert with COAMPS™ short-term forecasts, reduce the retrieval error and adjust the retrieval within the shallow boundary layer toward the designated "true" profile.

A study of theoretical retrieval error sensitivity to representative EPAC background state vector elements and associated errors established the *a priori* elements critical for successful 1DVAR retrievals.

The generally good agreement between theoretical retrieval errors and the error statistics calculated using non-linear iteration demonstrates the consistency and reliability of the NRL 1DVAR retrieval scheme.

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