Progress in modeling efforts related to radiance assimilation of water vapor, clouds, and precipitation

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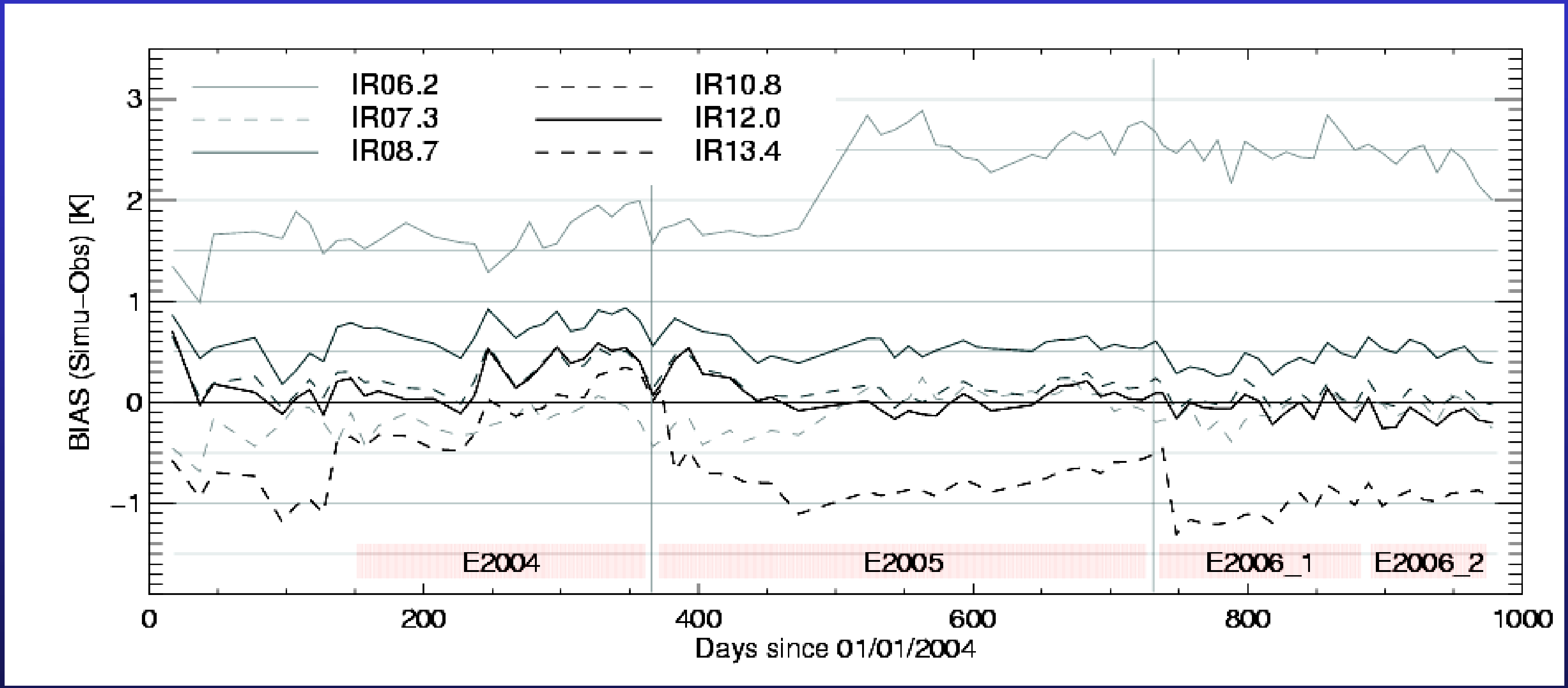
Outline

- Introduction
- The SOI Model - Status
- Water vapor from SEVIRI
- Cloud/precipitation overlap parameterization
- Future plans

The Successive Order of Interaction (SOI) radiative transfer model

- Fast forward IR and MW RT models (SOI) developed and tested.
- Tangent linear and adjoint model developed and tested.
- Model fully integrated in JCSDA CRTM
- Application examples:
    - Bias monitoring and water vapor retrieval in IR
    - MW precipitation/cloud overlap parameterization for NWP

Infrared: Global SEVIRI IR bias monitoring against NCEP/GFS



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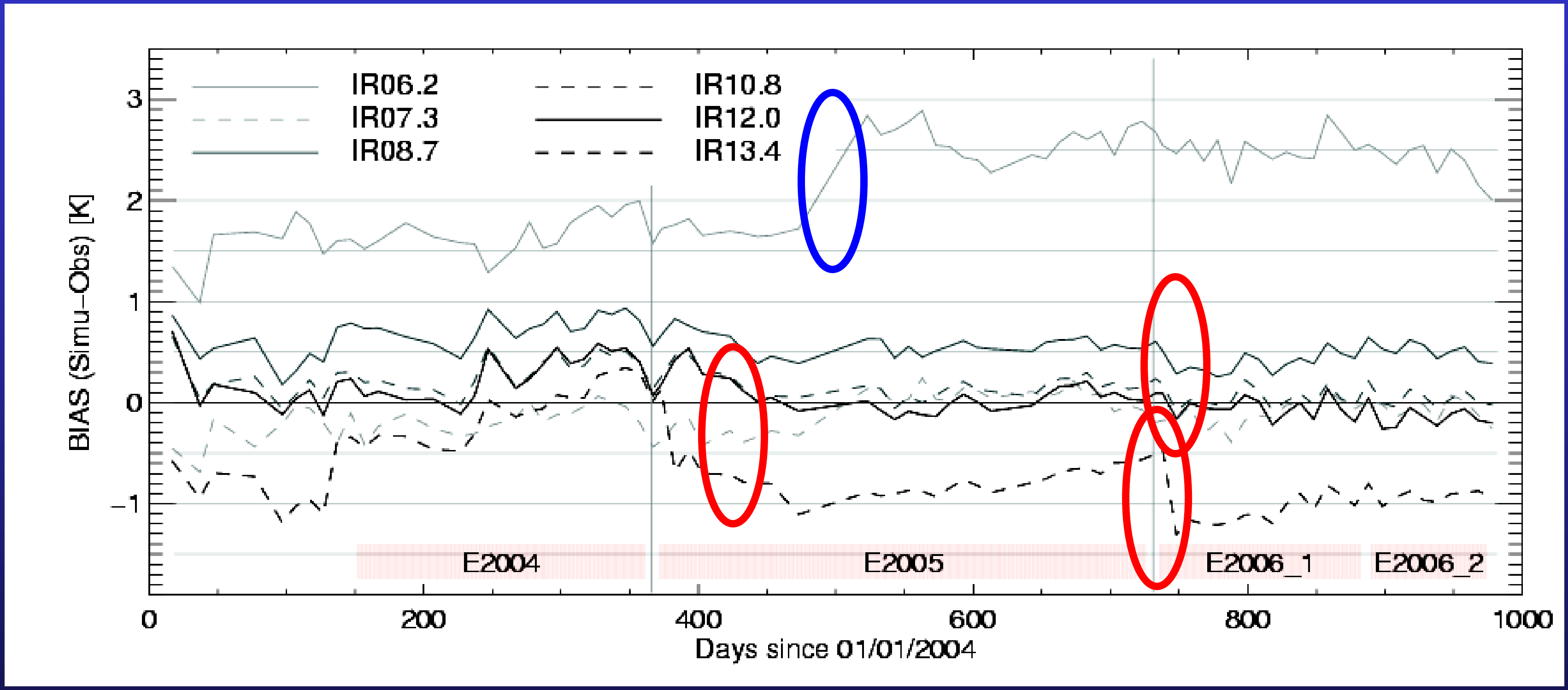
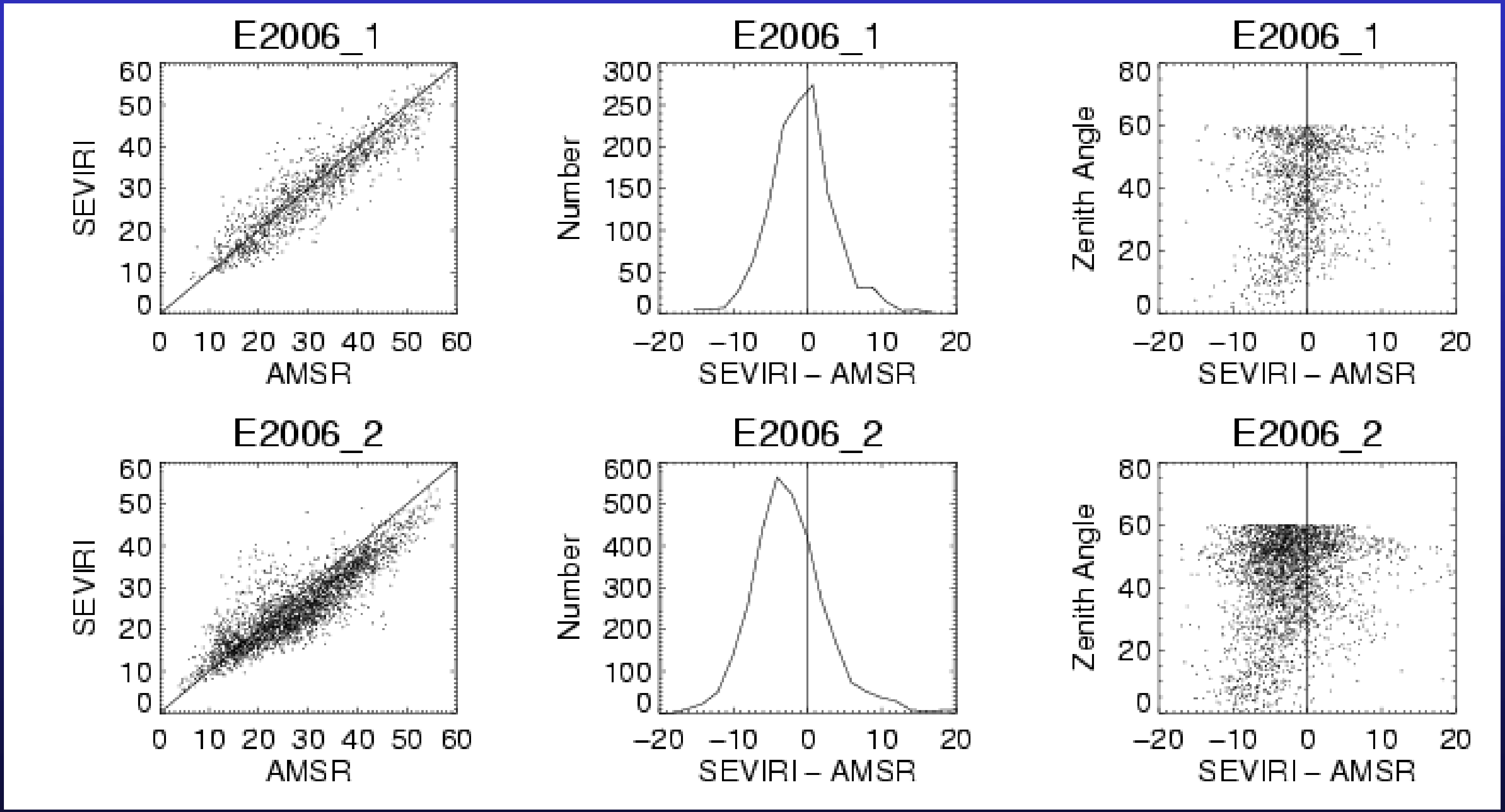


Optimal estimation of water vapor from SEVIRI

- Derives integrated water vapor, layer water vapor, and surface temperature
- From SEVIRI window and WV channels
- Integrated into EUMETSAT Climate-SAF

Optimal estimation of water vapor from SEVIRI

Water vapor column amount over water compared to passive microwave AMSR-E



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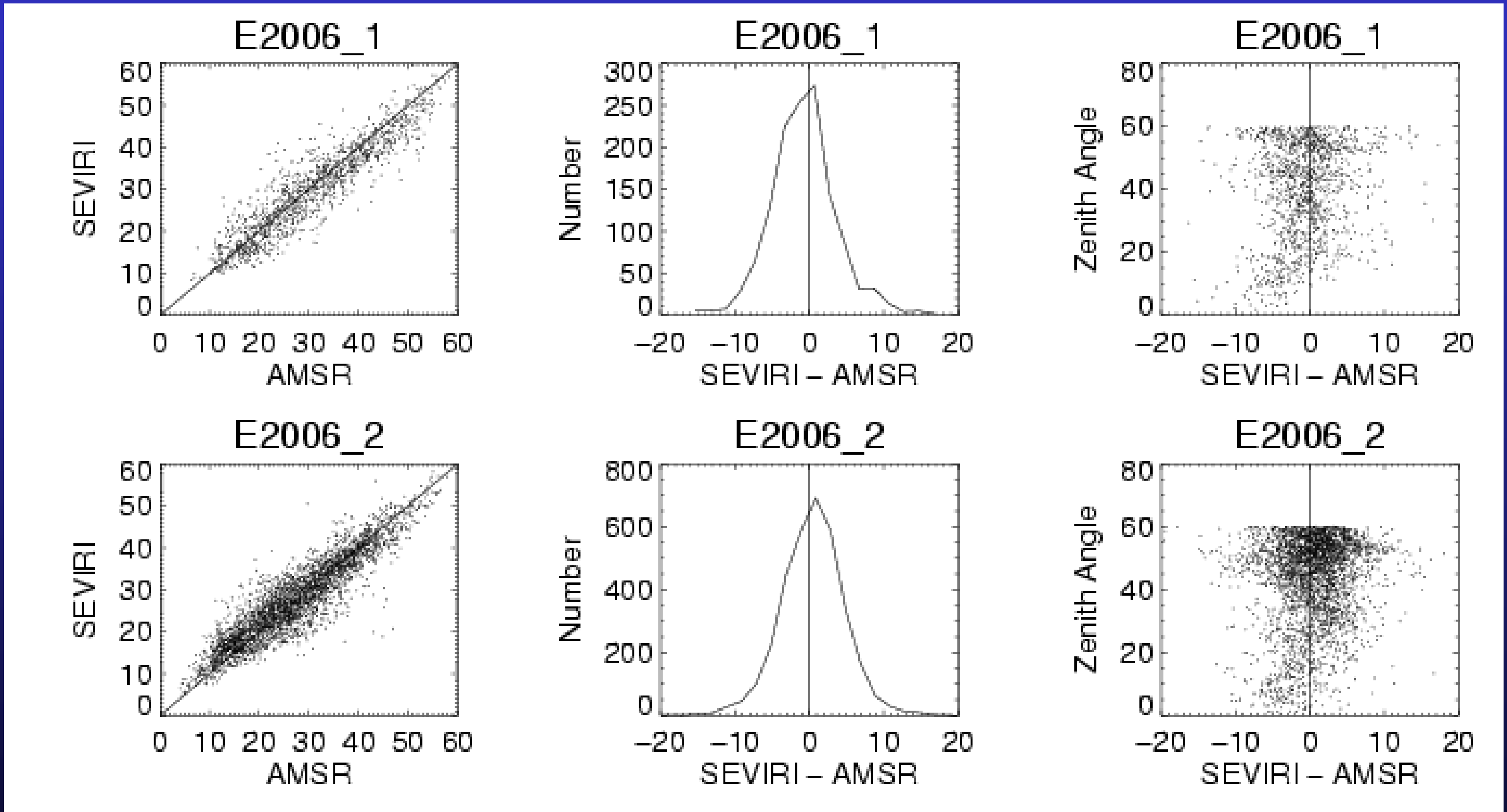


After 0.25 K bias correction in 8.7 micron channel

Optimal estimation of water vapor from SEVIRI

- Slight bias of window channel correction changes BIAS in WV retrieval from -2.5 kg/m^2 to 0.4 kg/m^2

- Absolute calibration and spectral dependency (differences of window channels are giving most information about water vapor column)

- High demands on spectral accuracy of surface emissivity. Land surfaces…..

- We need to think about better ways to integrate LSE into retrieval

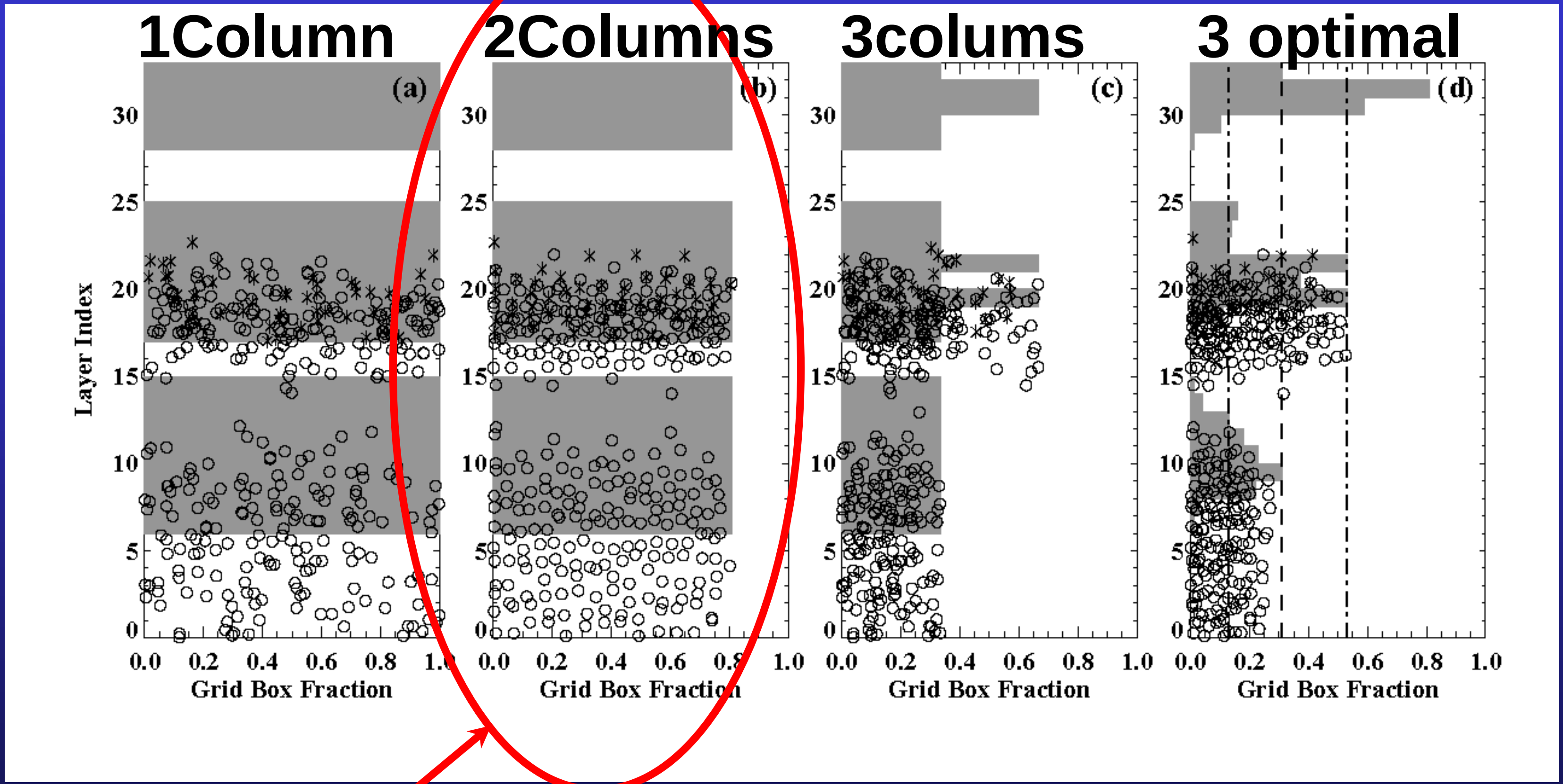
Forward modeling errors in microwave radiance assimilation of clouds/precipitation

- Uncertainties in gas absorption properties
- Radiative transfer solver
- Higher frequencies: Scattering of ice particles
- 3D/beam filling errors
- Handling of cloud overlap in forward model

Different cloud/precipitation overlap models

- Conventional approach uses cloud cover to subdivide NWP pixel in cloudy/precipitation
- New approach derives two/three optimal columns based on subscale distribution of precipitation columns with similar optical properties
- Numerically efficient (2-3 radiative transfer calculations per NWP grid point)
- Highly accurate against independent column/MR-overlap reference
- Optimal approach reduces errors due to cloud overlap from maximum values of 5-10 K to values < 1K

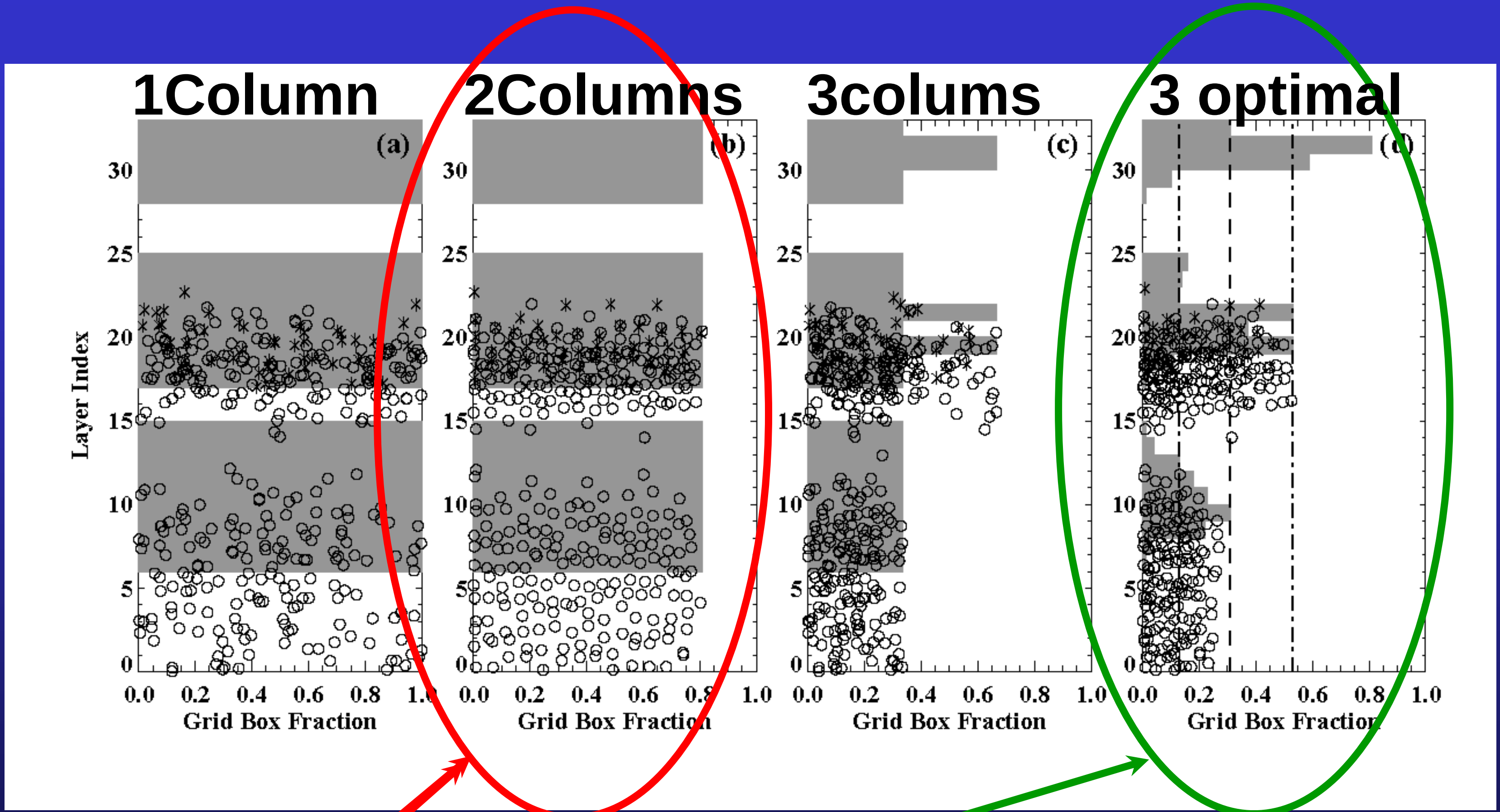
Different cloud/precipitation overlap models



Currently operational at ECMWF

O'Dell, Bauer, Bennartz, JAS, 2006

Different cloud/precipitation overlap models



Currently operational at ECMWF

New scheme with much better error characteristics

O'Dell, Bauer, Bennartz, JAS, 2006

Outlook

- Further development/refinement and integration of SOI into CRTM.
- Address errors/uncertainties/biases associated with various cloud microphysics parameterizations in different numerical models
- Expand work in infrared to infrared/application to AIRS.