Conversion of NO_2 slant column into vertical column

Summary of recent work

OMI NO_2 SP2 Algorithm Development Team
NASA Goddard Space Flight Center

Key Elements in Estimating Trop AMF

- Stratospheric Subtraction
- Surface Reflectance
- Cloud Correction
- Aerosol Correction
- NO_2 Vertical profile

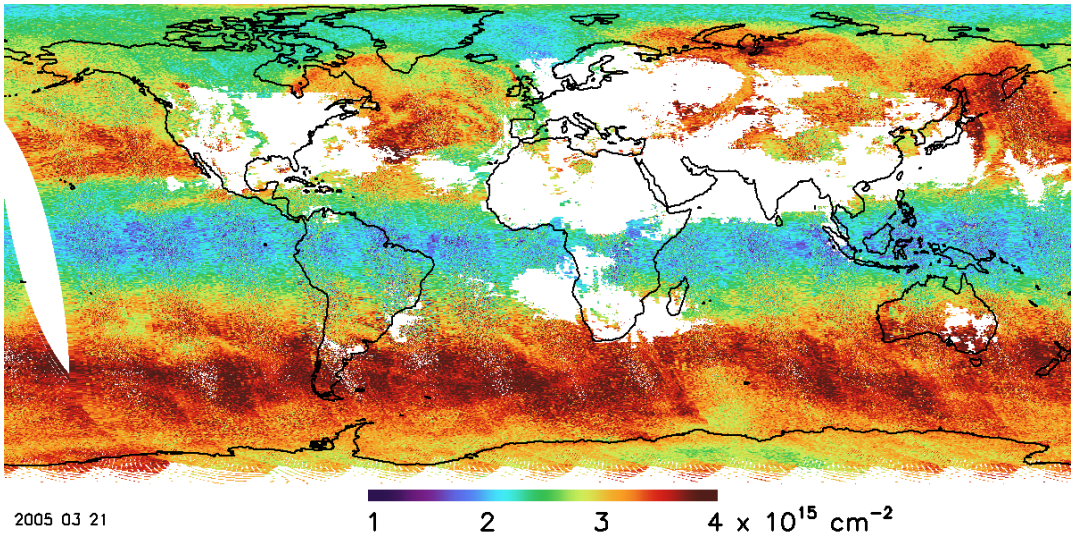
Stratospheric NO_2

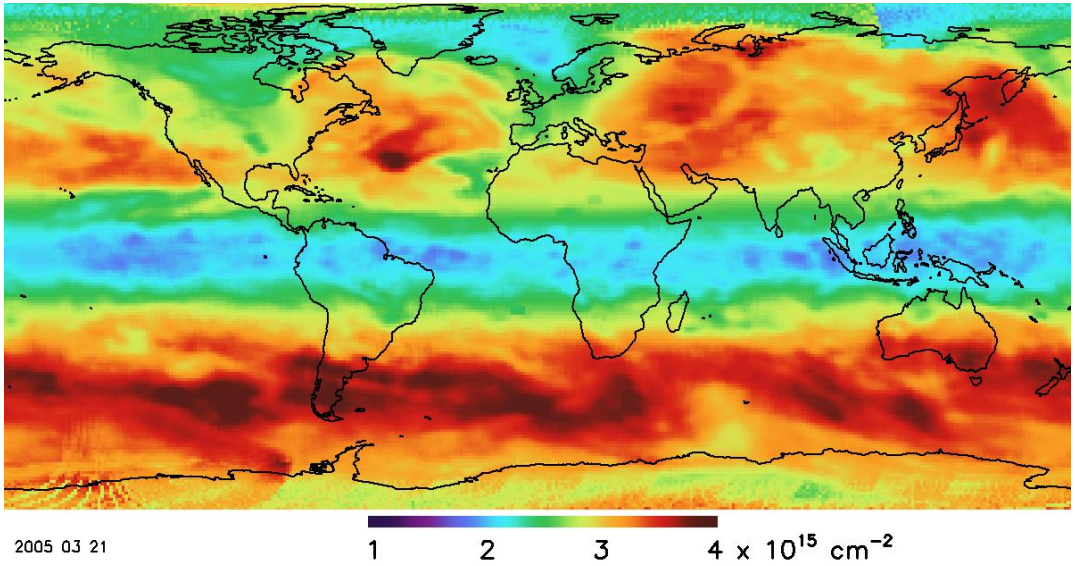
- 30-100% of total slant column
  - Slant column fraction is larger than for vertical column due to smaller trop AMF
- Longitudinal variability
  - can be large at Korean latitudes
- Diurnal variability
  - Problem is more serious for GEO than for sun-synchronous LEO

Methods of estimating strat NO_2

- Use CTM with assimilated winds
  - Normalize to the measurements taken in the Pacific or assimilated satellite data
  - CTM accounts for diurnal variability
- Derive from OMI data
  - Mask polluted areas using CTM and degree of cloud cover
  - Interpolate and smooth unmasked areas
  - Separate estimate of diurnal variability not req'd

Determination of Strat Field from OMI data

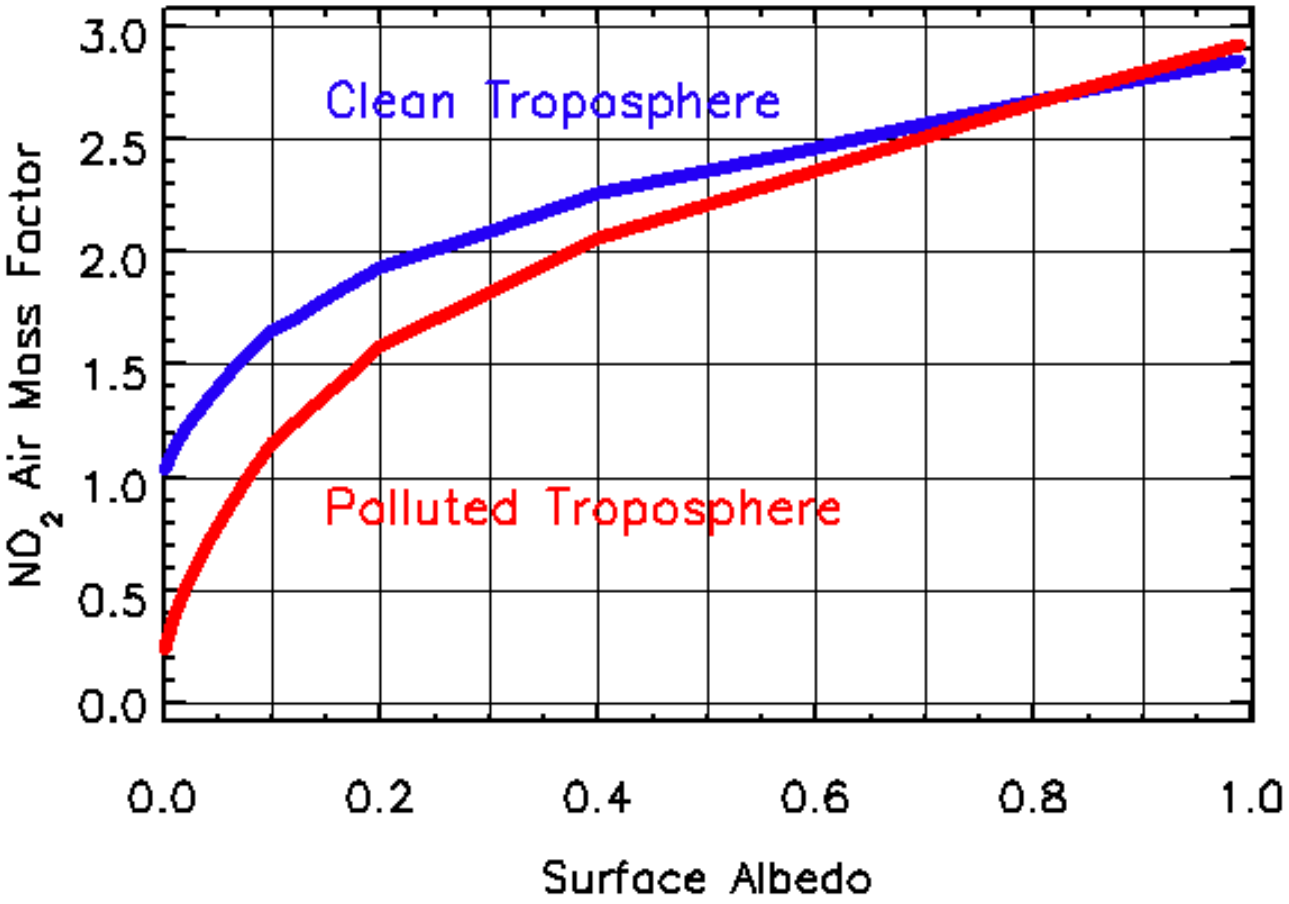




Issues:

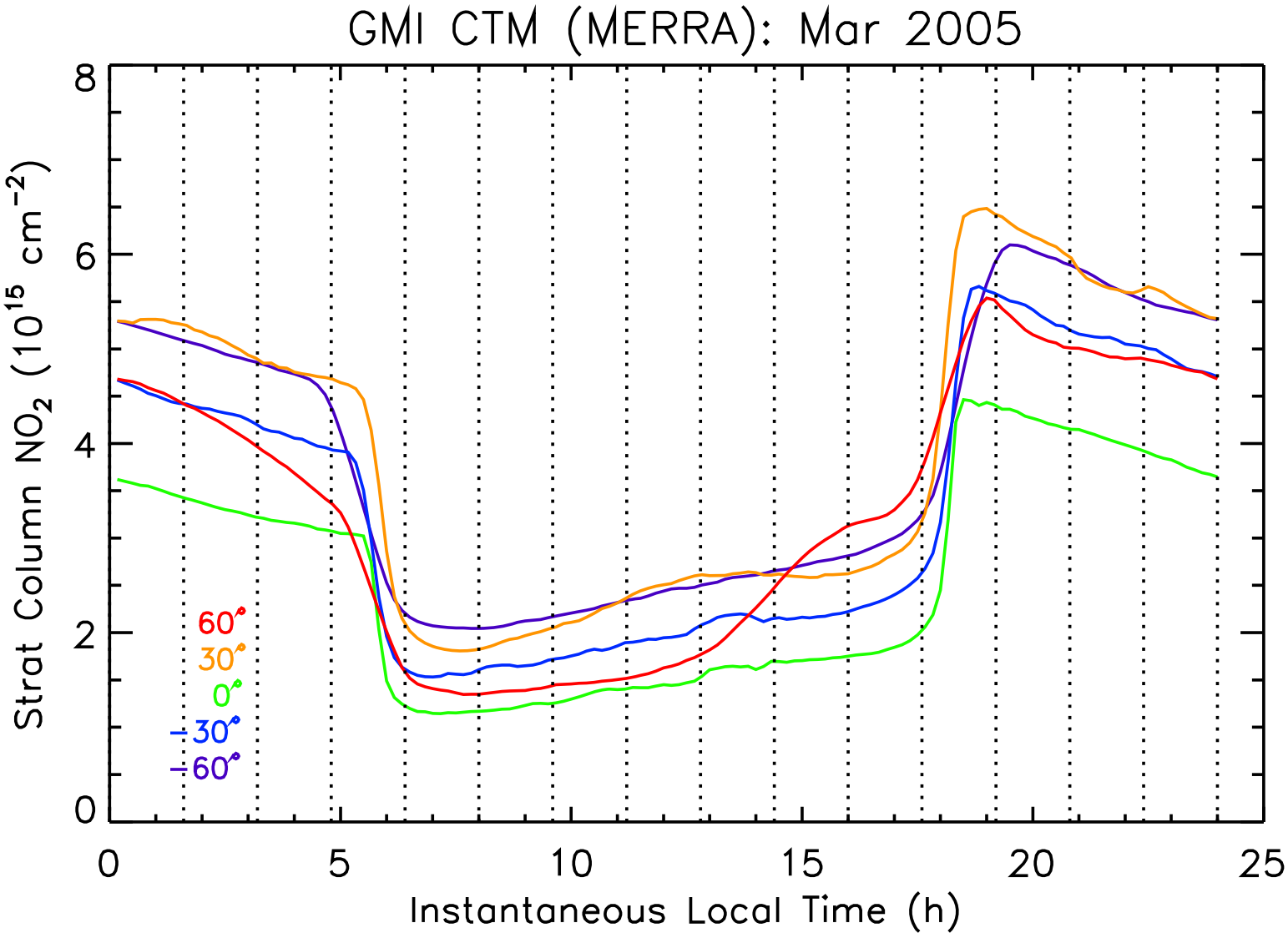
1. Large areas west of Korea are masked, so uncertainty in estimating strat NO2 may be larger
2. Large variability near Korea

Reflectance Effect



AMF varies by factor of 10, if one includes snow/ice pixels

Diurnal Variability of Stratospheric NO_2



Cloud Effect

- Need to know the fraction of radiation scattered by clouds, not cloud fraction
  - Varies not just with cloud properties but also by surface reflectance and Rayleigh path radiance
  - Cloud radiance fraction (CRF) technique developed by the OMI team works very well, except in presence of snow/ice
- Cloud height is important ONLY when clouds are below 2 km.

It is unlikely that cloud information from GOCI or AMI will help

Aerosol Effect

- Effect of aerosols and clouds differ primarily because they are at different heights
  - AOD effect is included in CRF, except for elevated smoke/dust.
- Effective cloud pressure derived from O_2-O absorption helps in reducing aerosol caused error
  - The effective pressure is higher when thick aerosols are present.
  - But this method needs further study.

It is unlikely that aerosol information from GOCI or AMI will help

NO_2 Vertical Profile

- NASA algorithm uses monthly climatology
  - derived from GMI model, which is based on GEOS-CHEM
  - driven by assimilated winds from NASA GSFC
  - Grid resolution is 2˚x 2.5˚
- Higher resolution model will be more useful for GEMS

Recommendation

- High res CTM driven by assimilated winds is essential for developing NO_2 algorithm
  - Needed for strat/trop separation & for providing vertical distribution
- Accurate surface BRDF data in the GEMS viewing area will need to be developed
- Better method for separating snow/ice from clouds needs to be developed
- Better method of handling aerosols is needed