ERA-40 Clouds for UV calculations

• 2.5 x 2.5 latitude/longitude grid
• 6 hour analyses
• two methods:
  – vertically integrated cloud water $\rightarrow$ cloud optical depth
    • instantaneous fields every 6 hours
    • grid box divided into clear and cloudy parts using total cloud cover
    • non-linearities cause problems
  – solar radiation diagnostics:
    • surface net solar radiation (SSR)
    • surface net solar radiation, clear sky (SSRC)
    • integrated sum over 6 hour forecast
    • ratio of SSR/SSRC $\rightarrow$ Cloud Modification Factor for full solar radiation
    • cloud effect in UV: modelling $\rightarrow$ $f(sza, SSR/SSRC,\ldots)$
OUTLINE

• CMF UV satellite vs. ERA-40
• CMF global radiation: ERA-40 versus obs (= $G_{\text{obs}} / G_{\text{cls_model}}$)
  – Daily sum
    • Jokioinen
    • Norrköping
    • Thessaloniki
    • Bilthoven
    • Potsdam
  – Annual sum
    • Potsdam
    • Bilthoven

• CMF error
  – As a function of CMF
  – As a function of day of year

• Conclusions
Mean over longitudes 0–30E during 1980–2000

Annual CMF$_{av}$

Summer (JJA) CMF$_{av}$

Annual Total Ozone

Summer (JJA) Total Ozone
Cloud Modification Factor, full solar radiation

Jokioinen 1995–2002

N = 2762
ME = 15.24%
RMS = 34.55%
corr. = 0.75

Norrköping 1983–2002

N = 3030
ME = 10.35%
RMS = 26.10%
corr. = 0.77
Cloud Modification Factor
full solar radiation
Bilthove 1965–2002

N = 1,3735
ME = +1.73%
RMS = 34.63%
corr. = 0.74
Cloud Modification Factor
full solar radiation
Potsdam 1958–2002

N = 16291;
ME = -10.49%
RMS = 33.84%
corr = 0.73
Bilthoven Annual CMF global radiation

Graph showing annual CMF global radiation for Bilthoven from 1960 to 2000.
Cloud Modification Factor
full solar radiation
Potsdam 1958-2002
Cloud Modification Factor
full solar radiation
Potsdam 1958–2002

CMF: Era–Obs

day of year
Mean yearly accumulated global radiation at 10 Swedish stations.

Relative difference: 100*(OBS-ERA40)/OBS.
conclusions

• quality of ERA-40 clouds?
  – available cloud parameters not enough to calculate COD
  – surface radiation diagnostics have some problems
  – $\text{CMF}_{\text{solar}}$ too high in comparison with all studied European sites
  – $\text{CMF}_{\text{uv}}$ higher than the TOMS data
  – Error in $\text{CMF}_{\text{solar}}$ depends on the cloud thickness, might be related to the difference in FOV
  – Correction of $\text{CMF}_{\text{solar}}$ ??
  – $\text{CMF}_{\text{uv}} = f(\text{sza}, \text{CMF}_{\text{solar}})$
  – Do we know enough about the geographical distribution?
Potsdam Annual global radiation
note: era is net, obs is downwelling
Potsdam Annual global radiation
note: era is net, obs is downwelling

\[ 100 \times \frac{\text{obs} - \text{era}}{\text{obs}} \]