# Comparison of Long-term Downward Radiation Observations at Tateno with JRA-25 and ERA-40 Data

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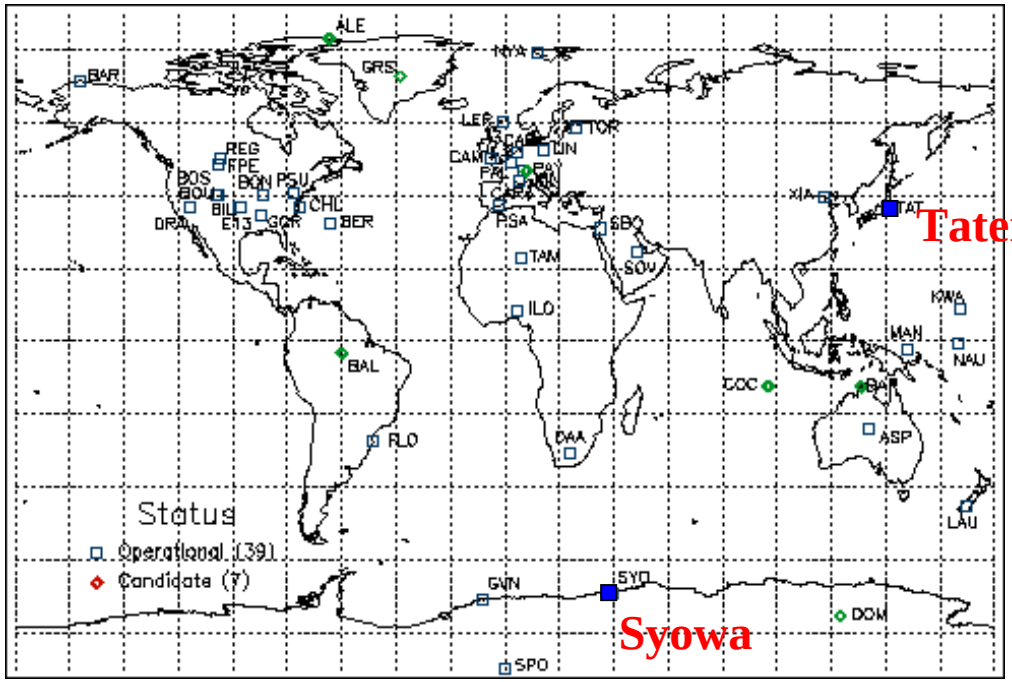
# Overviews of Radiation Observation at Tateno

- Aerological Observatory of Japan Meteorological Agency (Tateno) has been carrying out long-term observation shortwave and longwave radiation at surface since 1957, International Geophysical Year (IGY) .
- Tateno is one of the station of WCRP/GCOS Baseline Surface Radiation Network (BSRN) and has been providing accurate radiation data to researchers from 1996 via the BSRN data archive ( http://bsrn.ethz.ch/ ).



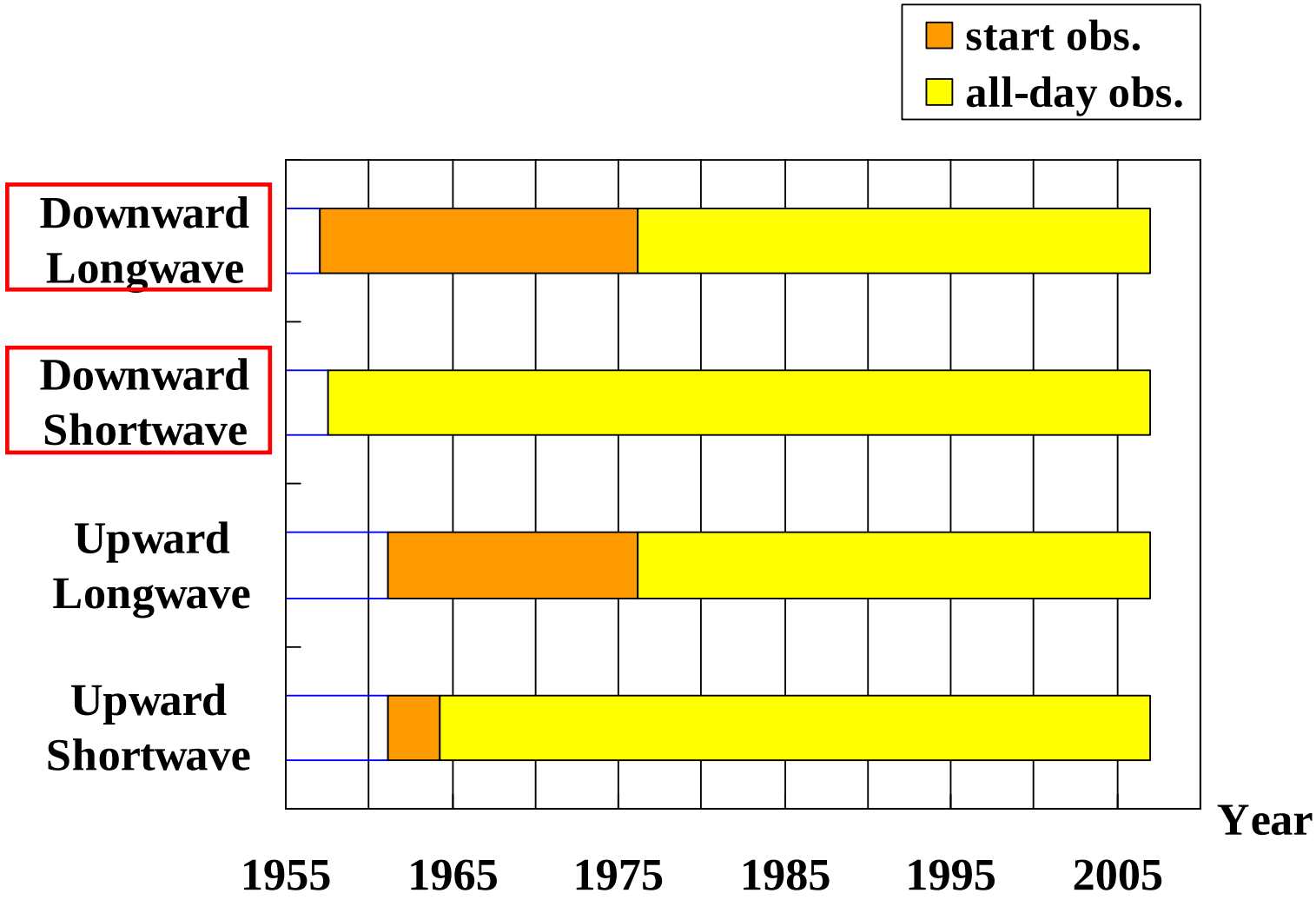

Running and Planned BSRN Stations (as of June 2006)


Aerological Observatory (Tateno)/JMA

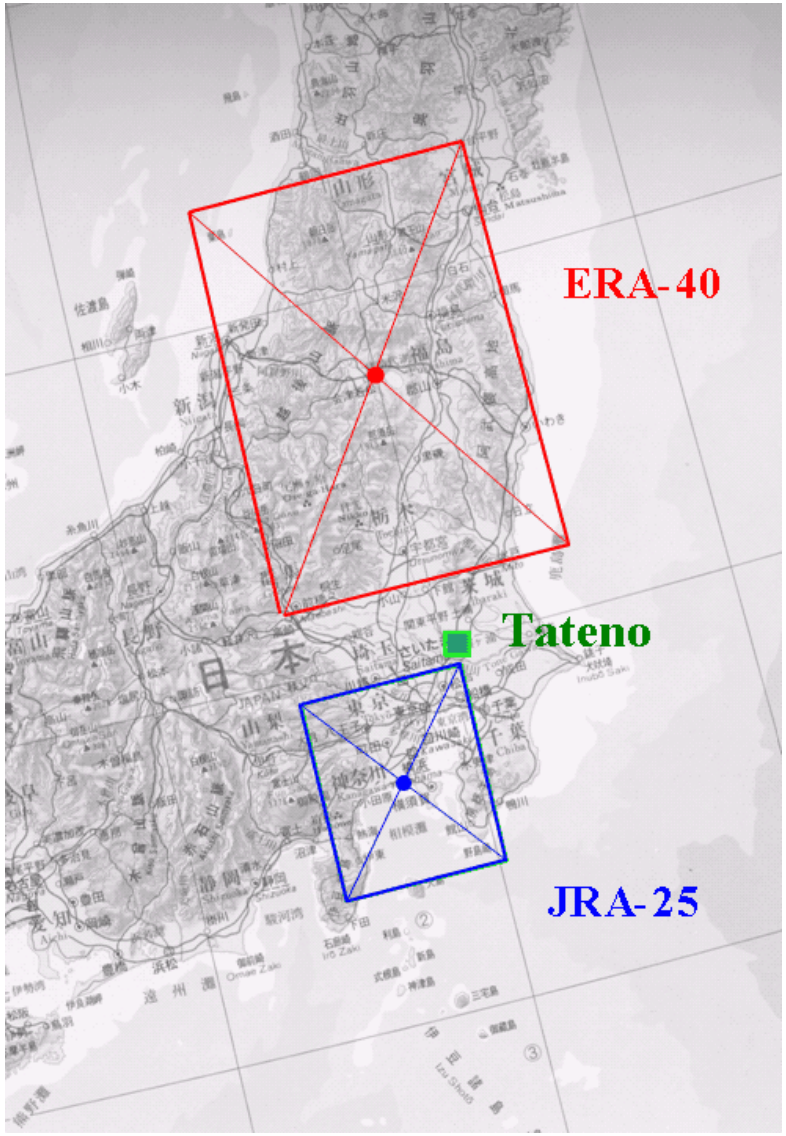

Upward components

Downward components

## • Data Periods at Tateno



# Conditions of Comparison between Tateno Observations and the Reanalyses Data




Location of Tateno and used grids of ERA-40 and JRA-25

## • Used Data in comparisons

– The nearest land grid point from Tateno is used in the comparisons.

- Tateno :

  36.050 deg. N,  140.133 deg. E
- JRA-25 grid center :

  35.327 deg. N,  139.500 deg. E (T106)
- ERA-40 grid center :

  37.500 deg. N, 140.000 deg. E (2.5x2.5deg.)

## • Used Data in comparisons

- Data Periods
  - JRA-25&Tateno : 1979-2004
  - ERA-40: 1979-2001
- Used Element Names of the Reanalyses Data
  - JRA-25: DSWRFsfc, DLWRFsfc (All Sky Comparison) ,
    CSDSFsfc, CSDLFsfc (Clear Sky Comparison)
  - ERA-40: SSRDsfc, STRDsfc (All Sky and Clear Sky Comparison)

Note: ERA-40 data under clear sky condition contain cloud effects, so we cannot discuss in detail about the comparison result of ERA-40 under clear sky condition.

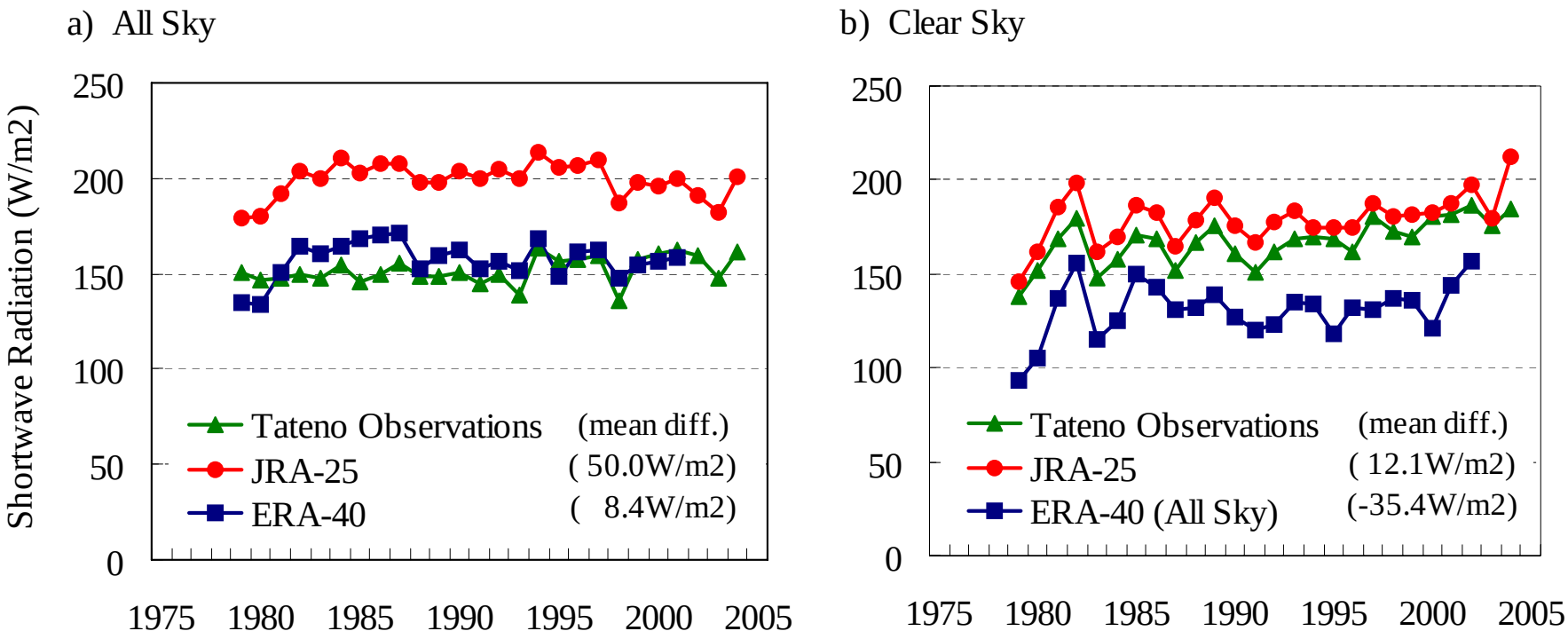
# Comparison of Downward Shortwave Radiation

– Before the comparison, the reanalyses data are converted to the value at Tateno according to the latitudes.

(multiplied by the ratio between the solar flux over Tateno and those over the center of the grids)

- Tateno : 36.050 deg. N
- JRA-25 grid center : 35.327 deg. N
- ERA-40 grid center : 37.500 deg. N

# • Annual Mean Downward Shortwave Radiation Comparison




- ERA-40 and JRA-25 denote the same tendency as Tateno observations.
- ERA-40 is well accorded with Tateno observations especially from the end of the 1980s under all sky condition.
- JRA-25 is well accorded with Tateno observations under clear sky condition although it has rather large difference (50.0W/m2) under all sky condition.
- This implies that JRA-25 underestimates cloud amount.

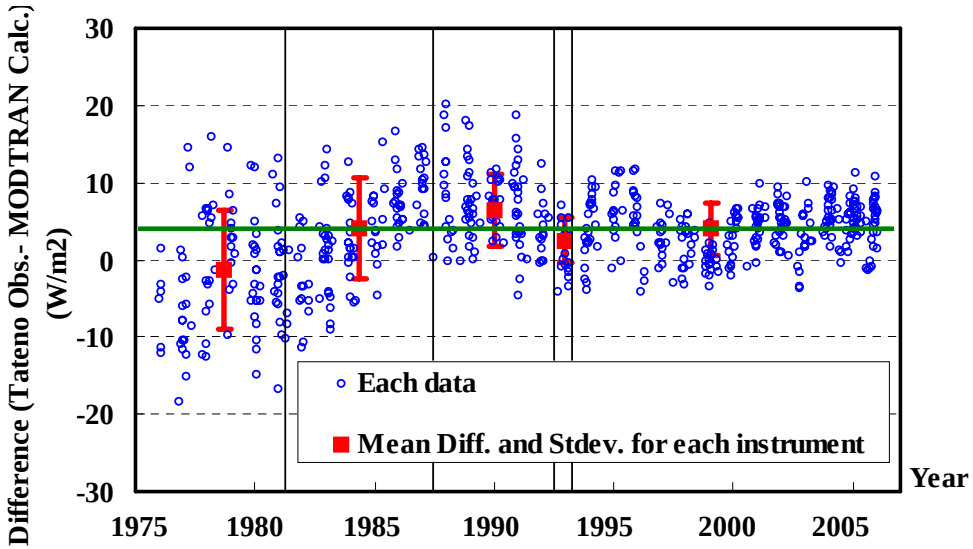
# Comparisons of Downward Longwave Radiation

## • Bias Correction of Tateno Observations

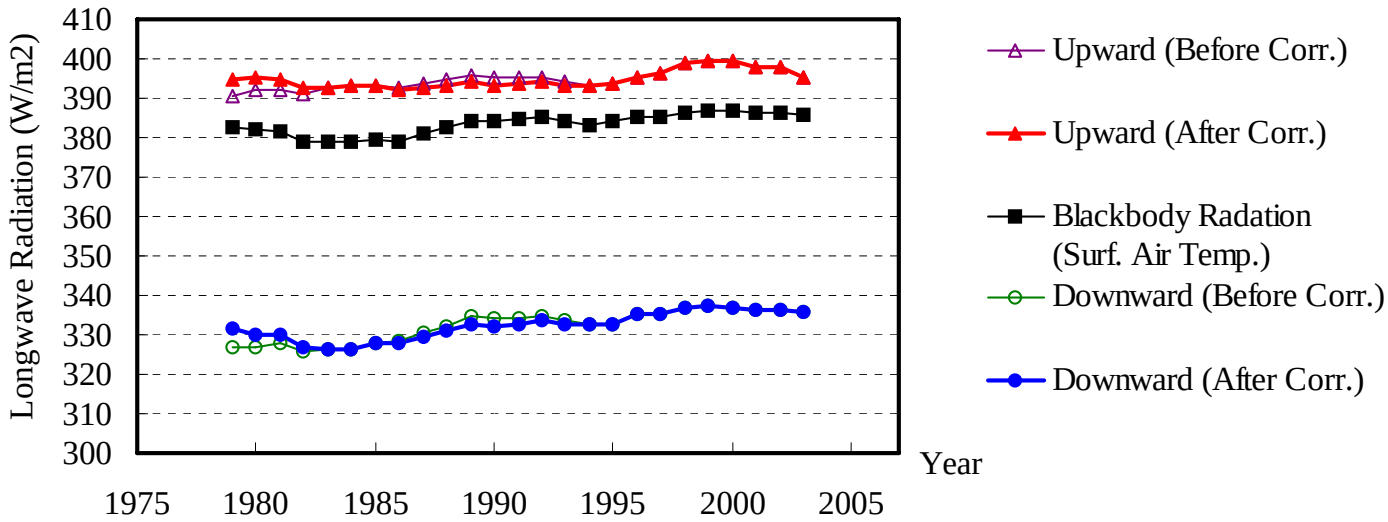
Tateno observations in nighttime (hourly mean data at 12UTC) under clear sky condition are compared with radiative transfer calculations and systematic biases due to instrument changes are corrected.

- Conditions of Radiative Transfer Calculation
  - Radiative Transfer Model:
    - MODTRAN
  - Temperature, Pressure and Water Vapor Profile:
    - Upper air data at Tateno at 12UTC(21LT).
  - CO2 :
    - Monthly average data in the mid latitude of the northern hemisphere (60 deg. N-30 deg. N) which are supplied by Atmospheric Environment Division of JMA.
  - Aerosol :
    - Only background stratospheric aerosol is taken into account.

# • Results of Bias Correction for Tateno Observations

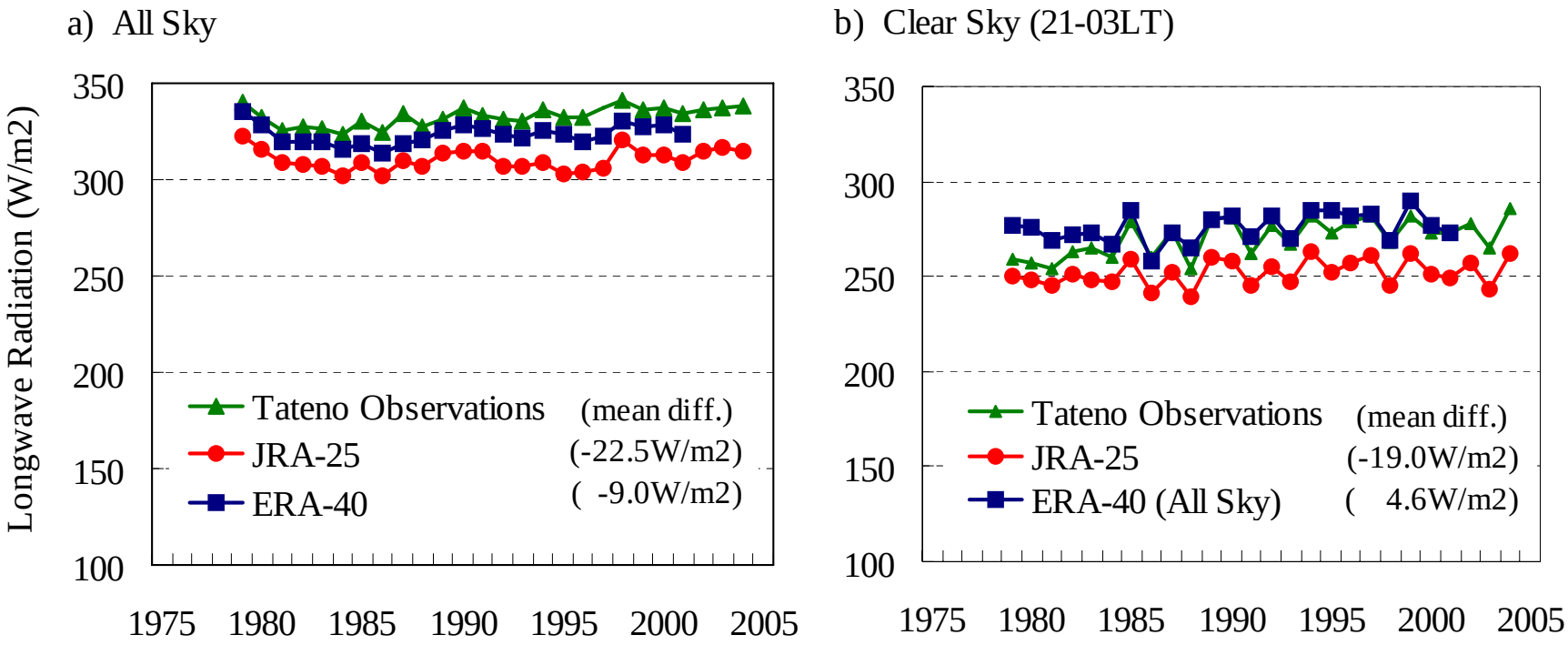



Bias for each type of instument is defined as deviation from the most recent type of instrument (green line in the figure).



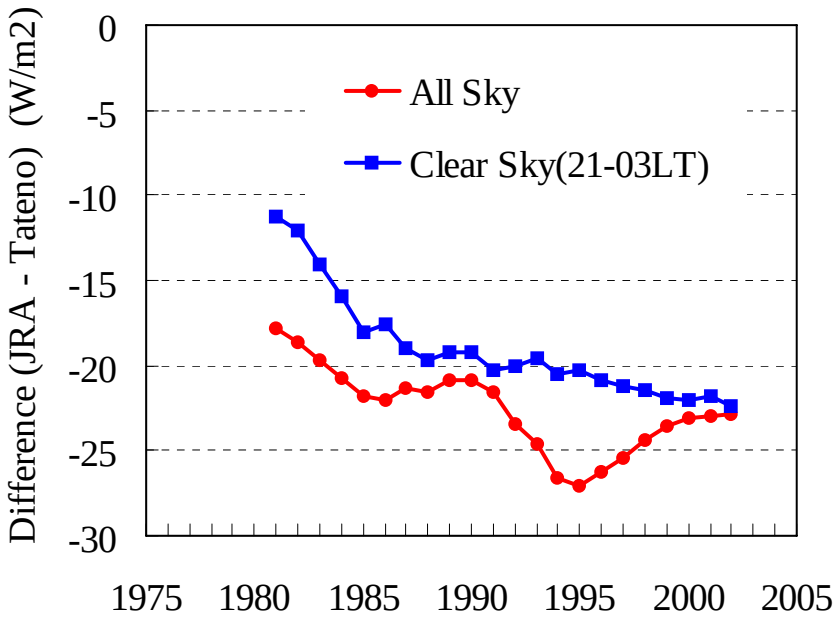

Comparisons between Tateno Observations and MODTRAN Calculations (Upper) and Results of Bias Correction (Lower)

# • Annual Mean Downward Longwave Radiation Comparison




- ERA-40 and JRA-25 denote the same tendency as Tateno observations with underestimation.
- JRA-25 seems to have larger underestimation than ERA-40.

## • Difference between JRA-25 and Tateno (5-year running mean)




Mean Difference
-22.5 W/m2 (All Sky)
-19.0 W/m2 (Clear Sky)

- The difference under all sky condition is greater than that under clear sky condition.
- This result is reasonable if JRA-25 underestimates cloud amount.
- The effect of cloud on longwave radiation (3.5W/m2) is smaller than that on shortwave radiation (37.9W/m2).

# Summary

- ERA-40 and JRA-25 have the same long term trend as Tateno observations in both shortwave and longwave radiation in general.
- ERA-40 is well accorded with Tateno observation with little differences except before middle of 1980s in shortwave radiation.
- Comparisons of shortwave radiation under all sky and clear sky imply that JRA-25 may underestimate cloud amount.
- This assumption is consistent with the results of longwave radiation comparisons under all sky and clear sky conditions for JRA-25.
- There exist differences between Tateno observations and the reanalyses.

  It may be due to cloud, radiation process in the model, and also atmospheric constituents which are not taken into account in the model such as CO2 and aerosol.

# Thank you!!