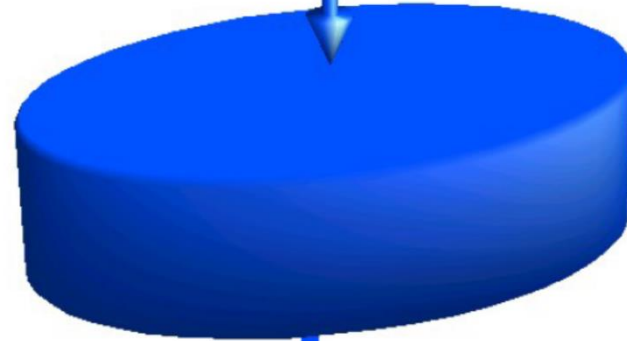


**Quasi real-time analysis of Solar radiation budget
using Geostationary Satellites with monitoring of
Solar thermal and Photovoltaic power generation.**

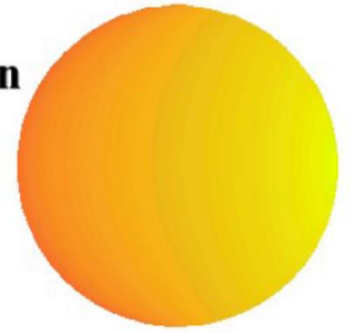
H.Takenaka, T.Nakajima, T.Y.Nakajima, T.Watanabe

Earth's Radiation Budget

Umbrella effect



Incoming
solar radiation



Thermal effect

Outgoing
terrestrial radiation



Advantages of Satellite data analysis for the Surface Solar radiation

“Cover the wide area”

Satellite data has a 2-Dimensional information.
Analysis algorithm is applied in wide area

“Independent system”

It does not require the connection to each ground points
Satellite is not disturbed by ground troubles

Analysis action items of solar radiation budget using Satellite for application of RE

“Hindcast”

Re-analysis of historic data

Solar energy potential map, Real Scenario

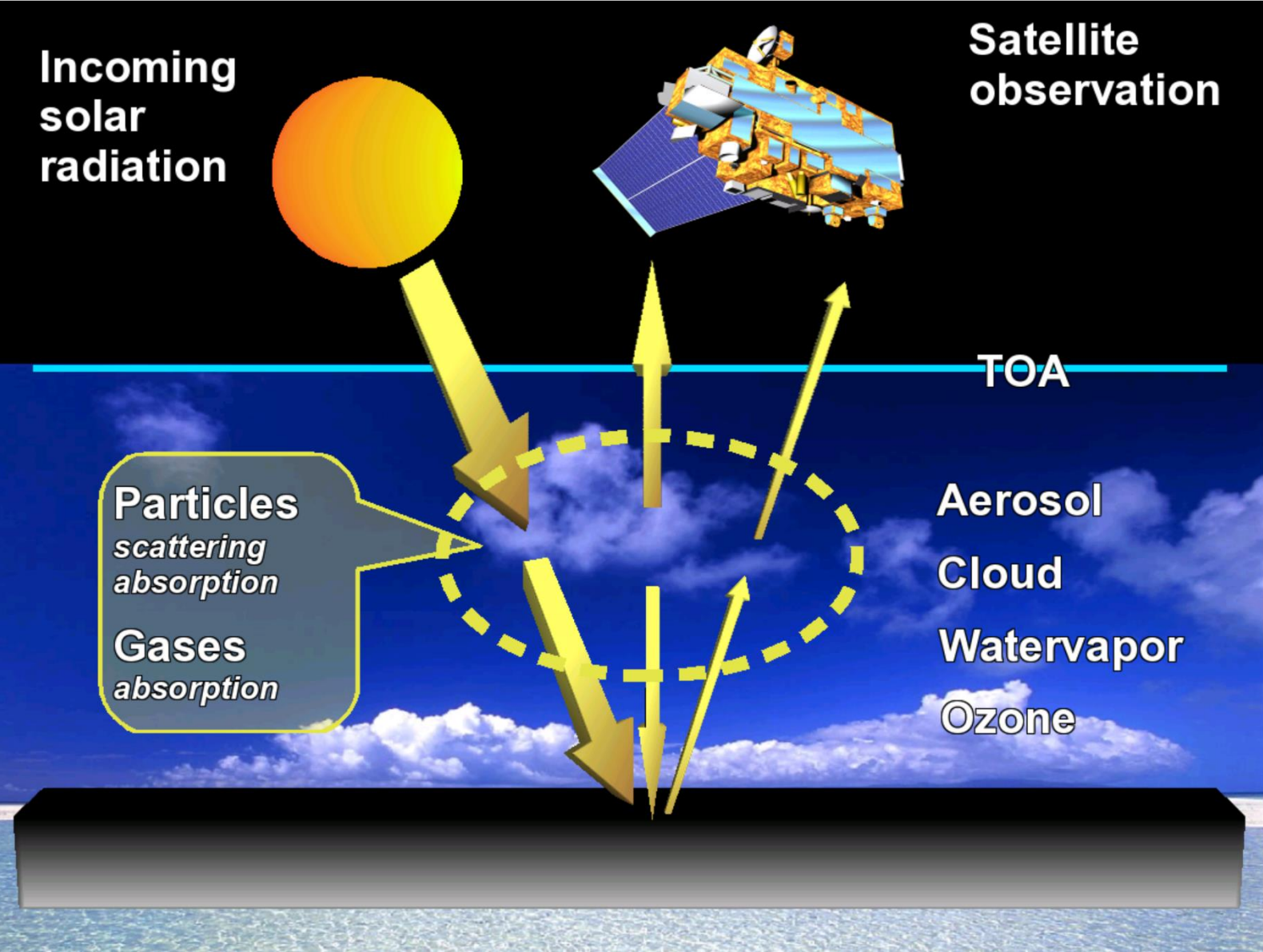
“Nowcast”

Monitoring of current status

Quasi real time data for current Solar energy

“Forecast”

Prediction of short term

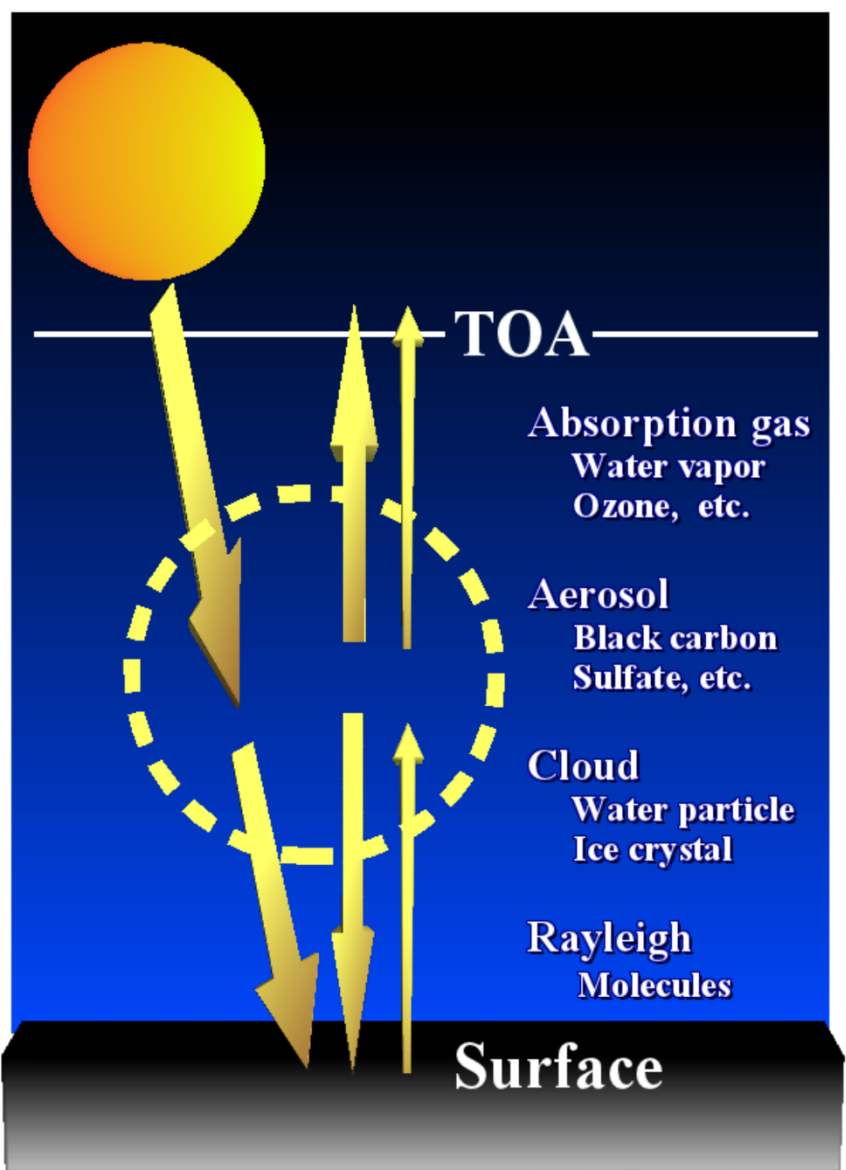
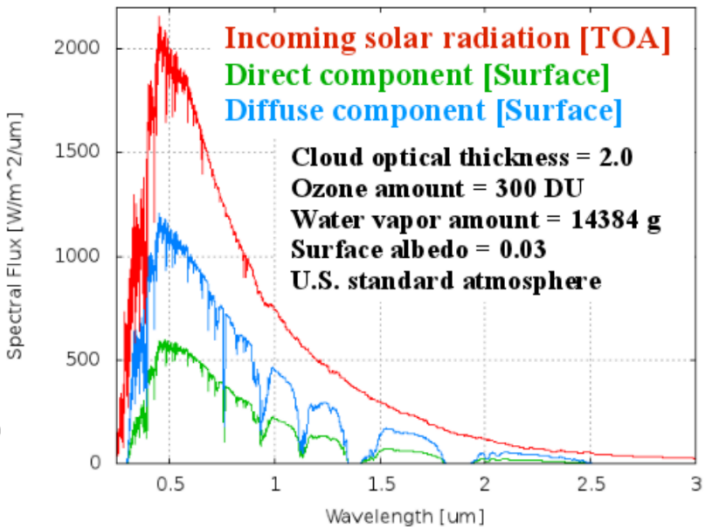
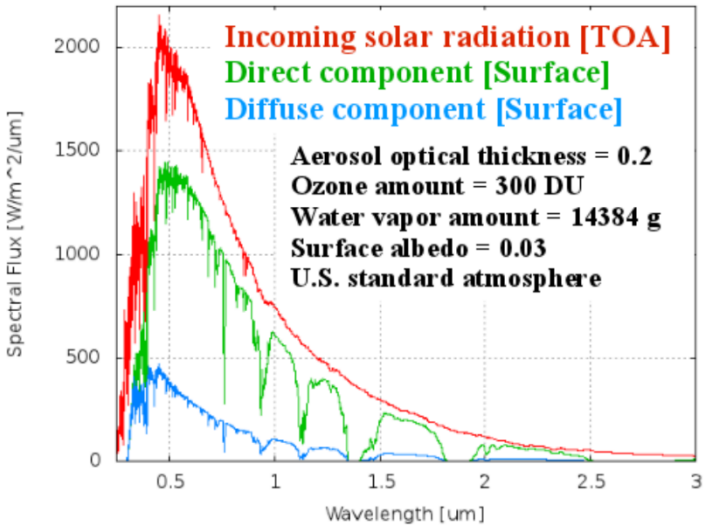


Satellite Remote Sensing

Atmospheric parameters retrieved by inversion analysis by scattering theory

Clear sky

Cloudy sky

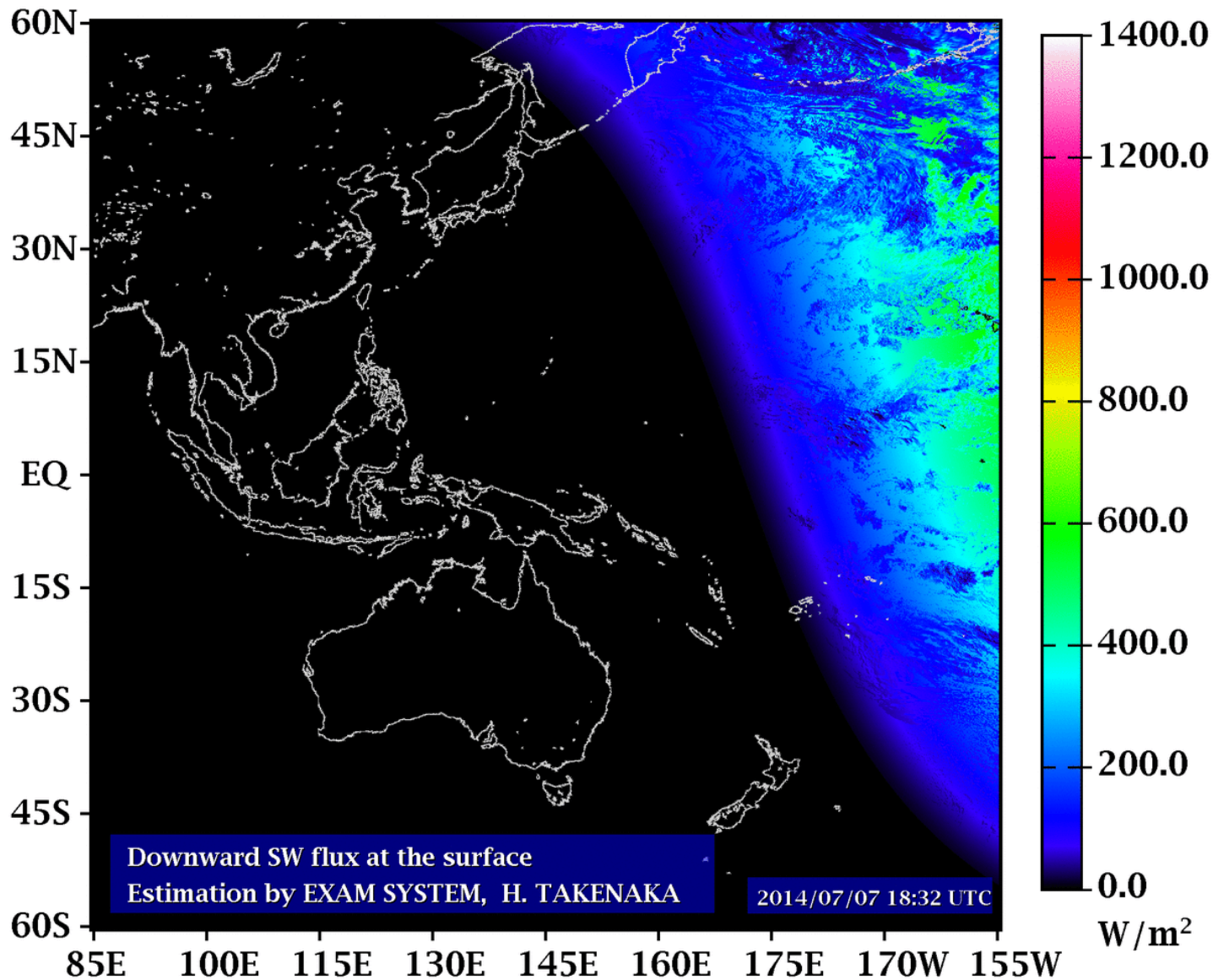


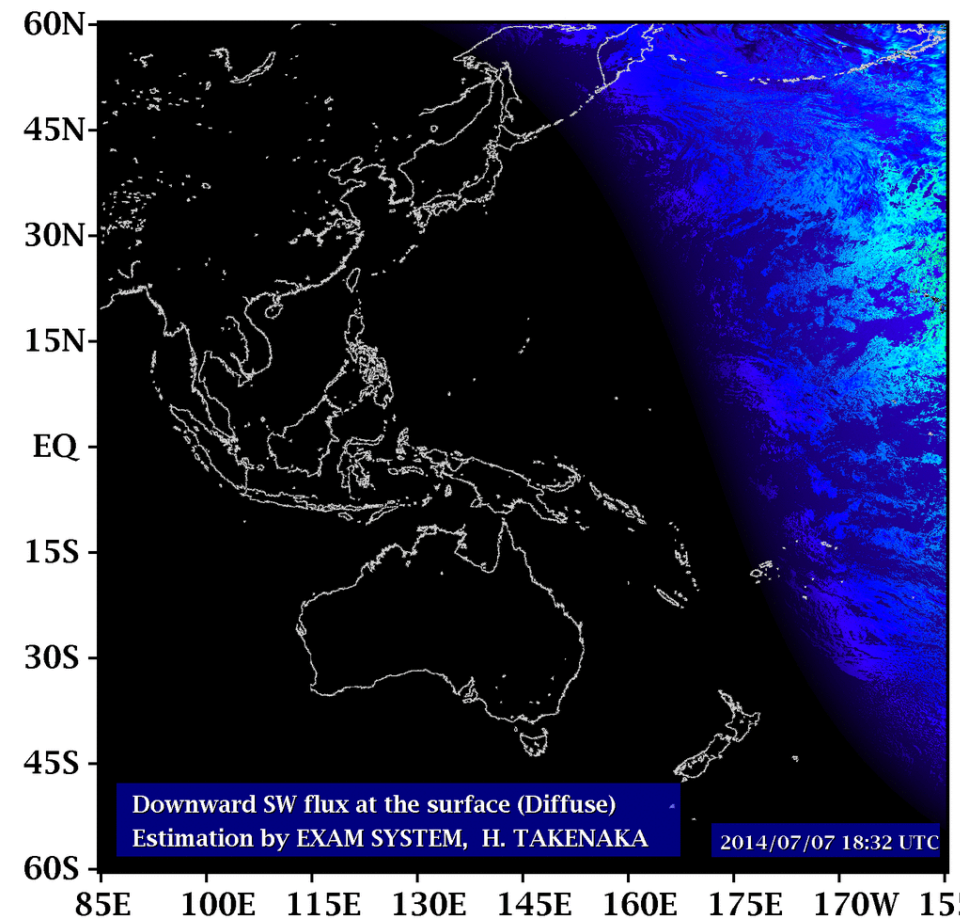
Estimation of Solar radiation budget at the Surface and TOA

Solar radiation is calculated based on radiative transfer code "RSTAR"

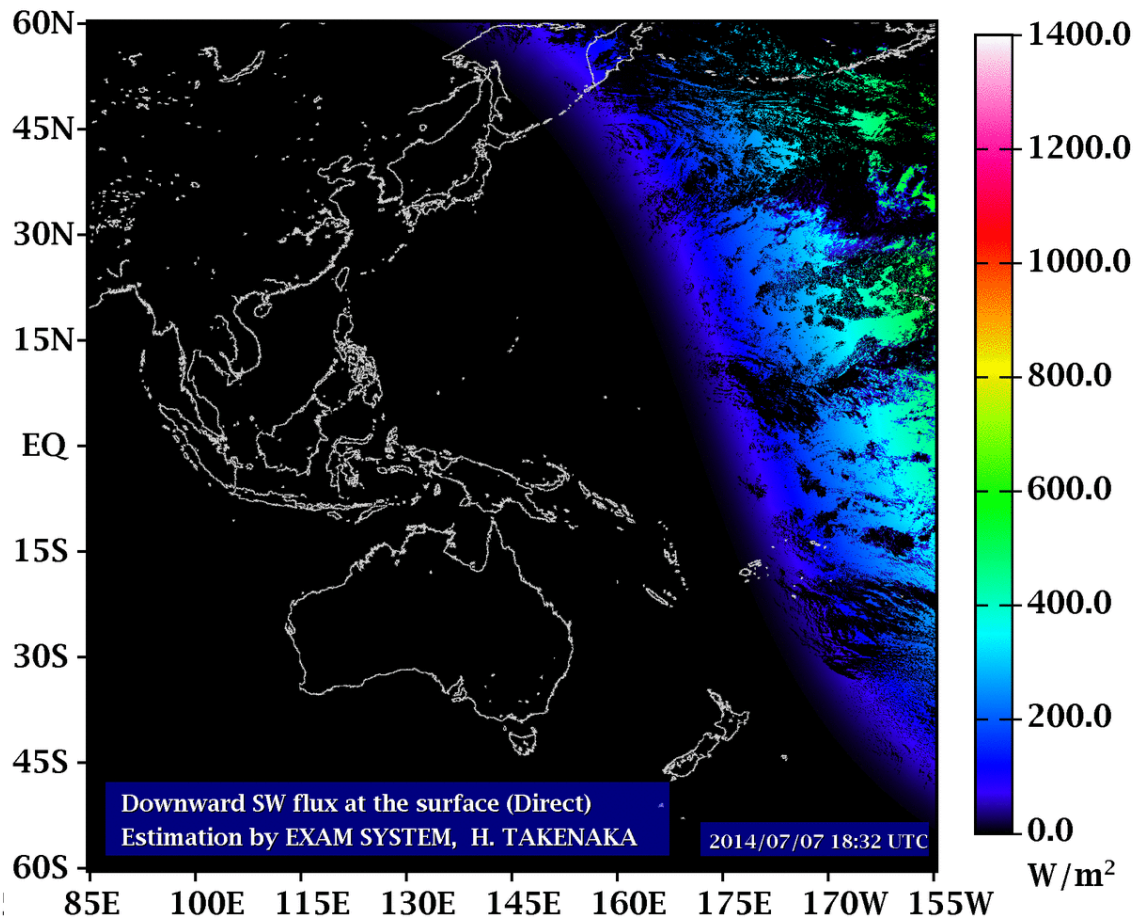
Downward SW flux at the Surface

4x4km





Diffuse component

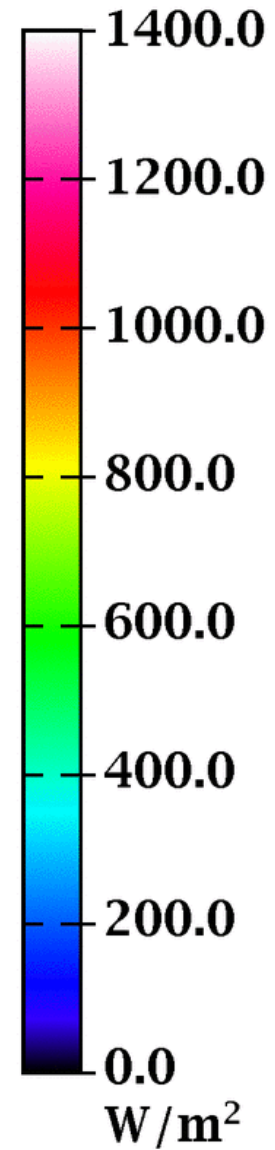
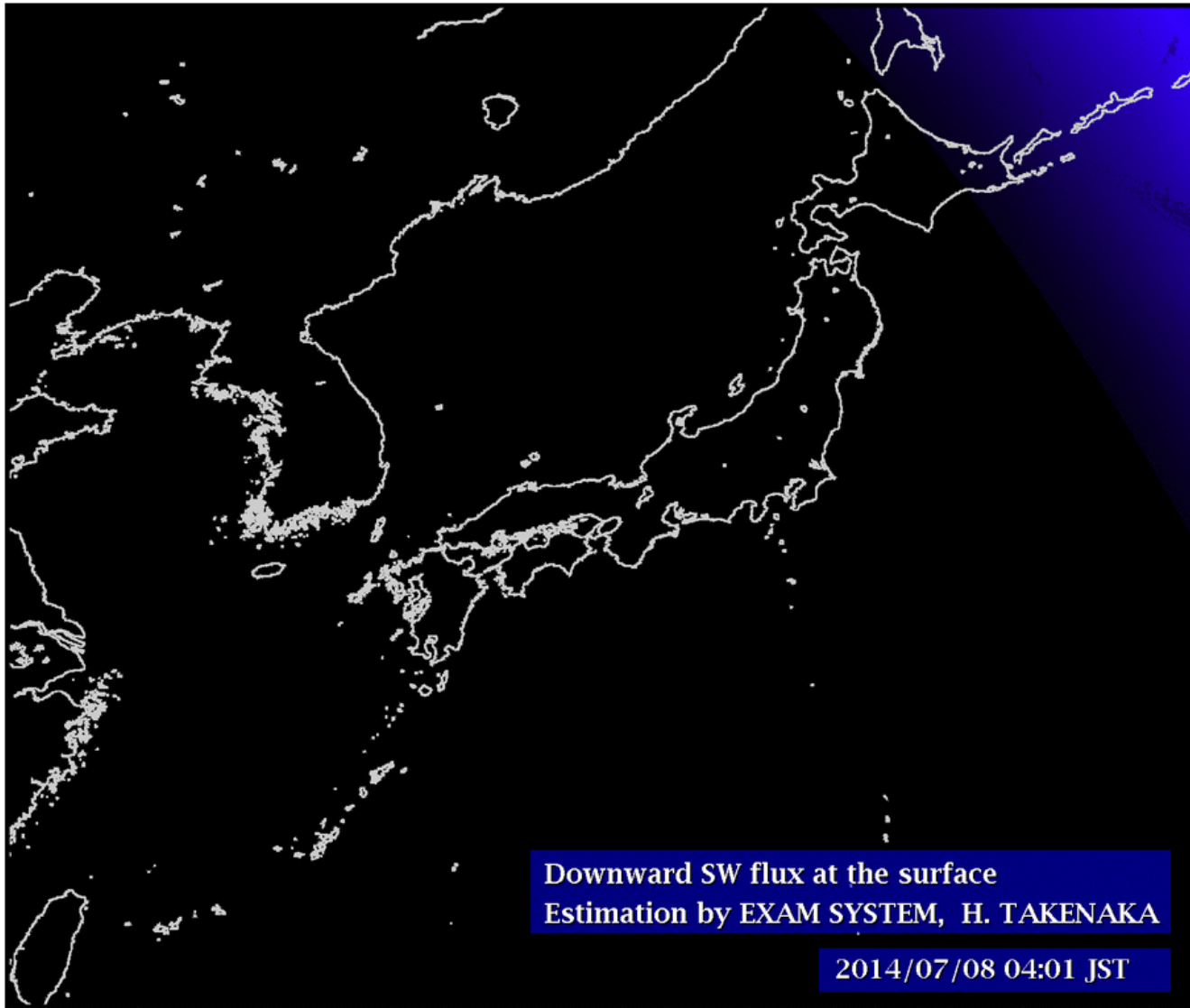


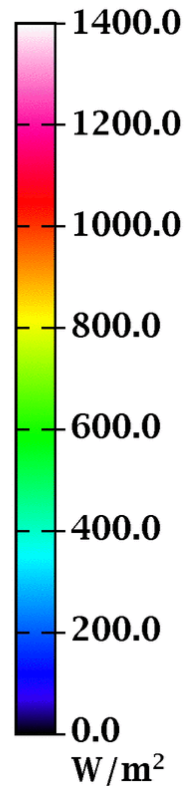
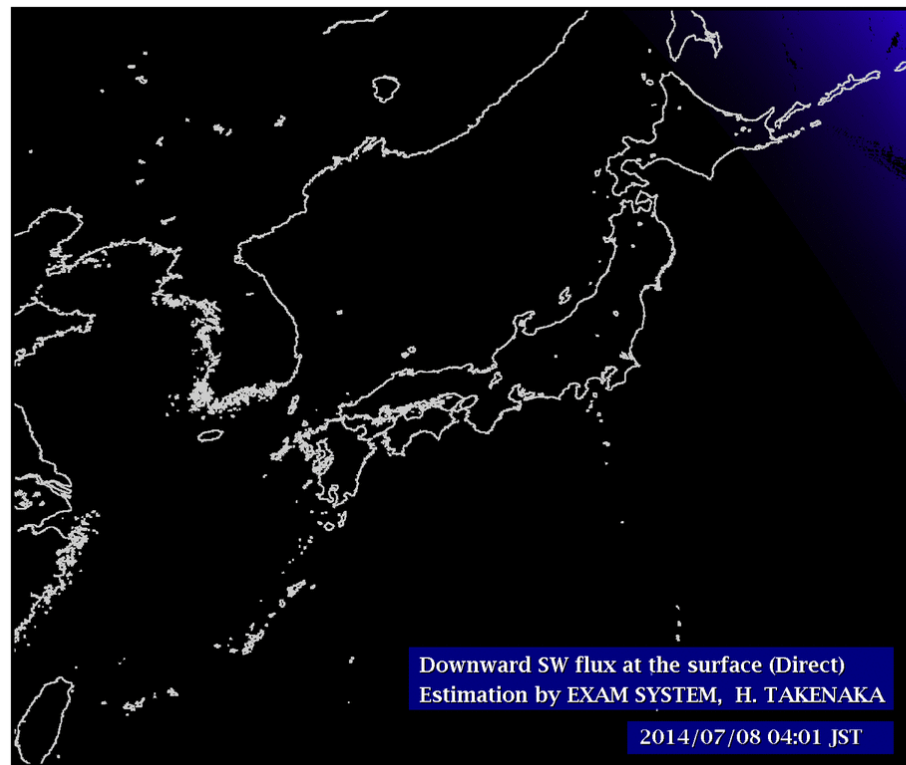
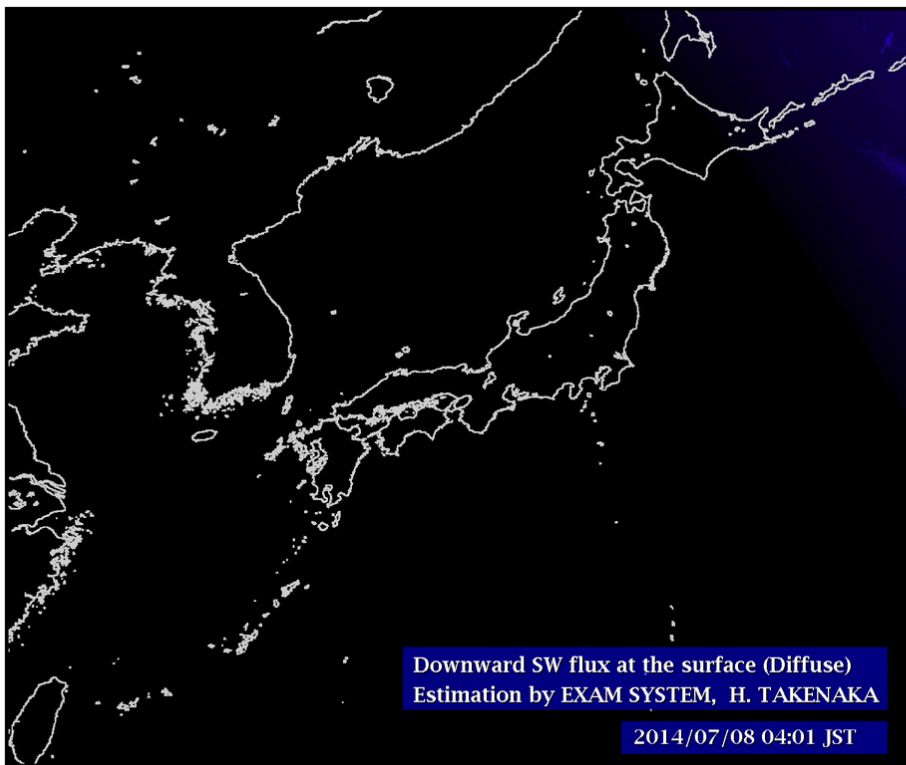
Direct component

4x4km

Downward SW flux at the Surface

1 x 1 km



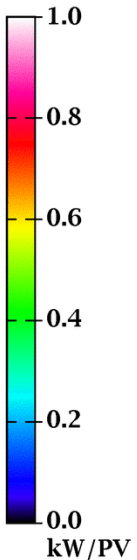
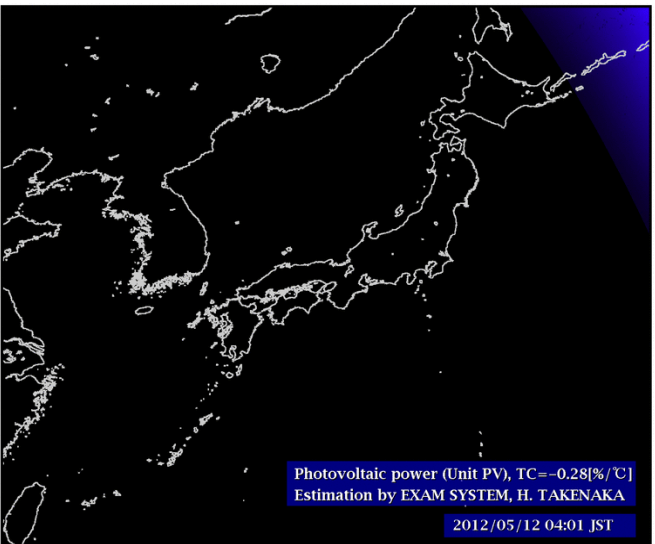


Diffuse component

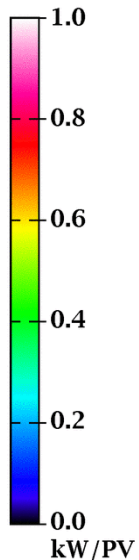
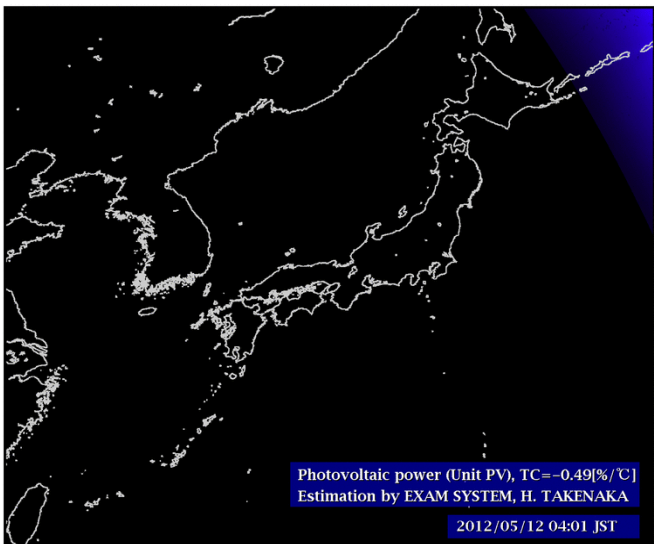
Direct component

1x1km

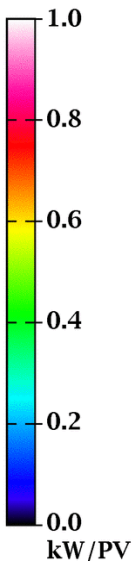
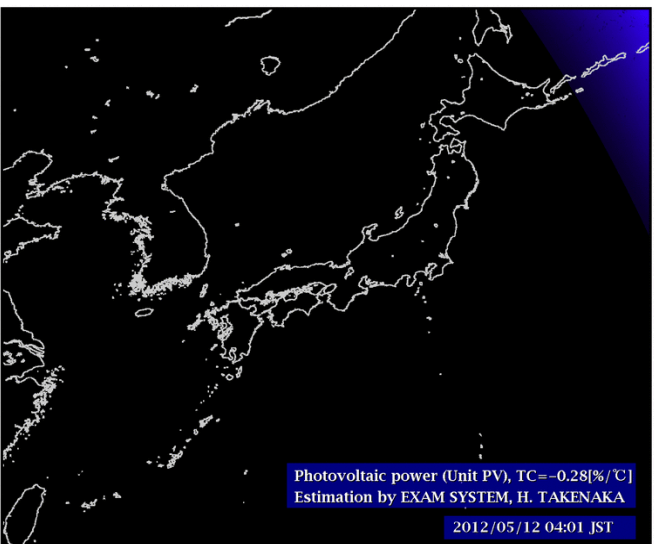
TC=-0.28[%/K]
AC=94.5[%]



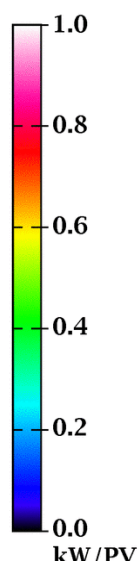
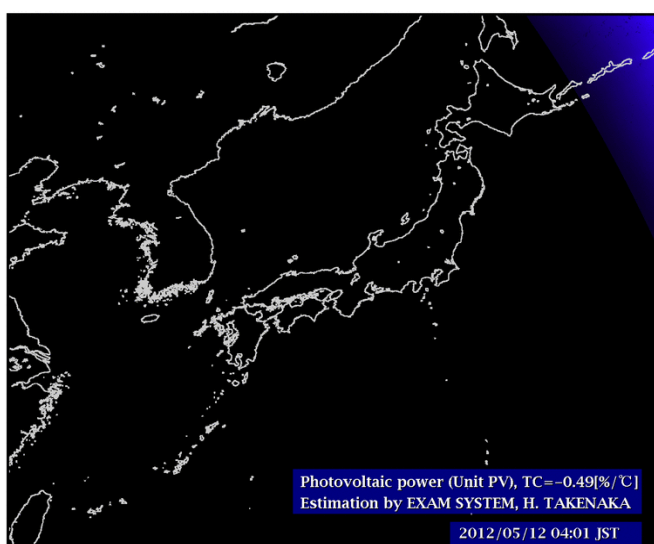
TC=-0.49[%/K]
AC=94.5[%]



TC=-0.28[%/K]
AC=98.5[%]

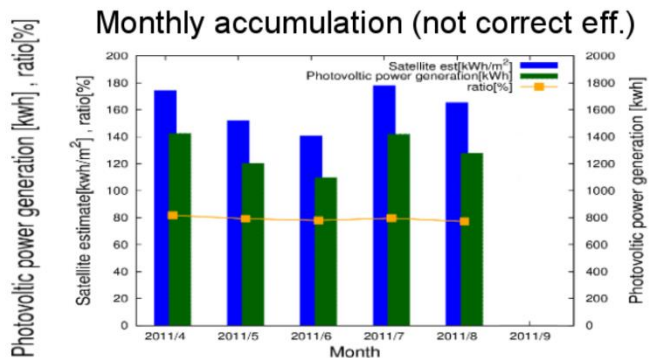
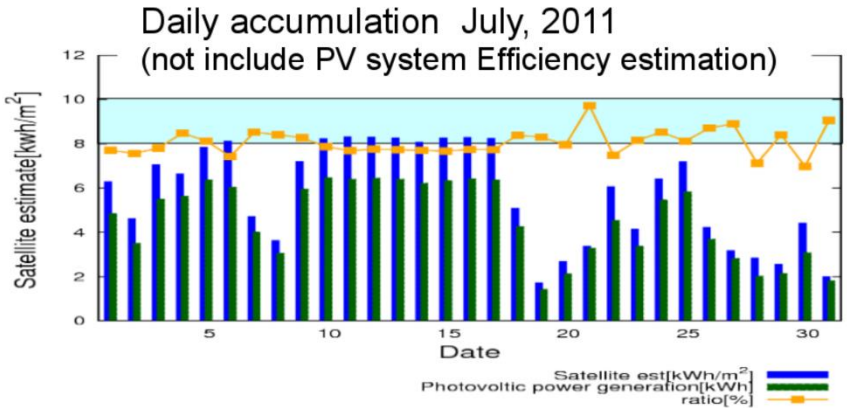


TC=-0.49[%/K]
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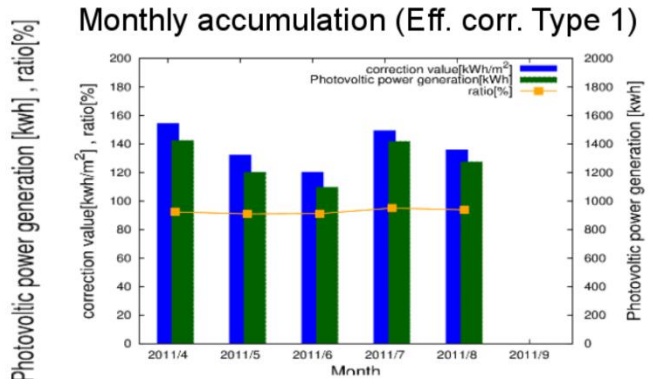
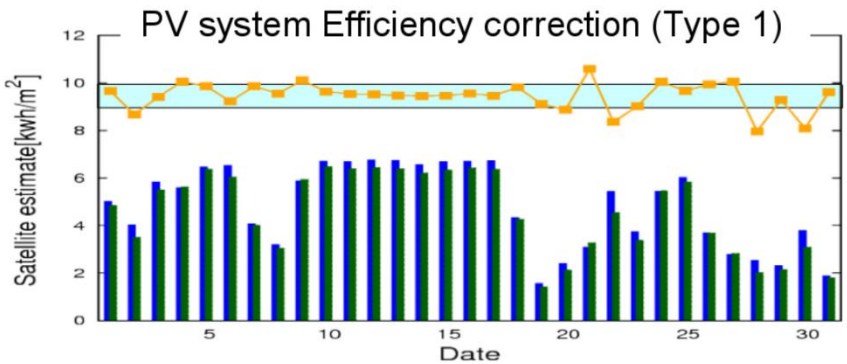


Comparison of PV power between satellite estimate and PV power log

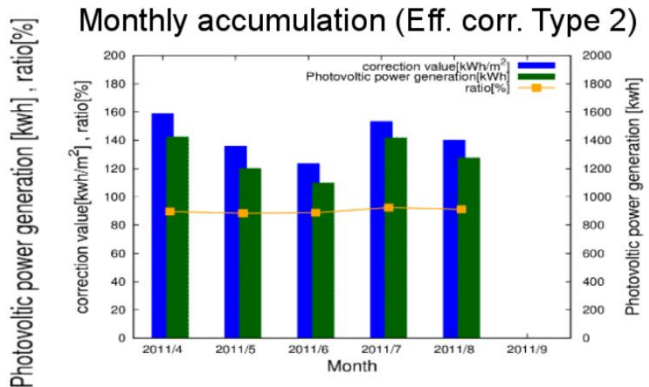
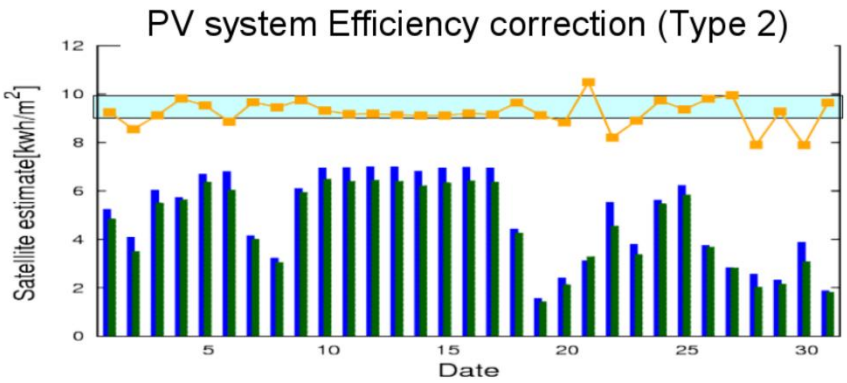
Monitoring of PV power



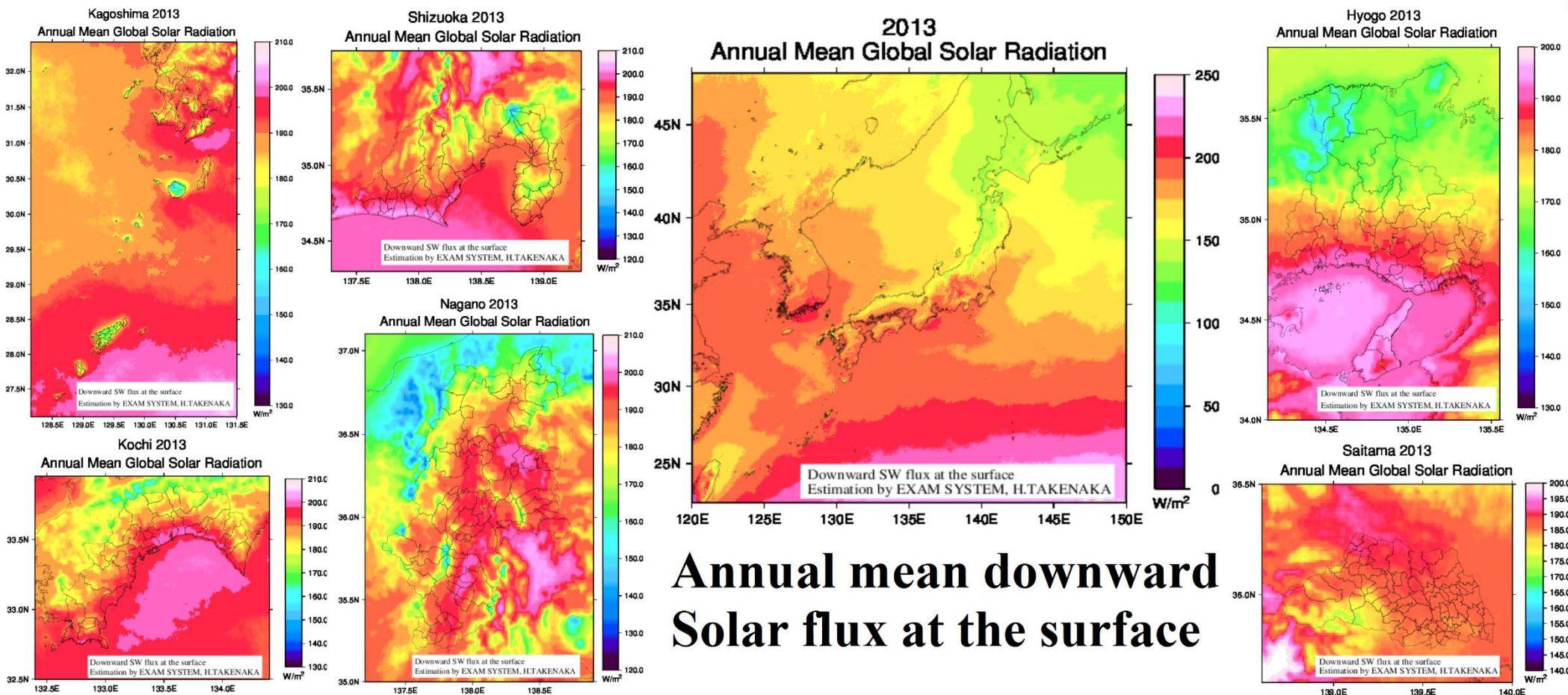
Not include
sys Efficiency



PV sys Efficiency is included
(PV panel and PC)



Solar potential map by Satellite Re-analysis



**Annual mean downward
Solar flux at the surface**

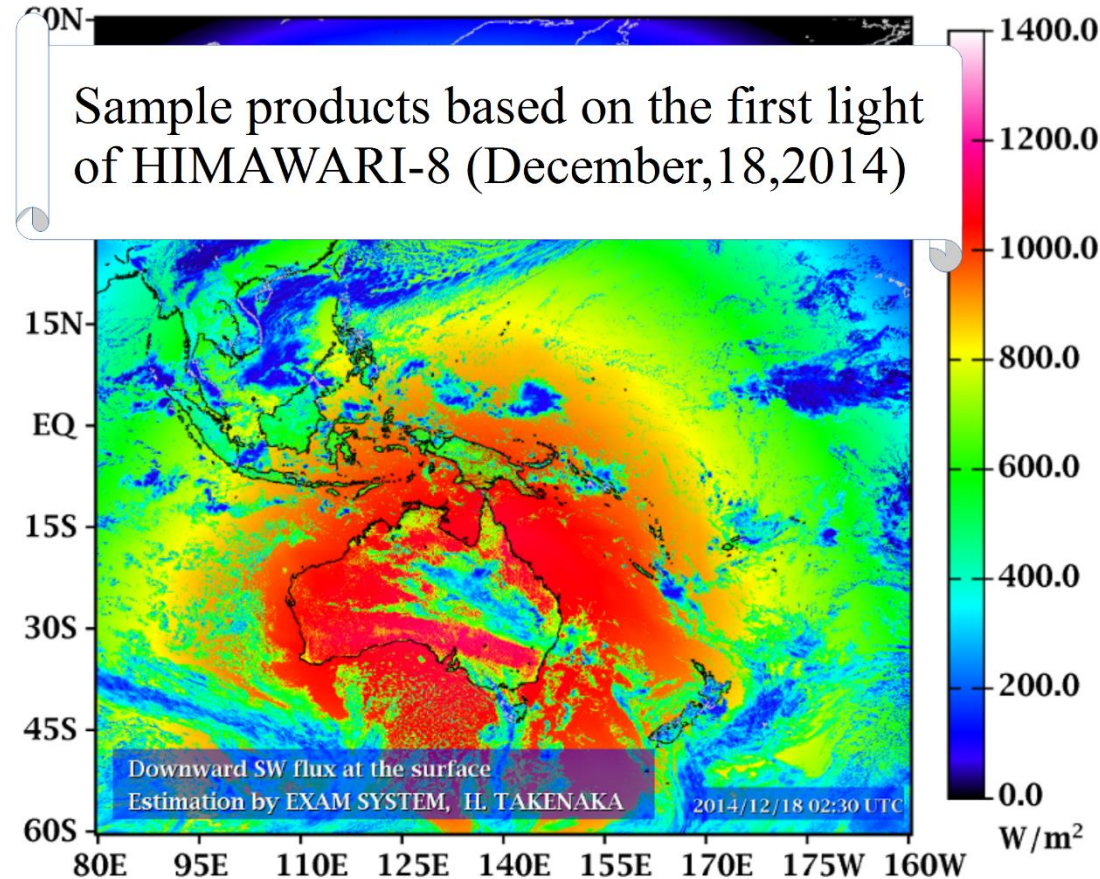
New Generation Geostationary satellite HIMAWARI-8

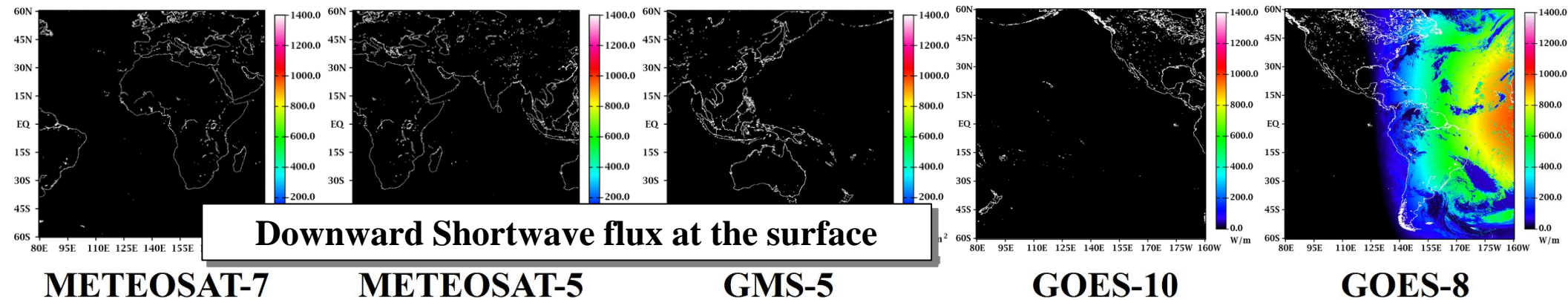
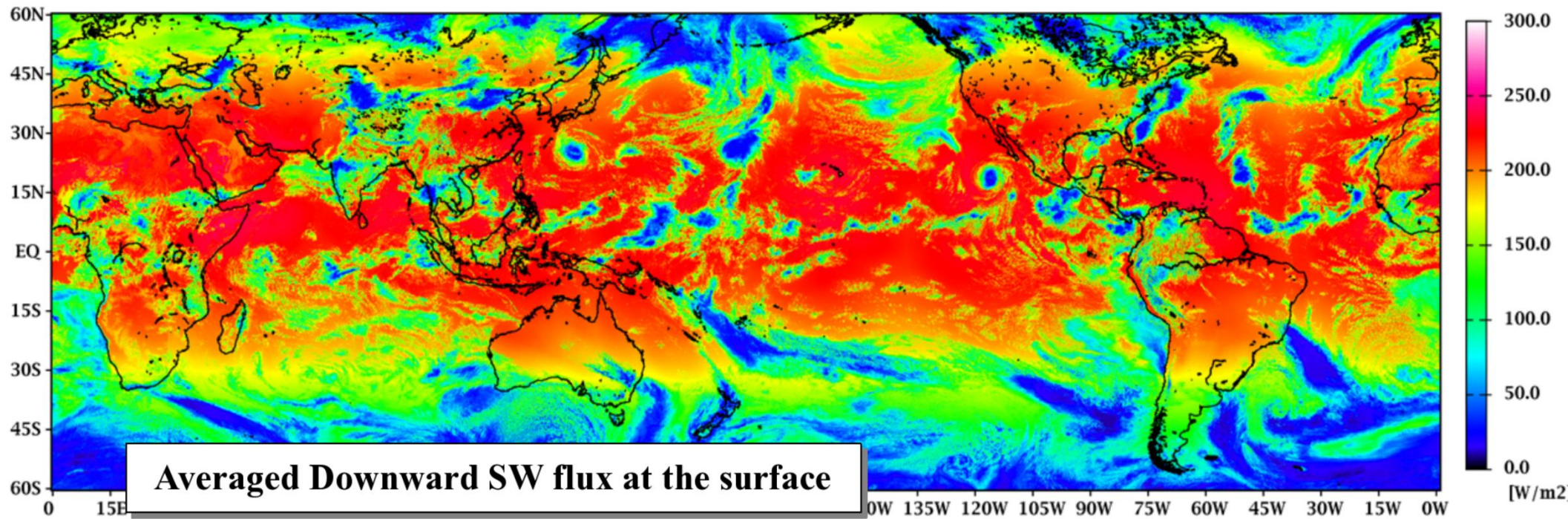
HIMAWARI-8/AHI analysis

The third generation geostationary satellite HIMAWARI-8 was launched at last October.

East Asia and West Oceania region is observed by every 10min.
Japanese region is observed by rapid scan every 2.5min

Our high-speed algorithm will provides solar radiation products by every 10 and 2.5min.





SUMMURY

Estimation of solar radiation budget using satellite

Quasi-real-time analysis product is available (MTSAT2)

Calculation time is 6min from satellite data arrival.

4x4km and 1x1km radiation product.

=> Global quasi-real-time analysis

Re-analysis of Solar radiation for Japanese region

1x1km products is available (2007, 2012, 2013, 2014)

=> Continuity data set from 2007 to Current

New Geostationary satellite HIMAWARI-8

Our high-speed algorithm will provides solar radiation products by every 10 and 2.5min.

