UPDATE ON IASI EMISSIVITY ATLAS

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INTRODUCTION

MetOp-A satellite was launched on 19 October 2006 and MetOp-B was launched on 17 September 2013. Two satellites flew in complementary orbits and in a sun synchronous "morning orbit" passing over the Equator at the same local time (9:30 am). MetOp-B phased 50 minutes apart from MetOp-A. Presented here are the global surface IR emissivity spectra retrieved from IASI measurements observed from both MetOp-A and MetOp-B satellites. Inter-comparison of the emissivities obtained from MetOp-A and MetOp-B is performed to ensure the continuity of emissivity monitoring and its trend analysis. Effort on emissivity validation continues with available ground in-situ measurements and retrieval consistency check through radiative transfer model simulations. The global-spatially-gridded resolution of emissivity climatology atlas is now changed from 0.5 to 0.25 degrees latitude-longitude, and available to the community.

EMISSIVITY EVALUATION

Surface parameter validation activity consists of comparing the surface emissivity products to be validated with similar products derived from other independent sources. There are two distinct methods to validate the products. One known as the direct method, it directly compares the ground-based measurements with satellite-derived products. The other known as the indirect method, it indirectly validates the non-validated product with the different satellite-derived products, model simulations, or other information and applications.

The channel radiance R_ν leaving the top of a non-scattering, clear atmosphere at a certain wavenumber ν can be computed via

$$R_\nu = \varepsilon_\nu B_\nu(T_s)\tau_\nu(p_s \to 0,\theta_{sat}) + \int_{p_s}^{0} B_\nu[T(p)]\frac{d\tau_\nu(p\to 0,\theta_{sat})}{dp}dp$$
$$+F_\nu^d \rho_\nu^t \tau_\nu(p_s \to 0,\theta_{sat}) + \frac{H_\nu}{\sec(\theta_{sun})}\tau_\nu(0\to p_s,\theta_{sun})\rho_\nu^s\tau_\nu(p_s\to 0,\theta_{sat}).$$

We assume the surface is assumed to be Lambertian, and reflectivity is assumed to be a function of surface emissivity, such as

$$\rho_\nu^t \approx (1-\varepsilon_\nu) \text{ and } \rho_\nu^s \approx (1-\varepsilon_\nu)/\pi.$$

Upwelling atmospheric emission is

$$A_\nu^\uparrow = \int_{p_s}^{0} B_\nu[T(p)]\frac{d\tau_\nu(p\to 0,\theta_{sat})}{dp}dp.$$

Downwelling atmospheric emission is

$$A_\nu^\downarrow = F_\nu^d \tau_\nu(p_s \to 0,\theta_{sat}).$$

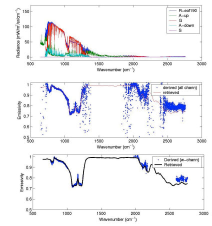
Surface emissions (at emissivity=1) is

$$G_\nu = B_\nu(T_s)\tau_\nu(p_s\to 0,\theta_{sat}).$$

Solar emission (at emissivity=0) is

$$S_\nu = \frac{H_\nu}{\sec(\theta_{sun})\pi}\tau_\nu(0\to p_s,\theta_{sun})\tau_\nu(p_s\to 0,\theta_{sat}).$$

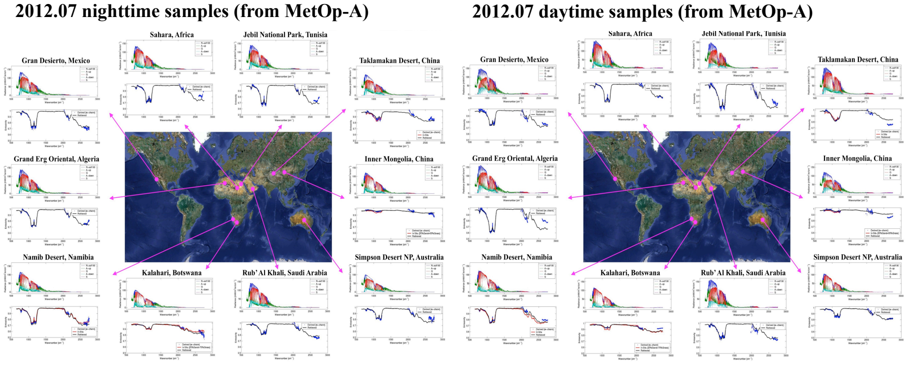
Surface window channel emissivity can be calculated via $\varepsilon_\nu \approx \dfrac{R_\nu - A_\nu^\uparrow - A_\nu^\downarrow - S_\nu}{G_\nu - A_\nu^\downarrow - S_\nu}$.



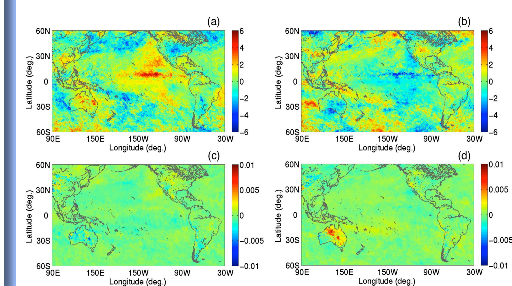
Grand Erg Oriental, Algeria
Date=2013.01.16, UTC=09:23:10
Lat.=29.65N, Lon.=6.32E

SELECTED EVALUATION SITES & SAMPLES

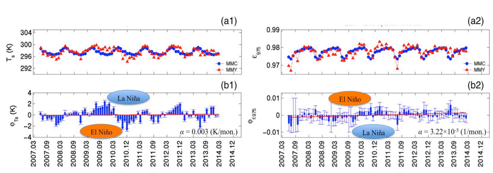
2012.07 nighttime samples (from MetOp-A) **2012.07 daytime samples (from MetOp-A)**



MONITORING: WALKER CIRCULATION EFFECT

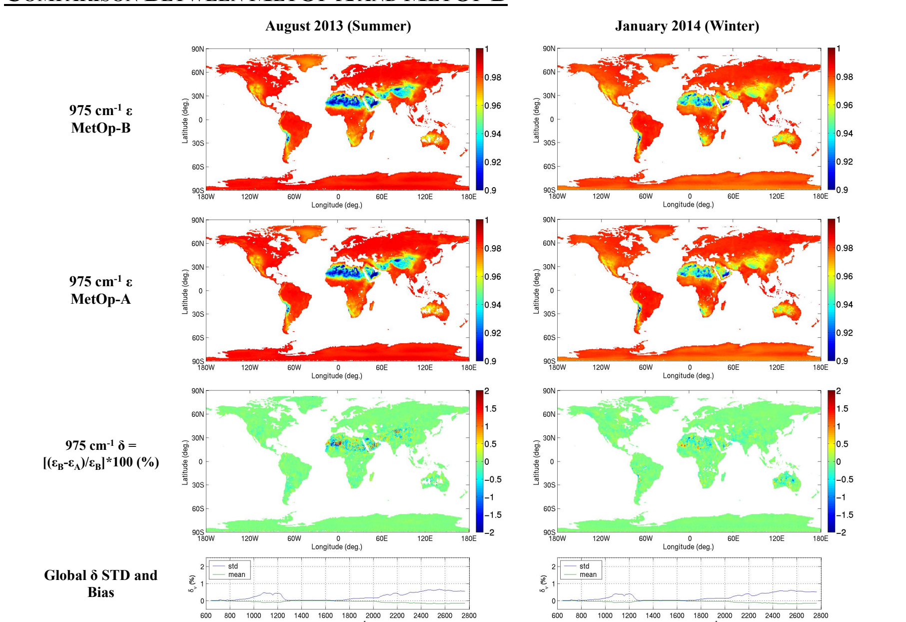


(a) and (b) show skin temperature anomalies for October 2009 and October 2010, respectively; and associated emissivity anomalies (at 975 cm^{-1}) are plotted in (c) and (d) for October 2009 and October 2010, respectively. During the October 2009 El Niño period, droughts happened in Australia and the land was drier, which causes a lower emissivity, while during October 2010 La Niña period, great rainfalls made the land wet and increased emissivity in the northeastern part of Australia.



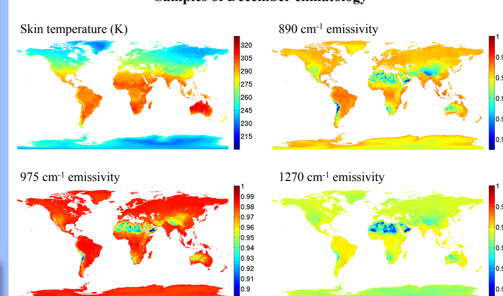
As El Niño plays the largest role in tropical drought occurrence, a location in Australia is chosen on right-column (24.75° S, 145.25° E) to illustrate ε_ν variation associated with the drought during the El Niño years and greater rainfall during La Niña events. Associated Pacific equatorial sea surface temperatures (0.25° N, 139.75° W) variation is plotted on left-column.

COMPARISON BETWEEN METOP-A AND METOP-B



EMISSIVITY ATLAS AVAIABLE

Samples of December climatology



Climatology data of monthly-mean global-gridded (i.e., 0.25×0.25 degree Latitude-Longitude) emissivity datasets are available upon request by email to daniel.k.zhou@nasa.gov.

CONCLUSIONS

- **Different land surface type properties are captured:** surface emissivity retrieved with IASI captures different land surface types. Relatively speaking, the change of surface cover (e.g., vegetation, snow/ice) and soil moisture are detected with its ε_ν depending on the surface background.
- **Seasonal and inter-annual variations are captured**: variation phenomenon at selected locations are reported. Users should be aware of this kind of variations.
- **Emissivity retrieved from MetOp-A and MetOp-B is almost the same:** This allows the emissivity data from MetOp-B to be utilized for global surface monitoring and trend analysis in conjunction with that from MetOp-A.
- **Use of emissivity and its trend in assisting surface weather monitoring and climate studies is recommended:** The period of last six years is long enough to observe surface variation and its behaviors. We will continue to produce surface data for monitoring.