Development of a common, consistent infrared and microwave emissivity database, for use as a priori information in the JCSDA

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Objective

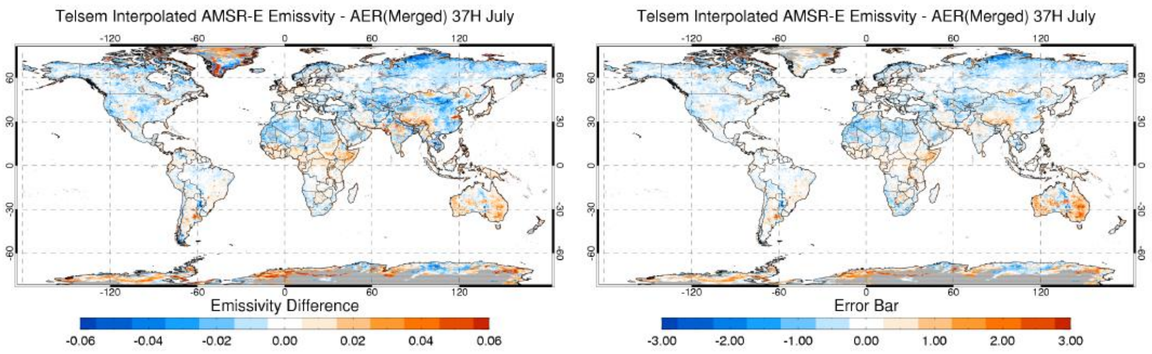
Development of the necessary tools for a convenient use of the emissivity information as background in the variational assimilation of the operational microwave and infrared observations in the JCSDA NWP system.

Previously done within this contract

Production of satellite-derived emissivity estimates in the microwave by Estellus (TELSEM tool and SSM/I derived record) and AER (AMSR-E-derived product).
Development of the operational chains to produce IASI-derived infrared emissivity estimates over a long time record. Production of 3 years of data.

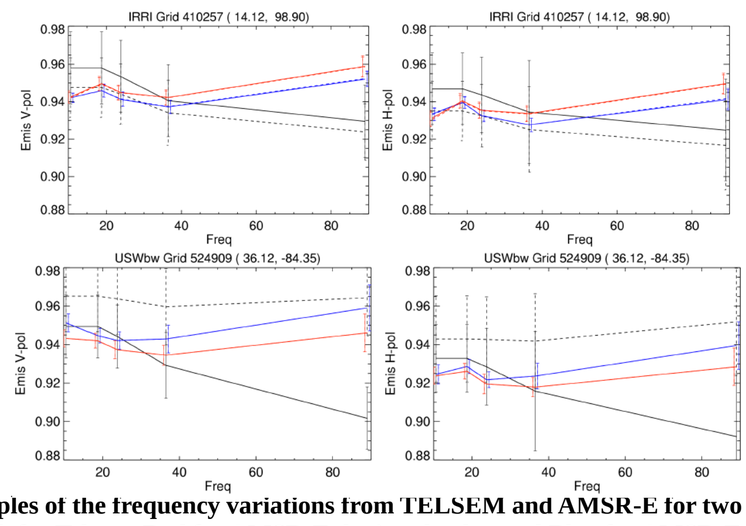
Evaluation of the emissivity databases

In the microwave, comparison of the TELSEM outputs with the AMSR-E estimates

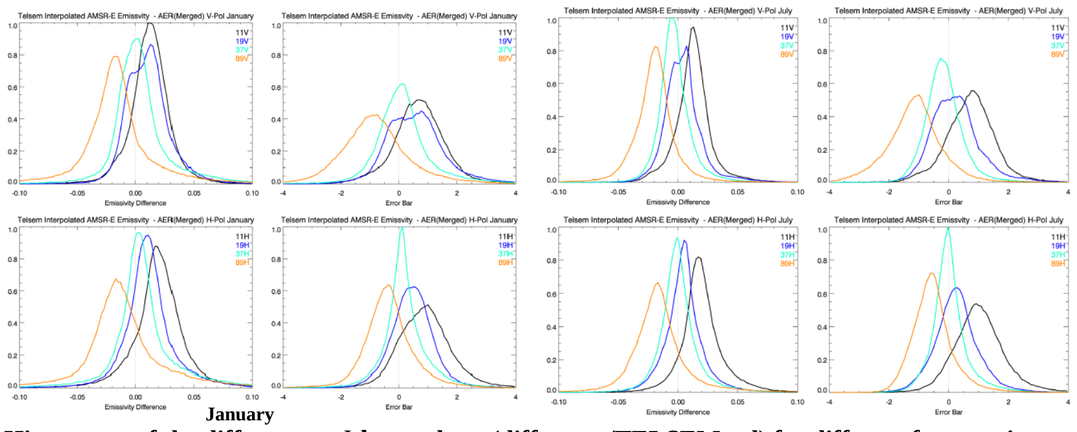


Differences between AMSR-E estimates and TELSEM at 37 GHz horizontal polarization for July 2003
(Right: the actual difference in emissivity
Left: error bar= emissivity difference / TELSEM std)

=> The mean differences are within the error bar specified in TELSEM for all frequencies, except for the 89 GHz.
Very good match at 37 GHz, good at 19 GHz. At 11GHz, remember that TELSEM just assume the 19GHz.
A gradient in the mean difference, as a function of frequency.
Investigation underway for the 89 GHz. Related to calibration issues?

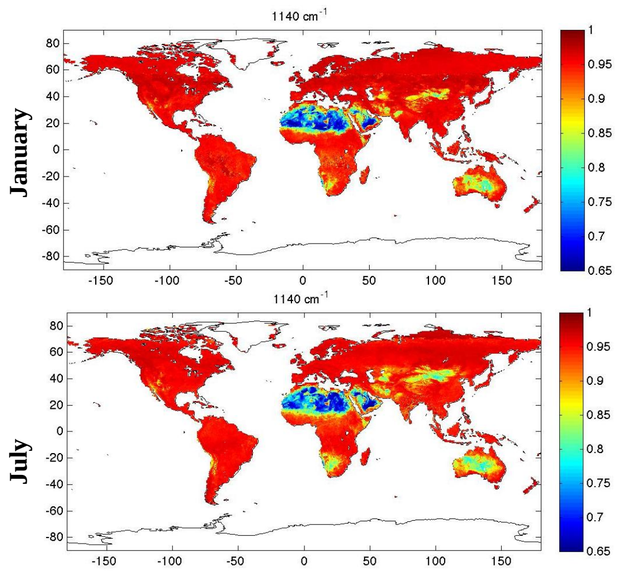


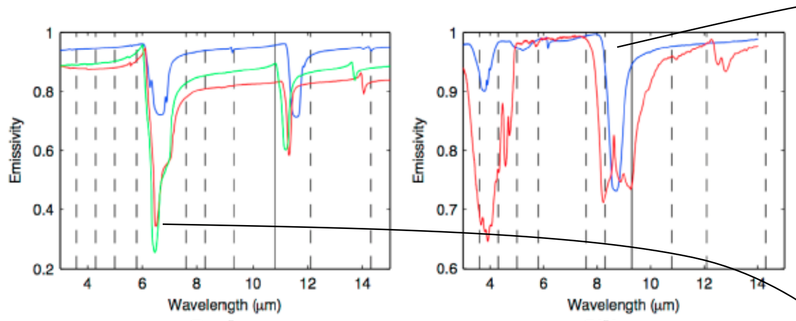
Exemples of the frequency variations from TELSEM and AMSR-E for two locations
(Black for Telsem, Red for AMSR-E during the day and Blue for AMSR-E at night.
Solid lines for July and dashed lines for January)



Histograms of the differences and error bars (difference/TELSEM std) for different frequencies

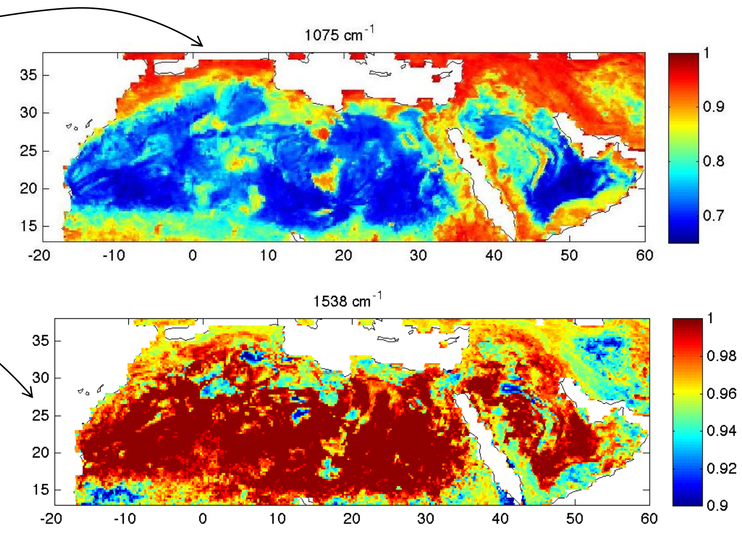
In the infrared, evaluation of the spatial, temporal, and spectral structures in the database





Measured infrared emissivities

⇒ Reasonable spatial, temporal, and spectral structures (here in the silicate and the carbonate spectral line).



Infrared emissivities in a silicate line (top) and in a carbonate line (bottom)

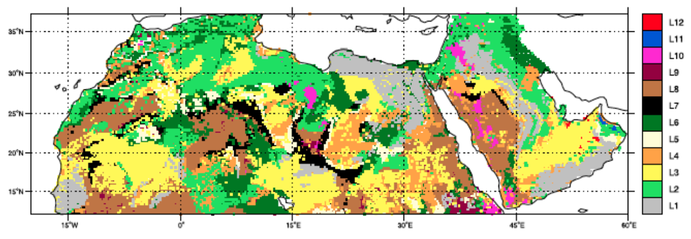
Consistency of the microwave and infrared emissivity data basis

- **To gain a better understanding of the physical mechanism that drive the emissivity in both wavelength ranges to improve the emissivity models.**

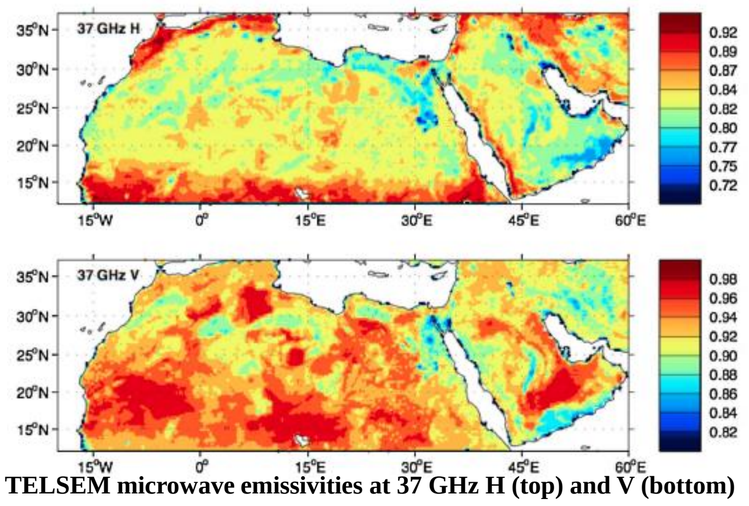
⇒ Over the desert for instance, the infrared and the microwave emissivities show similar structures that are related to the surface lithology.

See for instance the carbonate signatures with low emissivities in the microwaves in the Oman territory, corresponding to low emissivity in the carbonate line in the infrared.

The carbonate that have a low emissivity in the infrared in the silicate lines, have a high emissivity at 37GHz V polarization.



Lithology map of Northern Africa and the Arabian Peninsula derived during the study. The legend corresponds as follows: L1, carbonate rocks; L2, carbonate, siliceous, and evaporite rocks; L3, loose siliceous rocks; L4, indurated siliceous rocks; L5, siliceous, argillaceous, and evaporite rocks; L6, siliceous, argillaceous, and carbonate rocks; L7, siliceous and argillaceous rocks; L8, Precambrian shield; L9, granite; L10, basalt; L11, ophiolite; L12, evaporite.



TELSEM microwave emissivities at 37 GHz H (top) and V (bottom)

Next steps

- **Systematic in depth comparison of the satellite-derived emissivities with model outputs, for model improvements, toward the use of emissivity models at JCSDA.**
- **Development of the interface between the emissivity databases and CRTM, for both microwave and IR, including the implementation of the covariance matrix.**
- **Evaluation of the emissivity information in the JCSDA, in direct and in assimilation modes.**

References:
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