Typical Barrow Albedos Coupled with Solar Irradiance (Io) Variability: A Sensitivity Study

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A new set of incident solar irradiance spectra has been computed at extremely high spectral resolution, based on published solar atmosphere physical models representing various magnetic activity features (Fontenla, et al.). This set of spectra can be linearly combined to produce the Solar Spectral Irradiance for any solar activity level, as a weighted sum of the activity drivers. A subset of irradiances have been convolved at spectral sampling compatible with MODerate Resolution Atmospheric TRANSmission (MODTRAN®5.2.0.0), that is at 0.1, 1.0, 5.0 and 15.0 cm^{-1}. Since the MODTRAN radiative transfer calculations are linear with respect to the incident radiation, results of the computed cooling rates can also be linearly combined to yield the atmospheric cooling rate for any solar activity level. For this study, 3 simple levels of solar activity have been adopted, Low (quiet), Medium, and High. These have been coupled with 3 typical albedos near Barrow: sea ice, open ocean, and tundra. In order to delineate the altitudes of impact of the Io variability, 3 continguous spectral ranges were selected: Ultraviolet (UV), with Io heating and variability peaking near the stratopause, Chappuis (visible), peaking at 35km, and Short-wave Infrared, peaking in the troposphere (not shown). Sea ice preferentially enhances the small atmospheric heating near the surface, due to the reflection, while the darker albedos show much less surface impact.

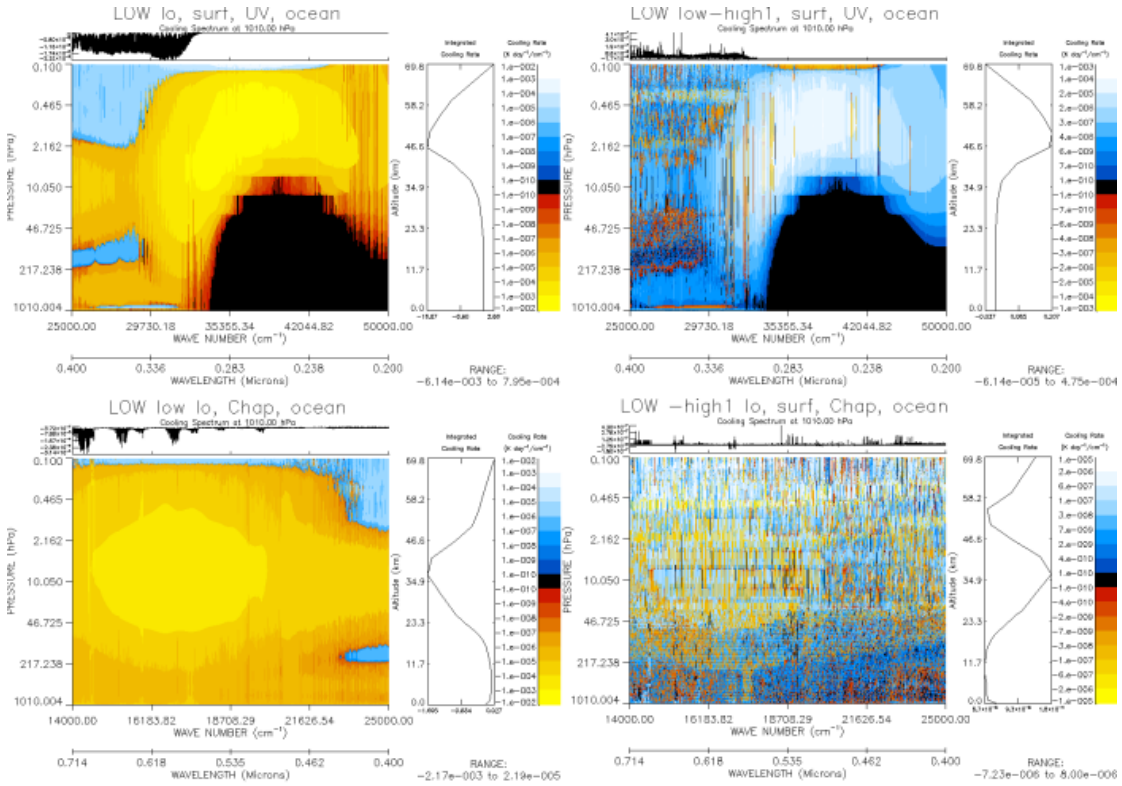

Figure 1. MODTRAN5.2 calculations ('yellow to red' heats, 'blue to white' cools) for an ocean albedo. The top pair show UV negative cooling (heating) peaked at the troposphere with the capability of isolating detailed studies in the Huggins band near 0.3µm. The lower pair show the visible spectral range (centered on 0.6µm) where the O_3 Chappuis band dominate. The difference spectra in the right pair of images show the variability in the 'low' vs 'high' solar irradiances over these spectral range, while the Io irradiance arriving at the surface is depicted in the left pair.