Extension of the PARMIO model into the IR

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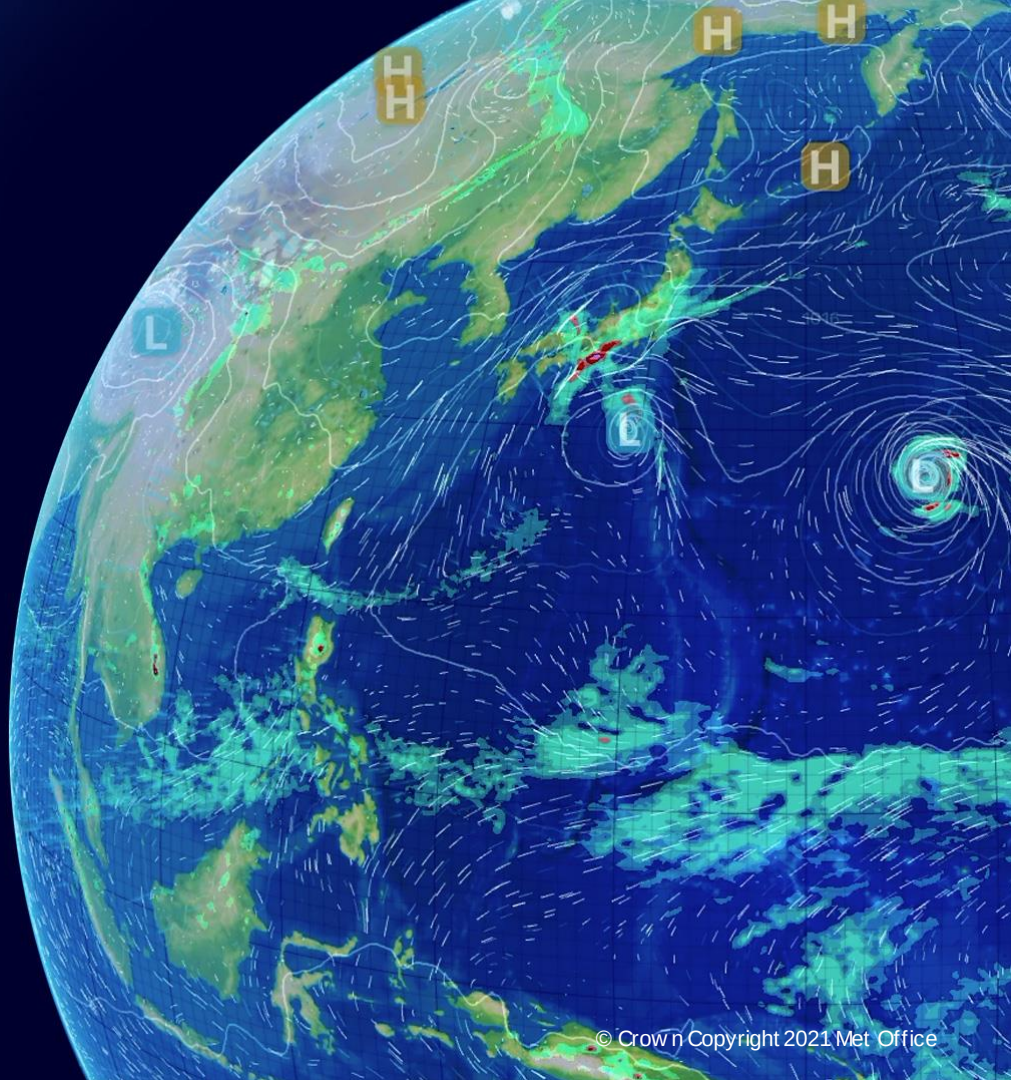
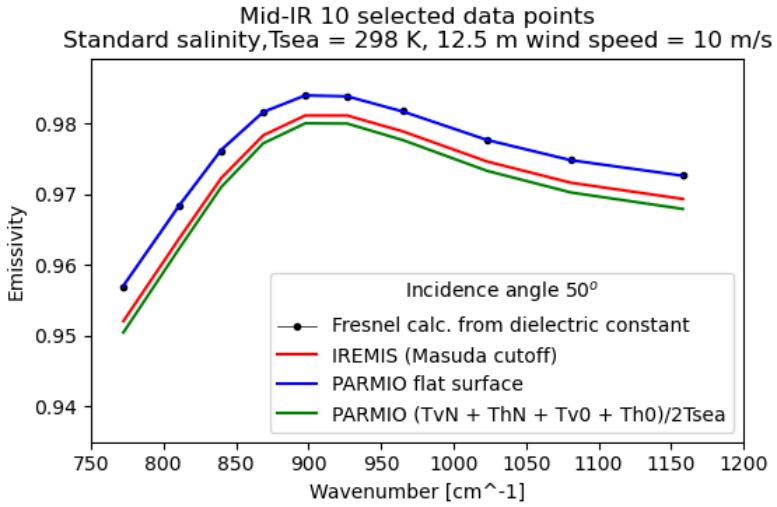
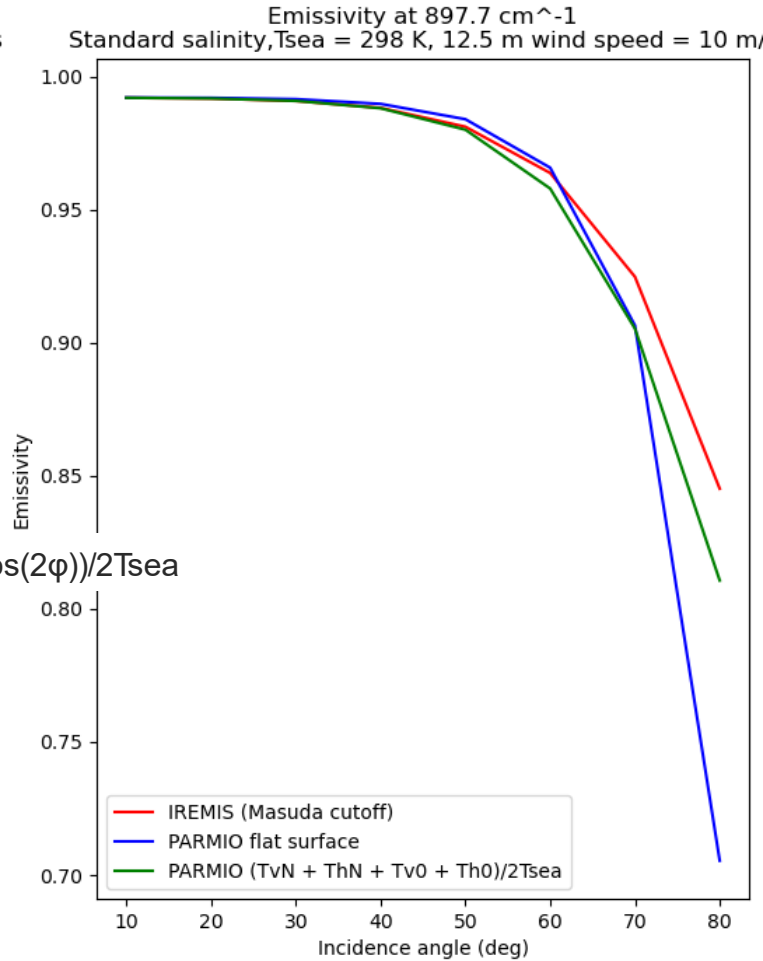


Met Office

Code lodged on GitHub

- Pull request for `edinnat/Ocean-reference-model`
- Option to choose ‘hifreq’ permittivity model:
  - Tabulated pure water refractive index from Rowe et al. (2020) in range 28.8 - 449677 GHz at 273 K and 298 K (vary linearly in T)
  - Salinity dependence from Pinkley and Williams (1976) only in IR range
  - Temperature dependence from Newman et al. (2005) in mid-IR range
- Estimate of foam contribution not yet included (small)
- Some work needed on the atmospheric correction?
- Without the atmosphere, outputs appear numerically sensible





$$\varepsilon = (TvN + ThN + Tv0 + Th0 + Tv1*\cos\varphi + Th1*\cos\varphi + Tv2*\cos(2\varphi) + Th2*\cos(2\varphi))/2Tsea$$

- Compare PARMIO with IREMIS (RTTOV emissivity model)
- Use Cox & Munk as common treatment of wave slopes
- Emissivity from IREMIS > PARMIO at larger angles
- Need to understand these differences…

Thanks to James Hocking for making IREMIS available in stand-alone form

- Possible explanation: Surface-Emitted Surface-Reflected (SESR) radiation in IREMIS

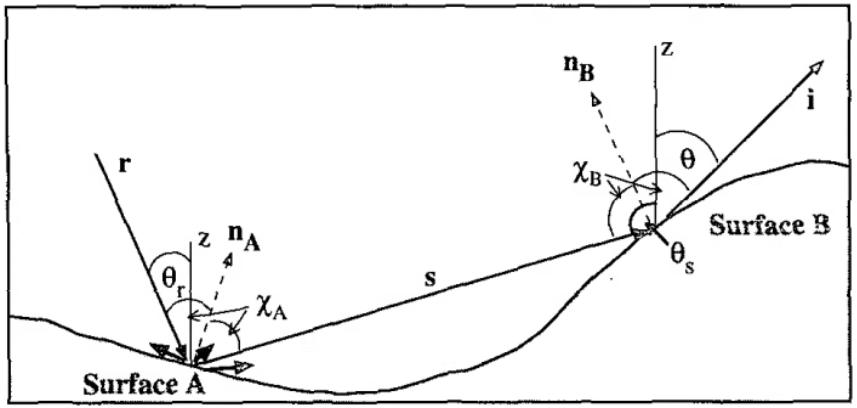


FIG. 3. Diagram to show the origin and geometry of direct and SESR emission and SRSR reflection.

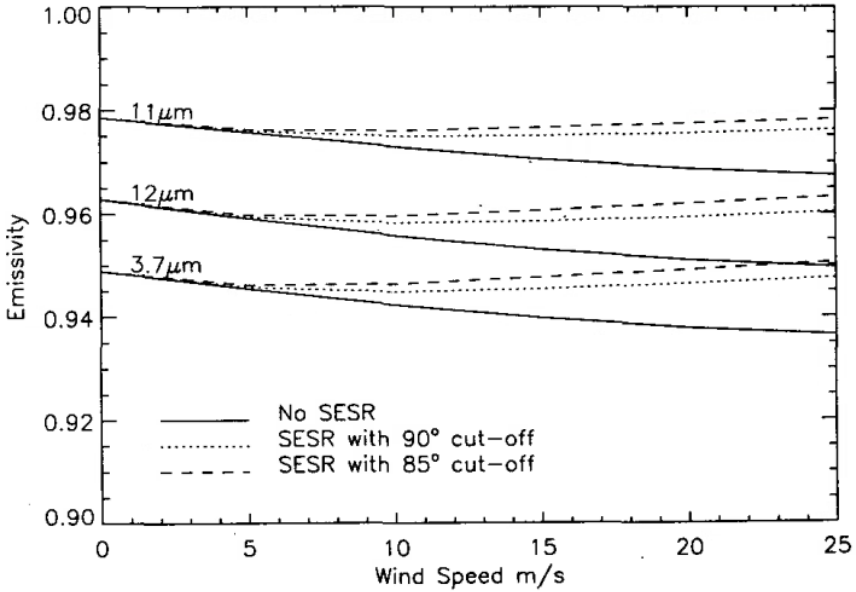


FIG. 5. The emissivity of a wind roughened sea for the three thermal channels at various wind speeds and at a forward view zenith angle of 55°. Three values are shown: the direct emissivity (no SESR) and the emissivities including the effect of SESR radiation with 90° and 85° cutoff horizons.

Figures from Watts et al. (1996)
IREMIS uses Wu and Smith (1997) SESR or Masuda (2006)