Impact of foam on infrared ocean emissivity

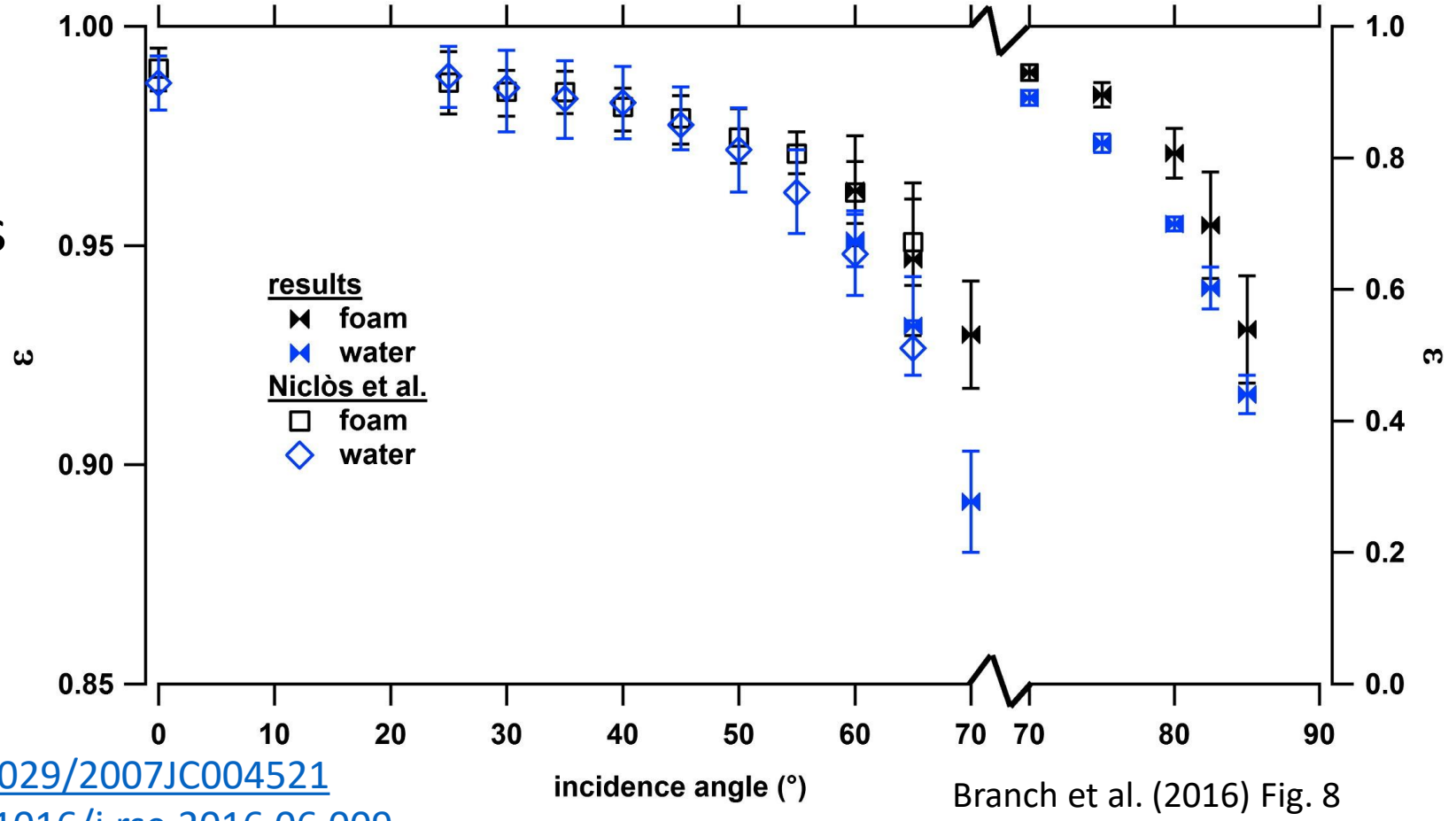
Stu Newman

ISSI team progress meeting

18 May 2021

Properties of foam in the infrared

- Niclòs et al. (2007), Branch et al. (2016) data on IR foam emissivity
- Data agree to within uncertainties
- 8-14 μm infrared window



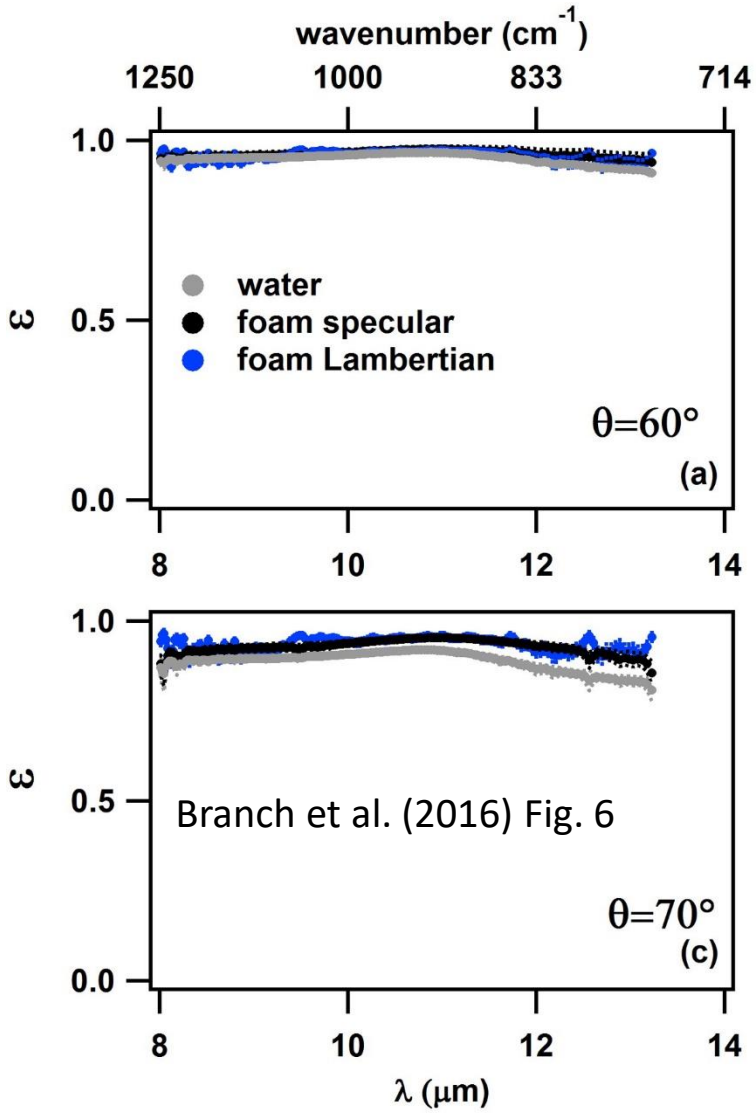
Niclòs et al. (2007) https://doi.org/10.1029/2007JC004521
Branch et al. (2016) https://doi.org/10.1016/j.rse.2016.06.009

Branch et al. (2016) Fig. 8

Properties of foam in the infrared

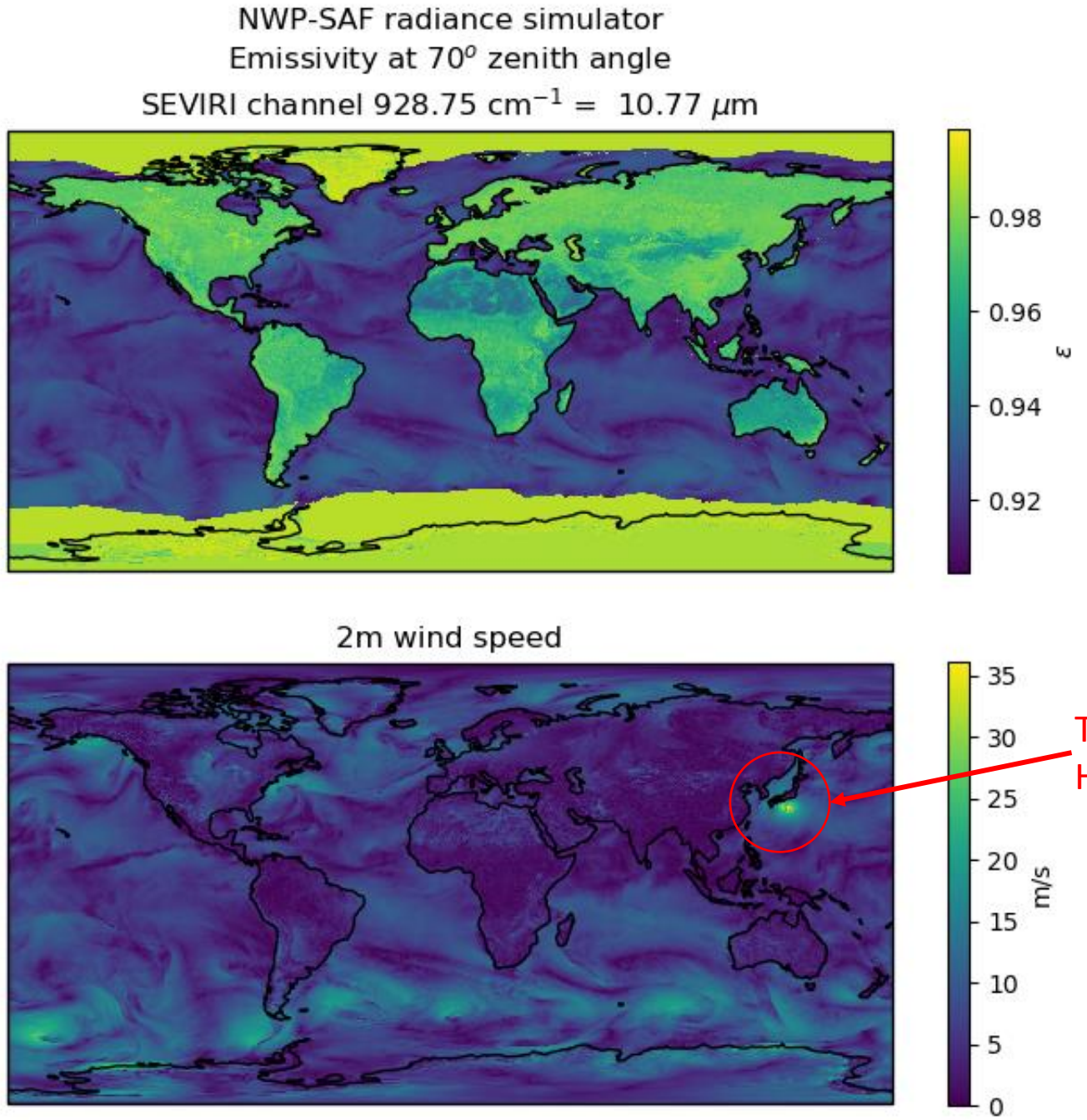
- Reduction in foam emissivity compared with water increases with incidence angle
- Clear separation of foam/water emissivity around 60-70°
- Range of satellite zenith angles in NWP up to ~57° (IASI) or up to ~68° (geostationary IR sensors such as SEVIRI)
- Sensitivity study: take Branch et al. estimate (8-14 μm) of

  $\varepsilon_{foam} - \varepsilon_{water} \approx 0.04$ at 70°



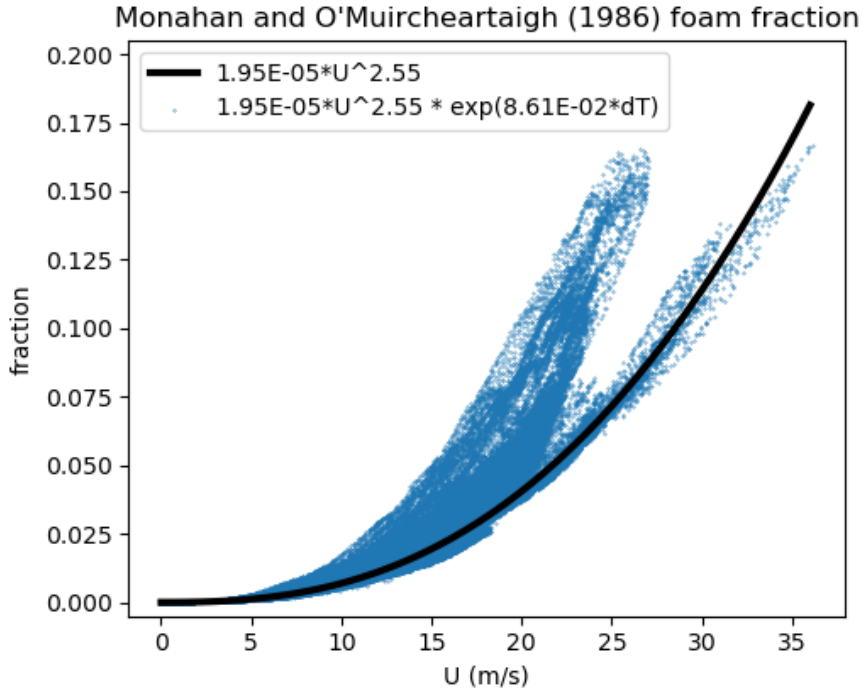
Sensitivity study

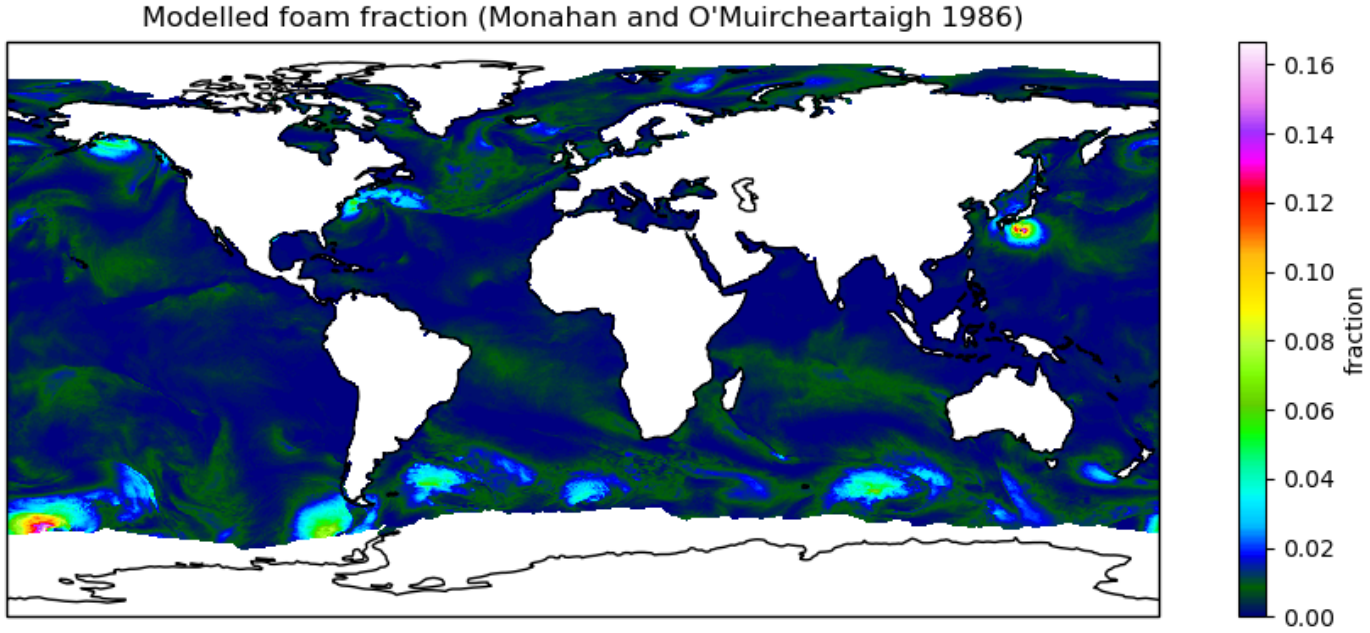
- 70° incidence angle
- Case study 2019-10-11 1800 UTC
- Surface winds 0 < U < 36 m/s
- Consider clear sky signal only



Sensitivity study

- Monahan and O’Muircheartaigh (1986) foam fraction W(U, dT) where dT is sea surface temperature minus air temperature

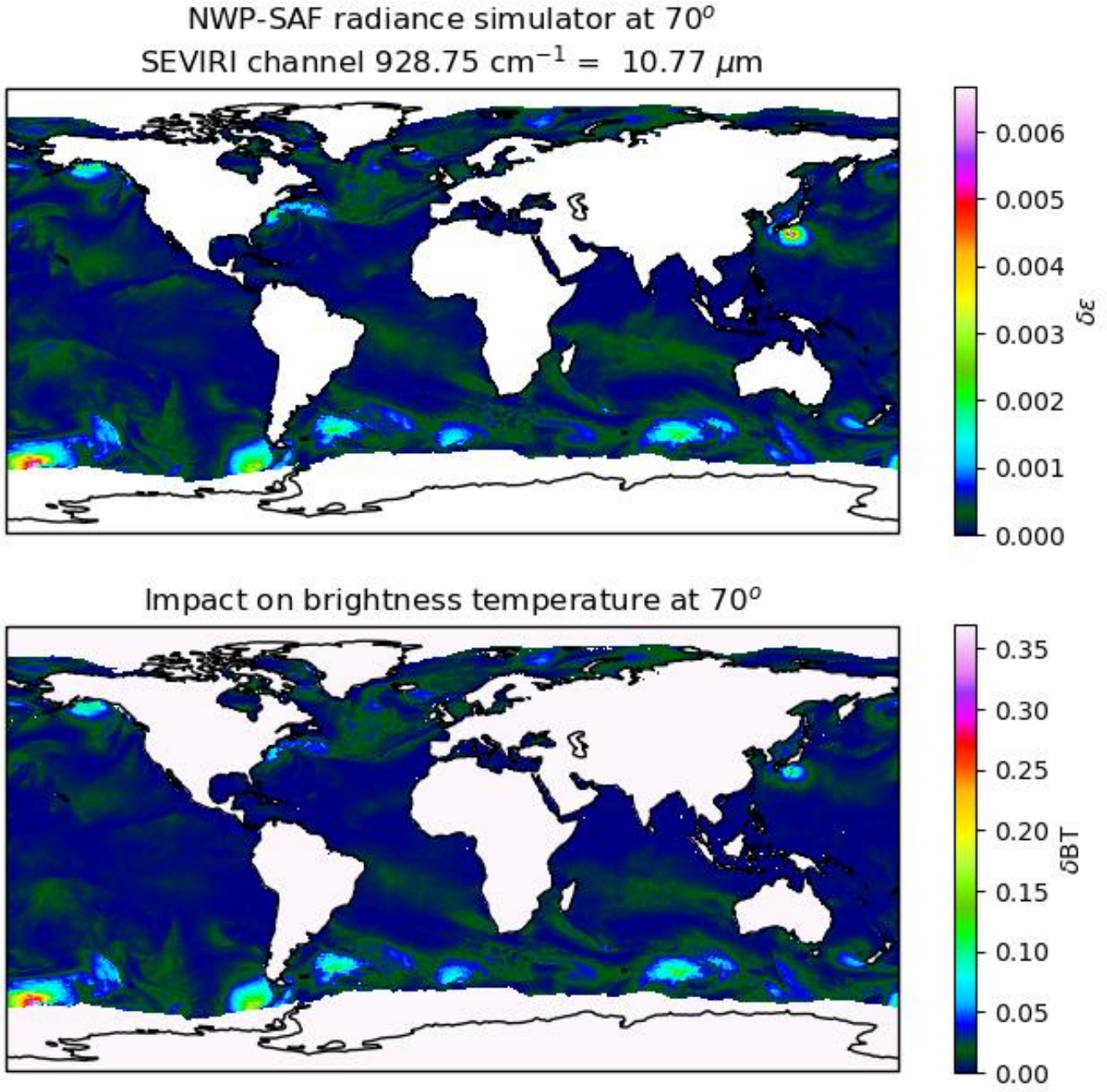




Sensitivity study

$\delta\varepsilon$ up to ~ 0.005

δBT up to ~ 0.3 K



Summary

- Infrared impact of foam restricted to large incidence angles of 60-70° or more
- Case study with Monahan and O'Muircheartaigh (1986) foam fraction shows expected impacts for SEVIRI 10.8 μm window channel are $\delta\varepsilon$ up to ~ 0.005, δBT up to ~ 0.3 K (at 70 °)
- Assumed formulation here:

$$\varepsilon_{total} = (1\text{-}W)\varepsilon_{water} + W\varepsilon_{foam}$$

with W(U) or W(U, dT)