Assignment 2: Global Energy flow perspective

**Question: Melting the Ice**

1) Total solar incoming radiation the earth receives=161 w/m2

2) Total forcing Radiation=Total Radiation Received- Total radiation emitted

Radiation received=Solar radiation + climate change radiation + Back radiation

Solar radiation=161 W/m2

Climate Change=3 W/m2

Back Radiation=333 W/m2

Total radiation at Earth surface =161+3+333=497 W/m2

Total Radiation emitted= Convection + latent heat + emitted from earth

Convection=17 W/m2

Latent heat=80 W/m2

Radiation emitted from earth surface=396 W/m2

Total Radiation emitted=17+80+396=493 W/m2

Total Forcing Radiation=497-493=**~4 W/m2**

3) Latent Heat of fusion (a) =3.34\*105J/kg

Total ice (Glacier + snow) (b)=24064\*103 km3

Density of ice(c) =914kg/m3=914\*109km3

Total Heat required to melt the ice in joules=a\*b\*c--------> (1)

Total radiating forcing =4W/m2=4\*106w/km2

Total Area of earth=510\*106 km2

Total energy from radiation (J) in “Y” no. of years=4\*106\*510\*106\*Y\*3600\*365\*24---> (2)

Above energy will melt the ice so,

Eq(1) = Eq(2)

After calculation, no. of years “Y”= **114.18 Years** required to melt all the ice

**Question: New Steady state Temperature**

1. Outgoing surface radiation = Total surface outgoing radiation +Total forcing radiation

Radiation emitted from earth surface=396 W/m2

Total Forcing Radiation=4w/m2

**Outgoing surface radiation =396+4=400w/m2**

1. At 16 oC, Radiating Flux TOA (1)= σ\*T4 (emissivity is 1 since earth is considered as black body)

σ=5.67X10-8

T=273.15+16=289.15K

TOA (1)=396W/m2

TOA (2)=5.67X10-8XT4

TOA(2)-TOA(1)=4

After calculating T=289.87K=16.72oC

**Increase in temperature=16.72-16=0.72 oC**

**Question : Warming the Ocean**

Total Radiating forcing(a)=4W/m2=4\*106 km2

Area of ocean(b) =360\*106 km2

Total energy in joules for Y no. of years =a\*b\*Y\*365\*3600\*24-----> (1)

Heat Capacity of sea water(c) =~3993 J/kg/k

Total Volume of Ocean (d) =1,338,000\*103 km3

Density of sea water(e)=1025 kg/m3=1025\*109 kg/km3

Total heat required to increase 1 degree temperature= c\*d\*e----->(2)

Heat required to increase the temperature of ocean will come from radiating force so,

Eq(1)=Eq(2)

By calculating for no of years Y,

**Y= 120.58 yrs** required to change 1 degree temperature change in ocean.