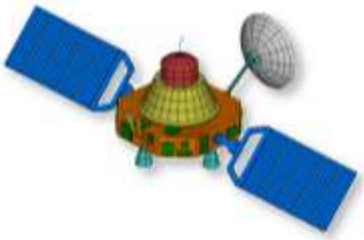


Modelado térmico de un satélite básico

Instituto Universitario de Microgravedad
'Ignacio da Riva'

Contenido

Crear un modelo térmico matemático de un satélite sencillo.

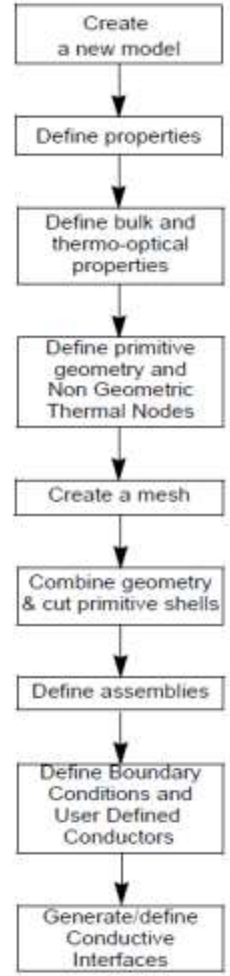


Figure 3-1 Flowchart of the geometric modelling process

Ref. ESATAN-TMS Workbench user manual

1. Definición de materiales y propiedades termo-ópticas

- Definir los materiales (Bulk): introduciendo nombre, densidad, calor específico y conductividad en unidades del S.I.

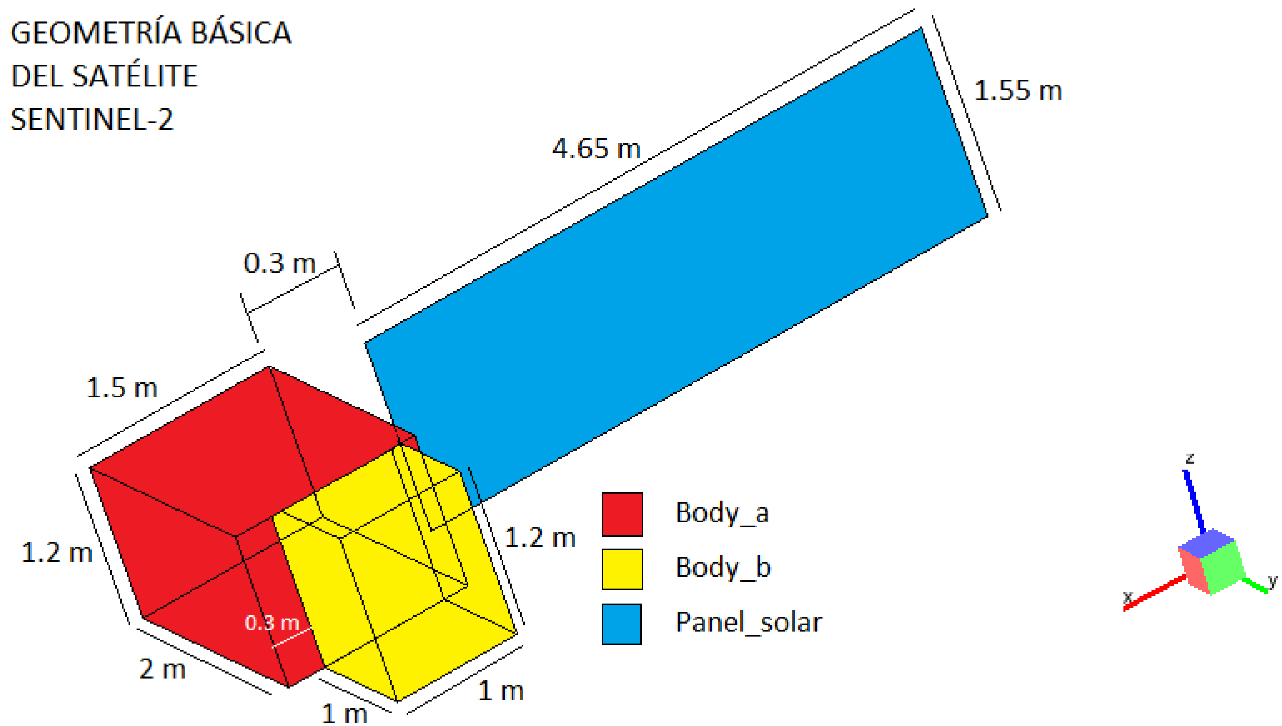
Bulk	Density (kg/m^3)	Specific Heat (J/kgK)	Conductivity (W/mK)
Al_6061	2700	900	160
MLI_foil	300	900	0
GaAs	5300	1000	55

- Definir propiedades ópticas (Optical Set): α y ε

Optical	ε	α
Black	0.84	0.97
Low_e	0.1	0.2
Solar_Cells	0.84	0.75
Kapton	0.61	0.36

2. Construcción de la geometría

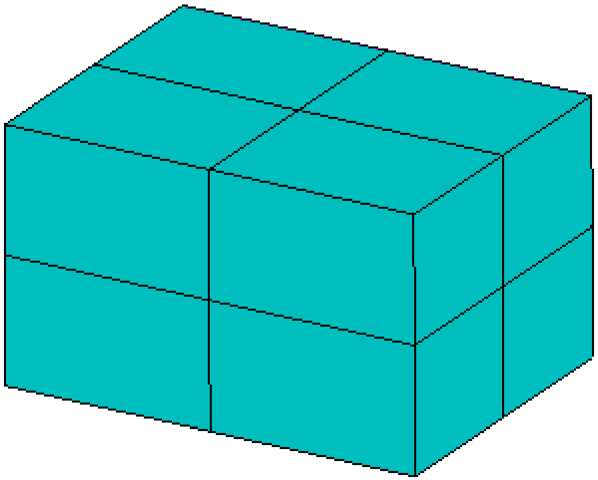
- Se construyen los tres elementos básicos de la figura con distintas estrategias



Body_a

Definición de la geometría

Property	Value
Geometry Name	Body_a
Shape	Box
Defined By	Parameters
height (m)	1.2
xmax (m)	1.5
ymax (m)	2.0



- **Body_a** Se introduce el mallado, las propiedades de cada cara, el material y el espesor

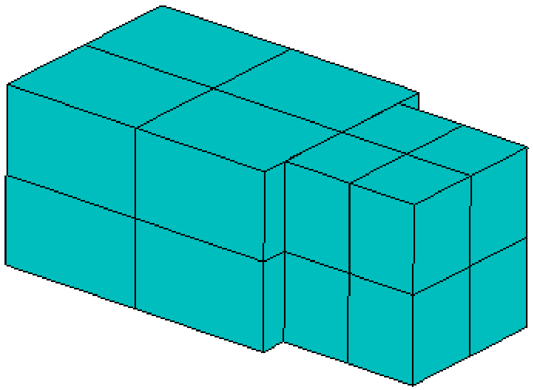
Property	Value
Nº of faces direction 1	2
Nº of faces direction 2	2
Nº of faces direction 3	2
Surface 1	
Label	Body_a_MLI
Optical	Low_e
Surface 2	
Label	Body_a_int
Optical	Black

Property	Value
Composition	DUAL
S1 – Material	MLI_Foil
S1 – Thickness	0.0005
S2 – Material	Al_6061
S2 – Thickness	0.002
Through Conductance	
Calculation Type	EFFECTIVE
Emittance	0.03

Body_b

Definición de la geometría

Property	Value
Geometry Name	Body_b
Shape	Box
Defined By	Parameters
height (m)	1.2
xmax (m)	1.0
ymax (m)	1.0
Tansformation	
X Distance (m)	0.25
Y Distance (m)	2.001



Body_b

Se introduce el mallado, las propiedades de cada cara, el material y el espesor

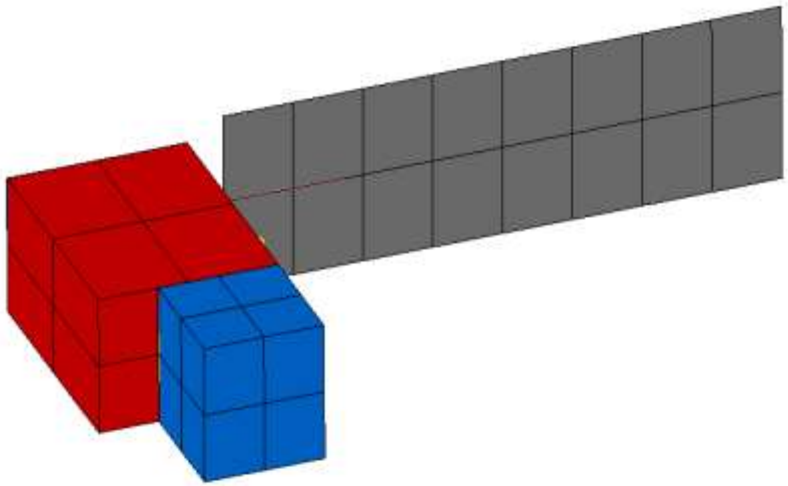
Property	Value
Nº of faces direction 1	2
Nº of faces direction 2	2
Nº of faces direction 3	2
Surface 1	
Label	Body_b_MLI
Optical	Low_e
Surface 2	
Label	Body_b_int
Optical	Black

Property	Value
Composition	DUAL
S1 – Material	MLI_Foil
S1 – Thickness	0.0005
S2 – Material	Al_6061
S2 – Thickness	0.002
Through Conductance	
Calculation Type	EFFECTIVE
Emittance	0.03

Solar Panel

Property	Value
Geometry Name	Solar_Panel
Shape	Rectangle
xmax (m)	4.65
ymax (m)	1.55
Tansformation	
X Angle (deg)	90
X Distance (m)	-4.95
Z Distance (m)	-0.175

Definición de la geometría



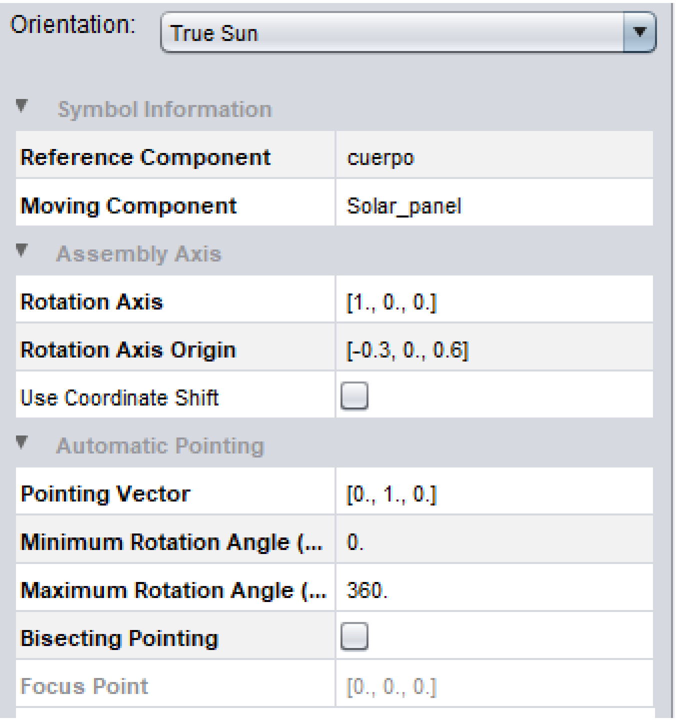
Solar Panel

Property	Value
Nº of faces direction 1	8
Nº of faces direction 2	2
Surface 1	
Label	Solar_Panel_Support
Optical	Kapton
Surface 2	
Label	Solar_Panel_Cells
Optical	Solar_Cells

Property	Value
Composition	DUAL
S1 – Material	Al_6061
S1 – Thickness	0.001
S2 – Material	GaAs
S2 – Thickness	0.001
Through Conductance	
Calculation Type	BULK

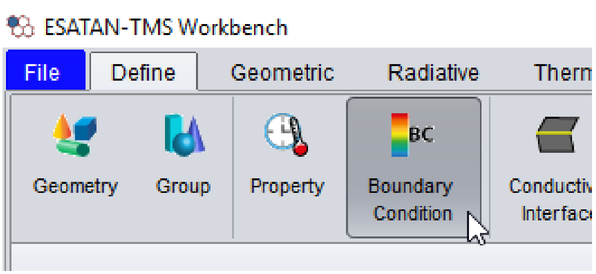
3. Agrupación y movimiento del panel

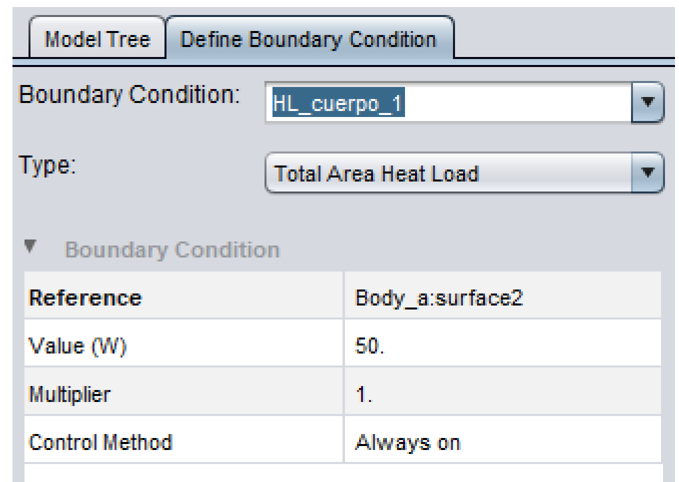
- Agrupar shells para formar estructura jerárquica del modelo



4. Condiciones de contorno

- Introducir las potencias disipadas por los equipos mediante interfaz gráfica

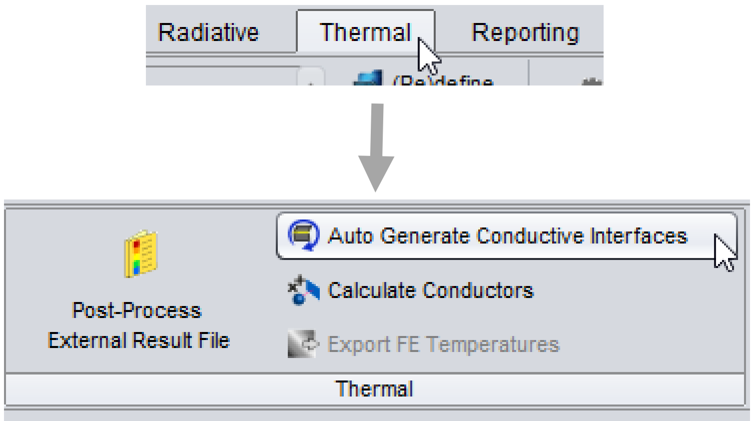


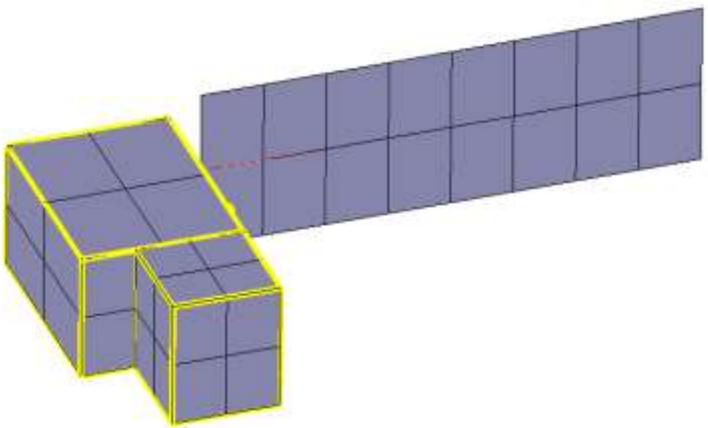


- Se reparten 75 W entre los dos nodos interiores: 50 W en el cuerpo_1 y 25 W en cuerpo_2.

5. Generación de interfaces conductivas

- Se generan aquellas que ESATAN detecta automáticamente.

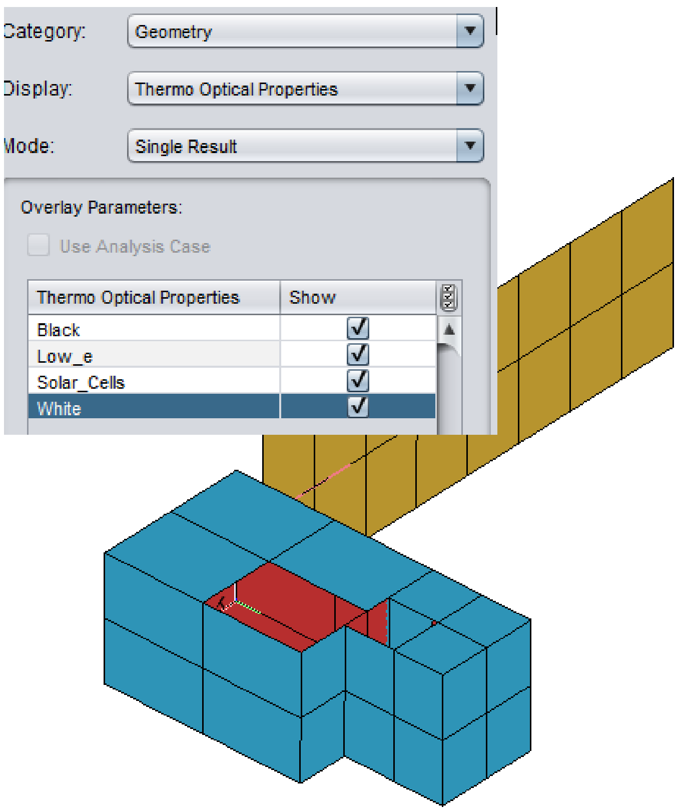




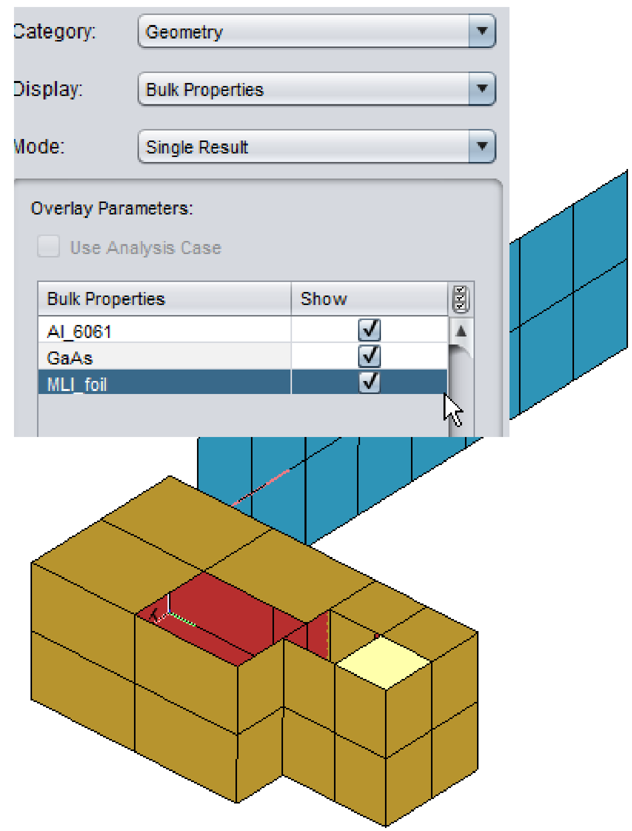
- Se cambian todas las interfaces a tipo 'Fused' (por defecto)

6. Comprobación del modelo

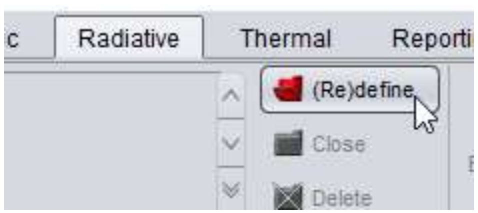
Propiedades termo-ópticas

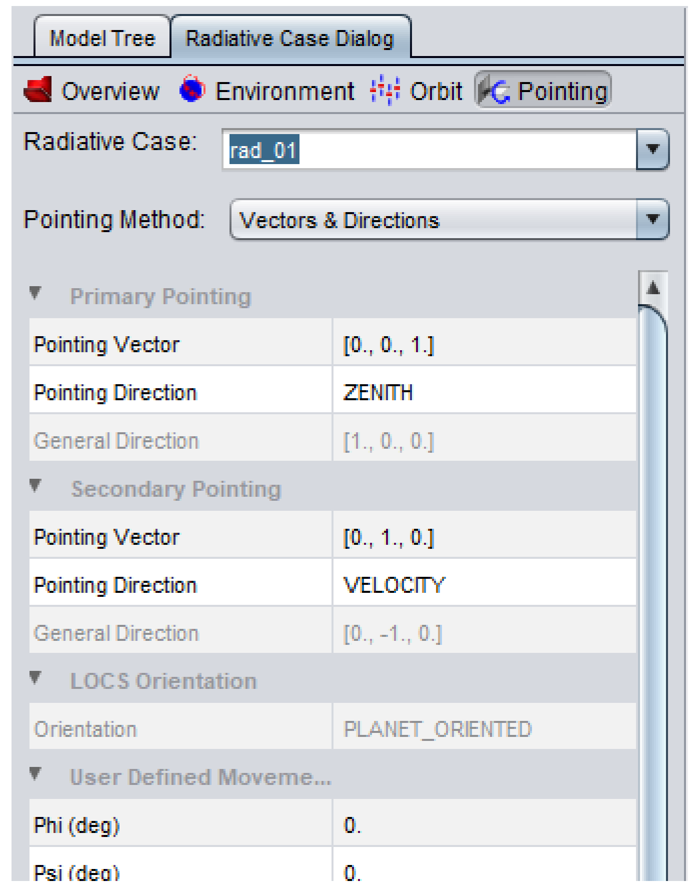


Materiales



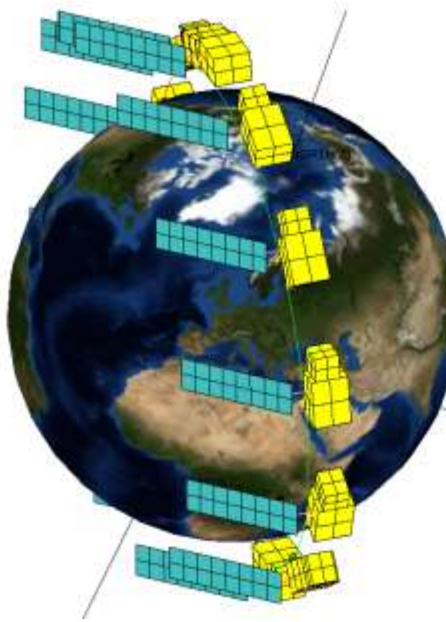
7. Caso radiativo

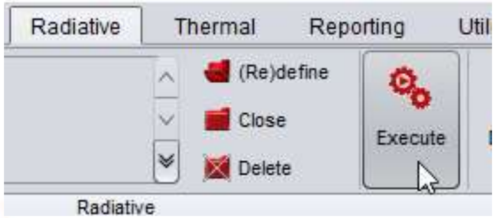


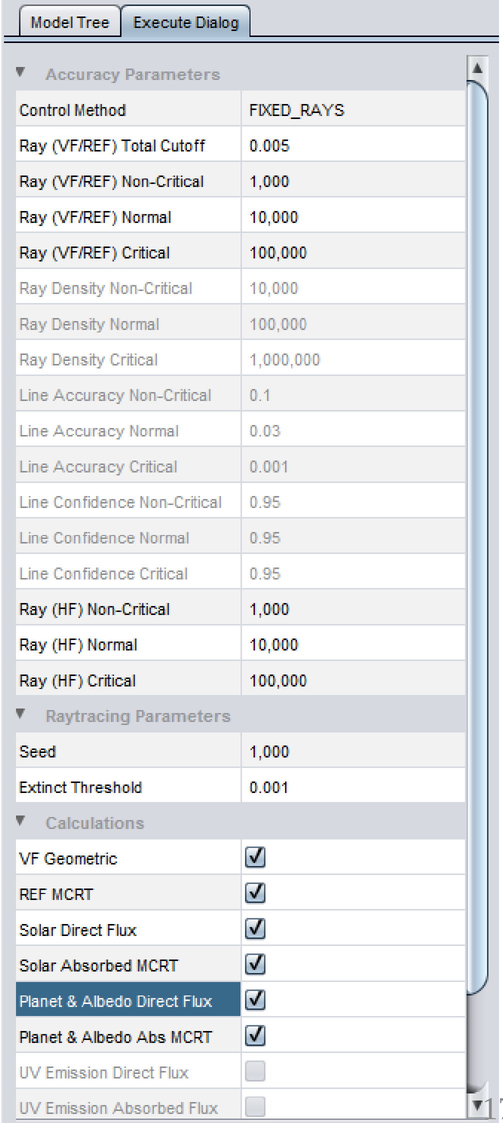


Control Térmico Espacial

- Se ejecuta para obtener los factores de vista, GRs y las cargas del Sol (QS), Albedo (QA) e infrarrojo terrestre (QE).

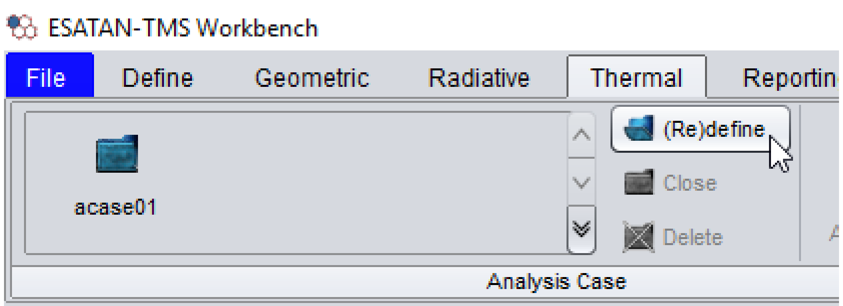


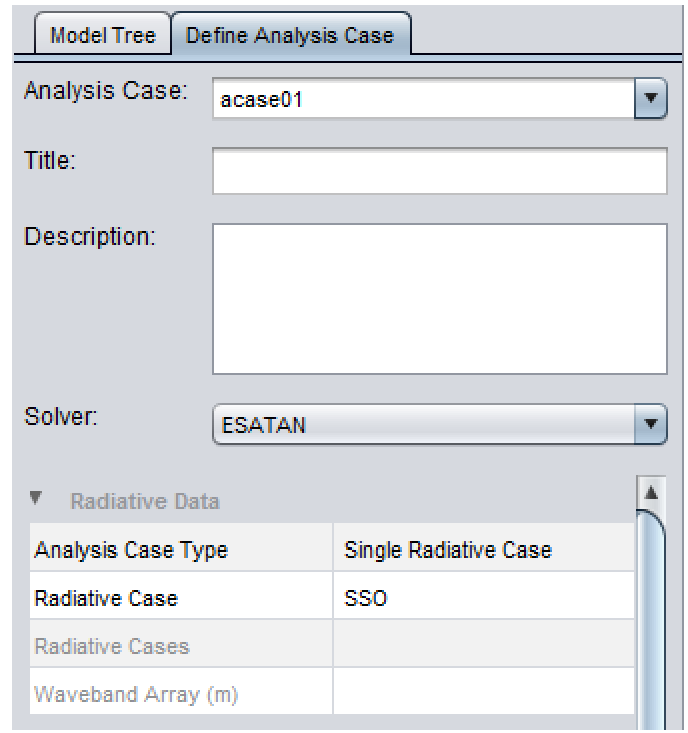




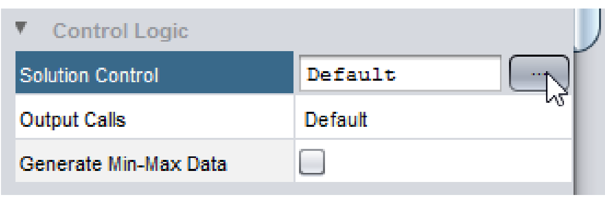
8. Caso de análisis

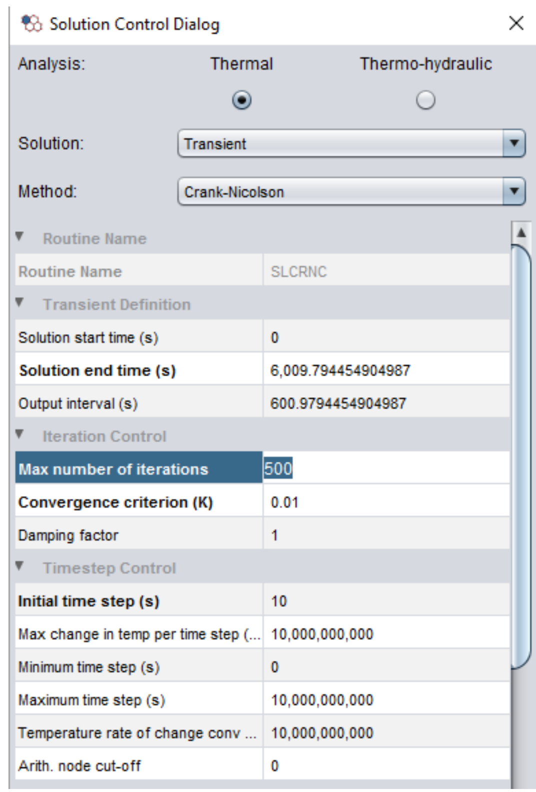
- Se selecciona el radiative case deseado: SS0

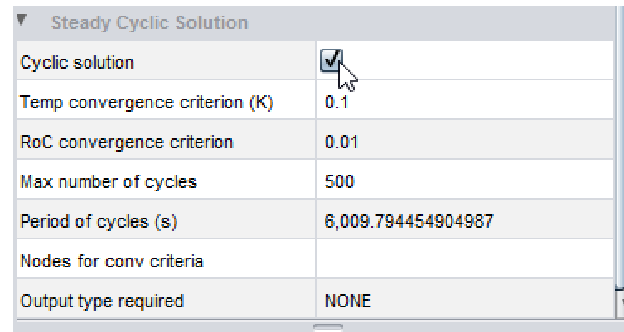


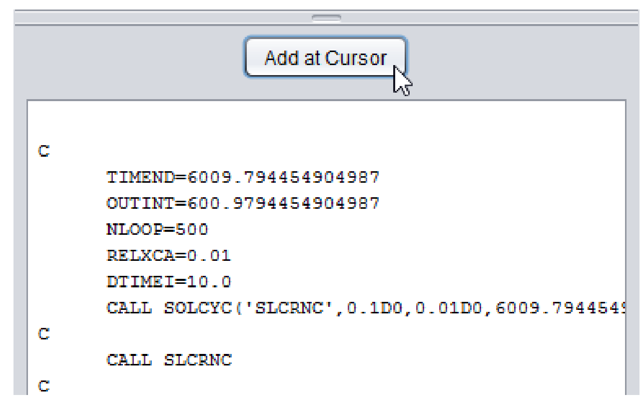


- Se define el esquema de solución (transitorio en este caso) y se añade al bloque de ejecución.

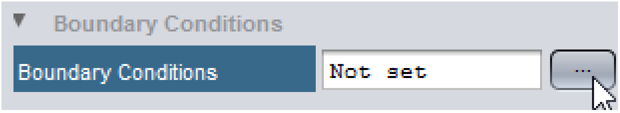


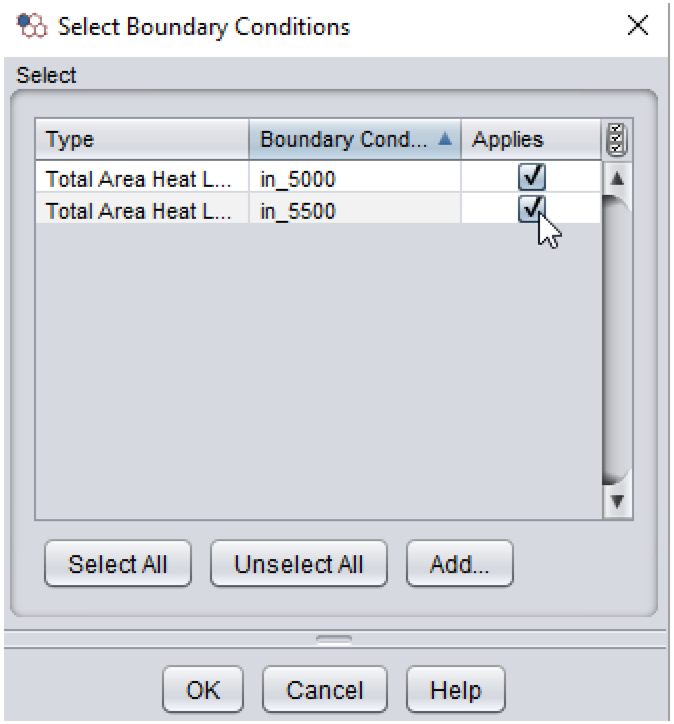






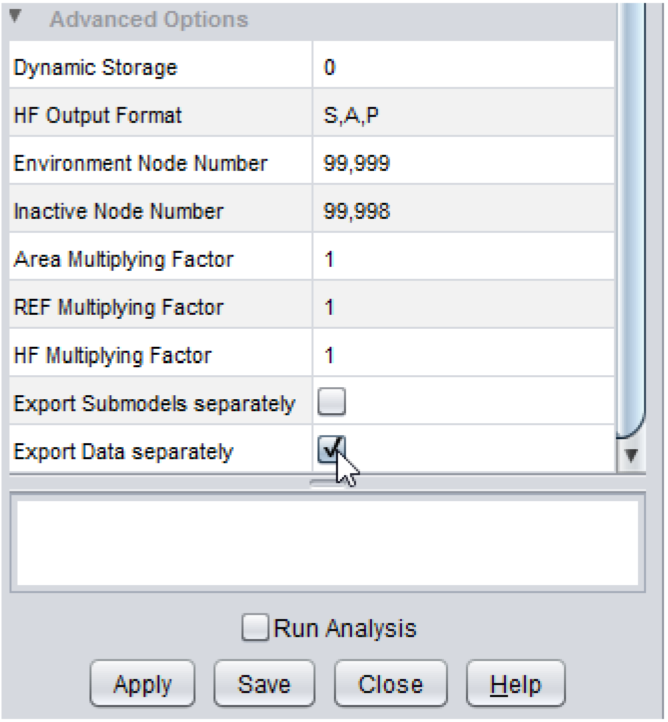
- Se seleccionan las condiciones de contorno, que en este caso son las potencias disipadas.





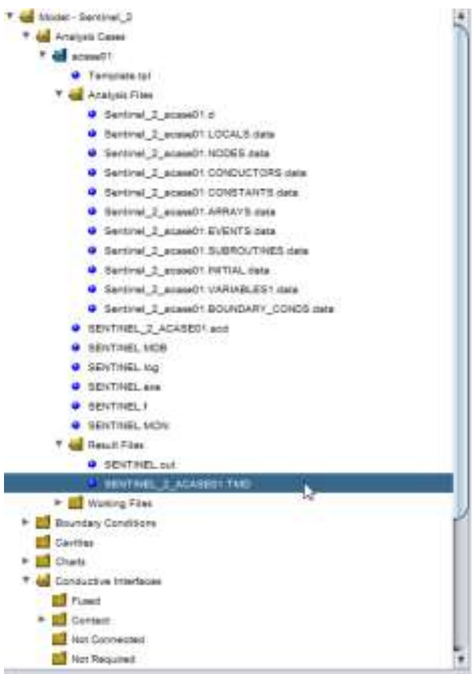
Control Térmico Espacial

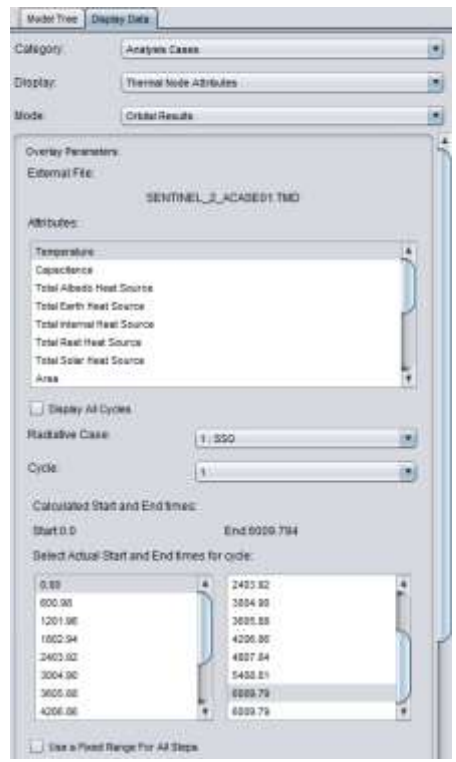
- Se pide que incluya los los flujos solar, albedo e infrarrojo y se pone número a los nodos de contorno (ambiente e inactivo).

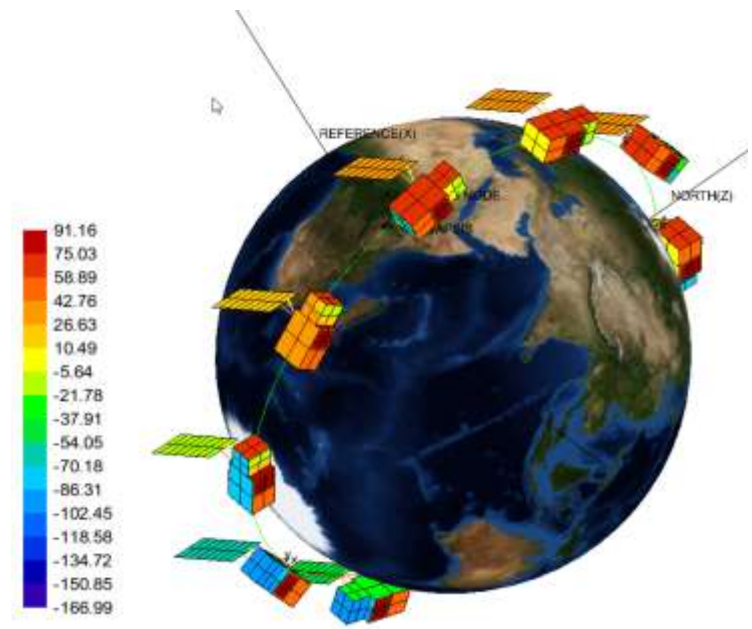


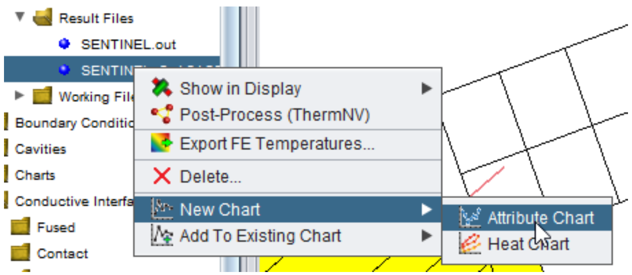
9. Visualización de resultados

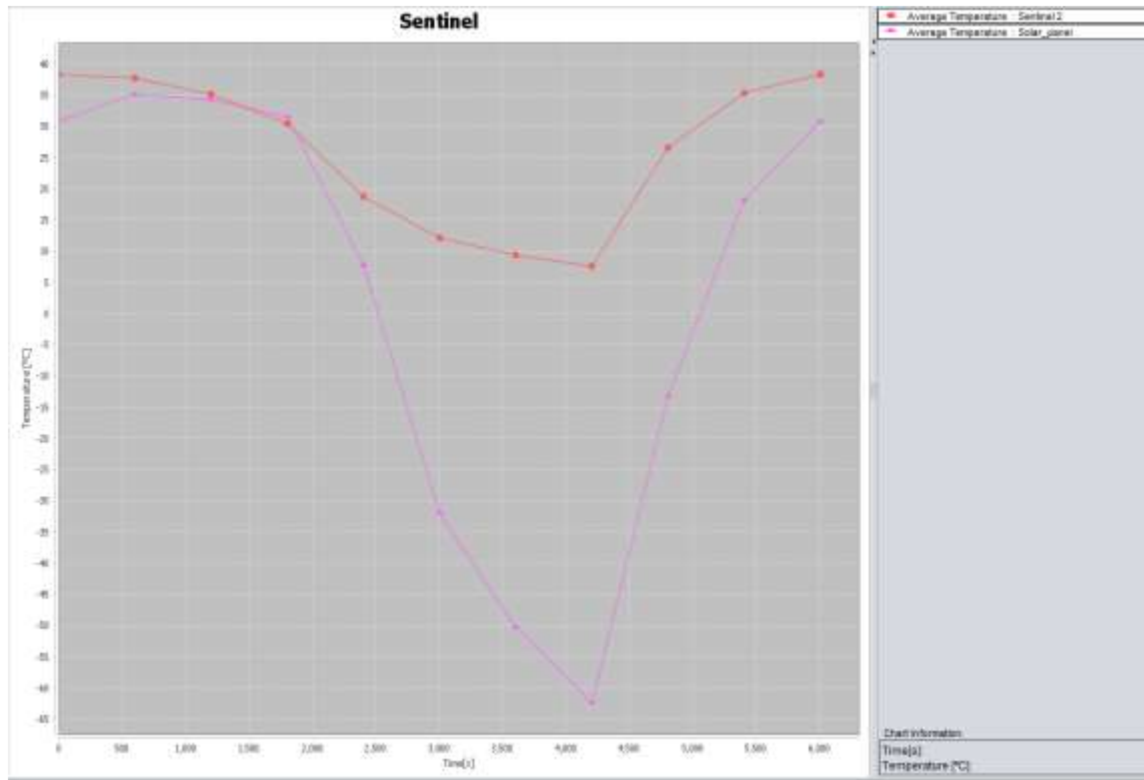
- Los resultados se guardan en un archivo TMD y se configura su visualización haciendo doble click en el archivo.



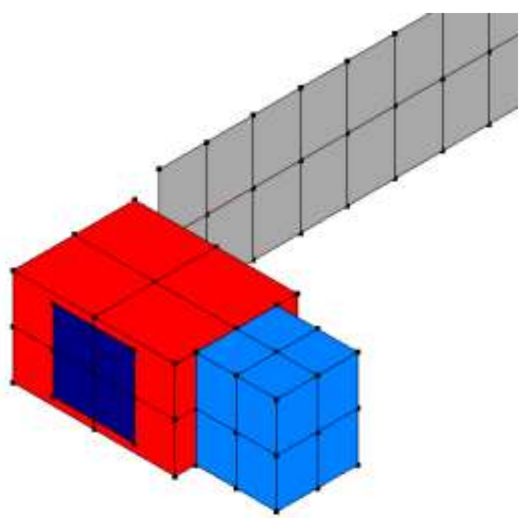





Result Files
SENTINEL.out
Working Files
Boundary Conditions
Cavities
Charts
Conductive Interfaces
Fused
Contact
Show in Display
Post-Process (ThermNV)
Export FE Temperatures...
Delete...
New Chart
Add To Existing Chart
Attribute Chart
Heat Chart


Sentinel

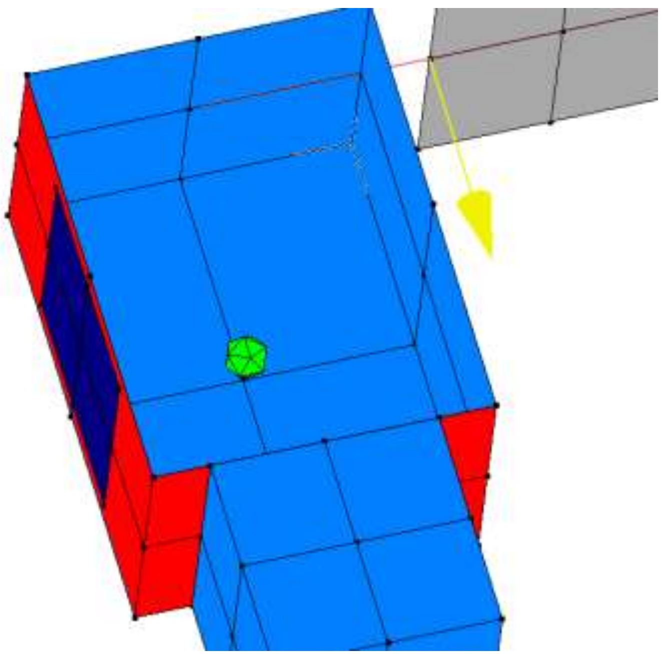
10. Radiador



Geometry Name:	Radiator
Shape:	Rectangle
Geometry Type:	(•) Shell ( ) Solid
Defined By:	Parameters
Params	
xmax (m)	1.0
ymax (m)	1.0
height (m)	0.0
xmin (m)	0.0
ymin (m)	0.0
Transform	
Method	X Y Z
X Angle (deg)	0
Y Angle (deg)	90
Z Angle (deg)	0
X Distance (m)	1.501
Y Distance (m)	0.5
Z Distance (m)	1.1
Application Order	XR, YR, ZR, XT, YT, ZT
Cutting	
Cutting Sense	Keep Outside

Surface 1	
Label	Radiator
Activity	Active
Radiative Criticality	NORMAL
Submodel name	
Base Node Number	18,500
Node Increment in Directi...	1
Node Increment in Directi...	
Optical Coating	White
Colour	DARK_BLUE
Surface 2	
Label	Radiator
Activity	Conductive
Radiative Criticality	NORMAL
Submodel name	
Base Node Number	18,000
Node Increment in Directi...	1
Node Increment in Directi...	
Optical Coating	White
Colour	BLUE_CYAN
Bulk Material	
Composition	SINGLE
Material	Aluminio
Thickness (m)	0.002
Surface 1 - Material	

11. Nodo no geométrico



12. Acoplamiento conductivo