MEHmed MEDITERRANEAN ENVIRONMENTAL CHANGE MANAGEMENT
MASTER STUDY & ECOSYSTEM BUILDING

Application des SIG dans le Calcul de la température de surface (LST)

Coordinator

Universitat de Girona

Co-funded by the Erasmus+ Programme of the European Union

info@mastermehmed.com
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PROJECT NUMBER: 598826-EPP-1-2018-1-ES-EPPKA2-CBHE-JP

Partners

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Présenté par : Dounia KHELLAF

- ✓ Membre du Laboratoire Architecture Bioclimatique & Environnement,
- ✓ Faculté d'architecture et d'urbanisme,
- ✓ Université Salah Boubnider, Constantine 3.

- 08 juin 2021 -

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Application des SIG dans le Calcul de la température de surface (LST)

Comparaison entre trois sites différents dans le globe terrestre

Matière: SIG appliqué à l'environnement

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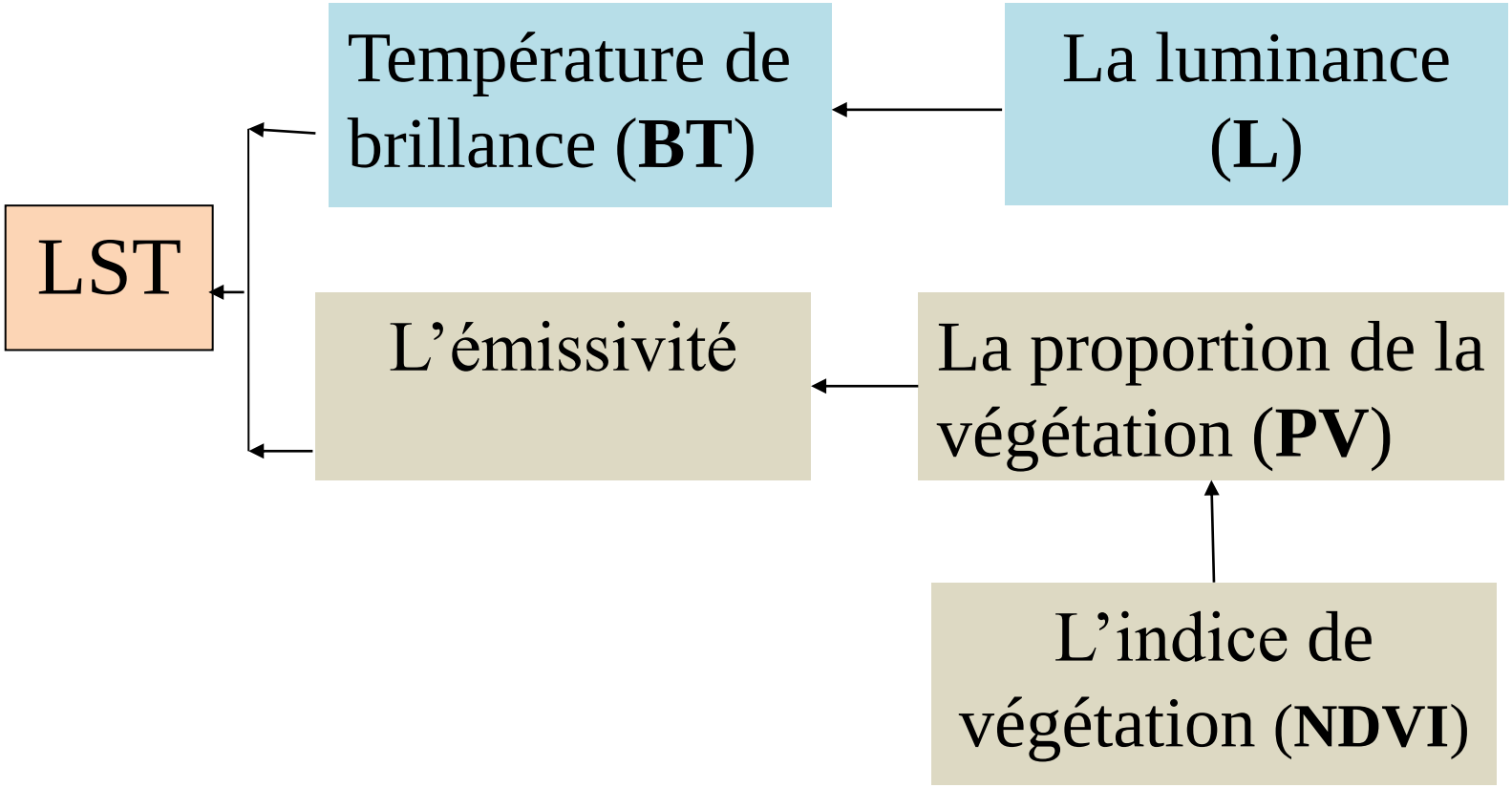
Diagramme de calcul de la température de surface LST



1

Convertir les valeurs numériques de la bande thermique (band10/ band11) en **luminance (TOA)**

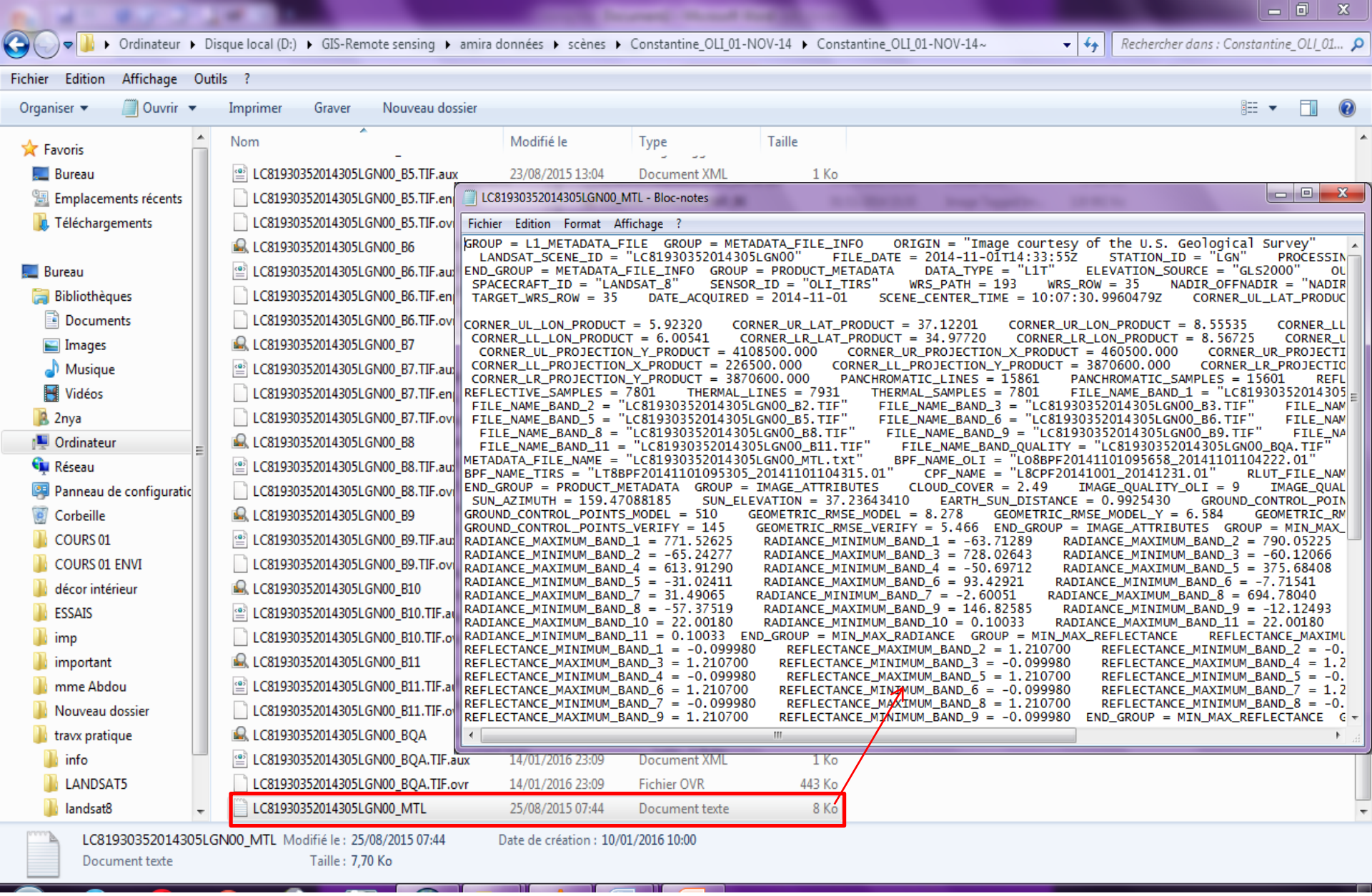
$$L_\lambda = M_L \times Q_{cal} + A_L$$

- L_λ = Luminance
- M_L = RADIANCE_MULT_BAND_x,
- A_L = RADIANCE_ADD_BAND_x,
- Q_{cal} = la bande spectral thermique considérée

EXEMPLE:

$$L_{B10} = 0.0003342 \times BAND10 + 0.1$$

Luminance = Radiance = Top Of the Atmosphere (TOA)



Ouvrir le fichier métadata de la scène satellitaire(MTL),
Copier les données dans un fichier word pour facilter la lecture

Conversion les valeurs numériques en luminance (TOA)

$$L_\lambda = M_L \times Q_{cal} + A_L$$

BANDE 10:

LB10=0.0003342*BAND10+0.1

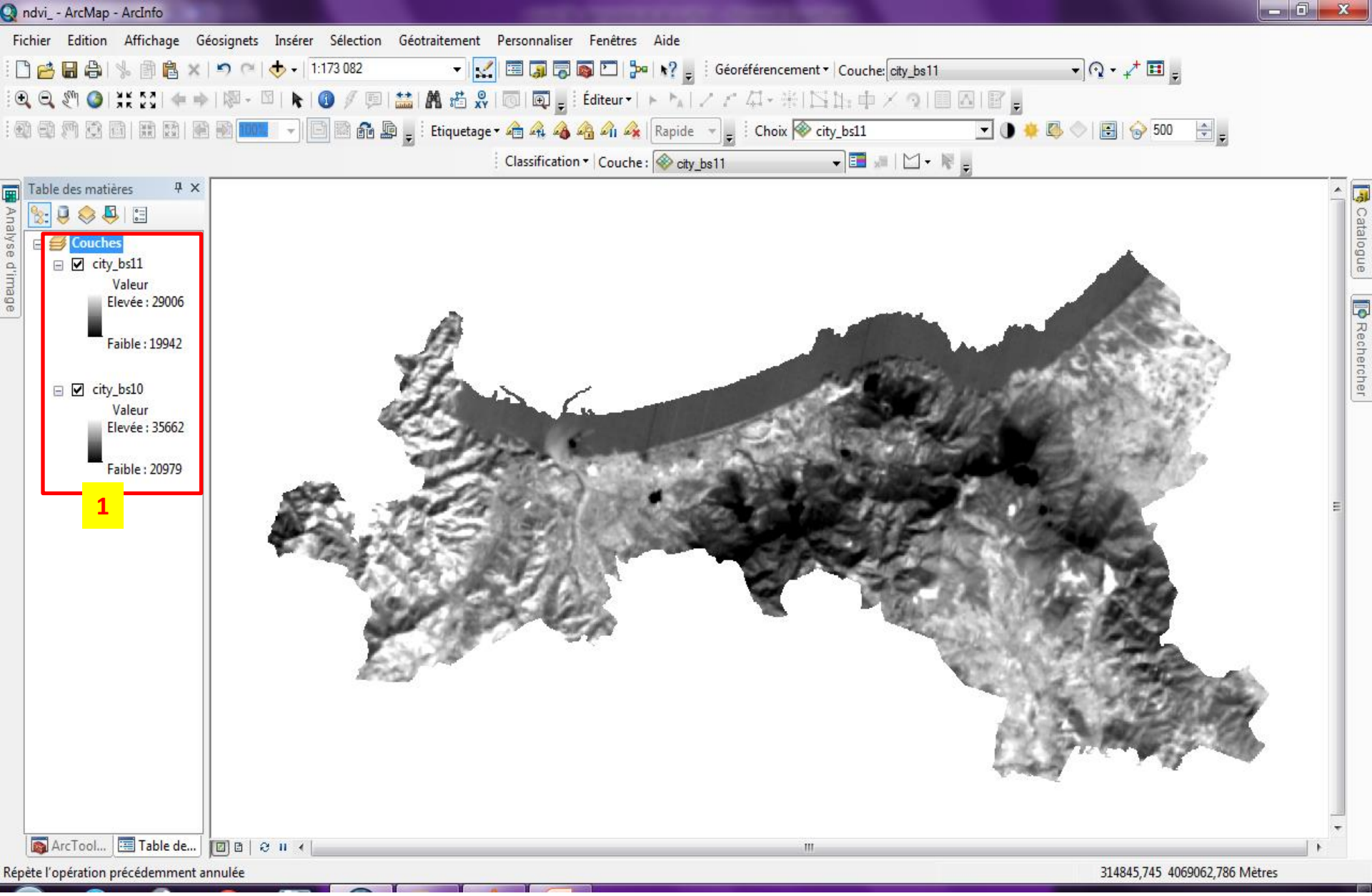
BANDE 11:

L_{B11}=0.0003342*BAND11+0.1

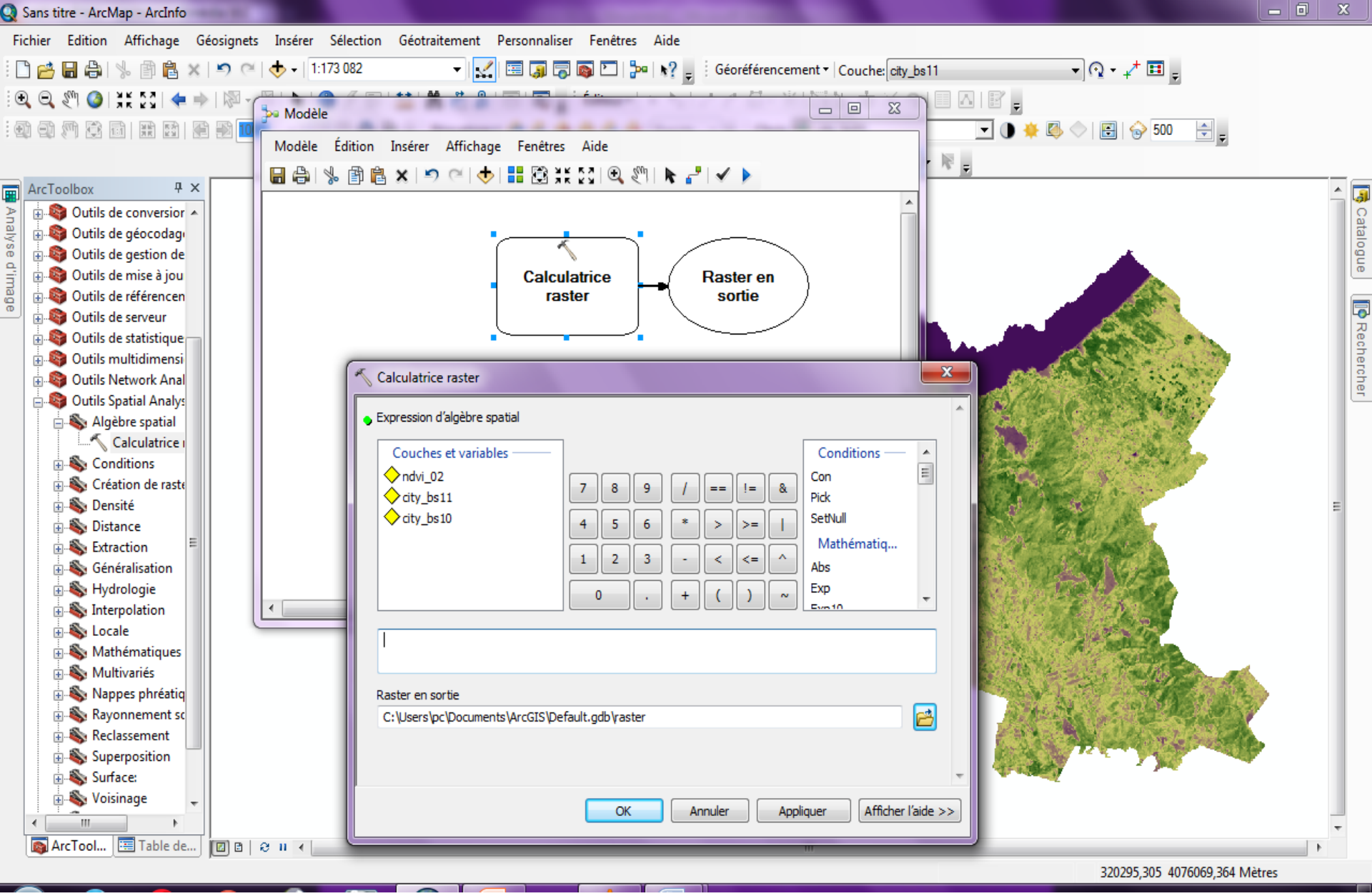
RADIANCE_ADD_BAND_10 = 0.10000
RADIANCE_ADD_BAND_11 = 0.10000
REFLECTANCE_MULT_BAND_1 = 2.0000E-05
REFLECTANCE_MULT_BAND_2 = 2.0000E-05
REFLECTANCE_MULT_BAND_3 = 2.0000E-05
REFLECTANCE_MULT_BAND_4 = 2.0000E-05
REFLECTANCE_MULT_BAND_5 = 2.0000E-05
REFLECTANCE_MULT_BAND_6 = 2.0000E-05
REFLECTANCE_MULT_BAND_7 = 2.0000E-05
REFLECTANCE_MULT_BAND_8 = 2.0000E-05
REFLECTANCE_MULT_BAND_9 = 2.0000E-05
REFLECTANCE_ADD_BAND_1 = -0.100000
REFLECTANCE_ADD_BAND_2 = -0.100000
REFLECTANCE_ADD_BAND_3 = -0.100000
REFLECTANCE_ADD_BAND_4 = -0.100000
REFLECTANCE_ADD_BAND_5 = -0.100000
REFLECTANCE_ADD_BAND_6 = -0.100000
REFLECTANCE_ADD_BAND_7 = -0.100000
REFLECTANCE_ADD_BAND_8 = -0.100000
REFLECTANCE_ADD_BAND_9 = -0.100000
END_GROUP = RADIOMETRIC_RESCALING
GROUP = TIRS_THERMAL_CONSTANTS
K1_CONSTANT_BAND_10 = 774.89
K1_CONSTANT_BAND_11 = 480.89
K2_CONSTANT_BAND_10 = 1321.08
K2_CONSTANT_BAND_11 = 1201.14
END_GROUP = TIRS_THERMAL_CONSTANTS
GROUP = PROJECTION_PARAMETERS

QUANTIZE_CAL_MAX_BAND_9 = 65535
QUANTIZE_CAL_MIN_BAND_9 = 1
QUANTIZE_CAL_MAX_BAND_10 = 65535
QUANTIZE_CAL_MIN_BAND_10 = 1
QUANTIZE_CAL_MAX_BAND_11 = 65535
QUANTIZE_CAL_MIN_BAND_11 = 1
END_GROUP = MIN_MAX_PIXEL_VALUE
GROUP = RADIOMETRIC_RESCALING
RADIANCE_MULT_BAND_1 = 1.2745E-02
RADIANCE_MULT_BAND_2 = 1.3051E-02
RADIANCE_MULT_BAND_3 = 1.2027E-02
RADIANCE_MULT_BAND_4 = 1.0141E-02
RADIANCE_MULT_BAND_5 = 6.2061E-03
RADIANCE_MULT_BAND_6 = 1.5434E-03
RADIANCE_MULT_BAND_7 = 5.2021E-04
RADIANCE_MULT_BAND_8 = 1.1477E-02
RADIANCE_MULT_BAND_9 = 2.4255E-03
RADIANCE_MULT_BAND_10 = 3.3420E-04
RADIANCE_MULT_BAND_11 = 3.3420E-04
RADIANCE_ADD_BAND_1 = -63.72563
RADIANCE_ADD_BAND_2 = -65.25582
RADIANCE_ADD_BAND_3 = -60.13268
RADIANCE_ADD_BAND_4 = -50.70727
RADIANCE_ADD_BAND_5 = -31.03032

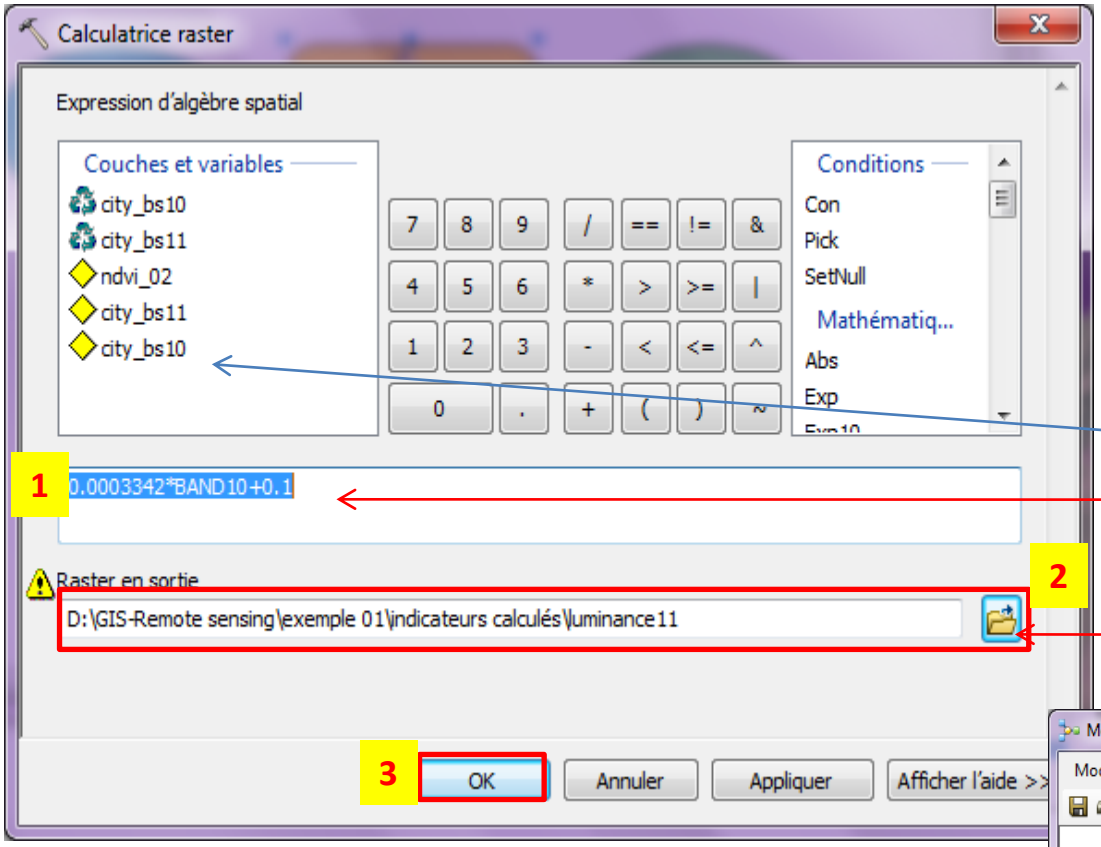
Le fichier Metadata



01: ajouter les couches thermiques 10 / 11.

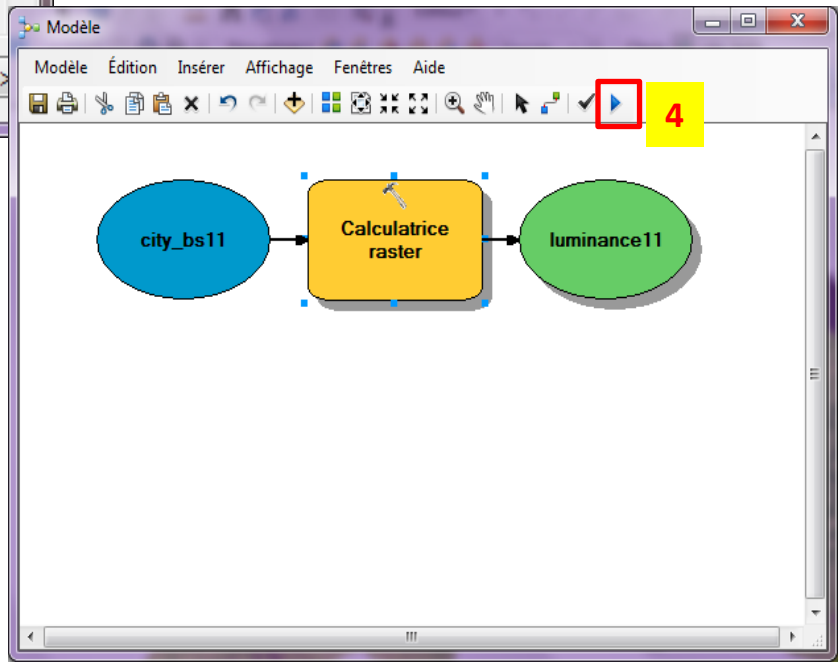


Arctoolbox/spatial analysis tools/Map Algebra/ Raster calculator



0.0003342* BAND10 +0.1

Gérer l'emplacement



- **Dans la formule «**BAND10 » doit être remplacé par la couche réel

2

Convertir la luminance (TOA) en **température de brillance (BT)**

$$BT = \left(\frac{K_2}{\ln\left(\frac{K_1}{L_\lambda} + 1\right)} \right) - 273.1$$

- L_λ**:** Luminance
- K_1 **,** K_2 **:** des constantes

EXEMPLE:

BT10 = (1321.08/ Ln (774.89/L10 +1)) -273.15

(-273,1) pour convertir les kelvins en **Celsius**

Convertir la luminance en température de brillance (BT)

$$BT = \left(\frac{K_2}{\ln\left(\frac{K_1}{L_\lambda}+1\right)} \right) - 273.1$$

BANDE 11:

T_{band11}= (1201.14/ln(480.89/ L_{B11}+1)) - 273,15

BANDE 10:

T_{band10}= (1321.08/ln(774.89/ L_{B10}+1)) - 273,15

-272,15 pour convertir les kelvin en Celsius.

```
REFLECTANCE_MULT_BAND_1 = 2.0000E-05
REFLECTANCE_MULT_BAND_2 = 2.0000E-05
REFLECTANCE_MULT_BAND_3 = 2.0000E-05
REFLECTANCE_MULT_BAND_4 = 2.0000E-05
REFLECTANCE_MULT_BAND_5 = 2.0000E-05
REFLECTANCE_MULT_BAND_6 = 2.0000E-05
REFLECTANCE_MULT_BAND_7 = 2.0000E-05
REFLECTANCE_MULT_BAND_8 = 2.0000E-05
REFLECTANCE_MULT_BAND_9 = 2.0000E-05
REFLECTANCE_ADD_BAND_1 = -0.100000
REFLECTANCE_ADD_BAND_2 = -0.100000
REFLECTANCE_ADD_BAND_3 = -0.100000
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K1_CONSTANT_BAND_11 = 480.89
K2_CONSTANT_BAND_10 = 1321.08
K2_CONSTANT_BAND_11 = 1201.14
END_GROUP = TIRS_THERMAL_CONSTANTS
GROUP = PROJECTION_PARAMETERS
```
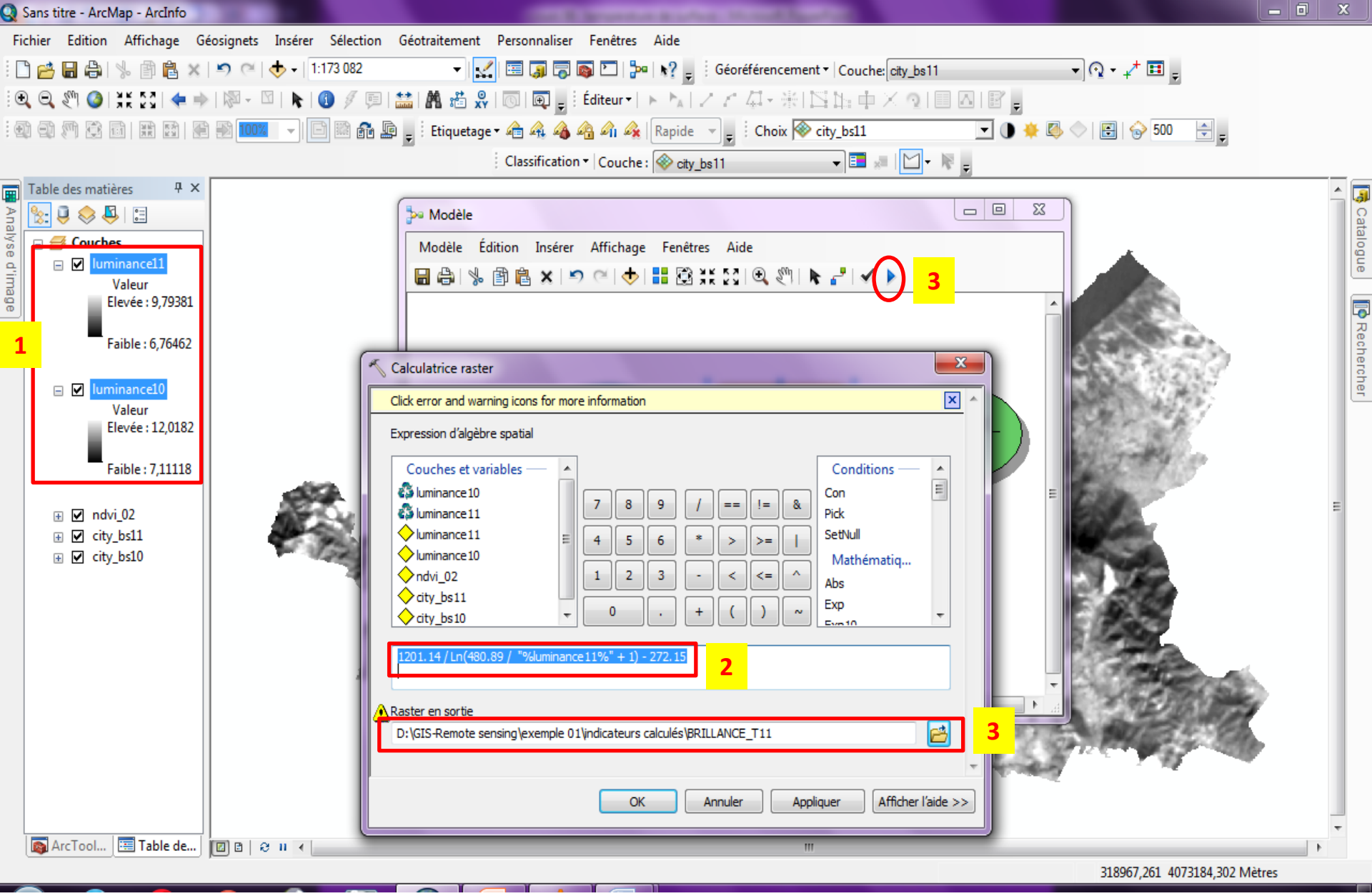

Metadata nécessaire



1: ajouter les couches « luminance » / 2: la formule de conversion convenable

3: gérer l'emplacement et OK /4: exécution

3

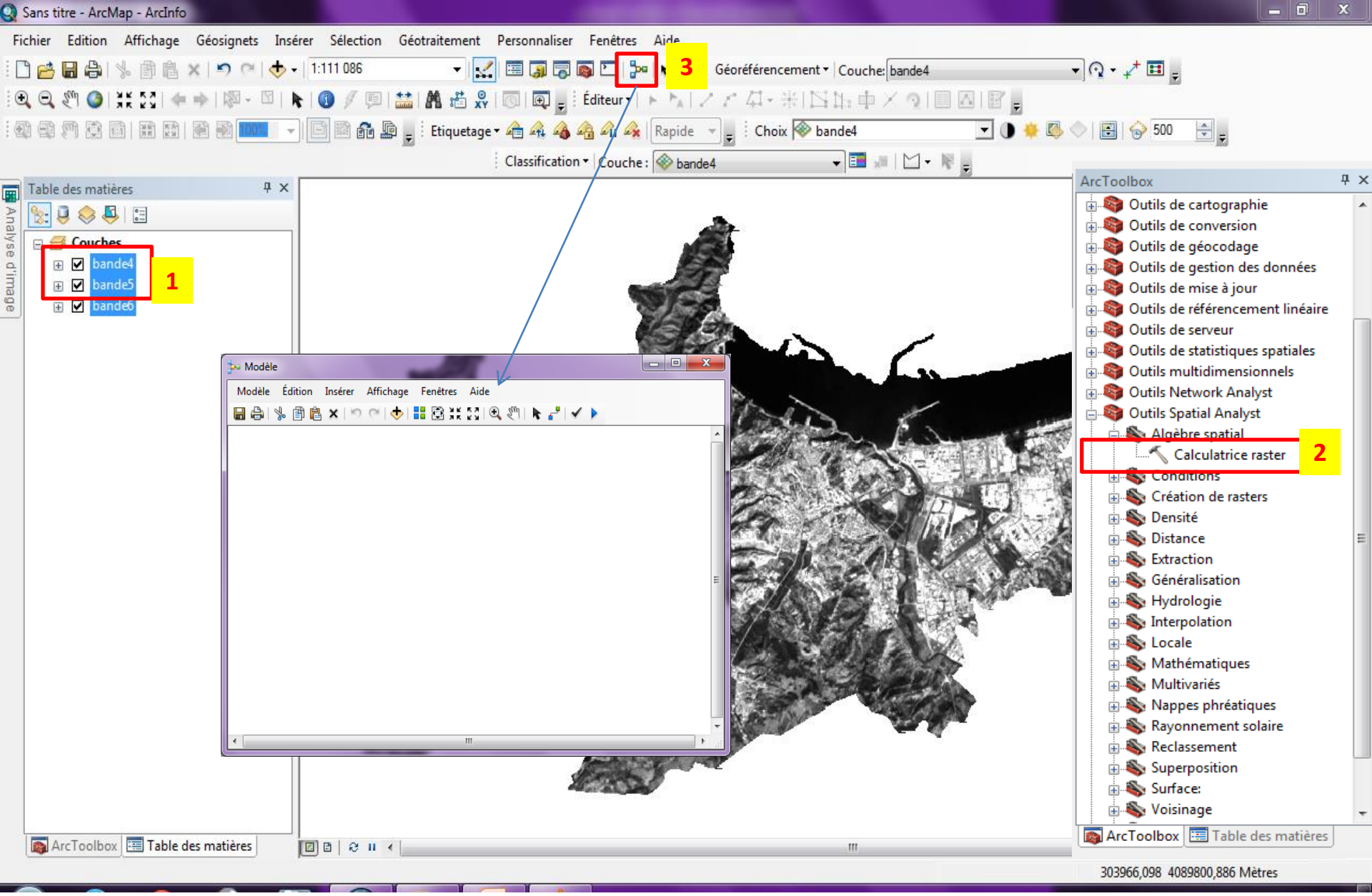
Calcul de l'indice de végétation – **NDVI** –

NDVI = (NIR - RED) / (NIR + RED)

NDVI = (band5-band4)/(band5+ band 4)

EXEMPLE:

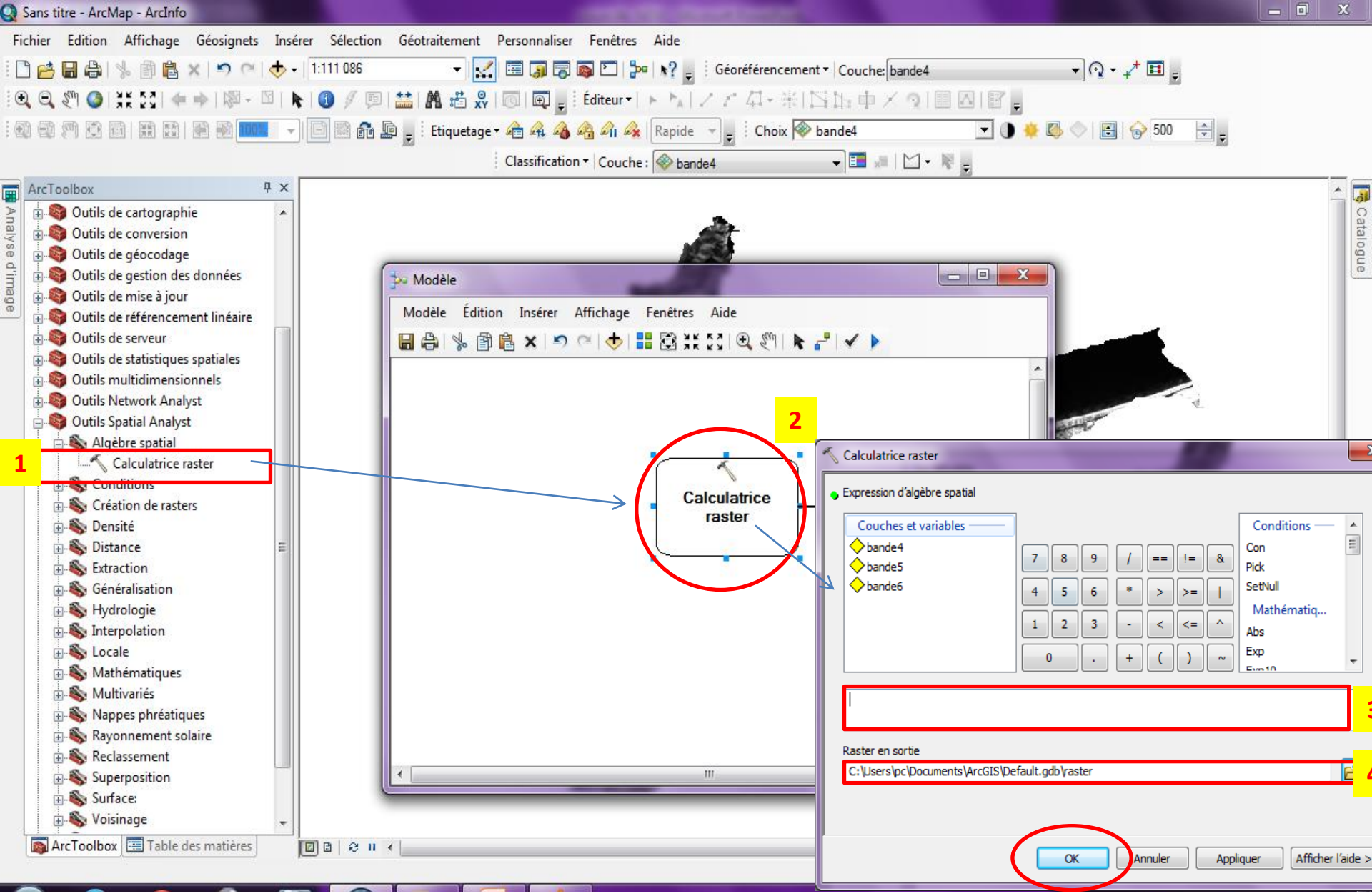
NDVI= float (couche 5-couche 4)/ float (couche 5+couche 4)



01: charger les couches « 4,5 »

02: ArcToolbox, choisir « calculatrice raster »

03: cliquer sur « ModelBuilder »



01: glisser l'option « calculatrice Raster » dans la fenêtre « modelBuilder »

02: double cliques sur « calculatrice raster »

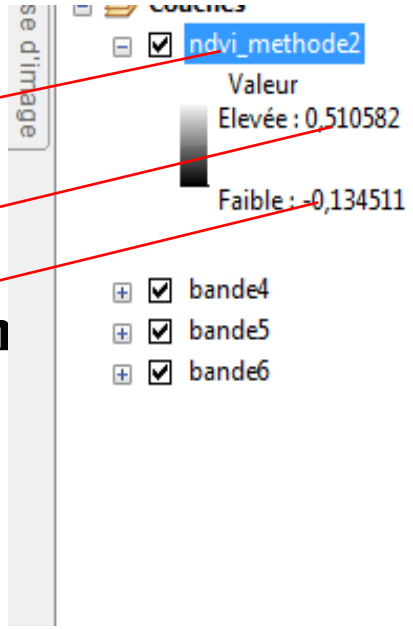
03: la formule « float (couche 5-couche 4)/ float (couche 5+couche 4)

4

Calcul de la proportion de la végétation – **PV** –

$$PV = \left(\frac{NDVI - NDVI_{min}}{NDVI_{max} - NDVI_{min}}\right)^2$$

PV= square (NDVI - NDVI min / NDVI max -NDVI min



Calcul de l'émissivité – ε –

5

$$\varepsilon = 0.004 \times PV + 0.986$$

Utiliser la même procédure (RASTER CALCULATOR) dans le calcul

6

Calcul de la Température de surface –**LST** –

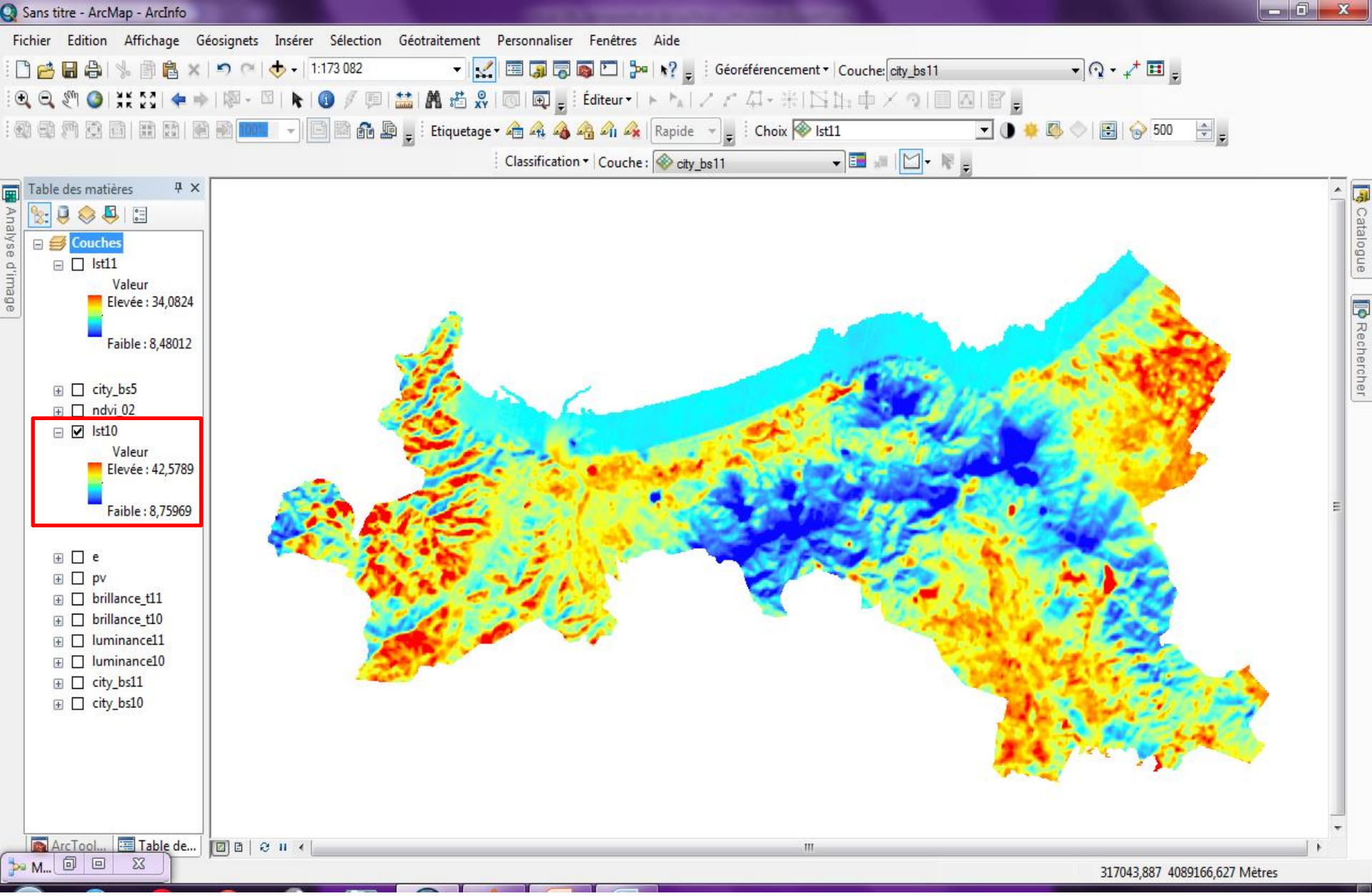
$$LST = \left(\frac{BT}{1 + \left(w \times \frac{BT}{P}\right) \times \ln(\varepsilon)}\right)$$

- **BT** = la température de brilliance
- ε = l'émissivité
- **P** = 14388
- **w** =la bande spectrale x

EXEMPLE:

LST10 = BT / 1+BAND 10 × (BT10/14388) × ln(e)

LST11 = BT / 1+BAND 11 × (BT11/14388) × ln(e)



Résultats LST (température de surface

Université de Constantine 3 — جامعة قسنطينة 3
صالح بوبنيدر
SALAH BOUBNIDER

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Merci de votre attention

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