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MEHmed MEDITERRANEAN ENVIRONMENTAL CHANGE MANAGEMENT MASTER STUDY & ECOSYSTEM BUILDING

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

Coordinator



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PROJECT NUMBER: 598826-EPP-1-2018-1-ES-EPPKA2-CBHE-JP

Partners





MASTER STUDY & ECOSYSTEM BUILDING



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Présenté par : Dounia KHELLAF



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- ✓ Faculté d'architecture et d'urbanisme,
- ✓ Université Salah Boubnider, Constantine 3.

- 08 juin 2021 -

Coordinator



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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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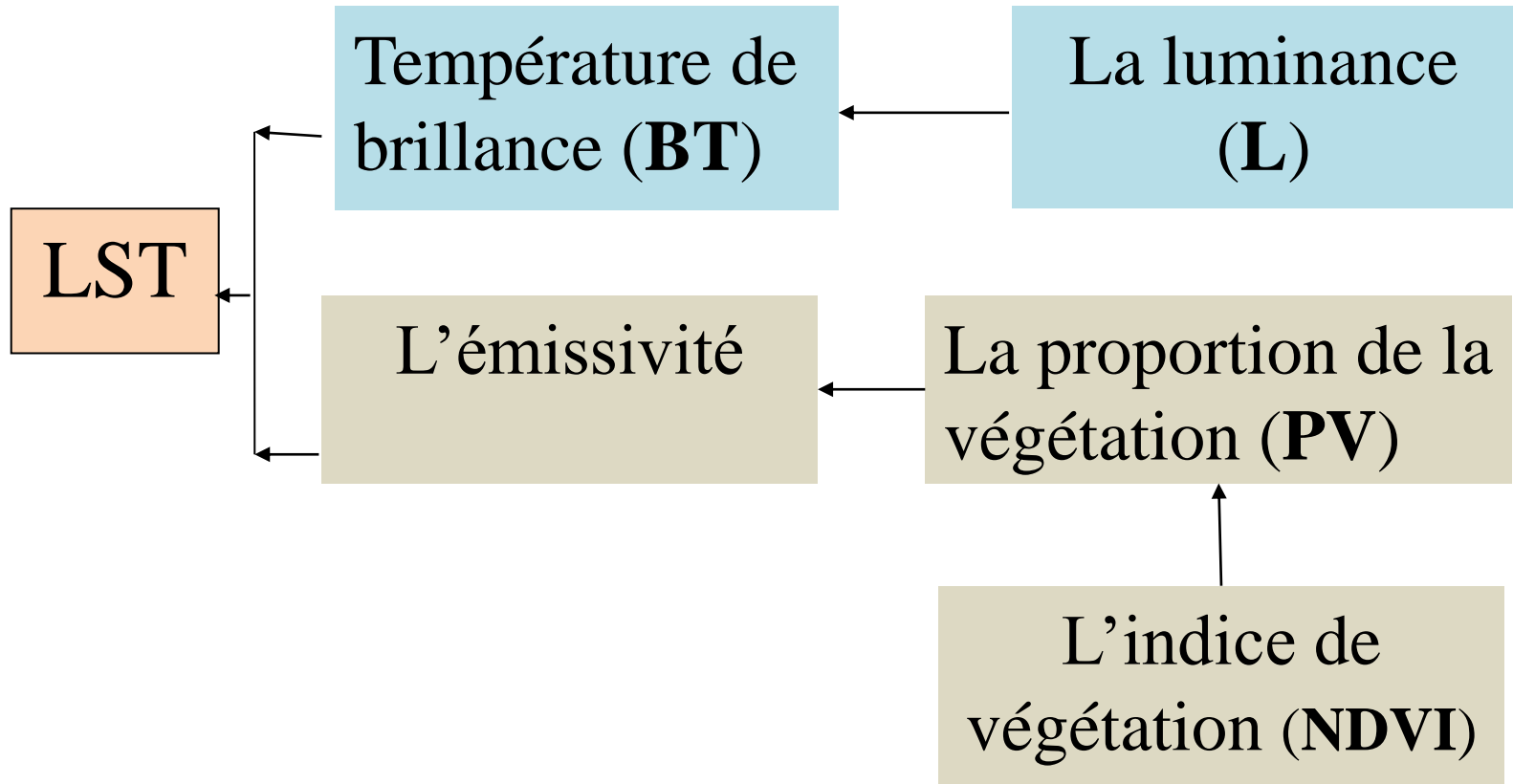
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Diagramme de calcul de la température de surface LST



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:

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

Luminance = Radiance = Top Of the Atmosphere (TOA)

Ordinateur > Disque local (D:) > GIS-Remote sensing > amira données > scènes > Constantine_OLI_01-NOV-14 > Constantine_OLI_01-NOV-14~

Rechercher dans : Constantine_OLI_01...

Fichier Edition Affichage Outils ?

Organiser Ouvrir Imprimer Graver Nouveau dossier

Favoris

- Bureau
- Emplacements récents
- Téléchargements
- Bureau
- Bibliothèques
- Documents
- Images
- Musique
- Vidéos
- 2nya
- Ordinateur
- Réseau
- Panneau de configurati...
- Corbeille
- COURS 01
- COURS 01 ENVI
- décor intérieur
- ESSAIS
- imp
- important
- mme Abdou
- Nouveau dossier
- travaux pratique
- info
- LANDSAT5
- landsat8

Nom	Modifié le	Type	Taille
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LC81930352014305LGN00_B5.TIF.ov			
LC81930352014305LGN00_B6			
LC81930352014305LGN00_B6.TIF.aux			
LC81930352014305LGN00_B6.TIF.en			
LC81930352014305LGN00_B6.TIF.ov			
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LC81930352014305LGN00_MTL	25/08/2015 07:44	Document texte	8 Ko

LC81930352014305LGN00_MTL - Bloc-notes

Fichier Edition Format Affichage ?

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CORNER_LL_LON_PRODUCT = 6.00541 CORNER_LR_LAT_PRODUCT = 34.97720 CORNER_LR_LON_PRODUCT = 8.56725 CORNER_L
CORNER_UL_PROJECTION_Y_PRODUCT = 4108500.000 CORNER_UR_PROJECTION_X_PRODUCT = 460500.000 CORNER_UR_PROJECTI
CORNER_LL_PROJECTION_X_PRODUCT = 226500.000 CORNER_LR_PROJECTION_Y_PRODUCT = 3870600.000 CORNER_LR_PROJECTI
CORNER_LR_PROJECTION_Y_PRODUCT = 3870600.000 PANCHROMATIC_LINES = 15861 PANCHROMATIC_SAMPLES = 15601 REFL
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RADIANCE_MAXIMUM_BAND_4 = 613.91290 RADIANCE_MINIMUM_BAND_4 = -50.69712 RADIANCE_MAXIMUM_BAND_5 = 375.68408
RADIANCE_MINIMUM_BAND_5 = -31.02411 RADIANCE_MAXIMUM_BAND_6 = 93.42921 RADIANCE_MINIMUM_BAND_6 = -7.71541
RADIANCE_MAXIMUM_BAND_7 = 31.49065 RADIANCE_MINIMUM_BAND_7 = -2.60051 RADIANCE_MAXIMUM_BAND_8 = 694.78040
RADIANCE_MINIMUM_BAND_8 = -57.37519 RADIANCE_MAXIMUM_BAND_9 = 146.82585 RADIANCE_MINIMUM_BAND_9 = -12.12493
RADIANCE_MAXIMUM_BAND_10 = 22.00180 RADIANCE_MINIMUM_BAND_10 = 0.10033 RADIANCE_MAXIMUM_BAND_11 = 22.00180
RADIANCE_MINIMUM_BAND_11 = 0.10033 END_GROUP = MIN_MAX_RADIANCE GROUP = MIN_MAX_REFLECTANCE REFLECTANCE_MAXIM
REFLECTANCE_MINIMUM_BAND_1 = -0.099980 REFLECTANCE_MAXIMUM_BAND_2 = 1.210700 REFLECTANCE_MINIMUM_BAND_2 = -0.
REFLECTANCE_MAXIMUM_BAND_3 = 1.210700 REFLECTANCE_MINIMUM_BAND_3 = -0.099980 REFLECTANCE_MAXIMUM_BAND_4 = 1.2
REFLECTANCE_MINIMUM_BAND_4 = -0.099980 REFLECTANCE_MAXIMUM_BAND_5 = 1.210700 REFLECTANCE_MINIMUM_BAND_5 = -0.
REFLECTANCE_MAXIMUM_BAND_6 = 1.210700 REFLECTANCE_MINIMUM_BAND_6 = -0.099980 REFLECTANCE_MAXIMUM_BAND_7 = 1.2
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LC81930352014305LGN00_MTL Modifié le : 25/08/2015 07:44 Date de création : 10/01/2016 10:00

Document texte Taille : 7,70 Ko

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

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

QUANTIZE_CAL_MAX_BAND_9 = 65535
QUANTIZE_CAL_MIN_BAND_9 = 1
QUANTIZE_CAL_MAX_BAND_10 = 65535
QUANTIZE_CAL_MIN_BAND_10 = 1

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

QUANTIZE_CAL_MAX_BAND_11 = 65535
QUANTIZE_CAL_MIN_BAND_11 = 1
END_GROUP = MIN_MAX_PIXEL_VALUE
GROUP = RADIOMETRIC_RESCALING

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

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

REFLECTANCE_ADD_BAND_2 = -0.100000
REFLECTANCE_ADD_BAND_3 = -0.100000
REFLECTANCE_ADD_BAND_4 = -0.100000
REFLECTANCE_ADD_BAND_5 = -0.100000

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

REFLECTANCE_ADD_BAND_6 = -0.100000
REFLECTANCE_ADD_BAND_7 = -0.100000
REFLECTANCE_ADD_BAND_8 = -0.100000
REFLECTANCE_ADD_BAND_9 = -0.100000

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

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

RADIANCE_ADD_BAND_2 = -65.25582
RADIANCE_ADD_BAND_3 = -60.13268
RADIANCE_ADD_BAND_4 = -50.70727
RADIANCE_ADD_BAND_5 = -31.03032

END_GROUP = TIRS_THERMAL_CONSTANTS
GROUP = PROJECTION_PARAMETERS

Conversion les valeurs numériques en luminance (TOA)

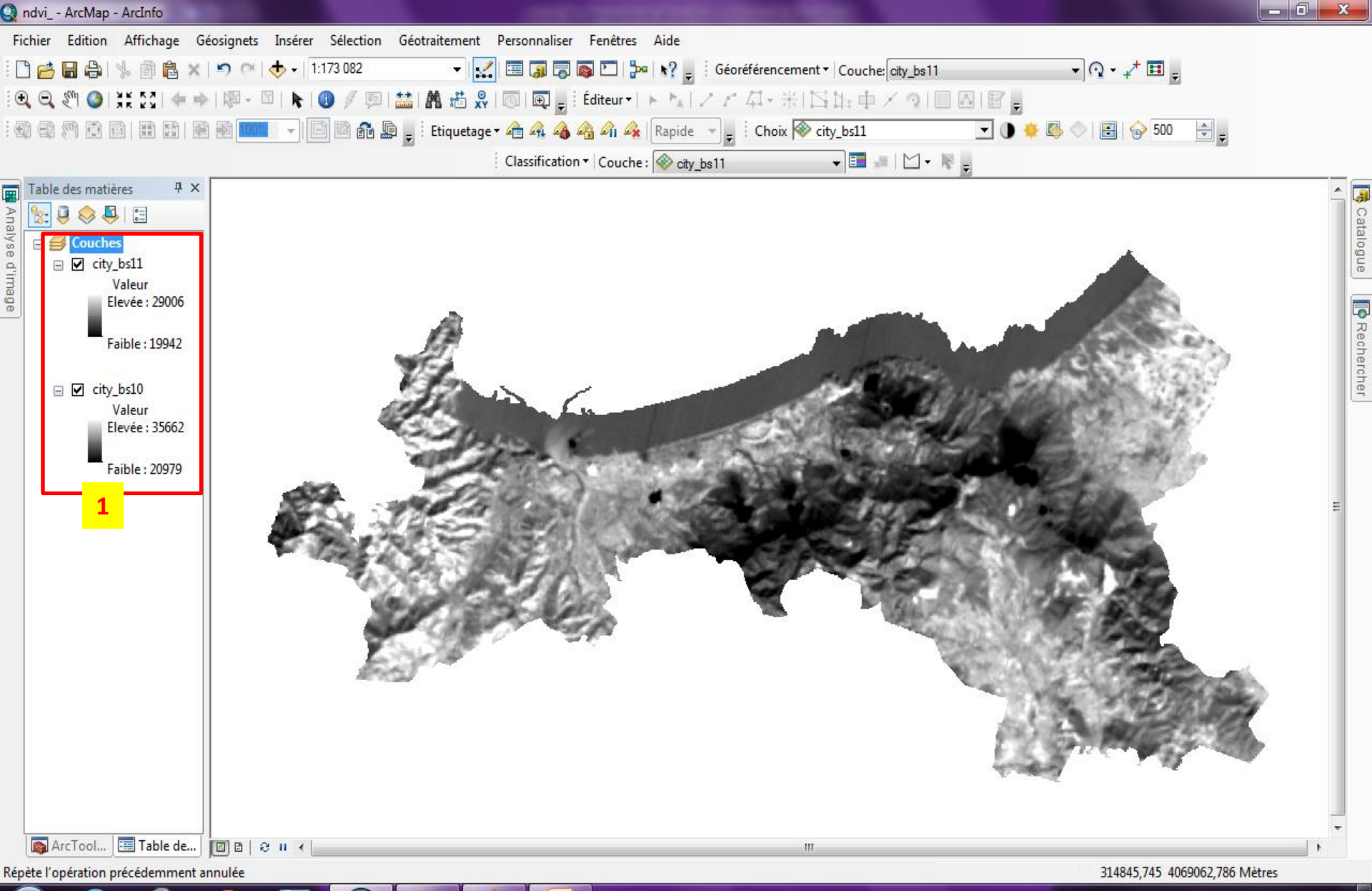
$$L_{\lambda} = M_L \times Q_{cal} + A_L$$

BANDE 10:

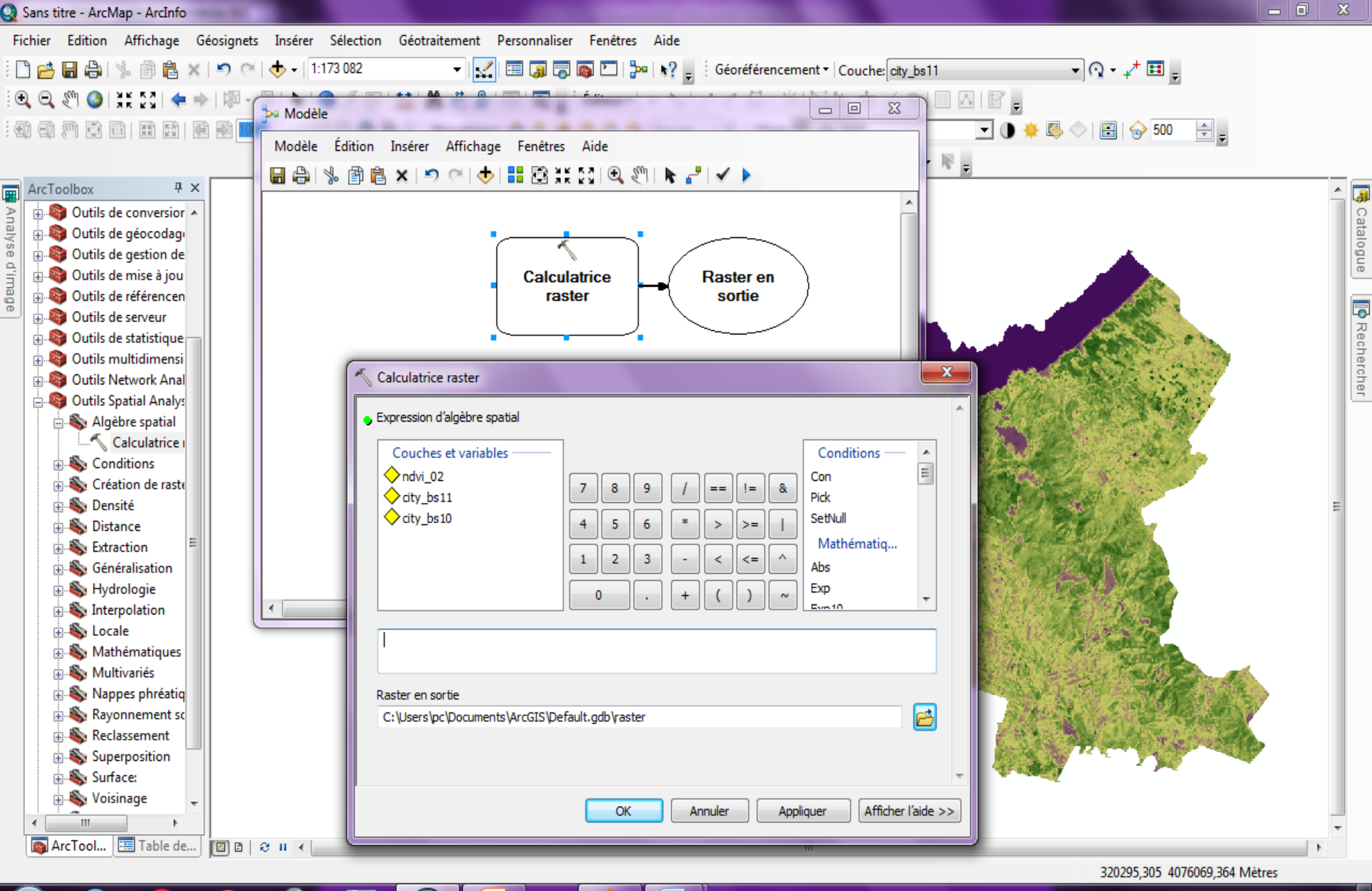
$$L_{B10} = 0.0003342 * BAND10 + 0.1$$

BANDE 11:

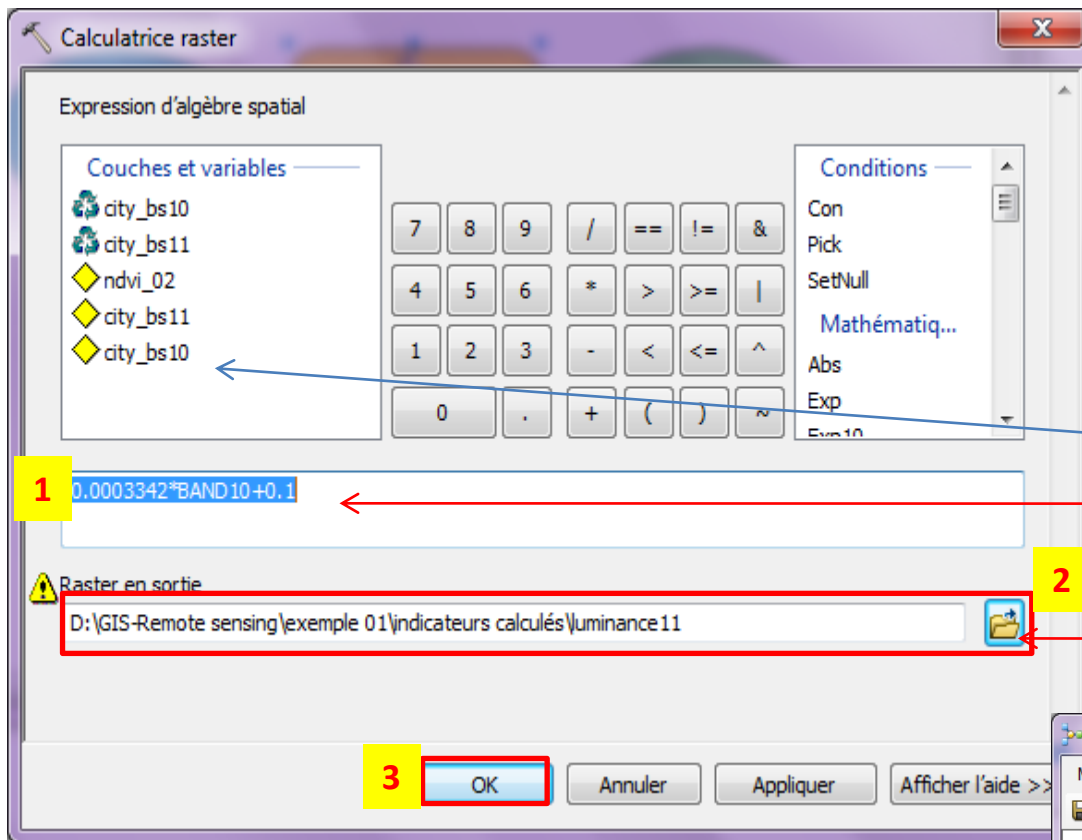
$$L_{B11} = 0.0003342 * BAND11 + 0.1$$



01: ajouter les couches thermiques 10 / 11.

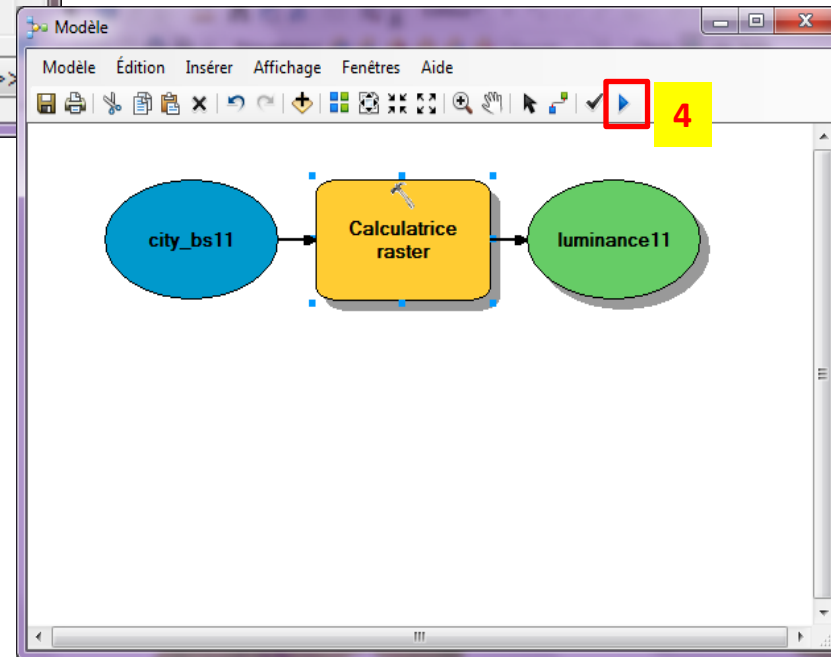


Arctoolbox/spatial analysis tools/Map Algebra/ Raster calculator



$0.0003342 * \text{BAND10} + 0.1$

Gérer l'emplacement



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

2

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

$$BT = \left(\frac{K_2}{\ln\left(\frac{K_1}{L_\lambda} + 1\right)} \right) - 273.15$$

- L_λ : Luminance
- K_1 , K_2 : des constantes

EXEMPLE:

$$BT_{10} = (1321.08 / \ln(774.89/L_{10} + 1)) - 273.15$$

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

Convertir la luminance en température de brillance (BT)

$$BT = \left(\frac{K_2}{\ln\left(\frac{K_1}{L_\lambda} + 1\right)} \right) - 273.15$$

BANDE 11:

$$T_{\text{band11}} = \left(\frac{1201.14}{\ln(480.89 / L_{B11} + 1)} \right) - 273,15$$

BANDE 10:

$$T_{\text{band10}} = \left(\frac{1321.08}{\ln(774.89 / L_{B10} + 1)} \right) - 273,15$$

-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
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

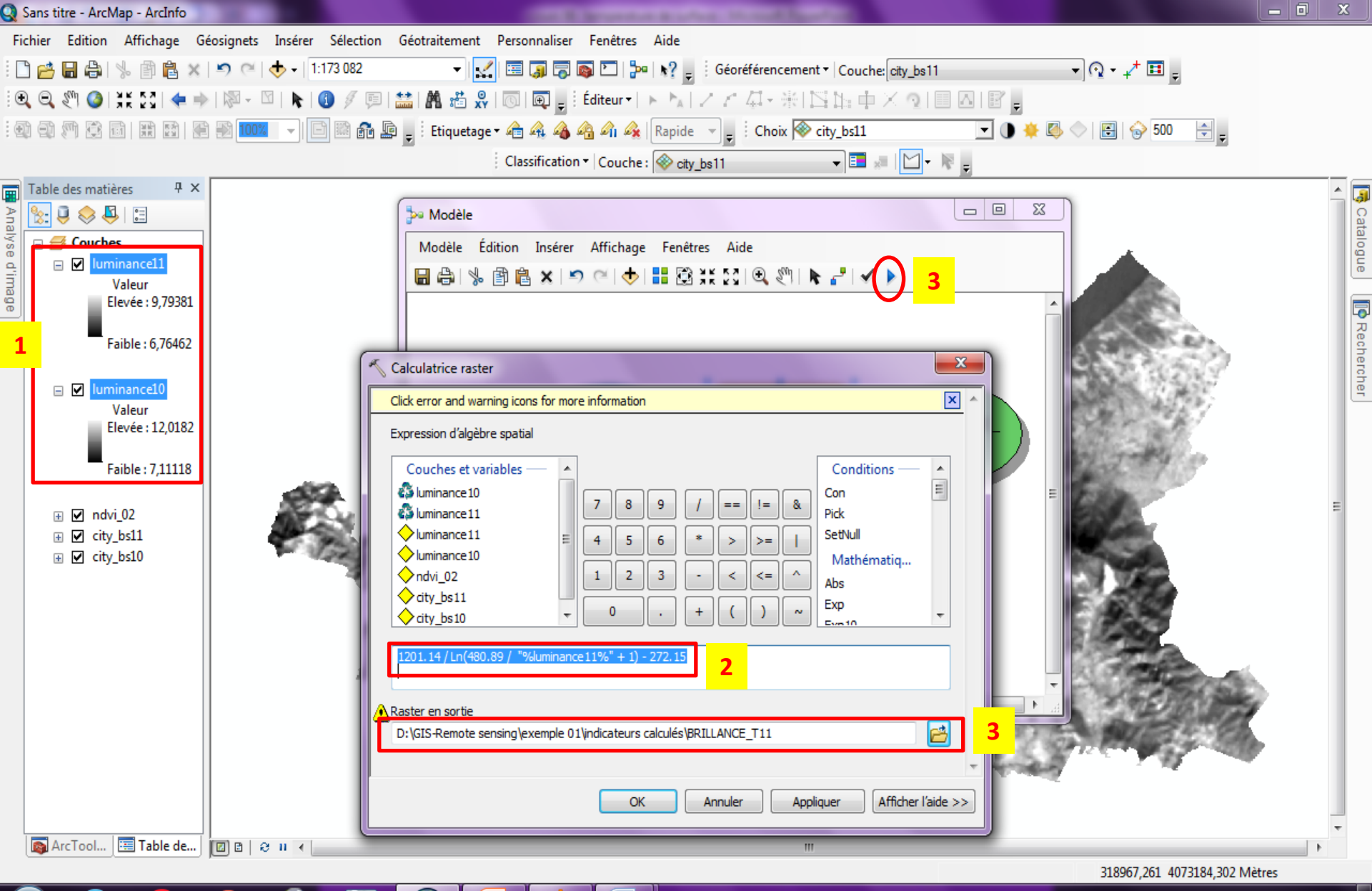
END_GROUP = RADIOMETRIC_RESCALING
GROUP = TIRS_THERMAL_CONSTANTS

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

Metadata nécessaire



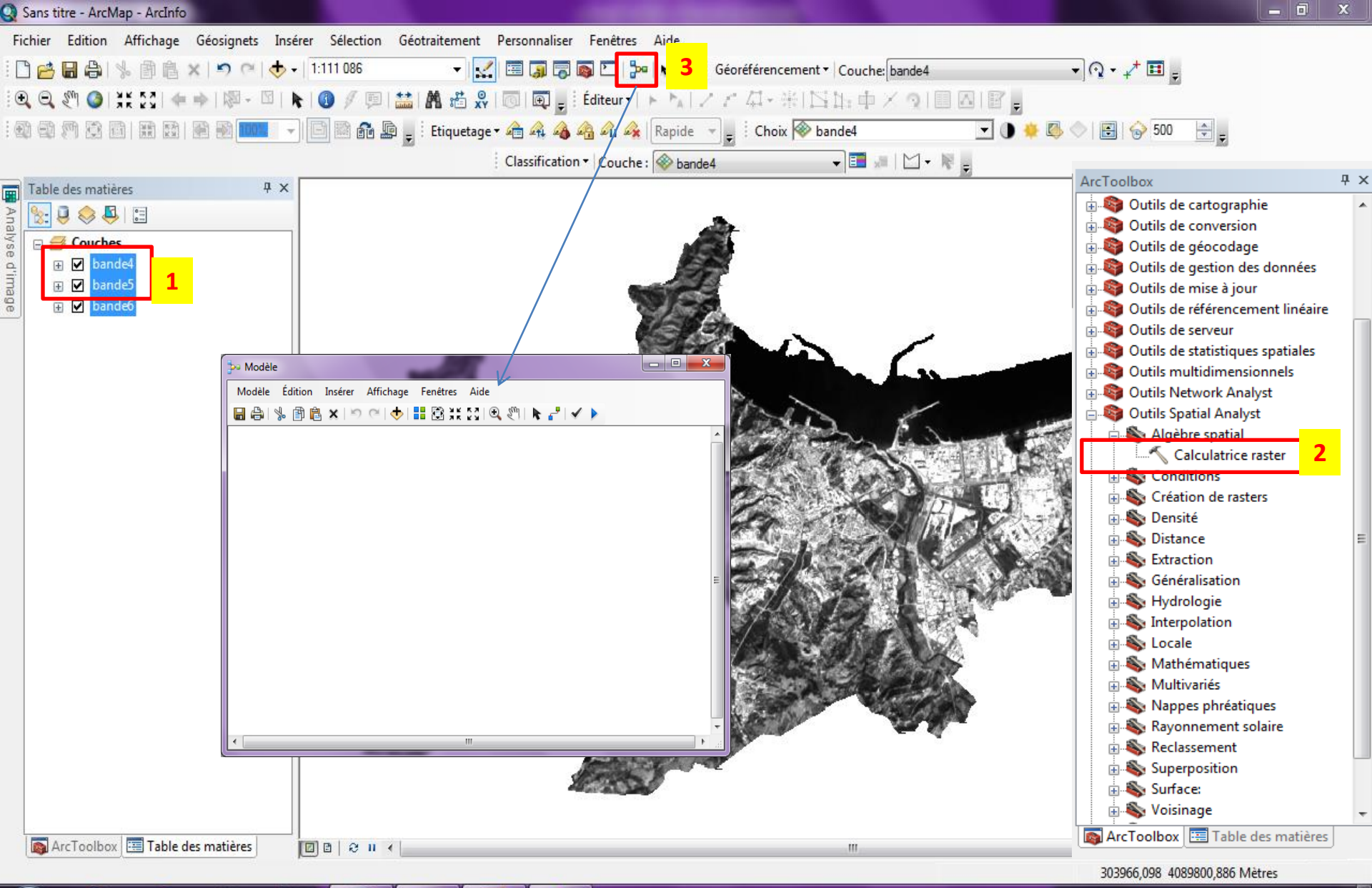
- 1: ajouter les couches « luminance »
- 2: la formule de conversion convenable
- 3: gérer l'emplacement et OK
- 4: exécution

$$\text{NDVI} = (\text{NIR} - \text{RED}) / (\text{NIR} + \text{RED})$$

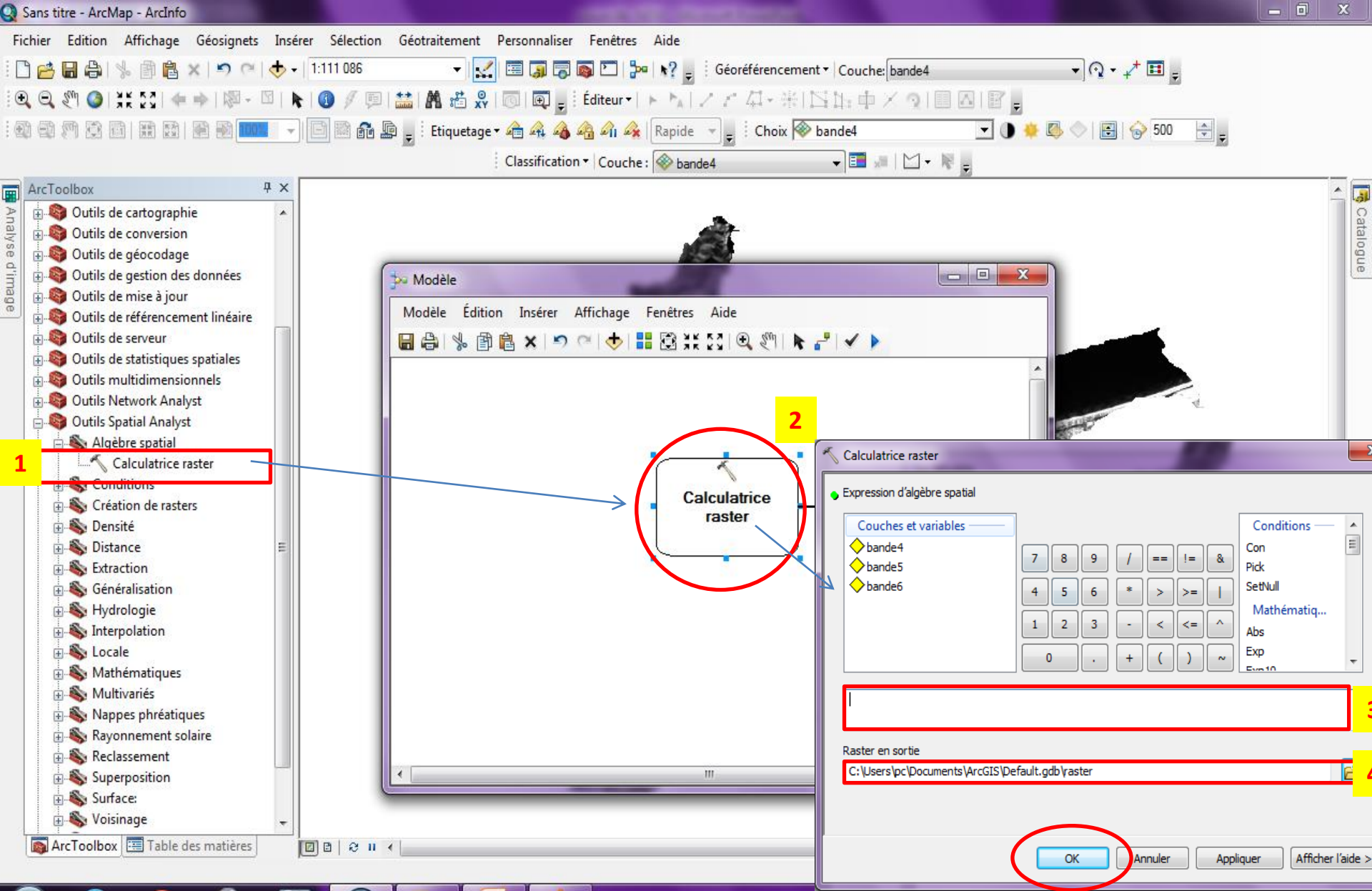
$$\text{NDVI} = (\text{band5} - \text{band4}) / (\text{band5} + \text{band 4})$$

EXEMPLE:

$$\text{NDVI} = \text{float}(\text{couche 5} - \text{couche 4}) / \text{float}(\text{couche 5} + \text{couche 4})$$



- 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

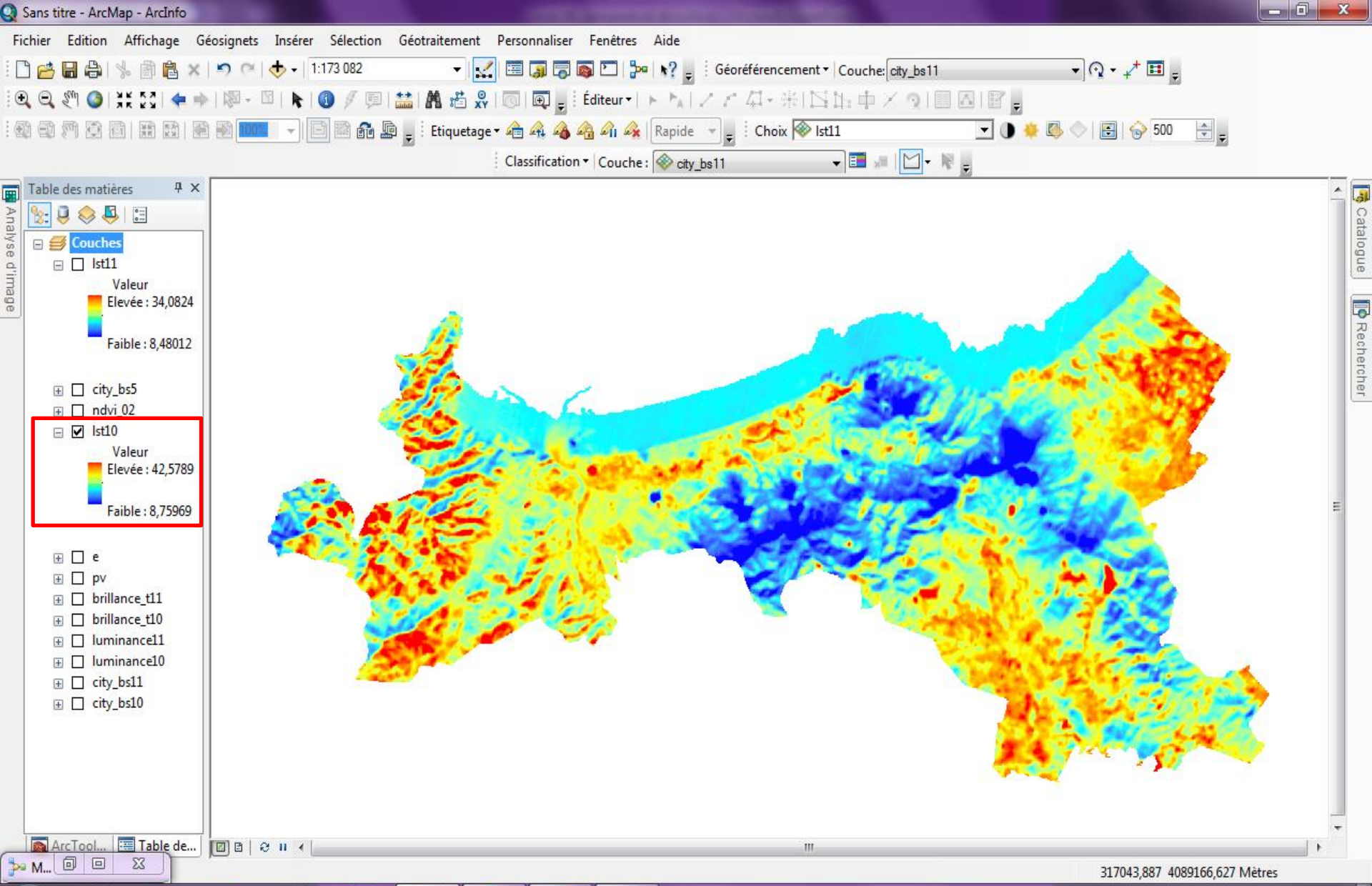
$$LST = \left(\frac{BT}{1 + \left(w \times \frac{BT}{P} \right) \times \ln(\varepsilon)} \right)$$

- **BT** = la température de brillance
- ε = l'émissivité
- **P** = 14388
- **w** = la bande spectrale λ .

EXEMPLE:

$$LST_{10} = BT / 1 + BAND_{10} \times (BT_{10}/14388) \times \ln(\varepsilon)$$

$$LST_{11} = BT / 1 + BAND_{11} \times (BT_{11}/14388) \times \ln(\varepsilon)$$



Résultats LST (température de surface)



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Merci de votre attention



Coordinator



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