

Extension des standards de symbolisation pour le rendu cartographique expressif

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Objectif du projet

Étendre les possibilités de rendu en cartographie...

... avec des méthodes issues du **rendu expressif**

Covisualisation de données hétérogènes

A. Masse - Géovisualisation du littoral

Interpolation de styles



Modèle de style expressif

⊙ Vous êtes ici

Génération de géométries expressives

Évaluation des rendus cartographiques

Cartes 'à la manière de'
Exposition de cartes

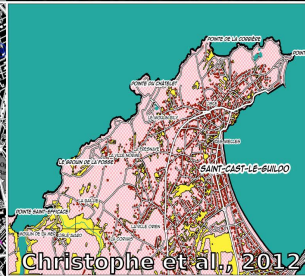
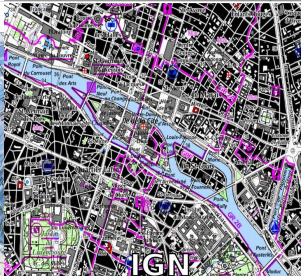
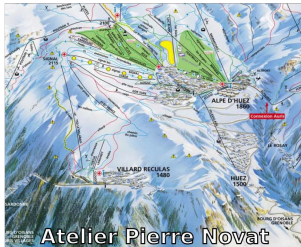
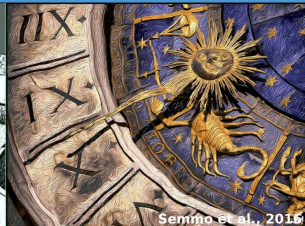
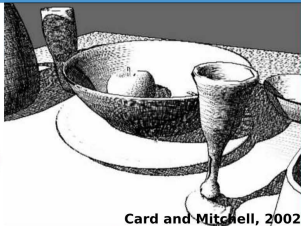
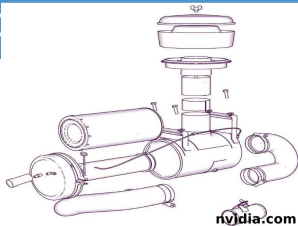
Qu'est-ce que le rendu expressif...

Des techniques de rendu non photoréaliste...

... pour abstraire ou mettre en avant des informations d'une image pour véhiculer une intention.

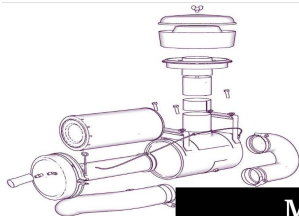
...qui s'appuient sur des techniques traditionnelles (peinture, dessin, gravure, etc.)



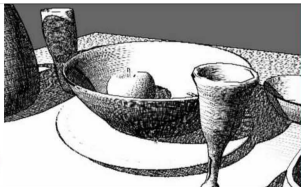


... et que peut-il apporter à la cartographie?

Compréhension



Automatisation



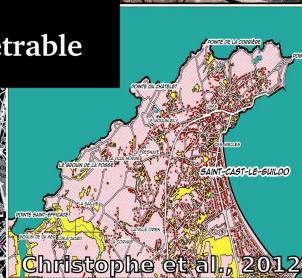
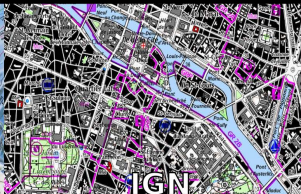
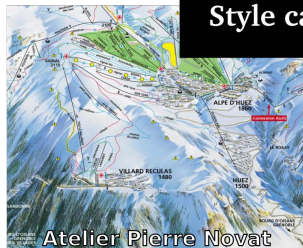
Esthétique



Méthodes contrôlables

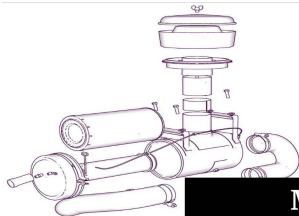


Style cartographique paramétrable



... et que peut-il apporter à la cartographie?

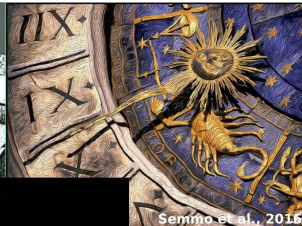
Compréhension



Automatisation

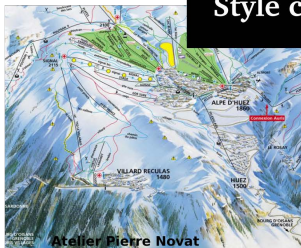


Esthétique

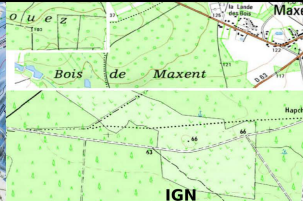


Semino et al., 2016

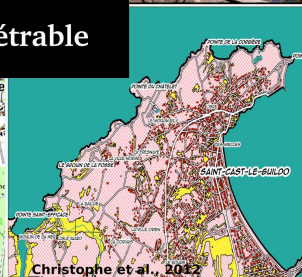
Méthodes contrôlables
▼
Style cartographique paramétrable



Atelier Pierre Novat



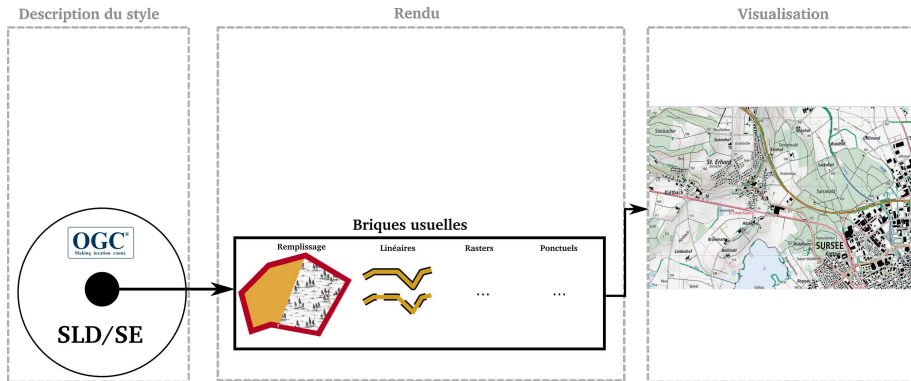
IGN



Christophe et al., 2012

Comment contrôler le style d'une carte ?

StyledLayerDescriptor (SLD) et Symbology Encoding (SE) → Description de briques de stylisation par un **formalisme XML**



Composants logiciels qui reproduisent un médium

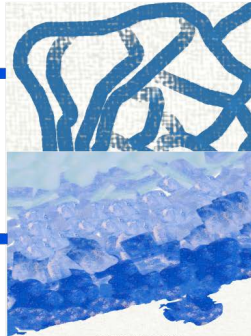
Original



Coups de pinceaux



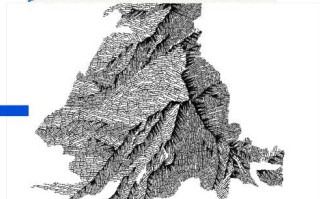
Briques expressives



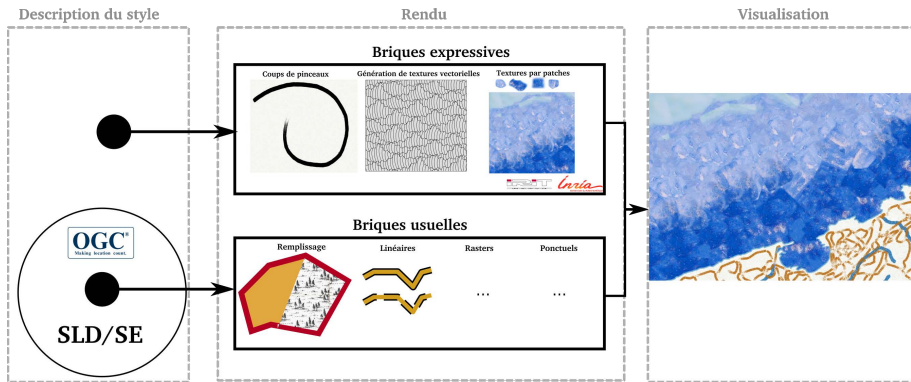
Patches



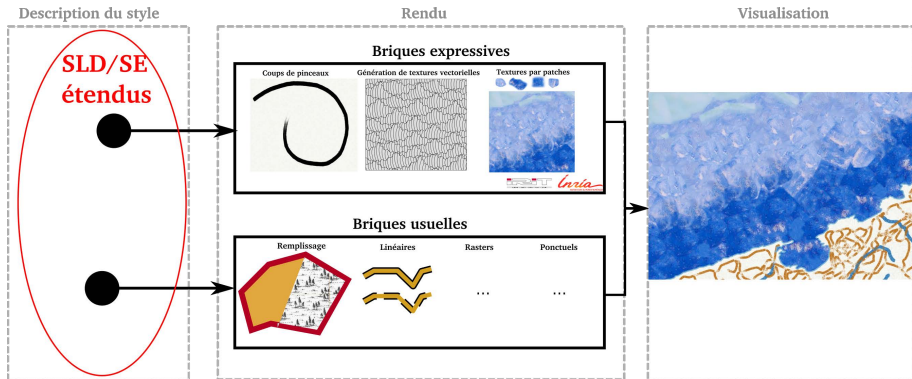
Motifs/
textures vectorielles



Paramétrer briques expressives + usuelles **de la même façon**
Contrôler ces briques



Proposition : extension de SLD et SE



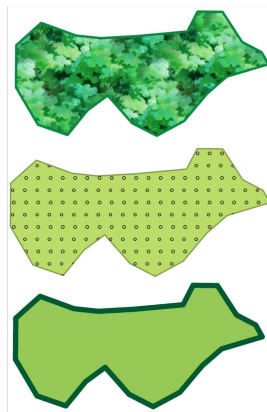
Aperçu de SLD/SE

Formalisme XML : **règles de symbolisation** pour décrire l'apparence des données.

On écrit des **fichiers de style**

Couche Style Règles Symboliseur Élément contrôlable

```
<NamedLayer>
  <Name>vegetation_OCS_100</Name>
  <UserStyle>
    <Name>Style créé pour le layer vegetation_OCS_100</Name>
    <IsDefault>false</IsDefault>
    <FeatureTypeStyle>
      <Rule>
        <LegendGraphic>
          ...
        </LegendGraphic>
        <PolygonSymbolizer uom="http://www.opengeospatial.org/se/units/metre"
          <GeometryPropertyName>geom</GeometryPropertyName>
          <Stroke>
            <CssParameter name="stroke">#4d9221</CssParameter>
            <CssParameter name="stroke-opacity">0.91</CssParameter>
            <CssParameter name="stroke-width">30.0</CssParameter>
            <CssParameter name="stroke-linecap">round</CssParameter>
          </Stroke>
          <Fill>
            <CssParameter name="fill">#97c955</CssParameter>
            <CssParameter name="fill-opacity">1.0</CssParameter>
          </Fill>
        </PolygonSymbolizer>
      </Rule>
    </FeatureTypeStyle>
  </UserStyle>
</NamedLayer>
```

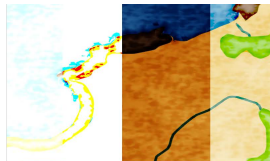


Éléments des standards à étendre

Au niveau des couches : **SLD**

Couche Style Règles Symboliseur Élément contrôlable

```
<NamedLayer>
  <Name>vegetation_OCS_100</Name>
  <UserStyle>
    <Name>Style créé pour le layer vegetation_OCS_100</Name>
    <IsDefault>false</IsDefault>
    <FeatureTypeStyle>
      <Rule>
        <LegendGraphic>
          ...
        </LegendGraphic>
        <PolygonSymbolizer uom="http://www.opengeospatial.org/se/units/metre">
          <GeometryPropertyName>geom</GeometryPropertyName>
          <Stroke>
            <CssParameter name="stroke">#4d9221</CssParameter>
            <CssParameter name="stroke-opacity">0.91</CssParameter>
            <CssParameter name="stroke-width">30.0</CssParameter>
            <CssParameter name="stroke-linecap">round</CssParameter>
          </Stroke>
          <Fill>
            <CssParameter name="fill">#97c955</CssParameter>
            <CssParameter name="fill-opacity">1.0</CssParameter>
          </Fill>
        </PolygonSymbolizer>
      </Rule>
    </FeatureTypeStyle>
  </UserStyle>
</NamedLayer>
```

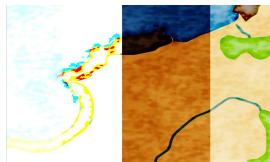


Éléments des standards à étendre

Au niveau des Symboliseurs : **SE**

Couche Style Règles Symboliseur Élément contrôlable

```
<NamedLayer>
  <Name>vegetation_OCS_100</Name>
  <UserStyle>
    <Name>Style créé pour le layer vegetation_OCS_100</Name>
    <IsDefault>false</IsDefault>
    <FeatureTypeStyle>
      <Rule>
        <LegendGraphic>
          ...
        </LegendGraphic>
        <PolygonSymbolizer uom="http://www.opengeospatial.org/se/units/metre" >
          <GeometryPropertyName>geom</GeometryPropertyName>
          <Stroke>
            <CssParameter name="stroke">#4d9221</CssParameter>
            <CssParameter name="stroke-opacity">0.91</CssParameter>
            <CssParameter name="stroke-width">30.0</CssParameter>
            <CssParameter name="stroke-linecap">round</CssParameter>
          </Stroke>
          <Fill>
            <CssParameter name="fill">#97c955</CssParameter>
            <CssParameter name="fill-opacity">1.0</CssParameter>
          </Fill>
        </PolygonSymbolizer>
      </Rule>
    </FeatureTypeStyle>
  </UserStyle>
</NamedLayer>
```

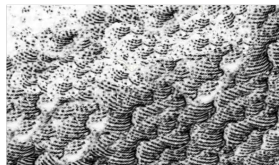
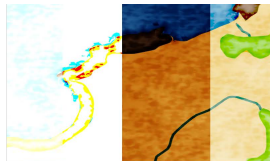


Éléments des standards à étendre

Au niveau des éléments contrôlables : **SE**

Couche Style Règles Symboliseur Élément contrôlable

```
<NamedLayer>
  <Name>vegetation_OCS_100</Name>
  <UserStyle>
    <Name>Style créé pour le layer vegetation_OCS_100</Name>
    <IsDefault>false</IsDefault>
    <FeatureTypeStyle>
      <Rule>
        <LegendGraphic>
          ...
        </LegendGraphic>
        <PolygonSymbolizer uom="http://www.opengeospatial.org/se/units/metre" >
          <GeometryPropertyName>geom</GeometryPropertyName>
          <Stroke>
            <CssParameter name="stroke">#4d9221</CssParameter>
            <CssParameter name="stroke-opacity">0.91</CssParameter>
            <CssParameter name="stroke-width">30.0</CssParameter>
            <CssParameter name="stroke-linecap">round</CssParameter>
          </Stroke>
          <Fill>
            <CssParameter name="fill">#97c955</CssParameter>
            <CssParameter name="fill-opacity">1.0</CssParameter>
          </Fill>
        </PolygonSymbolizer>
      </Rule>
    </FeatureTypeStyle>
  </UserStyle>
</NamedLayer>
```



Descripteurs de méthodes

Référence
à la méthode

Héritage entre
méthodes

Implémentation

Métadonnées
de
paramétrage

```
<?xml version="1.0" encoding="UTF-8" standalone="yes"?>
<RenderingMethod>
  <Name>DerainStrokePainting</Name>
  <GeneralMethodReference>BrushStroke</GeneralMethodReference>
  <ShaderList>
    <ShaderRef gltype="GL_FRAGMENT_SHADER">../shaders/subshader1d.derain.frag.glsl</ShaderRef>
  </ShaderList>
  <Parameters>
    <Parameter required="true">
      <Description>The portion of the stroke extremities where the brush
        sharpness smoothly increases/decreases.</Description>
      <Name>extremitiesLength</Name>
      <Type>float</Type>
      <Default>1.0</Default>
      <Restrictions>
        <BoundsRestriction min="0.0" max="1000.0" />
      </Restrictions>
      <UniformReference>extremitiesLength</UniformReference>
    </Parameter>
  </Parameters>
</RenderingMethod>
```

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  <Name>DerainStrokePainting</Name>
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  </ShaderList>
  <Parameters>
    <Parameter required="true">
      <Description>The portion of the stroke extremities where the brush
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      <Name>extremitiesLength</Name>
      <Type>float</Type>
      <Default>1.0</Default>
      <Restrictions>
        <BoundsRestriction min="0.0" max="1000.0" />
      </Restrictions>
      <UniformReference>extremitiesLength</UniformReference>
    </Parameter>
  </Parameters>
</RenderingMethod>
```

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```
<?xml version="1.0" encoding="UTF-8" standalone="yes"?>
<RenderingMethod>
  <Name>DerainStrokePainting</Name>
  <GeneralMethodReference>BrushStroke</GeneralMethodReference>
  <ShaderList>
    <ShaderRef gltype="GL_FRAGMENT_SHADER">../shaders/subshader1d.derain.frag.glsl</ShaderRef>
  </ShaderList>
  <Parameters>
    <Parameter required="true">
      <Description>The portion of the stroke extremities where the brush
        sharpness smoothly increases/decreases.</Description>
      <Name>extremitiesLength</Name>
      <Type>float</Type>
      <Default>1.0</Default>
      <Restrictions>
        <BoundsRestriction min="0.0" max="1000.0" />
      </Restrictions>
      <UniformReference>extremitiesLength</UniformReference>
    </Parameter>
  </Parameters>
</RenderingMethod>
```

Descripteurs de méthodes

Référence
à la méthode

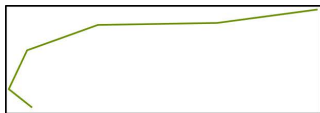
Héritage entre
méthodes

Implémentation

Métadonnées
de
paramétrage

```
<?xml version="1.0" encoding="UTF-8" standalone="yes"?>
<RenderingMethod>
  <Name>DerainStrokePainting</Name>
  <GeneralMethodReference>BrushStroke</GeneralMethodReference>
  <ShaderList>
    <ShaderRef gltype="GL_FRAGMENT_SHADER">../shaders/subshader1d.derain.frag.glsl</ShaderRef>
  </ShaderList>
  <Parameters>
    <Parameter required="true">
      <Description>The portion of the stroke extremities where the brush
        sharpness smoothly increases/decreases.</Description>
      <Name>extremitiesLength</Name>
      <Type>float</Type>
      <Default>1.0</Default>
      <Restrictions>
        <BoundsRestriction min="0.0" max="1000.0" />
      </Restrictions>
      <UniformReference>extremitiesLength</UniformReference>
    </Parameter>
  </Parameters>
</RenderingMethod>
```

Extension de la stylisation des linaires (Stroke)

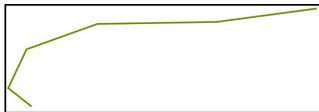


Géométrie linéaire



Coups de pinceaux 'à la Derain'

Extension de la stylisation des linaires (Stroke)

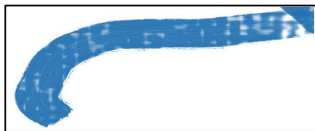


Géométrie linéaire



Fichier de style

```
<LineStyle uom="http://www.opengis.org/2008/units/metre">
  <Stroke>
    <CssParameter name="stroke">#2070b1</CssParameter>
    <CssParameter name="stroke-opacity">1.0</CssParameter>
    <CssParameter name="stroke-width">150.0</CssParameter>
    <CssParameter name="stroke-linejoin">round</CssParameter>
    <CssParameter name="stroke-linecap">round</CssParameter>
  </Stroke>
  <GeometryPropertyName>geom</GeometryPropertyName>
  <PerpendicularOffset>0.0</PerpendicularOffset>
</LineStyle>
```



Coups de pinceaux 'à la Derain'

Extension de la stylisation des linaires (Stroke)



```
<LineStyleSymbolizer uom="http://www.opengis.org/se/units/metre">
  <Stroke>
    <CssParameter name="stroke">#2070b1</CssParameter>
    <CssParameter name="stroke-opacity">1.0</CssParameter>
    <CssParameter name="stroke-width">150.0</CssParameter>
    <CssParameter name="stroke-linejoin">round</CssParameter>
    <CssParameter name="stroke-linecap">round</CssParameter>
  </Stroke>
  <GeometryPropertyName>geom</GeometryPropertyName>
  <PerpendicularOffset>0.0</PerpendicularOffset>
</LineStyleSymbolizer>
```

```
<Expression>
  <Name>DerainStrokePainting</Name>
  <GeneralMethodReference>BrushStroke</GeneralMethodReference>
  <ShaderList>
    <ShaderRef gltype="GL_FRAGMENT_SHADER">../shaders/subshaderid.derain_frag.glsl</ShaderRef>
  </ShaderList>
  <Parameters>
    <Parameter>
      <Description>The portion of the stroke extremities where the brush
      sharpness smoothly increases/decreases.</Description>
      <Name>restrictionLength</Name>
      <Type>float</Type>
      <Restrictions>
        <BoundsRestriction min="0.0" max="1000.0" />
      </Restrictions>
    </Parameter>
  </Parameters>
</Expression>
```



Géométrie linéaire

Fichier de style

Descripteur de méthode

Coups de pinceaux 'à la Derain'

Extension de la stylisation des linaires (Stroke)

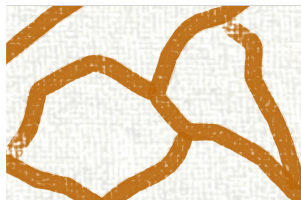
```
<NamedLayer>
  <Name>Routes</Name>
  <UserStyle>
    <Name>Style créé pour le layer Routes</Name>
    <FeatureTypeStyle>
      <Rule>
        <LineSymbolizer uom="http://www.opengeospatial.org/se/units/metre">
          <Stroke>
            <CssParameter name="stroke">#bb690c</CssParameter>
            <CssParameter name="stroke-opacity">1.0</CssParameter>
            <CssParameter name="stroke-width">100.0</CssParameter>
            <CssParameter name="stroke-linejoin">round</CssParameter>
            <CssParameter name="stroke-linecap">round</CssParameter>
            <ExpressiveStroke>
              <ExpressiveMethod>DerainStrokePainting</ExpressiveMethod>
              <ExpressiveParameter name="brushStartWidth">136</ExpressiveParameter>
              <ExpressiveParameter name="brushEndWidth">135</ExpressiveParameter>
              <ExpressiveParameter name="transitionSize">5</ExpressiveParameter>
              <ExpressiveParameter name="brushRoughness">4.5</ExpressiveParameter>
              <ExpressiveParameter name="strokePressure">6</ExpressiveParameter>
              <ExpressiveParameter name="strokeSoftness">0.4</ExpressiveParameter>
              <ExpressiveParameter name="extremitiesLength">210</ExpressiveParameter>
              <ExpressiveParameter name="paperReferenceMapScale">100000</ExpressiveParameter>
              <ExpressiveParameter name="paperSizeInCm">4</ExpressiveParameter>
              <ExpressiveParameter name="paperRoughness">6</ExpressiveParameter>
              <ExpressiveParameter name="paperTexture">
                <SimpleTexture>
                  <URI>../images/canvas-normalized.png</URI>
                </SimpleTexture>
              </ExpressiveParameter>
              <ExpressiveParameter name="brushTexture">
                <SimpleTexture>
                  <URI>../images/pencil-tiled-136-135.png</URI>
                </SimpleTexture>
              </ExpressiveParameter>
            </ExpressiveStroke>
          </Stroke>
          <GeometryPropertyName>geom</GeometryPropertyName>
          <PerpendicularOffset>0.0</PerpendicularOffset>
        </LineSymbolizer>
      </Rule>
    </FeatureTypeStyle>
  </UserStyle>
</NamedLayer>
```

ExpressiveStroke

Appel

Paramètres

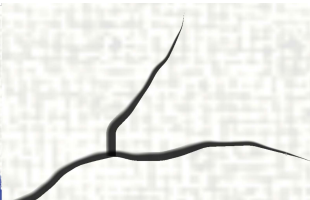
Exemples de stylisation de linéaires



Peinture à l'huile



Peinture à l'huile



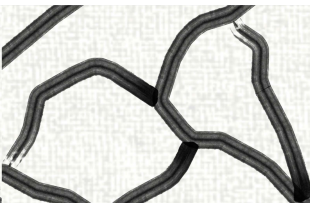
Craie



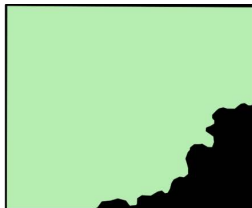
Pastel



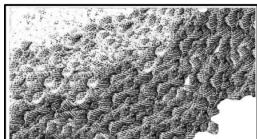
Encre de chine



Encre de chine

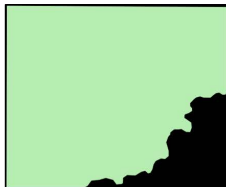


Géométrie Surfactive



Texture de mer 'Cassini'

Extension de la stylisation des surfaces (Fill)

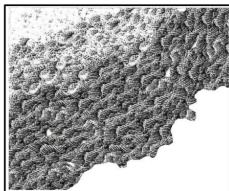


```
<PolygonSymbolizer uom="http://www.opengeospatial.org/se/units/metre">
  <Fill>
    <CssParameter name="fill">#ffffff</CssParameter>
    <CssParameter name="fill-opacity">1.0</CssParameter>
  </Fill>
  <GeometryPropertyName>geom</GeometryPropertyName>
</PolygonSymbolizer>
```

Géométrie Surfactive

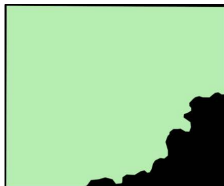


Fichier de style



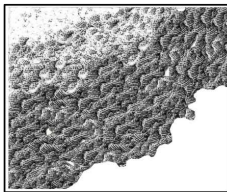
Texture de mer 'Cassini'

Extension de la stylisation des surfaces (Fill)



```
<PolygonSymbolizer uom="http://www.opengeospatial.org/se/units/metre">  
  <Fill>  
    <CssParameter name="fill">#ffffff</CssParameter>  
    <CssParameter name="fill-opacity">1.0</CssParameter>  
  </Fill>  
  <GeometryPropertyName>geom</GeometryPropertyName>  
</PolygonSymbolizer>
```

```
<RenderingMethod>  
  <Name>TextureFill</Name>  
  <GeneralMethodReference>WorldToScreenSpace</GeneralMethodReference>  
  <ShaderList>  
    <ShaderRef gltype="GL_VERTEX_SHADER">identity.vert.glsl</ShaderRef>  
    <ShaderRef gltype="GL_FRAGMENT_SHADER">polygon.texture.frag.glsl</ShaderRef>  
  </ShaderList>  
  <Parameters>  
    <Parameter>  
      <Name>fill-texture</Name>  
      <Type>Texture</Type>  
      <UniformRef>textureColor1</UniformRef>  
    </Parameter>  
  </Parameters>  
</RenderingMethod>
```



Géométrie Surfacique



Fichier de style



Descripteur de méthode



Texture de mer 'Cassini'

Extension de *Fill*

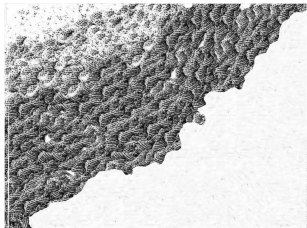
```
<Fill>
  <CssParameter name="fill">#ffffff</CssParameter>
  <CssParameter name="fill-opacity">1.0</CssParameter>
  <ExpressiveFill>
    <ExpressiveMethod>CassiniSeaPatches</ExpressiveMethod>
    <ExpressiveParameter name="fill-texture">
      <TileDistributionTexture XRepeat="false"
        YRepeat="false">
        <Displacement x="0.0" y="0.0" />
        <ScaleFactor x="0.5" y="0.5" />
        <Rotation Angle="0.0" />
        <MaxCoastlineLength>3000.0</MaxCoastlineLength>
        <Tile>
          <URI>../images/StJeanDeLuz/mer1.png</URI>
          <ScaleFactor>0.5</ScaleFactor>
          <MinDistance>0.0</MinDistance>
          <MaxDistance>2200.0</MaxDistance>
          <InRangeProbability>1.0</InRangeProbability>
          <OutOfRangeProbability>0.0</OutOfRangeProbability>
        </Tile>
        ...
        <Resolution>600.0</Resolution>
        <Blending>ALPHA</Blending>
        <DistributionManagement>KEEP_OUTSIDE</DistributionManagement>
        <BlurSize>1</BlurSize>
      </TileDistributionTexture>
    </ExpressiveParameter>
  </ExpressiveFill>
</Fill>
```

ExpressiveFill

Appel

Paramètres

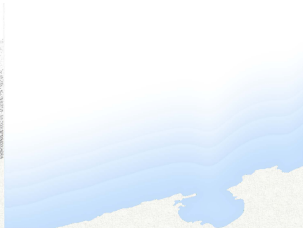
Exemples de stylisations de polygones



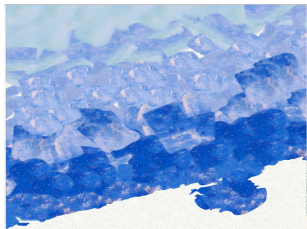
Gravure



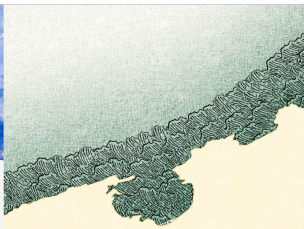
Gravure



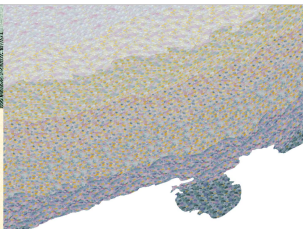
Vecteur



Tampons

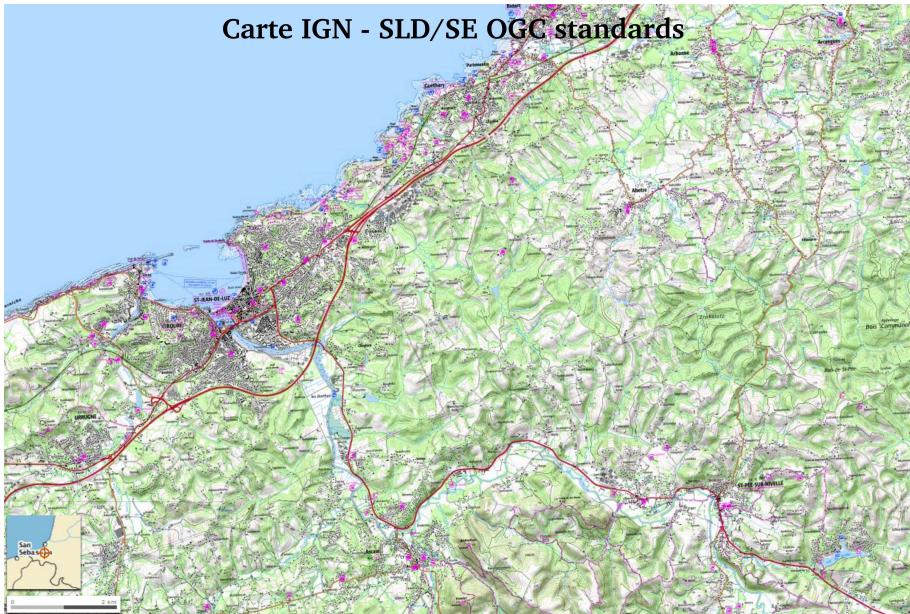


Encre de chine

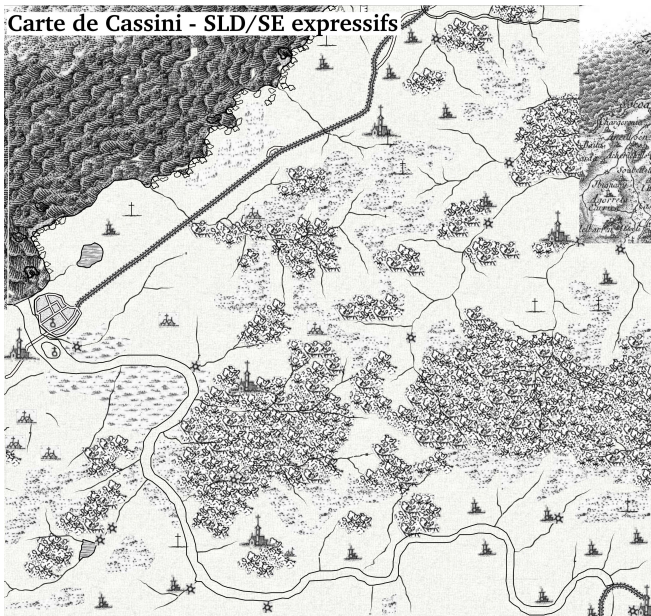


Pointillisme

Carte IGN - SLD/SE OGC standards



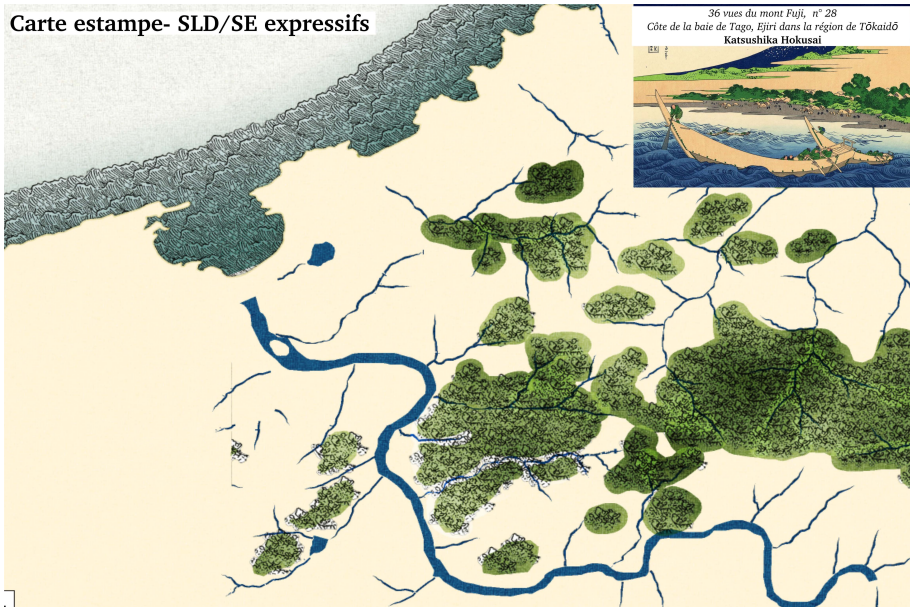
Résultat : Carte de Cassini Noir et Blanc



Carte de Cassini ed. 1815, feuille 139
BnF

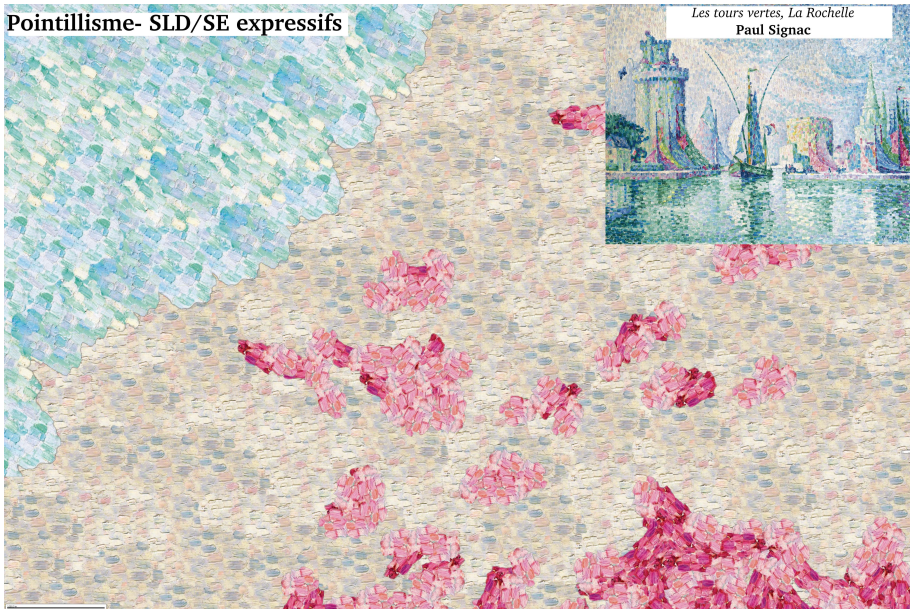


Carte estampe- SLD/SE expressifs



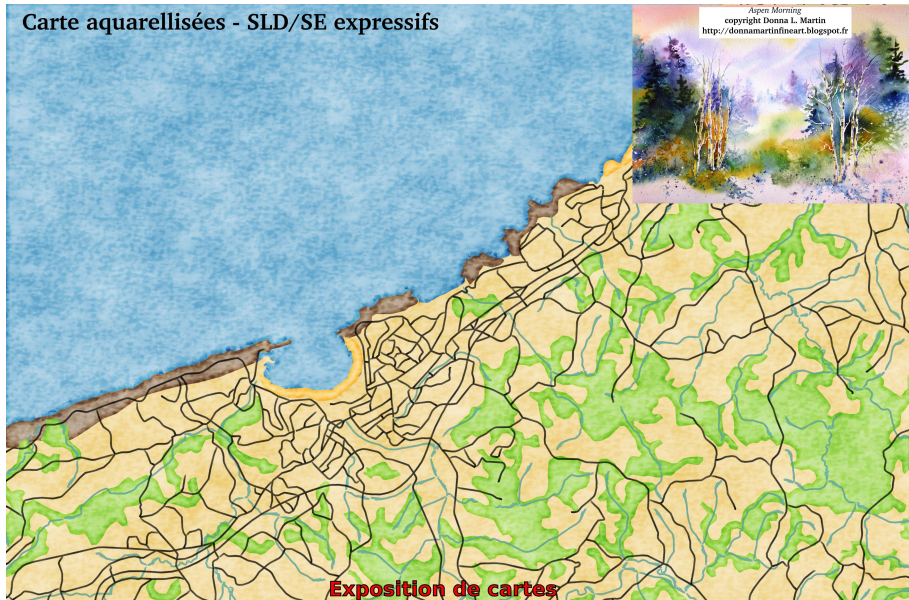
Résultat : Pointillisme

Pointillisme- SLD/SE expressifs



Résultat : Aquarelle

Carte aquarellisées - SLD/SE expressifs



Exposition de cartes

<Description du style>

<Extension des standards SLD/SE>

Méthodes expressives contrôlées depuis un fichier de style

</Extension des standards SLD/SE>

<Généricité>

On décorelle la description de l'implémentation

</Généricité>

</Description du style>

<Rendus expressifs>

<Éléments expressifs>

Pour l'instant Fill/Stroke et mélange

</Éléments expressifs>

</Rendus expressifs>

<Description du style>

<Architecture>

Vers une architecture en services? (iTowns, PLU++)

</Architecture>

<Normalisation>

Proposition de schéma SLD/SE expressifs

</Normalisation>

<Paramétrage>

Interfaces et méta-paramètres

</Paramétrage>

</Description du style>

<Rendus expressifs>

<Éléments expressifs>

Génération de données cartographiques

</Éléments expressifs>

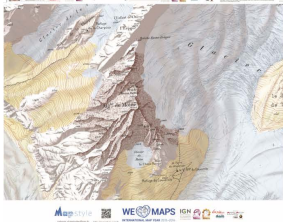
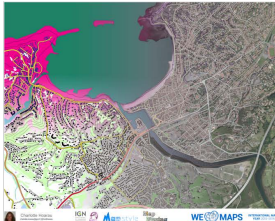
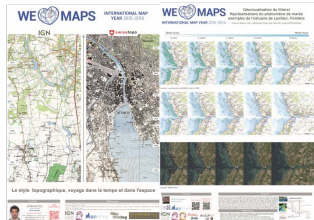
<3D>

Description du style pour les données 3D

</3D>

</Rendus expressifs>

Merci de votre attention



Venez à l'exposition de cartes!