

Color systems in cartography. Pre-publishing process and publishing maps and cartographic products.

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INTRODUCTION

- COLORS – possibility for right choice in the process of map compiling
- COLORS - guarantee in design of cartographic products
- Successful reproduction of colors – it is possible when there are enough knowledge about them



COLOR SYSTEMS

- Ancient, astronomy based
 - consists 7 base colors
corresponding of planets from Solar system
- System of fire, water, air and earth
- Aristotle – 4 base colors
- Signs of the zodiac – connection with colors



Ancient, astronomy based

| | Old color | New color |
|----------------|---------------|-------------|
| Sun | Yellow/ gold | Orange |
| Moon | White/ silver | Violet |
| Mars | Red | Red |
| Mercury | Neutral | Yellow |
| Jupiter | Blue | Indigo blue |
| Venus | Green | Blue |
| Saturn | Black | Green |



Signs of the zodiac

| | Old color | New color |
|--------------------|---------------|-----------------|
| Aries | Red | Red |
| Taurus | Dark green | Red-orange |
| Gemini | Maroon | Orange |
| Cancer | Silver | Orange - yellow |
| Leo | Gold | Yellow |
| Virgo | Parti colored | Yellow - green |
| Libra | Green | Green |
| Scorpio | Scarlet red | Green-blue |
| Sagittarius | Sky blue | Blue |
| Capricorn | Black | Blue-violet |
| Aquarius | Grey | Violet |
| Fishes | Sea blue | Violet-red |

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COLOR SYSTEMS

- **model CIE 1931**
(updated and changed in 1964 and 1976)

$$X=0,49R+0,31G+0,20B$$

$$Y=0,18R+0,81G+0,01B$$

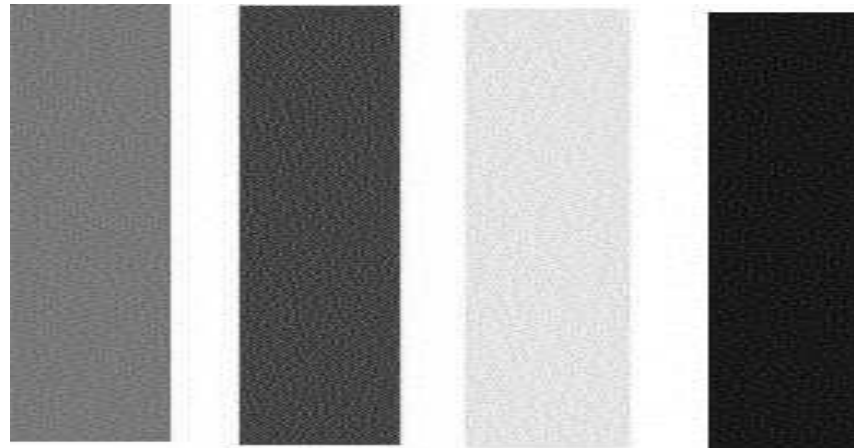
$$Z=0,00R+0,01G+0,99B$$

Commission Internationale de l'Eclairage



COLOR SYSTEMS

- ***SUBTRACTIVE COLOR SYSTEMS***



XIX c.

Cyan Magenta Yellow Key
(Black)

CMYK color system



COLOR SYSTEMS

SUBTRACTIVE COLOR SYSTEMS

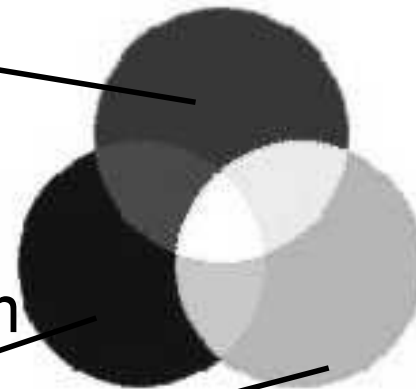
- *RGB color system*

$$C \equiv r'R + g'G + b'B$$

R = 700,0 nm

B = 435,8 nm

G = 546,1 nm



r', g', b' -

Co-ordinates of color

$r'R, g'G, b'B$ -

color components



COLOR SYSTEMS

- HVS color scheme (tonality)

Hue, Value, Saturation

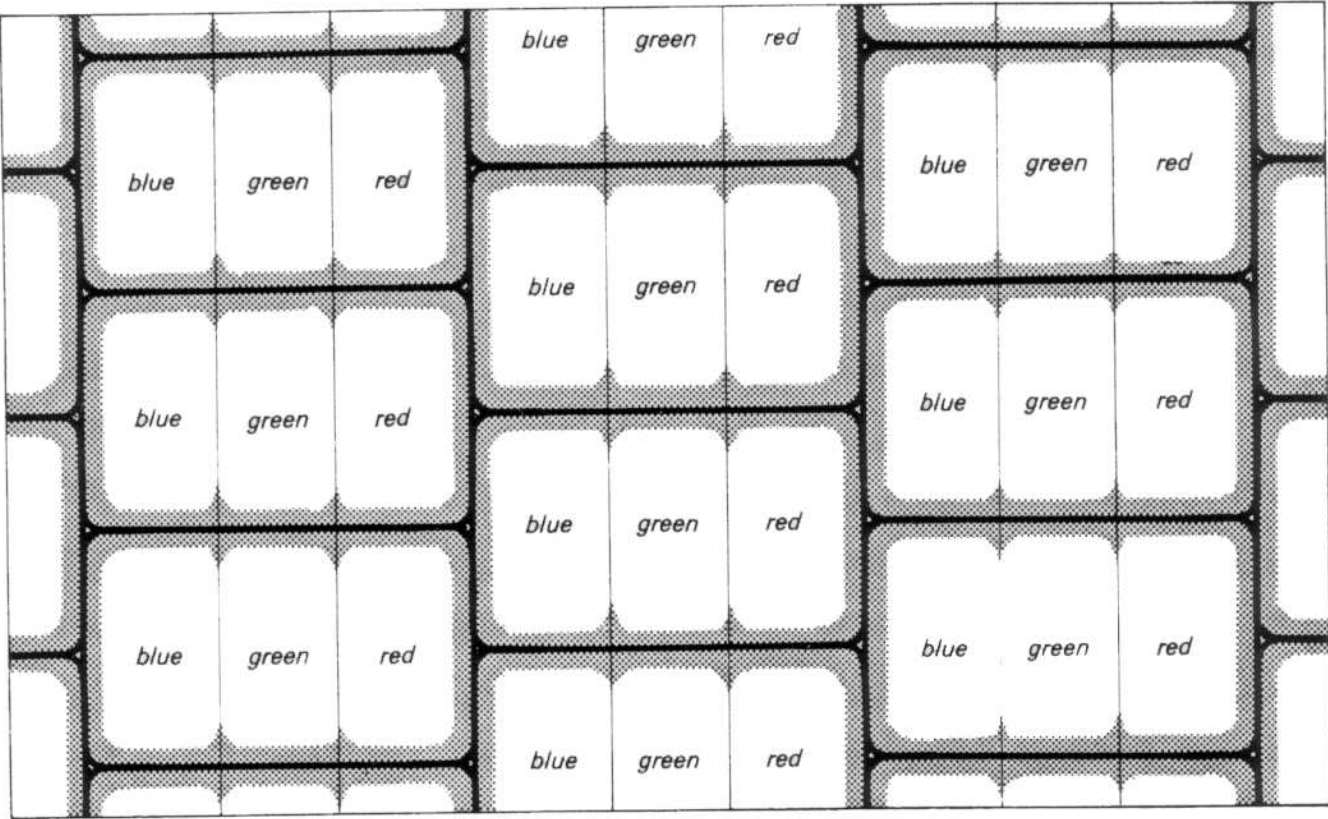
$$Hue = \frac{500}{\pi} \arctan \left[\frac{\sqrt{3}(Green - Blue)}{Red - \frac{1}{2}Green - \frac{1}{2}Blue} \right]$$

$$Saturation = \sqrt{(Red^2 + Green^2 + Blue^2 - Red.Green - Red.Blue - Green.Blue)}$$

$$Intensity = \frac{Red + Green + Blue}{3}$$



Multiple enlarge part of screen – RGB color system



Possible colors in 3 bits color system

Active spotlights

Perceiving colors

R G B

1 0 0

0 1 0

0 0 1

0 1 1

1 0 1

1 1 0

1 1 1

0 0 0

Red

Green

Blue

Cyan

Magenta

Yellow

White

Black



Number of colors in different color systems

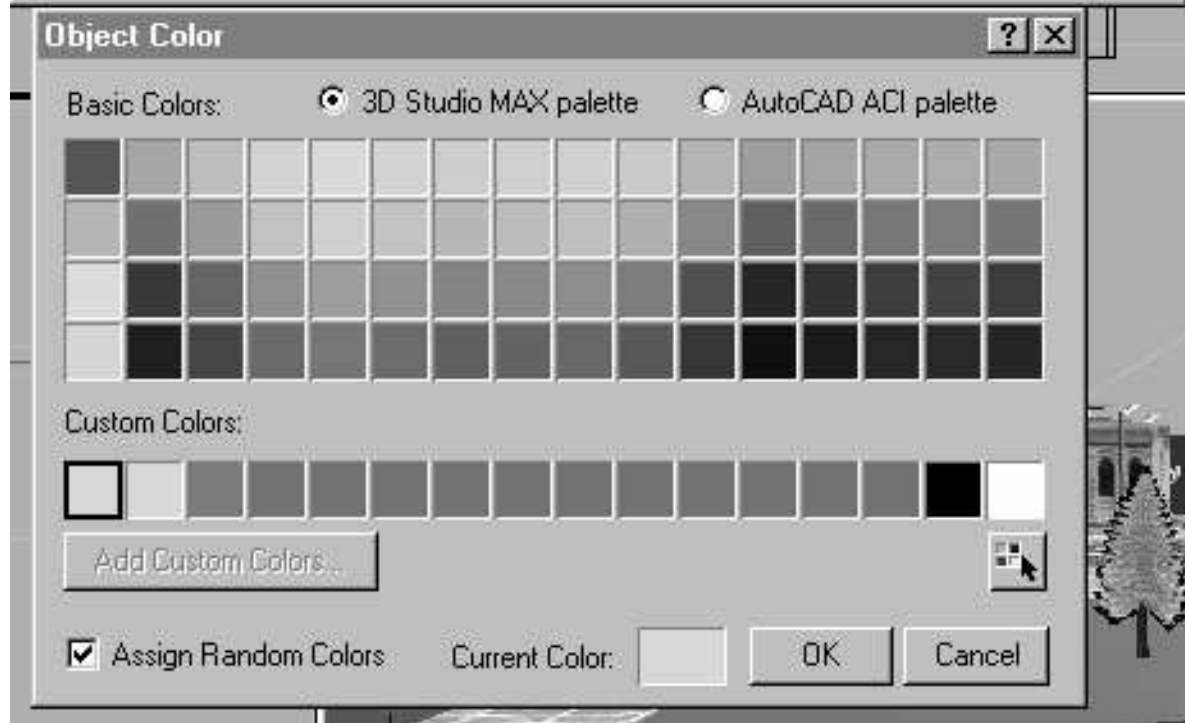
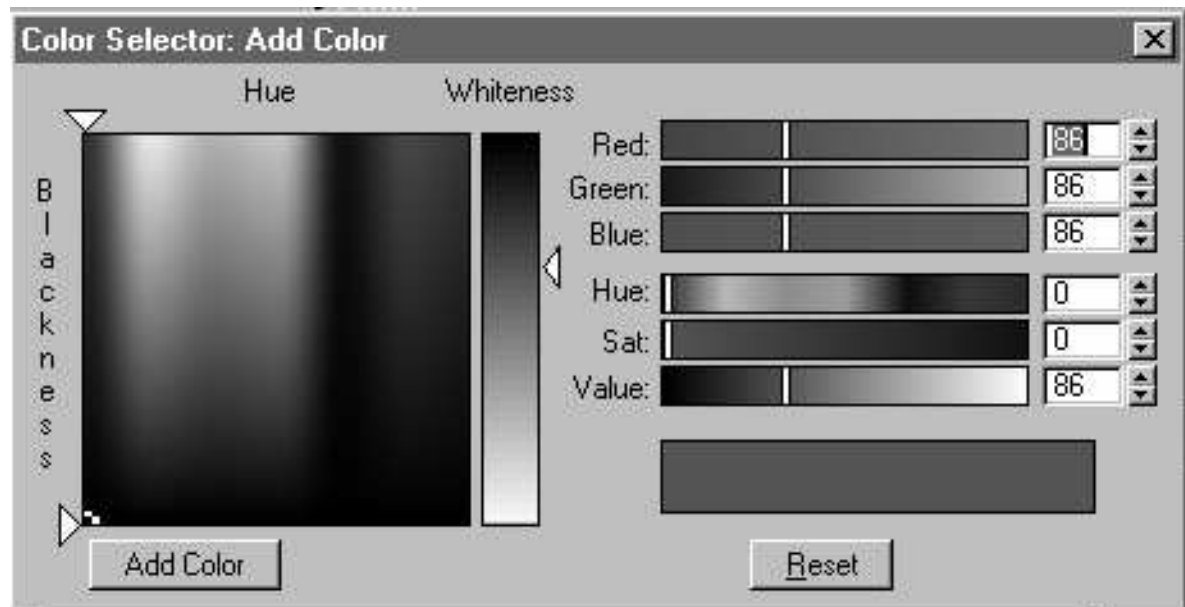
| <i>Color System</i> | <i>Quantity of info.</i> | <i>Number of colors</i> |
|---|--|--|
| 1. B/W B - black W - white | 1 bit / dot | $2^1 = 2$ colors |
| 2. B and W | 8 bit / dot | $2^8 = 256$ colors |
| 3. Indexed Colors | | $2^8 = 256$ colors |
| 4. RGB R - red G - green B - blue | 8 bit / dot 8 bit / dot 8 bit / dot | 24 bit / dot $2^{24} > 16,7$ Millions colors |
| 5. CMYK C - cyan M - magenta Y - yellow K - key black | 8 bit / dot 8 bit / dot 8 bit / dot 8 bit / dot | 32 bit / dot $2^{32} > 4$ Billiards colors |



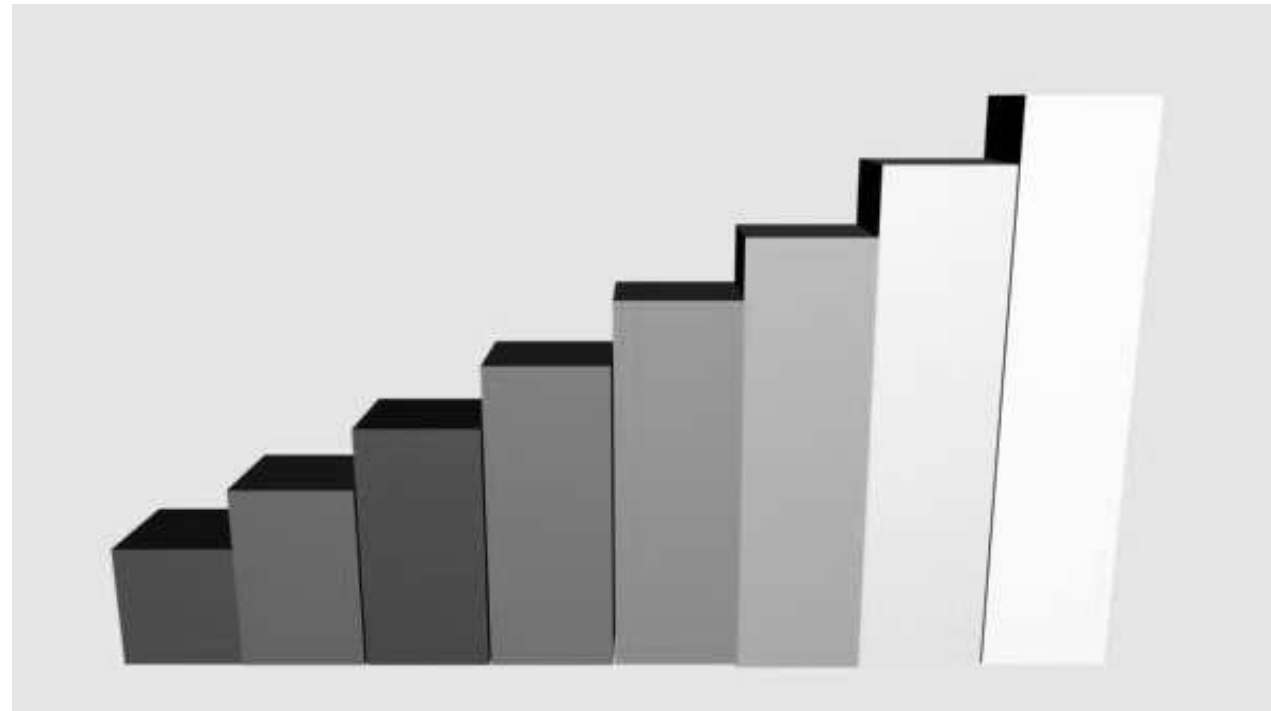
Number of colors necessary for map designing and screen visualizing

- 3 000 000 colors laid abreast
- 7 000 – for not abreast colors





Buildings' floors in 3D map



1 2 3 4 5 6 7
above7



Color definitions in 3D map

| Bilding/ floor | color | dimensions - RGB и HSV |
|---------------------------|--------------|--|
| 1 | Dark brown | R =130 G =52 B =0 H =17 S =255 V =130 |
| 2 | Brown | R =170 G =71 B =5 H =17 S =247 V =170 |
| 3 | Dark red | R =176 G =26 B =26 H =255 S = 217 V =176 |
| 4 | Red | R =220 G =67 B =67 H =255 S = 177 V =220 |
| 5 | Light red | R =226 G =96 B =96 H =255 S = 147 V =226 |
| 6 | Orange | R =224 G =143 B =87 H =17 S =156 V = 224 |
| 7 | Yellow | R =233 G =222 B =104 H =39 S =141 V =233 |
| above 7 | Light yellow | |

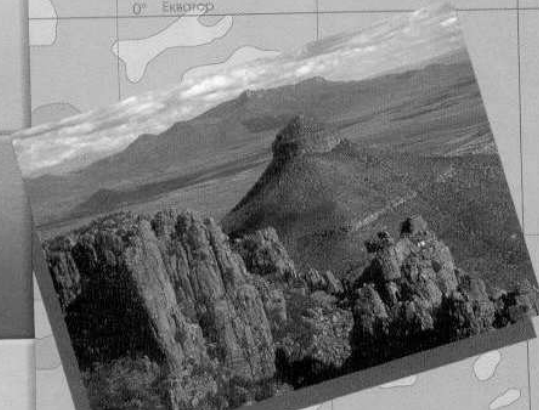
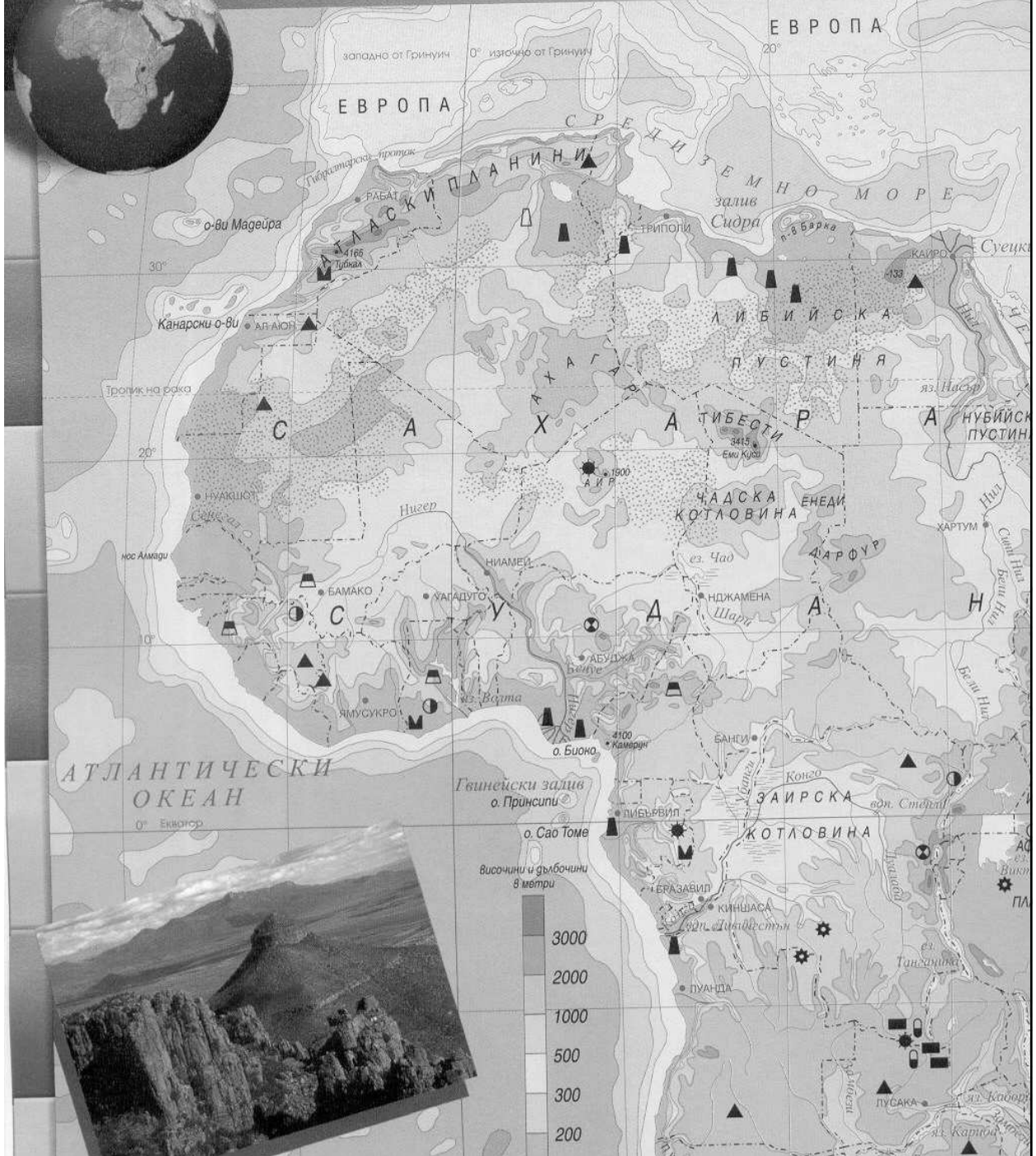


Colors in map designing and pre-publishing process

- 100% cyan for Hydrology
- 20, 30, 40% C – water areas – see and oceans
- 1,2,3 colors of CMYK – area color
- > 5% for every color
- Clean colors (without black - K)

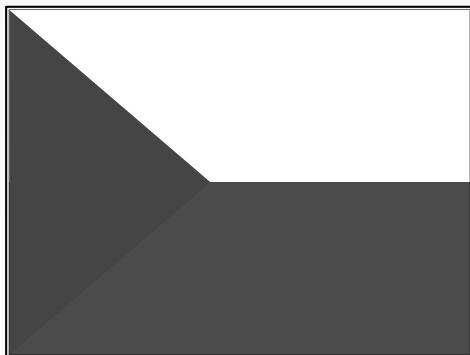
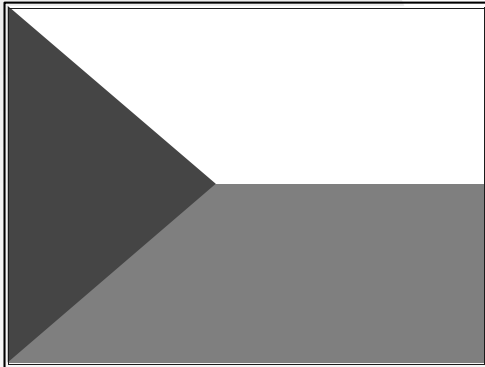


Африка Природа



CONCLUSIONS

- Dimensions for color defining – independent of color monitor and possibilities of print or publishing machines.
- Traditional rules for map coloring could be kept.
- Some limits in publishing process should be take into account in the first steps of map designing
- Unification of the colors could be lead to their standardizations.



**Thank you very much
for your attention**

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