

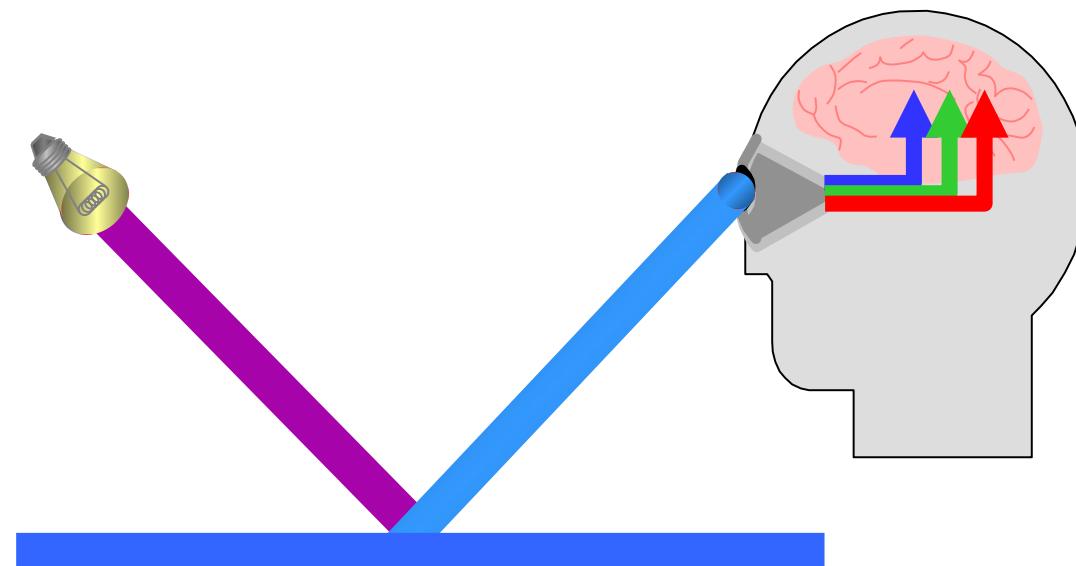
Colormanagement

Theory of Colormanagement

- Based on ICC-Technology
(ICC = International Color Consortium)
 - worldwide Standard
 - future-proof

What is color?

- Color is a visual information submitted by your eyes, interpreted by your brain



Auswirkung von Licht

- Different luminous sources → different effects
- Standard: D50 → Daylight 5000° Kelvin

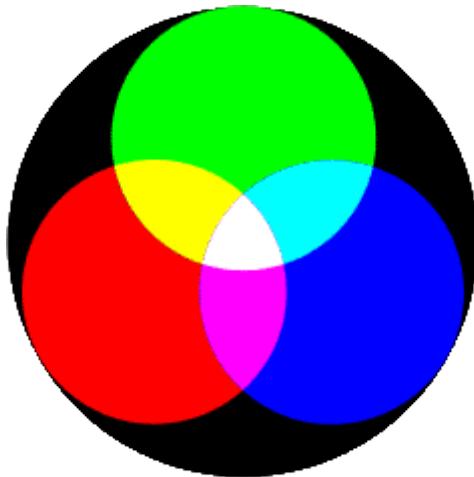


Impression influenced by environment

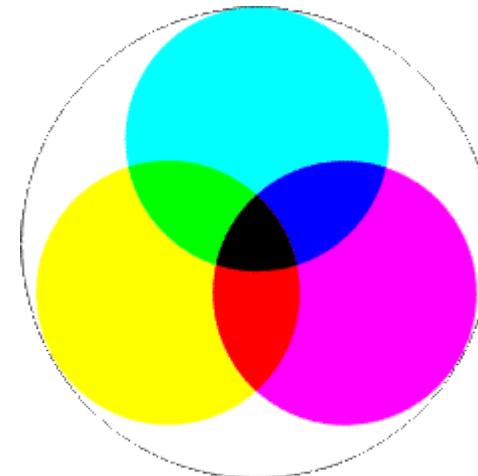


Systems of color mixture

- RGB → additive mixture of color
 - scanner
 - camera
 - display

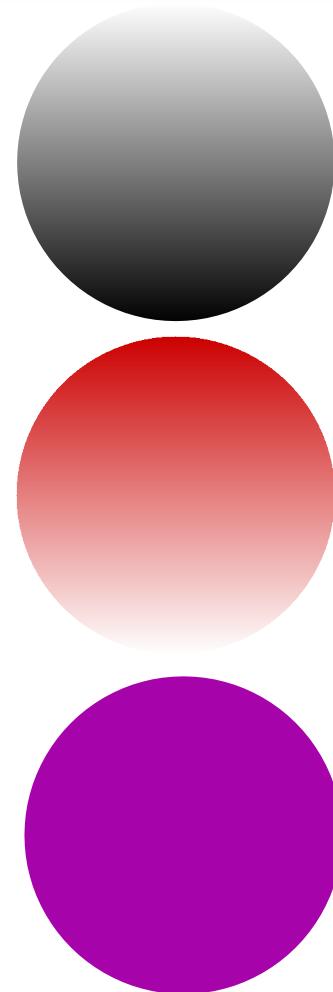


- CMY → subtractive mixture of color
 - printer
 - platesetter
 - printing press



What defines a color (What is HSL)?

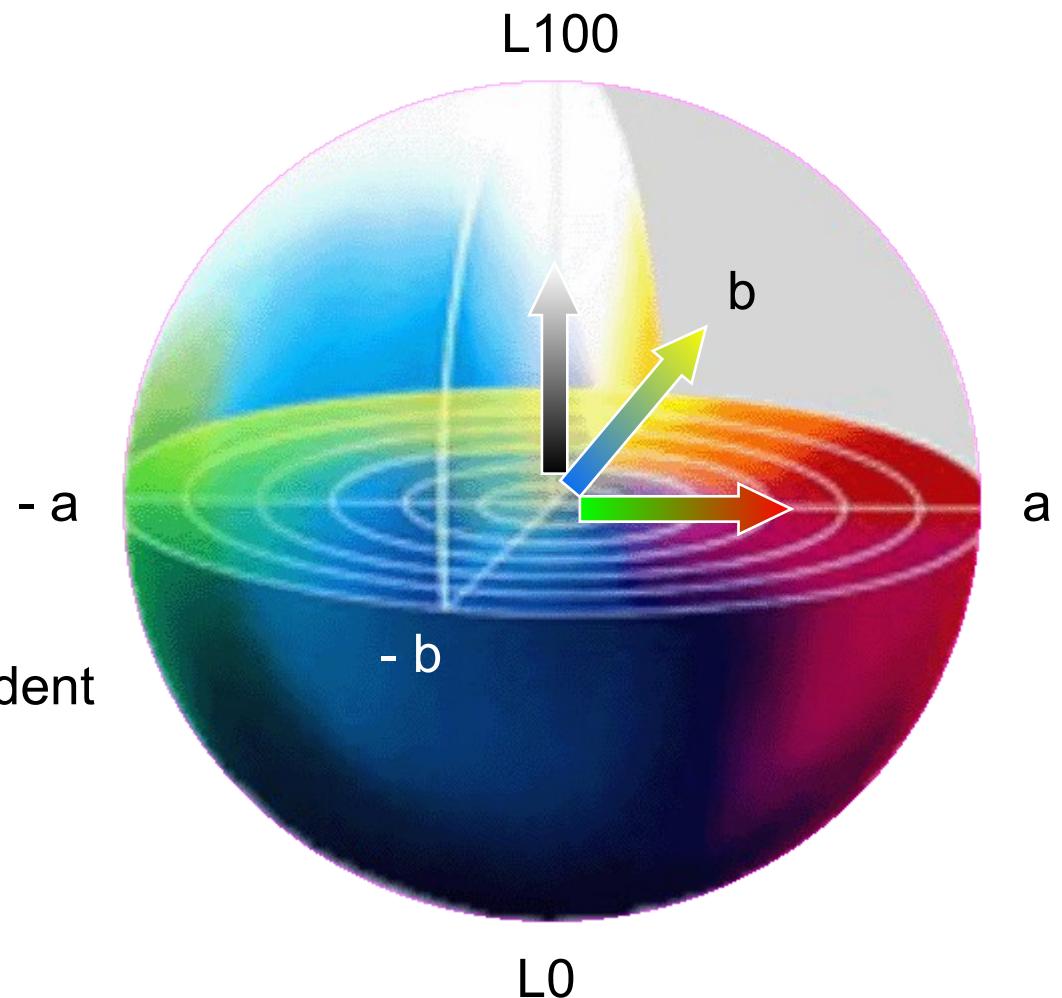
- Lightness/Luminance
- Saturation
- Hue



Lab-color-space

- L → Lightness/Luminance
 - 0 to 100
- a → red-green-axis
 - -127 to 127
- b → yellow-blue-axis
 - -127 to 127

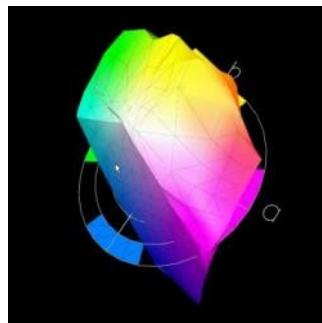
→ device-independent



Why Colormanagement?

- Treatment, handling and transmission of colordata
 - stable
 - predictable
 - Inside color-space of different devices (Gamut)

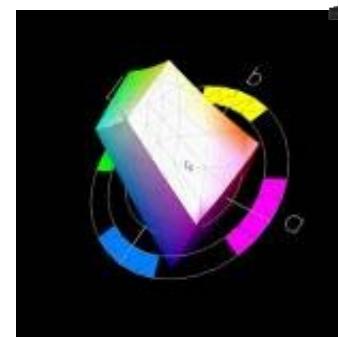
Displaying without Colormanagement



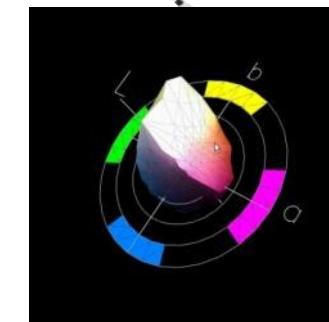
Scanner
RGB



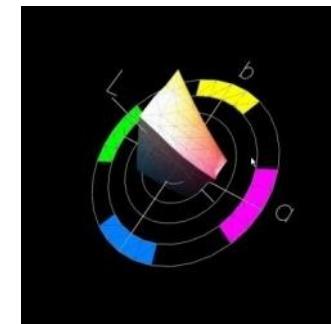
Monitor
RGB



Projektor
RGB

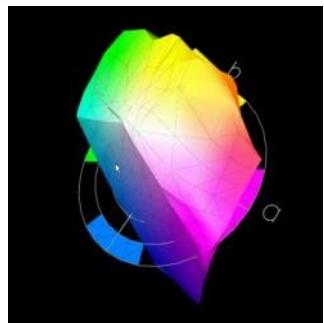


Inkjet



Offset

Goal of Colormanagement



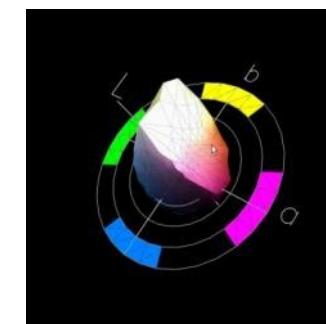
Scanner
RGB



Monitor
RGB



Projektor
RGB



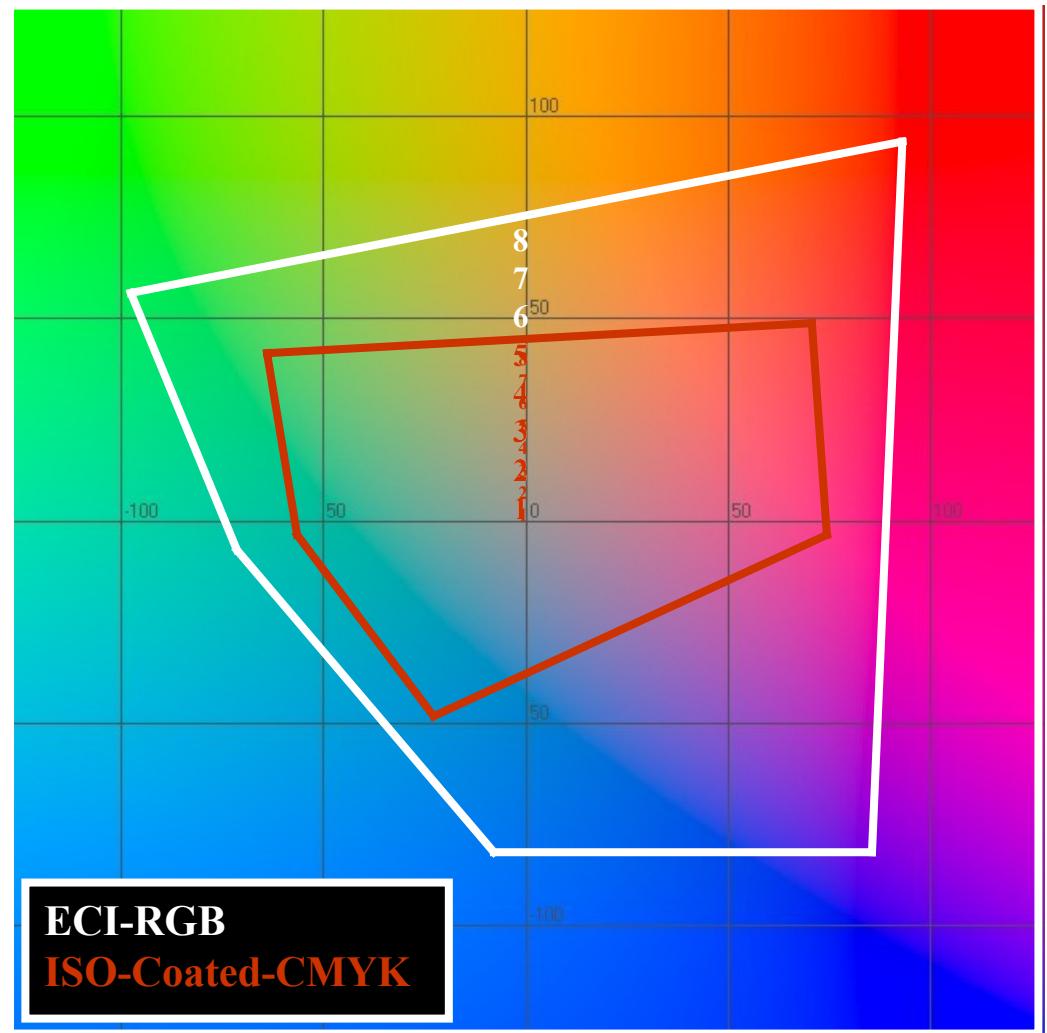
Inkjet



Offset

Gamutmapping

- Replacement of not viewable colors from source-color-space in destination-color-space → as unobstr



What is an ICC-Profile?

- Translation-Matrix for colors

RGB



Lab



CMYK

128 – 128 – 128

50 – 0 – 0

47 – 36 – 35 – 10

202 – 121 – 91

60 – 45 – 40

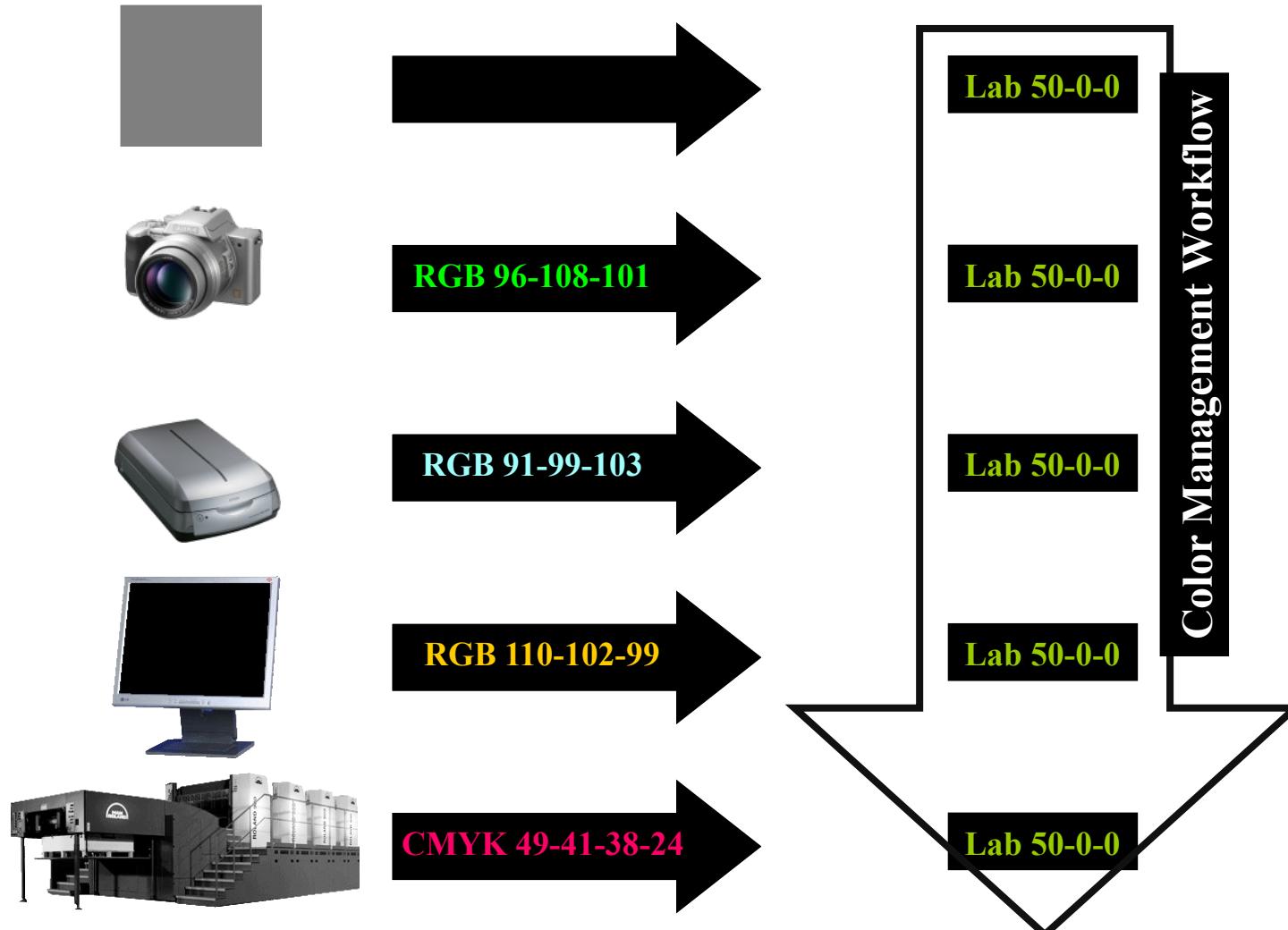
5 – 53 – 60 – 0

241 – 0 – 31

60 – 92 – 83

0 – 91 – 91 - 0

Utilization of ICC-Profiles



Functionality

Source-profile: Scanner



R = 130
G = 110
B = 115



L = 50
A = 0
B = 0



Target-profile: Display

L = 50
A = 0
B = 0



R = 118
G = 115
B = 123



Target-profile: printer

L = 50
A = 0
B = 0



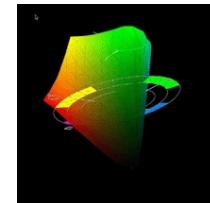
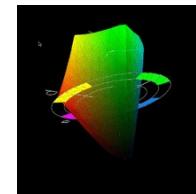
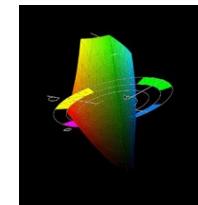
C = 49
M = 41
Y = 38
K = 24



Standardprofiles

Standardprofiles are defined standard-color-spaces in Lab

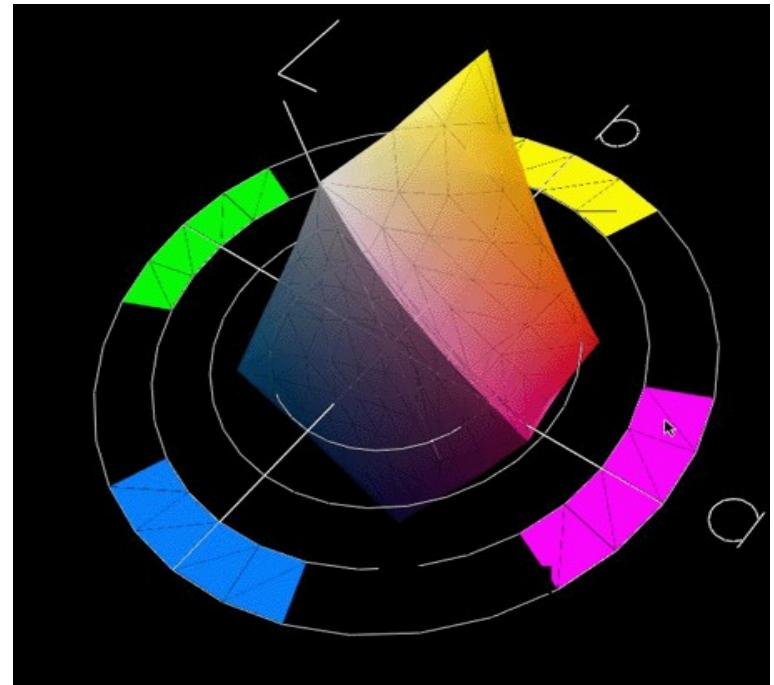
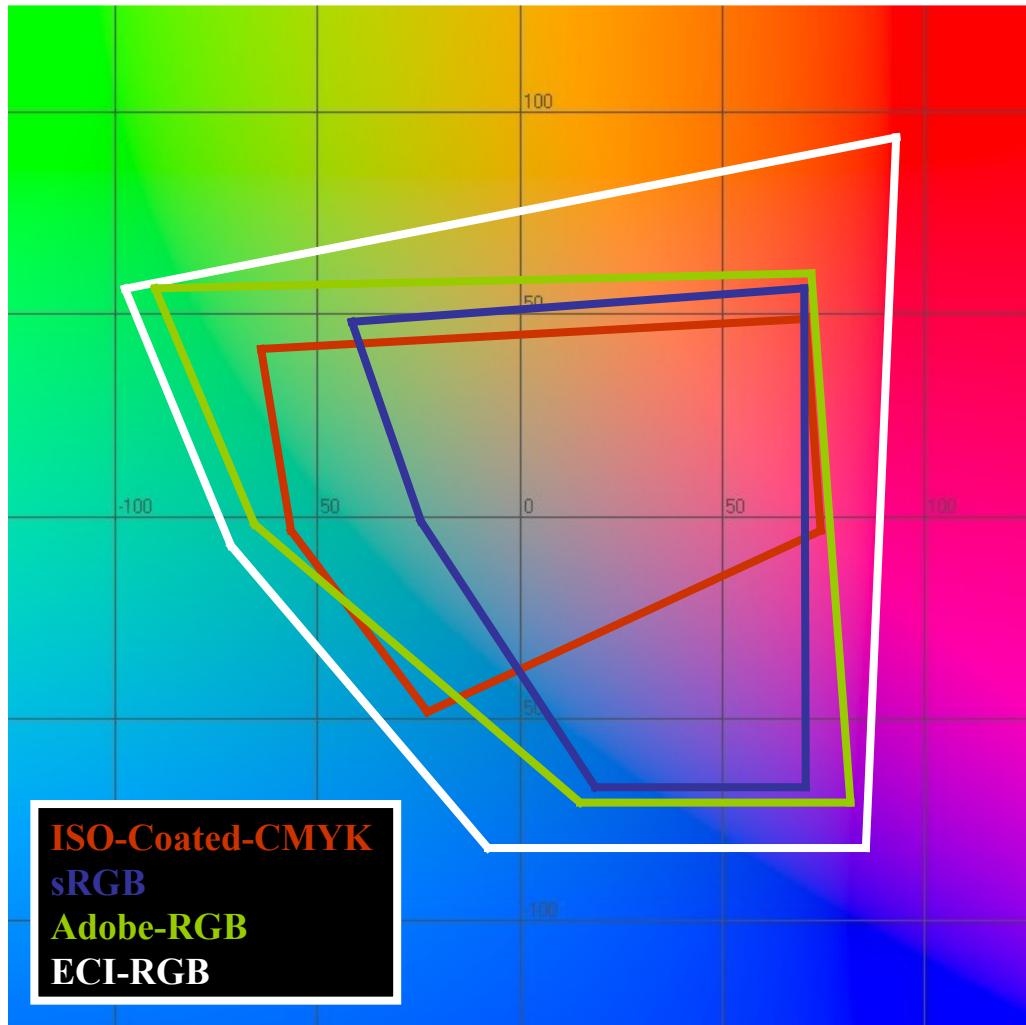
- sRGB
 - Average color-space of displays
- Adobe98-RGB
 - Internat. Standard-color-space
- ECI-RGB
 - Europ. Standard-color-space



Source-color-spaces for selfmade pictures or target-color-space for special functionalities (e.g. data-transmission)

ISO(un)coated standardprofile FOGRA

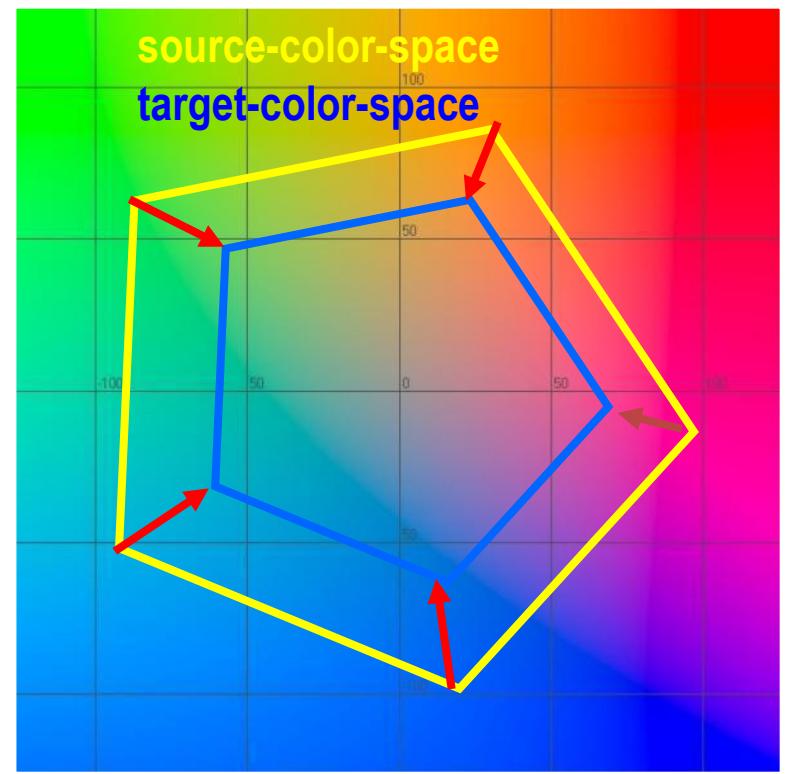
- Profile for printing by Proces Standard Offset



Advantage of ECI-RGB:
Contains these and most other
standardprofiles

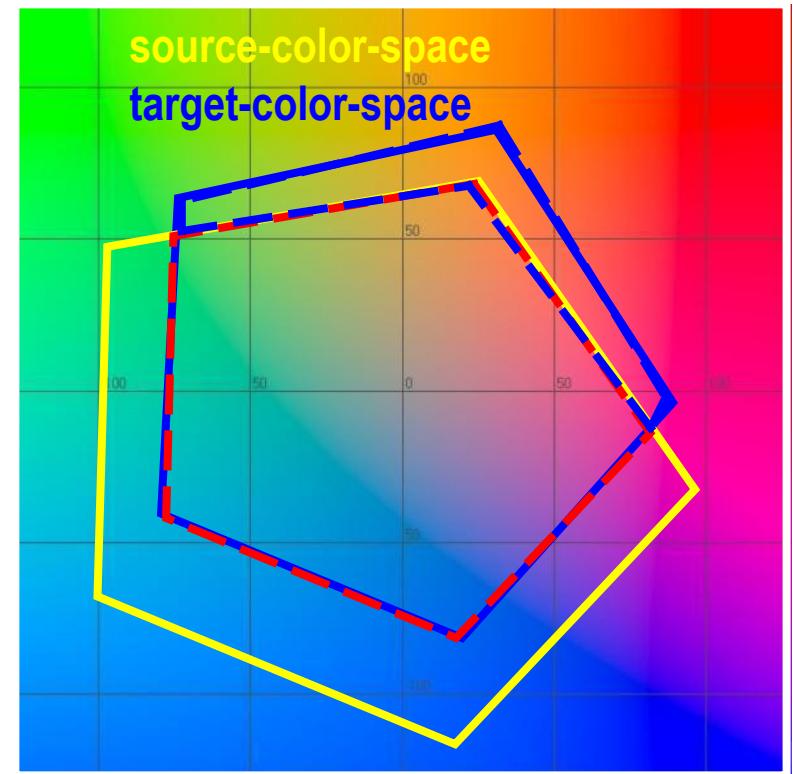
Transformation of color-spaces Methode 1

- Greater color-space will be compressed into smaller one
- colormetric all colors will be changed
- Appropriate to conserve the visual impression of the original



Transformation of color-spaces Methode 2

- Keep colors 1:1 with adjustment to smaller color-space (smallest distance of colors)
- Identical colors will be preserved
- Visual impression of colors not in destination-color-space may change

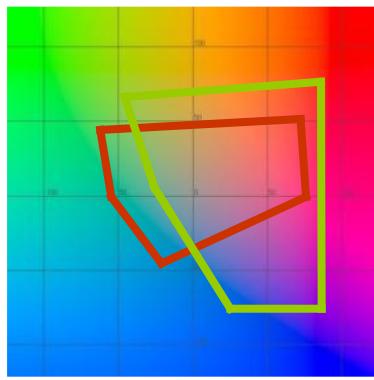


Rendering Intents

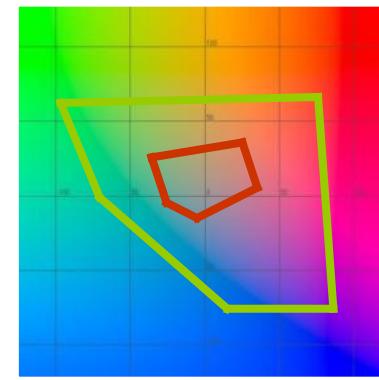
- Perception
 - Colors adjusted to visual impression(Compression)
 - Generating data for production (pictures)
- Relative colormetric
 - Smallest distance of colors
 - Generating data for production (pictures/Logos)
 - Proof to paper for print-run
- Absolutely colormetric
 - Smallest distance of colors with simulation of paper in destination-color-space (Whitepoint)
 - Proof to white proof-paper
- Saturation
 - Colors adjusted to max. saturation & hue
 - Business art work & charts

Rendering Intent

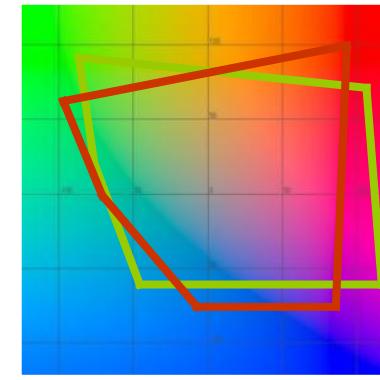
- How do i decide in real?
 - Use Rendering Intent with fewest changes of colors in picture
(Photoshop: use preview)



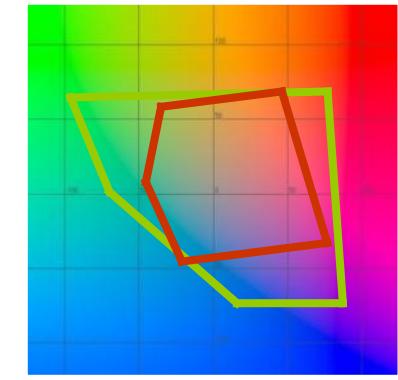
sRGB-RGB
ISO-Coated-CMYK



Adobe-RGB
Zeitung-CMYK



Scanner-RGB
ECI-RGB



Adobe-RGB
Fotolabor

Rules

- Rendering Intent mostly dependent on motive

but

- Never convert absolutely colormetric (Whitepoint will change to white of paper → color on none-printing areas)
- Never proof perceptive (colors will change to original → but goal of a proof is printig color mostly unchanged 1:1 if possible)
- Never convert perzeptive from smaller color-space to bigger ones (unwanted displacements of colors e.g. CMYK to RGB → 1:1 possible otherwise use relative colormetric)

- Technical equipment to get color information
- Software to generate profiles
- ICC-Profiles
 - source-profile
 - target-profile
- Software with integrated Colormanagement
(Adobe-Products/Corel/Quark/Scribus/Gimp)
- Knowledge about how to use color-profiles

Problem solved



RGB LAB



ICC-Profile scanner

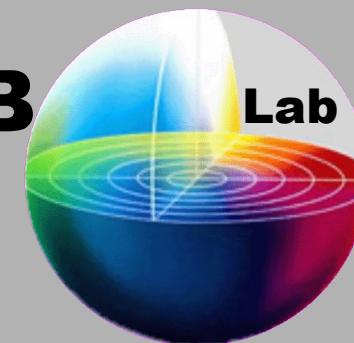
LAB



RGB LAB



ICC-Profile display



CMYK LAB



ICC-Profile print



Advantages of Colormanagement?

- reduces workload
- cost-efficiency
- quality-assurance
- less consumption of materials
- time-saving
- reduces customer complaint-rate

Calibrating & profiling displays

- Calibrating means standard adjustments of
 - Lightness/Luminance
 - Contrast
 - Adjusting color-temperature
 - D50 production & proofing (PSO)
 - D65 (still in use but obsolete)
 - CRTs need ca. 1h reaching color-temperature
 - LCDs & LEDs lose luminance after some time
- Profiling means generate translation-matrix for LAB to RGB-device-color-space
 - send special RGB-Values to display
 - measure RGB-output of display
 - Generate profile by measured Values of RGB based upon D50
 - Translation-matrix from display (Lab to RGB)

Periodically repeating calibration and profiling display

- Depends on type (cheap / high class)
- Depends on kind of display (LED / TFT / CRT / Plasma)
- Take care of cleaner-factor
- rough-and-ready-rule: once per month

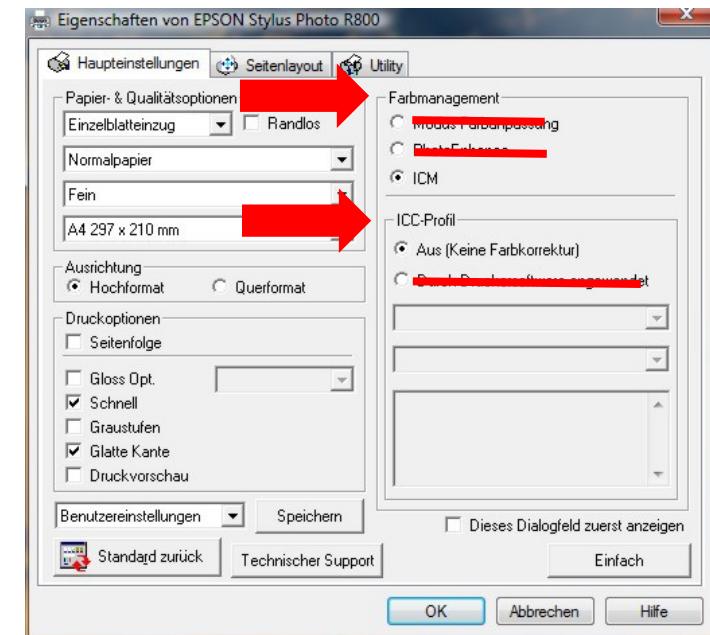
TAKE CARE: dependent on Software the activation of profile will be done by operating-system, Adobe CS or special calibration- and profiling-software

Printing process RGB or CMYK

- Printing by driver: RGB
- Controlled by RIP: CMYK
- Printing on printing press: CMYK

Profiling printer with testchart

- Testchart with plenty of color-fields
 - ECI 2002 Testchart (1485 colors)
- Linearisation (RIP-) Software
- Deactivate color-adjustments in driver and RIP
- Dot-gain must be known
- Testchart (RGB or CMYK) will be sent to printer and after that measured (Lab)
- Assign Lab-Values to CMYK- or RGB-Values
- Generate device-profile



Standard oder individual printer-profile

- Preferably individual profile because
 - A printer of same type is not YOUR printer
 - Individual profiles allow cosideration of YOUR whole workflow
 - Paperprofiles:
 - White paper will be read from every test-chart
 - Will be used by abs. colormetric Rendering Intent
 - New paper → new profile

Profiling scanner

- Read testcharts (Lab)
- Scan testcharts (RGB)
- Generate color-matrix RGB – Lab

TAKE CARE: even lamps in scanners will perish

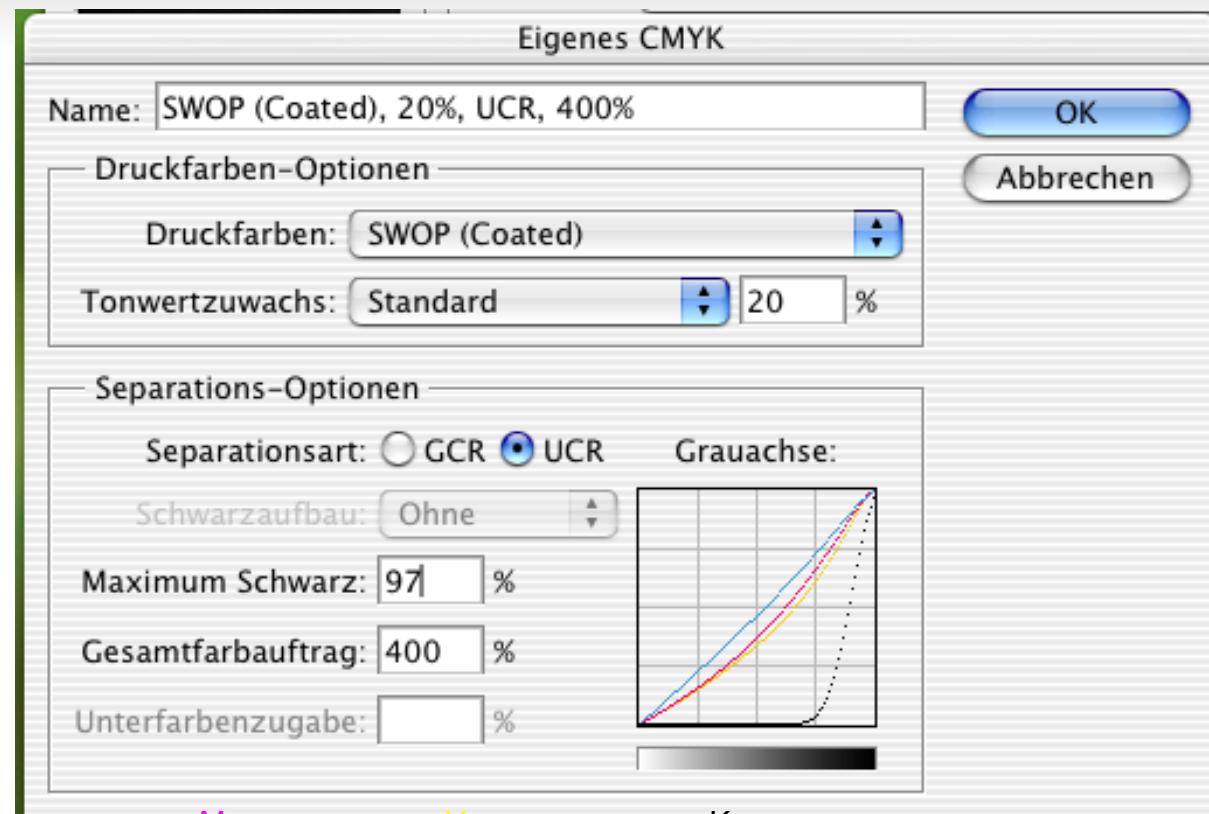
Mostly the profile can be imported directly to scanner-software

Profiling of cameras

- Because of unstable process individual profiles are very difficult and almost impossible to generate
- Possible when continuous shooting or stable lighting conditions
 - Needed when taking photos from products or fashion
 - Generating profile for camera equals generating profile for scanner
- No color-management inside of closed system camera
- But correct translation of values to Lab is possible
 - Cameras for private use mostly deliver sRGB
 - Cameras for professional use deliver AdobeRGB or
 - High-End devices use RAW-Format (no influence from outside)
 - After taking picture userdefined profiling in RAW-converter

Colorisation with CMY with black as skeleton

- All colors and also grey areas will be composed by CMY
- Black only as an skeleton with $\frac{3}{4}$ coverage
- Darkest color: 97%K 100%C 100%M 100%Y



UCR (Under Color Reduction)

- For every point composed by CMY the amount of CMY will be reduced and replaced by black
- Darkest color: 97%K 60%C 60%M 60%Y

Eigenes CMYK

Name: SWOP (Coated), 20%, UCR, 300%

Druckfarben-Optionen

Druckfarben: SWOP (Coated)

Tonwertzuwachs: Standard 20 %

Separations-Optionen

Separationsart: GCR UCR

Grauachse:

Schwarzauflauf: Ohne

Maximum Schwarz: 97 %

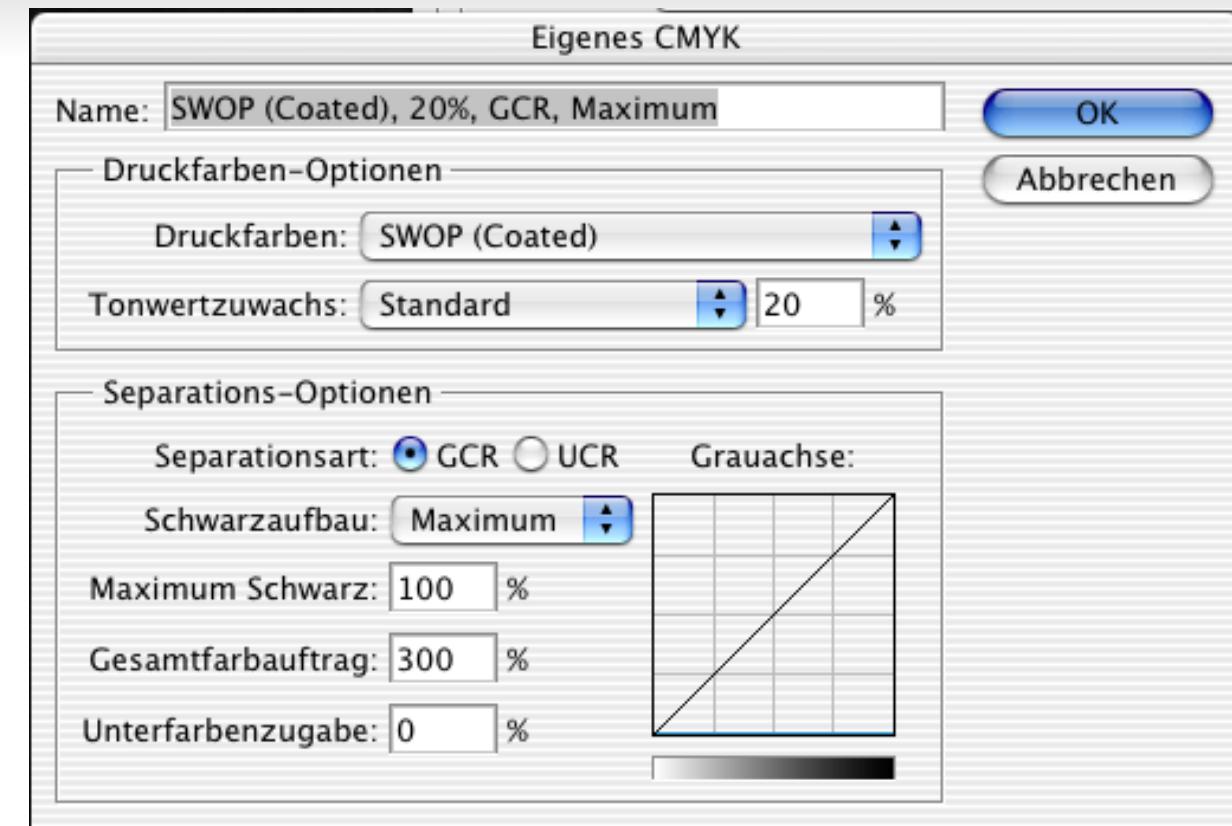
Gesamtfarbauftrag: 300 %

Unterfarbenzugabe: %

CMYK C M Y K

GCR (Gray Component Replacement)

- Every composition of CMY will be replaced by black
- Enhances stability in printing process
- Smallest amount of color needed
- Losing brilliance



Under Color Addition

- Real gray (amount of C=M=Y) replaced by black
- Adding CMY at $\frac{3}{4}$ -tones for better contrast

