

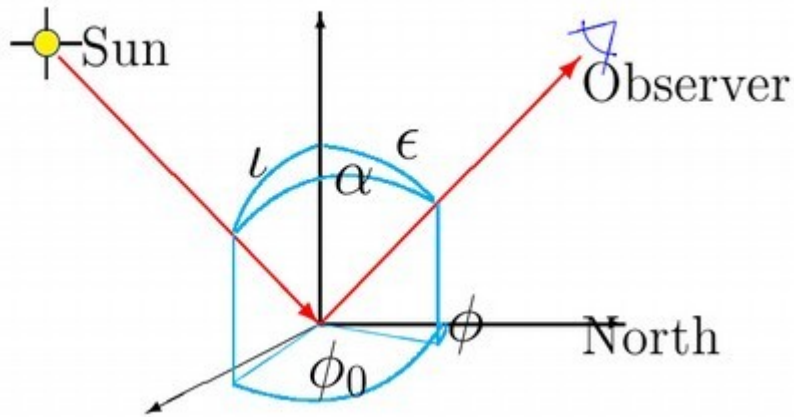
# Finnish Geodetic Institute's Reflectance library

Jouni Peltoniemi, Teemu Hakala, Maria Gritsevich, Juha Suomalainen,  
Eetu Puttonen, Lauri Markelin, Jyri Näränen, et al.

## Intro

- BRF
- Polarisation
- FIGIFIGO
- Measurements, campaigns
- Targets
- Library access
- Tools
- SPECCHIO
- Future perspectives

# Bidirectional reflectance factor (BRF)



- Observed reflectance depends on four angles
- $R = I / I_{\text{Lambert}}$  (unidirectional collimated incidence)
- $I(\epsilon, \Phi) = \cos l / \pi R(\epsilon, \Phi, l, \Phi_0) F_0(l, \Phi_0)$
- For real observations, integrate over full hemisphere and all sources
- To model polarisation,  $\mathbf{I} = [I, Q, U, V]$  and  $\mathbf{R} = 4 \times 4$  matrix
- Degree of linear polarisation  $I = -Q/I$

# FIGIFIGO

=Finnish Geodetic Institute Field Gonio-spectro-polari-radiometer

- Motorised arm of 150-250 cm
- Azimuth manually
- 40 kg, 2 person operatable
- Mounting 5-10 min, measurement 10-30 min
- Accuracy 0.01-0.03
- 400-2400 nm
- Rotating Glan-Thomson polariser, full spectral range
- 3 Stokes parameters: I, Q, U
  - V under construction
- Full hemisphere
- Unpolarised illumination



# Measurement efforts and campaigns

- Snow measurements
  - Sodankylä, Finland, 1997-2013
  - Greenland, 2010
- Vegetation
  - Suonenjoki, 2003, 2005
  - Sodankylä 2005-2010
  - Hyytiälä, Finland
  - Abisko (Sweden)
  - Andoya (Norway)
  - Masala
- Gravels
  - Sjäkulla
- Artificial targets
- ...

Some examples



## Data

- Altogether about 500 measurements
- Some cases repeated many times
- More than 50 with polarisation
- Indoors and outdoors
- In most cases only one angle of illumination, but sometimes also more
- In most cases over 100 angles of observation around the hemisphere, but sometimes only principal plane
- Quality varies, mostly normal
- Documentation limited

## ACCESS

- [https://webdisk.kotisivut.com/fgi/Reflectance\\_Library/](https://webdisk.kotisivut.com/fgi/Reflectance_Library/)
  - *Ask us for Username and Password*
  - Semi-public, you may use, you can give this password to your colleagues who need it, but not publish openly in web-pages or articles
- Possible to mount as a disk in W/M/L using WebDAV, just a few clicks in some network place folder
- When using the data as they are, give reference to the appropriate publication, when more support needed coauthorship appreciated



# Contents

- First level folders by campaign or major theme by the year
- Second level single BRF measurements
- Inside each measurement
  - \*.pdf containing some documentation and sample results
  - \*.xml file containing most metadata, in somewhat readable and editable form
  - \*HRF.h5 file containing outdoors measurements including the diffuse light
  - \*BRF.h5 file containing the BRF (without diffuse light)
  - Pictures subfolder, containing photos of the targets and measurements
  - Figs subfolder, containing large amounts of different plots made from the data
    - 3D cakes of BRF in various wavelengths
    - Principal plane curves
    - Spectra in various directions
    - Computed albedos
    - Polarisation curves

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## Tools

- **Matlab**
  - Several plotting routines
- **IDL**
  - `Mittausdataohjelma.pro`
    - Interactive plotter
  - `Makeallfigures.pro`
    - Reads all data and plots the sample plots
    - Computes albedos, makes several fits
    - Use as a template for batch processing, whatever you want to analyse
- ...

## Alternative access

- [www.specchio.ch](http://www.specchio.ch)
  - Common interface for many different spectral and BRF measurements
  - By Andreas Hüni, RSL, Zürich
  - Includes many database search functions and plotting options
- Part of the data now uploaded
  - Rest to be uploaded "soon"

## Work on progress

- Improve documentation
- Recheck quality, mark problems better
- Easier search for selected properties
- More fluent and up to date interfacing with SPECCHIO
- Reformat all data similarly (now at least 4 format is use)
- More usable toolsets
  - (now works well for us, but probably not too functional for general users)
- Much more new measurements

## Summary

- Large database of measured bidirectional reflectance factors available
- With spectrum and polarisation (partially)
- Much more to come

Thank you