

GAIA-CLIM General Assembly

WP1, Task 1.4 and STAT4GAPS

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www.unibg.it

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Deliverable 1.10

Assessment of gaps using a statistical approach (STAT4GAPS)

Task 1.4: Statistical assessment of geographical gaps
(lead: UniBergamo; involved: CNR, FMI, UBremen, ECMWF)

Deadline: August 31, 2017 (M30)

Topics of Task 1.4

1. Temperature and humidity profiles: RAOB (and GRUAN) geographic gaps (Unibg/CNR)
2. Ozone, carbone dioxide and methane (FMI)
3. Aerosol column: AERONET geographic gaps (Unibg/CNR)
4. Inputs to VO

Ozone results

Carbon dioxide and methane plans

VIKTORIA

Stat4gaps introduction

Unibg with support on data products by CNR is considering geographic gaps for temperature and moisture profiles and aerosol column.

Here we present very preliminary results about modeling, which is a necessary condition to define geographical gaps by the formula

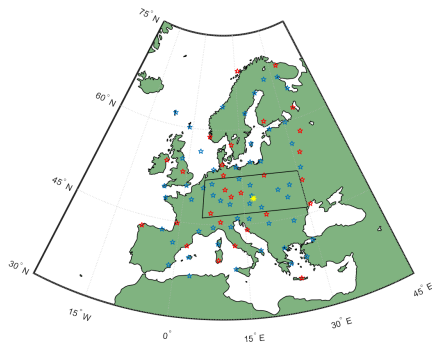
$$GAP = \{(lat, lon, h) : Var_{Kriging} > \lambda^2\}$$

This preliminary phase has the main motivation to prepare and test the code.

Temperature and humidity

Thanks to Ferdinand

Year 2015 RAOB profile data, retrieved from www.raob.com, include $n = 9824$ nighttime radiosondes, from 83 monitoring weather stations located within the geographic box ($36.72^{\circ}N$, $67.37^{\circ}N$, $-6.77^{\circ}W$, $34.8^{\circ}E$)



Blue stars for learning
Red stars for crossvalidation
In order to keep computational burden at minimum a reduced dataset has been based on the internal central EU trapezium.

Temperature and humidity

Simplified model

- Vertical range: 600 – 20'000m
- Vertical profiles:
Cubic B-spline representation with 10 basis only (Cressie used only four¹)
- functional D-STEM

$$y(s, t, h) = LAT(s, h) + SeasonalTrend(t, h) + \\ Markov(t, h) + LCM(s, t, h) + \\ \varepsilon(s, t, h)$$

¹Nguyen H, Cressie N, Braverman A. (2016) Multivariate spatial data fusion for very large remote sensing datasets, National Institute for Applied Statistics Research Australia, University of Wollongong, Working Paper 13-16, 31.

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Temperature and humidity

Functional kriging (interpolation)

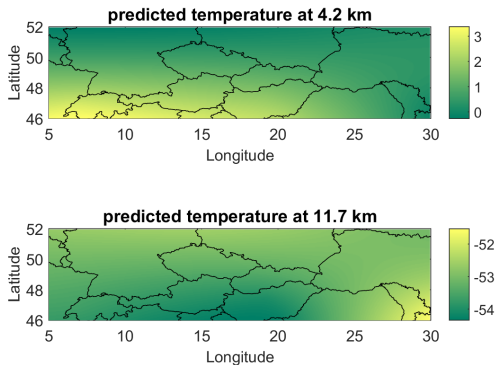


Figure: Sliced maps of 1 July, 2015 [$^{\circ}\text{C}$].

Temperature and humidity

Functional kriging variance

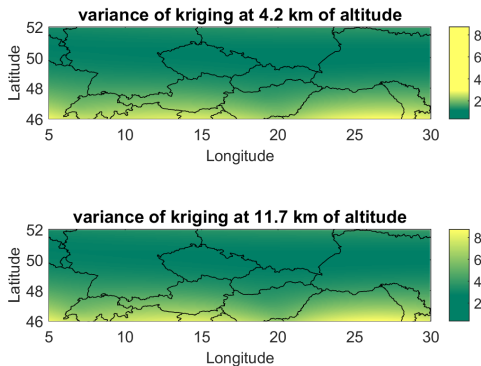


Figure: Sliced maps of 1 July, 2015 $[(C^\circ)^2]$.

Temperature and humidity

Crossvalidation

	<i>RMSE</i>		R^2	
	Smoothing	Kriging	Smoothing	Kriging
0.6 – 2.4km	1.005	3.266	0.982	0.815
2.4 – 4.2km	0.804	3.135	0.989	0.826
4.2 – 6.2km	0.845	3.117	0.990	0.861
6.2 – 8.6km	0.934	3.035	0.989	0.884
8.6 – 11.7km	1.499	2.984	0.960	0.840
11.7 – 15.5km	1.844	3.362	0.897	0.658
15.5 – 20km	1.483	2.382	0.919	0.791

Aerosols

Modis/Aeronet

Total column aerosol at global scale

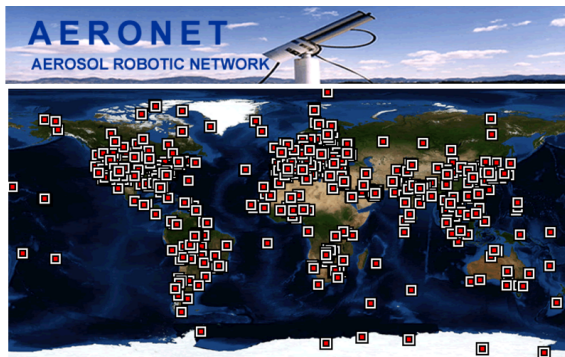


Figure: Aeronet network of photometers

Modis/Aeronet

1. ECV's: AOD
2. Satellite: Modis
(modis-atmos.gsfc.nasa.gov)
3. Reference: aeronet
(<http://aeronet.gsfc.nasa.gov/>)



Figure: Aeronet's direct sun photometers

1. Spatial Coverage: global
2. Temporal coverage: year 2014
3. Modis smoothing $10 \times 10 \text{ km} \times 5'$
4. Time- and geo-referenced data will include
 - 4.1 columnar aerosol and integrated water vapor (IWR),
 - 4.2 soil emissivity (MODIS),
 - 4.3 albedo (AERONET)
 - 4.4 view angles.

THANKS FOR
YOUR ATTENTION