UNIVERSITY OF TWENTE.

LESSON 5.
DOWNSCALING OF SATELLITE ETA AND ETP PRODUCTS

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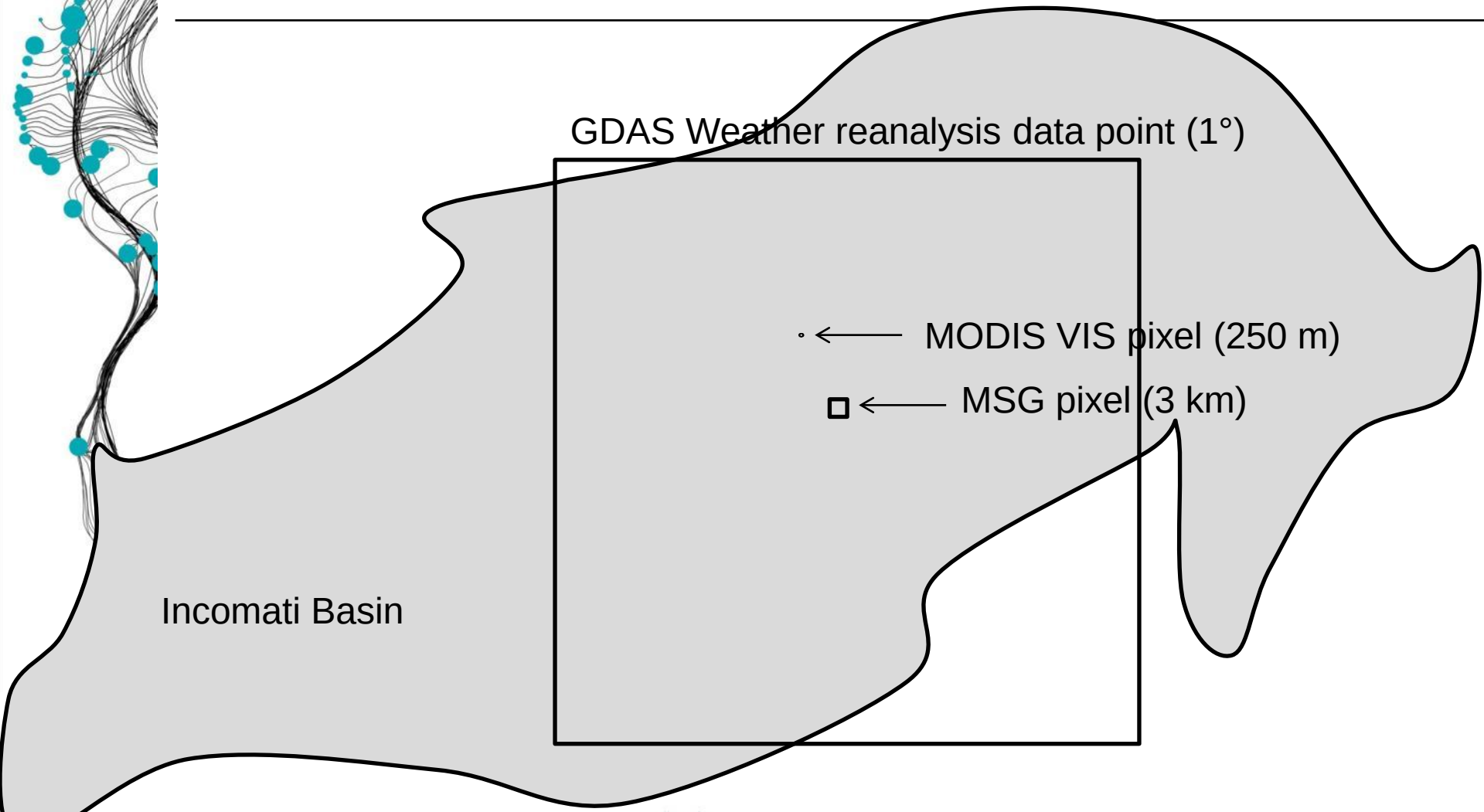
CONTENT

- This presentation gives the details on the method to downscale the EO data to come to the ET product on a 250 meter resolution
- More details can be found in the downloadable technical report:

Different resolutions of data



Problem:

We have ETa and ETp products at 3 km resolution, but we want to a have them at 250 m resolution.

Solution:

We will use MODIS products to downscale the ET products. The rationale is that ET scales positively with albedo, emissivity and vegetation density, thus with fractional vegetation cover.

Main idea

- ETp and ETa at 250 m is calculated from 3 km MSG products by means of a factor which has 250 m resolution.

$$ET_{\mathrm{p}}^{250\mathrm{m}} = F_{250\mathrm{m}} \times ET_{\mathrm{p}}^{\mathrm{FNET}}$$

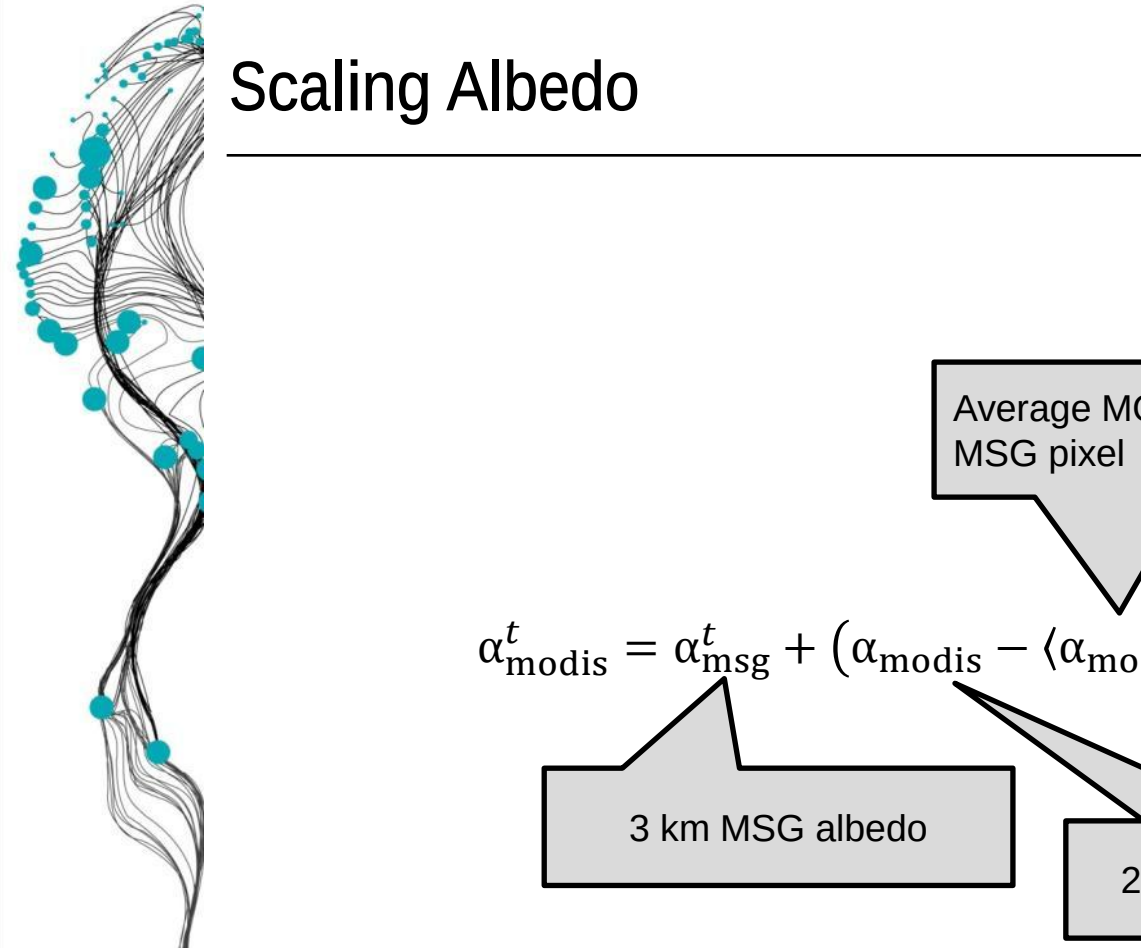
$$ET_{\mathrm{a}}^{250\mathrm{m}} = F_{250\mathrm{m}} \times ET_{\mathrm{a}}^{\mathrm{msg}}$$

- The scale factor F is a product of three factors: linearly scaling with:
  - The fraction of vegetation cover
  - Albedo
  - Emissivity

Rationale: ET scales with vegetation density

$$F_{250\mathrm{m}} = \frac{FVC_{250\mathrm{m}}}{FVC_{\mathrm{msg}}} \times \frac{\alpha_{\mathrm{msg}}}{\alpha_{500\mathrm{m}}} \times \frac{\varepsilon_{\mathrm{msg}}}{\varepsilon_{250\mathrm{m}}}$$

Scaling Albedo



Scaling vegetation cover fraction

$$\mathrm{FVC} = (NDVI - 0.0156)^2 / 0.712$$

From MODIS MYD13Q1

Average MODIS FVC within the MSG pixel

$$FVC^t_{\mathrm{modis}} = FVC^t_{\mathrm{msg}} + \left(FVC_{\mathrm{modis}} - \langle FVC_{\mathrm{modis}} \rangle_{\mathrm{msg}}\right) \frac{FVC^t_{\mathrm{msg}}}{\langle FVC_{\mathrm{modis}} \rangle_{\mathrm{msg}}}$$

3 km MSG FVC

250 m MODIS FVC

Scaling emissivity

- LANDSAF has no operational MSG emissivity product
- So the 250 m product of MODIS is used directly
- It is scaled to the resolution of MSG (3 km) by taking the average of the MODIS product in each MSG pixel:

$$\varepsilon^{t}_{\mathrm{msg}} = \langle \varepsilon_{\mathrm{modis}} \rangle_{\mathrm{msg}}$$

- Finally, we have everything to compute:

$$F_{250\mathrm{m}} = \frac{FVC_{250\mathrm{m}}}{FVC_{\mathrm{msg}}} \mathrm{x} \frac{\alpha_{\mathrm{msg}}}{\alpha_{500\mathrm{m}}} \mathrm{x} \frac{\varepsilon_{\mathrm{msg}}}{\varepsilon_{250\mathrm{m}}}$$

$$ET_{\mathrm{p}}^{250\mathrm{m}} = F_{250\mathrm{m}} \mathrm{x}\, ET_{\mathrm{p}}^{\mathrm{FNET}}$$

$$ET_{\mathrm{a}}^{250\mathrm{m}} = F_{250\mathrm{m}} \mathrm{x}\, ET_{\mathrm{a}}^{\mathrm{msg}}$$

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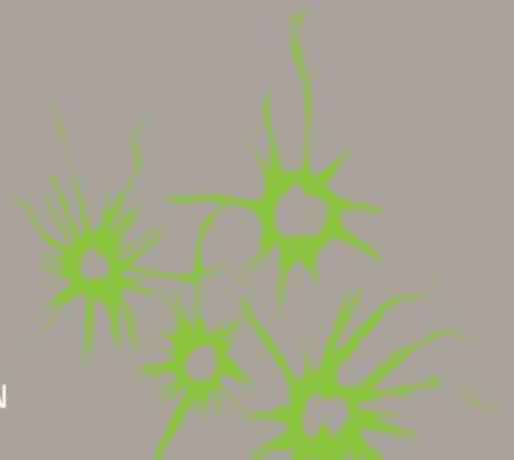
THE END

THANK YOU



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