Grasslands monitoring in Magallanes, a tool for farm planning as a socio-economic benefit for the Region

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Background information for the Magallanes and Chilean Antarctica Region

- 13.2 million hectares, 5.7 million hectares in agricultural use (Ministerio de Agricultura, 2012).

- 3.76 million hectares with some degree of soil erosion (CIREN, 2010).

- Chile has 2,185,000 sheep, and Magallanes region has 75% of sheep population (sheep survey, 2015).
Dynamic Monitoring System of Rangelands in Magallanes

High spatial resolution (Geoeyes, Ikonos, Worldview 2 // pixels ≤ 16 m²)
High temporal resolution (MODIS) every 16 days.

Main Results
• Satellite images
• Classification and analysis of vegetative communities
• Soils analysis
• Determination of livestock values
NDVI Monitoring Platform
Temperature (LST) Monitoring Platform
Snow Monitoring Platform
PET Monitoring Platform
Potential Evapotranspiration

Land Surface temperature
MODIS images
Monitoring Platform
Station Locations
Pasture Condition Index (PCI)

PCI of a grazing unit

\[ \text{ANDVI} - \text{PET} \]

- NDVI Anomalies
- Satellites
- LST and Ra

- LST and Ra
- Fieldwork
- Botanic composition
- Protein
- ME
- Digestibility
- Dry matter production
Pasture Map
Pasture Condition Index (PCI)

**Series de Tiempo**

Un círculo verde indica que el valor de ICP actual del potrero es mayor a la desviación estándar inferior.

Un círculo rojo indica que el valor de ICP actual del potrero es menor a la desviación estándar inferior.

El índice de vegetación muestra el vigor de la vegetación, un verde más oscuro indica un mayor vigor.

**NDVI:** Anomalía por periodo del NDVI

**LST:** Temperatura de la superficie

**ETP:** Evapotranspiración Potencial

El índice de condición del pastizal está formado por el ETP, el NDVI y el valor ganadero.

**Comunidades Vegetales**

- *Berberis buxifolia:* 0,06 ha
- *Chiliorchicum diffusum:* 2,98 ha
- *Cuerpos de agua:* 0,04 ha
- *Empetrum rubrum:* 2,58 ha
- *Festuca gracilis:* 28,93 ha
- *Paredes degradadas:* 2,81 ha
- *Paredes sembradas:* 0,00 ha
- *Suelo desnudo:* 10,11 ha
- *Vegas:* 7,79 ha
- **TOTAL:** 55,48 ha

**Valor Ganadero:** 6,23

**Monitoros**

- **ANDVI Actual:** 0,60 (-0,12)
- **ANDVI Histórico:** 0,72
- **ETP Actual:** 77,282 (-1,960)
- **ETP Histórico:** 79,222
- **LST Actual:** -0,72 ºC (-0,720)
- **LST Histórico:** 0,00 ºC
- **ICP Actual:** 48,75 (-2,86)
- **ICP Histórico:** 50,86

**Productos:**

- **ICP**
Pasture Condition Index (PCI)
NDVI for individual pastures
Vegetation Classification
Soils

- pH – OM – P – S – Bases – Al – Zn – Cu – Fe – Mn
- Bulk density

Improved pasture and cropland

**pH water**
- 4% at 5
- 13% at 5.5
- 28% at 6
- 31% at 6.5
- 10% at 7
- 9% at 7.5
- 3% at 8
- 1% at 8.5

**P-Olsen**
- 8% at 4
- 18% at 6
- 22% at 8
- 9% at 10
- 4% at 12
- 7% at 14
- 3% at 16
- 2% at 18
- 3% at 20
- 1% at 22
- 2% at 24
- 4% at 26
- 3% at 28
- 1% at 30
- 10% at 80

45% < 6

61% < 12 ppm
76% < 20 ppm
# Soils

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Valley greens</th>
<th>diddle dee</th>
<th>Steppe</th>
<th>Grasslands</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH water</td>
<td>4.7 – 8.0</td>
<td>5.2 – 5.9</td>
<td>5.6 – 7.0</td>
<td>4.9 – 7.8</td>
</tr>
<tr>
<td>P-Olsen (mg kg(^{-1}))</td>
<td>2.3 – 51.2</td>
<td>2.5 – 6.0</td>
<td>3.4 – 25.5</td>
<td>3.3 – 59.3</td>
</tr>
<tr>
<td>S (mg kg(^{-1}))</td>
<td>0.2 – 271.8</td>
<td>0.5 – 2.2</td>
<td>0.1 – 61.2</td>
<td>0.1 – 27.1</td>
</tr>
<tr>
<td>Sat. Al (%)</td>
<td>0.1 – 9.5</td>
<td>0.2 – 26.7</td>
<td>0.1 – 0.6</td>
<td>0.1 – 16.7</td>
</tr>
<tr>
<td>OM (g kg(^{-1}))</td>
<td>53.4 – 600.2</td>
<td>101.7 – 180.3</td>
<td>31.2 – 176.2</td>
<td>38.3 – 470.9</td>
</tr>
</tbody>
</table>
Study area corresponding to winter range (solid lines) and summer range (dashed lines), in Tierra del Fuego.
A. Average snow cover as a percent of the total area of each pasture. Line segment corresponds to the critical threshold for snow cover. Shaded area corresponds to use of winter pasture.

B. Mean NDVI for the four ranches on summer and winter pasture.
Land Surface Temperature (LST) of pastures (°C) throughout the year. The lower limit calculated was 5°C, as a parameter for cold tolerance in sheep.
Monitoring changes in *Hieracium pilosella* spatial distribution from 2004-2018 on grazing unit in Magallanes Region using Landsat temporal series

Objective: Estimate the spatial change of *H. pilosella* over 14 years using remote sensing techniques.
Monitoring changes in *Hieracium pilosella* spatial distribution from 2004-2018 on grazing unit in Magallanes Region using Landsat temporal series

Average growth of $63.35 \pm 15.35$ hectares per year.

This farm had 53.3% coverage by *H. pilosella* at the end of this study. Is important to improve the accuracy of this information with weather stations.
THANK YOU

http://www.monitoreopastizales.cl
Analysis of Climate Factors

• MODIS (Moderate Resolution Imaging Spectroradiometer) products from 2003 to 2011.
  – MOD13Q1: Corresponds to NDVI (Normalized Difference Vegetation Index). (every 16 days, 250m).
  – MOD10A2: Corresponds to detection of snow cover. (every 8 days, 500m).
  – MOD11A2: Corresponds to Land Surface Temperature (LST). (every 8 days, 1000m).