




Uso di dati e modelli in diversi contesti: dal monitoraggio agrometeorologico alle proiezioni di lungo termine per l'adattamento ai cambiamenti climatici in agricoltura. Casi studio da programmi FAO.

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FAO's climate strategy on climate change and Climate Smart Agriculture: recommendations

- ▶ **Include climate and climate change considerations in projects, programmes, policies for promoting a sustainable agriculture**
- ▶ **Promote the concept of “Climate Smart Agriculture”**
- ▶ **Improve the understanding of climate change impacts on agriculture, for informed adaptation decisions**
- ▶ **Strengthen meteorological and agrometeorological networks for higher quality monitoring and data**



**FARM-LEVEL ADVICE:
agrometeorology and
disease early warning
systems in Macedonia**

TCP project “Reducing the vulnerability of
Agriculture to Climate Change”

Meteorological vs. *agrometeorological* stations

AWS Measured parameters

- Tair (Tmax & Tmin)
- TH (Mx & Mn)
- Wind speed (10m height)
- Wind direction
- Global radiation
- Precipitation
- Atmospheric pressure
- Soil temperature (0, 5, 10, 20 cm)

Calculated:

Tdew

AAWS Measured parameters

- Tair (Tmax & Tmin)
- TH (Mx & Mn)
- Wind speed (2m)
- Wind direction
- Global radiation
- Precipitation
- Atmospheric pressure
- Soil temperature (0, 5, 10, 20 cm)
- Soil moisture (30, 60 cm)
- Leaf wetness

Calculated:

Tdew

Sum of degree days (SDD)

Chilling hours

Potential

evapotranspiration

Increasing agrometeorological network

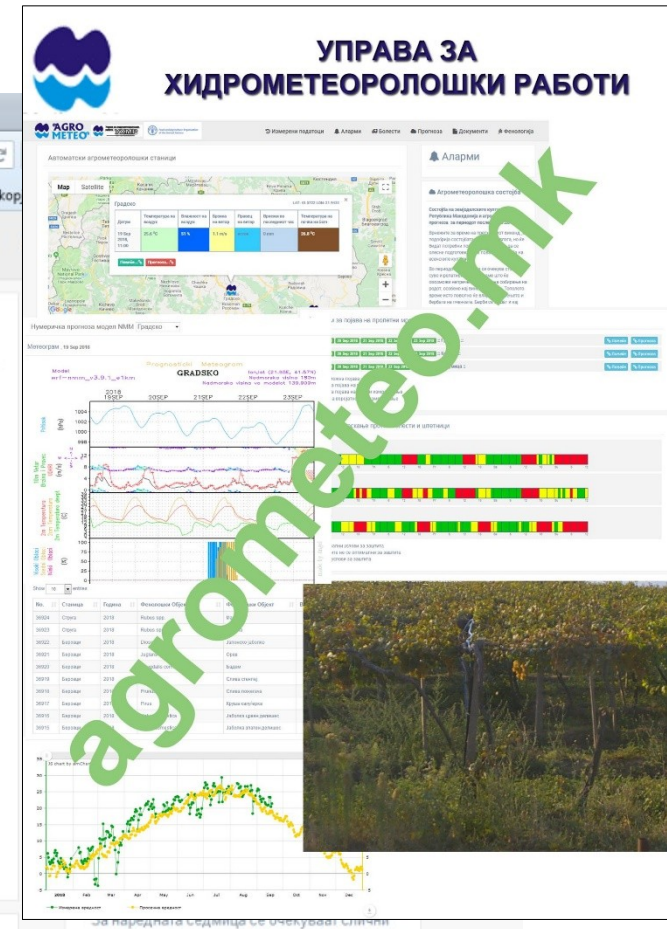
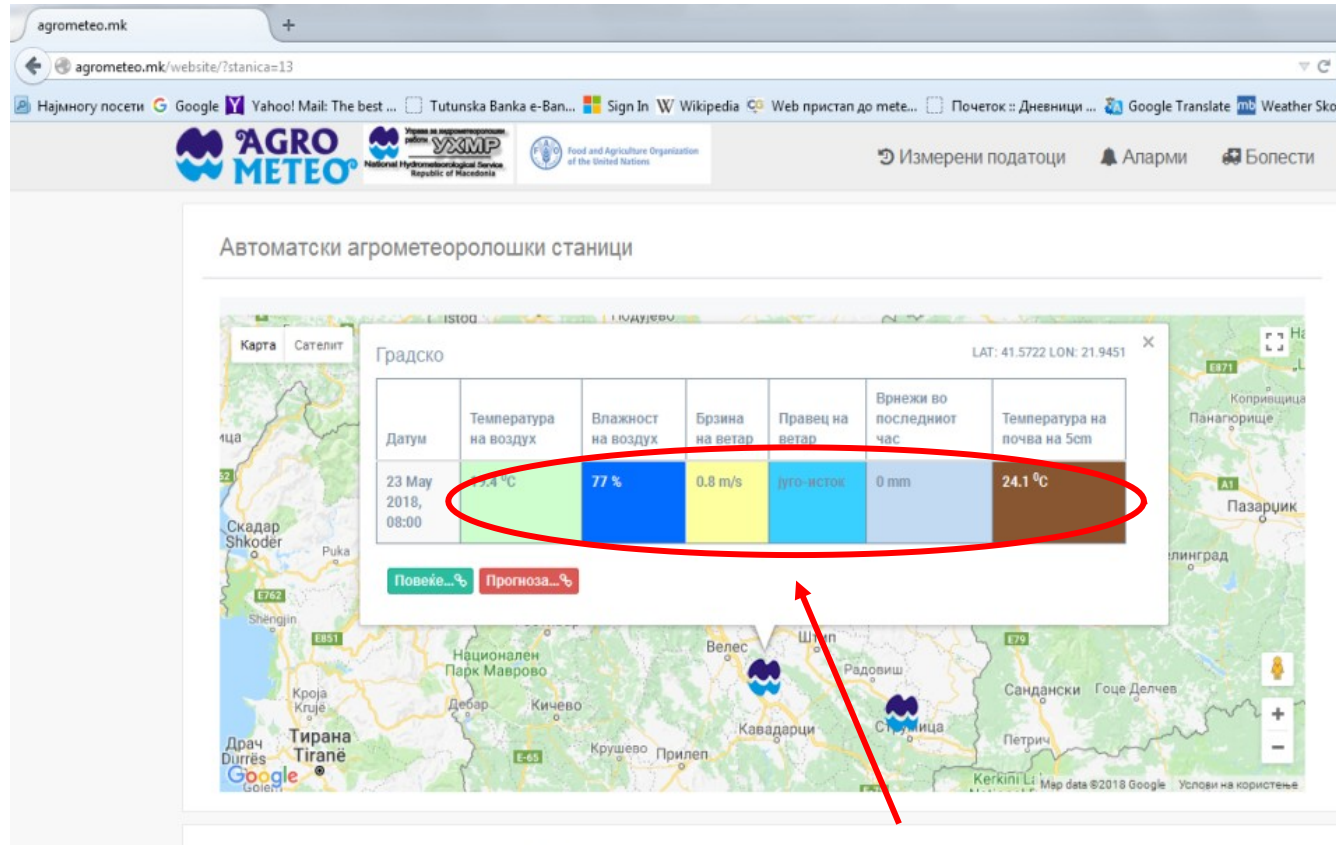
Three agriculturally important pilot sites were chosen for the installation of the automatic agrometeorological weather stations (AAWS):

- **Grandson** (vine region in the central part of the country)
- **Kocani** (rice plants in the east)
- **Strumica** (organic production of vegetables in the south east)

All sites represent important agricultural regions that require on farm monitoring of agrometeorological variables and calibration of crop and other agro-relevant models.



Development of knowledge sharing portal



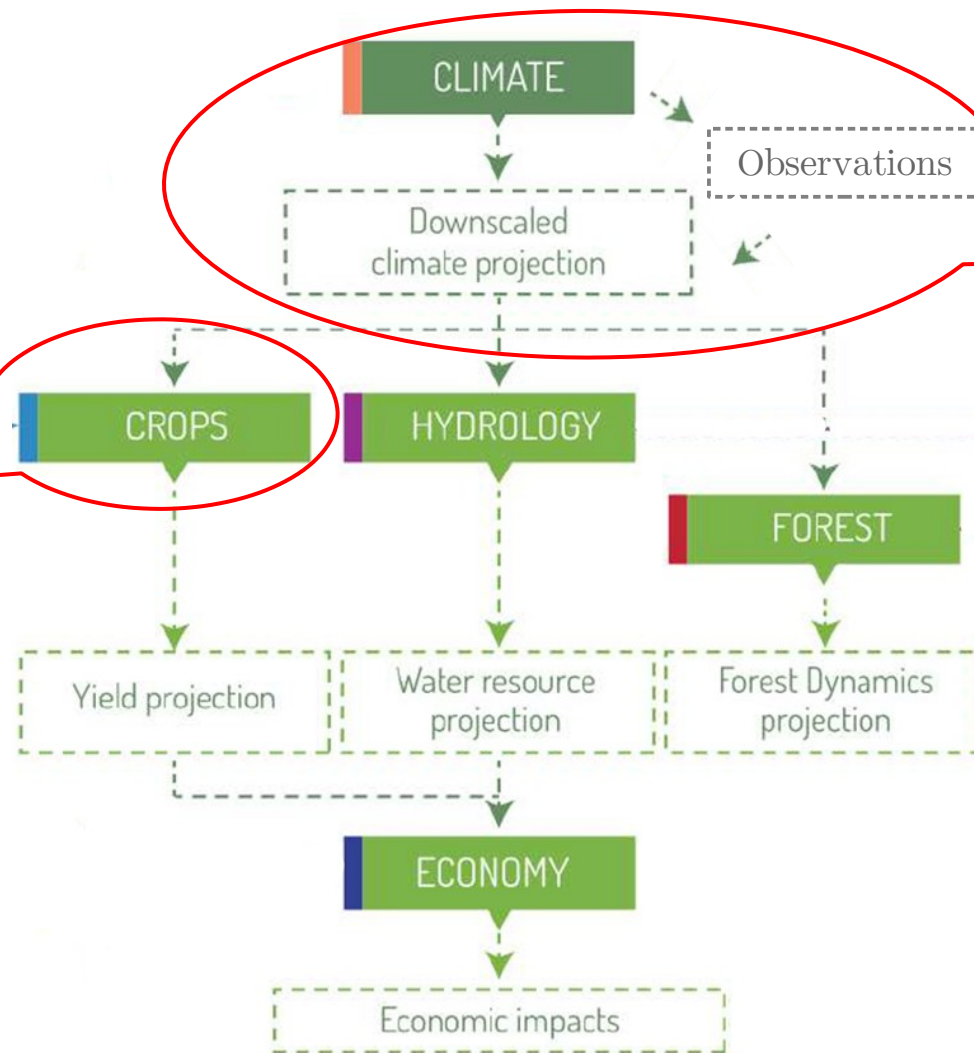
Temperature, precipitation, wind speed, soil moisture and soil temperature

Monitoring of plant diseases in collaboration with national research institutions

The screenshot shows the AGRO METEO website interface. On the left, there is a sidebar with disease information for 'ПЛАМЕНИЦА НА ВИНОВАТА ЛОЗА' (Grapevine Downy Mildew), 'Пепелица на виновата лоза' (Grapevine Powdery Mildew), 'СИБО ГНИЕЊЕ НА ГРОЗДЕТО' (Grapevine Botrytis), 'ЦРНА ДАМКАВОСТ (ЕКСКОРИОЗА) НА ЛОЗАТА' (Grapevine Black Rot), and 'КАДРАВОСТ НА ЛИСТОВИТЕ КАЈ ПРАСКАТА' (Grapevine Leafroll). The main content area features a detailed article for 'ПЛАМЕНИЦА НА ВИНОВАТА ЛОЗА Plasmopara viticola' with a photograph of affected leaves. To the right, there are sections for 'Аларми за појава на пролетни мразеви' (Alerts for spring frosts) and 'Аларми за прскање против болести и штетници' (Alerts for spraying against diseases and pests). The spraying alert section includes three bar charts for 'Градско', 'Бочани', and 'Струмица'. A red circle highlights a red segment in the 'Струмица' chart, with a red arrow pointing to it and the text 'Alerts for spraying'.

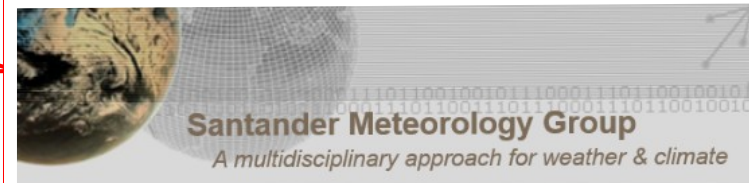
- > Measurements or estimations of leaf wetness can be used by plant pathologists to devise weather timed spray schemes, reduce the number of sprays required, lower costs and benefit the environment.
- > Potential for forecast warnings of potential upcoming disease outbreaks

MOSAICC: Modelling system for Agricultural Impacts of Climate Change



Water balance model (Wabal, based on **FAO irrigation paper 56**)
+
Statistical regression of historical yields with water balance and climate

Statistical Downscaling Portal



+
AURELHY interpolation
(Bénichou and Le Breton, 1986)

MOSAICC: capacity development and country-driven approach

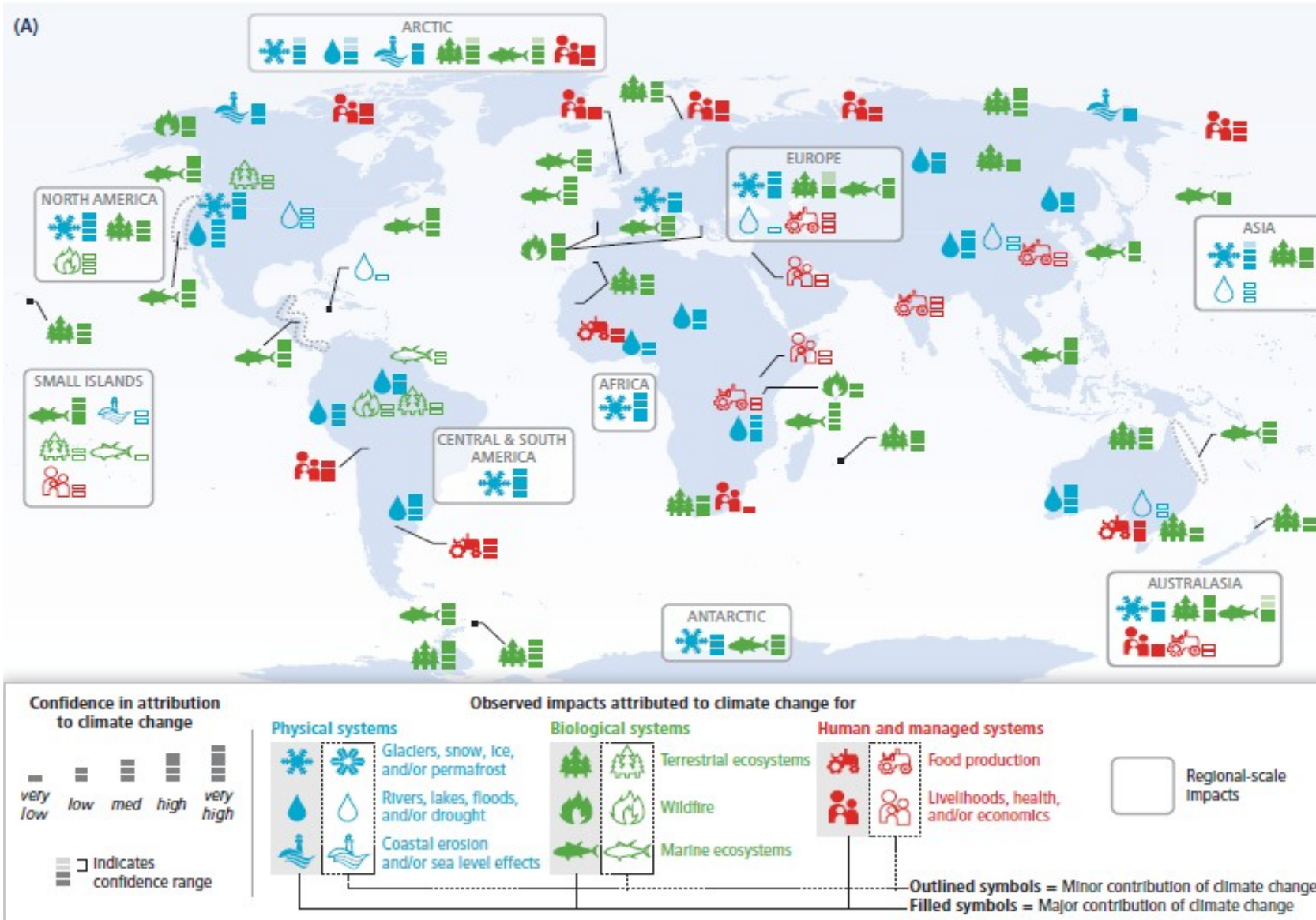
- ▶ **By** national scientists
- ▶ **With** country's own data
- ▶ **For** country's information needs

FAO's Strategy on capacity development: ***transformation of FAO's role from that of a provider of technical assistance to that of a facilitator of change over extended time horizons***. This new approach builds on local resources, including people, skills, technologies and organizations, and it focuses on strengthening the sustainability of CD interventions by encouraging ***national ownership in development processes***.

- ▶ Build the collaborative framework among experts and institutions
- ▶ Study design considering country's objectives, priorities, vulnerabilities
- ▶ Learn from other countries' "MOSAICC experiences"
- ▶ Learn the use of the MOSAICC platform
- ▶ Share and exchange data, knowledge, skills, etc. among experts of different fields
- ▶ Produce preliminary results and discuss them in relationship with country's priorities
- ▶ Build the basis for long-term collaborations, exchanges, projects etc.

Climate change is global, but several *impacts* are local

- ▶ AR5 WG2, observed climate change impacts over the world

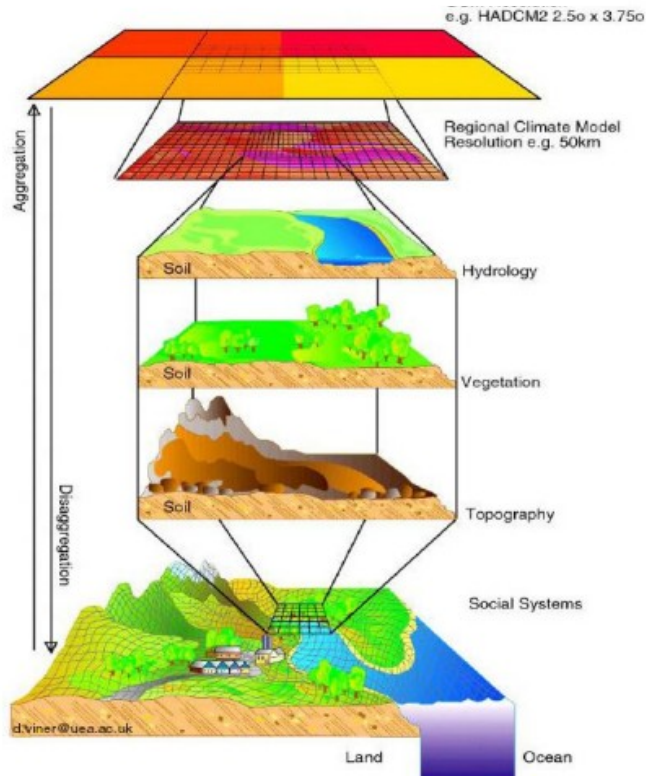


Some climate change impacts on crops (from IPCC AR5)

- ▶ *Negative impacts of climate change on crop yields: more common than positive impacts (high confidence)*
- ▶ *Projected impacts vary across crops and regions and adaptation scenarios, with about 10% of projections for the period 2030–2049 showing yield gains of more than 10%, and about 10% of projections showing yield losses of more than 25%, compared to the late 20th century.*
- ▶ *The smaller number of studies showing positive impacts relate mainly to **high-latitude regions**, though it is not yet clear whether the balance of impacts has been negative or positive in these regions (high confidence)*
- ▶ *For wheat, rice, and maize in tropical and temperate regions, climate change without adaptation is projected to negatively impact production for local temperature increases of 2°C or more above late-20th-century levels, although **individual locations may benefit** (medium confidence).*

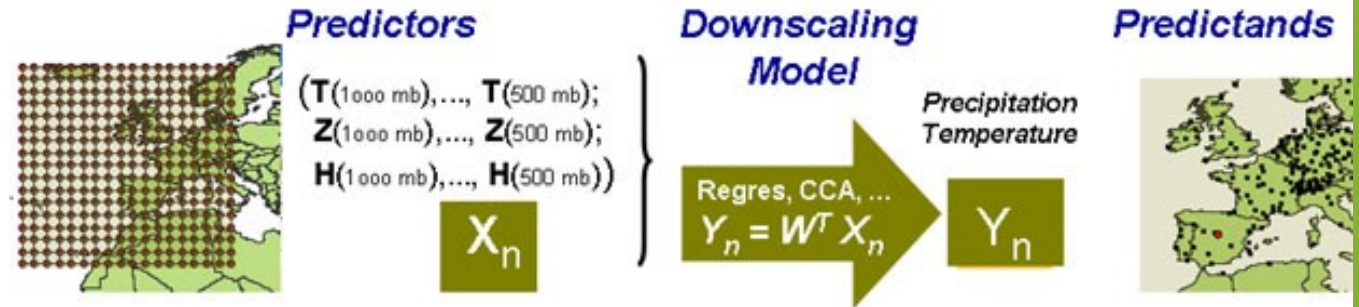
CLIMATE DOWNSCALING from global to local...

Dynamical

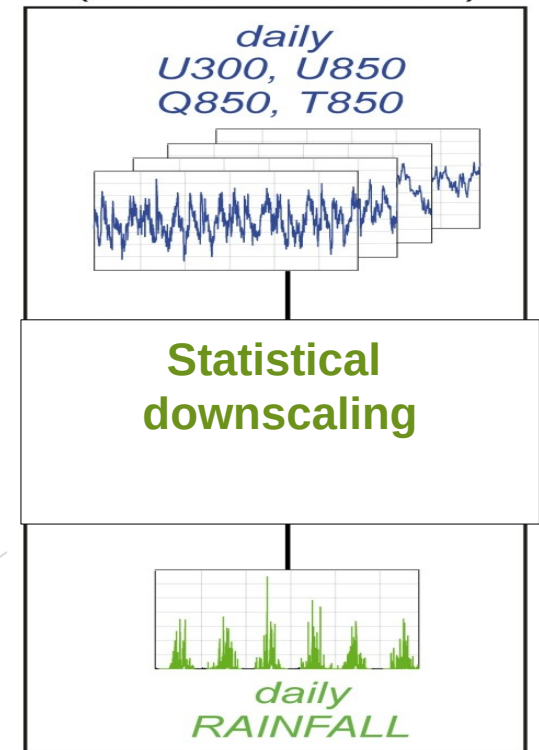


Many of the processes that control local climate, e.g., topography, vegetation, and hydrology, are not included in coarse-resolution GCMs. The development of statistical relationships between the local and large scales may include some of these processes implicitly.
Source: Viner, 2012

Statistical



Statistical downscaling links local observed climate (**predictand Y**) to global simulations given by the GCMs (**predictors X**) through some **function** and/or **parameters**



MOSAICC-climate SD (Peru)

Source: SENAMHI

Predictors

2T, SLP, Z, T,
Q, U, V

Levels

Surface, 1000,
850, 700, 500,
250 (hPa)

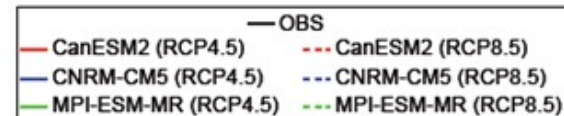
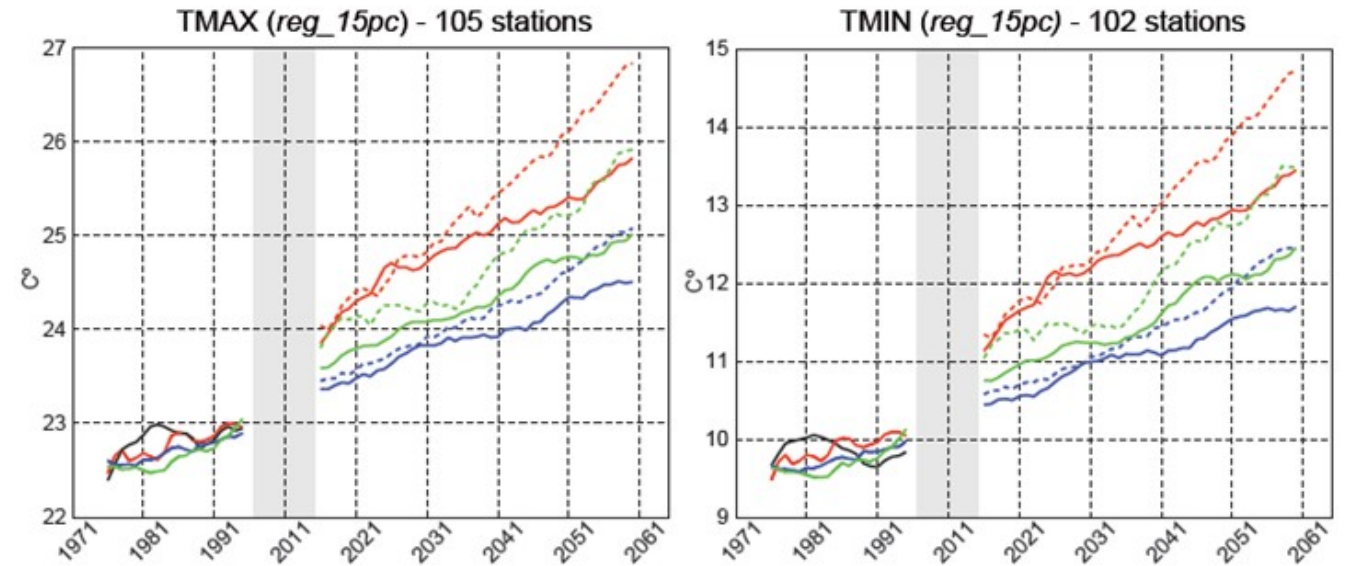
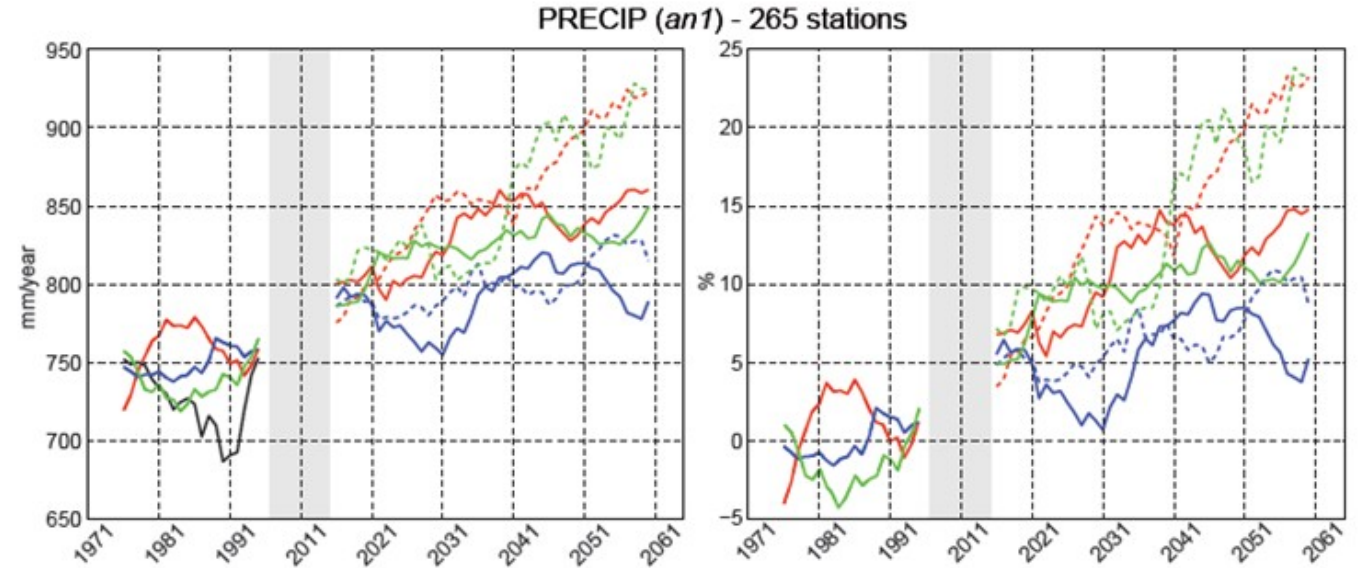
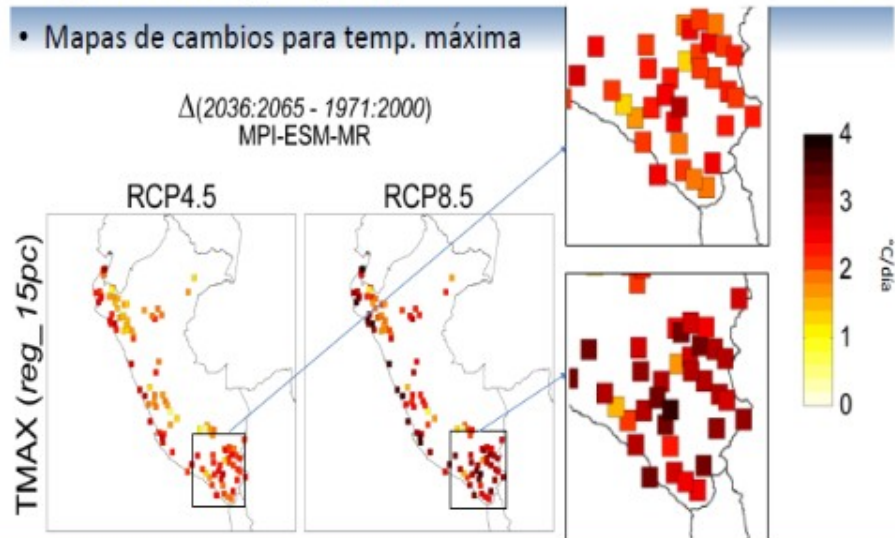
Nombre del ESM	Resolución	Metodo	Descripcion
CanESM2	2.8° × 2.8°	an1	Vecinos más cercanos
CNRM-CM5	1.4° × 1.4°	an5mean	Media de los cinco vecinos más cercanos
GFDL-ESM2M	2.5° × 2°	an15rnd	Uno de cada 15 vecinos (selección aleatoria)
IPSL-CM5A-MR	1.5° × 1.27°	reg 15pc	REG con 15 PCs
MIROC-ESM	2.8° × 2.8°	reg 4nn	REG con anomalías estandarizadas para las 4 grillas más cercanas
MPI-ESM-MR	1.8° × 1.8°	reg 15pc 4nn	REG con 15 PCs + con anomalías estandarizadas para las 4 grillas más cercanas

MOSAICC-climate SD results (Peru)

AMICAF project

Source: SENAMHI

• Mapas de cambios para temp. máxima



1) Criterios:

- Contribución a las exportaciones.
- Generación de puestos de empleo.
- Superficie que ocupa.
- Contribución al PBI agropecuario.
- Seguridad alimentaria.
- Ocupación de las pequeñas explotaciones (familiares).

2) Fuentes de información

- DIEA
- FUCREA
- INIA-INASE
- Molinos, malterías, empresas privadas
- Ensayos de INIA y FAGRO
- Económica: Cámara mercantil, CUSA

Fuentes de datos de fenología:

INIA-INASE

Datos de ensayos INIA y FAGRO

Publicaciones en Agrociencias; Tesis de grado

Empresas privadas (ERRO)

MOSAICC crop component: study design in Uruguay (NAP project)

3) Escala espacial

Puntos (estaciones meteorológicas INIA/INUMET)
Estaciones meteorológicas
Zonas climáticas
Departamentos
País

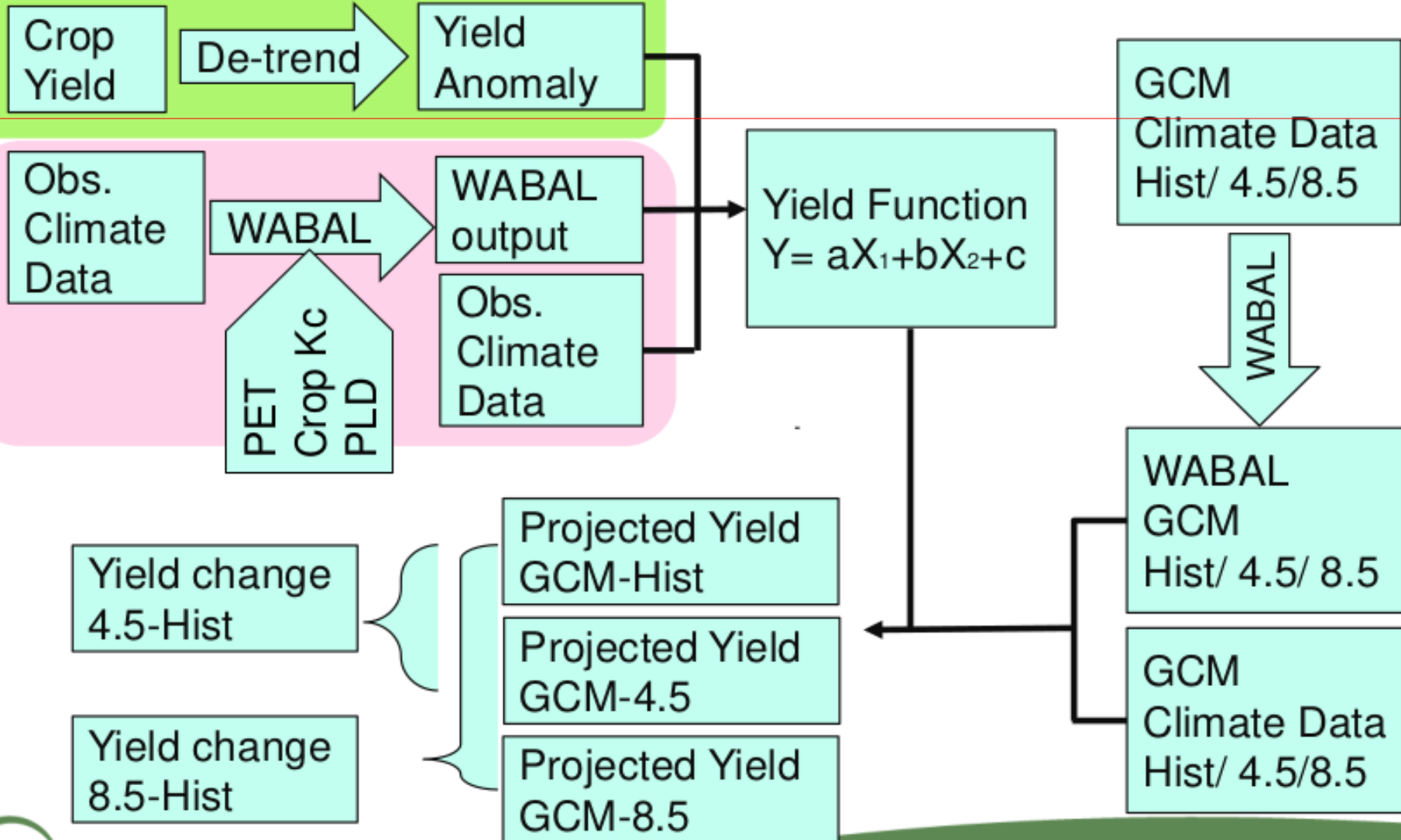
Need for interpolation

4) Cultivos

Soja
Trigo
Cebada
Maíz
Papa
Cebolla
Caña de azúcar

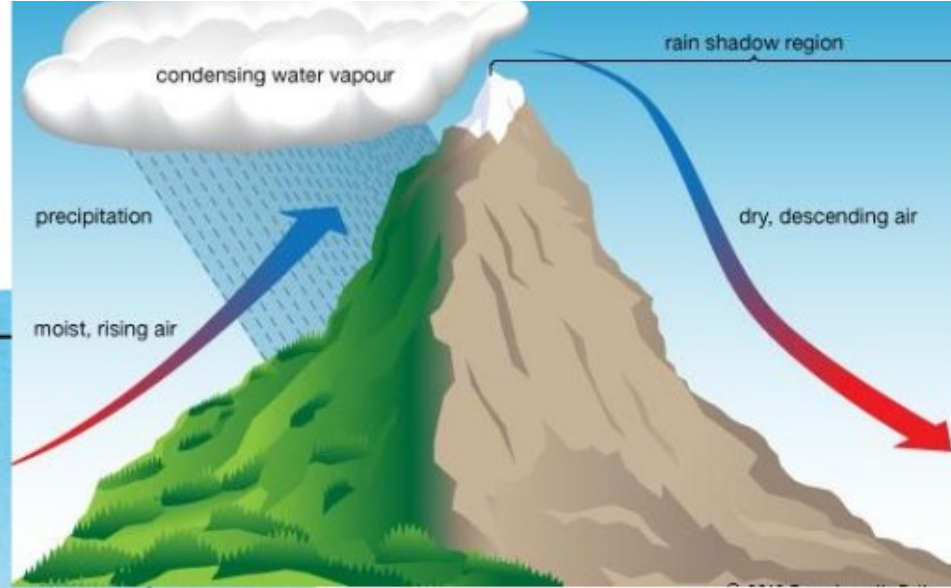
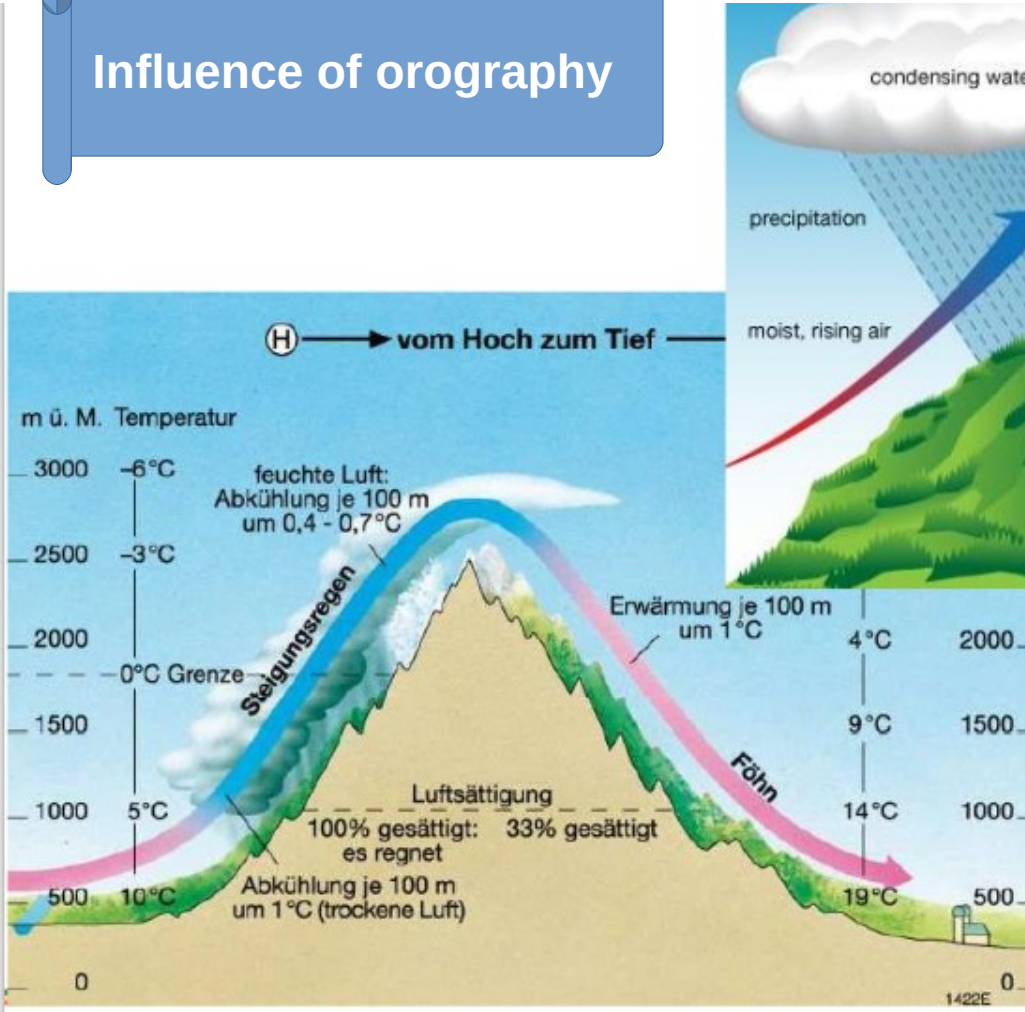
Yield Simulation (Summary)

Points and GRID



AURELHY interpolation scheme

Influence of orography



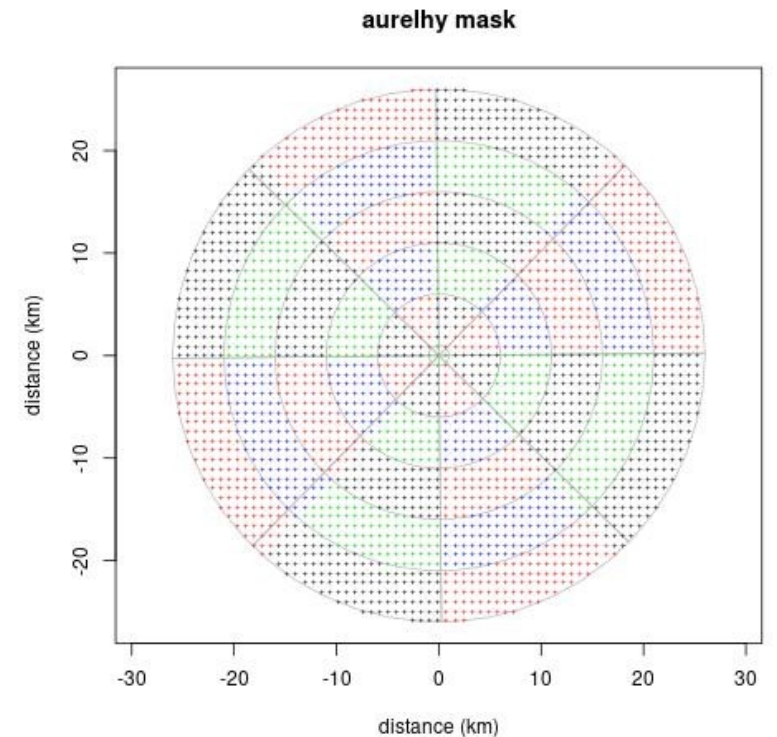
Influence of other phenomena - land-sea effects - E/W, N/S gradients

Model (Bénichou & Le Breton, 1987)

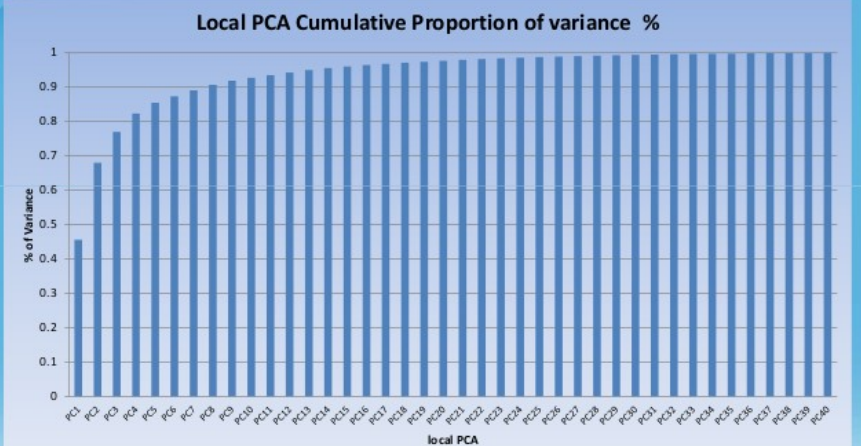
$$P(S_i) = P(x_i, y_i, R_i) = f(R_i) + \varepsilon(x_i, y_i)$$

AURELHY step-by-step

- Terrain analysis: each point identified by a “mask” of n points (121 in the original version)
- PCA of local topography variables
- Regression of climate variable against PC and other relevant variables
- Prediction of gridded climate variable
- Spatial interpolation of residuals by Kriging
- Adding surface of interpolated residuals to surface predicted by regression



Terrain analysis: 10 Pcs explain more than 92% of total variance

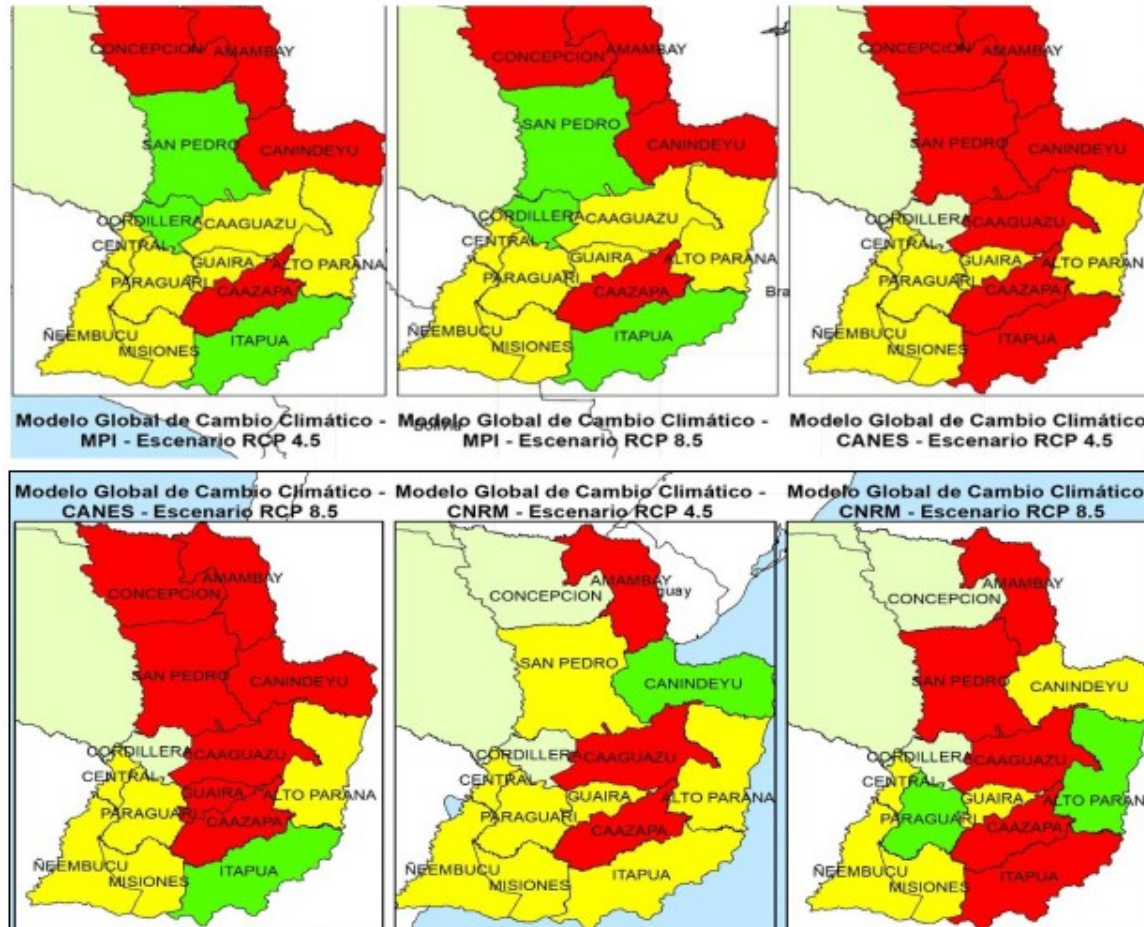


AURELHY issues in non-ideal conditions

- Regression against landscape variables: multicollinearity of predictors (reduced by stepwise method).
- Interpolation of highly temporally variable fields (daily, dekadal): more problematic for the “regression” part. Longterm averages: better regression, worse kriging of residuals.
- Low density of stations in several applications (average station distance in Morocco, Uruguay : 100 Km. In the original method: 15 Km).

MOSAICC-crop analysis in Paraguay (AMICAF project): some results

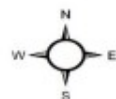
**PROYECCIONES DE CAMBIO DE RENDIMIENTO SIGNIFICATIVO
 CAÑA DE AZÚCAR**



Análisis y Mapeo de los Impactos del Cambio Climático para la Adaptación y Seguridad Alimentaria (AMICAF)

RESULTADOS OBTENIDOS PARA LA CAÑA DE AZÚCAR EN LOS ESCENARIOS RCP 4.5 y 8.5 en DIFERENTES MODELOS DE CAMBIO GLOBAL

- Disminución del rendimiento promedio
- Aumento del rendimiento promedio
- No se presentan diferencias significativas



Sistema de coordenadas WGS 1984 UTM Zone 21 S
 Proyección: Transverse Mercator
 Datum: WGS 1984
 Escala de mapas regionales= 1:7.500.000
 Unidad de medida: Metros
 Módulo Cultivos

MOSAICC-crop analysis in Peru (AMICAF project): some results



Cultivo de papa



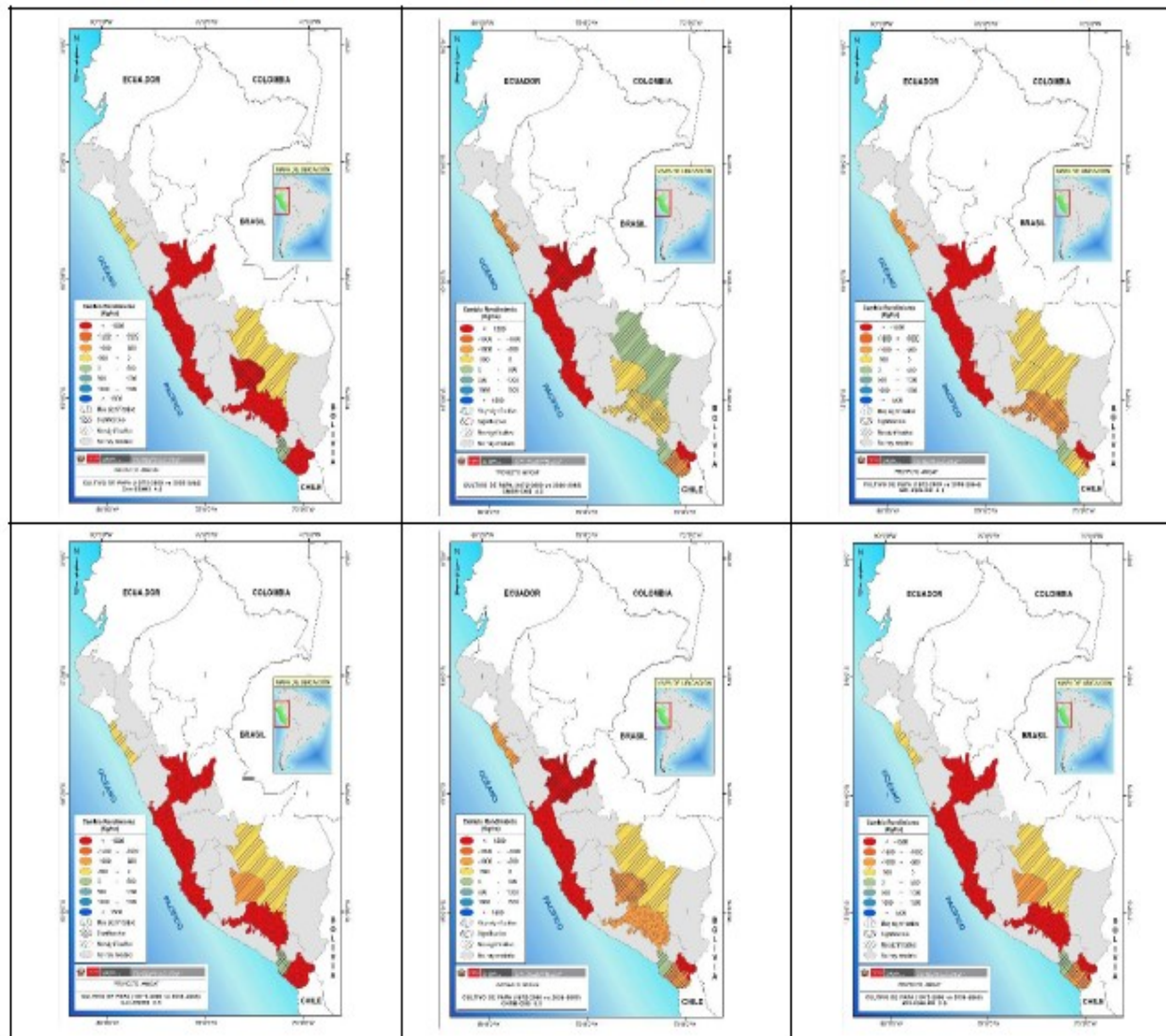
Cambio Rendimiento
(Kg/ha)



CanESM2

CNRM-CM5

MPI-ESM-MR

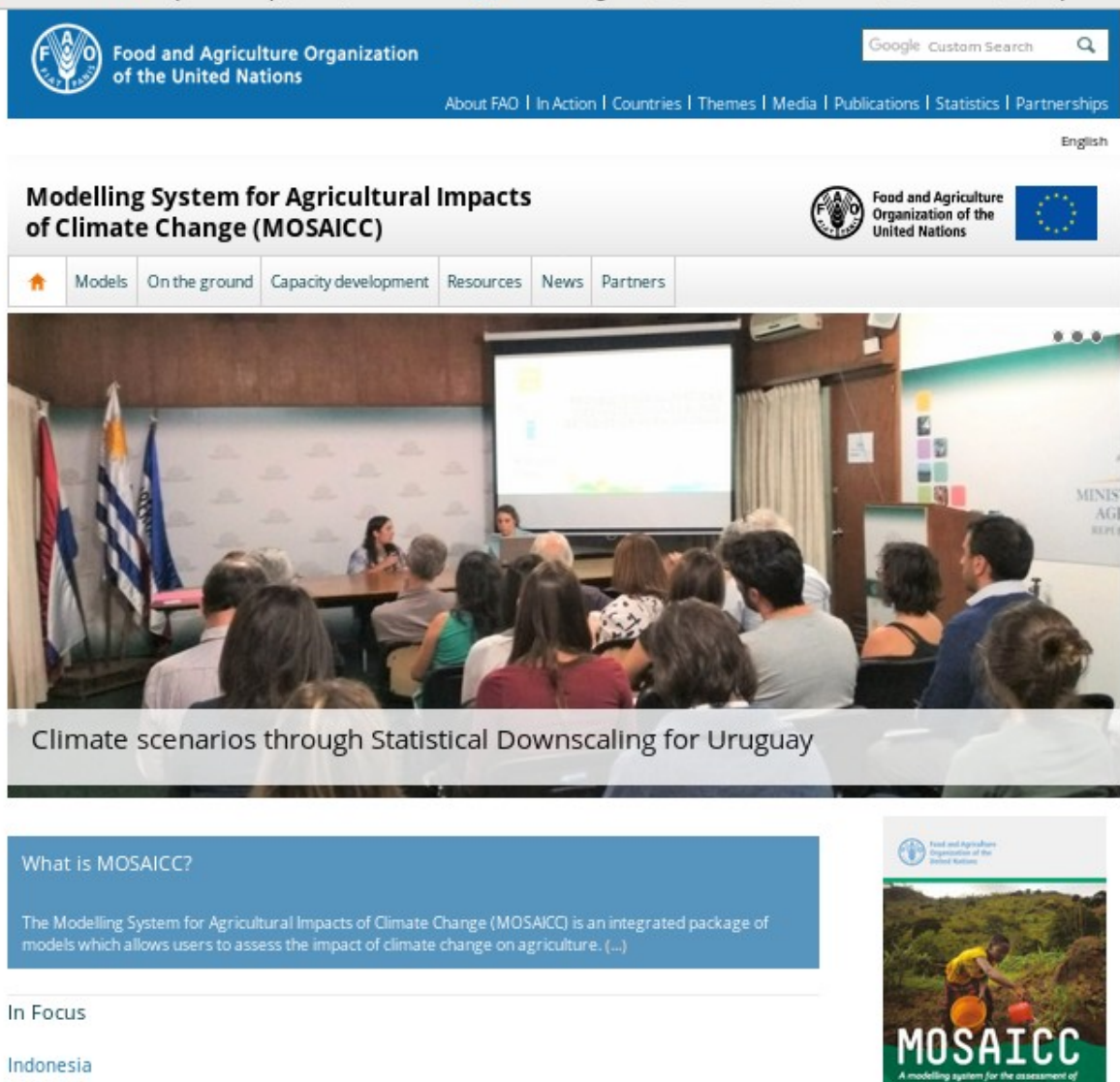


RCP 4.5

RCP 8.5

More information on:

<http://www.fao.org/in-action/mosaicc/en/>



The screenshot displays the MOSAICC website interface. At the top, the FAO logo and 'Food and Agriculture Organization of the United Nations' are visible, along with a search bar and navigation links. The main header reads 'Modelling System for Agricultural Impacts of Climate Change (MOSAICC)'. Below this is a navigation menu with options like 'Models', 'On the ground', 'Capacity development', 'Resources', 'News', and 'Partners'. A central video player shows a presentation slide titled 'Climate scenarios through Statistical Downscaling for Uruguay'. To the left, a sidebar contains a section 'What is MOSAICC?' with a brief description and an 'In Focus' section for 'Indonesia'. A MOSAICC logo is also present in the bottom right corner of the screenshot.

- **Description of the system and the approach**
- **Description or references to the models/components**
- **Technical reports from the countries**
- **Non-technical documents from the countries (e.g. recommendationd for policymakers)**

Demonstrations on request

Grazie per l'attenzione!