



Servicio
Meteorológico
Nacional
Argentina

KCCP: Reinforcement of meteorological services

-

Action Plan: Argentina

Implementation of Guidance short-term Temperature and Humidity Index forecasts for decision making in Livestock and Agrotechnological Sector

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National Meteorological Service

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- Stakeholders Analysis. Problem Analysis. Objectives Analysis
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Introduction



- In Argentina, cattle are raised and used along all the territory
- SENASA (National Agro-Food Health and Quality Service) in 2013 showed that the highest density of cattle is observed in Buenos Aires, Santa Fe, Corrientes, Córdoba and Entre Ríos.
- In certain environmental conditions (high temperatures and high relative humidity) can have a negative impact on the animal, altering the physiology of cattle, resulting in a reduction in biological efficiency and productive capacity.
- It is important to have biometeorological indicators (for example: **ITH, Humidity and Temperature Index**) to monitor this situation (past data) and consider the forecast of these indices (short-range forecast data).

Introduction



- It is important to have biometeorological indicators (for example: **ITH, Humidity and Temperature Index**) to monitor this situation (past data) and consider the forecast of these indices (short-range forecast data).

$$ITH = 1.8T + 32 - \frac{0.55 - 0.55HR}{100} (1.8T - 26)$$

Stakeholders Analysis



Beneficiaries and decision makers	Dairy companies	Companies of dairy products (milk, cheese, etc.) wants to know how weather affect their production
Funding agencies	Dairy companies	¿¿¿???
Potential opponents	Animal protection organizations	
Implementing agencies	National Meteorological Service	SMN Argentina
Supporting groups	Argentine national agricultural institute	INTA Argentina

Problem Analysis

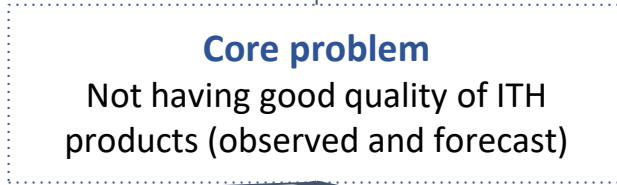
Problem analysis for observation ITH data for insurance companies
(not analyzed)

Dairy companies has a bad production

Why



Because



Bad quality of NWP

Limited dedicated human resources to generate ITH products

The products cannot being used by the potential users

Poor data assimilation

Not Guidance applied

There are another important requests to attend

There is no interest in addressing this problematic

The potential users does not understand the ITH forecast products

There is not enough technological development to provide services

Data is not arriving on time

Not enough in situ stations

Not enough knowledge of technics

Objectives Analysis

Objectives analysis for observation ITH data
(not analyzed)

Dairy companies production is improved

Then



If

Core Objective

Good quality of ITH products are generated (observed and forecast)

NWP Guidance products dissemination Approach

Good quality of NWP

More dedicated human resources to generate ITH products

The products can be used by the potential users

Rich data assimilation process

Application of own Guidance

Evaluation of available human resources

Preparation of institutional strategic plans with clear objectives

Generation of short workshops/webinar to explain the ITH forecast products

Evaluation of third party cloud services or others for web applications

Install new in situ stations

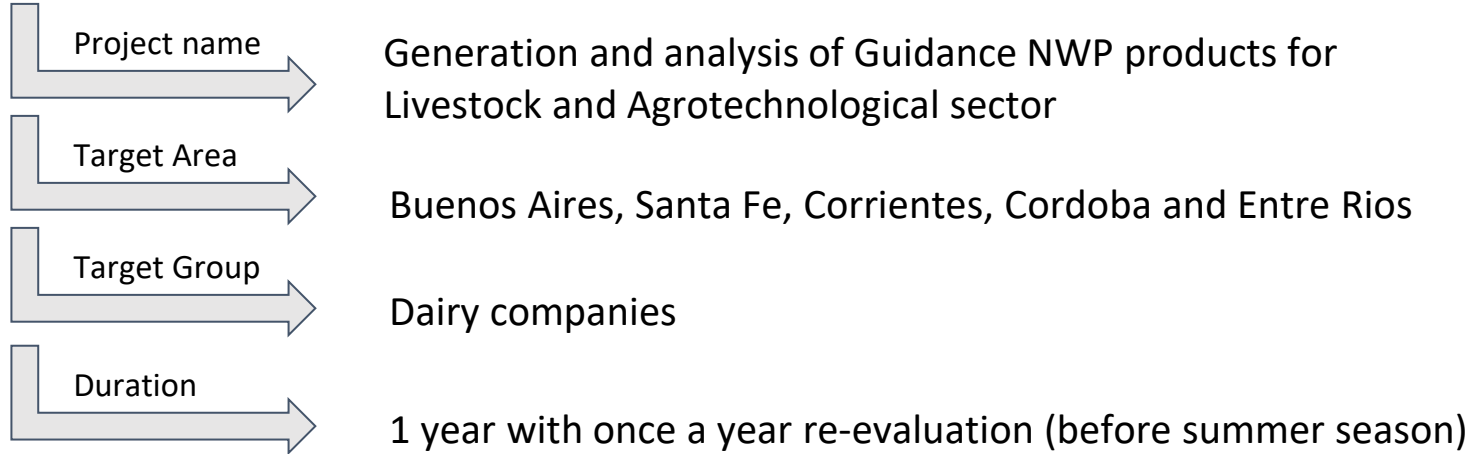
Use local stations networks

Learning of the new technics

https://www.argentina.gob.ar/sites/default/files/smn_pe_20-23.pdf

NWP products dissemination approach

Preliminar PDM



NWP Guidance products dissemination approach

Narrative Summary

Overall Goal

- Dairy companies production is improved

Project Purpose

- Good quality of ITH products are generated

Outputs

1. Application of Guidance with official data and local stations data
2. Generation and implementation of short workshops/webinar for users
3. Evaluation of third party cloud services or others technologies for web applications dissemination

Activities

- Continues in next slide...

NWP Guidance products dissemination approach

Narrative Summary

Outputs

1. Application of Guidance with official data and local stations data
2. Generation and implementation of short workshops/webinar for users
3. Evaluation and use of third party cloud services for dissemination of products

Activities

- 1-1. International cooperation to understand and evaluate the best techniques of Guidance for each situation.
 - 1-2. Evaluation of availability of official and local data (*Objective analysis for observation* → *evaluation of the quality of the data*, <https://repositorio.smn.gov.ar/handle/20.500.12160/1541>).
 - 1-3. Application of Guidance for the livestock sector.
 - 1-4. Products verification to know the degree of uncertainty.
-
- 2-1. Evaluation with sector to know the best way of transfer information.
 - 2-2. Short workshop or webinar implementations for the users to understand the data and error.
-
- 3-1. International cooperation to have knowledge of best technologies and languages for web apps dissemination.
 - 3-2. Creation of best front-end and back-end framework for best understanding of products.
 - 3-3. Deploying of app (1st version).
 - 3-4. Evaluation with user of 1st version.
 - 3-5. Improvement of 1st version app for a 2nd and final version.
 - 3-6. Re-evaluation of process once a year.

Argentinian NMS Team



Tus notas del organigrama



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Directora
Celeste Saulo

- Asuntos Internacionales
- Protocolo y Ceremonial
- Prensa y Comunicación Ciudadana
- Biblioteca - Repositorio - Museo
- Personal Militar

Dirección de Meteorología Aeronáutica
DMA
Roxana Vasques Ferro

→ Oficinas de Pronóstico Aeronáutico

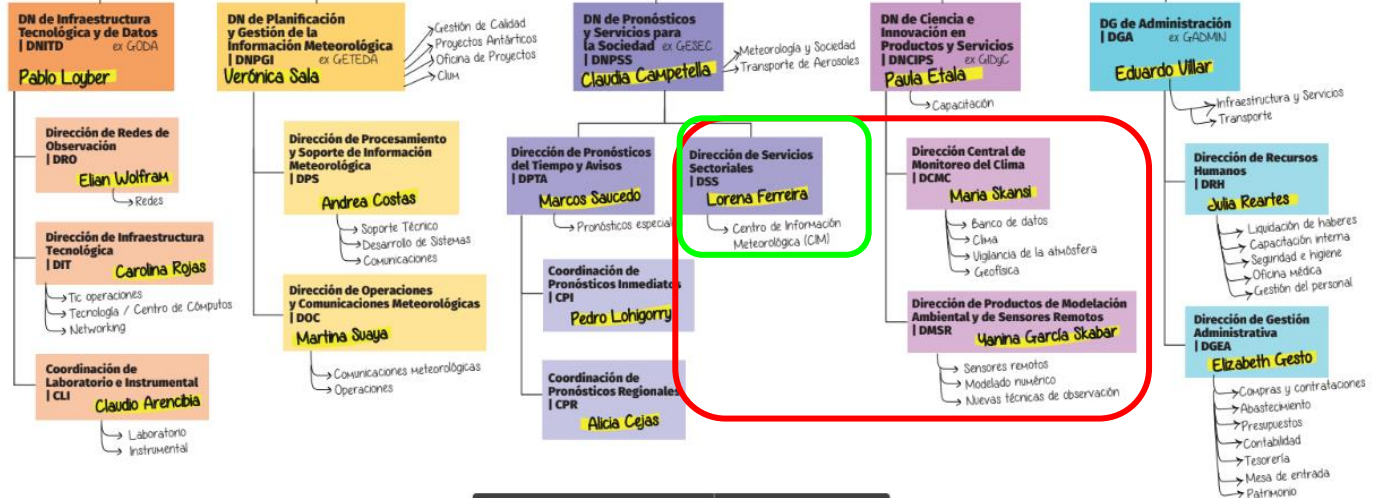
Dirección de Servicios Jurídicos
DSJ
Mafias Stempels Hernández

Unidad de Auditoría Interna
UAI
Paula D'Alessandro

Sindicatura General de la Nación
SIGEN

12 professionals
11 meteorologists
1 environmental

40 professionals
93% meteorologists
7% environmental or IT



Our experience (Guidance)

<https://repositorio.smn.gov.ar/handle/20.500.12160/1405>



Implementación del sistema de pronóstico numérico en el HPC: Calibración de temperaturas pronosticadas

Autores

Cutraro, Federico | Righetti, Silvina Andrea | Garcia Skabar, Yanina | Sacco, Maximiliano



Resumen

es en

Esta Nota Técnica forma parte de una serie que recopila informes realizados en el marco de la implementación del sistema de pronóstico numérico en el sistema de cómputo de alta performance HPC, Huayra Muyu (HM), adquirido a través del proyecto CyT Alerta. En la presente se aborda la problemática de corregir los errores sistemáticos en los pronósticos numéricos de la atmósfera que se utilizan en el Servicio Meteorológico Nacional (SMN). Para ello se aplica la metodología de Regresión Adaptada basada en el Filtro de Kalman (RAFK) a los modelos WRF y GFS, en sus versiones determinístico y ensamble, para los puntos de interés que poseen observaciones. Los resultados muestran que la metodología aplicada corrige los errores en los pronósticos de manera satisfactoria, mejorando así la calidad de los mismos. Para los puntos de interés que no poseen observaciones se plantea realizar una interpolación de la calibración obtenida en puntos con observaciones, ya sea temporal o espacial dependiendo del caso. Los resultados obtenidos muestran que la interpolación temporal en conjunto con el método ID de interpolación espacial permiten calibrar de manera adecuada aquellos puntos sin observaciones.

[gob.ar/page/about](https://repositorio.smn.gov.ar/page/about)

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Our experience (Guidance)

The screenshot shows a web browser displaying the AWS Registry of Open Data page for the dataset 'SMN Hi-Res Weather Forecast over Argentina'. The page header includes the AWS logo and the title 'Registry of Open Data on AWS'. A blue banner at the top states: 'The Registry of Open Data on AWS is now available on AWS Data Exchange. All datasets on the Registry of Open Data are now discoverable on AWS Data Exchange alongside 3,000+ existing data products from category-leading data providers across industries. Explore the catalog to find open, free, and commercial data sets. Learn more about AWS Data Exchange'. The main content area features the dataset title 'SMN Hi-Res Weather Forecast over Argentina' with tags for 'earth observation', 'meteorological', 'natural resource', and 'weather'. The 'Description' section explains that the Servicio Meteorológico Nacional de Argentina (SMN-Arg) shares its deterministic forecasts generated with WRF 4.0. The 'Resources on AWS' section provides details on the WRF SMN data, including its S3 bucket location, Amazon Resource Name (ARN), and region. It also includes the AWS CLI command for access and a link to explore the bucket. The URL 'https://registry.opendata.aws/smn-ar-wrf-dataset/' is highlighted at the bottom of the screenshot.

- Access to WRF regional high resolution model (4km) with Guidance
- Guidance for:
 - T2m
 - Tmax
 - Tmin
 - Wind10
 - *not for HR2*
- Kalman Filter technic
- Also Guidance for GFS model system

Our experience (Guidance)

Documentación



Buscar documentos

CONTENIDO:

Información general

Estructura de datos

Formato de datos

Acceso a los datos

Tutoriales

Preguntas frecuentes

Novedades

Suscripción a novedades

Contacto

English version

Las dimensiones de los datos se encuentra en la siguiente tabla:

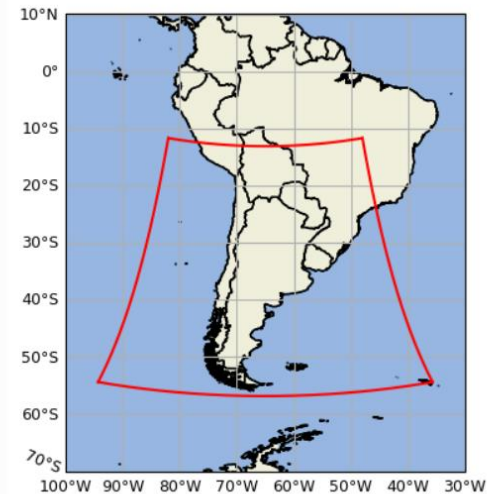
Dimensión	Valor
time	1
y	1249
x	999

https://odp-aws-smn.github.io/documentation_wrf_det/

Variables

Las variables presentes en los archivos son las siguientes:

Variable	Descripción	Unidad	Precisión	Frecue
PP	Precipitación acumulada en 10 minutos	mm	float32	10M
PP	Precipitación acumulada en una hora	mm	float32	01H
HR2	Humedad relativa a 2 metros	%	float32	01H
T2	Temperatura a 2 metros (*)	°C	float32	01H
dirViento10	Dirección del viento a 10 metros	°	float32	01H
magViento10	Magnitud del viento a 10 metros (*)	m/s	float32	01H
PSFC	Presión en superficie	hPa	float32	01H
ACLWDNB	Radiación de onda larga entrante (**)	J/m2	float32	01H
ACLWUPB	Radiación de onda larga saliente (**)	J/m2	float32	01H
ACSWDNB	Radiación de onda corta entrante (**)	J/m2	float32	01H
TSLB	Temperatura de suelo en la capa 0-10cm	°C	float32	01H
SMOIS	Humedad de suelo en la capa 0-10cm	m3/m3	float32	01H
Freezing_level	Altura sobre el nivel del mar de la isoterma de 0°C	m	float32	01H
Tmax	Temperatura máxima diaria (*)	°C	float32	24H
Tmin	Temperatura mínima diaria (*)	°C	float32	24H



Dominio WRF-Arg delimitado por contorno rojo

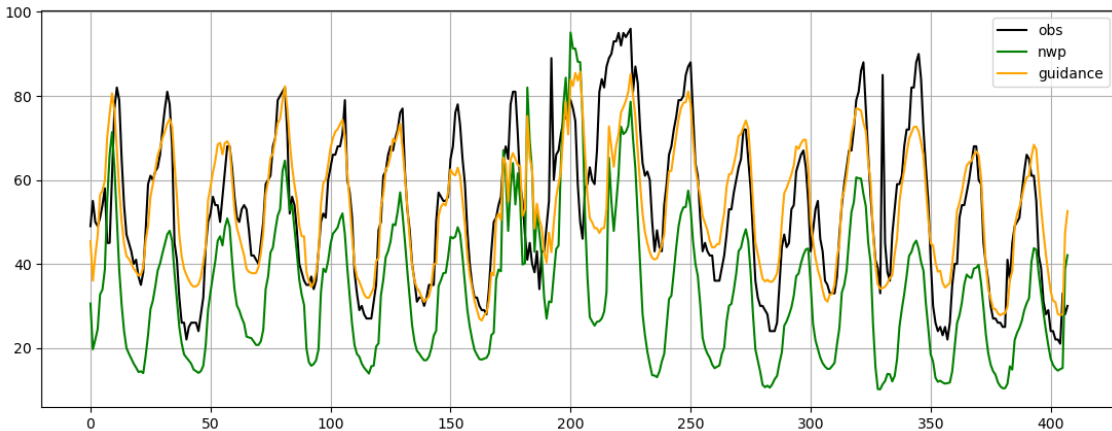
www.smn.gov.ar



Guidance for HR2

- Forecasts initialization: 00z
 - Period forecasts: 24h
 - Target variable: HR2.obs
 - Predictors: HR2.mod, T2.mod, V10.mod
-
- Training dataset: 2022-12-15 to 2022-12-31
 - Verification dataset: 2023-01-01 to 2023-01-15

Best result (training)



Dates	HR2.obs	HR2.mod	T2.mod	V10.mod
2022-12-15 00:00:00	49	30.55693	27.39517	6.675395
2022-12-15 01:00:00	51	19.67639	28.67996	10.086987
2022-12-15 02:00:00	54	21.93532	25.97479	8.268994
2022-12-15 03:00:00	58	24.51218	24.68359	5.965716
2022-12-15 04:00:00	45	32.70614	20.46149	4.763986
2022-12-15 05:00:00	45	33.92179	19.80768	5.025846
2022-12-15 06:00:00	61	38.70432	18.85138	5.799422
2022-12-15 07:00:00	77	55.39519	16.95236	4.579865

● ● ●

2022-12-31 16:00:00	22	17.44401	32.89279	6.519440
2022-12-31 17:00:00	21	15.94433	34.34851	6.395494
2022-12-31 18:00:00	33	15.09033	34.81747	5.845320
2022-12-31 19:00:00	28	14.60095	36.53183	6.429780
2022-12-31 20:00:00	30	14.95320	36.82608	6.486556
2022-12-31 21:00:00	34	15.23029	36.53162	6.766435
2022-12-31 22:00:00	39	38.71814	29.63272	5.369752
2022-12-31 23:00:00	38	42.08158	28.55676	2.820919

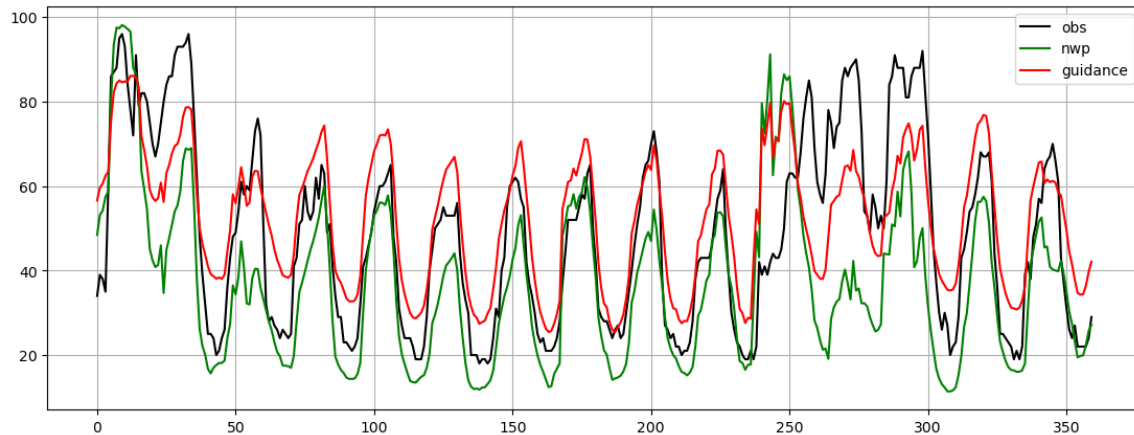
```
formula = HR2obs ~ HR2mod + T2mod + V10mod
Intercept    71.819583
HR2mod       0.418090
T2mod        -1.194468
V10mod       -0.970423
dtype: float64
```

Verification score of T fcst by Linear Regression

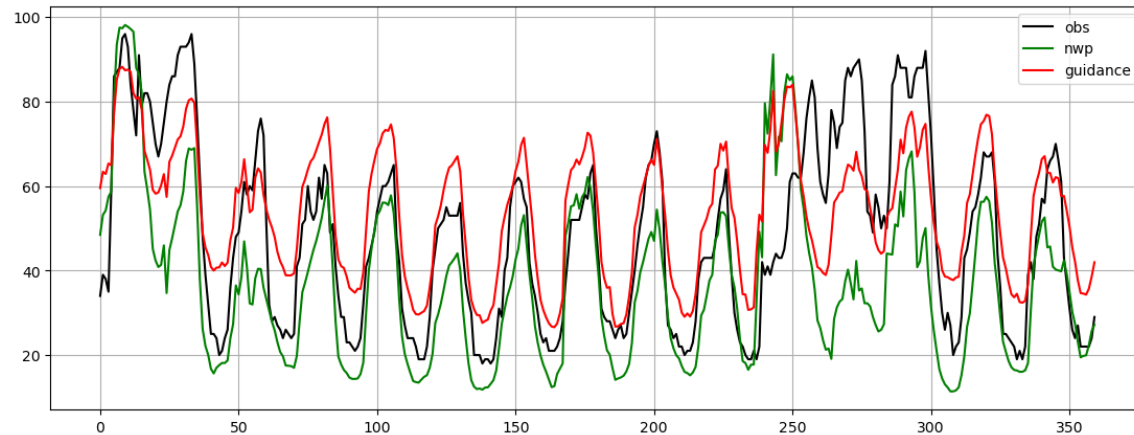
```
NWP : Bias = -19.7004, RMSE = 23.5642
Guid : Bias = -0.0000, RMSE = 10.3816
```

Guidance for HR2

Best results (verification)



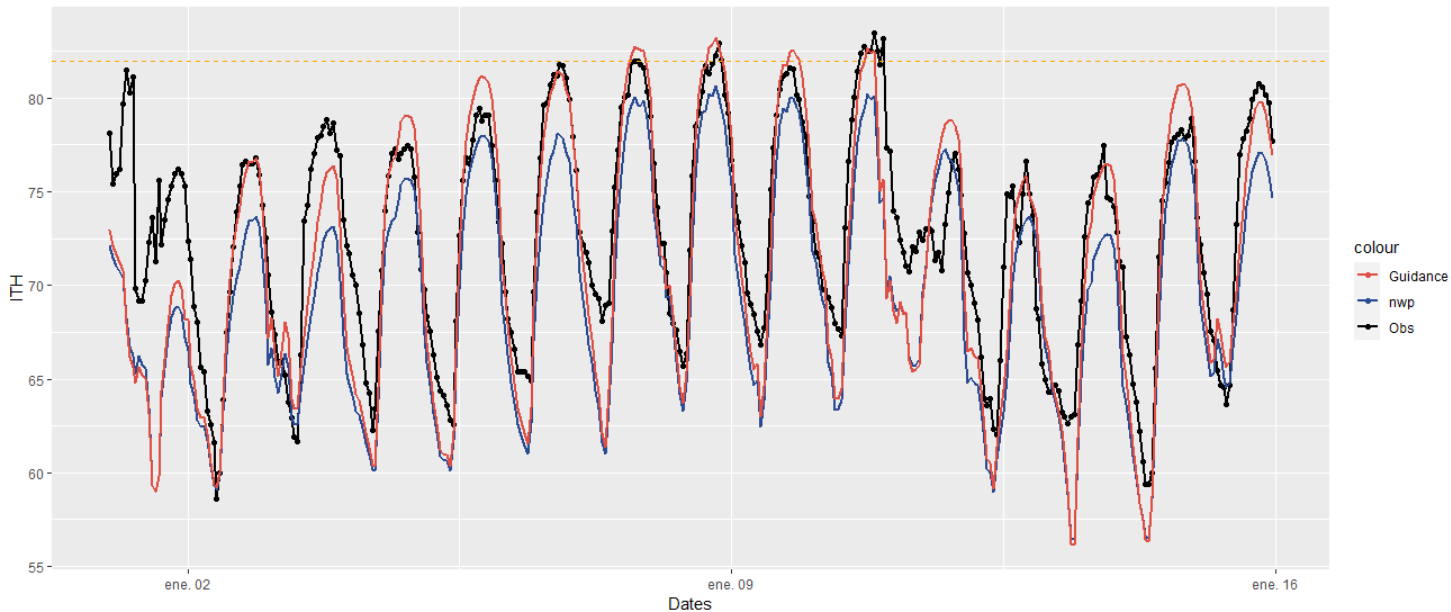
```
formula = HR2obs ~ HR2mod + T2mod
Intercept    73.693935
HR2mod       0.384357
T2mod       -1.407426
dtype: float64
Verification score of T_fcst2(independent) by Linear Regression
NWP  : Bias = -11.3334, RMSE = 19.6579
Guid : Bias =  4.1662, RMSE = 13.6705
```



```
formula = HR2obs ~ HR2mod + T2mod + V10mod
Intercept    71.819583
HR2mod       0.418090
T2mod       -1.194468
V10mod      -0.970423
dtype: float64
Verification score of T_fcst2(independent) by Linear Regression
NWP  : Bias = -11.3334, RMSE = 19.6579
Guid : Bias =  5.2414, RMSE = 14.1795
```


ITH improvement with HR2 Guidance

ITH Sunchales
Santa Fe District



Scores	nwp	Guid
r	0.89	0.89
RMSE	4.22	3.55
NS	0.48	0.64
BIAS (%)	-4.4	-2.2

Our experience (Dissemination)

- FTP (nowadays is the most popular option in Argentinian NMS)
- Email (users prefer this option sometimes but it is not the best option to automatization of processes)
- API (users do not have experience in the use of this technologies)
- **Web App** (new proposal because of the bigger demanding of users)

Our experience (Dissemination)

shinyapps.io by Posit

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New to Shiny? Deploy your applications for FREE.	More applications. More active hours!	Take your users to the next level!	Password protection? Authenticate your users!	Professional has it all! Personalize your domains.
5 Applications	25 Applications	Unlimited Applications	Unlimited Applications	Unlimited Applications
25 Active Hours	100 Active Hours	500 Active Hours	2,000 Active Hours	10,000 Active Hours
Community Support	Premium Email Support	Performance Boost Premium Email Support	Authentication Performance Boost Premium Email Support	Authentication Account Sharing Performance Boost Custom Domains Premium Email Support

Our experience (Dissemination)

https://dsssmn.shinyapps.io/appWRF_AWS/

Productos de las salidas SMN Hi-Res Weather Forecast AWS

Seleccione una fecha de pronóstico
2023-01-17

Selección del ciclo de pronóstico
00

Selección del dataset (plazo de pronóstico)
03H

DESCARGA DE DATOS

Seleccione la variable del dataset:
TSLB

Selección de longitud
-59.3

Selección de latitud
-33

Gráfica Información Puntual

Información puntual | Productos ITH WRF-OET | Productos ITH WRF-ENS

La evolución temporal de pronóstico de la variable es:

Mapa:

Download.csv

Los datos cercanos al punto seleccionado son:

Show 10 entries

lon.cercano	-59.29519553202012
lat.cercano	-32.99283961323242
1	31.9365968328125
2	29.9630126953125
3	26.22323606390436
4	26.7552368164062
5	25.47213745117188
6	24.25436401367188
7	23.16360473632812
8	22.227768209125

Showing 1 to 10 of 75 entries

Previous 1 2 3 4 5 ... 8 Next

Our experience (Dissemination)

Productos de las salidas SMN Hi-Res Weather Forecast AWS

Selección de hora de pronóstico WRF-ITH
(25) 2023-01-18 00:00:00

Grafica Mapa ITH-WRF-DET

Elige estación
Sunchoales

Grafica Serie ITH-WRF-DET

Momentaneamente funciona entre nov 2022 y mar 2023

Información puntual Productos ITH WRF-DET Productos ITH WRF-ENS

Mapas de ITH WRF-DET

Escala ITH

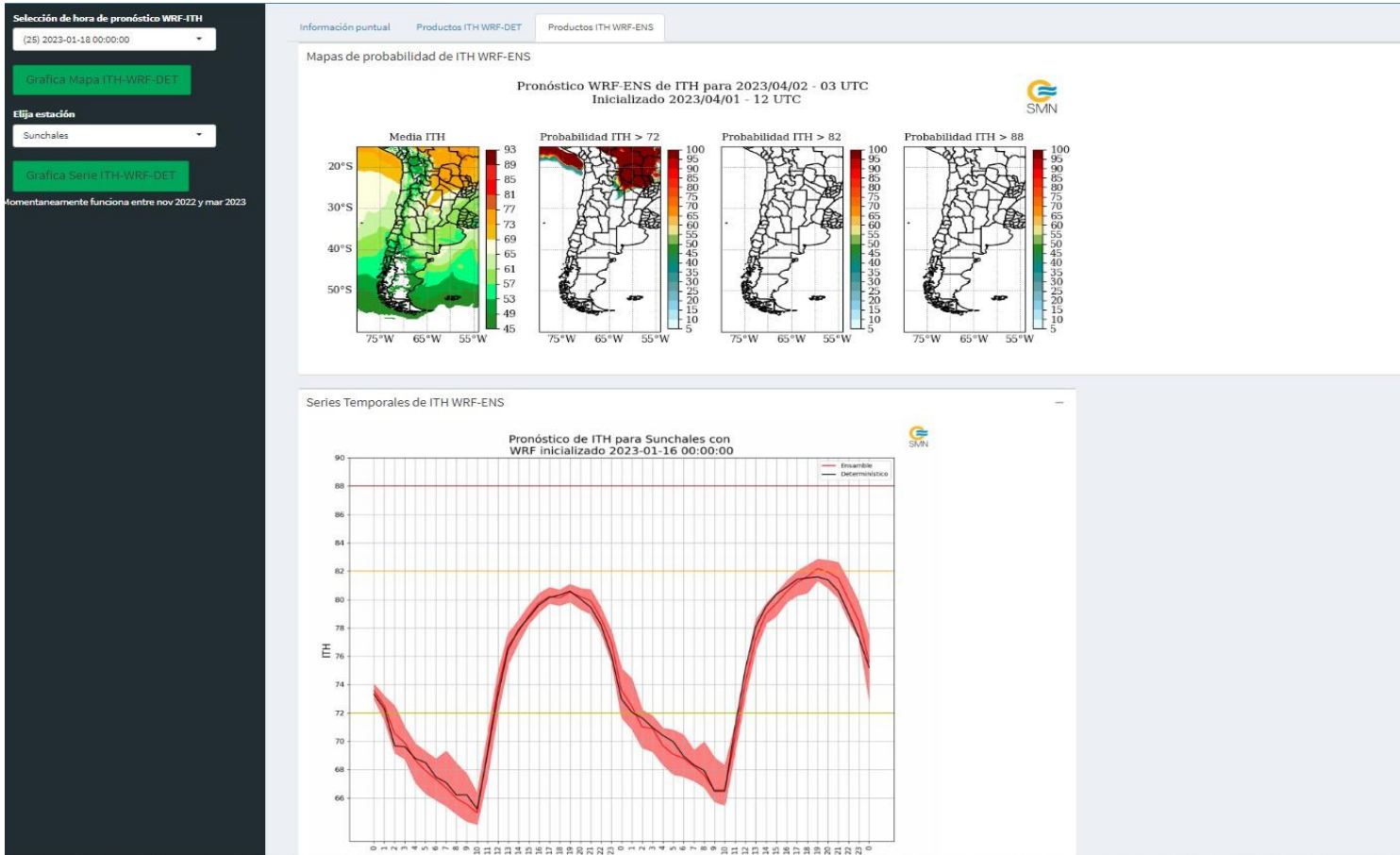
85
84
82
78
74
72
70
68
65

Series Temporales de ITH WRF-DET

18/1/2023, 9:00:00. Data-x: 69.9 Data-y: 69

Time	Observed ITH	Forecast Range (Lower - Upper)
06:00	70	68 - 72
12:00	68	66 - 70
18:00	84	80 - 88
06:00	70	68 - 72
12:00	68	66 - 70
18:00	84	80 - 88
06:00	70	68 - 72
12:00	68	66 - 70
18:00	84	80 - 88
06:00	70	68 - 72

Our experience (Dissemination)



Limitations of action plan

- Not enough in situ observations distribution for the application of a reliable Guidance
- Problem in finding the best technique of Guidance for each case (importance of promoting international cooperation)
- Ensure sufficient budget to be able to pay for cloud services (possibility for the user to pay for this service?)

Summary

- Statistical techniques for guidance or calibration of NWP such as those carried out in this training are fundamental for the improvement of the services provided by the National Meteorological Services around the world.
- It is very important to obtain advanced knowledge of these techniques or others in developing countries for the scientific and technical development of these countries.
- Knowing about different technologies for the dissemination of information in web or mobile applications can be very useful in countries that do not have extensive IT human resources.

Arigato

Muchas gracias

Thank you



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