Previsão Meteorológica **Operacional**: Modelos e Observações

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Ciência 2010
Meteorologia, Previsão e Modelação

5-Julho-2010

Ciência 2010: Alguns OBJECTIVOS

“ voltar à ciência, **aos problemas antigos por resolver, (...) às oportunidades económicas, à sociedade**.

(...) clarificar e debater, área a área, (...) fazer surgir as melhores ideias e as melhores lideranças, capazes de juntar pessoas, recursos e instituições, (...) investigação, indústria e ciência(...)”

José Mariano Gago, MCTES

Grupo de Previsão Numérica do Tempo (GPNT):

Antecedentes

- O GPNT surgiu em 1999 **devido a ausência de respostas do Instituto de Meteorologia** a solicitações da investigação e de actividades económicas e sociais no âmbito da Oceanografia, Poluição do Ar, Planeamento Biofísico, Energias Renováveis, etc.
- Beneficiou da experiência da Secção de Termodinâmica Aplicada do IST no desenvolvimento e aplicações de "CFD"(3d), Modelos de Turbulência, etc, iniciada nos anos 70

GPNT: Previsão Numérica do Tempo em Portugal com modelos de área limitada

- De entre as dezenas de modelos de área limitada a que teve acesso (USA, Europa, Canadá, Austrália) o GPNT optou pelo MM5, que implementou ,em **1999**, num cluster de PCs **sem qualquer financiamento público** explícito. Também implementou o ARWF tornando-o operacional após 3 anos de teste.

- Utilizando o Modelo Global AVN (USA) para condições iniciais e fronteira, iniciou em **2001** a divulgação da previsão meteorológica para Portugal Continental (http:/meteo.ist.pt), com uma resolução espacial de 9x9 km.

- **O GPNT foi o primeiro grupo a iniciar em Portugal , de modo operacional, a Previsão Numérica do Tempo e a disponibilizá-la publicamente.**

GPNT: Some Results

1. **Wind Prediction**
2. **Portuguese Coast Forecast System**
3. **Lisbon-Urban Heat Island**
4. **Civil Protection**
5. **Extreme events**

(See http://meteo.ist.utl.pt and http://jddomingos.ist.utl.pt)

Wind Prediction

1.Wind Energy for the National Electric Grid (TSO) :

- After a demonstration period of ~1 year and 2 one semester contracts, GPNT suggested an international tender, including IM, INETI and Portuguese Universities.
- since 2005, after the international bid and benchmarking contract awarded to GPNT and U. Aveiro for 4x day wind forecast.
- GPNT achieved 99.99% success rate (until now) with MM5 and WRF (9x9 and 3x3) for 92 wind farms.
- Prediction v. real time observation at : http://www.centrodeinformacao.ren.pt/EN/InformacaoExploracao/Pages/DiagramadeProduçãoEólica.aspx

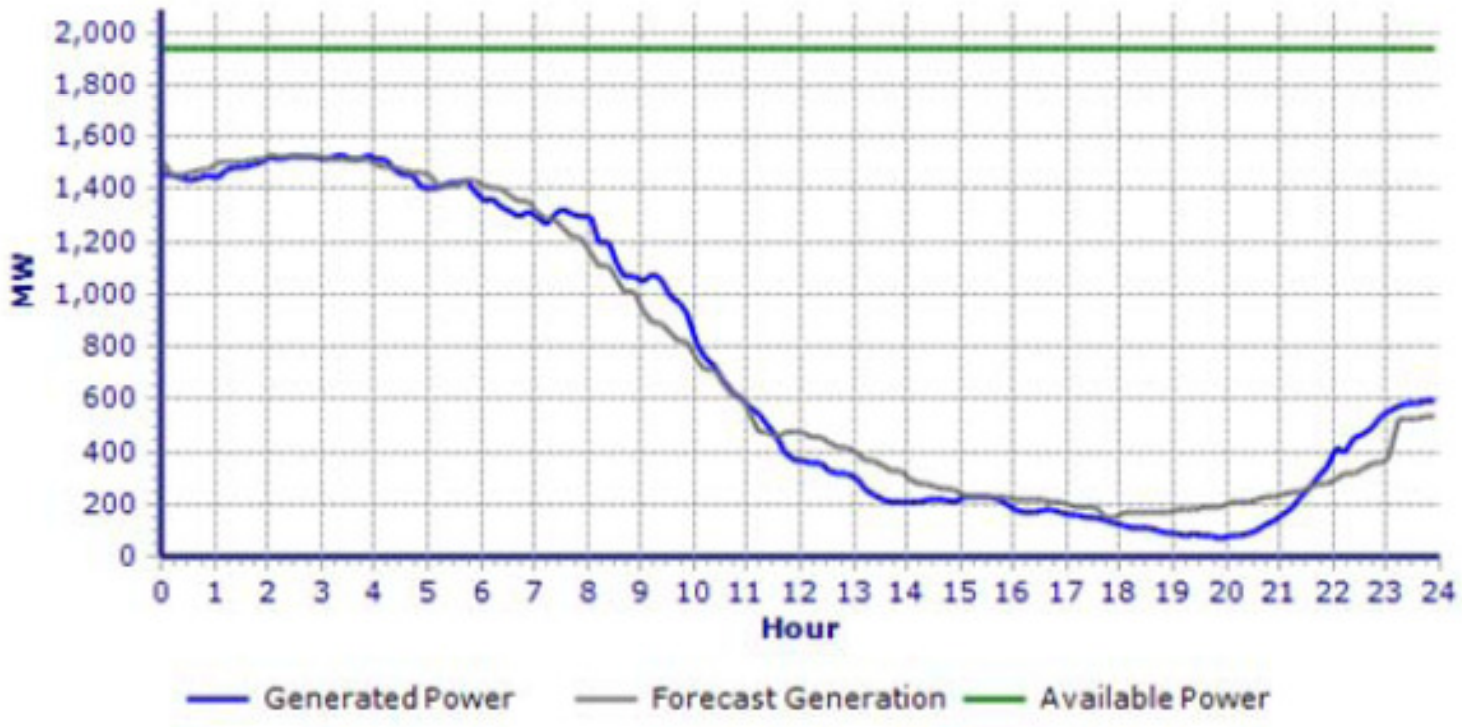
Wind Power Generation

Select Date

03-01-2010

Execute »

Telemetered Wind Farms



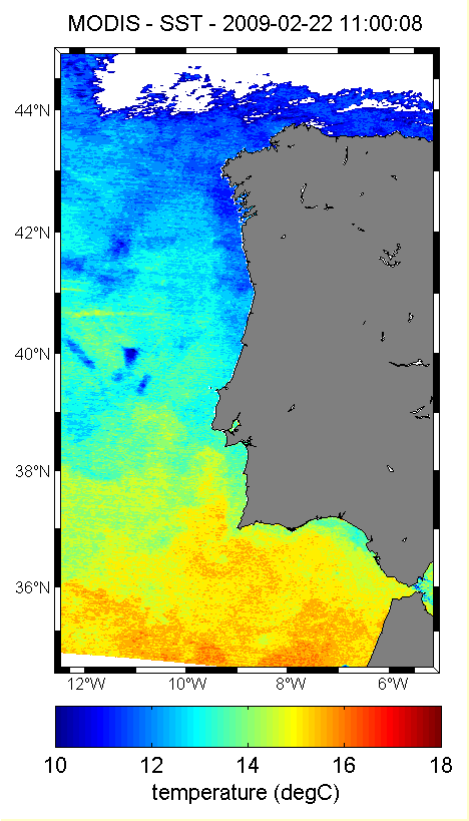
Information on REN Telemetered Wind Farms whose maximum power is represented by the green line.

Portuguese Coast forecasting

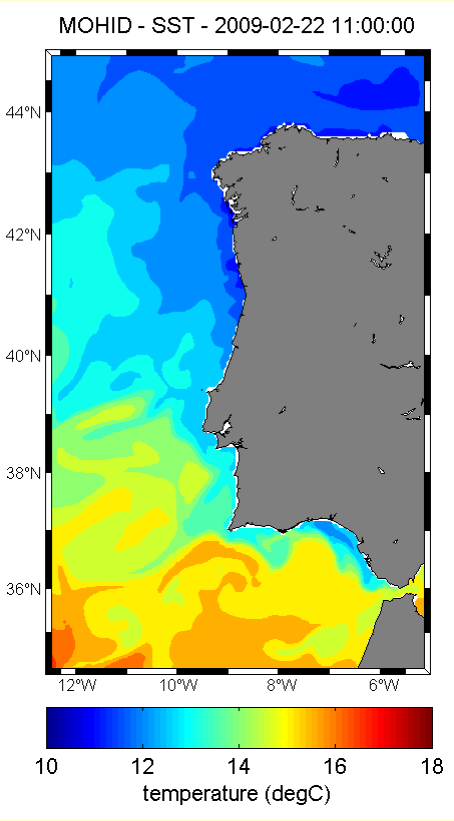
- GPNT provides the meteorological input required by the Portuguese Coast Forecasting system run by the closely connect group Maretec who developed the model MOHID (http://www.mohid.com/) widely known, internationally

- Just some results of an international benchmarking of MOHID, using input from GPNT:

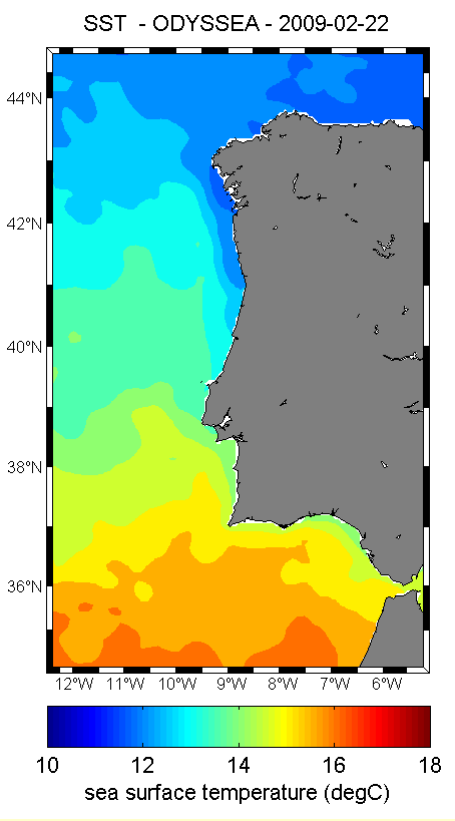
Validation - Sea surface temperature



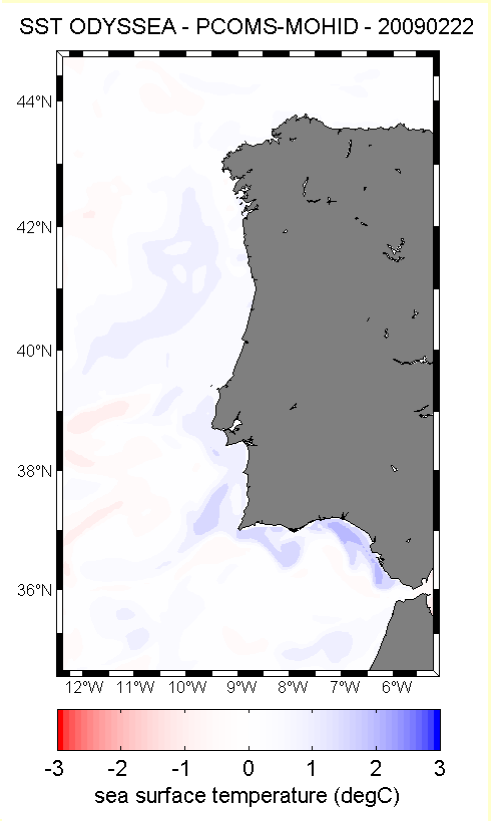
MODIS L2



PCOMS-MOHID



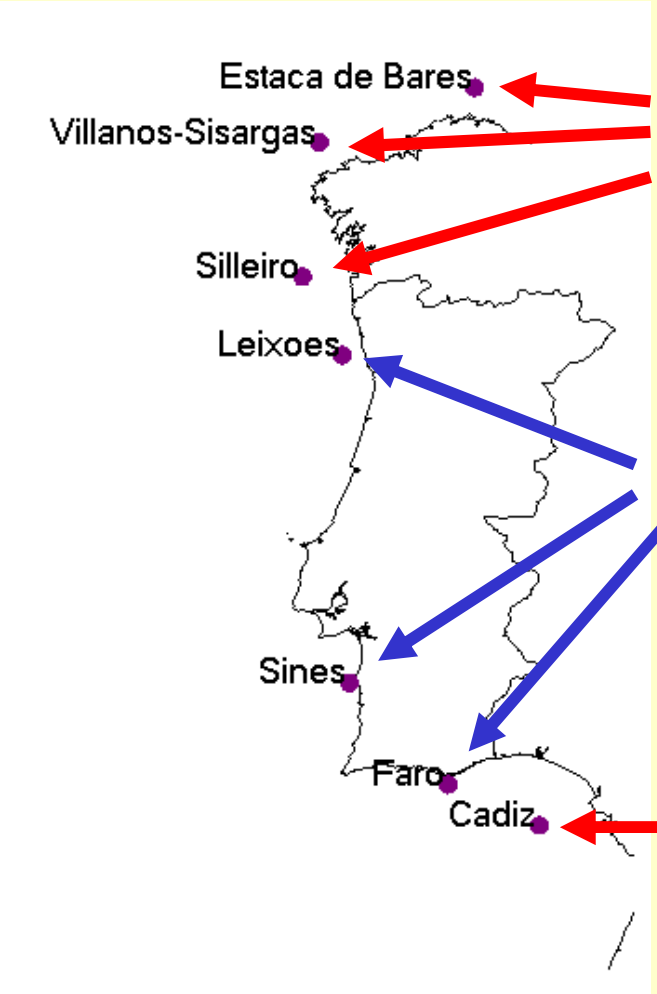
ODYSSEA



DIFFERENCE
ODYSSEA minus PCOMS-MOHID

22 Feb 2009

Validation – Surface buoys



Puertos del Estado - Spain

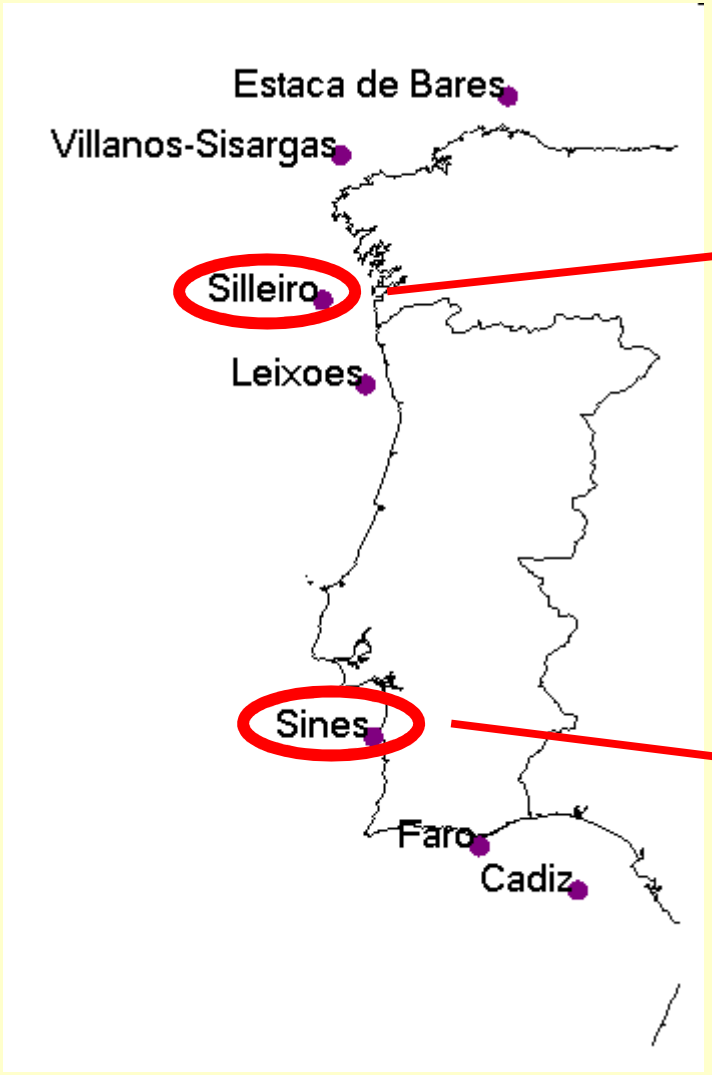
Surface currents, temperature and salinity

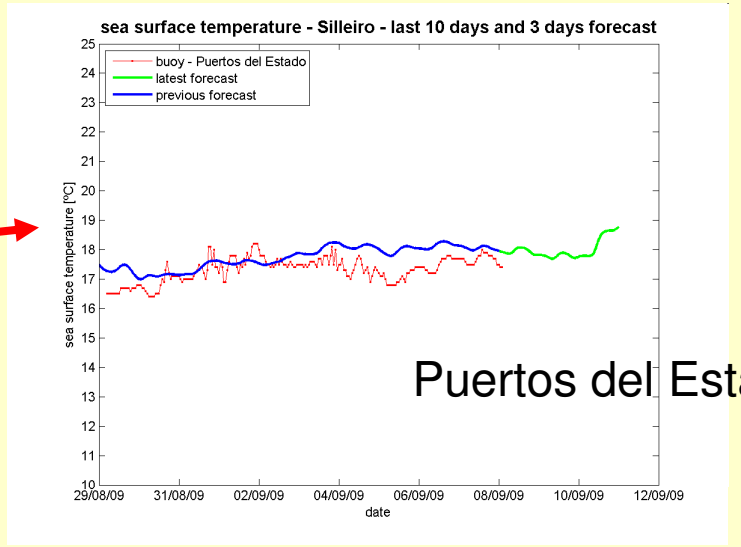
Instituto Hidrográfico - Portugal

Sea surface temperature

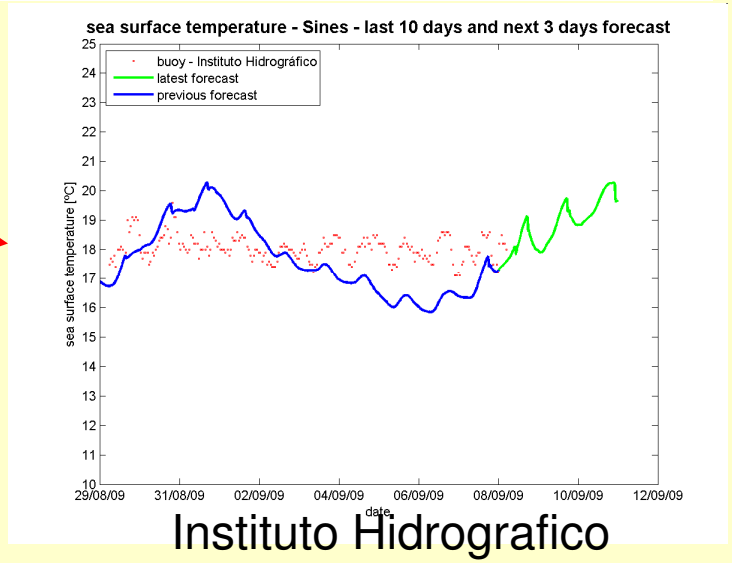
Puertos del Estado - Spain

Sea surface temperature



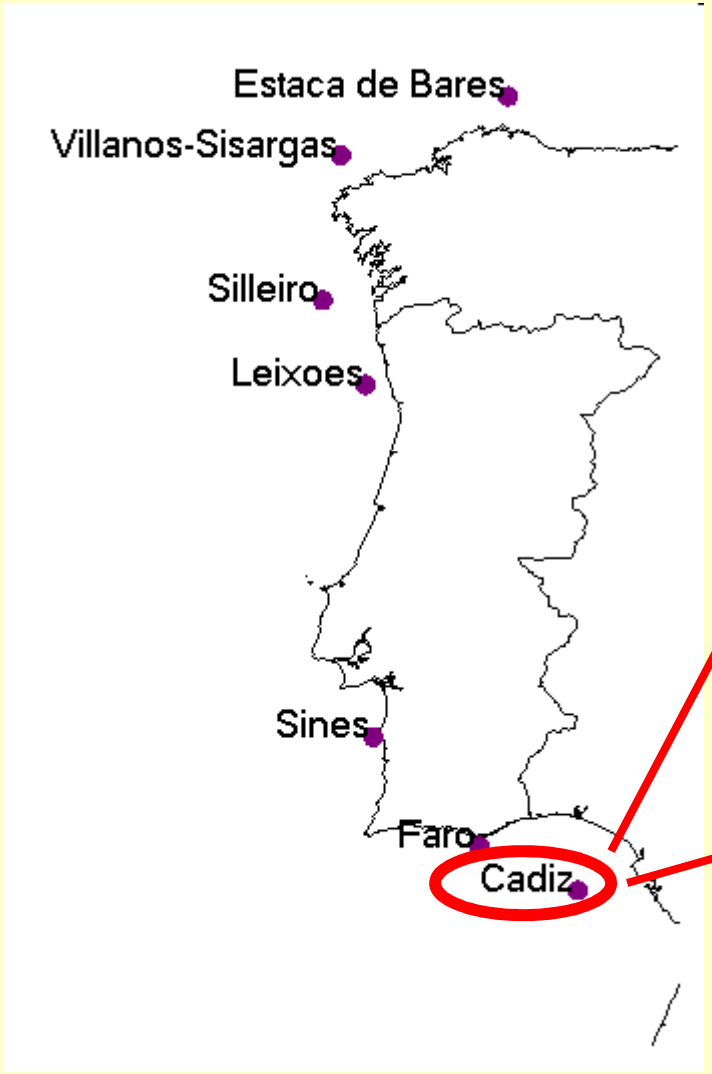


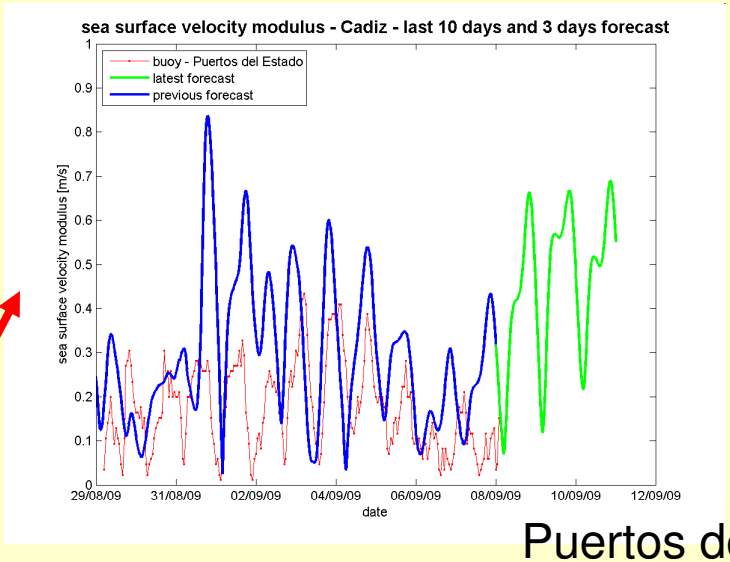
Puertos del Estado



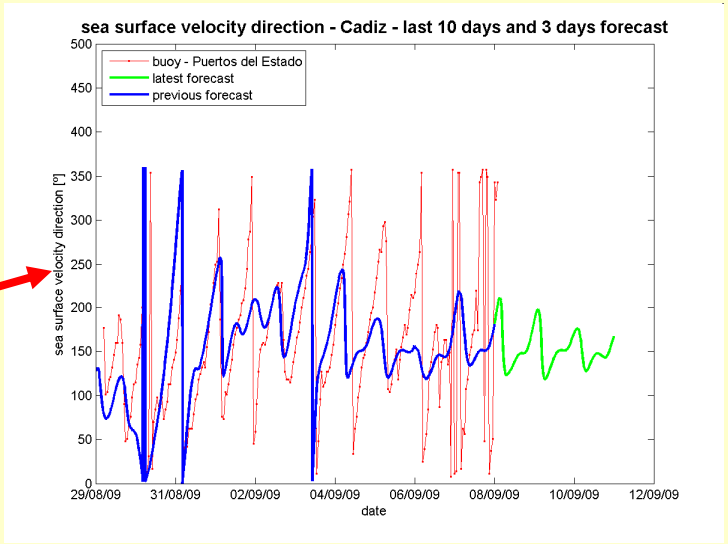
Instituto Hidrografico

Sea surface velocity & direction

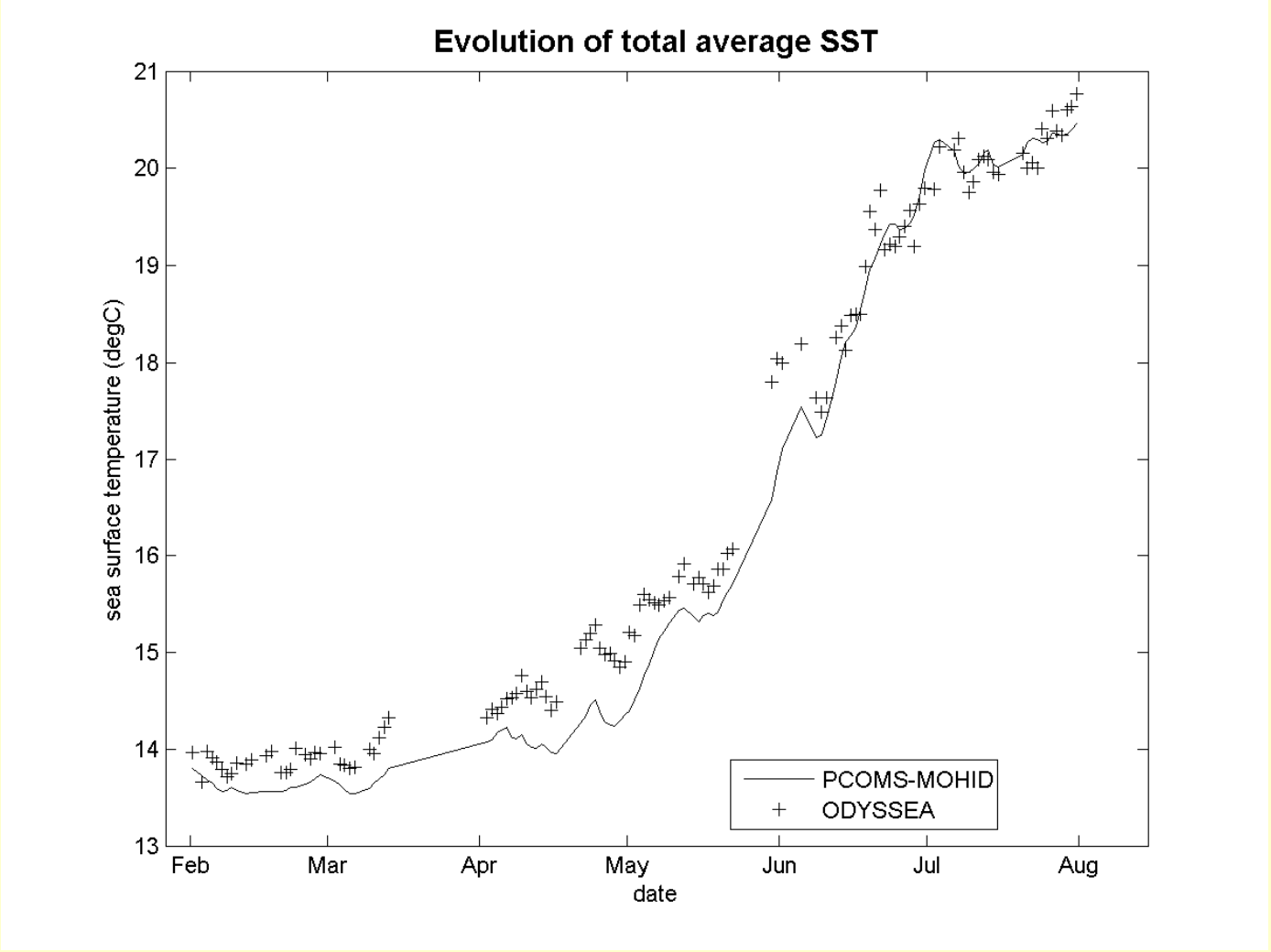




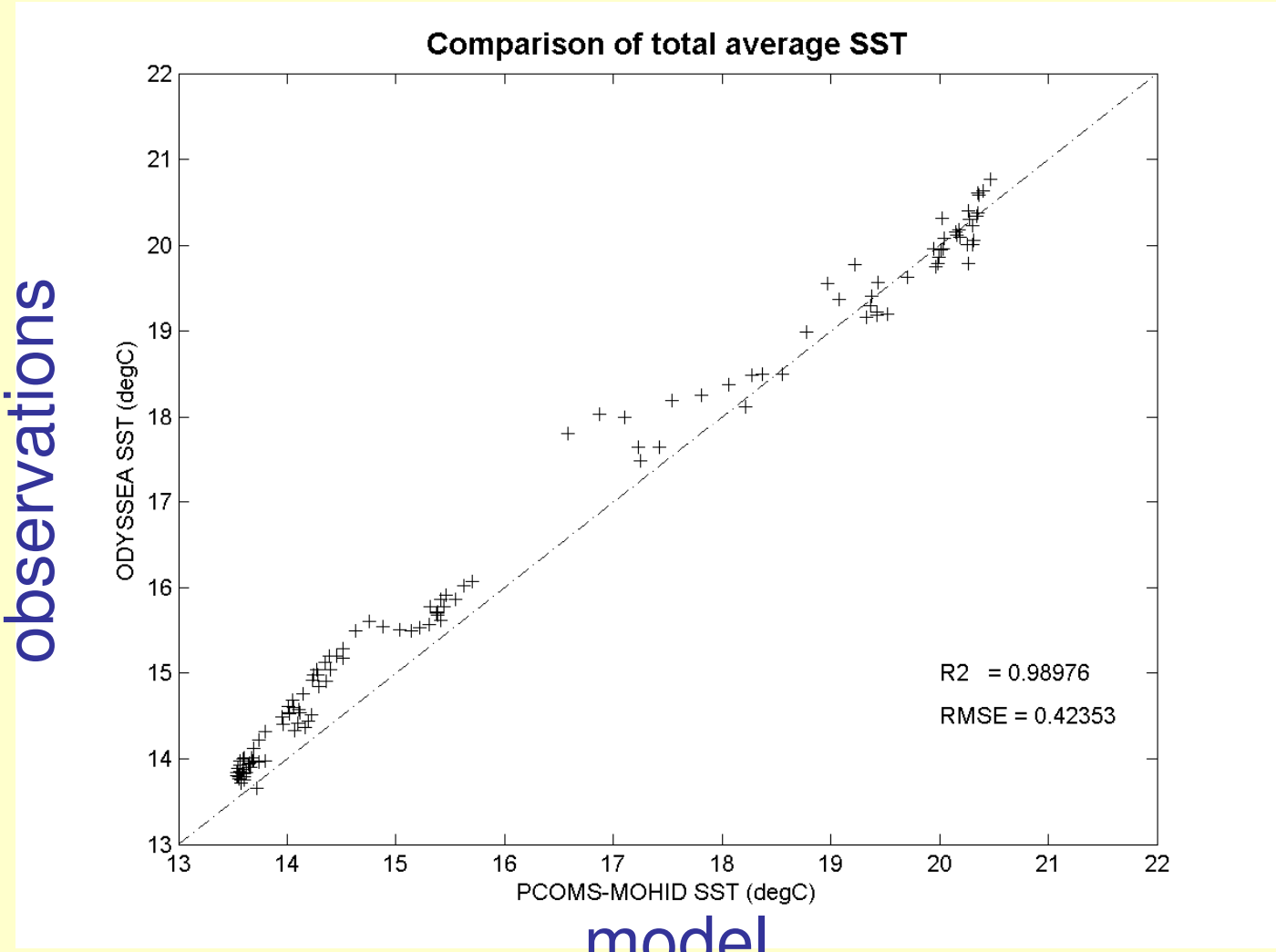
Puertos del Estado



Validation - TOP



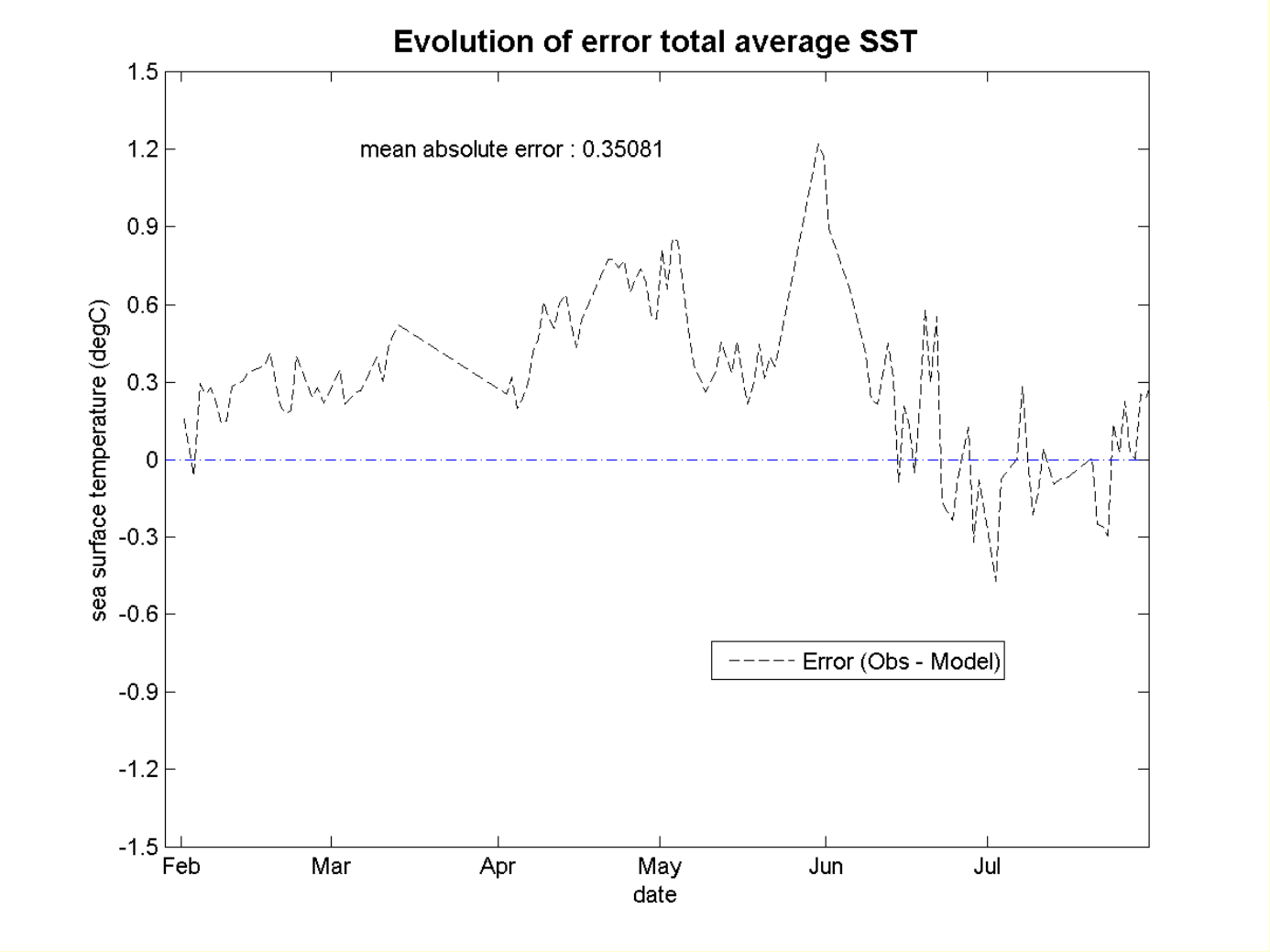
Validation - TOP



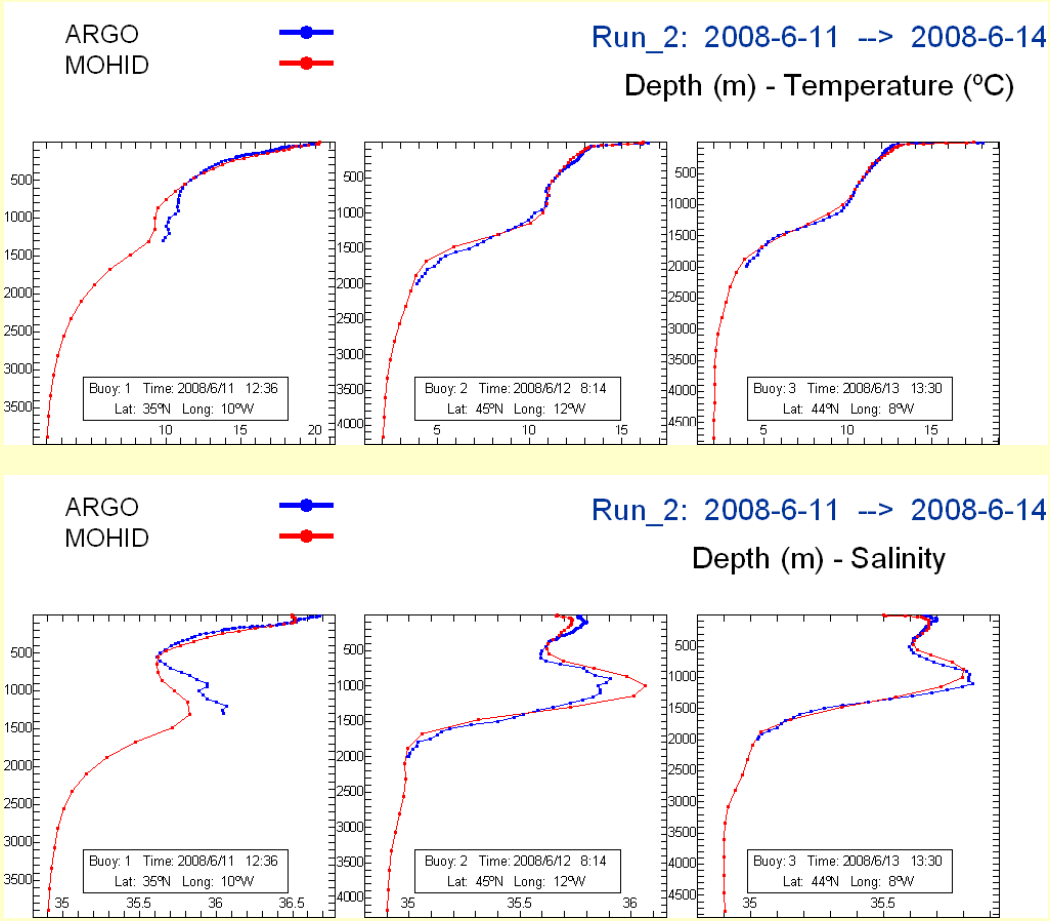
observations

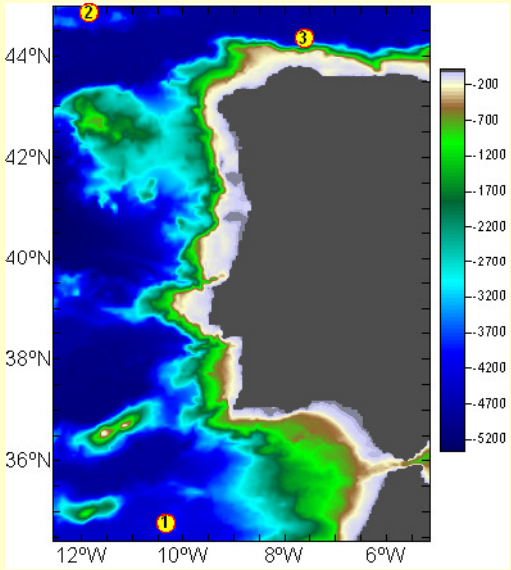
model

Validation - TOP



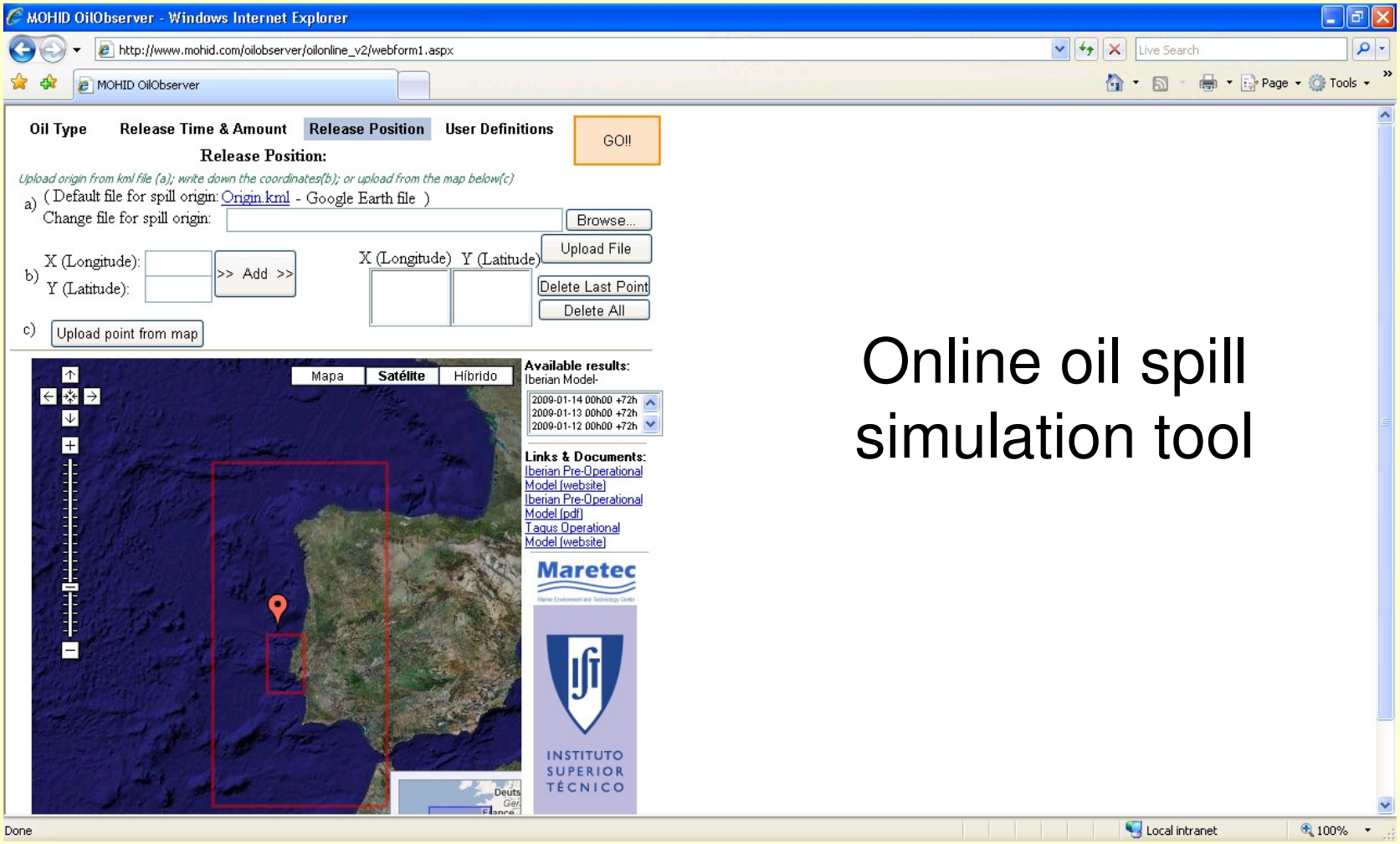
Validation – Argo floats





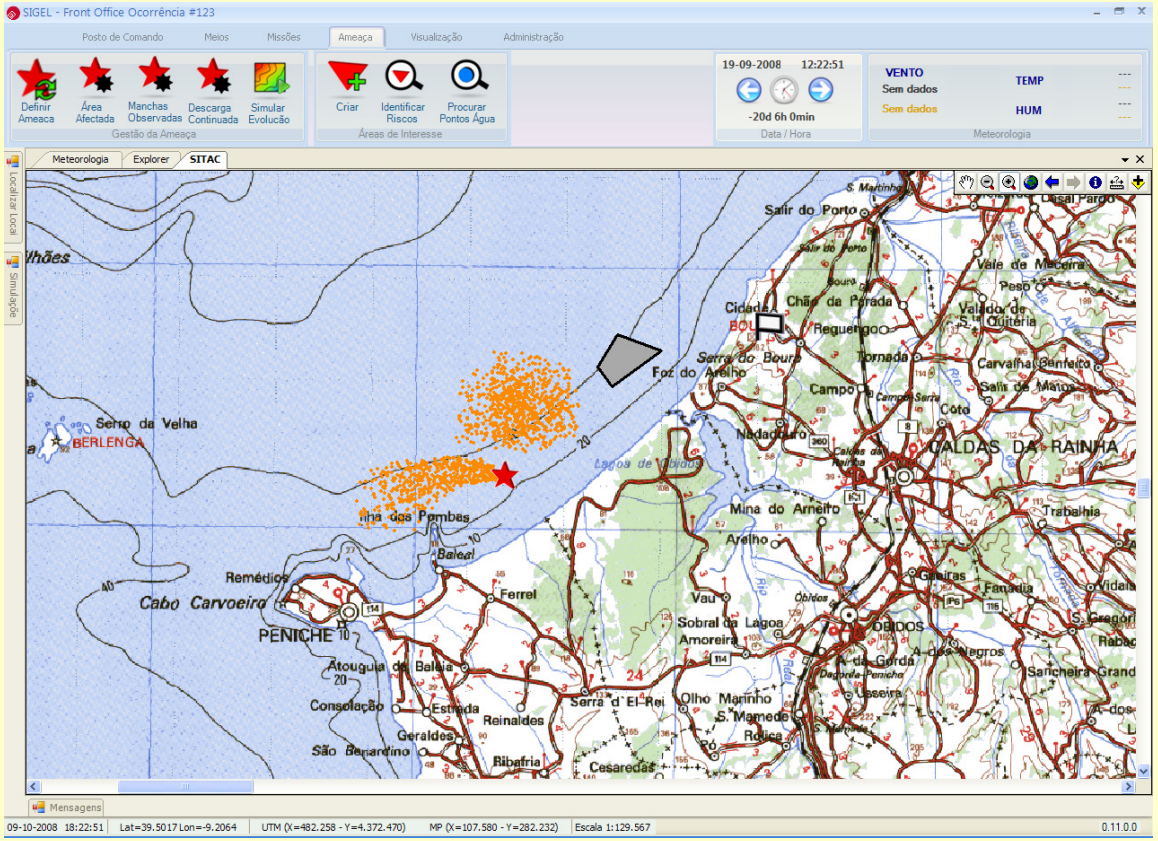
CORIOLIS project (http://www.coriolis.eu.org)

Oil Observer

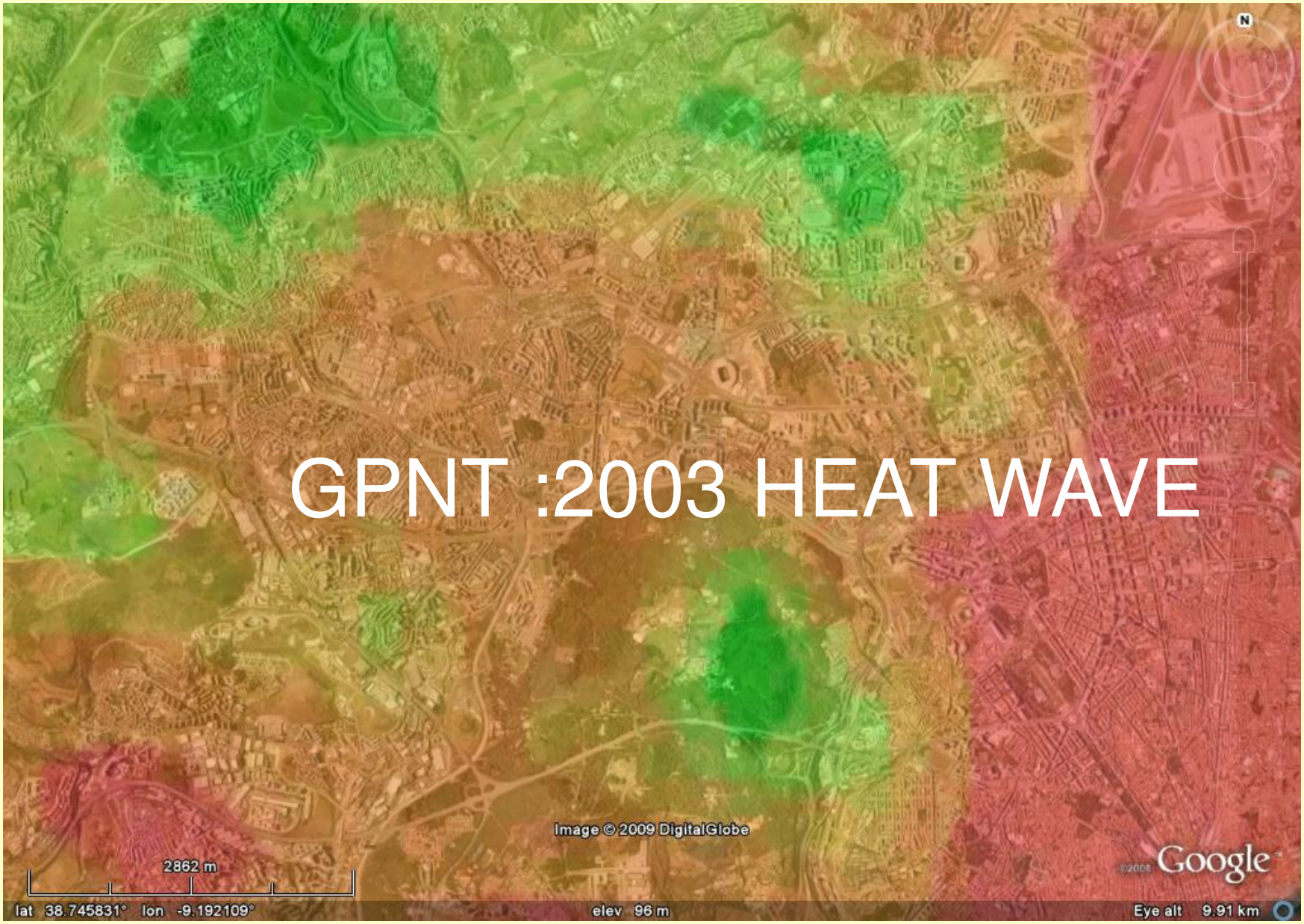


Online oil spill simulation tool

SIGEL project



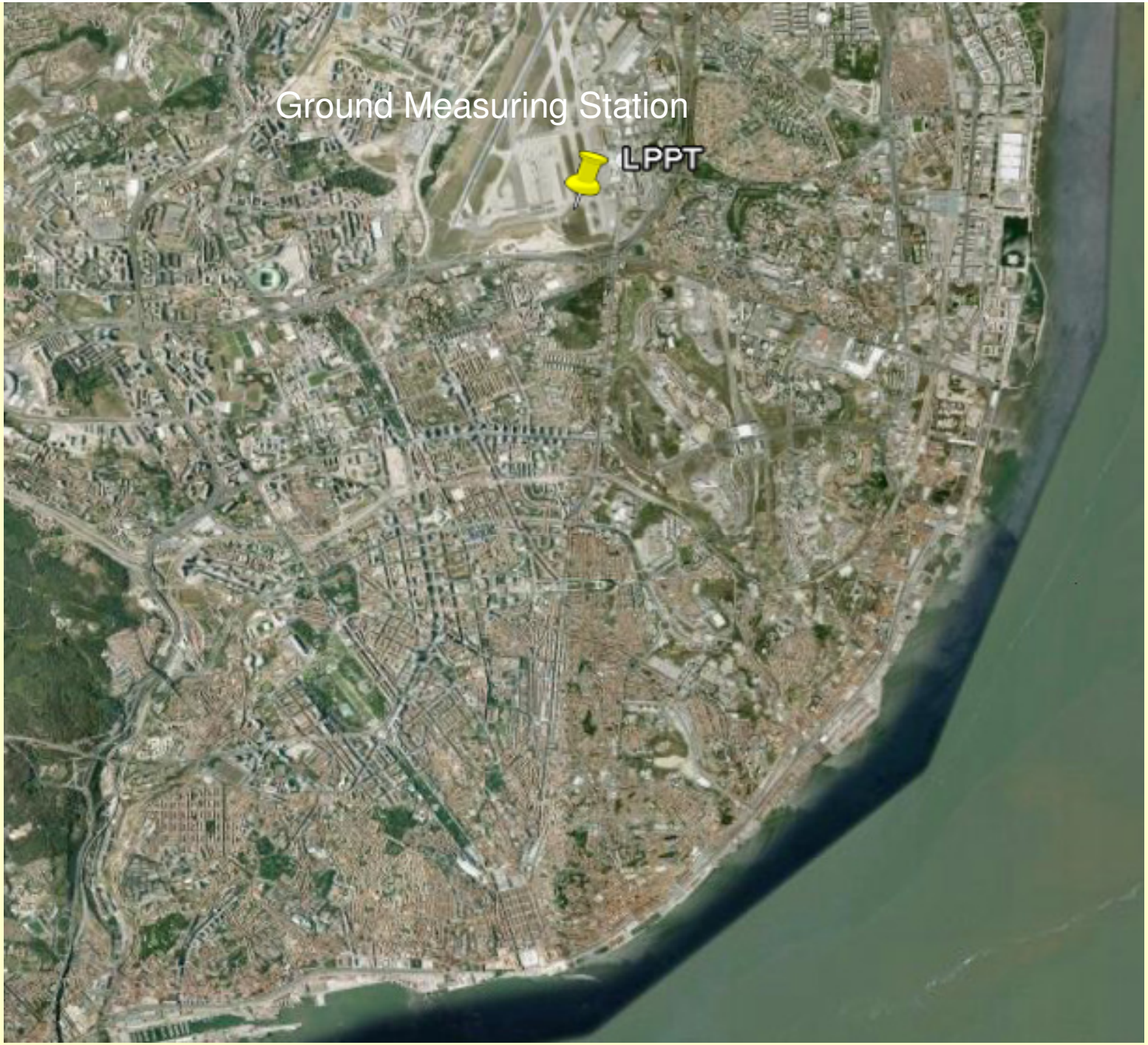
Oil spill emergency management smart client


GPNT :2003 HEAT WAVE
Image © 2009 DigitalGlobe
2862 m
Google
lat 38.745831° lon -9.192109°
elev 96 m
Eye alt 9.91 km

Lisbon -Urban Heat Island

GPNT participates on a ESA (European Space Agency) project on urban heat islands, as tester .

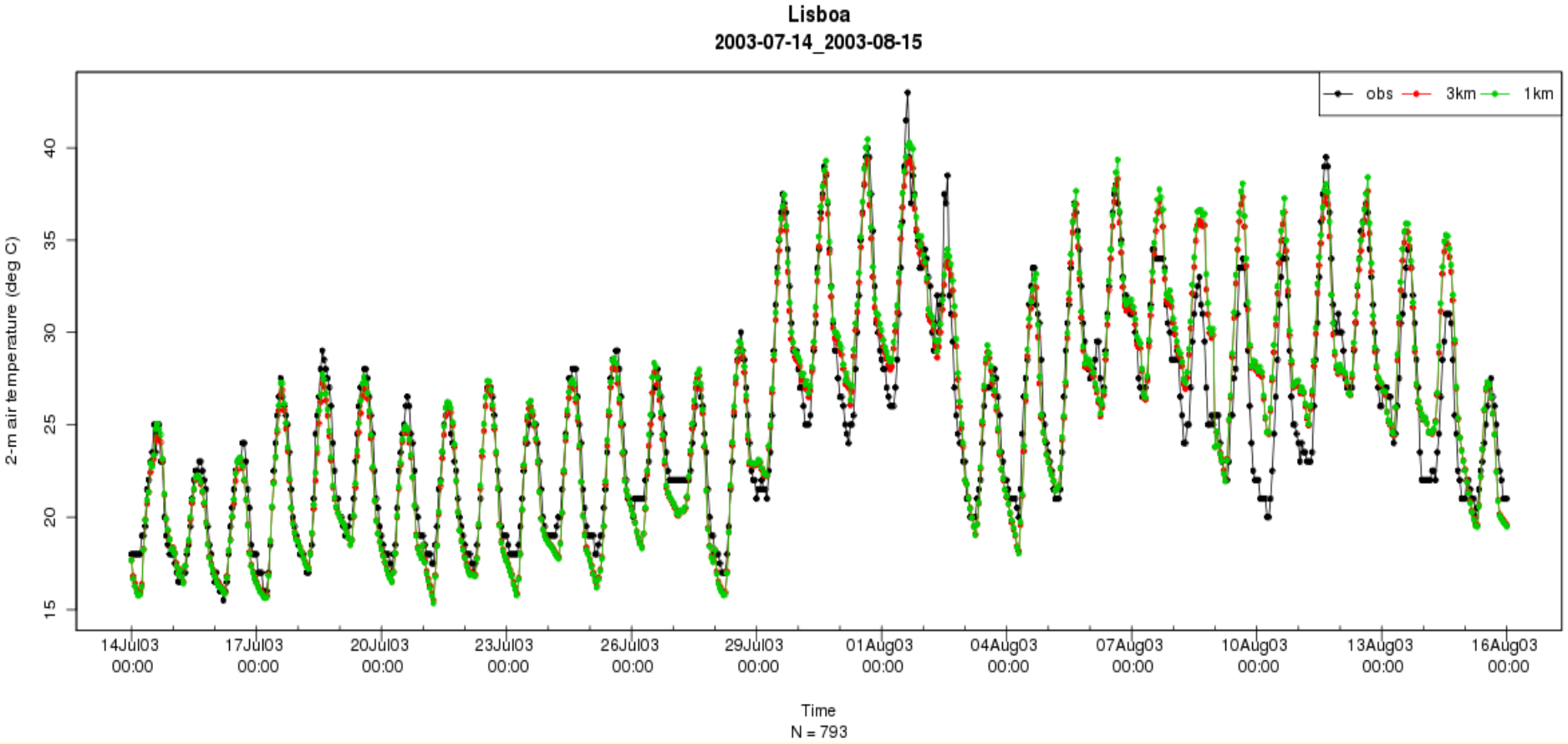
To access the usefulness of presently available thermal imagery from LASAF at a pixel resolution of 3x3 km, GPNT simulated the Heat Wave of 2003 with MM5 and AWRF at 9x9, 3x3 and 1x1km spatial resolutions and several soil models


Ground Measuring Station
LPPT

Urban Heat Island - Lisbon

The Heat wave of 2003

Predicted and Measured temperatures at Lisbon Airport

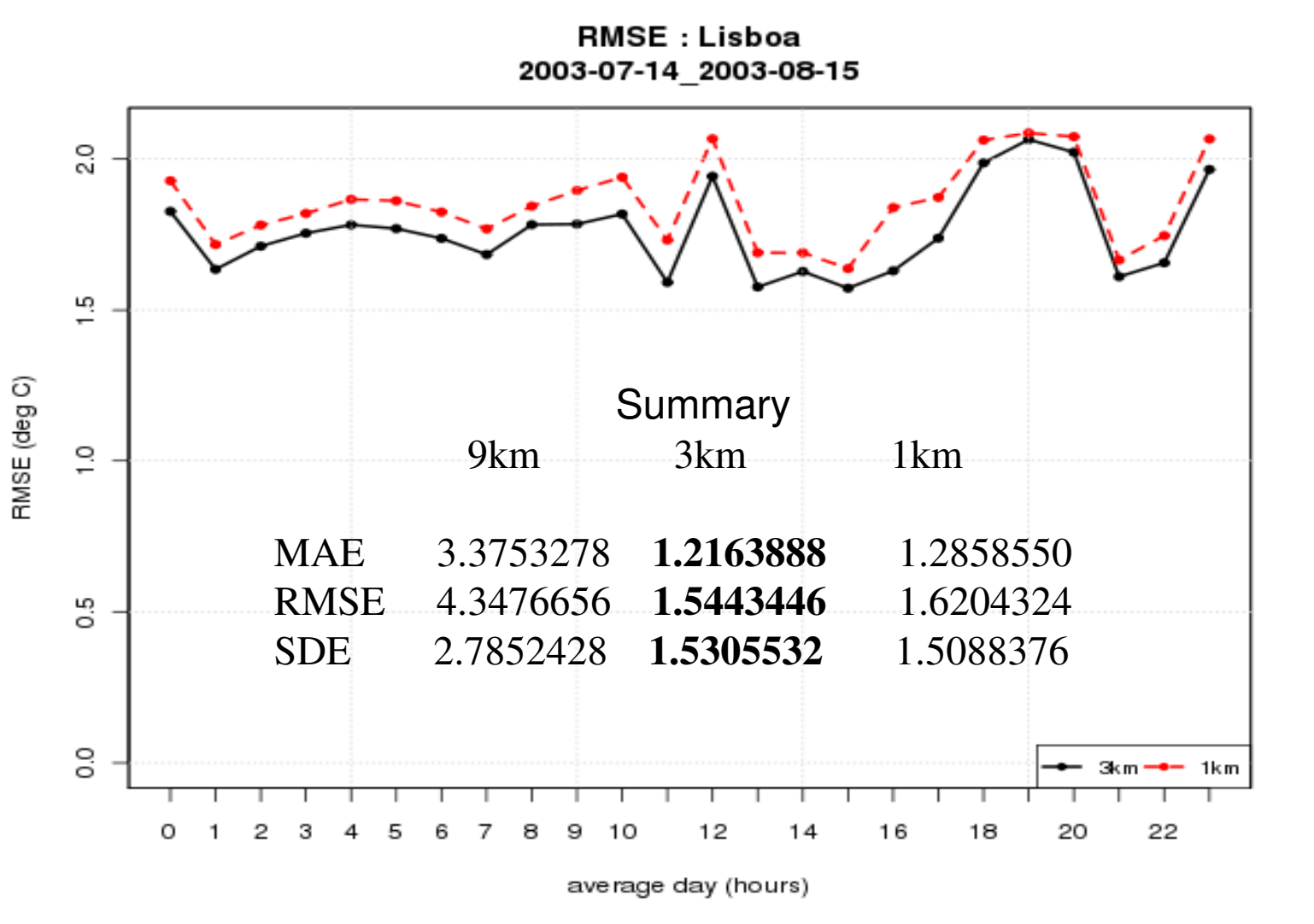


AWRF initialized with FNL (NCEP) 2 way nested (9km,3km, 1km)

Urban Heat Islands - Lisbon

The Heat wave of 2003

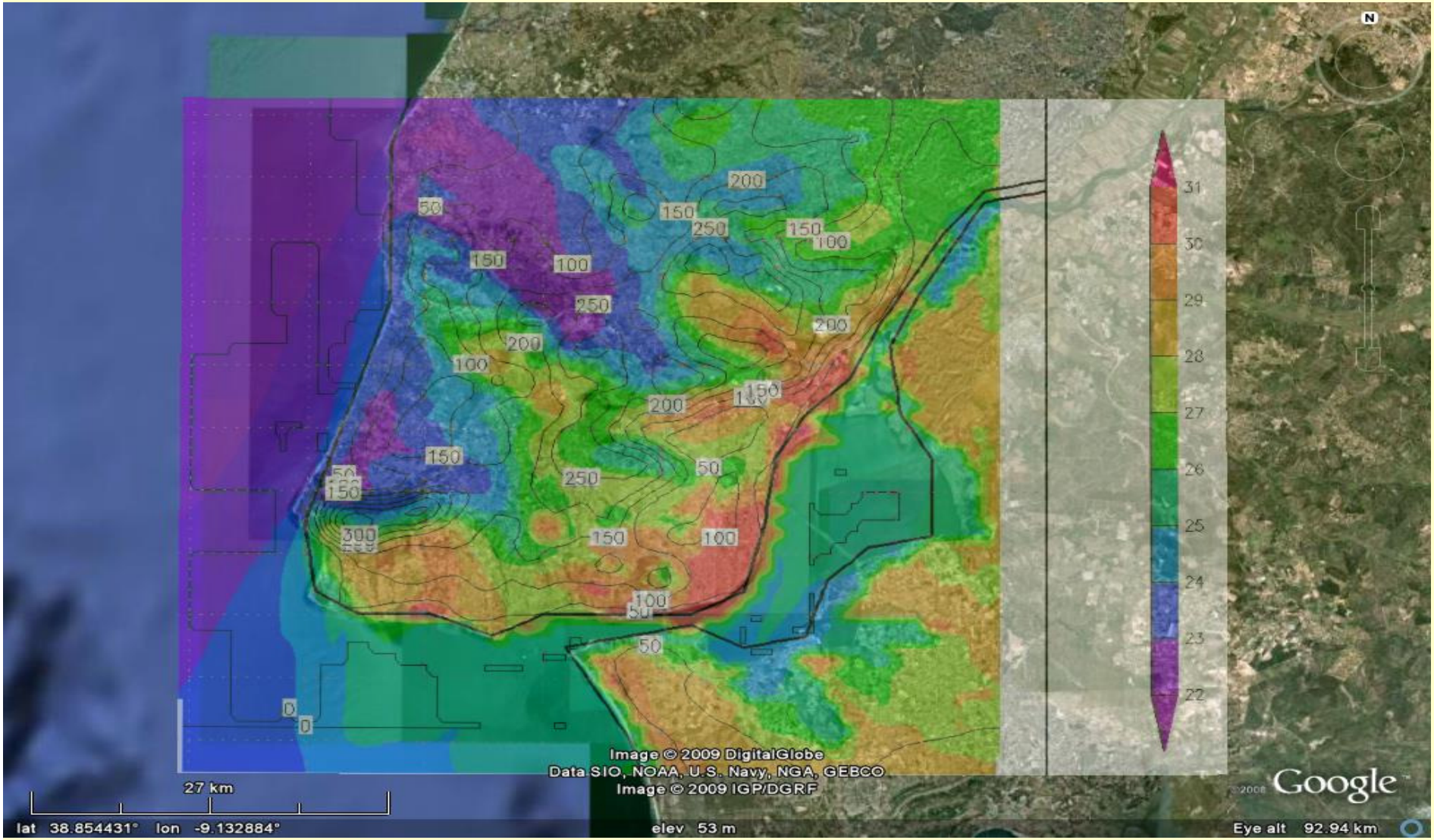
Root Mean Square Error at Lisbon Airport



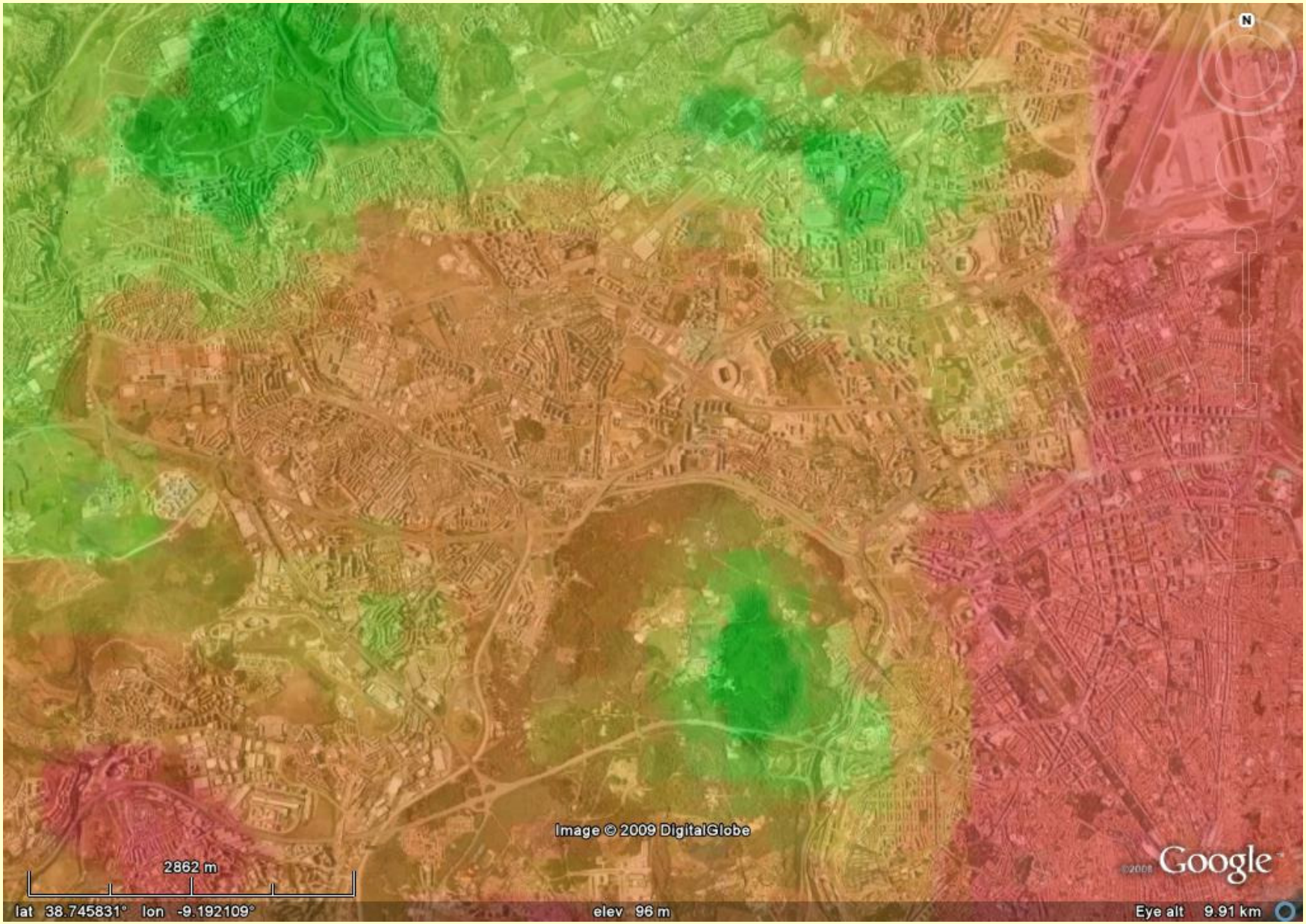
Urban Heat Islands - Lisbon

Heat wave of 2003

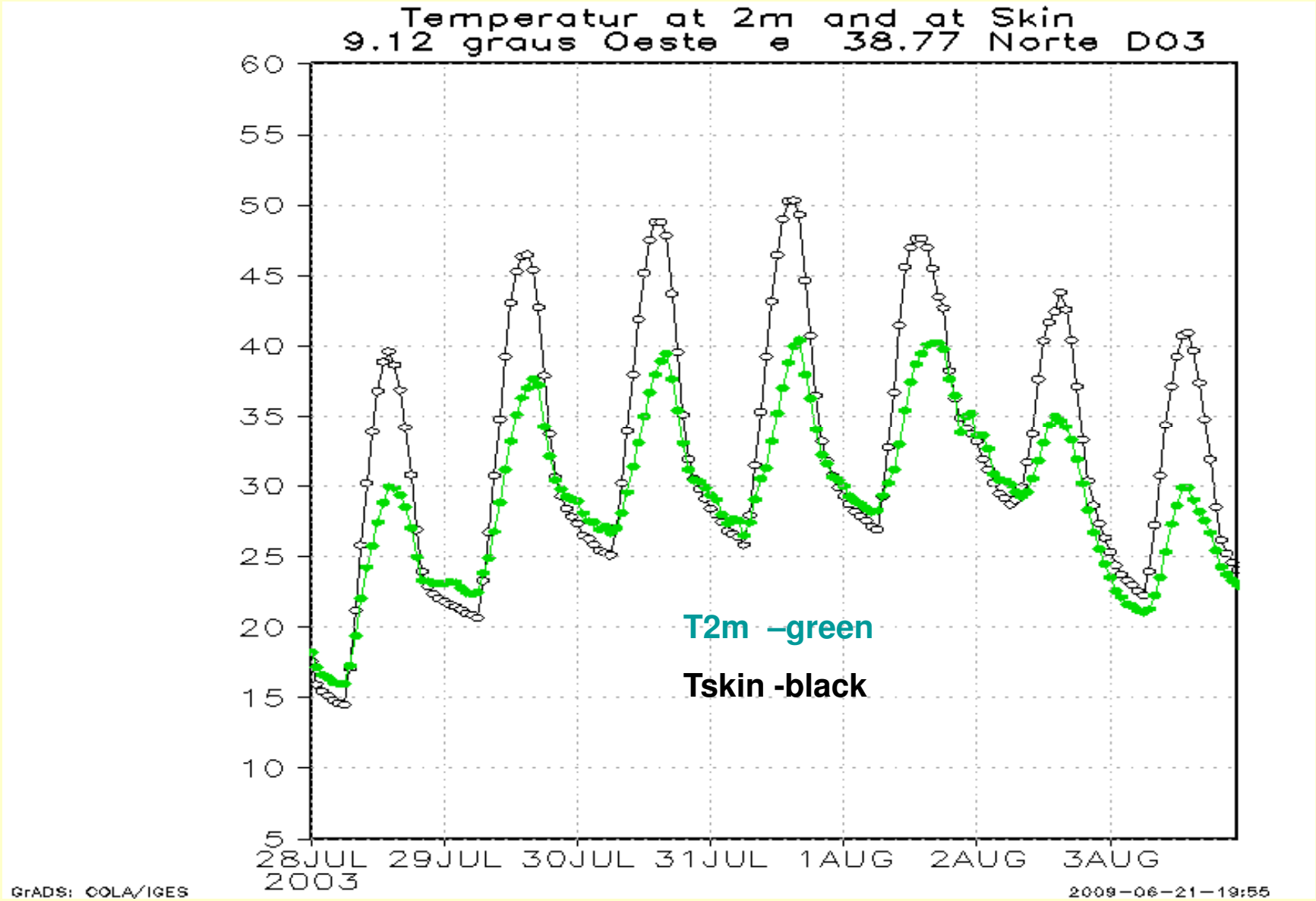
00 hours August 1



Temperatures 2003-08-01:00

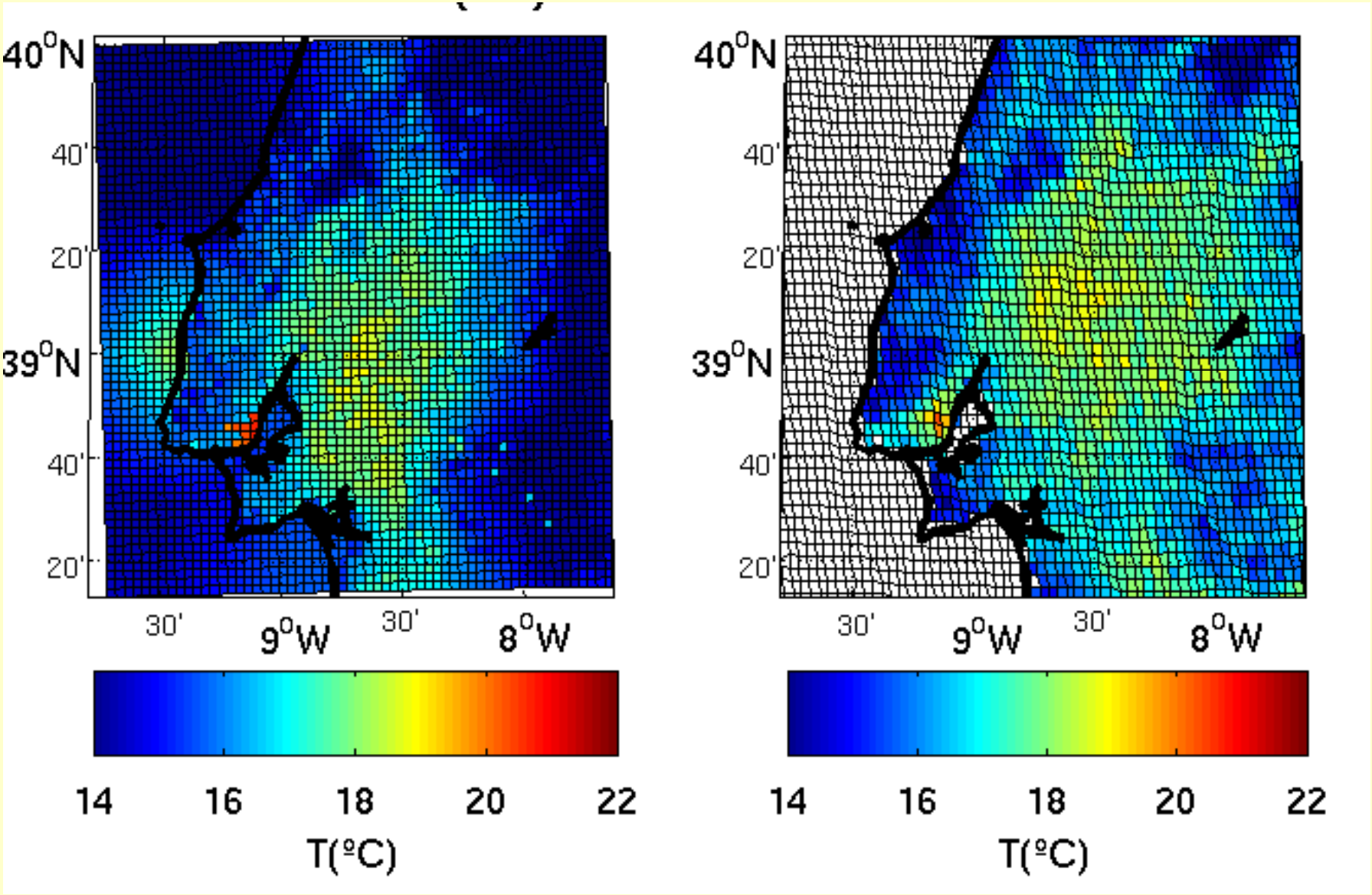


Urban Heat Island - Lisbon



WRF Prediction vs LSASAF

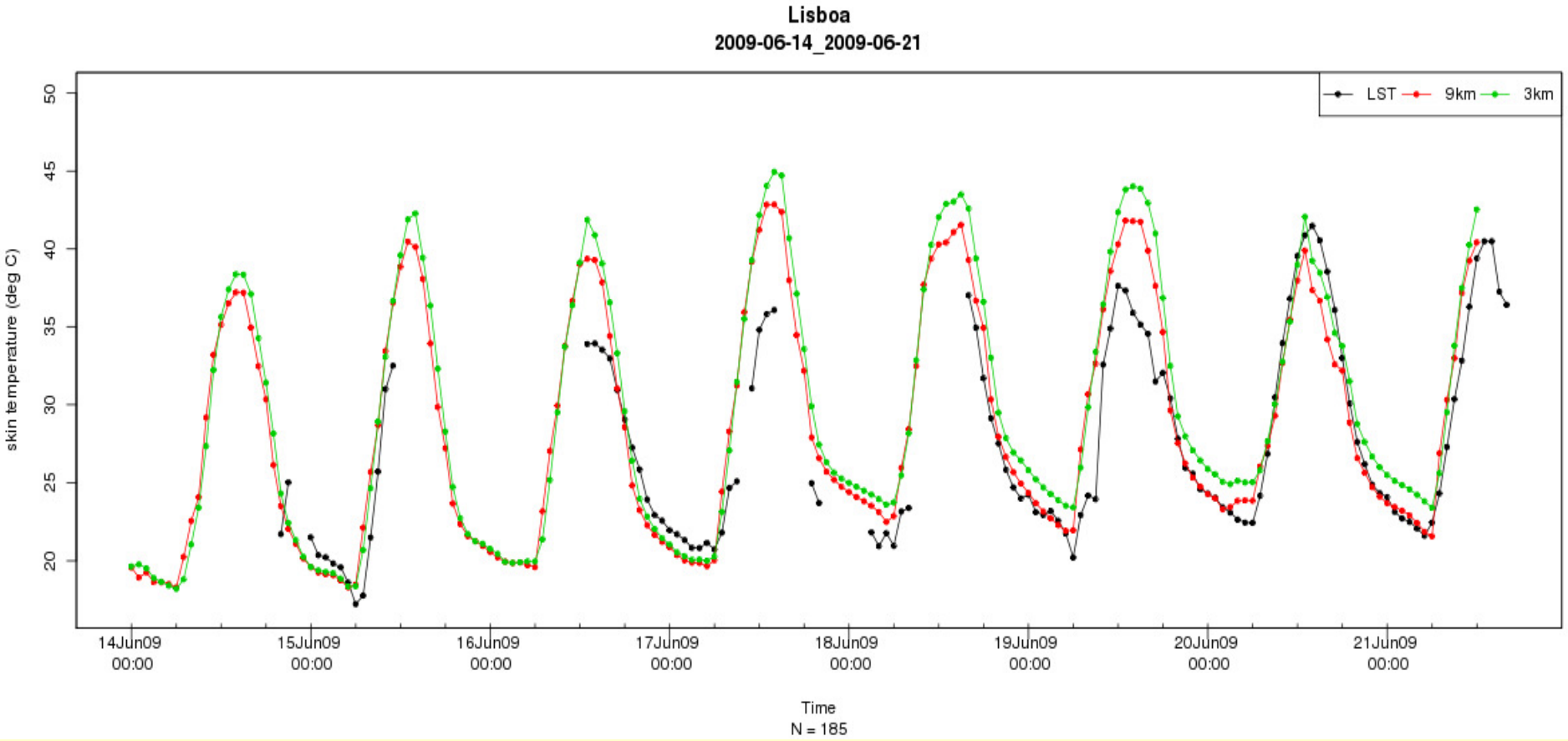
2009-03-10:18h (3x3 km resolution)



Prediction 2009-03-10:18h (3x3 km resolution)

Lisbon Skin Temperature predicted (WRF) and satelite (LSASAF) (3x3 km resolution) from 2009-06-14 to 2009-06-21

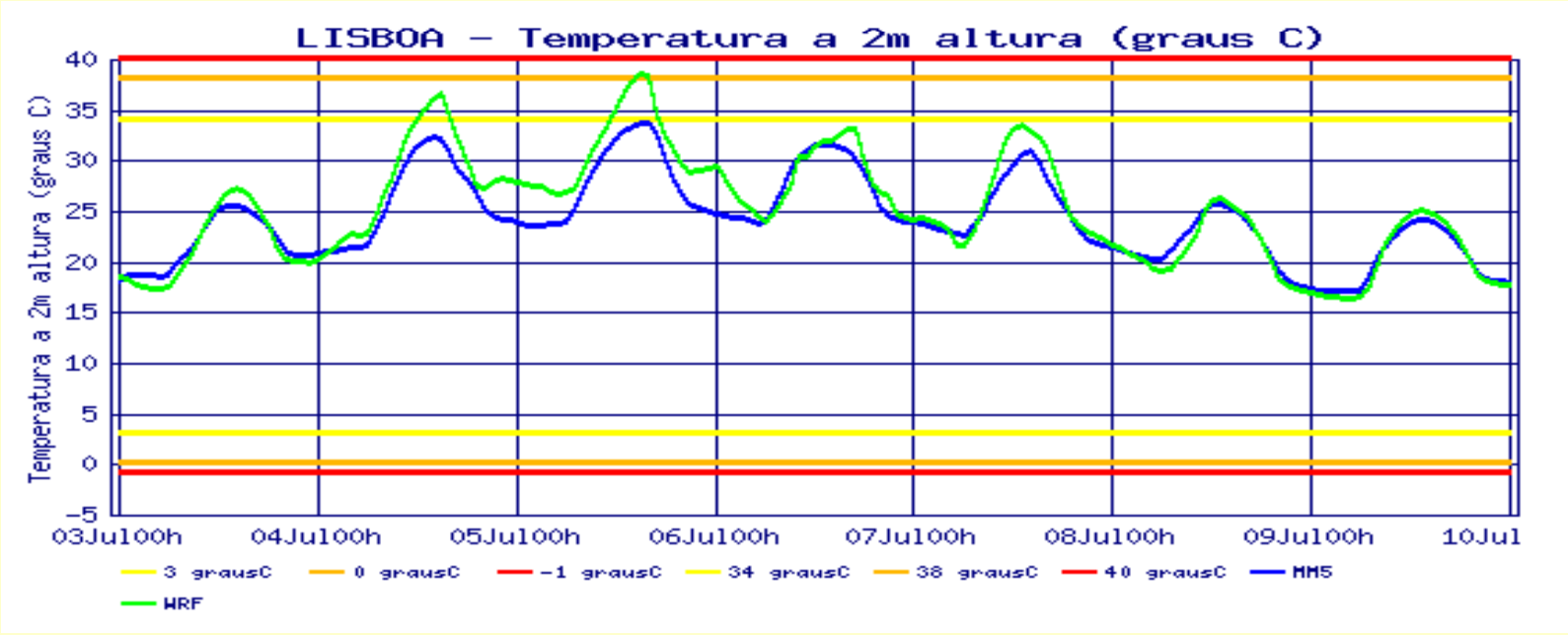
LSASAF 2009-03-10:18h (3x3 km resolution)



Lisbon Civil Protection

Lisbon Civil Protection receives daily a weather forecast for 7 days, updated every 6 hours, based on MM5 (9x9 km) and WRF (3x3 km) with a visual indication of official (IM) alarm levels.

For ex. at 6 am July 3, this one refers to air temperature at 2m



Extreme Events –basic considerations

LSASAF 2009-03-10:18h (3x3 km resolution)

- Predicting extreme events originated in small scale features requires limited area models with a spatial resolution of, at least, 3 grid points inside the characteristic scale. MM5 and WRF models have these **operational** capabilities.
- To be useful for Civil Protection the models must be run in Operational Mode coupled with an automatic alert system as , for example, the currently used by GPNT.
- Currently available computational resources do not allow a meaningful probabilistic ensemble forecast model to be run operationally at the required spatial resolution.

Extreme Events & GPNT

- To circumvent the **operational** limitations of conventional probabilistic ensemble forecasts, GPNT introduced operationally a time-lagged ensemble methodology, using daily a 168 hours(7 days) forecast based on 00h analysis, followed by 3 updated forecasts based on the analysis of 06h, 12h and 18h.

The methodology as proved quite successful at Lisbon Civil Protection since its introduction in 2008, and for Wind Power prediction at REN.

The Extreme Rain Event in Madeira on Feb 20,2010 & GPNT

IM-Instituto de Meteorologia made an official statement saying it would be impossible to predict the event with reasonable anticipation without the Meteorological Radar they were requesting for a long time.

IM also stated to be impossible an internal preparedness warning 7 days before, and a public red warning 48h before.

GPTN made public that its operational warning system, already tested at Lisboa Civil Protection, would have made an internal preparedness warning 7 days before, and would have recommend a public red warning 48h before.

GPNT also discarded the usefulness of a Meteorological Radar for the early prediction of this particular extreme event. It could even lead to a wrong evaluation

On June 30, 2010, the University of Évora convened the Portuguese Groups who do research and NWP to present their views in an open public discussion. Our presentation is already publicly available at GPNT site (http://meteo.ist.utl.pt)

NO one endorsed the official statements of IM

NO one questioned the scientific foundation of my public statements

Location of IM Meteo Stations

Estação	Lat (N)	Lon (O)
Areeiro	32°43’	16°55’
Funchal/Ob	32°38’	16°53’

http://www.meteo.pt/pt/enciclopedia/redes/redes.meteo/index.html

IM gives coordinates rounded to minits(‘). Areeiro is near another station with the same name from another organization (IGA) which rounds to seconds(‘’).

The coordinates given by IM to Funchal/Observatório puts it in the sea so we took the location of the Observatório adress .

GPNT: Time lagged Ensemble forecasts & obs

18_18_3km

18_12_3km

18_06_3km

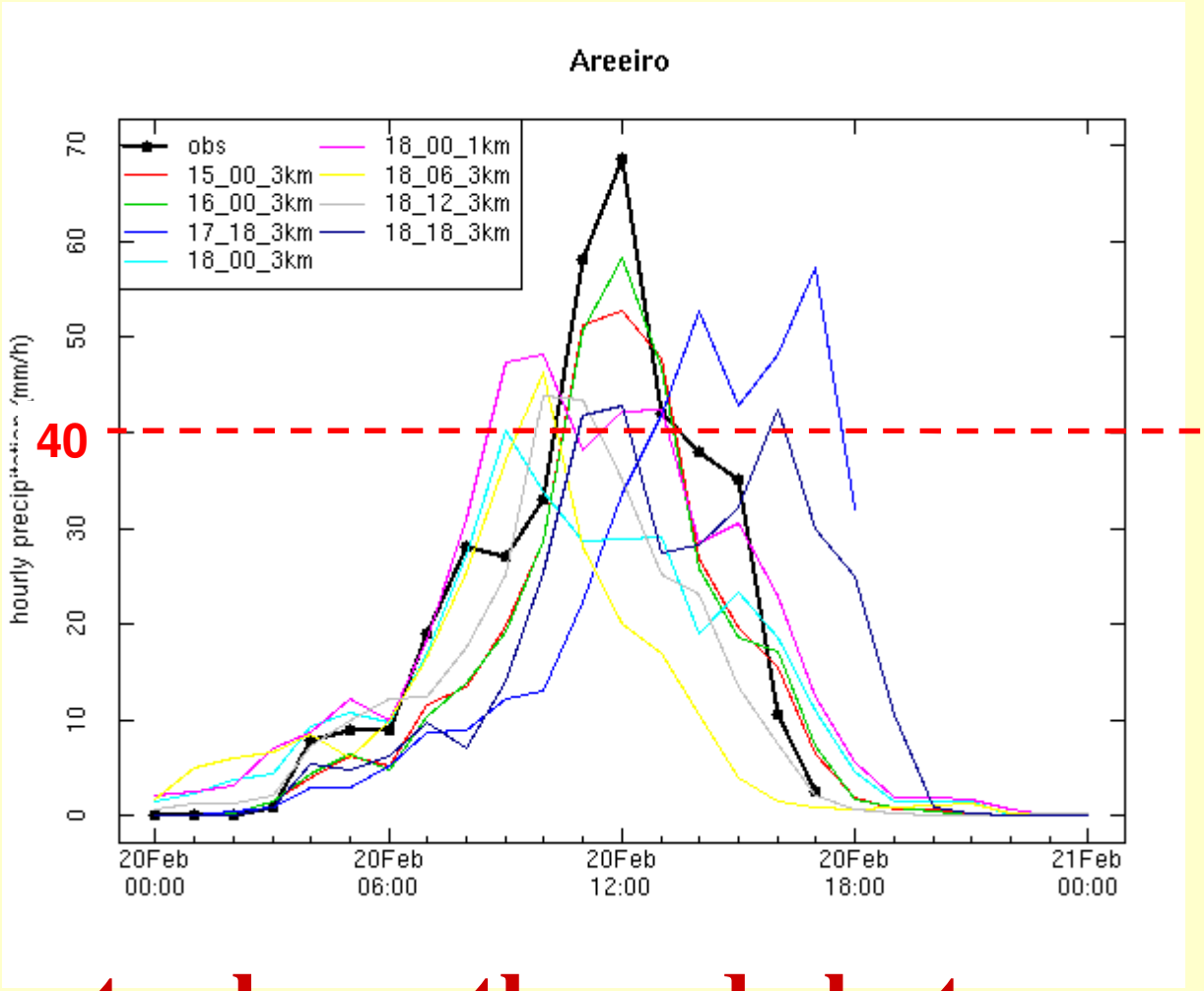
18_00_1km

18_00_3km

17_18_3km

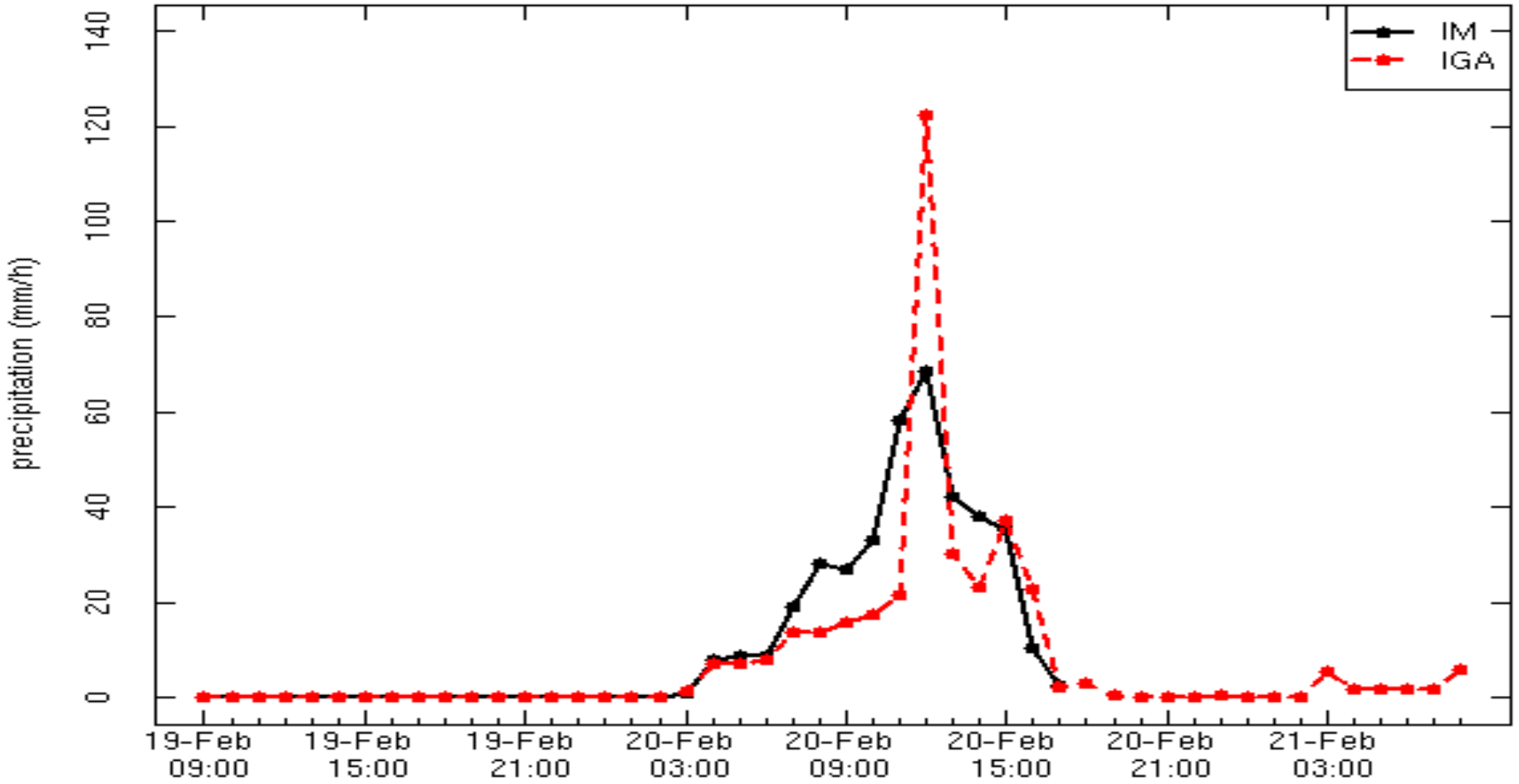
16_00_3km

15_00_3km



ALL forecasts above the red alert

Data according to IM and IGA at Areeiro



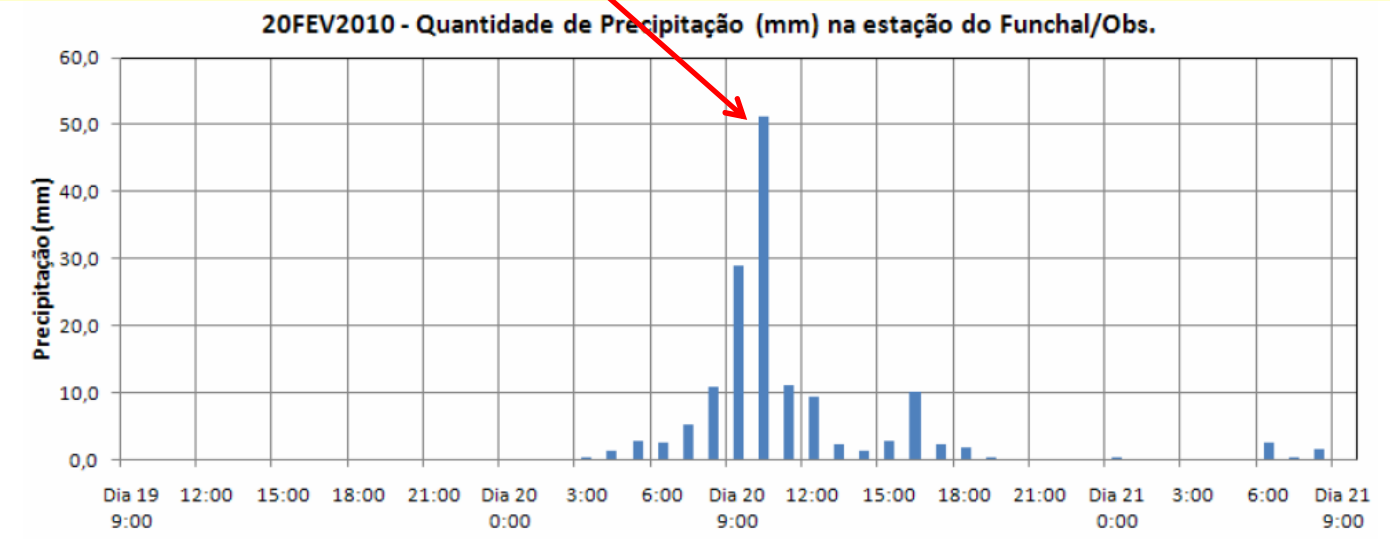
IM: Boletim Climatológico Fev 2010

Tabela 4 - Precipitação (mm) no dia 20 de Fevereiro no Arquipélago da Madeira.

Estações	Máx 10 min	Período	Máx 1 hora	Período	Máx 6 horas	Período	Máx 12 horas	Período	Total 00h-24h
Porto Santo/Aeroporto	2.1	12:20/12:30	7.5	12:00/13:00	17.0	08:00/14:00	20.8	04:00/16:00	20.9
Funchal/Observatório	11.0	11:00/11:10	51.3	08:50/09:50	111.5	05:10/11:10	138.4	04:00/16:00	144.3
Lugar de Baixo/P. do Sol	6.6	09:00/09:10	38.7	08:10/09:10	89.8	05:10/11:10	93.7*	-	95.3*
Calheta/P. do Pargo	9.2	12:30/12:40	41.7	12:20/13:20	85.5	08:00/14:00	93.4	02:00/14:00	97.4
Santana/P. de São Jorge	2.0	11:40/11:50	8.8	11:30/12:30	17.9	09:50/15:50	19.5	06:00/18:00	20.0
Areeiro	15.4	11:00/11:10	78.5	08:50/09:50	272.1	08:50/14:50	372.4	04:00/16:00	387.1*
Santa Catarina/Aeroporto	10.0	09:50/10:00	20.0	10:00/11:00	-	-	-	-	52.9**
Caniçal/P. São Lourenço	8.6	10:50/11:00	21.3	10:00/11:00	40.5	05:00/11:00	42.2*	-	42.2*

(*) Lugar de Baixo/Ponta do Sol – Falha a partir das 12h; Areeiro – falha a partir das 18h; Caniçal – Falha a partir das 12h.
(**) Os dados da quantidade de precipitação acumulada diária da estação de Santa Catarina/Aeroporto referem-se aos dados entre as 09h de dia 20 de Fevereiro às 09h do dia 21 de Fevereiro.

Pela tabela é entre as 8h50 e as 9h50
Segundo o gráfico é 2 horas depois das 9:00 e uma hora antes das 12:00, ou seja 11:00, ou 09:50/10:50.



Boletim Climatológico Fev 2010

Tabela 4 - Precipitação (mm) no dia 20 de Fevereiro no Arquipélago da Madeira.

Estações	Máx 10 min	Período	Máx 1 hora	Período	Máx 6 horas	Período	Máx 12 horas	Período	Total 00h-24h
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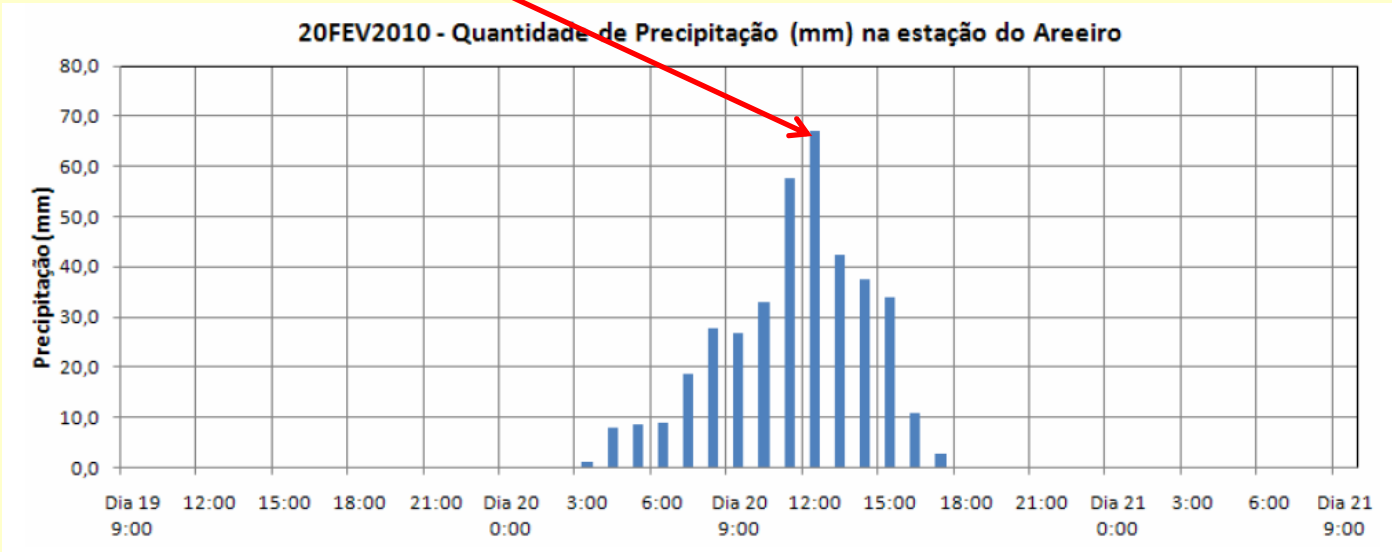
Funchal/Observatório	11.0	11:00/11:10	51.3	08:50/09:50	111.5	05:10/11:10	138.4	04:00/16:00	144.3
Lugar de Baixo/P. do Sol	6.6	09:00/09:10	38.7	08:10/09:10	89.8	05:10/11:10	93.7*	-	95.3*
Calheta/P. do Pargo	9.2	12:30/12:40	41.7	12:20/13:20	85.5	08:00/14:00	93.4	02:00/14:00	97.4
Santana/P. de São Jorge	2.0	11:40/11:50	8.8	11:30/12:30	17.9	09:50/15:50	19.5	06:00/18:00	20.0
Areeiro	15.4	11:00/11:10	78.5	08:50/09:50	272.1	08:50/14:50	372.4	04:00/16:00	387.1*
Santa Catarina/Aeroporto	10.0	09:50/10:00	20.0	10:00/11:00	-	-	-	-	52.9**
Caniçal/P. São Lourenço	8.6	10:50/11:00	21.3	10:00/11:00	40.5	05:00/11:00	42.2*	-	42.2*

(*) Lugar de Baixo/Ponta do Sol – Falha a partir das 12h; Areeiro – falha a partir das 18h; Caniçal – Falha a partir das 12h.
(**) Os dados da quantidade de precipitação acumulada diária da estação de Santa Catarina/Aeroporto referem-se aos dados entre as 09h de dia 20 de Fevereiro às 09h do dia 21 de Fevereiro.

Segundo o gráfico o - Máx (1hora) < 70 mm e não 78.5.
- Máx (1hora) ocorre depois das 12:00 e não às 08:50/09:50.



SOME CONCLUSIONS

Scientific Remarks :Models

MM5 and WRF are state of the art models. They became **a reference at international level.**

WRF benefited from the experience accumulated with MM5 and expanded remarkably its flexibility and user friendliness. Its dynamic user base and the individual and institutional contributors improves WRF with each yearly updated release. WRF_3.2 (2010) is now a robust and reliable system. **GPNT** was one of the testers before official release.

Accessing the reliability and quality of a Model is a very long, complex and time consuming task. Using it in real time operational mode is not trivial and requires experience.

There are other very good, state of the art models, namely in Europe. For specific research needs, they are clearly useful. However, for operational use, a full change from one model to another is always difficult to justify on a risk/benefit analysis

Scientific Remarks :DATA

The real Physical World do not read papers, or know about models. Models are always a simplified representation of what humans assume to be the Physical World .

To be a physical model (**not a science fiction fantasy**), its predictions must be compared with reliable and careful measurements. Reliable and careful measurements of meteorological variables are so important that taxpayers accept the considerable expenditure needed to get them. They even give unique legal rights to an institution on charge of it, which in Portugal is the **Instituto de Meteorologia**.

Meteorological data is a public good, and is paid by taxpayers because it is supposed to be so. In Portugal (like in some other countries, but not in USA …) Instituto de Meteorologia considers the data it collects with public money as private property to be sold or given at its only discretion. In the real human world, this attitude is the shortest way for a **complete loss of scientific accountability**.

Scientific and Institutional Accountability

Whatever the model or Institution's statements, its correctness or usefulness can only be reasonably accessed comparing its predictions and statements with careful and reliable measurements. **Otherwise, we are confusing a system of believes with Science.**

To be credible and accepted, **all the testing data must be freely available, as is becoming widely and officially recognized ,** (thanks to *Climate Gate ?).*

In Portugal, Instituto de Meteorologia practically refuses, when it bothers to answer, all requests of data, being it real or historical time series.

Lack of accountability leads directly to loss of data quality and reliability. The sloppiness already shown for Madeira is just a reminder.

“ voltar à ciência, **aos problemas antigos por resolver, (...) às oportunidades económicas, à sociedade”**

1.O acesso livre e gratuito aos dados refere-se aos *dados em bruto* , não a dados com valor acrescentado. Este suposto valor acrescentado pode facilmente transformar-se numa perigosa “*data massage*”.

2.O IM afirma sempre que disponibiliza os dados para trabalhos de investigação, a custo do suporte. Não é isto que sucede com grande frequencia. O mais comum é nem sequer responder ao pedido. Quando responde é a pedir um custo exorbitante (…pelo suporte ?).

3.O IM interpreta a prestação de serviços à comunidade feita pelas Universidades e seus Centros de Investigação como “ venda de serviços à pala da investigação (sic)”. Sendo todos estes organismos tutelados pelo mesmo Ministério que estimula, e bem, a prestação de serviços e a obtenção de receitas pelas Universidades e Centros de Invstigação, que fundamento ético ou legal invoca o IM para o seu modo de proceder?

“ voltar à ciência, aos problemas antigos por resolver, (...) às oportunidades económicas, à sociedade”

5. Pelo modo como o IM divulga as suas receitas próprias, tenho as maiores dúvidas que as receitas provenientes da venda de dados em bruto tenham valor significativo. É muito mais plausivel que se trate de um pretexto para escamotear a falta de qualidade e de fiabilidade que um escrutínio sério poria em eviencia.

6.Integrado num Ministério da Ciência é paradoxal que o IM não permita acesso aos dados e algoritmos em que baseia as suas estrondosas afirmações sobre as alterações climáticas que se teriam verificado ou irão verificar em Portugal.

Dadas as importantíssimas implicações sociais e económicas das decisões de politica nacional nesta matéria, poderá o Ministério aceitar que as *“verdades convenientes do IM”* se transformem em verdades científicas, acima de qualquer dúvida ou escrutínio ?. Não só não pode como certamente o não fará

6. O GPNT nasceu e existe, de modo totalmente independente do IM e totalmente financiado pela indústria (porque o seu trabalho tem valor económico), mas é e sempre foi UNIVERSITÁRIO.

“ voltar à ciência,, (...) às oportunidades económicas, à sociedade”

OBRIGADO PELA ATENÇÃO …