

VOLCADEC

DATOS BÁSICOS DEL PROYECTO

Referencia: CGL2015-70177-R

Modalidad: B

Investigador Principal 1: Martin Ménégoz

Organismo: Barcelona Supercomputing Center-Centro Nacional de Supercomputación, Earth Sciences Department

Subvención concedida (Costes directos): 168.190 €

Fecha inicio: 01/01/2015

Fecha finalización (prevista): 31/12/2018



PARTICIPANTES

Entidades participantes: Barcelona Supercomputing Center

Equipo de investigación:

Martin Ménégos (PI), Nicola Cortesi, Daniel Ortega (baja)

Equipo de trabajo:

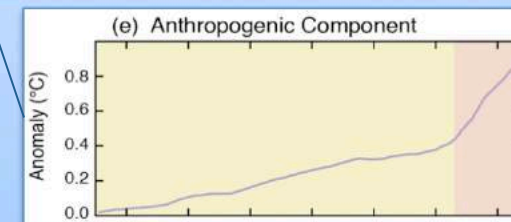
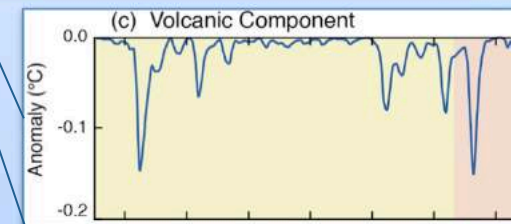
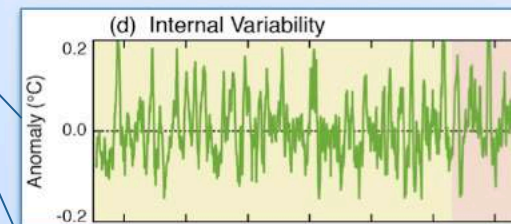
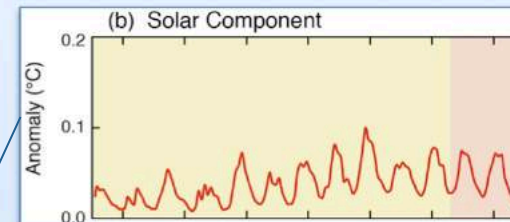
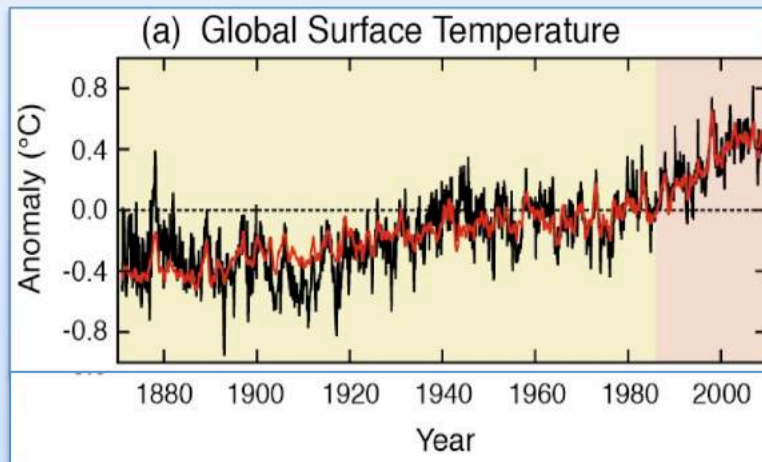
Researcher: *Roberto Bilbao (Post-Doc)*

Technical staff: *Xavier Yepes , Adria Quesada, Oriol Mula-Valls (baja)*

Junior engineers: *Miquel Canal, Eneko Martín (both incorporating)*



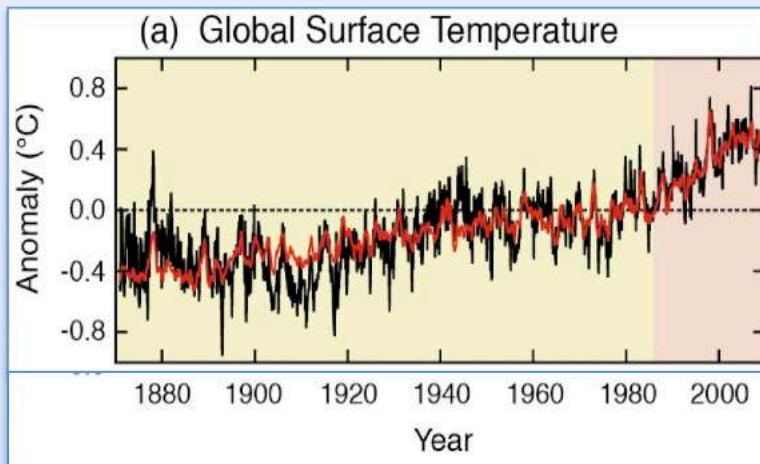
MOTIVACIÓN, HIPÓTESIS Y ESTRATEGIA DEL PROYECTO



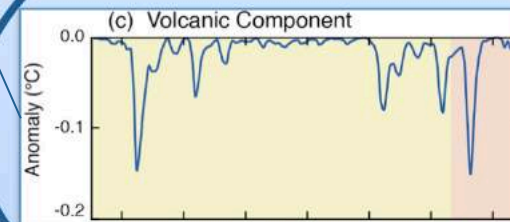
Climate variability is driven by internal variability of the atmosphere and the ocean. It is also affected by natural and anthropogenic forcings. Among them, **volcanic forcing** has a large impact at **seasonal to decadal timescales**.



MOTIVACIÓN, HIPÓTESIS Y ESTRATEGIA DEL PROYECTO



The VOLCADEC project aim at defining how **volcanic forcing** can be implemented in climate models to better simulate **past climate variability** and to anticipate the stratospheric aerosol forcing in **decadal forecasts**.



OBJETIVOS PROPUESTOS Y ALCANZADOS

Objective 1: Understanding the climate response to volcanic eruptions under different climate conditions **(70%)**.

Objective 2: Assessing the climate model skill related to volcanic forcing **(100%)**.

Objective 3: Forecasting the climate response to a new volcanic eruption **(70%)**.

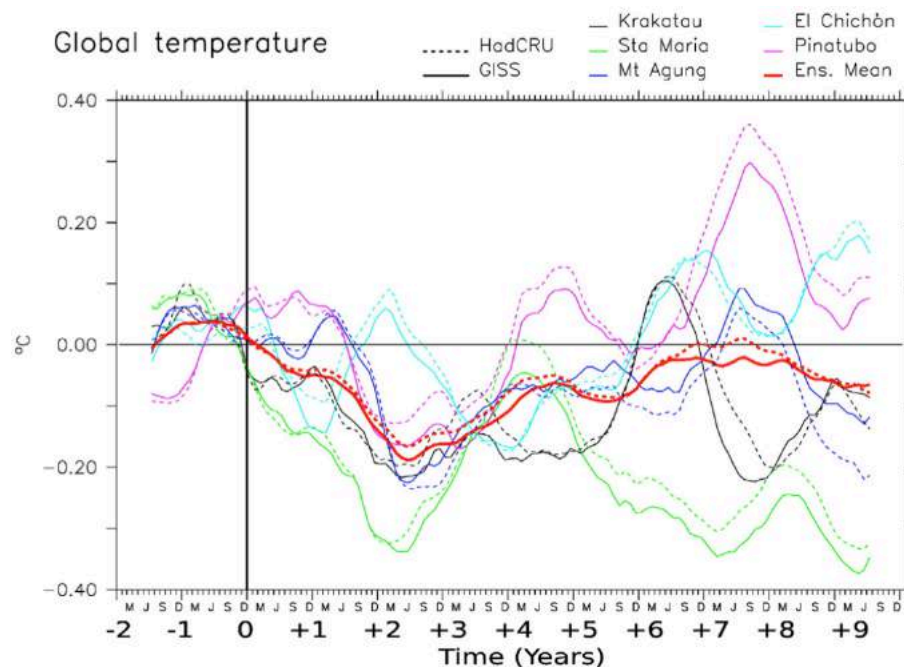
All the objectives are expected to be accomplished by the end of the project



RESULTADOS CIENTÍFICO-TÉCNICOS

Objective 1: Understanding the climate response to volcanic eruptions

- Volcanic eruptions (e.g. Pinatubo 1991) cool the atmosphere, with global temperature anomalies that can reach several tenth of degrees.



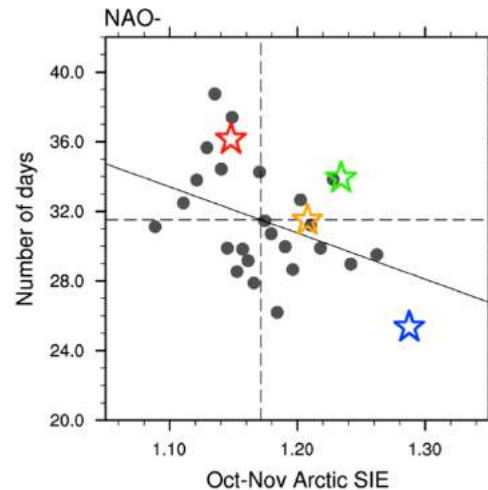
*Global temperature anomaly observed after large eruptions
Swingedouw et al., 2017,
Franco-Spanish collaboration*



RESULTADOS CIENTÍFICO-TÉCNICOS

Objective 1: Understanding the climate response to volcanic eruptions

- Volcanic eruptions (e.g. Pinatubo 1991) cool the atmosphere, with global temperature anomalies that can reach several tenths of degrees.
- Volcanic eruptions favours a chain of El-Niño - La Niña (3rd year) events.
- Tropical cooling and Arctic sea-ice growing induce a drastic decrease of NAO- conditions the 3rd year after an eruption.



NAO- occurrence in function of Arctic sea-ice extent, Ménéguez al., 2017, Franco-Spanish collaboration



RESULTADOS CIENTÍFICO-TÉCNICOS

Objective 1: Understanding the climate response to volcanic eruptions

- Volcanic eruptions (e.g. Pinatubo 1991) cool the atmosphere, with global temperature anomalies that can reach several tenths of degrees.
- Volcanic eruptions favour a chain of El-Niño - La Niña (3rd year) events.
- Tropical cooling and Arctic sea-ice growing induce a drastic decrease of NAO- conditions the 3rd year after an eruption.
- The dynamical response to volcanic forcing has a low signal-to-noise ratio, and it is modulated by natural Atlantic Multi-decadal Variability (AMV).

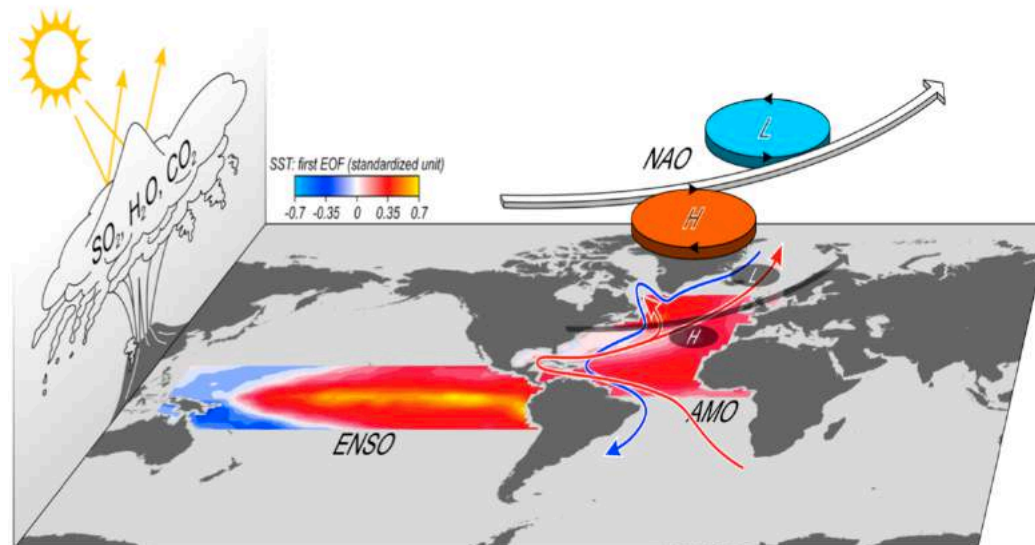
Ménégoz al., 2017, Franco-Spanish collaboration



RESULTADOS CIENTÍFICO-TÉCNICOS

Objective 2: Forecasting the climate response to volcanic eruptions

- The dynamical response of the NAO and ENSO to volcanic eruptions is model-dependent and has a low signal-to-noise: it is challenging to assess!



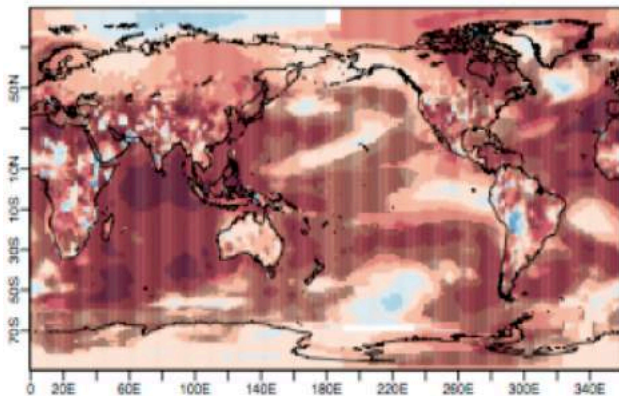
*Swingedouw et al., 2017,
Franco-Spanish collaboration*



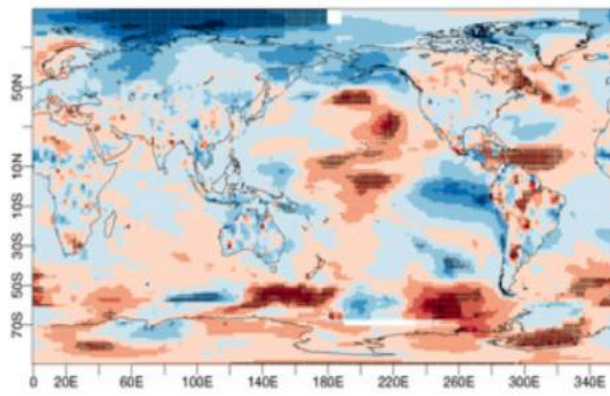
RESULTADOS CIENTÍFICO-TÉCNICOS

Objective 2: Assessing the climate model skill related to volcanic forcing

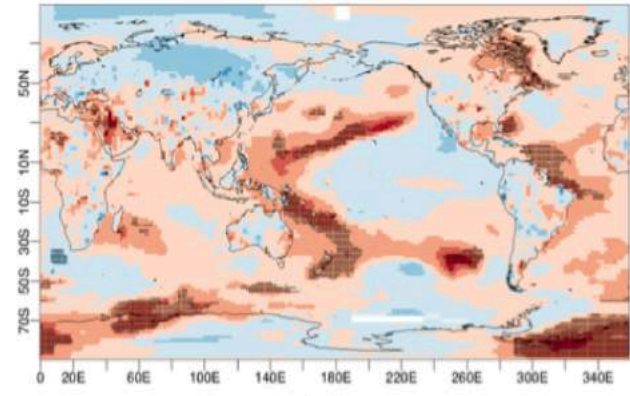
- A large part of the skill of decadal forecast systems is directly related to volcanic forcing in retrospective hindcasts.
- ENSO skill is not affected by volcanic forcing in EC-Earth forecasts.



(a) Total skill



(b) Initialisation



(c) Volcanic forcing

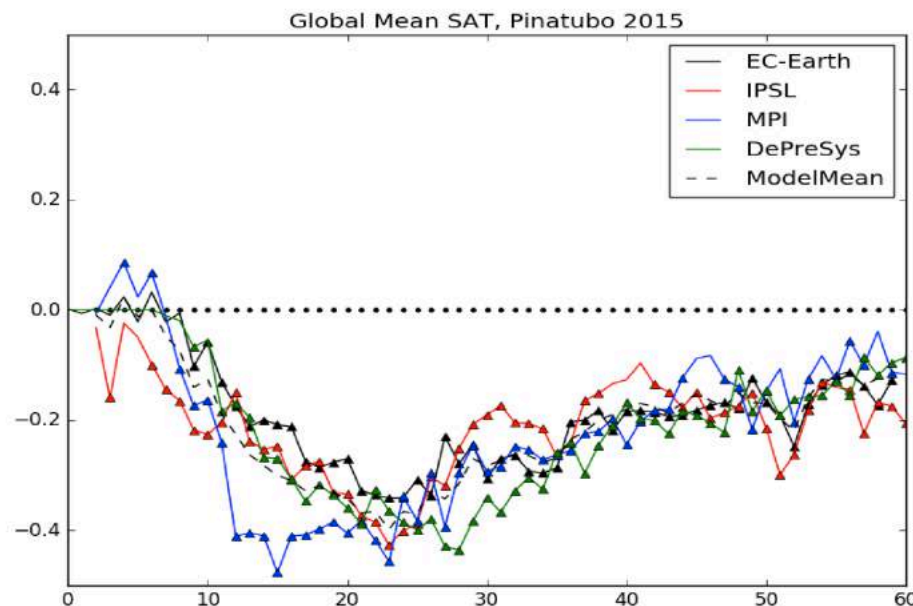
Temperature forecast, years 1-3, 1961-2001; (a) skill and contributions from (b) initialisation and (c) volcanic forcing, Siegert et al., 2017; Ménégos et al., 2018



RESULTADOS CIENTÍFICO-TÉCNICOS

Objective 3: Forecasting the climate response to a new volcanic eruption.

- Defining volcanic forcing in real-time forecasts
=> Two protocols have been tested and validated (*Ménégoz et al., 2018*)
- Multi-model forecast over 2015-2020 including a fictitious Pinatubo eruption



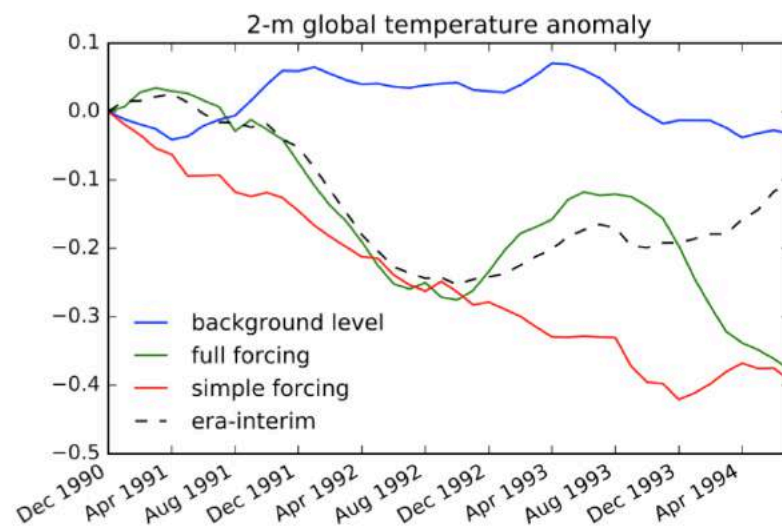
Multi-model global temperature anomaly forecasted after a 2015 Pinatubo eruption, BSC technical report, in preparation.



RESULTADOS CIENTÍFICO-TÉCNICOS

Objective 3: Forecasting the climate response to a new volcanic eruption.

- Defining volcanic forcing in real-time forecasts
=> Two protocols have been tested and validated (*Ménégoz et al., 2018*)
- Multi-model forecast over 2015-2020 including a fictive Pinatubo eruption
- Developing a new scheme for stratospheric aerosol forcing in EC-Earth.



Global temperature anomaly estimated from the era-interim reanalysis and simulated over 1990-1995 excluding (background level) and including the Pinatubo forcing with a “simple” and a “full” scheme, ongoing task.



RESUMEN DE LOS RESULTADOS DEL PROYECTO

	Número	Indicios de calidad
Artículos científicos derivados del proyecto en revistas JCR (de ellos cuantos en acceso abierto)	4 (1)	4 Q1
Revisiones (surveys), editoriales y otros artículos científicos (de ellos cuantos en acceso abierto)	1 (1)	NA
Libros, capítulos de libros y monografías (nac/ internac)	0	NA
Conferencias en congresos (nacionales/internac, indicando cuántas por invitación).	6 / 4	NA
Patentes/Registros Software (indicar estado)	0	0



FORMACIÓN DE PERSONAL

Tesis doctorales realizadas relacionadas con el proyecto (con indicación de título, fecha de inicio y de lectura, e indicadores relativos a publicaciones derivadas)

N/A

Actividades de formación de predoctorales y/o personal técnico relacionadas con el proyecto (destacar / agregar)

N/A

Contrato Predoctoral asociado al proyecto

N/A



INTERNACIONALIZACIÓN DE LA INVESTIGACIÓN

- New aerosol scheme implemented in **the European model EC-Earth** (European consortium, <https://www.ec-earth.org/>).
- **Public deliverable** devoted to decadal forecasts and stratospheric aerosol (European project SPECS, D43.2; <http://www.specs-fp7.eu/>).
- A **Franco-Spanish collaboration** have been built through MORDICUS (Mété-France project; 2014-2018) and VOLCADEC to better understand natural and forced climate variability.
- The VOLCADEC activities are organised to reinforce the involvement of the BSC in the **CMIP6 activities**, and in particular in VolMIP (<http://volmip.org/>).



Otros aspectos destacables relacionados con el proyecto

- **R Package developed for forecast verification** (s2dverification, Manubens et al., 2017), and protocols developed to evaluate forecast systems (Siegert et al., 2017).
- **Granted from 2 projects from the “Red Española de Supercomputacion (RES)**, referenced as “Volcanic activity in seasonal to decadal climate forecasts” (AECT-2017-2-0009 and AECT-2018-1-0006, for a total of **876 Kh CPU**).



EJECUCIÓN DEL PRESUPUESTO

Concepto	Ejecutado: Cantidad y (%)	Existen cambios relevantes respecto a solicitud original? (*)
Inventariable	2 012,91 € (100%)	No
Personal	94 230,34 € (84%)	No
Fungible	1 505,80 € (25%)	No
Viajes y dietas	3 907,06 € (21%)	No
Total	99 643,20 € (72%)	No



PLANTEAMIENTO FUTURO



The new stratospheric aerosol scheme will be used:

- To better understand the dynamical response to volcanic eruptions, in the framework of the VOLMIP activities (CMIP6, international).
- To better simulate the stratosphere-troposphere interactions, essential to reproduce the inter-annual variability and to produce seasonal-to-decadal forecasts (EC-Earth European model).

