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# STILLING PROJECT: ADVANCES IN THE COMPILATION AND HOMOGENIZATION OF HISTORICAL WIND SPEED DATA FOR THE ASSESSMENT OF THE STILLING PHENOMENON

CL5.03 - *Climate Data Homogenisation and Analysis of Climate Variability, Trends and Extremes*

POSTER # EGU2018-15160


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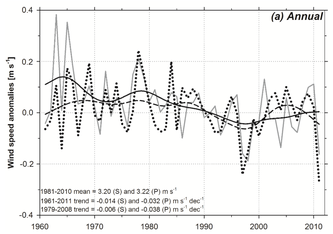
**ABSTRACT.** During the last decade scientists have reported a terrestrial slowdown in wind speed across the world. This weakening in wind speed has been recently termed the "stilling" phenomenon, with a worldwide average trend of -0.140 m $s^{-1}$ $decade^{-1}$ reported since the 1960s. The precise causes of this "stilling" remain largely uncertain and have been hypothetically attributed to several factors, mainly related to an increase in surface roughness (i.e. forest growth, land use changes, and urbanization) with little attention paid to changes in atmospheric circulation. Unlike this "stilling" over land, satellite measurements have revealed that wind speed has increased over ocean surfaces, which introduces uncertainty to the "stilling" debate. Therefore, scientists are currently debating if global warming has and will impact on changes in wind speed. The uncertainty on the causes driving the "stilling" over land is mainly due to short availability (i.e. since the 1960s) and low quality of observed wind speed records as stated by the Fifth Assessment Report (AR5) of the Intergovernmental Panel on Climate Change (IPCC) and the recent report "State of the Climate in 2016" . The main objective of the ongoing EU funded project STILLING (MSCAIF-2015 GA-703733) is to fill the key gap of short availability and low quality of wind speed datasets, and improve the limited knowledge on the causes driving the "stilling" in a climate change scenario. This has not yet been addressed by the scientific community due to (i) scientists have traditionally paid little attention on variability of wind speed; (ii) digitization of climate series at National Weather Services (NWS) systematically started in the 1960s, however, some longer but isolated past wind speed records are available for scientists to be rescued and analyzed; and (iii) efforts on advances in homogenization algorithms to improve quality of wind speed series have been scarce. The STILLING project covers a novel research niche on the "stilling" debate, and this contribution will present an overview of the project about the compilation and homogenization of historical wind speed data (prior to the 1960s) to better assess trends/cycles and causes on multidecadal time periods and reliable datasets than previous studies.


## 1.STILLING PHENOMENON

➢While most climate change and variability research has traditionally focused on air temperature and precipitation, **only over the last 20-years scientists have paid attention to analyze wind speed trends**.

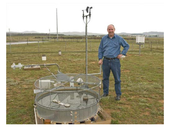



Azorin-Molina *et al.* 2014
*"Homogenization and Assessment of Observed Near-Surface Wind Speed Trends over Spain and Portugal, 1961–2011"*
*Journal of Climate, 27 (10), 3692-3712*

➢A major finding of this research has been the widespread decline in measured near-surface wind speed: termed **"STILLING"**

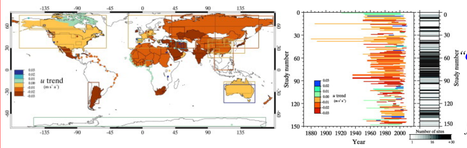
### Definition of the "Stilling"

➢ **Roderick *et al.* (2007)** evoked the term "STILLING" to refer to this decline of observed near-surface wind speed.



Roderick *et al.* 2007
*"On the attribution of changing pan evaporation"*
*Geophysical Research Letters, 34, L17403*

➢ **McVicar *et al.* (2012)** quantified the slowdown of wind speed in -0.140 meter per second per decade (m $s^{-1}$ $dec^{-1}$) detected on average over mid-latitude continental surfaces, particularly of the northern hemisphere, in the last 30-50 years.



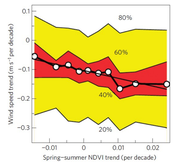

McVicar *et al.* 2012
*"Global review and synthesis of trends in observed terrestrial near-surface wind speeds: Implications for evaporation""*
*Journal of Hydrology, 416-417, 182-205*

## 2. INTEREST OF SCIENTISTS AND MEDIA


**WIKIPEDIA: Global terrestrial stilling**
https://en.wikipedia.org/wiki/Global_terrestrial_stilling

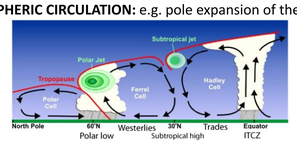
## 3. MAJOR CAUSES OF THE STILLING PHENOMENON

➢**INCREASE OF LAND SURFACE ROUGHNESS:** e.g., forest growth, land use changes and urbanization.



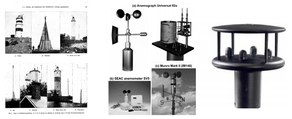

Vautard *et al.* 2010
*Northern Hemisphere atmospheric stilling partly attributed to an increase in surface roughness*
*Nature Geoscience, DOI: 10.1038/NGEO979*

➢**ATMOSPHERIC CIRCULATION:** e.g. pole expansion of the Hadley cell, slowdown in large-scale atmospheric circulation.




Lu *et al.* 2007
*Expansion of the Hadley cell under global warming*
*Geophysical Research Letters, 34(6), L06805*

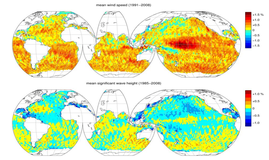
➢**INSTRUMENTAL, OBSERVATIONAL AND MEASURING ISSUES:** e.g. relocation of stations, changes of anemometer devices (sonic), changes of height of anemometers, calibration, measuring time-intervals, instrumental drift.



Wan *et al.* 2010
*Homogenization and trend analysis of Canadian near-surface wind speeds*
*Journal of Climate, 23 (5), 1209-1225.*

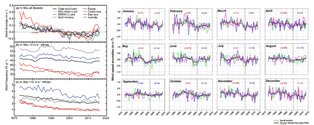
## 4. UNCERTAINTIES

➢**INCREASING TRENDS OVER OCEAN:** opposite global increasing trends observed over ocean surfaces.




Wentz *et al.* 2007
*How much more rain will global warming bring?*
*Science, 317(5835), 233-235*
Young *et al.* 2011
*Global trends in wind speed and wave height*
*Science, 332(6028), 451-455*

➢ **RECENT REBOUND IN WIND SPEED:** some recent studies have noticed a slight recovery of wind speed after the 2010s.



Dunn *et al.* 2016
*SotC 2015, Surface winds*
*BAMS, 97(8), S38-S40*
Azorin-Molina *et al.* 2017
*SotC 2016, Surface winds*
*BAMS, 98(8), S37-S39*

➢ **UNCLEAR EVIDENCES IN THE MID- AND UPPER LEVELS OF THE TROPOSPHERE:** decoupling in wind speed trends between low-level and mountain weather stations.


McVicar *et al.* 2010
*Observational evidence from two mountainous regions that near-surface wind speeds are declining more rapidly at higher elevations than lower elevations: 1960–2006*
*Geophysical Research Letters, 37(6)*

## 5. THE STILLING project: *TowardS improved undersTandIng of the worLdwide decline of wind speed in a cLImate chaNGe scenario*

### STILLING

**H2020-MSCA-IF-2015**


**Standard EF**

**HOSTED BY**

**BENEFICIARY**
UNIVERSITY OF GOTHENBURG
Regional Climate Group

**PARTNER ORG. (Secondment)**
Royal Netherlands Meteorological Institute
Ministry of Infrastructure and the Environment
KNMI

**SUPERVISOR:** Prof. Deliang Chen (UGOT)

**CO-SUPERVISOR:** Dr. Albert Klein-Tank (KNMI)

**RESEARCHER:** Dr. Cesar Azorin-Molina

### EXCELLENCE

**"GLOBAL STILLING"**

***Unexpected weakening in wind speed across the world since around the 1980s***


**WHY WINDS ARE SLOWING WORLDWIDE?**

***The precise causes are uncertain due to two key constraints:***

* ***Short availability (since the 1960s) &***
* ***Low quality of wind speed records***

**SCIENTIFIC AIM**

***To address the gap in the knowledge of the causes driving the "global stilling" in a climate change scenario***

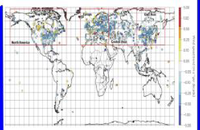
### IMPLEMENTATION

**WP1**

COMPILATION & HOMOGENIZATION OF HISTORICAL WIND SPEED DATA (prior to the 1960s)

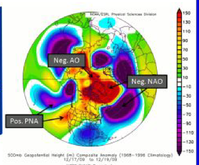
**WP2**

ASSESSMENT OF WIND SPEED TRENDS & CYCLES SINCE LATE 19th CENTURY



**WP3**

ATTRIBUTION OF WIND SPEED TRENDS & CYCLES TO LARGE-SCALE ATMOSPHERIC CIRCULATION



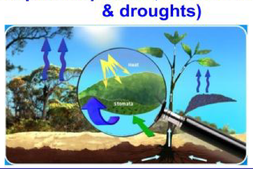

**WP4**

### IMPACT

**SCIENTIFIC**
**(e.g., confirm/change dogma of "global stilling")**

**SOCIOECONOMIC**
**(e.g., long-term wind power generation)**

**ENVIRONMENTAL**
**(e.g., evapotranspiration, water resources & droughts)**



### Concluding remarks

➢ The **compilation of centennial wind observations is crucial** for climate science focused on wind variability.

➢ **Wind data rescue over understudied regions** such as South America, Africa and Southeast Asia are strongly needed.

➢ Our previous experience in homogenizing wind datasets makes us confident to get **robust datasets**, but new approaches using e.g. 20CR should be validated.

➢The **STILLING project aims to closely work with C3S, ACRE, I-DARE initiatives** supplying rescued data or receiving any suggestion, support, new data, etc.!

**ANY COOPERATION AND NEW HISTORICAL WIND SPEED DATASETS ARE HGHLY WELCOME, AND WE STRONGLY ENCOURAGE YOUR CONTRIBUTION TO THE STILLING PROJECT, THANK YOU!**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