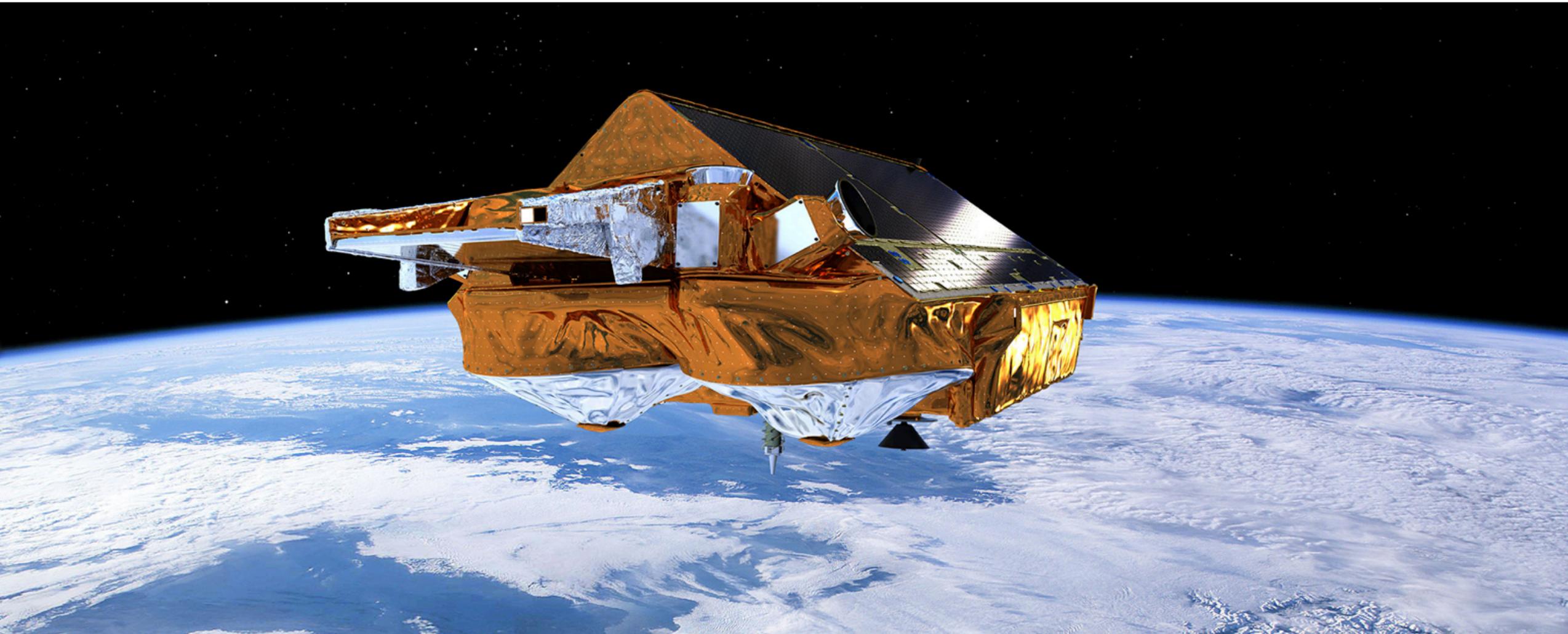


Exploiting observations to improve the predictive capacity in the Arctic, including its climate impacts

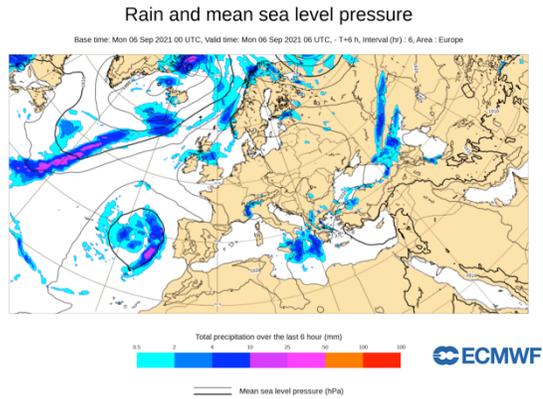


Dr. Pablo Ortega
Barcelona Supercomputing Center

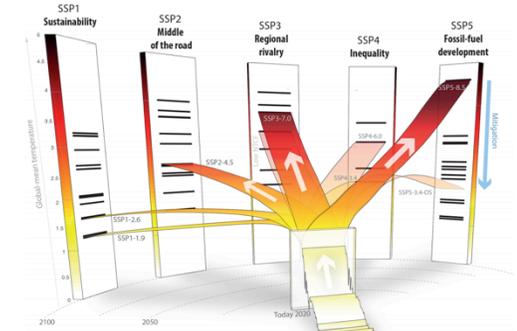


Fundamentals of Climate Prediction

Weather forecasts



Climate projections



Days

Weeks

Months

Seasons

Years

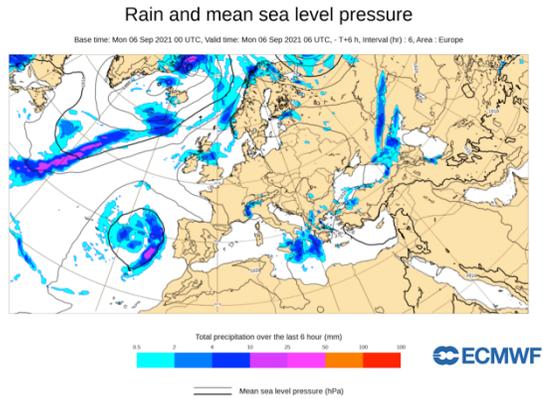
Decades

Centuries

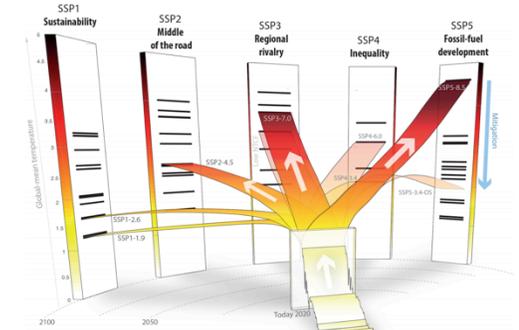


Fundamentals of Climate Prediction

Weather forecasts



Climate projections



Meinshausen et al. (2020)

Days

Weeks

Months

Seasons

Years

Decades

Centuries

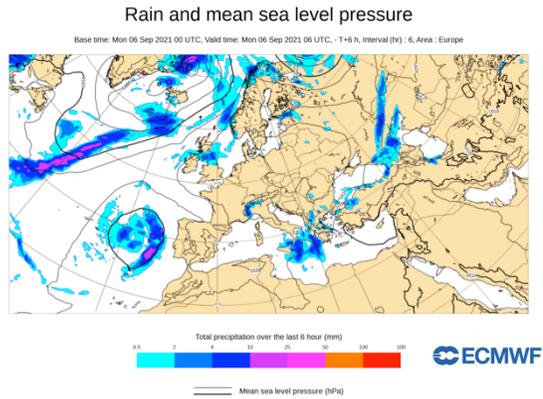
GHGs and Aerosols

Good guess of future changes in radiative forcing factors

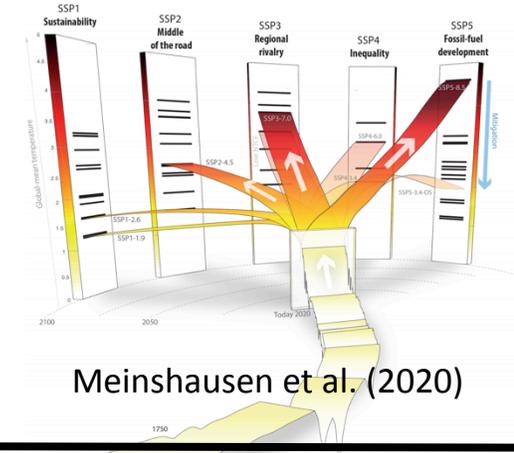


Fundamentals of Climate Prediction

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Days Weeks

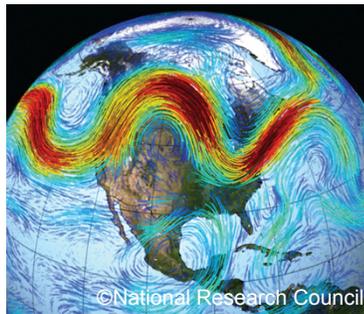
Months

Seasons

Years

Decades Centuries

Current Meteorological state



Initialization of **internal sources of predictability**

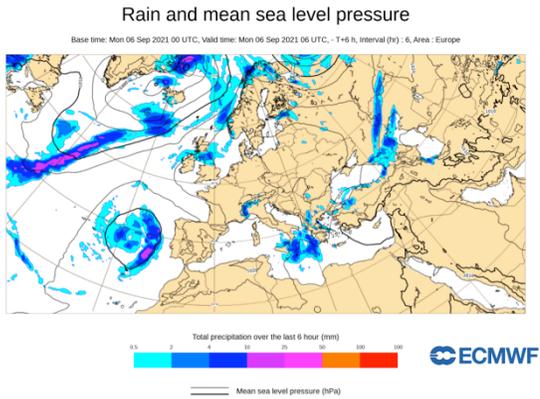
Good guess of future changes in **radiative forcing factors**

GHGs and Aerosols

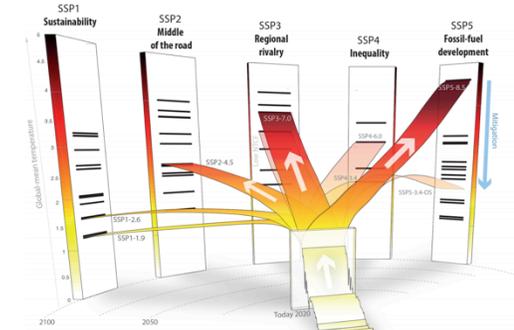


Fundamentals of Climate Prediction

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Climate projections



Meinshausen et al. (2020)

Days

Weeks

Months

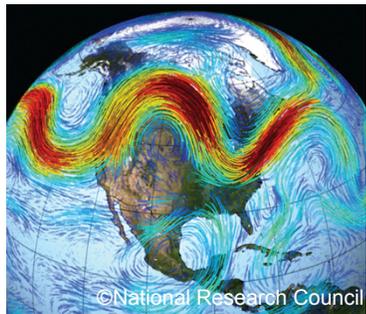
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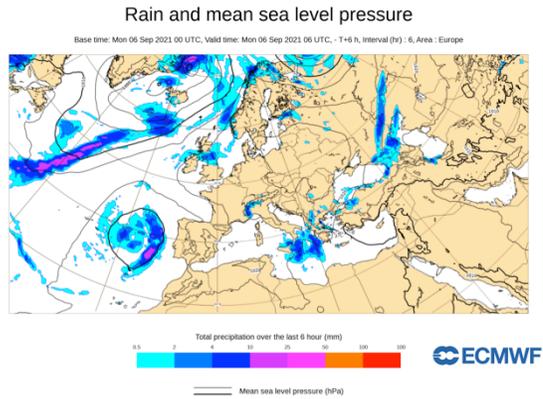
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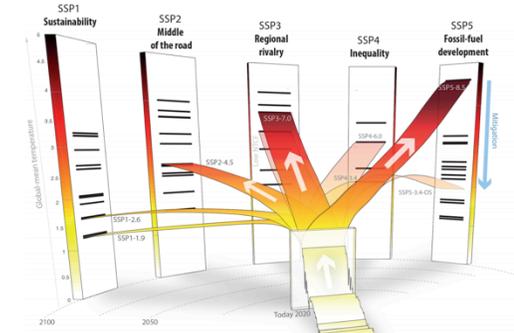


Fundamentals of Climate Prediction

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Climate projections



Meinshausen et al. (2020)

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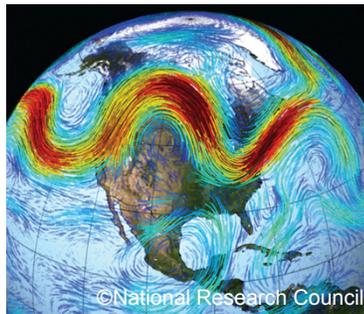
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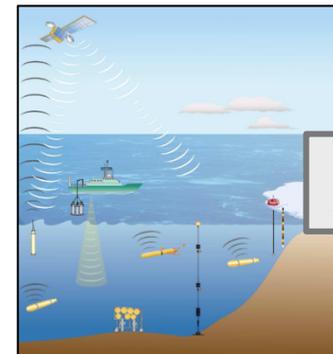
Current Meteorological state



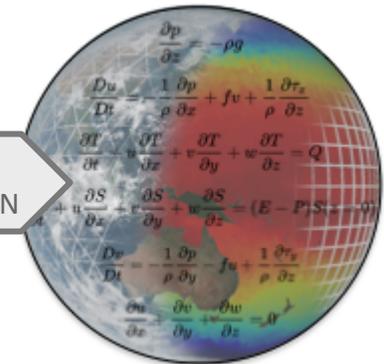
Initialization of internal sources of predictability



Observations



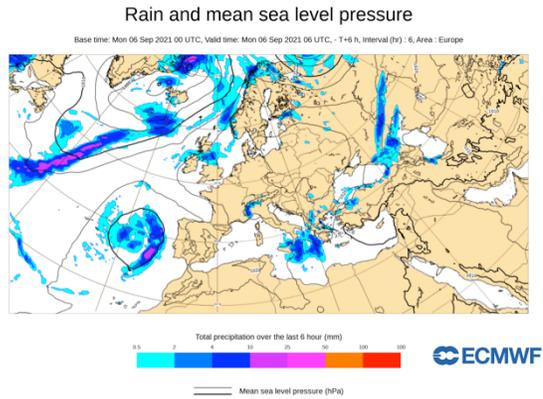
Global Earth System Model



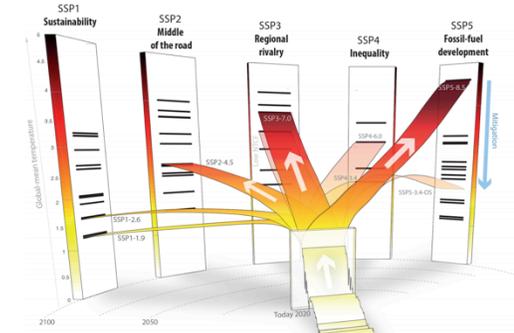
DATA ASSIMILATION

Fundamentals of Climate Prediction

Weather forecasts



Climate projections



Meinshausen et al. (2020)

Days

Weeks

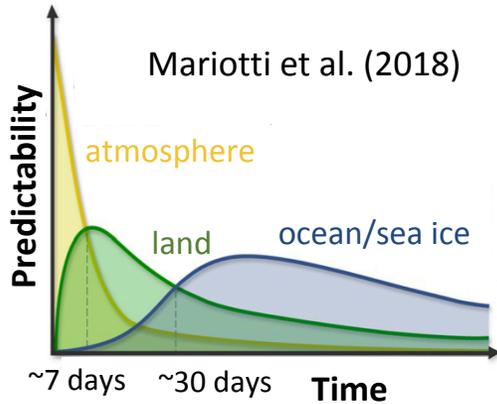
Months

Seasons

Years

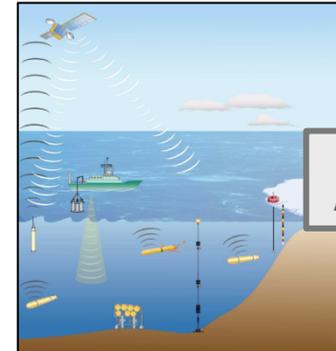
Decades

Centuries

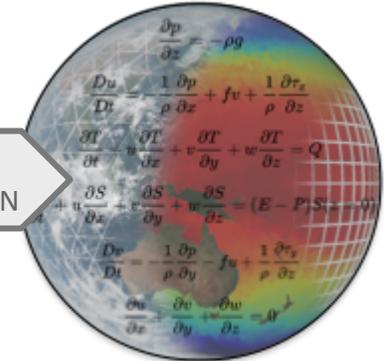


Predictability from slowly varying components of the Earth system

Observations



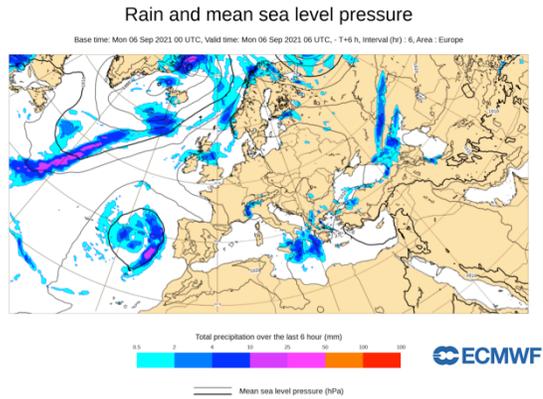
Global Earth System Model



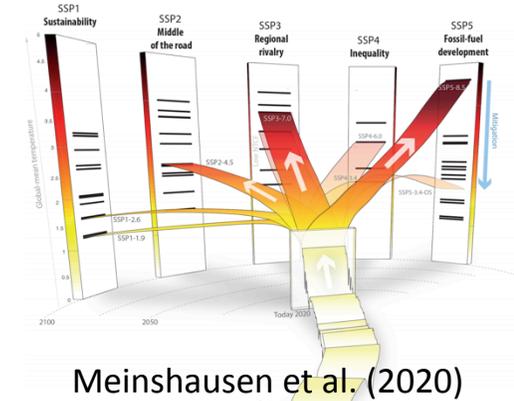
DATA ASSIMILATION

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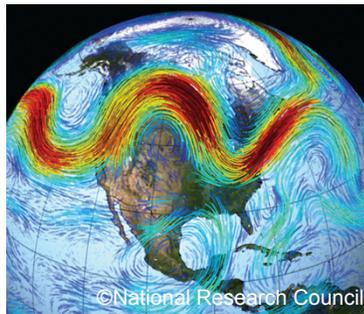
Seasons

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Initialization of internal sources of predictability

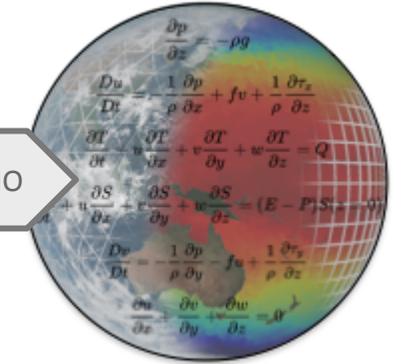


Observations



Global Earth System Model

DATA ASSIMILATION

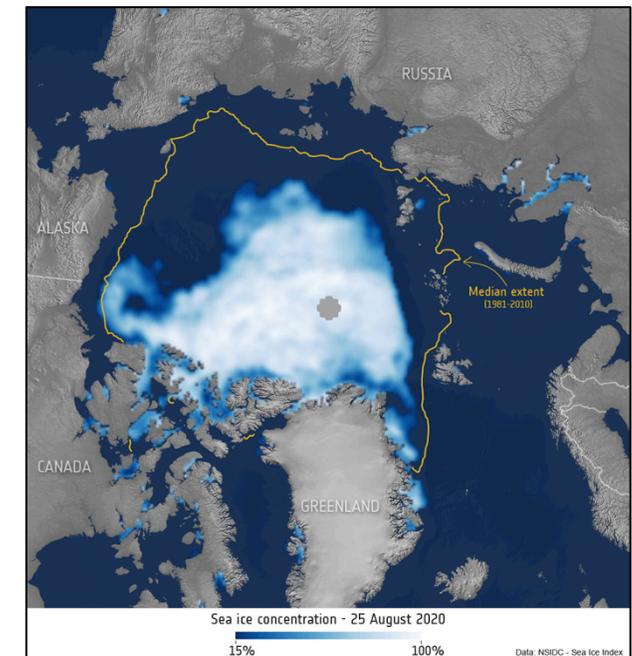


A growing network of Arctic observations

Satellite data are particularly useful for Arctic climate prediction

- Several decades of **uninterrupted spatially continuous fields** are already available covering the **whole Arctic region**
- This includes **key variables for the Arctic** such as:
 - **Sea ice concentration** (since 1979)
 - **Sea ice thickness** (since 2002)
- Thanks to their homogeneity in time and space, satellite data can be **easily assimilated** for forecast initialization

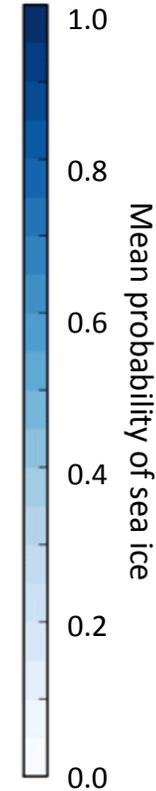
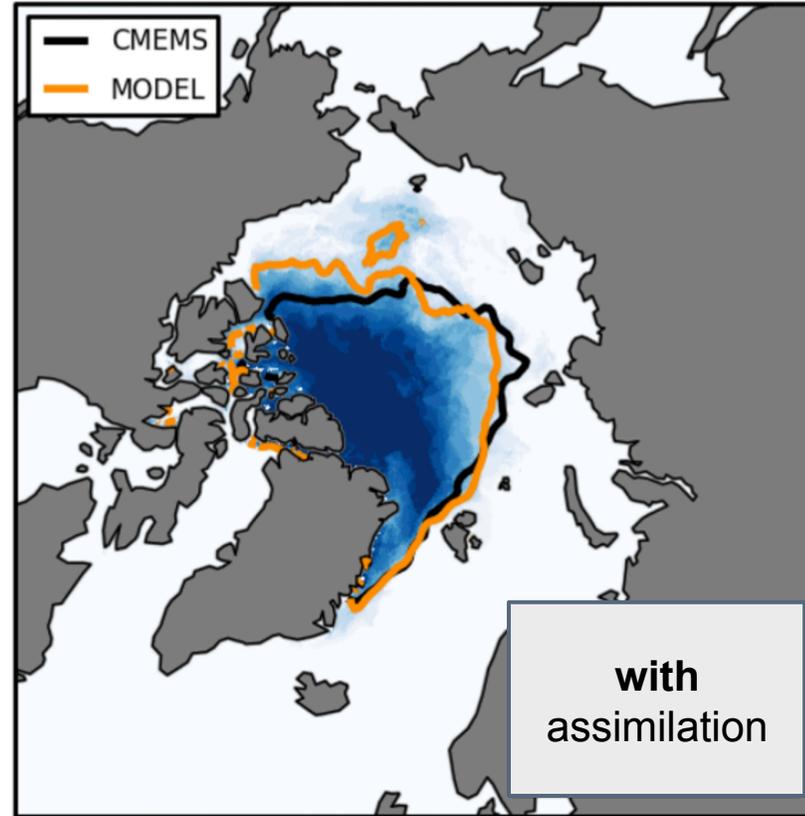
Sea ice concentration - 25 August 2020



Benefits of assimilating sea ice data (on Arctic)

Improvements in prediction skill for **september sea ice edge**

Assimilating Sea Ice Thickness



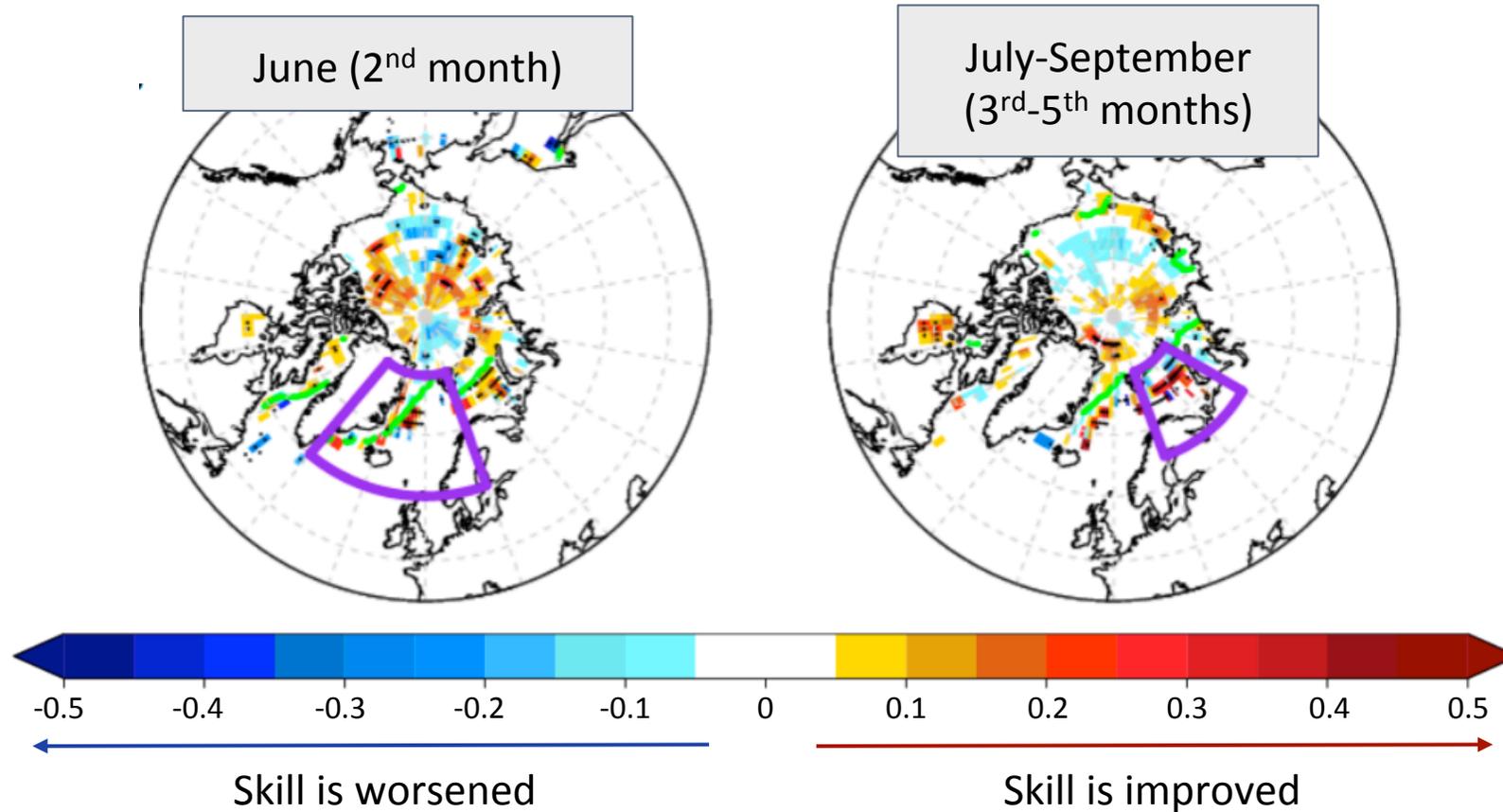
Model: **HadGEM**
Start month: **May**
Period: **2012**

Blockley & Peterson (2018)

Benefits of assimilating sea ice data (on Arctic)

Improvements in prediction skill for **summer sea ice concentrations**

Assimilating
Sea Ice Concentrations



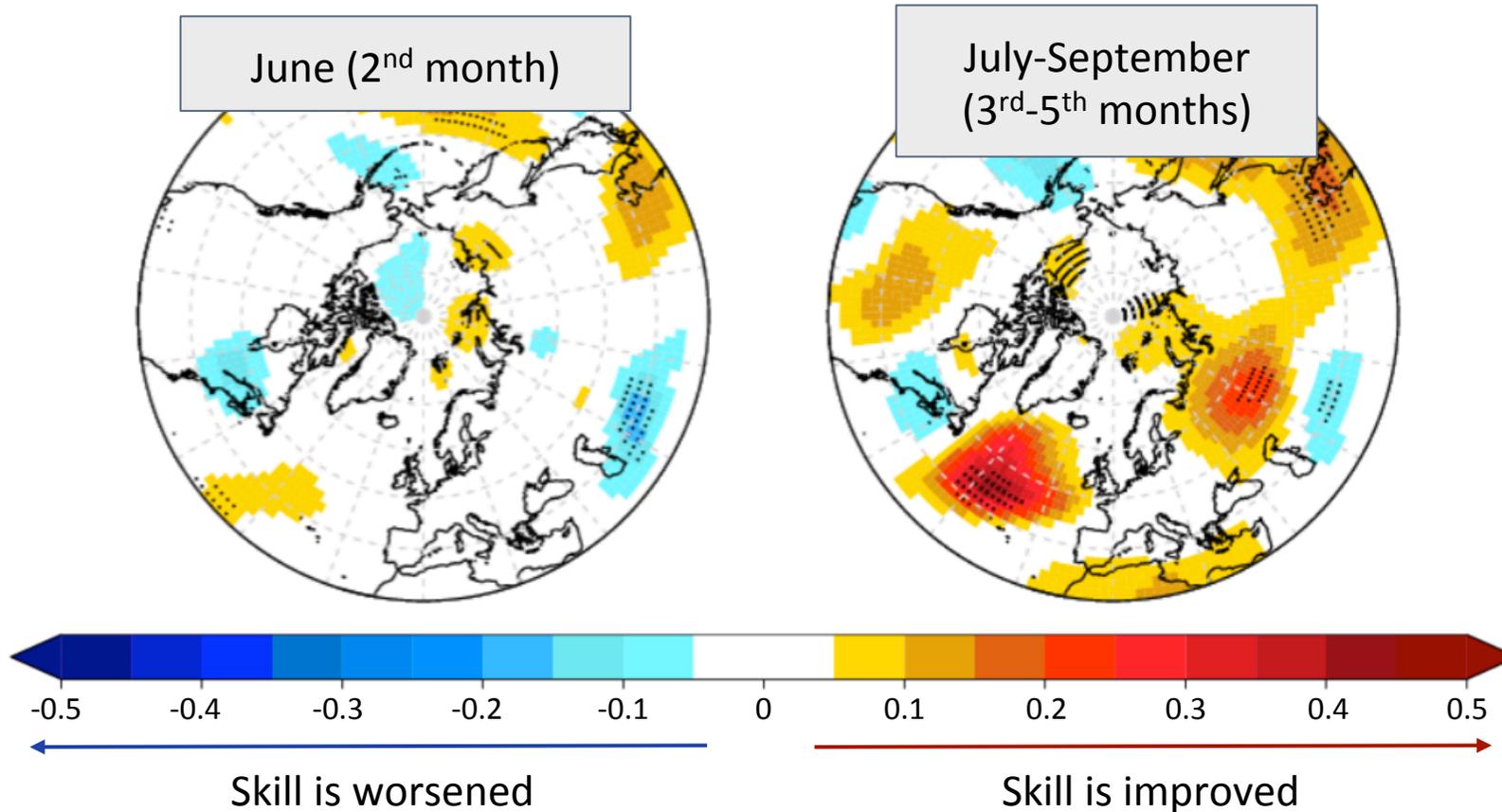
Model: **EC-Earth**
Start month: **May**
Period: **1992-2018**

Acosta-Navarro et al (in prep)

Benefits of assimilating sea ice data (beyond)

Improvements in prediction skill for summer atmospheric circulation

Assimilating Sea Ice Concentrations



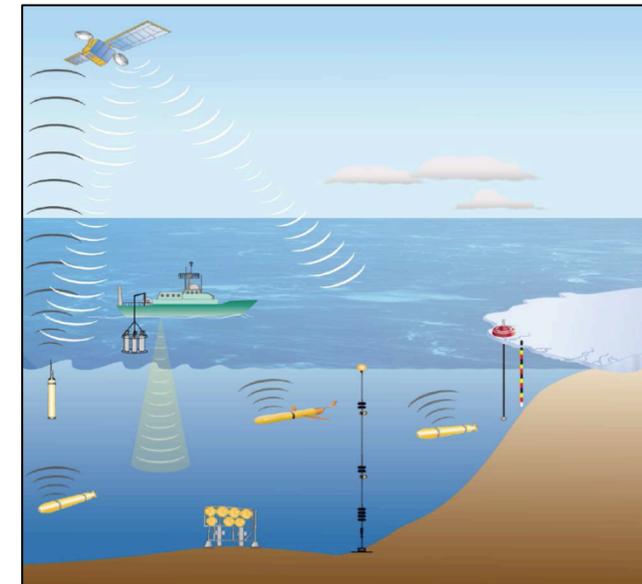
Model: **EC-Earth**
Start month: **May**
Period: **1992-2018**

Acosta-Navarro et al (in prep)

Take home messages

- **Arctic climate predictions are improving** their accuracy (and usefulness), benefiting from the increased observational network in the region
- **Benefits** in prediction skill are **also tangible beyond the Arctic**
- **Outside of the Arctic, ocean campaigns**, targeting in particular the ocean subsurface, **are also critical to** improve our understanding of the processes that govern the ocean circulation, its impacts on decadal variability (including the North Atlantic Cold Blob), and their **predictability**.

Sustained **observations are essential** to maintain and further develop current climate prediction capabilities



Key take home messages

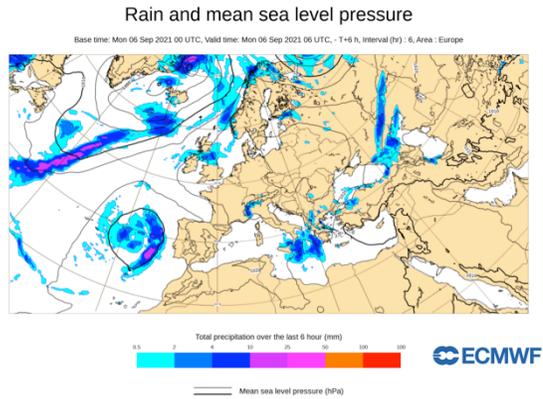


- **Arctic climate predictions are improving** their accuracy (and usefulness), benefiting from the increased observational network in the region
- **Benefits** in prediction skill are **also tangible beyond the Arctic**
- **Outside of the Arctic, ocean campaigns**, targeting in particular the ocean subsurface, which have been traditionally undersampled, **are also critical to** improve our understanding of the processes that govern the ocean circulation, its impacts on decadal climate variability (including the North Atlantic Cold Blob), and their **predictability**.
- Hence, **sustained observational efforts are essential** to maintain and further develop current climate prediction capabilities

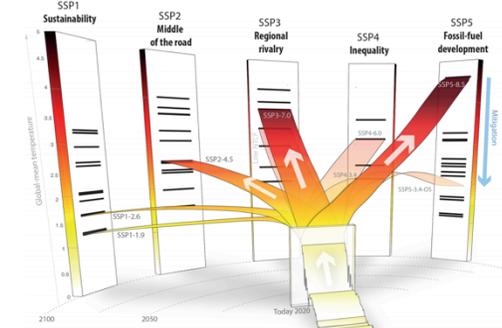


Cornerstones of Climate Prediction

Weather forecasts



Climate projections



Meinshausen et al. (2020)

Days Weeks

Months

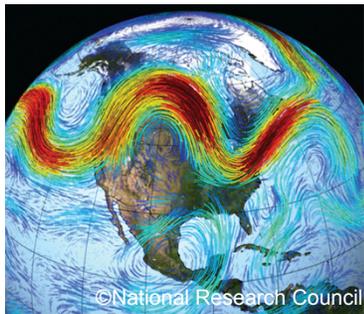
Seasons

Years

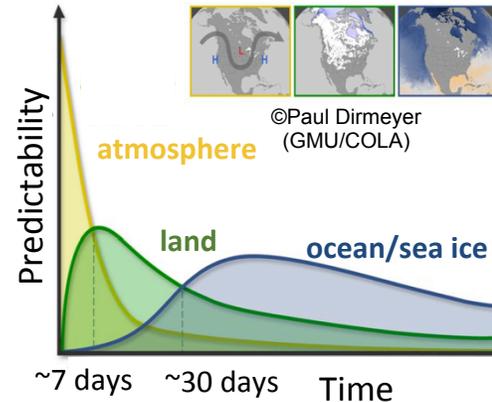
Decades

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Initialization of internal sources of predictability



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