12th International Workshop on Wave Hindcasting and Forecasting

Impact of a Warmer Climate on the Global Wave Field

Heinz Günther, *et al.*

Hawaii – November 2011

Helmholtz-Zentrum Geesthacht
Centre for Materials and Coastal Research

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Ralf Weisse
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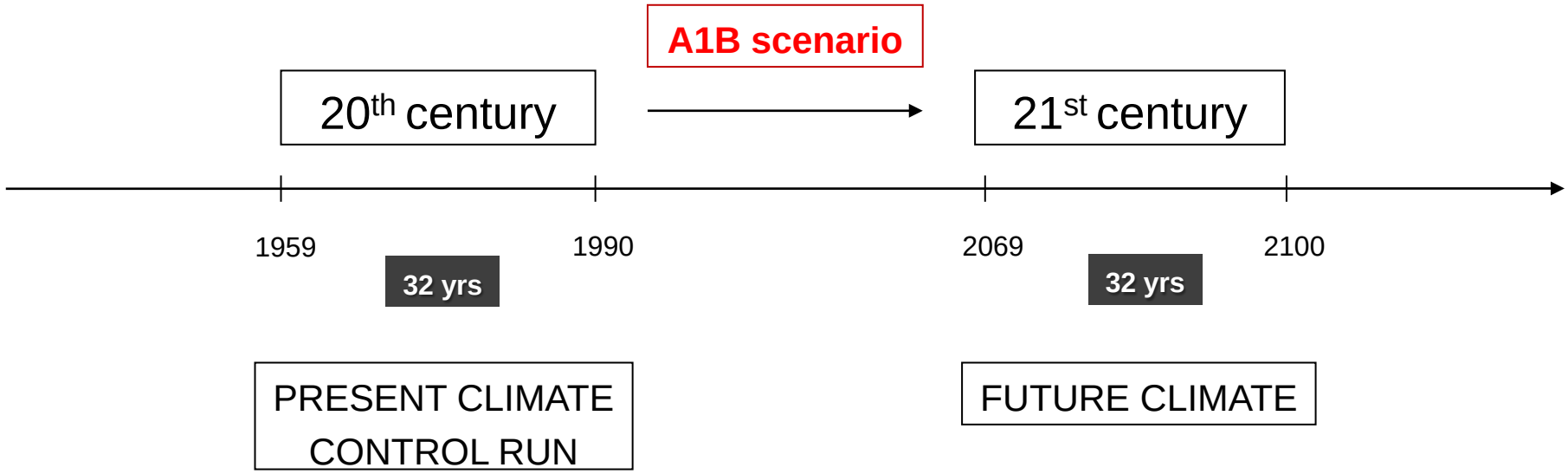
Uppsala University, Sweden and CINAV-Portuguese Naval Academy, Portugal

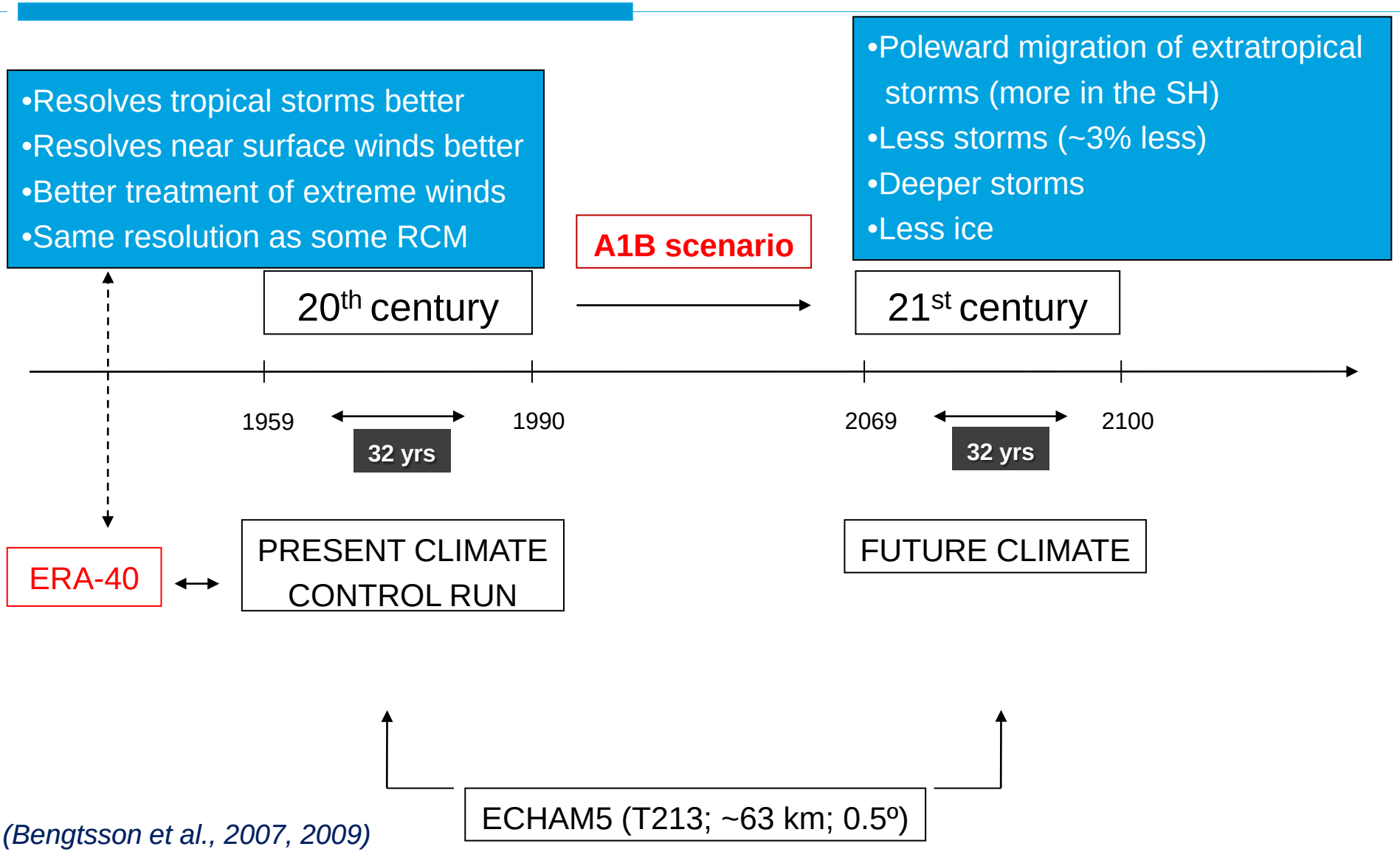
(4) Andreas Sterl
The Royal Netherlands Meteorological Institute

Impact of a Warmer Climate on the Global Wave Field



(Bengtsson et al., 2007, 2009)

Impact of a Warmer Climate on the Global Wave Field



(Bengtsson et al., 2007, 2009)

Impact of a Warmer Climate on the Global Wave Field

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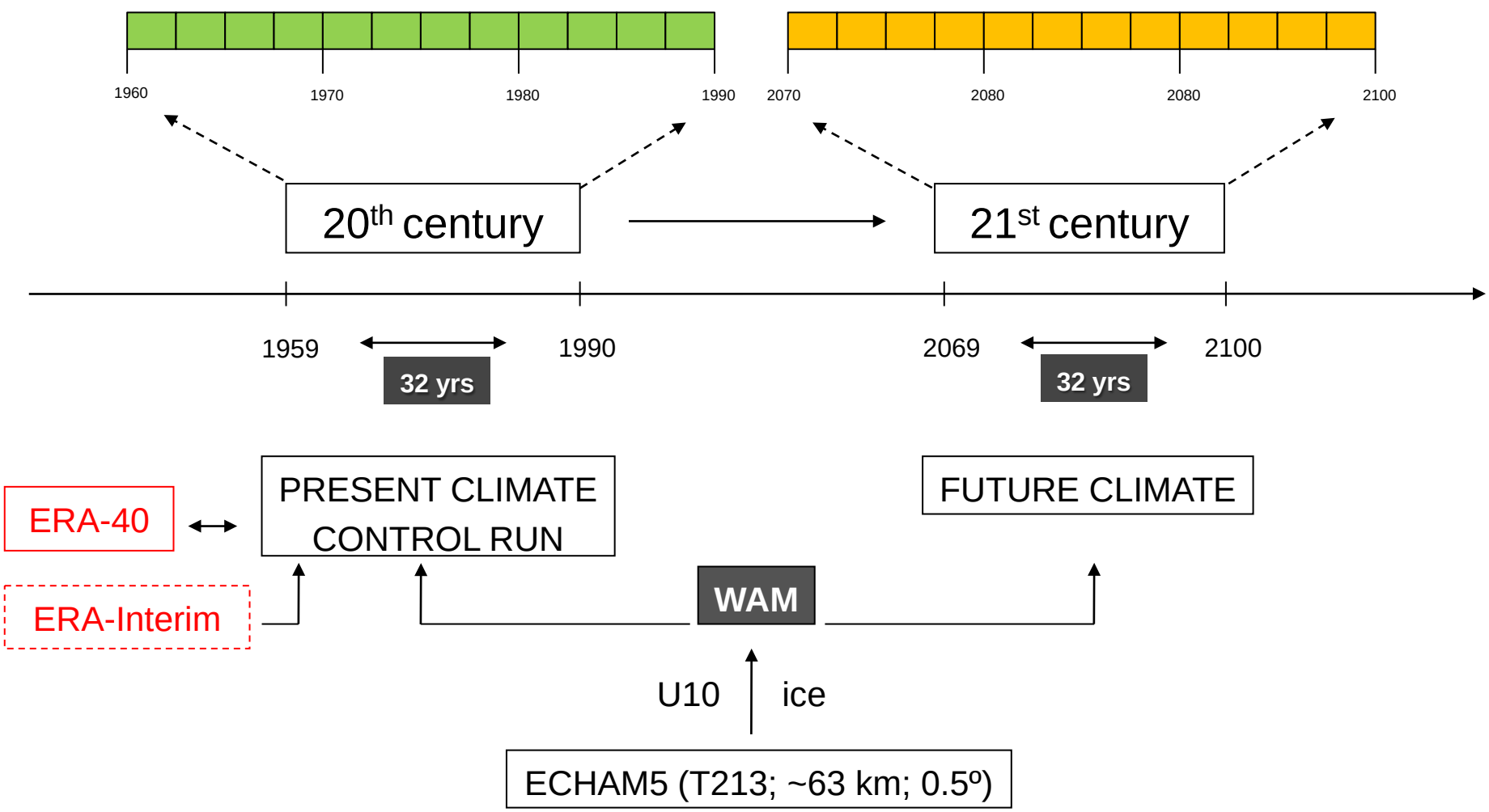

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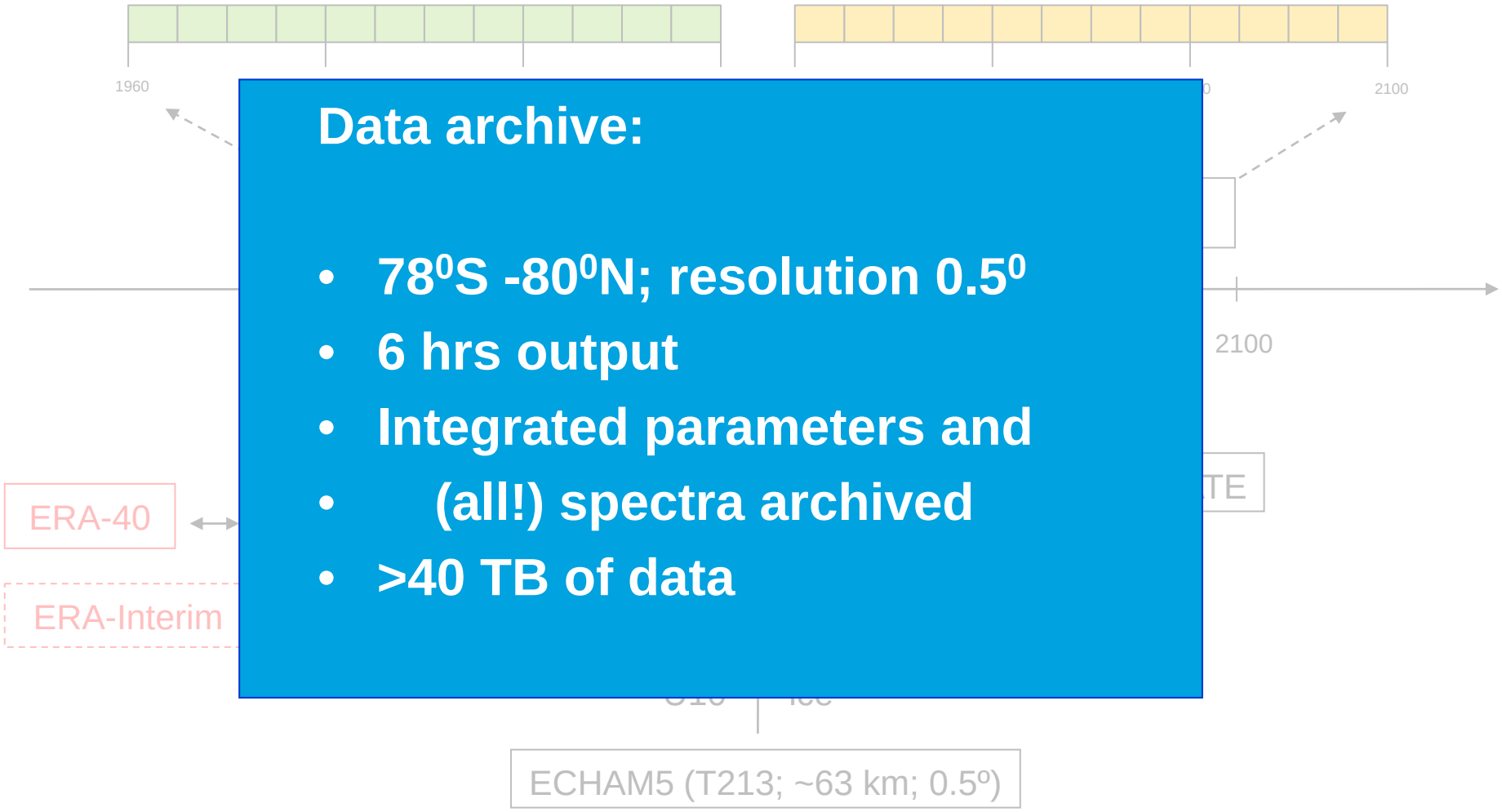


Data archive:

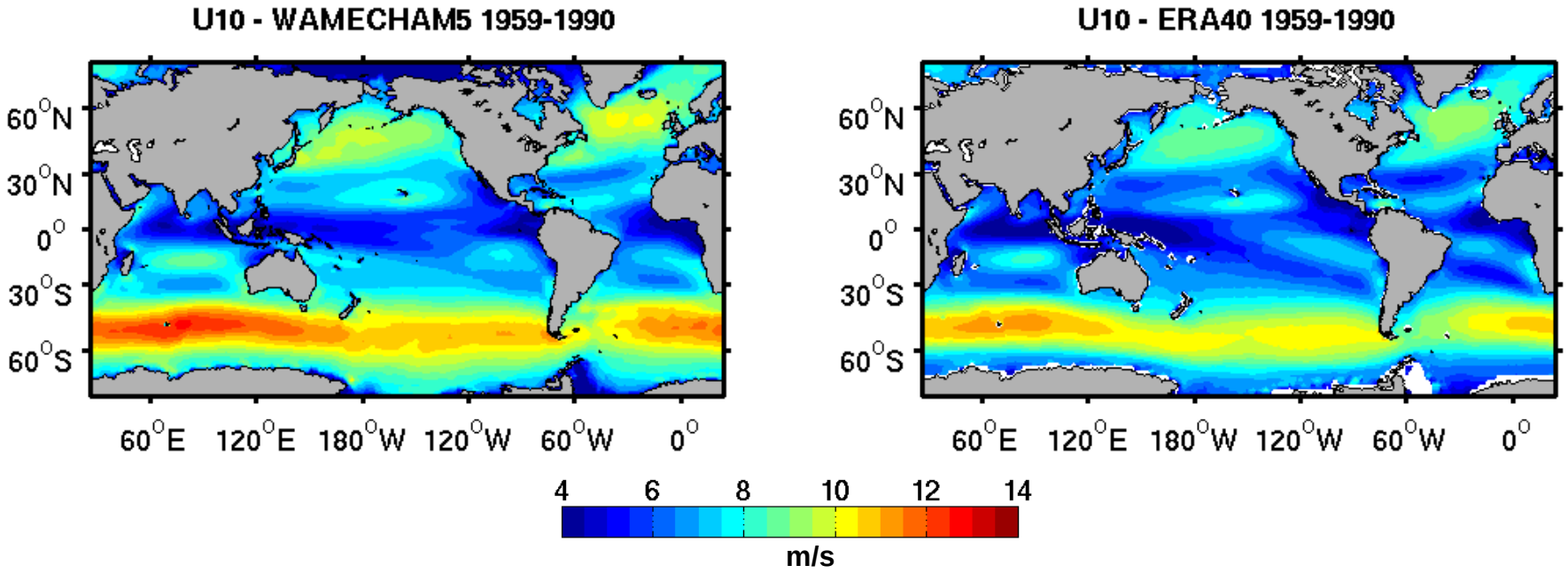
- **78^{0}S -80^{0}N; resolution 0.5^0**
- **6 hrs output**
- **Integrated parameters and**
- **(all!) spectra archived**
- **>40 TB of data**

Present climate run - validation

Validation of control run:

- **Comparisons (U10, Hs, and Tm1) with**
  - **ERA40 (1959-1990)**
  - **C-ERA40 (1959-1990)**
  - **ERA-Interim (1979-1990)**

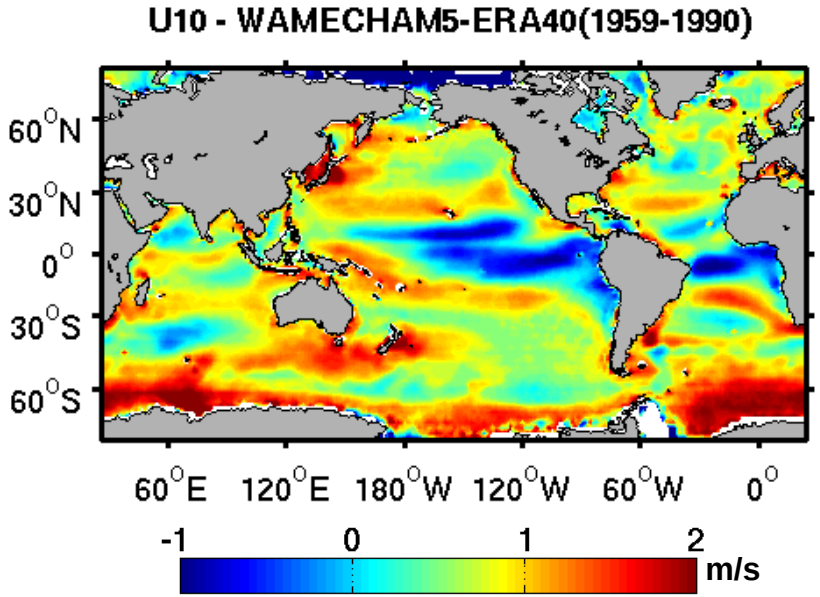
Present climate runs - validation

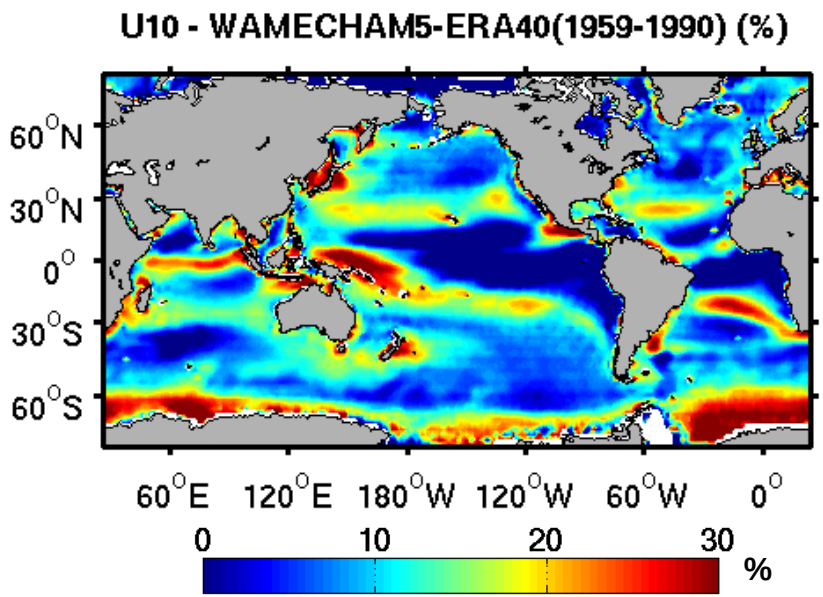


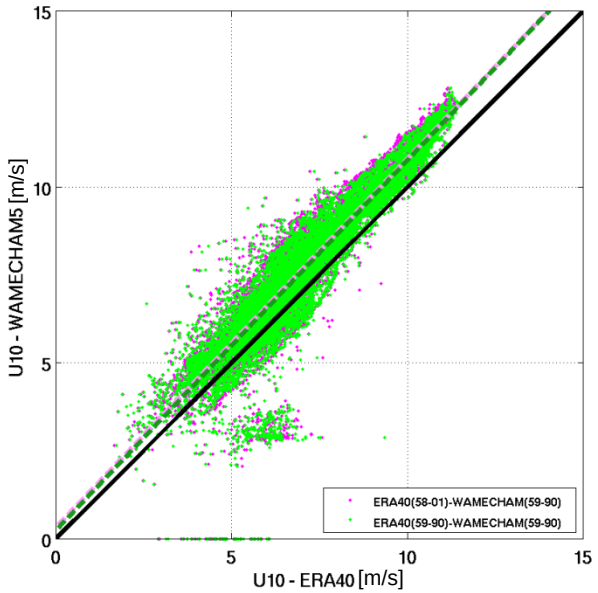
U10 yearly means

WAMECHAM5 vs ERA-40

Present climate runs - validation



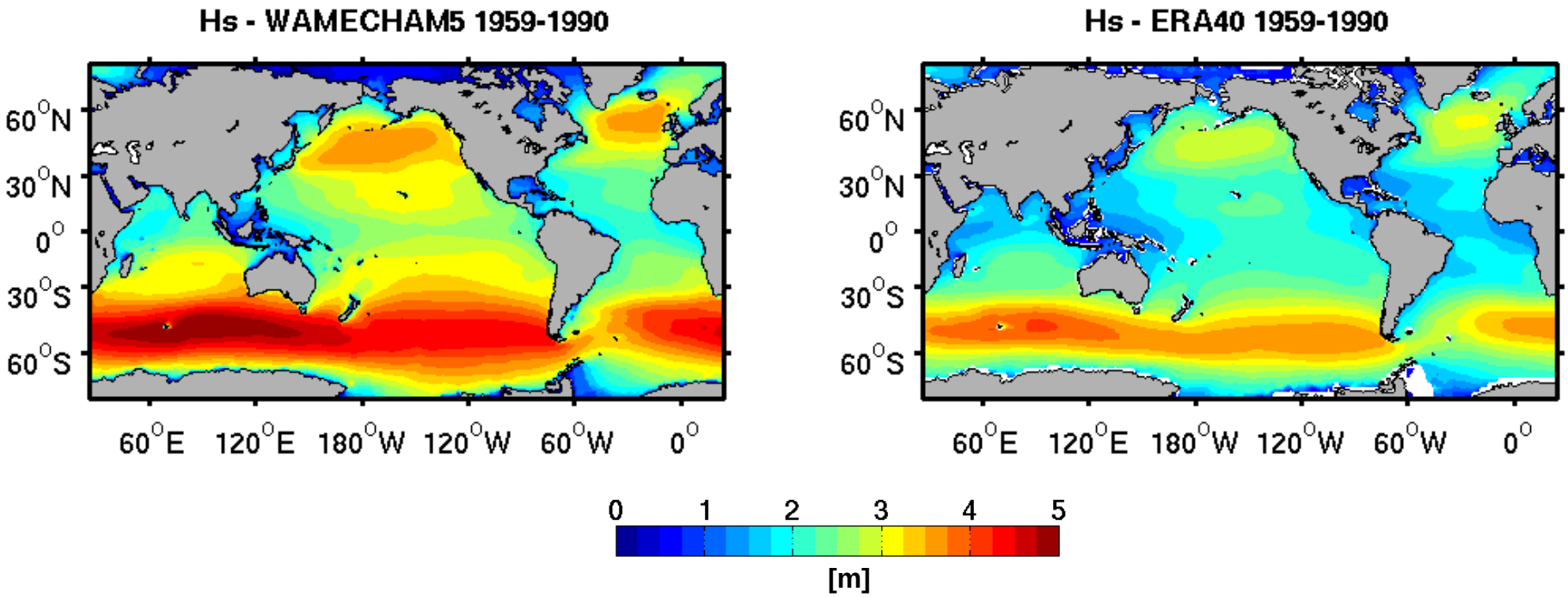




U10 yearly means

WAMECHAM5 vs ERA-40

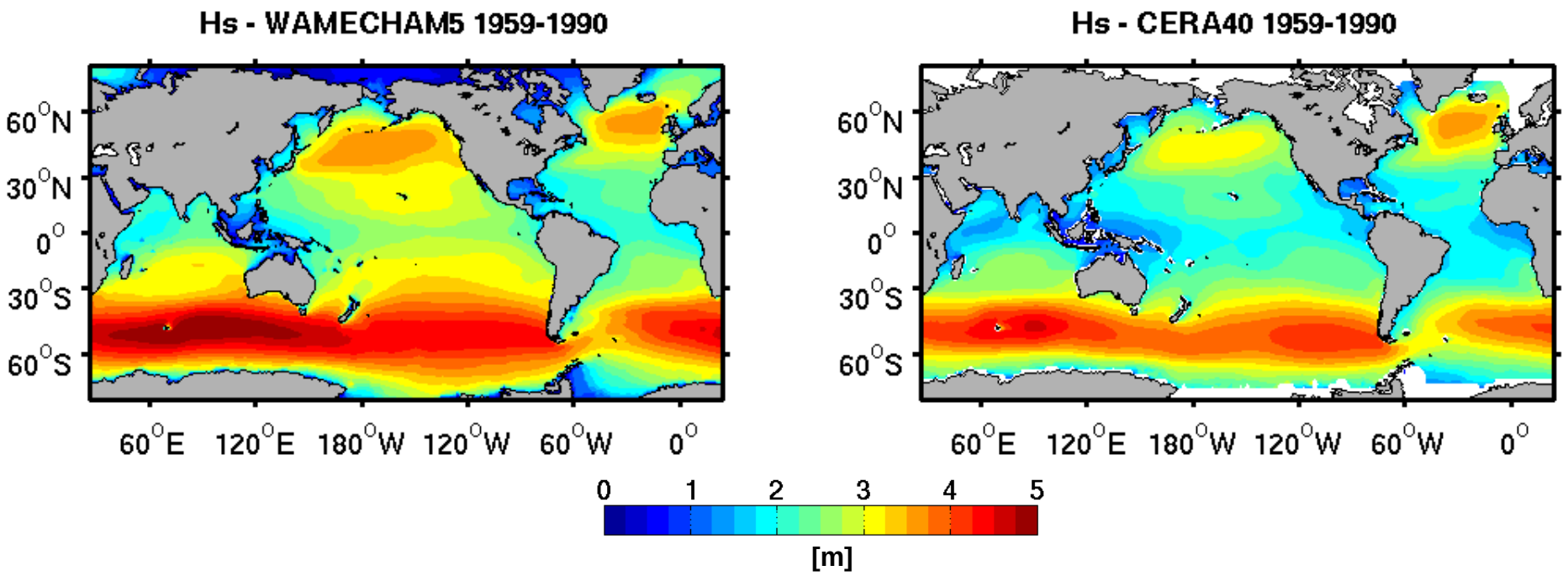
Present climate run - validation



Hs yearly means

WAMECHAM5 vs ERA40

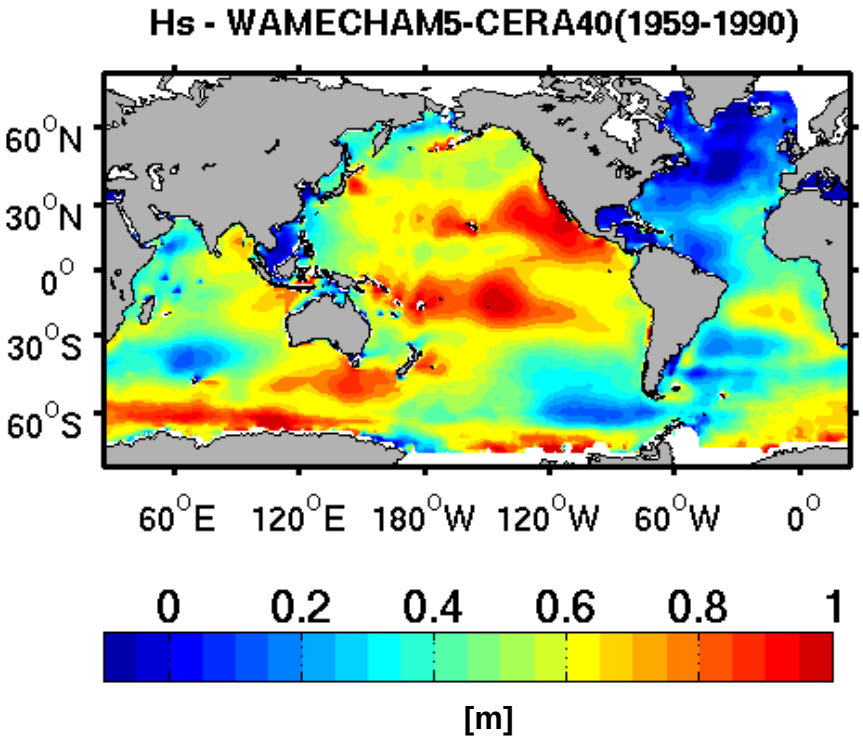
Present climate run - validation

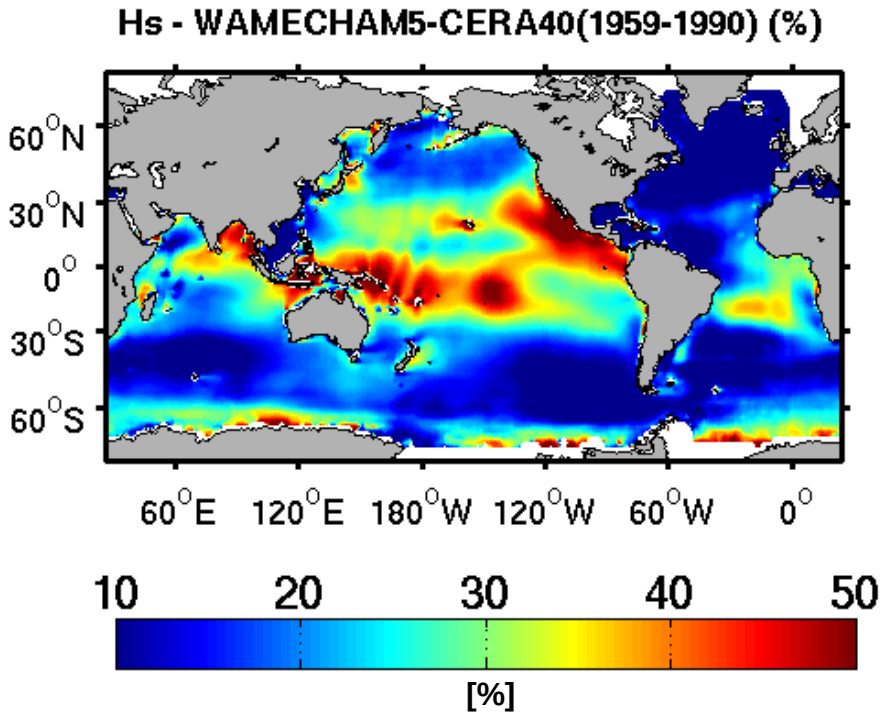


Hs yearly means

WAMECHAM5 vs C-ERA40

Present climate runs - validation

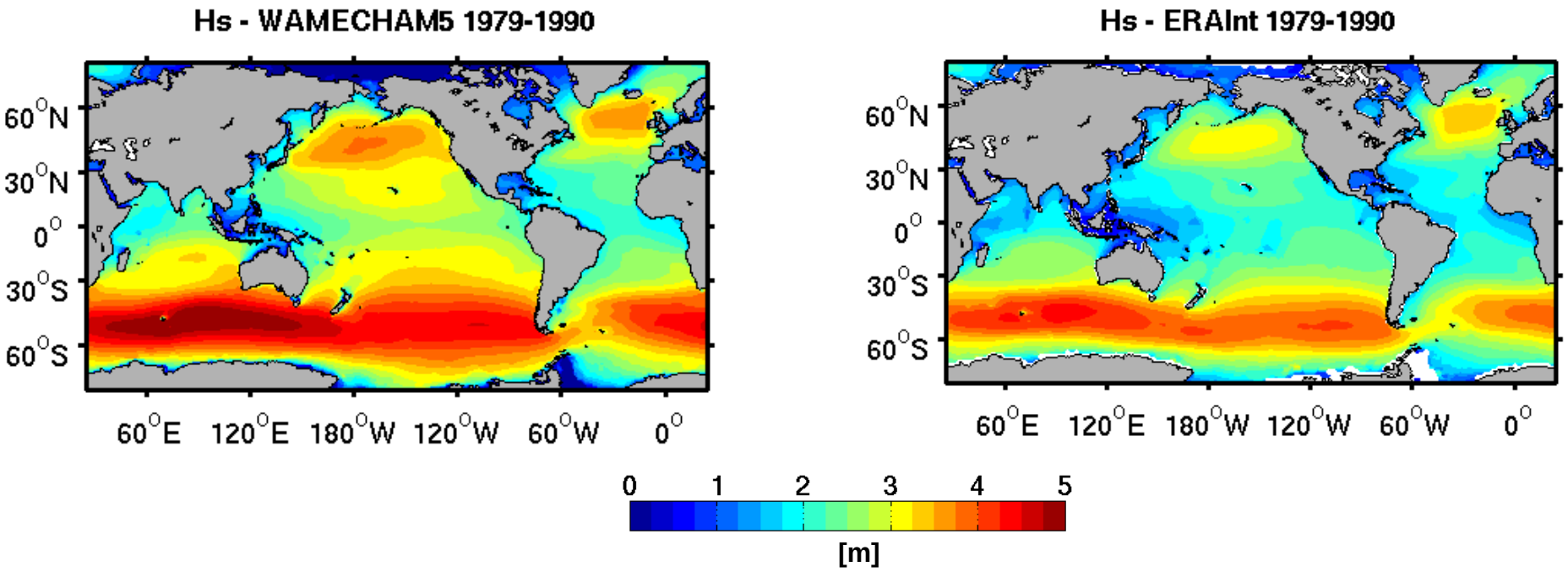




Hs yearly means

WAMECHAM5 vs C-ERA40

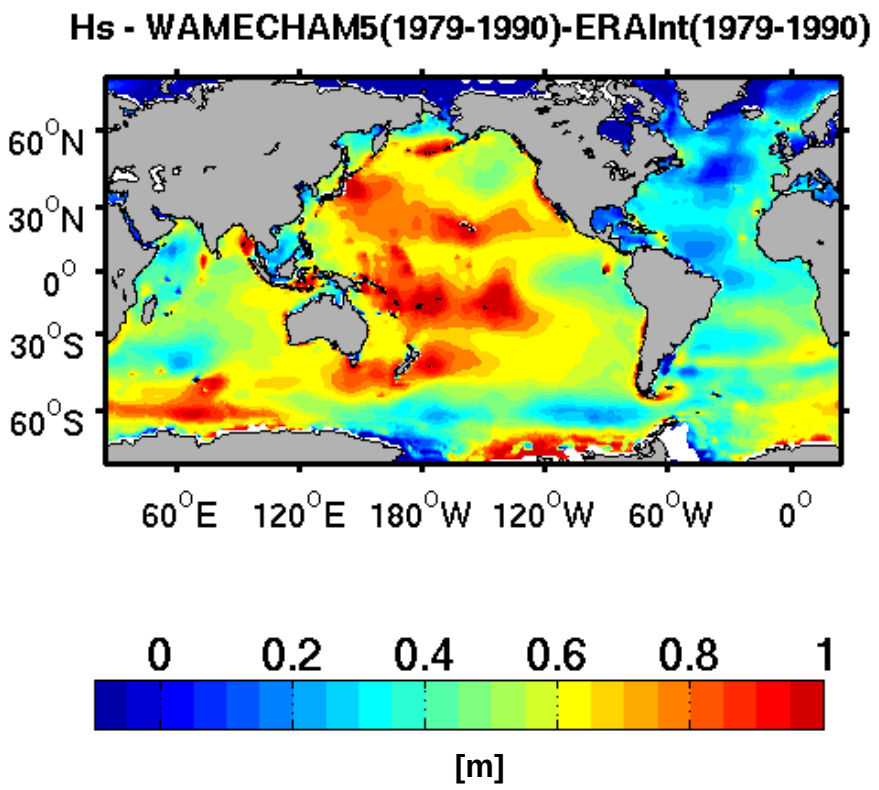
Present climate runs - validation

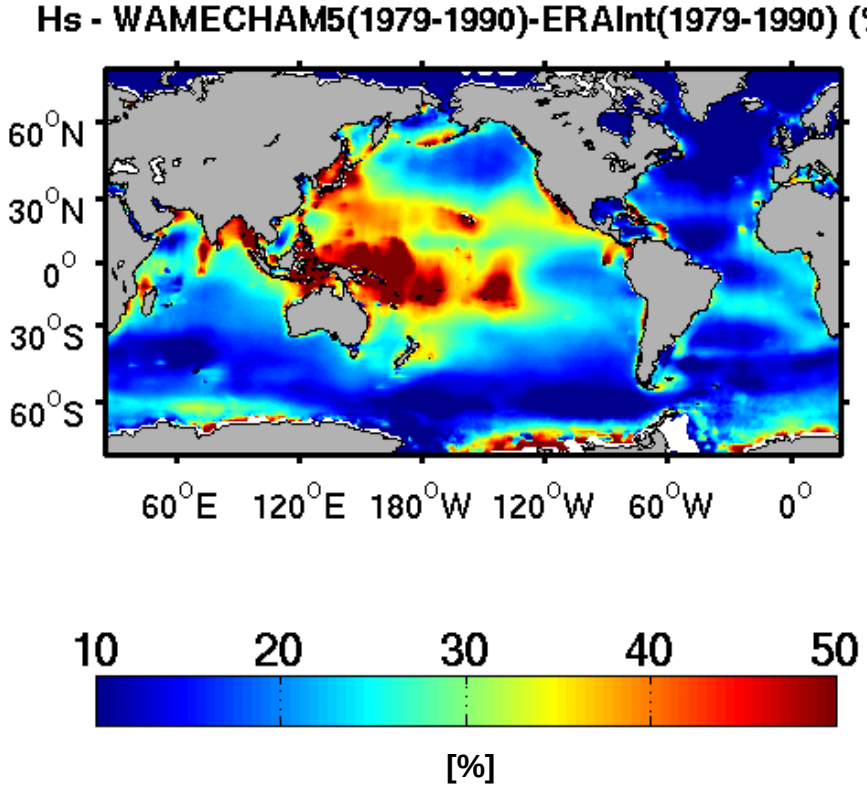


Hs yearly means

WAMECHAM5 vs ERA-Interim

Present climate runs - validation

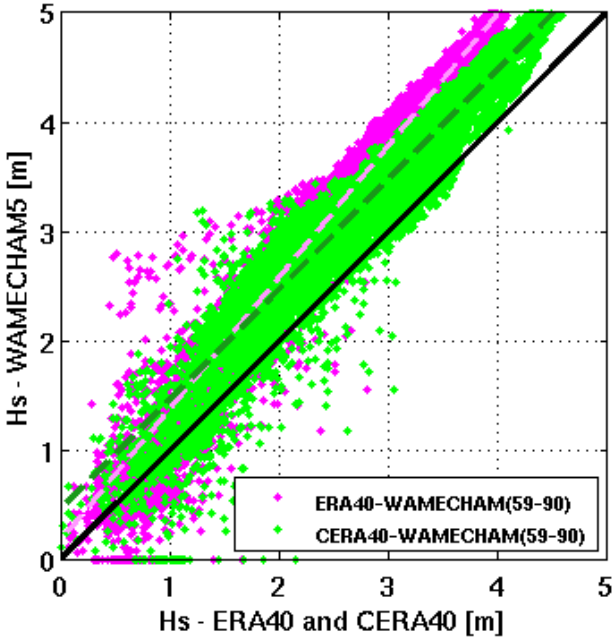


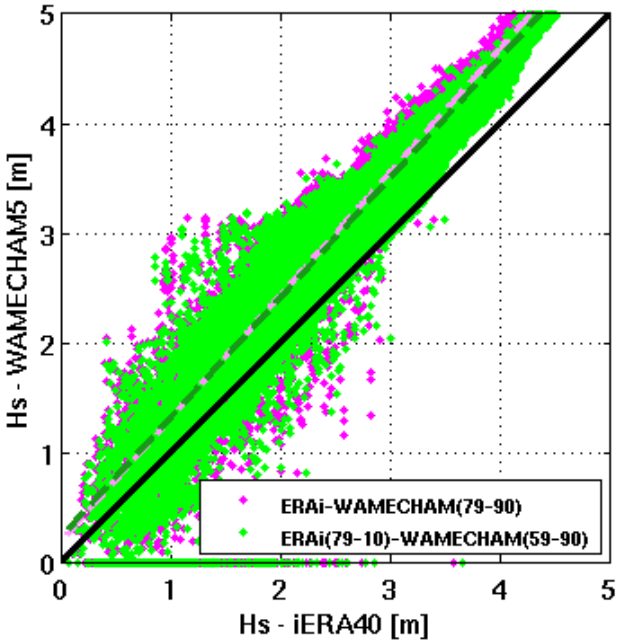


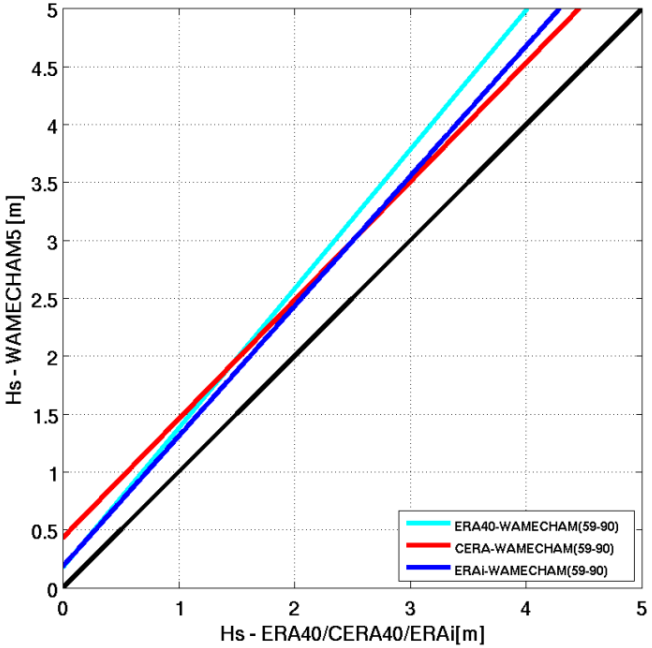
Hs yearly means

WAMECHAM5 vs ERA-Interim

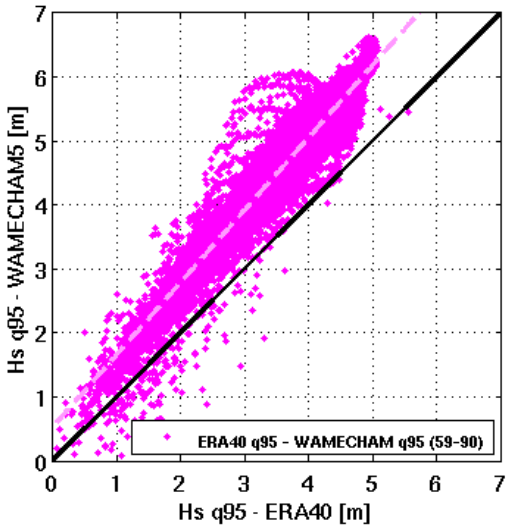
Present climate runs - validation

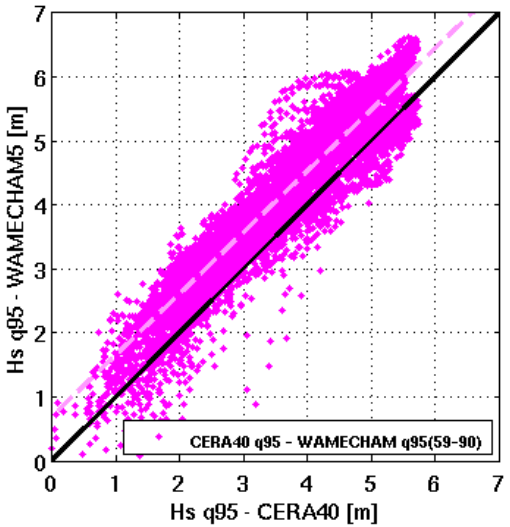


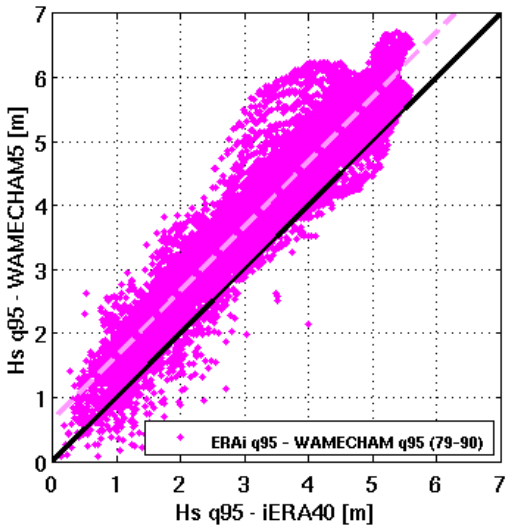


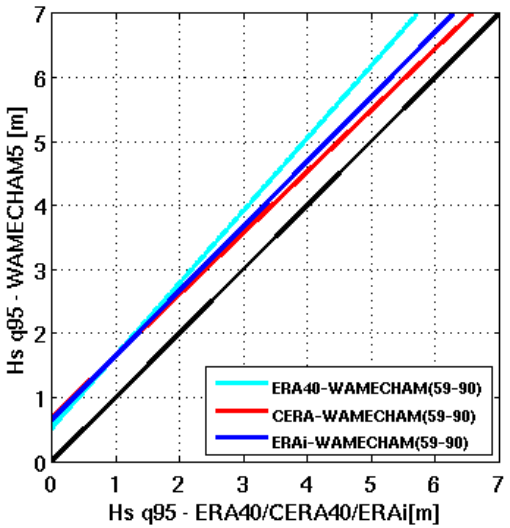


Present climate runs - validation





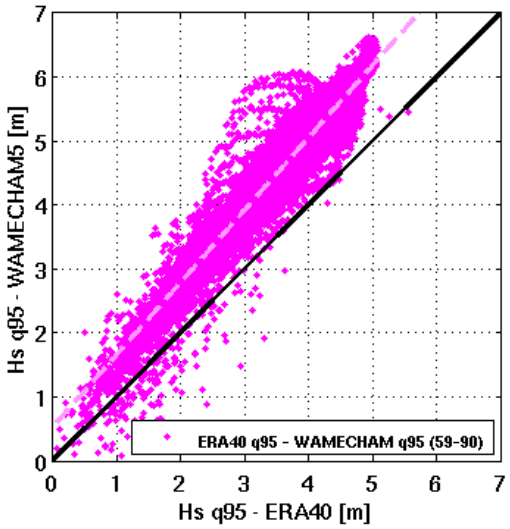


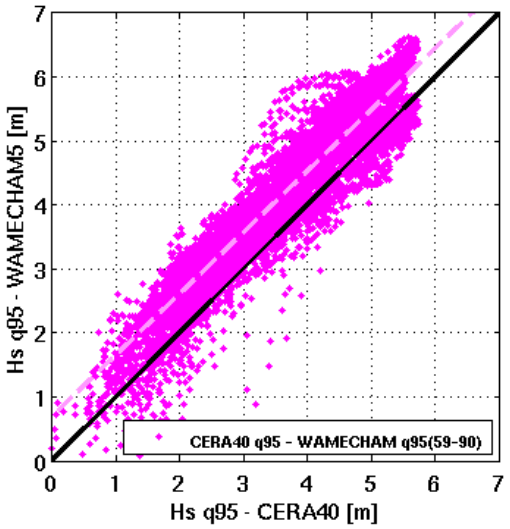


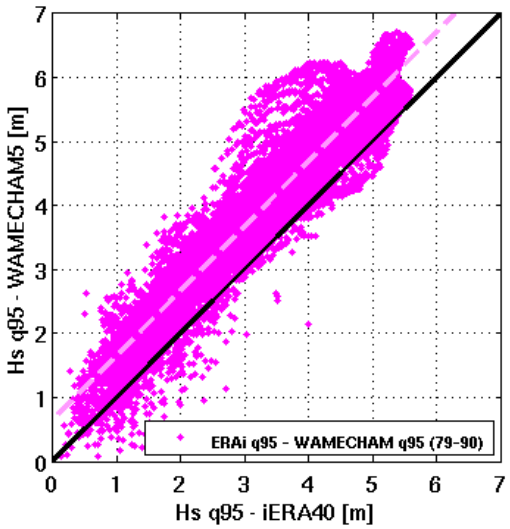
Hs quantiles (95%)

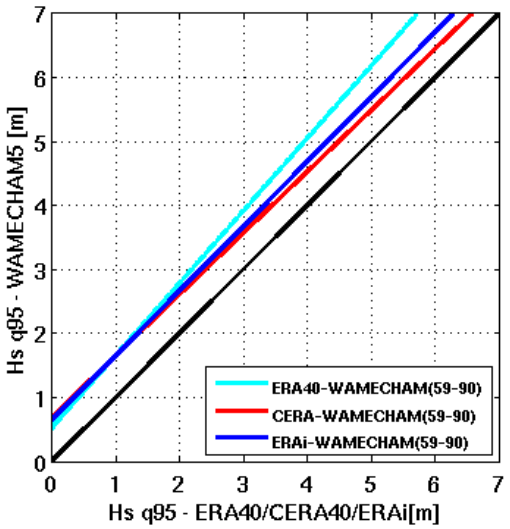
WAMECHAM5 vs ERA-40/C-ERA40/ERA-Int

Present climate runs - validation







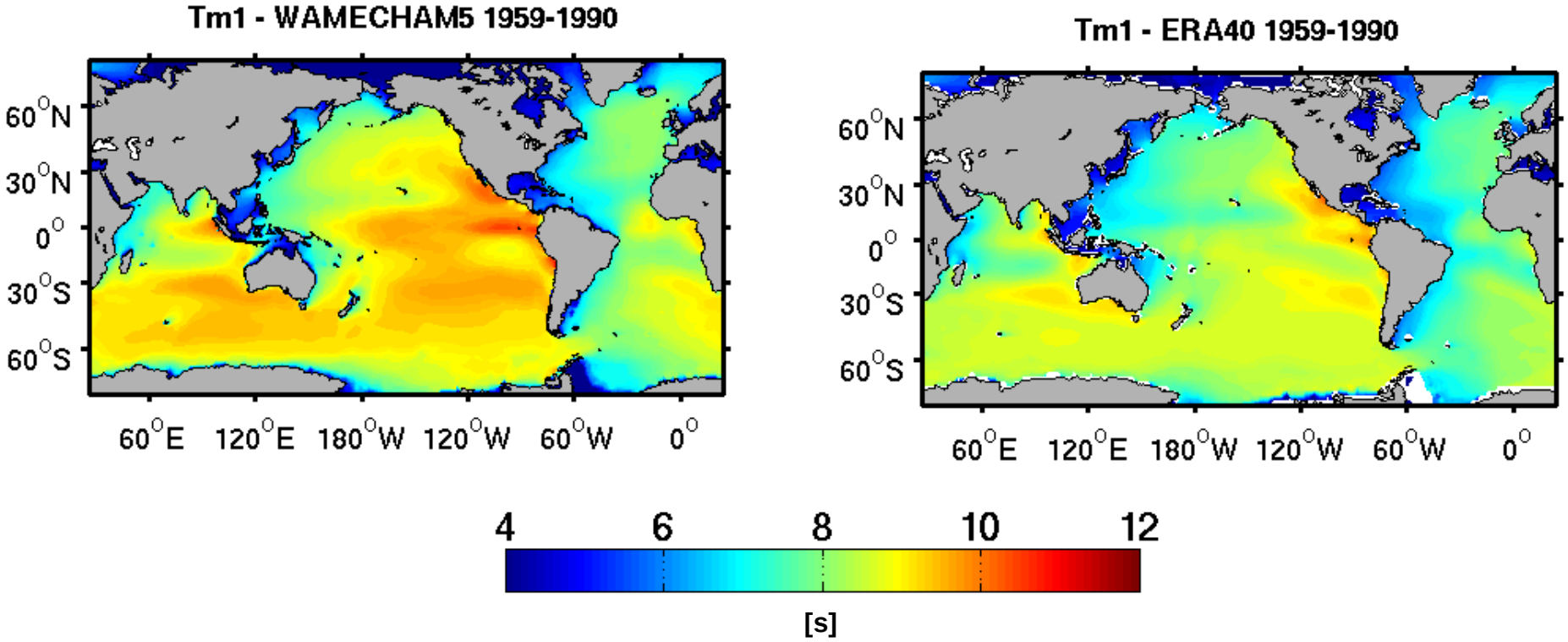


- WAMECHAM5 overpredicts Hs (more in the Pacific, in swell dominated areas)
- WAMECHAM5 Hs patterns are consistent with the reanalysis (C-ERA40 and ERA-Interim) wave fields
- Verification with remote sensing to be done

Hs quantiles (95%)

WAMECHAM5 vs ERA-40/C-ERA40/ERA-Int

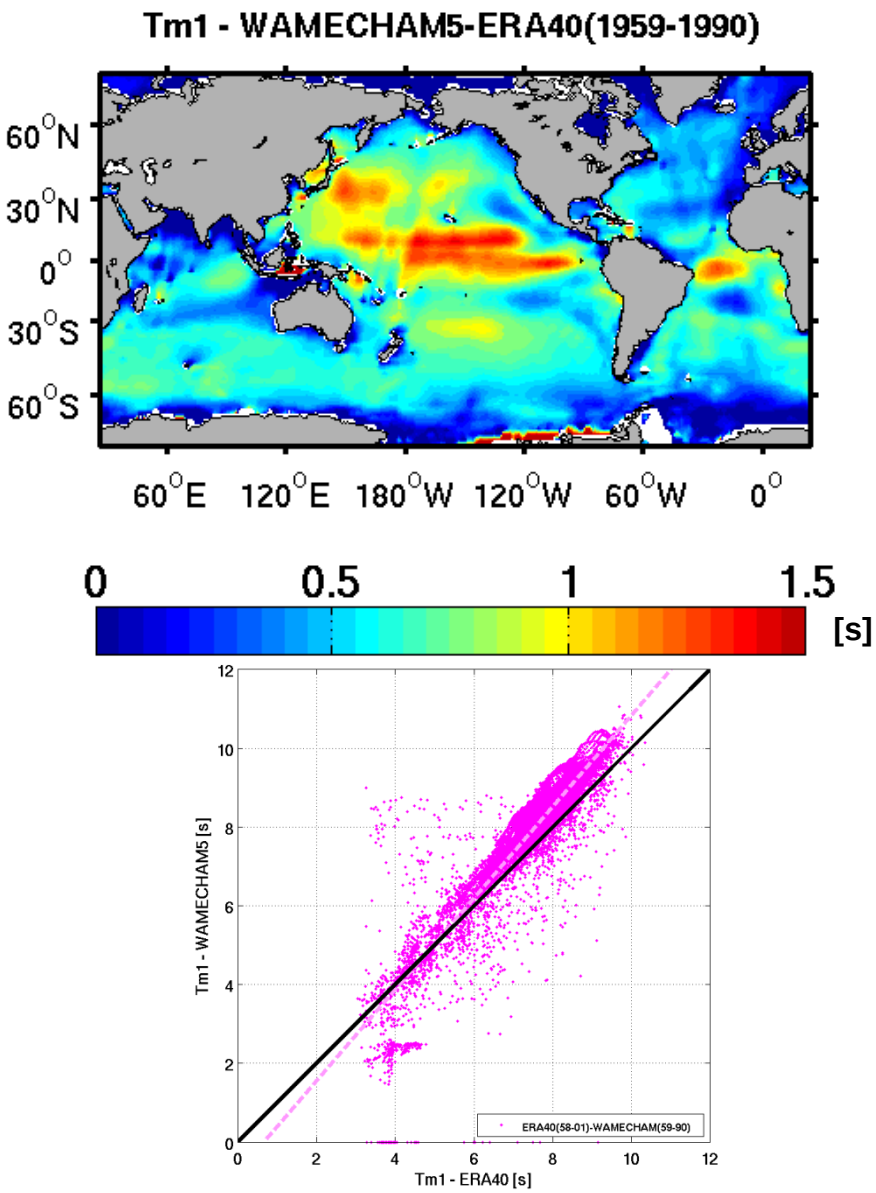
Present climate runs - validation

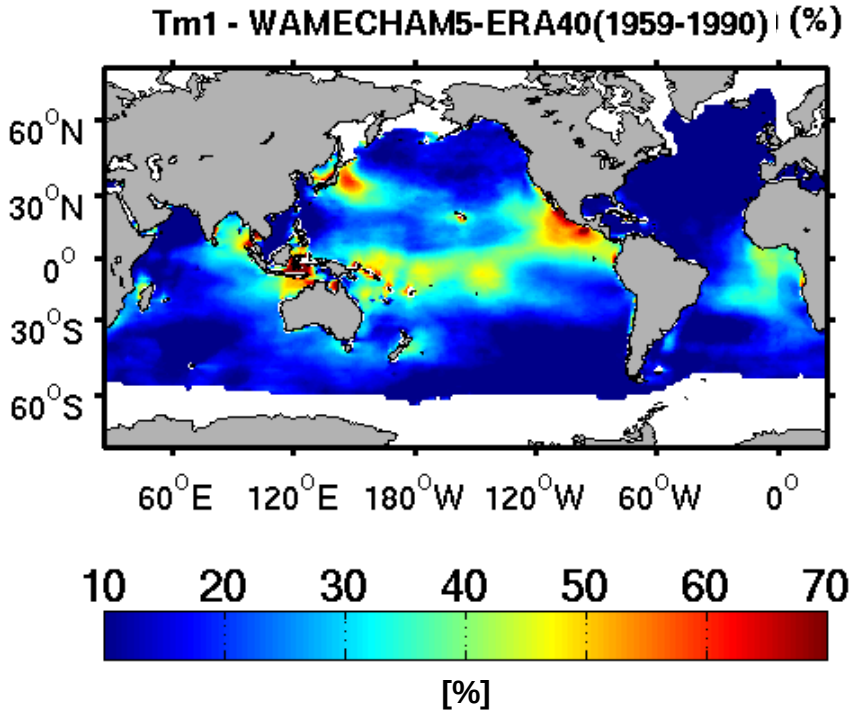


Tm1 yearly means

WAMECHAM5 vs ERA-Interim

Present climate runs - validation

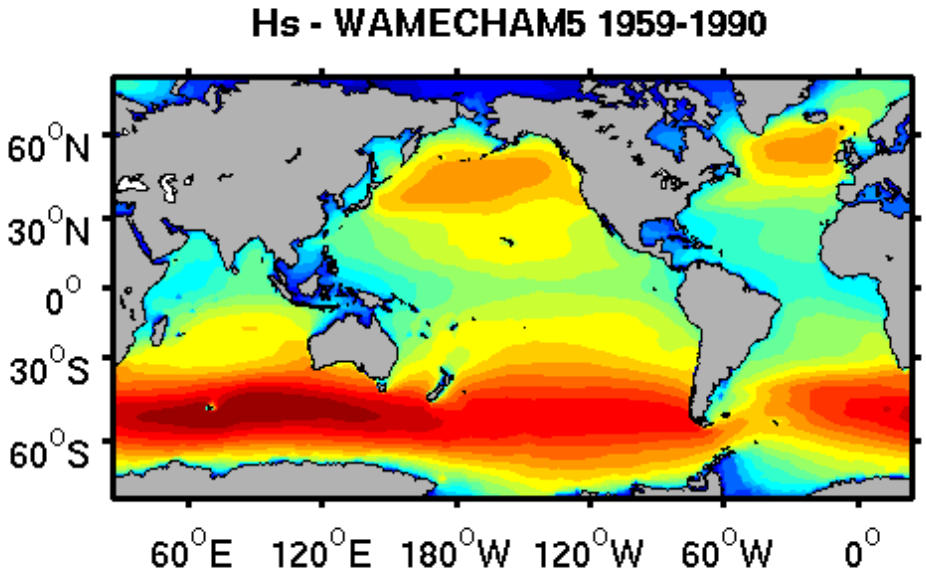




Tm1 yearly means

WAMECHAM5 vs ERA40

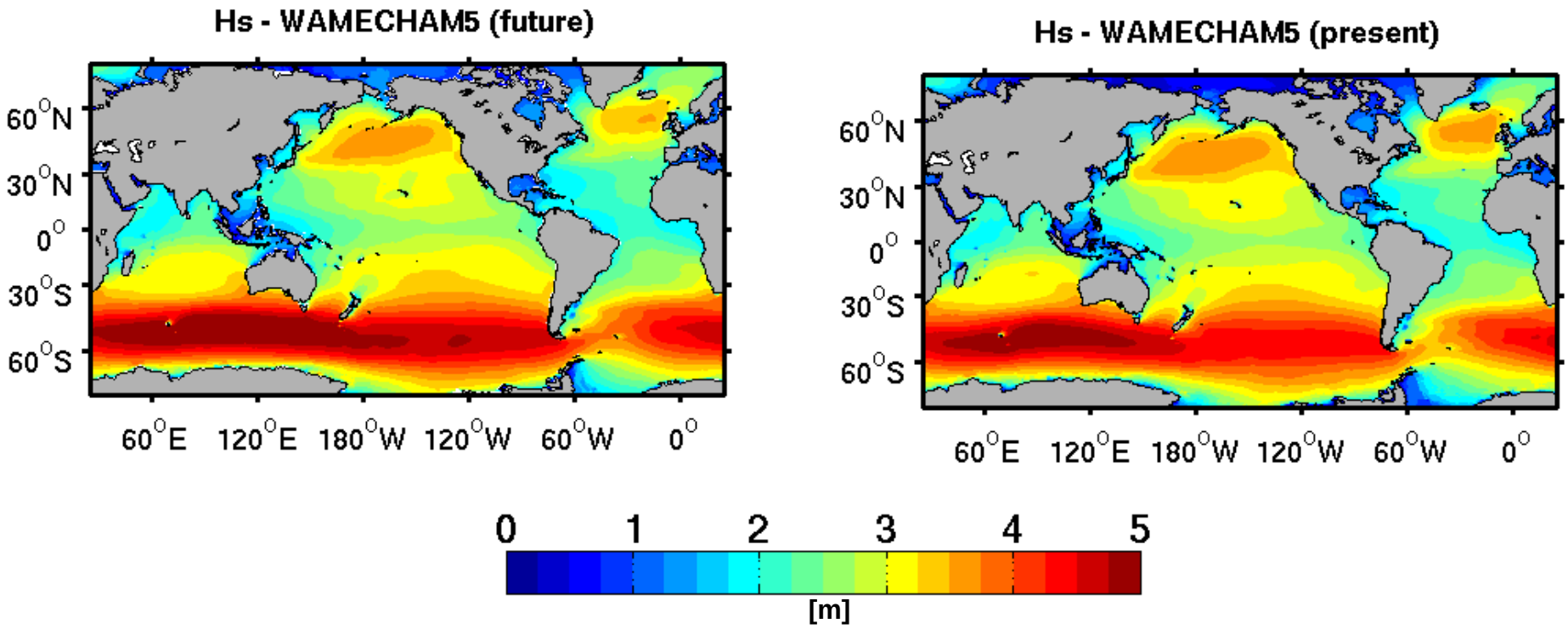
Present climate runs - validation



- WAMECHAM5 overpredicts Hs (more in the Pacific, in swell dominated areas)
- WAMECHAM5 Hs patterns are consistent with the reanalysis (C-ERA40 and ERA-Interim) wave fields
- Verification with remote sensing to be done

- ECHAM5 (might) overpredict U10
- WAMECHAM5 Tm1 patterns are consistent with the reanalysis (ERA40)
- WAMECHAM5 present climate can be used as a control run for future global wave climate projections

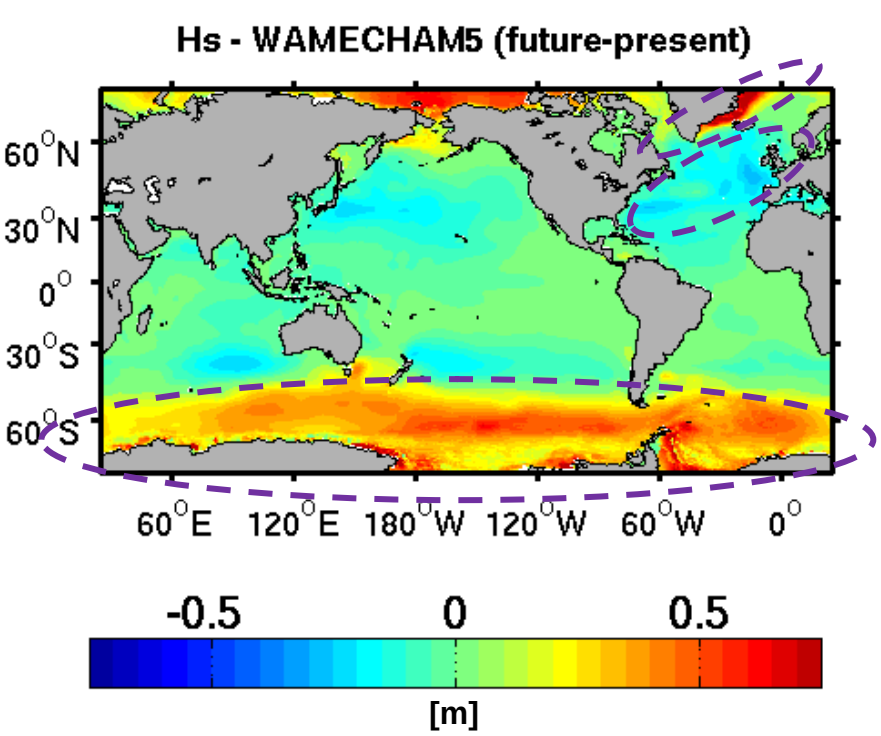
Future wave climate projections

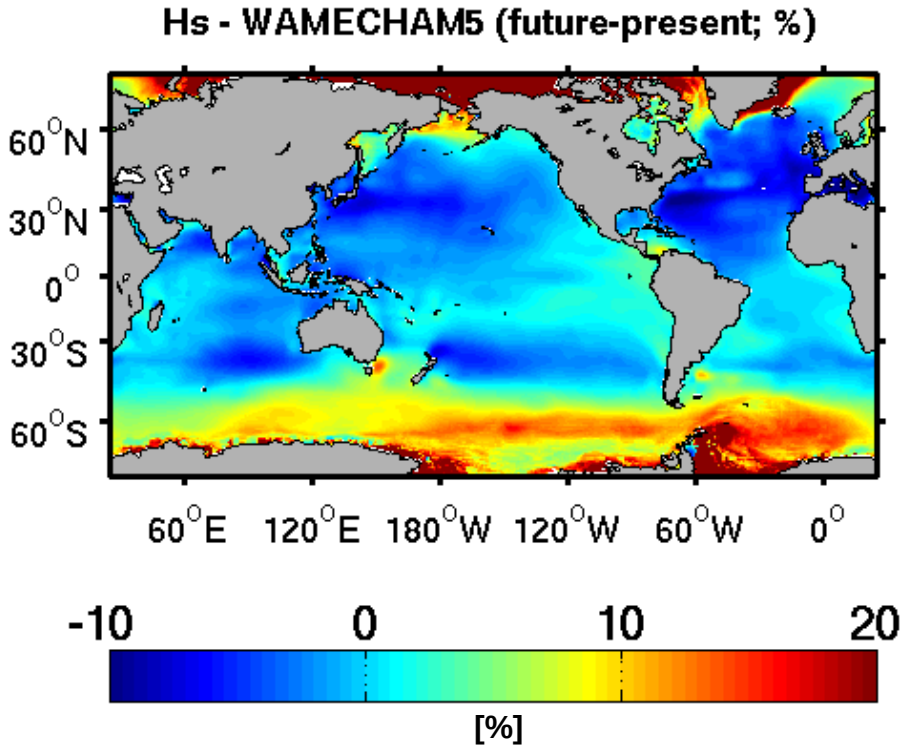


Hs yearly means

Future versus present

Future wave climate projections

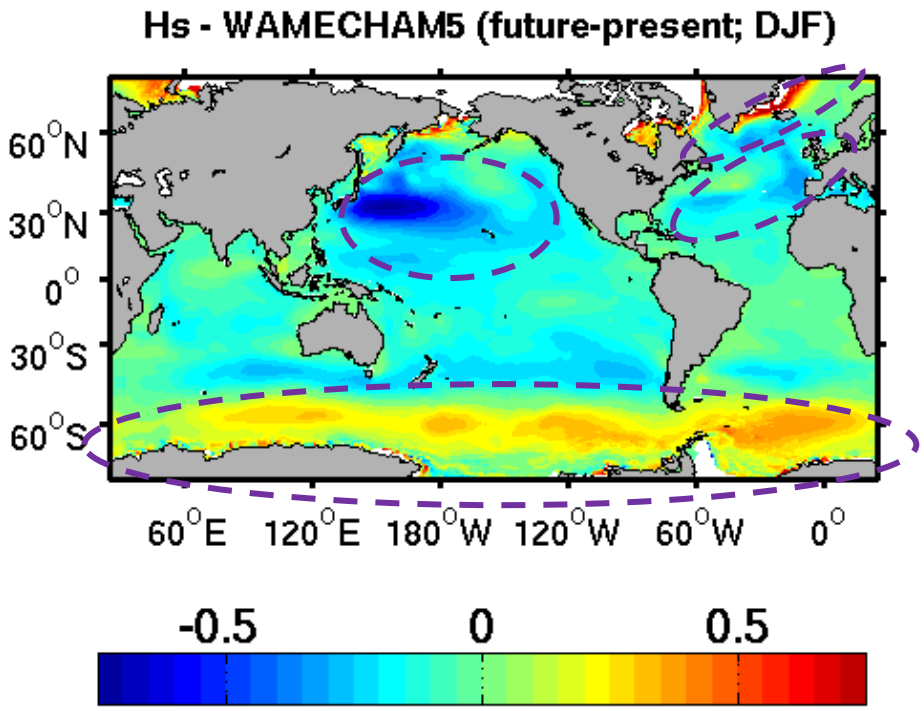


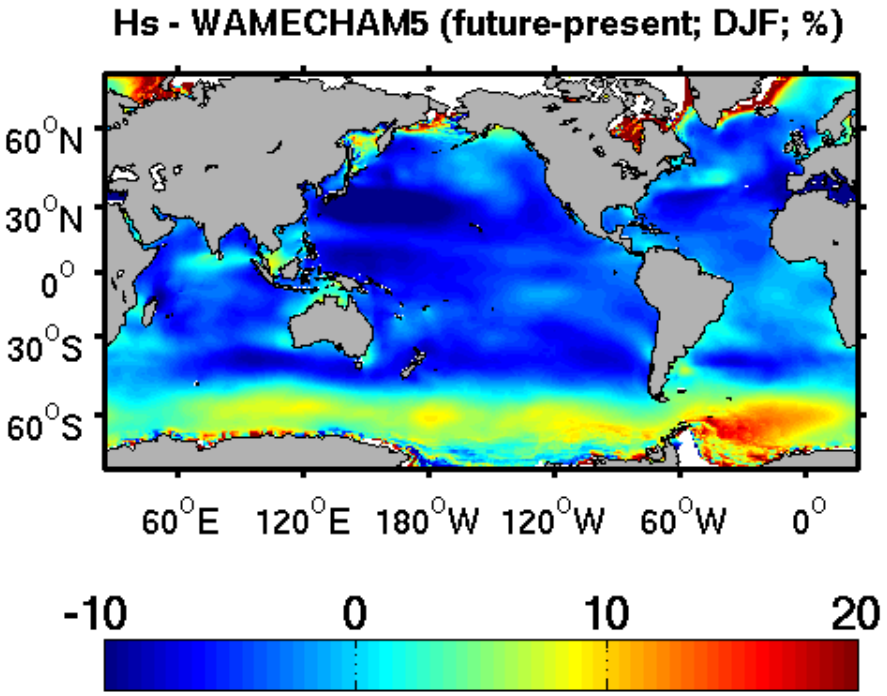


Hs yearly means

Future versus present

Future wave climate projections

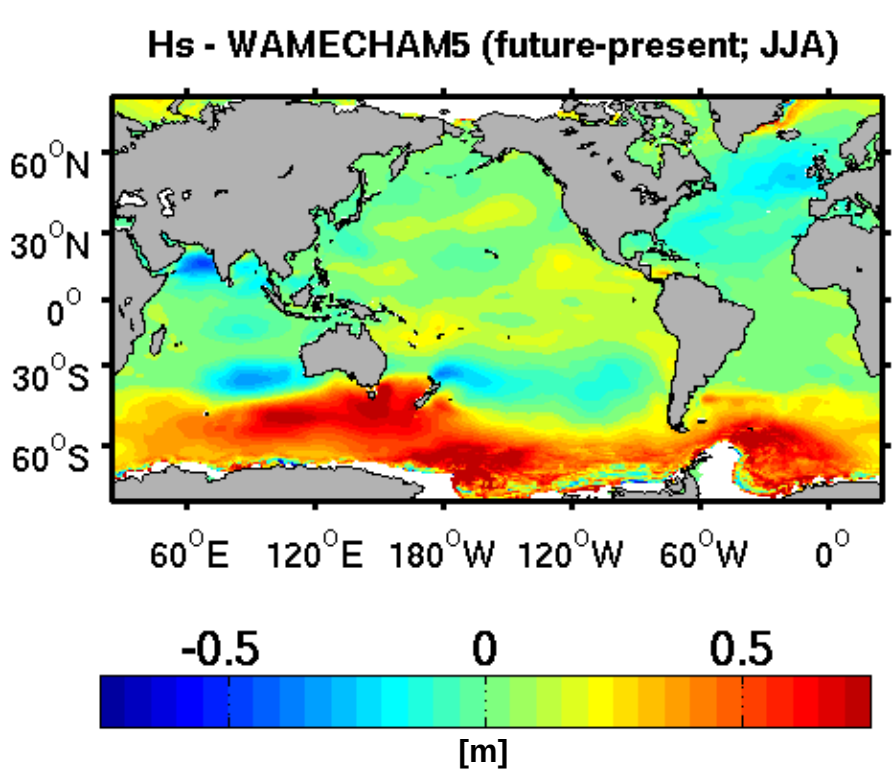


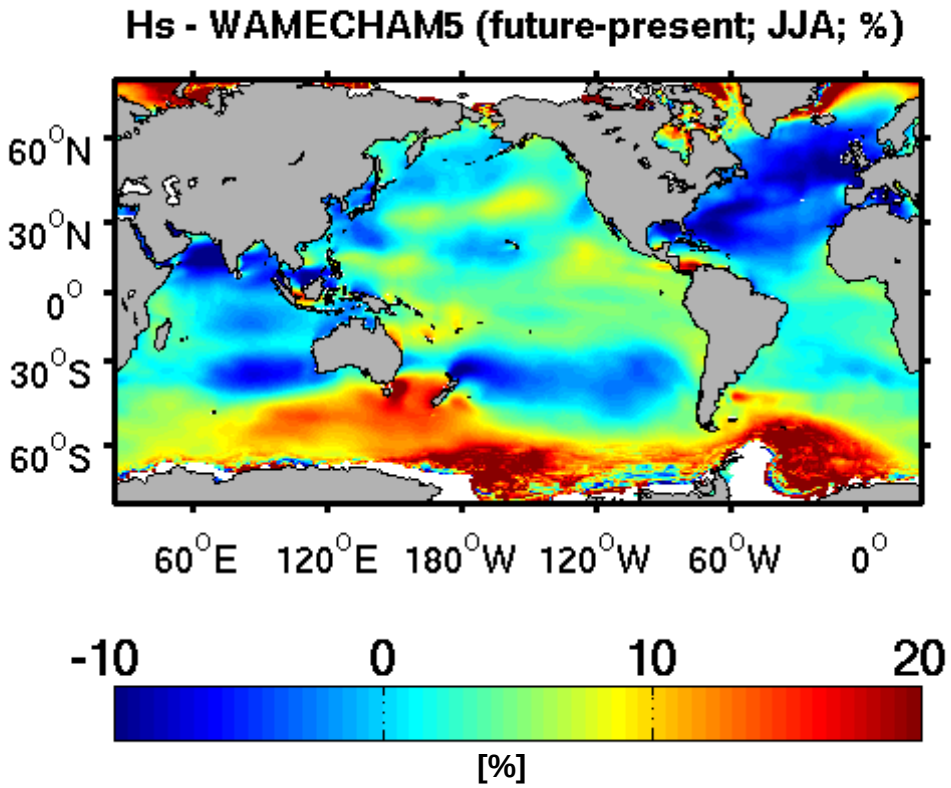


Hs DJF means

Future versus present

Future wave climate projections





Hs JJA means

Future versus present

Summary and conclusions

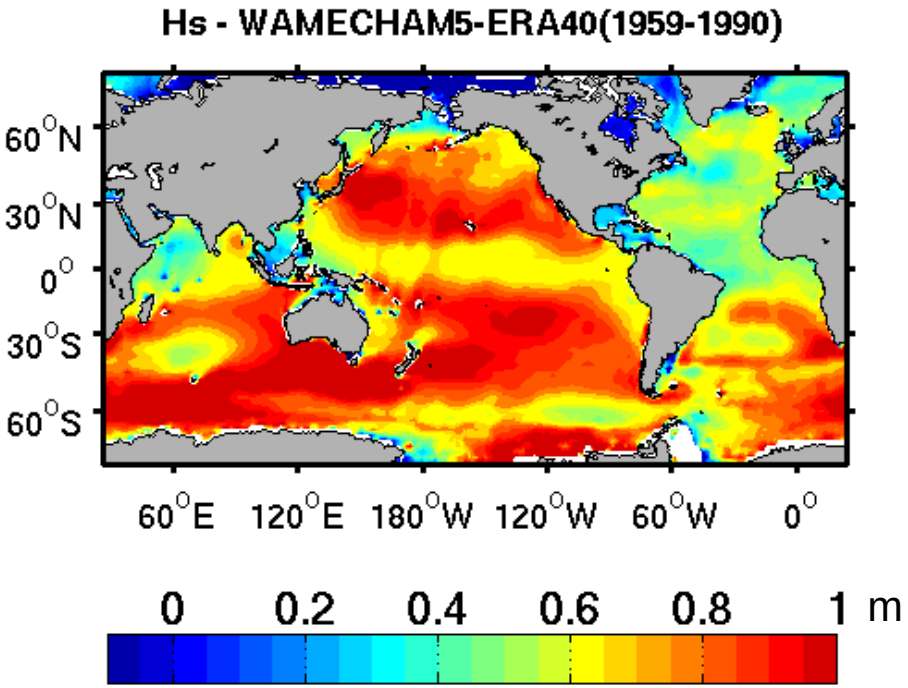
- Projection of future global future wave climate (Hs), forced by the A1B scenario, revealed:

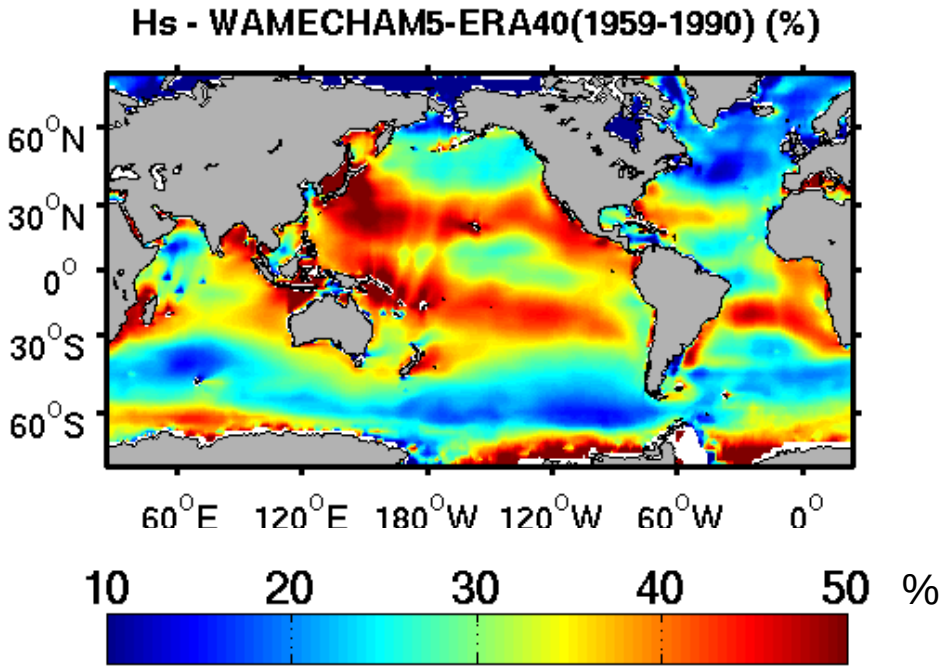
  - Poleward shift of Hs maxima, consistent with Bengtsson et al., 2007, 2009 (poleward shift of storm tracks, particularly in the Southern Hemisphere;
  - Slight decrease of Hs in the equator; and
  - Significant decrease of Hs in the mid latitudes in the Northern Hemisphere in DJF.

  - Future work

  - Investigate U10 present (validation) and future patterns;
  - Investigate wave energy flux projections; and
  - Validate present Hs fields with altimetry.

Present climate run - validation

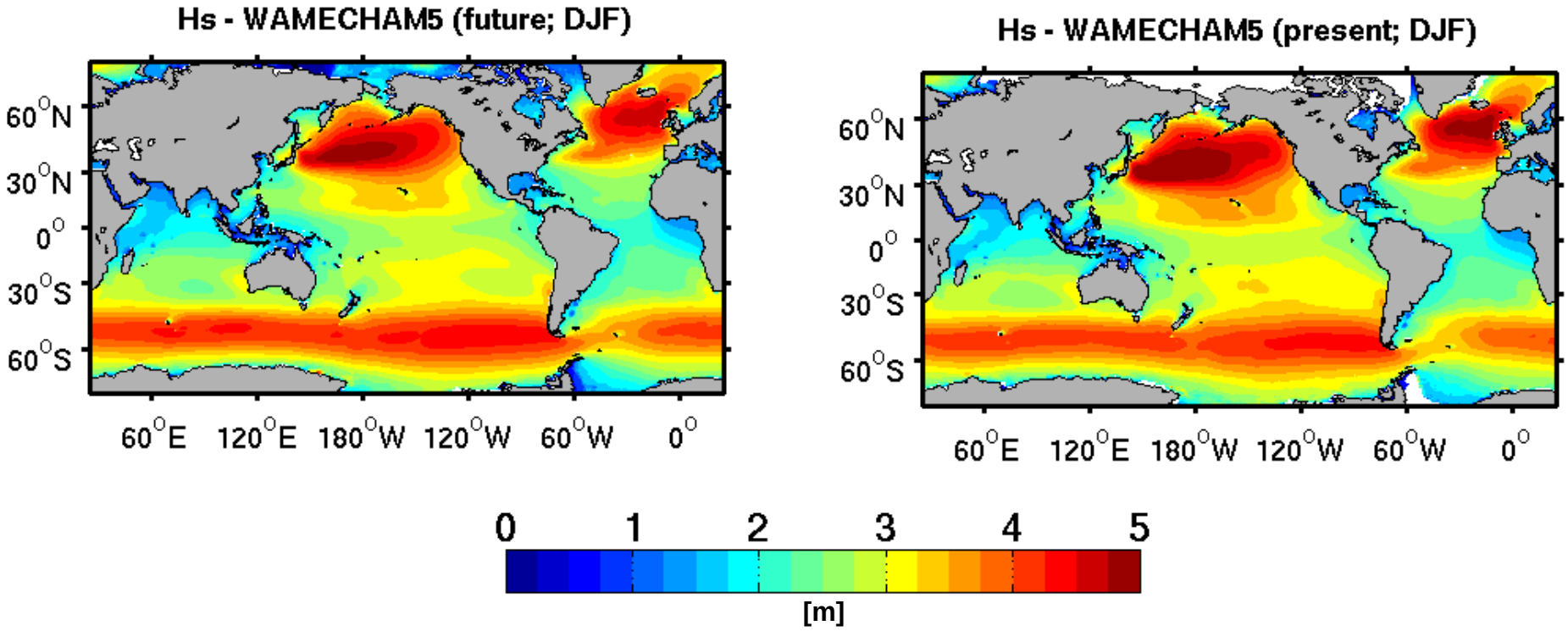




Hs yearly means

WAMECHAM5 vs ERA40

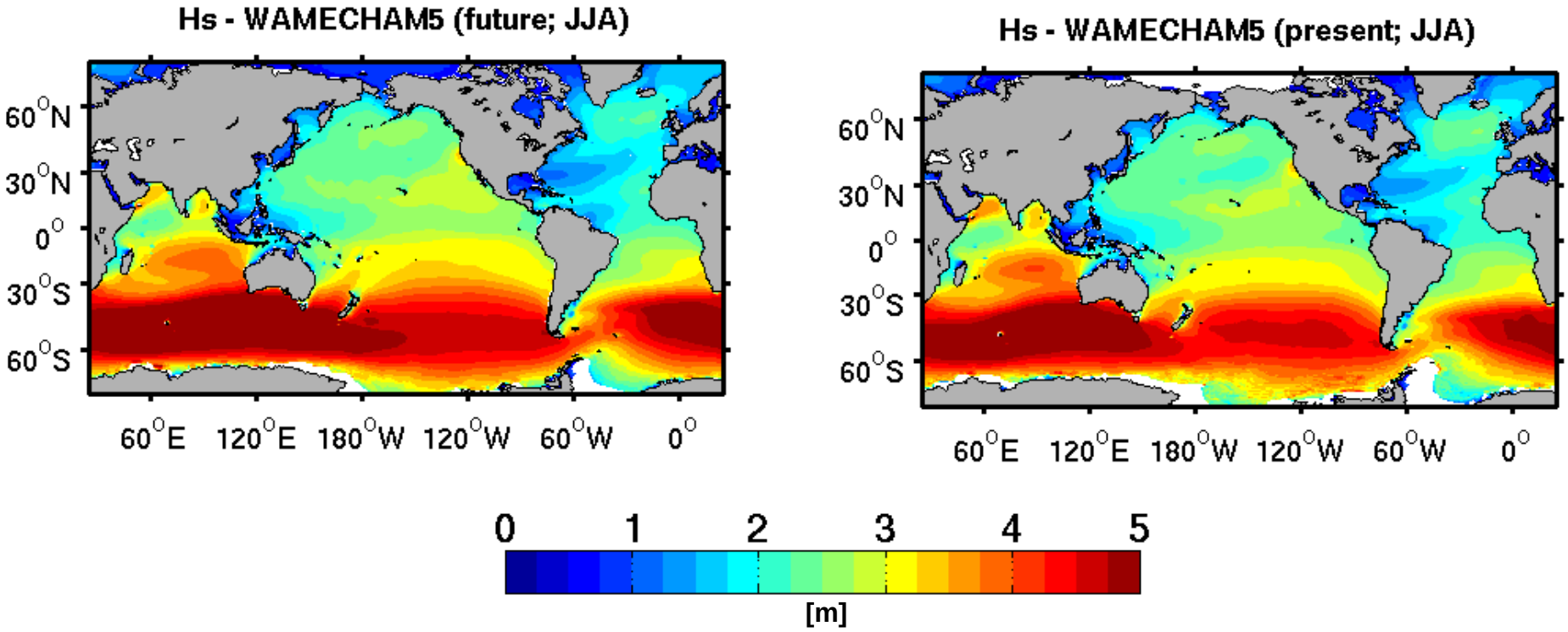
Future wave climate projections



Hs DJF means

Future versus present

Future wave climate projections



Hs JJA means

Future versus present