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EC-Earth Climate Prediction Working Group

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and the Climate Prediction Group at BSC

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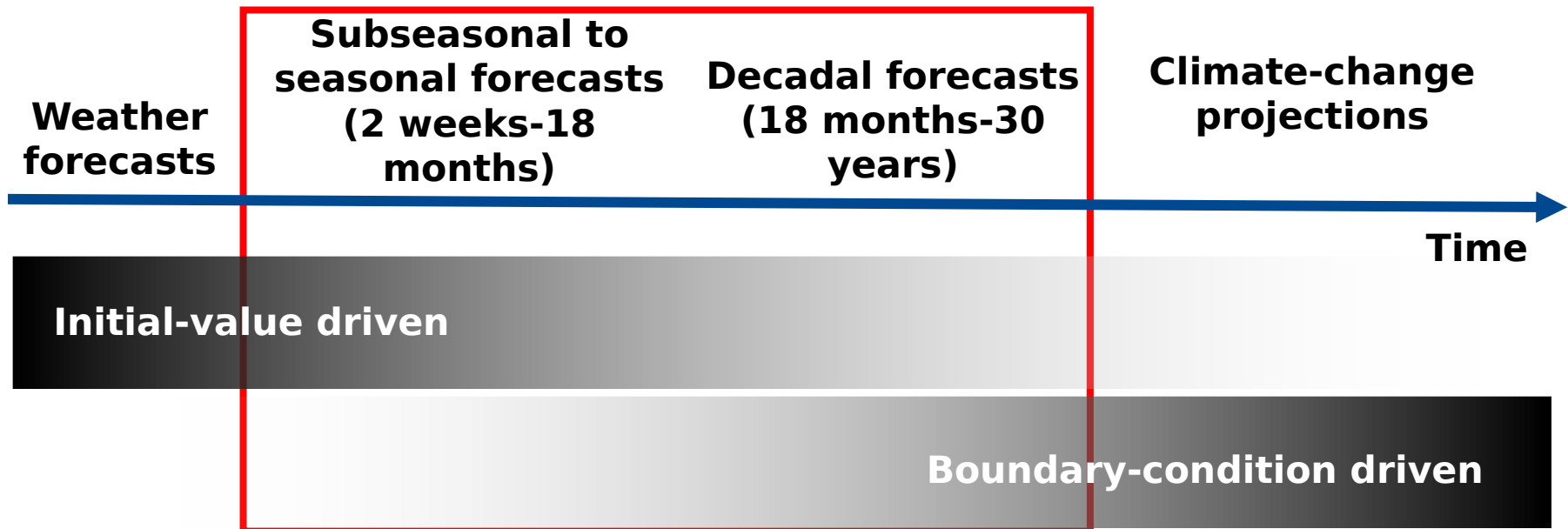


- Climate Prediction Overview
- Climate Prediction Group at BSC
- EC-Earth 3.2 seasonal prediction skill
- Future work : CMIP6 DCPP + HighResMIP

Climate prediction time scales



Progression from initial-value problems with weather forecasting at one end and multi-decadal to century projections as a forced boundary condition problem at the other, with climate prediction (**sub-seasonal, seasonal and decadal**) in the middle. Prediction involves initialization and systematic comparison with a **simultaneous** reference.



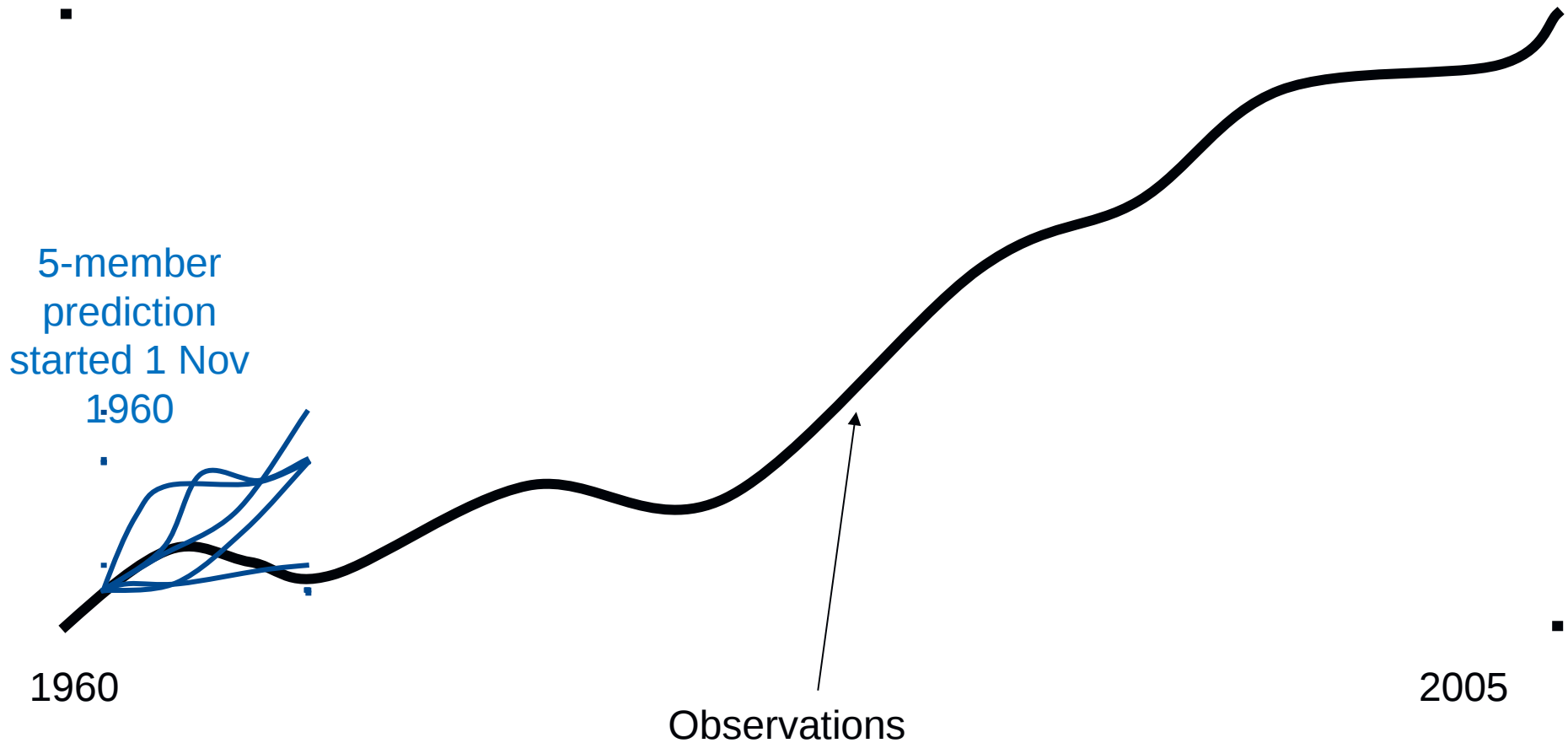
Adapted from Meehl et al. (2009)

Climate prediction experiments

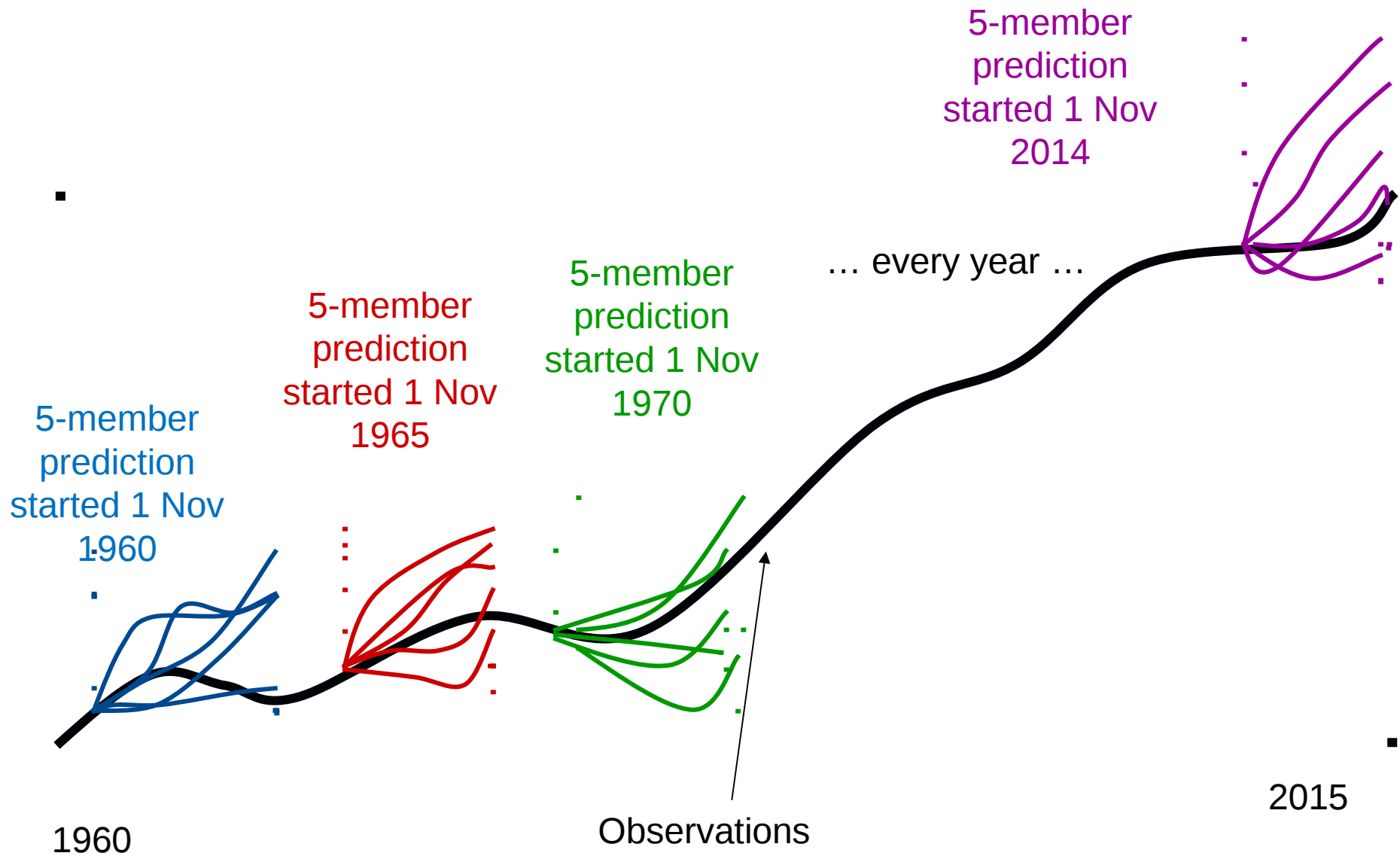


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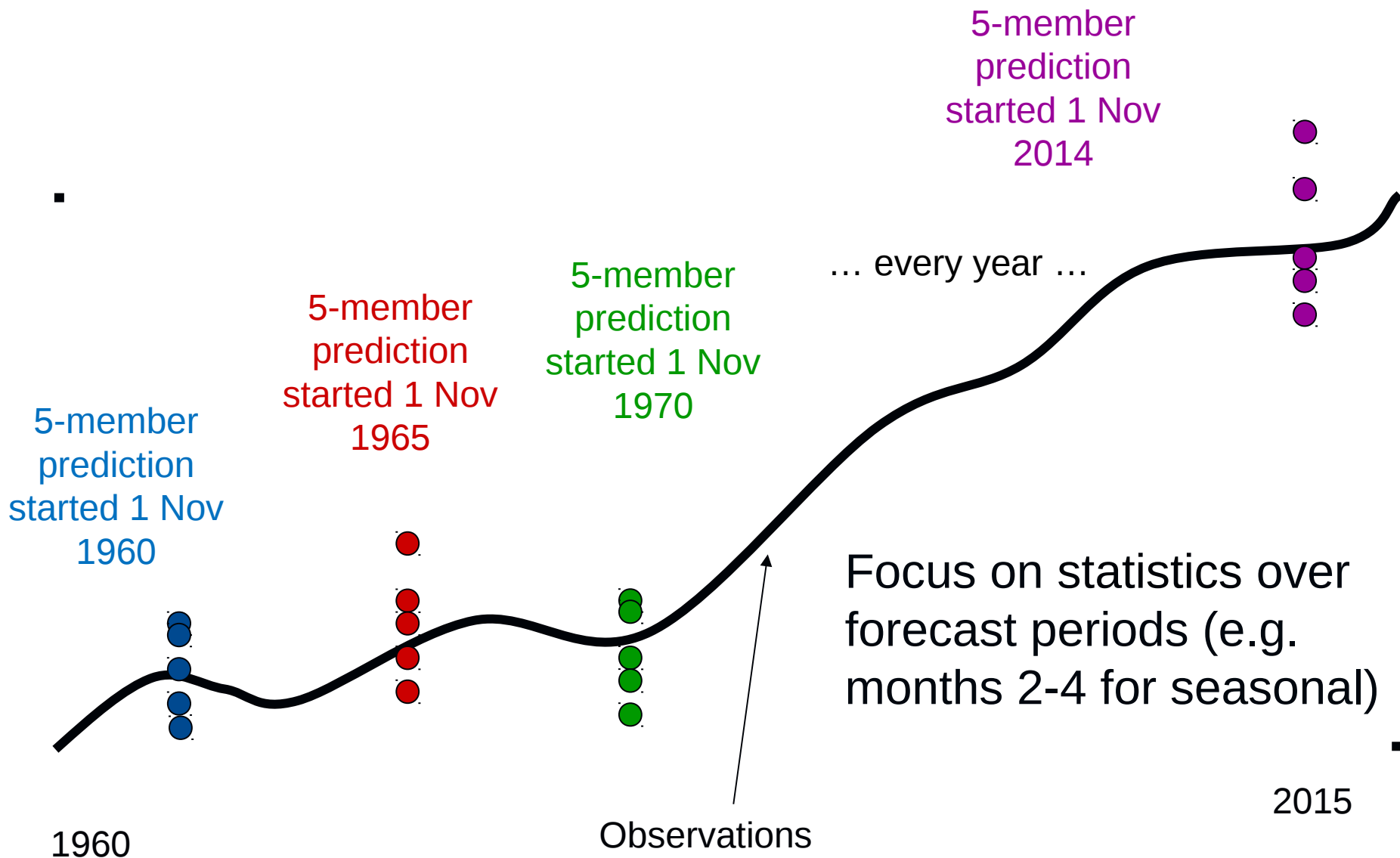
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Climate prediction experiments



Climate prediction experiments



Focus on statistics over forecast periods (e.g. months 2-4 for seasonal)

The EC-Earth forecast system



- 20 individual, 4 month climate predictions (May-August)
- init. conditions Atmosphere, Ice and Ocean Reanalyses
- init. soil conditions from climatology OR ERA-Land

4 months



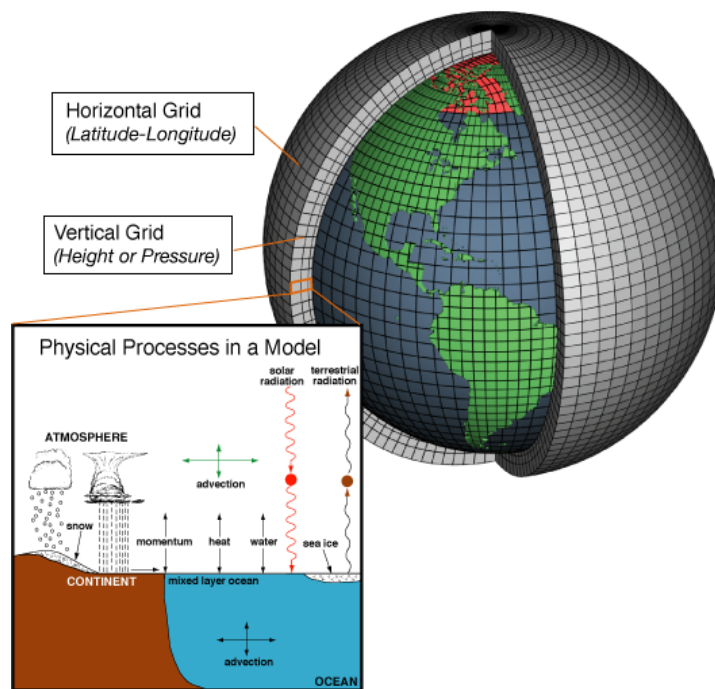
Atmosphere
Reanalysis
(ERA-Interim)

Ice
Reanalysis
(IC3/BSC)

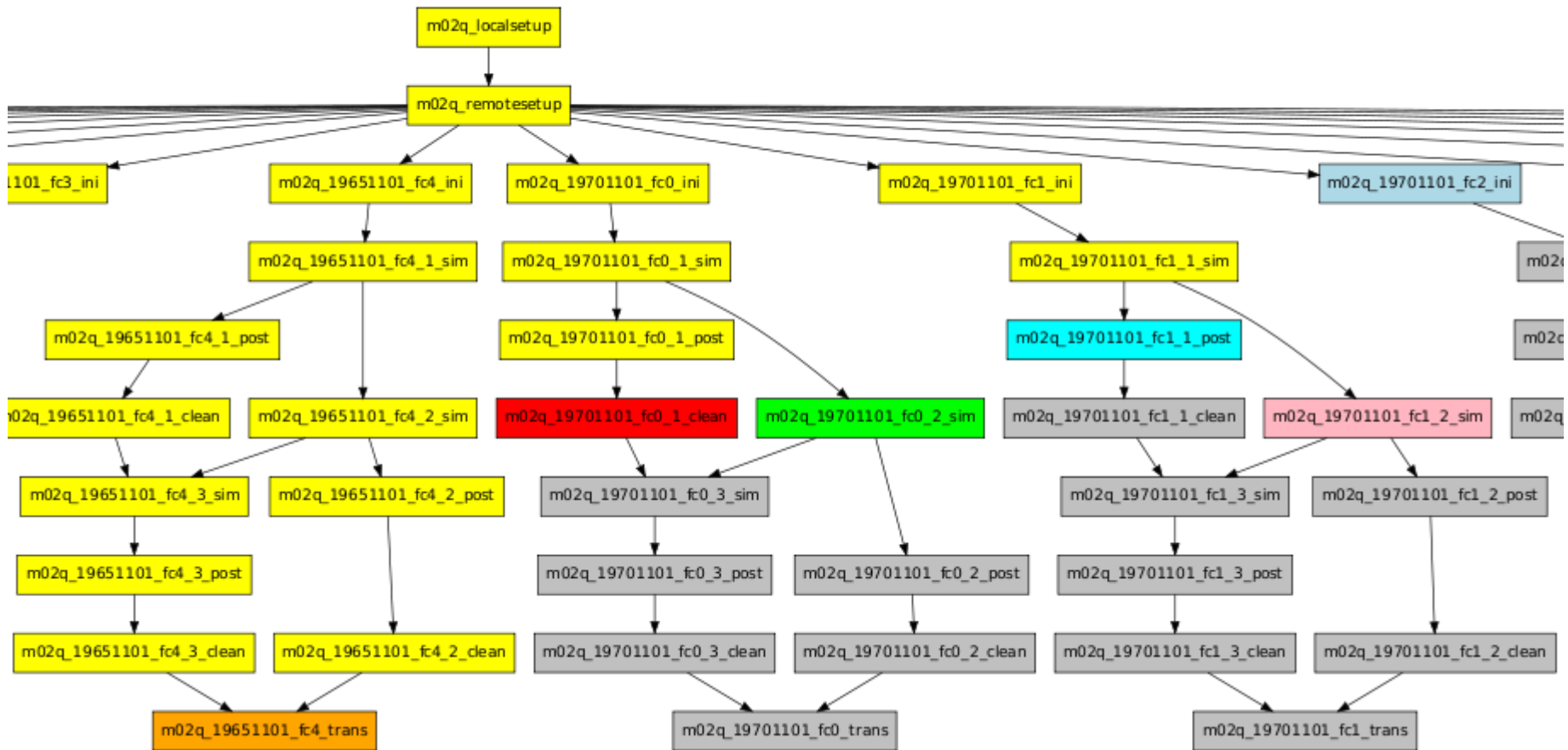
Land reanalysis
(ERA-Land)

Ocean reanalysis
(ECMWF S4)

EC-Earth coupled model



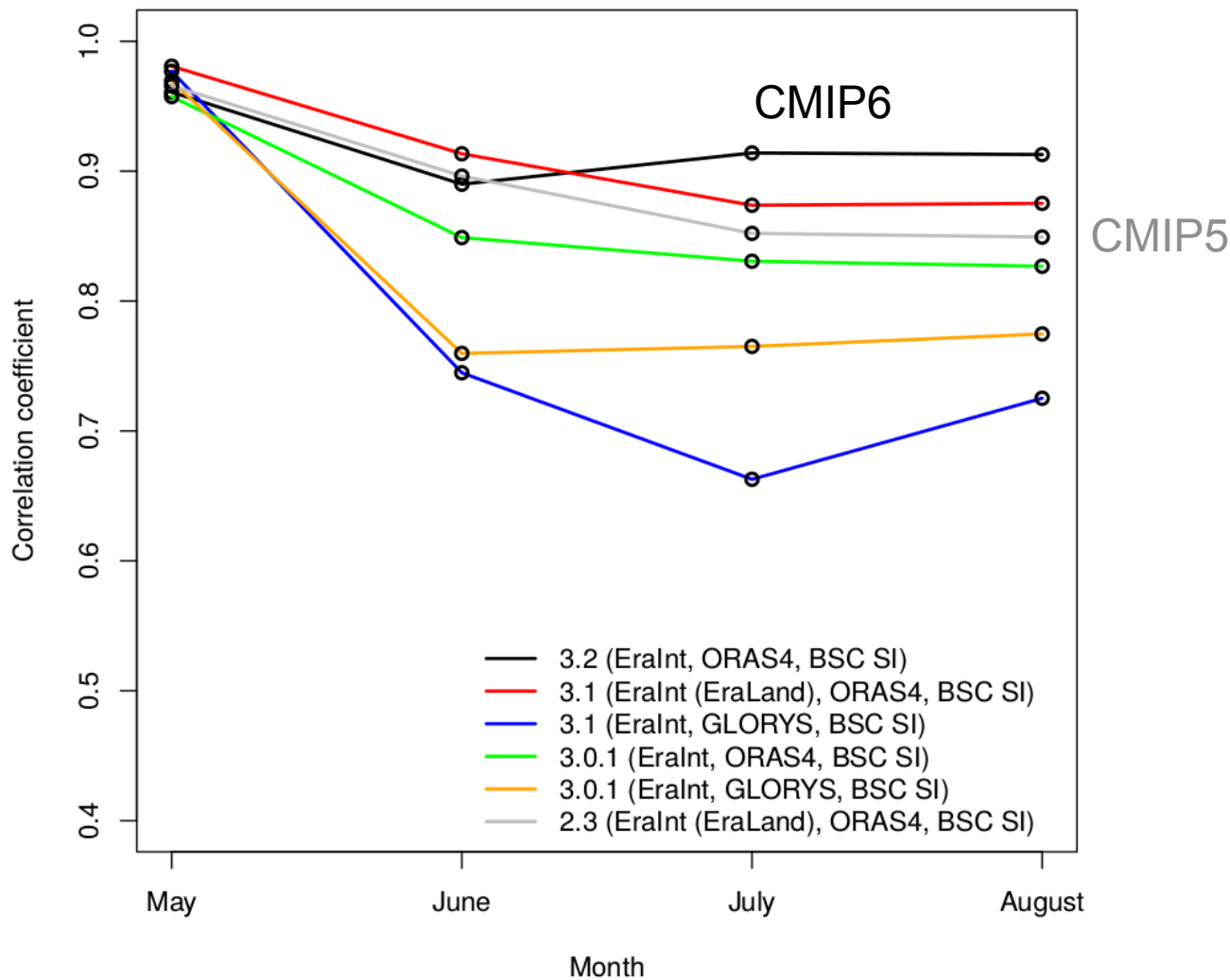
Climate Prediction Workflow



- 1) Generation of in-home **sea ice reconstruction** / reanalyzes – **data assimilation techniques** to exploit existing atmospheric and oceanic reanalyzes – development of initialization methods (anomaly versus full-field)
- 2) **Analyses of mechanisms** leading to model bias and development of bias correction techniques accounting for sensitivity of bias to prediction start date
- 3) **Improvement of forecast systems** through better process representation : inclusion of new parameterizations, new model components, high resolution, parameter calibration
- 4) **Identifying sources of skill** such as soil moisture, sea ice thickness, aerosols, biogeochemistry through multi-faceted forecast quality assessment and sensitivity experiments
- 5) Development of reliable techniques for attribution of extreme events, analysis of case studies : 2014 Antarctic sea ice maximum, 2010 heat wave
- 6) Dissemination : Tropical cyclone damages : **hosting of an operational website for the next hurricane season** gathering predictions from all existing centers

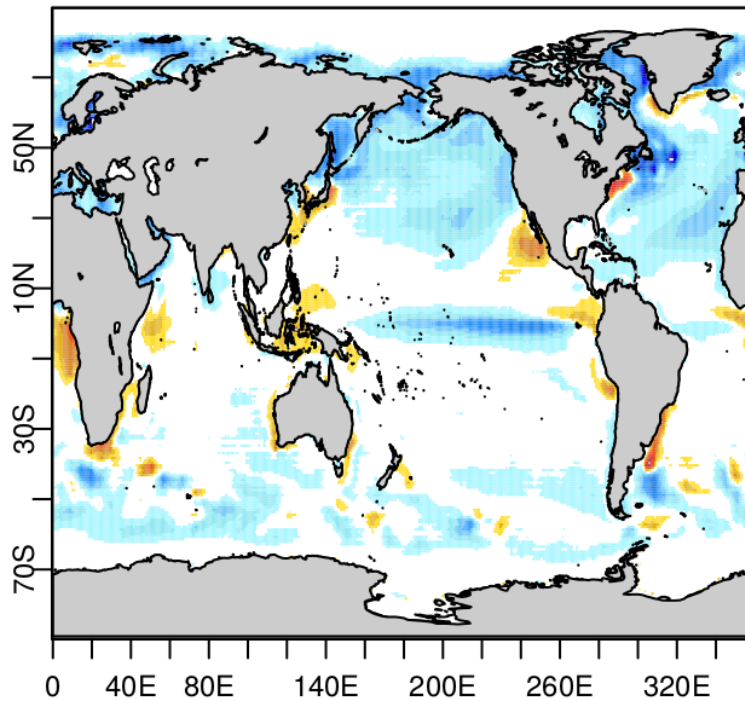
- T255L91/ORCA1L75
 - Runs in seasonal prediction mode
 - Stratospheric aerosols are being added (M. Ménégoz)
- T511L91/ORCA025L75
 - Fixed compatibility issues (see portal): bathymetry, closed seas, ...
 - Solved numerical instabilities from sea-ice conditions
- PRIMAVERA & HighResMIP output: ongoing (E. Tourigny)
- DCPP : awaiting for EC-Earth version (external & internal)
- BSC & SMHI : MetOffice decadal semi-operational experiment
- Initial Conditions available for climate prediction runs
- Reproducibility tests are underway (Massonnet, Ménégoz, Acosta)
- More in other EC-Earth meeting sessions

EC-Earth Niño3.4 Skill (1993-2009) (HadISST)



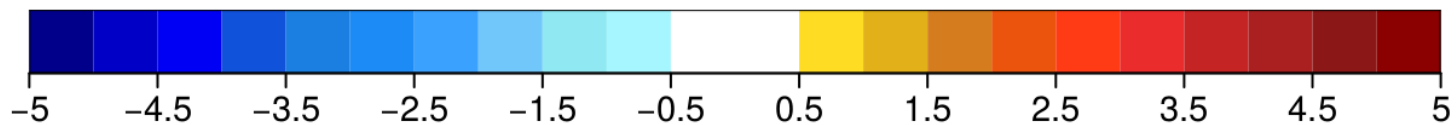
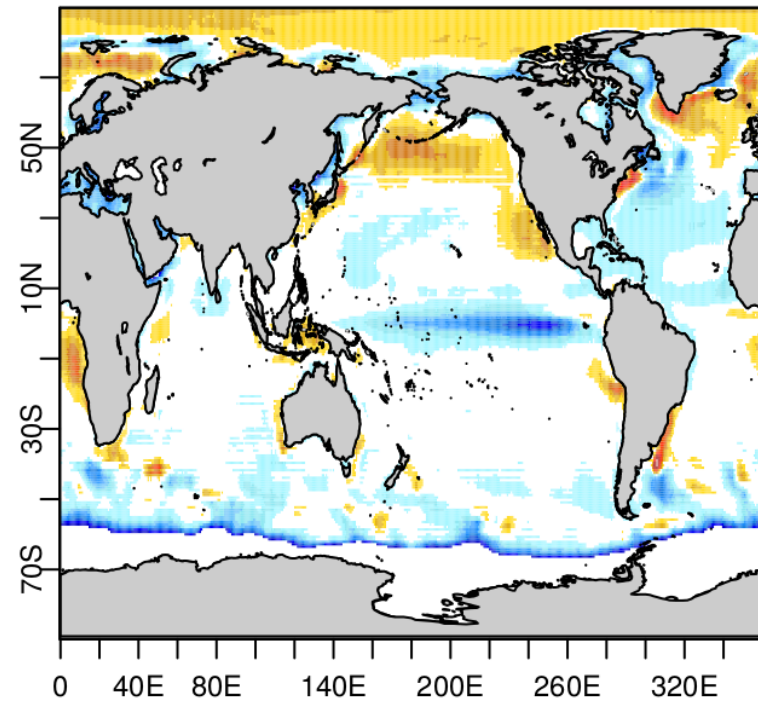
CMIP6

EC-Earth3.2 (CMIP6)



CMIP5

EC-Earth2.3 (CMIP5)

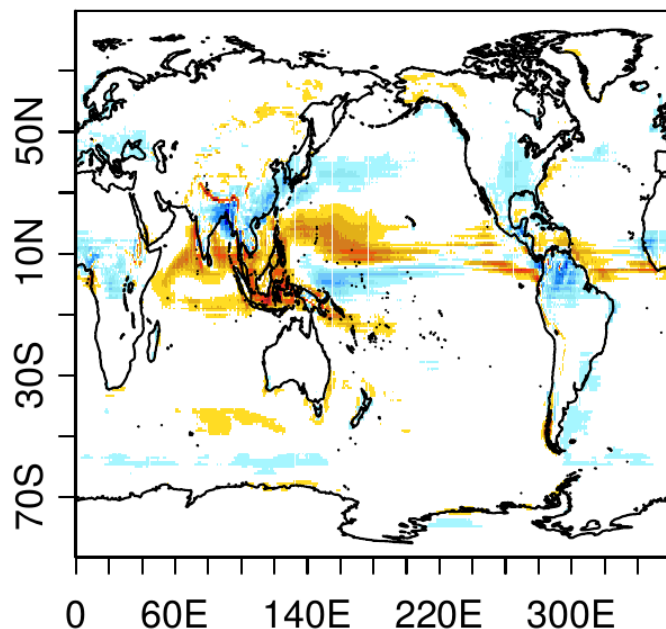


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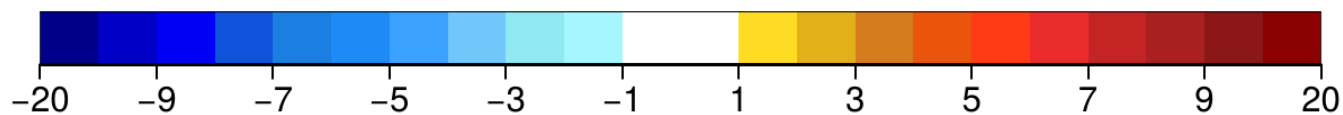
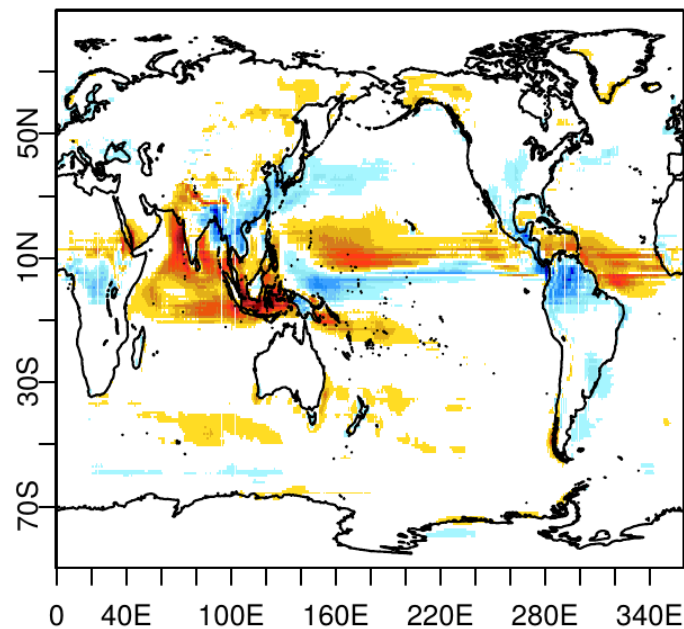
CMIP6

CMIP5

EC-Earth3.2 Bias [mm/day]



EC-Earth2.3 Bias [mm/day]



mm/day

- https://dev.ec-earth.org/projects/eearth3/wiki/Climate_Prediction_Working_Group
- WG mailing list : eearth.climate.prediction@bsc.es
- Terms of reference
 - To **tune** the EC-Earth 3.2 version in standard and high resolutions **in seasonal prediction mode**
 - Coordinate the participation of the EC-Earth consortium to **DCPP**
 - Develop **initialization** and ensemble generation techniques, **share initial conditions** to others
 - Assess climate forecast **quality** on sub-seasonal to decadal timescales
 - Investigate **sources and mechanisms** of predictability
- Experimental protocol for tuning in seasonal prediction mode
 - Run 5-member 4-month-long seasonal predictions initialized Nov. from 1993 to 2009
 - One 10-year-long simulation to be run by BSC at the end of the tuning process
- Repository for initialization, ensemble generation and verification tools
- Repository for initial conditions

- Atmosphere:
 - Atmospheric initial conditions generated using FULLPOS for three different resolutions of IFS. FULLPOS conducts a physical interpolation using the model executable and therefore ensures little model drift.
 - The initial conditions are prepared for periods:
 - 1960 - 2015 using ERA-40 (1960-1978)
 - ERA-Interim (1979-2015)
 - ERA-Land (1979-2015) - forced by GPCP, replaces surface model fields
 - 10-member (SST perturbation), Start dates each year in February, May, August, November
 - T511L91 & T255L91 resolutions
 - **We can produce more on demand!!!**

- Ocean:
 - ORAS4 interpolated/extrapolated 5-member restarts in the configuration ORCA1L75 covering the 1958-2013 period, at ECFS `ec:/c3y/restarts_ORAS4`
 - Many more available, and more can be produced easily
- Sea Ice:
 - 5-member ORCA1 reconstruction covering the 1958-2006 period = i056 at ECFS `ec:/c3y/restarts_i056`
 - 5-member ORCA1 reconstruction covering the 1979-present period = i057 at ECFS `ec:/c3y/restarts_i057`
 - 1-member ORCA025 reconstructions covering the 1958-2006 period = m063 at ECFS `ec:/c3n/restarts_m063`
 - 1-member ORCA1 reconstruction covering the 1958-2015 period = a05p
 - 24-member ORCA1 reconstructions with sea ice data assimilation (done using NEMO only), covering 1979-1999 (still ongoing): a0a9
 - 24-member ORCA1 reconstructions with sea ice data assimilation (done using EC-Earth), covering 1993-1995 (still ongoing, to be updated because major bug was found, ticket 289 on this portal) = a09p

- **Initial Conditions:**
 - prepared by BSC (atmosphere, ocean, sea ice)
 - for all years 1960-present
 - 4 start dates : **November**, February, May, August
- **Component A : Decadal hindcasts (6000 years)**
 - Every year from 1960-present
 - Starting in November of every year
 - 10 members
 - 5 year predictions, extended to 10 years
- **Component B : Semi-operational decadal forecast (100 years)**
 - 10 years x 10 members
- **Component C3: Volcano effects on decadal prediction (M. Menegoz)**
- **“Extra” seasonal prediction hindcasts**
 - Use the first months of the decadal runs initialized in November
 - Run short (4 month) predictions initialized in February, May, August
- **High Resolution Hindcasts (optional, 3000 years)**
 - 5 members, IF we obtain the hours from PRACE (as part of ENES) and only after we have completed everything else (HiResMIP and DCPP standard)

- Recent progress by other groups ?
- Plans for climate prediction experiments ?
- Using a workflow manager for climate prediction experiments
- DCPP
 - Partners and workload sharing
 - 3.2.x releases and tuning strategy
 - Output variables

- Priority levels:
 - Make sure that the basic variables that allow the forecast quality analysis & drift understanding are kept (no model level data because of cpu+space)
 - Priority 1 : all
 - Priority 2 : if not too prohibitive (cpu, space)
 - Priority 3 : those of interest to us



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EXCELENCIA
SEVERO
OCHOA

Thank you!

For further information please contact
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